

## GENERAL DESCRIPTION

The SP809/SP810 are low power microprocessor ( $\mu$ P) supervisory circuits used to monitor power supplies in  $\mu$ P and digital systems.

They provide applications with benefits of circuit reliability and low cost by eliminating external components. If the  $V_{CC}$  supply voltage falls below preset threshold then a reset signal is asserted for at least 140ms after  $V_{CC}$  has risen above the reset threshold.

Both the SP809 and SP810 were designed with a reset comparator to help identify invalid signals, which last less than 140ms. The only difference between them is that they have an active-low  $\overline{\text{RESET}}$  output and active-high RESET output, respectively. Low supply current (1 $\mu$ A) makes SP809/SP810 ideal for portable equipment.

The devices are available in 3 pin SOT-23 package.

## APPLICATIONS

- Portable Electronic Devices
- Electrical Power Meters
- Digital Still Cameras
- $\mu$ P Power Monitoring

## FEATURES

- Ultra Low Supply Current 1 $\mu$ A (typ)
- Guaranteed Reset valid to  $V_{CC} = 0.9V$
- 140ms Power-On Reset Pulse Width
- Internally Fixed Threshold  
2.3V, 2.6V, 2.9V, 3.1V, 4.4V, 4.6V
- 1.5% Voltage Threshold Tolerance
- 3 Pin SOT-23 Package

Part Number	Output Type
SP809N	Open Drain Active Low
SP809	Push-Pull Low
SP810	Push-Pull Active High

## TYPICAL APPLICATION DIAGRAM

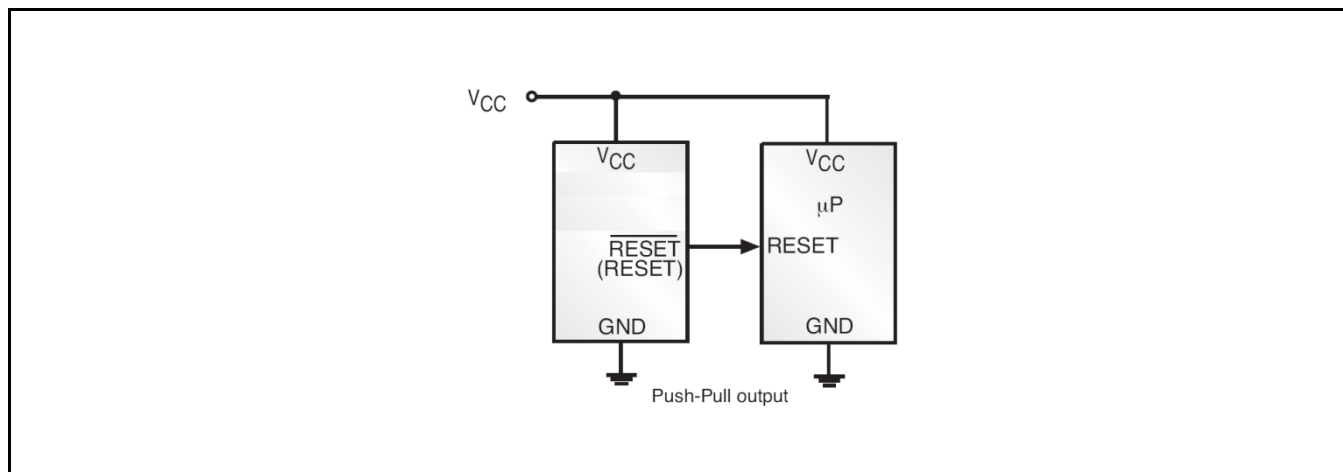


Fig. 1: SP809 / SP810 Application Diagram

## ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

$V_{CC}$  ..... -0.3V to 6.5V  
 RESET,  $\overline{\text{RESET}}$  ..... -0.3V to  $V_{CC}+0.3V$   
 Output Current (RESET,  $\overline{\text{RESET}}$ ) ..... 20mA  
 Power Dissipation ( $T_A=70^\circ\text{C}$ ) ..... 320mW  
 Junction Temperature .....  $125^\circ\text{C}$   
 Storage Temperature .....  $-65^\circ\text{C}$  to  $150^\circ\text{C}$

## OPERATING RATINGS

Input Voltage Range  $V_{CC}$  ..... 0.9V to 6V  
 Junction Temperature Range .....  $-40^\circ\text{C}$  to  $85^\circ\text{C}$

## ELECTRICAL SPECIFICATIONS

Specifications with standard type are for an Operating Temperature of  $T_A = 25^\circ\text{C}$  only; limits applying over the full Operating Temperature range are denoted by a "•". Minimum and Maximum limits are guaranteed through test, design, or statistical correlation. Typical values represent the most likely parametric norm at  $T_A = 25^\circ\text{C}$ , and are provided for reference purposes only. Unless otherwise indicated,  $T_A = 25^\circ\text{C}$ .

Parameter	Min.	Typ.	Max.	Units	Conditions
Operating Voltage Range $V_{CC}$	0.9		6.0	V	
Supply Current $I_{CC}$		1.0	3.0	$\mu\text{A}$	$V_{CC}=V_{TH}+0.1V$
Reset Threshold $V_{TH}$	2.265	2.3	2.335	V	$T_A = +25^\circ\text{C}$
	2.254		2.346		• $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$
	2.561	2.6	2.639		$T_A = +25^\circ\text{C}$
	2.548		2.652		• $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$
	2.857	2.9	2.944		$T_A = +25^\circ\text{C}$
	2.842		2.958		• $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$
	3.054	3.1	3.147		$T_A = +25^\circ\text{C}$
	3.038		3.162		• $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$
	4.334	4.4	4.466		$T_A = +25^\circ\text{C}$
	4.312		4.488		• $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$
	4.531	4.6	4.669		$T_A = +25^\circ\text{C}$
	4.508		4.692		• $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$
$V_{CC}$ Reset Delay $t_{TRIP}$		20		$\mu\text{s}$	$V_{CC}=V_{TH}$ to $(V_{TH} - 0.1V)$ , $V_{TH}=3.1V$
Reset Active Timeout Period $t_{RP}$	140	230	560	ms	$T_A = +25^\circ\text{C}$
	100		1030		• $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$
RESET Output Voltage $V_{OH}$	$0.8V_{CC}$			V	$V_{CC}=V_{TH} - 0.1V$ , $I_{SOURCE} = 1.2\text{mA}$
RESET Output Voltage $V_{OL}$			0.3		$V_{CC}=V_{TH} + 0.1V$ , $I_{SINK} = 1.2\text{mA}$
$\overline{\text{RESET}}$ Output Voltage $V_{OH}$	$0.8V_{CC}$			V	$V_{CC}=V_{TH} + 0.1V$ , $I_{SOURCE} = 1.2\text{mA}$
$\overline{\text{RESET}}$ Output Voltage $V_{OL}$			0.3		$V_{CC}=V_{TH} - 0.1V$ , $I_{SINK} = 1.2\text{mA}$

Note 1: RESET output is for SP809;  $\overline{\text{RESET}}$  output is for SP810.

## BLOCK DIAGRAM

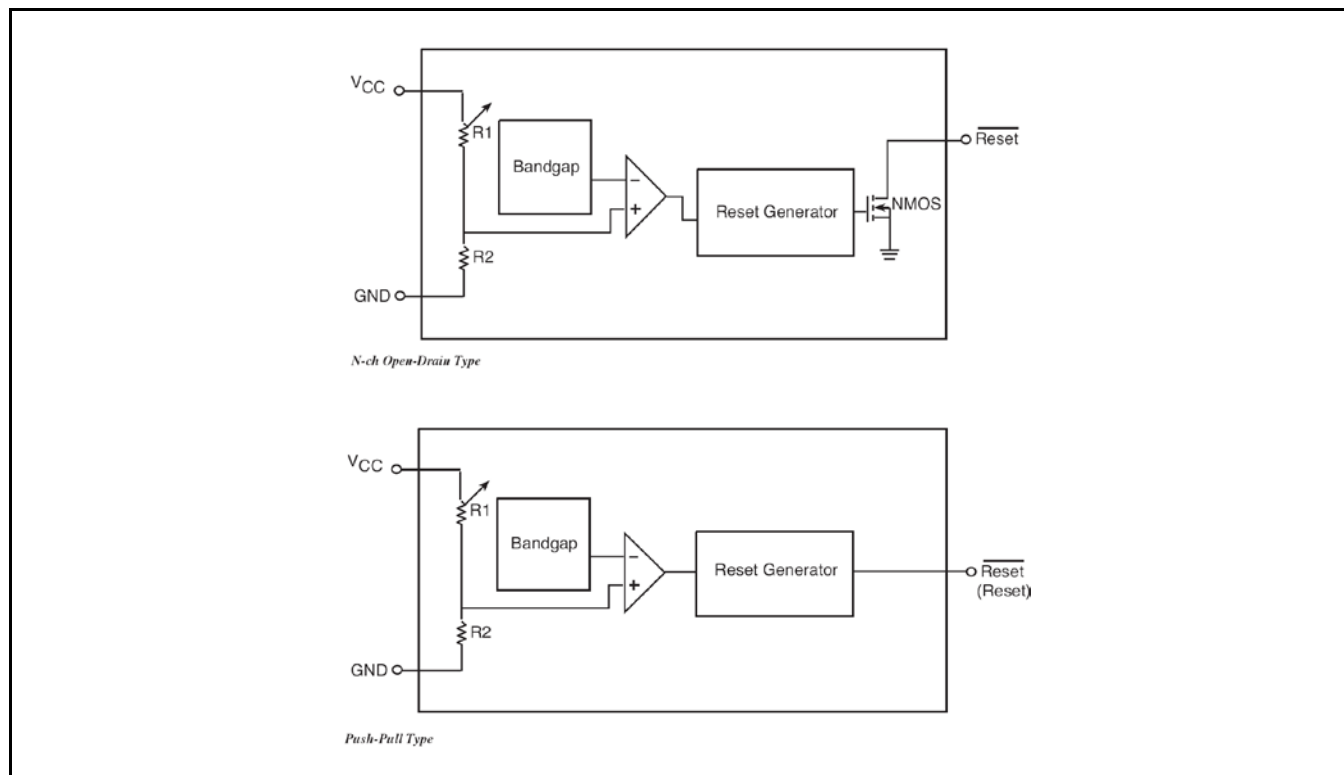


Fig. 2: SP809 / SP810 Block Diagram

## PIN ASSIGNMENT

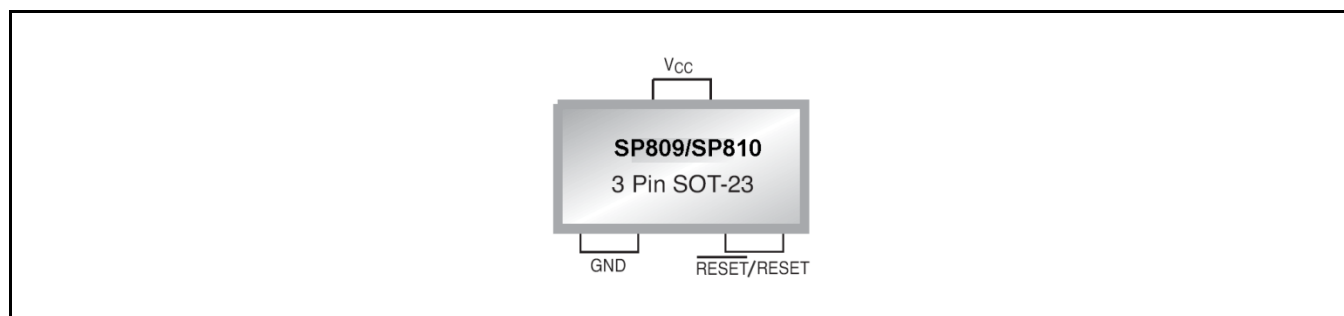


Fig. 3: SP809 / SP810 Pin Assignment

## PIN DESCRIPTION

Name	Pin Number	Description
GND	1	Ground Signal
$\overline{\text{RESET}}$	2	Active Low Output Pin. RESET Output remains high while VCC is below the reset threshold
RESET		Active High Output Pin. RESET Output remains high while VCC is below the reset threshold
V <sub>CC</sub>	3	Supply Voltage

**ORDERING INFORMATION<sup>(1)</sup>**

Part Number	Operating Temperature Range	Lead-Free	Package	Packing Method
SP809EK-L-2-3/TR	-40°C ≤ T <sub>A</sub> ≤ +85°C	Yes <sup>(2)</sup>	SOT23-3	Tape & Reel
SP809EK-L-2-6/TR				
SP809EK-L-2-9/TR				
SP809EK-L-3-1/TR <sup>(3)</sup>				
SP809EK-L-4-6/TR <sup>(3)</sup>				
SP809NEK-L-2-3/TR <sup>(3)</sup>				
SP809NEK-L-2-9/TR <sup>(3)</sup>				
SP809NEK-L-3-1/TR				
SP809NEK-L-4-6/TR <sup>(3)</sup>				
SP810EK-L-4-4/TR <sup>(3)</sup>				

**NOTES:**

1. Refer to [www.exar.com/SP809](http://www.exar.com/SP809) and [www.exar.com/SP810](http://www.exar.com/SP810) for most up-to-date Ordering Information.
2. Visit [www.exar.com](http://www.exar.com) for additional information on Environmental Rating.
3. NRND – Not Recommended for New Designs.

## TYPICAL PERFORMANCE CHARACTERISTICS

All data taken at  $T_A = 25^\circ\text{C}$ , unless otherwise specified - Schematic and BOM from Application Information section of this datasheet.

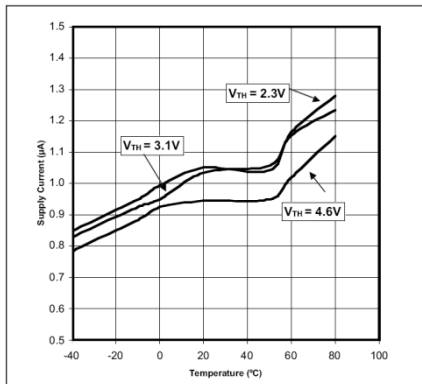


Fig. 4: Supply Current versus Temperature

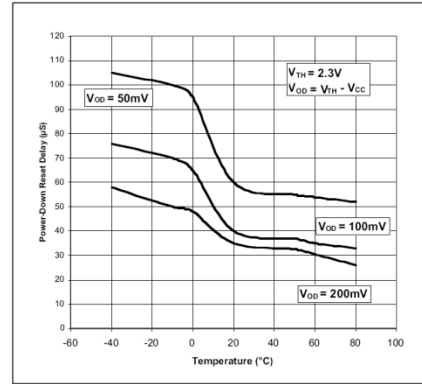


Fig. 5: Power-Down Reset Delay versus Temperature

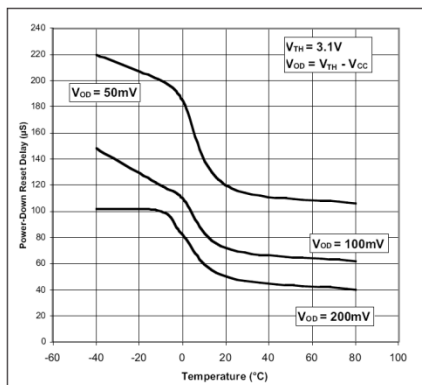


Fig. 6: Power-Down Reset Delay versus Temperature

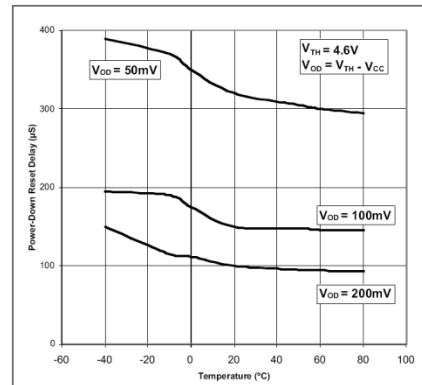


Fig. 7: Power-Down Reset Delay versus Temperature

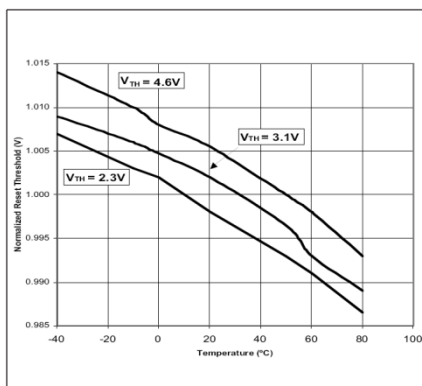


Fig. 8: Normalized Reset Threshold versus Temperature

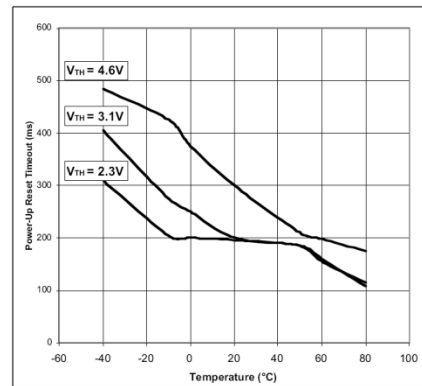


Fig. 9: Power-Up Reset Time-out versus Temperature

## THEORY OF OPERATION

$\mu$ P will be activated at a valid reset state. These  $\mu$ P supervisory circuits assert reset to prevent code execution errors during power-up, power-down, or brownout conditions.

Reset is guaranteed to be a logic low for  $V_{TH} > V_{CC} > 0.9V$ . Once  $V_{CC}$  exceeded the reset threshold, an internal timer keeps  $\overline{RESET}$  low for the reset timeout period; after this interval,  $\overline{RESET}$  goes high.

If a brownout condition occurs ( $V_{CC}$  drops below the reset threshold),  $\overline{RESET}$  goes low. Any time  $V_{CC}$  goes below the reset threshold, the internal timer resets to zero, and  $\overline{RESET}$  goes low. The internal timer is activated after  $V_{CC}$  returns above the reset threshold, and  $\overline{RESET}$  remains low for the reset timeout period.

## BENEFIT OF HIGHLY ACCURATE RESET THRESHOLD

SP809/810 with specified voltage as  $5V \pm 10\%$  or  $3V \pm 10\%$  are ideal for systems using a

$5V \pm 5\%$  or  $3V \pm 5\%$  power supply. The reset is guaranteed to assert after the power supply falls below the minimum specified operating voltage range of the system ICs. The pre-trimmed thresholds are reducing the range over which an undesirable reset may occur.

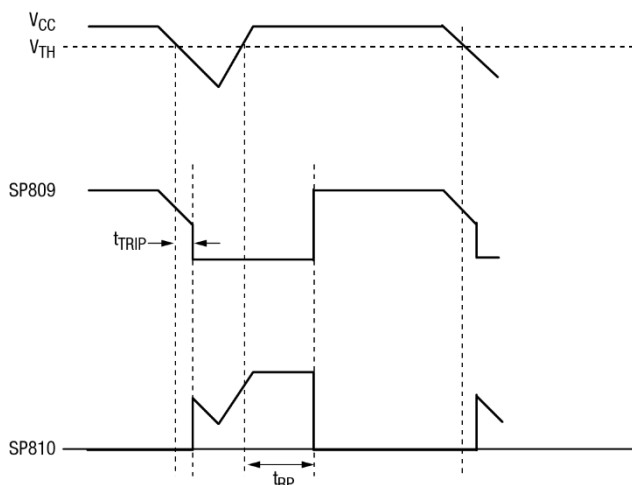


Fig. 10: Timing Waveforms

## APPLICATION INFORMATION

### NEGATIVE GOING $V_{CC}$ TRANSIENTS

In addition to issuing a reset to the  $\mu$ P during power-up, power-down, and brownout conditions, SP809 series are relatively resistant to short-duration negative-going  $V_{CC}$  transient.

### ENSURING A VALID RESET OUTPUT DOWN TO $V_{CC}=0$

When  $V_{CC}$  falls below 0.9V, SP809  $\overline{RESET}$  output no longer sinks current; it becomes an open circuit. In this case, high-impedance CMOS logic inputs connecting to  $\overline{RESET}$  can drift to undetermined voltages. Therefore, SP809/810 with CMOS is perfect for most applications of  $V_{CC}$  down to 0.9V.

However in applications where  $\overline{RESET}$  must be valid down to 0V, adding a pull-down resistor to  $\overline{RESET}$  causes any leakage currents to flow to ground, holding  $\overline{RESET}$  low.

## INTERFACING TO $\mu$ P WITH BIDIRECTIONAL RESET PINS

The  $\overline{RESET}$  output on the SP809N is open drain, this device interfaces easily with  $\mu$ Ps that have bidirectional reset pins. Connecting the  $\mu$ P supervisor's  $\overline{RESET}$  output directly to the microcontroller's  $\overline{RESET}$  pin with a single pull-up resistor allows either device to assert reset.

## TEST CIRCUIT

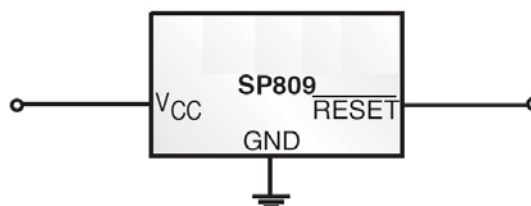
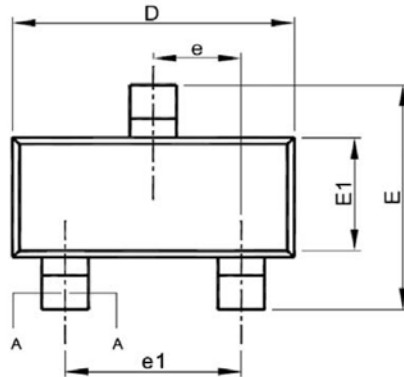


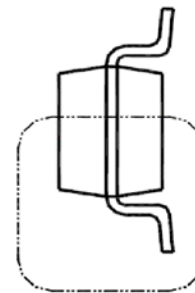
Fig. 11: Test Circuit

## PACKAGE SPECIFICATION

### 3-PIN SOT23

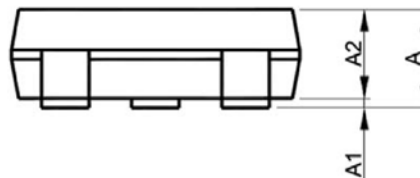


TOP VIEW



SEE VIEW B

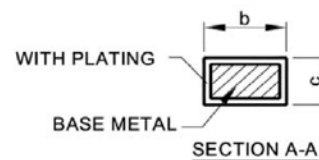
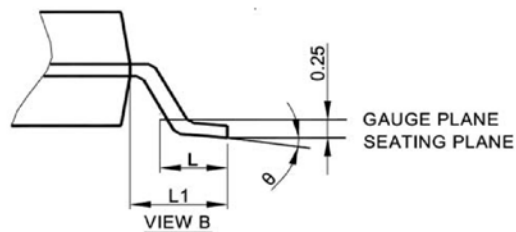
BOTTOM VIEW



SIDE VIEW

SYMBOL	SOT-23	
	MILLIMETERS	
	MIN.	MAX.
A	0.95	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.30	0.50
c	0.08	0.22
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.95 BSC	
e1	1.90 BSC	
L	0.30	0.60
L1	0.60 REF	
θ	0°	8°

TERMINAL DETAILS



1. Refer to Jecdec MO-178
2. Dimension "D" does not include mold flash, protrusions or gate burrs.  
Mold flash, protrusion or gate burrs shall not exceed 10mils per side.
3. Dimension "E1" does not include inter lead flash or protrusions.
4. All dimensions are millimeters.

Drawing No. - POD - 00000128

Revision: A

**REVISION HISTORY**

Revision	Date	Description
2.0.0	2011	Reformat of Datasheet Correction of package drawing
2.0.1	August 2017	Correct Reset Delay conditions. Updated to MaxLinear logo. Updated format and ordering information table.
2.0.2	November 2017	Corrected typo from rev 2.0.1, added 2 missing overlines to RESET in Electrical Specifications.

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