



# STGB20H60DF STGP20H60DF

600 V, 20 A high speed  
trench gate field-stop IGBT

Datasheet – preliminary data

## Features

- High speed switching
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- 6  $\mu$ s short-circuit withstand time
- Ultrafast soft recovery antiparallel diode

## Applications

- Motor control

## Description

This device is an IGBT developed using an advanced proprietary trench gate and field stop structure. This IGBT series offers the optimum compromise between conduction and switching losses, maximizing the efficiency of very high frequency converters. Furthermore, a positive  $V_{CE(sat)}$  temperature coefficient and very tight parameter distribution result in easier paralleling operation.

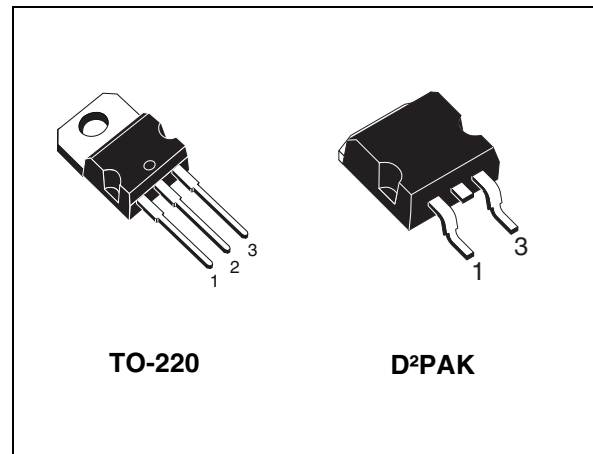


Figure 1. Internal schematic diagram

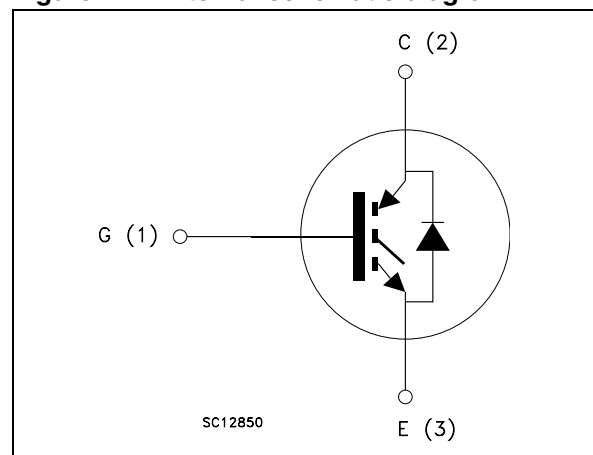


Table 1. Device summary

Order code	Marking	Package	Packaging
STGB20H60DF	GB20H60DF	D <sup>2</sup> PAK	Tape & reel
STGP20H60DF	GP20H60DF	TO-220	Tube

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	600	V
$I_C$	Continuous collector current at $T_C = 25\text{ °C}$	40	A
$I_C$	Continuous collector current at $T_C = 100\text{ °C}$	20	A
$I_{CP}^{(1)}$	Pulsed collector current	80	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$I_F$	Diode RMS forward current at $T_C = 25\text{ °C}$	30	A
$I_{FSM}$	Surge not repetitive forward current $t_p = 10\text{ ms}$ sinusoidal	90	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	100	W
$t_{SC}$	Short-circuit withstand time at $V_{CC} = 400\text{ V}$ , $V_{GE} = 15\text{ V}$	6	$\mu\text{s}$
$T_{STG}$	Storage temperature range	- 55 to 150	$^{\circ}\text{C}$
$T_J$	Operating junction temperature		

1. Pulse width limited by maximum junction temperature and turn-off within RBSOA

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case IGBT	1.25	$^{\circ}\text{C/W}$
$R_{thJC}$	Thermal resistance junction-case diode	2.5	$^{\circ}\text{C/W}$
$R_{thJA}$	Thermal resistance junction-ambient	62.5	$^{\circ}\text{C/W}$

## 2 Electrical characteristics

$T_J = 25\text{ °C}$  unless otherwise specified.

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 20\text{ A}$		1.6		V
		$V_{GE} = 15\text{ V}, I_C = 20\text{ A}$ $T_J = 125\text{ °C}$		1.7		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$		6.0		V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 600\text{ V}$			TBD	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			TBD	nA

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$	-	TBD	-	$\mu\text{F}$
$C_{oes}$	Output capacitance			TBD		
$C_{res}$	Reverse transfer capacitance			TBD		
$Q_g$	Total gate charge	$V_{CC} = 400\text{ V}, I_C = 20\text{ A},$ $V_{GE} = 15\text{ V}$	-	TBD	-	nC
$Q_{ge}$	Gate-emitter charge			TBD		
$Q_{gc}$	Gate-collector charge			TBD		

**Table 6. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}, I_C = 20\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$	-	TBD	-	ns
$t_r$	Current rise time			TBD		
$(di/dt)_{on}$	Turn-on current slope			TBD		
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}, I_C = 20\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$ $T_J = 125\text{ °C}$	-	TBD	-	ns
$t_r$	Current rise time			TBD		
$(di/dt)_{on}$	Turn-on current slope			TBD		
$t_r(V_{off})$	Off voltage rise time	$V_{CE} = 400\text{ V}, I_C = 20\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$	-	TBD	-	ns
$t_{d(off)}$	Turn-off delay time			TBD		
$t_f$	Current fall time			TBD		
$t_r(V_{off})$	Off voltage rise time	$V_{CE} = 400\text{ V}, I_C = 20\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$ $T_J = 125\text{ °C}$	-	TBD	-	ns
$t_{d(off)}$	Turn-off delay time			TBD		
$t_f$	Current fall time			TBD		

**Table 7. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CE} = 400\text{ V}, I_C = 20\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$	-	TBD	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses			TBD		mJ
$E_{ts}$	Total switching losses			TBD		mJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CE} = 400\text{ V}, I_C = 20\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$ $T_J = 125\text{ }^\circ\text{C}$	-	TBD	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses			TBD		mJ
$E_{ts}$	Total switching losses			TBD		mJ

1. Energy losses include reverse recovery of the diode.
2. Turn-off losses include also the tail of the collector current.

**Table 8. Collector-emitter diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_F$	Forward on-voltage	$I_F = 16\text{ A}$ $I_F = 16\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	TBD 1.3	2.2	V V
$t_{rr}$	Reverse recovery time	$I_F = 16\text{ A}, V_R = 400\text{ V},$ $di/dt = 100\text{ A}/\mu\text{s}$	-	TBD	-	ns
$Q_{rr}$	Reverse recovery charge			TBD		nC
$I_{rrm}$	Reverse recovery current			TBD		A
$t_{rr}$	Reverse recovery time	$I_F = 16\text{ A}, V_R = 400\text{ V},$ $di/dt = 100\text{ A}/\mu\text{s}, T_J = 125\text{ }^\circ\text{C}$	-	150	-	ns
$Q_{rr}$	Reverse recovery charge			330		nC
$I_{rrm}$	Reverse recovery current			5		A

### 3 Test circuits

Figure 2. Test circuit for inductive load switching

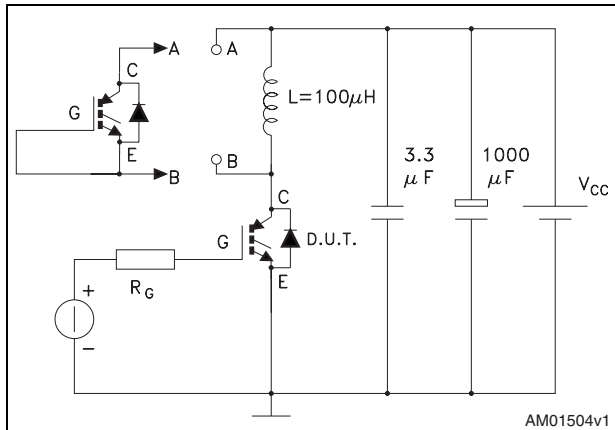


Figure 3. Gate charge test circuit

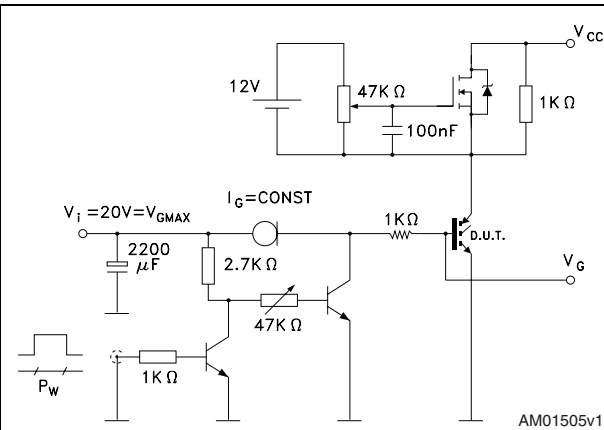


Figure 4. Switching waveform

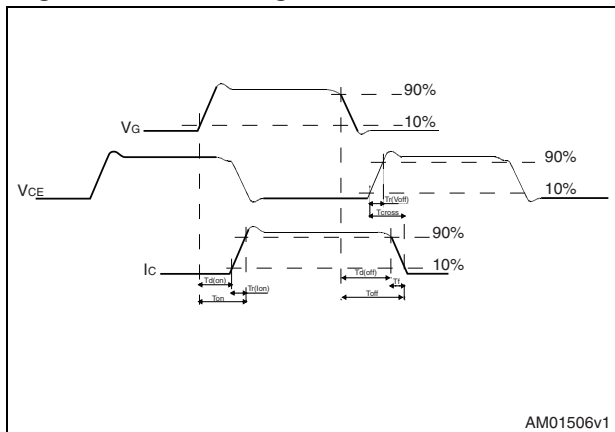
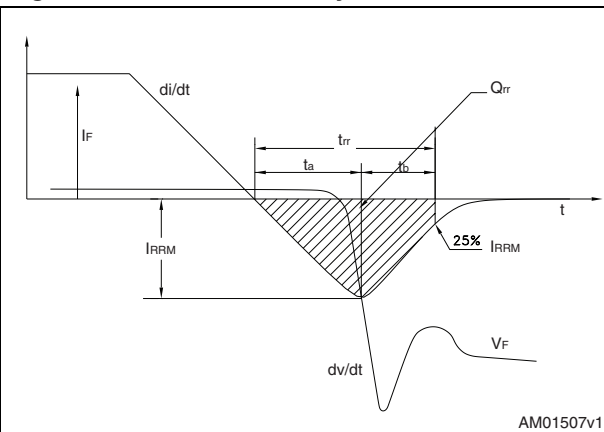


Figure 5. Diode recovery time waveform



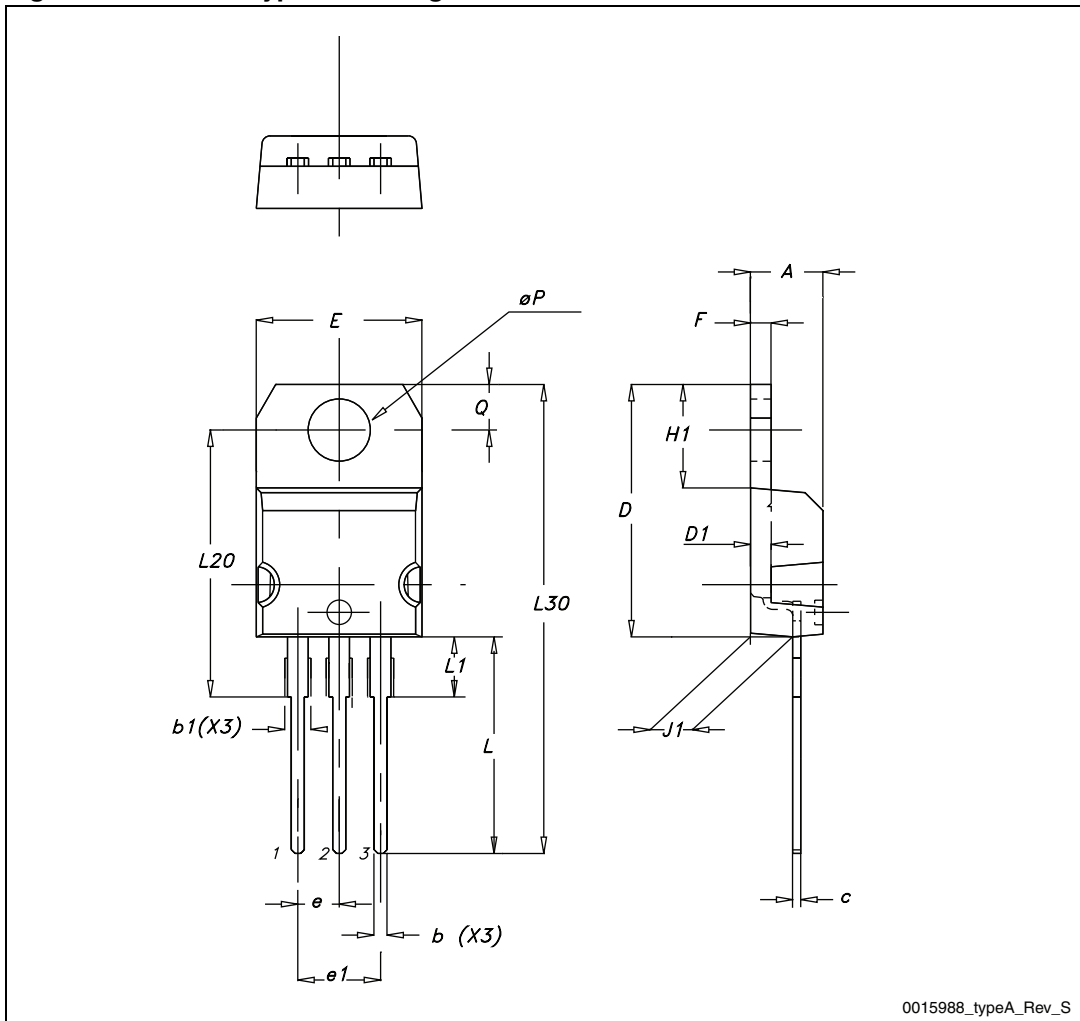
## 4 Package mechanical data

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

**Table 9. 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	
ØP	3.75		3.85
Q	2.65		2.95

Figure 6. TO-220 type A drawing



0015988\_typeA\_Rev\_S

Table 10. D<sup>2</sup>PAK 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 7. D<sup>2</sup>PAK drawing

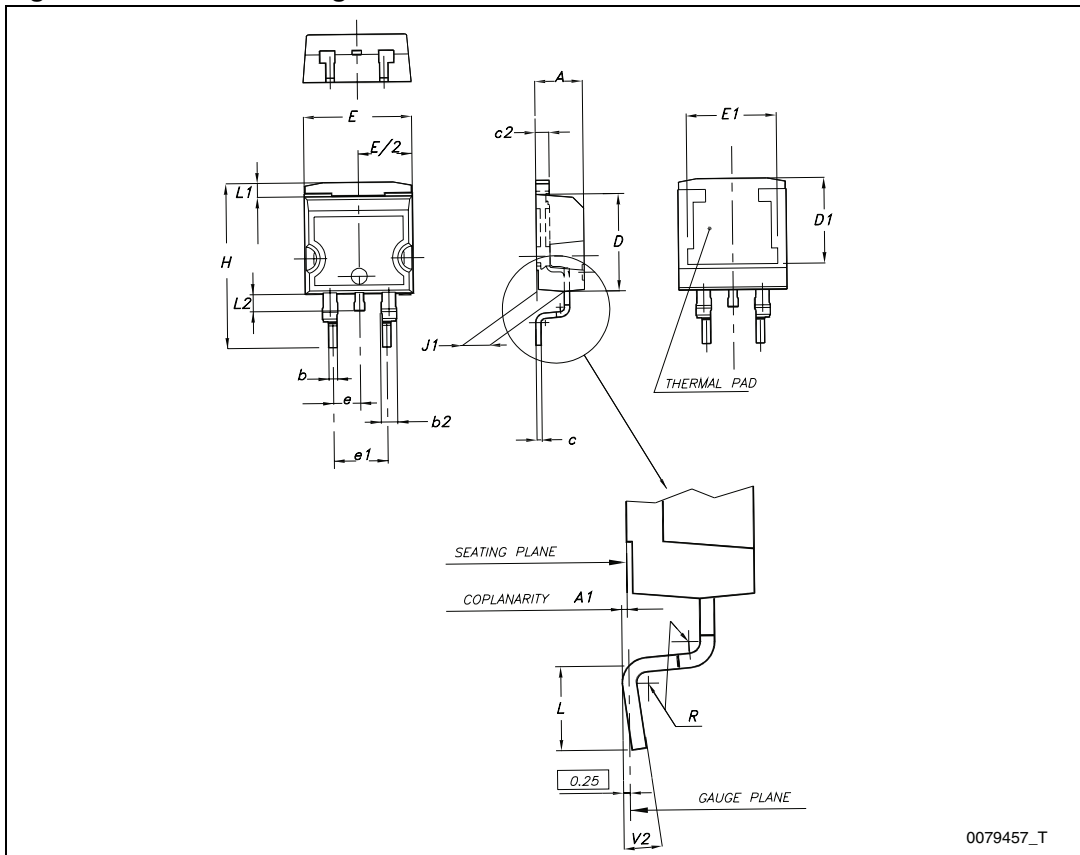
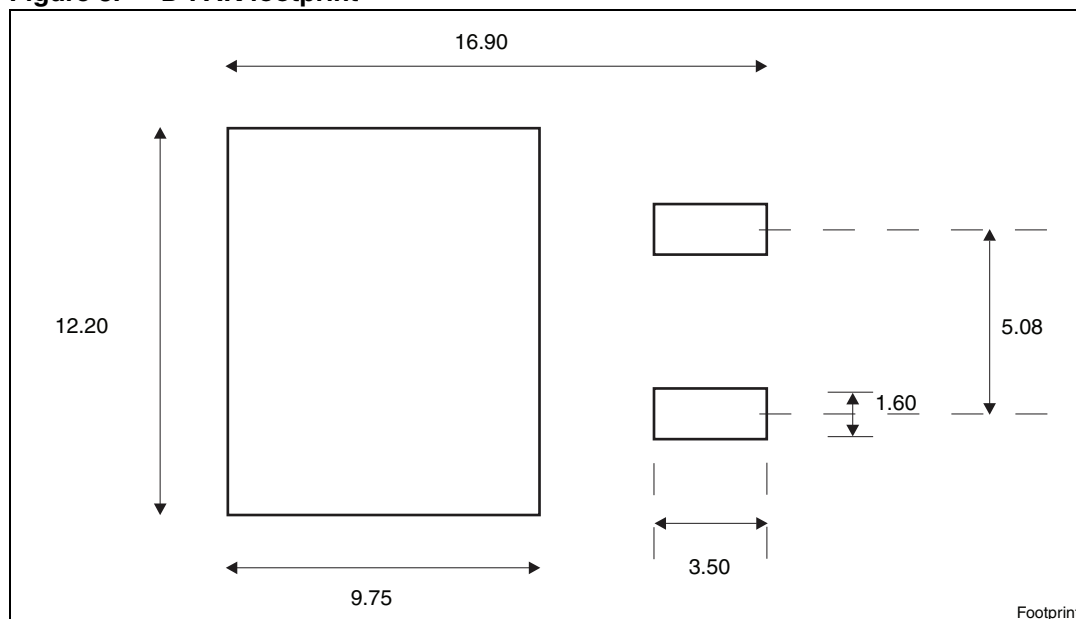


Table 11. D<sup>2</sup>PAK tape and reel mechanical data

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 8. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

Figure 9. Tape

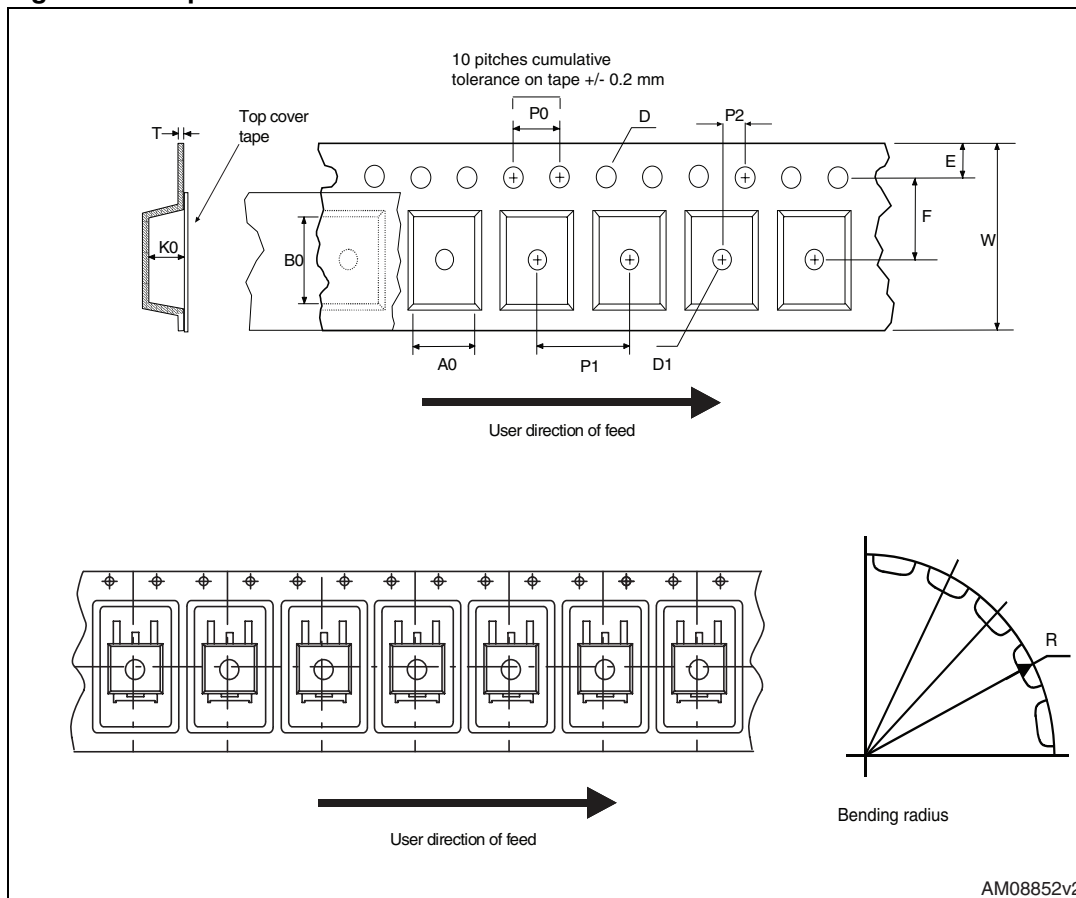
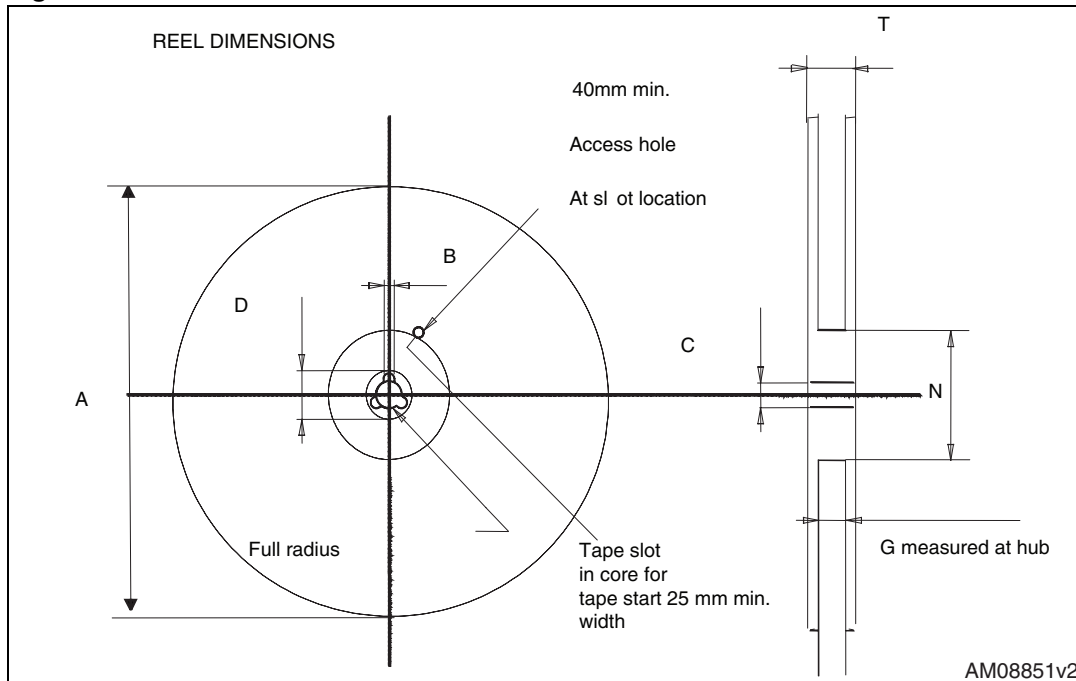


Figure 10. Reel



## 5 Revision history

Table 12. Document revision history

Date	Revision	Changes
03-Oct-2012	1	Initial release.

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