N-channel 650 V, 1.4 Ω typ., 3.5 A MDmesh™ M6 Power MOSFET in an IPAK package

TAB

IPAK

D(2, TAB)

G(1)

S(3)

AM01475V1

Features

Order code	V_{DS}	$R_{DS(on)}$max.	I_D
STU3N65M6	650 V	1.5 Ω	3.5 A

- Reduced switching losses
- Lower $R_{DS(on)}$ per area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

The new MDmesh™ M6 technology incorporates the most recent advancements to the well-known and consolidated MDmesh family of SJ MOSFETs. STMicroelectronics builds on the previous generation of MDmesh devices through its new M6 technology, which combines excellent $R_{DS(on)}$ per area improvement with one of the most effective switching behaviors available, as well as a user-friendly experience for maximum end-application efficiency.

STPOWER

Product status
STU3N65M6

Product summary	
Order code	STU3N65M6
Marking	3N65M6
Package	IPAK
Packing	Tube

DS11590 - **Rev 2** - **December 2018**
For further information contact your local STMicroelectronics sales office.

www.st.com

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	3.5	A
I_D	Drain current (continuous) at T_C = 100 °C	2.2	A
I_{DM} [1]	Drain current (pulsed)	14	A
P_{TOT}	Total power dissipation at T_C = 25 °C	45	W
dv/dt[2]	Peak diode recovery voltage slope	5	V/ns
dv/dt[3]	MOSFET dv/dt ruggedness	100	
T_J	Operating junction temperature range	-55 to 150	°C
T_{stg}	Storage temperature range		

1. *Pulse width limited by safe operating area*

2. $I_{SD} \leq 3.5$ A, di/dt=400 A/µs; $V_{DS\ peak} < V_{(BR)DSS}$, V_{DD} = 400 V

3. $V_{DS} \leq 520$ V

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	2.78	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	100	

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	1	A
E_{as}	Single pulse avalanche energy (starting T_j=25°C, I_D= I_{AR}, V_{DD}=50 V)	78	mJ

2   Electrical characteristics

T_C = 25 °C unless otherwise specified

Table 4. On/off-state

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 [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	2.25	3	3.75	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 1.75 A		1.4	1.5	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	-	150	-	pF
C_{oss}	Output capacitance		-	13	-	
C_{rss}	Reverse transfer capacitance		-	0.7	-	
$C_{oss\ eq.}$ [1]	Equivalent output capacitance	V_{DS} = 0 to 520 V, V_{GS} = 0 V	-	31	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D=0 A	-	5.2	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 3.5 A, V_{GS}= 0 to 10 V, (see Figure 14. Test circuit for gate charge behavior)	-	6	-	nC
Q_{gs}	Gate-source charge		-	1	-	
Q_{gd}	Gate-drain charge		-	3.2	-	

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}= 325 V, I_D = 1.75 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	5.2	-	ns
t_r	Rise time		-	5.4	-	
$t_{d(off)}$	Turn-off delay time		-	14.1	-	
t_f	Fall time		-	17.1	-	

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		3.5	A
I_{SDM} [1]	Source-drain current (pulsed)		-		14	A
V_{SD} [2]	Forward on voltage	I_{SD} = 3.5 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 3.5 A, di/dt = 100 A/µs, V_{DD} = 60 V, (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	159		ns
Q_{rr}	Reverse recovery charge		-	0.7		µC
I_{RRM}	Reverse recovery current		-	8.9		A
t_{rr}	Reverse recovery time	I_{SD} = 3.5 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_j = 150 °C (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	190		ns
Q_{rr}	Reverse recovery charge		-	0.8		µC
I_{RRM}	Reverse recovery current		-	8.5		A

1. *Pulse width 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
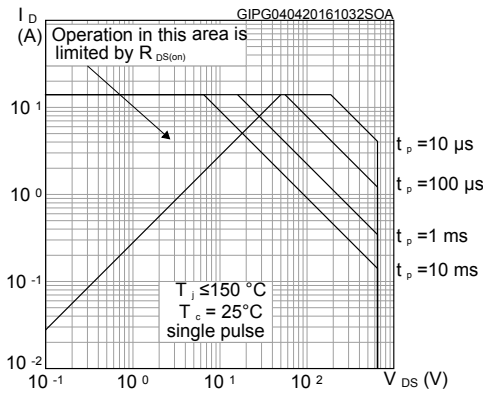
Figure 2. Thermal impedance
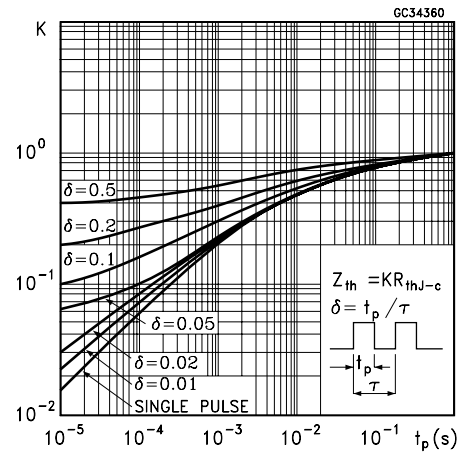
Figure 3. Output characteristics
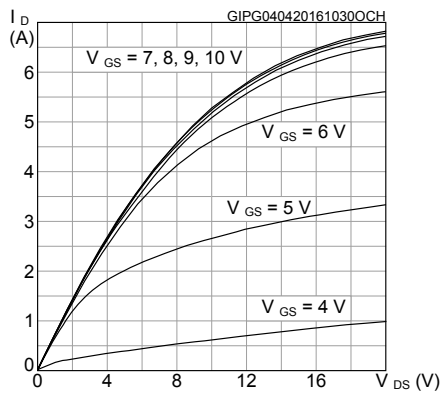
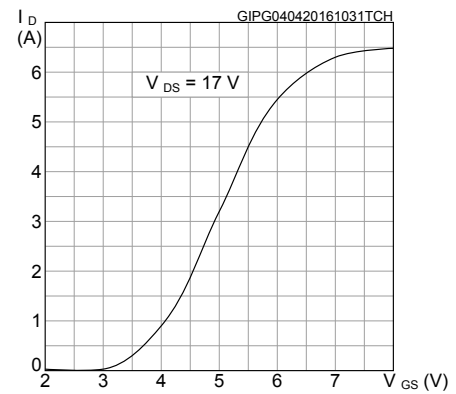**Figure 4. Transfer characteristics**

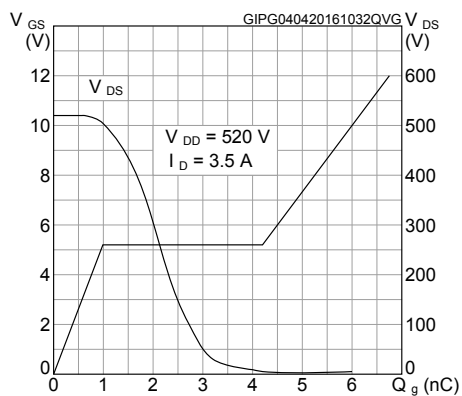**Figure 5. Gate charge vs gate-source voltage**

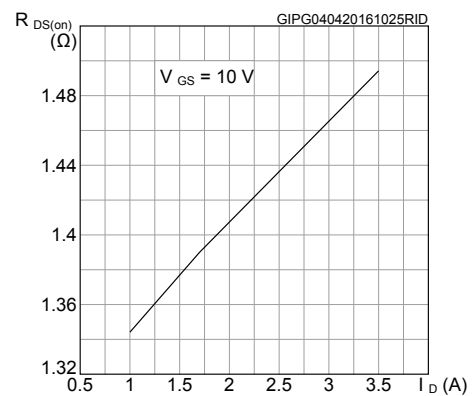**Figure 6. Static drain-source on-resistance**
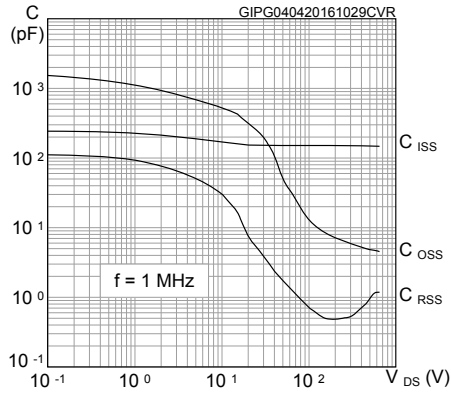
Figure 7. Capacitance variations

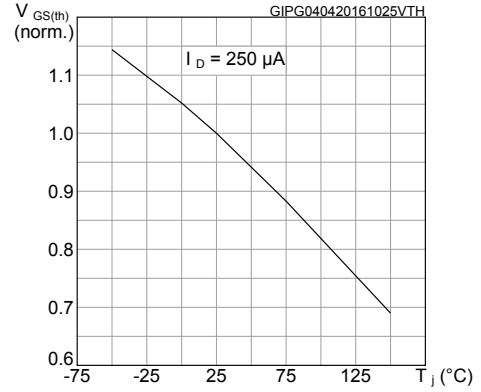**Figure 8. Normalized gate threshold voltage vs temperature**
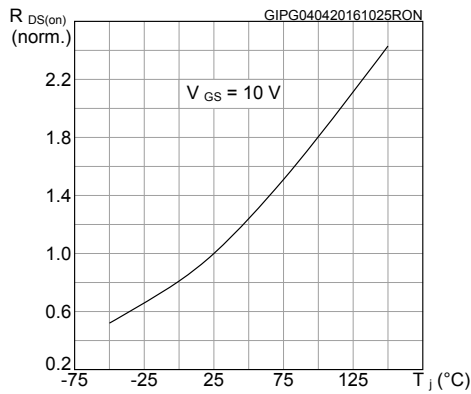

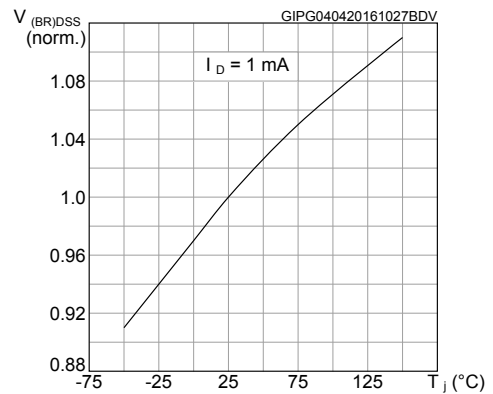**Figure 9. Normalized on-resistance vs temperature**

Figure 10. Normalized V$_{(BR)DSS}$ vs temperature

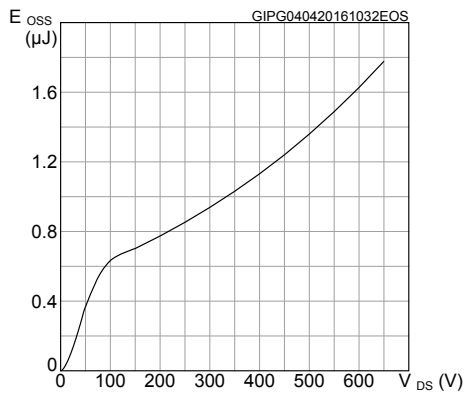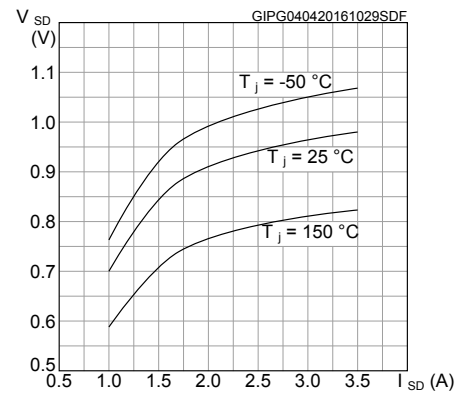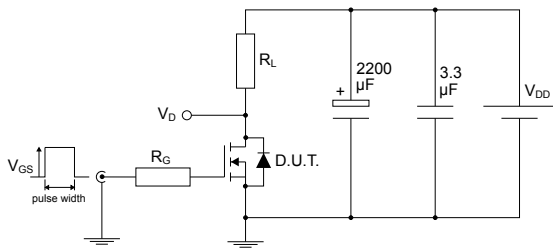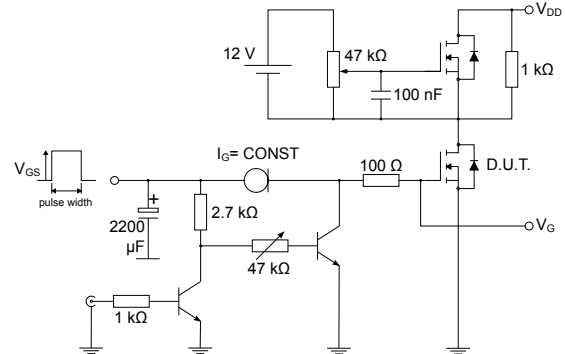**Figure 11. Output capacitance stored energy**

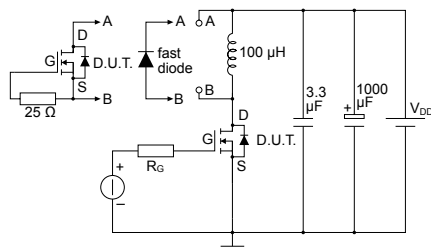**Figure 12. Source-drain diode forward characteristics**

3 Test circuits

Figure 13. Test circuit for resistive load switching times
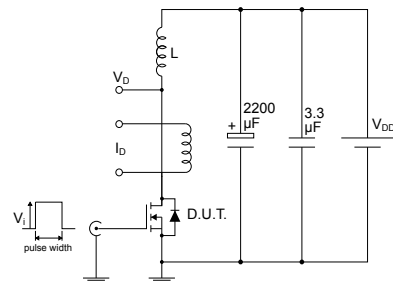

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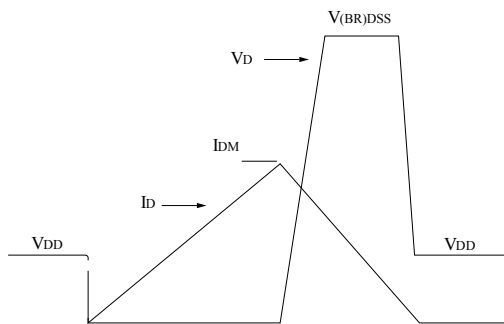**Figure 14. Test circuit for gate charge behavior**

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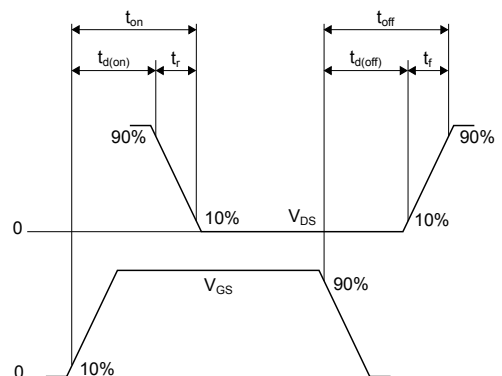**Figure 15. Test circuit for inductive load switching and diode recovery times**

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Figure 16. Unclamped inductive load test circuit

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Figure 17. Unclamped inductive waveform

AM01472v1

Figure 18. 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 (TO-251) type A package information

Figure 19. IPAK (TO-251) type A package outline
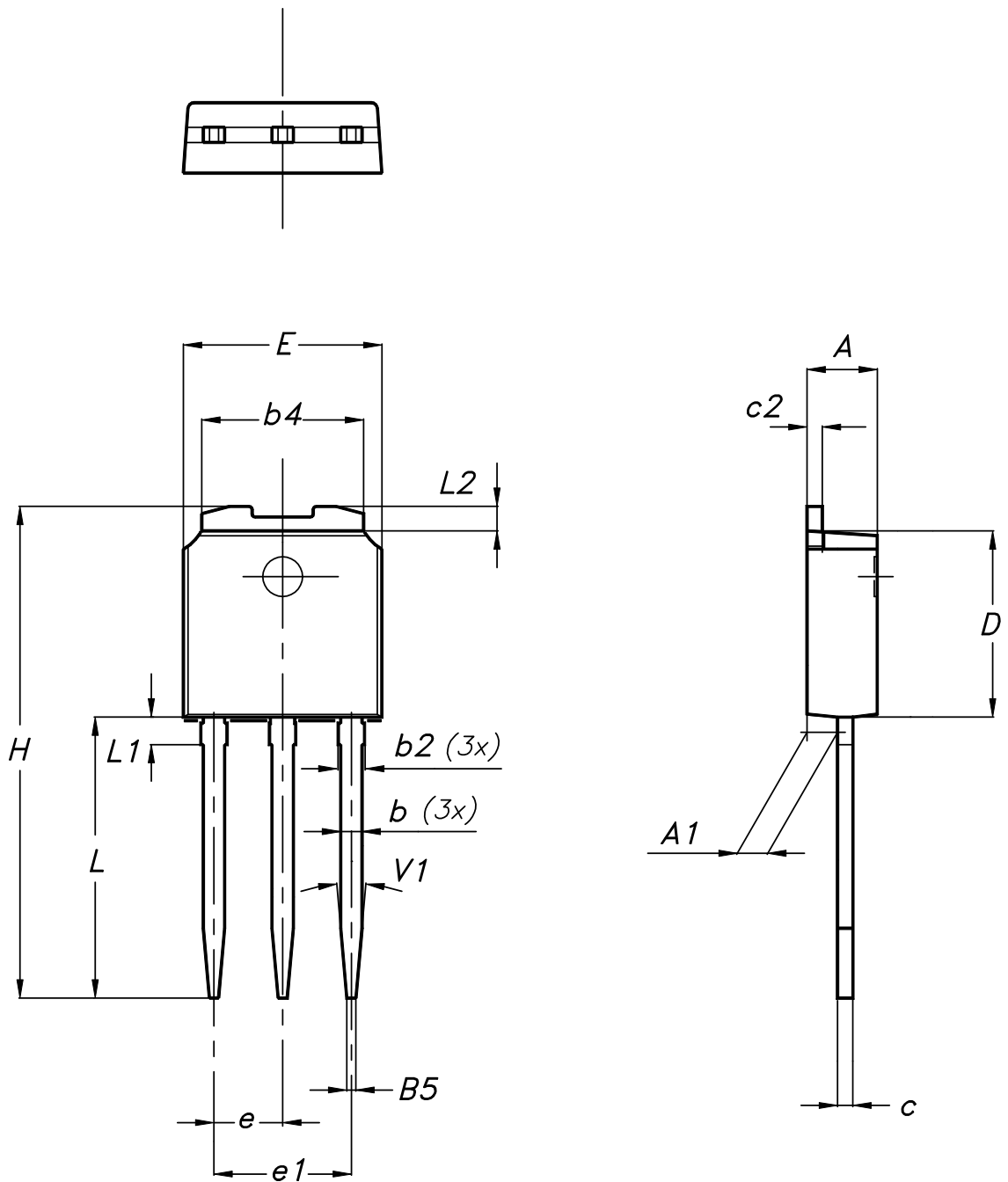
0068771_IK_typeA_rev14

Table 8. **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 IPAK (TO-251) type C package information

Figure 20. IPAK (TO-251) type C package outline
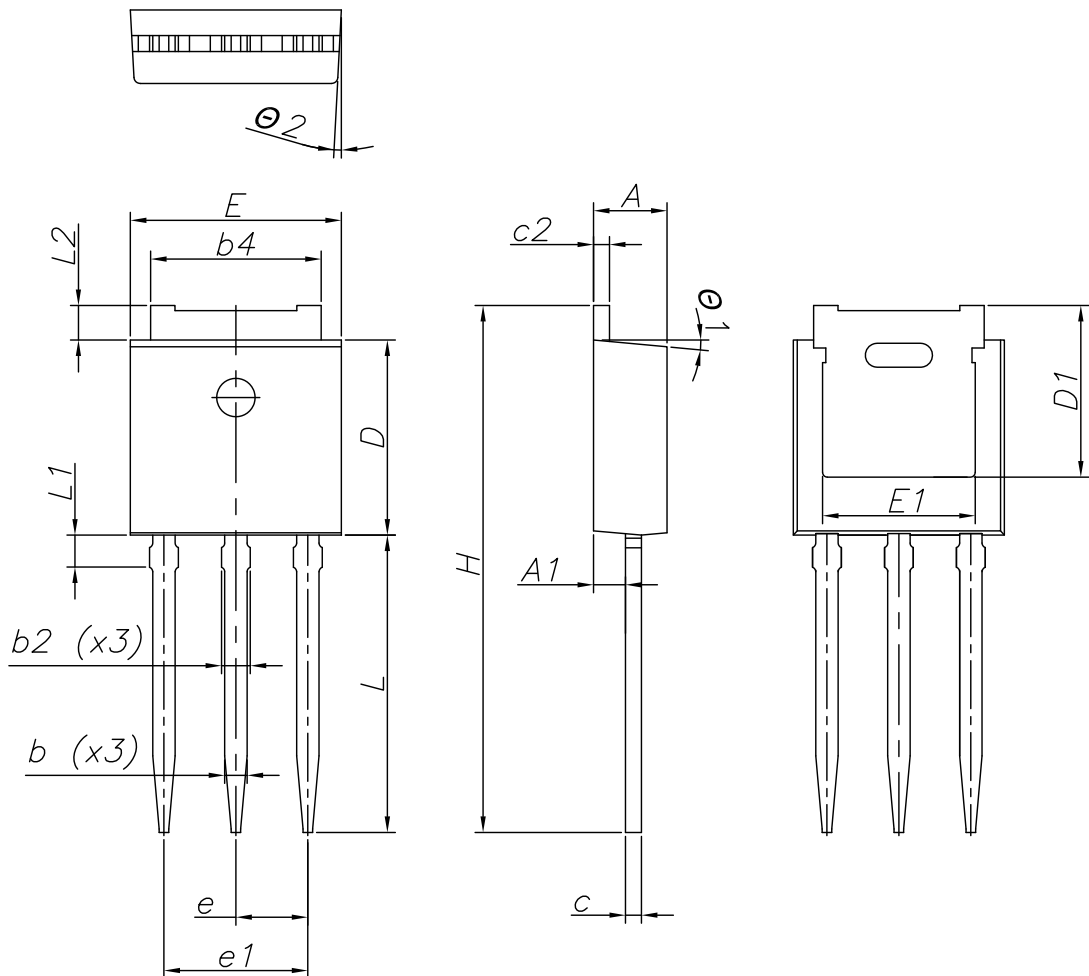
0068771_IK_typeC_rev14

Table 9. **IPAK (TO-251) type C package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.35
A1	0.90	1.00	1.10
b	0.66		0.79
b2			0.90
b4	5.23	5.33	5.43
c	0.46		0.59
c2	0.46		0.59
D	6.00	6.10	6.20
D1	5.20	5.37	5.55
E	6.50	6.60	6.70
E1	4.60	4.78	4.95
e	2.20	2.25	2.30
e1	4.40	4.50	4.60
H	16.18	16.48	16.78
L	9.00	9.30	9.60
L1	0.80	1.00	1.20
L2	0.90	1.08	1.25
θ1	3°	5°	7°
θ2	1°	3°	5°

Revision history

Table 10. Document revision history

Date	Revision	Changes
02-May-2016	1	Initial release.
18-Dec-2018	2	Added Section 4.2 IPAK (TO-251) type C package information.

Contents

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