STD11N65M2, STP11N65M2, STU11N65M2

N-channel 650 V, 0.6 Ω typ., 7 A MDmesh II Plus™ low Q_g Power MOSFETs in DPAK, TO-220 and IPAK packages

Datasheet - preliminary data

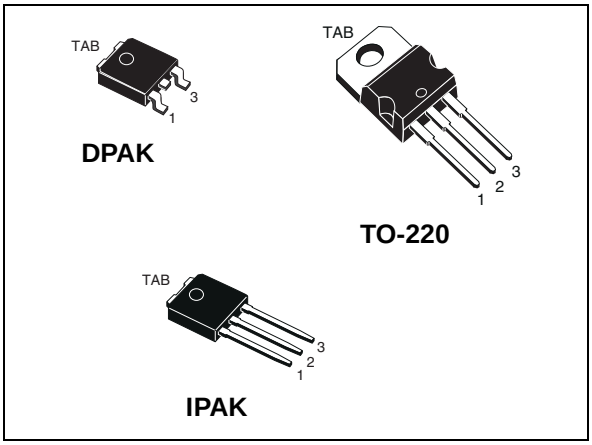
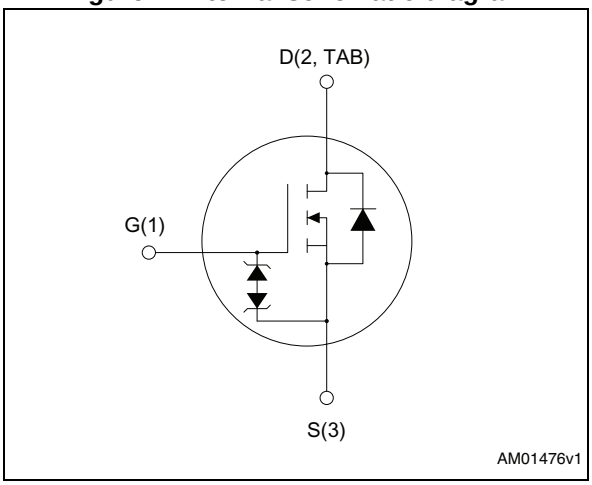


Figure 1. Internal schematic diagram



Features

Order codes	V_{DS}	$R_{DS(on)}$ max	I_D
STD11N65M2	650 V	0.67 Ω	7 A
STP11N65M2			
STU11N65M2			

- Extremely low gate charge
- Lower $R_{DS(on)}$ x area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using a new generation of MDmesh™ technology: MDmesh II Plus™ low Qg. These revolutionary Power MOSFETs associate a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. They are therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STD11N65M2	11N65M2	DPAK	Tape and reel
STP11N65M2		TO-220	Tube
STU11N65M2		IPAK	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D (1)	Drain current (continuous) at T_c = 25 °C	7	A
I_D (1)	Drain current (continuous) at T_c = 100 °C	4.4	A
I_{DM} (2)	Drain current (pulsed)	28	A
P_{TOT} (1)	Total dissipation at T_C = 25 °C	85	W
dv/dt (3)	Peak diode recovery voltage slope (starting T_j = 25 °C, I_D= I_{AS}, V_{DD} = 50 V)	15	V/ns
dv/dt (4)	MOSFET dv/dt ruggedness	50	V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; Tc = 25 °C)	2500	V
T_{stg}	Storage temperature	- 55 to 150	°C
T_j	Max. operating junction temperature	150	

1. The value is rated according to $R_{thj\text{-}case}$ and limited by package.
2. Pulse width limited by T_{jmax}
3. $I_{SD} \leq 7$ A, di/dt $\leq$ 400 A/μs; $V_{DS\ peak} < V_{(BR)DSS}$, V_{DD}=80% $V_{(BR)DSS}$.
4. $V_{DS} \leq 520$ V

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		DPAK	TO-220	IPAK	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	1.47			°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-amb max		62.5	100	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb max	50			°C/W

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

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	1.5	A
E_{AS}	Single pulse avalanche energy (starting T_j=25°C, I_D= I_{AR}; V_{DD}=50)	110	mJ

2 Electrical characteristics

(T_C = 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	V_{GS} = 0, I_D = 1 mA	650			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0, V_{DS} = 650 V			1	µA
		V_{GS} = 0, V_{DS} = 650 V, T_C=125 °C			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0, V_{GS} = ± 25 V			±10	µA
$V_{GS(th)}$	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 = 3.5 A		0.6	0.67	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{GS} = 0, V_{DS} = 100 V, f = 1 MHz,	-	410	-	pF
C_{oss}	Output capacitance		-	20	-	pF
C_{rss}	Reverse transfer capacitance		-	0.95	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0, V_{DS} = 0 to 520 V	-	83	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D=0	-	6.4	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 7 A, V_{GS} = 10 V (see *Figure 17*)	-	12.5	-	nC
Q_{gs}	Gate-source charge		-	3.2	-	nC
Q_{gd}	Gate-drain charge		-	5.8	-	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 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 325 V, I_D = 3.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 16* and *21*)	-	9.5	-	ns
t_r	Rise time		-	7.5	-	ns
$t_{d(off)}$	Turn-off delay time		-	26	-	ns
t_f	Fall time		-	15	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		7	A
I_{SDM} (1) (2)	Source-drain current (pulsed)		-		28	A
V_{SD} (3)	Forward on voltage	V_{GS} = 0, I_{SD} = 7 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 7 A (2), di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 18*)	-	318		ns
Q_{rr}	Reverse recovery charge		-	2.5		nC
I_{RRM}	Reverse recovery current		-	15.5		A
t_{rr}	Reverse recovery time	I_{SD} = 7 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j=150 °C (see *Figure 18*)	-	437		ns
Q_{rr}	Reverse recovery charge		-	3.2		nC
I_{RRM}	Reverse recovery current		-	15		A

1. Pulse width limited by safe operating area
2. Test condition is referred to through-hole package
3. Pulsed: pulse duration = 300 µs, duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for DPAK and IPAK

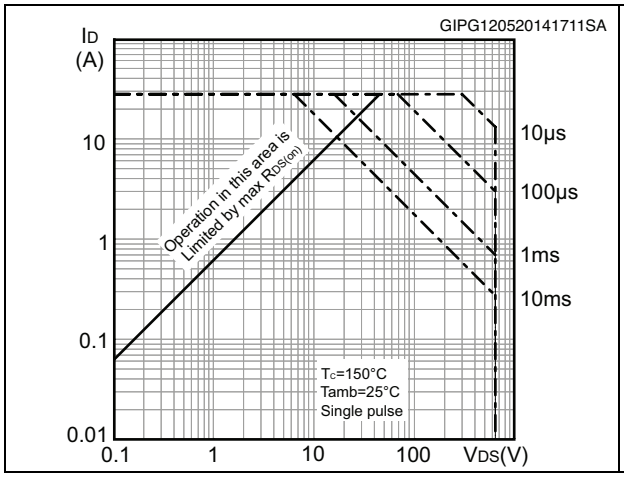


Figure 3. Thermal impedance for DPAK and IPAK

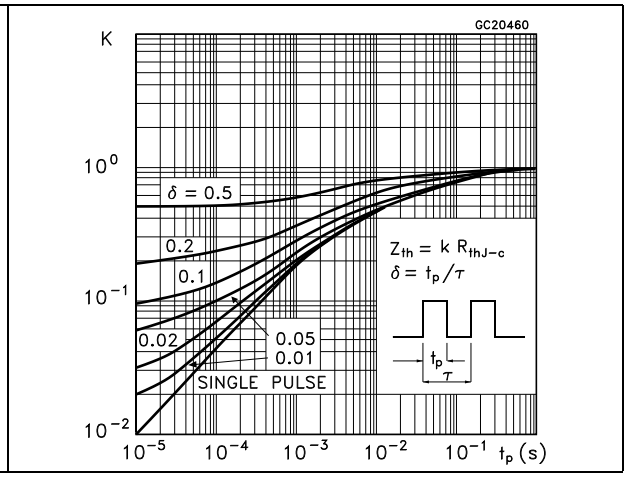


Figure 4. Safe operating area for TO-220

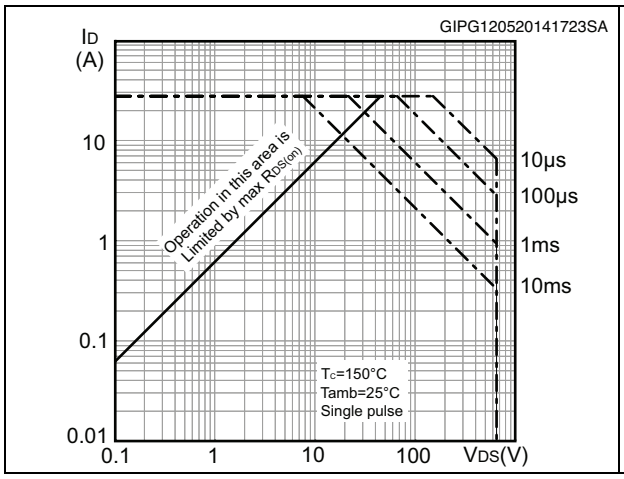


Figure 5. Thermal impedance for TO-220

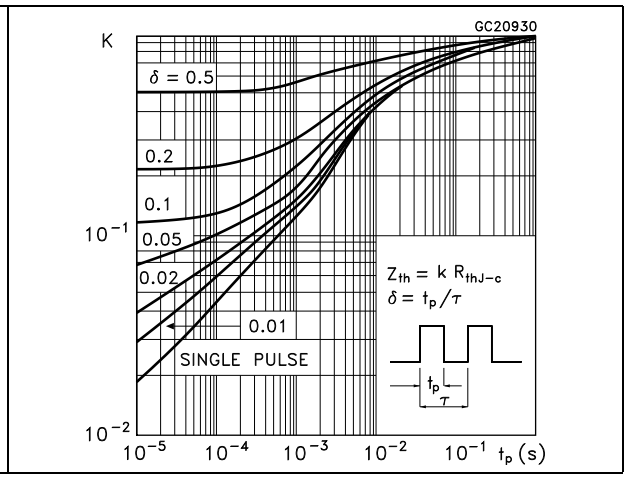


Figure 6. Output characteristics

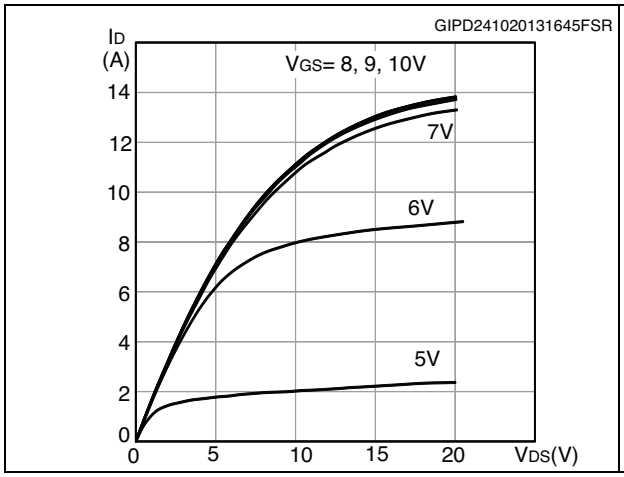


Figure 7. Transfer characteristics

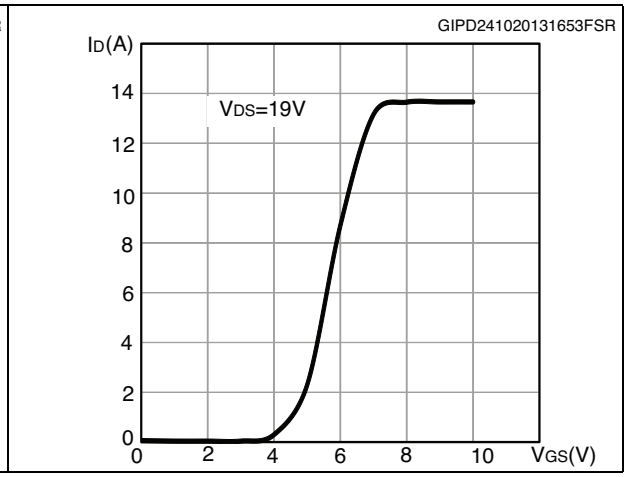


Figure 8. Normalized $V_{(BR)DSS}$ vs temperature

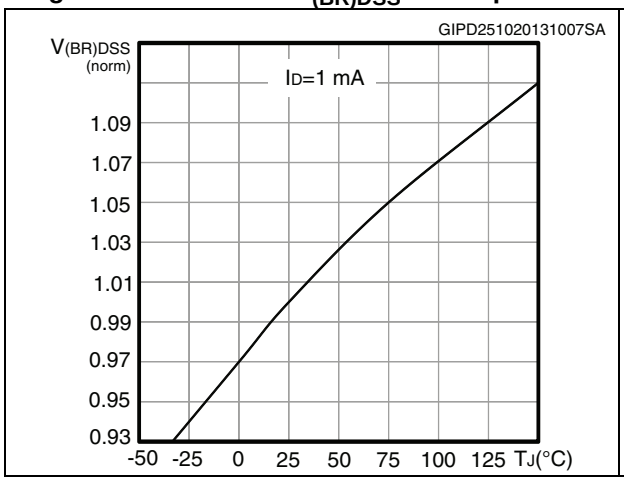


Figure 9. Static drain-source on-resistance

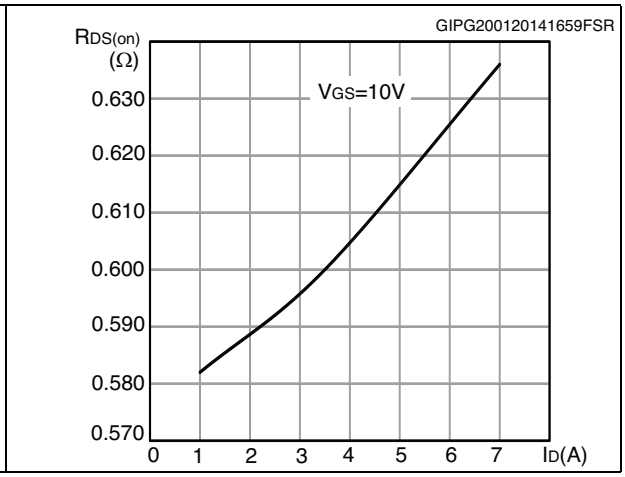


Figure 10. Gate charge vs gate-source voltage

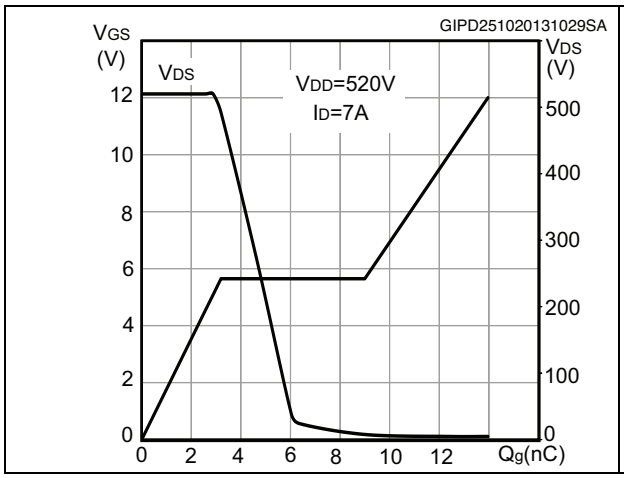


Figure 11. Capacitance variations

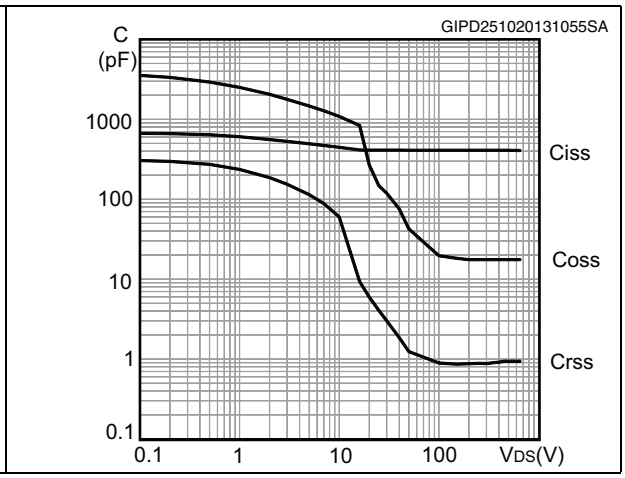


Figure 12. Normalized gate threshold voltage vs temperature

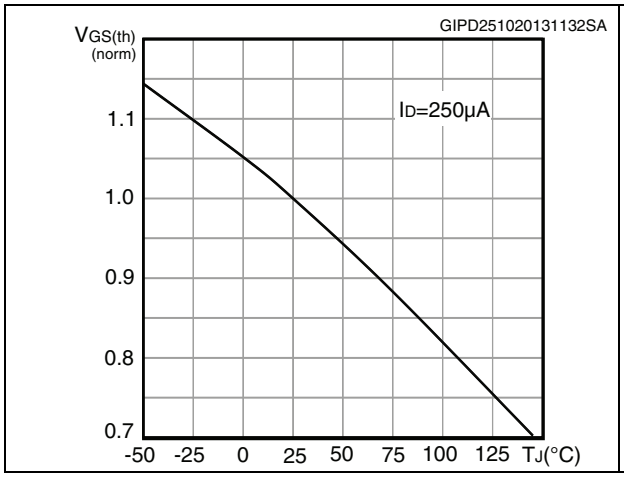


Figure 13. Normalized on-resistance vs temperature

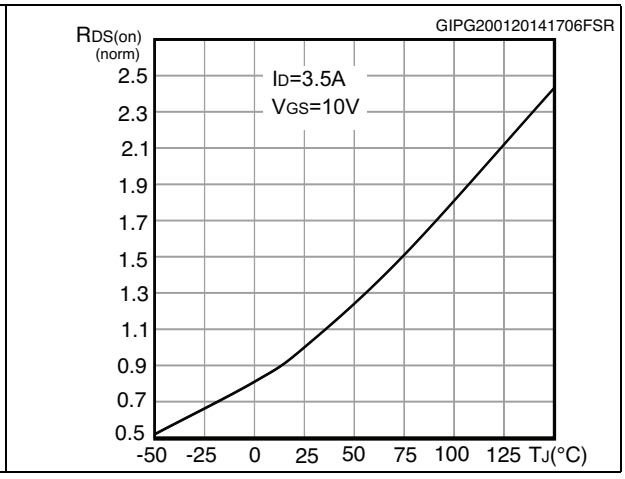


Figure 14. Source-drain diode forward characteristics

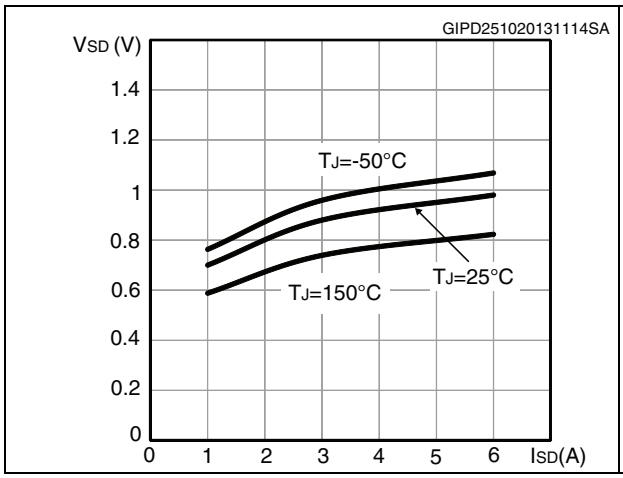
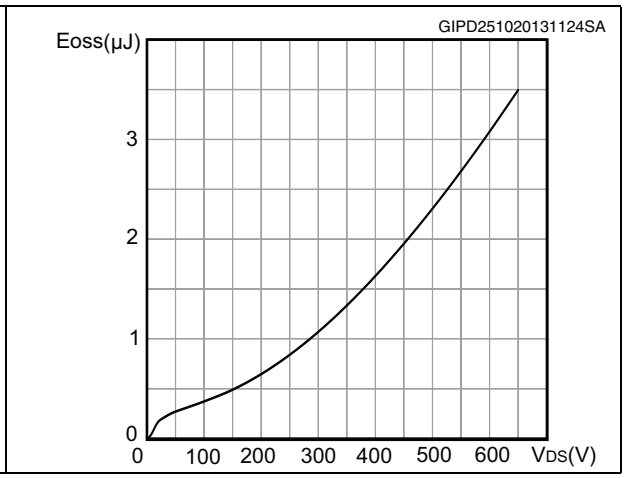


Figure 15. Output capacitance stored energy



3 Test circuits

Figure 16. Switching times test circuit for resistive load

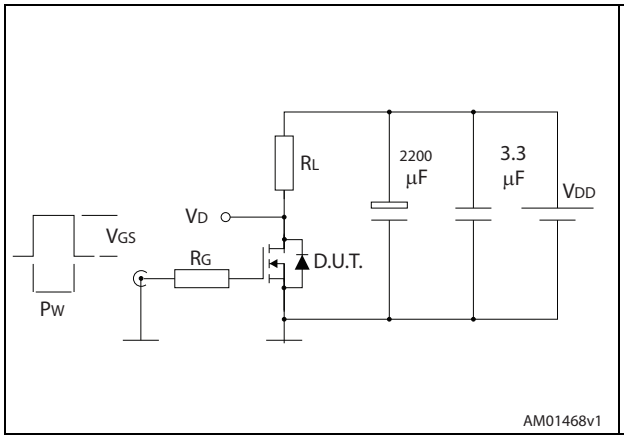


Figure 17. Gate charge test circuit

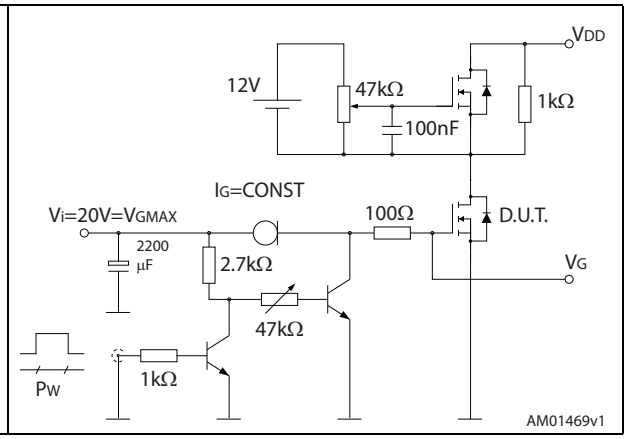


Figure 18. Test circuit for inductive load switching and diode recovery times

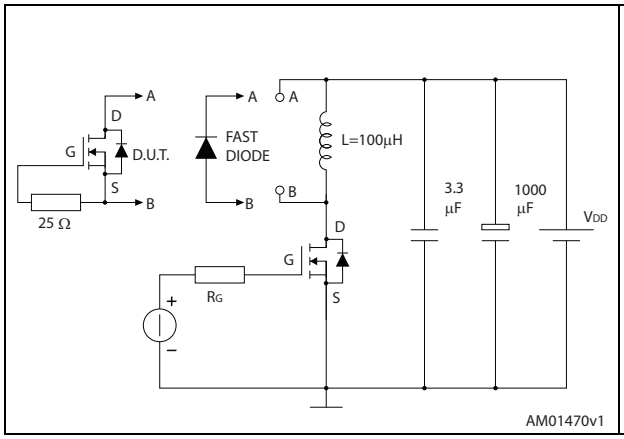


Figure 19. Unclamped inductive load test circuit

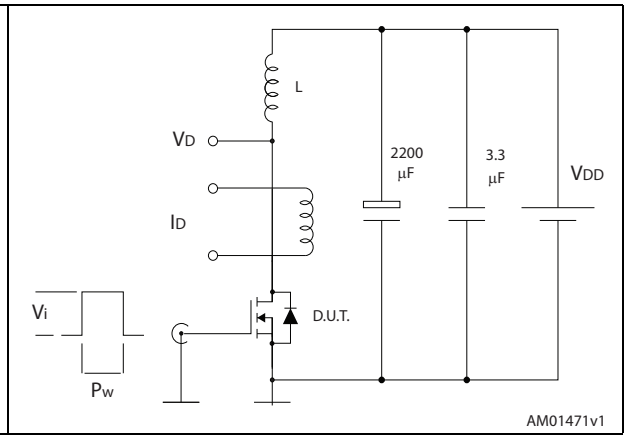


Figure 20. Unclamped inductive waveform

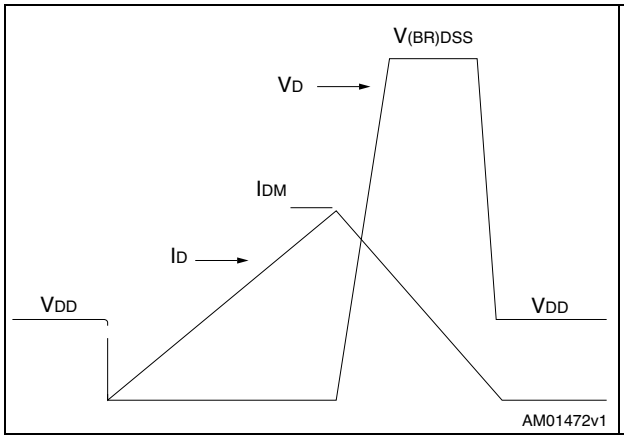
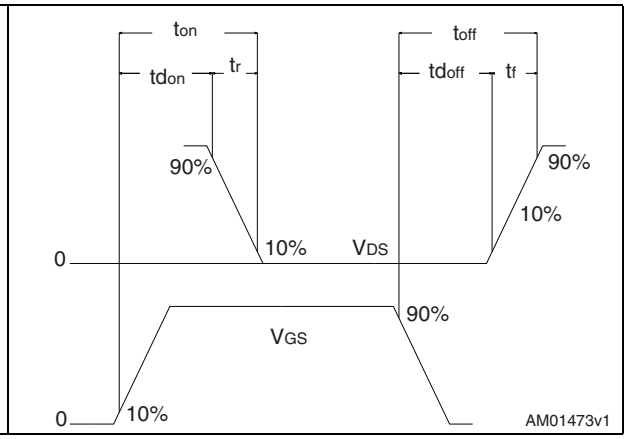


Figure 21. Switching time waveform



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.

4.1 DPAK, STD11N65M2

Figure 22. DPAK (TO-252) type A drawing

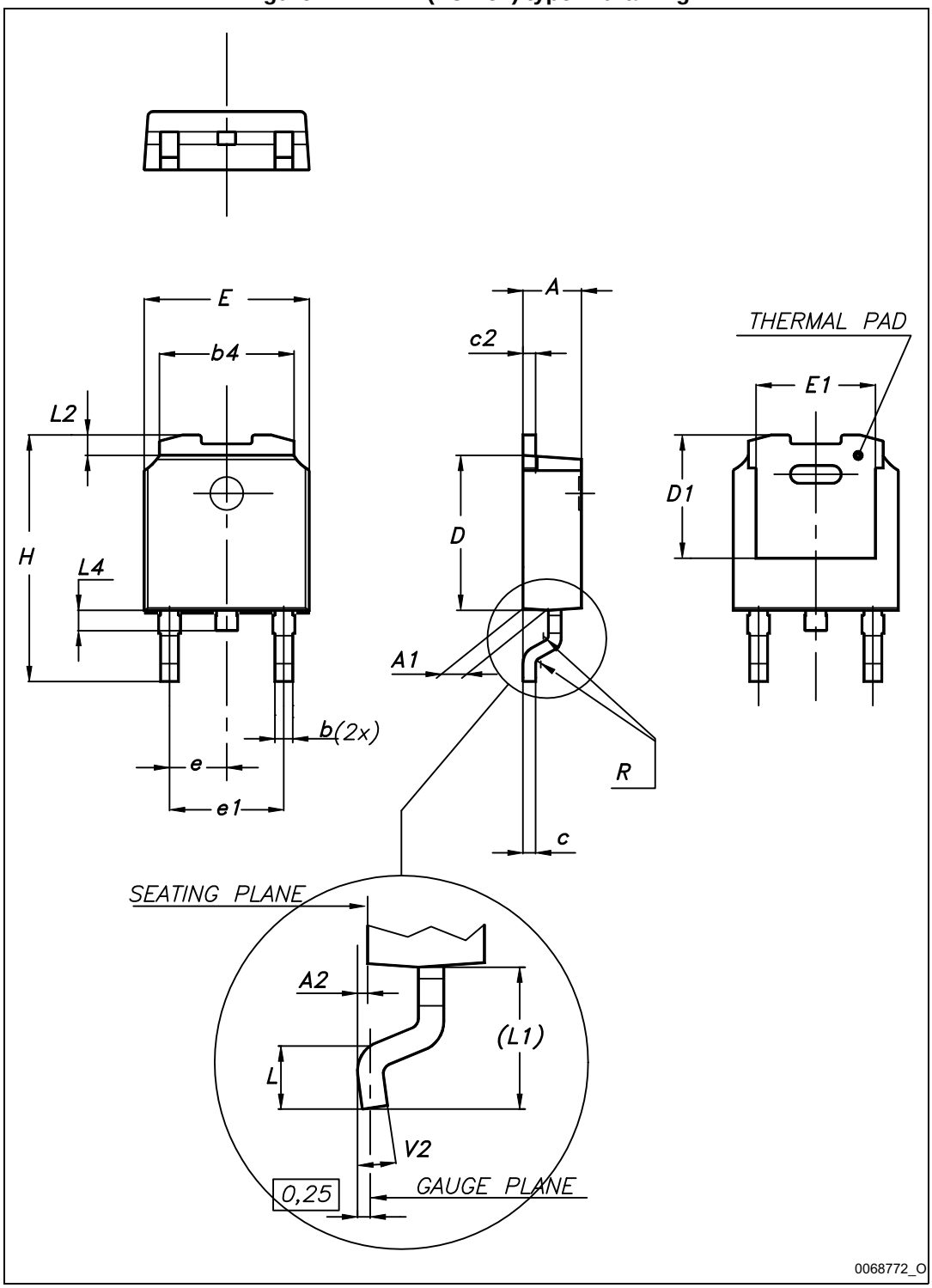
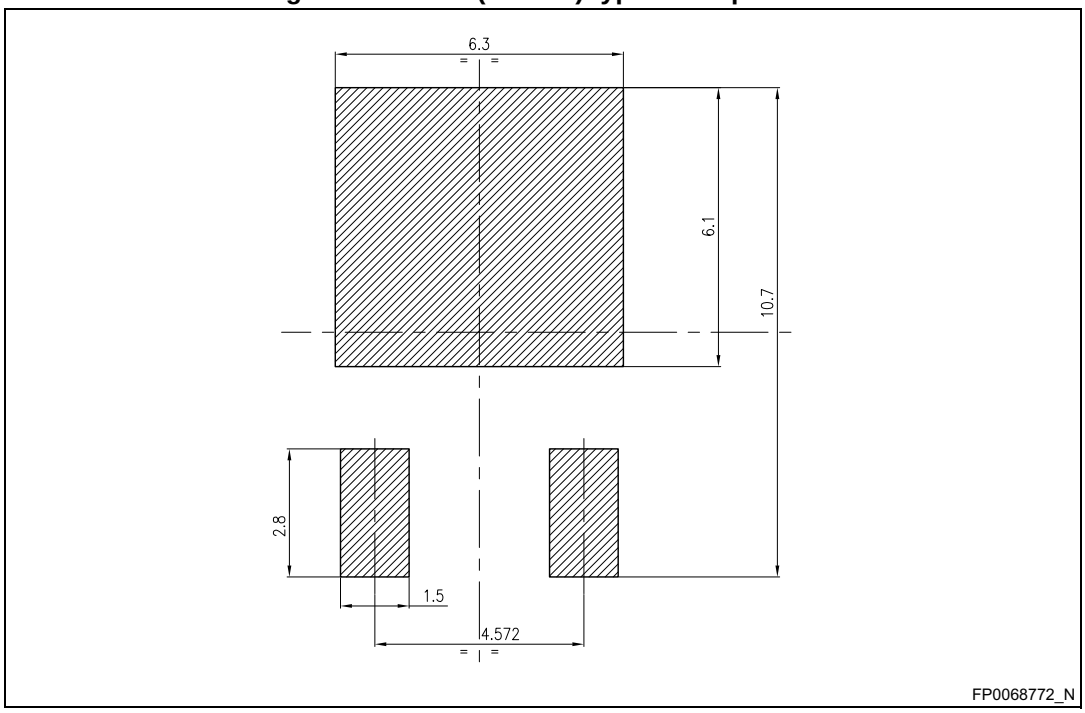


Table 9. DPAK (TO-252) type A mechanical data

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		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 23. DPAK (TO-252) type A footprint [(a)]



a. All dimensions are in millimeters

4.2 TO-220, STP11N65M2

Figure 24. TO-220 type A drawing

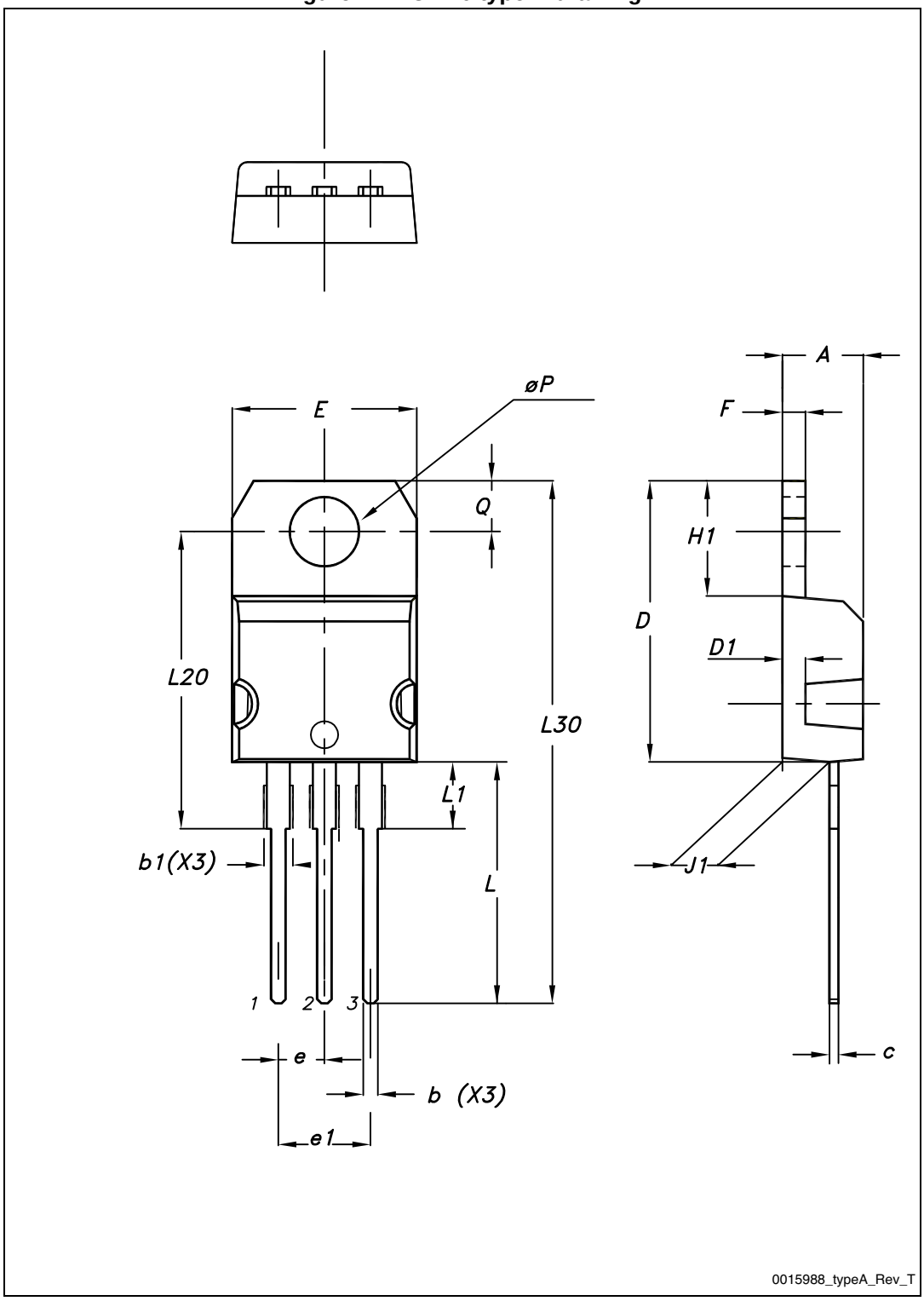


Table 10. TO-220 type A mechanical data

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

4.3 IPAK, STU11N65M2

Figure 25. IPAK (TO-251) drawing

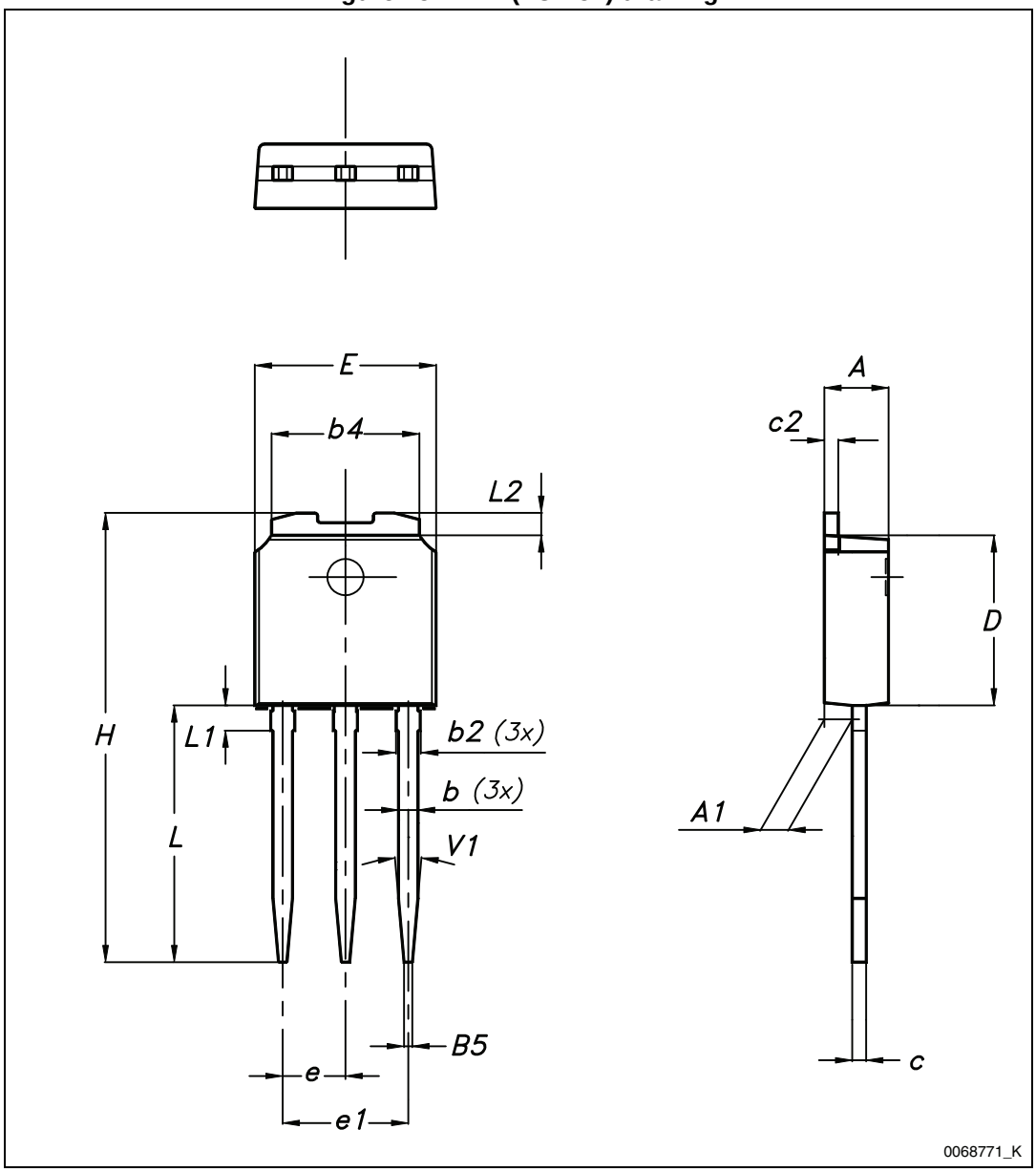


Table 11. IPAK (TO-251) mechanical data

DIM	mm.		
	min.	typ.	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.30	
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10°	

5 Packaging mechanical data

Figure 26. Tape for DPAK (TO-252)

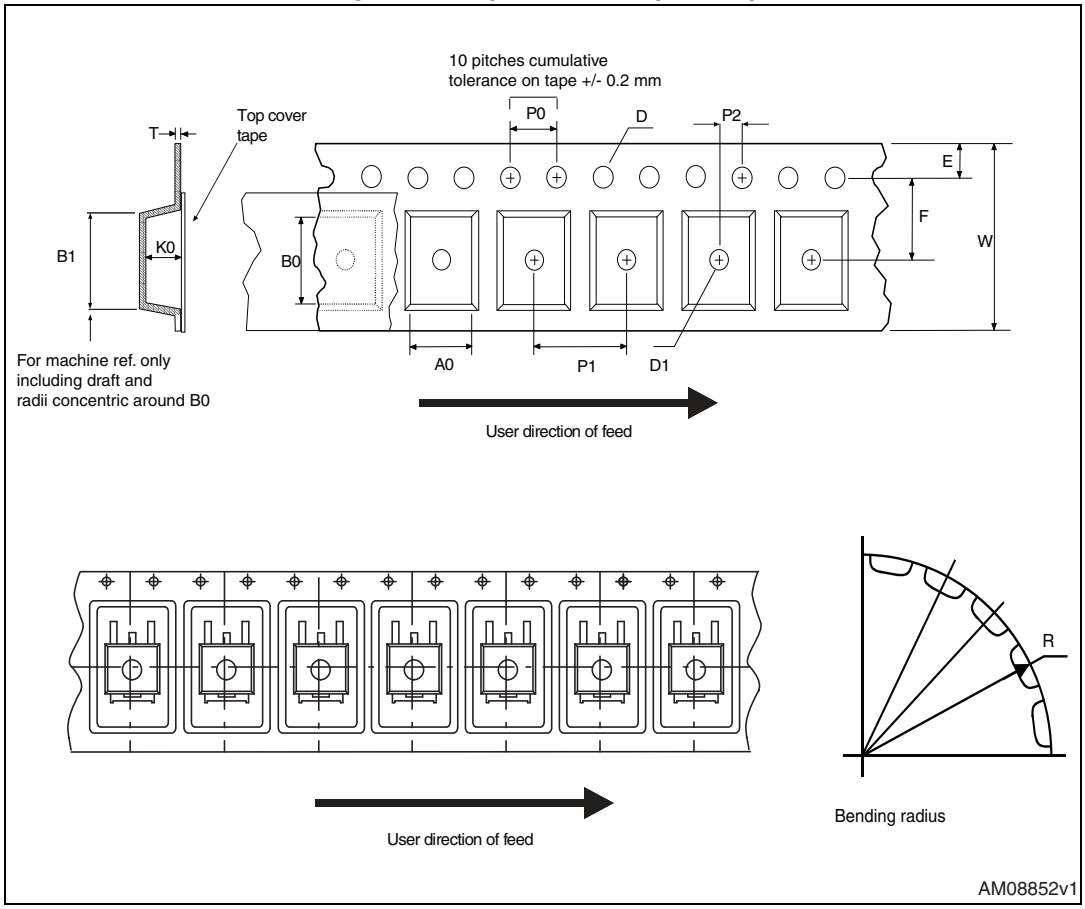


Figure 27. Reel for DPAK (TO-252)

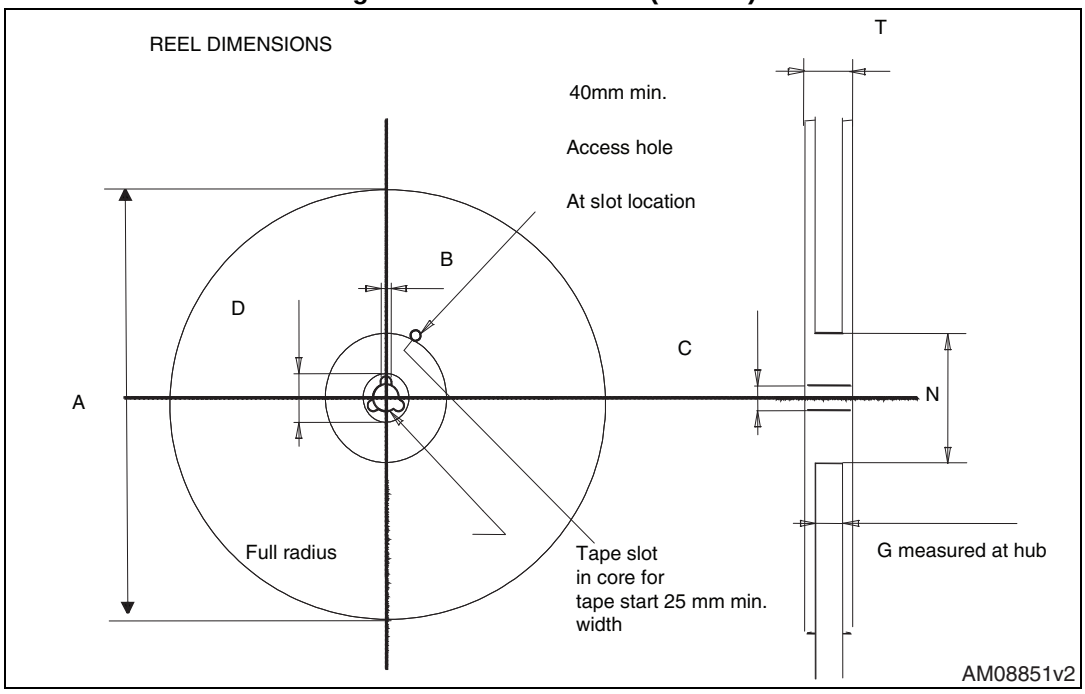


Table 12. DPAK (TO-252) tape and reel mechanical data

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			

6 Revision history

Table 13. Document revision history

Date	Revision	Changes
16-May-2014	1	First release.