

N-channel 650 V, 0.71 Ω typ., 5.5 A MDmesh™ M2 Power MOSFET in an IPAK package

Datasheet - production data

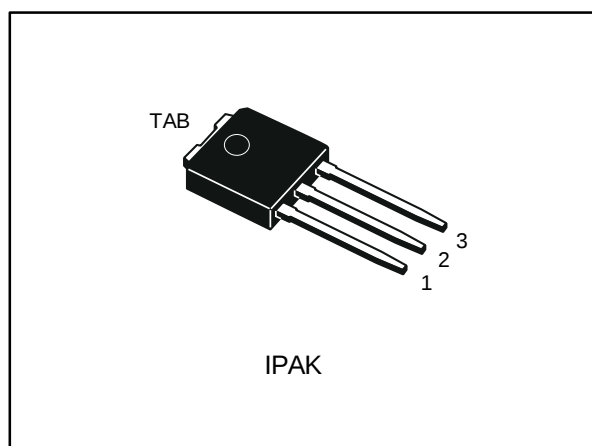
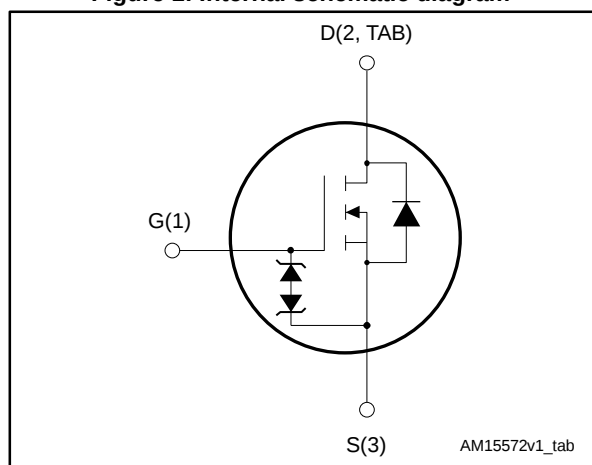


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STU9HN65M2	650 V	0.82 Ω	5.5 A

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance and optimized switching characteristics, rendering it suitable for the most demanding high efficiency converters.

Table 1: Device summary

Order code	Marking	Package	Packing
STU9HN65M2	9HN65M2	IPAK	Tube

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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 $T_C = 25\text{ }^{\circ}\text{C}$	5.5	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	3.5	A
$I_{DM}^{(1)}$	Drain current (pulsed)	22	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	60	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^{\circ}\text{C}$
T_j	Max. operating junction temperature	150	

Notes:

(1) Pulse width limited by safe operating area.

(2) $I_{SD} \leq 5.5\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$.

(3) $V_{DS} \leq 520\text{ V}$

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max.	2.08	$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max.	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})	1.0	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	105	mJ

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified).

Table 5: Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V _{(BR)DSS}	Drain-source breakdown voltage	V _{GS} = 0 V, I _D = 1 mA	650			V
I _{DSS}	Zero gate voltage drain current	V _{GS} = 0 V, V _{DS} = 650 V			1	μA
		V _{GS} = 0 V, V _{DS} = 650 V, T _C = 125 °C			100	μA
I _{GSS}	Gate-body leakage current	V _{DS} = 0 V, V _{GS} = ±25 V			±10	μA
V _{GS(th)}	Gate threshold voltage	V _{DS} = V _{GS} , I _D = 250 μA	2	3	4	V
R _{DS(on)}	Static drain-source on-resistance	V _{GS} = 10 V, I _D = 2.5 A		0.71	0.82	Ω

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	-	325	-	pF
C _{oss}	Output capacitance		-	16	-	pF
C _{rss}	Reverse transfer capacitance		-	0.85	-	pF
C _{oss eq. (1)}	Equivalent output capacitance	V _{DS} = 0 V to 520 V, V _{GS} = 0 V	-	109	-	pF
R _G	Intrinsic gate resistance	f = 1 MHz open drain	-	5.6	-	Ω
Q _g	Total gate charge	V _{DD} = 520 V, I _D = 5 A, V _{GS} = 10 V (see Figure 15: "Test circuit for gate charge behavior")	-	11.5	-	nC
Q _{gs}	Gate-source charge		-	2.5	-	nC
Q _{gd}	Gate-drain charge		-	5	-	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} = 325 V, I _D = 2.5 A R _G = 4.7 Ω, V _{GS} = 10 V (see Figure 14: "Test circuit for resistive load switching times" and Figure 19: "Switching time waveform")	-	7.5	-	ns
t _r	Rise time		-	4.6	-	ns
t _{d(off)}	Turn-off-delay time		-	24	-	ns
t _f	Fall time		-	14.5	-	ns

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		5.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		22	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 5\text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	268		ns
Q_{rr}	Reverse recovery charge		-	1.7		μC
I_{RRM}	Reverse recovery current		-	12.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	408		ns
Q_{rr}	Reverse recovery charge		-	2.6		μC
I_{RRM}	Reverse recovery current		-	13		A

Notes:

⁽¹⁾Pulse width is limited by safe operating area.

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

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

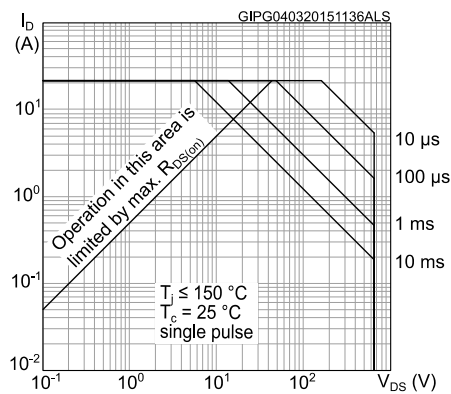


Figure 3: Thermal impedance

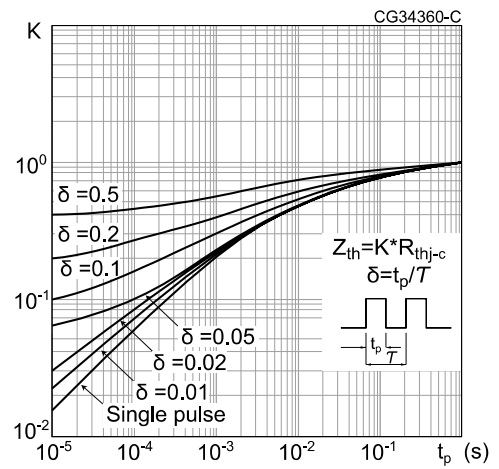


Figure 4: Output characteristics

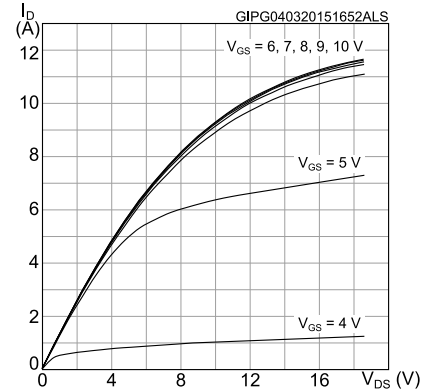


Figure 5: Transfer characteristics

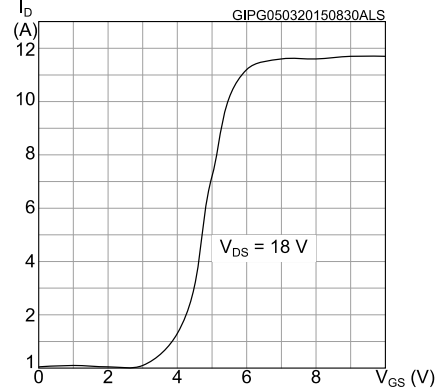


Figure 6: Normalized gate threshold voltage vs. temperature

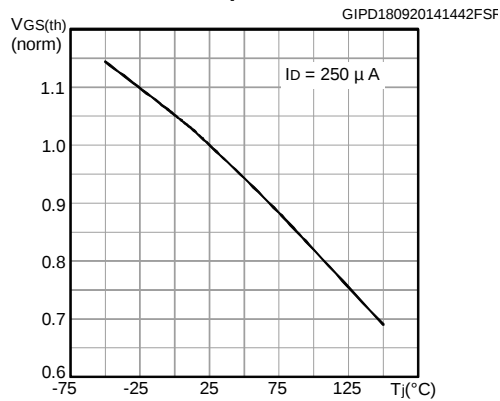


Figure 7: Normalized V(BR)DSS vs. temperature

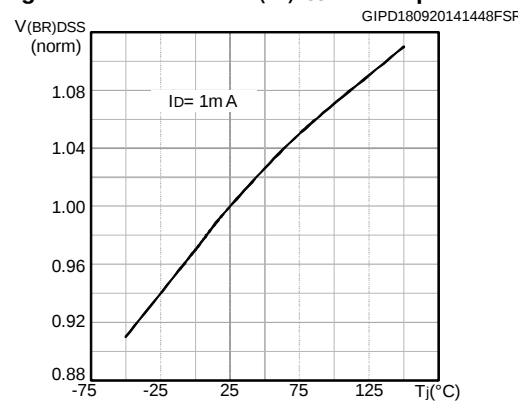


Figure 8: Static drain-source on-resistance

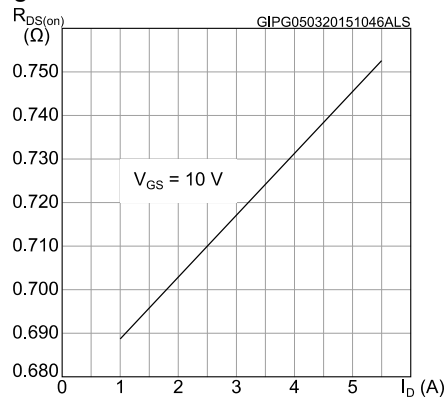


Figure 9: Normalized on-resistance vs. temperature

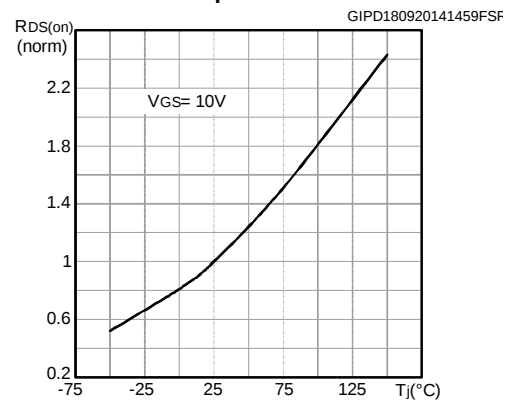


Figure 10: Gate charge vs. gate-source voltage

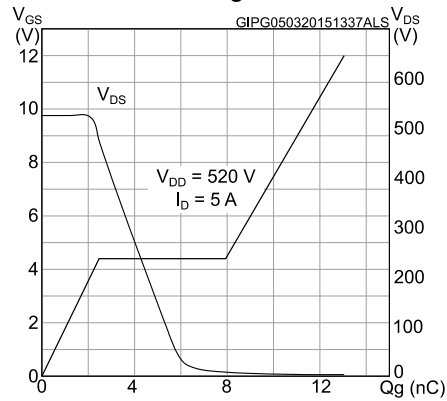


Figure 11: Capacitance variations

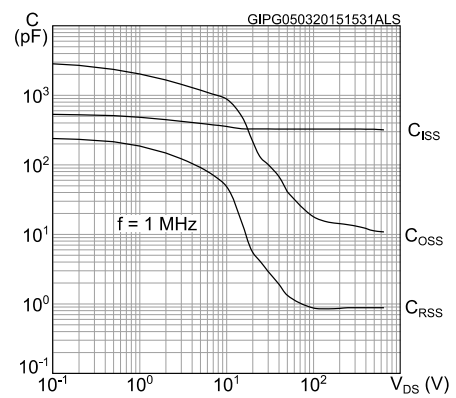


Figure 12: Output capacitance stored energy

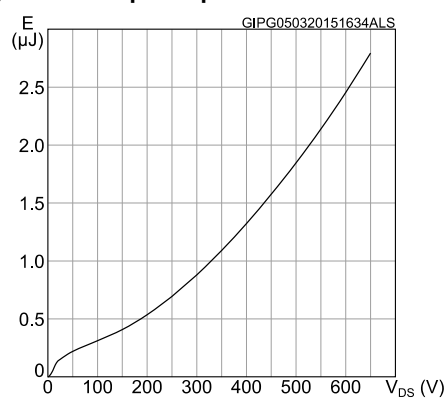
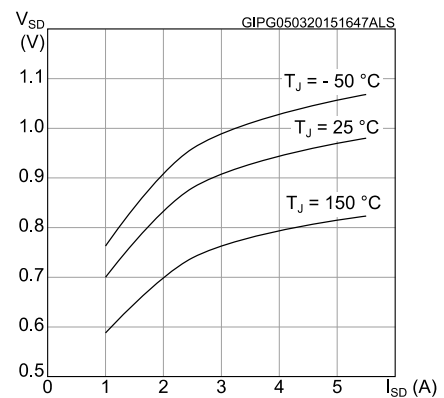


Figure 13: Source-drain diode forward characteristics



3 Test circuits

Figure 14: Test circuit for resistive load switching times

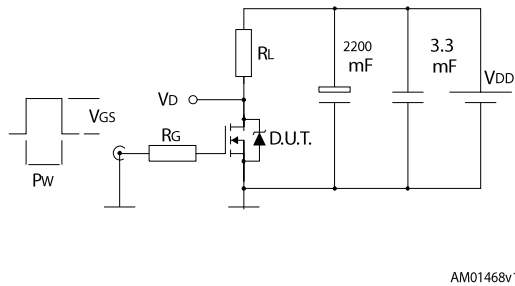


Figure 15: Test circuit for gate charge behavior

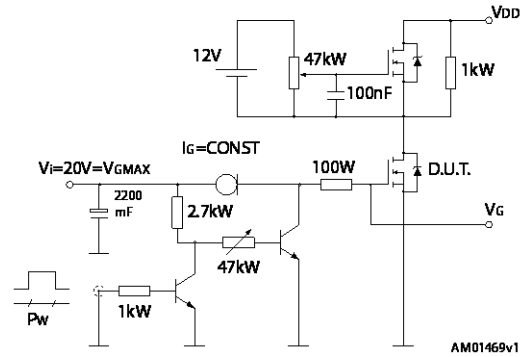


Figure 16: Test circuit for inductive load switching and diode recovery times

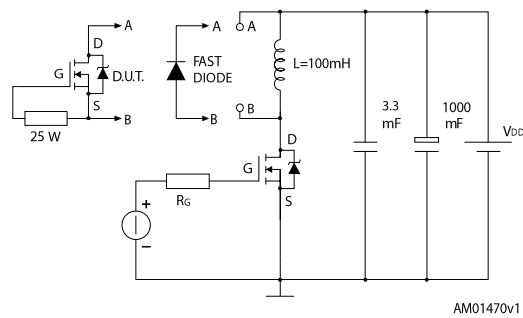


Figure 17: Unclamped inductive load test circuit

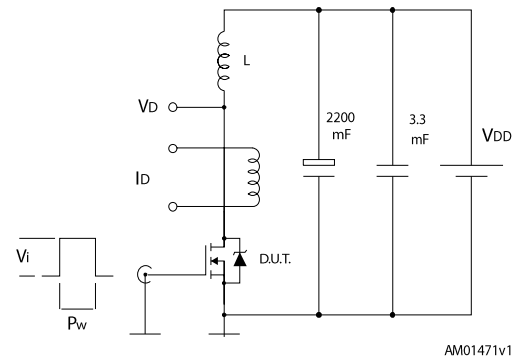


Figure 18: Unclamped inductive waveform

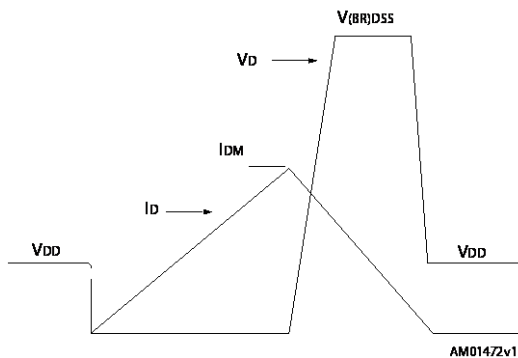
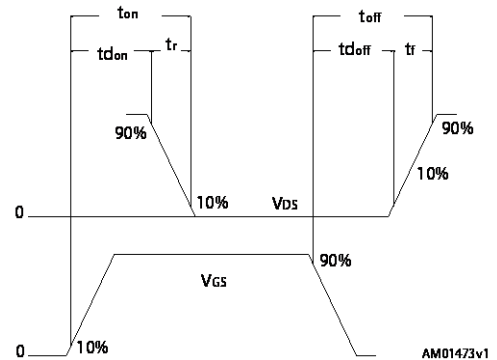


Figure 19: Switching time waveform



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 IPAK (TO-251) type A package information

Figure 20: IPAK (TO-251) type A package outline

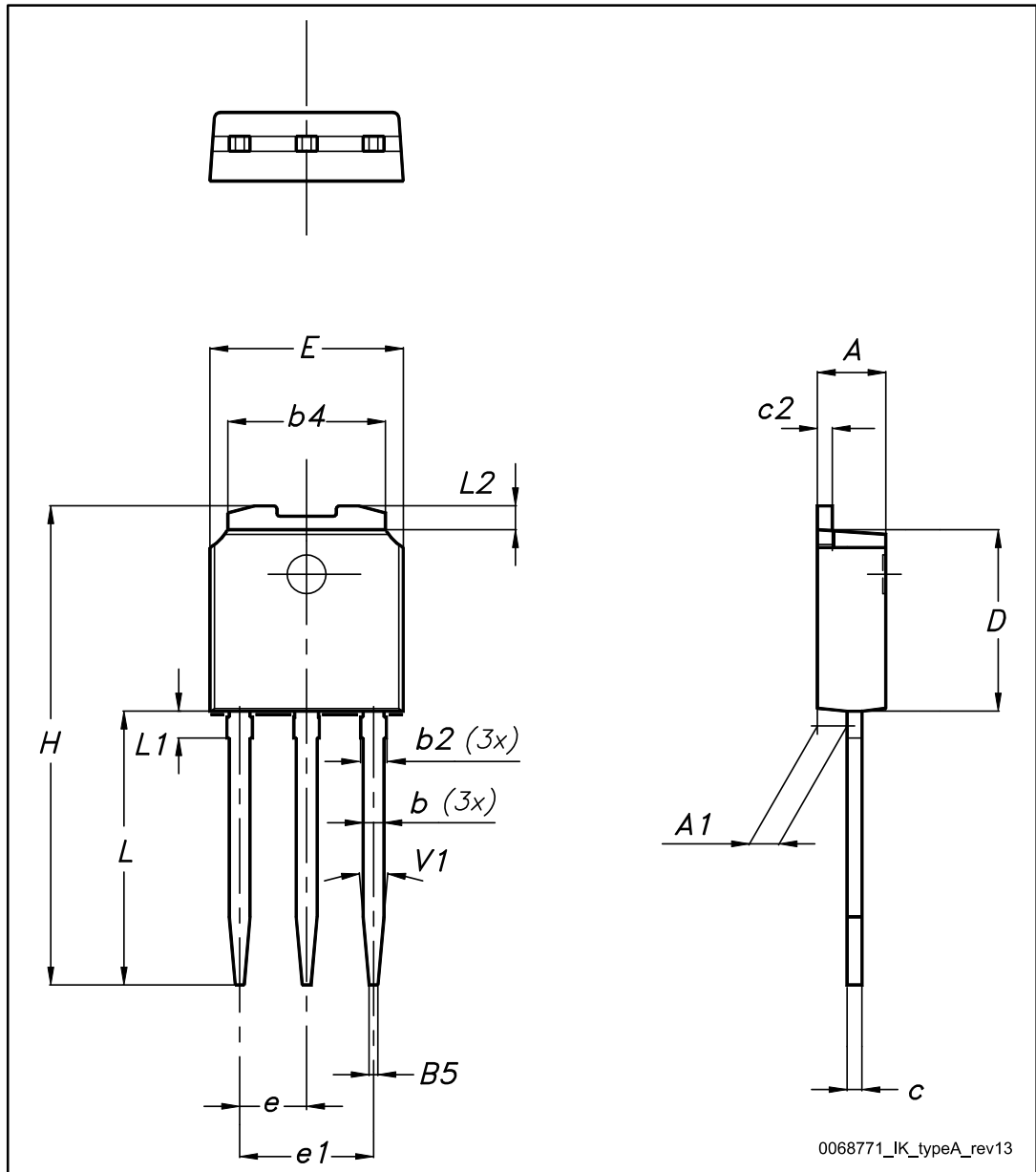


Table 9: IPAK (TO-251) type A package mechanical data

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°	

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
11-Mar-2015	1	Initial release.
23-Apr-2015	2	Document status promoted to 'Production data'.
05-Oct-2015	3	Updated the title and changed V_{DS} parameter in the table of features.

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