

N-channel 800 V, 2.75 Ω typ., 2 A MDmesh™ K5 Power MOSFET in TO-220 and IPAK packages

Datasheet - production data

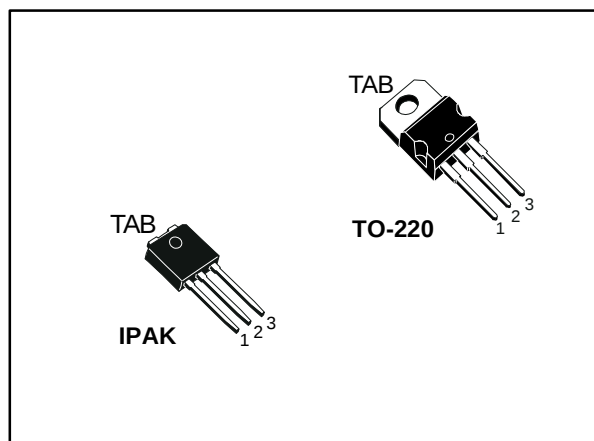


Figure 1: Internal schematic diagram

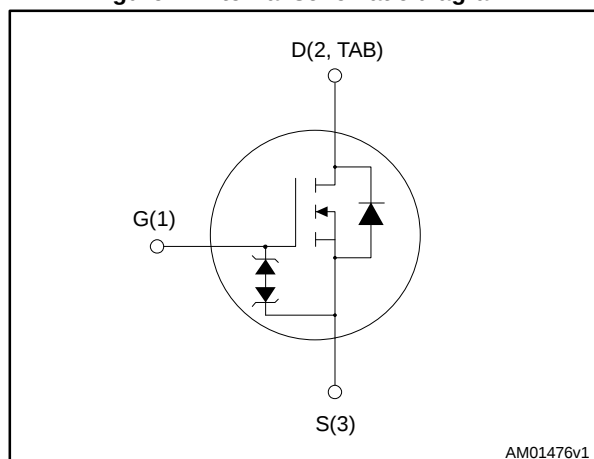


Table 1: Device summary

Order code	Marking	Package	Packing
STP3LN80K5	3LN80K5	TO-220	Tube
STU3LN80K5		IPAK	

Features

Order code	V _{DS}	R _{DS(on)} max	I _D
STP3LN80K5	800 V	3.25 Ω	2 A
STU3LN80K5			

- Industry's lowest R_{DS(on)} x area
- Industry's best FoM (figure of merit)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

These very high voltage N-channel Power MOSFET are designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	2	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	1.25	A
$I_D^{(1)}$	Drain current (pulsed)	8	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	45	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	
T_{stg}	Storage temperature range	- 55 to 150	$^{\circ}\text{C}$
T_j	Operating junction temperature range		

Notes:

(1) Pulse width limited by safe operating area.

(2) $I_{SD} \leq 2\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$; $V_{DSpeak} < V_{(BR)DSS}$, $V_{DD} = 640\text{ V}$.

(3) $V_{DS} \leq 640\text{ V}$.

Table 3: Thermal data

Symbol	Parameter	Value		Unit
		TO-220	IPAK	
$R_{thj-case}$	Thermal resistance junction-case	2.78		$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5	100	$^{\circ}\text{C}/\text{W}$

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	0.7	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25^{\circ}\text{C}$, $I_D = I_{AR}$; $V_{DD} = 50\text{ V}$)	155	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	I _D = 1 mA, V _{GS} = 0 V	800			V
I _{DSS}	Zero gate voltage drain current	V _{DS} = 800 V, V _{GS} = 0 V			1	μA
		V _{DS} = 800 V, V _{GS} = 0 V, T _C = 125 °C ⁽¹⁾			50	μA
I _{GSS}	Gate body leakage current	V _{GS} = ± 20 V, V _{DS} = 0 V			±10	μA
V _{GS(th)}	Gate threshold voltage	V _{DS} = V _{GS} , I _D = 100 μA	3	4	5	V
R _{DS(on)}	Static drain-source on-resistance	V _{GS} = 10 V, I _D = 1 A		2.75	3.25	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	-	102	-	pF
C _{oss}	Output capacitance		-	11	-	pF
C _{rss}	Reverse transfer capacitance		-	0.1	-	pF
C _{otr} ⁽¹⁾	Equivalent capacitance time related	V _{DS} = 0 to 640 V, V _{GS} = 0 V	-	20	-	pF
C _{oer} ⁽²⁾	Equivalent capacitance energy related		-	7	-	pF
R _G	Intrinsic gate resistance	f = 1 MHz, I _D = 0 A	-	12	-	Ω
Q _g	Total gate charge	V _{DD} = 640 V, I _D = 2 A, V _{GS} = 10 V (see Figure 17: "Test circuit for gate charge behavior")	-	2.63	-	nC
Q _{gs}	Gate-source charge		-	0.91	-	nC
Q _{gd}	Gate-drain charge		-	1.53	-	nC

Notes:

⁽¹⁾Time related 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}

⁽²⁾Energy related is defined as a constant equivalent capacitance giving the same stored energy 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	$V_{DD} = 400\text{ V}$, $I_D = 1\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 16: "Test circuit for resistive load switching times" and Figure 21: "Switching time waveform")	-	6.2	-	ns
t_r	Rise time		-	7	-	ns
$t_{d(off)}$	Turn-off delay time		-	30	-	ns
t_f	Fall time		-	26	-	ns

Table 8: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		2	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		8	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 2\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 2\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 18: "Test circuit for inductive load switching and diode recovery times")	-	210		ns
Q_{rr}	Reverse recovery charge		-	0.8		μC
I_{RRM}	Reverse recovery current		-	7.6		A
t_{rr}	Reverse recovery time	$I_{SD} = 2\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$, (see Figure 18: "Test circuit for inductive load switching and diode recovery times")	-	345		ns
Q_{rr}	Reverse recovery charge		-	1.2		μC
I_{RRM}	Reverse recovery current		-	7.2		A

Notes:

(1)Pulse width limited by safe operating area.

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

Table 9: Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$, $I_D = 0\text{ A}$	30	-	-	V

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area for TO-220

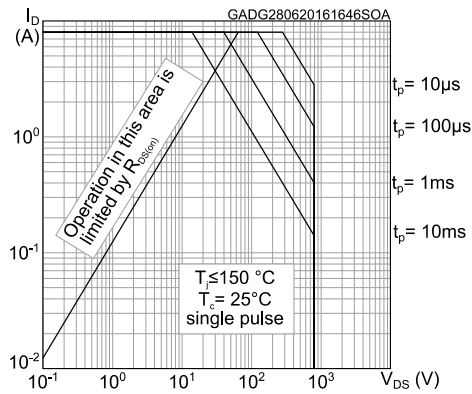


Figure 3: Thermal impedance for TO-220

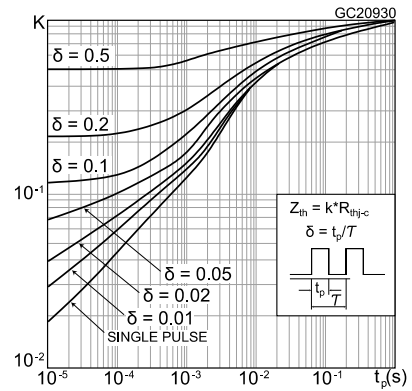


Figure 4: Safe operating area for IPAK

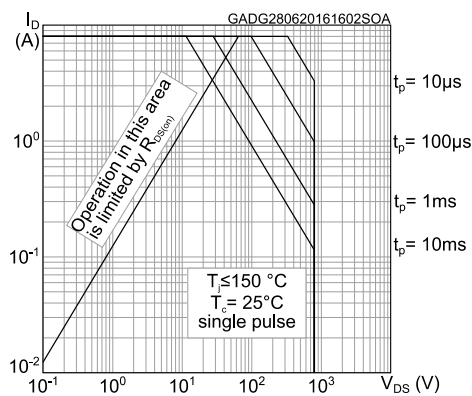


Figure 5: Thermal impedance for IPAK

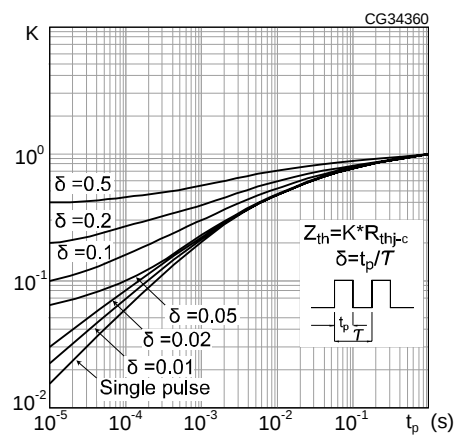


Figure 6: Output characteristics

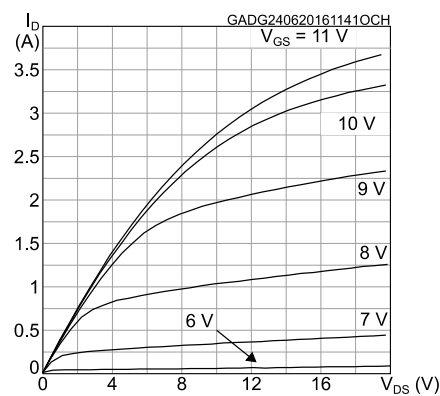


Figure 7: Transfer characteristics

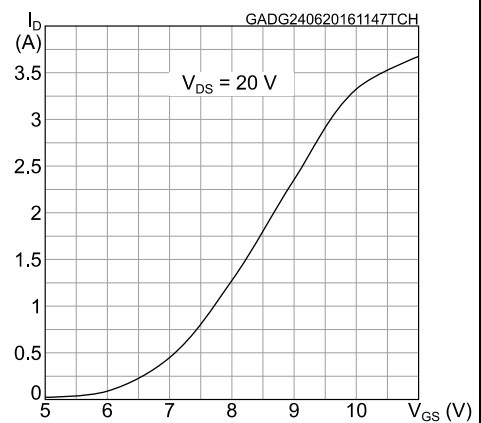


Figure 8: Gate charge vs gate-source voltage

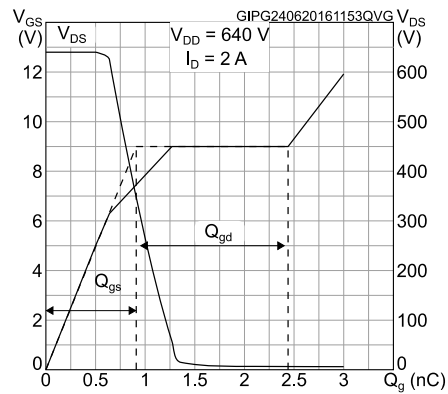


Figure 9: Static drain-source on-resistance

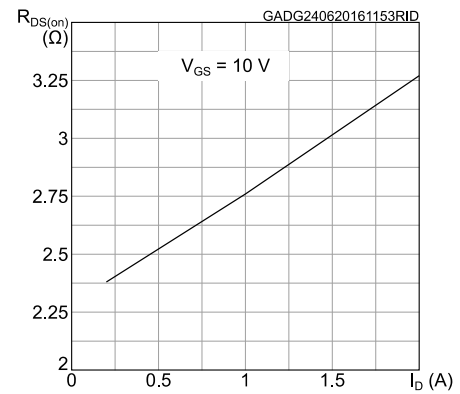


Figure 10: Capacitance variations

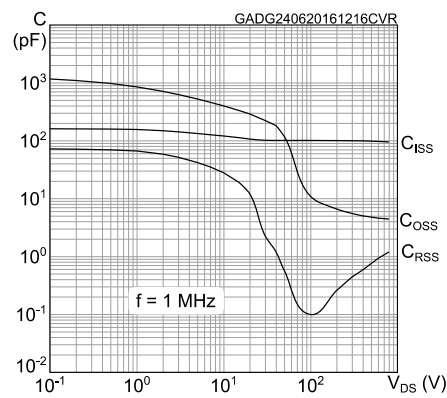


Figure 11: Source-drain diode forward characteristics

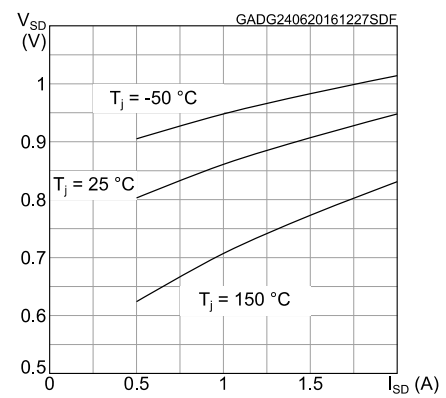


Figure 12: Normalized gate threshold voltage vs temperature

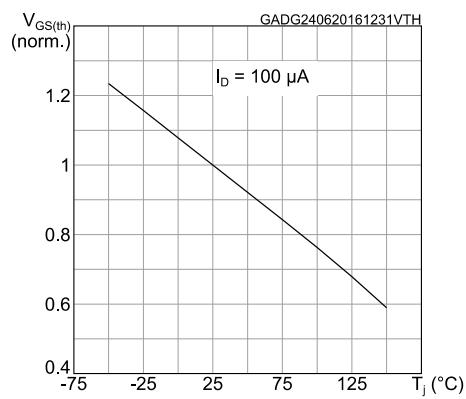


Figure 13: Normalized on-resistance vs temperature

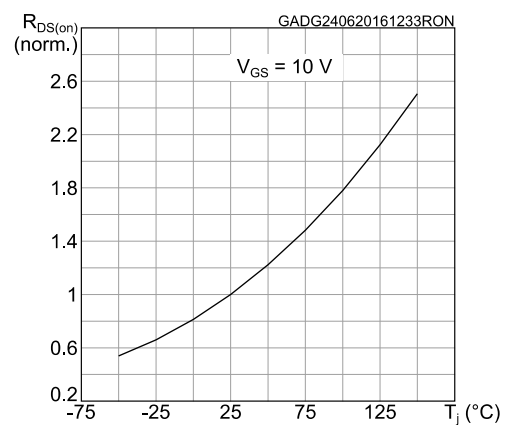
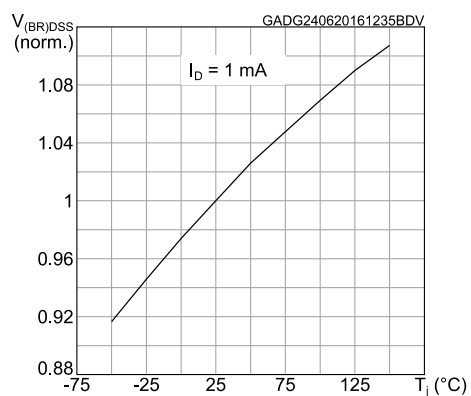
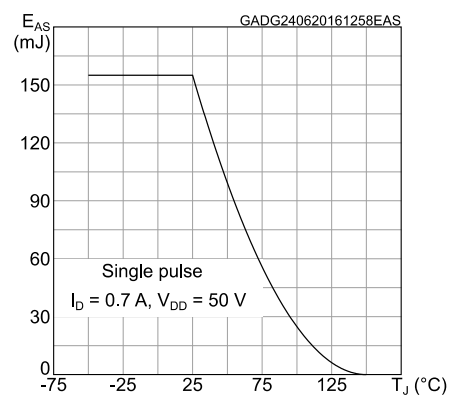
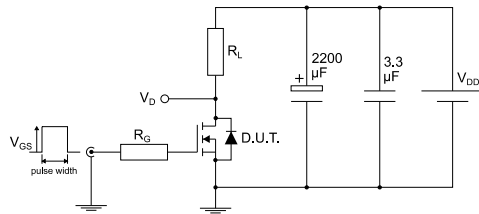


Figure 14: Normalized $V_{(BR)DSS}$ vs temperature**Figure 15: Maximum avalanche energy vs starting T_J** 

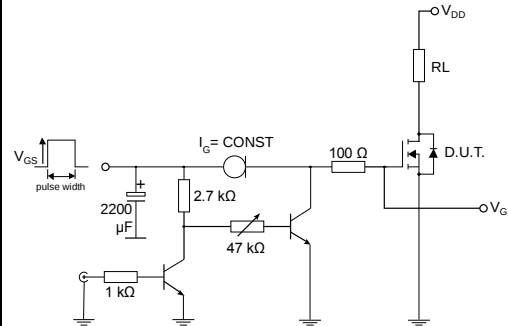
3 Test circuits

Figure 16: Test circuit for resistive load switching times



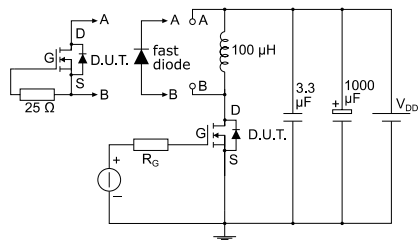
AM01468v1

Figure 17: Test circuit for gate charge behavior



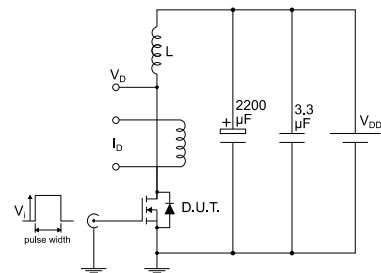
AM01469v10

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



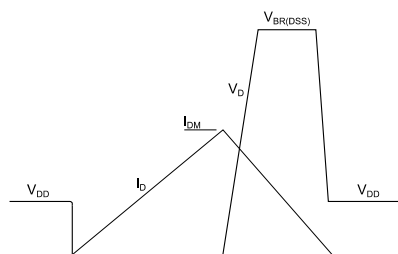
AM01470v1

Figure 19: Unclamped inductive load test circuit



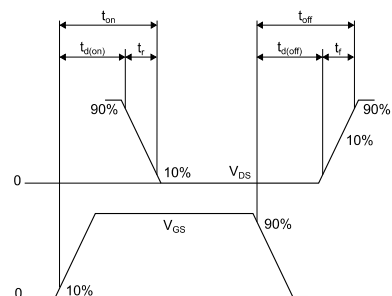
AM01471v1

Figure 20: Unclamped inductive waveform



AM01472v1

Figure 21: 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. ECOPACK® is an ST trademark.

4.1 IPAK package information

Figure 22: IPAK (TO-251) type A package outline

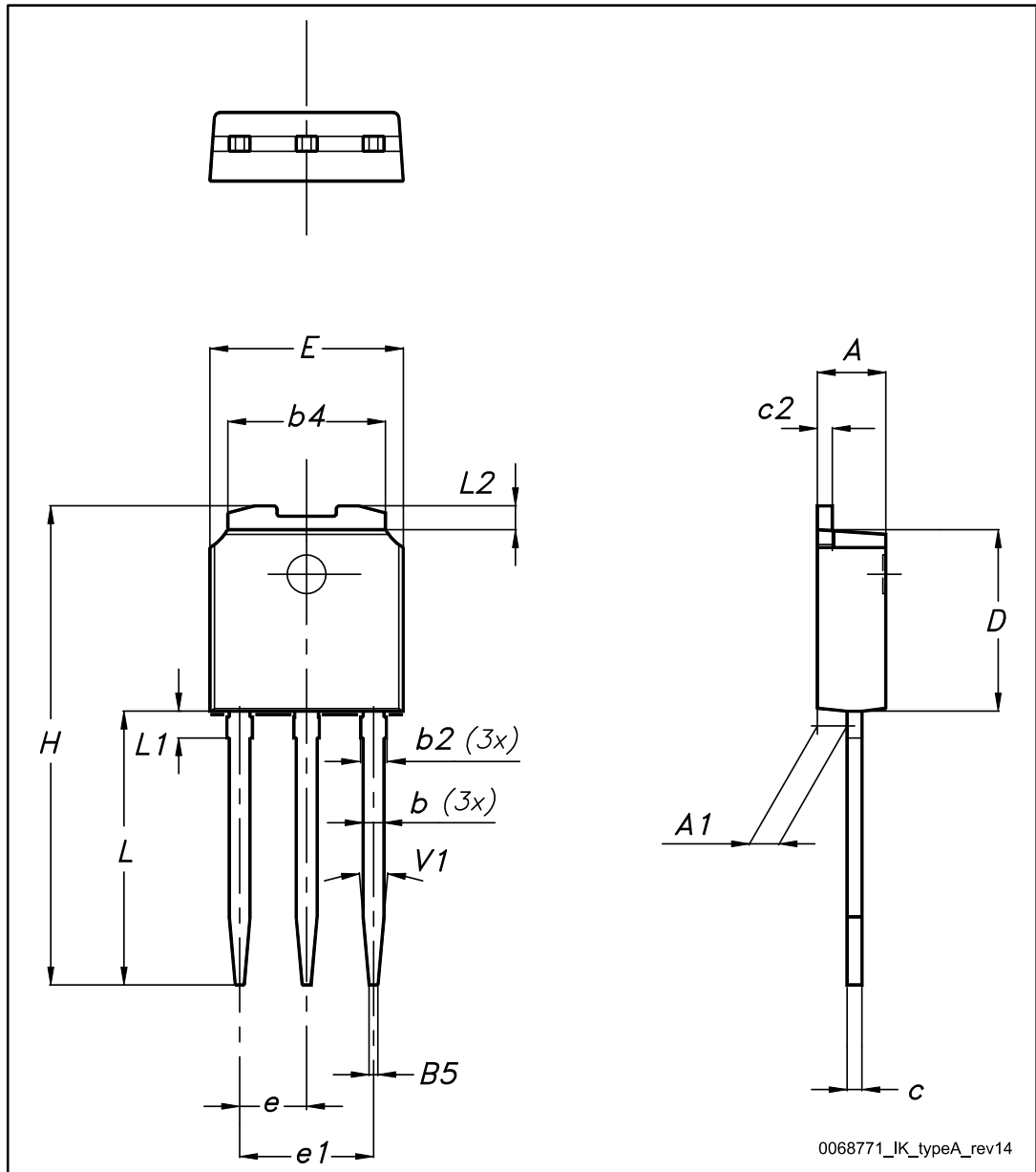


Table 10: IPAK (TO-251) type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.30	
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10°	

4.2 TO-220 type A package information

Figure 23: TO-220 type A package outline

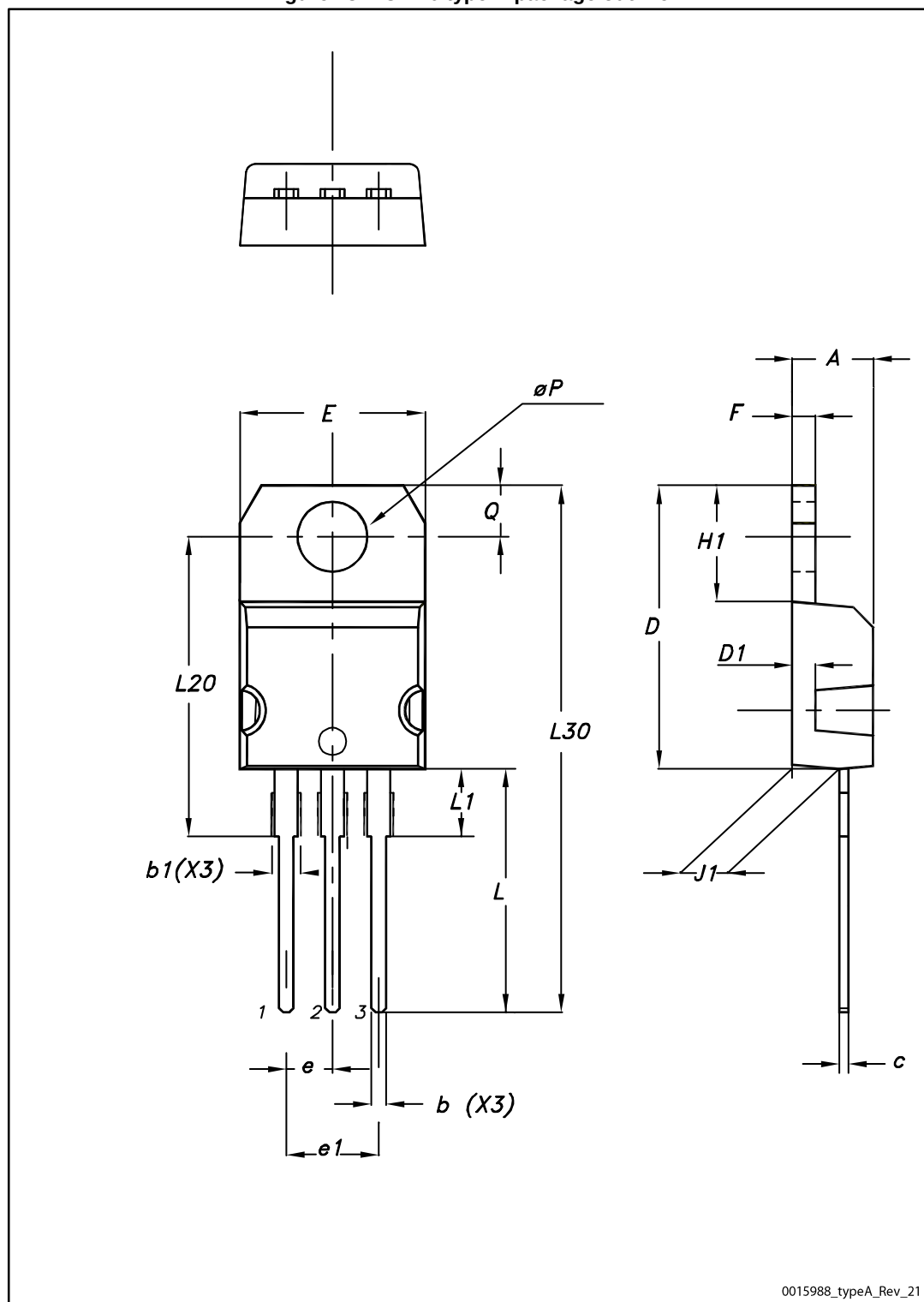


Table 11: TO-220 type A mechanical data

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

5 Revision history

Table 12: Document revision history

Date	Revision	Changes
09-Jul-2015	1	Initial release
28-Jun-2016	2	Updated title and features in cover page. Updated Section 1: "Electrical ratings" . Updated 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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