Introduction

The STM32F4DISCOVERY Discovery kit allows users to easily develop applications with the STM32F407VG high performance microcontroller with the ARM® Cortex®-M4 32-bit core. It includes everything required either for beginners or for experienced users to get quickly started.

Based on STM32F407VG, it includes an ST-LINK/V2 or ST-LINK/V2-A embedded debug tool, two ST-MEMS digital accelerometers, a digital microphone, one audio DAC with integrated class D speaker driver, LEDs, push buttons and a USB OTG micro-AB connector. To expand the functionality of the STM32F4DISCOVERY Discovery kit with the Ethernet connectivity, LCD display and more, visit the www.st.com/stm32f4dis-expansion webpage. The STM32F4DISCOVERY Discovery kit comes with the STM32 comprehensive free software libraries and examples available with the STM32Cube package, as well as a direct access to the ARM® mbed Enabled™ on-line resources at http://mbed.org.

Figure 1. STM32F4DISCOVERY

1. Picture is not contractual.
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1 Features

The STM32F4DISCOVERY offers the following features:

- STM32F407VGT6 microcontroller featuring 32-bit ARM Cortex®-M4 with FPU core, 1-Mbyte Flash memory, 192-Kbyte RAM in an LQFP100 package
- On-board ST-LINK/V2 on STM32F4DISCOVERY or ST-LINK/V2-A on STM32F407G-DISC1
- ARM® mbed Enabled™ (http://mbed.org) with ST-LINK/V2-A only
- USB ST-LINK with re enumeration capability and three different interfaces:
  - Virtual COM port (with ST-LINK/V2-A only)
  - Mass storage (with ST-LINK/V2-A only)
  - Debug port
- Board power supply:
  - Through USB bus
  - External power sources: 3 V and 5 V
- LIS302DL or LIS3DSH ST MEMS 3-axis accelerometer
- MP45DT02 ST MEMS audio sensor omni-directional digital microphone
- CS43L22 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)
  - 2 USB OTG LEDs LD7 (green) VBUS and LD8 (red) over-current
- Two push buttons (user and reset)
- USB OTG FS with micro-AB connector
- Extension header for all LQFP100 I/Os for quick connection to prototyping board and easy probing
- Comprehensive free software including a variety of examples, part of the STM32CubeF4 package or STSW-STM32068 for legacy standard library usage
2 Product marking

Tools marked as "ES" or "E" are not yet qualified and as such, they may be used only for evaluation purposes. ST shall not be liable for any consequences related with other ways of use of such non-qualified tools, for example, as reference design or for production.

Examples of location of "E" or "ES" marking:
- On target STM32 microcontroller part mounted on the board (for illustration, refer to section “Package information” of a STM32 datasheet at www.st.com).
- Next to the evaluation tool ordering part number, as a label stuck or a silk-screen printed on the board.

3 Ordering information

To order the Discovery kit for the STM32F407 line of microcontrollers, refer to Table 1.

<table>
<thead>
<tr>
<th>Order code</th>
<th>ST-LINK version</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32F4DISCOVERY</td>
<td>ST-LINK/V2</td>
</tr>
<tr>
<td>STM32F407G-DISC1</td>
<td>ST-LINK/V2-A (mbed Enabled)</td>
</tr>
</tbody>
</table>

4 Conventions

Table 2 provides the definition of some conventions used in the present document.

<table>
<thead>
<tr>
<th>Convention</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumper JP1 ON</td>
<td>Jumper fitted</td>
</tr>
<tr>
<td>Jumper JP1 OFF</td>
<td>Jumper not fitted</td>
</tr>
<tr>
<td>Solder bridge SBx ON</td>
<td>SBx connections closed by solder</td>
</tr>
<tr>
<td>Solder bridge SBx OFF</td>
<td>SBx connections left open</td>
</tr>
</tbody>
</table>
5 Quick start

The STM32F4DISCOVERY is a low-cost and easy-to-use development kit to quickly evaluate and start a development with an STM32F407VG high-performance microcontroller. Before installing and using the product, accept the Evaluation Product License Agreement from the www.st.com/stm32f4-discovery webpage.

For more information on the STM32F4DISCOVERY and for demonstration software, visit the www.st.com/stm32f4-discovery webpage.

5.1 Getting started

Follow the sequence below to configure the STM32F4DISCOVERY board and launch the DISCOVER application:

1. Check jumper position on the board, JP1 on, CN3 on (DISCOVERY selected).
2. Connect the STM32F4DISCOVERY board to a PC with a USB cable 'type A to mini-B' through USB connector CN1 to power the board. Red LED LD2 (PWR) then lights up.
3. Four LEDs between B1 and B2 buttons are blinking.
4. Press user button B1 to enable the ST MEMS sensor, move the board and observe the four LEDs blinking according to the motion direction and speed. (If a second USB cable 'type A to micro-B' is connected between PC and CN5 connector, then the board is recognized as standard mouse and its motion will also control the PC cursor).
5. To study or modify the DISCOVER project related to this demonstration, visit the www.st.com/stm32f4-discovery webpage and follow the tutorial.
6. Discover the STM32F407VG features, download and execute programs proposed in the list of projects.
7. Develop the application using available examples.

5.2 System requirements

- Windows® OS (XP, 7, 8 and 10), Linux® 64-bit or macOS™
- USB type A to Mini-B cable.

5.3 Development toolchains supported

- Keil® MDK-ARM\(^\text{(a)}\)
- IAR™ EWARM\(^\text{(a)}\)
- GCC-based IDEs including free SW4STM32 from AC6
- ARM® mbed Enabled™ online

\(^\text{a. On Windows® only.}\)
6 Hardware and layout

The STM32F4DISCOVERY is designed around the STM32F407VGT6 microcontroller in a 100-pin LQFP package.

*Figure 2* illustrates the connections between the STM32F407VGT6 and its peripherals (ST-LINK/V2 or ST-LINK/V2-A, push buttons, LEDs, Audio DAC, USB, ST-MEMS accelerometer and microphone, and connectors).

*Figure 3* and *Figure 4* help users to locate these features on the STM32F4DISCOVERY board.

*Figure 2. Hardware block diagram*
Figure 3. STM32F4DISCOVERY top layout

Note: Pin 1 of CN2, CN3, JP1, P1 and P2 connectors are identified by a red square.
6.1 Embedded ST-LINK/V2 (or V2-A)

ST-LINK/V2 on STM32F4DISCOVERY or ST-LINK/V2-A on STM32F407G-DISC1 is an embedded tool for programming and debugging.

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

The changes on ST-LINK/V2-A versus ST-LINK/V2 version are listed below.

New features supported on ST-LINK/V2-A:
- Virtual COM port interface on USB (see Section 6.1.3: ST-LINK/V2-A VCP configuration)
- Mass storage interface on USB
Features not supported on ST-LINK/V2-A:
- SWIM interface
- Minimum supported application voltage limited to 3 V
- USB power management request for more than 100 mA power on USB

Known limitation:
- Activating the readout protection on ST-LINK/V2-A target, prevents the target application from running afterwards. The target readout protection must be kept disabled on ST-LINK/V2-A boards.

There are two different ways to use the embedded ST-LINK/V2 (or V2-A) depending on the jumper states (see Table 3):
- Program/debug the STM32 on board (refer to Section 6.1.4: Using ST-LINK/V2 (or V2-A) to program/debug the STM32F407VG on board)
- Program/debug the STM32 in an external application board, using a cable connected to SWD connector CN2 (refer to Section 6.1.5: Using ST-LINK/V2 (or V2-A) to program/debug an external STM32 application)

<table>
<thead>
<tr>
<th>Jumper state</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both CN3 jumpers ON</td>
<td>ST-LINK/V2 (or V2-A) functions enabled for on board programming (default)</td>
</tr>
<tr>
<td>Both CN3 jumpers OFF</td>
<td>ST-LINK/V2 (or V2-A) functions enabled for application through external CN2 connector (SWD supported)</td>
</tr>
</tbody>
</table>

### 6.1.1 Drivers

Before connecting the STM32F4DISCOVERY board to a Windows® PC (XP, 7, 8 and 10) through the USB, a driver for the ST-LINK/V2 (or V2-A) must be installed. It is available at the www.st.com website. In case the STM32 Discovery is connected to the PC before the driver is installed, some Discovery interfaces may be declared as “Unknown” in the PC device manager. To recover from this situation, after installing the dedicated driver, the association of “Unknown” USB devices found on the STM32F4DISCOVERY board to this dedicated driver, must be updated in the device manager manually.

**Note:** It is recommended to proceed by using USB Composite Device, as shown in Figure 5.

Figure 5. USB composite device
6.1.2 ST-LINK/V2 (or V2-A) firmware upgrade

The ST-LINK/V2 (or V2-A) embeds a firmware upgrade mechanism for in-situ upgrade through the USB port. As the firmware may evolve during the life time of the ST-LINK/V2 (or V2-A) product (for example new functionalities, bug fixes, support for new microcontroller families), it is recommended to visit the [www.st.com](http://www.st.com) website before starting to use the Discovery board and periodically, to stay up-to-date with the latest firmware version.

6.1.3 ST-LINK/V2-A VCP configuration

The ST-LINK/V2-A supports a virtual COM port (VCP) on U2 pin 12 (ST-LINK_TX) and U2 pin 13 (ST-LINK_RX) but these pins are not connected to the USART of the STM32F407 microcontroller for mbed support.

Two solutions are possible to connect an STM32F407 USART to the VCP on the PC:

- Using an USART to USB dongle from the market connected for instance to STM32F407 USART2 available on connector P1 pin 14 (PA2: USART2_TX) and P1 pin 13 (PA3: USART2_RX).
- Using flying wires to connect ST-LINK/V2-A virtual COM port (ST-LINK VCP on U2 pin 12 and 13) to STM32F407 USART2 (PA2 and PA3: P1 pin 14 and 13) as shown in the Figure 6 below.

Figure 6. ST-LINK VCP connection to USART2
6.1.4 **Using ST-LINK/V2 (or V2-A) to program/debug the STM32F407VG on board**

To program the STM32F407VG on board, simply plug in the two jumpers on CN3, as shown in *Figure 7* in red, but do not use the CN2 connector as that could disturb communication with the STM32F407VG of the STM32F4DISCOVERY.

*Figure 7. STM32F4DISCOVERY connections*
6.1.5 Using ST-LINK/V2 (or V2-A) to program/debug an external STM32 application

It is very easy to use the ST-LINK/V2 (or V2-A) to program the STM32 on an external application. Simply remove the two jumpers from CN3, as shown in Figure 8, and connect the application to the CN2 debug connector according to Table 4.

**Note:** SB11 must be OFF if CN2 pin 5 is used in the external application.

Table 4. Debug connector CN2 (SWD)

<table>
<thead>
<tr>
<th>Pin</th>
<th>CN2</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD_TARGET</td>
<td>VDD from application</td>
</tr>
<tr>
<td>2</td>
<td>SWCLK</td>
<td>SWD clock</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>SWDIO</td>
<td>SWD data input/output</td>
</tr>
<tr>
<td>5</td>
<td>NRST</td>
<td>RESET of target STM32</td>
</tr>
<tr>
<td>6</td>
<td>SWO</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

Figure 8. ST-LINK connections
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 5V power supply.

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

- 5V and 3V can be used as output power supplies when another application board is connected to pins P1 and P2. In this case, the 5V and 3V pins deliver a 5V or 3V power supply and power consumption must be lower than 100 mA.
- 5V can also be used as input power supplies e.g. when the USB connector is not connected to the PC. In this case, the STM32F4DISCOVERY board must be powered by a power supply unit or by 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: 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: red LED indicates that the board is powered.
- User LD3: orange LED is a user LED connected to the I/O PD13 of the STM32F407VGT6.
- User LD4: green LED is a user LED connected to the I/O PD12 of the STM32F407VGT6.
- User LD5: red LED is a user LED connected to the I/O PD14 of the STM32F407VGT6.
- User LD6: blue LED is a user LED connected to the I/O PD15 of the STM32F407VGT6.
- USB LD7: green LED indicates when VBUS is present on CN5 and is connected to PA9 of the STM32F407VGT6.
- USB LD8: red LED indicates an overcurrent from VBUS of CN5 and is connected to the I/O PD5 of the STM32F407VGT6.

6.4 Push buttons

- B1 USER: User and Wake-Up buttons are connected to the I/O PA0 of the STM32F407VG.
- B2 RESET: Push button connected to NRST is used to RESET the STM32F407VG.
6.5 On-board audio capability

The STM32F407VG microcontroller uses an audio DAC (CS43L22) to output sounds through the audio mini-jack connector.

The STM32F407VG microcontroller controls the audio DAC through the I^2C interface and processes digital signals through an I^2S connection or an analog input signal.

- The sound can come independently from different inputs:
  - ST-MEMS microphone (MP45DT02): digital using PDM protocol or analog when using the low pass filter
  - USB connector: from external mass storage such as a USB key, USB HDD, and so on
  - Internal memory of the STM32F407VG microcontroller

- The sound can be output in different ways through the audio DAC:
  - Using I^2S protocol
  - Using DAC to analog input AIN1x of the CS43L22
  - Using the microphone output directly via a low-pass filter to analog input AIN4x of the CS43L22

6.6 USB OTG supported

The STM32F407VG microcontroller is used on this board to only drive the USB OTG full speed. 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 connected device

6.7 Motion sensor (ST-MEMS LIS302DL or LIS3DSH)

Two different versions of motion sensors (U5 in schematic) are available on the board depending on the PCB version. The LIS302DL is present on board MB997B (PCB revision B) and the LIS3DSH is present on board MB997C (PCB rev C).

The LIS302DL and LIS3DSH are both ultra-compact low-power three-axis linear accelerometers.

The motion sensor includes a sensing element and an IC interface able to provide the measured acceleration to the external world through the I^2C/SPI serial interfaces.

The LIS302DL has dynamically user selectable full scales of ±2g/±4g and it is capable of measuring acceleration with an output rate of 100Hz to 400Hz.

The LIS3DSH has ±2g/±4g/±6g/±8g/±16g dynamically selectable full-scale and it is capable of measuring acceleration with an output data rate of 3.125 Hz to 1.6 kHz.

The STM32F407VG microcontroller controls this motion sensor through the SPI interface.
6.8 JP1 (Idd)

Jumper JP1, labeled Idd, allows the consumption of STM32F407VG to be measured by removing the jumper and connecting an ammeter.

- Jumper on: STM32F407VGT6 is powered (default).
- Jumper off: an ammeter must be connected to measure the STM32F407VG current, (if there is no ammeter, the STM32F407VG is not powered).

6.9 OSC clock

6.9.1 OSC clock supply

If PH0 and PH1 are used as GPIOs instead of being used as a clock, then SB13 and SB14 are closed and R24, R25 and R68 are removed.

- **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 STM32F407VG. Configuration needed:
  - SB13, SB14 OPEN
  - R25\(^{(b)}\) removed
  - R68\(^{(b)}\) soldered

- **Oscillator on board.** From X2 crystal. For typical frequencies and its capacitors and resistors, refer to the STM32F407VG Datasheet at [www.st.com](http://www.st.com). Configuration needed:
  - SB13, SB14 OPEN
  - R25\(^{(b)}\) soldered
  - R68\(^{(b)}\) removed

- **Oscillator from external PH0.** From external oscillator through pin 7 of the P2 connector. Configuration needed:
  - SB13 closed
  - SB14 closed
  - R25 and R68 removed

6.9.2 OSC 32 KHz clock supply

If PC14 and PC15 are only used as GPIOs and not as a clock, then SB15 and SB16 are closed, and R21 and R22 are removed.

- **Oscillator on board.** From X1 crystal (not provided). Configuration needed:
  - SB15, SB16 OPEN
  - C16, C27, R21 and R22 soldered.

- **Oscillator from external PC14.** From external oscillator through the pin 9 of P2 connector. Configuration needed:
  - SB16 closed
  - SB15 closed
  - R21 and R22 removed

\(b.\) As the frequency supplied by X2 is the same as MCO (8 MHz), R25 and R68 are soldered.
6.10  Solder bridges

Table 5. Solder bridges

<table>
<thead>
<tr>
<th>Bridge</th>
<th>State(1)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB13,14 (X2 crystal)</td>
<td>OFF</td>
<td>X2, C14, C15, R24 and R25 provide a clock. Ph0, Ph1 are disconnected from P2.</td>
</tr>
<tr>
<td></td>
<td>ON</td>
<td>Ph0, Ph1 are connected to P2 (R24, R25 and R68 must not be fitted).</td>
</tr>
<tr>
<td>SB3, 5, 7, 9 (Default)</td>
<td>ON</td>
<td>Reserved, do not modify.</td>
</tr>
<tr>
<td>SB2, 4, 6, 8 (Reserved)</td>
<td>OFF</td>
<td>Reserved, do not modify.</td>
</tr>
<tr>
<td>SB15,16 (X3 crystal)</td>
<td>OFF</td>
<td>X3, C16, C27, R21 and R22 deliver a 32 kHz clock. Pc14, Pc15 are not connected to P2.</td>
</tr>
<tr>
<td></td>
<td>ON</td>
<td>Pc14, Pc15 are only connected to P2. Remove only R21, R22</td>
</tr>
<tr>
<td>SB1 (B2-RESET)</td>
<td>ON</td>
<td>B2 pushbutton is connected to the NRST pin of the STM32F407VGT6</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>B2 pushbutton is not connected the NRST pin of the STM32F407VG.</td>
</tr>
<tr>
<td>SB20 (B1-USER)</td>
<td>ON</td>
<td>B1 pushbutton is connected to PA0.</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>B1 pushbutton is not connected to PA0.</td>
</tr>
<tr>
<td>SB17 (VDD powered from 3V)</td>
<td>OFF</td>
<td>VDD is not powered from 3V, depends on JP1 jumper.</td>
</tr>
<tr>
<td></td>
<td>ON</td>
<td>VDD is permanently powered from 3V, JP1 jumper has no effect.</td>
</tr>
<tr>
<td>SB11 (NRST)</td>
<td>ON</td>
<td>NRST signal of the CN2 connector is connected to the NRST pin of the STM32F407VG.</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>NRST signal of the CN2 connector is not connected to the NRST pin of the STM32F407VG.</td>
</tr>
<tr>
<td>SB12 (SWO)</td>
<td>ON</td>
<td>SWO signal of the CN2 connector is connected to PB3.</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>SWO signal is not connected.</td>
</tr>
<tr>
<td>SB10 (STM_RST)</td>
<td>OFF</td>
<td>No incidence on STM32F103C8T6 (ST-LINK/V2) NRST signal.</td>
</tr>
<tr>
<td></td>
<td>ON</td>
<td>STM32F103C8T6 (ST-LINK/V2) NRST signal is connected to GND.</td>
</tr>
<tr>
<td>SB18 (BOOT0)</td>
<td>ON</td>
<td>BOOT0 signal of the STM32F407VG is held low through a 510 ohm pull-down resistor.</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>BOOT0 signal of the STM32F407VG is held high through a 10 Kohm pull-up resistor.</td>
</tr>
<tr>
<td>SB19 (BOOT1)</td>
<td>OFF</td>
<td>The BOOT1 signal of the STM32F407VG is held high through a 10 Kohm pull-up resistor.</td>
</tr>
<tr>
<td></td>
<td>ON</td>
<td>The BOOT1 signal of the STM32F407VG is held low through a 510 ohm pull-down resistor.</td>
</tr>
</tbody>
</table>

1. Default SBx state is shown in bold.
2. SB13 and SB14 are OFF to allow the user to choose between MCO and X2 crystal for clock source.

6.11  Extension connectors

The male headers P1 and P2 can connect the STM32F4DISCOVERY to a standard prototyping/wrapping board. STM32F407VG GPIOs are available on these connectors. P1 and P2 can also be probed by an oscilloscope, a logical analyzer or a voltmeter.
<table>
<thead>
<tr>
<th>STM32 pin</th>
<th>Board function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main function</strong></td>
<td><strong>Alternate functions</strong></td>
</tr>
<tr>
<td><strong>Alternate functions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BOOT0</strong></td>
<td>VPP</td>
</tr>
<tr>
<td><strong>NRST</strong></td>
<td>-</td>
</tr>
<tr>
<td><strong>PA0</strong></td>
<td>USART2_CTS/ USART4_TX/ ETH_MII_CRS/ TIM2_CH1_ETR/ TIM5_CH1/ TIM8_ETR/ ADC123_IN0/ WKUP</td>
</tr>
<tr>
<td><strong>PA1</strong></td>
<td>USART2_RTS/ USART4_RX/ ETH_RMI_REF_CLK/ ETH_MII_RX_CLK/ TIM5_CH2/ TIMM2_CH2/ ADC123_IN1</td>
</tr>
<tr>
<td><strong>PA2</strong></td>
<td>USART2_TX/ TIM5_CH3/ TIM9_CH1/ TIM2_CH3/ ETH_MDI0/ ADC123_IN2</td>
</tr>
<tr>
<td><strong>PA3</strong></td>
<td>USART2_RX/ TIM5_CH4/ TIM9_CH2/ TIM2_CH4/ OTG_HS_ULPI_D0/ ETH_MII_COL/ ADC123_IN3</td>
</tr>
<tr>
<td><strong>PA4</strong></td>
<td>SPI1_NSS/ SPI3_NSS/ USART2_CK/ DCMI_HSYNC/ OTG_HS_SOF/ I2S3_WS/ ADC12_IN4/ DAC1_OUT</td>
</tr>
<tr>
<td><strong>PA5</strong></td>
<td>SPI1_SCK/ OTG_HS_ULPI_CK/ TIM8_CH1_ETR/ TIM8_CH1N/ ADC12_IN6</td>
</tr>
<tr>
<td><strong>PA6</strong></td>
<td>SPI1_MISO/ TIM8_BKIN/ TIM13_CH1/ DCMI_PIXCLK/ TIM3_CH1/ TIM1_BKIN/ ADC12_IN6</td>
</tr>
<tr>
<td><strong>PA7</strong></td>
<td>SPI1_MOSI/ TIM8_CH1N/ TIM14_CH1TIM5_CH2/ ETH_MII_TX_DIV/ TIM11_CH1N/ RMII_CRS_DIV/ ADC12_IN7</td>
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<tr>
<td><strong>PA8</strong></td>
<td>MCO1/ USART1_CK/ TIM1_CH1/ I2C3_SCL/ OTG_FS_SOF</td>
</tr>
<tr>
<td><strong>PA9</strong></td>
<td>USART1_TX/ TIM1_CH2/ I2C3_SMB/ DCMI_D0/ OTG_FS_VBUS</td>
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Table 6. STM32 pin description versus board functions (continued)

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<th>STM32 pin</th>
<th>Board function</th>
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<tr>
<td>PA10</td>
<td>USART1_RX/ TIM1_CH3/ OTG_FS_ID/ DCMI_D1</td>
</tr>
<tr>
<td>PA11</td>
<td>USART1_CTS/ CAN1_RX/ TIM1_CHI/ OTG_FS_DM</td>
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<tr>
<td>PA12</td>
<td>USART1_RTS/ CAN1_TX/ TIM1_ETR/ OTG_FS_DP</td>
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<tr>
<td>PA13</td>
<td>JTIM-SWDO/</td>
</tr>
<tr>
<td>PA14</td>
<td>JTCK-SWCLK</td>
</tr>
<tr>
<td>PA15</td>
<td>TIM3_CH3/ TIM8_CH2/ OTG_HS_ULP1_D1/ ETH_MII_RXD2/ TIM1_CH2/ ADC12_IN8</td>
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<tr>
<td>PB0</td>
<td>TIM3_CH3/ TIM8_CH2/ OTG_HS_ULP1_D1/ ETH_MII_RXD2/ TIM1_CH2/ ADC12_IN8</td>
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<td>PB1</td>
<td>TIM3_CH4/ TIM8_CH3/ OTG_HS_ULP1_D2/ ETH_MII_RXD3/ OTG_HS_INT/ TIM1_CH3/ ADC12_IN9</td>
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<tr>
<td>PB2</td>
<td>BOOT1</td>
</tr>
<tr>
<td>PB3</td>
<td>JTDI/ TRACESWO/ SPI3_SCK/ TIM2_CH2/ SPI1_SCK</td>
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<td>PB4</td>
<td>NJTRST/ SPI3_MISO/ TIM3_CH1/ SPI1_MISO</td>
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<td>PB5</td>
<td>I2C1_SMA/ CAN2_RX/ OTG_HS_ULP1_D1/ ETH_PPS_OUT/ TIM3_CH2/ SPI1_MOSI/ SPI3_MOSI/ DCMI_D10/ I2C3_SD</td>
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<td>STM32 pin</td>
<td>Main function</td>
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<td>PB12</td>
<td>SPI2_NSS/I2S2_WS/I2C2_SMBA/USART3_CK/TIM1_BKIN/CAN2_RX/OTG_HS_ULPI_D5/ETH_RMMI_TXD0/ETH_RMMI_TXD0/OTG_HS_ID</td>
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<td>OTG_HS_ULPI_STP/ADC123_IN10</td>
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<td>ETH_MDC/ADC123_IN11</td>
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<td>SPI2_MISO/OTG_HS_ULPI_DIR/TH_MII_TXD2/I2S2EXT_SD/ADC123_IN12</td>
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<td>Main function</td>
<td>Alternate functions</td>
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<td>---------------------</td>
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<tr>
<td>PC3</td>
<td>SPI2_MOSI/ I2S2_SD/ OTH_HS_ULPI NXT/ ETH_MII_TX_CLK/ ADC123_IN13</td>
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<td>PC4</td>
<td>ETH_RMII_RX_D0/ ETH_MII_RX_D0/ ADC123_IN14</td>
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<td>ETH_RMII_RX_D1/ ETH_MII_RX_D1/ ADC123_IN15</td>
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<td>PC13</td>
<td>RTC_AF1</td>
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<td>PC14</td>
<td>OSC32_IN</td>
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<tr>
<td>PD0</td>
<td>FSMC_D2/ CAN1_RX</td>
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<td>PD1</td>
<td>FSMC_D3/ CAN1_TX</td>
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<td>PD2</td>
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<td>Alternate functions</td>
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<td>PD5</td>
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<td>FSMC_D12/ TIM1_BKIN</td>
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<td>OSC_OUT</td>
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</table>

1. Optional, for more details see Section 7: Electrical schematics.
Figure 9. STM32F407G-DISC1

Electrical schematics

STMicroelectronics

Title: Number: Rev: Sheet of

D.1(PCB.SCH)

Date: 8/9/2013

MB997 1 6

STM32F407G-DISC1

PA13 PA14

NRST

PB3

MCO

U_ST_LINK

ST_LINK_V2.SCHDOC

PA13 PA14

BOOT0

NRST

VDD

TCK/SWCLK

TMS/SWDIO

MCO

NRST

PB3 T_SWO

T_NRST

1

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3

4

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6

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P1

Header 25X2

P2

Header 25X2

U_Audio

Audio.SchDoc

U_IO Peripherals

IO Peripherals.SchDoc

Rev D.1 --> PCB label MB997 D-01, silkscreen modified for mbed-enabled, STM32F103C8T6 replaced by STM32F103CBT6

Rev C.1 --> PCB label MB997 C-01, R31 not fitted, PD0_0 of STM32F4 replaced by VSS

Replace LIS302DL by LIS3DSH (U5)

Rev B.2 --> PCB label MB997 B-02, R27 not fitted, R28 fitted

Rev B.1 --> PCB label MB997 B-01

STMicroelectronics

STM32F407G-DISC1
Figure 12. Audio

STMicroelectronics

Title: STM32F407G-DISC1 Audio

Date: 8/9/2013

MB99746

Sheet 1 of 3

D.1(PCB.SCH)

Device: ST-225-02

Component Descriptions:

- **Audio_RST**: 0.1uF
- **Audio_SDA**: 1uF (X7R)
- **Audio_SCL**: 1uF (X7R)
- **I2S3_MCKI2S3_WS**: 3V
- **I2S3_SCK**: 3V
- **I2S3_SD**: 3V
- **I2S3_DIN**: 3V
- **Audio_DAC_OUT**: 1uF (X7R)
- **PDM_OUT**: 1uF (X7R)
- **CLK_IN**: 3V

Connectors and Pins:

- **CN4**: 8-pin connector
- **PB4**: 12-pin connector
- **PC3**: 8-pin connector
- **PB6**: 12-pin connector
- **PC7**: 8-pin connector
- **PC10**: 12-pin connector
- **PA4**: 8-pin connector
- **PD4**: 12-pin connector

Resistors:

- **R43**: 10K
- **R61**: 51
- **R53**: 100
- **R52**: 100K
- **R44**: 100K
- **R55**: 0
- **R49**: 0
- **R54**: 1.2K

Capacitors:

- **C50**: 1uF (X7R)
- **C51**: 1uF (X7R)
- **C56**: 1uF (X5R)
- **C57**: 1uF (X5R)
- **C42**: 0.1uF
- **C46**: 150pF (COG)
- **C45**: 0.1uF
- **C54**: 0.022uF
- **C55**: 0.022uF
- **C44**: 1uF (X7R)
- **C47**: 1uF (X7R)
- **C48**: 10nF
- **C58**: 10uF

Diodes:

- **D1**: 3.3V
- **D2**: 3.3V

Miscellaneous:

- **ST-225-02**: Not fitted
- **CS43L22**: U7
- **MP45DT02**: U9
- **AGND**: 17
- **VQ**: 19
- **GND/Thermal Pad**: 41
- **VQ**: 19
- **AGND**: 17
- **VQ**: 19
- **GND/Thermal Pad**: 41

LM358

Note: All non-drawn components are not fitted.
Figure 14. Peripherals

STMicroelectronics
STM32F407G-DISC1 Peripherals

LEDs

 MEMS

USER & WAKE-UP Button

RESET Button

Not Fitted

Not Fitted

R40 510
R36 680
R41 680
R42 680

PD12

MB997

STM32F407G-DISC1 Peripherals

LEDs

MEMS

PD13

PD14

PD15

VDD

C38 100nF
R39 220K
VDD

B1

SW-PUSH-CMS

SB20

PA0

R35 330
R38 100

USER & WAKE-UP Button

RESET Button

Not Fitted

Not Fitted

C37 100nF
R37 100K
VDD

B2

SW-PUSH-CMS

SB1

Not Fitted

PD12

3V

C39 100nF

SPI1_MOSI

SPI1_SCK

PA7

PE0

PE1

MEMS_INT1

MEMS_INT2

MEMS

PD13

PD14

PD15

VDD_IO1

NC2
NC3
SCL/SPC
GND5
SDA/SDI/SDO
SEL/SDO
CS
INT2
Reserved
Reserved
INT1/DRDY
Reserved
Reserved
Reserved
Reserved
Reserved
Reserved
Reserved
Reserved
Reserved
Figure 15. STM32F4DISCOVERY mechanical drawing
# 9 Revision history

Table 7. Document revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Changes</th>
</tr>
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<tbody>
<tr>
<td>27-Sept-2011</td>
<td>1</td>
<td>Initial release.</td>
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<tr>
<td>30-Jan-2012</td>
<td>2</td>
<td>Added Section 5.1: STM32F407VGT6 microcontroller corrected Figure 3 MCU name, modified Figure 2 and Section 7: Electrical schematics. Modified Table 6 PE2 and PE3 entries.</td>
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<tr>
<td>28-Nov-2013</td>
<td>3</td>
<td>Updated for board rev. C. Modified title. Modified Section 6.7: Motion sensor (ST-MEMS LIS302DL or LIS3DSH) Updated Section 7: Electrical schematics</td>
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<td>29-Jan-2014</td>
<td>4</td>
<td>Modified Section 6: Hardware and layout, Figure 2, Section 6.7: Motion sensor (ST-MEMS LIS302DL or LIS3DSH), Table 6 adding ST MEMS LIS302DL reference.</td>
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<td>04-Feb-2016</td>
<td>5</td>
<td>New revision to introduce STM32F407G-DISC1 additional CPN that corresponds to mbed-enabled Discovery Kit. Updated Introduction, Features, Section 5: Quick start, Section 6: Hardware and layout, Section 6.1: Embedded ST-LINK/V2 (or V2-A), Section 7: Electrical schematics. Removed Section 4.1 STM32F407VG microcontroller.</td>
</tr>
<tr>
<td>31-May-2017</td>
<td>6</td>
<td>Updated Table 6: STM32 pin description versus board functions.</td>
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