VND5N07

OMNIFET II
fully autoprotected Power MOSFET

Features

Max. on-state resistance (per ch.)	$R_{DS\,(on)}$	0.2Ω
Current limitation (typ)	I_{LIMH}	5 A
Drain-Source clamp voltage	V_{CLAMP}	70V

- Linear current limitation
- Thermal shutdown
- Short circuit protection
- Integrated clamp
- Low current drawn from input pin
- Diagnostic feedback through input pin
- Esd protection
- Direct access to the gate of the power mosfet (analog driving)
- Compatible with standard Power MOSFET

DPAK
TO-252

IPAK
TO-251

ISOWATT200

SOT-82FM
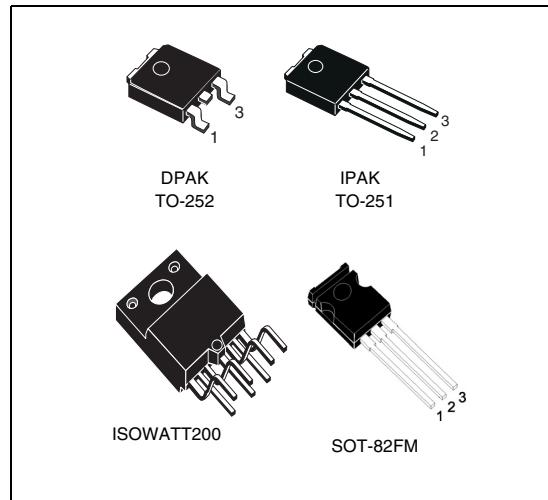
Description

The VND5N07 is a monolithic device designed in STMicroelectronics VIPower M0 technology, intended for replacement of standard Power MOSFETs from DC to 50KHz applications. Built in thermal shutdown, linear current limitation and overvoltage clamp protect the chip in harsh environments.

Fault feedback can be detected by monitoring the voltage at the input pin.

Table 1.   Device summary

Package	Order codes	
	Tube	Tape and reel
DPAK	VND5N07	VND5N0713TR
IPAK	VND5N07-1	
ISOWATT220	VNP5N07FI	
SOT-82FM	VNK5N07FM	

Contents

List of tables

List of figures

1 Block diagram and pin description

Figure 1.   **Block diagram**
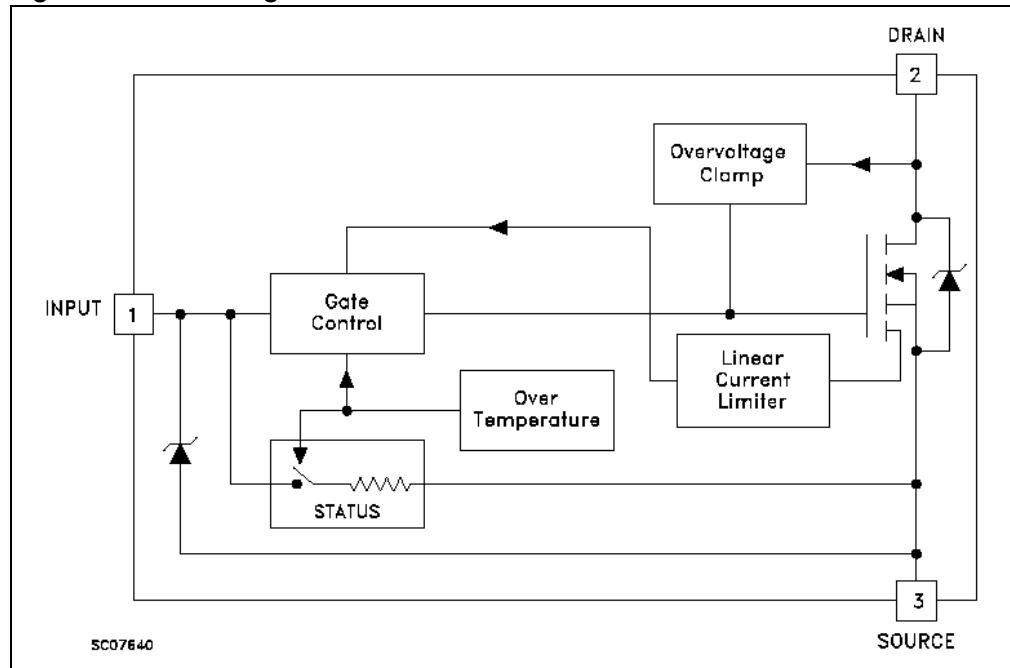
2   Electrical specifications

2.1   Absolute maximum ratings

Stressing the device above the rating listed in the "Absolute maximum ratings" table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to Absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE program and other relevant quality document.

Table 2.   Absolute maximum ratings

Symbol	Parameter	Value			Unit
		DPAK / IPAK	ISOWATT220	SOT-82FM	
V_{DSn}	Drain-Source voltage (V_{INn} = 0V)	Internally clamped			V
V_{INn}	Input voltage	18			V
I_{Dn}	Drain current	Internally limited			A
I_{Rn}	Reverse DC output current	-7			A
V_{ESD}	Electrostatic discharge (R = 1.5KΩ, C = 100pF)	2000			V
P_{tot}	Total dissipation at T_c = 25°C	60	24	9	W
T_j	Operating junction temperature	Internally limited			°C
T_c	Case operating temperature	Internally limited			°C
T_{stg}	Storage temperature	-55 to 150			°C

2.2   Thermal data

Table 3.   Thermal data

Symbol	Parameter	Max. value			Unit
		DPAK / IPAK	ISOWATT220	SOT-82FM	
$R_{thj\text{-}case}$	Thermal resistance junction-case	3.75	5.2	14	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	100	62.5	100	°C/W

2.3   Electrical characteristics

T_{case} = 25°C unless otherwise stated.

Table 4.   Off

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{CLAMP}	Drain-Source clamp voltage	V_{IN} = 0V; I_D = 200mA	60	70	80	V
V_{CLTH}	Drain-Source threshold voltage	V_{IN} = 0V; I_D = 2mA	55			V
I_{ISS}	Supply current from input pin	V_{DS} = 0V; V_{IN} = 10V		250	500	µA
V_{INCL}	Input-Source reverse clamp voltage	I_{IN} = 1mA	-1.0		-0.3	V
I_{DSS}	Zero input voltage drain current (V_{IN}=0V)	V_{DS} = 13V; V_{IN} = 0V; V_{DS} = 25V; V_{IN} = 0V			50 200	µA µA

Table 5.   On[1]

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$R_{DS(on)}$	Static Drain-Source on resistance	V_{IN} =10V; I_D = 2.5A; V_{IN} = 5V; I_D = 2.5A			200 280	mΩ
$V_{IN(th)}$	Input threshold voltage	V_{DS} = V_{in}; I_D + I_{in} = 1 mA	0.8		3	V

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

Table 6.   Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} [1]	Forward transconductance	V_{DS} = 13V; I_D = 2.5A	3	4		S
C_{OSS}	Output capacitance	V_{DS} = 13V; f = 1MHz; V_{IN} = 0V		200	300	pF

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

Table 7.   Switching[1]

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 15V; I_D = 2.5A V_{gen} = 10V; R_{gen} = 10Ω		50	100	ns
t_r	Rise time			60	100	ns
$t_{d(off)}$	Turn-off delay time			150	300	ns
t_f	Fall time			40	80	ns
$t_{d(on)}$	Turn-on delay time	V_{DD} = 15V; I_D = 2.5A V_{gen} = 10V; R_{gen} = 1kΩ		150	250	ns
t_r	Rise time			400	600	ns
$t_{d(off)}$	Turn-off delay time			3900	5000	ns
t_f	Fall time			1100	1600	ns
$(dI/dt)_{on}$	Turn-on current slope	V_{DD} = 15V; I_D = 2.5A V_{in} = 10V; R_{gen} = 10Ω		80		A/µS
Q_i	Total input charge	V_{DD} = 12V; I_D = 2.5A; V_{IN} = 10V		18		nC

1.   Parameters guaranteed by design / characterization.

Table 8.   Source Drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD}[1]	Forward On voltage	I_{SD} = 2.5A; V_{IN} = 0V			1.6	V
t_{rr}[2]	Reverse recovery time	I_{SD} = 2.5A; dI/dt = 100 A/µs V_{DD} = 30V;		150		ns
Q_{rr}[2]	Reverse recovery charge			0.3		µC
I_{RRM}[2]	Reverse recovery current			5.7		A

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

2.   Parameters guaranteed by design / characterization.

Table 9.   Protections (-40°C < T_j < 150°C, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{lim}	Drain current limit	V_{IN} = 10V; V_{DS} = 13V	3.5	5	7	A
		V_{IN} = 5V; V_{DS} = 13V	3.5	5	7	A
t_{dlim} [1]	Step response current limit	V_{IN} = 10V;		15	20	µS
		V_{IN} = 5V		40	60	µS
T_{jsh} [1]	Overtemperature shutdown		150			°C
T_{jrs} [1]	Overtemperature reset		135			°C
I_{gf} [1]	Fault sink current	V_{IN} = 10V; V_{DS} = 13V;		50		mA
		V_{IN} = 5V; V_{DS} = 13V		20		mA
E_{as} [1]	Single pulse avalanche energy	Starting T_j = 25°C; V_{DD} = 20V V_{IN} = 10V R_{gen} = 1kΩ; L = 10mH	0.2			J

1.   Parameters guaranteed by design / characterization.

Figure 2.   Switching time test circuit for resistive load
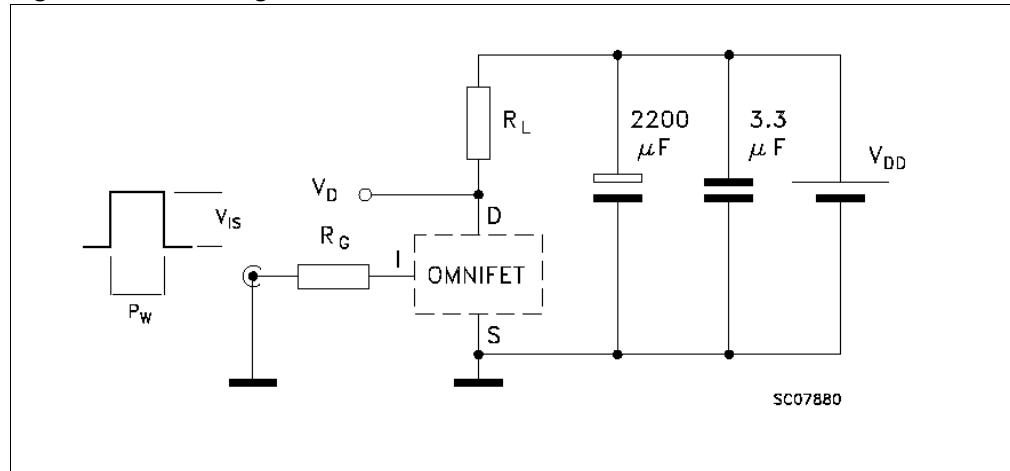

**Figure 3.   Test circuit for diode recovery times**
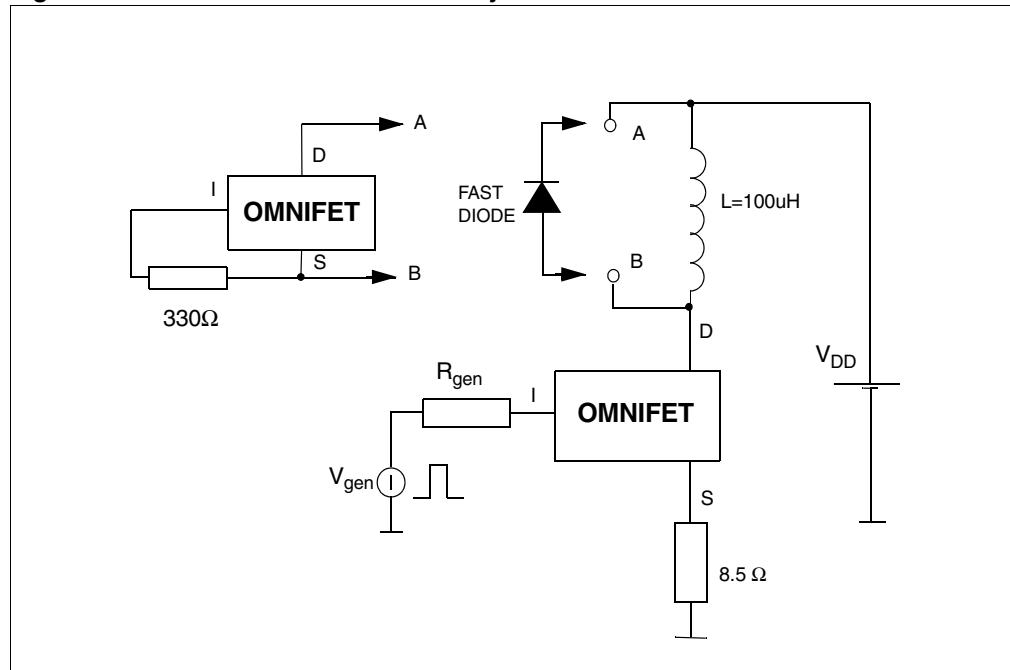
**Figure 4.   Unclamped inductive load test circuits**
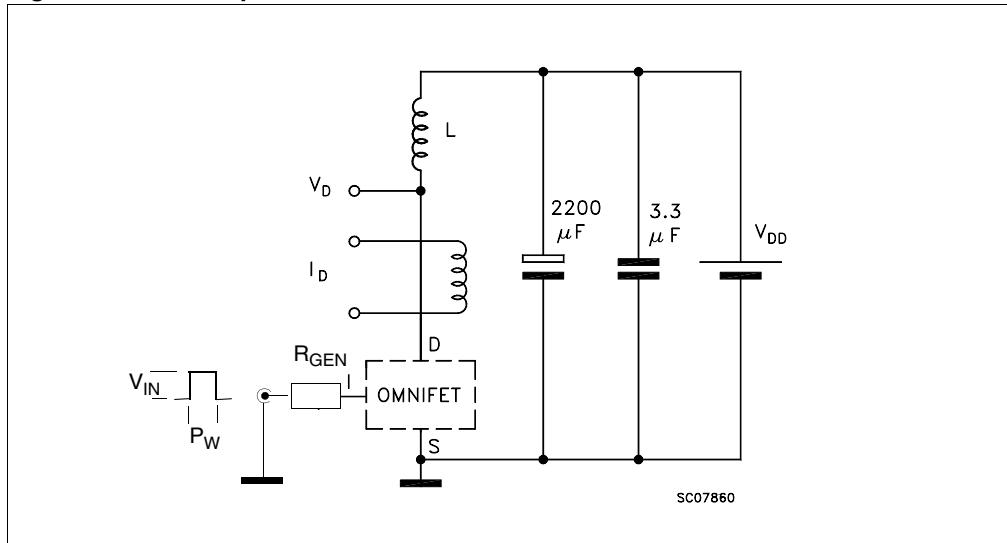
**Figure 5.   Input charge test circuit**
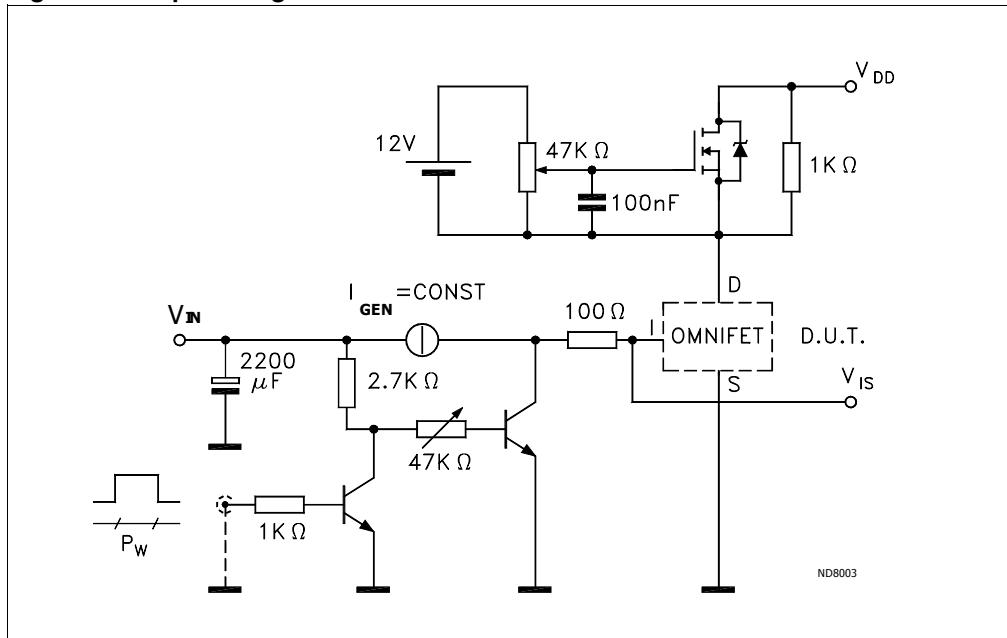
**Figure 6.   Unclamped inductive waveforms**
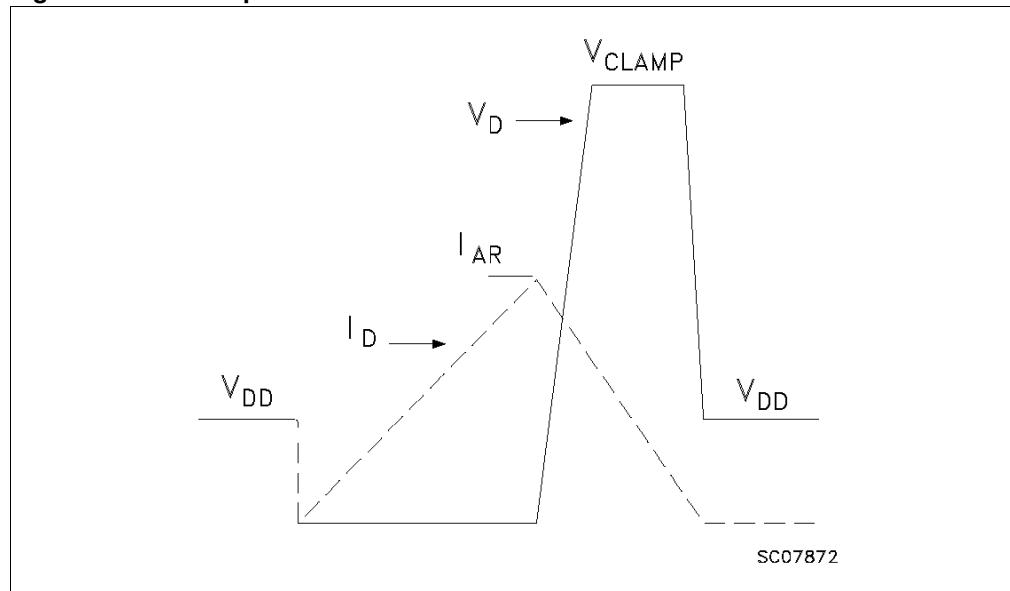
**Figure 7.   Switching waveforms**
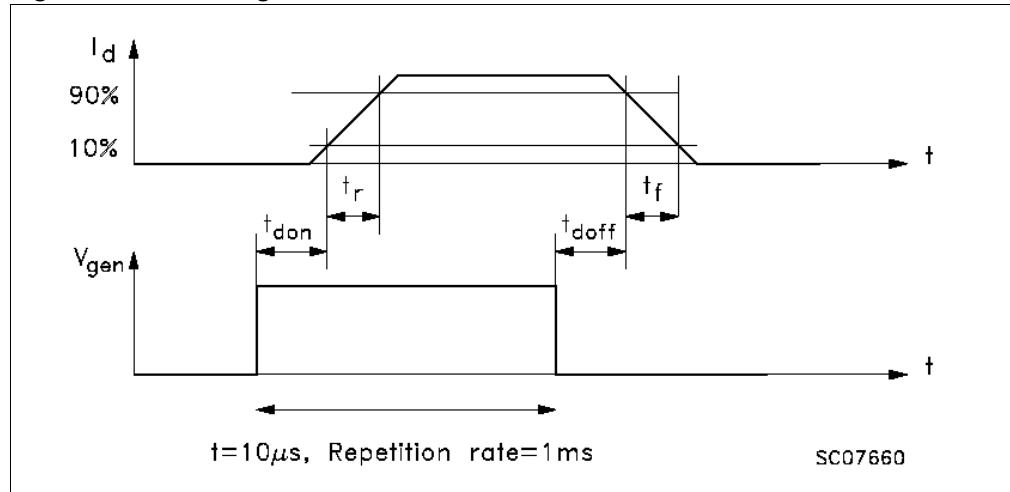
**Figure 8.   Thermal impedance for ISOWATT220**
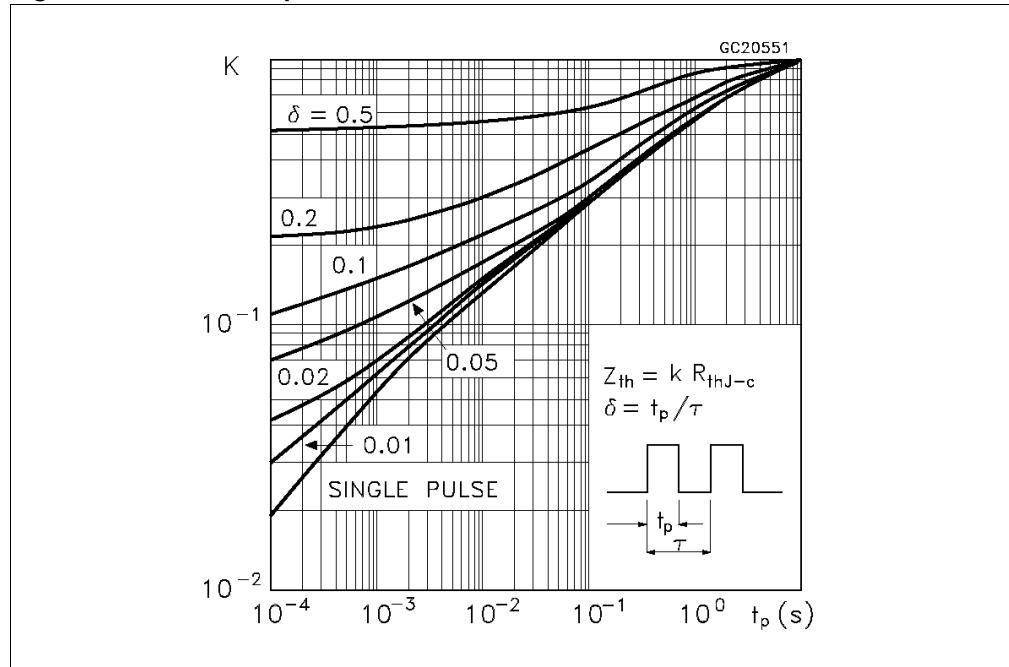
Figure 9.   Thermal impedance for DPAK / IPAK
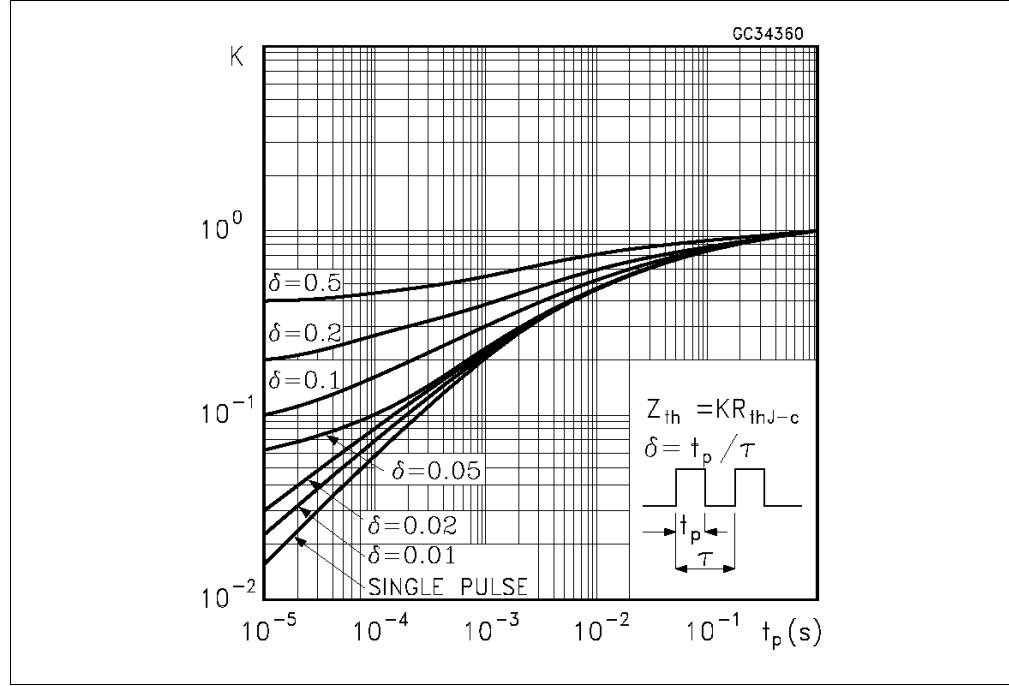
2.4 Electrical characteristics curves

**Figure 10. Source-Drain diode forward characteristics**
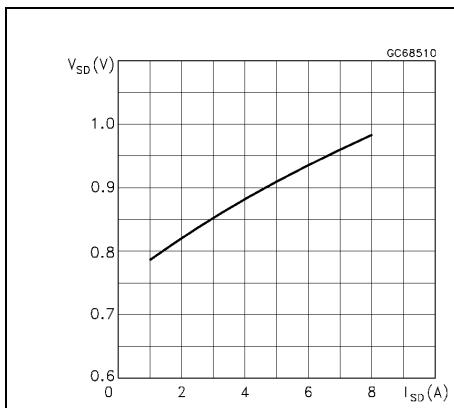
Figure 11. Static Drain-Source on resistance
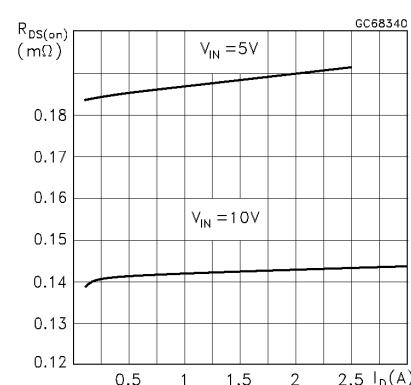

**Figure 12. Derating curve**
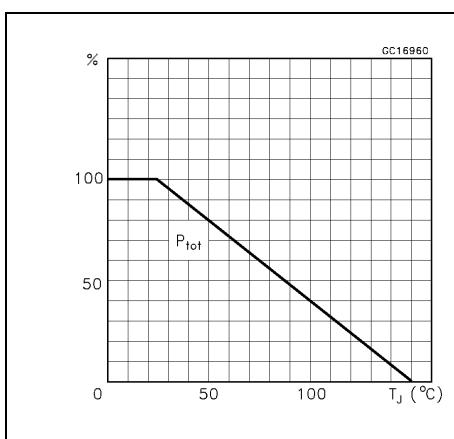
Figure 13. Static Drain-Source on resistance vs. input voltage
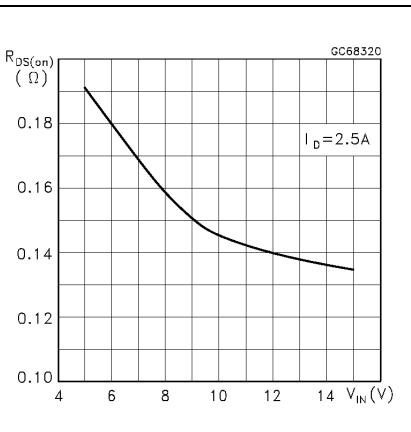
**Figure 14. Normalized on resistance Vs temperature**
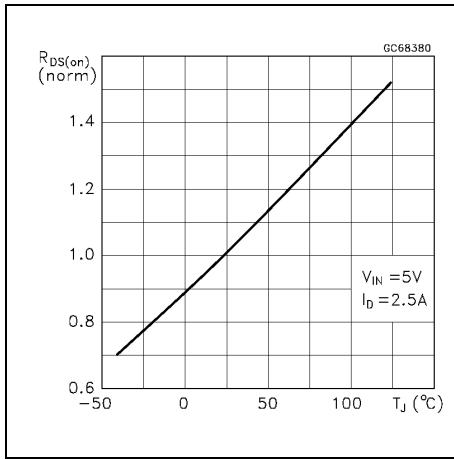
Figure 15. Transconductance
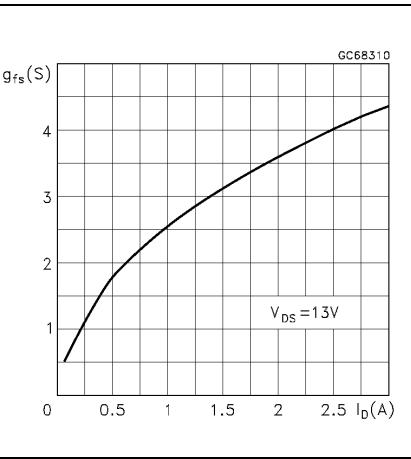
Figure 16. Static Drain-Source on resistance Vs. Id
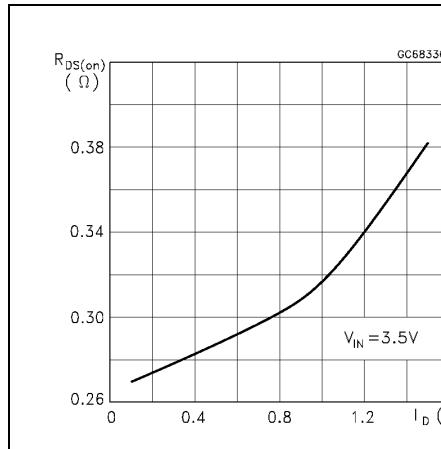
Figure 17. Switching time resistive load
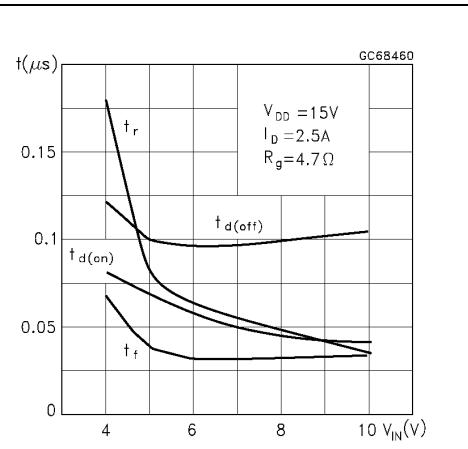
Figure 18. Turn-on current slope (V_IN = 10V)
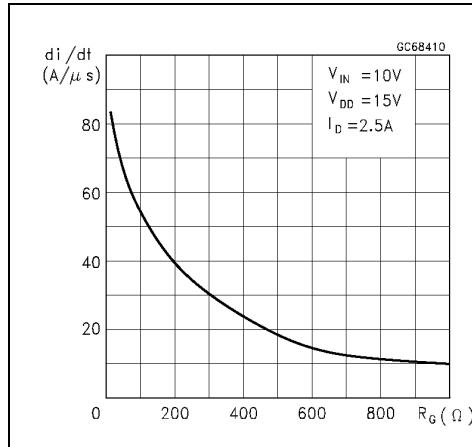
Figure 19. Turn-on current slope (V_IN = 5V)
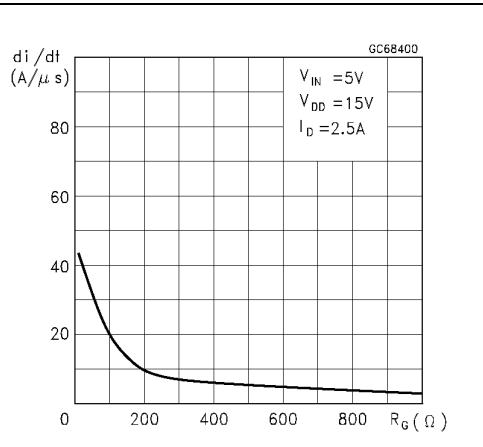
Figure 20. Input voltage Vs. input charge
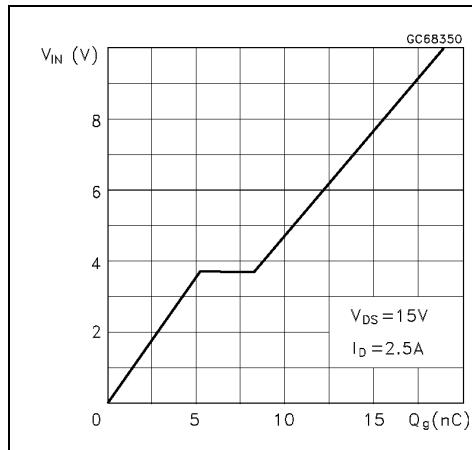
Figure 21. Turn-off Drain Source voltage slope

14/24
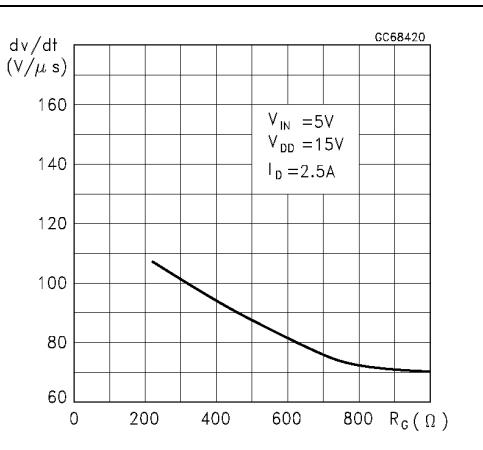
Figure 22. Turn-off Drain-Source voltage slope

Figure 23. Capacitance variations
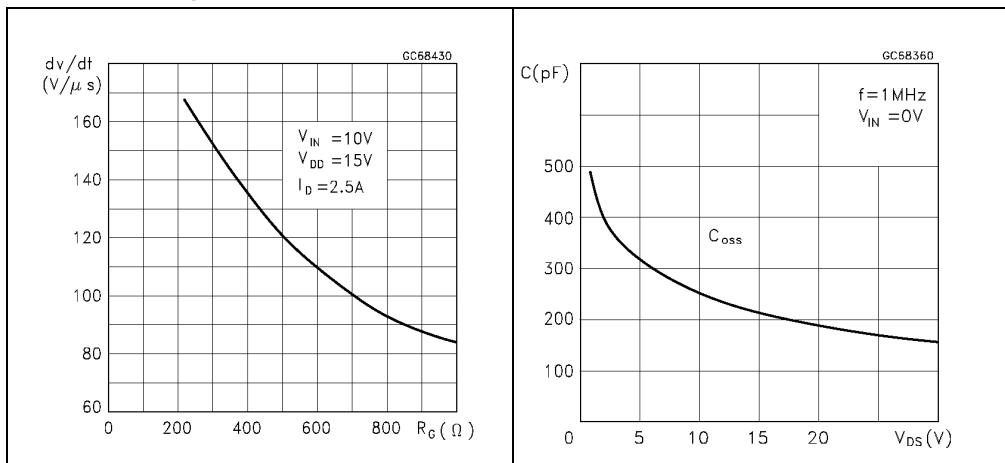
Figure 24. Switching time resistive load

Figure 25. Step response current limit
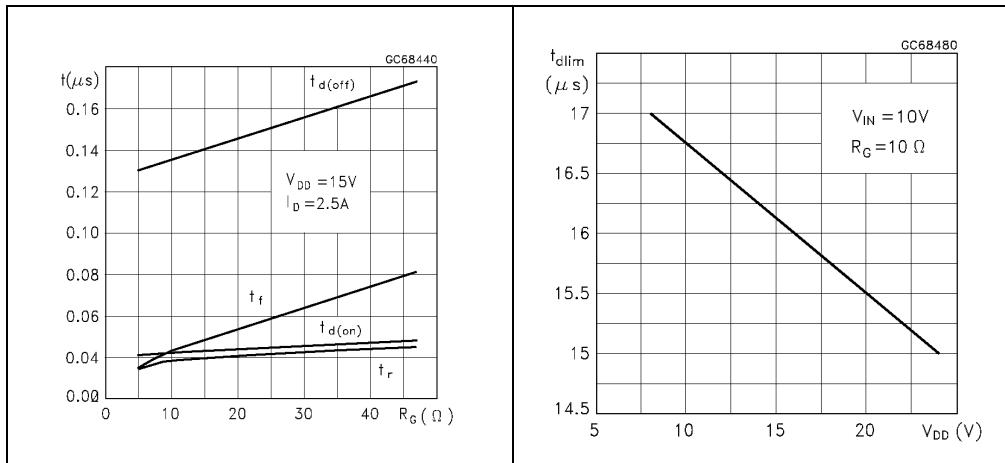
Figure 26. Output characteristics
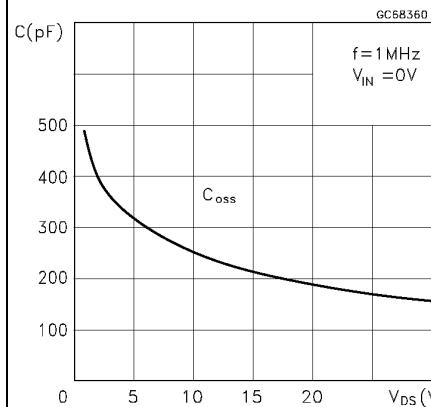
Figure 27. Normalized on resistance Vs. temperature
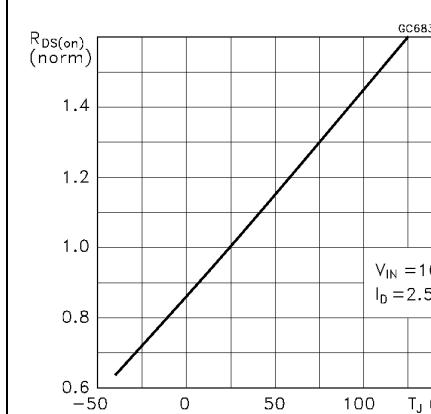
Figure 28. Normalized Input threshold   Figure 29. Normalized current limit Vs.
**   voltage Vs. temperature   junction temperature**
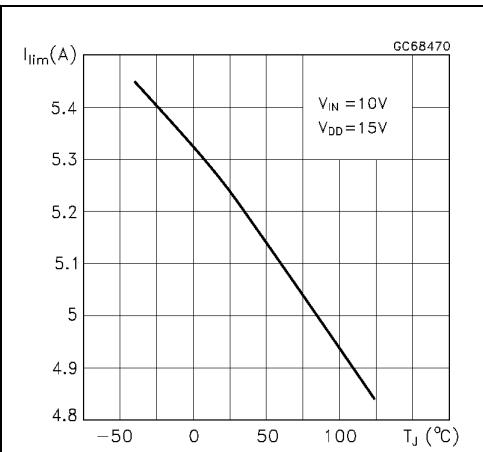
3   Protection features

During normal operation, the INPUT pin is electrically connected to the gate of the internal power MOSFET.

The device then behaves like a standard power MOSFET and can be used as a switch from DC to 50KHz. The only difference from the user's standpoint is that a small DC current I_{ISS} flows into the INPUT pin in order to supply the internal circuitry.

The device integrates:

3.1   Overvoltage clamp protection

Internally set at 70V, along with the rugged avalanche characteristics of the Power MOSFET stage give this device unrivalled ruggedness and energy handling capability. This feature is mainly important when driving inductive loads.

3.2   Linear current limiter circuit

Limits the drain current I_D to I_{lim} whatever the INPUT pin voltages. When the current limiter is active, the device operates in the linear region, so power dissipation may exceed the capability of the heatsink. Both case and junction temperatures increase, and if this phase lasts long enough, junction temperature may reach the overtemperature threshold T_{jsh}.

3.3   Overtemperature and short circuit protection

These are based on sensing the chip temperature and are not dependent on the input voltage. The location of the sensing element on the chip in the power stage area ensures fast, accurate detection of the junction temperature. Overtemperature cutout occurs at minimum 150 °C. The device is automatically restarted when the chip temperature falls below 135 °C .

3.4   Status feedback

In the case of an overtemperature fault condition, a Status Feedback is provided through the Input pin. The internal protection circuit disconnects the input from the gate and connects it instead to ground via an equivalent resistance of 100 Ω The failure can be detected by monitoring the voltage at the Input pin, which will be close to ground potential.

Additional features of this device are ESD protection according to the Human Body model and the ability to be driven from a TTL Logic circuit (with a small increase in $R_{DS(on)}$).

4 Package and packing information

4.1 ECOPACK® packages

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.

4.2 DPAK mechanical data

Figure 30. DPAK package dimensions

P032P
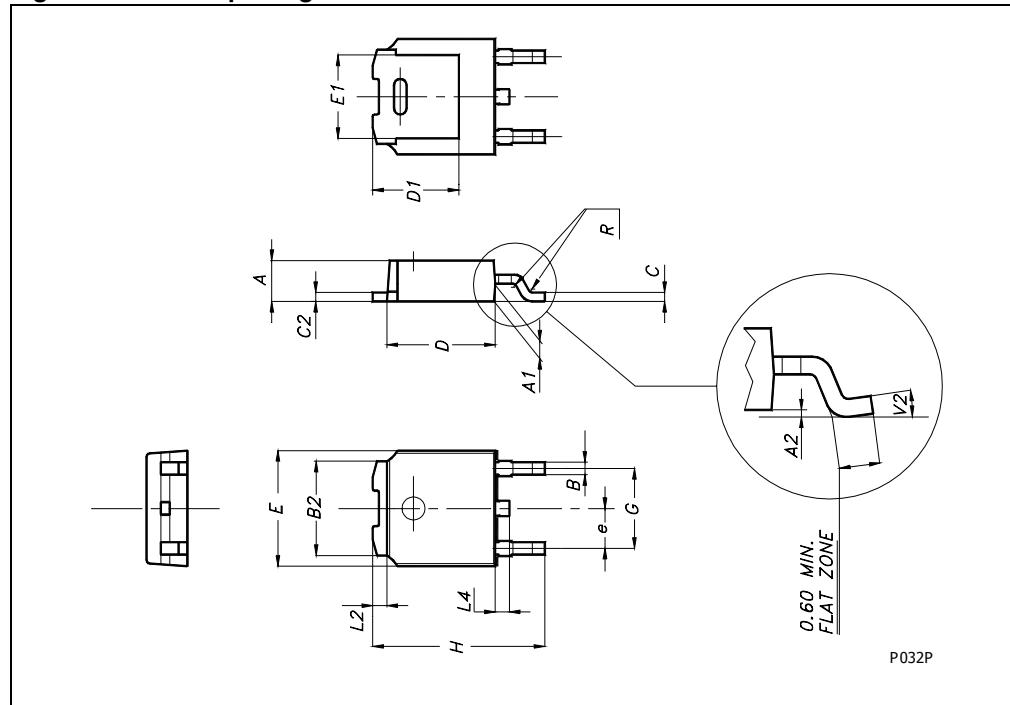
Table 10. DPAK mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
B	0.64		0.90
B2	5.20		5.40
C	0.45		0.60
C2	0.48		0.60
D	6.00		6.20
D1		5.1	
E	6.40		6.60
E1		4.7	
e		2.28	
G	4.40		4.60
H	9.35		10.10
L2		0.8	
L4	0.60		1.00
R		0.2	
V2	0°	8°	
Package weight	Gr. 0.29		

4.3 IPAK mechanical data

Figure 31. IPAK mechanical data and package outline
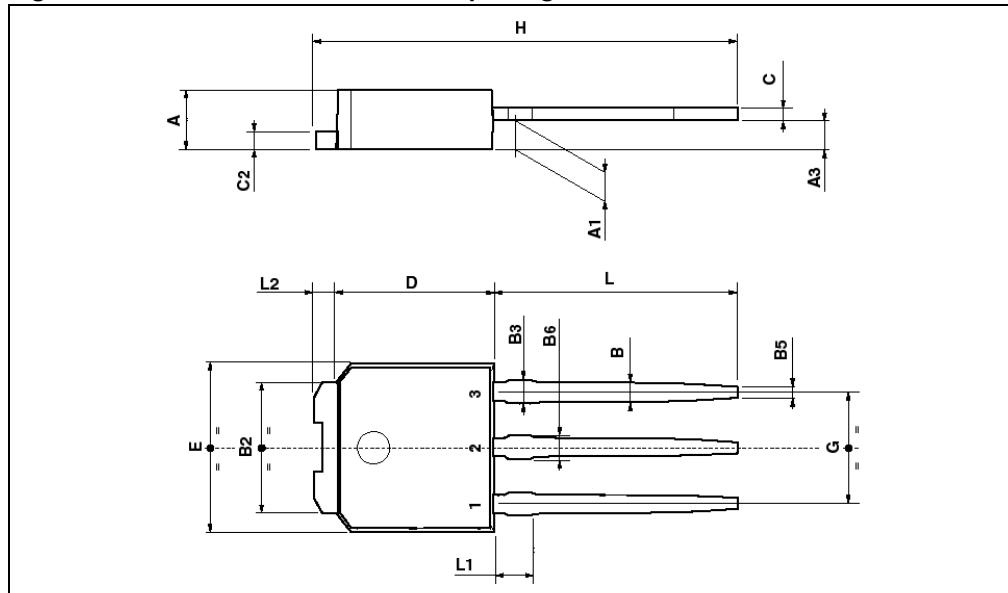
Table 11. IPAK mechanical data

Symbol	mm		
	Min.	Typ.	Max.
A	2.2		2.4
A1	0.9		1.1
A3	0.7		1.3
B	0.64		0.9
B2	5.2		5.4
B3			0.85
B5		0.3	
B6			0.95
C	0.45		0.6
C2	0.48		0.6
D	6		6.2
E	6.4		6.6
G	4.4		4.6
H	15.9		16.3
L	9		9.4
L1	0.8		1.2
L2		0.8	1

4.4 ISOWATT220 mechanical data

Figure 32. ISOWATT220 mechanical data and package outline
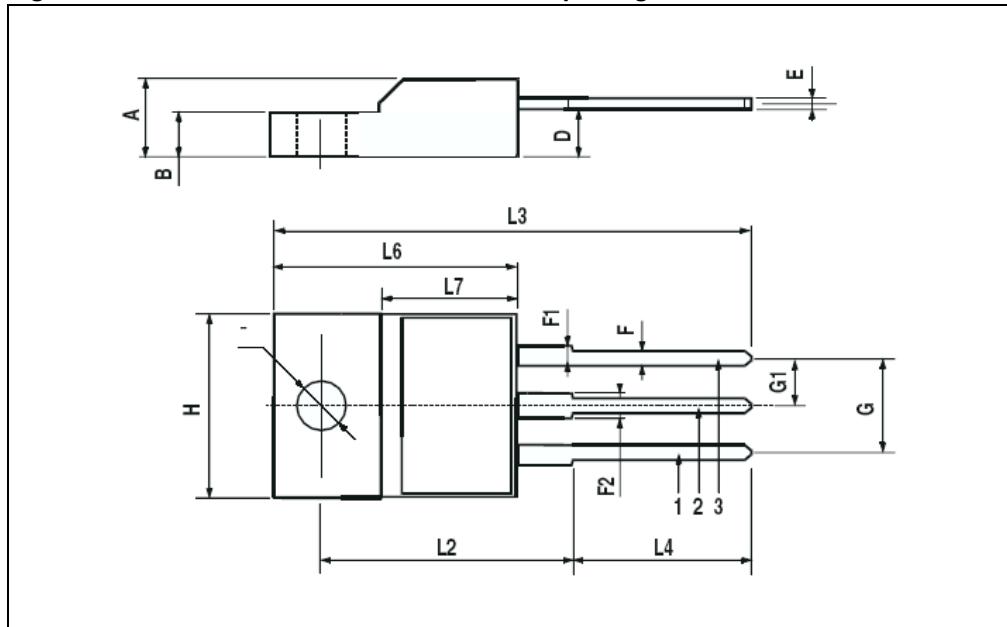
Table 12. ISOWATT220 mechanical data

Symbol	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.4		0.7
F	0.75		1
F1	1.15		1.7
F2	1.15		1.7
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
L6	15.9		16.4
L7	9		9.3
	3		3.2

4.5 SOT-82FM mechanical data

Figure 33. SOT-82FM mechanical data and package outline
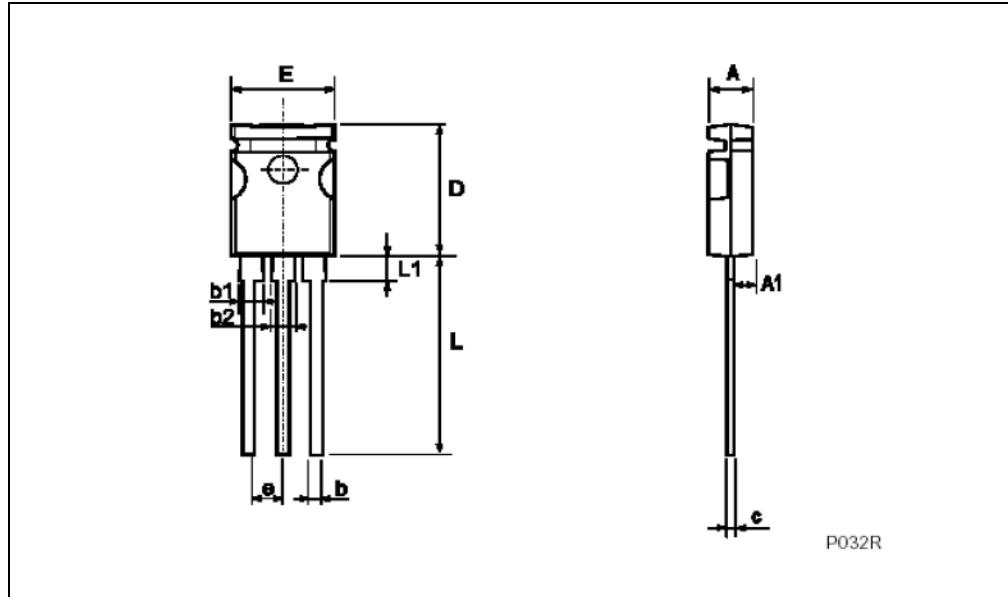
Table 13. SOT-82FM mechanical data

Symbol	mm		
	Min.	Typ.	Max.
A	2.85		3.05
A1	1.47		1.67
b	0.40		0.60
b1	1.4		1.6
b2	1.3		1.5
c	0.45		0.6
D	10.5		10.9
e	2.2		2.8
E	7.45		7.75
L	15.5		15.9
L	1 1.95		2.35

5   Revision history

Table 14.   Document revision history

Date	Revision	Changes
09-Sep-2004	1	Initial release.
17-Dec-2007	2	Stylesheet update. No content change.
11-Dec-2008	3	Document restructured and reformatted. Added *ECOPACK® packages* information.

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.

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