



STB32N65M5, STF32N65M5, STI32N65M5 STP32N65M5, STW32N65M5

N-channel 650 V, 0.095 Ω , 24 A, MDmesh™ V Power MOSFET
in D²PAK, I²PAK, TO-220FP, TO-220, TO-247

Features

Type	V _{DSS} @ T _{Jmax}	R _{DS(on)} max	I _D
STB32N65M5	710 V	< 0.119 Ω	24 A
STF32N65M5	710 V	< 0.119 Ω	24 A ⁽¹⁾
STI32N65M5	710 V	< 0.119 Ω	24 A
STP32N65M5	710 V	< 0.119 Ω	24 A
STW32N65M5	710 V	< 0.119 Ω	24 A

1. Limited only by maximum temperature allowed

- Worldwide best R_{DS(on)}* area
- Higher V_{DSS} rating
- High dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% avalanche tested

Application

- Switching applications

Description

MDmesh V is a revolutionary Power MOSFET technology, which combines an innovative proprietary vertical process with the well known company's PowerMESH™ horizontal layout. The resulting product has an extremely low on-resistance, unmatched among silicon-based Power MOSFETs, making it especially suited for applications which require superior power density and outstanding efficiencies.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STB32N65M5	32N65M5	D ² PAK	Tape and reel
STF32N65M5	32N65M5	TO-220FP	Tube
STI32N65M5	32N65M5	I ² PAK	Tube
STP32N65M5	32N65M5	TO-220	Tube
STW32N65M5	32N65M5	TO-247	Tube

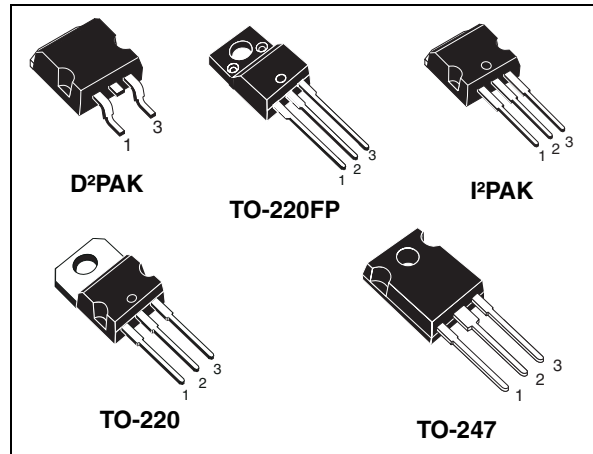
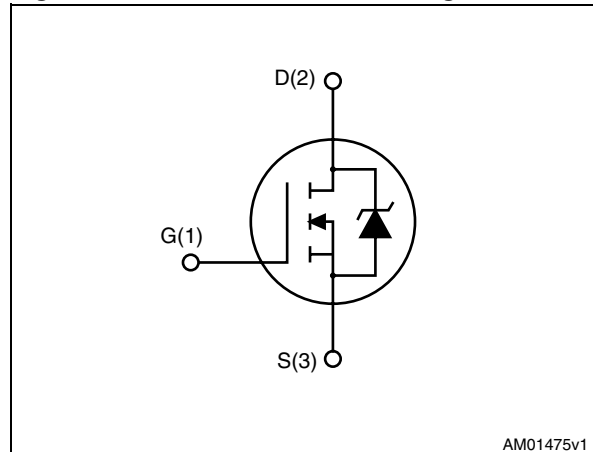


Figure 1. Internal schematic diagram



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	16
6	Revision history	17

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220, D ² PAK TO-247, I ² PAK	TO-220FP	
V _{GS}	Gate- source voltage	± 25		V
I _D	Drain current (continuous) at T _C = 25 °C	24	24 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	15	15 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	96	96 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	150	35	W
I _{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T _{JMAX})	8		A
E _{AS}	Single pulse avalanche energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	650		mJ
dv/dt ⁽³⁾	Peak diode recovery voltage slope	15		V/ns
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T _C =25 °C)	2500		V
T _{stg}	Storage temperature	- 55 to 150		°C
T _j	Max. operating junction temperature	150		°C

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- I_{SD} ≤ 24 A, di/dt = 400 A/μs, peak V_{DS} < V_{(BR)DSS}

Table 3. Thermal data

Symbol	Parameter	Value					Unit
		D ² PAK	I ² PAK	TO-220	TO-247	TO-220FP	
R _{thj-case}	Thermal resistance junction-case max	0.83			3.6	°C/W	
R _{thj-amb}	Thermal resistance junction-ambient max		62.5	50	62.5	°C/W	
R _{thj-pcb}	Thermal resistance junction-pcb max	30				°C/W	
T _l	Maximum lead temperature for soldering purpose	300					°C

2 Electrical characteristics

($T_C = 25\text{ °C}$ unless otherwise specified)

Table 4. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	650			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$, $T_C = 125\text{ °C}$			1 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 12\text{ A}$		0.095	0.119	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	3320	-	pF
C_{oss}	Output capacitance			75		pF
C_{rss}	Reverse transfer capacitance			5		pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0$, $V_{DS} = 0\text{ to }520\text{ V}$	-	210	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related	$V_{GS} = 0$, $V_{DS} = 0\text{ to }520\text{ V}$	-	357	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	2	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 12\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 20)	-	72	-	nC
Q_{gs}	Gate-source charge			17		nC
Q_{gd}	Gate-drain charge			29		nC

1. $C_{oss\text{ eq}}$, time related is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

2. $C_{oss\text{ eq}}$, energy related is defined as a constant equivalent capacitance giving the same stored energy as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$, $I_D = 14\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 21)	-	53	-	ns
t_r	Rise time			12		ns
$t_{d(off)}$	Turn-off-delay time			56		ns
t_f	Fall time			16		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		24	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				96	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 24\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 24\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 21)	-	375		ns
Q_{rr}	Reverse recovery charge			6		nC
I_{RRM}	Reverse recovery current			33		A
t_{rr}	Reverse recovery time	$I_{SD} = 24\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 21)	-	440		ns
Q_{rr}	Reverse recovery charge			8		nC
I_{RRM}	Reverse recovery current			36		A

1. Pulse width limited by safe operating area
2. Pulsed: Pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220, D²PAK, I²PAK

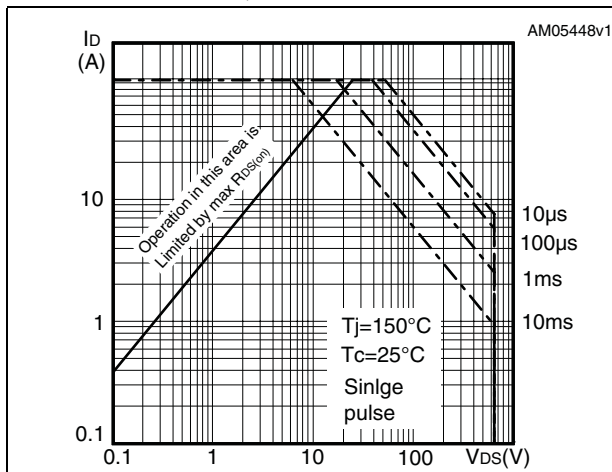


Figure 3. Thermal impedance for TO-220, D²PAK, I²PAK

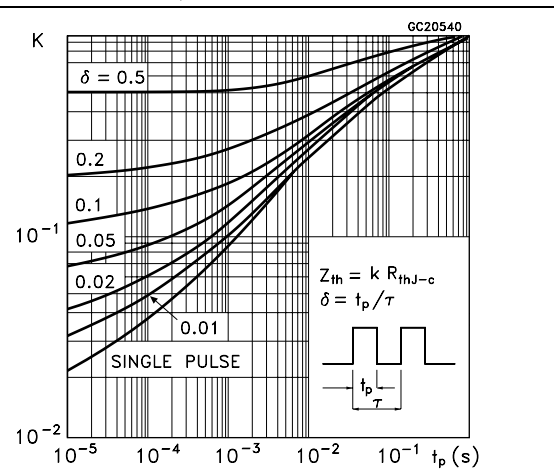


Figure 4. Safe operating area for TO-247

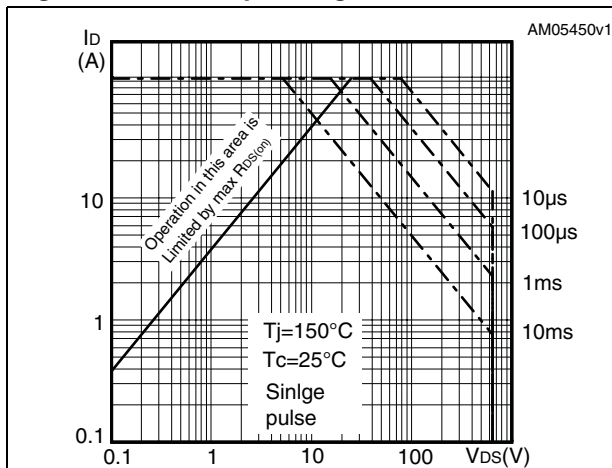


Figure 5. Thermal impedance for TO-247

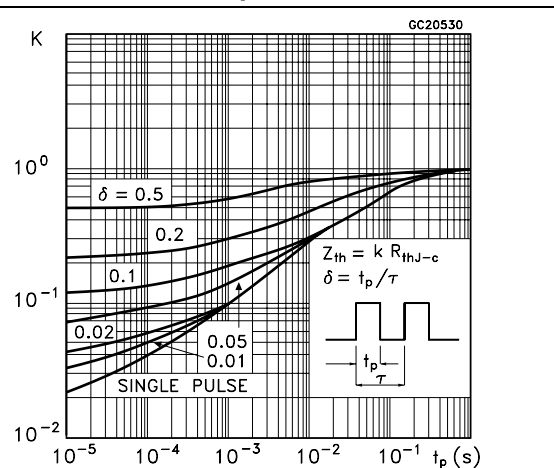


Figure 6. Safe operating area for TO-220FP

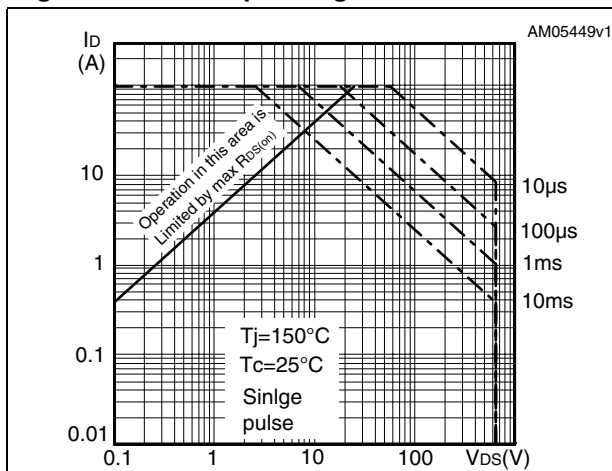


Figure 7. Thermal impedance for TO-220FP

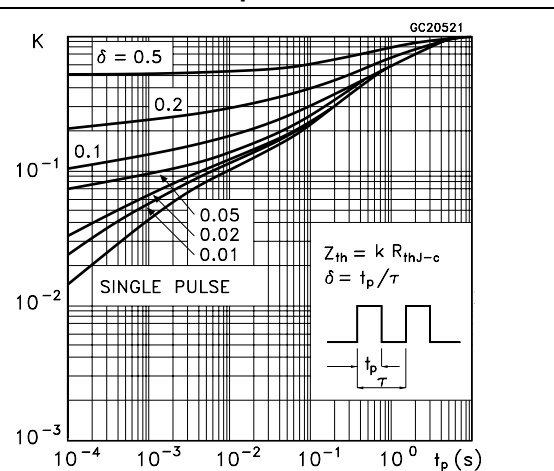


Figure 8. Output characteristics

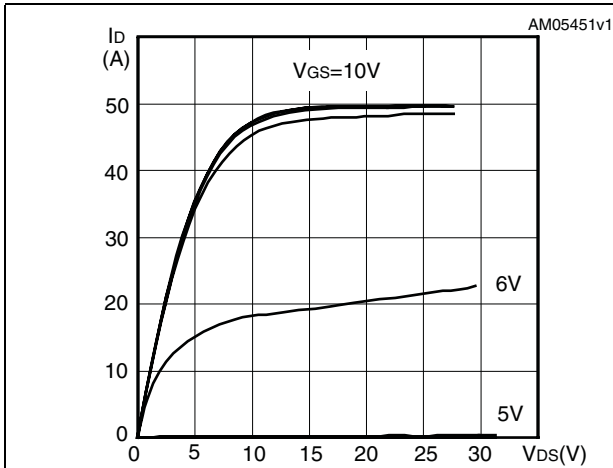


Figure 9. Transfer characteristics

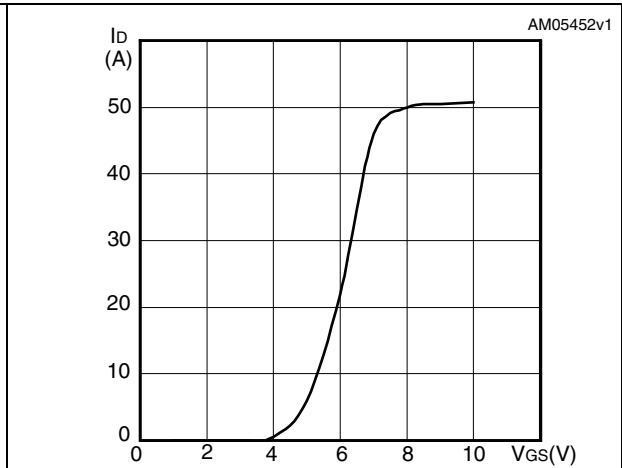


Figure 10. Gate charge vs gate-source voltage Figure 11. Static drain-source on resistance

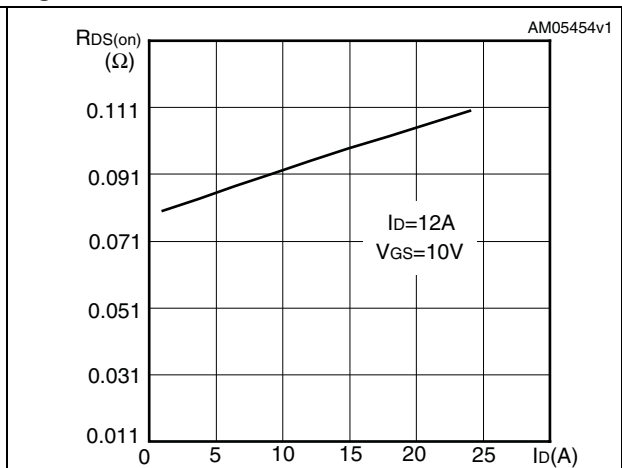
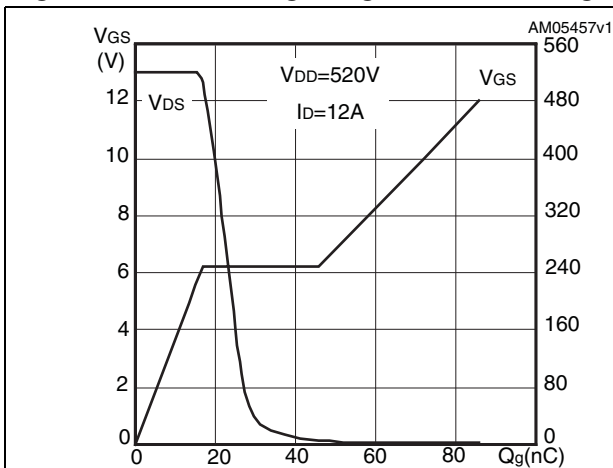


Figure 12. Capacitance variations

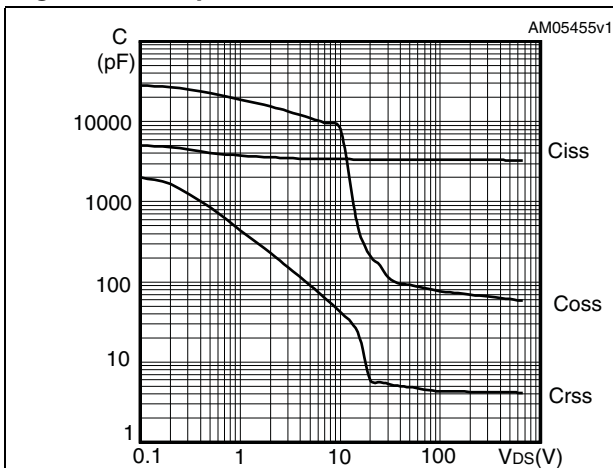


Figure 13. Output capacitance stored energy

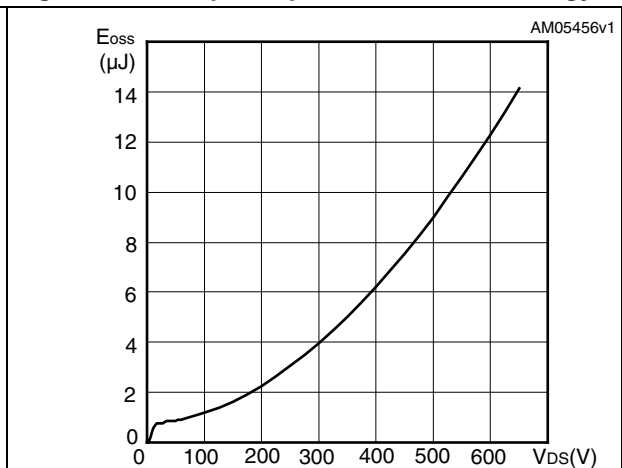


Figure 14. Normalized gate threshold voltage vs temperature

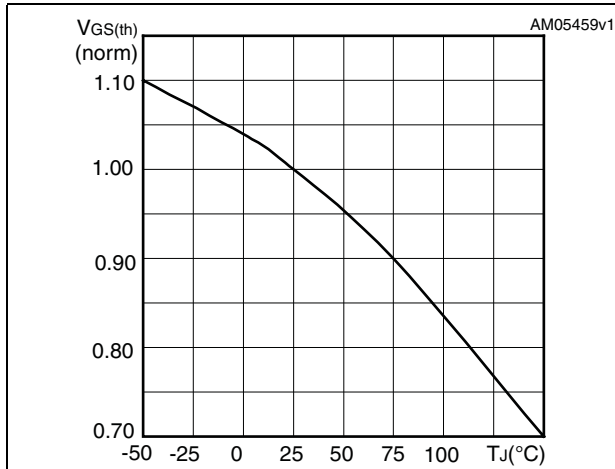


Figure 15. Normalized on resistance vs temperature

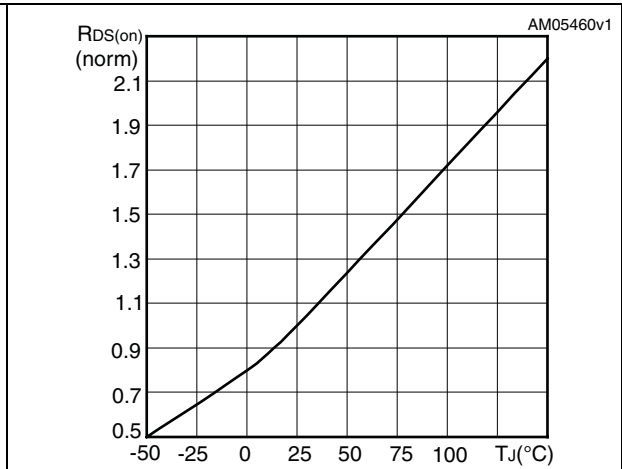


Figure 16. Source-drain diode forward characteristics

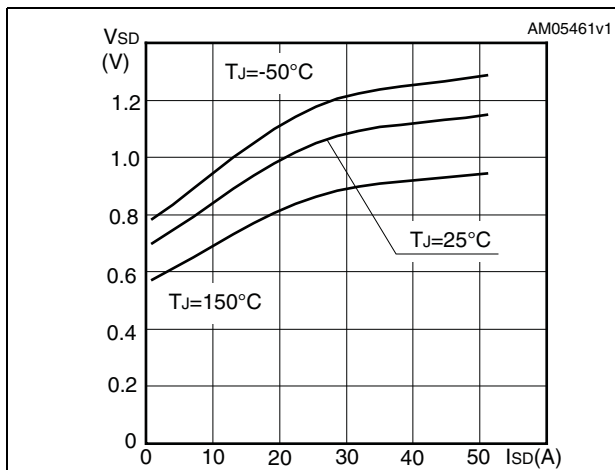


Figure 17. Normalized BV_{DSS} vs temperature

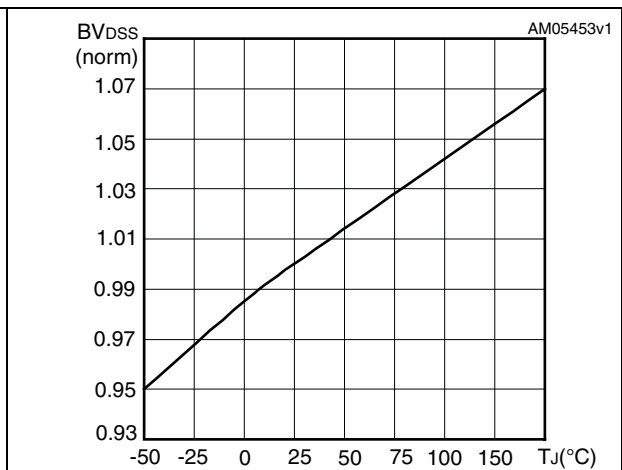
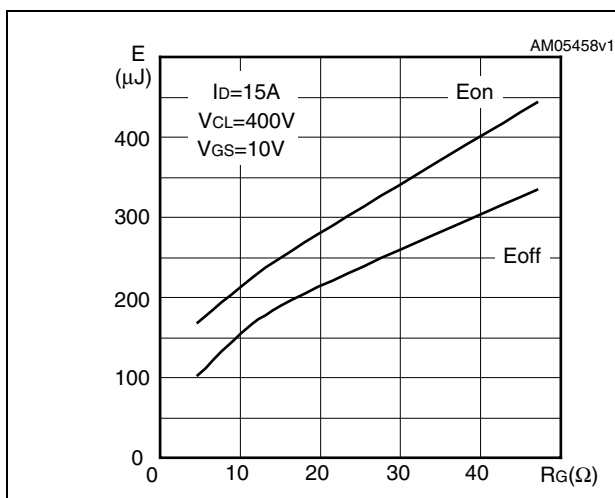


Figure 18. Switching losses vs gate resistance (1)



1. Eon including reverse recovery of a SiC diode

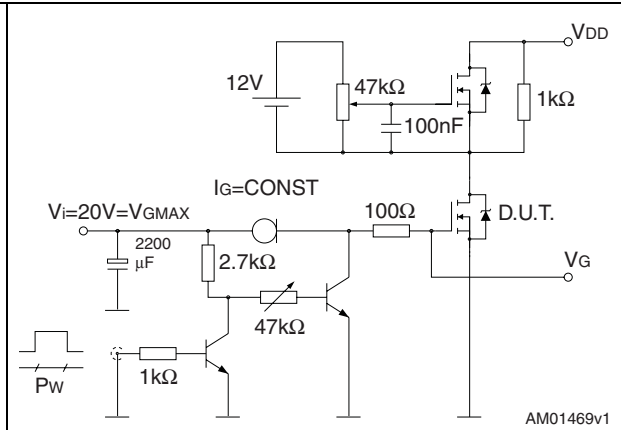
3 Test circuits

Figure 19. Switching times test circuit for resistive load



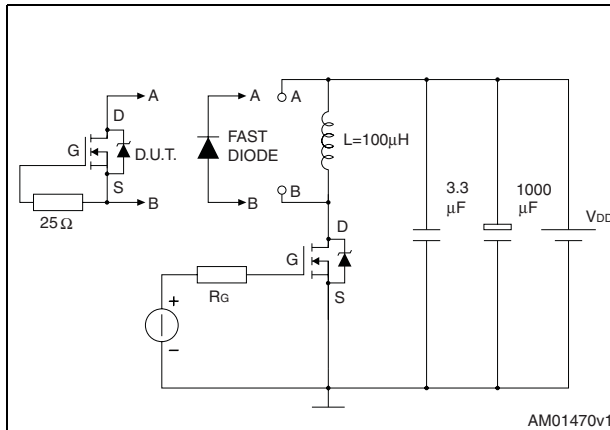
AM01468v1

Figure 20. Gate charge test circuit



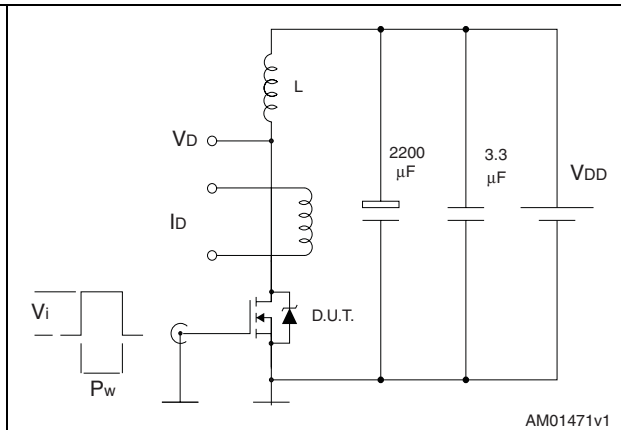
AM01469v1

Figure 21. Test circuit for inductive load switching and diode recovery times



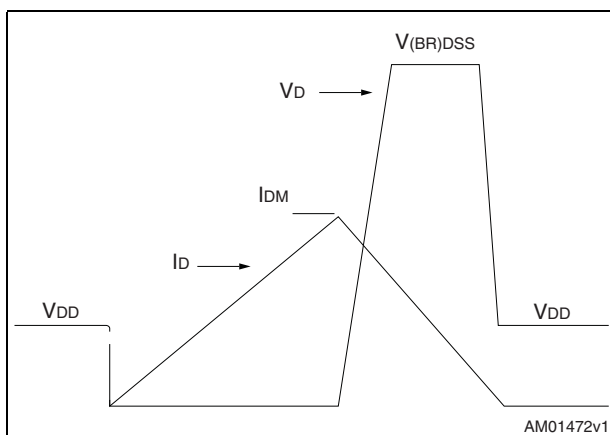
AM01470v1

Figure 22. Unclamped inductive load test circuit



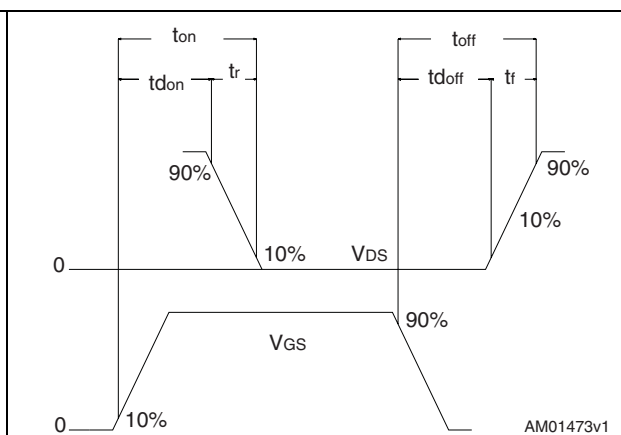
AM01471v1

Figure 23. Unclamped inductive waveform



AM01472v1

Figure 24. Switching time waveform



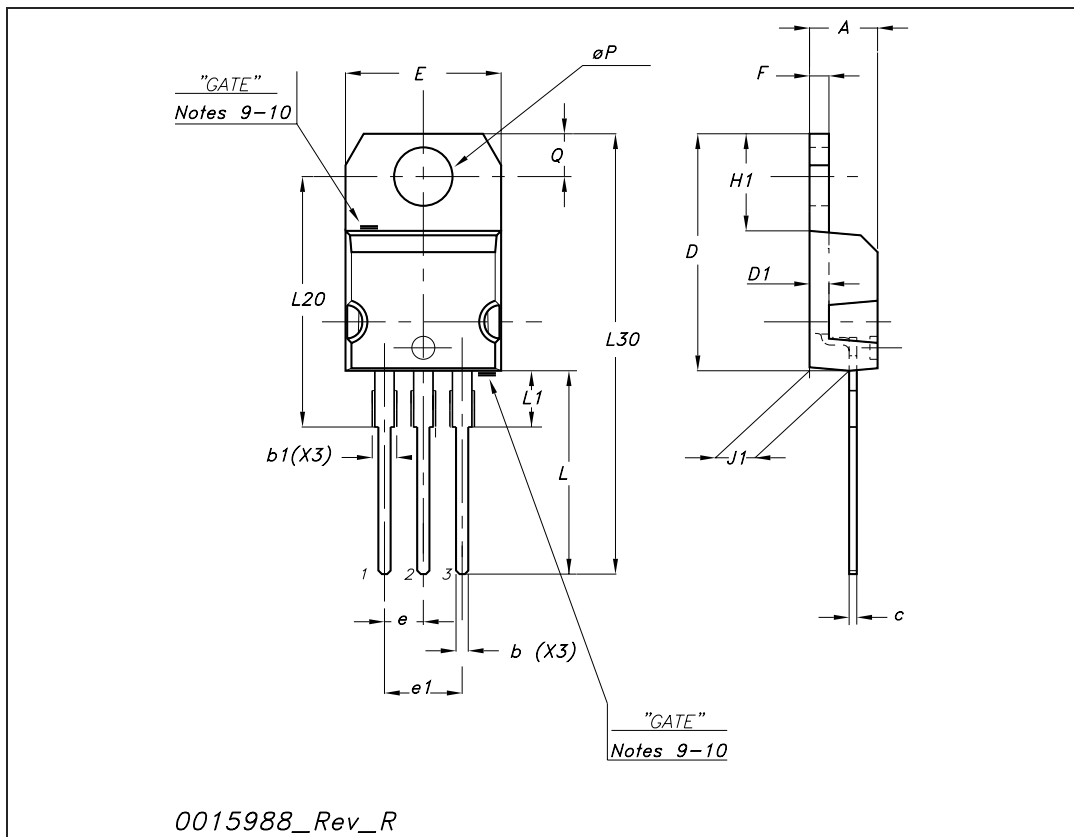
AM01473v1

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.

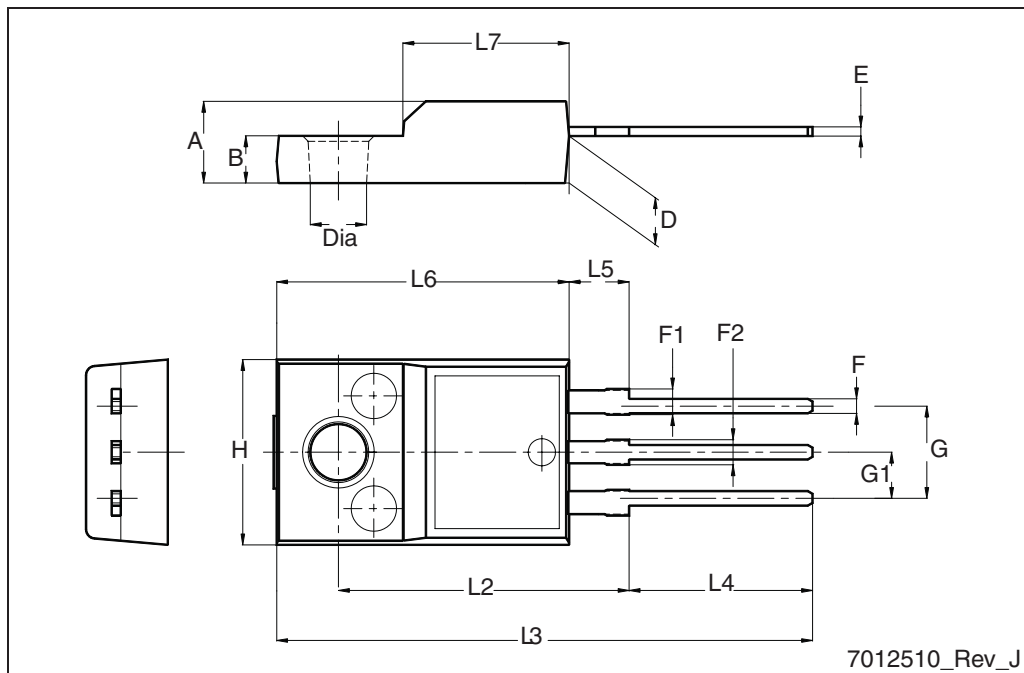
TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



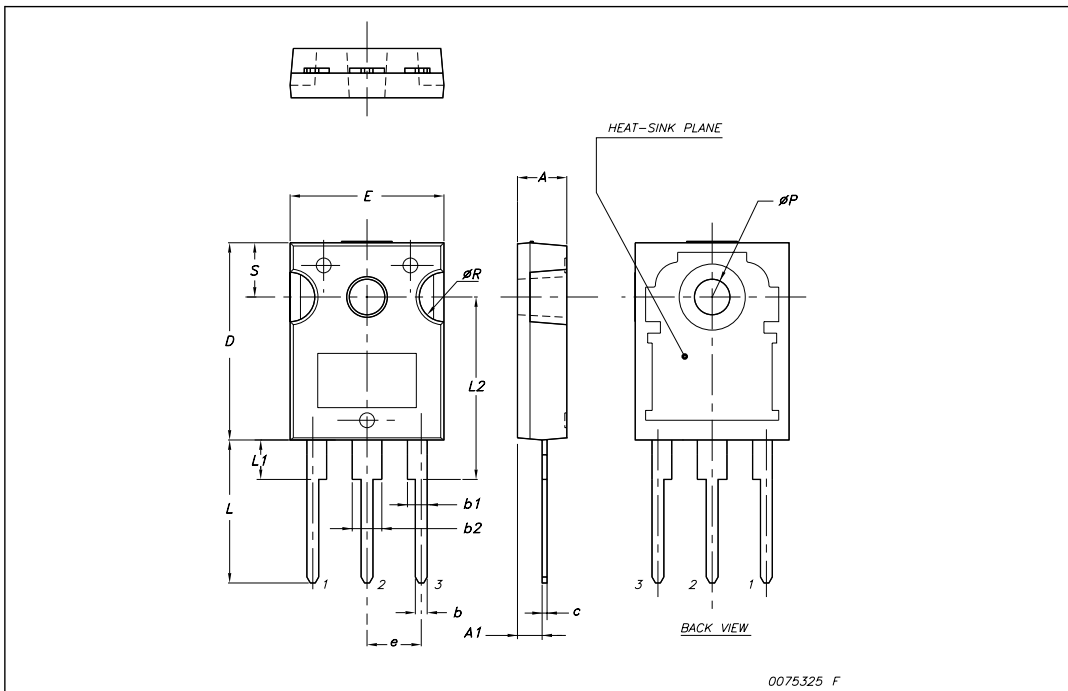
TO-220FP mechanical data

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		1.5
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



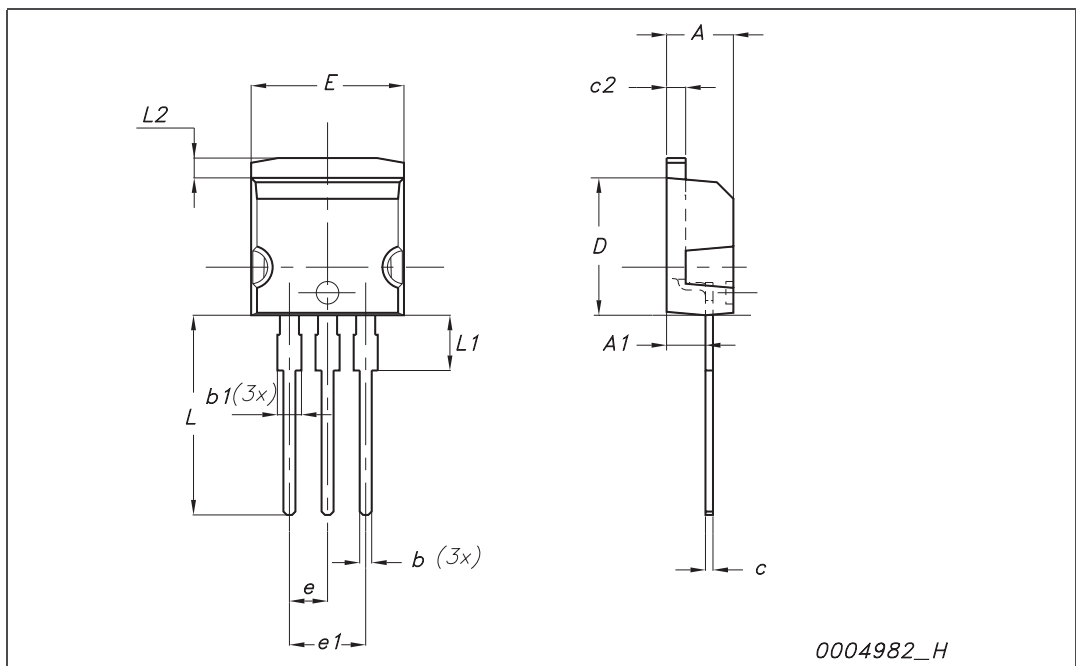
TO-247 Mechanical data

Dim.	mm.		
	Min.	Typ	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	



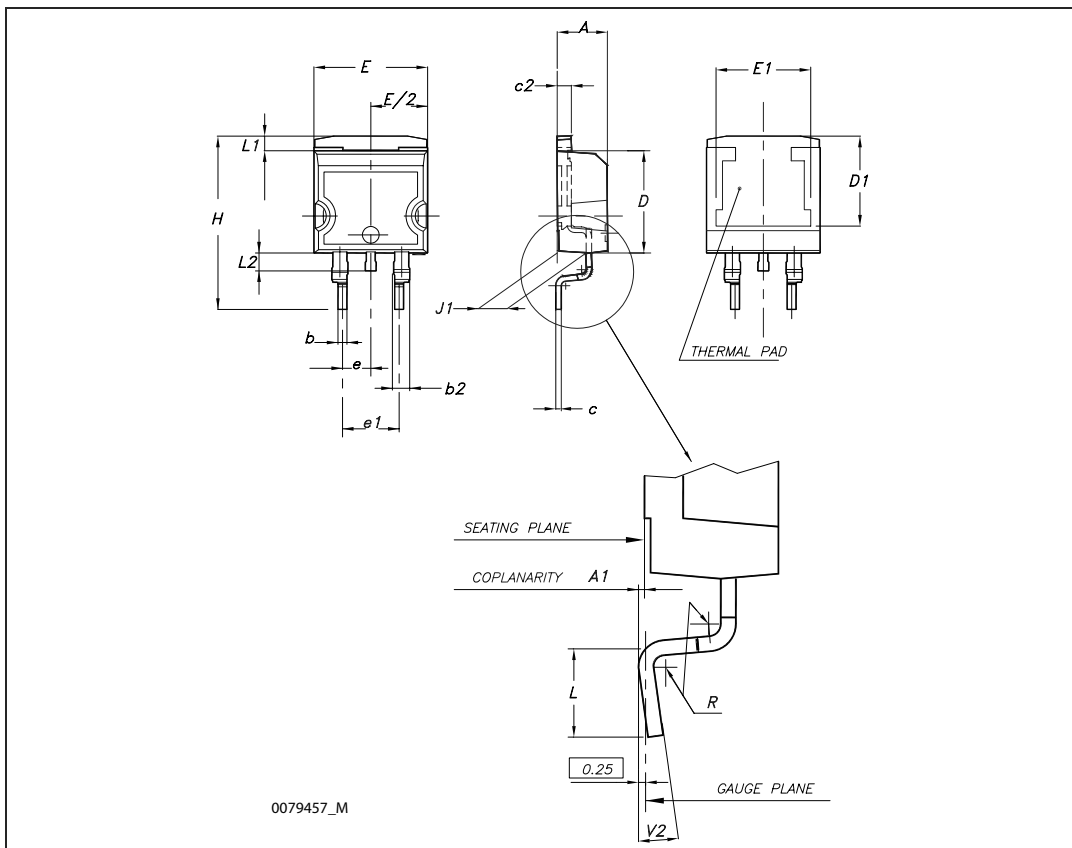
I²PAK (TO-262) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055



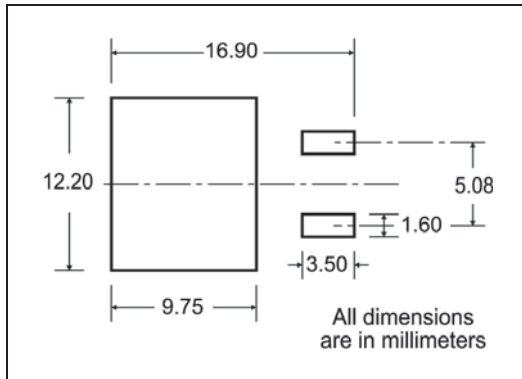
D²PAK (TO-263) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°



5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137
W	23.7	24.3	0.933	0.956

REEL MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

10 pitches cumulative tolerance on tape + / - 0.2 mm

Center line of cavity

Bending radius

6 Revision history

Table 8. Document revision history

Date	Revision	Changes
16-Jan-2009	1	First release
01-Sep-2009	2	Document status promoted from preliminary data to datasheet.
30-Sep-2009	3	Corrected V_{GS} value on Table 2: Absolute maximum ratings

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.

© 2009 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