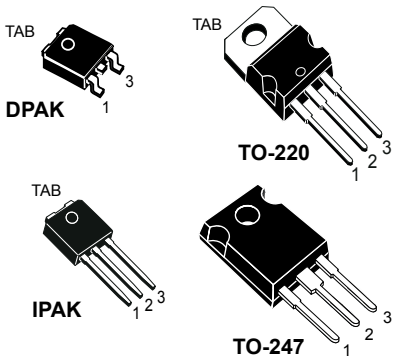
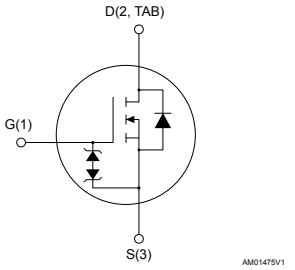
STD6N95K5, STP6N95K5
STU6N95K5, STW6N95K5

Datasheet

N-channel 950 V, 1 Ω typ., 9 A MDmesh™ K5 Power MOSFETs in DPAK, TO-220, IPAK and TO-247 packages





Product status link
STD6N95K5
STP6N95K5
STU6N95K5
STW6N95K5

Features

Order codes	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STD6N95K5	950 V	1.25 Ω	9 A	90 W
STP6N95K5				
STU6N95K5				
STW6N95K5				

- DPAK 950 V worldwide best $R_{DS(on)}$
- Worldwide 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 MOSFETs 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.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate- source voltage	± 30	V
I_D	Drain current (continuous) at T_C = 25 °C	9	A
I_D	Drain current (continuous) at T_C = 100 °C	6	A
I_{DM} (1)	Drain current (pulsed)	24	A
P_{TOT}	Total dissipation at T_C = 25 °C	90	W
I_{AR} (2)	Max current during repetitive or single pulse avalanche	3	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D=I_{AS}, V_{DD}= 50 V)	90	mJ
dv/dt (3)	Peak diode recovery voltage slope	4.5	V/ns
dv/dt (4)	MOSFET dv/dt ruggedness	50	V/ns
T_j	Operating junction temperature range	- 55 to 150	°C
T_{stg}	Storage temperature range		

1. *Pulse width limited by safe operating area.*
2. *Pulse width limited by T_{Jmax}.*
3. *I_{SD} ≤ 9 A, di/dt ≤ 100 A/µs, $V_{DS(peak)}$ ≤ $V_{(BR)DSS}$*
4. *V_{DS} ≤ 760 V*

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		TO-220, IPAK	DPAK	TO-247	
$R_{thj\text{-}case}$	Thermal resistance junction-case	1.39			°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-amb	62.5		50	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb		50		°C/W

1. *When mounted on 1 inch² FR-4 board, 2 oz Cu*

2 Electrical characteristics

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

Table 3. 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	950			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 950 V			1	µA
		V_{GS} = 0 V, V_{DS} = 950 V, Tc=125 °C(1)			50	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0, V_{GS} = ± 20 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= 3 A		1	1.25	Ω

1. *Defined by design, not subject to production test.*

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{GS}=0 V, V_{DS} =100 V, f=1 MHz	-	450	-	pF
C_{oss}	Output capacitance		-	30	-	pF
C_{rss}	Reverse transfer capacitance		-	1.6	-	pF
$C_{o(tr)}$ (1)	Equivalent capacitance time related	V_{GS} = 0 V, V_{DS} = 0 to 760 V	-	45	-	pF
$C_{o(er)}$ (2)	Equivalent capacitance energy related		-	19	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D=0 A	-	7	-	Ω
Q_g	Total gate charge	V_{DD} = 760 V, I_D = 6 A, V_{GS} = 0 to 10 V, (see Figure 17. Test circuit for gate charge behavior)	-	13	-	nC
Q_{gs}	Gate-source charge		-	3	-	nC
Q_{gd}	Gate-drain charge		-	7	-	nC

1. *$C_{o(tr)}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.*
2. *$C_{o(er)}$ is a constant capacitance value that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.*

Table 5. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 475 V, I_D = 3 A, R_G=4.7 Ω, V_{GS}=10 V (see Figure 16. Test circuit for resistive load switching times and Figure 21. Switching time waveform)	-	12	-	ns
t_r	Rise time		-	12	-	ns
$t_{d(off)}$	Turn-off delay time		-	33	-	ns
t_f	Fall time		-	21	-	ns

Table 6. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		9	A
I_{SDM} (1)	Source-drain current (pulsed)		-		24	A
V_{SD} (2)	Forward on voltage	I_{SD}= 6 A, V_{GS}=0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD}= 6 A, V_{DD}= 60 V	-	372		ns
Q_{rr}	Reverse recovery charge	di/dt = 100 A/µs,	-	4		µC
I_{RRM}	Reverse recovery current	(see Figure 18. Test circuit for inductive load switching and diode recovery times)	-	22		A
t_{rr}	Reverse recovery time	I_{SD}= 6 A,V_{DD}= 60 V	-	522		ns
Q_{rr}	Reverse recovery charge	di/dt=100 A/µs, Tj=150 °C	-	5		µC
I_{RRM}	Reverse recovery current	(see Figure 18. Test circuit for inductive load switching and diode recovery times)	-	20		A

1. *Pulse width limited by safe operating area.*
2. *Pulsed: pulse duration = 300µs, duty cycle 1.5%*

Table 7. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	I_{GS} = ± 1mA, I_D= 0 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 1. Safe operating area for DPAK and IPAK

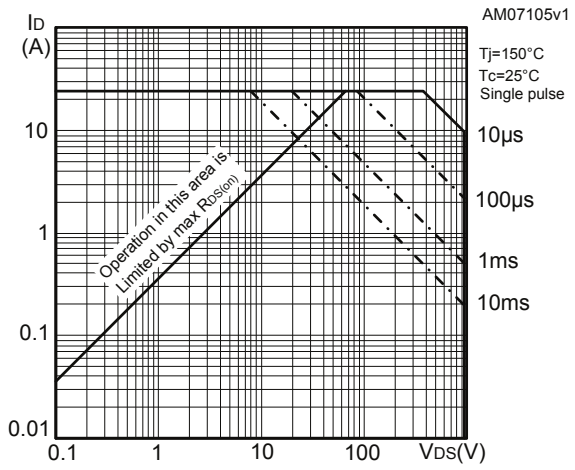


Figure 2. Thermal impedance for DPAK and IPAK

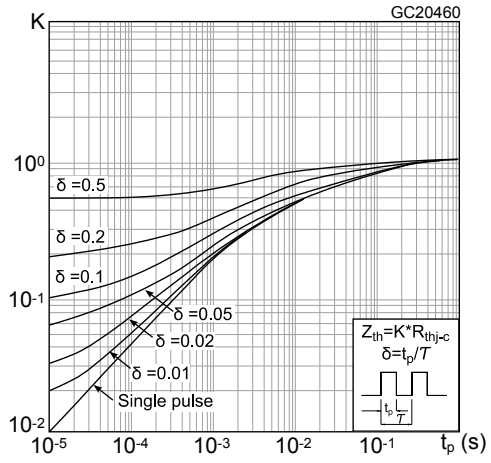


Figure 3. Safe operating area for TO-220 and TO-247

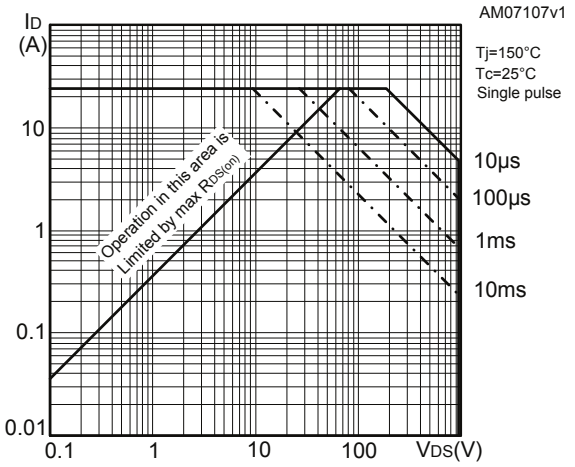


Figure 4. Thermal impedance for TO-220 and TO-247

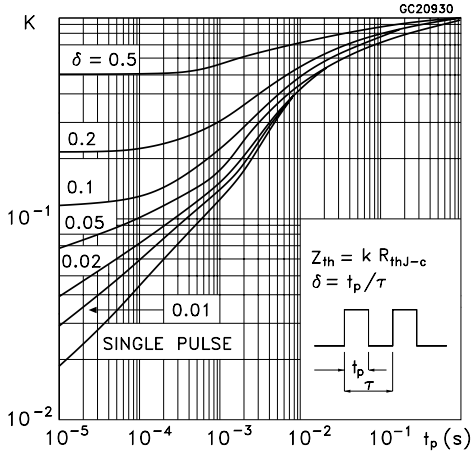


Figure 5. Output characteristics

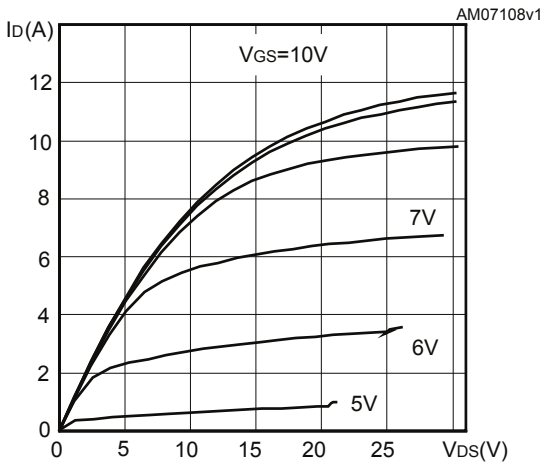


Figure 6. Transfer characteristics

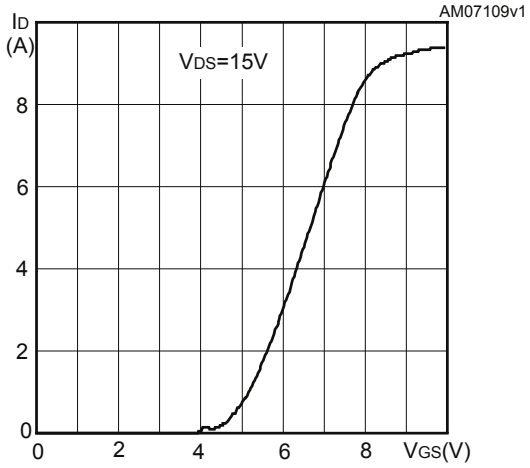


Figure 7. Gate charge vs gate-source voltage

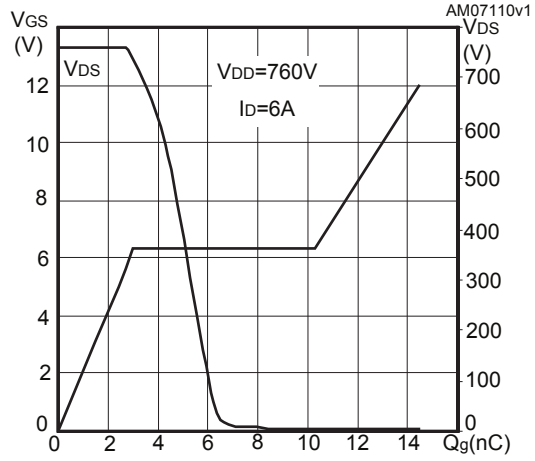


Figure 8. Static drain-source on-resistance

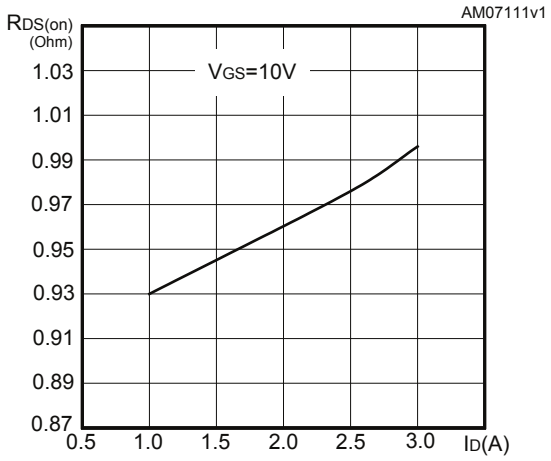


Figure 9. Capacitance variations

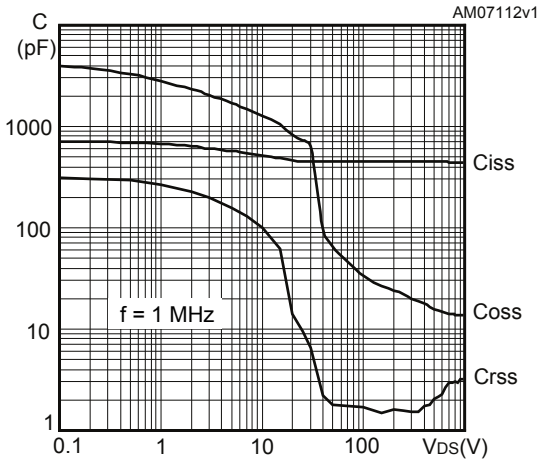


Figure 10. Output capacitance storage energy

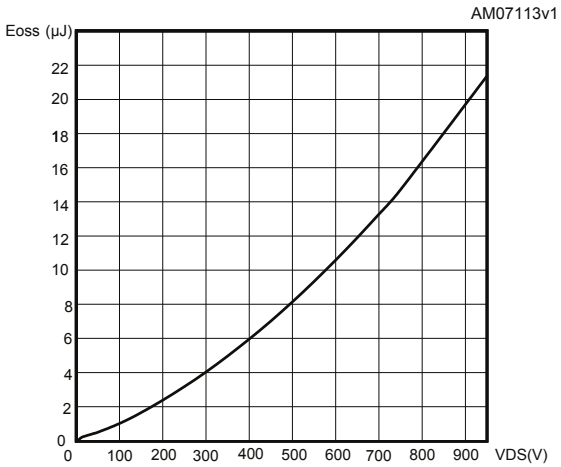


Figure 11. Normalized gate threshold voltage vs temperature

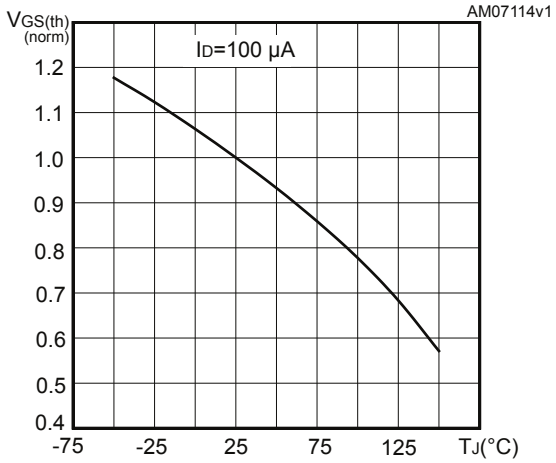


Figure 12. Normalized on-resistance vs temperature

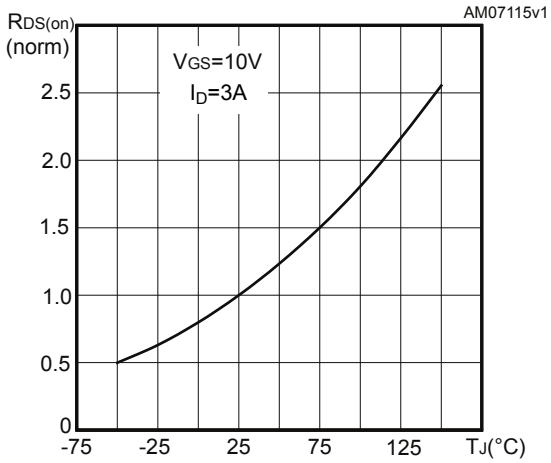


Figure 13. Source-drain diode forward characteristics

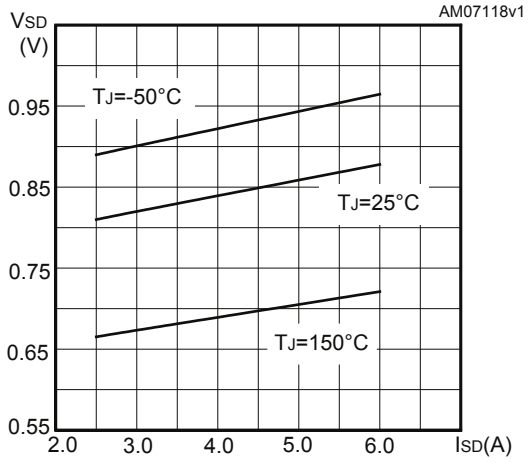


Figure 14. Normalized $V_{(BR)DSS}$ vs temperature

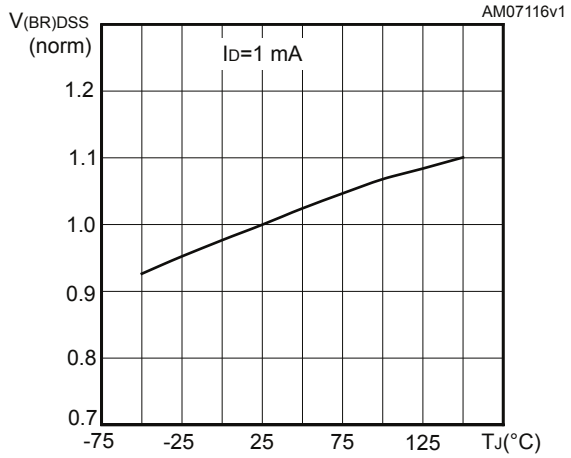
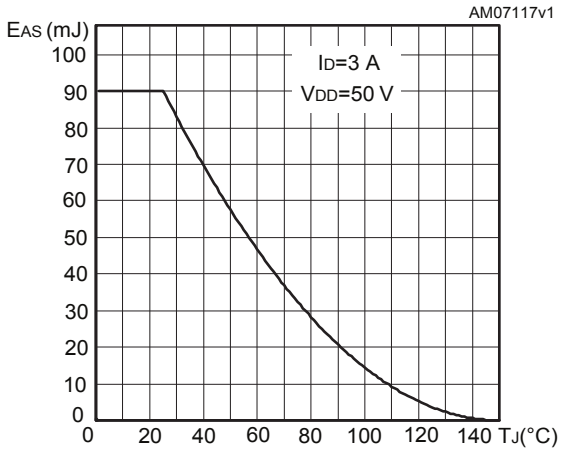


Figure 15. Maximum avalanche energy vs starting T_j



3 Test circuits

Figure 16. Test circuit for resistive load switching times

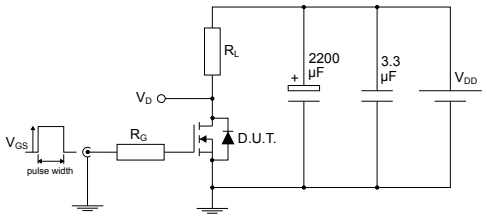


Figure 17. Test circuit for gate charge behavior

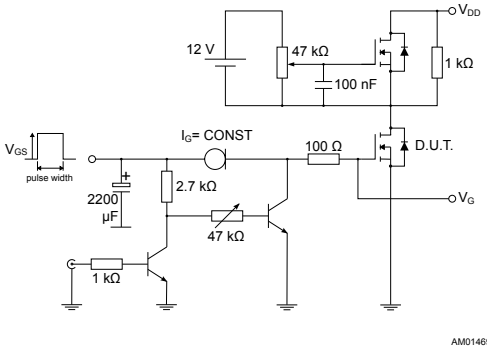


Figure 18. Test circuit for inductive load switching and diode recovery times

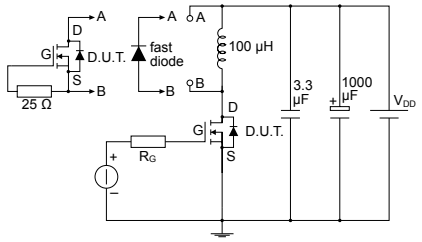


Figure 19. Unclamped inductive load test circuit

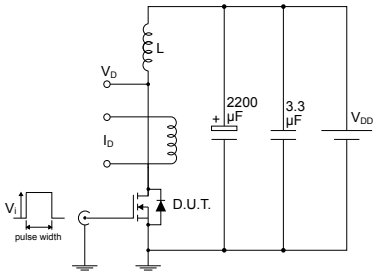


Figure 20. Unclamped inductive waveform

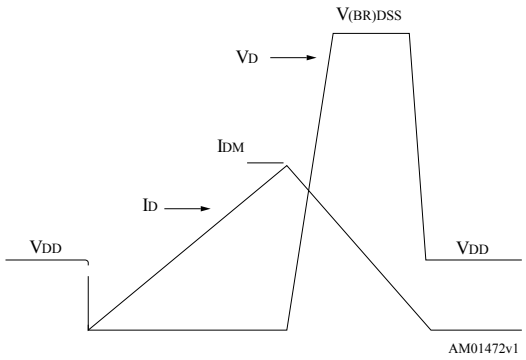
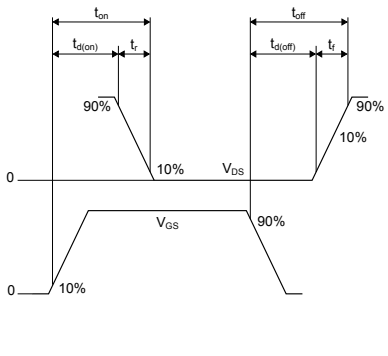


Figure 21. Switching time waveform



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 A2 package information

Figure 22. **DPAK (TO-252) type A2 package outline**

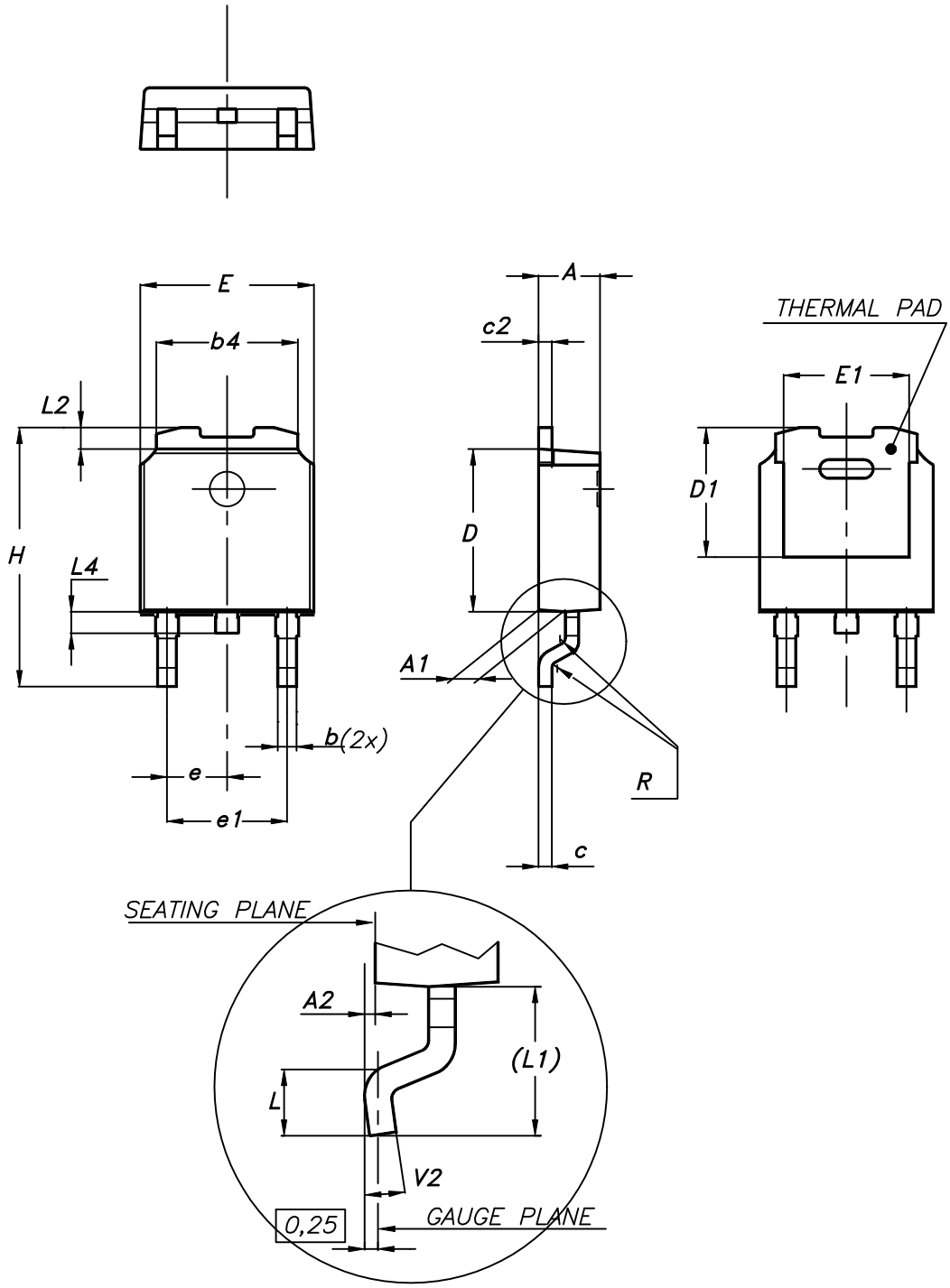


Table 8. **DPAK (TO-252) type A2 mechanical data**

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	5.10	5.20	5.30
e	2.16	2.28	2.40
e1	4.40		4.60
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 C2 package information

Figure 23. **DPAK (TO-252) type C2 package outline**

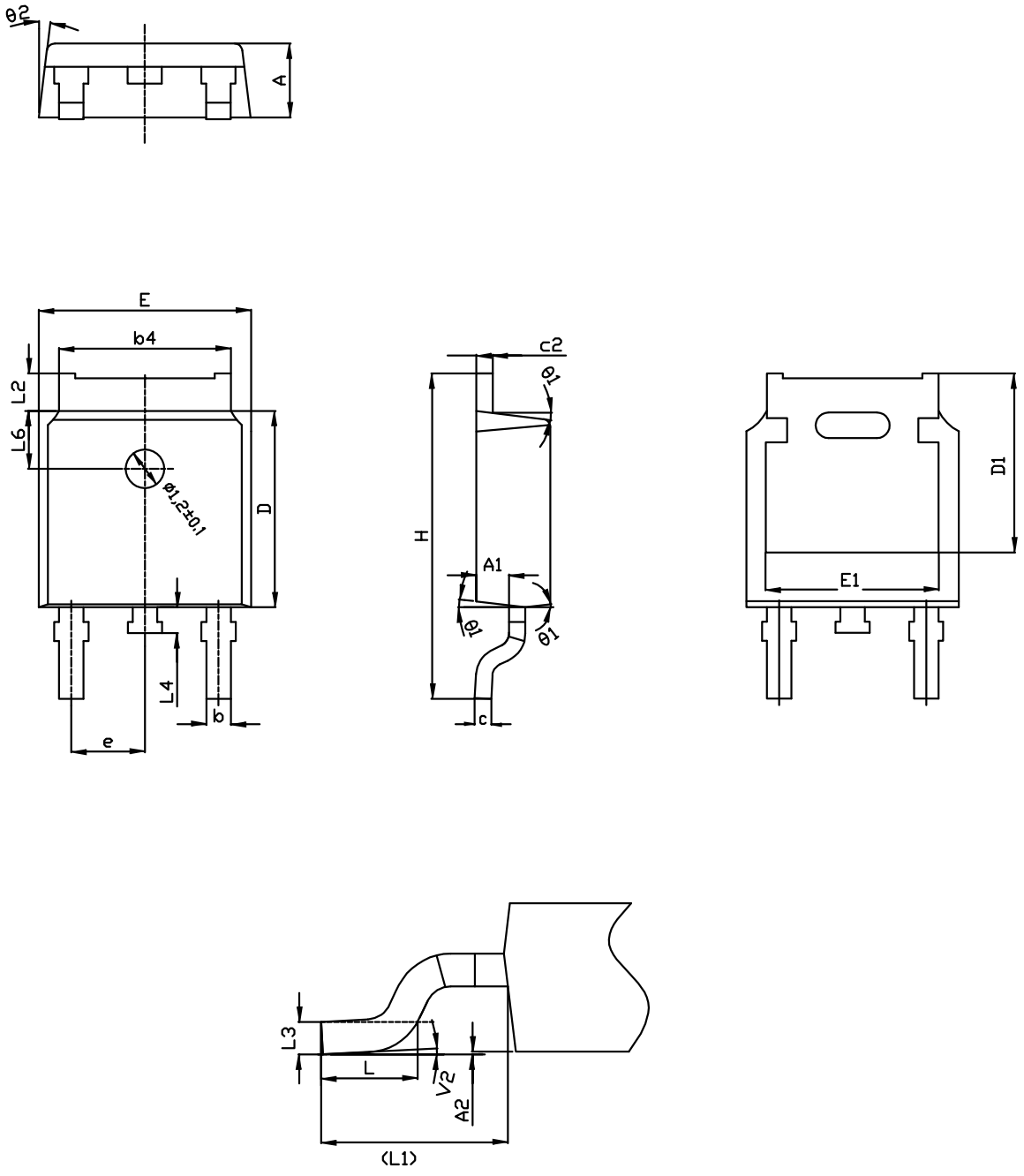


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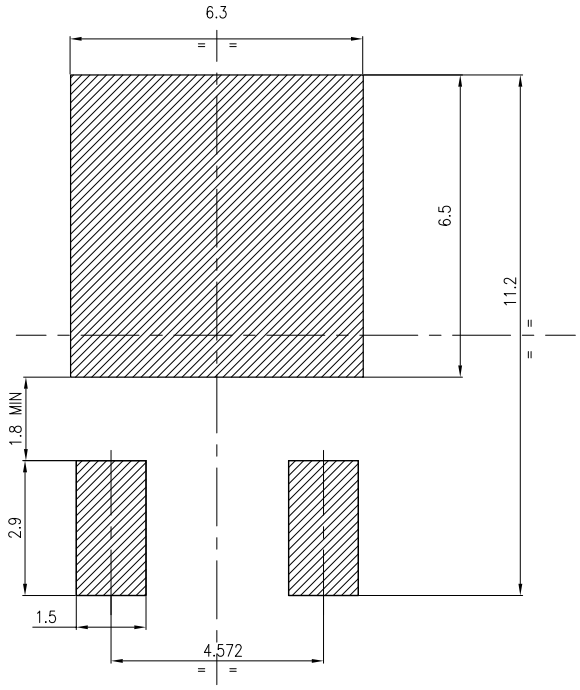
Table 9. DPAK (TO-252) type C2 mechanical data

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	5.10		5.60
E	6.50	6.60	6.70
E1	5.20		5.50
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°

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



4.3 DPAK (TO-252) packing information

Figure 25. DPAK (TO-252) tape outline

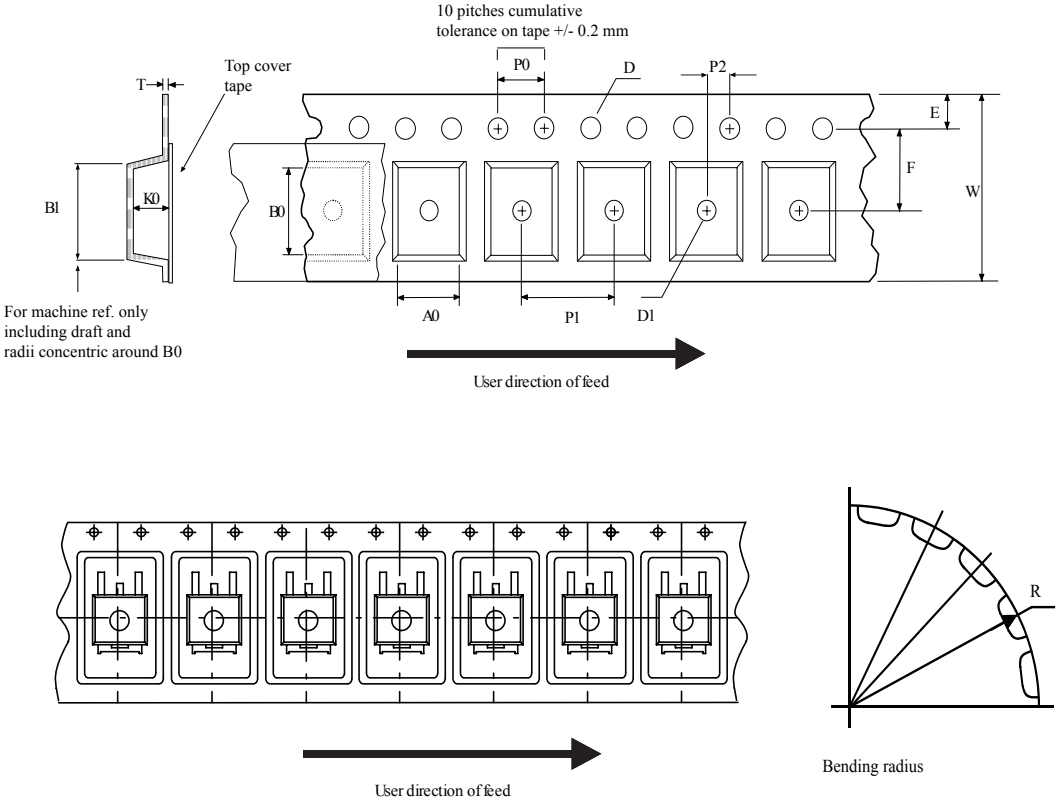


Figure 26. **DPAK (TO-252) reel outline**

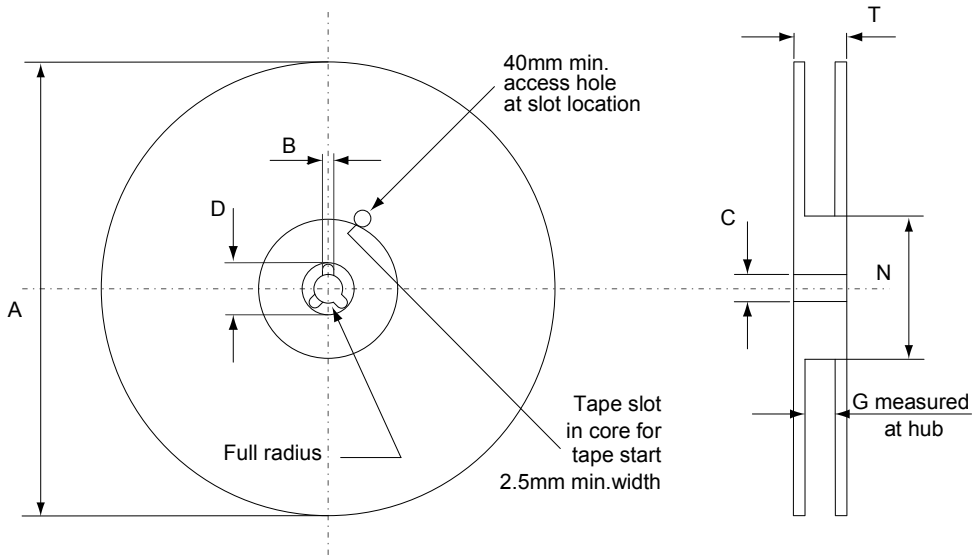


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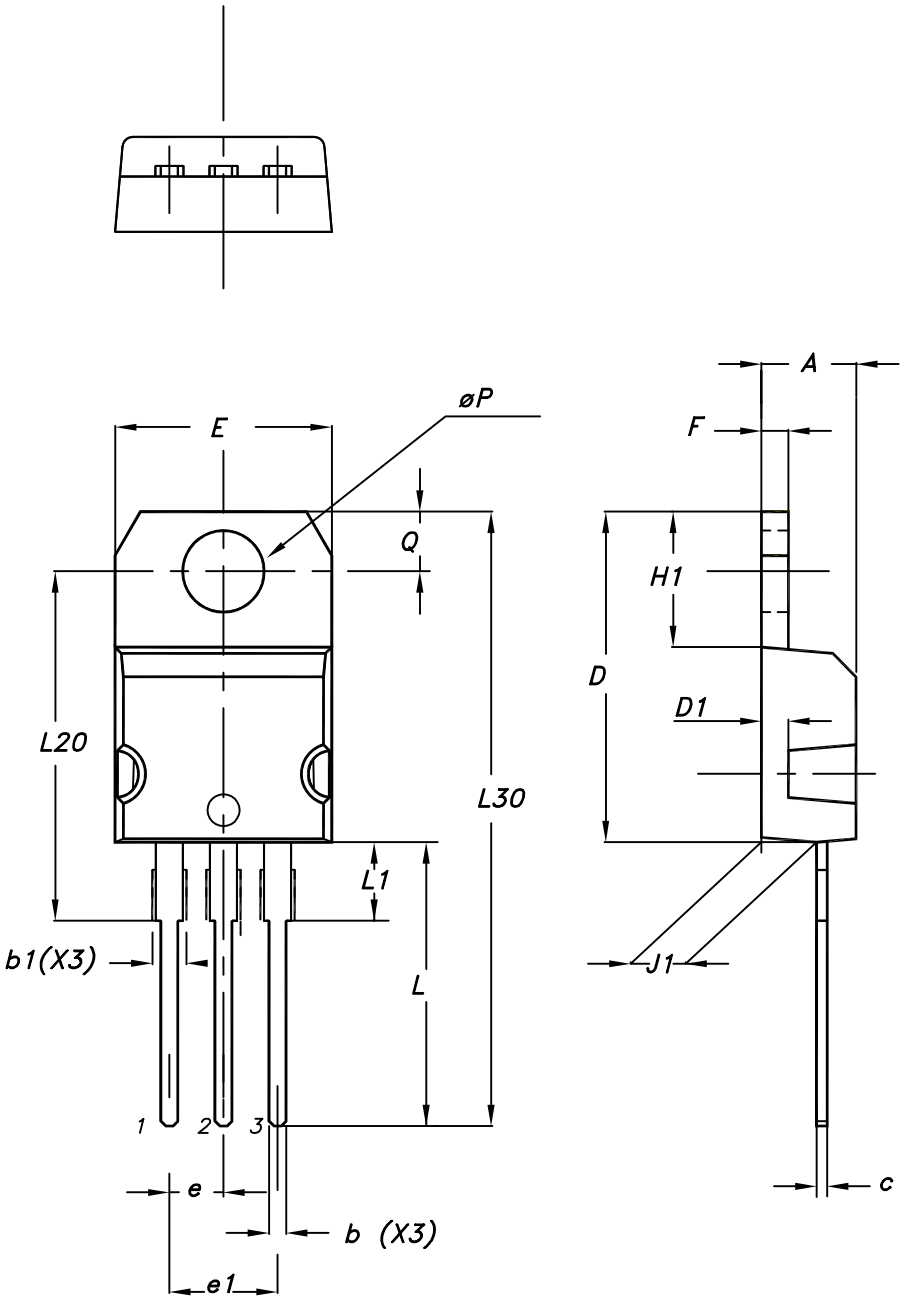
Table 10. **DPAK (TO-252) tape and reel mechanical data**

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			

4.4 TO-220 type A package information

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



0015988_typeA_Rev_21

Table 11. **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

4.5 IPAK (TO-251) type A package information

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

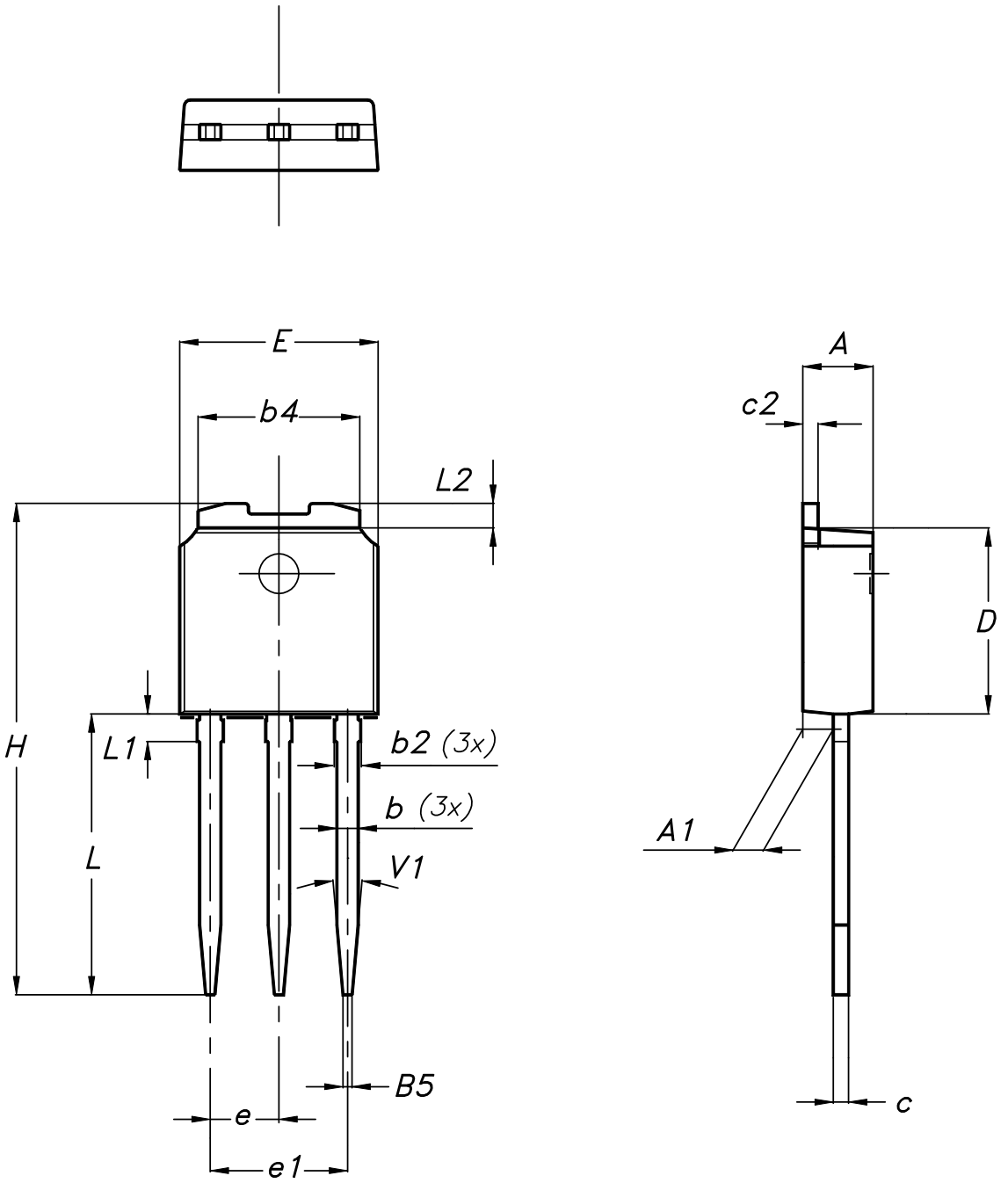
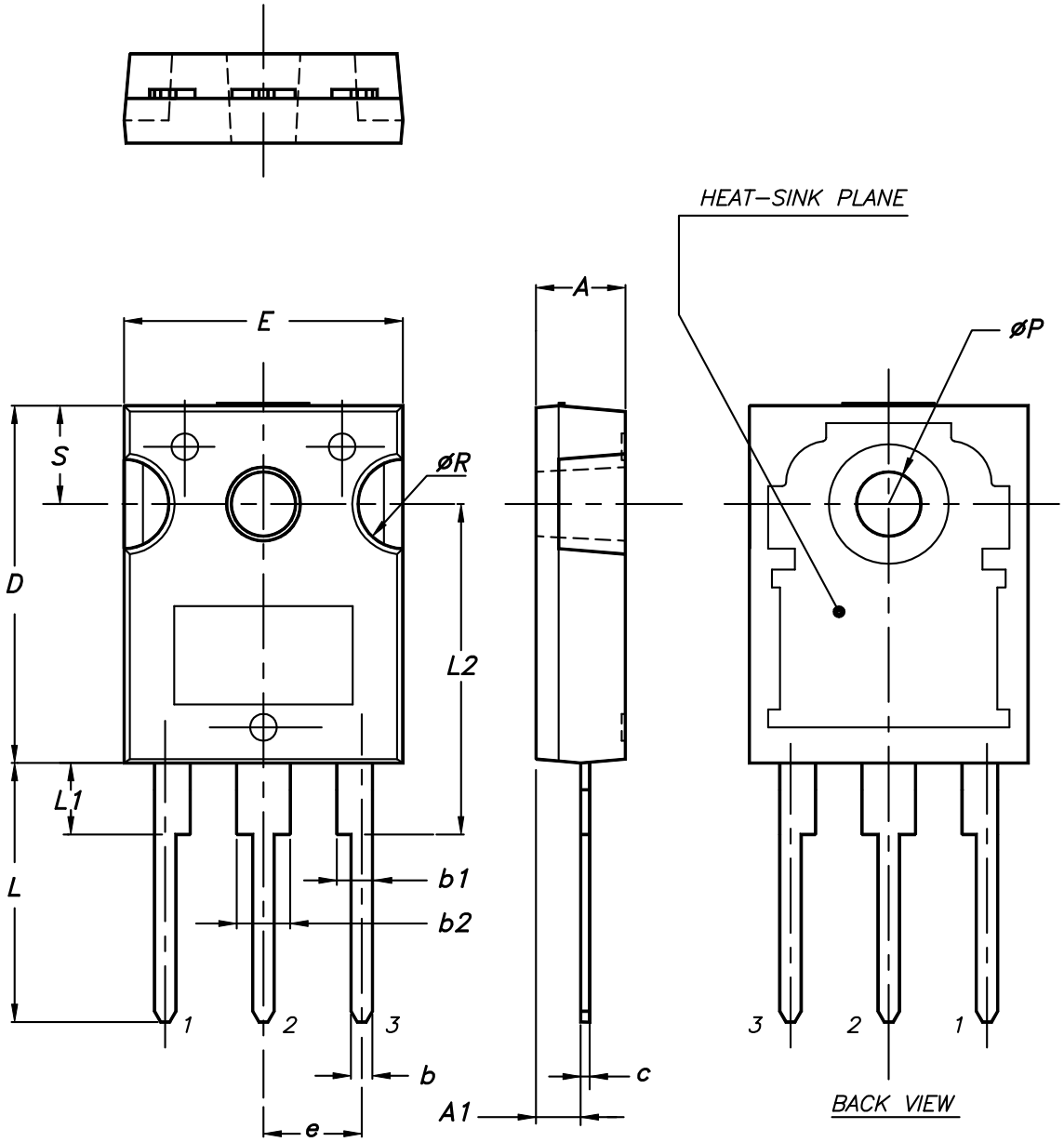


Table 12. **IPAK (TO-251) type A package mechanical data**

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°	

4.6 TO-247 package information

Figure 29. **TO-247 package outline**



0075325_9

Table 13. **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

5 Ordering information

Table 14. **Ordering information**

Order code	Marking	Package	Packing
STD6N95K5	6N95K5	DPAK	Tape and reel
STP6N95K5	6N95K5	TO-220	Tube
STU6N95K5	6N95K5	IPAK	Tube
STW6N95K5	6N95K5	TO-247	Tube

Revision history

Table 15. **Document revision history**

Date	Revision	Changes
12-Jan-2010	1	First release.
01-Jul-2010	2	Document status promoted from preliminary data to datasheet.
31-Aug-2012	3	Inserted new device in IPAK. Updated *Table 1: Device summary*, *Table 2: Absolute maximum ratings*, and *Table 3: Thermal data.* Updated *Section 4: Package mechanical data* and *Section 5: Packaging mechanical data*. Minor text changes in the cover page.
16-May-2014	4	The part number STF6N95K5 has been moved to a separate datasheet. Added: MOSFET dv/dt ruggedness parameter in *Table 2* Updated: *Section 4: Package mechanical data* Minor text changes
22-Mar-2018	5	Removed maturity status indication and updated title and description from cover page. The document status is production data. Updated Section 1 Electrical ratings, Section 2 Electrical characteristics. Updated Figure 9. Capacitance variations and Figure 12. Normalized on-resistance vs temperature. Updated Section 4 Package information. Minor text changes.

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