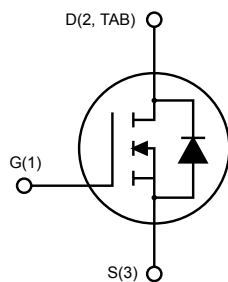
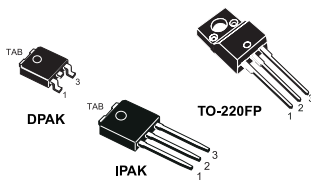


N-channel 600 V, 0.8 Ω typ., 5 A MDmesh™ II Power MOSFETs in DPAK, TO-220FP and IPAK packages



AM01475v1_noZen

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 $T_C = 25\text{ °C}$	5	5 ⁽¹⁾	A
I_D	Drain current (continuous) at $T_C = 100\text{ °C}$	3	3 ⁽¹⁾	A
I_{DM} ⁽²⁾	Drain current (pulsed)	20	20 ⁽¹⁾	A
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	45	20	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat-sink ($t = 1\text{ s}$, $T_C = 25\text{ °C}$)		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			

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- $I_{SD} \leq 5\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DSpeak} \leq V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$.

Table 2. Thermal data

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

- 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

- Pulse width limited by T_j max.
- Starting $T_j = 25\text{ °C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$.

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$, $T_C = 125\text{ °C}$ ⁽¹⁾			100	μA
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 2.5\text{ A}$		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	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	363	-	μF
C_{oss}	Output capacitance			24.6		
C_{rSS}	Reverse transfer capacitance			1.1		
$C_{oss\text{ eq.}}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }480\text{ V}$, $V_{GS} = 0\text{ V}$	-	130	-	μF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	5.4	-	Ω
Q_g	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 5\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (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. $C_{oss\text{ eq.}}$ 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	$V_{DD} = 300\text{ V}$, $I_D = 2.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	7	-	ns
t_r	Rise time			10		
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	26	-	ns
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	$I_{SD} = 5\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$		213		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}$ (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	$I_{SD} = 5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$		265		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (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%.

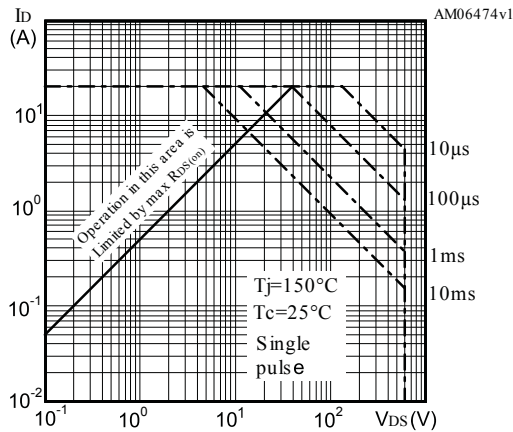
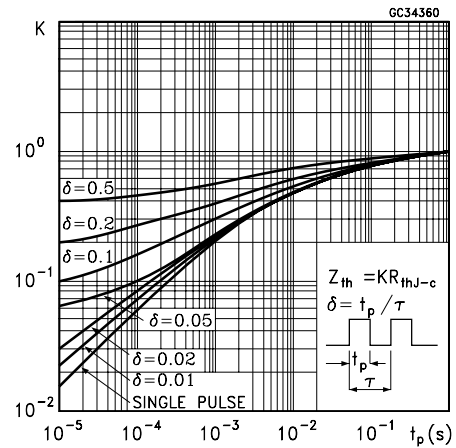
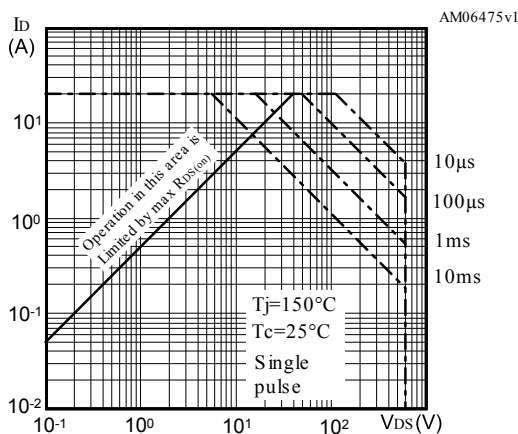
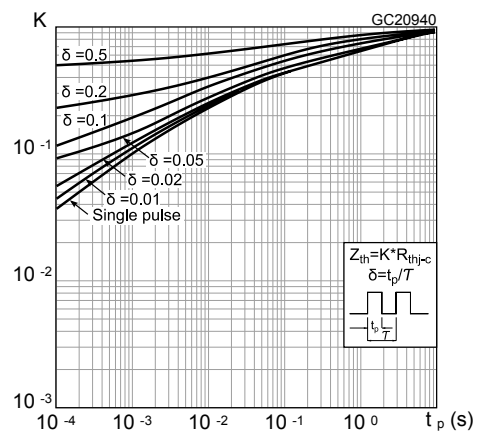
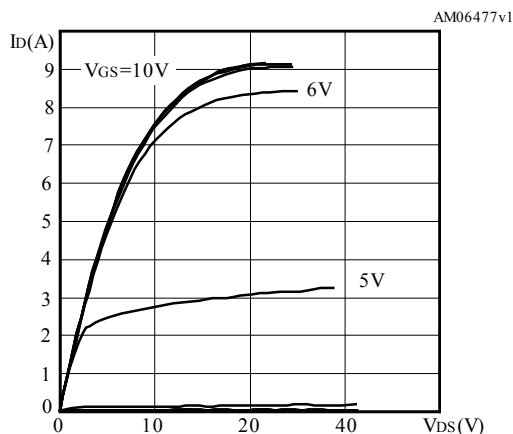
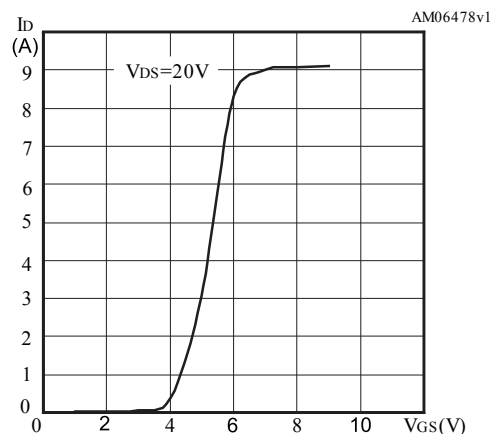
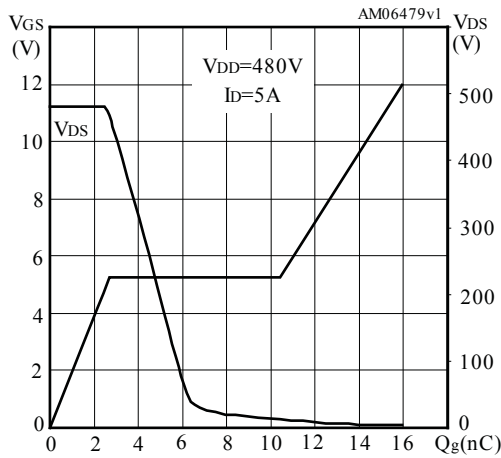
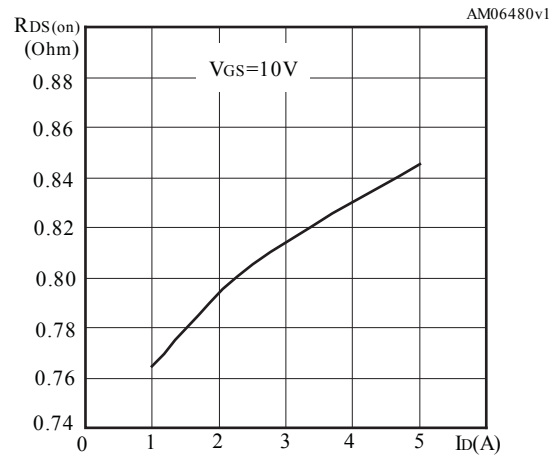
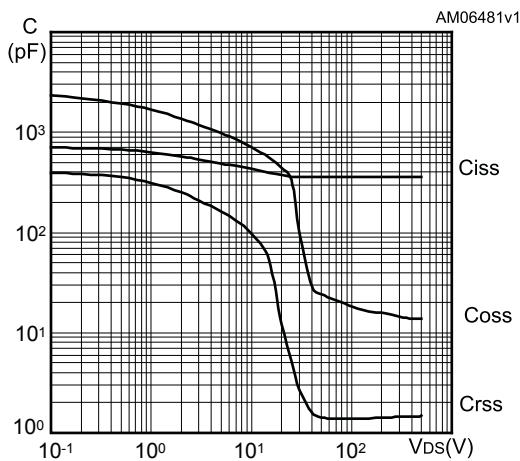
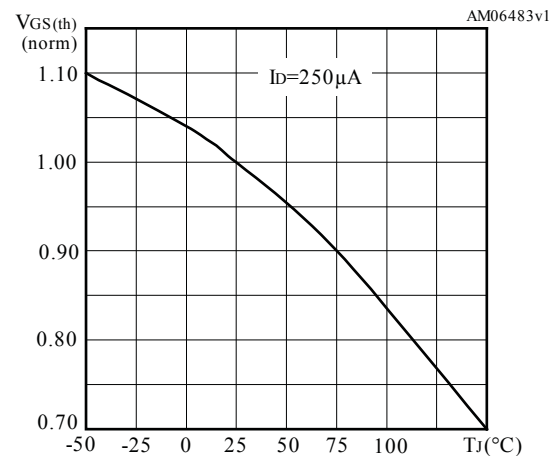
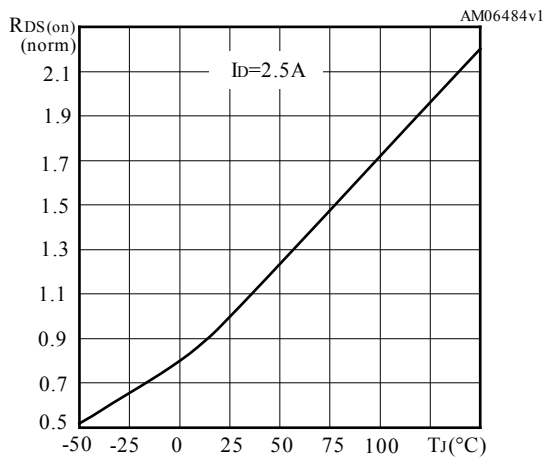
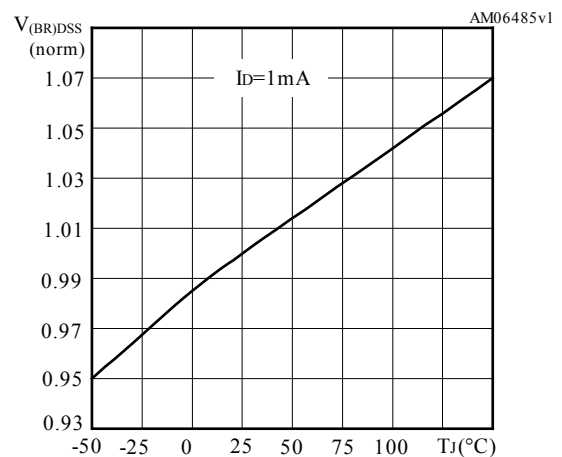
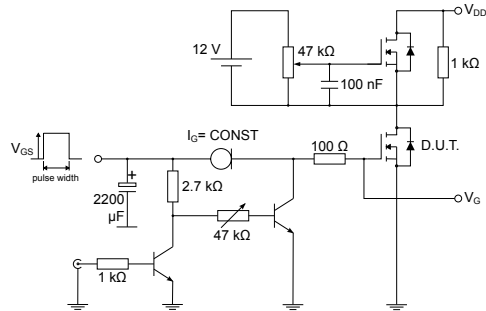
2.1 Electrical characteristics curves
Figure 1. Safe operating area for DPAK and IPAK

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 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


3 Test circuits

Figure 13. Test circuit for resistive load switching times


AM01468v1

Figure 14. Test circuit for gate charge behavior


AM01469v1

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


AM01470v1

Figure 16. Unclamped inductive load test circuit


AM01471v1

Figure 17. Unclamped inductive waveform


AM01472v1

Figure 18. Switching time waveform

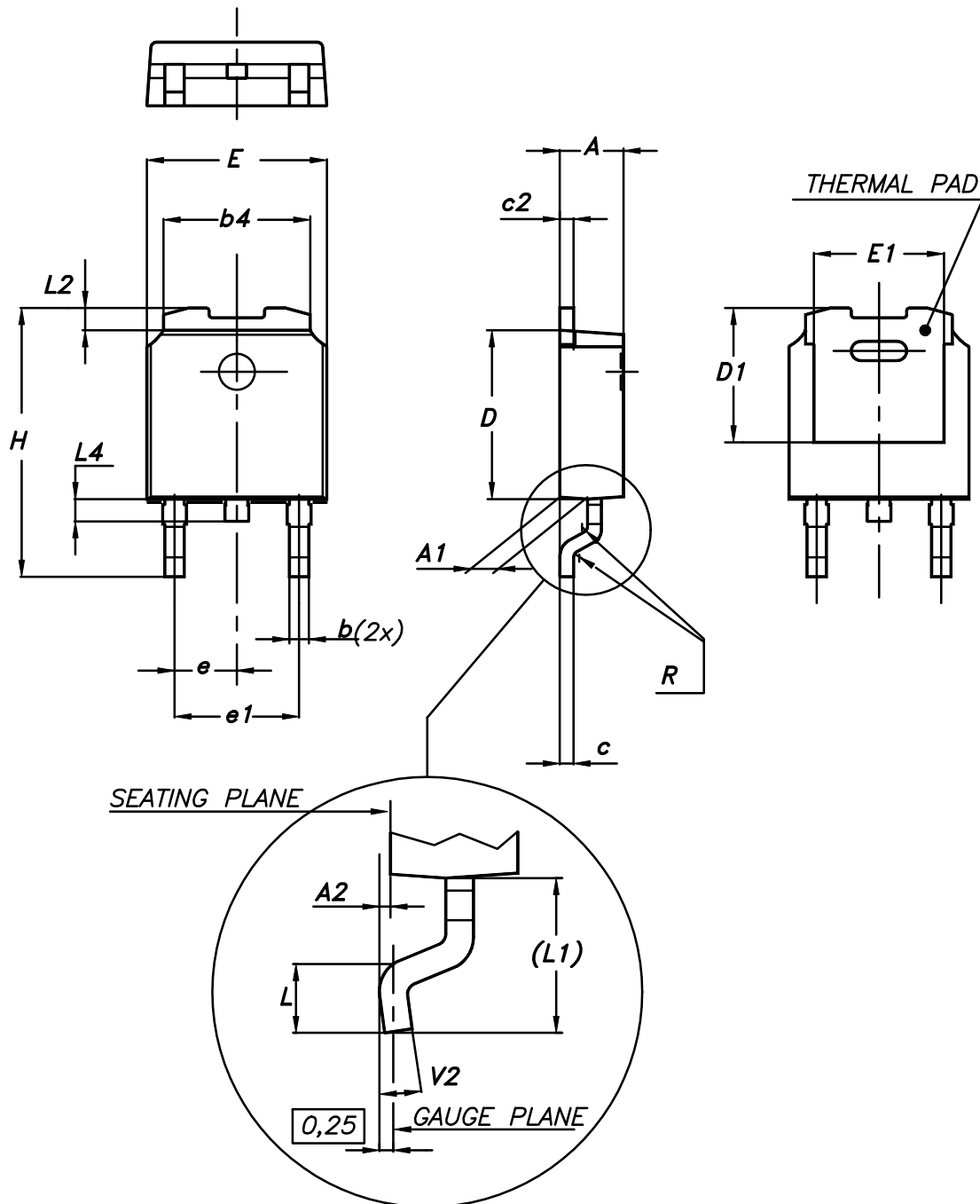

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4 Package information

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



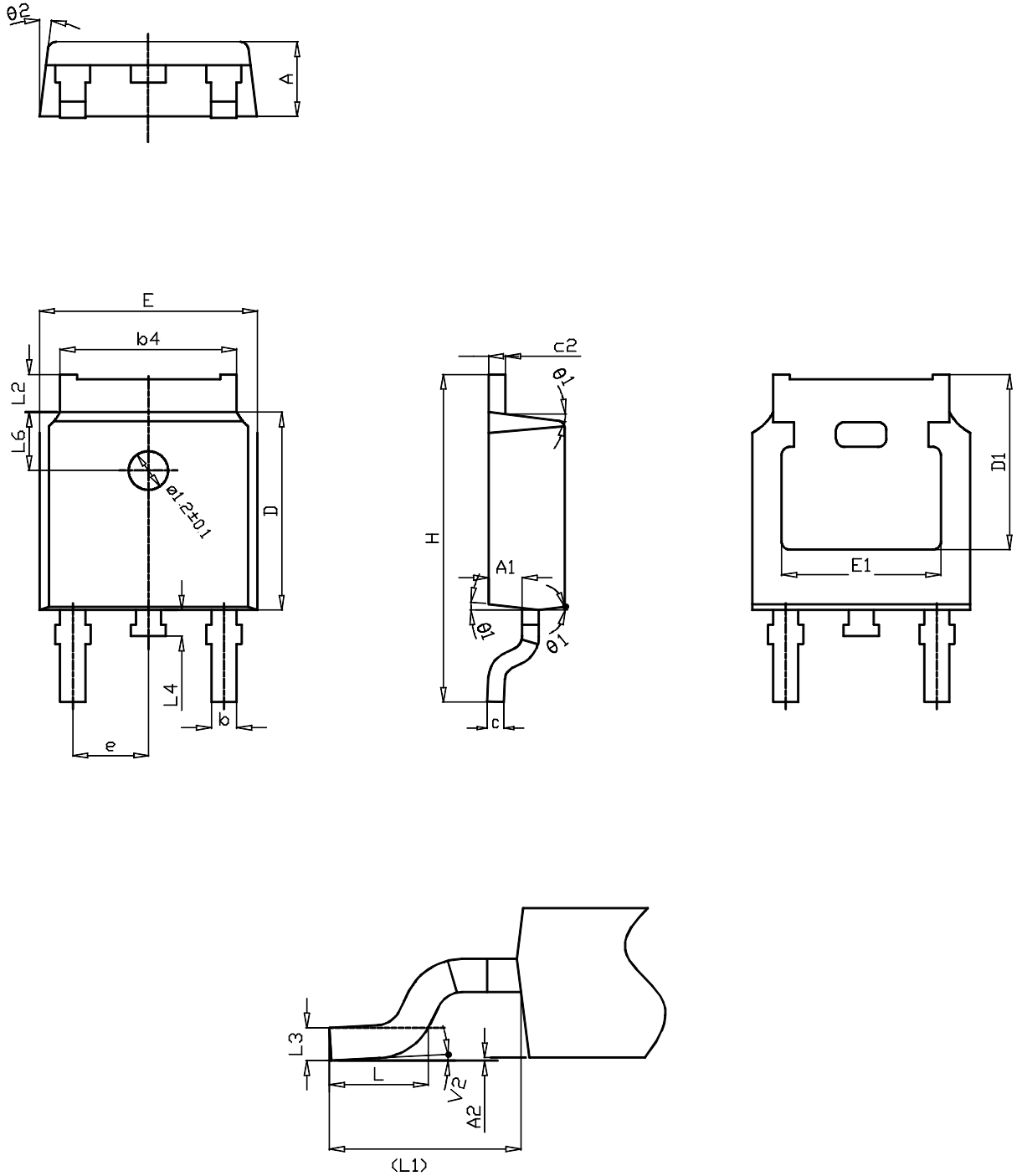
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Table 8. DPAK (TO-252) type A mechanical data

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°

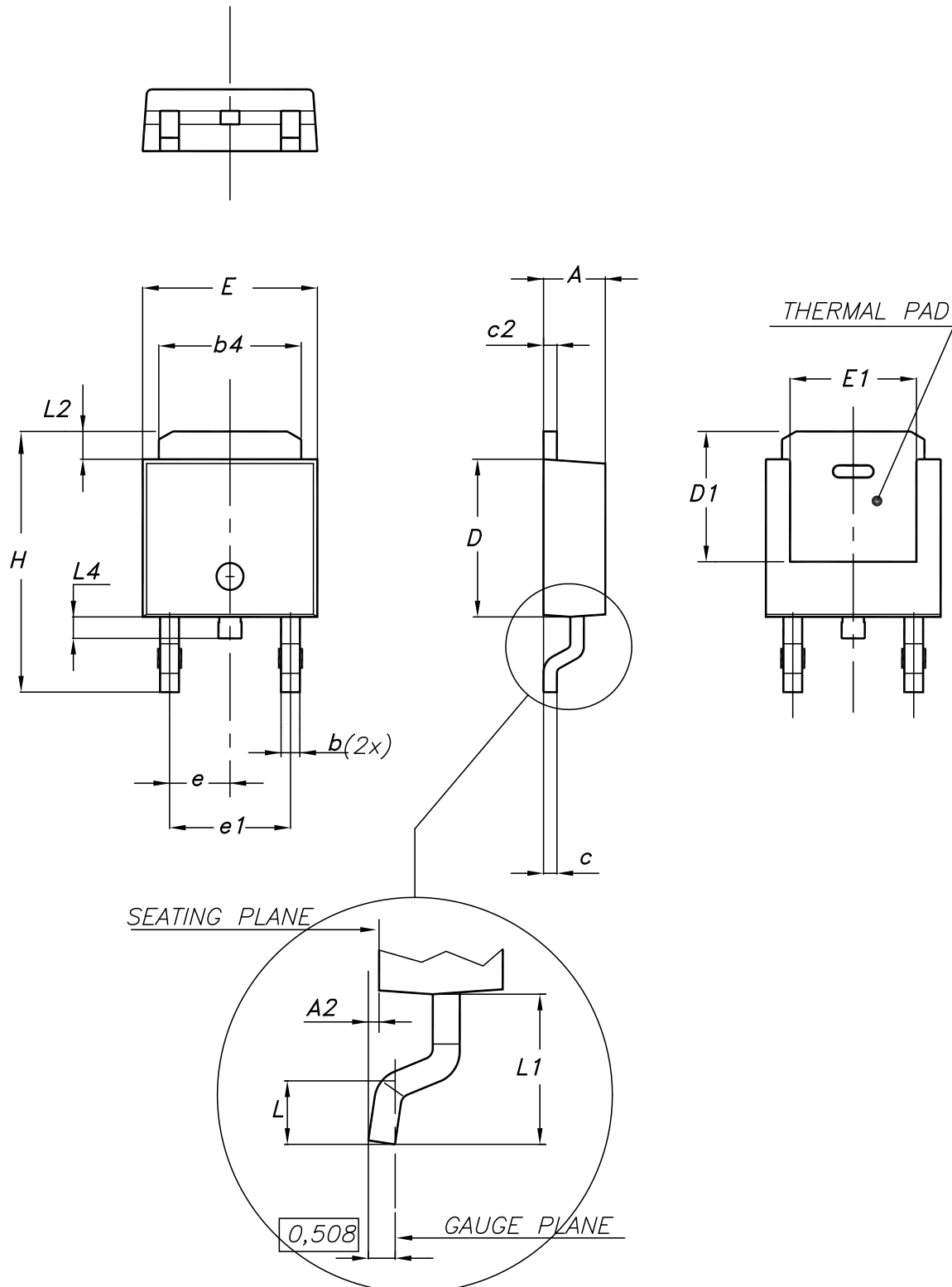
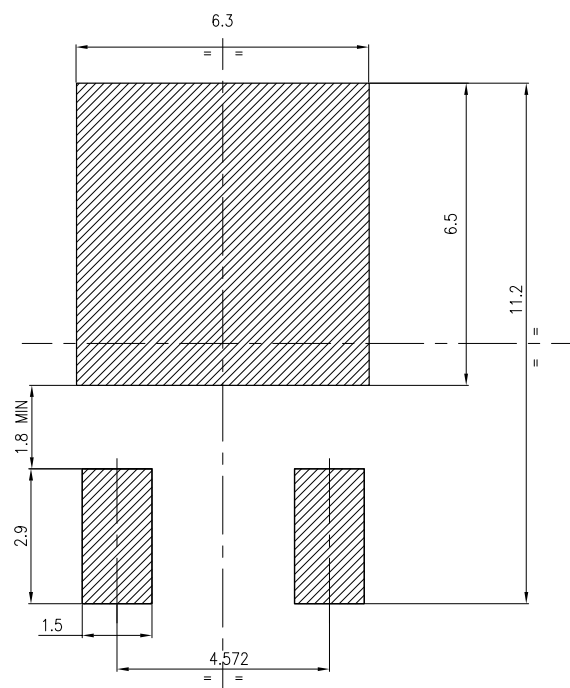
4.3 DPAK (TO-252) type E package information
Figure 21. DPAK (TO-252) type E package outline


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

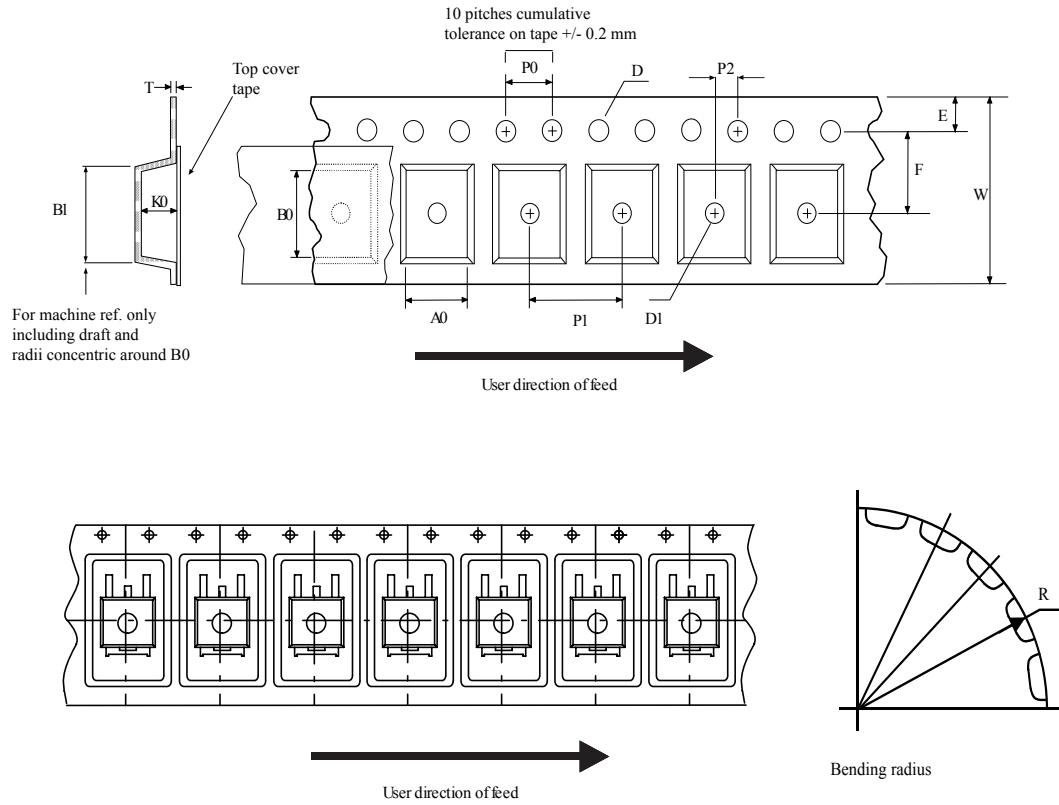
Dim.	mm		
	Min.	Typ.	Max.
A	2.18		2.39
A2			0.13
b	0.65		0.884
b4	4.95		5.46
c	0.46		0.61
c2	0.46		0.60
D	5.97		6.22
D1	5.21		
E	6.35		6.73
E1	4.32		
e		2.286	
e1		4.572	
H	9.94		10.34
L	1.50		1.78
L1		2.74	
L2	0.89		1.27
L4			1.02

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


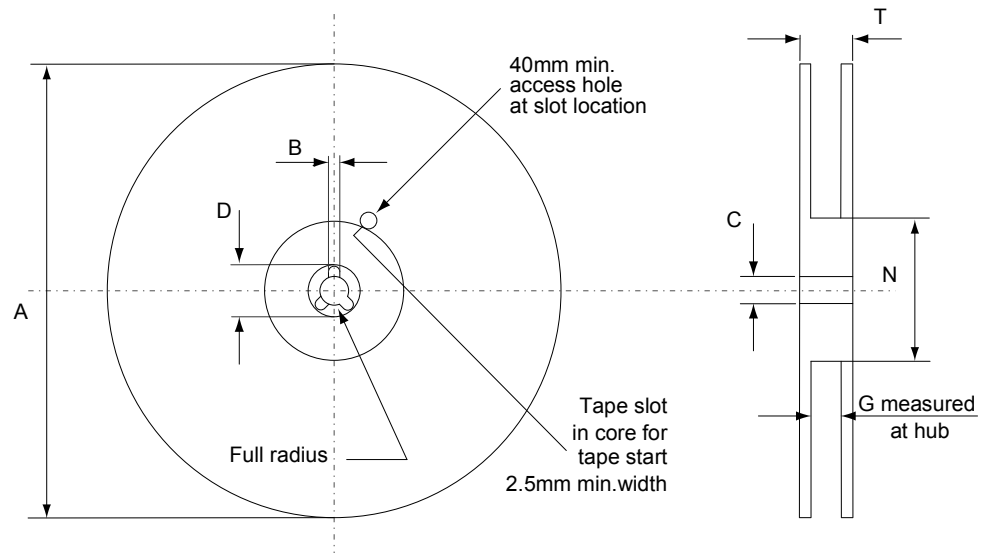
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4.4 DPAK (TO-252) packing information

Figure 23. DPAK (TO-252) tape outline



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Figure 24. DPAK (TO-252) reel outline


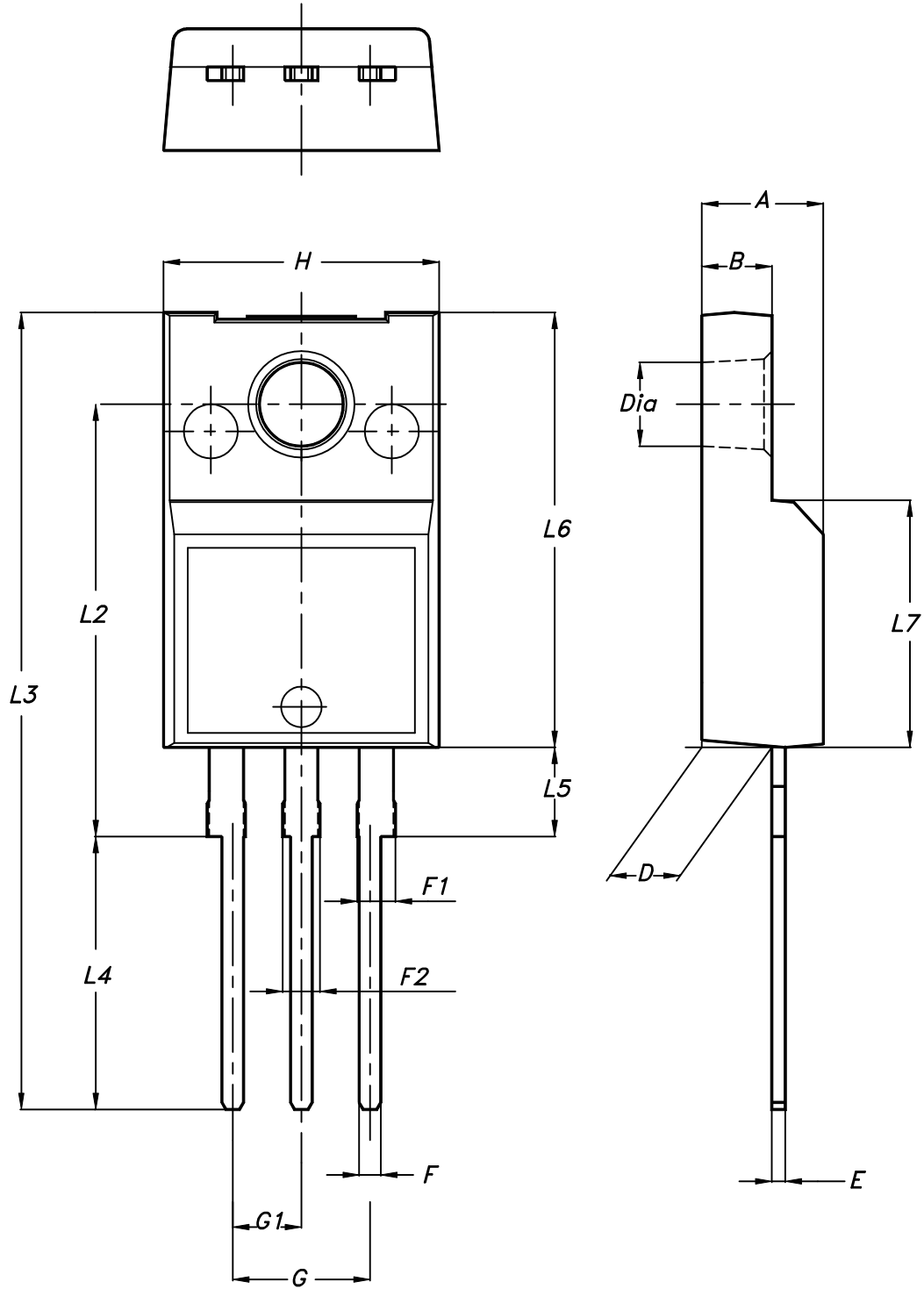
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Table 11. DPAK (TO-252) tape and reel mechanical data

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



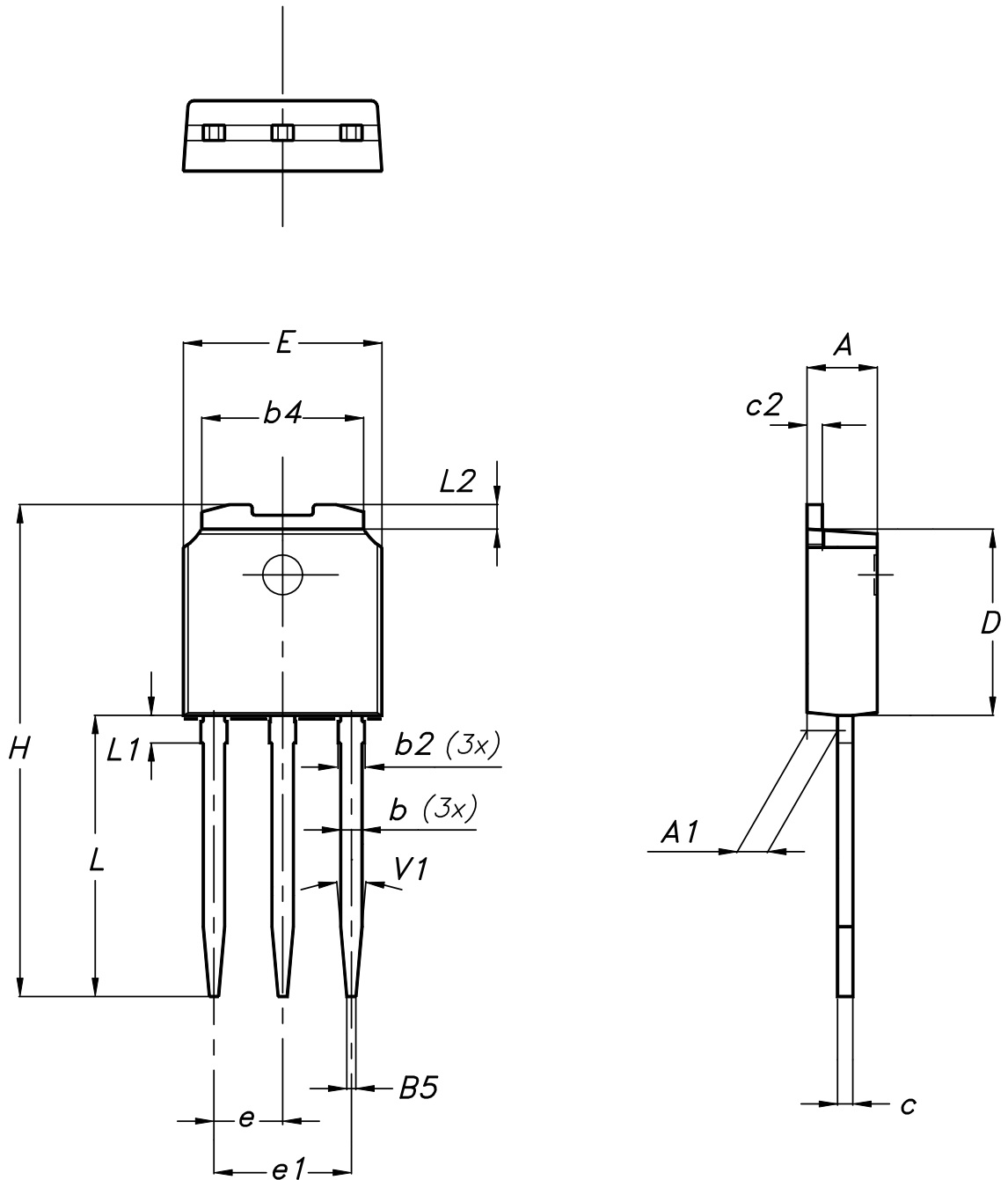
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Table 12. TO-220FP package mechanical data

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



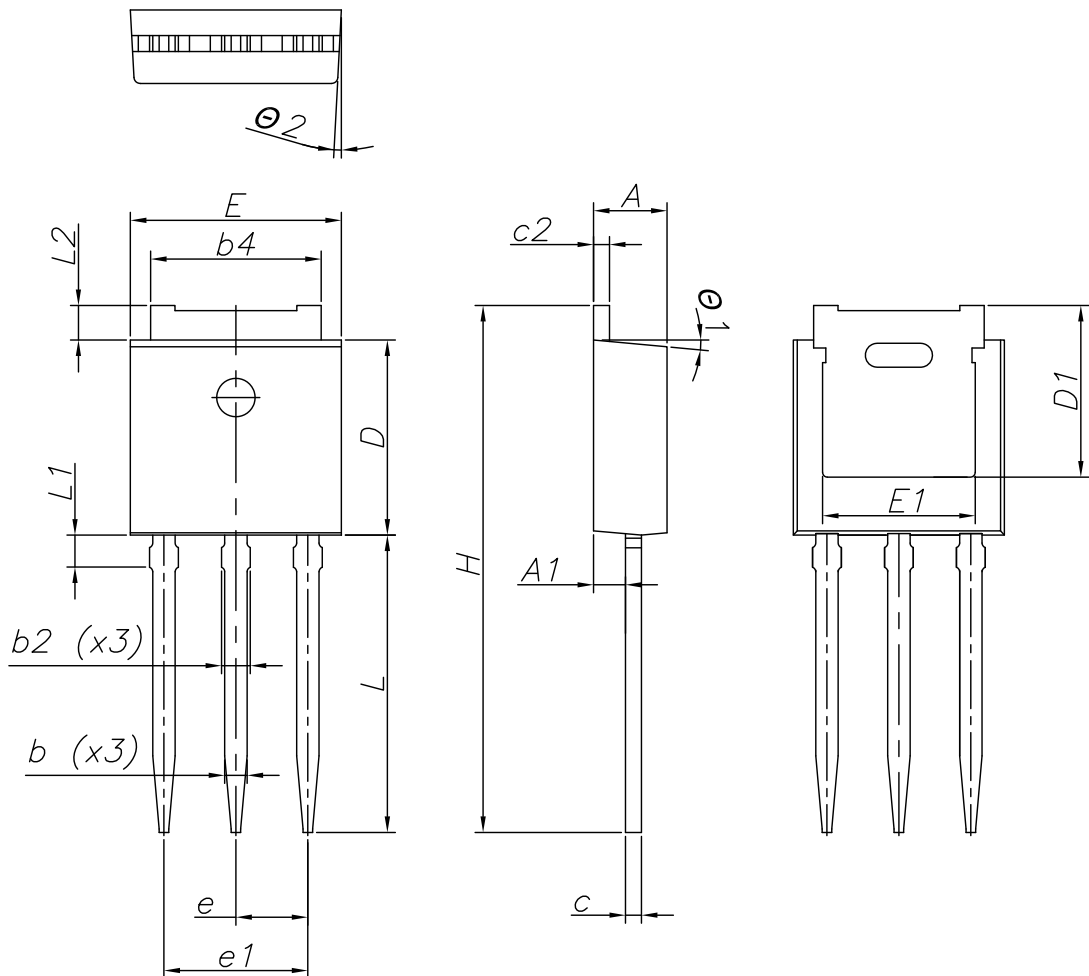
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Table 13. IPAK (TO-251) type A package mechanical data

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



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. 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		<p>The part number STP7NM60N has been moved to a separate datasheet.</p> <p>Removed maturity status indication from cover page. The document status is production data.</p> <p>Updated title and features in cover page.</p> <p>Updated Section 1 Electrical ratings, Section 2 Electrical characteristics and Section 4 Package information.</p> <p>Minor text changes.</p>

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