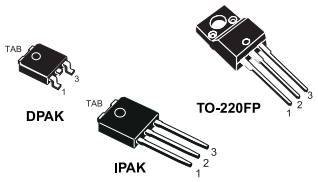
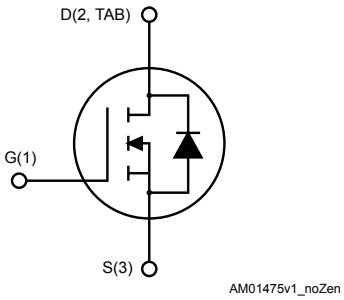
Datasheet

N-channel 600 V, 0.8 Ω typ., 5 A MDmesh™ II Power MOSFETs in DPAK, TO-220FP and IPAK packages





Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	Package
STD7NM60N	600 V	0.9 Ω	5 A	DPAK
STF7NM60N				TO-220FP
STU7NM60N				IPAK

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh™ technology. These revolutionary Power MOSFETs associate a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. They are therefore suitable for the most demanding high-efficiency converters.

Product status link
STD7NM60N
STF7NM60N
STU7NM60N

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		DPAK, IPAK	TO-220FP	
V_{DS}	Drain-source voltage	600		V
V_{GS}	Gate-source voltage	±25		V
I_D	Drain current (continuous) at T_C = 25 °C	5	5 (1)	A
I_D	Drain current (continuous) at T_C = 100 °C	3	3 (1)	A
I_{DM} (2)	Drain current (pulsed)	20	20 (1)	A
P_{TOT}	Total dissipation at T_C = 25 °C	45	20	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat-sink (t = 1 s, T_C = 25 °C)		2.5	kV
dv/dt (3)	Peak diode recovery voltage slope	15		V/ns
T_j	Operating junction temperature range	-55 to 150		°C
T_{stg}	Storage temperature range			

1. *Limited by maximum junction temperature.*
2. *Pulse width limited by safe operating area.*
3. *I_{SD} ≤ 5 A, di/dt ≤ 100 A/µs, V_{DSpeak} ≤ $V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		DPAK	TO-220FP	IPAK	
$R_{thj\text{-}case}$	Thermal resistance junction-case	2.78	6.25	2.78	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient		62.5	100	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb	50			°C/W

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

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS} (1)	Avalanche current, repetitive or not-repetitive	2	A
E_{AS} (2)	Single pulse avalanche energy	119	mJ

1. *Pulse width limited by T_j max.*
2. *Starting T_j = 25 °C, I_D = I_{AS}, V_{DD} = 50 V.*

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	I_D = 1 mA, V_{GS} = 0 V	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C (1)			100	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V			100	nA
$V_{GS(th)}$	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		0.8	0.9	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} = 50 V, f = 1 MHz, V_{GS} = 0 V	-	363	-	pF
C_{oss}	Output capacitance			24.6		
C_{rss}	Reverse transfer capacitance			1.1		
$C_{oss\ eq.}$ (1)	Equivalent capacitance time related	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	130	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	5.4	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 5 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	14	-	nC
Q_{gs}	Gate-source charge			2.7		
Q_{gd}	Gate-drain charge			7.7		

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} = 300 V, I_D = 2.5 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)	-	7	-	ns
t_r	Rise time			10		
$t_{d(off)}$	Turn-off delay time			26		
t_f	Fall time			12		

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		5	A
I_{SDM} (1)	Source-drain current (pulsed)				20	
V_{SD} (2)	Forward on voltage	I_{SD} = 5 A, V_{GS} = 0 V	-		1.3	V
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs	-	213		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V (see Figure 15. Test circuit for inductive load switching and diode recovery times)		1.5		µC
I_{RRM}	Reverse recovery current			14		A
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs	-	265		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V, T_j = 150 °C(see Figure 15. Test circuit for inductive load switching and diode recovery times)		1.8		µC
I_{RRM}	Reverse recovery current			14		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 for DPAK and IPAK

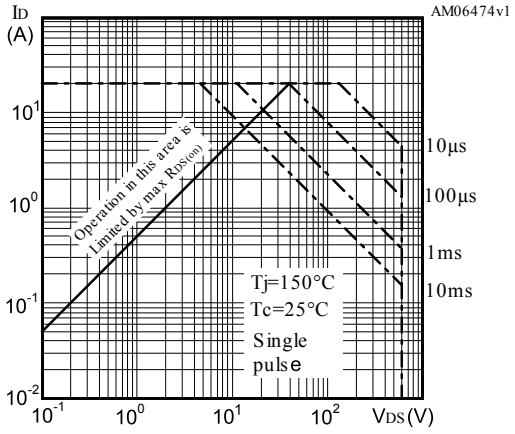


Figure 2. Thermal impedance for DPAK and IPAK

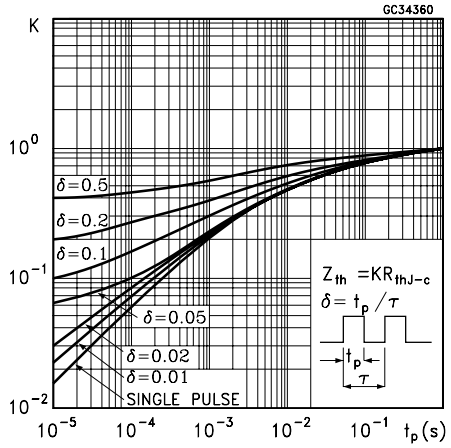


Figure 3. Safe operating area for TO-220FP

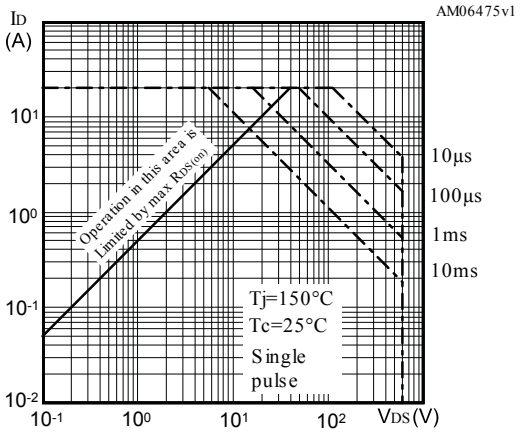


Figure 4. Thermal impedance for TO-220FP

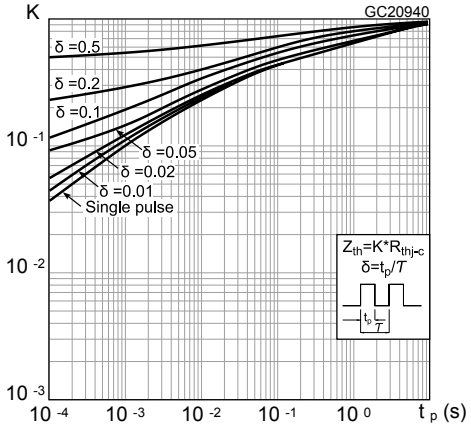


Figure 5. Output characterisics

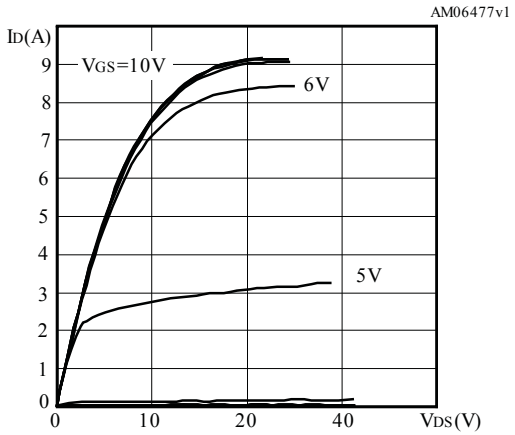


Figure 6. Transfer characteristics

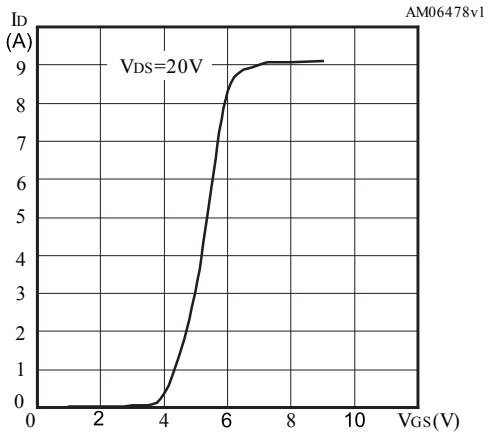


Figure 7. Gate charge vs gate-source voltage

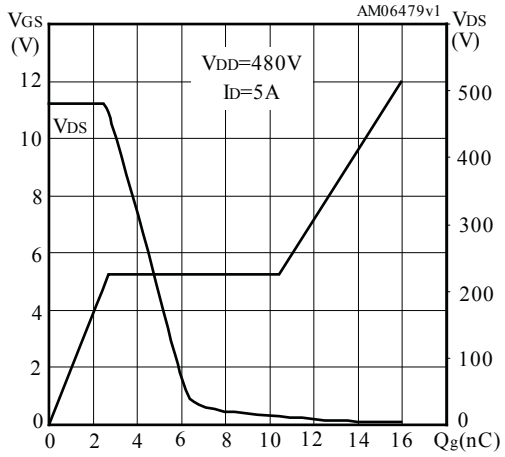


Figure 8. Static drain-source on-resistance

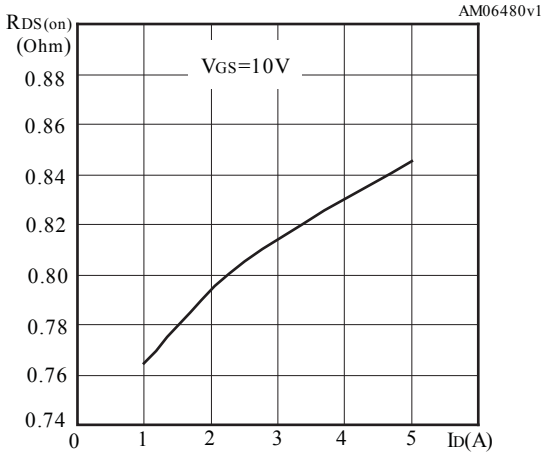


Figure 9. Capacitance variations

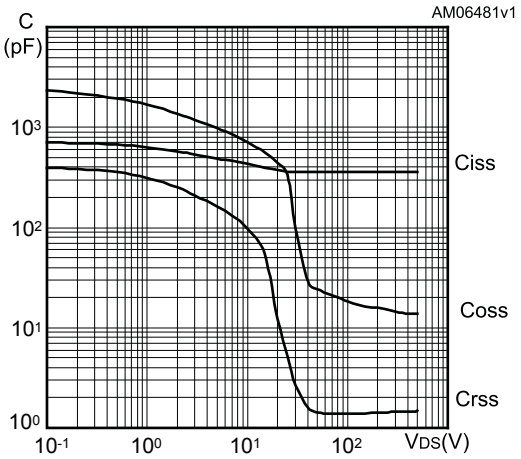


Figure 10. Normalized gate threshold voltage vs temperature

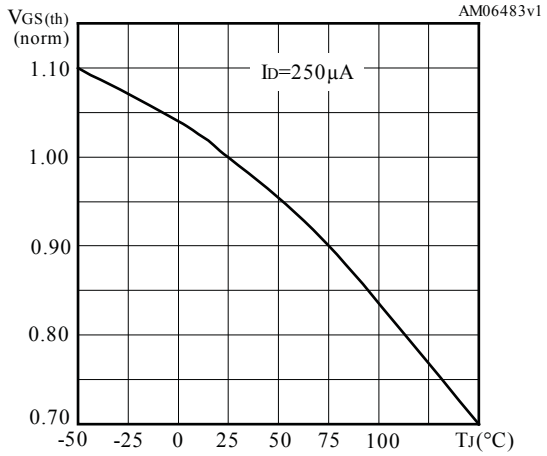


Figure 11. Normalized on-resistance vs temperature

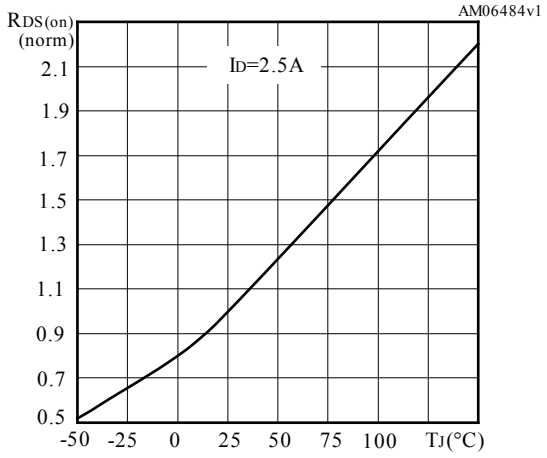
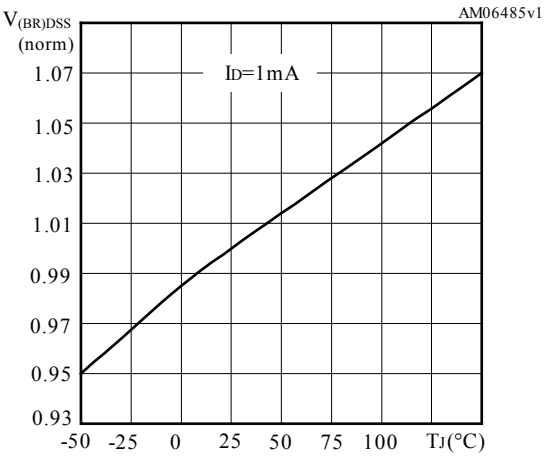


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature



3 Test circuits

Figure 13. Test circuit for resistive load switching times

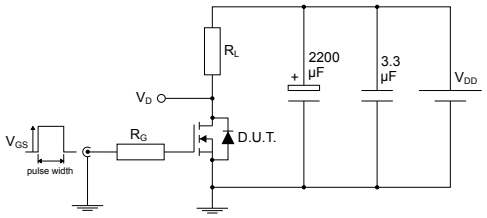


Figure 14. Test circuit for gate charge behavior

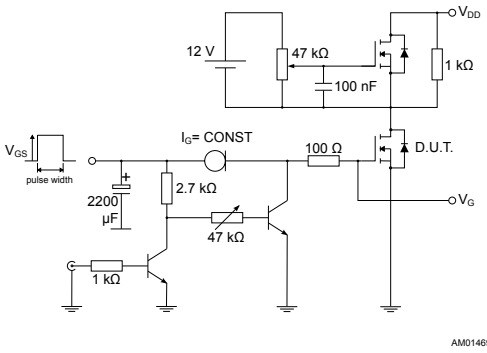


Figure 15. Test circuit for inductive load switching and diode recovery times

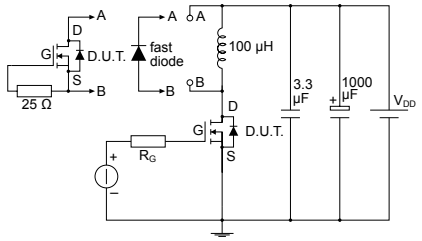


Figure 16. Unclamped inductive load test circuit

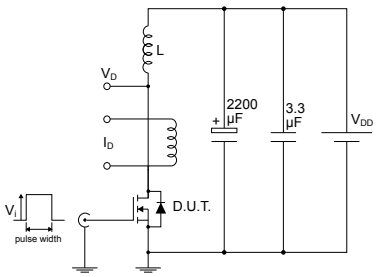


Figure 17. Unclamped inductive waveform

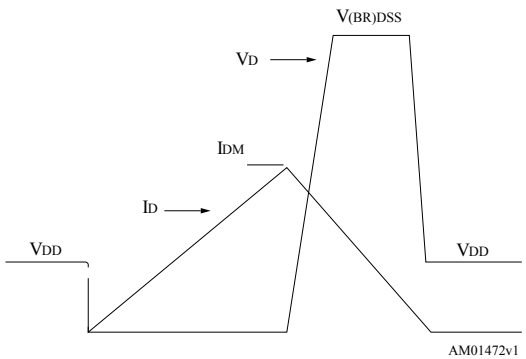
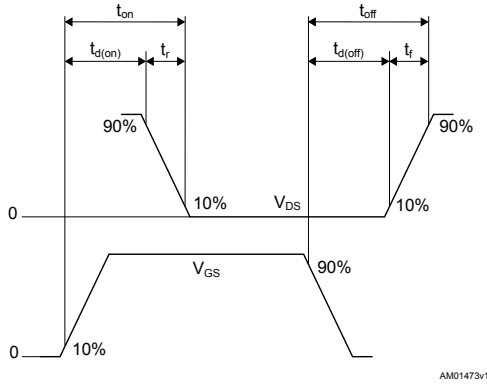


Figure 18. Switching time waveform



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

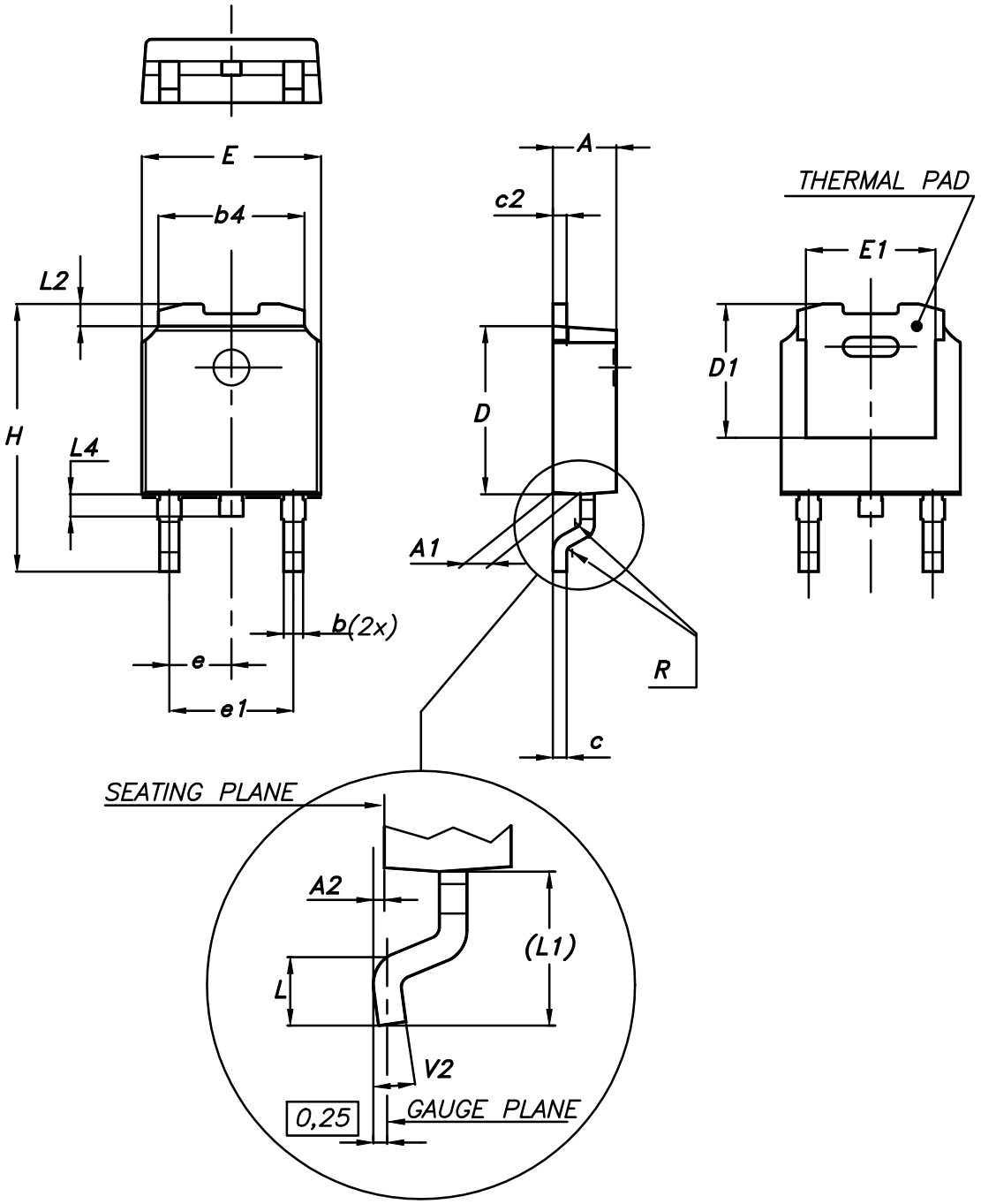


Table 8. **DPAK (TO-252) type A mechanical data**

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

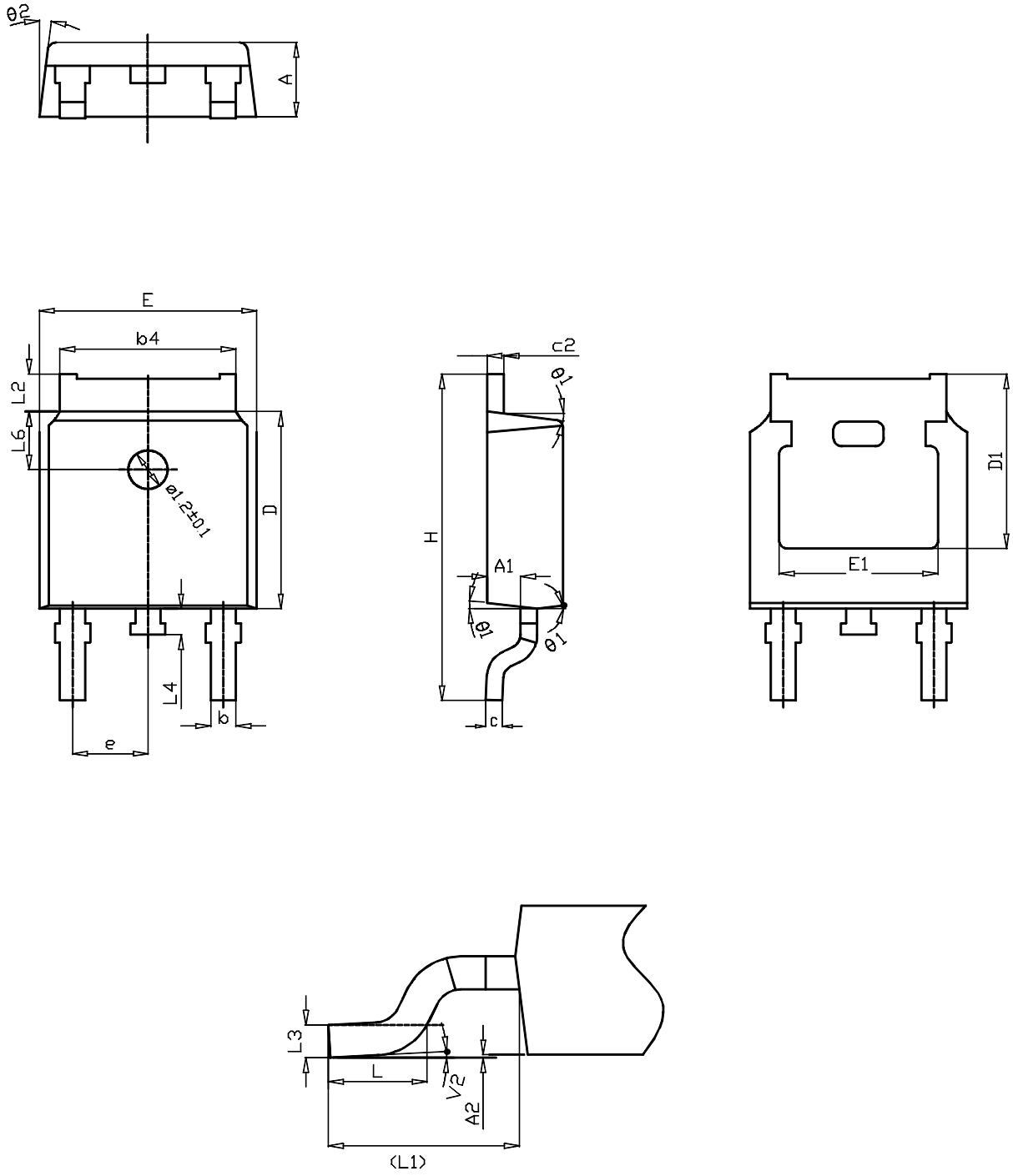


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Table 9. DPAK (TO-252) type C mechanical data

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

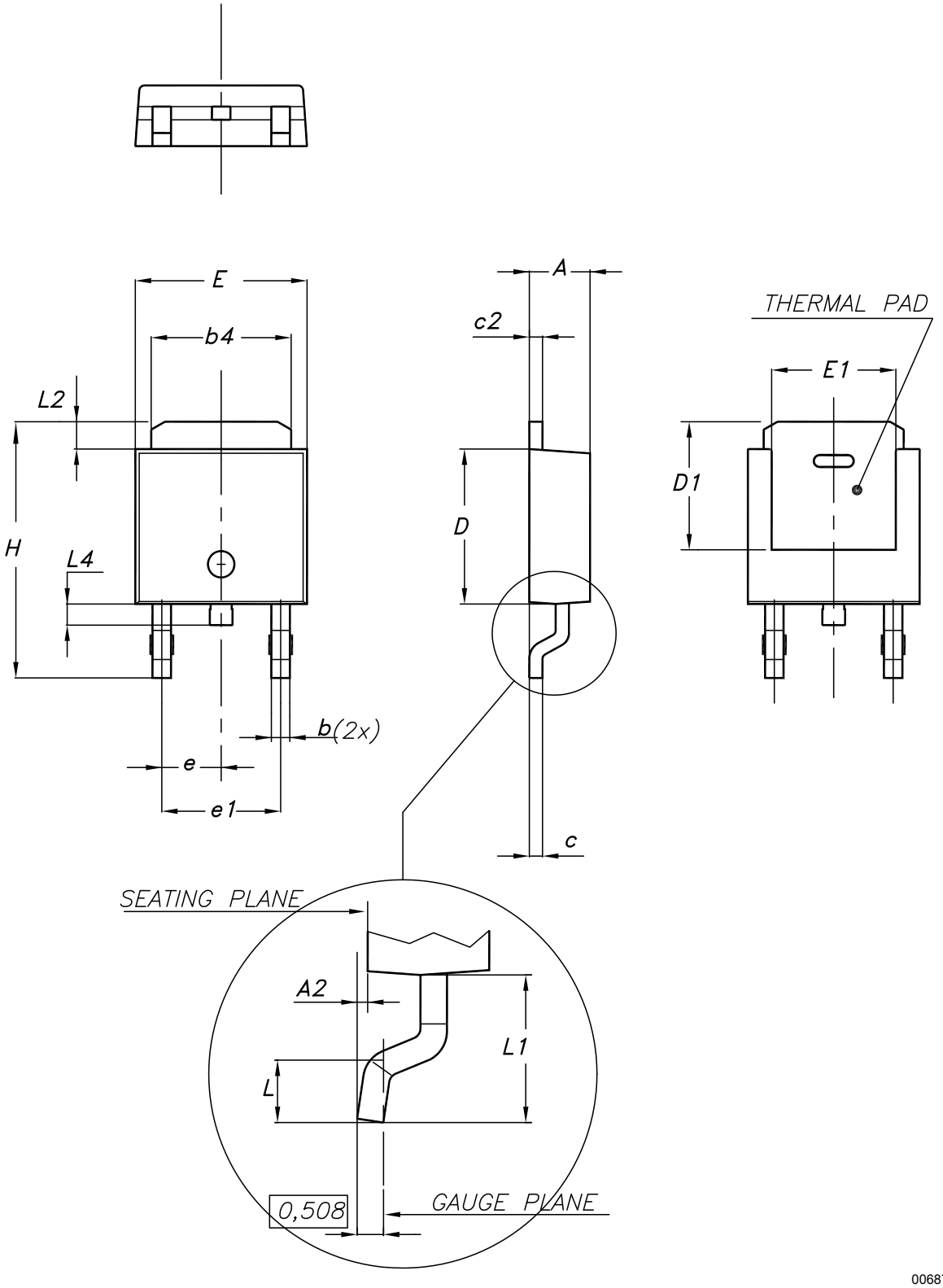

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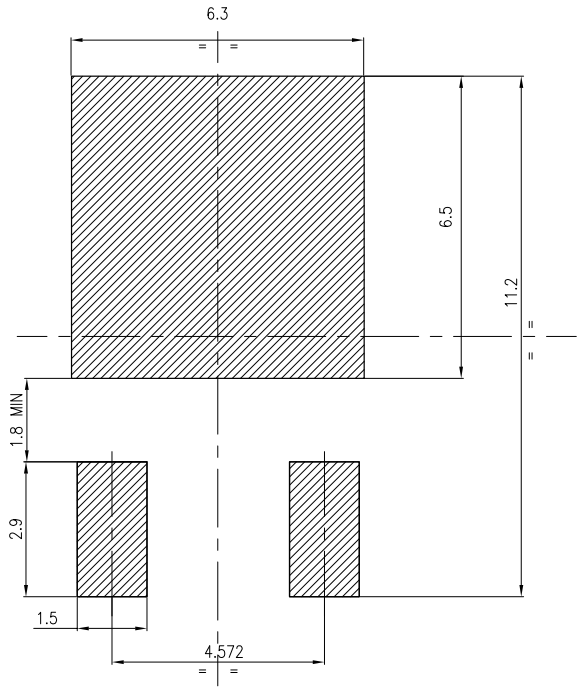
Table 10. **DPAK (TO-252) type E mechanical data**

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



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4.4 DPAK (TO-252) packing information

Figure 23. DPAK (TO-252) tape outline

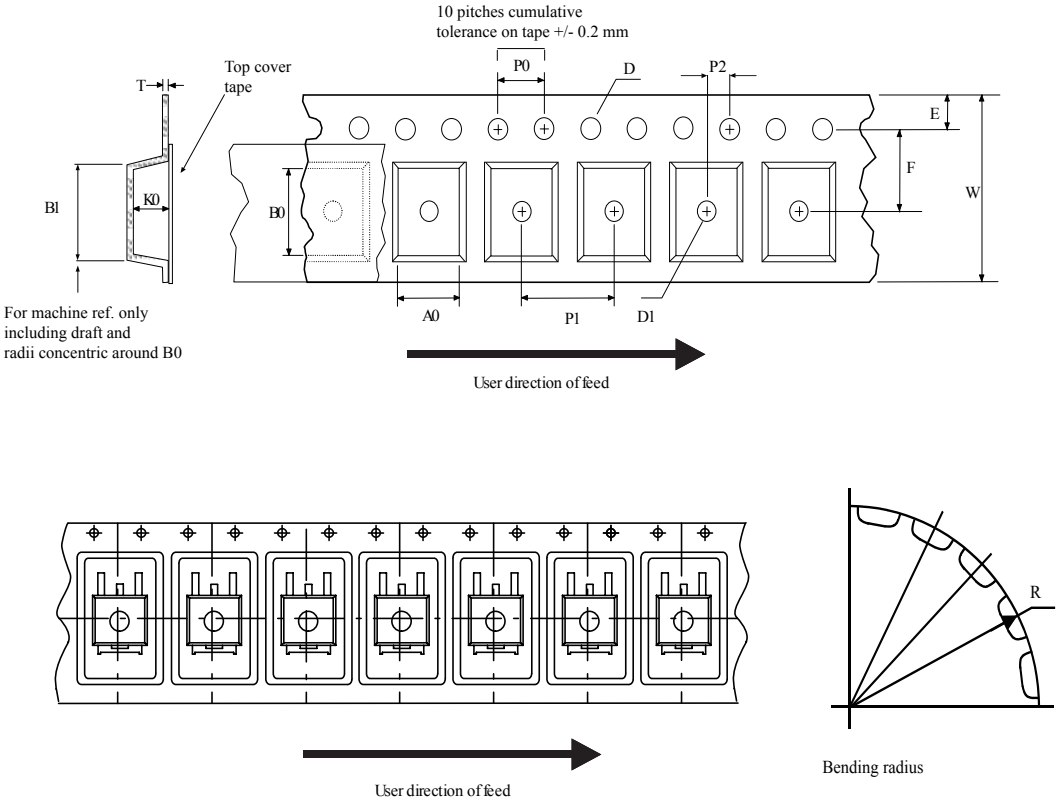

Figure 24. **DPAK (TO-252) reel outline**

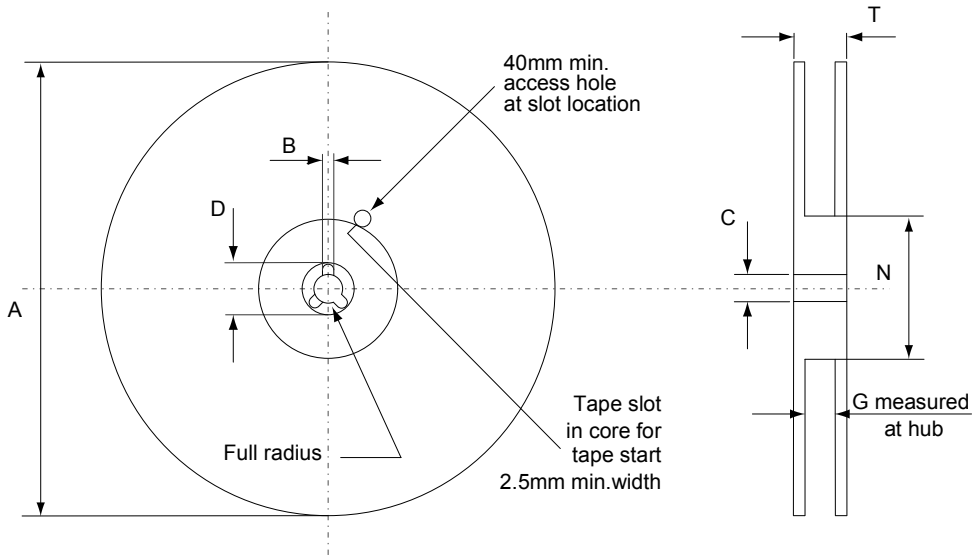

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Table 11. **DPAK (TO-252) tape and reel mechanical data**

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-220FP package information

Figure 25. **TO-220FP package outline**

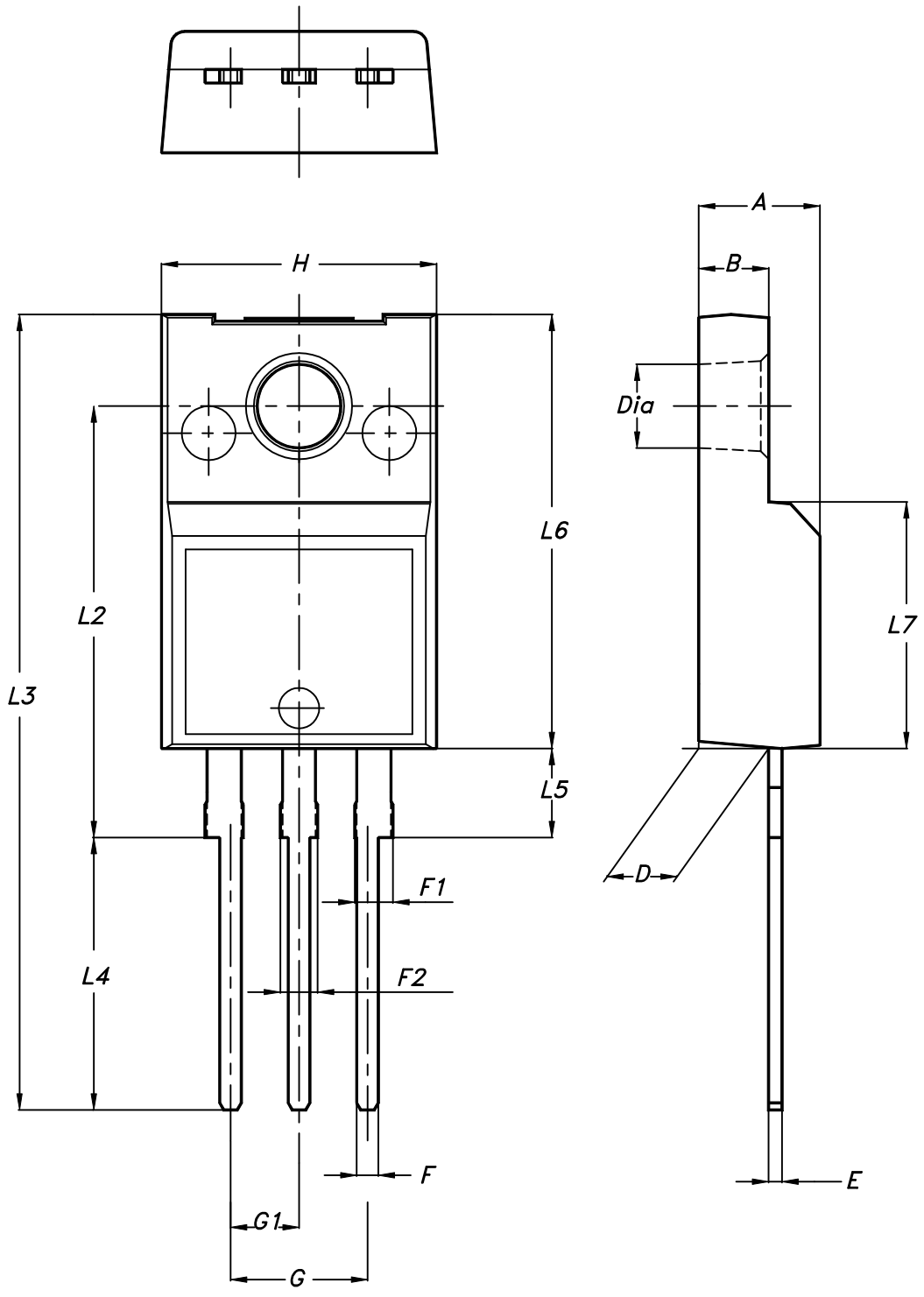

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Table 12. **TO-220FP package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

4.6 IPAK (TO-251) type A package information

Figure 26. **IPAK (TO-251) type A package outline**

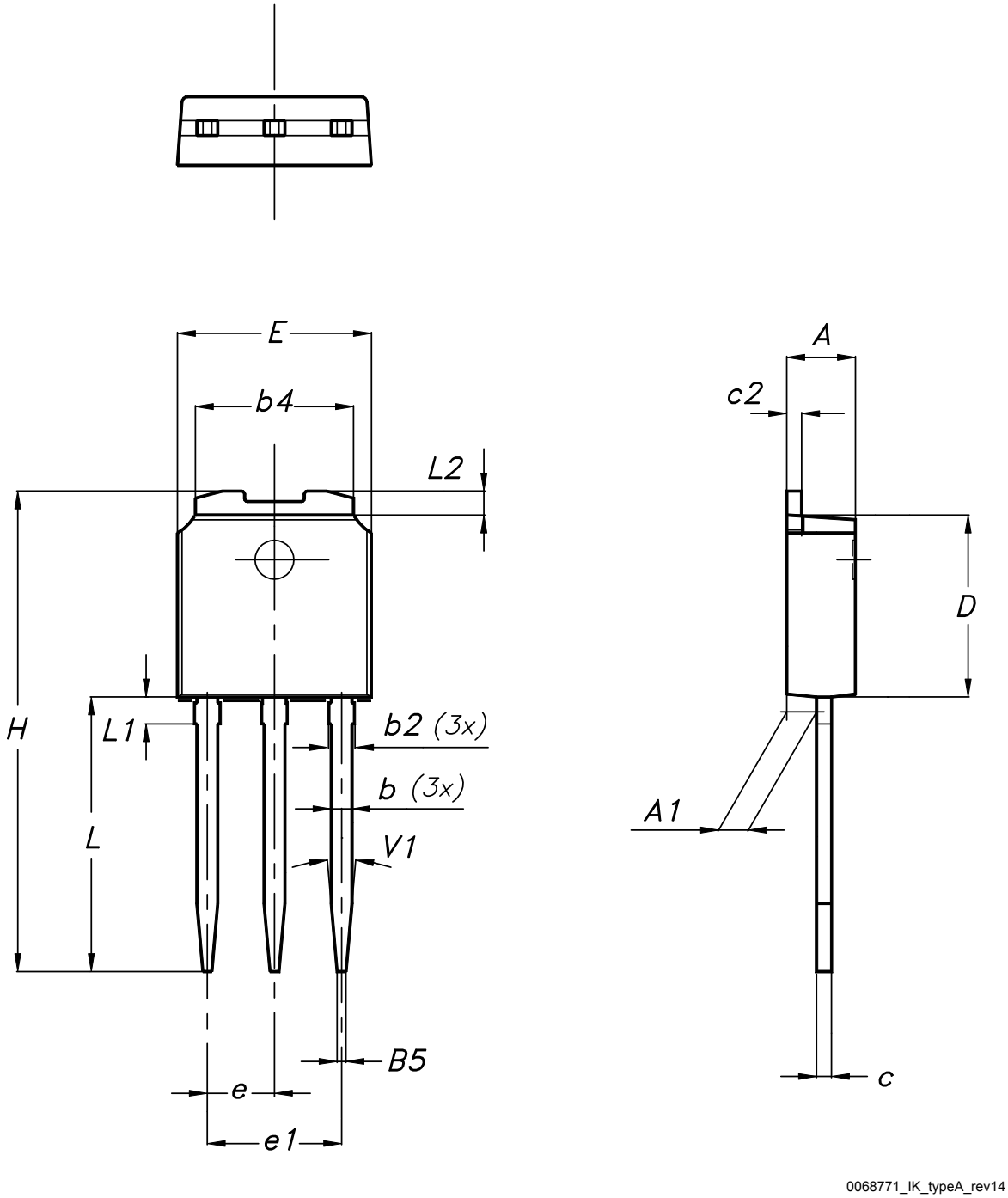

Table 13. **IPAK (TO-251) type A package mechanical data**

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

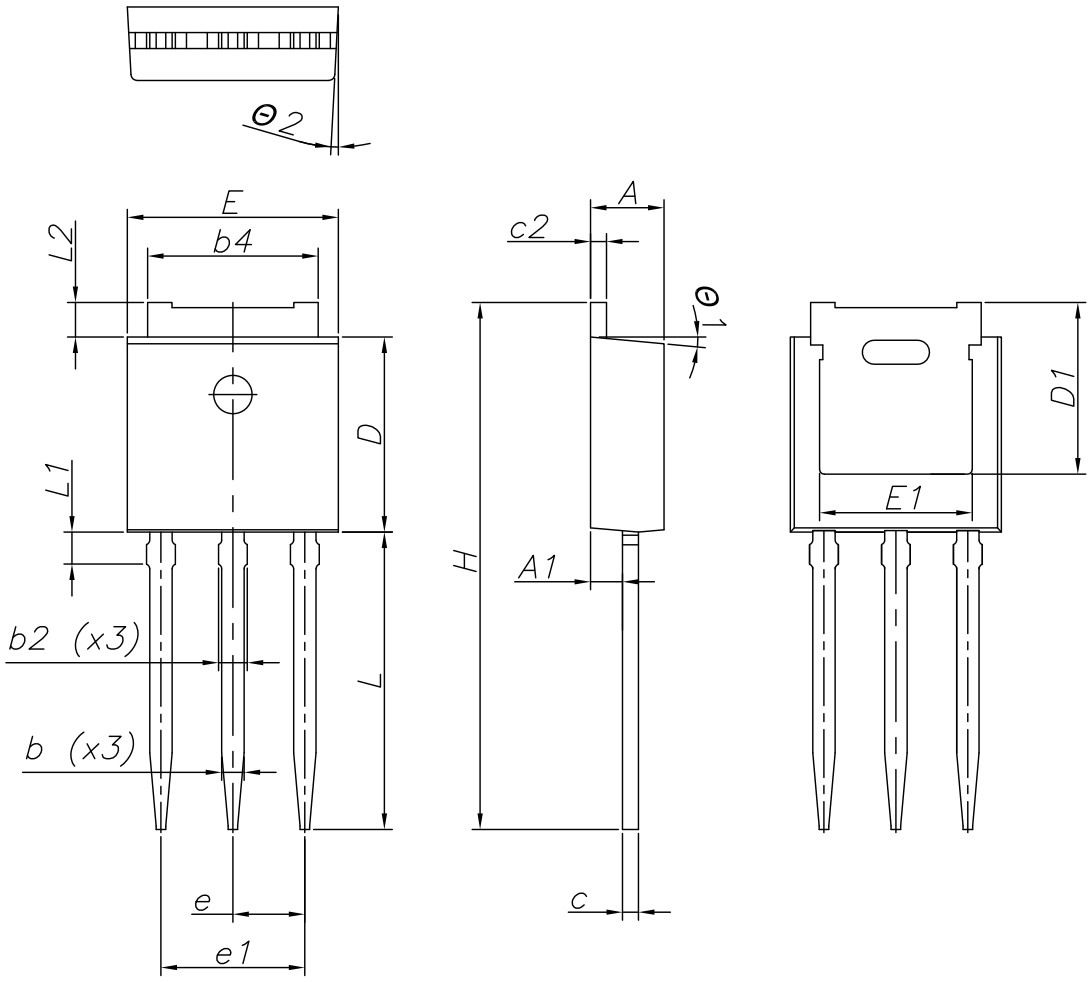

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Table 14. **IPAK (TO-251) type C package mechanical data**

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. **Order codes**

Order code	Marking	Package	Packing
STD7NM60N	7NM60N	DPAK	Tape and reel
STF7NM60N		TO-220FP	Tube
STU7NM60N		IPAK	

Revision history

Table 16. **Document revision history**

Date	Version	Changes
29-Oct-2009	1	First release.
19-Jul-2010	2	Corrected values in Table 3: Thermal data.
11-Oct-2010	3	Inserted new value in Table 6: Dynamic
04-Nov-2010		Changed $R_{DS(on)}$ typical value.
05-Sep-2018		The part number STP7NM60N has been moved to a separate datasheet. Removed maturity status indication from cover page. The document status is production data. Updated title and features in cover page. Updated Section 1 Electrical ratings, Section 2 Electrical characteristics and Section 4 Package information. Minor text changes.

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