



STGx19NC60HD STGWA19NC60HD

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

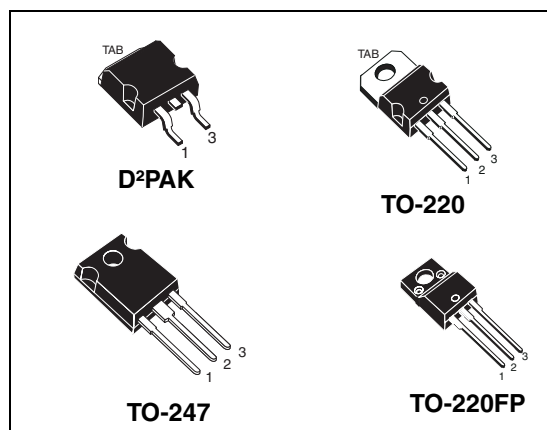


Figure 1. Internal schematic diagram

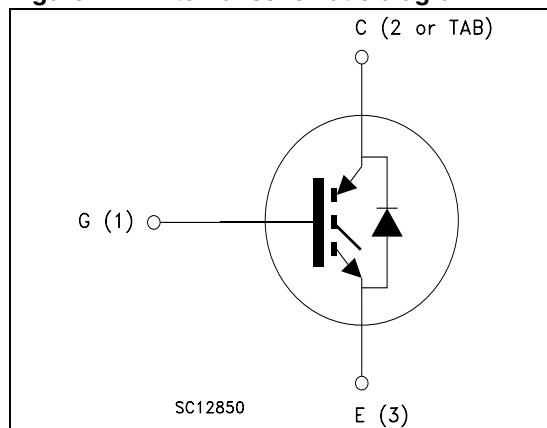


Table 1. Device summary

Part numbers	Marking	Package	Packaging
STGB19NC60HDT4	GB19NC60HD	D²PAK	Tape and reel
STGF19NC60HD	GF19NC60HD	TO-220FP	Tube
STGP19NC60HD	GP19NC60HD	TO-220	Tube
STGWA19NC60HD	GWA19NC60HD	TO-247 long leads	Tube
STGW19NC60HD	GW19NC60HD	TO-247	Tube

Contents

1 **Electrical ratings** 3

2 **Electrical characteristics** 4

 2.1 Electrical characteristics (curves) 6

3 **Test circuits** 9

4 **Package mechanical data** 10

5 **Packaging mechanical data** 17

6 **Revision history** 18



1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value				Unit
		TO-220 D ² PAK	TO-220FP	TO-247	TO-247 long leads	
V _{CES}	Collector-emitter voltage (V _{GE} = 0)	600				V
I _C ⁽¹⁾	Continuous collector current at T _C = 25 °C	40	16	42	52	A
I _C ⁽¹⁾	Continuous collector current at T _C = 100 °C	19	10	21	31	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	208	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. V_{clamp}=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 D ² PAK	TO-220FP	TO-247	TO-247 long leads	
R _{thj-case}	Thermal resistance junction-case IGBT	0.95	3.9	0.9	0.6	°C/W
	Thermal resistance junction-case diode	3	5.5	3		°C/W
R _{thj-amb}	Thermal resistance junction-ambient	62.5		50		°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 ($V_{GE} = 0$)	$I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 12\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$, $T_J = 100\text{ °C}$ $V_{GE} = 15\text{ V}$, $I_C = 12\text{ A}$, $T_J = 125\text{ °C}$		1.8 2 2.5 1.6	2.5	V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.75		5.75	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}$, $T_J = 125\text{ °C}$			150 1	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			± 100	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 15\text{ V}$, $I_C = 12\text{ A}$		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}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$	-	1180	-	pF
C_{oes}	Output capacitance			130		pF
C_{res}	Reverse transfer capacitance			36		pF
Q_g	Total gate charge	$V_{CE} = 390\text{ V}$, $I_C = 5\text{ A}$,	-	53	-	nC
Q_{ge}	Gate-emitter charge	$V_{GE} = 15\text{ V}$,		10		nC
Q_{gc}	Gate-collector charge	Figure 21		23		nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$	-	25	-	ns
t_r	Current rise time	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	7	-	ns
$(di/dt)_{on}$	Turn-on current slope	Figure 22	-	1600	-	A/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$	-	24	-	ns
t_r	Current rise time	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	8	-	ns
$(di/dt)_{on}$	Turn-on current slope	$T_J = 125\text{ }^\circ\text{C}$ Figure 22	-	1400	-	A/ μ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$	-	27	-	ns
$t_{d(V_{off})}$	Turn-off delay time	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	97	-	ns
t_f	Current fall time	Figure 22	-	73	-	ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$	-	58	-	ns
$t_{d(V_{off})}$	Turn-off delay time	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	144	-	ns
t_f	Current fall time	$T_J = 125\text{ }^\circ\text{C}$ Figure 22	-	128	-	ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}	Turn-on switching losses	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$	-	85	-	μ J
$E_{off}^{(1)}$	Turn-off switching losses	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	189	-	μ J
E_{ts}	Total switching losses	Figure 22	-	274	-	μ J
E_{on}	Turn-on switching losses	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$	-	187	-	μ J
$E_{off}^{(1)}$	Turn-off switching losses	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	407	-	μ J
E_{ts}	Total switching losses	$T_J = 125\text{ }^\circ\text{C}$ Figure 22	-	594	-	μ J

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	$I_F = 12\text{ A}$	-	2.6	-	V
		$I_F = 12\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	2.1	-	V
t_{rr}	Reverse recovery time	$I_F = 12\text{ A}$, $V_R = 40\text{ V}$,	-	31	-	ns
Q_{rr}	Reverse recovery charge	$di/dt = 100\text{ A}/\mu\text{s}$	-	30	-	nC
I_{rrm}	Reverse recovery current	Figure 23	-	2	-	A
t_{rr}	Reverse recovery time	$I_F = 12\text{ A}$, $V_R = 40\text{ V}$,	-	59	-	ns
Q_{rr}	Reverse recovery charge	$T_J = 125\text{ }^\circ\text{C}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	102	-	nC
I_{rrm}	Reverse recovery current	Figure 23	-	4	-	A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

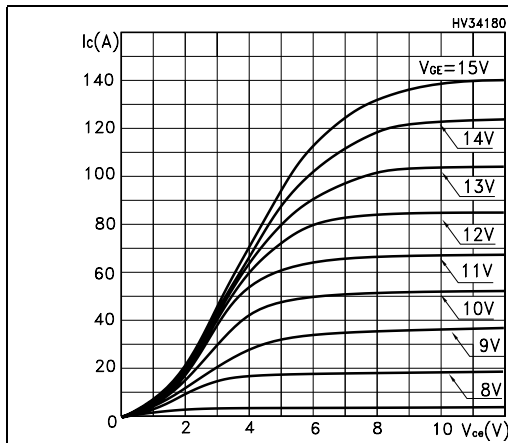


Figure 3. Transfer characteristics

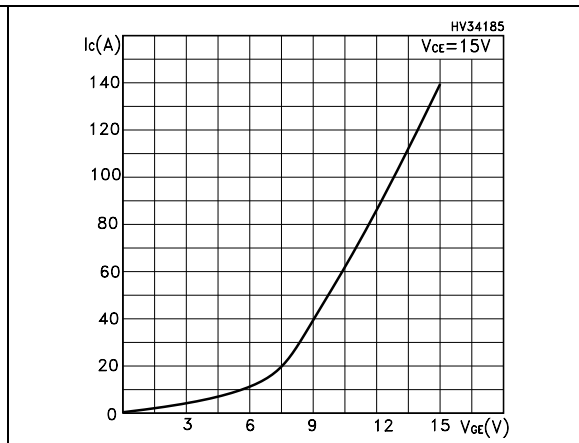


Figure 4. Transconductance

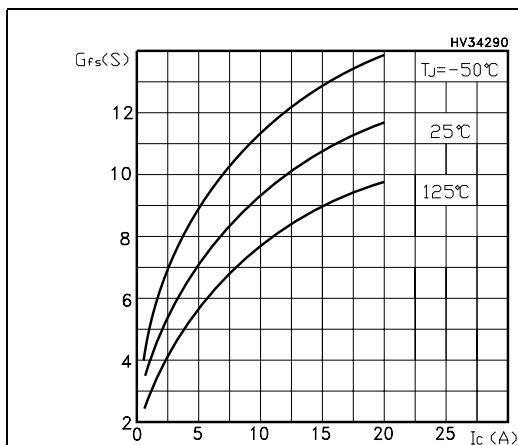


Figure 5. Collector-emitter on voltage vs temperature

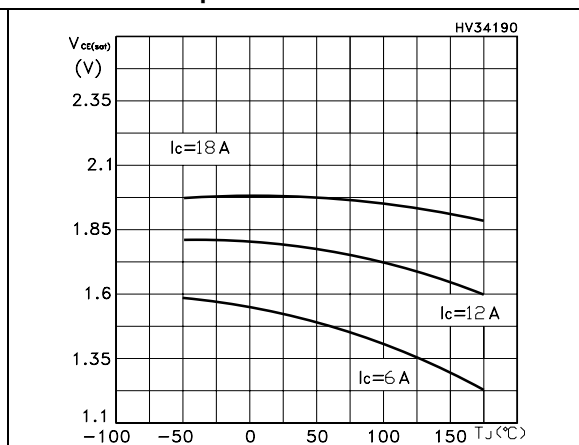


Figure 6. Gate charge vs gate-source voltage

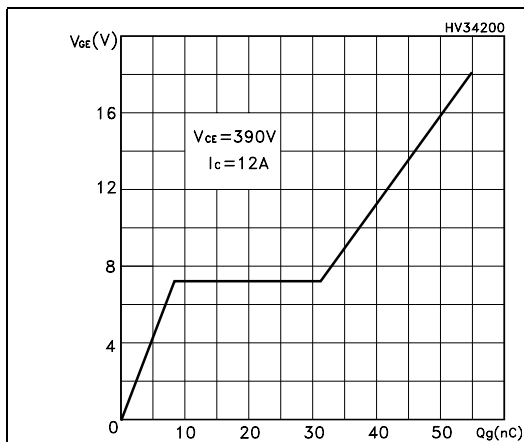


Figure 7. Capacitance variations

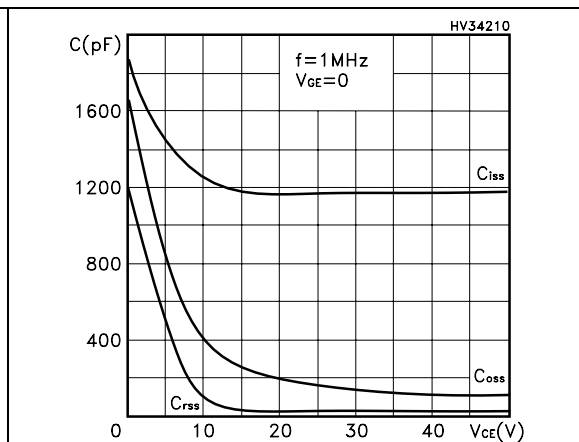


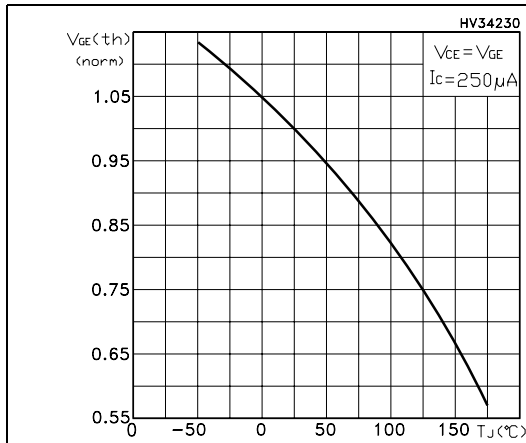
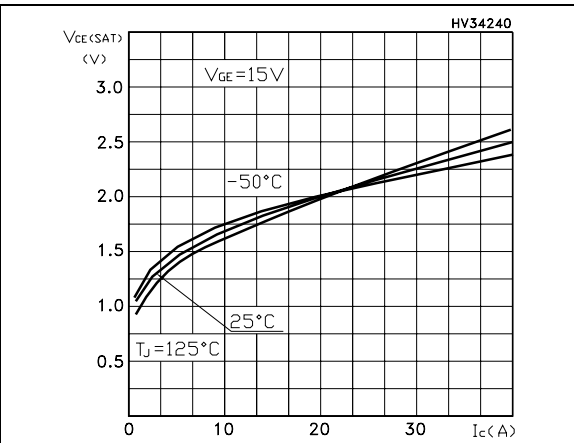
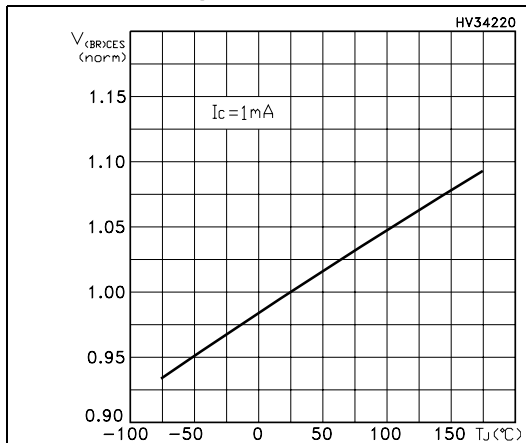
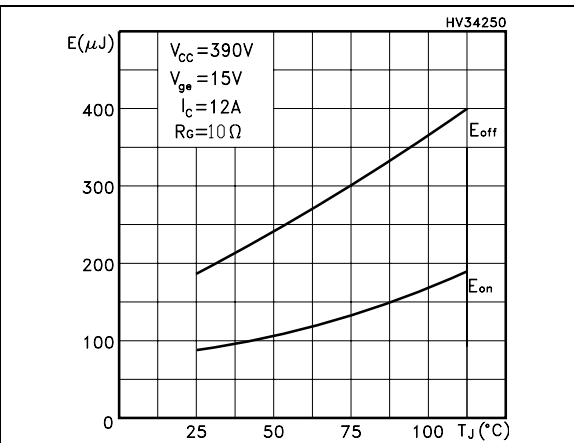
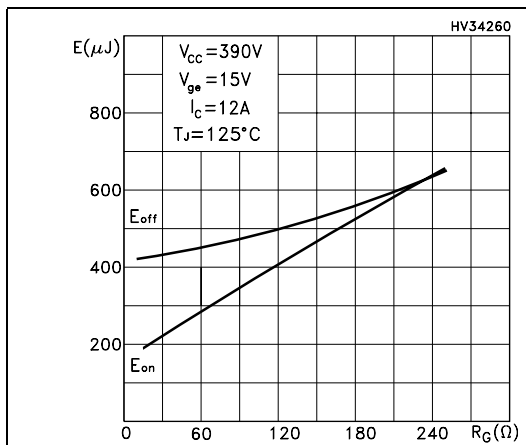
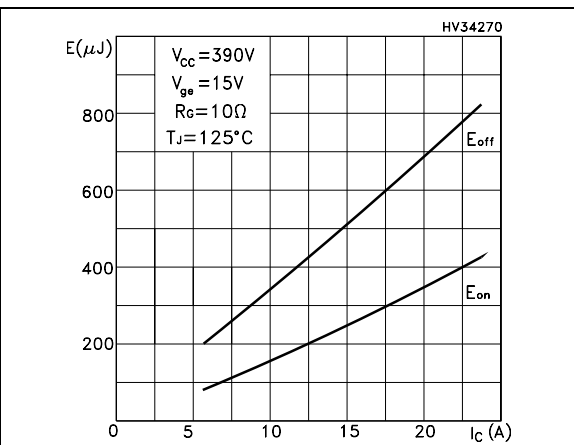
Figure 8. Normalized gate threshold voltage vs temperature**Figure 9. Collector-emitter on voltage vs collector current****Figure 10. Normalized breakdown voltage vs temperature****Figure 11. Switching losses vs temperature****Figure 12. Switching losses vs gate resistance****Figure 13. Switching losses vs collector current**

Figure 14. Turn-off SOA

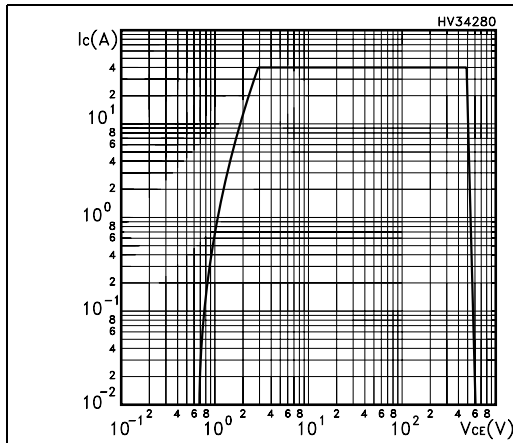


Figure 15. Thermal impedance for TO-247

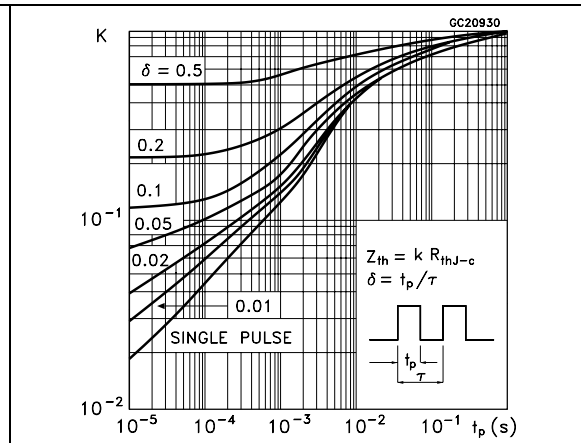
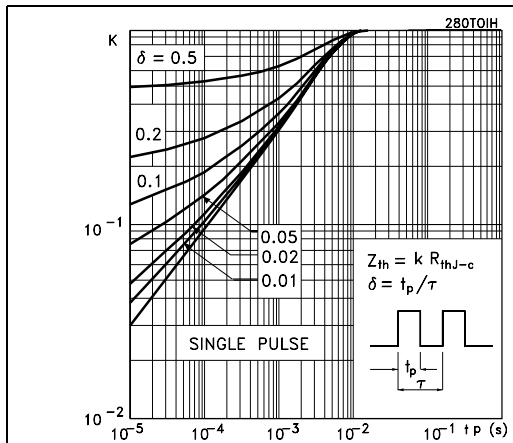
Figure 16. Thermal impedance for TO-220, D²PAK

Figure 17. Thermal impedance for TO-220FP

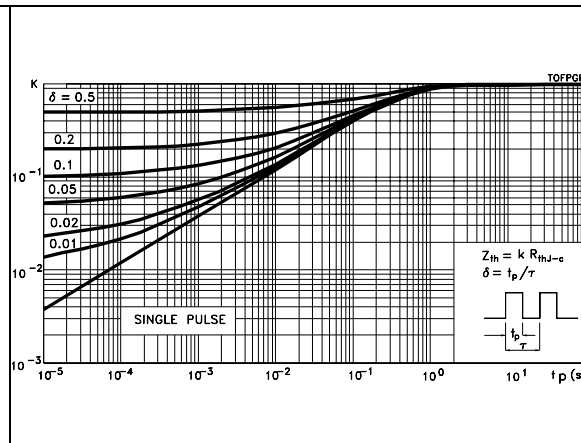


Figure 18. Forward voltage drop versus forward current

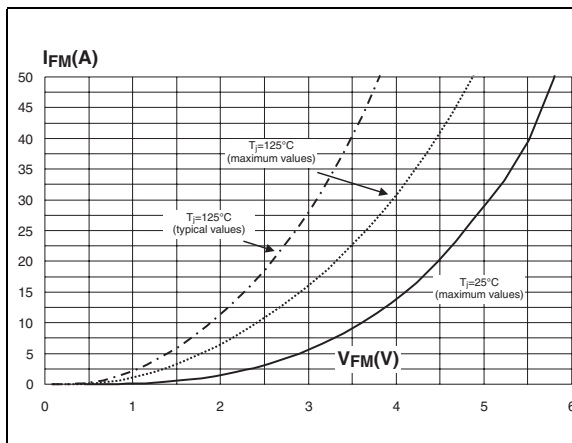
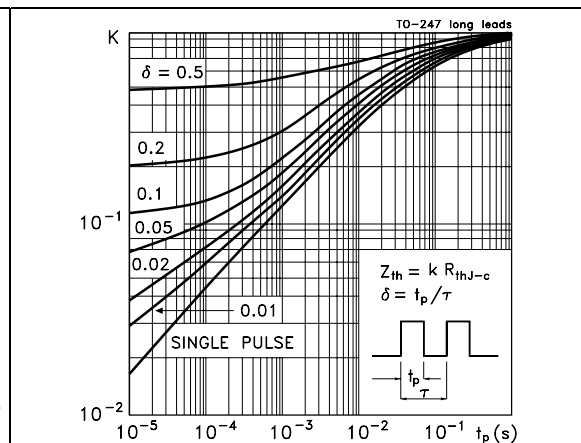


Figure 19. Thermal impedance for TO-247 long leads



3 Test circuits

Figure 20. Test circuit for inductive load switching

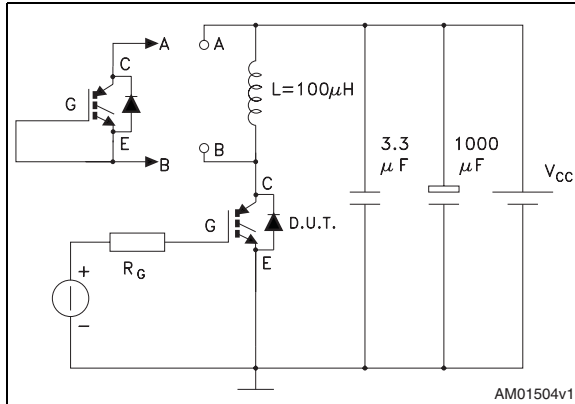


Figure 21. Gate charge test circuit

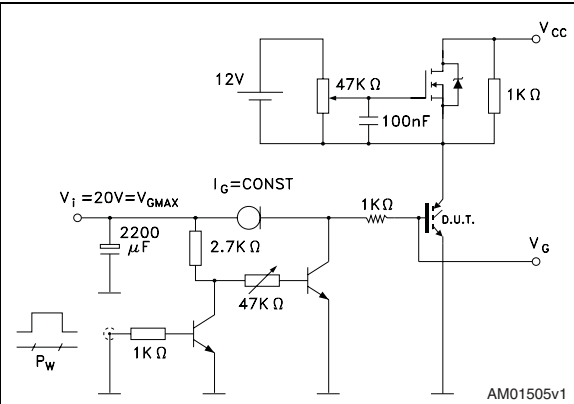


Figure 22. Switching waveform

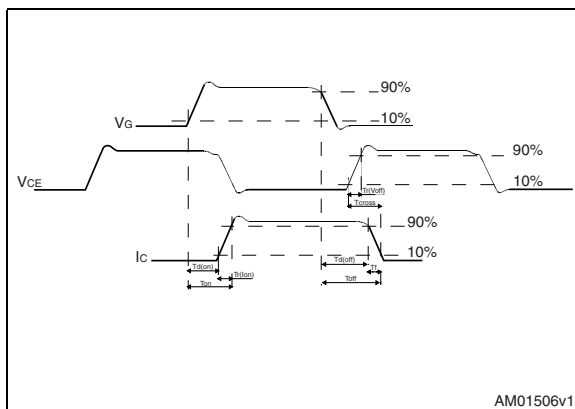
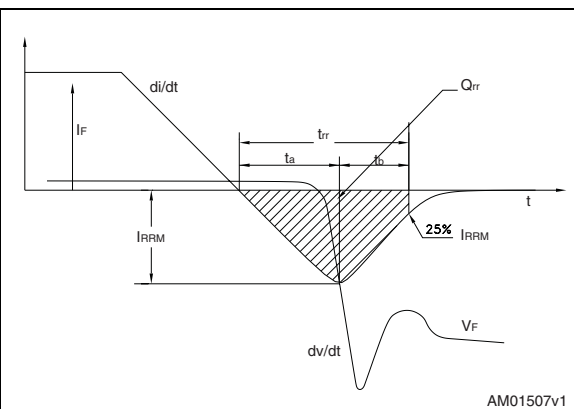


Figure 23. Diode recovery time waveform



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 24. TO-220FP drawing

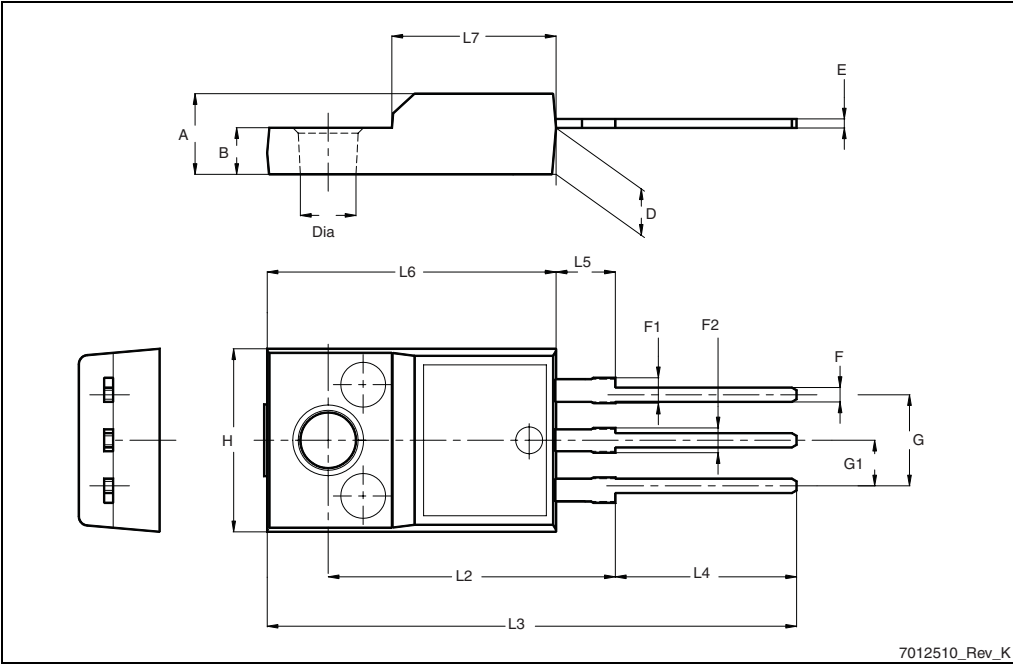


Table 10. TO-247 long leads mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.90		5.15
D	1.85		2.10
E	0.55		0.67
F	1.07		1.32
F1	1.90		2.38
F2	2.87		3.38
G	10.90 BSC		
H	15.77		16.02
L	20.82		21.07
L1	4.16		4.47
L2	5.49		5.74
L3	20.05		20.30
L4	3.68		3.93
L5	6.04		6.29
M	2.27		2.52
V		10°	
V1		3°	
V3		20°	
Dia.	3.55		3.66

Figure 25. TO-247 long leads drawing

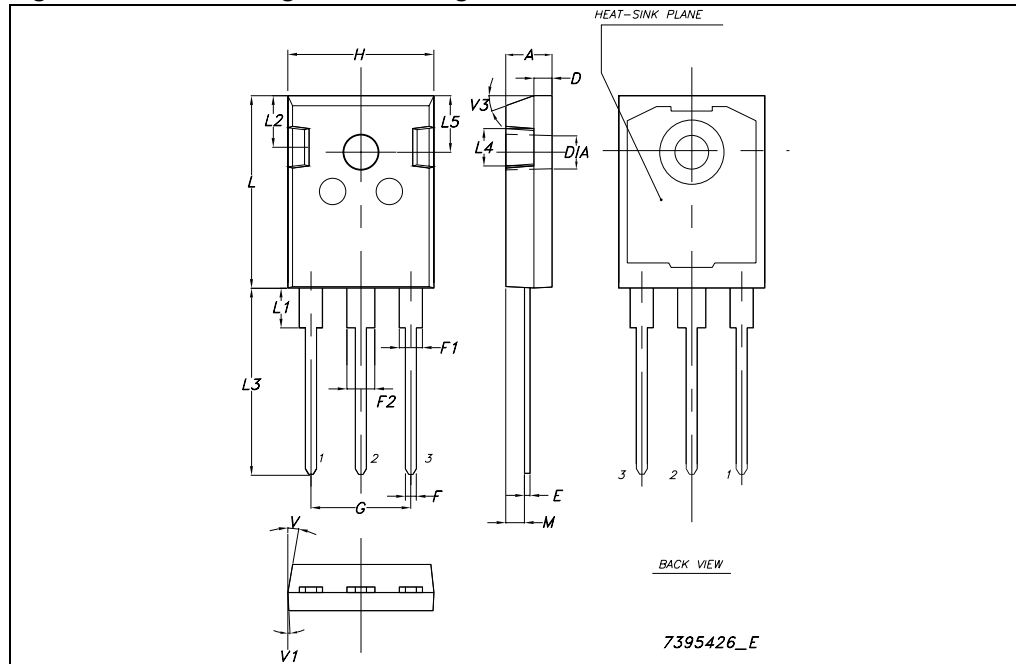
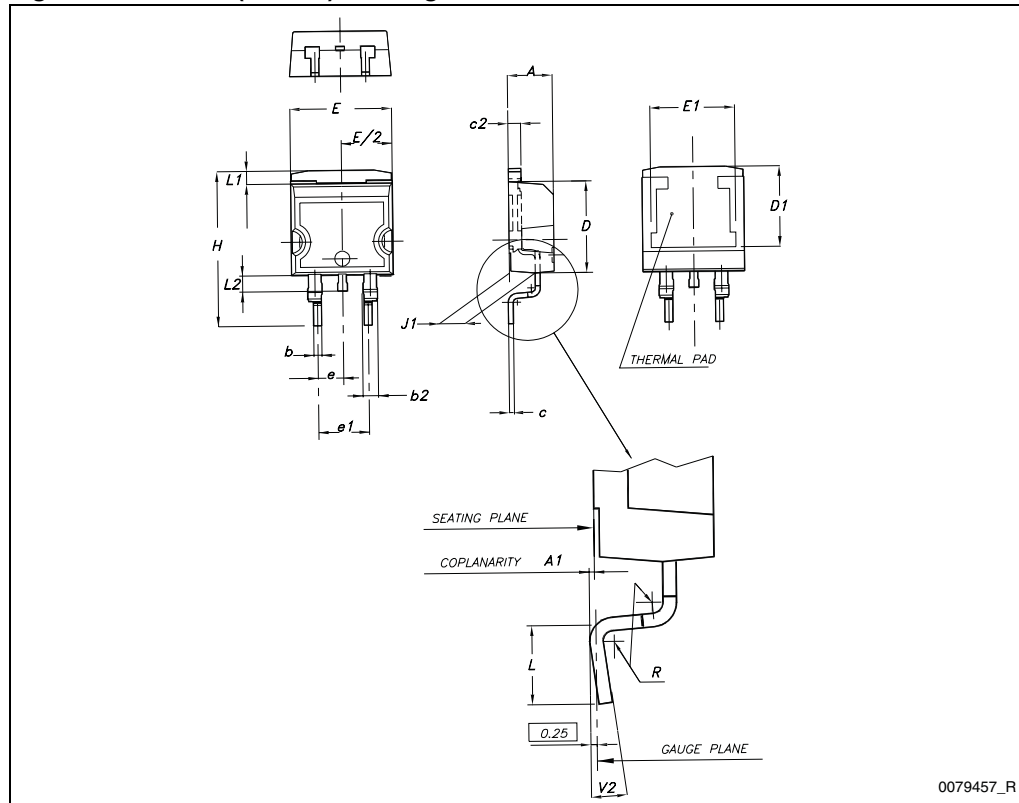


Table 11. D²PAK (TO-263) mechanical data

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°

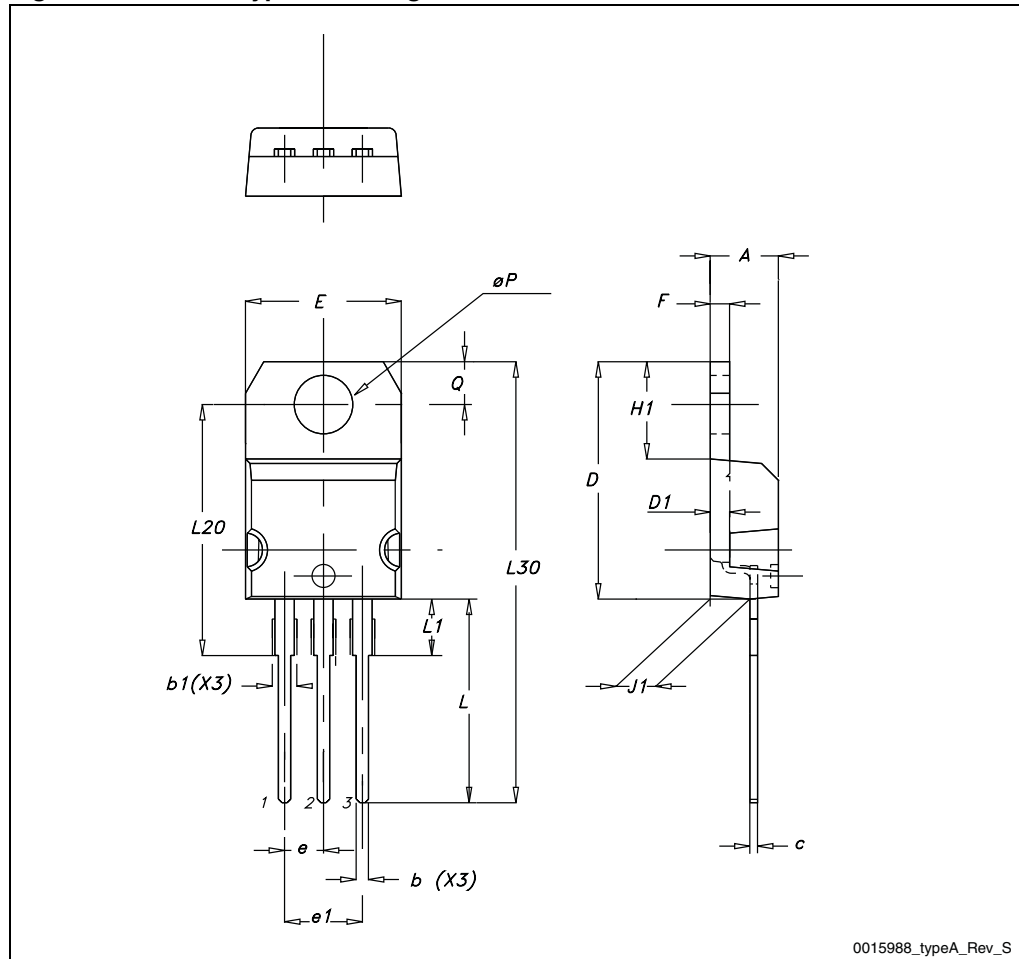
Figure 26. D²PAK (TO-263) drawing

0079457_R

Table 12. 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 27. TO-220 type A drawing

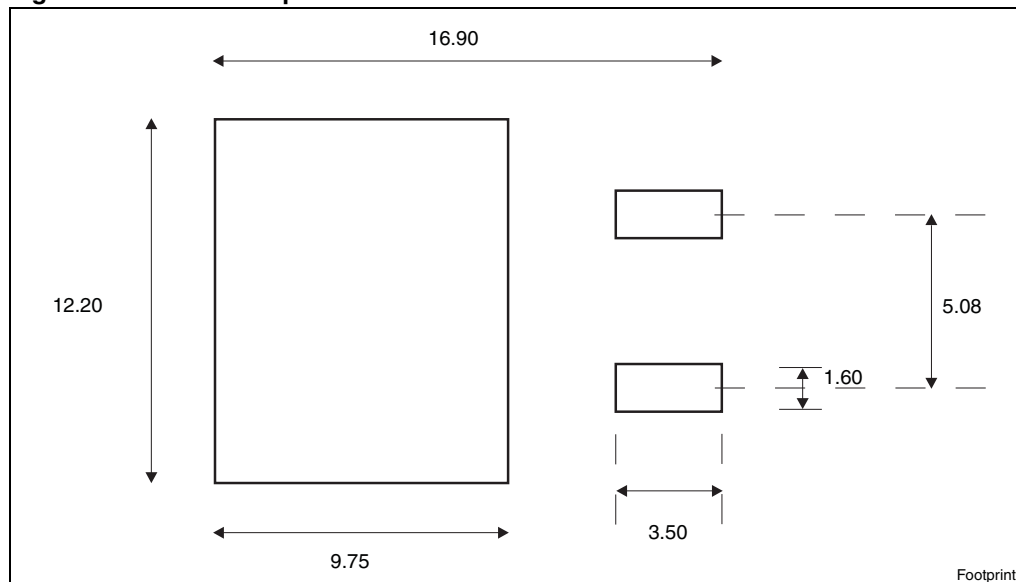


5 Packaging mechanical data

Table 13. 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 28. D²PAK footprint^(a)



a. All dimension are in millimeters

Figure 29. Tape

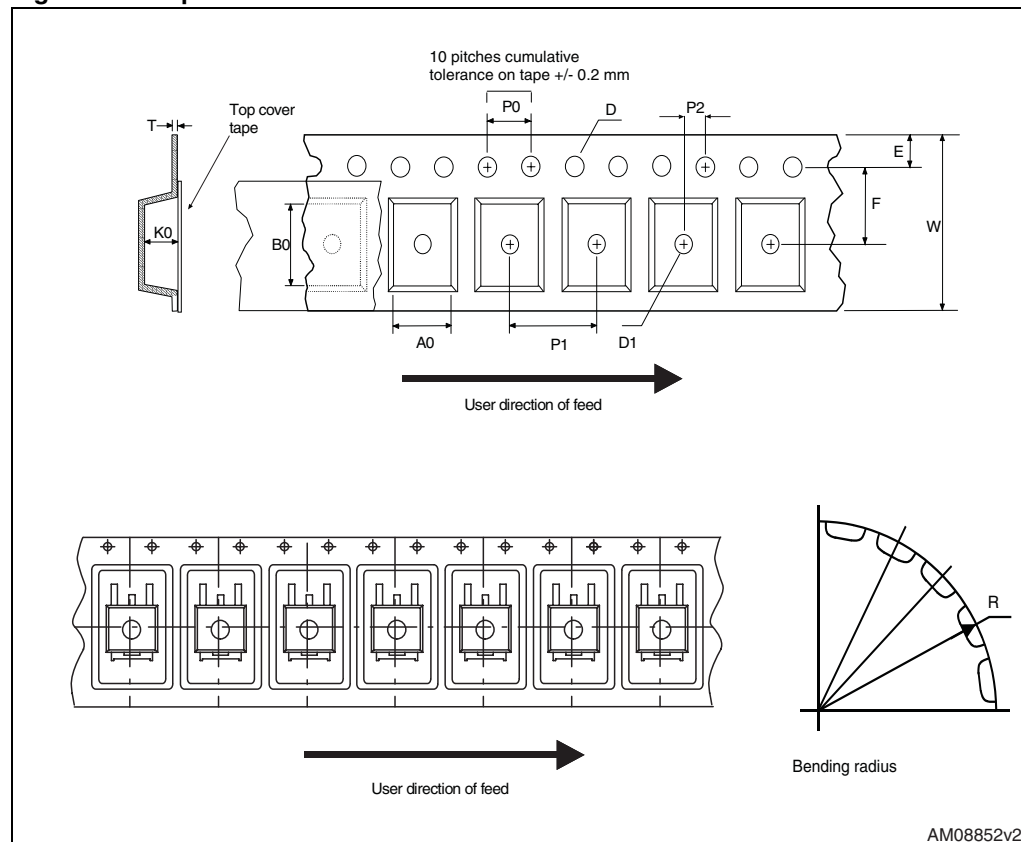
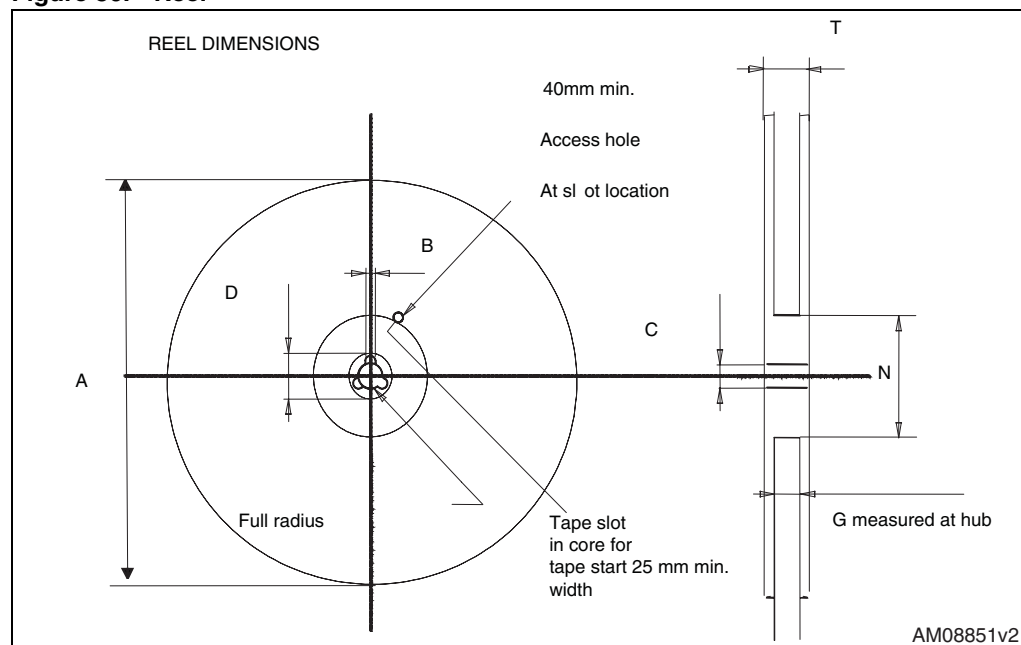


Figure 30. Reel



6 Revision history

Table 14. 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 .

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 AN AUTHORIZED ST REPRESENTATIVE, 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.

© 2010 STMicroelectronics - All rights reserved

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

