

N-channel 60 V, 0.22 Ω typ., 38 A, STripFET™ II Power MOSFET in a TO-220 package

Datasheet – production data

Features

Order code	V _{DS}	R _{DS(on)}	I _D
STP45NF06	60 V	0.028 Ω	38 A

- Typical R_{DS(on)} = 0.022 Ω
- Exceptional dv/dt capability
- 100% avalanche tested
- Standard threshold drive

Applications

- Switching application

Description

This Power MOSFET has been developed using STMicroelectronics' unique STripFET process, which is specifically designed to minimize input capacitance and gate charge. This renders the device suitable for use as primary switch in advanced high-efficiency isolated DC-DC converters for telecom and computer applications, and applications with low gate charge driving requirements.

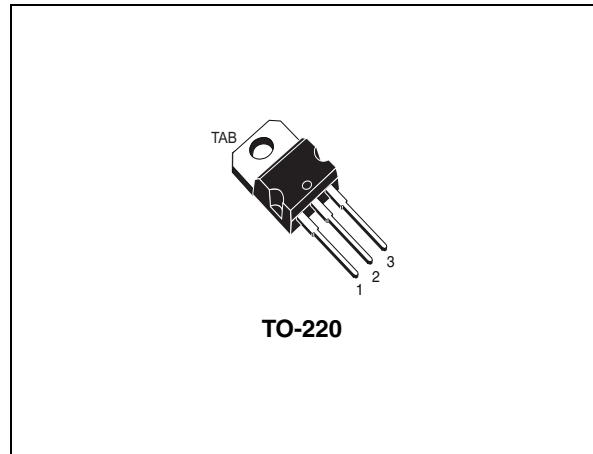


Figure 1. Internal schematic diagram

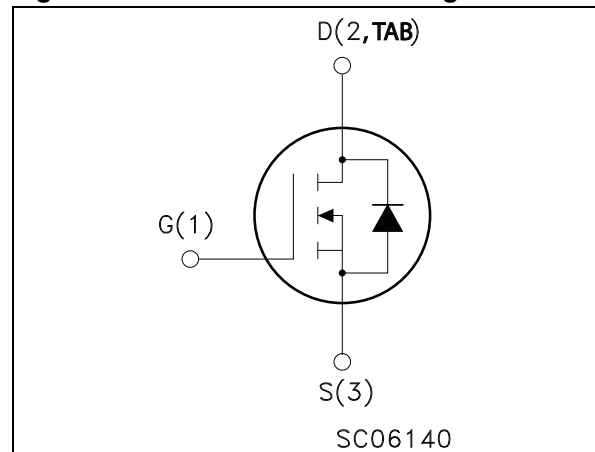


Table 1. Device summary

Order code	Marking	Package	Packaging
STP45NF06	45NF06	TO-220	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves)	6
3	Test circuits	8
4	Package mechanical data	9
5	Revision history	12

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	60	V
V_{DGR}	Drain-gate voltage ($R_{GS}=20\text{ k}\Omega$)	60	V
V_{GS}	Gate-source voltage	± 20	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	38	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	26	A
$I_{DM}^{(1)}$	Drain current (pulsed)	152	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	80	W
	Derating factor	0.53	W/ $^\circ\text{C}$
$dv/dt^{(2)}$	Peak diode recovery voltage slope	7	V/ns
T_{stg}	Storage temperature	- 65 to 175	$^\circ\text{C}$
T_j	Max. operating junction temperature	175	$^\circ\text{C}$

1. Pulse width limited by safe operating area

2. $I_{SD} \leq 38\text{ A}$, $di/dt \leq 300\text{ A}/\mu\text{s}$; $V_{DS(\text{peak})} < V_{(BR)DSS}$, $V_{DD}=80\% V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-case}}$	Thermal resistance junction-case max	1.88	$^\circ\text{C}/\text{W}$
$R_{thj\text{-amb}}^{(1)}$	Thermal resistance junction-ambient max	35	$^\circ\text{C}/\text{W}$

1. When mounted on 1 inch² FR-4, 2 Oz copper board.

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by $T_{j\text{max}}$)	38	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$; $V_{DD}=50\text{ V}$)	135	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	$I_D = 250\text{ mA}$, $V_{GS} = 0$	60			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 60\text{ V}$ $V_{DS} = 60\text{ V}$, $T_C = 125\text{ °C}$			1 10	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 19\text{ A}$		0.022	0.028	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} > I_{D(on)} * R_{DS(on)max}$, $I_D = 19\text{ A}$	-	24		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	1730 215 63		pF pF pF
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 48\text{ V}$, $I_D = 38\text{ A}$, $V_{GS} = 10\text{ V}$	-	43 9 15	58	ns ns ns

1. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r	Turn-on delay time Voltage rise time	$V_{DD} = 30\text{ V}$, $I_D = 19\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14)	-	20 100	-	ns ns
$t_{d(off)}$ t_f	Turn-off delay time Fall time		-	50 20	-	ns ns
$t_{d(off)}$ t_f t_c	Off-voltage rise time Fall time Cross-over time	$V_{clamp} = 48\text{ V}$, $I_D = 38\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 16)	-	45 42 60	-	ns ns ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		38	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		152	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 38 \text{ A}, V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 38 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$	-	95		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 100 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$	-	260		μC
I_{RRM}	Reverse recovery current	(see Figure 16)	-	5.5		A

1. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2. Pulse width limited by safe operating area.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

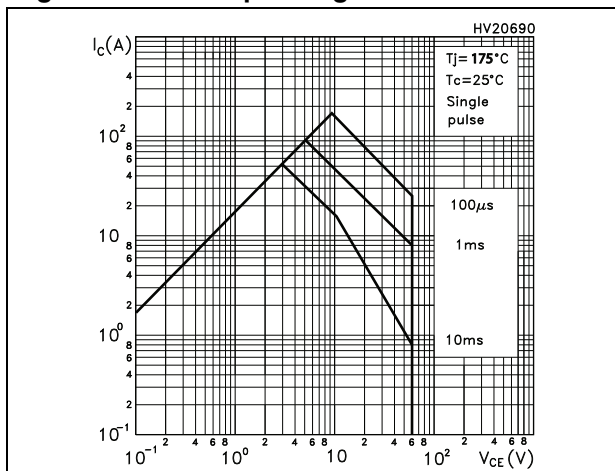


Figure 3. Thermal impedance

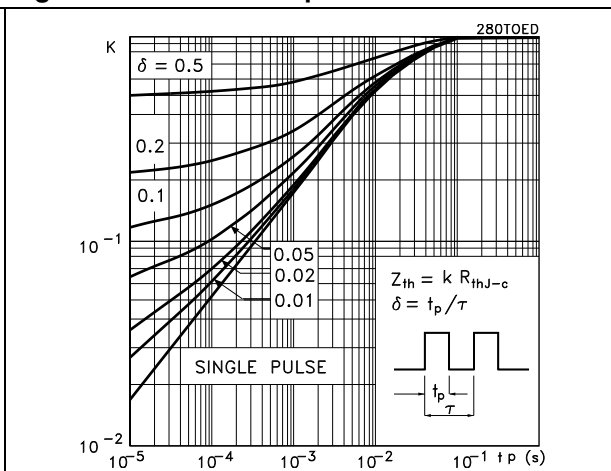


Figure 4. Output characteristics

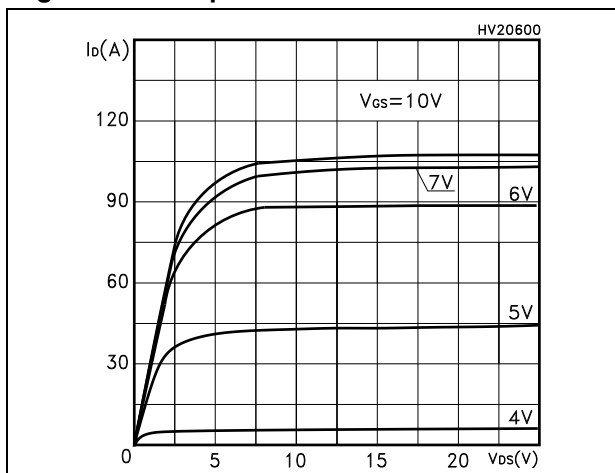


Figure 5. Transfer characteristics

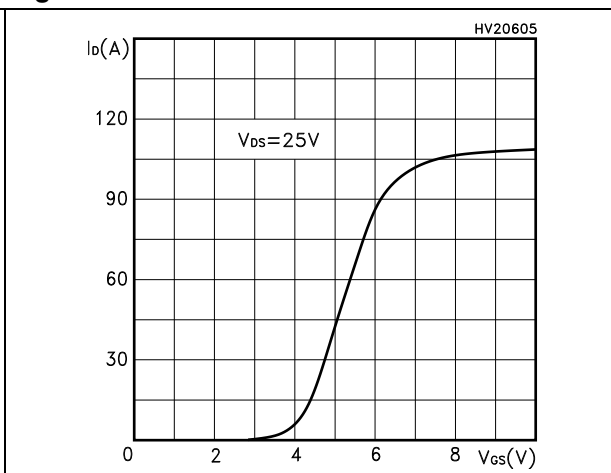


Figure 6. Transconductance

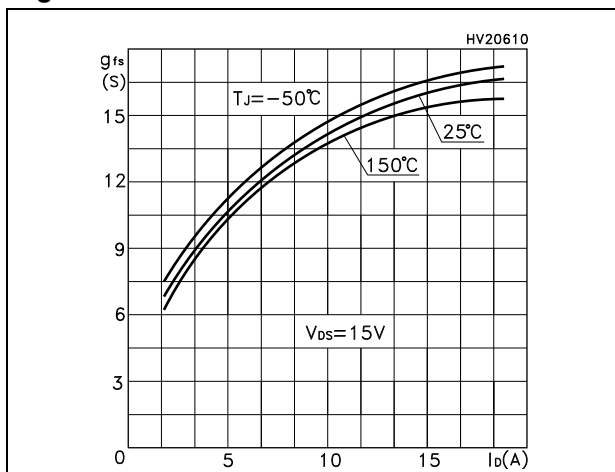


Figure 7. Static drain-source on-resistance

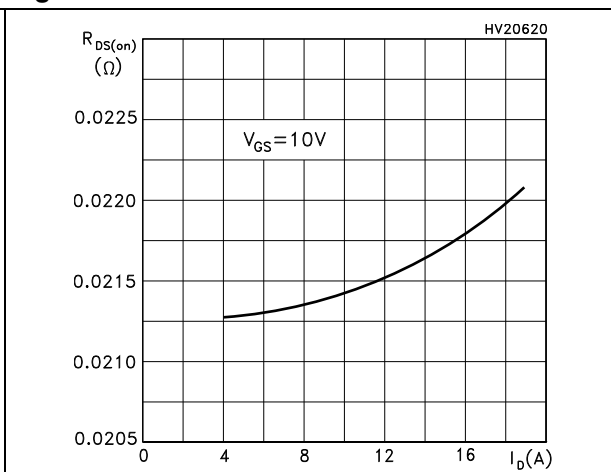


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

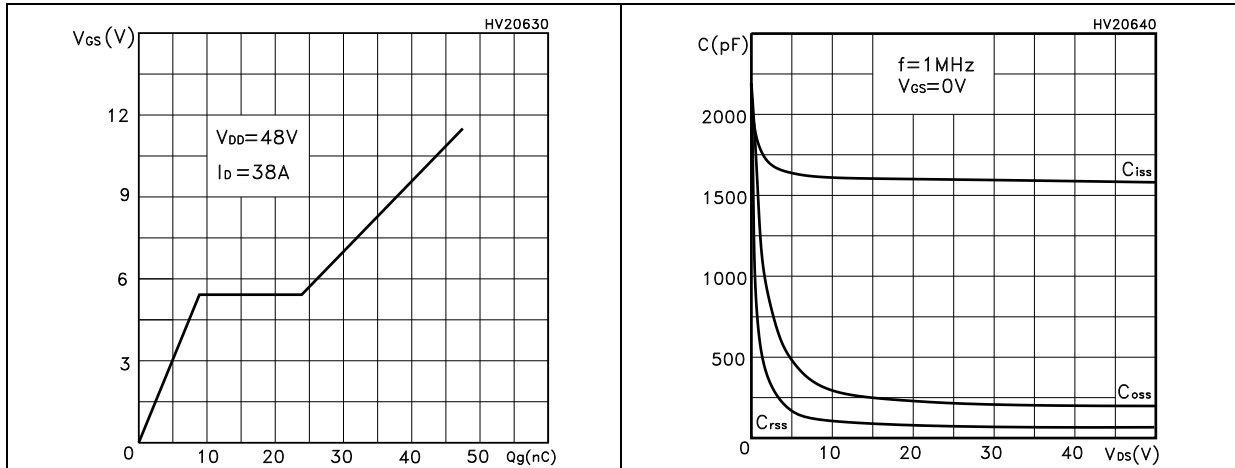


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on-resistance vs temperature

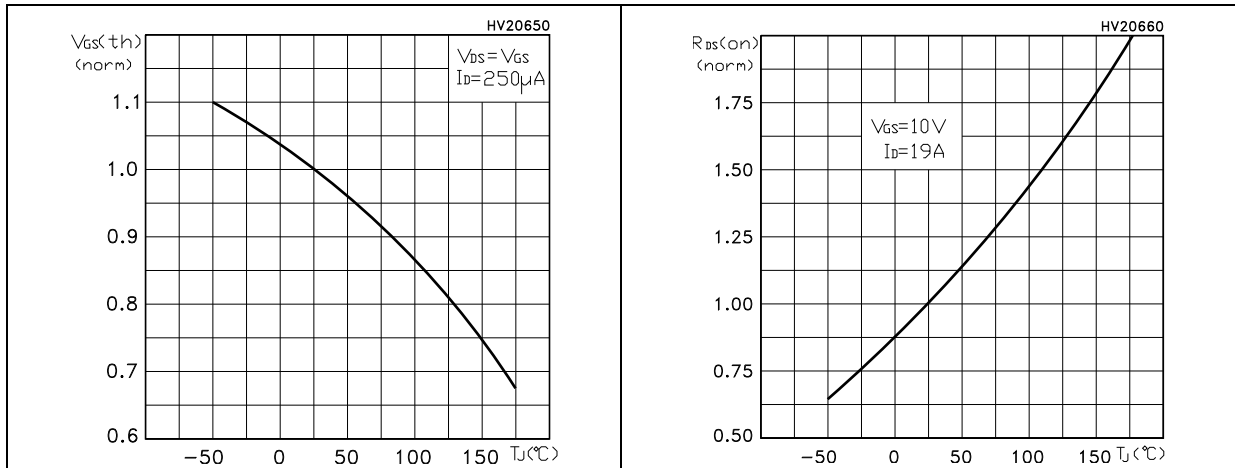
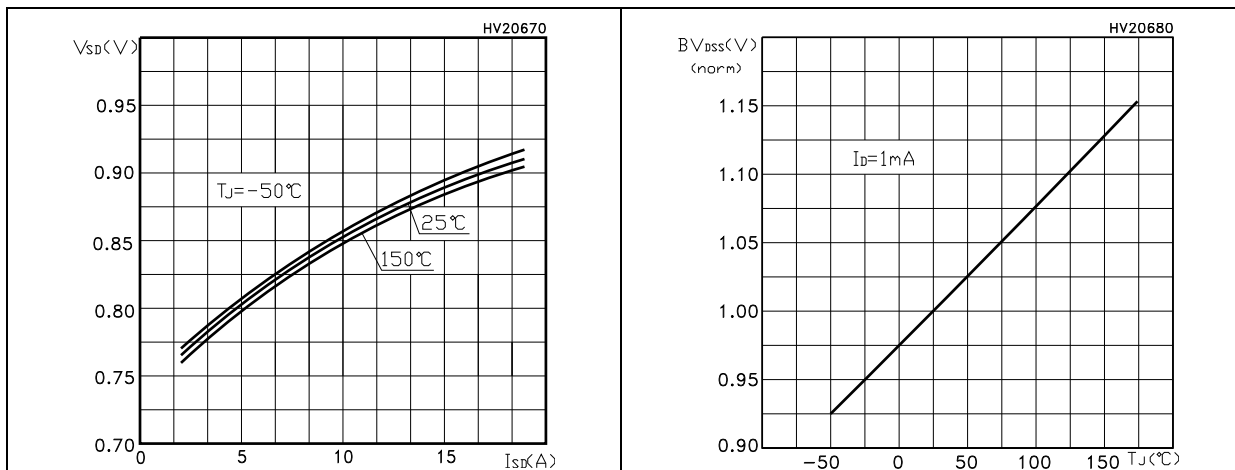


Figure 12. Source-drain diode forward characteristics Figure 13. Normalized $B_{V_{DS}}$ vs temperature



3 Test circuits

Figure 14. Switching times test circuit for resistive load



Figure 15. Gate charge test circuit

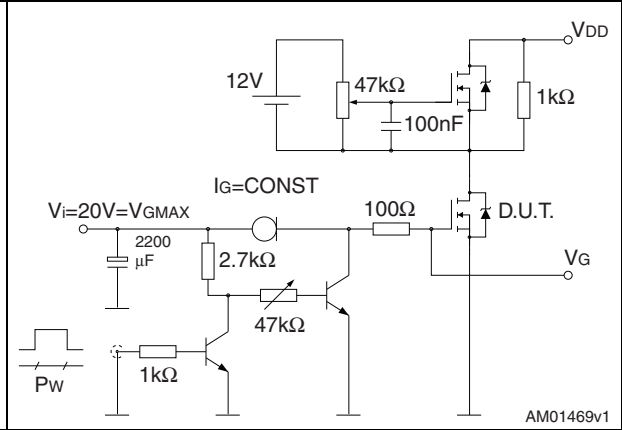


Figure 16. Test circuit for inductive load switching and diode recovery times

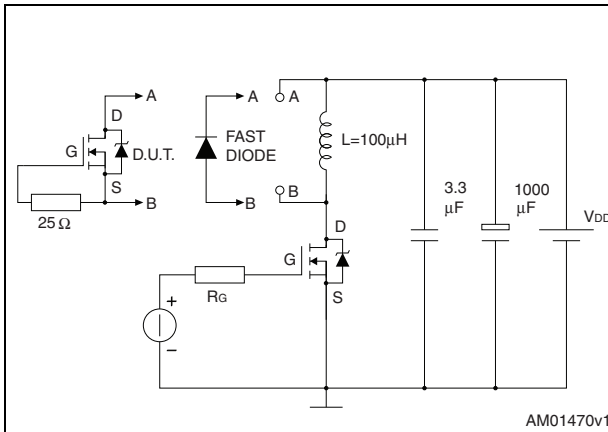


Figure 17. Unclamped inductive load test circuit

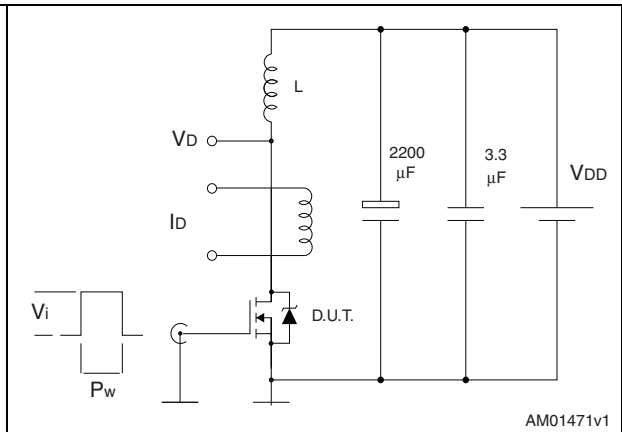


Figure 18. Unclamped inductive waveform

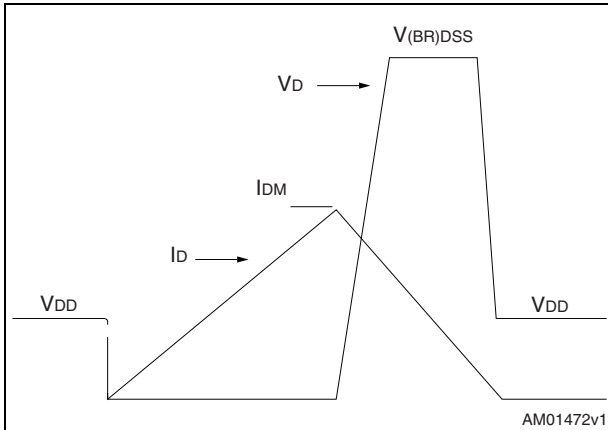
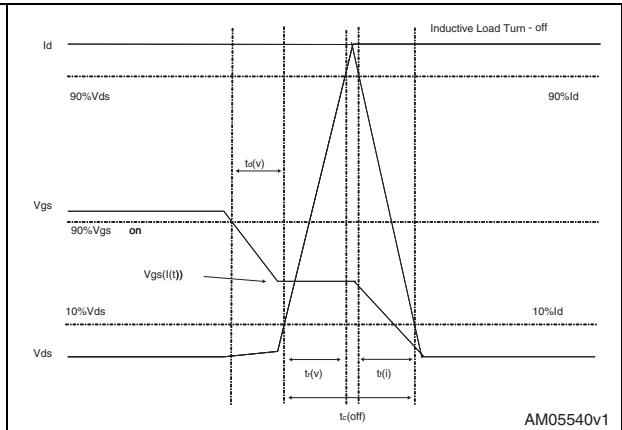


Figure 19. Switching time waveform



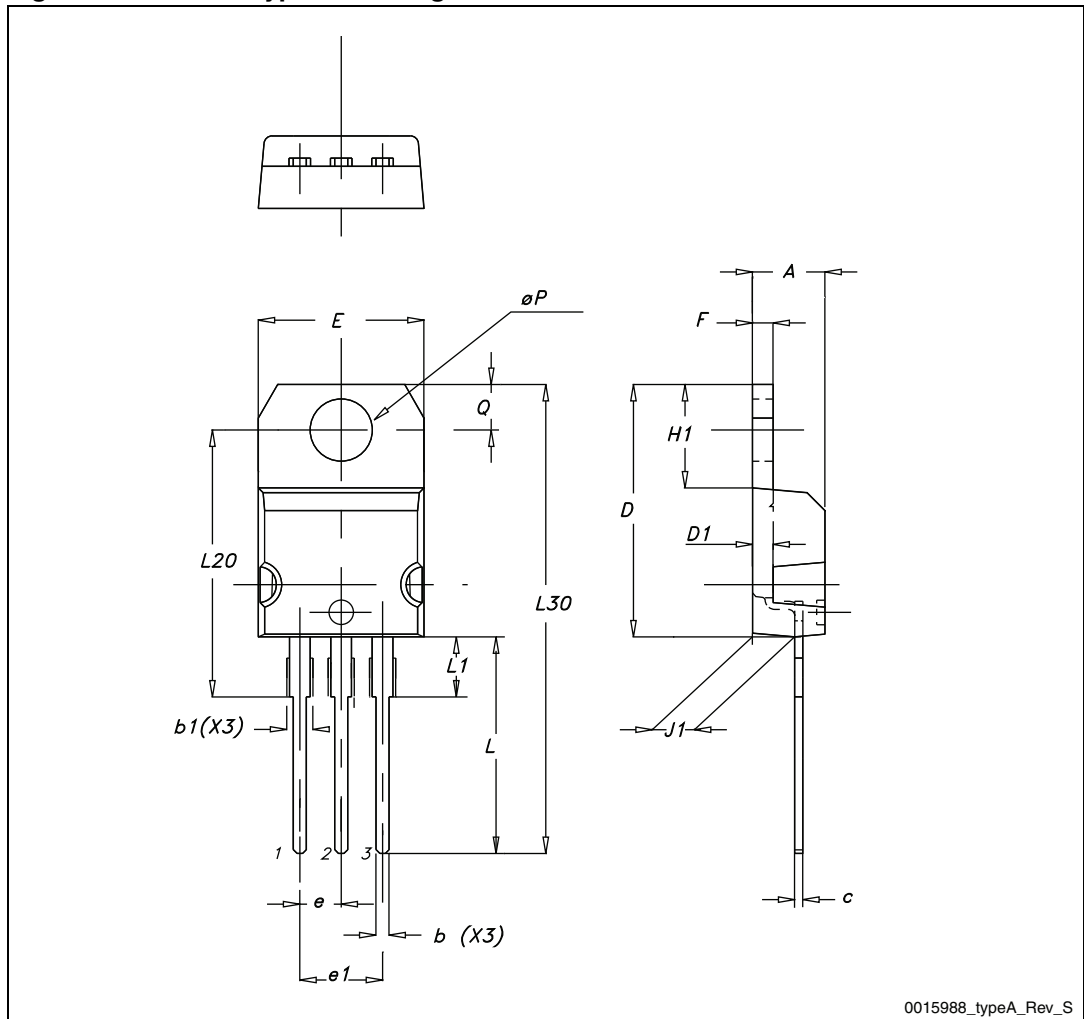
4 Package mechanical data

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	
ØP	3.75		3.85
Q	2.65		2.95

Figure 20. TO-220 type A drawing



5 Revision history

Table 10. Revision history

Date	Revision	Changes
09-Sep-2004	1	Preliminary version.
04-Feb-2005	2	Complete version.
17-Aug-2006	3	New template. No content change.
13-Nov-2006	4	Inserted new value.
05-Jul-2010	5	Updated Section 2.1: Electrical characteristics (curves) .
19-Dec-2012	6	Updated: Section 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 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

