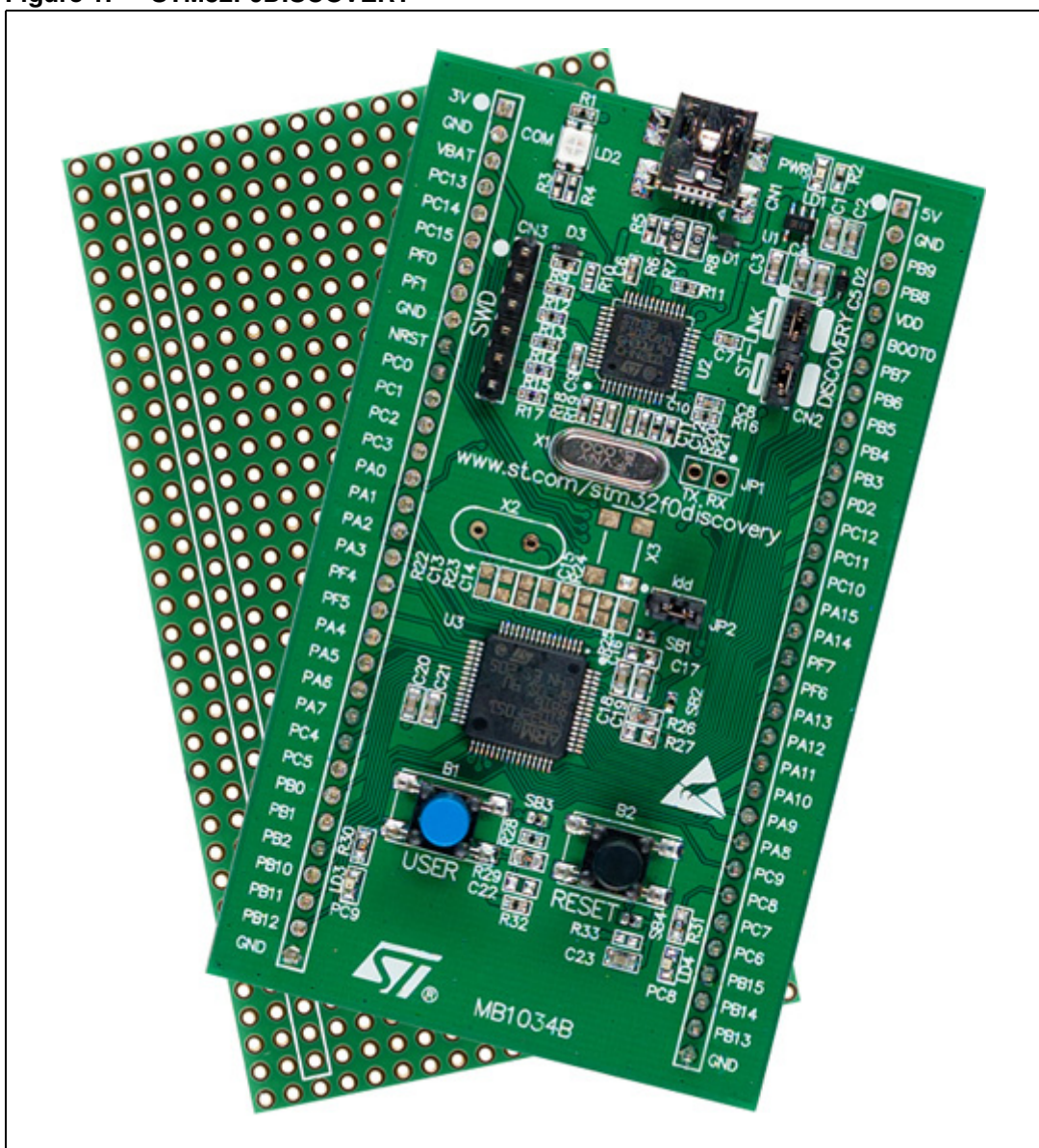


Introduction

The STM32F0DISCOVERY helps you to discover the STM32F0 Cortex-M0 features and to develop your applications easily. It is based on an STM32F051R8T6 and includes an ST-LINK/V2 embedded debug tool, LEDs, push buttons and a prototyping board.

Figure 1. STM32F0DISCOVERY



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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 STM32F0DISCOVERY is a low-cost and easy-to-use development kit to quickly evaluate and start a development with an STM32F0 microcontroller.

Before installing and using the product, please accept the Evaluation Product License Agreement from www.st.com/stm32f0discovery.

For more information on the STM32F0DISCOVERY and for demonstration software, visit www.st.com/stm32f0discovery.

2.1 Getting started

Follow the sequence below to configure the STM32F0DISCOVERY board and launch the DISCOVER application:

1. Check jumper position on the board, JP2 on, CN2 on (DISCOVERY selected).
2. Connect the STM32F0DISCOVERY 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/stm32f0discovery and follow the tutorial.
7. Discover the STM32F0 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 STM32F0DISCOVERY

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

2.4 Order code

To order the STM32F0 discovery kit, use the order code STM32F0DISCOVERY.

3 Features

The STM32F0DISCOVERY kit offers the following features:

- STM32F051R8T6 microcontroller featuring 64 KB Flash, 8 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/stm32f0discovery to support quick evaluation and development.

4 Hardware and layout

The STM32F0DISCOVERY is designed around the STM32F051R8T6 microcontroller in a 64-pin LQFP package.

Figure 2 illustrates the connections between the STM32F051R8T6 and its peripherals (ST-LINK/V2, push button, LEDs and connectors).

Figure 3 and Figure 4 help you to locate these features on the STM32F0DISCOVERY.

Figure 2. Hardware block diagram

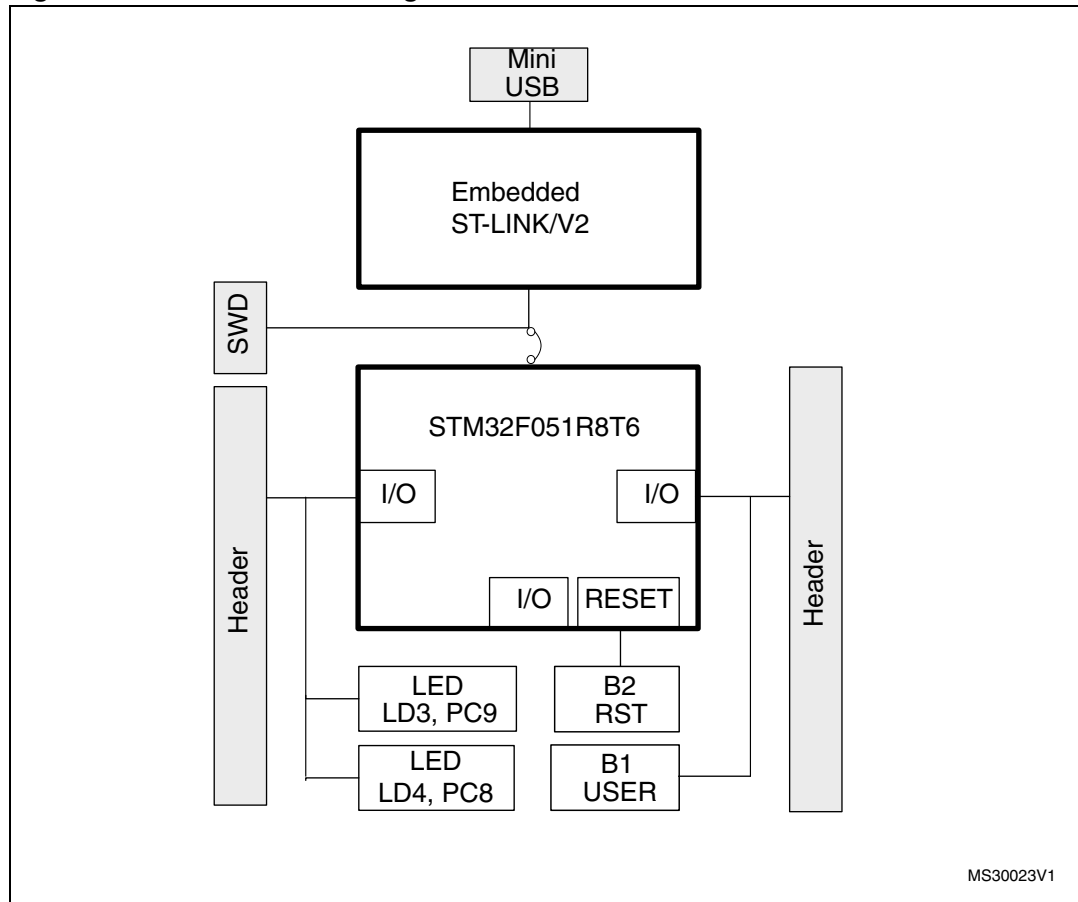
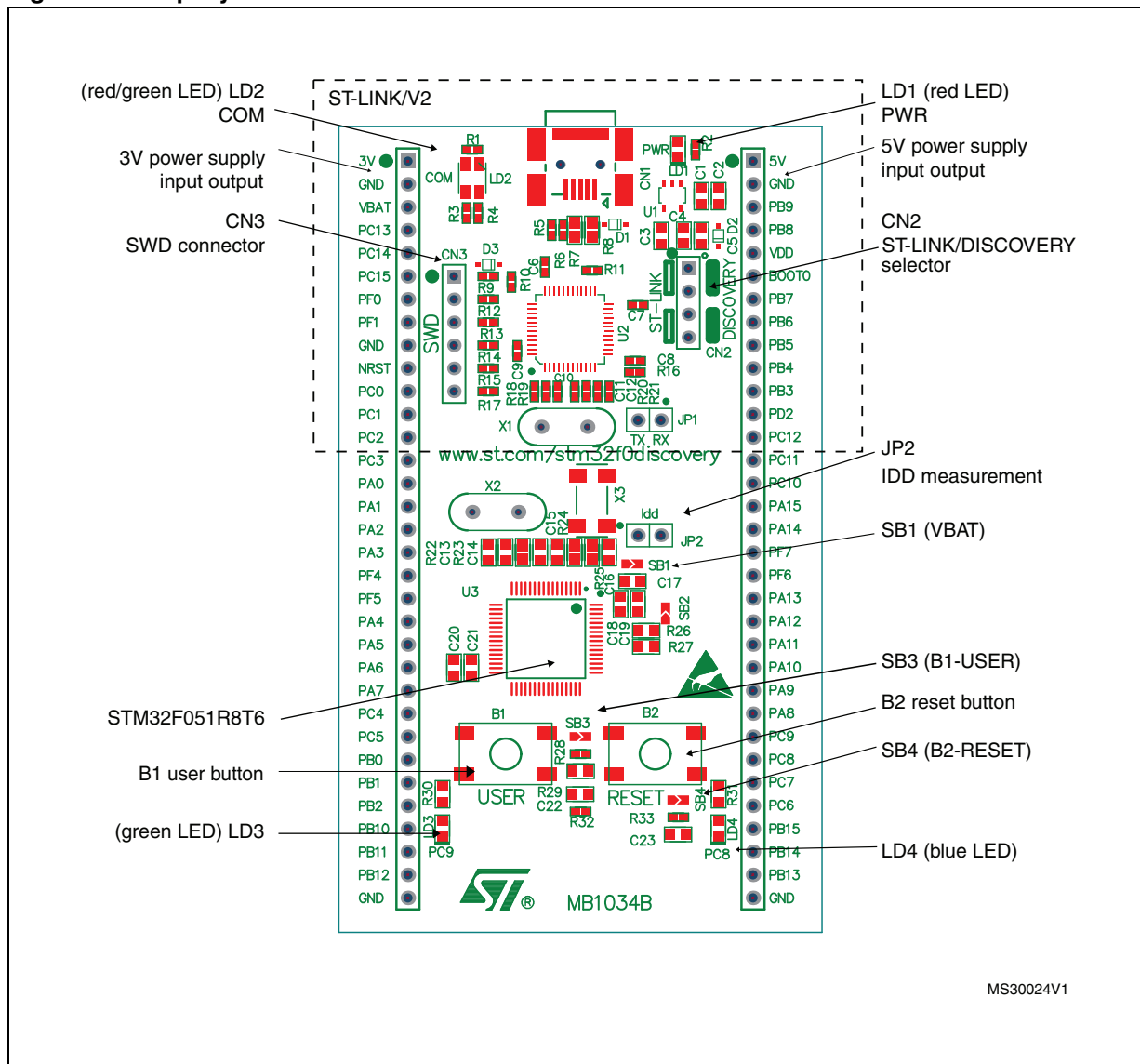


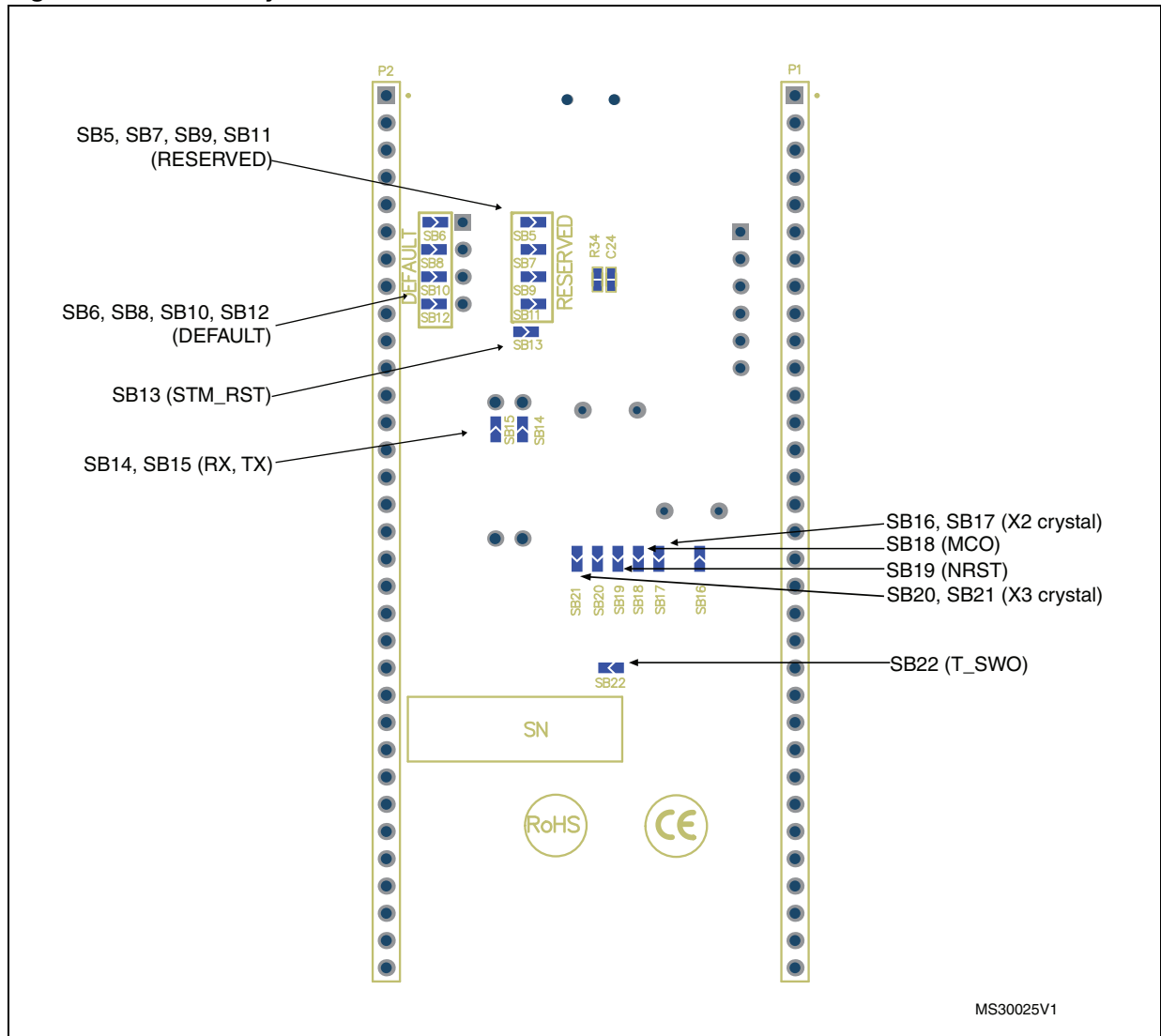
Figure 3. Top layout



MS30024V1

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

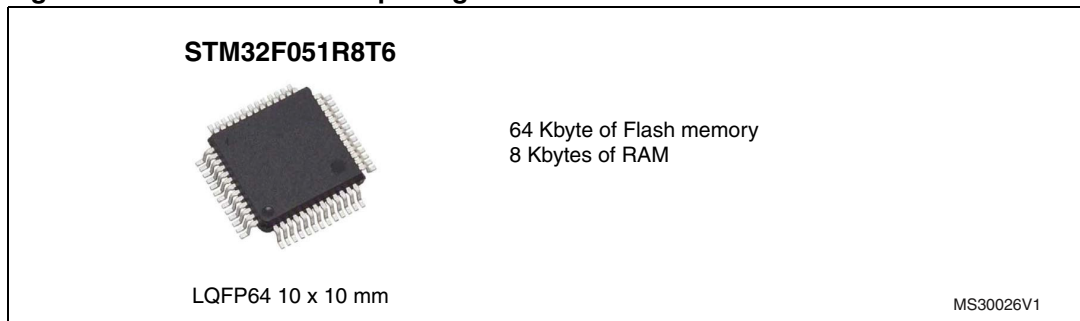
Figure 4. Bottom layout



4.1 STM32F051R8T6 microcontroller

This 32-bit low- and medium-density advanced ARM™ MCU has 64 KB Flash, 8 KB RAM, RTC, timers, ADC, DAC, comparators and comm. interfaces.

Figure 5. STM32F051R8T6 package



The STM32 F0 delivers 32-bit performance and STM32 DNA essentials into applications typically addressed by 8- or 16-bit microcontrollers. It benefits from the combination of real-time performance, low-power operation, advanced architecture and peripherals associated to the STM32 ecosystem, which has made the STM32 a reference in the market. Now all this is accessible for cost-sensitive applications. The STM32 F0 offers unparalleled flexibility and scalability for home-entertainment products, appliances, and industrial equipment.

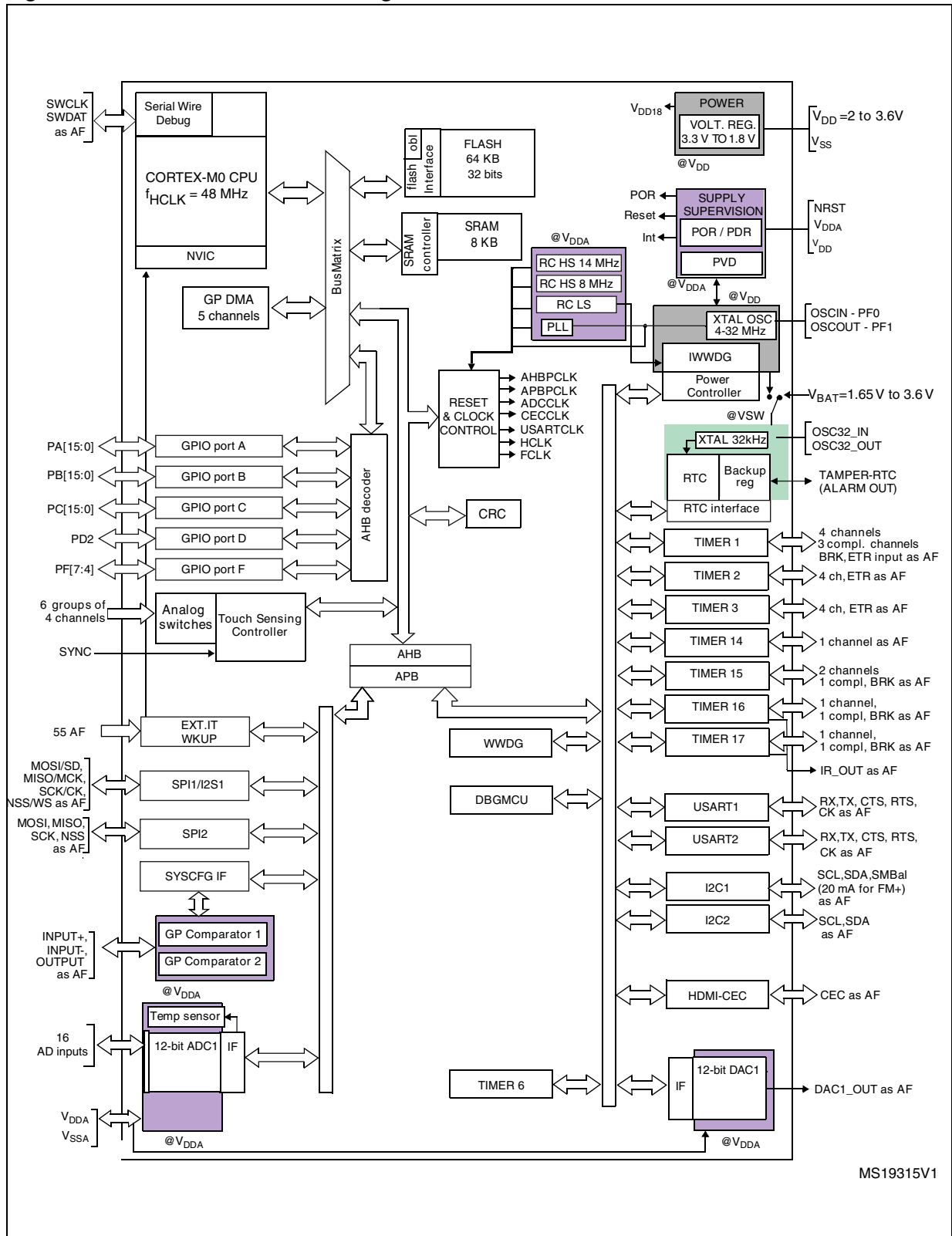
This device provides the following benefits.

- Superior code execution for better performance and excellent code efficiency for reduced embedded memory usage
- High-performance connectivity and advanced analog peripherals to support a wide range of applications
- Flexible clock options and low power modes with fast wake-up for low power consumption

It has the following key features:

- Core and operating conditions
 - ARM® Cortex™-M0 0.9 DMIPS/MHz up to 48 MHz
 - 1.8/2.0 to 3.6 V supply range
- High-performance connectivity
 - 6 Mbit/s USART
 - 18 Mbit/s SPI with 4- to 16-bit data frame
 - 1 Mbit/s I²C fast-mode plus
 - HDMI CEC
- Enhanced control
 - 1x 16-bit 3-phase PWM motor control timer
 - 5x 16-bit PWM timers
 - 1x 16-bit basic timer
 - 1x 32-bit PWM timer
 - 12 MHz I/O toggling

Figure 6. STM32F051R8T6 block diagram



4.2 Embedded ST-LINK/V2

The ST-LINK/V2 programming and debugging tool is integrated on the STM32F0DISCOVERY. 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

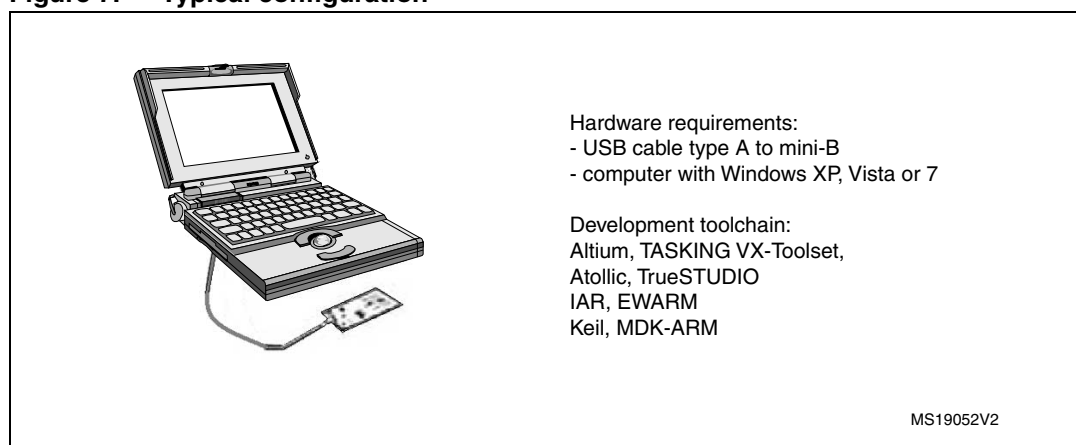


Table 2. Jumper states

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)

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

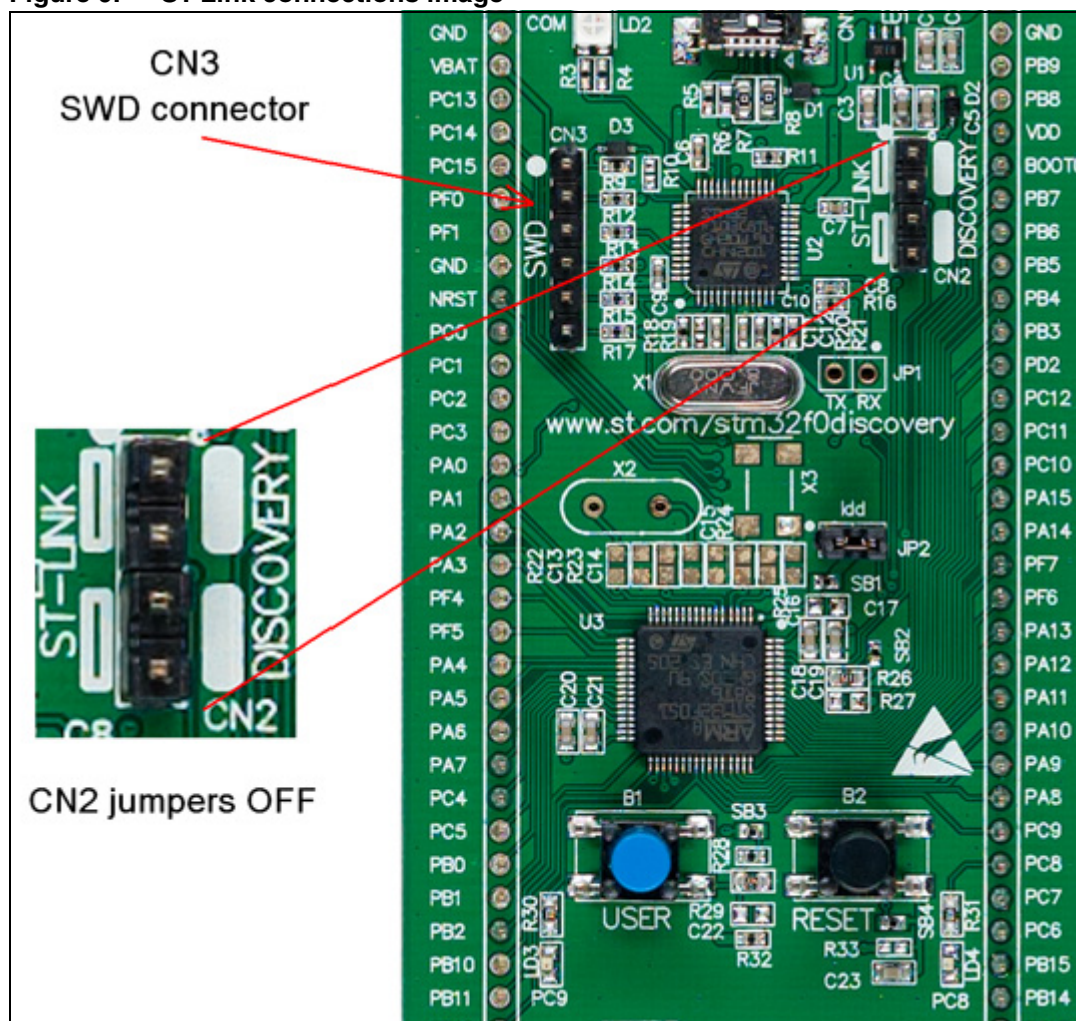
It is very easy to use the ST-LINK/V2 to program the STM32 on an external application. Simply remove the 2 jumpers from CN2 as shown in [Figure 9](#), and connect your application to the CN3 debug connector according to [Table 3](#).

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 image



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 STM32F0DISCOVERY 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 initialisation
 - Fast blinking Red LED/Off : After the first correct communication between PC and STLINK/V2 (enumeration)
 - Red LED On: When initialisation between PC and ST-LINK/V2 is successfully finished
 - Green LED On: After successful target communication initialisation
 - 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 STM32F051R8T6.
- User LD4: Blue user LED connected to the I/O PC8 of the STM32F051R8T6.

4.5 Push buttons

- B1 USER: User push button connected to the I/O PA0 of the STM32F051R8T6.
- B2 RESET: Push button used to RESET the STM32F051R8T6.

4.6 JP2 (Idd)

Jumper JP2, labeled Idd, allows the consumption of STM32F051R8T6 to be measured by removing the jumper and connecting an ammeter.

- Jumper on: STM32F051R8T6 is powered (default).
- Jumper off: an ammeter must be connected to measure the STM32F051R8T6 current, (if there is no ammeter, the STM32F051R8T6 is not powered).

4.7 OSC clock

4.7.1 OSC clock supply

PF0 and PF1 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 PF0-OSC_IN of the STM32F051R8T6. 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 STM32F051R8T6 Datasheet. Configuration needed:
 - SB16, SB17 SB18 OPEN
 - R22, R23, C13, C14 soldered
- **Oscillator from external PF0.** 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 through 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. PF0, PF1 are disconnected from P1.
	ON	PF0, PF1 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 STM32F051R8T6 MCU.
	OFF	B2 push button is not connected the NRST pin of the STM32F051R8T6 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 STM32F051R8T6 MCU.
	OFF	NRST signal of the CN3 connector is not connected to the NRST pin of the STM32F051R8T6 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 STM32F051R8T6 MCU is held low through a 510 Ohm pull-down resistor.
	OFF	BOOT0 signal of the STM32F051R8T6 MCU can be set high through a 10 KOhm pull-up resistor R27 to solder.
SB18 (MCO) ⁽²⁾	ON	Provides the 8 MHz for OSC_IN from MCO of STM32F103C8T6.
	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 STM32F0DISCOVERY to a standard prototyping/wrapping board. STM32F051R8T6 GPIOs 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 (page 1 of 7)

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	2_CTS, IN0, 2_CH1_ETR, 1_INM6, 1_OUT, TSC_G1_IO1, RTC_TAMP2, WKUP1	14	USER							15	
PA1	2_RTS, IN1, 2_CH2, 1_INP, TSC_G1_IO2, EVENTOUT	15								16	
PA2	2_TX, IN2, 2_CH3, 15_CH1, 2_INM6, 2_OUT, TSC_G1_IO3	16								17	
PA3	2_RX, IN3, 2_CH4, 15_CH2, 2_INP, TSC_G1_IO4,	17								18	

Table 5. MCU pin description versus board function (page 2 of 7)

MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
PA4	1_NSS / 1_WS, 2_CK, IN4, 14_CH1, DAC1_OUT, 1_INM4, 2_INM4, TSC_G2_IO1	20								21	
PA5	1_SCK / 1_CK, CEC, IN5, 2_CH1_ETR, (DAC2_OUT), 1_INM5, 2_INM5, TSC_G2_IO2	21								22	
PA6	1_MISO / 1_MCK, IN6, 3_CH1, 1_BKIN, 16_CH1, 1_OUT, TSC_G2_IO3, EVENTOUT	22								23	
PA7	1_MOSI / 1_SD, IN7, 3_CH2, 14_CH1, 1_CH1N, 17_CH1, 2_OUT, TSC_G2_IO4, EVENTOUT	23								24	
PA8	1_CK, 1_CH1, EVENTOUT, MCO	41									25
PA9	1_TX, 1_CH2, 15_BKIN, TSC_G4_IO1	42									24

Table 5. MCU pin description versus board function (page 3 of 7)

MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
PA10	1_RX, 1_CH3, 17_BKIN, TSC_G4_IO2	43									23
PA11	1_CTS, 1_CH4, 1_OUT, TSC_G4_IO3, EVENTOUT	44									22
PA12	1_RTS, 1_ETR, 2_OUT, TSC_G4_IO4, EVENTOUT	45									21
PA13	IR_OUT, SWDAT	46			SWDIO				4		20
PA14	2_TX, SWCLK	49			SWCLK				2		17
PA15	1_NSS / 1_WS, 2_RX, 2_CH1_ETR, EVENTOUT	50									16
PB0	IN8, 3_CH3, 1_CH2N, TSC_G3_IO2, EVENTOUT	26								27	
PB1	IN9, 3_CH4, 14_CH1, 1_CH3N, TSC_G3_IO3	27								28	
PB2 or NPOR (1.8V mode)	TSC_G3_IO4	28								29	
PB3	1_SCK / 1_CK, 2_CH2, TSC_G5_IO1, EVENTOUT	55			SWO				6		11

Table 5. MCU pin description versus board function (page 4 of 7)

MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
PB4	1_MISO / 1_MCK, 3_CH1, TSC_G5_IO2, EVENTOUT	56									10
PB5	1_MOSI / 1_SD, 1_SMBA, 16_BKIN, 3_CH2	57									9
PB6	1_SCL, 1_TX, 16_CH1N, TSC_G5_IO3	58									8
PB7	1_SDA, 1_RX, 17_CH1N, TSC_G5_IO4	59									7
PB8	1_SCL, CEC, 16_CH1, TSC_SYNC	61									4
PB9	1_SDA, IR_EVENTOUT, 17_CH1, EVENTOUT	62									3
PB10	2_SCL, CEC, 2_CH3, SYNC	29								30	
PB11	2_SDA, 2_CH4, G6_IO1, EVENTOUT	30								31	
PB12	2_NSS, 1_BKIN, G6_IO2, EVENTOUT	33								32	
PB13	2_SCK, 1_CH1N, G6_IO3	34									32

Table 5. MCU pin description versus board function (page 5 of 7)

MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
PB14	2_MISO, 1_CH2N, 15_CH1, G6_IO4	35									31
PB15	2_MOSI, 1_CH3N, 15_CH1N, 15_CH2, RTC_REFIN	36									30
PC0	IN10, EVENTOUT	8								11	
PC1	IN11, EVENTOUT	9								12	
PC2	IN12, EVENTOUT	10								13	
PC3	IN13, EVENTOUT	11								14	
PC4	IN14, EVENTOUT	24								25	
PC5	IN15, TSC_G3_IO1	25								26	
PC6	3_CH1	37									29
PC7	3_CH2	38									28
PC8	3_CH3	39		BLUE							27
PC9	3_CH4	40		GREEN							26
PC10		51									15
PC11		52									14
PC12		53									13
PC13	RTC_TAMP1, RTC_TS, RTC_OUT, WKUP2	2								4	

Table 5. MCU pin description versus board function (page 6 of 7)

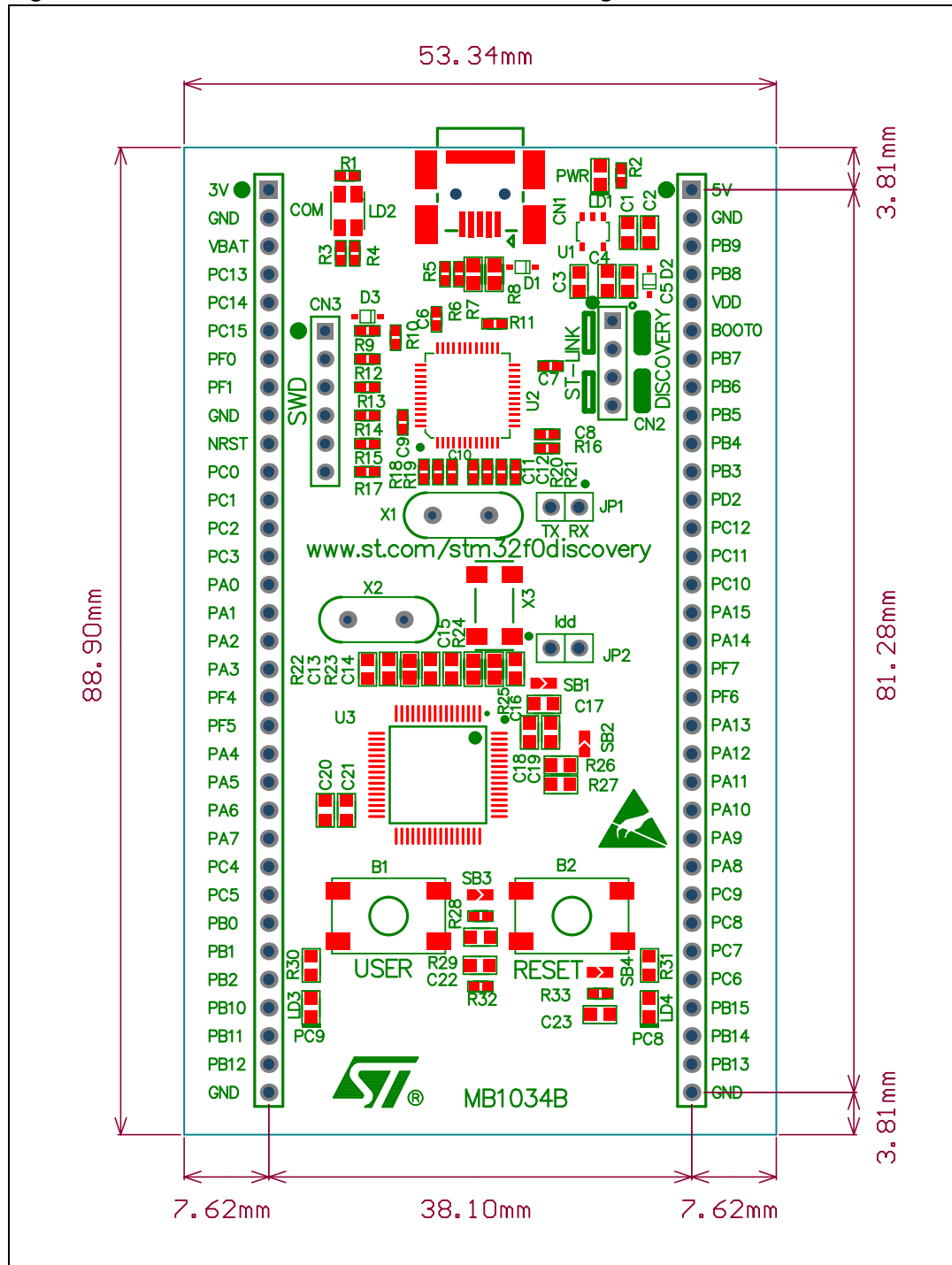
MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
PC14-OSC32_IN	OSC32_IN	3				OSC32_IN				5	
PC15-OSC32_OUT	OSC32_OUT	4				OSC32_OUT				6	
PD2	3_ETR	54									12
PF0-OSC_IN	OSC_IN	5				OSC_IN				7	
PF1-OSC_OUT	OSC_OUT	6				OSC_OUT				8	
PF4	EVENTOUT	18								19	
PF5	EVENTOUT	19								20	
PF6	2_SCL	47									19
PF7	2_SDA	48									18
VBAT	VBAT	1								3	
VDD_1		64									
VDD_2		32									
VDDA		13									
VSS_1		63									
VSS_2		31									
VSSA		12									
								5V			1
								3V		1	
								VDD			5
								GND		2	2
					GND			GND	3		

Table 5. MCU pin description versus board function (page 7 of 7)

MCU pin			Board function								
Main function	Alternate functions	LQFP64	Push button	LED	SWD	OSC	Free I/O	Power supply	CN3	P1	P2
								GND		6	
								GND		33	33

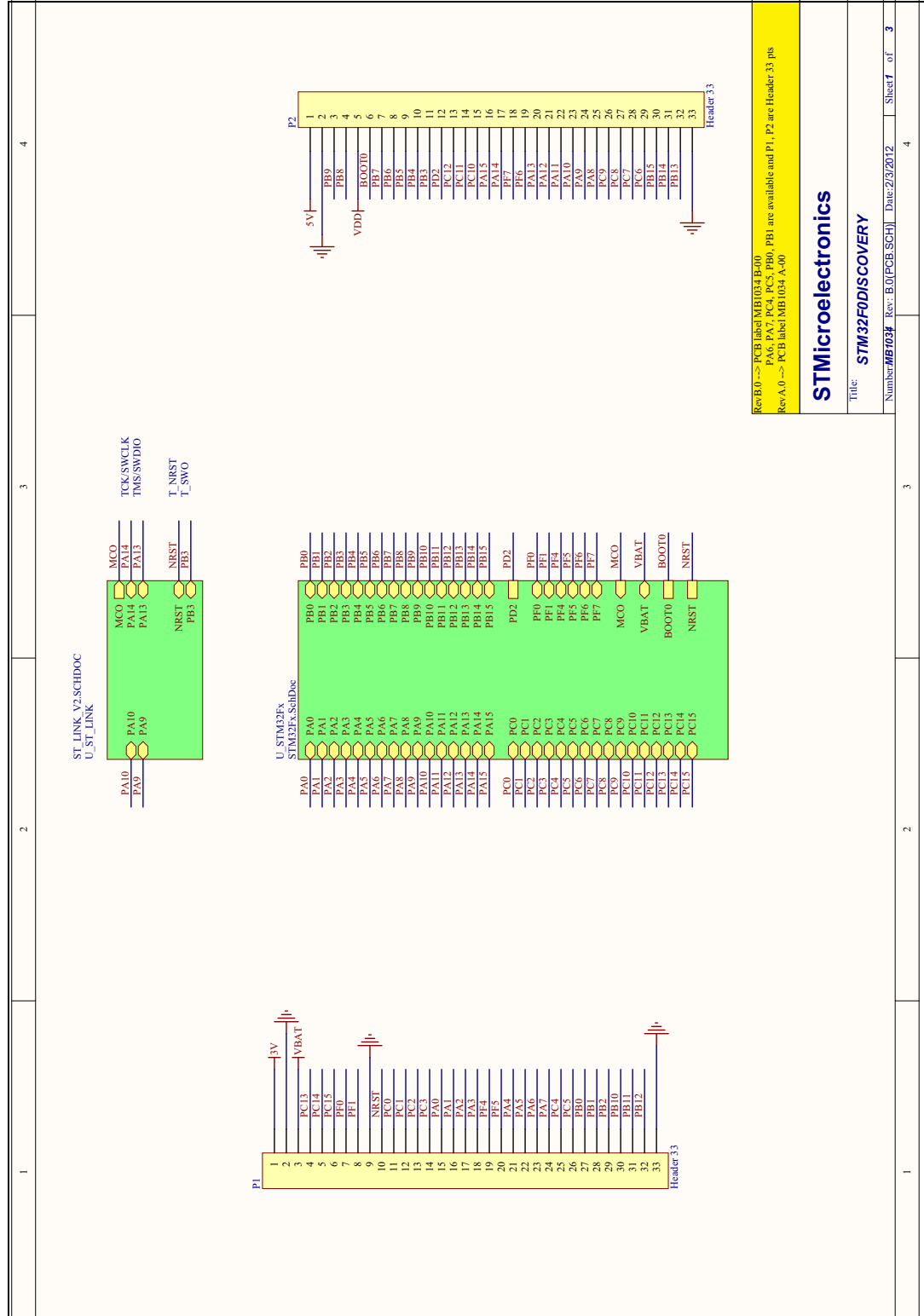
5 Mechanical drawing

Figure 10. STM32F0DISCOVERY mechanical drawing



6 Electrical schematics

Figure 11. STM32F0DISCOVERY



Rev B0 -> PCB label MB1034-B-00
 PA6, PA7, PC4, PC5, PB0, PB1 are available and P1, P2 are Header 33 pins
 Rev A.0 -> PCB label MB1034-A-00

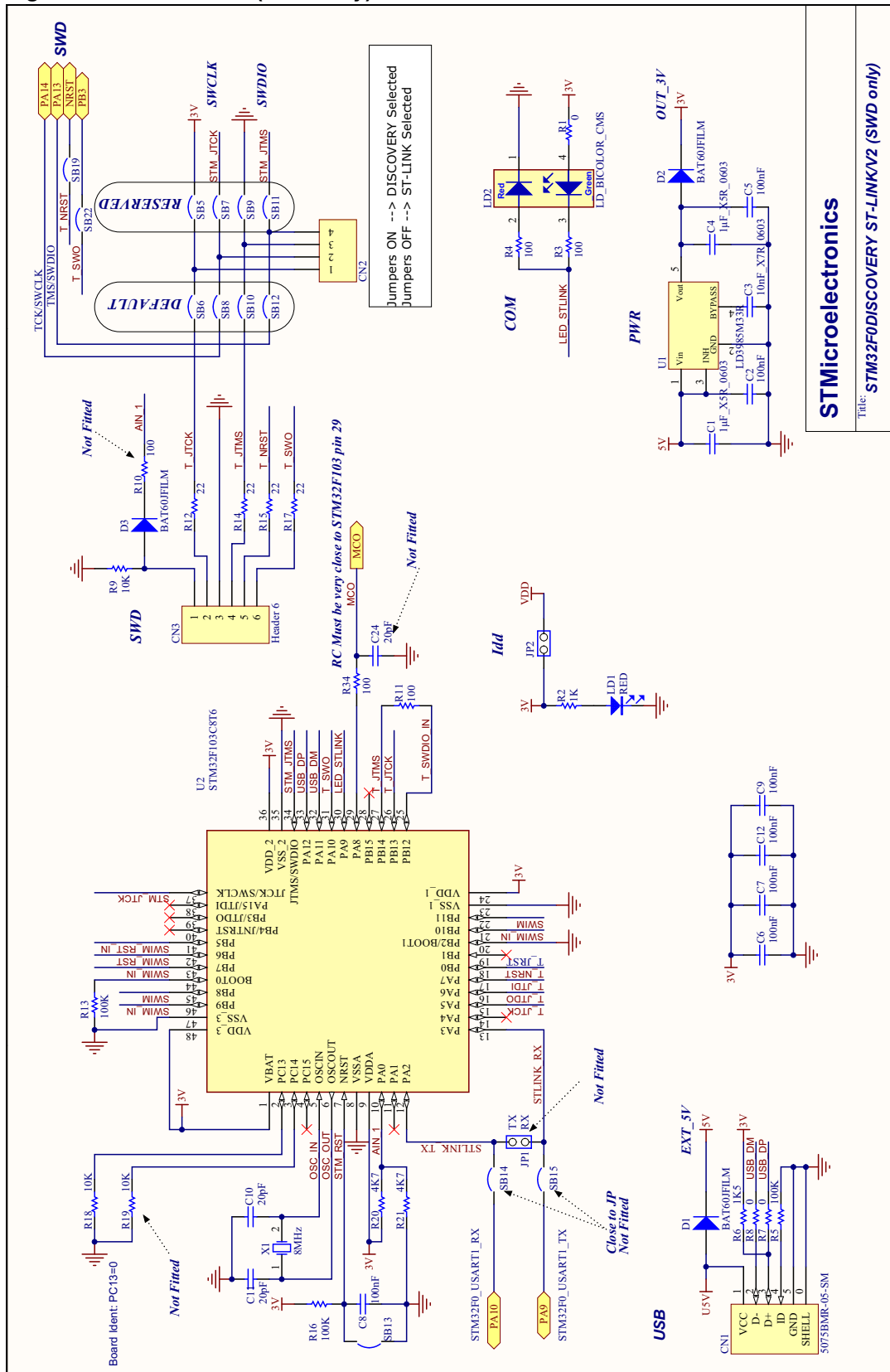
STMicroelectronics

Title: **STM32F0DISCOVERY**

Number **MB1034** Rev: B.0(PCB SCH) Date: 2/3/2012 Sheet 1 of 3



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



7 Revision history

Table 6. Document revision history

Date	Revision	Changes
20-Mar-2012	1	Initial release.

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