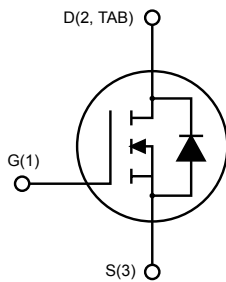
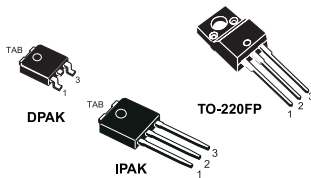


## N-channel 600 V, 0.8 $\Omega$ typ., 5 A MDmesh™ II Power MOSFETs in DPAK, TO-220FP and IPAK packages



AM01475v1\_noZen

### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$	Package
STD7NM60N	600 V	0.9 $\Omega$	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 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ °C}$	3	3 <sup>(1)</sup>	A
$I_{DM}$ <sup>(2)</sup>	Drain current (pulsed)	20	20 <sup>(1)</sup>	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
$dv/dt$ <sup>(3)</sup>	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
$R_{thj-pcb}$ <sup>(1)</sup>	Thermal resistance junction-pcb	50			°C/W

- When mounted on 1inch<sup>2</sup> FR-4 board, 2 oz Cu.

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AS}$ <sup>(1)</sup>	Avalanche current, repetitive or not-repetitive	2	A
$E_{AS}$ <sup>(2)</sup>	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	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ , $T_C = 125\text{ °C}$ <sup>(1)</sup>			100	$\mu\text{A}$
$I_{GSS}$	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	$\Omega$

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	-	$\mu\text{F}$
$C_{oss}$	Output capacitance			24.6		
$C_{rSS}$	Reverse transfer capacitance			1.1		
$C_{oss\ eq.}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }480\text{ V}$ , $V_{GS} = 0\text{ V}$	-	130	-	$\mu\text{F}$
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	5.4	-	$\Omega$
$Q_g$	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.  $C_{oss\ eq.}$  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**

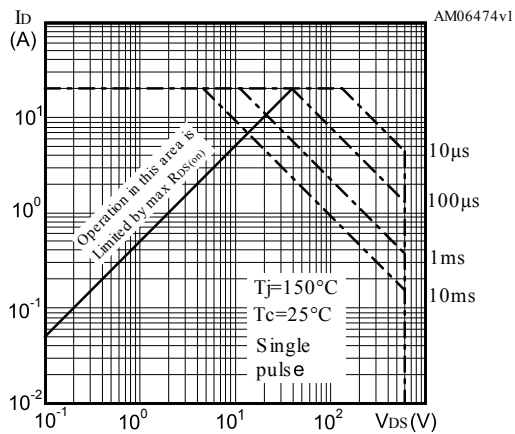
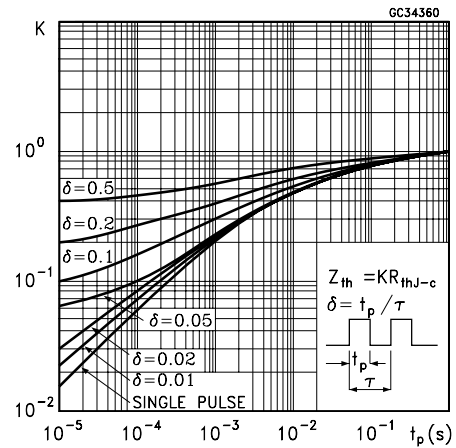
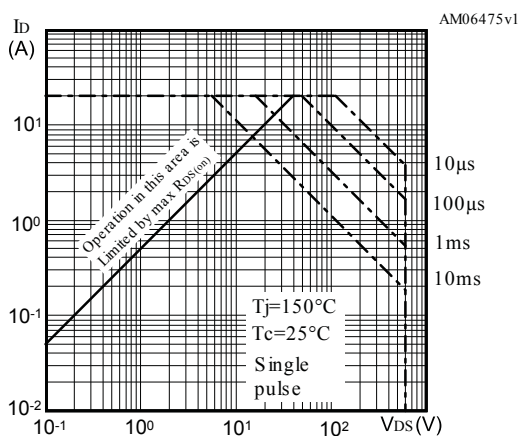
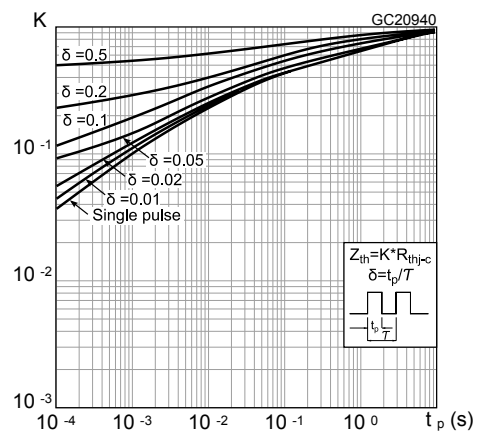
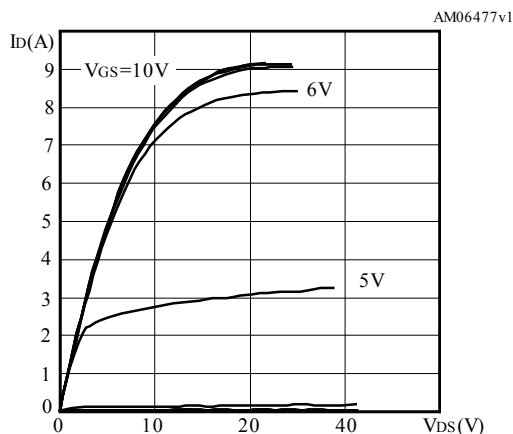
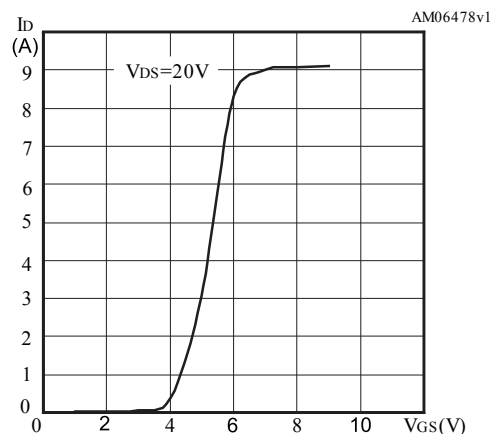
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$ , $I_D = 2.5\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	7	-	ns
$t_r$	Rise time			10		
$t_{d(off)}$	Turn-off delay time			26		
$t_f$	Fall time			12		

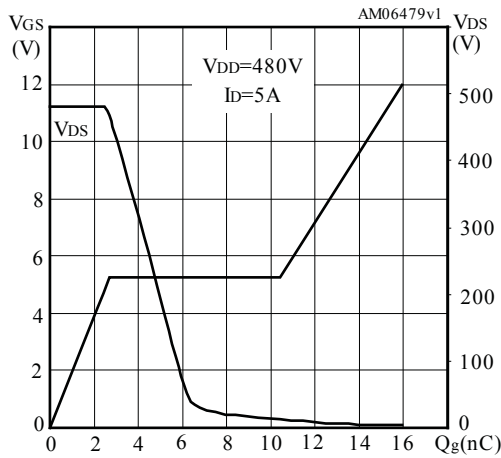
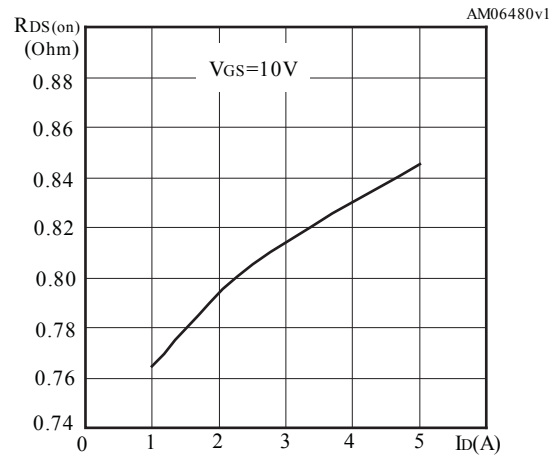
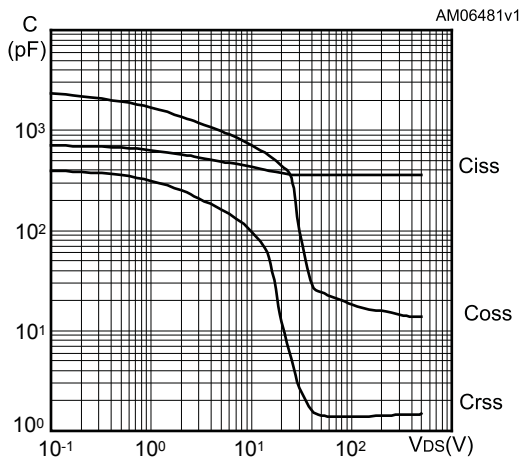
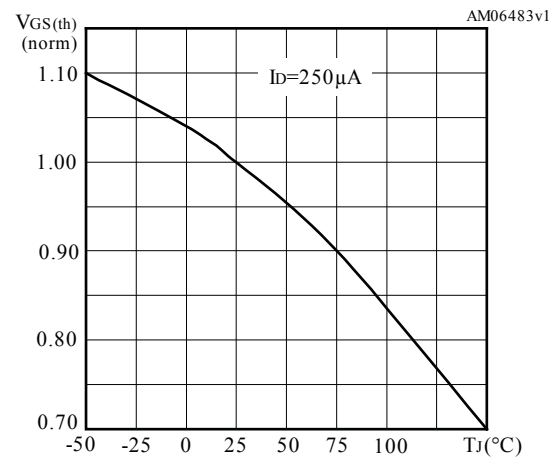
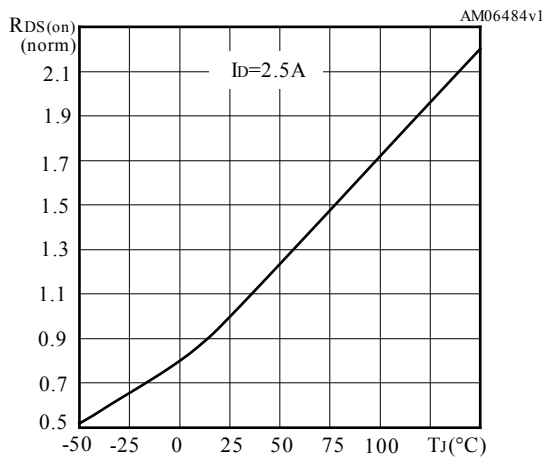
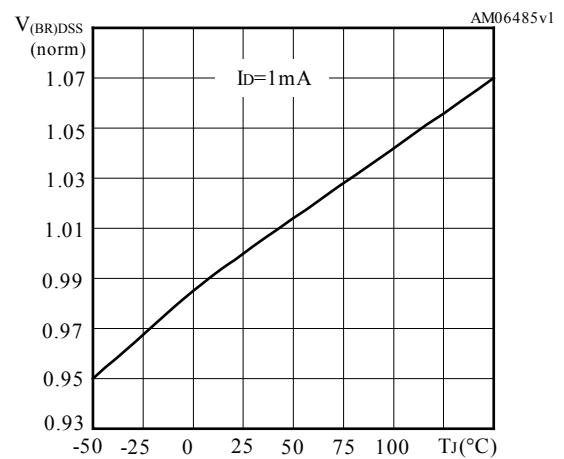
**Table 7. Source drain diode**

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	$I_{SD} = 5\text{ A}$ , $V_{GS} = 0\text{ V}$	-		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		$\mu\text{C}$
$I_{RRM}$	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		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			14		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics curves

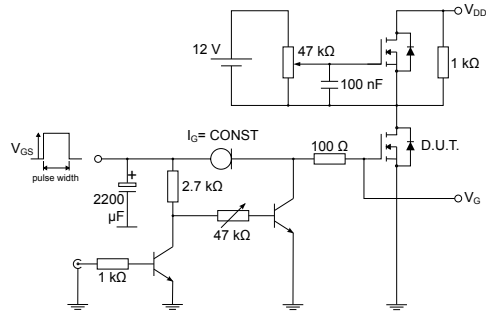
**Figure 1. Safe operating area for DPAK and IPAK**

**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**

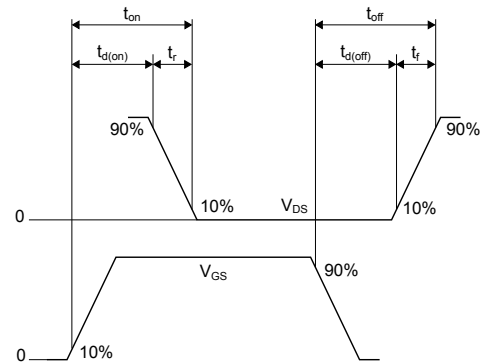

AM01470v1

**Figure 16. Unclamped inductive load test circuit**


AM01471v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


AM01473v1

## 4 Package information

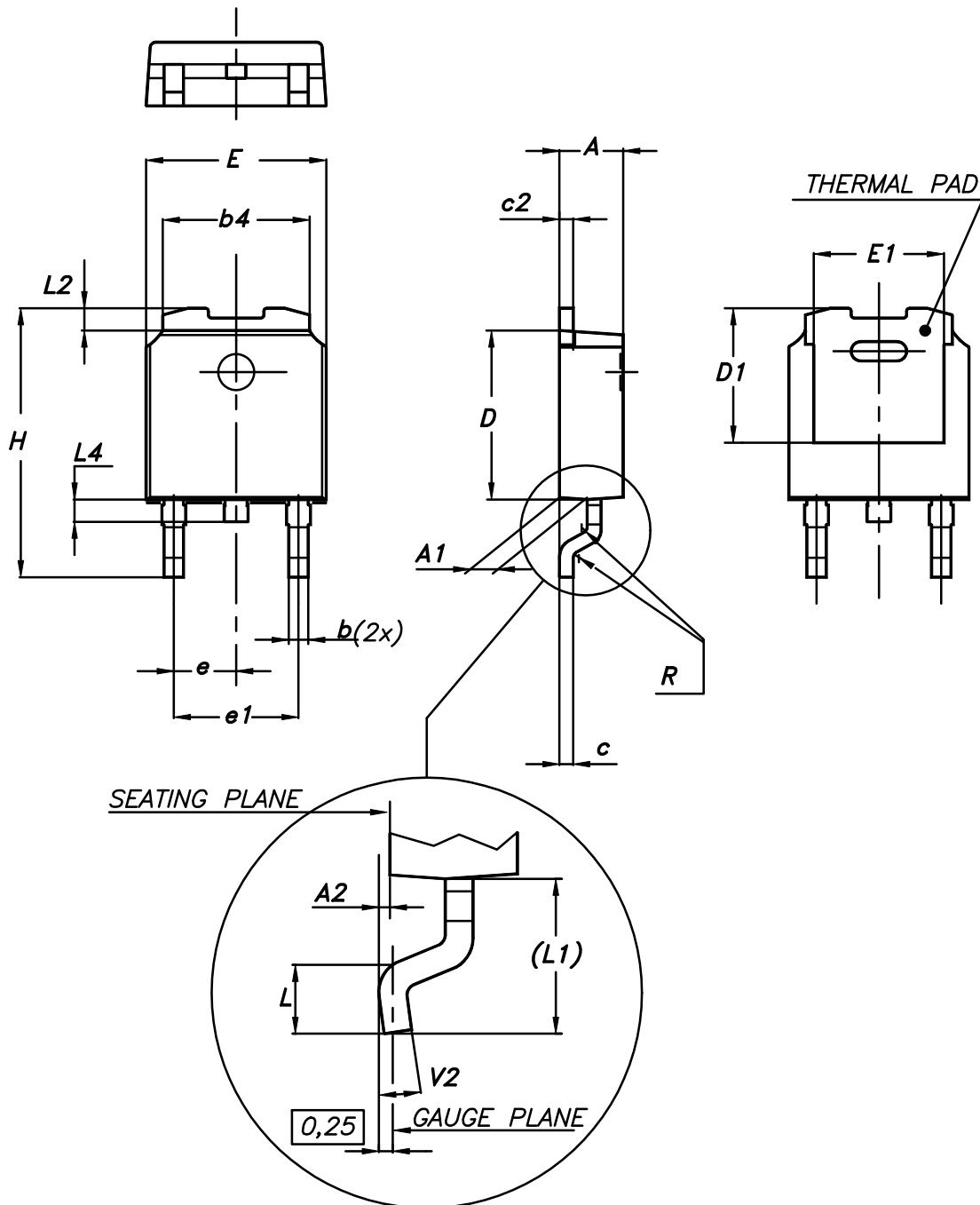
---

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](http://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



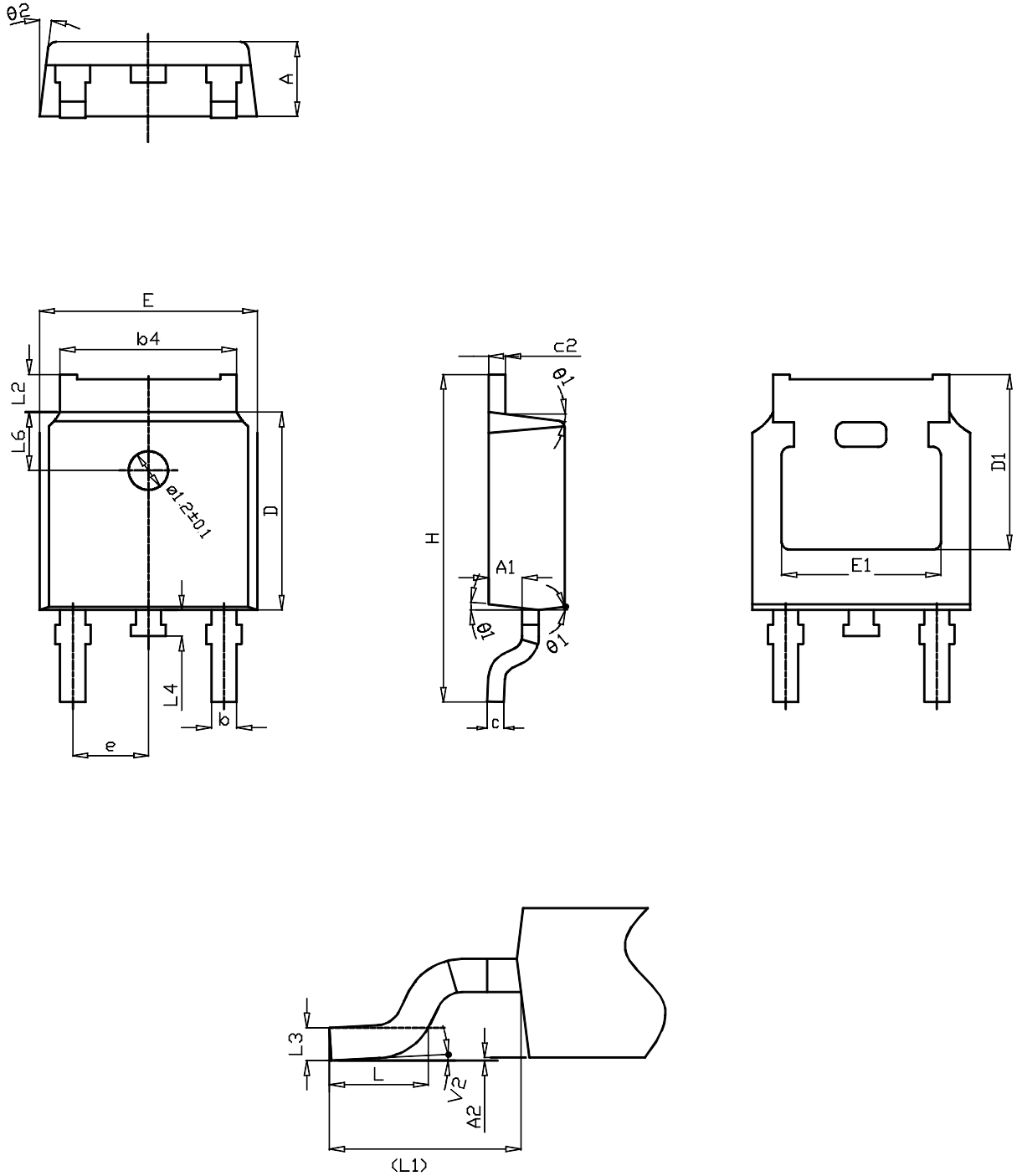
0068772\_A\_25

**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

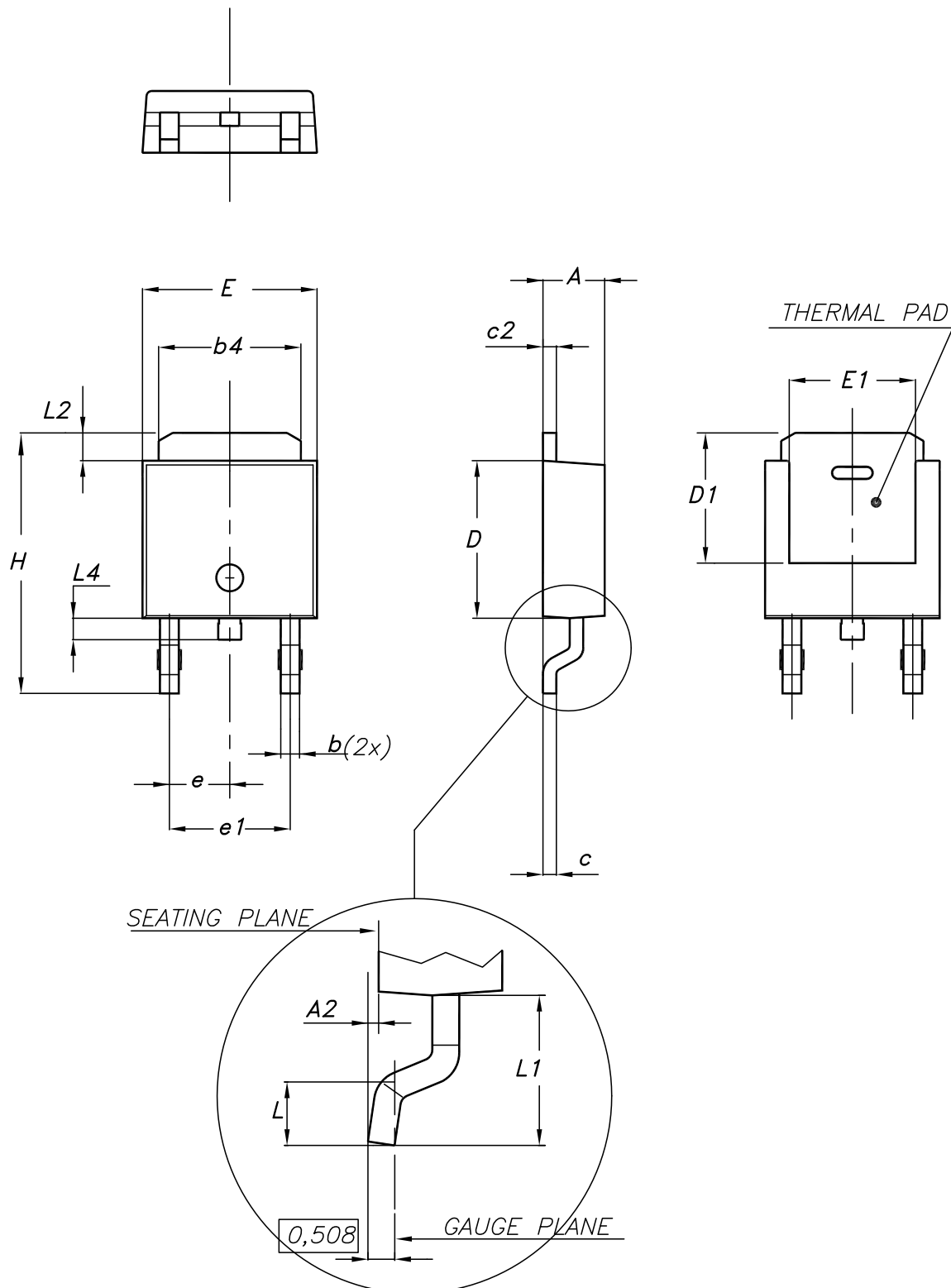
Figure 20. DPAK (TO-252) type C package outline



0068772\_C\_25

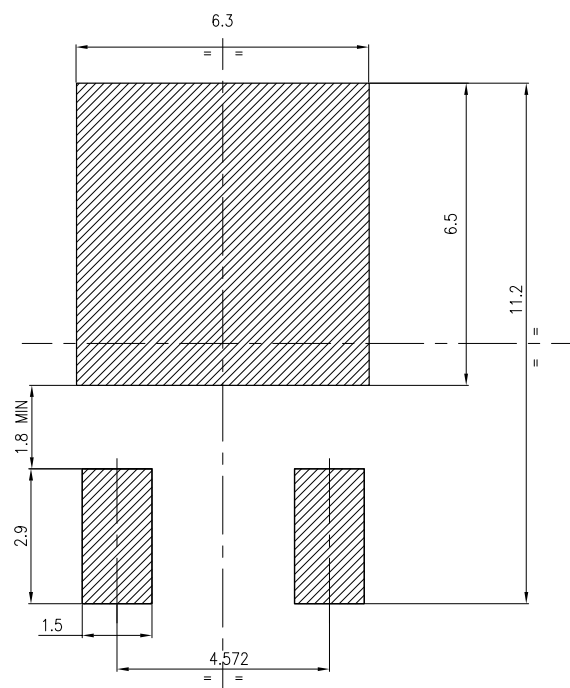
**Table 9. DPAK (TO-252) type C mechanical data**

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**

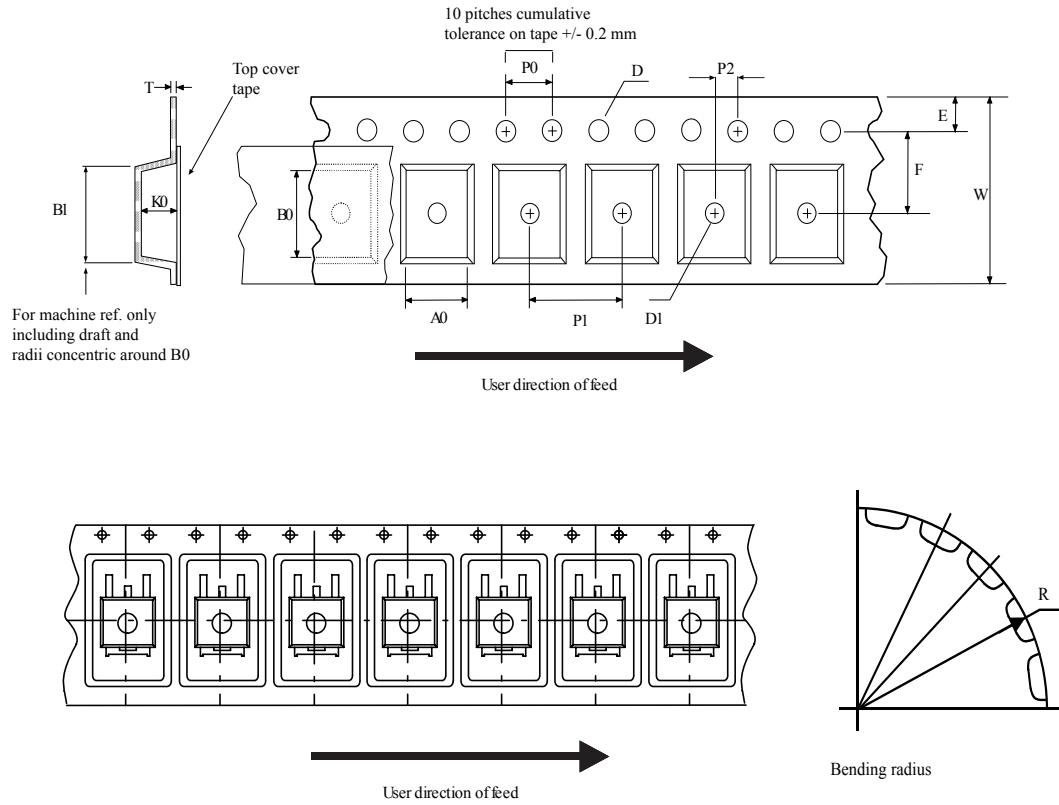
Dim.	mm		
	Min.	Typ.	Max.
A	2.18		2.39
A2			0.13
b	0.65		0.884
b4	4.95		5.46
c	0.46		0.61
c2	0.46		0.60
D	5.97		6.22
D1	5.21		
E	6.35		6.73
E1	4.32		
e		2.286	
e1		4.572	
H	9.94		10.34
L	1.50		1.78
L1		2.74	
L2	0.89		1.27
L4			1.02

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


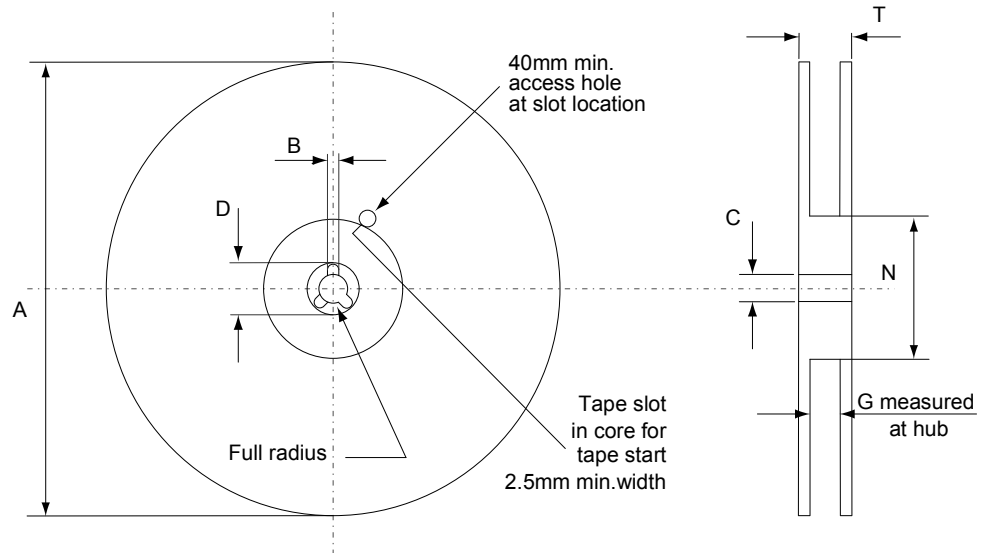
FP\_0068772\_25

### 4.4 DPAK (TO-252) packing information

Figure 23. DPAK (TO-252) tape outline



AM08852v1

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


AM06038v1

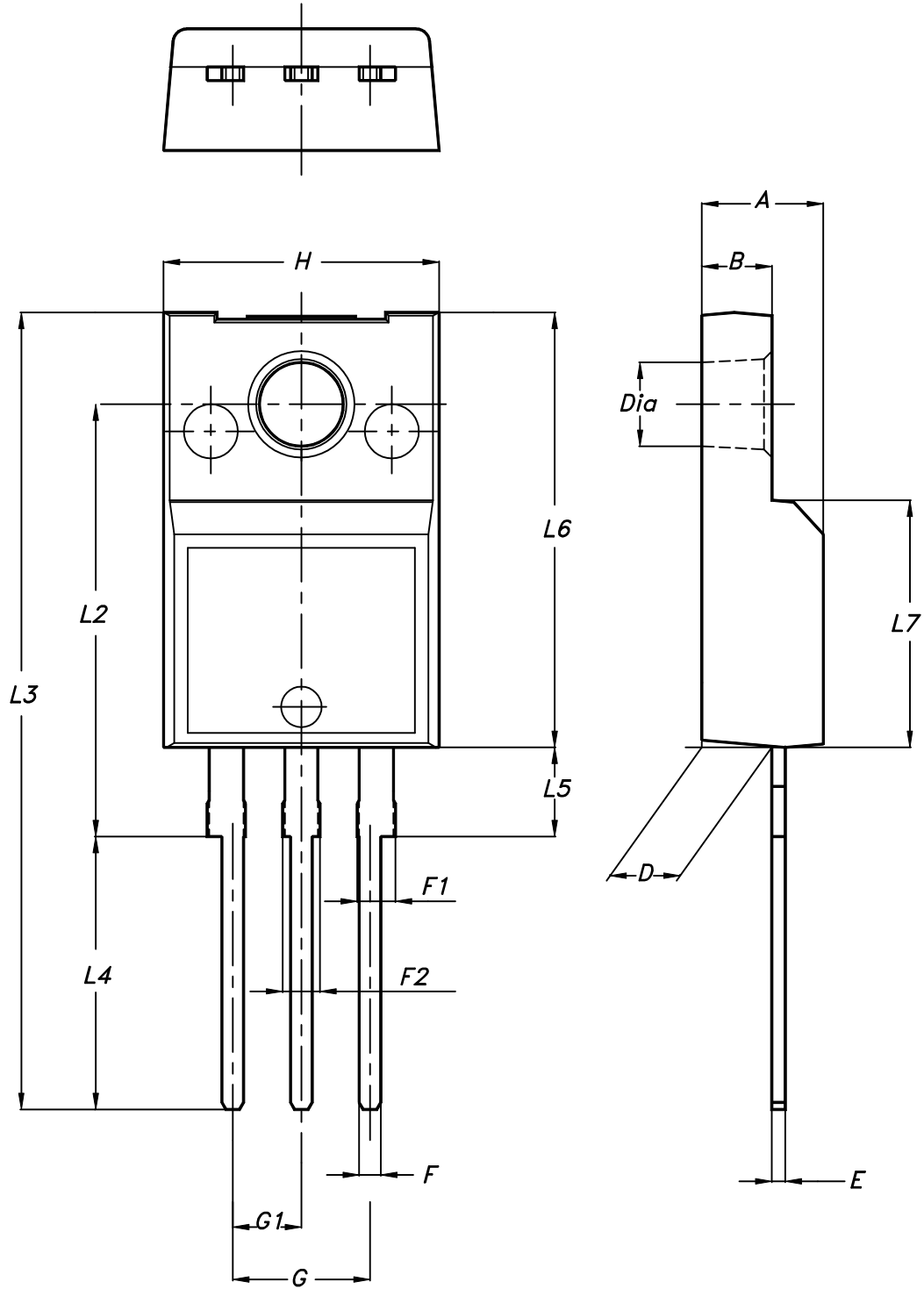
**Table 11. DPAK (TO-252) tape and reel mechanical data**

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-220FP package information

Figure 25. TO-220FP package outline



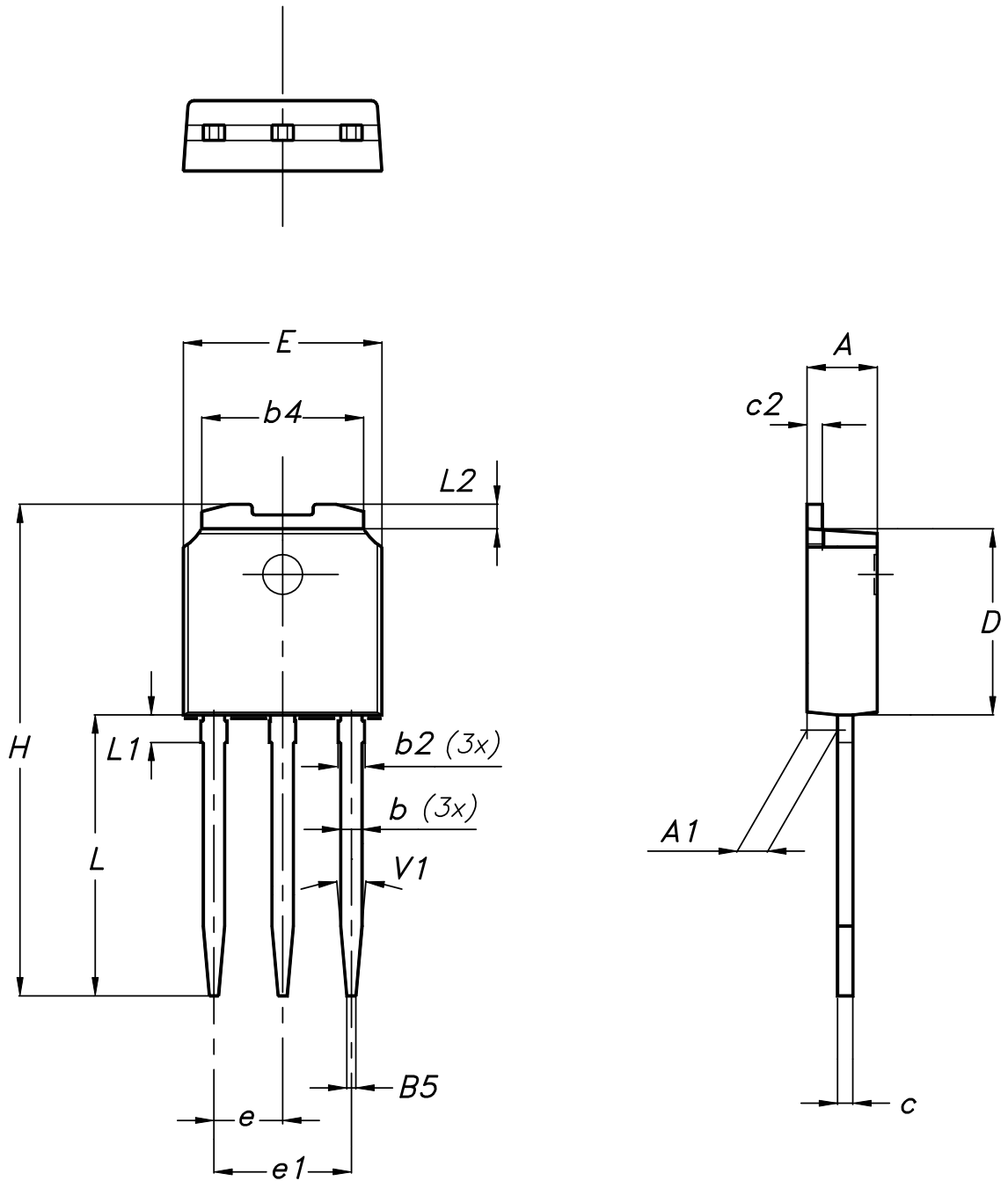
7012510\_Rev\_12\_B

**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

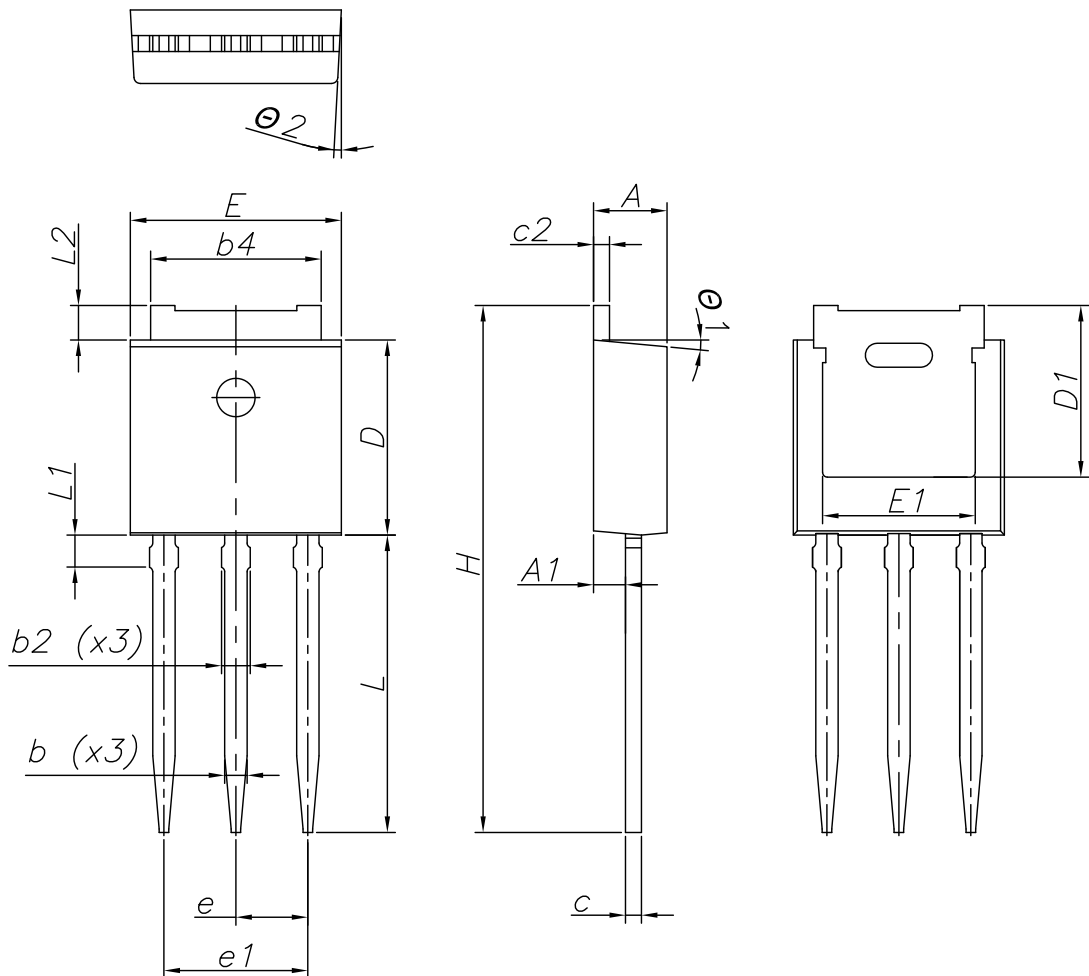
Figure 26. IPAK (TO-251) type A package outline



0068771\_IK\_typeA\_rev14

**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 <a href="#">Section 1 Electrical ratings</a>, <a href="#">Section 2 Electrical characteristics</a> and <a href="#">Section 4 Package information</a>.</p> <p>Minor text changes.</p>



## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>2</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>3</b>
<b>2.1</b>	Electrical characteristics curves .....	5
<b>3</b>	<b>Test circuits</b> .....	<b>7</b>
<b>4</b>	<b>Package information</b> .....	<b>8</b>
<b>4.1</b>	DPAK (TO-252) type A package information .....	8
<b>4.2</b>	DPAK (TO-252) type C package information .....	10
<b>4.3</b>	DPAK (TO-252) type E package information .....	12
<b>4.4</b>	DPAK (TO-252) packing information .....	14
<b>4.5</b>	TO-220FP package information .....	16
<b>4.6</b>	IPAK (TO-251) type A package information .....	18
<b>4.7</b>	IPAK (TO-251) type C package information .....	20
<b>5</b>	<b>Ordering information</b> .....	<b>23</b>
	<b>Revision history</b> .....	<b>24</b>

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2018 STMicroelectronics – All rights reserved

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[STMicroelectronics:](#)

[STF7NM60N](#) [STD7NM60N](#) [STU7NM60N](#)