



# STRH40N25FSY3

N-channel 250V - 0.084Ω - TO-254AA  
Rad-hard low gate charge STripFET™ Power MOSFET

PRELIMINARY DATA

## Features

Type	V <sub>DSS</sub>
STRH40N25FSY3	250V

- Low R<sub>DS(on)</sub>
- Fast switching
- Single event effect (SEE) hardened
- Low total gate charge
- Light weight
- 100% avalanche tested
- Application oriented characterization
- Hermetically sealed
- Heavy ion SOA
- 100kRad TID
- SEL & SEGR with 34Mev/cm<sup>2</sup>/mg LET ions

## Description

This Power MOSFET series realized with STMicroelectronics unique STripFET process has specifically been designed to improve immunity to space effect. It is therefore suitable as power switch in mainly high-efficiency DC-DC converters and Motor Control applications. It is also intended for any application with low gate charge drive requirements.

## Applications

- Satellite
- High reliability applications

## Order codes

Part number	Marking	Package	Packaging
STRH40N25FSY1 <sup>(1)</sup>	RH40N25FSY1	TO-254AA	Individual strip pack
STRH40N25FSY3 <sup>(2)</sup>	RH40N25FSY3	TO-254AA	Individual strip pack

1. Mil temp range

2. Space flights parts (full ESA flow screening)

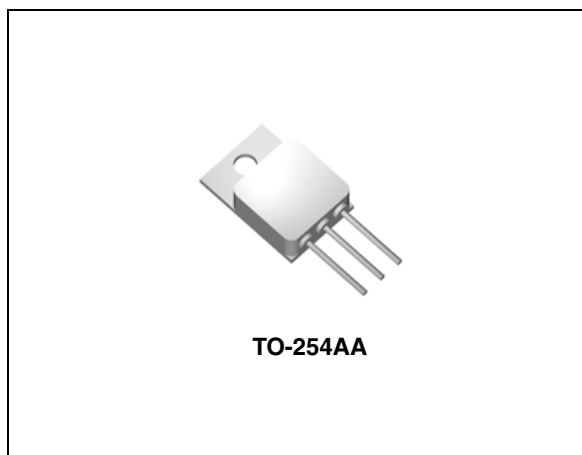
March 2007

Rev 2

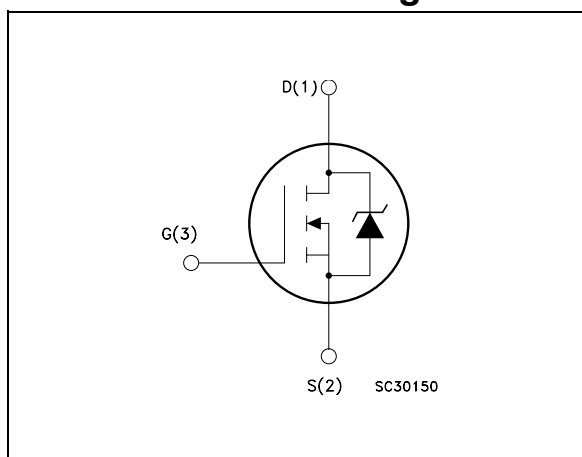
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This is preliminary information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

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## Internal schematic diagram



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# 1 Electrical ratings

**Table 1. Absolute maximum ratings (pre-irradiation)**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	250	V
$V_{GS}$	Gate-source voltage	$\pm 16$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	36	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	23	A
$I_{DM}^{(2)}$	Drain current (pulsed)	144	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25^\circ\text{C}$	278	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	4	V/ns
$T_{stg}$	Storage temperature	-55 to 150	$^\circ\text{C}$
$T_j$	Max. operating junction temperature	150	$^\circ\text{C}$

1. Rated according to the  $R_{thj-case}$
2. Pulse width limited by safe operating area
3.  $I_{SD} \leq 40\text{A}$ ,  $di/dt \leq 400\text{A}/\mu\text{s}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.45	$^\circ\text{C}/\text{W}$
$R_{thc-s}$	Case-to-sink	0.21	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction -amb	48	$^\circ\text{C}/\text{W}$

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j \text{ Max}$ )	40	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$ , $I_d = I_{AR}$ , $V_{DD} = 50\text{V}$ )	320	mJ
$E_{AR}$	Repetitive avalanche	25	mJ

## 2 Electrical characteristics

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

### 2.1 Pre-irradiation

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	80% $BV_{DSS}$			10	$\mu A$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 16V$			$\pm 100$	nA
$BV_{DSS}$	Drain-to-source breakdown voltage	$I_D = 1mA, V_{GS} = 0V$	250			V
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1mA$	2		4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 12V, I_D = 20A$		0.084	0.1	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 0V, f = 1MHz,$ $V_{GS} = 12V$		9100 650 45		pF pF pF
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-to-source charge Gate-to-drain ("Miller") charge	$V_{DD} = 200V, I_D = 40A,$ $V_{GS} = 12V$		202 34 58	280 47 80	nC nC nC
$R_G$	Gate input resistance	$f = 1MHz$ Gate DC Bias=0 Test signal level=20mV open drain		1.4	3	$\Omega$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_f$	Turn-on delay time Rise time Turn-off-delay time Fall time	$V_{DD} = 125V, I_D = 40A,$ $R_G = 4.7\Omega, V_{GS} = 12V$		33 80 123 145		ns ns ns ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$I_{SD}$	Source-drain current				36	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				144	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 40A, V_{GS} = 0$			1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 40A, di/dt = 100A/\mu s$ $V_{DD} = 50V, T_j = 150^\circ C$		484		ns
$Q_{rr}$	Reverse recovery charge			8.4		$\mu C$
$I_{RRM}$	Reverse recovery current			35		A

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

## 2.2 Post-irradiation

The ST Rad-Hard Power MOSFETs are tested to verify the radiation capability. The technology is extremely resistant to assurance well functioning of the device inside the radiation environments. Every manufacturing lot is tested for total ionizing dose.

(@ $T_j = 25^\circ C$  up to 100Krad <sup>(a)</sup>)

**Table 8. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	80% $BV_{DSS}$			10	$\mu A$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 16V$			$\pm 100$	nA
$BV_{DSS}$	Drain-to-source breakdown voltage	$I_D = 1mA, V_{GS} = 0V$	250			V
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1mA$	2		4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 12V, I_D = 20A$		0.084	0.1	$\Omega$

- a. According to ESCC 22900 specification, Co60 gamma rays, dose rags:0.1rad/sec.

**Table 9. Single event effect, SOA<sup>(1)</sup>**

Ion	Let (Mev/(mg/cm2))	Energy (MeV)	Range (µm)	V <sub>DS</sub> (V) @V <sub>GS</sub> 0V
Kr	34	316	43	250
Xe	55.9	459	43	244

1. Rad-Hard Power MOSFETs have been characterized in heavy ion environment for single event effect (SEE). Single event effect characterization is illustrated

**Table 10. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I <sub>SD</sub>	Source-drain current				36	A
I <sub>SDM</sub> <sup>(1)</sup>	Source-drain current (pulsed)				144	A
V <sub>SD</sub> <sup>(2)</sup>	Forward on voltage	I <sub>SD</sub> = 40A, V <sub>GS</sub> = 0			1.5	V
t <sub>rr</sub>	Reverse recovery time	I <sub>SD</sub> = 40A, di/dt = 100A/µs V <sub>DD</sub> = 50V, T <sub>j</sub> = 150°C		484		ns
Q <sub>rr</sub>	Reverse recovery charge			8.4		µC
I <sub>RRM</sub>	Reverse recovery current			35		A

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

### 2.3 Electrical characteristics (curves)

Figure 1. Safe operating area

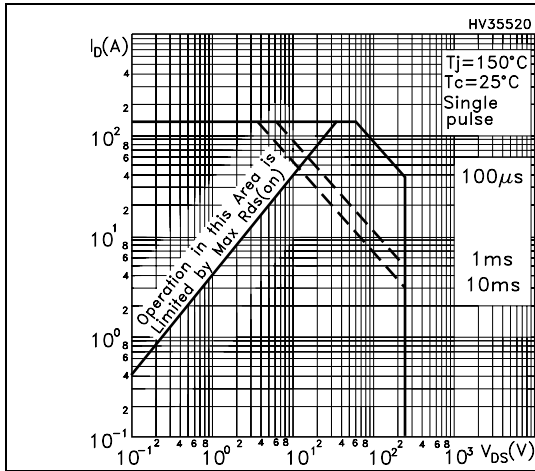


Figure 2. Thermal impedance

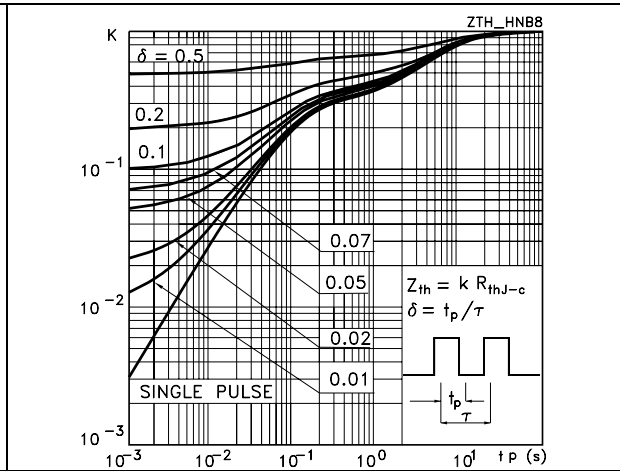


Figure 3. Output characteristics

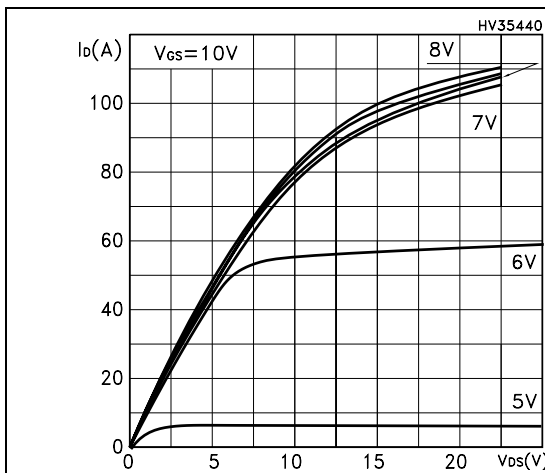


Figure 4. Transfer characteristics

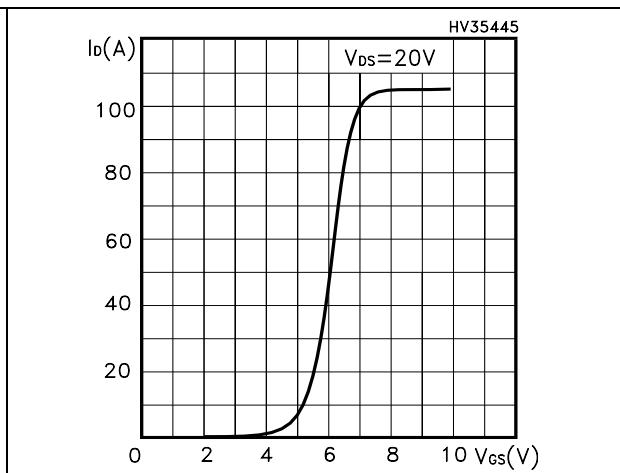


Figure 5. Gate charge vs. gate-source voltage

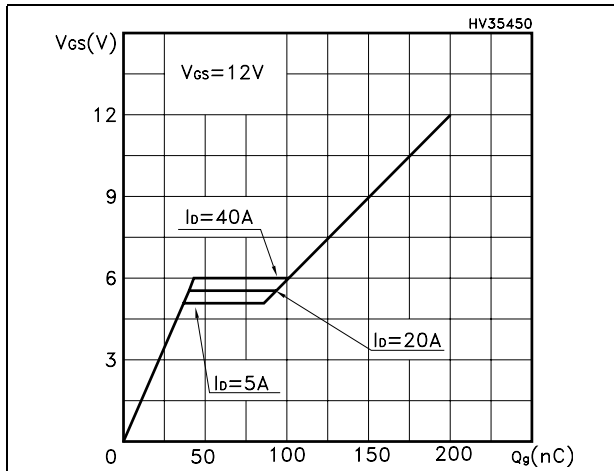


Figure 6. Capacitance variations

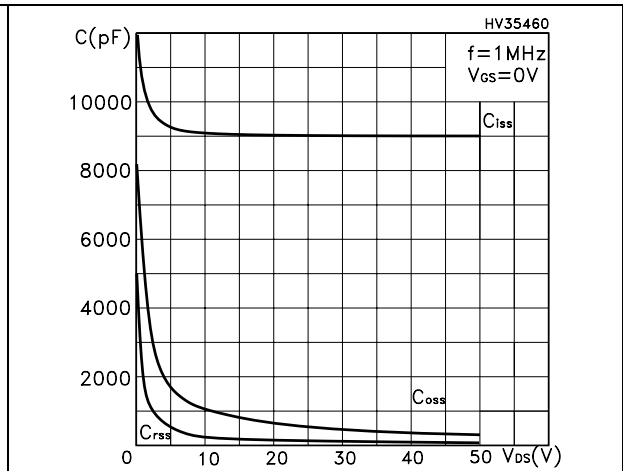


Figure 7. Normalized  $BV_{DSS}$  vs. temperature

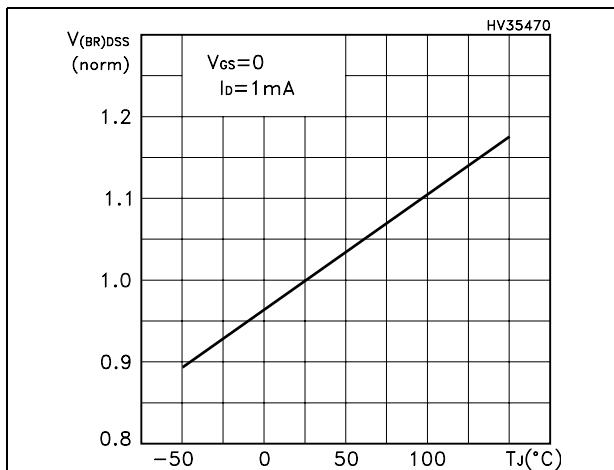
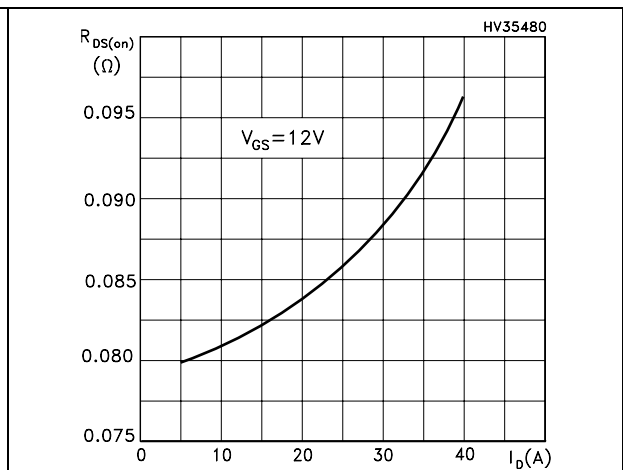
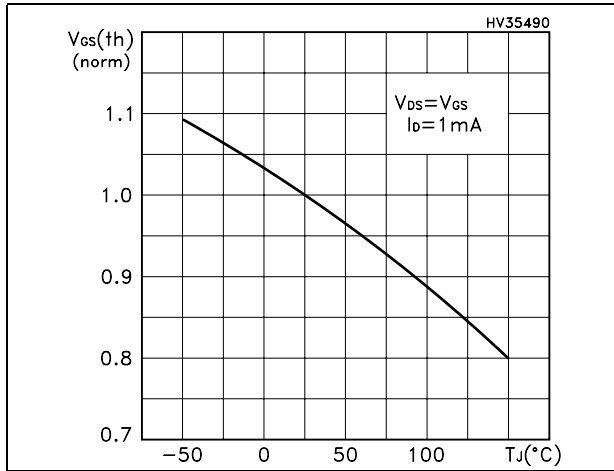


Figure 8. Static drain-source on resistance

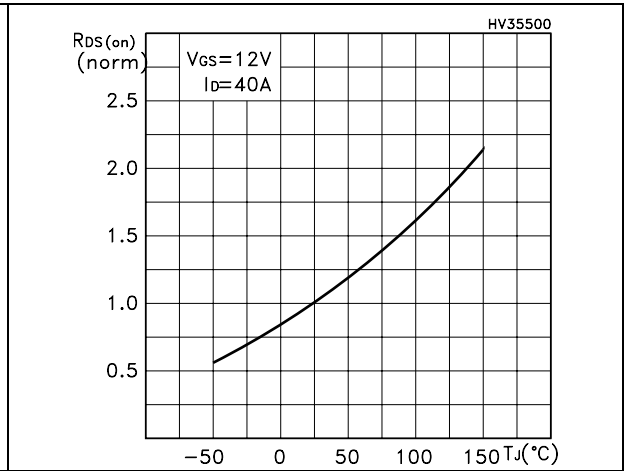




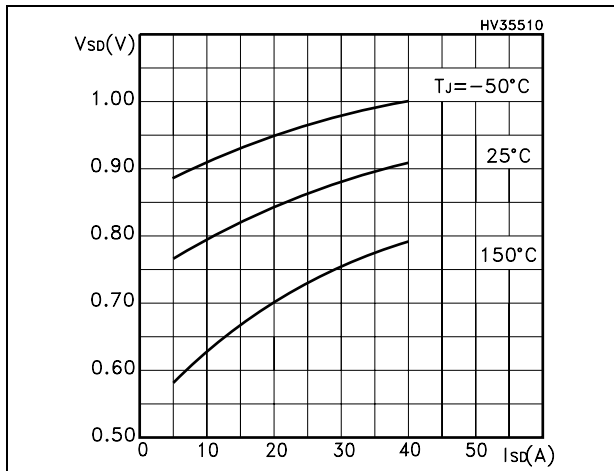
**Figure 9. Normalized gate threshold voltage vs. temperature**



**Figure 10. Normalized on resistance vs. temperature**

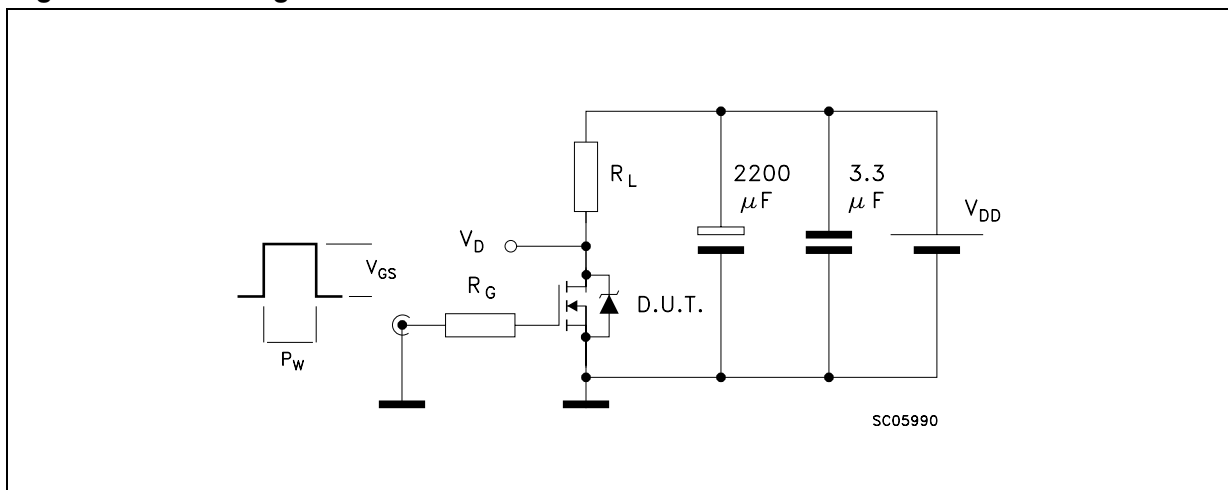


**Figure 11. Source drain-diode forward characteristics**



### 3 Test circuit

Figure 12. Switching times test circuit for resistive load (1)

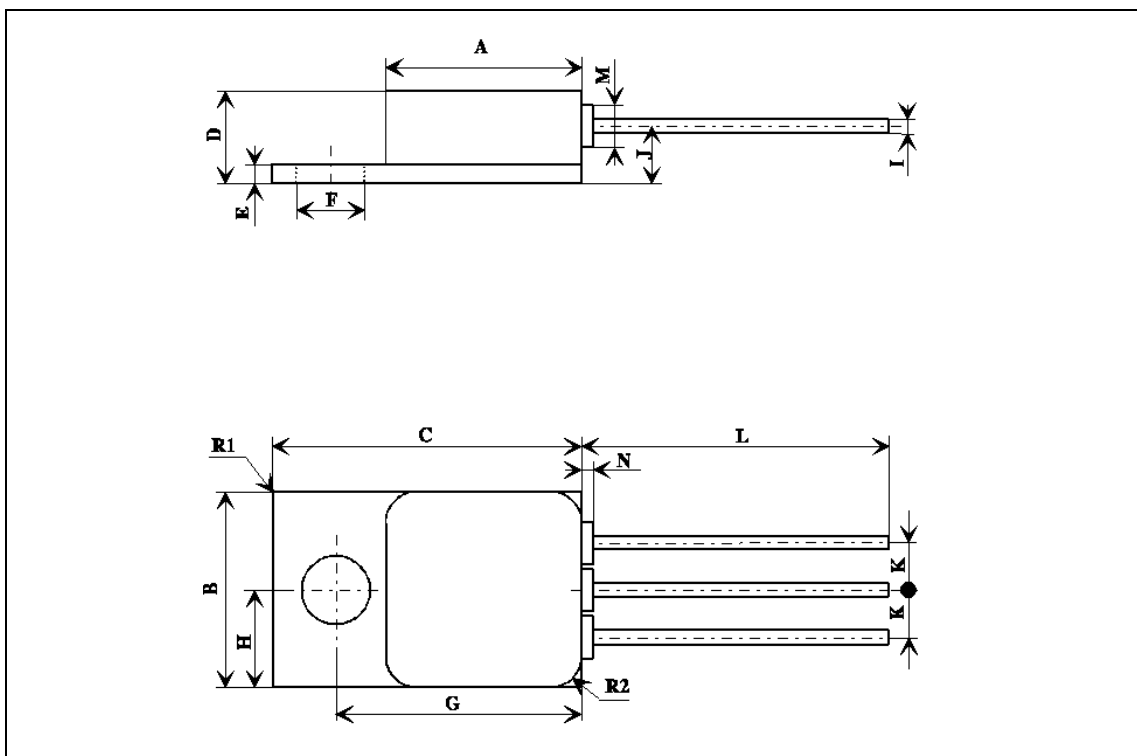


1. Max driver  $V_{GS}$  slope = 1V/ns (no DUT)

## 4 Package mechanical data

### TO-254AA MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	13.59		13.84	0.535		0.545
B	13.59		13.84	0.535		0.545
C	20.07		20.32	0.790		0.80
D	6.32		6.60	0.249		0.260
E	1.02		1.27	0.040		0.050
F	3.53		3.78	0.139		0.149
G	16.89		17.40	0.665		0.685
H		6.86			0.270	
I	0.89		1.14	0.035		0.045
J		3.81			0.150	
K		3.81			0.150	
L	12.95		14.50	0.510		0.570
M		3.05			0.120	
N			0.71			0.025
R1			1.0			0.040
R2		1.65			0.065	



## 5 Revision history

Table 11. Revision history

Date	Revision	Changes
18-Dec-2006	1	First release
02-Mar-2007	2	Some values changed on <a href="#">Table 4</a> and <a href="#">Table 8</a>

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