



STRH50P6FSY1 STRH50P6FSY3

P-channel 60V - 0.047Ω - TO-254AA
Rad-hard low gate charge STripFET™ Power MOSFET

Features

Type	V _{DSS}
STRH50P6FSY1	60 V
STRH50P6FSY3	60 V

- Low R_{DS(on)}
- Fast switching
- Single event effect (SEE) hardened
- Low total gate charge
- Light weight
- 100% avalanche tested
- Application oriented characterization
- Hermetically sealed
- Heavy ion SOA
- 100 kRad TID
- SEL & SEGR with 34Mev/cm²/mg LET ions

Applications

- Satellite
- High reliability

Description

This Power MOSFET series realized with STMicroelectronics unique STripFET process has specifically been designed to sustain high TID and provide immunity to heavy ion effects. It is therefore suitable as power switch in mainly high-efficiency DC-DC converters. It is also intended for any application with low gate charge drive requirements.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STRH50P6FSY1 ⁽¹⁾	RH50P6FSY1	TO-254AA	Individual strip pack
STRH50P6FSY3 ⁽²⁾	RH50P6FSY3	TO-254AA	Individual strip pack

1. Mil temp range

2. Space flights parts (full ESCC flow screening)

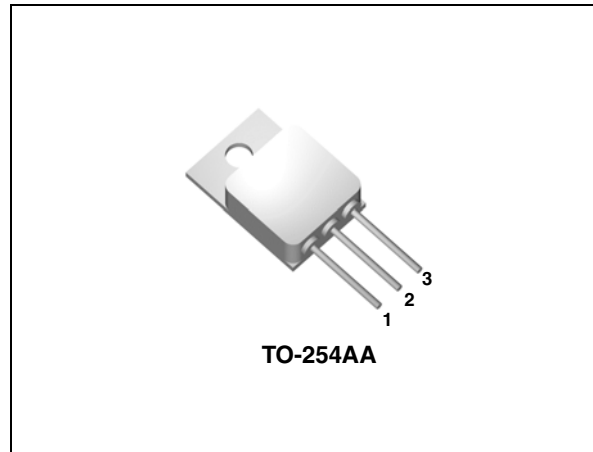
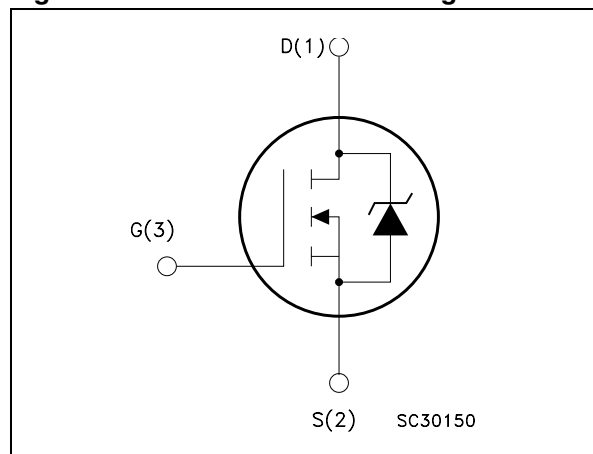


Figure 1. Internal schematic diagram



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1 Electrical ratings

Table 2. Absolute maximum ratings (pre-irradiation)

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	60	V
V_{GS}	Gate-source voltage	± 18	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	50	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	32	A
$I_{DM}^{(2)}$	Drain current (pulsed)	200	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25^\circ\text{C}$	180	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	1.4	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 $R_{thj-case} + R_{thc-s}$
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 50$ A, $di/dt \leq 56$ A/ μs , $V_{DD} = 80\%V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.5	$^\circ\text{C/W}$
R_{thc-s}	Case-to-sink	0.21	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction -amb	48	$^\circ\text{C/W}$

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j Max)	25	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 42$ V)	932	mJ
$E_{AR}^{(1)}$	Repetitive avalanche	45	mJ

1. Pulse number = 10; $f = 10$ KHz; D.C. = 50%

Note: For the P-channel MOSFET actual polarity of voltages and current has to be reversed

2 Electrical characteristics

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

2.1 Pre-irradiation

Table 5. 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	μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 18 V$			± 100	nA
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250 \mu A, V_{GS} = 0$	100			V
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1 mA$	2		4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 12 V, I_D = 25 A$		0.047	0.053	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
C_{iss}	Input capacitance	$V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0$	2632	3290	3948	pF
C_{oss}	Output capacitance		440	550	660	pF
C_{rss}	Reverse transfer capacitance		187.2	234	280.8	pF
Q_g	Total gate charge	$V_{DD} = 50 V, I_D = 25 A, V_{GS} = 12 V$	92.8	116	139.2	nC
Q_{gs}	Gate-source charge		10.4	13	15.6	nC
Q_{gd}	Gate-drain charge		20.8	26	31.2	nC
R_G	Gate input resistance	f=1MHz Gate DC Bias=0 Test signal level=20 mV open drain	0.8	1	1.2	Ω

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 30 V, I_D = 25 A, R_G = 4.7 \Omega, V_{GS} = 12 V$	13.6	17	20.4	ns
t_r	Rise time		40	50	60	ns
$t_{d(off)}$	Turn-off-delay time		65.6	82	98.4	ns
t_f	Fall time		28.8	36	43.2	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit		
I_{SD}	Source-drain current				50	A		
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				200	A		
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 50 \text{ A}, V_{GS} = 0$			1.1	V		
t_{rr}	Reverse recovery time	$I_{SD} = 50 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 20 \text{ V}, T_j = 25^\circ\text{C}$	240	300	360	ns		
Q_{rr}	Reverse recovery charge						3.85	μC
I_{RRM}	Reverse recovery current						25.6	
t_{rr}	Reverse recovery time	$I_{SD} = 50 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 20 \text{ V}, T_j = 150^\circ\text{C}$	300	376	451	ns		
Q_{rr}	Reverse recovery charge						5.64	μC
I_{RRM}	Reverse recovery current						30	

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

(@ $T_j=25^\circ\text{C}$ up to 100Krad ^(a))

Table 9. 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	μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 18 \text{ V}$			±100	nA
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250 \mu\text{A}, V_{GS} = 0$	100			V
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1 \text{ mA}$	2		4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 12 \text{ V}, I_D = 25 \text{ A}$		0.047	0.053	Ω

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

Table 10. Single event effect, SOA⁽¹⁾

Ion	Let (Mev/(mg/cm2))	Energy (MeV)	Range (μm)	V _{DS} (V) @V _{GS} 0V
Kr	34	316	43	60
Xe	55.9	459	43	48

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

Figure 2. Bias condition during radiation

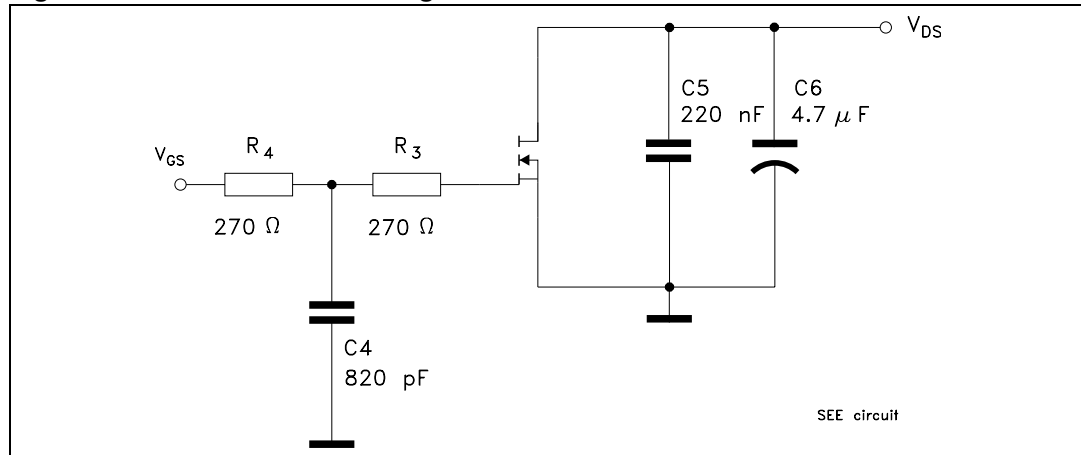


Table 11. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I _{SD}	Source-drain current				50	A
I _{SDM} ⁽¹⁾	Source-drain current (pulsed)				200	A
V _{SD} ⁽²⁾	Forward on voltage	I _{SD} = 50 A, V _{GS} = 0			1.1	V
t _{rr}	Reverse recovery time	I _{SD} = 50 A, di/dt = 100 A/μs V _{DD} = 20 V, T _J = 25°C	240	300	360	ns
Q _{rr}	Reverse recovery charge			3.85		μC
I _{RPM}	Reverse recovery current			25.6		A
t _{rr}	Reverse recovery time	I _{SD} = 50 A, di/dt = 100 A/μs V _{DD} = 20 V, T _J = 150°C	300	376	451	ns
Q _{rr}	Reverse recovery charge			5.64		μC
I _{RPM}	Reverse recovery current			30		A

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

2.3 Electrical characteristics (curves)

Figure 3. Safe operating area

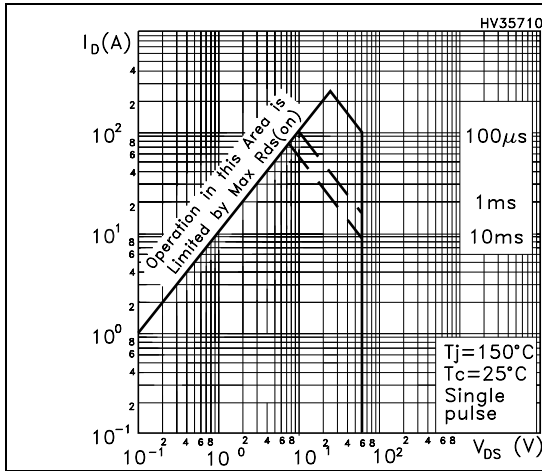


Figure 4. Thermal impedance

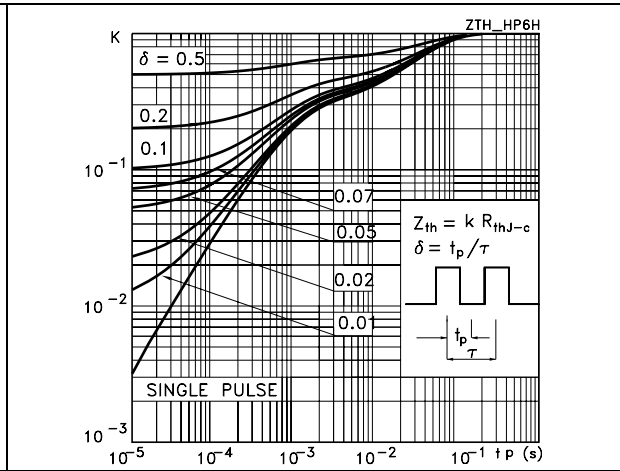


Figure 5. Output characteristics

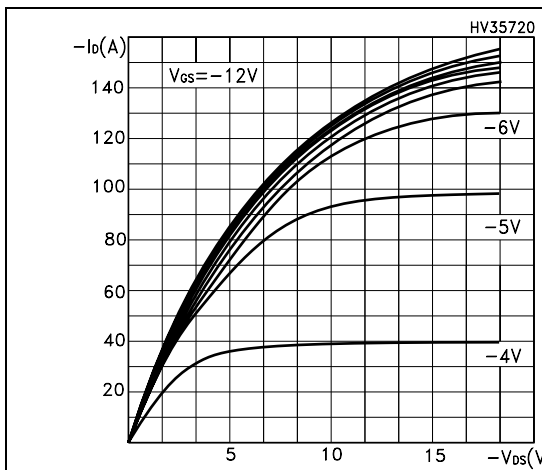


Figure 6. Transfer characteristics

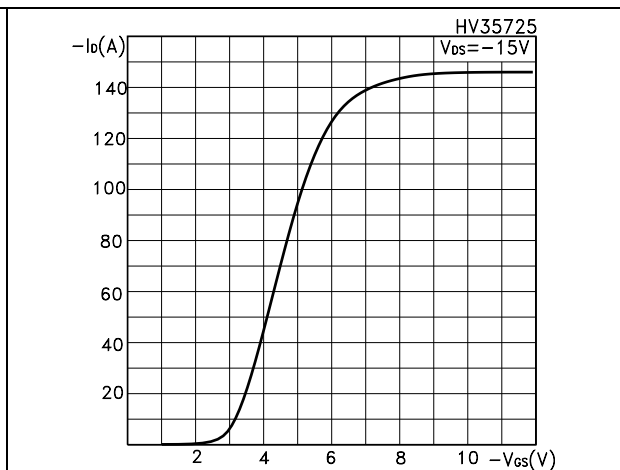


Figure 7. Gate charge vs gate-source voltage

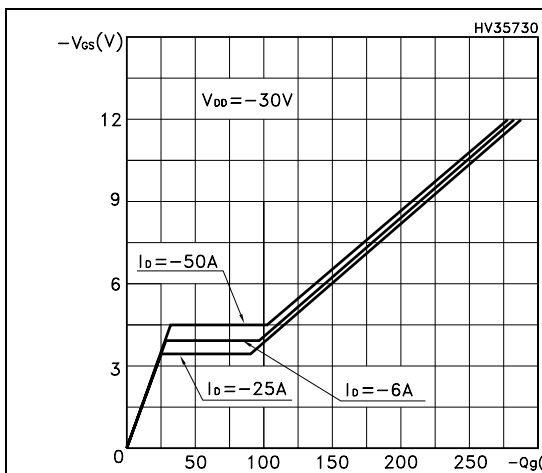


Figure 8. Capacitance variations

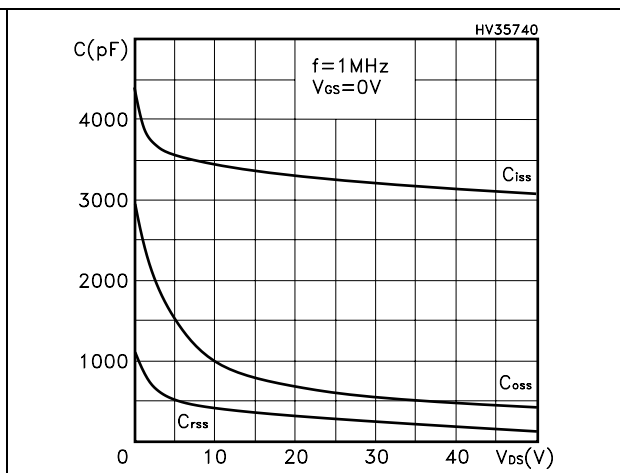


Figure 9. Normalized BV_{DSS} vs temperature Figure 10. Static drain-source on resistance

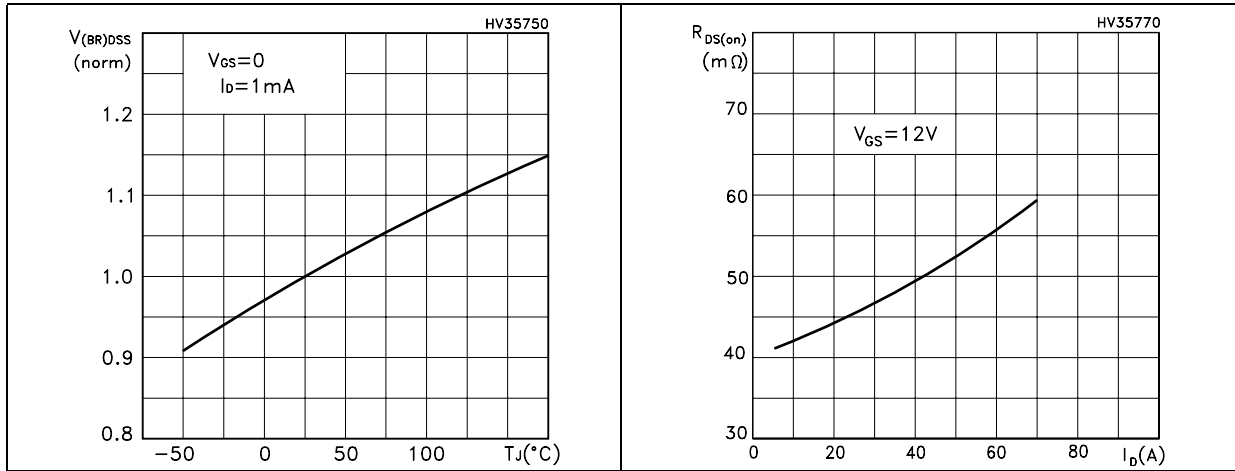


Figure 11. Normalized gate threshold voltage vs temperature Figure 12. Normalized on resistance vs temperature

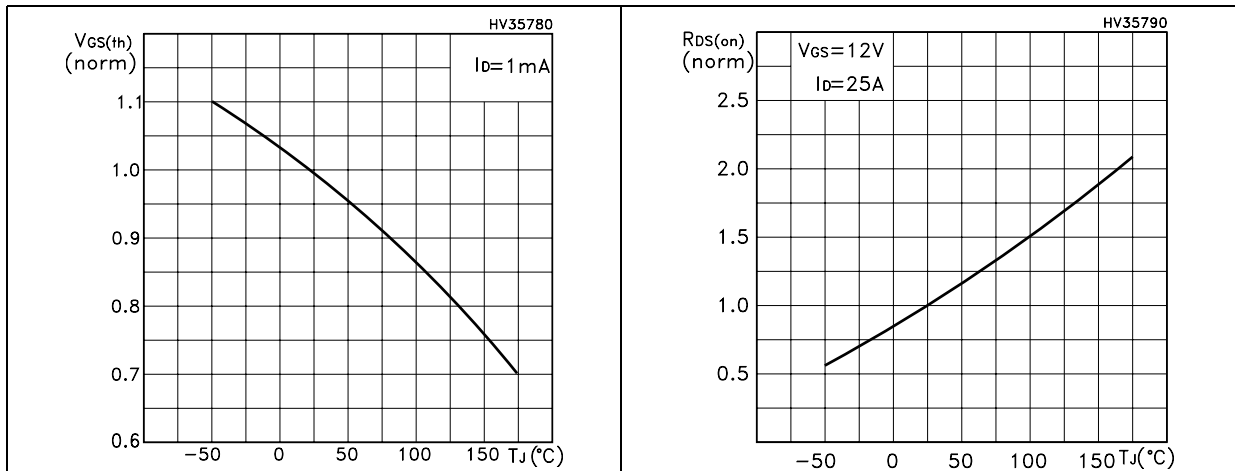
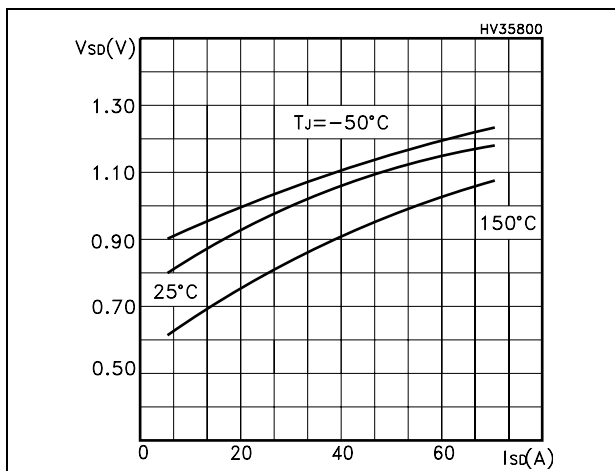
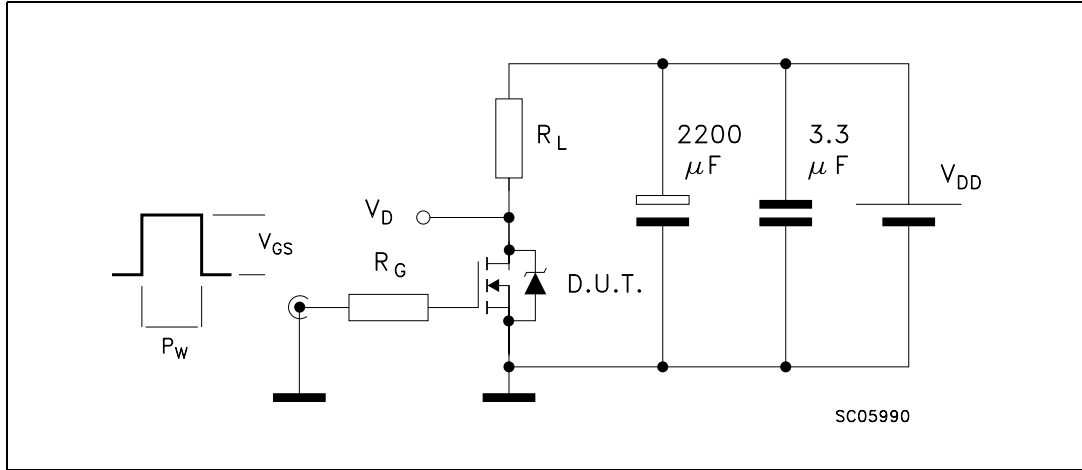


Figure 13. Source drain-diode forward characteristics



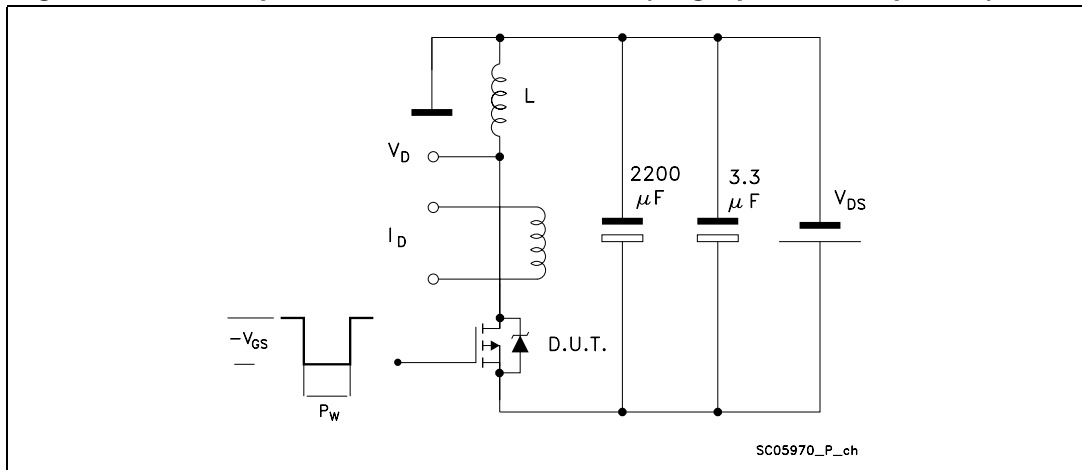
3 Test circuit

Figure 14. Switching times test circuit for resistive load ⁽¹⁾



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

Figure 15. Unclamped inductive load test circuit (single pulse and repetitive)



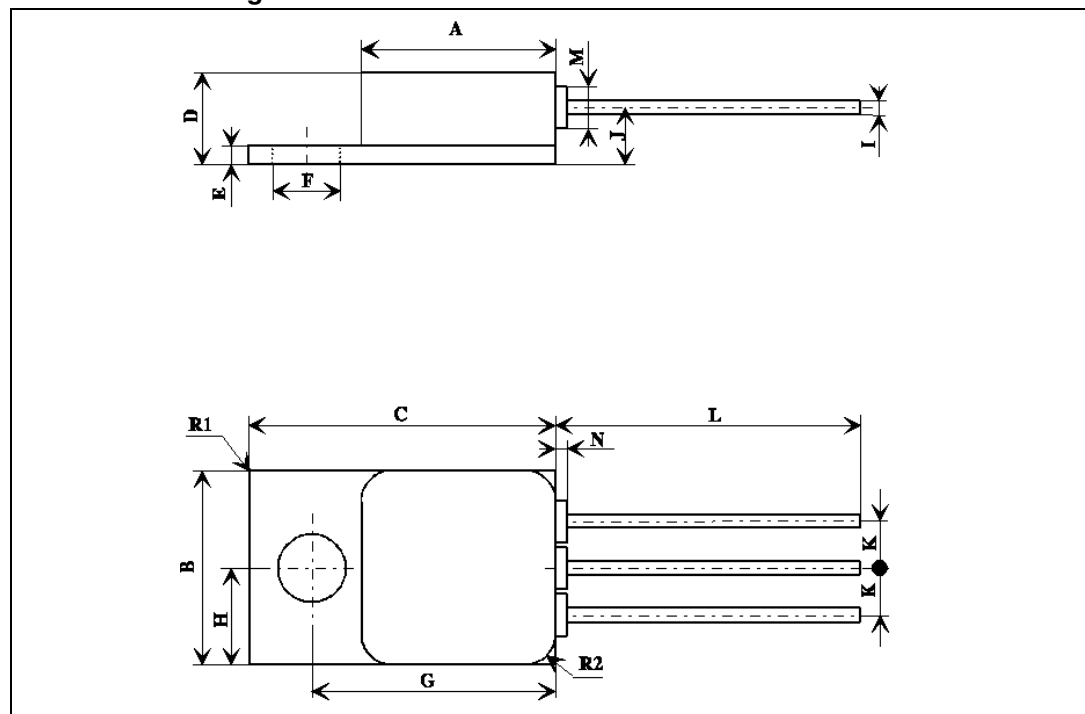
4 Package mechanical data

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

Table 12. 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	

Mechanical drawing



5 Revision history

Table 13. Document revision history

Date	Revision	Changes
05-Jul-2006	1	First release
20-Dec-2006	2	<i>Figure 3.</i> has been updated
20-Nov-2007	3	Note 2 on device summary has been corrected Added figures: <i>2</i> and <i>15</i> . Updated values on tables: <i>6, 7, 8</i> and <i>11</i> Minor text changes to improve readability

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