



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.

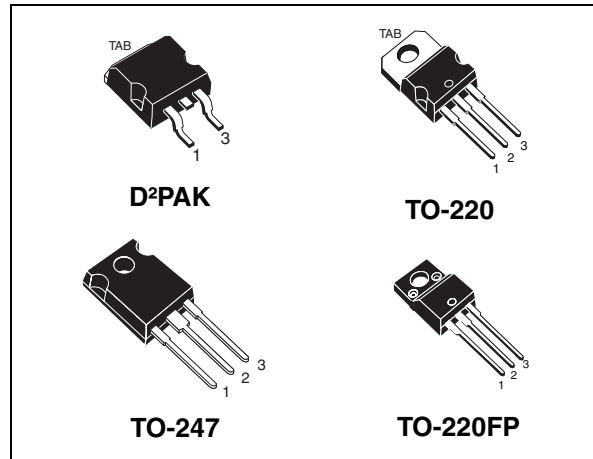


Figure 1. Internal schematic diagram

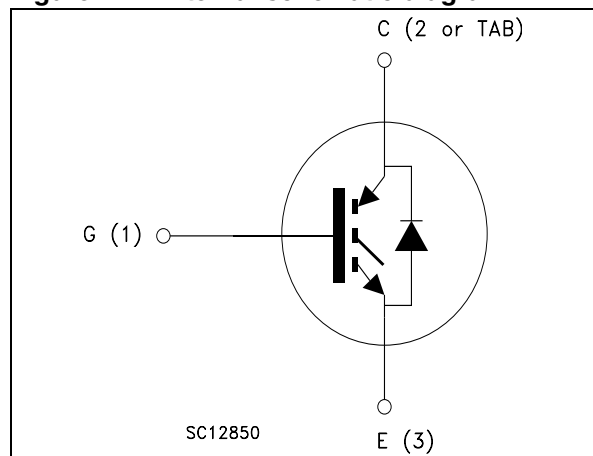


Table 1. Device summary

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

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220 D ² PAK	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. 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	
R _{thj-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-amb}	Thermal resistance junction-ambient	62.5			°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	$V_{CE} = 390\text{ V}$, $I_C = 5\text{ A}$, $V_{GE} = 15\text{ V}$, Figure 20	-	53	-	nC
Q_{ge}	Gate-emitter charge			10		nC
Q_{gc}	Gate-collector charge			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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, Figure 21	-	7	-	ns
$(di/dt)_{on}$	Turn-on current slope			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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ Figure 21	-	8	-	ns
$(di/dt)_{on}$	Turn-on current slope			1400		A/ μ s
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$		27		ns
$t_{d(Voff)}$	Turn-off delay time	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, Figure 21	-	97	-	ns
t_f	Current fall time			73		ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$		58		ns
$t_{d(Voff)}$	Turn-off delay time	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ Figure 21	-	144	-	ns
t_f	Current fall time			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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, Figure 21	-	189	-	μ J
E_{ts}	Total switching losses			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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ Figure 21	-	407	-	μ J
E_{ts}	Total switching losses			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	$I_F = 12\text{ A}$ $I_F = 12\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	2.6 2.1	-	V V
t_{rr}	Reverse recovery time	$I_F = 12\text{ A}$, $V_R = 40\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$ Figure 22	-	31	-	ns
Q_{rr}	Reverse recovery charge			30	-	nC
I_{rrm}	Reverse recovery current			2		A
t_{rr}	Reverse recovery time	$I_F = 12\text{ A}$, $V_R = 40\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$, $di/dt = 100\text{ A}/\mu\text{s}$ Figure 22	-	59	-	ns
Q_{rr}	Reverse recovery charge			102	-	nC
I_{rrm}	Reverse recovery current			4		A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

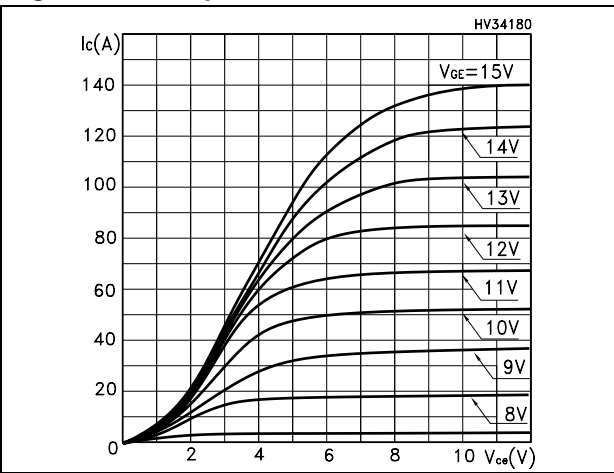


Figure 3. Transfer characteristics

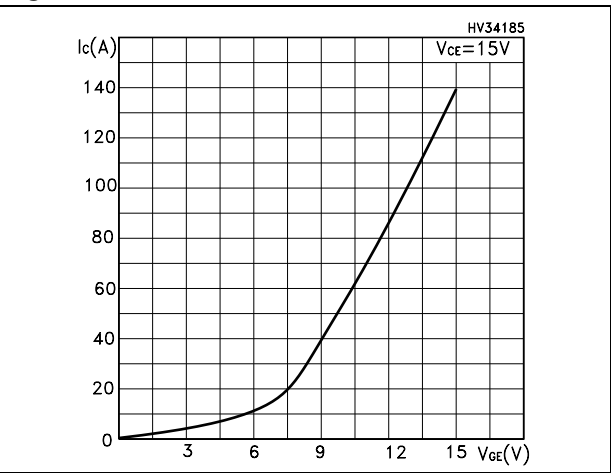


Figure 4. Transconductance

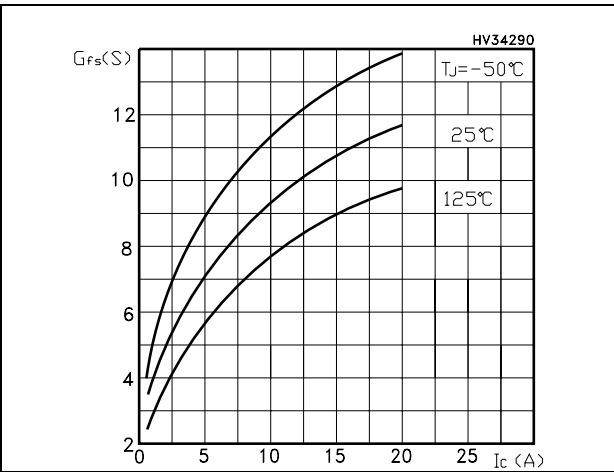


Figure 5. Collector-emitter on voltage vs. temperature

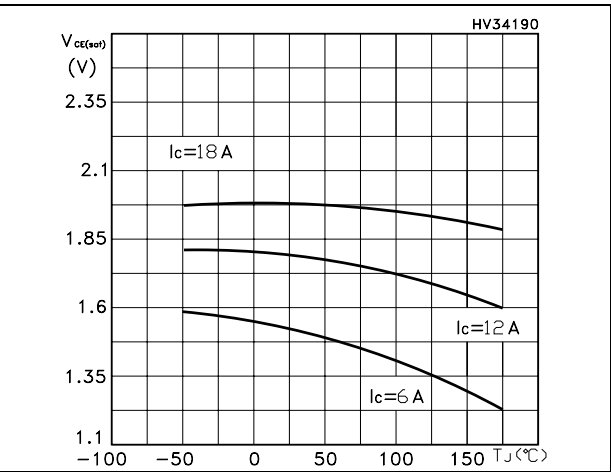


Figure 6. Gate charge vs. gate-source voltage

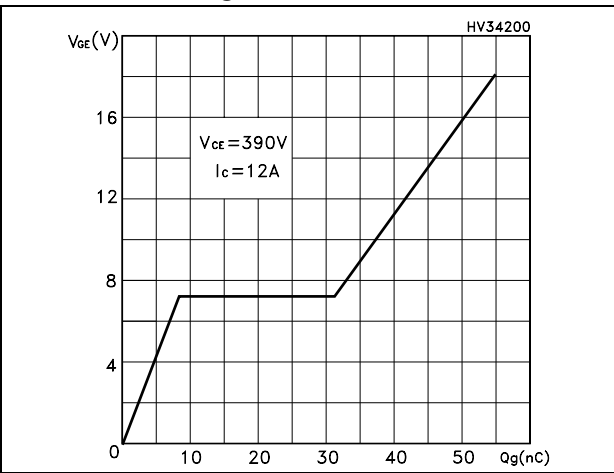


Figure 7. Capacitance variations

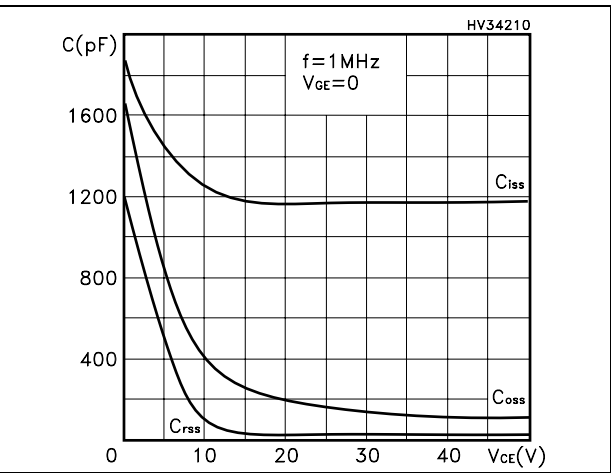


Figure 8. Normalized gate threshold voltage vs. temperature

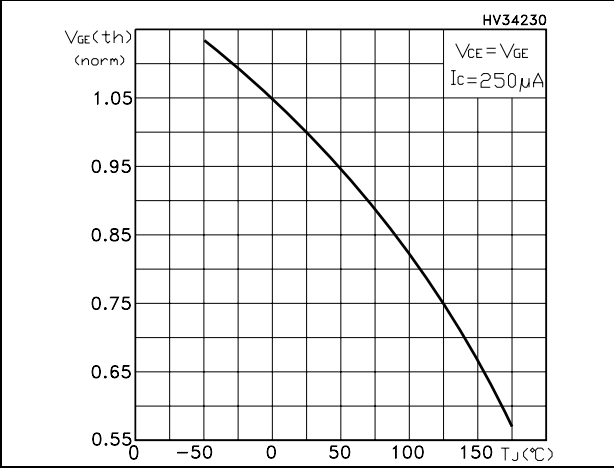


Figure 9. Collector-emitter on voltage vs. collector current

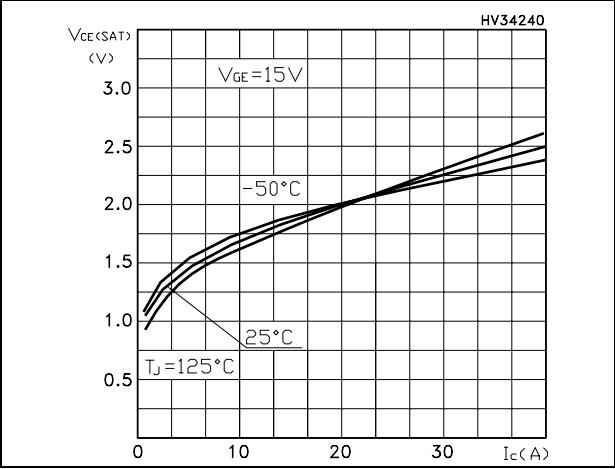


Figure 10. Normalized breakdown voltage vs. temperature

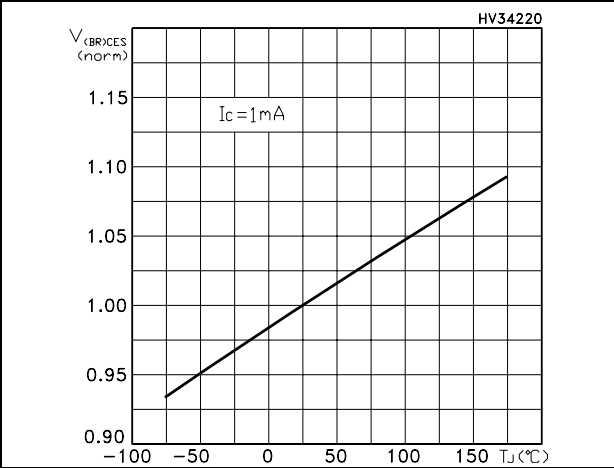


Figure 11. Switching losses vs. temperature

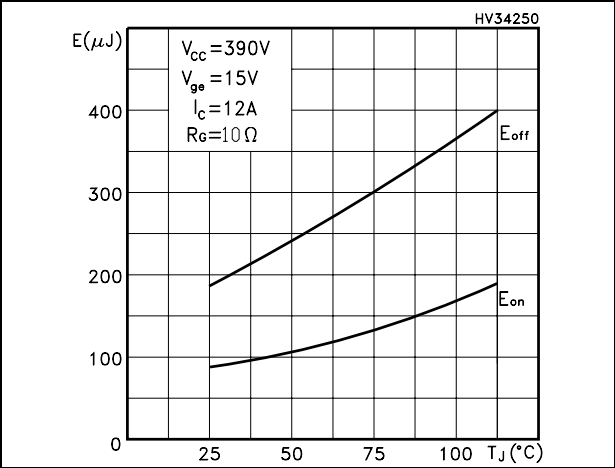


Figure 12. Switching losses vs. gate resistance

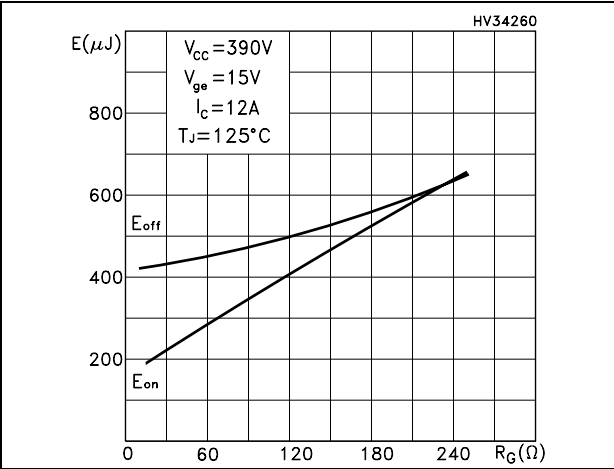


Figure 13. Switching losses vs. collector current

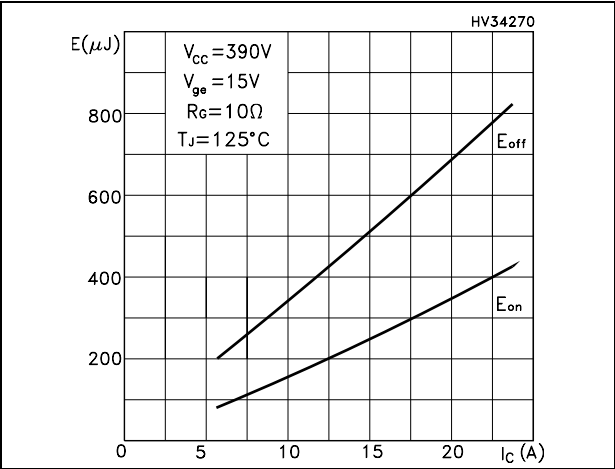


Figure 14. Turn-off SOA

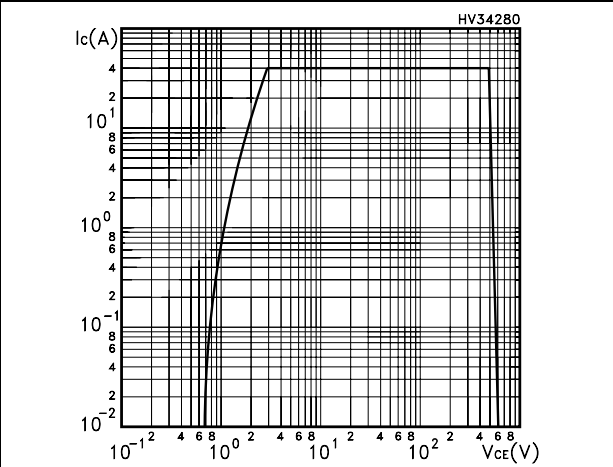


Figure 15. Thermal impedance for TO-247

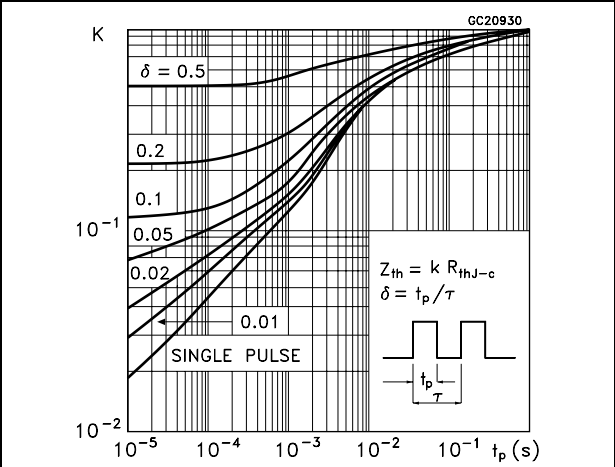


Figure 16. Thermal impedance for TO-220, D²PAK

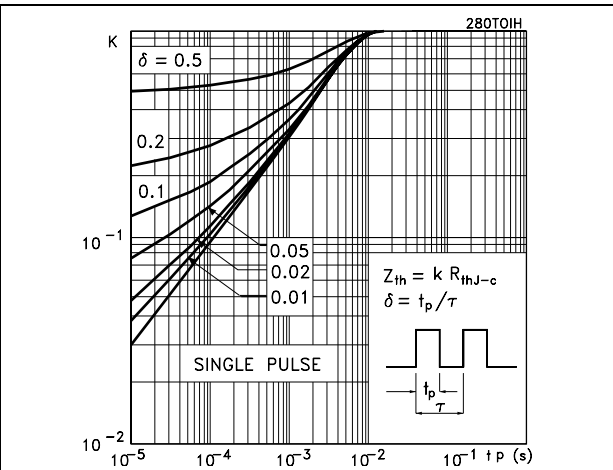


Figure 17. Thermal impedance for TO-220FP

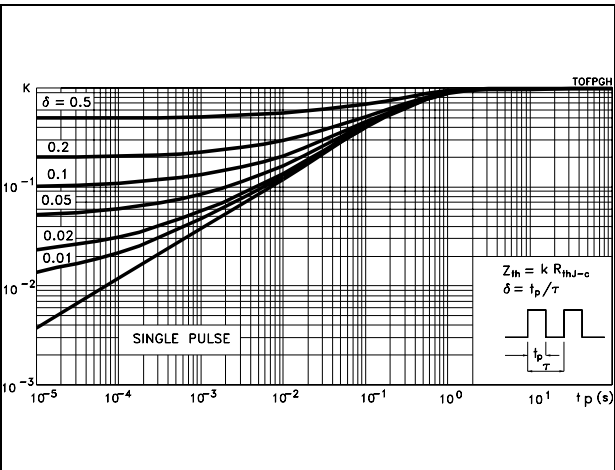
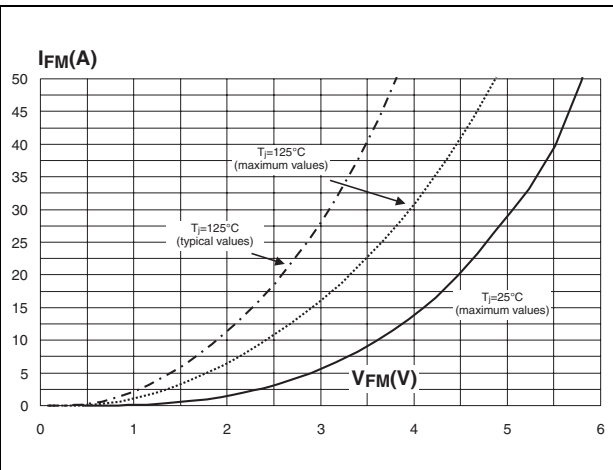


Figure 18. Forward voltage drop vs. forward current



3 Test circuits

Figure 19. Test circuit for inductive load switching

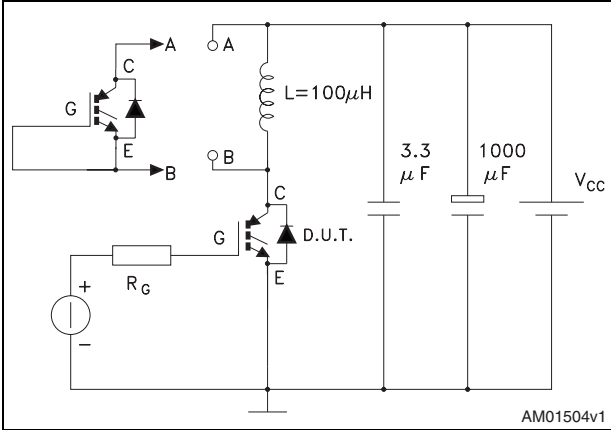


Figure 20. Gate charge test circuit

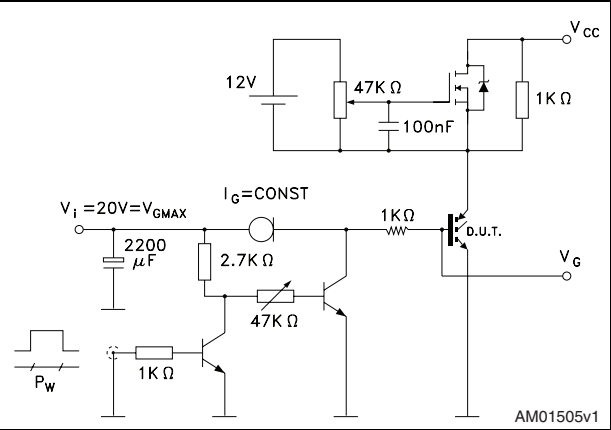


Figure 21. Switching waveform

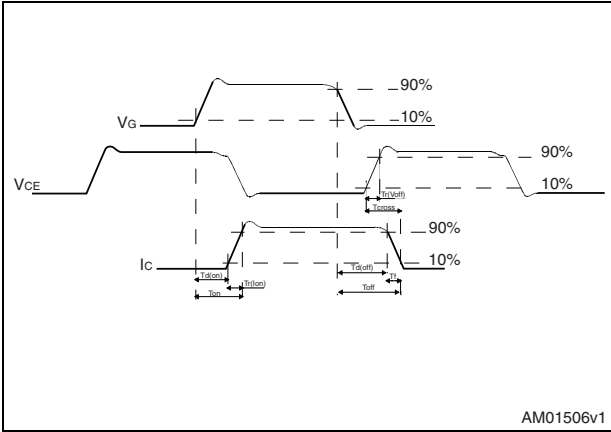
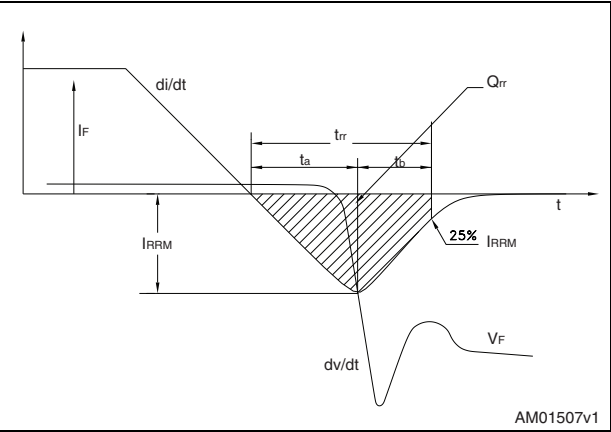


Figure 22. Diode recovery time waveform



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

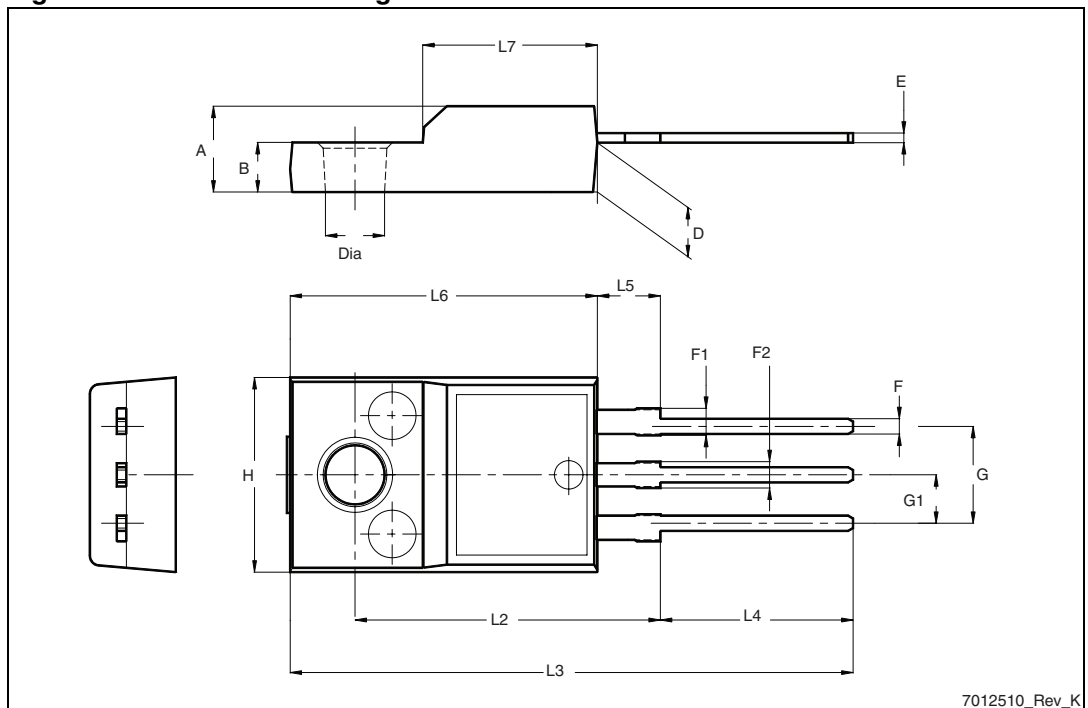
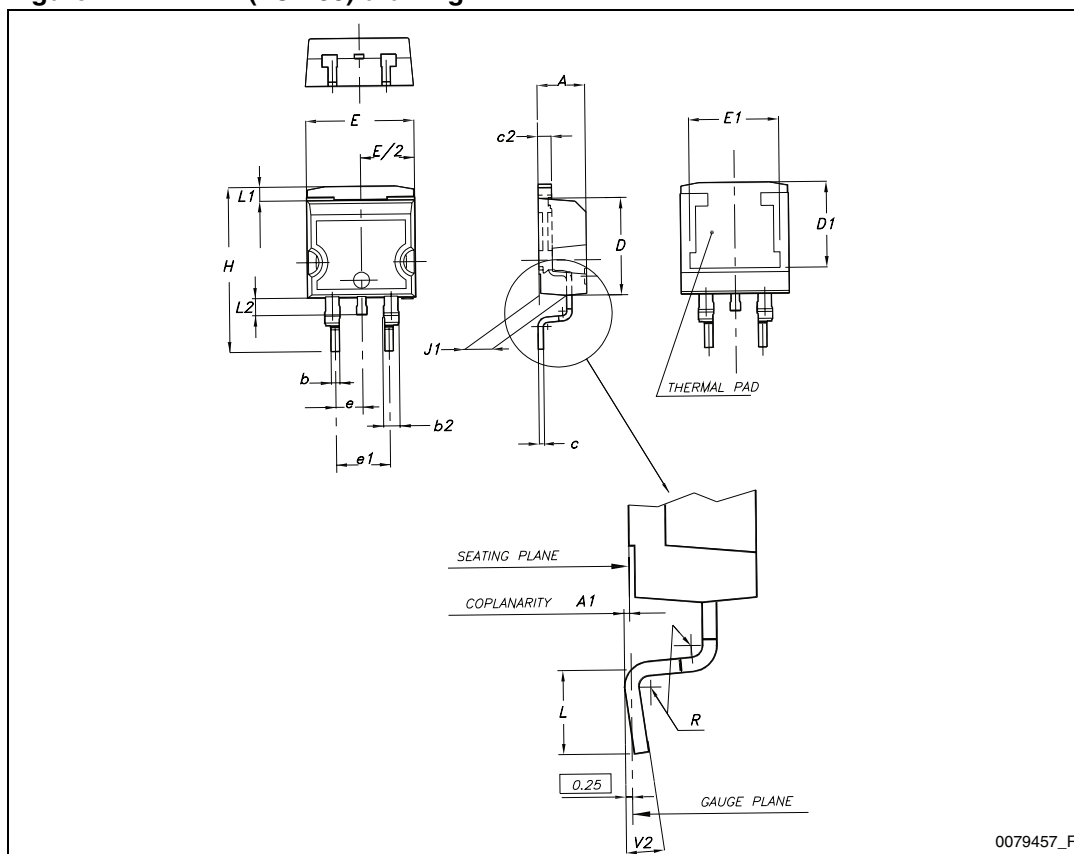
Figure 23. TO-220FP drawing

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°

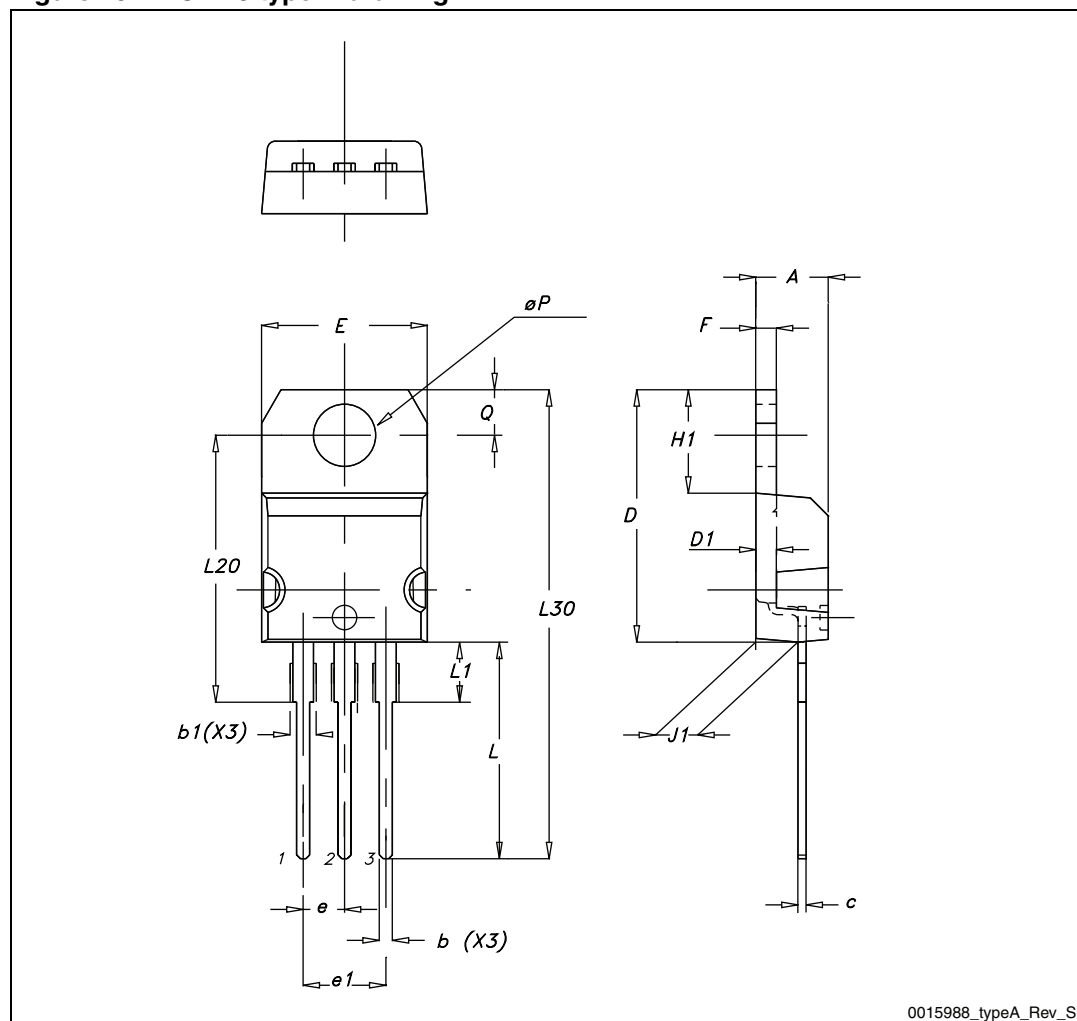
Figure 24. D²PAK (TO-263) drawing

0079457_R

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	
ØP	3.75		3.85
Q	2.65		2.95

Figure 25. TO-220 type A drawing

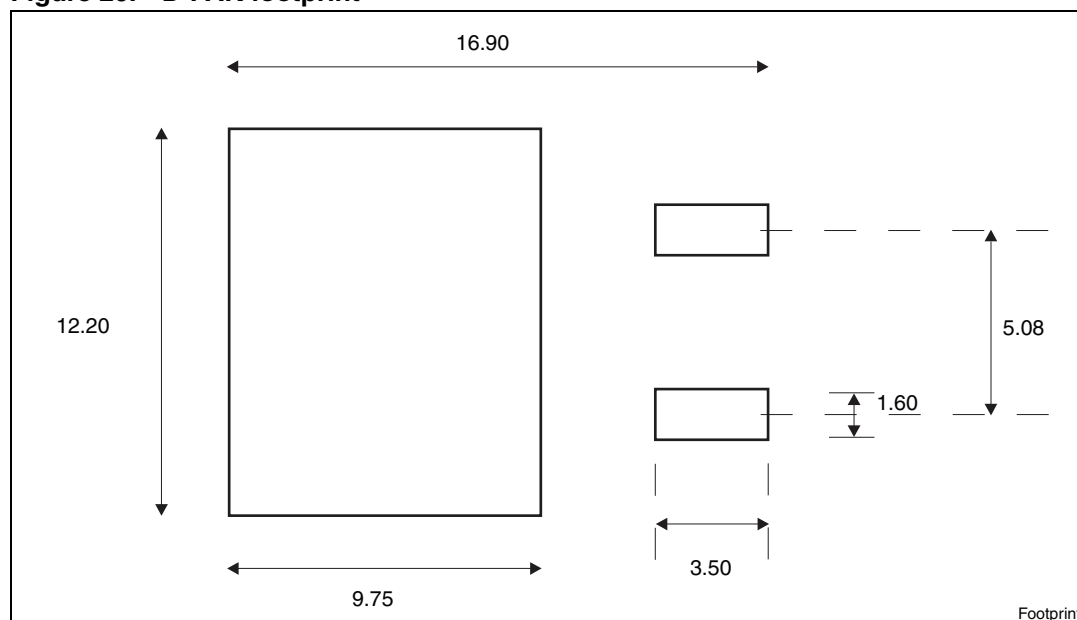


5 Packaging mechanical data

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

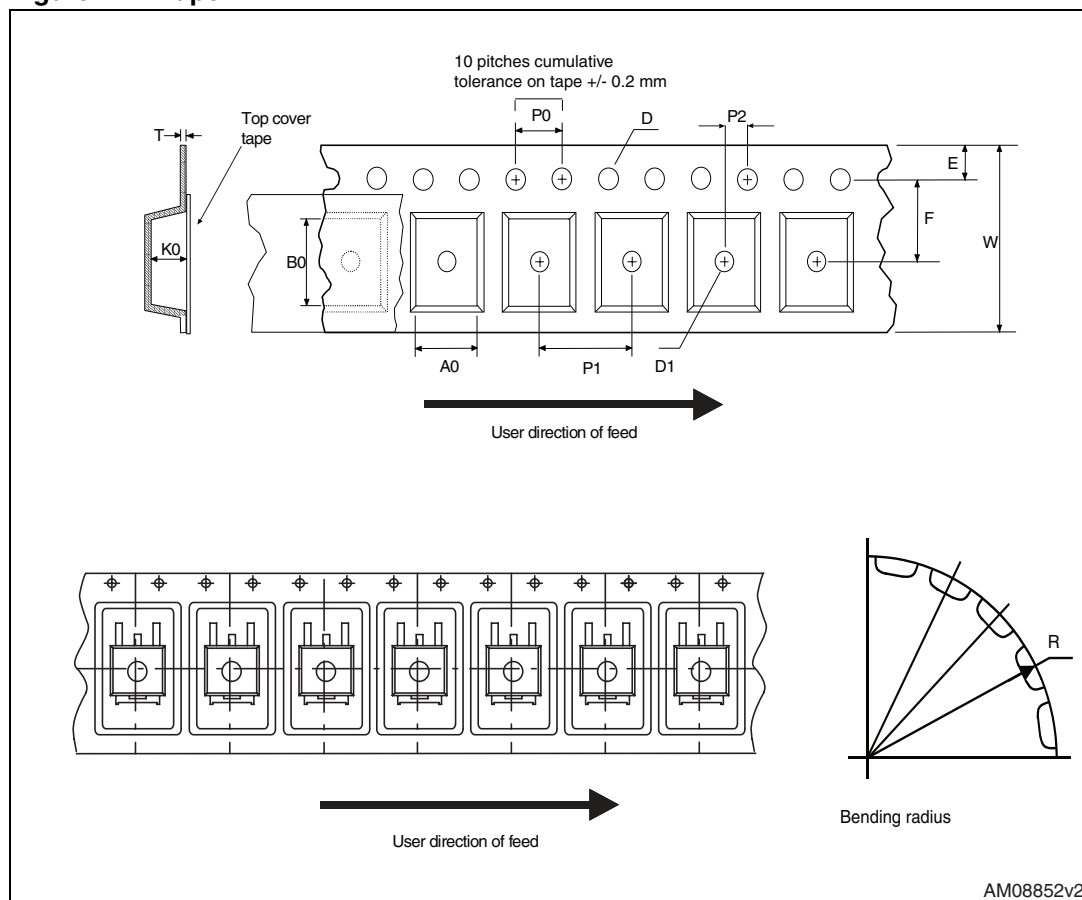
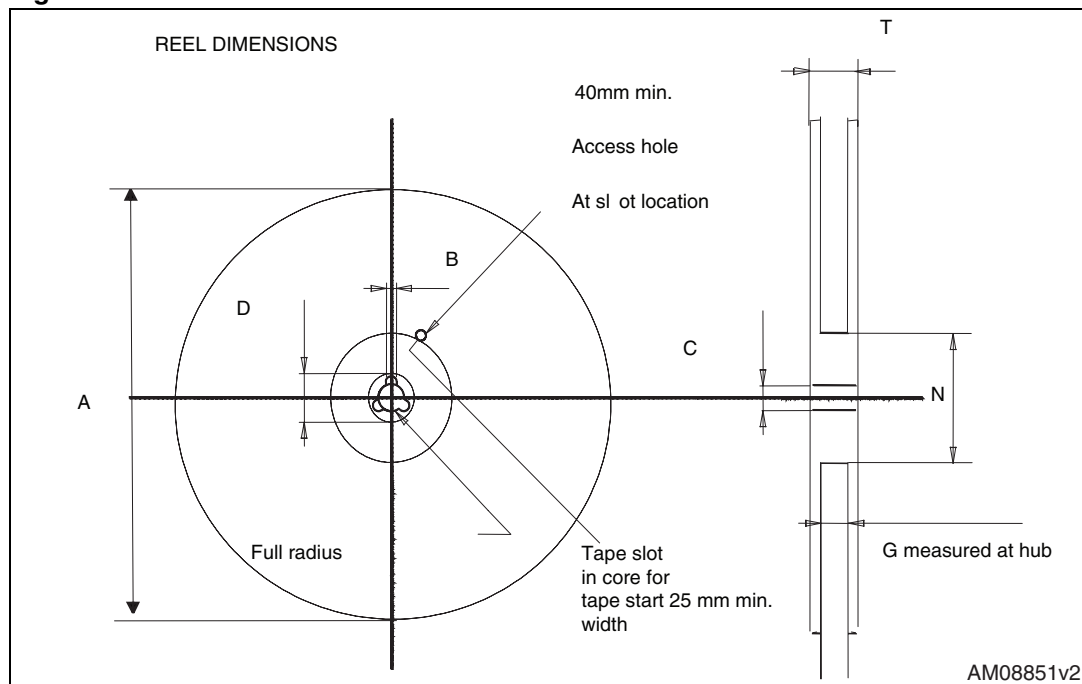


Figure 28. Reel



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.

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