
User Guide for the Evaluation Kit ATAK55002-V1 and the ATAK55002-V2 and ATAK55002-V3 Extension Boards

ATAN0104

Features

- User guide for the evaluation kit ATAK55002-V1 and extension boards ATAK55002-V2 and -V3
- This kit demonstrates a Flash application with the
 - ATAK55002-V1 evaluation kit:
with the Atmel® SIGFOX™ ATA8520 transmitter device and an Atmel ATmega328P AVR® microcontroller with AT30TS75A temperature sensor as a battery-powered kit for standalone operation
 - ATAK55002-V2 and -V3 extension boards:
Includes Atmel SIGFOX ATA8520 transmitter device with an AT30TS75A temperature monitoring device. An additional MCU application development kit, i.e. Xplained mini or Arduino UNO is required.

Description

This user guide describes an evaluation kit and the extension boards for a SIGFOX application. This application uses an Atmel ATmega328P AVR microcontroller to read out an AT30TS75A temperature sensor using the built-in TWI connection and controls the RF telegram transmission using the SIGFOX ATA8520 transmitter 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/ATA8520.aspx>. These tool packs include

- The ATAN0054 quick start guide for the kit and the Atmel ATAN0104 user guide
- The schematic, layout and Gerber data for the ATAB0101A PCB
- The source code for the Atmel ATmega328P as an Atmel Studio 6 project

The Atmel ATA8520 SIGFOX transmitter is a SIGFOX-certified device which includes the complete SIGFOX protocol stack to operate in the SIGFOX network within the 868MHz 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 a ATA8520 library as C source code for the SPI commands.

References

- [1] Atmel® ATA8520 datasheet and user guide
- [2] Atmel AT30TS75A datasheet
- [3] <http://www.sigfox.com>
- [4] <http://backend.sigfox.com>
- [5] <http://www.atmel.com/devices/ATA8520.aspx>
- [6] Atmel ATAN0054 – ATAK55002-V1/2/3 quick start guide
- [7] ATA55002-V123_Tool_pack_V1.0.zip

1. Getting Started with the ATAK55002-V1 Kit

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

- A single PCB ATAB0101A with
 - An Atmel® ATA8520 SIGFOX™ transmitter device
 - An Atmel ATmega328P AVR® microcontroller at 8MHz
 - An AT30TS75A temperature sensor with TWI
- An 868MHz monopole antenna for connection to the SMA connector

The kit requires an external power supply or battery for 3.0V to 3.3V at 50mA which is not included in the kit.

Figure 1-1. ATAK55002-V1 Kit Components



The 868MHz monopole antenna is connected to the 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 one-hour intervals or when pressing the SW1 button. The red LED1 starts blinking for about 7-8s, 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.

The Atmel ATA8520 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 is installed in the front end. Atmel Studio 6 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].

2. Getting Started with the ATAK55002-V2 and -V3 Extension Boards

Figure 2-1 and Figure 2-2 show the components which are required for the evaluation kit. The kit includes

- A single PCB ATAB0101A with
 - An Atmel® ATA8520 SIGFOX™ transmitter device
 - An AT30TS75A temperature sensor with TWI
- An 868MHz monopole antenna for connection to the SMA connector

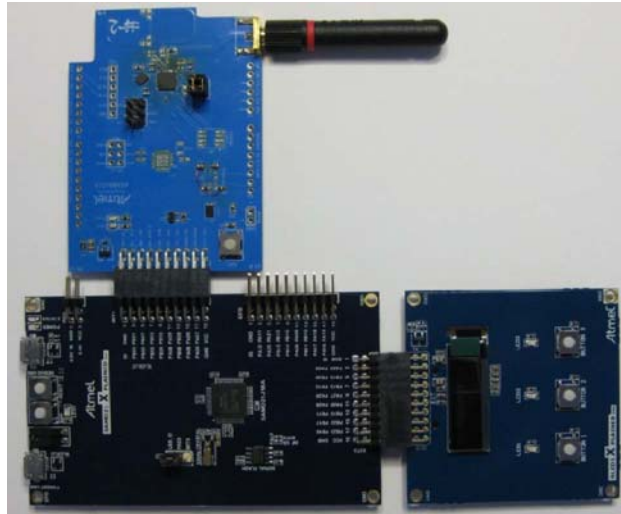
The kit is available in two versions depending on the connector type of the additionally required development kit:

- An ATAK52002-V2 Xplained mini (Figure 2-1): to be used with an additional Xplained mini or Arduino UNO kit
- An ATAK52002-V3 Xplained PRO (Figure 2-2): to be used with an additional Xplained PRO kit.

Figure 2-1. ATAK55002-V2 Xplained Mini Extension Board with Attached External Antenna



Figure 2-2. ATAK55002-V3 Xplained PRO Extension Board with SAMD21 Xplained PRO Kit



The 868MHz monopole antenna is connected to the SMA connector of the PCB and the board is powered from the attached evaluation kit using 3V/5V for the ATAK55002-V2 Xplained Mini and 3V for the ATAK55002-V2 Xplained PRO.

The following Flash applications are available as part of tool pack distribution:

- Xplained mini – Atmega328P application at 5V/16MHz
- Arduino UNO sketch and library at 5V/16MHz
- SAMD21 application for Xplained PRO 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 7-8s, 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.

The ATA8520 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 is installed in the front end. Atmel Studio 6 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/ATA8520.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\ATAK55002-V1	Atmel® Studio 6 project directory for ATAK55002-V1 kit with ATmega328P
..\Software\ATAK55002-V2	Atmel Studio 6 project directory for ATAK55002-V2 board with Atmega328P
..\Software\ATAK55002-V3	Atmel Studio 6 project directory for ATAK55002-V3 board with SAMD21

4. ATA8520 SIGFOX Certified Transmitter

The Atmel ATA8520 SIGFOX™ transmitter includes the SIGFOX protocol library and a SPI communication interface for controlling device operation. The transmitter buffer of the device is loaded with a max. of 12 bytes of payload data for transmission in the 868MHz ISM band. The Atmel ATA8520 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 telegram are:

- RF channels: 868.0 to 868.6MHz
- RF output power: max. 14.5dBm
- Data rate: 100bit/s with DBPSK modulation
- Data payload: max. 12byte with LSB first
- Duty cycle: max. 5 telegrams/hour, i.e. < 1%

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.

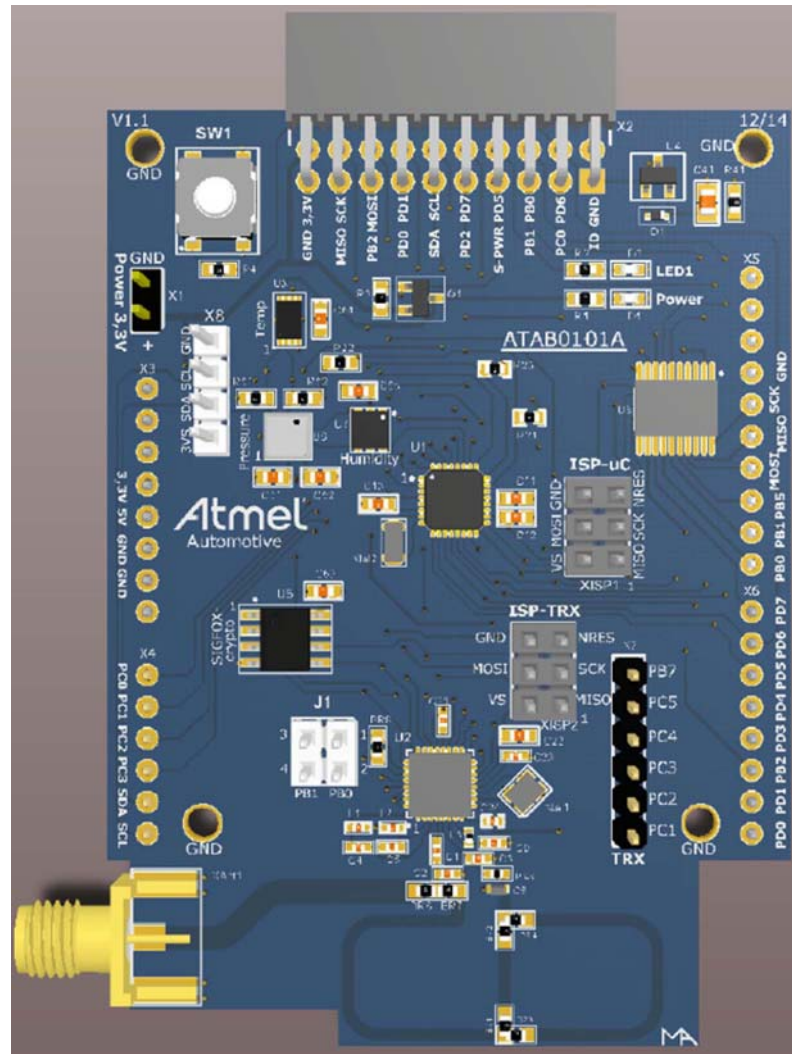
5. ATAB0101A PCB Description

Figure 5-1 on page 8 shows the ATAB0101A PCB used as a platform for the SIGFOX™ kits. It works in three different modes depending on the component mounted on the PCB:

1. Battery powered standalone operating mode for the ATAK55002-V1 kit:
 - Includes the Atmel® ATA8520 SIGFOX 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 ATAES132 crypto device (currently not in use)
 - Includes an SMA antenna connector for an 868MHz external monopole antenna
 - Two LEDs:
 - i. Green LED LD1 to indicate the sensor power
 - ii. 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:
 - i. BMP180 air pressure sensor
 - ii. HTU20D/SHT20 humidity sensor
2. Operating mode with an additional Xplained mini or Arduino UNO kit for the ATAK55002-V2 extension board using an ATmega328P:
 - Includes the Atmel ATA8520 SIGFOX device
 - Includes the AT30TS75A temperature sensor with TWI
 - Includes an ATAES132 crypto device (currently not in use)
 - Includes an SMA antenna connector for an 868MHz external monopole antenna
 - Two LEDs:
 - i. Green LED LD1 to indicate the sensor power
 - ii. 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:
 - i. BMP180 air pressure sensor
 - ii. HTU20D / SHT20 humidity sensor
 - Includes the connectors X3, X4, X5 and X6 for connecting the PCB on top of an Xplained mini or an Arduino UNO board
3. Operating mode with an additional Xplained PRO kit for the ATAK55002-V3 extension board using a SAMD21:
 - Includes the Atmel ATA8520 SIGFOX device
 - Includes the AT30TS75A temperature sensor with TWI
 - Includes an ATAES132 crypto device (currently not in use)
 - Includes an SMA antenna connector for an 868MHz external monopole antenna
 - Two LEDs:
 - i. Green LED LD1 to indicate the sensor power
 - ii. 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:
 - i. BMP180 air pressure sensor
 - ii. HTU20D / SHT20 humidity sensor
- Includes the connector X2 to for connecting the PCB to an Xplained PRO board

Figure 5-1. ATAB0101A Board



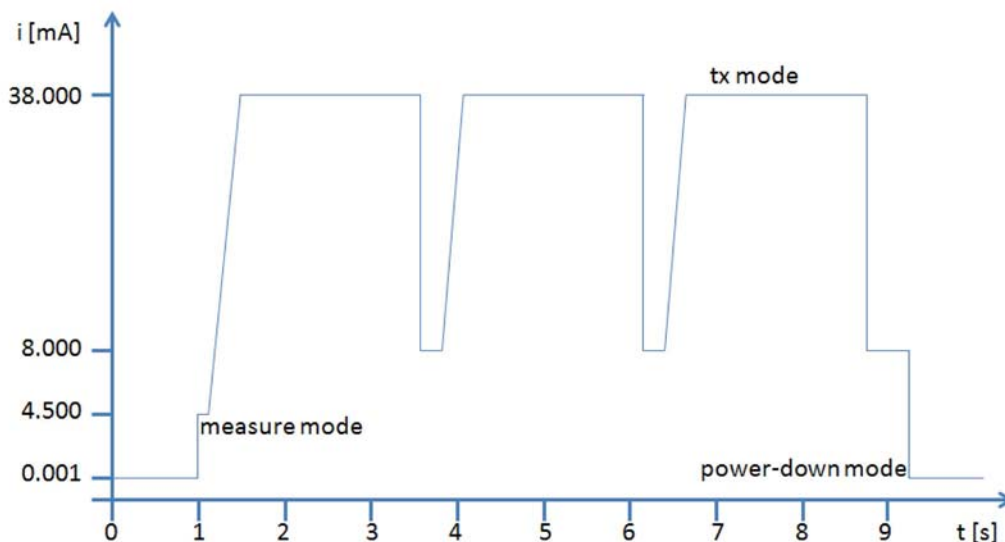
5.1 ATA55002-V1 Power Consumption and Battery Selection

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 ~10 to 20µA (see [Table 5-1](#) for 5 messages per day). In this mode the sensor power is switched off and the Atmel[®] ATA8520 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.

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 ATAB0101A. 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.

Table 5-1. Battery Life at 20°C

Messages/Day	Mean Current [mA] ⁽¹⁾	Battery Lifetime (Days and Years)	
		3V Lithium Battery (1800mAh)	
		Days	Years
140	0.421	178	0.5
100	0.301	249	0.7
50	0.151	497	1.4
20	0.061	1230	3.4
5	0.016	4689	12.8

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

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 on page 8](#).

Table 5-2. ATAB0101A Connectors

Connector	ATAK55002-V1 Standalone Version	ATAK55002-V3 Xplained PRO Extension	ATAK55002-V2 Xplained Mini Extension
X1 ext. power	External 3V power supply	--	--
X2 Xplained PRO	--	Extension connector	--
X3 Xplained mini	--	--	Shield connector1
X4 Xplained mini	--	--	Shield connector2
X5 Xplained mini	--	--	Shield connector3
X6 Xplained mini	--	--	Shield connector4
X7 RF debug	--	--	--
X8 sensor	External sensors	External sensors	External sensors
J1 RF config.	PB0/PB1 pin usage	PB0/PB1 pin usage	PB0/PB1 pin usage
XISP1	ISP-microcontroller connector	--	--
XISP2	--	--	--

5.2.1 Connector X1

Connector X1 is used for supplying an external 3V power source for standalone battery powered applications for the ATAK55002-V1 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 XplainedPRO MCU kit. In this connection mode the PCB is supplied with 3V of power from the XplainedPRO 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	AES_NSS (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

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
-	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/AES_NSS	8

5.2.4 Connector X7

Connector X7 is not typically mounted. These Atmel® ATA8520 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
RPB7/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 J1

The connector J1 is used for connecting the PWRON and NRES pins of the ATA8520 to the PB0 and PB1 port pins of the MCU. If the PB0 and PB1 pins are used for other purposes, these connections are removed. In this case the PWRON pin can be connected to pin NSS of the ATA8520 using the 0Ω resistor BR8. A device reset can also be forced using the “system reset” SPI command.

Table 5-11. Connector J1

Function	Pin	Pin	Function
RF_PWRON	1	2	PB0
RF_NRES	3	4	PB1

5.2.7 Connector ISP-TRX

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

Table 5-12. Connector ISP-TRX

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

5.2.8 Connector ISP-microcontroller

Connector ISP-microcontroller is used for ATmega328P programming and debugging for the kit ATAK55002-V1. This connector is not mounted in the ATAK55002-V2 kit.

Table 5-13. 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.

The PCB contains also a AES crypto device connected to the SPI bus which can be controlled from the MCU or from the RF device. Currently only the MCU will control this device using the AES_NSS signal for the chip select. This chip select is connected to port pin PD7 and to the connectors X2/pin10 and X6/pin8.

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	ATAK55002-V1	ATAK55002-V2 Xplained Mini	ATAK55002-V3 Xplained PRO
Oscillator and CPU clock	Internal 8MHz RC oscillator	External 16MHz clock	External 32.768kHz crystal
Timer2	External 32.768kHz crystal	Internal system clock 16MHz	Internal system clock 48MHz
Sleep mode	Power down mode	Idle in main loop	Idle in main loop
System clock	8MHz	16MHz	48MHz

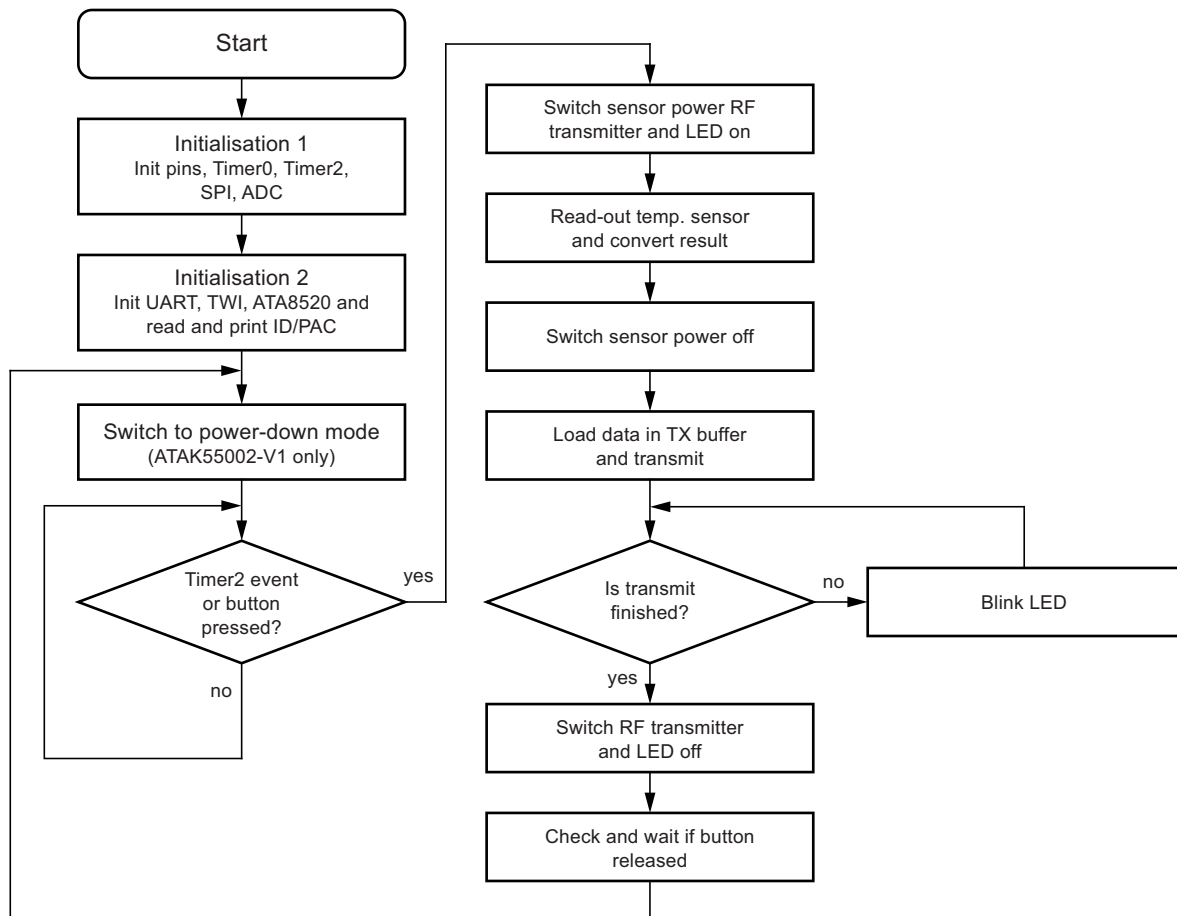
The source code for all applications is available within the tool pack distribution [7].

The program flow for the Flash application is illustrated in [Figure 6-1](#). The application first initializes all required peripherals such as pins, timers, SPI, ADC, UART, TWI and the ATA8520 SIGFOX transmitter by reading out the ID/PAC information required for SIGFOX™ registration. This ID/PAC data is sent 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 ATAK51002-V1 kit or the
- Internal system clock for the ATAK55002-V2 and -V3 kits.

Timer2 is configured to wake up the MCU every hour or 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



6.1 Software Development

Atmel® Studio 6 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 [Section 3. “Tool Pack for the Kits” on page 6](#) is generated.

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

..\ATAK55002-V1\ATAB0101A	ATmega328P project for ATAK55002-V1 kit
..\ATAK55002-V2\XplainedMini_SW	Xplained Mini project for ATAK55002-V2 kit
..\ATAK55002-V2\ArduinoUNO_SW	Arduino IDE sketch for ATAK55002-V2 kit
..\ATAK55002-V3\SAMD21_XplainedPRO_SW	SAMD21 Xplained PRO project for ATAK55002-V3 kit

The Atmel Studio 6 installation makes all USB drivers and debugger supports available when plugging in the development kits. Not included is the ATAK55002-V1 standalone kit which requires an AVR® debugger to be connected to the connector ISP-microcontroller for debugging and programming.

When using the Arduino UNO sketch application, the Arduino IDE has to be installed first along with the Atmel ATA8520 library.

7. Revision History

Please note that the following page numbers referred to in this section refer to the specific revision mentioned, not to this document.

Revision No.	History
9373B-AUTO-02/15	<ul style="list-style-type: none">• Title on page 1 updated• Section “Features” on page 1 updated• Section “Description” on page 1 updated• Section “References” on page 2 updated• Section 1 “Getting Started with the ATAK55002-V1 Kit” on page 3 updated• Section 2 “Getting Started with the ATAK55002-V2 and -V3 Extension Boards” on page 4 updated• Section 3 “Tool Pack for the Kits” on page 6 updated• Section 5 “ATAB0101A PCB Description” on page 7 updated• Table 5-2 “ATAB0101A Connectors” on page 10 updated• Section 6 “Application Description” on pages 15 to 16 updated

