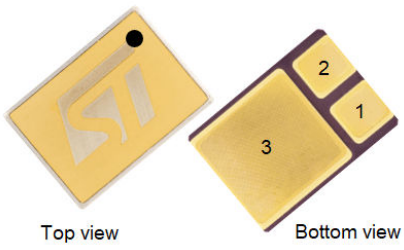
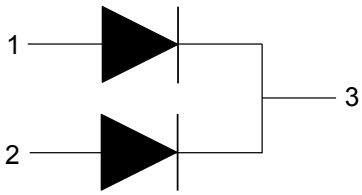
STTH60200CHR

Datasheet

Rad-Hard 60 A - 200 V ultrafast rectifier in SMD1 package



SMD1



Terminals 1 : Anode 1
Terminals 2: Anode 2
Terminals 3: Cathode

Features

- Forward current: 2 x 30 A
- Repetitive peak reverse voltage: 200 V
- Low forward voltage drop: 0.95 V max. at 30 A and 125 °C
- Negligible switching losses
- High surge current capability: 300 A per diode
- Ceramic hermetic package SMD1
- Tested radiation performance
  - TID: 3 Mrad(Si) high dose rate
  - SEE: no burn out at 60 MeV.cm²/mg
- ESCC qualified: 5103/033

Application

- Satellite and spacecraft power systems
- Switch mode power supply
- High voltage DC-DC converter output rectification
- Reverse polarity protection
- Redundancy OR-Ing power bus diode
- DC motor chopper or inverter free wheeling diode

Product status link
STTH60200CHR

Product summary	
$I_{F(AV)}$	2 x 30 A
V_{RRM}	200 V
T_j(max)	175 °C
$V_{F(max)}$ at 2 x 30 A / 125 °C	0.95 V

Description

The STTH60200CHR is a 2 x 30 A 200 V monolithic dual ultrafast rectifier that is housed in the hermetic surface mount package SMD1, and that is ESCC certified including the radiation tests for harsh cosmic environments.

Its full planar technology allows a superior trade-off leakage current versus on-state voltage and high reliability up to 175 °C junction temperature.

This diode is ESCC qualified, which makes it eligible for use in space programs. It is typically used in high frequency DC-to-DC converters or high voltage step-down regulators where it performs secondary rectification, redundancy OR-Ing, free-wheeling diode, or reverse polarity protection.

1 Characteristics

1.1 Absolute maximum ratings

The absolute maximum ratings are limiting values at 25°C, per diode unless otherwise notified. Values provided in Table 1 shall not be exceeded at any time during use or storage

Table 1. Absolute maximum ratings

Symbol	Parameter		Value	Unit
V_{RRM}	Repetitive peak reverse voltage		200	V
V_{RWM} (1)	Peak working reverse voltage		200	V
I_O	Average output rectified current per diode (2) per package		40 60	A
I_{FSM} (3)	Non repetitive surge forward current	t_p = 10 ms sinusoidal	300	A
T_{stg}	Storage temperature range		-65 to +175	°C
T_{op}	Operating temperature range (case temperature)		-65 to +175	°C
T_j	Maximum junction temperature		+175	°C
T_{sol}	Maximum soldering temperature (4)		+245	°C
ESD	Electro static discharge	Air discharge, HBM model, class 3	8	kV

1. *See Figure 1.*
2. *DC value. For T_{case} > +65 °C, derate linearly to 0 A at +175 °C.*
3. *At T_{amb}<= +25 °C*
4. *Maximum duration 5 s. The same package cannot be re-soldered until 3 minutes have elapsed after initial soldering*

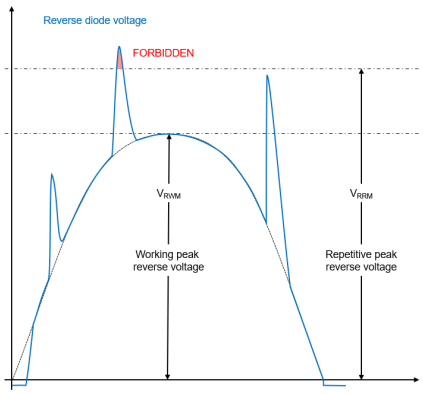
1.2 Thermal parameters

Table 2. Thermal parameters

Symbol	Parameter		Typ. value	Max. value	Unit
$R_{th(j-c)}$	Thermal resistance, junction to case (1)	Per diode	-	2.4	°C/W
		Per package	-	2.0	

1. *When only 1 diode is used, the dissipation is made from a part of the die, hence to a higher thermal resistance.*

Figure 1. V_{RRM} and V_{RWM} definition with their waveform



1.3 Electrical characteristics

Limiting value per diodes, unless otherwise specified.

Table 3. Static electrical characteristics

Symbol	Parameter	MIL-STD-750 test method	Test conditions[1]		Min.	Typ.	Max.	Unit
I_R	Reverse leakage current	4016	DC method, V_R = 200 V	T_j = 25 °C	-	0.02	30	µA
				T_j = 125 °C	-	105	300	
V_F [2]	Forward voltage drop	4011	I_F = 5 A	T_j = -55 °C	-	0.88	1.04	V
				T_j = 25 °C	-	0.74	0.87	
				T_j = 125 °C	-	0.57	0.66	
			I_F = 10 A	T_j = -55 °C	-	0.92	1.07	
				T_j = 25 °C	-	0.81	0.92	
				T_j = 125 °C	-	0.65	0.75	
			I_F = 20 A	T_j = -55 °C	-	0.98	1.15	
				T_j = 25 °C	-	0.88	1.02	
				T_j = 125 °C	-	0.74	0.87	
			I_F = 30 A	T_j = -55 °C	-	1.03	1.20	
				T_j = 25 °C	-	0.95	1.09	
				T_j = 125 °C	-	0.82	0.95	
			I_F = 40 A	T_j = -55 °C	-	1.08	1.25	
				T_j = 25 °C	-	1.00	1.15	
				T_j = 125 °C	-	0.88	1.02	

1. *Test performed with both anode terminals 1 and 2 tied together*
2. *Pulse width 680 µs, duty cycle ≤ 2%*

Table 4. Dynamic electrical characteristics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
C[1]	Junction capacitance	T_j = 25 °C	V_R = 10 V, F = 1 MHz	-	-	225	pF
t_{rr}[2]	Reverse recovery time	T_j = 25 °C	I_F = 1 A, dIF/dt = -50 A/µs, V_R = 30 V	-	-	60	ns
I_{RM}	Reverse recovery current	T_j = 125 °C	I_F = 30 A, dI_F/dt = -200 A/µs, V_R = 160 V	-	10.5		A
Q_{RR}	Reverse recovery charges			-	335		nC
S_{factor}	Softness factor			-	0.25		

1. *By default, guaranteed by sampling. Guaranteed by a 100% test in case the sampling acceptance criteria is not met.*
2. *Guaranteed by design and characterization. Not tested in production*

1.4 Characteristics (curves)

Figure 2. Typical forward voltage drop versus forward current

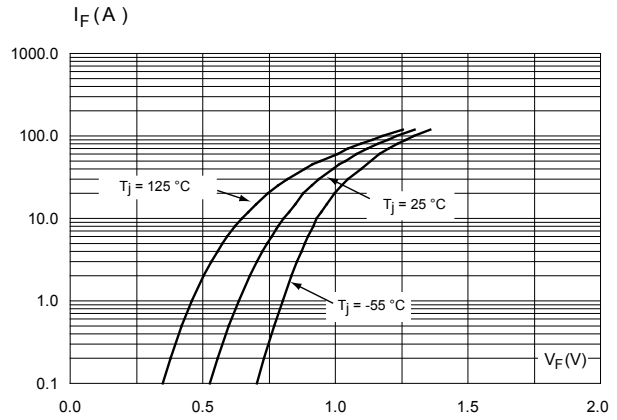


Figure 3. Maximum forward voltage drop versus forward current

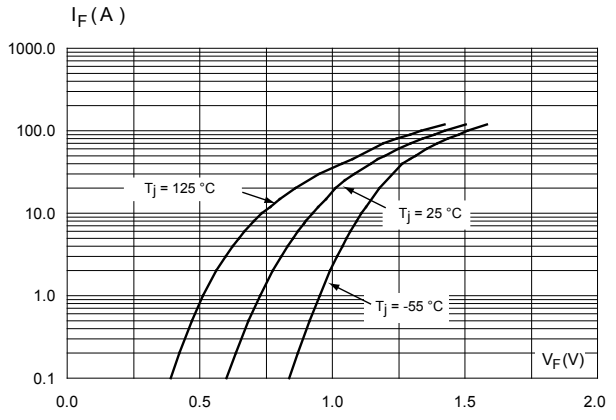


Figure 4. Relative variation of thermal impedance junction to case versus single square pulse duration

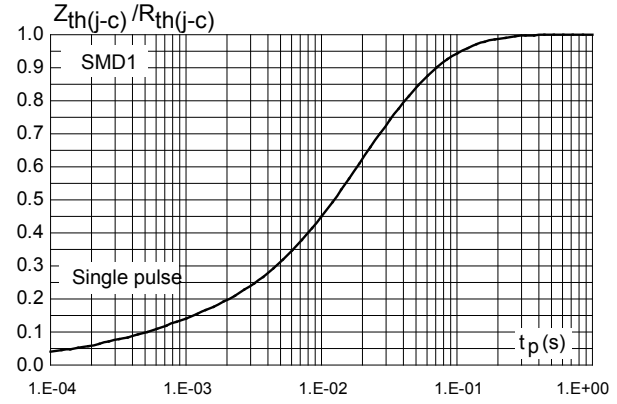


Figure 5. Typical peak reverse recovery current versus dI_F/dt

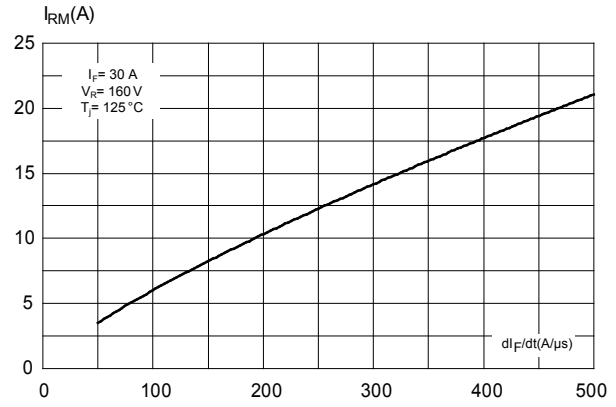


Figure 6. Typical reverse recovery time versus dI_F/dt

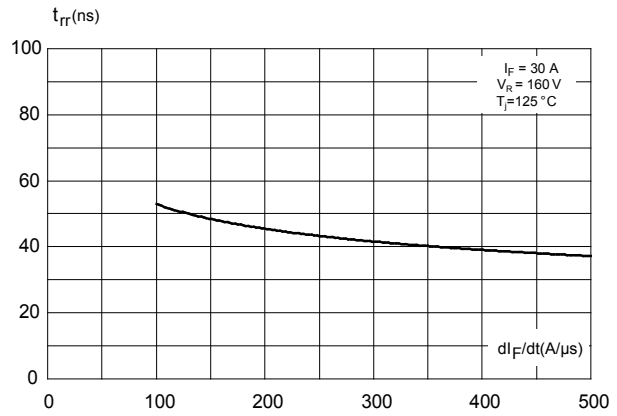


Figure 7. Typical reverse recovery charges versus dI_F/dt

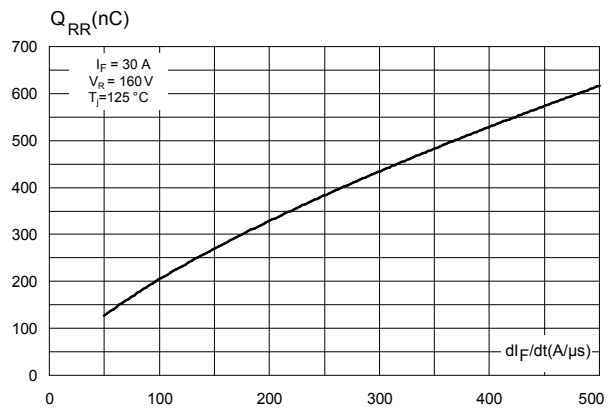
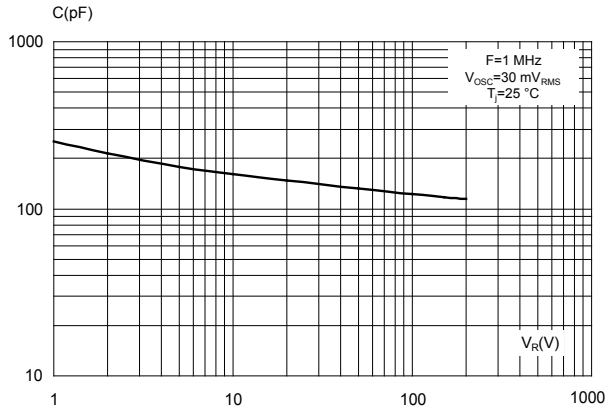


Figure 8. Typical junction capacitance versus reverse voltage applied



2 Radiation

The ultrafast switching rectifiers are intrinsically resistant to radiative environments in total ionizing dose (TID) up to 300 krad(Si), as described in the ECSS-Q-ST-60-15C1 radiation hardness assurance standard.

The STMicroelectronics STTH60200CHR goes beyond this standard and is characterized in TID up to three Mrad(Si) at high dose rate and in single effect event (SEE) up to 60 MeV.cm²/mg.

2.1 Total dose radiation (TID) testing

The part has been characterized in total ionizing dose at high dose rate on 12 parts packaged in SMD1, 4 unbiased parts, 4 parts reverse biased parts and 4 forward biased parts. All parts were from the same wafer lot.

The irradiation has been done according to the ESCC 22900 specification, with standard window conditions.

Both pre-irradiation and post-irradiation performances have been tested using the same circuitry and test conditions for a direct comparison can be done (T_{amb} = 22 ±3 °C).

The specified electrical parameters were measured in four following cases:

- Before irradiation
- After irradiation at final dose 3 Mrad(Si)
- After 168 hrs at room temperature
- After 168 hrs at 100 °C anneal

Based on this characterization, the device is deemed able to sustain 3 Mrad(Si) while maintaining all its parameters within its specifications.

2.2 Single event effect

The Single Event Effect (SEE) relevant to power rectifiers is characterized, to determine the Single Event Burnout (SEB).

The tests are performed as per ESCC 25100, each one on 3 pieces out of the same wafer at room temperature.

The accept/reject criteria are :

- SEB (Destructive mode):
  The diode is reverse biased during irradiation. The test is stopped as soon as a SEB occurs or when the reverse leakage current is above the specification or when the overall fluency on the component reaches 10^{E7} cm².
- Post irradiation stress test (PIST):
  After the irradiation, a stress is applied to the diode in order to reveal any latent damage on the irradiated devices.
  The reverse voltage value is increased from 0 V to 100% of V_{RWM} and then decreased from 100% of the V_{RWM} to 0 V. At each step, the reverse leakage current value is measured.

Table 5. Radiation hardness assurance summary

Type	Conditions	Result
Total ionisation dose	Characterization of 1 wafer up to 3 Mrad(Si) Test of 4 reverse biased + 4 forward biased + 4 unbiased samples Test at High Dose Rate	Immune up to 3 Mrad(Si)
Single effect burnout	LET : 61.2 MeV.cm²/mg V_{cc} : 200 V	No burnout

3 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.

3.1 SMD1 package information

Figure 9. SMD1 package outline

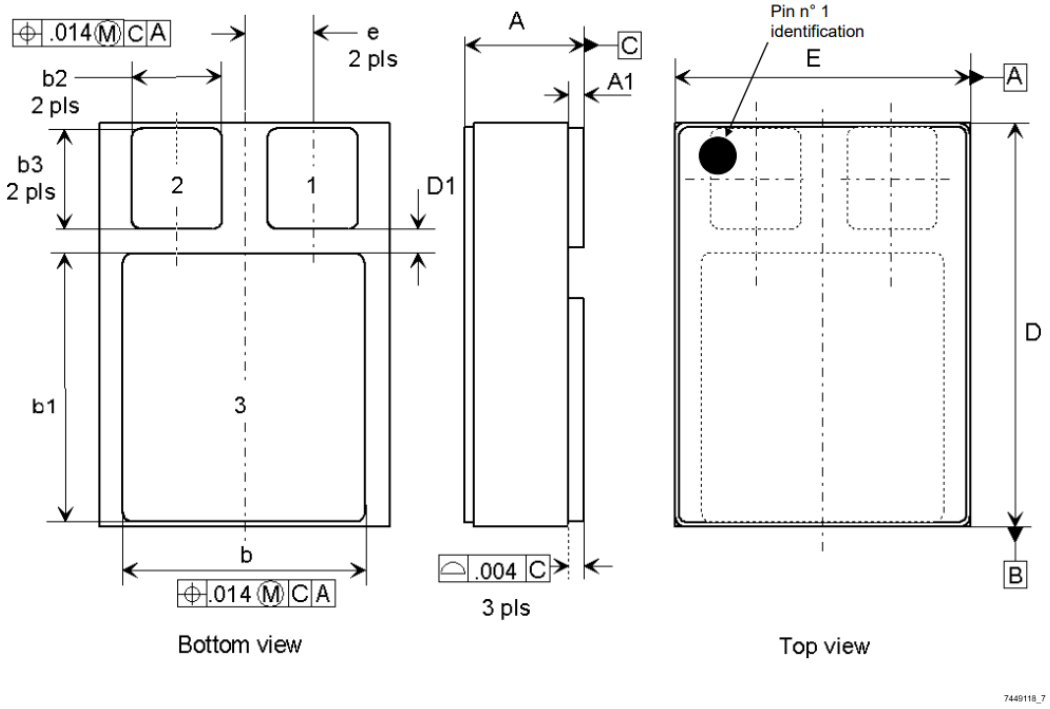


Table 6. SMD1 package mechanical data

Symbols	Dimensions (mm)		
	Min.	Typ.	Max.
A	3.3		3.61
A1	0.25		0.51
b	9.4		9.65
b1	10.41		10.67
b2	3.43		3.68
b3	3.86		4.11
D	15.75		16
D1	0.76		
E	11.3		11.56
e		2.67 BSC	

4 Ordering information

Table 7. Ordering information

Order codes	ESCC detail specification	Quality level	Package	Lead finishing	Marking	Mass	Base Qty.	Packing
STTH60200CSA1	-	engineering model	SMD1	Gold	STTH60200CSA1	2.4 g	15	Strip pack
STTH60200CSAG	5103/033/03	Flight model			510303303			
STTH60200CSAT	5103/033/04	Flight model		Solder dip	510303304			

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

5 Other information

5.1 Product marking and traceability

Figure 10. **Product marking outline, flight model top view**

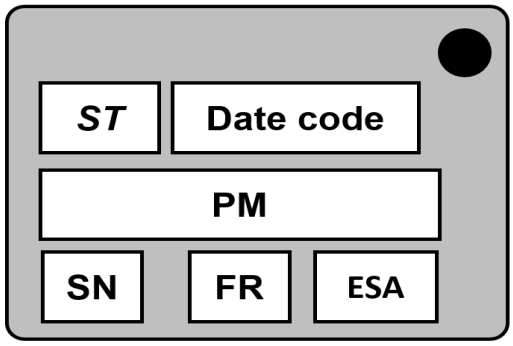


Figure 11. **Product marking outline, engineering model top view**

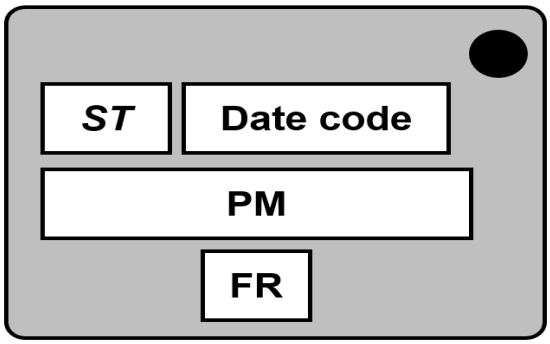


Table 8. **Product marking description**

Field	Model	Description
ST	Engineering and flight	Standard ST logo
PM	Engineering	Product part number
	Flight	ESCC part number
Date code	Engineering	3yywwN(1)
	Flight	yywwN(2)
SN	Flight	Serialization number
ESA	Flight	ESA logo
FR	Engineering and flight	Country of origin

1. *yy= year ; ww = week ; N = alfa-numeric digit for lot of week; 3 = EM type*
2. *yy= year ; ww = week ; N = alfa-numeric digit for lot of week*

Note: Black dot marks terminal 1 position underneath.

5.2 Packing information

Figure 12. **Strip pack view, label side**

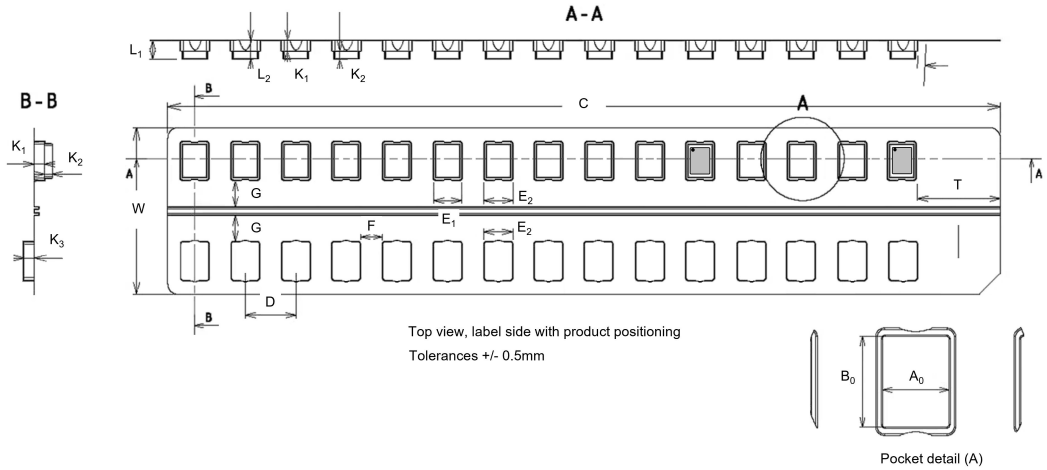


Table 9. **Strip pack dimension data**

Strip pack typical dimension (mm)														
A0	B0	C	D	E1	E2	F	G	K1	K2	K3	L1	L2	T	W
11.70	16.10	400.00	24.30	13.50	14.00	10.30	12.50	5.00	3.80	5.00	9.10	8.80	40.00	80.00

5.3 Documentation

In the Table 10 is a summary of the documentation provided with each type of products. Further quality information on engineering model product is also available in the technical note TN1181.

Table 10. **Documentation provided for each type of product**

Quality level	Documentation
Engineering model	Certificate of conformance including : • Customer name • Customer purchase order number • ST sales order number and item • ST commercial product code • Quantity delivered • Date code • Reference data sheet • Reference to TN1181 on engineering models • ST Rennes assembly lot ID number
Flight model	Certificate of conformance including : • Customer name • Customer purchase order number • ST sales order number and item • ST commercial product code • Quantity delivered • Date code • Serial numbers • Wafer diffusion plant location and wafer size • Wafer diffusion lot ID number and wafer ID number • Reference of the applicable ESCC qualification maintenance lot • Reference to the ESCC detail specification • ST Rennes assembly lot ID number

Revision history

Table 11. **Document revision history**

Date	Revision	Changes
12-Jul-2018	1	First issue.
12-May-2020	2	Updated ESCC qualification on *Features* and *Table 1*.
20-Mar-2024	3	Inserted Application paragraphe on cover page. Updated *Table 1*, *Figure 1*, and *Table 7*. Minor text changes.
25-Nov-2025	4	Updated Table 7.

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