STFW3N150, STH3N150-2, STP3N150, STW3N150

N-channel 1500 V, 2.5 A, 6 Ω typ., PowerMESH™ Power MOSFETs in TO-3PF, H²PAK-2, TO-220 and TO247 packages

Datasheet - production data

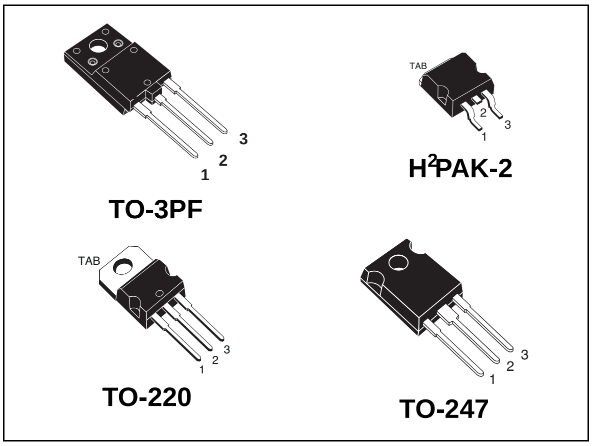
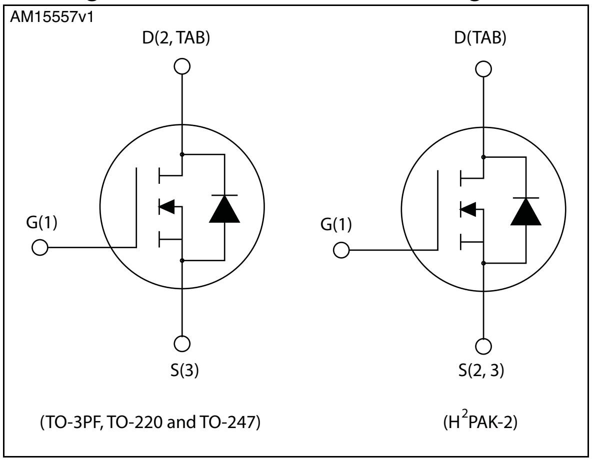


Figure 1. Internal schematic diagram



Features

Order codes	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STFW3N150	1500 V	9 Ω	2.5 A	63 W
STH3N150-2				140 W
STP3N150				
STW3N150				

- 100% avalanche tested
- Intrinsic capacitances and Qg 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 company's 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.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STFW3N150	3N150	TO-3PF	Tube
STH3N150-2		H²PAK-2	Tape and reel
STP3N150		TO-220	Tube
STW3N150		TO-247	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-3PF	H^2PAK-2, TO-220, TO-247	
V_{DS}	Drain-source voltage	1500		V
V_{GS}	Gate-source voltage	± 30		V
I_D	Drain current (continuous) at T_C = 25 °C	2.5(1)	2.5	A
I_D	Drain current (continuous) at T_C = 100 °C	1.6(1)	1.6	A
I_{DM} (1)	Drain current (pulsed)	10(1)	10	A
P_{TOT}	Total dissipation at T_C = 25 °C	63	140	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T_C=25 °C)	3500		V
	Derating factor	0.5	1.12	W/°C
T_{stg}	Storage temperature	-50 to 150		°C
T_j	Max. operating junction temperature	150		°C

1. Pulse width limited by safe operating area

Table 3. Thermal data

Symbol	Parameter	TO-3PF	H^2PAK-2	TO-220	TO-247	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max	2	0.89			°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	50		62.5	50	°C/W
$R_{thj\text{-}pcb}$	Thermal resistance junction-pcb max		35(1)			°C/W

1. When mounted on 1 inch^2 FR-4 board, 2 oz Cu

Table 4. Avalanche characteristics

Symbol	Parameter	Max value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	2.5	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	450	mJ

2 Electrical characteristics

(T_{case} = 25 °C unless otherwise specified)

Table 5. 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	1500			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 1500 V			10	µA
		V_{DS} = 1500 V, T_C=125 °C			500	µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 30 V			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 1.3 A		6	9	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward transconductance	V_{DS} = 30 V, I_D = 1.3 A	-	2.6	-	S
C_{iss}	Input capacitance	V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0	-	939	-	pF
			-		-	pF
			-		-	pF
C_{oss}	Output capacitance		-	102	-	pF
C_{rss}	Reverse transfer capacitance		-	13.2	-	pF
$C_{oss\ eq.}$ (2)	Equivalent output capacitance	V_{DS}=0 to 1200 V, V_{GS} = 0	-	100	-	pF
R_g	Gate input resistance	f = 1 MHz, gate DC Bias = 0, test signal level = 20 mV, I_D = 0	-	4	-	Ω
Q_g	Total gate charge	V_{DD} = 1200 V, I_D = 2.5 A, V_{GS} = 10 V *(Figure 19)*	-	29.3	-	nC
Q_{gs}	Gate-source charge		-	4.6	-	nC
Q_{gd}	Gate-drain charge		-	17	-	nC

1. Pulsed: pulse duration = 300 µs, duty cycle 1.5%
2. $C_{oss\ eq.}$ 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 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 750 V, I_D = 1.25 A, R_G = 4.7 Ω, V_{GS} = 10 V *(Figure 18)*	-	24	-	ns
t_r	Rise time		-	47	-	ns
$t_{d(off)}$	Turn-off-delay time		-	45	-	ns
t_f	Fall time		-	61	-	ns

Table 8. 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	I_{SD} = 2.5 A, V_{GS} = 0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 2.5 A, di/dt = 100 A/µs V_{DD}= 60 V *(Figure 20)*	-	410		ns
Q_{rr}	Reverse recovery charge		-	2.4		µC
I_{RRM}	Reverse recovery current		-	11.7		A
t_{rr}	Reverse recovery time	I_{SD} = 2.5 A, di/dt = 100 A/µs V_{DD}= 60 V, Tj = 150 °C *(Figure 20)*	-	540		ns
Q_{rr}	Reverse recovery charge		-	3.3		µC
I_{RRM}	Reverse recovery current		-	12.3		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 2. Safe operating area for TO-3PF

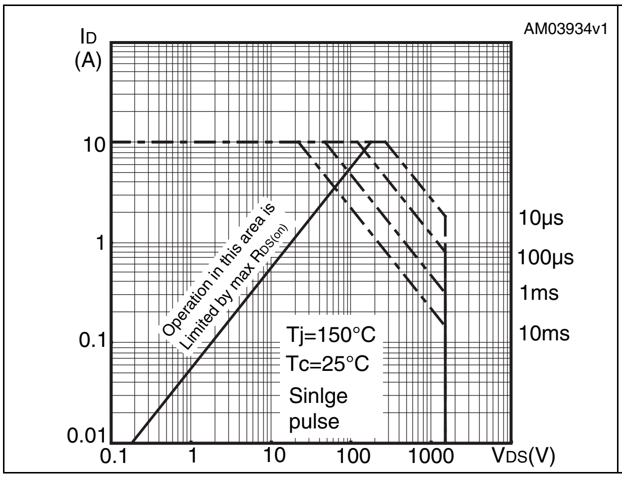


Figure 3. Thermal impedance for TO-3PF

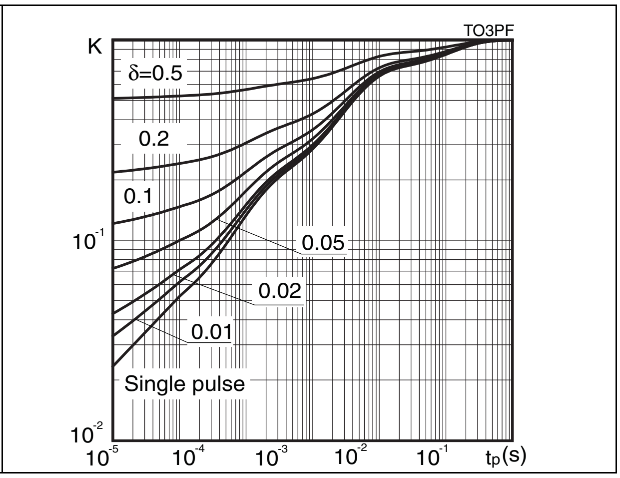


Figure 4. Safe operating area for H^2PAK-2 and TO-220

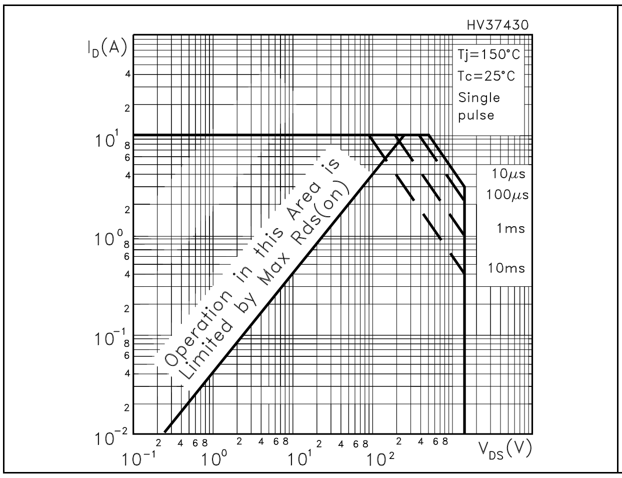


Figure 5. Thermal impedance for H^2PAK-2 and TO-220

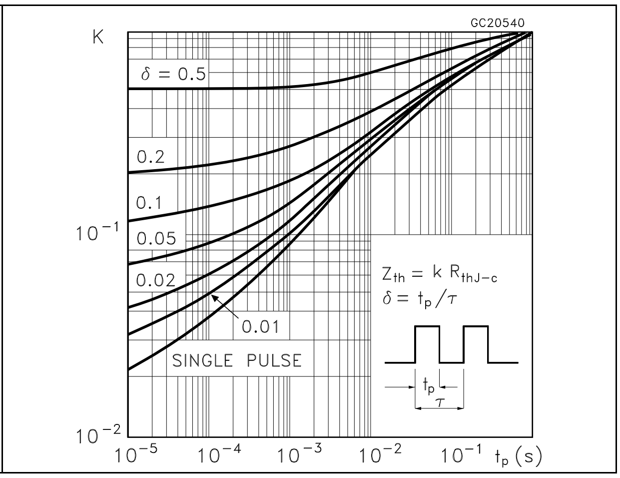


Figure 6. Safe operating area for TO-247

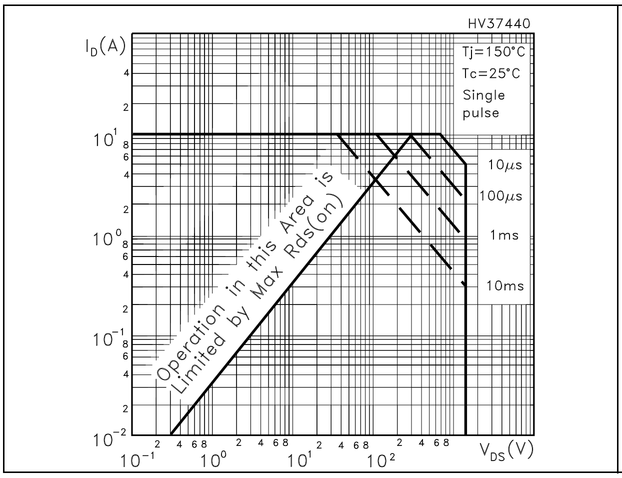


Figure 7. Thermal impedance for TO-247

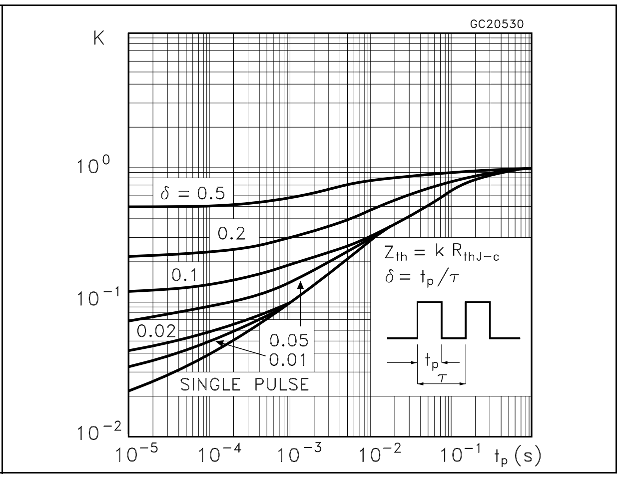


Figure 8. Output characteristics

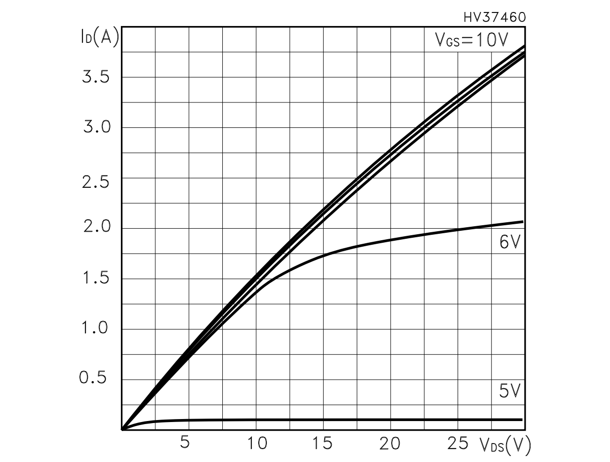


Figure 9. Transfer characteristics

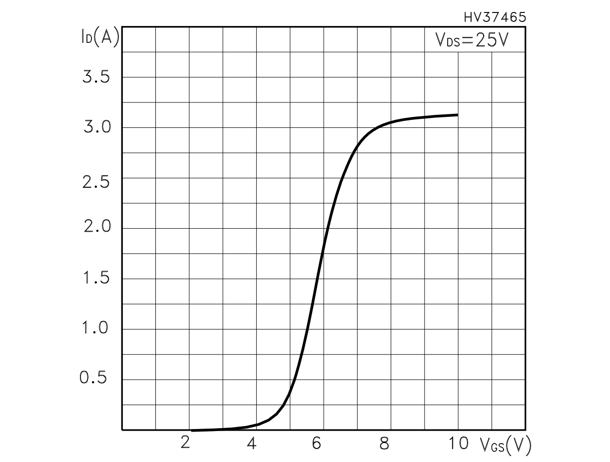


Figure 10. Normalized BV_{DSS} vs. temperature

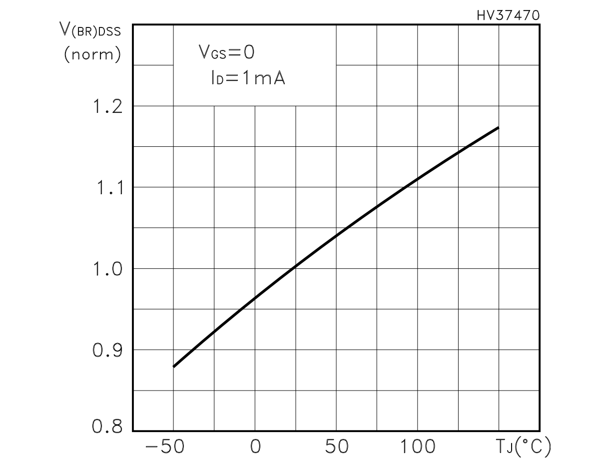


Figure 11. Static drain-source on-resistance

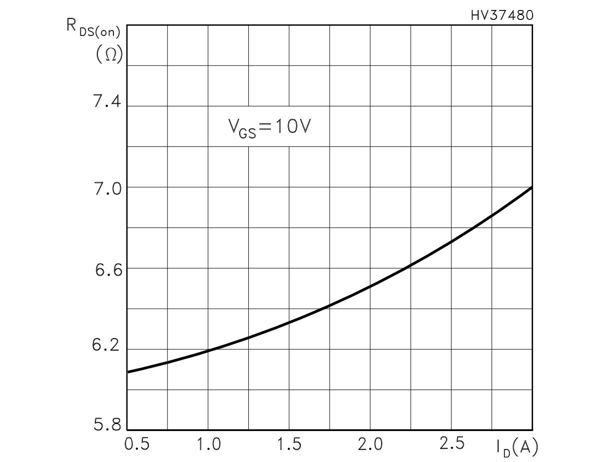


Figure 12. Gate charge vs. gate-source voltage

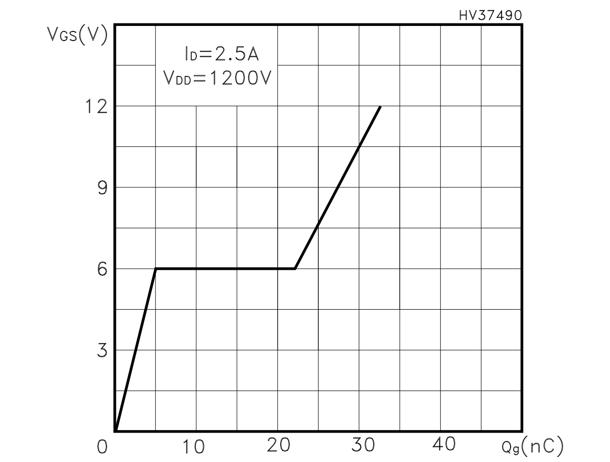


Figure 13. Capacitance variations

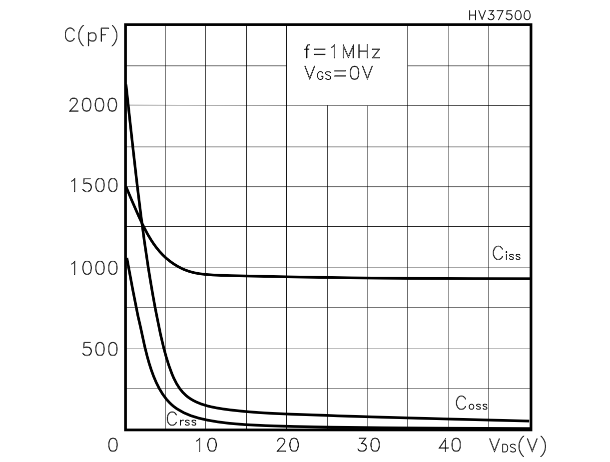


Figure 14. Normalized gate threshold voltage vs. temperature

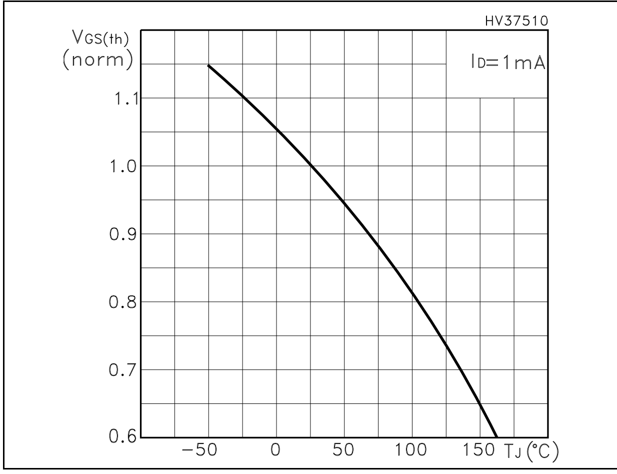


Figure 15. Normalized on resistance vs. temperature

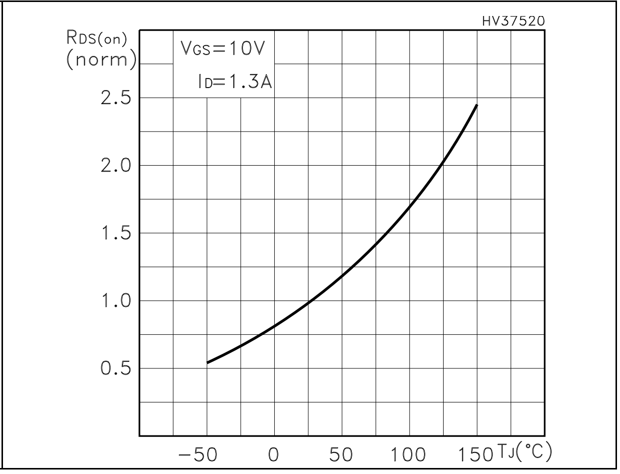


Figure 16. Source-drain diode forward characteristics

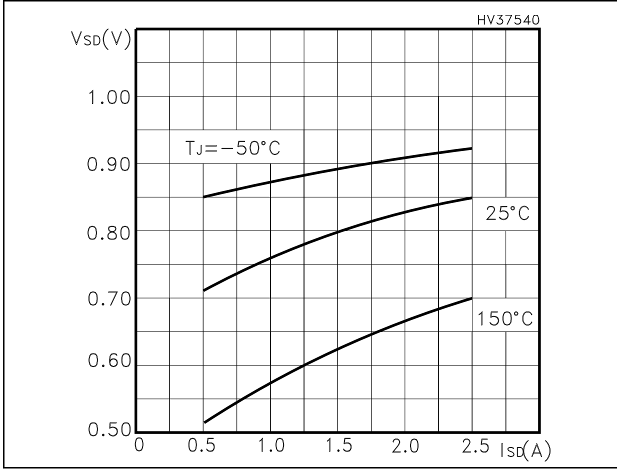
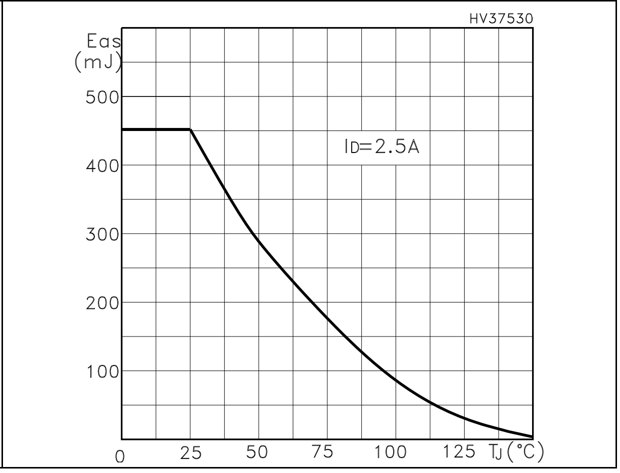


Figure 17. Maximum avalanche energy vs Tj



3 Test circuits

Figure 18. Switching times test circuit for resistive load

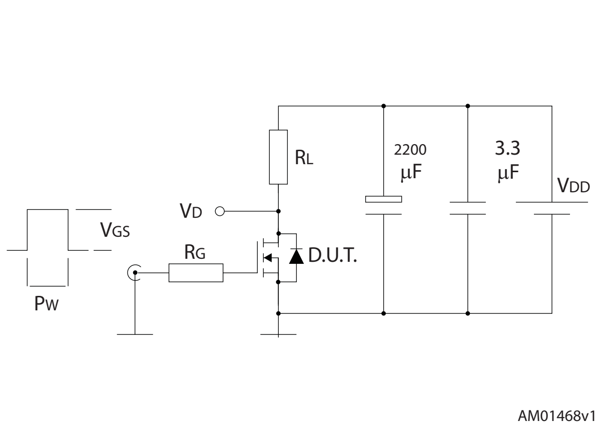


Figure 19. Gate charge test circuit

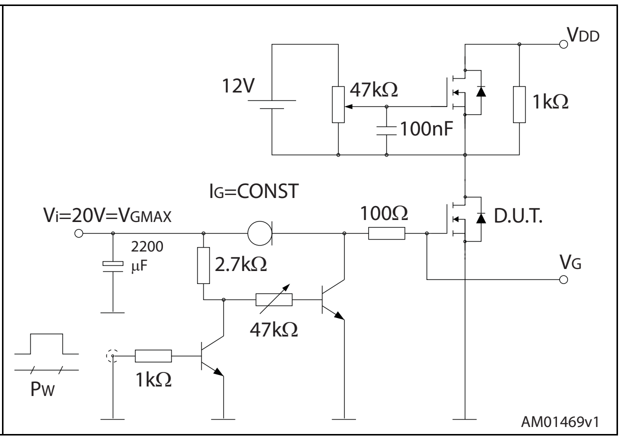


Figure 20. Test circuit for inductive load switching and diode recovery times

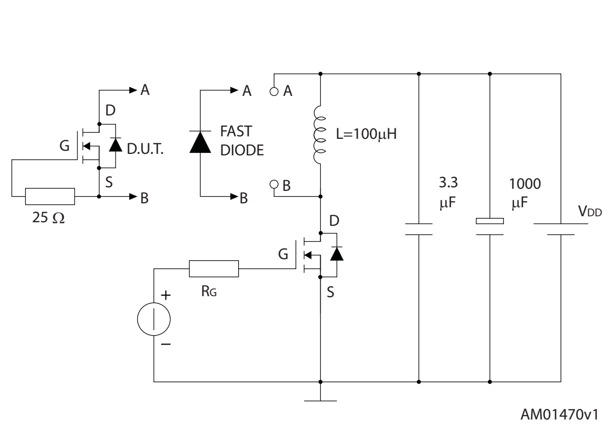


Figure 21. Unclamped inductive load test circuit

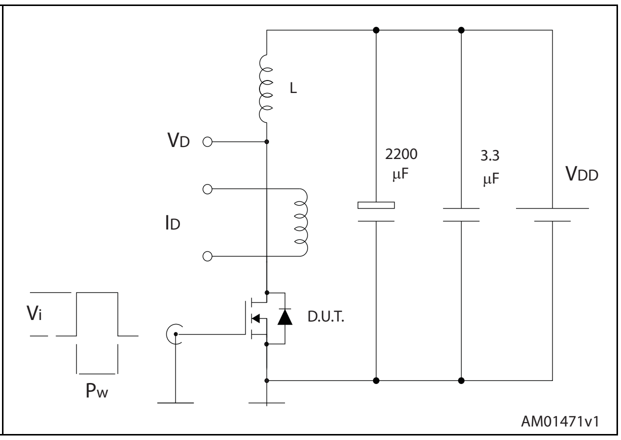


Figure 22. Unclamped inductive waveform

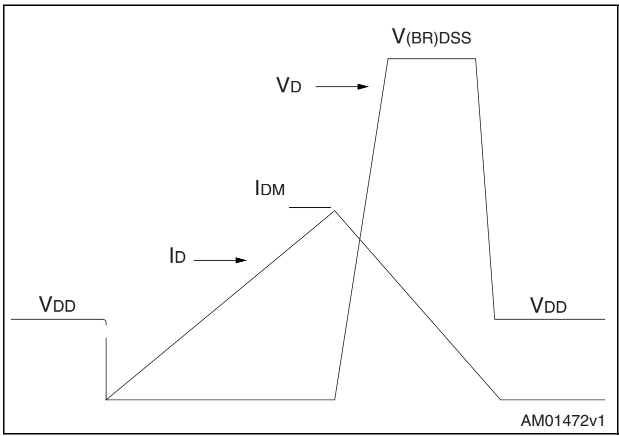
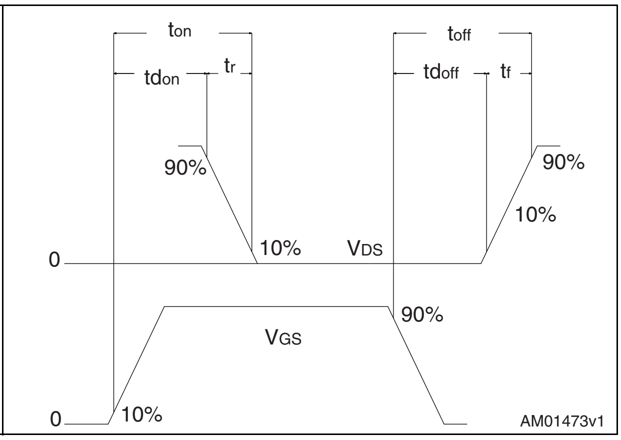


Figure 23. Switching time waveform



4 Package mechanical data

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.

Figure 24. TO-3PF drawing

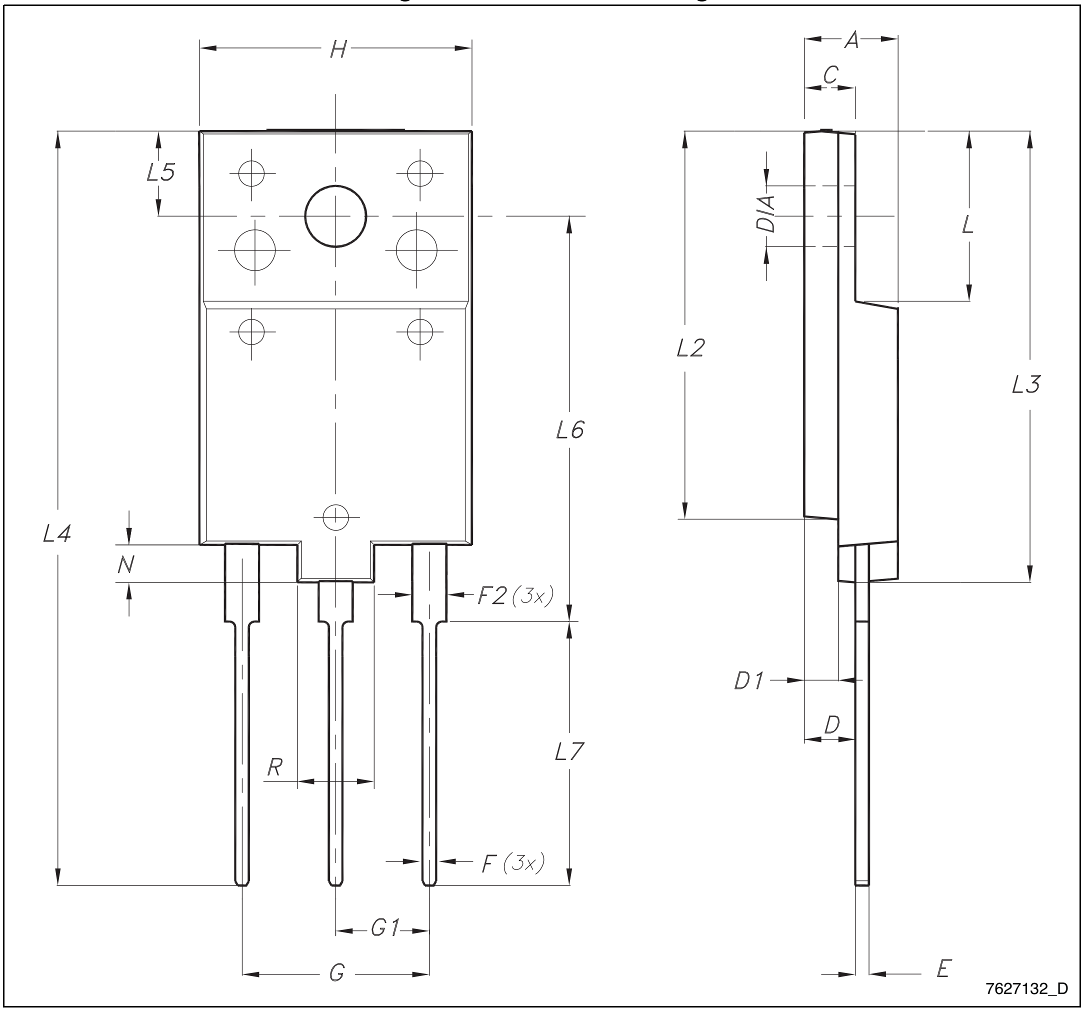


Table 9. TO-3PF mechanical data

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	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
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

Figure 25. H²PAK-2 drawing

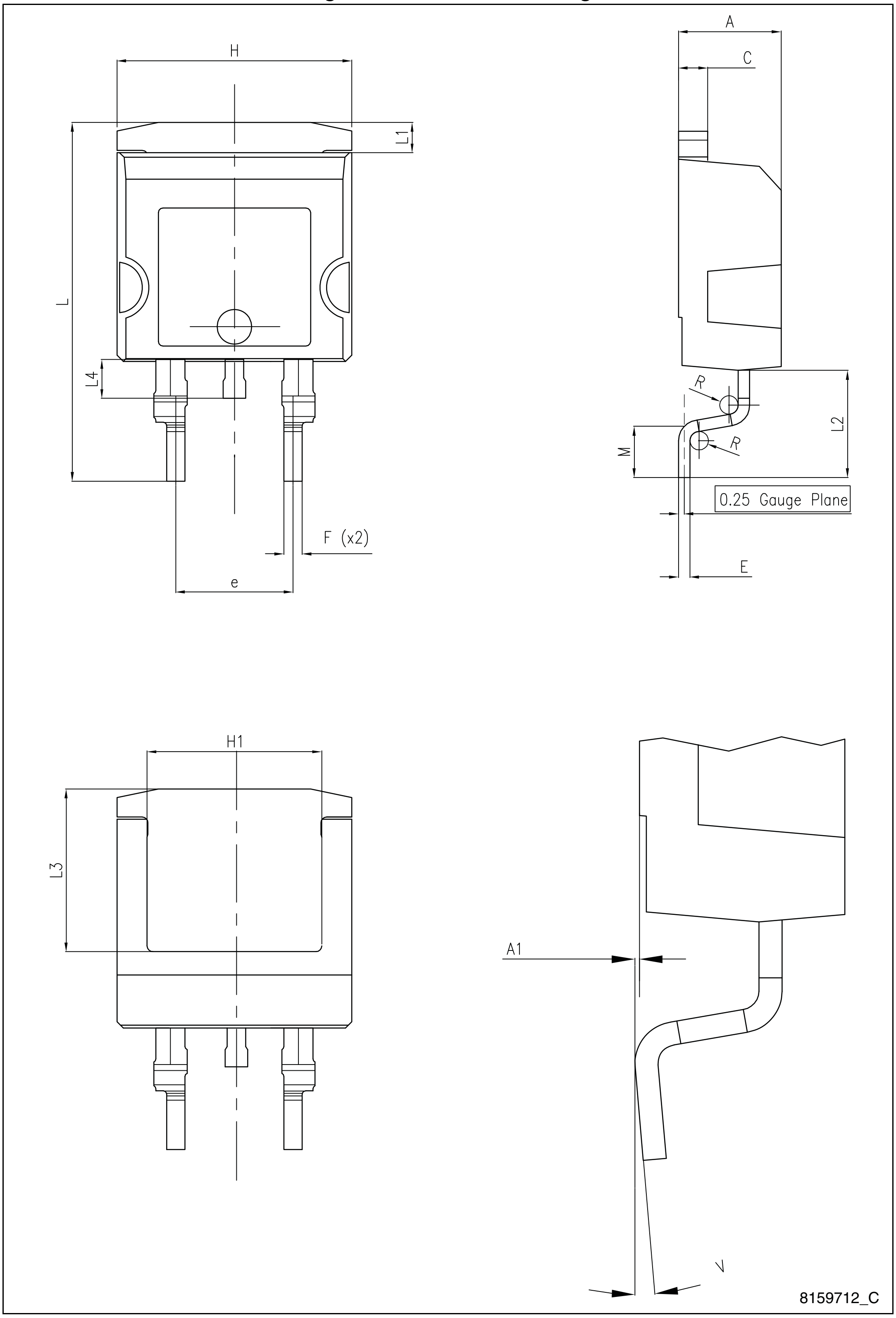


Table 10. H²PAK-2 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.30	-	4.80
A1	0.03		0.20
C	1.17		1.37
e	4.98		5.18
E	0.50		0.90
F	0.78		0.85
H	10.00		10.40
H1	7.40		7.80
L	15.30		15.80
L1	1.27		1.40
L2	4.93		5.23
L3	6.85		7.25
L4	1.5		1.7
M	2.6		2.9
R	0.20		0.60
V	0°		8°

Figure 26. H²PAK-2 recommended footprint (dimensions are in mm)

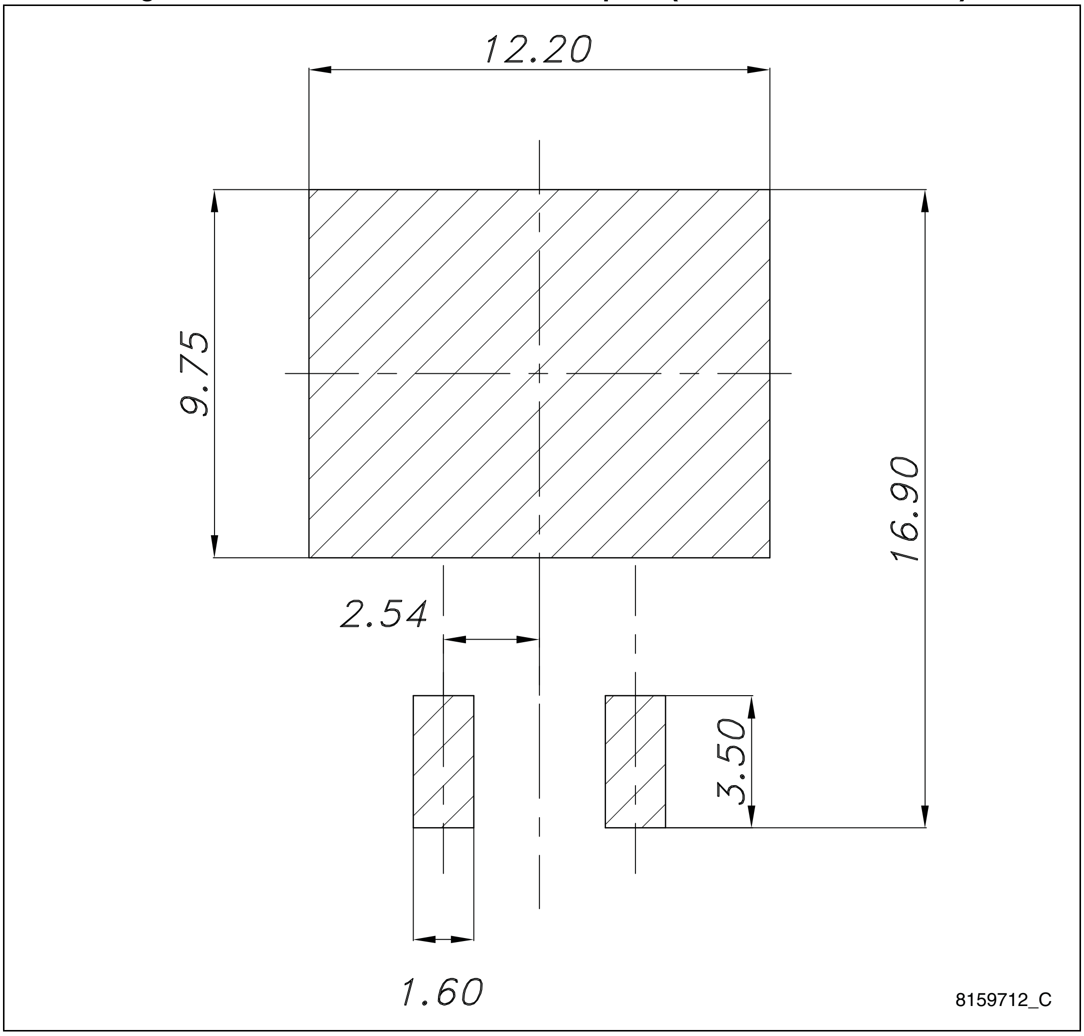


Figure 27. TO-220 type A drawing

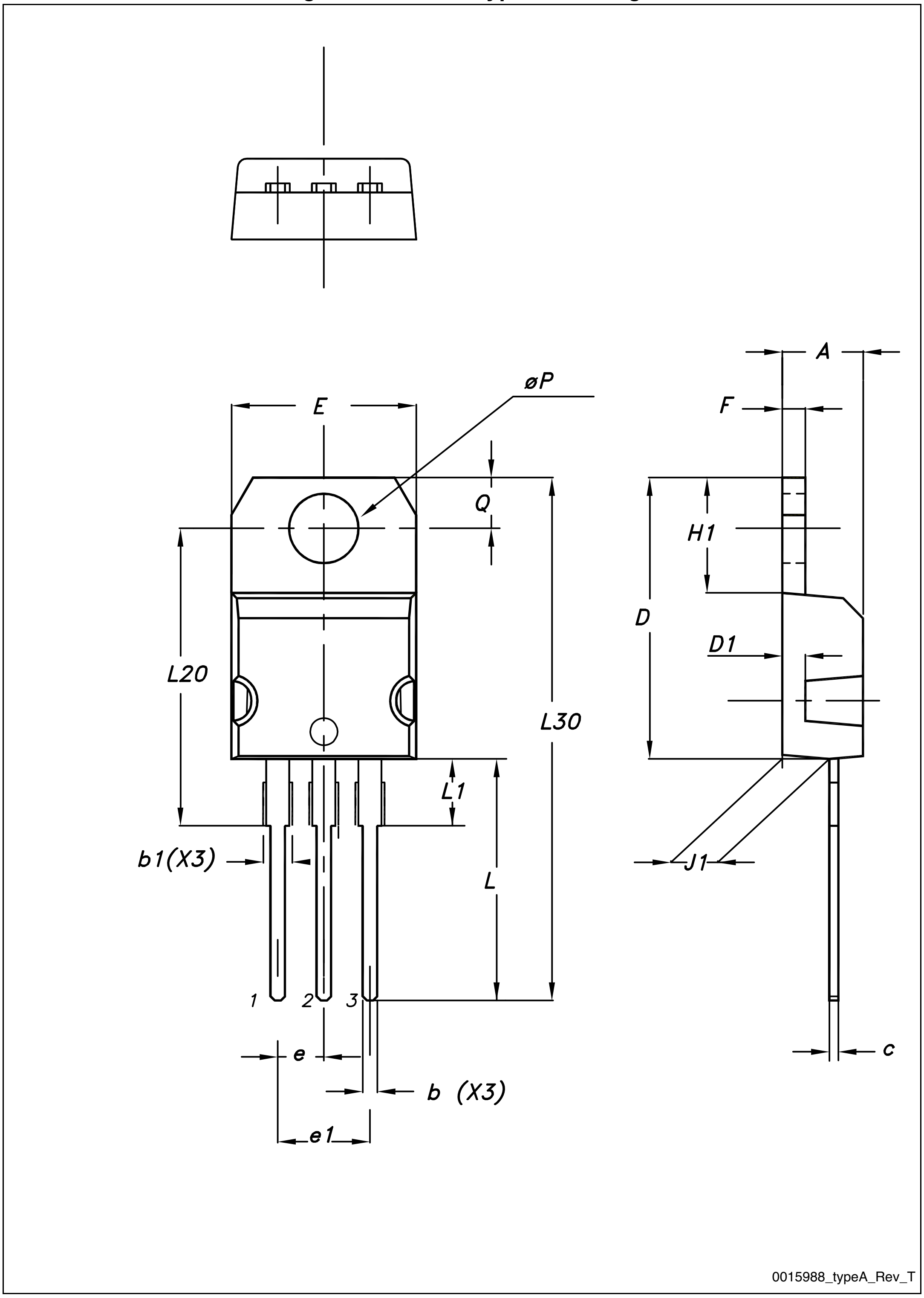


Table 11. TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		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		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95

Figure 28. TO-247 drawing

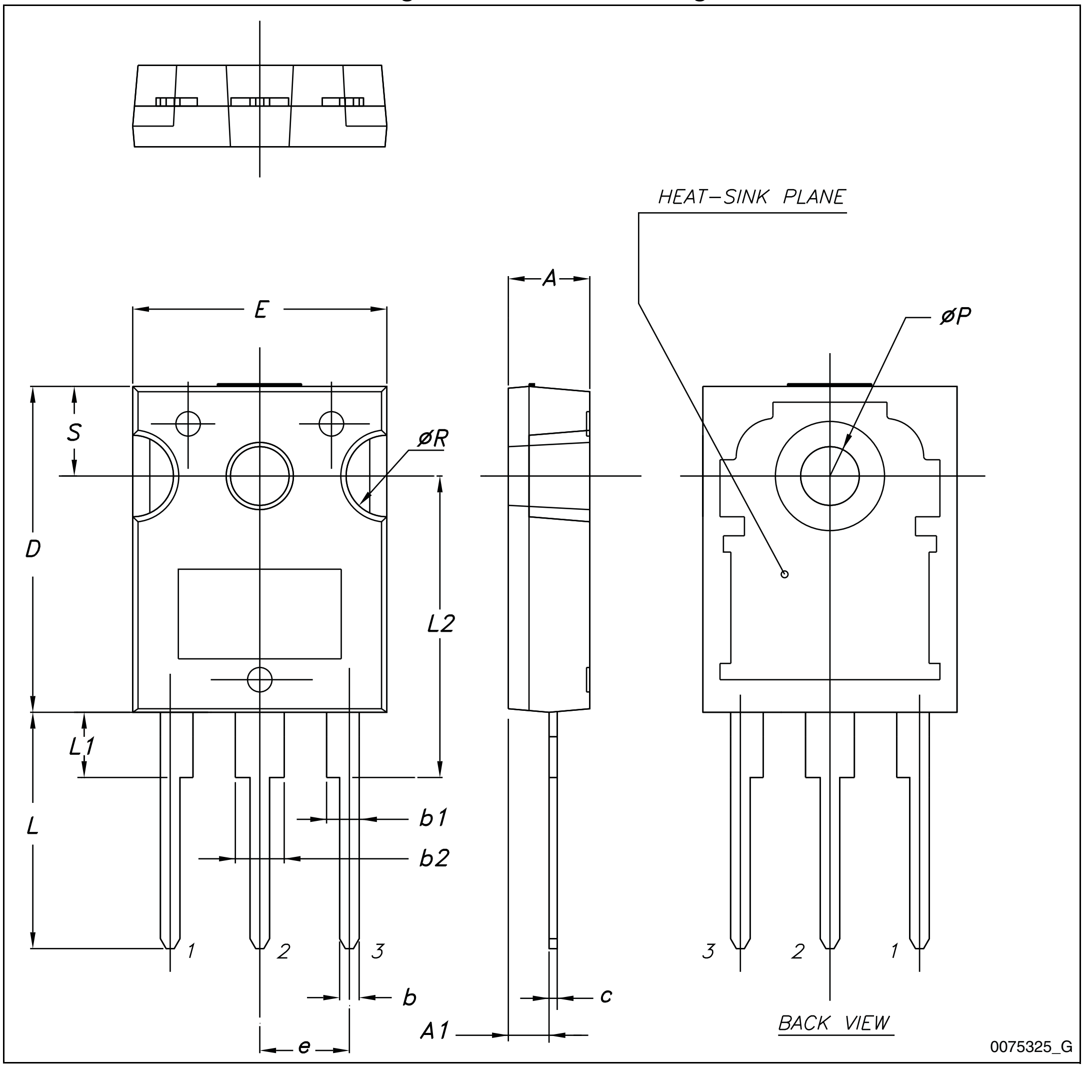


Table 12. TO-247 mechanical data

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	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

5 Packaging mechanical data

Figure 29. Tape

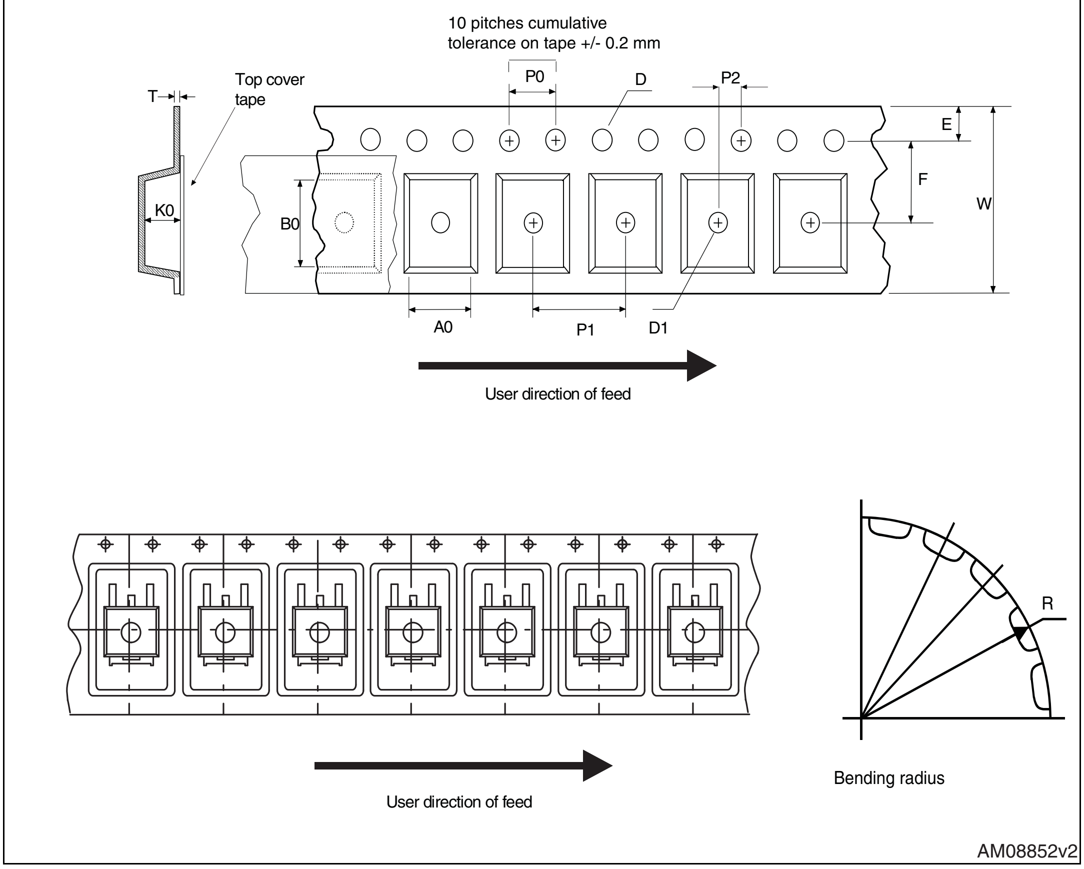


Figure 30. Reel

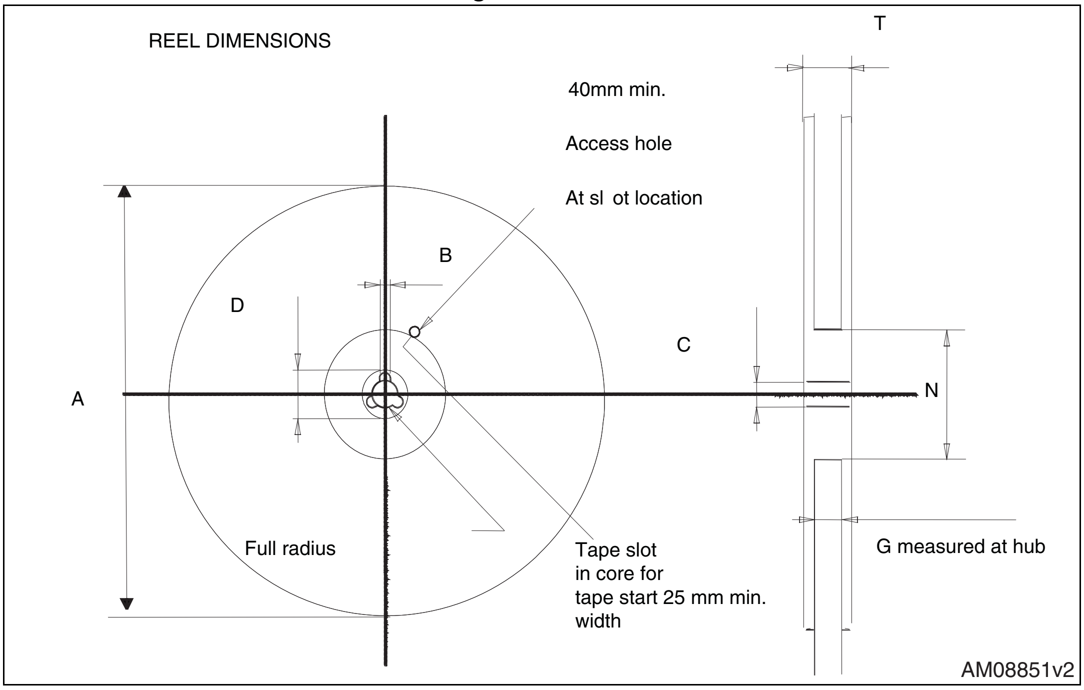


Table 13. H²PAK-2 tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	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 qty		1000
P2	1.9	2.1	Bulk qty		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

6 Revision history

Table 14. Document revision history

Date	Revision	Changes
12-Jan-2007	1	First release
17-Apr-2007	2	Added new value on *Table 6.*
14-May-2007	3	The document has been reformatted
29-Aug-2007	4	$R_{DS(on)}$ value changed, updated *Figure 15*
09-Apr-2008	5	Added new package: TO-3PF
13-Feb-2009	6	Added P_{TOT} value for TO-3PF (*Table 2: Absolute maximum ratings*)
01-Dec-2009	7	– Document status promoted from preliminary data to datasheet – Removed TO-220FH package and mechanical data
10-Dec-2009	8	Corrected V_{ISO} value in *Table 2: Absolute maximum ratings*
29-Jun-2010	9	Corrected unit in *Table 3.*
08-Feb-2013	10	– Minor text changes – Modified: *Table 3* – Changed: *Figure 1* – Added: H^2PAK-2 package
18-Feb-2014	11	– Modified: *Figure 1* – Updated: *Figure 18*, *19*, *20* and *21* – Updated: *Figure 27* and *Table 11* – Updated: *Section 4: Package mechanical data* – Minor text changes