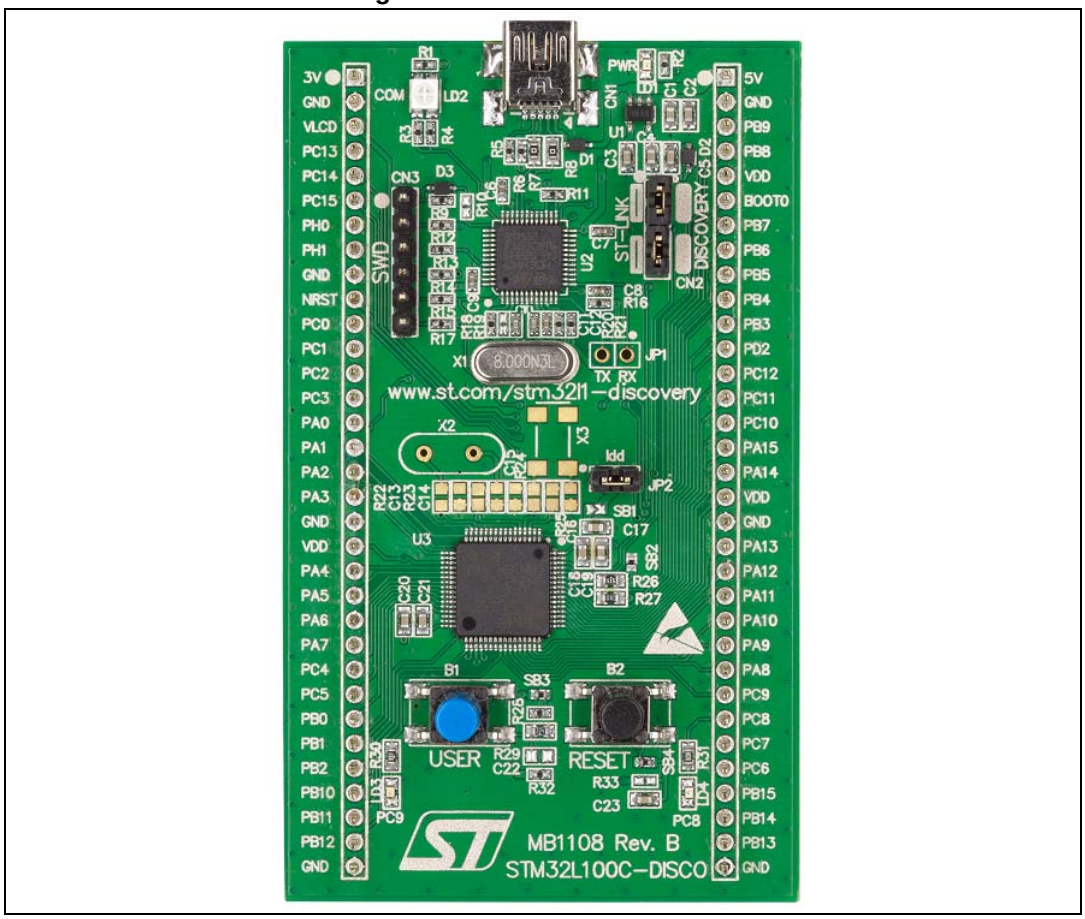
UM1656
User manual

32L100CDISCOVERY discovery kit for STM32L100 Value Line microcontrollers

Introduction

The 32L100CDISCOVERY helps you to discover the features of the STM32L100 Value Line 32-bit ARM® Cortex™-M3 microcontrollers and to develop your applications easily. It is based on STM32L100RCT6 and includes an ST-LINK/V2 embedded debug tool, LEDs, and push buttons.

Figure 1. 32L100CDISCOVERY



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1 Conventions

Table 1 provides the definition of some conventions used in the present document.

Table 1. ON/OFF conventions

Convention	Definition
Jumper JP1 ON	Jumper fitted
Jumper JP1 OFF	Jumper not fitted
Solder bridge SBx ON	SBx connections closed by solder
Solder bridge SBx OFF	SBx connections left open

2 Quick start

The 32L100CDISCOVERY is a low-cost and easy-to-use development kit to quickly evaluate and start development with an STM32L100 Value Line series.

Before installing and using the product, please accept the Evaluation Product License Agreement from *www.st.com/stm32l1-discovery*.

For more information on the 32L100CDISCOVERY and for demonstration software, visit *www.st.com/stm32l1-discovery*.

2.1 Getting started

Follow the sequence below to configure the 32L100CDISCOVERY board and launch the DISCOVER application:

1. Check jumper position on the board, JP2 on, CN2 on (Discovery selected).
2. Connect the 32L100CDISCOVERY board to a PC with a USB cable ‘type A to mini-B’ through USB connector CN1 to power the board. Red LED LD1 (PWR) and LD2 (COM) light up and green LED LD3 blinks.
3. Press user button B1 (bottom left corner of the board).
4. Observe how the green LED LD3 blinking changes according to USER button B1 clicks.
5. Each click on USER button B1 is confirmed by the blue LED LD4.
6. To study or modify the DISCOVER project related to this demo, visit *www.st.com/stm32l1-discovery* and follow the tutorial.
7. Discover the STM32L100 Value Line features, download and execute programs proposed in the list of projects.
8. Develop your own application using available examples.

2.2 System requirements

- Windows PC (XP, Vista, 7)
- USB type A to Mini-B USB cable

2.3 Development toolchain supporting the 32L100CDISCOVERY

- Altium®, TASKING™ VX-toolset
- ARM®, Atollic TrueSTUDIO®
- IAR™, EWARM (IAR Embedded Workbench®)
- Keil™, MDK-ARM™

2.4 Order code

To order the STM32L100 Value Line Discovery kit, use the order code STM32L100C-DISCO.

3 Features

The 32L100CDISCOVERY kit offers the following features:

- STM32L100RCT6 microcontroller featuring 256 KB Flash, 16 KB RAM in an LQFP64 package
- On-board ST-LINK/V2 with selection mode switch to use the kit as a standalone ST-LINK/V2 (with SWD connector for programming and debugging)
- Board power supply: through USB bus or from an external 5 V supply voltage
- External application power supply: 3 V and 5 V
- Four LEDs:
  - LD1 (red) for 3.3 V power on
  - LD2 (red/green) for USB communication
  - LD3 (green) for PC9 output
  - LD4 (blue) for PC8 output
- Two push buttons (user and reset)
- Extension header for LQFP64 I/Os for quick connection to prototyping board and easy probing.
- An additional board is provided with the kit which can be connected to the extension connector for even easier prototyping and probing.
- A large number of free ready-to-run application firmware examples are available on *www.st.com/stm32l1-discovery* to support quick evaluation and development.

4 Hardware and layout

The 32L100CDISCOVERY is designed around the STM32L100RCT6 microcontroller in a 64-pin LQFP package.

Figure 2 illustrates the connections between the STM32L100RCT6 and its peripherals (ST-LINK/V2, push button, LEDs and connectors).

Figure 3 and *Figure 4* help you to locate these features on the 32L100CDISCOVERY.

Figure 2. Hardware block diagram

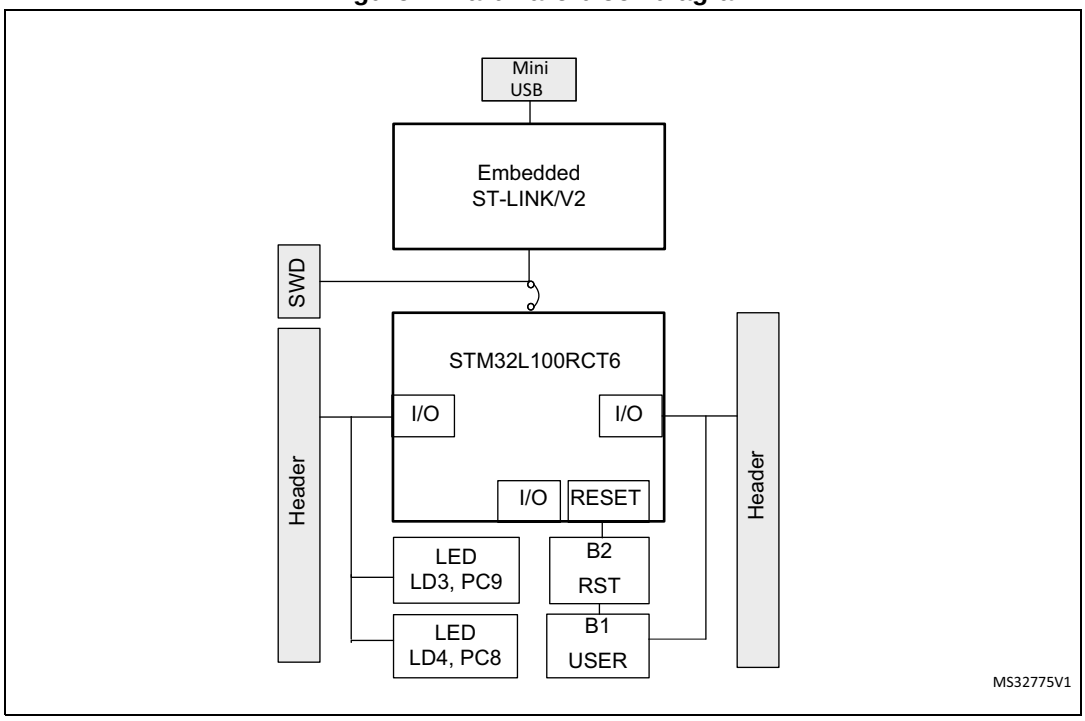
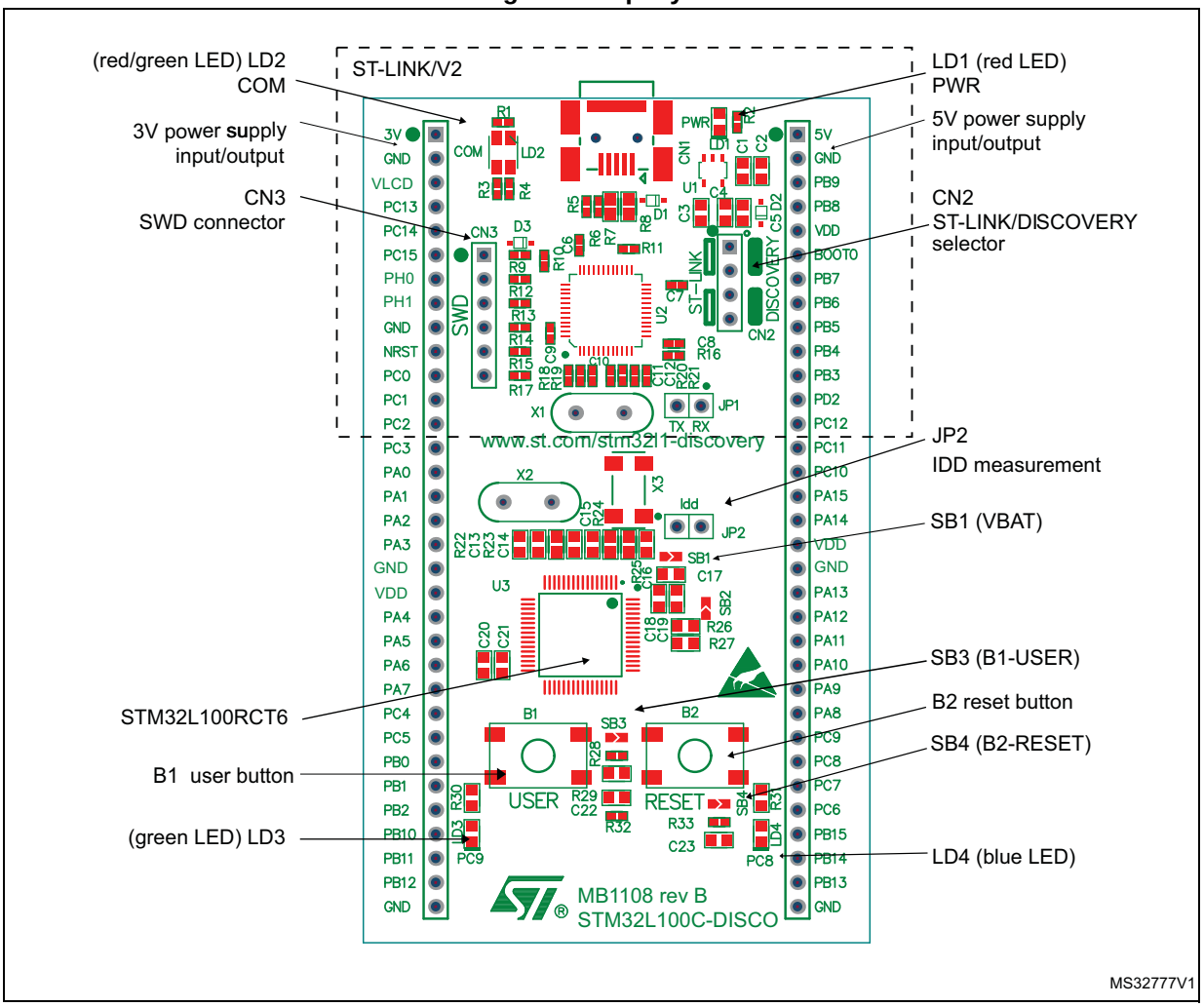
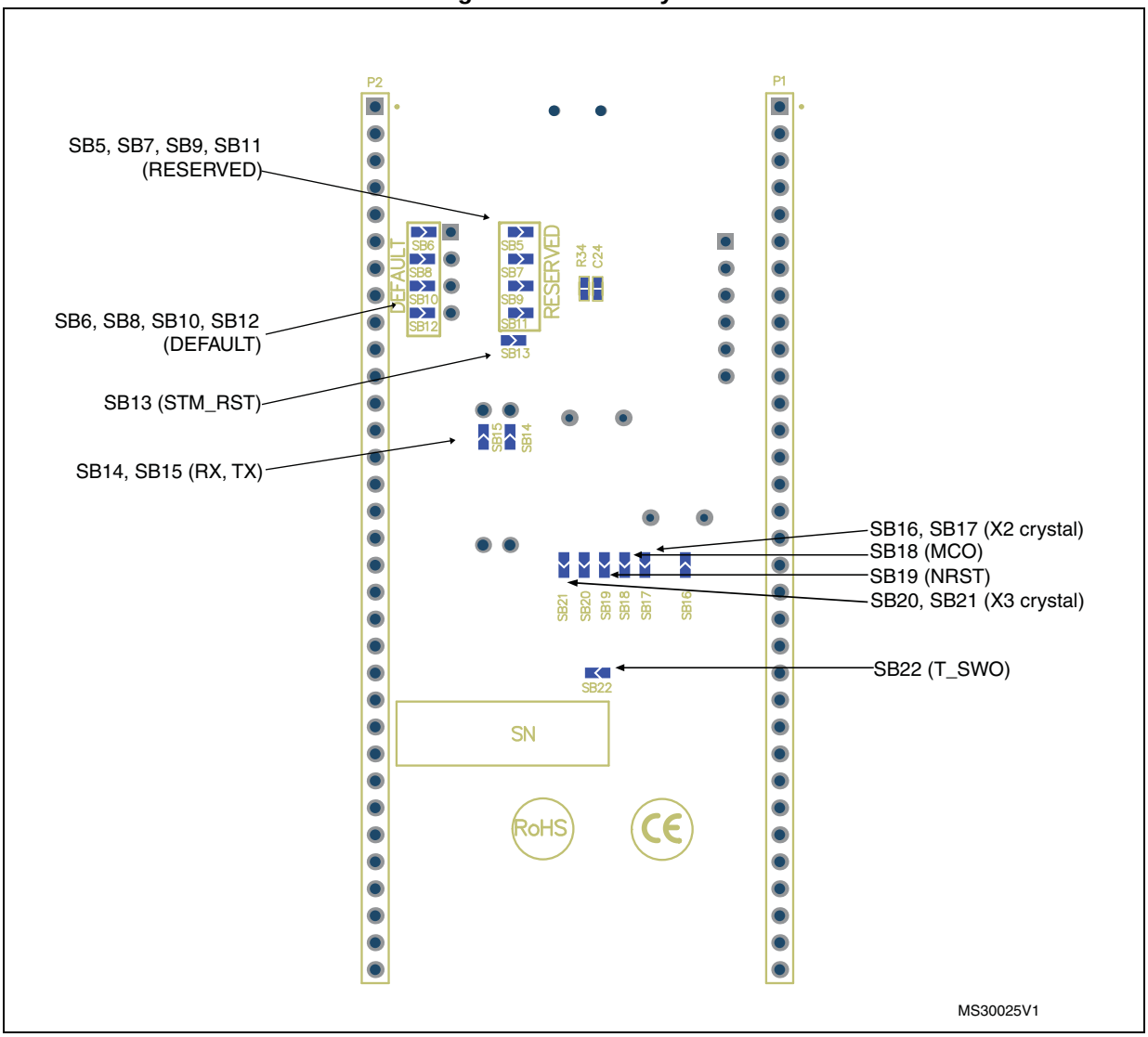


Figure 3. Top layout



1. Pin 1 of CN2, CN3, P1 and P2 connectors are identified by a square.

Figure 4. Bottom layout



4.1 STM32L100RCT6 microcontroller

The Value Line STM32L100RCT6 incorporates the connectivity power of the universal serial bus (USB) with the high-performance ARM Cortex™-M3 32-bit RISC core operating at a 32 MHz frequency, a memory protection unit (MPU), high-speed embedded memories (256 Kbytes of Flash memory and 16 Kbytes of RAM) and an extensive range of enhanced I/Os and peripherals connected to two APB buses.

The STM32L100RCT6 device offers one 12-bit ADC, two DACs, two ultra-low-power comparators, six general-purpose 16-bit timers and two basic timers, which can be used as time bases.

Moreover, the STM32L100RCT6 device contains standard and advanced communication interfaces: two I2Cs, three SPIs, two I2S, three USARTs and a USB.

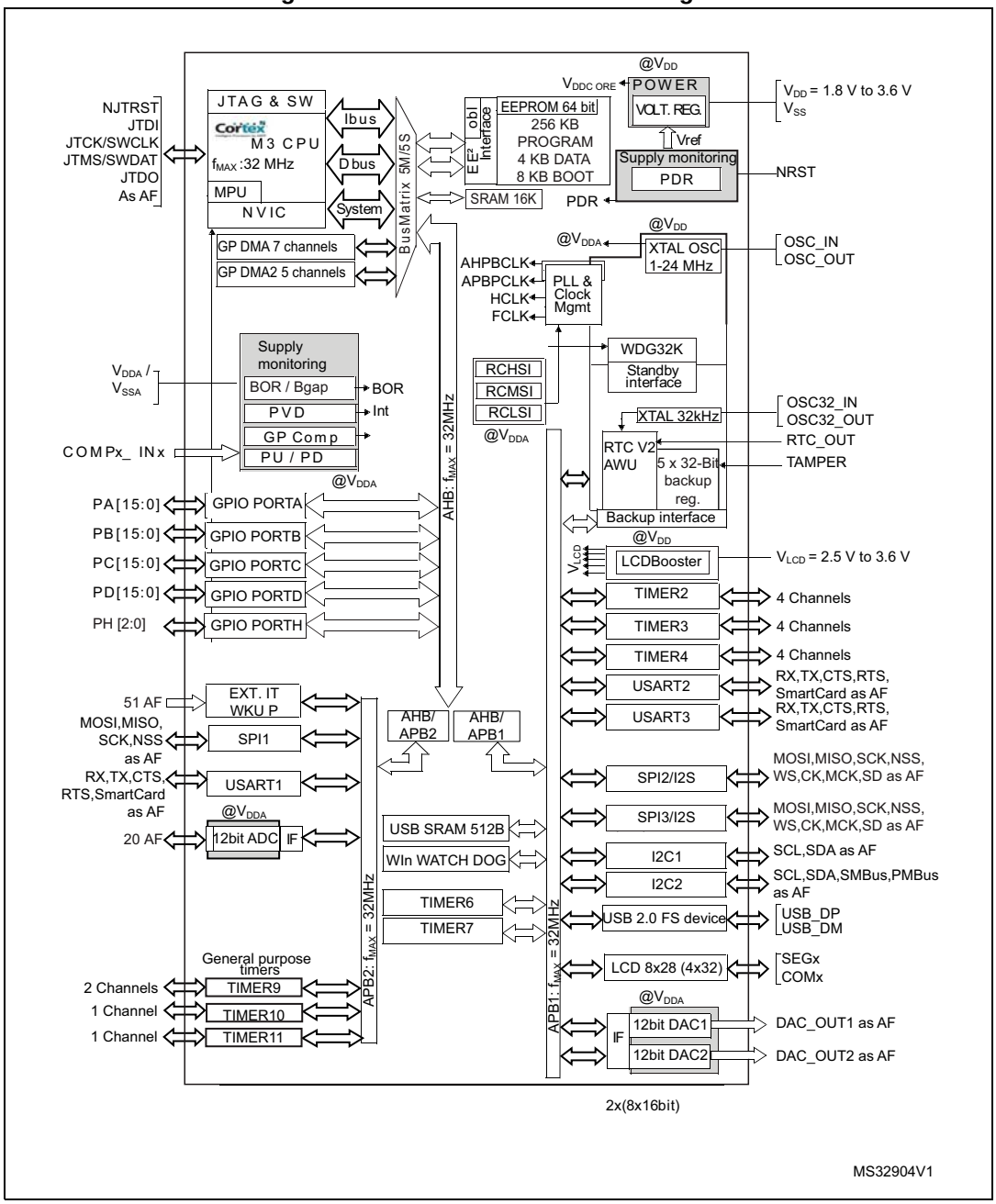
It also includes a real-time clock and a set of backup registers that remain powered in Standby mode.

Finally, the integrated LCD controller has a built-in LCD voltage generator that allows you to drive up to 8 multiplexed LCDs with contrast independent of the supply voltage.

The ultra-low-power STM32L100RCT6 operates from a 1.8 to 3.6 V power supply with BOR. It is available in the -40 to +85 °C temperature range. A comprehensive set of power-saving modes allows the design of low-power applications.

Figure 5. STM32L100RCT6 package

Figure 6. STM32L100RCT6 block diagram



4.2 Embedded ST-LINK/V2

The ST-LINK/V2 programming and debugging tool is integrated on the 32L100CDISCOVERY. The embedded ST-LINK/V2 can be used in 2 different ways according to the jumper states (see *Table 2*):

- Program/debug the MCU on board,
- Program/debug an MCU in an external application board using a cable connected to SWD connector CN3.

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

Figure 7. Typical configuration

Hardware requirements:
- USB cable type A to mini-B
- computer with Windows XP, Vista or 7

Development toolchain:
Altium, TASKING VX-Toolset,
Atollic, TrueSTUDIO
IAR, EWARM
Keil, MDK-ARM

MS19052V2

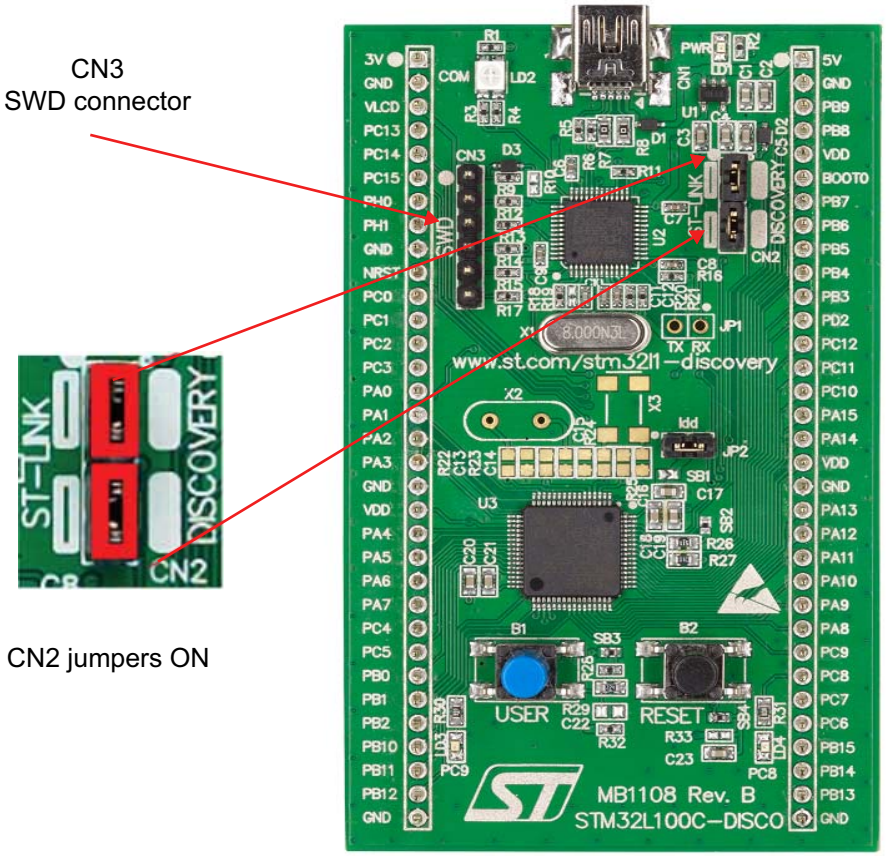
Table 2. Jumper states

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

4.2.1 Using ST-LINK/V2 to program/debug the STM32L100 Value Line on board

To program the STM32L100 Value Line microcontroller on board, simply plug in the two jumpers on CN2, as shown in *Figure 8* in red, but do not use the CN3 connector as that could disturb communication with the STM32L100RCT6 of the 32L100CDISCOVERY.

Figure 8. 32L100CDISCOVERY connections



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

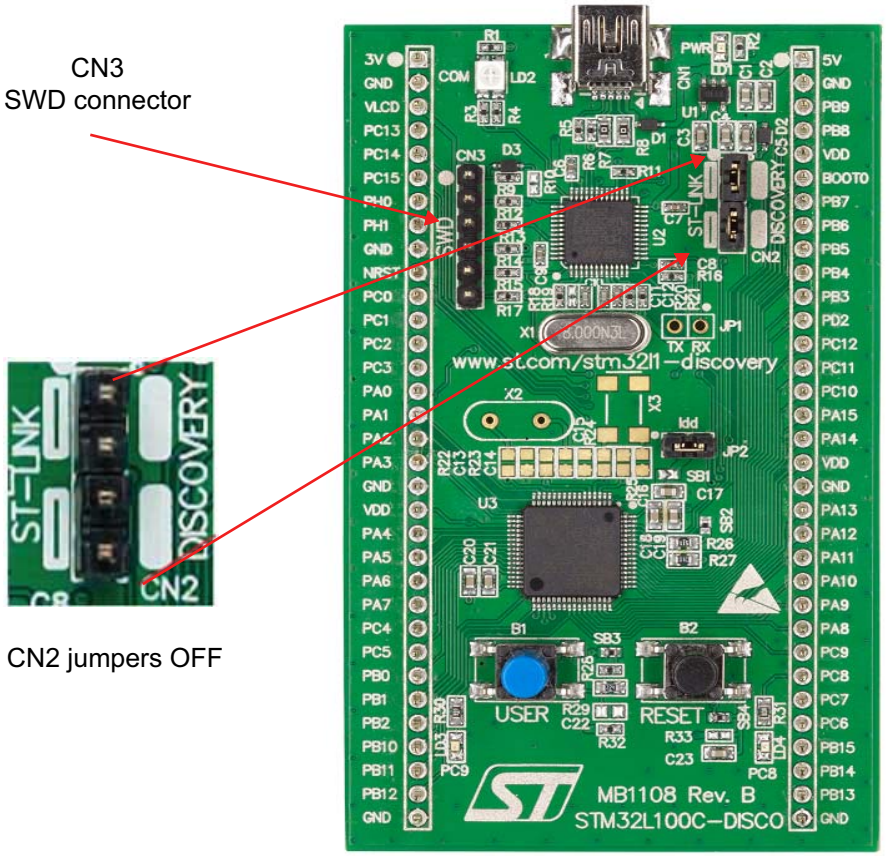
It is very easy to use the ST-LINK/V2 to program the STM32 on an external application. Simply remove the 2 jumpers from CN2 as shown in *Figure 9*, and connect your application to the CN3 debug connector according to *Table 3*.

Note: SB19 and SB22 must be OFF if you use CN3 pin 5 in your external application.

Table 3. Debug connector CN3 (SWD)

Pin	CN3	Designation
1	VDD_TARGET	VDD from application
2	SWCLK	SWD clock
3	GND	Ground
4	SWDIO	SWD data input/output
5	NRST	RESET of target MCU
6	SWO	Reserved

Figure 9. ST-LINK connections



4.3 Power supply and power selection

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

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

- 5V and 3V can be used as output power supplies when another application board is connected to pins P1 and P2.
  In this case, the 5V and 3V pins deliver a 5V or 3V power supply and power consumption must be lower than 100 mA.
- 5V can also be used as input power supplies e.g. when the USB connector is not connected to the PC.

  In this case, the 32L100CDISCOVERY board must be powered by a power supply unit or by auxiliary equipment complying with standard EN-60950-1: 2006+A11/2009, and must be Safety Extra Low Voltage (SELV) with limited power capability.

4.4 LEDs

- LD1 PWR: Red LED indicates that the board is powered.
- LD2 COM: Tricolor LED (COM) advises on the communication status as follows:
  - Slow blinking Red LED/Off: At power on before USB initialization
  - Fast blinking Red LED/Off: After the first correct communication between PC and STLINK/V2 (enumeration)
  - Red LED On: When initialization between PC and ST-LINK/V2 is successfully finished
  - Green LED On: After successful target communication initialization
  - Blinking Red/Green LED: During communication with target
  - Red LED On: Communication finished and OK
  - Orange LED On: Communication failure
- User LD3: Green user LED connected to the I/O PC9 of the STM32L100RCT6.
- User LD4: Blue user LED connected to the I/O PC8 of the STM32L100RCT6.

4.5 Push buttons

- B1 USER: User push button connected to the I/O PA0 of the STM32L100RCT6.
- B2 RESET: Push button used to RESET the STM32L100RCT6.

4.6 JP2 (I_{DD})

Jumper JP2, labeled I_{DD}, allows the consumption of STM32L100RCT6 to be measured by removing the jumper and connecting an ammeter.

- Jumper on: STM32L100RCT6 is powered (default).
- Jumper off: an ammeter must be connected to measure the STM32L100RCT6 current, (if there is no ammeter, the STM32L100RCT6 is not powered).

4.7 Oscillator clock (OSC)

4.7.1 OSC clock supply

PH0 and PH1 can be used as GPIO or as HSE oscillator. By default these I/Os are configured as GPIO, so SB16 and SB17 are closed, SB18 is open and R22, R23, C13 and C14 are not populated.

An external HSE clock can be provided to the MCU in three ways:

- **MCO from ST-LINK**. From MCO of the STM32F103. This frequency cannot be changed, it is fixed at 8 MHz and connected to PH0-OSC_IN of the STM32L100RCT6. Configuration needed:
  - SB16, SB18 CLOSED
  - R22, R23 removed
  - SB17 OPEN
- **Oscillator onboard**. From X2 crystal (not provided). For typical frequencies and its capacitors and resistors, please refer to the STM32L100RCT6 Datasheet. Configuration needed:
  - SB16, SB17 SB18 OPEN
  - R22, R23, C13, C14 soldered
- **Oscillator from external PH0**. From external oscillator through pin 7 of the P1 connector. Configuration needed:
  - SB16, SB17 CLOSED
  - SB18 OPEN
  - R22 and R23 removed

4.7.2 OSC 32 KHz clock supply

PC14 and PC15 can be used as GPIO or as LSE oscillator. By default these I/Os are configured as GPIO, so SB20 & SB21 are closed and X3, R24, R25 are not populated.

An external LSE clock can be provided to the MCU in two ways:

- **Oscillator onboard**. From X3 crystal (not provided). Configuration needed:
  - SB20, SB21 OPEN
  - C15, C16, R24 and R25 soldered.
- **Oscillator from external PC14**. From external oscillator trough the pin 5 of P1 connector. Configuration needed:
  - SB20, SB21 CLOSED
  - R24 and R25 removed

4.8 Solder bridges

Table 4. Solder bridge settings

Bridge	State[1]	Description
SB16,17 (X2 crystal)[2]	**OFF**	X2, C13, C14, R22 and R23 provide a clock. PH0, PH1 are disconnected from P1.
	ON	PH0, PH1 are connected to P1 (R22, R23 and SB18 must not be fitted).
SB6,8,10,12 (Default)	**ON**	Reserved, do not modify.
SB5,7,9,11 (Reserved)	**OFF**	Reserved, do not modify.
SB20,21 (X3 crystal)	**OFF**	X3, C15, C16, R24 and R25 deliver a 32 KHz clock. PC14, PC15 are not connected to P1.
	ON	PC14, PC15 are only connected to P1 (R24, R25 must not be fitted).
SB4 (B2-RESET)	**ON**	B2 push button is connected to the NRST pin of the STM32L100RCT6 MCU.
	OFF	B2 push button is not connected the NRST pin of the STM32L100RCT6 MCU.
SB3 (B1-USER)	**ON**	B1 push button is connected to PA0.
	OFF	B1 push button is not connected to PA0.
SB1 (VBAT powered from VDD)	**ON**	VBAT is permanently powered from VDD.
	OFF	VBAT is not powered from VDD but pin3 of P1.
SB14,15 (RX,TX)	**OFF**	Reserved, do not modify.
	ON	Reserved, do not modify.
SB19 (NRST)	**ON**	NRST signal of the CN3 connector is connected to the NRST pin of the STM32L100RCT6 MCU.
	OFF	NRST signal of the CN3 connector is not connected to the NRST pin of the STM32L100RCT6 MCU.
SB22 (T_SWO)	**ON**	SWO signal of the CN3 connector is connected to PB3.
	OFF	SWO signal is not connected.
SB13 (STM_RST)	**OFF**	No incidence on STM32F103C8T6 (ST-LINK/V2) NRST signal.
	ON	STM32F103C8T6 (ST-LINK/V2) NRST signal is connected to GND.
SB2 (BOOT0)	**ON**	BOOT0 signal of the STM32L100RCT6 MCU is held low through a 510 Ohm pull-down resistor.
	OFF	BOOT0 signal of the STM32L100RCT6 MCU can be set high through a 10 K Ω pull-up resistor R27 to solder.
SB18 (MCO)[2]	**ON**	Provides the 8 MHz for OSC_IN from MCO of STM32L100RCT6.
	OFF	See SB16, SB17 description.

1. Default SBx state is shown in bold.
2. OSC_IN clock comes from MCO if SB18 is ON and SB16,17 are OFF and comes from X2 if SB18 is OFF and SB16,17 are ON.

4.9 Extension connectors

The male headers P1 and P2 can connect the 32L100CDISCOVERY to a standard prototyping/wrapping board. STM32L100RCT6 GPI/Os are available on these connectors. P1 and P2 can also be probed by an oscilloscope, logical analyzer or voltmeter.

Table 5. MCU pin description versus board function

MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
BOOT0	BOOT0	60									6
NRST	NRST	7	RESET		NRST				5	10	
PA0	WKUP1/RTC_TAMP2/ TIM2_CH1_ETR/ USART2_CTS/ADC_IN0/ COMP1_INP	14	USER							15	
PA1	TIM2_CH2/USART2_RTS/ LCD_SEG0/ADC_IN1/ COMP1_INP/OPAMP1_VINP	15								16	
PA2	TIM2_CH3/TIM9_CH1/ USART2_TX/LCD_SEG1/ ADC_IN2/COMP1_INP/ OPAMP1_VINM	16								17	
PA3	TIM2_CH4/TIM9_CH2/ USART2_RX/LCD_SEG2/ ADC_IN3/COMP1_INP/ OPAMP1_VOUT	17								18	
PA4	SPI1_NSS/SPI3_NSS/ I2S3_WS/USART2_CK/ ADC_IN4/DAC_OUT1/ COMP1_INP	20								21	
PA5	TIM2_CH1_ETR/SPI1_SCK /ADC_IN5/DAC_OUT2/ COMP1_INP	21								22	
PA6	TIM3_CH1/TIM10_CH1/ SPI1_MISO/LCD_SEG3/ ADC_IN6/COMP1_INP/ OPAMP2_VINP	22								23	

Table 5. MCU pin description versus board function (continued)

MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
PA7	TIM3_CH2/TIM11_CH1/ SPI1_MOSI/LCD_SEG4/ ADC_IN7/COMP1_INP /OPAMP2_VINM	23								24	
PA8	USART1_CK/MCO/ LCD_COM0	41									25
PA9	USART1_TX/LCD_COM1	42									24
PA10	USART1_RX/LCD_COM2	43									23
PA11	USART1_CTS/USB_DM/ SPI1_MISO	44									22
PA12	USART1_RTS/USB_DP/ SPI1_MOSI	45									21
PA13	JTMS-SWDAT	46			SWDIO				4		20
PA14	JTCK-SWCLK	49			SWCLK				2		17
PA15	TIM2_CH1_ETR/SPI1_NSS /SPI3_NSS/I2S3_WS/ LCD_SEG17	50									16
PB0	TIM3_CH3/LCD_SEG5/ ADC_IN8/COMP1_INP/ VREF_OUT/ OPAMP2_VOUT	26								27	
PB1	TIM3_CH4/LCD_SEG6/ ADC_IN9/COMP1_INP/ VREF_OUT	27								28	
PB2/BOOT1	COMP1_INP	28								29	
PB3	TIM2_CH2/SPI1_SCK/ SPI3_SCK/I2S3_CK/ LCD_SEG7/COMP2_INM	55			SWO				6		11

Table 5. MCU pin description versus board function (continued)

MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
PB4	TIM3_CH1/SPI1_MISO/ SPI3_MISO/LCD_SEG8/ COMP2_INP	56									10
PB5	TIM3_CH2/I2C1_SMBA/ SPI1_MOSI/SPI3_MOSI /I2S3_SD/LCD_SEG9/ COMP2_INP	57									9
PB6	TIM4_CH1/I2C1_SCL/ USART1_TX/COMP2_INP	58									8
PB7	TIM4_CH2/I2C1_SDA/ USART1_RX/PVD_IN/ COMP2_INP	59									7
PB8	TIM4_CH3/TIM10_CH1 /I2C1_SCL/LCD_SEG16	61									4
PB9	TIM4_CH4/TIM11_CH1 /I2C1_SDA/LCD_COM3	62									3
PB10	TIM2_CH3/I2C2_SCL/ USART3_TX/LCD_SEG10	29								30	
PB11	TIM2_CH4/I2C2_SDA/ USART3_RX/LCD_SEG11	30								31	
PB12	TIM10_CH1/I2C2_SMBA/ SPI2_NSS/I2S2_WS/ USART3_CK/LCD_SEG12/ ADC_IN18/COMP1_INP	33								32	
PB13	TIM9_CH1/SPI2_SCK/ I2S2_CK/USART3_CTS/ LCD_SEG13/ADC_IN19 /COMP1_INP	34									32
PB14	TIM9_CH2/SPI2_MISO/ USART3_RTS/LCD_SEG14 /ADC_IN20/COMP1_INP	35									31
PB15	TIM11_CH1/SPI2_MOSI /I2S2_SD/LCD_SEG15/ ADC_IN21/COMP1_INP/ RTC_REFIN	36									30

Table 5. MCU pin description versus board function (continued)

MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
PC0	LCD_SEG18/ADC_IN10/ COMP1_INP	8								11	
PC1	LCD_SEG19/ADC_IN11/ COMP1_INP	9								12	
PC2	LCD_SEG20/ADC_IN12/ COMP1_INP	10								13	
PC3	LCD_SEG21/ADC_IN13/ COMP1_INP	11								14	
PC4	LCD_SEG22/ADC_IN14/ COMP1_INP	24								25	
PC5	LCD_SEG23/ADC_IN15/ COMP1_INP	25								26	
PC6	TIM3_CH1/I2S2_MCK /LCD_SEG24	37									29
PC7	TIM3_CH2/I2S3_MCK/ LCD_SEG25	38									28
PC8	TIM3_CH3/LCD_SEG26	39		BLUE							27
PC9	TIM3_CH4/LCD_SEG27	40		GREEN							26
PC10	SPI3_SCK/I2S3_CK/ USART3_TX/LCD_SEG28/ LCD_SEG40/LCD_COM4	51									15
PC11	SPI3_MISO/USART3_RX/ LCD_SEG29/LCD_SEG41/ LCD_COM5	52									14
PC12	SPI3_MOSI/I2S3_SD/ USART3_CK/LCD_SEG30/ LCD_SEG42/LCD_COM6	53									13
PC13	WKUP2/RTC_TAMP1/ RTC_TS/RTC_OUT	2								4	

Table 5. MCU pin description versus board function (continued)

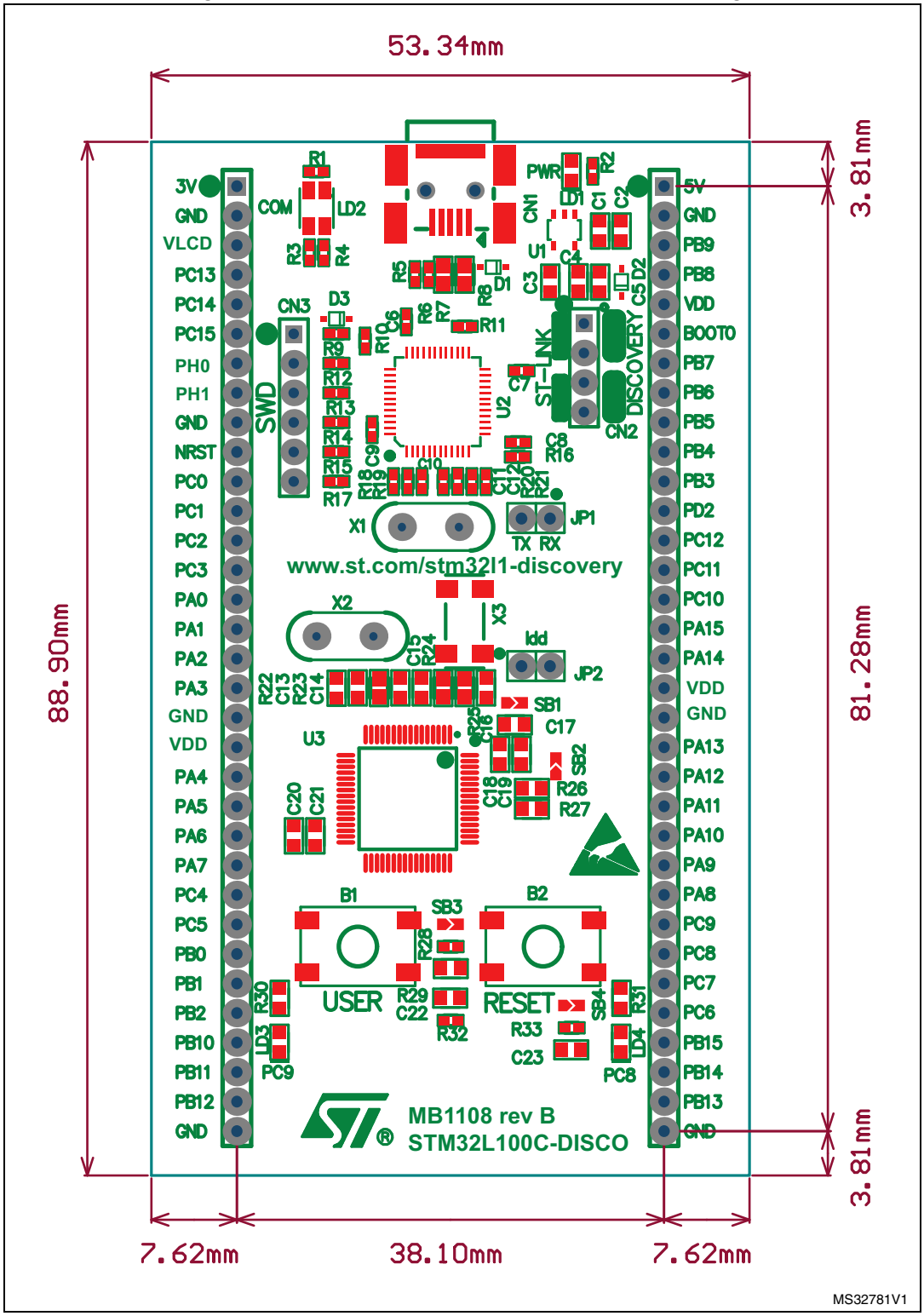
MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
PC14-OSC32_IN	OSC32_IN	3				OSC32_IN				5	
PC15-OSC32_OUT	OSC32_OUT	4				OSC32_OUT				6	
PD2	TIM3_ETR/LCD_SEG31/ LCD_SEG43/LCD_COM7	54									12
PH0-OSC_IN	OSC_IN	5				OSC_IN				7	
PH1-OSC_OUT	OSC_OUT	6				OSC_OUT				8	
VSS	VSS	18								19	
VDD	VDD	19								20	
VSS_2	VSS	47									19
VDD_2	VDD	48									18
VLCD	VLCD	1								3	
VDD_3		64									
VDD_1		32									
VDDA		13									
VSS_3		63									
VSS_1		31									
VSSA		12									
								5V			1
								3V		1	
								VDD			5

Table 5. MCU pin description versus board function (continued)

MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
								GND		2	2
					GND			GND	3		
								GND		9	
								GND		33	33

5 Mechanical drawing

Figure 10. 32L100CDISCOVERY mechanical drawing



6 Electrical schematics

Figure 11. 32L100CDISCOVERY

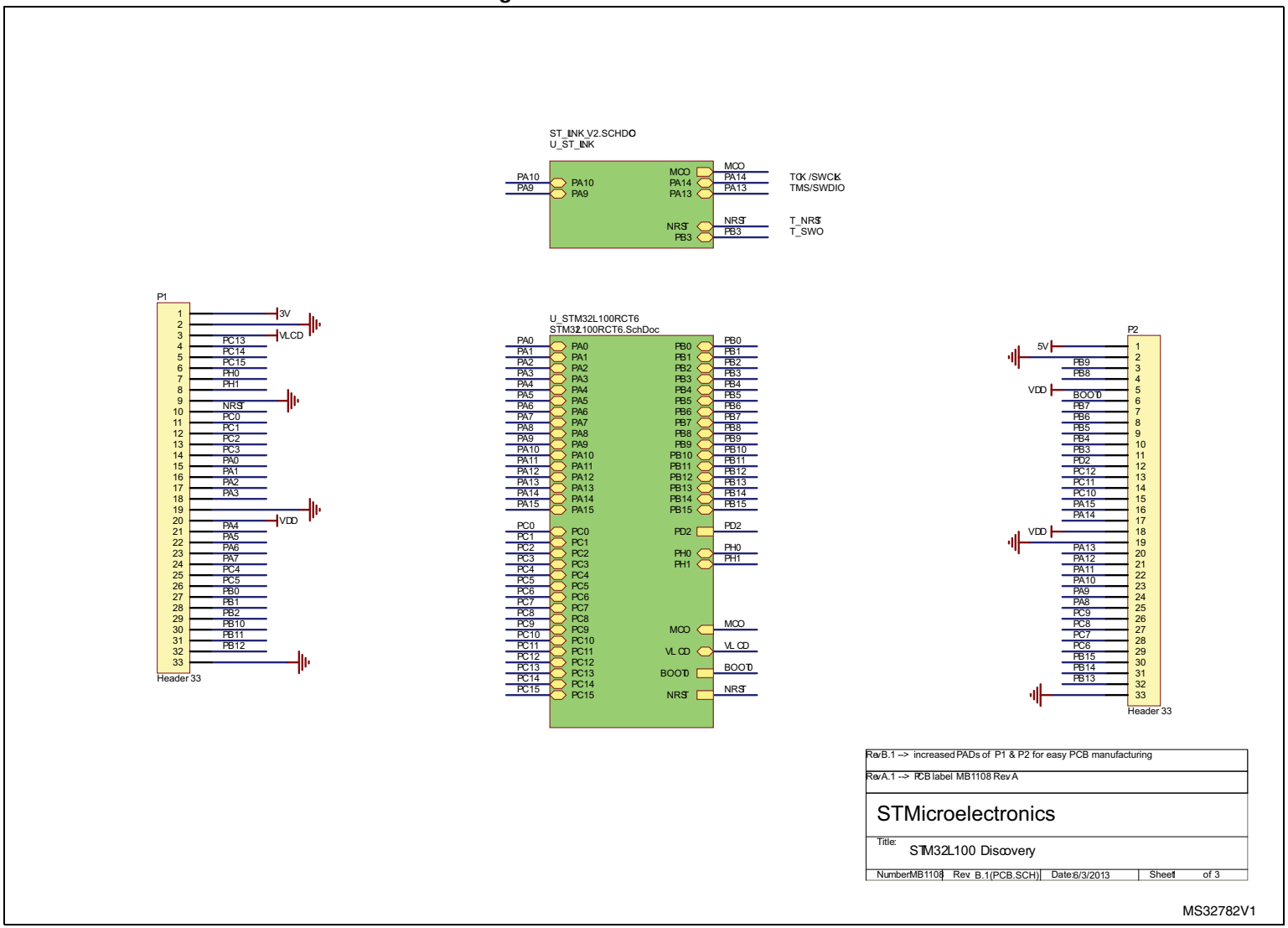


Figure 12. ST-LINK/V2 (SWD only)

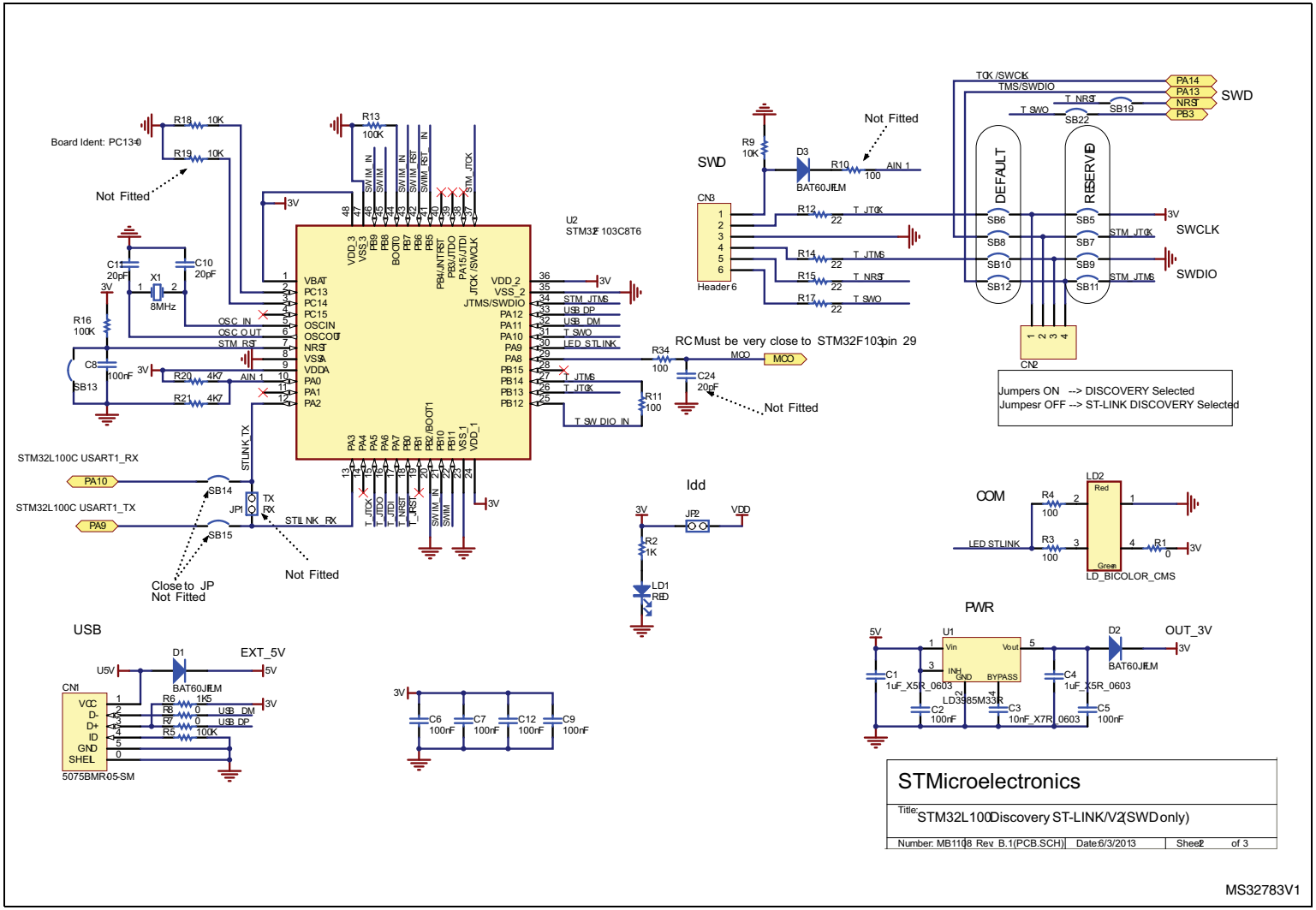
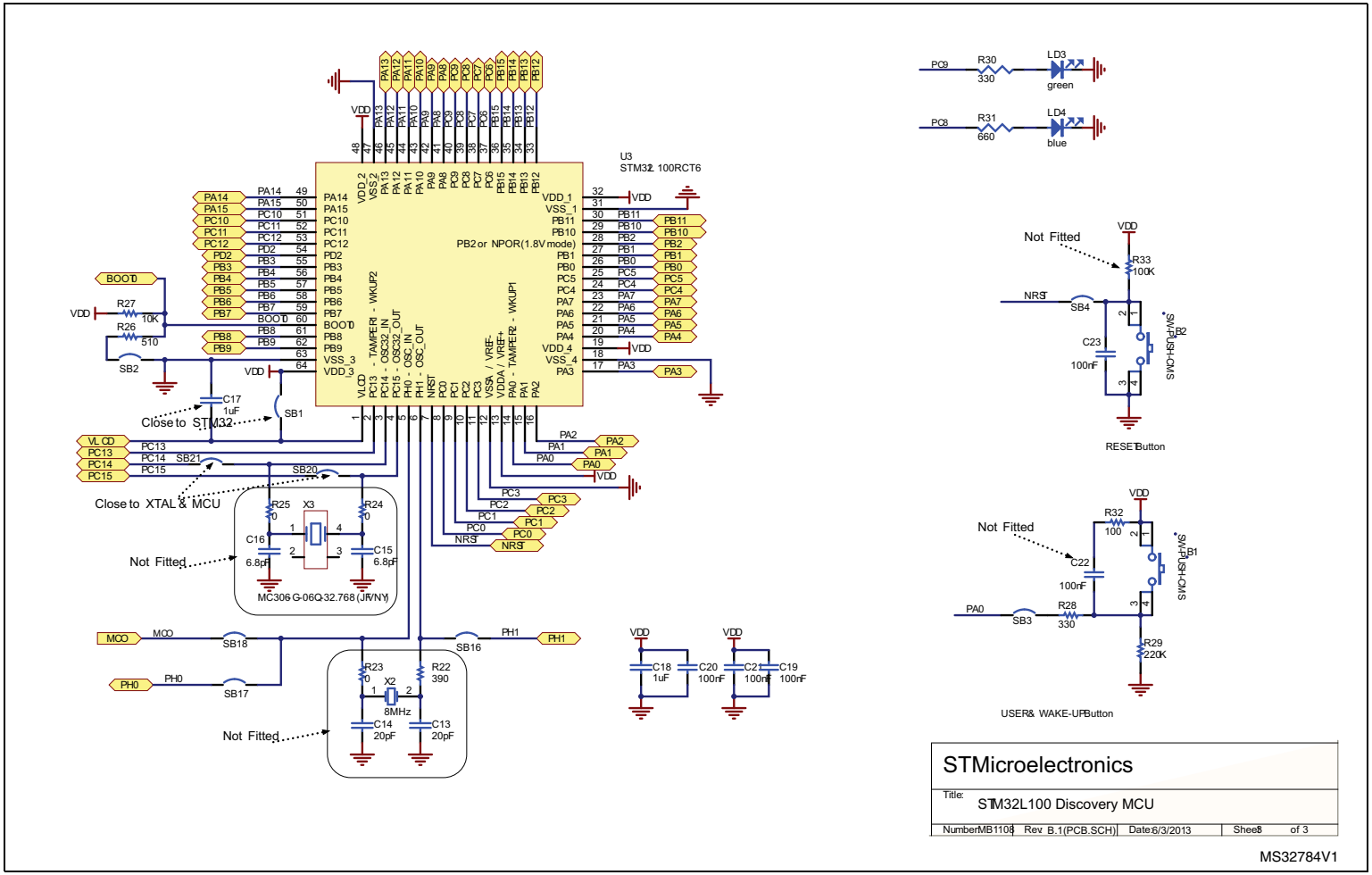


Figure 13. MCU



7 Revision history

Table 6. Document revision history

Date	Revision	Changes
12-Aug-2013	1	Initial release.

Please Read Carefully:

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