Rectifier Switch for Reverse Battery Connection

No. EA-320-1811214

OUTLINE

The R5590x is a rectifier switch, which allows the reverse connection of battery. This device can output the voltage rectified in either positive or negative polarity regardless of the polarity of the input voltage. Therefore, this device allows the various applications without being limited by the battery loading directions or the connector insertion directions. This device also protect the device system from the accidental reverse connection of battery.

A small loss resistance of typically 0.4 Ω (SON1612-6)/ 0.5 Ω (SOT-23-5) and a small supply current of typically 50 nA at 1.5 V input voltage make this device ideal for the applications using a battery.

For the applications using multiple batteries in series or in parallel, the output pin should also be connected in series or in parallel to rectify the power source and protect the device system.

This device is offered in a small 5-pin SOT-23-5 package or an ultra-small and thin 6-pin SON1612-6 package which achieves easy and the smallest possible footprint solutions on board where area is limited.

FEATURES

- Input Voltage Range (Maximum Rating) ····· 0.9 V to 5.25 V (6.0 V)
- Supply Current ····· Typ. 50 nA (Input Voltage 1.5 V)
- Loss Resistance ····· Typ. 0.4 Ω (Input Voltage 1.5 V, SON1612-6)
  Typ. 0.5 Ω (Input Voltage 1.5 V, SOT-23-5)
- Package ····· SON1612-6, SOT-23-5

APPLICATIONS

- Battery Driven Toys, Remote Controllers, Mouse
- Mobile Health Care Devices

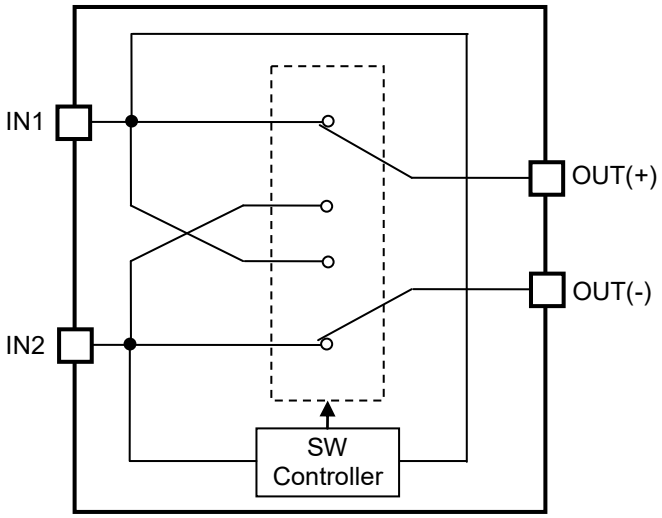
SELECTION GUIDE

The package is a user-selectable option.

Selection Guide

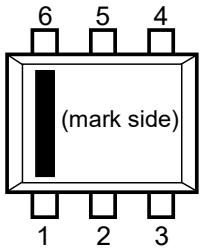
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R5590D001A-TR-FE	SON1612-6	4,000 pcs	Yes	Yes
R5590N001A-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

BLOCK DIAGRAMS

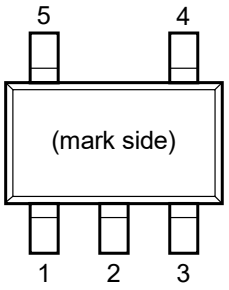


R5590x001A Block Diagram

PIN DESCRIPTION



SON1612-6 Pin Configuration



SOT-23-5 Pin Configuration

SON1612-6 Pin Description

Pin No.	Symbol	Description
1	IN2	Input Pin 2
2	OUT (−)	Negative Output Pin(1)
3	NC	No Connection
4	IN1	Input Pin 1
5	OUT (−)	Negative Output Pin(1)
6	OUT (+)	Positive Output Pin

SOT-23-5 Pin Description

Pin No.	Symbol	Description
1	IN1	Input Pin 1
2	OUT (−)	Negative Output Pin
3	NC	No Connection
4	IN2	Input Pin 2
5	OUT (+)	Positive Output Pin

(1) No. 2 pin and No. 5 pin must be wired together at mounting on a board.

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings

Symbol	Parameter			Rating	Unit
ΔV_{IN}	Input Pin Voltage Difference (|IN1 − IN2|)			6.0	V
ΔV_{OUT}	Output Pin Voltage (OUT(+) − OUT(−))			0 to ΔV_{IN}	V
I_{OUT}	Output Current			400	mA
P_D	Power Dissipation(2)	SON1612-6	Standard Test Land Pattern	500	mW
		SOT-23-5	JEDEC STD.51-7	660	
Tj	Junction Temperature Range			−40 to 125	°C
Tstg	Storage Temperature Range			−55 to 125	°C

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS

Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
V_{IN}	Input Voltage	0.9 ~ 5.25	V
Ta	Operating Temperature Range	−40 ~ 85	°C

RECOMMENDED OPERATING CONDITONS

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

(2) Refer to *POWER DISSIPATION* for detailed information.

ELECTRICAL CHARACTERISTICS

The specifications surrounded by [ ] are guaranteed by design engineering at −40°C ≤ Ta ≤ 85°C.

R5590D001A Electrical Characteristics (Ta = 25°C)

Symbol	Parameter	Test Conditions/Comments		Min.	Typ.	Max.	Unit
ΔV_{IN}	Input Pin Voltage Difference			[0.9]		5.25	V
R_{ON}	Switch On Resistance	V_{IN} = 1 V, I_{OUT} = 100 mA			0.65	[1.40]	Ω
		V_{IN} = 1.5 V, I_{OUT} = 100 mA			0.40	[0.85]	
		V_{IN} = 5.25 V, I_{OUT} = 100 mA			0.30	[0.62]	
I_{SS}	Supply Current	V_{IN} = 1.5 V, I_{OUT} = 0 mA	Ta = 25°C		0.05		μA
		V_{IN} = 5.25 V, I_{OUT} = 0 mA	Ta = 25°C		0.15	4.5	
			−40°C ≤ Ta ≤ 85°C			[55]	

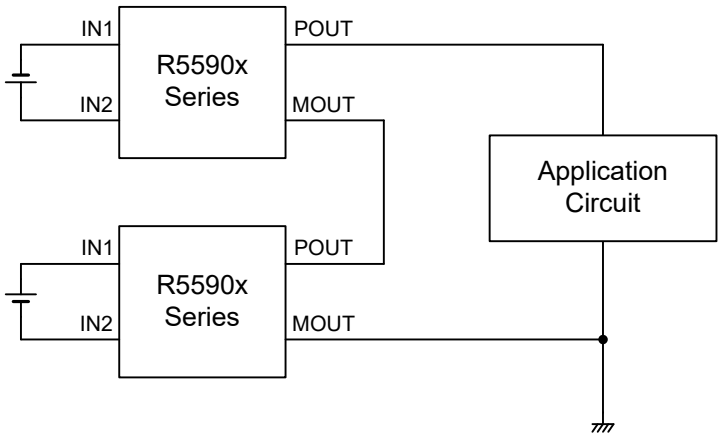
All parameters listed under *ELECTRICAL CHARACTERISTICS* are done under the pulse load condition (Tj ≈ Ta = 25°C).

R5590N001A Electrical Characteristics (Ta = 25°C)

Symbol	Parameter	Test Conditions/Comments		Min.	Typ.	Max.	Unit
ΔV_{IN}	Input Pin Voltage Difference			[0.9]		5.25	V
R_{ON}	Switch On Resistance	V_{IN} = 1 V, I_{OUT} = 100 mA			0.75	[1.45]	Ω
		V_{IN} = 1.5 V, I_{OUT} = 100 mA			0.50	[0.88]	
		V_{IN} = 5.25 V, I_{OUT} = 100 mA			0.35	[0.65]	
I_{SS}	Supply Current	V_{IN} = 1.5 V, I_{OUT} = 0 mA	Ta = 25°C		0.05		μA
		V_{IN} = 5.25 V, I_{OUT} = 0 mA	Ta = 25°C		0.15	4.5	
			−40°C ≤ Ta ≤ 85°C			[55]	

All test items listed under *ELECTRICAL CHARACTERISTICS* are done under the pulse load condition (Tj ≈ Ta = 25°C).

APPLICATION INFORMATION



Typical Rectification Circuit with 2 Serial Batteries

TECHNICAL NOTES

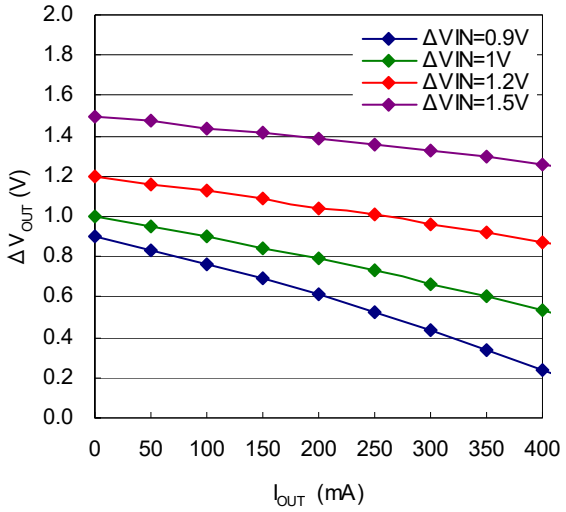
If the input voltage difference becomes less than output voltage difference, which could happen when the AC power source is rectified or the DC power source having different voltage is used in parallel, the current flows from the output side to the input side. To prevent this, use a reverse current prevention diode.

The short circuit current flows when the output pin is shorted while bias voltage is applied to the input pin. The R5590x should be operated within the absolute maximum ratings of each package.

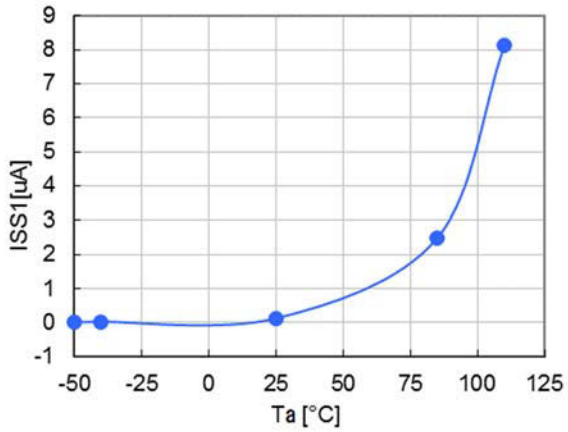
TYPICAL CHARACTERISTICS

Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1. Output Current vs. Output Pin Voltage (Ta = 85°C)



2. Operating Temperature vs. Supply Current (IN1=5.25V)



Ver. A

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following conditions are used in this measurement.

Measurement Conditions

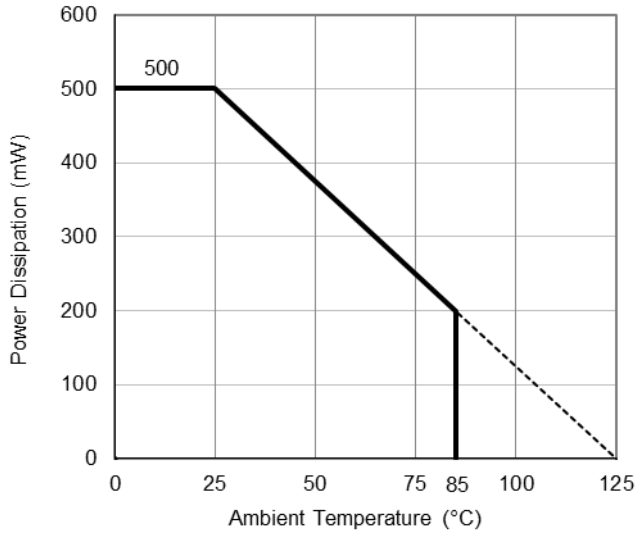
Item	Standard Test Land Pattern
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Double-Sided Board)
Board Dimensions	40 mm × 40 mm × 1.6 mm
Copper Ratio	Top Side: Approx. 50% Bottom Side: Approx. 50%
Through-holes	ϕ 0.5 mm × 24 pcs

Measurement Result (Ta = 25°C, Tjmax = 125°C)

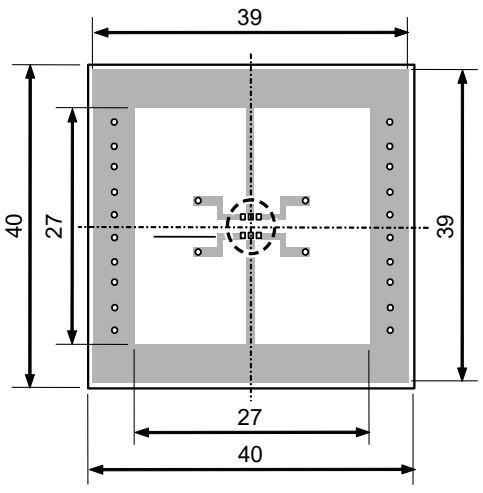
Item	Standard Test Land Pattern
Power Dissipation	500 mW
Thermal Resistance (θja)	θja = 200°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 82°C/W

θja: Junction-to-Ambient Thermal Resistance

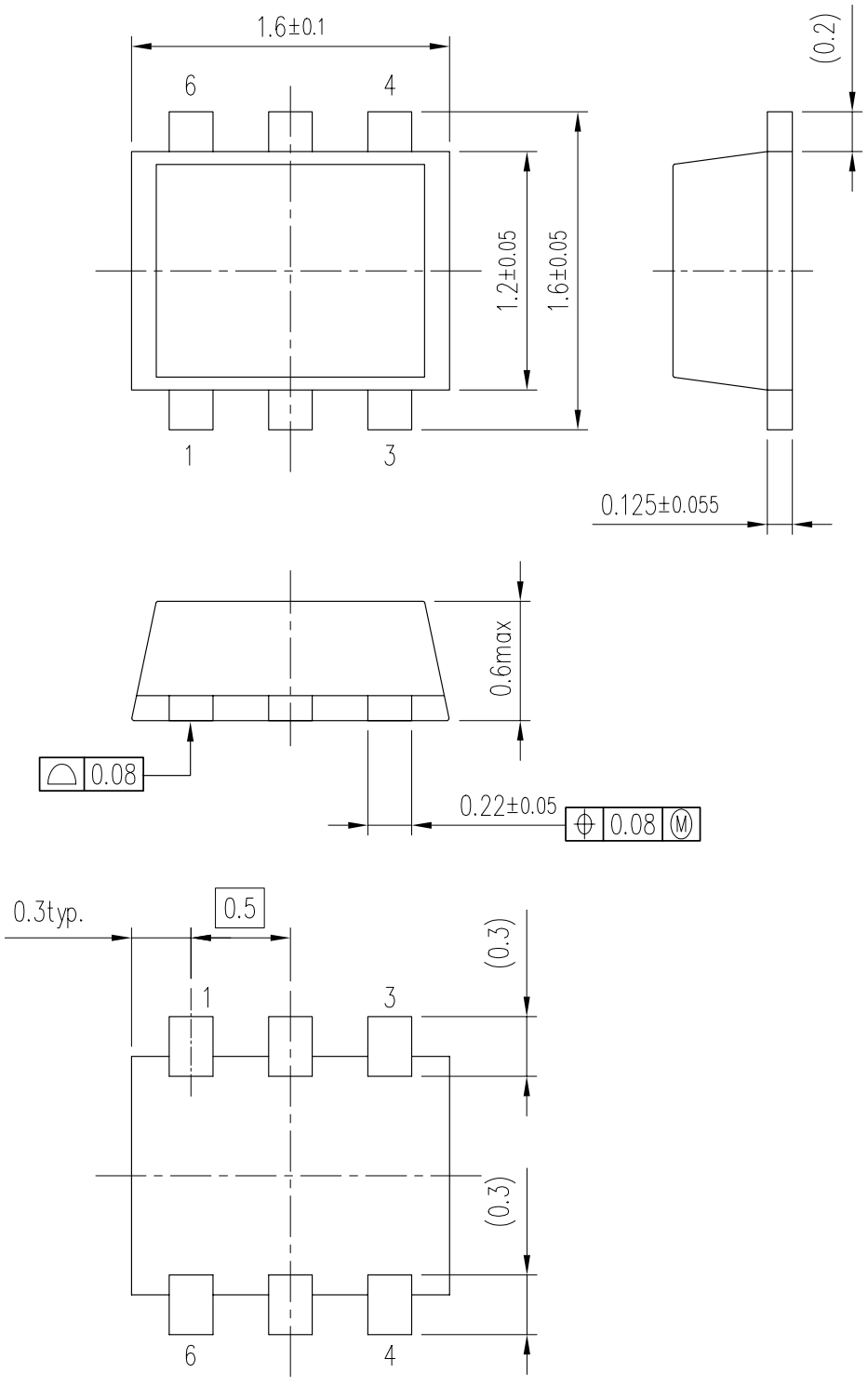
ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern



UNIT: mm

SON1612-6 Package Dimensions

Ver. A

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

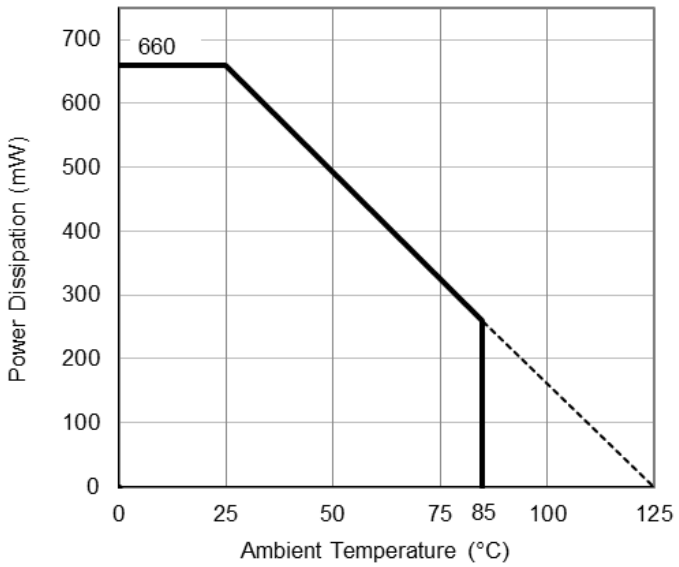
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 7 pcs

Measurement Result (Ta = 25°C, Tjmax = 125°C)

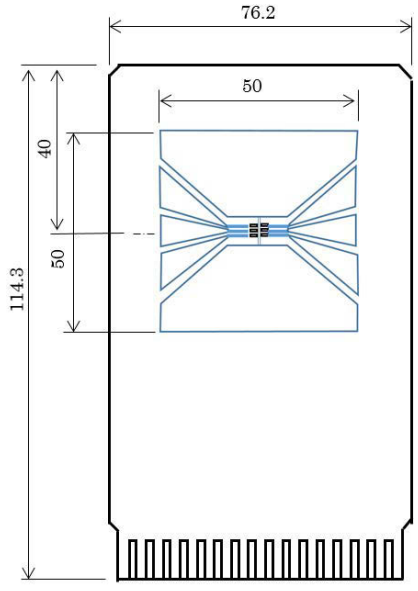
Item	Measurement Result
Power Dissipation	660 mW
Thermal Resistance (θja)	θja = 150°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 51°C/W

θja: Junction-to-Ambient Thermal Resistance

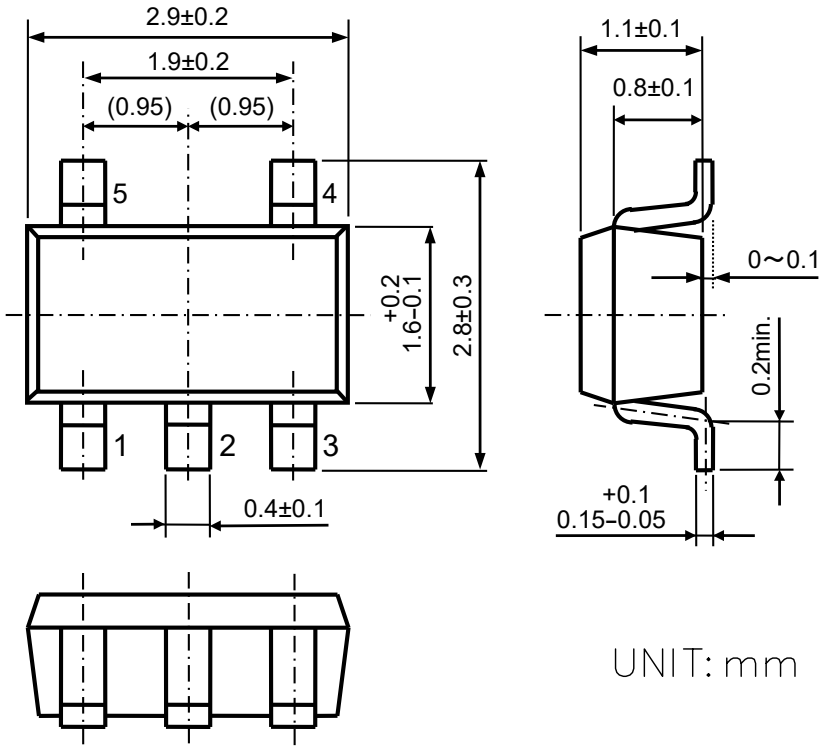
ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern



SOT-23-5 Package Dimensions

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