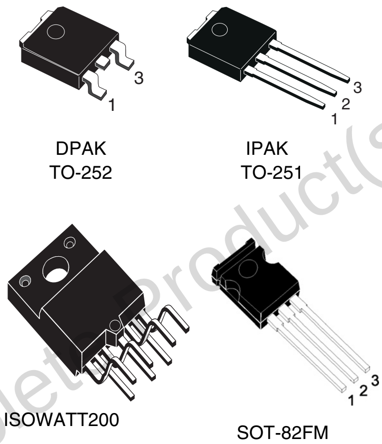
VND5N07

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



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	

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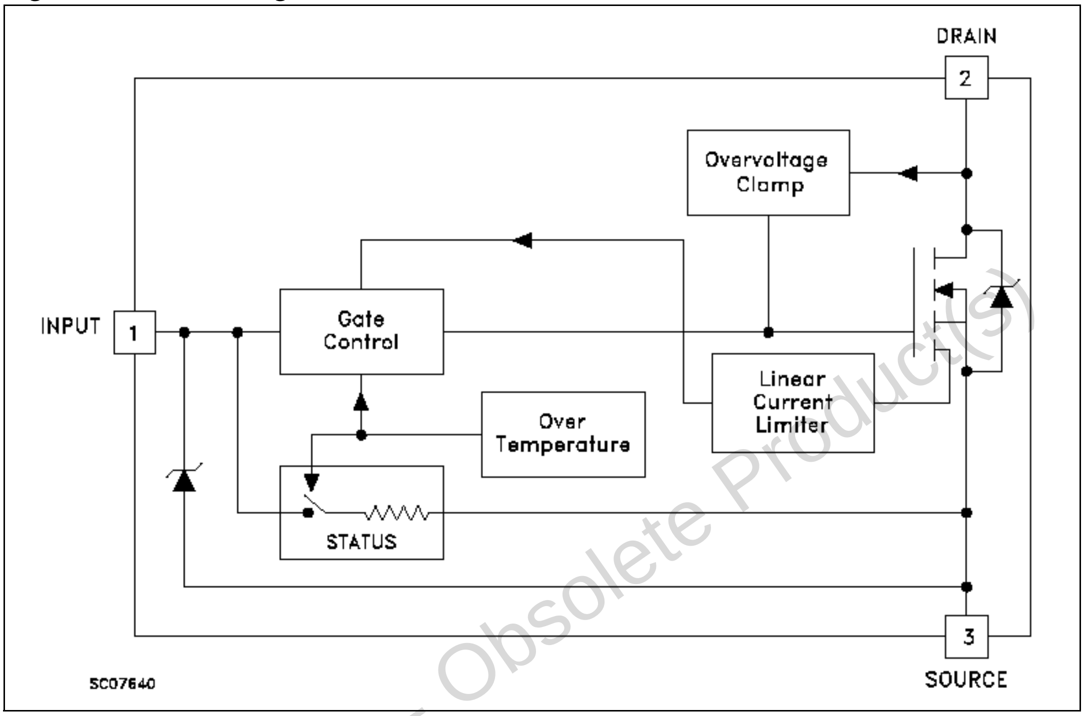
1 Block diagram and pin description

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	
$R_{thj-case}$	Thermal resistance junction-case	3.75	5.2	14	°C/W
$R_{thj-amb}$	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	$V_{DD} = 15V$; $I_D = 2.5A$ $V_{gen} = 10V$; $R_{gen} = 10\Omega$		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	$V_{DD} = 15V$; $I_D = 2.5A$ $V_{gen} = 10V$; $R_{gen} = 1k\Omega$		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	$V_{DD} = 15V$; $I_D = 2.5A$ $V_{in} = 10V$; $R_{gen} = 10\Omega$		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	$V_{IN} = 10V$; $V_{DS} = 13V$ $V_{IN} = 5V$; $V_{DS} = 13V$	3.5 3.5	5 5	7 7	A A
t_{dlim}(1)	Step response current limit	$V_{IN} = 10V$; $V_{IN} = 5V$		15 40	20 60	µS µS
T_{jsh}(1)	Overtemperature shutdown		150			°C
T_{jrs}(1)	Overtemperature reset		135			°C
I_{gf}(1)	Fault sink current	$V_{IN} = 10V$; $V_{DS} = 13V$; $V_{IN} = 5V$; $V_{DS} = 13V$		50 20		mA mA
E_{as}(1)	Single pulse avalanche energy	Starting $T_j = 25°C$; $V_{DD} = 20V$ $V_{IN} = 10V$ $R_{gen} = 1k\Omega$; $L = 10mH$	0.2			J

1. Parameters guaranteed by design / characterization.

Figure 2. Switching time test circuit for resistive load

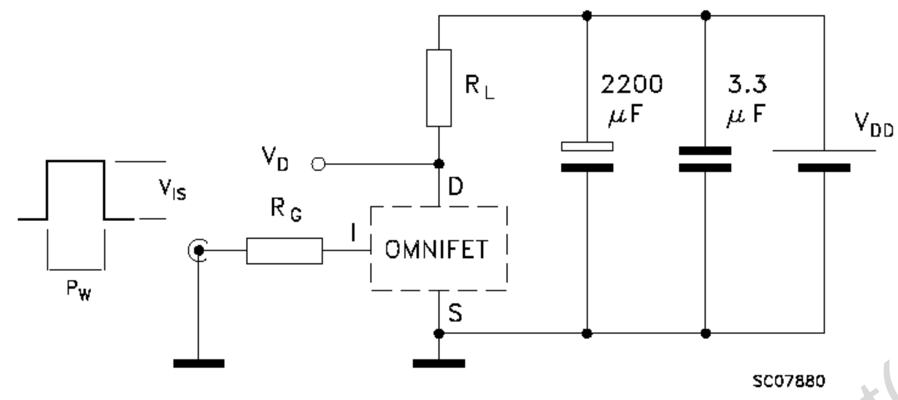


Figure 3. Test circuit for diode recovery times

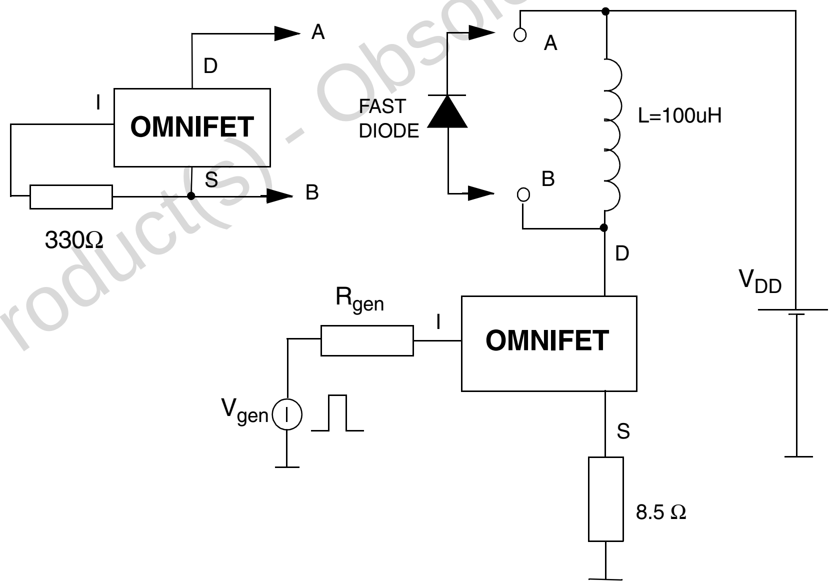


Figure 4. Unclamped inductive load test circuits

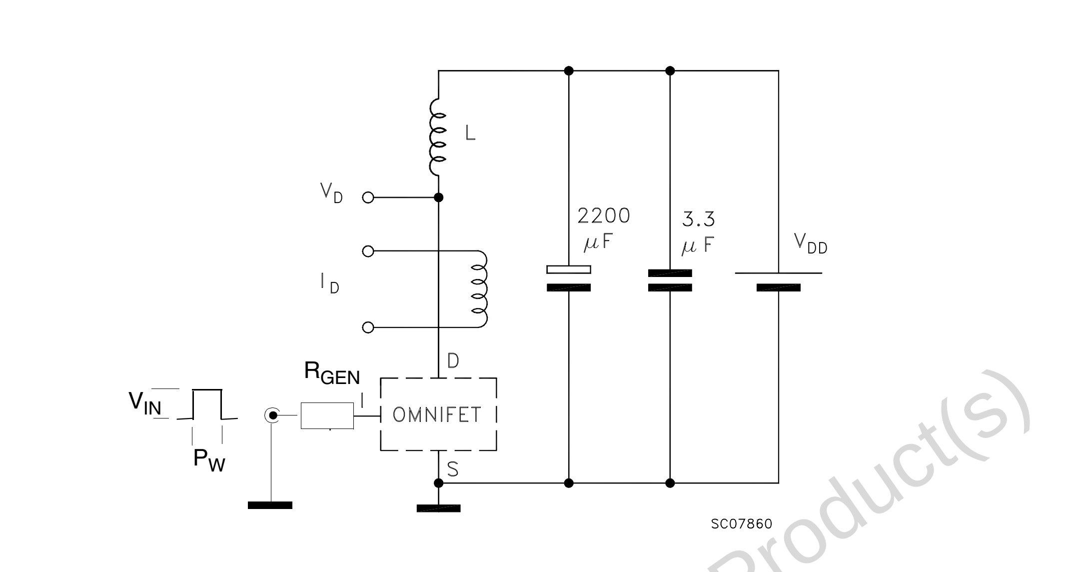


Figure 5. Input charge test circuit

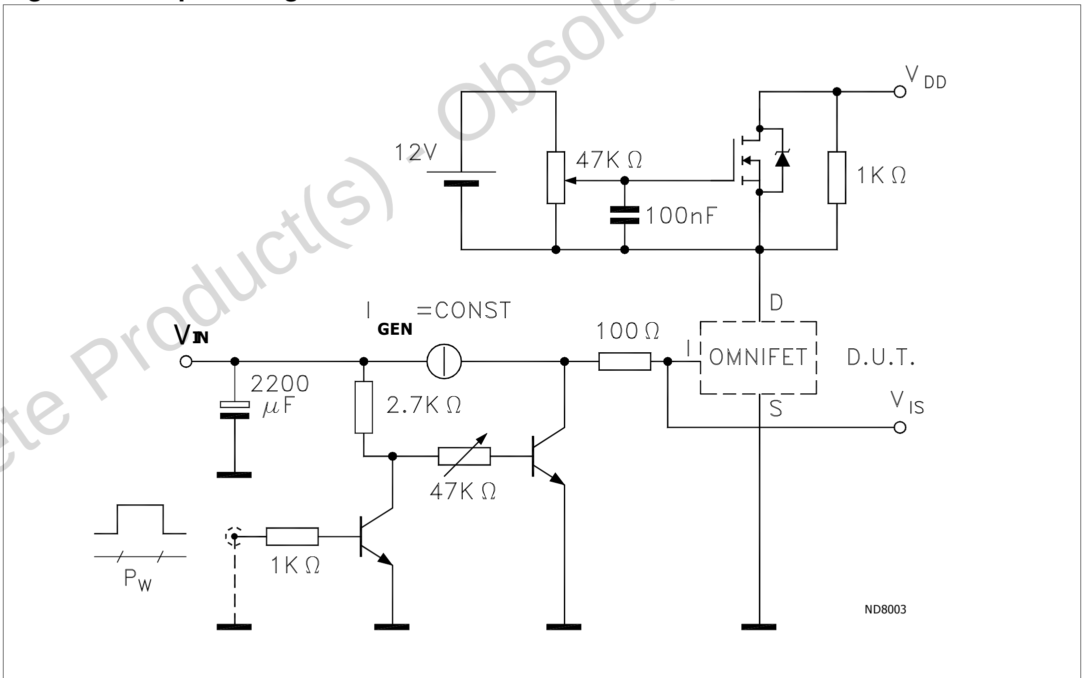


Figure 6. Unclamped inductive waveforms

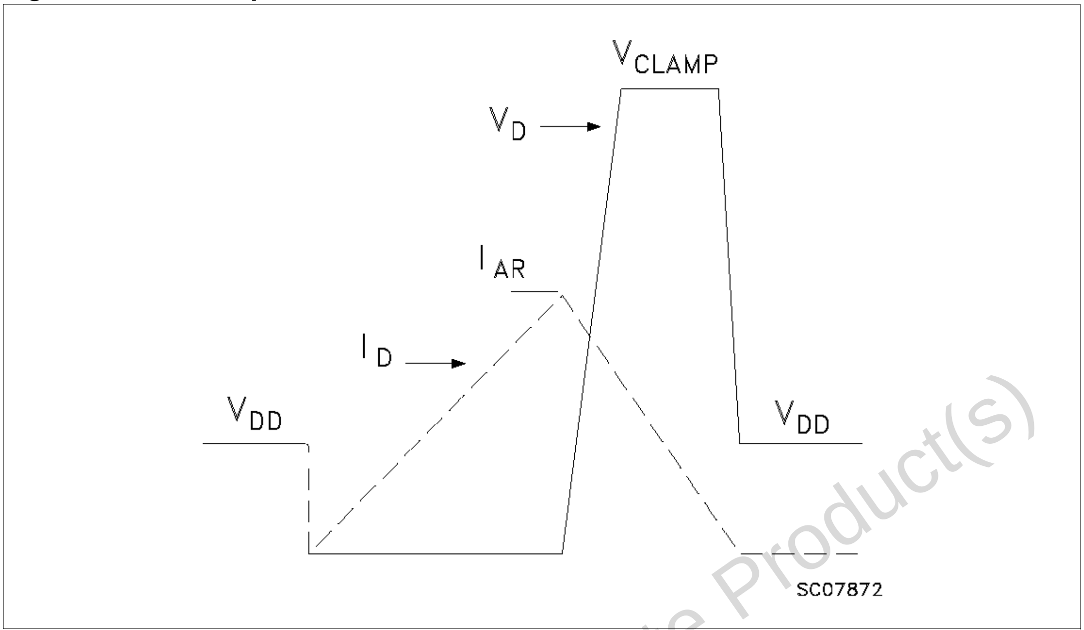


Figure 7. Switching waveforms

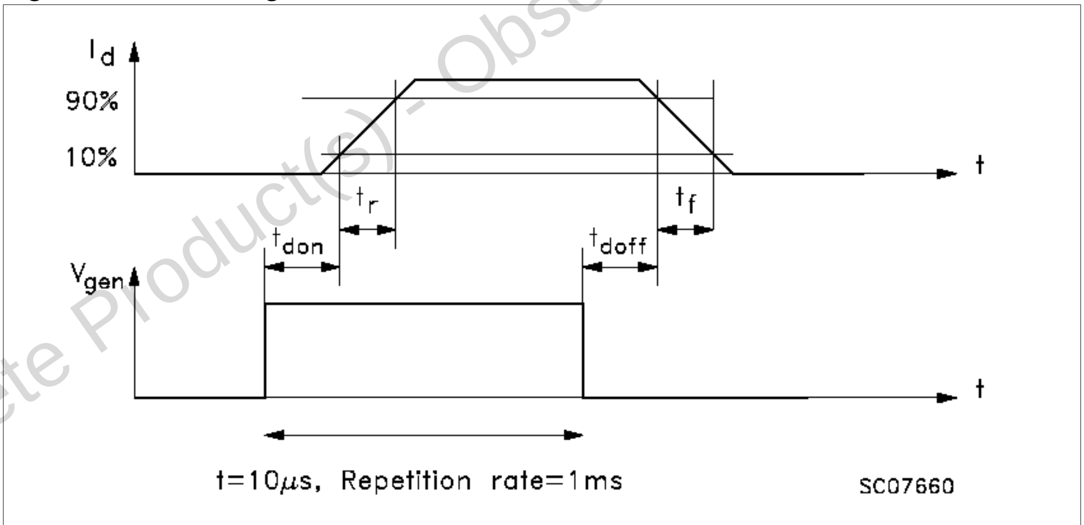


Figure 8. Thermal impedance for ISOWATT220

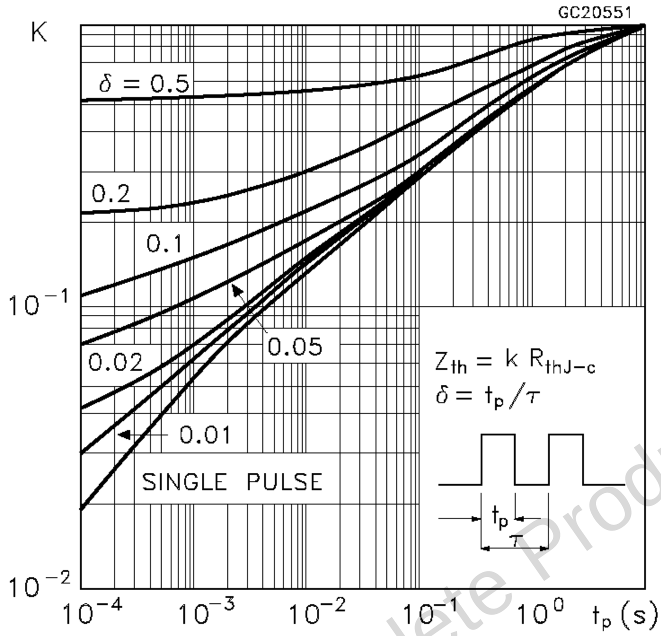
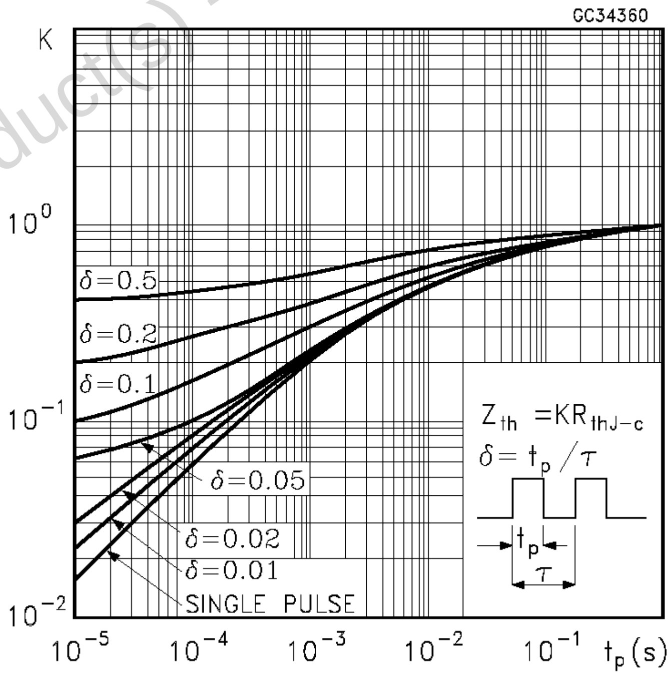


Figure 9. Thermal impedance for DPAK / IPAK



2.4 Electrical characteristics curves

Figure 10. Source-Drain diode forward characteristics

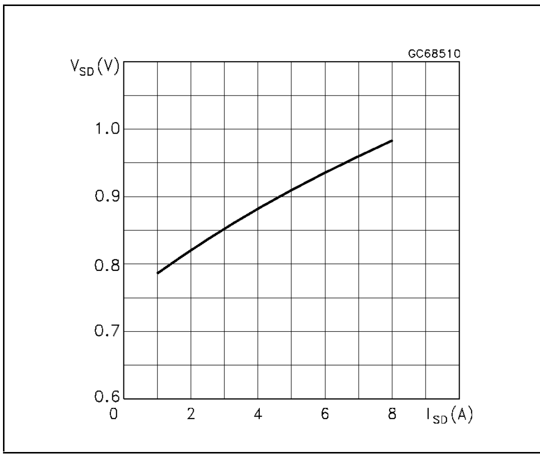


Figure 11. Static Drain-Source on resistance

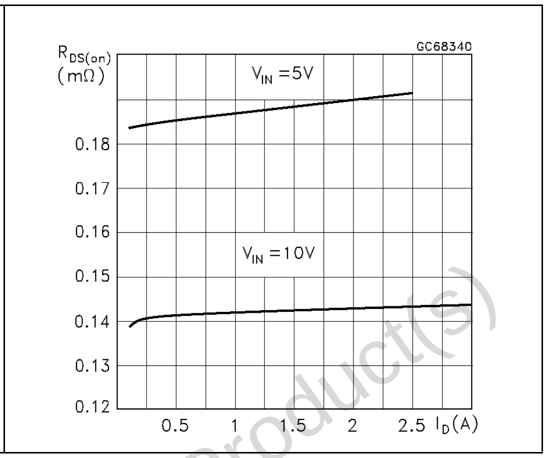


Figure 12. Derating curve

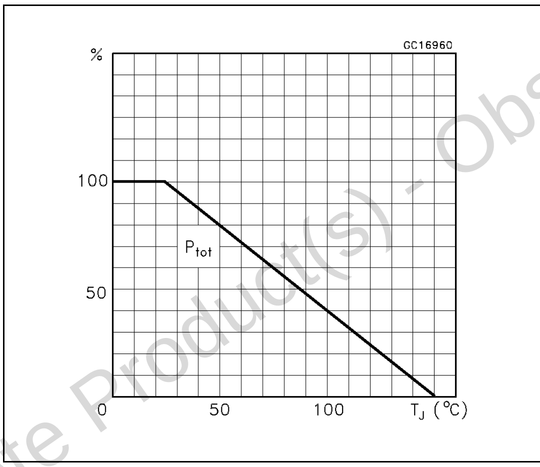


Figure 13. Static Drain-Source on resistance vs. input voltage

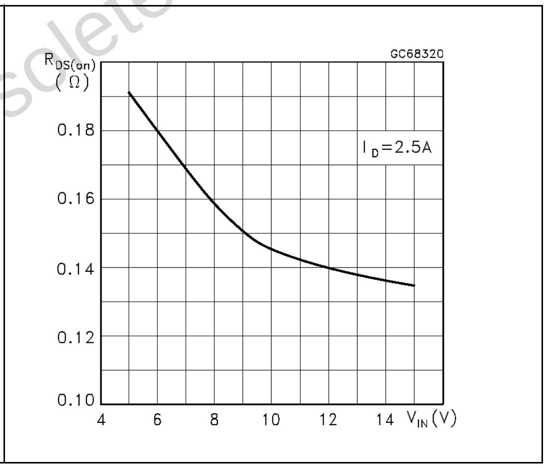


Figure 14. Normalized on resistance Vs temperature

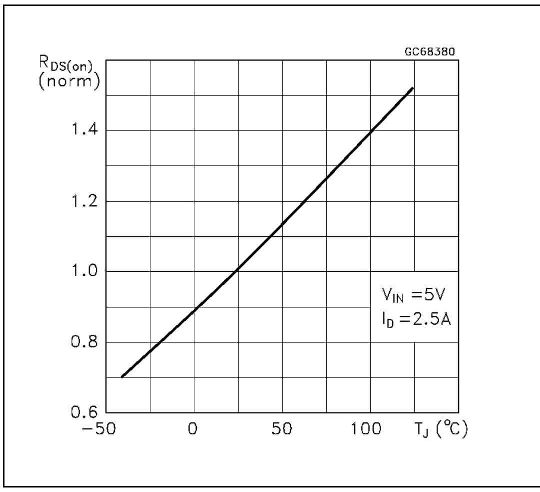


Figure 15. Transconductance

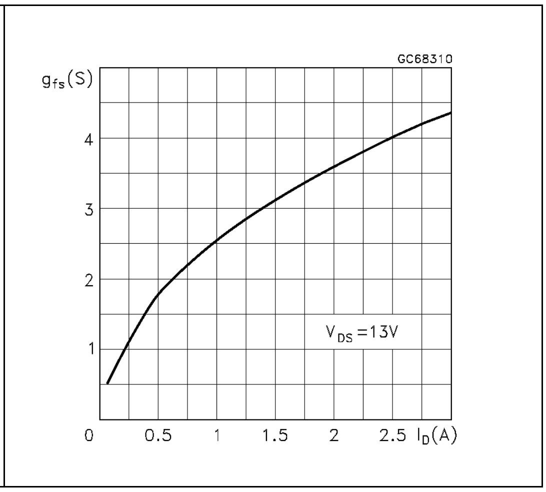


Figure 16. Static Drain-Source on resistance Vs. Id

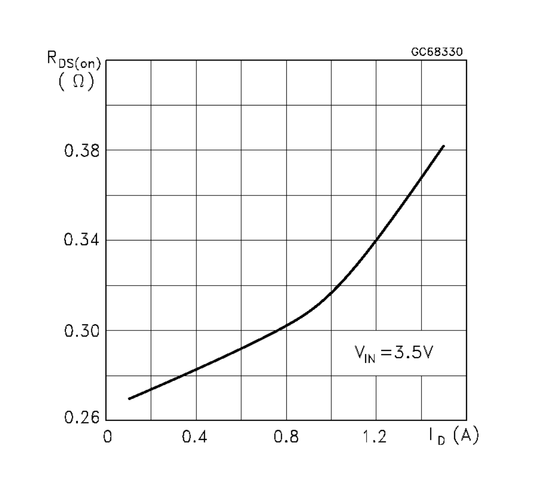


Figure 17. Switching time resistive load

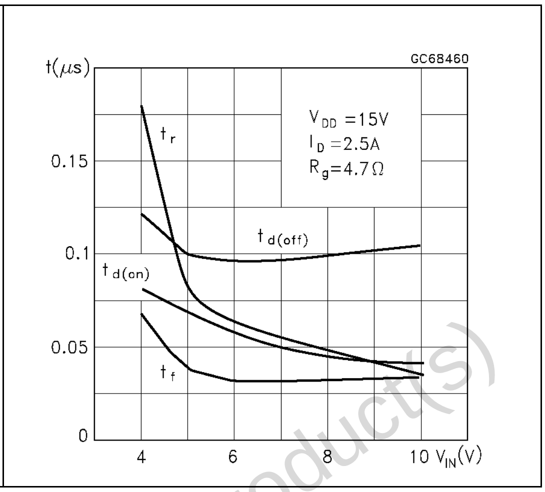


Figure 18. Turn-on current slope (V_{IN} = 10V)

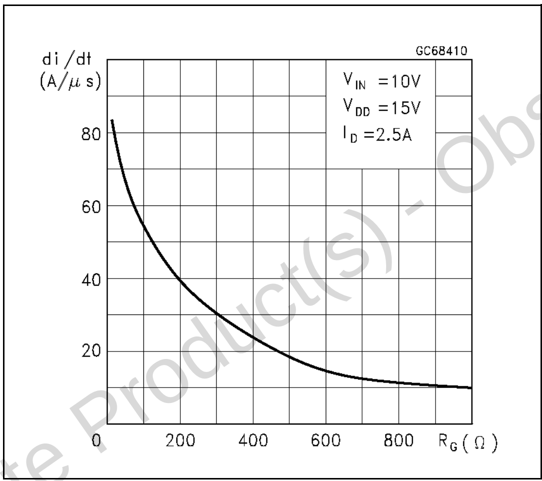


Figure 19. Turn-on current slope (V_{IN} = 5V)

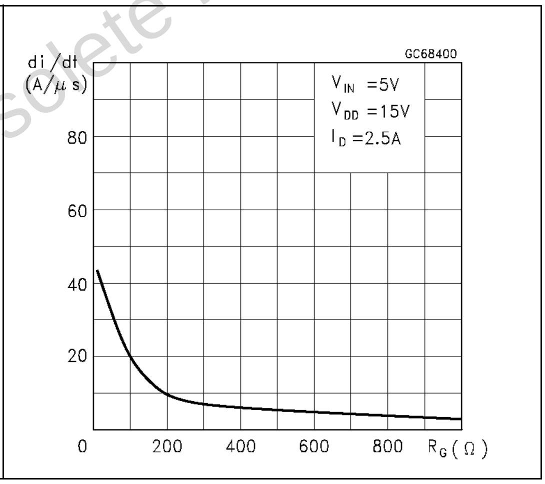


Figure 20. Input voltage Vs. input charge

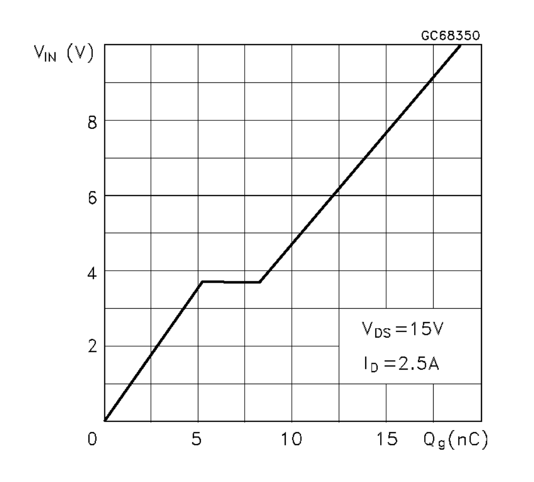


Figure 21. Turn-off Drain Source voltage slope

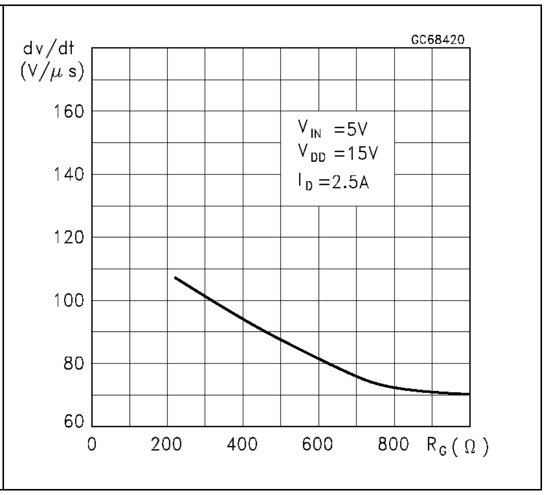


Figure 22. Turn-off Drain-Source voltage slope

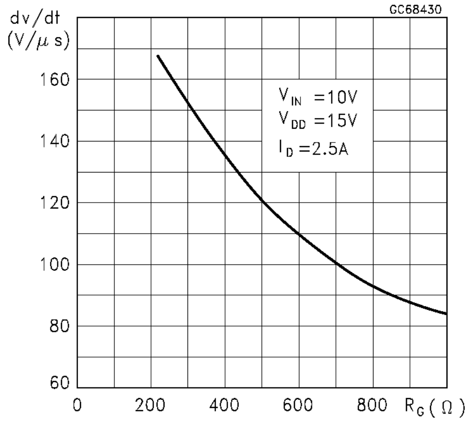


Figure 23. Capacitance variations

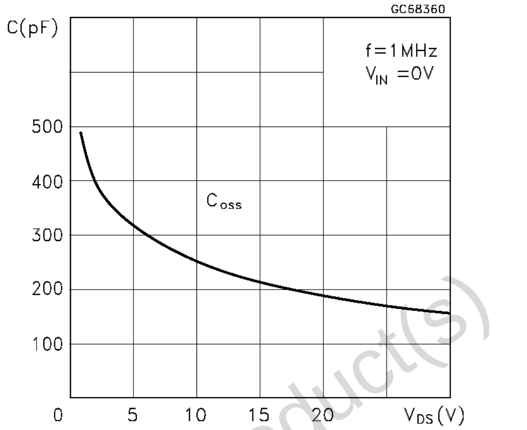


Figure 24. Switching time resistive load

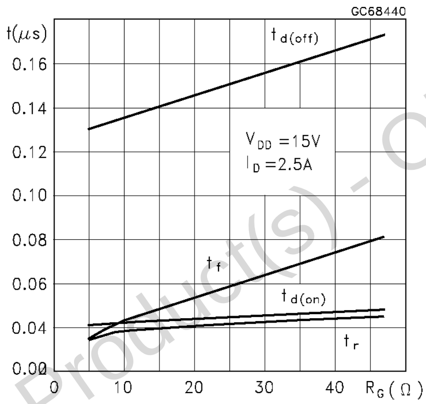


Figure 25. Step response current limit

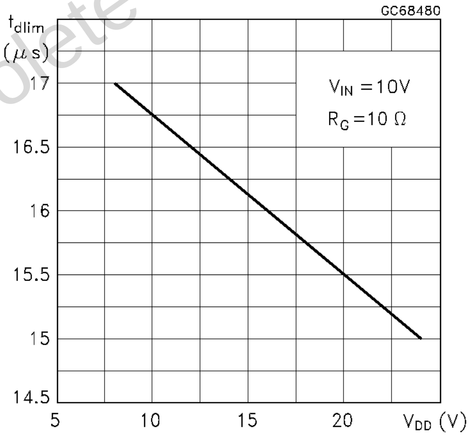


Figure 26. Output characteristics

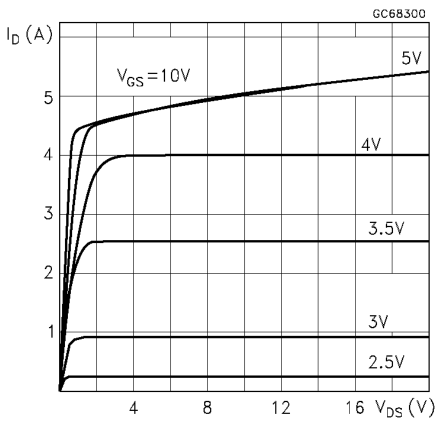


Figure 27. Normalized on resistance Vs. temperature

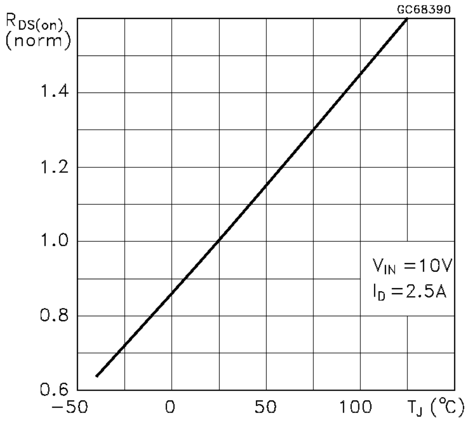


Figure 28. Normalized Input threshold voltage Vs. temperature

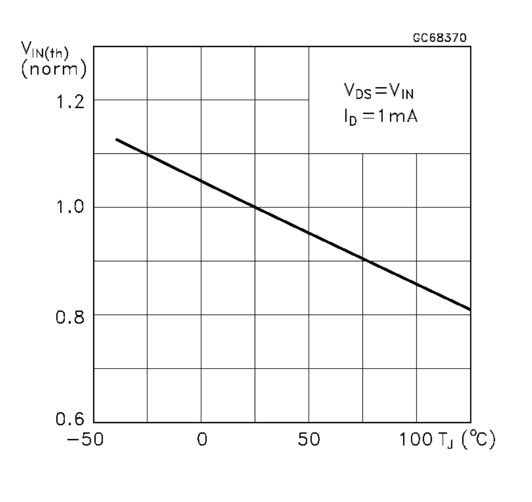
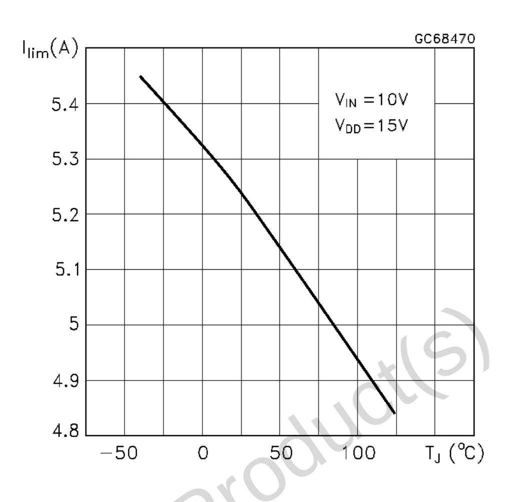


Figure 29. Normalized current limit Vs. junction temperature



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

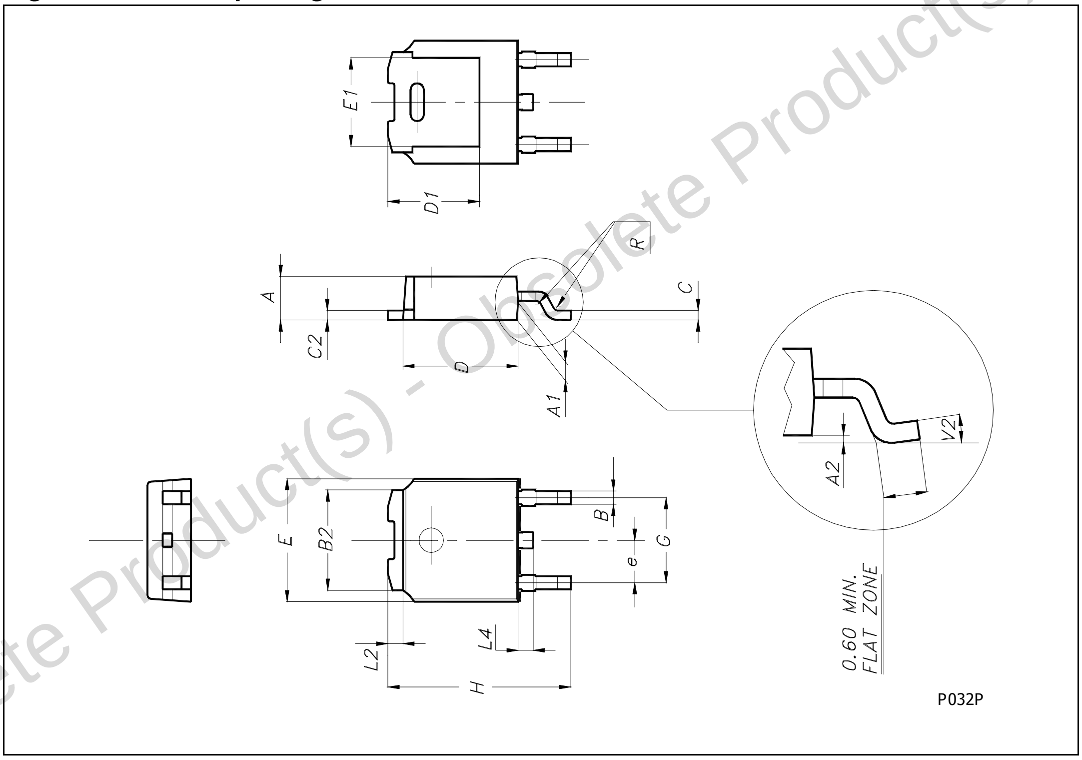


Table 10. DPAK mechanical data

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

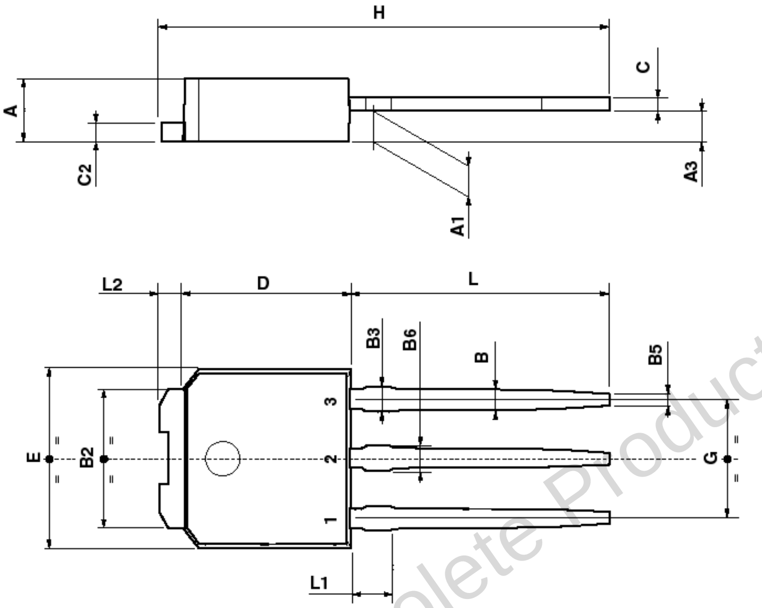


Table 11. IPAK mechanical data

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

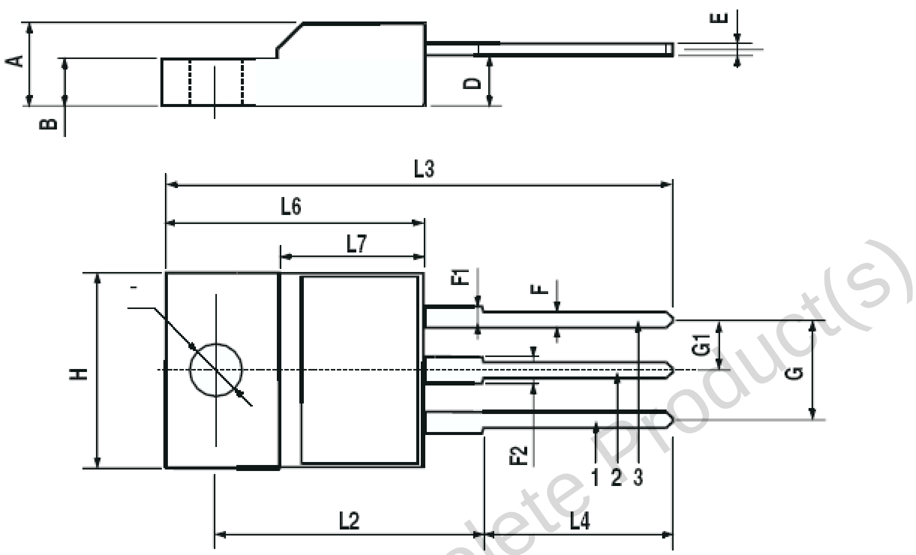


Table 12. ISOWATT220 mechanical data

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

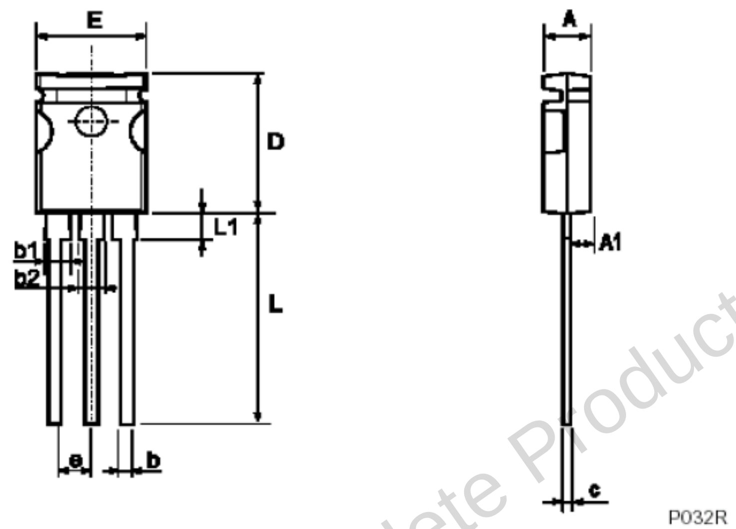


Table 13. SOT-82FM mechanical data

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
9-Sep-2004	1	Initial release.
17-Dec-2007	2	Stylesheet update.
11-Dec-2008	3	Document restructured and reformatted. Added ECOPACK® packages information.
25-Sep-2013	4	Updated Disclaimer

Please Read Carefully: