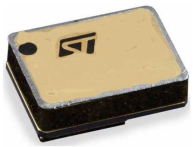
STTH60400HR

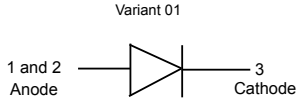
Datasheet

Rad-Hard 60 A - 400 V fast recovery rectifier



SMD1

The upper metallic lid is not internally connected to any pin, nor to the IC die inside the package



Features

- Very small conduction losses
- Negligible switching losses
- High surge current capability
- Hermetic package
- TID and SEE tested
- Package mass: 2.3 g
- ESCC qualified : 5103/032

Description

The STTH60400HR is a single monolithic rectifier assembled in an SMD1 hermetic package and tested in total dose at high dose rate and in single event effect to be used in Rad-Hard applications.

The ESCC Detail Specification for this device is available from the European Space Agency web site. ST guarantees full compliance of qualified parts with the ESCC detailed specification.

Product status link
STTH60400HR

Product summary	
$I_{F(AV)}$	60 A
V_{RRM}	400 V
T_j(max)	175 °C
$V_{F(max)}$ at 60 A / 125 °C	1.15 V

1 Characteristics

1.1 Absolute maximum ratings

Table 1. Absolute maximum ratings

Symbol	Parameter		Value	Unit
V_{RRM}	Repetitive peak reverse voltage		400	V
I_O (1)	Average output rectified current		60	A
I_{FSM} (2)	Forward surge current	t_p = 10 ms sinusoidal	500	A
T_j	Maximum junction temperature		+175	°C
T_{stg}	Storage temperature range		-65 to +175	°C
T_{sol} (3)	Soldering temperature		+245	°C

1. *At $T_j \geq +29.2$ °C, derate linearly to 0 A at +175 °C.*
2. *At $T_{amb} \leq +25$ °C*
3. *Duration 5 seconds maximum with at least 3 minutes between consecutive temperature peaks.*

1.2 Thermal parameters

Table 2. Thermal parameters

Symbol	Parameter	Value	Unit
$R_{th(j-c)}$ (1)	Thermal resistance, junction to case	1.8	°C/W
$R_{th(j-a)}$	Thermal resistance, junction to ambient	55	°C/W

1. *Package mounted on infinite heatsink.*

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.	Max.	Unit
I_R	Reverse leakage current	4016	DC method, V_R = 400 V	T_j = 25 °C	-	20	µA
				T_j = 125 °C	-	200	
V_F [2]	Forward voltage drop	4011	I_F = 60 A	T_j = -55 °C	-	1.35	V
				T_j = 25 °C	-	1.30	
				T_j = 125 °C	-	1.15	

1. *Test performed with both anode terminals 2 and 3 tied together*
2. *Pulse width ≤ 680 µs, duty cycle ≤ 2%*

Table 4. Dynamic electrical characteristics

Symbol	Parameter	MIL-STD-750 test method	Test conditions		Min.	Typ.	Max.	Unit
C[1]	Junction capacitance	4001	T_j = 25 °C	V_R = 10 V, F = 1 MHz	-		250	pF
t_{rr}	Reverse recovery time	4031	T_j = 25 °C	I_F = 1 A, dIF/dt = -50 A/µs, V_R = 30 V	-		80	ns
t_{fr}[2]	Forward recovery time	4026	T_j = 25 °C	I_F = 60 A, V_{FR} = 2 V, dIF/dt = 100 A/µs	-	690		ns
V_{FP}	Forward recovery voltage	4026	T_j = 25 °C	I_F = 60 A, V_{FR} = 2 V, dIF/dt = 100 A/µs	-	3		V
I_{RM}	Reverse recovery current	4031	T_j = 125 °C	I_F = 20 A, dIF/dt = -200 A/µs, V_R = 160 V	-	19		A
Q_{RR}	Reverse recovery charges	4031			-	1400		nC
S_{factor}	Softness factor	4031			-	0.3		

1. *By default, guaranteed by sampling. Guaranteed by a 100% test in case the sampling acceptance criteria is not met.*
2. *AC characteristics (t_{rr}, t_{fr}, V_{fr}, I_{RM}, S_{factor} and Q_{rr}) are guaranteed by design and characterization. They are not tested in production.*

1.4 Characteristics (curves)

Figure 1. Average forward power dissipation versus average forward current

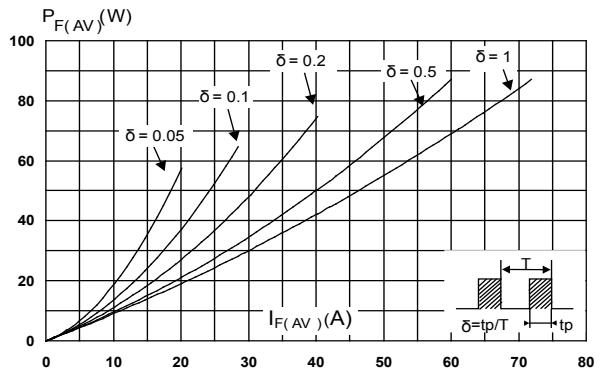


Figure 2. Forward voltage drop versus forward current (typical values)

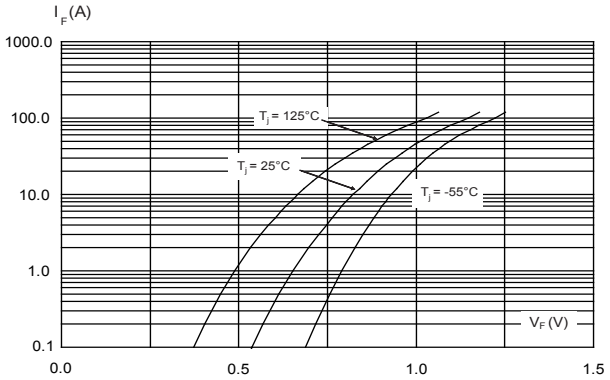


Figure 3. Forward voltage drop versus forward current (maximum values)

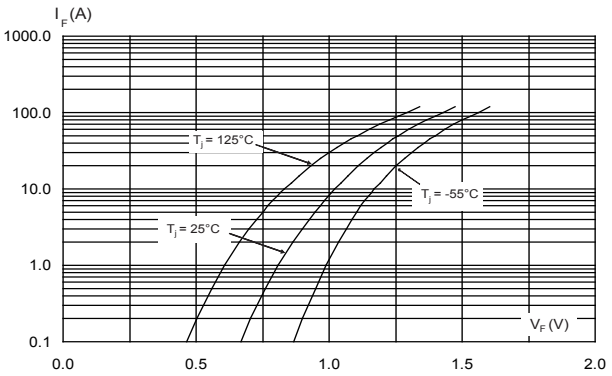


Figure 4. Relative variation of thermal impedance junction to case versus pulse duration

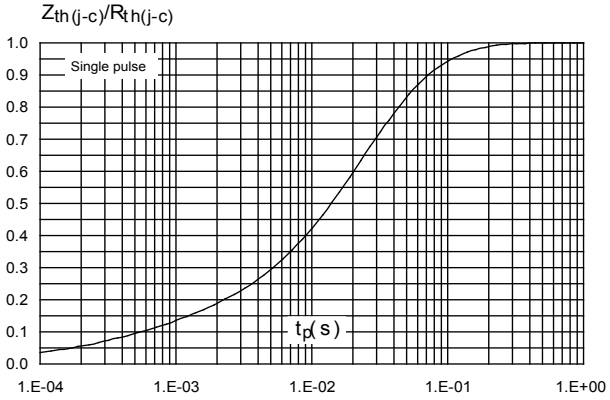


Figure 5. Peak reverse recovery current versus dI_F/dt (typical values)

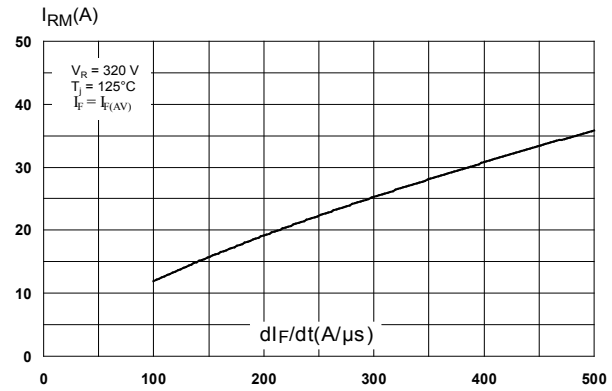


Figure 6. Reverse recovery time versus dI_F/dt (typical values)

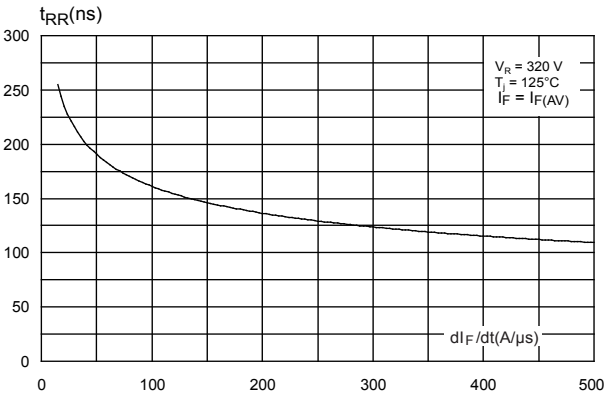


Figure 7. Reverse recovery charges versus dI_F/dt (typical values)

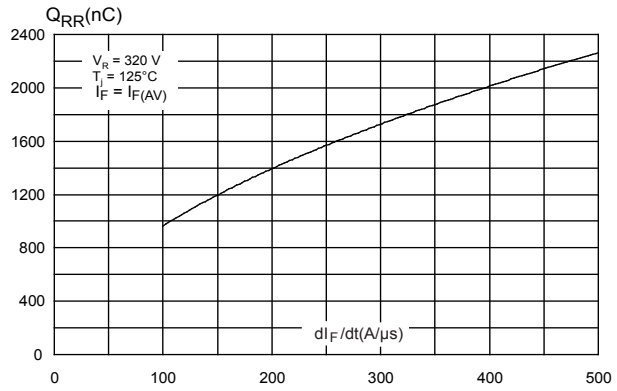


Figure 8. Reverse recovery softness factor versus dI_F/dt (typical values)

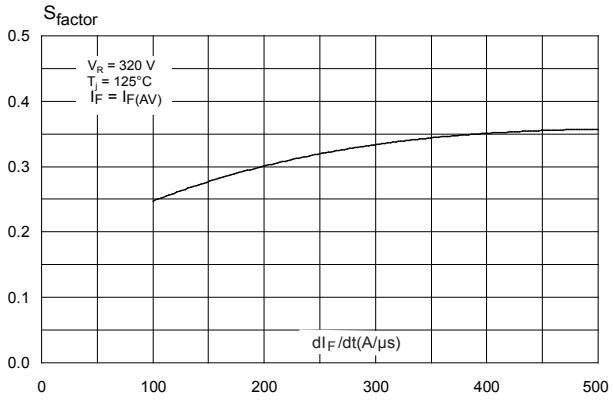


Figure 9. Relative variations of dynamic parameters versus junction temperature

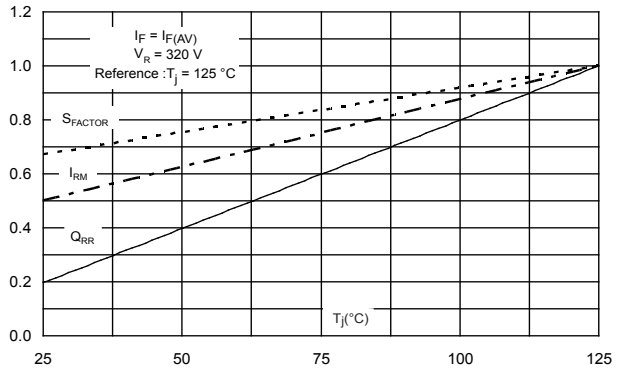


Figure 10. Transient peak forward voltage versus dIF/dt (typical values)

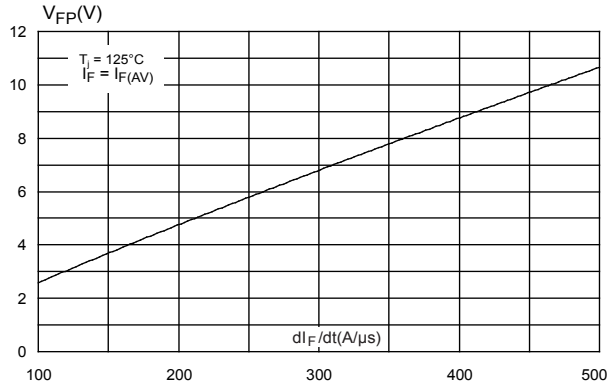


Figure 11. Forward recovery time versus dI_F/dt (typical values)

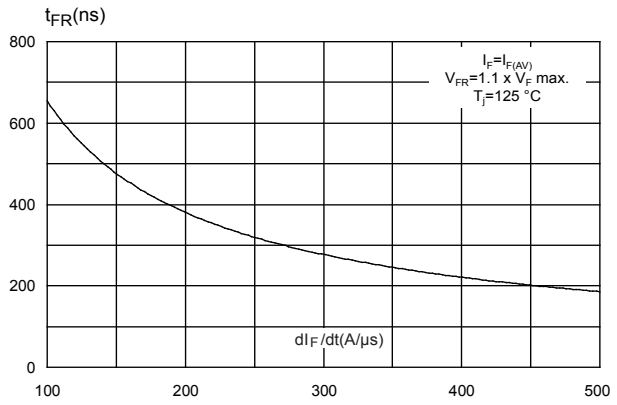
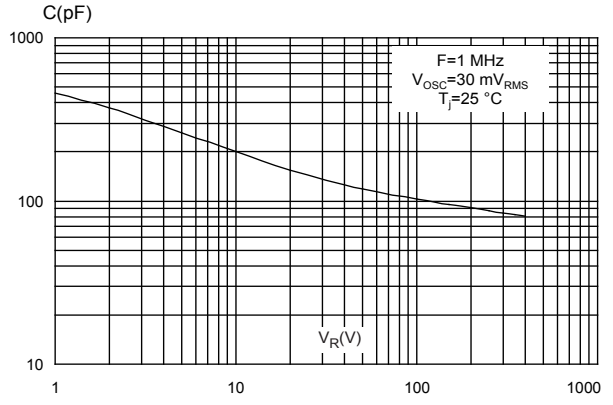


Figure 12. Junction capacitance versus reverse voltage applied (typical values)



2 Radiation

The technology of the STMicroelectronics Rad-Hard rectifier's diodes is intrinsically highly resistant to radiative environments.

The product radiation hardness assurance is supported by a Total Ionisation Dose (TID) test at high dose rate on each diffusion lot and a Single Effect Event (SEE) characterization.

2.1 Total dose radiation (TID) testing

Each diffusion lot is tested in total ionizing dose at high dose rate on 10 parts housed in SMD1, 5 biased and 5 unbiased.

The irradiation is done according to the ESCC 22900 specification, standard window.

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

The following parameters are measured :

- Before irradiation
- After irradiation (target 1 Mrad (Si))
- After 24 hrs at room temperature
- after 168 hrs at 100 °C anneal

2.2 Single event effect

The Single Event Effect (SEE) relevant to power rectifiers are characterized, i.e. the Single Event Burnout (SEB).

The tests are performed as per ESCC 25100, each one on 3 pieces from 1 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 influence on the component reaches 1E7 cm².
- PIST (Post-Irradiation STress) test:

  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 $V_R$max. and then decreased from 100% of the $V_R$max. 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	High dose rate 5 biased + 5 unbiased Each wafer lot	Immune up to 1 Mrad(Si)
Single Effect Burnout	LET= Tbd V_{cc}: Tbd	No burnout

3 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.

3.1 SMD1 package information

Figure 13. SMD1 package outline

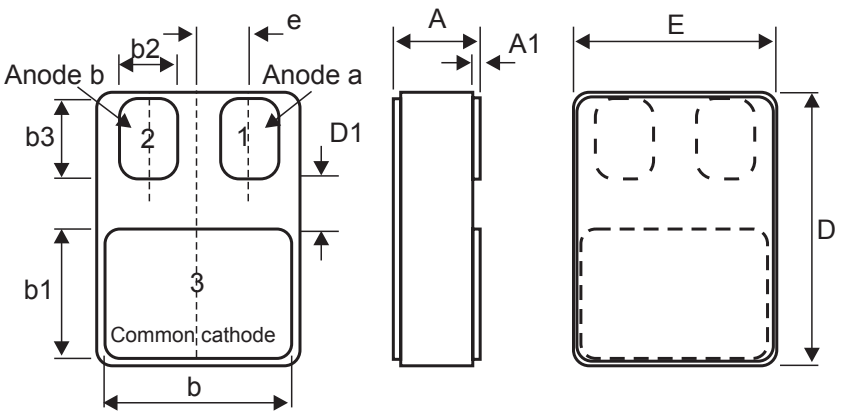


Table 6. SMD1 package mechanical data

Symbols	Dimansions (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 code	ESCC detailed specification	Package	Lead finishing	Comment	Marking	Weight	Packing
STTH60400SA1	-	SMD1	Gold	Single die	STTH60400SA1	2.3 g	Strip pack
STTH60400SAG	5103/032/01				510303201		

5 Other information

5.1 Traceability information

Date code in formation is structured as described in Table 8. Date codes

Table 8. Date codes

Model	Datacode[1]
EM	3yywwN
ESCC	yywwN

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

5.2 Documentation

The table below provides the default documentation packed together with the parts depending on their quality level.

Table 9. Default documentation provided with the parts

Quality level	Documentation
Engineering Model	Certificate of Conformance
ESCC Flight	Certificate of Conformance includes the reference of the ESCC qualification maintenance test lot.

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
07-Mar-2017	1	First issue.
21-Jul-2017	2	Updated Table 2: "Absolute ratings" and Table 5: "Dynamic electrical characteristics". Added Section 1.1: "Characteristics (curves)".
03-Jun-2020	3	Updated Section Product status / summary and Table 7. Minor text changed.