STP45N60DM6, STW45N60DM6

N-channel 600 V, 0.085 Ω typ., 30 A MDmesh™ DM6 Power MOSFETs in TO-220 and TO-247 packages

Datasheet - production data

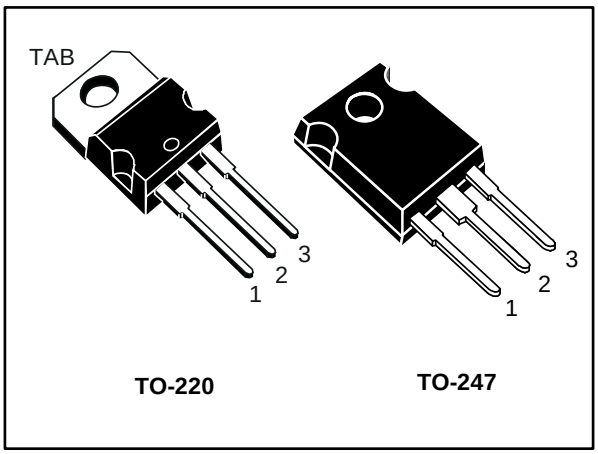
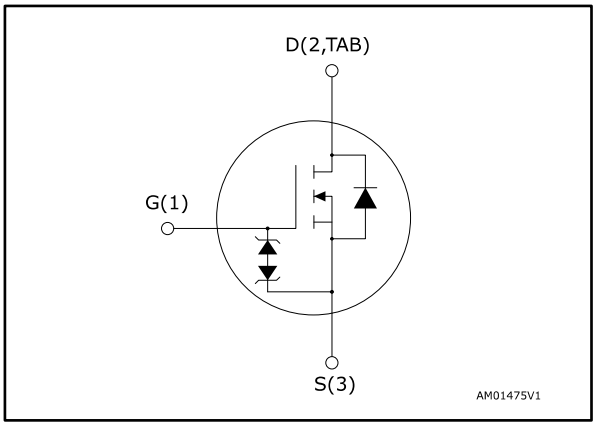


Figure 1: Internal schematic diagram



Features

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

- Fast-recovery body diode
- Lower $R_{DS(on)}$ x 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 $R_{DS(on)}$ * 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.

Table 1: Device summary

Order code	Marking	Package	Packing
STP45N60DM6	45N60DM6	TO-220	Tube
STW45N60DM6		TO-247	

Contents

1 Electrical ratings 3
2 Electrical characteristics 4
2.1 Electrical characteristics (curves) 6
3 Test circuits 9
4 Package information 10
4.1 TO-220 type A package information 11
4.2 TO-247 package information 13
5 Revision history 15

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at T_C = 25 °C	30	A
I_D	Drain current (continuous) at T_C = 100 °C	19	A
I_D(1)	Drain current (pulsed)	95	A
P_{TOT}	Total dissipation at T_C = 25 °C	210	W
dv/dt(2)	Peak diode recovery voltage slope	50	V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature range	- 55 to 150	°C
T_j	Operating junction temperature range		

Notes:

(1)Pulse width limited by safe operating area.

(2)I_{SD} ≤ 30 A, di/dt ≤ 900 A/µs; $V_{DS(peak)} < V_{(BR)DSS}$, V_{DD} = 400 V.

(3)V_{DS} ≤ 480 V

Table 3: Thermal data

Symbol	Parameter	Value		Unit
		TO-220	TO-247	
$R_{thj\text{-}case}$	Thermal resistance junction-case	0.6		°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	62.5	50	°C/W

Table 4: 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 °C, I_D = I_{AR}; V_{DD} = 50 V)	630	mJ

2 Electrical characteristics

T_C = 25 °C unless otherwise specified

Table 5: On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			5	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C(1)			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±5	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3.25	4	4.75	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 15 A		0.085	0.099	Ω

Notes:

(1)Defined by design, not subject to production test

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS}= 100 V, f = 1 MHz, V_{GS} = 0 V	-	1920	-	pF
C_{oss}	Output capacitance		-	120	-	pF
C_{rss}	Reverse transfer capacitance		-	2	-	pF
$C_{oss\ eq.}$(1)	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	310	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	1.5	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 30 A, V_{GS} = 0 to 10 V (see *Figure 17: "Test circuit for gate charge behavior"*)	-	44	-	nC
Q_{gs}	Gate-source charge		-	10	-	nC
Q_{gd}	Gate-drain charge		-	25	-	nC

Notes:

(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 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 15 A R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 18: "Test circuit for inductive load switching and diode recovery times"*) and *Figure 21: "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 8: 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 V, I_{SD} = 30 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 30 A, di/dt = 100 A/µs, V_{DD} = 60 V (see *Figure 18: "Test circuit for inductive load switching and diode recovery times"*)	-	110		ns
Q_{rr}	Reverse recovery charge		-	0.5		µC
I_{RRM}	Reverse recovery current		-	9		A
t_{rr}	Reverse recovery time	I_{SD} = 30 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_j = 150 °C (see *Figure 18: "Test circuit for inductive load switching and diode recovery times"*)	-	215		ns
Q_{rr}	Reverse recovery charge		-	2		µC
I_{RRM}	Reverse recovery current		-	17		A

Notes:

(1)Pulse width is limited by safe operating area

(2)Pulsed: pulse duration = 300 µs, duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area for TO-220

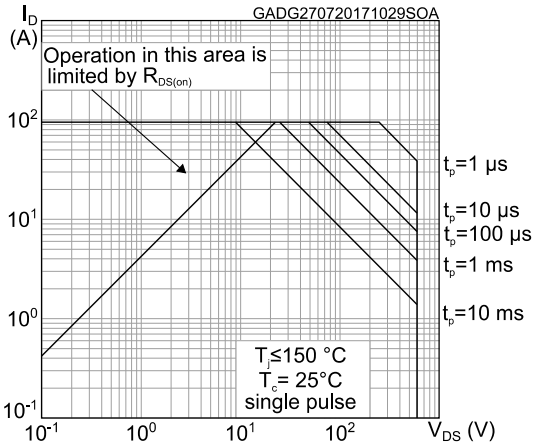


Figure 3: Thermal impedance for TO-220

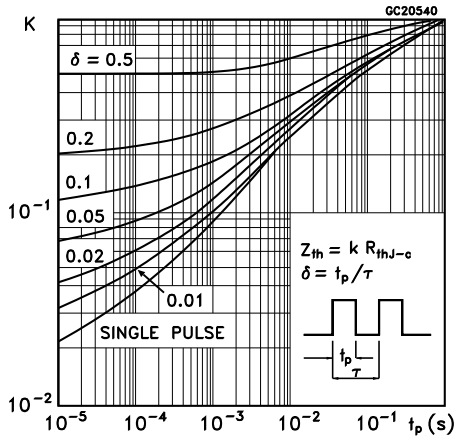


Figure 4: Safe operating area for TO-247

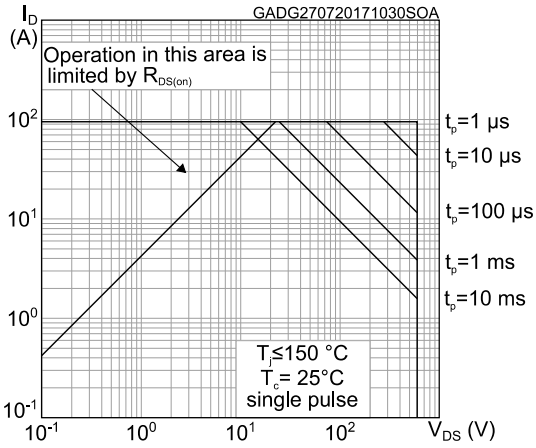


Figure 5: Thermal impedance for TO-247

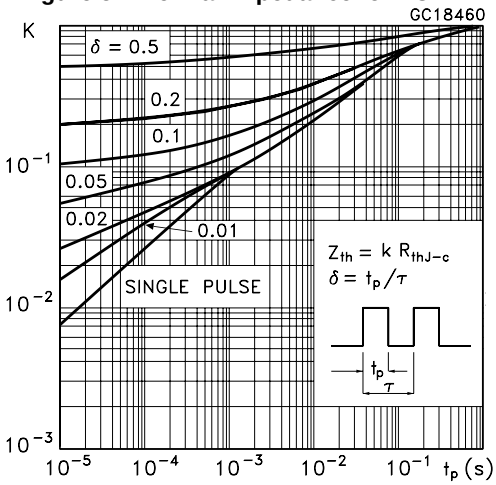


Figure 6: Output characteristics

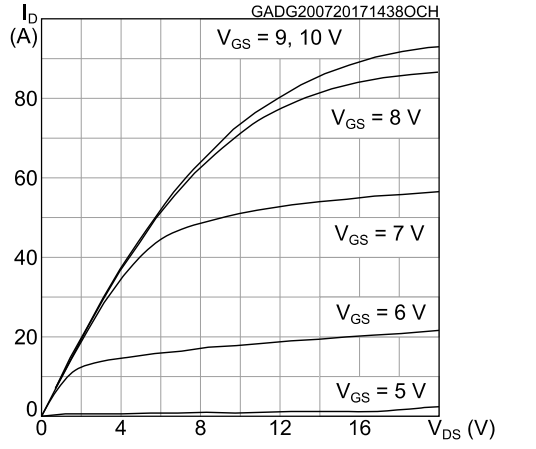


Figure 7: Transfer characteristics

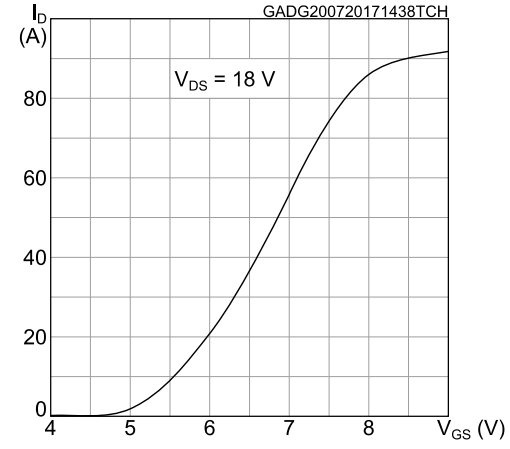


Figure 8: Gate charge vs gate-source voltage

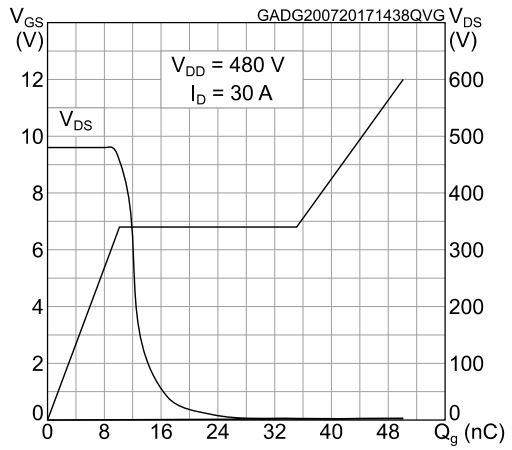


Figure 9: Static drain-source on-resistance

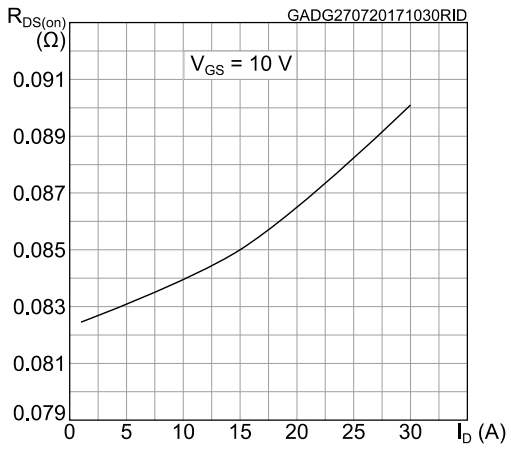


Figure 10: Capacitance variations

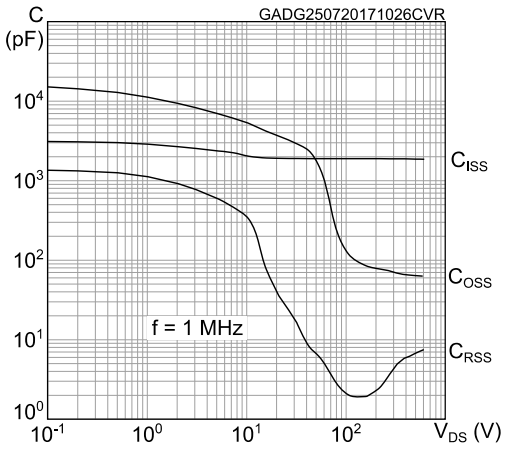


Figure 11: Normalized gate threshold voltage vs temperature

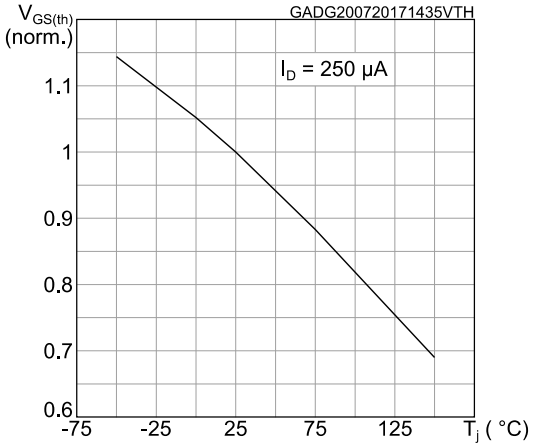


Figure 12: Normalized on-resistance vs temperature

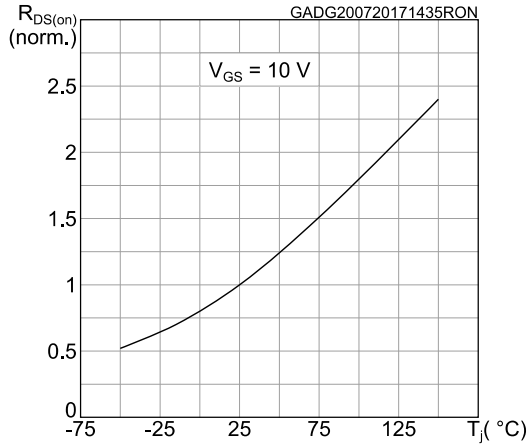


Figure 13: Normalized $V_{(BR)DSS}$ vs temperature

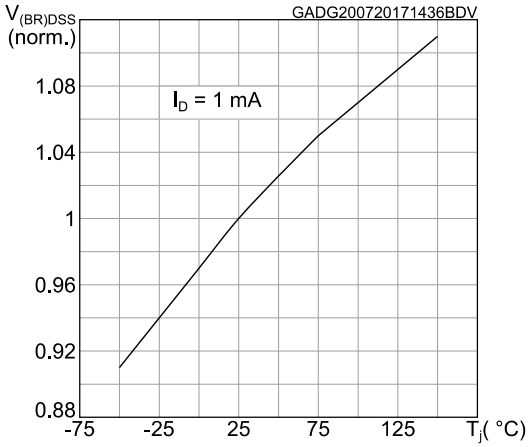


Figure 14: Source-drain diode forward characteristics

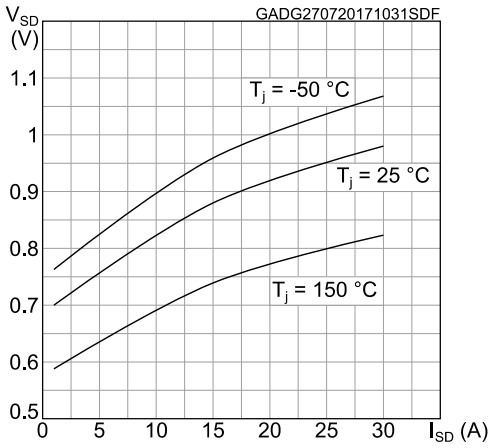
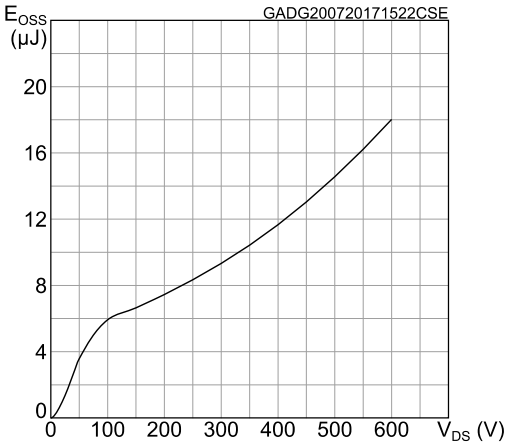


Figure 15: Output capacitance stored energy



3 Test circuits

Figure 16: Test circuit for resistive load switching times

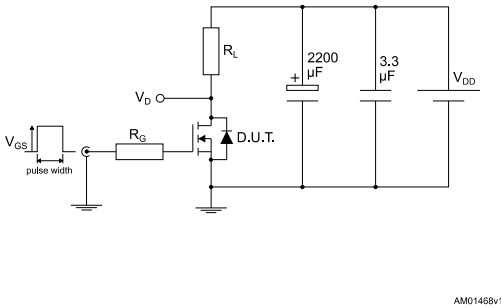


Figure 17: Test circuit for gate charge behavior

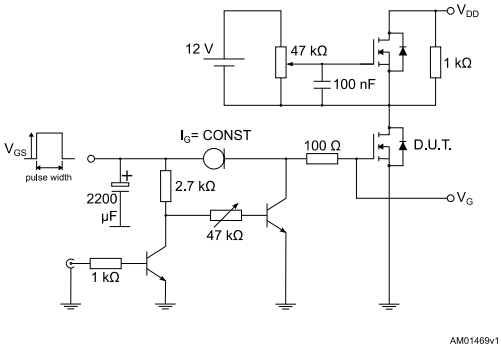


Figure 18: Test circuit for inductive load switching and diode recovery times

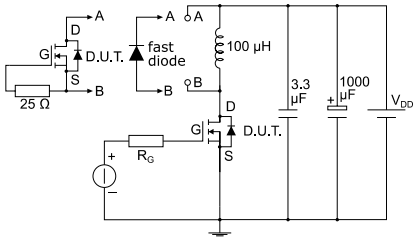


Figure 19: Unclamped inductive load test circuit

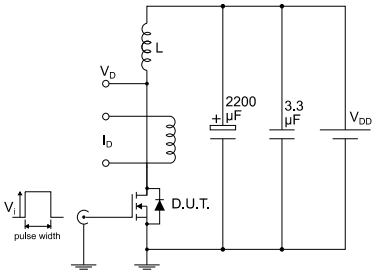


Figure 20: Unclamped inductive waveform

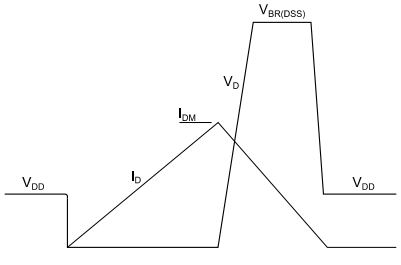
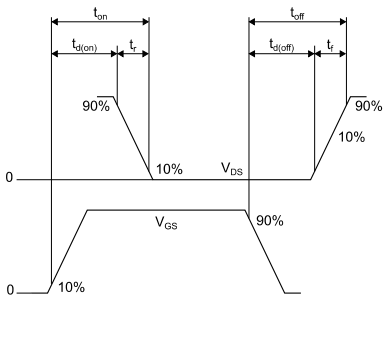


Figure 21: Switching time waveform



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***. ECOPACK® is an ST trademark.

4.1 TO-220 type A package information

Figure 22: TO-220 type A package outline

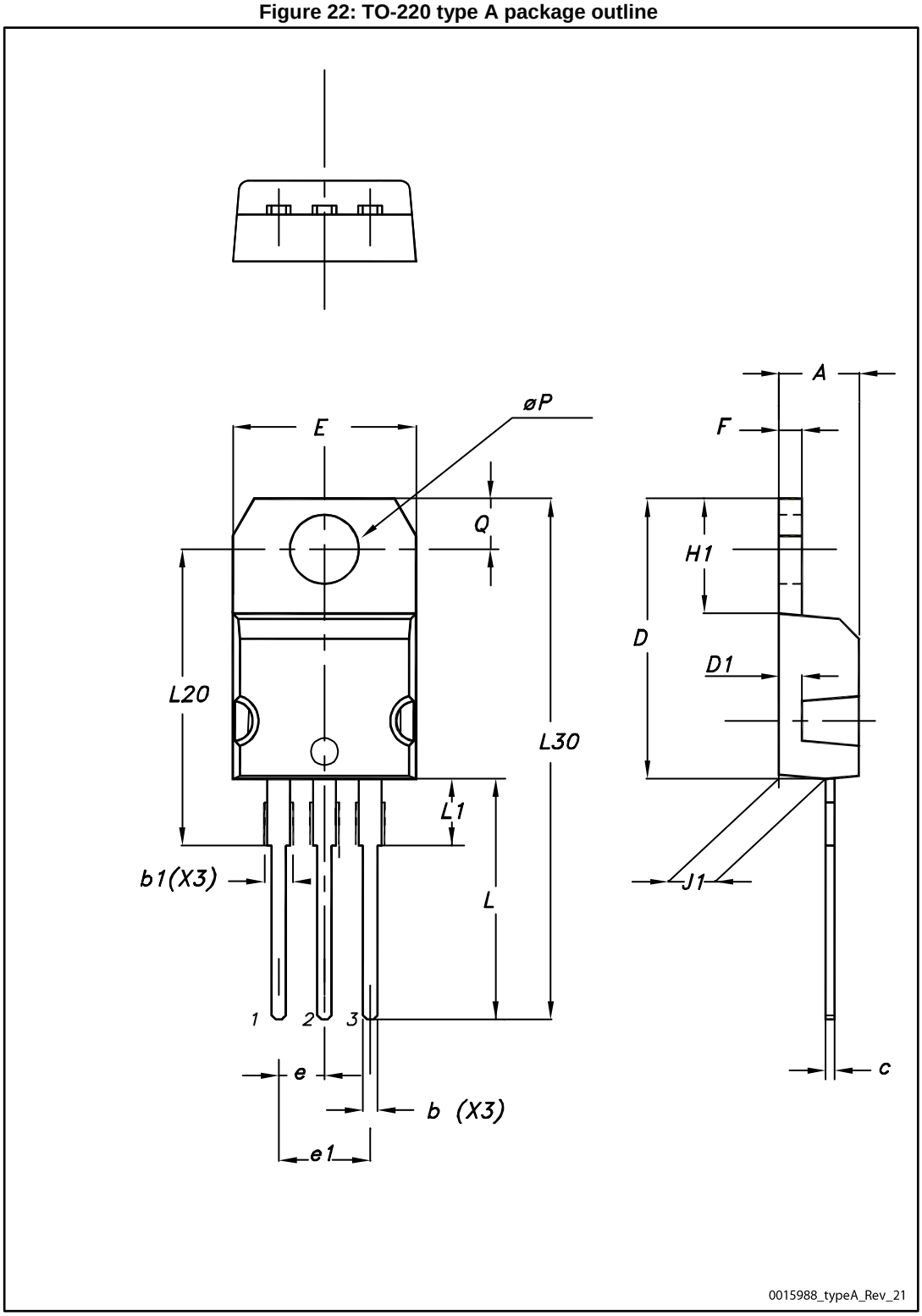


Table 9: TO-220 type A package mechanical data

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

4.2 TO-247 package information

Figure 23: TO-247 package outline

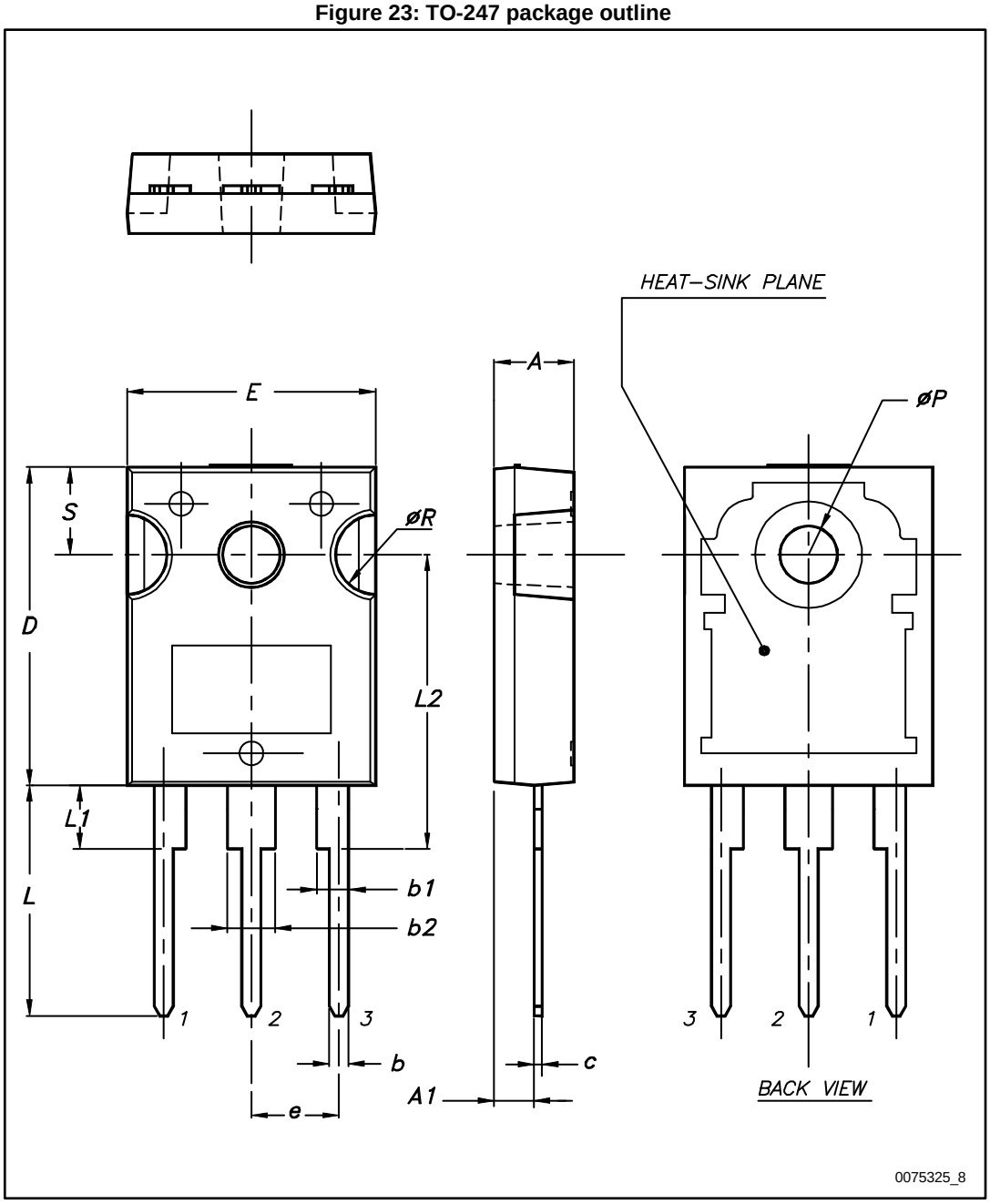


Table 10: TO-247 package mechanical data

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

5 Revision history

Table 11: Document revision history

Date	Revision	Changes
27-May-2016	1	First release.
01-Aug-2017	2	Updated title and in cover page. Updated *Section 1: "Electrical ratings"* and *Section 2: "Electrical characteristics"*. Added *Section 2.1: "Electrical characteristics (curves)"*. Document status promoted from preliminary to production data. Minor text changes.

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