



# STF18N65M5, STI18N65M5, STP18N65M5, STW18N65M5

N-channel 650 V, 0.198  $\Omega$  typ., 15 A MDmesh™ V Power MOSFET in TO-220FP, I<sup>2</sup>PAK, TO-220 and TO-247 packages

Datasheet — production data

## Features

Order code	V <sub>DSS</sub> @ T <sub>Jmax</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STF18N65M5	710 V	< 0.22 $\Omega$	15 A
STI18N65M5			
STP18N65M5			
STW18N65M5			

- Worldwide best R<sub>DS(on)</sub> \* area
- Higher V<sub>DSS</sub> rating and high dv/dt capability
- Excellent switching performance
- 100% avalanche tested

## Applications

- Switching applications

## Description

These devices are N-channel MDmesh™ V Power MOSFETs based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

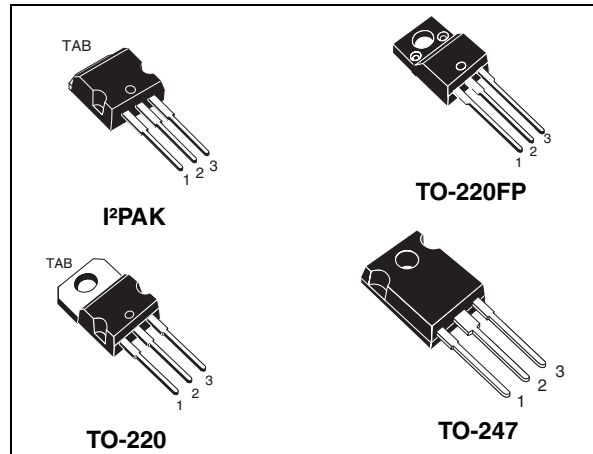
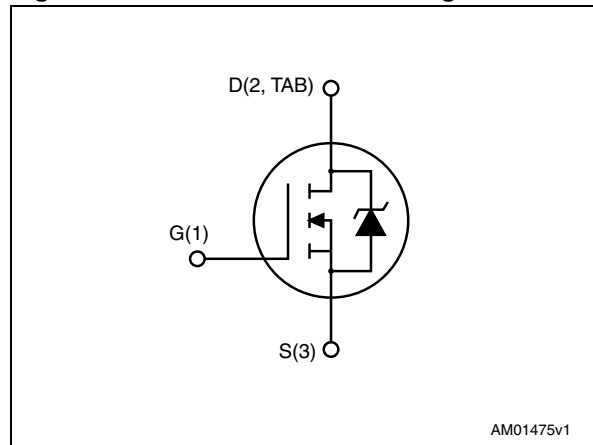


Figure 1. Internal schematic diagram



AM01475v1

Table 1. Device summary

Order code	Marking	Package	Packaging
STF18N65M5	18N65M5	TO-220FP	Tube
STI18N65M5		I <sup>2</sup> PAK	
STP18N65M5		TO-220	
STW18N65M5		TO-247	

## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>4</b>
	2.1 Electrical characteristics (curves) .....	6
<b>3</b>	<b>Test circuits</b> .....	<b>9</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>10</b>
<b>5</b>	<b>Revision history</b> .....	<b>18</b>

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value				Unit
		I <sup>2</sup> PAK	TO-220	TO-247	TO-220FP	
V <sub>GS</sub>	Gate-source voltage	± 25				V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	15		15 <sup>(1)</sup>		A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	9.4		9.4 <sup>(1)</sup>		A
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	60		60 <sup>(1)</sup>		A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	110		25		W
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	15				V/ns
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T <sub>C</sub> = 25 °C)				2500	V
T <sub>stg</sub>	Storage temperature	- 55 to 150				°C
T <sub>j</sub>	Max. operating junction temperature	150				°C

1. Limited by maximum junction temperature.

2. I<sub>SD</sub> ≤ 15 A, di/dt ≤ 400 A/μs; V<sub>DSPeak</sub> < V<sub>(BR)DSS</sub>; V<sub>DD</sub> = 400 V

**Table 3. Thermal data**

Symbol	Parameter	Value				Unit
		I <sup>2</sup> PAK	TO-220	TO-247	TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case max	1.14			5	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	62.5		50	62.5	°C/W

**Table 4. Avalanche characteristics**

Symbol	Parameter	Value	Unit
I <sub>AR</sub>	Avalanche current, repetitive or not repetitive (pulse width limited by T <sub>jmax</sub> )	4	A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>J</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> ; V <sub>DD</sub> = 50 V)	210	mJ

## 2 Electrical characteristics

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

**Table 5. 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 ( $V_{GS} = 0$ )	$V_{DS} = 650\text{ V}$ $V_{DS} = 650\text{ V}$ , $T_C = 125\text{ °C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25\text{ V}$			$\pm 100$	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	$V_{GS} = 10\text{ V}$ , $I_D = 7.5\text{ A}$		0.198	0.22	$\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	1240	-	pF
$C_{oss}$	Output capacitance			32		pF
$C_{rss}$	Reverse transfer capacitance			3.2		pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$ , $V_{GS} = 0$	-	99	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related			30		pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	3	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}$ , $I_D = 7.5\text{ A}$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 20</a> )	-	31	-	nC
$Q_{gs}$	Gate-source charge			8		nC
$Q_{gd}$	Gate-drain charge			14		nC

1. 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. 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 7. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(V)}$	Voltage delay time	$V_{DD} = 400\text{ V}$ , $I_D = 9.5\text{ A}$ ,		36		ns
$t_{r(V)}$	Voltage rise time	$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$		7		ns
$t_{f(i)}$	Current fall time	(see <a href="#">Figure 21</a> and	-	9	-	ns
$t_{c(off)}$	Crossing time	<a href="#">Figure 24</a> )		11		ns

**Table 8. Source drain diode**

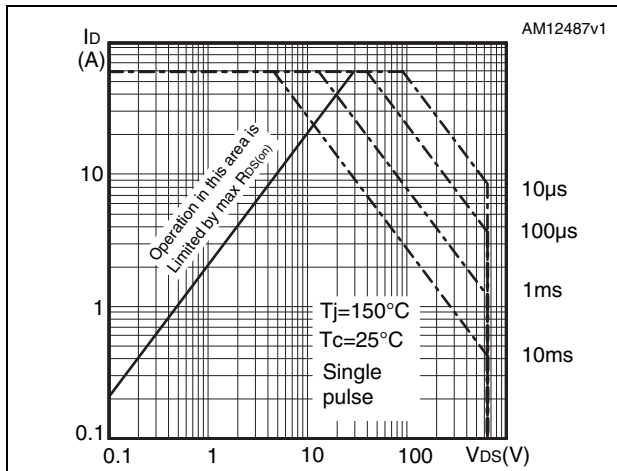
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current				15	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		60	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 15\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 15\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		290		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100\text{ V}$ (see <a href="#">Figure 24</a> )	-	3.4		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			23.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 15\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		352		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$	-	4		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see <a href="#">Figure 24</a> )		24		A

1. Pulse width limited by safe operating area.

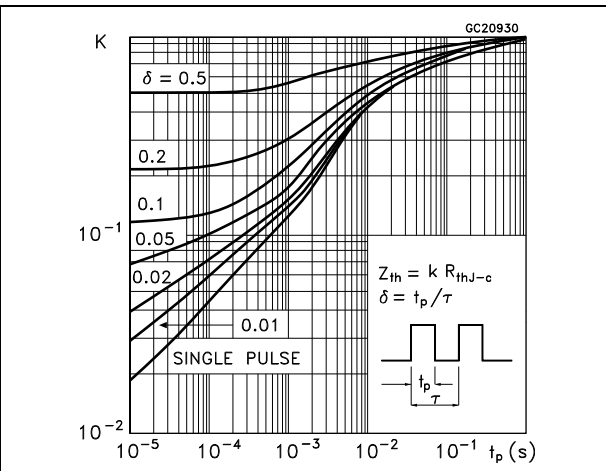
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

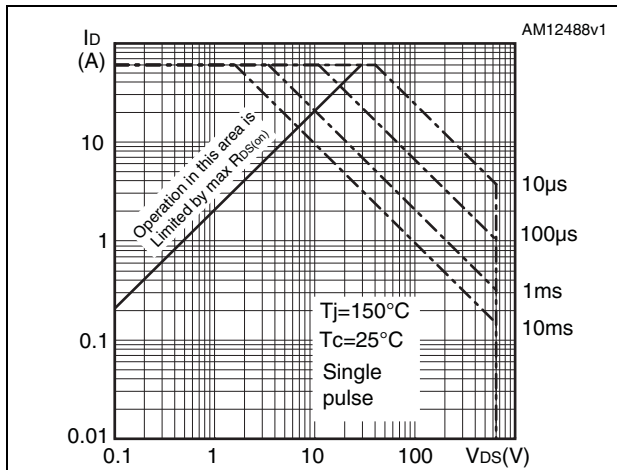
**Figure 2. Safe operating area for I<sup>2</sup>PAK and TO-220**



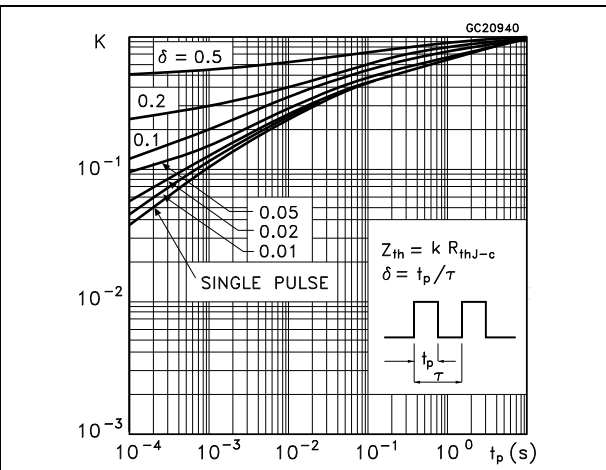
**Figure 3. Thermal impedance for I<sup>2</sup>PAK and TO-220**



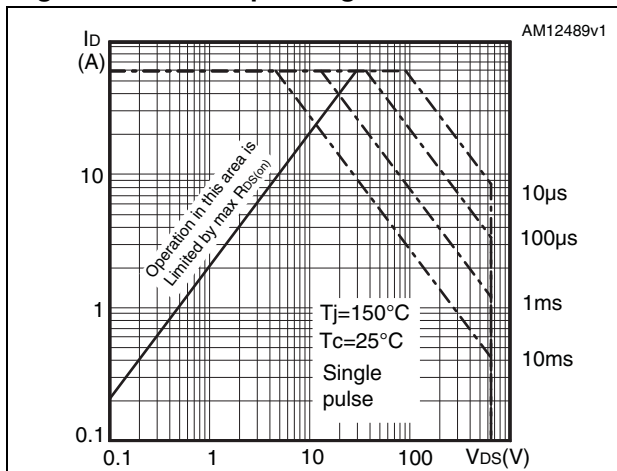
**Figure 4. Safe operating area TO220FP**



**Figure 5. Thermal impedance for TO-220FP**



**Figure 6. Safe operating area TO-247**



**Figure 7. Thermal impedance TO-247**

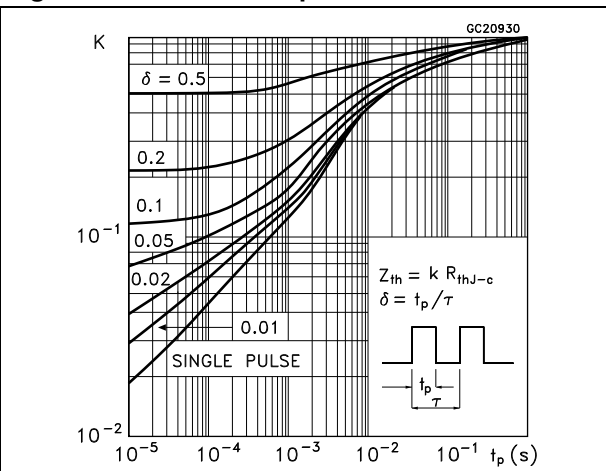


Figure 8. Output characteristics

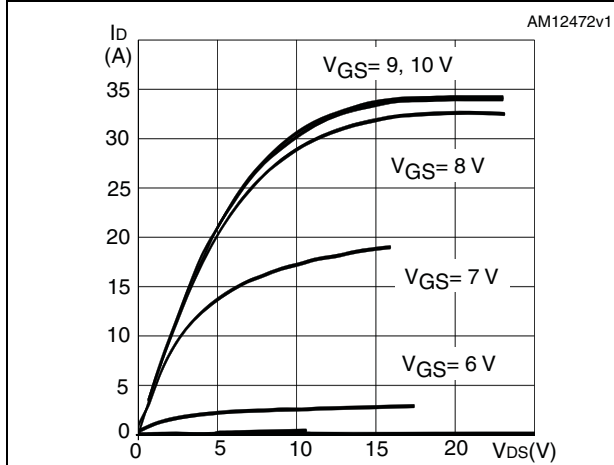


Figure 9. Transfer characteristics

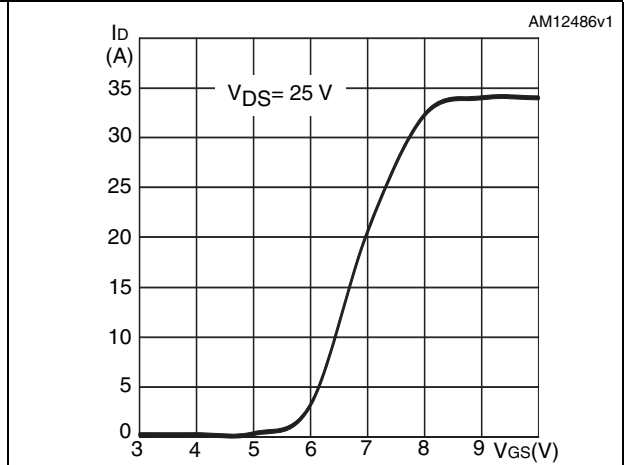


Figure 10. Gate charge vs gate-source voltage Figure 11. Static drain-source on-resistance

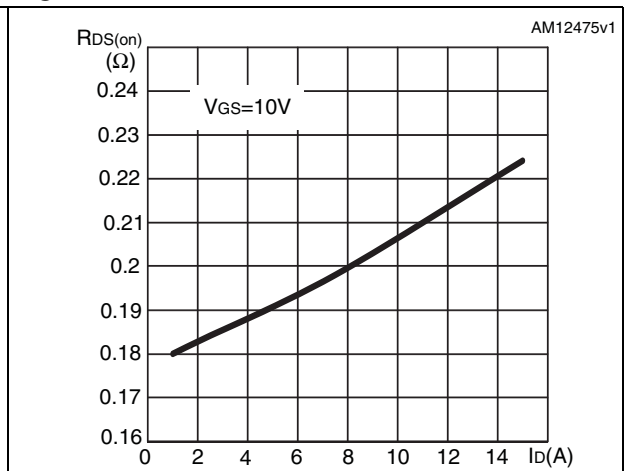
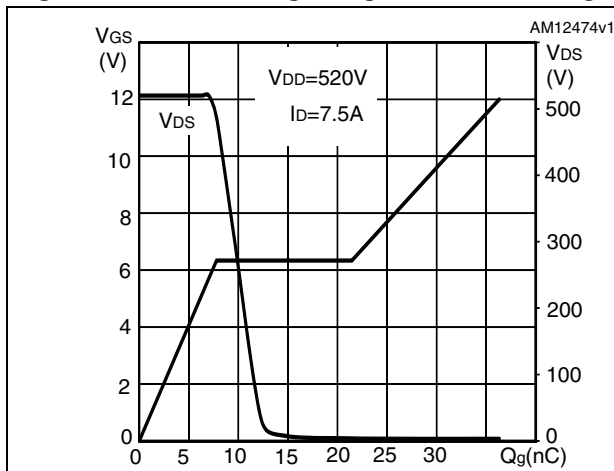


Figure 12. Capacitance variations

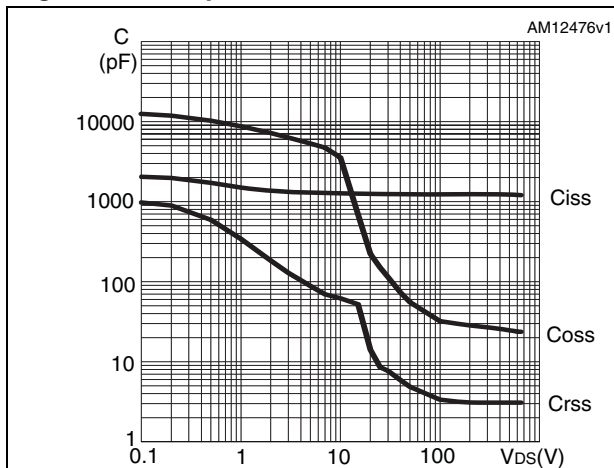


Figure 13. Output capacitance stored energy

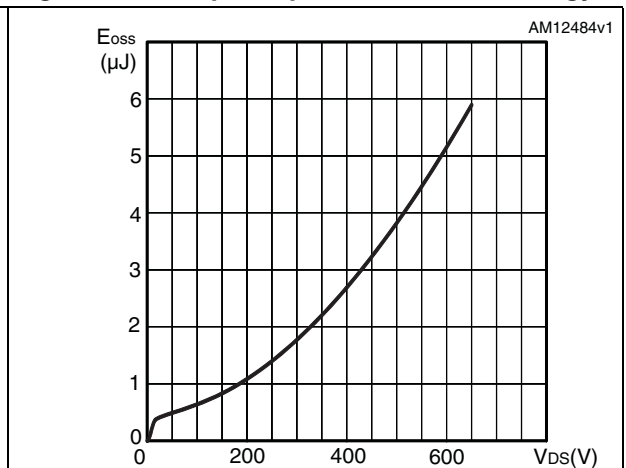


Figure 14. Normalized gate threshold voltage vs temperature

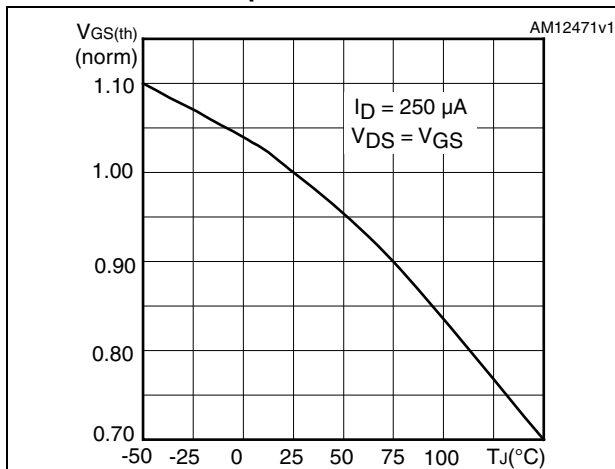


Figure 15. Normalized on-resistance vs temperature

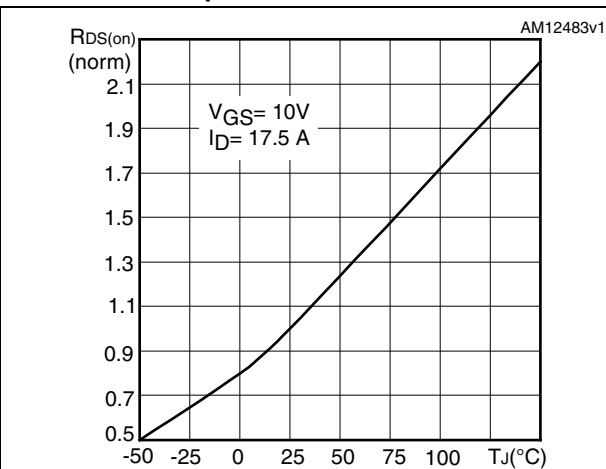


Figure 16. Drain-source diode forward characteristics

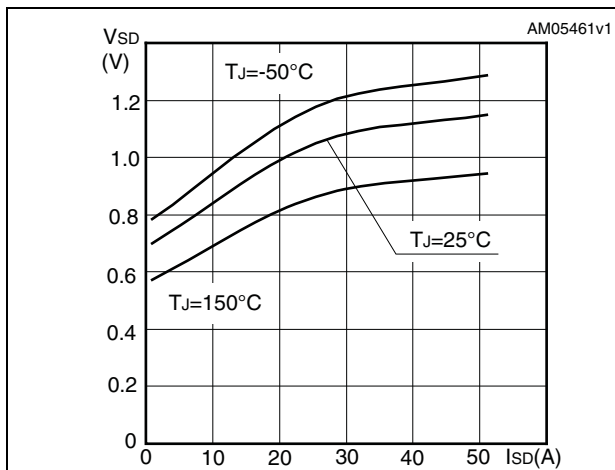


Figure 17. Normalized BV<sub>DSS</sub> vs temperature

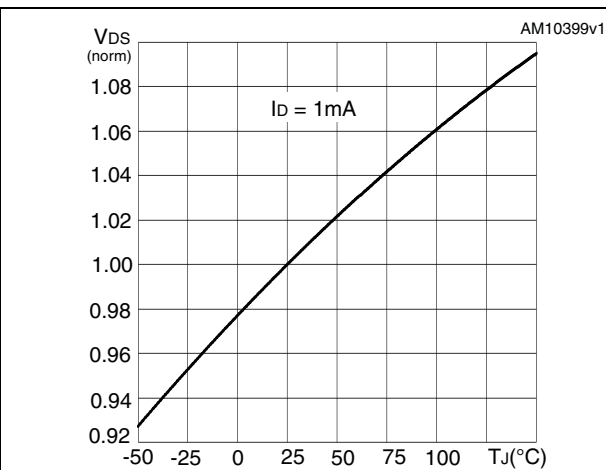
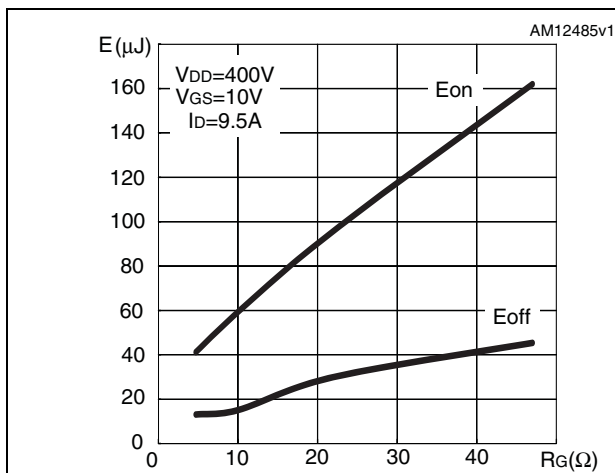


Figure 18. Switching losses vs gate resistance (1)

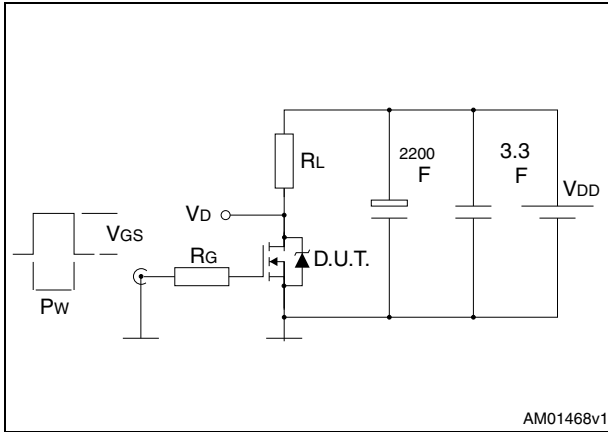


1. Eon including reverse recovery of a SiC diode

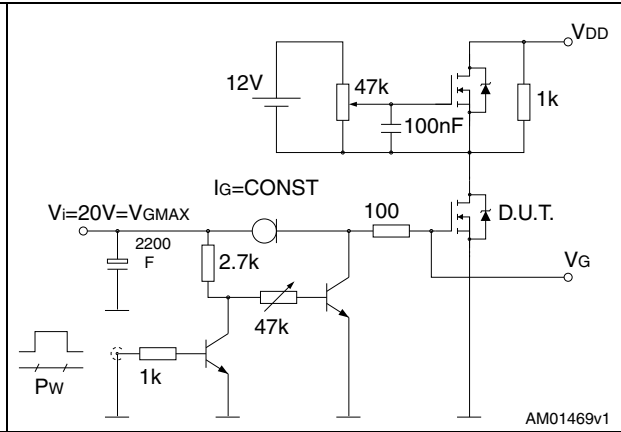


### 3 Test circuits

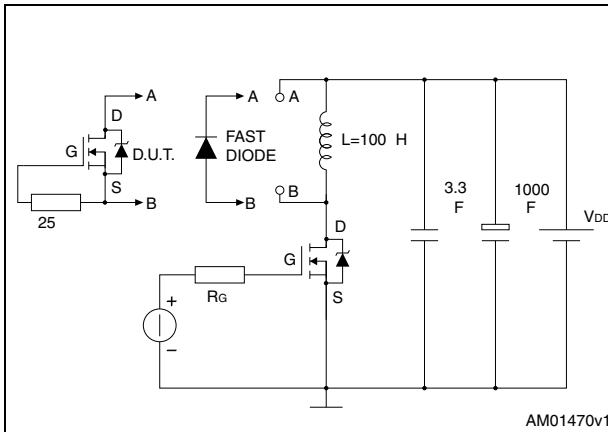
**Figure 19. Switching times test circuit for resistive load**



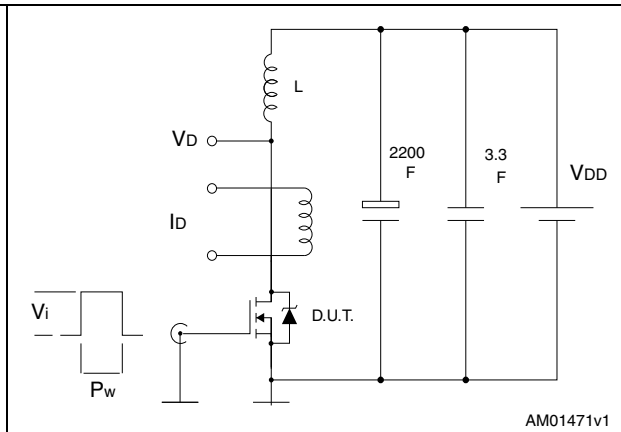
**Figure 20. Gate charge test circuit**



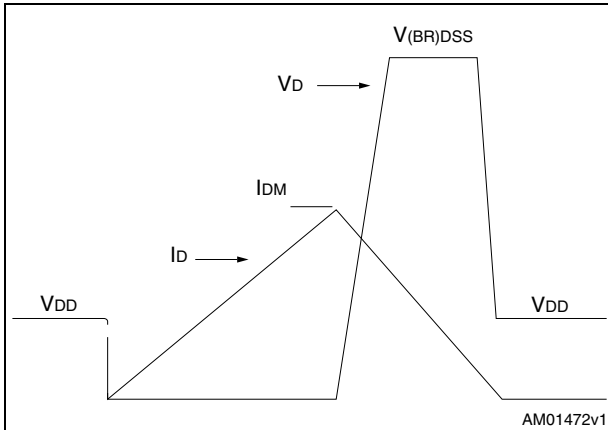
**Figure 21. Test circuit for inductive load switching and diode recovery times**



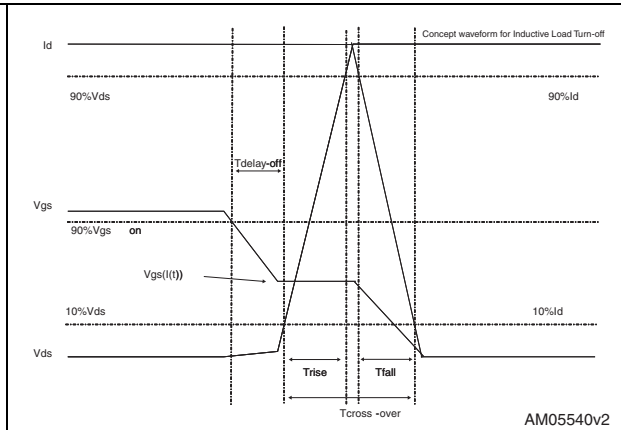
**Figure 22. Unclamped inductive load test circuit**



**Figure 23. Unclamped inductive waveform**



**Figure 24. Switching 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](http://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 25. TO-220FP drawing

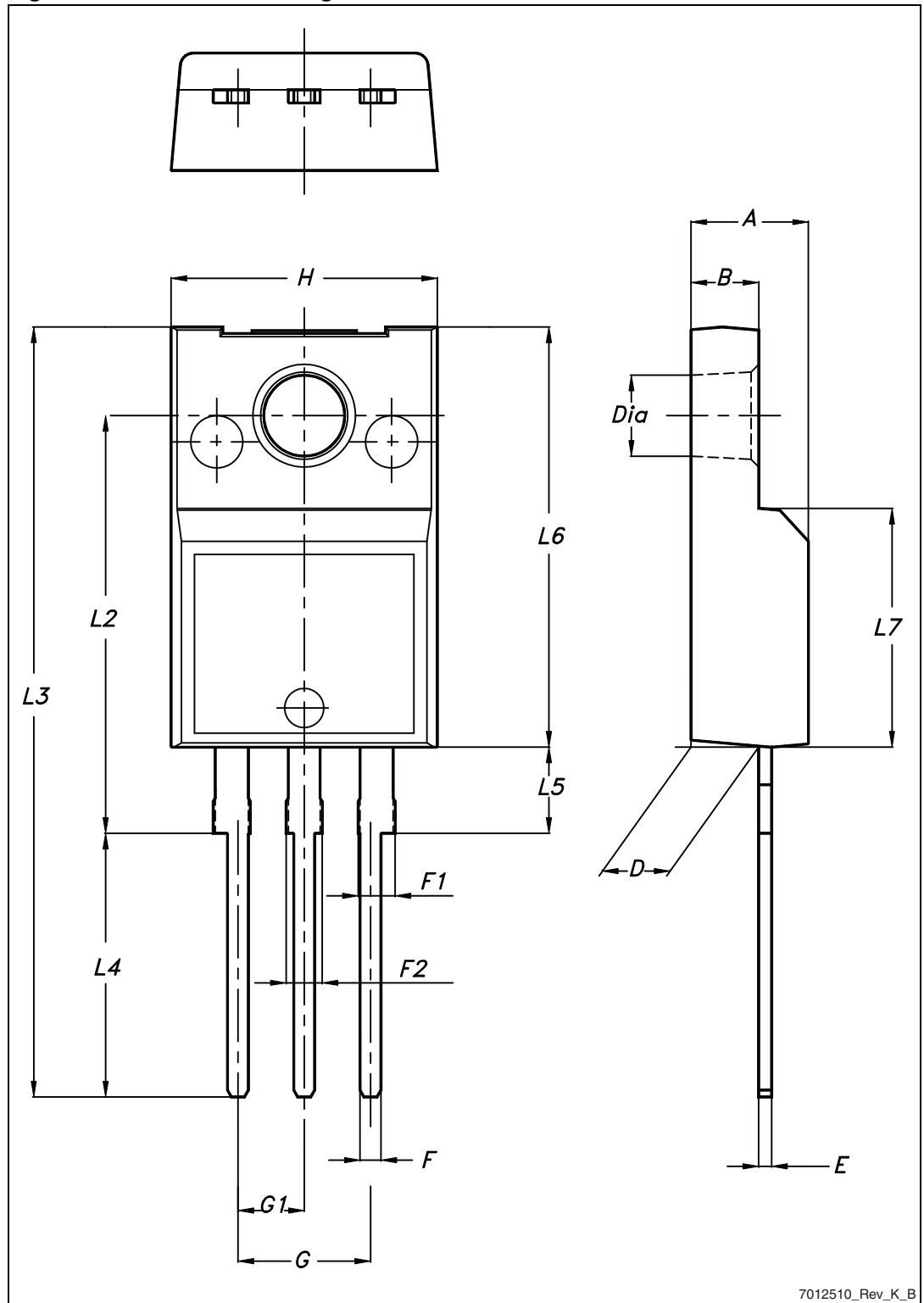


Table 10. I<sup>2</sup>PAK (TO-262) mechanical data

DIM.	mm.		
	min.	typ	max.
A	4.40		4.60
A1	2.40		2.72
b	0.61		0.88
b1	1.14		1.70
c	0.49		0.70
c2	1.23		1.32
D	8.95		9.35
e	2.40		2.70
e1	4.95		5.15
E	10		10.40
L	13		14
L1	3.50		3.93
L2	1.27		1.40

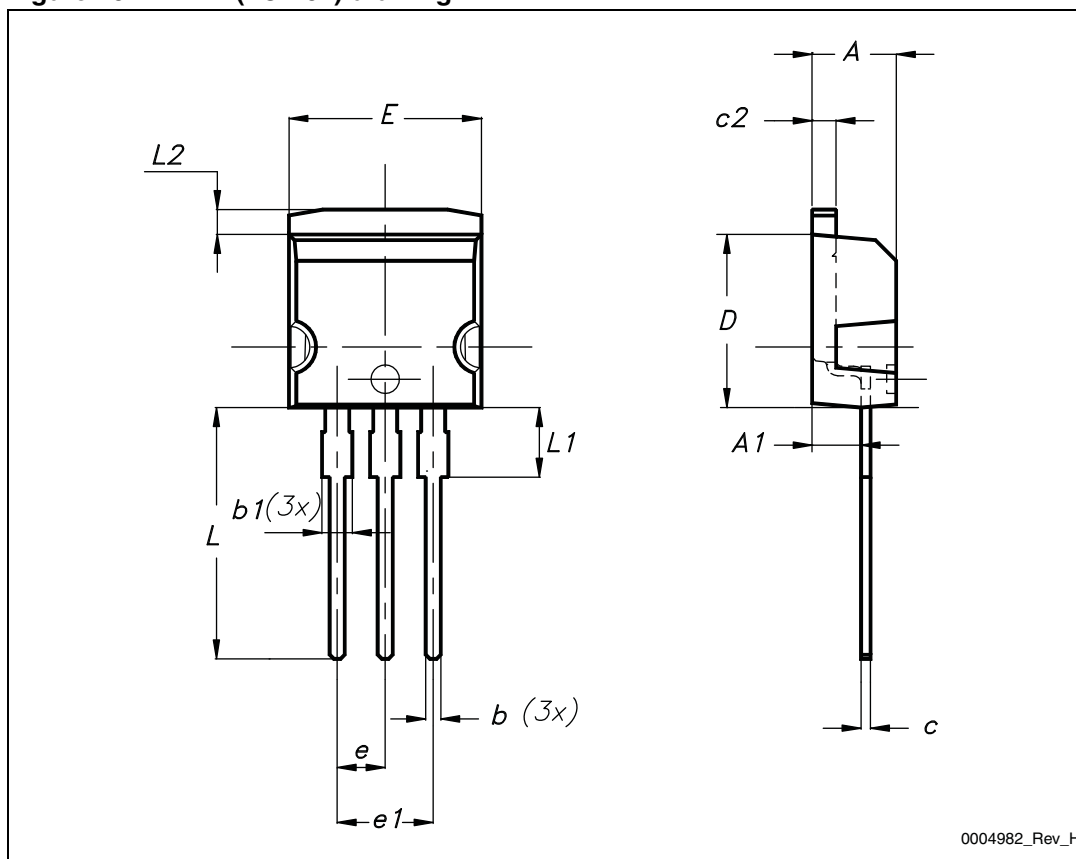
Figure 26. I<sup>2</sup>PAK (TO-262) drawing

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	
ØP	3.75		3.85
Q	2.65		2.95

Figure 27. TO-220 type A drawing

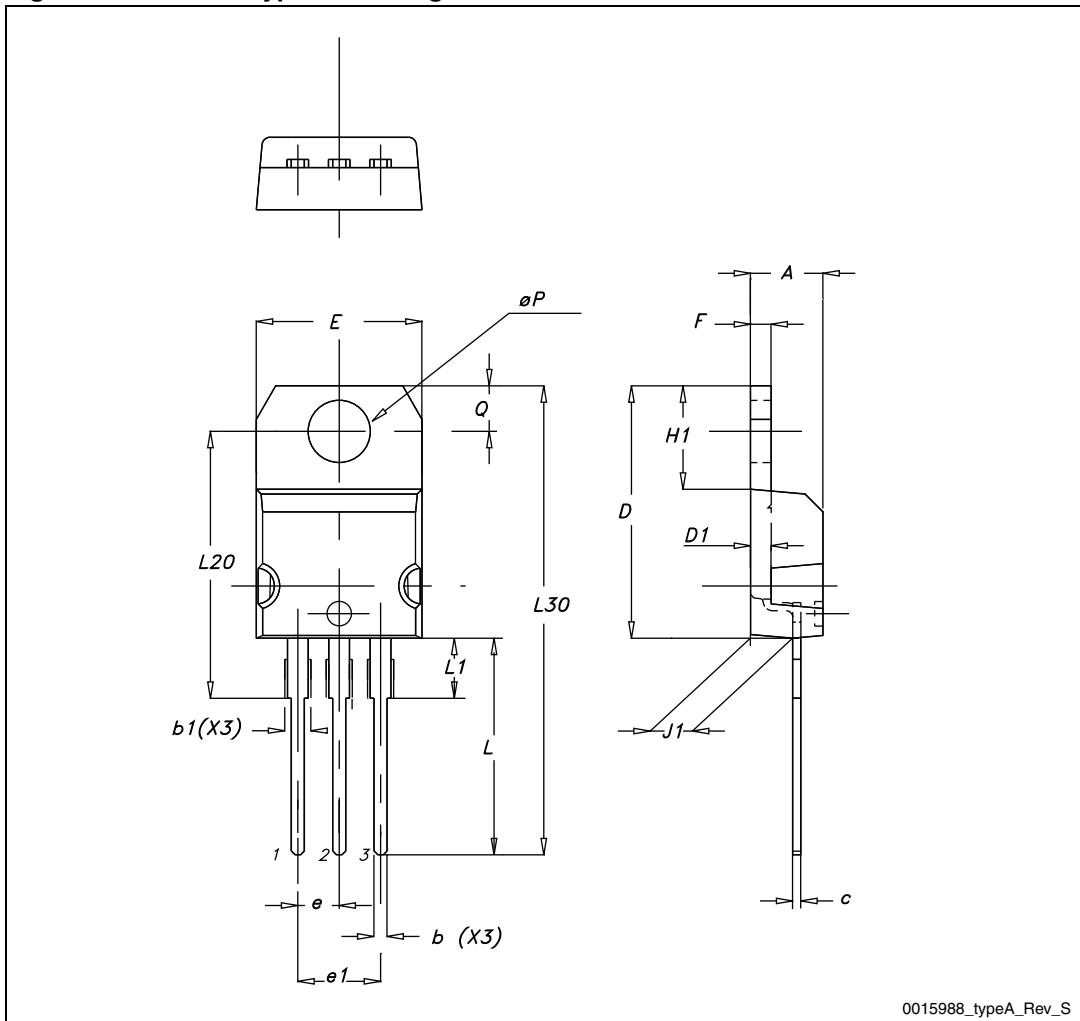
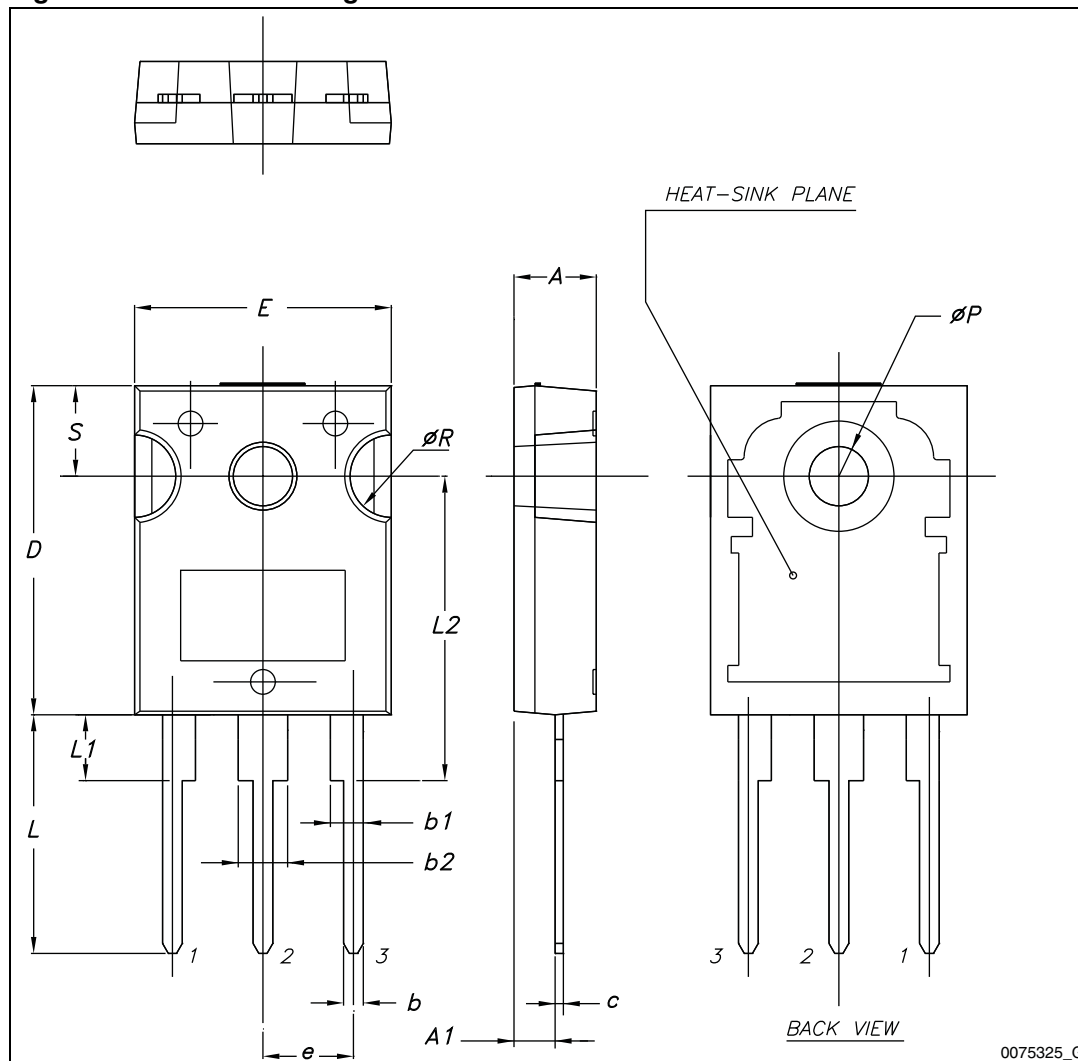


Table 12. TO-247 mechanical data

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	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70



Figure 28. TO-247 drawing



## 5 Revision history

Table 13. Document revision history

Date	Revision	Changes
01-Mar-2012	1	First release.
11-Jul-2012	2	The part numbers STB18N65M5 and STD18N65M5 have been moved to a separate datasheet. The part numbers STI18N65M5 and STW18N65M5 in I <sup>2</sup> PAK and TO-247 packages have been added. Document status promoted from preliminary data to production data. Added <a href="#">Section 2.1: Electrical characteristics (curves)</a> .
19-Jul-2012	3	Updated <a href="#">Figure 8: Output characteristics</a> , <a href="#">Figure 11: Static drain-source on-resistance</a> and <a href="#">Figure 14: Normalized gate threshold voltage vs temperature</a> .

**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.

© 2012 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](http://www.st.com)

