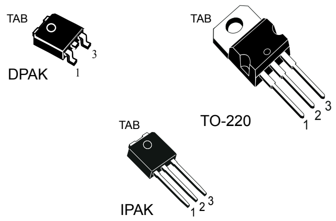
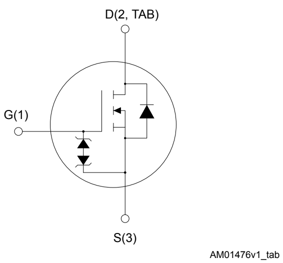
N-channel 800 V, 0.95 Ω typ., 6 A MDmesh K5 Power MOSFETs in DPAK, TO-220 and IPAK packages





Features

Order code	V_{DS}	$R_{DS(on)}$ max	I_D
STD7N80K5	800 V	1.2 Ω	6 A
STP7N80K5			
STU7N80K5			

- 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 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.

Product status link
STD7N80K5
STP7N80K5
STU7N80K5

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	6	A
I_D	Drain current (continuous) at T_C = 100 °C	3.8	A
I_{DM} (1)	Drain current (pulsed)	24	A
P_{TOT}	Total power dissipation at T_C = 25 °C	110	W
I_{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{jmax})	2	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D=I_{AS}, V_{DD}= 50 V)	88	mJ
dv/dt (2)	Peak diode recovery voltage slope	4.5	V/ns
di/dt (2)	Peak diode recovery current slope	100	A/µs
dv/dt (3)	MOSFET dv/dt ruggedness	50	V/ns
T_j	Operating junction temperature range	-55 to 150	°C
T_{stg}	Storage temperature range		°C

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 6 A, $V_{DS(peak)}$ ≤ $V_{(BR)DSS}$*
3. *V_{DS} ≤ 640 V*

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		DPAK	TO-220	IPAK	
$R_{thj\text{-}case}$	Thermal resistance junction-case	1.14			°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-amb		62.5	100	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb	50			°C/W

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

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	800			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V; V_{DS} = 800 V			1	µA
		V_{GS} = 0 V; V_{DS} = 800 V, Tc = 125 °C [(1)]			50	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V; 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		0.95	1.2	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_{DS} = 100 V, f = 1 MHz, V_{GS}= 0 V	-	360	-	pF
C_{oss}	Output capacitance		-	30	-	pF
C_{rss}	Reverse transfer capacitance		-	1	-	pF
$C_{o(tr)}$ [(1)]	Equivalent capacitance time related	V_{GS} = 0 V, V_{DS} = 0 to 640 V	-	47	-	pF
$C_{o(er)}$ [(2)]	Equivalent capacitance energy related		-	20	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	6	-	Ω
Q_g	Total gate charge	V_{DD} = 640 V, I_D = 6 A V_{GS} = 0 to 10 V (see Figure 17. Test circuit for gate charge behavior)	-	13.4	-	nC
Q_{gs}	Gate-source charge		-	3.7	-	nC
Q_{gd}	Gate-drain charge		-	7.5	-	nC

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 5. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 400 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)	-	11.3	-	ns
t_r	Rise time		-	8.3	-	ns
$t_{d(off)}$	Turn-off delay time		-	23.7	-	ns
t_f	Fall time		-	20.2	-	ns

Table 6. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		6	A
I_{SDM}	Source-drain current (pulsed)		-		24	A
V_{SD} (1)	Forward on voltage	I_{SD} = 6 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 6 A, V_{DD} = 60 V di/dt = 100 A/µs, (see Figure 18. Test circuit for inductive load switching and diode recovery times)	-	315		ns
Q_{rr}	Reverse recovery charge		-	2.8		µC
I_{RRM}	Reverse recovery current		-	17.5		A
t_{rr}	Reverse recovery time	I_{SD} = 6 A,V_{DD} = 60 V di/dt = 100 A/µs, Tj = 150 °C (see Figure 18. Test circuit for inductive load switching and diode recovery times)	-	480		ns
Q_{rr}	Reverse recovery charge		-	3.8		µC
I_{RRM}	Reverse recovery current		-	16		A

1. *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} = ± 1 mA, 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

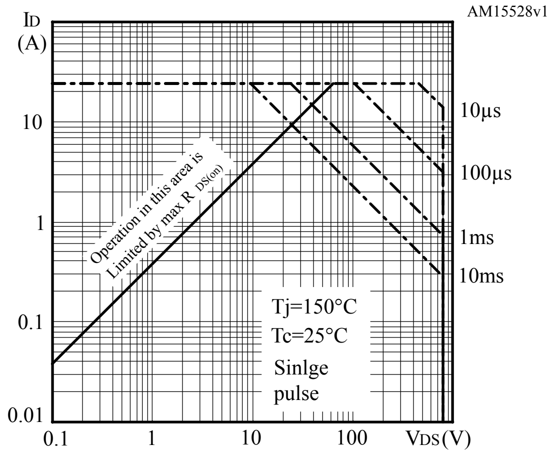


Figure 2. Thermal impedance for DPAK and IPAK

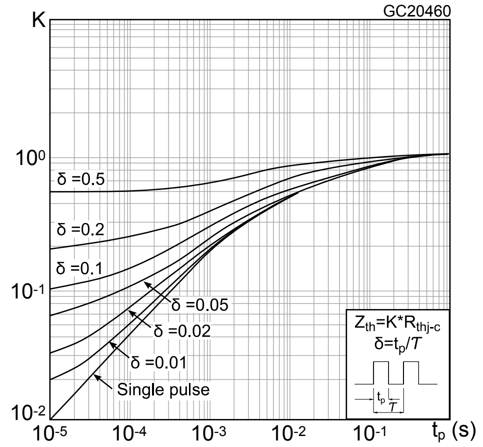


Figure 3. Safe operating area for TO-220

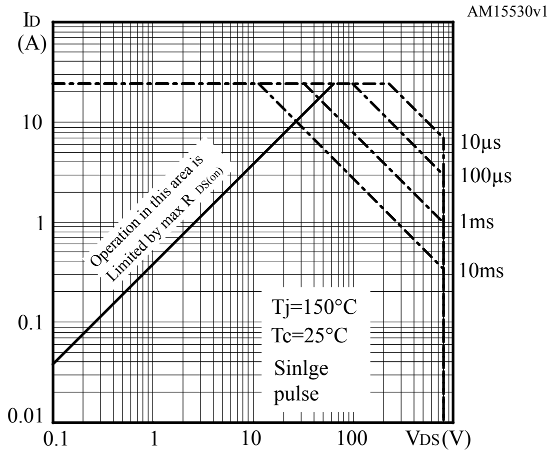


Figure 4. Thermal impedance for TO-220

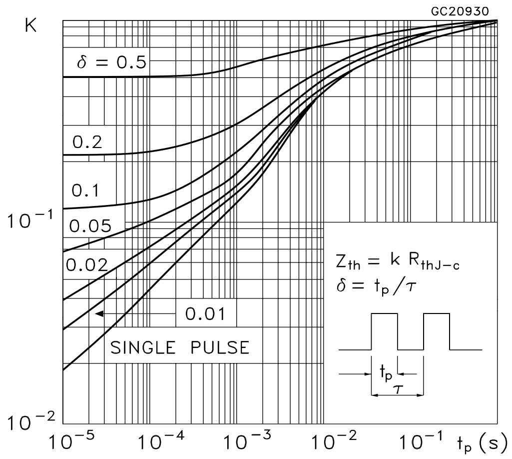


Figure 5. Output characteristics

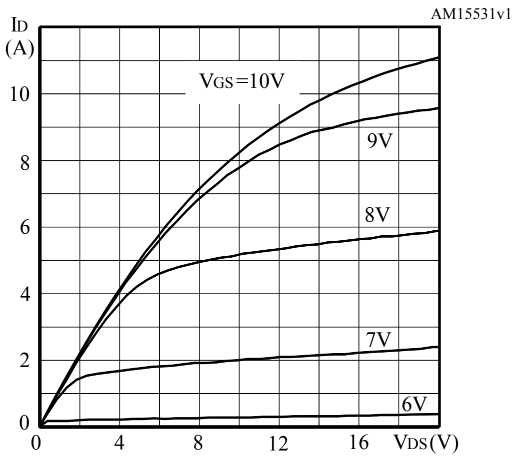


Figure 6. Transfer characteristics

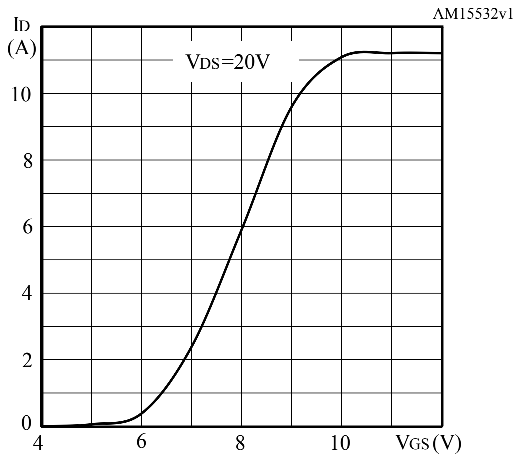


Figure 7. Gate charge vs gate-source voltage

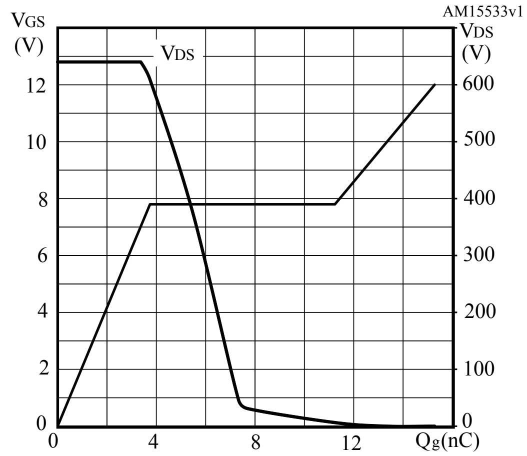


Figure 8. Static drain-source on-resistance

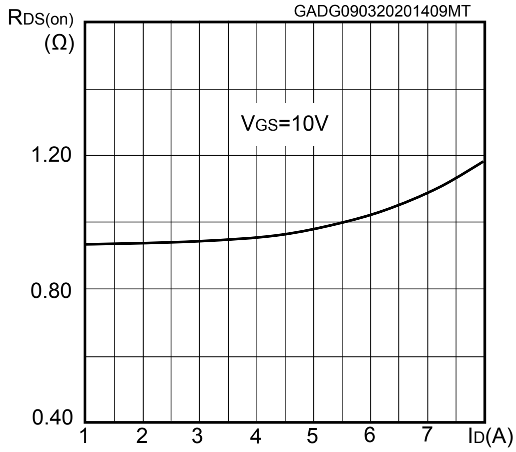


Figure 9. Capacitance variations

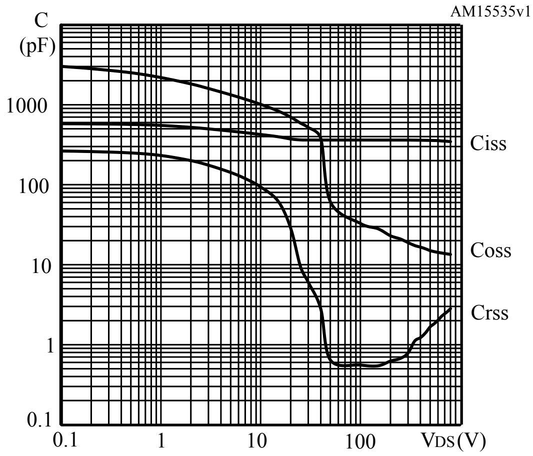


Figure 10. Output capacitance stored energy

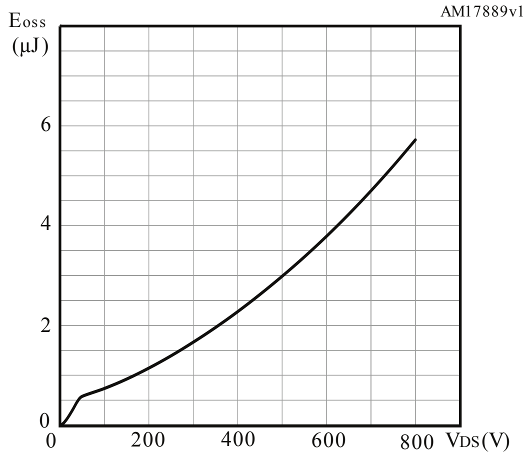


Figure 11. Normalized gate threshold voltage vs temperature

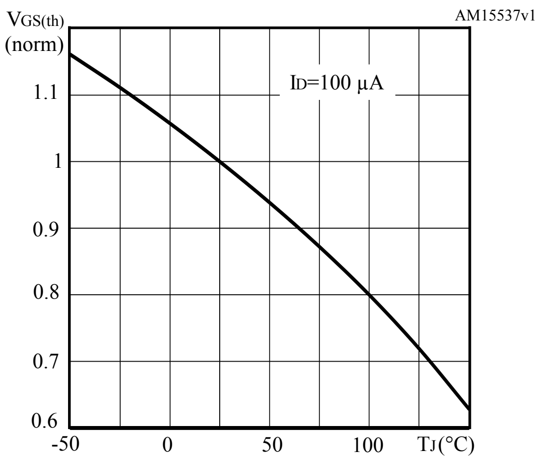


Figure 12. Normalized on-resistance vs temperature

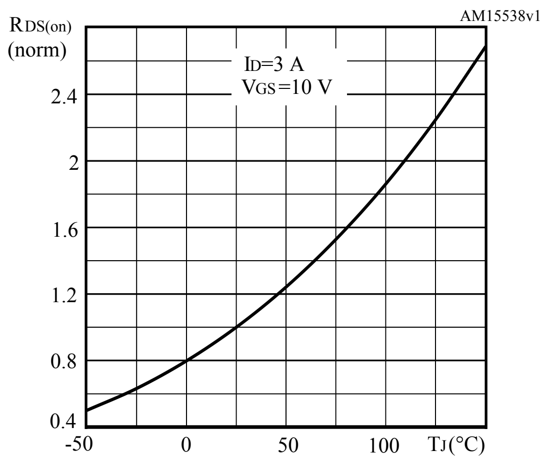


Figure 13. Maximum avalanche energy vs starting T_J

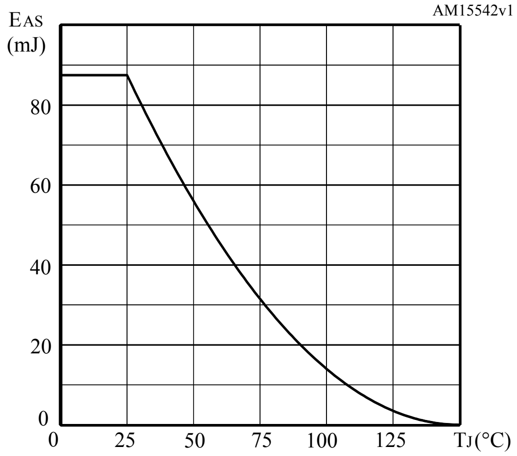


Figure 14. Normalized $V_{(BR)DSS}$ vs temperature

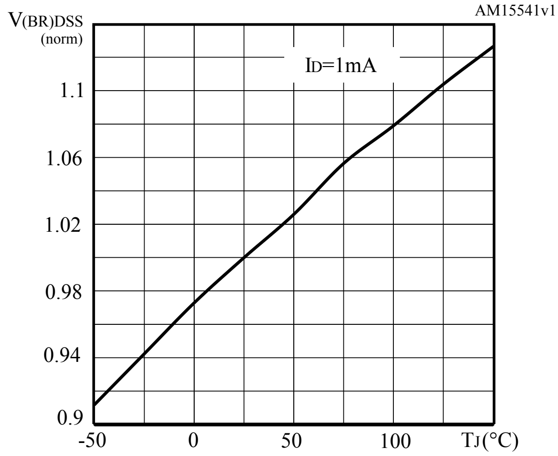
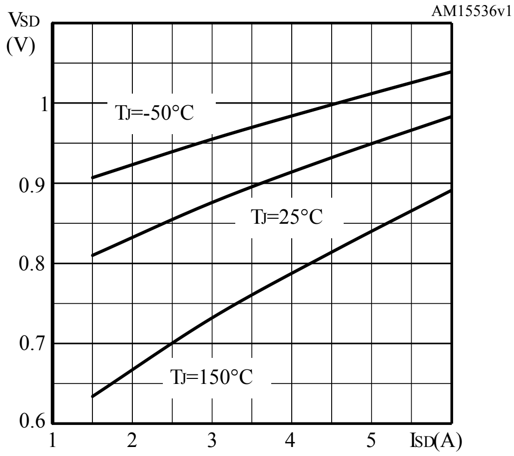


Figure 15. Source-drain diode forward characteristics



3 Test circuits

Figure 16. Test circuit for resistive load switching times

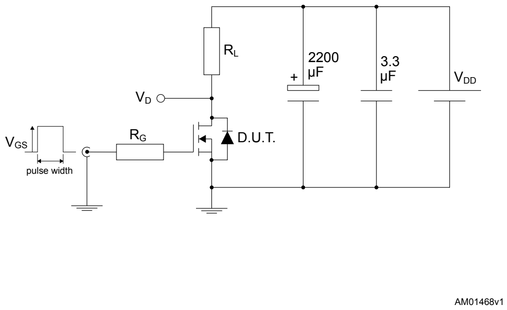


Figure 17. Test circuit for gate charge behavior

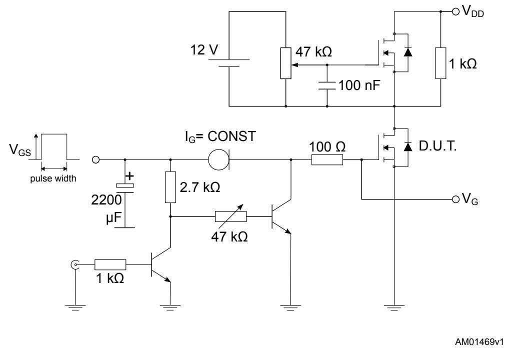


Figure 18. Test circuit for inductive load switching and diode recovery times

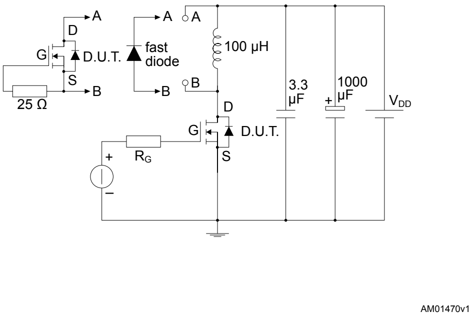


Figure 19. Unclamped inductive load test circuit

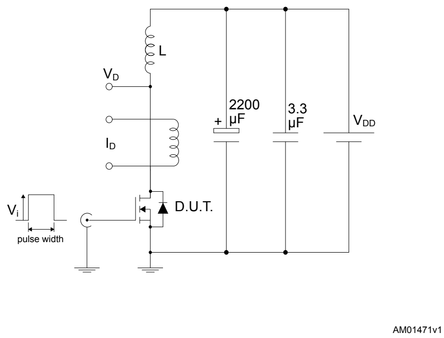


Figure 20. Unclamped inductive waveform

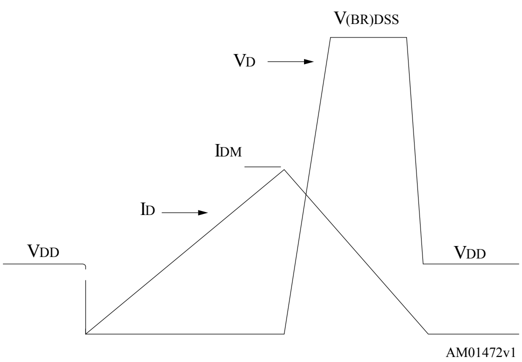
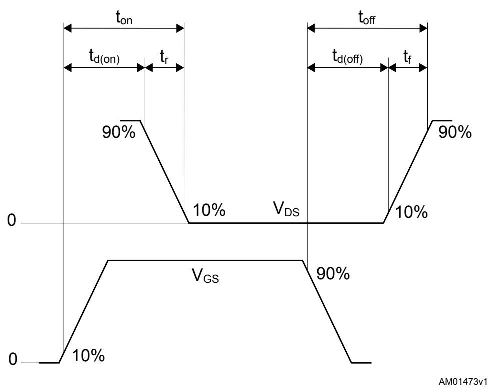


Figure 21. Switching time waveform

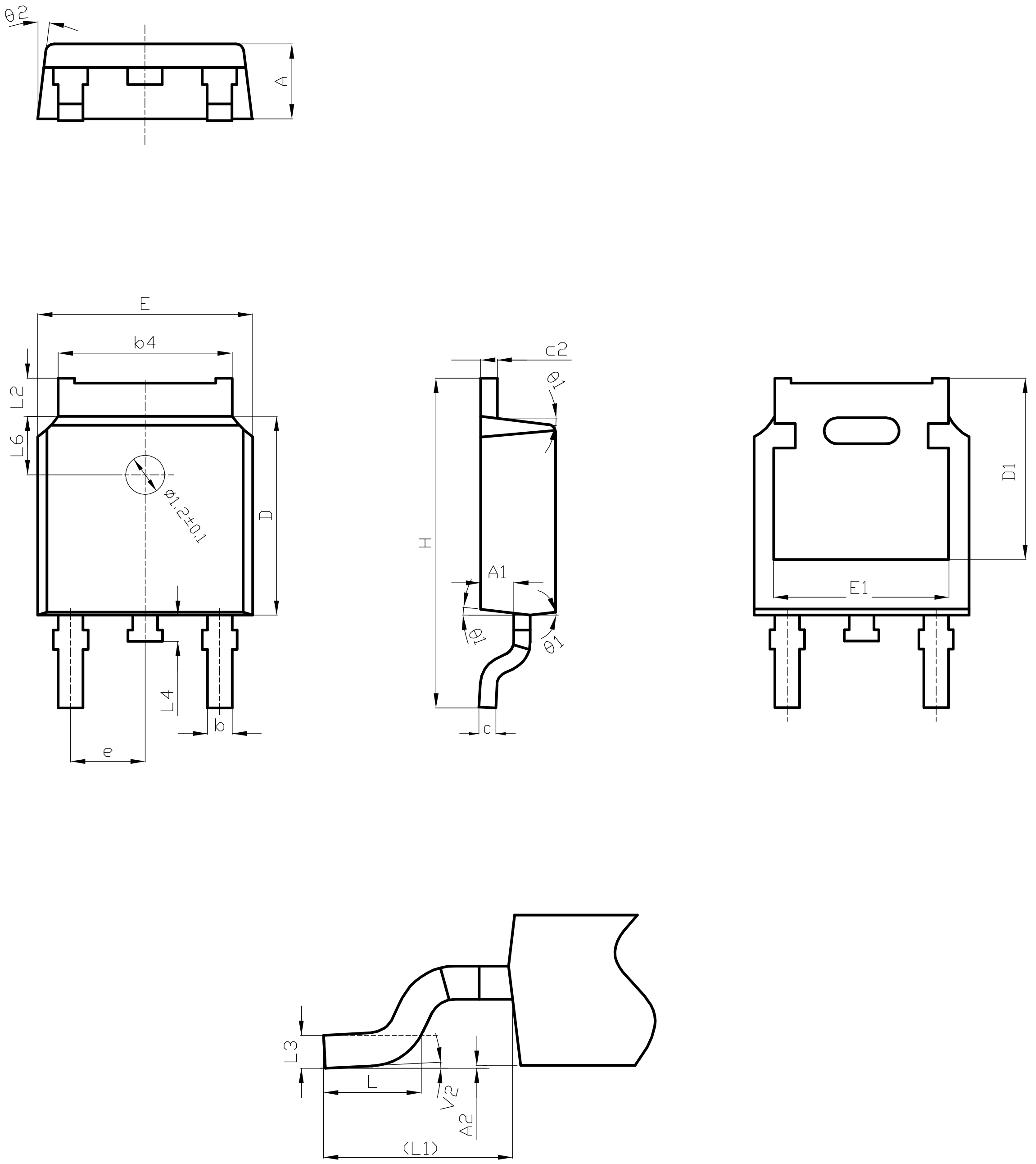


4 Package information

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 C2 package information

Figure 22. **DPAK (TO-252) type C2 package outline**



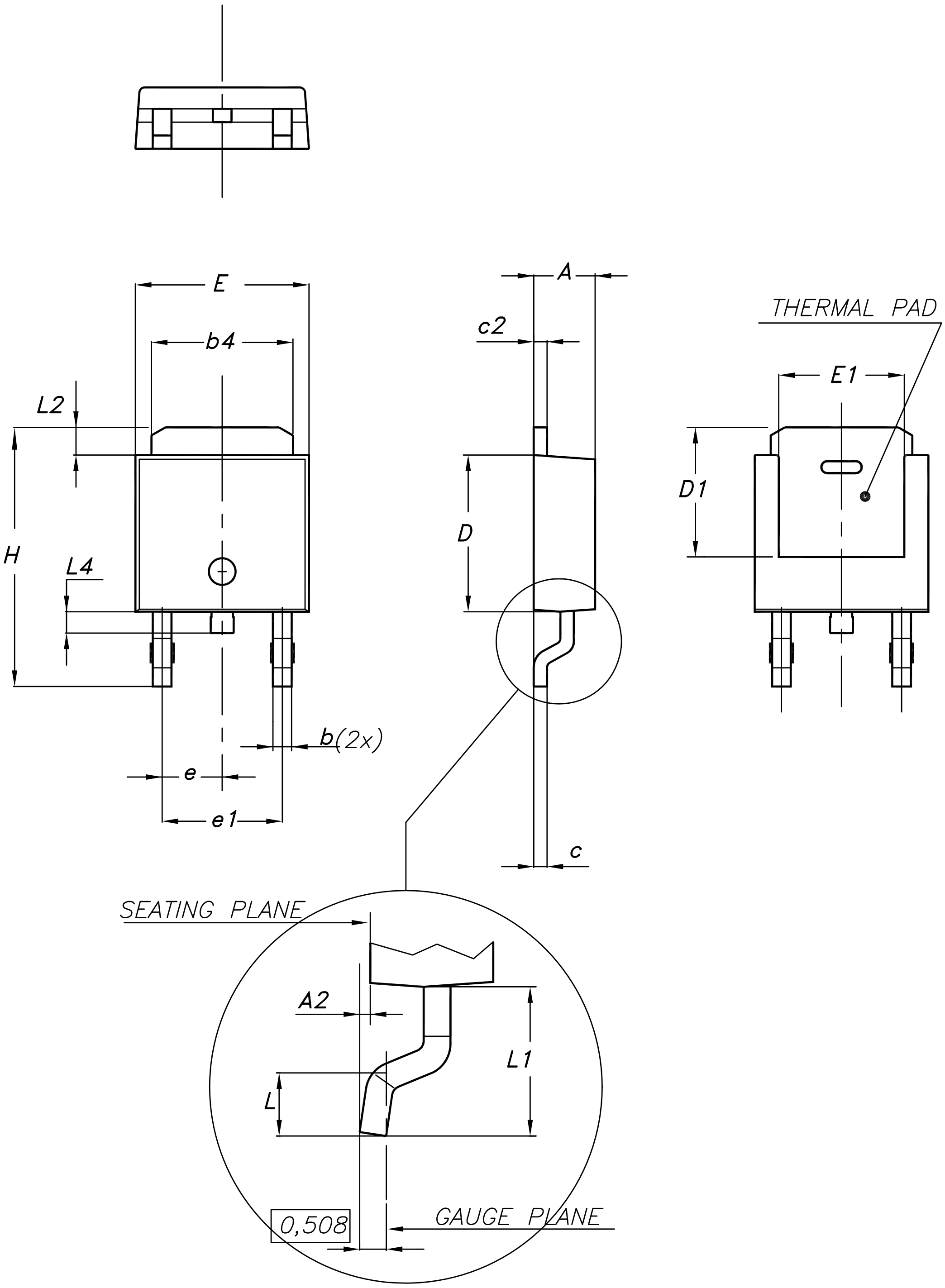
0068772_type-C2_rev29

Table 8. **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°

4.2 DPAK (TO-252) type E package information

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

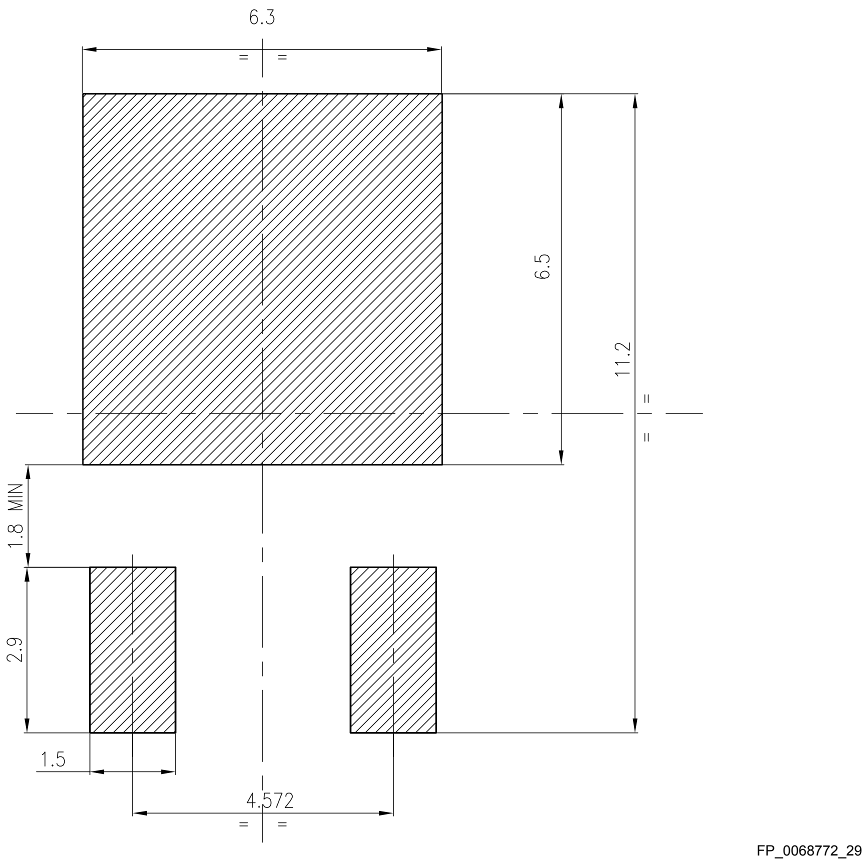


0068772_type-E_rev.29

Table 9. 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)**



4.3 DPAK (TO-252) packing information

Figure 25. DPAK (TO-252) tape outline

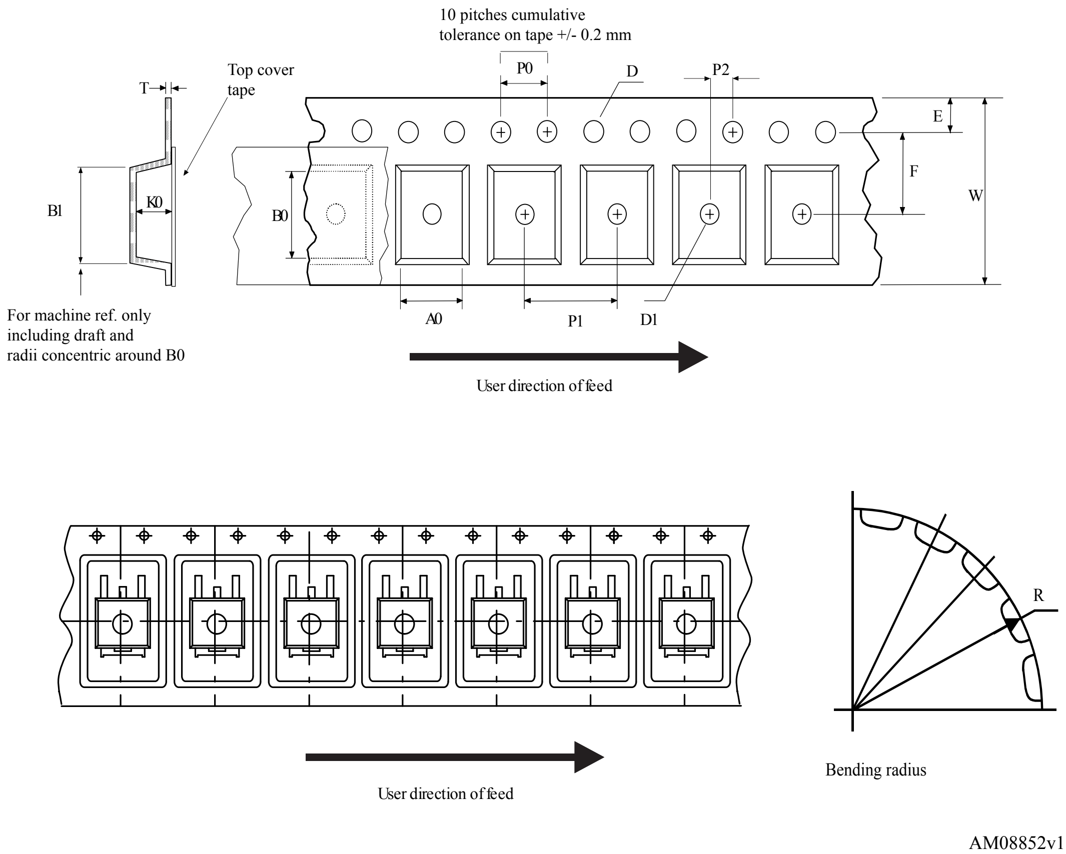


Figure 26. DPAK (TO-252) reel outline

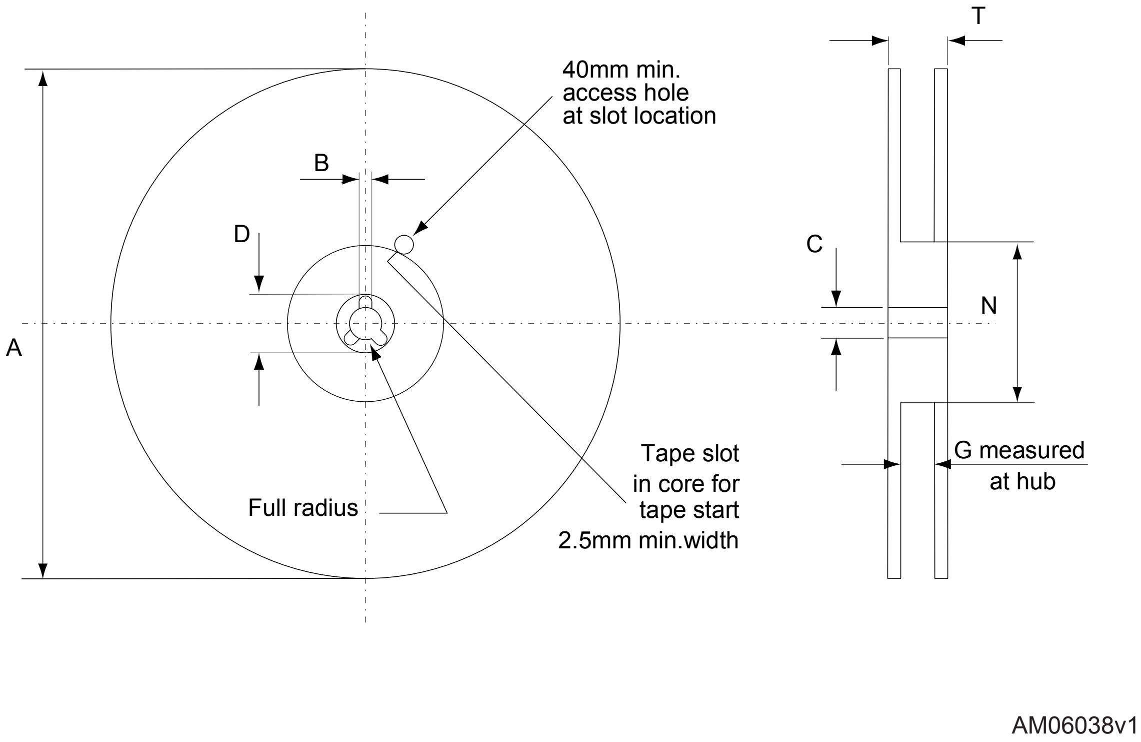


Table 10. DPAK (TO-252) tape and reel mechanical data

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

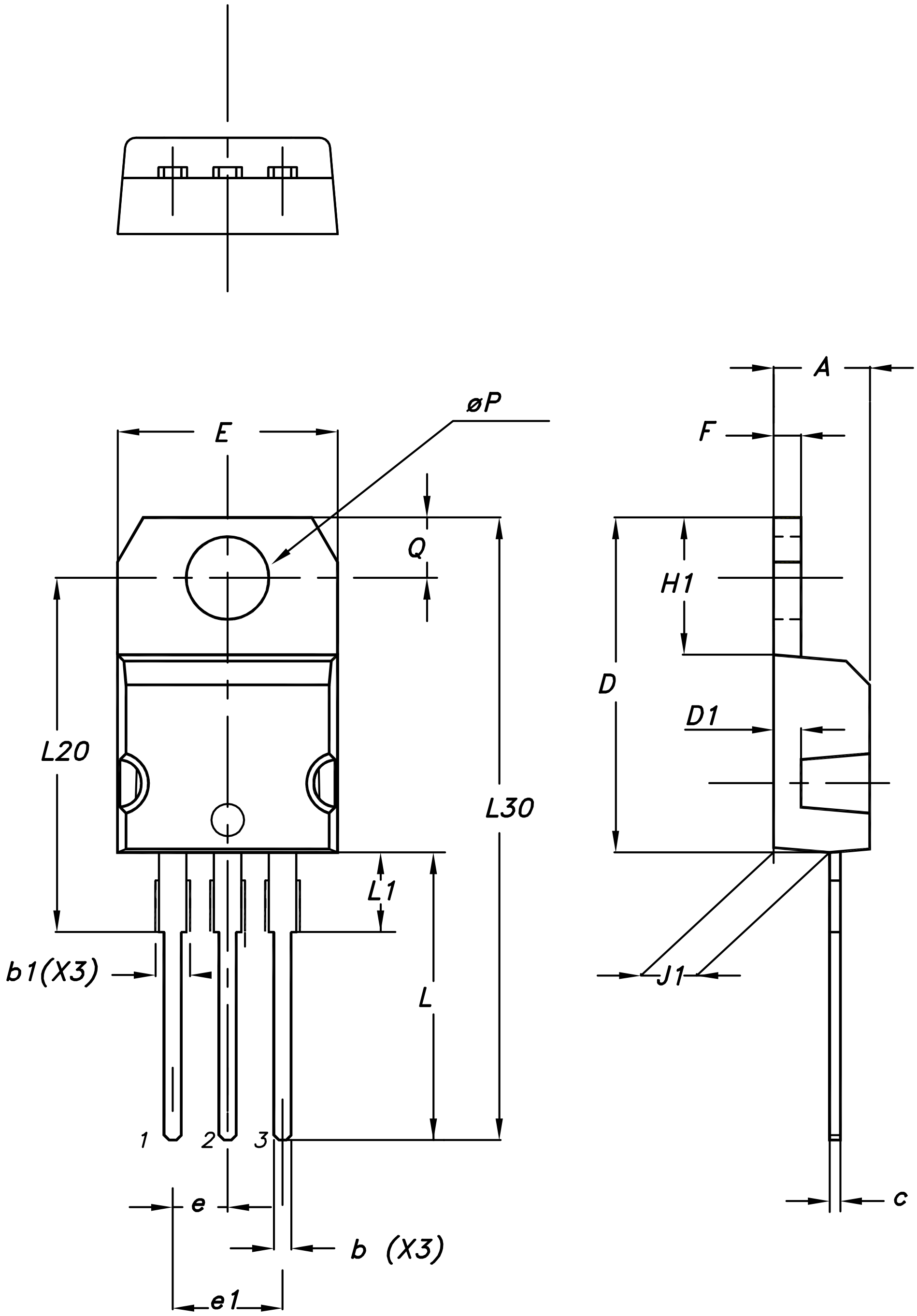
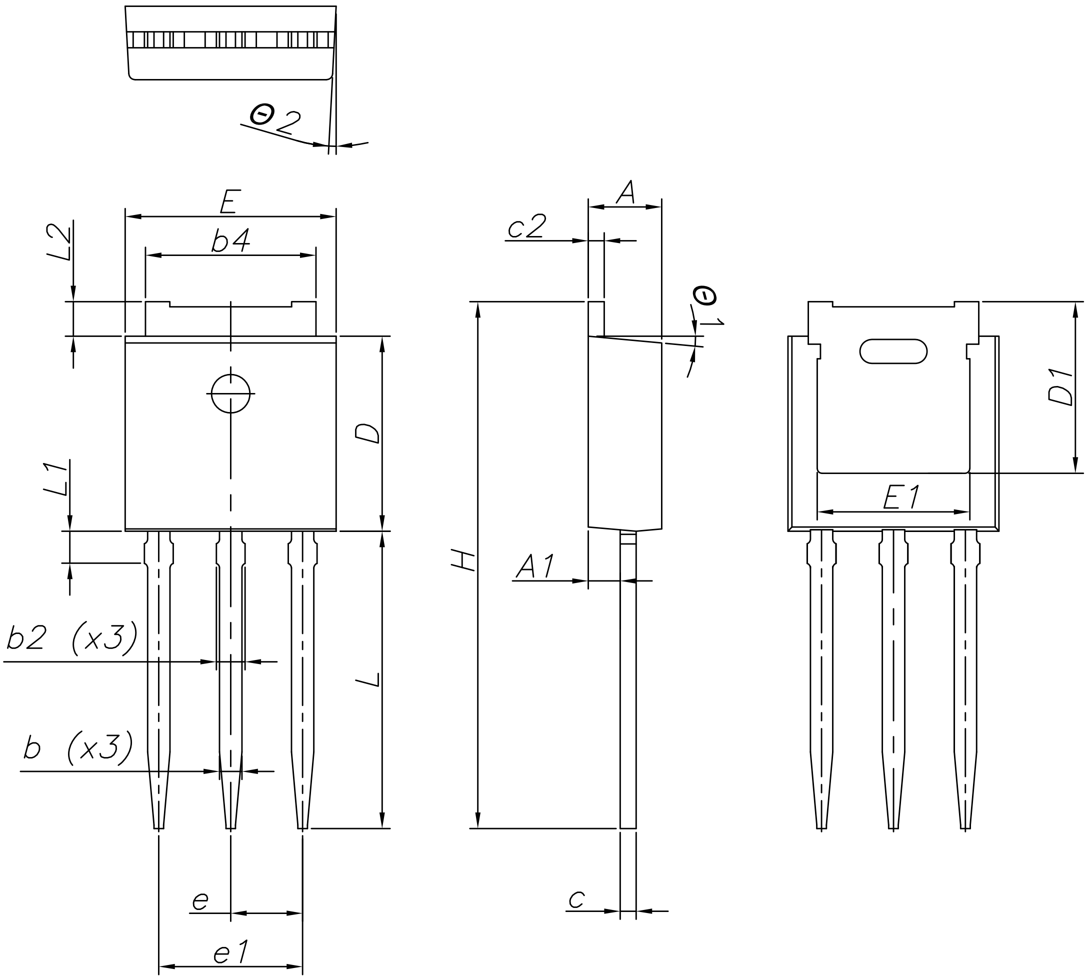


Table 11. **TO-220 type A package mechanical data**

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
Slug flatness		0.03	0.10

4.5 IPAK (TO-251) type C package information

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



0068771_IK_typeC_rev15

Table 12. **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 13. **Ordering information**

Order code	Marking	Package	Packing
STD7N80K5	7N80K5	DPAK	Tape and reel
STP7N80K5		TO-220	Tube
STU7N80K5		IPAK	

Revision history

Table 14. Document revision history

Date	Revision	Changes
17-Jul-2012	1	First release.
17-Oct-2012	2	Minor text changes in cover page Modified: title and I_D value in cover page
19-Dec-2012	3	Minor text changes Added: IPAK package Updated: Section 4: Package mechanical data for IPAK
18-Mar-2013	4	Modified: I_{AR} value on Table 2 Updated: Section 4: Package mechanical data only for DPAK package
09-Oct-2013	5	The part number STF7N80K5 has been moved to a separate datasheet Minor text changes
19-May-2017	6	Updated title, description and features in cover page. Updated *Table 2: "Absolute maximum ratings"* and *Table 4: "On/off states"*. Updated *Section 4: "Package information"*. Minor text changes.
09-Sep-2020	7	The DPAK type A2 and IPAK type A package information have been removed from the datasheet. Minor text changes.

Contents