# User manual

## Evaluation board with STM32L073VZ MCU

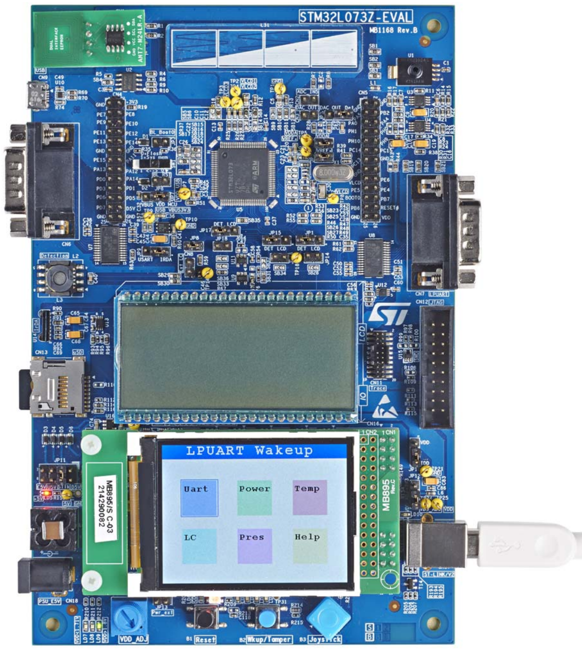
## Introduction

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 $I^2C$ buses, two SPI interfaces, four USART interfaces, one UART interface, 12-bit ADC and DAC, LCD driver, up to 192-Kbyte Flash memory, 20-Kbyte RAM, 6-Kbyte Touch sensing, USB OTG FS, LCD controller, SWD debugging support. This evaluation board can be used as reference design for user application development but it is not considered as a final application.

The full range of hardware features on the board can help the user to evaluate all peripherals (USB OTG FS, USART, 12-bit ADC and DAC, color TFT LCD, LCD glass, USART, low-power UART, IrDA, microSD card, touch sensing slider, pressure measurement, temperature measurement, LC sensor metering) and develop his 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**




1. Picture not contractual.

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# 1 Features

- Four 5 V power supply options: power jack, ST-LINK USB connector, user USB OTG FS connector, or extension connector CN4
- STM32 voltage selectable: 3.3 V or adjustable from 1.7 V to 3.6 V
- MicroSD card interface
- RF-EEPROM on $I^2C$ interface
- RS232 interface configurable for communication or flashloader
- Low-power UART
- IrDA transceiver
- USB FS connector
- Pressure sensor
- LC sensor metering
- Joystick with 4-direction control and selector
- Reset and Wake-up/Tamper buttons
- Touch slider
- LCD glass 40x8 segments connected to LCD driver of STM32L073VZT6
- A 2.8-inch color LCD TFT with resistive touchscreen
- ADC and DAC signal connectors
- STM32 consumption measurement circuit
- SWD, user interface by USB virtual com port, ST-LINK/V2-1 embedded
- Extension connector for daughterboard or wrapping board
- Boards RoHS compliant (lead free)

# 2 Demonstration software

Demonstration software is preloaded in the STM32L073VZT6 Flash memory, for easy demonstration of the device peripherals in stand-alone mode. For more information and to download the latest version available, refer to the STM32L073Z-EVAL demonstration software available on www.st.com.

# 3 Product marking

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

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

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

# 4 Order code

To order the STM32L073VZT6 evaluation board, use the order code: STM32L073Z-EVAL.

# 5 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**

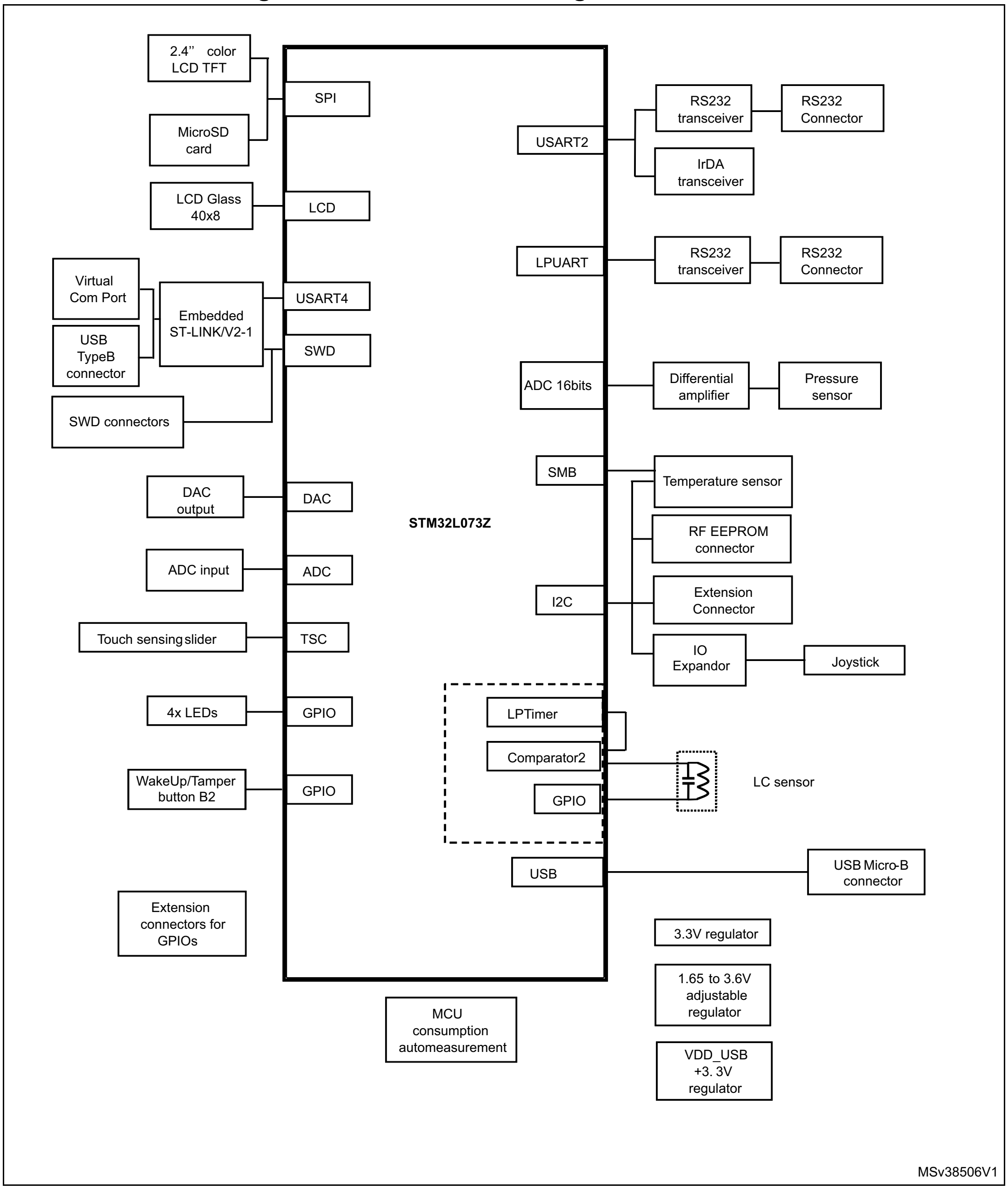
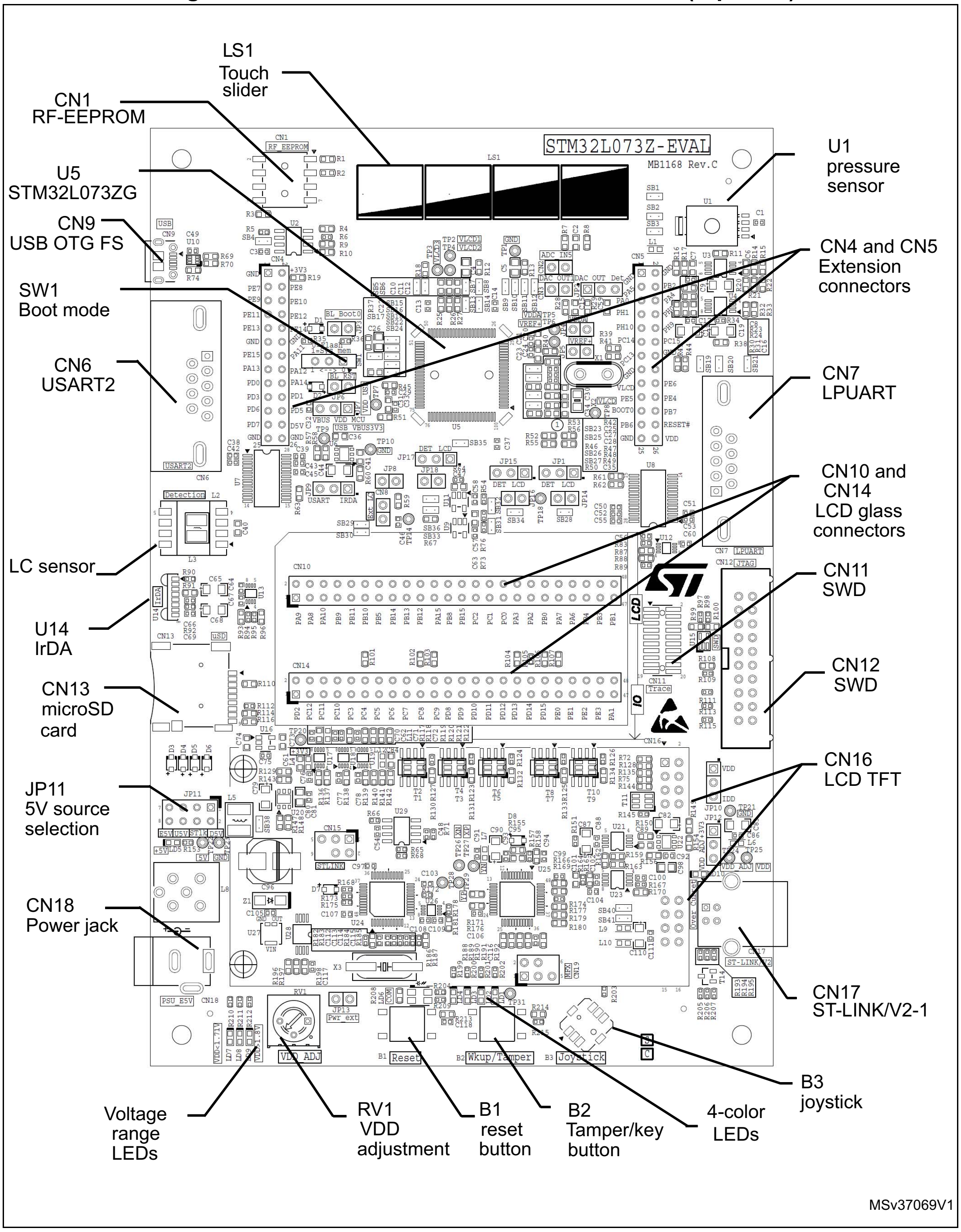


**Figure 3. STM32L073Z-EVAL evaluation board (top view)**




## 5.1 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 refer to ST-LINK/V2 User Manual UM1075.

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.*

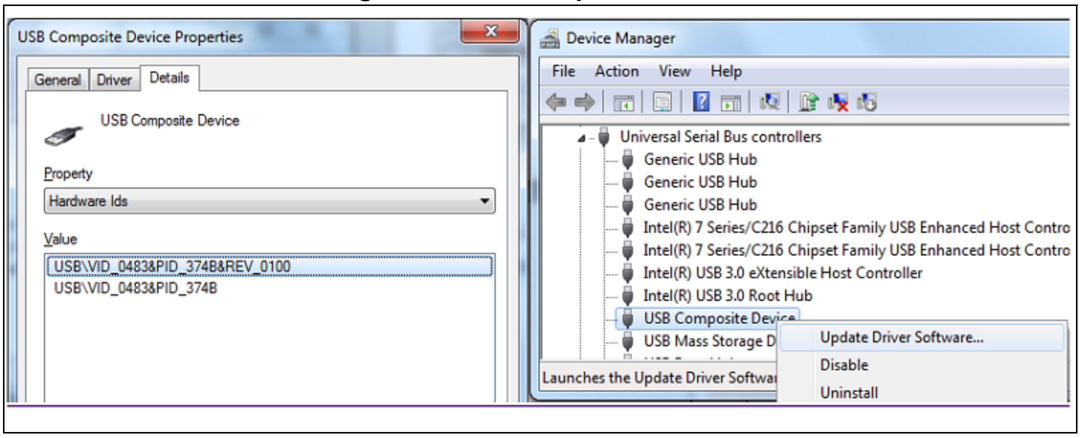
### 5.1.1 Drivers

The ST-LINK/V2-1 requires a dedicated USB driver, which can be found on *www.st.com* for Windows® XP, 7, 8.

In case the STM32L073Z-EVAL evaluation board is connected to the PC before the driver is installed, some STM32L073Z-EVAL interfaces may be declared as “Unknown” in the PC device manager. In this case the user must install the driver files, and update the driver of the connected device from the device manager.

*Note: Prefer using the “USB Composite Device” handle for a full recovery.*

**Figure 4. USB Composite device**




### 5.1.2 ST-LINK/V2-1 firmware upgrade

The ST-LINK/V2-1 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/V2-1 product (for example new functionality, bug fixes, support for new microcontroller families), it is recommended to visit www.st.com before starting to use the STM32L073Z-EVAL evaluation board and periodically, in order to stay up-to-date with the latest firmware version.

## 5.2 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.

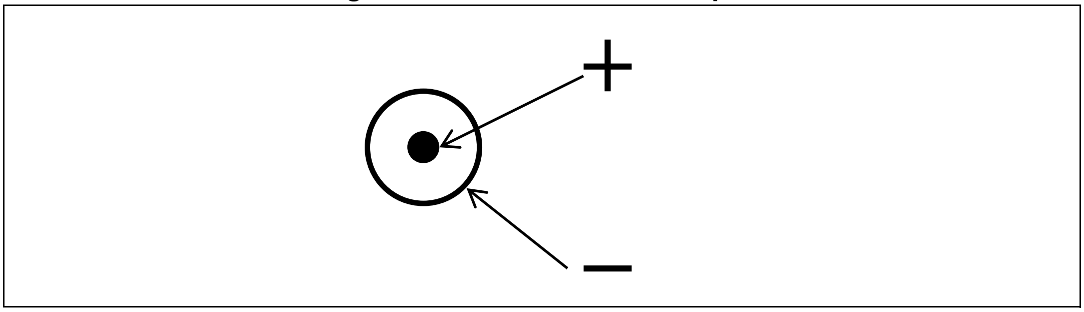
## 5.3 Power supply

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 ST890 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 will not be 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 should 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 1: Power related jumpers*.

**Table 1. Power related jumpers**

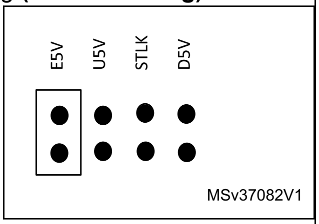
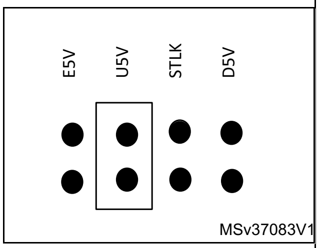
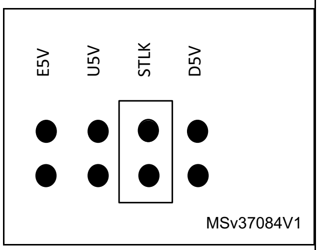
| Jumper | Description |
|---|---|
| JP11 | JP11 is used to select one of the four possible power supply sources.<br>To supply STM32L073Z-EVAL only from a 5 V power adapter connected to CN18 (PSU_E5V), set the jumper to E5V location, as following **(Default setting)**:<br><br> |
| | To supply STM32L073Z-EVAL only from the USB connector CN9 set the jumper to U5V location, as following:<br><br> |
| | 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 should be opened.<br><br> |

**Table 1. Power related jumpers (continued)**

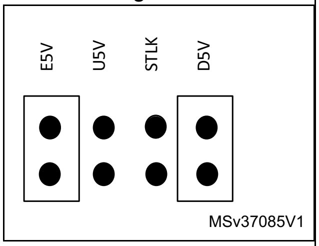
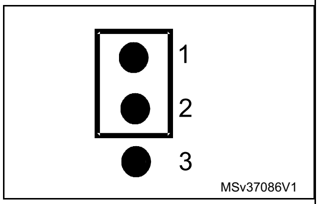
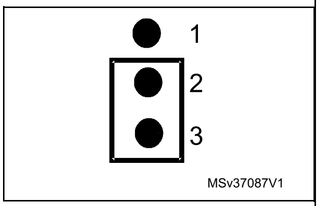
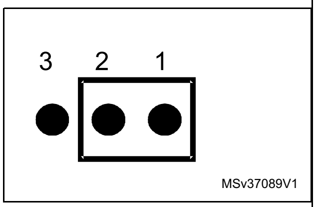
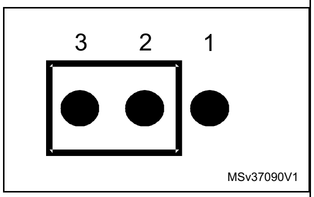
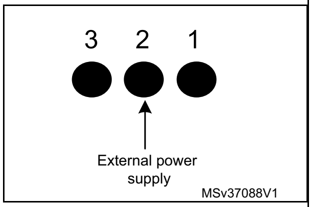
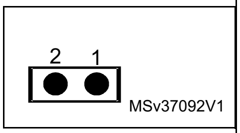
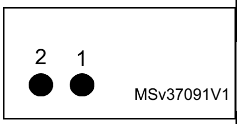
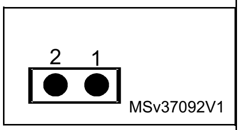
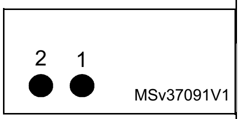
<table>
<tr><th>Jumper</th><th>Description</th></tr>
<tr><td>JP11</td><td>To supply both STM32L073Z-EVAL and a daughterboard connected to extension connectors CN4 and CN5, (daughterboard should have its own power supply not connected), set jumpers to E5V and D5V locations, as following:<br><br></td></tr>
<tr><td rowspan="2">JP12</td><td>$V_{DD\_MCU}$ (pins $V_{DD}$ of STM32L073Z) is connected to fixed +3.3 V DC power when JP12 is set as shown (Default setting):<br><br></td></tr>
<tr><td>$V_{DD\_MCU}$ is connected to the adjustable DC power from 1.65 V to 3.6 V when JP12 is set as shown:<br><br></td></tr>
<tr><td rowspan="2">JP7</td><td>$V_{DD\_MCU}$ power pin of STM32L073Z is connected to VDD_MCU when JP7 is set as shown (Default setting):<br><br></td></tr>
<tr><td>$V_{DD\_MCU}$ power pin of STM32L073Z is powered by the USB connector CN9 when JP7 is set as shown here:<br><br></td></tr>
</table>

**Table 1. Power related jumpers (continued)**

| Jumper | Description |
|---|---|
| JP7 | $V_{DD\_MCU}$ power pin of STM32L073Z 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:   |
| JP4 | $V_{DDA}$ power pin of STM32L073Z is connected to $V_{DD\_MCU}$ when JP4 is closed as shown **(default setting):**   |
| | To measure the current drawn by $V_{DDA}$ pin of STM32L073Z, remove the jumper of JP4 and connect an ampere-meter to JP4, positive terminal to pin 1, negative to pin 2.   |
| JP5 | $V_{REF+}$ pin of STM32L073Z is connected to $V_{DD\_MCU}$ when JP5 is closed as shown **(default setting):**   |
| | To measure the current drawn by $V_{REF+}$ pin of STM32L073Z, remove the jumper of JP5 and connect an ampere-meter to JP5, positive terminal to pin 1, negative to pin 2.   |
| JP13 | 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**).<br>If JP13 is connected, ST-LINK will never supply the evaluation board from ST-LINK USB. |

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

### 5.3.1 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.

## 5.4 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 2. 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 32Khz 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 32Khz quartz X2. |

**Table 3. 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. |

## 5.5 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
- RS232 connector CN6 for ISP. Jumper JP6 should be closed for RESET to be handled by pin 8 of RS232 connector CN6 (CTS signal).

## 5.6 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 4*. 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 5: Boot related jumper*. This can be used to force the execution of the bootloader and start user Flash memory flashing 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 4. Boot related switch**

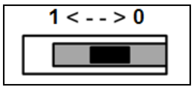
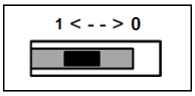
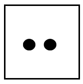
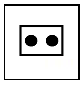
| Switch | | Description |
|---|---|---|
| SW1 |   (default setting) | STM32L073Z-EVAL evaluation board boots from **User Flash.** BOOT0 pin is tied to “Low”. |
| |   | STM32L073VZT6 boots from system Flash memory (nBOOT1 bit of FLASH_OPTR register is set high) or from RAM (nBOOT1 is set low). BOOT0 pin is tied to "high". |

**Table 5. 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 flashing process. |

## 5.7 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 glass 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 to 3.6 V internally or externally through jumper JP7. Refer to *Section 5.3: Power supply* for more details regarding JP7 use.

### 5.7.1 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 should be connected, please refer to *Section 5.3: 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.

## 5.8 SMBus temperature sensor

A temperature sensor STLM75M2F is connected to I2C1 bus and to the SMBus of the microcontroller STM32L073VZT6.

The $I^2C$ address of 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 6. 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 glass module has to be mounted on “IO” position.

However, if the LCD glass is used and then mounted on “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 glass.

Refer to *Section 5.19: LCD glass display module* for more details.

### 5.8.1 Limitations

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

### 5.8.2 Operating voltage

The operating voltage of temperature sensor STLM75M2F is 2.7 to 3.6 V.

## 5.9 RS-232 USART2 and IrDA

### 5.9.1 RS-232

The evaluation board STM32L073Z-EVAL offers an RS232 communication port at the DB9 male connector CN6. The signals RX, TX, RTS and CTS from USART2 of STM32L073VZT6 are available.

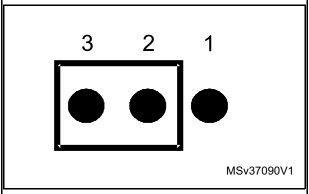
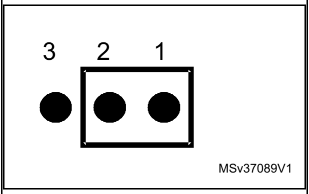
Signals Bootloader_RESET and Bootloader_BOOT0 can be added on RS-232 connector CN6 for ISP support. To use Bootloader_RESET, resistor R63 must be removed and jumper JP6 must be closed. If Bootloader_BOOT0 is used, the jumper JP3 must be closed.

For jumpers settings refer to the *Table 7: RS232 and IrDA jumper settings*.

### 5.9.2 IrDA

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

**Table 7. RS232 and IrDA jumper settings**

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

### 5.9.3 Limitations

RS232 from USART2 and IrDA are exclusives.

### 5.9.4 Operating voltage

RS232 from USART2 and IrDA are operating on the whole $V_{DD}$ voltage range: 1.65 V to 3.6 V.

## 5.10 RS232 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.

### 5.10.1 Limitations

LPUART is exclusive with LCD glass. LCD glass module should be mounted in I/O position.

### 5.10.2 Operating voltage

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

## 5.11 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: 115200b/s, 8bits, no parity, 1 stop bit, no flow control.

### 5.11.1 Limitations

No limitation.

### 5.11.2 Operating voltage

The Virtual Com Port is operating over the whole $V_{DD}$ range: 1.65 V to 3.6 V.

## 5.12 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 8. 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) |

### 5.12.1 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 should be 8 MHz maximum.

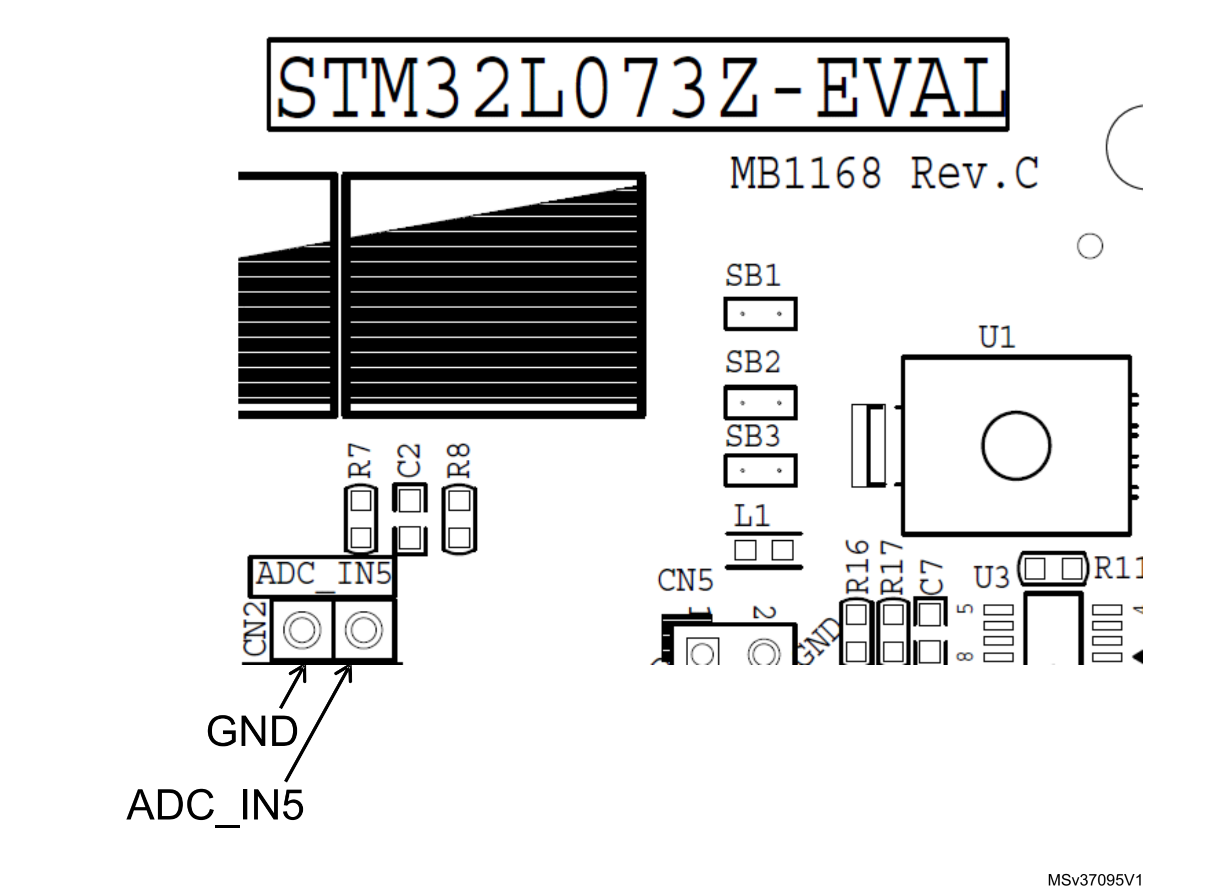
### 5.12.2 Operating voltage

STM32L073Z-EVAL evaluation board Micro SD card is operating over whole range of $V_{DD}$: 1.65 V to 3.6 V.

## 5.13 Analog input ADC

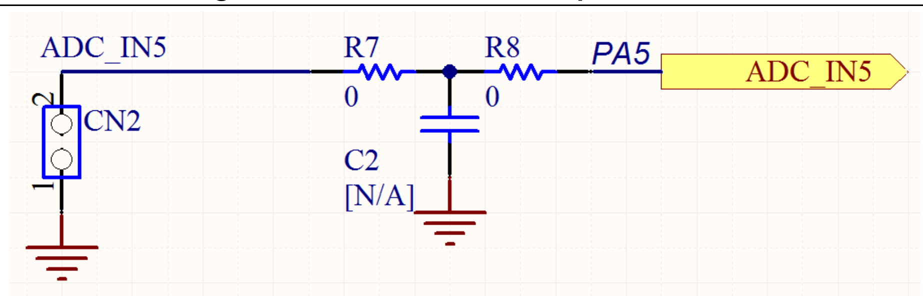
The analog input ADC_IN5 (port PA5) of the microcontroller STM32L073VZT6 is available at connector CN2. It is located below right to the touch sensing slider LS1. The 2-pin connector CN2 allows connection of a GND reference to the left pin of CN2, and the voltage to be converted is connected to the right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

### 5.13.1 Operating voltage

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

## 5.14 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 should be closed.

**Figure 8. Location of DAC output CN3 and JP2**

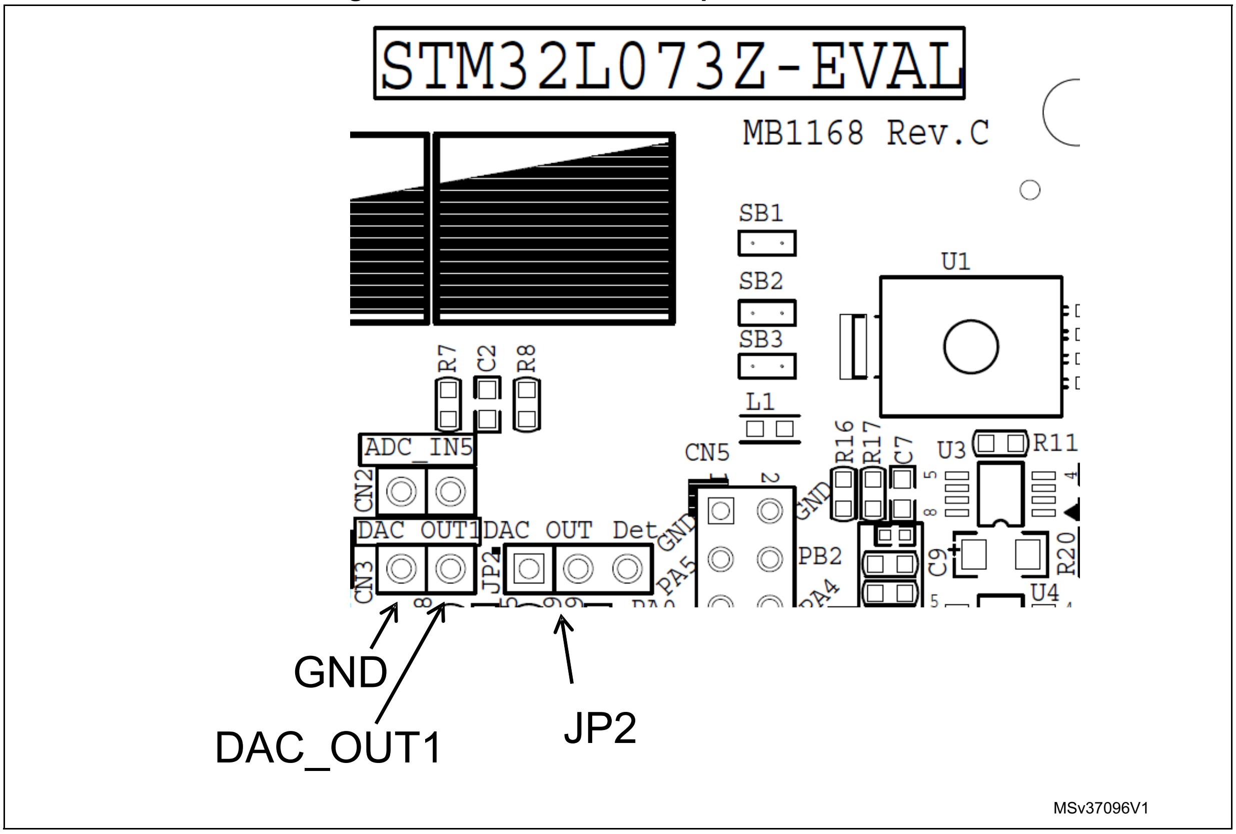
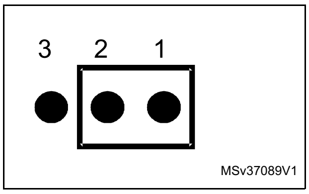
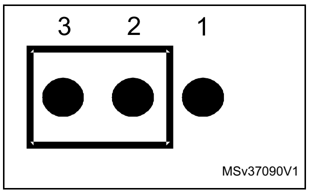
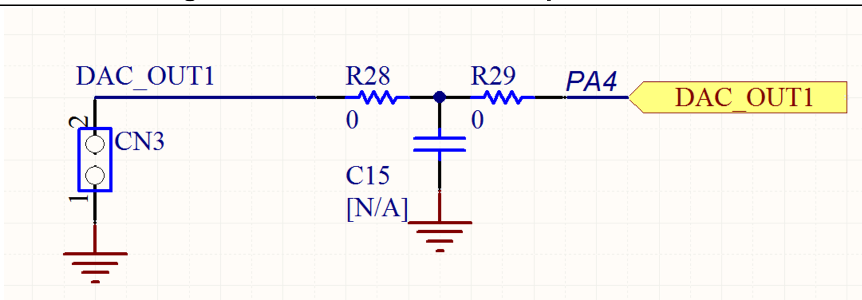


**Table 9. Analog input related jumper JP2 settings**

| 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 5.20.1: 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.

Please 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 should be closed.

## 5.14.1 Limitations

DAC Output is exclusive with LC sensor metering.

## 5.14.2 Operating voltage

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

## 5.15 TFT LCD display

The 2.4” color TFT LCD is connected to SPI1 port of STM32L073VZT6. The LCD TFT module is the MB895/S.

**Table 10. 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 LCD module 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 LCD module has a specific mode in which it may 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.

### 5.15.1 Limitations

No exclusivity.

### 5.15.2 Operating voltage

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

## 5.16 User LEDs

Four general purpose color LEDs (LD 1, 2, 3, 4) are available as display devices.

**Table 11. 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 |

## 5.17 Input devices

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

**Table 12. 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 |

## 5.18 RF-EEPROM

An RF-EEPROM daughterboard MB1020 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 MB1020 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.

## 5.19 LCD glass display module

A LCD glass module 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 LCD glass module is mounted in LCD position, the LCD glass display is connected to the LCD driver pins of the STM32L073VZT6 and all peripherals shared with LCD glass are disconnected. See *Figure 10: LCD glass board in LCD position*
- When LCD glass module is mounted in IO position, all peripherals shared with the LCD glass are connected to the STM32L073VZT6 and the LCD glass is disconnected. See *Figure 11: LCD glass board in IO position*.
- When LCD glass module 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 glass board in LCD position

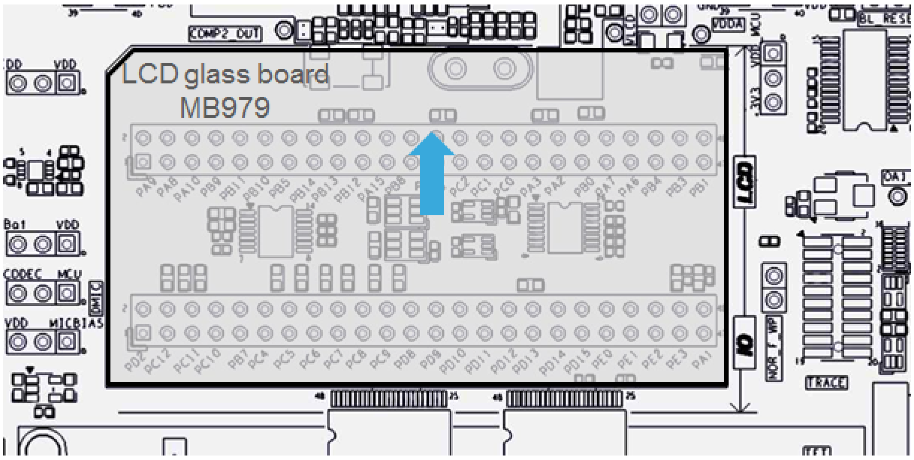
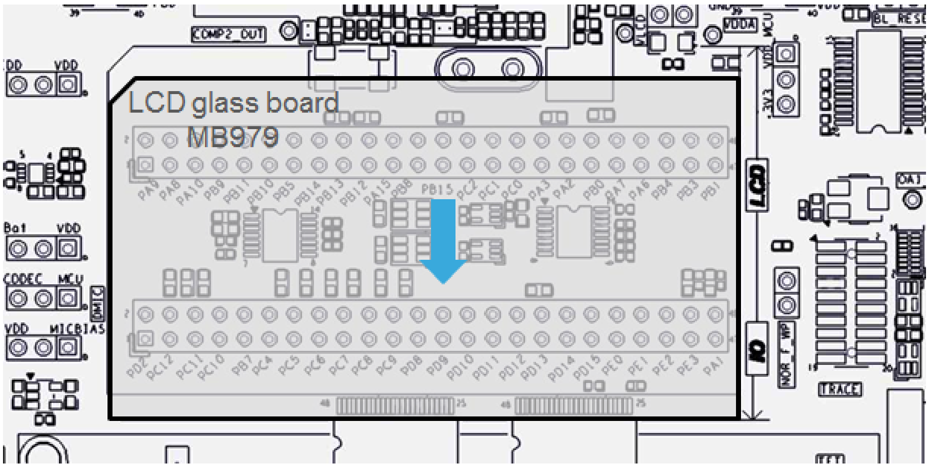



Figure 11. LCD glass board in IO position




The custom LCD glass module used on MB979 daughterboard is XHO5002B. The signal mapping of each LCD segment is detailed in following table (rows are LCD_COMx, columns LCD_SEGy, with x comprised between 0 and 7, y from 0 to 39):

Table 13. LCD glass 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 14. LCD glass 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 15. LCD glass 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 16. LCD glass 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**

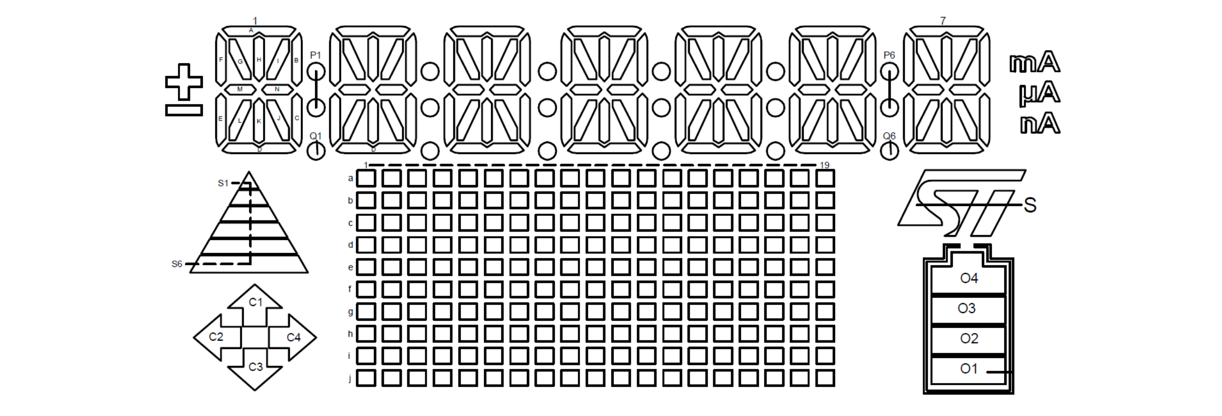



**Table 17. LCD glass related jumpers and solder bridges**

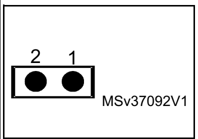
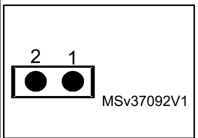
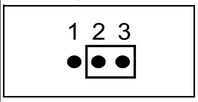
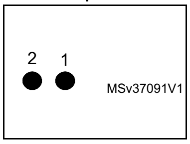
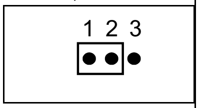
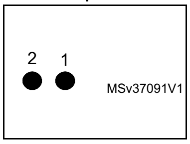
| Jumpers, solder bridges, resistors | | Description |
|---|---|---|
| JP8, SB29, SB30 | JP8 closed   SB29, SB30 closed **(default setting)** | The LC network (L2 or L3, and C40) on STM32L073Z-EVAL is used for LC sensor metering. Nothing is connected to connector CN8. |
| | JP8 closed   SB29, SB30 opened | 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 TSV611ILT is used to generate the $V_{DD}/2$ voltage. |
| | SB31 opened, R67 removed, SB32 closed, SB33 closed | The operational amplifier U9 TSV611ILT is used to generate the $V_{DD}/2$ voltage. |

**Table 17. LCD glass 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<br><br>JP14, JP16, JP18: opened<br> | LC sensor metering is used, exclusive with LCD glass and DAC output.<br>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.<br>JP2 with pins 2 and 3 closed: port PA4 is used for LC sensor metering signal DET_DAC_OUT1<br>JP14, JP16, JP18 opened: reserved use. |
| | JP1, JP15, JP17, JP2: 1,2 closed<br><br>JP14, JP16, JP18: opened<br> | LCD glass is used, DAC output on CN3 is used, both are exclusive with LCD glass<br>JP1, JP15, JP17 with pins 1 and 2 closed: ports PA7, PB4, PC0 are used for LCD glass: LCDSEG4, LCDSEG8 and LCDSEG18 respectively.<br>JP2 with pins 1 and 2 closed: port PA4 is used for DAC output connector CN3, signal DAC_OUT1.<br>JP14, JP16, JP18 opened: reserved use. |

### 5.19.1 Limitations

LCD glass is exclusive with LPUART, LC sensor metering, temperature sensor INT, EXT RESET.

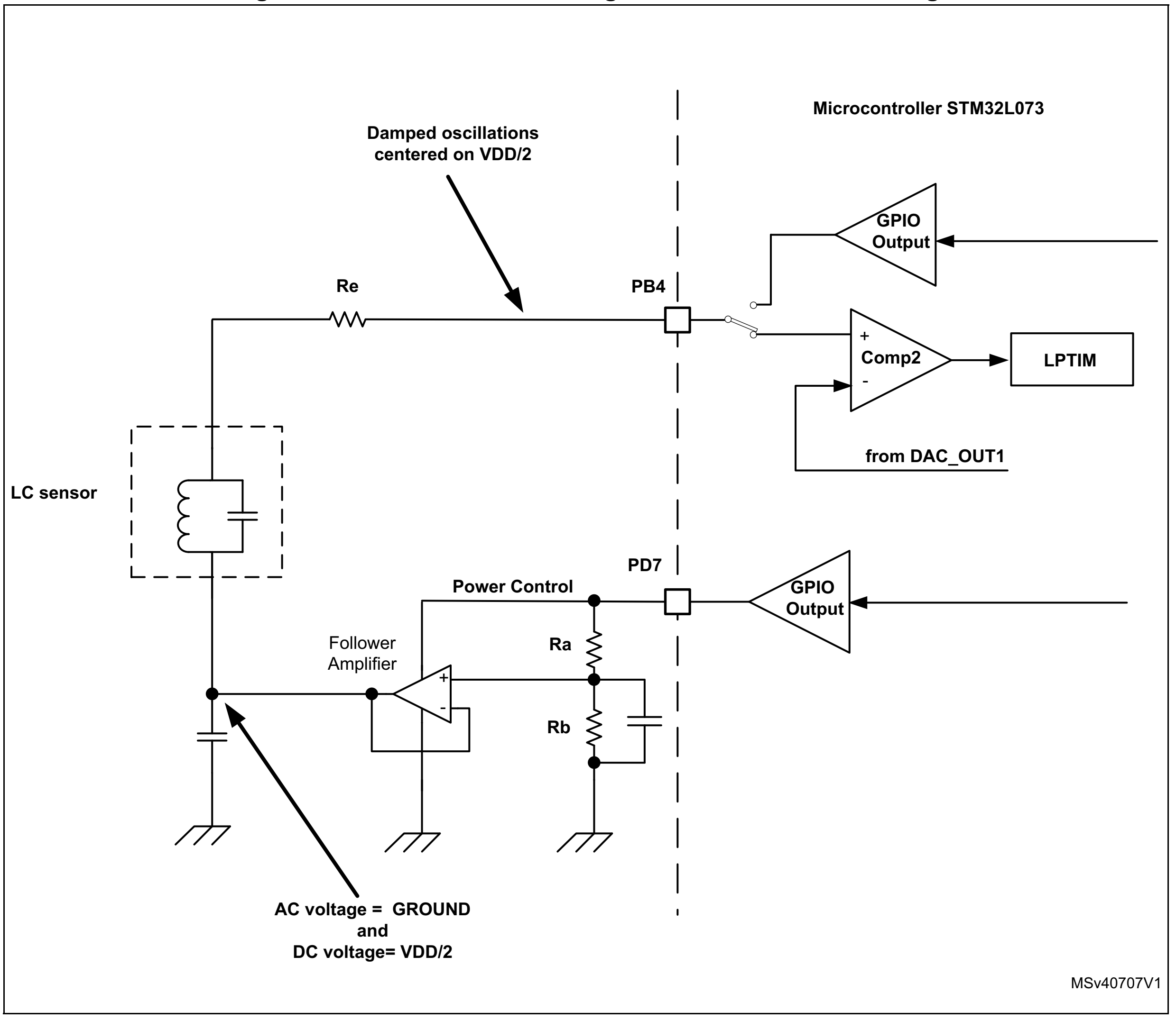
## 5.20 LC sensor metering

The LC sensor metering is a metal detector based on a resonating LC network connected to the microcontroller STM32L073VZT6. The STM32L073VZT6 trigs periodically the LC network 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.

### 5.20.1 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 VDD/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 will deliver pulses to the Low Power timer LPTIM. LPTIM is in charge to count the number of oscillations.

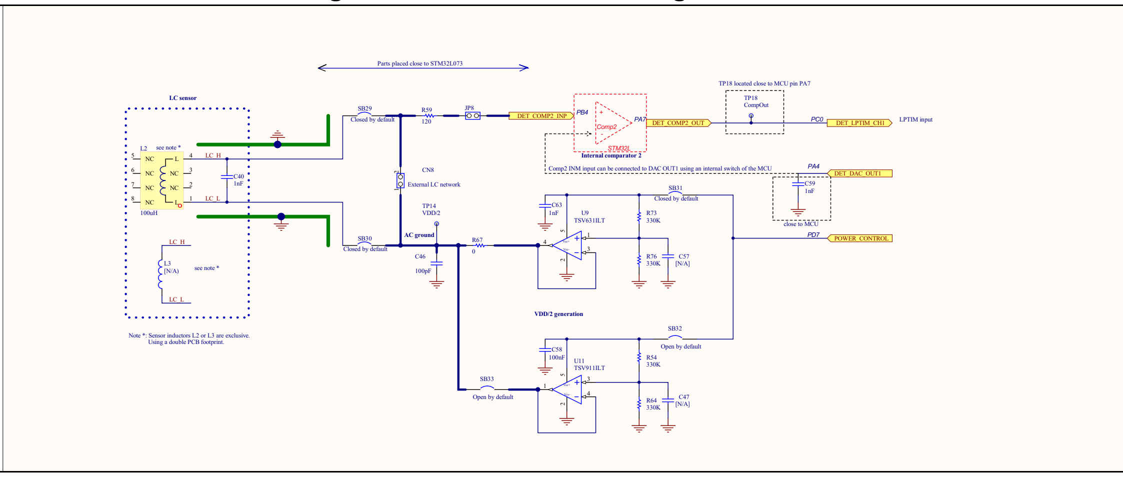
The value in the counter LPTIM depends directly on the decay time of the oscillations, and therefore to the quality factor of the inductor L.

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.

### 5.20.2 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 to solder 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 TSV631ILT 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 TSV911ILT U11 is available in back-up of U9 with improved output impedance performances over frequency but with a higher operating current.

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

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, trigs 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 should 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 should be set properly to enable the LC sensor metering, refer to *Table 18: Solder bridges and jumpers for LC sensor metering*:

**Table 18. Solder bridges and jumpers for LC sensor metering**

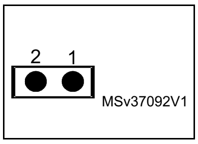
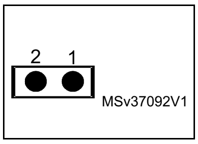
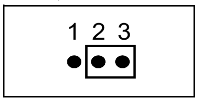
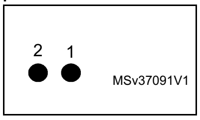
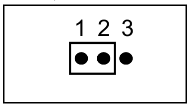
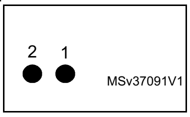
| Jumpers, solder bridges, resistors | | Description |
|---|---|---|
| JP8, SB29, SB30 | JP8 closed   SB29, SB30 closed<br>**(default setting)** | The LC network (L2 or L3, and C40) on STM32L073Z-EVAL is used for LC sensor metering. Nothing is connected to connector CN8. |
| | JP8 closed   SB29, SB30 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<br>**(default setting)** | The operational amplifier U9 TSV611ILT is used to generate the $V_{DD}/2$ voltage. |
| | SB31 opened, R67 removed, SB32 closed, SB33 closed | The operational amplifier U9 TSV611ILT is used to generate the $V_{DD}/2$ voltage. |

**Table 18. 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 glass and DAC output.<br>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.<br>JP2 with pins 2 and 3 closed: port PA4 is used for LC sensor metering signal DET_DAC_OUT1<br>JP14, JP16, JP18 opened: reserved use. |
| | JP1, JP15, JP17, JP2: 1,2 closed   JP14, JP16, JP18: opened   | LCD glass (without LCDSEG4, LCDSEG8, LCDSEG18) is used, DAC output on CN3 is used, both are exclusive with LCD glass.<br>JP1, JP15, JP17 with pins 1 and 2 closed: ports PA7, PB4, PC0 are used for LCD glass: LCDSEG4, LCDSEG8, LCDSEG18 respectively.<br>JP2 with pins 1 and 2 closed: port PA4 is used for DAC output connector CN3, signal DAC_OUT1.<br>JP14, JP16, JP18 opened: reserved use. |

### 5.20.3 Limitations

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

But it is possible to use LCD glass 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 glass can be used in such limited manner with LC sensor metering. In that case jumpers JP1, JP15, JP17 and JP2 should have pins 1 and 2 closed.

## 5.21 Pressure sensor

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

### 5.21.1 Calculations

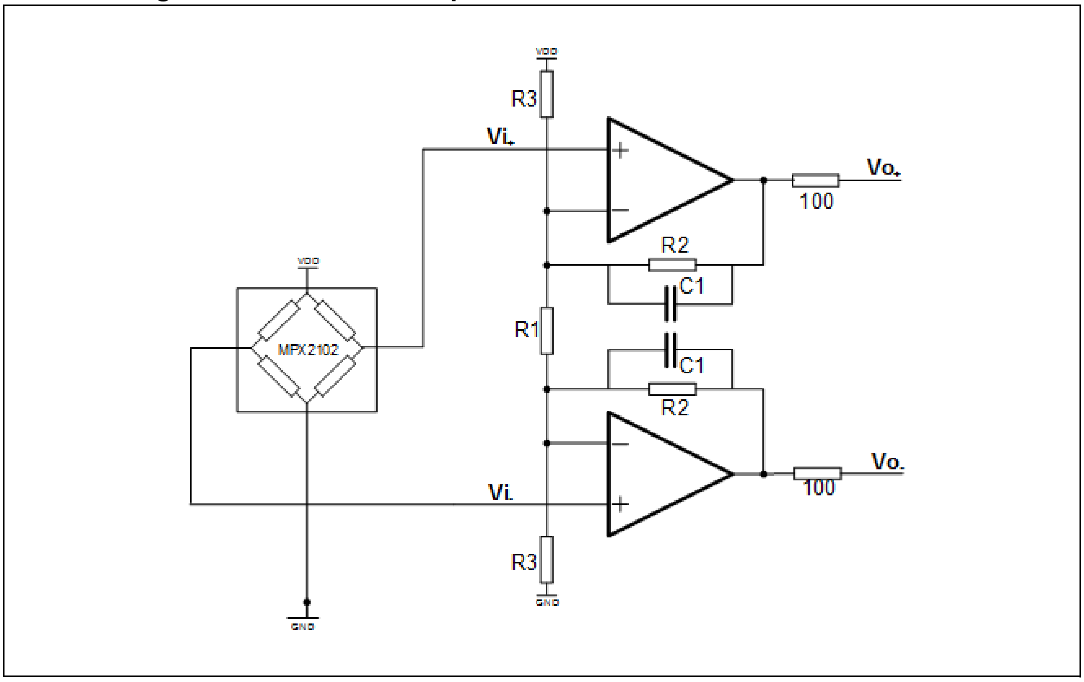
The equivalent schematic of the sensor is a Wheastone bridge with a following differential voltage output considering it is supplied with +3.3 V:

**Table 19. 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, R2 = 47Kohm, R3=27.4Kohm 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 20: Differential voltage*):

**Table 20. 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 | -1.3V |
| 1000 HPa | 13.2mV | 0V |
| 1200 HPa | 15.84 mV | +1.23V |

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 21. Single output voltage to the ADC**

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

### 5.21.2 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 himself is 6 HPa. Finally the total absolute error is 0.4+2+6 = 8.4 HPa.

### 5.21.3 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 may use a calibration. It allows to determine the linear equation between the measured voltage and the atmospheric pressure. The slope of the linear equation is typically:

$$(2880 - 1650) / 200 = \frac{6.15\text{mV}}{\text{HPa}}$$

### 5.21.4 Filtering

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

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

### 5.21.5 Limitations

No exclusivity.

### 5.21.6 Operating voltage

Operating voltage is fixed at: +3.3 V

## 5.22 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 22*:

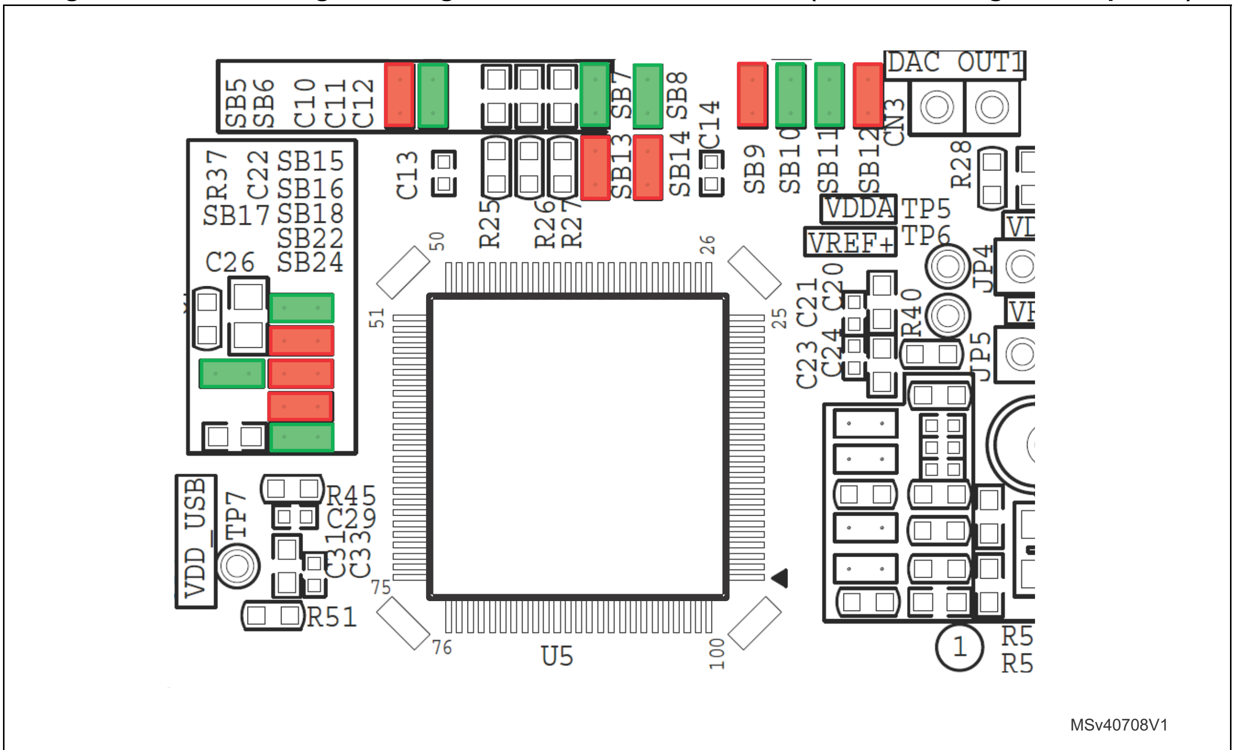
**Table 22. Touch sensing related solder bridges**

| Solder bridges | Settings to enable touch sensing | STM32 port | Description |
|---|---|---|---|
| SB6 | Close | PB12 | Connects the 1st touch sensing zone to PB12. |
| SB5 | Open | PB12 | Disconnects PB12 from track to LCD glass to avoid disturbances. |
| SB8 | Close | PB0 | Connects the 2nd touch sensing zone to PB0. |
| SB14 | Open | PB0 | Disconnects PB0 from track to LCD glass to avoid disturbances. |
| SB11 | Close | PA1 | Connects the 3rd touch sensing zone to PA1. |
| SB12 | Open | PA1 | Disconnects PA1 from track to LCD glass to avoid disturbances. |
| SB17 | Close | PC6 | Connects the shield to PC6. |
| SB18 | Open | PC6 | Disconnects PC6 from track to LCD glass to avoid disturbances. |
| SB24 | Close | PC7 | Connects the charge capacitor of shield to PC7. |
| SB22 | Open | PC7 | Disconnects PC7 from track to LCD glass to avoid disturbances. |
| SB15 | Close | PB13 | Connects the charge capacitor to PB13. |
| SB16 | Open | PB13 | Disconnects PB13 from track to LCD glass to avoid disturbances. |
| SB7 | Close | PB1 | Connects the charge capacitor to PB1. |
| SB13 | Open | PB1 | Disconnects PB1 from track to LCD glass to avoid disturbances. |

**Table 22. 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 glass to avoid disturbances. |

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



### 5.22.1 Limitations

Touch sensing slider is exclusive with LCD glass.

## 5.23 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 glass connectors.

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

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

For more details regarding clock pins, refer to *Section 5.4: Clock source*.

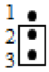
**Table 23. Extension connectors pin-out**

| 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 | $V_{DD}$ |

## 5.24 IDD auto-measurement

In addition to the jumpers allowing to measure separately each power domain 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.

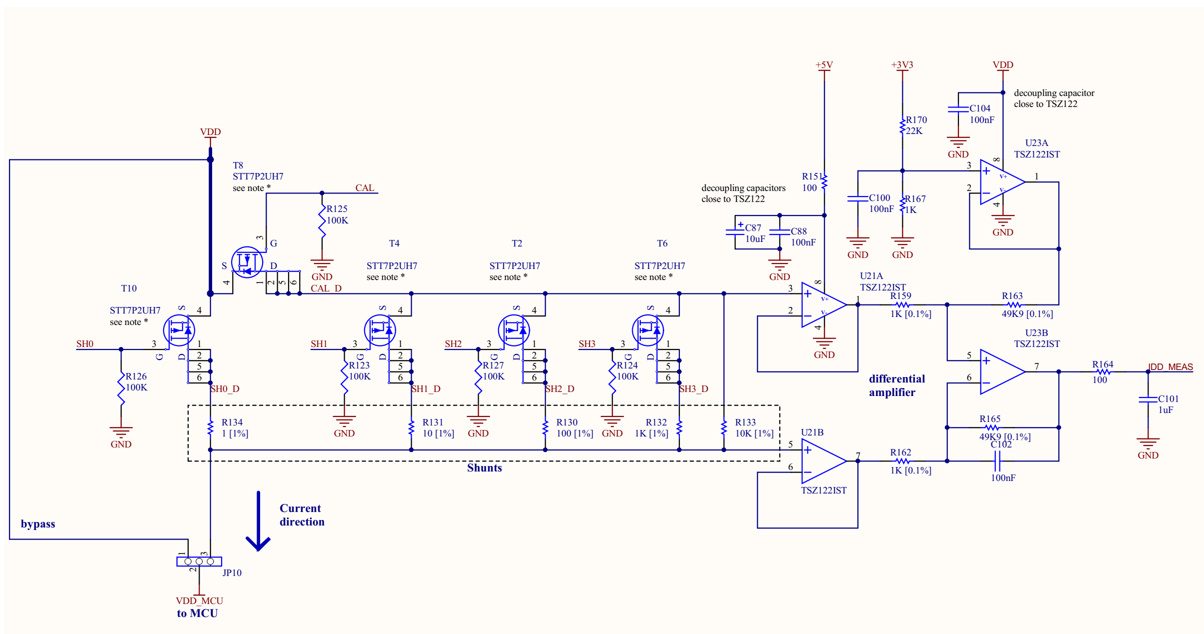
**Table 24. IDD auto-measurement related jumper settings**

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

## 5.24.1 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 ohm to 10 Kohm allows to measure currents from 100 mA to few 10 mA typically. This covers all functional modes of the STM32L073VZT6 microcontroller.

**Figure 17. Figure: analog section schematic**



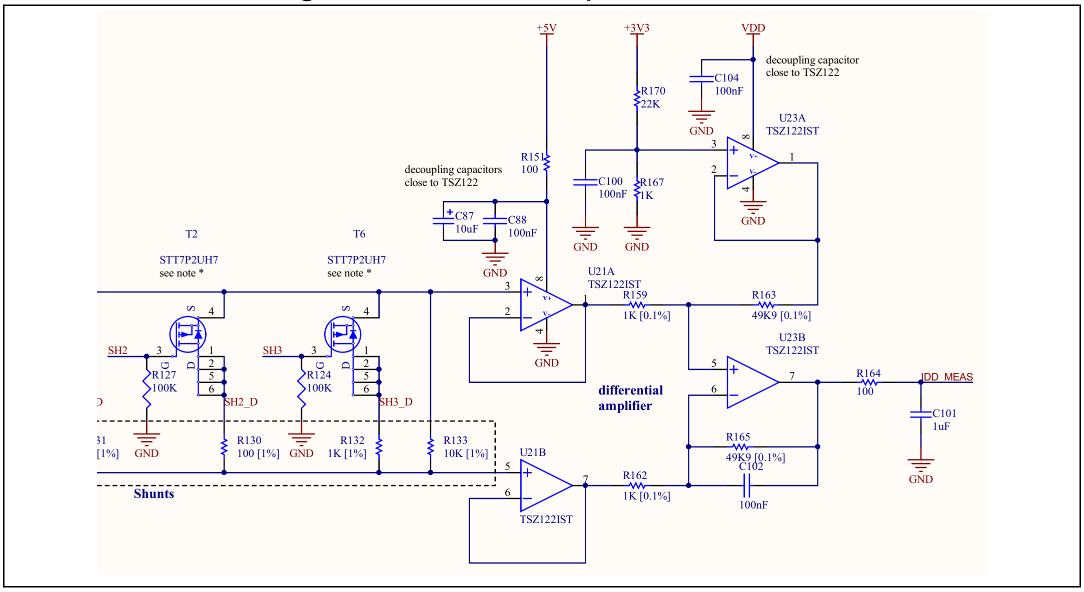
The voltage drop across the selected shunt is amplified by a very high accuracy and zero-drift operational amplifier TSZ122.

The voltage drop is connected to pins 3 and 5 of the operational amplifier TSZ122 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.

## 5.24.2 Difference amplifier

**Figure 18. Difference amplifier**




The voltage measured over the shunt is amplified by a difference amplifier based on high performances operational amplifiers TSZ122. The DC gain is 49.9. Finally the output voltage $I_{DD\_MEAS}$ is available for conversion and treatment by the digital section.

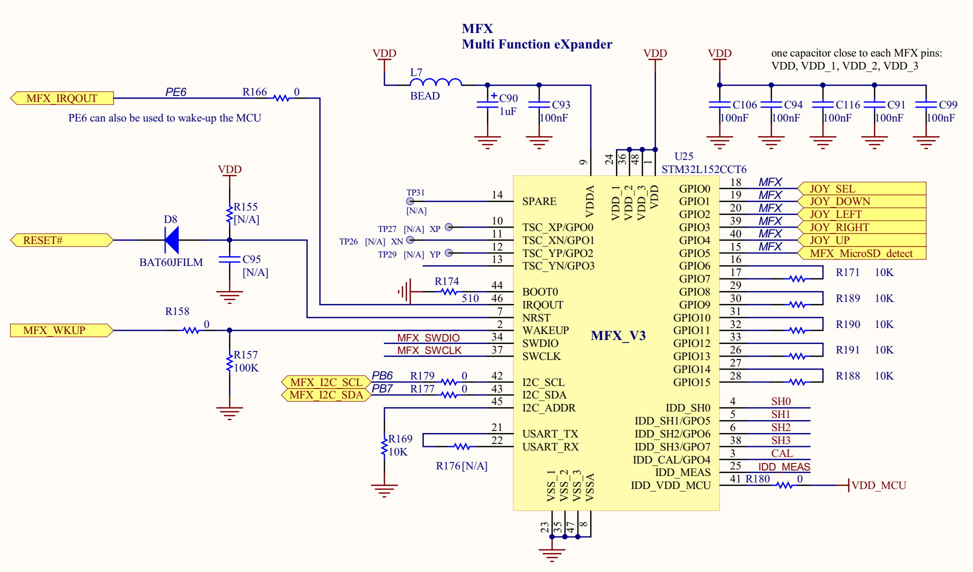
## 5.24.3 Digital section description

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$^2$C 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 will measure the current. At the end, the measured value can be read by the host STM32L073VZT6 inside the MFX registers through the I$^2$C bus.

**Figure 19. Digital section schematic**

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**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.**

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# 6 Connectors

## 6.1 RS232 connector CN6

Figure 20. RS232 connector CN6 (front view)

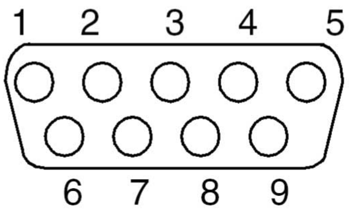


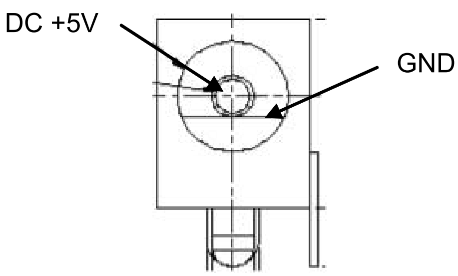

Table 25. RS232 connector CN6

| 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 | - | - |

## 6.2 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



## 6.3 LCD glass daughterboard connectors CN10 and CN14

Two 48-pins male headers CN10 and CN14 are used to connect with the LCD glass daughterboard (MB979). The space between these two connectors and the position of every LCD glass signals are defined as a standard, which allows to develop common daughterboards for several evaluations 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 LCD glass board is not plugged in. For signals assignment details refer to *Table 26: LCD glass daughterboard connectors*.

**Table 26. LCD glass 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 GPI/O extension connectors on a daughterboard, odd pins and even pins must not be connected directly on the daughterboard.

## 6.4 ST-LINK/V2-1 programming connector CN15

The connector CN16 is used only for embedded ST-LINK/V2-1 programming during board manufacture. It is not populated by default and not for end user.

## 6.5 ST-LINK/V2-1 USB Type B connector CN17

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

**Figure 22. USB type B connector CN17**

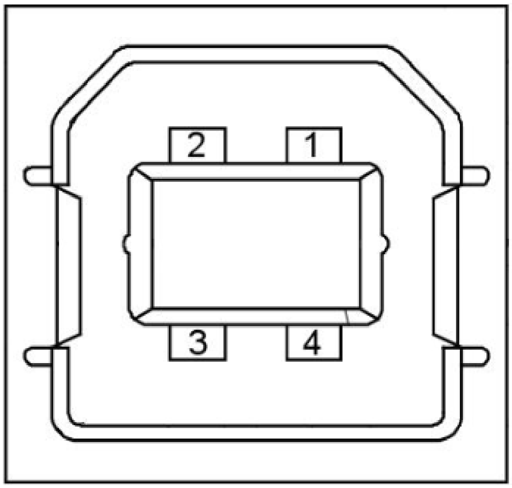



**Table 27. USB type B connector CN17**

| Pin number | Description | Pin number | Description |
|---|---|---|---|
| 1 | VBUS (power) | 4 | GND |
| 2 | DM | 5,6 | Shield |
| 3 | DP | - | - |

## 6.6 SWD connector CN12

Figure 23. Trace debugging connector CN12 (top view)

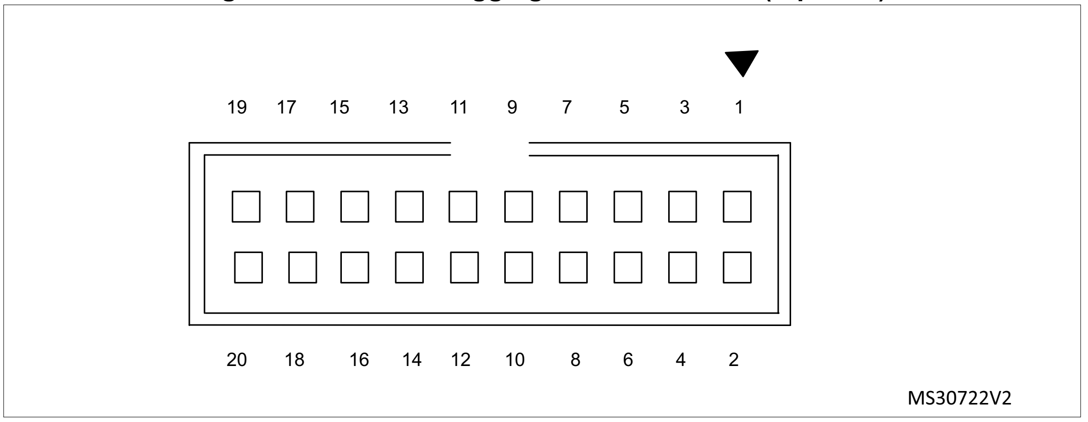



Table 28. SWD debugging connector CN12

| 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 |

## 6.7 Trace debugging connector CN11

Figure 24. Trace debugging connector CN11 (top view)

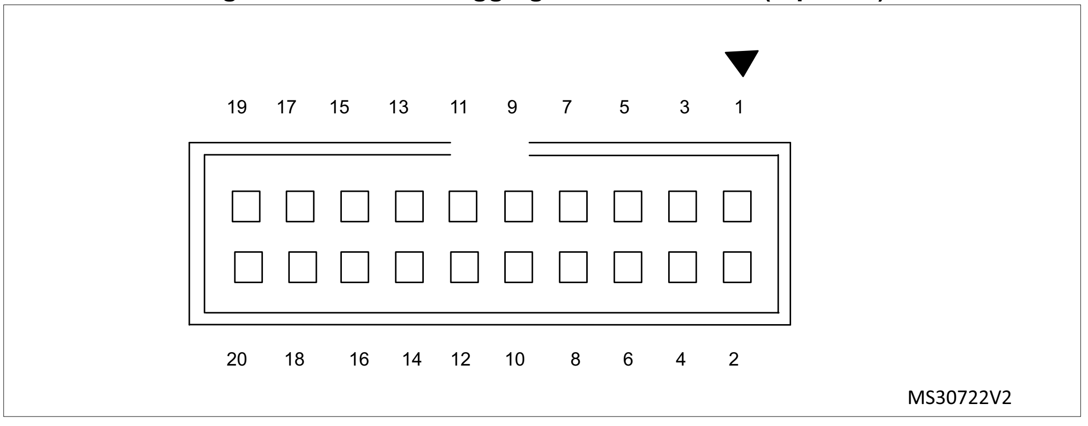


**Table 29. Trace debugging connector CN11**

| 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 | - |

## 6.8 MicroSD connector CN3

**Figure 25. MicroSD connector CN3**

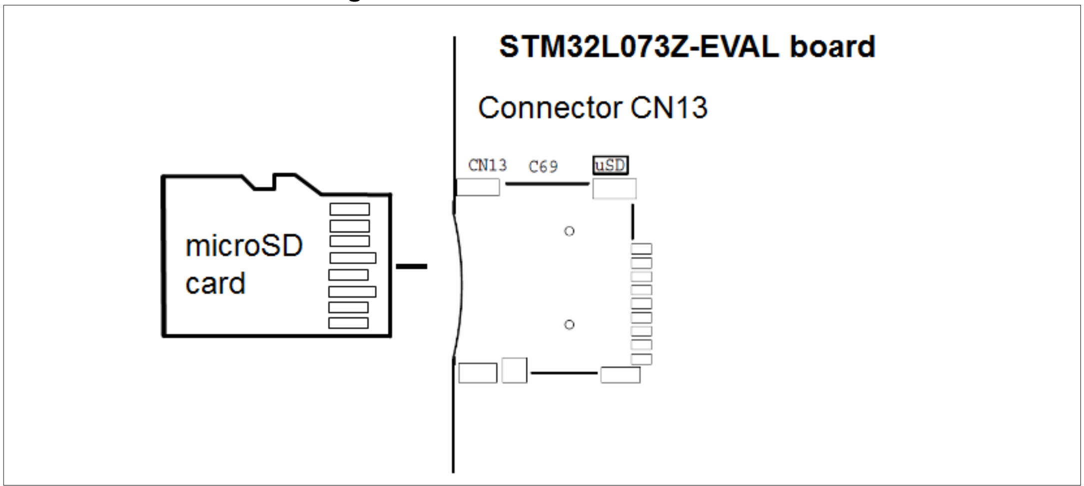



**Table 30. MicroSD connector CN3**

| 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) |

## 6.9 RF-EEPROM daughterboard connector CN3

Figure 26. RF-EEPROM daughterboard connector CN3 (front view)

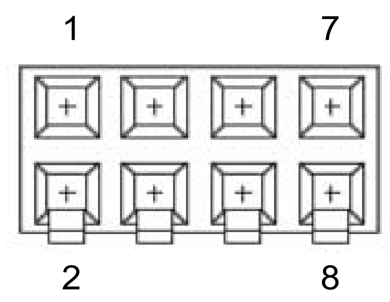
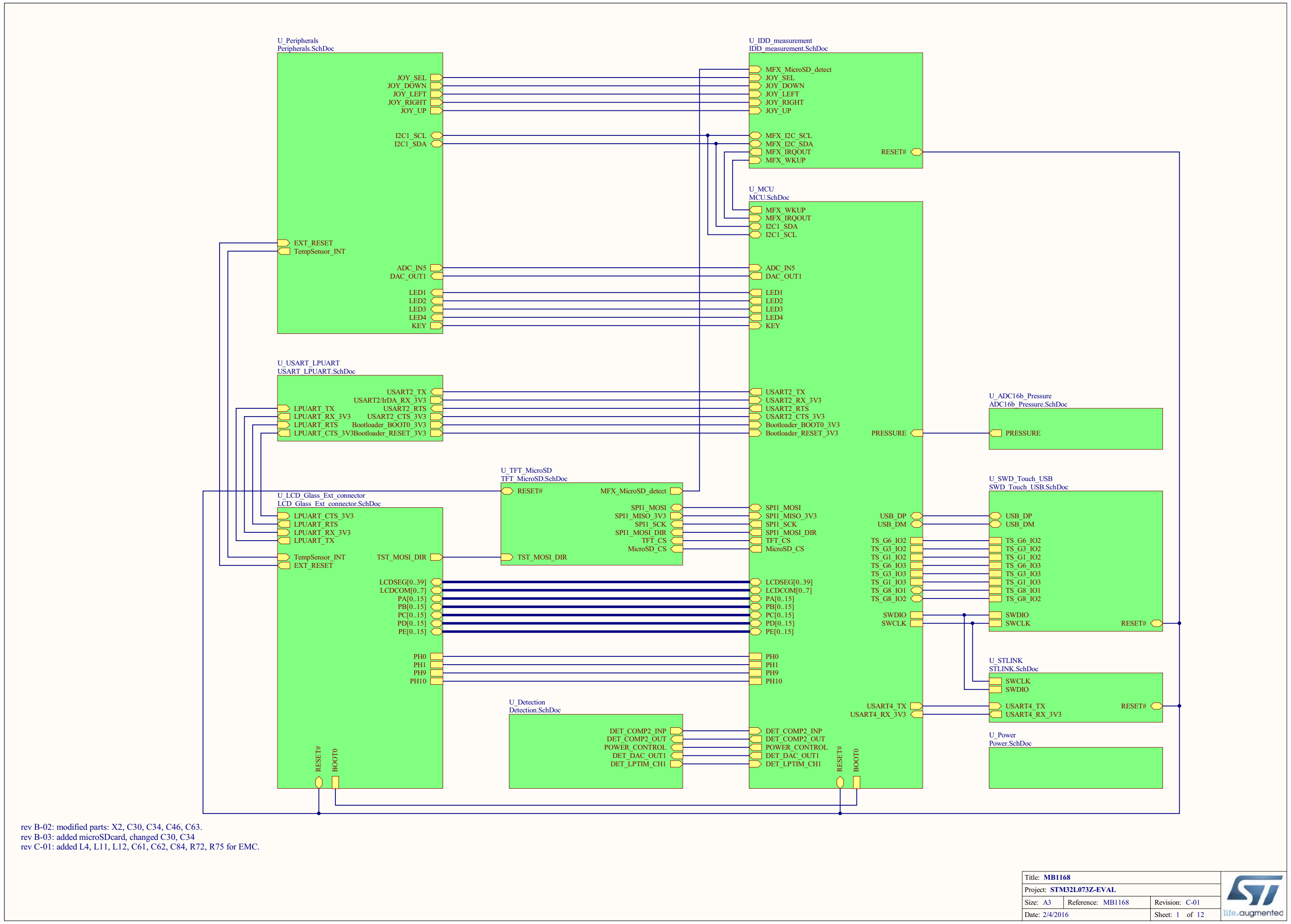



Table 31. RF-EEPROM daughterboard connector CN3

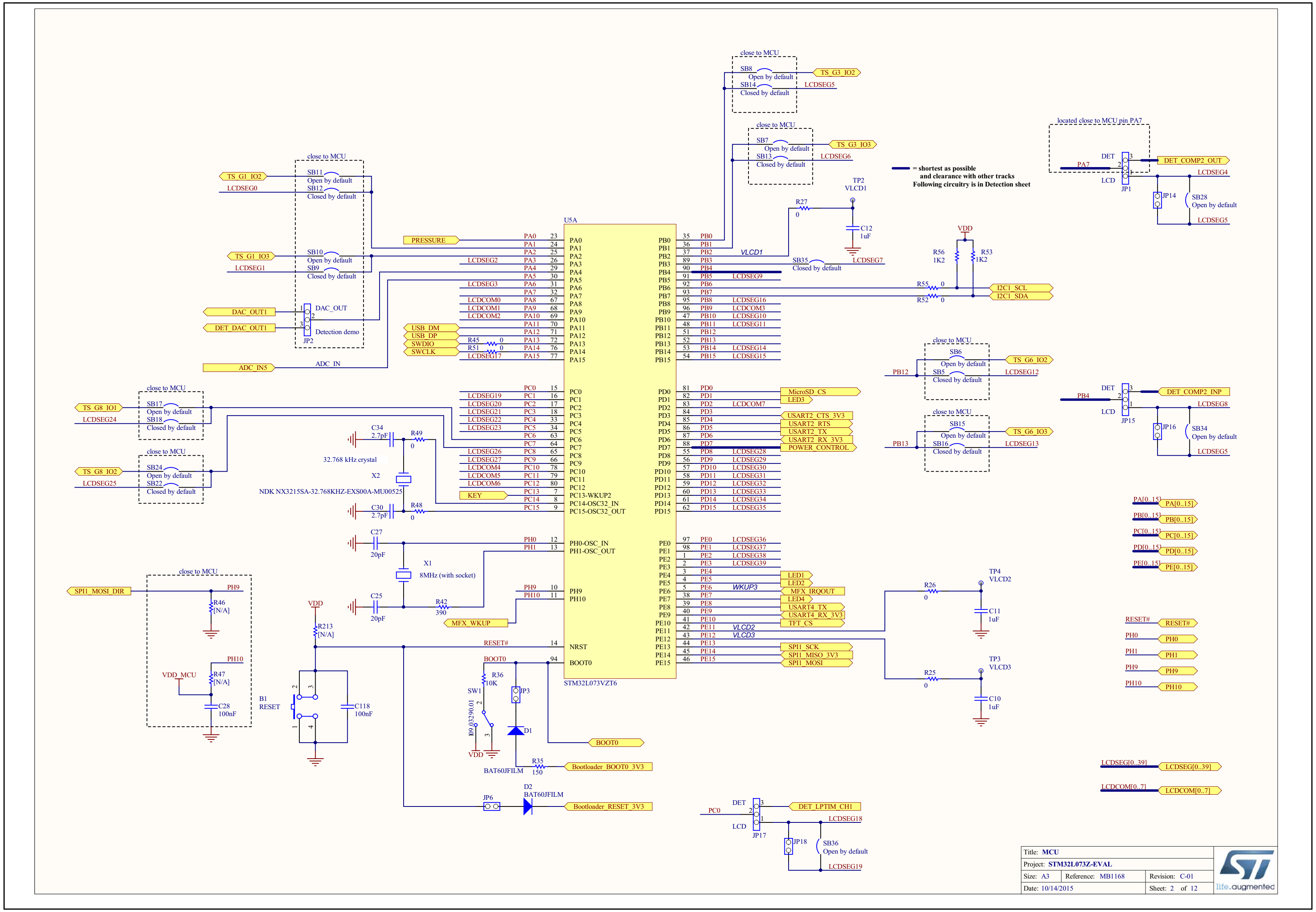
| Pin number | Description | Pin number | Description |
|---|---|---|---|
| 1 | I2C_SDA (PG13) | 5 | $V_{DD}$ |
| 2 | NC | 6 | NC |
| 3 | I2C_SCL (PG14) | 7 | GND |
| 4 | EXT_RESET(PC6) | 8 | NC |

# Appendix A Electrical schematics

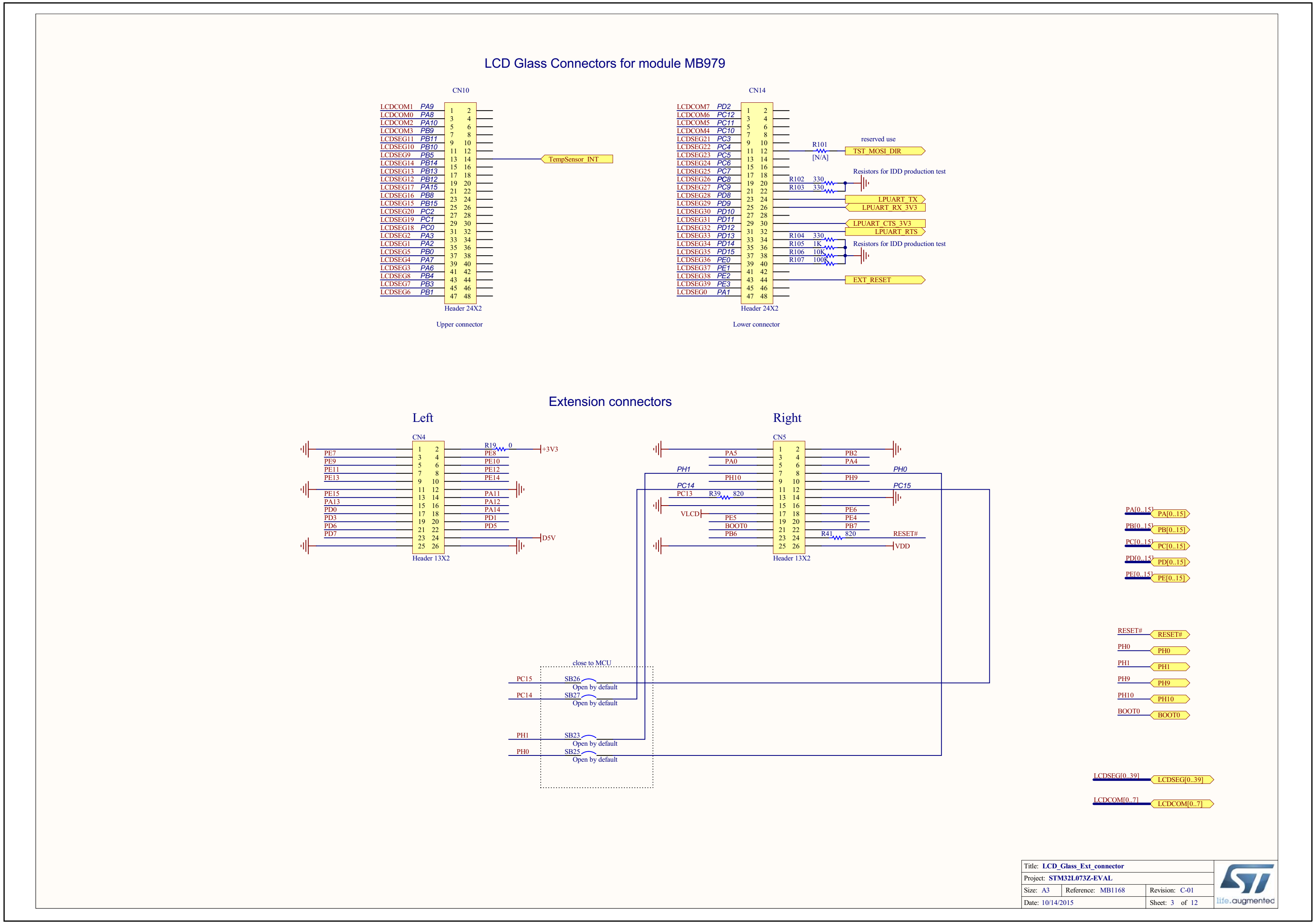
**Figure 27. STM32L073Z-EVAL**



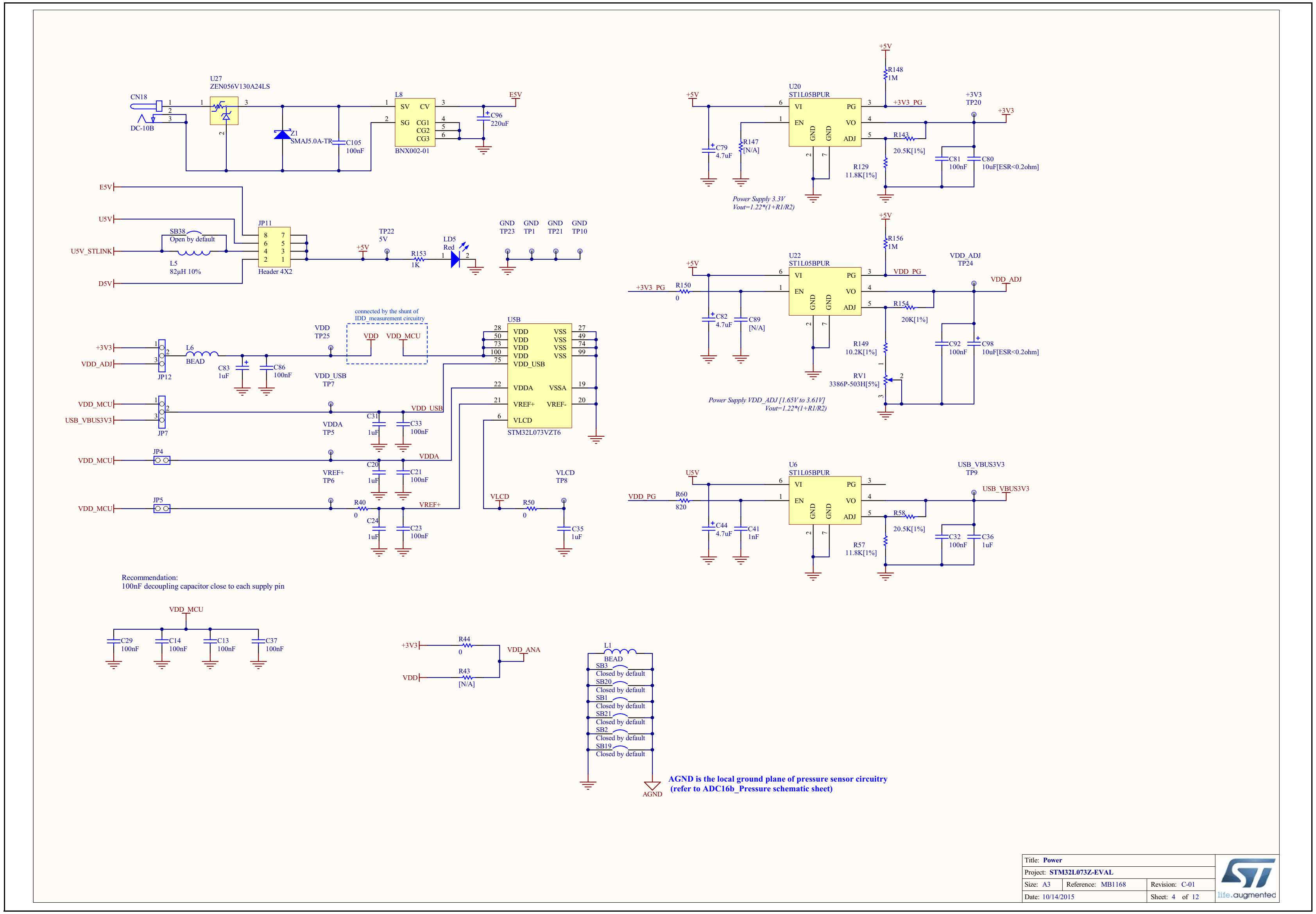
# Figure 28. MCU



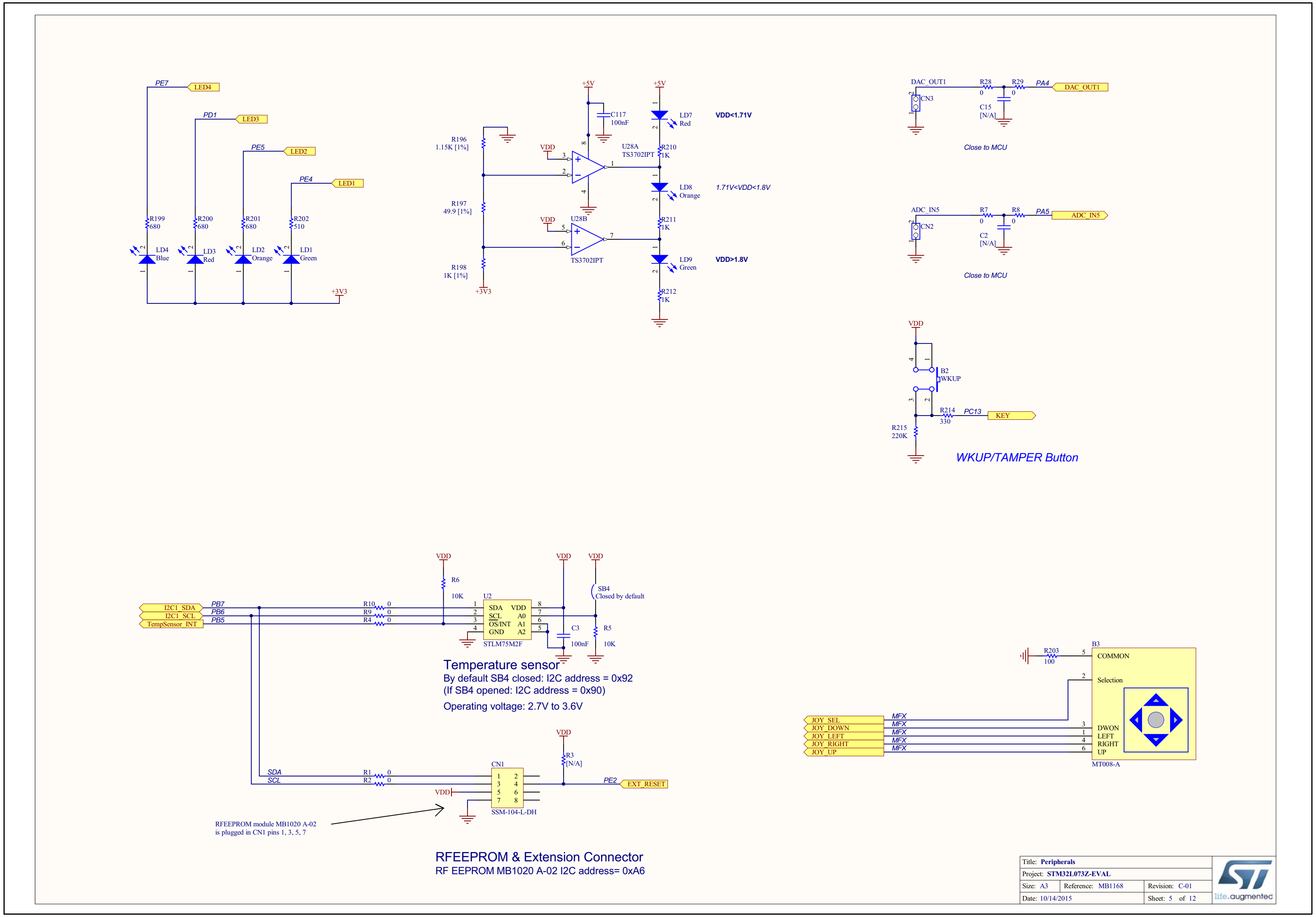
# Figure 29. LCD glass external connector



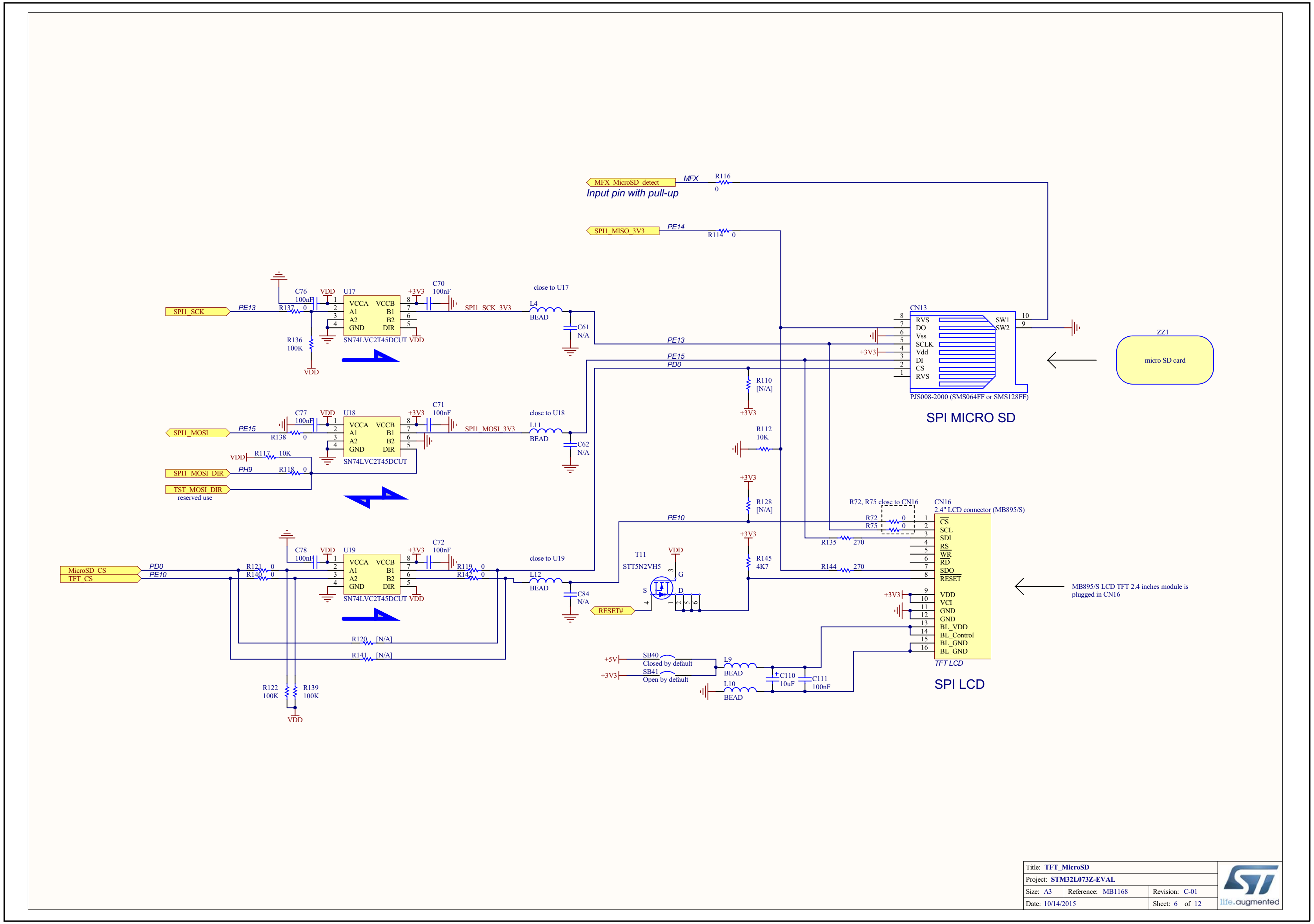
# Figure 30. Power



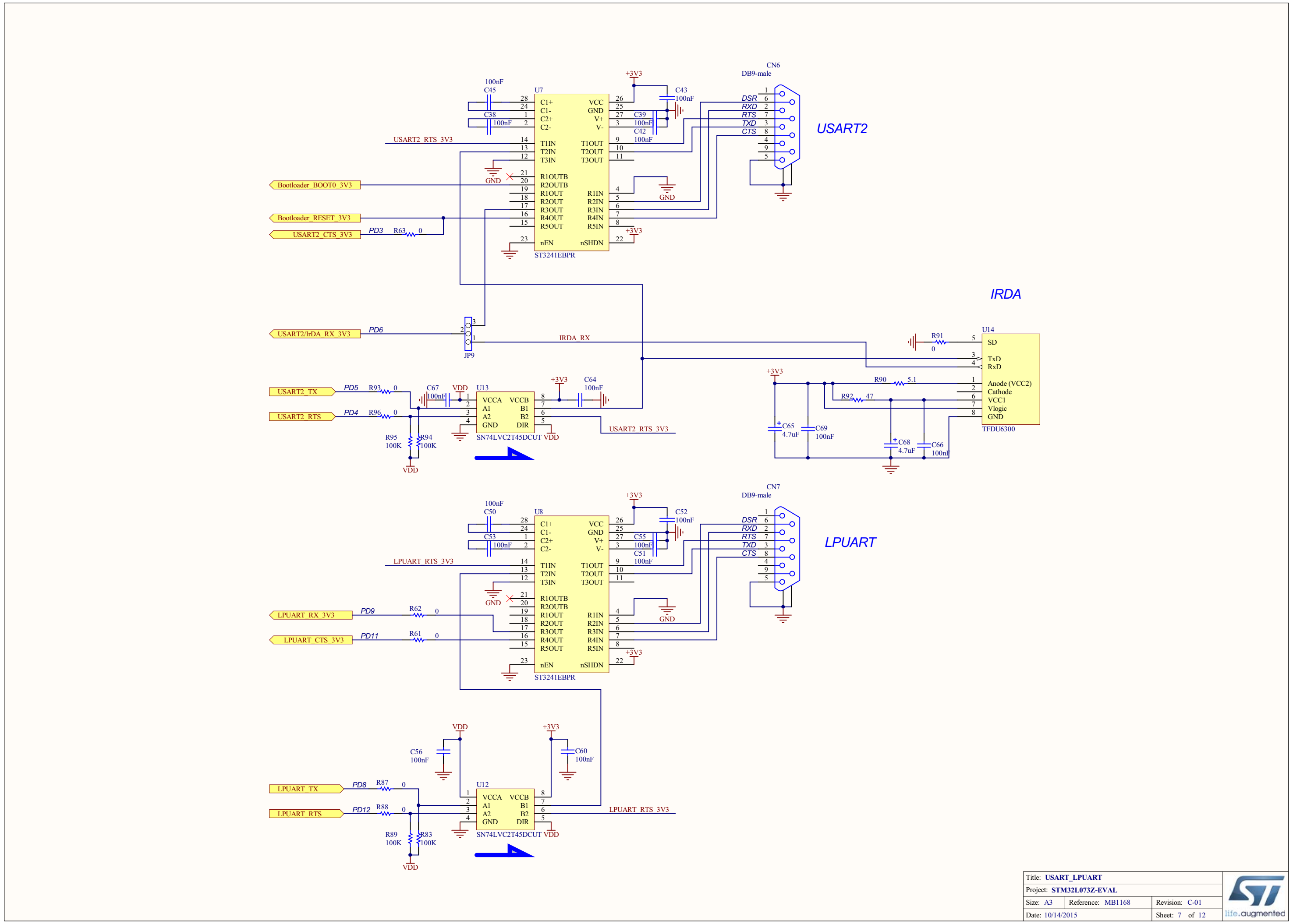
# Figure 31. Peripherals



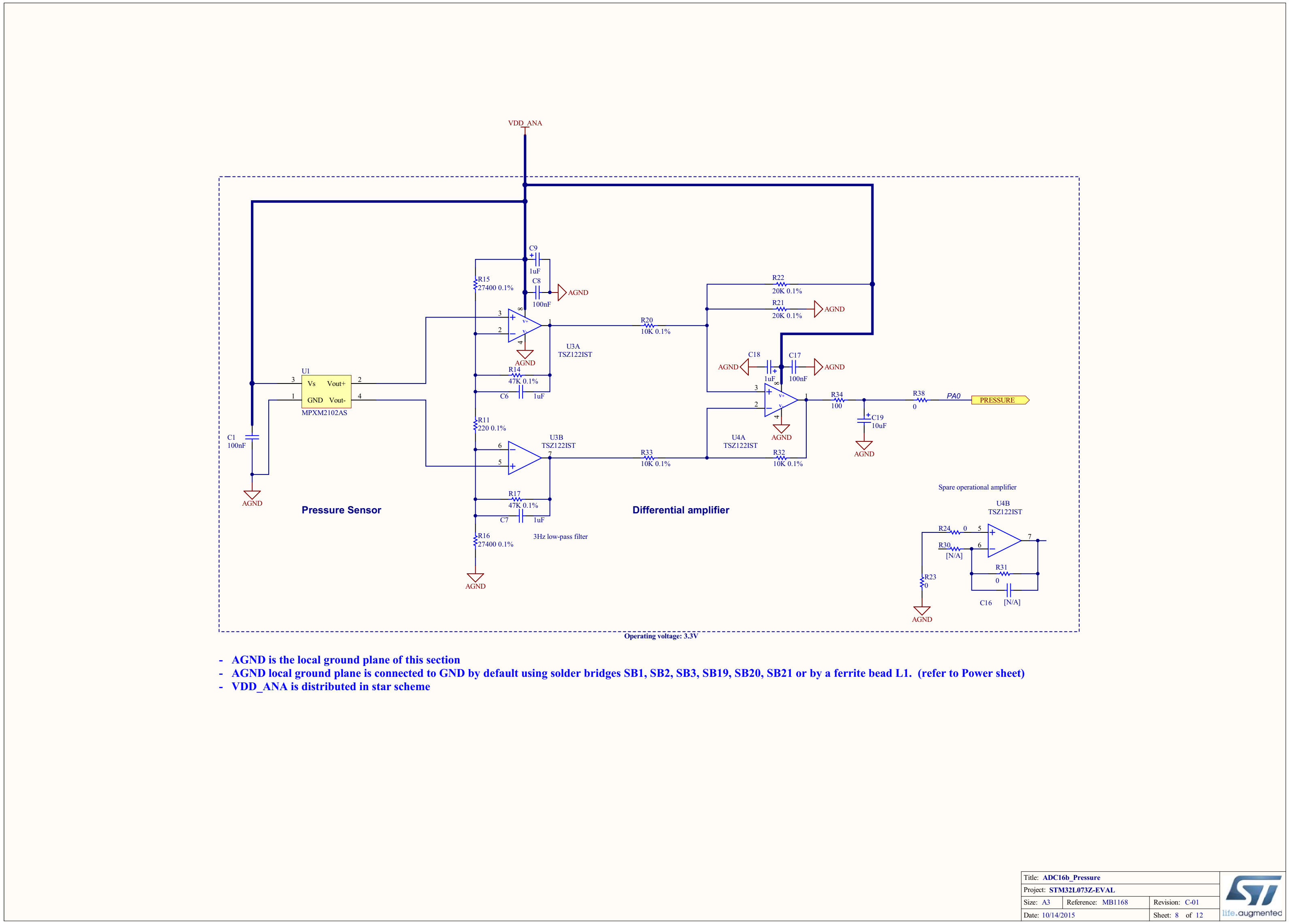
# Figure 32. TFT microSD



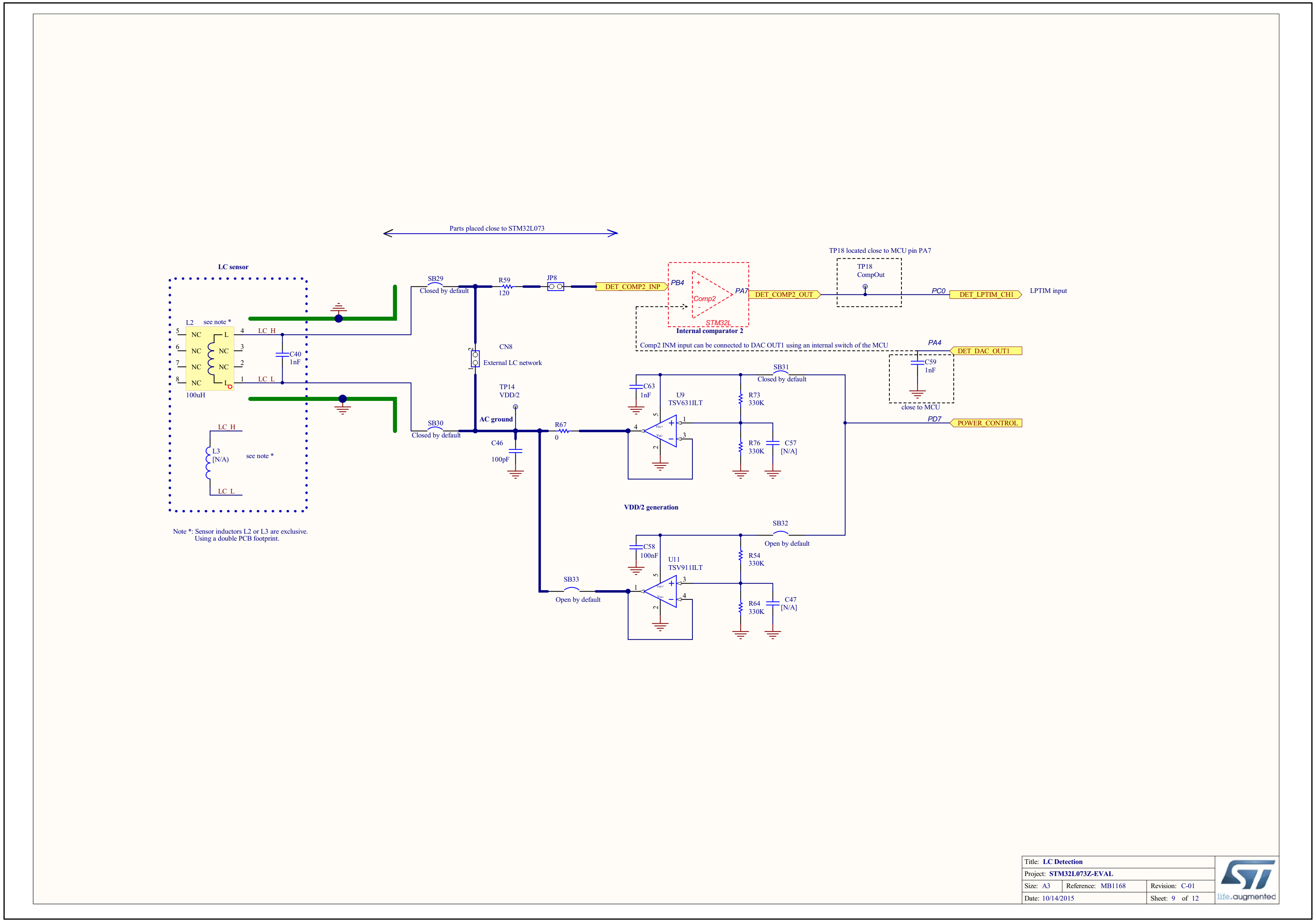
# Figure 33. USART_LPUART



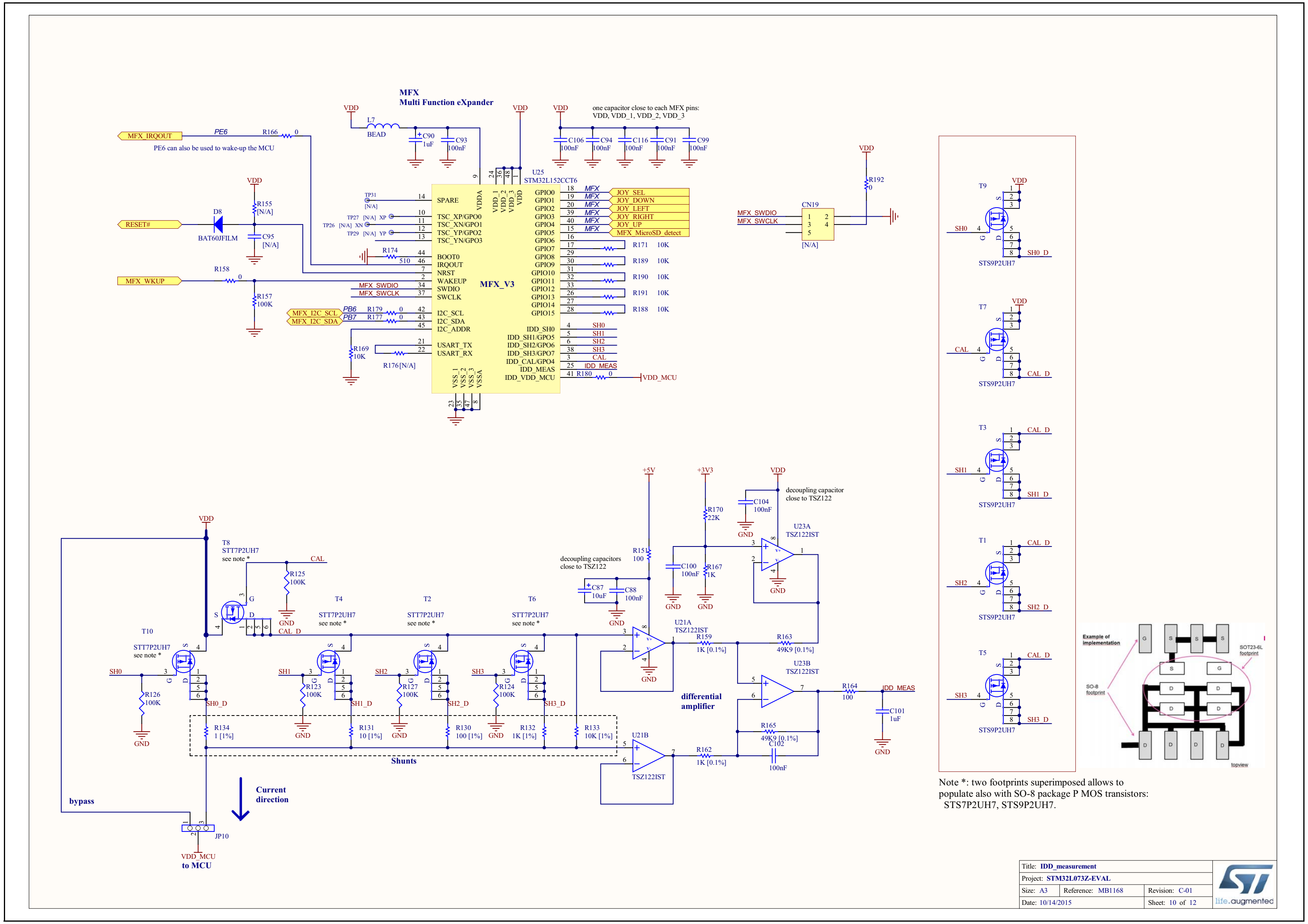
# Figure 34. Pressure sensor



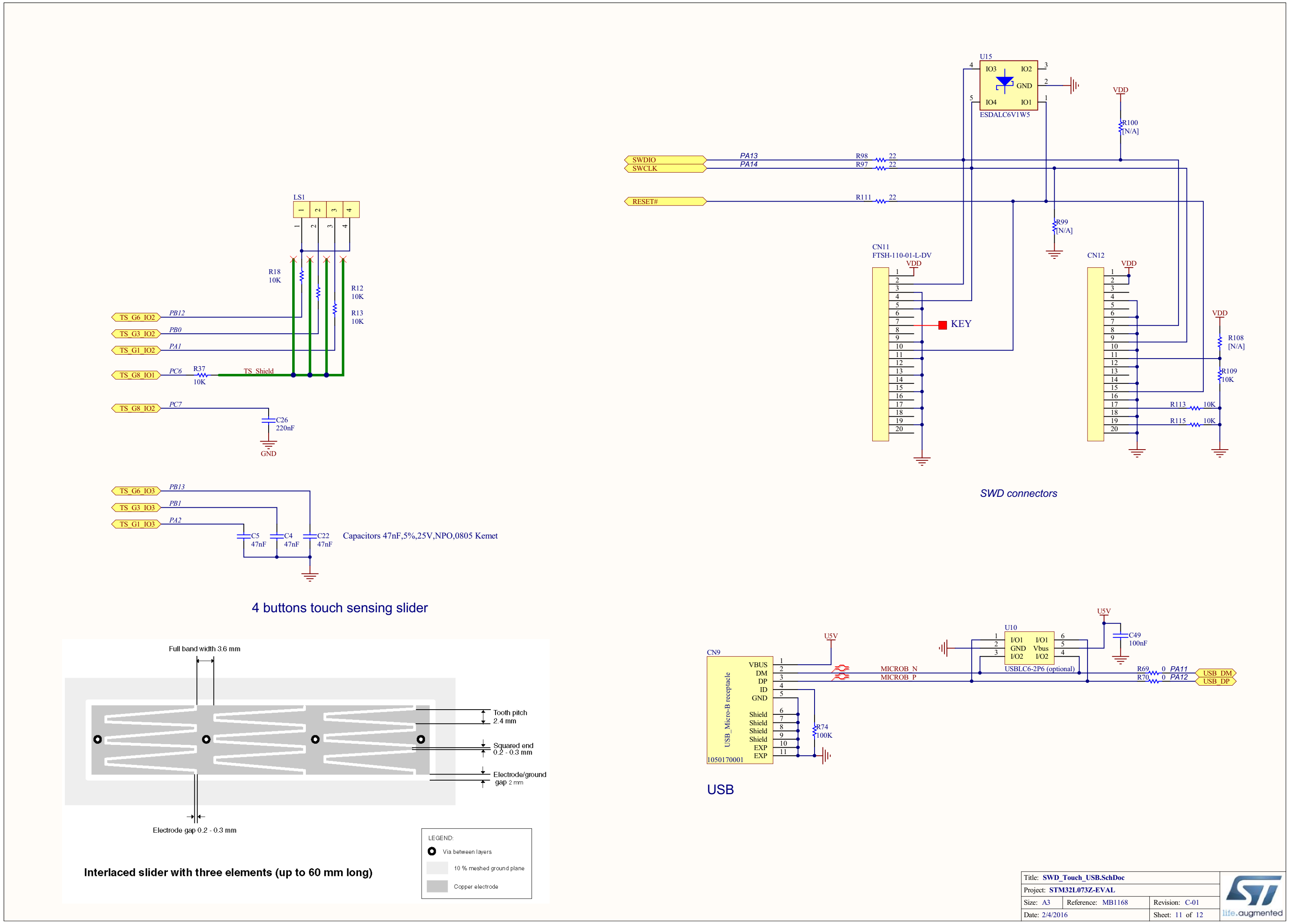
# Figure 35. LC sensor metering



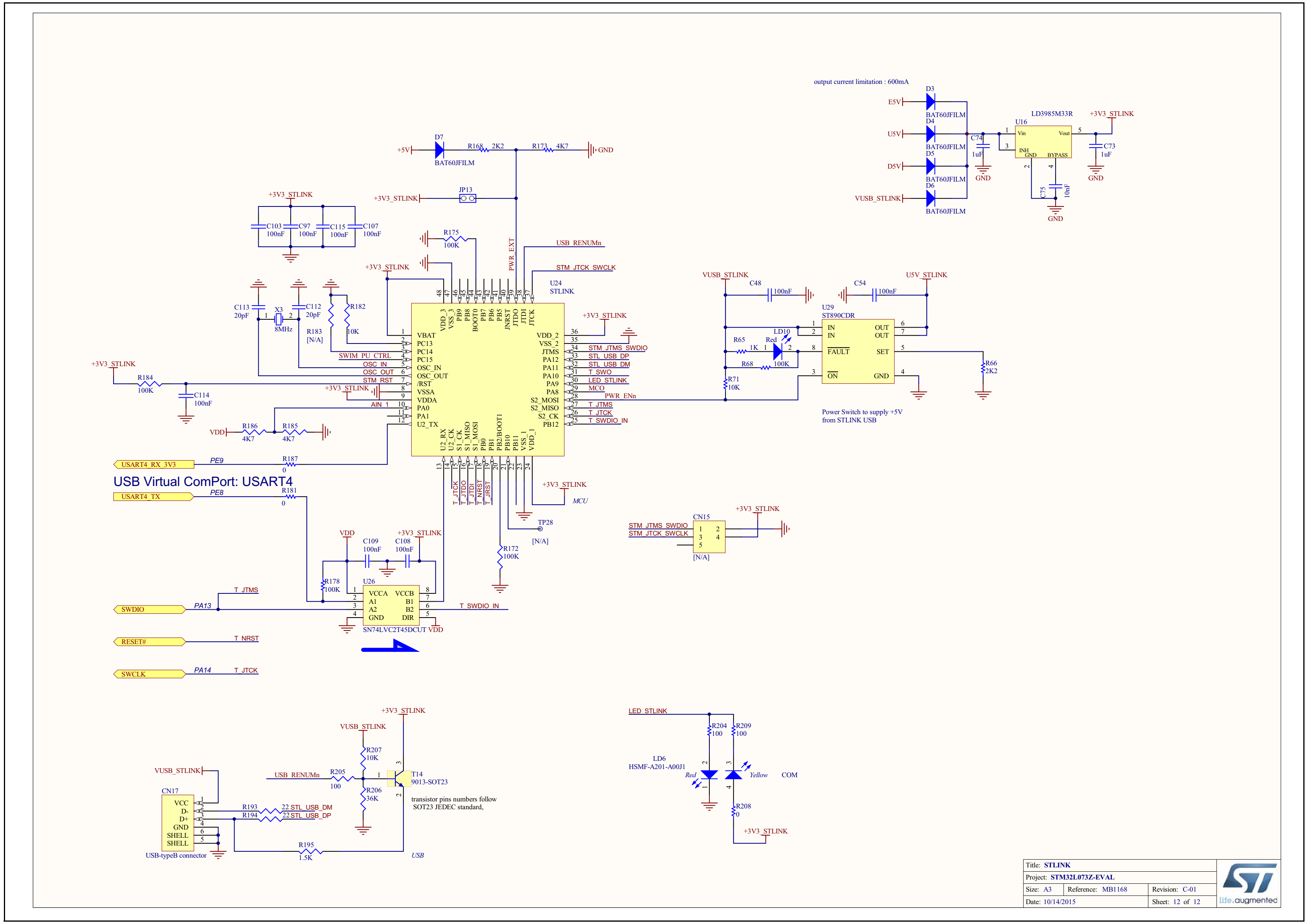
# Figure 36. IDD measurement



# Figure 37. SWD, Touch, USB

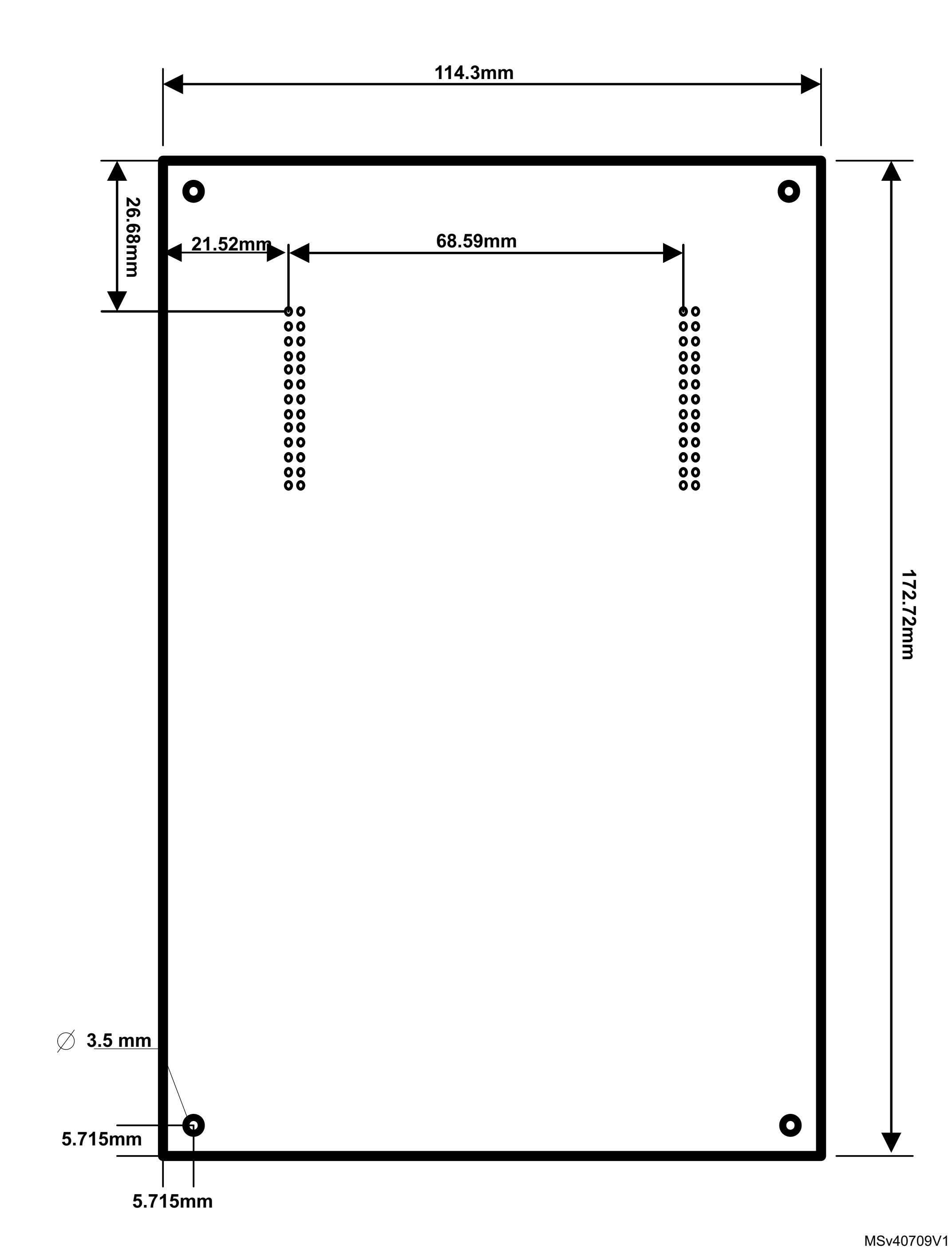


# Figure 38. ST-LINK/V2-1



# Appendix B Mechanical dimensions

Figure 39. Mechanical dimensions



# 7 Revision History

**Table 32. Document Revision History**

| Date | Version | Revision Details |
|---|---|---|
| 16-Feb-2016 | 1 | Initial version. |