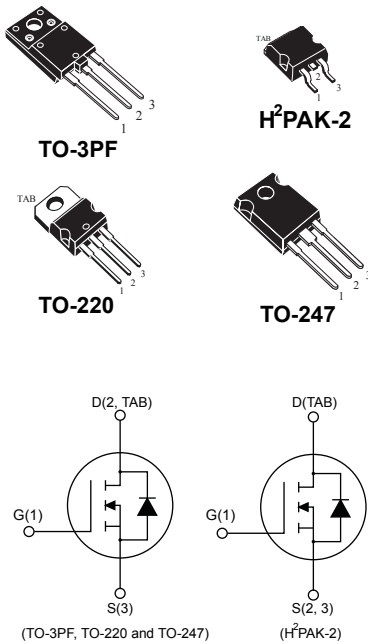


N-channel 1500 V, 2.5 A, 6  $\Omega$  typ., PowerMESH Power MOSFETs in TO-3PF, H<sup>2</sup>PAK-2, TO-220 and TO247 packages



AM15557v1



## Features

Order codes	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STFW3N150	1500 V	9 $\Omega$	2.5 A	63 W
STH3N150-2				140 W
STP3N150				
STW3N150				

- 100% avalanche tested
- Intrinsic capacitances and Q<sub>g</sub> minimized
- High speed switching
- Fully isolated TO-3PF plastic package, creepage distance path is 5.4 mm (typ.)

## Applications

- Switching applications

## Description

These Power MOSFETs are designed using the STMicroelectronics consolidated strip-layout-based MESH OVERLAY process. The result is a product that matches or improves on the performance of comparable standard parts from other manufacturers.

### Product status link

<a href="#">STFW3N150</a>
<a href="#">STH3N150-2</a>
<a href="#">STP3N150</a>
<a href="#">STW3N150</a>

# 1 Electrical ratings

**Table 1.**

Symbol	Parameter	Value				Unit
		TO-3PF	H <sup>2</sup> PAK-2	TO-220	TO-247	
V <sub>DS</sub>	Drain-source voltage	1500				V
V <sub>GS</sub>	Gate-source voltage	±30				V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	2.5 <sup>(1)</sup>	2.5			A
	Drain current (continuous) at T <sub>C</sub> = 100 °C	1.6 <sup>(1)</sup>	1.6			
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	10				A
P <sub>TOT</sub>	Total power dissipation at T <sub>C</sub> = 25 °C	63	140			W
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T <sub>C</sub> = 25 °C)	3.5				kV
	Derating factor	0.5	1.12			W/°C
T <sub>stg</sub>	Storage temperature range	-55 to 150				°C
T <sub>J</sub>	Operating junction temperature range					

1. Limited by maximum junction temperature.
2. Pulse width limited by safe operating area.

**Table 2. Thermal data**

Symbol	Parameter	Value				Unit
		TO-3PF	H <sup>2</sup> PAK-2	TO-220	TO-247	
R <sub>thj-case</sub>	Thermal resistance junction-case	2	0.89			°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient	50		62.5	50	°C/W
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb		35			°C/W

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

**Table 3.**

Symbol	Parameter	Max value	Unit
I <sub>AR</sub>	Avalanche current, repetitive or not-repetitive (pulse width limited by T <sub>J</sub> max)	2.5	A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>J</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V)	450	mJ

## 2 Electrical characteristics

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

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	1500			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 1500\text{ V}$			10	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 1500\text{ V}$ , $T_C = 125\text{ °C}$ <sup>(1)</sup>			500	
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 30\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 1.3\text{ A}$		6	9	$\Omega$

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	939	-	$\text{pF}$
$C_{oss}$	Output capacitance		-	102	-	
$C_{rss}$	Reverse transfer capacitance		-	13.2	-	
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }1200\text{ V}$ , $V_{GS} = 0\text{ V}$	-	100	-	$\text{pF}$
$R_g$	Gate input resistance	$f = 1\text{ MHz}$ , gate DC Bias = 0, test signal level = 20 mV, $I_D = 0\text{ A}$	-	4	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 1200\text{ V}$ , $I_D = 2.5\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 18. Test circuit for gate charge behavior)	-	29.3	-	nC
$Q_{gs}$	Gate-source charge		-	4.6	-	
$Q_{gd}$	Gate-drain charge		-	17	-	

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**

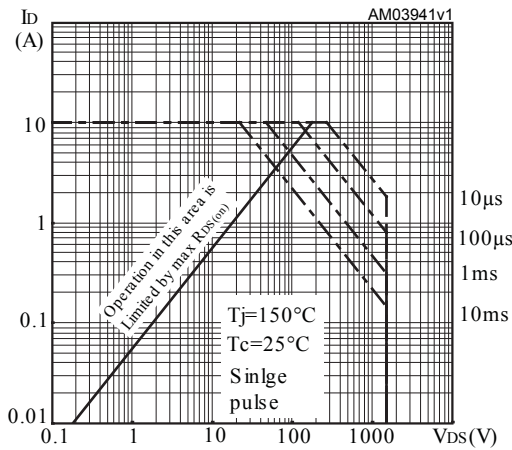
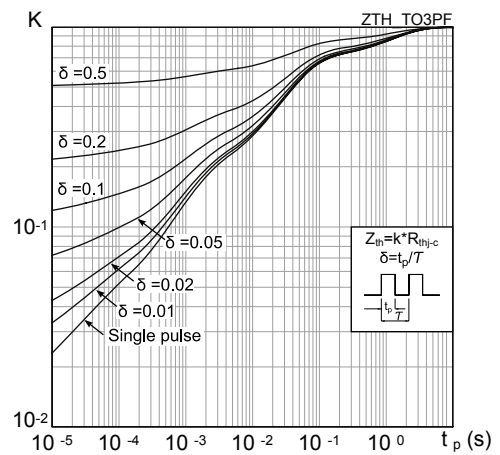
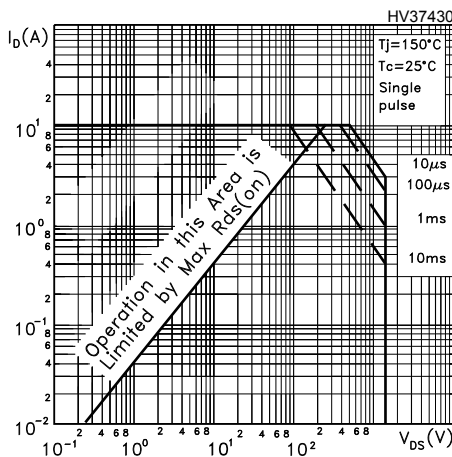
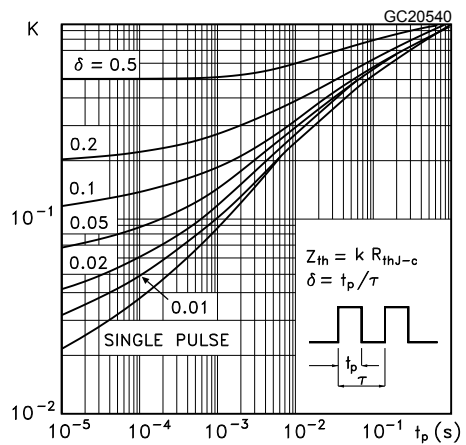
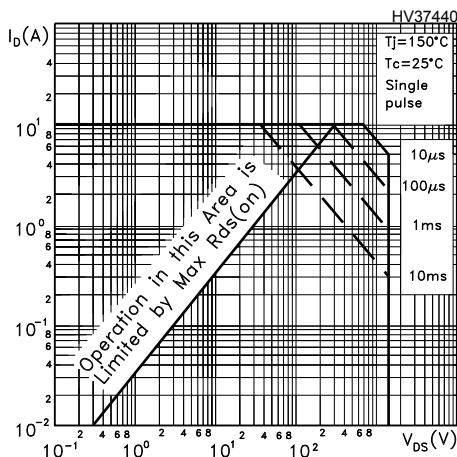
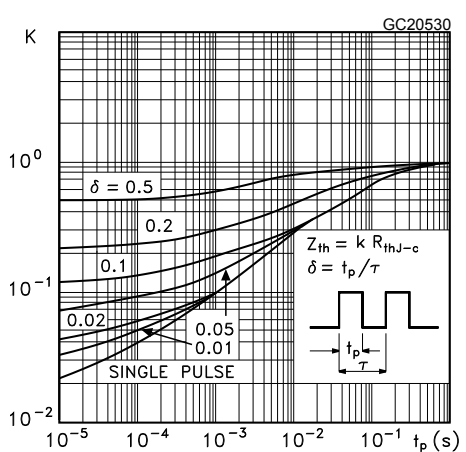
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 750\text{ V}$ , $I_D = 1.25\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 17. Test circuit for resistive load switching times and Figure 22. Switching time waveform)	-	24	-	ns
$t_r$	Rise time		-	47	-	
$t_{d(off)}$	Turn-off delay time		-	45	-	
$t_f$	Fall time		-	61	-	

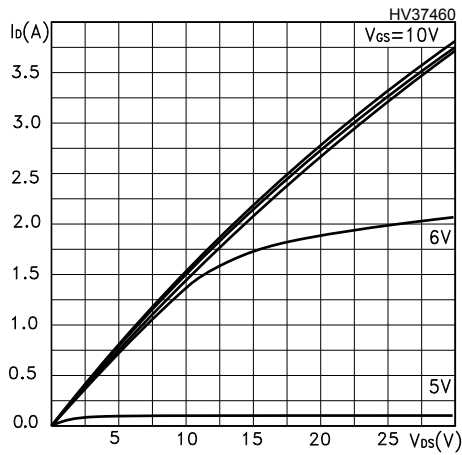
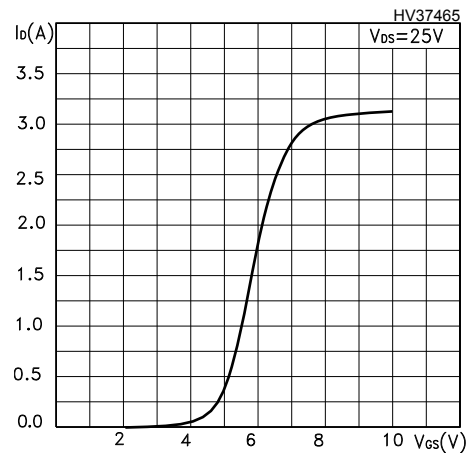
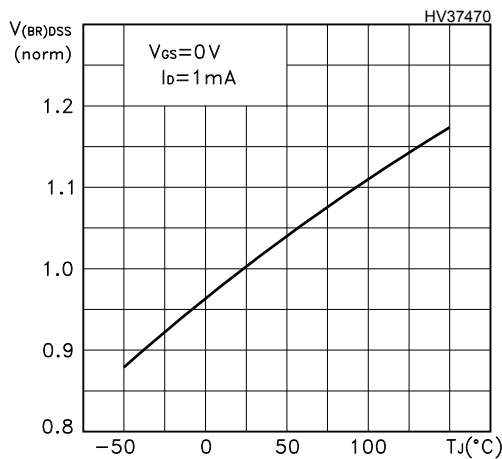
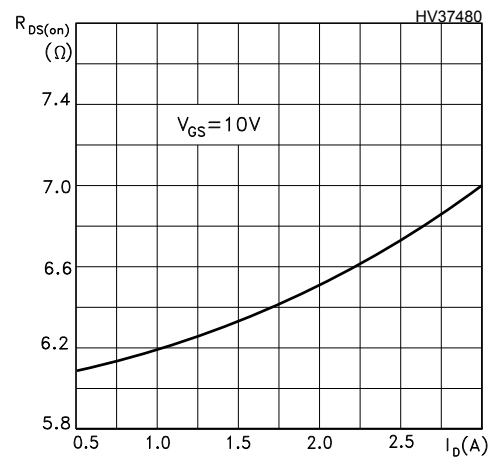
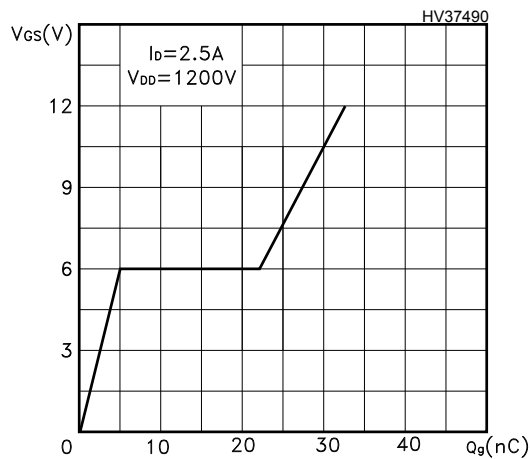
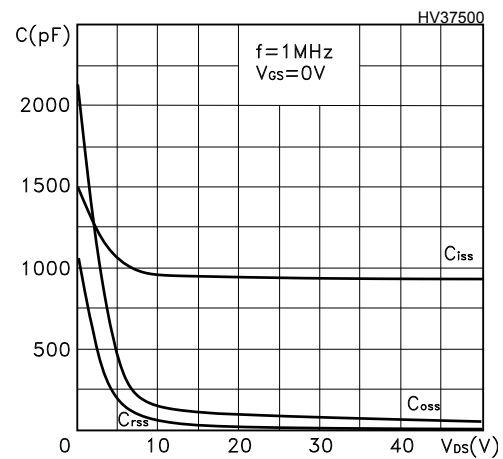
**Table 7. Source-drain diode**

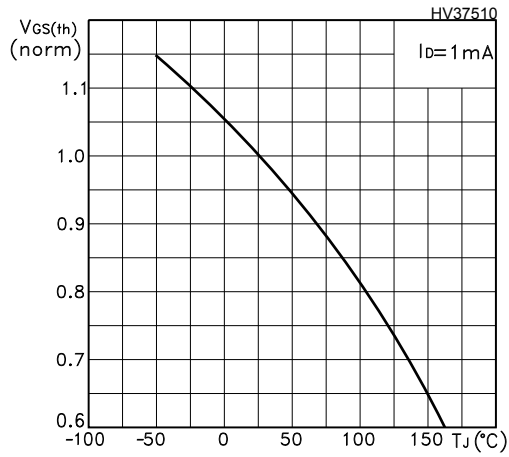
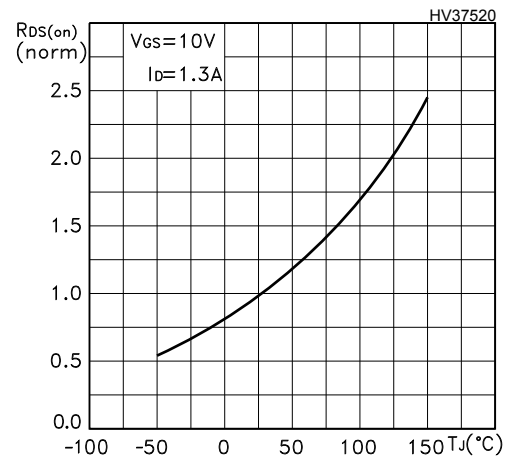
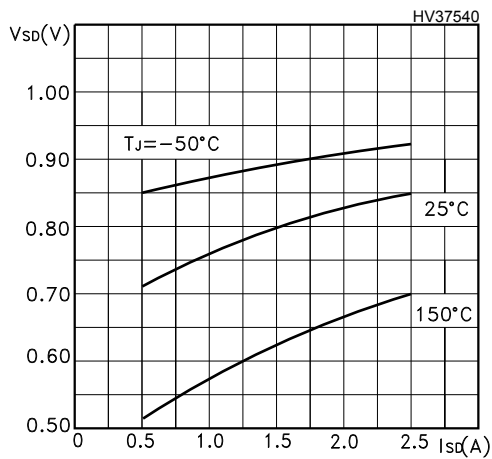
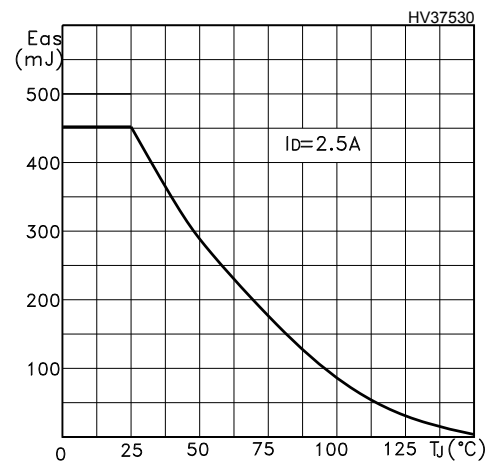
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		2.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		10	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 2.5\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 2.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	410		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$	-	2.4		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 19. Test circuit for inductive load switching and diode recovery times)	-	11.7		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 2.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	540		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$	-	3.3		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 19. Test circuit for inductive load switching and diode recovery times)	-	12.3		A

1. Pulse width is limited by safe operating area.

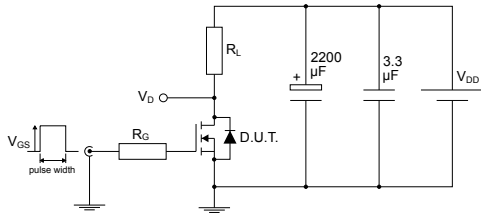
2. Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

**2.1 Electrical characteristics (curves)**
**Figure 1. Safe operating area for TO-3PF**

**Figure 2. Thermal impedance for TO-3PF**

**Figure 3. Safe operating area for H<sup>2</sup>PAK-2 and TO-220**

**Figure 4. Thermal impedance for H<sup>2</sup>PAK-2 and TO-220**

**Figure 5. Safe operating area for TO-247**

**Figure 6. Thermal impedance for TO-247**


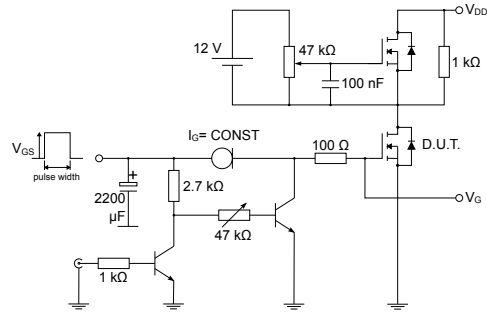
**Figure 7. Output characteristics**

**Figure 8. Transfer characteristics**

**Figure 9. Normalized  $V_{(BR)DSS}$  vs temperature**

**Figure 10. Static drain-source on-resistance**

**Figure 11. Gate charge vs gate-source voltage**

**Figure 12. Capacitance variations**


**Figure 13. Normalized gate threshold voltage vs temperature**

**Figure 14. Normalized on resistance vs temperature**

**Figure 15. Source-drain diode forward characteristics**

**Figure 16. Maximum avalanche energy vs  $T_J$** 


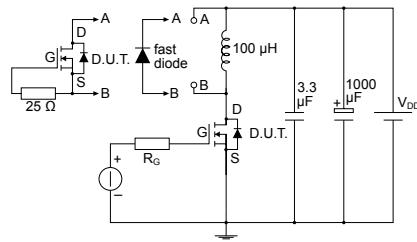
### 3 Test circuits

**Figure 17. Test circuit for resistive load switching times**


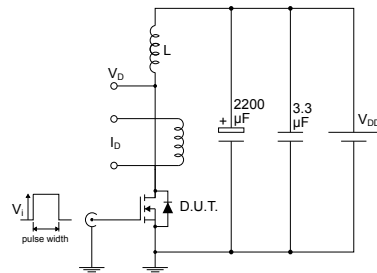
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**Figure 18. Test circuit for gate charge behavior**


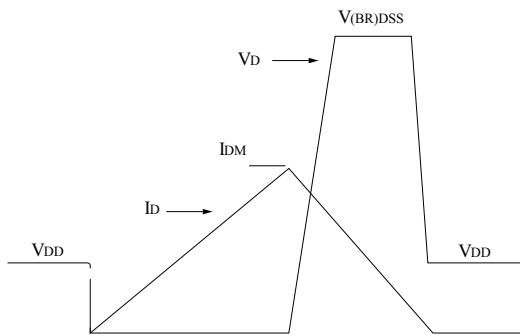
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**Figure 19. Test circuit for inductive load switching and diode recovery times**


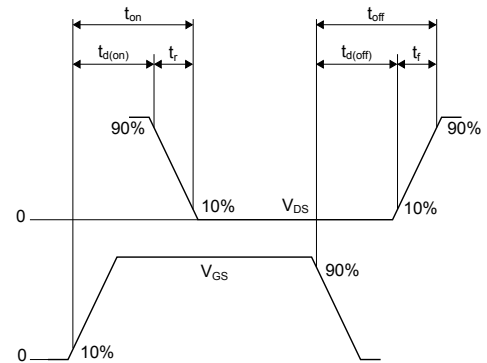
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**Figure 20. Unclamped inductive load test circuit**


AM01471v1

**Figure 21. Unclamped inductive waveform**


AM01472v1

**Figure 22. Switching time waveform**


AM01473v1

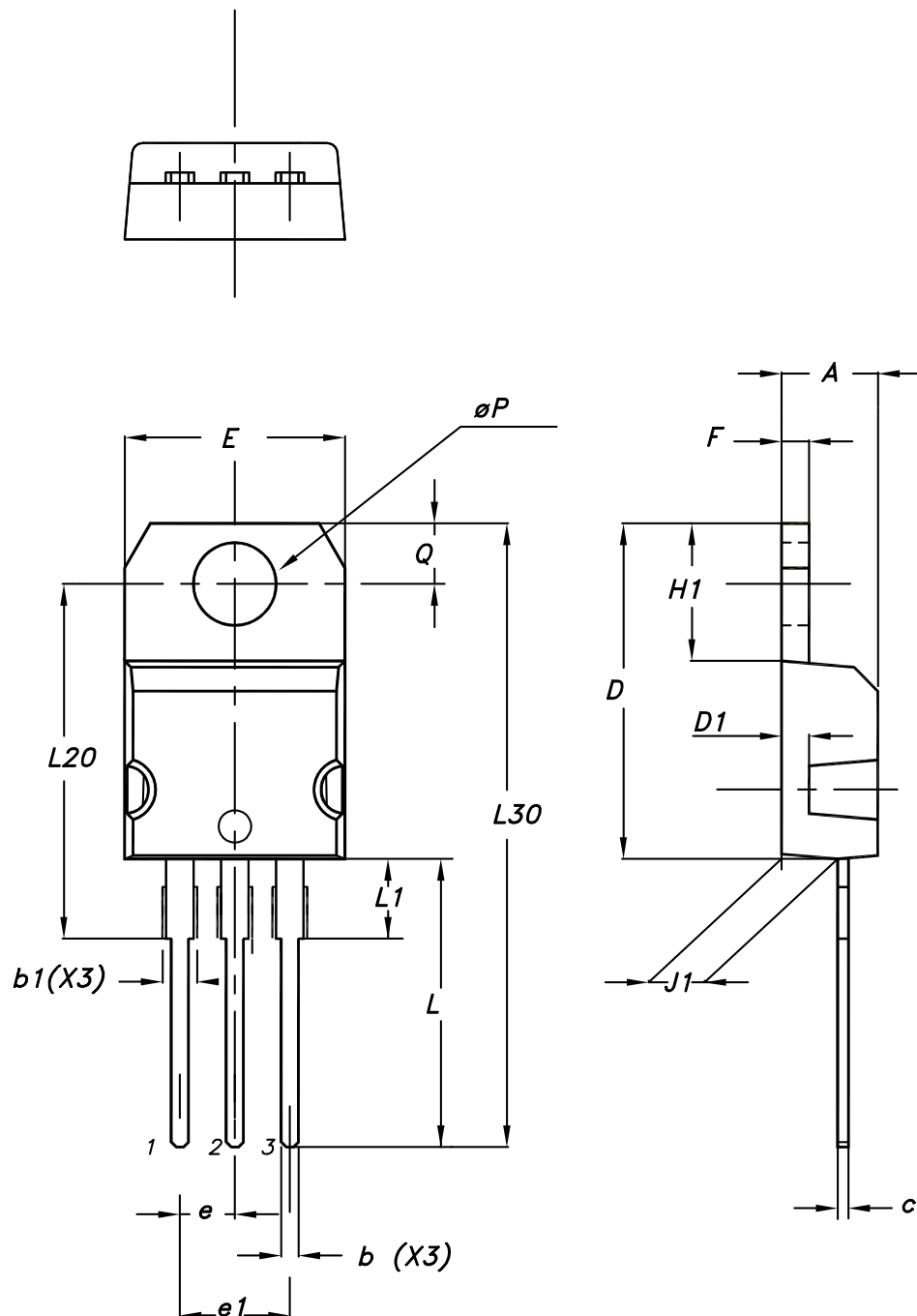


## 4 Package information

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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 TO-220 type A package information

Figure 23. TO-220 type A package outline



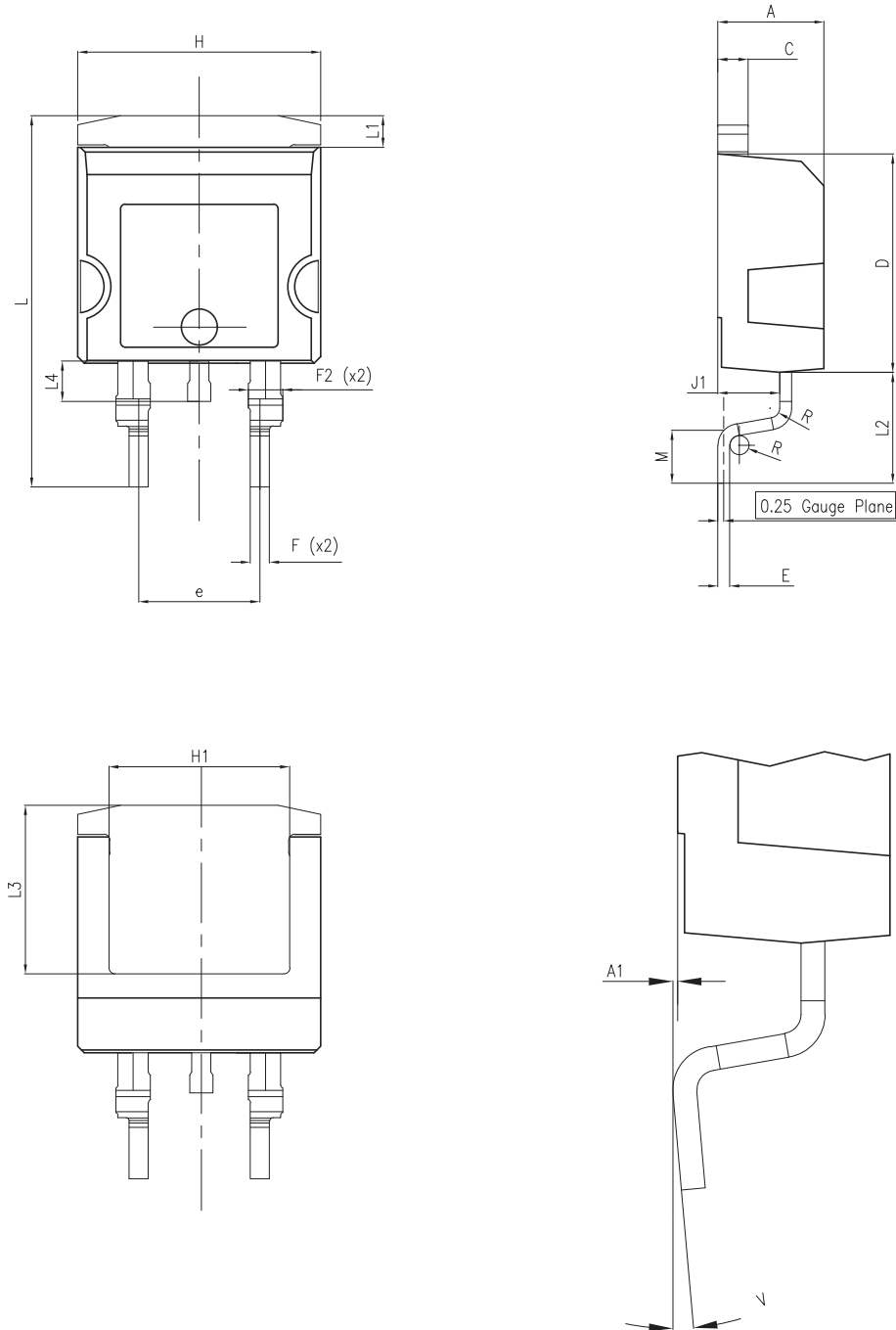
0015988\_typeA\_Rev\_23

**Table 8. 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
Slug flatness		0.03	0.10

## 4.2 H<sup>2</sup>PAK-2 package information

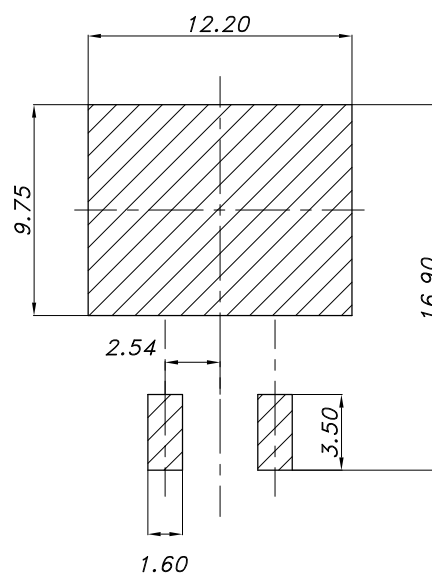
Figure 24. H<sup>2</sup>PAK-2 package outline



8159712\_9

**Table 9. H<sup>2</sup>PAK-2 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.30		4.70
A1	0.03		0.20
C	1.17		1.37
D	8.95		9.35
e	4.98		5.18
E	0.50		0.90
F	0.78		0.85
F2	1.14		1.70
H	10.00		10.40
H1	7.40	-	7.80
J1	2.49		2.69
L	15.30		15.80
L1	1.27		1.40
L2	4.93		5.23
L3	6.85		7.25
L4	1.50		1.70
M	2.60		2.90
R	0.20		0.60
V	0°		8°

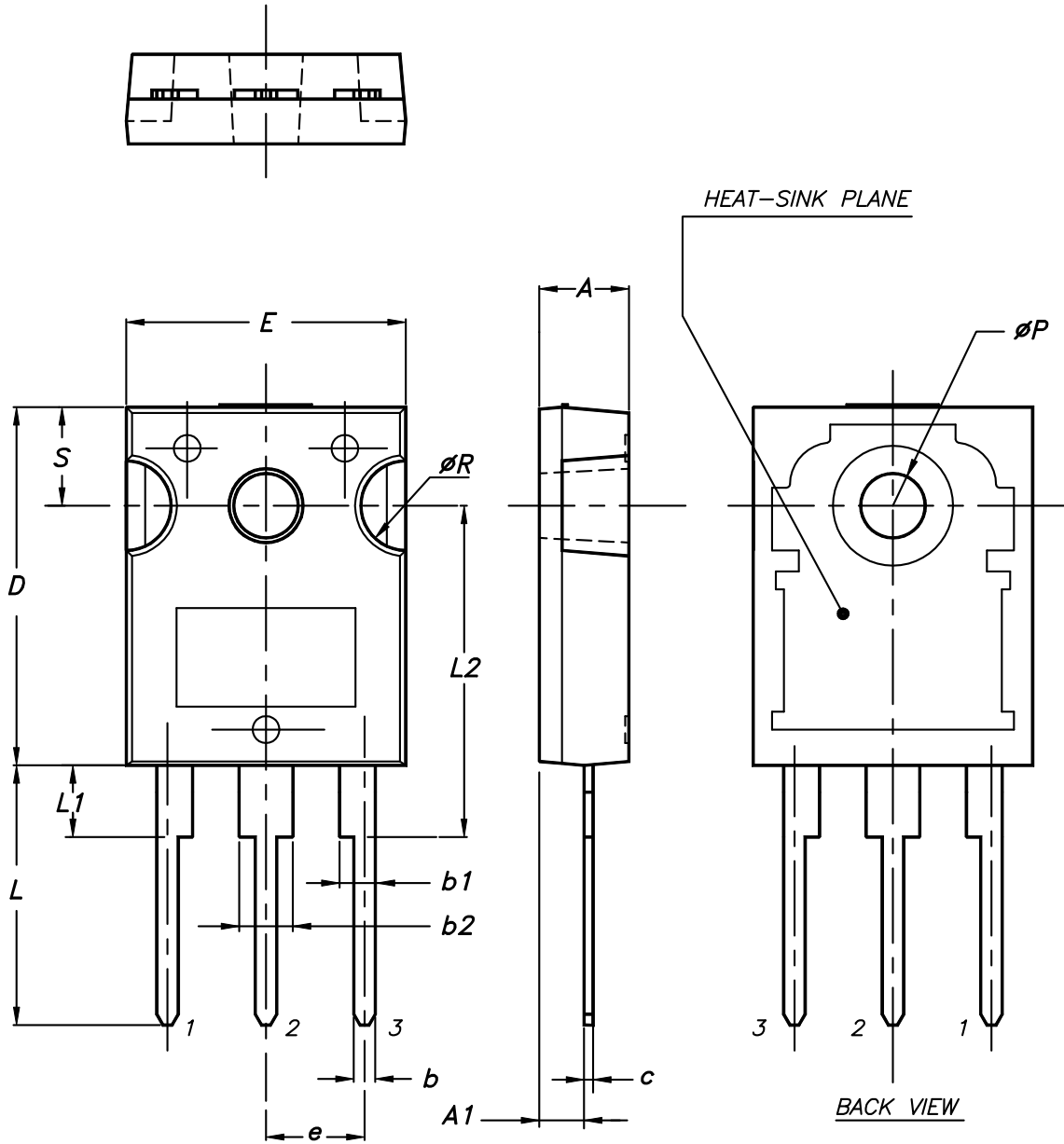
**Figure 25. H<sup>2</sup>PAK-2 recommended footprint**


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Note: Dimensions are in mm.

### 4.3 TO-247 package information

Figure 26. TO-247 package outline



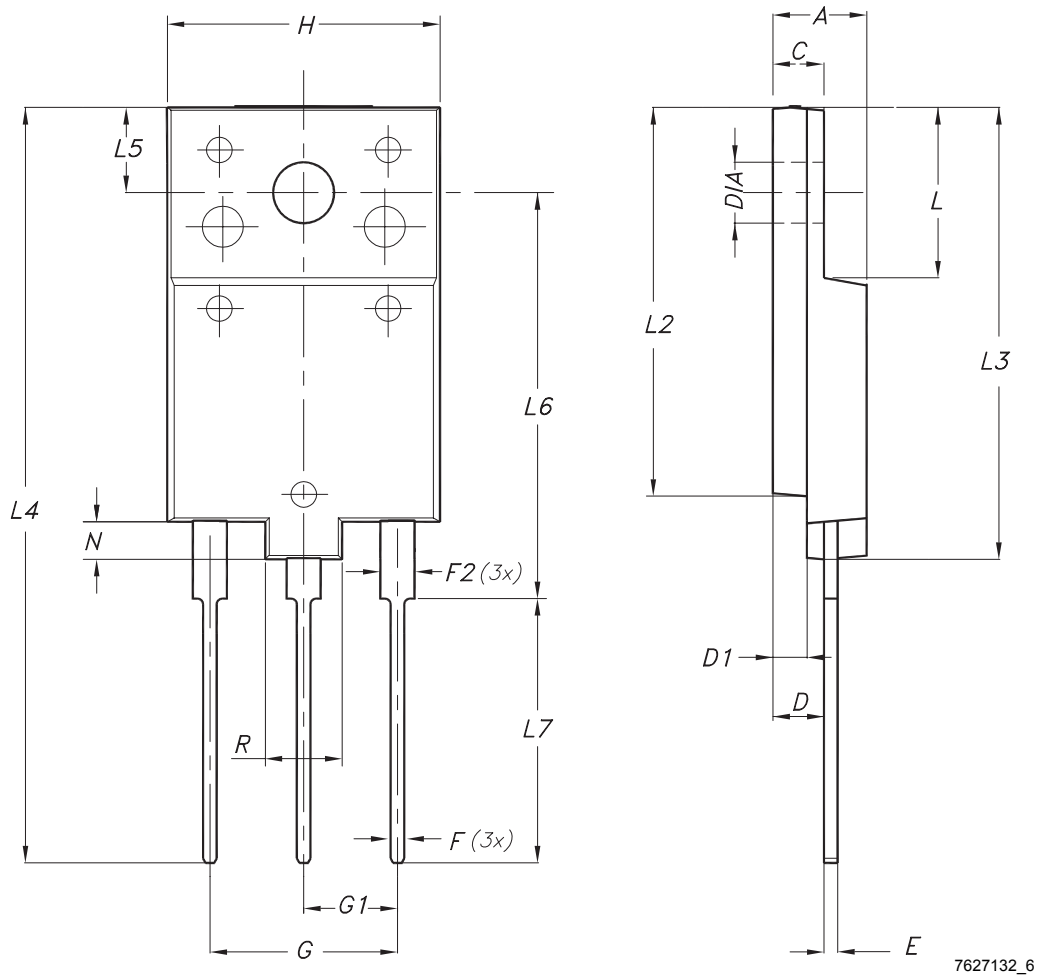
0075325\_9

**Table 10. TO-247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

#### 4.4 TO-3PF package information

Figure 27. TO-3PF package outline



7627132\_6

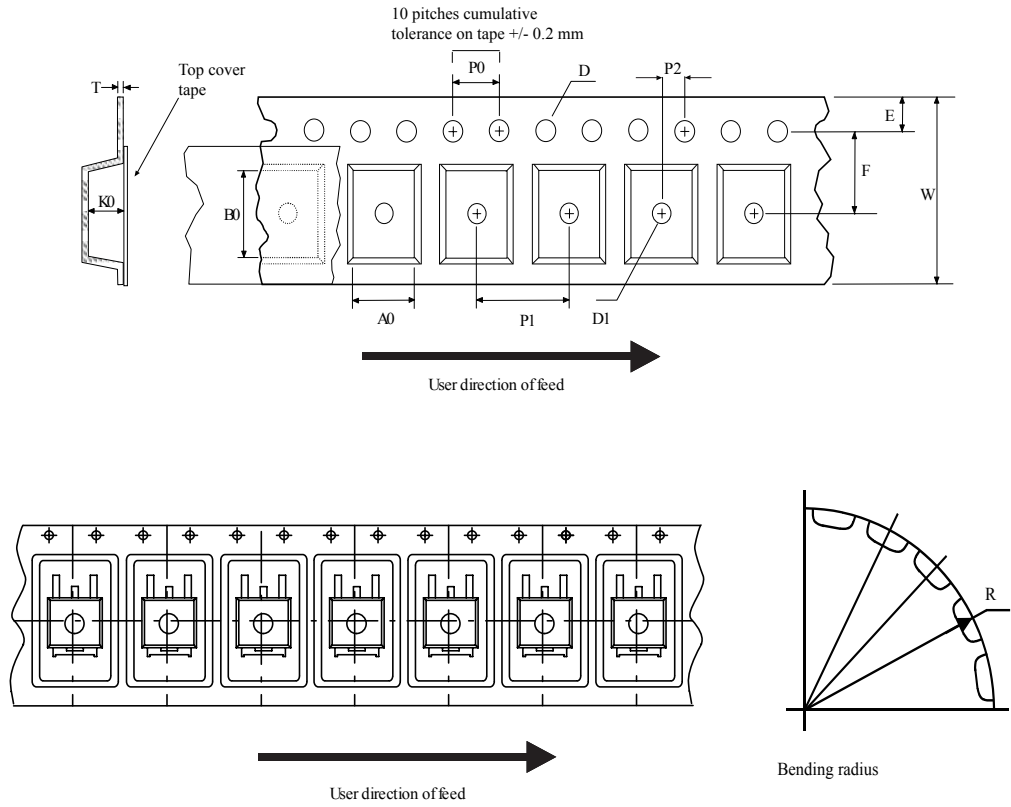
**Table 11. TO-3PF mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
H	15.30		15.70
L	9.80	10.00	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15.00
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

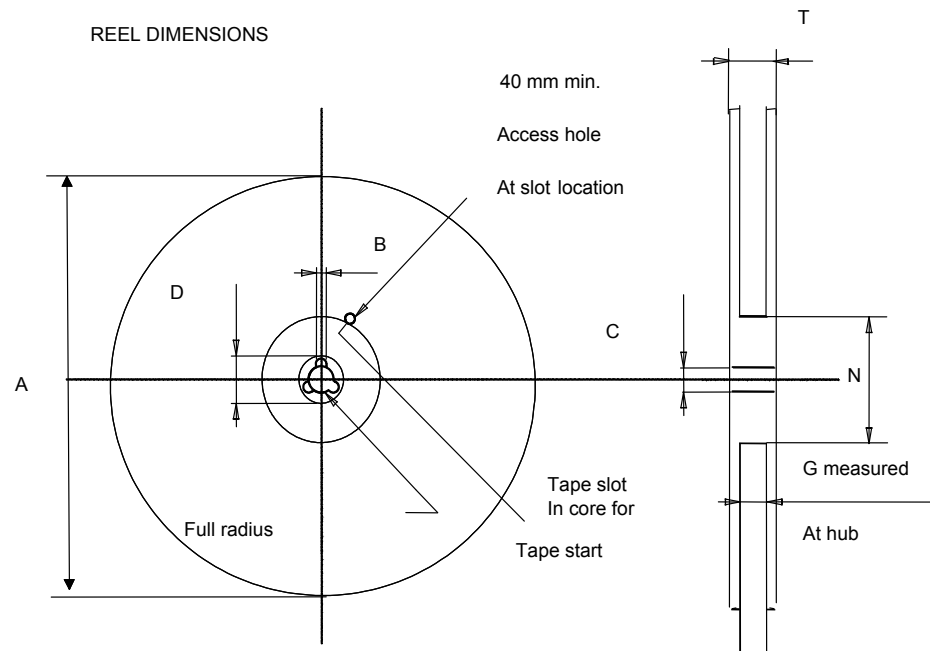


## 4.5 Packing information

Figure 28. Tape outline



AM08852v2

**Figure 29. Reel outline**

**Table 12. Tape and reel mechanical data**

Dim.	Tape		Dim.	Reel	
	mm			mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

## 5 Ordering information

Table 13. Order codes

Order codes	Marking	Package	Packing
STFW3N150	3N150	TO-3PF	Tube
STH3N150-2	H3N150	H <sup>2</sup> PAK-2	Tape and reel
STP3N150	P3N150	TO-220	Tube
STW3N150	3N150	TO-247	

## Revision history

**Table 14. Document revision history**

Date	Revision	Changes
12-Jan-2007	1	First release
17-Apr-2007	2	Added new value on <i>Table 6</i> .
14-May-2007	3	The document has been reformatted
29-Aug-2007	4	RDS(on) value changed, updated <i>Figure 15</i>
09-Apr-2008	5	Added new package: TO-3PF
13-Feb-2009	6	Added PTOT value for TO-3PF ( <i>Table 2: Absolute maximum ratings</i> )
01-Dec-2009	7	<ul style="list-style-type: none"> <li>– Document status promoted from preliminary data to datasheet</li> <li>– Removed TO-220FH package and mechanical data</li> </ul>
10-Dec-2009	8	Corrected VISO value in <i>Table 2: Absolute maximum ratings</i>
29-Jun-2010	9	Corrected unit in <i>Table 3</i> .
08-Feb-2013	10	<ul style="list-style-type: none"> <li>– Minor text changes</li> <li>– Modified: <i>Table 3</i></li> <li>– Changed: <i>Figure 1</i></li> <li>– Added: H<sup>2</sup>PAK-2 package</li> </ul>
18-Feb-2014	11	<ul style="list-style-type: none"> <li>– Modified: <i>Figure 1</i></li> <li>– Updated: <i>Figure 18, 19, 20 and 21</i></li> <li>– Updated: <i>Figure 27 and Table 11</i></li> <li>– Updated: <i>Section 4: Package mechanical data</i></li> <li>– Minor text changes</li> </ul>
12-May-2020	12	Updated <a href="#">Section 5 Ordering information</a> . Minor text changes.

## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>2</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>3</b>
<b>2.1</b>	<b>Electrical characteristics (curves)</b> .....	<b>5</b>
<b>3</b>	<b>Test circuits</b> .....	<b>8</b>
<b>4</b>	<b>Package information</b> .....	<b>9</b>
<b>4.1</b>	<b>TO-220 type A package information</b> .....	<b>9</b>
<b>4.2</b>	<b>H<sup>2</sup>PAK-2 package information</b> .....	<b>11</b>
<b>4.3</b>	<b>TO-247 package information</b> .....	<b>13</b>
<b>4.4</b>	<b>TO-3PF package information</b> .....	<b>15</b>
<b>4.5</b>	<b>Packing information</b> .....	<b>17</b>
<b>5</b>	<b>Ordering information</b> .....	<b>19</b>
	<b>Revision history</b> .....	<b>20</b>



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