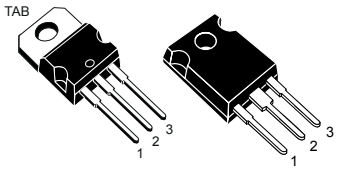
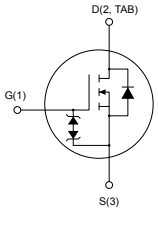
STP45N60DM6, STW45N60DM6

Datasheet

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



TO-220 TO-247



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 $R_{DS(on)}$ 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	±25	V
I_D	Drain current (continuous) at T_C = 25 °C	30	A
	Drain current (continuous) at T_C = 100 °C	19	A
I_{DM} (1)	Drain current (pulsed)	95	A
P_{TOT}	Total power dissipation at T_C = 25 °C	210	W
dv/dt (2)	Peak diode recovery voltage slope	100	V/ns
di/dt (2)	Peak diode recovery current slope	1000	A/µs
dv/dt (3)	MOSFET dv/dt ruggedness	100	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		

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

Table 2. 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 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 °C, I_D = I_{AR}; V_{DD} = 50 V)	630	mJ

2 Electrical characteristics

T_C = 25 °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 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

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 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 16. Test circuit for gate charge behavior	-	44	-	nC
Q_{gs}	Gate-source charge		-	10	-	nC
Q_{gd}	Gate-drain charge		-	25	-	nC

1. *$C_{oss\ eq.}$ 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 V, I_D = 15 A R_G = 4.7 Ω, V_{GS} = 10 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 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 17. 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 17. 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

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 1. Safe operating area for TO-220

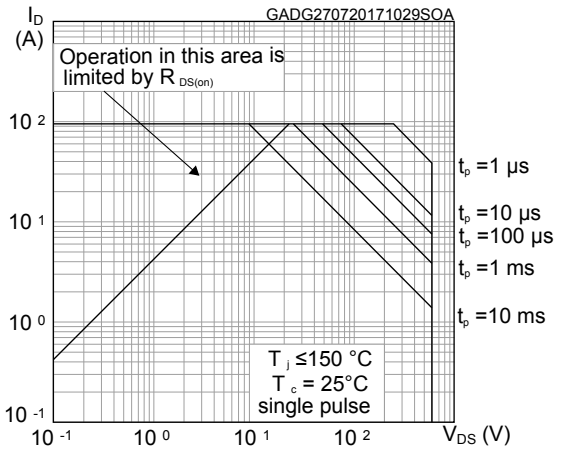


Figure 2. Thermal impedance for TO-220

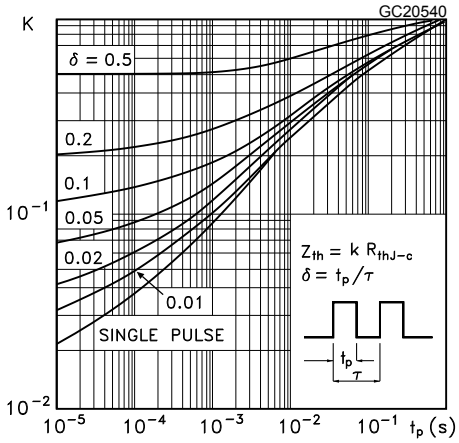


Figure 3. Safe operating area for TO-247

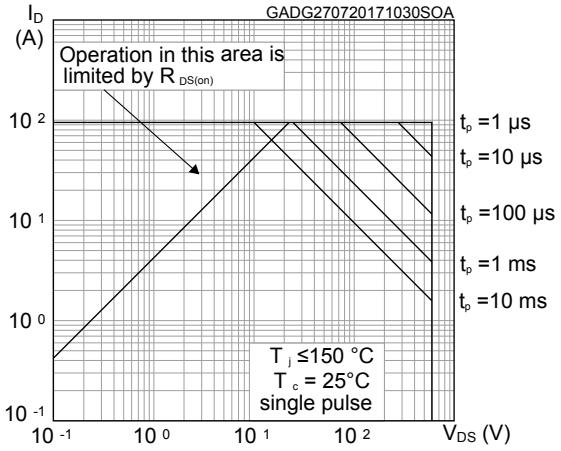


Figure 4. Thermal impedance for TO-247

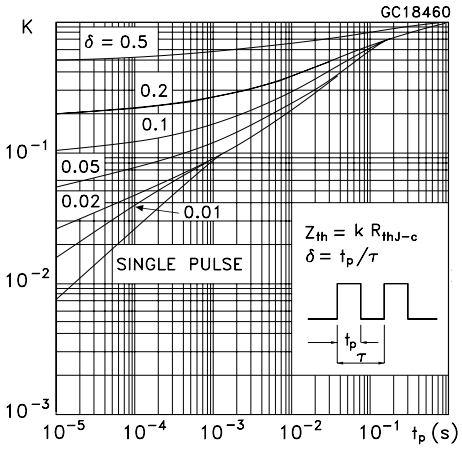


Figure 5. Output characteristics

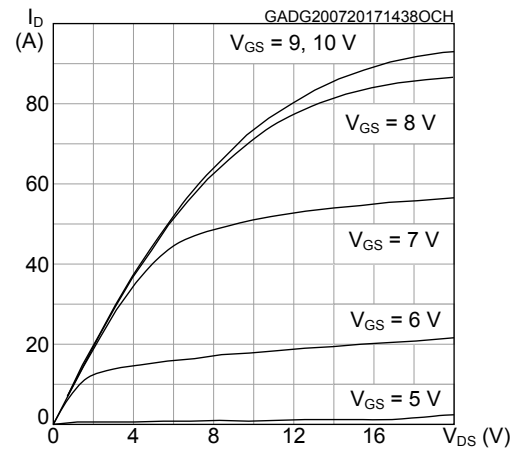


Figure 6. Transfer characteristics

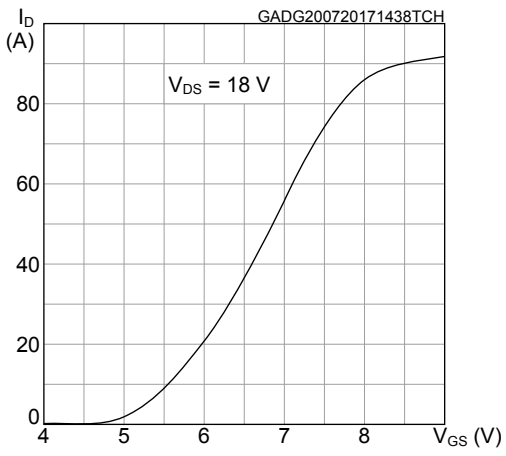


Figure 7. Gate charge vs gate-source voltage

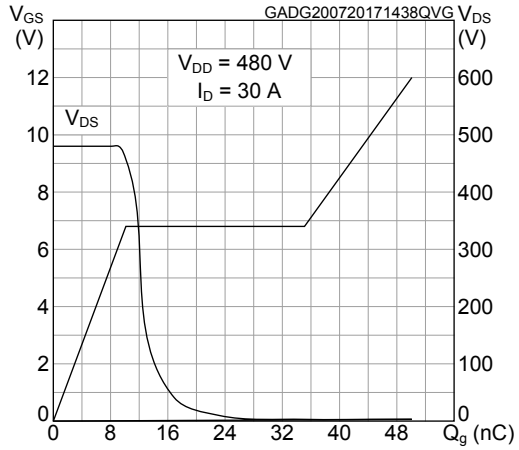


Figure 8. Static drain-source on-resistance

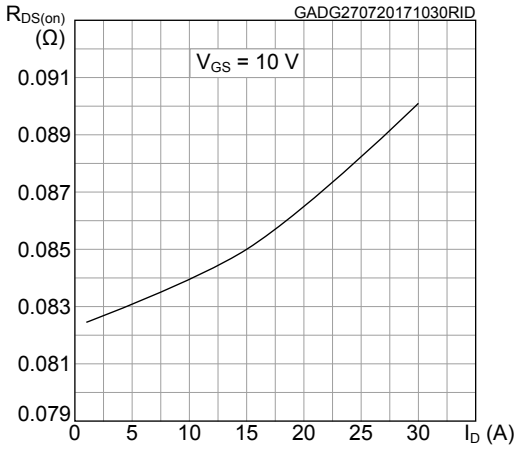


Figure 9. Capacitance variations

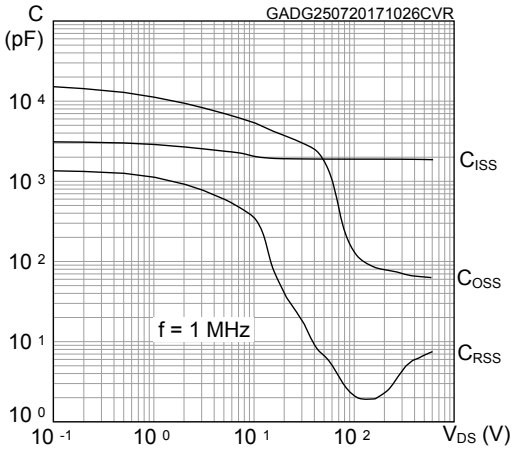


Figure 10. Normalized gate threshold voltage vs temperature

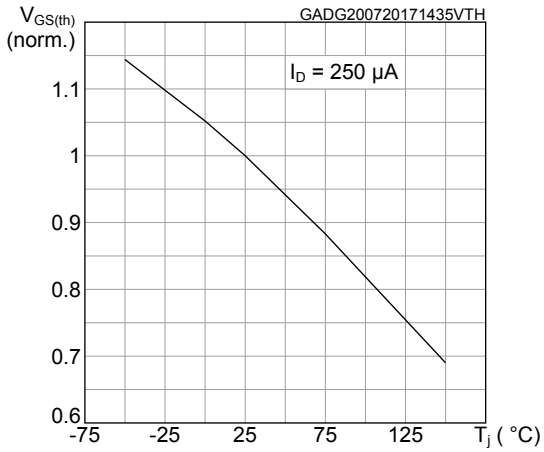


Figure 11. Normalized on-resistance vs temperature

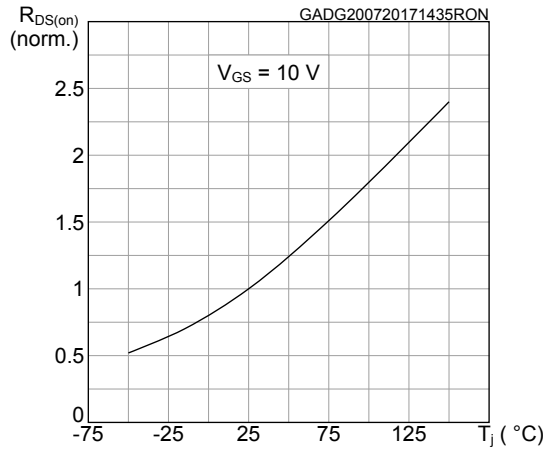


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature

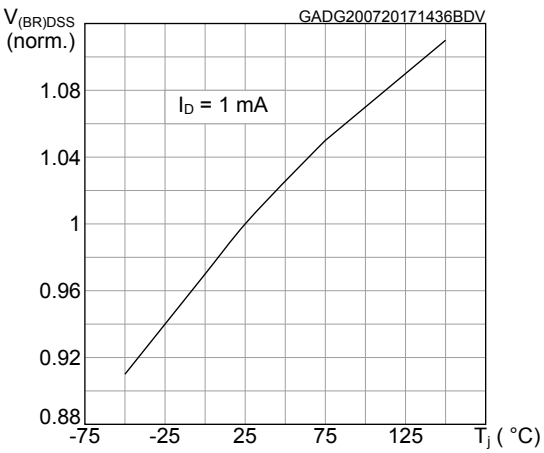


Figure 13. Source-drain diode forward characteristics

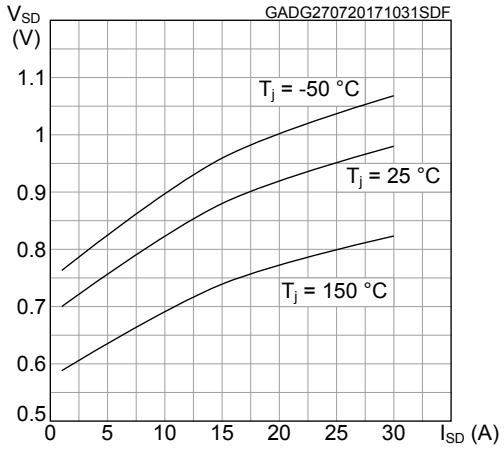
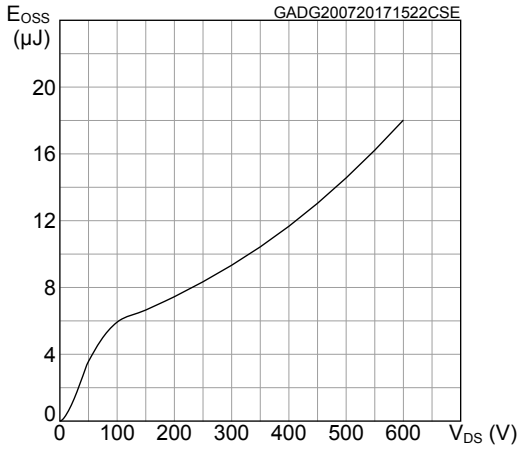


Figure 14. Output capacitance stored energy



3 Test circuits

Figure 15. Test circuit for resistive load switching times

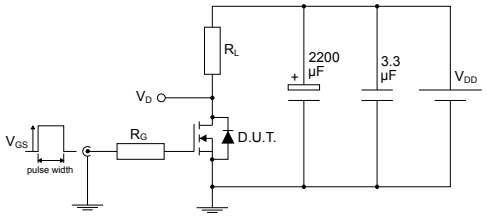


Figure 16. Test circuit for gate charge behavior

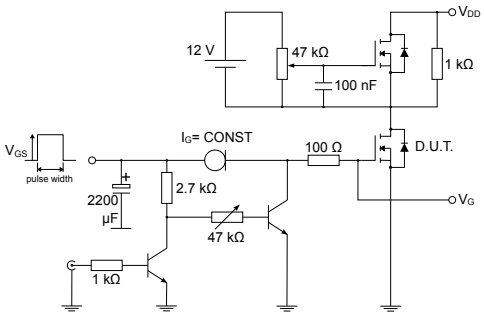


Figure 17. Test circuit for inductive load switching and diode recovery times

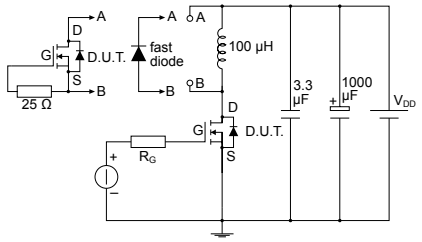


Figure 18. Unclamped inductive load test circuit

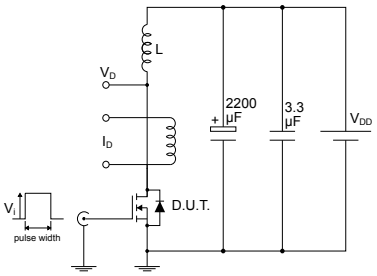


Figure 19. Unclamped inductive waveform

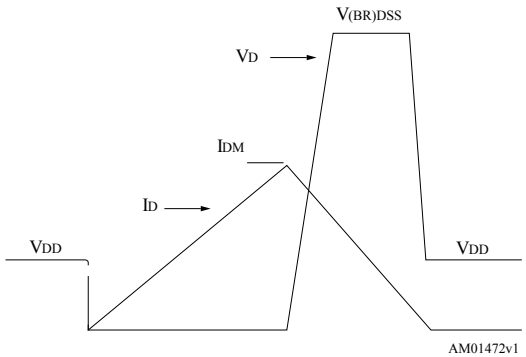
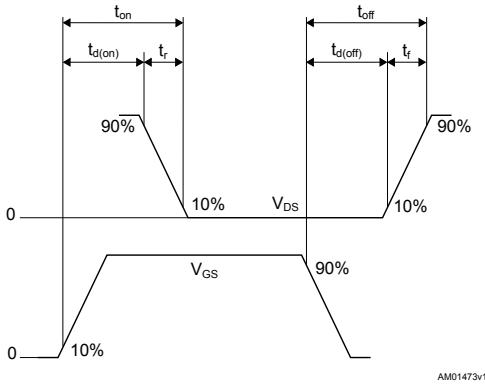


Figure 20. Switching time waveform



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 21. **TO-220 type A package outline**

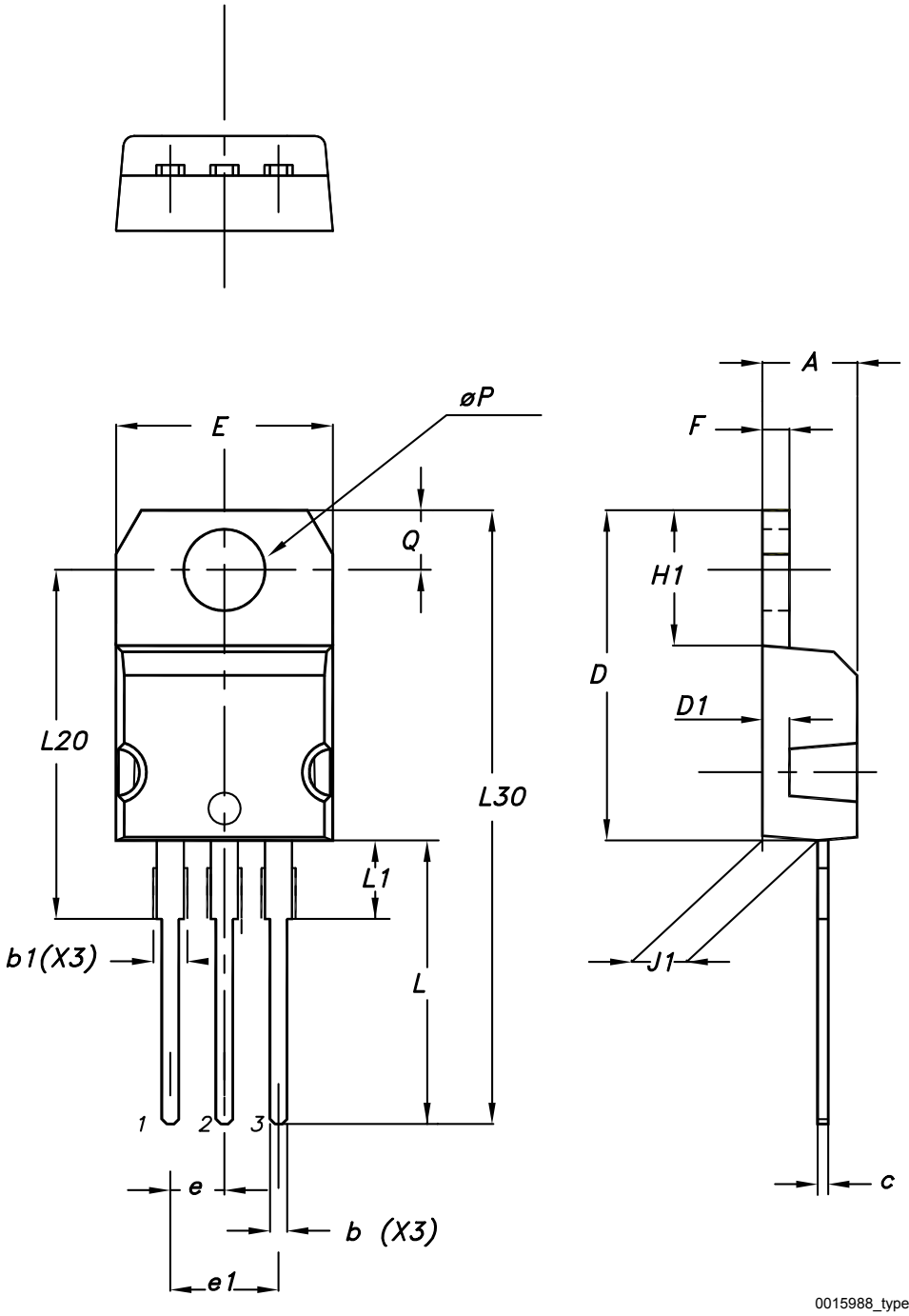


Table 8. **TO-220 type A package mechanical data**

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**

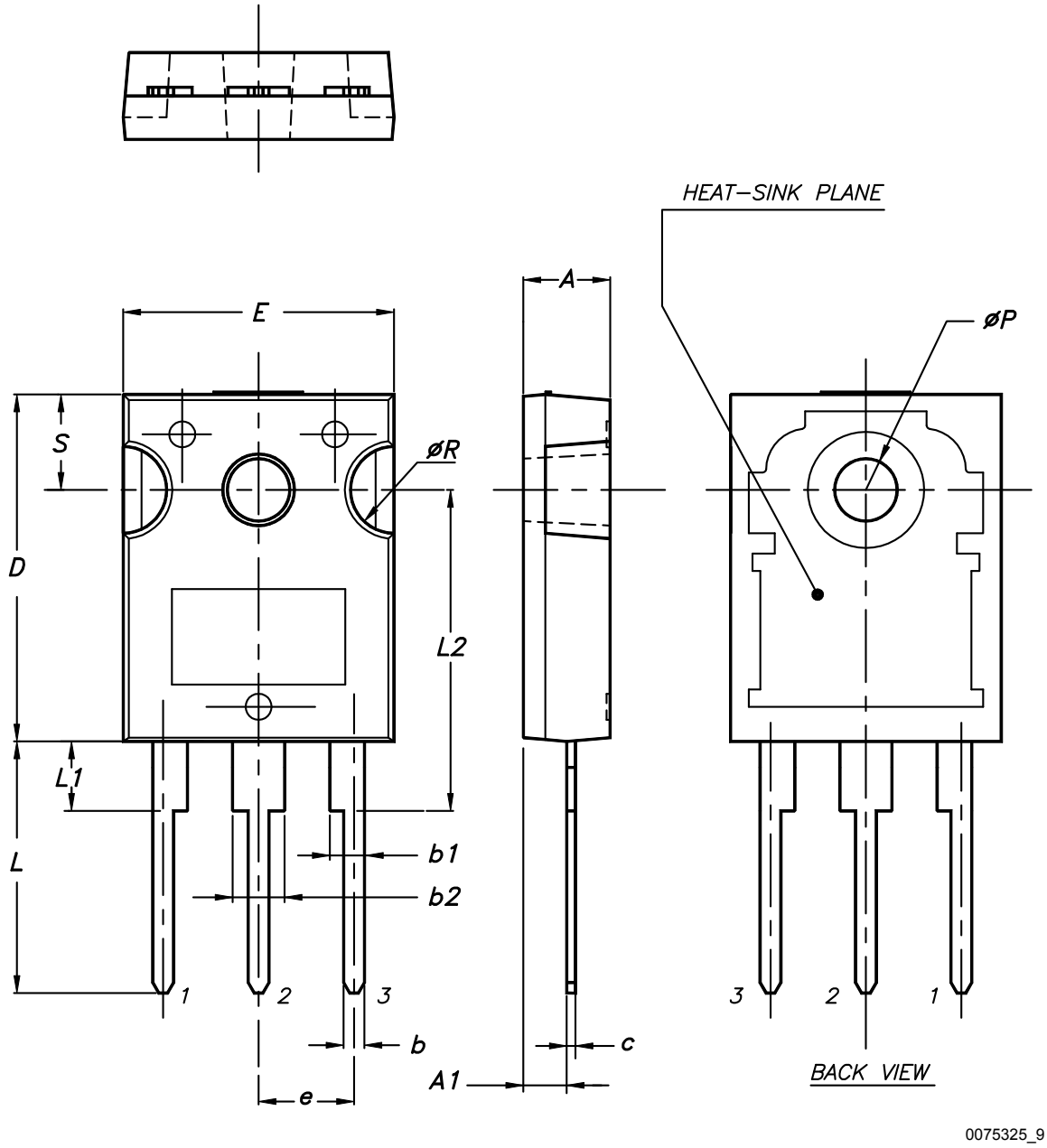


Table 9. **TO-247 package mechanical data**

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 *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.
03-Jul-2020	3	Modified Table 1. Absolute maximum ratings. Minor text changes.

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