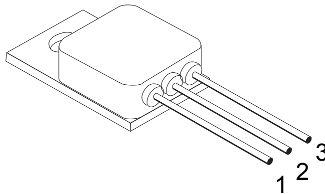
STRH12P10

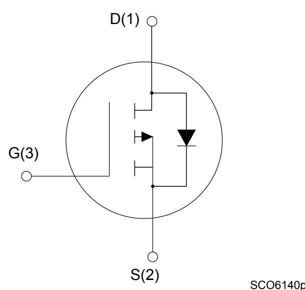
Datasheet

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



TO-257 AA

The case is not connected to any lead



Product status link
STRH12P10

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 developed with the Rad-hard STripFET technology in hermetic TO-257AA package.

Specifically designed to sustain Total Ionized Dose and immunity to heavy ion effects, it is qualified as per ESCC 5205/029 detail specification. In case of discrepancies between this datasheet and the relevant agency specification, the latter takes precedence.

Product 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	TO-257AA	Gold	100 krad
STRH12P10GYT	ESCC flight	5205/029	TO-257AA	Solder dip	100 krad

Note: See Table 8 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}	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 °C	12	A
	Drain current (continuous) at T_{case} = 100 °C	7.5	A
I_{DM} (2)	Drain current (pulsed)	48	A
P_{TOT}	Total power dissipation at T_{case} = 25 °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 $R_{thj\text{-}case}$ + $R_{thc\text{-}s}$*
2. *Pulse width limited by safe operating area.*
3. *I_{SD} ≤ 12 A, di/dt ≤ 36 A/µs, V_{DD} = 80 %$V_{(BR)DSS}$.*

Table 2. Thermal data

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

Symbol	Parameter	Test conditions	Min.	Max.	Unit
I_{DSS}	Zero gate voltage drain current	80% $V_{(BR)DSS}$		10	µA
I_{GSS}	Gate body leakage current	V_{GS} = 16 V		100	nA
		V_{GS} = -16 V	-100		
		V_{GS} = 16 V, T_C = 125 °C		200	
		V_{GS} = -16 V, T_C = 125 °C	-200		
$V_{(BR)DSS}$ (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	2.0	4.5	V
		V_{DS} = V_{GS}, I_D = 1 mA, T_C = 125 °C	1.6	3.8	
		V_{DS} = V_{GS}, I_D = 1 mA, T_C = -55 °C	2.2	5.2	
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 12 V, I_D = 12 A		0.30	Ω
C_{iss} (2)	Input capacitance	V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 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 V, I_D = 12 A, V_{GS} = 12 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 V, I_D = 6 A, R_G = 4.7 Ω, V_{GS} = 12 V	5	13	ns
t_r	Rise time		7	31	ns
$t_{d(off)}$	Turn-off delay time		18	42	ns
t_f	Fall time		3.5	10.5	ns
I_{SD}	Source-drain current			12	A
I_{SDM} (3)	Source-drain current (pulsed)			48	A
V_{SD}	Forward on voltage	I_{SD} = 12 A, V_{GS} = 0 V		1.5	V
		I_{SD} = 12 A, V_{GS} = 0 V, T_C = 125 °C		1.25	
t_{rr}	Reverse recovery time	I_{SD} = 12 A, di/dt = 40 A/µs, V_{DD} = 60 V,T_j = 25 °C	178	258	ns
Q_{rr}	Reverse recovery charge		1700	2560	nC
I_{RRM}	Reverse recovery current		14	24	A
t_{rr}	Reverse recovery time	I_{SD} = 12 A, di/dt = 40 A/µs, V_{DD} = 60 V, T_J = 150 °C	225	335	ns
Q_{rr}	Reverse recovery charge		2650	3950	nC
I_{RRM}	Reverse recovery current		18.5	28.5	A

1. *This rating is guaranteed at $T_J \leq 25$ °C (see Figure 9. Normalized $V_{(BR)DSS}$ vs temperature).*
2. *Not tested, guaranteed by process.*
3. *Pulse width limited by safe operating area*

3 Radiation characteristics

This products is guaranteed in radiation as per ESCC 5205/029 and ESCC 22900 specification at 100 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% $V_{(BR)DSS}$	+1	μA
I_{GSS}	Gate body leakage current	V_{GS} = 12 V	1.5	nA
		V_{GS} = -12 V	-1.5	
$V_{(BR)DSS}$	Drain-to-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	+5%	V
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA	+ 150%	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 12 A	-4% / +35%	Ω
Q_g	Total gate charge	V_{DS} = 50 V, I_G = 1 mA, V_{GS} = 12 V, I_{DS} = 12A	-15% / +5%	nC
Q_{gs}	Gate-to-source charge		-5% / +200%	
Q_{gd}	Gate-to-drain charge		-10% / +100%	
V_{DS} (1)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 12 A	±5%	V

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

3.2 Single event effect SOA

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 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

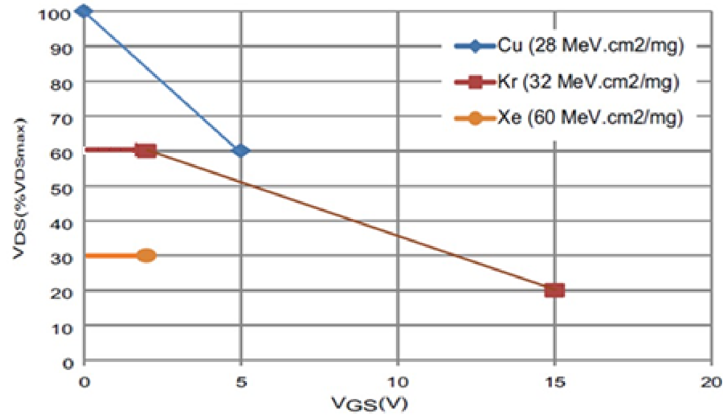
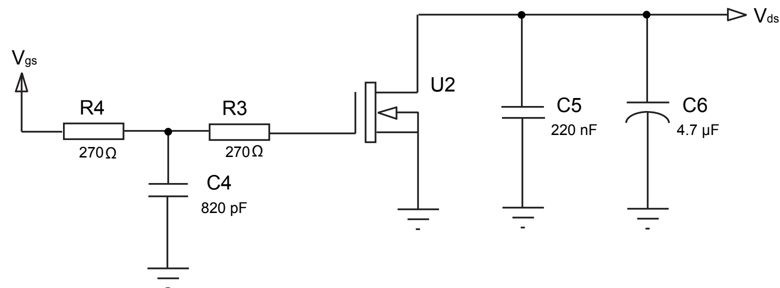


Figure 2. Single event effect, bias circuit



4 Electrical characteristics (curves)

Figure 3. Safe operating area

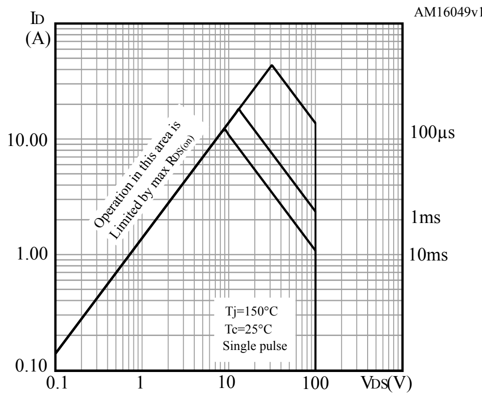


Figure 4. Thermal impedance

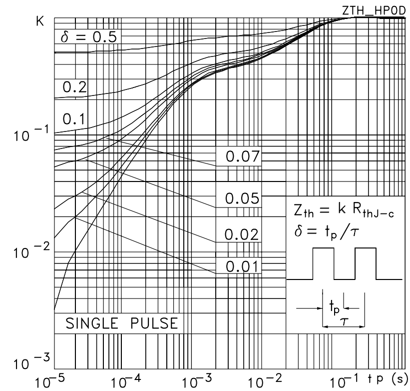


Figure 5. Output characteristics

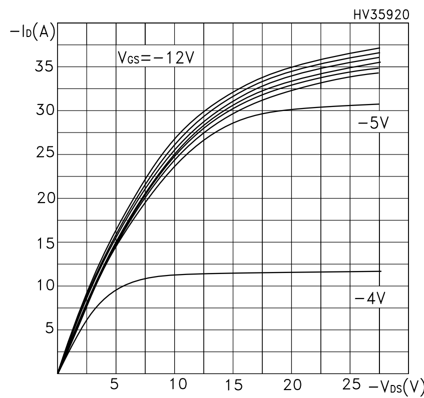


Figure 6. Transfer characteristics

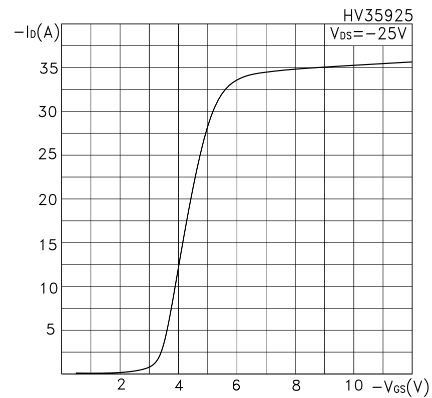


Figure 7. Gate charge vs gate-source voltage

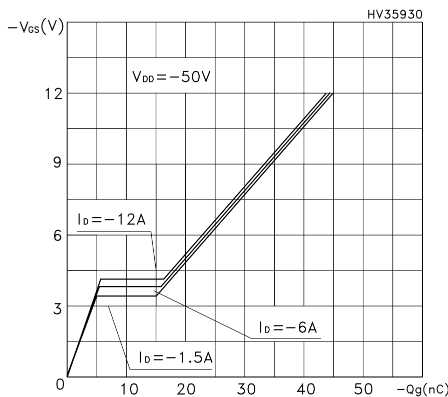


Figure 8. Capacitance variations

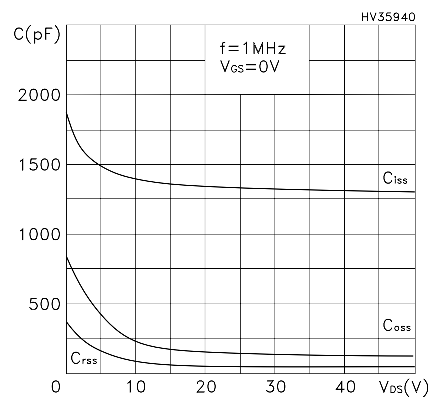


Figure 9. Normalized $V_{(BR)DSS}$ vs temperature

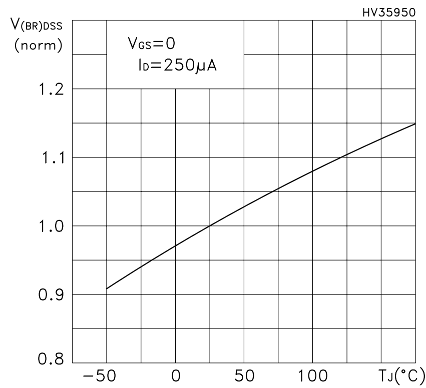


Figure 10. Static drain-source on-resistance

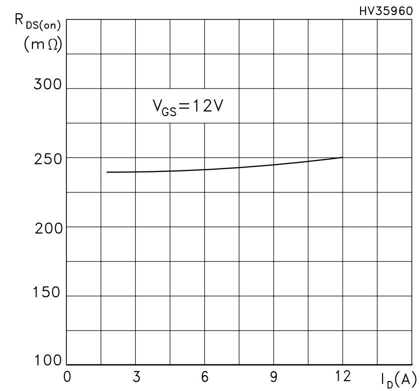


Figure 11. Normalized gate threshold voltage vs temperature

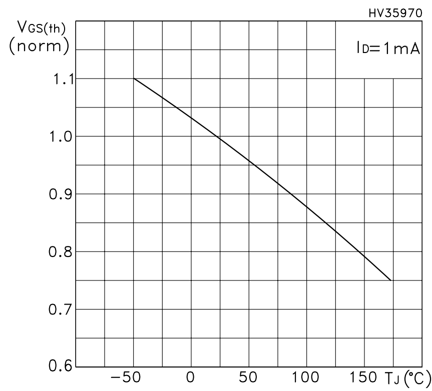


Figure 12. Normalized on-resistance vs temperature

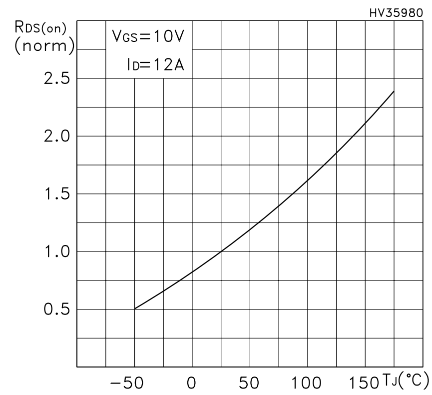
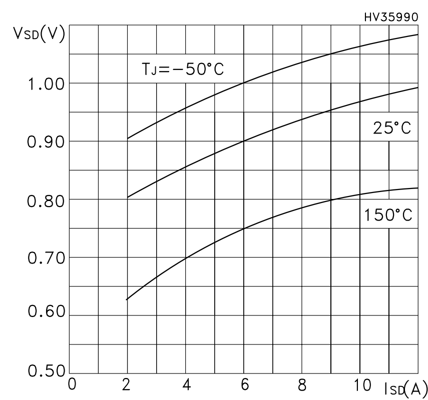


Figure 13. Source drain-diode forward characteristics



5 Test circuits

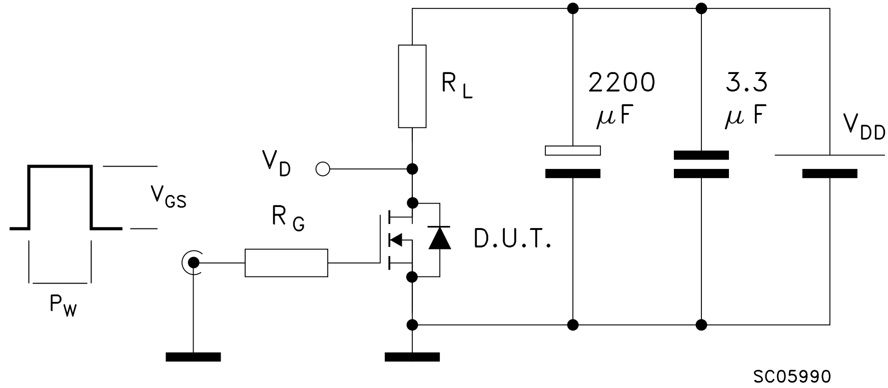


Figure 14. Switching times test circuit for resistive load

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

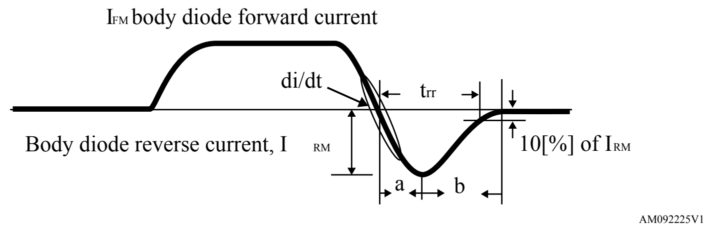


Figure 15. Source drain diode waveform

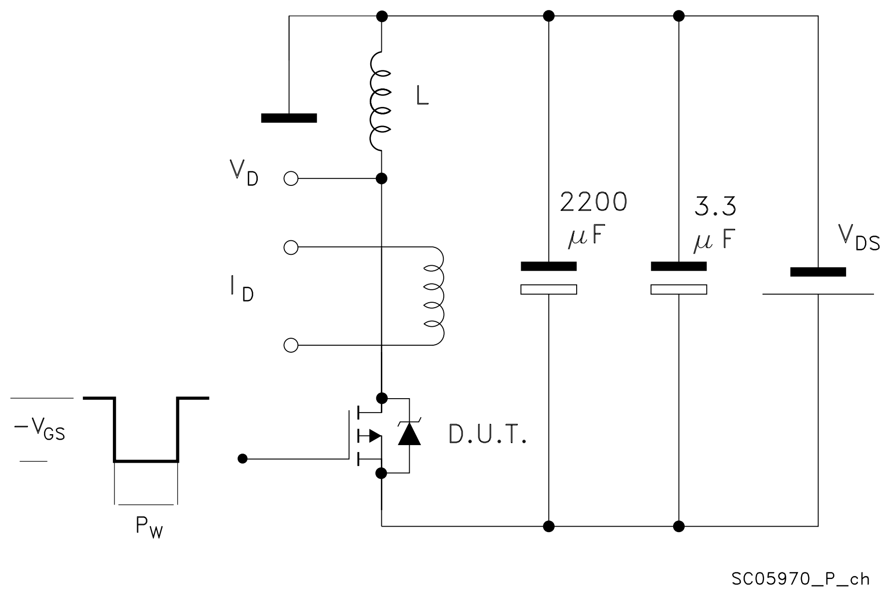


Figure 16. Unclamped inductive load test circuit (single pulse and repetitive)

6 Package information

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-257AA package information

Figure 17. TO-257AA package outline

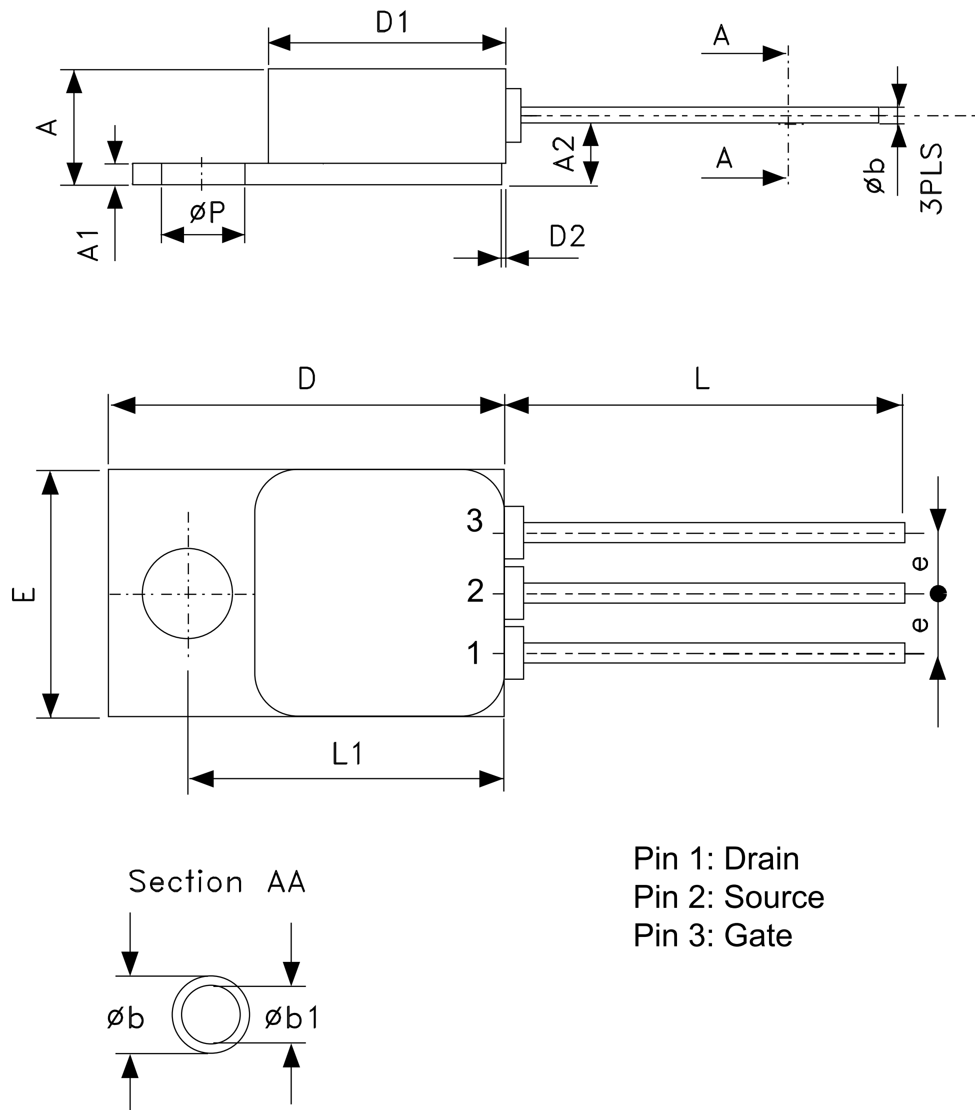


Table 7. **TO-257AA package mechanical data**

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	Quality level	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: 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

8.1 Traceability information

Date code information is described in the table below.

Table 9. Date codes

Model	Date code
EM	3yywwN
ESCC	yywwN

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

8.2 Documentation

Table 10. Documentation provided for each type of product

Quality level	Radiation level	Documentation
Engineering model	-	Certificate of conformance
ESCC	100 krad	Certificate of conformance ESCC qualification maintenance lot reference Radiation data at 25 / 50 / 70 / 100 krad at 0.1 rad / s.

Revision history

Table 11. **Document revision history**

Date	Version	Changes
07-Oct-2011	1	First release.
24-Jun-2013	2	Document status promoted form preliminary data to production data. – Modified: Figure 1 – Modified: EAS, EAR parameter and values in Table 4 – Modified: IGSS, and added note 1 in Table 5 – Added: note 1 in Table 6 – Modified: trr, qrr and IRRM parameter in Table 8 – Modified: RDS(on) test conditions in Table 9, the entire test conditions in Table 10 – Modified: Figure 4
25-Nov-2013	3	– Modified: package drawing and Figure 1.
18-Dec-2013	4	– Updated Table 1: Device summary and Table 14: Ordering information. – Updated Section : Total dose radiation (TID) testing.
19-Jan-2015	5	– Updated Table 13.: TO-257AA mechanical data – Minor text changes
02-May-2019	6	Updated Table 7. Pre-irradiation source drain diode and Table 4. Preirradiation on/off states. Minor text changes
29-Feb-2020	7	Updated Table 10 and TO-257 AA package information.
21-Jan-2021	8	Updated Product summary, Table 4, Table 5, Table 6, Figure 1, Table 8 and Table 10.

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