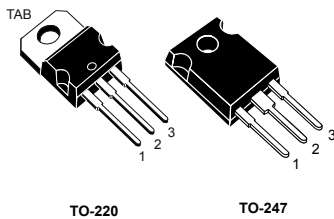
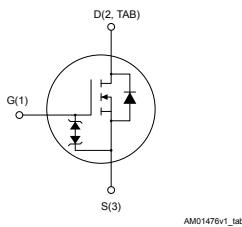


## N-channel 600 V, 0.085 $\Omega$ typ., 30 A MDmesh DM6 Power MOSFETs in TO-220 and TO-247 packages



TO-220

TO-247



AM01476v1\_sab



### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$
STP45N60DM6	600 V	0.099 $\Omega$	30 A
STW45N60DM6			

- 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

[STP45N60DM6](#)
[STW45N60DM6](#)

#### Product summary

Order code	STP45N60DM6
Marking	45N60DM6
Package	TO-220
Packing	Tube
Order code	STW45N60DM6
Marking	45N60DM6
Package	TO-247
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 $T_C = 25\text{ }^\circ\text{C}$	30	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	19	A
$I_{DM}^{(1)}$	Drain current (pulsed)	95	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	210	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		

1. Pulse width limited by safe operating area
2.  $I_{SD} \leq 30\text{ A}$ ,  $V_{DS}(\text{peak}) < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$
3.  $V_{DS} \leq 480\text{ V}$

**Table 2. Thermal data**

Symbol	Parameter	Value		Unit
		TO-220	TO-247	
$R_{thj-case}$	Thermal resistance junction-case	0.6		$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5	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 $T_{Jmax}$ )	6	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ ; $V_{DD} = 50\text{ V}$ )	630	mJ

## 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	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	600			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}$			5	$\mu\text{A}$
		$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}, T_C = 125\text{ }^\circ\text{C}^{(1)}$			100	$\mu\text{A}$
$I_{GSS}$	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	$V_{GS} = 10\text{ V}, I_D = 15\text{ A}$		0.085	0.099	$\Omega$

1. Defined by design, not subject to production test

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	1920	-	pF
$C_{oss}$	Output capacitance		-	120	-	pF
$C_{riss}$	Reverse transfer capacitance		-	2	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }480\text{ V}, V_{GS} = 0\text{ V}$	-	310	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	1.5	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 30\text{ A}, V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 16. Test circuit for gate charge behavior)	-	44	-	nC
$Q_{gs}$	Gate-source charge		-	10	-	nC
$Q_{gd}$	Gate-drain charge		-	25	-	nC

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	$V_{DD} = 300\text{ V}, I_D = 15\text{ A}$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see Figure 17. Test circuit for inductive load switching and diode recovery times) and Figure 20. Switching time waveform	-	15	-	ns
$t_r$	Rise time		-	5.3	-	ns
$t_{d(off)}$	Turn-off-delay time		-	50	-	ns
$t_f$	Fall time		-	7.3	-	ns

**Table 7. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		30	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		95	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 30\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 30\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see )Figure 17. Test circuit for inductive load switching and diode recovery times	-	110		ns
$Q_{rr}$	Reverse recovery charge		-	0.5		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	9		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 30\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see )Figure 17. Test circuit for inductive load switching and diode recovery times	-	215		ns
$Q_{rr}$	Reverse recovery charge		-	2		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	17		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 for TO-220

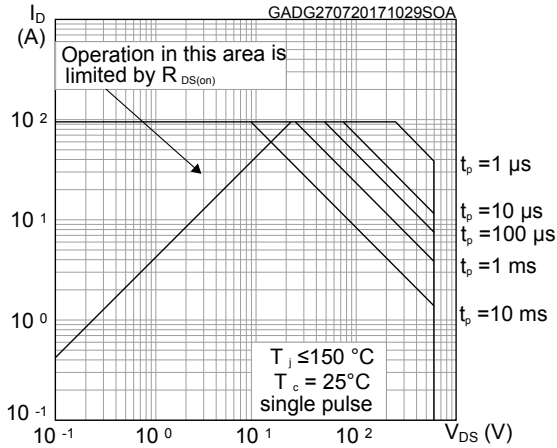


Figure 2. Thermal impedance for TO-220

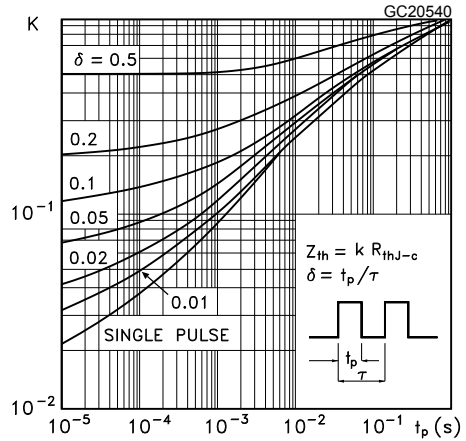


Figure 3. Safe operating area for TO-247

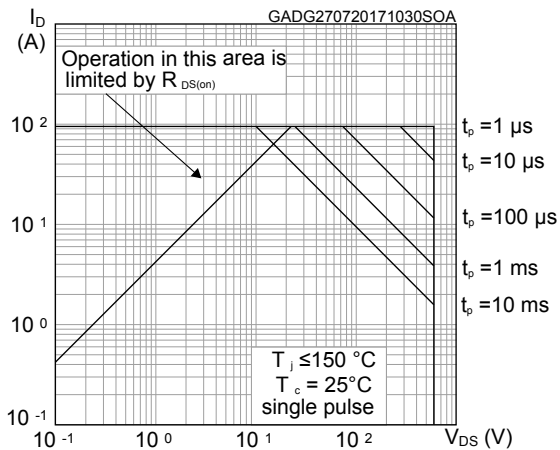


Figure 4. Thermal impedance for TO-247

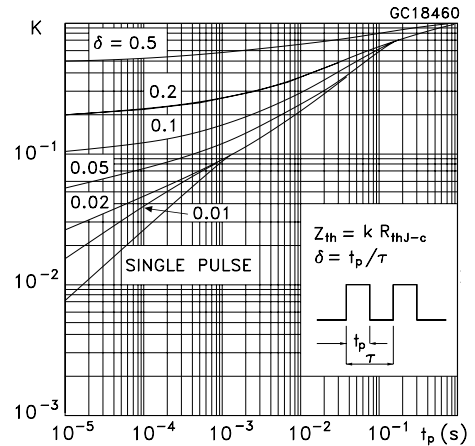


Figure 5. Output characteristics

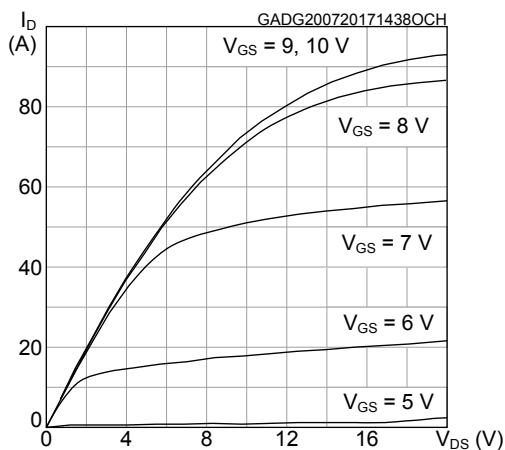
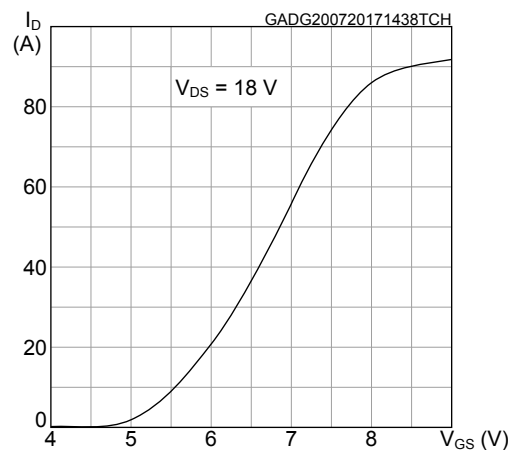


Figure 6. Transfer characteristics



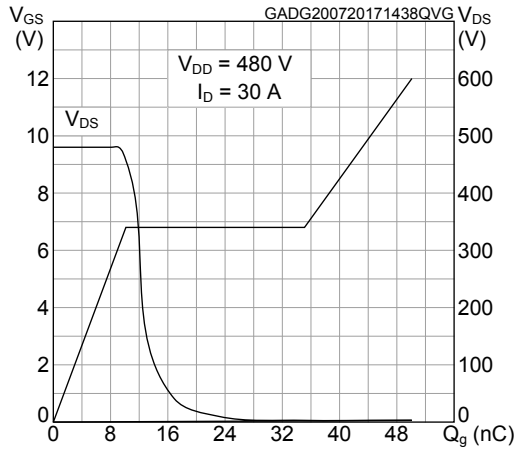
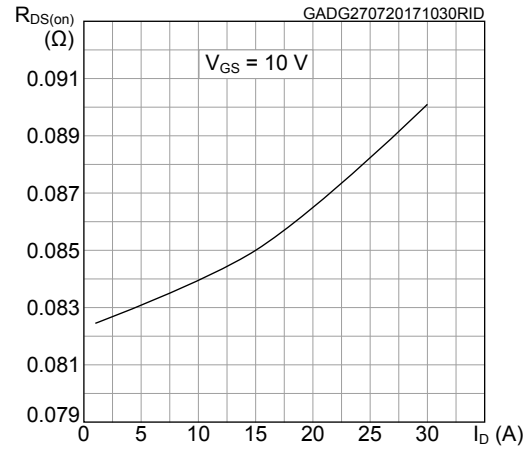
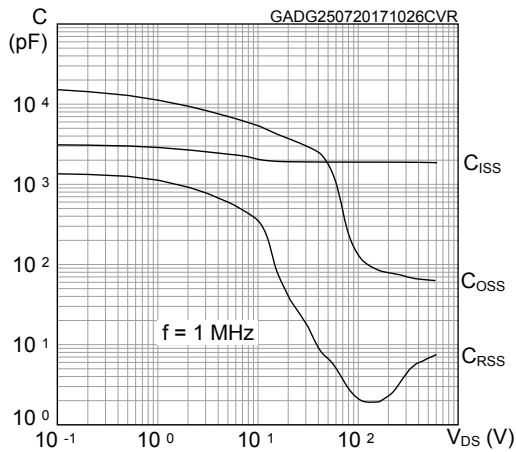
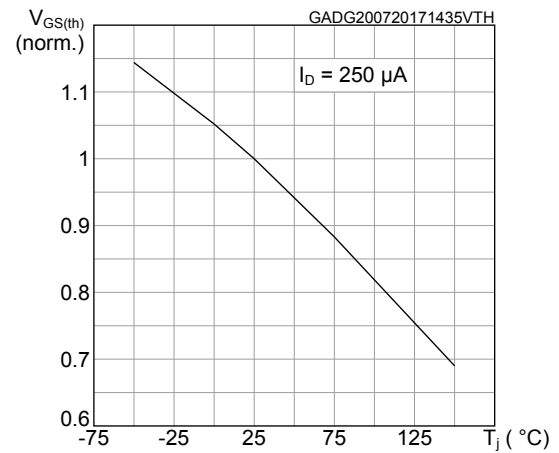
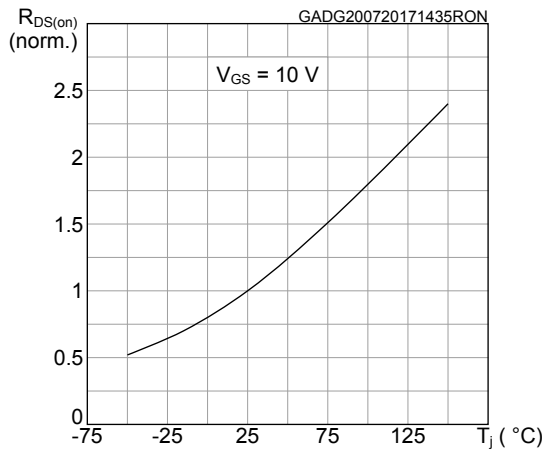
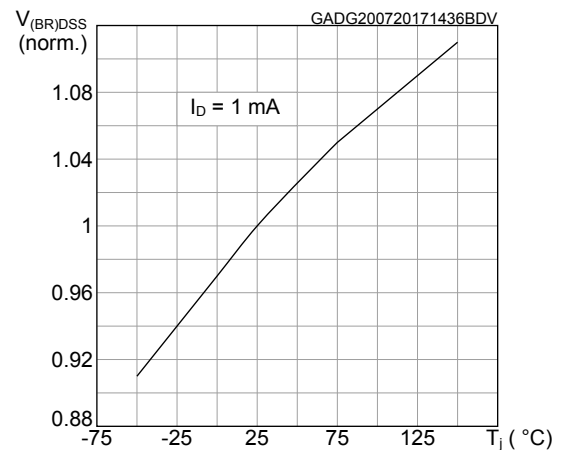
**Figure 7. Gate charge vs gate-source voltage**

**Figure 8. Static drain-source on-resistance**

**Figure 9. Capacitance variations**

**Figure 10. Normalized gate threshold voltage vs temperature**

**Figure 11. Normalized on-resistance vs temperature**

**Figure 12. Normalized V(BR)DSS vs temperature**


Figure 13. Source-drain diode forward characteristics

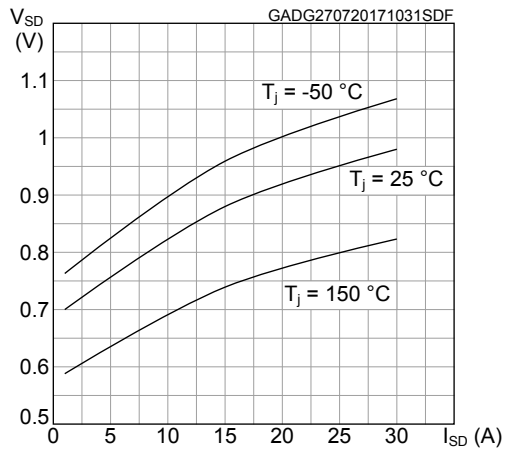
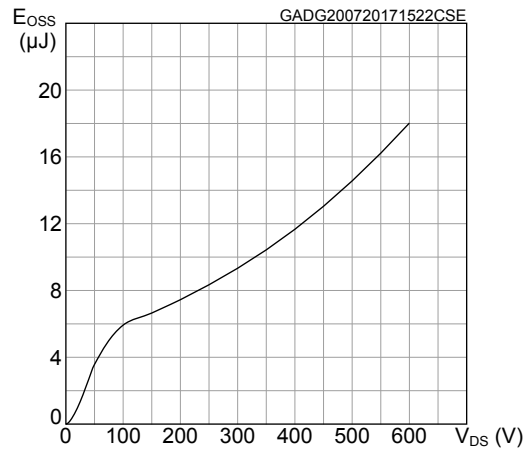
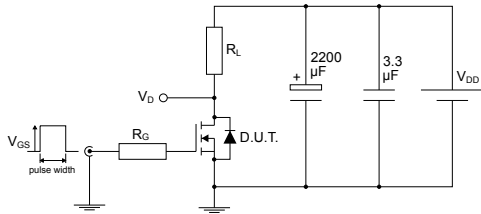


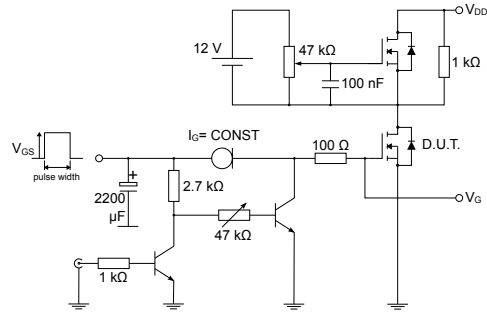
Figure 14. Output capacitance stored energy



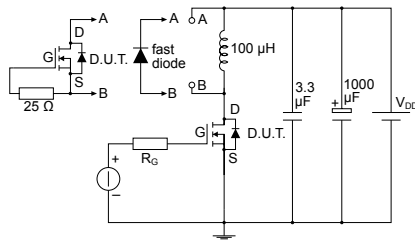
### 3 Test circuits

**Figure 15. Test circuit for resistive load switching times**


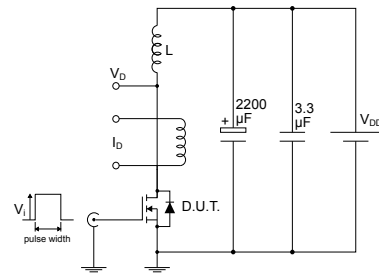
AM01468v1

**Figure 16. Test circuit for gate charge behavior**


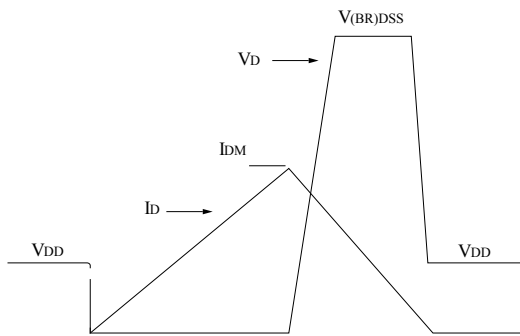
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**Figure 17. Test circuit for inductive load switching and diode recovery times**


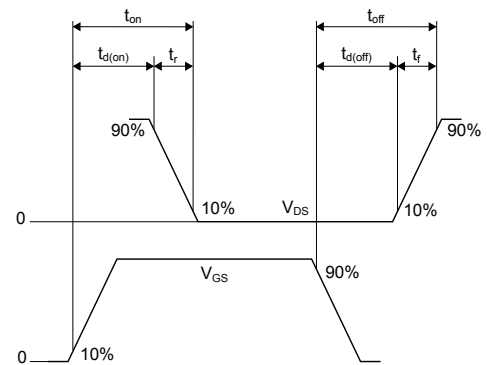
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**Figure 18. Unclamped inductive load test circuit**


AM01471v1

**Figure 19. Unclamped inductive waveform**


AM01472v1

**Figure 20. Switching time waveform**


AM01473v1

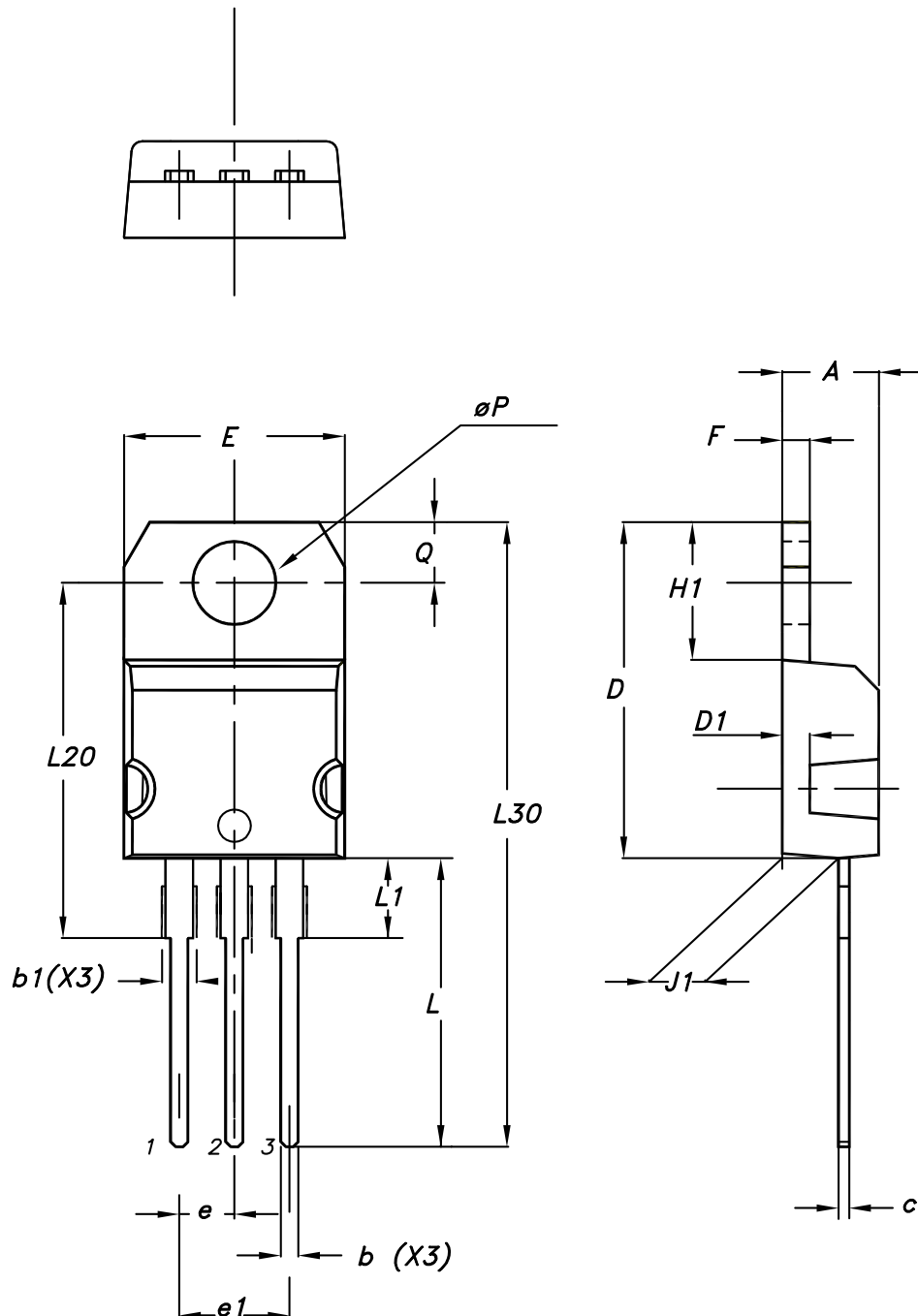


## 4 Package information

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-220 type A package information

Figure 21. TO-220 type A package outline



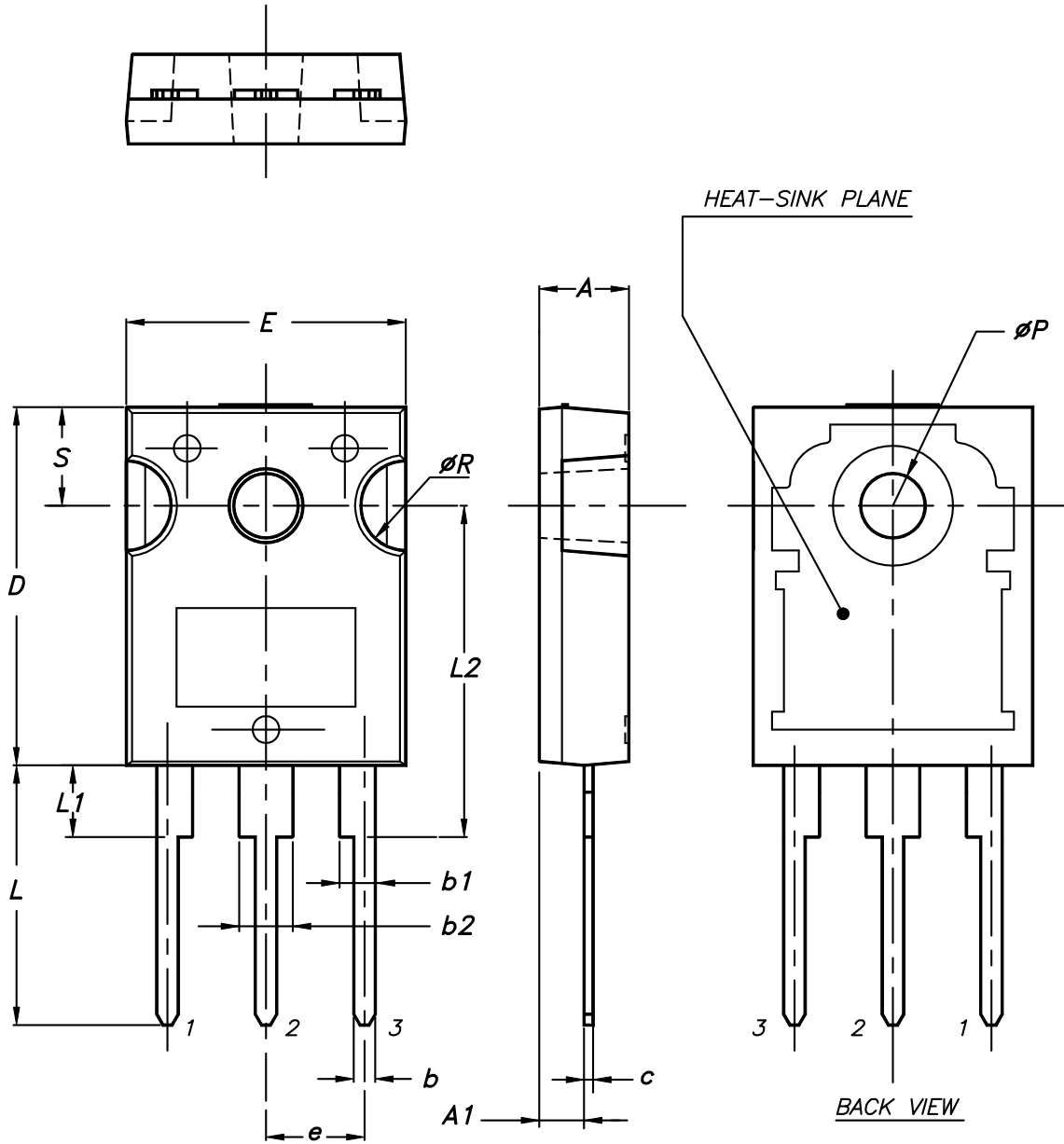
0015988\_typeA\_Rev\_23

**Table 8. TO-220 type A package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95
Slug flatness		0.03	0.10

## 4.2 TO-247 package information

Figure 22. TO-247 package outline



0075325\_9

Table 9. 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

## Revision history

**Table 10. Document revision history**

Date	Revision	Changes
27-May-2016	1	First release.
01-Aug-2017	2	Updated title and in cover page. Updated <i>Section 1: "Electrical ratings"</i> and <i>Section 2: "Electrical characteristics"</i> . Added <i>Section 2.1: "Electrical characteristics (curves)"</i> . Document status promoted from preliminary to production data. Minor text changes.
03-Jul-2020	3	Modified <a href="#">Table 1. Absolute maximum ratings</a> . Minor text changes.

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<b>4</b>	<b>Package information</b> .....	<b>9</b>
<b>4.1</b>	<b>TO-220 type A package information</b> .....	<b>9</b>
<b>4.2</b>	<b>TO-247 package information</b> .....	<b>11</b>
	<b>Revision history</b> .....	<b>13</b>

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