UM1842
User manual

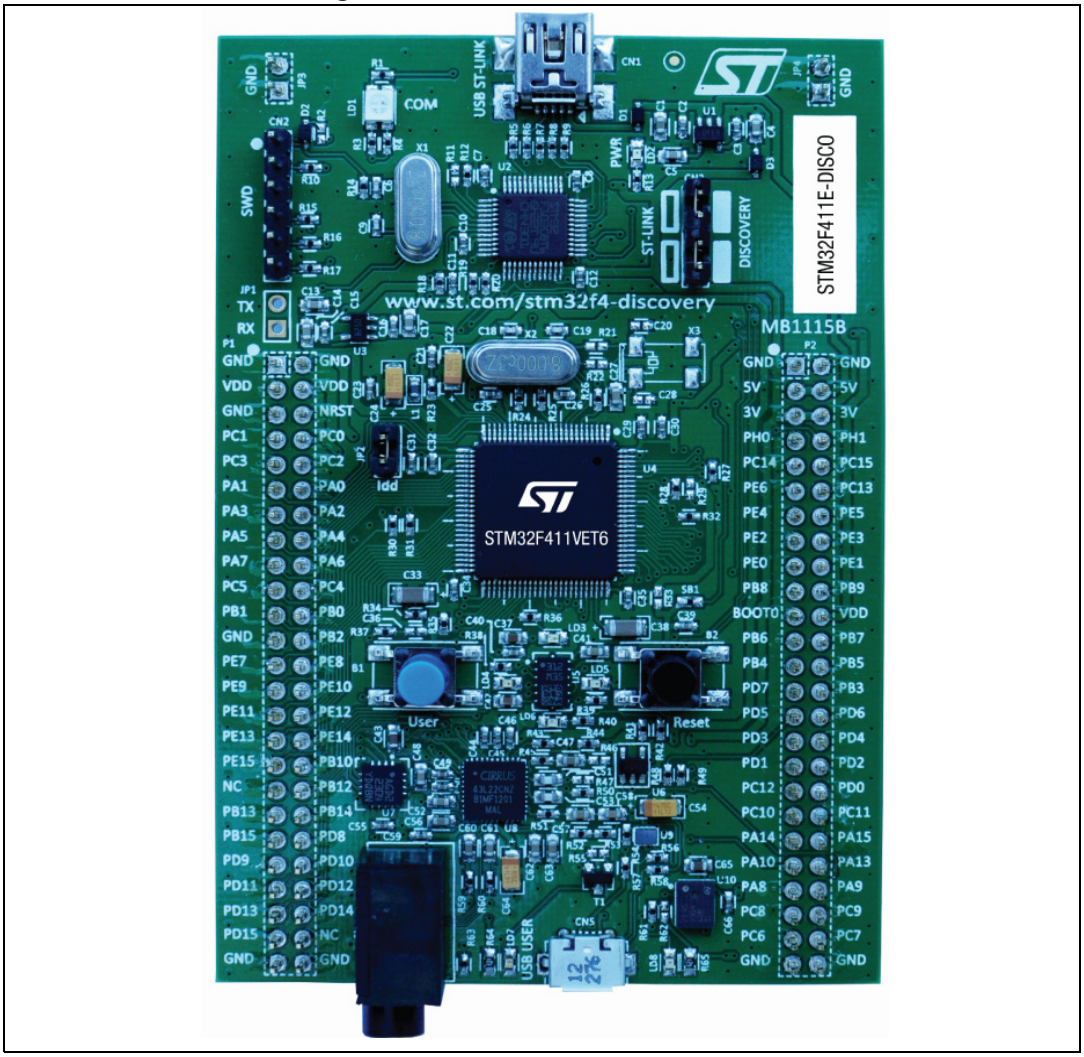
Discovery kit with STM32F411VE MCU

Introduction

The Discovery kit (32F411EDISCOVERY) helps users to discover the STM32F411 entry-level microcontrollers in the STM32F4 Series, and develop their applications easily. It offers everything required for beginners and experienced users to get started quickly.

Based on the STM32F411VE, it includes an ST-LINK/V2 embedded debug tool, a gyroscope, an e-compass, a digital microphone, an audio DAC with integrated class-D speaker driver, an OTG Micro-AB connector, LEDs, and push-buttons.

Figure 1. 32F411EDISCOVERY board



Picture is not contractual.

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1 Features

- STM32F411VE Arm®[a]-based microcontroller featuring 512 Kbytes of Flash memory and 128 Kbytes of RAM in an LQFP100 package
- USB OTG FS
- ST MEMS 3-axis digital output gyroscope
- ST MEMS 3D digital linear accelerometer and magnetic sensor
- ST MEMS digital microphone
- Audio DAC with integrated class-D speaker driver
- Eight LEDs:
  - LD1 (red/green) for USB communication
  - LD2 (red) for 3.3 V power on
  - Four user LEDs: LD3 (orange), LD4 (green), LD5 (red) and LD6 (blue)
  - Two USB OTG LEDs: LD7 (green) VBUS and LD8 (red) over-current
- Two user and reset push-buttons
- Board connectors:
  - USB OTG FS Micro-AB connector
  - ST-LINK Mini-B USB connector
  - Extension header for all LQFP100 I/Os for quick connection to the prototype board and easy probing
- Flexible power-supply options:
  - ST-LINK USB connector
  - External 5 V supply voltage
- On-board ST-LINK/V2 debugger/programmer with mode selection switch to use the kit as a standalone ST-LINK probe (featuring an SWD connector for programming and debugging)
- Comprehensive free software including a variety of examples, part of the STM32CubeF4 MCU Package or STSW-STM32136 for legacy Standard Libraries usage
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE

arm

a. Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

2 Ordering information

To order the Discovery kit (32F411EDISCOVERY), refer to *Table 1*. Additional information is available from the datasheet and reference manual of the target STM32.

Table 1. Ordering information

Order code	Board reference	Target STM32	Differentiating features
STM32F411E-DISCO	MB1115B	STM32F411VET6	– L3GD20 3-axis gyroscope(1) – LSM303DLHC e-compass – MP45DT02 digital MEMS microphone(1)
	MB1115D		– I3G4250D 3-axis gyroscope – LSM303AGR e-compass – IMP34DT05 digital MEMS microphone

1. Obsolete.

2.1 Codification

The meaning of the codification is explained in *Table 2*.

Table 2. Codification explanation

32XXYYZDISCOVERY	Description	Example: 32F411EDISCOVERY
32XX	MCU series in STM32 32-bit Arm Cortex MCUs	STM32F4 Series
YY	MCU product line in the series	STM32F411
Z	STM32 Flash memory size: E for 512 Kbytes	512 Kbytes
DISCOVERY	Discovery kit	Discovery kit

3 Development environment

3.1 System requirements

- Windows® OS (7, 8, and 10)
- USB Type-A or USB Type-C® to Mini-B cable

3.2 Development toolchains

- IAR Systems- IAR Embedded Workbench®(a)
- Keil® - MDK-ARM(a)
- STMicroelectronics - STM32CubeIDE

3.3 Demonstration software

The demonstration software, included in the STM32Cube MCU Package corresponding to the on-board microcontroller, is preloaded in the STM32 Flash memory for easy demonstration of the device peripherals in standalone mode. The latest versions of the demonstration source code and associated documentation can be downloaded from *www.st.com*.

4 Conventions

Table 3 provides the conventions used for the ON and OFF settings in the present document.

Table 3. ON/OFF conventions

Convention	Definition
Jumper JPx ON	Jumper fitted
Jumper JPx OFF	Jumper not fitted
Jumper JPx [1-2]	Jumper fitted between Pin 1 and Pin 2
Solder bridge SBx ON	SBx connections closed by 0 Ω resistor
Solder bridge SBx OFF	SBx connections left open
Resistor Rx ON	Resistor soldered
Resistor Rx OFF	Resistor not soldered

In this document, board figures and photos are based on version B, version D is similar.

a. On Windows® only.

5 Quick start

The Discovery kit (32F411EDISCOVERY) is a low-cost and easy-to-use development kit to quickly evaluate and start development with an STM32F4 entry-level microcontroller.

Before installing and using the product, please accept the Evaluation Product License Agreement from www.st.com/stm32f4-discovery.

For more information on the 32F411EDISCOVERY board and for demonstration software, visit www.st.com/stm32f4-discovery.

5.1 Getting started

Follow the sequence below to configure the 32F411EDISCOVERY board and launch the DISCOVER application:

1. Ensure that the jumpers JP2 and CN3 are ON (Discovery mode).
2. Connect the board to a PC using a USB Type-A or USB Type-C® to Mini-B cable through the USB ST-LINK connector CN1 to power the board. The LED LD2 (PWR) lights up and the four LEDs between the B1 and B2 buttons start blinking.
3. Press the B1 user button to enable the MEMS sensor. The four LEDs indicate the board inclination with respect to X and Y axes. When connected through CN5 to a PC with a second USB Type-A or USB Type-C® to Micro-B cable, the board is recognized as a standard mouse. Tilt the board relative to the horizontal plane to move the cursor on the screen.
4. The demo software, as well as other software examples that allow the user to discover the STM32 F4 series features, are available on www.st.com/stm32f4-discovery.

6 Hardware layout

The 32F411EDISCOVERY board has been designed around the STM32F411VET6 microcontroller in a 100-pin LQFP package.

Figure 2 illustrates the connections between the STM32F411VET6 and its peripherals (ST-LINK/V2, pushbutton, LED, Audio DAC, USB, ST MEMS gyroscope, ST MEMS accelerometer + magnetometer, ST MEMS microphone, and connectors).

Figure 3 and *Figure 4* help you to locate these features on the 32F411EDISCOVERY board.

Figure 2. Hardware block diagram

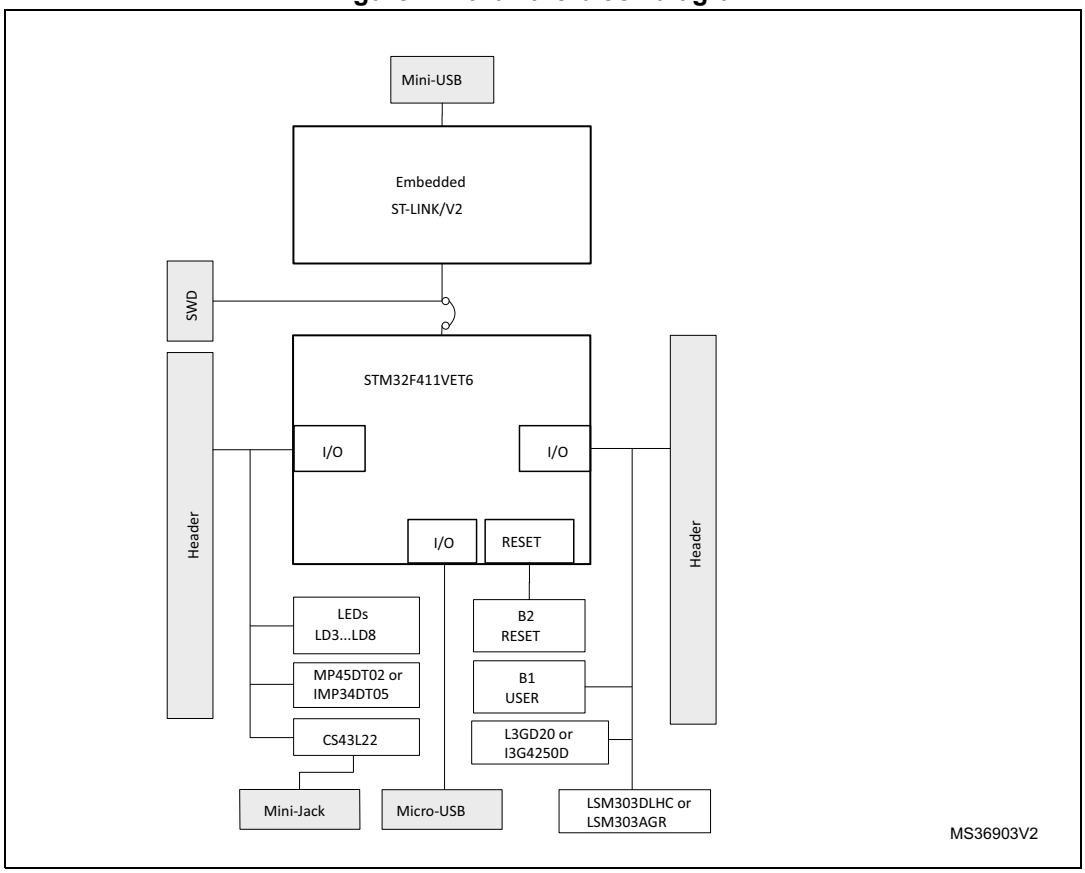


Figure 3. Top layout

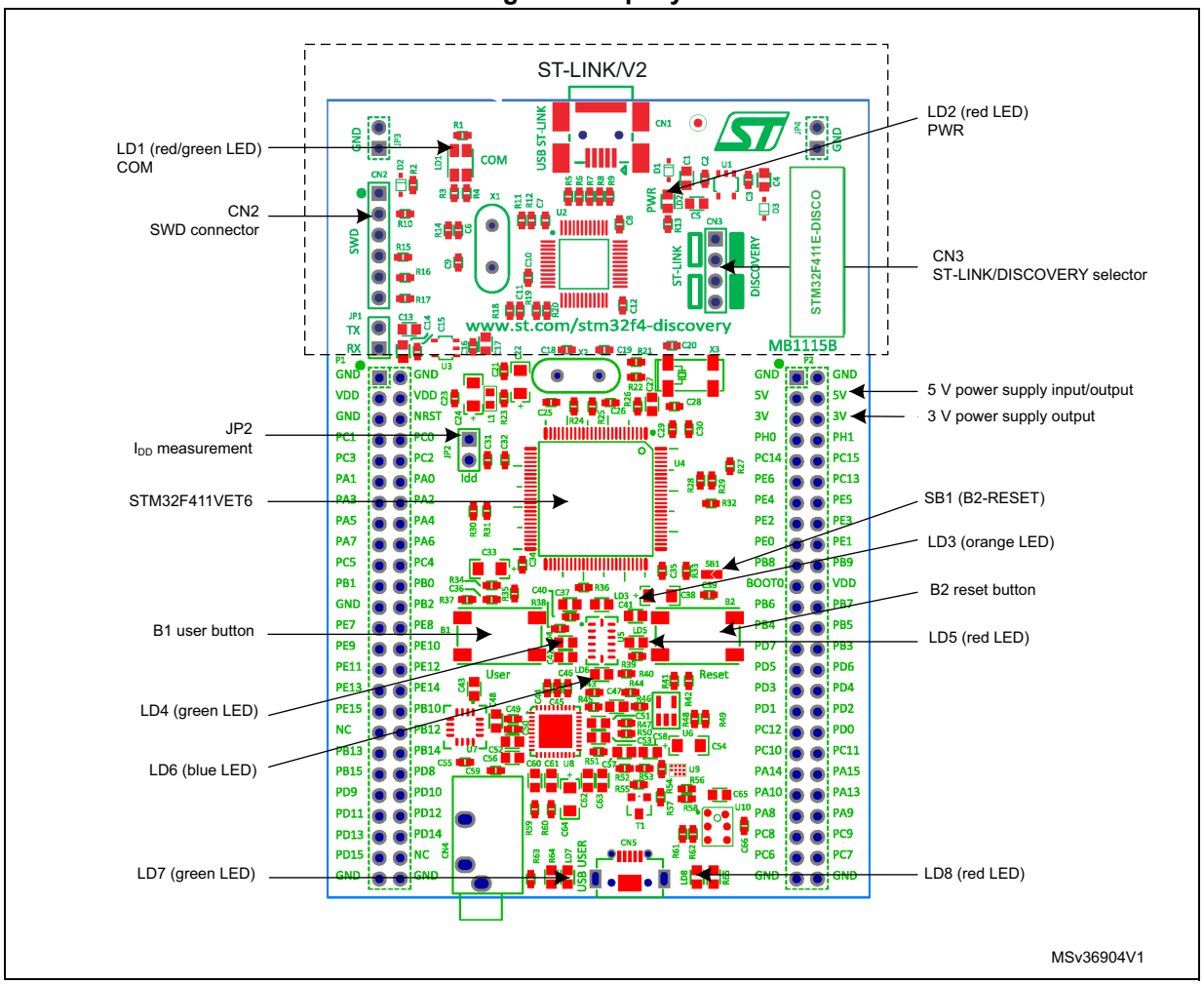
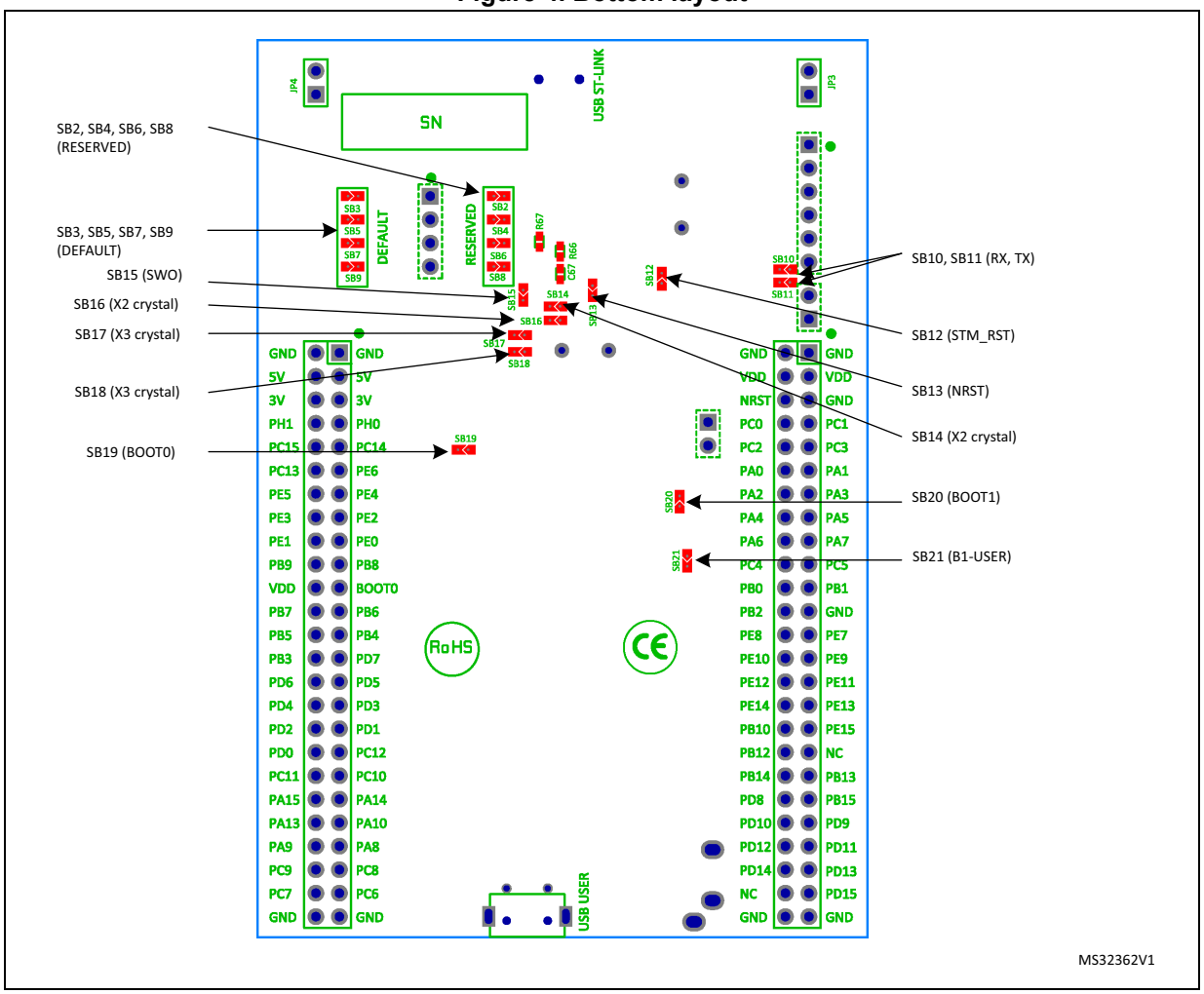


Figure 4. Bottom layout



6.1 Embedded ST-LINK/V2

The ST-LINK/V2 programming and debugging tool is integrated on the 32F411EDISCOVERY board. The embedded ST-LINK/V2 can be used in 2 different ways according to the jumper states (see *Table 4*):

- Program/debug the MCU on board,
- Program/debug an MCU in an external application board using a cable connected to SWD connector CN2.

The embedded ST-LINK/V2 supports only SWD for STM32 devices. For information about debugging and programming features, refer to user manual UM1075 (ST-LINK/V2 in-circuit debugger/programmer for STM8 and STM32) which describes in detail all the ST-LINK/V2 features.

Figure 5. Typical configuration

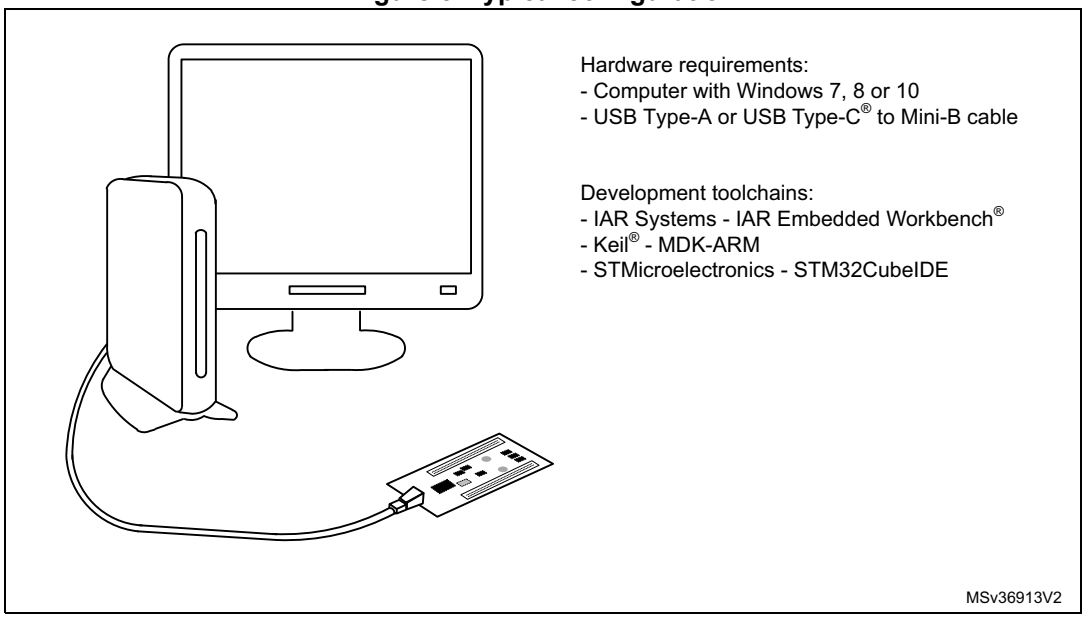


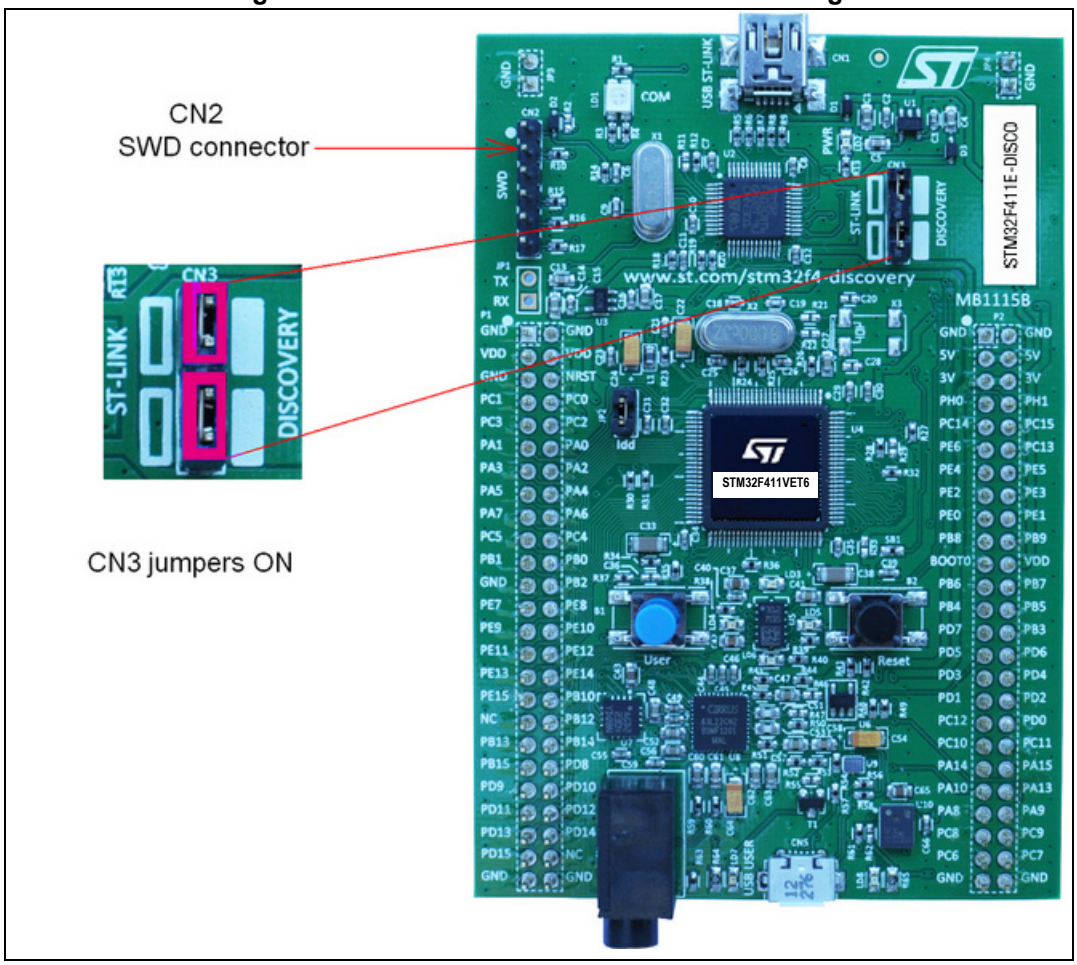
Table 4. Jumper states

Jumper state	Description
Both CN3 jumpers ON	ST-LINK/V2 functions enabled for on-board programming (default)
Both CN3 jumpers OFF	ST-LINK/V2 functions enabled for application through external CN2 connector (SWD supported)

6.1.1 Using ST-LINK/V2 to program/debug the on-board STM32F411VET6

To program the on-board STM32F411VET6, simply plug in the two jumpers on CN3, as shown in *Figure 6* in red, but do not use the CN2 connector as that may disturb communication with the STM32F411VE of the 32F411EDISCOVERY board.

Figure 6. 32F411EDISCOVERY connections image



6.1.2 Using ST-LINK/V2 to program/debug an external STM32 application

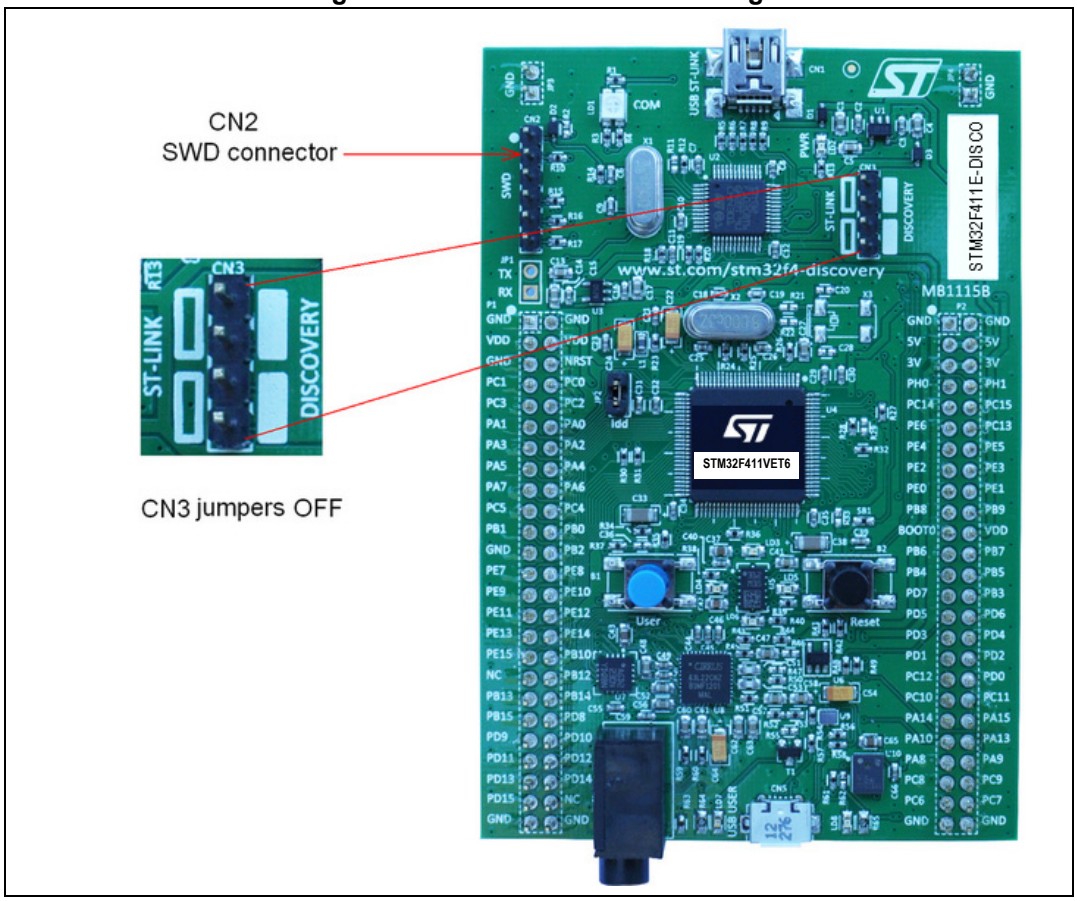
It is very easy to use the ST-LINK/V2 to program the STM32 on an external application. Simply remove the two jumpers from CN3 as shown in *Figure 7*, and connect the application to the CN2 debug connector according to *Table 5*.

Note: SB13 must be OFF to use CN2 pin 5 in the external application.

Table 5. Debug connector CN2 (SWD)

Pin	CN2	Designation
1	VDD_TARGET	VDD from application
2	SWCLK	SWD clock
3	GND	Ground
4	SWDIO	SWD data input/output
5	NRST	RESET of target MCU
6	SWO	Reserved

Figure 7. ST-LINK connections image



6.2 Power supply and power selection

The power supply is provided either by the host PC through the USB cable, or by an external 5 V power supply.

The D1 and D2 diodes protect the 5 V and 3 V pins from external power supplies:

- 5 V and 3 V can be used as output power supplies when another application board is connected to pins P1 and P2.
  In this case, the 5 V and 3 V pins deliver a 5 V or 3 V power supply, and the power consumption must be lower than 100 mA.
- 5 V can also be used as input power supplies, e.g. when the USB connector is not connected to the PC.
  In this case, the 32F411EDISCOVERY board must be powered by a power supply unit or auxiliary equipment complying with standard EN-60950-1: 2006+A11/2009, and must be Safety Extra Low Voltage (SELV) with limited power capability.

6.3 LEDs

- LD1 COM:
  The LD1 default status is red. LD1 turns to green to indicate that communications are in progress between the PC and the ST-LINK/V2.
- LD2 PWR:
  The red LED indicates that the board is powered.
- User LD3:
  The orange LED is a user LED connected to the I/O PD13 of the STM32F411VET6.
- User LD4:
  The green LED is a user LED connected to the I/O PD12 of the STM32F411VET6.
- User LD5:
  The red LED is a user LED connected to the I/O PD14 of the STM32F411VET6.
- User LD6:
  The blue LED is a user LED connected to the I/O PD15 of the STM32F411VET6.
- USB LD7:
  The green LED indicates when VBUS is present on CN5 and is connected to PA9 of the STM32F411VET6.
- USB LD8:
  The red LED indicates an overcurrent from VBUS of CN5 and is connected to the I/O PD5 of the STM32F411VET6.

6.4 Pushbuttons

- B1 USER:
  User and Wake-Up button connected to the I/O PA0 of the STM32F411VE.
- B2 RESET:
  The pushbutton connected to NRST is used to RESET the STM32F411VE.

6.5 On-board audio capability

The 32F411EDISCOVERY uses an audio DAC (CS43L22) to output sounds through the audio mini-jack connector.

The 32F411EDISCOVERY controls the audio DAC through the I^2C interface and processes digital signals through an I^2S connection or analog input signal.

- The sound can come independently from different inputs:
  - The ST MEMS microphone (MP45DT02 or IMP34DT05): digital using PDM protocol or analog when using the low pass filter.
  - The USB connector: from external mass storage such as a USB key, USB HDD, and so on.
  - The internal memory of the STM32F411VET6.
- The sound can be output in different ways through audio DAC:
  - Using the I^2S protocol
  - Using the microphone output directly via a low pass filter to analog input AIN4x of the CS43L22

6.6 USB OTG supported

The STM32F411VET6 is used to drive only USB OTG full speed on this board. The USB micro-AB connector (CN5) allows the user to connect a host or device component, such as a USB key, mouse, and so on.

Two LEDs are dedicated to this module:

- LD7 (green LED) indicates when VBUS is active
- LD8 (red LED) indicates an overcurrent from a connected device.

6.7 E-compass MEMS (ST MEMS LSM303DLHC or LSM303AGR)

The LSM303DLHC or LSM303AGR is an ultra-compact low-power system-in-package featuring a 3D digital linear acceleration sensor and a 3D digital magnetic sensor. It includes a sensing element and an IC interface able to provide the measured acceleration to the external world through an I^2C serial interface.

The LSM303DLHC has dynamically user-selectable full scales of ± 2g/± 8g and is capable of measuring the acceleration, and a magnetic field full scale from ±1.3 g to 8.1 g with an output data rate of 100 Hz or 400 Hz.

The LSM303AGR has linear acceleration full scales of ± 2g/± 4g/± 8g/± 16g and a magnetic field dynamic range of ±50 gauss with an output data rate of 100 kHz, 400 kHz, 1 MHz, and 3.4 MHz.

The STM32F411VET6 MCU controls this motion sensor through the I^2C interface.

6.8 Gyroscope MEMS (ST MEMS L3GD20 or I3G4250D)

The L3GD20 or I3G4250D is an ultra-compact, low-power, three-axis angular rate sensor. It includes a sensing element and an IC interface able to provide the measured angular rate to the external world through the I^2C/SPI serial interface.

The L3GD20 has dynamically user-selectable full scales of ± 250 dps / 500 dps / ±2000 dps and is capable of measuring rates.

The I3G4250D has a selectable full scale ±245 dps / ±500 dps / ±2000 dps and is capable of measuring rates with a user-selectable bandwidth.

The STM32F411VET6 MCU controls this motion sensor through the SPI interface.

6.9 JP2 (Idd)

Jumper JP2, labeled Idd, allows the consumption of STM32F411VE to be measured by removing the jumper and connecting an ammeter.

- When the jumper is ON, STM32F411VET6 is powered (default).
- When the jumper is OFF, an ammeter must be connected to measure the STM32F411VE current. Without an ammeter, the STM32F411VET6 is not powered.

6.10 OSC clock

6.10.1 OSC clock supply

If PH0 and PH1 are only used as GPIOs instead of as a clock, then SB14 and SB16 are ON. R24, R25, and R66 are OFF.

MCO from ST-LINK (from MCO of the STM32F103)
This frequency cannot be changed, it is fixed at 8 MHz and connected to PH0-OSC_IN of the STM32F411VET6. The configuration needed is:

- SB14, SB16 OFF
- R25 OFF
- R66 ON

On-board oscillator (from X2 crystal)
For typical frequencies and its capacitors and resistors, please refer to the STM32F411VET6 datasheet. The configuration needed is:

- SB14, SB16 OFF
- R25 ON
- R66 OFF

Oscillator from external PH0 (from external oscillator through pin 7 of the P2 connector)
The configuration needed is:

- SB14 ON
- SB16 ON
- R25 and R66 OFF

6.10.2 OSC 32 KHz clock supply

If PC14 and PC15 are only used as GPIOs instead of as a clock, then SB17 and SB18 are ON, while R21 and R22 are OFF.

On-board oscillator (from X1 Crystal (not provided))
The configuration needed is:

- SB17 and SB18 are OFF
- C20, C28, R21, and R22 are ON

Oscillator from external PC14 (from external oscillator trough the pin 9 of P2 connector)
The configuration needed is:

- SB17 ON
- SB18 ON
- R21 and R22 OFF

6.11 BOOT0 configuration

BOOT0 is at level “0” through a pull-down R28. If you want to set BOOT0 at level “1”, it can be configured by setting a jumper between P2.21 (BOOT0) and P2.22 (V_{DD}).

Note: If it is necessary to set BOOT0 at level "1" continuously, then open the SB19 solder bridge to avoid consumption of 6 mA, while connecting P2 pins 21 and 22 with a jumper or with a wire.

6.12 Solder bridges

Table 6. Solder bridges

Bridge	State (1)	Description
SB14,16 (X2 crystal)	**OFF**	X2, C18, C19, R24, and R25 provide a clock. PH0 and PH1 are disconnected from P2
	ON	PH0 and PH1 are connected to P2 R24, R25, and R66 must be OFF).
SB3,5,7,9 (Default)	ON	Reserved, do not modify
SB2,4,6,8 (Reserved)	OFF	Reserved, do not modify
SB17,18 (X3 crystal)	**ON**	PC14 and PC15 are only connected to P2. Remove only R21, R22.
	OFF	X3, C20, C28, R21, and R22 deliver a 32 KHz clock. PC14 and PC15 are not connected to P2.
SB1 (B2-RESET)	**ON**	B2 pushbutton is connected to the NRST pin of the STM32F411VET6 MCU
	OF	B2 pushbutton is not connected to the NRST pin of the STM32F411VET6 MCU
SB21 (B1-USER)	**ON**	B1 pushbutton is connected to PA0
	OFF	B1 pushbutton is not connected to PA0
SB13 (NRST)	**ON**	NRST signal of the CN2 connector is connected to the NRST pin of the STM32F411VET6 MCU
	OFF	NRST signal of the CN2 connector is not connected to the NRST pin of the STM32F411VET6 MCU

Table 6. Solder bridges (continued)

Bridge	State [1]	Description
SB15 (SWO)	**ON**	SWO signal of the CN2 connector is connected to PB3
	OFF	SWO signal is not connected
SB10,11 (RX,TX)	**OFF**	Reserved, do not modify
	ON	Reserved, do not modify
SB12 (STM_RST)	**OFF**	No incidence on STM32F103C8T6 (ST-LINK/V2) NRST signal
	ON	STM32F103C8T6 (ST-LINK/V2) NRST signal is connected to GND
SB19 (BOOT0)	**ON**	BOOT0 signal of the STM32F411VET6 MCU is held low through a 510 Ω pull-down resistor
	OFF	BOOT0 signal of the STM32F411VET6 MCU is held high through a 10 KΩ pull-up resistor
SB20 (BOOT1)	**OFF**	The BOOT1 signal of the STM32F411VET6 MCU is held high through a 10 KΩ pull-up resistor
	ON	The BOOT1 signal of the STM32F411VET6 MCU is held low through a 510 Ω pull-down resistor

1. Default solder bridge state is shown in bold.

6.13 Extension connectors

The male headers P1 and P2 can connect the 32F411EDISCOVERY board to a standard prototyping/wrapping board. STM32F411VET6 GPI/Os are available on these connectors. P1 and P2 can also be probed by an oscilloscope, logical analyzer, or voltmeter.

Table 7. MCU pin description versus board function (page 1 of 9)[1]

MCU pin			Board function														
Main function	Alternate functions	LQFP100	CS43L22	MP45DT02 or IMP34DT05	L3GD20 or I3G4250D	LSM303DLHC or LSM303AGR	Pushbutton	LED	SWD	USB	OSC	Free I/O	Power supply	CN5	CN2	P1	P2
BOOT0	-	94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
NRST	-	14	-	-	-	-	RESET	-	-	-	-	-	-	-	-	-	-

Table 7. MCU pin description versus board function (page 2 of 9)(1) (continued)

MCU pin			Board function														
Main function	Alternate functions	LQFP100	CS43L22	MP45DT02 or IMP34DT05	L3GD20 or I3G4250D	LSM303DLHC or LSM303AGR	Pushbutton	LED	SWD	USB	OSC	Free I/O	Power supply	CN5	CN2	P1	P2
PA0-WKUP	TIM2_CH1/TIM2_ETR, TIM5_CH1, USART2_CTS, ADC1_0, WKUP	23	-	-	-	-	USER	-	-	-	-	-	-	-	-	-	-
PA1	TIM2_CH2, TIM5_CH2, USART2_RTS, ADC1_1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PA2	TIM2_CH3, TIM5_CH3, TIM9_CH1, USART2_TX, ADC1_2	25	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-
PA3	TIM2_CH4, TIM5_CH4, TIM9_CH2, USART2_RX, ADC1_3	26	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-
PA4	SPI1_NSS, SPI3_NSS/I2S3_WS, USART2_CK, ADC1_4	29	LRCK/AIN1x	-	-	-	-	-	-	-	-	-	-	-	-	16	-
PA5	TIM2_CH1/TIM2_ETR, SPI1_SCK, ADC1_5	30	-	-	SCL/SPC	-	-	-	-	-	-	-	-	-	-	15	-
PA6	TIM1_BKIN, TIM3_CH1, SPI1_MISO, ADC1_6	31	-	-	SDO	-	-	-	-	-	-	-	-	-	-	18	-
PA7	TIM1_CH1N, TIM3_CH2, SPI1_MOSI, ADC1_7	32	-	-	SDA/SDI/SDO	-	-	-	-	-	-	-	-	-	-	17	-

Table 7. MCU pin description versus board function (page 3 of 9)(1) (continued)

MCU pin			Board function														
Main function	Alternate functions	LQFP100	CS43L22	MP45DT02 or IMP34DT05	L3GD20 or I3G4250D	LSM303DLHC or LSM303AGR	Pushbutton	LED	SWD	USB	OSC	Free I/O	Power supply	CN5	CN2	P1	P2
PA8	MCO_1, TIM1_CH1, I2C3_SCL, USART1_CK, USB_FS_SOF	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43
PA9	TIM1_CH2, I2C3_SMBAL, USART1_TX, USB_FS_VBUS	68	-	-	-	-	-	GREEN	-	VBUS	-	-	-	1	-	-	44
PA10	TIM1_CH3, USART1_RX, USB_FS_ID	69	-	-	-	-	-	-	-	ID	-	-	-	4	-	-	41
PA11	TIM1_CH4, USART1_CTS, USART6_TX, USB_FS_DM	70	-	-	-	-	-	-	-	DM	-	-	-	2	-	-	-
PA12	TIM1_ETR, USART1_RTS, USART6_RX, USB_FS_DP	71	-	-	-	-	-	-	-	DP	-	-	-	3	-	-	-
PA13	JTMS-SWDIO	72	-	-	-	-	-	-	SWDIO	-	-	-	-	-	4	-	42
PA14	JTCK-SWCLK, I2S3ext_WS	76	-	-	-	-	-	-	SWCLK	-	-	-	-	-	2	-	39
PA15	JTDI, TIM2_CH1/TIM2_ETR, SPI1_NSS, SPI3_NSS/I2S3_WS	77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40
PB0	TIM1_CH2N, TIM3_CH3, ADC1_8	35	-	-	-	-	-	-	-	-	-	-	-	-	-	22	-

Table 7. MCU pin description versus board function (page 4 of 9)[1] (continued)

MCU pin			Board function														
Main function	Alternate functions	LQFP100	CS43L22	MP45DT02 or IMP34DT05	L3GD20 or I3G4250D	LSM303DLHC or LSM303AGR	Pushbutton	LED	SWD	USB	OSC	Free I/O	Power supply	CN5	CN2	P1	P2
PB1	TIM1_CH3N, TIM3_CH4, ADC1_9	36	-	-	-	-	-	-	-	-	-	-	-	-	-	21	-
PB2		37	-	-	-	-	-	-	-	-	-	-	-	-	-	24	-
PB3	JTDO-SWO, TIM2_CH2, SPI1_SCK, SPI3_SCK/I2S3_CK, I2C2_SDA	89	-	-	-	-	-	-	SWO	-	-	-	-	-	6	-	28
PB4	JTRST, TIM3_CH1, SPI1_MISO, SPI3_MISO, I2S3ext_SD, I2C3_SDA	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
PB5	TIM3_CH2, I2C1_SMBAL, SPI1_MOSI, SPI3_MOSI/I2S3_SD	91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26
PB6	TIM4_CH1, I2C1_SCL, USART1_TX, USB_FS_INT	92	SCL	-	-	SCL	-	-	-	-	-	-	-	-	-	-	23
PB7	TIM4_CH2, I2C1_SDA, USART1_RX	93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24
PB8	TIM4_CH3, TIM10_CH1, I2C1_SCL, USB_FS_SCL, SDIO_D4	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19
PB9	TIM4_CH4, TIM11_CH1, I2C1_SDA, SPI2_NSS/I2S2_WS, USB_FS_SDA, SDIO_D5	96	SDA	-	-	SDA	-	-	-	-	-	-	-	-	-	-	20

Table 7. MCU pin description versus board function (page 5 of 9)[1] (continued)

MCU pin			Board function														
Main function	Alternate functions	LQFP100	CS43L22	MP45DT02 or IMP34DT05	L3GD20 or I3G4250D	LSM303DLHC or LSM303AGR	Pushbutton	LED	SWD	USB	OSC	Free I/O	Power supply	CN5	CN2	P1	P2
PB10	TIM2_CH3, I2C2_SCL, SPI2_SCK/I2S2_CK	47	-	-	-	-	-	-	-	-	-	-	-	-	-	34	-
VCAP1	-	48	-	-	-	-	-	-	-	-	-	-	-	-	-	35	-
PB12	TIM1_BKIN, I2C2_SMBAL, SPI2_NSS/I2S2_WS, I2S2ext_WS	51	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-
PB13	TIM1_CH1N, SPI2_SCK/I2S2_CK, I2S2ext_CK	52	-	-	-	-	-	-	-	-	-	-	-	-	-	37	-
PB14	TIM1_CH2N, SPI2_MISO, I2S2ext_SD	53	-	-	-	-	-	-	-	-	-	-	-	-	-	38	-
PB15	RTC_50Hz, TIM1_CH3N, SPI2_MOSI/I2S2_SD, I2S2ext_MISO	54	-	-	-	-	-	-	-	-	-	-	-	-	-	39	-
PC0	ADC1_10	15	-	-	-	-	-	-	-	PowerOn	-	-	-	-	-	8	-
PC1	ADC1_11	16	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-
PC2	SPI2_MISO, I2S2ext_SD, ADC1_12	17	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-
PC3	SPI2_MOSI/I2S2_SD, ADC1_13	18	AIN4x	PDM_OUT	-	-	-	-	-	-	-	-	-	-	-	9	-
PC4	ADC1_14	33	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-
PC5	ADC1_15	34	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-

Table 7. MCU pin description versus board function (page 6 of 9)[1] (continued)

MCU pin			Board function														
Main function	Alternate functions	LQFP100	CS43L22	MP45DT02 or IMP34DT05	L3GD20 or I3G4250D	LSM303DLHC or LSM303AGR	Pushbutton	LED	SWD	USB	OSC	Free I/O	Power supply	CN5	CN2	P1	P2
PC6	TIM3_CH1, I2S2_MCK, USART6_TX, SDIO_D6	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47
PC7	TIM3_CH2, I2S3_MCK, USART6_RX, SDIO_D7	64	MCLK	-	-	-	-	-	-	-	-	-	-	-	-	-	48
PC8	MCO_CPUCK, TIM3_CH3, USART6_CK, SDIO_D0	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45
PC9	MCO_2, TIM3_CH4, I2C3_SDA, I2S2_CKIN, SDIO_D1	66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46
PC10	I2S3ext_CK, SPI3_SCK/I2S3_CK, SDIO_D2	78	SCLK	-	-	-	-	-	-	-	-	-	-	-	-	-	37
PC11	I2S3ext_SD, SPI3_MISO, SDIO_D3	79		-	-	-	-	-	-	-	-	-	-	-	-	-	38
PC12	I2S3ext_MISO, SPI3_MOSI/I2S3_SD, SDIO_CK	80	SDIN	-	-	-	-	-	-	-	-	-	-	-	-	-	35
PC13	TAMP_1	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
PC14	OSC32_IN	8	-	-	-	-	-	-	-	-	OSC32_IN	-	-	-	-	-	9
PC15	OSC32_OUT	9	-	-	-	-	-	-	-	-	OSC32_OUT	-	-	-	-	-	10
PD0	-	81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36
PD1	-	82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33

Table 7. MCU pin description versus board function (page 7 of 9)(1) (continued)

MCU pin			Board function														
Main function	Alternate functions	LQFP100	CS43L22	MP45DT02 or IMP34DT05	L3GD20 or I3G4250D	LSM303DLHC or LSM303AGR	Pushbutton	LED	SWD	USB	OSC	Free I/O	Power supply	CN5	CN2	P1	P2
PD2	-	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34
PD3	-	84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31
PD4	-	85	RESET	-	-	-	-	-	-	-	-	-	-	-	-	-	32
PD5	-	86	-	-	-	-	-	RED	-	-	-	-	-	-	-	-	-
PD6	-	87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PD7	-	88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PD8	-	55	-	-	-	-	-	-	-	-	-	-	-	-	-	40	
PD9	-	56	-	-	-	-	-	-	-	-	-	-	-	-	-	41	
PD10	-	57	-	-	-	-	-	-	-	-	-	-	-	-	-	42	
PD11	-	58	-	-	-	-	-	-	-	-	-	-	-	-	-	43	
PD12	TIM4_CH1	59	-	-	-	-	-	GREEN	-	-	-	-	-	-	-	44	-
PD13	TIM4_CH2	60	-	-	-	-	-	ORANGE	-	-	-	-	-	-	-	45	-
PD14	TIM4_CH3	61	-	-	-	-	-	RED	-	-	-	-	-	-	-	46	-
PD15	TIM4_CH4	62	-	-	-	-	-	BLUE	-	-	-	-	-	-	-	47	-
PE0	TIM4_ETR	97	-	-	INT1	-	-	-	-	-	-	-	-	-	-	-	17
PE1	-	98	-	-	INT2	-	-	-	-	-	-	-	-	-	-	-	18

Table 7. MCU pin description versus board function (page 8 of 9)[1] (continued)

MCU pin			Board function														
Main function	Alternate functions	LQFP100	CS43L22	MP45DT02 or IMP34DT05	L3GD20 or I3G4250D	LSM303DLHC or LSM303AGR	Pushbutton	LED	SWD	USB	OSC	Free I/O	Power supply	CN5	CN2	P1	P2
PE2	-	1	-	-	-	DRDY	-	-	-	-	-	-	-	-	-	-	15
PE3	-	2	-	-	CS_I2C/SPI	-	-	-	-	-	-	-	-	-	-	-	16
PE4	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
PE5	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
PE6	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
PE7	-	38	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-
PE8	-	39	-	-	-	-	-	-	-	-	-	-	-	-	-	26	-
PE9	-	40	-	-	-	-	-	-	-	-	-	-	-	-	-	27	-
PE10	-	41	-	-	-	-	-	-	-	-	-	-	-	-	-	28	-
PE11	TIM1_CH2, SPI4_NSS	42	-	-	-	-	-	-	-	-	-	-	-	-	-	29	-
PE12	TIM1_CH3N, SPI4_SCK	43	-	-	-	-	-	-	-	-	-	-	-	-	-	30	-
PE13	TIM1_CH3, SPI4_MISO	44	-	-	-	-	-	-	-	-	-	-	-	-	-	31	-
PE14	TIM1_CH4, SPI4_MOSI	45	-	-	-	-	-	-	-	-	-	-	-	-	-	32	-
PE15	TIM1_BKIN	46	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-
PH0	OSC_IN	12	-	-	-	-	-	-	-	-	OSC_IN	-	-	-	-	-	7
PH1	OSC_OUT	13	-	-	-	-	-	-	-	-	OSC_OUT	-	-	-	-	-	8

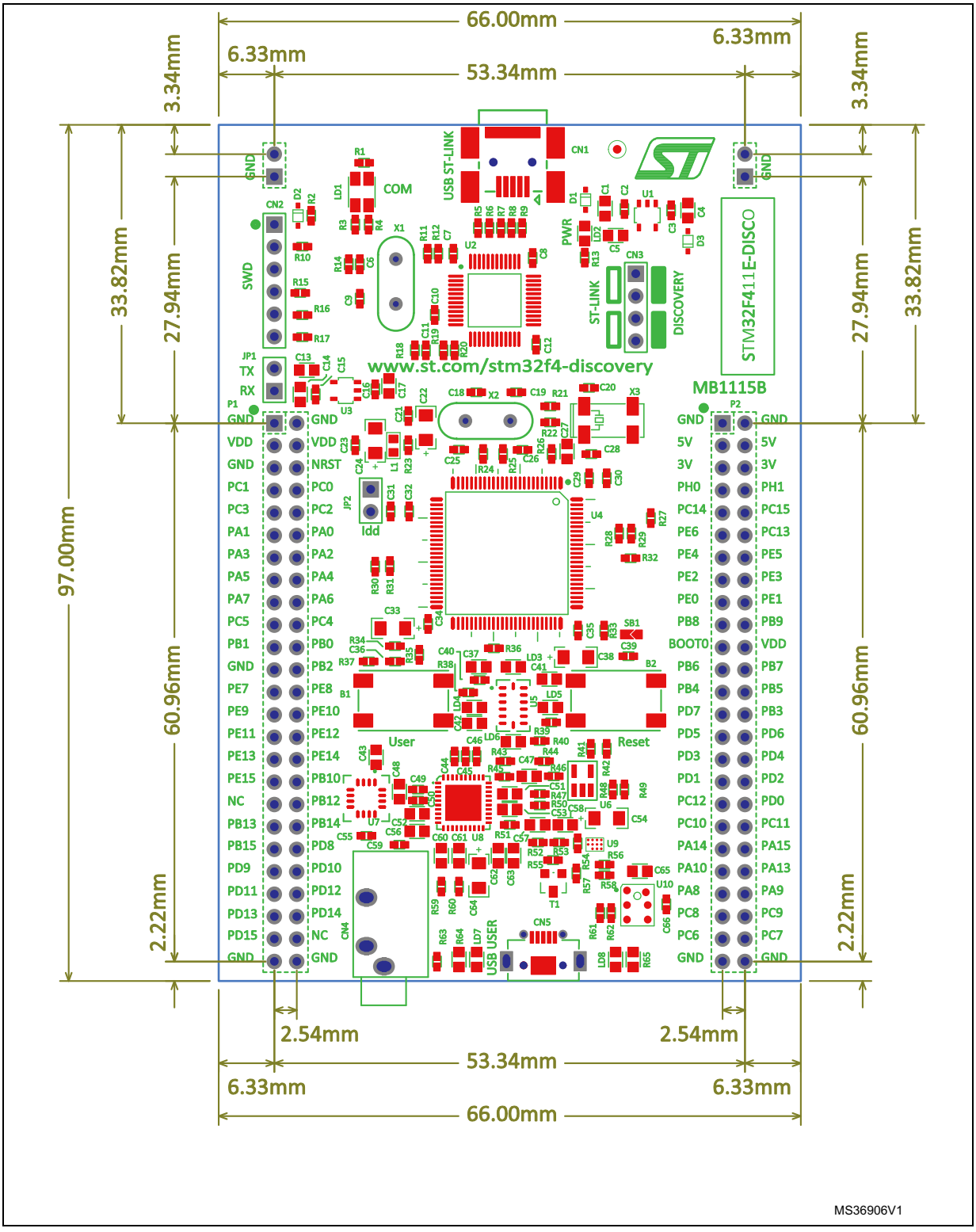
Table 7. MCU pin description versus board function (page 9 of 9)(1) (continued)

MCU pin			Board function														
Main function	Alternate functions	LQFP100	CS43L22	MP45DT02 or IMP34DT05	L3GD20 or I3G4250D	LSM303DLHC or LSM303AGR	Pushbutton	LED	SWD	USB	OSC	Free I/O	Power supply	CN5	CN2	P1	P2
-	-	-	-	-	-	-	-	-	-	-	-	-	5 V	-	-	-	3
-	-	-	-	-	-	-	-	-	-	-	-	-	5 V	-	-	-	4
-	-	-	-	-	-	-	-	-	-	-	-	-	3 V	-	-	-	5
-	-	-	-	-	-	-	-	-	-	-	-	-	3 V	-	-	-	6
-	-	-	-	-	-	-	-	-	-	-	-	-	VDD	-	-	3	22
-	-	-	-	-	-	-	-	-	-	-	-	-	VDD	-	-	4	-
-	-	-	-	-	-	-	-	-	GND	GND	-	-	GND	5	3	1	-
-	-	-	-	-	-	-	-	-	-	-	-	-	GND	-	-	2	-
-	-	-	-	-	-	-	-	-	-	-	-	-	GND	-	-	5	-
-	-	-	-	-	-	-	-	-	-	-	-	-	GND	-	-	23	-
-	-	-	-	-	-	-	-	-	-	-	-	-	GND	-	-	49	-
-	-	-	-		-	-	-	-	-	-	-	-	GND	-	-	50	-

1. The default configuration for the functions used on the boards, is shown in grey.

7 Mechanical drawing

Figure 8. 32F411EDISCOVERY board mechanical drawing



8 32F411EDISCOVERY information

8.1 Product marking

The sticker located on the top or bottom side of the PCB board shows the information about product identification such as board reference, revision, and serial number.

The first identification line has the following format: “MBxxxx-Variant-yzz”, where “MBxxxx” is the board reference, “Variant” (optional) identifies the mounting variant when several exist, "y" is the PCB revision and "zz" is the assembly revision: for example B01.

The second identification line is the board serial number used for traceability.

Evaluation tools marked as “ES” or “E” are not yet qualified and therefore not ready to be used as reference design or in production. Any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering sample tools as reference designs or in production.

“E” or “ES” marking examples of location:

- On the target STM32 that is soldered on the board (for illustration of STM32 marking, refer to the STM32 datasheet “Package information” paragraph at the *www.st.com* website).
- Next to the evaluation tool ordering part number that is stuck or silk-screen printed on the board.

The board reference for the 32F411EDISCOVERY base board is MB1115.

8.2 Board revision history

8.2.1 MB1115 (STM32F411E-DISCO)

Revision B02

The revision B-02 of the MB1115 board is the initial official release.

Revision B03

This version is the same as B-02, only the silkscreen is modified from STM32F401C-DISCO to STM32F411E-DISCO directly on the Gerber.

Revision D01

MEMS parts are updated in this version:

1. U10 is modified to IMP34DT05TR,
2. U5 is modified to LSM303AGR,
3. and U7 is modified to I3G4250D.

8.3 Known limitations

8.3.1 MB1115

Revision B02

None

Revision B03

None

Revision D01

None

Appendix A Federal Communications Commission (FCC) and ISED Canada Compliance Statements

A.1 FCC Compliance Statement

Part 15.19

This device complies with Part 15 of the FCC Rules. 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.

Part 15.21

Any changes or modifications to this equipment not expressly approved by STMicroelectronics may cause harmful interference and void the user's authority to operate this equipment.

Part 15.105

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 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.

Note: Use only shielded cables.

Responsible party (in the USA)

Terry Blanchard
Americas Region Legal | Group Vice President and Regional Legal Counsel, The Americas
STMicroelectronics, Inc.
750 Canyon Drive | Suite 300 | Coppell, Texas 75019
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A.2 ISED Compliance Statement

This device complies with FCC and ISED Canada RF radiation exposure limits set forth for general population for mobile application (uncontrolled exposure). This device must not be collocated or operating in conjunction with any other antenna or transmitter.

Compliance Statement

Notice: This device complies with ISED Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

ISED Canada ICES-003 Compliance Label: CAN ICES-3 (B) / NMB-3 (B).

Déclaration de conformité

Avis: Le présent appareil est conforme aux CNR d'ISDE 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'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Étiquette de conformité à la NMB-003 d'ISDE Canada : CAN ICES-3 (B) / NMB-3 (B).

Appendix B CE conformity

B.1 Warning

EN 55032 / CISPR32 (2012) Class B product

Warning: this device is compliant with Class B of EN55032 / CISPR32. In a residential environment, this equipment may cause radio interference.

Avertissement : cet équipement est conforme à la Classe B de la EN55032 / CISPR 32. Dans un environnement résidentiel, cet équipement peut créer des interférences radio.

Revision history

Table 8. Document revision history

Date	Revision	Changes
16-Dec-2014	1	Initial release.
22-Sep-2020	2	Added sensor differences for board variants in *Ordering information* and reorganized the entire document: – Updated *Introduction*, *Features*, *Ordering information*, *Development environment*, *Development toolchains* and *Demonstration software* – Added *Codification*, *Section 8: 32F411EDISCOVERY information*, *Appendix A: Federal Communications Commission (FCC) and ISED Canada Compliance Statements*, and *Appendix B: CE conformity* – Removed Electrical schematics