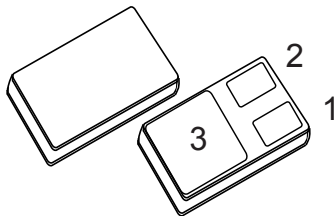
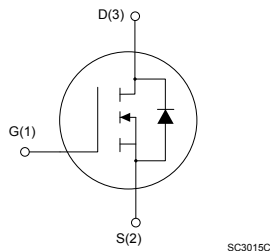


Rad-Hard 100 V, 6 A, N-channel Power MOSFET


SMD.5


Features

V_{DS}	I_D	$R_{DS(on)}$ typ.	Q_g typ.
100 V	6 A	0.27 Ω	18.5 nC

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

Description

The STRH8N10 is a 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. 5205/023 and available in SMD.5 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 case of discrepancies between this datasheet and the relevant agency specification, the latter takes precedence.

Product status link

STRH8N10

Device summary

Product summary					
Part numbers	Quality level	ESCC Part number	Package	Lead finish	Radiation level
STRH8N10S1	Engineering model	5205/023	SMD.5	Gold	-
STRH8N10SG	ESCC flight			Solder-dip	50 krad
STRH8N10ST					

Note: See [Table 8](#) for 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)	6	A
I_D	Drain current (continuous) at $T_{amb} = 100\text{ }^\circ\text{C}$	4.1	A
$I_{DM}^{(4)}$	Drain current (pulsed)	24	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	62.5	W
P_{TOT}	Total dissipation at $T_a = 25\text{ }^\circ\text{C}$	2.4	W
$dv/dt^{(5)}$	Peak diode recovery voltage slope	6.4	V/ns
T_{op}	Operating temperature range	-55 to 150	$^\circ\text{C}$
T_j	Max. operating junction temperature range	150	$^\circ\text{C}$

1. This rating is guaranteed at $T_J \geq 25\text{ }^\circ\text{C}$ (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. $I_{SD} \leq 6\text{ A}$, $di/dt \leq 1060\text{ A}/\mu\text{s}$, $V_{DD} = 80\%V_{(BR)DSS}$

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	2	$^\circ\text{C}/\text{W}$
R_{thJA}	Thermal resistance, junction-to-ambient	52	$^\circ\text{C}/\text{W}$

2 Avalanche data

Table 3. Avalanche data

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max.)	4	A
$E_{AS}^{(1)}$	Single pulse avalanche energy (starting $T_j = 25\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	457	mJ
E_{AS}	Single pulse avalanche energy (starting $T_j = 110\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	134	
E_{AR}	Repetitive avalanche ($V_{DD} = 50\text{ V}$, $I_{AR} = 4\text{ A}$, $f = 100\text{ KHz}$, $T_j = 25\text{ °C}$, duty cycle = 10 %)	4.3	mJ
	Repetitive avalanche ($V_{DD} = 50\text{ V}$, $I_{AR} = 4\text{ A}$, $f = 100\text{ KHz}$, $T_j = 110\text{ °C}$, duty cycle = 10 %)	1.4	

1. Maximum rating value.

3 Electrical characteristics

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

Symbol	Parameter	Test conditions	Min.	Max.	Unit
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	100 % $V_{(BR)DSS}$		1	mA
		80 % $V_{(BR)DSS}$		10	μ A
		80 % $V_{(BR)DSS}$, $T_C = 125\text{ °C}$		100	μ A
I_{GSS}	Gate body leakage current, ($V_{DS} = 0$)	$V_{GS} = 20\text{ V}$		100	nA
		$V_{GS} = -20\text{ V}$	-100		
		$V_{GS} = 20\text{ V}$, $T_C = 125\text{ °C}$		200	
		$V_{GS} = -20\text{ V}$, $T_C = 125\text{ °C}$	-200		
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 1\text{ mA}$	2	4.5	V
		$V_{DS} = V_{GS}$, $I_D = 1\text{ mA}$, $T_C = 125\text{ °C}$	1.5	3.7	
		$V_{DS} = V_{GS}$, $I_D = 1\text{ mA}$, $T_C = -55\text{ °C}$	2.1	5.5	
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 12\text{ V}$, $I_D = 4\text{ A}$		0.3	Ω
		$V_{GS} = 12\text{ V}$, $I_D = 4\text{ A}$, $T_a = 125\text{ °C}$		0.72	
C_{iss}	Input capacitance		527	791	pF
$C_{oss}^{(1)}$	Output capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	76	114	pF
C_{rss}	Reverse transfer capacitance		31	47	pF
Q_g	Total gate charge		15	22	nC
Q_{gs}	Gate-to-source charge	$V_{DD} = 50\text{ V}$, $I_D = 4\text{ A}$, $V_{GS} = 12\text{ V}$	2.5	4.5	nC
Q_{gd}	Gate-to-drain ("Miller") charge		4.3	6.5	nC
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 50\text{ V}$, $I_D = 4\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 12\text{ V}$	5	10	ns
t_r	Rise time		2	9	
$t_{d(off)}$	Turn-off delay time		13	30	
t_f	Fall time		2.5	7.5	
I_{SD}	Source-drain current			6	A
$I_{SDM}^{(2)}$	Source-drain current (pulsed)			24	A
V_{SD}	Diode forward voltage	$I_{SD} = 8\text{ A}$, $V_{GS} = 0\text{ V}$		1.5	V
		$I_{SD} = 8\text{ A}$, $V_{GS} = 0\text{ V}$, $T_a = 125\text{ °C}$		1.275	
$t_{rr}^{(1)}$	Reverse recovery time	$I_{SD} = 8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 50\text{ V}$, $T_j = 25\text{ °C}$	196	294	ns

1. Not tested in production, guaranteed by process.
2. Pulse width limited by safe operating area.
3. Pulsed: pulse duration = 300 μ s, duty cycle $\leq 1.5\%$

4 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.

4.1 Total dose radiation (TID) testing

The bias with $V_{GS} = +15\text{ V}$ and $V_{DS} = 0\text{ V}$ 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 ($T_{amb} = 25\text{ °C}$ unless otherwise specified)

Symbol	Parameter	Test conditions	Drift values Δ	Unit
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	80 % $V_{(BR)DSS}$	+1	μA
I_{GSS}	Gate body leakage current, ($V_{DS} = 0$)	$V_{GS} = 20\text{ V}$	1.5	nA
		$V_{GS} = -20\text{ V}$	-1.5	
$V_{(BR)DSS}$	Drain-to-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	-25%	V
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 1\text{ mA}$	-60% / +30%	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 4\text{ A}$	$\pm 10\%$	Ω
V_{SD}	Diode forward voltage	$I_{SD} = 8\text{ A}$, $V_{GS} = 0\text{ V}$	$\pm 2\%$	V

1. Pulsed: pulse duration = 300 μs , duty cycle $\leq 1.5\%$

4.2 Single event effect RBSOA

The STRH8N10 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), reverse biased safe operating area (RBSOA)

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

Figure 1. Single event effect, RBSOA

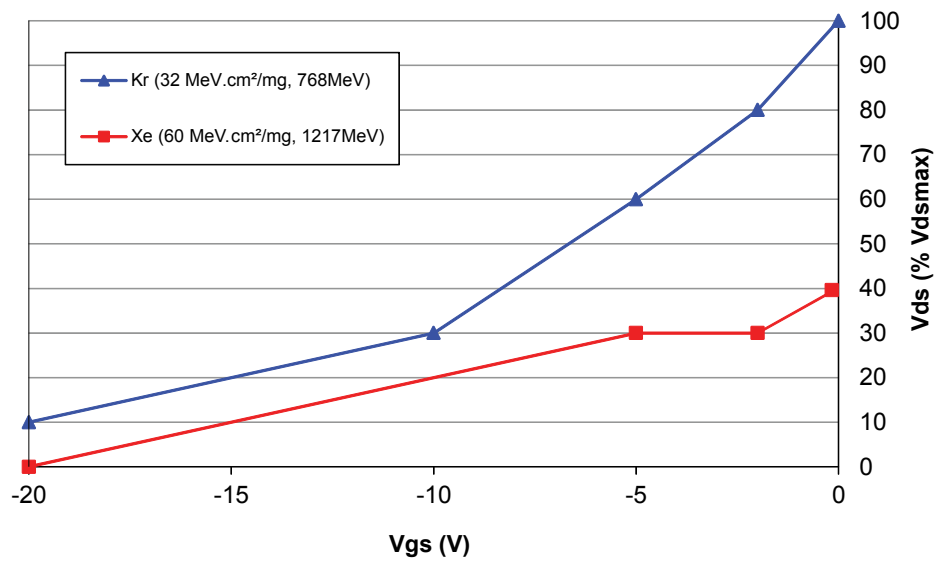
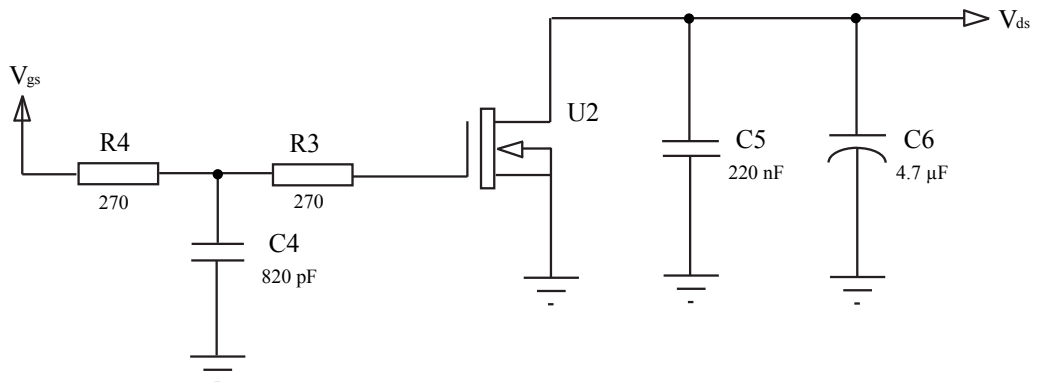


Figure 2. Single event effect, bias circuit



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5 Electrical characteristics (curves)

Figure 3. Safe operating area

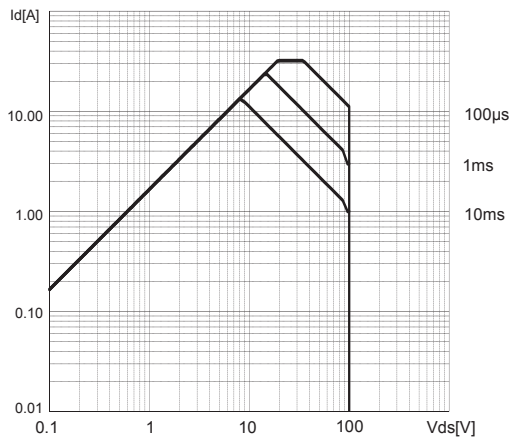


Figure 4. Thermal impedance

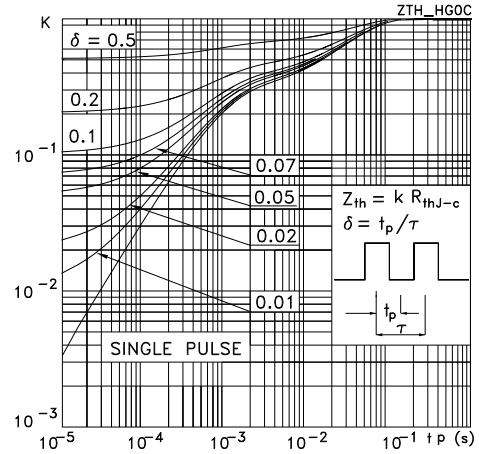


Figure 5. Output characteristics

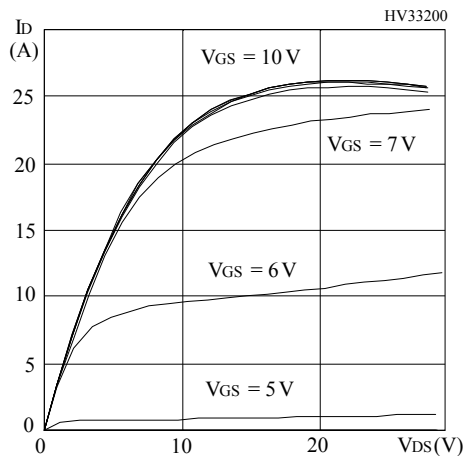


Figure 6. Transfer characteristics

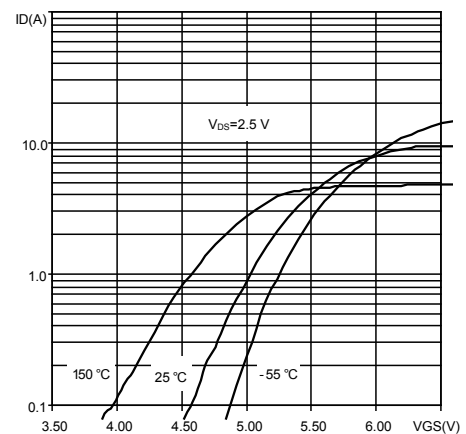


Figure 7. Gate charge vs gate-source voltage

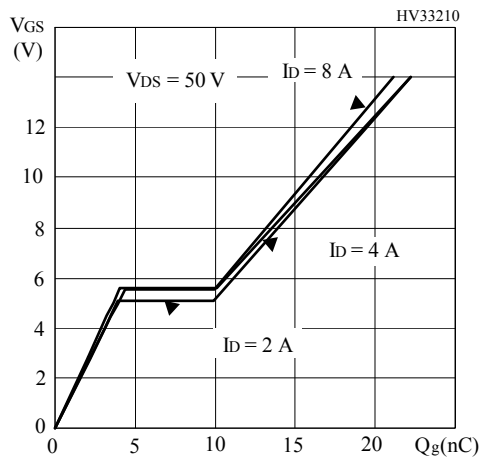


Figure 8. Capacitance variations

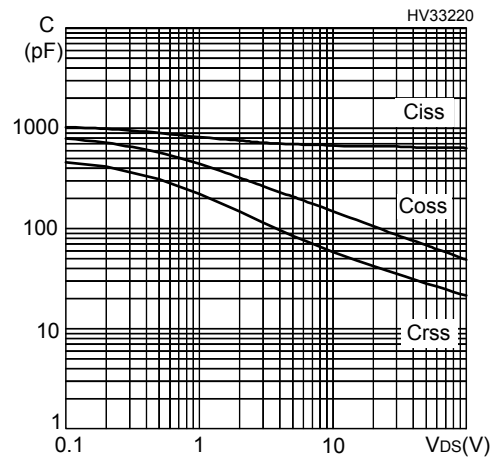


Figure 9. Normalized $V_{(BR)DSS}$ vs temperature

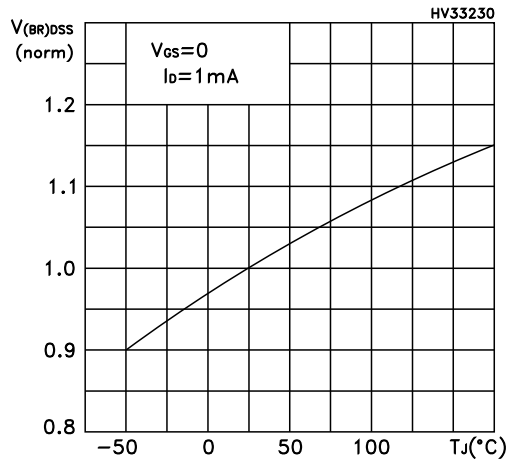


Figure 10. Static drain-source on-resistance

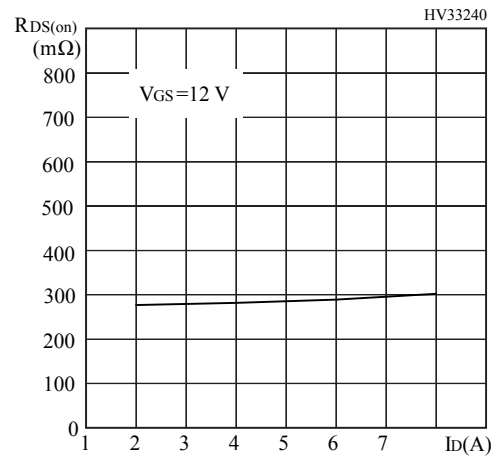


Figure 11. Normalized gate threshold voltage vs temperature

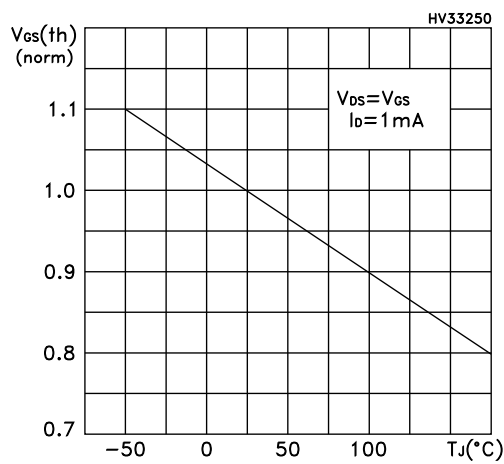


Figure 12. Normalized on-resistance vs temperature

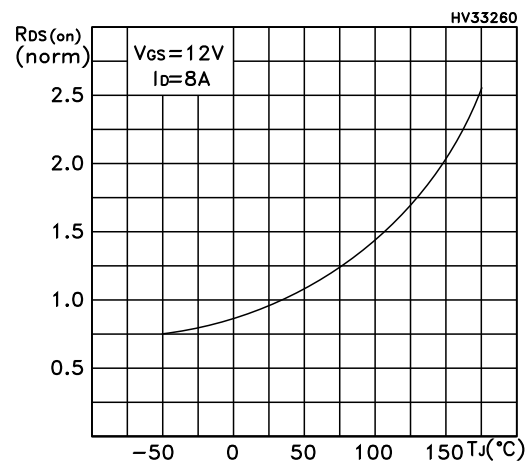
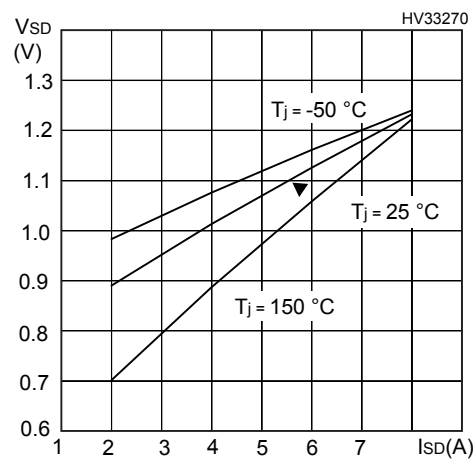
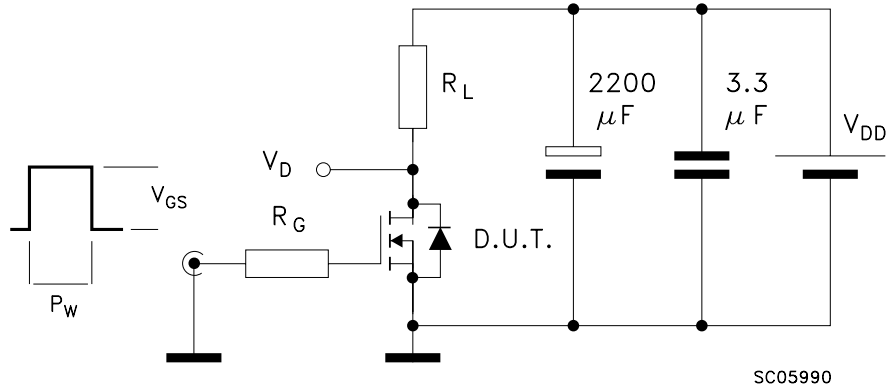


Figure 13. Source drain-diode forward characteristics



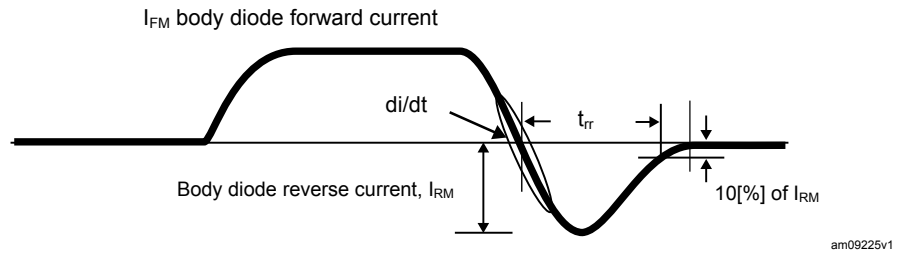
6 Test circuits

Figure 14. Switching times test circuit for resistive load



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

Figure 15. Source drain diode waveform

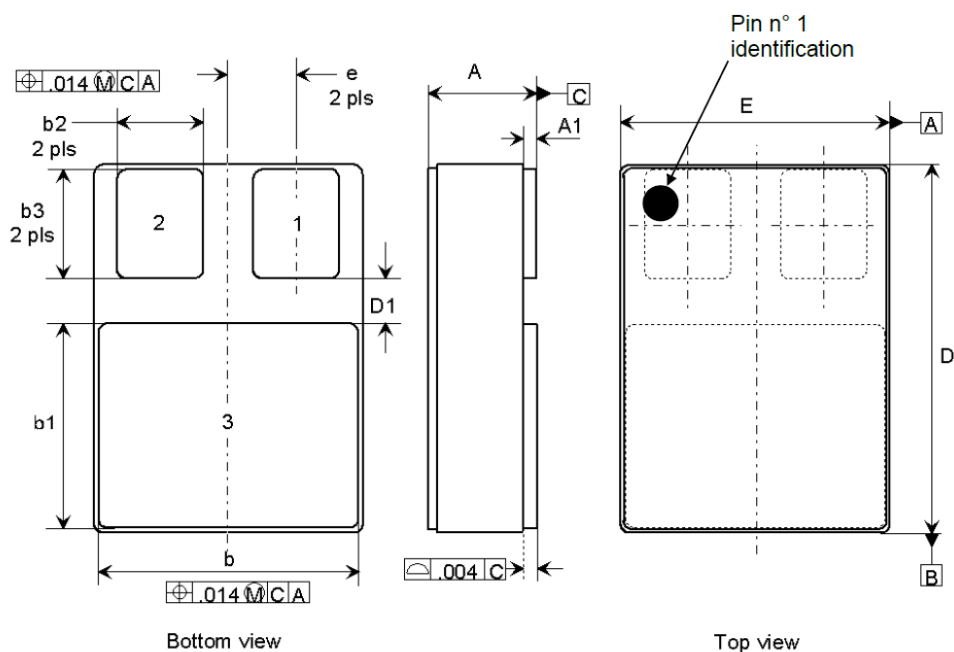


7 Package information

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.

7.1 SMD.5 package information

Figure 16. SMD.5 package outline



7386434_REV7

Table 7. SMD.5 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.84		3.30
A1	0.25	0.38	0.51
b	7.13	7.26	7.39
b1	5.58	5.72	5.84
b2	2.28	2.41	2.54
b3	2.92	3.05	3.18
D	10.03	10.16	10.28
D1	0.76		
E	7.39	7.52	7.64
e		1.91	

Note: The lid is not connected to any pin.

8 Order codes

Table 8. Ordering information

Part number	Agency specification	Quality level	Radiation level	Package	Weight	Lead finish	Marking ⁽¹⁾	Packing
STRH8N10S1	-	Engineering model	-	SMD.5	1 g	Gold	STRH8N10S1	Strip pack
STRH8N10SG	5205/023/01	ESCC	50 krad				520502301F	
STRH8N10ST	5205/023/02	flight				Solder-dip	520502302F	

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: ST logo, 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.

9 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	Revision	Changes
20-May-2011	1	First release.
09-Nov-2011	2	Updated dynamic values on Table 6: Dynamic, Table 7: Switching times.
03-Jun-2013	3	Added new package and mechanical data: SMD.5 Removed TO-39 package.
16-Dec-2013	4	Updated Description Minor text changes
09-Apr-2014	5	Document status promoted from preliminary data to production data Modified: Figure 2. Minor text changes.
26-May-2014	6	Updated Figure 1.
04-Mar-2016	7	Updated: Features, Table 5, Table 6, Table 9, Table 10, Table 11 and Table 15. Updated Section 6: Package information. Minor text changes.
10-Feb-2017	8	Updated Table 6: Dynamic and Table 8: Source drain diode.
04-Oct-2021	9	Updated Description. Minor text changes.
19-May-2022	10	Updated Table 4, Figure 15 and Section 9 Other information.
18-Jan-2024	11	Updated Table 4. Electrical characteristics ($T_{amb} = 25\text{ °C}$ unless otherwise specified). Minor text changes.

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