UM1878
User manual

Evaluation board with STM32L073VZ MCU

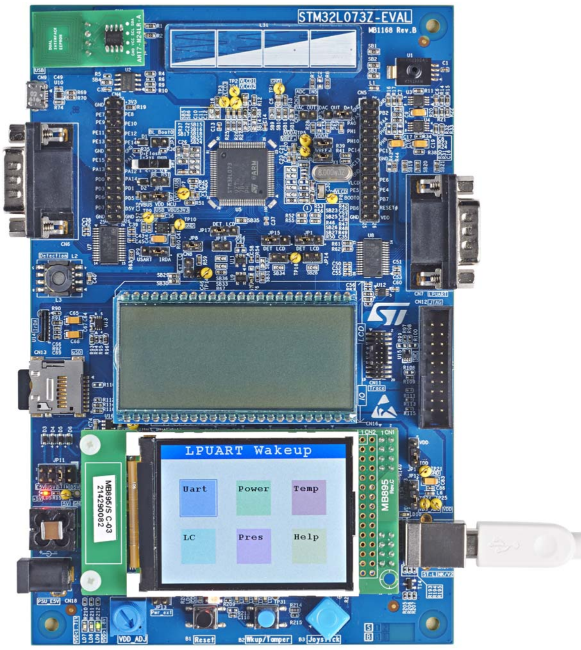
Introduction

The STM32L073Z-EVAL Evaluation board is designed as a complete demonstration and development platform for the STMicroelectronics Arm® Cortex®-M0+ core-based STM32L073VZT6 microcontroller with three I^{2}Cs, two SPIs, four USARTs, one UART, one 12-bit ADC, two 12-bit DACs, LCD driver, up to 192-Kbyte flash memory, 20-Kbyte RAM, 6-Kbyte EEPROM, touch sensing, USB FS, LCD controller, SWD debugging support. This Evaluation board can be used as a reference design for user application development but is not considered as a final application.

The full range of hardware features on the board helps the user to evaluate all peripherals (USB FS, RS-232, USART, 12-bit ADC and DAC, color TFT LCD, LCD segments, low-power UART, IrDA, microSD™ card, touch-sensing slider, pressure measurement, temperature measurement, LC sensor metering) and to develop applications. The extension headers offer the possibility to connect a daughterboard or a wrapping board for a specific application.

An embedded ST-LINK/V2-1 debugger facilitates the software development and the programming of the STM32L073VZT6 microcontroller.

Figure 1. STM32L073Z-EVAL Evaluation board



Picture is not contractual.

Contents

List of tables

List of figures

1 Features

- STM32L073VZT6 ultra-low-power Arm®[a] Cortex® core-based microcontroller featuring 192 Kbytes of flash memory and 20 Kbytes of RAM in an LQFP100 package
- Selectable MCU voltage: 3.3 V or adjustable from 1.71 V to 3.6 V
- 2.8-inch color TFT LCD with resistive touch panel
- LCD 40 × 8 segments
- USB 2.0 FS
- IrDA transceiver
- Pressure sensor
- LC sensor metering
- Touch-sensing linear sensor
- User and reset push-buttons
- 4-direction joystick with selection button
- On-board current measurement
- Board connectors:
  - 2× RS-232 with DB9
  - USB with Micro-B
  - microSD™ card
  - RF-EEPROM daughterboard expansion
  - Extension for daughterboard or wrapping board
- Four 5 V power supply options: power jack, ST-LINK USB connector, user USB FS connector, or daughterboard
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, Virtual COM port, and debug port
- Comprehensive free software libraries and examples available with the STM32CubeL0 MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE

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

2 Ordering information

To order the STM32L073Z-EVAL Evaluation board, refer to *Table 1*. Additional information is available from the datasheet and reference manual of the target STM32.

Table 1. List of available products

Order code	Board reference	Target STM32
STM32L073Z-EVAL	– MB895(1) – MB979(2) – MB1020(3) – MB1168(4) – MB1199(5)	STM32L073VZT6

1. TFT LCD daughterboard.
2. LCD segment daughterboard.
3. RF-EEPROM daughterboard.
4. Main board.
5. Detection accessory daughterboard.

2.1 Codification

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

Table 2. Codification explanation

STM32L0XXY-EVAL	Description	Example: STM32L073Z-EVAL
STM32L0	MCU series in STM32 32-bit Arm Cortex MCUs	STM32L0 series
XX	MCU product line in the series	STM32L0x3 includes the STM32L073xx MCUs
Y	STM32 flash memory size: – Z for 192 Kbytes	192 Kbytes
EVAL	Toolkit type: – Evaluation board	Evaluation board

3 Development environment

3.1 System requirements

- Multi-OS support: Windows®[a] 10, Linux®[b] 64-bit, or macOS® [c]
- USB Type-A or USB Type-C® to Type-B cable

3.2 Development toolchains

- IAR Systems® - IAR Embedded Workbench®[d]
- Keil® - MDK-ARM[d] [e]
- 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*.

a. Windows is a trademark of the Microsoft group of companies.

b. Linux® is a registered trademark of Linus Torvalds.

c. macOS® is a trademark of Apple Inc. registered in the U.S. and other countries and regions.

d. On Windows® only.

e. Free MDK-ARM for Arm® Cortex®-M0/M0+ cores.

4 Hardware layout and configuration

STM32L073Z-EVAL Evaluation board is designed around the STM32L073VZT6 (LQFP 100 package). The hardware block *Figure 2: Hardware block diagram* illustrates the connections between the STM32L073VZT6 and peripherals while *Figure 3: STM32L073Z-EVAL Evaluation board (top view)* helps the user to locate these features on the actual Evaluation board.

Figure 2. Hardware block diagram

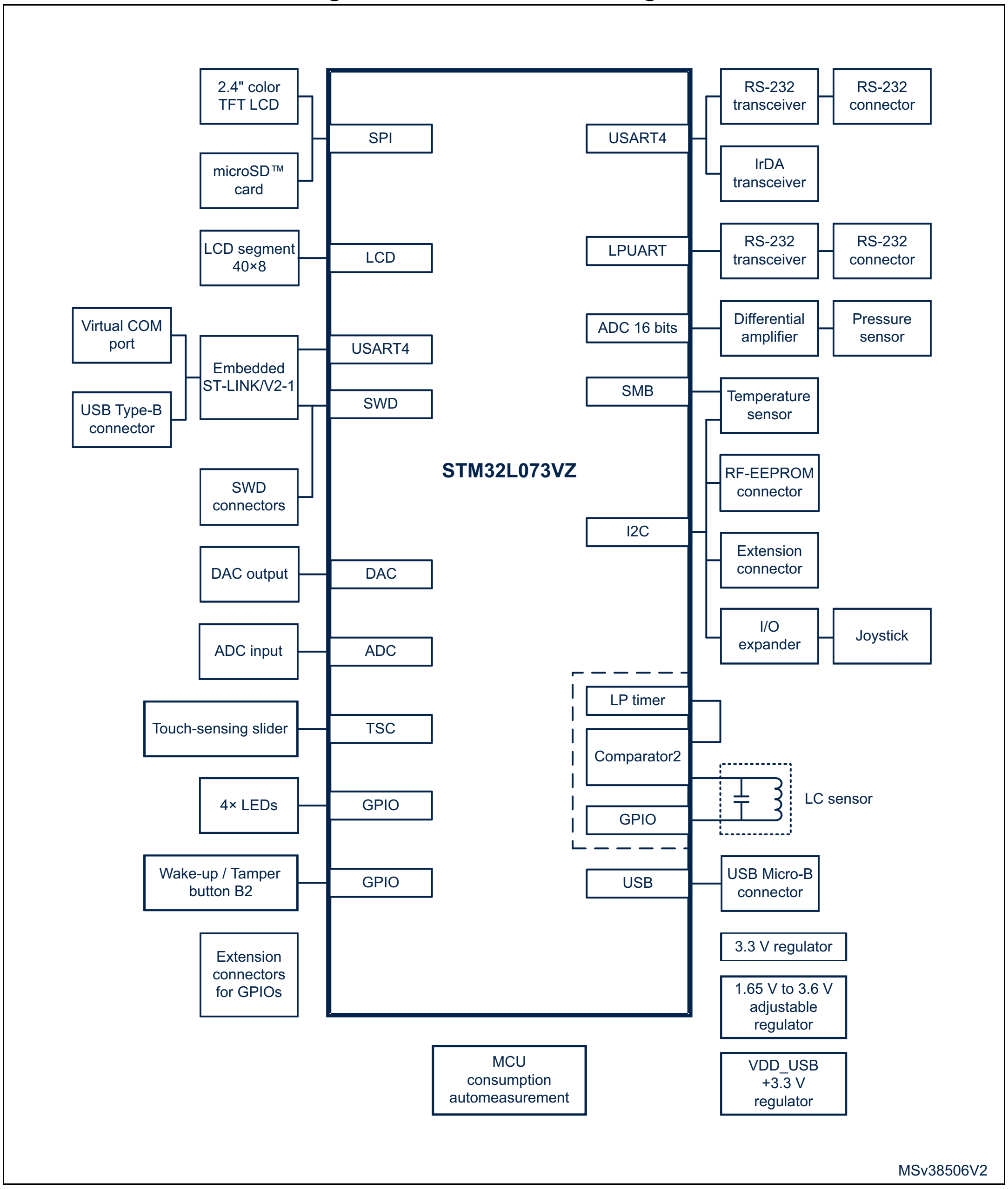
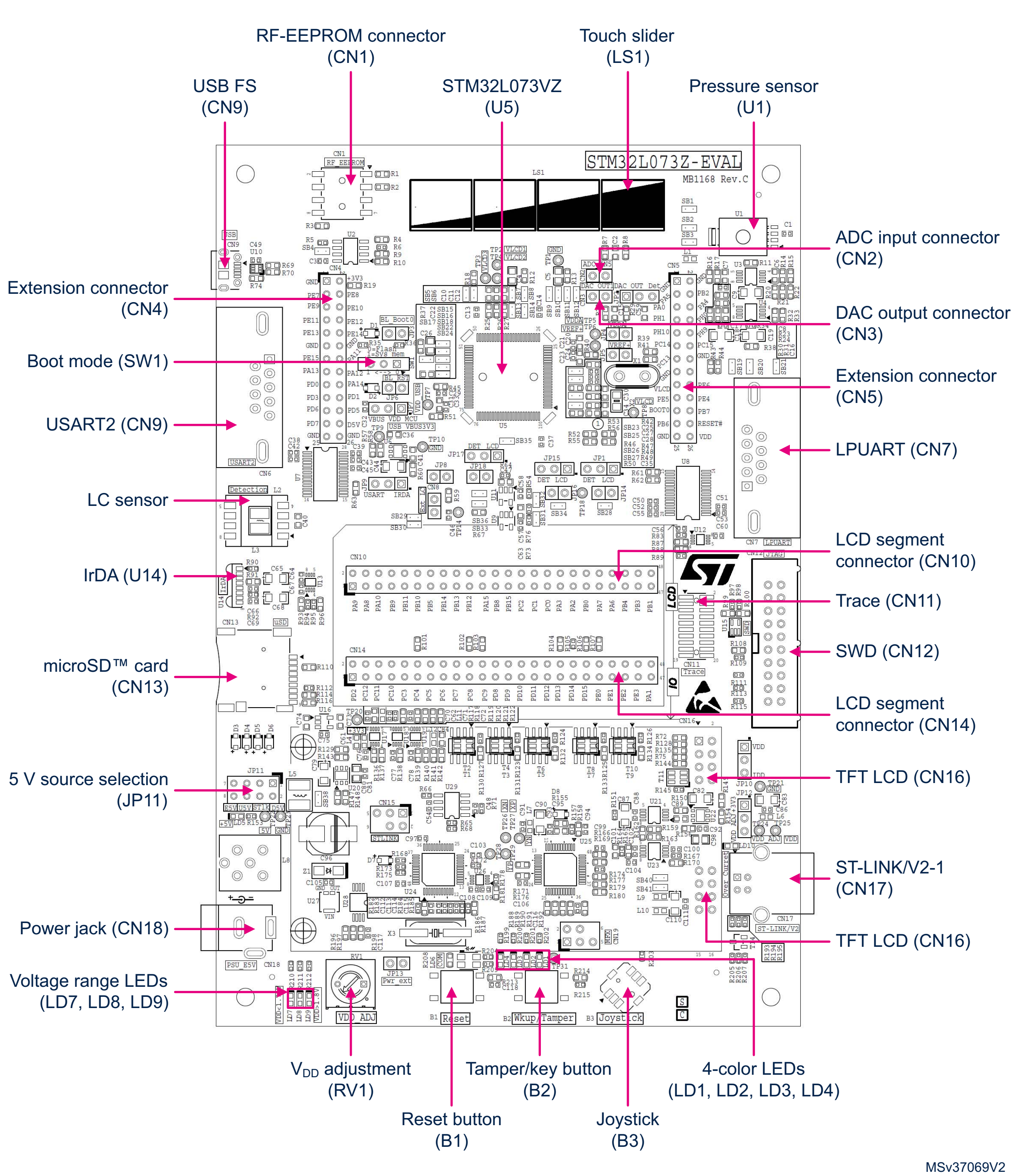


Figure 3. STM32L073Z-EVAL Evaluation board (top view)



4.1 Embedded ST-LINK/V2-1

The ST-LINK/V2-1 programming and debugging tool is integrated on the STM32L073Z-EVAL Evaluation board. Compared to ST-LINK/V2 the changes are listed below.

The new features supported on ST-LINK/V2-1 are:

- USB software re-enumeration
- Virtual COM port interface on USB
- Mass storage interface on USB
- USB power management request for more than 100 mA power on USB

This feature is no more supported on ST-LINK/V2-1:

- SWIM interface

For all general information concerning debugging and programming features common between V2 and V2-1 please refer to ST-LINK/V2 user manual (UM1075) and technical note (TN1235).

Known limitation:

Activating the readout protection on ST-LINK/V2-1 target, prevents the target application from running afterwards. The target readout protection must be kept disabled on ST-LINK/V2-1 boards.

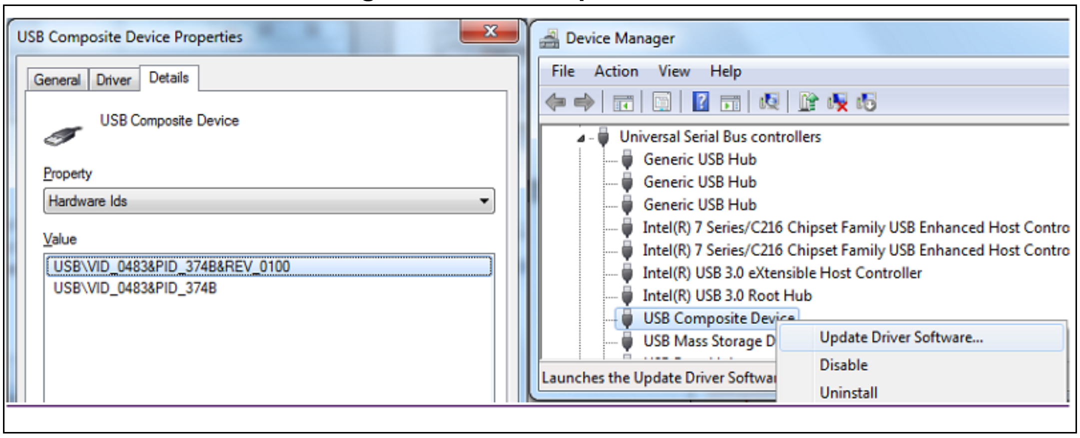
Note: It is possible to power the board via CN17 (Embedded ST-LINK/V2-1 USB connector) even if an external tool is connected to connectors CN11 or CN12.

4.1.1 Drivers

Before connecting the STM32L073Z-EVAL board to a Windows® 7, Windows® 8 or Windows® 10 PC via USB, a driver for ST-LINK/V2-1 must be installed. It can be downloaded from the *www.st.com* webpage.

If the STM32L073Z-EVAL Evaluation board is connected to the PC before the driver is installed, the Windows® device manager might report some USB devices found on STM32L073Z-EVAL as “Unknown”. To recover from this situation, after installing the dedicated driver downloaded from the *www.st.com* webpage, the association of “Unknown” USB devices found on STM32L073Z-EVAL to this dedicated driver, must be updated in the device manager manually. It is recommended to proceed using the *USB Composite Device* line, as shown in *Figure 4*.

Figure 4. USB Composite device



4.1.2 ST-LINK/V2-1 firmware upgrade

ST-LINK/V2-1 facility for debug and programming of the target microcontroller STM32L073VZT6 is integrated on the STM32L073Z-EVAL Evaluation board. For its own operation, ST-LINK/V2-1 employs a dedicated MCU with flash memory. Its firmware determines ST-LINK/V2-1 functionality and performance. The firmware may evolve during the life span of STM32L073Z-EVAL to include new functionality, fix bugs, or support new target microcontroller families. It is therefore recommended to keep ST-LINK/V2-1 firmware up to date. The latest version is available at *www.st.com.* ST-LINK/V2-1 supports a mechanism that allows programming its dedicated MCU via the USB interface on the hosting board, here STM32L073Z-EVAL. The whole process is controlled from a Windows® PC application also available at *www.st.com*.

4.2 SWD connectors

Only Serial Wire Debug interface can be used on trace connectors CN11 and CN12. SWDIO, SWCLK and RESET of the microcontroller STM32L073VZT6 are available. The parallel trace and JTAG are not available on the STM32L073VZT6 microcontroller.

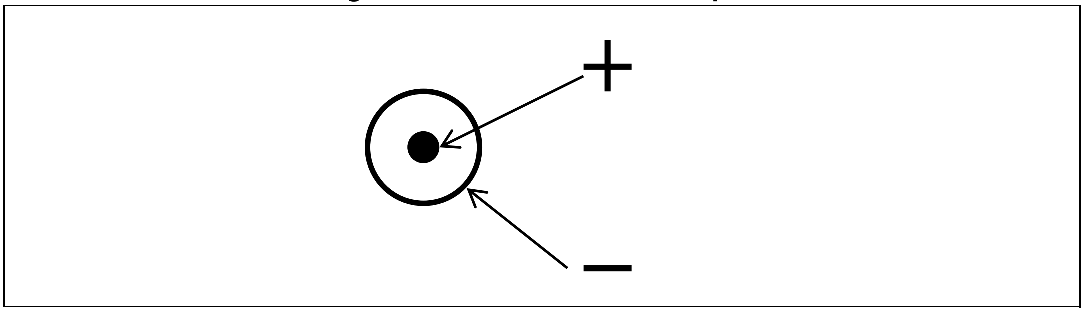
4.3 Power supply

STM32L073Z-EVAL Evaluation board is designed to be powered by a 5 V DC power supply and to be protected from wrong power plug-in event by PolyZen. It is possible to configure the Evaluation board to use any of the following four power supply sources:

- a 5 V DC power adapter connected on the board to the power jack CN18, called PSU_E5V on silkscreen. It is selected by a jumper placed in E5V location of JP11. The external power supply does not come with the board but can be ordered separately.
- a 5 V DC power with 300 mA limitation from the USB Type-B connector of ST-LINK/V2-1 CN17 (silkscreen marking (ST-LINK/V2)).Note that only the ST-LINK part is power supplied before the USB enumeration, as the host PC only provides 100 mA to the board at that time. During the USB enumeration, the STM32L073Z-EVAL Evaluation board requires 300 mA of current to the host PC. If the host is able to provide the required power, the enumeration ends by a “SetConfiguration” command and then, the power switch U29 is switched ON, the red LED LD5 is turned ON, thus the Evaluation board can consume a maximum of 300 mA current, not more. If the host is not able to provide the required current, the enumeration fails, therefore the power switch U29 remains OFF and the STM32 including its peripherals are not powered. As a consequence the red LED LD5 remains turned OFF. In such case it is mandatory to use one external power supply connected to power jack CN18. This power switch features also a current limitation to protect the PC in case of short-circuit on board. If overcurrent (more than 600 mA) happens on board, the LED LD10 is lighted on.
- 5 V DC power with 500 mA limitation from the USB FS connector CN9. This connector is a Micro-B receptacle with a silkscreen marking on the PCB: USB. This 5 V input is called U5V.
- 5 V DC power from a customer daughterboard plugged in pin 24 of extension connector CN4. This 5 V input is called D5V.

Note: The 5 V DC power adapter must have the positive polarity at center pin, as shown in Figure 5: Pin-out of 5 V DC adapter.

Figure 5. Pin-out of 5 V DC adapter



The power supply selection is done by the jumpers **JP11, JP12, JP7, JP4, JP5 and JP13** as described in *Table 3: Power related jumpers*.

Table 3. Power related jumpers

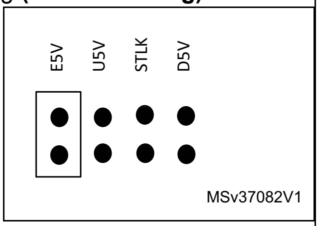
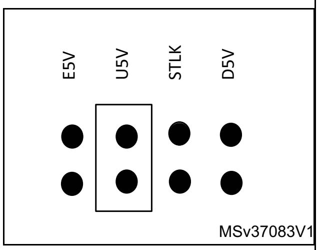
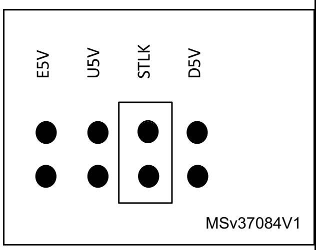
Jumper	Description
JP11	JP11 is used to select one of the four possible power supply sources. To supply STM32L073Z-EVAL only from a 5 V power adapter connected to CN18 (PSU_E5V), set the jumper to E5V location, as following **(Default setting)**: 
	To supply STM32L073Z-EVAL only from the USB connector CN9 set the jumper to U5V location, as following: 
	To supply STM32L073Z-EVAL only from the USB connector CN17 of ST-LINK/V2, set the jumper JP11 to STlk location, as showed in the below figure. In this case, the jumper of ST-LINK JP13 must be opened. 

Table 3. Power related jumpers (continued)

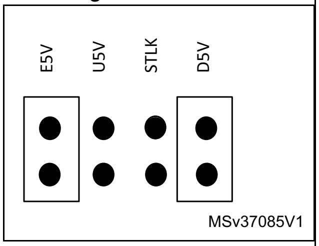
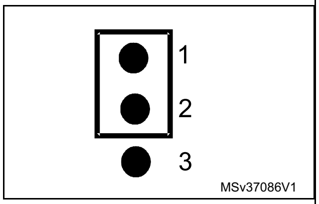
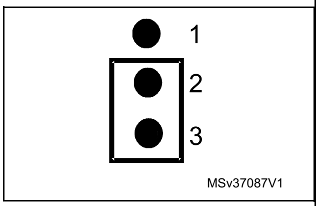
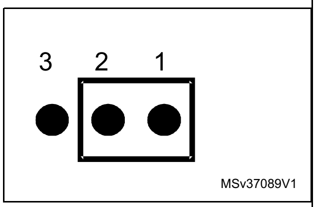
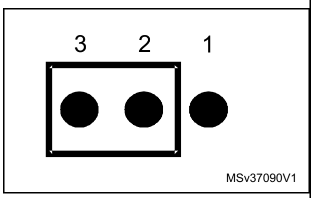
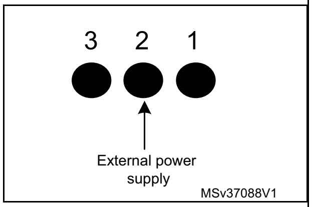
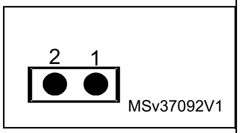
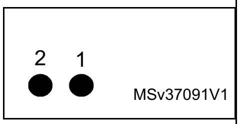
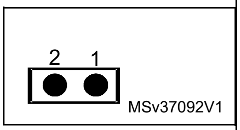
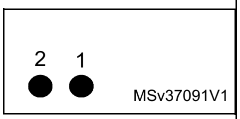
Jumper	Description
JP11	To supply both STM32L073Z-EVAL and a daughterboard connected to extension connectors CN4 and CN5, **(daughterboard must have its own power supply not connected)**, set jumpers to E5V and D5V locations, as following: 
JP12	V_{DD_MCU} (pins V_{DD} of STM32L073VZ) is connected to fixed +3.3 V DC power when JP12 is set as shown **(Default setting):** 
	V_{DD_MCU} is connected to the adjustable DC power from 1.65 V to 3.6 V when JP12 is set as shown: 
JP7	V_{DD_USB} power pin of STM32L073VZ is connected to VDD_MCU when JP7 is set as shown **(Default setting):** 
	V_{DD_USB} power pin of STM32L073VZ is powered by the USB connector CN9 when JP7 is set as shown here: 

Table 3. Power related jumpers (continued)

<table>
<tr><th>Jumper</th><th>Description</th></tr>
<tr><td>JP7</td><td>V_{DD_MCU} power pin of STM32L073VZ can be powered externally by an external power supply, providing no jumper is connected to JP7. The external supply can be connected to pin2 of JP7, as shown here:
</td></tr>
<tr><td rowspan="2">JP4</td><td>V_{DDA} power pin of STM32L073VZ is connected to V_{DD_MCU} when JP4 is closed as shown (default setting):
</td></tr>
<tr><td>To measure the current drawn by V_{DDA} pin of STM32L073VZ, remove the jumper of JP4 and connect an ampere-meter to JP4, positive terminal to pin 1, negative to pin 2.
</td></tr>
<tr><td rowspan="2">JP5</td><td>V_{REF+} pin of STM32L073VZ is connected to V_{DD_MCU} when JP5 is closed as shown (default setting):
</td></tr>
<tr><td>To measure the current drawn by V_{REF+} pin of STM32L073VZ, remove the jumper of JP5 and connect an ampere-meter to JP5, positive terminal to pin 1, negative to pin 2.
</td></tr>
<tr><td>JP13</td><td>By default JP13 is not connected to let ST-LINK detect automatically if it should provide the supply of the board from ST-LINK USB V_{BUS} (default setting).
If JP13 is connected, ST-LINK does not supply the Evaluation board from ST-LINK USB.</td></tr>
</table>

The red LED LD5 is on when the board STM32L073Z-EVAL is powered correctly by the 5 V.

4.3.1 Adjustable power supply

As detailed above the STM32L073VZT6 microcontroller can be supplied by a variable voltage when pins 2 and 3 of JP12 are connected by a jumper. Use the potentiometer RV1 to adjust the voltage from 1.65 V to 3.6 V. The three LEDs LD7, LD8, LD9 warn the user that voltage is below 1.7 V or above 1.8 V.

4.4 Clock source

Two clock sources are available for the microcontroller STM32L073VZT6 on the Evaluation board STM32L073Z-EVAL:

- The 32.768 kHz crystal X2 for embedded RTC
- The 8 MHz crystal X1 8 MHz with a socket. It can be removed when the internal RC clock is used.

Table 4. 32.768 kHz crystal X2 solder bridges

Solder bridge		Description
SB27	Open **(default setting)**	PC14 is connected to the crystal X2.
	closed	PC14 is connected to pin11 of extension connector CN5. In such case R49 must be removed to avoid disturbance due to the 32 kHz quartz X2.
SB26	Open **(default setting)**	PC15 is connected to 32 kHz crystal.
	closed	PC15 is connected to pin 12 of extension connector CN5. In such case R48 must be removed to avoid disturbance due to the 32 kHz quartz X2.

Table 5. 8 MHz crystal X1 solder bridges

Solder bridge		Description
SB25	Open **(default setting)**	PH0 is connected to 8 MHz crystal X1.
	closed	PH0 is connected to pin 8 of extension connector CN5. In such case X1 and C27 must be removed to avoid disturbance due to the crystal.
SB23	Open **(default setting)**	PH1 is connected to 8 MHz crystal X1.
	closed	PH1 is connected to pin 7 of extension connector CN5. In such case R342 must be removed to avoid disturbance due to the crystal.

4.5 Reset sources

The RESET signal of STM32L073Z-EVAL Evaluation board is active low.

Sources of reset are:
- Reset button B1
- Debugging tools from SWD connectors CN12 and CN11.
- From a daughterboard connected to extension connectors, RESET is pin 24 of connector CN5.
- Embedded ST-LINK/V2-1
- RS-232 connector CN6 for ISP. Jumper JP6 must be closed for RESET to be handled by pin 8 of RS-232 connector CN6 (CTS signal).

4.6 Boot option

After reset, the STM32L073VZT6 MCU can boot from the following embedded memory locations:
- User flash memory
- System flash memory
- Embedded RAM (for debugging)

The microcontroller is configured to one of the listed boot options by setting the STM32L073VZT6 port BOOT0 level by the switch SW1 and by setting nBOOT1 bit of FLASH_OPTR option bytes register, as shown in *Table 6*. Depending on JP3, BOOT0 level can be forced to high and, SW1 action overruled, by DSR line of RS-232 connector CN6, as shown in *Table 7: Boot related jumper*. This can be used to force the execution of the bootloader and start user flash memory programming process (ISP) from RS-232 interface. The option bytes of STM32L073VZT6 and their modification procedure are described in the reference manual RM0367. *STM32 microcontroller system memory boot mode* Application Note (AN2606) details the bootloader mechanism and configurations.

Table 6. Boot related switch

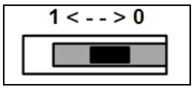
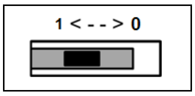
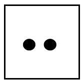
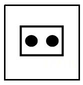
Switch		Description
SW1	 (default setting)	STM32L073Z-EVAL Evaluation board boots from **user flash memory.** BOOT0 pin is tied to low.
		STM32L073VZT6 boots from system flash memory (nBOOT1 bit of FLASH_OPTR register is set high) or from RAM (nBOOT1 is set low). BOOT0 pin is tied to high.

Table 7. Boot related jumper

Jumper		Description
JP3	 jumper not fitted **(default setting)**	By default, BOOT0 is only controlled by switch SW1.
	 Jumper fitted	BOOT0 can be forced high with terminal 6 of CN6 connector (RS-232 DSR line). This configuration is used to allow the device connected via RS-232 to initiate STM32L073VZT6 programming process.

4.7 USB FS

STM32L073Z-EVAL Evaluation board supports USB2.0 FS communication. The USB connector is the Micro-B type connector CN9.

The USB functionality is independent of LCD segment connectors.

STM32L073VZT6 ports PA11 and PA12 are used for the USB DM and DP signals respectively. In case PA11 and PA12 are not used for USB, it can be accessed for another usage by the extension connector CN4, providing resistors R69 and R70 are removed.

USB section of the micro-controller STM32L073VZT6 V_{DD_USB} must be supplied with 3.0 V to 3.6 V internally or externally through jumper JP7. Refer to *Section 4.3: Power supply* for more details regarding JP7 use.

4.7.1 Operating voltage

- If V_{DD_USB} is supplied from V_{DD}: USB is working typically with V_{DD} > 3.0 V. JP7 pins 1 and 2 must be connected, refer to *Section 4.3: Power supply* for more details.
- If V_{DD_USB} is supplied from USB (U5V voltage), STM32L073Z-EVAL is functional in all the voltage range: 1.65 V to 3.6 V.

4.8 SMBus temperature sensor

A temperature sensor is connected to the I2C1 bus and to the SMBus of the microcontroller STM32L073VZT6.

The I^2C address of the temperature sensor is by default 0x92 with address pin A0 set to 1 by the closed solder bridge SB4.

By opening SB4, it is possible to change the temperature sensor address into 0x90.

Table 8. Temperature sensor related solder bridge

Solder bridge		Description
SB4	Closed **(default setting)**	Temperature sensor I^2C address set to 0x92.
	Open	Temperature sensor I^2C address set to 0x90.

To enable SMBus functionality, the LCD segment daughterboard must be mounted on the “IO” position.

However, if the LCD segment daughterboard is used and then mounted on the “LCD” position, it is still possible to use the temperature sensor through the I^2C bus without SMBus because PB5 previously used for SMBus is used for LCD segments.

Refer to *Section 4.19: LCD segments* for more details.

4.8.1 Limitations

The temperature sensor INT signal of SMBus is exclusive with LCD segments.

4.8.2 Operating voltage

The operating voltage of the temperature sensor is 2.7 to 3.6 V.

4.9 RS-232 USART2 and IrDA

4.9.1 RS-232

The Evaluation board STM32L073Z-EVAL offers an RS-232 communication port at the DB9 male connector CN6. The signals RX, TX, RTS and CTS from USART2 of STM32L073VZT6 are available.

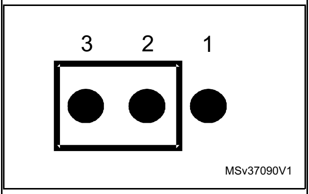
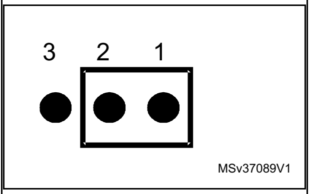
Signals Bootloader_RESET and Bootloader_BOOT0 can be added on RS-232 connector CN6 for ISP support. To use Bootloader_RESET, resistor R63 must be removed and jumper JP6 must be closed. If Bootloader_BOOT0 is used, the jumper JP3 must be closed.

For jumpers settings refer to the *Table 9: RS-232 and IrDA jumper settings*.

4.9.2 IrDA

The Evaluation board STM32L073Z-EVAL is offering an IrDA communication through the IrDA transceiver U14 located in the middle of left side of the board. Jumpers settings are described inside the below table.

Table 9. RS-232 and IrDA jumper settings

Jumpers and resistors		Description
JP9	2 and 3 connected  (default setting)	RS-232 use: DB9 connector CN9 RXD signal is connected to PD6 of STM32L073VZT6 used as USART2 RX.
	1 and 2 connected 	IrDA use: RxD pin of IrDA transceiver U14 is connected to PD6 of STM32L073VZT6 used as IrDA Rx.

4.9.3 Limitations

RS-232 from USART2 and IrDA are exclusive.

4.9.4 Operating voltage

RS-232 from USART2 and IrDA are operating on the whole V_{DD} voltage range: 1.65 V to 3.6 V.

4.10 RS-232 LPUART

LPUART signals RX, TX, RTS, CTS are available at DB9 connector CN7 located on the right side of the board. The LPUART can be used on the whole voltage range of V_{DD} because level shifters are used.

4.10.1 Limitations

LPUART is exclusive with LCD segments. The LCD segment daughterboard must be mounted in the “IO” position.

4.10.2 Operating voltage

LPUART is operating over the whole V_{DD} range (1.65 V to 3.6 V).

4.11 Virtual COM port

RX and TX of USART4 are available in a USB Virtual COM port managed by the ST-LINK/V2-1. The USB connector of ST-LINK/V2-1 is CN17. Virtual COM port can be used over the whole operating voltage range of the microcontroller because level shifters are used.

By default, the serial communication settings are: 115200 bit/s, 8 bits, no parity, 1 stop bit, no flow control.

4.11.1 Limitations

No limitation.

4.11.2 Operating voltage

The Virtual COM port is operating over the whole V_{DD} range: 1.65 V to 3.6 V.

4.12 microSD™ card

A 4-Gbyte microSD™ card can be plugged into the connector CN13, located at the left side of the board. It communicates with the microcontroller STM32L073VZT6 using the SPI1 port. The card detection switch is connected to the GPIO expander MFX, part U25.

Level shifters insure functionality of microSD™ card over the whole voltage range.

Table 10. microSD™ connector CN13

Pin number	Description	Pin number	Description
1	NC	6	GND
2	MicroSD_CS (PD0)	7	SPI_MISO (PE14)
3	SPI_MOSI (PE15)	8	NC
4	+3V3	9	GND
5	SPI_CLK (PE13)	10	MicroSDcard_detect (to expander MFX)

4.12.1 Limitations

With V_{DD} > 2.7 V, the SPI clock can be at maximum speed: 16 MHz.

If V_{DD} < 2.7 V, the SPI clock must be limited to 8 MHz maximum.

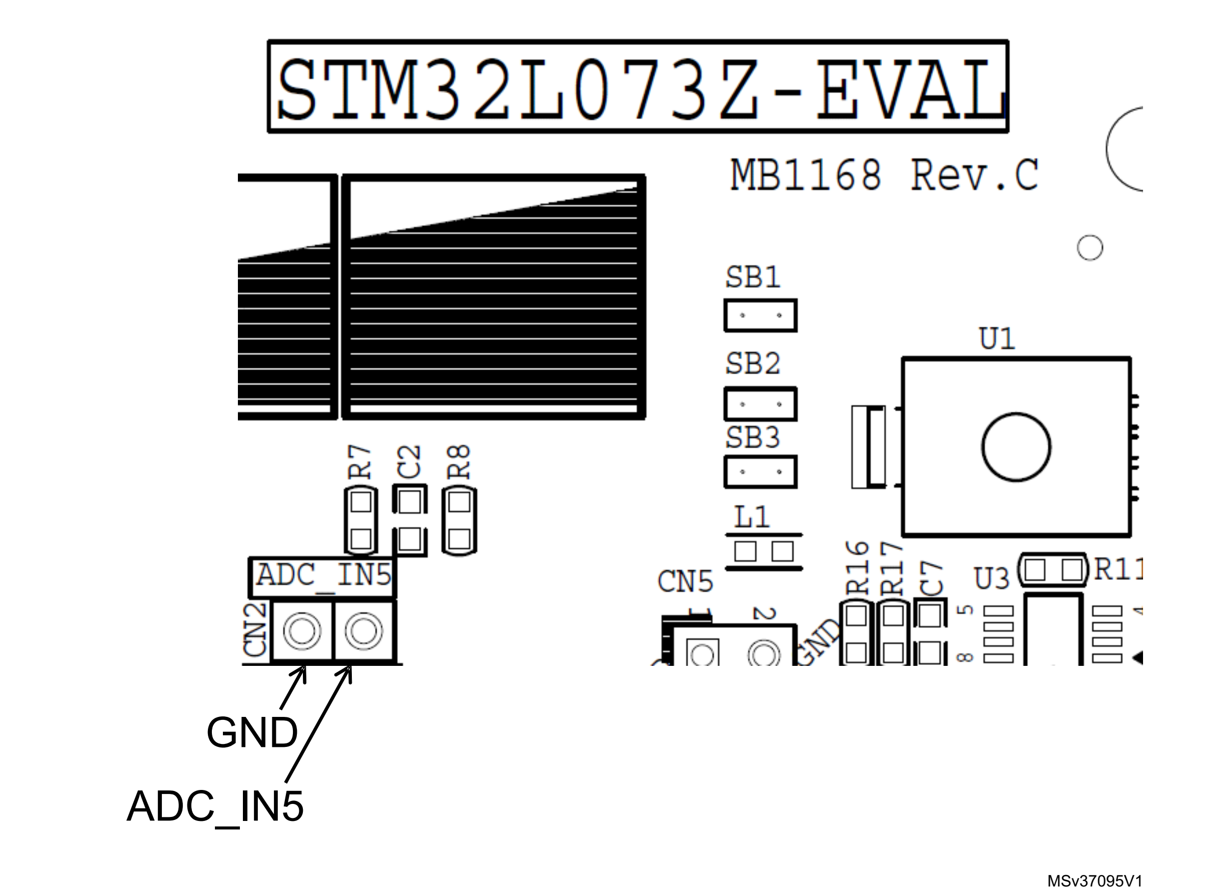
4.12.2 Operating voltage

STM32L073Z-EVAL Evaluation board microSD™ card is operating over the whole range of V_{DD}: 1.65 V to 3.6 V.

4.13 Analog input ADC

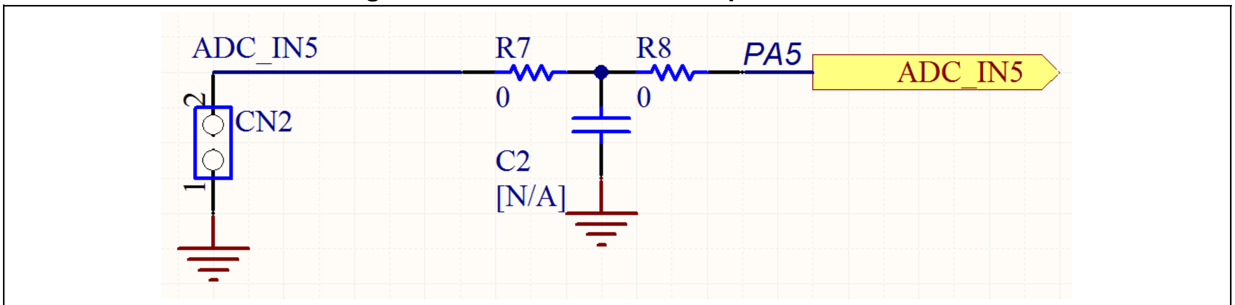
The analog input ADC_IN5 (port PA5) of the microcontroller STM32L073VZT6 is available at connector CN2. It is located below right to the touch-sensing slider LS1. The 2-pin connector CN2 allows the connection of a GND reference to the left pin of CN2, and the voltage to be converted is connected to the right pin of CN2.

Figure 6. Location of ADC input connector CN2



A low-pass filter can be implemented for the ADC input by replacing R7 and C2 by appropriate values depending on the application.

Figure 7. Provision for filter implementation



As the port PA5 can be used also a DAC output, the STM32L073Z-EVAL Evaluation board gives also provision to build an output filter structure by replacing R8 and C2 by appropriate values.

Note that V_{REF+} pin must be connected to a reference voltage to allow a proper conversion by the ADC. In general case, V_{REF} is connected to V_{DD_MCU}, then jumper JP5 must be closed.

4.13.1 Operating voltage

ADC input is operational with V_{DD} > 1.8 V.

4.14 Analog output DAC

The analog output DAC_OUT1 (port PA4) of microcontroller STM32L073VZT6 is available at connector CN3 located below the touch-sensing slider as shown below. The left pin of CN3 is the connection of GND reference, and right pin is DAC output voltage. As PA4 is also used by LC sensor metering, pins 1 and 2 of the selection jumper JP2 must be closed.

Figure 8. Location of DAC output CN3 and JP2

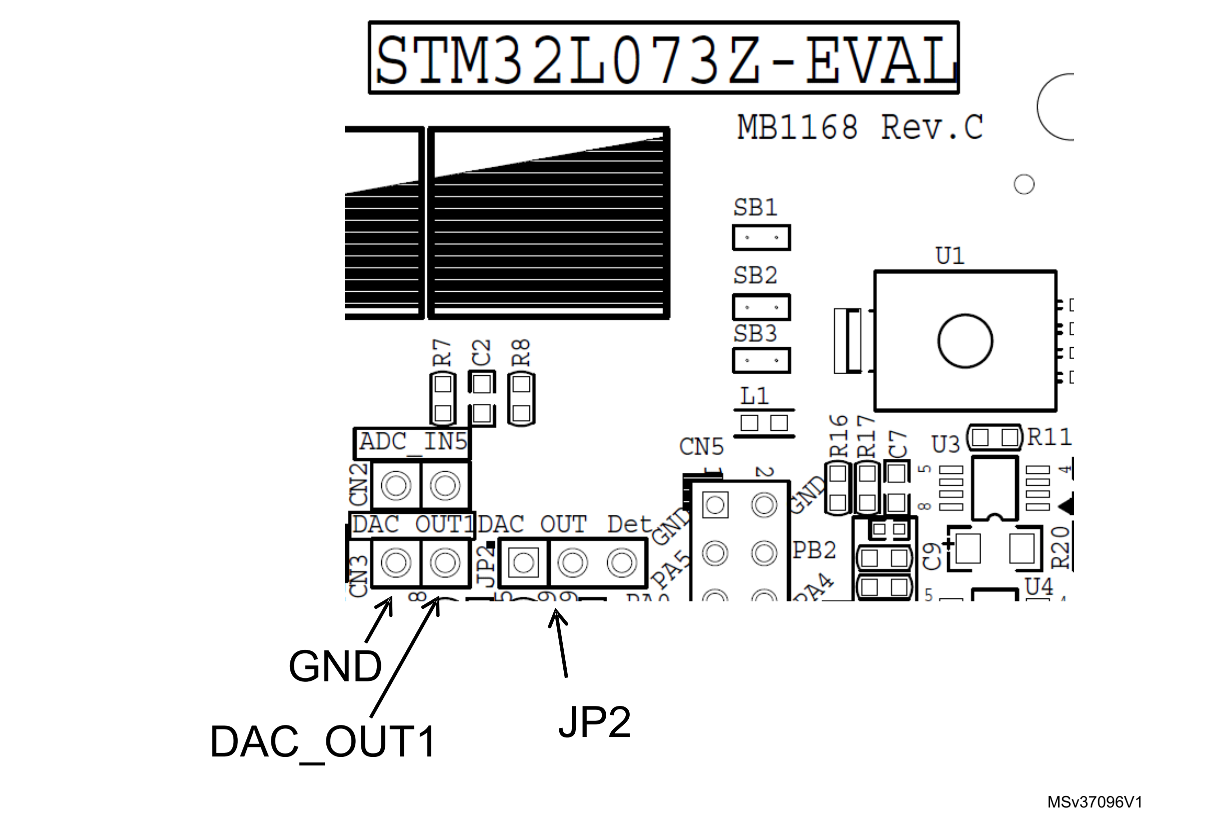
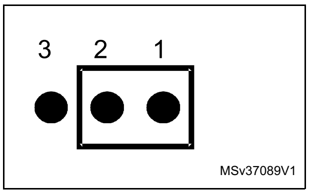
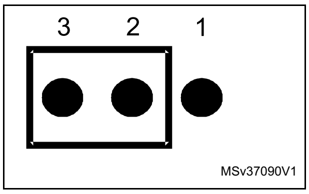
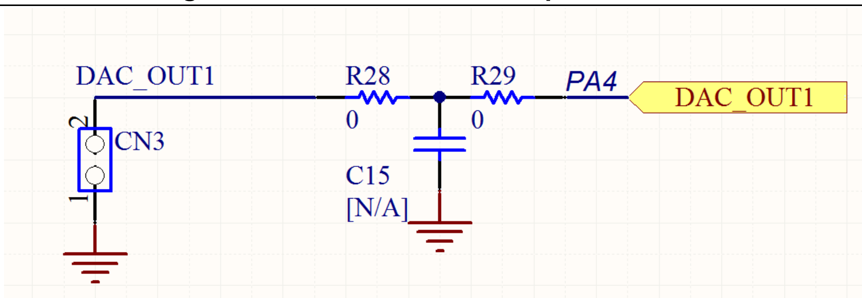


Table 11. Analog input related jumper JP2 settings

Jumpers and resistors		Description
JP2	2 and 3 connected  (default setting)	**LC sensor metering use:** PA4 is connected to the capacitor C59 to filter the DAC_OUT1 voltage for LC sensor metering. DAC_OUT1 is connected internally to the inverting input of the internal comparator Comp2 (refer to *Section 4.20.1: LC sensor metering principle* for more details).
	1 and 2 connected 	**DAC output DAC_OUT1 use:** PA4 is connected to CN3 connector to be used as a DAC Output.

A low-pass filter can be implemented for the DAC output by replacing R29 and C15 by appropriate values depending on the application.

Figure 9. Provision for filter implementation



As the port PA4 can be used also as ADC input IN4, the STM32L073Z-EVAL Evaluation board gives also provision to build an input filter structure by replacing R28 and C15 by appropriate values.

Note that V_{REF+} pin must be connected to a reference voltage to allow a proper conversion by the ADC and the DAC. In general case, V_{REF+} is connected to V_{DD_MCU}, then jumper JP5 must be closed.

4.14.1 Limitations

DAC Output is exclusive with LC sensor metering.

4.14.2 Operating voltage

DAC output is operational with V_{DD} > 1.8 V.

4.15 TFT LCD display

The 2.4” color TFT LCD is connected to SPI1 port of STM32L073VZT6. The TFT LCD daughterboard is the MB895-Serial.

Table 12. TFT LCD connector

2.4” TFT LCD connector CN16					
Pin	**Description**	**Pin connection**	**Pin**	**Description**	**Pin connection**
1	CS	PE10	9	V_{DD}	3.3V
2	SCL	PE13	10	VCI	3.3V
3	SDI	PE15	11	GND	GND
4	RS	-	12	GND	GND
5	WR	-	13	BL_VDD	5V
6	RD	-	14	BL_Control	5V
7	SDO	PE14	15	BL_GND	GND
8	RESET	RESET#	16	BL_GND	GND

Voltage translators are implemented on SPI bus between the microcontroller STM32L073VZT6 and TFT LCD daughterboard to allow the LCD to be functional over the whole voltage range of the microcontroller. A bidirectional voltage translator is used on SPI_MOSI PE15 because the TFT LCD daughterboard has a specific mode in which it is able to send back information on this line. The direction of this voltage translator is controlled by SPI_MOSI_DIR PH9. PE15 is working as MOSI when PH9 is high or as MISO when PH9 is low.

4.15.1 Limitations

No exclusivity.

4.15.2 Operating voltage

The whole operating range of STM32L073VZT6 is: 1.65 V to 3.6 V.

4.16 User LEDs

Four general purpose color LEDs (LD1, LD2, LD3, LD4) are available as display devices.

Table 13. User LEDs

User LEDs	Pin used	comment
LED LD1 (Green)	PE4	Low = LED lighted
LED LD2 (Orange)	PE5	Low = LED lighted
LED LD3 (Red)	PD1	Low = LED lighted
LED LD4 (Blue)	PE7	Low = LED lighted

4.17 Input devices

The 4-direction joystick B3 with selection, Wake-up/ Tamper button B2, Reset button B1 are available as input devices.

Table 14. Input devices

Input devices	Pin used	Circuit
Joystick SEL	GPIO0	MFX U25
Joystick DOWN	GPIO1	MFX U25
Joystick LEFT	GPIO2	MFX U25
Joystick RIGHT	GPIO3	MFX U25
Joystick UP	GPIO4	MFX U25
Wake-up/ Tamper button B2	PC13	STM32L073VZT6 U5
Reset B1	NRST	STM32L073VZT6 U5

4.18 RF-EEPROM

An RF-EEPROM daughterboard MB1020 revision A02 can be plugged into connector CN1 of the STM32L073Z-EVAL Evaluation board. The connector CN1 is located at the top left corner of the board. The RF-EEPROM can be accessed by the microcontroller via the I2C1 bus.

The I^2C address of the RF-EEPROM module on MB1020 revision A02 is 0xA6.

CN1 can be used also as an I^2C extension connector offering SDA and SCL from I2C1 bus, GND at pins 1, 3, 7 respectively.

4.19 LCD segments

An LCD segment daughterboard (MB979) is mounted in the connectors CN10 and CN14 of the STM32L073Z-EVAL Evaluation board. It can be connected to the LCD driver pins of the STM32L073VZT6 or work as a set of jumpers to route the microcontroller pins for another usage, depending on the position:

- When theLCD segment daughterboard is mounted in LCD position, the LCD segments are connected to the LCD driver pins of the STM32L073VZT6 and all peripherals shared with the LCD segments are disconnected. See *Figure 10: LCD segment daughterboard in LCD position*
- When the LCD segment daughterboard is mounted in the “IO” position, all peripherals shared with the LCD segments are connected to the STM32L073VZT6 and the LCD segments are disconnected. See *Figure 11: LCD segment daughterboard in “IO” position*.
- When the LCD segment daughterboard is not plugged in, the connectors CN10 and CN14 give access to ports of the microcontroller. Refer to *Figure 3: STM32L073Z-EVAL Evaluation board (top view)* for more details.

Figure 10. LCD segment daughterboard in LCD position

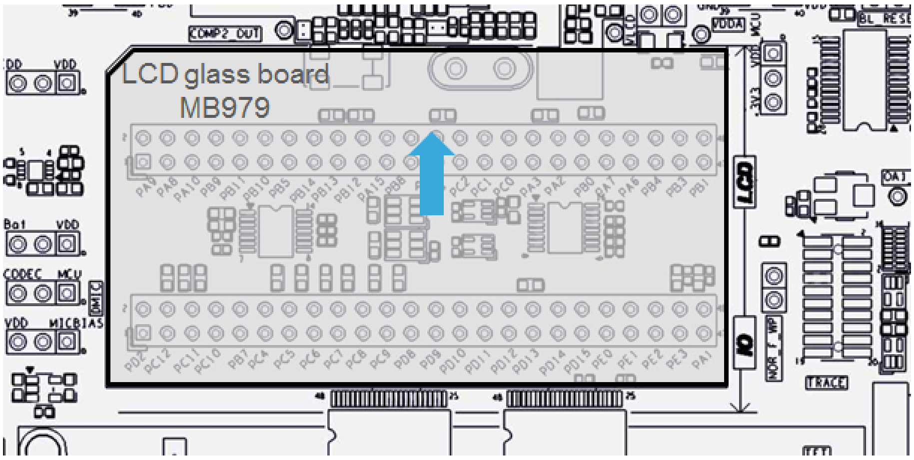
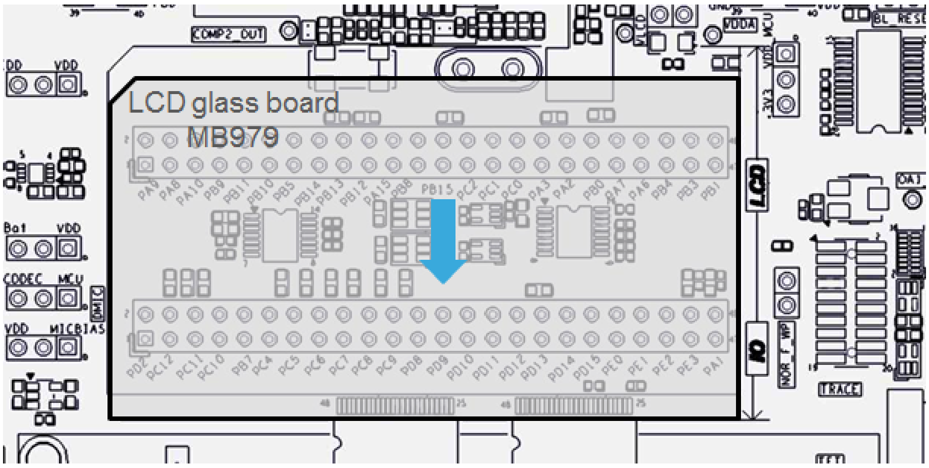


Figure 11. LCD segment daughterboard in “IO” position



The signal mapping of each LCD segment is detailed in the following table (rows are LCD_COMx, columns LCD_SEGy, with x comprised between 0 and 7, y from 0 to 39):

Table 15. LCD segments 21 to 28 mapping table

SEG	21	22	23	24	25	26	27	28
COM7	1g	2g	3g	4g	5g	6g	7g	8g
COM6	1h	2h	3h	4h	5h	6h	7h	8h
COM5	1i	2i	3i	4i	5i	6i	7i	8i
COM4	1j	2j	3j	4j	5j	6j	7j	8j
COM3	1d	2d	3d	4d	5d	6d	7d	8d
COM2	1c	2c	3c	4c	5c	6c	7c	8c
COM0	1e	2e	3e	4e	5e	6e	7e	8e
COM1	1f	2f	3f	4f	5f	6f	7f	8f

Table 16. LCD segments 0 and 29 to 39 mapping table

SEG	29	30	31	32	33	34	35	36	37	38	39	0
COM7	9g	10g	11g	12g	13g	14g	15g	16g	17g	18g	19g	5J
COM6	9h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	5C
COM5	9i	10i	11i	12i	13i	14i	15i	16i	17i	18i	19i	5B
COM4	9j	10j	11j	12j	13j	14j	15j	16j	17j	18j	19j	5I
COM3	9d	10d	11d	12d	13d	14d	15d	16d	17d	18d	19d	13a
COM2	9c	10c	11c	12c	13c	14c	15c	16c	17c	18c	19c	13b
COM0	9e	10e	11e	12e	13e	14e	15e	16e	17e	18e	19e	O1
COM1	9f	10f	11f	12f	13f	14f	15f	16f	17f	18f	19f	O2

Table 17. LCD segments 1 to 8, 15, 18 to 20 mapping table

SEG	6	7	8	3	4	5	1	2	18	19	20	15
COM7	7J	7N	7E	6J	6N	6E	5N	5E	4J	4N	4E	3J
COM6	7C	7M	P6	6C	6M	P5	5M	P4	4C	4M	P3	3C
COM5	7B	7H	7F	6B	6H	6F	5H	5F	4B	4H	4F	3B
COM4	7I	7A	7G	6I	6A	6G	5A	5G	4I	4A	4G	3I
COM3	19a	18a	17a	16a	15a	14a	12a	11a	10a	9a	8a	7a
COM2	19b	18b	17b	16b	15b	14b	12b	11b	10b	9b	8b	7b
COM0	S	7D	Q6	O4	6D	Q5	5D	Q4	µA	4D	Q3	C4
COM1	nA	7K	7L	O3	6K	6L	5K	5L	mA	4K	4L	C3

Table 18. LCD segments 9 to 14, 16, 17 mapping table

SEG	16	17	12	13	14	9	10	11
COM7	3N	3E	2J	2N	2E	1J	1N	1E
COM6	3M	P2	2C	2M	P1	1C	1M	+
COM5	3H	3F	2B	2H	2F	1B	1H	1F
COM4	3A	3G	2I	2A	2G	1I	1A	1G
COM3	6a	5a	4a	3a	2a	1a	S3	S1
COM2	6b	5b	4b	3b	2b	1b	S4	S2
COM0	3D	Q2	C1	2D	Q1	S5	1D	-
COM1	3K	3L	C2	2K	2L	S6	1K	1L

Figure 12. LCD segment names

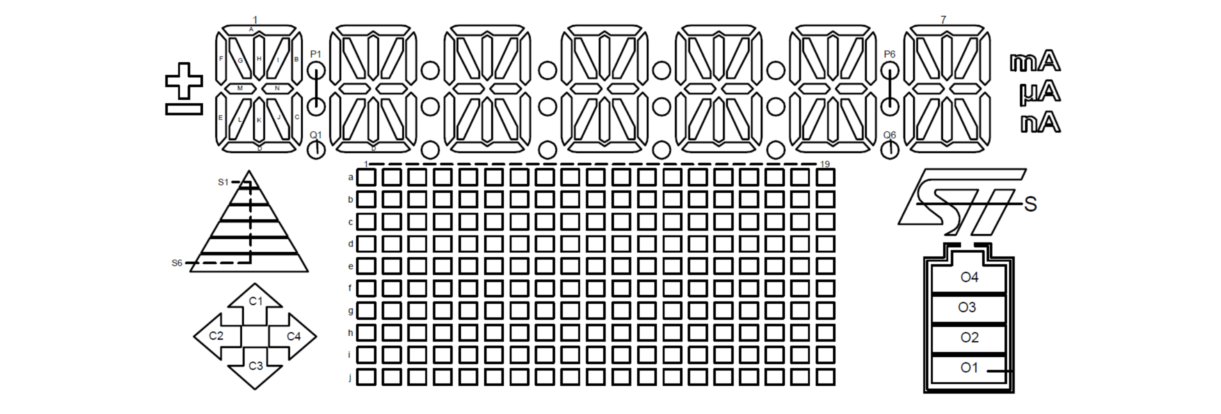
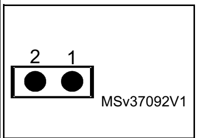
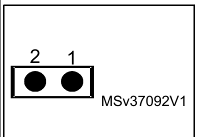


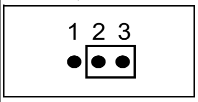
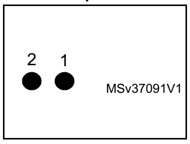
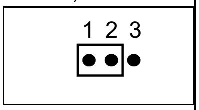
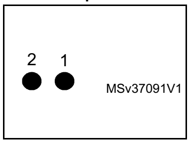
Table 19. LCD segments related jumpers and solder bridges

<table>
<tr><th colspan="2">Jumpers, solder bridges, resistors</th><th>Description</th></tr>
<tr><td rowspan="2">JP8, SB29, SB30</td><td>JP8 closed


SB29, SB30 closed
(default setting)</td><td>The LC network (L2 or L3, and C40) on STM32L073Z-EVAL is used for LC sensor metering. Nothing is connected to connector CN8.</td></tr>
<tr><td>JP8 closed


SB29, SB30 opened</td><td>An external LC network on STM32L073Z-EVAL can be connected to connector CN8 for LC sensor metering.</td></tr>
<tr><td rowspan="2">SB31, R67, SB32, SB33</td><td>SB31 closed, R67 soldered, SB32 opened, SB33 opened (default setting)</td><td>The operational amplifier U9 is used to generate the $V_{DD}/2$ voltage.</td></tr>
<tr><td>SB31 opened, R67 removed, SB32 closed, SB33 closed</td><td>The operational amplifier U9 is used to generate the $V_{DD}/2$ voltage.</td></tr>
</table>

Table 19. LCD segments related jumpers and solder bridges (continued)

Jumpers, solder bridges, resistors		Description
JP1, JP2, JP14, JP15, JP16, JP17, JP18	JP1, JP15, JP17, JP2: 2,3 closed  JP14, JP16, JP18: opened 	LC sensor metering is used, exclusive with LCD segments and DAC output. JP1, JP15, JP17 with pins 2 and 3 closed: ports PA7, PB4, PC0 are used for LC sensor metering signals: DET_COMP2_OUT, DET_COMP2_INP, DET_LPTIM_CH1 respectively. JP2 with pins 2 and 3 closed: port PA4 is used for LC sensor metering signal DET_DAC_OUT1 JP14, JP16, JP18 opened: reserved use.
	JP1, JP15, JP17, JP2: 1,2 closed  JP14, JP16, JP18: opened 	LCD segments are used, DAC output on CN3 is used, both are exclusive with LCD segments. JP1, JP15, JP17 with pins 1 and 2 closed: ports PA7, PB4, PC0 are used for LCD segments: LCDSEG4, LCDSEG8 and LCDSEG18 respectively. JP2 with pins 1 and 2 closed: port PA4 is used for DAC output connector CN3, signal DAC_OUT1. JP14, JP16, JP18 opened: reserved use.

4.19.1 Limitations

LCD segments are exclusive with LPUART, LC sensor metering, temperature sensor INT, EXT RESET.

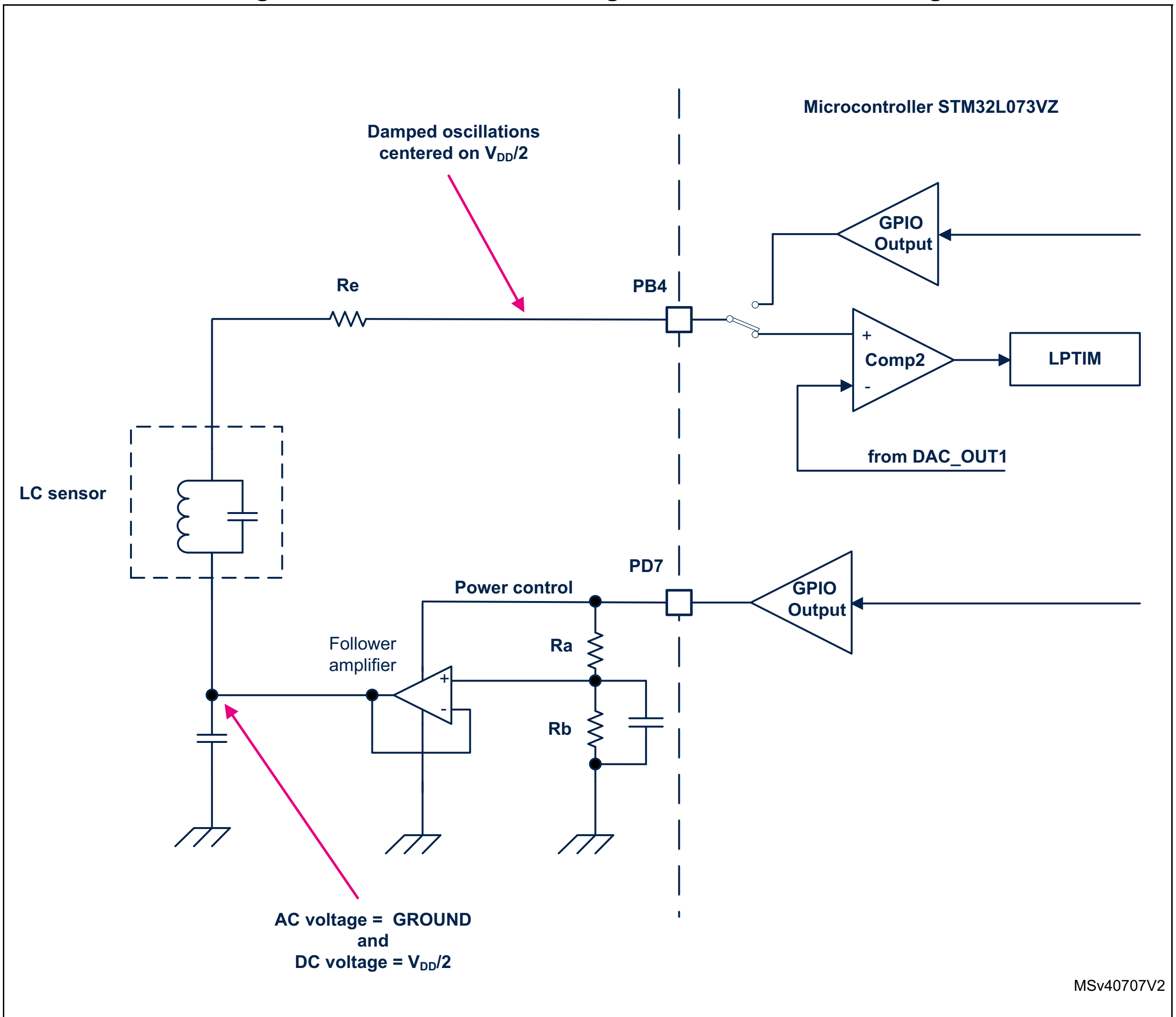
4.20 LC sensor metering

The LC sensor metering is a metal detector based on a resonating LC network connected to the microcontroller STM32L073VZT6. The STM32L073VZT6 triggers the LC network periodically to initiate self-oscillations. If a non-ferrous metal plate is placed in the magnetic field of the inductor L, the higher loss reduces the number of self-oscillations. Using the comparator and the low-power timer LPTIM embedded inside the microcontroller, it is possible for the software to detect the presence of non-ferrous metal by a lower count of the timer LPTIM.

A small board called Detection Accessory MB1199 is proposed with the Evaluation board STM32L073Z-EVAL, to test the LC sensor metering quickly. The copper area to detect is 12 mm by 12 mm wide.

4.20.1 LC sensor metering principle

Figure 13. Functional block diagram of LC sensor metering



The port PD7 of the microcontroller STM32L073VZT6 is configured in GPIO output to deliver a high state. PD7 is in fact the signal called POWER_CONTROL. It is in charge to provide power supply to the resistor divider Ra, Rb and the follower amplifier based on an operational amplifier. The DC voltage at the output the operational amplifier is approximately $V_{DD}/2$ as Ra = Rb.

In a second phase, the port PB4 is used in GPIO output to cause a DC current flowing inside the inductor of the LC sensor.

In steady state, the DC current is $V_{DD}/2$ Re. The inductor stores the electrical energy in his magnetic core.

PB4 is internally disconnected from the GPIO and connected to the positive input of the comparator Comp2 of the microcontroller STM32L073VZT6. The current disruption causes high frequency voltage self-oscillations of the LC resonator circuit. The lower connection of the LC resonator is considered grounded from an AC point of view thanks to the capacitor and the low output impedance of the follower amplifier. Then, the voltage oscillations are available at port PB4 with a superimposition of a DC voltage of $V_{DD}/2$ respectively to the ground. After the comparator threshold controlled by the DAC_OUT1 voltage is set properly by a calibration, the comparator delivers pulses to the low-power timer LPTIM. LPTIM is in charge to count the number of oscillations.

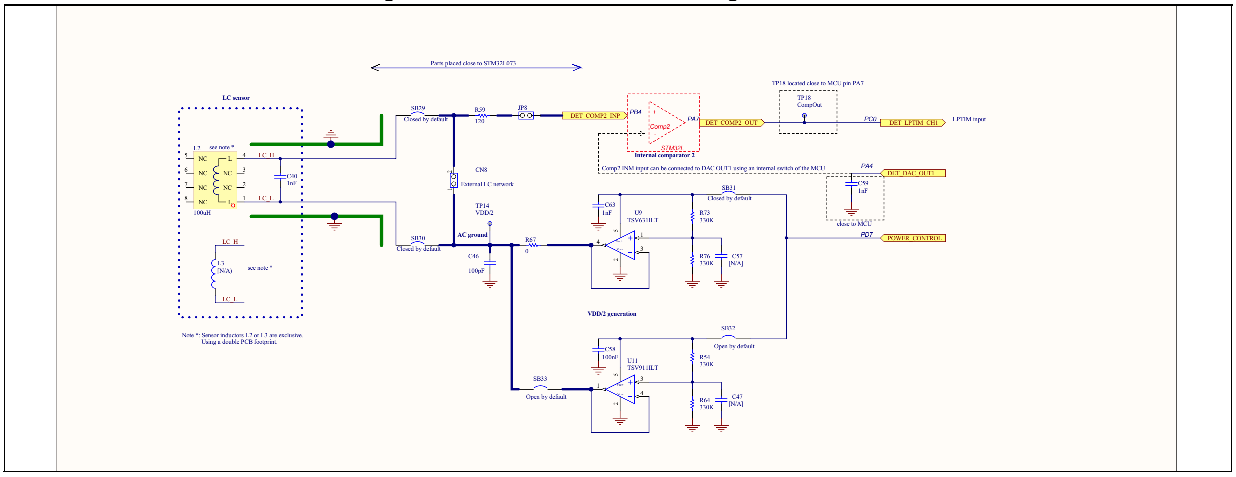
The value in the counter LPTIM depends directly on the decay time of the oscillations, and therefore to the quality factor of the inductor L.

Finally if a piece of non-ferrous metal is placed in the magnetic field of the inductor, losses increase, reducing the decay time and then it reduces the number of counts in LPTIM. The software can thus detect the presence of a piece of non-ferrous metal by comparing the value of LPTIM timer that is lower with metal presence than without.

4.20.2 LC sensor metering description

The LC sensor metering of STM32L073Z-EVAL Evaluation board follows closely the principle described above (see *Figure 14*).

Figure 14. LC sensor metering schematic



The LC network used for LC sensor metering is based on the inductor L2 or L3 and the capacitor C40. A double footprint allows the soldering of inductor L2 or L3 exclusively, the location is called detection on the PCB. The inductor L2 or L3 is called L for sake of simplicity in this description. The POWER_CONTROL PD7 supplies the voltage divider R73, R76 and the low-power operational amplifier U9 to generate a $V_{DD}/2$ voltage at the LC_L net of the LC network (refer to *Figure 14: LC sensor metering schematic*). From AC voltage point of view, LC_L net is grounded, thanks to the capacitor C46 and the low output impedance of the operational amplifier.

Another operational amplifier U11 is available in back-up of U9 with improved output impedance performance over frequency but with a higher operating current.

To store magnetic energy inside the inductor L, the ports PB7 and PB4 must be set in GPIO output mode, with PD7 high, PB4 low. The DC current flowing inside L is $V_{DD}/2 \times R59$.

After the energy is stored in the inductor L, the port PB4 called DET_COMP2_INP is switched from GPIO output into a positive input of the comparator Comp2. This current disruption inside the inductor L, triggers the self-oscillations of the LC network. The oscillation frequency is typically in the range of 500 kHz to 700 kHz.

The threshold of the comparator is the voltage on the negative input of Comp2. It is generated by the DAC_OUT1 connected internally inside the microcontroller. The DAC_OUT1 voltage must be set to a voltage a bit higher to $V_{DD}/2$, typically a few 10 mV over $V_{DD}/2$. The port PA4 called DET_DAC_OUT1 connected to internal voltage DAC_OUT1 allows the connection to the external capacitor C59 for a more stable threshold voltage.

The port PA7 DET_COMP2_OUT delivers calibrated pulses to the low-power timer input DET_LPTIM_CH1, port PC0.

An external LC network can be used by removing the solder bridges SB29, SB30 and by connecting an external parallel LC network to the connector CN8.

Some solder bridges and jumpers must be set properly to enable the LC sensor metering. Refer to *Table 20: Solder bridges and jumpers for LC sensor metering*.

Table 20. Solder bridges and jumpers for LC sensor metering

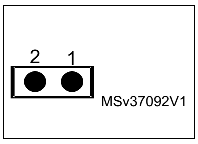
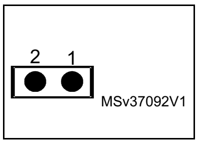
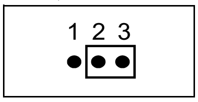
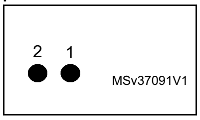
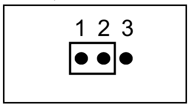
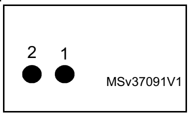
Jumpers, solder bridges, resistors		Description
JP8, SB29, SB30	JP8 closed  SB29, SB30 closed **(default setting)**	The LC network (L2 or L3, and C40) on STM32L073Z-EVAL is used for LC sensor metering. Nothing is connected to connector CN8.
	JP8 closed  SB29, SB30 opened	An external LC network on STM32L073Z-EVAL can be connected to connector CN8 for LC sensor metering.
SB31, R67, SB32, SB33	SB31 closed, R67 soldered, SB32 opened, SB33 opened **(default setting)**	The operational amplifier U9 is used to generate the $V_{DD}/2$ voltage.
	SB31 opened, R67 removed, SB32 closed, SB33 closed	The operational amplifier U9 is used to generate the $V_{DD}/2$ voltage.

Table 20. Solder bridges and jumpers for LC sensor metering (continued)

Jumpers, solder bridges, resistors		Description
JP1, JP2, JP14, JP15, JP16, JP17, JP18	JP1, JP15, JP17, JP2: 2,3 closed  JP14, JP16, JP18: opened  **(default setting)**	LC sensor metering is used, and is exclusive with LCD segments and DAC output. JP1, JP15, JP17 with pins 2 and 3 closed: ports PA7, PB4, PC0 are used for LC sensor metering signals: DET_COMP2_OUT, DET_COMP2_INP, DET_LPTIM_CH1 respectively. JP2 with pins 2 and 3 closed: port PA4 is used for LC sensor metering signal DET_DAC_OUT1 JP14, JP16, JP18 opened: reserved use.
	JP1, JP15, JP17, JP2: 1,2 closed  JP14, JP16, JP18: opened 	LCD segments (without LCDSEG4, LCDSEG8, LCDSEG18) are used, DAC output on CN3 is used, both are exclusive with LCD segments. JP1, JP15, JP17 with pins 1 and 2 closed: ports PA7, PB4, PC0 are used for LCD segments: LCDSEG4, LCDSEG8, LCDSEG18 respectively. JP2 with pins 1 and 2 closed: port PA4 is used for DAC output connector CN3, signal DAC_OUT1. JP14, JP16, JP18 opened: reserved use.

4.20.3 Limitations

LC sensor metering is exclusive with LCD segments and DAC output.

Nevertheless, it is possible to use LCD segments without segments SEG4, SEG8, SEG18 with LC sensor metering with JP1, JP15, JP17, JP2: 1,2 closed.

However, if LCD segments SEG4, SEG8, SEG18 are not used, the LCD segments can be used in such limited manner with LC sensor metering. In that case jumpers JP1, JP15, JP17 and JP2 must have pins 1 and 2 closed.

4.21 Pressure sensor

An absolute pressure sensor with 0 hPa to 1000 hPa measurement range is used.

4.21.1 Calculations

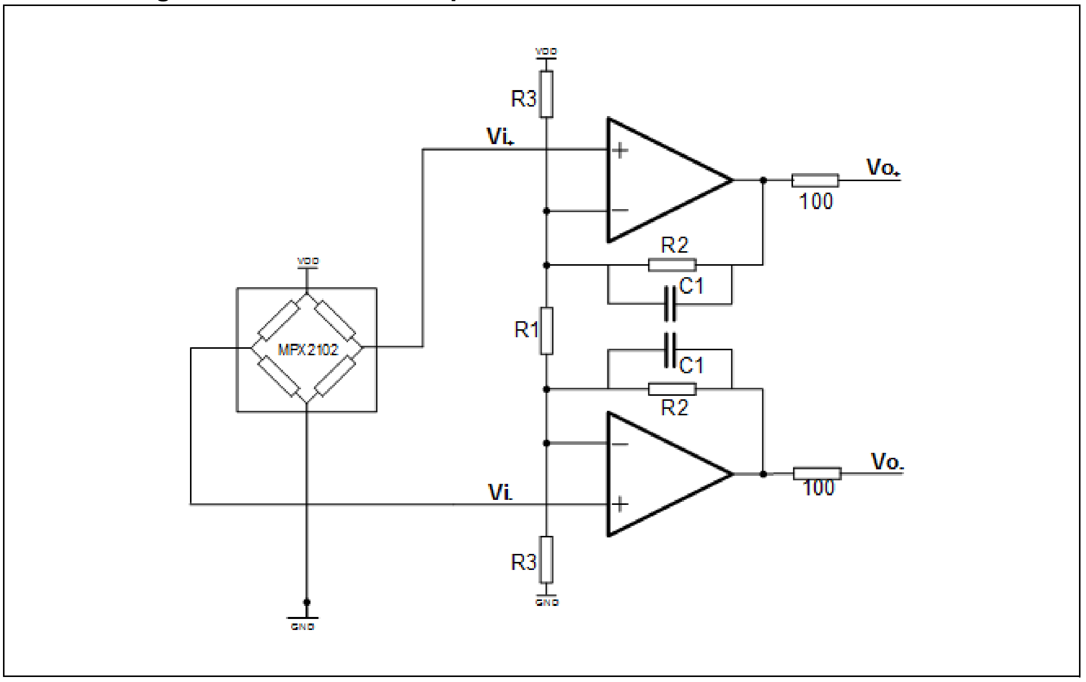
The equivalent schematic of the sensor is a Wheastone bridge with a following differential voltage output considering it is supplied with +3.3 V:

Table 21. Sensor differential voltage

Pressure	Sensor differential voltage
0 hPa	0 mV
800 hPa	10.56 mV
1000 hPa	13.2mV
1200 hPa	15.84 mV

As the proposed pressure measurement targets only barometric use, the sensor is used only in the range from 800 hPa to 1000 hPa, then the amplification is centered on this range. Then it leads to use a differential amplifier with offset voltage (see *Table 15*):

Figure 15. Differential amplifier with offset correction



Following the formula, the differential output voltage (V_{o+} - V_{o-}) versus differential input voltage (V_{i+} - V_{i-}) is:

V_{o+}- V_{o}- = [(R1R3 + R1R2 + 2R2R3) / R1R3]* (V_{i+} - V_{i-}) – V_{DD}*R2/R3.

Using R1 = 220 Ω, R2 = 47 kΩ, R3=27.4 kΩ the output differential voltage is:

(V_{o+}- V_{o-}) = 430* (V_{i+} - V_{i-}) - 1.71*V_{DD}

It gives the following differential voltages referring to a virtual ground equal to V_{DD}/2 (see *Table 22: Differential voltage*):

Table 22. Differential voltage

Pressure	Sensor differential voltage (V_{i+} - V_{i-})	Differential V_{out} (V_{o+} - V_{o-})
0 hPa	0 mV	Saturated at -V_{DD}
800 hPa	10.56 mV	-1.3 V
1000 hPa	13.2 mV	0 V
1200 hPa	15.84 mV	+1.23 V

Finally, in STM32L073Z-EVAL Evaluation board, the differential voltage is shifted by a $V_{DD}/2$ offset and changed in a single voltage by the last unity gain operational amplifier. The output of this amplifier, delivers the single output voltage to the ADC input PA0:

Table 23. Single output voltage to the ADC

Pressure	Sensor differential voltage (V_{i+} - V_{i-})	Single output voltage ADC input PA0
0 hPa	0 mV	0 V
800 hPa	10.56 mV	0.163 V
1000 hPa	13.2 mV	1.65 V
1200 hPa	15.84 mV	$\pm$2.88 V

4.21.2 Errors

Offset error: with 0.1% tolerance resistors, the error is 22.6 mV, then equivalent to 0.4 hPa. Gain error: with 0.1% tolerance resistors, the gain error is roughly 0.2%, at 1000 hPa is equivalent to 2 hPa. So, errors due to electronic circuitry is around 2.4 hPa at 1000 hPa and error due to the sensor itself is 6 hPa. Finally the total absolute error is
0.4 + 2 + 6 = 8.4 hPa.

4.21.3 Pressure computation

The relation between the atmospheric pressure and the measured voltage is linear. To overcome gain and offset errors, the software of the user can use a calibration. It allows the formulation of the linear equation between the measured voltage and the atmospheric pressure. The slope of the linear equation is typically:

$$(2880 - 1650) / 200 = \frac{6.15\,\mathrm{mV}}{\mathrm{hPa}}$$

4.21.4 Filtering

Low-pass filtering is mandatory to reduce unwanted noise and also to avoid aliasing, because the ADC oversamples the value to simulate a 16-bit ADC.

A first-order low pass with 3 Hz cut-off frequency, is composed of 47 kΩ resistors combined with 1 µF capacitors to feedback the first amplifiers U3A and U3B.

4.21.5 Limitations

No exclusivity.

4.21.6 Operating voltage

Operating voltage is fixed at: +3.3 V

4.22 Touch-sensing slider

The STM32L073Z-EVAL Evaluation board supports a touch-sensing slider based on either RC charging or charge transfer technology. The charge transfer technology is enabled by the default assembly.

The touch-sensing slider is connected to PB12, PB0, PA1 and the related charge capacitors are respectively connected to PB13, PB1 and PA2. PC6 and PC7 manage an active shield reducing sensitivity to other signals. The active shield is placed on the internal layer 2, immediately under the slider to eliminate influence from other circuits.

Some rework on solder bridges and resistors is necessary to use touch sensing and it is described in the below *Table 24*:

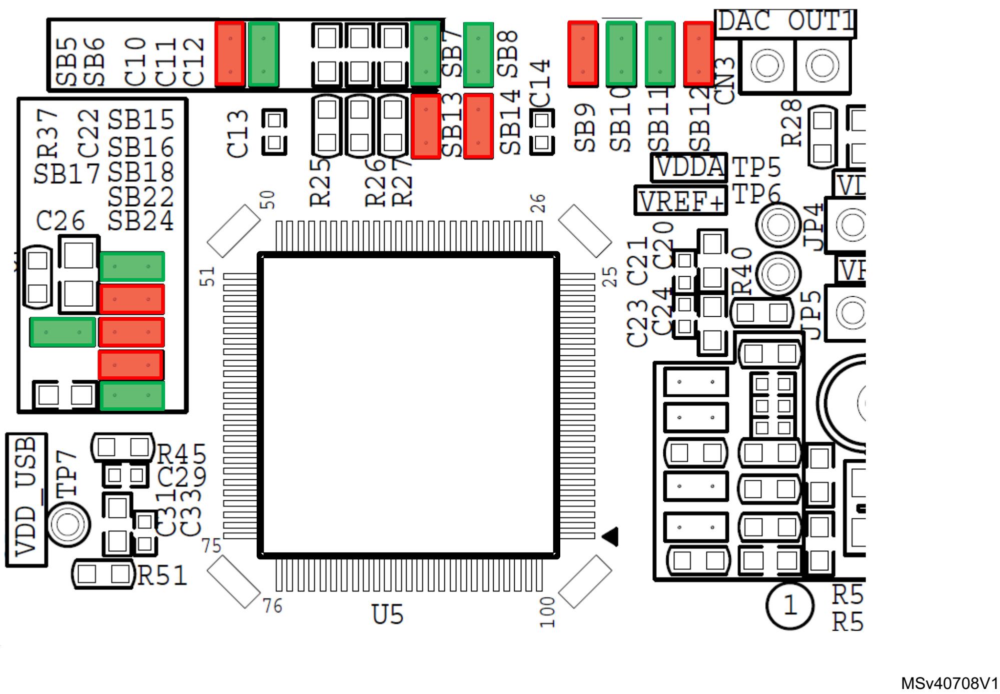
Table 24. Touch sensing related solder bridges

Solder bridges	Settings to enable touch sensing	STM32 port	Description
SB6	Close	PB12	Connects the first touch-sensing zone to PB12.
SB5	Open	PB12	Disconnects PB12 from track to LCD segments to avoid disturbances.
SB8	Close	PB0	Connects the second touch-sensing zone to PB0.
SB14	Open	PB0	Disconnects PB0 from track to LCD segments to avoid disturbances.
SB11	Close	PA1	Connects the third touch-sensing zone to PA1.
SB12	Open	PA1	Disconnects PA1 from track to LCD segments to avoid disturbances.
SB17	Close	PC6	Connects the shield to PC6.
SB18	Open	PC6	Disconnects PC6 from track to LCD segments to avoid disturbances.
SB24	Close	PC7	Connects the charge capacitor of shield to PC7.
SB22	Open	PC7	Disconnects PC7 from track to LCD segments to avoid disturbances.
SB15	Close	PB13	Connects the charge capacitor to PB13.
SB16	Open	PB13	Disconnects PB13 from track to LCD segments to avoid disturbances.
SB7	Close	PB1	Connects the charge capacitor to PB1.
SB13	Open	PB1	Disconnects PB1 from track to LCD segments to avoid disturbances.

Table 24. Touch sensing related solder bridges (continued)

Solder bridges	Settings to enable touch sensing	STM32 port	Description
SB10	Close	PA2	Connects the charge capacitor to PA2.
SB9	Open	PA2	Disconnects PA2 from track to LCD segments to avoid disturbances.

Figure 16. Solder bridges settings to enable the touch slider (red = closed, green = opened)



4.22.1 Limitations

Touch-sensing slider is exclusive with LCD segments.

4.23 Extension connectors

Two 2.54 mm pitch headers CN4 and CN5 called “extension connectors” are intended to connect an external board to the STM32L073Z-EVAL Evaluation board.

Both connectors CN4 and CN5 give access to the GPIOs that are not accessible by the LCD segment connectors.

In addition to GPIOs, CN4 and CN5 have the following supplies and signals:

GND, +3V3, D5V, RESET#, V_{DD}, clock pins (PC14, PC15, PH0, PH1).

For more details regarding clock pins, refer to *Section 4.4: Clock source*.

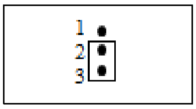
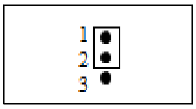
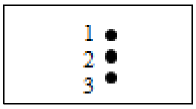
Table 25. Extension connectors pin-out

CN4 (left side)		CN5 (right side)	
Pin	Signal	Pin	Signal
1	GND	1	GND
2	+3V3	2	GND
3	PE7	3	PA5
4	PE8	4	PB2
5	PE9	5	PA0
6	PE10	6	PA4
7	PE11	7	PH1
8	PE12	8	PH0
9	PE13	9	PH10
10	PE14	10	PH9
11	GND	11	PC14
12	GND	12	PC15
13	PE15	13	PC13
14	PA11	14	GND
15	PA13	15	GND
16	PA12	16	NC
17	PD0	17	VLCD
18	PA14	18	PE6
19	PD3	19	PE5
20	PD1	20	PE4
21	PD6	21	BOOT0
22	PD5	22	PB7
23	PD7	23	PB6
24	D5V	24	RESET#
25	GND	25	GND
26	GND	26	V_{DD}

4.24 IDD auto-measurement

In addition to the jumpers allowing the measurement of each power domain separately or the whole microcontroller consumption, the STM32L073Z-EVAL Evaluation board offers also an automatic consumption measurement. The current of the microcontroller STM32L073VZT6 can be autonomously measured while it is in Run or Low power saving modes.

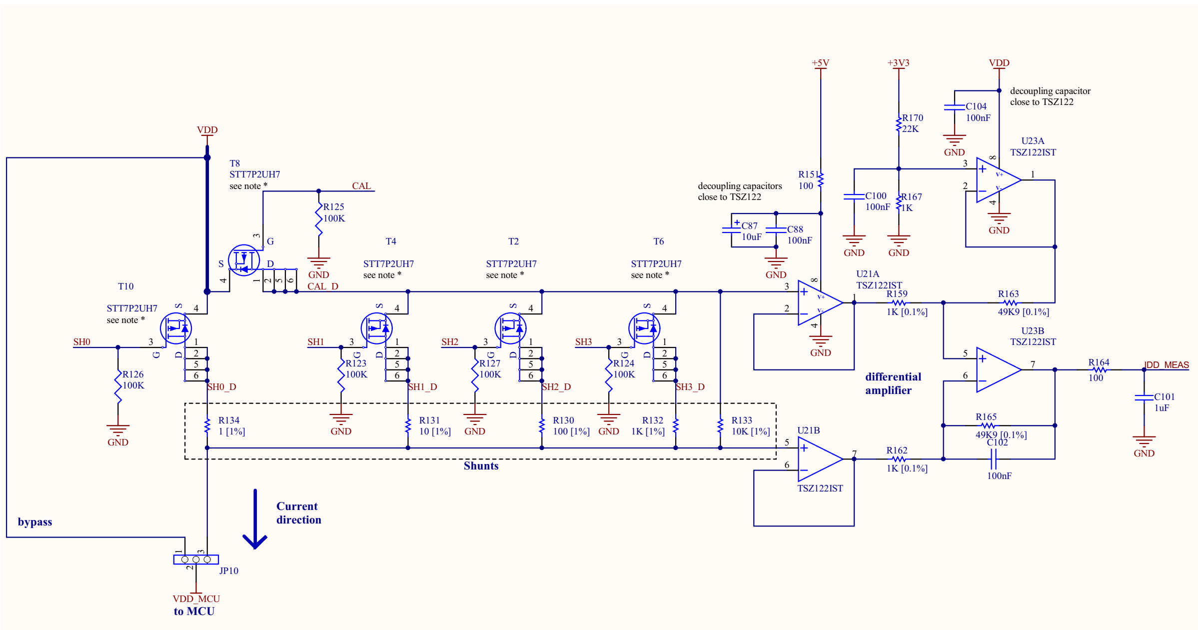
Table 26. IDD auto-measurement related jumper settings

Jumper		Description
JP10		JP10 2 and 3 closed (jumper in IDD position): STM32L073VZT6 is powered through IDD measurement circuit.
	 **(default setting)**	JP10 1 and 2 closed (jumper in V_{DD} position): IDD measurement circuit is bypassed, STM32L073VZT6 is powered directly.
		JP10: no jumper to pins 1, 2, 3. STM32L073VZT6 total current consumption can be measured by connecting an ammeter between pins 1 and 2 of JP10.

4.24.1 Analog section description

The analog part of the IDD auto-measurement circuit is based on five shunts resistors: R134, R131, R130, R132 and R133, switched by PMOS transistors to get enough resolution and precision over a wide range of currents. The possibility to use shunts from 1 Ω to 10 kΩ allows the measurement of currents from 100 mA to a few 10 mA typically. This covers all functional modes of the STM32L073VZT6 microcontroller.

Figure 17. Figure: analog section schematic



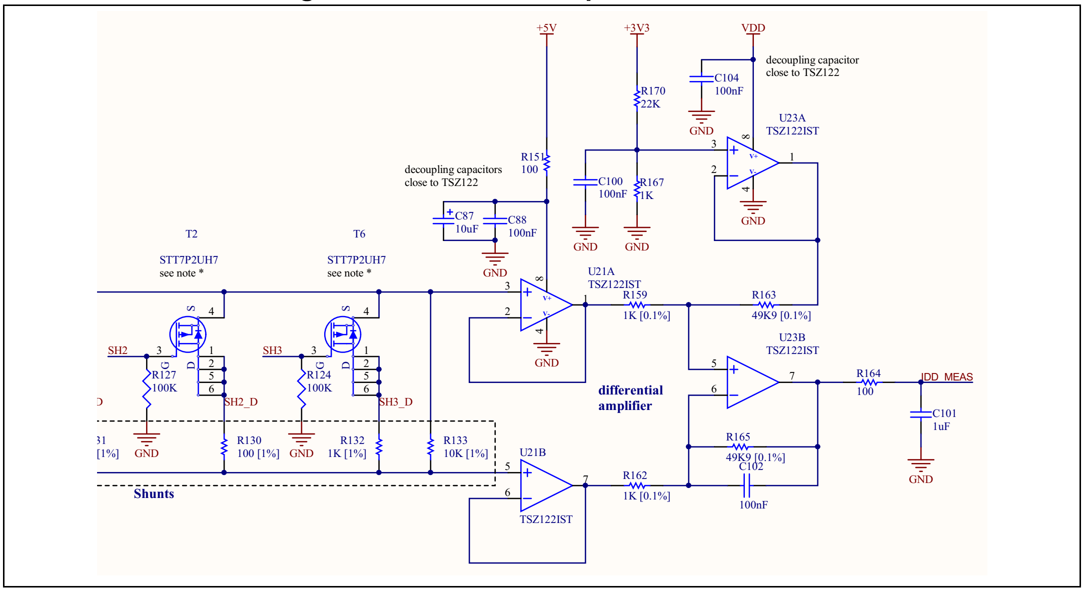
The voltage drop across the selected shunt is amplified by a very high accuracy and zero-drift operational amplifier.

The voltage drop is connected to pins 3 and 5 of the operational amplifier U21.

The digital section switches or not to a higher resistance shunt for a better measurement, depending on the measurement result obtained with one shunt. The transistor T8 is used to set to zero the voltage difference for the calibration of the analog amplifier.

4.24.2 Difference amplifier

Figure 18. Difference amplifier



The voltage measured over the shunt is amplified by a difference amplifier based on high-performance operational amplifiers. The DC gain is 49.9. Finally the output voltage I_{DD_MEAS} is available for conversion and treatment by the digital section.

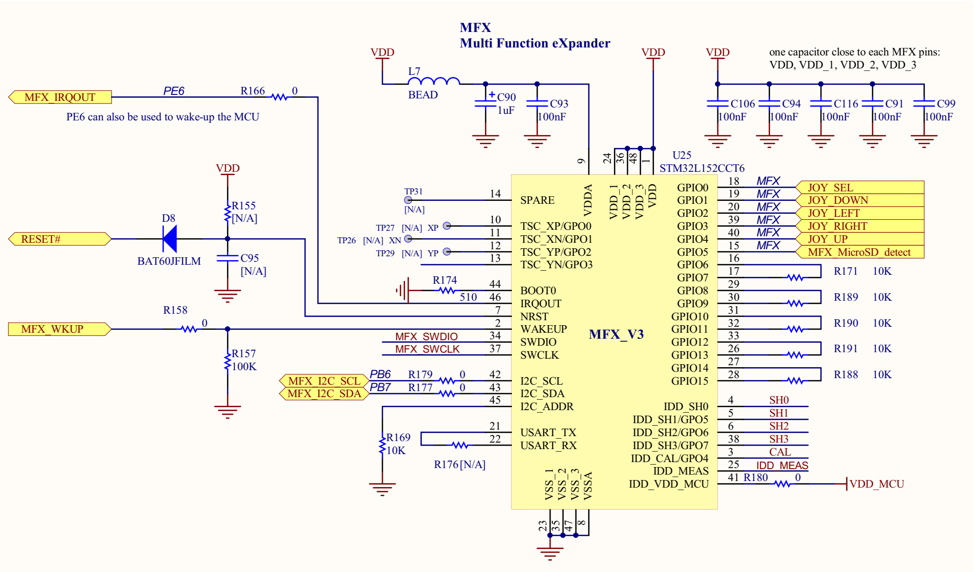
4.24.3 Digital section description

The multifunction expander MFX U25 is, among other functions, in charge of sequencing and acquiring the IDD auto-measurement feature.

It controls the switches of the analog section to measure the current sequentially from the lowest resistance shunt to the highest one, to maximize the precision of the current measurement. It works as an auto-range ampere-meter. It has internally some functionalities to avoid a too big voltage drop on the supply voltage of the microcontroller under test.

From SW point of view, it is up to the host STM32L073VZT6 to send the commands to the MFX to measure the current via the I^2C bus. A delay can be used to allow the host STM32 to request a measurement and have enough time to go in low-power mode. After the given delay the MFX measures the current. At the end, the measured value can be read by the host STM32L073VZT6 inside the MFX registers through the I^2C bus.

Figure 19. Digital section schematic



Warning:

To avoid current injection from STM32 to components on the board during IDD measurement it is strongly recommended to keep $V_{DD\_MCU} \leq 3.3$ V. Some components on the board are powered by 3.3 V so that, if V_{DD_MCU} is higher than 3.3 V, a current can be injected.

5 Connectors

5.1 RS-232 connector CN6

Figure 20. RS-232 connector CN6 (front view)

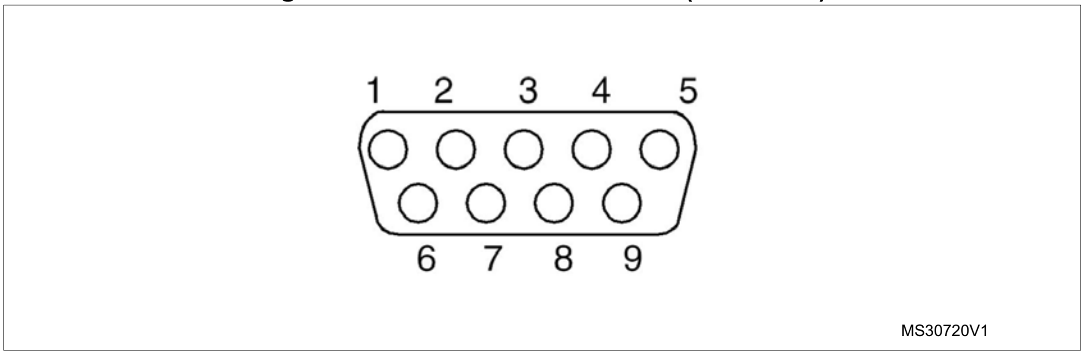


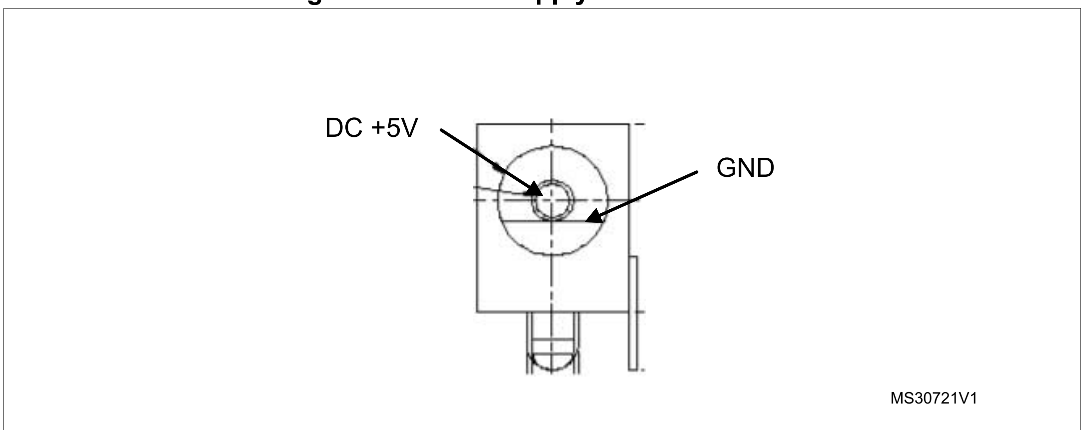
Table 27. RS-232 connector CN6

Pin number	Description	Pin number	Description
1	NC	6	Bootloader_BOOT0
2	RX (PD6)	7	RTS (PD4)
3	TX (PD5)	8	CTS/ Bootloader_RESET
4	NC	9	NC
5	GND	-	-

5.2 Power connector CN18

STM32L073Z-EVAL Evaluation board can be powered from a DC 5 V power supply via the external power supply jack (CN18) shown in *Figure 21: Power supply connector CN18*. The central pin must be positive.

Figure 21. Power supply connector CN18



5.3 LCD segment daughterboard connectors CN10 and CN14

Two 48-pins male headers CN10 and CN14 are used to connect with the LCD segment daughterboard (MB979). The space between these two connectors and the position of every LCD segment signals are defined as a standard, which allows the development of common daughterboards for several Evaluation boards. The standard width between CN10 pin 1 and CN14 pin 1 is 700 mils (17.78 mm).

GPIO signals on these two connectors can be tested on odd pins when the LCD segment daughterboard is not plugged in. For signals assignment details refer to *Table 28: LCD segment daughterboard connectors*.

Table 28. LCD segment daughterboard connectors

CN10		CN14	
Odd pin	GPIO signal	Odd pin	GPIO signal
1	PA9	1	PD2
3	PA8	3	PC12
5	PA10	5	PC11
7	PB9	7	PC10
9	PB11	9	PC3
11	PB10	11	PC4
13	PB5	13	PC5
15	PB14	15	PC6
17	PB13	17	PC7
19	PB12	19	PC8
21	PA15	21	PC9
23	PB8	23	PD8
25	PB15	25	PD9
27	PC2	27	PD10
29	PC1	29	PD11
31	PC0	31	PD12
33	PA3	33	PD13
35	PA2	35	PD14
37	PB0	37	PD15
39	PA7	39	PE0
41	PA6	41	PE1
43	PB4	43	PE2
45	PB3	45	PE3
47	PB1	47	PA1

If CN10 and CN14 are used as GPIO extension connectors on a daughterboard, odd pins and even pins must not be connected directly on the daughterboard.

5.4 ST-LINK/V2-1 programming connector CN15

The connector CN15 is used only for embedded ST-LINK/V2-1 programming during board manufacture. It is not populated by default and not for end user.

5.5 ST-LINK/V2-1 USB Type-B connector CN17

The USB connector CN17 is used to connect the embedded ST-LINK/V2-1 to the PC for board debugging.

Figure 22. USB Type-B connector CN17

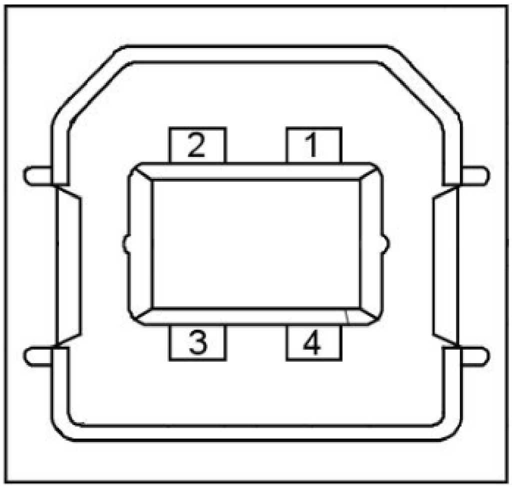


Table 29. USB Type-B connector CN17

Pin number	Description	Pin number	Description
1	V_{BUS} (power)	4	GND
2	DM	5,6	Shield
3	DP	-	-

5.6 SWD connector CN12

Figure 23. Trace debugging connector CN12 (top view)

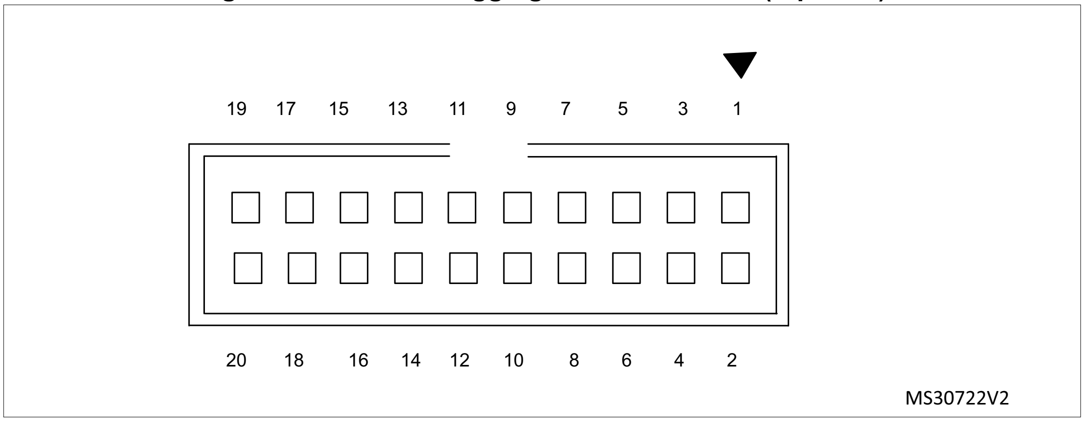


Table 30. SWD debugging connector CN12

Pin number	Description	Pin number	Description
1	V_{DD} power	2	V_{DD} power
3	-	4	GND
5	-	6	GND
7	SWDIO PA13	8	GND
9	SWCLK PA14	10	GND
11	-	12	GND
13	-	14	GND
15	RESET#	16	GND
17	DBGRQ	18	GND
19	DBGACK	20	GND

5.7 Trace debugging connector CN11

Figure 24. Trace debugging connector CN11 (top view)

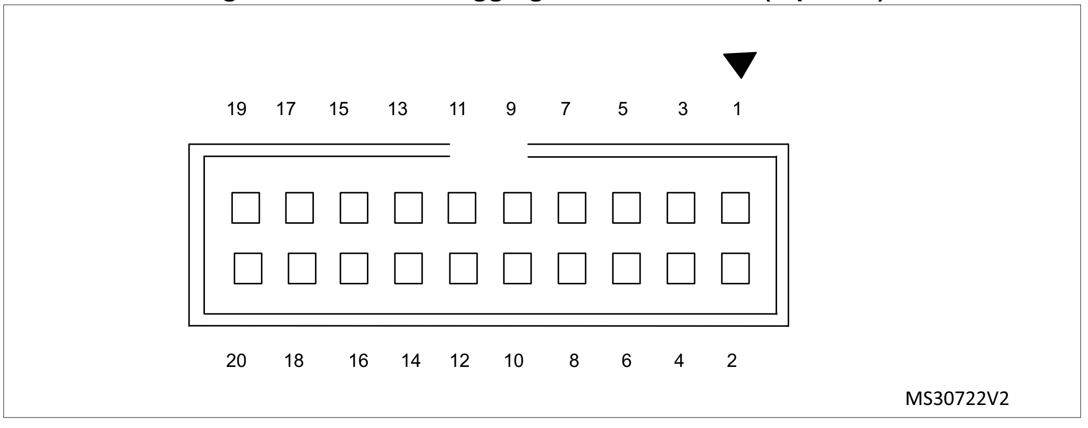


Table 31. Trace debugging connector CN11

Pin number	Description	Pin number	Description
1	V_{DD} power	2	SWDIO PA13
3	GND	4	SWCLK PA14
5	GND	6	-
7	Pin is removed	8	-
9	GND	10	RESET#
11	GND	12	-
13	GND	14	-
15	GND	16	-
17	GND	18	-
19	GND	20	-

5.8 microSD™ connector CN13

Figure 25. microSD™ connector CN13

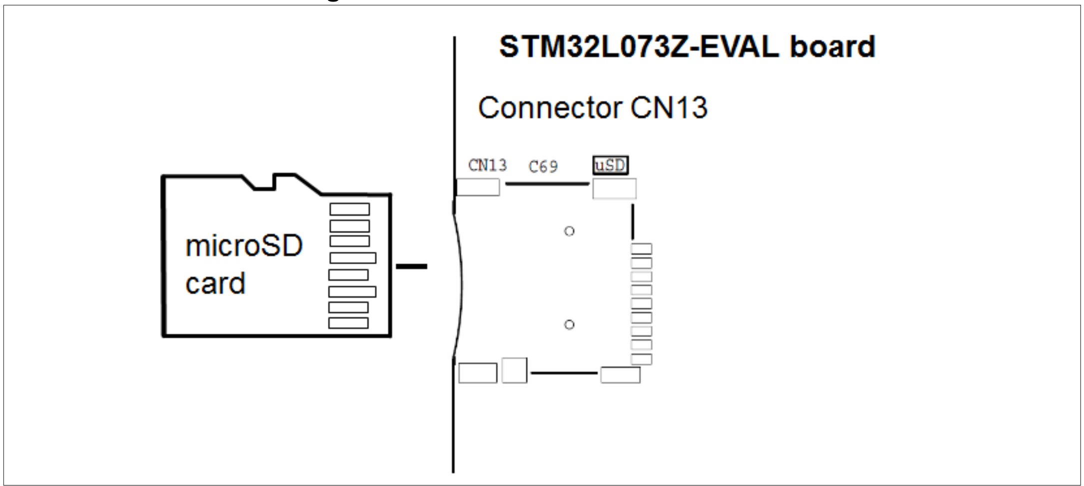


Table 32. microSD™ connector CN13

Pin number	Description	Pin number	Description
1	NC	6	GND
2	MicroSD_CS (PD0)	7	SPI_MISO (PE14)
3	SPI_MOSI (PE15)	8	NC
4	+3V3	9	GND
5	SPI_CLK (PE13)	10	MicroSDcard_detect (to expander MFX)

5.9 RF-EEPROM daughterboard connector CN1

Figure 26. RF-EEPROM daughterboard connector CN1 (front view)

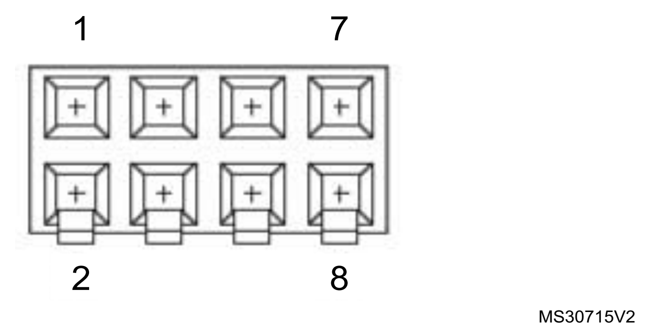
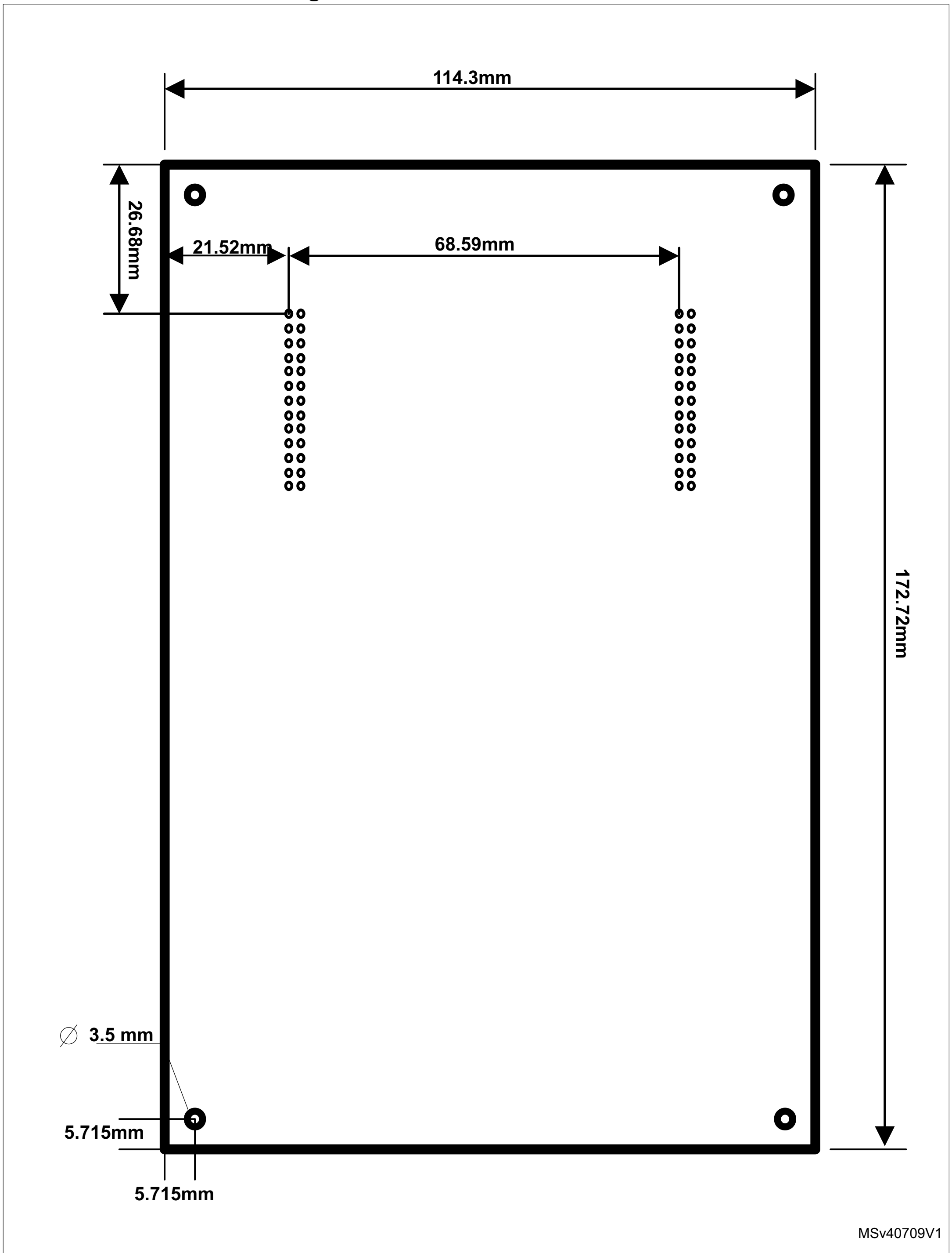


Table 33. RF-EEPROM daughterboard connector CN1

Pin number	Description	Pin number	Description
1	I2C_SDA (PG13)	5	V_{DD}
2	NC	6	NC
3	I2C_SCL (PG14)	7	GND
4	EXT_RESET(PC6)	8	NC

6 Mechanical dimensions

Figure 27. Mechanical dimensions



7 STM32L073Z-EVAL Evaluation board information

7.1 Product marking

The stickers located on the top or bottom side of all PCBs provide product information:

- First sticker: product order code and product identification, generally placed on the main board featuring the target device.
  Example:

  Product order code
  Product identification

- Second sticker: board reference with revision and serial number, available on each PCB.
  Example:

  MBxxxx-Variant-yzz
  syywwxxxxx

On the first sticker, the first line provides the product order code, and the second line the product identification.

On the second sticker, the first 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 line shows the board serial number used for traceability.

Parts marked as *"ES"* or *"E"* are not yet qualified and therefore not approved for use in production. ST is not responsible for any consequences resulting from such use. In no event will ST be liable for the customer using any of these engineering samples in production. ST's Quality department must be contacted prior to any decision to use these engineering samples to run a qualification activity.

"E" or *"ES"* marking examples of location:

- On the targeted STM32 that is soldered on the board (for an 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.

Some boards feature a specific STM32 device version, which allows the operation of any bundled commercial stack/library available. This STM32 device shows a *"U"* marking option at the end of the standard part number and is not available for sales.

To use the same commercial stack in their applications, the developers might need to purchase a part number specific to this stack/library. The price of those part numbers includes the stack/library royalties.

7.2 STM32L073Z-EVAL product history

Table 34. Product history

Order code	Product identification	Product details	Product change description	Product limitations
STM32L073Z-EVAL	STM32L073Z-EVAL/	MCU: – STM32L073VZT6 revision "Z" MCU errata sheet: – *STM32L07xxx/L08xxx device errata* (ES0292) Boards: – MB895-Serial-C03 (TFT LCD daughterboard) – MB979-Default-A01 (LCD segment daughterboard) – MB1020-Default-A02 (RF-EEPROM daughterboard) – MB1168-Default-C01 (main board) – MB1199-Default-A01 (detection accessory daughterboard)	Initial revision	No limitation
	VA32L073Z$AU1	MCU: – STM32L073VZT6 revision "Z", "P", or "1" MCU errata sheet: – *STM32L07xxx/L08xxx device errata* (ES0292) Boards: – MB895-Serial-C04 (TFT LCD daughterboard) – MB979-Default-A01 (LCD segment daughterboard) – MB1020-Default-A02 (RF-EEPROM daughterboard) – MB1168-L073VZT6-C02 (main board) – MB1199-Default-A01 (detection accessory daughterboard)	– Packaging: plastic blister replaced by a carton box – Main board revision changed – TFT LCD daughterboard revision changed	No limitation

7.3 Board revision history

Table 35. Board revision history

<table>
<tr><th>Board reference</th><th>Board variant and revision</th><th>Board change description</th><th>Board limitations</th></tr>
<tr><td rowspan="2">MB895
(TFT LCD daughterboard)</td><td>Default-C03</td><td>Initial revision</td><td>No limitation</td></tr>
<tr><td>Serial-C04</td><td>Several part references updated due to obsolescence (such as inductor or others, refer to the bill of materials for details)</td><td>No limitation</td></tr>
<tr><td>MB979
(LCD segment daughterboard)</td><td>Default-A01</td><td>Initial revision</td><td>No limitation</td></tr>
<tr><td>MB1020
(RF-EEPROM daughterboard)</td><td>Default-A02</td><td>Initial revision</td><td>No limitation</td></tr>
<tr><td rowspan="2">MB1168
(main board)</td><td>Default-C01</td><td>Initial revision</td><td>Inversion of the VLCD1 and VLCD2 labels of the PB2 and PB12/PE11 pins in the top silkscreen.</td></tr>
<tr><td>L073VZT6-C02</td><td>Several part references updated due to obsolescence (such as transistors or others, refer to the bill of materials for details)</td><td>Inversion of the VLCD1 and VLCD2 labels of the PB2 and PB12/PE11 pins in the top silkscreen.</td></tr>
<tr><td>MB1199
(detection accessory daughterboard)</td><td>Default-A01</td><td>Initial revision</td><td>No limitation</td></tr>
</table>

8 Federal Communications Commission (FCC) and ISED Canada Compliance Statements

8.1 FCC Compliance Statement

8.1.1 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.

8.1.2 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.

8.1.3 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)

Francesco Doddo
STMicroelectronics, Inc.
200 Summit Drive | Suite 405 | Burlington, MA 01803
USA
Telephone: +1 781-472-9634

8.2 ISED Compliance Statement

Compliance Statement

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

Déclaration de conformité

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

Revision history

Table 36. Document revision history

Date	Revision	Changes
16-Feb-2016	1	Initial version.
25-May-2018	2	Added *Chapter 3: System requirements* and *Chapter 4: Development toolchains*. Updated *Chapter 1: Features*, *Chapter 2: Product marking*, *Chapter 5: Demonstration software*, and *Chapter 6: Ordering information*.
30-Jan-2024	3	Removed *Appendix A: Electrical schematics*. Added *Chapter 7: STM32L073Z-EVAL Evaluation board information* and *Chapter 8: Federal Communications Commission (FCC) and ISED Canada Compliance Statements*. Updated JP7 description in *Table 3: Power related jumpers*. Updated *Section 4.1: Embedded ST-LINK/V2-1*. Updated *Figure 2: Hardware block diagram*, *Figure 3: STM32L073Z-EVAL Evaluation board (top view)*, and *Table 26: IDD auto-measurement related jumper settings*. Revised the beginning of the document: – Updated *Introduction*, *Chapter 1: Features*, *Chapter 2: Ordering information*, *Section 3.1: System requirements*, and *Section 3.2: Development toolchains* – Added *Section 2.1: Codification*