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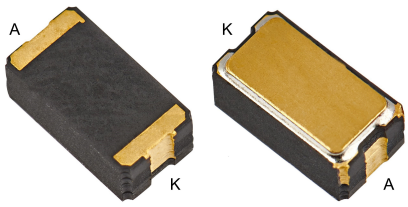
1N5806U

Datasheet

Aerospace 150 V, 2.5 A ultrafast rectifier in LCC-2A package



Leadness chip-carrier 2 (LCC-2A)

Product status link
1N5806U

Product summary	
$I_{F(AV)}$	2.5 A
V_{RRM}	150 V
V_F(max.)	1 V
T_J(max.)	175 °C

Features

- Surface mount hermetic LCC-2A package
  - Low thermal case resistance: 13 °C/W
  - Low package weight, 120 mg
- Low leakage off state, I_R = 0.5 µA at 150 V
- Low forward voltage: V_F = 1 V at 2.5 A and +25 °C
- Ultrafast switchings, t_{rr} = 30 ns at -50 A/µs and T_j = 25 °C
- Radiation performance
  - 3 Mrad (Si) high dose rate
- ESCC qualified: detail specification 5101/014

Applications

- Satellite and spacecraft power systems
- Switch mode power supply
- Flyback or forward converter output rectification
- Free wheeling diode for DC motor chopper or 3-phase motor inverter
- Reverse polarity protection

Description

Designed for harsh cosmic radiation conditions, the 1N5806U is a 2.5 A - 150 V low leakage ultrafast rectifier that is housed in the lightweight, high thermal conductive LCC-2A package.

This hermetic surface mount package exhibits an industry standard compatible footprint, such as the D5A.

The full planar technology 1N5806U rectifier allows superior performances and high reliability up to 175 °C and is characterized in total ionizing dose for rad-hard applications.

This rectifier is ESCC qualified, which makes it eligible for use in space programs. It is typically used in low voltage switch-mode power converters, step-down regulators, high frequency DC-to-DC, or chopper drives, performing as secondary ultrafast rectification, free-wheeling diode, or reverse polarity protection.

1 Characteristics

Table 1. Absolute ratings (limiting values)

Symbol	Parameter		Value	Unit
V_{RRM}	Repetitive peak reverse voltage		150	V
V_{RWM} (1)	Peak working reverse voltage		150	V
$I_{F(RMS)}$	RMS forward current		10	A
$I_{F(AV)}$	Average forward current	$T_C \geq 142$ °C, $\delta = 0.5$	2.5	A
I_{FSM}	Non repetitive surge forward current(2)	t_p = 8.3 ms sinusoidal	35	A
		t_p = 10 ms sinusoidal	33	
T_{stg}	Storage temperature range		-65 to +175	°C
T_{op}	Operating temperature range (case temperature)		-65 to +175	°C
T_j	Maximum operating junction temperature		175	°C
T_{sol}	Maximum soldering temperature(3)		245	°C
ESD	Electro static discharge, air discharge, HBM model, class 3B		8	kV

1. *See Figure 1.*
2. *T_{amb} initial = 25°C*
3. *Maximum duration 5 s. The same package cannot be re-soldered until 3 minutes have elapsed after initial soldering.*

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

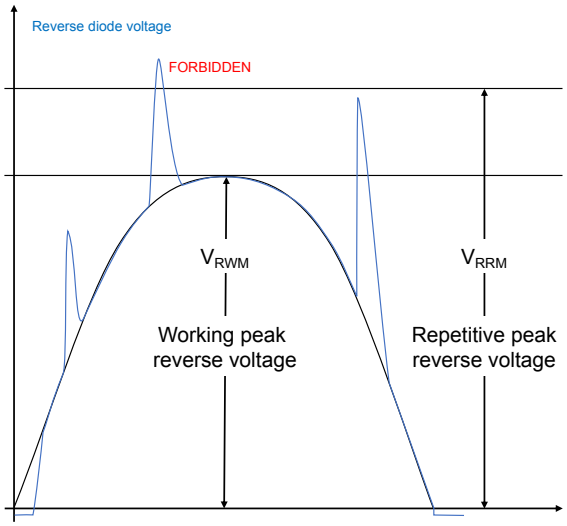


Table 2. Thermal parameters

Symbol	Parameter	Max. value	Unit
$R_{th(j-c)}$	Junction to case (DC) , mounted on infinite heat sink	13	°C/W

For more information, refer to the application note:

- AN5088: Rectifiers thermal management, handling and mounting recommendation

Table 3. Static electrical characteristics

Symbol	Parameter	Test conditions		Max.	Unit
I_R (1)	Reverse leakage current	T_j = -65 °C	V_R = 160 V	10	µA
		T_j = 25 °C		10	
		T_j = 25 °C	$V_R = V_{RWM}$	0.5	
		T_j = 125 °C		20	
V_F (2)	Forward voltage drop	T_j = -65 °C	I_F = 1 A	1.075	V
		T_j = 25 °C		0.88	
		T_j = 125 °C		0.8	
		T_j = 25 °C	I_F = 2.5 A	1.0	

1. *Pulse test: t_p = 5 ms, δ < 2%, δ = duty cycle*
2. *Pulse test: t_p = 680 µs, δ < 2%*

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Test conditions	Max.	Unit
t_{RR}	Reverse recovery time	$I_F = I_R$ = 0.5 A, I_{RR} = 0.05 A, dI_F/dt = -65 A/µs	T_j = 25 °C	25	ns
		I_F = 1 A, dI_F/dt = -50 A/µs, V_R = 30 V		30	
C_j	Total diode capacitance	V_R = 10 V, F = 1 MHz	T_j = 25 °C	25	pF
V_{FP}	Forward recovery voltage	I_F = 0.5 A	T_j = 25 °C	2.2	V
t_{FR}	Forward recovery time	I_F = 0.5 A, $V_{FR} = 1.1 \times V_F$	T_j = 25 °C	15	ns

To evaluate the conduction losses, use the following equation:

$P = 0.70 \times I_{F(AV)} + 0.1 \times I_F{}^2{}_{(RMS)}$

For more information, refer to the following application notes related to the power losses:

- AN604: Calculation of conduction losses in a power rectifier
- AN4021: Calculation of reverse losses on a power diode

1.1 Characteristics (curves)

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

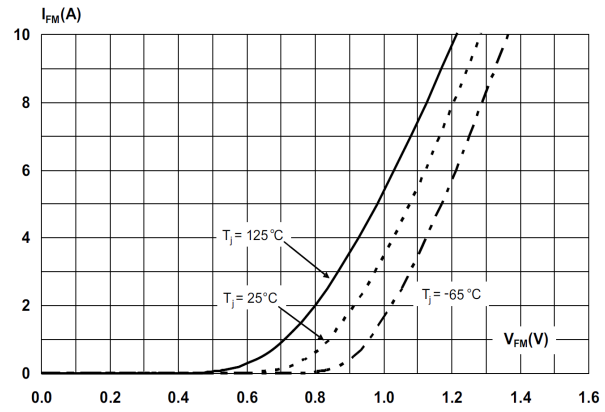


Figure 3. Forward voltage drop versus forward current (maximum values)

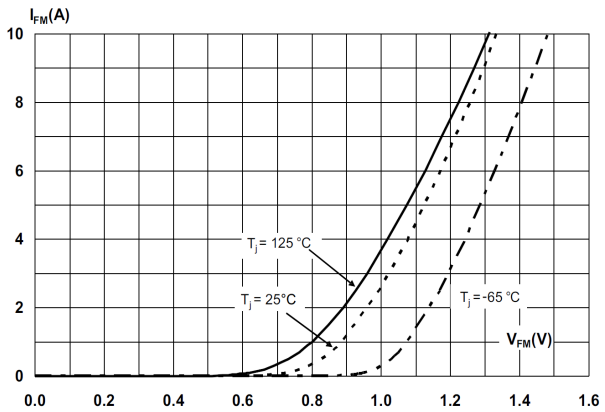


Figure 4. Reverse leakage current versus reverse voltage applied (typical values)

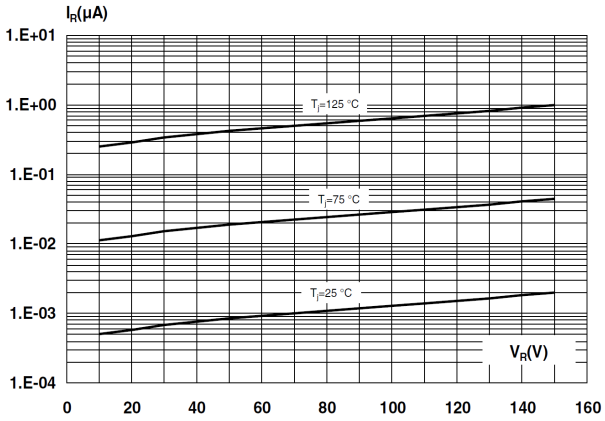


Figure 5. Relative variation of thermal impedance, junction to case, versus single square pulse duration

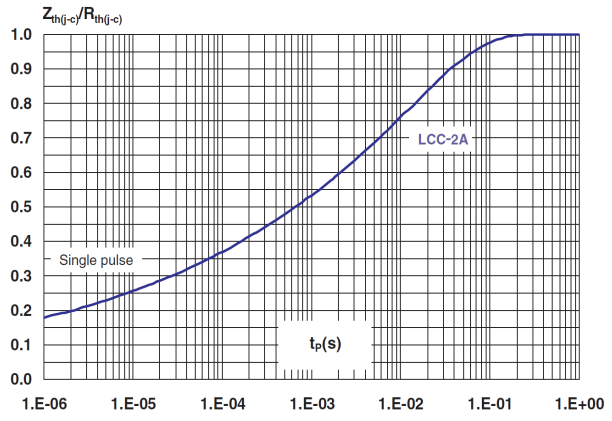


Figure 6. Reverse recovery time versus dI_F/dt (typical values)

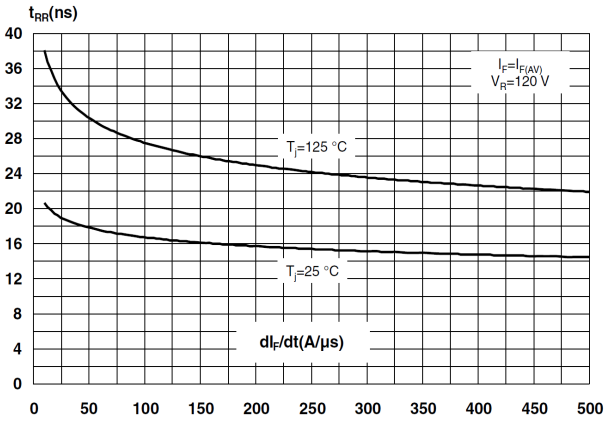
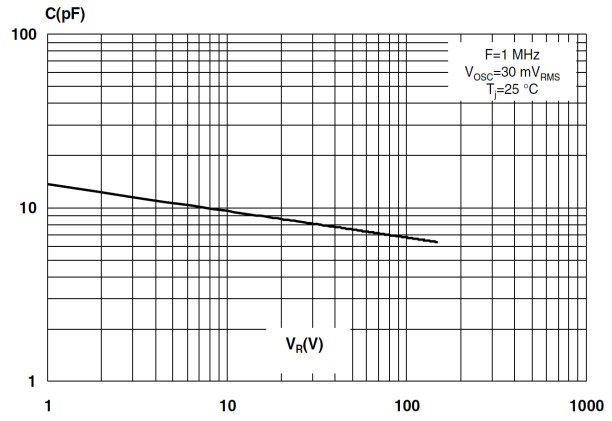


Figure 7. Junction capacitance versus reverse voltage applied (typical values)



2 Radiation

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

The STMicroelectronics 1N5806U goes beyond the standard and is characterized in total ionization dose test at high dose rates (TID) up to three Mrad(Si) as described below.

2.1 Total ionisation dose

The total ionizing dose tests relevant to ultrafast switching rectifier are done at high dose rate on 10 parts housed in LCC2A where 5 are reverse biased, 5 forward biased and 5 unbiased.

The irradiation is done according to the ESCC 22900 specification, standard window, at 620 krad(Si)/h.

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

These electrical parameters are measured :

- Before irradiation
- After irradiation
- After 24 hours at room temperature
- After 168-hours annealing at 100 °C

2.2 Single event effect

Based on ECSS-Q-ST-60-15C the ultrafast switching rectifiers are intrinsically resistant to single event effect (SEE) up to a LET threshold LET_{th} > 60 MeV.cm²/mg.

3 Package information

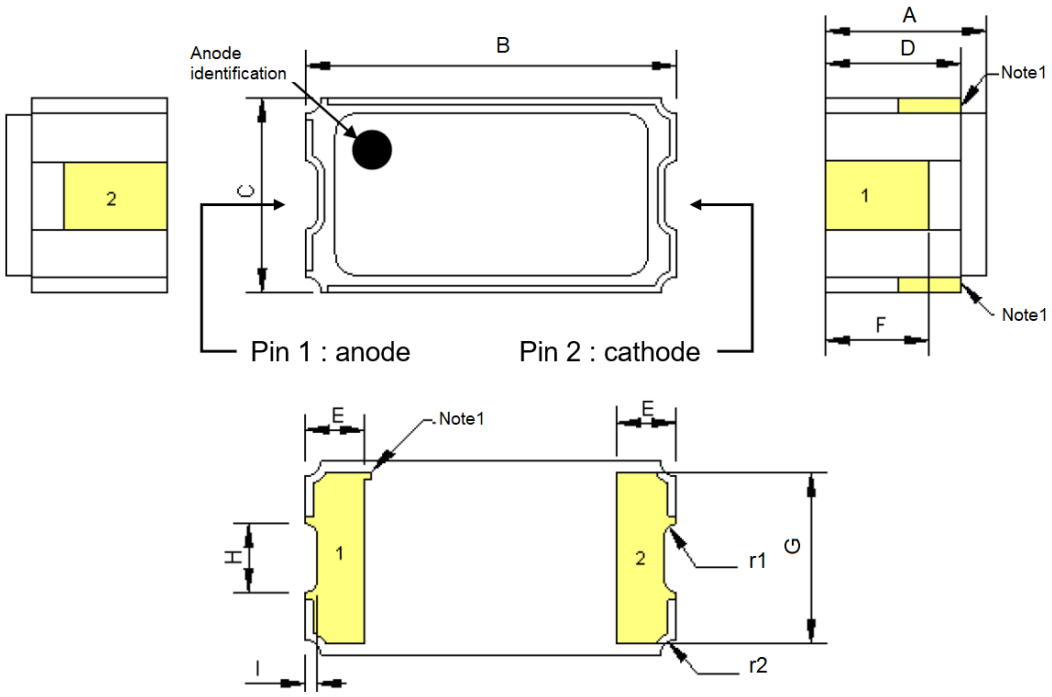
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

3.1 LCC-2A package information

The LCC-2A package is available with two lead tinning versions : Gold plated or SnPb 63/37 solder dip leads.

Its metallic lid is electrically floating and not connected to any pin. Connecting it to ground doesn't affect the electrical characteristics.

Figure 8. LCC-2A package outline



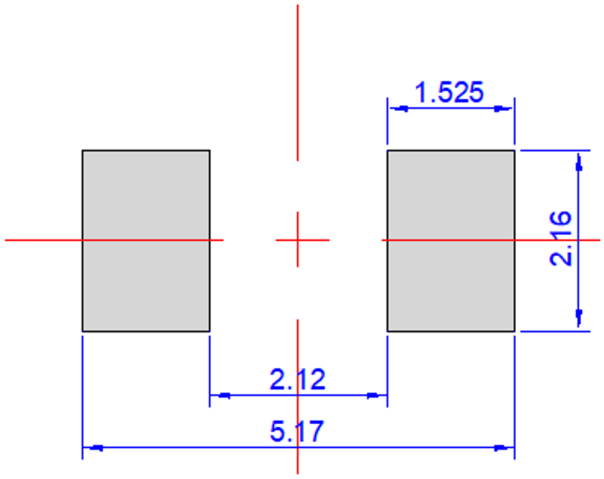
Note: The anode is identified by a metallization in the two top angle castellations and by the index mark on the bottom metallization n° 1.

Table 5. LCC-2A package mechanical data

Ref.	Dimensions					
	Millimeters			Inches (for reference only)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A(1)	1.86	2.03	2.20	0.073	0.080	0.087
B	4.54	4.67	4.87	0.179	0.184	0.192
C	2.33	2.46	2.59	0.092	0.097	0.102
D	1.53	1.7	1.87	0.060	0.067	0.074
E	0.48		0.71	0.019		0.028
F		1.3			0.051	
G		2.16			0.085	
H		0.86			0.034	
I		0.15			0.006	
r1		0.15			0.006	
r2		0.20			0.008	

1. *Measurement prior to solder coating the mounting pads on bottom of package.*

Figure 9. LCC2-A footprint density level B



4 Ordering information

Table 6. Ordering information

Order code	ESCC detail specification	Quality level	Package	Lead finishing	Product marking	Mass	Base qty.	Packing
1N5806UA1	-	Engineering model	LCC-2A	Gold	1N5806UA1	120 mg	50	Wafle pack
1N5806U01A	5101/014/13	Flight model		Gold	510101413			
1N5806U02A	5101/014/14	Flight model		Solder dip	510101414			

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

5 Other information

5.1 Product marking description

Here below is described the marking of the package of both the engineering and flight models.

Figure 10. ESCC flight model marking outline

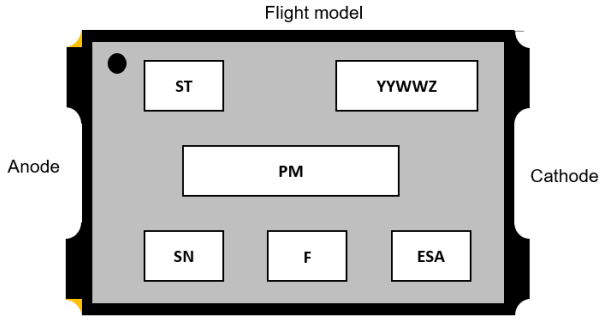


Table 7. ESCC flight model marking

Field	Description
ST	ST logo
YYWWZ	Date code and lot index in the week(1)
PM	Product marking
SN	Serialization number
F	Country of origin
ESA	ESA logo

1. *Date cote includes YY = two-digit year, WW = two-digit week, Z = assembly plant code.*

Figure 11. Engineering model marking outline

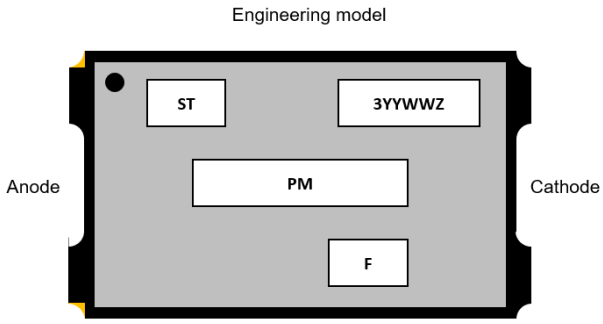


Table 8. Engineering model marking

Field	Description
ST	ST logo
YYWWZ	Date code and lot index in the week(1)
PM	Product marking
F	Country of origin

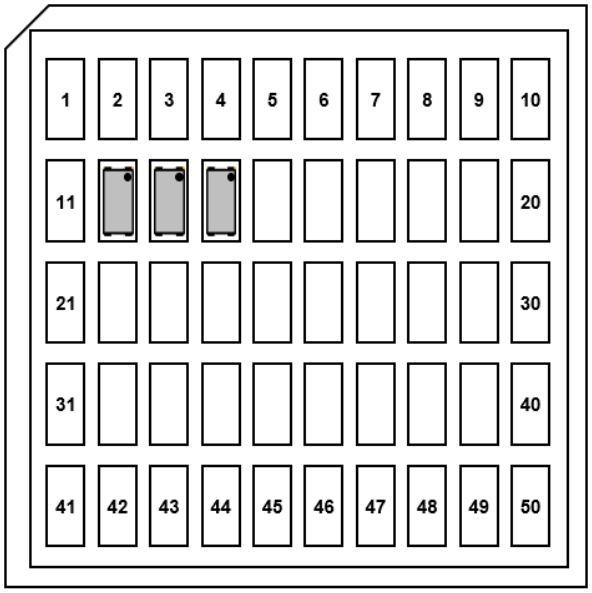
1. *Date cote includes YY = two-digit year, WW = two-digit week, Z = assembly plant code.*

5.2 Packing information

The 1N5806U versions are delivered in a 50-position, 50.8 x 50.8 mm² waffle pack consecutively populated from position 1.

The Figure 12 shows how to identify position 1, the orientation of the product in the waffle pack.

Figure 12. 1N5806U waffle pack outline



The diode anode is on the top pin of the device, and the anode identification dot is orientated at the opposite of the waffle pack truncated corner.

5.3 Documentation

In the Table 9 is a summary of the documentation provided with each type of products.

Table 9. 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 part number • Quantity delivered • Date code • Reference data sheet • Reference to TN1181 on engineering models • ST Rennes assembly lot ID
Flight model	Certificate of conformance including : • Customer name • Customer purchase order number • ST sales order number and item • ST part number • Quantity delivered • Date code • Serial numbers • Diffusion line (plant + wafer size) • Diffusion run (wafer lot number) and wafer ID • Reference of the applicable ESCC qualification maintenance lot • Reference to the ESCC detail specification • ST Rennes assembly lot ID number

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
27-Jul-2009	1	First issue.
25-Mar-2010	2	Updated ESCC status in *Features* and added footnote to *Table 3*.
8-Nov-2013	3	Updated *Table 1*, *Table 5* and *Table 7* and inserted *Other information*.
04-Dec-2015	4	Updated *Table 7* and reformatted to current standard.
14-May-2024	5	Updated *Features*, *Description*, and Section 5: Other information. Added *Applications* and Section 5.2: Packing information. Minor text changes.

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