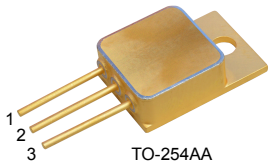
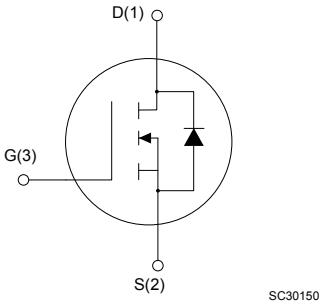
Rad-Hard 100 V, 48 A N-channel Power MOSFET





Product status link
STRH100N10

Features

V_{DS}	I_D	$R_{DS(on)}$ typ.	Q_g
100 V	48 A	30 mΩ	135 nC

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

Description

The STRH100N10 is a N-channel Power MOSFET developed with the Rad-hard STripFET technology in hermetic TO-254AA package.

Specifically designed to sustain Total Ionized Dose and immunity to heavy ion effects, it is qualified as per ESCC 5205/021 detail specification. In case of discrepancies between this datasheet and the relevant agency specification, the latter takes precedence.

Product summary

Product summary					
Part number	Quality level	ESCC part number	Package	Lead finish	Radiation level
STRH100N10HY1	Engineering model	-	TO-254AA	Gold	-
STRH100N10HYG	ESCC flight	5205/021			50 krad
STRH100N10HYT				Solder dip	

Note: *See Table 8. Ordering information.*

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}(1)	Drain-source voltage (V_{GS} = 0)	100	V
V_{GS}(2)	Gate-source voltage	±20	V
I_D(3)	Drain current (continuous) at T_{case} = 25 °C	48	A
	Drain current (continuous) at T_{case} = 100 °C	30	A
I_{DM}(4)	Drain current (pulsed)	192	A
P_{TOT}	Total power dissipation at T_{case} = 25 °C	170	W
dv/dt(5)	Peak diode recovery voltage slope	2.6	V/ns
T_{op}	Operating temperature range	-55 to 150	°C
T_j	Max. operating junction temperature range	150	°C

1. *This rating is guaranteed at $T_J \geq 25$ °C (see Figure 9).*
2. *This value is guaranteed over the full range of temperature.*
3. *Rated according to the $R_{thj\text{-}case}$ + $R_{thc\text{-}s}$*
4. *Pulse width limited by safe operating area.*
5. *$I_{SD} \leq 48$ A, di/dt ≤ 100 A/µs, $V_{DD} = 80\ \%V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case (maximum)	0.52	°C/W
$R_{thc\text{-}s}$	Thermal resistance case-sink (typical)	0.21	°C/W

Table 3. Avalanche data

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive, (pulse width limited by T_j max)	24	A
E_{AS}(1)	Single pulse avalanche energy (starting T_j = 25 °C, $I_D = I_{AR}$, V_{DD} = 50 V)	954	mJ
E_{AS}	Single pulse avalanche energy (starting T_j = 110 °C, $I_D = I_{AR}$, V_{DD} = 50 V)	280	mJ
E_{AR}	Repetitive pulse avalanche energy (V_{DD} = 50 V, I_{AR} = 24 A, f = 10 KHz, T_J = 25 °C, duty cycle = 50%)	60	mJ
E_{AR}	Repetitive pulse avalanche energy (V_{DD} = 50 V, I_{AR} = 24 A, f = 100 KHz, T_J = 25 °C, duty cycle = 10%)	24	
	Repetitive pulse avalanche energy (V_{DD} = 50 V, I_{AR} = 24 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)	80% BV_{Dss}		10	µA
		80% BV_{Dss}, T_C = 125 °C		100	
I_{GSS}	Gate body leakage current (V_{DS} = 0)	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		
BV_{DSS} (1)	Drain-to-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	100		V
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA, T_C = -55 °C	2.1	5.5	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	
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 12 V, I_D = 24 A		0.035	Ω
		V_{GS} = 12 V, I_D = 24 A, T_C = 125 °C		0.063	
C_{iss}	Input capacitance	V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 V	3940	5910	pF
C_{oss} (2)	Output capacitance		543	814	pF
C_{rss}	Reverse transfer capacitance		190	284	pF
Q_g	Total gate charge	V_{DD} = 50 V, I_D = 48 A, V_{GS} = 12 V	108	162	nC
Q_{gs}	Gate-to-source charge		21.6	32.4	nC
Q_{gd}	Gate-to-drain (“Miller”) charge		36	54	nC
R_G (2)	Gate input resistance	f = 1 MHz gate DC bias = 0 test signal level = 20 mV open drain	1.2	2	Ω
$t_{d(on)}$	Turn-on delay time	V_{DD} = 50 V, I_D = 24 A, R_G = 4.7 Ω, V_{GS} = 12 V	23.6	35.4	ns
t_r	Rise time		34.4	51.6	ns
$t_{d(off)}$	Turn-off delay time		79	119	ns
t_f	Fall time		33.6	50.4	ns
V_{SD} (3)	Forward on voltage	I_{SD} = 48 A, V_{GS} = 0 V		1.5	V
		I_{SD} = 48 A, V_{GS} = 0 V, T_c = 125 °C		1.275	V
t_{rr} (2)	Reverse recovery time	I_{SD} = 48 A, di/dt = 100 A/µs, V_{DD} = 50 V, T_J = 25 °C	332	498	ns
t_{rr} (2)	Reverse recovery time	I_{SD} = 48 A, di/dt = 100 A/µs, V_{DD} = 50 V, T_J = 150 °C	400	600	ns

1. *This rating is guaranteed at T_J ≥ 25 °C (see Figure 9).*
2. *Not tested in production, garanteed by process.*
3. *Pulsed: pulse duration = 300 µs, duty cycle ≤ 1.5%*

3 Radiation characteristics

This products is guaranteed in radiation as per ESCC 5205/021 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 V_{GS} = + 15 V and V_{DS} = 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	Min.	Max.	Unit
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 80 V		10	µA
I_{GSS}	Gate body leakage current	V_{GS} = 20 V		100	nA
		V_{GS} = -20 V	-100		
BV_{DSS}	Drain-to-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	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 = 24 A		0.035	Ω
V_{SD} (1)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 48 A		1.5	V

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

3.2 Single event effect RBSOA

This products is extremely resistant to heavy ion environment for single event effect (as per MIL-STD-750E, 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 Effects (SEB and SEGR) RBSOA

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

Figure 1. Single event effect, SOA

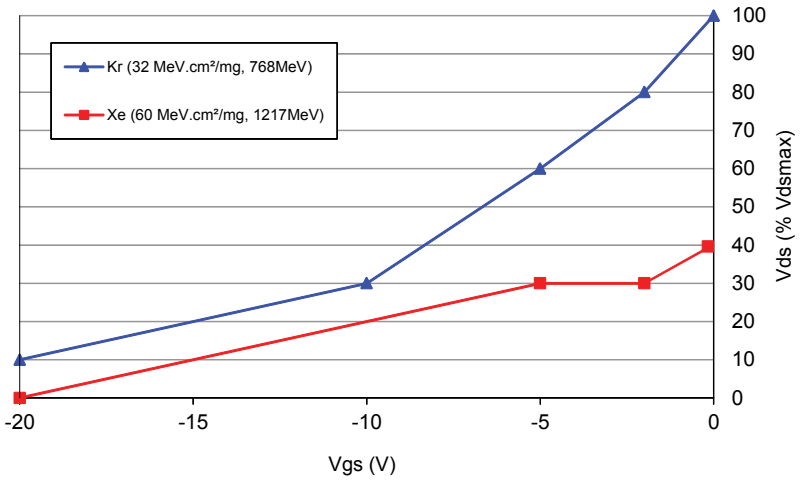
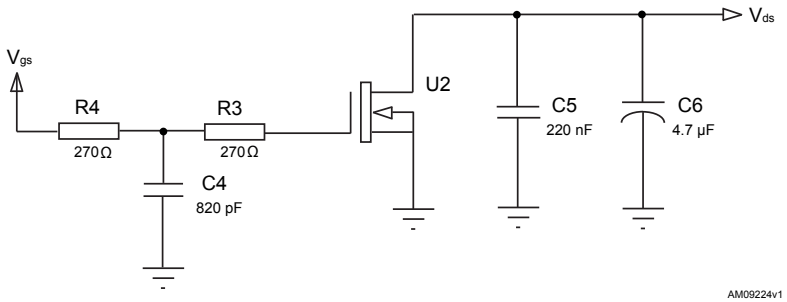


Figure 2. Single event effect, bias circuit



Note: Bias condition during radiation refer to Table 6.

4 Electrical characteristics (curves)

Figure 3. Safe operating area

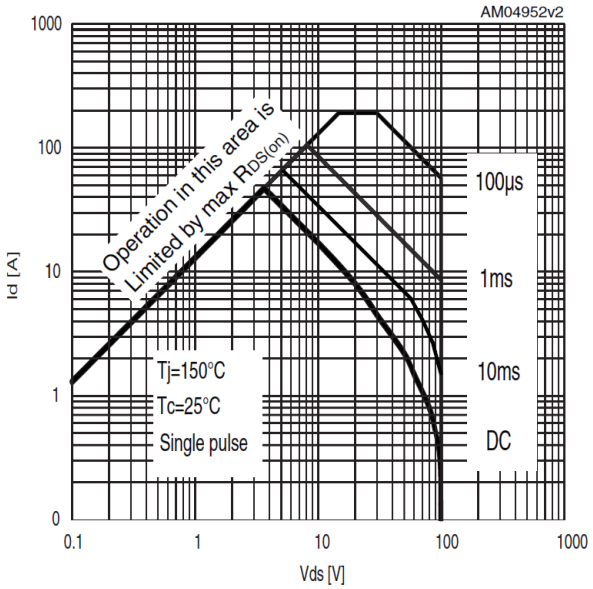


Figure 4. Thermal impedance

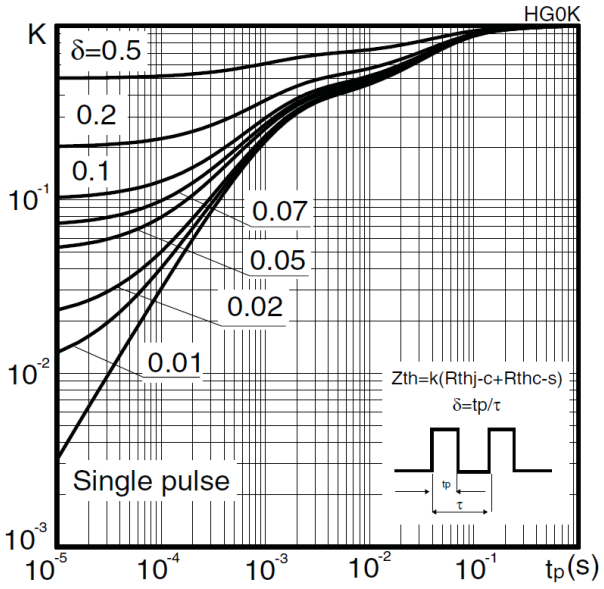


Figure 5. Output characteristics

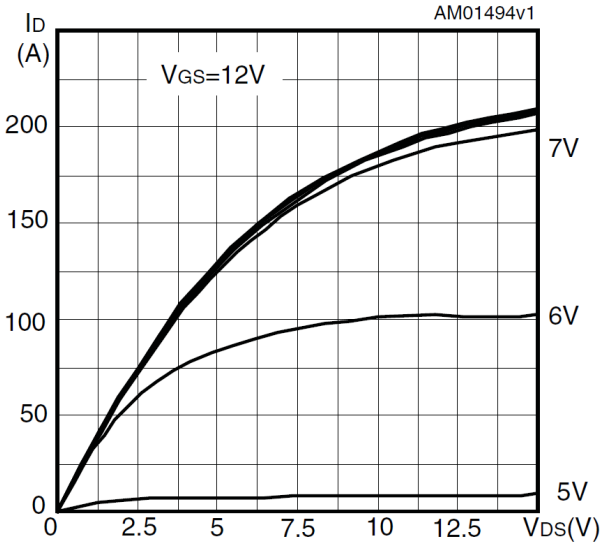


Figure 6. Transfer characteristics

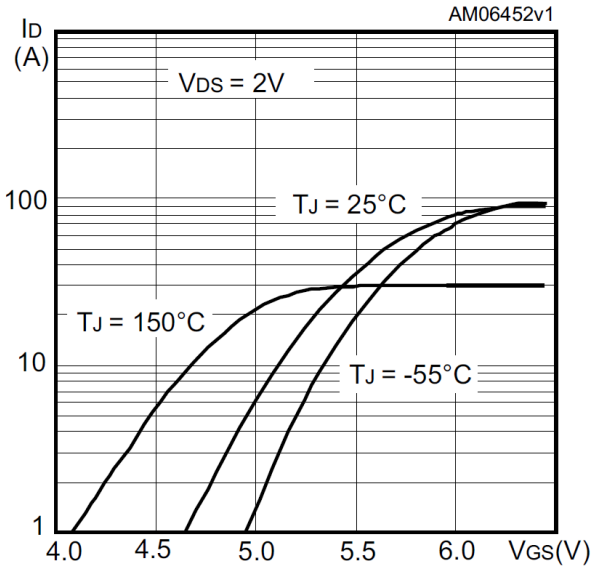


Figure 7. Gate charge vs gate-source voltage

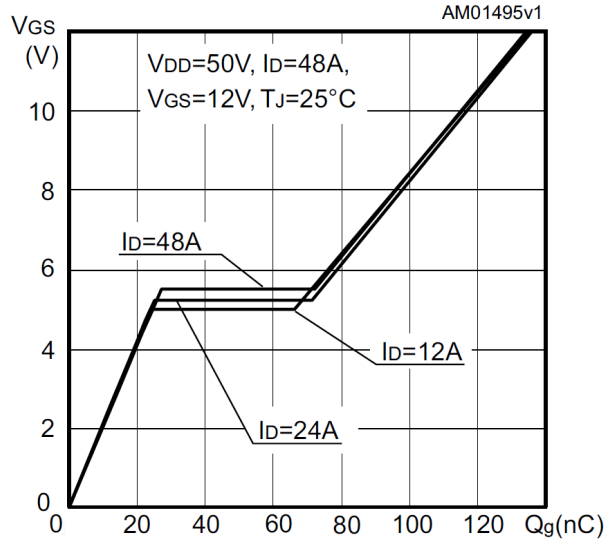


Figure 8. Capacitance variations

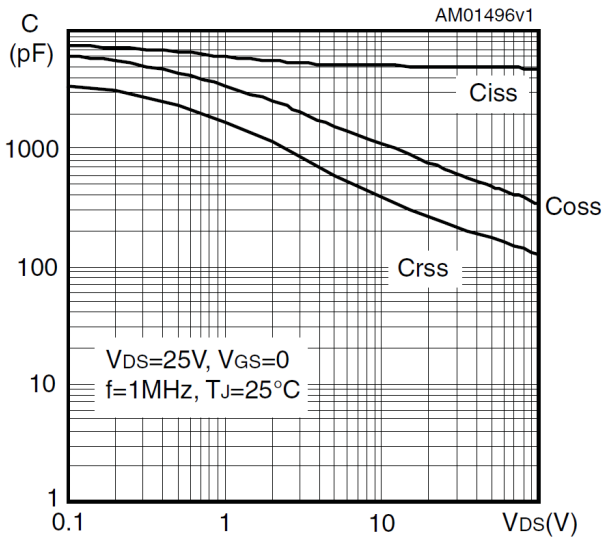


Figure 9. Normalized BV_{DSS} vs temperature

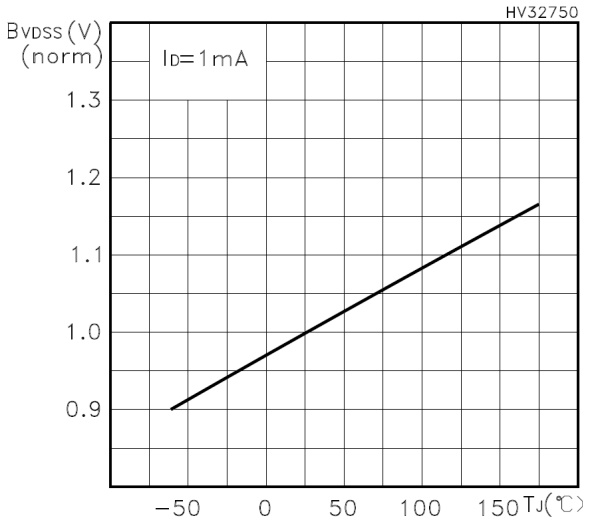


Figure 10. Static drain-source on-resistance

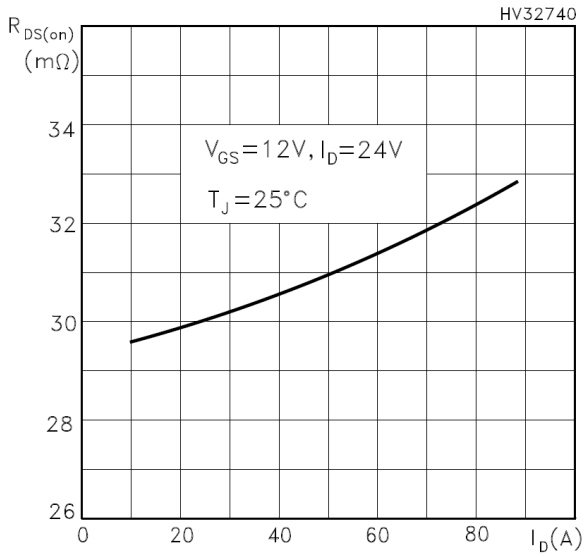


Figure 11. Normalized gate threshold voltage vs temperature

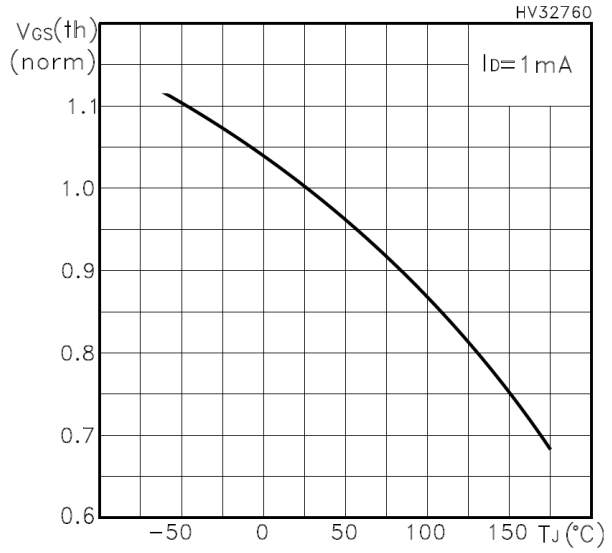


Figure 12. Normalized on-resistance vs temperature

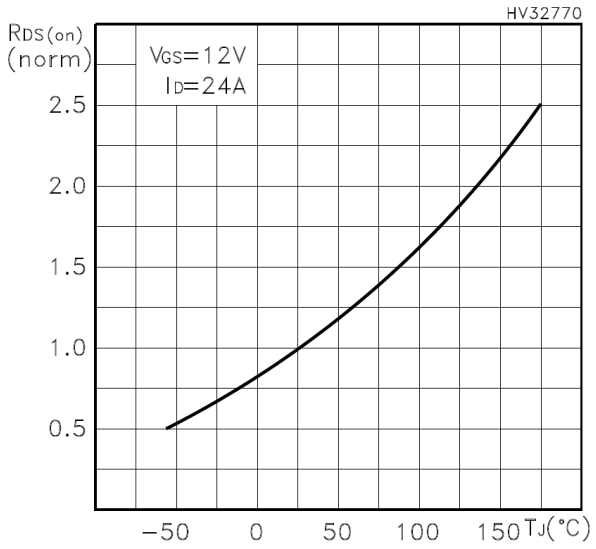
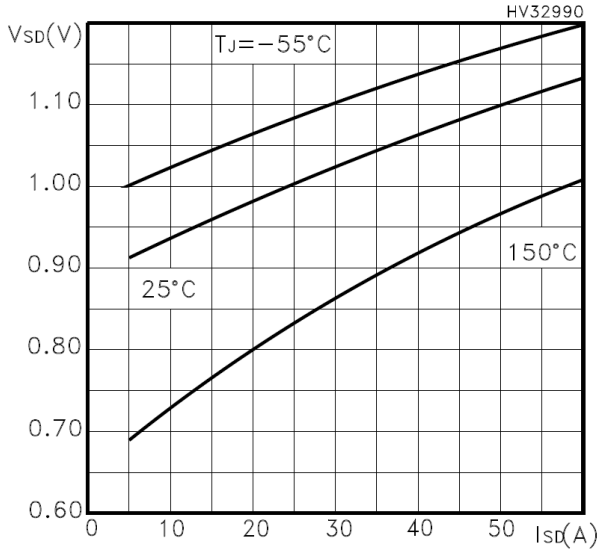
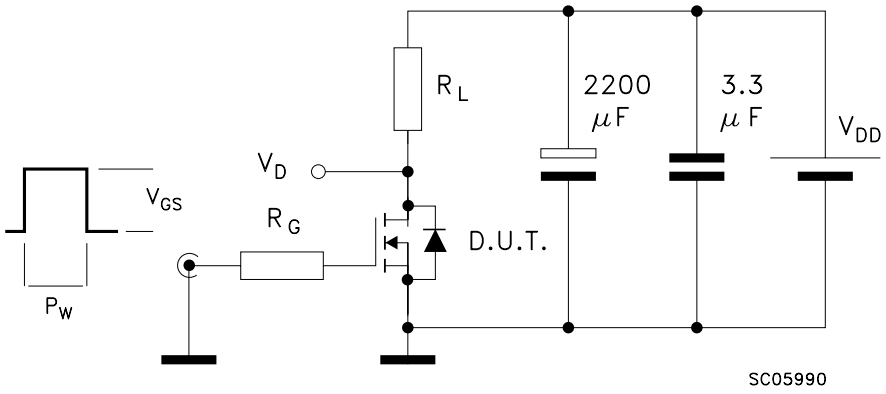


Figure 13. Source drain-diode forward characteristics



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 waveform**

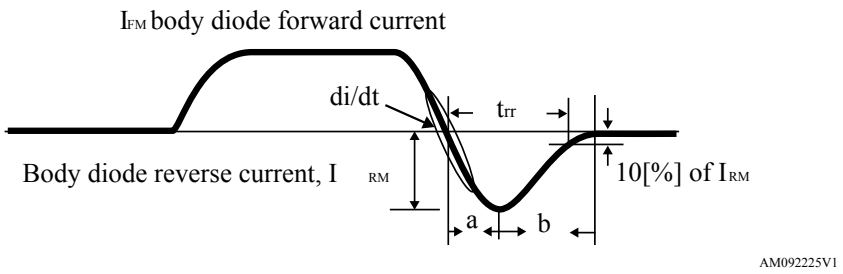
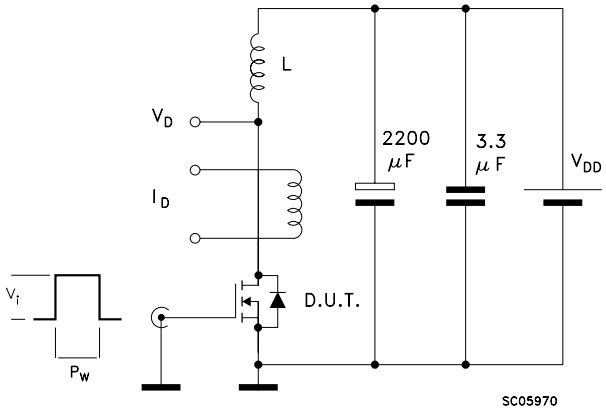


Figure 16. **Unclamped inductive load test circuit (single pulse and repetitive)**

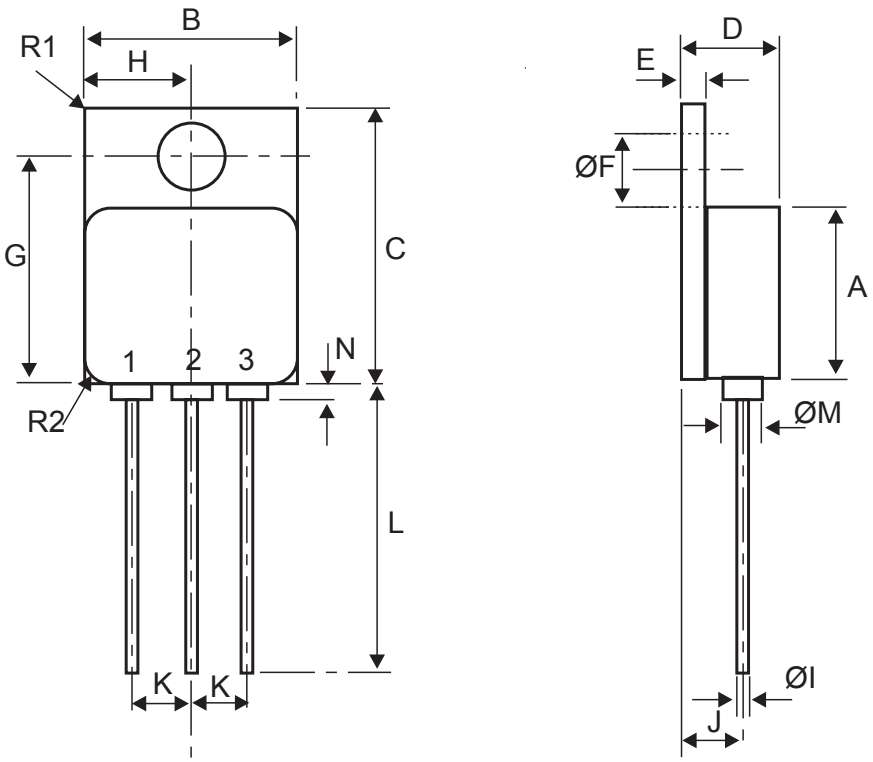


6 Package information

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 information

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

Part number	Agency specification	Quality level	Radiation level	Package	Weight	Lead finish	Marking[1]	Packing
STRH100N10HY1		Engineering model	-	TO-254AA	10 g	Gold	STRH40P10HY1 + BeO	Strip pack
STRH100N10HYG	5205/021/01	ESCC flight	50 krad				520502501R + BeO	
STRH100N10HYT	5205/021/02		50 krad			Solder dip	520502502R + 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 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
13-May-2010	1	First release.
14-Jun-2010	2	Updated Table 1: Device summary.
18-Oct-2010	3	Updated Table 1, 5, 9 and 14.
23-Dec-2010	4	Updated Figure 2: Single event effect, SOA. and TO-254AA mechanical data.
25-Jul-2011	5	Updated order codes in Table 1: Device summary and Table 14: Ordering information. Minor text changes.
09-Nov-2011	6	Updated dynamic values on Table 6: Pre-irradiation dynamic, Table 7: Switching times (pre-irradiation) and Table 8: Source drain diode (pre-irradiation).
31-May-2013	7	Updated Table 1, Table 12, Table 14, Figure 2 and Section 7: Order codes. Minor text changes in Section 3: Radiation characteristics.
09-Apr-2014	8	Modified: Figure 2. Minor text changes.
17-Dec-2015	9	Updated features in cover page. Updated Table 5, Table 8, Table 9, Table 10, Table 11 and Table 15.
06-Apr-2016	10	Updated Table 8: Source drain diode (pre-irradiation). Minor text changes.
19-Jan-2021	11	Updated Product summary, Table 1, Table 4, Table 5, Table 6, Table 8 and Table 10. Minor text changes.
10-Dec-2024	12	Updated Table 4, Table 5, and Other information.