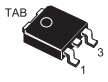
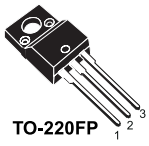
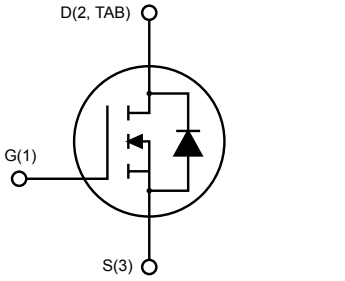
N-channel 250 V, 0.195 Ω typ., 14 A STripFET™ II Power MOSFETs in DPAK and TO-220FP packages



DPAK



TO-220FP



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	Package
STD16NF25	250 V	0.235 Ω	14 A	DPAK
STF16NF25				TO-220FP

- Exceptional dv/dt capability
- 100% avalanche tested
- Low gate charge

Applications

- Switching applications

Description

These Power MOSFETs have been developed using STMicroelectronics' unique STripFET process, which is specifically designed to minimize input capacitance and gate charge. This renders the devices suitable for use as primary switch in advanced high-efficiency isolated DC-DC converters for telecom and computer applications, and applications with low gate charge driving requirements.

STPOWER

Product status link
STD16NF25
STF16NF25

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		DPAK	TO-220FP	
V_{DS}	Drain-source voltage	250		V
V_{GS}	Gate-source voltage	±20		V
I_D	Drain current (continuous) at T_C = 25 °C	14	14 (1)	A
I_D	Drain current (continuous) at T_C = 100 °C	8.8	8.8 (1)	A
I_{DM} (2)	Drain current (pulsed)	56	56(1)	A
P_{TOT}	Total power dissipation at T_C = 25 °C	85	25	W
dv/dt (3)	Peak diode recovery voltage slope	15		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. *Limited by maximum junction temperature.*
2. *Pulse width limited by safe operating area.*
3. *I_{SD} ≤ 13 A, di/dt ≤ 300 A/µs, V_{DD} = 80% $V_{(BR)DSS}$, T_j ≤ T_{JMAX}.*

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		
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient		62.5	

1. *When mounted on FR-4 board of 1 inch², 2 oz Cu.*

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR} (1)	Avalanche current, repetitive or not-repetitive	13	A
E_{AS} (2)	Single pulse avalanche energy	100	mJ

1. *Pulse width limited by T_{jmax}.*
2. *Starting T_j = 25°C, I_D = I_{AR}, V_{DD} = 50 V.*

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	V_{GS} = 0 V, I_D = 1 mA	250			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 250 V			1	µA
		V_{GS} = 0 V, V_{DS} = 250 V, T_C = 125 °C (1)			10	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V			±100	nA
$V_{GS(th)}$	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 = 6.5 A		0.195	0.235	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} = 25 V, f = 1 MHz, V_{GS} = 0 V	-	680	-	pF
C_{oss}	Output capacitance			125		
C_{rss}	Reverse transfer capacitance			20		
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0 V to 200 V	-	48	-	pF
R_G	Gate input resistance	f = 1 MHz, I_D = 0 A	-	2.1	-	Ω
Q_g	Total gate charge	V_{DD} = 200 V, I_D = 13 A, V_{GS} = 0 to 10 V (see Figure 16. Test circuit for gate charge behavior)	-	18	-	nC
Q_{gs}	Gate-source charge			3		
Q_{gd}	Gate-drain charge			9		

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} = 125 V, I_D = 6.5 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)	-	9	-	ns
t_r	Rise time			17		
$t_{d(off)}$	Turn-off delay time			35		
t_f	Fall time			17		

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		14	A
I_{SDM} (1)	Source-drain current (pulsed)		-		56	
V_{SD} (2)	Forward on voltage	I_{SD} = 13 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 13 A, di/dt = 100 A/µs	-	133		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V (see Figure 17. Test circuit for inductive load switching and diode recovery times)	-	651		nC
I_{RRM}	Reverse recovery current		-	10		A
t_{rr}	Reverse recovery time	I_{SD} = 13 A, di/dt = 100 A/µs	-	157		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)	-	895		nC
I_{RRM}	Reverse recovery current		-	11		A

1. *Pulse width is 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

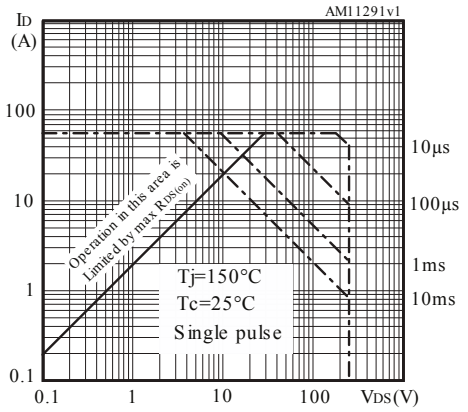


Figure 2. Thermal impedance for DPAK

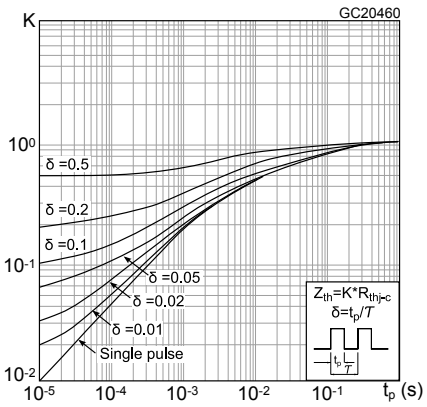


Figure 3. Safe operating area for TO-220FP

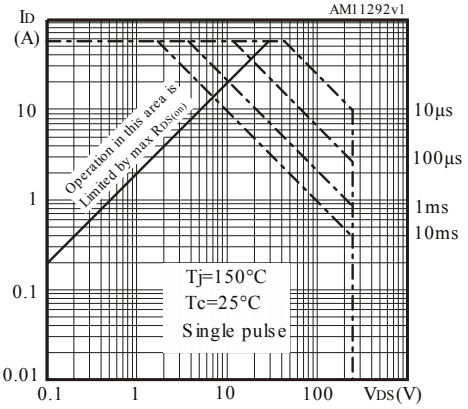


Figure 4. Thermal impedance for TO-220FP

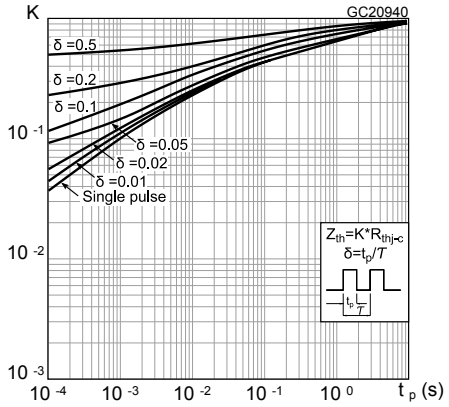


Figure 5. Output characterisics

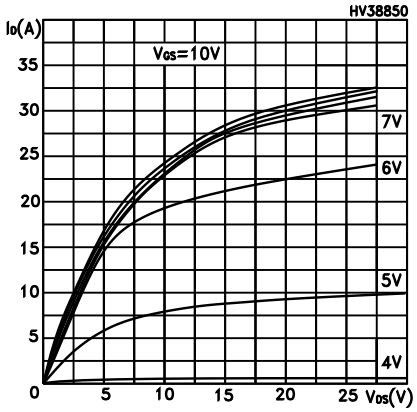


Figure 6. Transfer characteristics

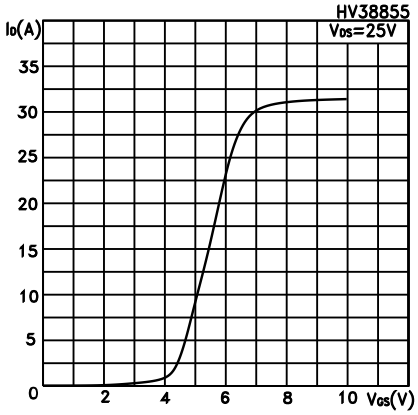


Figure 7. Normalized $V_{(BR)DSS}$ vs temperature

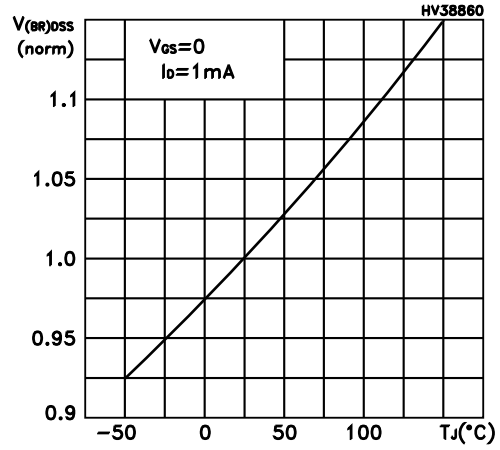


Figure 8. Static drain-source on resistance

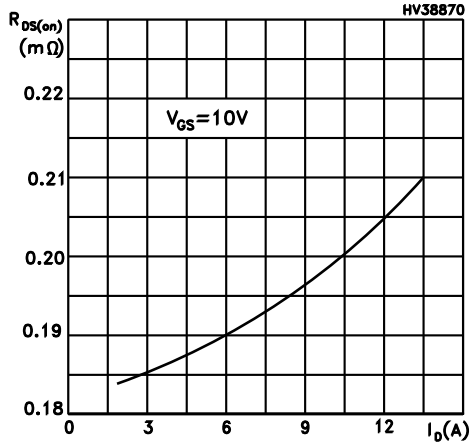


Figure 9. Gate charge vs gate-source voltage

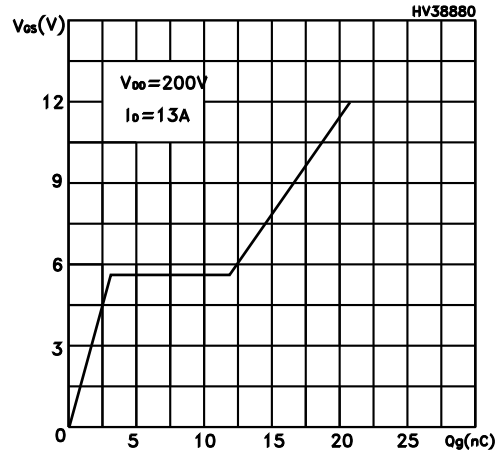


Figure 10. Capacitance variations

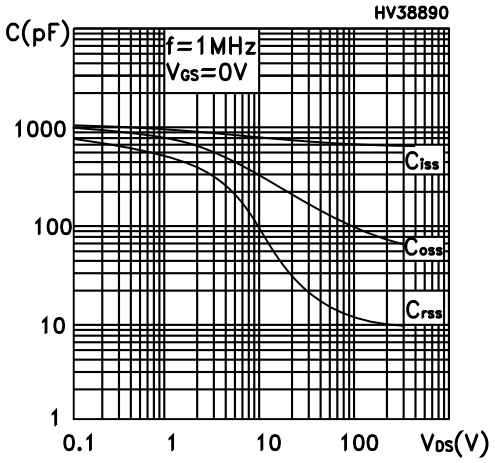


Figure 11. Normalized gate threshold voltage vs temperature

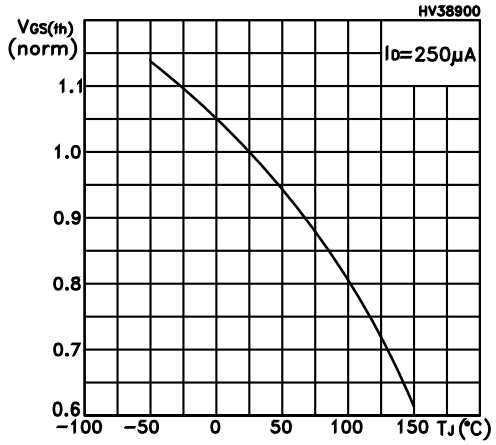


Figure 12. Normalized on resistance vs temperature

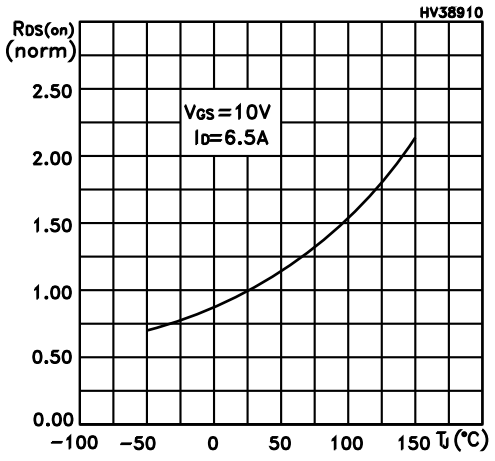


Figure 13. Source-drain diode forward characteristics

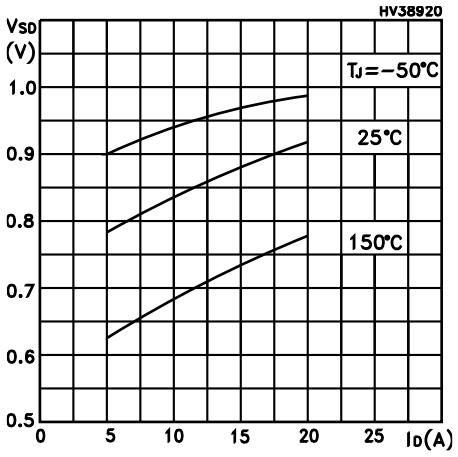
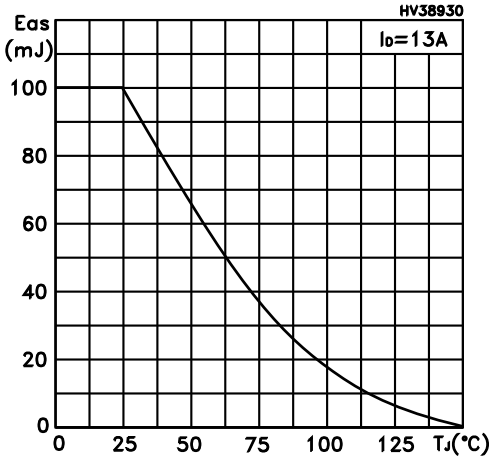


Figure 14. Maximum avalanche energy vs temperature



3 Test circuits

Figure 15. Test circuit for resistive load switching times

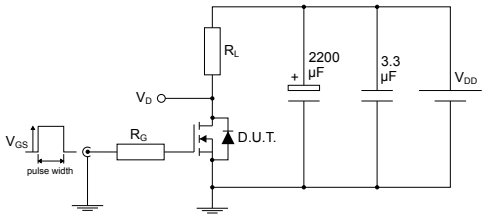


Figure 16. Test circuit for gate charge behavior

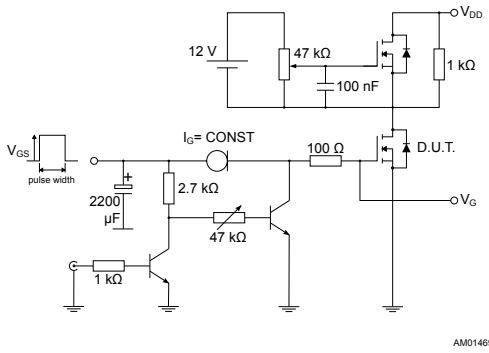


Figure 17. Test circuit for inductive load switching and diode recovery times

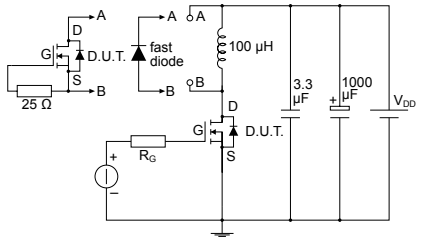


Figure 18. Unclamped inductive load test circuit

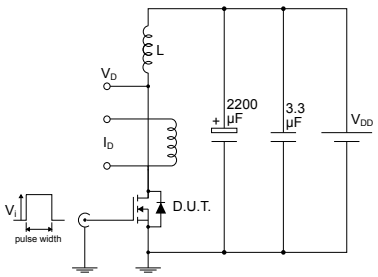


Figure 19. Unclamped inductive waveform

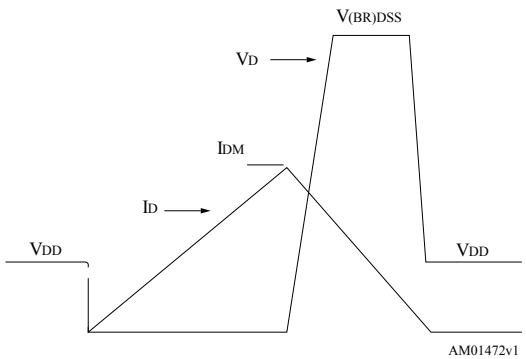
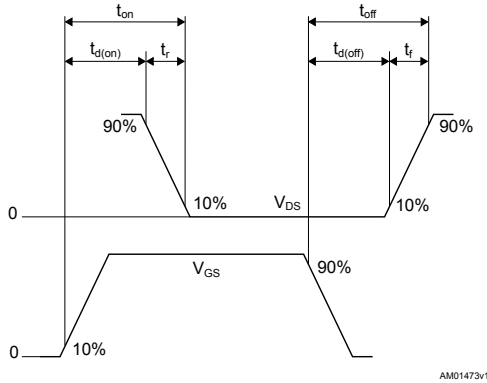


Figure 20. Switching time waveform

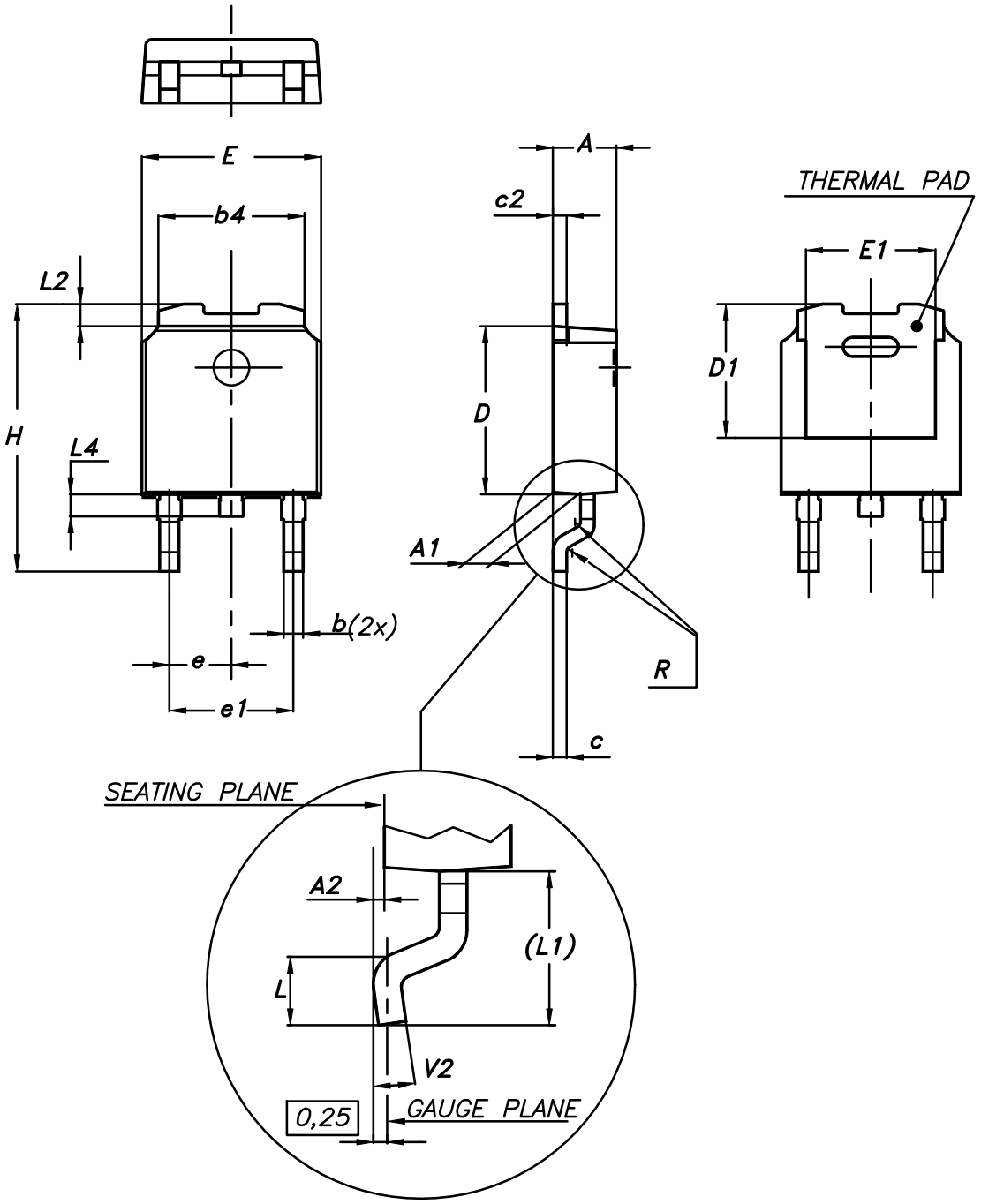


4 Package information

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**



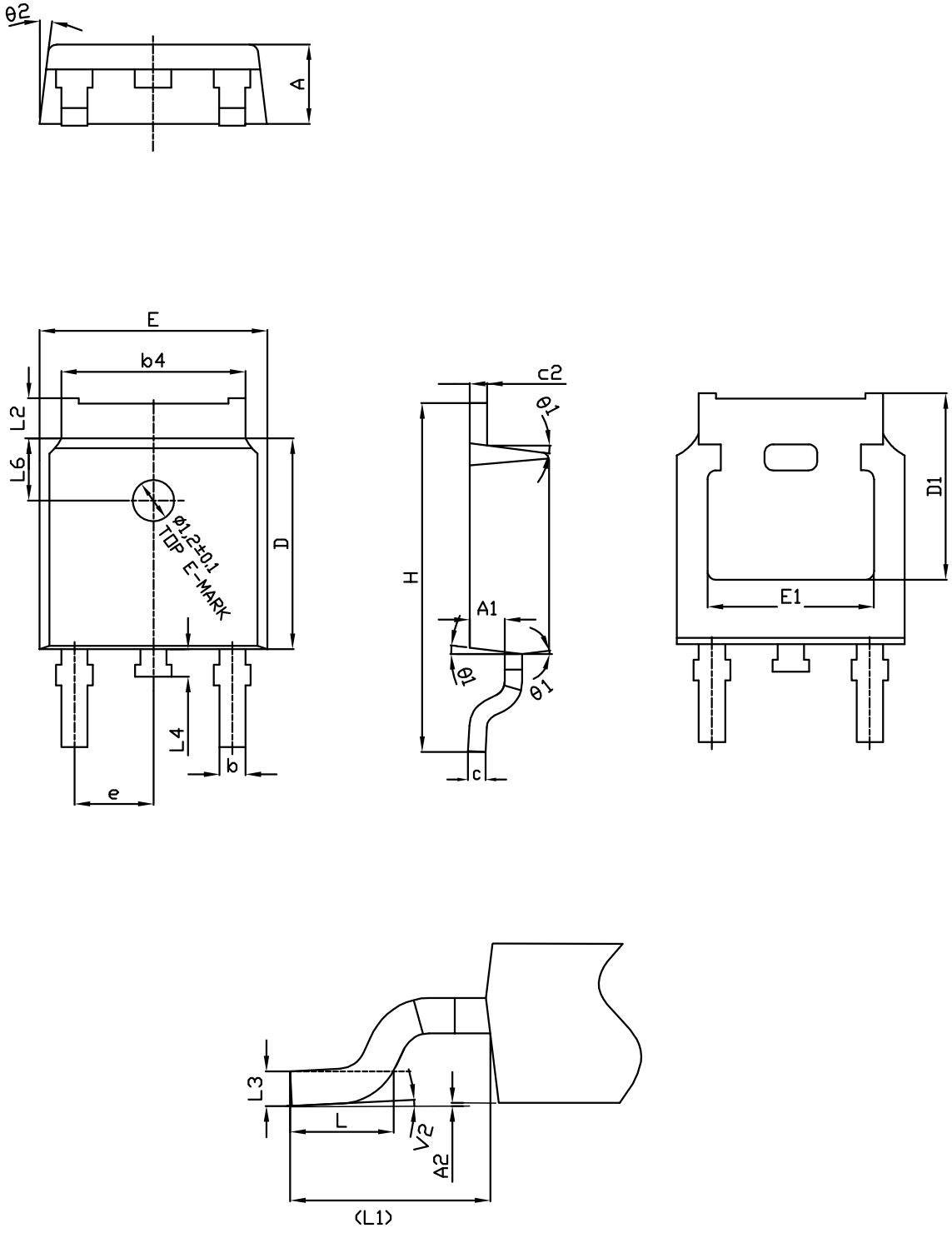
0068772_A_26

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 C2 package information

Figure 22. **DPAK (TO-252) type C2 package outline**

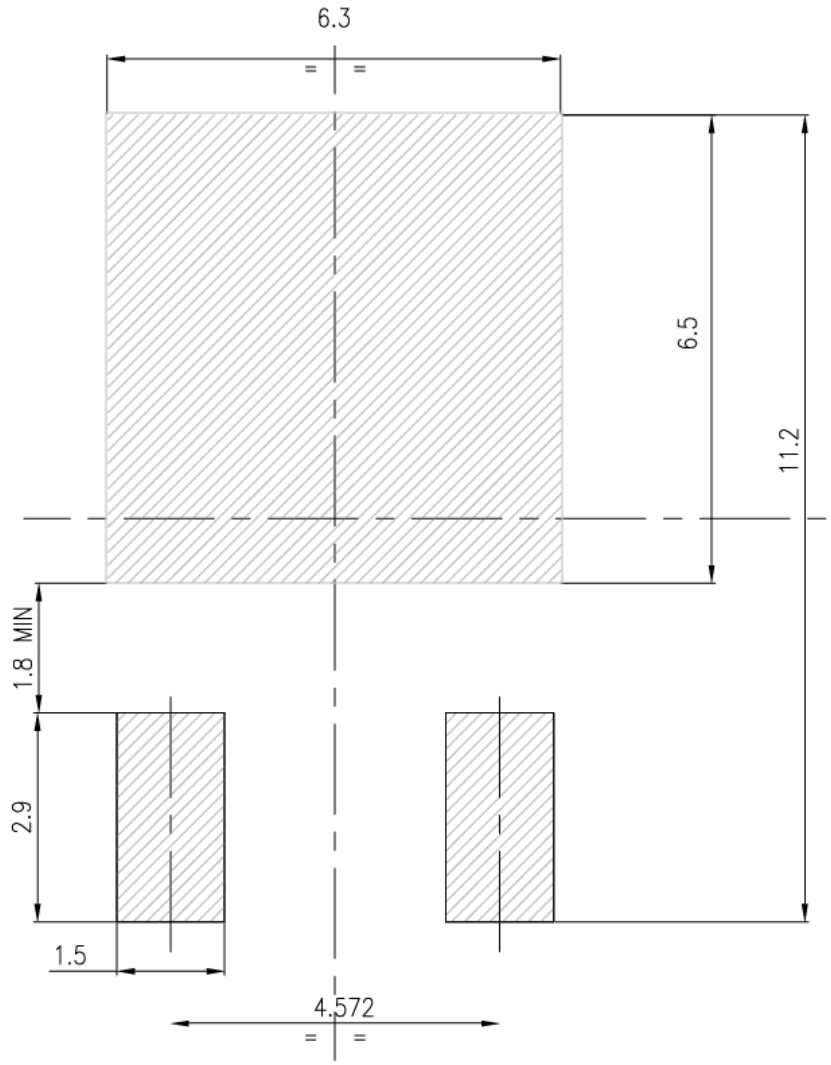


0068772_type-C2_rev26

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



4.3 DPAK (TO-252) packing information

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

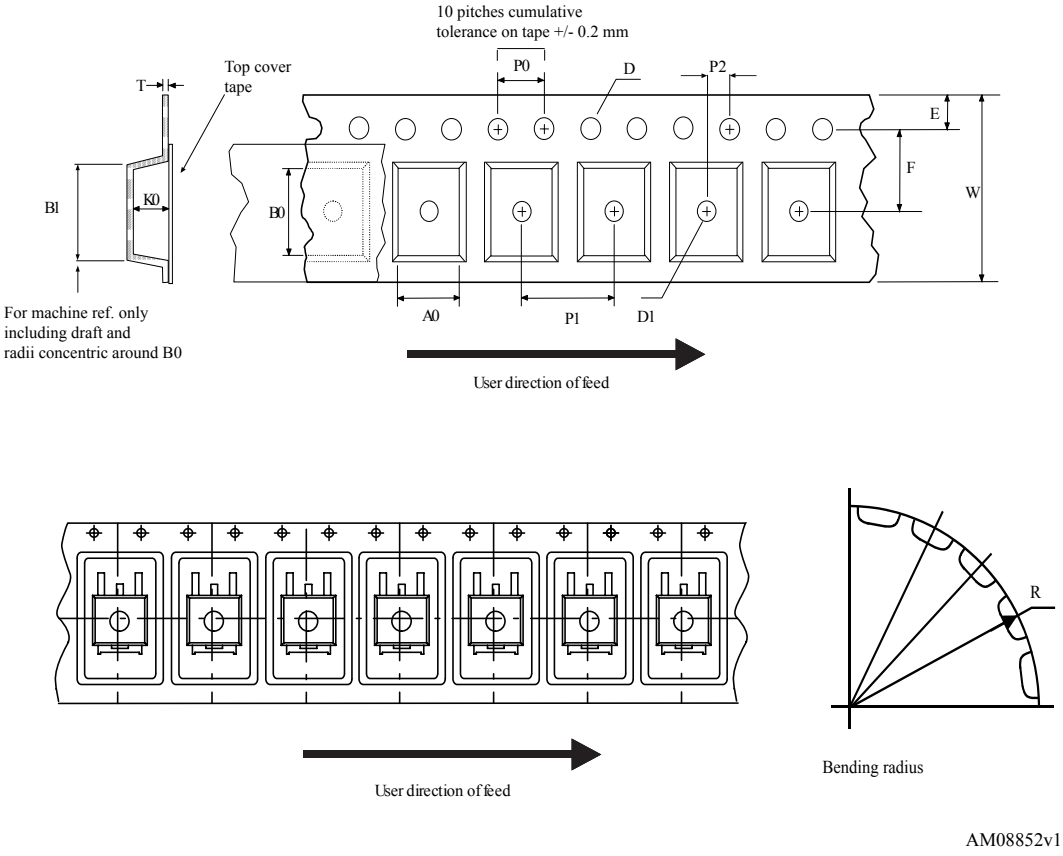
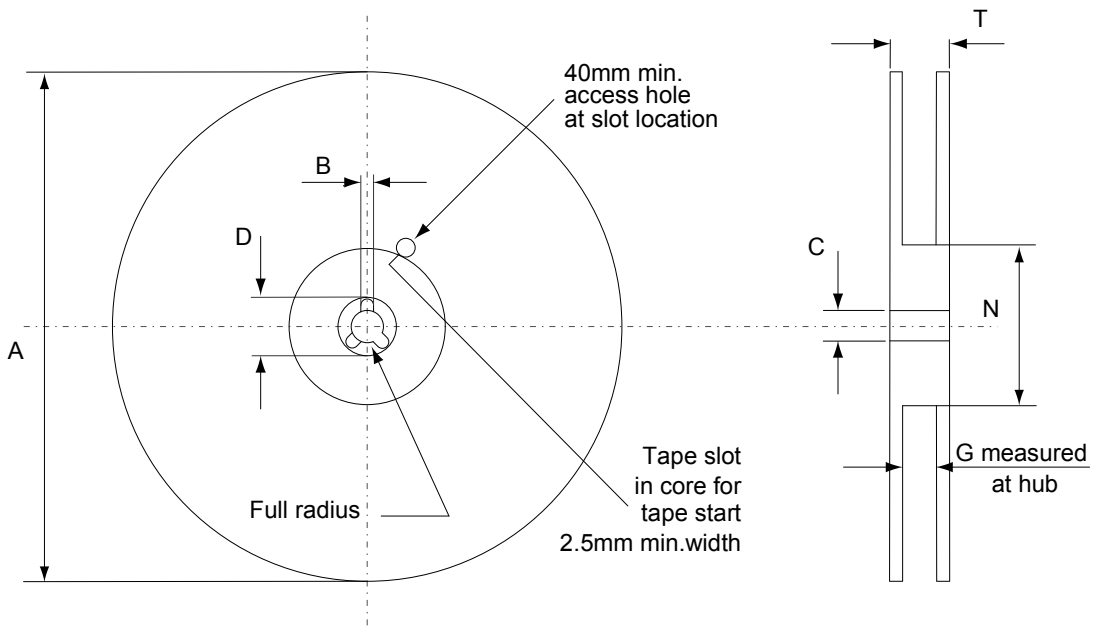


Figure 25. **DPAK (TO-252) reel outline**



AM06038v1

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 26. **TO-220FP package outline**

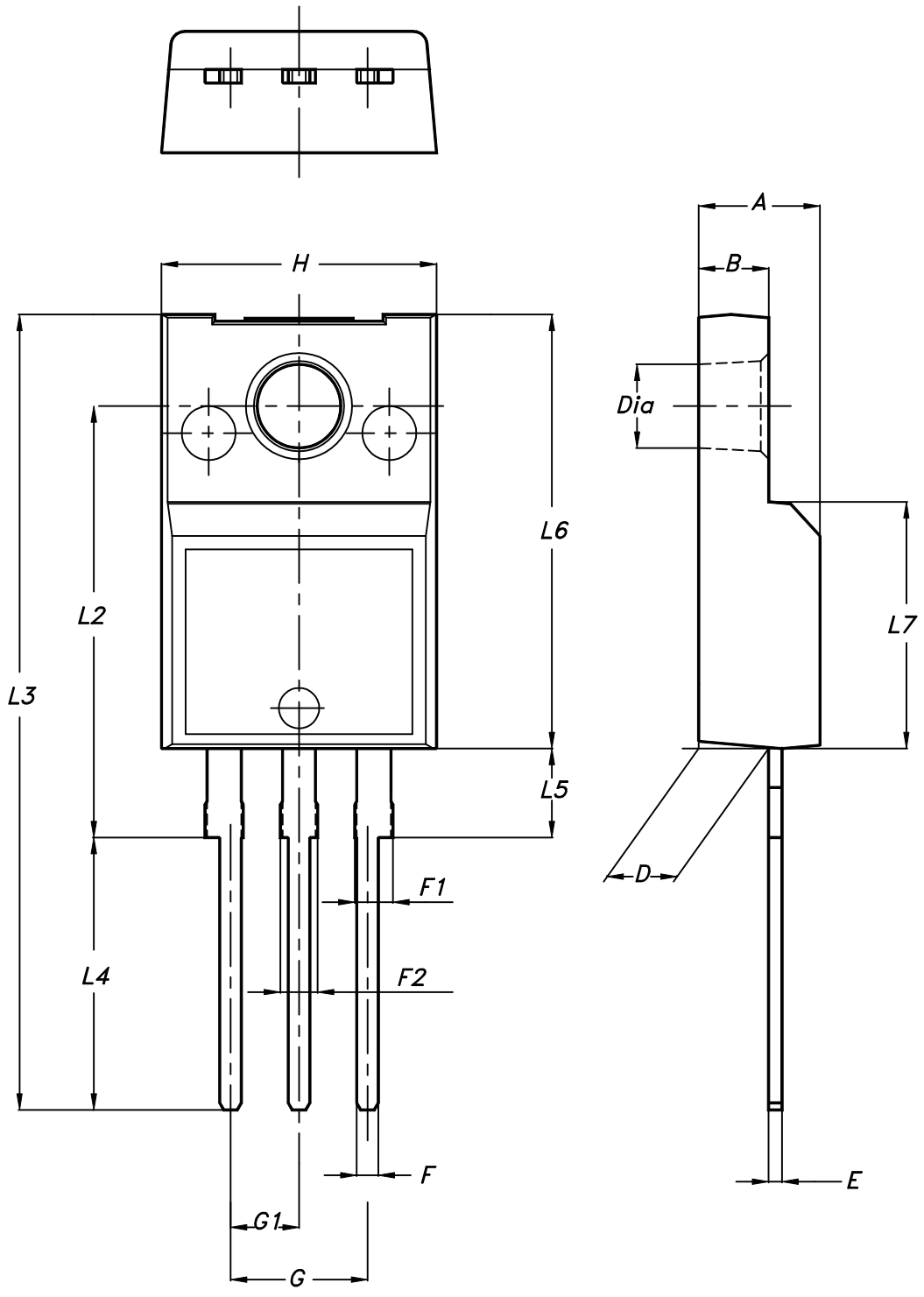


Table 11. **TO-220FP package mechanical data**

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

5 Ordering information

Table 12. **Order codes**

Order code	Marking	Package	Packing
STD16NF25	16NF25	DPAK	Tape and reel
STF16NF25		TO-220FP	Tube

Revision history

Table 13. **Document revision history**

Date	Version	Changes
12-Oct-2007	1	Initial release.
13-Nov-2007	2	Modified: *Figure 13: Capacitance variations.*
29-Mar-2012	3	*Figure 2: Safe operating area for TO-220, Figure 4: Safe operating area for TO-220FP* and *Figure 6: Safe operating area for DPAK* have been updated. *Section 4: Package mechanical data* and *Section 5: Packaging mechanical data* have been updated. Minor text changes
06-Mar-2013	4	– Modified: PTOT, derating factor values, *note 1* on *Table 2*, Rthj-case, Rthj-amb only for TO-220 and DPAK – Updated: *Section 4: Package mechanical data* – Minor text changes
21-Jan-2019	5	The part number STP16NF25 has been moved to a separate datasheet. Removed maturity status indication from cover page. The document status is production data. Updated Section 4 Package information. Minor text changes.

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