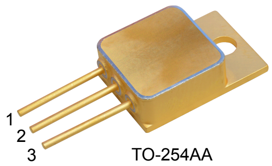
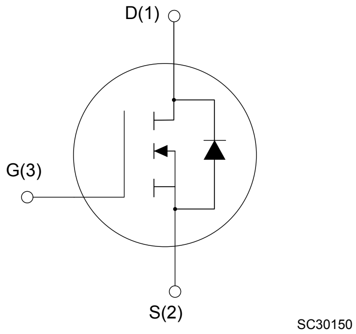
STRH100N6

Datasheet

Rad-Hard 60 V, 40 A, N-channel Power MOSFET



TO-254AA



Product status link
STRH100N6

Features

V_{DS}	I_D	$R_{DS(on)}$ typ.	Q_g
60 V	40 A	12 mΩ	134.4 nC

- Fast switching
- 100% avalanche tested
- Hermetic package
- 50 krad TID
- SEE radiation hardened

Description

The STRH100N6 is an N-channel Power MOSFET able to operate under severe environment conditions and radiation exposure. It provides high reliability performance and immunity to the total ionizing dose (TID) and single event effects (SEE).

Qualified as per ESCC detail specification No. 5205/022 and available in a TO-254AA hermetic package it is specifically recommended for space and harsh environment applications and suitable for in-Satellite power conversion, motor control, and power switch circuits.

In a case of discrepancies between this datasheet and the relevant agency specification, the latter takes precedence.

Product summary

<table>
<tr><th colspan="6">Product summary</th></tr>
<tr><th>Part number</th><th>Quality level</th><th>ESCC part number</th><th>Package</th><th>Lead finish</th><th>Radiation level</th></tr>
<tr><td>STRH100N6HY1</td><td>Engineering model</td><td rowspan="3">5205/022</td><td rowspan="3">TO-254AA</td><td rowspan="2">Gold</td><td>-</td></tr>
<tr><td>STRH100N6HYG</td><td>Flight model</td><td rowspan="2">50 krad</td></tr>
<tr><td>STRH100N6HYT</td><td>Flight model</td><td>Solder dip</td></tr>
</table>

Note: See Ordering information for ordering information.

1 Electrical ratings

T_C = 25 °C unless otherwise specified.

Table 1. Absolute maximum ratings (pre-irradiation)

Symbol	Parameter	Value	Unit
V_{DS} (1)	Drain-source voltage (V_{GS} = 0)	60	V
V_{GS} (2)	Gate-source voltage	±20	V
I_D (3)	Drain current (continuous) at T_{case} = 25 °C	40	A
	Drain current (continuous) at T_{case} = 100 °C	25	A
I_{DM} (4)	Drain current (pulsed)	160	A
P_{TOT} (3)	Total power dissipation at T_{case} = 25 °C	176	W
dv/dt (5)	Peak diode recovery voltage slope	2.5	V/ns
T_{OP}	Operating temperature range	-55 to 150	°C
T_j	Max. operating junction temperature	150	°C

1. *This rating is guaranteed at T_J > 25 °C (see Figure 9. Normalized $V_{(BR)DSS}$ vs temperature).*
2. *This value is guaranteed over the full range of temperature.*
3. *Rated according to the $R_{thj-case}$ + R_{thc-s}*
4. *Pulse width limited by safe operating area.*
5. *I_{SD} ≤ 40 A, di/dt ≤ 600 A/µs, V_{DD} = 80 %$V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max.	0.50	°C/W
R_{thc-s}	Thermal resistance case-sink typ.	0.21	°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	40	A
E_{AS} (1)	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 40 V)	954	mJ
E_{AS}	Single pulse avalanche energy (starting T_j = 110 °C, I_D = I_{AR}, V_{DD} = 40 V)	280	mJ
E_{AR}	Repetitive pulse avalanche energy (V_{DD} = 40 V, I_{AR} = 40 A, f = 10 KHz, T_J = 25 °C, duty cycle = 50%)	40	mJ
	Repetitive pulse avalanche energy (V_{DD} = 40 V, I_{AR} = 40 A, f = 100 KHz, T_J = 25 °C, duty cycle = 10%)	24	mJ
	Repetitive pulse avalanche energy (V_{DD} = 40 V, I_{AR} = 40 A, f = 100 KHz, T_J = 110 °C, duty cycle = 10%)	7.7	

1. *Maximum rating value.*

2 Electrical characteristics

Table 4. Electrical characteristics (T_{amb} = 25 °C unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Max.	Unit
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 48 V		10	µA
		V_{GS} = 0 V, V_{DS} = 48 V, T_C = 125 °C		100	
I_{GSS}	Gate body leakage current	V_{GS} = 20 V		100	nA
		V_{GS} = -20 V	-100		
		V_{GS} = 20 V, T_C = 125 °C		200	
		V_{GS} = -20 V, T_C = 125 °C	-200		
$V_{(BR)DSS}$ (1)	Drain-to-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	60		V
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA, T_C = -55 °C	2.2	5.0	V
		V_{DS} = V_{GS}, I_D = 1 mA	2.0	4.5	
		V_{DS} = V_{GS}, I_D = 1 mA, T_C = 125 °C	1.5	3.7	
$R_{DS(on)}$ (2)	Static drain-source on resistance	V_{GS} = 12 V, I_D = 40 A		13.5	mΩ
		V_{GS} = 12 V, I_D = 40 A, T_C = 125 °C		24	
C_{iss} (3)	Input capacitance	V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 V	3900	5900	pF
C_{oss} (3)	Output capacitance		860	1300	pF
C_{rss} (3)	Reverse transfer capacitance		300	470	pF
Q_g (3)	Total gate charge	V_{DD} = 30 V, I_D = 40 A, V_{GS} = 12 V	100	160	nC
Q_{gs} (3)	Gate-to-source charge		18	30	nC
Q_{gd} (3)	Gate-to-drain ("Miller") charge		29	51	nC
$t_{d(on)}$ (3)	Turn-on delay time	V_{DD} = 30 V, I_D = 40 A, R_G = 4.7 Ω, V_{GS} = 12 V	16	40	ns
t_r (3)	Rise time		60	260	ns
$t_{d(off)}$ (3)	Turn-off delay time		50	120	ns
t_f (3)	Fall time		60	160	ns
V_{SD} (2)	Forward on voltage	I_{SD} = 40 A, V_{GS} = 0 V		1.5	V
		I_{SD} = 40 A, V_{GS} = 0 V, T_C = 125 °C		1.275	
t_{rr} (3)	Reverse recovery time	I_{SD} = 40 A, di/dt = 100 A/µs, V_{DD} = 48 V	300	480	ns

1. *This rating is guaranteed at T_J > 25 °C (see Figure 9).*
2. *Pulsed: pulse duration ≤ 680 µs, duty cycle ≤ 2%.*
3. *Not tested, guaranteed by process.*

3 Radiation characteristics

This products is guaranteed in radiation as per ESCC 5205/023 and ESCC 22900 specification at 50 krad. Each lot tested in radiation is accepted according to the characteristics as per Table 5.

3.1 Total dose radiation (TID) testing

The bias with VGS = + 15 V and VDS = 0 V is applied during irradiation exposure.

The parameters listed in Table 5 are measured:

- Before irradiation
- After irradiation
- After 24 hrs at room temperature
- after 168 hrs at 100 °C anneal

Table 5. Post-irradiation electrical characteristics (T_{amb} = 25 °C unless otherwise specified)

Symbol	Parameter	Test conditions	Drift values Δ	Unit
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	80% $V_{(BR)DSS}$	+10	µA
I_{GSS}	Gate body leakage current	V_{GS} = 20 V	1.5	nA
		V_{GS} = -20 V	-1.5	
$V_{(BR)DSS}$	Drain-to-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	-15%	V
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA	-60% / + 25%	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 40 A	±15%	Ω
V_{SD}[(1)]	Forward on voltage	V_{GS} = 0 V, I_{SD} = 40 A	±5%	V

1. *Pulsed: pulse duration ≤ 680 µs, duty cycle ≤ 2%.*

3.2 Single event effect SOA

The STRH100N6 is extremely resistant to heavy ions exposure as per MIL-STD-750E, test method 1080, bias circuit of Figure 2.

SEB and SEGR tests are performed with a fluence of 3e+5 ions/cm² with the following acceptance criteria:

- SEB test: drain voltage checked, trigger level is set to V_{DS} = - 5 V. Stop condition: as soon as a SEB occurs or if the fluence reaches 3e+5 ions/cm².
- SEGR test: the gate current is monitored every 200 ms. A gate stress is performed before and after irradiation. Stop condition: as soon as the gate current reaches 100 nA (during irradiation or during PIGS test) or if the fluence reaches 3e+5 ions/cm².

Table 6. Single event effect (SEE), safe operating area (SOA)

Ion	Let (Mev/(mg/cm^2))	Energy (MeV)	Range (µm)
Kr	32	768	94
Xe	60	1217	89

Ion	Let (Mev/(mg/cm^2)	Energy (MeV)	Range (µm)
Kr	32	768	94

Figure 1. **Single event effect, SOA**

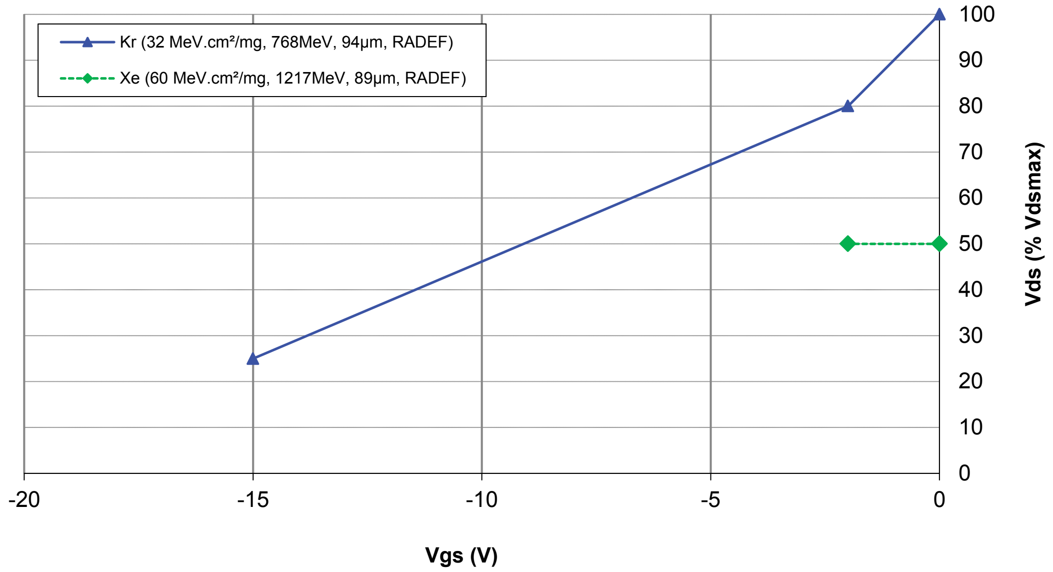
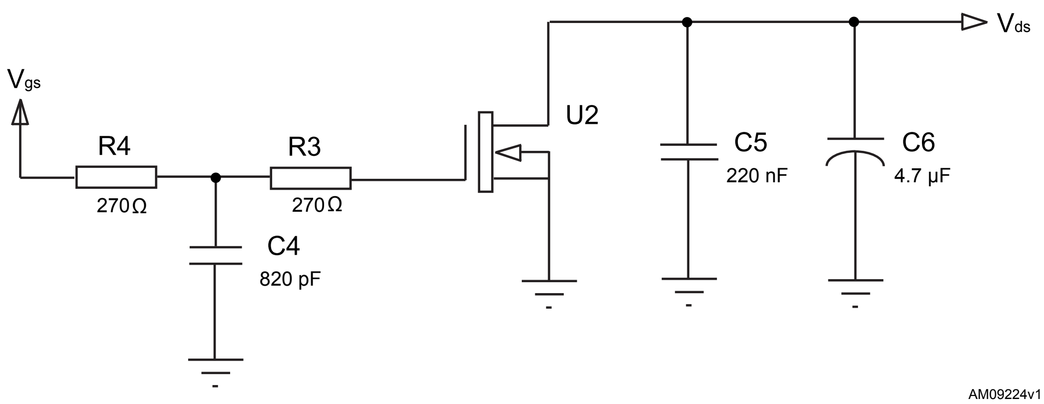


Figure 2. **Single event effect, bias circuit**



4 Electrical characteristics (curves)

Figure 3. Safe operating area

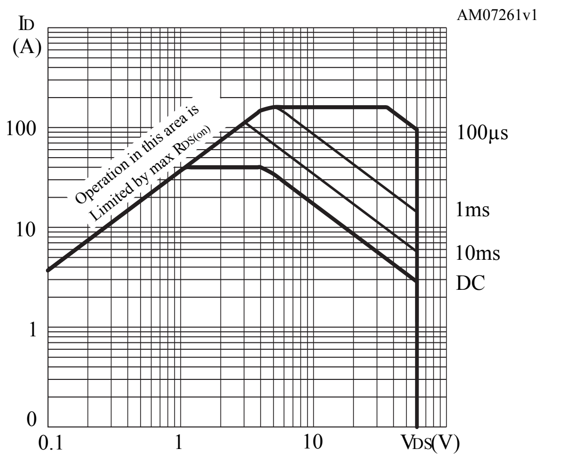


Figure 4. Thermal impedance

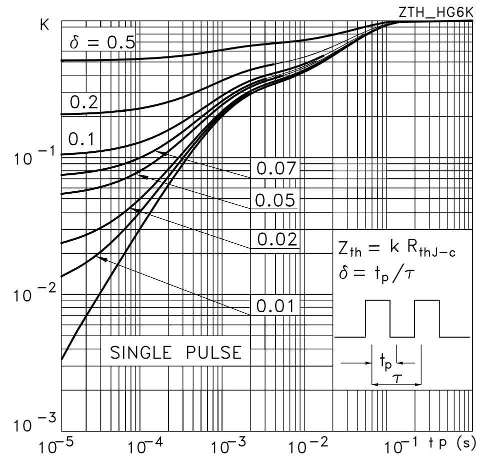


Figure 5. Output characteristics

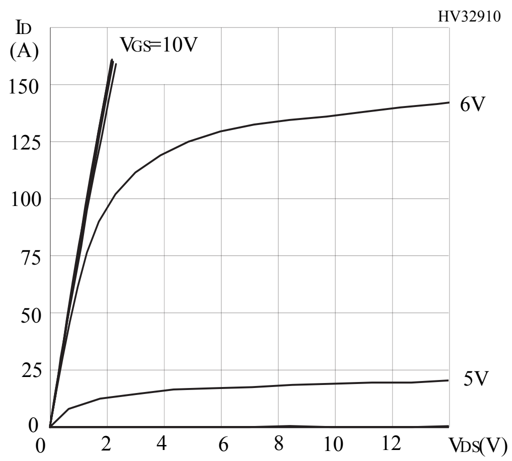


Figure 6. Transfer characteristics

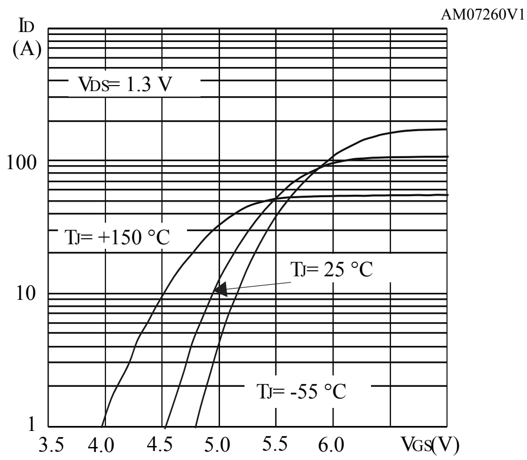


Figure 7. Gate charge vs gate-source voltage

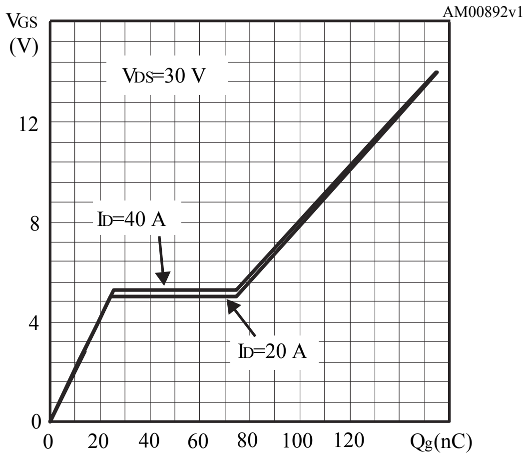


Figure 8. Capacitance variations

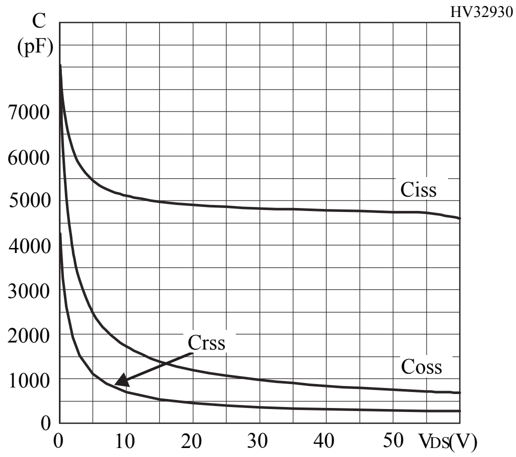


Figure 9. Normalized $V_{(BR)DSS}$ vs temperature

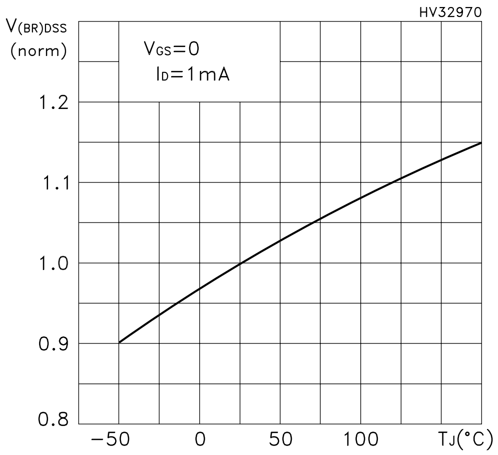


Figure 10. Static drain-source on-resistance

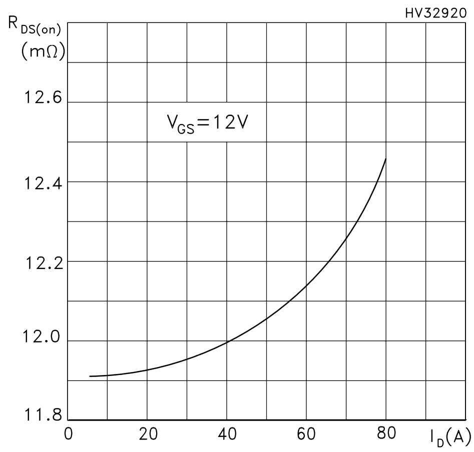


Figure 11. Normalized gate threshold voltage vs temperature

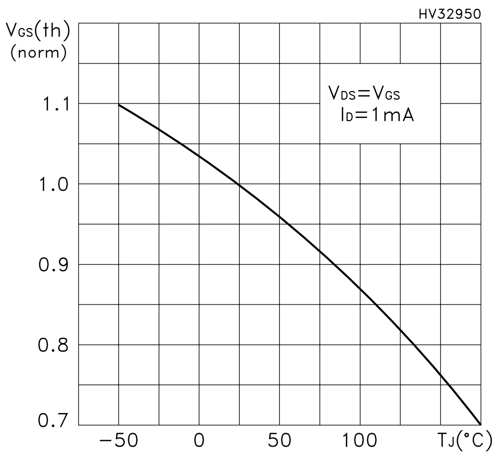


Figure 12. Normalized on-resistance vs temperature

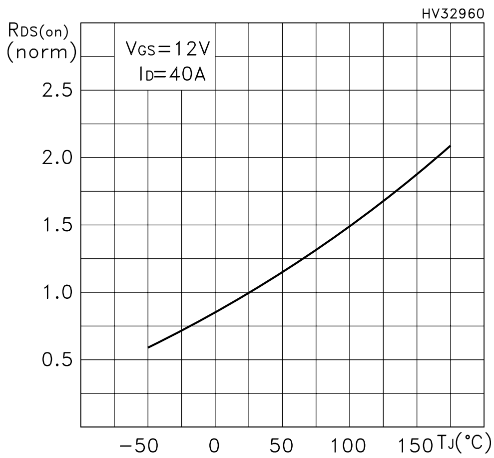
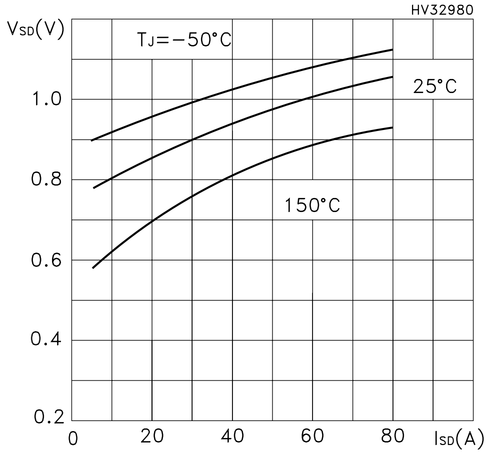


Figure 13. **Source drain-diode forward characteristics**



5 Test circuits

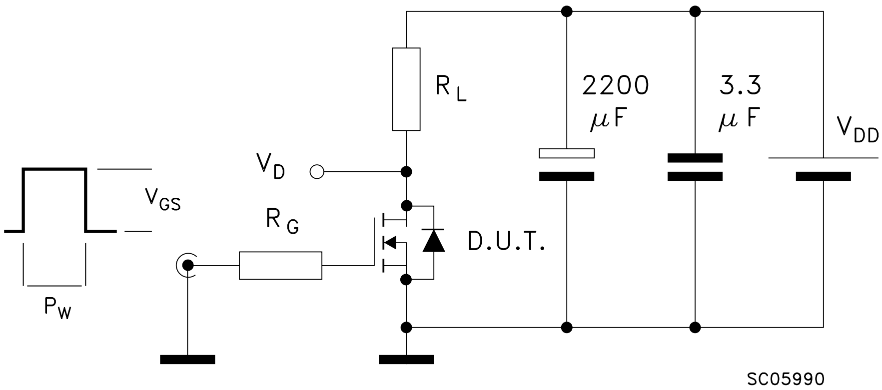


Figure 14. Switching times test circuit for resistive load

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

Figure 15. Source drain diode

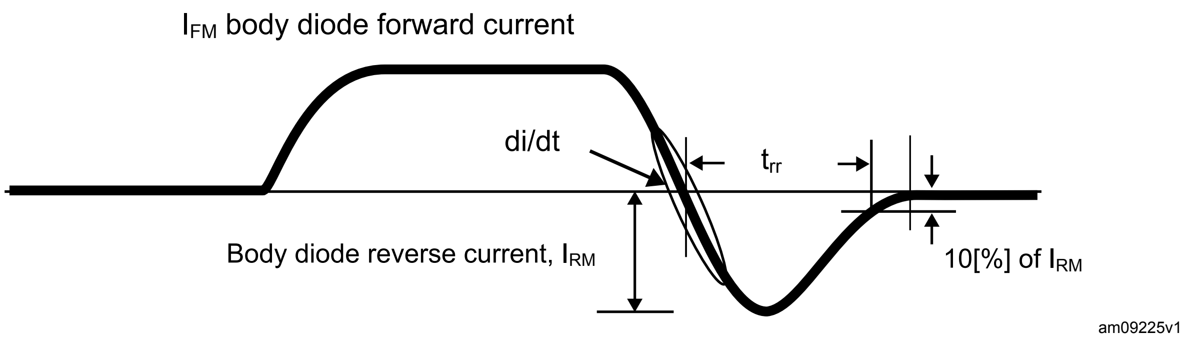
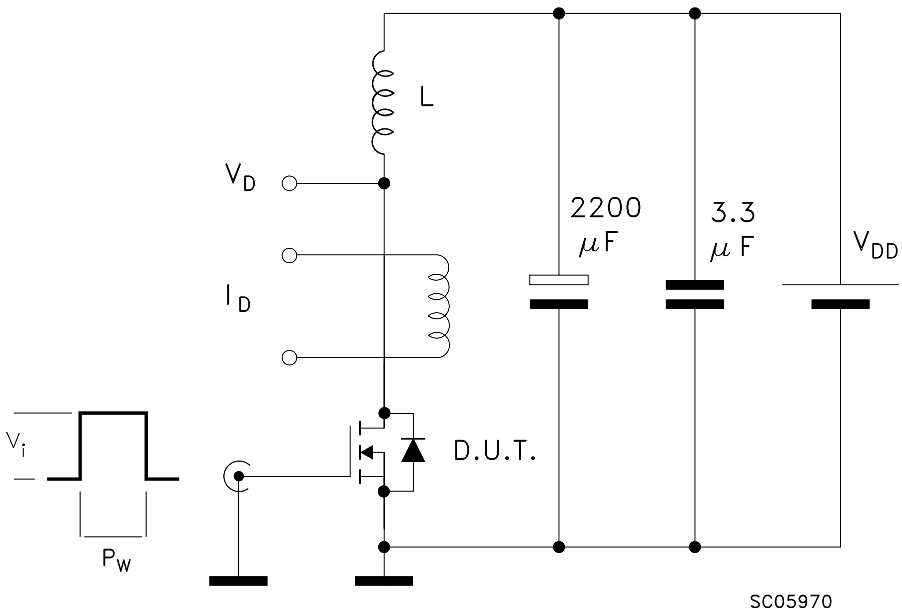


Figure 16. **Unclamped inductive load test circuit (single pulse and repetitive)**

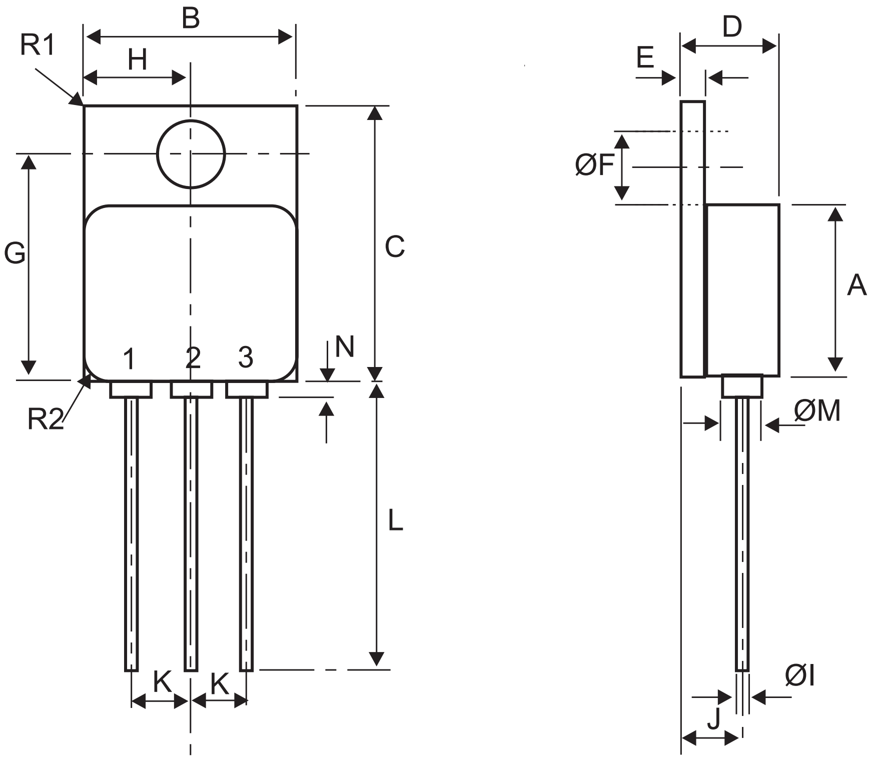


6 Package information

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.

6.1 TO-254AA package outline

Figure 17. TO-254AA package outline



The TO-254-AA is a metallic package. It is not connected to any pin nor to the inside die. 0005824 rev13

Table 7. **TO-254AA package mechanical data**

Symbols	Dimensions (mm)			Dimension (inches)		
	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		0.800
D	6.30		6.70	0.248		0.264
E	1.00		1.35	0.039		0.054
ØF	3.50		3.90	0.137		0.154
G	16.89		17.40	0.665		0.685
H		6.86			0.270	
ØI	0.89	1.14	2.00	0.035	0.045	0.079
J		3.81			0.150	
K		3.81			0.150	
L	12.95		14.50	0.510		0.571
ØM		3.05			0.120	
N			0.71			0.028
R1			1.00			0.039
R2		1.65			0.065	

7 Order codes

Table 8. Ordering information

Order codes	Agency specification	Quality level	Radiation level	Package	Weight	Lead finish	Marking(1)	Packing
STRH100N6HY1		Engineering model	-	TO-254AA	10 g	Gold	STRH100N6HY1 + BeO	Strip pack
STRH100N6HYG	5205/022/01	ESCC flight	50 krad				520502201F + BeO	
STRH100N6HYT	5205/022/02					Solder dip	520502202F + BeO	

1. *Specific marking only. The full marking includes in addition: For the Engineering Models: ST logo, date code; country of origin (FR). For ESCC flight parts: STlogo, date code, country of origin (FR), ESA logo, serial number of the part within the assembly lot.*

Contact ST sales office for information about the specific conditions for products in die form.

8 Other information

Table 9. Traceability and documentation

Screening type	Date code[1]	Radiation level	Documentation
Engineering model	3yywwN	-	Certificate of conformance
Flight model	yywwN	50 krad	Certificate of conformance ESCC qualification maintenance lot reference Radiation verification test (RVT) report at 10 / 20 / 30 / 50 krad at 0.1 rad / s.

1. *yy = year, ww = week number, N = lot index in the week.*

Revision history

Table 10. **Document revision history**

Date	Version	Changes
04-Jan-2011	1	First release.
27-Jul-2011	2	Updated order codes in Table 1: Device summary and Table 14: Ordering information. Minor text changes.
09-Nov-2011	3	Updated dynamic values on Table 6: Pre-irradiation dynamic and Table 7: Pre-irradation switching times.
27-Feb-2013	4	Corrected ID value on: – Features – Table 2: Absolute maximum ratings (pre-irradiation) – Table 5: Pre-irradation on/off states – Table 6: Pre-irradation dynamic – Table 8: Pre-irradation source drain diode – Table 9: Post-irradiation on/off states at T_J = 25 °C, (Co60 g rays 70 K Rad(Si)) – Table 10: Dynamic post-irradiation at T_J = 25 °C, (Co60 g rays 70 K Rad(Si)) – Table 11: Source drain diode post-irradiation at T_J = 25 °C, (Co60 g rays 70 K Rad(Si))
02-Jul-2013	5	Updated Table 1: Device summary and Table 14: Ordering information. Added Chapter 7.1: Other information.
16-Dec-2013	6	Modified: Description Minor text changes
16-Dec-2015	7	Updated features in cover page. Updated Table 5, Table 8, Table 9, Table 10, Table 11 and Table 15.
31-Mar-2016	8	Updated Table 8: Pre-irradation source drain diode. Minor text changes.
21-Dec-2016	9	Updated Table 7: Pre-irradation switching times and Table 8: Pre-irradation source drain diode. Minor text changes.
20-Mar-2019	10	Updated Table 8. Ordering information. Minor text changes.
15-Jul-2022	11	Removed ST Power logo. Updated Section Description, Table 4, and Other information. Minor text changes.