



## IRF640T

N-channel 200V - 0.15Ω - 15A - TO-220  
MESH OVERLAY™ Power MOSFET

### General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
IRF640T	200V	<0.16Ω	15A

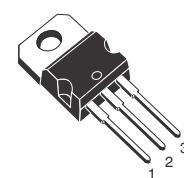
- Extremely high dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitances

### Description

This Power MOSFET is designed using the company's consolidated strip layout-based MESH OVERLAY™ process. This technology matches and improves the performances compared with standard parts from various sources.

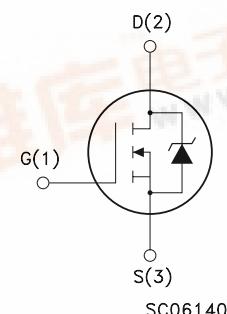
### Applications

- Switching application



TO-220

### Internal schematic diagram



### Order codes

Part number	Marking	Package	Packaging
IRF640T	IRF640T	TO-220	Tube

## 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 circuit</b>	<b>8</b>
<b>4</b>	<b>Package mechanical data</b>	<b>9</b>
<b>5</b>	<b>Packaging mechanical data</b>	<b>12</b>
<b>6</b>	<b>Revision history</b>	<b>13</b>

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	200	V
$V_{GS}$	Gate-source voltage	$\pm 20$	V
$I_D$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	15	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	10	A
$I_{DM}^{(1)}$	Drain current (pulsed)	60	A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	90	W
	Derating factor	0.72	W/ $^\circ\text{C}$
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$T_J$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 150	$^\circ\text{C}$

1. Pulse width limited by safe operating area
2.  $I_{SD} \leq 15\text{A}$ ,  $di/dt \leq 300\text{A}/\mu\text{s}$ ,  $V_{DD} = 80\%V_{(BR)DSS}$

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	1.38	$^\circ\text{C}/\text{W}$
$R_{thj-a}$	Thermal resistance junction-ambient max	62.5	$^\circ\text{C}/\text{W}$
$T_J$	Maximum lead temperature for soldering purpose	300	$^\circ\text{C}$

**Table 3. Avalanche data**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_J$ Max)	15	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{V}$ )	110	mJ

## 2 Electrical characteristics

( $T_{CASE}=25^{\circ}\text{C}$  unless otherwise specified)

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{mA}$ , $V_{GS} = 0$	200			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ , $V_{DS} = \text{Max rating} @ 125^{\circ}\text{C}$			1 10	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{V}$			$\pm 100$	nA
$V_{GS(\text{th})}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$	2	3	4	V
$R_{DS(\text{on})}$	Static drain-source on resistance	$V_{GS} = 10\text{V}$ , $I_D = 7.5\text{A}$		0.15	0.16	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 8\text{V}$ , $I_D = 7.5\text{A}$		12		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25\text{V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$		800 165 26		pF pF pF
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 160\text{V}$ , $I_D = 15\text{A}$ $V_{GS} = 10\text{V}$ (see Figure 14)		24 4.4 11.6		nC nC nC

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

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on delay time Rise time	$V_{DD}=100\text{ V}$ , $I_D=7.5\text{A}$ , $R_G=4.7\Omega$ , $V_{GS}=10\text{V}$ (see Figure 13)		11.5 22		ns ns
$t_{d(off)}$ $t_f$	Turn-off delay time Fall time	$V_{DD}=100\text{ V}$ , $I_D=7.5\text{A}$ , $R_G=4.7\Omega$ , $V_{GS}=10\text{V}$ (see Figure 13)		19 11		ns ns

**Table 7. 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	$I_{SD}=15\text{A}$ , $V_{GS}=0$			1.6	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}=15\text{A}$ , $V_{DD}=50\text{V}$ $di/dt=100\text{A}/\mu\text{s}$ , (see Figure 18)		125 0.55 8.8		ns $\mu\text{C}$ A
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}=15\text{A}$ , $V_{DD}=50\text{V}$ $di/dt=100\text{A}/\mu\text{s}$ , $T_j=150^\circ\text{C}$ (see Figure 18)		148 0.73 9.9		ns $\mu\text{C}$ 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 1. Safe operating area

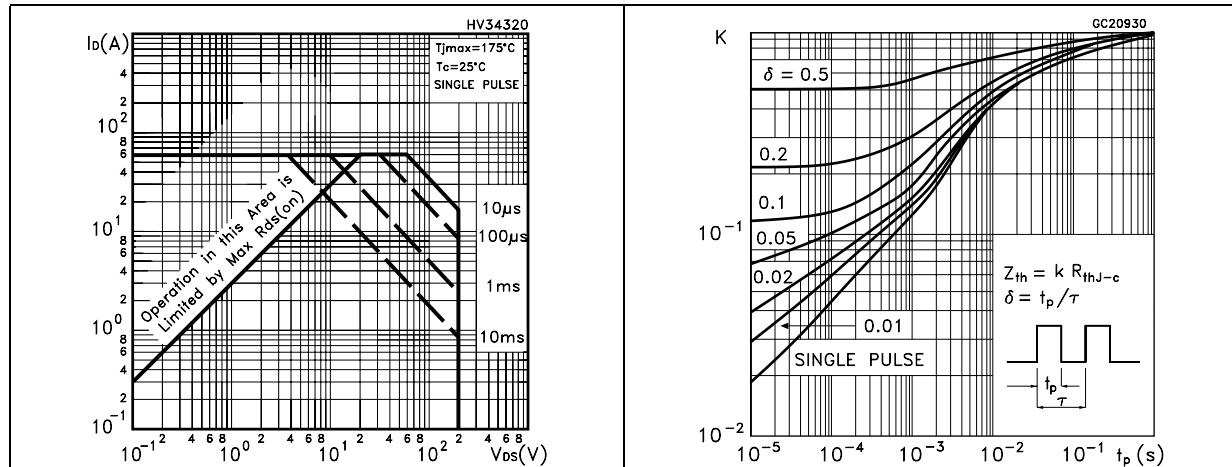


Figure 3. Output characteristics

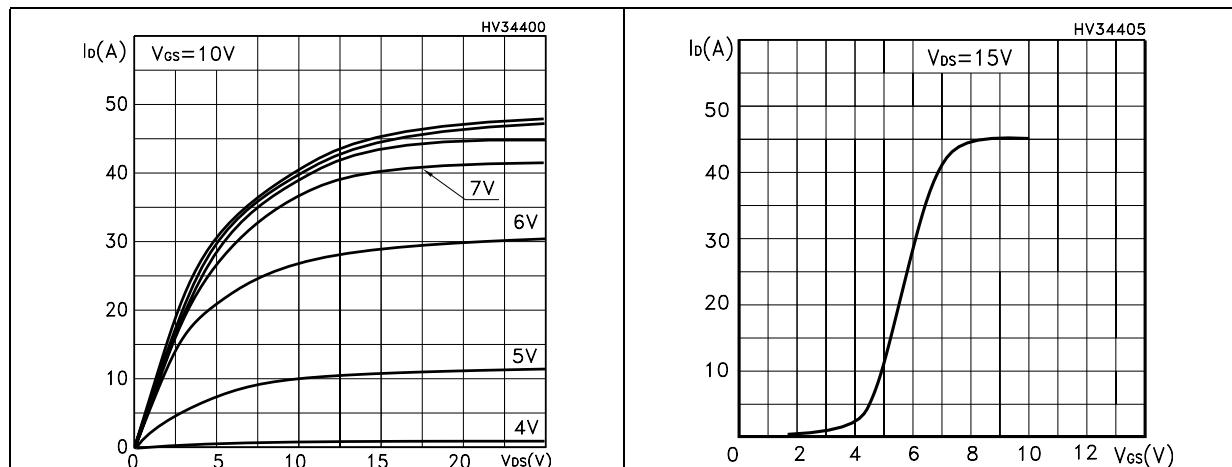


Figure 5. Static drain-source on resistance

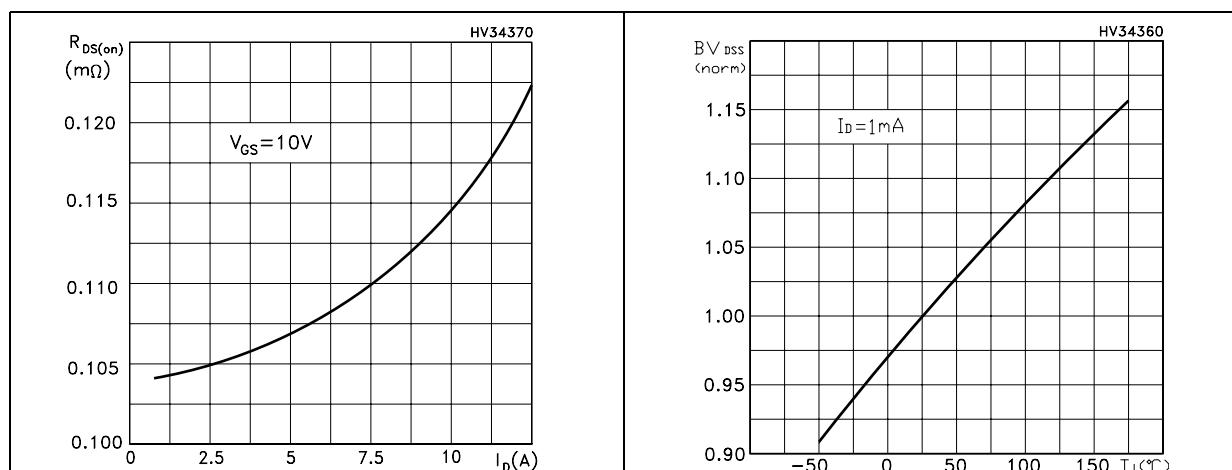


Figure 2. Thermal impedance

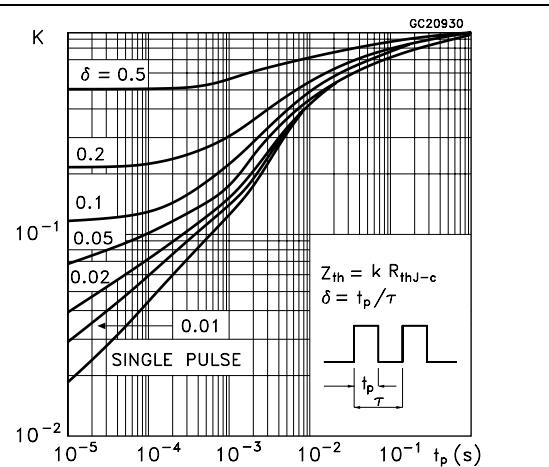
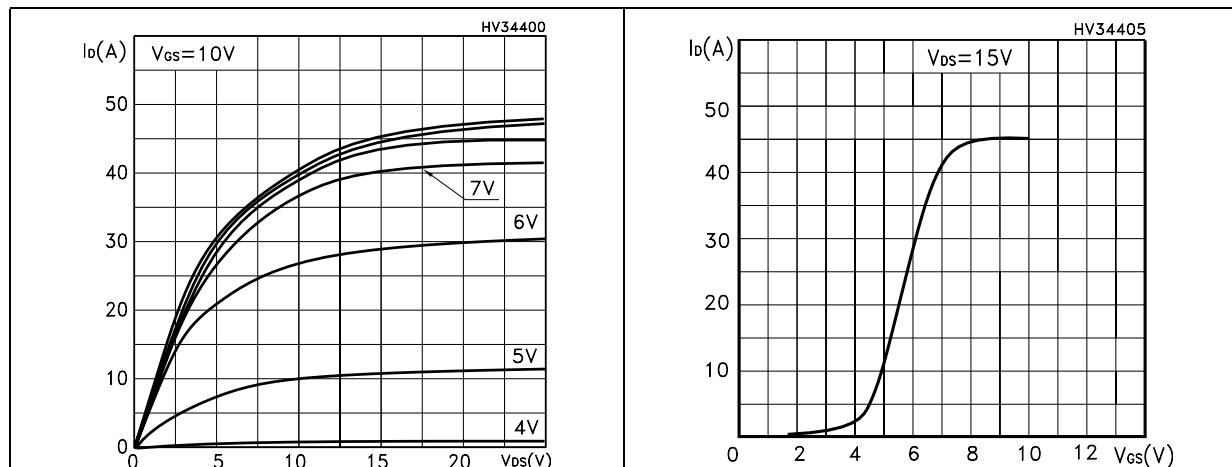
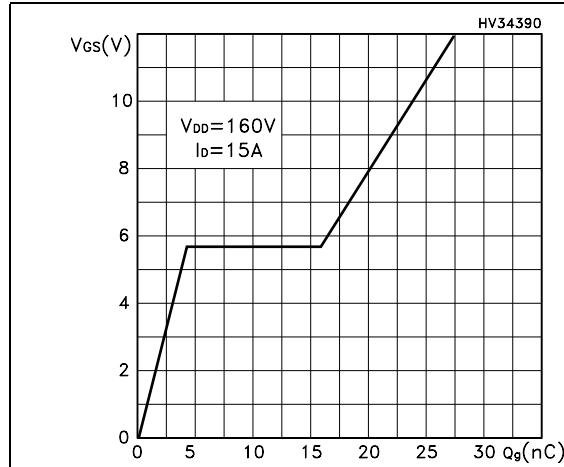
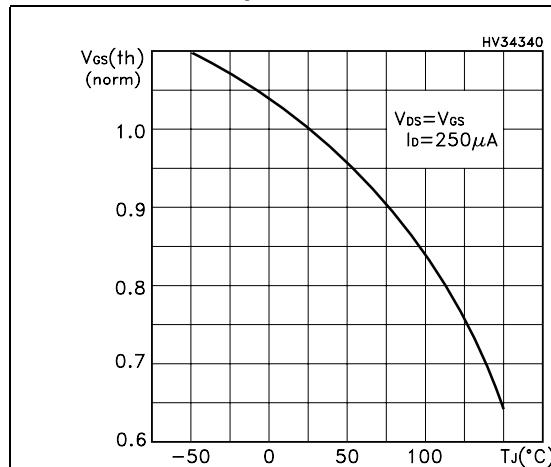
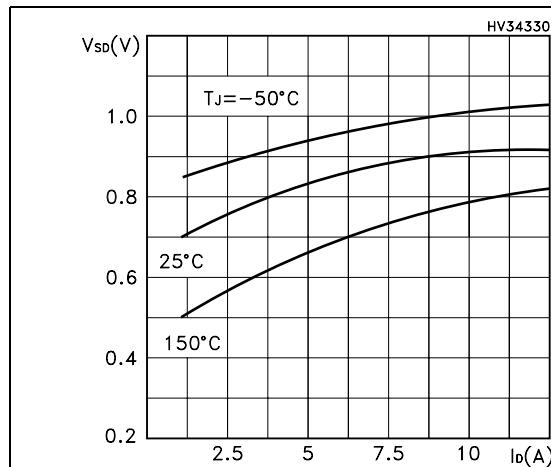
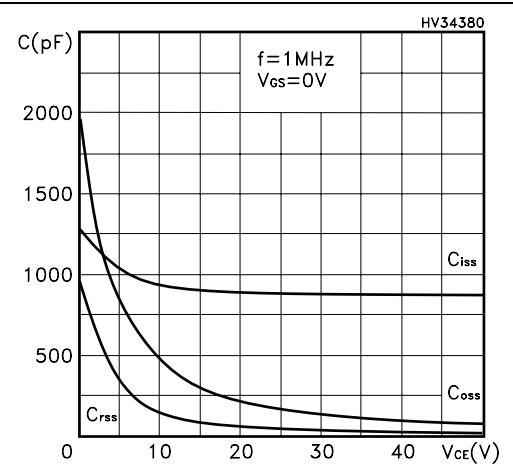
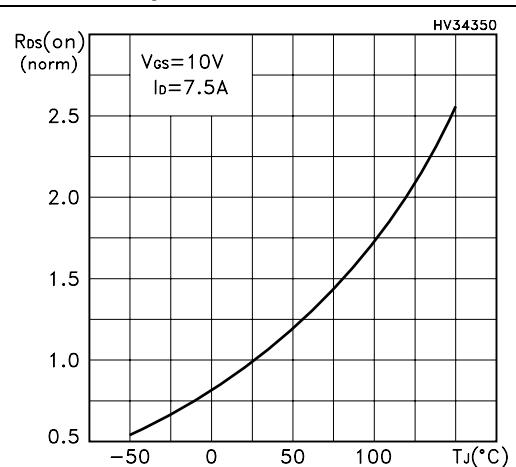
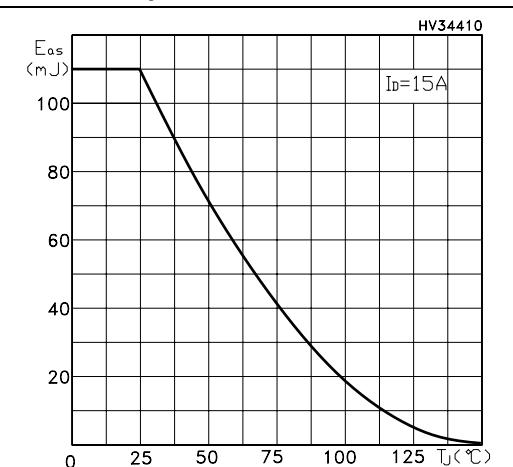


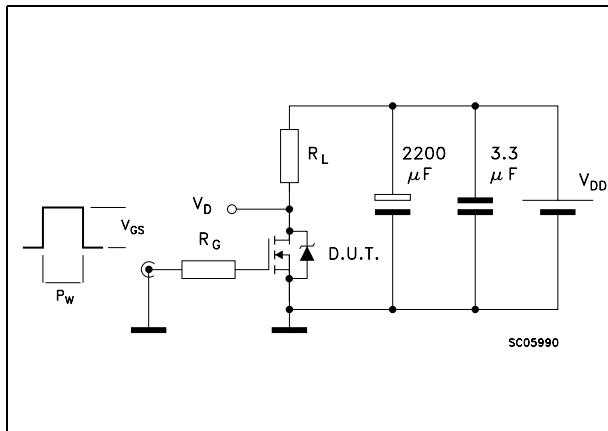
Figure 4. Transfer characteristics

Figure 6. Normalized BV<sub>DSS</sub> vs temperature

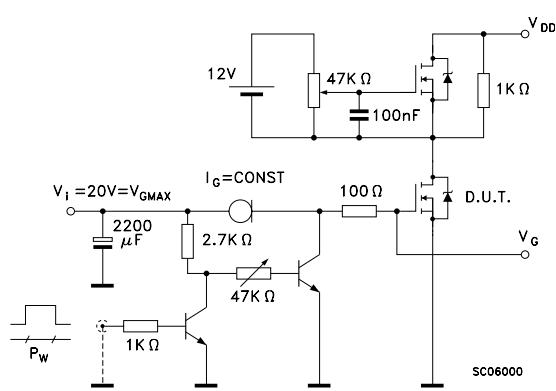
**Figure 7. Gate charge vs gate-source voltage****Figure 9. Normalized gate threshold voltage vs temperature****Figure 11. Source-drain forward characteristics****Figure 8. Capacitance variations****Figure 10. Normalized on resistance vs temperature****Figure 12. Maximum avalanche energy vs temperature**

### 3 Test circuit

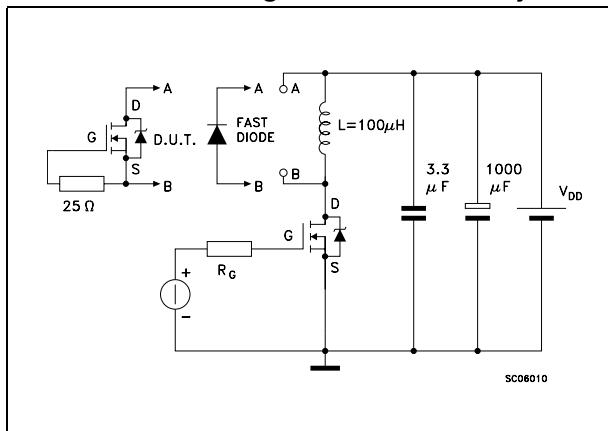
**Figure 13. Switching times test circuit for resistive load**



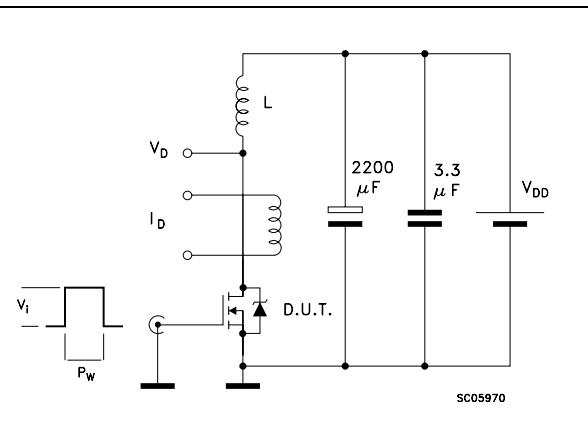
**Figure 14. Gate charge test circuit**



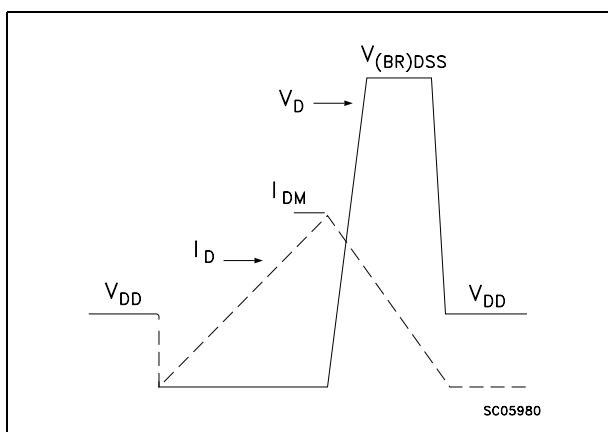
**Figure 15. Test circuit for inductive load switching and diode recovery times**



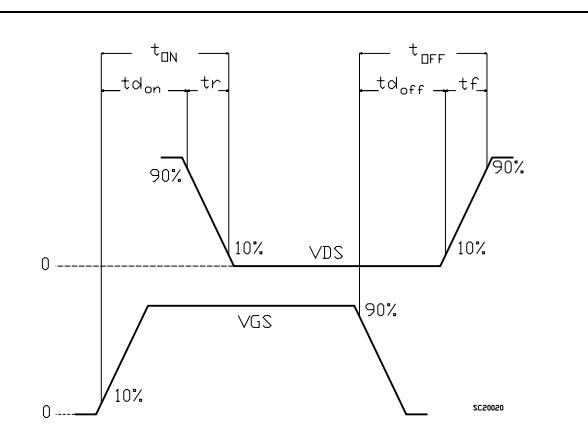
**Figure 16. Unclamped Inductive load test circuit**



**Figure 17. Unclamped inductive waveform**



**Figure 18. Switching time waveform**

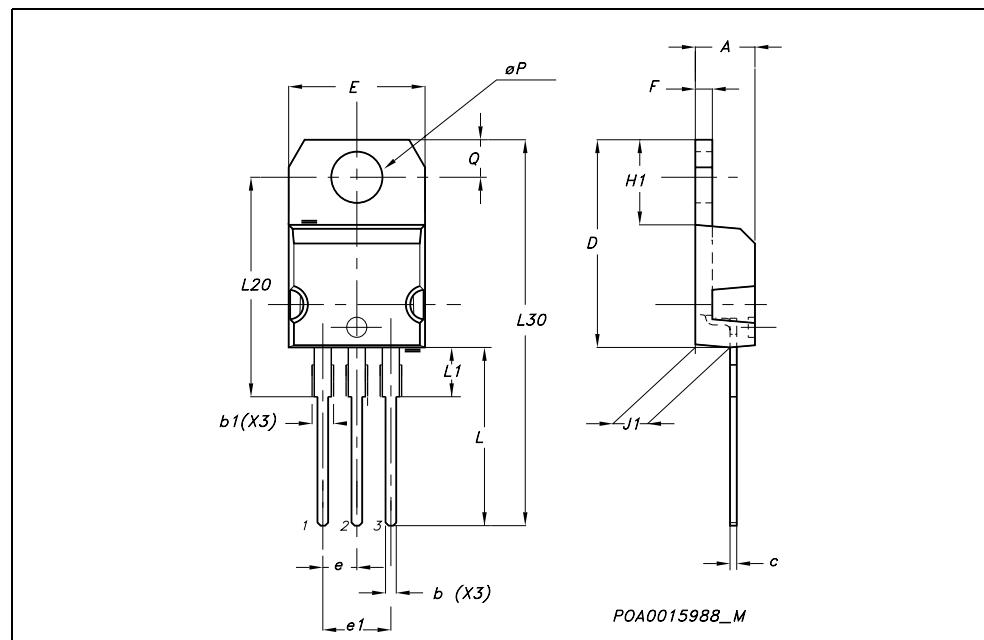


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

## 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	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
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		0.052
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	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



## 5 Revision history

**Table 8. Revision history**

Date	Revision	Changes
06-Oct-2006	1	First Release

**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.

© 2006 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 - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)