Getting started with the STEVAL-BCNKT01V1 BlueCoin kit: augmented acoustics and motion sensing development platform

Introduction

The STEVAL-BCNKT01V1 integrated development and prototyping platform for augmented acoustic and motion sensing for IoT applications builds on the listening and balancing capabilities of the human ear.

With the expanded capabilities of its starter kit, BlueCoin lets you explore advanced sensor fusion and signal processing functions for robotics and automation applications with a 4 digital MEMS microphone array, a high-performance 9-axis inertial and environmental sensor unit and time-of-flight ranging sensors.

A high-performance STM32F446 180 MHz MCU enables real-time implementation of the very advanced sensor fusion algorithms like adaptive beamforming and sound source localization, with ready-to-use, royalty-free building blocks.

The BlueCoin can connect via the on-board BLE link to any IoT and smart industry wireless sensor network.

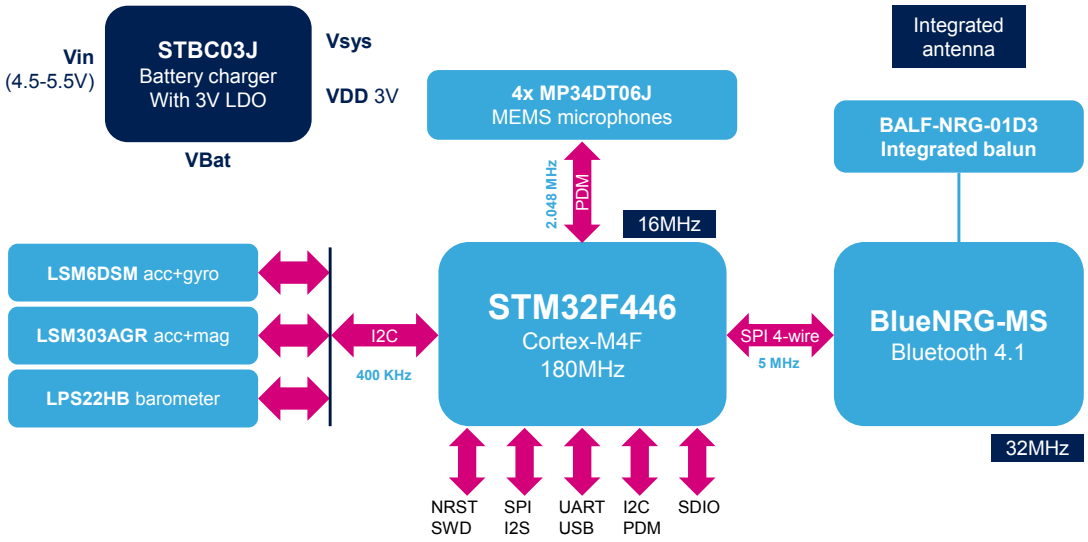
To upload new firmware onto the BlueCoin an external SWD debugger (not included in the starter-kit) is needed. It is recommended to use the ST-LINK V2.1 found on any "STM32 Nucleo-64" development board.

The kit includes two expansion boards for the BlueCoin Core System:

- the CoinStation for software and system architecture design support, featuring two ranging sensors with time-of-flight technology and a low-power stereo DAC
- a compact Cradle host featuring an SD card interface for on-field testing and data acquisition campaign.

It contains FCC ID: S9NBCOIN01 and module IC 8976C-BCOIN01 certified with PMN: STEVAL-BCNKT01V1; HVIN: STEVAL-BCNCS01V1; HMN: STEVAL-BCNCR01V1; FVIN: bluenrg_7_2_c_Mode_2-32MHz-XO32K_4M.img.

Figure 1. BlueCoin functional block diagram



1 Getting started

1.1 Overview

The STEVAL-BCNKT01V1 BlueCoin starter kit is designed to support the prototyping phases of new projects and can be used as:

- **An evaluation system:**
  - to evaluate high accuracy ST sensors in an optimized system architecture
  - to field-test data fusion and embedded signal processing algorithms
  - to deploy data collection campaigns to support custom algorithm development
- **A reference design:**
  - as a compact solution for high-performance, low-power motion, environmental and audio sensor data in compact form-factor designs
  - to start from hardware and software samples and create new designs (e.g., schematics, Gerber files, bill of materials, 3D CAD models)
- **An embedded software development kit**
  - to supply source code project samples based on the STM32Cube architecture
  - fully compatible with the Open.Software embedded processing libraries and supported by the STM32 ODE
- **A fast prototyping tool**
  - to plug onto your prototype motherboard to instantly add its embedded sensing and communication functions to your design
  - to integrate the BlueCoin in your mechanical design via the 3D CAD files

1.2 Package components

The STEVAL-BCNKT01V1 package contains all the components needed to test a demo on this optimized platform and to start developing your application.

Figure 2. BlueCoin kit blister

1.3 Initial setup with pre-loaded demo

After unpacking the contents, the easiest way to begin is to run the preloaded software using the BlueCoin board together with the CoinStation (STEVAL-BCNCS01V1).

Step 1. Take the BlueCoin and plug it on the CoinStation through the dedicated connectors. Take care to match the orientation shown below.

Figure 3. Orientation of BlueCoin and CoinStation connectors

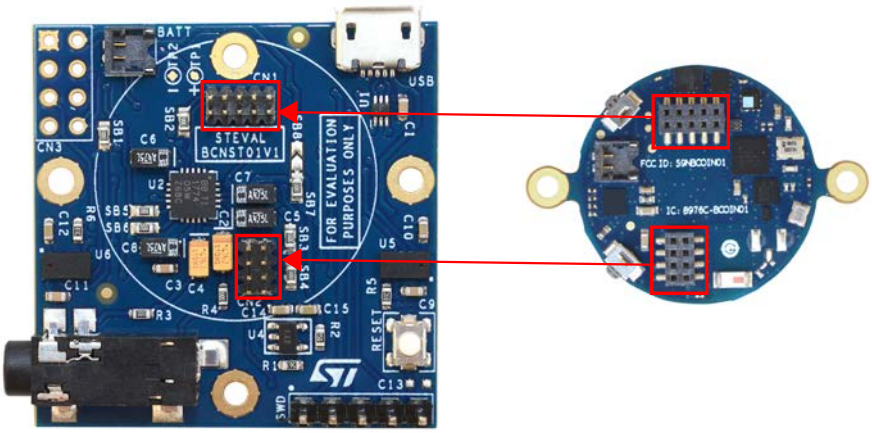
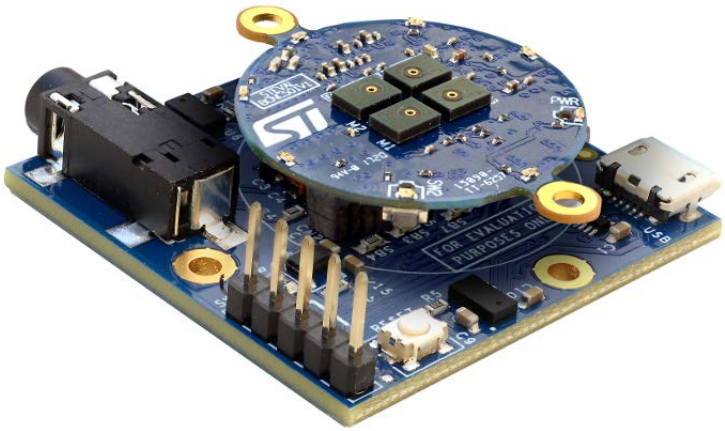


Figure 4. BlueCoin mounted on CoinStation



Step 2. Connect a USB type A to mini-B USB cable to turn the board on for the first time.

The LED next to the ST logo turns on and, if you speak close to the board, another LED starts blinking towards your direction.(For the PC software and the detailed documentation for the pre-loaded demo please refer to the FP-AUD-SMARTMIC1 function pack available on www.st.com.)

1.4 System requirements

As the STEVAL-BCNKT01V1 starter kit is already programmed with the FP-AUD-SMARTMIC1 firmware, to run the demo, you only need:

- a Windows™ PC (ver. 7 or higher)

- a USB type A to micro USB cable for power supply and communication (connected to a PC, AC adapter or any other source)

To start designing your own project, you need:

- A Windows™ PC (ver. 7 or higher) with an IAR, KEIL or AC6 firmware development environment
- A USB type A to Micro USB male cable to connect the STEVAL-BCNKT01V1 to the PC for power supply
- An STM32 Nucleo board with ST-LINK V2.1 in-circuit debugger/programmer (preferred) or other compatible device
- The ST-LINK utility for firmware download(1)

1. *Refer to www.st.com for the latest embedded software version.*

2 STEVAL-BCNCS01V1 hardware description

The STEVAL-BCNCS01V1 (BlueCoin Core System) evaluation board is a highly integrated development and prototyping platform for augmented acoustic and motion sensing for IoT applications inspired by the listening and balancing capabilities of the human ear. It can also easily support development of monitoring and tracking applications as a standalone sensor node connected to iOS™/Android™ smartphone applications.

The BlueCoin Core System comes in a very small circular shape (25 mm).

Most of the electronic components are on the bottom side of the pcb with small connectors to easily plug and unplug the board, whereas on the top side there are four digital MEMS microphones and eight LEDs.

Figure 5. STEVAL-BCNCS01V1 evaluation board main components: top view

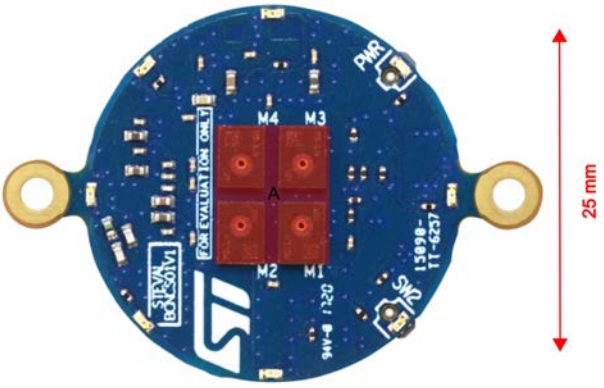


Figure 6. STEVAL-BCNCS01V1 evaluation board main components: bottom view

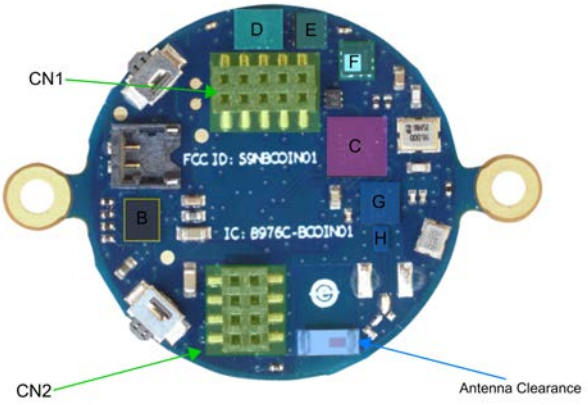


Table 1. STEVAL-BCNCS01V1 component list

Reference	Device	Description
A	MP34DT06J	MEMS audio sensor digital microphones
B	STBC03J	150 mA battery charger integrating an LDO 3 V
C	STM32F446ME	ARM Cortex-M4 core with DSP and FPU, 180 MHz, 512 Kbytes Flash
D	LSM6DSM	iNEMO inertial module: low-power 3D accelerometer and 3D gyroscope
E	LSM303AGR	Ultra-compact high-performance eCompass module: ultra-low power 3D accelerometer and 3D magnetometer
F	LPS22HB	MEMS nano pressure sensor: 260-1260 hPa absolute digital output barometer
G	BlueNRG-MS	Bluetooth low energy network processor
H	BALF-NRG-01D3	50 Ω balun with integrated harmonic filter

Table 2. STEVAL-BCNCS01V1 pinout

Connectors pin	Pin name	MCU pin	Main functions(1)
CN1.1	VBAT	VDD	I/O power supply for battery
CN1.2	GND	VSS	Ground
CN1.3	VDD	VDD	Power supply from STBC03J (LDO) [3V]
CN1.4	PC6	PC6	Xshutdown pin for Time-of-Flight
CN1.5	SWDIO	PA13	SWD Programming interface IO
CN1.6	SWDCLK	PA14	SWD Programming interface clock
CN1.7	I2C1_SCL	PB8	I2C clock
CN1.8	OTG_FS_DP	PA12	USB_OTG_FS DP
CN1.9	I2C1_SDA	PB9	I2C data
CN1.10	OTG_FS_DM	PA11	USB_OTG_FS DM
CN2.1	VIN	-	Power supply for STBC03J [2V-5.5V]
CN2.2	GND	VSS	Ground
CN2.3	USART1_RX/SAI1_FS_A	-	USART1 RX or SAI1_FS_A,
CN2.4	SDIO_CMD/USART1_TX/ SAI1_MCLK_A	PD2/PB6/PE2	USART1 TX or SAI1_MCLK_A or SDIO command
CN2.5	SAI1_SCK_A/SDIO_D0/ PB12/PB15	PB10/PC8/PB12/PB15	SAI1_SCK_A or SDIO data or PB12/PB15 pin
CN2.6	SAI1_SD_A_SDIO_CK	PB2	SAI1_SD_A or SDIO clock
CN2.7	RESET	NRST	STM32 Reset
CN2.8	VSYS	-	Unregulated output [VBAT or VIN]

1. *Refer to STM32F446 Datasheet on www.st.com for the complete set of functions of each pin*

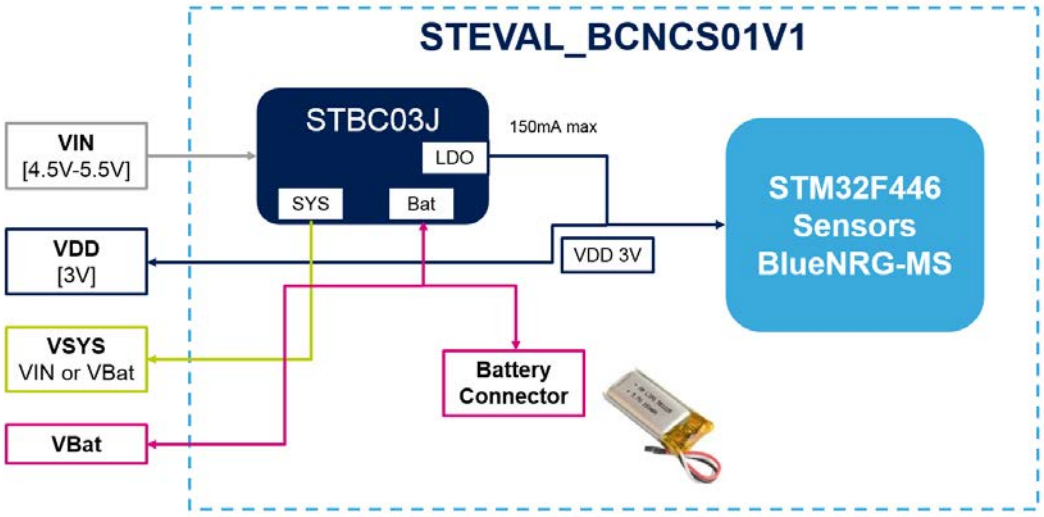
2.1 Power supply

The BlueCoin board has the following input supply pins:

1. VIN is the input for the on-board battery charger generating 3 V (150 mA max) VDD.

2. VDD is regulated by STBC03J internal LDO and is used as a power supply for the STM32F446, sensors and BlueNRG-MS
3. VBAT refers to the voltage on the Li-Po battery
4. VSYS voltage source is managed by the STBC03J and can be either VIN or VBAT depending on the operating conditions

Figure 7. STEVAL-BCNCS01V1 power supply block diagram



The on-board STBC03J battery charger IC is configured by default with a charging current of 100 mA. It is possible to modify this current by changing the R20 resistor value.

Equation 1:

$$I_{chrg} = \frac{1V}{R20} \cdot 200 \quad (1)$$

The default 2 kΩ value for R20 hence gives:

$$\frac{1V}{2K} \cdot 200 = 100mA \quad (2)$$

2.2 Power on/off procedure

To power the BlueCoin board on/off there are two different procedures (see point 1 to power on and point 2 to power off).

Step 1. When the system is fed by a Li-PO battery, push the PWR button for about a second to power the board on.

Note: This procedure is implemented thanks to the battery charger WAKE-UP feature (STBC03J)

Step 2. Push the PWR button.

In the provided software examples, the microcontroller detects the click and activates the battery charger SHUTDOWN pin to switch the power supply off.

3 STEVAL-BCNST01V1 hardware description

The STEVAL-BCNST01V1 (CoinStation) is an easy-to-use companion board for the BlueCoin. The BlueCoin Core System can be plugged onto the CoinStation through the dedicated connectors (see Figure 3. Orientation of BlueCoin and CoinStation connectors and Figure 4. BlueCoin mounted on CoinStation).

Figure 8. STEVAL-BCNST01V1 main components

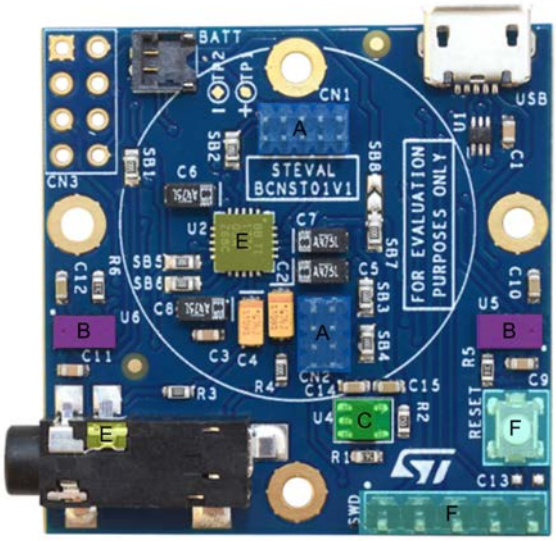


Table 3. STEVAL-BCNST01V1 main components

Reference	Device	Description
A	BlueCoin connectors	To plug the BlueCoin Core System
B	2x VL53L0X	Time-of-Flight (ToF) ranging sensor
C	LDK120M	200 mA low quiescent current very low noise LDO
D	micro-USB connector, USBLC6-2P6	micro USB socket and ESD protection
E	Audio DAC, phono jack	16-Bit, low-power stereo audio DAC and 3.5 mm stereo phono jack
F	SWD connector, Reset button	5-pin SWD connector for programming/debugging and reset button

3.1 Power supply

The power is either supplied by the host PC via USB or by a 130 mAh Li-Po battery through the battery connector.
The on-board LDO provides 2.8 V to the Time-of-Flight sensors and to the Audio DAC.

3.2 USB device

The board USB connector can be used for power supply and for communication (USB_OTG_FS).

3.3 Audio DAC

The BlueCoin can drive the PCM1774 low-power stereo DAC designed for portable digital audio applications to play any kind of audio stream.
A dedicated 3.5 mm audio jack makes it easy to connect headphones or active loudspeakers.
To use the on-board audio DAC (U2), the following solder bridges must be closed (they are open by default):

- SB1, SB2 to connect the I²C interface
- SB3, SB4, SB5, SB6 to connect the I²S interface

3.4 Time-of-Flight

The VL53L0X is a new generation Time-of-Flight (ToF) laser-ranging module housed in the smallest package on the market today, providing accurate distance measurement regardless of target reflectance.

It can measure absolute distances up to 2 m.

To use the on-board ToFs (U5, U6), SB1 and SB2 must be closed to connect the I²C peripheral.

3.5 Solder bridge details

Table 4. STEVAL-BCNST01V1 solder bridge details

Solder bridge	BlueCoin signal	On-board signal	External signal
SB1	I2C1_SCL	I2C1_SCL_ST	CN3.8
SB2	2C1_SDA	I2C1_SDA_ST	CN3.7
SB3	SAI1_MCLK_A	DAC control – SCKI	CN3.4
SB4	SAI1_SD_A	DAC Audio – DIN	CN3.6
SB5	SAI1_SCK_A	DAC Audio – BCK	CN3.3
SB6	SAI1_FS_A	DAC Audio – LRCK	CN3.5
SB7	-	DAC Audio – VIO/VDD (V_DAC)	
SB8	3V0	DAC Audio – VIO/VDD (V_DAC)	CN3.2

4 STEVAL-BCNCR01V1 hardware description

STEVAL-BCNCR01V1 (BlueCoin Cradle) is a small companion board for the BlueCoin, geared at the development of form factor prototypes. The BlueCoin Core System can be plugged onto the Cradle through the dedicated connectors.

The small cradle is ideal for applications requiring small, standalone, battery-powered sensor nodes.

Figure 9. STEVAL-BCNCR01V1 cradle main components: top view

Figure 10. STEVAL-BCNCR01V1 cradle main components: bottom view

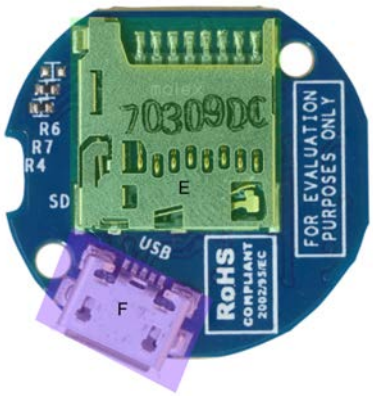


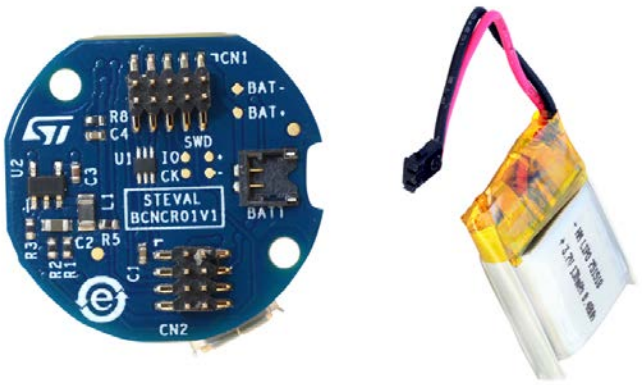
Table 5. **STEVAL-BCNCR01V1 main components**

Reference	Device	Description
A	BlueCoin connectors	To plug the BlueCoin board
B	ST1S12XX	Adjustable step-down switching regulator
C	Battery connector	2 pin socket for LiPo battery
D	SWD test points	Test points for SWD programming/ debugging interface
E	Micro SD card socket	
F	Micro USB connector	

4.1 Power supply

The STEVAL-BCNCR01V1 evaluation board power supply is the 130 mAh lithium-Ion polymer battery plugged to the appropriate connector on the PCB.

Figure 11. **Battery connection**



The battery can be recharged via USB connected to a PC or any micro-USB battery charger. The ST1S12 step down DC-DC converter provides 3.3 V to the micro SD card.

4.2 BlueCoin and cradle assembly in form factor case

Refer to the following image for the orientation of the plugged BlueCoin and cradle boards in the dedicated form factor case.

Figure 12. **BlueCoin, cradle and plastic case: 3D rendering**

Figure 13. **BlueCoin, cradle and plastic case: assembled**

5 BlueCoin programming interface

To program the board, connect an external ST-LINK to the SWD connector on the CoinStation; a 5-pin flat cable is provided in the BlueCoin Kit package.

On the Cradle board it is possible to access to SWD programming interface signals through some dedicated test points.

The easiest way to obtain an ST-LINK device is to get an STM32 Nucleo board, which bundles an ST-LINK V2.1 debugger and programmer.

Ensure that CN2 jumpers are OFF and connect your STM32 Nucleo board to the CoinStation board expansion via the cable provided, paying attention to the polarity of the connectors (Pin 1 is identified by a small dot on the PCB silkscreen).

Figure 14. STM32 Nucleo board, cradle and cradle expansion SWD connectors

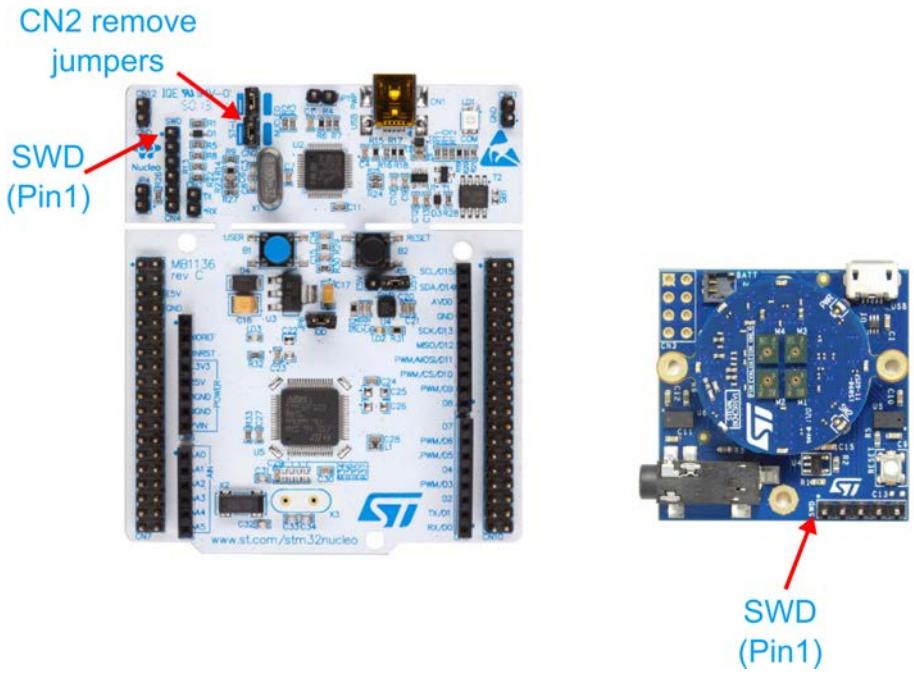
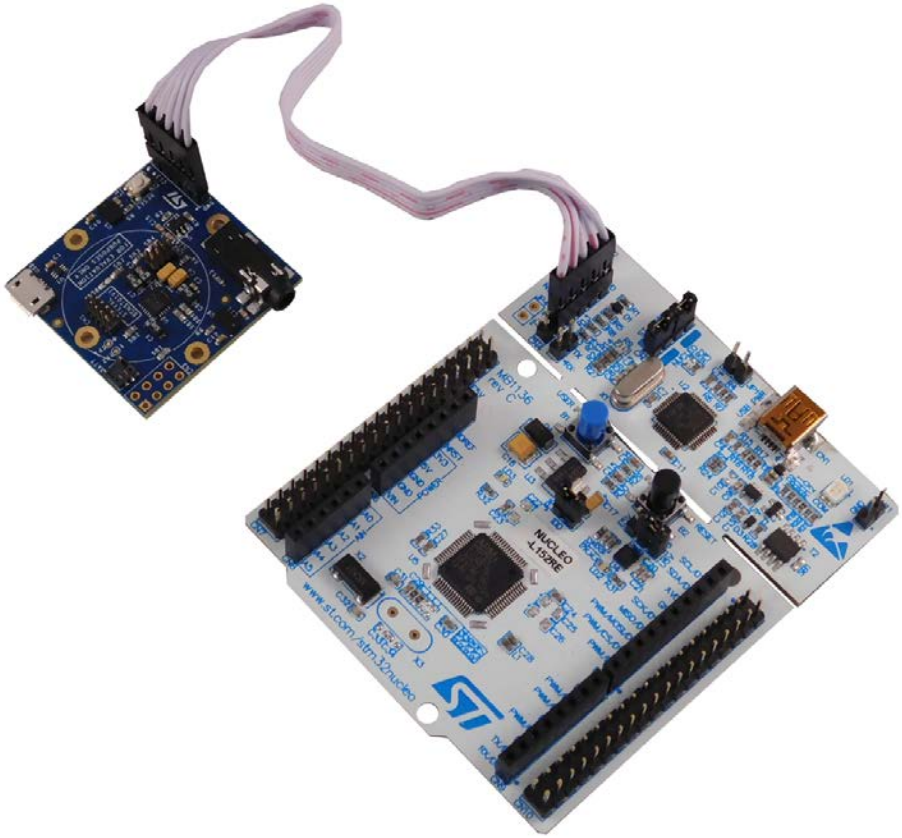


Figure 15. **SWD connections with 5-pin flat cable**



6 Main components

6.1 LSM6DSM

The LSM6DSM is a system-in-package featuring a 3D digital accelerometer and a 3D digital gyroscope performing at 0.65 mA in high-performance mode and enabling always-on low-power features for an optimal motion experience for the consumer. The LSM6DSM supports main OS requirements, offering real, virtual and batch sensors with 4 Kbytes for dynamic data batching.

ST's family of MEMS sensor modules leverages the robust and mature manufacturing processes already used for the production of micromachined accelerometers and gyroscopes. The various sensing elements are manufactured using specialized micromachining processes, while the IC interfaces are developed using CMOS technology that allows the design of a dedicated circuit which is trimmed to better match the characteristics of the sensing element.

The LSM6DSM has a full-scale acceleration range of ±2/±4/±8/±16 g and an angular rate range of ±125/±245/±500/±1000/±2000 dps. The LSM6DSM fully supports EIS and OIS applications as the module includes a dedicated configurable signal processing path for OIS and auxiliary SPI configurable for both gyroscope and accelerometer.

High robustness to mechanical shock makes the LSM6DSM the preferred choice of system designers for the creation and manufacturing of reliable products.

6.2 LSM303AGR

The LSM303AGR is an ultra-low-power high-performance system-in-package featuring a 3D digital linear acceleration sensor and a 3D digital magnetic sensor. The Device has linear acceleration full scales of ±2g/±4g/±8g/±16g and a magnetic field dynamic range of ±50 gauss.

The LSM303AGR includes an I2C serial bus interface that supports standard, fast mode, fast mode plus, and high-speed (100 kHz, 400 kHz, 1 MHz, and 3.4 MHz) and an SPI serial standard interface. The system can be configured to generate an interrupt signal for free-fall, motion detection and magnetic field detection.

The magnetic and accelerometer blocks can be enabled or put into power-down mode separately.

6.3 LPS22HB

The LPS22HB is an ultra-compact piezoresistive absolute pressure sensor which functions as a digital output barometer. The device comprises a sensing element and an IC interface which communicates through I²C or SPI from the sensing element to the application.

The sensing element, which detects absolute pressure, consists of a suspended membrane manufactured using a dedicated process developed by ST.

The LPS22HB is available in a full-mold, holed LGA package (HLGA). It is guaranteed to operate over a temperature range extending from -40 °C to +85 °C. The package is holed to allow external pressure to reach the sensing element.

LPS22HB is factory calibrated but a residual offset could be introduced by the soldering process. This offset can be removed with a one-point calibration.(For further details, refer to application note AN4833, "Measuring pressure data from ST's LPS22HB digital pressure sensor", on www.st.com.)

6.4 MP34DT06J

The MP34DT06J is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated to producing audio sensors.

The IC interface is manufactured using a CMOS process that allows designing a dedicated circuit able to provide a digital signal externally in PDM format.

The MP34DT06J is a low-distortion digital microphone with an acoustic overload point of 122.5 dBSPL, a 64 dB signal-to-noise ratio and –26 dBFS ± 1 dB sensitivity.

6.5 BLUENRG-MS

The BlueNRG-MS is a very low power Bluetooth low energy (BLE) single-mode network processor, compliant with Bluetooth specification v4.1. The BlueNRG-MS supports multiple roles simultaneously and can act at the same time as Bluetooth smart sensor and hub device.

The Bluetooth Low Energy stack runs on the embedded ARM Cortex-M0 core. The stack is stored on the on-chip non-volatile Flash memory and can be easily upgraded via SPI.

The device comes pre-programmed with a production-ready stack image(Its version could change at any time without notice). A different or more up-to-date stack image can be downloaded from the ST website and programmed on the device through the ST provided software tools.

The BlueNRG-MS allows applications to meet the tight advisable peak current requirements imposed by standard coin cell batteries.

The maximum peak current is only 10 mA at 1 dBm output power. Ultra low-power sleep modes and very short transition times between operating modes allow very low average current consumption, resulting in longer battery life.

The BlueNRG-MS offers the option of interfacing with external microcontrollers via SPI transport layer.

6.6 BALF-NRG-01D3

BALF-NRG-01D3 is a 50 Ω conjugate match to BlueNRG-MS (QFN32 package) that integrates balun transformer and harmonics filtering. It features high RF performances with a very small footprint and a RF BOM reduction. It has been chosen as the best trade-off for costs, area occupation and high radio performances. The layout has been optimized to suit a 4-layer design and a chip antenna.

6.7 STBC03J

The STBC03 is a linear charger for single-cell Li-Ion batteries integrating an always ON LDO and several battery protections (PCM). The device uses a CC/CV algorithm to charge the battery; the fast-charge and pre-charge current can be programmed using an external resistor. The STBC03 integrates (PCM) over-charge, overdischarge and over-current protection circuitry to prevent the battery from being damaged under fault conditions; it also features a charger enable input to stop the charging process when needed.

7 Bill of materials

Table 6. **STEVAL-BCNST01V1 bill of materials**

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	BATT	Battery Connector		Molex	78171-0002
2	1	CN1	FTSH-105-03-L-D		Samtec	FTSH-105-03-L-D
3	1	CN2	FTSH-104-03-L-D		Samtec	FTSH-104-03-F-D
4	1	CN3	HEADER 4X2	DNM		
5	2	C1,C3	100nF	X7R		
6	2	C2,C4	47uF	Tantal		
7	4	C5,C6,C7,C8	4.7 µF > 6.3 V <2 OHM ESR 3216-16	Tantal		
8	2	C9,C11	100 nF 10 V C_0603	X5R		
9	2	C10,C12	4.7 µF 10 V C_0603	X5R		
10	1	C13	NC C_0603	X7R DNM		
11	2	C14,C15	4.7 µF 10 V C_0603	X5R DNM		
12	1	J1		PHONOJACK STEREO	Switchcraft	35RASMT4BHNTRX
13	4	J5, J6, J7, J8		PCB Hole		
14	1	RESET	SYS_MODE		C&K Components	PTS820 J20M SMTR LFS
15	1	R1	56 K ±1% R_0603			
16	1	R2	140 K ±1% R_0603			
17	9	SB1, SB2, SB3, R3, SB4, R4, SB5, SB6, SB7	0 R R_0603			
18	2	R5, R6	10 K ±1% R_0603			
19	1	SB8	NC R_0603	DNM		
20	1	SWD	CON5			
21	1	TP1	VBAT	DNM		
22	1	TP2	GND	DNM		
23	1	USB	USB-Micro-B	USB-MICRO	GCT	USB3075-30-A
24	1	U1	USBLC6-2P6 SOT666	Very low capacitance ESD protection	ST	USBLC6-2P6
25	1	U2	PCM1774RGP VQFN20		TI	PCM1774RGP
26	1	U4	LDK120M-R SOT23-5L	Very low noise LDO	ST	LDK120M-R

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
27	2	U5, U6	VL53L0CXV0DH/1	Time-of-Flight ranging sensor	ST	VL53L0X
28	1	SWD Cable	5 pin 2.54mm - L=15cm	Ribbon cable		

Table 7. STEVAL-BCNS01V1 bill of materials

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	A1	JT_2450AT18A100E 3.2x1.6x1.3		Johanson Technology	2450AT18A100E
2	1	A2		U.FL connector DNM	Hirose	U.FL-R-SMT-1(10)
3	1	BATT		Battery Connector	Molex	78171-0002
4	1	CN1	CLP-105-02-L-D		Samtec	CLP-105-02-L-D
5	1	CN2	CLP-104-02-L-D		Samtec	CLP-104-02-L-D
6	3	C1,C6,C34	4.7 µF 6.3 V X5R C_0402	Capacitor		
7	2	C2,C15	10 µF 6.3 V X5R C_0603	Capacitors		
8	6	C3,C10,C17,C25,C27,C36	1 µF 10 V X5R C_0402	Capacitors		
9	18	C4,C5,C8,C11,C13,C14,C16,C18,C20,C21,C22,C28,C29,C30,C32,C35,C37,C41	100 nF C_0201 X7R	Capacitors		
10	2	C7,C39	2.2 µF 6.3 V C_0402 X5R	Capacitors		
11	2	C9,C12	10 pF C_0402 C0G	Capacitors		
12	1	C19	220 nF C_0201 X7R	Capacitor		
13	2	C23,C33	12 pF C_0402 C0G	Capacitors		
14	2	C24,C26	100 pF C_0201 C0G	Capacitors		
15	1	C31	150 nF C_0402 X5R	Capacitor		
16	1	C38	NC C_0201 C0G	Capacitor		
17	1	C40	0.5 pF 25 V ±0.1 pF C_0201 C0G	Capacitor	Murata	GJM0335C1ER50BB01D
18	8	LED1,LED2,LED3,LED4,LED5,LED6,LED7,LED8	LED_R LED_0402	LEDs		
19	1	L2	3.9 nH L_0402		Murata	LQG15HN3N9SO2D
20	4	M1,M2,M3,M4	MP34DT06J (3 x 4 x 1 mm)	MEMS digital microphones	ST	MP34DT06JTR
21	2	R1,R22	0 R R_0201	Resistors		
22	4	R2,R4,R18,R19	100 K R_0201	Resistors		
23	1	R3	10 K R_0201	Resistor		

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
24	8	R5,R6,R9,R10,R11, R12,R13,R14	560 R 50 mW R_0201	Resistors		
25	2	R7,R8	4K7 R_0201	Resistors		
26	1	R15	9.1 nH 250 mA R_0201	Resistor	Murata	LQP03TQ9N1H02D
27	1	R16	133 K ±1% R_0201	Resistor		
28	1	R17	56 K ±1% R_0201	Resistor		
29	1	R20	2 K ±1% R_0201	Resistor		
30	1	R21	20 K ±1% R_0201	Resistor		
31	1	R23	10 K ±1% R_0201	Resistor		
32	1	SW1	SW1	Tactile switch	OMRON ELECTRONIC	B3U-3000P-B
33	1	SW2	SW2	Tactile switch	OMRON ELECTRONIC	B3U-3000P-B
34	1	TP1	VBAT	DNM		
35	1	TP2	GND	DNM		
36	1	TP3	VIn	DNM		
37	1	TP4	SWDIO	DNM		
38	1	TP5	SWDCLK	DNM		
39	1	U1	STM32F446 WLCSP81	Accelerator	ST	STM32F446
40	1	U2	BLUENRG-MSCSP	BLE metwork processor	ST	BLUENRG-MSCSP
41	1	U3	STBC03J	Battery management	ST	STBC03JR
42	1	U4	AS11P2TLR DFN6L		ST	DFN6L
43	1	U5	BALF-NRG-01D3 Flip-Chip-4	Balun	ST	BALF-NRG-01D3
44	1	U6	LSM303AGR (2 x 2 x 1 mm)	3D accelerometer and magnetometer	ST	LSM303AGR
45	1	U7	LSM6DSM LGA-14 (3x2.5x1 mm)	3D accelerometer and gyroscope	ST	LSM6DSM
46	1	U8	LPS22HB (2 x 2 x 0.76 mm)	MEMS nano pressure sensor	ST	LPS22HB
47	1	X1	16 MHz 2.5x2 mm		NDK	NX2520SA-16.000000MHZ
48	1	X2	32 MHz 2.0x1.6 mm		NDK	NX2016SA 32MHz EXS00A-CS06644

Table 8. STEVAL-BCNCR01V1 bill of materials

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	BATT		Battery connector	Molex	78171-0002
2	1	CN1			Samtec	FTSH-105-03-L-DV or FTSH-105-03-F-DV
3	1	CN2			Samtec	FTSH-104-03-L-DV or FTSH-104-03-F-DV

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
4	2	C1,C4	100 nF X7R C_0402	Capacitor		
5	1	C2	10 µF X5R 10 V C_0603	Capacitor		
6	1	C3	4.7 µF X5R 10 V C_0402	Capacitor		
7	1	L1	2.2 µH 700 mA 20% L_0805 ±20%		Wurth Elektronik	74479775222
8	1	R1	120 K 1% R_0402 ±1%			
9	1	R2	27 K 1% R_0402 ±1%			
10	1	R3	100 K 1% R_0402 ±1%			
11	4	R4,R5,R7,R8	47 K R_0402	Resistors		
12	1	R6	NC R_0402	DNM		
13	1	SD		Micro-SD	Molex	503398-1892
14	1	TP1	VBAT	DNM		
15	1	TP2	GND	DNM		
16	1	USB	USB-Micro-B	USB-MICRO	HIROSE	ZX62-B-5PA (33)
17	1	U1	USBLC6-2P6 SOT666	Very low capacitance ESD protection	ST	USBLC6-2P6
18	1	U2	ST1S12XX TSOT23-5L	Step down DC-DC converter	ST	ST1S12XX
19	1	Battery	LiPO-751518 3.7 V 130 mAh	2 pin connector	Himax electronics	LiPO-751518
20	1	Plastic Box	Plastic Box			
21	4	M2-Nut	HEX Nut M2 - steel	M2	RS	
22	2	M2-Screw	12 mm M2 - steel	Pan head - phillips	RS	
23	2	M2-Screw	10 mm M2- steel	Pan head - phillips	RS	

8 STEVAL-BCNKT01V1 schematic diagrams

Figure 16. STEVAL-BCNST01V1 circuit schematic

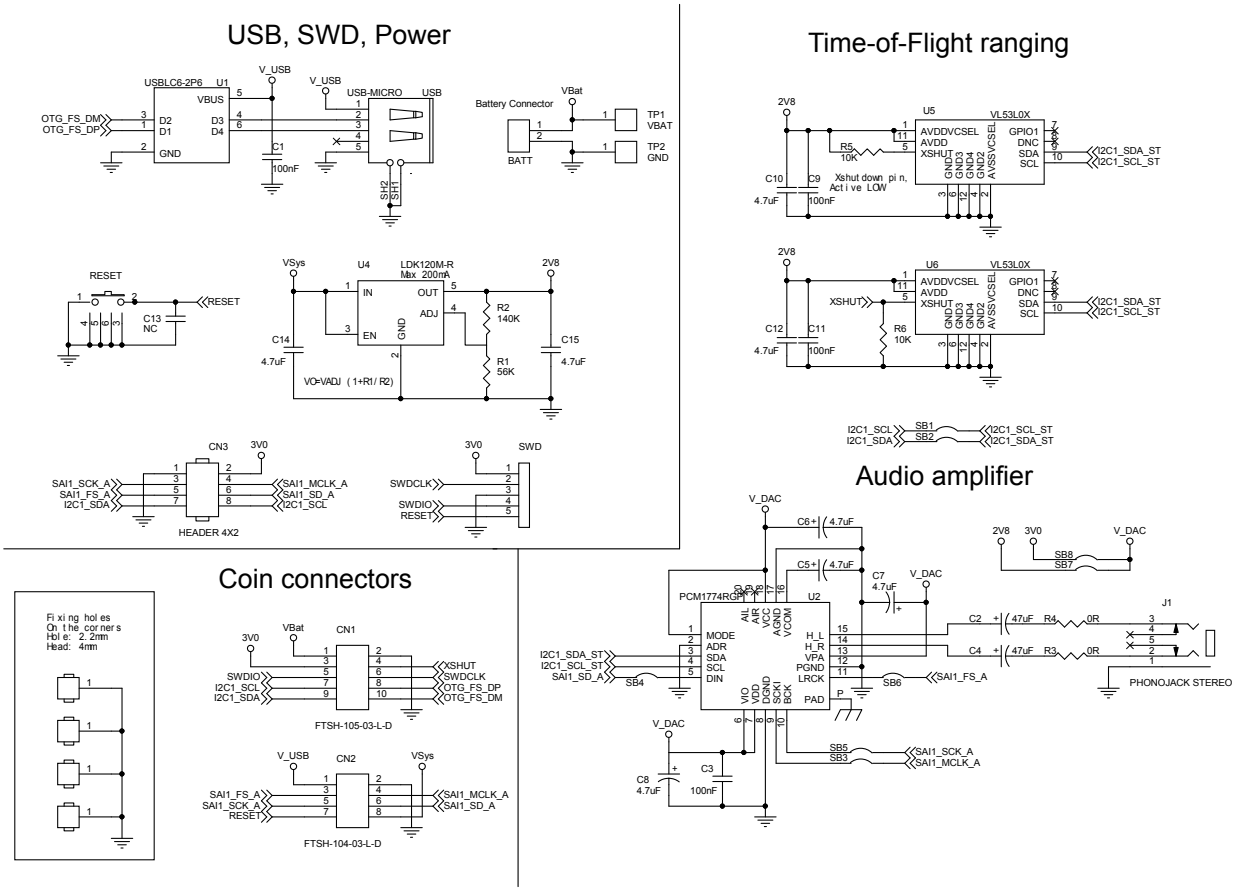
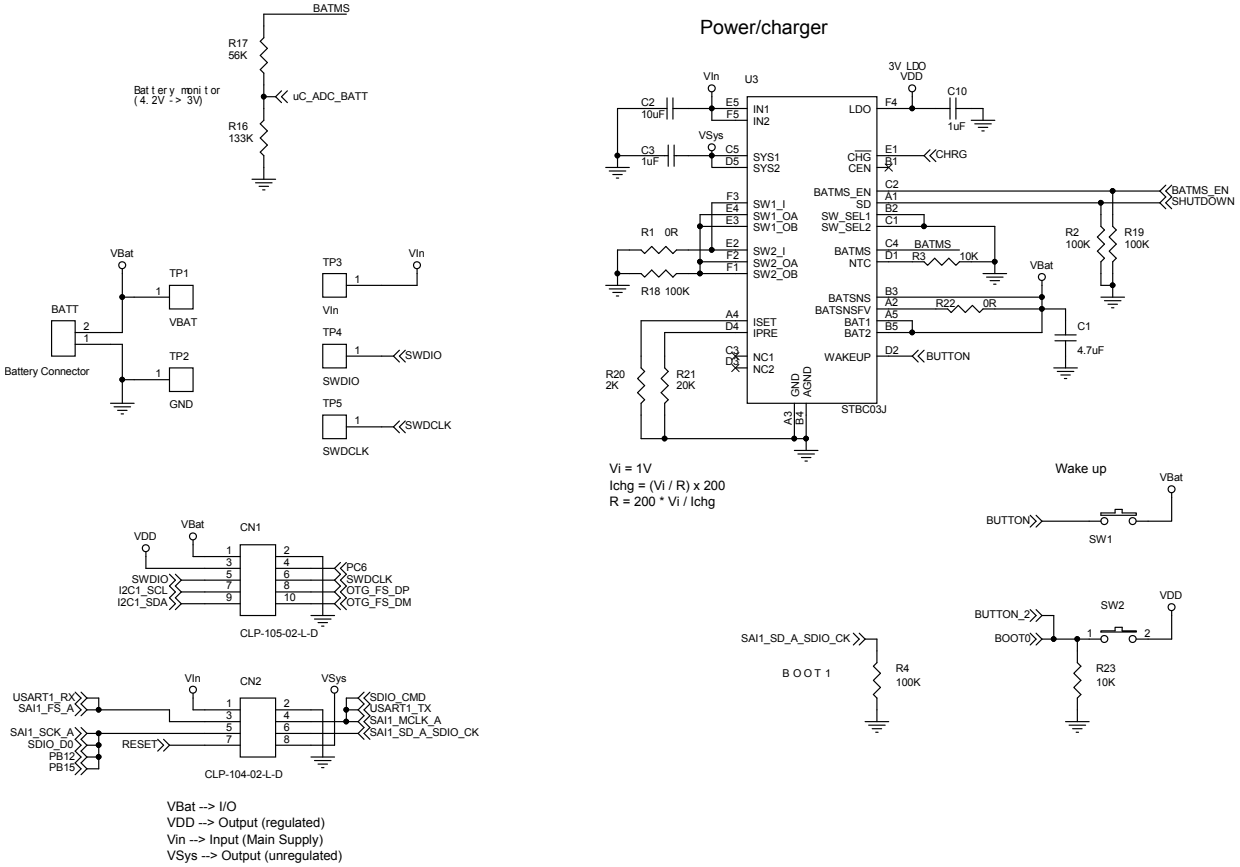


Figure 17. STEVAL-BCNCS01V1 circuit schematic (1 of 4): connectors and power



VBat --> I/O
VDD --> Output (regulated)
Vin --> Input (Main Supply)
VSys --> Output (unregulated)

Figure 18. **STEVAL-BCNCS01V1 circuit schematic (2 of 4): STM32F446MEY6**

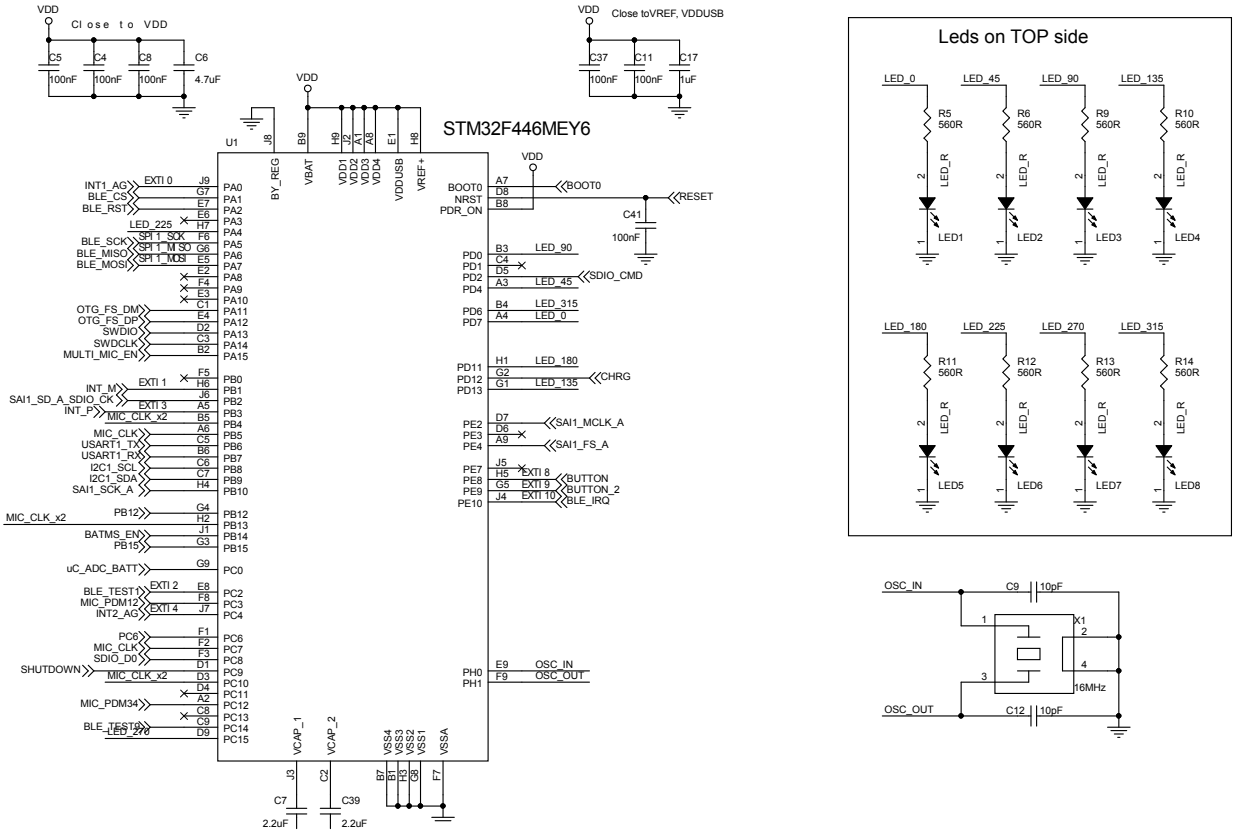


Figure 19. **STEVAL-BCNCS01V1 circuit schematic (3 of 4): MEMS**

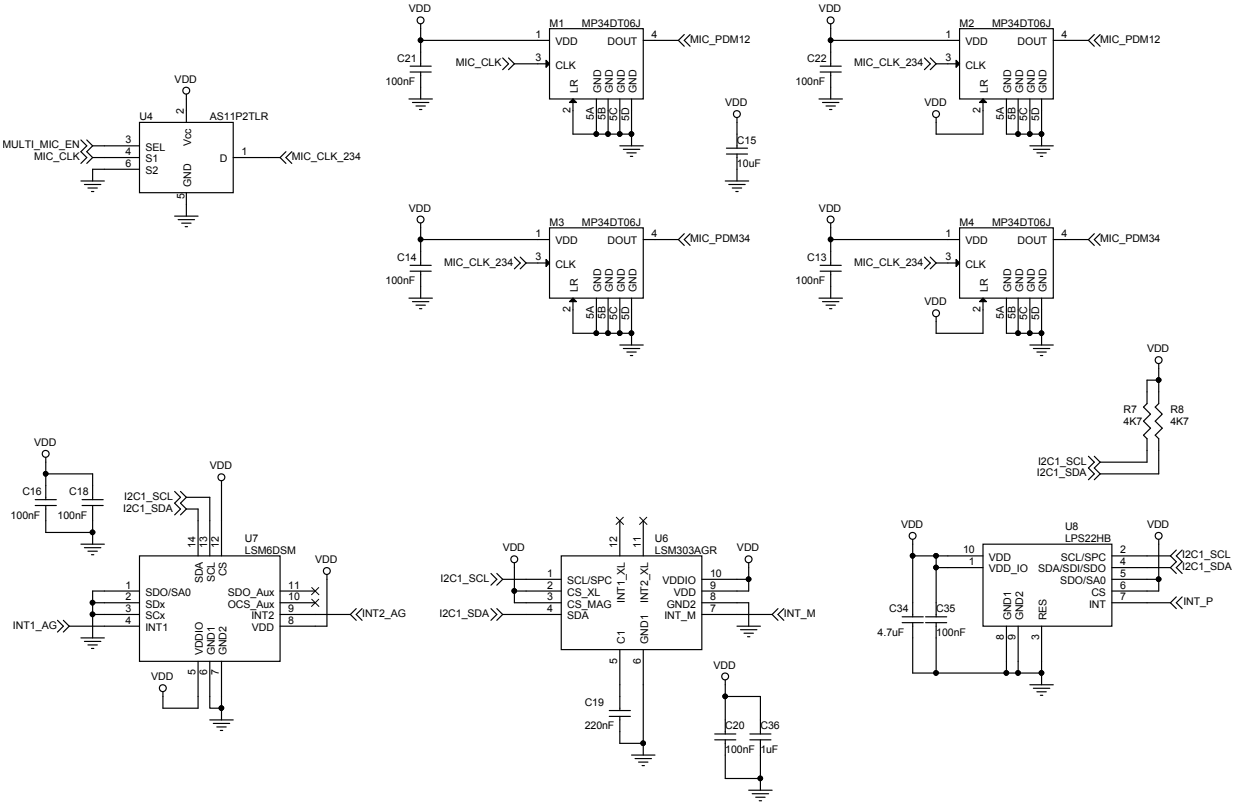
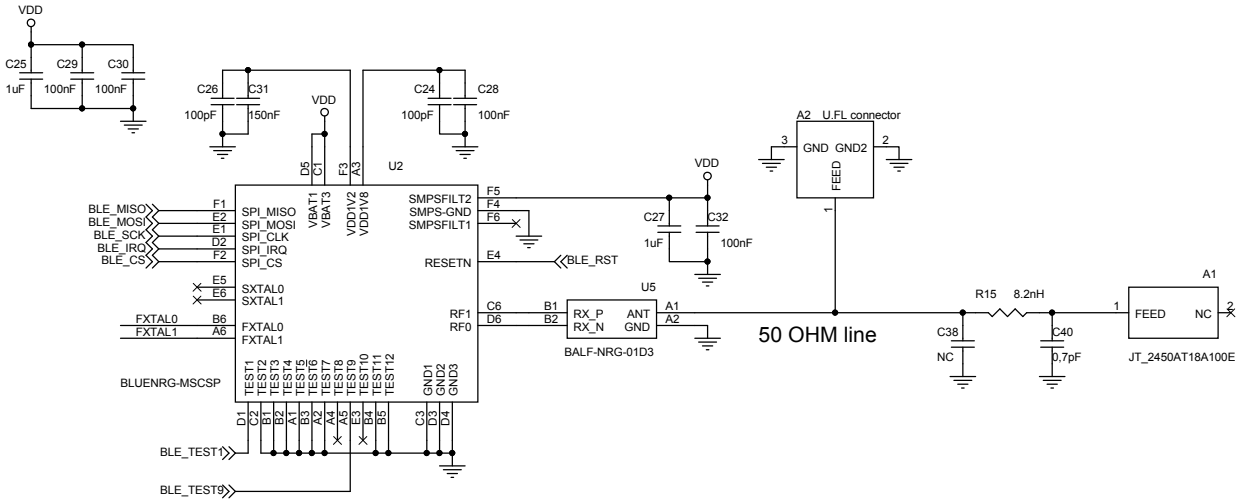


Figure 20. **STEVAL-BCNCS01V1 circuit schematic (4 of 4): BlueNRG-MS/Balf/Antenna**



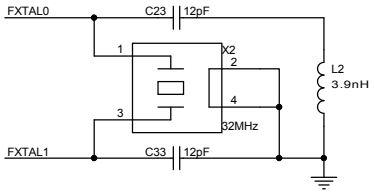
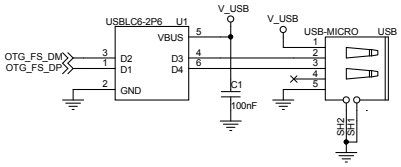
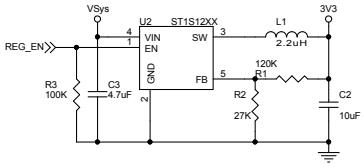
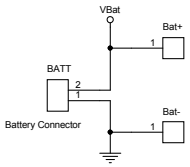
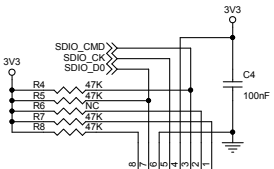


Figure 21. **STEVAL-BCNCR01V1 circuit schematic**

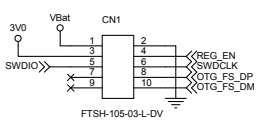


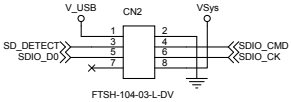


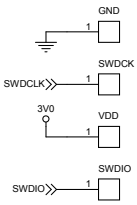




Coin connectors (SMD)







9 Formal notices required by the U.S. Federal Communications Commission ("FCC")

FCC NOTICE: This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the manufacturer could void the user’s authority to operate the equipment.

Additional warnings for FCC

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's by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the 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.

10 Formal product notice required by the Industry Canada ("IC")

Innovation, Science and Economic Development Canada Compliance - This device complies with Innovation, Science and Economic Development RSS standards. 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. Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

Conformité à Innovation, Sciences et Développement Économique Canada - Cet appareil est conforme aux normes RSS d'Innovation, Science et Développement économique. L'utilisation est soumise aux deux conditions suivantes: (1) cet appareil ne doit pas causer d'interférences nuisibles, et (2) cet appareil doit accepter de recevoir tous les types d'interférence, y comprises les interférences susceptibles d'entraîner un fonctionnement indésirable. Les changements ou les modifications non expressément approuvés par le fabricant pourraient annuler le permis d'utiliser l'équipement.

Revision history

Table 9. **Document revision history**

Date	Version	Changes
17-Jul-2017	1	Initial release.
11-Oct-2018	2	Updated Figure 1. BlueCoin functional block diagram, Section 7 Bill of materials and Figure 19. STEVAL-BCNCS01V1 circuit schematic (3 of 4): MEMS. Added references to MP34DT06J microphone and Section 6.4 MP34DT06J.