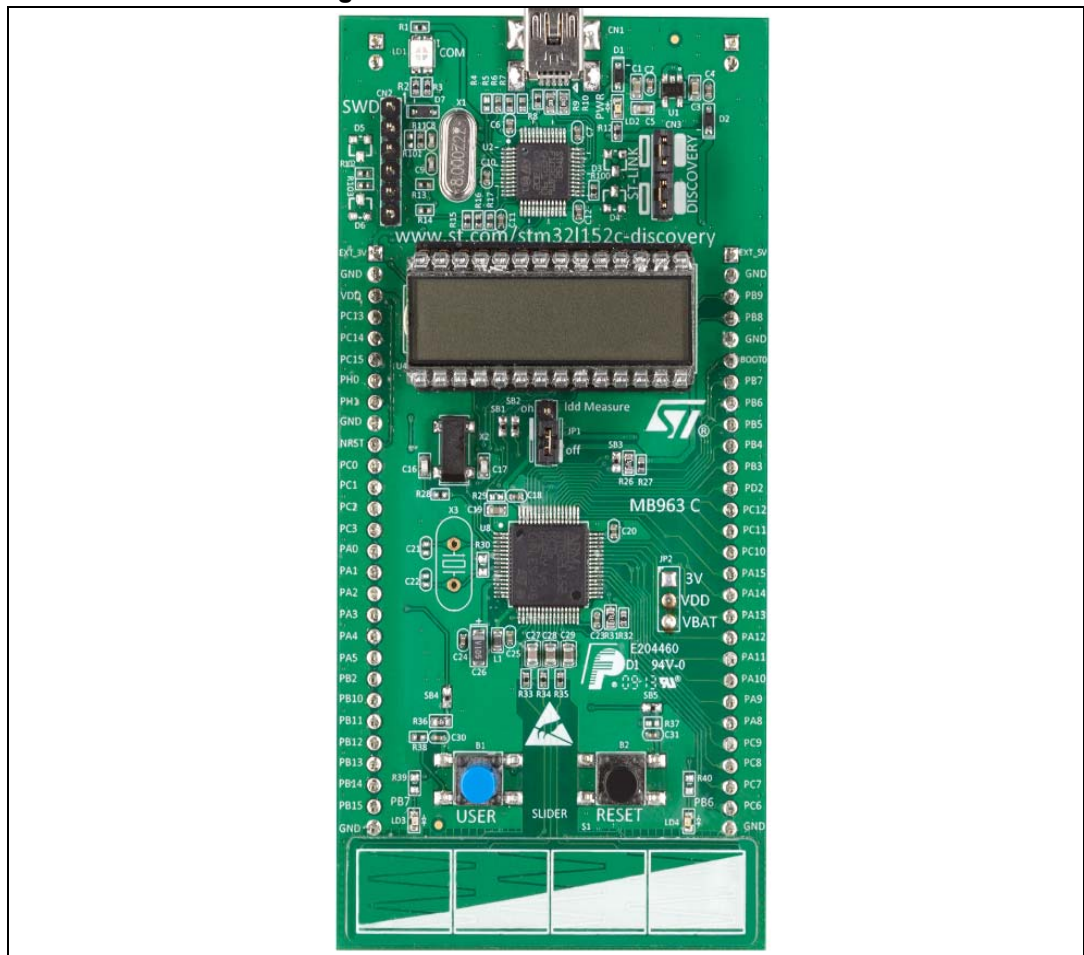Discovery kit with STM32L152RC MCU

Introduction

The 32L152CDISCOVERY Discovery kit helps the development of applications based on the STM32L1 series microcontrollers and benefits from the ultra-low-power features of these devices.

Based on the STM32L152RC microcontroller, this Discovery kit includes an ST-LINK/V2 embedded debugging tool interface, a 24-segment 4-common LCD, LEDs, push-buttons, a linear touch sensor, and touchkeys.

Figure 1. 32L152CDISCOVERY board

1. Picture is not contractual.

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1 Features

- STM32L152RC Arm®(a) Cortex®-M3 core-based microcontroller with 256 Kbytes of flash memory, 32 Kbytes of RAM, and 8 Kbytes of data EEPROM in an LQFP64 package
- 24-segment 4-common LCD in a DIP28 package
- Four LEDs:
  - LD1 (red/green) for USB communication
  - LD2 (red) for 3.3 V power-on
  - Two user LEDs, LD3 (green) and LD4 (blue)
- User and reset push-buttons
- One linear touch sensor and four touchkeys
- Board connectors:
  - Serial Wire Debug port (SWD)
  - Extension header for LQFP64 I/Os for quick connection to prototyping board and easy probing
- Flexible power supply options: ST-LINK USB VBUS or external sources
- External application power supply: 3 V and 5 V
- IDD current measurement
- Comprehensive free software libraries and examples available with the STM32Cube MCU Package
- On-board ST-LINK/V2 debugger/programmer with USB re-enumeration capability: Virtual COM port, and debug port
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE
- The former STM32L-DISCOVERY Discovery kit offered the same features except for the STM32L152RB microcontroller with 128 Kbytes of flash memory, 16 Kbytes of RAM, and 4 Kbytes of data EEPROM, in an LQFP64 package.

arm

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

2 Ordering information

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

Table 1. Ordering information

Order code	Board reference	Target STM32L1
STM32L152C-DISCO[1]	MB963	STM32L152RCT6
STM32L-DISCOVERY[2]		STM32L152RBT6

1. Subsequently called main board in the rest of the documentation.
2. STM32L-DISCOVERY is replaced by STM32L152C-DISCO.

2.1 Codification

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

Table 2. Codification explanation

STM32XXYYZ-DISCO	Description	Example: STM32L152C-DISCO
STM32XX	MCU series in STM32 32-bit Arm Cortex MCUs	STM32L1 series
YY	MCU product line in the series	STM32L151/152
Z	STM32L1 flash memory size: -C for 256 Kbytes	256 Kbytes
DISCO	Discovery kit	Discovery kit

3 System requirements

3.1 System requirements

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

3.2 Development toolchains

- IAR Systems[®] - IAR Embedded Workbench[®](d)
- Keil[®] - MDK-ARM[(d)]
- STMicroelectronics - STM32CubeIDE

3.3 Demonstration software

The demonstration software, included in the STM32Cube MCU Package corresponding to the on-board microcontroller, is preloaded in the STM32 flash memory for easy demonstration of the device peripherals in standalone mode. The latest versions of the demonstration source code and associated documentation can be downloaded from *www.st.com*.

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

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

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

d. On Windows[®] only.

4 Conventions

Table 3 provides the conventions used for the ON and OFF settings in the present document.

Table 3. ON/OFF conventions

Convention	Definition
Jumper JPx ON	Jumper fitted
Jumper JPx OFF	Jumper not fitted
Jumper JPx [1-2]	Jumper fitted between pin 1 and pin 2
Solder bridge SBx ON	SBx connections closed by 0 Ω resistor
Solder bridge SBx OFF	SBx connections left open
Resistor Rx ON	Resistor soldered
Resistor Rx OFF	Resistor not soldered
Capacitor Cx ON	Capacitor soldered
Capacitor Cx OFF	Capacitor not soldered

The following sections of this user manual are also applicable to the STM32L-DISCOVERY except for specific features of the STM32L152RB microcontroller with 128 Kbytes of flash memory, 16 Kbytes of RAM, and 4 Kbytes of data EEPROM.

5 Quick start

Before using the Discovery kit, accept the evaluation product license agreement available on the 32L152CDISCOVERY page of the www.st.com/mcu website.

5.1 Getting started

The following sequence configures 32L152CDISCOVERY and launches the Discovery application:

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

Depending on the function selected, the voltage value, the linear touch sensor position, the touchkeys status, or the STM32L152RC, the current consumption is displayed on the LCD.

Table 4. Executed functions when clicking the B1 button

Function	LED LD3/4	Bar status	Value displayed on LCD	Main function
1	LD3 and LD4 blink		Measured STM32L152RC 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			STM32L152RC consumption is measured in Run mode (4 MHz).	STM32L152RC current consumption measurement
			STM32L152RC consumption is measured in Sleep mode (4 MHz).	
5			STM32L152RC consumption is measured in Run mode (32 KHz).	
	LD3 and LD4 OFF		STM32L152RC consumption is measured in Low-power sleep mode (32 KHz).	
6			STM32L152RC consumption is measured in Stop mode, RTC ON.	
			STM32L152RC consumption is measured in Stop mode, RTC OFF.	
7			STM32L152RC consumption is measured in Standby mode.	

Refer to the *www.st.com/mcu* website for more details on the Discovery project and the STM32L152RC features.

6 Hardware and layout

The 32L152CDISCOVERY is designed around one STM32L152RC packaged in an LQFP64.

Figure 2 illustrates the connections between the STM32L152RC microcontroller and its peripherals (ST-LINK/V2, push-buttons, LEDs, LCD, linear touch sensor, touchkeys, and connectors). These connections are the same for the STM32L-DISCOVERY.

Figure 2. Hardware block diagram
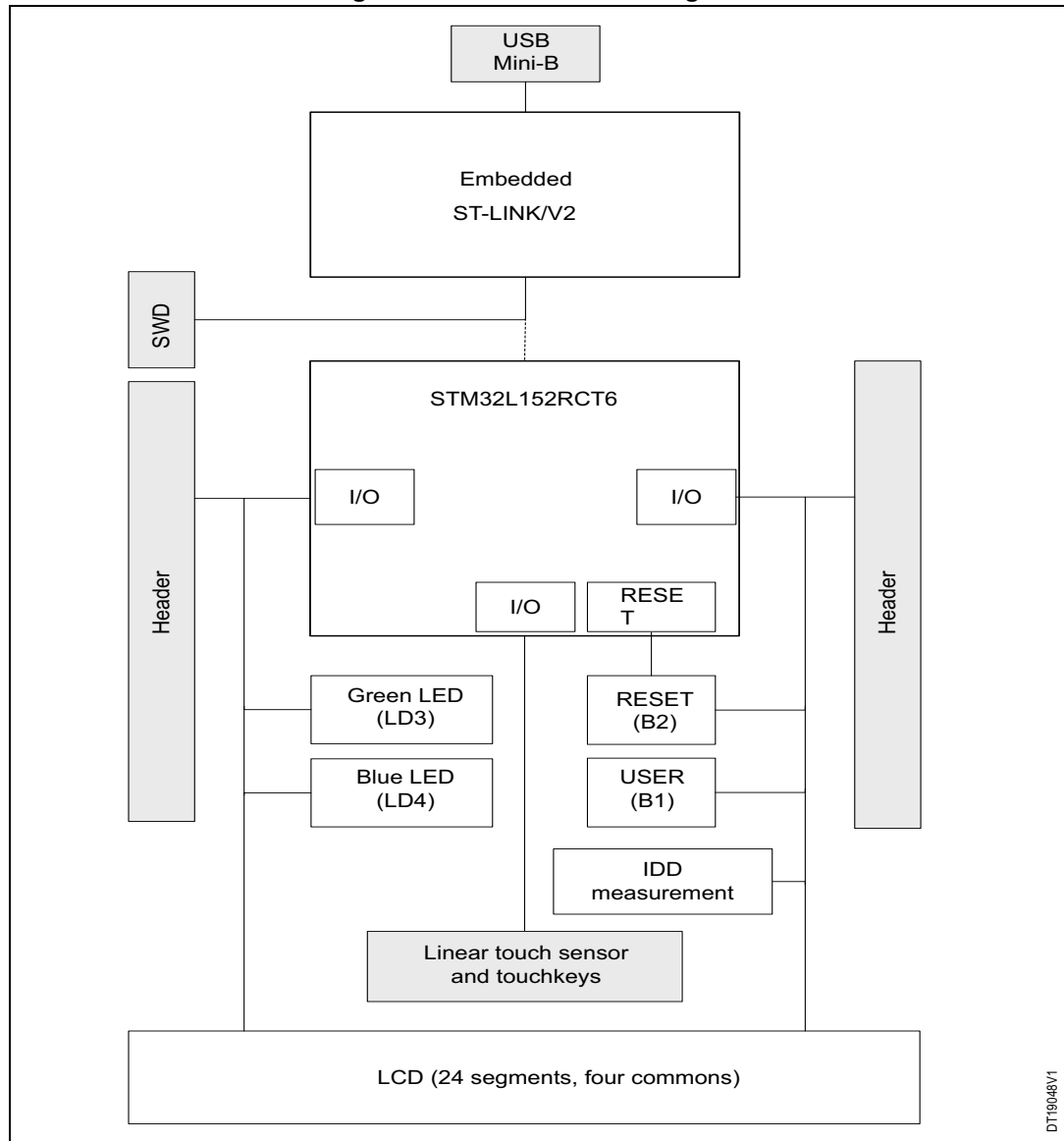
Figure 3 and *Figure 4* locate these features on the board.

6.1 32L152CDISCOVERY top and bottom layouts

Figure 3. Top layout
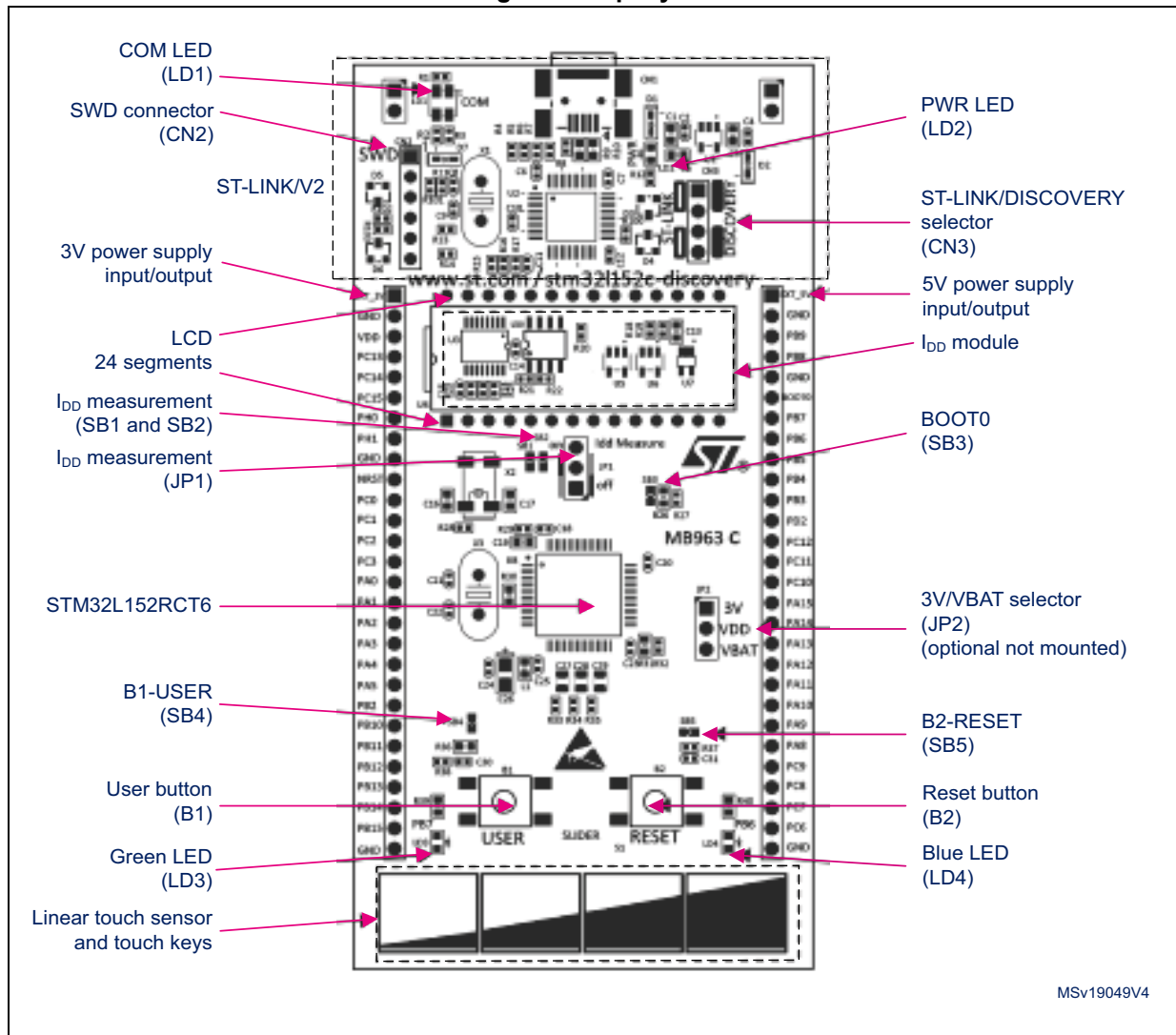
1. A square identifies pin1 of the CN1, CN2, P1, and P2 connectors.

Figure 4. Bottom layout
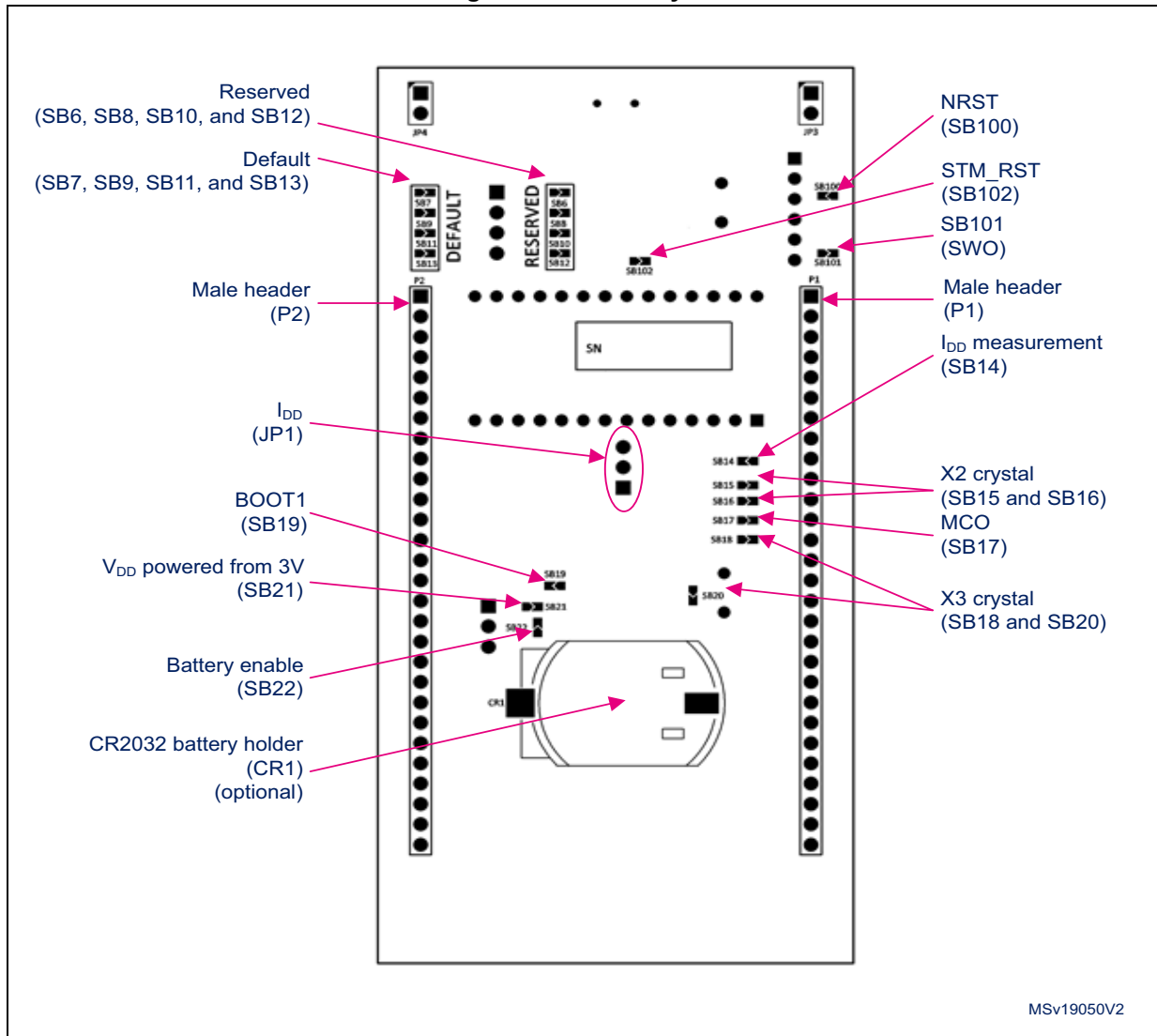
1. A square identifies pin 1 of the CN1, CN2, P1, and P2 connectors.

6.2 Mechanical drawing

Figure 5. Mechanical drawing
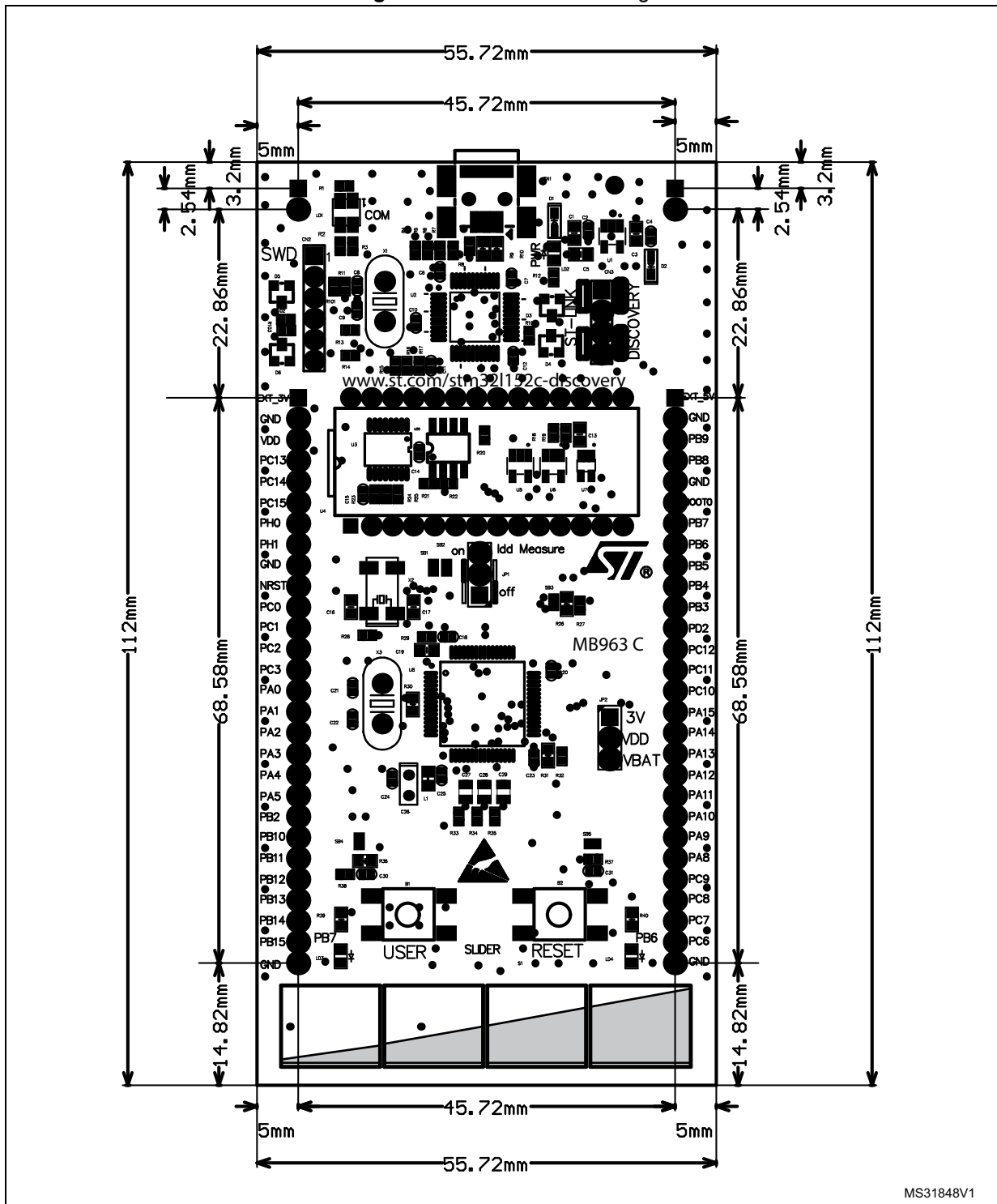
MS31848V1

6.3 Embedded ST-LINK/V2

The ST-LINK/V2 programming and debugging tool is integrated into the 32L152CDISCOVERY. The embedded ST-LINK/V2 can be used in two different ways according to the jumper configuration (refer to *Table 5*):

- Program/debug the MCU on board
- Program/debug an MCU in an external application board using a cable connected to the 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).

Table 5. Jumper states

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

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

Figure 6 shows how to plug the two jumpers on CN3 to program the STM32L152RC on the board. The usage of CN2 is forbidden as it might disturb communication with the microcontroller.

Figure 6. 32L152CDISCOVERY connections

MSv19053V3
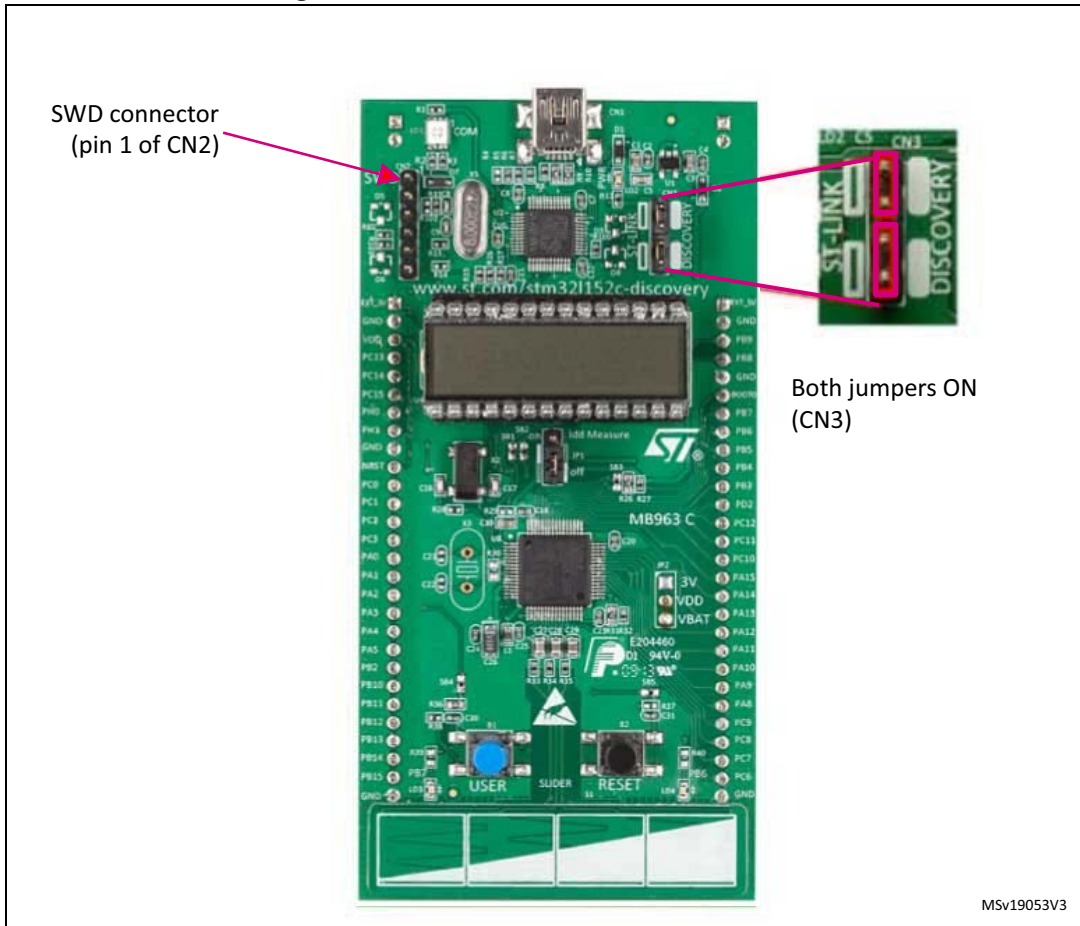
6.3.2 Using the ST-LINK/V2 to program/debug an external application

The ST-LINK/V2 allows also the programming of an STM32 device on an external application. *Figure 7* shows how to remove the two jumpers from CN3 and connect the external application to the CN2 debug connector according to the instructions in *Table 6*.

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

Table 6. SWD debug connector (CN2)

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 7. ST-LINK connections
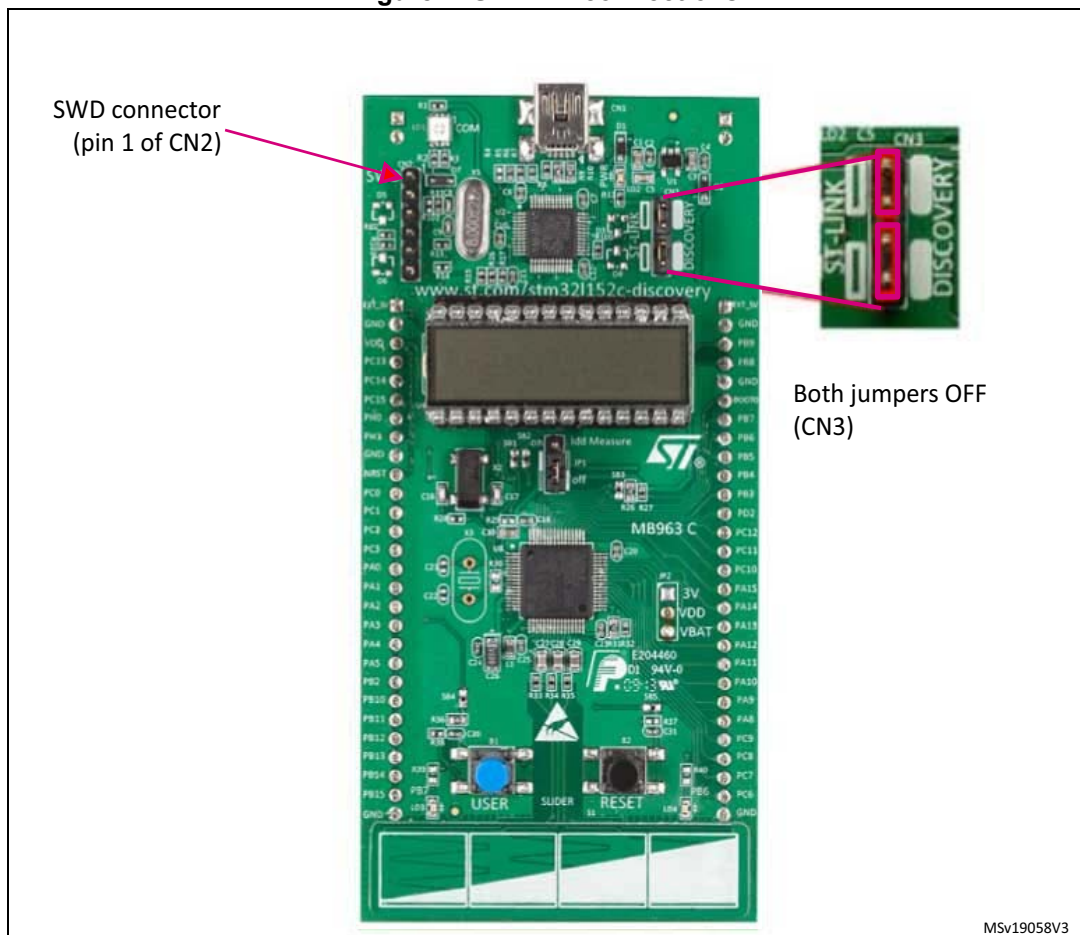
6.4 Power supply and power selection

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 using the EXT_5V and EXT_3V pins independently as input or output power supplies (refer to *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, a power supply unit or auxiliary equipment complying with standard EN-60950-1: 2006+A11/2009 must provide the power to the board. 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 (refer to *Table 7*).

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 (refer to *Figure 7*)
- Select the battery as a 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 STM32L152RC of the board

Note: *In this configuration, it is possible to power the* STM32L152RC *from the 3 V supply voltage of the board by setting a jumper between VDD and 3V.*

- Plug the CR2032 battery into the CR1 holder.

The demonstration is now ready to run.

Warning: **Wrong solder bridge configuration can damage the board components.**

6.5 LEDs

- COM LED: LD1 default status is red. LD1 turns to green to indicate that the communications are in progress between the computer and the ST-LINK/V2.
- PWR LED: Red LD2 indicates that the board is powered.
- User LD3: This user green LED is connected to the PB7 I/O of the STM32L152RC.
- User LD4: This user blue LED is connected to the PB6 I/O of the STM32L152RC.

6.6 Push-buttons

- B1 USER: The user push-button is connected to the I/O PA0 of the MCU.
- B2 RESET: The reset push-button is used to reset the MCU.

6.7 Linear touch sensor and touchkeys

To demonstrate touch sensing capabilities, the 32L152CDISCOVERY includes a linear touch sensor that can be used either as a 3-position linear touch sensor or as four touchkeys. Both functionalities are illustrated in the demonstration software (refer to *Table 4*).

Three pairs of I/O ports are assigned to the linear touch sensor and the 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 and the 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 STM32L152RC datasheet.
- For information on software development, refer to Discovery application software at www.st.com/mcu.
- For more detail concerning touch sensing application design and layout, refer to the application note *Guidelines for designing touch sensing applications with surface sensors* (AN4312).
- STM32 touch-sensing library available from www.st.com/mcu

6.8 Built-in I_{DD} measurement circuit

The 32L152CDISCOVERY built-in I_{DD} measurement circuit allows measuring the consumption of the STM32L152RC and displaying the value on the LCD glass while the MCU is in Run or Low-power modes.

- JP1 ON: The STM32L152RC is powered through the I_{DD} measurement circuit (default).
- JP1 OFF: The STM32L152RC is directly powered. The I_{DD} measurement circuit is bypassed.

Note: *When jumper JP1 is removed, the current consumption of the STM32L152RC 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 8* is implemented on the 32L152CDISCOVERY. The solder bridges (SB1, SB2, and SB14) and jumper (JP1) must be ON. The low I_{DD} range procedure (refer to *Section 6.8.2*) is recommended when the MCU is in Low-power mode and the I_{DD} current does not exceed 60 µA. The high I_{DD} range procedure (refer to *Section 6.8.1*) is applicable when the MCU operates in Run mode and can sink up to 30 mA.

Figure 8. I_{DD} measurement circuit
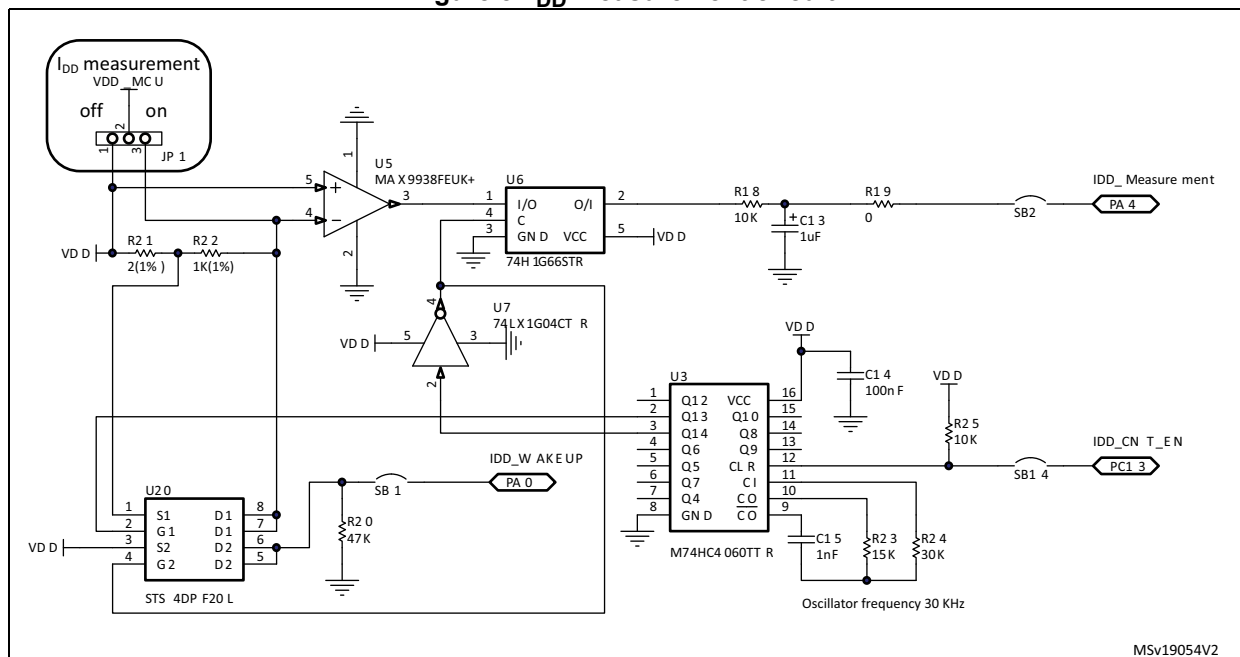
6.8.1 High I_{DD} range mode

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.

6.8.2 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 9*.

Low I$_{DD}$ range measurement principle

The principle used to measure the consumption current when the STM32L152RC is in low I$_{DD}$ range mode is as follows:

1. Configure the ADC to measure the voltage on the IDD_Measurement pin.
2. Configure PA0 to serve as a wake-up 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 waking up to measure the voltage corresponding to the Low-power mode on the capacitor (C13).
6. Reset the counter by programming IDD_CNT_EN high (in less than 150 ms after the wake-up) to avoid the R22 1 kΩ resistor being connected later in Run mode.

The measurement timing is given in *Figure 9*. 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 kΩ resistor when the current I$_{DD}$ becomes very low.

Figure 9 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, which is required for current stabilization, R22 is shorted, the I$_{DD}$ measurement is stored in C13, and the MCU is woken up. After waking up, the MCU measures the I$_{DD}$ current corresponding to the Low-power mode stored in C13.

Figure 9. Low I_{DD} range measurement timing diagram
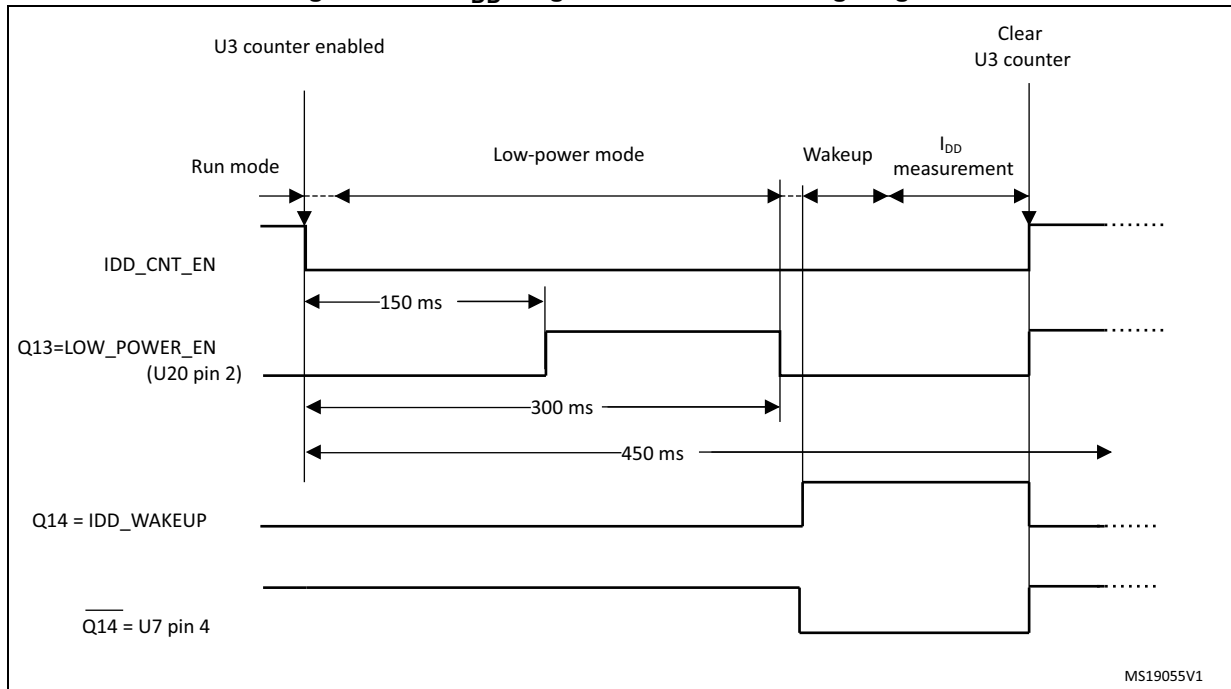
6.8.3 I_{BIAS} current measurement procedure

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 the MCU does not sink this current. I_{BIAS} is measured during the 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 the USER button (B1), and power on the board from the USB.
4. Wait at least 1 second before releasing B1. The LCD shows the I_{BIAS} measurement.
5. Power off the board (disconnect the USB cable).
6. Set JP1 ON. The I_{BIAS} value is stored in the data EEPROM. The bias current is then subtracted from the I_{DD} measured in I_{DD} range mode.

6.9 Solder bridges

Table 7. Solder bridges

Bridge	State[1]	Description
SB18,20 (X3 crystal)[2]	**ON**	PH0 and PH1 are connected to P1 (X3, C21, C22, R30 must not be fitted).
	OFF	PH0 and PH1 are disconnected from P1. X3, C21, C22, and R30 provide a clock. Refer to electrical schematics.
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, and PC13 are used for the I_{DD} measurement. JP1 ON.
	OFF	PA0, PA4, and PC13 are available and the IDD module cannot be used JP1 OFF.
SB15,16 (X2 crystal)	**OFF**	X2, C16, C17, and R28 deliver a 32 KHz clock. PC14 and PC15 are not connected to P1.
	ON	PC14 and PC15 are only connected to P1. Do not remove X2, C16, C17, and R28.
SB5 (B2-RESET)	**ON**	B2 push-button is connected to the NRST pin of the STM32L152 MCU.
	OFF	B2 push-button is not connected to the NRST pin of the STM32L152 MCU.
SB4 (B1-USER)	**ON**	B1 push-button is connected to PA0.
	OFF	B1 push-button 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 STM32L152RC.
	OFF	The NRST signal of the CN2 connector is not connected to the NRST pin of the STM32L152RC.
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 STM32L152RC NRST signal.
	ON	STM32L152RC NRST signal is connected to GND.

Table 7. Solder bridges (continued)

Bridge	State[1]	Description
SB3 (BOOT0)	**ON**	The BOOT0 signal of the STM32L152RC is held low through a 510 Ω pull-down resistor.
	OFF	The BOOT0 signal of the STM32L152RC is held high through a 10 kΩ pull-up resistor.
SB19 (BOOT1)	**OFF**	The BOOT1 signal of the STM32L152RC is held high through a 10 kΩ pull-up resistor.
	ON	The BOOT1 signal of the STM32L152RC is held low through a 510 Ω pull-down resistor.
SB17 (MCO)[2]	**OFF**	STM32L152RC MCO clock signal is not used.
	ON	STM32L152RC MCO clock signal is connected to OSC_IN of the STM32L152RC

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 the clock source.

6.10 LCD (24 segments, four commons)

This LCD allows the STM32L152RC to display any information on six 14-segment digits and four bars, using all COMs. (Refer to the LCD segment mapping in *Figure 10* and pin connections in *Table 8*.)

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 two 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, and then plug it into the socket.

Characteristics overview:

- 24 segments and four 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 in, all the I/O ports listed in Table 8 are unavailable. To use one of these as I/O, you must remove the LCD.*

Figure 10. LCD segment mapping
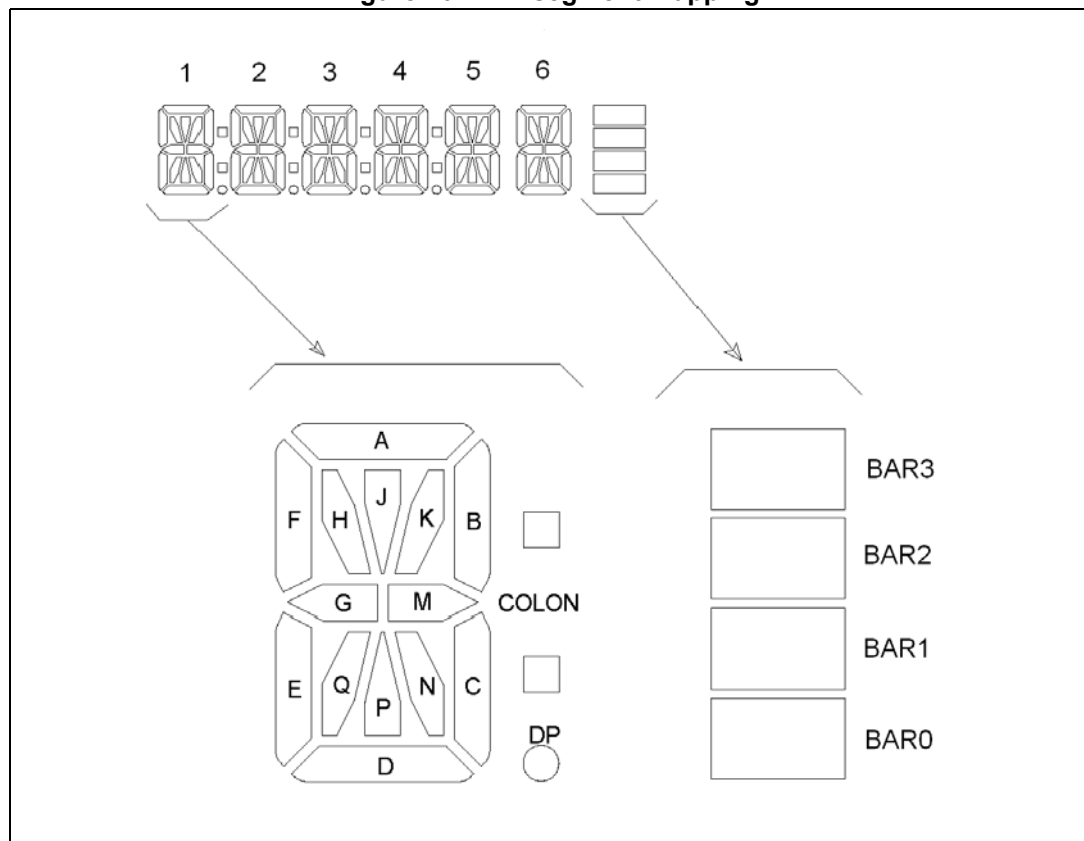
Table 8. LCD connections

STM32L152RC	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

7 Extension connectors

The male headers P1 and P2 can connect the 32L152CDISCOVERY to a standard prototyping/wrapping board. The STM32L152RC GPIOs are available on these connectors. An oscilloscope, a logic analyzer, or a voltmeter can also probe P1 and P2.

Table 9. 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	WAKE UP	-	-	-	-	-	15	-
PA1	USART2_RTS/ADC_IN1/ TIM2_CH2/LCD_SEG0/ COMP1_INP	15	SEG 0	-	-	-	-	-	-	-	-	16	-
PA2	USART2_TX/ADC_IN2/ TIM2_CH3/TIM9_CH1/ LCD_SEG1/COMP1_INP	16	SEG 1	-	-	-	-	-	-	-	-	17	-
PA3	USART2_RX/ADC_IN3/ TIM2_CH4/TIM9_CH2/ LCD_SEG2/COMP1_INP	17	SEG 2	-	-	-	-	-	-	-	-	18	-
PA4	SPI1_NSS/USART2_CK/ ADC_IN4/DAC_OUT1/ COMP1_INP	20		-	-	Measurement	-	-	-	-	-	19	-
PA5	SPI1_SCK/ADC_IN5/ DAC_OUT2/ TIM2_CH1_ETR/COMP1_INP	21	-	-	-	-	-	-	-	X	-	20	-

Table 9. 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
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	COM 0	-	-	-	-	-	-	-	-	-	23
PA9	USART1_TX/LCD_ COM1	42	COM 1	-	-	-	-	-	-	-	-	-	22
PA10	USART1_RX/LCD_ COM2	43	COM 2	-	-	-	-	-	-	-	-	-	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	SEG 12	-	-	-	-	-	-	-	-	-	16
PB0	ADC_IN8/TIM3_CH3/ LCD_SEG5/COMP 1_INP/ VREF_OUT	26	-	PB0	-	-	-	-	-	-	-	-	-
PB1	ADC_IN9/TIM3_CH4/ LCD_SEG6/COMP 1_INP/ VREF_OUT	27	-	PB1	-	-	-	-	-	-	-	-	-
PB2/BOOT1	-	28	-	-	-	-	-	-	-	-	-	21	-

Table 9. 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
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_SMBAl/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	-
PB12	SPI2_NSS/I2C2_SMBA/ USART3_CK/LCD_SEG12/ADC_IN18/ COMP1_INP/ TIM10_CH1	33	SEG 8	-	-	-	-	-	-	-	-	-	24	-

Table 9. MCU pin description versus board function (continued)

MCU pin			Board function										
Main function	Alternate functions	LQF P64 pin num	LCD glass	Linear Touch Sensor	Push butt on	I_{DD}	LED	SWD	OSC	Free I/O	Pow er supp ly	P1	P2
PB13	SPI2_SCK/USART 3_CTS/ LCD_SEG13/ADC_ IN19/ COMP1_INP/TIM9 _CH1	34	SEG 9	-	-	-	-	-	-	-	-	25	-
PB14	SPI2_MISO/USAR T3_RTS/LCD_SEG 14/ADC_IN20/ COMP1_INP/TIM9 _CH2	35	SEG 10	-	-	-	-	-	-	-	-	26	-
PB15	SPI2_MOSI/TIM1_ CH3N/ LCD_SEG15/ADC_ IN21/ COMP1_INP/TIM1 1_CH1/ RTC_50_60Hz	36	SEG 11	-	-	-	-	-	-	-	-	27	-
PC0	ADC_IN10/LCD_S EG18/ COMP1_INP	8	SEG 14	-	-	-	-	-	-	-	-	11	-
PC1	ADC_IN11/LCD_S EG19/ COMP1_INP	9	SEG 15	-	-	-	-	-	-	-	-	12	-
PC2	ADC_IN12/LCD_S EG20/ COMP1_INP	10	SEG 16	-	-	-	-	-	-	-	-	13	-
PC3	ADC_IN13/LCD_S EG21/ COMP1_INP	11	SEG 17	-	-	-	-	-	-	-	-	14	-
PC4	ADC_IN14/LCD_S EG22/ COMP1_INP	24	-	PC4	-	-	-	-	-	-	-	-	-
PC5	ADC_IN15/LCD_S EG23/ COMP1_INP	25	-	PC5	-	-	-	-	-	-	-	-	-
PC6	TIM3_CH1/LCD_S EG24	37	SEG 18	-	-	-	-	-	-	-	-	-	27
PC7	TIM3_CH2/LCD_S EG25	38	SEG 19	-	-	-	-	-	-	-	-	-	26
PC8	TIM3_CH3/LCD_S EG26	39	SEG 20	-	-	-	-	-	-	-	-	-	25

Table 9. 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**
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	-

8 32L152CDISCOVERY product information

8.1 Product marking

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

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

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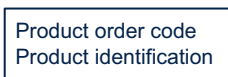
- Second sticker: board reference with revision and serial number, available on each PCB.
  Example:

  MBxxxx-Variant-yzz
  syywwxxxxx
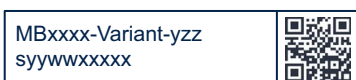
On the first sticker, the first line provides the product order code, and the second line the product identification.

On the second sticker, the first line has the following format: *"MBxxxx-Variant-yzz"*, where *"MBxxxx"* is the board reference, *"Variant"* (optional) identifies the mounting variant when several exist, *"y"* is the PCB revision and *"zz"* is the assembly revision, for example B01. The second line shows the board serial number used for traceability.

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

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

- On the targeted STM32 that is soldered on the board (for an illustration of STM32 marking, refer to the STM32 datasheet *Package information* paragraph at the *www.st.com* website).

- Next to the evaluation tool ordering part number that is stuck or silk-screen printed on the board.

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

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

8.2 32L152CDISCOVERY product history

Table 10. Product history

Order code	Product identification	Product details	Product change description	Product limitations
STM32L152C-DISCO	STM32L152CDISC/	MCU: – STM32L152RCT6 any revision	Initial revision	No limitation
		MCU errata sheet: – *STM32L15xxC and STM32L162xC device errata (ES0241)*		
		Board: – MB963-C02 (main board)		
	DK32L152C$AX1	MCU: – STM32L152RCT6 revision "1,v"	Packaging: plastic blister replaced by a carton box. Board revision upgrade	No limitation
		MCU errata sheet: – *STM32L15xxC and STM32L162xC device errata (ES0241)*		
		Board: – MB963-C03 (main board)		

8.3 Board revision history

Table 11. Board revision history

Board reference	Board variant and revision	Board change description	Board limitations
MB963 (main board)	MB963-C02	Initial revision	No limitation
	MB963-C03	Several part references updated due to obsolescence such as: – U3 STMicroelectronics M74HC4060 replaced by Texas Instruments SN74HC4060PWT – U6 STMicroelectronics 74H1G66 replaced by Maxim Integrated MAX4514CUK+T – U7 STMicroelectronics 74LX1G04 replaced by Diodes Incorporated 74LVC1G04SE – U20 STMicroelectronics STS4DPF20L replaced by Taiwan Semiconductor TSM4953DCS RLG Refer to the bill of materials for details.	No limitation

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

9.1   FCC Compliance Statement

9.1.1   Part 15.19

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

9.1.2   Part 15.21

Any changes or modifications to this equipment not expressly approved by STMicroelectronics may cause harmful interference and void the user's authority to operate this equipment.

9.1.3   Part 15.105

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Note: *Use only shielded cables.*

Responsible party (in the USA)

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9.2   ISED Compliance Statement

Compliance Statement

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

Déclaration de conformité

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

10 Revision history

Table 12. 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: STM32L152RB or STM32L152RC microcontroller*, *Section 4.2.1: 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: STM32L152RB block diagram*, *Figure 13: LCD segment mapping*, and all schematics in *Section 7.*
23-Jan-2017	4	Updated: Title, *Section 4.6: Linear touch sensor and touchkeys* where AN4312 replaces AN2869, and all schematics in *Section 7*.
06-Oct-2023	5	Document reshuffled to align with the latest standards: – *Introduction* to *Quick start* reordering – Removed *Electrical schematics* – Added *32L152CDISCOVERY product information* and *Federal Communications Commission (FCC) and ISED Canada Compliance Statements*

IMPORTANT NOTICE – READ CAREFULLY