Description

The SX8124 is 24 hours timer with an analog programmable duty cycle that synchonizes on European standard (220V/50Hz) and US standard (110V/60Hz) mains for high timing precision without calibration or resonator.

The SX8124 starts counting time when connected to the mains, its internal counter can be reset on the press of a button (optional) or by setting the duration to zero. The SX8124 duty cycle is set using one single resistive divider. Its output can be forced on or off with the press of the optional button.

SX8124 outputs are complementary to simplify the connection of switches and an optional LED can confirm the timer status.

Features

- 24 hours timer synchronized on mains frequency
- Analog period setting
- Automatic 50 Hz and 60 Hz detection
- Simplest usage
- Manual on/off/reset option
- LED status option

Applications

- Mosquito repellent
- Odor killers
- Illuminated decoration
- Xmas animation

Ordering Information

Part number	Function	Package
SX8124ISTRT	24 hours timer	SOIC-8

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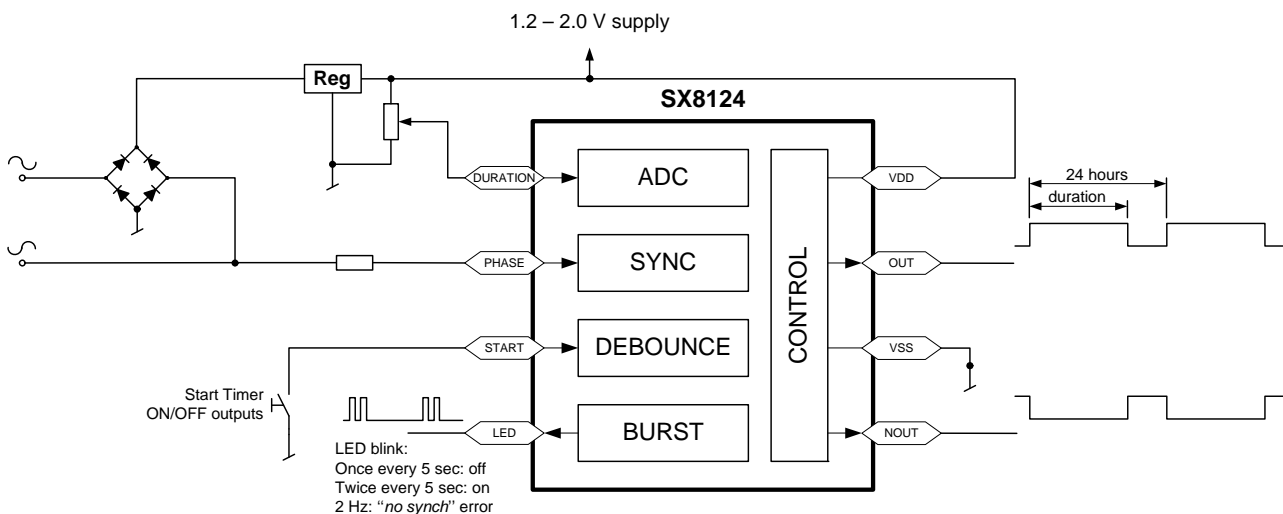
Functional Bloc Diagram

TABLE OF CONTENT

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		V_{AMRVDD}	-0.3	2.5	V
Pin Voltage (non-supply pins)		V_{AMRVIN}	VSS - 0.3	VDD + 0.3	V
Sink or source current on any pin		I_{AMRISS}	-100	100	mA
Storage Temp		T_{STOR}	-50	+150	°C
ESD conditions	HBM	ESD_{HBM}	4000		V
	CDM	ESD_{CDM}	1000		V
	MM	ESD_{MM}	200		V

2 Specifications

2.1 Operating Conditions

Note	Circuit operates within the Supply Voltage Range VDD-VSS = VDDOC. The specification is verified within the Full Spec Voltage Range VDD-VSS = VDDSPEC.

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 TOC and VDD-VSS within VDDSPEC, unless otherwise stated.

Table 3. Circuit electrical specification

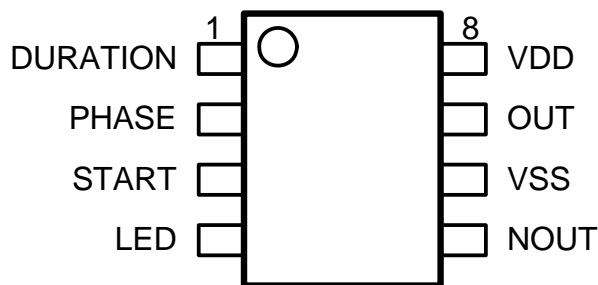| Parameter		Symbol	Min	Typ	Max	Unit
Safe mode low limit		V_{SAFE}		0.6	0.7	V
POR voltage	Threshold	V_{POR}		0.9		V
	Hysteresis	$V_{PORHYST}$		150		mV
Switch ON level		V_{ON}	0.95	1.05	1.15	V
Switch OFF level	T : 0 to 70°C	V_{OFF}	0.85	0.95	1.00	V
	T : -40 to 85°C		0.85	0.95	1.05	V

3.1 Digital input levels

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

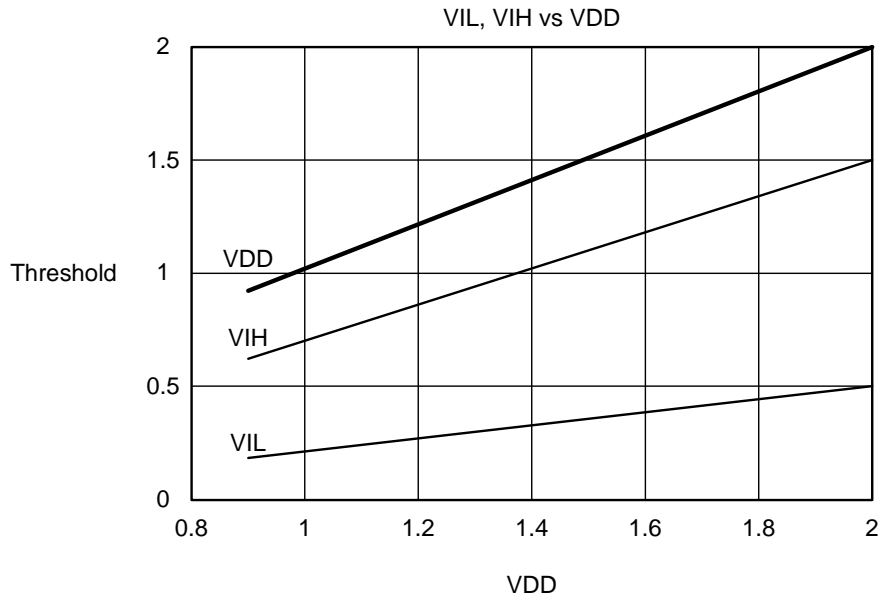*Figure 2. Input level scales with VDD*

3.2 Pin states

Table 8.   Pinout vs Power mode

| Pin#	Pin name	Pin type	Pin state		
			Safe mode	Low voltage mode	Active mode
1	DURATION	Analog input	High impedance	High impedance	High impedance
2	PHASE	Digital input	High impedance	High impedance	High impedance
3	START	Digital input	High impedance	pull up	pull up
4	LED	Digital output	High impedance	VSS	43kHz burst or VSS
5	NOUT	Digital output	High impedance	VSS	VSS or VDD
6	VSS	Power ground	Negative supply	Negative supply	Negative supply
7	OUT	Digital input	High impedance	VDD	VSS or VDD
8	VDD	Power positive	Positive supply	Positive supply	Positive supply

4   Power Modes
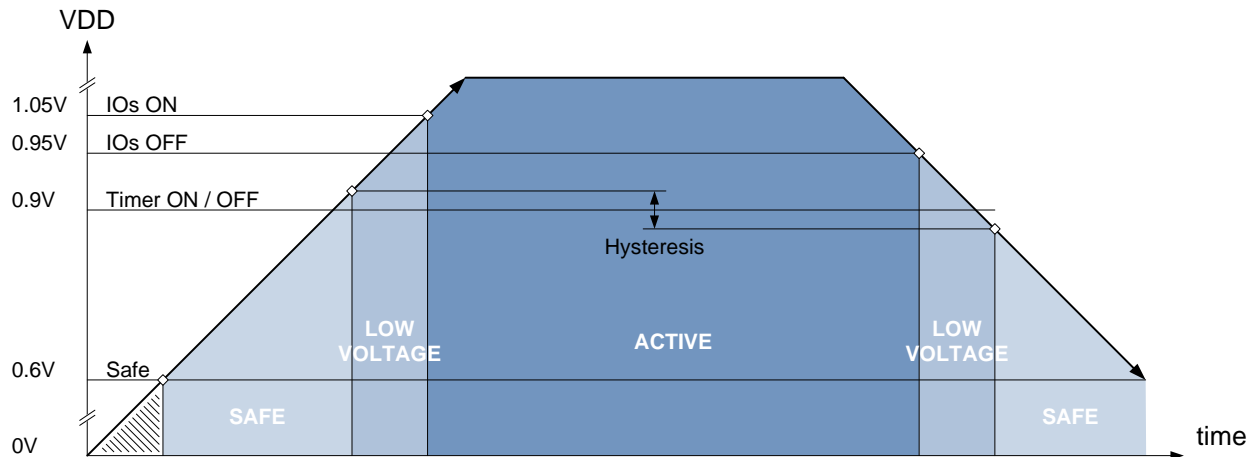
Figure 3. Operating modes vs VDD voltage

4.1   Safe mode

The internal system goes in Safe mode as soon as the VDD 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.

4.2   Low voltage mode

The internal 24h timer and phase detection/synchronization functions are active. All input (BUTTON, PHASE, DURATION) pins functionalities remains active but will not activate the outputs.

All outputs are forced to a default static state as follows:
- OUT pin is forced high
- NOUT pin is forced low
- LED pin is low

4.3   Active mode

The outputs are active and set according to the device internal states:
- OUT and NOUT pin active (see **"Operating" on page 10**)
- LED pin sending 250ms bursts (see **"LED output" on page 15**)

5   System architecture

The system is based on its internal timer to track frequency and to disciminate 50 Hz vs 60 Hz supply. If there is no input on PHASE pin, the system timing will use the internal oscillator (10% precise).
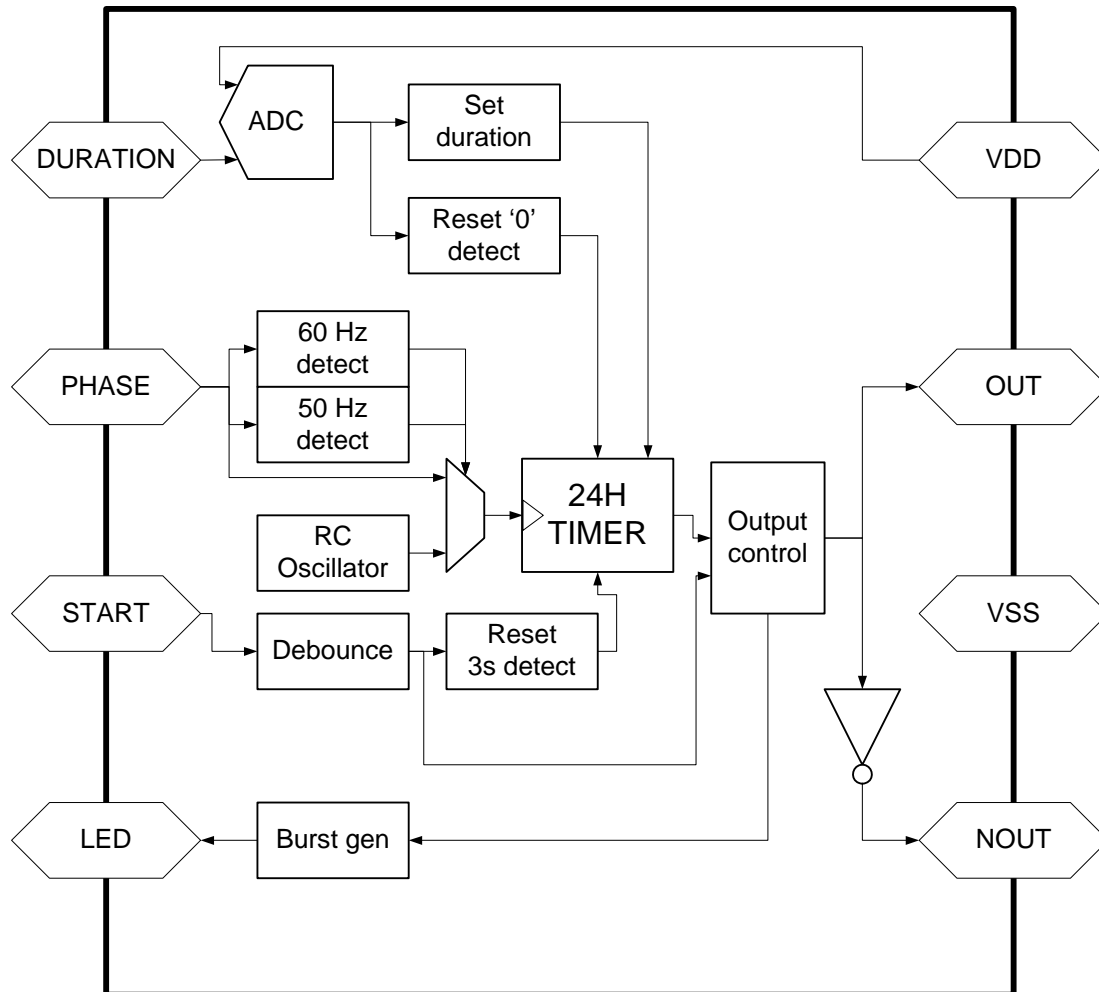

Figure 4. SX8124 Architecture

Once the system is locked on the mains phase, its time precision is given by the mains frequency precision. The period of the output signal on OUT and NOUT is 24 hours. The duty cycle on these pins is equal to the relative voltage on pin DURATION version the voltage on pin VDD. If DURATION is 1/3 of VDD, OUT will be high for 8 hours and down for 16 hours.

Remark that when the OUT state is manually modified using the START pin, this does not influence the internal counter: the OUT (and NOUT) pins will continue to be switched "on" at the end of the 24 hours cycle and "off" after the programmed duty cycle. The LED outputs is a signal indicating the internal chip status (see **10. LED output**).

6   24h Timer
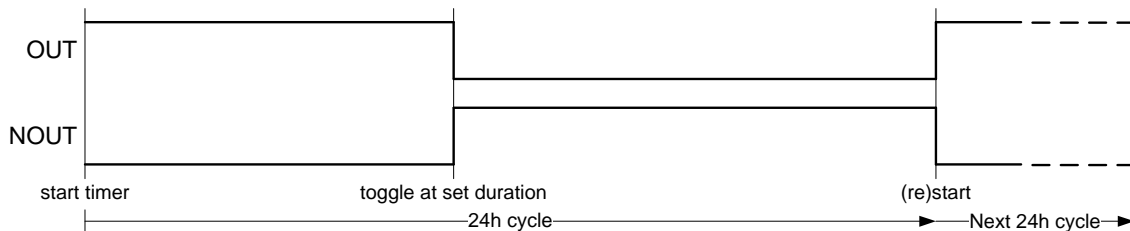
6.1   Operating

Figure 5. Outputs waveforms during the 24 h cycle

The pin START is used to change the OUT (and NOUT) state. A short pulse (below 1 second) on this pin manually changes the OUT and NOUT state (**Figure 6**). A long pulse (around 3 seconds or more) resets the system and restarts the synchronization of the chip on its PHASE input.
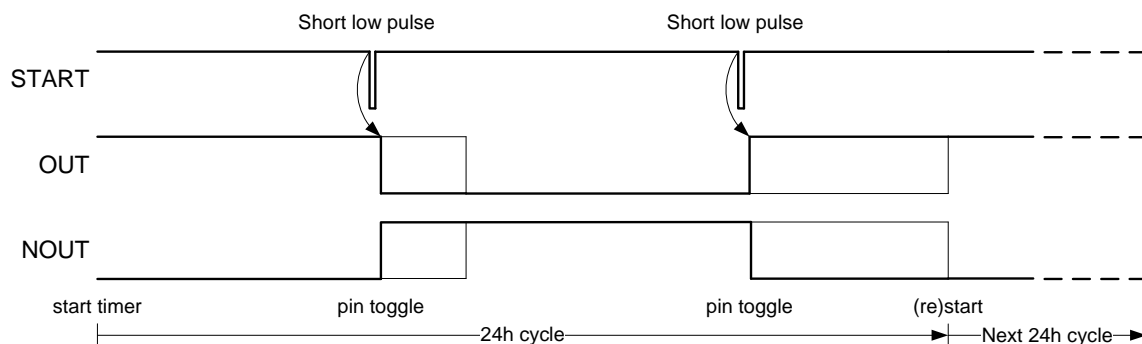

Figure 6. Outputs toggling pushing START pin down during less than 1 second

6.2   Debounce on START pin

The START pin is active low. For a start/stop command detection, the voltage on the START 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.

7   Setting duration

The measurement of DURATION pin voltage is ratiometric to VDD. The 24h duty cycle on OUT and NOUT pins is equal to the relative voltage on pin DURATION versus the voltage on pin VDD. For example if DURATION is 1/3 of VDD, OUT will be high for 8 hours and down for 16 hours.

The voltage resolution on the DURATION pin is 256, so the OUT and NOUT pin can toggle at each step of 24H / 256 = 5.625 minutes.
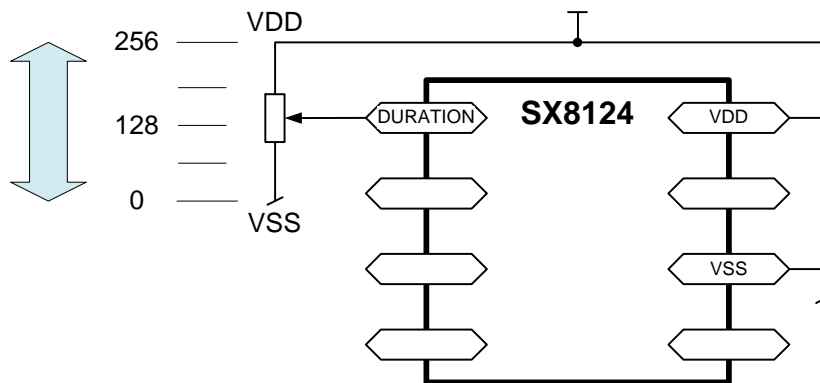

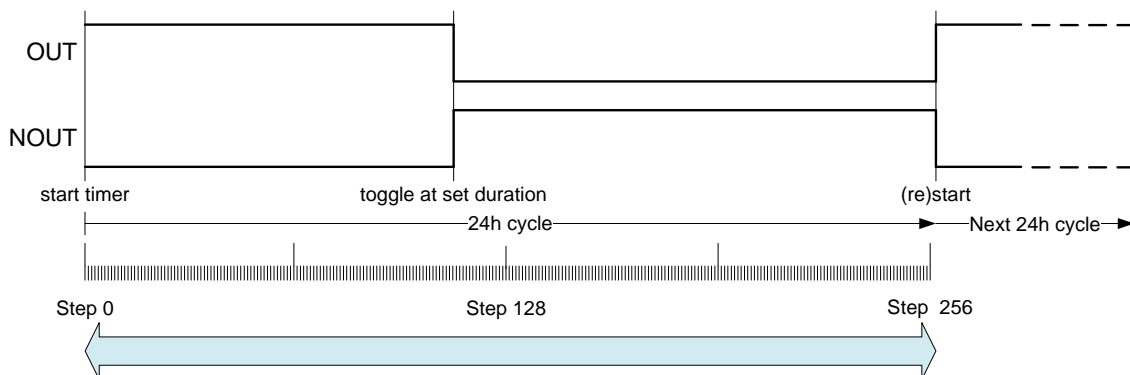*Figure 7. 256 steps resolution on DURATION pin*

Figure 8. 256 steps on the 24H timer cycle

Steps 0 to 2 on the DURATION pin are reserved for detection of a Reset command with the pin set to ground. The timer can not be set to toggle OUT and NOUT during the 15 first minutes after the start of the 24H cycle. See **"Reset with the DURATION pin" on page 14** .

While the duration is set to '0', the LED pin is not active and set to VSS.

8   Timer synchronization on a 50Hz or 60Hz external phase

To avoid timing drifts over the time, the SX8124 can be synchronised on a signal from the mains. The SX8124 permanently checks the duration between two consecutive edges on the PHASE pin.
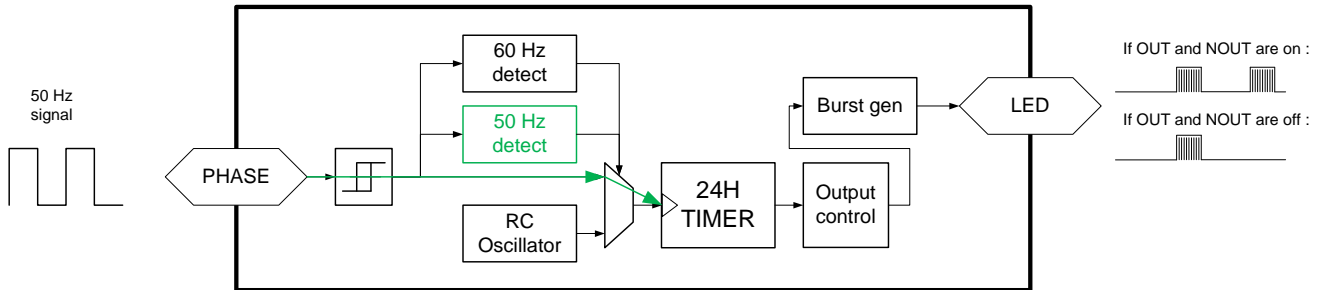
8.1   External phase available for synchronization

Figure 9. Example: timer synchronized on a 50Hz phase

Please note that for correct phase detection the edges on the PHASE pin must be sharp . A sinus or triangular wave is not recommended.

8.2   No phase available for synchronization

If there is no clean 50Hz or 60Hz signal on PHASE pin, the system timing switch on the internal RC oscillator. In this case the timer will be 10% precise. The LED output is sending 2Hz burst to indicate that the timer is not synchronized and counting based on the internal base time.
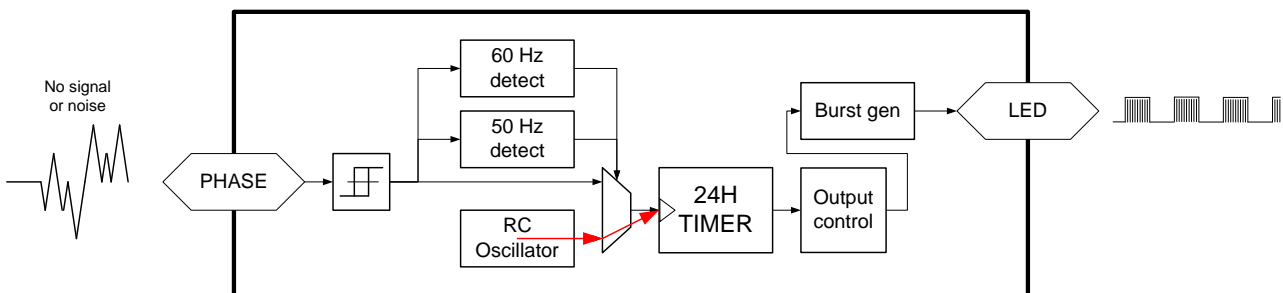
Figure 10. Timer not synchronized on an external phase

The maximum frequency on PHASE pin should not exceed 20kHz. If the signal on this pin has a frequency potentially higher than 20kHz it must be low pass filtered with a capacitor.

9   Timer reset

9.1   Reset with the START pin

A button can be connected between the BUTTON pin and VSS. Holding START down during 3 seconds or more resets the 24 hours timer and the system.

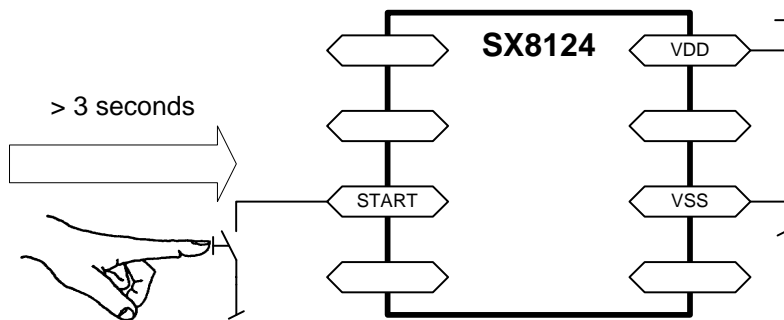Pressing shortly the button changes the output state without modifying the internal counter.
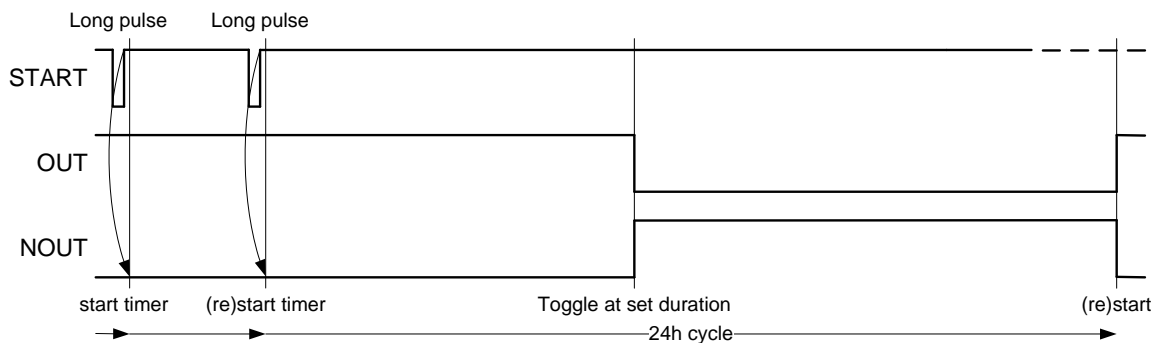

Figure 11. Timer reset with the START button

Figure 12. Manual reset holding START pin down during 3 seconds or more

9.2   Reset with the DURATION pin

Moving the DURATION voltage to 0V and then moving it back to the desired duration will reset the 24 hours timer. This can be done either with a switch in parallel with the DURATION resistive divider or if this divider is made with a potentiometer by turning this potentiometer to 0 leaving it there for a few seconds and then bring it back to the desired position.
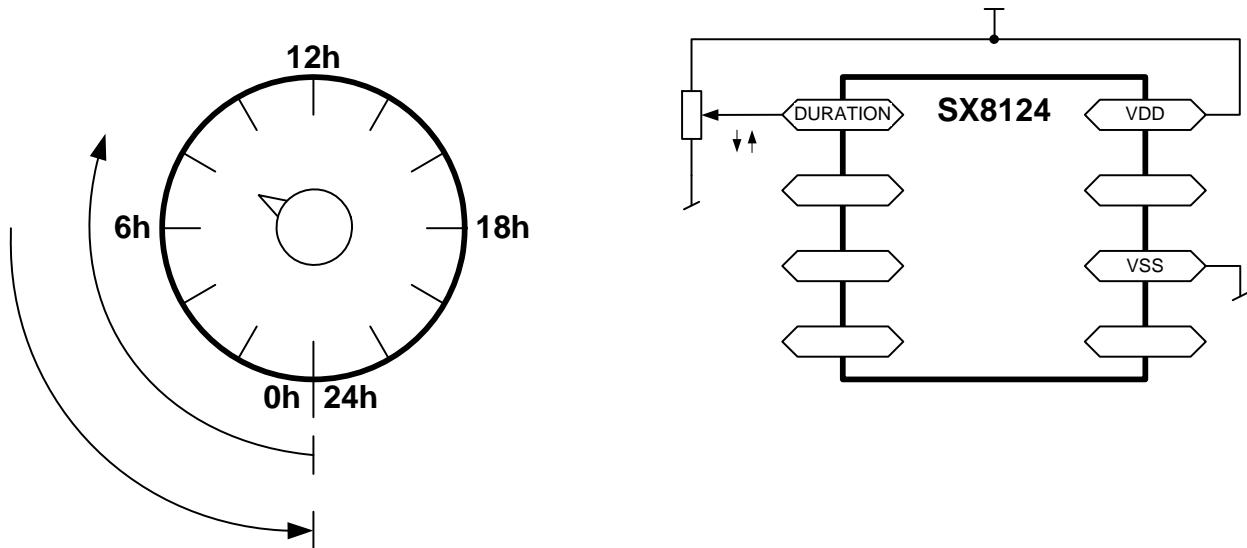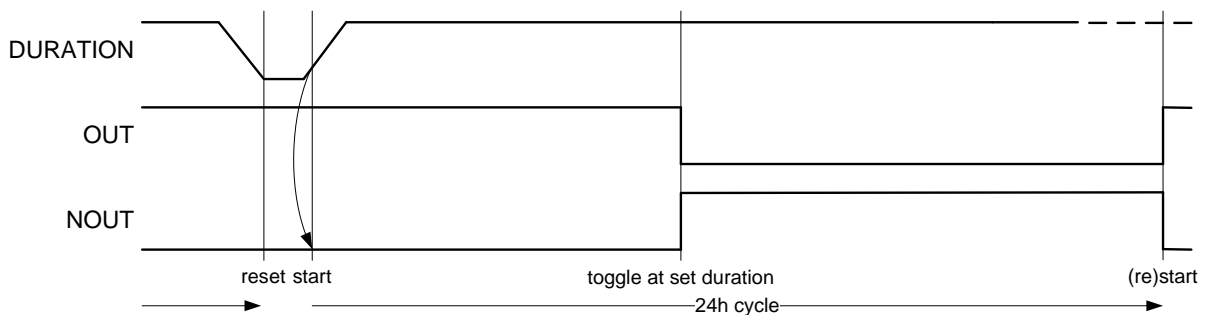

Figure 13. Timer reset by pushing DURATION pin to ground

Figure 14. Manual reset moving DURATION pin voltage down to 0V

The voltage on DURATION pin remains ratiometric to VDD while VDD is below 1.8V.

Additionally, if the voltage on DURATION pin exceeds |1.8V| the timer is reinitialized.

10.3   Not synchronized on phase
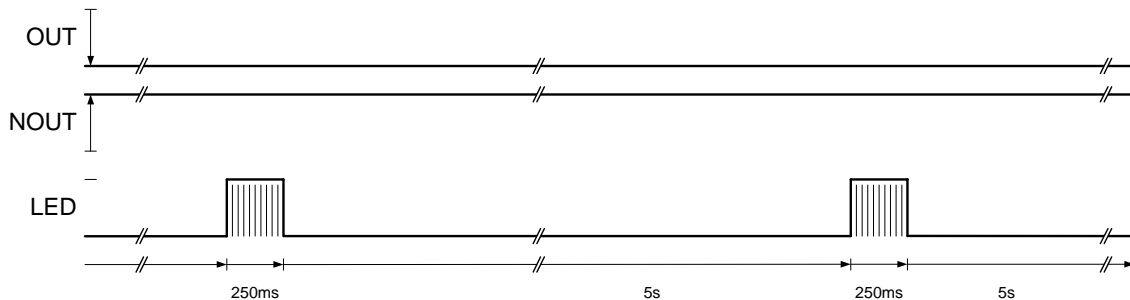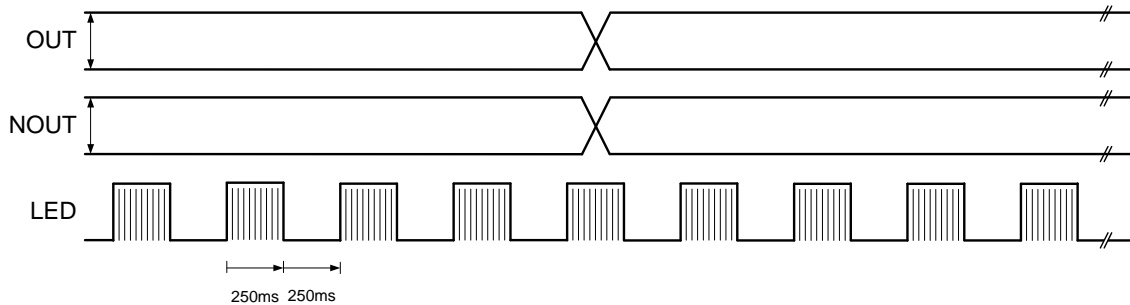

Figure 17. Continuous pulses

APPLICATION EXAMPLES
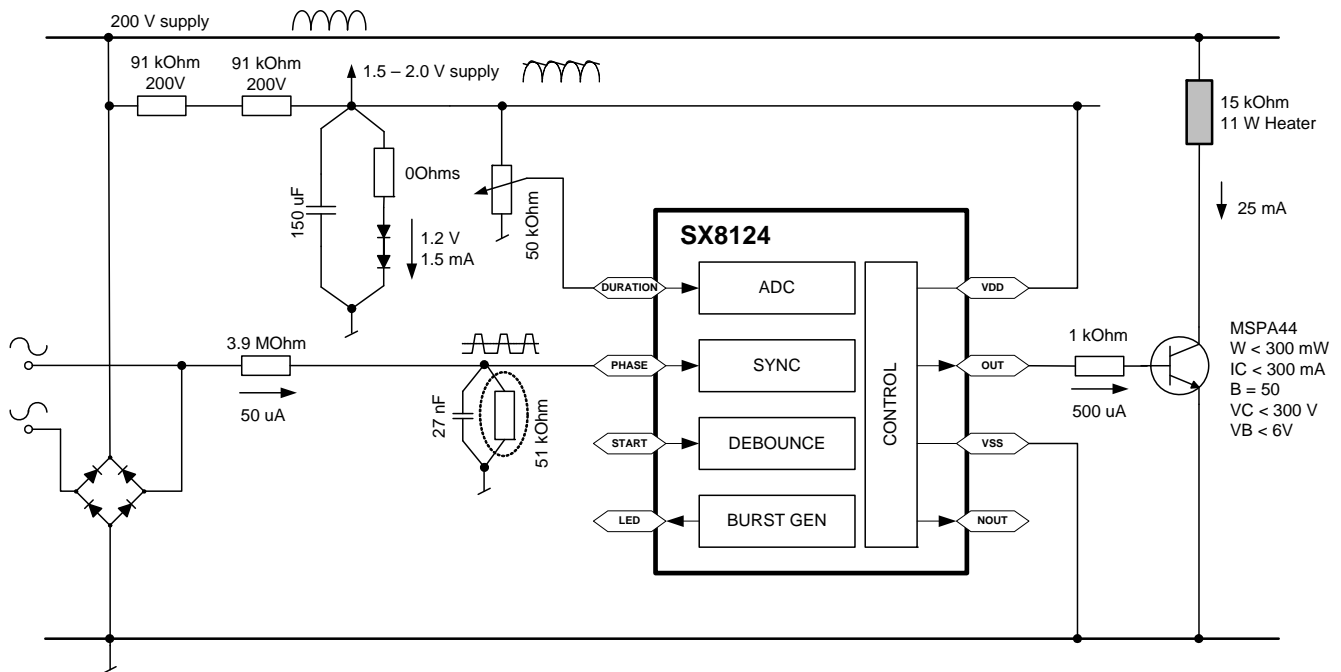
11 Complete application schematics

Figure 18. Application schematics with low-power sleep mode (below 0.3 W)

The circuit can be directly powered from the mains through a diode bridge and a resistor as long as the supply voltage is limited at ~1.2V by diodes or similar devices. The choice of the resistor that limits the supply current must be made so that it delivers enough current for the system to supply the IC and any other device that is connected to that supply, but the resistor must be large enough to limit the current in sleep mode (120 kOhm will limit power dissipation below 0.3W on a 220V network).

The RC filter on the power supply is there to reject 100 Hz or 120 Hz variations.

The phase detector is used to increase the precision on the 24 hours counter. It is recommended to protect the pin with external diodes. The filter on the phase detector is there to reject high frequency perturbations (several kHz) but must let the 50 Hz or 60 Hz go through with limited attenuation.

The timer element is a potentiometer. The total resitivity of the potentiometer must be low enough to avoid sensitivity to the DURATION pin impedance (> 500 kOhm) and high enough to limit current drift current. The voltage applied on the potentiometer is 1/100 of the voltage applied on the resistor that protects the supply voltage of the chip, therefore the current through these resistors will be in the same ratio if they have the same value.

The power element (either a resistove heater for a diffuser or a motor for a ventilator) will be controlled through an NPN transistor.

11.1   LED boosters

The chip sends bursts to trigger the LED. If the LED is supplied by the regulated voltage VDD it is expected to be connected to a transistor and in parallel with a coil to get enough voltage to light.
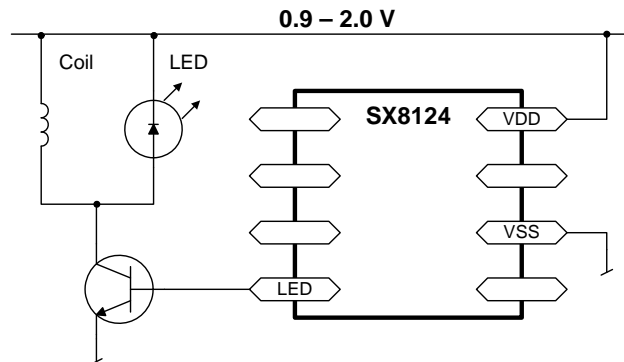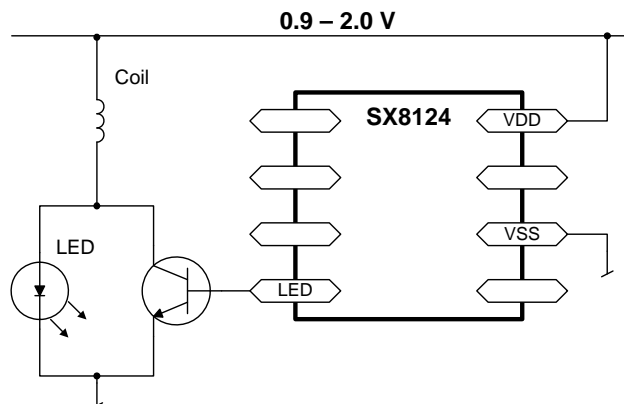

Figure 19. Booster for red LED

Figure 20. Booster for white/blue LED

11.2 Low cost LED output

The schematic on **Figure 21** below shows a LED driving without the usage of a coil to drive the LED, and also reduce the costs of the BOM. The Rlim, Rb resistors and the transistor hfe must be carefully choosed according to the LED and mains voltage.

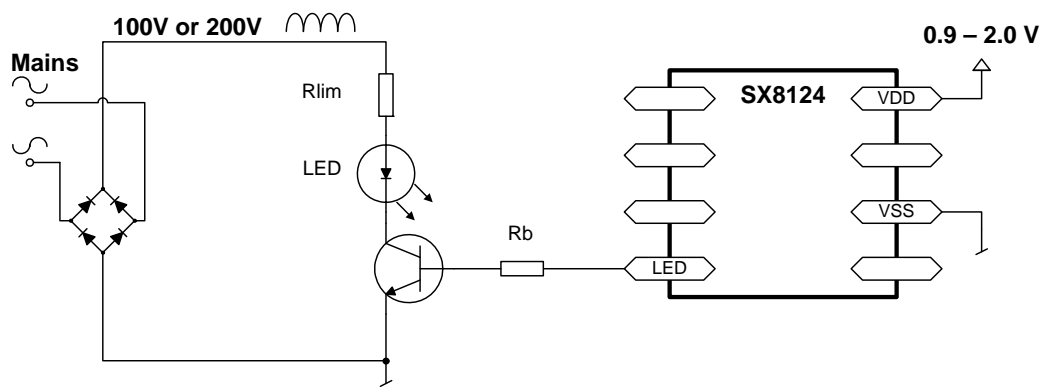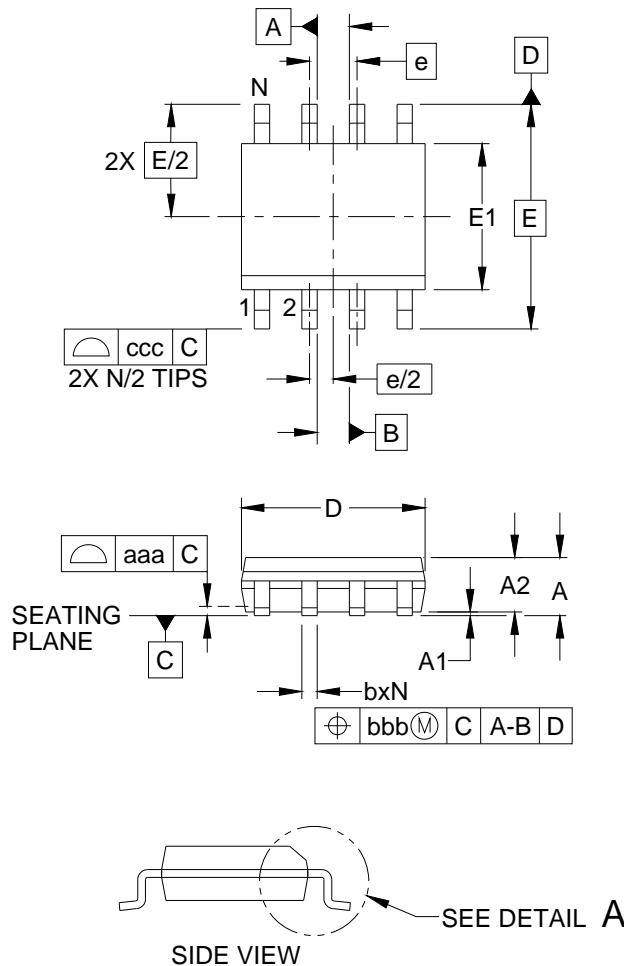*Figure 21. LED supplied by the mains*

MECHANICAL SPECIFICATION

12   Packages

12.1   SOIC-8

12.1.1 Outline drawing

DIM	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.053	-	.069	1.35	-	1.75
A1	.004	-	.010	0.10	-	0.25
A2	.049	-	.065	1.25	-	1.65
b	.012	-	.020	0.31	-	0.51
c	.007	-	.010	0.17	-	0.25
D	.189	.193	.197	4.80	4.90	5.00
E1	.150	.154	.157	3.80	3.90	4.00
E	.236 BSC			6.00 BSC		
e	.050 BSC			1.27 BSC		
h	.010	-	.020	0.25	-	0.50
L	.016	.028	.041	0.40	0.72	1.04
L1	(.041)			(1.04)		
N	8			8		
θ1	0°	-	8°	0°	-	8°
aaa	.004			0.10		
bbb	.010			0.25		
ccc	.008			0.20		

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.

12.1.2 Land pattern

This land pattern is for reference purposes only. Consult your manufacturing group to ensure your company's manufacturing guidelines are met.
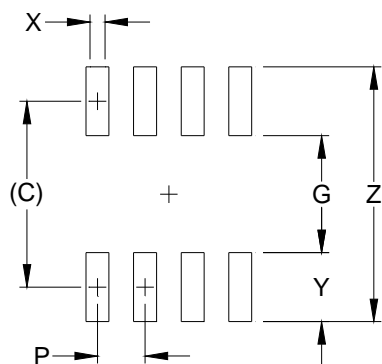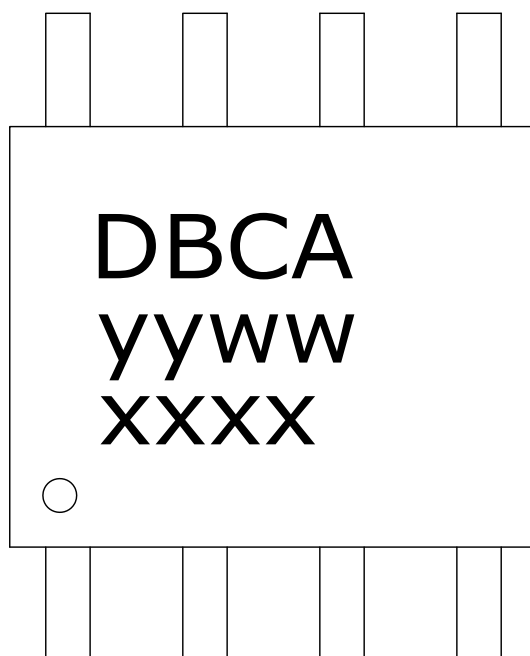
DIMENSIONS		
DIM	INCHES	MILLIMETERS
C	(.205)	(5.20)
G	.118	3.00
P	.050	1.27
X	.024	0.60
Y	.087	2.20
Z	.291	7.40

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.

12.1.3   Marking information

Top Mark

DBCA
yyww
xxxx

TOP MARK	
CHAR	ROWS
7/7/5	3

Marking for the SOIC 8 Lead package:

nnnn = Part Number (Example : DBCA)
yyww = Date Code (Example : 1012)
xxxx = Semtech Lot No. (Example : E9010)

Contact information

Semtech Corporation Advanced Communications & Sensing Products

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