STGB19NC60HDT4, STGF19NC60HD STGP19NC60HD, STGW19NC60HD

19 A, 600 V, very fast IGBT with Ultrafast diode

Features

- Low on-voltage drop ($V_{CE(sat)}$)
- Very soft Ultrafast recovery anti-parallel diode

Applications

- High frequency motor drives
- SMPS and PFC in both hard switch and resonant topologies

Description

This device is an ultrafast IGBT. It utilizes the advanced Power MESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

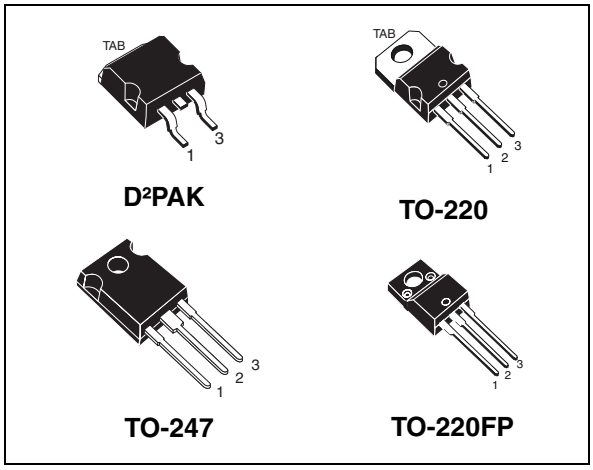


Figure 1. Internal schematic diagram

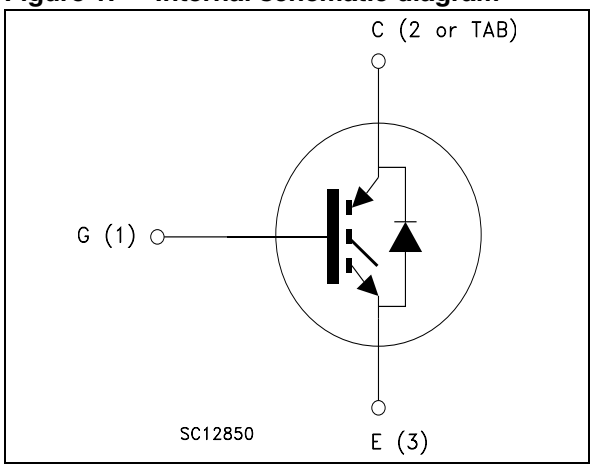


Table 1. Device summary

Part numbers	Marking	Package	Packaging
STGB19NC60HDT4	GB19NC60HD	D²PAK	Tape and reel
STGF19NC60HD	GF19NC60HD	TO-220FP	Tube
STGP19NC60HD	GP19NC60HD	TO-220	Tube
STGW19NC60HD	GW19NC60HD	TO-247	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220 D²PAK	TO-220FP	TO-247	
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600			V
I_C (1)	Continuous collector current at T_C = 25 °C	40	16	42	A
I_C (1)	Continuous collector current at T_C = 100 °C	19	10	21	A
I_{CL} (2)	Turn-off latching current	40			A
I_{CP} (3)	Pulsed collector current	60			A
I_F	Diode RMS forward current at T_C = 25 °C	20			A
I_{FSM}	Surge not repetitive forward current t_p=10 ms sinusoidal	50			A
V_{GE}	Gate-emitter voltage	±20			V
P_{TOT}	Total dissipation at T_C = 25 °C	130	32	140	W
V_{ISO}	Isolation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)		2500		V
T_j	Operating junction temperature	- 55 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%V_{CES}, T_J= 150 °C, R_G =1 0 Ω, V_{GE} = 15 V
3. Pulse width limited by maximum permissible junction temperature and turn-off within RBSOA

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		TO-220 D²PAK	TO-220FP	TO-247	
$R_{thj\text{-}case}$	Thermal resistance junction-case IGBT	0.95	3.9	0.9	°C/W
	Thermal resistance junction-case diode	3	5.5	3	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	62.5		50	°C/W

2 Electrical characteristics

(T_J = 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	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE}= 15 V, I_C= 12 A V_{GE}= 15 V, I_C= 15 A V_{GE}= 15 V, I_C=30 A,T_J=100 °C V_{GE}= 15 V, I_C=12 A,T_J=125 °C		1.8 2 2.5 1.6	2.5	V
$V_{GE(th)}$	Gate threshold voltage	V_{CE}= V_{GE}, I_C= 250 µA	3.75		5.75	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE}= 600 V V_{CE}= 600 V,T_J= 125 °C			150 1	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE}= ±20 V			±100	nA
g_{fs} (1)	Forward transconductance	V_{CE} = 15 V, I_C= 12 A		5		S

1. Pulsed: pulse duration = 300 µs, duty cycle 1.5%

Table 5. Dynamic

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	-	1180 130 36	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390 V, I_C = 5 A, V_{GE} = 15 V, *Figure 20*	-	53 10 23	-	nC nC nC

Table 6. Switching on/off (inductive load)

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} = 390 V, I_C = 12 A R_G= 10 Ω, V_{GE}= 15 V, *Figure 21*	-	25 7 1600	-	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} = 390 V, I_C = 12 A R_G= 10 Ω, V_{GE}= 15 V, TJ = 125 °C *Figure 21*	-	24 8 1400	-	ns ns A/µs
$t_{r(Voff)}$ $t_{d(Voff)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 12 A R_G= 10 Ω, V_{GE}= 15 V, *Figure 21*	-	27 97 73	-	ns ns ns
$t_{r(Voff)}$ $t_{d(Voff)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 12 A R_G= 10 Ω, V_{GE}= 15 V, T_J = 125 °C *Figure 21*	-	58 144 128	-	ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} E_{off}(1) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 12 A R_G= 10 Ω, V_{GE}= 15 V, *Figure 21*	-	85 189 274	-	µJ µJ µJ
E_{on} E_{off}(1) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 12 A R_G= 10 Ω, V_{GE}= 15 V, T_J = 125 °C *Figure 21*	-	187 407 594	-	µJ µJ µJ

1. 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 = 12 A I_F = 12 A, T_J = 125 °C	-	2.6 2.1	-	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 12 A, V_R = 40 V, di/dt = 100 A/µs *Figure 22*	-	31 30 2	-	ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 12 A, V_R = 40 V, T_J =125 °C, di/dt = 100 A/µs *Figure 22*	-	59 102 4	-	ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

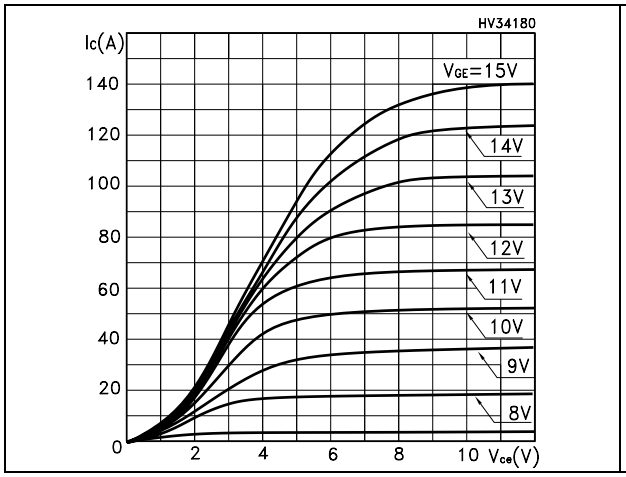


Figure 3. Transfer characteristics

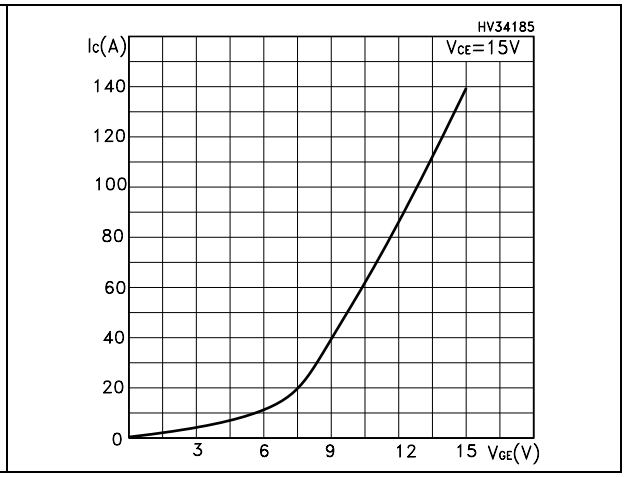


Figure 4. Transconductance

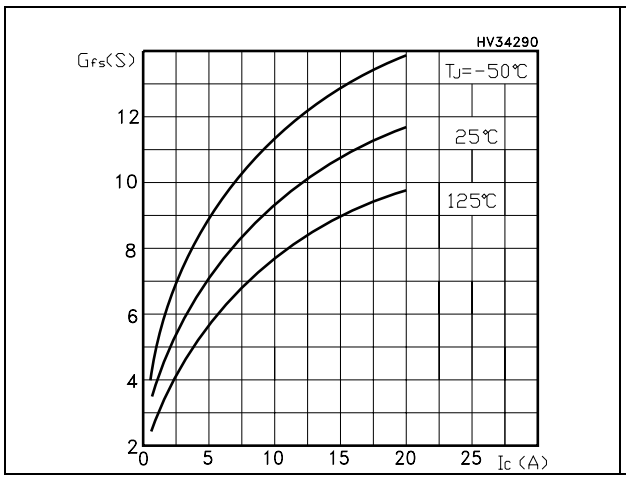


Figure 5. Collector-emitter on voltage vs. temperature

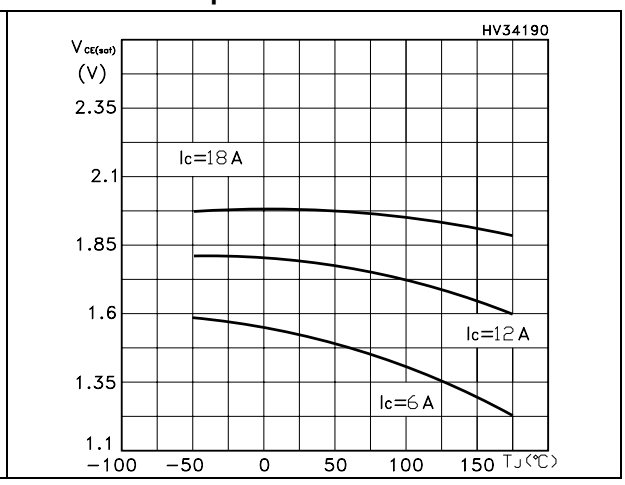


Figure 6. Gate charge vs. gate-source voltage

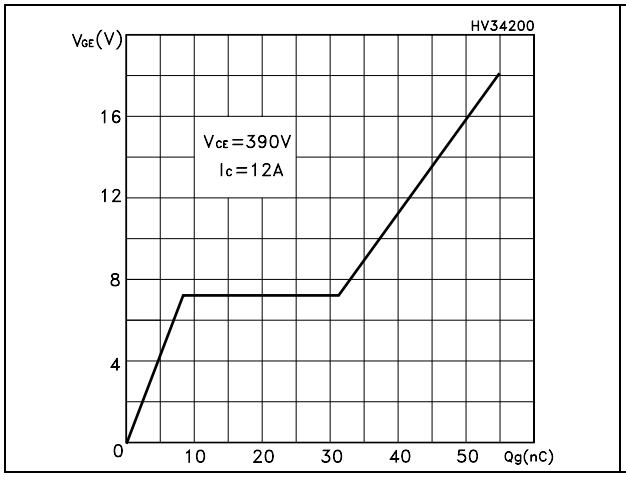


Figure 7. Capacitance variations

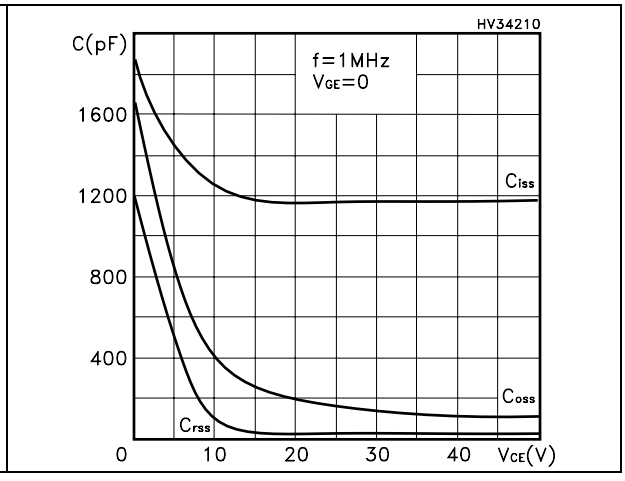


Figure 8. Normalized gate threshold voltage vs. temperature

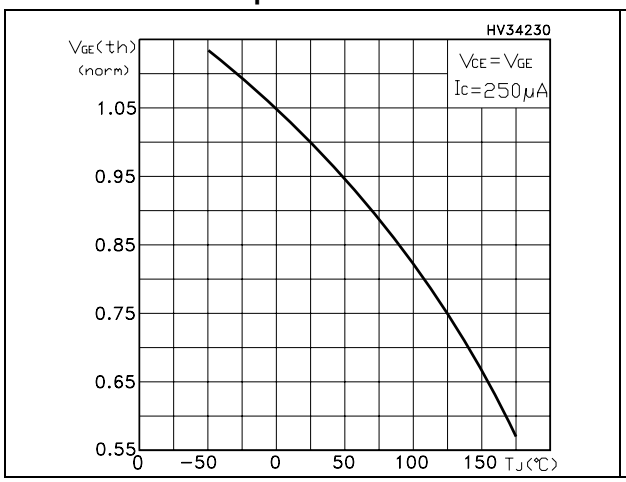


Figure 9. Collector-emitter on voltage vs. collector current

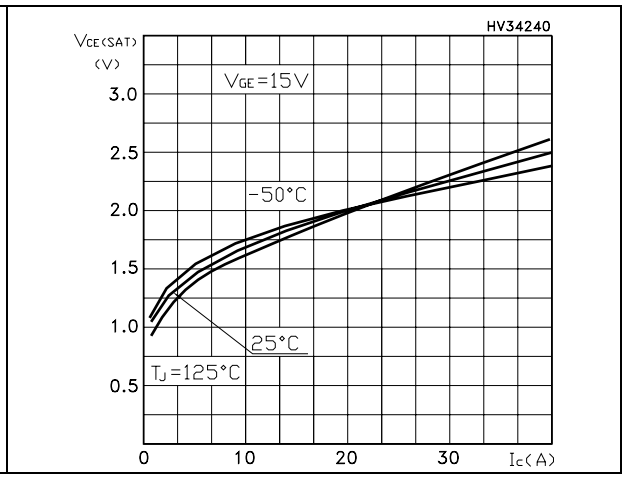


Figure 10. Normalized breakdown voltage vs. temperature

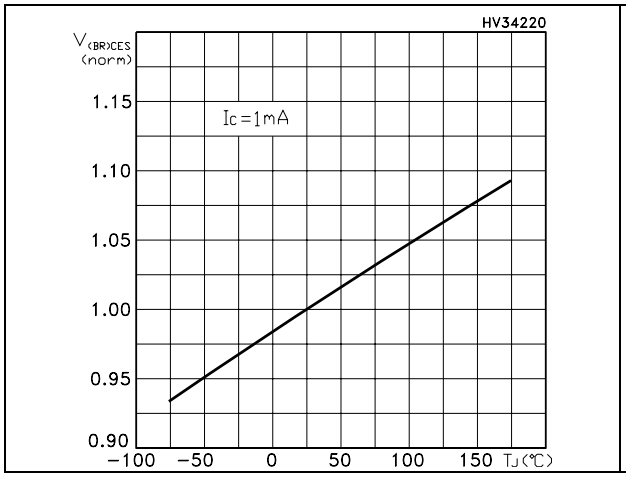


Figure 11. Switching losses vs. temperature

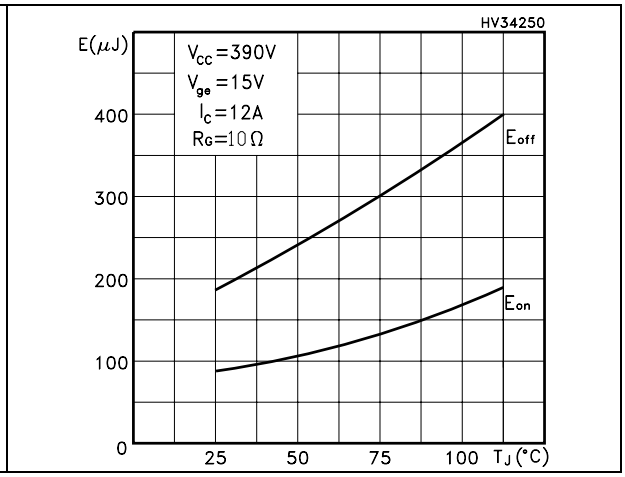


Figure 12. Switching losses vs. gate resistance

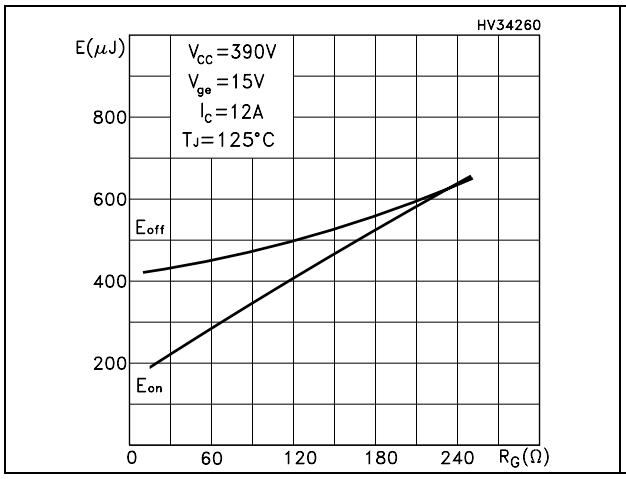


Figure 13. Switching losses vs. collector current

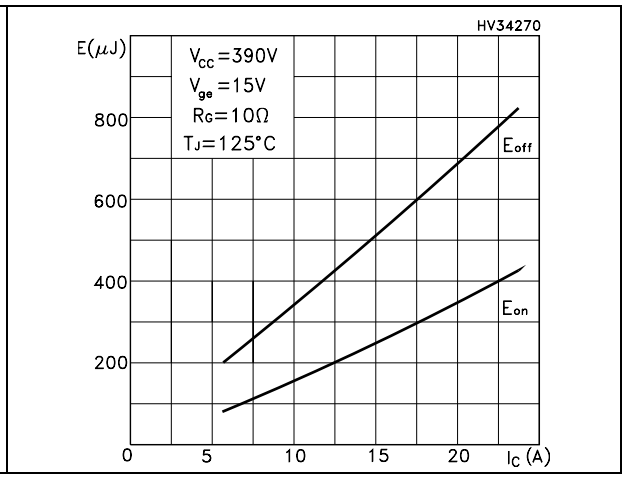


Figure 14. Turn-off SOA

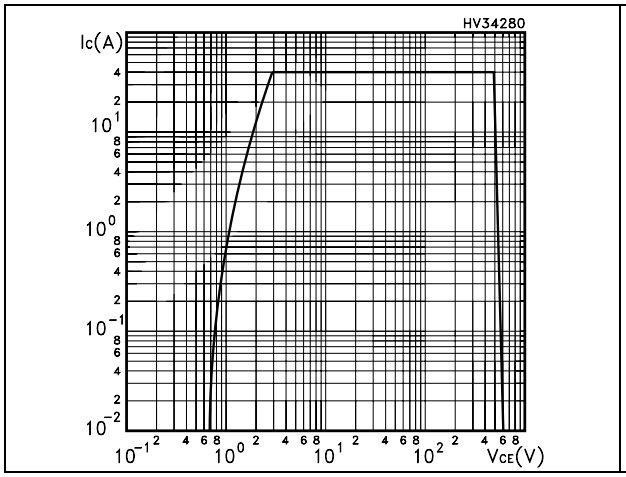


Figure 15. Thermal impedance for TO-247

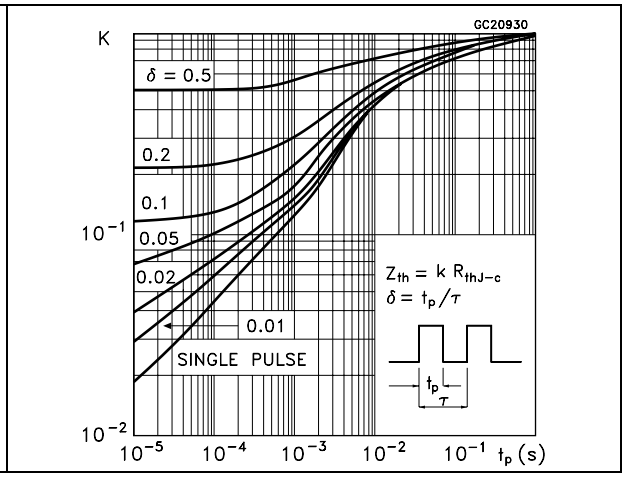


Figure 16. Thermal impedance for TO-220, D²PAK

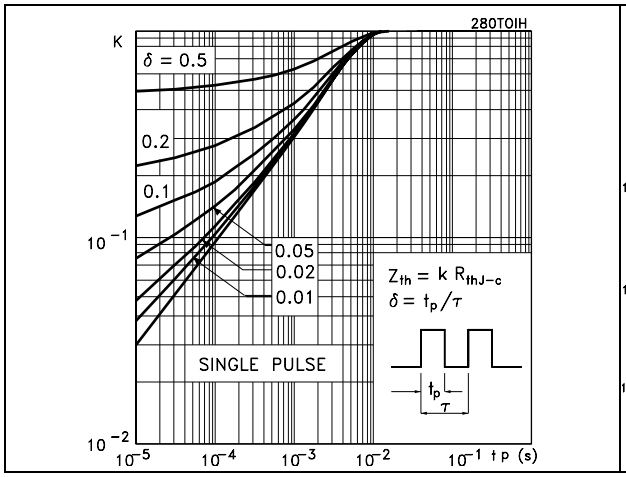


Figure 17. Thermal impedance for TO-220FP

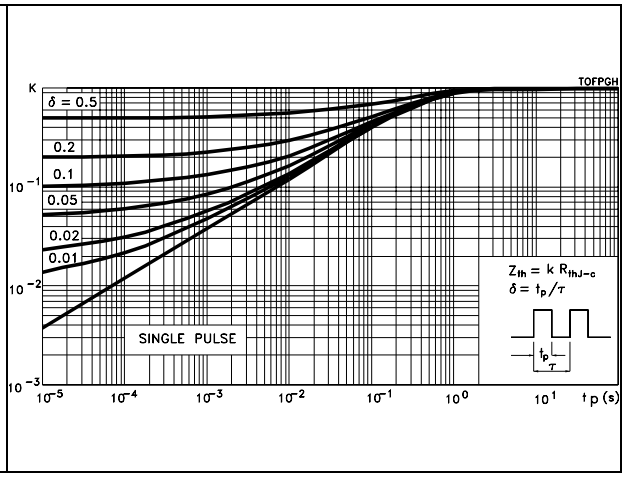
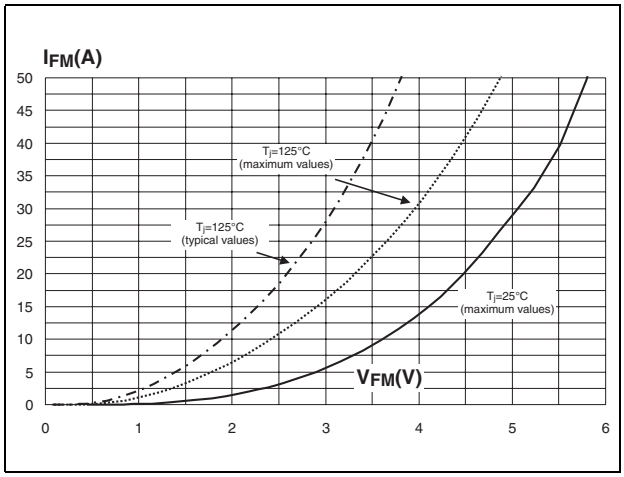


Figure 18. Forward voltage drop vs. forward current



3 Test circuits

Figure 19. Test circuit for inductive load switching

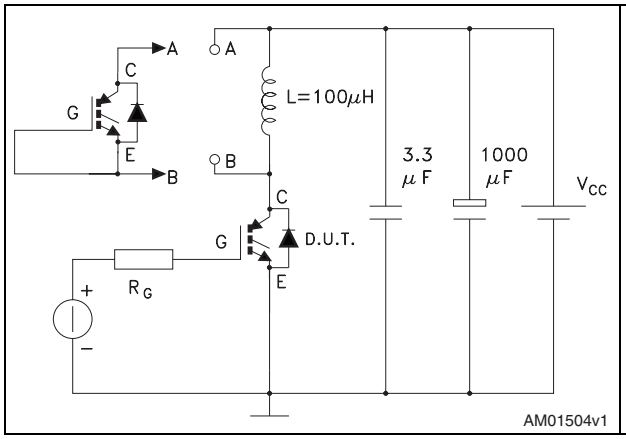


Figure 20. Gate charge test circuit

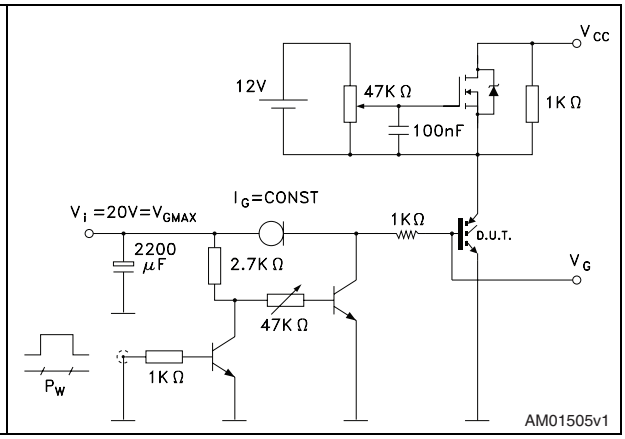


Figure 21. Switching waveform

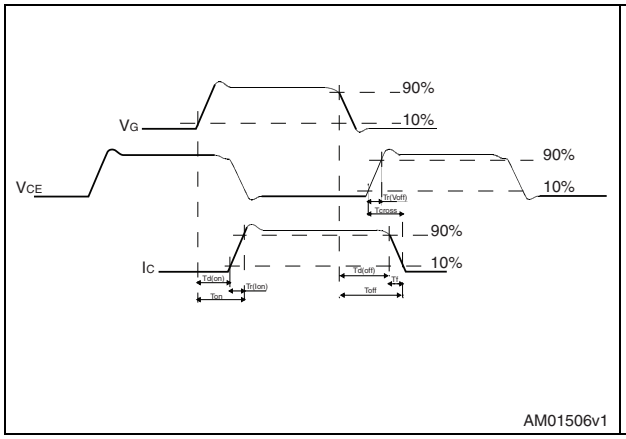
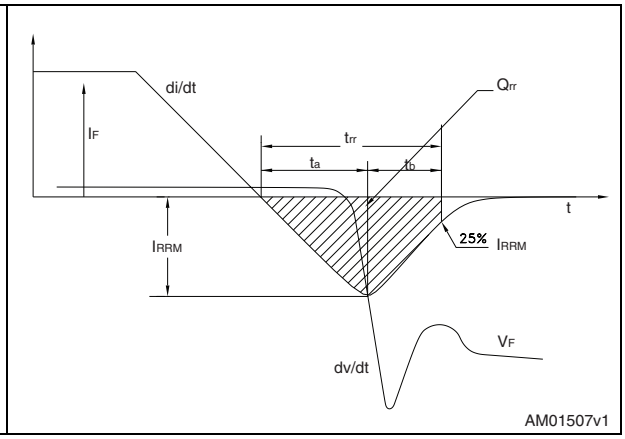


Figure 22. Diode recovery time waveform



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. ECOPACK is an ST trademark.

Table 9. 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 23. TO-220FP drawing

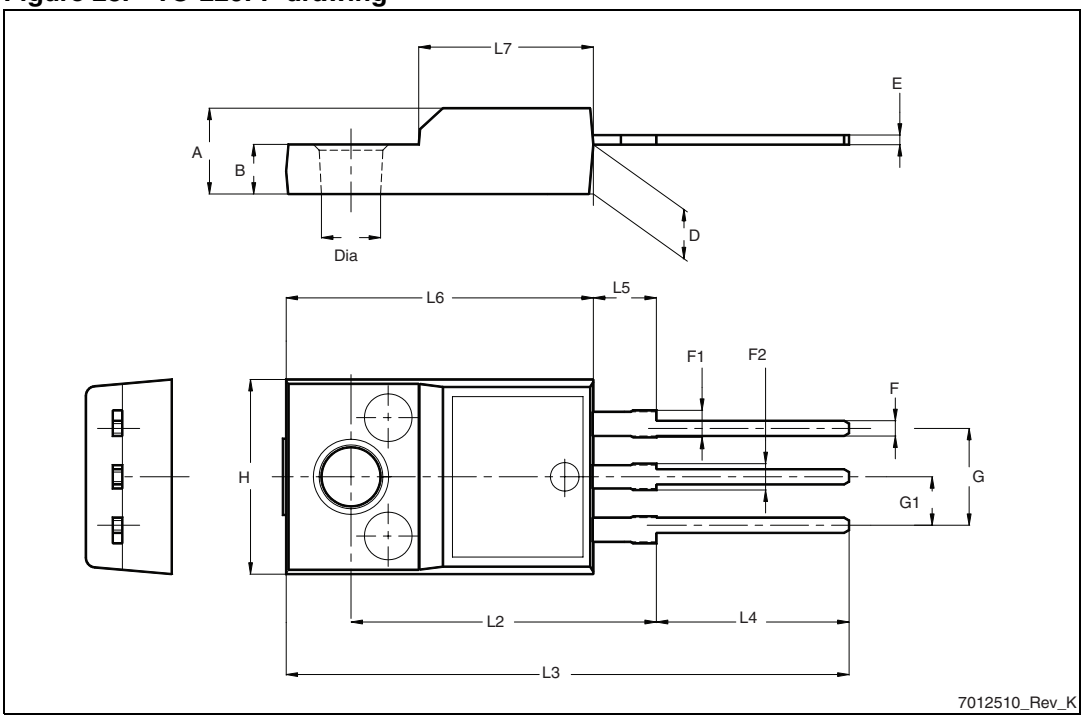


Table 10. D²PAK (TO-263) mechanical data

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 24. D²PAK (TO-263) drawing

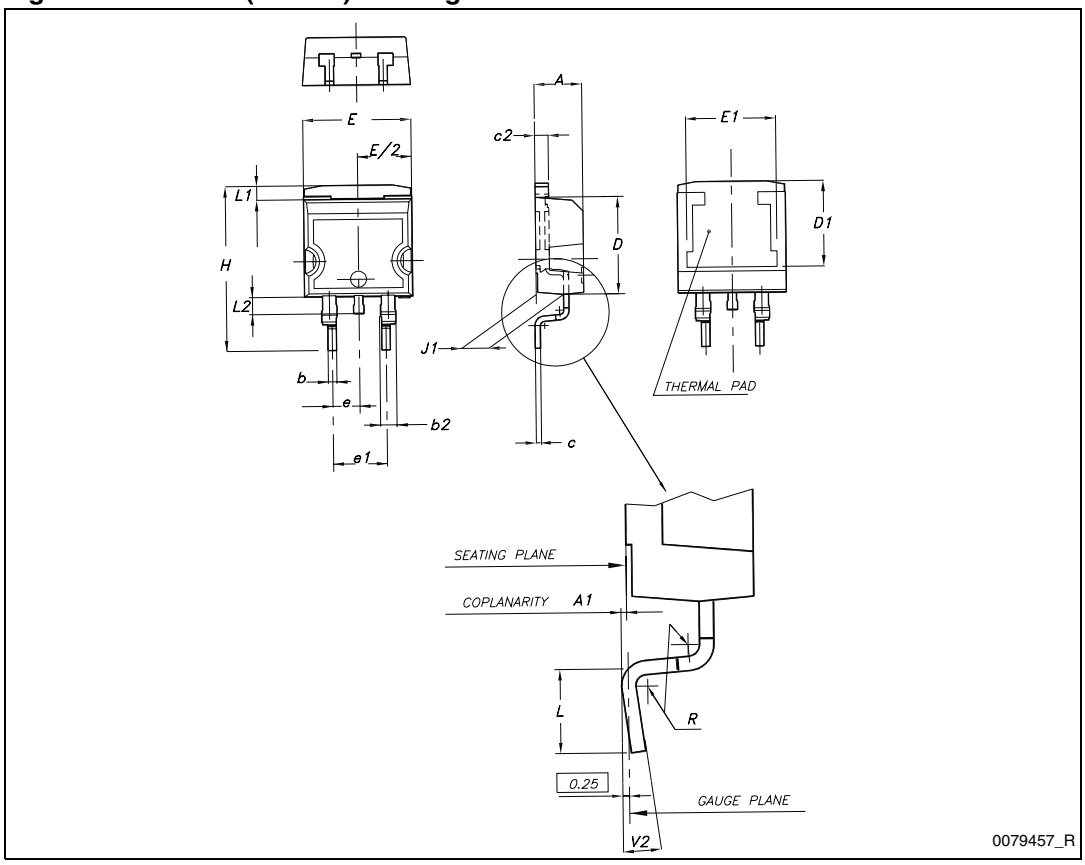
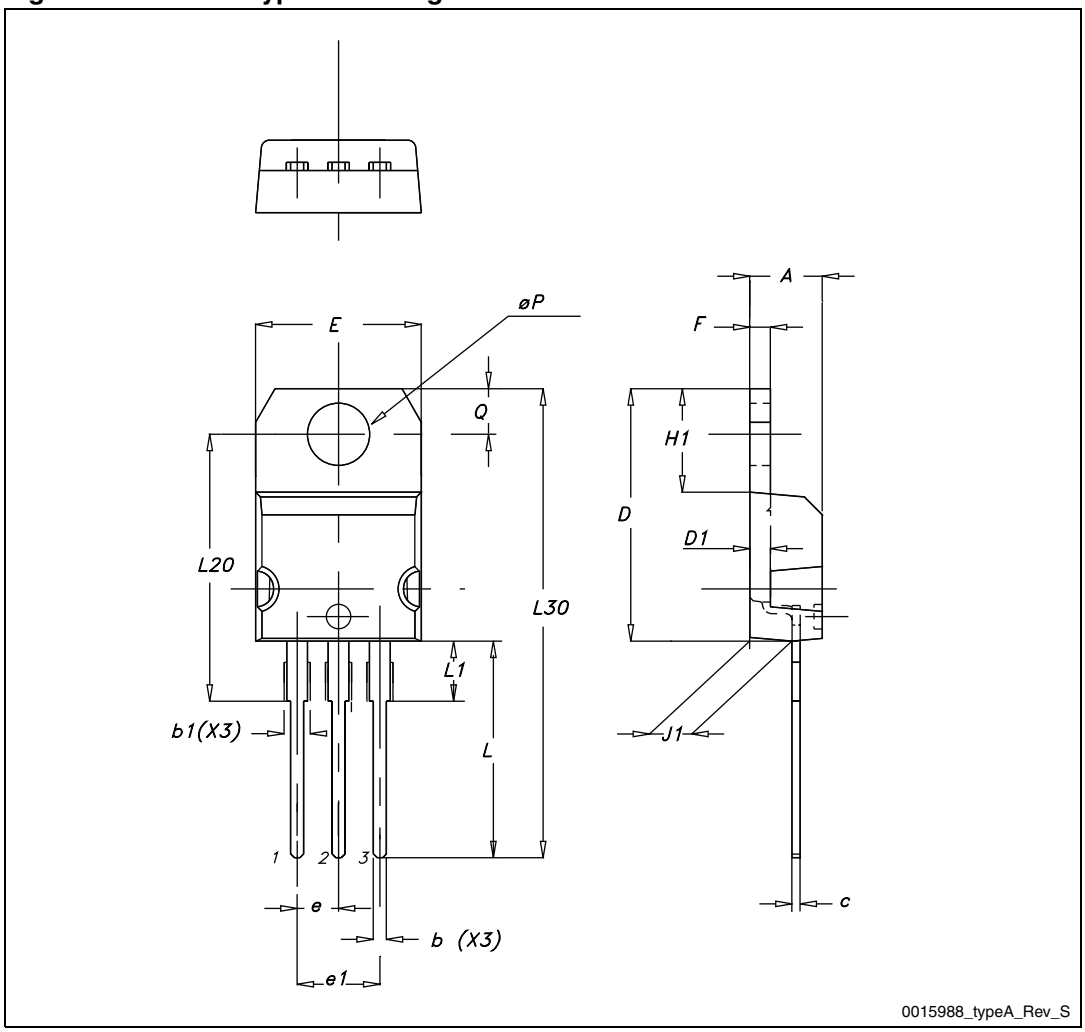


Table 11. TO-220 type A mechanical data

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

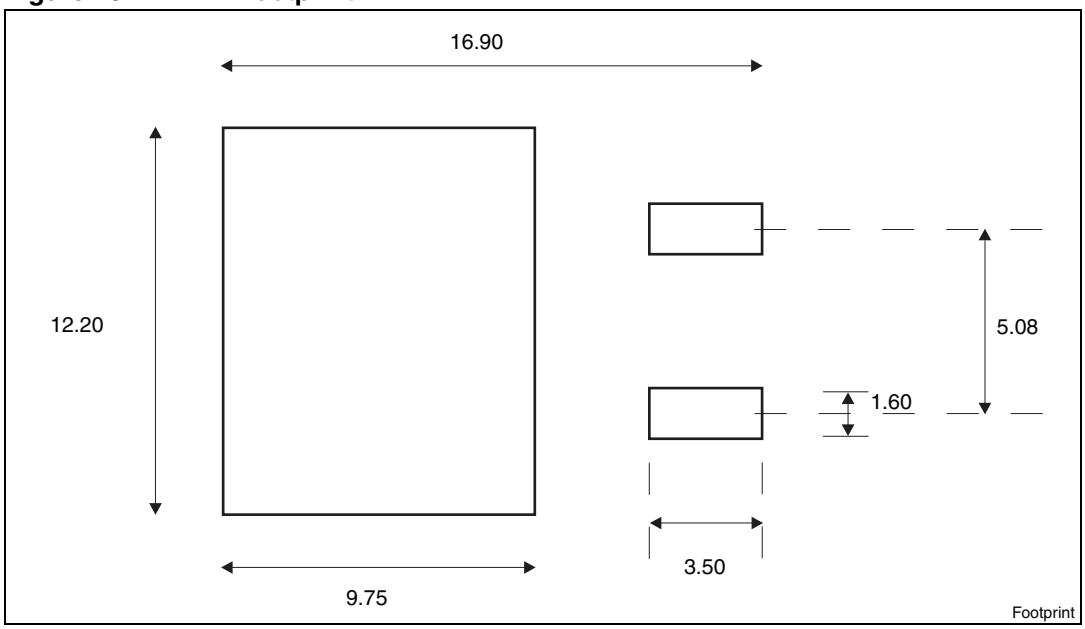


5 Packaging mechanical data

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. D²PAK footprint(a)



a. All dimension are in millimeters

Figure 27. Tape

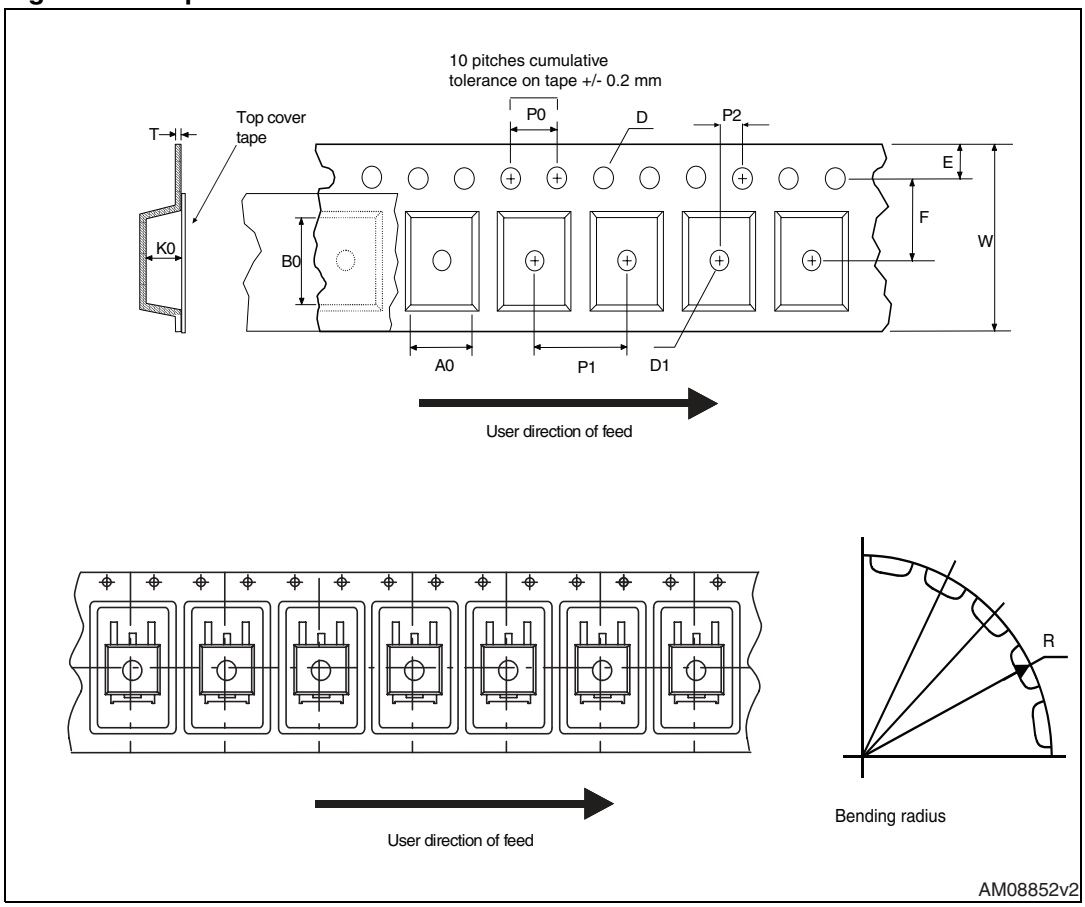
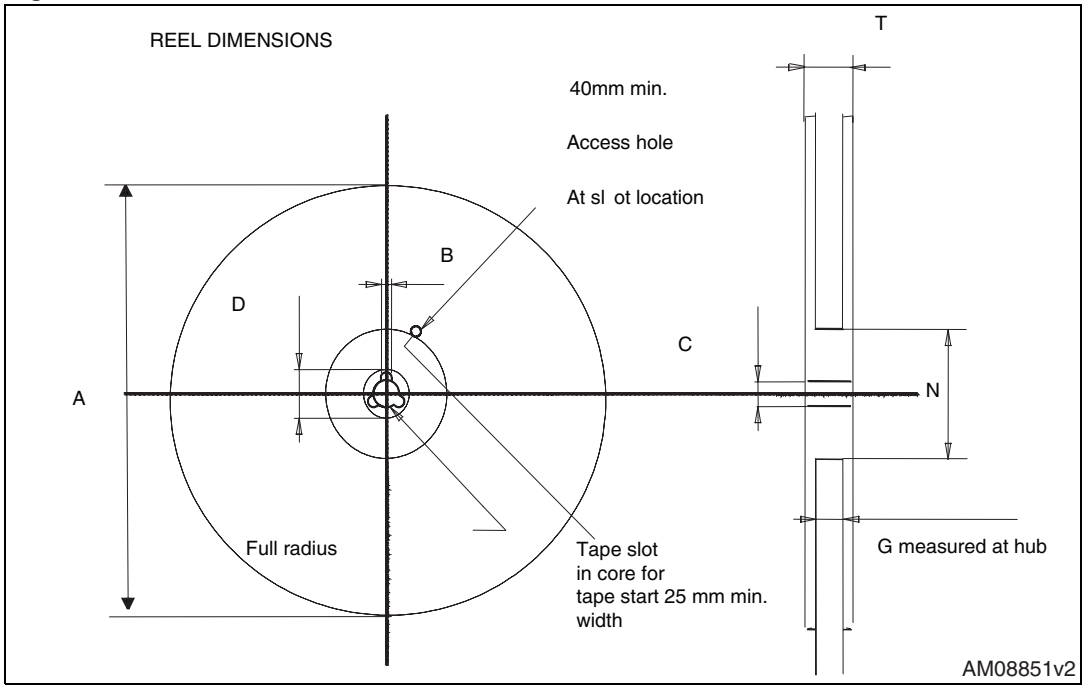


Figure 28. Reel



6 Revision history

Table 13. Document revision history

Date	Revision	Changes
02-Nov-2006	1	Initial release.
05-Jan-2007	2	Complete version.
01-Jul-2008	3	Modified: *Table 2: Absolute maximum ratings*. Inserted new packages, mechanical data: TO-220FP, TO-247.
13-Oct-2008	4	V_{ISO} inserted in *Table 2* for TO-220FP.
15-May-2009	5	Updated I_{CP} value.
19-May-2009	6	Updated: mechanical data for TO-220FP.
24-Nov-2010	7	Inserted new order code STGWA19NC60HD in TO-247 long leads package.
14-Dec-2010	8	Updated *Table 4: Static*.
02-Sep-2011	9	Removed order code STGWA19NC60HD in TO-247 long leads package.

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST’s terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST’S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY TWO AUTHORIZED ST REPRESENTATIVES, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER’S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com