UM1079
User manual

Discovery kits with STM32L152RCT6 and STM32L152RBT6 MCUs

Introduction

The STM32L152RCT6 Discovery kit (32L152CDISCOVERY) and the STM32L152RBT6 (STM32L-DISCOVERY) allow to develop applications based on the STM32L1 Series and to benefit from the ultra-low-power features of these microcontollers.

The 32L152CDISCOVERY is based on an STM32L152RCT6 (256 Kbytes of Flash memory). The STM32L-DISCOVERY is based on an STM32L152RBT6 (128 Kbytes of Flash memory).

These discovery kits include the ST-LINK/V2 in-circuit debugger, one LCD (24 segments, 4 commons), four LEDs, two pushbuttons, one linear touch sensor and four touchkeys.

Figure 1. 32L152CDISCOVERY board

1. Picture is not contractual.

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1 Ordering information

To order the 32L152CDISCOVERY ultra-low-power discovery board, refer to *Table 1*.

Table 1. Ordering information

Part number	Order code	Description
32L152CDISCOVERY	STM32L152C-DISCO	Discovery kit based on STM32L152RCT6
STM32L-DISCOVERY	STM32L-DISCOVERY(1)	Discovery kit based on STM32L152RBT6

1. STM32L-DISCOVERY is replaced by STM32L152C-DISCO.

2 Conventions

Table 2 provides some definitions used in this user manual.

Table 2. ON/OFF conventions

Convention	Definition
Jumper JP1 ON	Jumper placed between pin 2 and 3
Jumper JP1 OFF	Jumper placed between pin 1 and 2
Solder bridge SBx ON	SBx connections closed by solder
Solder bridge SBx OFF	SBx connections left open

The following sections of this user manual are also applicable to the STM32L-DISCOVERY except specific features of the STM32L152RBT6 microcontroller (128 Kbyte Flash memory, 16 Kbyte RAM, 4 Kbyte data EEPROM).

2.1 Quick start

Before using the discovery kit, please accept the Evaluation product license agreement available on the 32L152CDISCOVERY page of the www.st.com/mcu web site.

2.2 Getting started

The following sequence allows to configure the 32L152CDISCOVERY and to launch the discovery application:

- Check jumper positions on the board: JP1 and CN3 must be ON (discovery selected) (see *Figure 3*).
- Connect the 32L152CDISCOVERY to a computer with an USB cable to power the board. The red LEDs LD2 (PWR) and LD1 (COM) are lit up.The Function 1 is executed.
- Click on user button B1 to change the executed function as described in *Table 3*. The 4-LED bar shows the function being performed (1 to 4 bars can be switched ON).

Depending on the function selected, the voltage value, the linear touch sensor position, the touchkeys status or the STM32L152RCT6 current consumption is displayed on the LCD.

Table 3. Functions executed when clicking B1 button

Function	LED LD3/4	Bar status	Value displayed on LCD	Main function
1	LD3 and LD4 blink		Measured STM32L152RCT6 VDD voltage	Voltage measurement
2	LD3 ON		Linear touch sensor position from 0 to 100%	Touch sensing
3	LD4 ON		Status of the four touchkeys	
4	LD3 and LD4 OFF		STM32L152RCT6 consumption measured in Run mode (4 MHz)	STM32L152RCT6 current consumption measurement
			STM32L152RCT6 consumption measured in Sleep mode (4 MHz)	
5			STM32L152RCT6 consumption measured in Run mode (32 KHz)	
			STM32L152RCT6 consumption measured in Low-power sleep mode (32 KHz)	
6			STM32L152RCT6 consumption measured in Stop mode, RTC ON	
			STM32L152RCT6 consumption measured in Stop mode, RTC OFF	
7			STM32L152RCT6 consumption measured in Standby mode	

Please refer to the www.st.com/mcu web site for more details on the discovery project and the STM32L152RCT6 features.

2.3 System requirements

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

2.4 Development toolchain supporting the 32L152CDISCOVERY

- Altium TASKING® VX-Toolset
- Atollic® TrueSTUDIO®
- IAR™ EWARM
- Keil™ MDK-ARM

2.5 Demonstration software

The demonstration software, preloaded in the board Flash memory, uses the built-in I_{DD} measurement feature to automatically measure and display the MCU consumption on the LCD (in Run and Low-power modes).This software also allows to demonstrate touch sensing functionalities such as linear touch sensor or touchkeys.

The latest version of this demonstration source code and associated documentation can be downloaded from www.st.com/mcu

3 Features

The 32L152CDISCOVERY offers the following features:

- An STM32L152RCT6 microcontroller (256 Kbyte Flash memory, 32 Kbyte RAM, 8 Kbyte data EEPROM) in a 64-pin LQFP 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 3.3 or 5 V supply voltage
- External application power supply: 3 V and 5 V
- I_{DD} current measurement
- LCD
  - DIP28 package
  - 24 segments, 4 commons
- Four LEDs:
  - LD1 (red/green) indicating USB communication
  - LD2 (red) indicating that 3.3 V power supply is ON
  - Two user LEDs, LD3 (green) and LD4 (blue)
- Two pushbuttons (user and reset)
- One linear touch sensor and four touchkeys
- An extension header for LQFP64 I/Os for quick connection to prototyping board and easy probing

The STM32L-DISCOVERY offers the same features except an STM32L152RBT6 microcontroller (128 Kbyte Flash memory, 16 Kbyte RAM, 4 Kbyte data EEPROM) in a 64-pin LQFP package.

4 Hardware and layout

The 32L152CDISCOVERY is designed around one STM32L152RCT6 packaged in an LQFP64.

Figure 2 illustrates the connections between the STM32L152RCT6 microcontroller and its peripherals (ST-LINK/V2, pushbuttons, LEDs, LCD, linear touch sensor, touchkeys, and connectors). These connections are the same for the STM32L-DISCOVERY.

Figure 2. Hardware block diagram

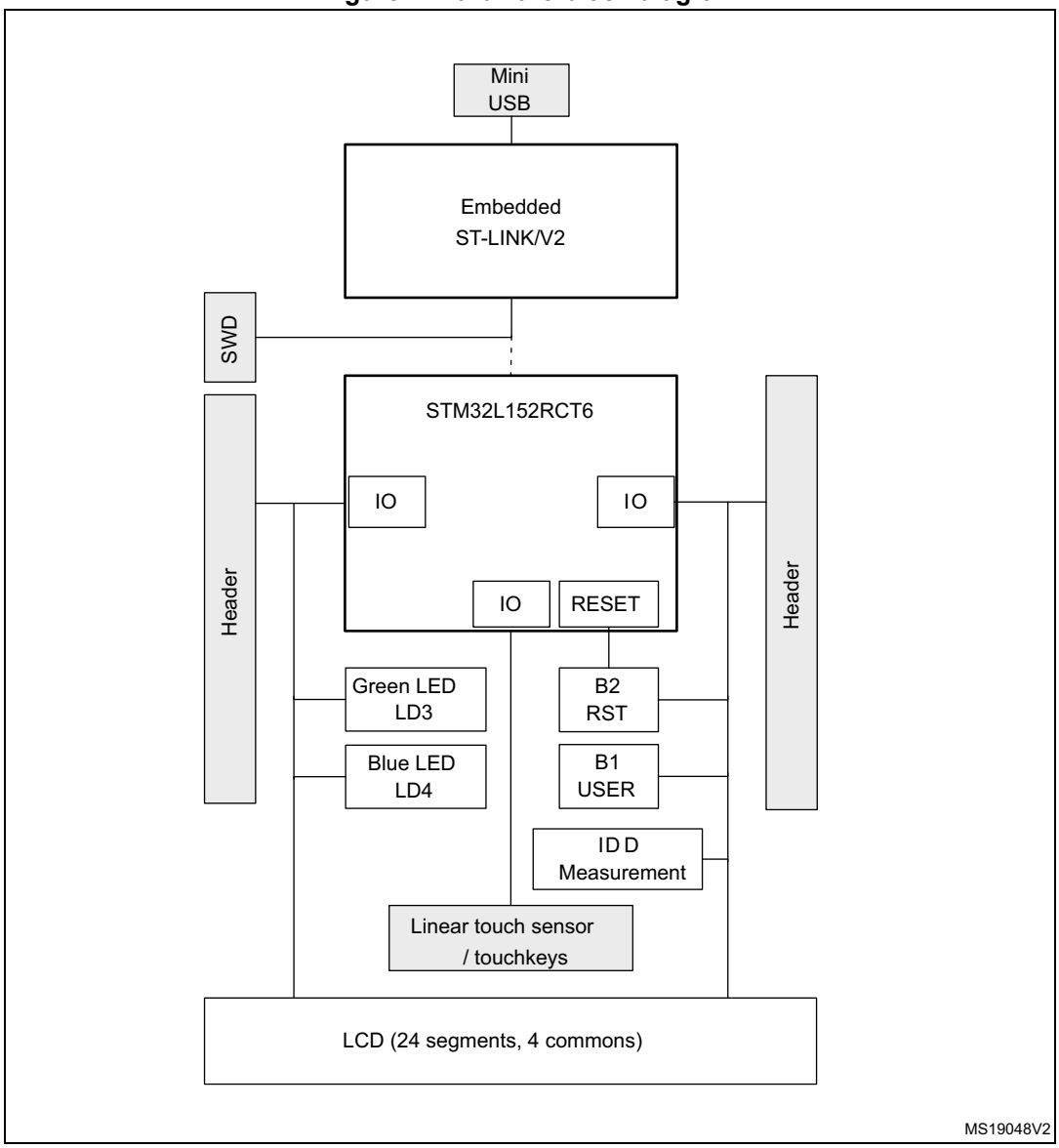
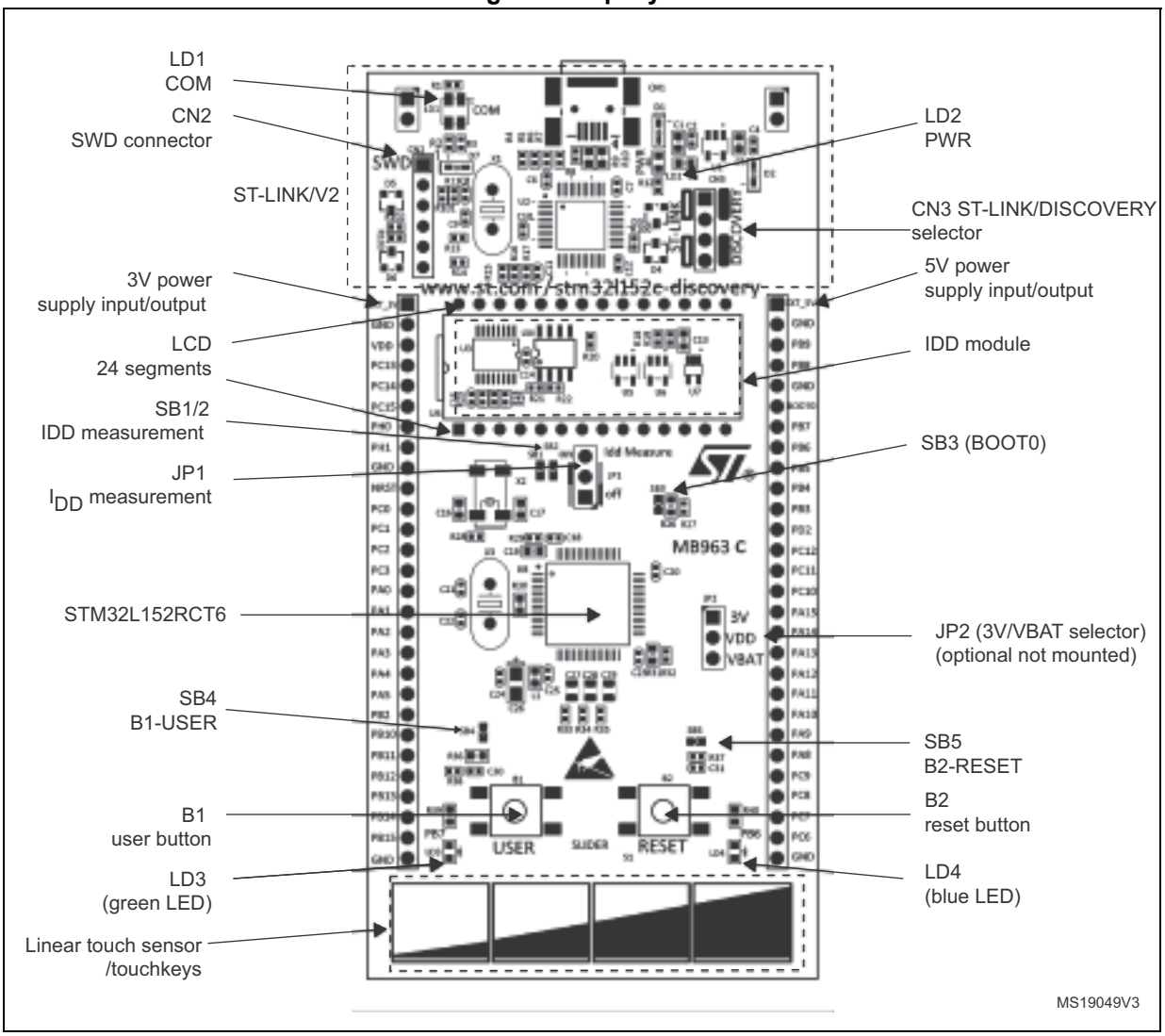


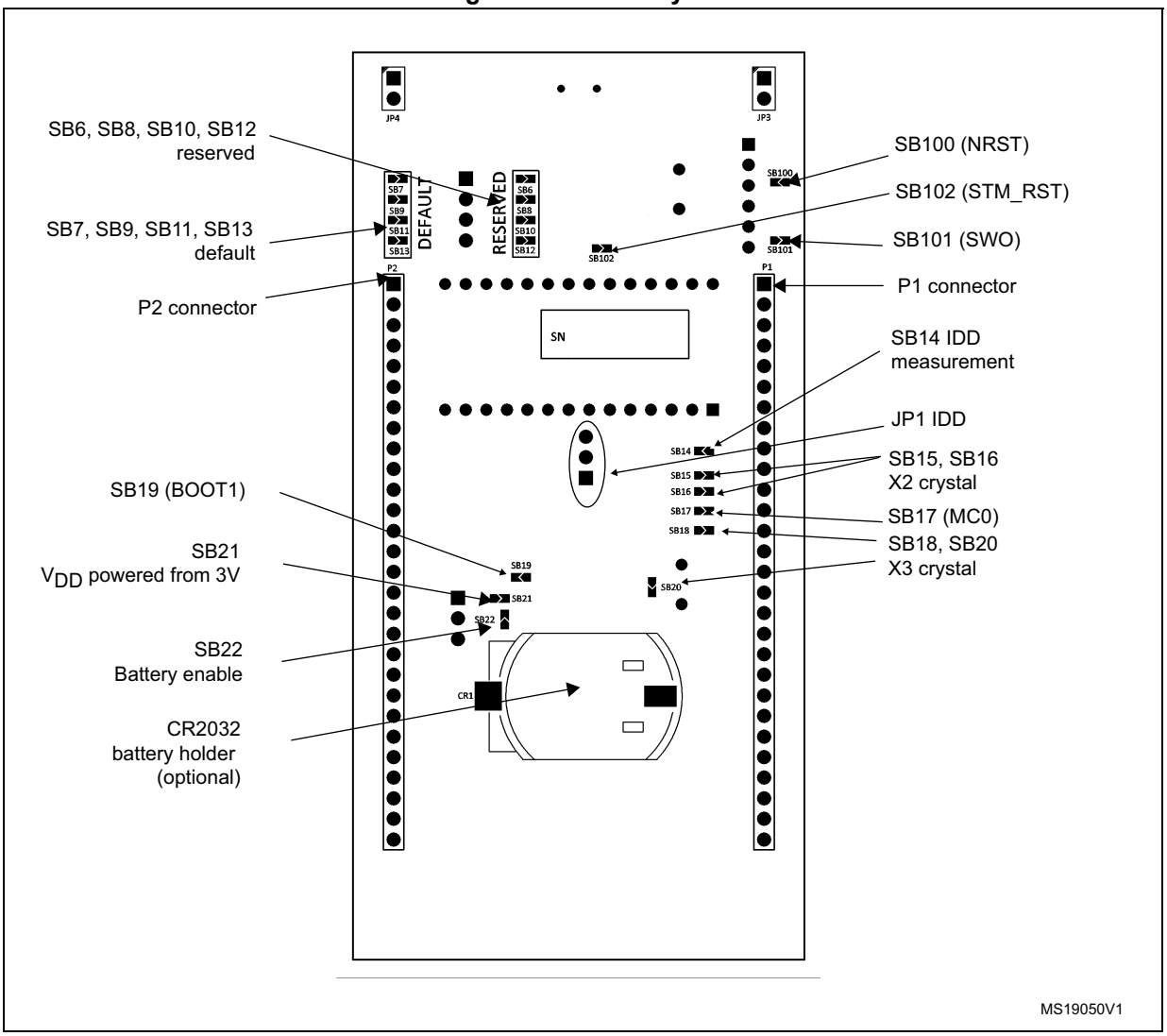
Figure 3 and *Figure 4* allow to locate these features on the board.

Figure 3. Top layout



1. Pin 1 of CN1, CN2, P1 and P2 connectors are identified by a square.

Figure 4. Bottom layout



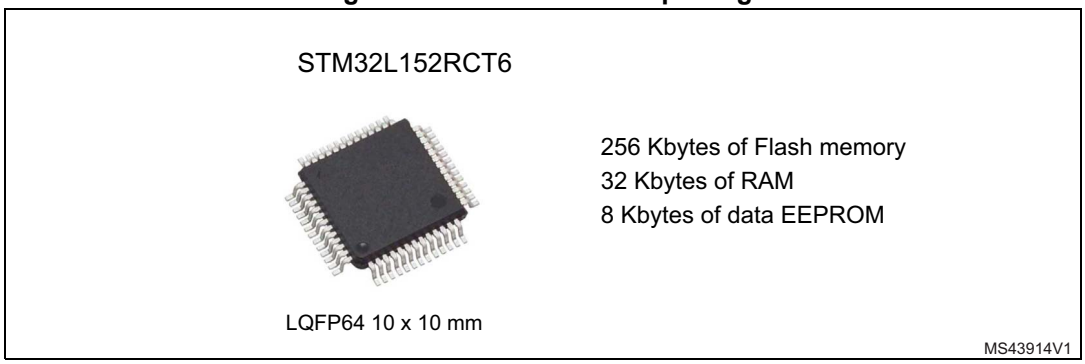
1. Pin 1 of CN1, CN2, P1 and P2 connectors are identified by a square.

4.1 STM32L152RCT6 microcontroller

The STM32L152RCT6 features 256 Kbytes of Flash memory, 32 Kbytes of RAM and 8 Kbytes data of EEPROM.

This microcontroller embeds RTC, LCD, timers, USART, I2C, SPI, ADC, DAC, and comparators.

Figure 5. STM32L152RCT6 package



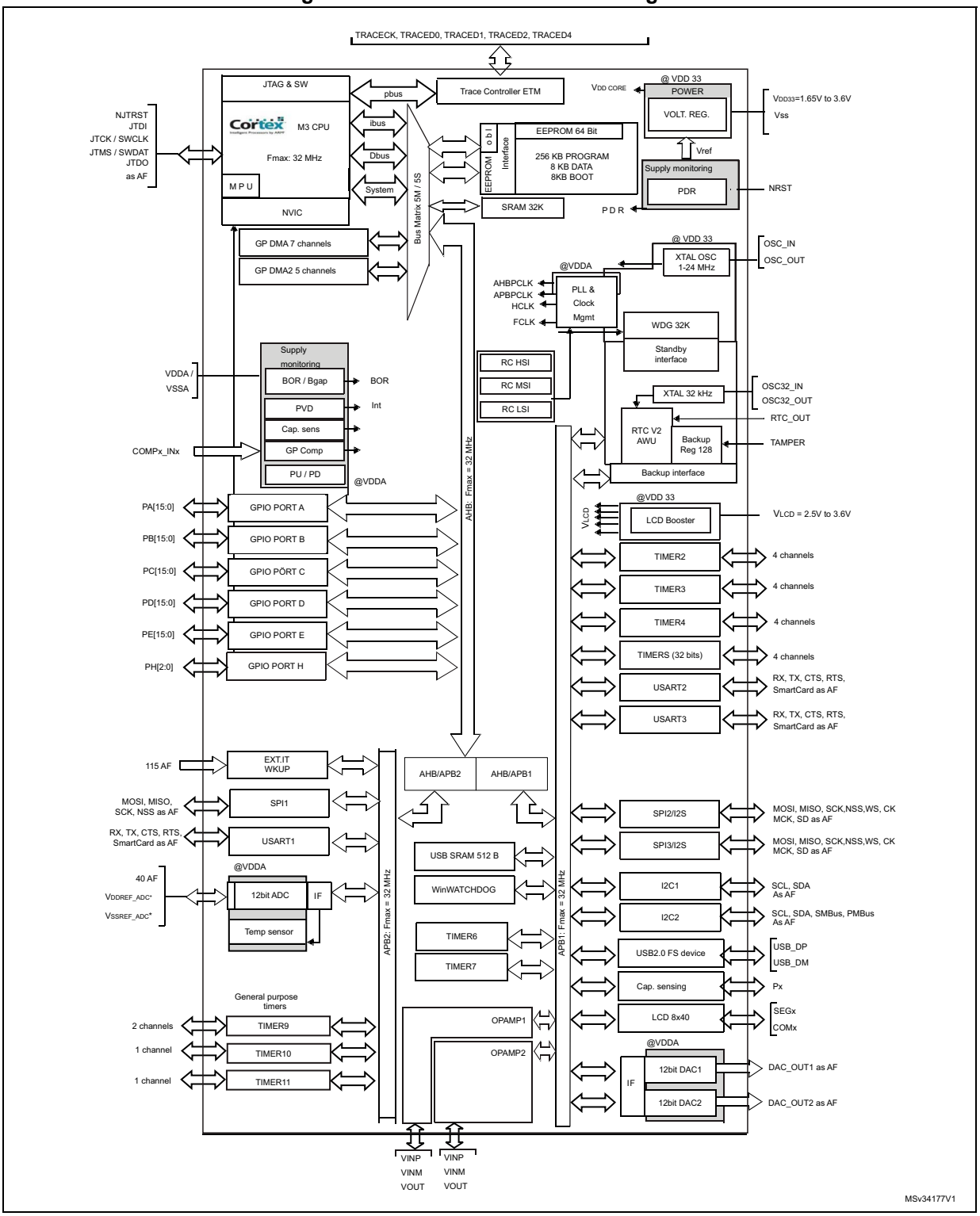
The STM32L152RCT6 provides the following benefits:

- Ultra low power proprietary 130 nm technology: speed and power consumption independent of MCU power supply, and ultra low leakage
- Ultra Low power design (clock gating, low-power Flash with power-off capability): reduced overall Run and Wait mode current consumption by turning off clocks of unused peripherals or Flash
- Sub 1 µA hardware RTC and AWU system unit:

  Ultra-low-power modes for applications requesting regular wake up
- Up to 6 Low-power modes: suitable for many applications from complete switch off to continuous monitoring at ultra low frequency
- Advanced and flexible clock system (multiple internal and external clock sources): switch and adjust frequency and clock sources on the fly depending on application needs
- Direct memory access on board (up to 12 DMA channels): autonomy for peripherals, independent from the core; can switch off Flash memory and CPU (large current consumption contributors) while keeping peripherals active
- Ultra Low power and ultrasafe features (POR, PDR, BOR, PVD) allowing integrated application safety and security
- Unique identifier to enhance user data confidentiality/reliability
- Ultrafast wakeup from lowest consumption low-power mode allowing fast switching from static and dynamic power modes
- Analog functional down to 1.8 V, and programming down to 1.65 V
- Full functionality over the complete V_{DD} range

For more information, refer to STM32L152RCT6 datasheet available on ST website.

Figure 6. STM32L152RCT6 block diagram



4.2 Embedded ST-LINK/V2

The ST-LINK/V2 programming and debugging tool is integrated on the 32L152CDISCOVERY. The embedded ST-LINK/V2 can be used in 2 different ways according to the jumper states (see *Table 4*):

- Program/debug the MCU on board
- Program/debug an MCU in an external application board using a cable connected to SWD connector CN2

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

Figure 7. Typical configuration

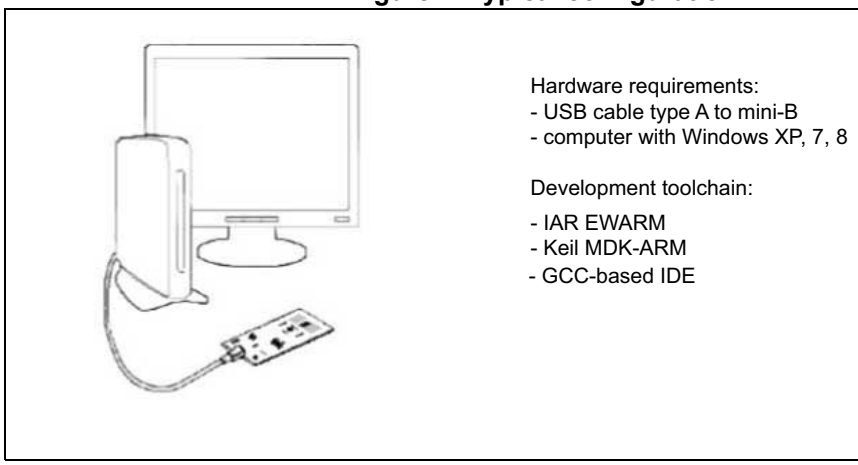


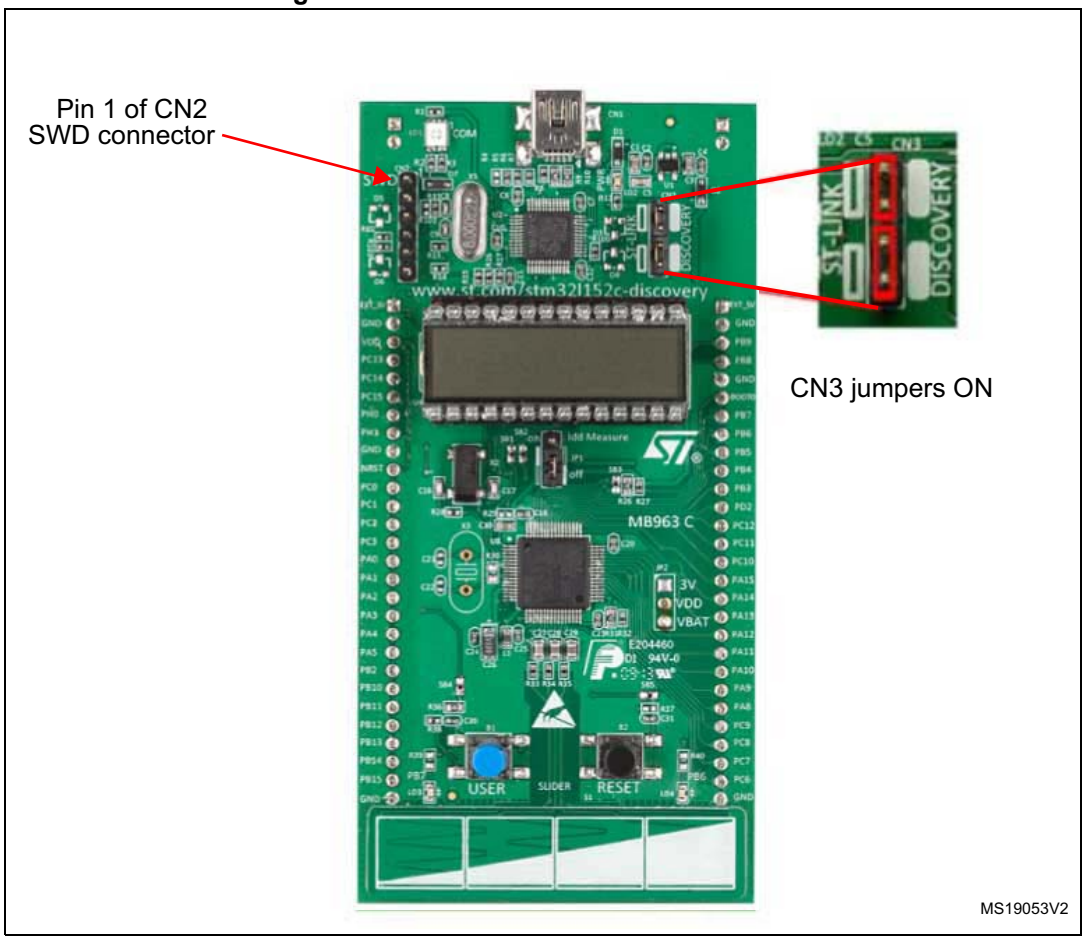
Table 4. Jumper states

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

4.2.1 Using the ST-LINK/V2 to program/debug the microcontroller on board

Figure 8 shows how to plug the two jumpers on CN3 to program the STM32L152RCT6 on the board. The usage of CN2 is forbidden as it could disturb communication with the microcontroller.

Figure 8. 32L152CDISCOVERY connections



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

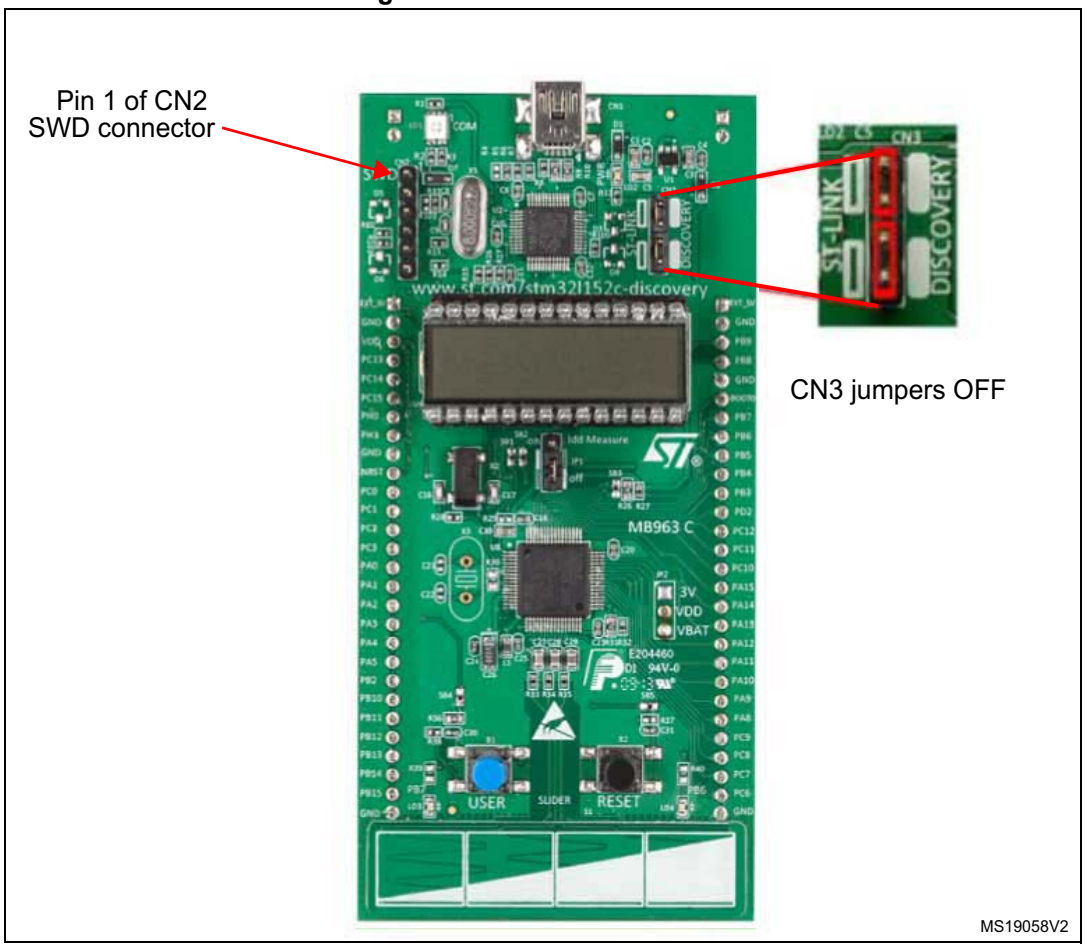
The ST-LINK/V2 allows also to program an STM32 device on an external application. *Figure 9* shows how to remove the 2 jumpers from CN3 and to connect the external application to the CN2 debug connector according to instructions in *Table 5*.

Note: SB100 must be OFF if you the CN2 pin 5 is used in the external application.

Table 5. Debug connector CN2 (SWD)

Pin	CN2	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 computer through the USB cable, or by an external 5 V or 3.3 V power supply.

The D1 and D2 protection diodes allow to use the EXT_5V and EXT_3V pins independently as input or output power supplies (see *Figure 3*):

- EXT_5V and EXT_3V can be used as output power supplies when the application board is connected to pins P1 and P2. In this case, the EXT_5V and EXT_3V pins deliver a 5 V or 3 V power supply and power consumption must be lower than 100 mA.
- EXT_5V and EXT_3V can also be used as input power supplies when the USB connector is not connected to the computer. In this case, the power of the board must be provided by a power supply unit or by an auxiliary equipment complying with standard EN-60950-1: 2006+A11/2009. This power source must be Safety Extra Low Voltage (SELV) with limited power capability.

Battery powered (optional)

The 32L152CDISCOVERY board has been designed to run from a CR2032 standalone battery (no connection with USB or other power supply is required).

By default, no battery holder is mounted on the board and SB21 and SB22 are configured in their default state (see *Table 6: Solder bridges on page 21*).

Follow the procedure below to power the 32L152CDISCOVERYfrom the battery:

- Solder a B7410AP2L battery holder from LOTES on CR1
- Configure SB100 OFF
- Remove both jumpers from CN3 (see *Figure 9: ST-Link connections on page 16*)
- Select the battery as power supply. Two solutions are possible:
  - Solder bridge: configure SB21 OFF, and SB22 ON. No header is required on JP2.
  - Jumper: configure SB21 and SB22 OFF. Solder a header on JP2, identical to JP1 on the top side. Set a jumper between VDD and VBAT to power the STM32L152RCT6 of the board

Note: In this configuration, it is possible to power the STM32L152RCT6 *from the 3 V supply voltage of the board by setting a jumper between VDD and 3V.*

- Plug the CR2032 battery into CR1 holder.

The demonstration is now ready to run.

Warning: Wrong solder bridge configuration can damage board components.

4.4 LEDs

- LD1 COM: LD1 default status is red. LD1 turns to green to indicate that communications are in progress between the computer and the ST-LINK/V2.
- LD2 PWR: red LED indicates that the board is powered.
- User LD3: user green LED connected to the I/O PB7 of the STM32L152RCT6.
- User LD4: user blue LED connected to the I/O PB6 of the STM32L152RCT6.

4.5 Pushbuttons

- B1 USER: User pushbutton connected to the I/O PA0 of the STM32L152RCT6.
- B2 RESET: Pushbutton is used to RESET the STM32L152RCT6.

4.6 Linear touch sensor / touchkeys

To demonstrate touch sensing capabilities, the 32L152CDISCOVERY includes a linear touch sensor which can be used either as a 3-position linear touch sensor or as 4 touchkeys. Both functionalities are illustrated in the demonstration software (see *Table 3: Functions executed when clicking B1 button on page 7*).

Three pairs of I/O ports are assigned to the linear touch sensor / touchkeys. Each pair must belong to the same analog switch group:

- PA6, PA7 (group 2)
- PC4, PC5 (group 9)
- PB0, PB1 (group 3)

To minimize the noise, these pairs are dedicated to the linear touch sensor / touchkeys and are not connected to external headers.

To design a touch sensing application, refer to the following documentation and firmware:

- For details concerning I/O ports, refer to the STM32L152RCT6 datasheet.
- For information on software development, see discovery application software on www.st.com/mcu.
- For more detail concerning touch sensing application design and layout, refer to *Guidelines for designing touch sensing applications with surface sensors* (AN4312).
- STM32 touch sensing library available from www.st.com/mcu

4.7 Built-in I_{DD} measurement circuit

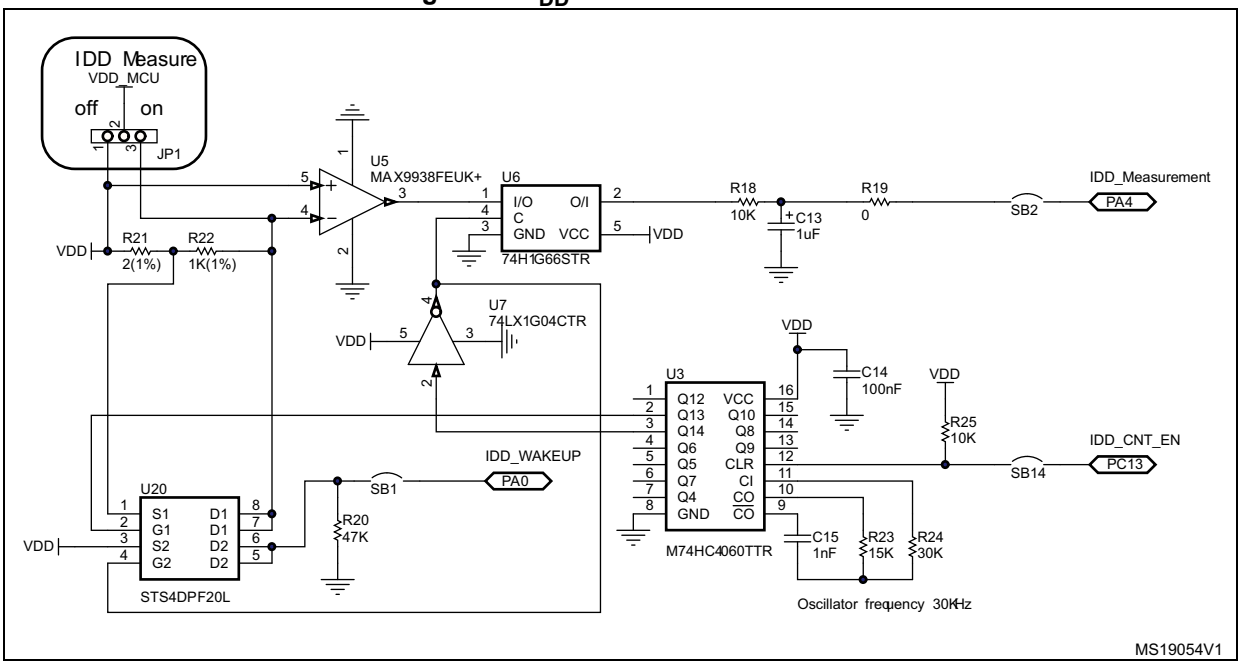
The 32L152CDISCOVERY built-in I_{DD} measurement circuit allows to measure the consumption of the STM32L152RCT6 and to display the value on the LCD glass while the MCU is in Run or Low-power modes.

- JP1 ON: the STM32L152RCT6 is powered through the I_{DD} measurement circuit (default).
- JP1 OFF: the STM32L152RCT6 is directly powered. The I_{DD} measurement circuit is bypassed.

Note: When jumper JP1 is removed, the current consumption of the STM32L152RCT6 *can be measured by connecting an ammeter between jumper pin 1 and pin 2 of JP1.*

To perform the I_{DD} measurement by the MCU itself, the circuit shown in *Figure 10* is implemented on the 32L152CDISCOVERY. The solder bridges SB1, SB2 and SB14 must be closed and JP1 must be ON.The low IDD range procedure (see *Section 4.7.2*) is recommended when the MCU is in Low-power mode and the IDD current does not exceed 60 µA. The high IDD range procedure (see *Section 4.7.1*)is applicable when the MCU operates in Run mode and can sink up to 30 mA.

Figure 10. I_{DD} measurement circuit



4.7.1 High I_{DD} range mode

In high I_{DD} range mode, the I_{DD} current is measured using the operational amplifier MAX9938FEUK+ (U5) connected to the 2 Ω shunt resistor (R21). In this case IDD_CNT_EN remains high during the measurement. R22 remains in short-circuit during the measurement because the FET transistor 1 of U20 remains ON permanently.

4.7.2 Low I_{DD} range mode

In low I_{DD} range mode, the operational amplifier MAX9938FEUK+ (U5) is connected to the 1 KΩ shunt resistor (R22), controlled by the FET transistor 1 of U20. In this case the counter 74HC4060 (U3) enabled by IDD_CNT_EN manages the measurement timing according to *Figure 11*.

Low I_{DD} range measurement principle

The principle used to measure the consumption current when the STM32L152RCT6 is in low I_{DD} range mode is as follows:

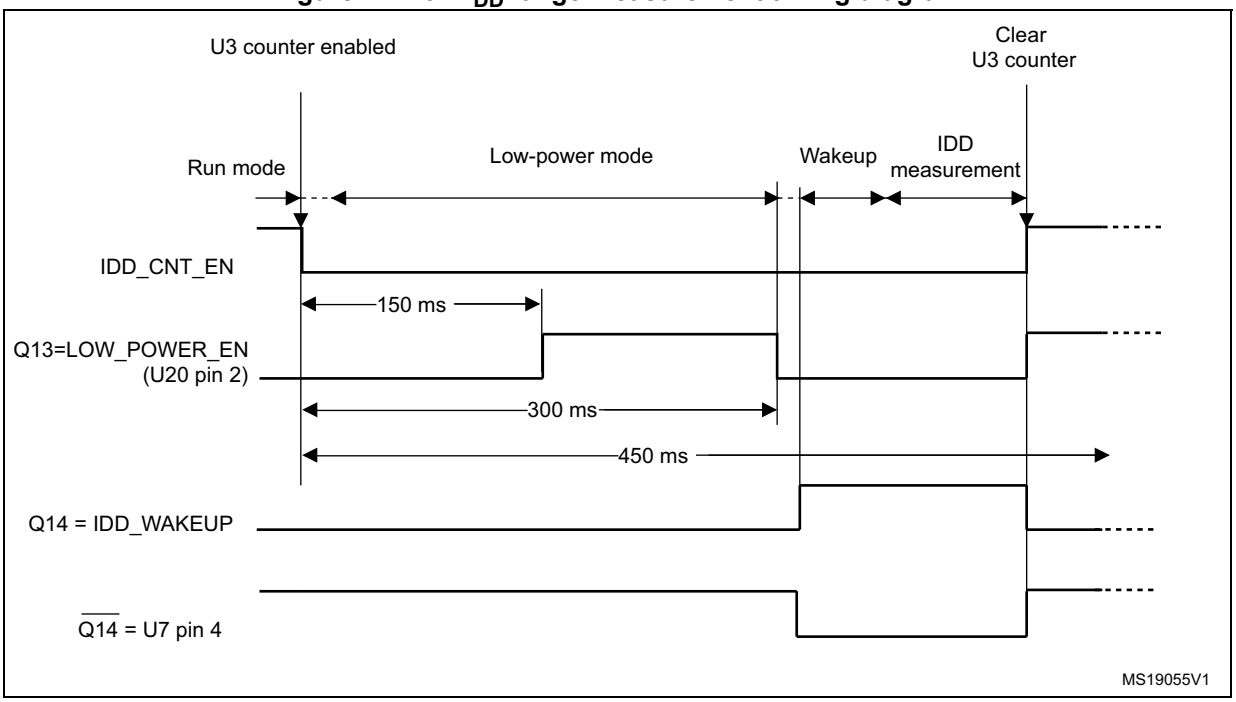
1. Configure ADC to measure voltage on the IDD_Measurement pin.
2. Configure PA0 to serve as wakeup pin.
3. Enter low I_{DD} range mode after setting IDD_CNT_EN (PC13) signal low.
4. IDD_WAKEUP rising edge wakes up the MCU after around 300 ms.
5. Start ADC conversion as soon as possible after wakeup in order to measure the voltage corresponding to Low-power mode on capacitor C13.
6. Reset the counter by programming IDD_CNT_EN high (in less than 150 ms after the wakeup) to avoid the R22 1 KΩ resistor being connected later in Run mode.

The measurement timing is given in *Figure 11*. In low I_{DD} range mode, the 1 KΩ resistor is connected when the FET transistor 1 of U20 goes OFF, after entering low I_{DD} range mode.

The Q13 output of the counter allows connecting the 1 KW resistor when the current I_{DD} becomes very low.

Figure 11 shows how the counter and the FET transistor 1 of U20 ensure that, 150 ms after IDD_CNT_EN falling edge, the shunt resistor R22 is connected between VDD_MCU and the power supply to reduce the measurement range to 60 µA for the full scale. Then after another 150 ms required for current stabilization, R22 is shorted, the I_{DD} measurement is stored in C13, and the MCU is woken up. After wakeup, the MCU measures the I_{DD} current corresponding to the Low-power mode stored in C13.

Figure 11. Low I_{DD} range measurement timing diagram



4.7.3 I_{BIAS} current measurement procedure

In low I_{DD} range mode, the bias current of the operational amplifier input (U5 pin 4) is not negligible compared to I_{DD} current (typical I_{BIAS} is ~240 nA). To obtain a reliable I_{DD} measurement, it is mandatory to subtract the bias current from the low I_{DD} current value since this current is not sunk by the MCU. I_{BIAS} is measured during production test and stored in the MCU data EEPROM. The discovery demonstration software uses this value to display the correct I_{DD}.

The procedure for I_{BIAS} measurement implemented in the demonstration software is:

1. Power off the board (disconnect the USB cable).
2. Set JP1 OFF.
3. Push down B1 (USER button), power on the board from the USB.
4. Wait at least 1 second before releasing B1. The LCD displays the I_{BIAS} measurement.
5. Power off the board (disconnect the USB cable).
6. Set JP1 ON. The I_{BIAS} value is stored in data EEPROM. The bias current is then subtracted from the I_{DD} measured in I_{DD} range mode.

4.8 Solder bridges

Table 6. Solder bridges

Bridge	State(1)	Description
SB18,20 (X3 crystal)(2)	**ON**	PH0, PH1 are connected to P1 (X3, C21, C22, R30 must not be fitted).
	OFF	X3, C21, C22 and R30 provide a clock as shown in *Section 7: Electrical schematics*. PH0, PH1 are disconnected from P1.
SB7,9,11,13 (DEFAULT)	ON	Reserved, do not modify.
SB6,8,10,12 (RESERVED)	OFF	Reserved, do not modify.
SB1,2,14 (IDD_Measurement)	**ON**	PA0, PA4, PC13 are used by the I_{DD} measurement. JP1 ON.
	OFF	PA0, PA4, PC13 are available and IDD module cannot be used JP1 OFF.
SB15,16 (X2 crystal)	**OFF**	X2, C16, C17 and R28 deliver a 32 KHz clock. PC14, PC15 are not connected to P1.
	ON	PC14, PC15 are only connected to P1. Do not remove X2, C16, C17, R28.
SB5 (B2-RESET)	**ON**	B2 Pushbutton is connected to the NRST pin of the STM32L152 MCU.
	OFF	B2 Pushbutton is not connected the NRST pin of the STM32L152 MCU.
SB4 (B1-USER)	**ON**	B1 Pushbutton is connected to PA0.
	OFF	B1 Pushbutton is not connected to PA0.
SB21 (VDD powered from 3 V)	**ON**	V_{DD} is powered from 3 V, SB22 must be OFF.
	OFF	V_{DD} is not powered from 3 V, SB22 must be ON.
SB22 (Battery enable)	**OFF**	V_{DD} is not powered by the CR2032 battery, SB21 must be ON.
	ON	V_{DD} is powered by the CR2032 battery, SB21 must be OFF.
SB100 (NRST)	**ON**	The NRST signal of the CN2 connector is connected to the NRST pin of the STM32L152RCT6.
	OFF	The NRST signal of the CN2 connector is not connected to the NRST pin of the STM32L152RCT6.
SB101 (SWO)	**ON**	The SWO signal of the CN2 connector is connected to PB3.
	OFF	The SWO signal is not connected.
SB102 (STM_RST)	**OFF**	No incidence on STM32L152RCT6 NRST signal.
	ON	STM32L152RCT6 NRST signal is connected to GND.

Table 6. Solder bridges (continued)

Bridge	State[1]	Description
SB3 (BOOT0)	**ON**	The BOOT0 signal of the STM32L152RCT6 is held low through a 510 Ω pull-down resistor.
	OFF	The BOOT0 signal of the STM32L152RCT6 is held high through a 10 KΩ pull-up resistor.
SB19 (BOOT1)	**OFF**	The BOOT1 signal of the STM32L152RCT6 is held high through a 10 KΩ pull-up resistor.
	ON	The BOOT1 signal of the STM32L152RCT6 is held low through a 510 Ω pull-down resistor.
SB17 (MCO)[2]	**OFF**	STM32L152RCT6 MCO clock signal is not used.
	ON	STM32L152RCT6 MCO clock signal is connected to OSC_IN of the STM32L152RCT6

1. Default SBx state is shown in bold.
2. SB17 and SB20 are OFF to allow the user to choose between MCO and X3 crystal for clock source.

4.9 LCD (24 segments, 4 commons)

This LCD allows the STM32L152RCT6 to display any information on six 14-segment digits and 4 bars, using all COMs. (See the LCD segment mapping in *Figure 17* and pin connections in *Table 7*.)

Note: This LCD also supports six 8-segment digits by only using COM0 and COM1. This configuration allows COM2 and COM3 to be used as I/O ports. In this case the 2 LCD pins must not be plugged into the LCD socket. To proceed with this configuration, remove the LCD carefully, slightly open the COM2 and COM3 pins (pin 13 and pin 14) of the LCD, then replug it in the socket.

Characteristics overview:

- 24 segments and 4 commons
- Drive method: multiplexed 1/4 duty, 1/3 bias
- Operating voltage: 3 V
- Operating temperature: 0 to 50°C
- Connector: 28-pin DIL 2.54 mm pitch

Note: When the LCD is plugged, all I/O ports listed in Table 7 are unavailable. To use one of these as I/O, you must remove the LCD.

Figure 12. LCD segment mapping

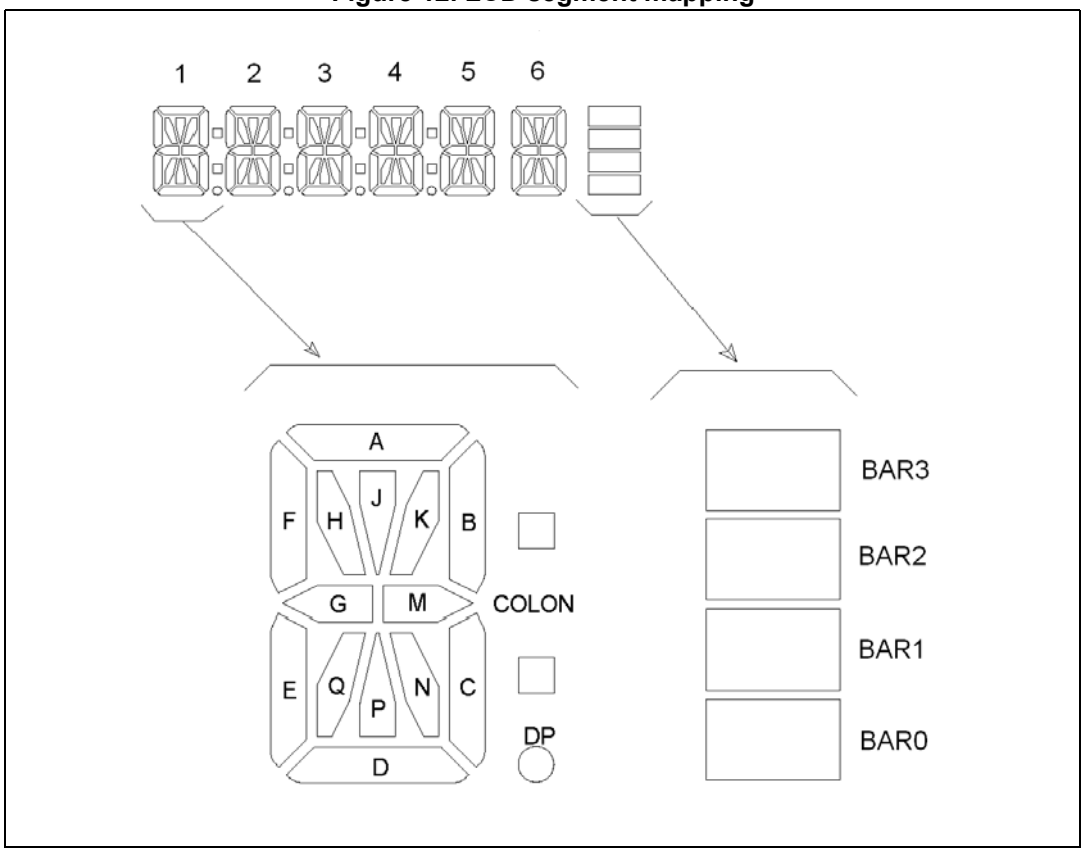


Table 7. LCD connections

STM32L152RCT6	LCD					
GPIO Name	**Pin**	**COM3**	**COM2**	**COM1**	**COM0**	**Name**
PA1	1	1N	1P	1D	1E	LCDSEG0
PA2	2	1DP	1COLON	1C	1M	LCDSEG1
PA3	3	2N	2P	2D	2E	LCDSEG2
PB3	4	2DP	2COLON	2C	2M	LCDSEG3
PB4	5	3N	3P	3D	3E	LCDSEG4
PB5	6	3DP	3COLON	3C	3M	LCDSEG5
PB10	7	4N	4P	4D	4E	LCDSEG6
PB11	8	4DP	4COLON	4C	4M	LCDSEG7
PB12	9	5N	5P	5D	5E	LCDSEG8
PB13	10	BAR2	BAR3	5C	5M	LCDSEG9
PB14	11	6N	6P	6D	6E	LCDSEG10
PB15	12	BAR0	BAR1	6C	6M	LCDSEG11
PB9	13	COM3	-	-	-	LCDCOM3
PA10	14	-	COM2	-	-	LCDCOM2
PA9	15	-	-	COM1	-	LCDCOM1
PA8	16	-	-	-	COM0	LCDCOM0
PA15	17	6J	6K	6A	6B	LCDSEG12
PB8	18	6H	6Q	6F	6G	LCDSEG13
PC0	19	5J	5K	5A	5B	LCDSEG14
PC1	20	5H	5Q	5F	5G	LCDSEG15
PC2	21	4J	4K	4A	4B	LCDSEG16
PC3	22	4H	4Q	4F	4G	LCDSEG17
PC6	23	3J	3K	3A	3B	LCDSEG18
PC7	24	3H	3Q	3F	3G	LCDSEG19
PC8	25	2J	2K	2A	2B	LCDSEG20
PC9	26	2H	2Q	2F	2G	LCDSEG21
PC10	27	1J	1K	1A	1B	LCDSEG22
PC11	28	1H	1Q	1F	1G	LCDSEG23

5 Extension connectors

The male headers P1 and P2 can connect the 32L152CDISCOVERY to a standard prototyping/wrapping board. The STM32L152RCT6 GPIOs are available on these connectors. P1 and P2 can also be probed by an oscilloscope, a logical analyzer or a voltmeter.

Table 8. MCU pin description versus board function

MCU pin			Board function										
Main function	**Alternate functions**	**LQFP64 pin num**	**LCD glass**	**Linear Touch Sensor**	**Push button**	**I_{DD}**	**LED**	**SWD**	**OSC**	**Free I/O**	**Power supply**	**P1**	**P2**
-	-	-	-	-	-	-	-	-	-	-	EXT_3V	1	-
-	-	-	-	-	-	-	-	-	-	-	EXT_5V		1
BOOT0	-	60	-	-	-	-	-	-	-	-	-	-	6
NRST	-	7	-	-	-	-	-	NRST	-	-	-	10	-
PA0	WKUP1/USART2_CTS/ ADC_IN0/TIM2_CH1_ETR/COMP1_INP	14	-	-	PA0	WAKEUP	-	-	-	-	-	15	-
PA1	USART2_RTS/ADC_IN1/ TIM2_CH2/LCD_SEG0/ COMP1_INP	15	SEG0	-	-	-	-	-	-	-	-	16	-
PA2	USART2_TX/ADC_IN2/ TIM2_CH3/TIM9_CH1/ LCD_SEG1/COMP1_INP	16	SEG1	-	-	-	-	-	-	-	-	17	-
PA3	USART2_RX/ADC_IN3/ TIM2_CH4/TIM9_CH2/ LCD_SEG2/COMP1_INP	17	SEG2	-	-	-	-	-	-	-	-	18	-
PA4	SPI1_NSS/USART2_CK/ ADC_IN4/DAC_OUT1/ COMP1_INP	20	-	-	-	Measurement	-	-	-	-	-	19	-

Table 8. MCU pin description versus board function (continued)

MCU pin			Board function										
Main function	Alternate functions	LQFP64 pin num	LCD glass	Linear Touch Sensor	Push button	I_{DD}	LED	SWD	OSC	Free I/O	Power supply	P1	P2
PA5	SPI1_SCK/ADC_IN5/ DAC_OUT2/ TIM2_CH1_ETR/COMP1_INP	21	-	-	-	-	-	-	-	X	-	20	-
PA6	SPI1_MISO/ADC_IN6/ TIM3_CH1/TIM1_BKIN/ LCD_SEG3/TIM10_CH1/ COMP1_INP	22	-	PA6	-	-	-	-	-	-	-	-	-
PA7	SPI1_MOSI/ADC_IN7/ TIM3_CH2/TIM1_CH1N /LCD_SEG4/TIM11_CH1/ COMP1_INP	23	-	PA7	-	-	-	-	-	-	-	-	-
PA8	USART1_CK/MCO/ LCD_COM0	41	COM0	-	-	-	-	-	-	-	-	-	23
PA9	USART1_TX/LCD_COM1	42	COM1	-	-	-	-	-	-	-	-	-	22
PA10	USART1_RX/LCD_COM2	43	COM2	-	-	-	-	-	-	-	-	-	21
PA11	USART1_CTS/USBDM/ SPI1_MISO	44	-	-	-	-	-	-	-	X	-	-	20
PA12	USART1_RTS/USBDP/ SPI1_MOSI	45	-	-	-	-	-	-	-	X	-	-	19
JTMS/ SWDIO	PA13	46	-	-	-	-	-	SWDIO	-	-	-	-	18
JTCK/ SWCLK	PA14	49	-	-	-	-	-	SWCLK	-	-	-	-	17
JTDI	TIM2_CH1_ETR/PA15/ SPI1_NSS/LCD_SEG17	50	SEG12	-	-	-	-	-	-	-	-	-	16
PB0	ADC_IN8/TIM3_CH3/ LCD_SEG5/COMP1_INP/ VREF_OUT	26	-	PB0	-	-	-	-	-	-	-	-	-

Table 8. MCU pin description versus board function (continued)

MCU pin			Board function										
Main function	Alternate functions	LQFP64 pin num	LCD glass	Linear Touch Sensor	Push button	I_{DD}	LED	SWD	OSC	Free I/O	Power supply	P1	P2
PB1	ADC_IN9/TIM3_CH4/ LCD_SEG6/COMP1_INP/ VREF_OUT	27	-	PB1	-	-	-	-	-	-	-	-	-
PB2/BOOT1	-	28	-	-	-	-	-	-	-	-	-	21	-
JTDO	TIM2_CH2/PB3/TRACESWO/SPI1_SCK/COMP2_INM/LCD_SEG7	55	SEG 3	-	-	-	-	SWO	-	-	-	-	11
JNTRST	TIM3_CH1/PB4/SPI1_MISO/COMP2_INP/LCD_SEG8	56	SEG 4	-	-	-	-	-	-	-	-	-	10
PB5	I2C1_SMBAI/TIM3_CH2/ SPI1_MOSI/COMP2_INP/ LCD_SEG9	57	SEG 5	-	-	-	-	-	-	-	-	-	9
PB6	I2C1_SCL/TIM4_CH1/ USART1_TX/LCD_SEG8	58	-	-	-	-	Blue	-	-	-	-	-	8
PB7	I2C1_SDA/TIM4_CH2/ USART1_RX/PVD_IN	59	-	-	-	-	Green	-	-	-	-	-	7
PB8	TIM4_CH3/I2C1_SCL/ LCD_SEG16/TIM10_CH1	61	SEG 13	-	-	-	-	-	-	-	-	-	4
PB9	TIM4_CH4/I2C1_SDA/ LCD_COM3/TIM11_CH1	62	COM 3	-	-	-	-	-	-	-	-	-	3
PB10	I2C2_SCL/USART3_TX/ TIM2_CH3/LCD_SEG10	29	SEG 6	-	-	-	-	-	-	-	-	22	-
PB11	I2C2_SDA/USART3_RX/ TIM2_CH4/LCD_SEG11	30	SEG 7	-	-	-	-	-	-	-	-	23	-

Table 8. MCU pin description versus board function (continued)

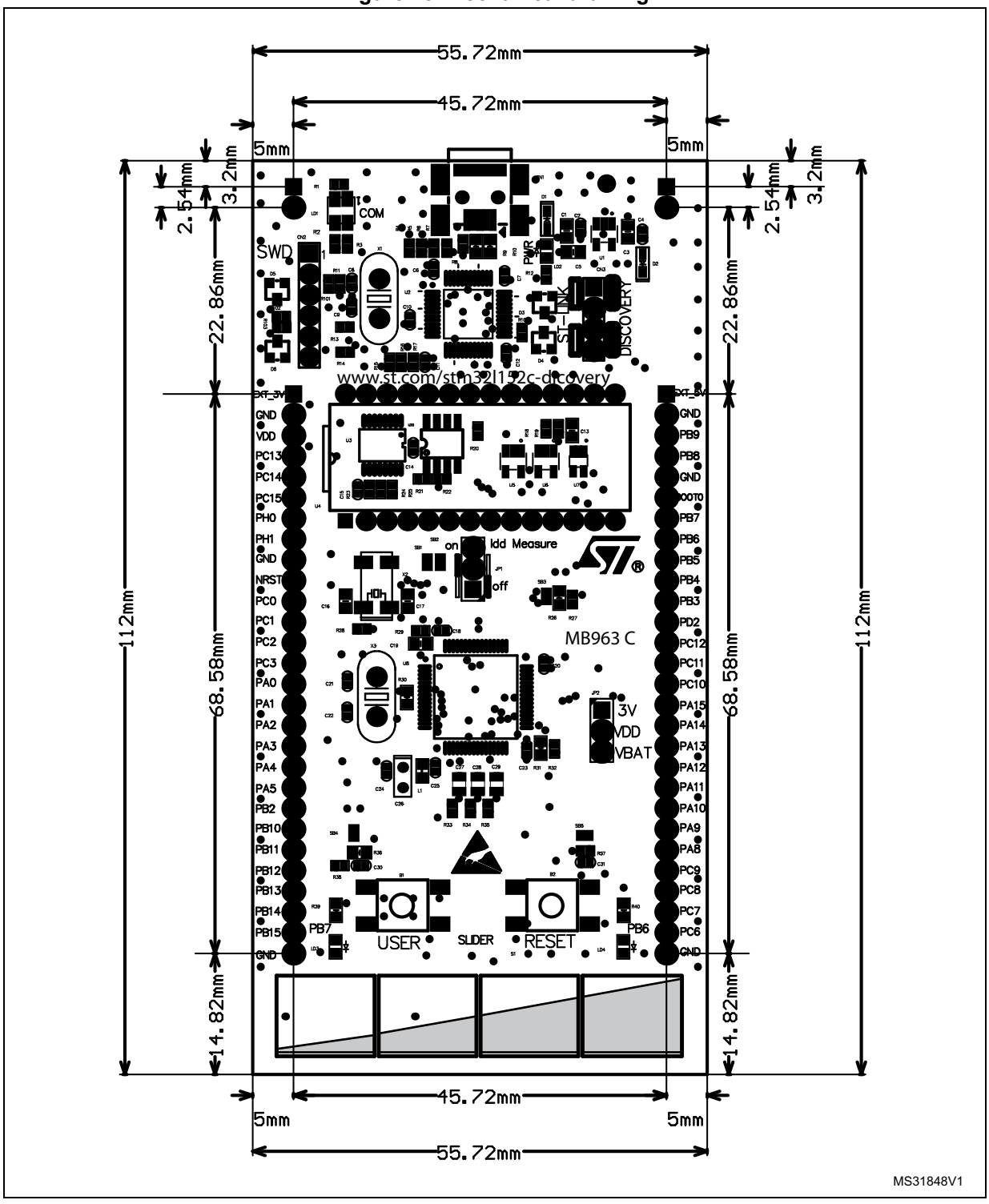
MCU pin			Board function										
Main function	Alternate functions	LQFP64 pin num	LCD glass	Linear Touch Sensor	Push button	I_{DD}	LED	SWD	OSC	Free I/O	Power supply	P1	P2
PB12	SPI2_NSS/I2C2_SMBA/ USART3_CK/LCD_SEG12/ADC_IN18/ COMP1_INP/ TIM10_CH1	33	SEG 8	-	-	-	-	-	-	-	-	24	-
PB13	SPI2_SCK/USART3_CTS/ LCD_SEG13/ADC_IN19/ COMP1_INP/TIM9_CH1	34	SEG 9	-	-	-	-	-	-	-	-	25	-
PB14	SPI2_MISO/USART3_RTS/LCD_SEG14/ADC_IN20/ COMP1_INP/TIM9_CH2	35	SEG 10	-	-	-	-	-	-	-	-	26	-
PB15	SPI2_MOSI/TIM1_CH3N/ LCD_SEG15/ADC_IN21/ COMP1_INP/TIM11_CH1/ RTC_50_60Hz	36	SEG 11	-	-	-	-	-	-	-	-	27	-
PC0	ADC_IN10/LCD_SEG18/ COMP1_INP	8	SEG 14	-	-	-	-	-	-	-	-	11	-
PC1	ADC_IN11/LCD_SEG19/ COMP1_INP	9	SEG 15	-	-	-	-	-	-	-	-	12	-
PC2	ADC_IN12/LCD_SEG20/ COMP1_INP	10	SEG 16	-	-	-	-	-	-	-	-	13	-
PC3	ADC_IN13/LCD_SEG21/ COMP1_INP	11	SEG 17	-	-	-	-	-	-	-	-	14	-
PC4	ADC_IN14/LCD_SEG22/ COMP1_INP	24	-	PC4	-	-	-	-	-	-	-	-	-
PC5	ADC_IN15/LCD_SEG23/ COMP1_INP	25	-	PC5	-	-	-	-	-	-	-	-	-

Table 8. MCU pin description versus board function (continued)

MCU pin			Board function										
Main function	Alternate functions	LQFP64 pin num	LCD glass	Linear Touch Sensor	Push button	I_{DD}	LED	SWD	OSC	Free I/O	Power supply	P1	P2
PC6	TIM3_CH1/LCD_SEG24	37	SEG 18	-	-	-	-	-	-	-	-	-	27
PC7	TIM3_CH2/LCD_SEG25	38	SEG 19	-	-	-	-	-	-	-	-	-	26
PC8	TIM3_CH3/LCD_SEG26	39	SEG 20	-	-	-	-	-	-	-	-	-	25
PC9	TIM3_CH4/LCD_SEG27	40	SEG 21	-	-	-	-	-	-	-	-	-	24
PC10	USART3_TX/LCD_SEG28/LCD_SEG40/LCD_COM4	51	SEG 22	-	-	-	-	-	-	-	-	-	15
PC11	USART3_RX/LCD_SEG29/LCD_SEG41/ LCD_COM5	52	SEG 23	-	-	-	-	-	-	-	-	-	14
PC12	USART3_CK/LCD_SEG30/LCD_SEG42/ LCD_COM6	53	-	-	-	-	-	-	-	X	-	-	13
PC13	RTC_AF1/WKUP2	2	-	-	-	CNT_EN	-	-	-	-	-	4	-
PC14	OSC32_IN	3	-	-	-	-	-	-	OSC32_IN	-	-	5	-
PC15	OSC32_OUT	4	-	-	-	-	-	-	OSC32_OUT	-	-	6	-
PD2	TIM3_ETR/LCD_SEG31/ LCD_SEG43/LCD_COM7	54	-	-	-	-	-	-	-	X	-	-	12
OSC_IN	PH0	5	-	-	-	-	-	-	OSC_IN	-	-	7	-
OSC_OUT	PH1	6	-	-	-	-	-	-	OSC_OUT	-	-	8	-
-	-	-	-	-	-	-	-	-	-	-	GND	2	2
-	-	-	-	-	-	-	-	-	-	-	GND	9	5
-	-	-	-	-	-	-	-	-	-	-	GND	28	28
-	-	-	-	-	-	-	-	-	-	-	VDD	3	-

6 Mechanical drawing

Figure 13. Mechanical drawing



7 Electrical schematics

Figure 14. 32L152CDISCOVERY

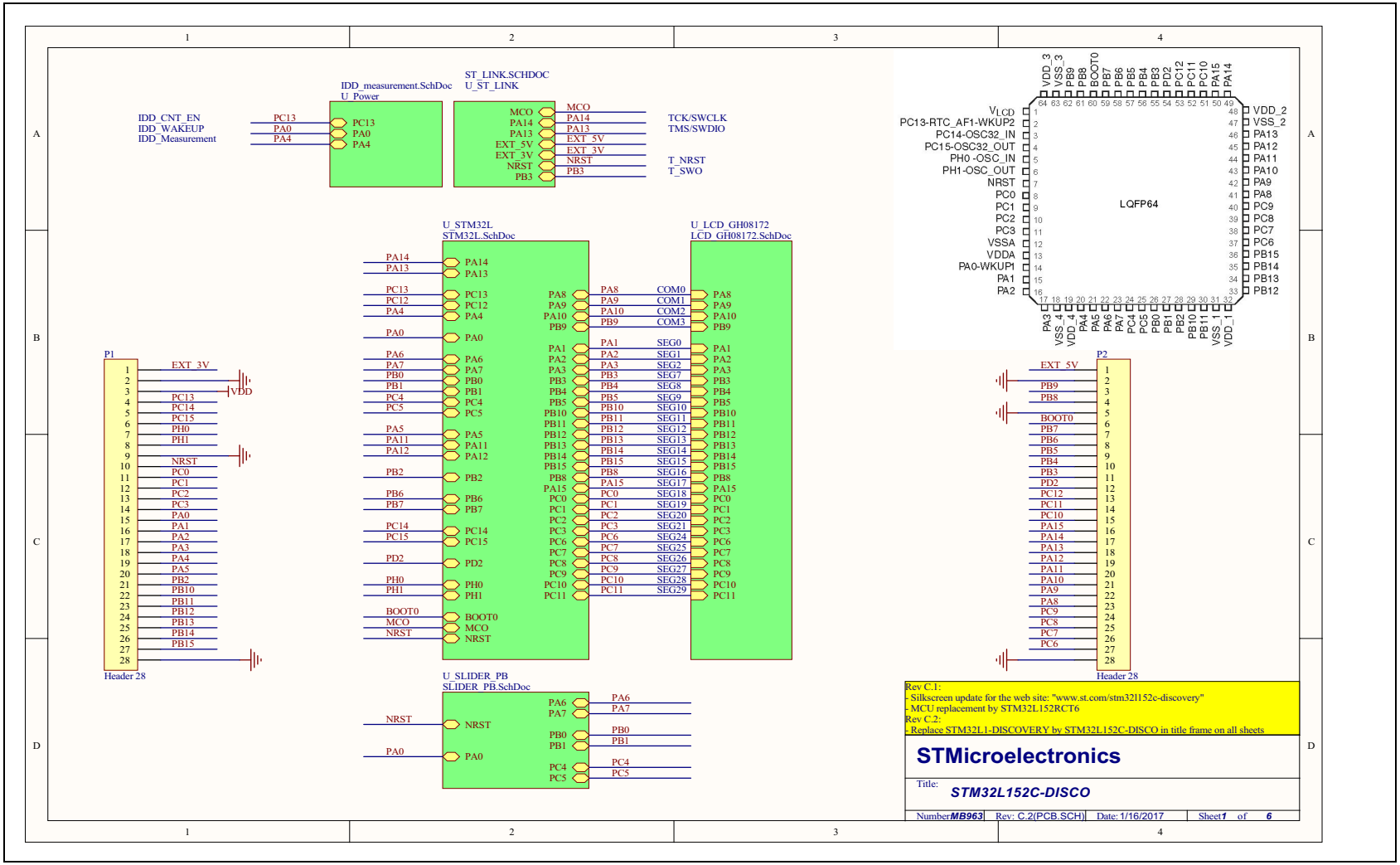


Figure 15. ST-LINK/V2 (SWD only)

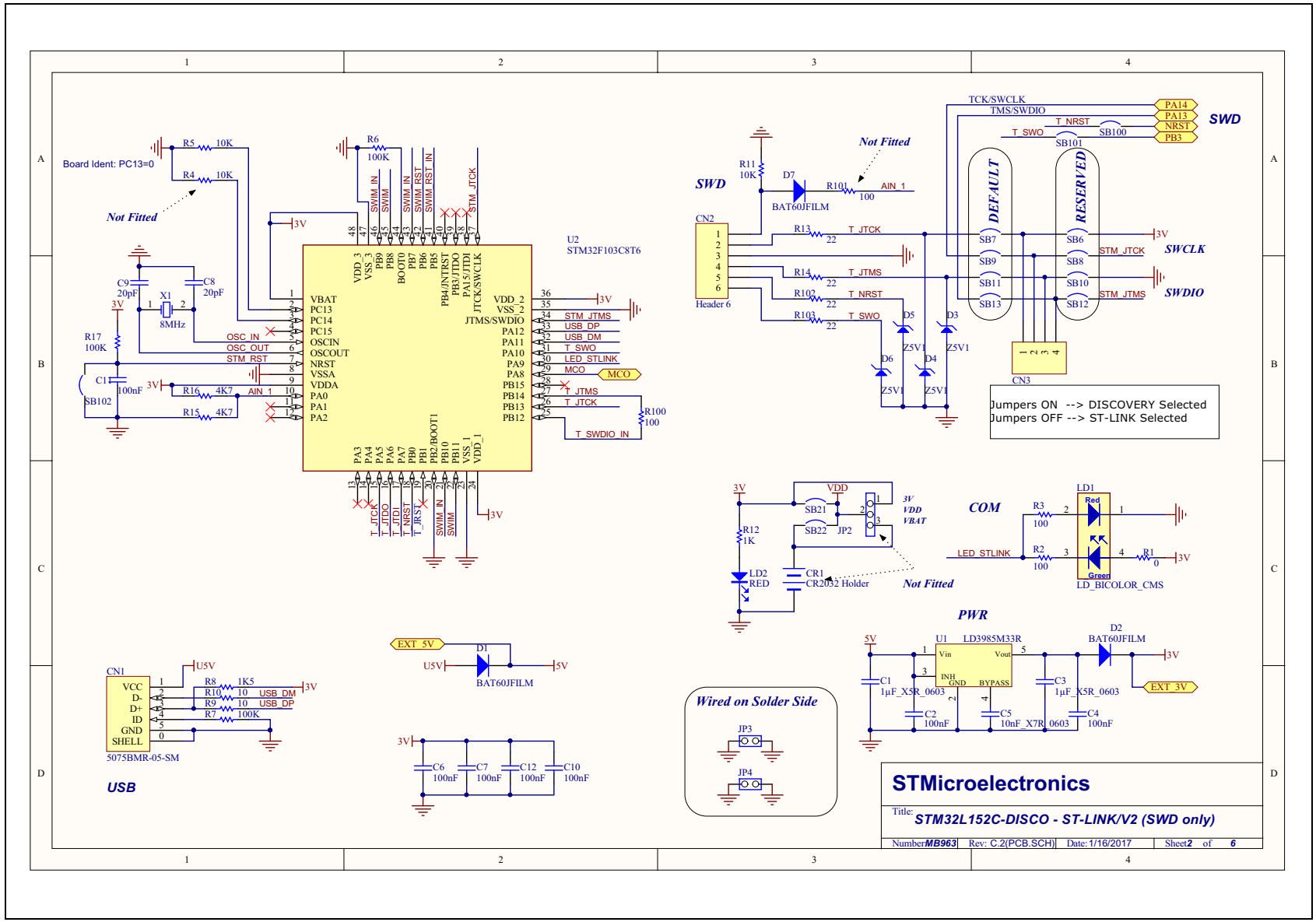


Figure 16. MCU

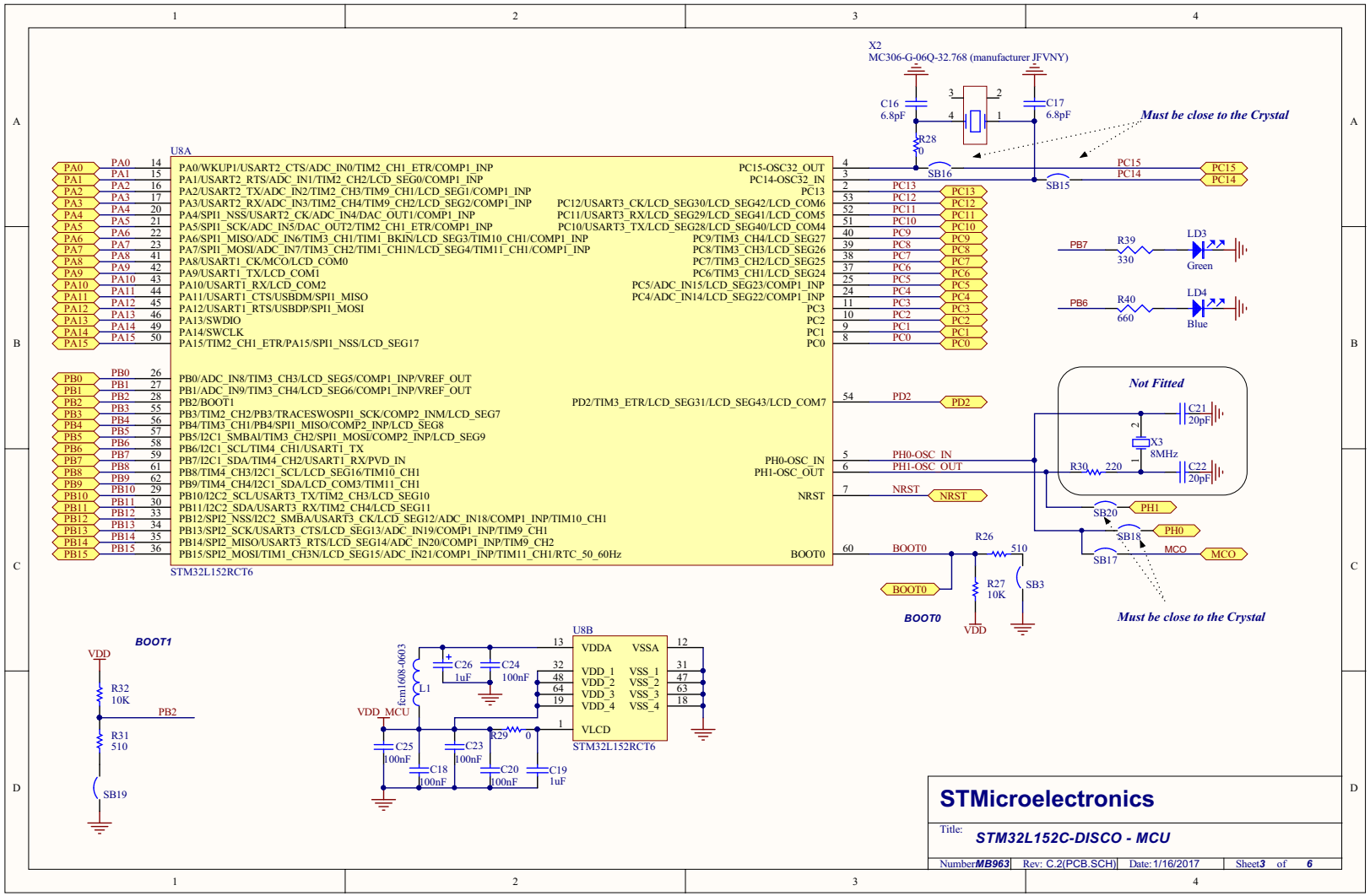


Figure 17. LCD

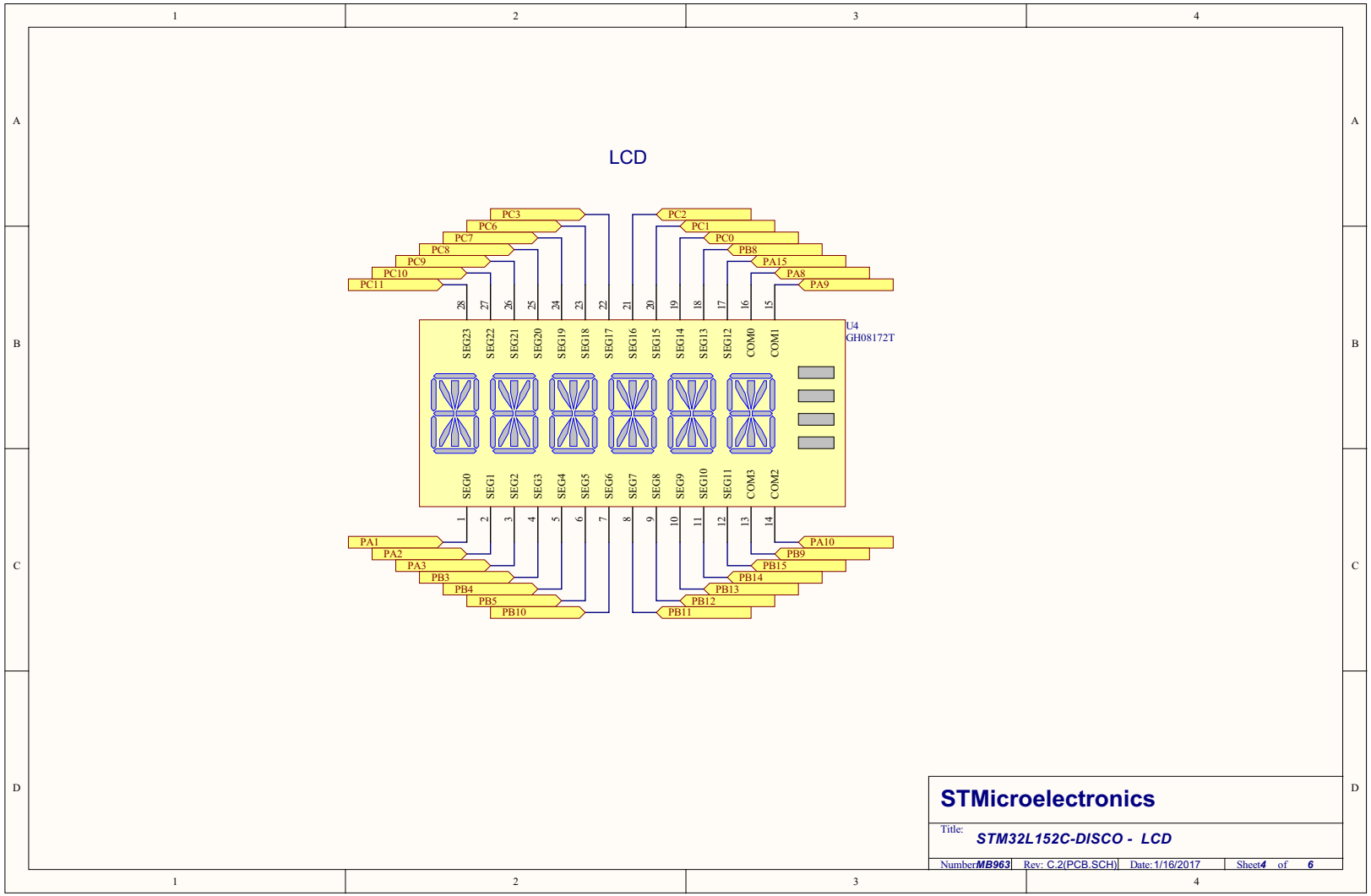


Figure 18. I_{DD} measurement

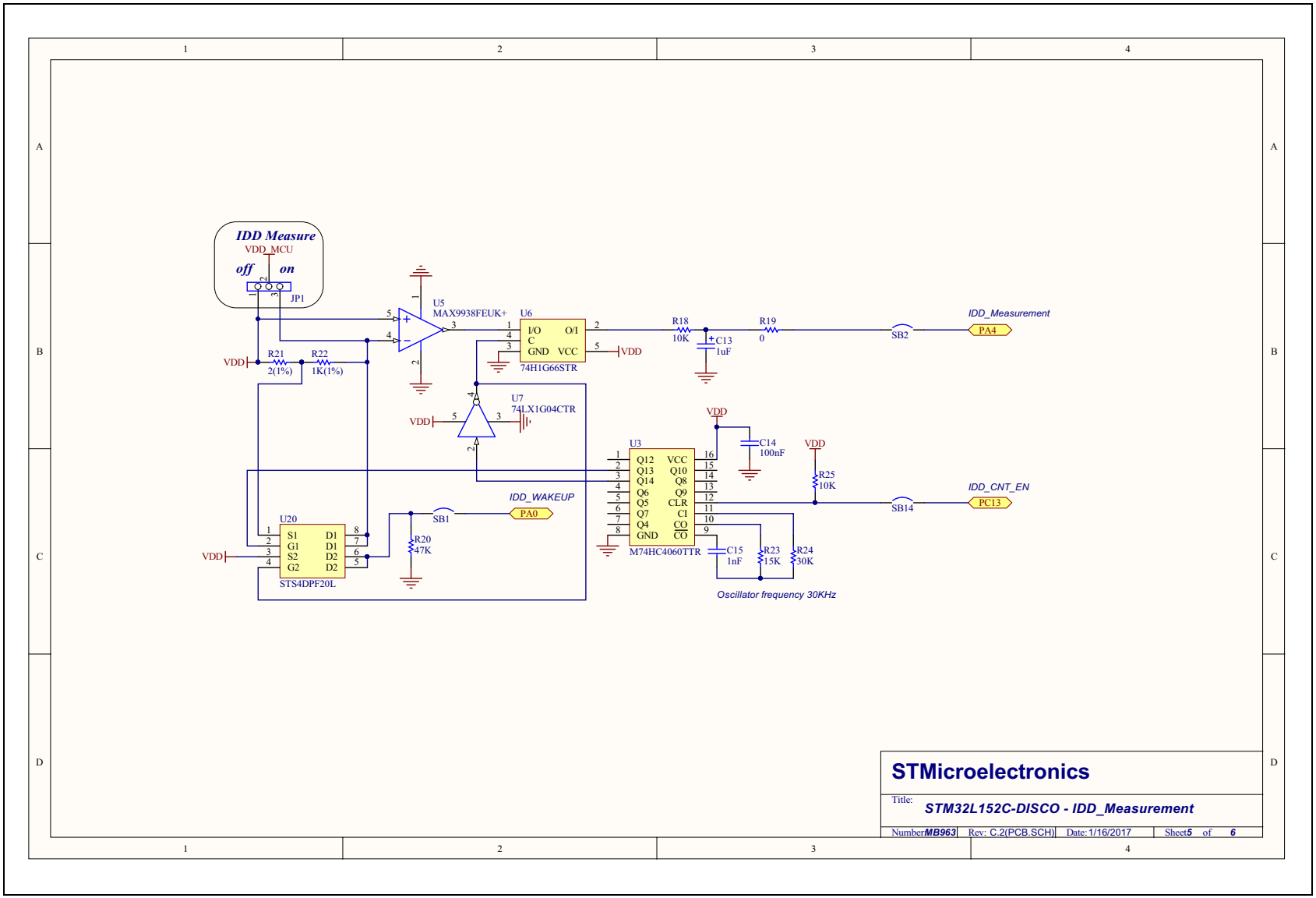
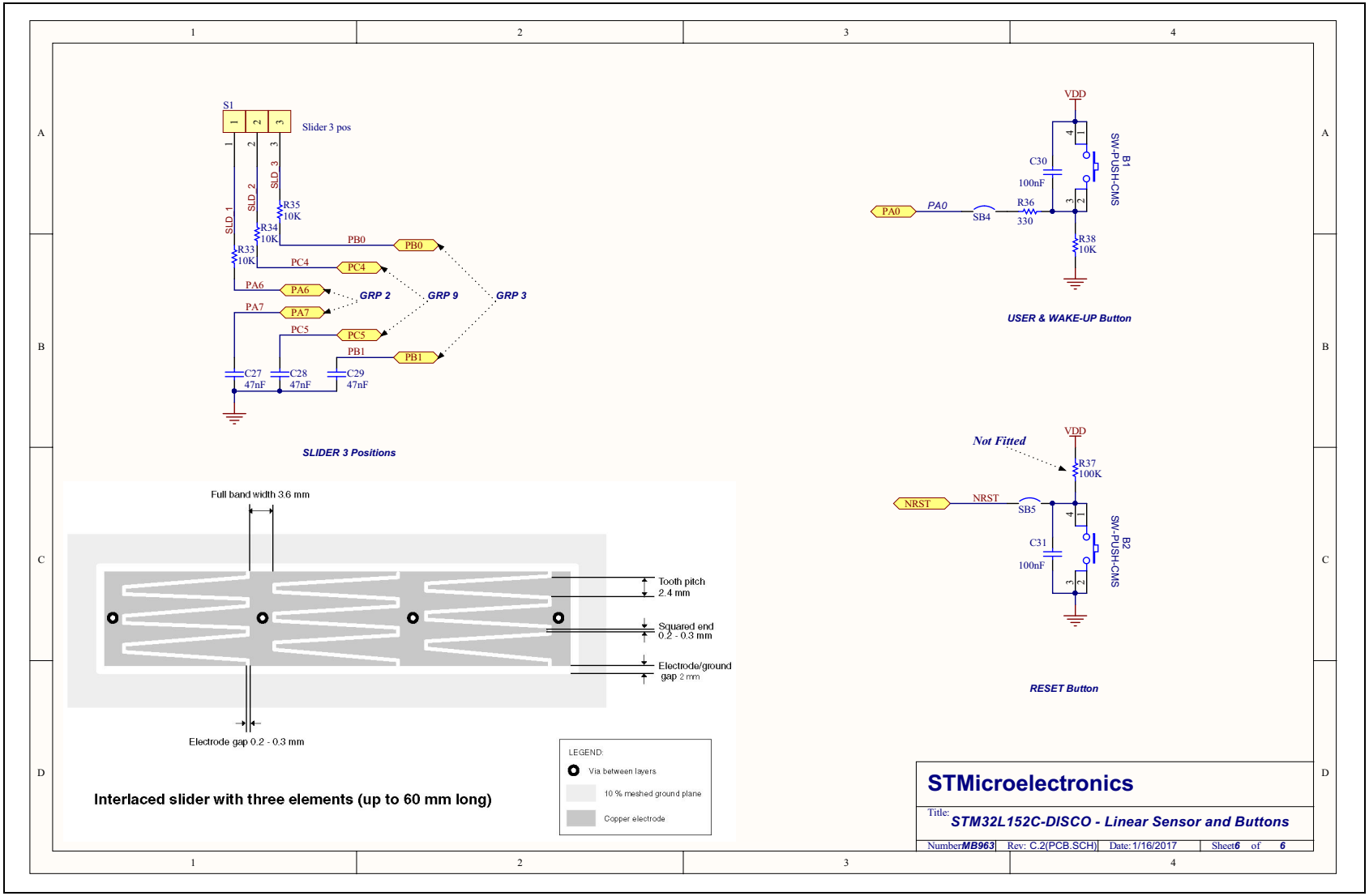


Figure 19. Linear touch sensor/touchkeys



8 Revision history

Table 9. Document revision history

Date	Revision	Changes
10-May-2011	1	Initial release.
24-June-2011	2	Added *Chapter 6: Mechanical drawing.* Modified *Chapter 4.3: Power supply and power selection.*
19-Apr-2013	3	Added 32L152CDISCOVERY, related features. Updated STM32L-DISCOVERY url. Modified *Section 2.2: System requirements, Section 2.5: Order codes, Section 4.1: STM32L152RBT6 or STM32L152RCT6 microcontroller, Section 4.2.1: Using the ST-LINK/V2 to program/debug the STM32L on board,* and *Section 4.2.2: Using the ST-LINK/V2 to program/debug an external STM32L application* Updated *Figure 1: STM32L1 discovery board, Figure 2: Hardware block diagram, Figure 3: Top layout, Figure 6: STM32L152RBT6 block diagram, Figure 13: LCD segment mapping* and all schematics in *Section 7*.
23-Jan-2017	4	– Updated title. – Updated *Section 4.6: Linear touch sensor / touchkeys*: AN2869 replaced by AN4312. – Updated all schematics in *Section 7*.