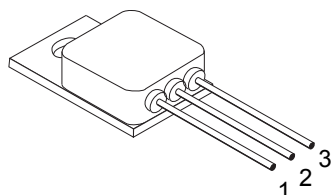
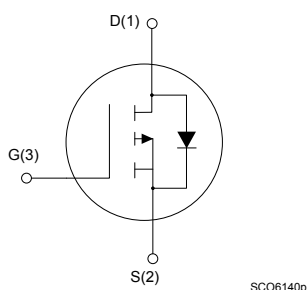


Rad-Hard 100 V, 12 A, P-channel Power MOSFET



TO-257 AA

The case is not connected to any lead



Features

V_{DS}	I_D	$R_{DS(on)}$ typ.	Q_g
100 V	12 A	265 mΩ	40 nC

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

Description

The **STRH12P10** is a P-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. 5205/029 and available in TO-257AA 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

[STRH12P10](#)

Device summary

Product summary					
Part numbers	Quality level	ESCC part number	Package	Lead finish	Radiation level
STRH12P10GY1	Engineering model	-	TO-257AA	Gold	-
STRH12P10GYG	ESCC flight	5205/029		Solder dip	100 krad
STRH12P10GYT					100 krad

Note: See [Table 8](#) for ordering information.

1 Electrical ratings

$T_C = 25\text{ °C}$ unless otherwise specified

Table 1. Absolute maximum ratings (pre-irradiation)

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	100	V
V_{GS}	Gate-source voltage	± 18	V
$I_D^{(1)}$	Drain current (continuous) at $T_{case} = 25\text{ °C}$	12	A
	Drain current (continuous) at $T_{case} = 100\text{ °C}$	7.5	A
$I_{DM}^{(2)}$	Drain current (pulsed)	48	A
P_{TOT}	Total power dissipation at $T_{case} = 25\text{ °C}$	75	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	2.4	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_j	Max. operating junction temperature range	150	°C

1. Rated according to the $R_{thj-case} + R_{thc-s}$
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 12\text{ A}$, $di/dt \leq 36\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max.	1.47	°C/W
R_{thc-s}	Thermal resistance case-sink typ.	0.20	°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)	6	A
$E_{AS}^{(1)}$	Single pulse avalanche energy (starting $T_j = 25\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) at 110 °C	112	mJ
E_{AR}	Repetitive pulse avalanche energy ($V_{DS} = 50\text{ V}$, $I_{AR} = 6\text{ A}$, $f = 10\text{ KHz}$, $T_j = 25\text{ °C}$, duty cycle = 50%)	17	mJ
	Repetitive pulse avalanche energy ($V_{DS} = 50\text{ V}$, $I_{AR} = 6\text{ A}$, $f = 10\text{ KHz}$, $T_j = 110\text{ °C}$, duty cycle = 50%)	5.5	mJ

1. Maximum rating value.

2 Electrical characteristics

For the P-channel MOSFET polarity of voltages and current has to be reversed.

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	$V_{DS} = 80\text{ V}$		10	μA
		$V_{DS} = 80\text{ V}, T_C = 125\text{ °C}$		100	
I_{GSS}	Gate body leakage current	$V_{GS} = 16\text{ V}$		100	nA
		$V_{GS} = -16\text{ V}$	-100		
		$V_{GS} = 16\text{ V}, T_C = 125\text{ °C}$		200	
		$V_{GS} = -16\text{ V}, T_C = 125\text{ °C}$	-200		
$V_{(BR)DSS}^{(1)}$	Drain-to-source breakdown voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	100		V
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	2.0	4.5	V
		$V_{DS} = V_{GS}, I_D = 1\text{ mA}, T_C = 125\text{ °C}$	1.6	3.8	
		$V_{DS} = V_{GS}, I_D = 1\text{ mA}, T_C = -55\text{ °C}$	2.2	5.2	
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 12\text{ V}, I_D = 12\text{ A}$		0.30	Ω
		$V_{GS} = 12\text{ V}, I_D = 12\text{ A}, T_C = 125\text{ °C}$		0.6	
$C_{iss}^{(2)}$	Input capacitance	$V_{DS} = 25\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	940	1410	pF
$C_{oss}^{(2)}$	Output capacitance		135	205	pF
$C_{rss}^{(2)}$	Reverse transfer capacitance		55	85	pF
Q_g	Total gate charge	$V_{DD} = 50\text{ V}, I_D = 12\text{ A}, V_{GS} = 12\text{ V}$	32	48	nC
Q_{gs}	Gate-to-source charge		3.5	6.5	nC
Q_{gd}	Gate-to-drain ("Miller") charge		7	13	nC
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 50\text{ V}, I_D = 6\text{ A}, R_G = 4.7\text{ }\Omega, V_{GS} = 12\text{ V}$	5	15	ns
t_r	Rise time		7	31	ns
$t_{d(off)}$	Turn-off delay time		18	50	ns
t_f	Fall time		3.5	10.5	ns
V_{SD}	Forward on voltage	$I_{SD} = 12\text{ A}, V_{GS} = 0\text{ V}$		1.5	V
		$I_{SD} = 12\text{ A}, V_{GS} = 0\text{ V}, T_C = 125\text{ °C}$		1.25	
t_{rr}	Reverse recovery time	$I_{SD} = 6\text{ A}, di/dt = 50\text{ A}/\mu\text{s}, V_{DD} = 50\text{ V}$	178	310	ns

1. This rating is guaranteed at $T_J \leq 25\text{ °C}$ (see Figure 9. Normalized $V_{(BR)DSS}$ vs temperature).

2. Not tested, guaranteed by process.

3 Radiation characteristics

The STRH12P10 is guaranteed in radiation for single event effects (SEE) as per ESCC25100 and total ionizing dose (TID) as per ESCC 22900.

3.1 Total dose radiation (TID) testing

Each lot is tested in radiation and accepted according to the parameters of Table 5 at the following conditions.

- $V_{GS} = -15\text{ V}$ and $V_{DS} = 0\text{ V}$ applied during irradiation exposure.
- 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	Min.	Max.	Unit
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 80\text{ V}$		10	μA
I_{GSS}	Gate body leakage current	$V_{GS} = 16\text{ V}$		100	nA
		$V_{GS} = -16\text{ V}$	-100		
$V_{(BR)DSS}$	Drain-to-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	80		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	$V_{GS} = 12\text{ V}$, $I_D = 12\text{ A}$		0.3	Ω
$V_{SD}^{(1)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 12\text{ A}$		1.5	V

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

3.2 Single event effect SOA

Single event burnout (SEB) and single event gate rupture (SEGR) are performed according to MIL-STD-750E, method 1080, using bias circuit shown in Figure 2. Single event effect, bias circuit, at the following conditions.

- Fluence of $3e+5$ ions/cm
- 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. The test is halted as soon as the gate current reaches 100 nA during irradiation or during post irradiation gate stress (PIGS) 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
		756	92
Cu	28	285	43
Xe	60	1217	89

Figure 1. Single event effect, SOA

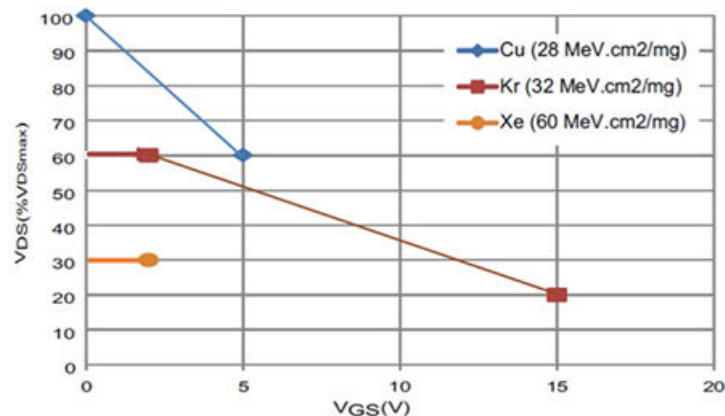
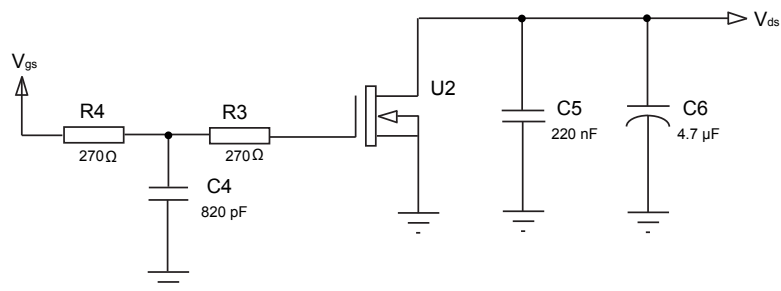


Figure 2. Single event effect, bias circuit



AM09224v1

4 Electrical characteristics (curves)

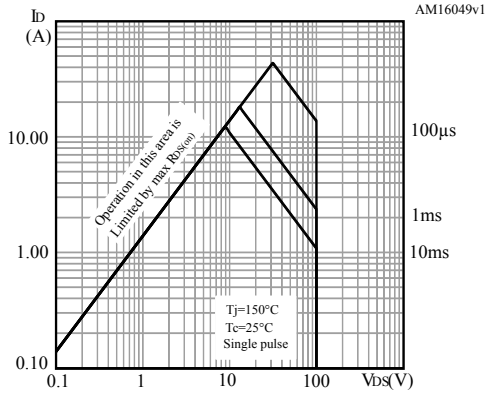
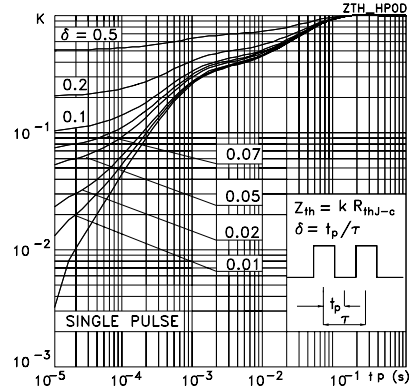
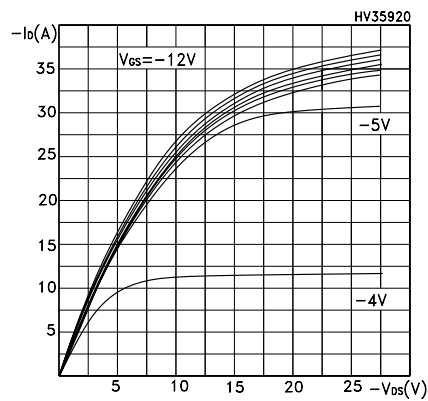
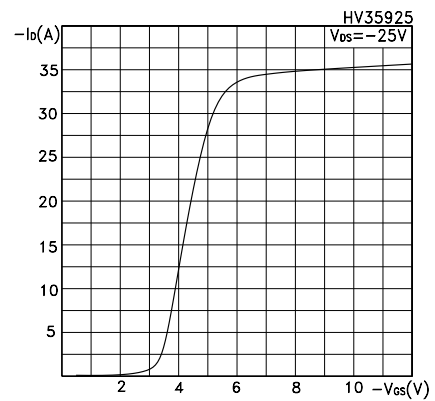
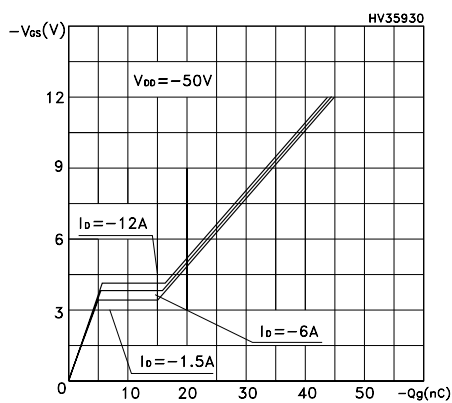
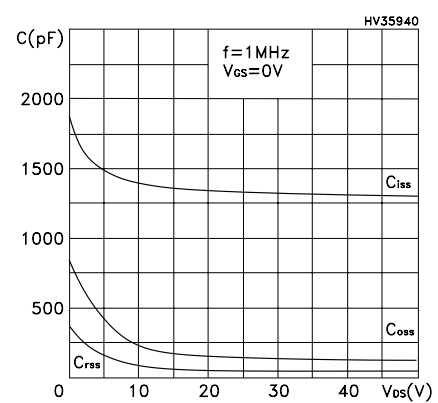
Figure 3. Safe operating area

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

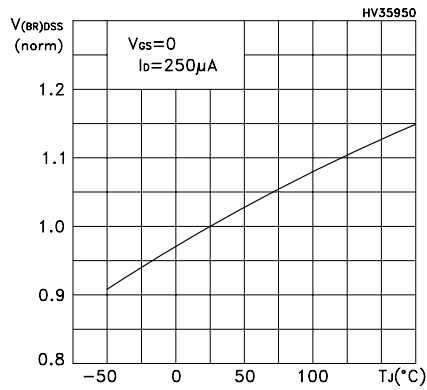


Figure 10. Static drain-source on-resistance

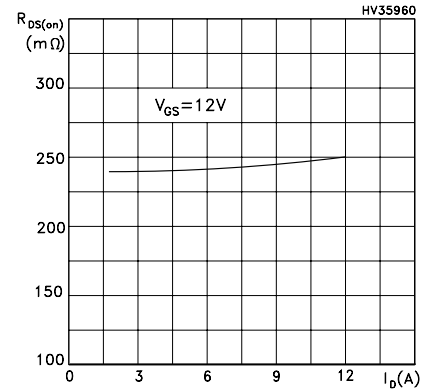


Figure 11. Normalized gate threshold voltage vs temperature

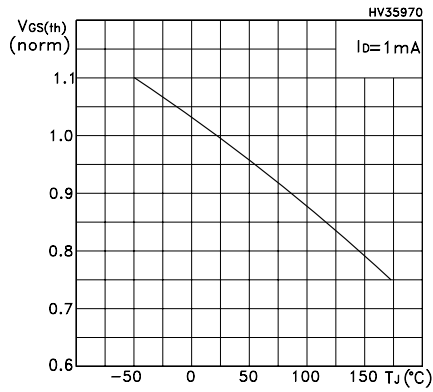


Figure 12. Normalized on-resistance vs temperature

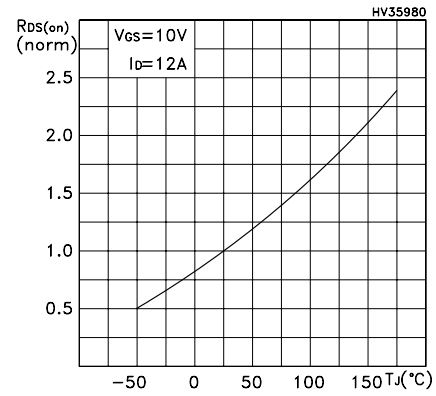
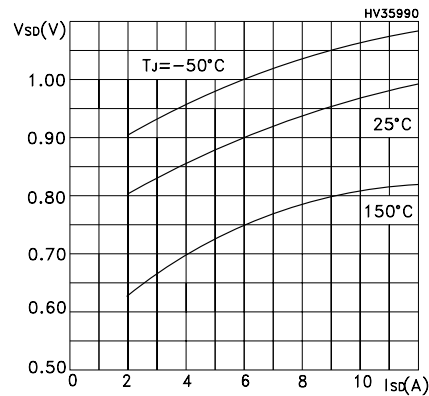
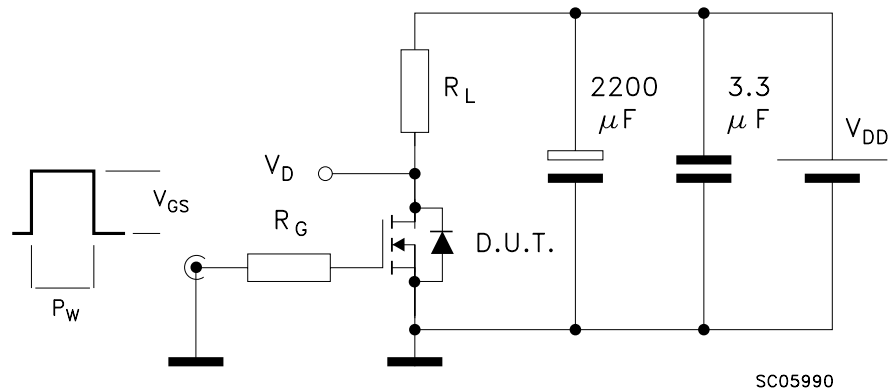


Figure 13. Source drain-diode forward characteristics



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 waveform

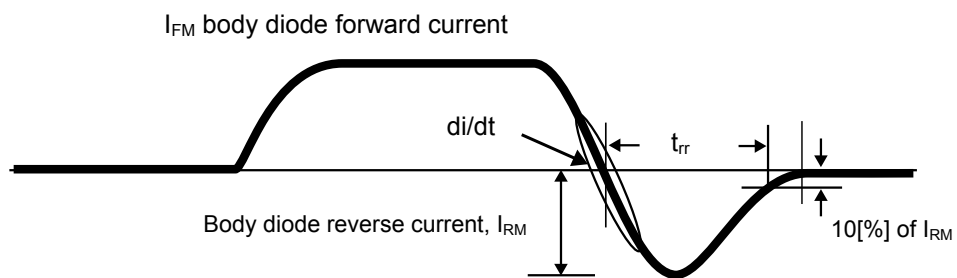
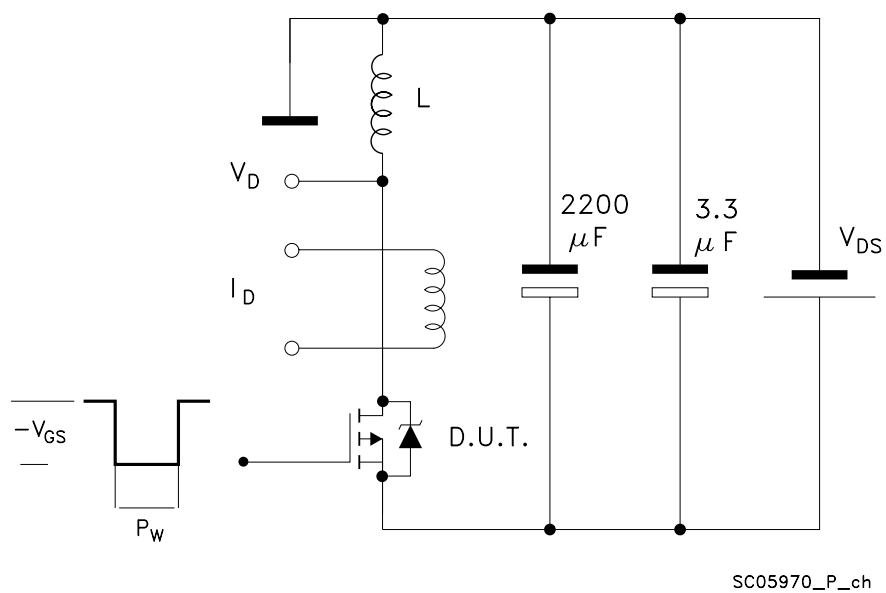


Figure 16. Unclamped inductive load test circuit (single pulse and repetitive)

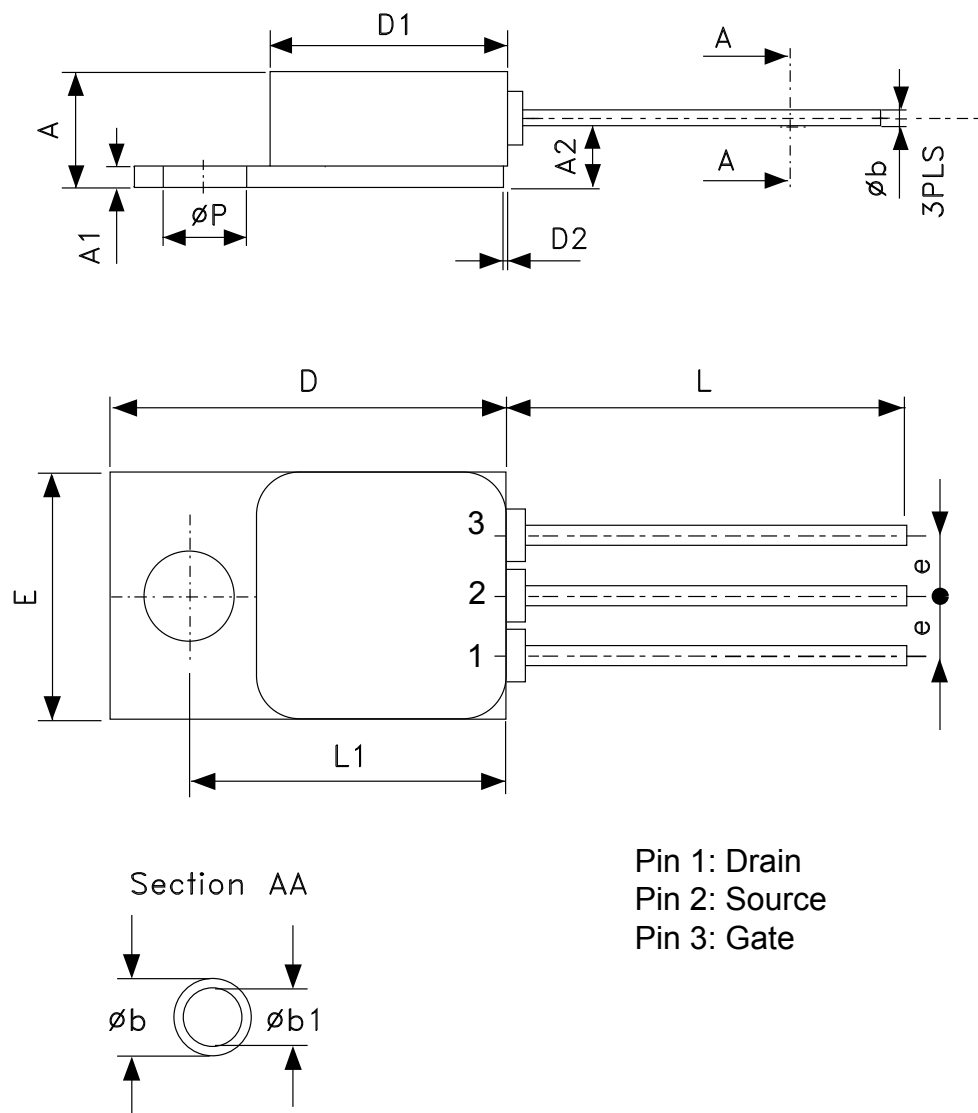


6 Package information

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-257AA package information

Figure 17. TO-257AA package outline



0117268_E

Table 7. TO-257AA package mechanical data

Symbols	Dimensions (mm)			Dimensions (inches)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.83		5.08	0.190		0.200
A1	0.89		1.14	0.035		0.045
A2		3.05			0.120	
b	0.64		1.02	0.025		0.040
b1	0.64	0.76	0.89	0.025	0.030	0.035
D	16.38		16.89	0.645		0.665
D1	10.41		10.92	0.410		0.430
D2	-	-	0.97			0.038
e		2.54			0.100	
E	10.41		10.67	0.410		0.420
L	15.24		16.51	0.600		0.650
L1	13.39		13.64	0.527		0.537
P	3.56		3.81	0.140		0.150

Note: The case is not connected to any lead.

7 Order codes

Table 8. Ordering information

Part number	Agency specification	Screening option	Radiation level	Package	Weight	Lead finish	Marking ⁽¹⁾	Packing
STRH12P10GY1		Engineering model	-	TO-257AA	5 g	Gold	STRH12P10GY1 + BeO	Strip pack
STRH12P10GYG	5205/029/01	ESCC flight	100 krad				520502901R + BeO	
STRH12P10GYT	5205/029/02		100 krad			Solder dip	520502902R + 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: 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 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	100 krad	Certificate of conformance ESCC qualification maintenance lot reference Radiation verification test (RVT) report at 25/50 /70/100 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
07-Oct-2011	1	First release.
24-Jun-2013	2	Document status promoted from preliminary data to production data. – Modified: <i>Figure 1</i> – Modified: EAS, EAR parameter and values in <i>Table 4</i> – Modified: IGSS, and added note 1 in <i>Table 5</i> – Added: note 1 in <i>Table 6</i> – Modified: trr, qrr and IRRM parameter in <i>Table 8</i> – Modified: RDS(on) test conditions in <i>Table 9</i> , the entire test conditions in <i>Table 10</i> – Modified: <i>Figure 4</i>
25-Nov-2013	3	– Modified: <i>package drawing</i> and <i>Figure 1</i> .
18-Dec-2013	4	– Updated <i>Table 1: Device summary</i> and <i>Table 14: Ordering information</i> . – Updated <i>Section : Total dose radiation (TID) testing</i> .
19-Jan-2015	5	– Updated <i>Table 13: TO-257AA mechanical data</i> – Minor text changes
02-May-2019	6	Updated <i>Table 7. Pre-irradiation source drain diode</i> and <i>Table 4. Preirradiation on/off states</i> . Minor text changes
29-Feb-2020	7	Updated <i>Table 10</i> and <i>TO-257 AA package information</i> .
21-Jan-2021	8	Updated <i>Product summary</i> , <i>Table 4</i> , <i>Table 5</i> , <i>Table 6</i> , <i>Figure 1</i> , <i>Table 8</i> and <i>Table 10</i> .
05-May-2022	9	Updated <i>features</i> in cover page. Updated <i>Table 4. Electrical characteristics (Tamb = 25 °C unless otherwise specified)</i> , <i>Section 3 Radiation characteristics</i> , <i>Section 3.1 Total dose radiation (TID) testing</i> , <i>Section 3.2 Single event effect RBSOA</i> and <i>Traceability information</i> . Minor text changes.
15-Oct-2024	10	Updated <i>Table 4</i> , and <i>Table 5</i> .

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