

User Guide for the Evaluation Kit ATA8520-EK1-F and the ATA8520-EK3-F Extension Board (US Version)

DRAFT APPLICATION NOTE

Features

- User guide for the evaluation kit ATA8520-EK1-F and extension board ATA8520-EK3-F (for the US market)
- This kit demonstrates a Flash application with the
 - ATA8520-EK1-F evaluation kit:
with the Atmel® SIGFOX™ ATA8520E V2.3 transceiver device and an Atmel ATmega328P AVR® microcontroller with AT30TS75A temperature sensor as a battery-powered kit for standalone operation
 - ATA8520-EK3-F extension board:
Includes Atmel SIGFOX ATA8520E V2.3 transceiver device with an AT30TS75A temperature monitoring device. An additional MCU application development kit, i.e., XplainedPro SAMD20 or SAMD21 and 3V power-supply is required.
- The PCB can be modified to be used together with an Atmel Xplained mini or Arduino UNO kit

Description

This user guide describes an evaluation kit and an extension board for SIGFOX™ applications. The example application uses an Atmel® ATmega328P AVR® or SAMD20/D21 microcontroller to read out an AT30TS75A temperature sensor using the built-in TWI connection and controls the RF telegram transmission using the SIGFOX ATA8520E V2.3 transceiver device. This application requires a SIGFOX base station infrastructure to capture the RF telegram and supply payload data at the SIGFOX back end of the SIGFOX Cloud. For more information on operating the SIGFOX network and SIGFOX Cloud, see <http://www.sigfox.com> information.

The evaluation and development kit tool packs are available for download from the Atmel website: <http://www.atmel.com/devices/ATA8520E.aspx>

These tool packs include

- The Atmel ATAN0157 quick start guide for the kit and the Atmel ATAN0156 user guide

- The schematic, layout and Gerber data for the ATAB0102A PCB and the attached stamp PCB
- The source code for the Atmel ATmega328P and SAMD20/D21 as an Atmel Studio 6 project

The Atmel ATA8520E SIGFOX transceiver is a SIGFOX-certified device which includes the complete SIGFOX protocol stack to operate in the SIGFOX network within the 902MHz ISM band. The device is controlled from any host MCU using the SPI commands as described in the datasheet [1]. Included in the tool pack is an Atmel ATA8520E library as C source code for the SPI commands.

The ATA8520-EK1-F kit is designed to be used for standalone operation and not to be integrated into systems and devices.

Compliance Statements

This kit complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Changes or modifications made to this equipment not expressly approved by Atmel® may void the FCC authorization to operate this equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20cm de distance entre la source de rayonnement et votre corps.

Ce transmetteur ne doit pas etre place au meme endroit ou utilise simultanement avec un autre transmetteur ou antenne.

References

- [1] Atmel® ATA8520E datasheet and user guide
- [2] Atmel AT30TS75A datasheet
- [3] <http://www.sigfox.com>
- [4] <http://backend.sigfox.com>
- [5] <http://www.atmel.com/devices/ATA8520E.aspx>
- [6] Atmel ATAN0157 Quick Start Guide - ATA8520-EK1-F and ATA8520-EK3-F
- [7] ATA8520-EK13-F_Tool_pack_V1.0.zip
- [8] FCC ID: 2AHW9-ATAB8520E
- [9] SIGFOX certification 7154_FCC_LC_DL

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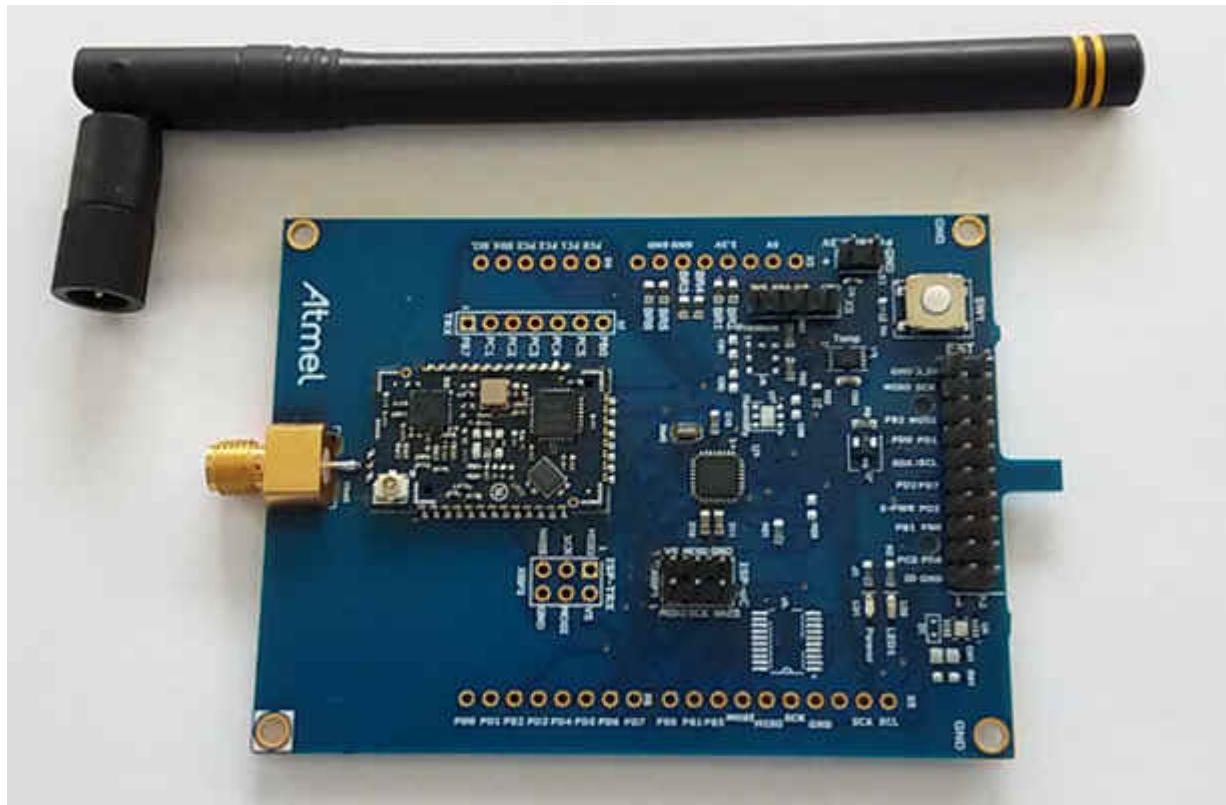
1. Getting Started with the ATA8520-EK1-F Kit

Figure 1-1 shows the components which are included in the evaluation kit. The kit includes

- A single PCB ATAB0102A with
 - An Atmel® ATA8520E SIGFOX™ transceiver device
 - An Atmel ATmega328P AVR® microcontroller at 8MHz
 - An AT30TS75A temperature sensor with TWI
- An 902MHz monopole antenna for connection to the RP-SMA connector

The kit requires an external power supply or battery for 3.0V to 3.3V at 300mA which is not included in the kit.

Figure 1-1. ATA8520-EK1-F Kit Components



The 902Hz monopole antenna is connected to the RP-SMA connector of the PCB and the external power supply or battery has to be connected to connector X1.



Caution: Ensure correct polarity at the connection to avoid damage to the equipment. The PCB has no reverse polarity protection for the power supply connection.

The kit comes with preconfigured devices for starting the Flash application of the Atmel ATmega328P once the power is applied. This application controls the RF telegram transmission and reads out the temperature sensor at 15 min. intervals or when pressing the SW1 button. The red LED1 starts blinking for about 2-3s, i.e. during telegram transmission. The device then enters power-down mode until a wake-up from the internal timer or a button press occurs.

Every fifth transmission is executed as an uplink/downlink request, i.e. it will first transmit the RF telegram with sensor data and requests a payload data packet from the SIGFOX cloud via a base station. The execution of these request will take about 40-50s.

The Atmel ATA8520E device includes the SIGFOX ID and PAC registration code (see label attached to PCB) to register the kit with the user's account for the SIGFOX back end. The user has to open a SIGFOX cloud account to access the back end. From this account the data payload transmitted from the devices can be retrieved in various ways as described in the SIGFOX online help.

An Atmel debugger (Atmel JTAGICE3 or Atmel ICE), which can be connected to connector XISP1, is required for application development. Please see the marker for pin1 to connect with the correct orientation. The debugger can only be used if Atmel Studio 6 or 7 is installed in the front end. Atmel Studio 6 or 7 can be downloaded from <http://www.atmel.com> with additional user instructions and tools. The documentation for the kit components and for the software is included in the tool pack zip folder [7] which can be downloaded from the Atmel website [5].

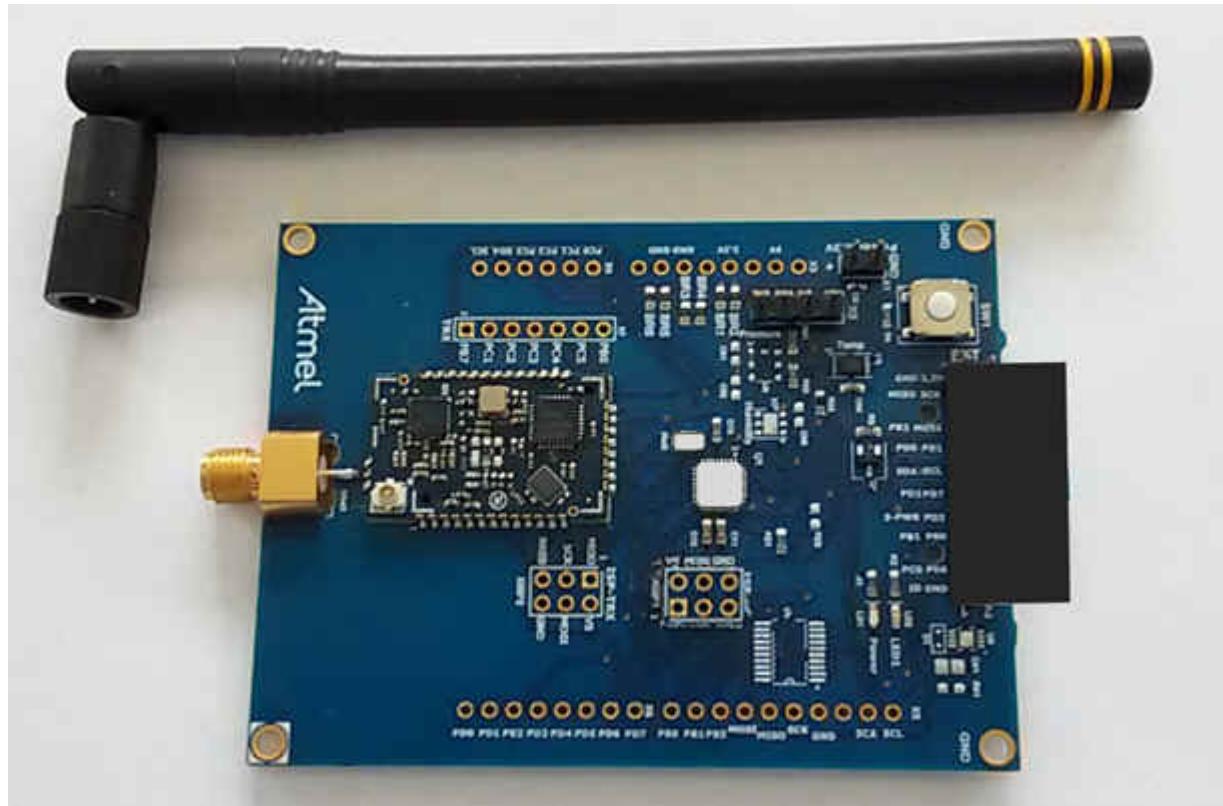
The kit and the boards are preprogrammed and temperature calibrated to operate at room temperature (24°C). For operation with a wider temperature range a temperature calibration as described in "ATAN0142 - ATA8520E Crystal Calibration" has to be applied.

2. Getting Started with the ATA8520-EK3-F Extension Board

The kit as shown in [Figure 2-1](#) includes

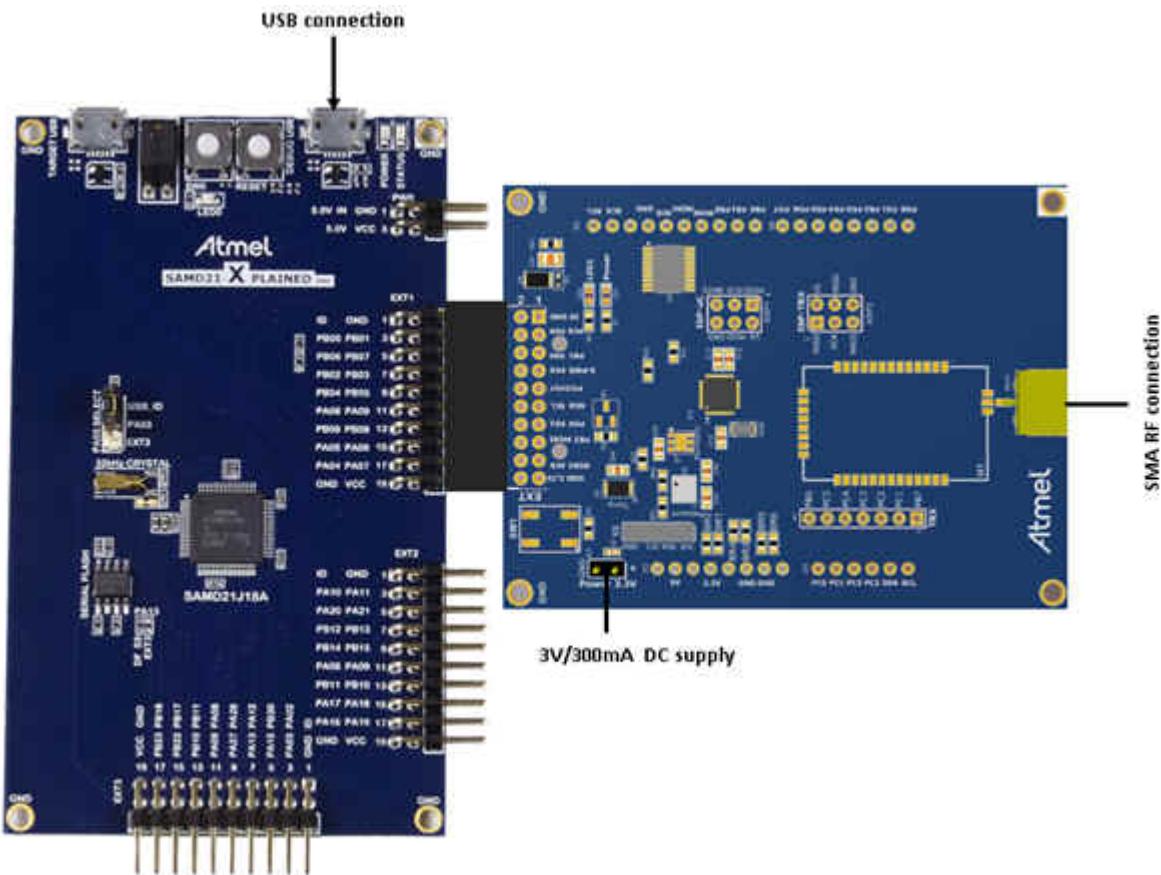
- A single PCB ATAB0102A with
 - An Atmel® ATA8520E SIGFOX™ transceiver device
 - An AT30TS75A temperature sensor with TWI
- An 902MHz monopole antenna for connection to the RP-SMA connector

[Figure 2-1. ATA8520-EK3-F Xplained Pro Extension Board](#)



The kit requires an additional XplainedPro SAMD20 or SAMD21 development kit and a 3.0V power supply with 300mA (connected to X1) as shown in [Figure 2-2](#).

Figure 2-2. ATA8520-EK3-F Xplained Pro Extension Board with SAMD20 or SAMD21 Xplained Pro Kit



The 902MHz monopole antenna is connected to the RP-SMA connector of the PCB and the board is powered by an external 3V supply.

The tool pack [7] includes an example application for the SAMD20 and SAMD21 Xplained Pro kit at 3V/48MHz.

This application controls the RF telegram transmission and reads out the temperature sensor at 15-minute intervals or when pressing the SW1 button. The red LED1 starts blinking for about 2-3s, i.e. during telegram transmission. The device then runs in a main loop until an event from the internal timer or a button press occurs.

Every fifth transmission is executed as an uplink/downlink request, i.e. it will first transmit the RF telegram with sensor data and requests a payload data packet from the SIGFOX cloud via a base station. The execution of these request will take about 40-50s.

The ATA8520E device includes the SIGFOX ID and PAC registration code (see label attached on the PCB) to register the kit with the user's SIGFOX back-end account. The user has to open a SIGFOX cloud account to access the back end. From this account the data payload transmitted from the devices can be retrieved in various ways as described in the SIGFOX online help.

The Atmel debugger included in the development kits can be used for application development. Application development and use of the debugger is only possible if Atmel Studio 6 or 7 is installed in the front end. Atmel Studio 6 or 7 can be downloaded from <http://www.atmel.com> with additional user instructions and tools. The documentation for the kit components and for the software is included in the tool pack zip folder [7] which can be downloaded from <http://www.atmel.com/devices/ATA8520E.aspx>.

3. Tool Pack for the Kits

The tool pack zip folder [7] contains the documentation and software for the kit. Extract the folder into a directory on the PC to get the following structure:

..\Application_Notes	documentation for the kit and the application notes for the devices
..\Documentation	data sheets of the devices
..\Hardware	hardware documentation of the boards
..\Software	software for the kit
..\Software\ATA8520-EK1-F	Atmel® Studio 6 project directory for ATA8520-EK1-F kit with ATmega328P
..\Software\ATA8520-EK3-F	Atmel Studio 6 project directory for ATA8520-EK3-F board with SAMD20 or SAMD21 XplainedPro kit

4. ATA8520E SIGFOX Certified Transceiver

The Atmel® ATA8520E SIGFOX™ transceiver includes the SIGFOX protocol library and a SPI communication interface for controlling device operation. The transceiver buffer of the device is loaded with a max. of 12 bytes of payload data for transmission in the 902MHz ISM band in the US. The Atmel ATA8520E device can also receive payload data with 8 Bytes from the SIGFOX cloud when transmitting an uplink/downlink request. The Atmel ATA8520E device is certified by SIGFOX to participate in their network. A second certification step for the module or system including antenna is also required with a classification of the module or system RF performance, i.e. radiated RF output power. As a result, the RF path including antenna must also have SIGFOX certification.

The key parameters for the RF link of the kits are:

- RF channels: 902MHz to 906MHz for up- and downlink
- RF output power: max. 23dBm
- RF sensitivity: -126dBm
- Data rate: 600bit/s with DBPSK modulation for uplink and 600bit/s with GFSK modulation for downlink
- Data payload: max. 12byte with LSB first for uplink and 8bytes for downlink
- Data transfer: max. 140 telegrams/day for uplink and max. 4 telegrams/day for downlink

The data transmission is AES encrypted.

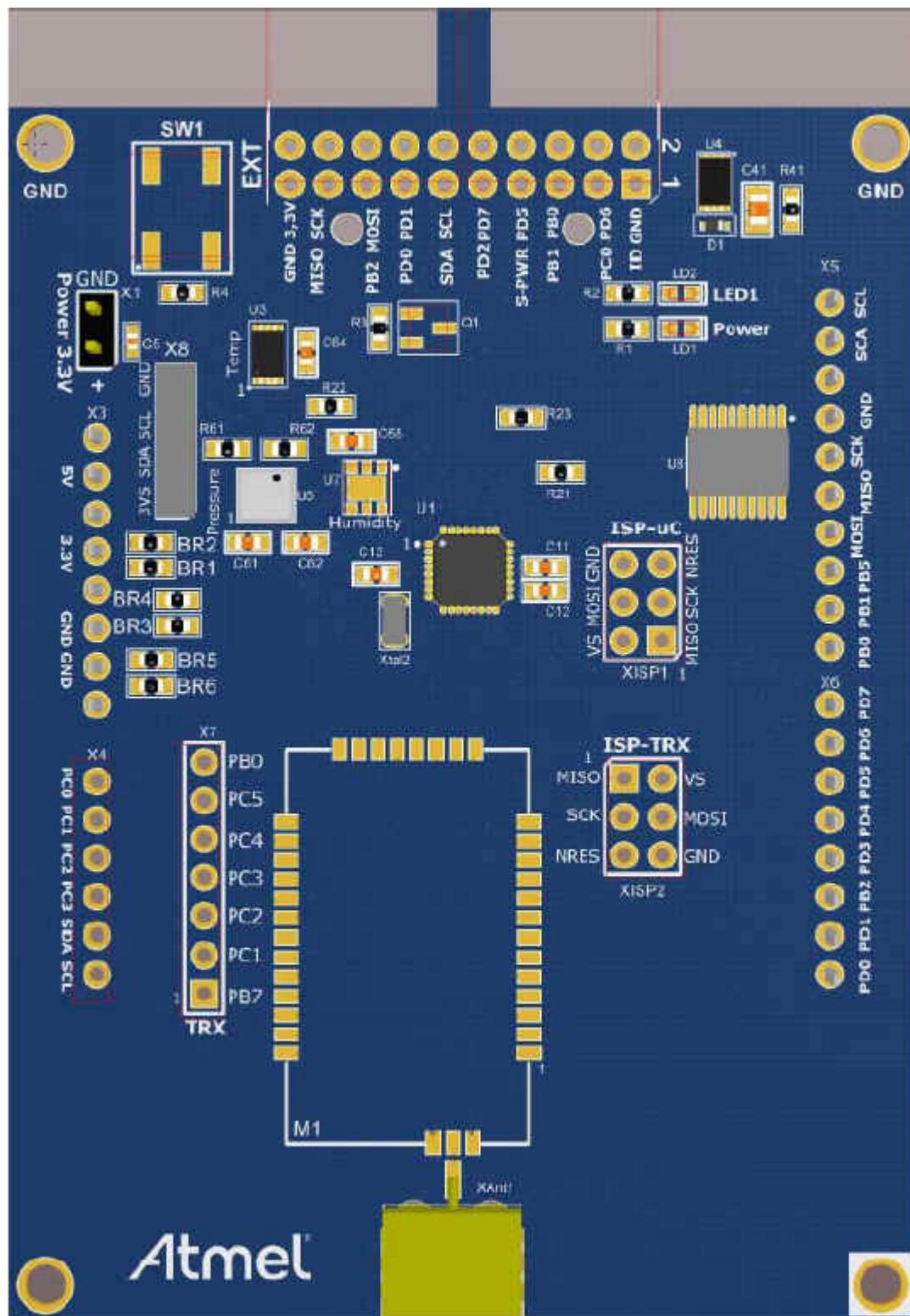
The SIGFOX ID and PAC registration code are printed on a label attached to the PCB and can also be read out from the device using the SPI command interface. This ID and code are required for registering the device with the user's account for the SIGFOX back end.

5. ATAB0102A PCB Description

Figure 5-1 shows the ATAB0102A PCB used as a platform for the SIGFOX™ kits. It works in two different modes depending on the component mounted on the PCB:

1. Battery powered standalone operating mode for the ATA8520-EK1-F kit:
 - Includes the Atmel® ATA8520E SIGFOX device mounted on a stamp board together with a Front-End-Module device
 - Includes the Atmel ATmega328P AVR® microcontroller with 8MHz internal clock and external 32.768kHz crystal
 - Includes the AT30TS75A temperature sensor with TWI
 - Includes an RP-SMA antenna connector for an 902MHz external monopole antenna
 - Two LEDs:
 - Green LED LD1 to indicate the sensor power
 - Red LED LD2 connected to port pin PD5 and connector X2/pin8 and X6/pin6 for the user application
 - User button SW1 connected to port pin PD6 and to connectors X2/pin4 and X6/pin7
 - Supply voltage divider connected to pin ADC0 to measure the battery voltage against the internal 1.1V reference
 - Includes the footprint for the following TWI sensor devices:
 - BMP180 air pressure sensor
 - HTU20D/SHT20 humidity sensor
2. Operating mode with an additional Xplained Pro kit for the ATA8520-EK3-F extension board using a SAMD20 or SAMD21:
 - Includes the Atmel ATA8520E SIGFOX device mounted on a stamp board together with a Front-End-Module device
 - Includes the AT30TS75A temperature sensor with TWI
 - Includes an RP-SMA antenna connector for an 902MHz external monopole antenna
 - Two LEDs:
 - Green LED LD1 to indicate the sensor power
 - Red LED LD2 connected to port pin PD5 and connector X2/pin8 and X6/pin6 for the user application
 - User button SW1 connected to port pin PD6 and to connectors X2/pin4 and X6/pin7
 - Supply voltage divider connected to pin ADC0 to measure the supply voltage against the internal 1.1V reference
 - Includes the footprint for the following TWI sensor devices:
 - BMP180 air pressure sensor
 - HTU20D / SHT20 humidity sensor
 - Includes the connector X2 to for connecting the PCB to an Xplained Pro board

Figure 5-1. ATAB0102A Board



5.1. ATA8520-EK1-F Power Consumption and Battery Selection

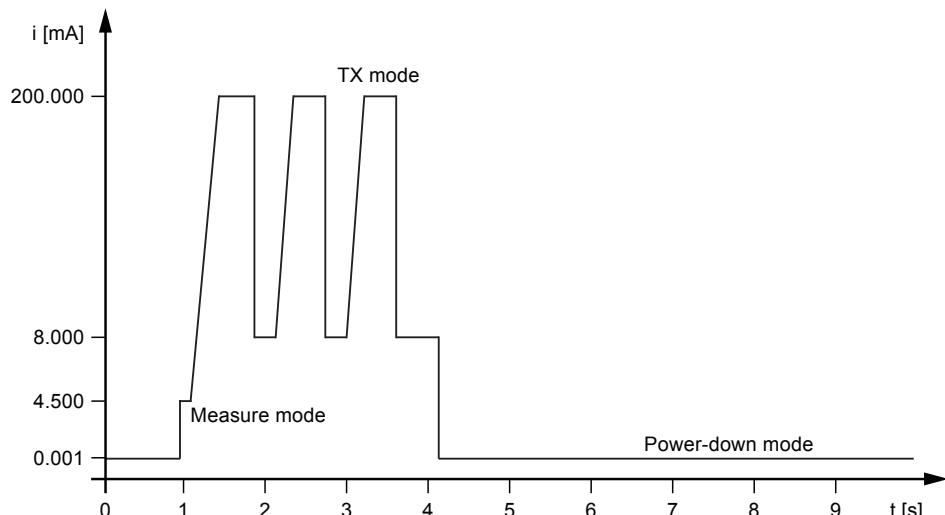
When using the PCB in standalone mode, the AVR® microcontroller can be set to a power-down mode while running the Timer2 with the external 32.768kHz crystal. This will reduce the mean current consumption to $\sim 10\mu\text{A}$ to $20\mu\text{A}$ (see [Table 5-1](#) for 5 messages per day). In this mode the sensor power is switched off and the Atmel® ATA8520E device is in OFF mode and the MCU only wakes up by pressing the button, applying an external interrupt signal or from the internal Timer2 interrupt.

[Figure 5-2](#) shows the typical current consumption profile from the different operating modes of the Flash application during a telegram transmission. This allows the calculation of a mean current consumption depending on the wake-up intervals.

The shown current profile is a typical profile and depends on the Flash application of the Atmel ATmega328P device and the attached sensors.

During the telegram transmission the MCU is performing the LED flashing to indicate activity. This increases the current consumption and can be replaced by setting the MCU in power-down mode. When the transmission is finished an event is generated on pin PB6 of the ATA8520E which can be used to wake-up the MCU.

Figure 5-2. Standalone Mode Current Consumption at 24°C



[Table 5-1](#) summarizes battery service life for a typical Lithium battery which can be used with the ATAB0102A. When selecting the battery, it is important to know the peak current consumption which has to be supplied by the battery cells. It is assumed that the battery voltage drops from the initial value of 3V down to 2V at the end of its service life. The self-discharge is defined by the manufacturer as typically 1% per year at an ambient temperature of 20°C. Battery Life at 20°C

Table 5-1. Battery Life at 20°C

Messages/Day	Mean Current [mA] ⁽¹⁾	Battery Lifetime (Days and Years)	
		Days	Years
140	0.383	196	0.5
100	0.274	274	0.7
50	0.138	545	1.5

		Battery Lifetime (Days and Years)	
		3V Lithium Battery (1800mAh)	
Messages/Day	Mean Current [mA] ⁽¹⁾	Days	Years
20	0.056	1348	3.7
5	0.015	5117	14.0

Note:

1. The mean current values shown in the table are only for indication and cannot be taken as reference.

When operating in uplink/downlink mode the transmission and reception will take about 40s to 50s. In this period the device will first send a data telegram three times as shown in [Figure 5-2](#), followed by an idle mode with about 4.5mA current consumption for about 20s and will then enter the receive mode for about 20s with 19mA current consumption. Finally a confirm telegram is sent for about 0.35s. This uplink/downlink mode is only possible for max. 4 transmissions/day and has to be added to the Mean Current consumptions in [Table 5-1](#).

During the uplink/downlink operation the MCU can be placed in power-down mode and can wake-up by the event of the ATA8520E.

5.2. Connector Description

The PCB has several connectors which are used differently depending on the PCB configuration. [Table 5-2](#) summarizes the connectors and how different PCB versions are used. The placement of the connectors at the PCB is shown in [Figure 5-1](#).

Table 5-2. ATAB0102A Connectors

Connector	ATA8520-EK1-F	ATA8520-EK3-F
	Standalone Version	Xplained Pro Extension
X1 ext. power	External 3V power supply	--
X2 Xplained Pro	--	Extension connector
X3 ⁽¹⁾	--	--
X4 ⁽¹⁾	--	--
X5 ⁽¹⁾	--	--
X6 ⁽¹⁾	--	--
X7 RF debug	--	--
X8 sensor	External sensors	External sensors
XISP1	ISP-microcontroller connector	--
XISP2	--	--

Note:

1. These connectors can be used to attach a Xplained mini or Arduino UNO kit.

5.2.1. Connector X1

Connector X1 is used for supplying an external 3V power source for standalone battery powered applications for the ATA8520-EK1-F kit.



Caution: These pins have no reverse polarity protection.

Table 5-3. Connector X1

Function	Pin	Pin	Function
+3.3V	1	2	GND

5.2.2. Connector X2

Connector X2 is used for connecting to an Xplained Pro MCU kit. In this connection mode the PCB is supplied with 3V of power from the Xplained Pro MCU board.

Table 5-4. Connector X2

Function	Pin	Pin	Function
ID_data	1	2	GND
PC0 (PB00)	3	4	SW1 (PB01)
PB1/RF_NRES (PB06)	5	6	PB0/RF_PWRON (PB07)
SNS_PWR (PB02)	7	8	LED1 (PB03)
RF_EVNT (PB04)	9	10	PD7 (PB05)
SDA (PA08)	11	12	SCL (PA09)
PD0 (PB09)	13	14	PD1 (PB08)
RF_NSS (PA05)	15	16	MOSI (PA06)
MISO (PA04)	17	18	SCK (PA07)
GND	19	20	+3.3V

Note:

Port pins in brackets are for the SAMD20 and SAMD21 device.

5.2.3. Connectors X3, X4, X5 and X6

Connectors X3, X4, X5 and X6 are used for connecting to an Xplained mini or Arduino UNO kit. In this connection mode the PCB is supplied with 3V and 5V of power from the Xplained mini or Arduino UNO board.

Connector X3 is used for supplying power to the add-on boards.

Table 5-5. Connector X3

Function	Pin
-	1
-	2

Function	Pin
-	3
+3.3V	4
+5V	5
GND	6
GND	7
-	8

Connector X4 is used for the port C pins of the MCU.

Table 5-6. Connector X4

Function	Pin
PC0	1
PC1	2
PC2	3
PC3	4
PC4/SDA	5
PC5/SCL	6

Connector X5 is used for the port B pins of the MCU. Pins 1 to 6 are connected to a 3V/5V level shifter to convert the signals to 3V at PCB level.

Table 5-7. Connector X5

Function	Pin
PB0/RF_PWRON	1
PB1/RF_NRES	2
PB2/RF_NSS	3
PB3/MOSI	4
PB4/MISO	5
PB5/SCK/LED	6
GND	7
-	8
-	9
-	10

Connector X6 is used for the port D pins of the MCU. Pins 3 and 8 are connected to a 3V/5V level shifter to convert the signals to 3V at PCB level.

Table 5-8. Connector X6

Function	Pin
PD0	1
PD1	2
PD2/RF_EVNT	3
PD3/SNS_PWR	4
PD4	5
PD5/LED1	6
PD6/SW1	7
PD7	8

5.2.4. Connector X7

Connector X7 is not typically mounted. These Atmel® ATA8520E pins can also be used as supplementary I/O pins.

Table 5-9. Connector X7

Function	Pin
RPC1/RF_NPRON1	1
RPC2/RF_TRPA	2
RPC3/RF_TMDO	3
RPC4/RF_TMDI	4
RPC5/RF_TRPB	5
RPC7/RF_RX_ACTIVE	6

5.2.5. Connector X8

Connector X8 is not typically mounted and is used for the TWI bus connection with the switched power supply. This connector can be used to attach additional sensors and devices with the TWI connection. The power consumption is limited to ~50mA.

Table 5-10. Connector X8

Function	Pin
+3.3Vsens	1
SDA	2
SCL	3
GND	4

5.2.6. Connector ISP-TRX

Connector ISP-TRX is not mounted and is not required for applications.

Table 5-11. Connector ISP-TRX

Function	Pin	Pin	Function
MISO	1	2	VCC
SCK	3	4	MOSI
nRES	5	6	GND

5.2.7. Connector ISP-microcontroller

Connector ISP-microcontroller is used for ATmega328P programming and debugging for the kit ATA8520-EK1-F.

Table 5-12. Connector ISP-microcontroller

Function	Pin	Pin	Function
MISO	1	2	V _{CC}
SCK	3	4	MOSI
nRES	5	6	GND

5.3. LED, Button and Sensors

The green LED LD1 is connected to the sensor power and indicates if the sensor power is switched on.

The red LED LD2 is connected to port PD5 on Atmel® ATmega328P and to the connectors X2/pin8 and X6/pin6 and can be controlled by the MCU application.

The button SW1 is connected to port PD6 on Atmel ATmega328P and to the connectors X2/pin4 and X6/pin7 and can be read by the MCU application.

The PCB contains a temperature sensor connected to the TWI bus of the MCU and in addition two footprints for additional sensors, i.e. an air pressure sensor and a humidity sensor device. With the TWI connector X8 additional sensors can be connected as long as the current on the 3.3V supply will not exceed 50mA.

6. Application Description

The Flash application for both kits is set up in the same way with the exceptions described in [Table 6-1](#). The main differences are found in the CPU and system and Timer2 clock and sleep modes.

Table 6-1. Flash Application Differences

Feature	ATA8520-EK1-F	ATA8520-EK3-F Xplained Pro
Oscillator and CPU clock	Internal 8MHz RC oscillator	External 32.768kHz crystal
Timer2	External 32.768kHz crystal	Internal system clock 48MHz
Sleep mode	Power down mode	Idle in main loop
System clock	8MHz	48MHz

The source code for all applications is available within the tool pack distribution [7].

The program flow for the Flash application is illustrated in [Figure 6-1](#) and [Figure 6-2](#). The application first initializes all required peripherals such as pins, timers, SPI, ADC, UART, TWI and the Atmel® ATA8520E SIGFOX transceiver by reading out the ID/PAC information required for SIGFOX™ registration. This ID/PAC data is send via the UART interface to a PC terminal application. The Timer2 is used as a real-time clock and uses either the

- External 32.768kHz crystal for the ATA8520-EK1-F kit or the
- Internal system clock for the ATA8520-EK3-F kit.

Timer2 is configured to wake up the MCU every 15 minutes. Pressing button SW1 also causes the MCU to wake up. The temperature sensor is powered up and read out and after this a data telegram is transmitted. The device then enters power-down mode again until the next wake-up by the RTC (or manually by pressing SW1).

Figure 6-1. Flash Application Flow Chart 1

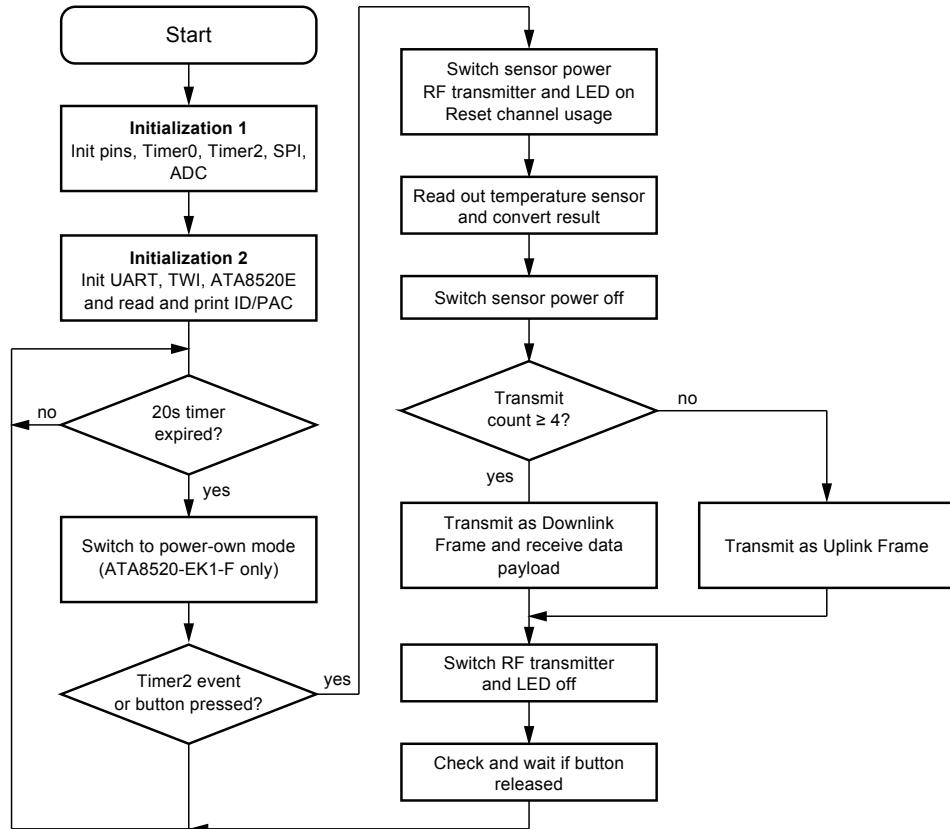
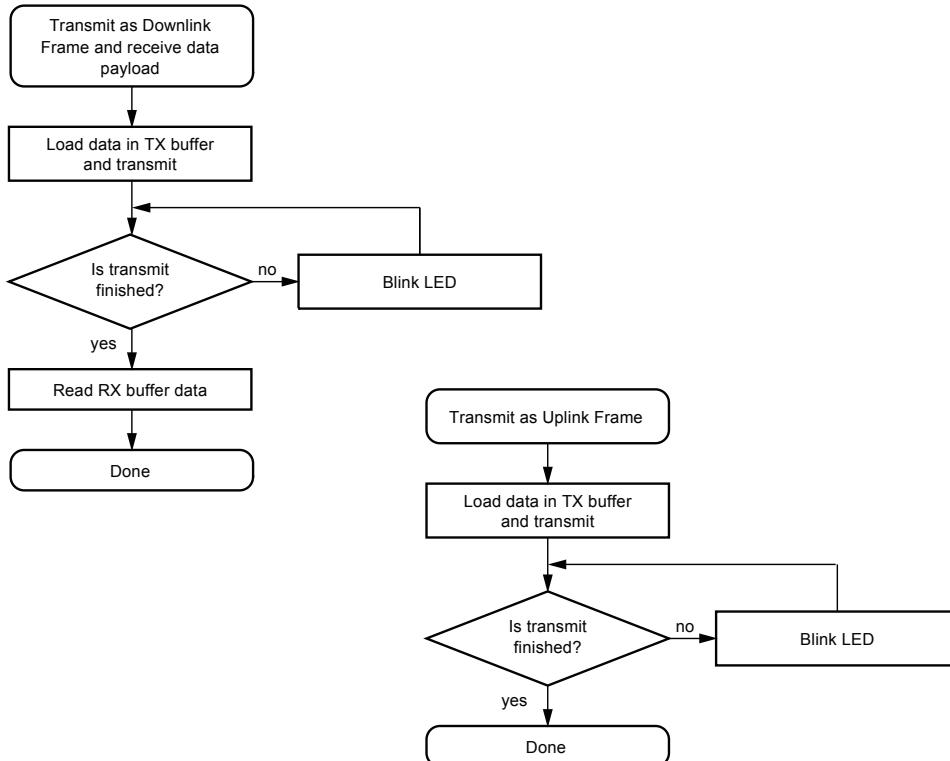


Figure 6-2. Flash Application Flow Chart 2



During the step Initialization1 the application will perform a check for the device version to be V2.3. This device version supports the US mode operation.

6.1. Software Development

Atmel® Studio 6 or 7 is required for software development and can be downloaded from the Atmel website [5]. The tool pack [7] with software and documentation is also required. When unpacking the tool pack, the folder structure as described in [#unique_28](#) is generated.

Three different applications and folder structures are included with sample applications for the kit versions.

..\\ATA8520-EK1-F\\ATAB0102A ATmega328P project for ATA8520-EK1-F kit
..\\ATA8520-EK3-F\\SAMD20_XplainedPRO_SW SAMD20 Xplained Pro project for ATA8520-EK3 kit
..\\ATA8520-EK3-F\\SAMD21_XplainedPRO_SW SAMD21 Xplained Pro project for ATA8520-EK3 kit

The Atmel Studio 6 or 7 installation makes all USB drivers and debugger supports available when plugging in the development kits. The ATA8520-EK1-F standalone kit may require an AVR® debugger connected to the connector ISP-microcontroller for debugging and programming, which is not included in the kit.

6.2. FCC Compliance Application

To be compliant with the FCC regulations according the RF transmission the following SPI commands and sequences have to be used in the application code.

During End-Of-Line testing of the hardware and the ATA8520E device the following settings have to be applied and configured in the EEPROM as described in the data sheet of the ATA8520E device:

- The RF transmit frequency has to be set to 902.2MHz
- The RF receive frequency has to be set to 905.2MHz
- The US mode has to be enabled in the EEPROM configuration
- The channel usage has to be configured with 9 macro channels
- Each macro channel will use 6 micro channels

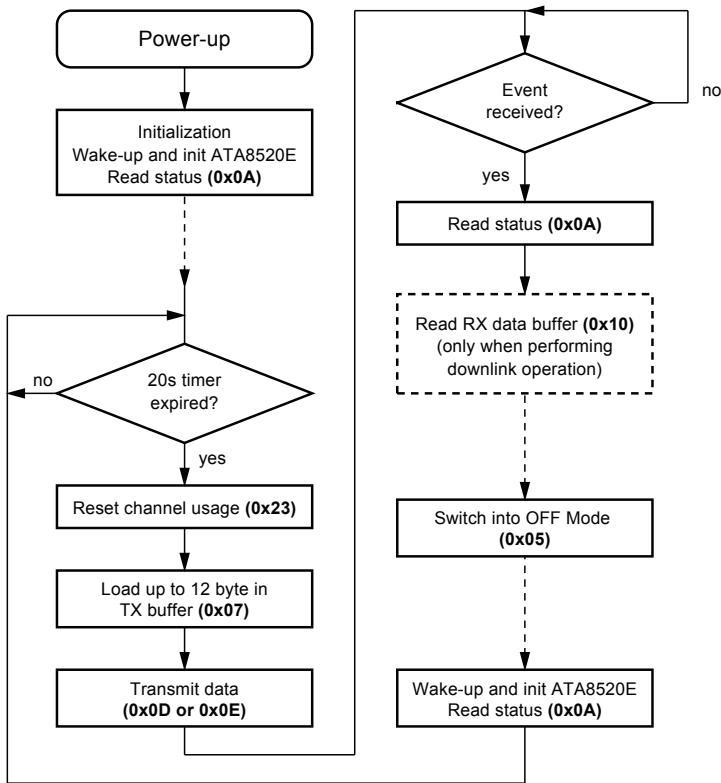
The SPI commands for the configuration are summarized in [Table 6-2](#).

Table 6-2. SPI Commands and Parameters for ATA8520E Configuration

SPI Command	Parameter	Description
Store System Configuration (0x11)	DDRC, PORTC, 0x02, 0x3B	Enable US mode with up-/downlink and 3V supply
Store Frequencies (0x1A)	902200000, 905200000	Store TX and RX frequencies [Hz]
Store Channel Configuration (0x22)	0xFF, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x00	Enable 9 macro channels from 902.2 to 904.6MHz

The application flow has to be according to [Figure 6-3](#) for the transmission of message payload up to 12 byte using the described SPI commands.

Figure 6-3. Application Flow



The SPI commands for the application flow are summarized in [Table 6-3](#).

Table 6-3. SPI Commands and Parameters for ATA8520E Application

SPI Command	Parameter	Description
Get Status (0x0A)	Status information returned	Read ATA8520E device status and clear a pending event
Reset channel usage (0x23)	none	Reset channel usage scheme for macro and micro channels
Write TX buffer (0x07)	Up to 12 byte payload data	Load transmit buffer with payload data
Send Frame (0x0D)	None	Transmit data frame and generate event when finished
Send/Receive Frame (0x0E)	None	Transmit data frame, wait for receive frame and generate event when finished
Read RX buffer (0x10)	8 byte returned	Read receive buffer data
OFF mode (0x05)	None	Switch ATA8520E into OFF mode (Wake-up is performed with PWRON or NPWRONx pins)

To be compliant with the FCC transmission requirements a 20 seconds idle time has to be performed after wake-up of the ATA8520E device.



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[DRAFT]