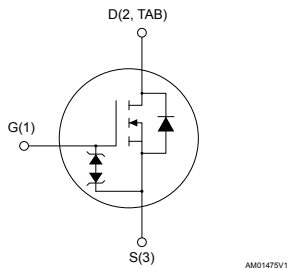


## N-channel 500 V, 0.45 $\Omega$ typ., 8 A MDmesh™ M2 Power MOSFETs in DPAK and TO-220FP packages



DPAK

TO-220FP



AM01475V1

### Features

Order code	$V_{DS} @ T_{Jmax}$	$R_{DS(on)max.}$	$I_D$	Package
STD11N50M2	550 V	0.53 $\Omega$	8 A	DPAK
STF11N50M2				TO-220FP

- Extremely low gate charge
- Excellent output capacitance ( $C_{OSS}$ ) profile
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

These devices are N-channel Power MOSFETs developed using the MDmesh™ M2 technology. Thanks to their strip layout and improved vertical structure, these devices exhibit low on-resistance and optimized switching characteristics, rendering them suitable for the most demanding high-efficiency converters.



#### Product status

STD11N50M2

STF11N50M2

#### Product summary

Order code	STD11N50M2
Marking	11N50M2
Package	DPAK
Packing	Tape and reel
Order code	STF11N50M2
Marking	11N50M2
Package	TO-220FP
Packing	Tube

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		DPAK	TO-220FP	
$V_{GS}$	Gate-source voltage	±25		V
$I_D$	Drain current (continuous) at $T_C = 25\text{ °C}$	8		A
$I_D$	Drain current (continuous) at $T_C = 100\text{ °C}$	5		A
$I_{DM}^{(1)}$	Drain current (pulsed)	32		A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	85	25	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15		V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	50		V/ns
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t=1\text{ s}$ ; $T_C = 25\text{ °C}$ )	2.5		kV
$T_j$	Operating junction temperature range	-55 to 150		°C
$T_{stg}$	Storage temperature range			

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 8\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS(peak)} < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .
3.  $V_{DS} \leq 400\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value		Unit
		DPAK	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case	1.47	5	°C/W
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	50		°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient		62.5	°C/W

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

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ Max)	2	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ °C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	190	mJ

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$	500			V
$I_{DSS}$	Zero gate voltage drain current	$V_{DS} = 500\text{ V}$ , $V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
		$V_{DS} = 500\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_C = 125\text{ }^{\circ}\text{C}$ <sup>(1)</sup>			100	$\mu\text{A}$
$I_{GSS}$	Gate body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}$ , $I_D = 4\text{ A}$		0.45	0.53	$\Omega$

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ISS}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	395	-	$\mu\text{F}$
$C_{OSS}$	Output capacitance			26		
$C_{RSS}$	Reverse transfer capacitance			1		
$C_{OSS\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ to }400\text{ V}$	-	108	-	$\mu\text{F}$
$R_g$	Gate input resistance	$f = 1\text{ MHz}$ open drain	-	6.3	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 400\text{ V}$ , $I_D = 8\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 16. Test circuit for gate charge behavior)	-	12	-	nC
$Q_{gs}$	Gate-source charge			2		
$Q_{gd}$	Gate-drain charge			6.4		

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	$V_{DD} = 250\text{ V}$ , $I_D = 4\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform)	-	11	-	ns
$t_r$	Rise time			9		
$t_{d(off)}$	Turn-off delay time			8		
$t_f$	Fall time			28.5		

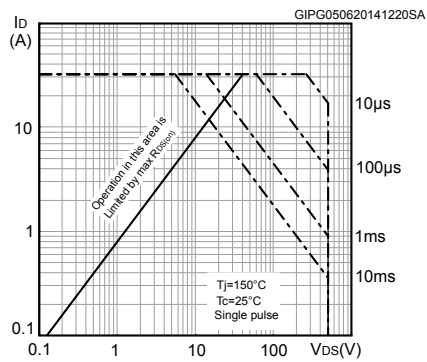
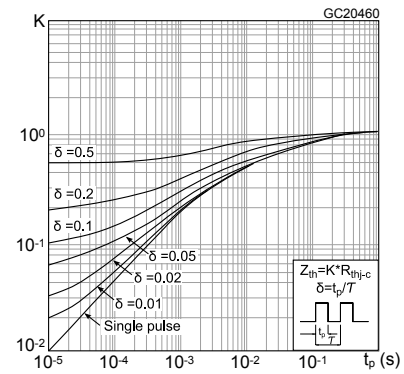
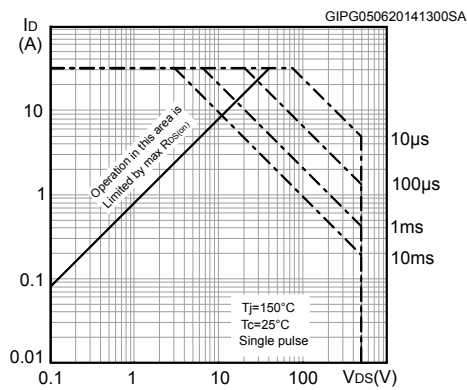
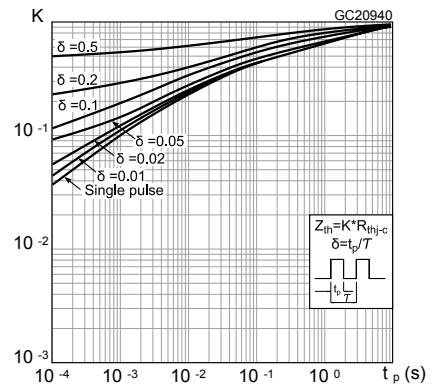
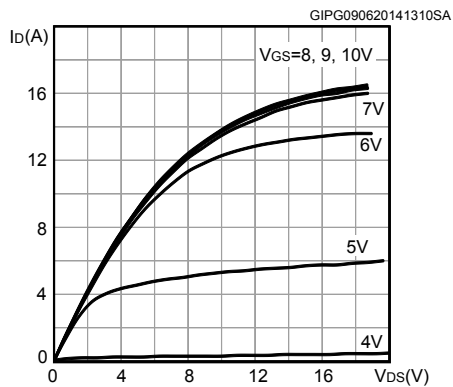
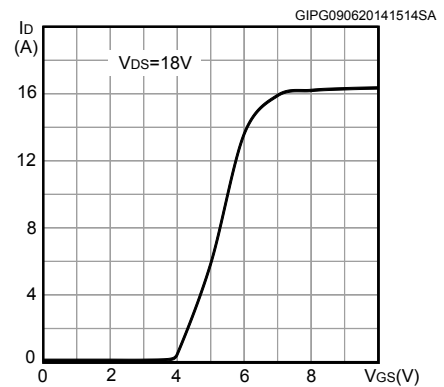
**Table 7. Source-drain diode**

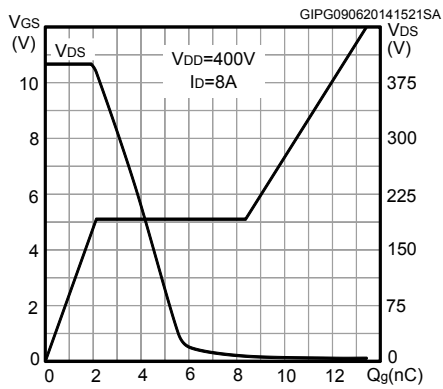
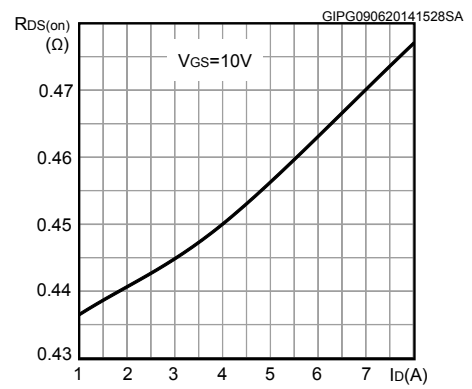
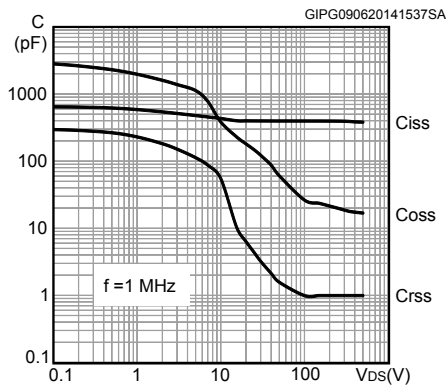
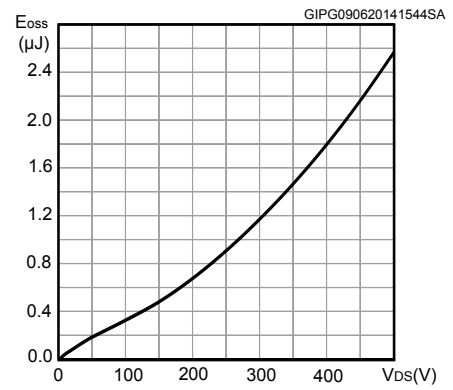
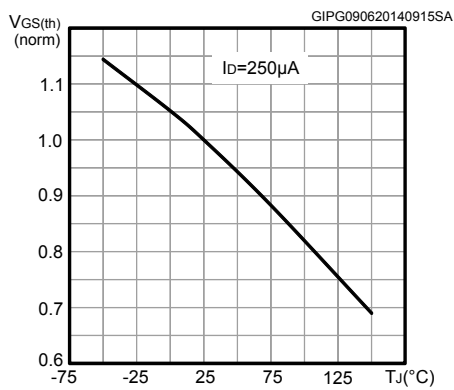
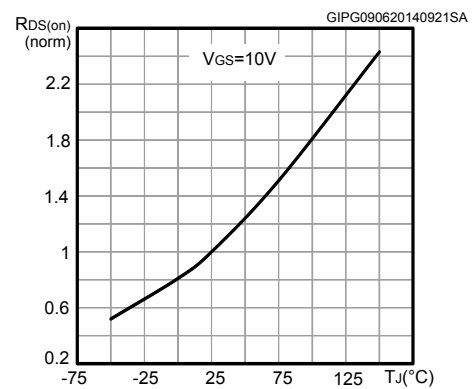
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current				8	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		32	
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 8\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 8\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		258		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$ (see Figure 17. Test circuit for inductive load switching and diode recovery times)	-	1.84		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			14.3		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 8\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		370		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see Figure 17. Test circuit for inductive load switching and diode recovery times)	-	2.87		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			15.5		A

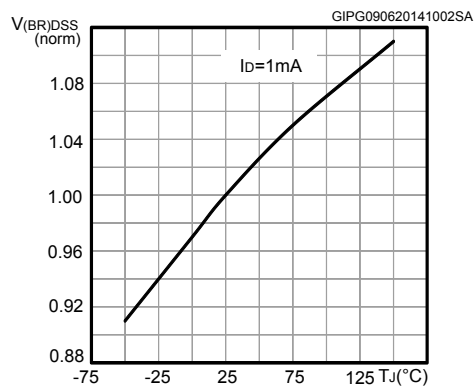
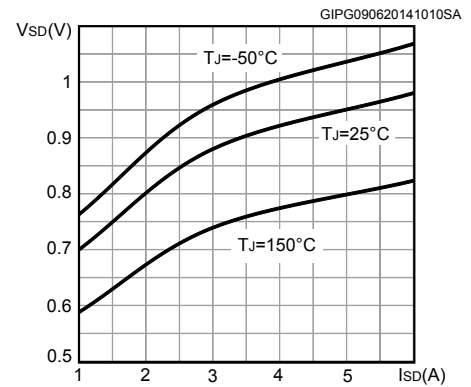
1. Pulse width limited by safe operating area.

2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

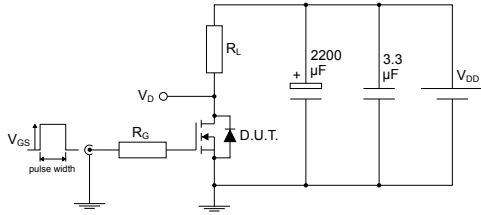
## 2.1 Electrical characteristics (curves)

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

**Figure 2. Thermal impedance for DPAK**

**Figure 3. Safe operating area for TO-220FP**

**Figure 4. Thermal impedance for TO-220FP**

**Figure 5. Output characteristics**

**Figure 6. Transfer characteristics**


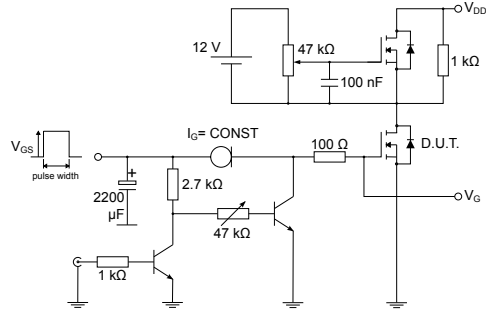
**Figure 7. Gate charge vs gate-source voltage**

**Figure 8. Static drain-source on-resistance**

**Figure 9. Capacitance variations**

**Figure 10. Output capacitance stored energy**

**Figure 11. Normalized gate threshold voltage vs temperature**

**Figure 12. Normalized on-resistance vs temperature**


**Figure 13. Normalized  $V_{(BR)DSS}$  vs temperature**

**Figure 14. Source-drain diode forward characteristics**


### 3 Test circuits

**Figure 15. Test circuit for resistive load switching times**


AM01468v1

**Figure 16. Test circuit for gate charge behavior**


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**Figure 17. Test circuit for inductive load switching and diode recovery times**

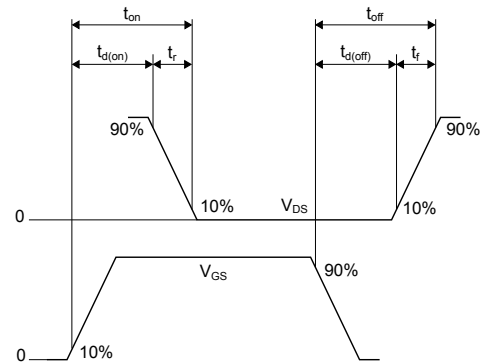

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**Figure 18. Unclamped inductive load test circuit**


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**Figure 19. Unclamped inductive waveform**


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**Figure 20. Switching time waveform**


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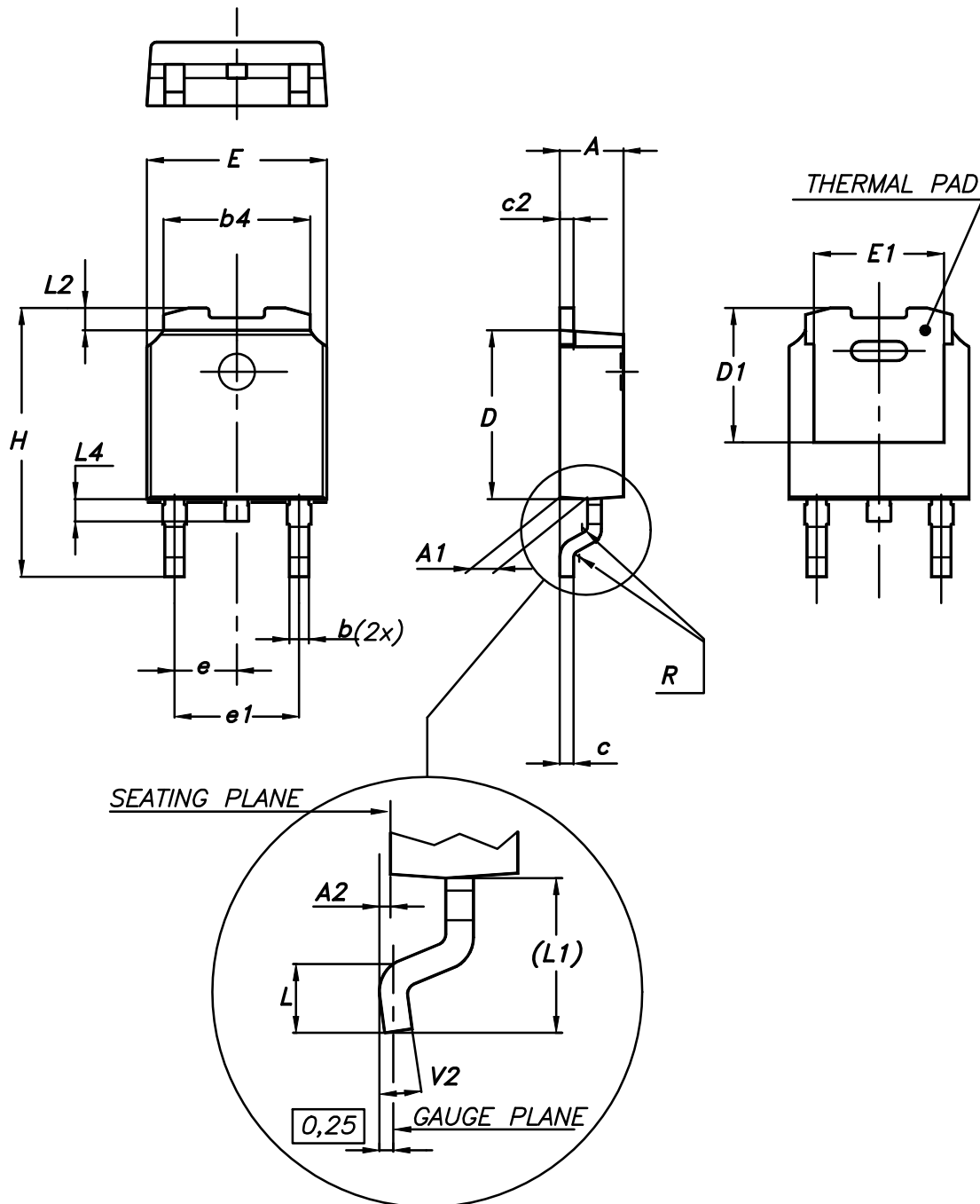
## 4 Package information

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In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK<sup>®</sup>** packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

#### 4.1 DPAK (TO-252) type A package information

Figure 21. DPAK (TO-252) type A package outline



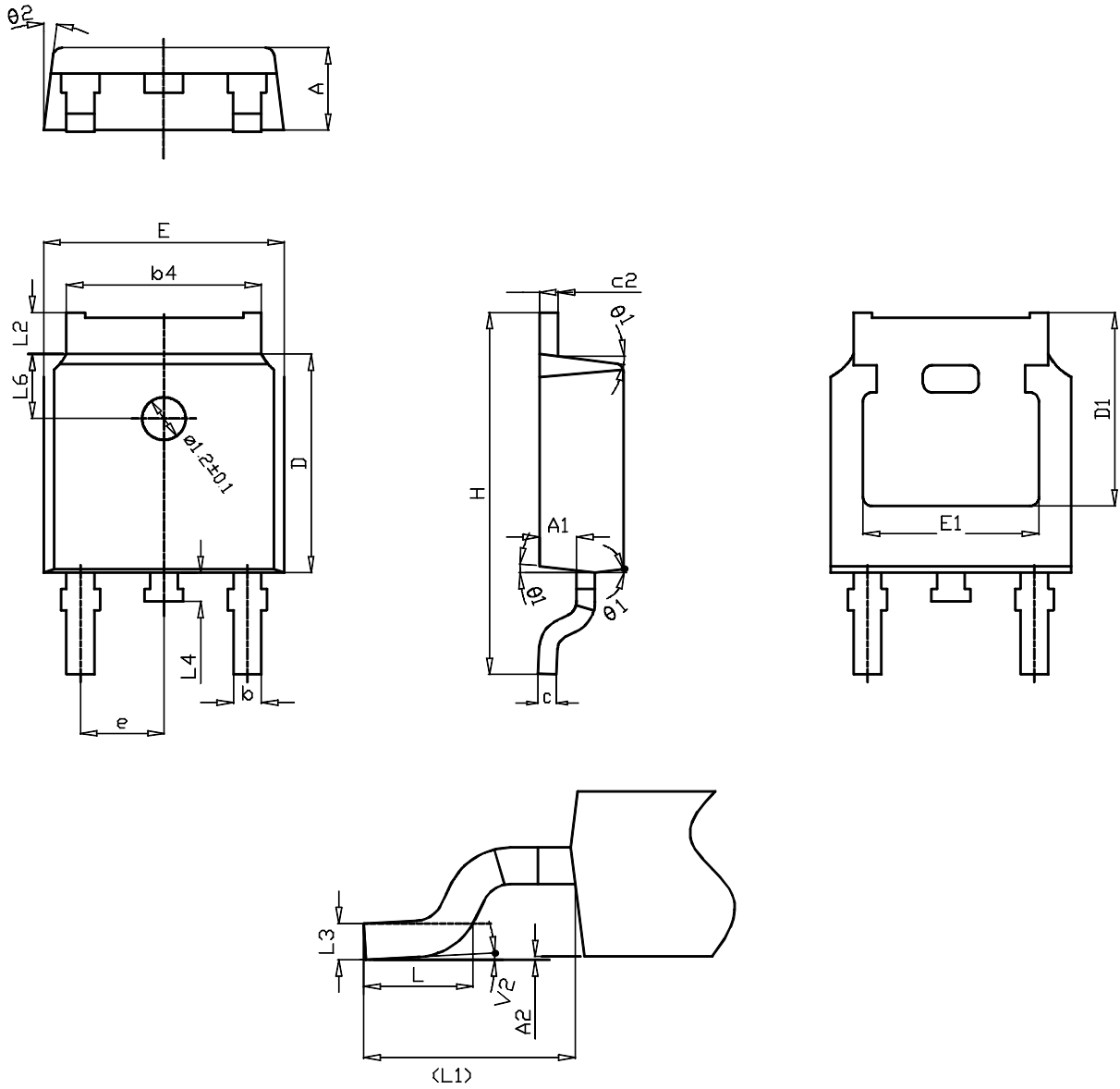
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**Table 8. DPAK (TO-252) type A mechanical data**

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 22. DPAK (TO-252) type C package outline



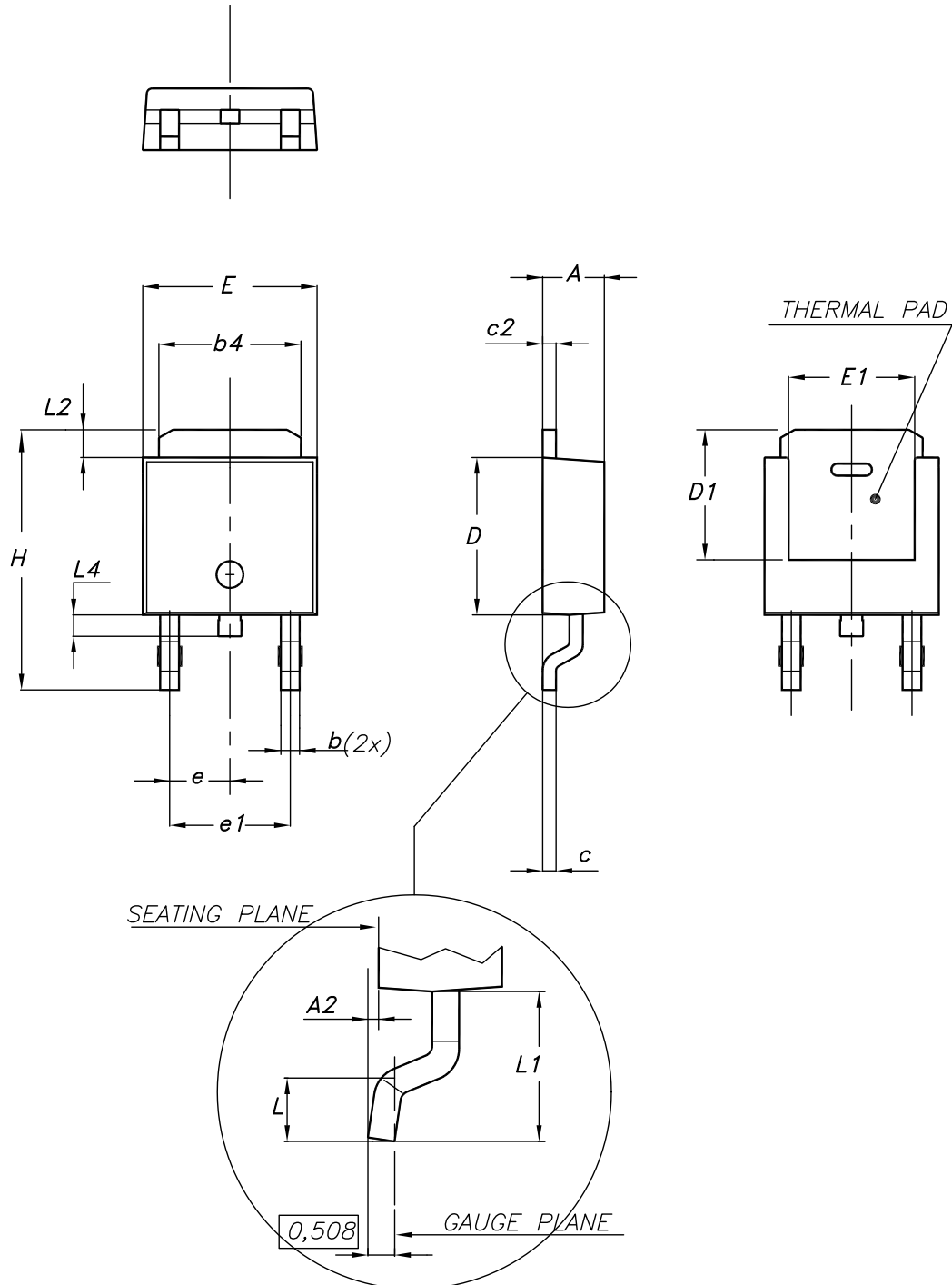
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**Table 9. DPAK (TO-252) type C mechanical data**

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

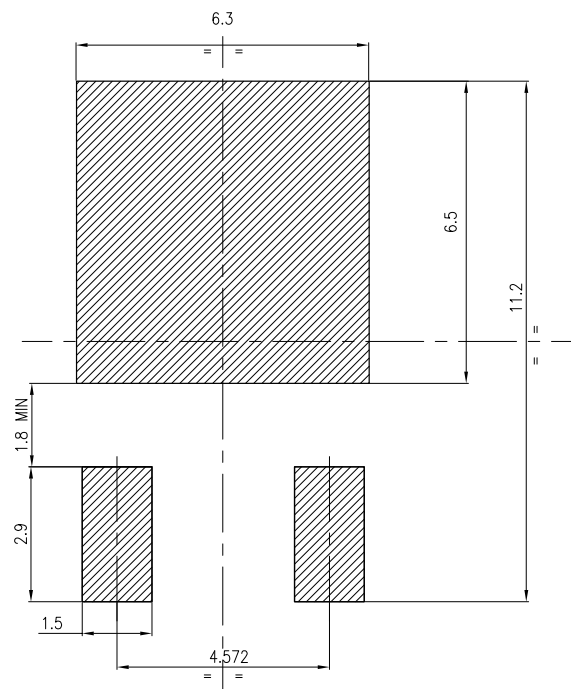


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**Table 10. DPAK (TO-252) type E mechanical data**

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



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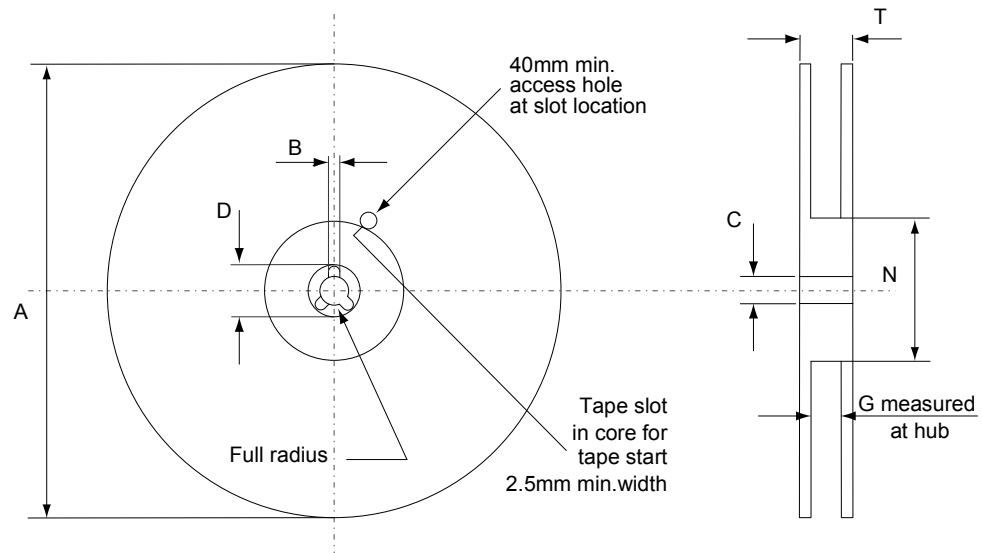
#### 4.4 DPAK (TO-252) packing information

Figure 25. DPAK (TO-252) tape outline



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


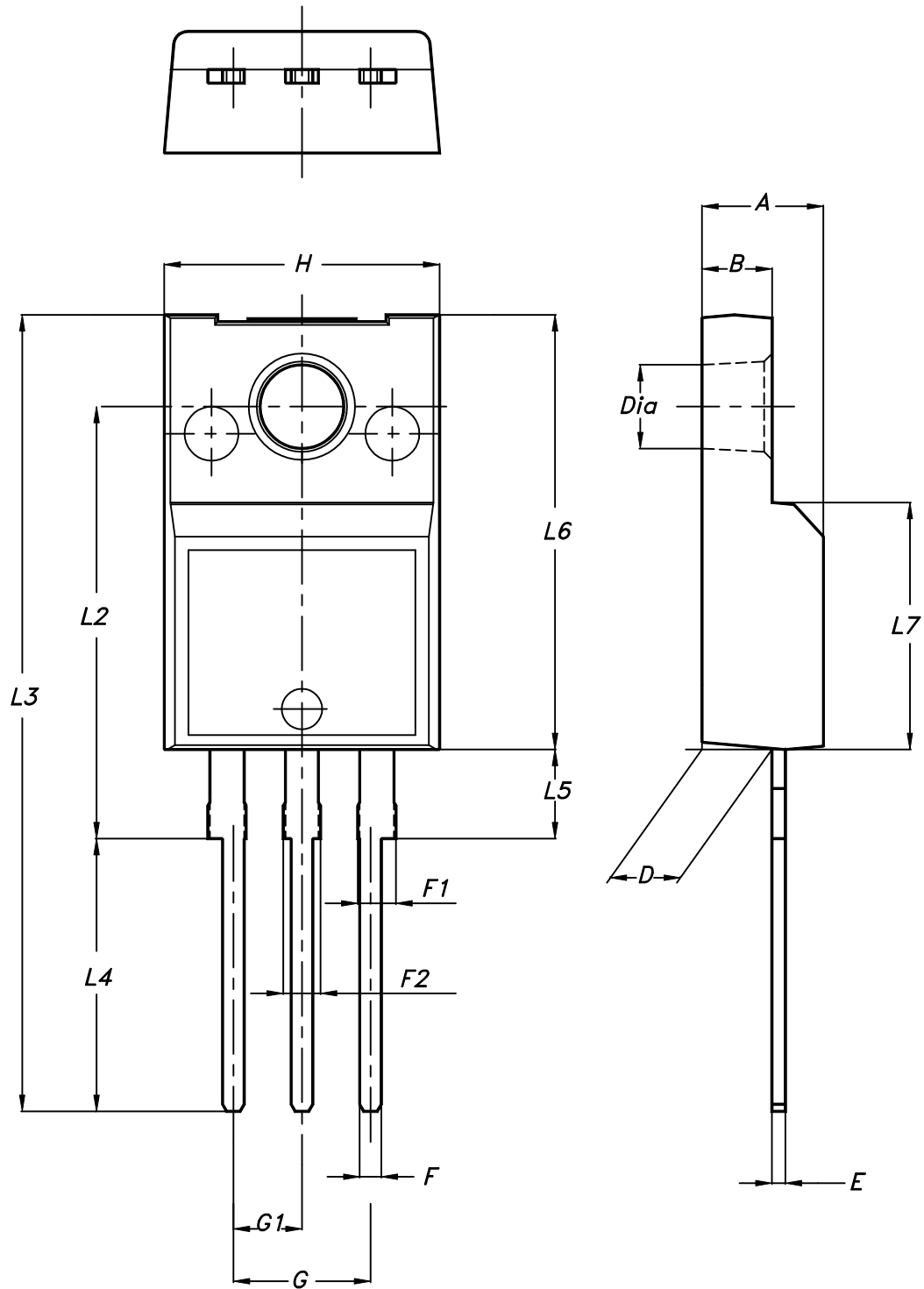
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**Table 11. DPAK (TO-252) tape and reel mechanical data**

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 27. 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

## Revision history

**Table 13. Document revision history**

Date	Version	Changes
12-Mar-2014	1	First release.
17-Jun-2014	2	<ul style="list-style-type: none"> <li>– Modified: title</li> <li>– Modified: dv/dt values in <i>Table 2</i></li> <li>– Modified: values in <i>Table 4</i></li> <li>– Modified: R<sub>DS(on)</sub> value in <i>Table 5</i></li> <li>– Modified: the entire typical values in <i>Table 6, 7 and 8</i></li> <li>– Added: <i>Section 2.1: Electrical characteristics (curves)</i></li> <li>– Updated: <i>Section 4: Package mechanical data</i></li> <li>– Minor text changes</li> </ul>
26-Oct-2018	3	<p>Removed maturity status indication from cover page. The document status is production data.</p> <p>Modified title, features and description on cover page.</p> <p>Updated <a href="#">Section 4 Package information</a>.</p> <p>Minor text changes.</p>

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- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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