



# 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.

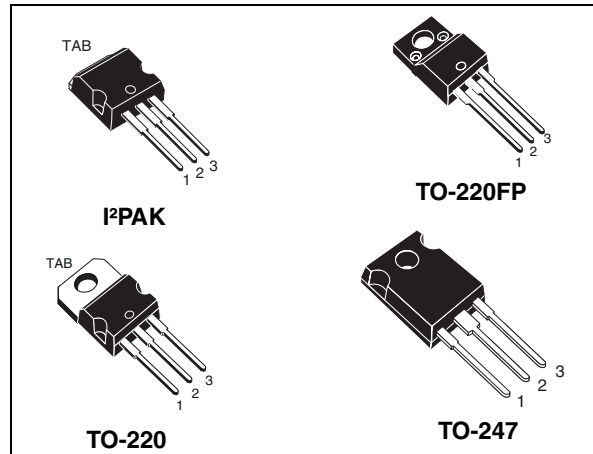


Figure 1. Internal schematic diagram

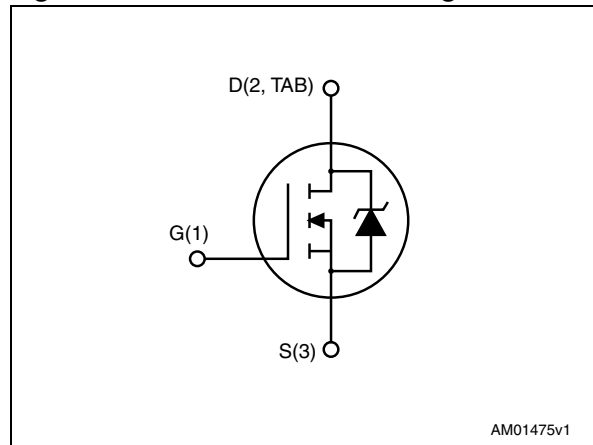


Table 1. Device summary

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

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# 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> )	4A	
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
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	1240 32 3.2	-	pF pF pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$ , $V_{GS} = 0$	-9	9	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-3	0	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	3	-	$\Omega$
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 520\text{ V}$ , $I_D = 7.5\text{ A}$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 20</a> )	-	31 8 14	-	nC nC 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**

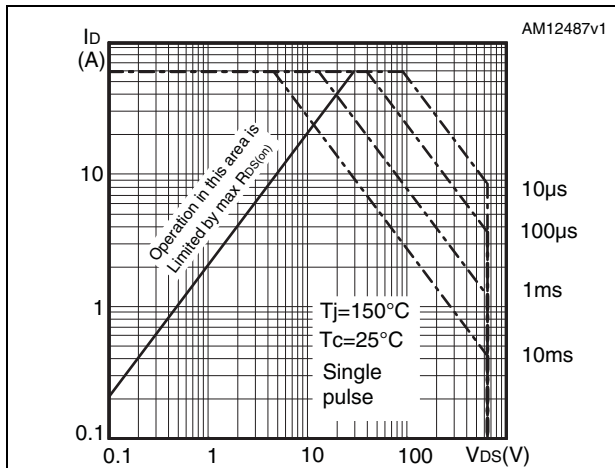
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current				15	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		60	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 15\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 15\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		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.

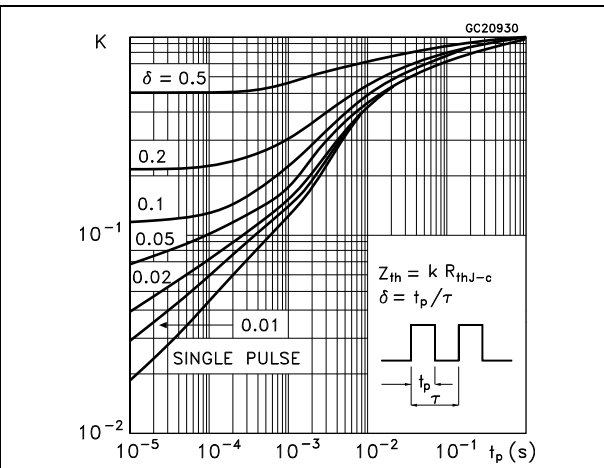
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

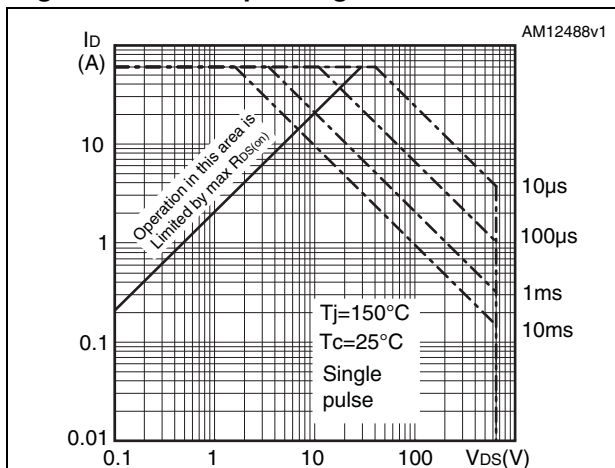
**Figure 2. Safe operating area for I<sup>2</sup>PAK and TO-220**



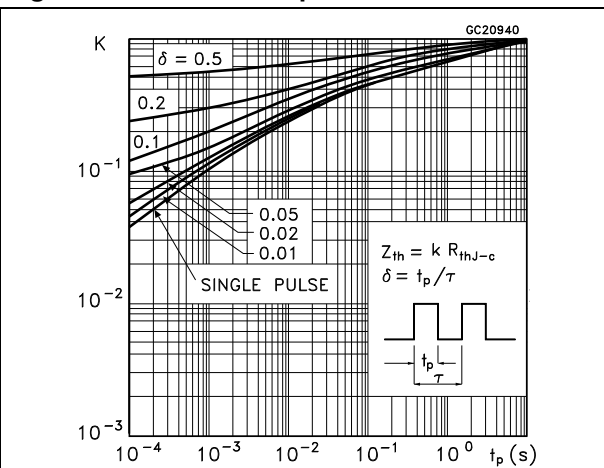
**Figure 3. Thermal impedance for I<sup>2</sup>PAK and TO-220**



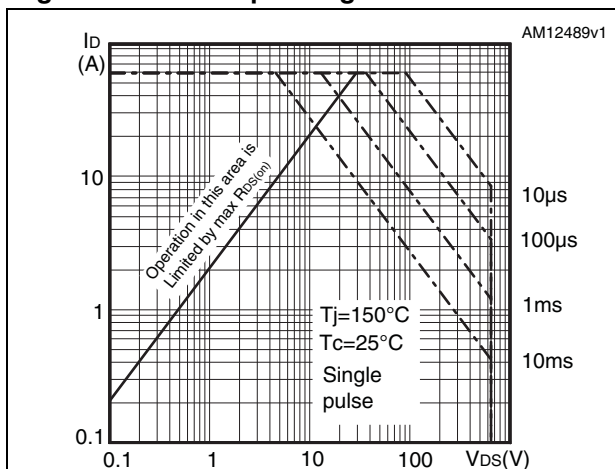
**Figure 4. Safe operating area TO220FP**



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



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



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

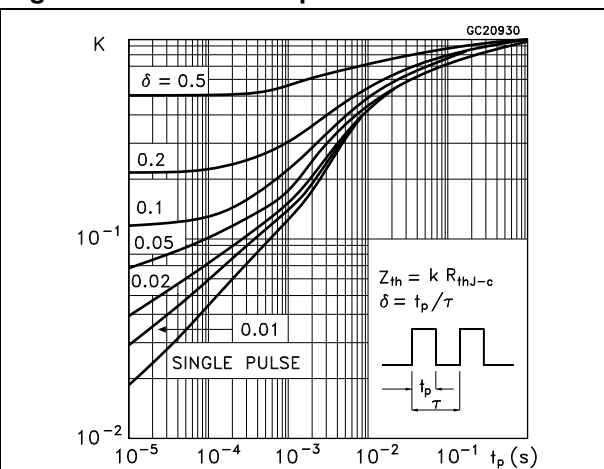


Figure 8. Output characteristics

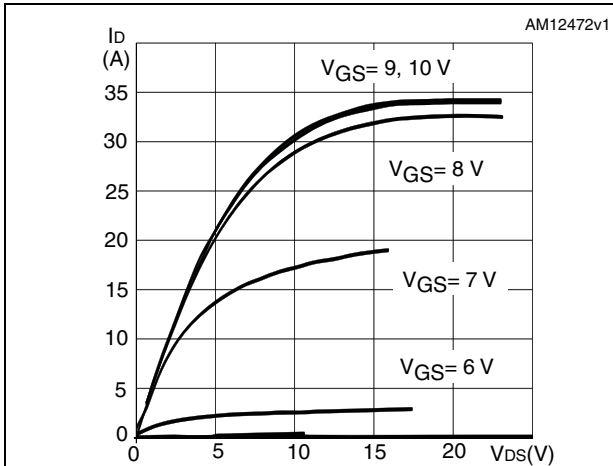


Figure 9. Transfer characteristics

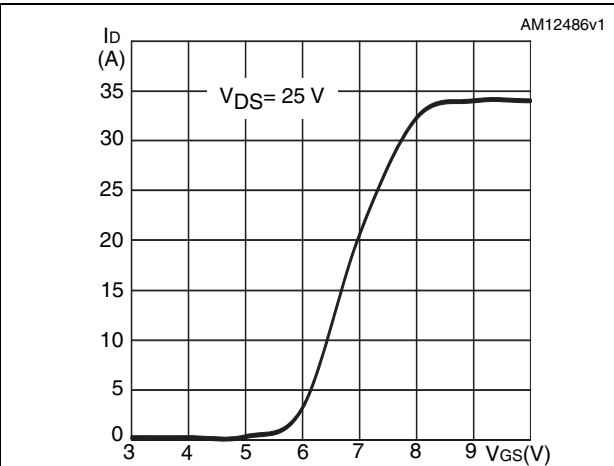


Figure 10. Gate charge vs gate-source voltage Figure 11. Static drain-source on-resistance

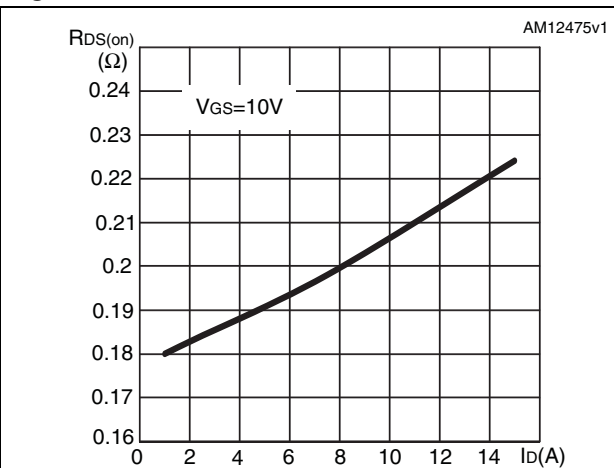
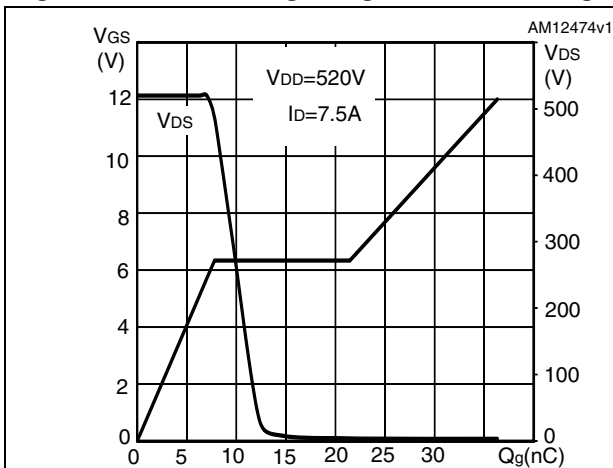


Figure 12. Capacitance variations

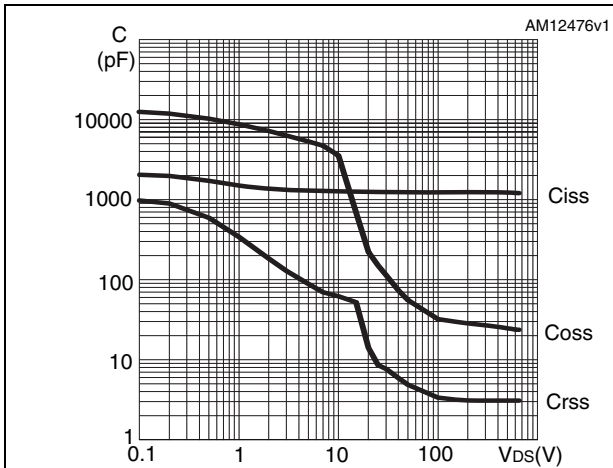


Figure 13. Output capacitance stored energy

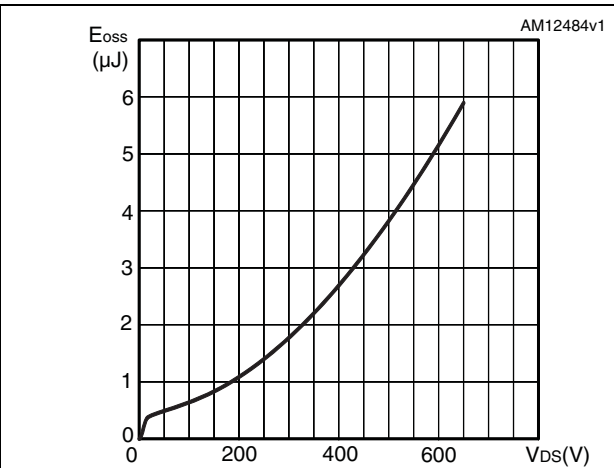


Figure 14. Normalized gate threshold voltage vs temperature

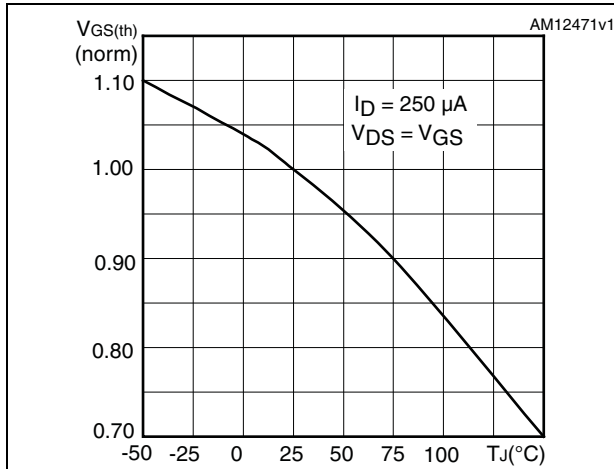


Figure 15. Normalized on-resistance vs temperature

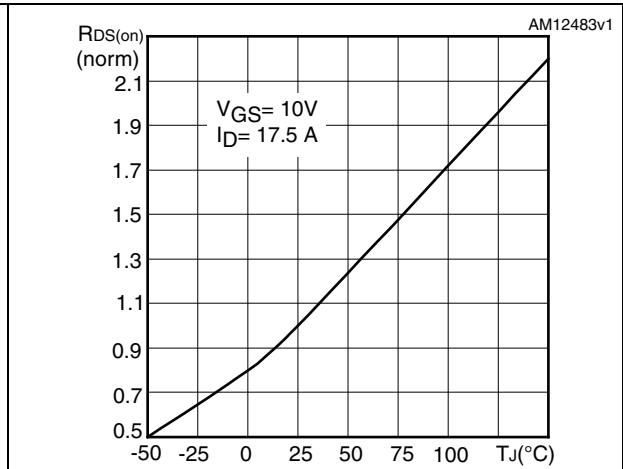


Figure 16. Drain-source diode forward characteristics

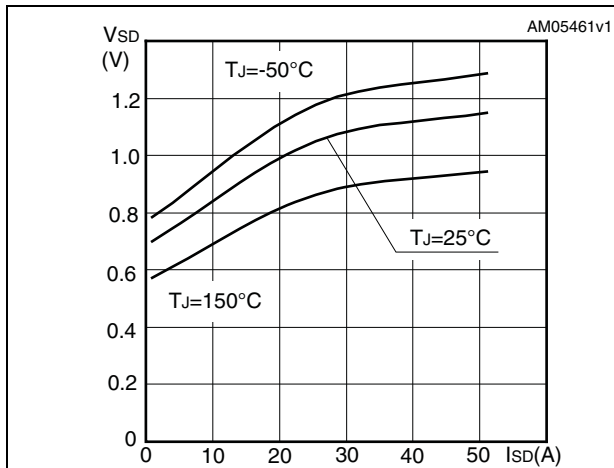


Figure 17. Normalized BV<sub>DSS</sub> vs temperature

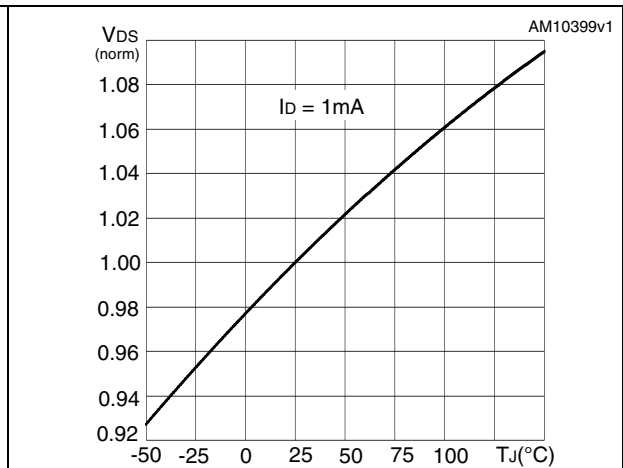
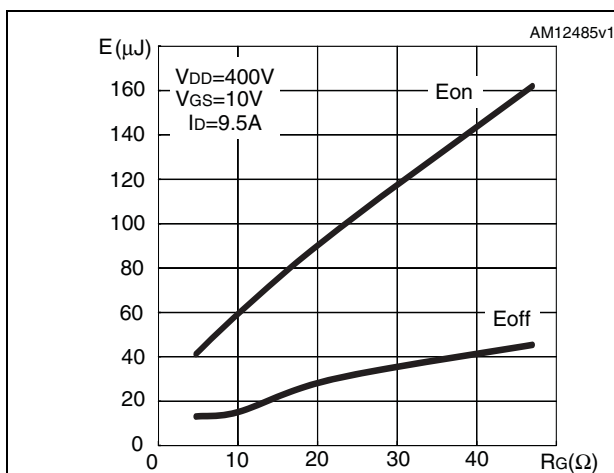


Figure 18. Switching losses vs gate resistance (1)



1. Eon including reverse recovery of a SiC diode



### 3 Test circuits

Figure 19. Switching times test circuit for resistive load

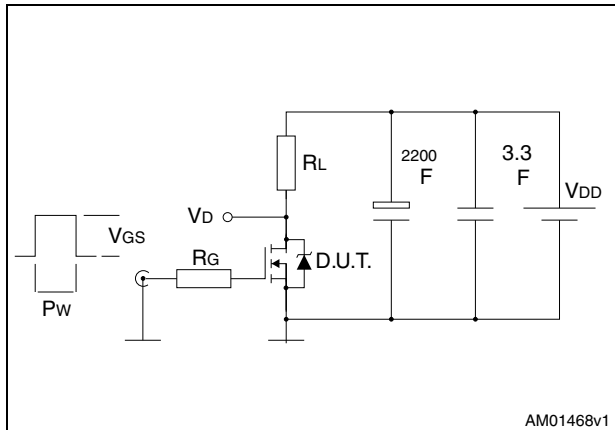


Figure 20. Gate charge test circuit

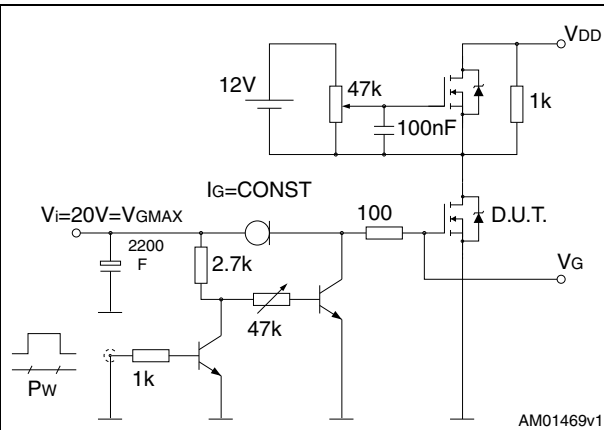


Figure 21. Test circuit for inductive load switching and diode recovery times

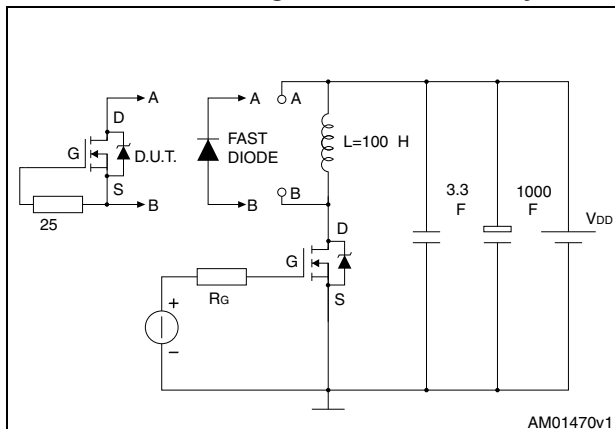


Figure 22. Unclamped inductive load test circuit

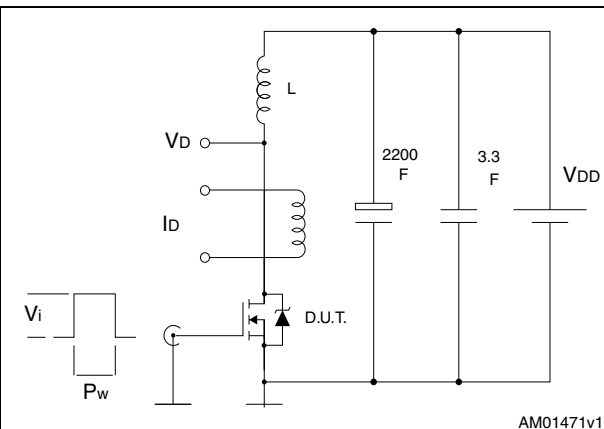


Figure 23. Unclamped inductive waveform

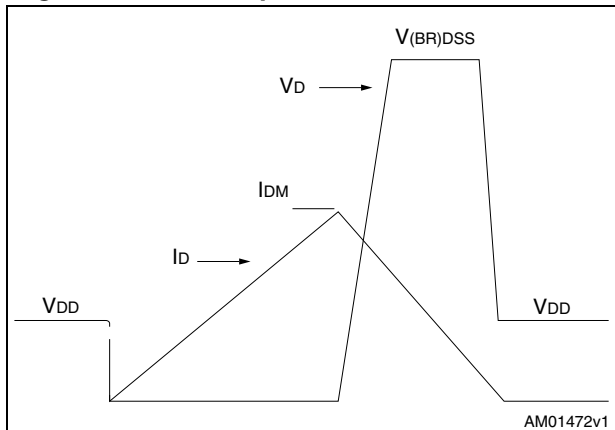
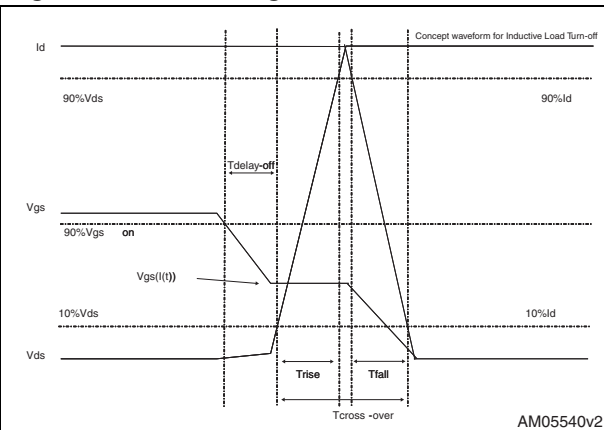


Figure 24. Switching time waveform



## 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.
A4	.4		4.6
B2	.5		2.7
D2	.5		2.75
E	0.45		0.7
F0	.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H1	0		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

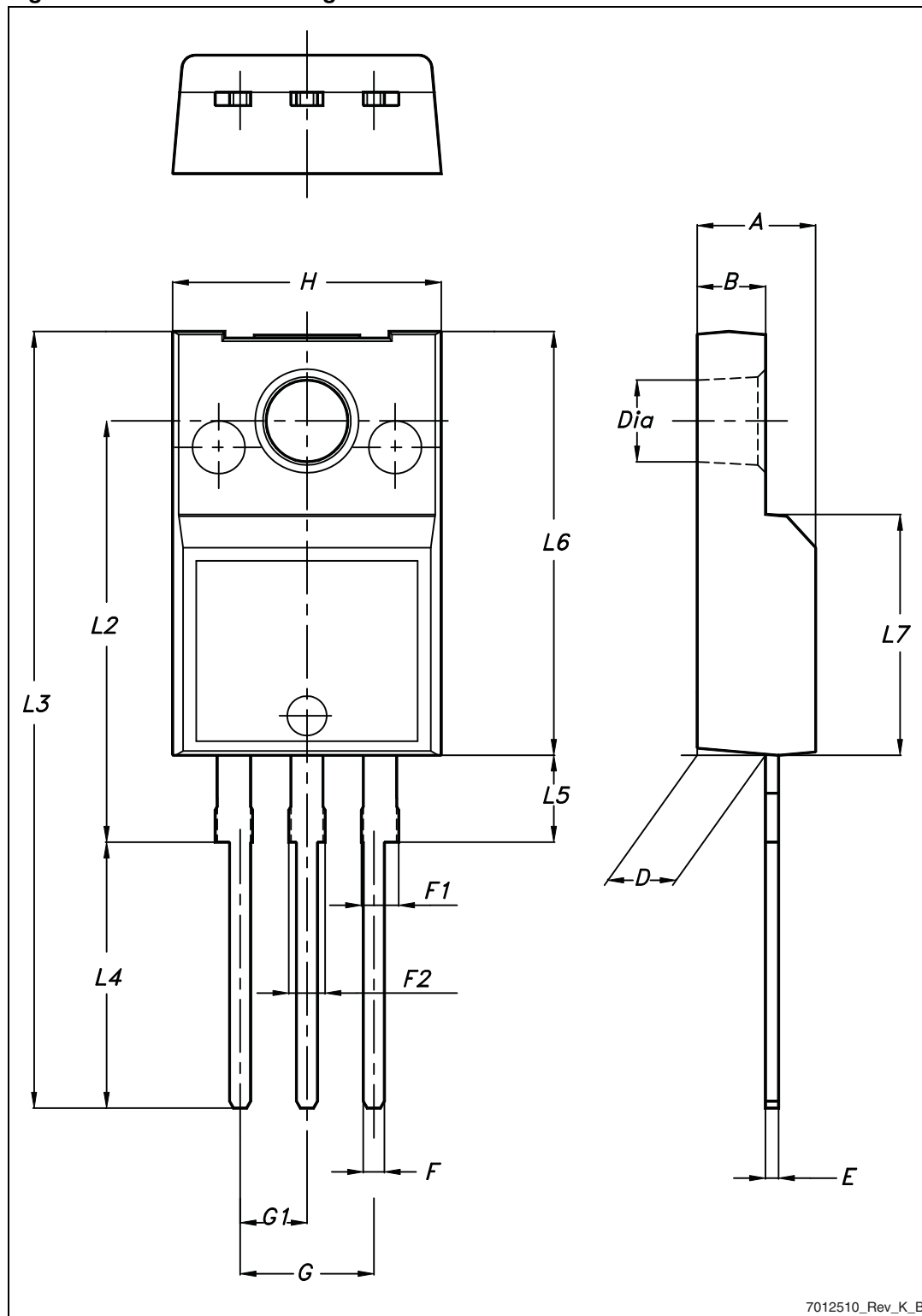
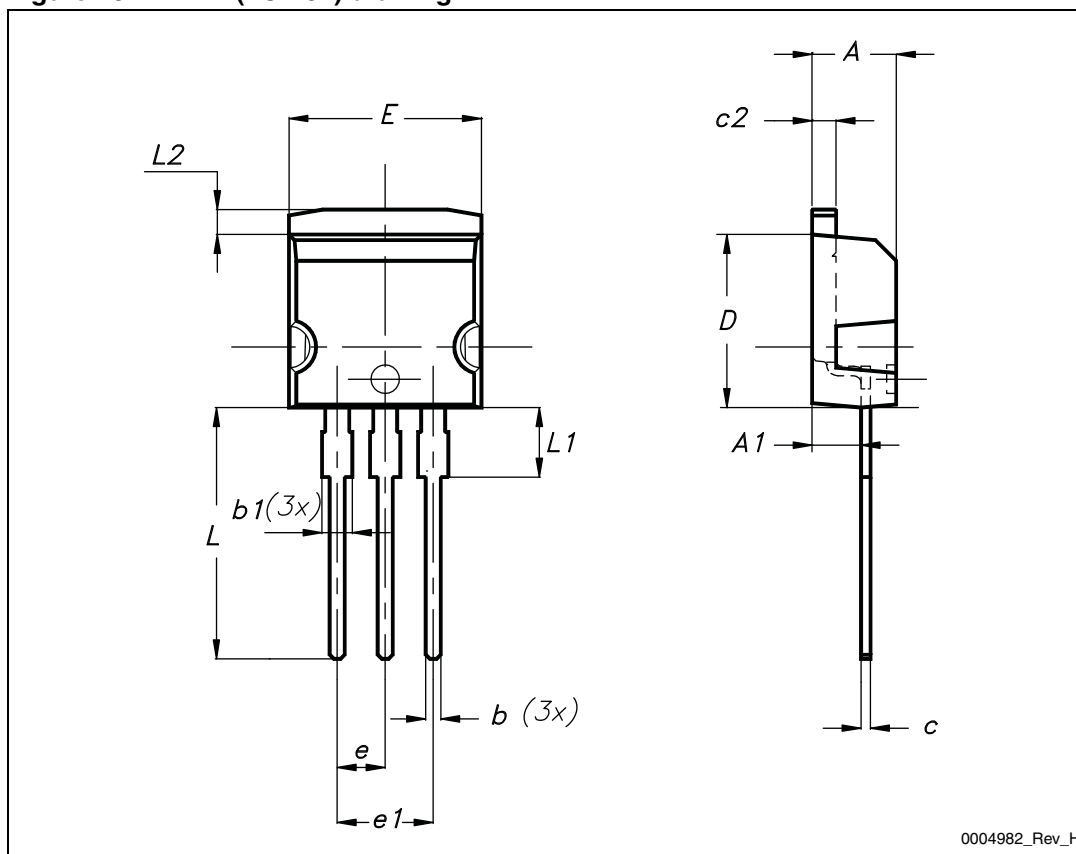


Table 10. I<sup>2</sup>PAK (TO-262) mechanical data

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
E1	0		10.40
L1	3		14
L1	3.50		3.93
L2	1.27		1.40

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



0004982\_Rev\_H

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
L1	3		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

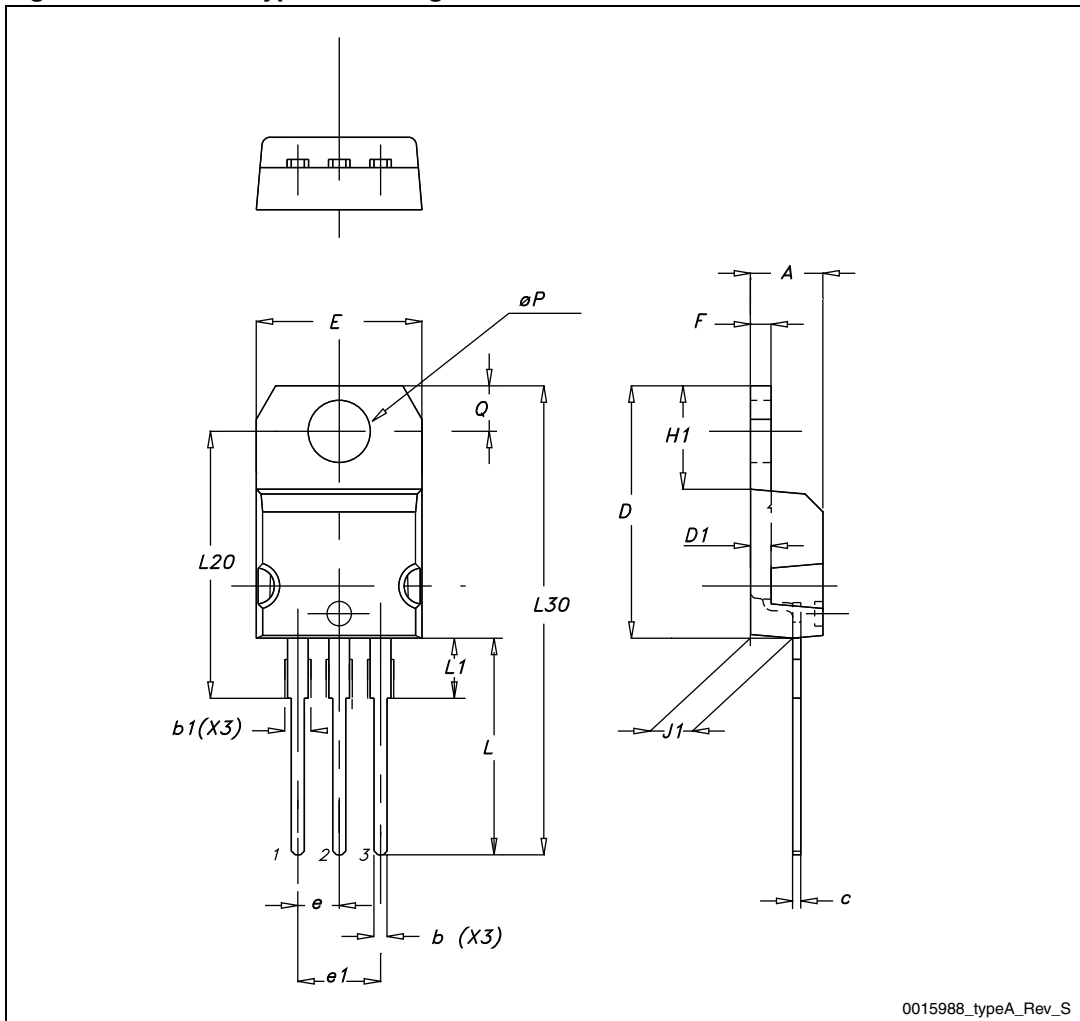
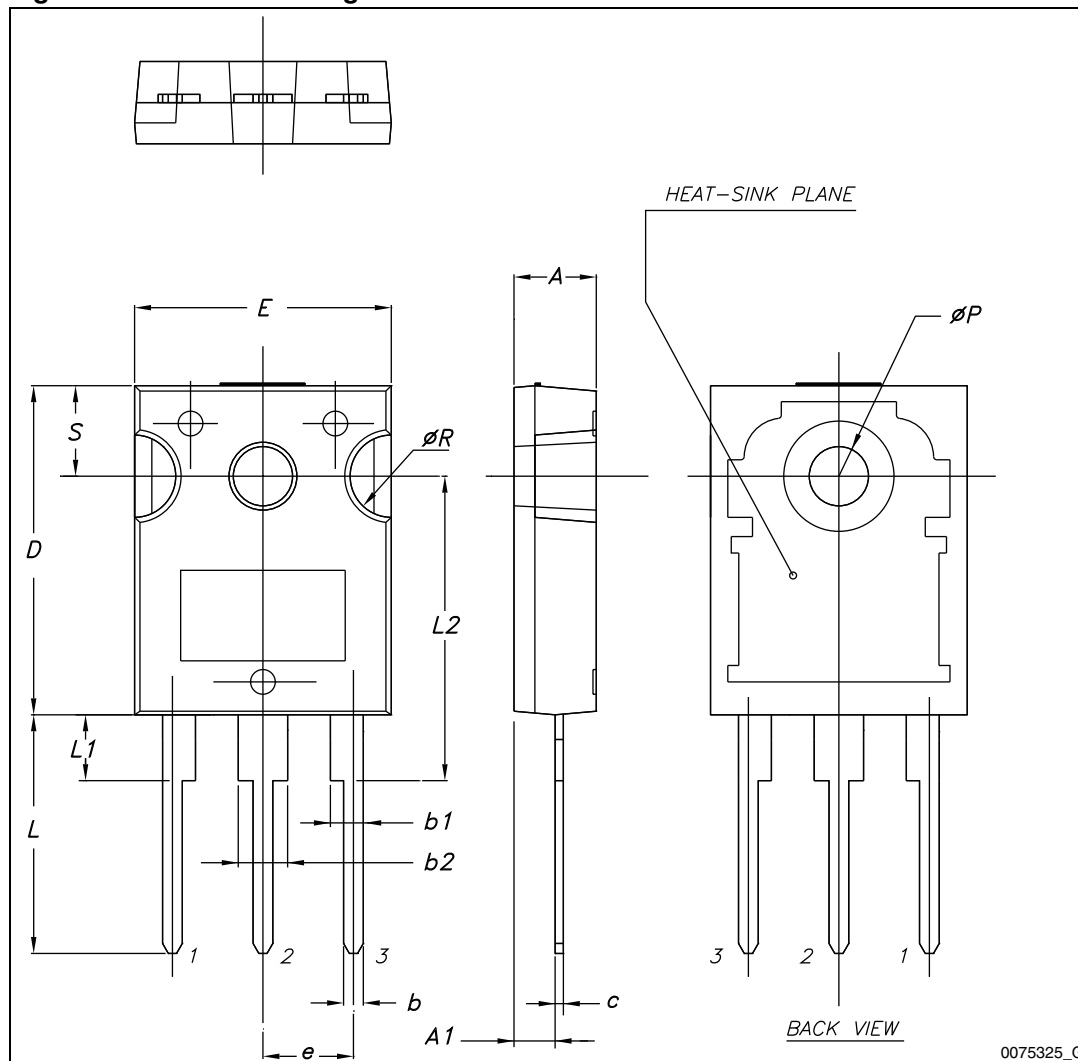


Table 12. TO-247 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b1	.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> .

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