

## Description

The SX8122 is an analog controlled of 1 Volt motor/LED timer.

The SX8122 toggles its output high or low according to the state of an analog pin (TRIGGER). Threshold voltages on the analog pin are set to 1/3 and 2/3 of VDD.

One output pin (LED) send bursts when the motor is on to control a LED which threshold voltage is above VDD or to generate a boosted supply.

One output goes low when VDD is higher than the full charge voltage of an NiMH cell to control a minimal charger.

The SX8122 controls its IO state starting at 0.6V to facilitate power-up.

## Features

- 1 V operation
- 1 button operation
- Boosted LED control (drives bright white and green LEDs)
- NiMH cell charger control (allows USB recharge)

## Applications

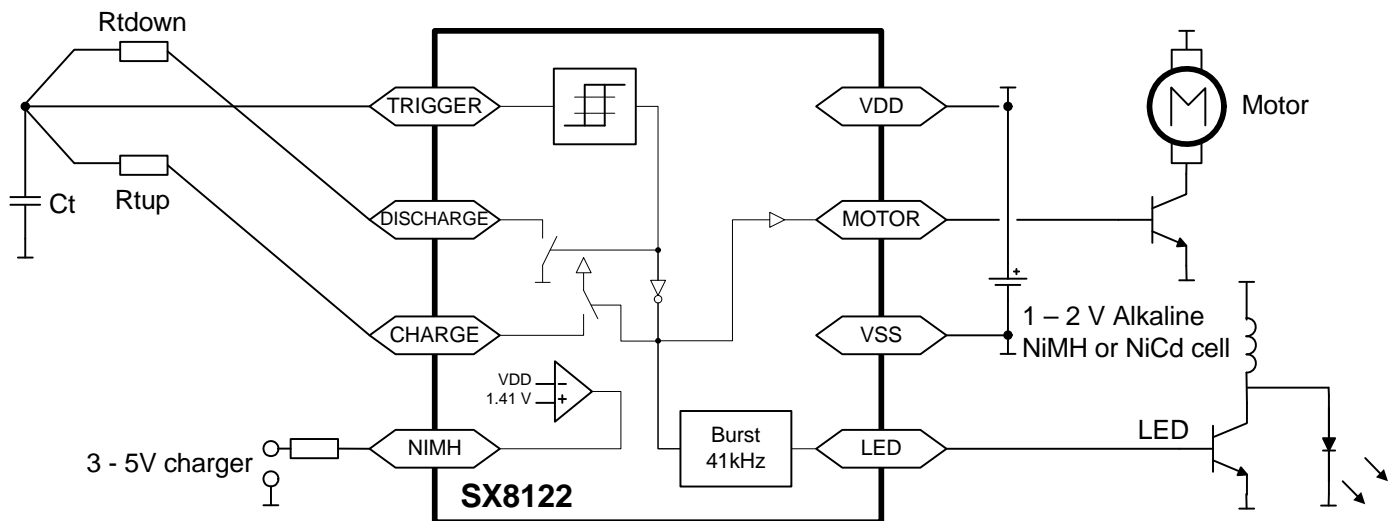
- Toys - LED animation
- LED pointer
- USB rechargeable
- 555 timer applications

## Ordering Information

Part number	Function	Time out
SX8122ISTRT	1V motor controller	Set by externals

- Available in tape and reel only
- WEEE/RoHS compliant- Pb-Free and Halogen Free.

## Functional Bloc Diagram



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## ELECTRICAL SPECIFICATION

### 1 Absolute Maximum Ratings

**Note** The Absolute Maximum Ratings, in table below, are stress ratings only. Functional operation of the device at conditions other than those indicated in the Operating Conditions sections of this specification is not implied. Exposure to the absolute maximum ratings, where different to the operating conditions, for an extended period may reduce the reliability or useful lifetime of the product.

**Table 1. Absolute maximum ratings**

Parameter		Symbol	Min	Max	Unit
Supply Voltage		VAMRVDD	-0.3	2.5	V
Pin Voltage (non-supply pins)		VAMRVIN	VSS - 0.3	VDD + 0.3	V
Sink or source current on any pin		IAMRISS	-100	100	mA
Storage Temp		TSTOR	-50	+150	°C
ESD conditions	HBM	ESDHBM	4000		V
	CDM	ESDCDM	1000		V
	MM	ESDMM	200		V

### ESD CAUTION



**ESD (electrostatic discharge) sensitive device**

Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precaution should be taken to avoid performance degradation or loss of functionality.

## 2 Specifications

### 2.1 Operating Conditions

**Note** Circuit operates within the Supply Voltage Range  $V_{DD}-V_{SS} = V_{DDOC}$ .  
The specification is verified within the Full Spec Voltage Range  $V_{DD}-V_{SS} = V_{DDSPEC}$ .

**Table 2. Operating range**

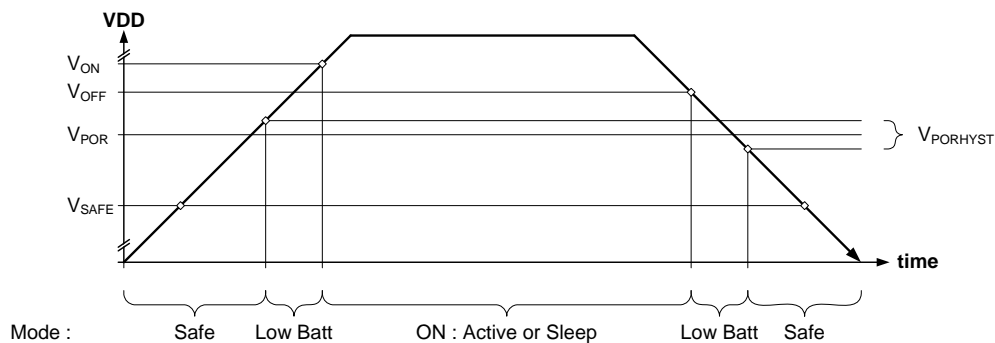
Parameter	Symbol	Min	Max	Unit
Supply Voltage Range	$V_{DDOC}$	0.9	2.0	V
Full Spec Voltage Range	$V_{DDSPEC}$	1.0	1.8	V
Ambient Temperature	$T_{OC}$	-40	+85	°C

### 2.2 Circuit specification

**Note** Conditions: Temperature within  $T_{OC}$  and  $V_{DD}-V_{SS}$  within  $V_{DDSPEC}$ , unless otherwise stated.

**Table 3. Circuit electrical specification**

Parameter	Symbol	Min	Typ	Max	Unit	
Safe mode low limit	$V_{SAFE}$		0.6	0.7	V	
POR voltage	Threshold	$V_{POR}$	0.9		V	
	Hysteresis	$V_{PORHYST}$	150		mV	
Switch ON level	$V_{ON}$	0.95	1.07	1.15	V	
Switch OFF level	$T : 0 \text{ to } 70^{\circ}\text{C}$	$V_{OFF}$	0.85	0.95	1.00	V
	$T : -40 \text{ to } 85^{\circ}\text{C}$	$V_{OFF}$	0.85	0.95	1.05	V



**Table 4. Circuit power consumption specifications**

Parameter		Symbol	Min	Typ	Max	Unit
Supply current in Force Charge and Continue Charge modes (outputs no loaded, MOTOR pin on, burst on LED pin)	VDD=1.2V	ICHARGE		54		μA
	VDD=2.0V			80		μA
Supply current in Force Discharge and Continue Discharge modes (outputs no loaded, MOTOR pin off, LED pin tied to ground)	VDD=1.2V	IDISCHARGE		50		μA
	VDD=2.0V			73		μA
Supply current in Sleep mode (outputs no loaded, MOTOR pin off, LED pin tied to ground)	VDD=1.2V	ISLEEP		10	30	μA
	VDD=2.0V			15	40	μA
Supply current in Low Batt mode		ILOWBATT		10	30	μA
Supply current in Safe mode		ISAFE			10	μA

**Table 5. Digital IOs specifications**

Parameter		Symbol	Min	Typ	Max	Unit
Output High Voltage		VOH	3/4 VDD		VDD	V
Output Low Voltage		VOL	VSS		1/4 VDD	V
Max Source Current at min VOH	VDD = 0.9 V	IOH09	4			mA
	VDD >= 1.2 V	IOH12	10			mA
Max Sink Current at max VOL	VDD = 0.9 V	IOL09	4			mA
	VDD >= 1.2 V	IOL12	10			mA
Input capacitance		CI			10	pF

**Table 6. General specifications**

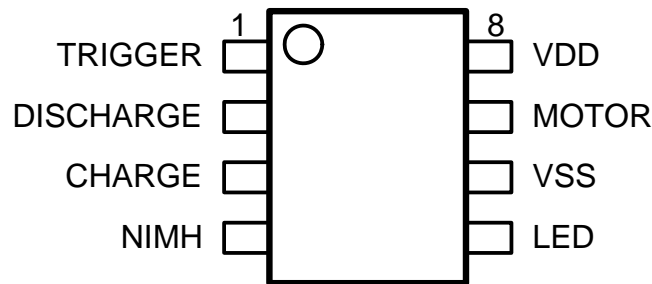
Parameter		Symbol	Min	Typ	Max	Unit
Startup time at power-on		tSTART		0.1		s
Threshold voltage high on TRIGGER		VTHIGH		0.66		VDD
Threshold voltage low on TRIGGER		VTLOW		0.33		VDD
NIMH pin switch voltage	Threshold	VNIMH		1.41		V
	Hysteresis			30		mV

### 3 Pinout

#### 3.1 SOIC-8 pinout

**Table 7. SX8122 pinout**

Pin	Pin name	Pin type	Pin function	Safe mode	Low Batt mode
1	TRIGGER	Analog input	Signal used to trigger the device	High impedance	High impedance
2	DISCHARGE	Output open collector to VSS	Used to discharge the capacitive load via a resistor	High impedance	VSS
3	CHARGE	Output open collector to VDD	Used to charge the capacitive load via a resistor	High impedance	Open source
4	NIMH	Digital output	Checks the battery status	High impedance	VDD
5	LED	Digital output	Sends bursts to light a LED when the MOTOR is on	High impedance	VSS
6	VSS	Power – ground	Negative supply and IC ground	-	-
7	MOTOR	Digital output	Motor control output	High impedance	VSS
8	VDD	Power – positive	Positive supply	-	-


*Figure 1. SX8122 pinout*

## TECHNICAL DESCRIPTION

### 4 System architecture

#### 4.1 SX8122 architecture

The system is based on the cyclic acquisition of the TRIGGER and VDD voltages.

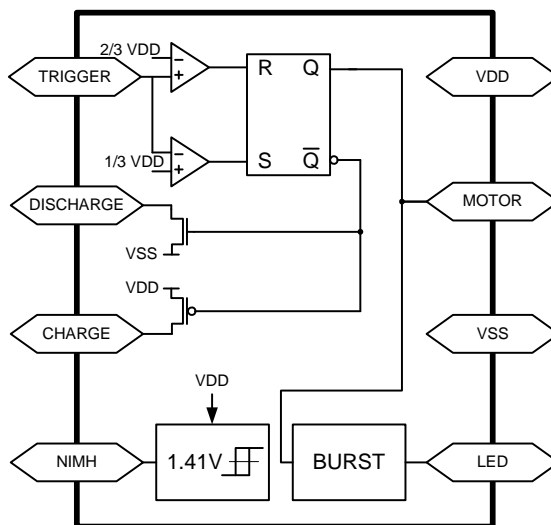


Figure 2. SX8122 Architecture

#### 4.2 SX8122 timer behavior

The SX8122 has an internal level detector that compares the TRIGGER voltage to the VDD voltage. When TRIGGER is above  $2/3$  of VDD, the comparator sets its output to high; when the TRIGGER is below  $1/3$  of VDD, the comparator sets its output to low. As long as the TRIGGER voltage is between  $1/3$  VDD and  $2/3$  VDD, the comparator output remains unchanged.

### 4.3 Active modes

The circuit has 4 modes of operation when on:

1. Force Charge: pin CHARGE is connected to pin VDD, pin DISCHARGE is in open drain.
2. Continue Charge: pin CHARGE is connected to pin VDD, pin DISCHARGE is in open drain.
3. Force Discharge: pin DISCHARGE is connected to pin VSS, pin CHARGE is in open source.
4. Continue Discharge: pin DISCHARGE is connected to pin VSS, pin CHARGE is in open source.

When TRIGGER voltage is below 1/3 of VDD, then the circuit is in Force Charge mode (1).

When TRIGGER voltage is above 2/3 of VDD, then the circuit is in Force Discharge mode (3).

When TRIGGER voltage is between 1/3 of VDD and 2/3 of VDD, the circuit goes into mode 2 or 4 depending on which mode it was previously.

The acquisition cycle is continuous and has a cycle frequency of ~5 kHz.

### 4.4 NiMH pin

Pin NIMH goes high when VDD is below the NiMH threshold of 1.41V and low when VDD is above the same threshold.

A 30mV hysteresis allow to remove NiMH pin oscillation when the VDD voltage is near the threshold.

The supply voltage on VDD pin is checked at a 1Hz rate, so the NiMH pin can switch with a delay of 1 seconds max.



## 5 Operating Modes

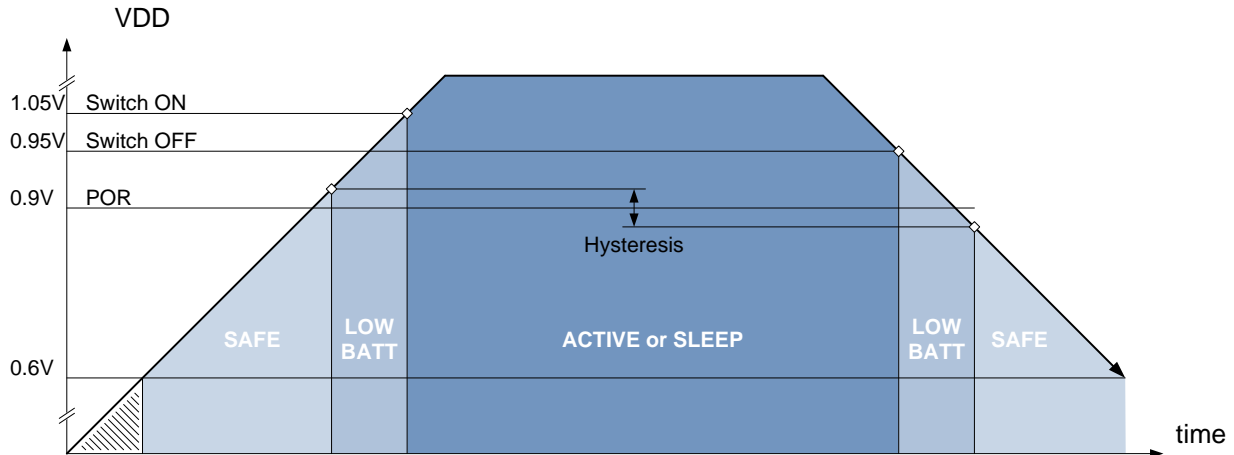


Figure 3. Operating modes vs battery voltage <sup>1</sup>

1. Typical values.

### 5.1 Safe Mode

The internal system goes in Safe mode as soon as the battery voltage is above 0.6-0.7V. In this mode all pins are set in high impedance and are inactive. This guarantees a safe start-up when a battery is inserted. The power consumption is 10uA max and prevents the battery from leaking when it is empty.

### 5.2 Low Batt mode

The device is in Low Batt mode as soon as the battery voltage reaches the 0.9V POR threshold. In this mode, each output pin is in a static state. The device will not react to the TRIGGER pin. The LED and MOTOR pins are set to ground.

The chip internally checks the VDD voltage each seconds and wakes up to Sleep mode when  $VDD > V_{ON}$  (1.05V typical). NIMH pin is forced high until the VDD voltage goes below 0.9V (back to Safe mode), or above 1.41V (battery full).

The pin configuration in Low Batt mode corresponds to the Force Discharge mode.

### 5.3 Active modes

The chip reacts to the TRIGGER pin voltage. See [4.3. Active modes](#).

- Force charge
- Continue charge
- Force discharge
- Continue discharge

NIMH pin is set according to VDD voltage. See [4.4. NiMH pin](#).

## APPLICATION EXAMPLES

### 6 Motor and LED timers

#### 6.1 Dual slope controlled oscillator

By connecting a capacitor between TRIGGER and VSS and resistors between pin TRIGGER and pins CHARGE and DISCHARGE, one builds an oscillator which ramp-down is controlled by  $R_{tdown} * C$  and ramp-up by  $R_{tup} * C$ .

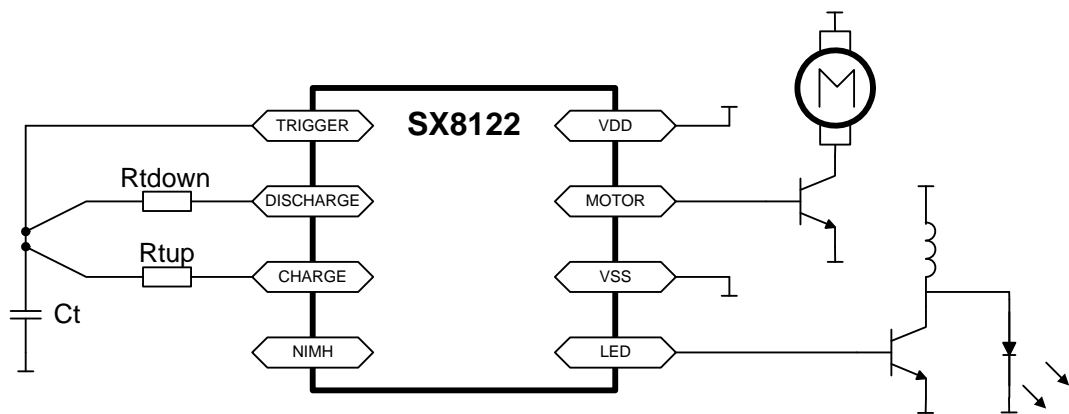


Figure 4. Oscillator controlled by two resistors - schematics

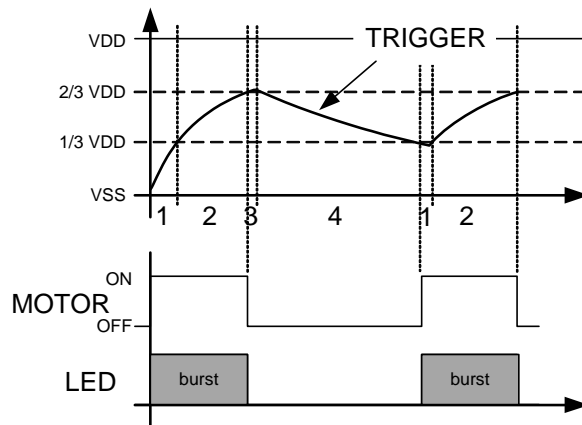


Figure 5. Oscillator controlled by two resistors - waveform

## 6.2 Single shot timer

The same schematics without the resistor between TRIGGER and DISCHARGE will make a single shot timer controlled by  $R_{tup} \cdot C$ .

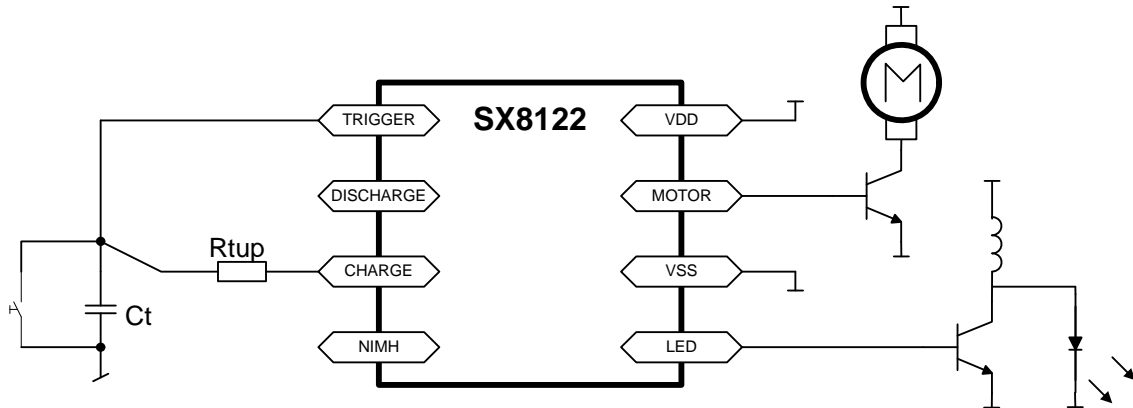


Figure 6. Oscillator controlled by two resistors - schematics

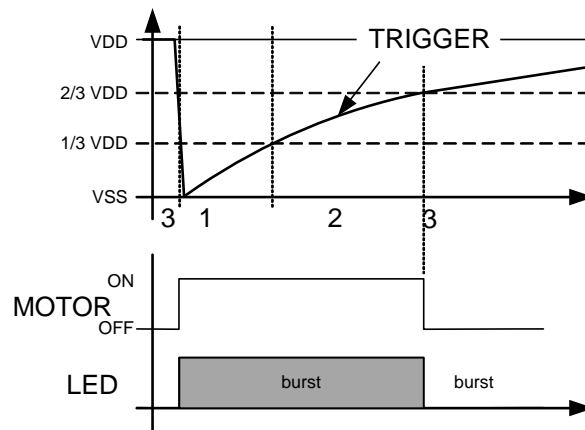


Figure 7. Oscillator controlled by two resistors - waveform

## 7 Power management

The internal system goes in a safe mode (IOs set as high impedance inputs) as long as the supply is below 0.6-0.7 V. It starts reacting to TRIGGER when the supply reaches 1.1 V and continues to operate until the supply goes back below 0.9V. When the supply goes below 0.9V, it goes back to safe mode. See **5. Operating Modes**.

Pin NIMH goes high when VDD is below the NiMH threshold of ~1.41V and low when VDD is above the same threshold. Pin NIMH low means that if the power is coming from one NiMH cell, this one is full.

### 7.1 Low bat indicator for alkaline cell

The SX8122 can be used to indicate low bat of an alkaline cell, even when the cell voltage is below the LED threshold voltage. It can either indicate it with a LED continuously on (simpler schematics, but is drains more current), or with a blinking LED.

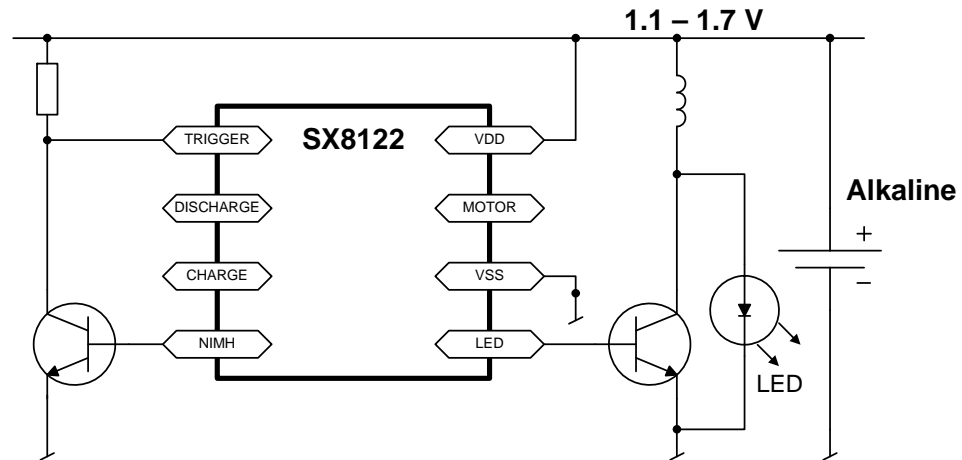


Figure 8. LED is continuously on when the supply voltage is below NiMH threshold

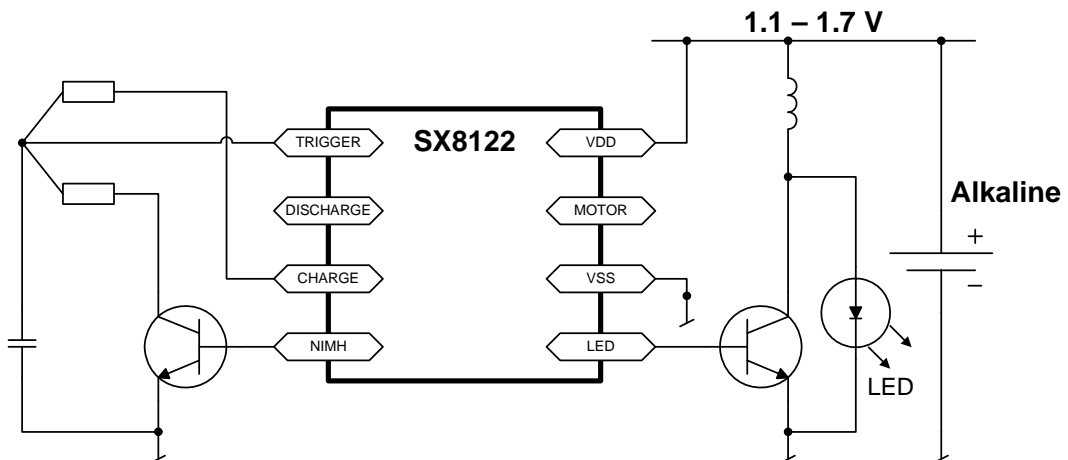
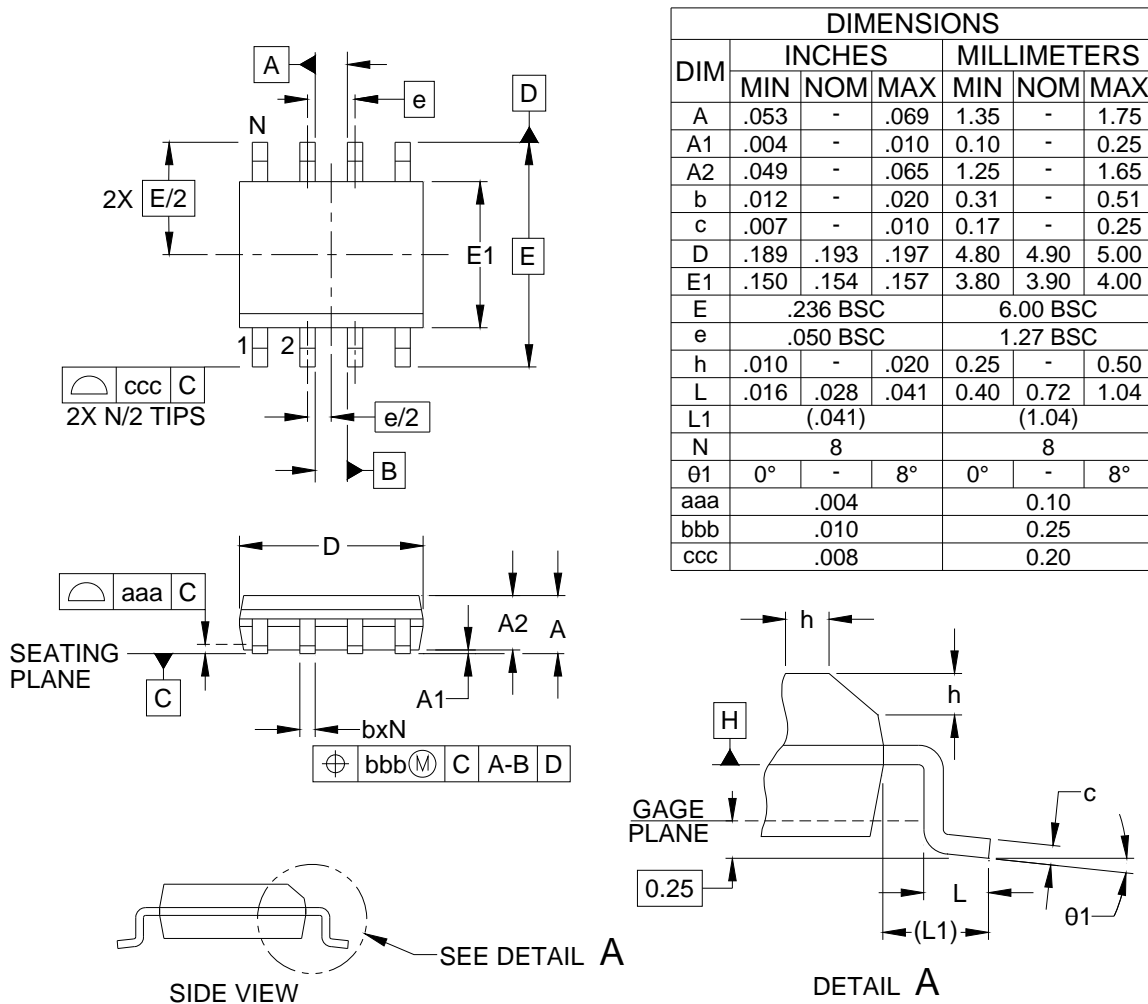


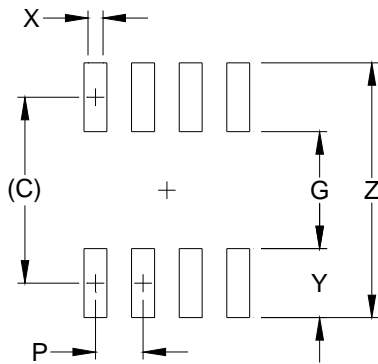
Figure 9. LED is blinking on when the supply voltage is below NiMH threshold

**MECHANICAL SPECIFICATION**
**8 Packages**
**8.1 SOIC-8**
**8.1.1 Outline drawing**

**NOTES:**

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DATUMS  $\square$ -A $\square$  AND  $\square$ -B $\square$  TO BE DETERMINED AT DATUM PLANE  $\square$ -H $\square$ .
3. DIMENSIONS "E1" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
4. REFERENCE JEDEC STD MS-012, VARIATION AA.

**8.1.2 Land pattern**

This land pattern is for reference purposes only. Consult your manufacturing group to ensure your company's manufacturing guidelines are met.



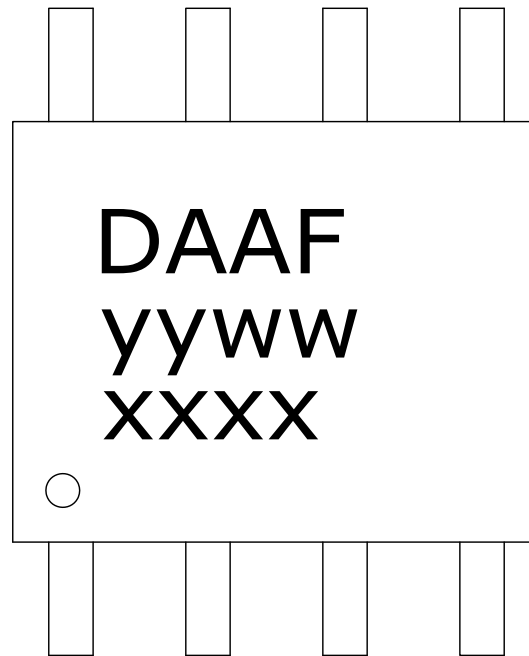
DIMENSIONS		
DIM	INCHES	MILLIMETERS
C	(.205)	(5.20)
G	.118	3.00
P	.050	1.27
X	.024	0.60
Y	.087	2.20
Z	.291	7.40

**NOTES:**

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.
2. REFERENCE IPC-SM-782A, RLP NO. 300A.

**8.1.3 Marking information**

## Top Mark



TOP MARK	
CHAR	ROWS
7/7/5	3

Marking for the SOIC 8 Lead package:

nnnn = Part Number (Example : DAAF)

yyww = Date Code (Example : 1012)

xxxx = Semtech Lot No. (Example : E9010)

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