



## Application Note: AS3935-AN09 – Keychain Reference Design

# AS3935

## AN09-Keychain Reference Design



## Table of Contents

1	General Description .....	3
2	Getting Started .....	3
3	Hardware Description.....	3
4	Sensor Settings.....	4
5	Detailed Description – Case Studies .....	5
5.1	No Lightning .....	5
5.2	Lightning at 20 km.....	5
5.3	Lightning Recedes .....	6
5.4	Disturbances .....	6
6	Operation Environment .....	6
7	Board Schematics, Layout and BOM.....	7
7.1	Schematic .....	7
7.2	Layout .....	8
7.3	Bill of Materials.....	9

## Revision History

Revision	Date	Owner	Description
1.0	24.01.2014	JRY	Initial Release

## 1 General Description

Fast moving storms with lightning pose a serious threat to personal safety when shelter is not nearby. Now, with the invention of the Franklin Lightning Sensor™ IC, truly portable lightning detectors can be the size of a wristwatch and operate for months with a coin cell battery.

In fact, the highly integrated AS3935 from ams can be easily integrated into existing products such as GPS, weather stations, fish finders and many other battery powered consumer electronic devices.

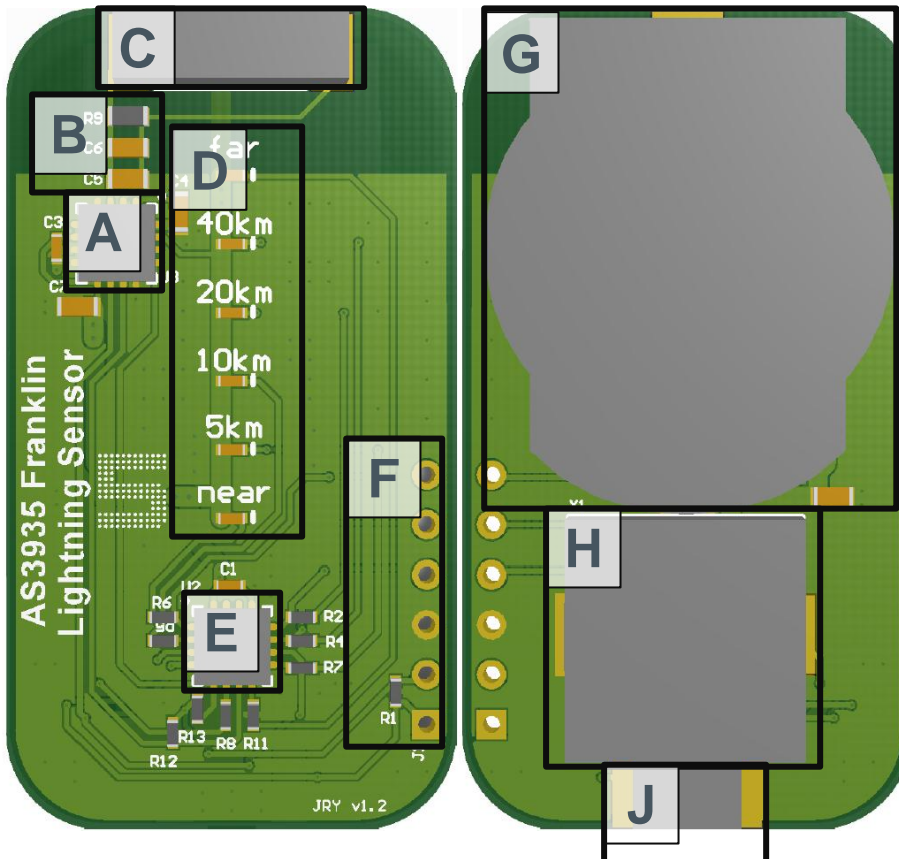
This application note contains instructions for proper operation of the Franklin Lightning Sensor™ demonstrator using certain scenarios as key examples

## 2 Getting Started

- Turn on the lightning detector by pressing the on/off button (J). The buzzer signals once and the indicator LEDs light up one after the other.
- Battery strength: the number of LEDs that light up indicates the amount of battery charge. The battery is empty only when the “near” LED lights up after turning on the device.
- The lightning detector is automatically switched to listening mode which is indicated by the “far” LED blinking continuously.
- Turn off the lightning detector by pressing the on/off button again (J).

## 3 Hardware Description

Figure 1: Hardware Description



Label	Designator	Description	Info
A	U3	AS3935	Franklin Lightning Sensor™
B	C5, C6, R9	Tuning Circuit	Tuning capacitors and Q adjustment resistor
C	ANT1	RFID Transponder Coil	
D	near ... far	Distance indicator LEDs	The current distance to the storm is indicated by the currently blinking LED
E	U2	Microcontroller	PIC16F616-I
F	J1	Programming Interface	
G	U1	Battery Holder	CR2032 coin cell
H	X1	Buzzer	Audible indication of detected lightning events
J	S1	On/Off switch	

## 4 Sensor Settings

The Keychain reference design does not offer the possibility to change the chip settings. Therefore, the device is set for an outdoor environment. Additionally, the minimum number of strikes feature is used to minimize the possibility of false alerts. All other settings which are not given in the table below are set to default as described in the AS3935 datasheet.

**Figure 2: AS3935 Keychain Settings**

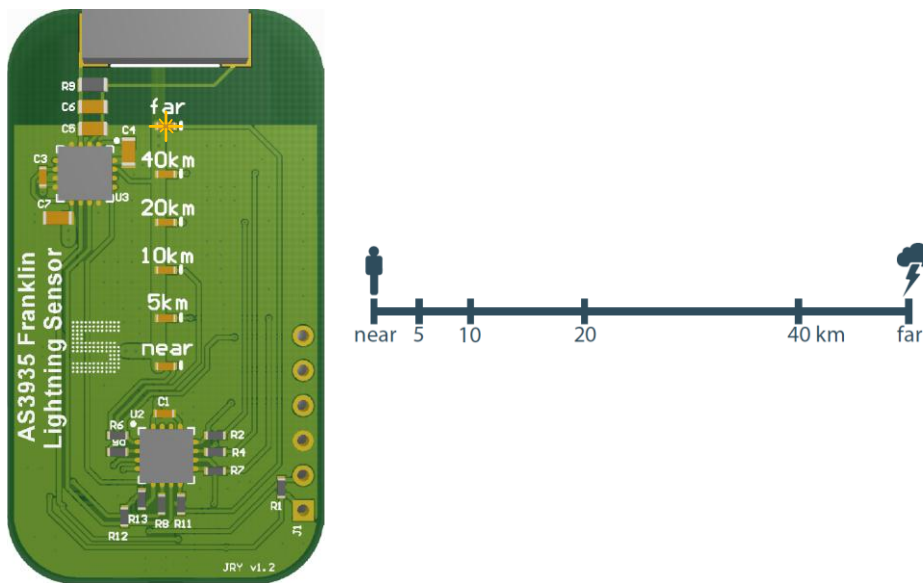
Register [hex]	Value [hex]	Description
0x00	0x1C	Gain = Outdoor
0x01	0x24	Noise Floor default, Watchdog threshold 4
0x02	0xD2	Minimum Number of lightning = 5
0x03	0xC0	Antenna frequency divided by 128 for start-up tuning

## 5 Detailed Description – Case Studies

### 5.1 No Lightning

The lightning detector is switched on and no lightning has been detected. The “far” LED blinks continuously indicating that there are no lightning storms within range.

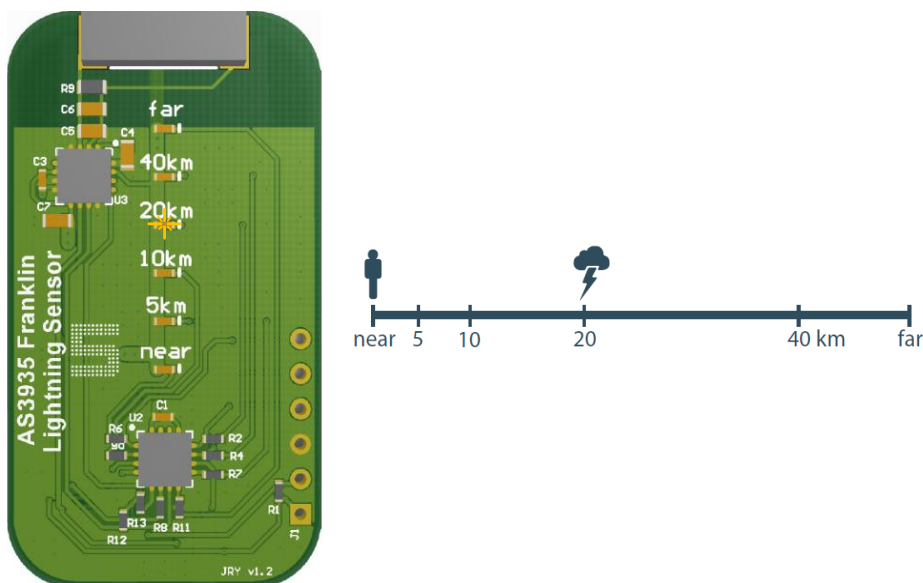
Figure 3: There is no lightning within reach



### 5.2 Lightning at 20 km

The buzzer signals once and all LEDs starting from “far” to “20 km” light up. Then the “20 km” LED will blink continuously indicating that the closest lightning detected was at distance of 20 km.

Figure 4: Lightning detected at 20 km



### 5.3 Lightning Recedes

As the lightning storm moves away, indicator lights will move towards “far”.

**Figure 5: Lightning storm is moving away**



### 5.4 Disturbances

The LED indicating the closest lightning detected blinks quickly several times. This means that signals coming from electronic devices such as mobile phones are being detected. Make sure that electronic devices that can produce interfering signals are not close to the detector.

**Figure 6: Non-lightning signals are being detected**



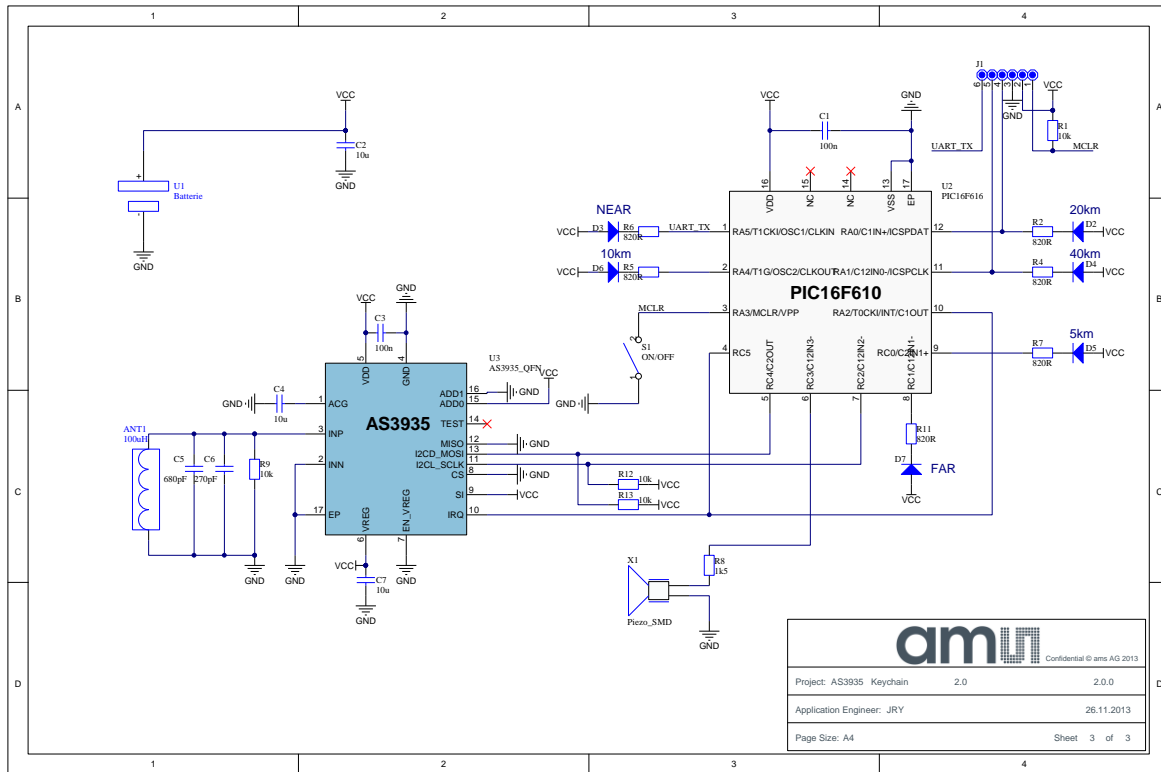
## 6 Operation Environment

Be advised that the lightning detector will not work properly when close to electronic devices such as computers or cell phones. The noise from such devices can prevent the lightning detector from detecting lightning signals. If this is the case, move the lightning detector away from electronic devices until the currently active indicator LED starts blinking with the normal blinking frequency.

## 7 Board Schematics, Layout and BOM

### 7.1 Schematic

Figure 7: AS3935 Franklin Lightning Sensor™ Keychain Reference Design Schematic



## 7.2 Layout

Figure 8: AS3935 Franklin Lightning Sensor™ Keychain Reference Design – Top Layer

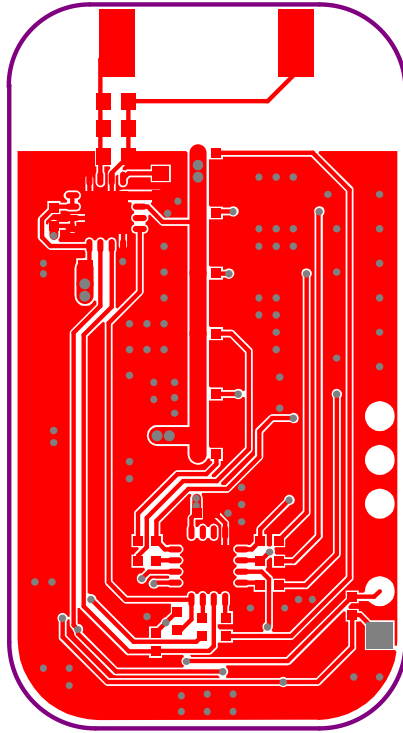
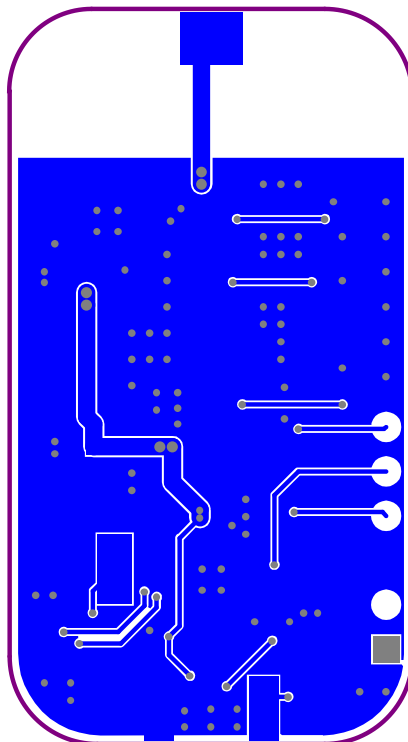


Figure 9: AS3935 Franklin Lightning Sensor™ Keychain Reference Design – Bottom Layer







### 7.3 Bill of Materials

Figure 10: AS3935 Franklin Lightning Sensor™ Keychain Reference Design BOM

Bill of Materials									
#	Designator	Comment	Component Description	Manufacturer 1	Manufacturer Part Number 1	Supplier 1	Supplier Part Number 1	Quantity	
Company: ams AG									
Application Engineer: JRY									
Product Number: AS3935									
ARS Project Name: Keychain									
Boardtype & Version: 2.0									
Release Date: 26.11.2013									
Revision: 2.0.0									
ANT1	100uH		RFID Transponder Coil	Coilcraft	MA5532-AE	Coilcraft	MA5532-AE	1	
C1, C3	100n		KEMET - C0402C104K4RACT1	KEMET	C0402C104K4RACTU	Farnell	1288252RL	2	
C2, C4, C7	10u		MURATA - GRM188R60G106M1	MURATA	GRM188R60G106ME47	Farnell	7806558	3	
C5	880pF		YAGEO (PHYCOMP) - CC060	YAGEO (PHYCOMP)	CC0603JRNPO96N681	Farnell	430897	1	
C6	270pF		KEMET - C0603C271J5GACT1	KEMET	C0603C271J5GACTU	Farnell	1414629RL	1	
D2	20km		LED 1X0.5MM 570NM GN WTI	Kingbright Company LLC	APHHS1005CGCK	Digi-Key	754-1104-2-ND	1	
D3	near		LED 1X0.5MM 630NM RD WTI	Kingbright Company LLC	APHHS1005SURCK	Digi-Key	754-1104-2-ND	1	
D4	40km		LED 1X0.5MM 570NM GN WTI	Kingbright Company LLC	APHHS1005CGCK	Digi-Key	754-1104-2-ND	1	
D5	5km		LED 1X0.5MM 630NM RD WTI	Kingbright Company LLC	APHHS1005SURCK	Digi-Key	754-1104-2-ND	1	
D6	10km		LED 1X0.5MM 630NM RD WTI	Kingbright Company LLC	APHHS1005SURCK	Digi-Key	754-1104-2-ND	1	
D7	far		LED 1X0.5MM 570NM GN WTI	Kingbright Company LLC	APHHS1005CGCK	Digi-Key	754-1104-2-ND	1	
U1	Programming Interface, not as Pin Header		TE CONNECTIVITY / AMP	TE CONNECTIVITY / AMP	S-146289-6	Farnell	2311671	1	
R1, R9, R12, R13	10k		TE CONNECTIVITY / NEOHM	TE CONNECTIVITY / NEOHM	CPF0402B10K1	Farnell	1697334	4	
R2, R4, R5, R6, R7, R11	820R		VISHAY DRALORIC - CRCW0	VISHAY DRALORIC	CRCW0402B20RFKED	Farnell	2121593	6	
R8	1k5		PANASONIC - ERA2AEB152X	PANASONIC	ERA2AEB152X	Farnell	1577711RL	1	
S1	ON/OFF		C & K COMPONENTS - KSS3 C & K COMPONENTS	C & K COMPONENTS	KSS331G LFS	Farnell	1201407	1	
U1	Battene		HARWIN - S8421-45R - HOLD	HARWIN	S8421-45R	Farnell	2115305	1	
U2	PK16F616		IC:MCU 8BIT 3.5KB FLASH 16	Microchip Technology	PIC16F616-JML	Digi-Key	PIC16F616-JML-ND	1	
U3	AS3935_OFN		IC SENSOR LIGHTNING MLK	ams	AS3935-BOFT	Digi-Key	AS3935-BOFTTR-ND	1	
X1	Piezo_SMD		MURATA - PKLCS1212E4001	MURATA	PKLCS1212E4001-R1	Farnell	1192551	1	
Approved by									
Notes									
32									

## Copyright

Copyright © 1997-2012, ams AG, Tobelbader Strasse 30, 8141 Unterpremstaetten, Austria-Europe. Trademarks Registered ®. All rights reserved. The material herein may not be reproduced, adapted, merged, translated, stored, or used without the prior written consent of the copyright owner.

All products and companies mentioned are trademarks or registered trademarks of their respective companies.

## Disclaimer

Devices sold by ams AG are covered by the warranty and patent indemnification provisions appearing in its Term of Sale. ams AG makes no warranty, express, statutory, implied, or by description regarding the information set forth herein or regarding the freedom of the described devices from patent infringement. ams AG reserves the right to change specifications and prices at any time and without notice. Therefore, prior to designing this product into a system, it is necessary to check with ams AG for current information.

This product is intended for use in normal commercial applications. Applications requiring extended temperature range, unusual environmental requirements, or high reliability applications, such as military, medical life-support or lifesustaining equipment are specifically not recommended without additional processing by ams AG for each application. For shipments of less than 100 parts the manufacturing flow might show deviations from the standard production flow, such as test flow or test location.

The information furnished here by ams AG is believed to be correct and accurate. However, ams AG shall not be liable to recipient or any third party for any damages, including but not limited to personal injury, property damage, loss of profits, loss of use, interruption of business or indirect, special, incidental or consequential damages, of any kind, in connection with or arising out of the furnishing, performance or use of the technical data herein. No obligation or liability to recipient or any third party shall arise or flow out of ams AG rendering of technical or other services.

***Note: This product is intended to be used as an early warning indicator for lightning related storms. It does not guarantee accuracy or predict exact strike locations. By using the part, the user shall be aware that he cannot just rely on the indication in order to prevent accidents caused by lightning strikes. ams expressly states that the user must follow the generally known and recommended instructions how to behave in the event of lightning strikes. In no event shall ams or its suppliers be liable for any direct, indirect, incidental, special, exemplary or consequential damages (including, but not limited to procurement of substitute goods or services, loss of use, data or profits, or business interruption) arising out of user's disregarding of such warnings and instructions.***