UM1817
User manual

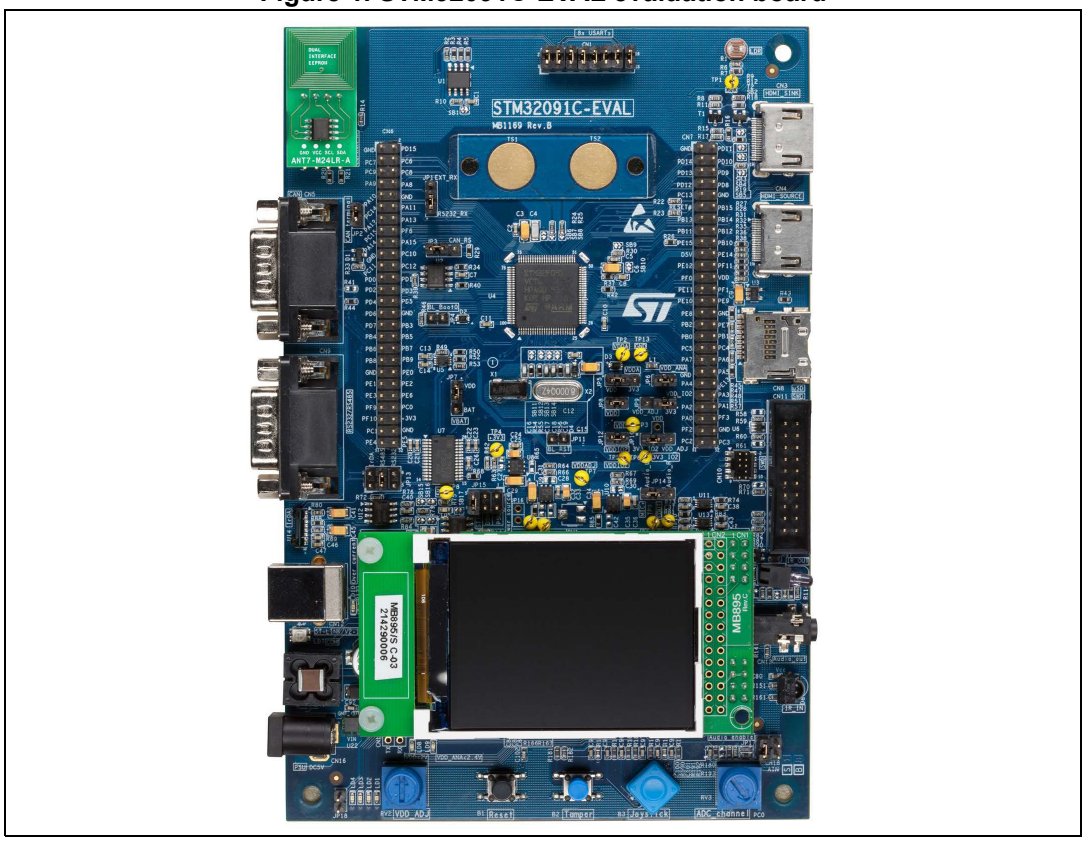
Evaluation board with STM32F091VC MCU

Introduction

The STM32091C-EVAL evaluation board is designed as a complete demonstration and development platform for STMicroelectronics ARM® Cortex®-M0 core-based STM32F091VCT6 microcontroller, with two I^2Cs, two SPIs, eight USARTs, one CAN, 12-bit ADC, 12-bit DAC, two GP comparators, internal SRAM and 256-Kbyte Flash memory, Touch sensing, CEC and SWD debugging support.

The full range of hardware features on the board helps the user to evaluate all the peripherals (8x USARTs, RS-232, RS-485, Audio DAC, microphone ADC, Touch sensing buttons, TFT LCD, CAN, IrDA, IR LED, IR receiver, LDR, microSD card, CEC on two HDMI connectors, smartcard slot, RF-EEPROM and temperature sensor) and to develop applications. Extension headers make it possible to easily connect a daughterboard or wrapping board for a specific application. An ST-LINK/V2-1 is integrated on the board as an embedded in-circuit debugger and programmer for the STM32.

Figure 1. STM32091C-EVAL evaluation board



1. Picture not contractual.

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1 Overview

1.1 Features

- STM32F091VCT6 microncontroller with 256-Kbyte Flash memory and 32-Kbyte RAM
- Three 5 V power supply options: power jack, ST-LINK/V2-1 USB connector or daughterboard
- Stereo audio jack which supports headset with microphone connected to DAC and ADC of the STM32F091VCT6
- 2-Gbyte (or more) SPI interface microSD card
- I^2C compatible serial interface temperature sensor
- RF-EEPROM
- RS-232 and RS-485 communication
- IrDA transceiver
- IR LED and IR receiver
- SWD debug support, ST-LINK/V2-1 embedded
- 240x320 TFT color LCD connected to SPI interface of STM32F091VCT6
- Joystick with 4-direction control and selector
- Reset, Tamper and user-buttons
- 4-color user LEDs and two LEDs as STM32 low-power alarm
- Extension connector for daughterboard or wrapping board
- STM32 voltage choice fixed 3.3 V or adjustable from 1.65 V to 3.6 V
- Touch sensing buttons
- RTC with backup battery
- CAN2.0A/B compliant connection
- Light dependent resistor (LDR)
- Potentiometer
- Two HDMI connectors with DDC and CEC
- Smartcard slot
- 8x USARTs chain connector

1.2 Demonstration software

Demonstration software is preloaded in the STM32F091VCT6 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 STM32091C-EVAL demonstration software available on the *www.st.com* website.

1.3 Order code

To order the evaluation board for the STM32F091VCT6 MCU, use the order code STM32091C-EVAL.

1.4 Delivery recommandations

Before using the board for the first time, the user should check that it has not been visibly damaged during the shipment, and that no components are unplugged or missing.

When the board is extracted from its plastic bag, check that no component remains in the bag.

The main components to verify are:

1. The 8 MHz crystal (X2) which may have been removed from its socket by a shock.
2. The microSD card which may have been ejected from the CN8 connector (right side of the board).
3. The dual-interface EEPROM board (ANT7-M24LR-A) which may have been unplugged from the CN2 connector (top left corner of the board).

For all information concerning the version of the MCU used on the board, its specification and possible related limitations, visit the ST web site *www.st.com* to download relevant datasheet and errata sheet.

2 Hardware layout and configuration

The STM32091C-EVAL evaluation board is designed around the STM32F091VCT6 (100-pin LQFP package). The hardware block diagram *Figure 2* illustrates the connection between the STM32F091VCT6 and the peripherals (8x USARTs, RS-232, RS-485, Audio DAC, microphone ADC, Touch sensing buttons, TFT LCD, CAN, IrDA, IR LED, IR receiver, LDR, microSD card, CEC on two HDMI connectors, smartcard slot, RF-EEPROM and Temperature sensor) and *Figure 3* helps the user to locate these features on the actual evaluation board. The *Figure 4* and the *Table 1* show the board mechanical dimensions.

Figure 2. Hardware block diagram

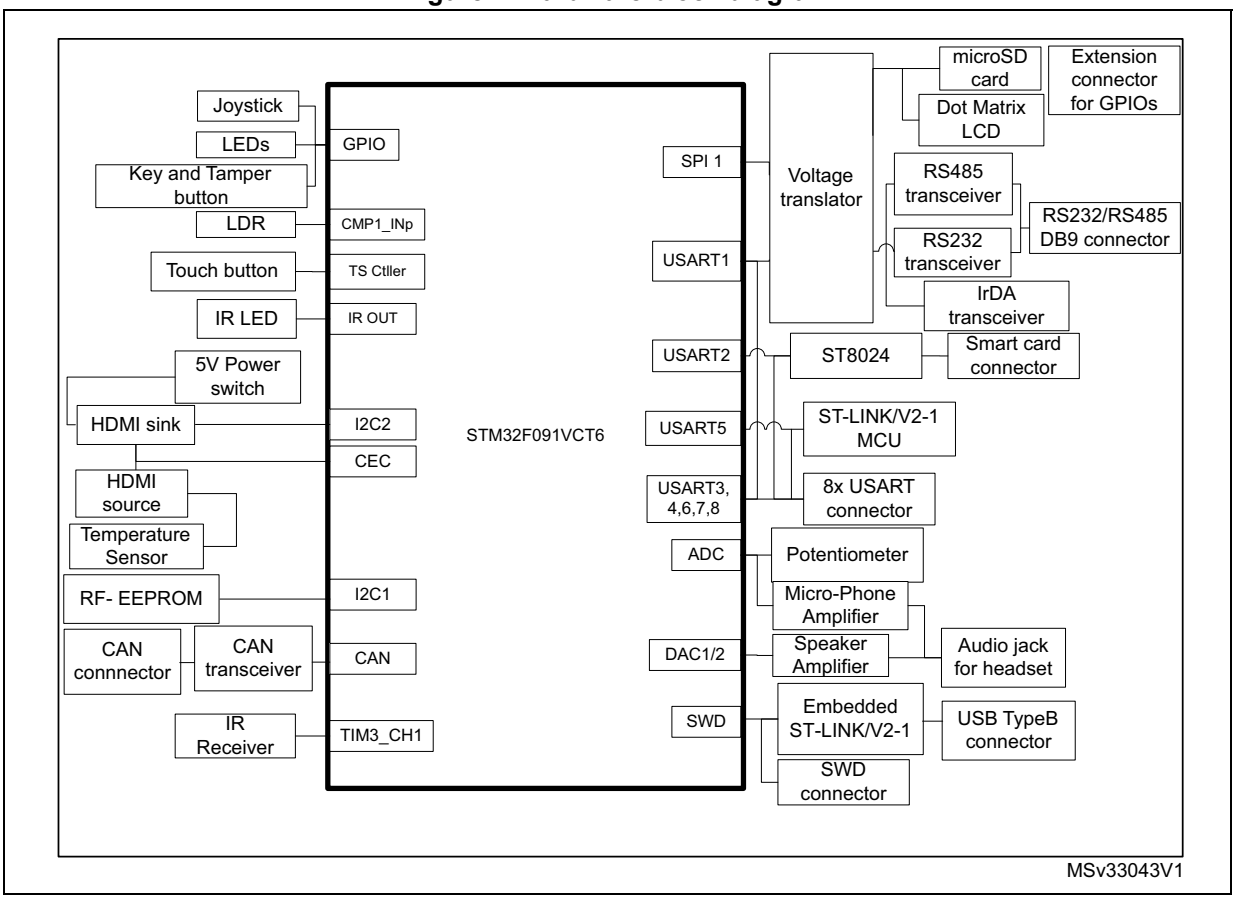


Figure 3. STM32091C-EVAL board layout

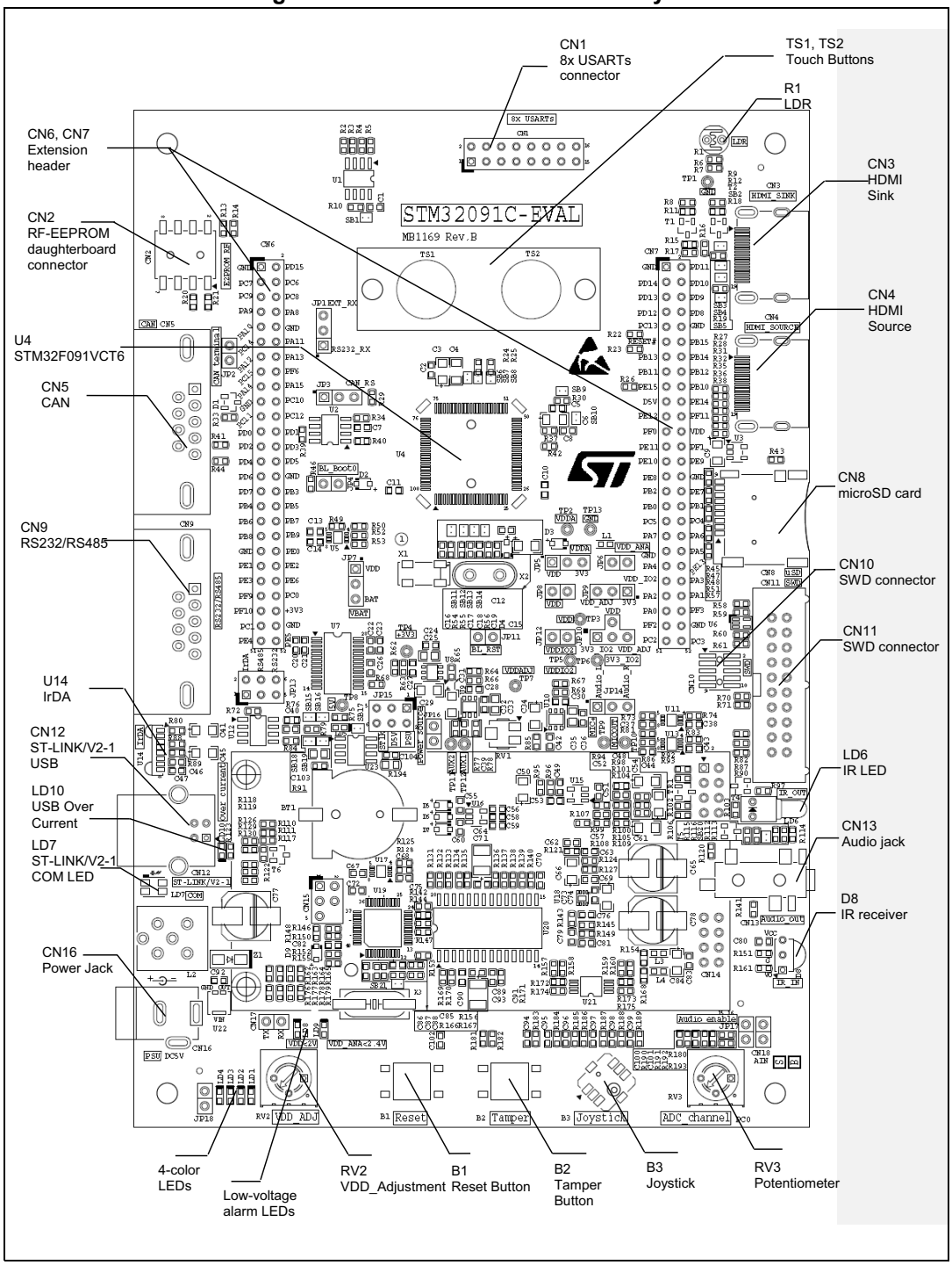


Figure 4. Mechanical dimensions

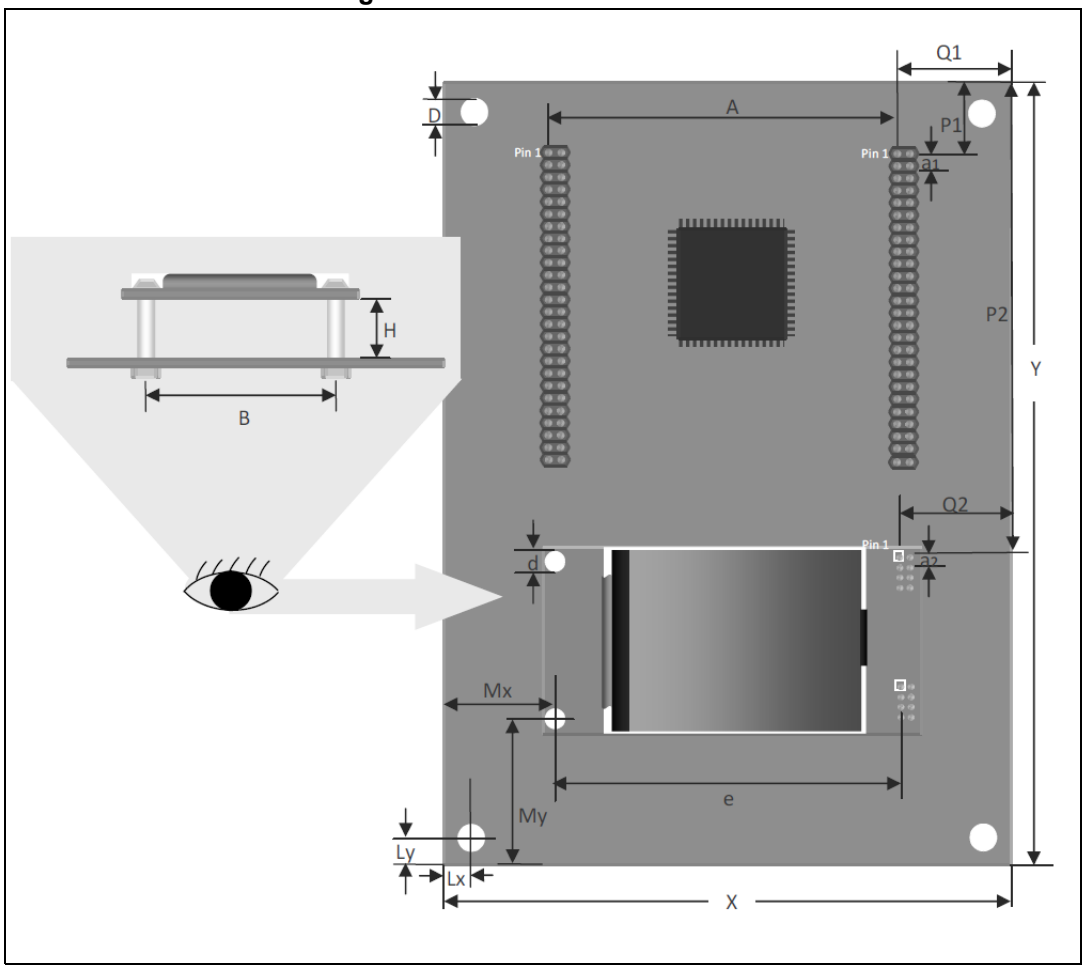


Table 1. Mechanical dimensions

Symbol	Size (mm)	Symbol	Size (mm)	Symbol	Size (mm)
A	68.58	e	77.44	P1	26.67
a1	2.54	H	11	P2	111.76
a2	2.54	Lx	5.715	Q1	24.12
B	36	Ly	5.715	Q2	17.70
D	3.5	Mx	19.08	X	114.3
d	3.2	My	23.81	Y	172.72

2.1 Embedded ST-LINK/V2-1

The ST-LINK/V2-1 programming and debugging tool is integrated on the STM32091C-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 the *ST-LINK/V2 in-circuit debugger/programmer for STM8 and STM32ST-LINK/V2* User manual (UM1075).

Note: It is possible to power the board via CN12 (Embedded ST-LINK/V2-1 USB connector) even if an external tools is connected to CN10 (High density SWD connector) or CN11 (SWD connector).

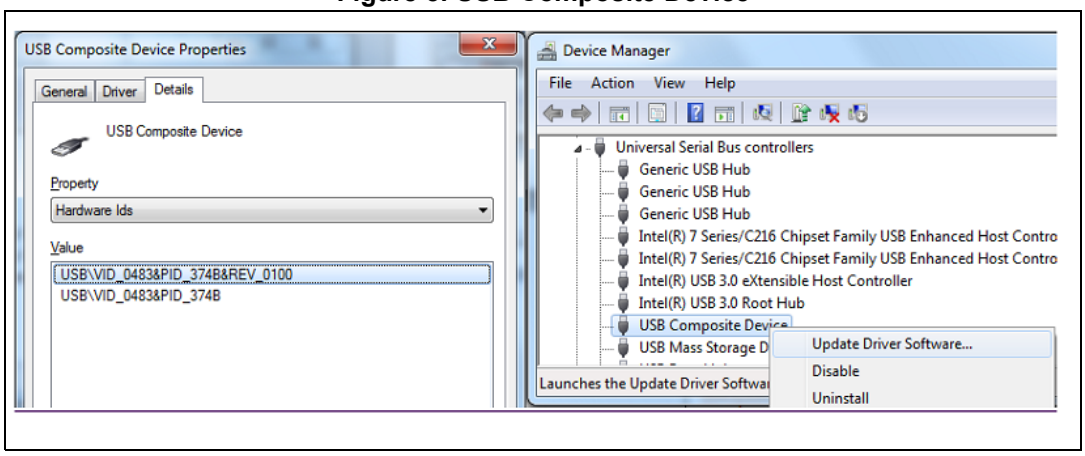
2.1.1 Drivers

The ST-LINK/V2-1 requires a dedicated USB driver, which can be found at the www.st.com website for Windows® 7 and 8. On Windows® XP the ST-LINK/V2-1 driver requires WinUsb to be installed before using the ST-LINK/V2-1 (either available from Microsoft website or included in the USB driver for ST-LINK/V2 for XP).

In case the STM32091C-EVAL evaluation board is connected to the PC before the driver is installed, some STM32091C-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 5. USB Composite Device



2.1.2 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 functionalities, bug fixes, support for new microcontroller families), it is recommended to visit the *www.st.com* website before starting to use the STM32091C-EVAL board and periodically, in order to stay up-to-date with the latest firmware version.

2.2 Board power supply

STM32091C-EVAL evaluation board is designed to be powered by 5 V DC power supply and to be protected by PolyZen from wrong power plug-in event. It is possible to configure the evaluation board to use any of the following three sources for the power supply:

- 5 V DC power adapter connected to CN16 (the Power jack on the board showed as PSU on JP15 silkscreen and called E5V). The external power supply is not provided with the board.
- 5 V DC power from CN12 (the USB Type-B connector of ST-LINK/V2-1, that is showed as STlk on JP15 silkscreen and called U5V). If the USB enumeration succeeds (as explained below), the ST-LINK U5V power is enabled, by asserting the PWR_EN pin. This pin is connected to a power switch (ST890), which powers the board. This power switch features also a current limitation to protect the PC in case of short-circuit on the board. If overcurrent (more than 600 mA) happens on board, the LED LD10 is lit.
- 5 V DC power from CN7 (the extension connector for daughterboard, that is showed as D5V on JP15 silkscreen).

STM32091C-EVAL evaluation board can be powered from ST-LINK USB connector CN12 (U5V), but only the ST-LINK part has the power before USB enumeration, because the host PC only provides 100 mA to the board at that time. During the USB enumeration, the STM32091C-EVAL board asks for the 300 mA power to the host PC. If the host is able to provide the required power, the enumeration finishes by a “SetConfiguration” command and then, the power transistor U23 (ST890) is switched ON, the red LED LD5 is turned ON, thus STM32091C-EVAL board can consume maximum 300 mA current, but not more. If the host is not able to provide the requested current, the enumeration fails. Therefore the ST890 (U23) remains OFF and the STM32 part including the extension board will not be powered. As a consequence the red LED LD5 remains turned OFF. In this case it is mandatory to use an external power supply as extra power supply.

E5V (from PSU) or D5V can be used as external power supply in case the current consumption of the STM32091C-EVAL board exceeds the allowed current on the USB. In this condition it is still possible to use the USB for communication, for programming or debugging only, but it is mandatory to power the board first using E5V or D5V, then connecting the USB cable to the PC. Proceeding this way the enumeration succeeds thanks to the external power source.

The following power sequence procedure must be respected:

4. Connect jumper JP15 for PSU or D5V side
5. Check that JP18 is removed
6. Connect the external power source to PSU or D5V (daughterboard mounted)
7. Check red LED LD5 is turned ON
8. Connect the PC to USB connector CN12

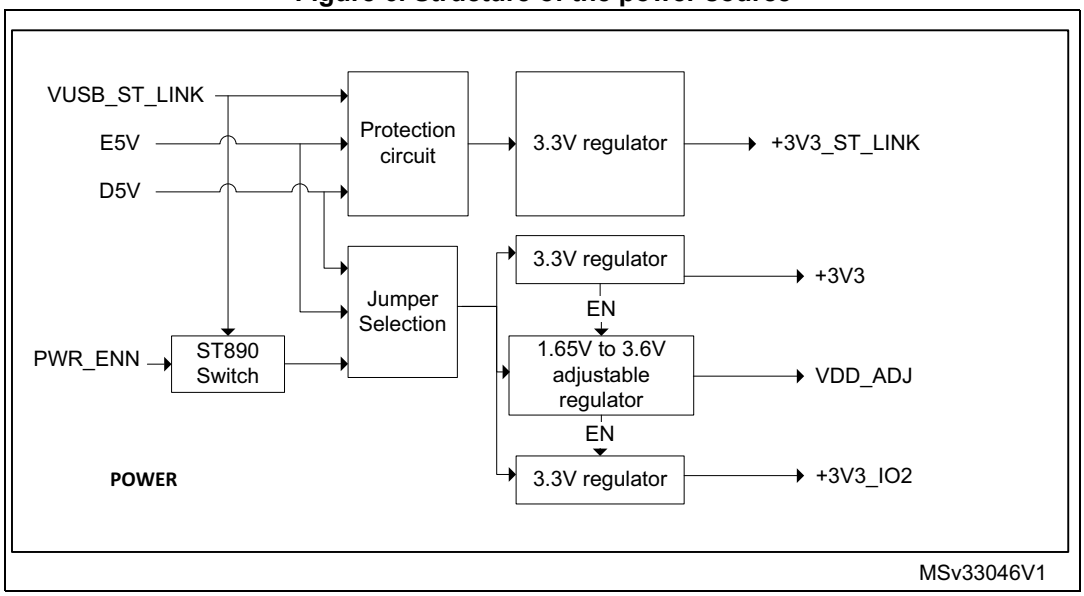
If this order is not respected, the board may be powered by VBUS first then E5V or D5V, and the following risks may be encountered:

1. If more than 300 mA current is needed by the board, the PC may be damaged or current can be limited by PC. As a consequence the board is not powered correctly.
2. 300 mA is requested at enumeration (since JP18 must be OFF), so there is risk that the request is rejected and the enumeration does not succeed if the PC cannot provide such current. Consequently the board is not powered (LED LD5 remains OFF).

Note: In case the board is powered by a USB charger, there is no USB enumeration, so the led LD5 remains set to OFF permanently and the board is not powered. Only in this specific case the jumper JP18 needs to be set to ON, to allow the board to be powered anyway.

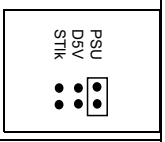
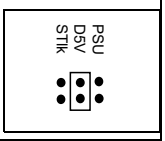
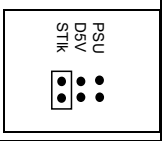
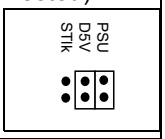
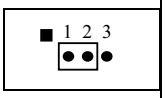
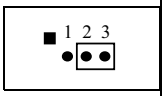
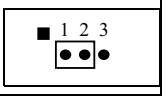
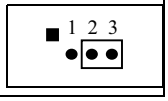
Figure 6 helps to understand the structure of the power source on the evaluation board.

Figure 6. Structure of the power source



The power source is selected by setting the related jumpers **JP15, JP7 and JP10** as described in *Table 2*.

Table 2. Power source related jumpers

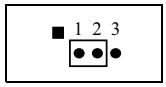
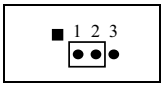
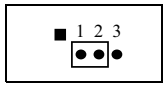
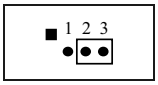
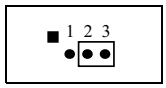
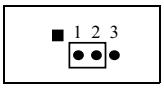
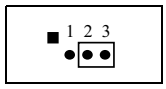
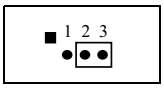
Jumper	Description
JP15	JP15 is used to select one of the three possible power supply resources. For **power supply jack** (CN16) to the STM32091C-EVAL only, JP15 is set as shown to the right: 
	For power supply from the **daughterboard connectors** (CN7) to STM32091C-EVAL only, JP15 is set as shown to the right: 
	For power supply from USB (CN12) of ST-LINK/V2-1 to STM32091C-EVAL only, JP15 is set as shown to the right: (Default Setting) 
	For power supply from **power supply jack** (CN16) to both STM32091C-EVAL and daughterboard connected on CN6 and CN7, JP15 is set as shown to the right (**daughterboard must not have its own power supply connected**) 
JP7	The Vbat pin of STM32F091VCT6 is connected to VDD when JP7 is set as shown to the right (Default setting): 
	The Vbat pin of STM32F091VCT6 is connected to the 3 V battery when JP7 is set as shown to the right: 
JP10	The VDDIO2 pin of STM32F091VCT6 is connected to 3.3V when JP10 is set as shown to the right (Default setting): 
	The VDDIO2 pin of STM32F091VCT6 is connected to VDD_ADJ when JP10 is set as shown to the right: 

2.3 STM32 power-mode configuration

Total three power modes are supported on the board that are configured by setting the related jumpers **JP5, JP6, JP8, JP9 and JP12** as described in *Table 3* and in the Notes below.

- Mode1: The VDD and VDDA are connected together and powered by fixed 3.3 V.
- Mode2: The VDD and VDDA are connected together and powered by adjustable voltage from 1.65 V to 3.6 V.
- Mode3: The VDD is powered by adjustable voltage from 1.65 V to 3.6 V while VDDA is powered by fixed 3.3 V.

Table 3. Power mode related jumpers

Power mode	Power mode configuration		VDD_MCU Idd measurement (On JP8)
	JP9	JP5	
Mode1			OK
			NOT allowed
Mode2			OK
Mode3			NOT allowed

Note:1 *JP8 allows current measurement on VDD_MCU. Current measurement is performed by replacing JP8 by an ammeter.*

Note:2 *JP12 allows current measurement on VDDIO2. Current measurement is performed by replacing JP12 by an ammeter.*

Note:3 *JP6 allows to connect analog power source VDD_ANA to the STM32 VDDA. JP6 must be opened (to disconnect VDDA from all analog power VDD_ANA which is connected to analog circuits on the board) for STM32 Idd measurement.*

Note:4 *LD8 is lit when VDD < 2V and in this case STM32 is not functional. LD9 is lit when VDDA < 2.4 V and in this case analogue parts in STM32F091VCT6 are not functional.*

The LED LD5 is lit when the STM32091C-EVAL evaluation board is powered by the 5 V correctly.

Table 4 shows the low-voltage limitations that might apply depending on the characteristics of some peripheral components. Components might work incorrectly when the power level is lower than the limitation.

Table 4. Low-voltage limitation

Peripheral	Component	IO name	Low-voltage limitation
Audio amplifier	U18	Audio input	2.2 V (VDDA)
Microphone amplifier	U15	Audio output	2.7 V (VDDA)
CAN	CN5	CAN	3 V (VDDIO2)
Smartcard	CN19	USART2	2.7 V (VDD)

CAUTION:

1. JP8 and JP12 are not allowed to be opened; otherwise STM32F091VCT6 would be damaged due to a lack of power supply on its power pins.
2. Risk of explosion if battery is replaced by an incorrect type. Dispose of used batteries according to the instructions.

2.4 Clock source

Two clock sources are available on the STM32091C-EVAL evaluation board for STM32F091VCT6 and RTC embedded.

- X1, 32 KHz crystal for embedded RTC
- X2, 8 MHz crystal with socket for STM32F091VCT6 microcontroller, it can be removed from socket when internal RC clock is used.

See *Table 5* and *Table 6*.

Table 5. 32 KHz crystal X1 related solder bridges

Jumper	Description
SB11	PC14 is connected to the 32KHz crystal when SB11 is open. (Default setting)
	PC14 is connected to extension connector CN6 when SB11 is closed. In such case R54 must be removed to avoid disturbance due to the 32 Khz quartz.
SB12	PC15 is connected to the32 KHz crystal when SB12 is open. (Default setting)
	PC15 is connected to extension connector CN6 when SB12 is closed. In such case R55 must be removed to avoid disturbance due to the 32 Khz quartz.

Table 6. 8MHz crystal X2 related solder bridges

Jumper	Description
SB13	PF0 is connected to the 8 MHz crystal when SB13 is open. (Default setting)
	PF0 is connected to the extension connector CN7 when SB13 is closed. In such case C18 and X2 must be removed.

Table 6. 8MHz crystal X2 related solder bridges (continued)

SB14	PF1 is connected to 8MHz crystal when SB14 is open. (Default setting)
	PF1 is connected to extension connector CN7 when SB14 is closed. In such case R56 must be removed to avoid disturbance due to the 8 Mhz quartz.

2.5 Reset source

The reset signal of STM32091C-EVAL evaluation board is low active and the reset sources include:

- Reset button B1
- Debugging tools from SWD connector CN10 and CN11
- Daughterboard from CN7
- Embedded ST-LINK/V2-1
- RS-232 connector CN9 for ISP.

Note: The jumper JP11 must be closed for RESET handled by pin 8 of the RS-232 connector CN9 (CTS signal). Refer to Section 2.8 for details.

2.6 Boot option

The STM32091C-EVAL evaluation board is able to boot from:

- Embedded user Flash
- System memory with boot loader for ISP
- Embedded SRAM for debugging

The boot option is configured by setting one jumper cap on CN7 between pin 22 and pin 24 and one option bit (see *Table 7*).

Table 7. Boot related switch

Switch configuration	bit12 in USER OPTION BYTES	Boot from
CN7 pin 22 and pin 24 opened	X	STM32091C-EVAL boot from User Flash. (Default setting)
CN7 pin 22 and pin 24 closed by jumper	0	STM32091C-EVAL boot from Embedded SRAM.
CN7 pin 22 and pin 24 closed by jumper	1	STM32091C-EVAL boot from System Memory.

The BOOT0 can also be configured via RS-232 connector CN9, as shown in *Table 8*.

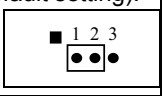
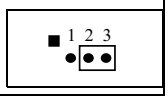
Table 8. Boot0 related jumpers

Jumper	Description
JP4	The Bootloader_BOOT0 is managed by pin 6 of the connector CN9 (RS-232 DSR signal) when JP4 is closed. This configuration is used for the bootloader application only. Default Setting: Not fitted

2.7 Audio

STM32091C-EVAL evaluation board supports stereo audio playback and microphone recording by an external headset connected on audio jack CN13. Audio play is connected to DAC output of the STM32F091VCT6 through an audio amplifier and microphone on headset is connected to ADC input of the STM32F091VCT6 through a microphone amplifier. Audio amplifier is enabled or disabled by setting JP17 and mono/stereo playback is selected by setting JP14, refer to *Table 9* for details.

Table 9. Audio related jumpers

Jumper	Description
JP17	Speaker amplifier U18 is enabled when JP17 is closed (Default setting)
	Speaker amplifier U18 is disabled when JP17 is open
JP14	Mono playback is enabled when JP14 is set as shown to the right (Default setting): 
	Stereo playback is enabled when JP14 is set as shown to the right: 

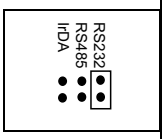
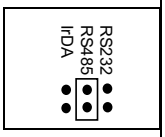
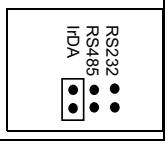
Audio amplifier operates correctly when VDDA > 2.2V and microphone amplifier operates correctly when VDDA > 2.7V.

2.8 RS-232, RS-485 and IrDA

The RS-232 (with hardware flow control CTS and RTS), the RS-485 and the IrDA communication are supported by the D-type 9-pins RS-232/RS-485 connectors CN9, and by the IrDA transceiver U14 which is connected to the USART1 of the STM32F091VCT6 on the STM32091C-EVAL evaluation board. The signal Bootloader_RESET (shared with CTS signal) and the Bootloader_BOOT0 (shared with DSR signal) are added on the RS-232 connector CN9 for ISP support.

USART1_Rx is chosen by setting of JP13, refer to *Table 10* for details.

Table 10. RS-232 and IrDA related jumpers

Jumper	Description
JP13	RS232_RX is connected to RS-232 transceiver and RS-232 communication is enabled when JP13 is set as shown to the right (Default setting): 
	RS485_RX is connected to RS-485 transceiver and RS-485 communication is enabled when JP13 is set as shown to the right: 
	IrDA_RX is connected to IrDA transceiver and IrDA communication is enabled when JP13 is set as shown to the right: 

The RS-485 communication is supported by the RS-485 transceiver ST3485EBDR which is connected to pin 4 and pin 9 of D-type 9-pins connectors CN9 (share same connector with USART1), see *Table 11*.

Table 11. RS-485 related solder bridges

Jumper	Description
SB15, SB18	The external failsafe biasing are enabled when solder bridges SB15 and SB18 are closed Default Setting: Not fitted
SB19	The bus termination is enabled when solder bridge SB19 is closed. Default Setting: Not fitted
SB16	The AC termination is disabled when solder bridge SB16 is closed for high baud rate communication. Default Setting: Not fitted

2.9 Touch sensing buttons

Two touch sensing buttons are supported on the STM32091C-EVAL evaluation board and they are connected to three capacitive sensing channels (PD[12:14]) in group8 with active shield being connected to two capacitive sensing channels (PB11 and PB12) in group6 (see *Table 12*).

Table 12. Touch sensing buttons related solder bridges

Solder Bridge	Description
SB7	PD13 is connected to touch slider when SB7 is open. (Default setting)
	PD13 is connected to extension connector CN7 when SB7 is closed. In such case R24 must be removed to avoid disturbance due to the touch button.
SB8	PD12 is connected to touch slider when SB8 is open. (Default setting)
	PD12 is connected to extension connector CN7 when SB8 is closed. In such case R25 must be removed to avoid disturbance due to the touch button.
SB6	PD14 is connected to sampling capacitor when SB6 is open. (Default setting)
	PD14 is connected to extension connector CN7 when SB6 is closed. In such case C4 must be removed to avoid disturbance due to the capacitor.
SB9	PB12 is connected to shield when SB9 is open. (Default setting)
	PB12 is connected to extension connector CN6 when SB9 is closed. In such case R30 must be removed to avoid disturbance due to the shield.
SB10	PB11 is connected to shield charge capacitor when SB10 is open. (Default setting)
	PB11 is connected to extension connector CN6 when SB10 is closed. In such case R37 must be removed to avoid disturbance due to the capacitor.

Note: Touch sensing buttons are fully functional only when the STM32091C-EVAL board is powered on in power mode 1 (both VDD and VDDA are connected to fixed 3.3 V). It is potentially necessary to adjust the capacitor value of C8 and the firmware to adapt them to the voltage range from 1.65 V to 3.6 V of VDD on power-mode 2 and 3.

2.10 microSD card

The 2-Gbyte (or more) microSD card connected to SPI1 port (Shared with color LCD) of the STM32F091VCT6 is available on the board. microSD card detection is managed by standard IO port PE11 and it should be set with internal pull-up.

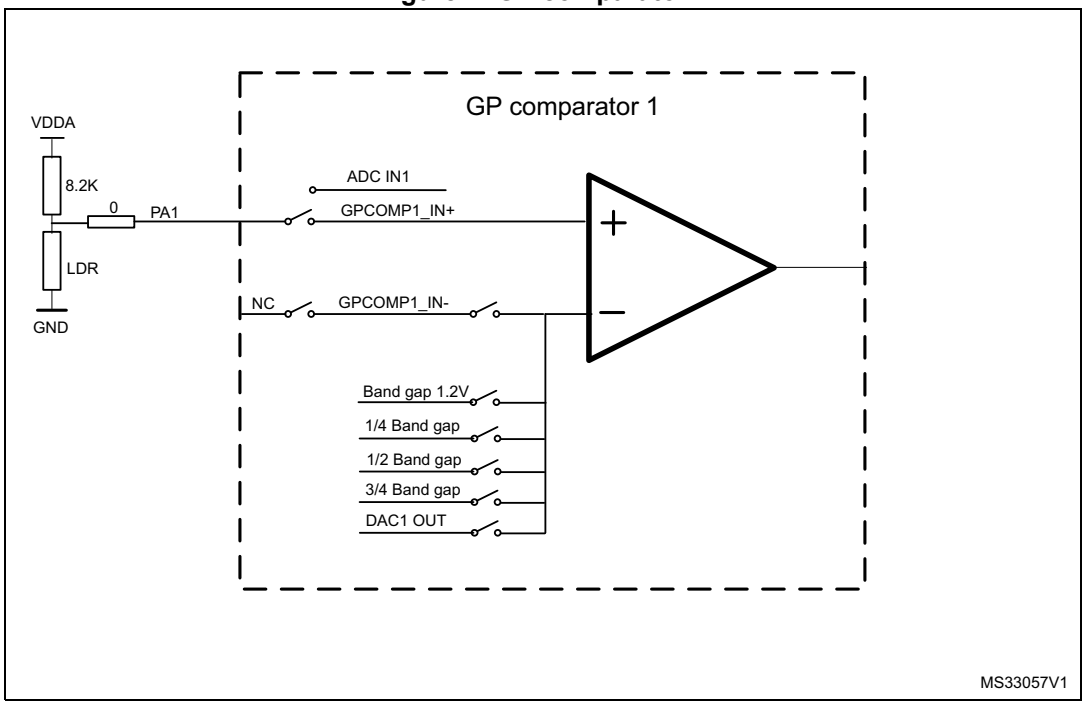
2.11 Analog input

The two-pin header CN18 and the 10K ohm potentiometer RV3 are connected to PC0 of STM32F091VCT6 as analog input. A low-pass filter is implemented by replacing R191 and C101 with the right value of resistor and capacitor as requested by end user's application.

2.12 LDR (Light Dependent Resistor)

The VDDA is divided by resistor bridge of LDR VT9ON1 and 8.2K resistor and connected to PA1 (COM1_IN+/ADC IN1) as shown below in *Figure 7* on the STM32091C-EVAL evaluation board.

Figure 7. GP comparator 1



It is possible to compare LDR output with 1/4 band gap, 1/2 band gap, 3/4 band gap, band gap and DAC1 OUT and to connect LDR output to ADC IN1 for AD conversion.

2.13 Temperature sensor

A temperature sensor STLM75M2F is connected to I2C1 bus of the STM32F091VCT6, and share same I2C1 bus with RF-EEPROM and DDC on HDMI_Source connector CN4.

I^2C address of temperature sensor is 0b100100 (A0), A0 can be 0 or 1, depending on the setting of SB1, see *Table 13*.

Table 13. Temperature sensor or related solder bridge

Solder Bridge	Description
SB1	I^2C address A0 is 0 when SB1 is open (Default setting)
	I^2C address A0 is 1 when SB1 is closed.

Note: The temperature result measured from STLM75M2F would be a little higher than the ambient temperature due to the power dissipation of the components on the board.

2.14 Smartcard

STMicroelectronics smartcard interface chip ST8024L is used on the STM32091C-EVAL evaluation board for asynchronous 1.8 V, 3 V and 5 V smartcards. It performs all supply protection and control functions based on the connections with the STM32F091VCT6 listed in *Table 14*.

Table 14. Connection between ST8024L and STM32F091VCT6

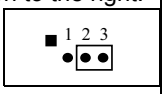
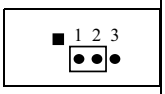
Signals of ST8024L	Description	Connect to STM32F091VCT6
5 V/3 V	smartcard power supply selection pin	PC2
I/OUC	STM32 data I/O line	PA2
XTAL1	Crystal or external clock input	PD7
OFF	Detect presence of a card, Interrupt to MCU	PC3
RSTIN	Card Reset Input from MCU	PA3
CMDVCC	Start activation sequence input (active low)	PA7
1.8V	1.8 V V_{CC} operation selection. Logic high selects 1.8 V operation and overrides any setting on the 5 V/3 V pin.	PC1

Smartcard operates correctly when VDD > 2.7 V.

2.15 CAN

STM32091C-EVAL evaluation board supports one channel of CAN2.0A/B compliant CAN bus communication based on 3.3 V CAN transceiver. The high-speed mode, standby mode and slope-control mode are available and selectable by setting JP3 (see *Table 15*).

Table 15. CAN related jumpers

Jumper	Description
JP3	CAN transceiver is working in standby mode when JP3 is set as shown to the right: 
	CAN transceiver is working in high-speed mode when JP3 is set as shown to the right: (default setting) 
	CAN transceiver is working in slope-control mode when JP3 is open.
JP2	CAN terminal resistor is enabled when JP2 is fitted. Default setting: Not fitted

CAN operates correctly when VDDIO2 > 3V.

2.16 RF-EEPROM

A RF-EEPROM module ANT7-M24LR-A is mounted on connector CN2 and connected to I2C1 bus of the STM32F091VCT6, this bus shares same I2C1 bus with the temperature sensor U1 and DDC on HDMI_Source connector CN4.

The I^2C address of the RF-EEPROM daughterboard is 0b1010000.

2.17 HDMI CEC

Two HDMI connectors CN3 and CN4 are available on the STM32091C-EVAL board.

- The connector CN3 is HDMI sink connector with:
  - DDC connected to I2C2 of the STM32F091VCT6
  - HPD controlled by I/O PD11 through transistor T1
  - CEC connected to PB10 through transistor T2
- The connector CN4 is HDMI source connector with:
  - DDC connected to I2C1 of the STM32F091VCT6 and shared with the temperature sensor and RF-EEPROM
  - HPD controlled by I/O PD10
  - CEC connected to PB10 through transistor T2
  - HDMI 5 V powered by power switch U3

The signals TDMS D+[0..2], TDMS_CLK+, TDMS D-[0..2], TDMS_CLK- on these two HDMI connectors are connected together.

The CEC injector mode is enabled by some PCB reworks for debugging purpose only:

- Remove resistors R15, R17, R19, R28, R31, R35 and R38.
- Close solder bridges SB2, SB3, SB4 and SB5.

Note: The I/O PD11 must be set in open-drain output mode by firmware when working as an HPD signal control on the HDMI sink connector CN3.

2.18 IR LED and IR receiver

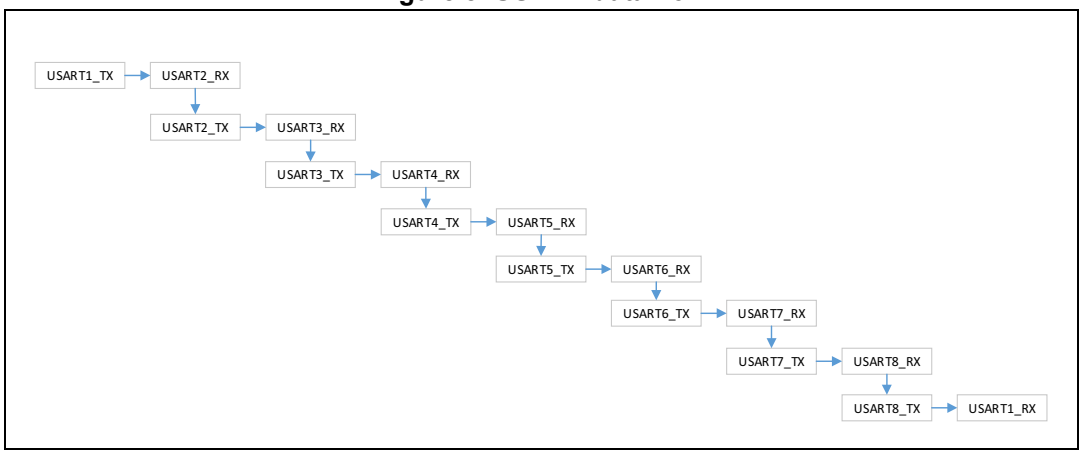
The IR receiver TSOP34836 is connected to PC6 of the STM32F091VCT6 and a current around 100 mA on IR LED is driven by PB9 through transistors T4 and T5 on the board.

Note: The IR LED may be driven by PB9 directly with 20 mA current when SB20 is closed and R116 is removed.

2.19 8x USARTs

USART chain could be routed to a 2*8 header so that some jumpers could be used to connect them to demonstrate 8x USART channels in daisy chain.The data flow is showed in the below *Figure 8*.

Figure 8. USART data flow



At the end both data sent at USART1_TX and data received at USART_RX can be compared and validated thanks to USARTs chain on CN1.

Warning: USART1/4/8 belongs to VDDIO2 power domain and USART2/3/5/6/7 belongs to VDDIO power domain, so the same voltage level for VDDIO and VDDIO2 is needed, to demonstrate USART chain application on this header.

2.20 Display and input devices

The 2.4” color TFT LCD connected to SPI1 port of the STM32F091VCT6 and 4-general-purpose-color LEDs (LD 1,2,3,4) are available as display device. The 4-direction joystick (B3) with selection key, which connects to PA0 and supports wakeup feature, and Tamper button (B2) are also available as input devices (see *Table 16*).

Table 16. LCD modules

2.4” TFT LCD connector CN14					
Pin	**Description**	**Pin connection**	**Pin**	**Description**	**Pin connection**
1	CS	PE10	9	VDD	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	5 V
6	RD	-	14	BL_Control	5 V
7	SDO	PE14	15	BL_GND	GND
8	RESET	RESET#	16	BL_GND	GND

Note: The bi-directional voltage translator is implemented on SPI MOSI signal between the STM32F091VCT6 and the LCD to support 3-wires serial interface for various voltage level interface. The direction of this voltage translator is controlled by I/O PE9 (the I/O PE15 is working as MOSI when PE9 is high or as MISO when PE9 is LOW).

3 Connectors

3.1 8x USARTs connector CN1

Figure 9. 8x USARTs connector CN1 (top view)

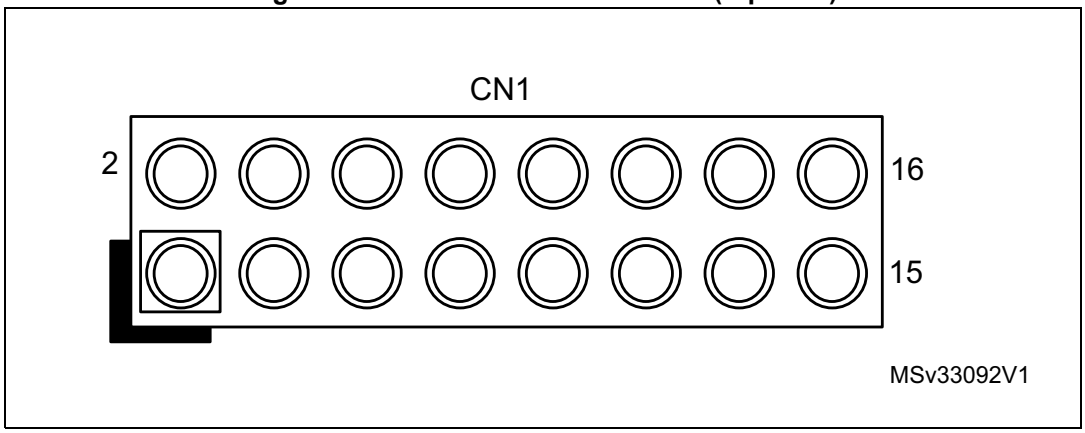


Table 17. 8x USARTs connector CN1

Pin number	Description	Pin number	Description
1	USART1_TX (PA9)	2	USART2_RX (PD6)
3	USART2_TX (PD5)	4	USART3_RX (PD9)
5	USART3_TX (PD8)	6	USART4_RX (PC11)
7	USART4_TX (PC10)	8	USART5_RX (PB4)
9	USART5_TX (PB3)	10	USART6_RX (PF10)
11	USART6_TX (PF9)	12	USART7_RX (PF3)
13	USART7_TX (PF2)	14	USART8_RX (PC9)
15	USART8_TX (PC8)	16	USART1_RX (PA10)

3.2 RF-EEPROM connector CN2

Figure 10. RF-EEPROM daughterboard connector CN2 (front view)

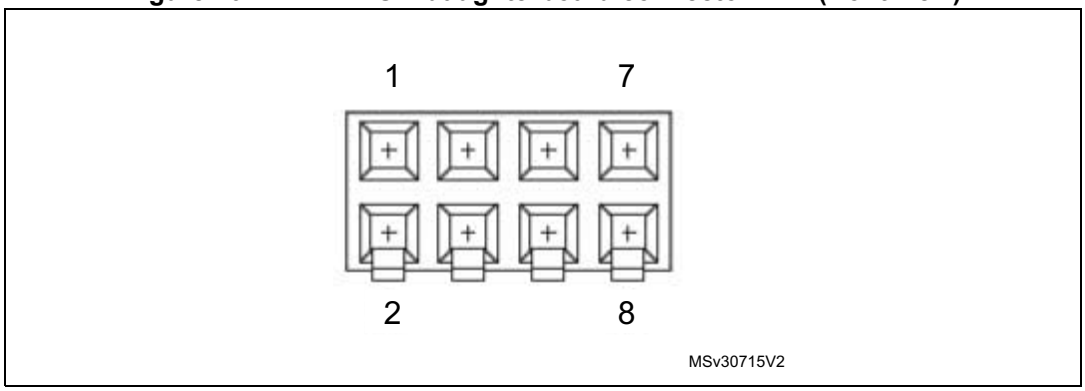


Table 18. RF-EEPROM connector CN2

Pin number	Description	Pin number	Description
1	I2C1_SDA (PB7)	5	+5 V
2	NC	6	NC
3	I2C1_SCL (PB6)	7	GND
4	EX_RESET (PD7)	8	NC

3.3 HDMI sink connector CN3

Figure 11. HDMI sink connector CN3 (front view)

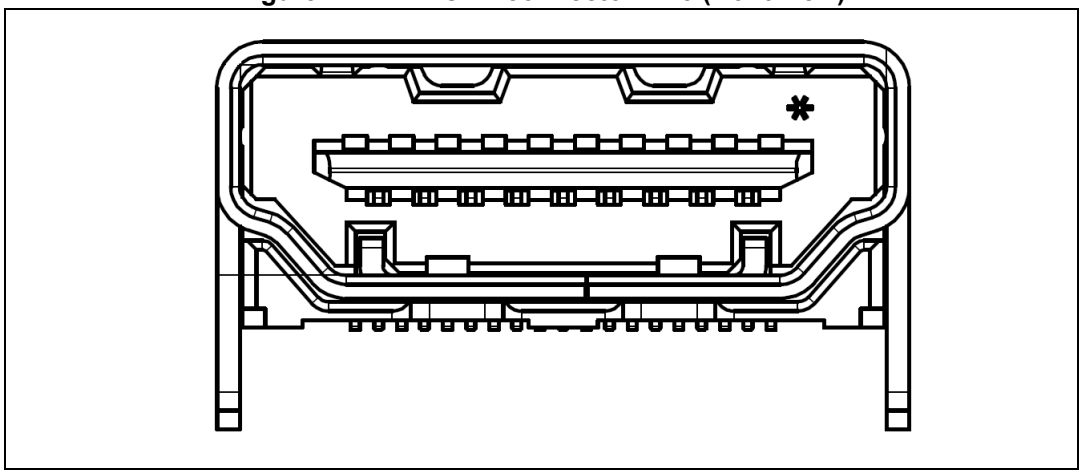


Table 19. HDMI sink connector CN3

Pin number	Description	Pin number	Description
1,3,4,6,7,9,10,12	TMDS differential signal pair connected to CN4	16	I2C2_SDA (PB14)
13	CEC (PB10)	2,5,8,11,17	GND
14	NC	18	HDMI_5V_Sink
15	I2C2_SCL (PB13)	19	HPD (PD11 through transistor)

3.4 HDMI source connector CN4

Figure 12. HDMI source connector CN4 (front view)

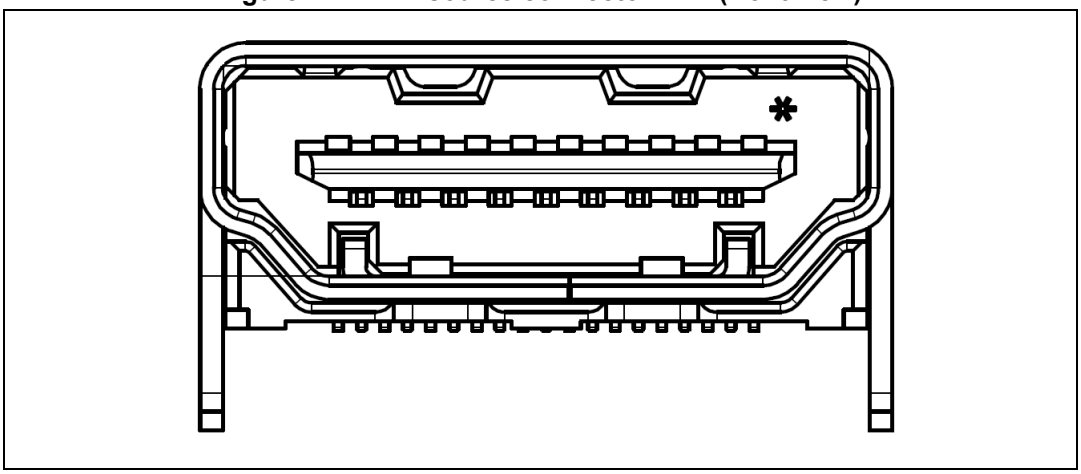


Table 20. HDMI source connector CN4

Pin number	Description	Pin number	Description
1,3,4,6,7,9,10,12	TMDS differential signal pair connected to CN3	16	I2C1_SDA (PB7)
13	CEC (PB10)	2,5,8,11,17	GND
14	NC	18	HDMI_5V_Source from power switch U3
15	I2C1_SCL (PB6)	19	HPD (PD10)

3.5 CAN D-type 9-pin male connector CN5

Figure 13. CAN D-type 9-pin male connector CN5 (front view)

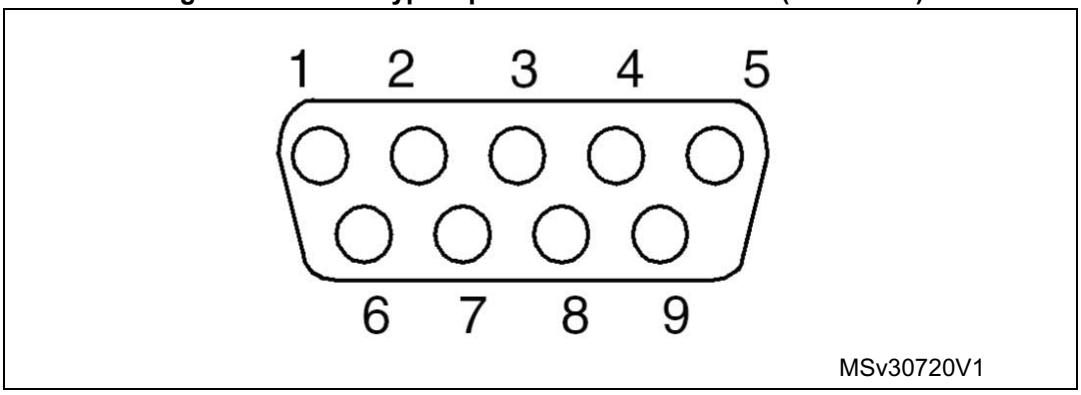


Table 21. CAN D-type 9-pin male connector CN5

Pin number	Description	Pin number	Description
1,4,8,9	NC	7	CANH
2	CANL	3,5,6	GND

3.6 Daughterboard extension connectors CN6 and CN7

Two 52-pin male headers CN6 and CN7 are used to connect with daughterboard or standard wrapping board to the STM32091C-EVAL evaluation board. All GPIOs are available on it. The space between these two connectors, position of power, GND and RESET pin are defined as a standard which allows developing common daughterboards for several STM32 evaluation boards. The standard width between CN6 pin 1 and CN7 pin 1 is 2700 mils (68.58 mm). Most of evaluation boards implement this standard.

Each pin on CN6 and CN7 can be used by a daughterboard after disconnecting it from the corresponding function block on the STM32091C-EVAL evaluation board. Refer to *Table 22* and *Table 23* for details.

Table 22. Daughterboard extension connector CN6

Pin	Description	Alternative function	How to disconnect with function block on the STM32091C-EVAL board
1	GND	-	-
3	PC7	-	-
5	PC9	8xUSART8_RX	No Jumper mounted on CN1
7	PA9	8xUSART1_TX/USART1_TX	Remove R52, No Jumper mounted on CN1
9	PA10	8xUSART1_RX/USART1_RX	no Jumper mounted on JP1
11	PC14	OSC32_IN	Remove R54, Close SB11
13	PA12	USART1_RTS/RS485_DIR	Remove R50
15	PC15	OSC32_OUT	Remove R55, Close SB12
17	PA14	SWCLK	Remove R60
19	GND	-	-
21	PC11	8xUSART4_RX	No Jumper mounted on CN1
23	PD0	CAN_RX	Remove R34
25	PD2	USART5_RX	Remove R153
27	PD4	-	-
29	PD6	8xUSART2_RX	No Jumper mounted on CN1
31	PD7	SmartCard_CK	Remove R134
33	PB4	8xUSART5_RX	No Jumper mounted on CN1
35	PB6	I2C1_SCL	Remove R4,R20,R27,R28

Table 22. Daughterboard extension connector CN6 (continued)

Pin	Description	Alternative function	How to disconnect with function block on the STM32091C-EVAL board
37	PB8	EX_RESET	Remove R13
39	GND	-	-
41	PE1	LED2	Remove R164
43	PE3	JOY_RIGHT	Remove R189
45	PF9	8xUSART6_TX	No Jumper mounted on CN1
47	PF10	8xUSART6_RX	No Jumper mounted on CN1
49	PC1	SmartCard_1.8V	Remove R140
51	PE4	JOY_UP	Remove R187
2	PD15	-	-
4	PC6	IR_IN	Remove R161
6	PC8	8xUSART8_TX	No Jumper mounted on CN1
8	PA8	-	-
10	GND	-	-
12	PA11	USART1_CTS	Remove R68
14	PA13	SWDAT	Remove R59
16	PF6	-	-
18	PA15	-	
20	PC10	8xUSART4_TX	No Jumper mounted on CN1
22	PC12	USART5_TX	Remove R125
24	PD1	CAN_TX	Remove R40
26	PD3	-	-
28	PD5	8xUSART2_TX	No Jumper mounted on CN1
30	GND	-	-
32	PB3	8xUSART5_TX	No Jumper mounted on CN1
34	PB5	TempSensor_INT	Remove R3
36	PB7	I2C1_SDA	Remove R5,R21,R32,R31
38	PB9	IR_OUT	Remove R113
40	PE0	LED1	Remove R165
42	PE2	JOY_LEFT	Remove R186
44	PE6	-	-
46	PC0	Potentiometer	Remove R190
48	+3V3	-	-
50	GND	-	-
52	PE5	JOY_DOWN	Remove R184

Table 23. Daughterboard extension connector CN7

Pin	Description	Alternative Function	How to disconnect with function block on STM32091C-EVAL board
1	GND	-	-
3	PD14	TS_CT	Remove C4, Close SB6
5	PD13	TS2	Remove R24, Close SB7
7	PD12	TS1	Remove R25, Close SB8
9	PC13	TAMPER_KEY	Remove R181
11	RESET#	-	-
13	PB13	I2C2_SCL	Remove R16
15	PB11	SHIELD_CT	Remove R37, close SB10
17	PE15	SPI1_MOSI	Remove R83
19	D5V	-	-
21	PE12	MicroSD_CS	Remove R57
23	PF0	OSC_IN	Remove X2,C18, Close SB13
25	PE11	SDcard_detect	Remove R43
27	PE10	LCD_CS	Remove R93
29	PE8	LED4	Remove R162
31	PB2	-	-
33	PB0	-	-
35	PC5	-	-
37	PA7	SmartCard_CMDVCC	Remove R137
39	GND	-	-
41	PA4	Audio_OUT_LEFT	Remove R121
43	VDD_IO2	-	-
45	PA2	SmartCard_IO	Remove R133
47	PA0	JOY_SEL	Remove R185
49	PF2	8xUSART7_TX	No Jumper mounted on CN1
51	PC2	SmartCard_3/5V	Remove R170
2	PD11	HDMI_HPD_SINK	Remove R8
4	PD10	HDMI_HPD_Source	Remove R36
6	PD9	8xUSART3_RX	No Jumper mounted on CN1
8	PD8	8xUSART3_TX	No Jumper mounted on CN1
10	GND	-	-
12	PB15	-	-
14	PB14	I2C2_SDA	Remove R18
16	PB12	SHIELD	Remove R30, close SB9

Table 23. Daughterboard extension connector CN7 (continued)

Pin	Description	Alternative Function	How to disconnect with function block on STM32091C-EVAL board
18	PB10	HDMI_CEC	Remove R12
20	PE14	SPI1_MISO	Remove R45
22	PF11	BOOT0	Remove R46, open JP4
24	VDD	-	-
26	PF1	OSC_OUT	Remove R56, Close SB14
28	PE9	SPI1_MOSI_DIR	Remove R81
30	GND	-	-
32	PE7	LED3	Remove R163
34	PB1	-	-
36	PC4	-	-
38	PA6	Audio_IN	Remove R107
40	PA5	Aduio_OUT_RIGHT	Keep JP14 open
42	PE13	SPI1_SCK	Remove R74
44	PA3	SmartCard_RST	Remove R136
46	PA1	LDR_IN	Remove R7
48	PF3	8xUSART7_RX	No Jumper mounted on CN1
50	GND	-	-
52	PC3	SmartCard_OFF	Remove R135

3.7 microSD connector CN8

Figure 14. microSD connector CN8 (front view)

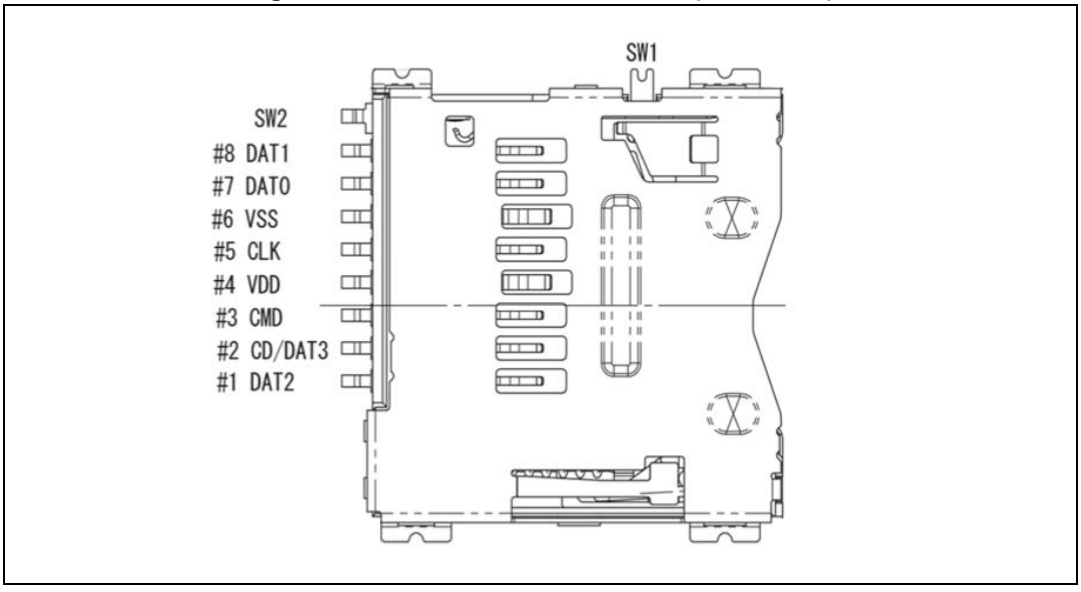


Table 24. microSD connector CN8

Pin number	Description
1	NC
2	SDcard_CS (PE12)
3	SDcard_DIN (PE15)
4	+3V3
5	SDcard_CLK (PE13)
6	Vss/GND
7	SDcard_DOUT (PE14)
8	NC
10	SDcard_detect (PE11)

3.8 RS-232 and RS-485 connector CN9

Figure 15. RS-232 and RS-485 connector CN9 (front view)

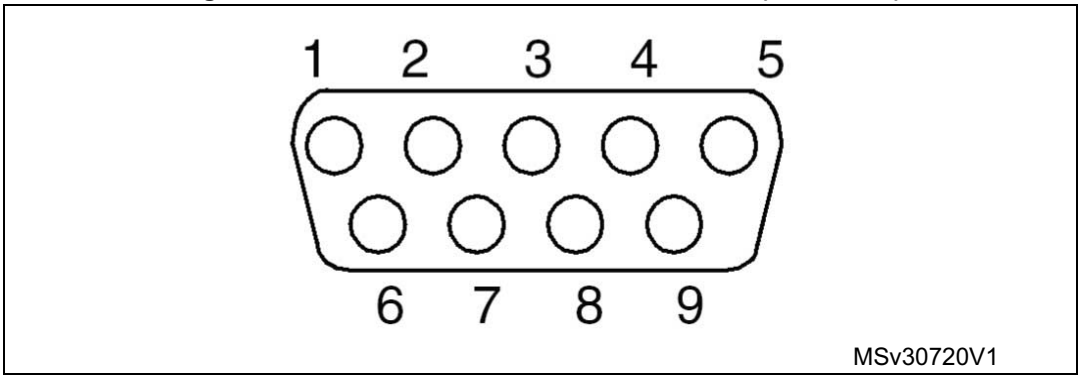


Table 25. RS-232 and RS-485 connector CN9

Pin number	Description
1	NC
2	RS232_RX (PA10)
3	RS232_TX (PA9)
4	RS485_A
5	GND
6	Bootloader_BOOT0
7	RS232_RTS (PA12)
8	RS232_CTS (PA11)/Bootloader_RESET
9	RS485_B

3.9 High density SWD connector CN10

Figure 16. High density SWD debugging connector CN10 (top view)

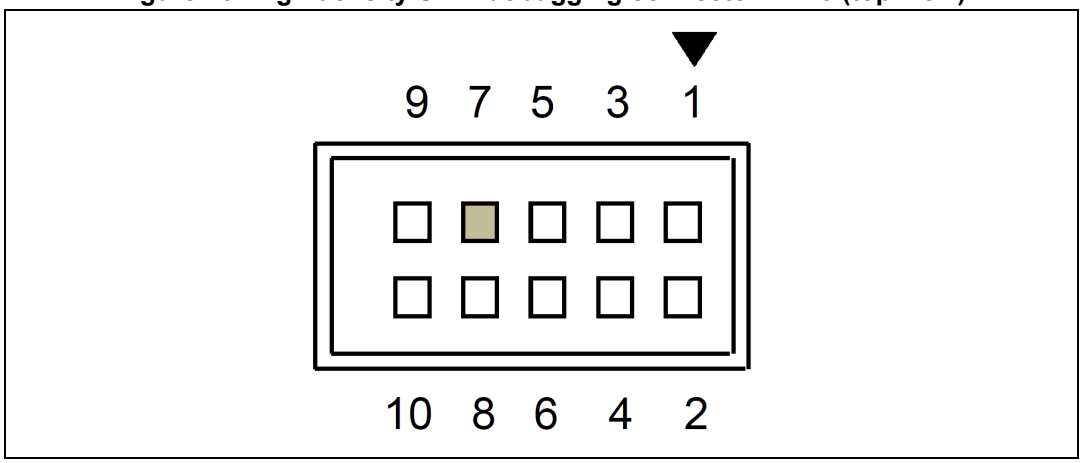


Table 26. High density SWD connector CN10

Pin number	Description
1	VDDIO2
3	GND
5	GND
7	KEY
9	GND
2	SWDAT (PA13)
4	SWCLK (PA14)
6	NC
8	NC
10	RESET#

3.10 Standard SWD connector CN11

Figure 17. Standard SWD debugging connector CN11 (top view)

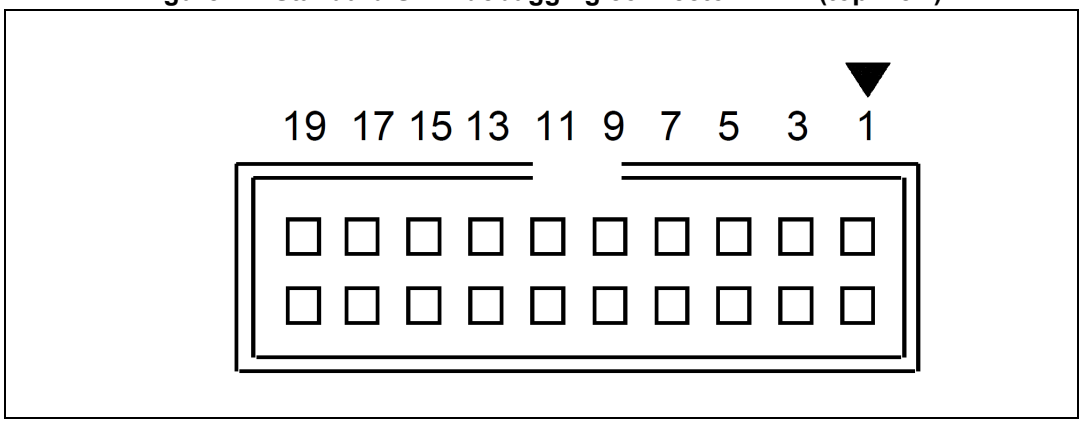


Table 27. Standard SWD debugging connector CN11

Pin number	Description
1	VDDIO2
3	NC
5	NC
7	SWDAT (PA13)
9	SWCLK (PA14)
11	10K pull-down
13	NC
15	RESET#
17	10K pull-down
19	10K pull-down
2	VDDIO2
4	GND
6	GND
8	GND
10	GND
12	GND
14	GND
16	GND
18	GND
20	GND

3.11 ST-LINK/V2-1 USB Type-B connector CN12

The USB connector CN12 is used to connect embedded ST-LINK/V2-1 to PC for debugging of board.

Figure 18. USB Type-B connector CN12 (front view)

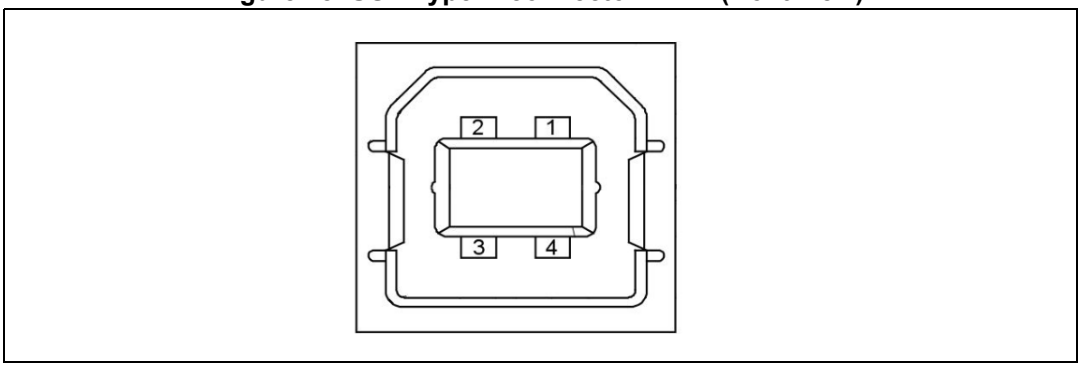


Table 28. USB Type-B connector CN12

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

3.12 Audio jack CN13

A 3.5 mm stereo audio jack CN13 connected to audio DAC and ADC is available on the STM32091C-EVAL board.

3.13 FT LCD connector CN14

A TFT color LCD board is mounted on CN14. Refer to *Section 2.20* for details.

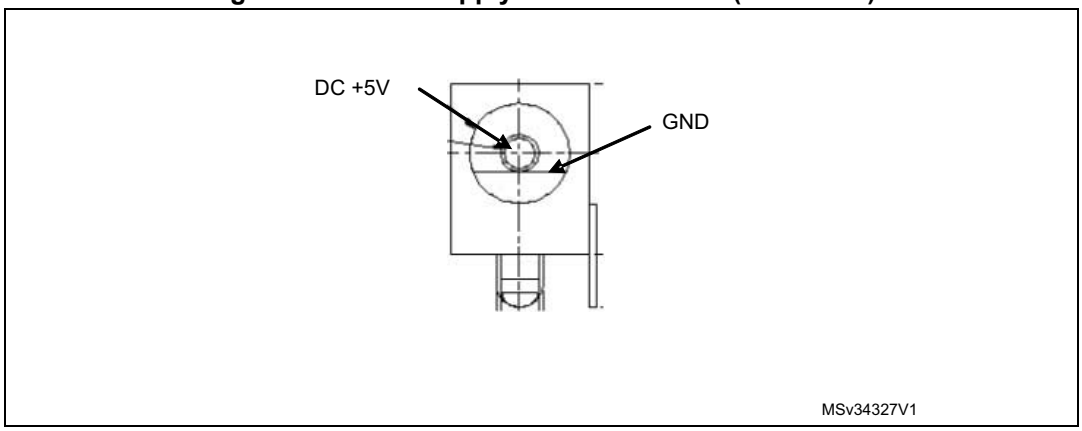
3.14 ST-LINK/V2-1 programming connector CN15

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

3.15 Power connector CN16

The STM32091C-EVAL evaluation board can be powered from a DC 5 V power supply via the external power supply jack (CN16) shown in *Figure 16*. The central pin of CN16 must be positive.

Figure 19. Power supply connector CN16 (front view)



3.16 Analog input-output connector CN18

Figure 20. Analog input-output connector CN18

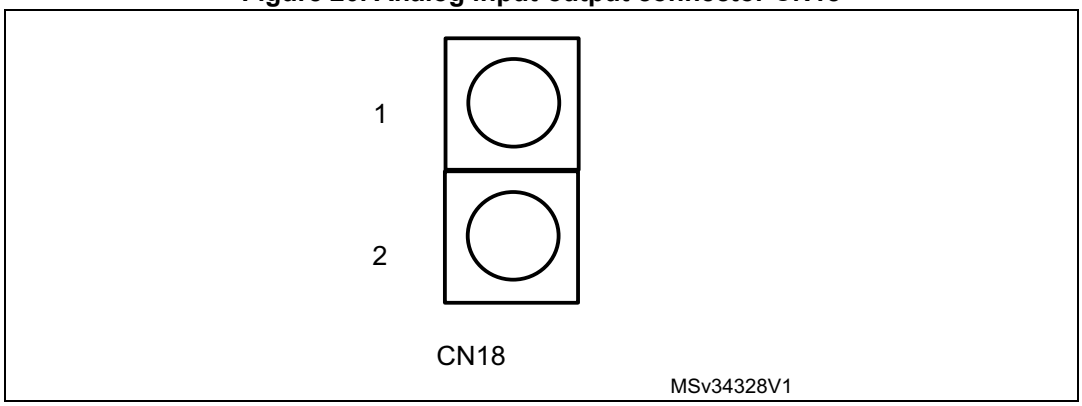


Table 29. Analog input-output connector CN18

Pin number	Description
1	Analog input-output PC0
2	GND

3.17 Smartcard connector CN19

Figure 21. Smartcard connector CN19 (front view)

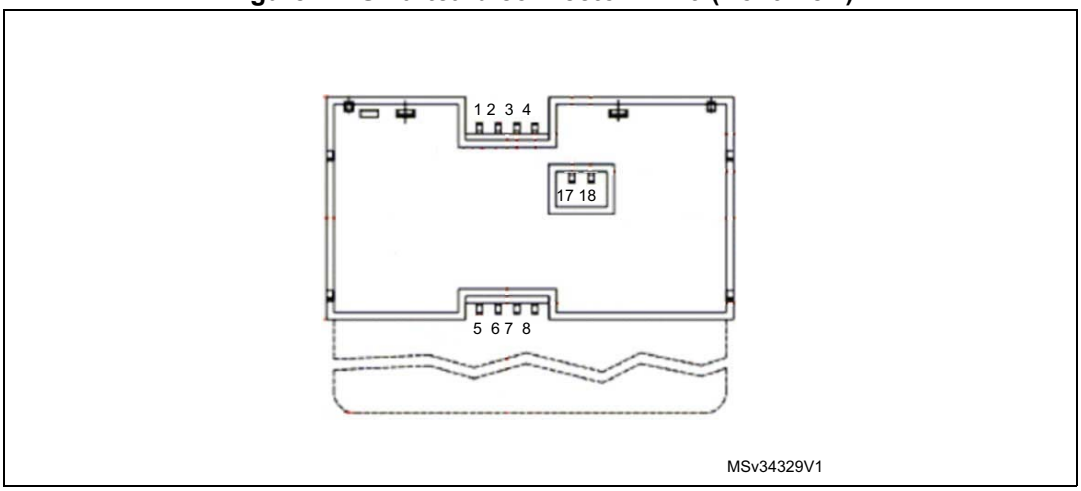


Table 30. Smartcard connector CN19

Pin number	Description
1	VCC
2	RST
3	CLK
4	NC
17	Detection pin of card presence
5	GND
6	NC
7	I/O
8	NC
18	Detection pin of card presence

Appendix A STM32091C-EVAL IO assignment

Table 31. I/O assignment

Pin No.	Pin name	STM32091C-EVAL IO assignment
1	PE2	JOY_LEFT
2	PE3	JOY_RIGHT
3	PE4	JOY_UP
4	PE5	JOY_DOWN
5	PE6	-
6	VBAT	VBAT
7	PC13	TAMPER_KEY
8	PC14-OSC32_IN	OSC32_IN
9	PC15-OSC32_OUT	OSC32_OUT
10	PF9	8x_USART6_TX
11	PF10	8x_USART6_RX
12	PF0-OSC_IN	OSC_IN
13	PF1-OSC_OUT	OSC_OUT
14	NRST	NRST
15	PC0	Potentiometer
16	PC1	Smartcard_1V8
17	PC2	Smartcard_3/5V
18	PC3	Smartcard_OFF
19	PF2	8x_USART7_TX
20	VSSA	VSSA
21	VDDA	VDDA
22	PF3	8x_USART7_RX
23	PA0	JOY_SEL
24	PA1	LDR_IN A
25	PA2	Smartcard_IO
26	PA3	Smartcard_RST
27	VSS_3	-
28	VDD_3	-
29	PA4	Audio_OUT_LEFT
30	PA5	Aduio_OUT_RIGHT
31	PA6	Audio_IN
32	PA7	Smartcard_CMDVCC

Table 31. I/O assignment (continued)

Pin No.	Pin name	STM32091C-EVAL IO assignment
33	PC4	-
34	PC5	-
35	PB0	-
36	PB1 or NPOR	-
37	PB2 or NPOR	-
38	PE7	LED3
39	PE8	LED4
40	PE9	SPI1_MOSI_DIR
41	PE10	LCD_CS_OD
42	PE11	SDcard_detect
43	PE12	MicroSD_CS_OD
44	PE13	LCD/SD_SPI1_SCK
45	PE14	LCD/SD_SPI1_MISO
46	PE15	LCD/SD_SPI1_MOSI
47	PB10	HDMI_CEC_OD
48	PB11	TS_Shield_CAP_G6_IO1
49	VSS_2	VSS
50	VDD_2	VDD
51	PB12	TS_Shield_CAP_G6_IO2
52	PB13	HDMI_Sink_I2C2_SCL
53	PB14	HDMI_Sink_I2C2_SDA
54	PB15	-
55	PD8	8x_USART3_TX
56	PD9	8x_USART3_RX
57	PD10	HDMI_HPD_Source
58	PD11	HDMI_HPD_Sink_OD
59	PD12	TS_CH1_G8_IO1
60	PD13	TS_CH2_G8_IO2
61	PD14	TS_CAP_G8_IO3
62	PD15	-
63	PC6	IR_IN
64	PC7	-
65	PC8	8x_USART8_TX
66	PC9	8x_USART8_RX
67	PA8	-

Table 31. I/O assignment (continued)

Pin No.	Pin name	STM32091C-EVAL IO assignment
68	PA9	RS-232/RS-485/irDA/8x_USART1_TX
69	PA10	RS-232/RS-485/irDA/8x_USART1_RX
70	PA11	RS232_USART1_CTS
71	PA12	RS232_USART1_RTS / RS485_DIR
72	PA13	SWDAT
73	PF6	-
74	VSS_4	VSS
75	VDDIO2	VDDIO2
76	PA14	SWCLK
77	PA15	-
78	PC10	8x_USART4_TX
79	PC11	8x_USART4_RX
80	PC12	ST-Link_USART5_TX
81	PD0	CAN_RX
82	PD1	CAN_TX
83	PD2	ST-Link_USART_RX
84	PD3	-
85	PD4	-
86	PD5	8x_USART2_TX
87	PD6	8x_USART2_RX
88	PD7	Smartcard_CK
89	PB3	8x_USART5_TX
90	PB4	8x_USART5_RX
91	PB5	TempSensor_INT I2C1_SMBA
92	PB6	TempSensor/HDMI/RF_I2C1_SCL
93	PB7	TempSensor/HDMI/RF_I2C1_SDA
94	PF11 + BOOT0	BOOT0
95	PB8	ACP_RST
96	PB9	IR_OUT
97	PE0	LED1
98	PE1	LED2
99	VSS_1	VSS
100	VDD_1	VDD

Appendix B Schematics

Figure 22. STM32091C-EVAL top view

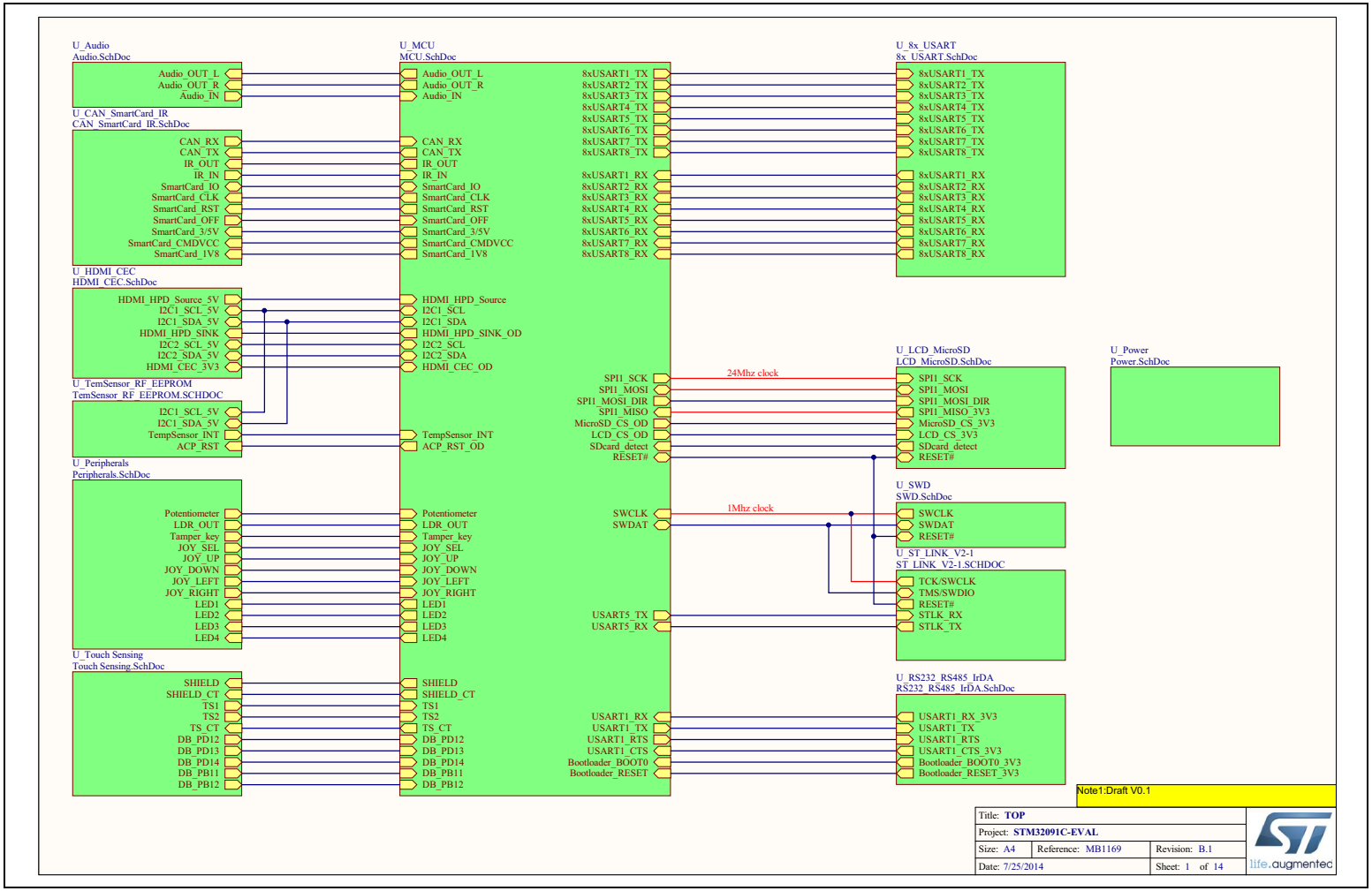


Figure 23. STM32091C-EVAL MCU

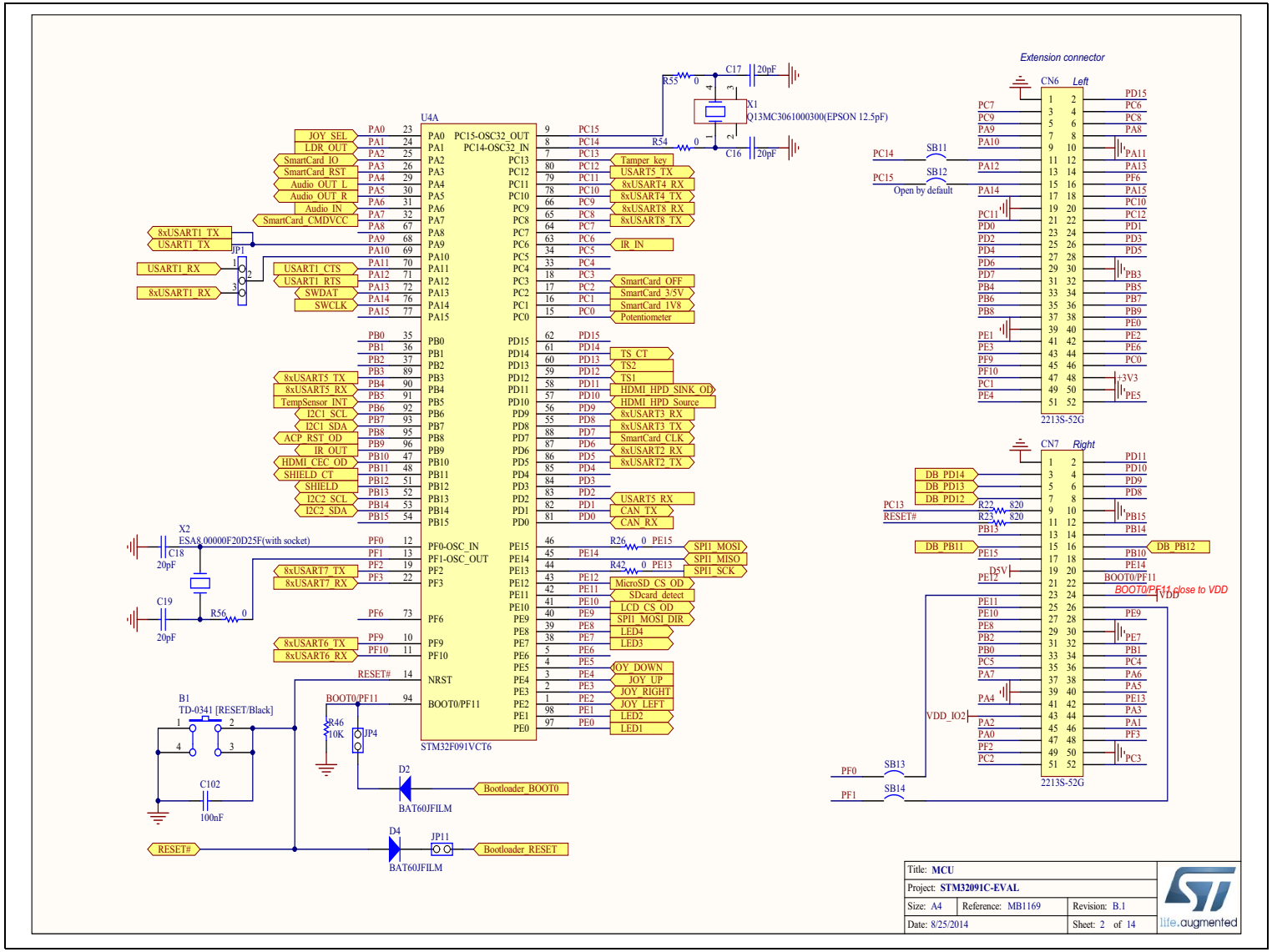


Figure 24. STM32091C-EVAL Power

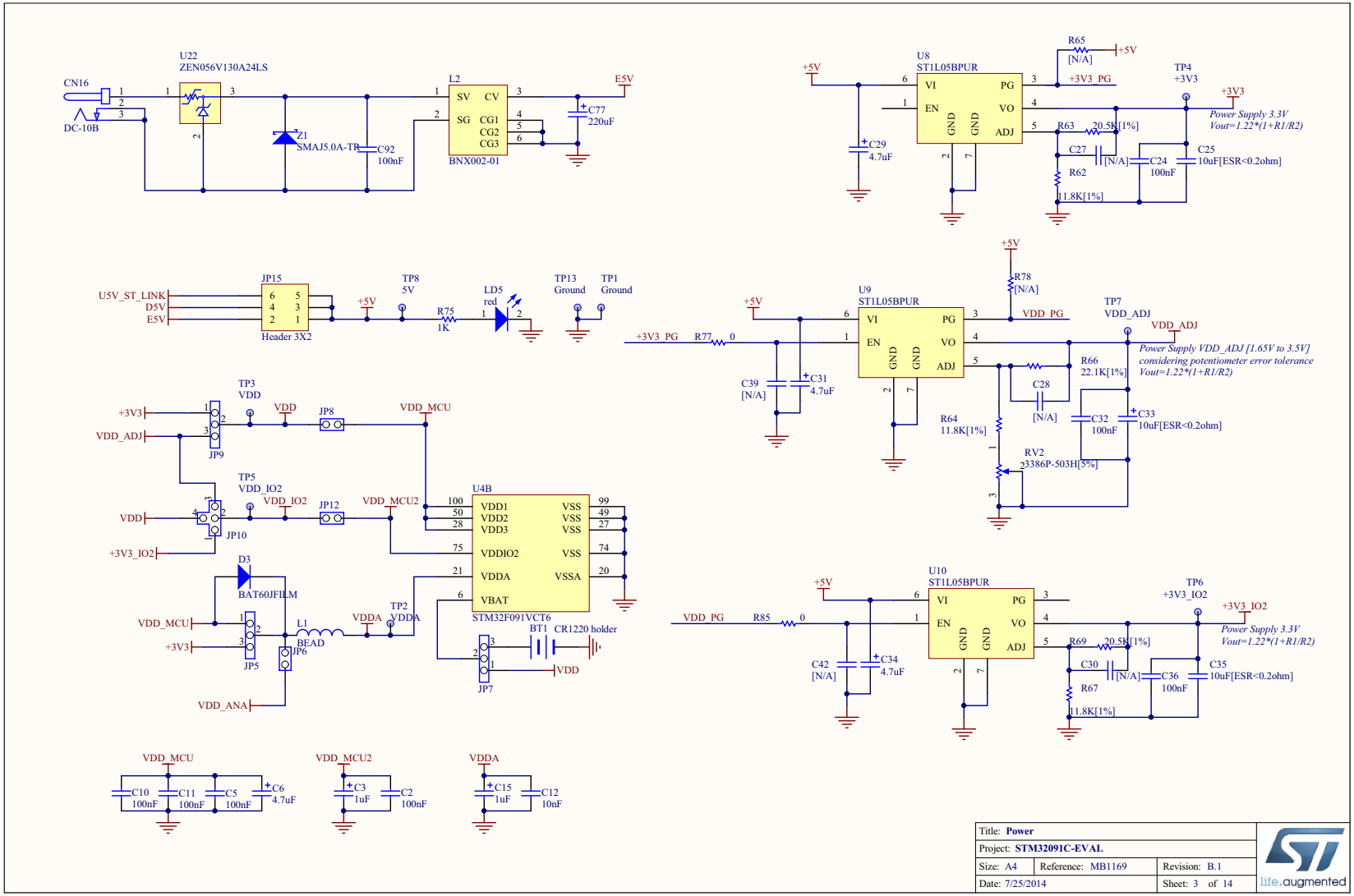


Figure 25. STM32091C-EVAL Audio

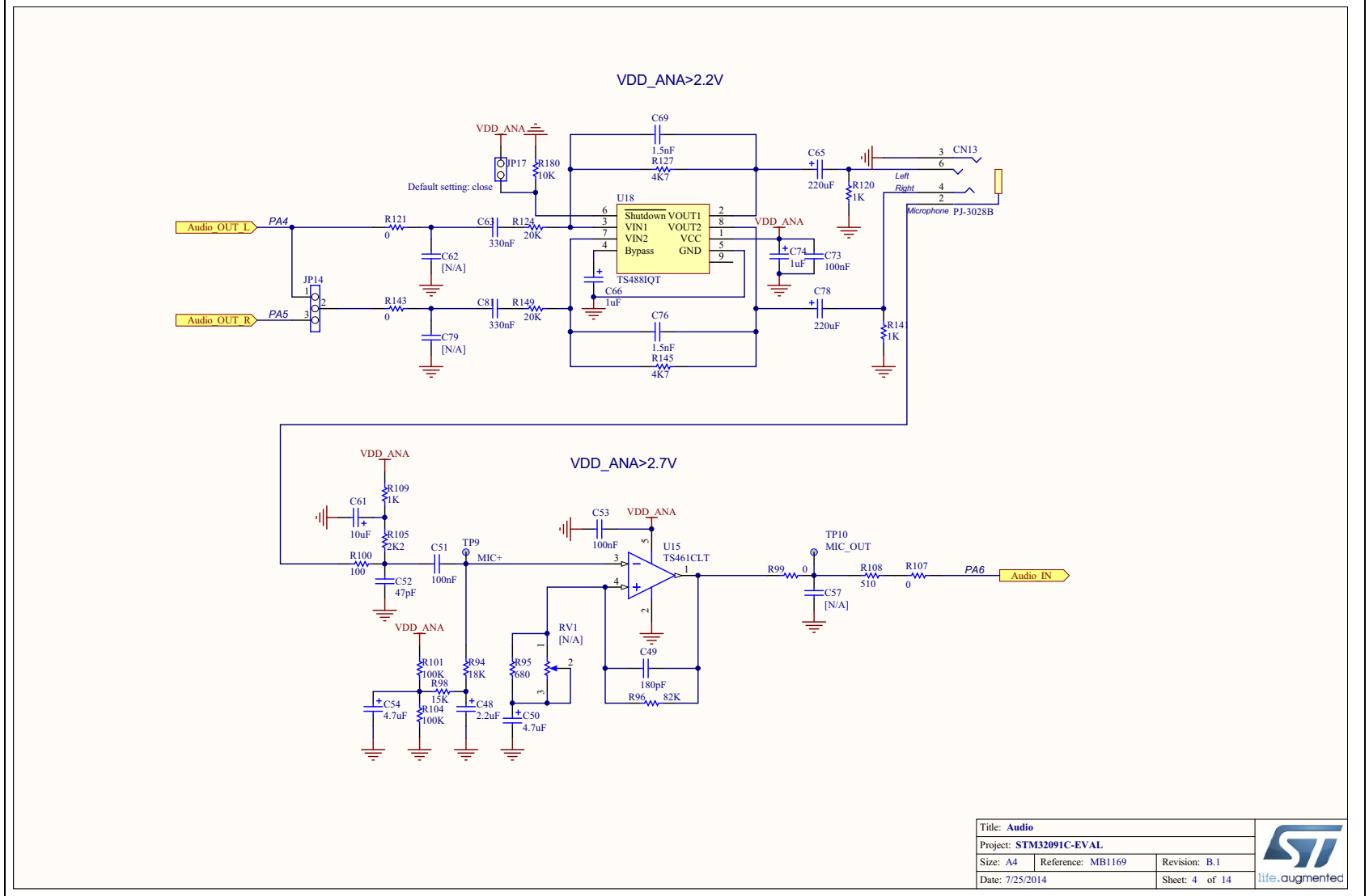


Figure 26. STM32091C-EVAL HDMI_CEC

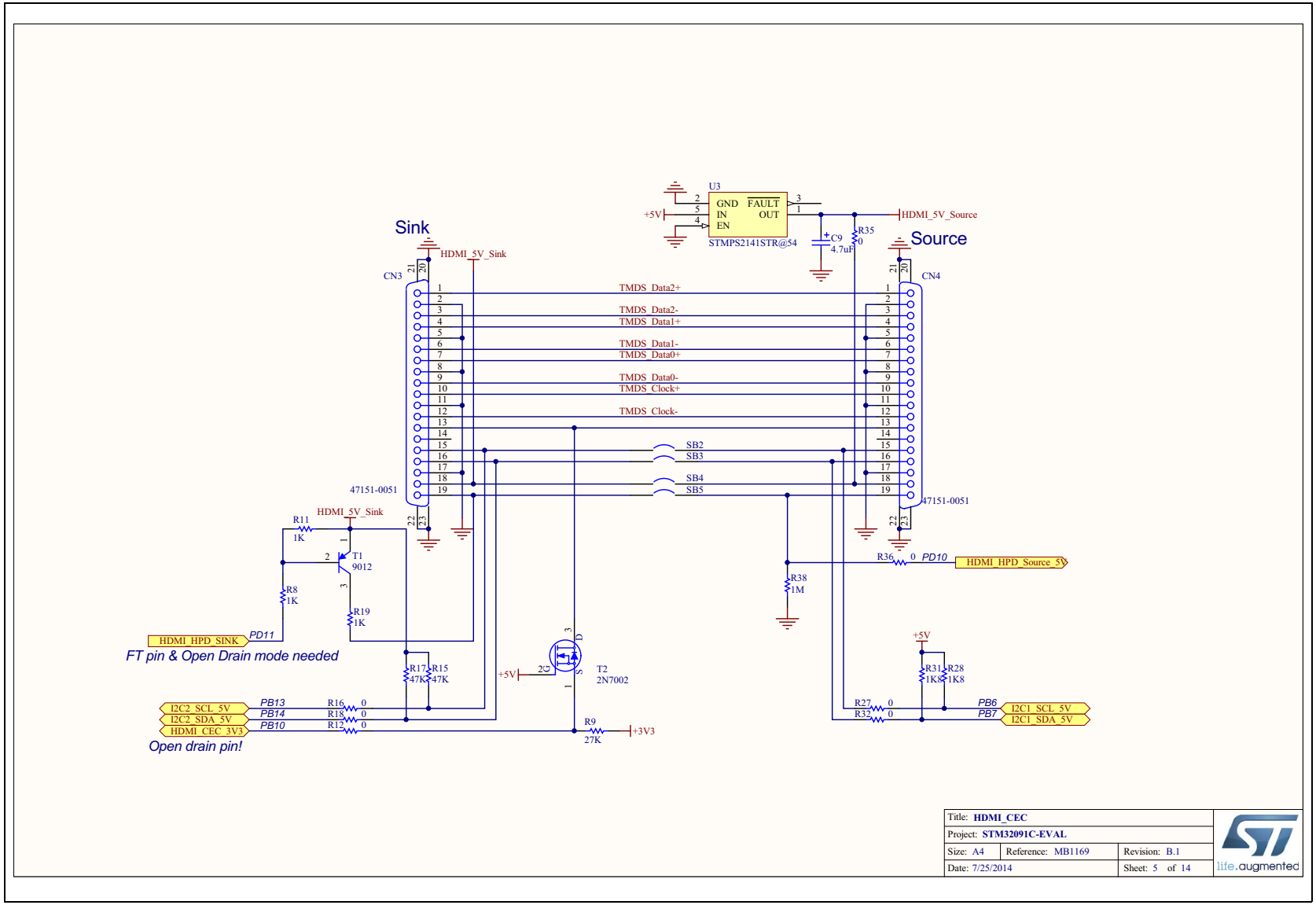


Figure 27. STM32091C-EVAL LCD and microSD card

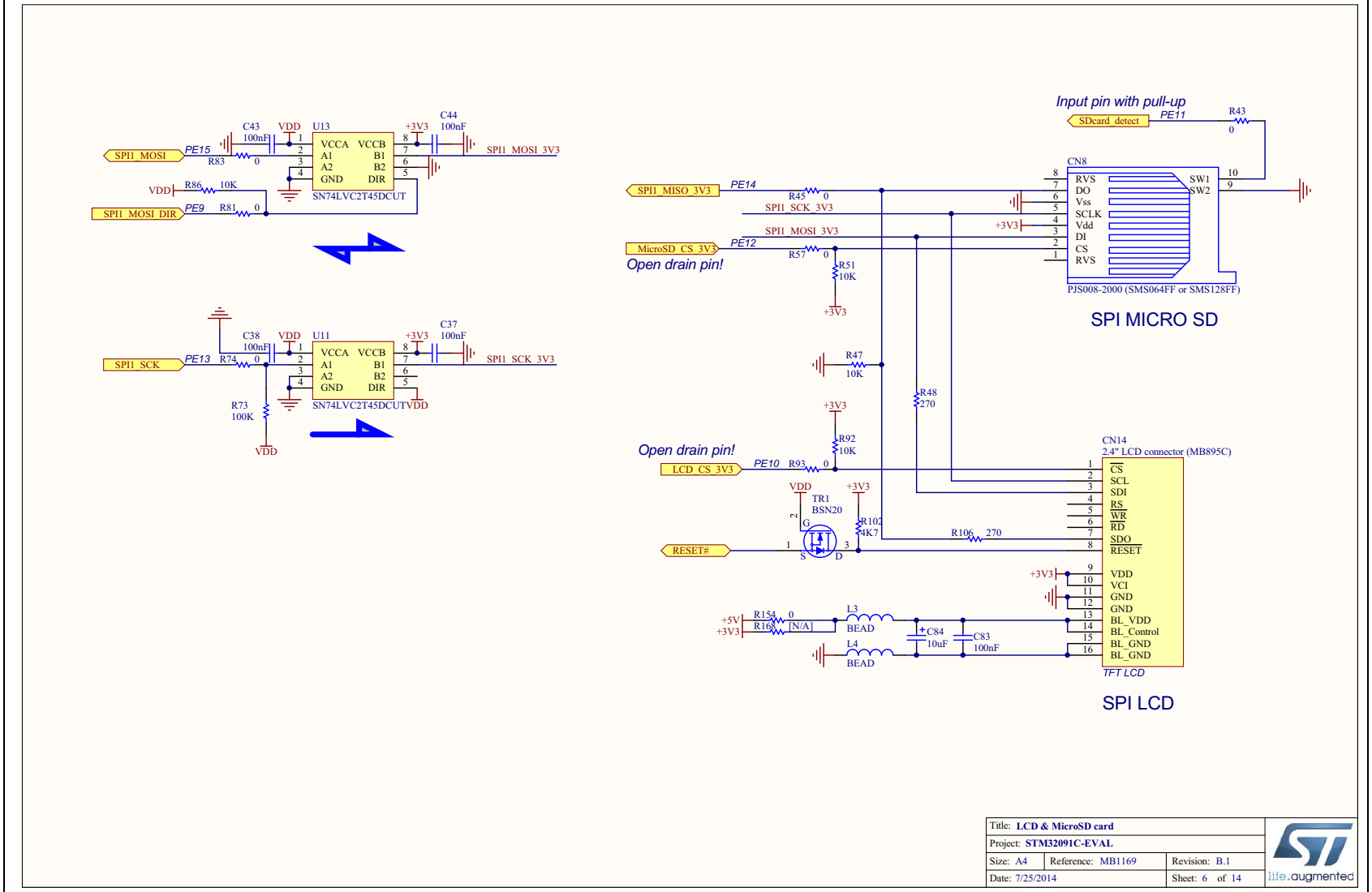


Figure 28. STM32091C-EVAL peripherals

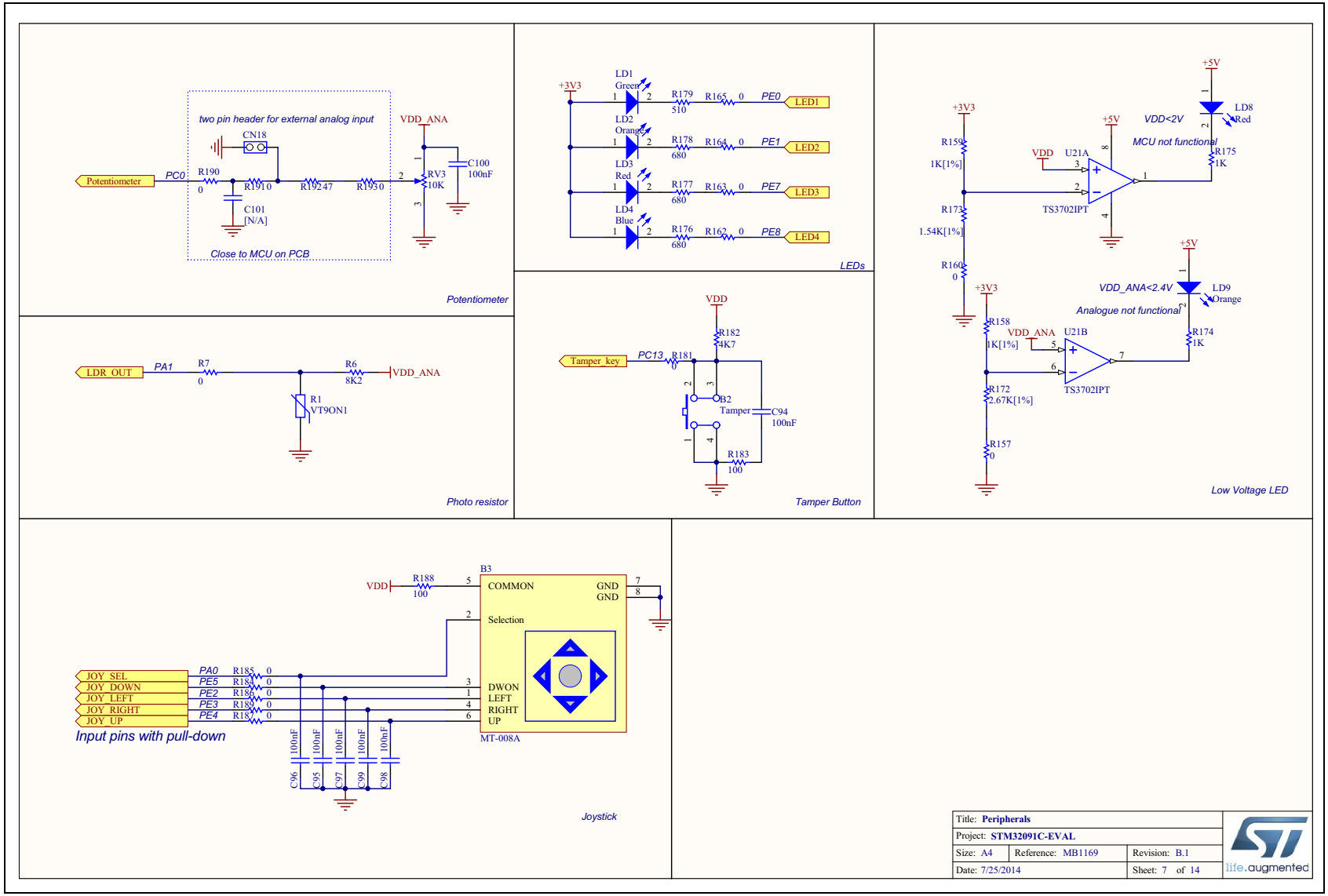


Figure 29. STM32091C-EVAL RS-232, RS-485 and IrDA

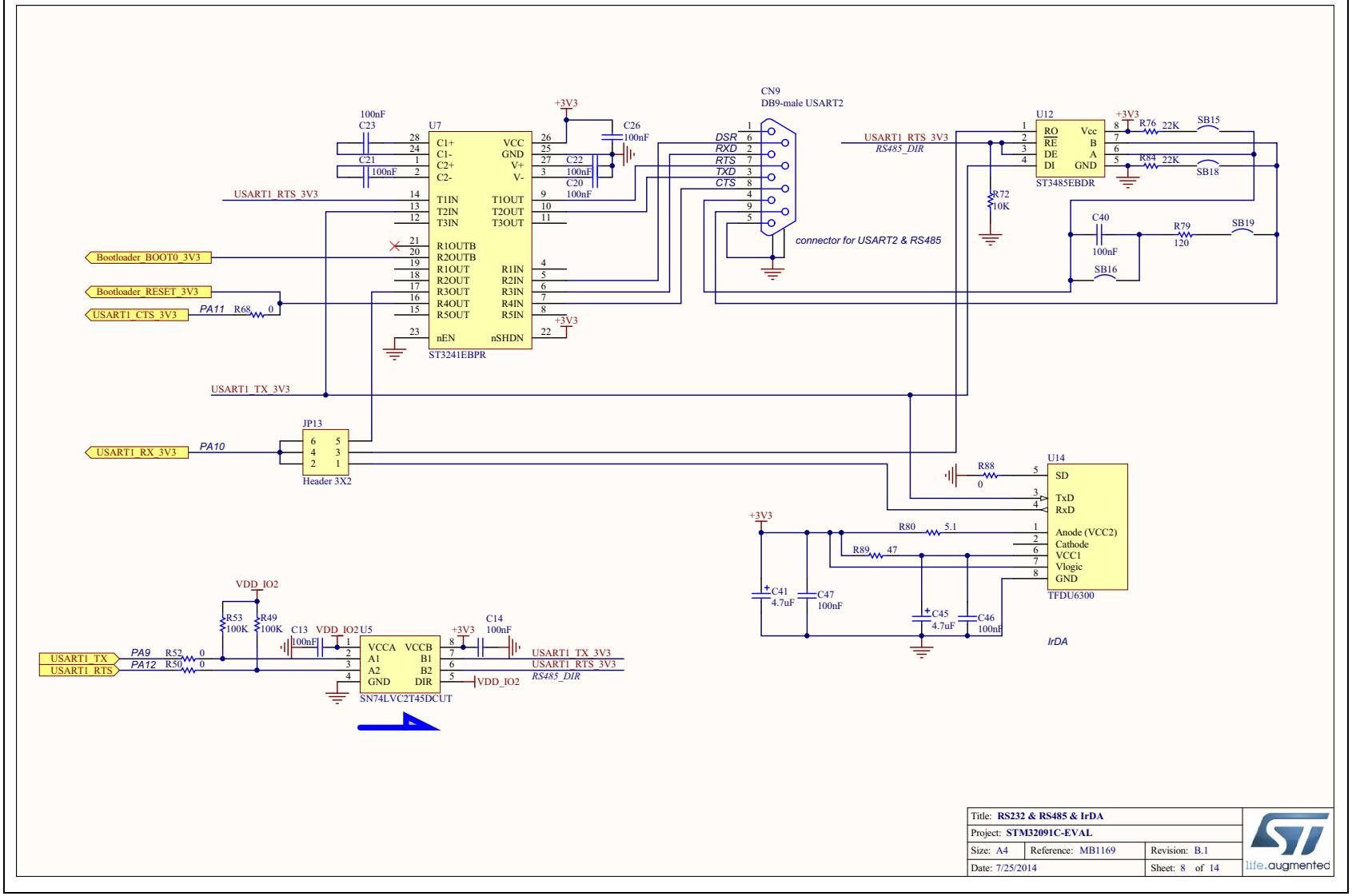


Figure 30. STM32091C-EVAL temperature sensor and RF-EEPROM

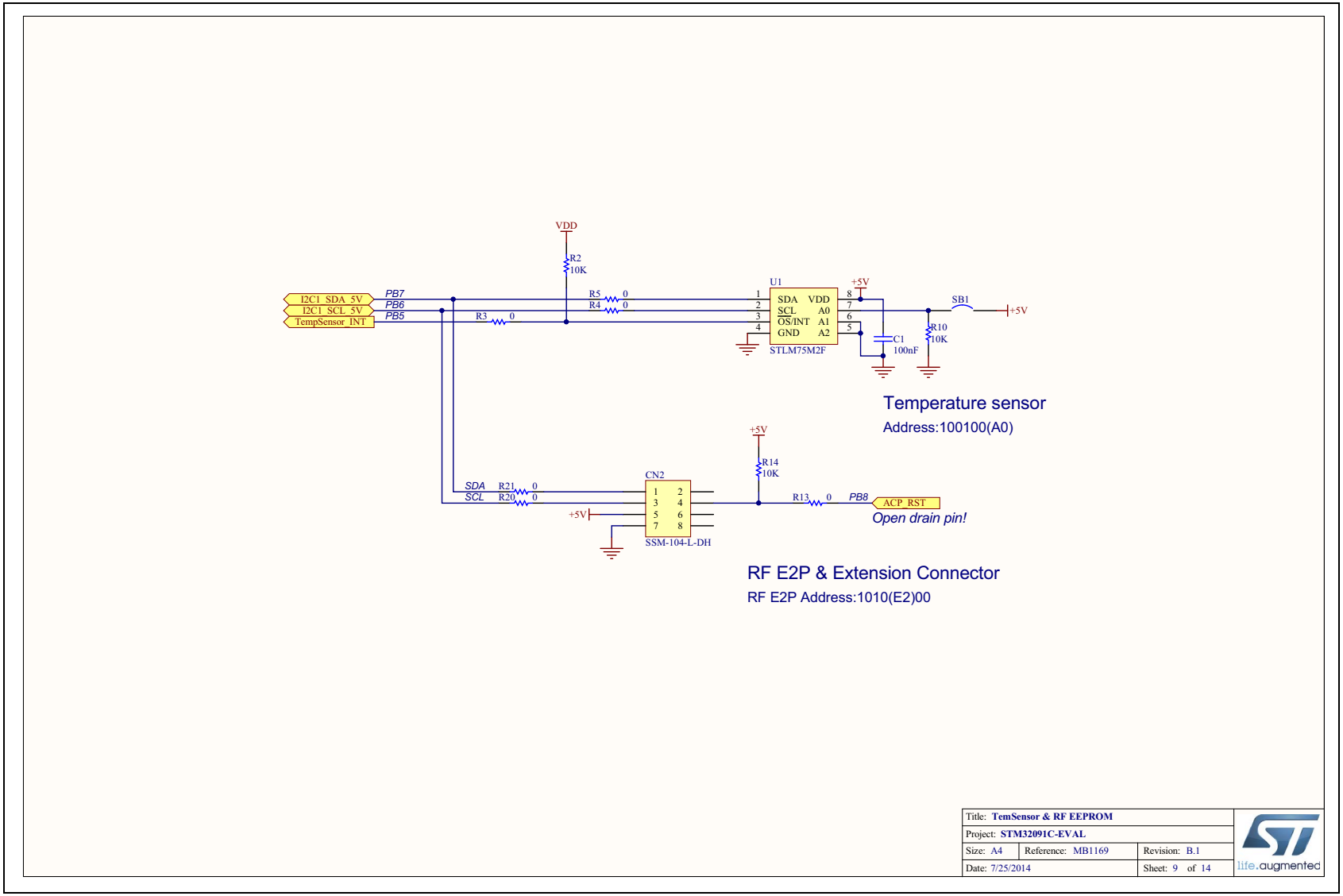


Figure 31. STM32091C-EVAL CAN, smartcard and IR

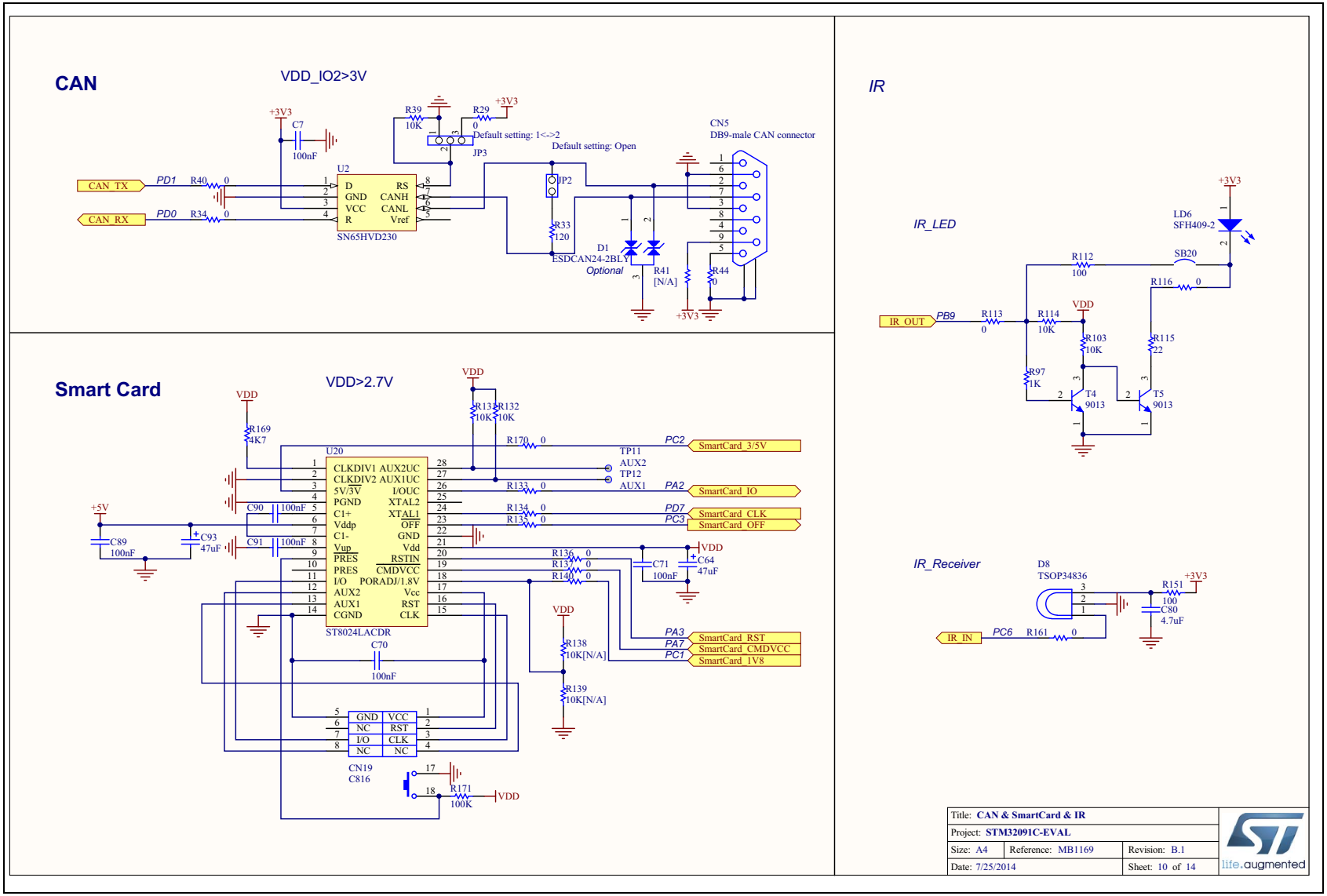


Figure 32. STM32091C-EVAL SWD

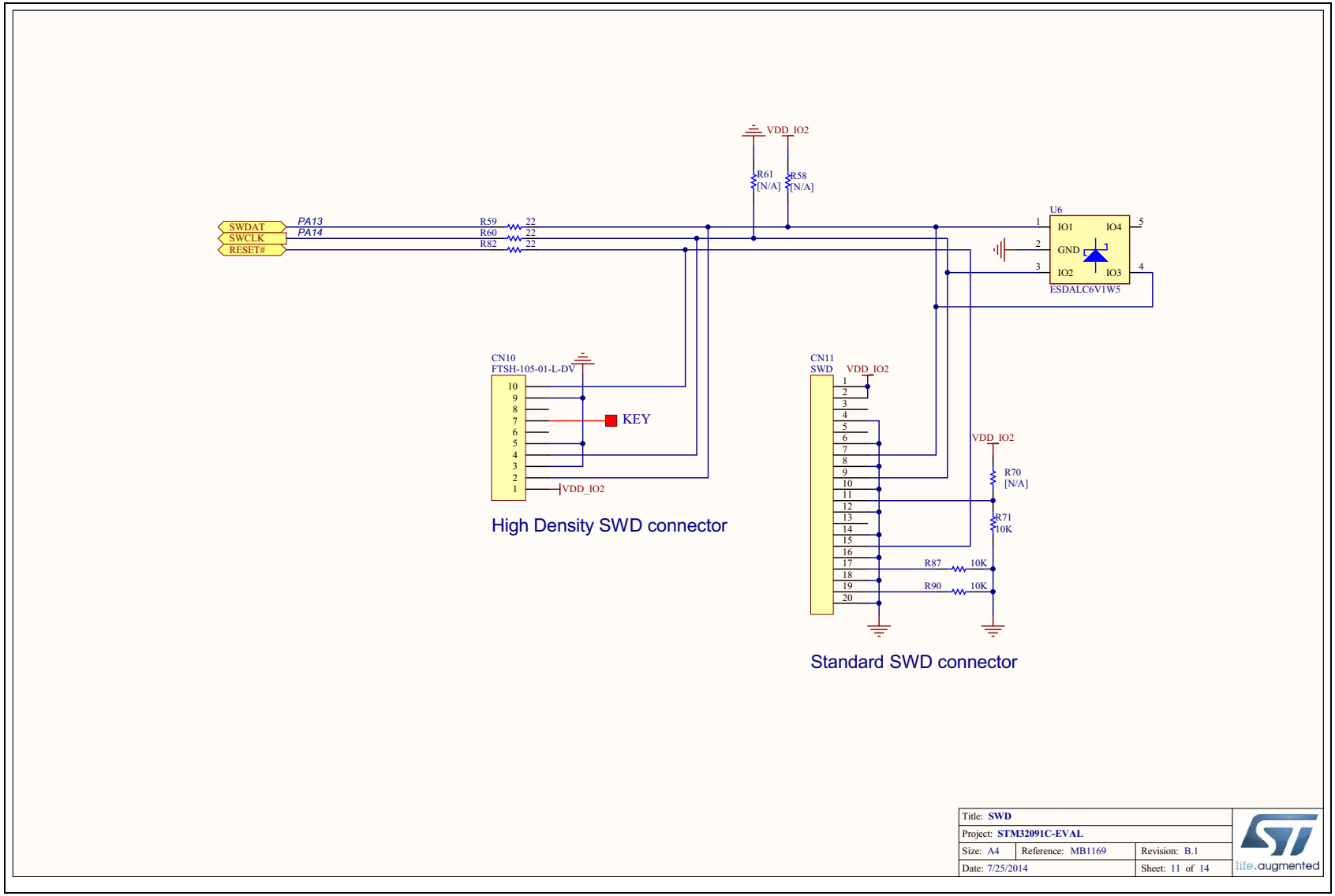


Figure 33. STM32091C-EVAL touch sensing

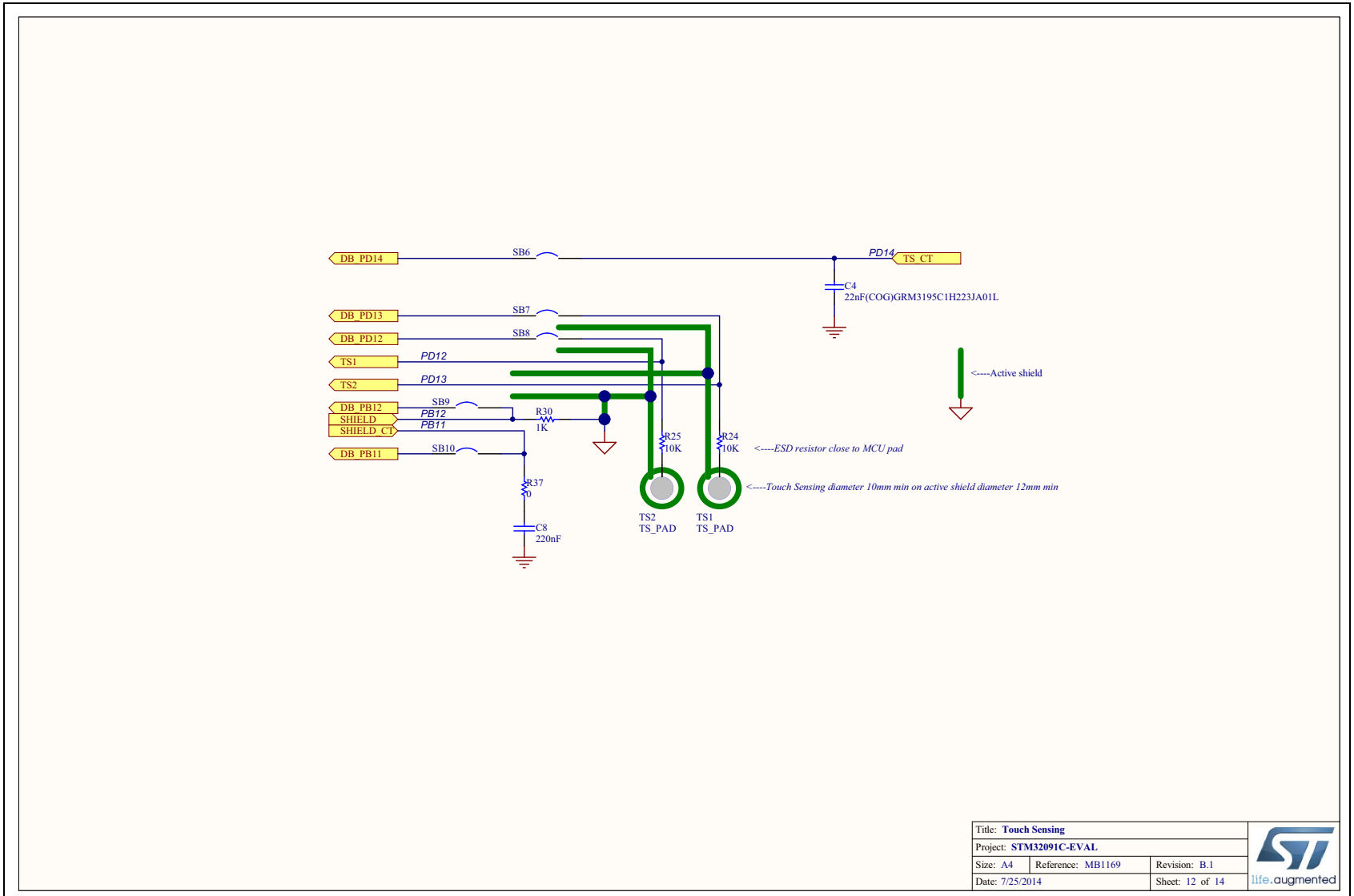


Figure 34. STM32091C-EVAL ST-LINK/V2-1 (SWD only)

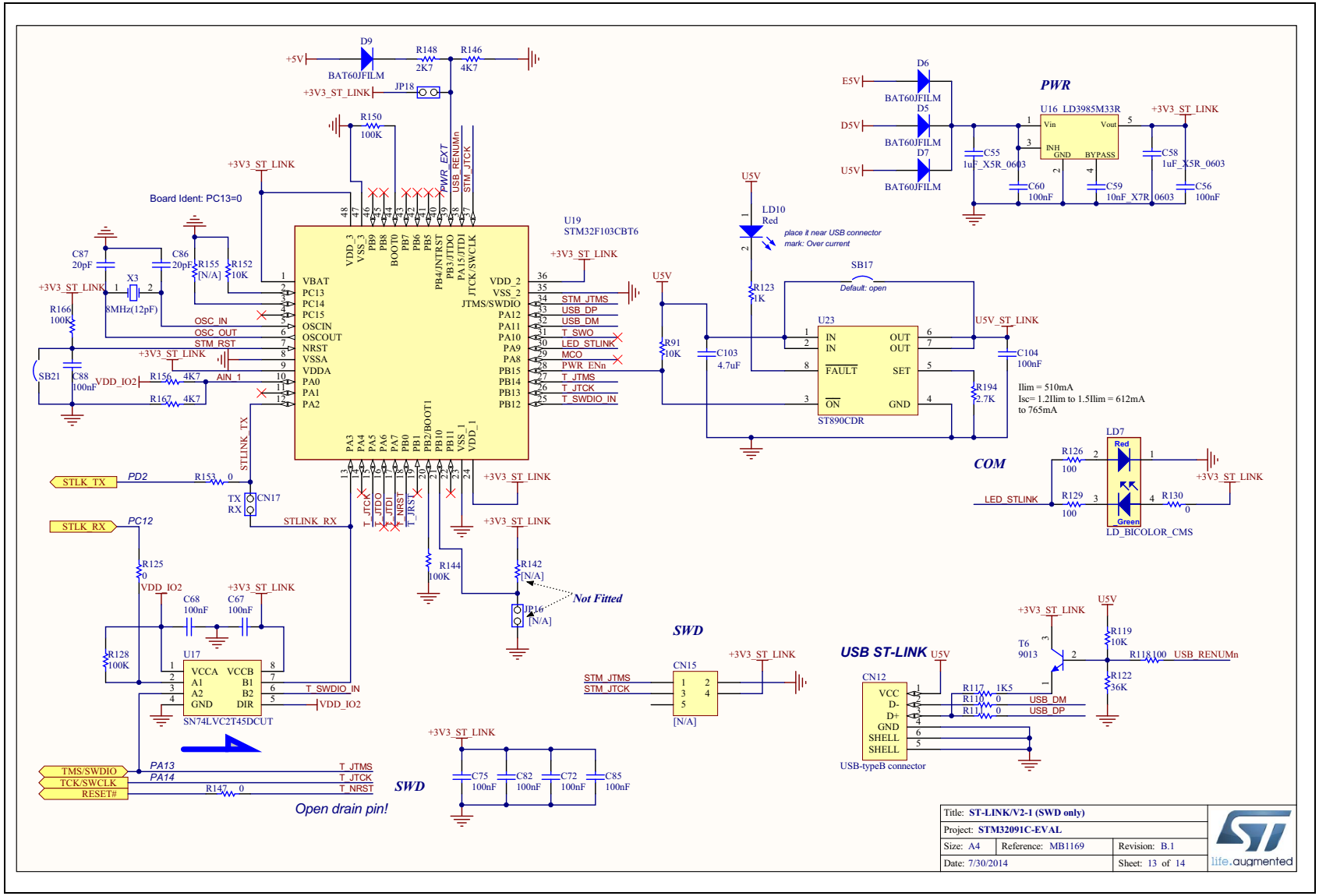


Figure 35. STM32091C-EVAL 8x_USART

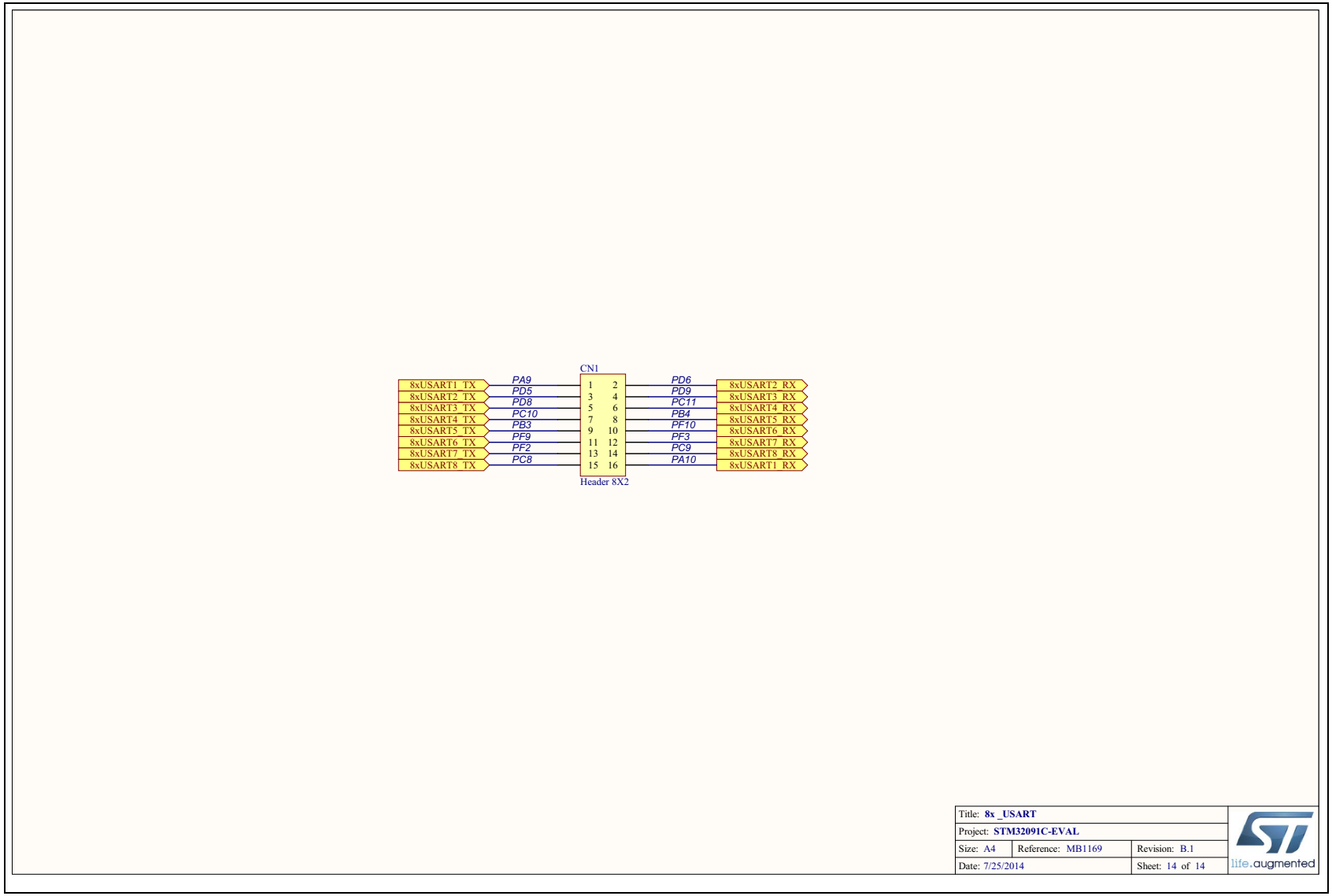
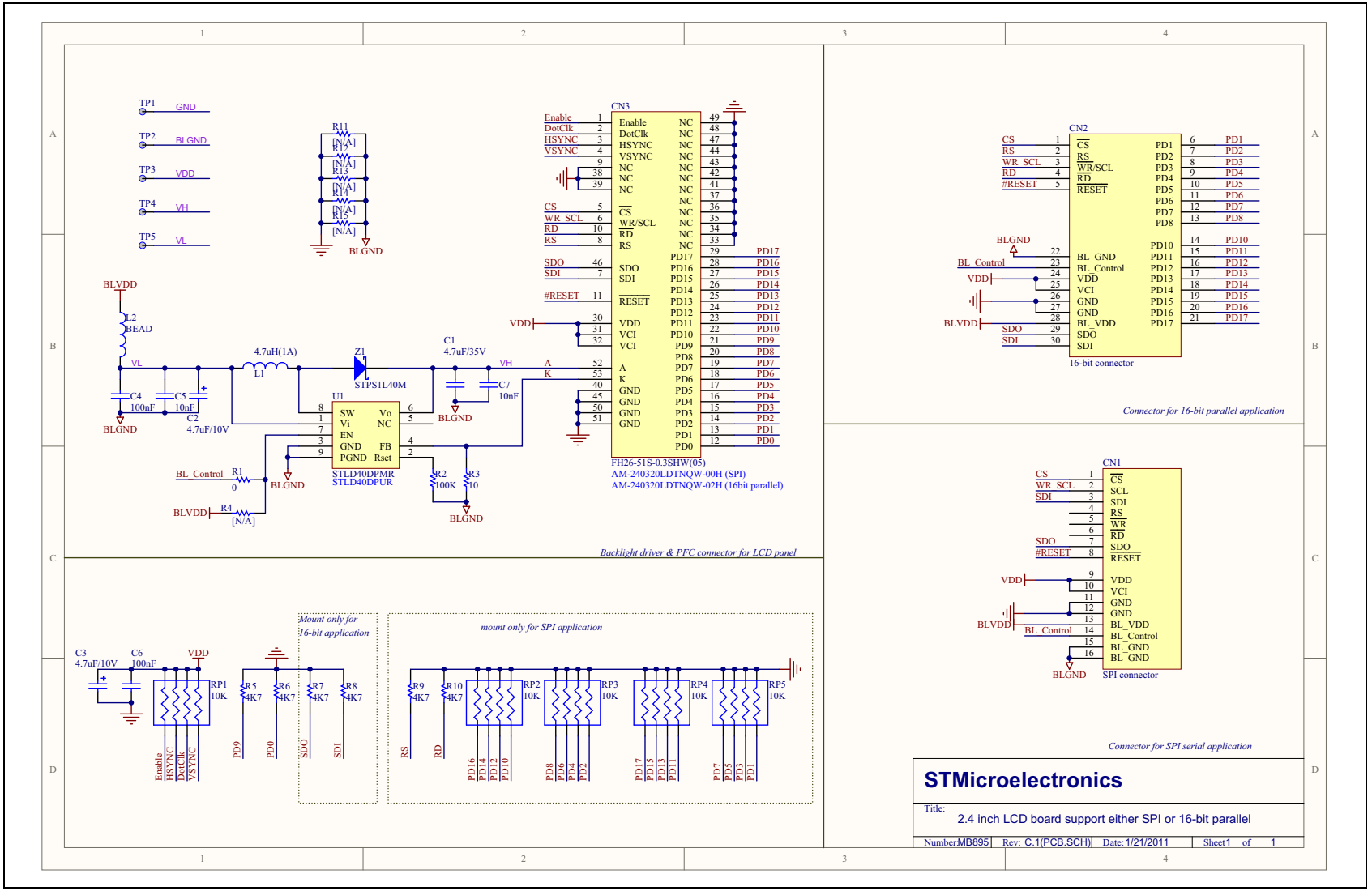


Figure 36. TFT LCD daughterboard MB895



Revision history

Table 32. Document revision history

Date	Revision	Changes
31-Oct-2014	1	Initial Version.
06-Feb-2015	2	Updated document title. Updated schematics.
20-Jun-2016	3	Updated *Table 31: I/O assignment* and *Table 24: microSD connector CN8*.