

## Description

The SX8120/21 is a series of 1 V motor/LED control timers.

The SX8120/21 goes active on the press of a button. The output goes back to sleep on the next button press or after a preset time-out (15 sec or 30 sec on SX8120, 10 minutes or never on the SX8121). The time-out duration and the motor control polarity are pin-selected.

When the SX8120/21 is active, it sets its MOTOR control pin to high or low and sends a burst on its LED pin to control a LED or boost a command voltage.

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

The SX8120/21 controls its IO state starting at 0.6V to facilitate power-up.

## Features

- 1 V operation
- 1 button operation
- Pin selection of time-out
- Pin selection of motor polarity
- Boosted LED control (drives bright white and green LEDs)
- NiMH cell charger control (allows USB recharge)

## Applications

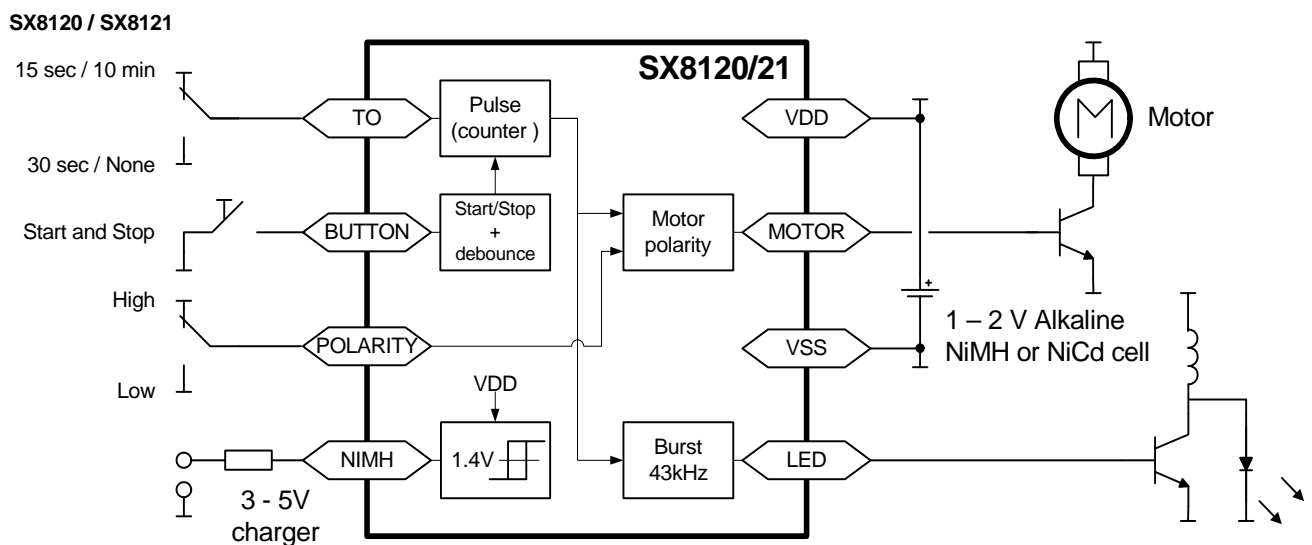
- Electric toothbrushes
- Electric razors
- Toys - LED animation
- LED pointer
- USB rechargeable

## Ordering Informations

Part number	Function	Time out
SX8120IISTR	1V motor controller	15 or 30 second
SX8121IISTR	1V motor controller	10 minute or none

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

## Functional Block 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**

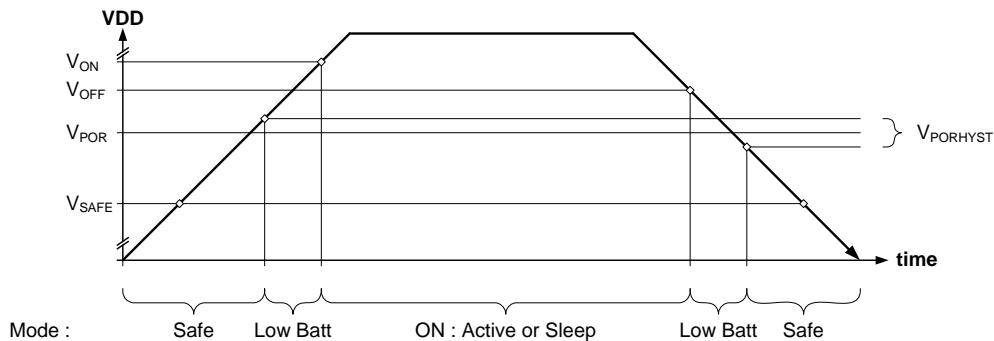
Parameter	Symbol	Min	Max	Unit
Supply Voltage Range	VDDOC	0.9	2.0	V
Full Spec Voltage Range	VDDSPEC	1.0	1.8	V
Ambient Temperature	TOC	-40	+85	°C

### 2.2 Circuit specification

**Note** Conditions: Temperature within TOC and  $V_{DD}-V_{SS}$  within VDDSPEC, unless otherwise stated.

**Table 3. Circuit electrical specification**

Parameter	Symbol	Min	Typ	Max	Unit	
Safe mode low limit	VSAFE		0.6	0.7	V	
POR voltage	Threshold	V <sub>POR</sub>	0.9		V	
	Hysteresis	V <sub>PORHYST</sub>	150		mV	
Switch ON level	V <sub>ON</sub>	0.95	1.07	1.15	V	
Switch OFF level	T : 0 to 70°C	V <sub>OFF</sub>	0.85	0.95	1.00	V
	T : -40 to 85°C	V <sub>OFF</sub>	0.85	0.95	1.05	V



**Table 4. Circuit power consumption specifications**

Parameter		Symbol	Min	Typ	Max	Unit
Supply current in Active mode (outputs no loaded, Motor pin on, LED pin bursting, counting)	VDD=1.2V	I <sub>ACTIVE</sub>		20		μA
	VDD=2.0V			30		μA
Supply current in Sleep mode (outputs no loaded, Motor pin off, LED pin tied to ground, not counting)	VDD=1.2V	I <sub>SLEEP</sub>		10	30	μA
	VDD=2.0V			15	40	μA
Supply current in Low Batt mode		I <sub>LOWBATT</sub>		10	30	μA
Supply current in Safe mode		I <sub>SAFE</sub>			10	μA

**Table 5. Digital IOs specifications**

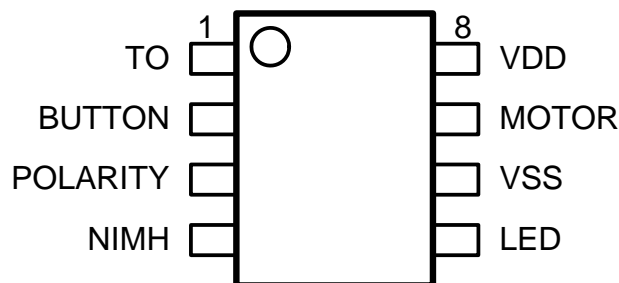
Parameter		Symbol	Min	Typ	Max	Unit
Startup time at power-on		t <sub>START</sub>		0.1		s
NIMH pin switch voltage	Threshold	V <sub>NIMH</sub>		1.41		V
	Hysteresis			30		mV
Output High Voltage		V <sub>OH</sub>	3/4 VDD		VDD	V
Output Low Voltage		V <sub>OL</sub>	VSS		1/4 VDD	V
Max Source Current at min V <sub>OH</sub>	VDD = 0.9 V	I <sub>OH09</sub>	4			mA
	VDD ≥ 1.2 V	I <sub>OH12</sub>	10			mA
Max Sink Current at max V <sub>OL</sub>	VDD = 0.9 V	I <sub>OL09</sub>	4			mA
	VDD ≥ 1.2 V	I <sub>OL12</sub>	10			mA
Input capacitance		C <sub>I</sub>			10	pF

### 3 Pinout

#### 3.1 SOIC-8 pinout

**Table 6. SX8120/21 pinout**

Pin number	Pin name	Pin type	Pin function	Safe mode
1	TO	Digital input	Connect to VDD or VSS to select timeout period	High impedance
2	BUTTON	Digital input	Switch to VSS to start/stop motor	High impedance
3	POLARITY	Digital input	- Connect to VDD for MOTOR pin high when on. - Connect to VSS for MOTOR pin low when on.	High impedance
4	NIMH	Digital output	Checks the battery status	High impedance
5	LED	Digital output	Sends bursts to light a LED when the MOTOR is on	High impedance
6	VSS	Power – ground	Negative supply and IC ground	-
7	MOTOR	Digital output	Motor control output (polarity is set by POLARITY)	High impedance
8	VDD	Power – positive	Positive supply	-


*Figure 1. SX8120/21 pinout*

**TECHNICAL DESCRIPTION**
**4 System architecture**
**4.1 SX8120/21 architecture**

The system is based on an integrated 5% precise counter. It starts and stops pulses based on the command of a button and times-out after a selectable period of time.

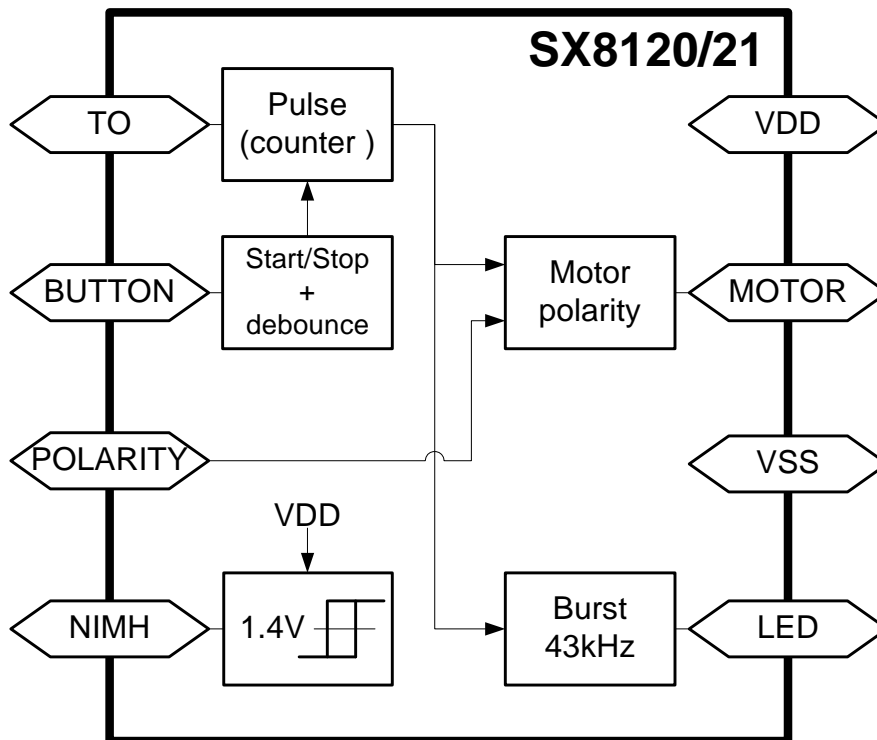


Figure 2. SX8120/21 Architecture









The MOTOR output polarity is controlled by the POLARITY input. If POLARITY is connected the VDD that the MOTOR will be active high, if POLARITY is connected the VSS, the MOTOR will be active low. MOTOR output is usually followed by an NPN transistor to drive the motor, in this case it is active high.

In parallel with the motor there is a LED output that sends 3 us pulses at 43 kHz that can be used to drive a white or green LED with an NPN transistor and a 40-200 uH coil.

## 4.2 SX8120/21 timing and output

The following settings are available on the SX8120/21.

**Table 7. SX8120/21 settings**

Part number	TO	Polarity	Active motor	Time out after
SX8120	VDD	VDD		15 seconds
		VSS		15 seconds
	VSS	VDD		30 seconds
		VSS		30 seconds
SX8121	VDD	VDD		10 minutes
		VSS		10 minutes
	VSS	VDD		never
		VSS		never

The timeout and polarity values are set at chip startup and at each start/stop command.



### 4.3 Digital input levels

Input thresholds levels scale with VDD. Inputs have an hysteresis based on a Schmitt trigger schematics.

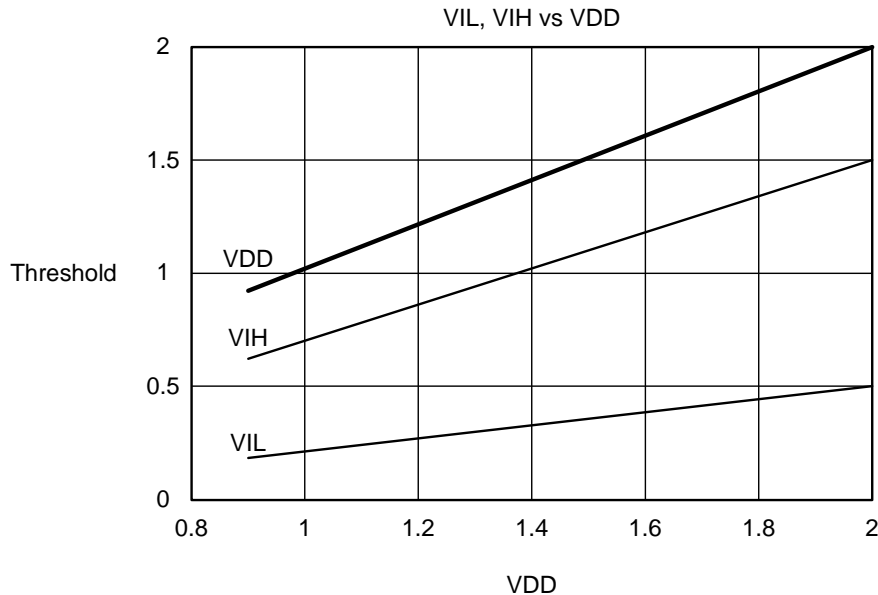


Figure 3. Input level scales with VDD

### 4.4 Debounce on BUTTON pin

The BUTTON pin is active low. For a start/stop command detection, the voltage on the BUTTON pin must be maintained low during 10ms. Then, a delay of 20ms is necessary before the next start/stop command.

This allow to remove wrong start/stop commands due to oscillations when using of low-cost push buttons.

### 4.5 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

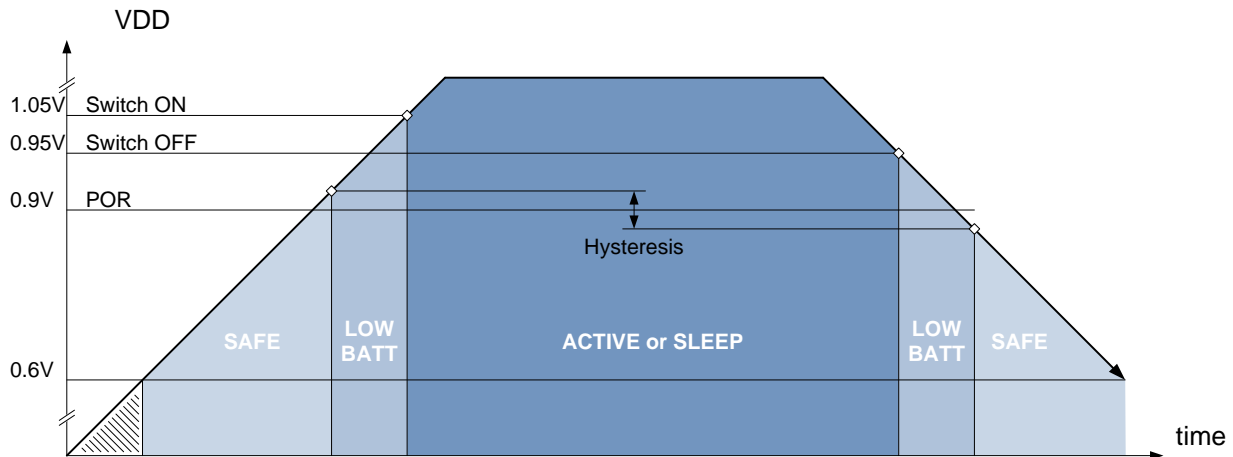


Figure 4. Operating modes vs battery voltage <sup>1</sup>

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 BUTTON pin. The LED pin is set to ground. The MOTOR pin is off according to POLARITY pin, meaning at VSS if POLARITY was set to '1' or at VDD if POLARITY was set to '0'. 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).

### 5.3 Sleep mode

The MOTOR pin is off according to POLARITY pin, meaning at VSS if POLARITY was set to '1' or at VDD if POLARITY was set to '0'. LED pin is tied to ground. The chip reacts to the BUTTON pin and if a low pulse occurs, the device switch to Active mode. NIMH pin is set according to VDD voltage (see [4.5. NiMH pin](#)).

### 5.4 Active Mode

The MOTOR pin is on according to the POLARITY pin, meaning at VDD if POLARITY was set to '0' or at VSS if POLARITY was set to '1'. The LED pin send 43kHz burst. The internal system is in Active mode until the timeout occurs or the button is pulsed again and then goes back to the Sleep mode. NIMH pin is set according to VDD voltage (see [4.5. NiMH pin](#)).

## APPLICATION EXAMPLES

### 6 Motor and LED timer

#### 6.1 Start/stop a motor with a 30 seconds time-out.

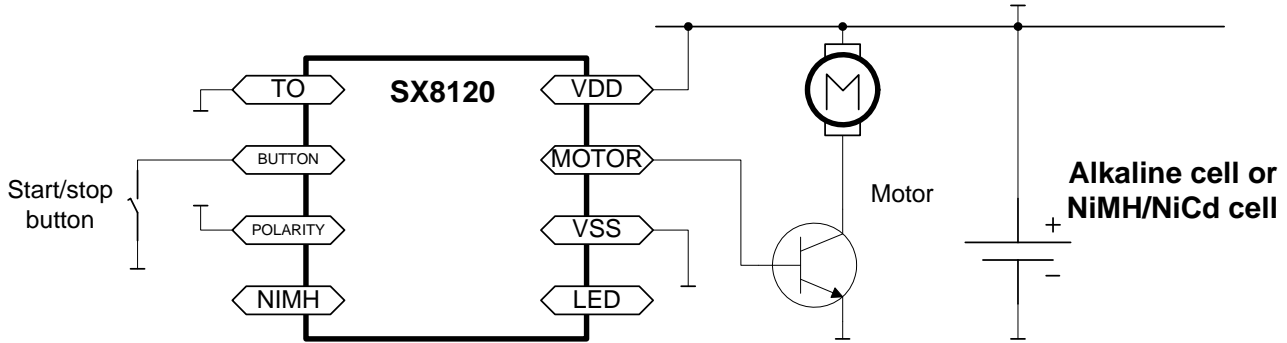


Figure 5. Pressing the button will start the motor for 30 seconds or until the button is pressed again.

#### 6.2 Start/stop a LED with a 15 seconds time-out

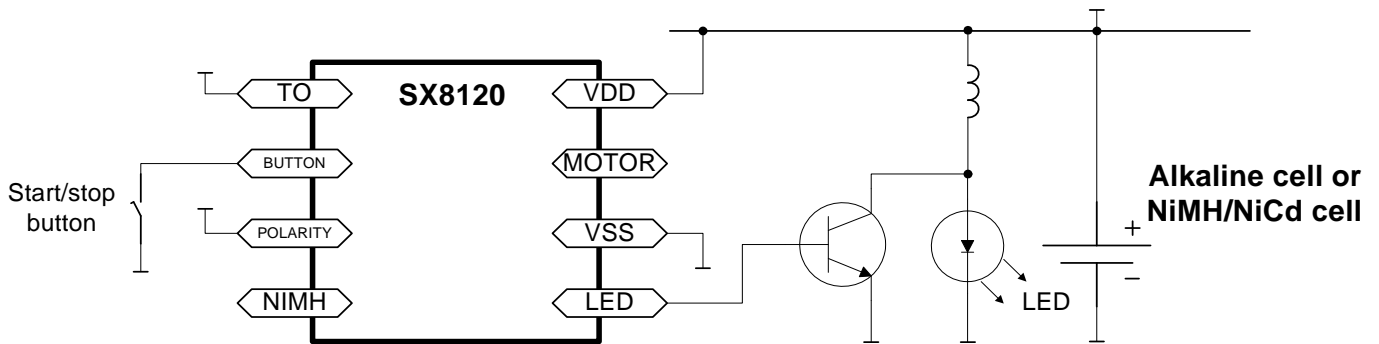


Figure 6. Pressing the button will light up the LED for 15 seconds or until the button is pressed again.

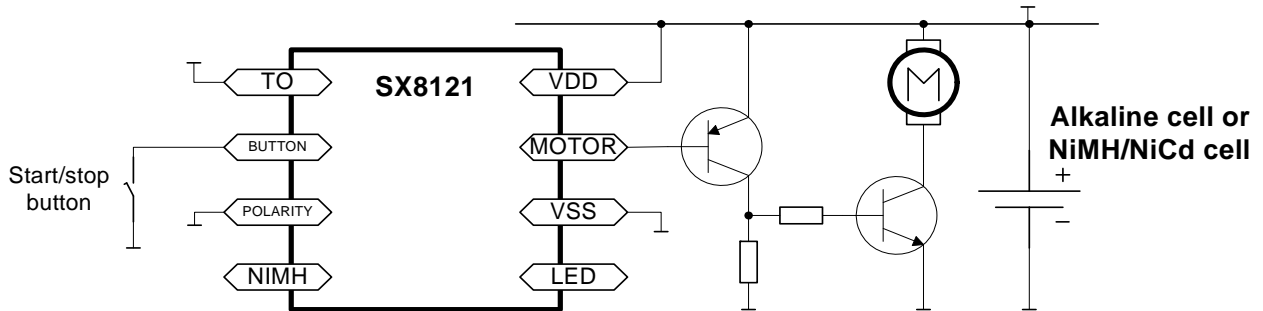
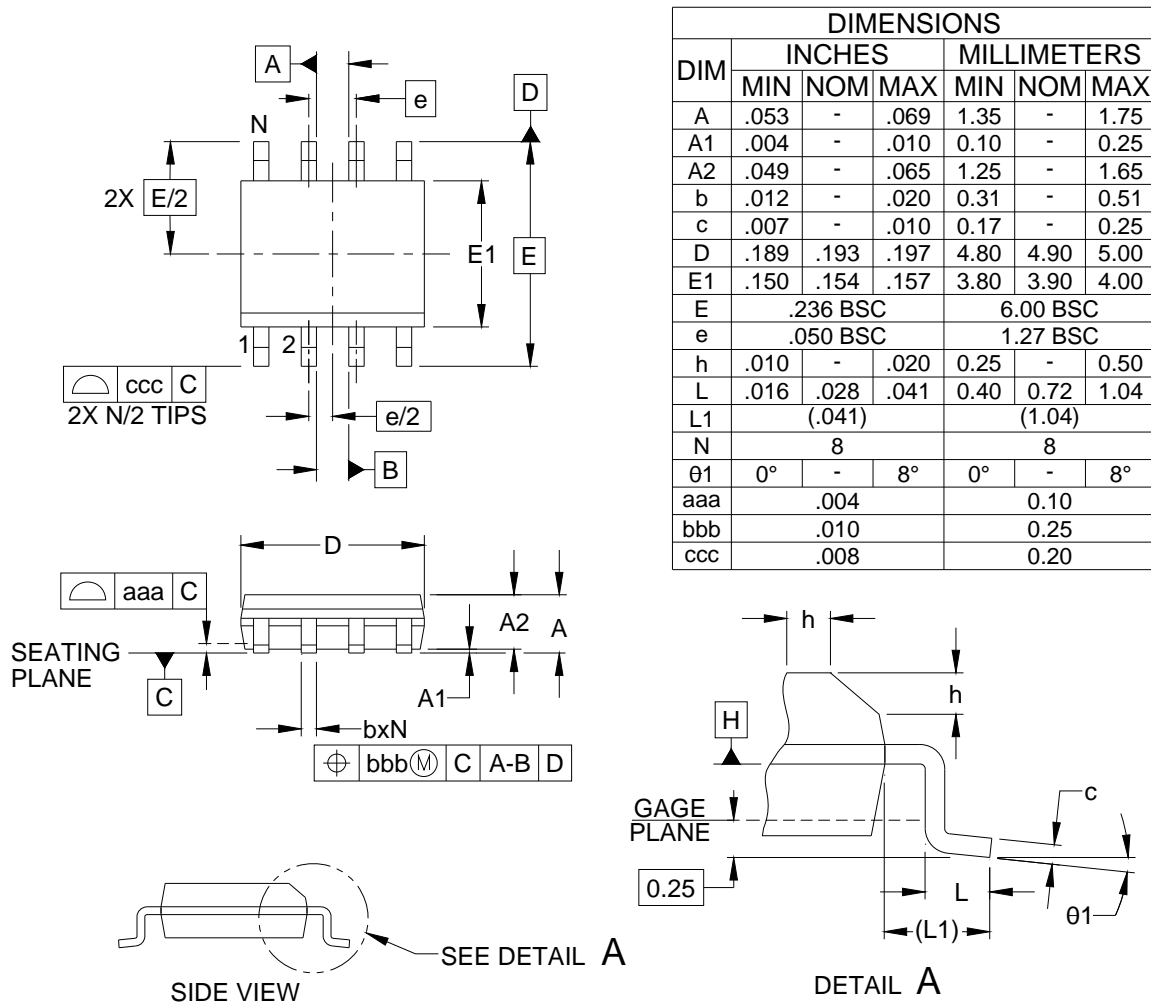
**6.3 Start/stop a high current motor with 10 minutes time-out**


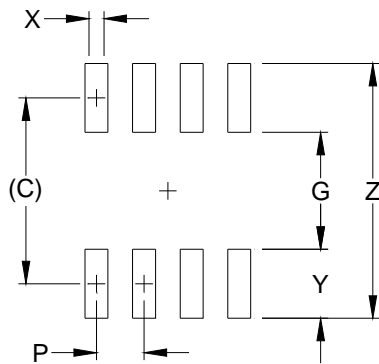
Figure 7. Pressing the button will start the motor for 10 minutes or until the button is pressed again.

**MECHANICAL SPECIFICATION**
**7 Packages**
**7.1 SOIC-8**
**7.1.1 Outline drawing**

**NOTES:**

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

**7.1.2 Land pattern**

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



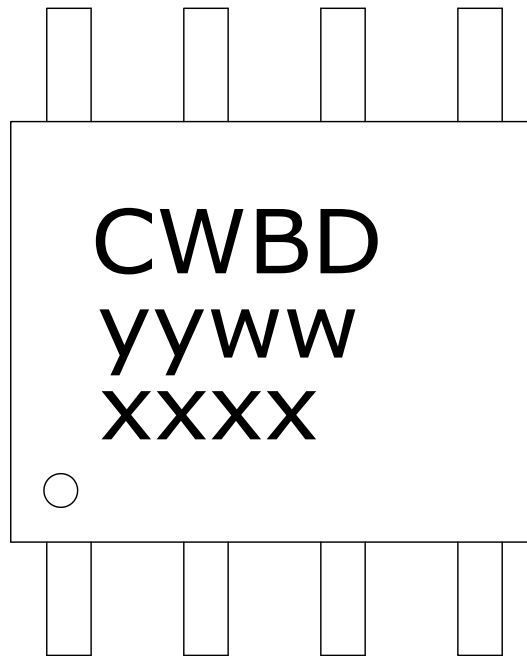
DIMENSIONS		
DIM	INCHES	MILLIMETERS
C	(.205)	(5.20)
G	.118	3.00
P	.050	1.27
X	.024	0.60
Y	.087	2.20
Z	.291	7.40

**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.

**7.1.3 SX8120 marking information**

## Top Mark



TOP MARK	
CHAR	ROWS
7/7/5	3

Marking for the SOIC 8 Lead package:

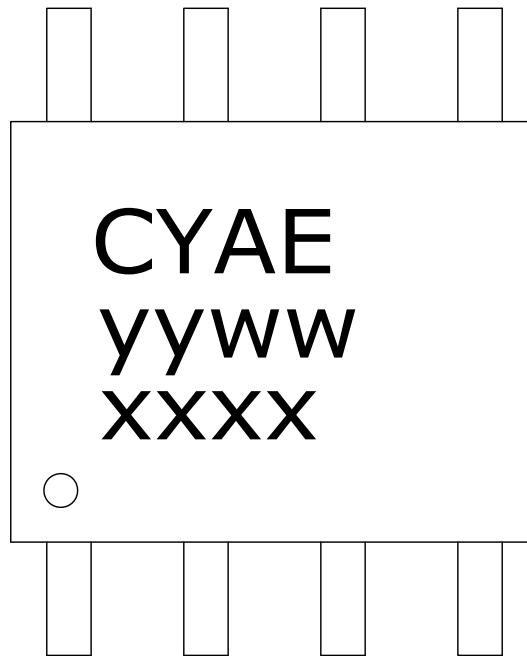
nnnn = Part Number (Example : CWBD)

yyww = Date Code (Example : 1012)

xxxx = Semtech Lot No. (Example : E9010)

**7.1.4 SX8121 marking information**

## Top Mark



TOP MARK	
CHAR	ROWS
7/7/5	3

Marking for the SOIC 8 Lead package:

nnnn = Part Number (Example : CYAE)

yyww = Date Code (Example : 1012)

xxxx = Semtech Lot No. (Example : E9010)



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