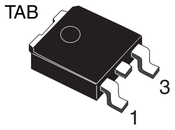
STGD10HF60KD

10 A, 600 V, short-circuit rugged IGBT with Ultrafast diode

Preliminary data

Features

- Low on-voltage drop ($V_{CE(sat)}$)
- Low C_{res} / C_{ies} ratio (no cross conduction susceptibility)
- Switching losses include diode recovery energy
- Short-circuit rated
- Very soft Ultrafast recovery anti-parallel diode



DPAK

Applications

- High frequency inverters
- SMPS and PFC in both hard switch and resonant topologies
- Motor drives
- Injection systems

Description

This device utilizes the advanced PowerMESH™ process for the IGBT and the Turbo 2 Ultrafast high voltage technology for the diode. The combination results in a very good trade-off between conduction losses and switching behavior rendering the product ideal for diverse high voltage applications operating at high frequencies.

Figure 1. Internal schematic diagram

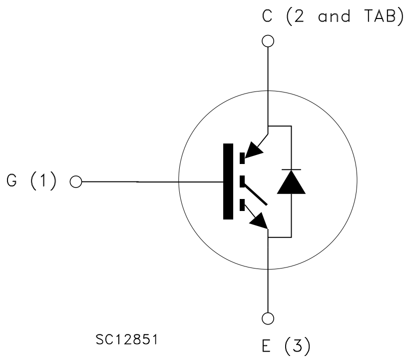


Table 1. Device summary

Order code	V_{CES}	Package	Packaging
STGD10HF60KD	600 V	DPAK	Tape and reel

Contents

1 Electrical ratings

T_{CASE} = 25 °C unless otherwise specified.

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600	V
I_C (1)	Collector current (continuous) at T_C = 25 °C	18	A
I_C (1)	Collector current (continuous) at T_C = 100 °C	10	A
I_{CL} (2)	Turn-off latching current	30	A
I_{CP} (3)	Pulsed collector current	30	A
V_{GE}	Gate-emitter voltage	± 20	V
V_{GEM}	Gate-emitter voltage pulsed (t_p ≤ 1 ms)	± 30	V
I_F	Diode RMS forward current	7	A
I_{FSM}	Surge non repetitive forward current t_p = 10 ms sinusoidal	20	A
P_{TOT}	Total dissipation	62.5	W
t_{scw}	Short circuit withstand time (V_{CE} = 50 V, V_{GE} = 15 V, T_C = 150 °C)	10	µs
T_j	IGBT operating junction temperature	– 55 to 150	°C
	Diode operating junction temperature	– 55 to 175	°C
T_{stg}	Storage temperature	– 65 to 150	°C

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

2. Vclamp = 80% of V_{CES}, T_j =150 °C, R_G=10 Ω, V_{GE}=15 V
3. Pulse width limited by max. junction temperature allowed

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT	2	°C/W
$R_{thj-case}$	Thermal resistance junction-case diode	5.8	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	100	°C/W

2 Electrical characteristics

T_{CASE}=25 °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 = 1 mA, T_C = -40 °C [1] I_C = 1 mA I_C = 1 mA, T_C = 125 °C	600	610 650 700		V V V
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ±20 V V_{GE} = ±20 V, T_C = 125 °C			±100 ± 1	nA µA
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 600 V V_{CE} = 600 V, T_C = 125 °C			150 1	µA mA
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 250 µA	4.5		6.5	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 5 A	1.75	2.25	2.75	V

1. Limits guaranteed by design

Table 5. Dynamic (1)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies} C_{oes} C_{res}	Input capacitance Output capacitance Reverse transfer capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE}= 0	-	450 55 10	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 400 V, I_C = 5 A, V_{GE} = 15 V	-	23 TBD TBD	-	nC nC nC

1. Limits guaranteed by design

Table 6. Switching on/off (inductive load) (1)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 400 V, I_C = 5 A R_G = 10 Ω, V_{GE} = 15 V	-	15 6.2 620	-	ns ns A/µs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 400 V, I_C = 5 A R_G = 10 Ω, V_{GE}= 15 V T_C = 125 °C	-	15 6.3 610	-	ns ns A/µs
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 400 V, I_C = 5 A, R_{GE} = 10 Ω, V_{GE} = 15 V	-	22 30 70	-	ns ns ns
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 400 V, I_C = 5 A, R_{GE} = 10 Ω, V_{GE} = 15 V T_C= 125 °C	-	49 36 130	-	ns ns ns

1. Limits guaranteed by design

Table 7. Switching energy (inductive load) (1)

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
Eon (2) E_{off} (3) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 400 V, I_C = 5 A R_G = 10 Ω, V_{GE} = 15 V	-	TBD 60 TBD	-	µJ µJ µJ
Eon (2) E_{off} (3) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 400 V, I_C = 5 A R_G = 10 Ω, V_{GE}= 15 V T_C = 125 °C	-	TBD 150 TBD	-	µJ µJ µJ

1. Limits guaranteed by design
2. IGBT and diode are at the same temperature
3. 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 = 3 A I_F = 3 A, T_C= 125 °C	-	1.8 1.3	-	V V
t_{rr} (1) Q_{rr} (1) I_{rm} (1)	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 3 A, V_R = 400 V, di/dt = 100 A/µs	-	31 37 2.2	-	ns nC A
t_{rr} (1) Q_{rr} (1) I_{rm} (1)	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 3 A, V_R = 400 V, T_C= 125 °C, di/dt = 100 A/µs	-	50 85 2.8	-	ns nC A

1. Limits guaranteed by design

Figure 2. IGBT thermal impedance

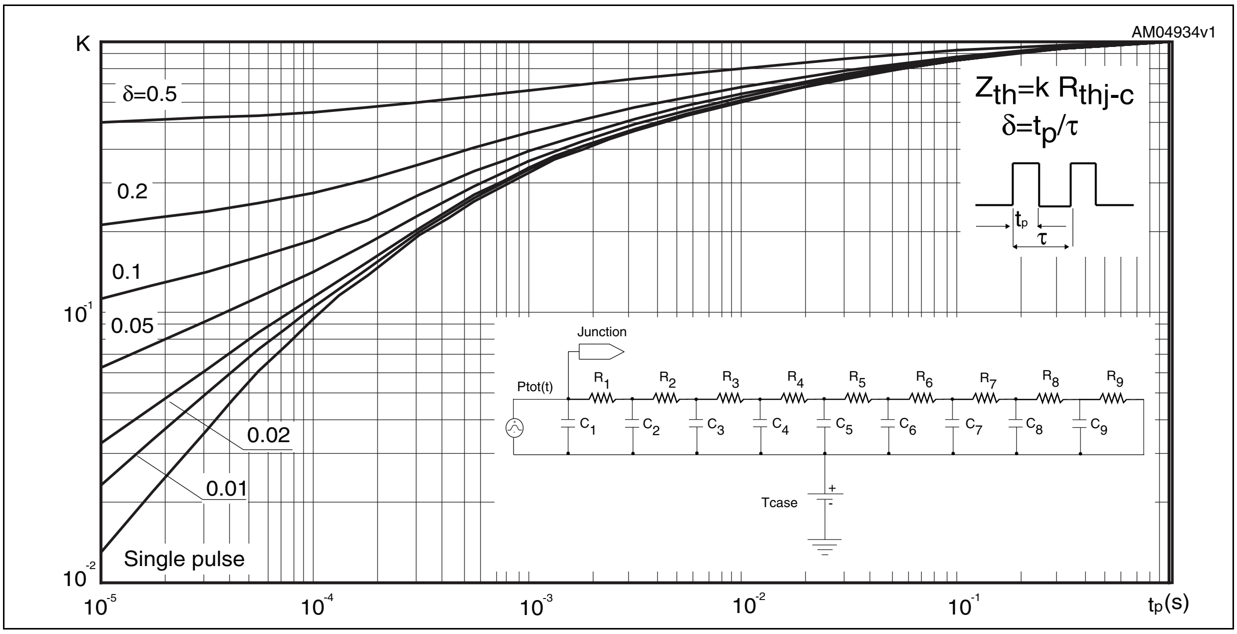


Table 9. IGBT RC-Cauer thermal network

Symbol	Value	Unit	Symbol	Value	Unit
R_1	0.344	°C/W	C_1	0.4E-3	W*s/°C
R_2	0.0686	°C/W	C_2	0.162E-4	W*s/°C
R_3	0.0958	°C/W	C_3	0.684E-3	W*s/°C
R_4	0.177	°C/W	C_4	0.923E-4	W*s/°C
R_5	0.250	°C/W	C_5	0.3E-2	W*s/°C
R_6	0.245	°C/W	C_6	0.9E-2	W*s/°C
R_7	0.152	°C/W	C_7	0.678E-3	W*s/°C
R_8	0.135	°C/W	C_8	0.807E-3	W*s/°C
R_9	0.530	°C/W	C_9	0.248	W*s/°C

Figure 3. Diode thermal impedance

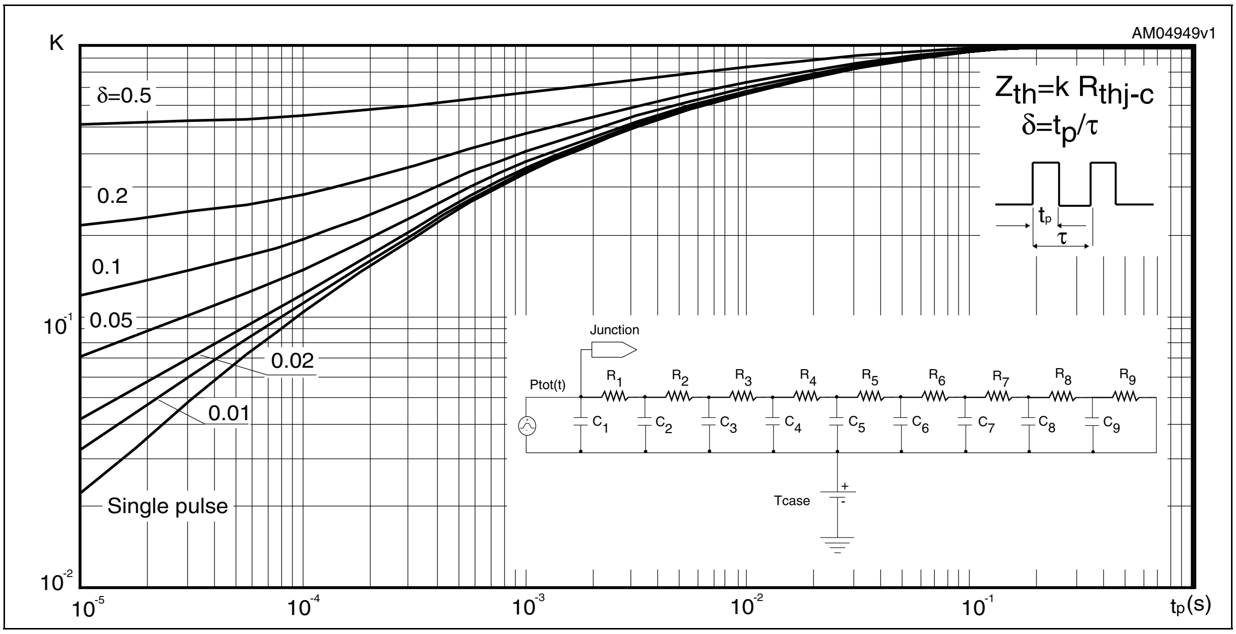


Table 10. Diode RC-Cauer thermal network

Symbol	Value	Unit	Symbol	Value	Unit
R_1	0.478	°C/W	C_1	0.8E-4	W*s/°C
R_2	0.542	°C/W	C_2	1E-4	W*s/°C
R_3	0.600	°C/W	C_3	2E-4	W*s/°C
R_4	0.277	°C/W	C_4	0.5E-5	W*s/°C
R_5	0.844	°C/W	C_5	0.145E-2	W*s/°C
R_6	0.313	°C/W	C_6	0.499E-4	W*s/°C
R_7	0.108	°C/W	C_7	0.727E-3	W*s/°C
R_8	0.891	°C/W	C_8	0.393E-4	W*s/°C
R_9	1.73	°C/W	C_9	0.0176	W*s/°C

3 Test circuits

Figure 4. Test circuit for inductive load switching

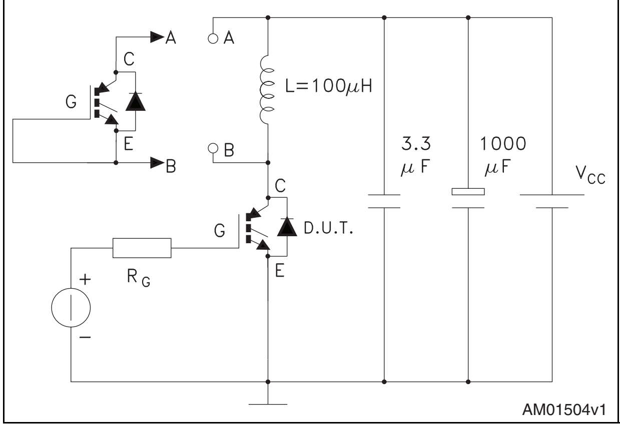


Figure 5. Gate charge test circuit

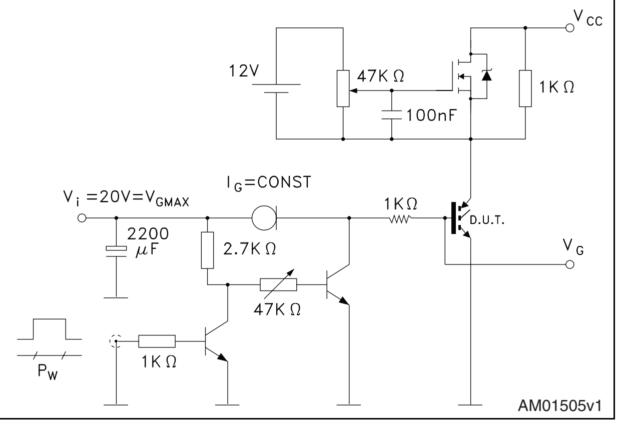


Figure 6. Switching waveforms

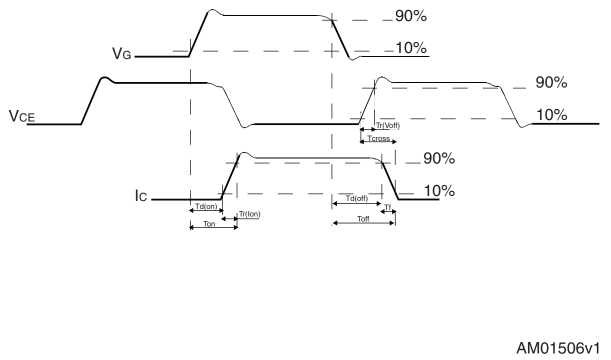
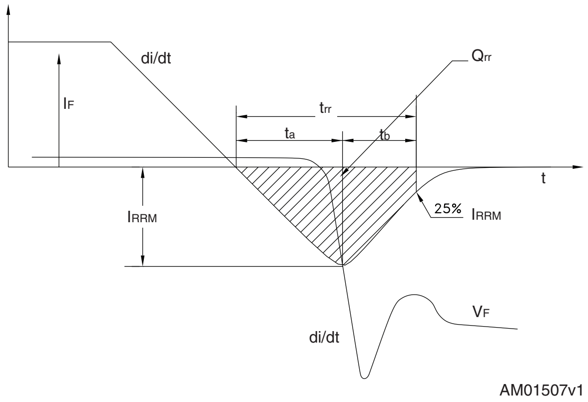


Figure 7. Diode recovery times waveform



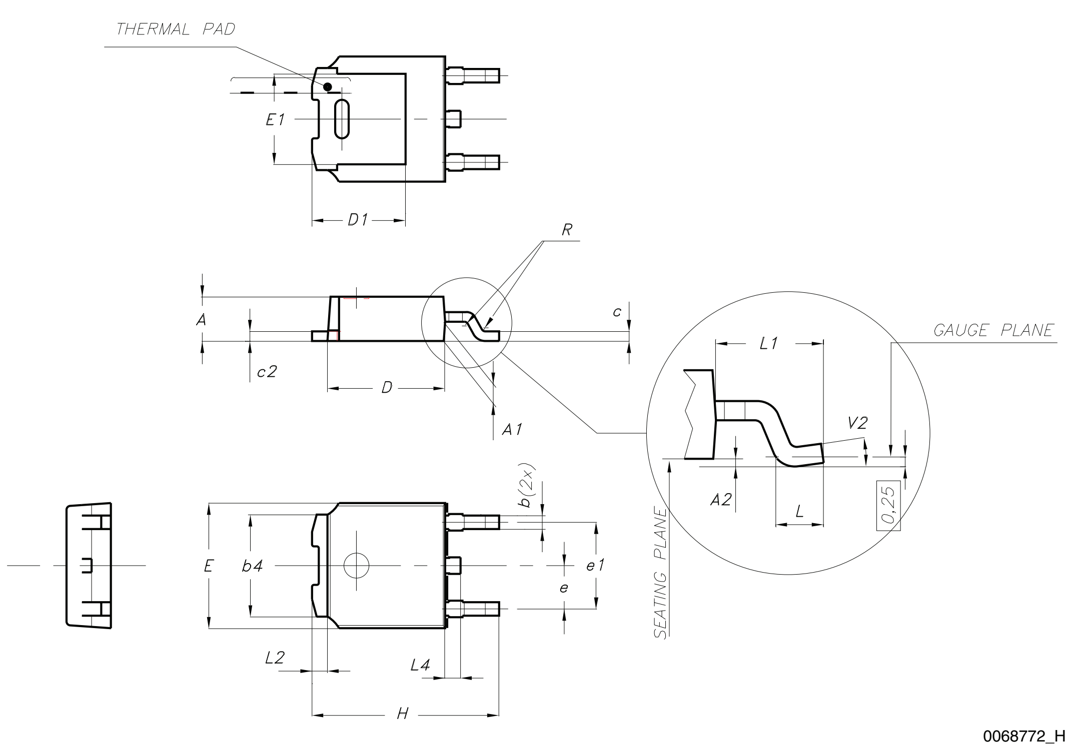
4 Package mechanical data

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 11. DPAK (TO-252) 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		1.50
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°

Figure 8. DPAK (TO-252) drawing

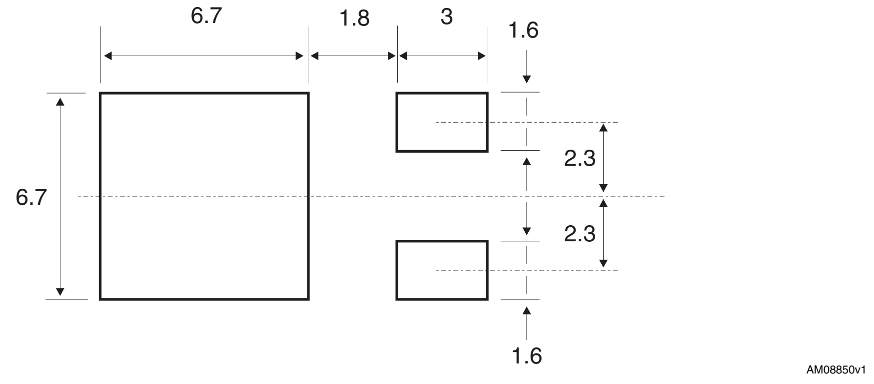


5 Packaging mechanical data

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			

Figure 9. DPAK footprint [a]



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a. All dimensions are in millimeters

Figure 10. Tape for DPAK (TO-252)

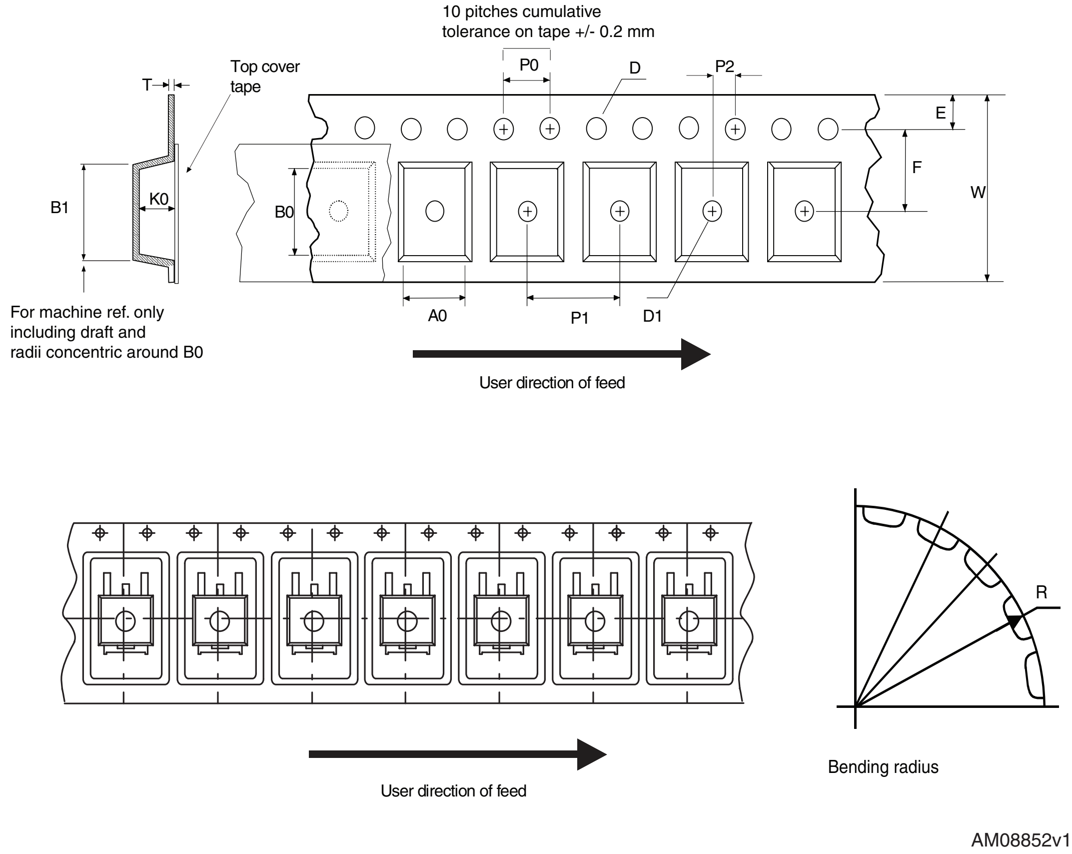
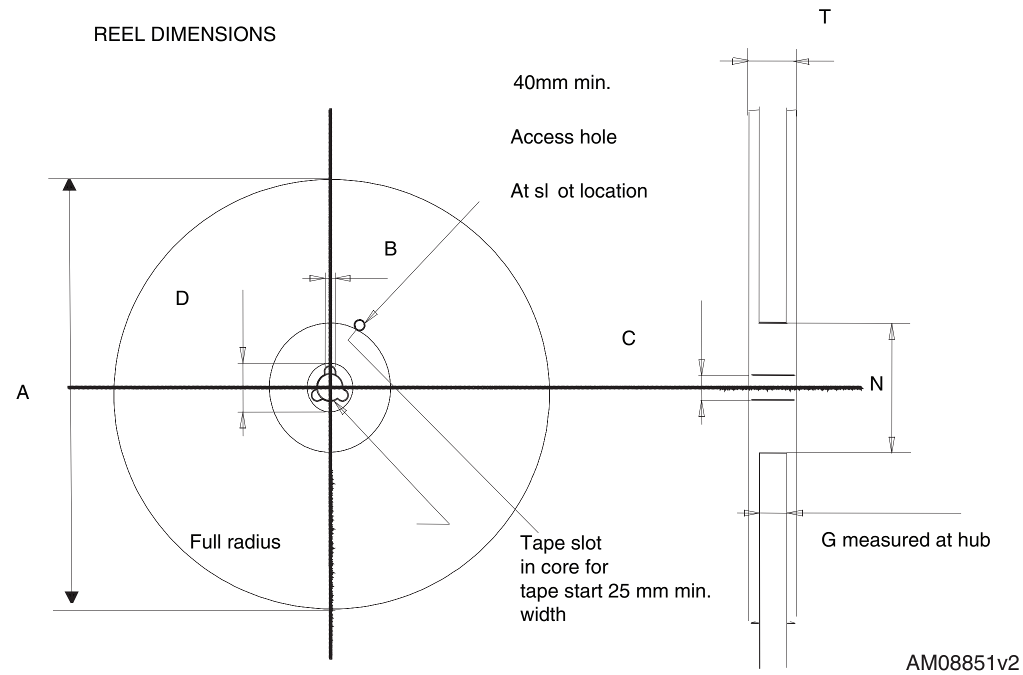


Figure 11. Reel for DPAK (TO-252)



6 Revision history

Table 13. Document revision history

Date	Revision	Changes
28-Feb-2012	1	First release

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