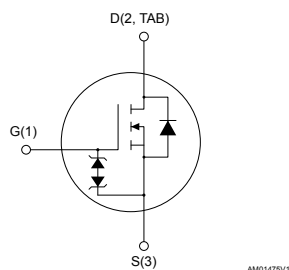
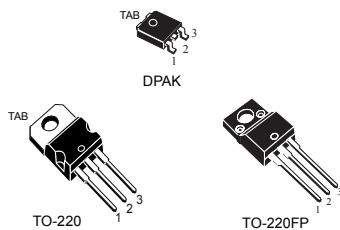


N-channel 500 V, 0.24 Ω typ., 13 A MDmesh™ M2 Power MOSFETs in DPAK, TO-220FP and TO-220 packages



Features

Order code	V_{DS} at T_J max.	$R_{DS(on)}$ max.	I_D	Packages
STD16N50M2	550 V	0.28 Ω	13 A	DPAK
STF16N50M2				TO-220FP
STP16N50M2				TO-220

- 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 link

[STD16N50M2](#)
[STF16N50M2](#)
[STP16N50M2](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		DPAK	TO-220	TO-220FP	
V_{GS}	Gate-source voltage	±25			V
I_D	Drain current (continuous) at $T_C = 25\text{ °C}$	13			A
I_D	Drain current (continuous) at $T_C = 100\text{ °C}$	8			A
$I_{DM}^{(1)}$	Drain current (pulsed)	52			A
P_{TOT}	Total power dissipation at $T_C = 25\text{ °C}$	110		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 ($t = 1\text{ s}$, $T_C = 25\text{ °C}$)	2500			V
T_{stg}	Storage temperature range	-55 to 150			°C
T_j	Operating junction temperature range				

1. Pulse width is limited by safe operating area.
2. $I_{SD} \leq 13\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS\ peak} < V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$
3. $V_{DS} \leq 400\text{ V}$

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		DPAK	TO-220	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case	1.14			°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5			
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	50			

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 non-repetitive (pulse width limited by T_{jmax})	4	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	215	mJ

2 Electrical characteristics

($T_C = 25\text{ °C}$ unless otherwise specified).

Table 4. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	500			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$, $T_C = 125\text{ °C}$			100	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS}^{(1)} = \pm 25\text{ V}$			± 10	μA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}$, $I_D = 6.5\text{ A}$		0.24	0.28	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	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	710	-	pF
C_{oss}	Output capacitance		-	44	-	pF
C_{rss}	Reverse transfer capacitance		-	1.35	-	pF
$C_{oss\ eq.}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}$, $V_{GS} = 0\text{ V}$	-	192	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	5.2	-	Ω
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0\text{ to } 10\text{ V}$ (see Figure 18. Test circuit for gate charge behavior)	-	19.5	-	nC
Q_{gs}	Gate-source charge		-	4	-	nC
Q_{gd}	Gate-drain charge		-	8	-	nC

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	$V_{DD} = 250\text{ V}$, $I_D = 6.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 17. Test circuit for resistive load switching times and Figure 22. Switching time waveform)	-	9.6	-	ns
t_r	Rise time		-	7.6	-	ns
$t_{d(off)}$	Turn-off-delay time		-	32	-	ns
t_f	Fall time		-	10	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		13	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		52	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 13\text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 13\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 19. Test circuit for inductive load switching and diode recovery times)	-	280		ns
Q_{rr}	Reverse recovery charge		-	2.85		μC
I_{RRM}	Reverse recovery current		-	20.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 13\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 19. Test circuit for inductive load switching and diode recovery times)	-	388		ns
Q_{rr}	Reverse recovery charge		-	4.5		μC
I_{RRM}	Reverse recovery current		-	21		A

1. Pulse width is limited by safe operating area.
2. Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

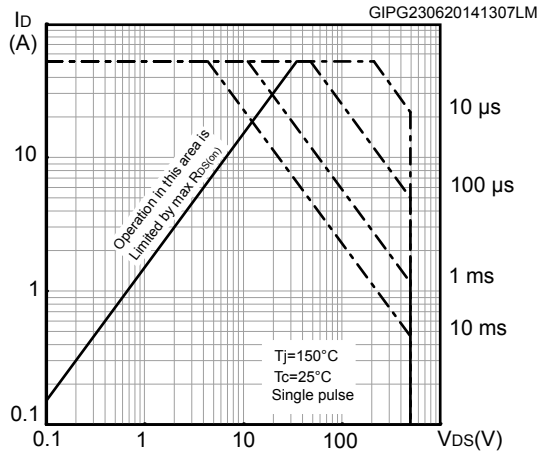
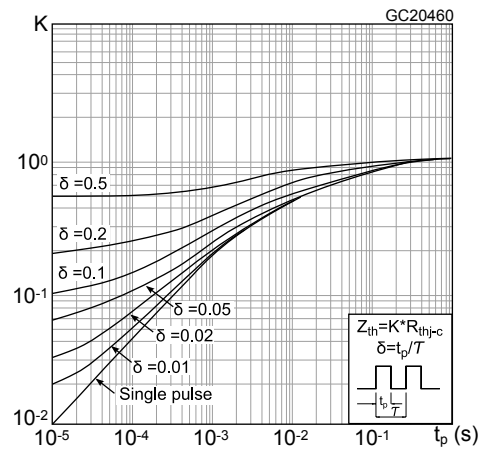
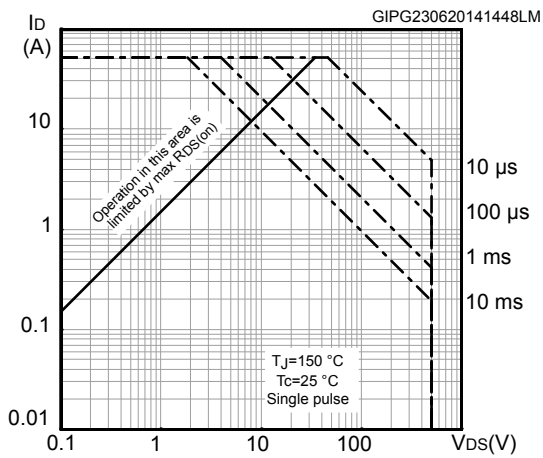
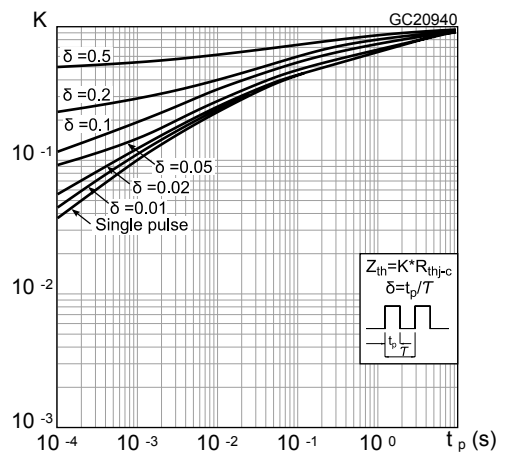
2.1 Electrical characteristics (curves)
Figure 1. Safe operating area for DPAK

Figure 2. Thermal impedance for DPAK

Figure 3. Safe operating area for TO-220FP

Figure 4. Thermal impedance for TO-220FP


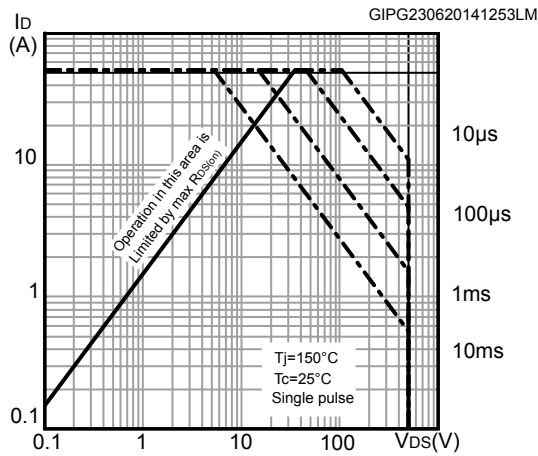
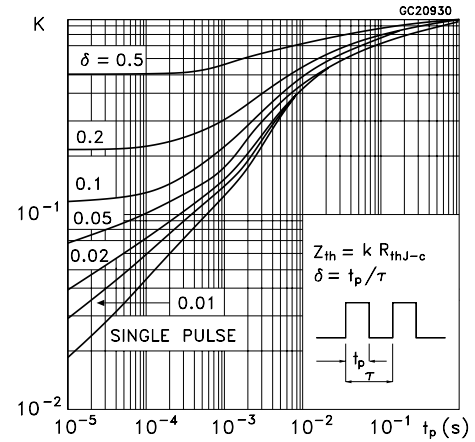
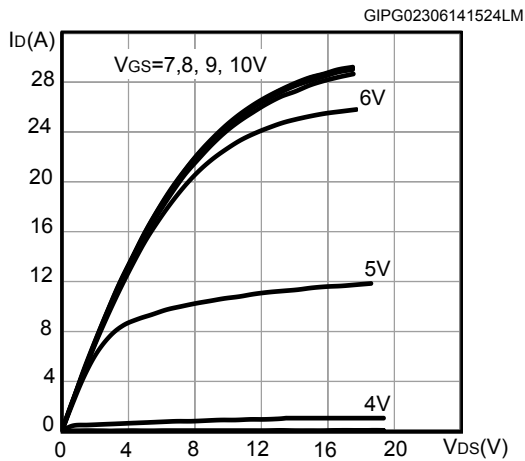
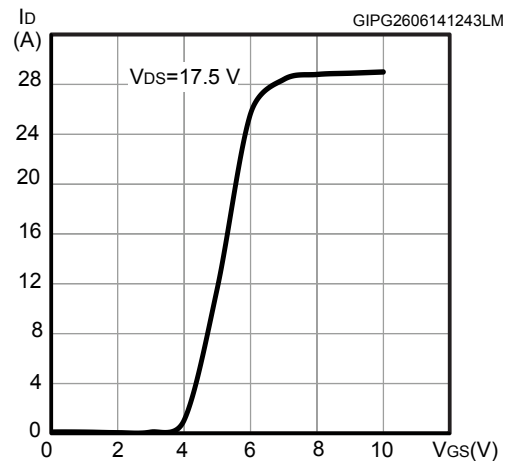
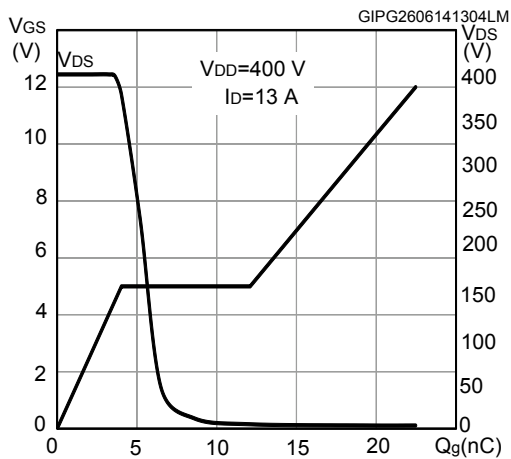
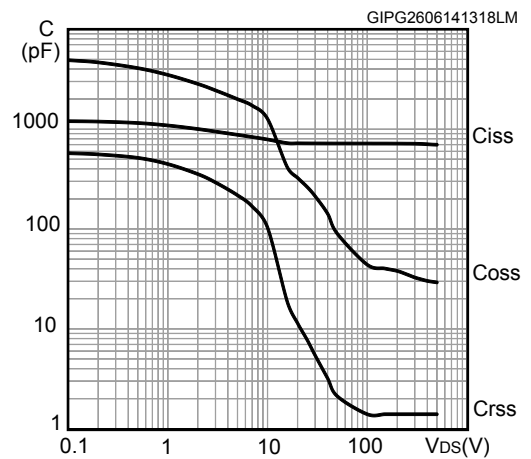
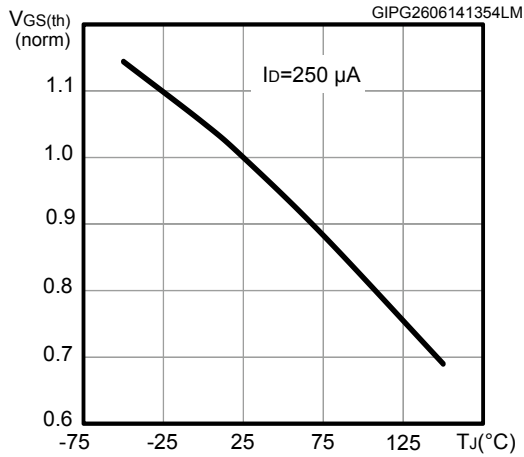
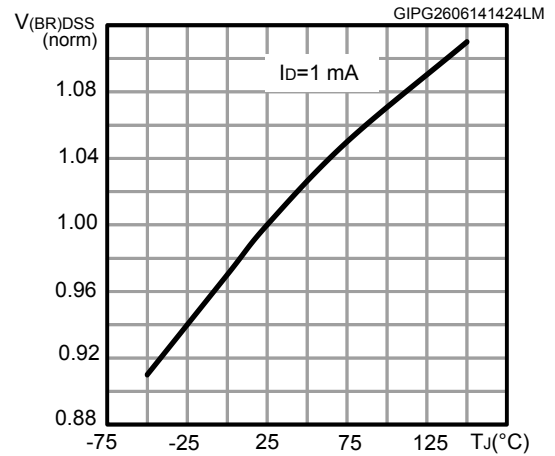
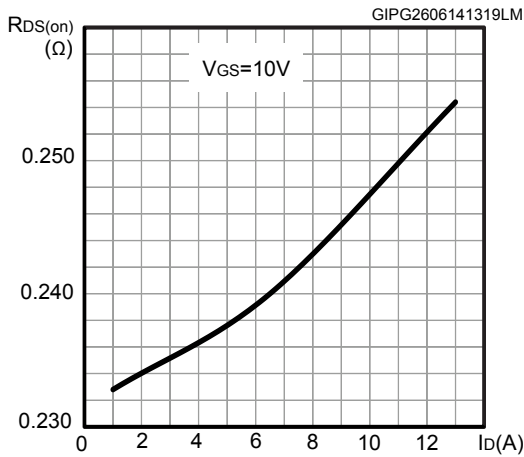
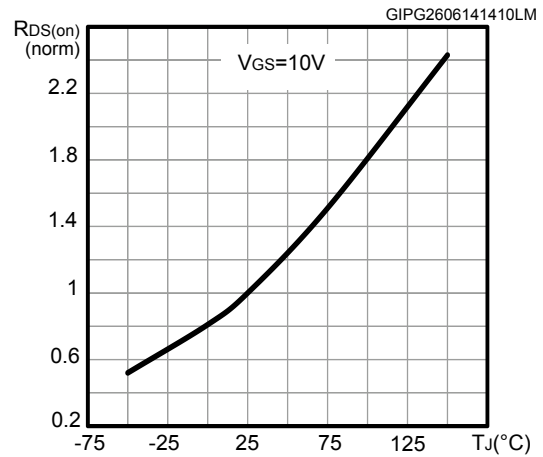
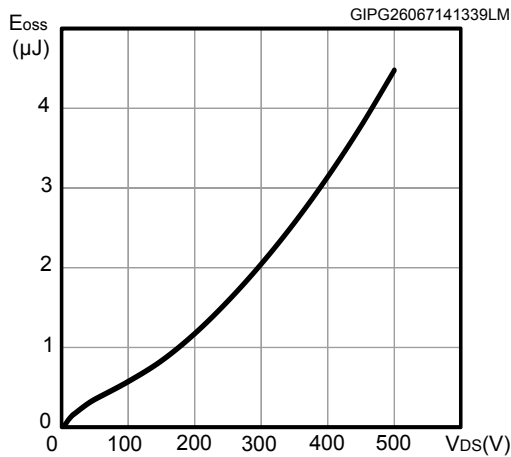
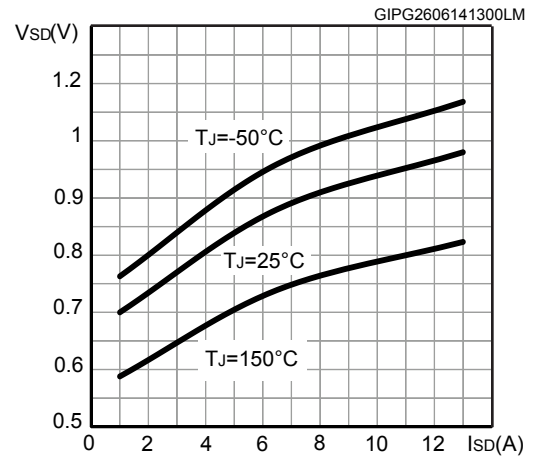
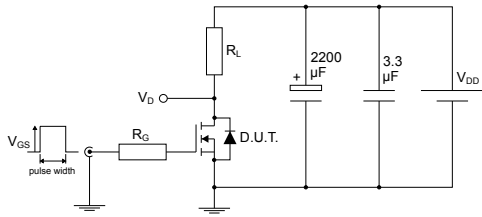
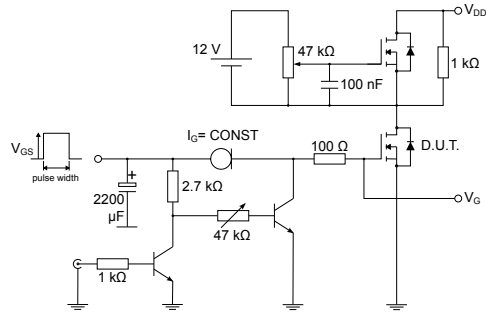
Figure 5. Safe operating area for TO-220

Figure 6. Thermal impedance for TO-220

Figure 7. Output characteristics

Figure 8. Transfer characteristics

Figure 9. Gate charge vs. gate-source voltage

Figure 10. Capacitance variations


Figure 11. Normalized gate threshold voltage vs. temperature

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

Figure 13. Static drain-source on-resistance

Figure 14. Normalized on-resistance vs. temperature

Figure 15. Output capacitance stored energy

Figure 16. Source-drain diode forward characteristics


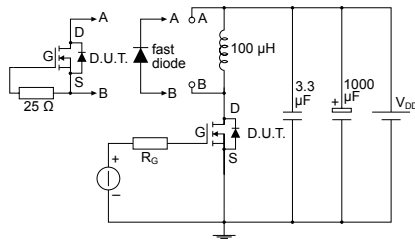
3 Test circuits

Figure 17. Test circuit for resistive load switching times


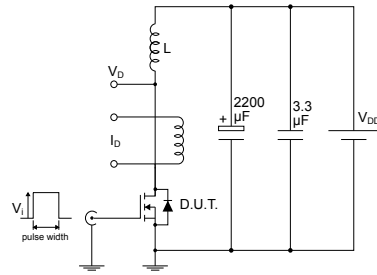
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Figure 18. Test circuit for gate charge behavior


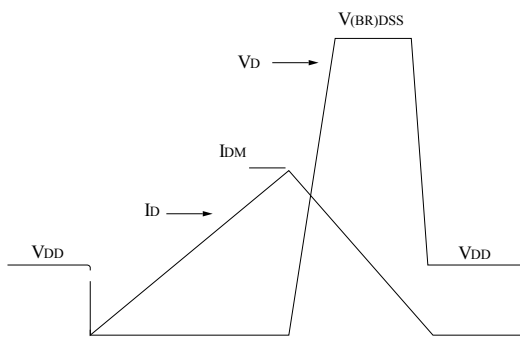
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Figure 19. Test circuit for inductive load switching and diode recovery times


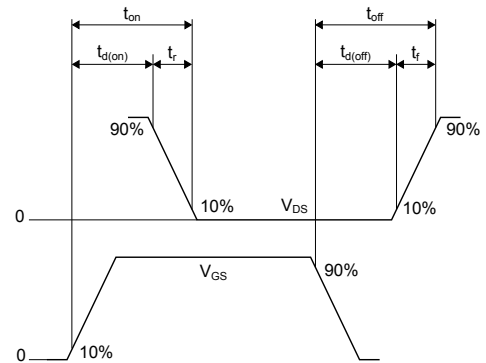
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Figure 20. Unclamped inductive load test circuit


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Figure 21. Unclamped inductive waveform


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Figure 22. Switching time waveform


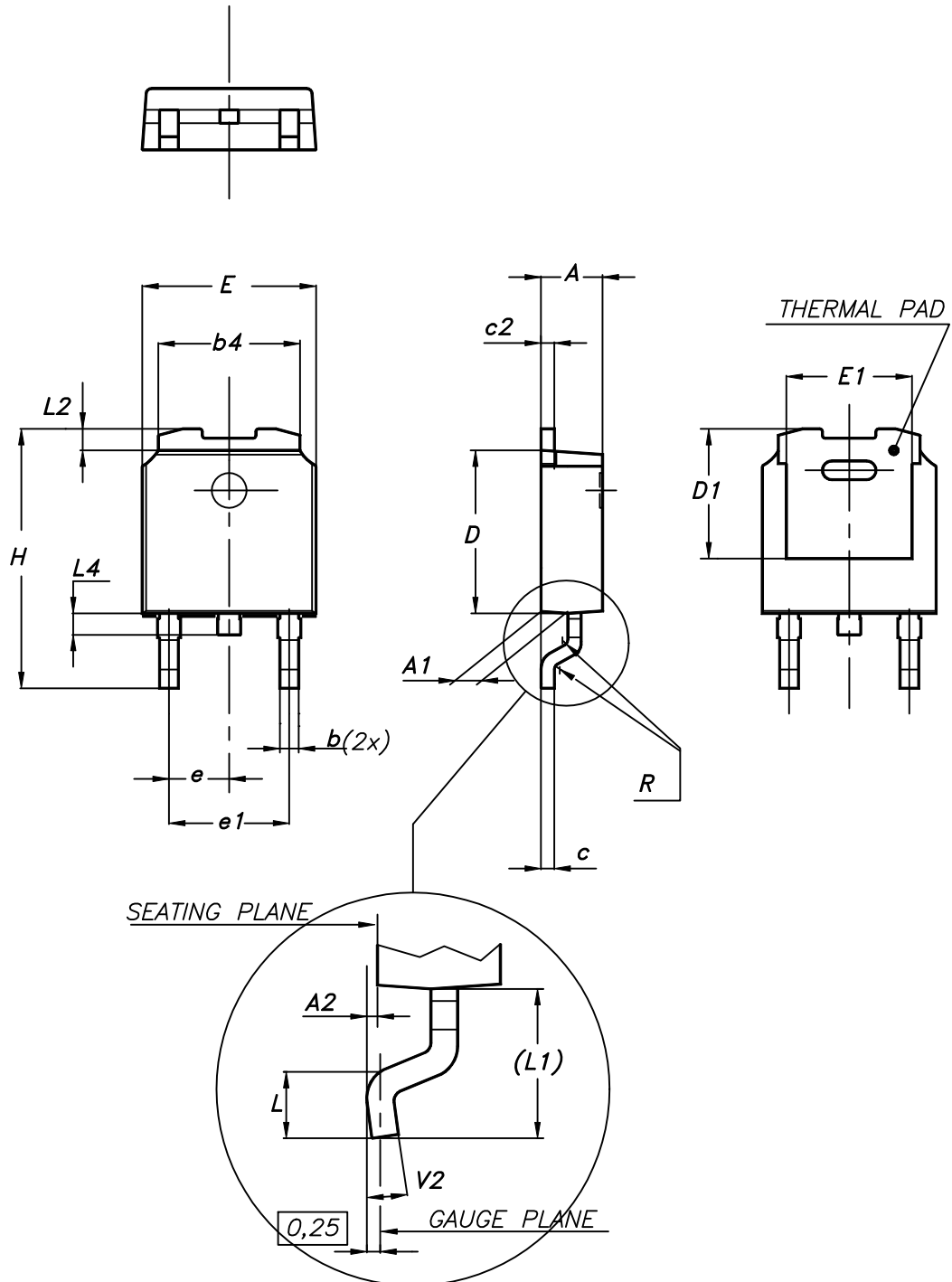
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4 Package information

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 A2 package information

Figure 23. DPAK (TO-252) type A2 package outline



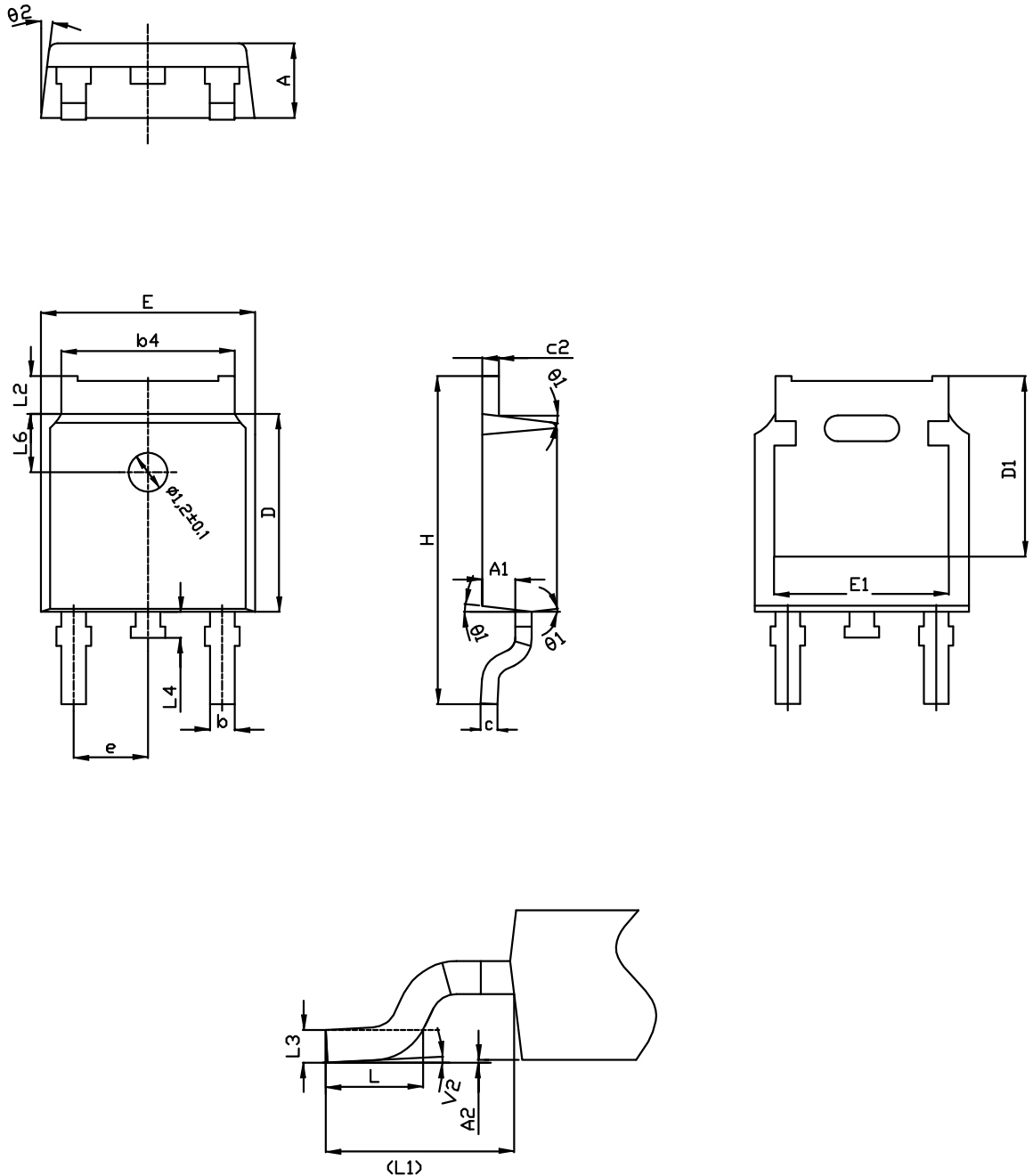
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Table 8. DPAK (TO-252) type A2 mechanical data

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	5.10	5.20	5.30
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 C2 package information

Figure 24. DPAK (TO-252) type C2 package outline

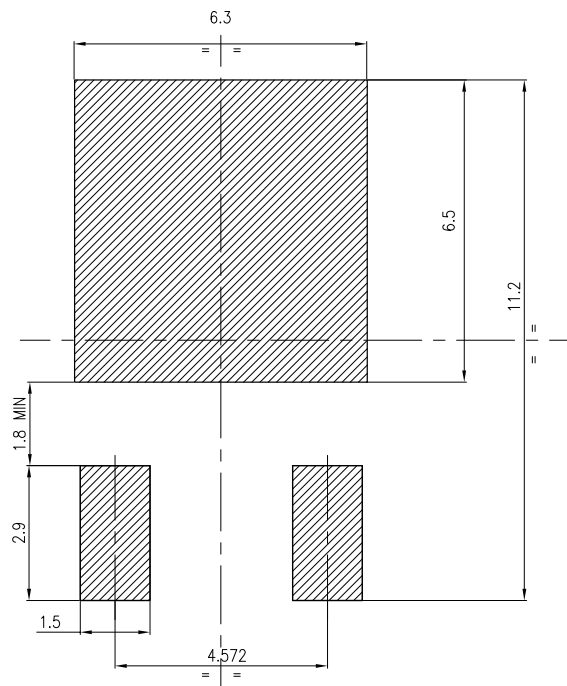


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Table 9. DPAK (TO-252) type C2 mechanical data

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	5.10		5.60
E	6.50	6.60	6.70
E1	5.20		5.50
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°

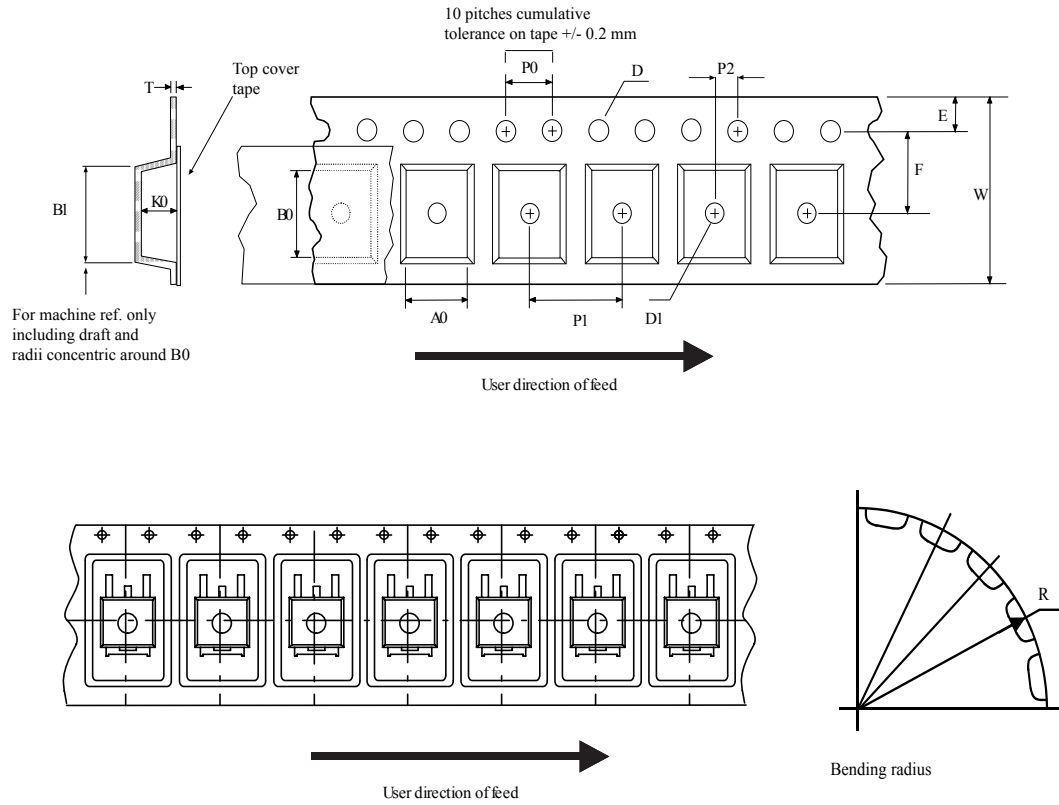
Figure 25. DPAK (TO-252) recommended footprint (dimensions are in mm)



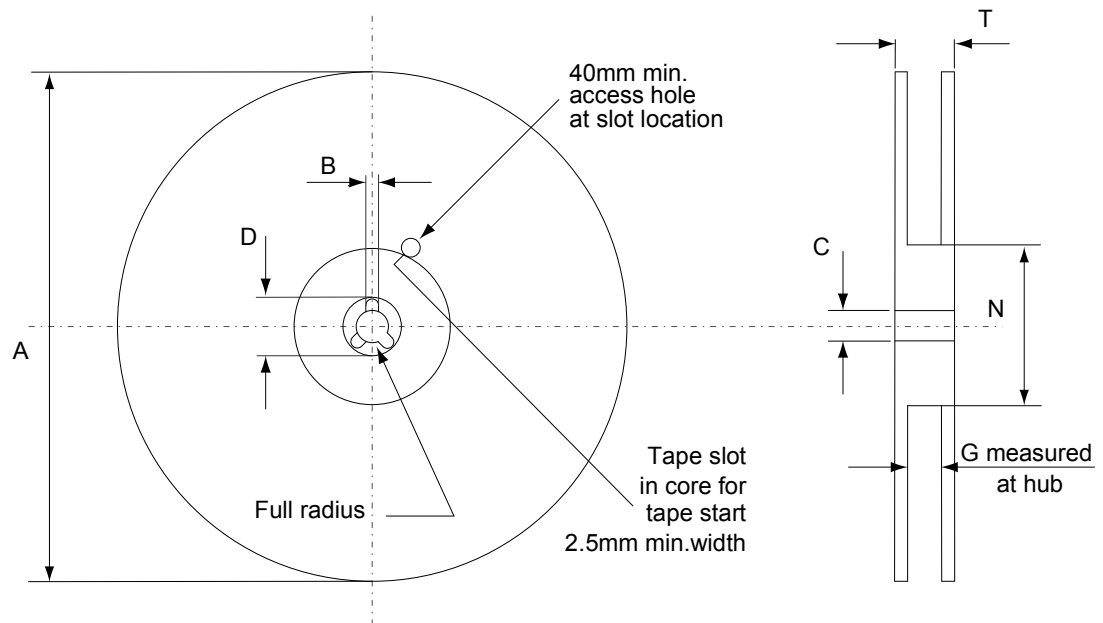
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4.3 DPAK (TO-252) packing information

Figure 26. DPAK (TO-252) tape outline



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Figure 27. DPAK (TO-252) reel outline


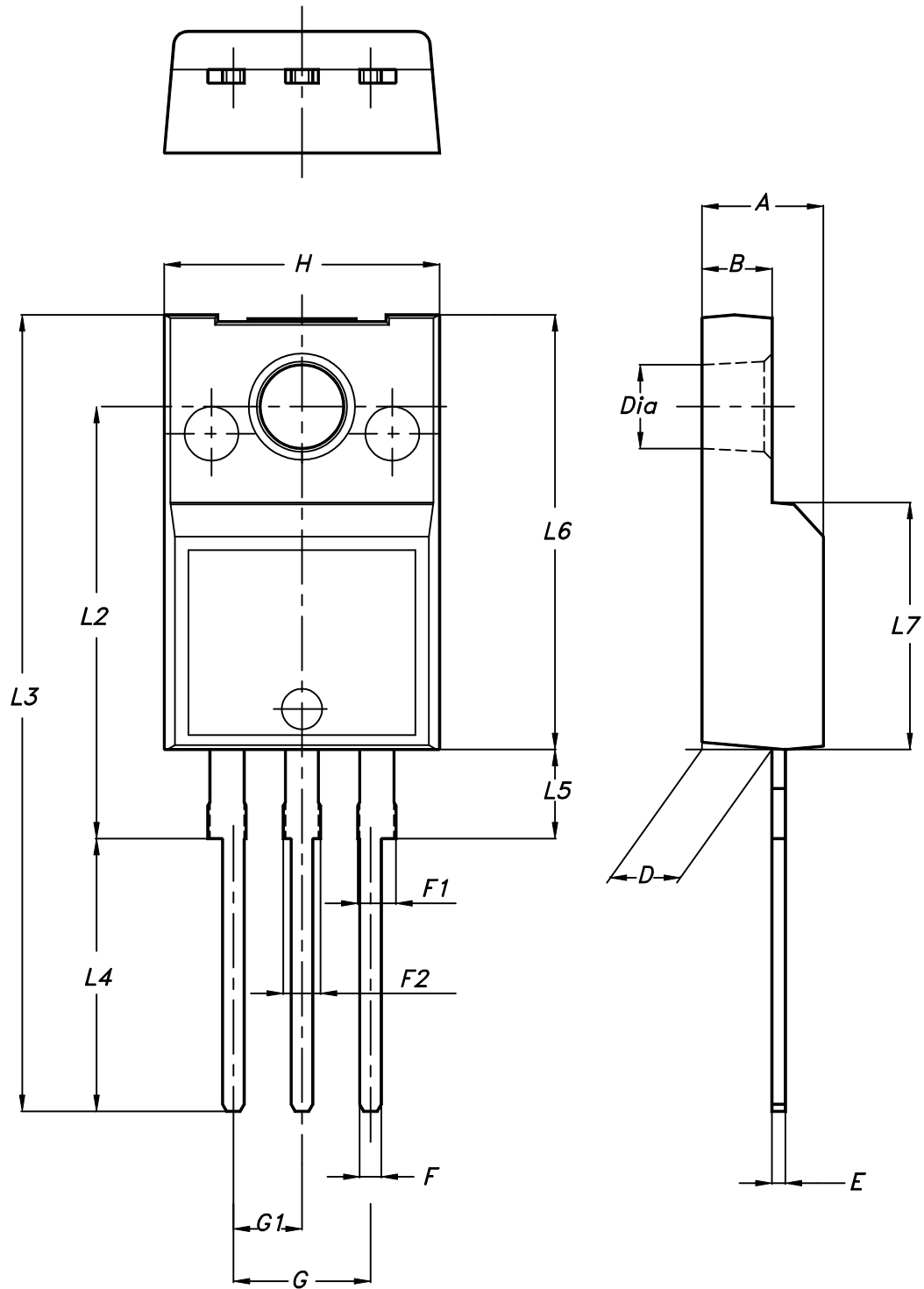
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Table 10. DPAK (TO-252) tape and reel mechanical data

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			

4.4 TO-220FP package information

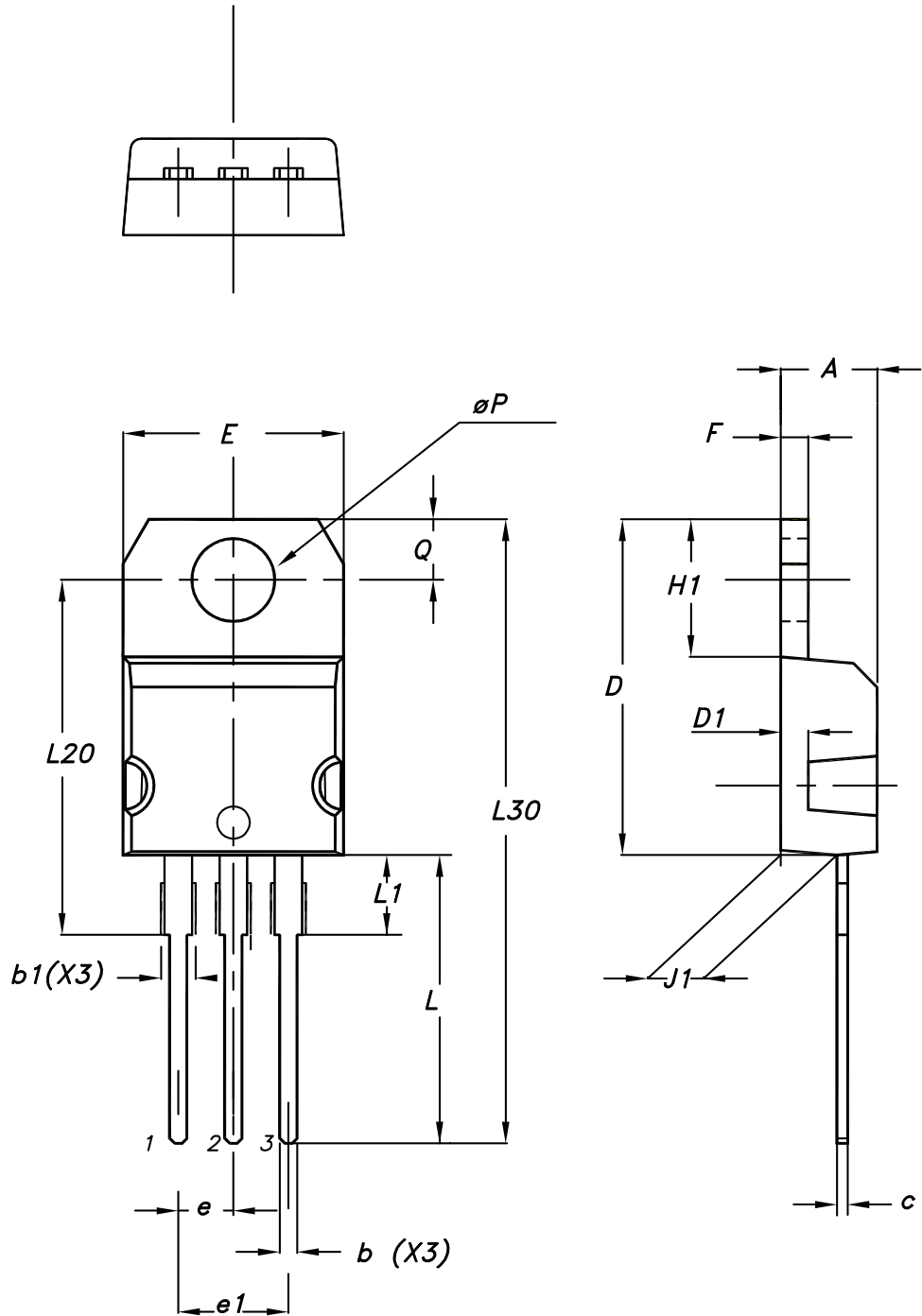
Figure 28. TO-220FP package outline



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Table 11. 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

4.5 TO-220 type A package information
Figure 29. TO-220 type A package outline


0015988_typeA_Rev_22

Table 12. TO-220 type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

5 Ordering information

Table 13. Ordering information

Order code	Marking	Package	Packing
STD16N50M2	16N50M2	DPAK	Tape and reel
STF16N50M2		TO-220FP	Tube
STP16N50M2		TO-220	

Revision history

Table 14. Document revision history

Date	Revision	Changes
04-Jul-2014	1	Initial release.
18-Jul-2014	2	Updated <i>Figure 9</i> .
31-Jul-2014	3	Updated <i>Figure 2</i> and <i>Figure 4</i> .
25-Aug-2016	4	Datasheet promoted from preliminary data to production data Changed: <i>Section 4.1: "DPAK (TO-252) type A2 package information"</i> Minor text changes
04-May-2017	5	Updated marking in Table 1: "Device summary". Updated Figure 3: "Thermal impedance for DPAK". Minor text changes
04-Dec-2018	6	Updated Features, Table 1. Absolute maximum ratings , Table 4. On /off states , Table 5. Dynamic . Added Section 4.2 DPAK (TO-252) type C2 package information and Section 5 Ordering information .

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4.3	DPAK (TO-252) packing information	14
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