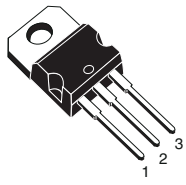
STP20NM65N
STF20NM65N

N-channel 650 V, 0.250 Ω, 15 A TO-220, TO-220FP second generation MDmesh™ Power MOSFET

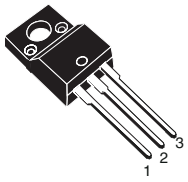
Features

Order codes	V_{DSS} @T_{jmax}	$R_{DS(on)}$ max.	I_D
STP20NM65N	710 V	0.270 Ω	15 A
STF20NM65N			

- 100 % avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance



TO-220



TO-220FP

Application

- Switching applications

Description

These devices are N-channel Power MOSFETs realized using the second generation MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Figure 1. Internal schematic diagram

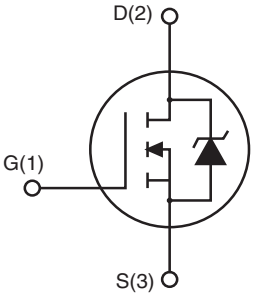


Table 1. Device summary

Order codes	Marking	Package	Packaging
STP20NM65N	20NM65N	TO-220	Tubes
STF20NM65N	20NM65N	TO-220FP	Tubes

Contents

1 Electrical ratings 3

2 Electrical characteristics 4

2.1 Electrical characteristecs (curves) 6

3 Test circuits 9

4 Package mechanical data 10

5 Revision history 15

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220	TO-220FP	
V_{DS}	Drain source voltage	650		V
V_{GS}	Gate source voltage	± 25		V
I_D	Drain current continuous T_C =25 °C	15	15(1)	A
I_D	Drain current continuous T_C =100 °C	9.45		A
I_{DM} (2)	Drain current pulsed	60		A
P_{TOT}	Total dissipation at T_C=25 °C	125	30	W
dv/dt (3)	Peak diode recovery voltage slope	15		V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heatsink (t=1 s; T_C = 25 °C)		2500	V
T_{stg} T_J	Storage temperature Max. operating junction temperature	-55 to 150 150		°C

1. Limited only by maximum temperature allowed.
2. Pulse width limited by safe operating area.
3. I_{SD} ≤15 A, di/dt ≤400 A/µs, $V_{DS\ peak}$ ≤$V_{(BR)DSS}$, V_{DD} = 80 % $V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameters	Value		Unit
		TO-220	TO-220FP	
R_{thjc}	Thermal resistance junction-case max.	1	4.17	°C/W
R_{thja}	Thermal resistance junction-ambient max.	62.50		°C/W
T_J	Max. lead temperature for soldering purposes	300		°C

Table 4. Avalanche characteristics

Symbol	Parameters	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by Tj max)	4	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	115	mJ

2 Electrical characteristics

(T_C = 25 °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 mA, V_{GS} = 0	650			V
I_{DSS}	Zero gate voltage drain current (V_{GS}=0)	V_{DS} = max rating V_{DS} = max rating @ 125 °C			1 100	µA µA
I_{GSS}	Gate body leakage (V_{DS}=0)	V_{GS}= ±25 V, V_{DS}=0			100	nA
$V_{GS(th)}$	Gate threshold voltage	I_D = 250 µA, V_{GS} = V_{DS}	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	I_D=7.5 A, V_{GS}=10 V		0.250	0.270	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1MHz, V_{GS} = 0	-	1280	-	pF
C_{oss}	Output capacitance			110		pF
C_{rss}	Reverse capacitance			10		pF
$C_{oss\ eq}$ (1)	Equivalent output capacitance	V_{DS} = 0 to V_{GS} = 0	-	260	-	pF
R_G	Intrinsic gate resistance	f = 1MHz open drain	-	4.8	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 15 A, V_{GS} = 10 V (see *Figure 16*)	-	44	-	nC
Q_{gs}	Gate source charge			8		nC
Q_{gd}	Gate-drain charge			22		nC

1. $C_{oss\ eq}$: defined as a constant equivalent capacitance giving the same charging time 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
$t_{d(on)}$	Turn-on delay time	V_{DD} = 325 V, I_D=7.5 A, R_g=4.7 Ω, V_{GS}=10 V (see *Figure 15*) (see *Figure 20*)	-	15	-	ns
t_r	Rise time			13.5		ns
$t_{d(off)}$	Turn-off-delay time		-	75	-	ns
t_f	Fall time			21		ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM} (1)	Source drain current Source drain current (pulsed)		-		15 60	A A
V_{SD} (2)	Forward on voltage	I_{SD} = 15 A, V_{GS} = 0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 15 A, di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 17*)	-	455		ns
Q_{rr}	Reverse recovery charge			5.5		nC
I_{RRM}	Reverse recovery current			24.5		A
t_{rr}	Reverse recovery time	I_{SD} =15 A, di/dt = 100 A/µs V_{DD} = 60 V, Tj = 150 °C (see *Figure 17*)	-	710		ns
Q_{rr}	Reverse recovery charge			8		nC
I_{RRM}	Reverse recovery current			24		A

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

2.1 Electrical characteristecs (curves)

Figure 2. Safe operating area for TO-220

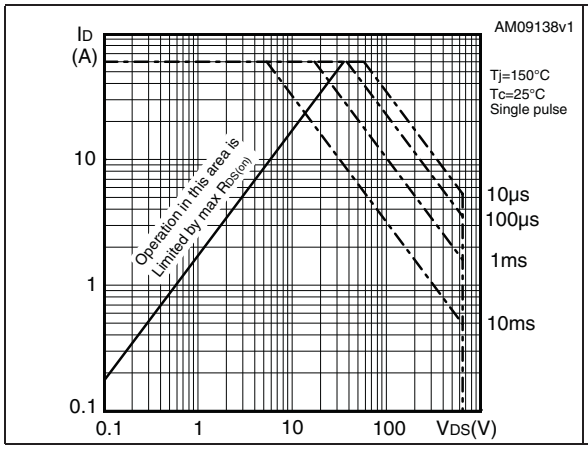


Figure 3. Thermal impedance for TO-220

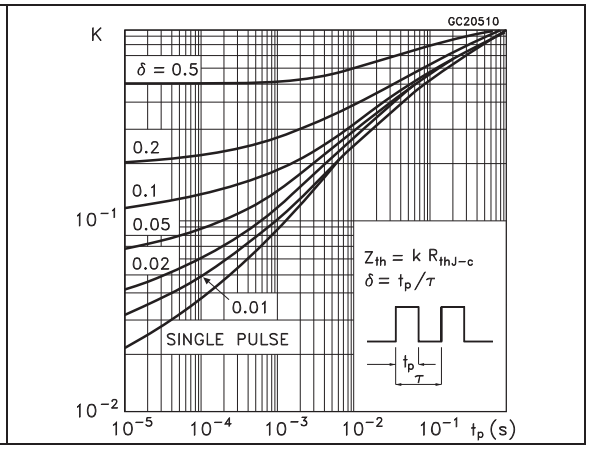


Figure 4. Safe operating area for TO-220FP

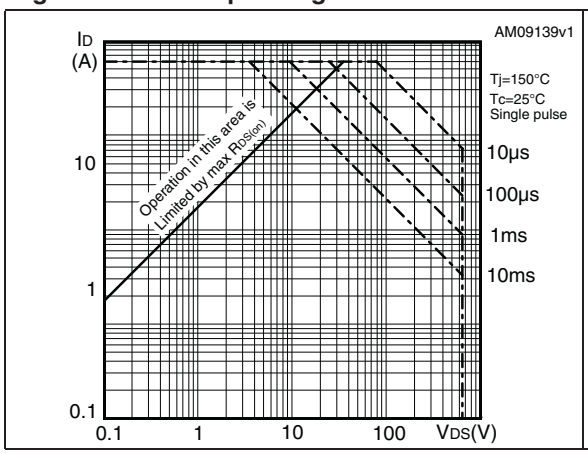


Figure 5. Thermal impedance for TO-220FP

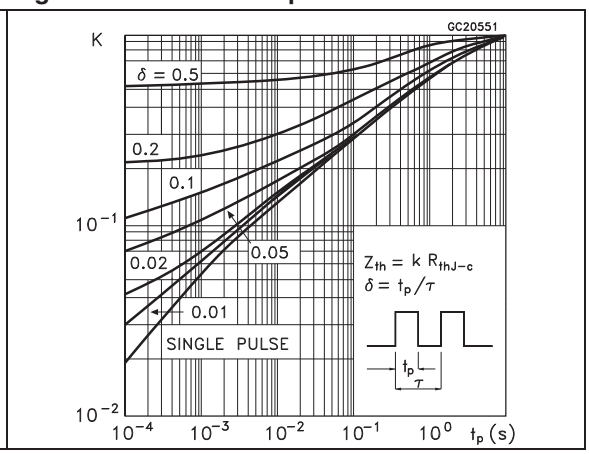


Figure 6. Output characteristics

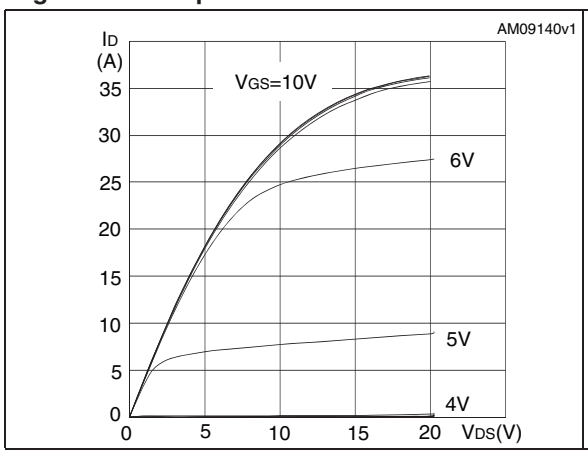


Figure 7. Transfer characteristics

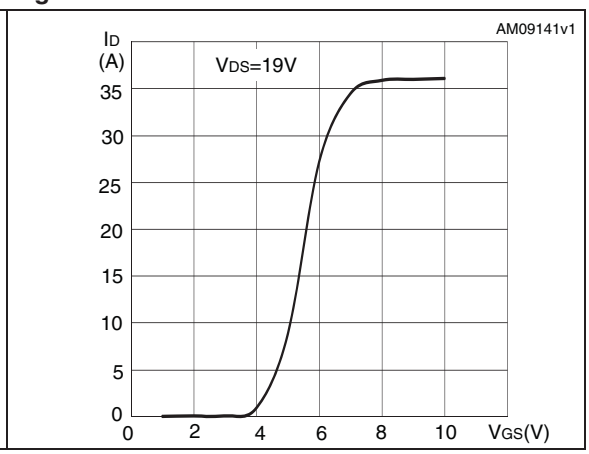


Figure 8. Normalized B_{VDSS} vs temperature

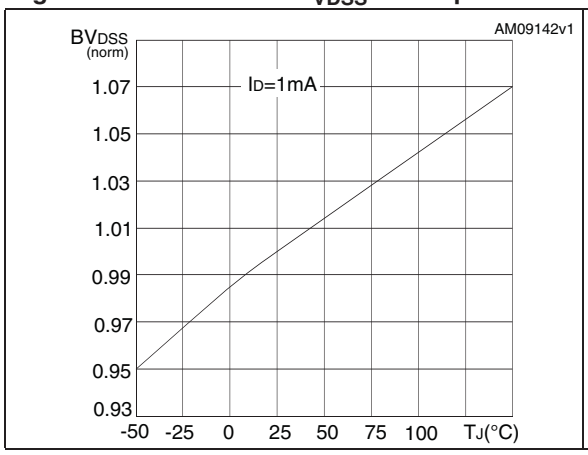


Figure 9. Static drain-source on resistance

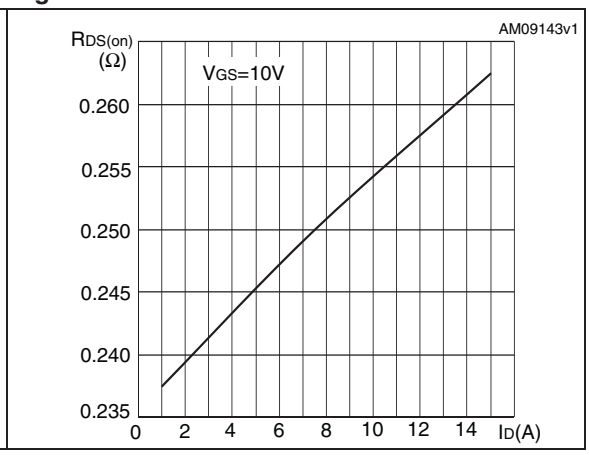


Figure 10. Gate charge vs gate-source voltage

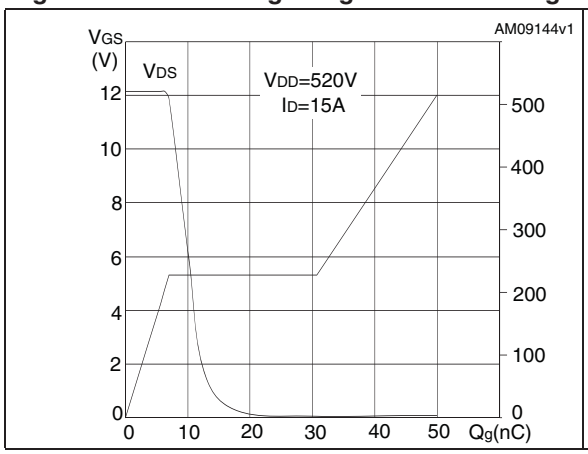


Figure 11. Capacitance variations

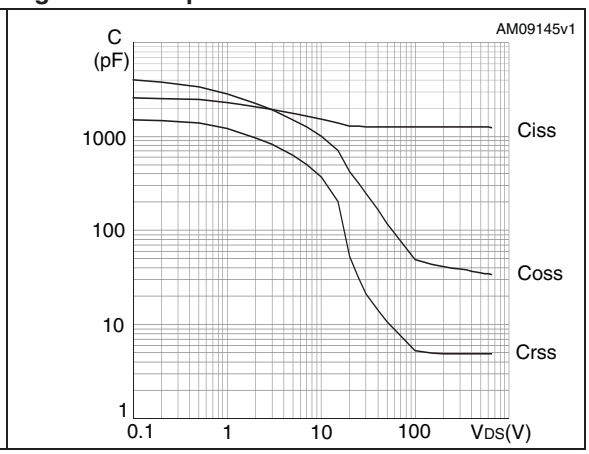


Figure 12. Normalized gate threshold voltage vs temperature

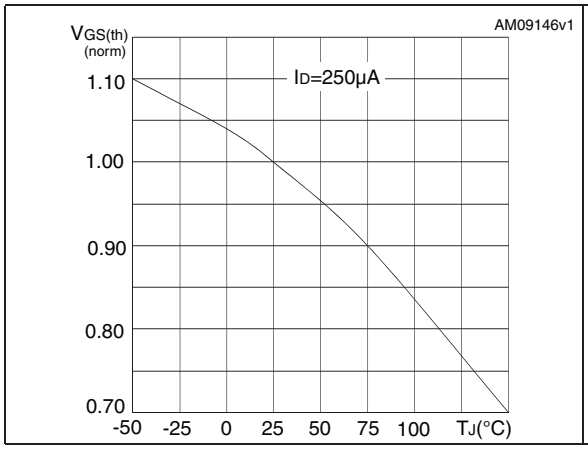


Figure 13. Normalized on resistance vs temperature

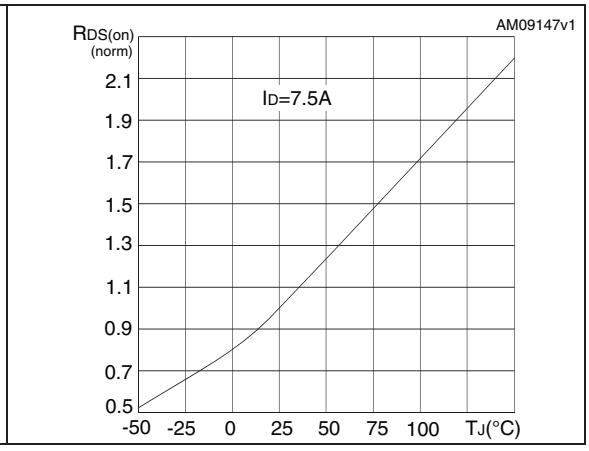
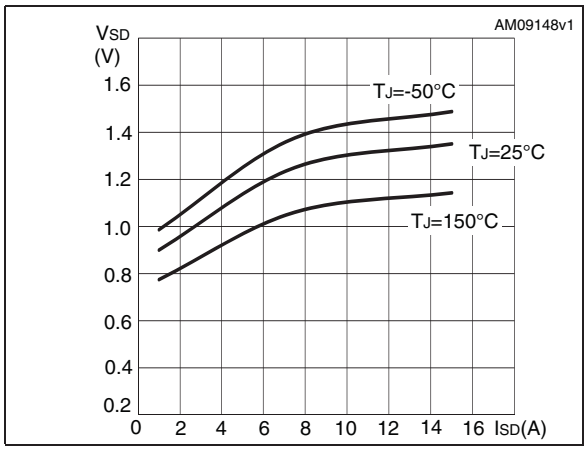


Figure 14. Source-drain diode forward characteristics



3 Test circuits

Figure 15. Switching times test circuit for resistive load

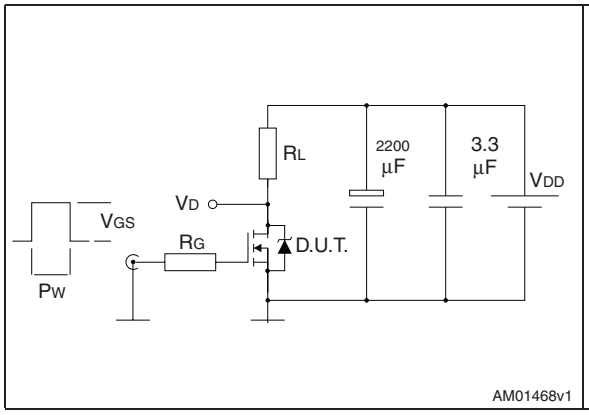


Figure 16. Gate charge test circuit

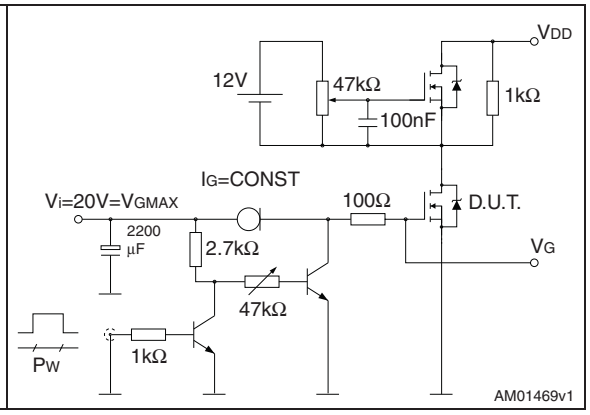


Figure 17. Test circuit for inductive load switching and diode recovery times

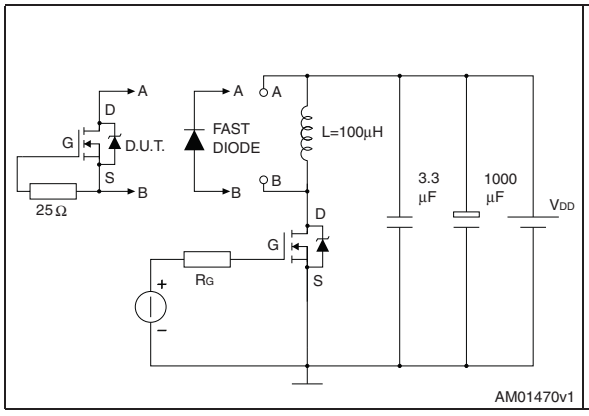


Figure 18. Unclamped inductive load test circuit

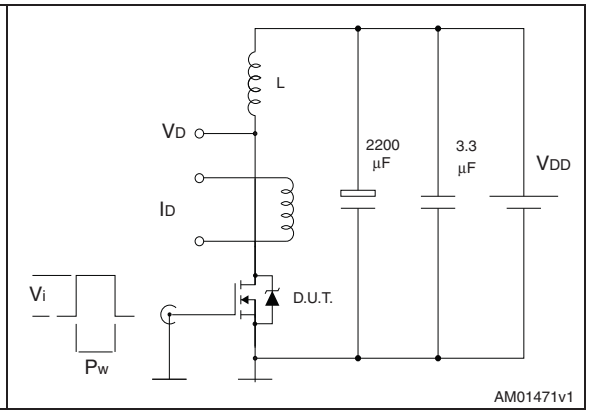


Figure 19. Unclamped inductive waveform

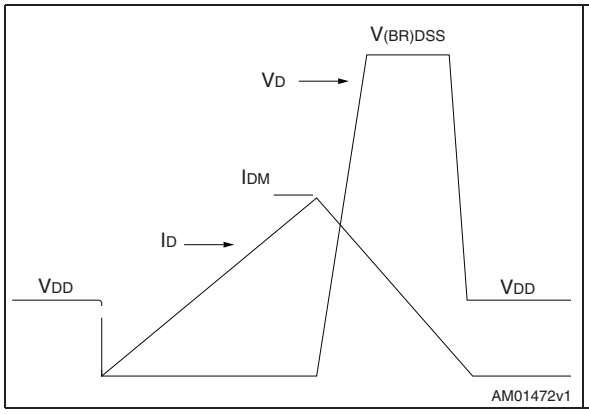
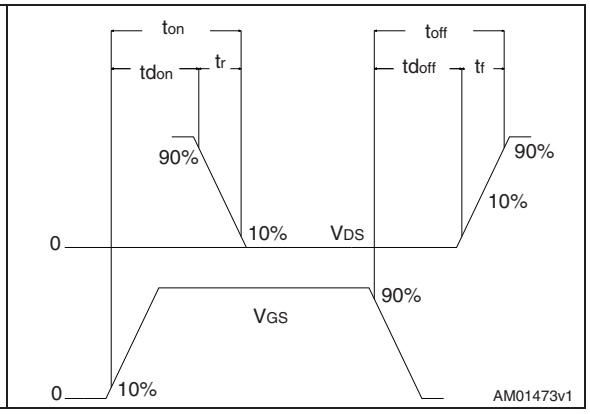


Figure 20. Switching time waveform



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. ECOPACK is an ST trademark.

Table 9. 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	
∅P	3.75		3.85
Q	2.65		2.95

Figure 21. TO-220 type A drawing

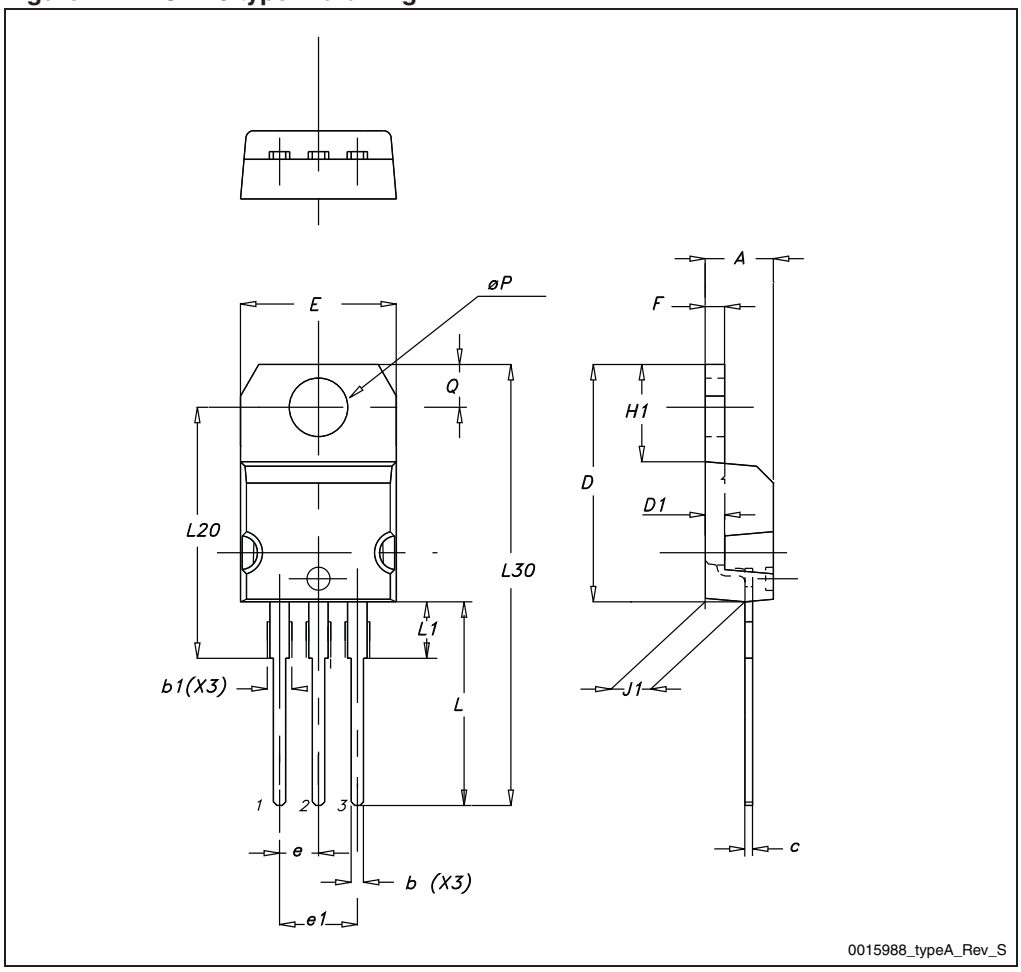
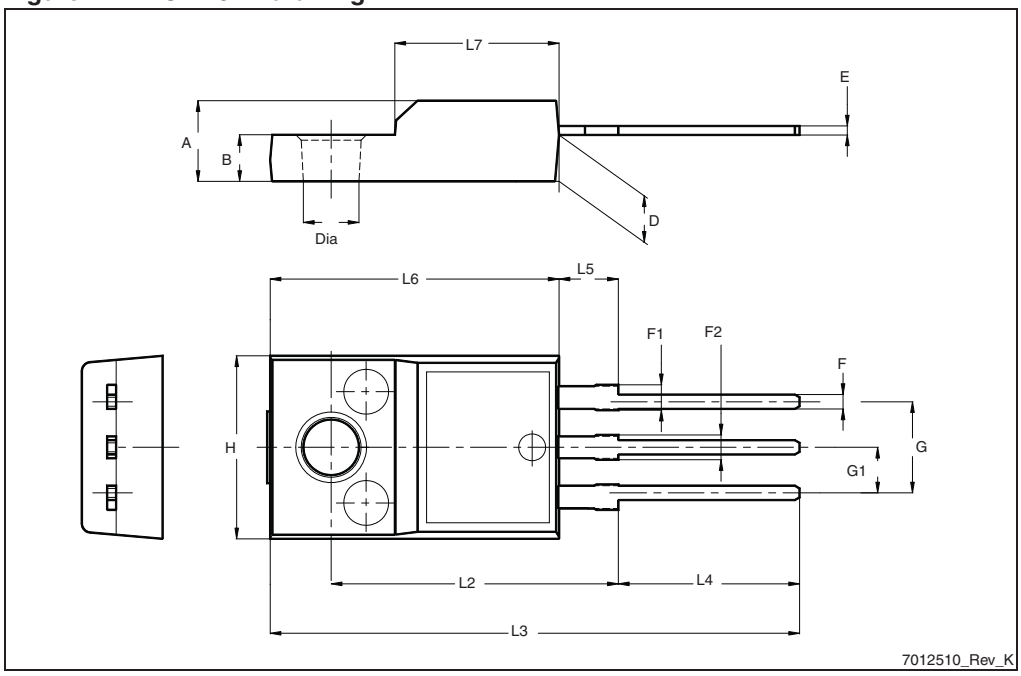


Table 10. TO-220FP mechanical data

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 22. TO-220FP drawing



5 Revision history

Table 11. Revision history

Date	Revision	Changes
12-Sep-2007	1	Initial release.
23-May-2011	2	Updated *Chapter 4: Package mechanical data*.

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.

© 2011 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