AND9321/D

AX-SIGFOX: Sigfox® Compliant Reference Design

ON Semiconductor®

APPLICATION NOTE

INTRODUCTION

About Sigfox

In the Internet of Things, the domain of nationwide coverage and ultra−low power consumption for smallest amounts of data cannot be addressed by established standards such as GPRS or LTE. This void is now filled by Sigfox, the ultra−low power cellular connectivity solution. It combines a low cost and simple approach together with ultra−low power consumption (see examples of battery life in the AX−Sigfox datasheet).

About the Chips

This application note describes the ON Semiconductor SIGFOX reference design. The ON Semiconductor SIGFOX chip is available in two versions: AX−SFEU and AX−SFEU−API. The chips add Sigfox functionality for up−link and down−link to any existing system at the cost of 20×13 mm^2 PCB area. They can also be used as single chip solutions that control small sensor nodes. The AX−SFEU

device is fully programmed for immediate operation as a Sigfox node, while the AX−SFEU chip addresses applications where the user wants to add additional software or wants control over the whole MCU.

AX−SFEU

AX−SFEU is delivered fully ready and contains all the necessary firmware to transmit and receive data from the SIGFOX network. It connects to the customer product using a logic level RS232 UART. AT Commands are used to send frames and configure radio parameters. The commands adhere to SIGFOX AT Command Specification 0.7 (PRS−UNBT_AT_CMD).
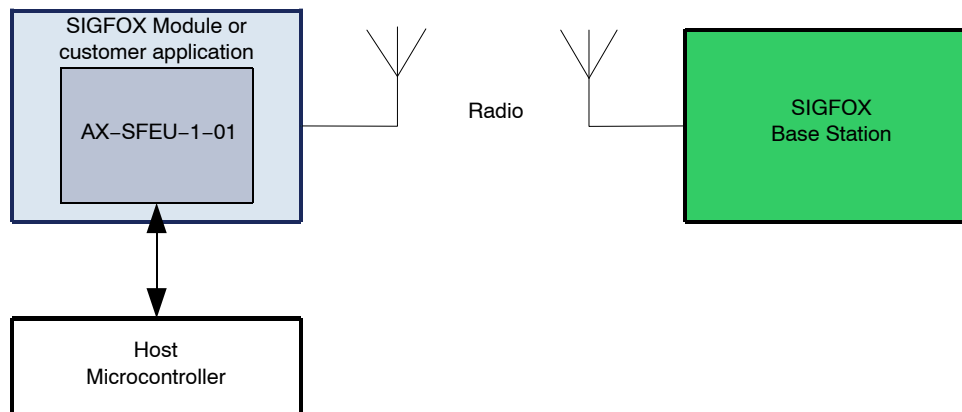

Figure 1.

AX−SFEU is already SIGFOX ready certified for end products. If the reference design and BOM are followed exactly, no other certification from SIGFOX is required. EN300220 compliance checking is required.

AX−SFEU−API

AX−SFEU−API is not delivered with any firmware. The Sigfox protocol library needs to be purchased. This version is ideal for customers who do not want another microcontroller in their product, but instead want to

implement product functionality on the AX−SFEU−API chip. AX−SFEU−API is SIGFOX ready certified for end products. If the reference design, BOM and AX−SFEU documentation are followed exactly, no other certification from SIGFOX is required. EN300220 compliance checking is required.

The API of the library corresponds to the SIGFOX API.

On guidance or help on how to setup and program the chip, please refer to the AX−Sigfox Software Manual.

REFERENCE DESIGN

Eagle and Gerber files of the reference design as well as PDF−files of both the schematic and the layout are part of this application note. A list of the components for the reference design is also provided. With this information, it is possible to recreate the reference design.

The layout is 20 mm × 13 mm. The antenna output is on the left side of the board. A 50 Ω antenna with a center frequency of 869 MHz must be connected.

The connection to the host microcontroller and the power supply is located on the right side of the board. The module must be supplied with a DC voltage in the range of 1.8 V to 3.6 V as specified in the datasheet. A peak current of 50 mA during transmit at maximum power must be provided.

Several test points for additional signals are available in the reference design. The chip supports up to 4 status LEDs for radio activity, CPU activity, transmit and receive. LEDs must be connected to ground via a series resistor (around 220 Ohm). There are also 10 GPIO signals that can be queried and set using AT commands. Please refer to the AX−Sigfox Datasheet for the pin table.

COMMAND INTERFACE

Serial Parameters: 9600, 8, N, 1

The module uses UART0 to communicate with a host and uses a bitrate of 9600 baud, no parity, 8 data bits and one stop bit.

Power Modes

To conserve power, the module can be put into sleep or turned off completely.

Sleep

Use the command AT$P=1 to put the module into sleep. In this mode, only the wakeup timer of out−of−band messages is still running. To wake up the module again, toggle the serial RX pin, e.g. by sending a break.

We recommend using sleep mode when you don't need the module. This means: Wake the module up when a message needs to be sent and after transmission, send it back to sleep. If the module remains in standby (0.5 mA) optimal overall power consumption cannot be achieved.

Deep Sleep

In Deep Sleep, the module is completely turned off and only draws negligible leakage current. Deep Sleep can be activated with the command AT$P=2. Pull GPIO9 to ground to wake up the module again.

When using this state, please keep in mind that:
- Everything is turned off, timers are not running are all and all settings will be lost (They can be saved to flash however with the command AT$WR). Out−of−band messages will therefore not be sent.
- The pins are frozen in deep sleep and will output 1 or 0 constantly. Ensure that this will not result in a condition of the application which would draw a lot of current. External pull−ups or −downs can also consume power.

AT COMMANDS

Numeric Syntax

```
hexdigit   ::= [0−9A−Fa−f]
hexnum     ::= "0x" hexdigit+
decnum     ::= "0" | [1−9] [0−9]*
octnum     ::= "0" [0−7]+
binnum     ::= "0b" [01]+
bit        ::= [01]
optnum     ::= "−1"
frame      ::= (hexdigit hexdigit)+
uint       ::= hexnum | decnum | octnum | binnum
uint_opt   ::= uint | optnum
```

Command Syntax

A command starts with 'AT' (everything is case sensitive!), continues with the actual command followed by parameters (if any) and ends with any kind of whitespace (space, tab, newline etc.)

If incorrect syntax is detected ("parsing error") all input is ignored up until the next whitespace character.

Also note that any number can be entered in any format (Hexadecimal, Decimal, Octal and Binary) by adding the corresponding prefix ('0x', '0', '0b'). The only exception is the 'Send Frame' command (AT$SF) which expects a list of hexadecimal digits without any prefix. For a complete list of available AT Commands and possible examples, please refer to the AX−Sigfox Datasheet.

Return Codes

A successful command execution is indicated by sending 'OK'. If a command returns a value (e.g. by querying a register) only the value is returned.

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