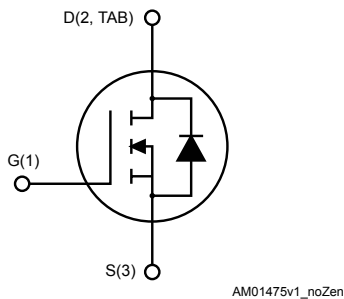


## N-channel 250 V, 0.195 $\Omega$ typ., 14 A STripFET™ II Power MOSFETs in DPAK and TO-220FP packages



### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$	Package
STD16NF25	250 V	0.235 $\Omega$	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.



#### 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 $T_C = 25\text{ °C}$	14	14 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ °C}$	8.8	8.8 <sup>(1)</sup>	A
$I_{DM}$ <sup>(2)</sup>	Drain current (pulsed)	56	56 <sup>(1)</sup>	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	85	25	W
$dv/dt$ <sup>(3)</sup>	Peak diode recovery voltage slope	15		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			

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- $I_{SD} \leq 13\text{ A}$ ,  $di/dt \leq 300\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$ .

**Table 2. Thermal data**

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

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

**Table 3. Avalanche characteristics**

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

- Pulse width limited by  $T_{jmax}$ .
- Starting  $T_j = 25\text{ °C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$ .

## 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	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	250			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 250\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 250\text{ V}$ , $T_C = 125\text{ °C}$ <sup>(1)</sup>			10	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$			$\pm 100$	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	$V_{GS} = 10\text{ V}$ , $I_D = 6.5\text{ A}$		0.195	0.235	$\Omega$

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	680	-	$\mu\text{F}$
$C_{oss}$	Output capacitance			125		
$C_{rSS}$	Reverse transfer capacitance			20		
$C_{oss\text{ eq.}}$ <sup>(1)</sup>	Equivalent output capacitance	$V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ V to } 200\text{ V}$	-	48	-	$\mu\text{F}$
$R_G$	Gate input resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	2.1	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 200\text{ V}$ , $I_D = 13\text{ A}$ , $V_{GS} = 0\text{ to } 10\text{ V}$ (see Figure 16. Test circuit for gate charge behavior)	-	18	-	nC
$Q_{gs}$	Gate-source charge			3		
$Q_{gd}$	Gate-drain charge			9		

1.  $C_{oss\text{ eq.}}$  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**

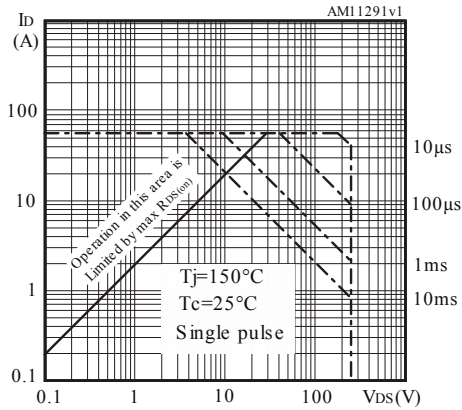
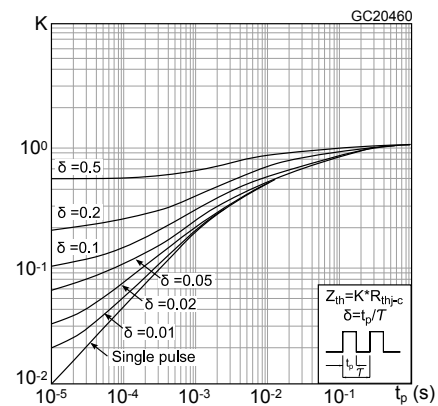
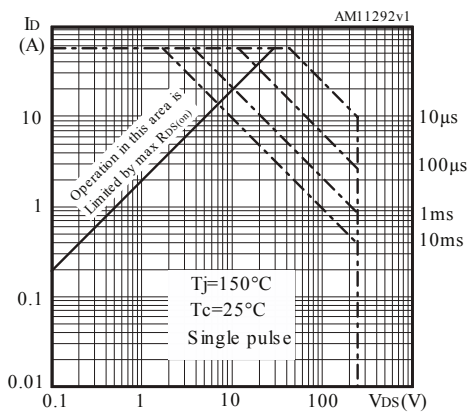
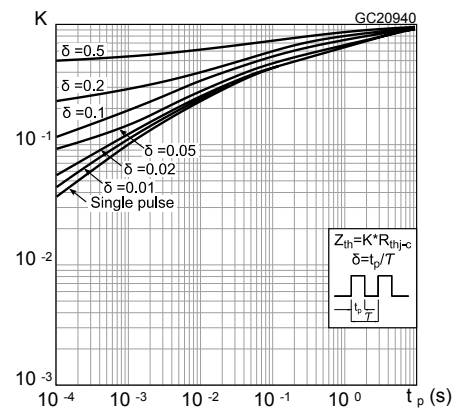
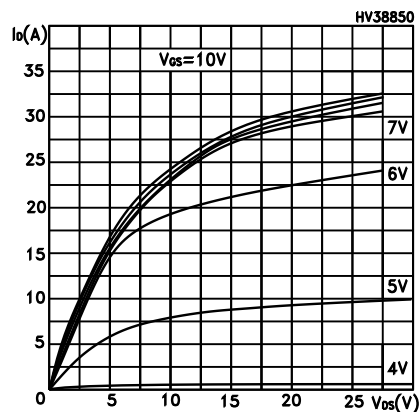
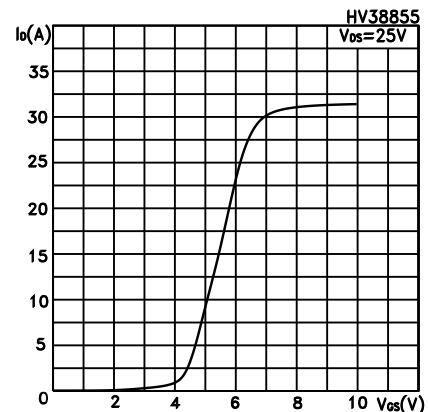
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 125\text{ V}$ , $I_D = 6.5\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform)	-	9	-	ns
$t_r$	Rise time			17		
$t_{d(off)}$	Turn-off delay time			35		
$t_f$	Fall time			17		

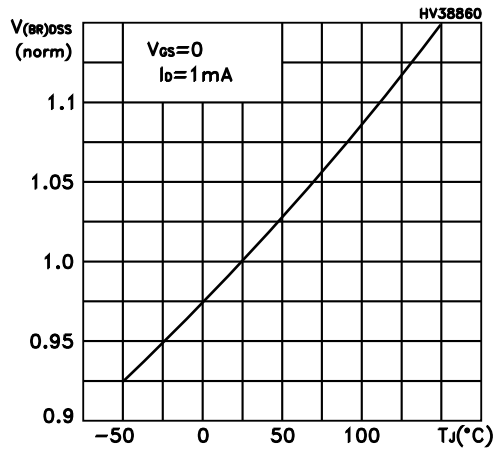
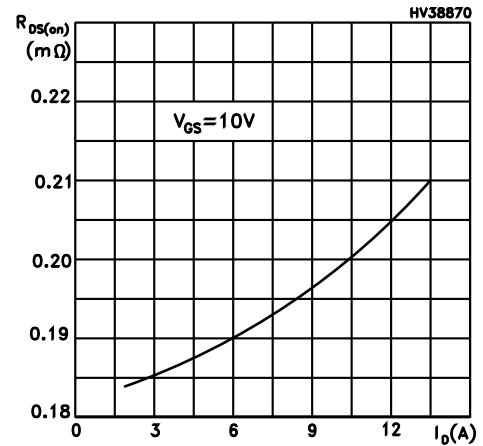
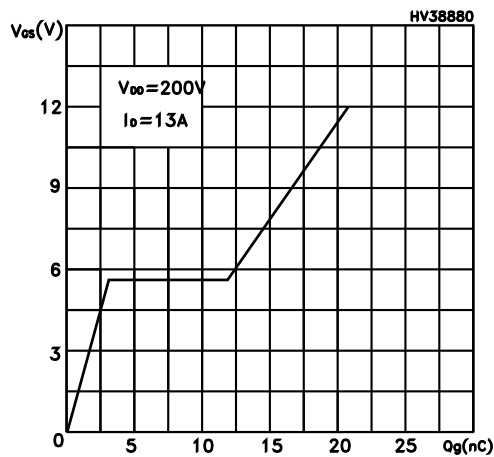
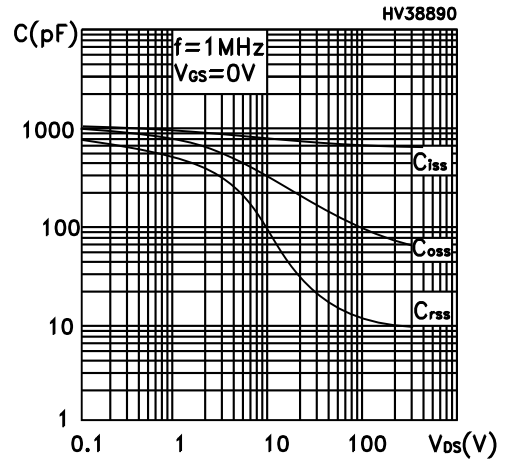
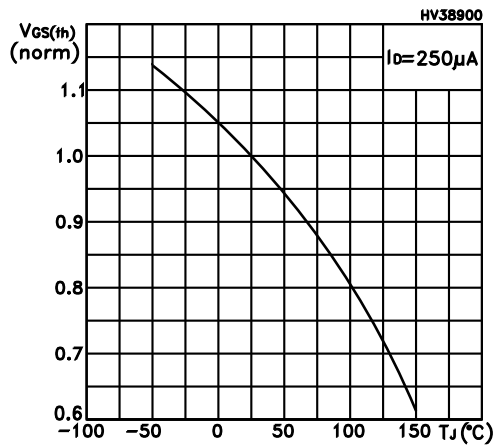
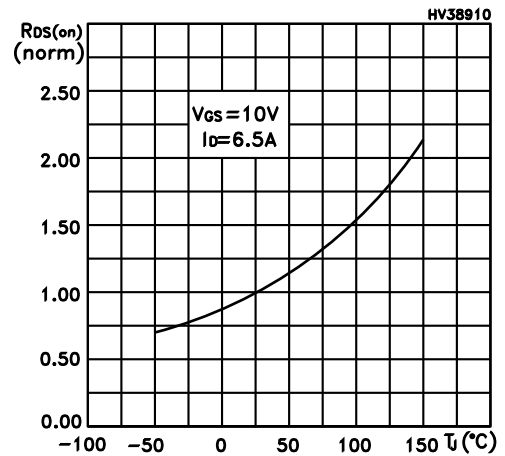
**Table 7. Source-drain diode**

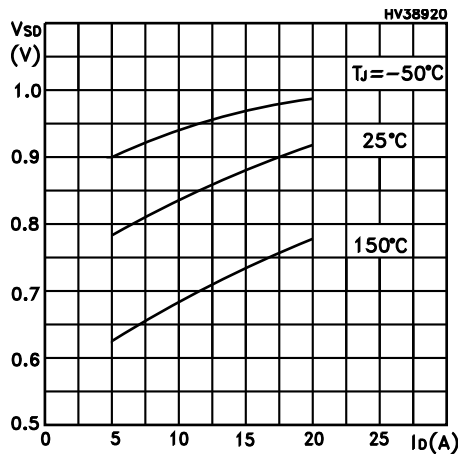
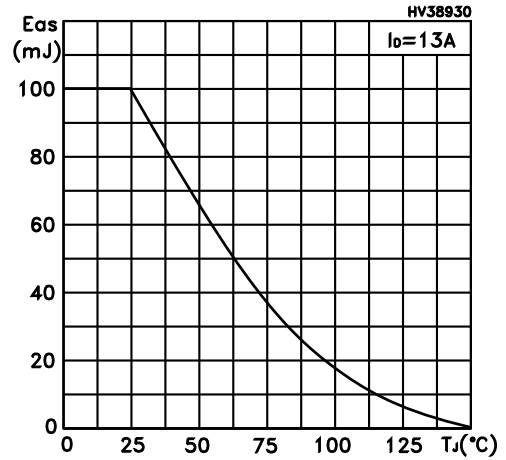
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		14	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		56	
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 13\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 13\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$	-	133		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$ (see <a href="#">Figure 17. Test circuit for inductive load switching and diode recovery times</a> )	-	651		nC
$I_{RRM}$	Reverse recovery current		-	10		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 13\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$	-	157		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 17. Test circuit for inductive load switching and diode recovery times</a> )	-	895		nC
$I_{RRM}$	Reverse recovery current		-	11		A

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

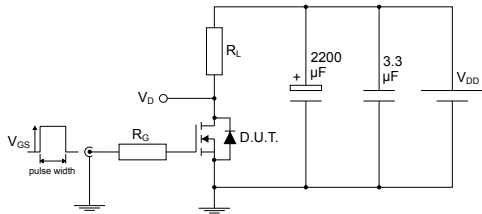
## 2.1 Electrical characteristics (curves)

**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**


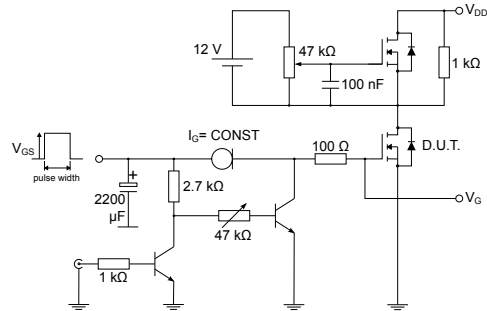
**Figure 7. Normalized  $V_{(BR)DSS}$  vs temperature**

**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**


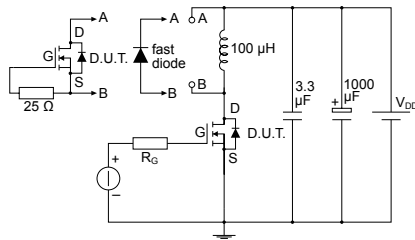
### 3 Test circuits

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


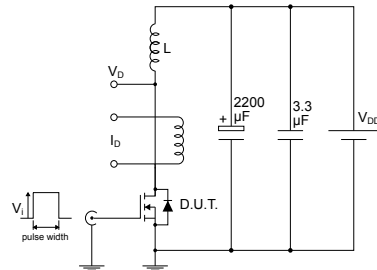
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**Figure 16. Test circuit for gate charge behavior**


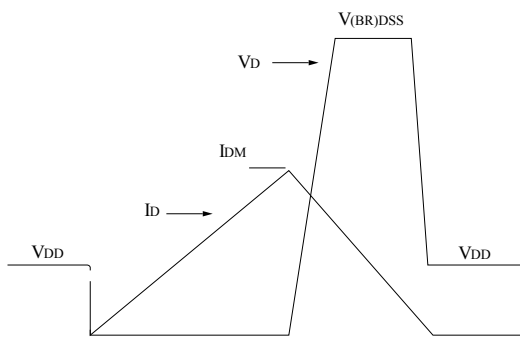
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**Figure 17. Test circuit for inductive load switching and diode recovery times**


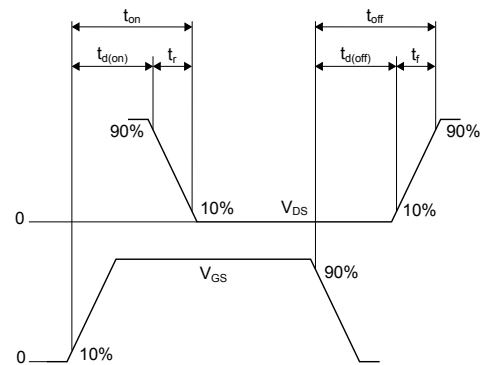
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**Figure 18. Unclamped inductive load test circuit**


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**Figure 19. Unclamped inductive waveform**


AM01472v1

**Figure 20. Switching time waveform**


AM01473v1



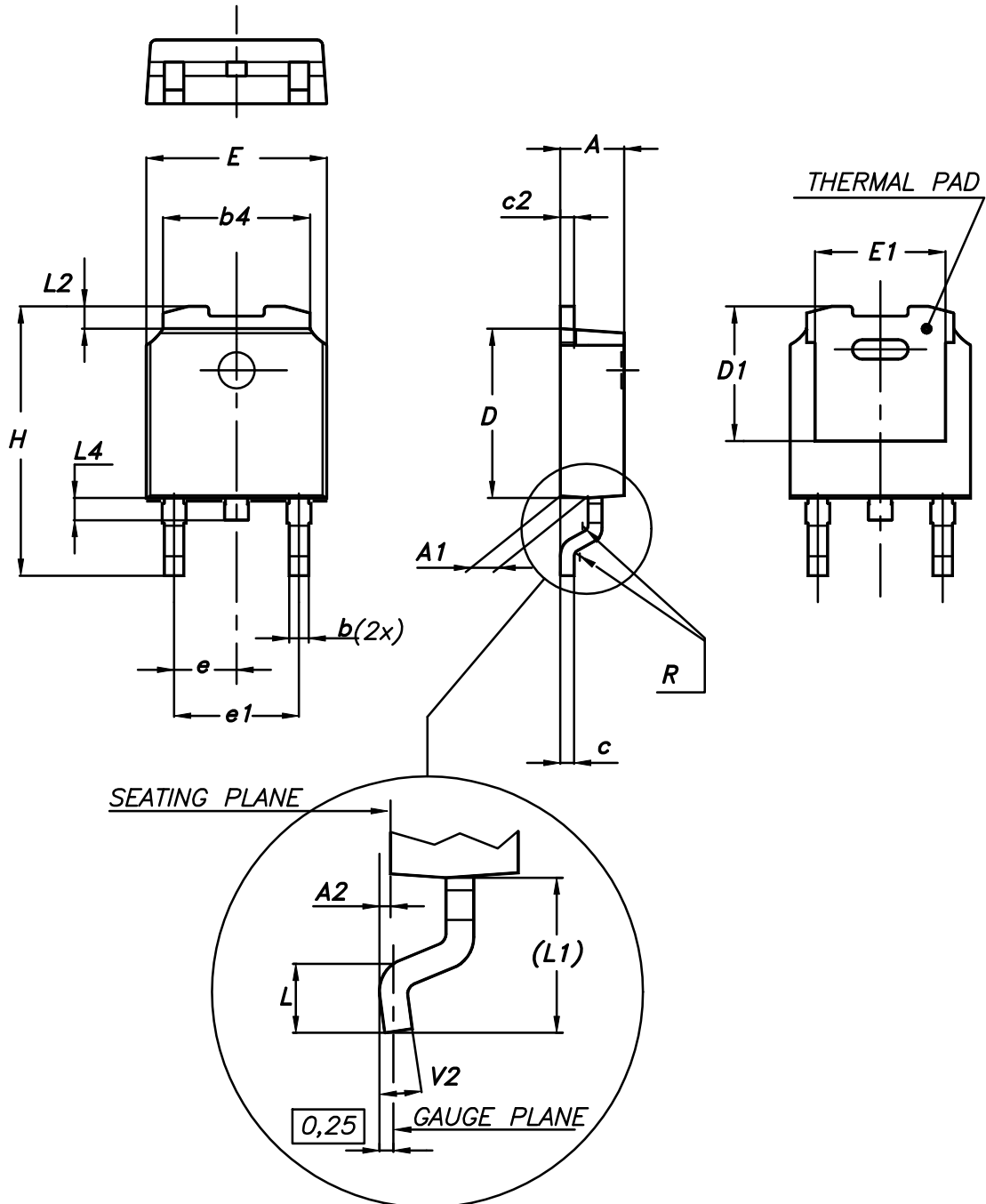
## 4 Package information

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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



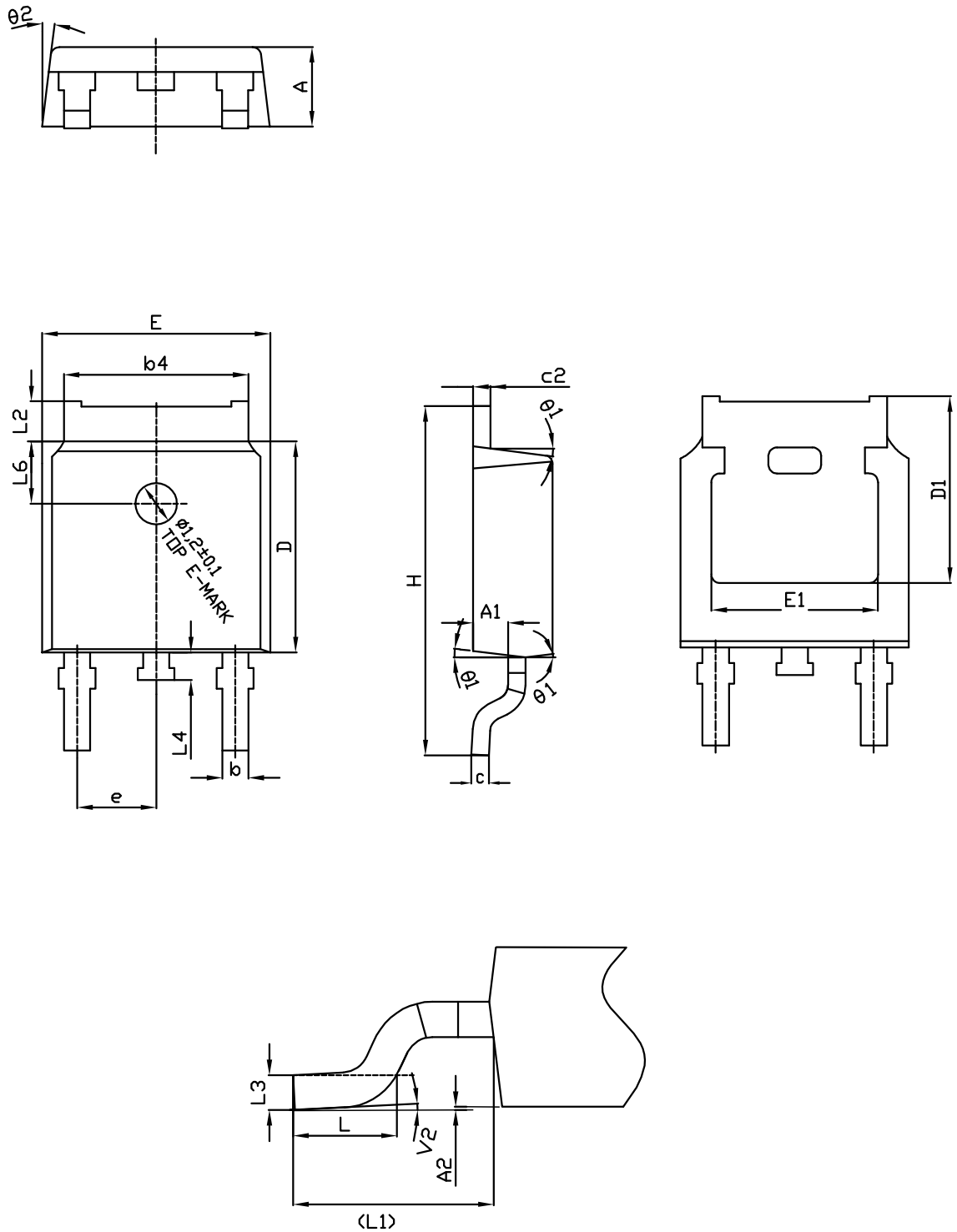
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**Table 8. DPAK (TO-252) type A mechanical data**

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 C2 package information

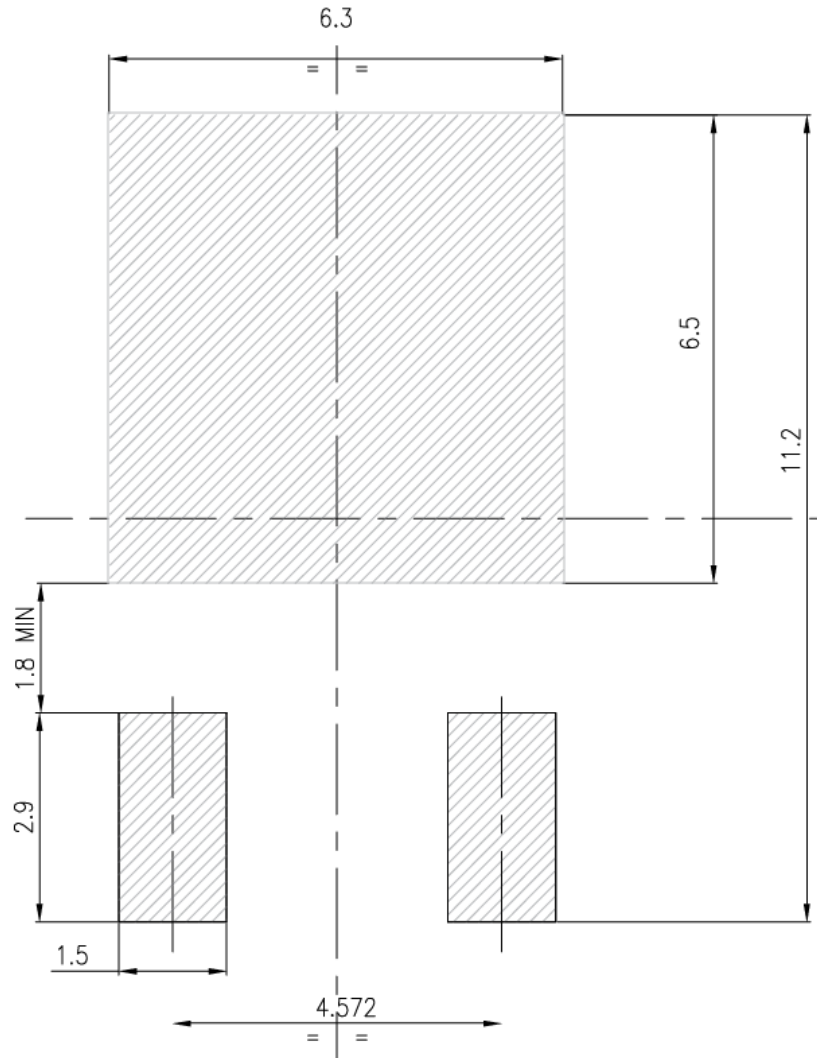
Figure 22. DPAK (TO-252) type C2 package outline



**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°

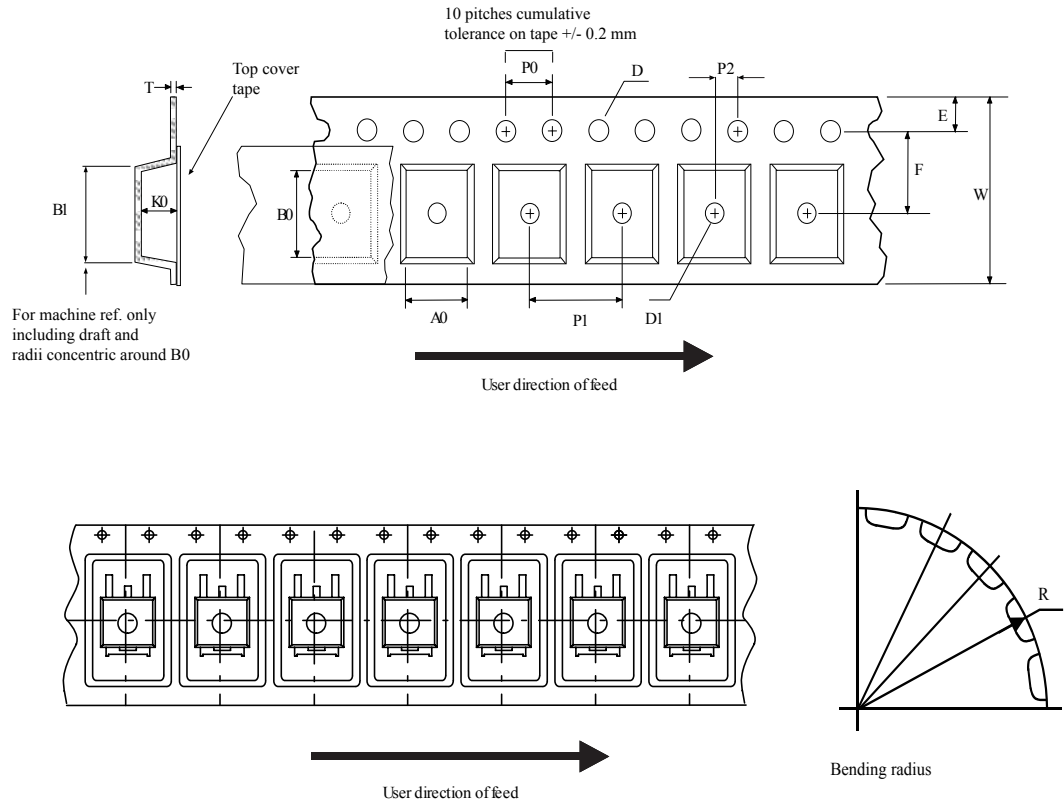
**Figure 23. DPAK (TO-252) recommended footprint (dimensions are in mm)**



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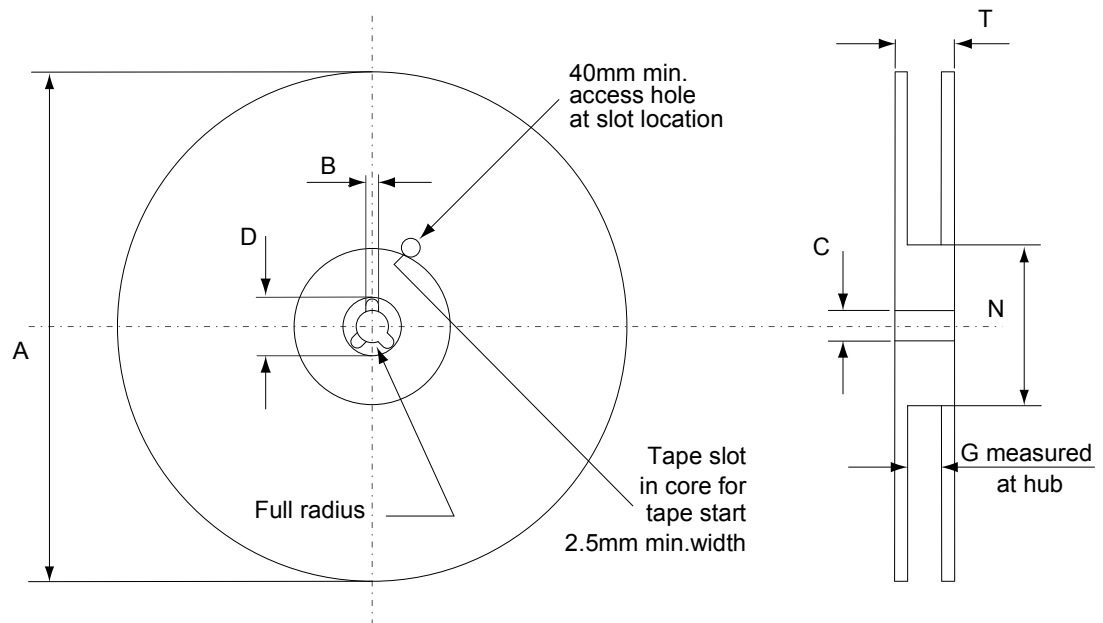
### 4.3 DPAK (TO-252) packing information

Figure 24. DPAK (TO-252) tape outline



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

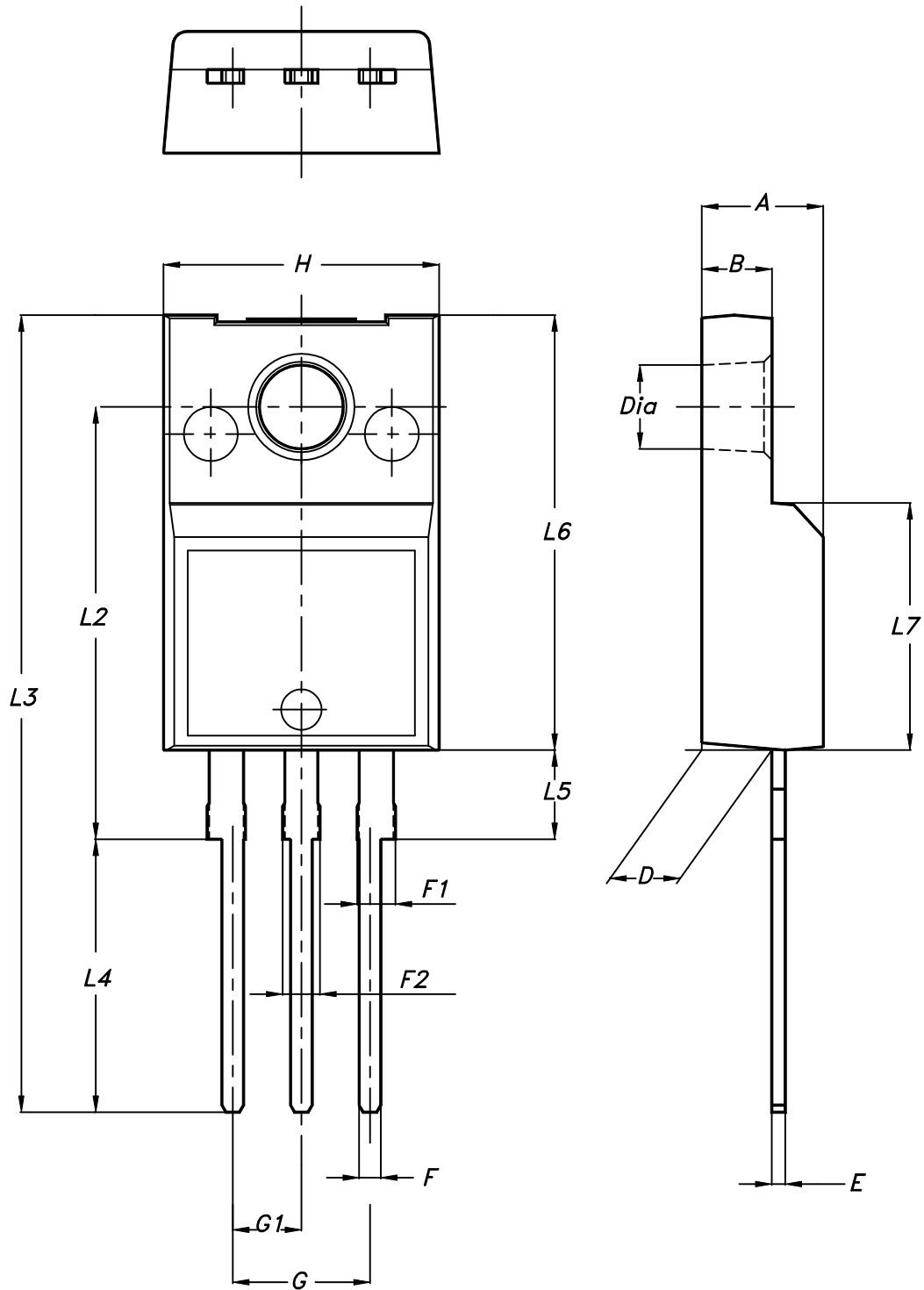


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**Table 10. DPAK (TO-252) tape and reel mechanical data**

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 26. TO-220FP package outline**


7012510\_Rev\_12\_B

**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: <i>Figure 13: Capacitance variations.</i>
29-Mar-2012	3	<i>Figure 2: Safe operating area for TO-220, Figure 4: Safe operating area for TO-220FP and Figure 6: Safe operating area for DPAK</i> have been updated. <i>Section 4: Package mechanical data and Section 5: Packaging mechanical data</i> have been updated. Minor text changes
06-Mar-2013	4	– Modified: PTOT, derating factor values, <i>note 1 on Table 2</i> , Rthj-case, Rthj-amb only for TO-220 and DPAK – Updated: <i>Section 4: Package mechanical data</i> – 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 <a href="#">Section 4 Package information</a> . Minor text changes.

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