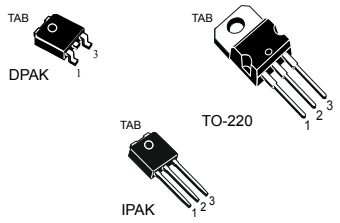
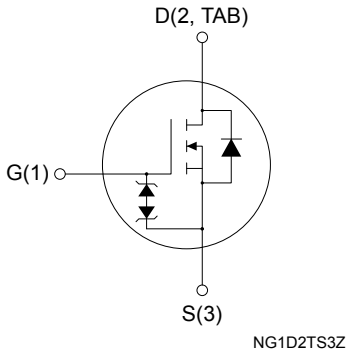
STD11N65M2, STP11N65M2, STU11N65M2

Datasheet

N-channel 650 V, 0.60 Ω typ., 7 A MDmesh™ M2 Power MOSFET in DPAK, TO-220 and IPAK packages





Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}	Package
STD11N65M2	650 V	0.68 Ω	7 A	85 W	DPAK
STP11N65M2					TO-220
STU11N65M2					IPAK

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

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the MDmesh M2 technology. Thanks to their strip layout and improved vertical structure, these devices exhibit low on-resistance and optimized switching characteristics, rendering them suitable for the most demanding high-efficiency converters.

STPOWER

Product status link
STD11N65M2
STP11N65M2
STU11N65M2

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_{case} = 25 °C	7	A
	Drain current (continuous) at T_{case} = 100 °C	4.4	
I_{DM} (1)	Drain current (pulsed)	28	A
P_{TOT}	Total power dissipation at T_{case} = 25 °C	85	W
dv/dt (2)	Peak diode recovery voltage slope	15	V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	50	
T_{stg}	Storage temperature range	-55 to 150	°C
T_j	Operating junction temperature range		

1. *Pulse width limited by T_{jmax}.*
2. *I_{SD} ≤ 7 A, di/dt ≤ 400 A/µs, V_{DS} (peak) ≤ $V_{(BR)DSS}$, V_{DS} = 400 V*
3. *V_{DS} ≤ 520 V.*

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		DPAK	TO-220	IPAK	
$R_{thj\text{-}case}$	Thermal resistance junction-case	1.47			°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient		62.5	100	
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb	50			

1. *When mounted on a 1-inch² FR-4, 2 Oz copper board.*

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR} (1)	Avalanche current, repetitive or not repetitive	1.5	A
E_{AS} (2)	Single pulse avalanche energy	110	mJ

1. *Pulse width limited by T_{jmax}.*
2. *starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V.*

2 Electrical characteristics

(T_{case} = 25 °C unless otherwise specified)

Table 4. 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_{case} = 125 °C(1)			100	
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 = 3.5 A		0.60	0.68	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	-	410	-	pF
C_{oss}	Output capacitance		-	20	-	
C_{rss}	Reverse transfer capacitance		-	0.9	-	
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 520 V, V_{GS} = 0 V	-	43	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	6.4	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 7 A, V_{GS} = 0 to 10 V (see Figure 16)	-	12.5	-	nC
Q_{gs}	Gate-source charge		-	3.2	-	
Q_{gd}	Gate-drain charge		-	5.8	-	

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 = 3.5 A R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 15 and Figure 20)	-	9.5	-	ns
t_r	Rise time		-	7.5	-	
$t_{d(off)}$	Turn-off delay time		-	26	-	
t_f	Fall time		-	15	-	

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		7	A
I_{SDM} (1)	Source-drain current (pulsed)		-		28	A
V_{SD} (2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 7 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 7 A, di/dt = 100 A/µs, V_{DD} = 60 V (see Figure 17)	-	318		ns
Q_{rr}	Reverse recovery charge		-	2.5		µC
I_{RRM}	Reverse recovery current		-	15.5		A
t_{rr}	Reverse recovery time	I_{SD} = 7 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_j = 150 °C (see Figure 17)	-	437		ns
Q_{rr}	Reverse recovery charge		-	3.2		µC
I_{RRM}	Reverse recovery current		-	15		A

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 1. Safe operating area for DPAK and IPAK

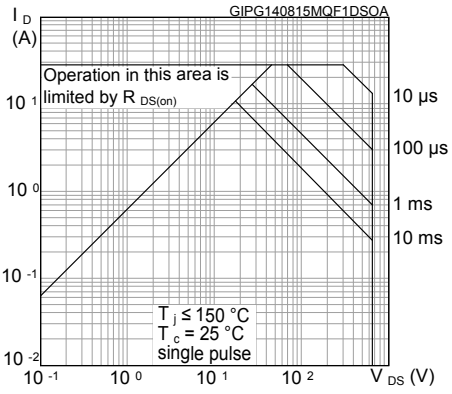


Figure 2. Thermal impedance for DPAK and IPAK

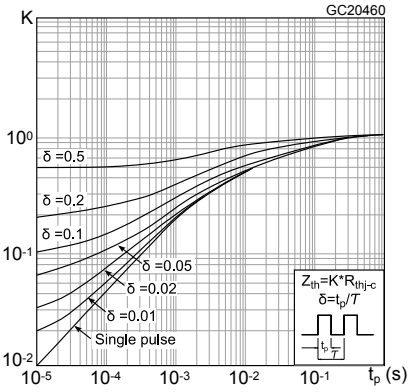


Figure 3. Safe operating area for TO-220

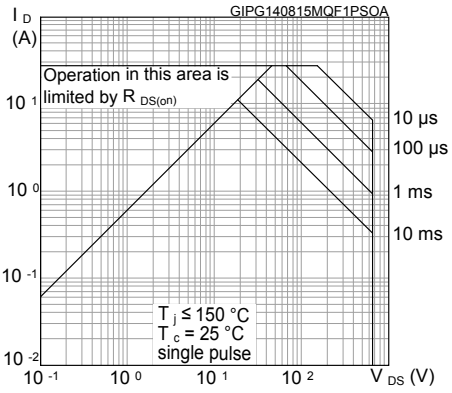


Figure 4. Thermal impedance for TO-220

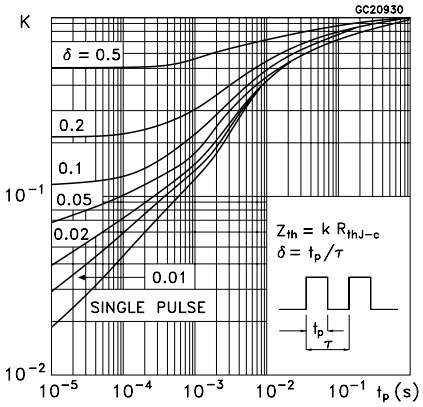


Figure 5. Output characteristics

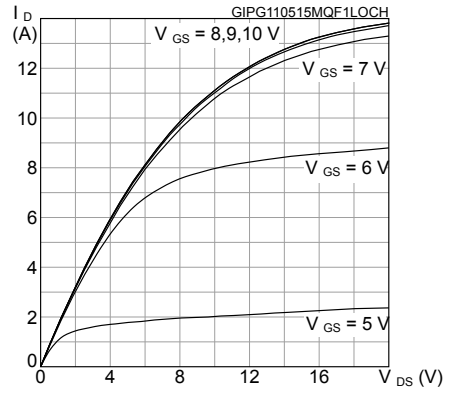


Figure 6. Transfer characteristics

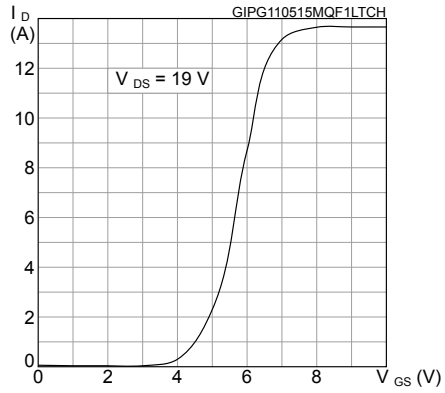


Figure 7. Gate charge vs gate-source voltage

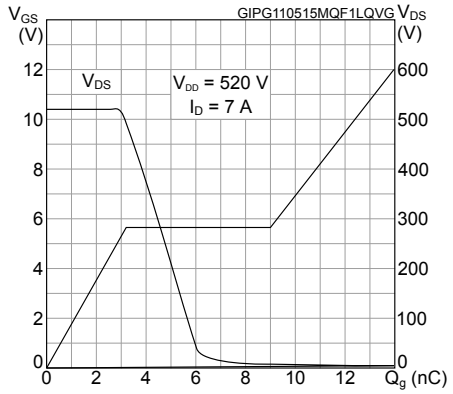


Figure 8. Static drain-source on-resistance

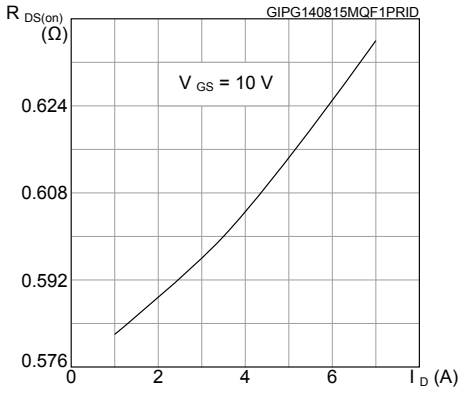


Figure 9. Capacitance variations

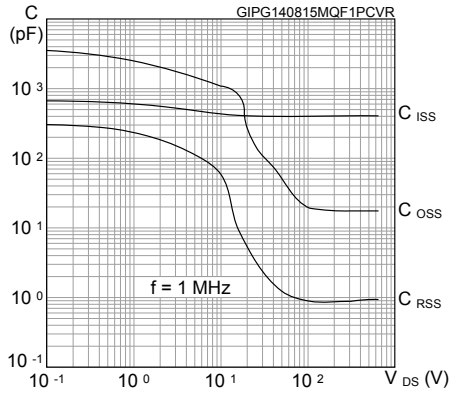


Figure 10. Normalized gate threshold voltage vs temperature

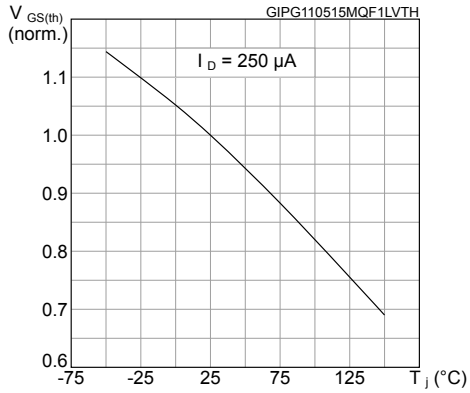


Figure 11. Normalized on-resistance vs temperature

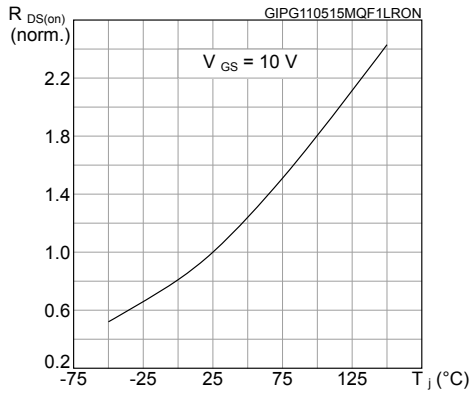


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature

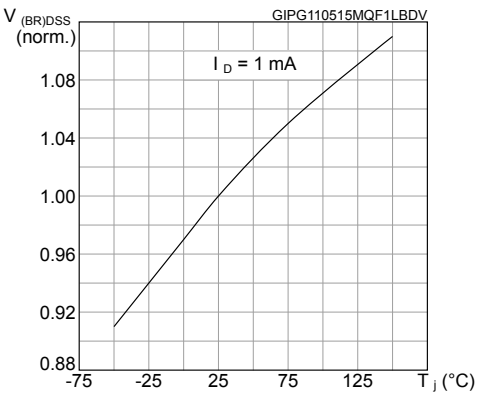


Figure 13. Output capacitance stored energy

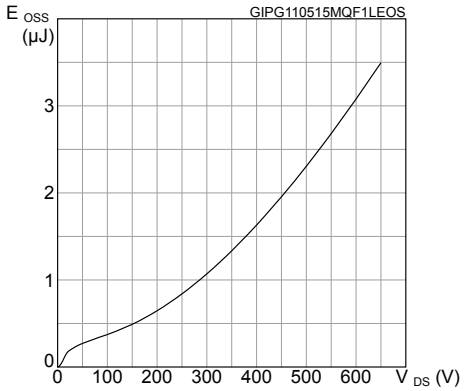
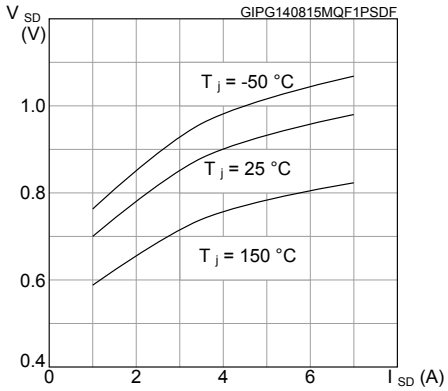


Figure 14. Source- drain diode forward characteristics



3 Test circuits

Figure 15. Test circuit for resistive load switching times

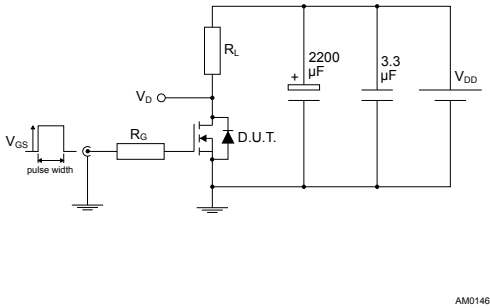


Figure 16. Test circuit for gate charge behavior

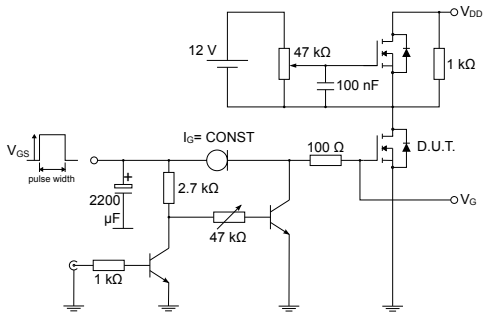


Figure 17. Test circuit for inductive load switching and diode recovery times

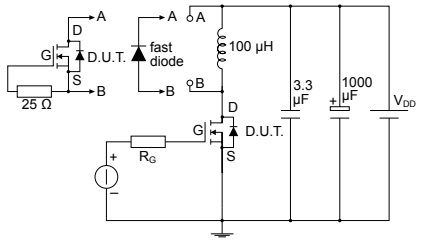


Figure 18. Unclamped inductive load test circuit

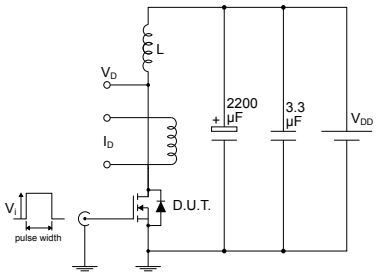


Figure 19. Unclamped inductive waveform

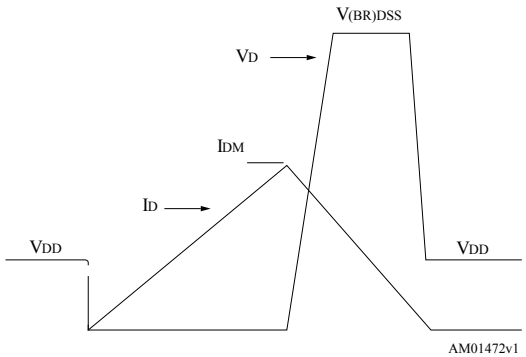
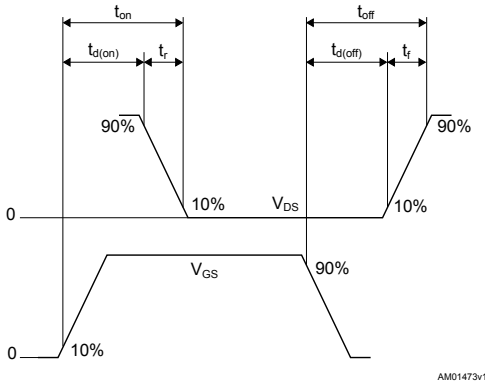


Figure 20. Switching time waveform



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 DPAK (TO-252) type A package information

Figure 21. **DPAK (TO-252) type A package outline**

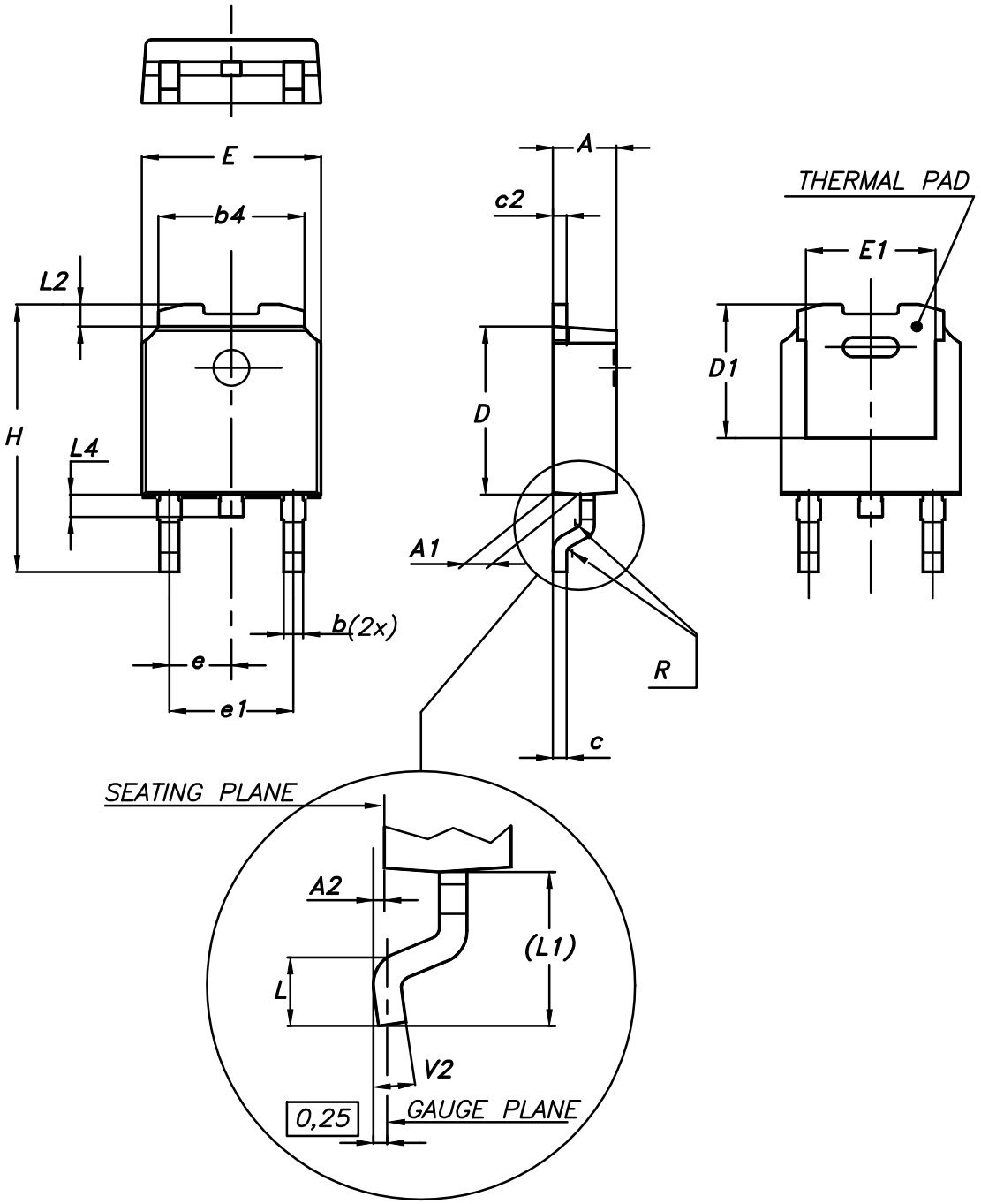


Table 8. **DPAK (TO-252) type A mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1	4.95	5.10	5.25
E	6.40		6.60
E1	4.60	4.70	4.80
e	2.159	2.286	2.413
e1	4.445	4.572	4.699
H	9.35		10.10
L	1.00		1.50
(L1)	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

4.2 DPAK (TO-252) type C package information

Figure 22. **DPAK (TO-252) type C package outline**

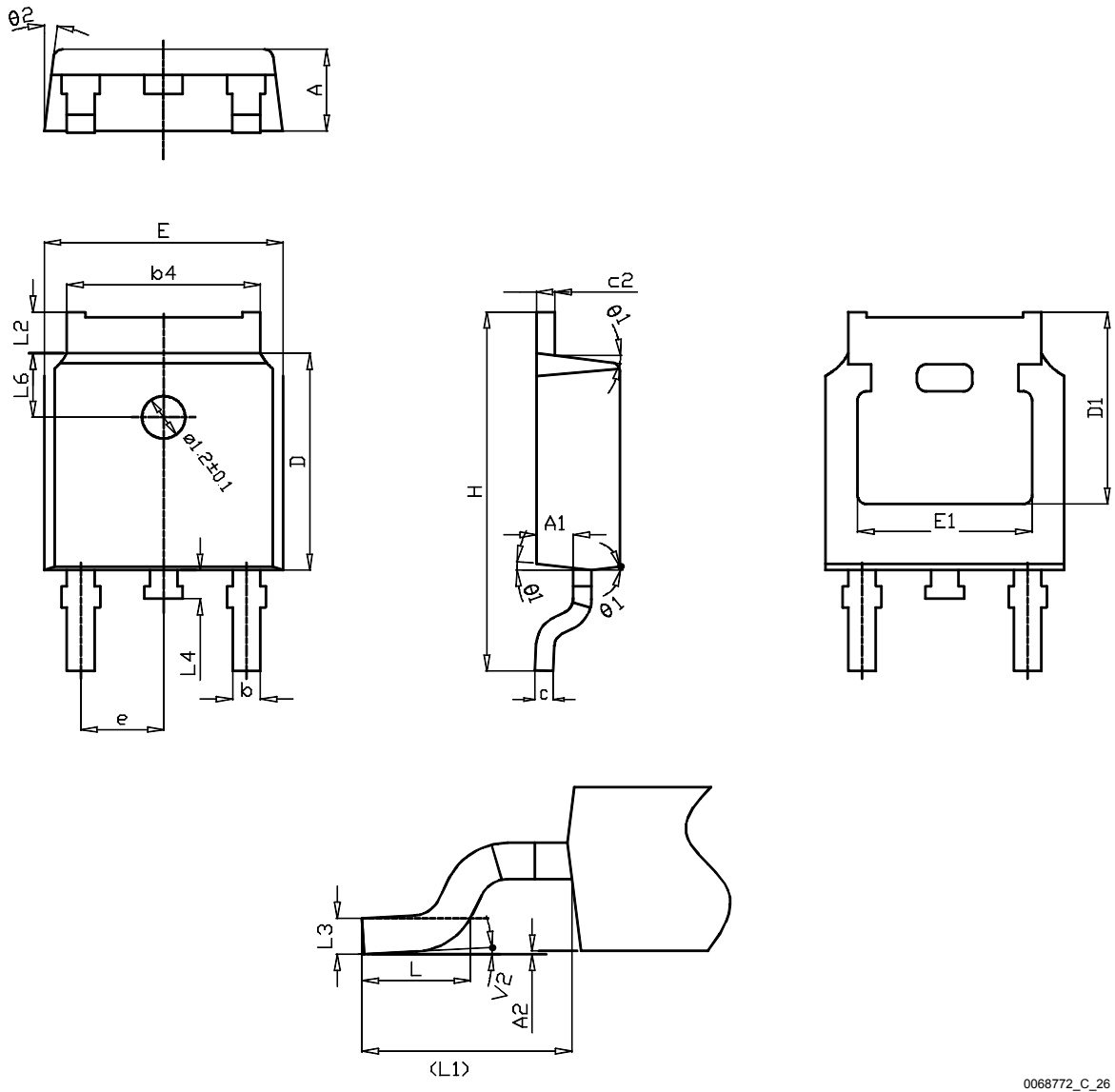


Table 9. **DPAK (TO-252) type C mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.90	1.01	1.10
A2	0.00		0.10
b	0.72		0.85
b4	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.25		
E	6.50	6.60	6.70
E1	4.70		
e	2.186	2.286	2.386
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1		2.90 REF	
L2	0.90		1.25
L3		0.51 BSC	
L4	0.60	0.80	1.00
L6		1.80 BSC	
θ1	5°	7°	9°
θ2	5°	7°	9°
V2	0°		8°

4.3 DPAK (TO-252) type E package information

Figure 23. **DPAK (TO-252) type E package outline**

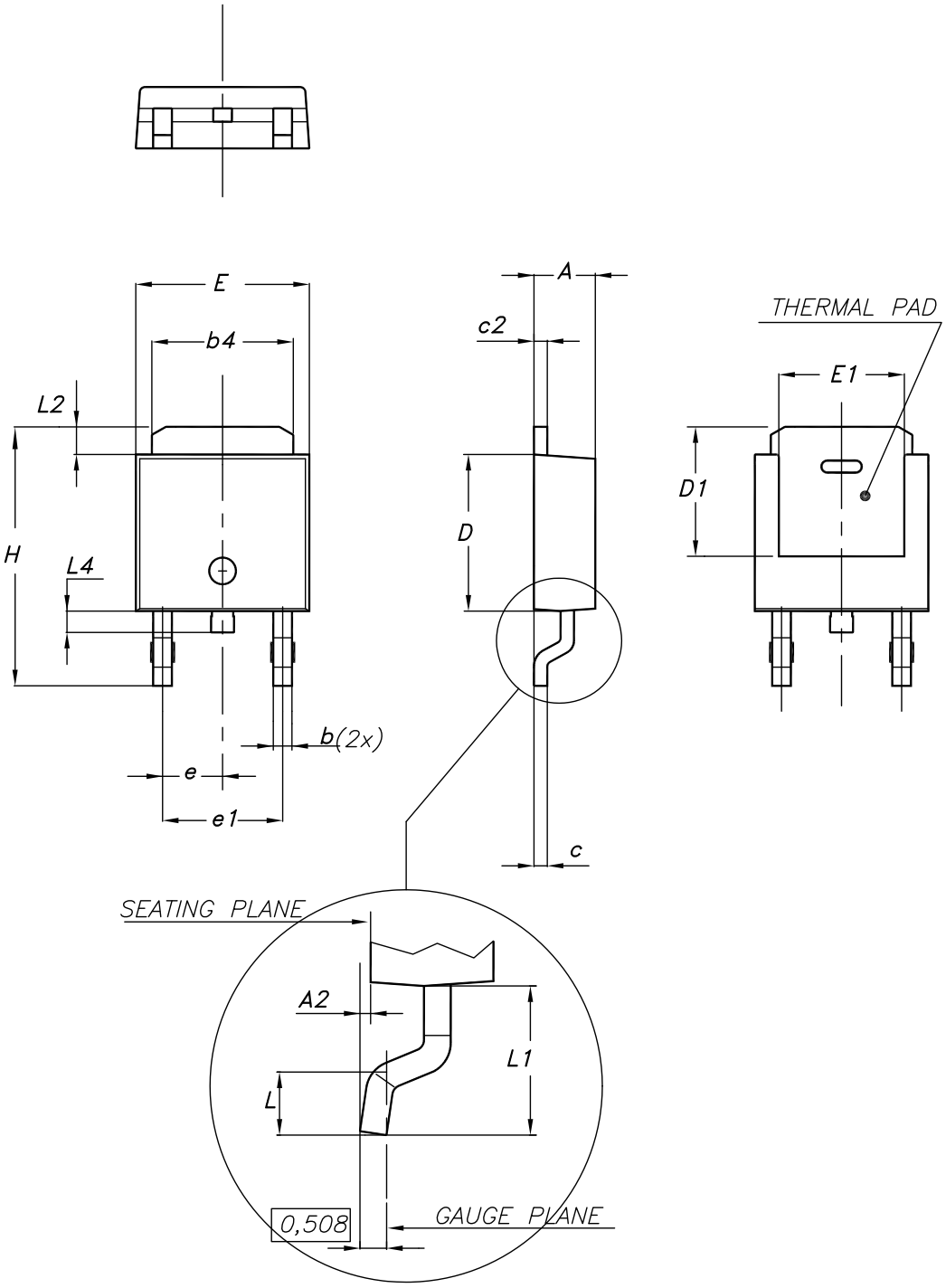
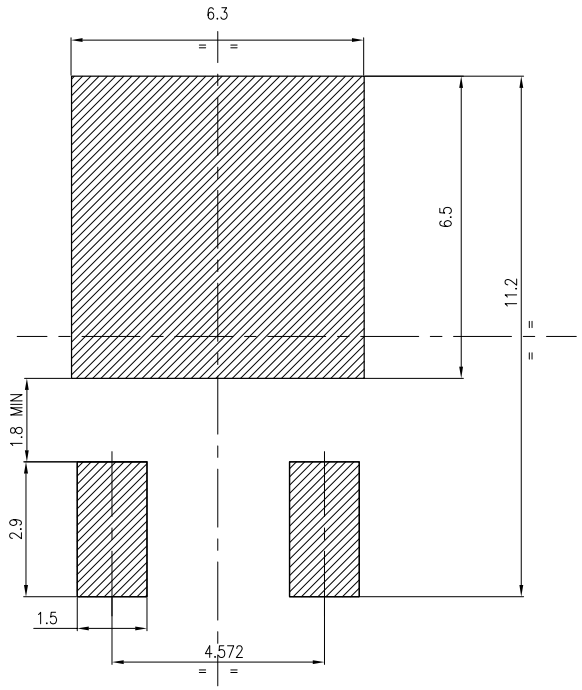


Table 10. **DPAK (TO-252) type E mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.18		2.39
A2			0.13
b	0.65		0.884
b4	4.95		5.46
c	0.46		0.61
c2	0.46		0.60
D	5.97		6.22
D1	5.21		
E	6.35		6.73
E1	4.32		
e		2.286	
e1		4.572	
H	9.94		10.34
L	1.50		1.78
L1		2.74	
L2	0.89		1.27
L4			1.02

Figure 24. **DPAK (TO-252) recommended footprint (dimensions are in mm)**



FP_0068772_26

4.4 DPAK (TO-252) packing information

Figure 25. **DPAK (TO-252) tape outline**

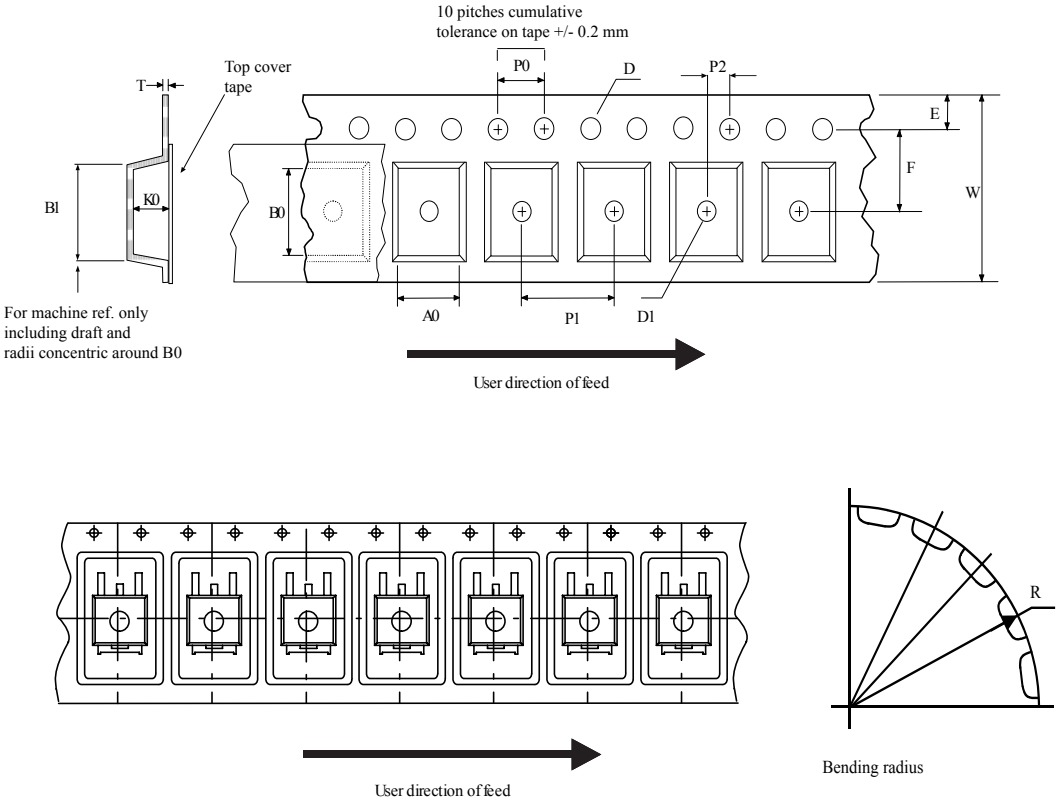
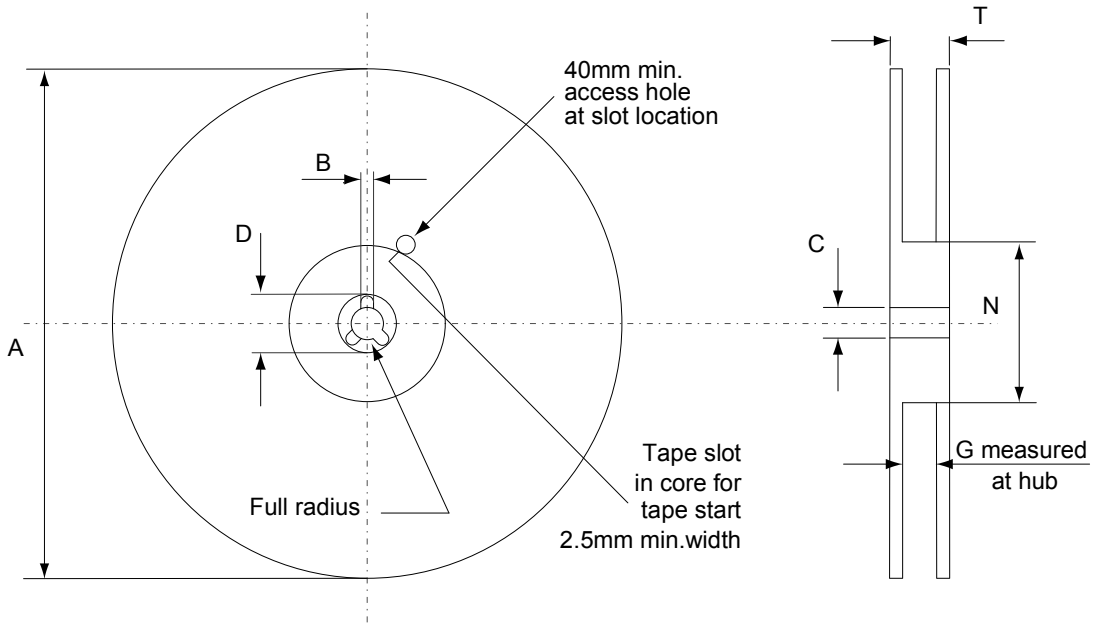


Figure 26. **DPAK (TO-252) reel outline**



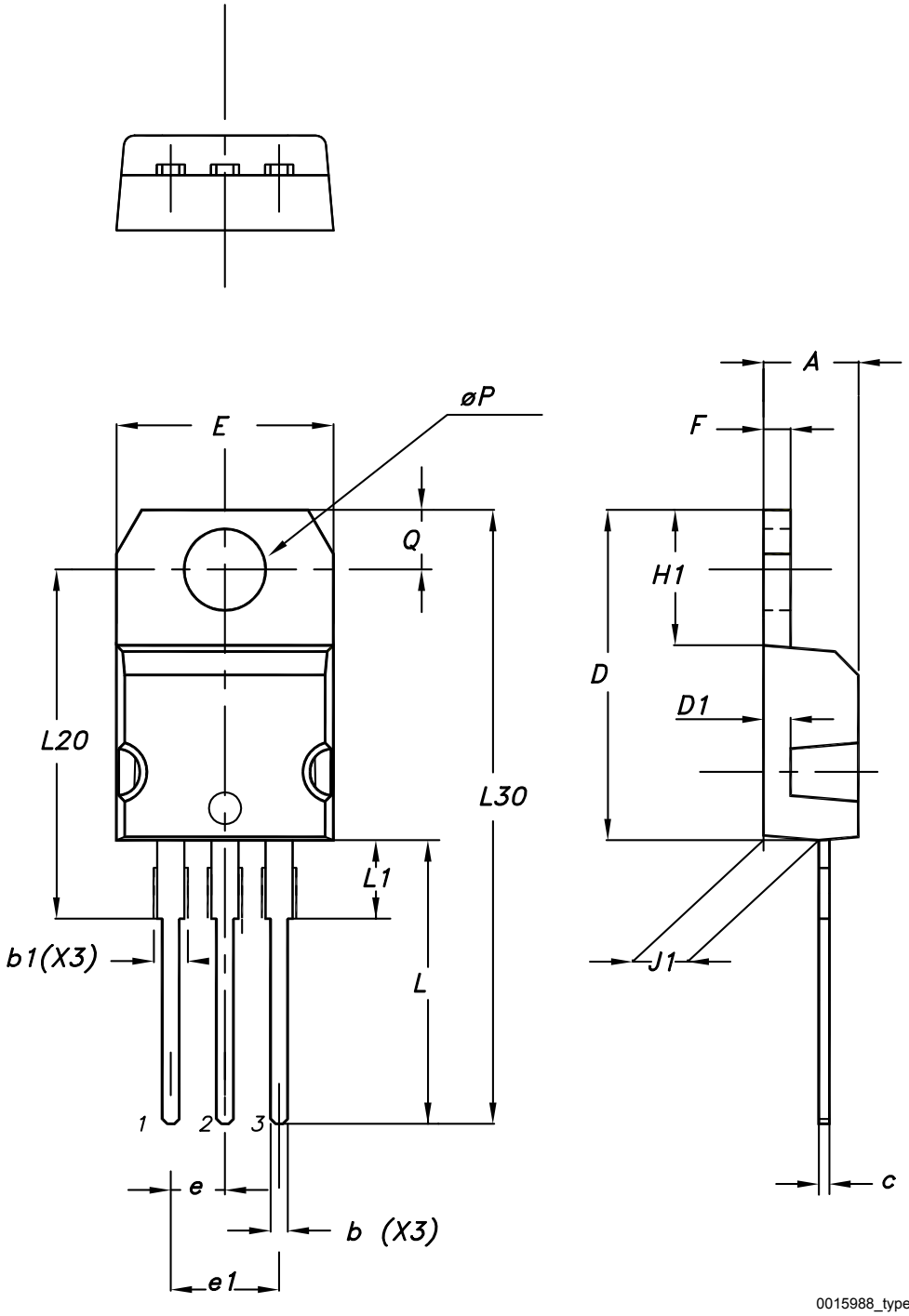
AM06038v1

Table 11. **DPAK (TO-252) tape and reel mechanical data**

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

4.5 TO-220 type A package information

Figure 27. **TO-220 type A package outline**



0015988_typeA_Rev_22

Table 12. **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

4.6 IPAK (TO-251) type A package information

Figure 28. **IPAK (TO-251) type A package outline**

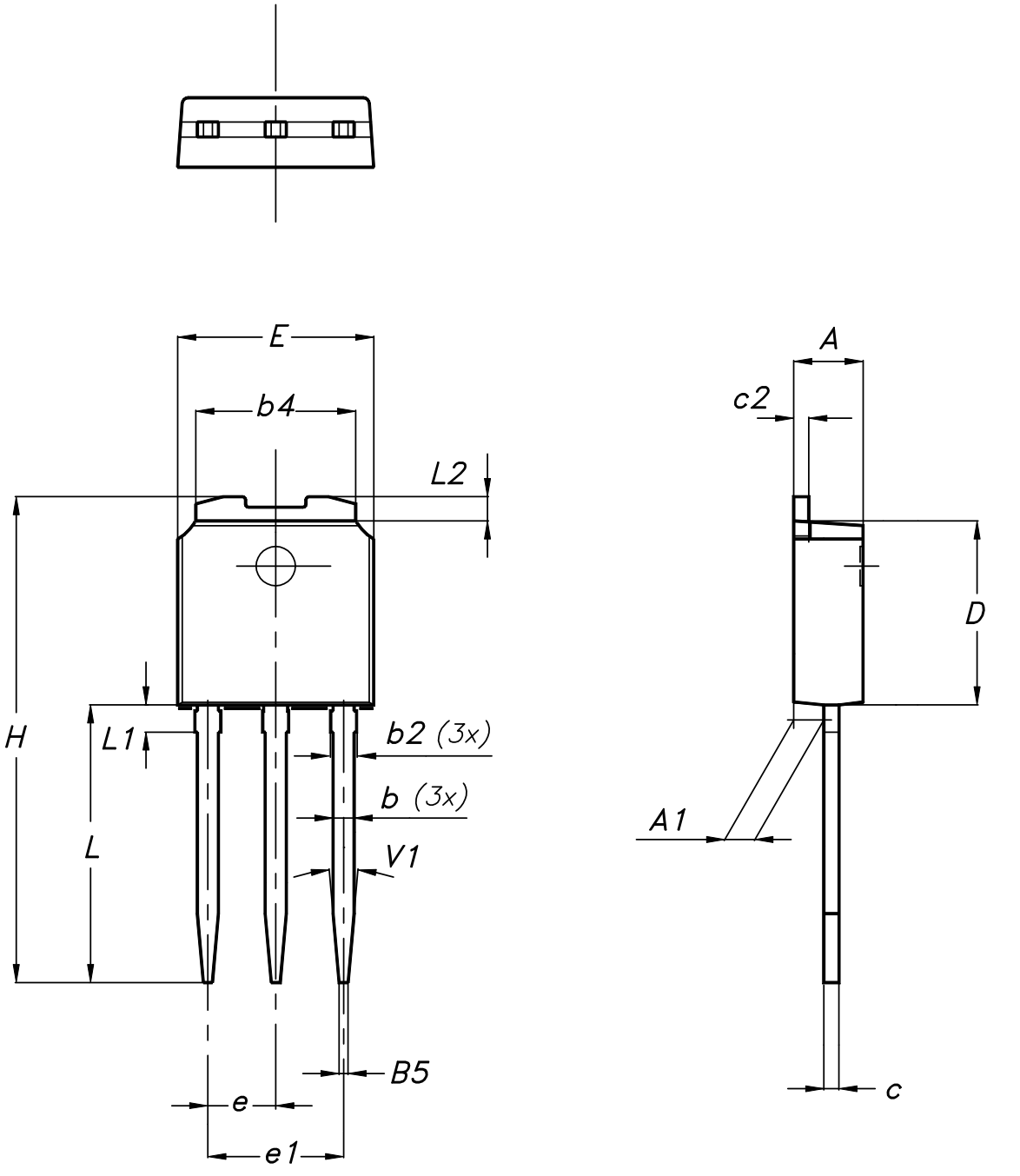
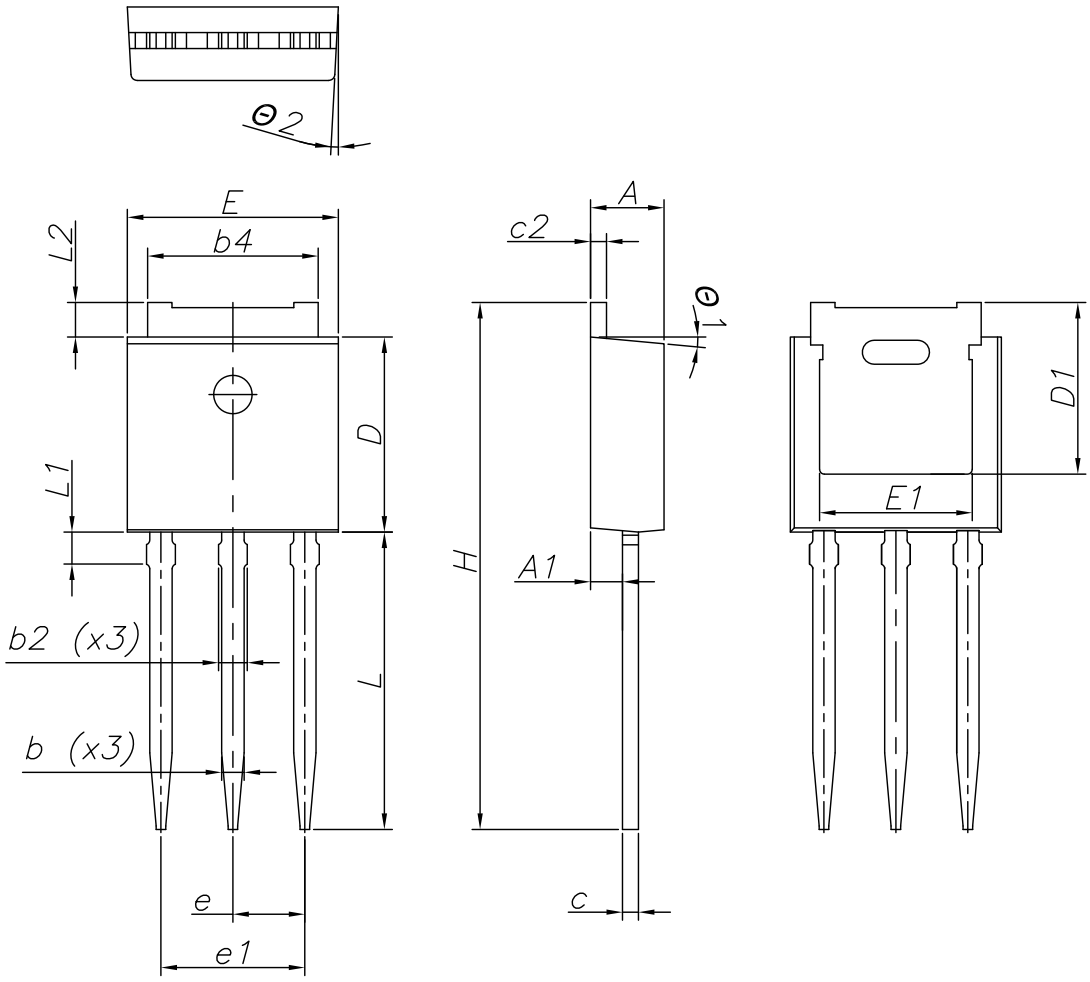


Table 13. **IPAK (TO-251) type A package mechanical data**

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°	

4.7 IPAK (TO-251) type C package information

Figure 29. **IPAK (TO-251) type C package outline**



0068771_IK_typeC_rev14

Table 14. **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°

5 Ordering information

Table 15. **Ordering information**

Order code	Marking	Package	Packing
STD11N65M2	11N65M2	DPAK	Tape and reel
STP11N65M2		TO-220	Tube
STU11N65M2		IPAK	

Revision history

Table 16. **Document revision history**

Date	Revision	Changes
16-May-2014	1	First release.
14-Aug-2015	2	Text and formatting chamges throughout document. On cover page: - updated *Title*, *Features* and *Description* In section *Electrical characteristics*: - updated and renamed table *Static* (was On /off states) Updated section *Electrical characteristics (curves)* Updated and renamed section *Package information* (was Package mechanical data)
17-Aug-2015	3	Datasheet promoted from preliminary data to production data. In section *Electrical ratings*: - updated and renamed table *Absolute maximum ratings* In section *Electrical characteristics*: - updated table *Source-drain diode* In section *Electrical characteristics (curves)* - updated figure *Thermal impedance for DPAK and IPAK* Updated and renamed section *IPAK (TO-251) Type C package information* (was IPAK (TO-251) Type A package information)
07-Sep-2015	4	Minor text and formatting changes throughout document.
16-Oct-2018	5	Updated Section 4 Package information. Minor text changes.
18-Jun-2019	6	Updated Section 3 Minor text changes.

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