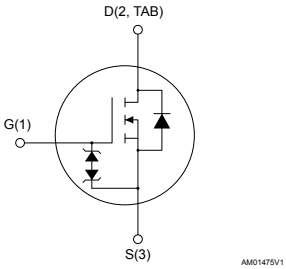
N-channel 500 V, 0.45 Ω typ., 8 A MDmesh™ M2 Power MOSFETs in DPAK and TO-220FP packages



Features

Order code	V_{DS} @ T_{Jmax}	$R_{DS(on)}$max.	I_D	Package
STD11N50M2	550 V	0.53 Ω	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 °C	8		A
I_D	Drain current (continuous) at T_C = 100 °C	5		A
I_{DM} (1)	Drain current (pulsed)	32		A
P_{TOT}	Total power dissipation at T_C = 25 °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 s; T_C = 25 °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} ≤ 8 A, di/dt ≤ 400 A/µs, $V_{DS(peak)}$ < $V_{(BR)DSS}$, V_{DD} = 400 V.*
3. *V_{DS} ≤ 400 V.*

Table 2. Thermal data

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

1. *When mounted on 1 inch² 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 °C, I_D = I_{AR}, V_{DD} = 50 V)	190	mJ

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	500			V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 500 V, V_{GS} = 0 V			1	µA
		V_{DS} = 500 V, V_{GS} = 0 V, T_C = 125 °C (1)			100	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±10	µA
$V_{GS(th)}$	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 = 4 A		0.45	0.53	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} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	395	-	pF
C_{oss}	Output capacitance			26		
C_{rss}	Reverse transfer capacitance			1		
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0 to 400 V	-	108	-	pF
Rg	Gate input resistance	f = 1 MHz open drain	-	6.3	-	Ω
Q_g	Total gate charge	V_{DD} = 400 V, I_D = 8 A, V_{GS} = 0 to 10 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. *$C_{oss\ eq.}$ 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 V, I_D = 4 A, R_G = 4.7 Ω, V_{GS} = 10 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 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 8 A, di/dt = 100 A/µs	-	258		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V (see Figure 17. Test circuit for inductive load switching and diode recovery times)		1.84		µC
I_{RRM}	Reverse recovery current			14.3		A
t_{rr}	Reverse recovery time	I_{SD} = 8 A, di/dt = 100 A/µs	-	370		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V, T_j = 150 °C (see Figure 17. Test circuit for inductive load switching and diode recovery times)		2.87		µC
I_{RRM}	Reverse recovery current			15.5		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

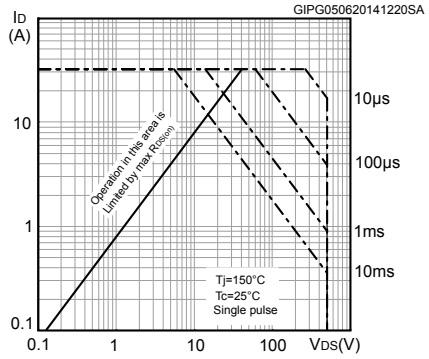


Figure 2. Thermal impedance for DPAK

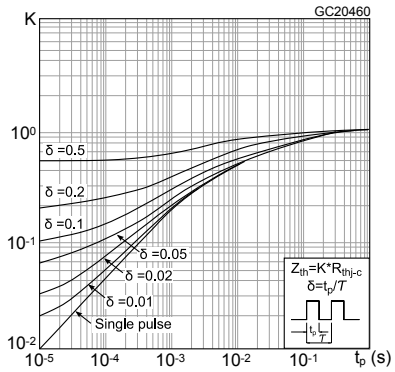


Figure 3. Safe operating area for TO-220FP

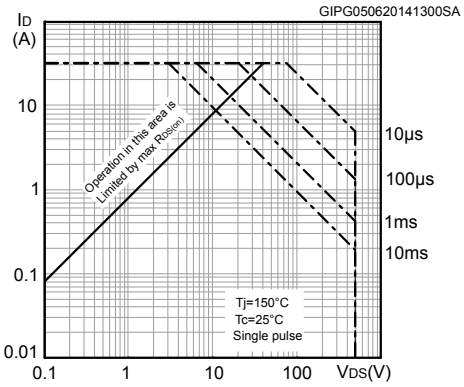


Figure 4. Thermal impedance for TO-220FP

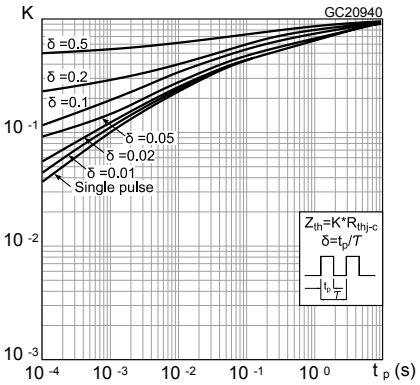


Figure 5. Output characterisics

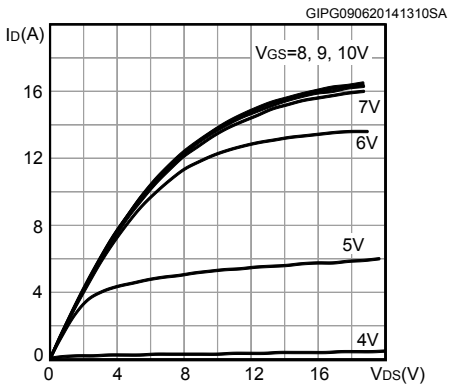


Figure 6. Transfer characteristics

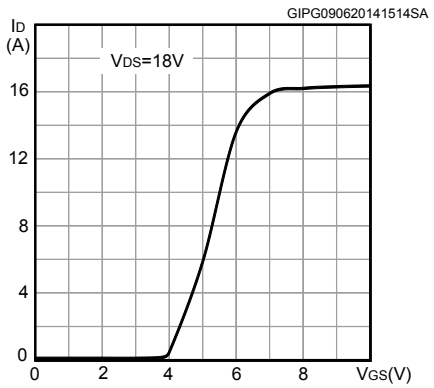


Figure 7. Gate charge vs gate-source voltage

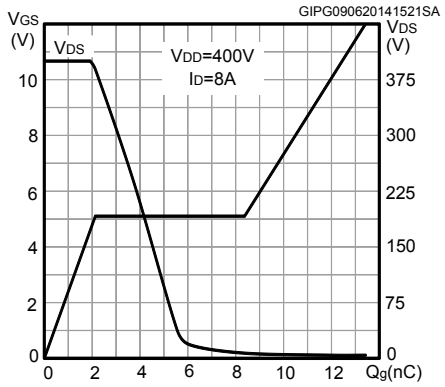


Figure 8. Static drain-source on-resistance

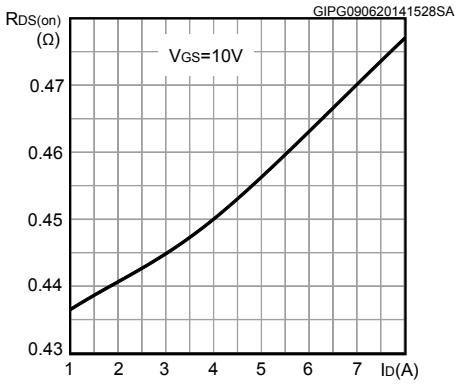


Figure 9. Capacitance variations

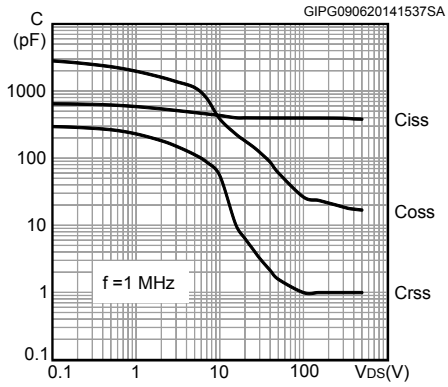


Figure 10. Output capacitance stored energy

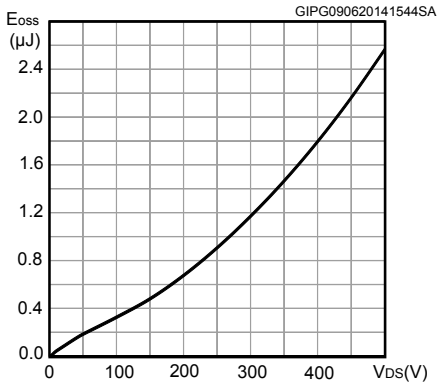


Figure 11. Normalized gate threshold voltage vs temperature

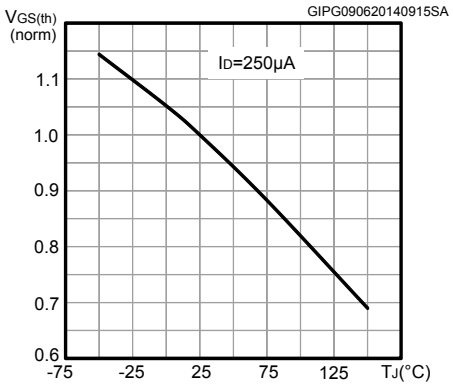


Figure 12. Normalized on-resistance vs temperature

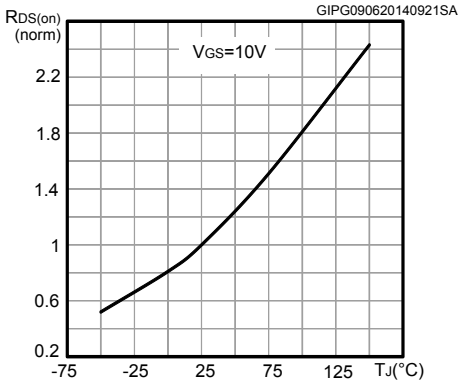


Figure 13. Normalized $V_{(BR)DSS}$ vs temperature

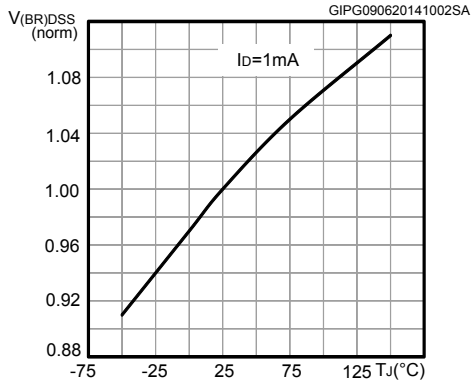
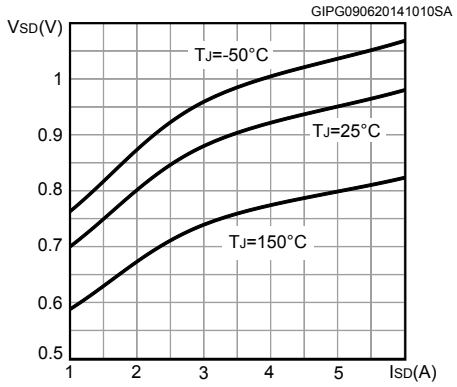


Figure 14. Source-drain diode forward characteristics



3 Test circuits

Figure 15. Test circuit for resistive load switching times

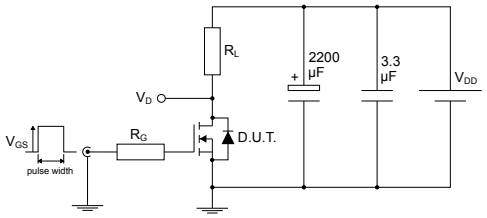


Figure 16. Test circuit for gate charge behavior

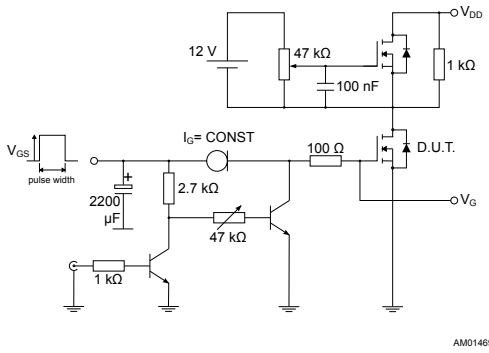


Figure 17. Test circuit for inductive load switching and diode recovery times

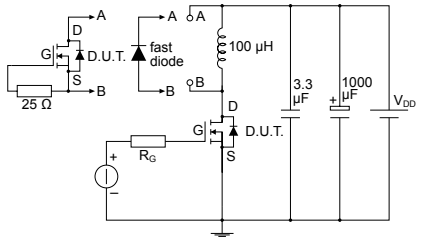


Figure 18. Unclamped inductive load test circuit

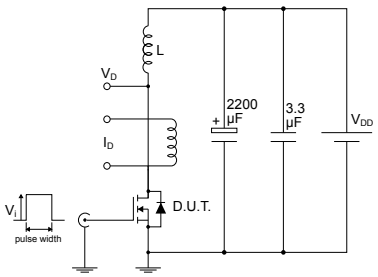


Figure 19. Unclamped inductive waveform

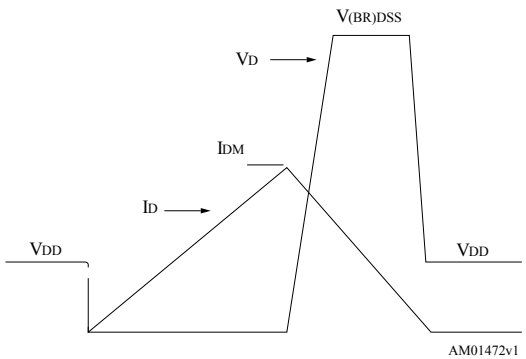
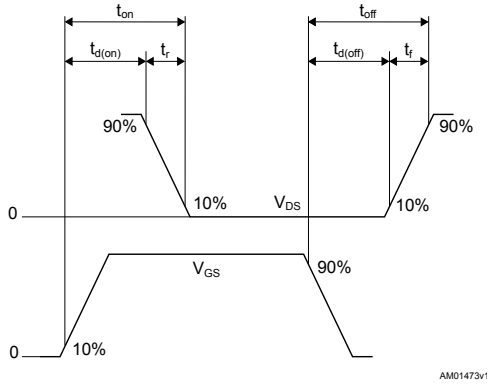


Figure 20. Switching time waveform



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

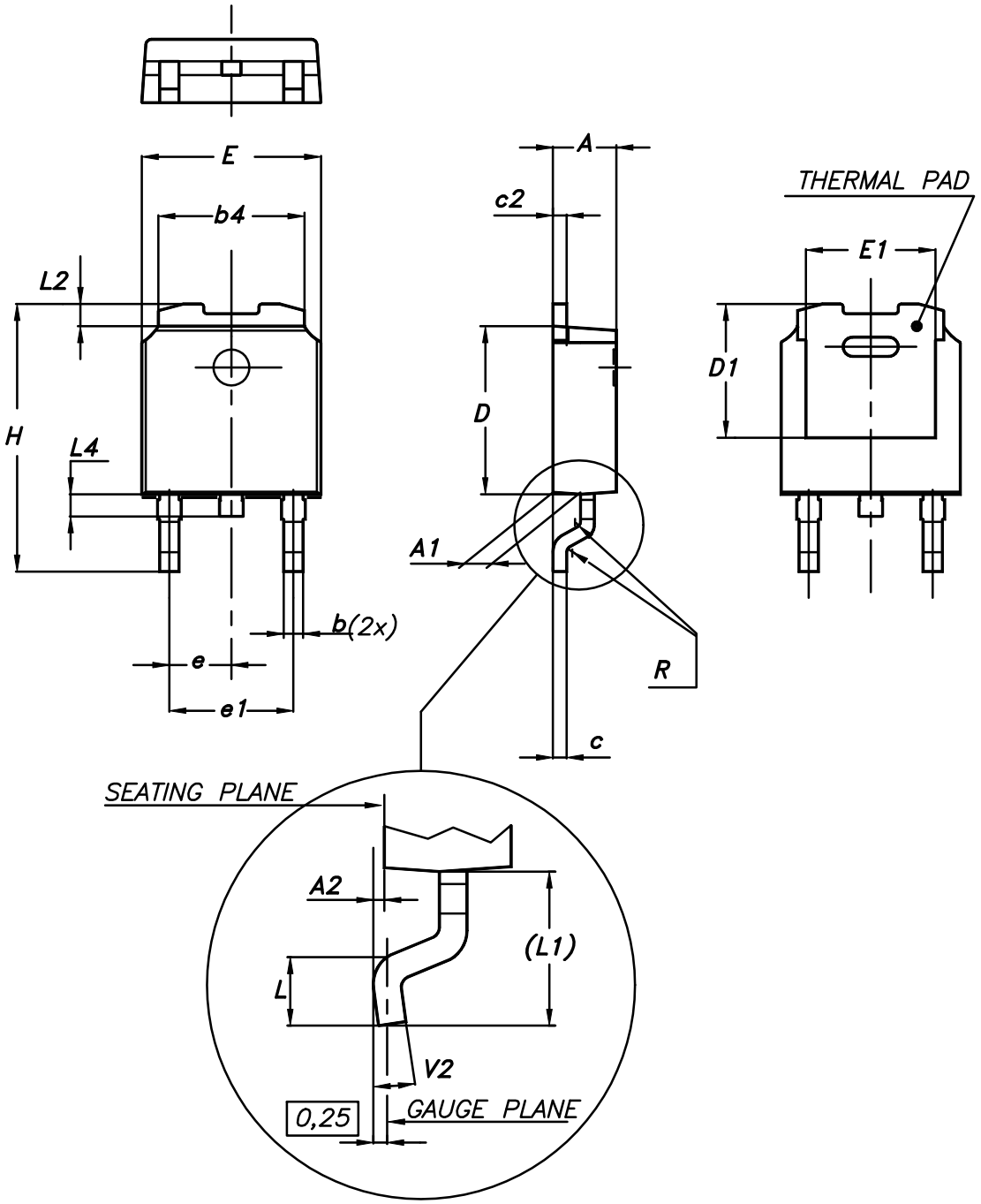


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Table 8. **DPAK (TO-252) type A mechanical data**

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**

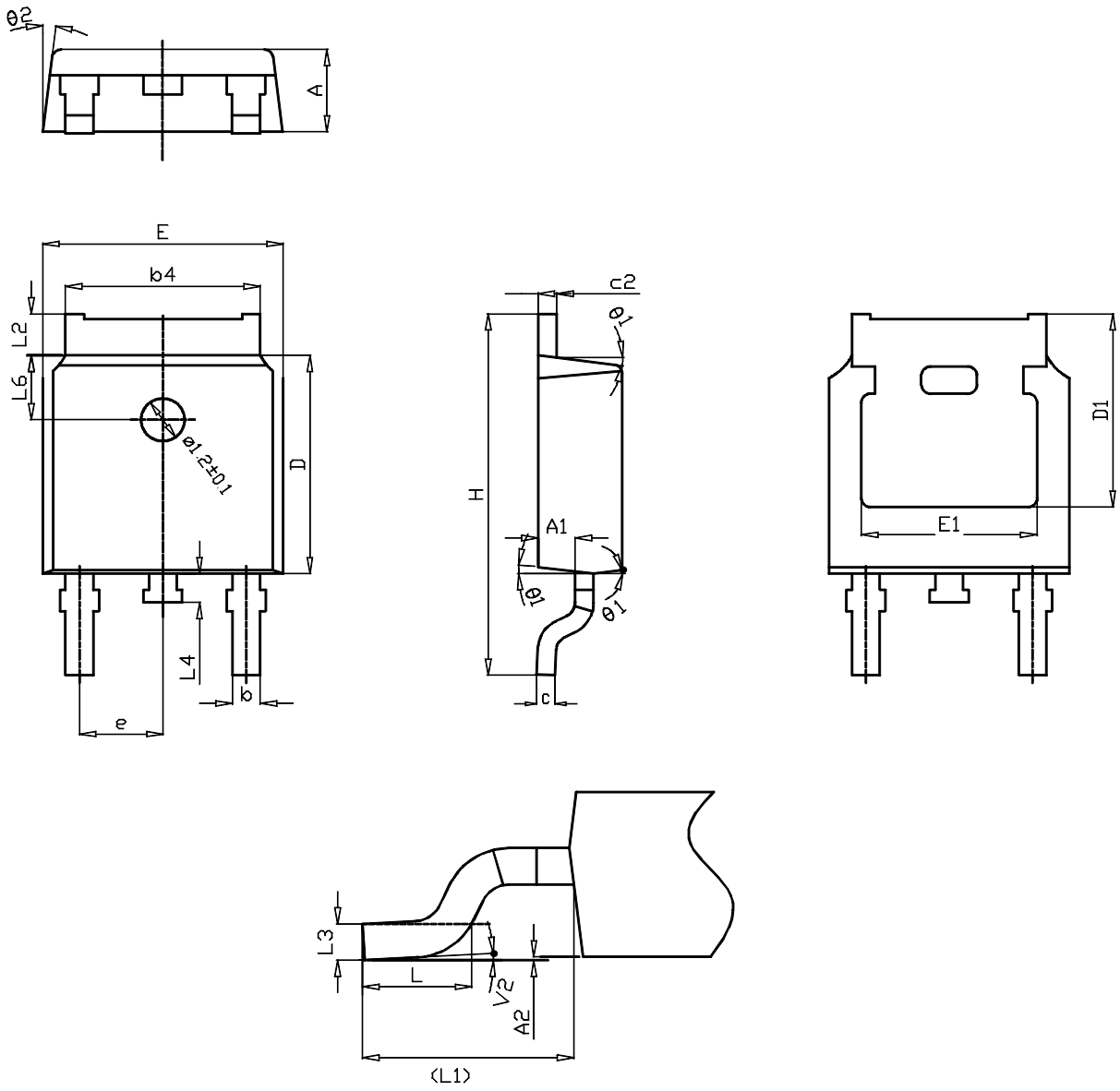

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Table 9. DPAK (TO-252) type C mechanical data

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**

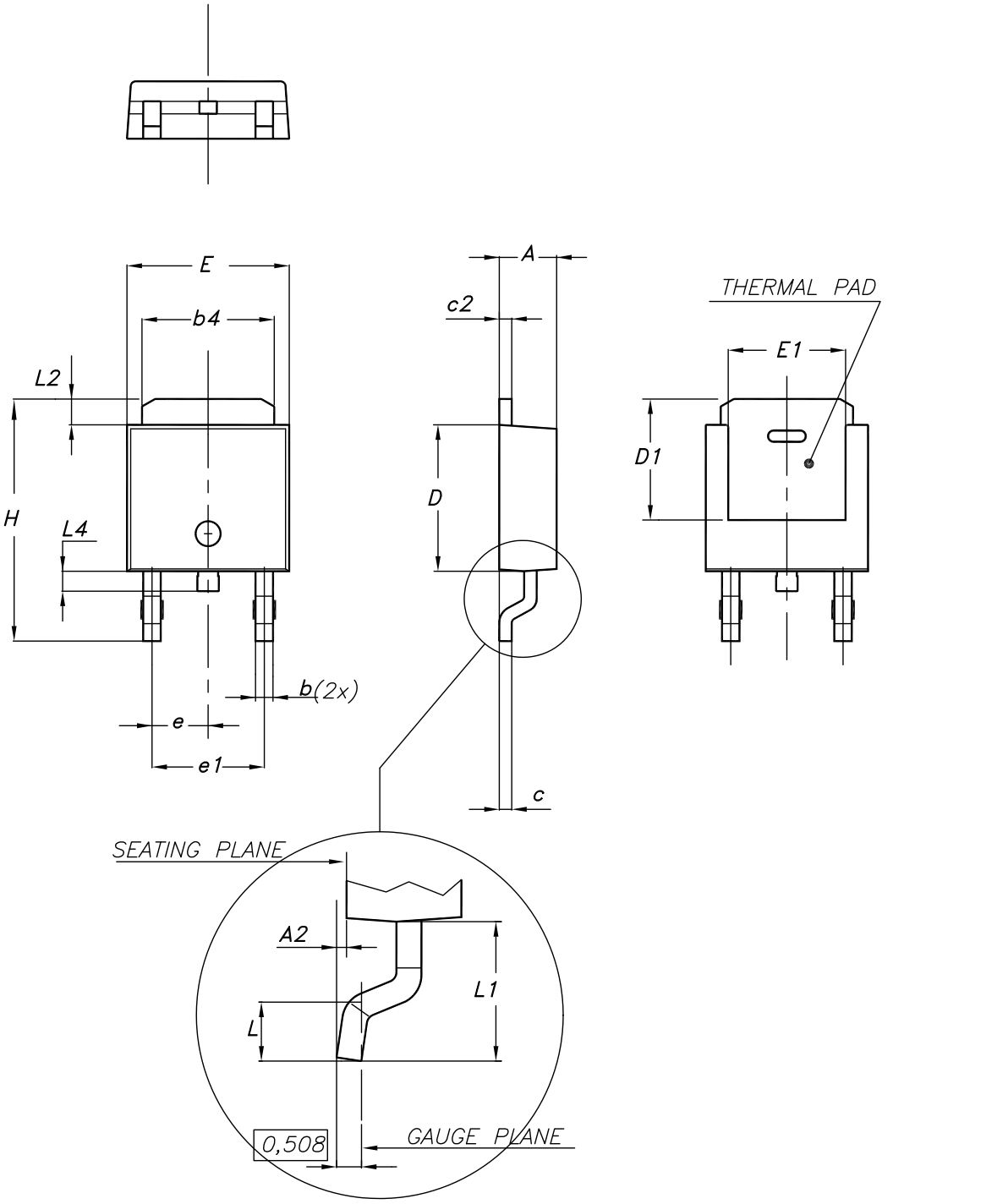
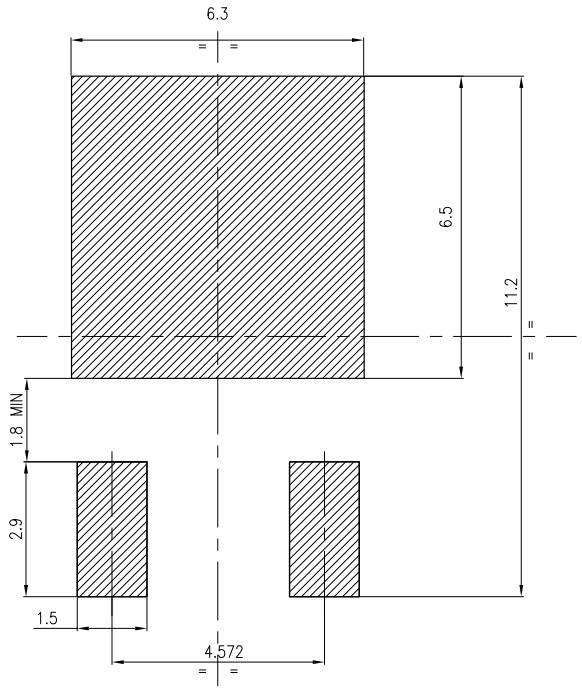


Table 10. **DPAK (TO-252) type E mechanical data**

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**

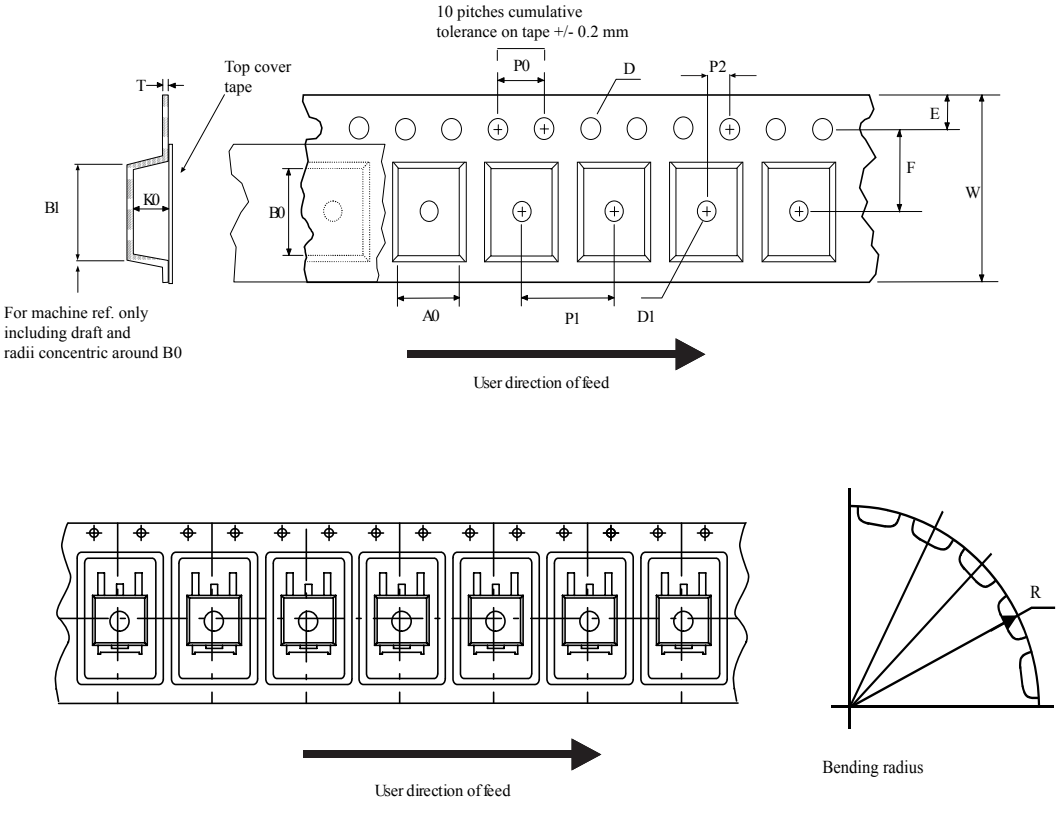

Figure 26. **DPAK (TO-252) reel outline**

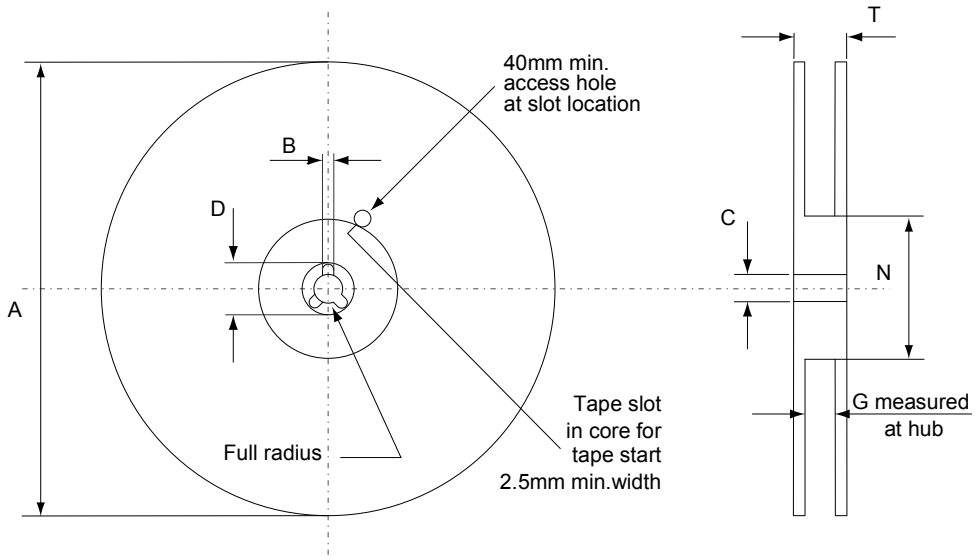

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Table 11. **DPAK (TO-252) tape and reel mechanical data**

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**

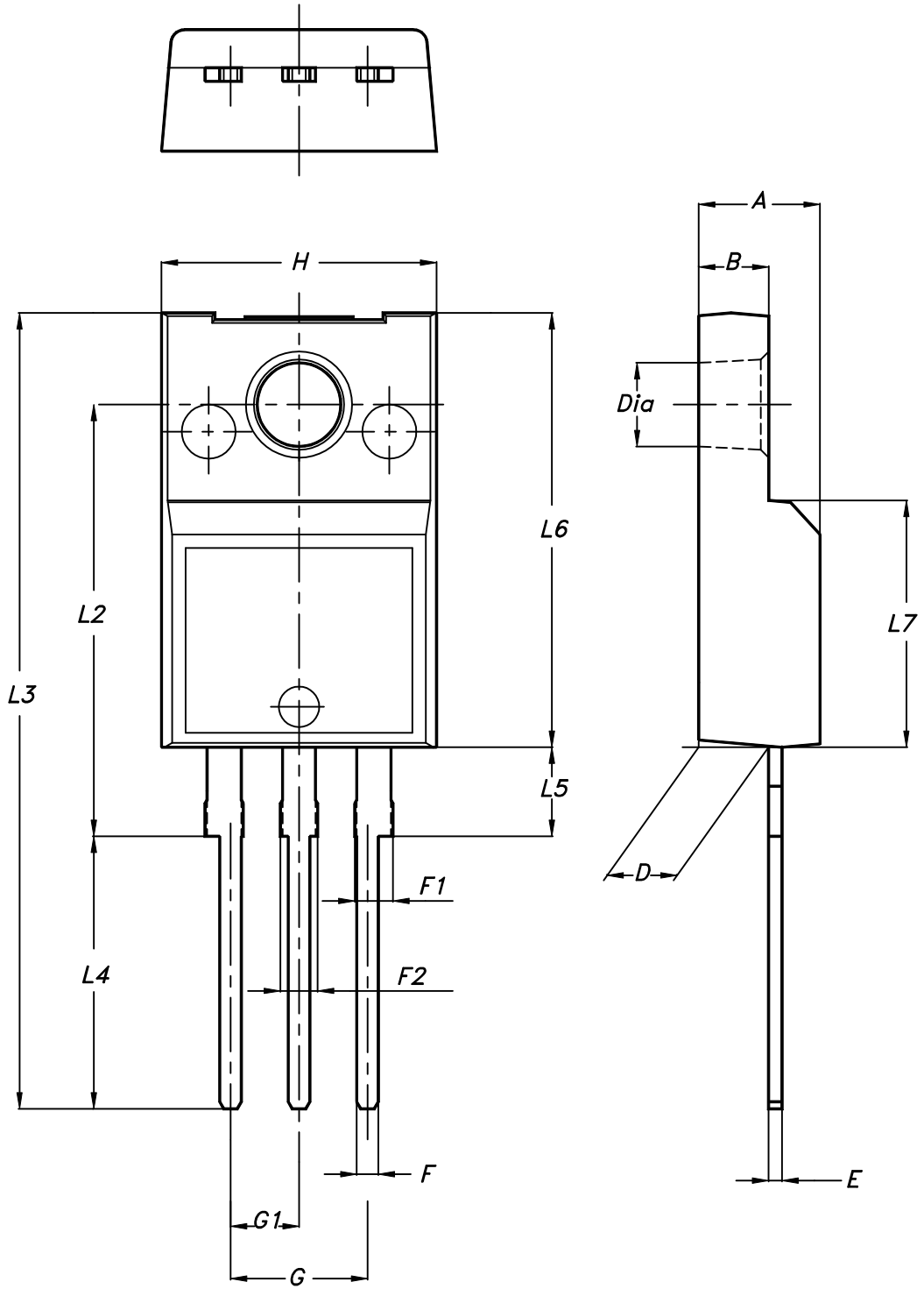

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Table 12. **TO-220FP package mechanical data**

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

Revision history

Table 13. **Document revision history**

Date	Version	Changes
12-Mar-2014	1	First release.
17-Jun-2014	2	– Modified: title – Modified: dv/dt values in *Table 2* – Modified: values in *Table 4* – Modified: $R_{DS(on)}$ value in *Table 5* – Modified: the entire typical values in *Table 6*, *7* and *8* – Added: *Section 2.1: Electrical characteristics (curves)* – Updated: *Section 4: Package mechanical data* – Minor text changes
26-Oct-2018	3	Removed maturity status indication from cover page. The document status is production data. Modified title, features and description on cover page. Updated Section 4 Package information. Minor text changes.

Contents