STB26NM60N, STF26NM60N, STP26NM60N

N-channel 600 V, 0.135 Ω typ., 20 A MDmesh™ II Power MOSFETs in D^2PAK, TO-220FP and TO-220 packages

Datasheet - production data

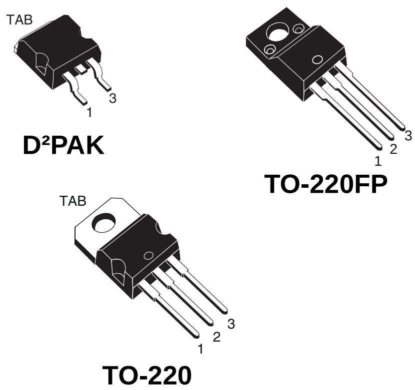
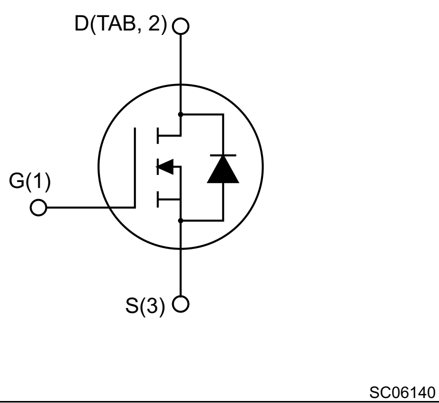


Figure 1. Internal schematic diagram



Features

Order codes	V_{DS}	$R_{DS(on)}$ max	I_D
STB26NM60N	600 V	0.165 Ω	20 A
STF26NM60N			
STP26NM60N			

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STB26NM60N	26NM60N	D^2PAK	Tape and reel
STF26NM60N		TO-220FP	Tube
STP26NM60N		TO-220	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D²PAK, TO-220	TO-220FP	
V_{DS}	Drain-source voltage	600		V
V_{GS}	Gate-source voltage	± 30		V
I_D	Drain current (continuous) at T_C = 25 °C	20	20(1)	A
I_D	Drain current (continuous) at T_C = 100 °C	12.6	12.6 (1)	A
I_{DM} (2)	Drain current (pulsed)	80	80(1)	A
P_{TOT}	Total dissipation at T_C = 25 °C	140	35	W
	Derating factor	1.12	0.28	W/°C
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)		2500	V
T_{stg}	Storage temperature	–55 to 150		°C
T_j	Max. operating junction temperature	150		°C

1. Limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq$ 20 A, di/dt $\leq$ 400 A/µs, $V_{DSpeak} \leq V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		D²PAK	TO-220FP	TO-220	
$R_{thj-case}$	Thermal resistance junction-case max	0.89	3.6	0.89	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max		62.5		°C/W
$R_{thj-pcb}$(1)	Thermal resistance junction-pcb max	30			°C/W

1. When mounted on FR-4 board of 1inch², 2oz Cu, t < 10 sec.

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_{jmax})	6	A
E_{AS}	Single pulse avalanche energy (starting T_J=25 °C, I_D=I_{AS}, V_{DD}=50 V)	610	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	600			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 600 V V_{DS} = 600 V, T_C = 125 °C			1 100	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 25 V			±0.1	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 = 10 A		0.135	0.165	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0	-	1800	-	pF
C_{oss}	Output capacitance			115	-	pF
C_{rss}	Reverse transfer capacitance		-	1.1	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0, V_{DS} = 0 to 480 V	-	310	-	pF
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 20 A, V_{GS} = 10 V, *(see Figure 17)*	-	60	-	nC
Q_{gs}	Gate-source charge		-	8.5	-	nC
Q_{gd}	Gate-drain charge		-	30	-	nC
R_g	Gate input resistance	f=1 MHz Gate DC Bias=0 Test signal level = 20 mV open drain	-	2.8	-	Ω

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_{DS}

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 10 A R_G = 4.7 Ω V_{GS} = 10 V *(see Figure 16)*	-	13	-	ns
t_r	Rise time		-	25	-	ns
$t_{d(off)}$	Turn-off delay time		-	85	-	ns
t_f	Fall time		-	50	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I_{SD}	Source-drain current		-		20	A
I_{SDM} (1)	Source-drain current (pulsed)		-		80	A
V_{SD} (2)	Forward on voltage	I_{SD} = 20 A, V_{GS} = 0	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 20 A, di/dt = 100 A/µs V_{DD} = 60 V *(see Figure 18)*	-	370		ns
Q_{rr}	Reverse recovery charge		-	5.8		µC
I_{RRM}	Reverse recovery current		-	31.6		A
t_{rr}	Reverse recovery time	I_{SD} = 20 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C *(see Figure 18)*	-	450		ns
Q_{rr}	Reverse recovery charge		-	7.5		µC
I_{RRM}	Reverse recovery current		-	32.5		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 D²PAK and TO-220

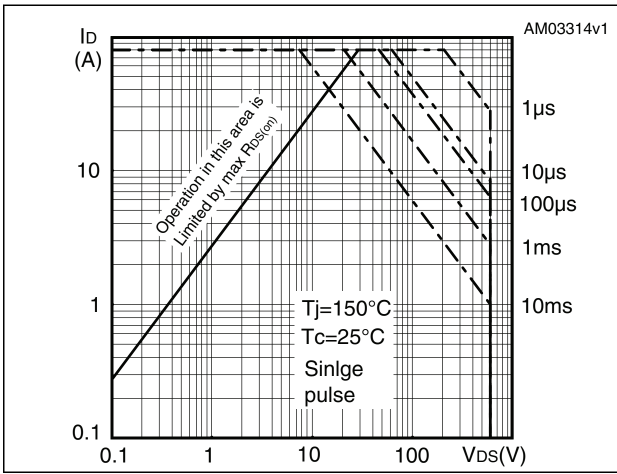


Figure 3. Thermal impedance for D²PAK and TO-220

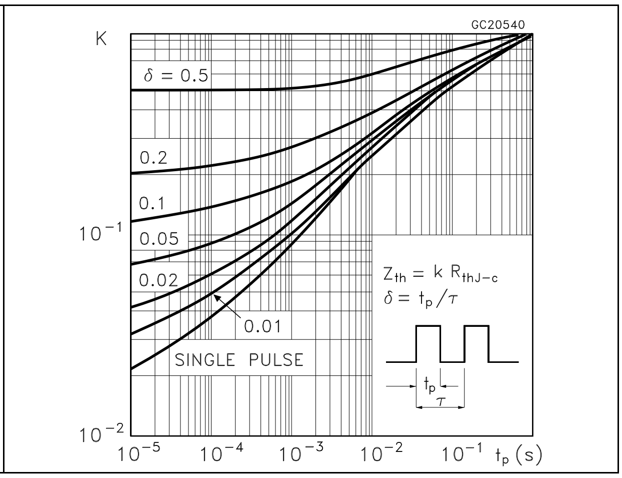


Figure 4. Safe operating area for TO-220FP

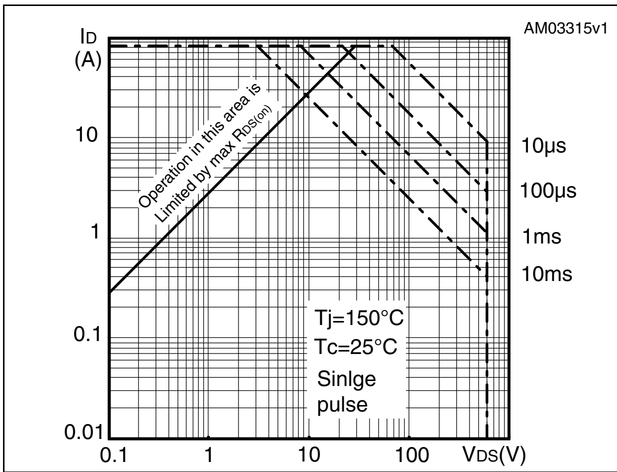


Figure 5. Thermal impedance for TO-220FP

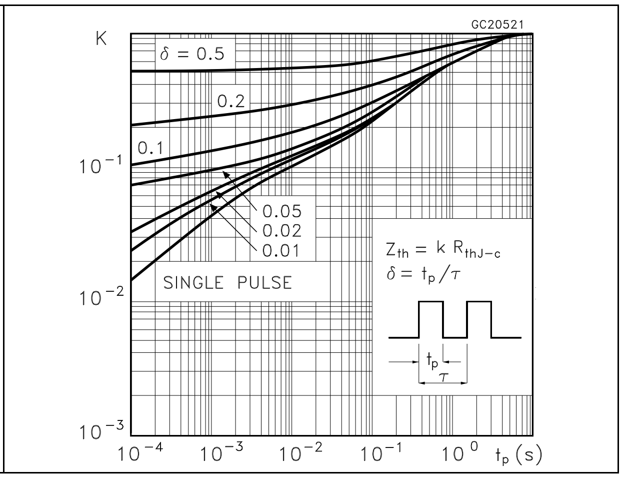


Figure 6. Output characteristics

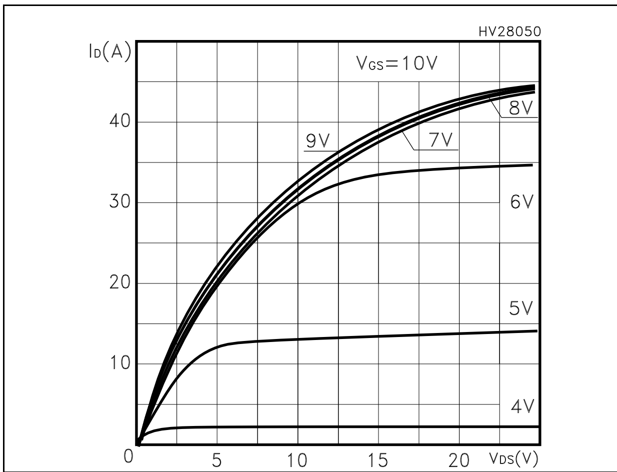


Figure 7. Transfer characteristics

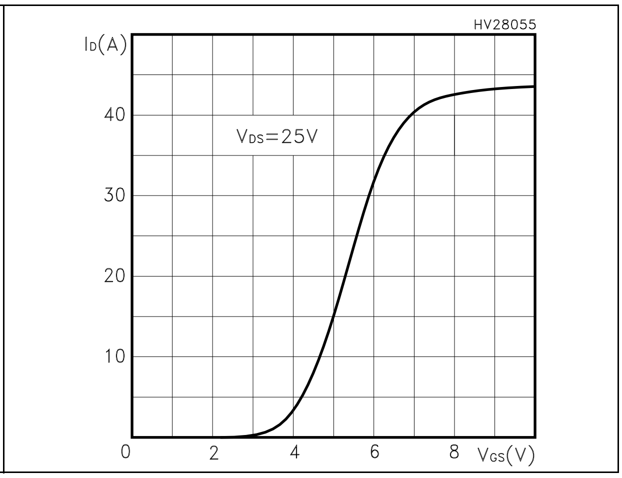


Figure 8. Transconductance

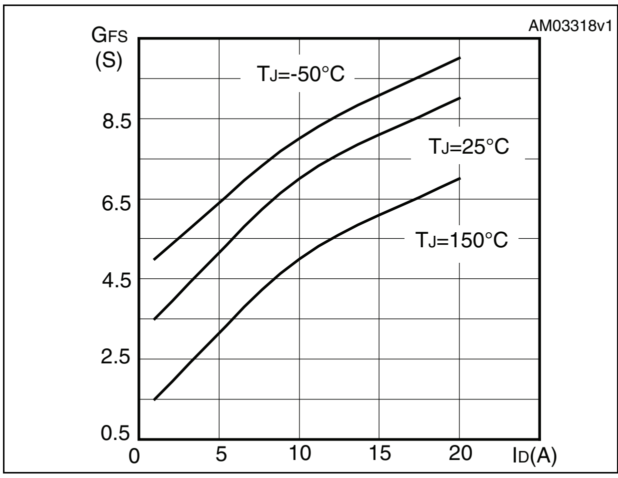


Figure 9. Static drain-source on-resistance

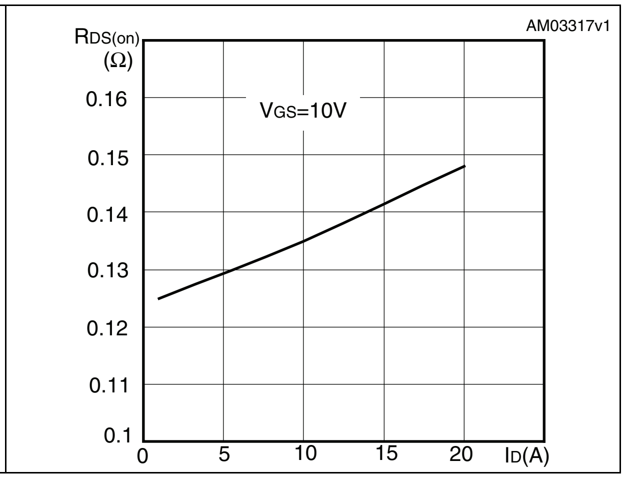


Figure 10. Gate charge vs gate-source voltage

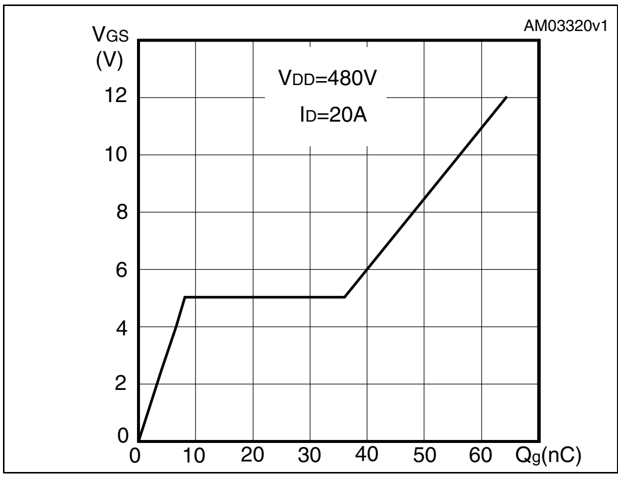


Figure 11. Capacitance variations

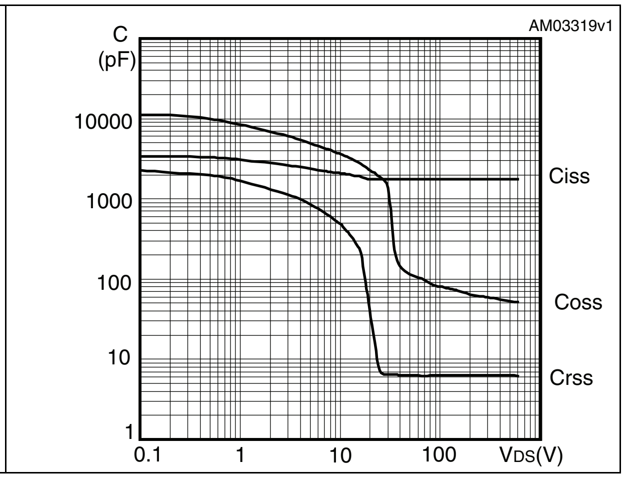


Figure 12. Normalized gate threshold voltage vs temperature

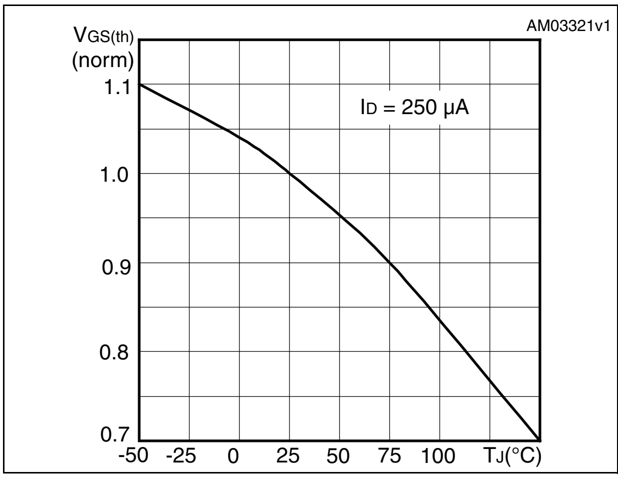


Figure 13. Normalized on resistance vs temperature

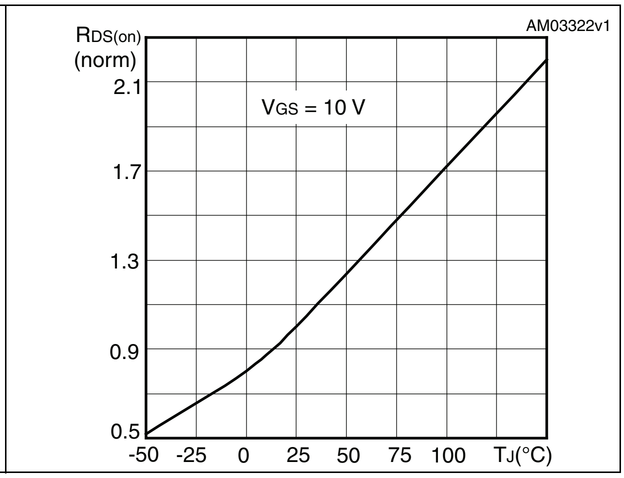


Figure 14. Source-drain diode forward characteristics

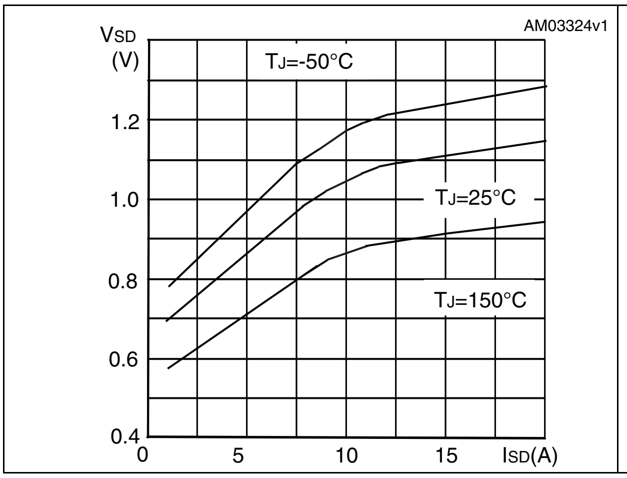
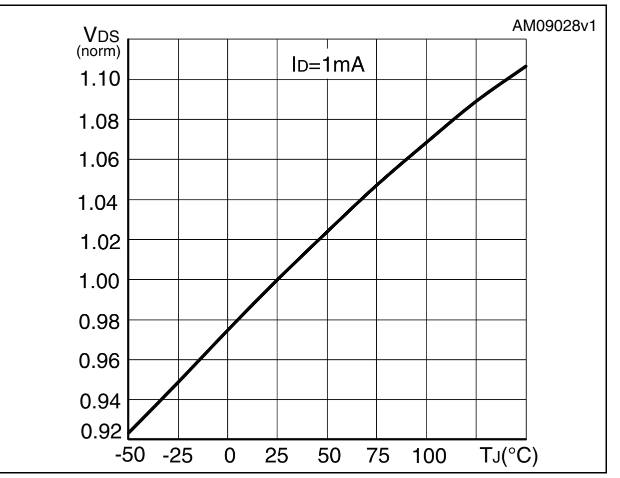


Figure 15. Normalized V_{DS} vs temperature



3 Test circuits

Figure 16. Switching times test circuit for resistive load

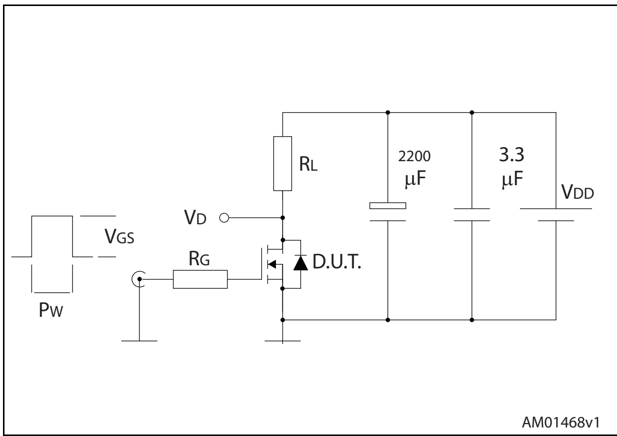


Figure 17. Gate charge test circuit

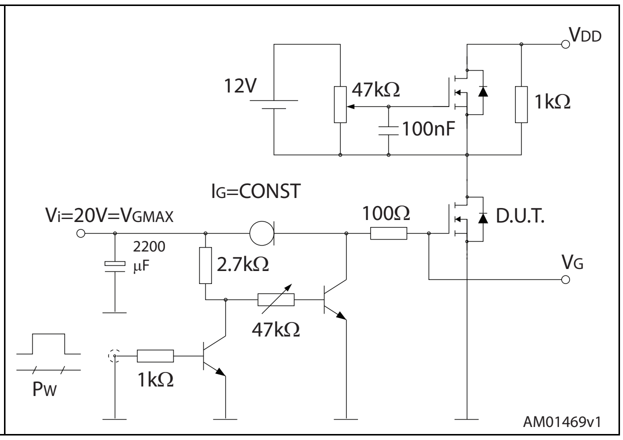


Figure 18. Test circuit for inductive load switching and diode recovery times

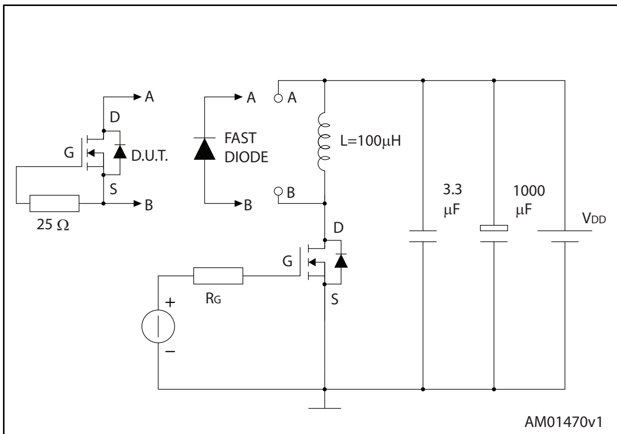


Figure 19. Unclamped inductive load test circuit

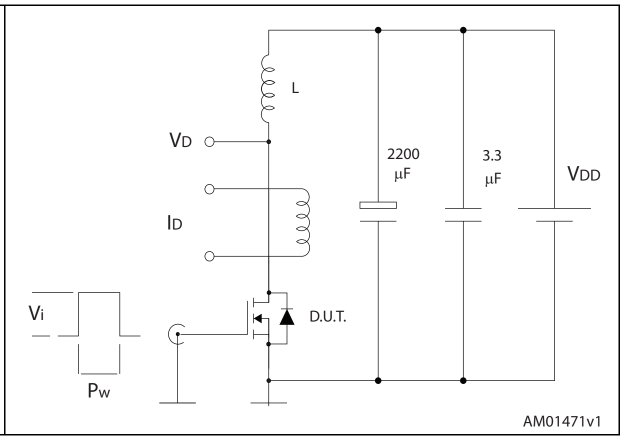


Figure 20. Unclamped inductive waveform

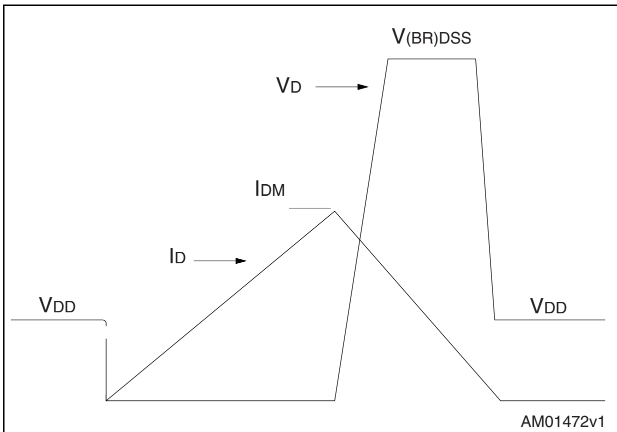
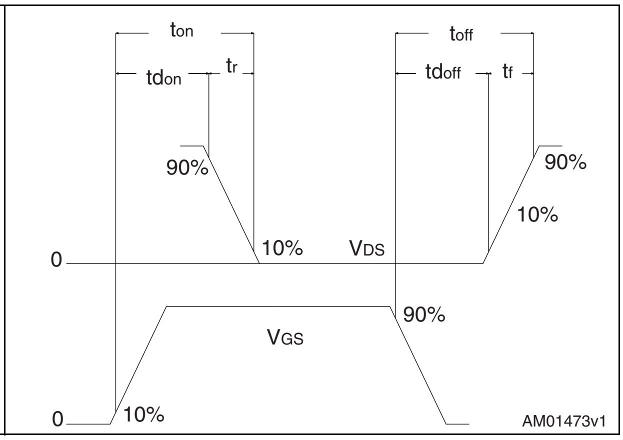


Figure 21. Switching time waveform



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.

Table 9. D²PAK (TO-263) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 22. D²PAK (TO-263) drawing

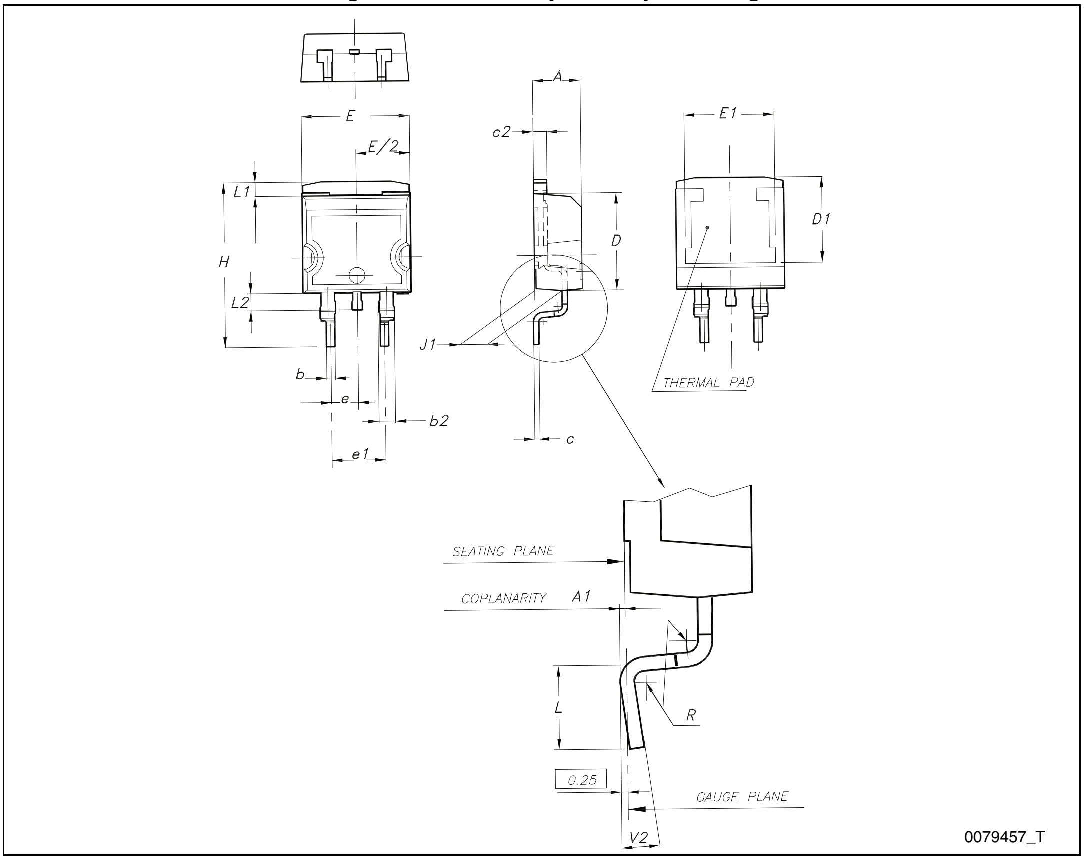
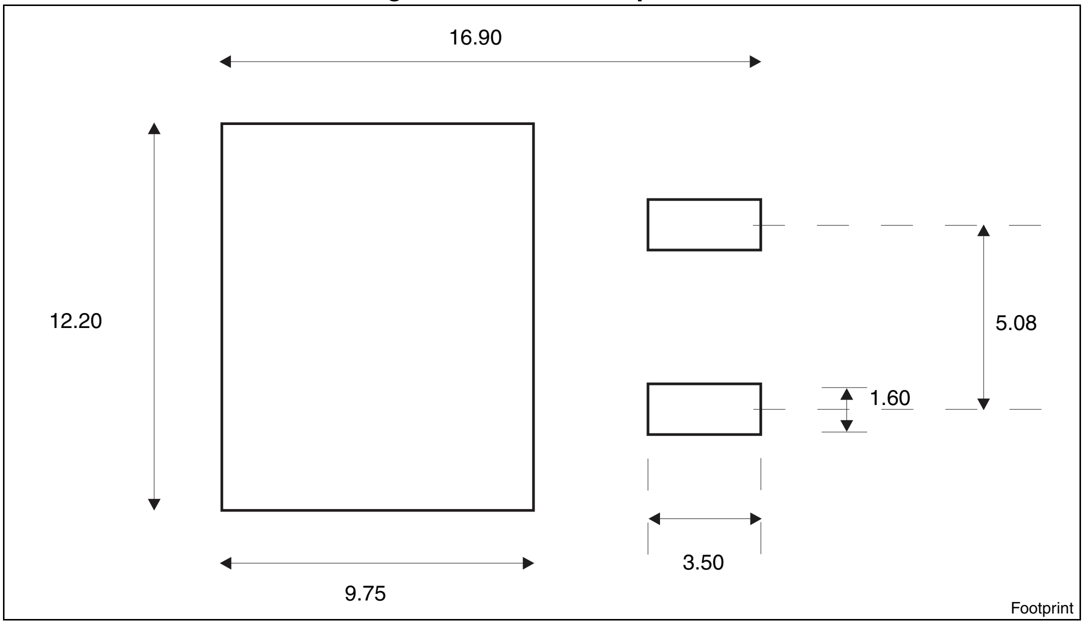


Figure 23. D²PAK footprint[(a)]



a. All dimension are in millimeters

Table 10. TO-220FP 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

Figure 24. TO-220FP drawing

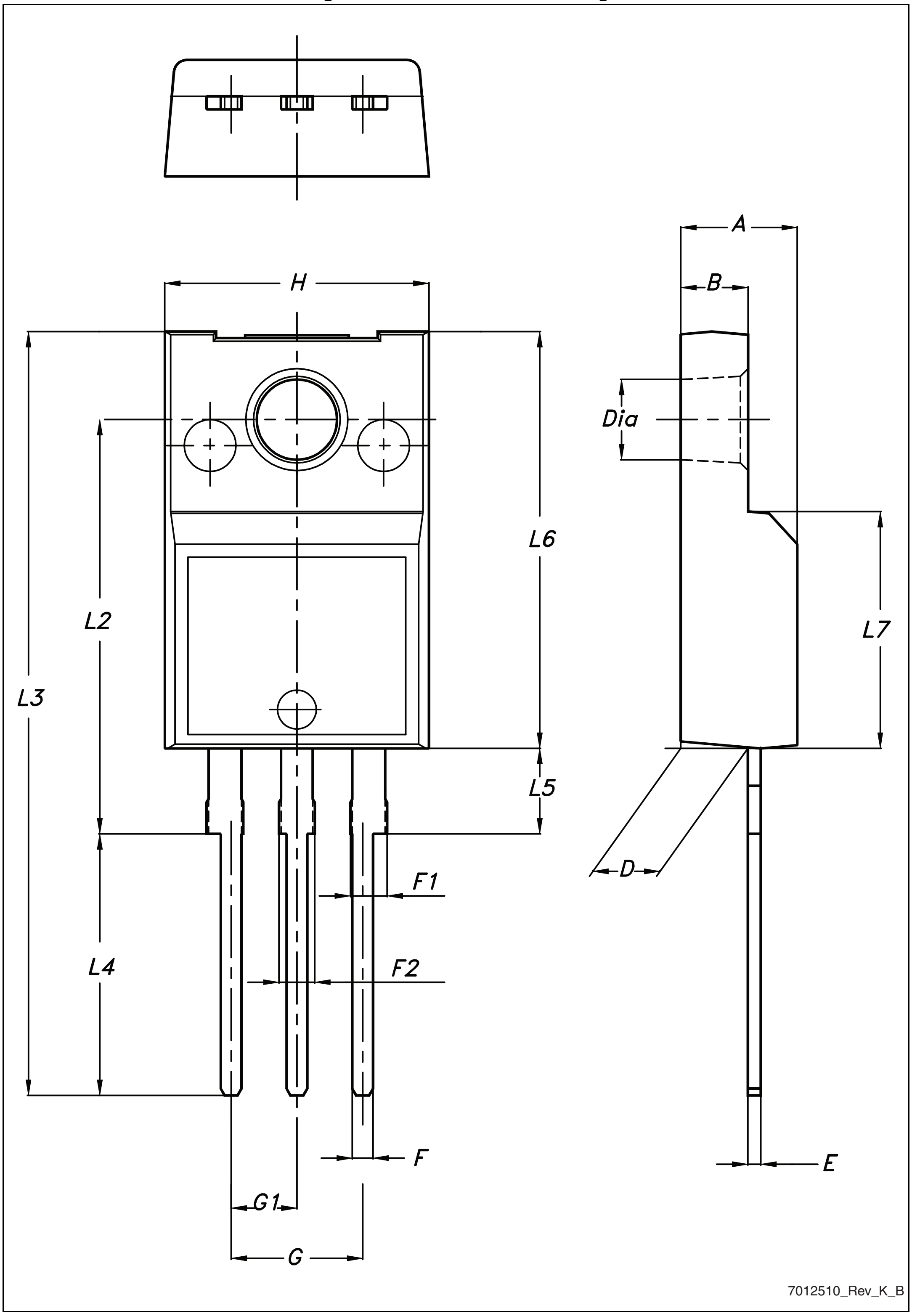
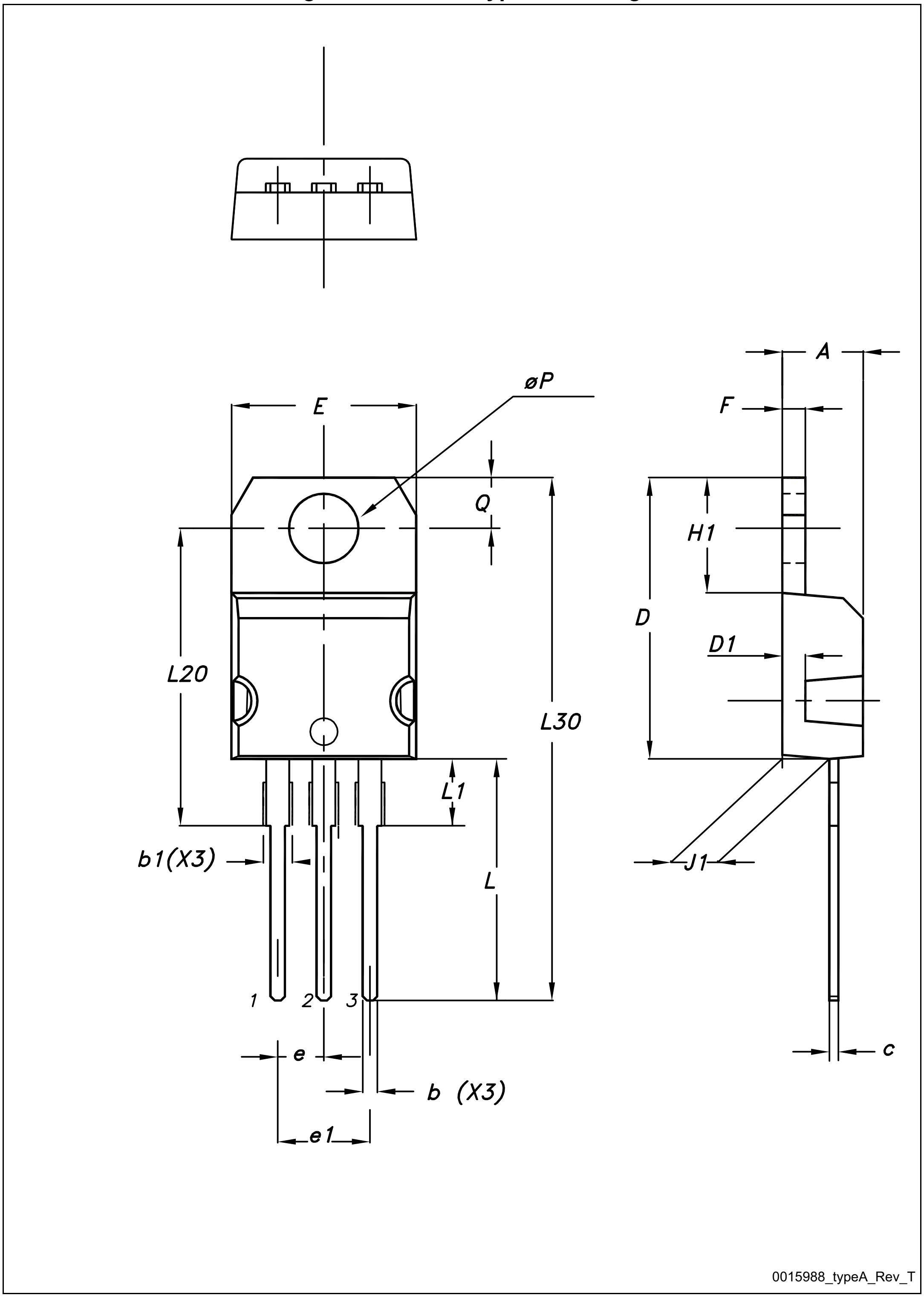


Table 11. TO-220 type A mechanical data

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 25. TO-220 type A drawing



5 Packaging mechanical data

Table 12. D²PAK (TO-263) 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			

Figure 26. Tape

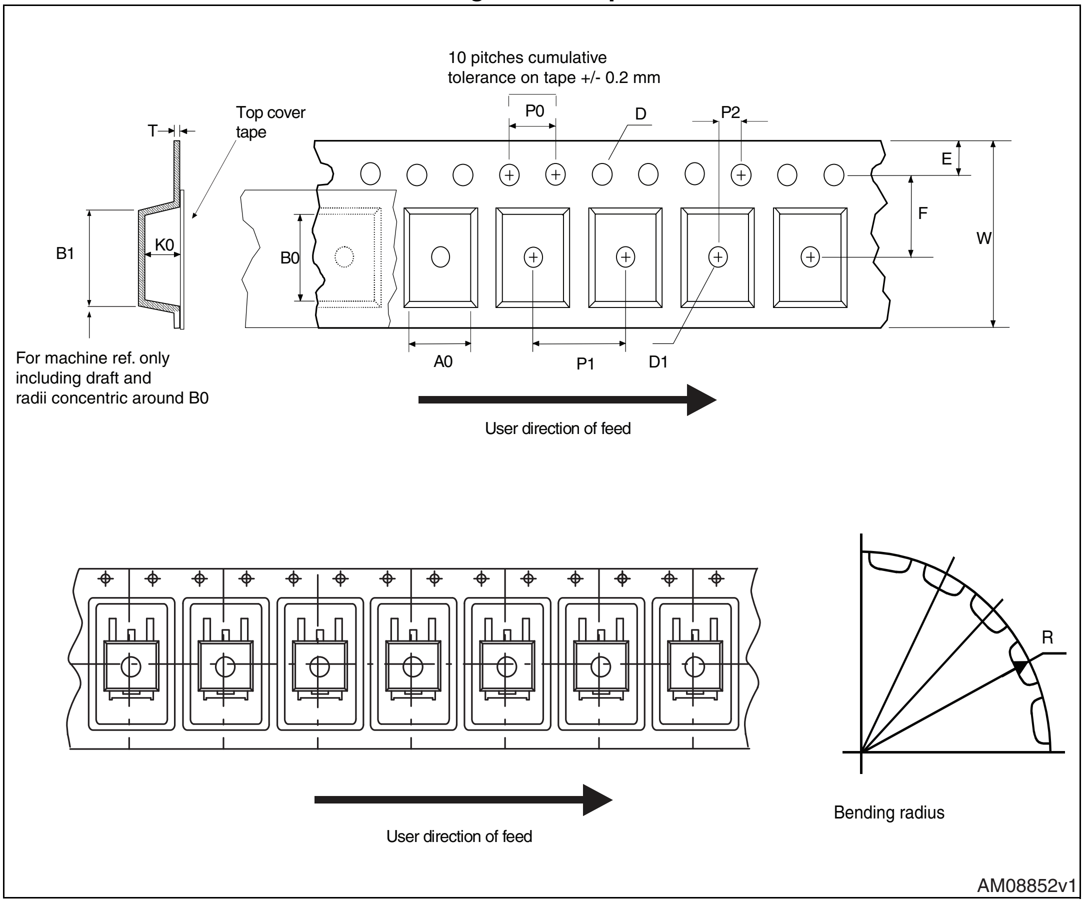
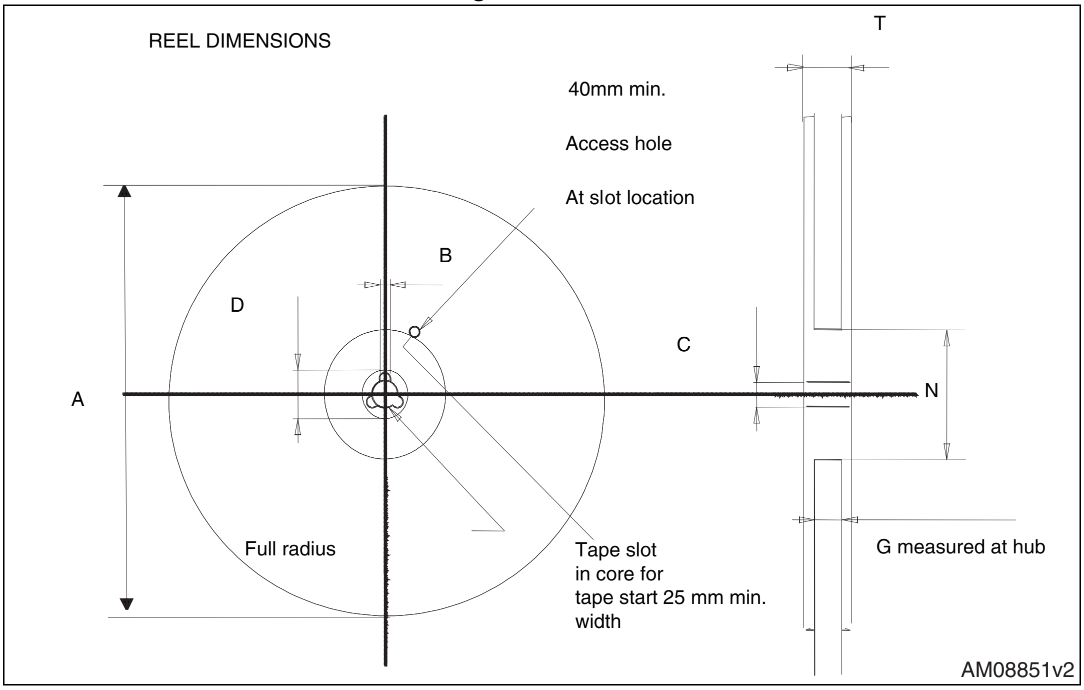


Figure 27. Reel



6 Revision history

Table 13. Document revision history

Date	Revision	Changes
29-Apr-2009	1	First release
17-Dec-2009	2	Added new package, mechanical data: D^2PAK
20-Jun-2011	3	Inserted device in I^2PAK.
13-Mar-2012	4	Updated P_{TOT} and derating factor in *Table 2*. Update $R_{thj\text{-}case}$ for TO-220FP in *Table 3*. Update *Figure 10* and *Figure 15*. Update *Section 5: Packaging mechanical data*.
20-Jun-2012	5	Updated title on the cover page. Minor text changes.
09-Sep-2013	6	– The part numbers STI26NM60N and STW26NM60N have been moved to the separate datasheets – Modified: V_{GS} value in *Table 2*