Application Note

Connecting J-Link to STM32-Discovery eval boards

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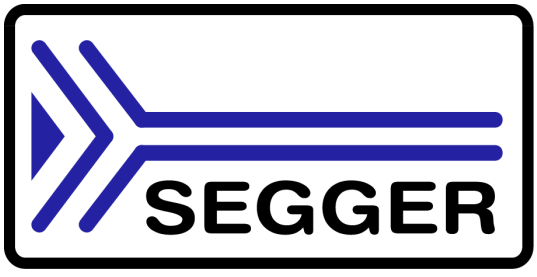

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Manual versions

This manual describes the current hardware version. If any error occurs, inform us and we will try to assist you as soon as possible.
Contact us for further information on topics or routines not yet specified.

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Revision	Date	By	Description
0	160427	TH	Initial version

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About this document

Assumptions

This document assumes that you already have a solid knowledge of the following:

- The software tools used for building your application (assembler, linker, C compiler)
- The C programming language
- The target processor
- DOS command line

If you feel that your knowledge of C is not sufficient, we recommend The C Programming Language by Kernighan and Richie (ISBN 0-13-1103628), which describes the standard in C-programming and, in newer editions, also covers the ANSI C standard.

How to use this manual

This document describes how to connect J-Link to STM32-Discovery boards.

J-Link is a JTAG emulator designed for ARM cores. It connects via USB to a PC running Microsoft Windows 2000, Windows XP, Windows 2003, Windows Vista or Windows 7. J-Link has a built-in 20-pin JTAG connector, which can be used to connect to STM32-Discovery boards.

Typographic conventions for syntax

This manual uses the following typographic conventions:

Style	Used for
Body	Body text.
`Keyword`	Text that you enter at the command-prompt or that appears on the display (that is system functions, file- or pathnames).
`Parameter`	Parameters in API functions.
`Sample`	Sample code in program examples.
`Sample comment`	Comments in program examples.
Reference	Reference to chapters, sections, tables and figures or other documents.
GUIElement	Buttons, dialog boxes, menu names, menu commands.
Emphasis	Very important sections.

Table 1.1: Typographic conventions

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SEGGER Microcontroller GmbH & Co. KG develops and distributes software development tools and ANSI C software components (middleware) for embedded systems in several industries such as telecom, medical technology, consumer electronics, automotive industry and industrial automation.

SEGGER's intention is to cut software development time for embedded applications by offering compact flexible and easy to use middleware, allowing developers to concentrate on their application.

Our most popular products are emWin, a universal graphic software package for embedded applications, and embOS, a small yet efficient real-time kernel. emWin, written entirely in ANSI C, can easily be used on any CPU and most any display. It is complemented by the available PC tools: Bitmap Converter, Font Converter, Simulator and Viewer. embOS supports most 8/16/32-bit CPUs. Its small memory footprint makes it suitable for single-chip applications.

Apart from its main focus on software tools, SEGGER develops and produces programming tools for flash micro controllers, as well as J-Link, a JTAG emulator to assist in development, debugging and production, which has rapidly become the industry standard for debug access to ARM cores.

Corporate Office:
http://www.segger.com

United States Office:
http://www.segger-us.com

EMBEDDED SOFTWARE (Middleware)

emWin
Graphics software and GUI
emWin is designed to provide an efficient, processor- and display controller-independent graphical user interface (GUI) for any application that operates with a graphical display.

embOS
Real Time Operating System
embOS is an RTOS designed to offer the benefits of a complete multitasking system for hard real time applications with minimal resources.

embOS/IP
TCP/IP stack
embOS/IP a high-performance TCP/IP stack that has been optimized for speed, versatility and a small memory footprint.

emFile
File system
emFile is an embedded file system with FAT12, FAT16 and FAT32 support. Various Device drivers, e.g. for NAND and NOR flashes, SD/MMC and CompactFlash cards, are available.

USB-Stack
USB device/host stack
A USB stack designed to work on any embedded system with a USB controller. Bulk communication and most standard device classes are supported.

SEGGER TOOLS

Flasher
Flash programmer
Flash Programming tool primarily for micro controllers.

J-Link
JTAG emulator for ARM cores
USB driven JTAG interface for ARM cores.

J-Trace
JTAG emulator with trace
USB driven JTAG interface for ARM cores with Trace memory. supporting the ARM ETM (Embedded Trace Macrocell).

J-Link / J-Trace Related Software
Add-on software to be used with SEGGER's industry standard JTAG emulator, this includes flash programming software and flash breakpoints.

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Chapter 1

Introduction

J-Link has a built-in 20-pin JTAG connector, which is compatible with the standard 20-pin connector defined by ARM. Unfortunately, the STM32-Discovery boards do not include this 20-pin connector, but the J-Link is also compatible to ARM's Serial Wire Debug (SWD). With a total of 7 wires, J-Link easily connects to the board and enables its SWD capability.

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Chapter 2

Connecting J-Link

This chapter describes how to connect J-Link to STM32-Discovery boards using J-Link's SWD capability.

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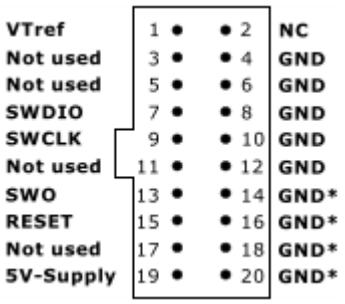
2.1 J-Link Pinout for SWD

The J-Link connector is compatible to ARM's Serial Wire Debug (SWD).

*On later J-Link products like the J-Link Ultra, these pins are reserved for firmware extension purposes. They can be left open or connected to GND in normal debug environment. They are not essential for JTAG/SWD in general.

The following table lists the J-Link SWD pinout:



PIN	SIGNAL	TYPE	Description
1	VTref	Input	This is the target reference voltage. It is used to check if the target has power, to create the logic-level reference for the input comparators and to control the output logic levels to the target. It is normally fed from Vdd of the target board and must not have a series resistor.
2	Not connected	NC	This pin is not connected in J-Link.
3	Not Used	NC	This pin is not used by J-Link. If the device may also be accessed via JTAG, this pin may be connected to nTRST, otherwise leave open.
5	Not Used	NC	This pin is not used by J-Link. If the device may also be accessed via JTAG, this pin may be connected to TDI, otherwise leave open.
7	SWDIO	I/O	Single bi-directional data pin. A pull-up resistor is required. ARM recommends 100 kOhms.
9	SWCLK	Output	Clock signal to target CPU. It is recommended that this pin is pulled to a defined state on the target board. Typically connected to TCK of target CPU.
11	Not Used	NC	This pin is not used by J-Link when operating in SWD mode. If the device may also be accessed via JTAG, this pin may be connected to RTCK, otherwise leave open.
13	SWO	Output	Serial Wire Output trace port. (Optional, not required for SWD communication.)
15	RESET	I/O	Target CPU reset signal. Typically connected to the RESET pin of the target CPU, which is typically called "nRST", "nRESET" or "RESET".
17	Not Used	NC	This pin is not connected in J-Link.
19	5V-Supply	Output	This pin can be used to supply power to the target hard-ware. Older J-Links may not be able to supply power on this pin.

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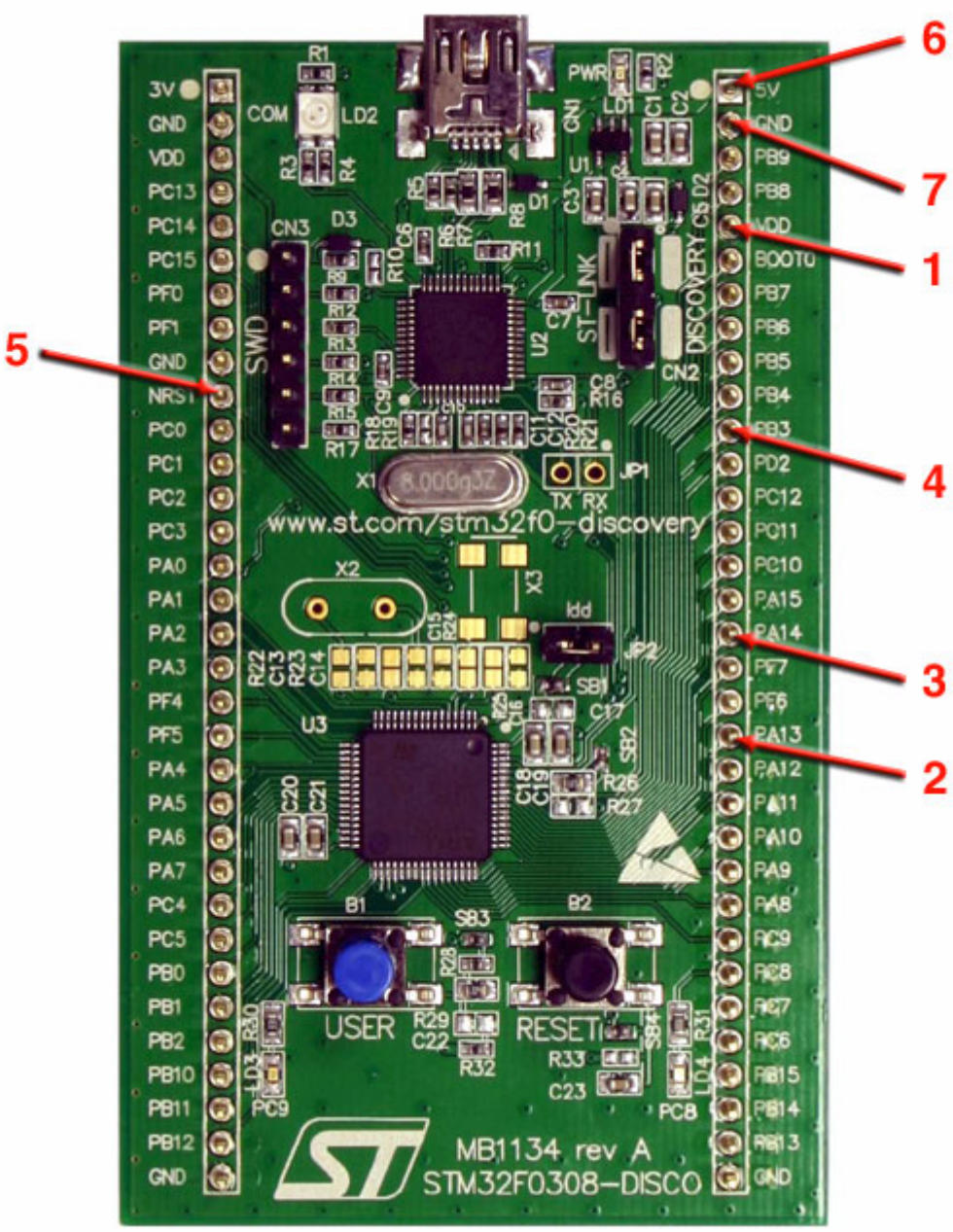
2.2 Connect J-Link to STM32F0308

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN2 (ST-Link) must be removed for external debug to work.

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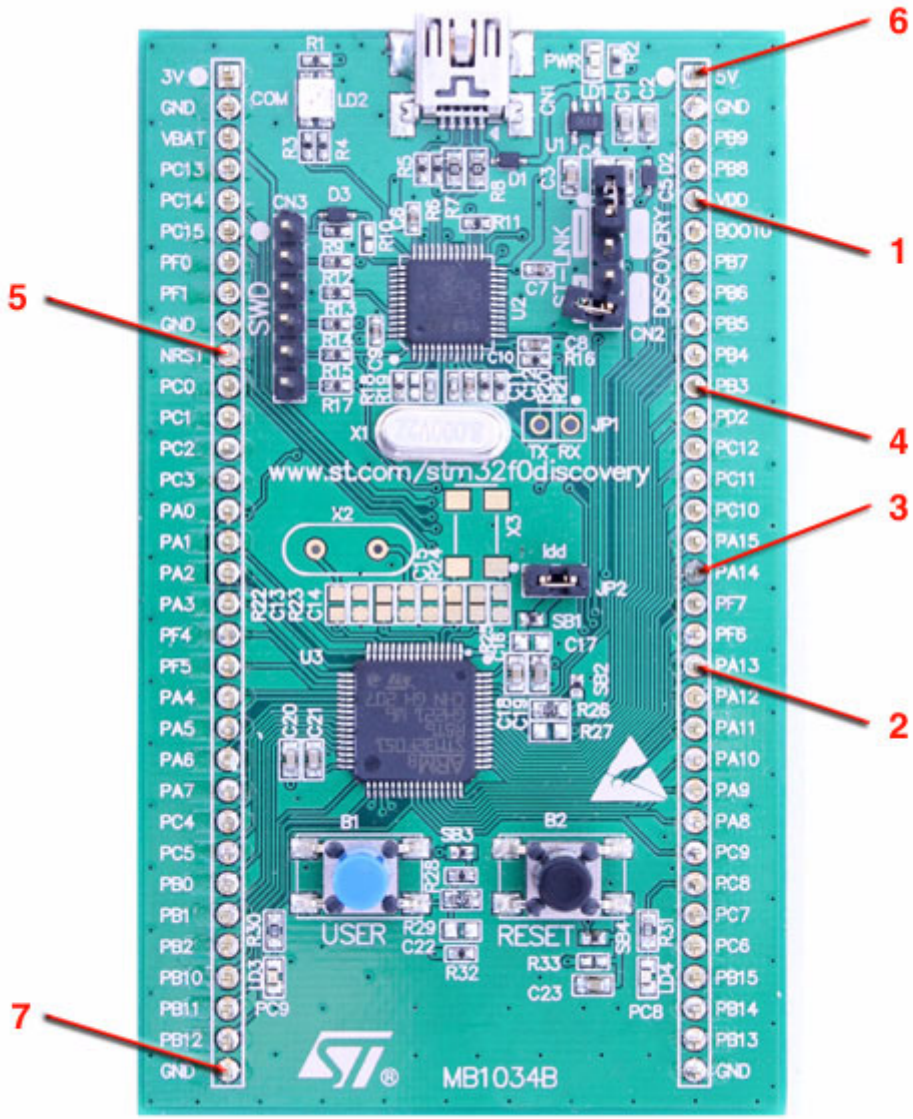
2.3 Connect J-Link to STM32F0

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN2 (ST-Link) must be removed for external debug to work.

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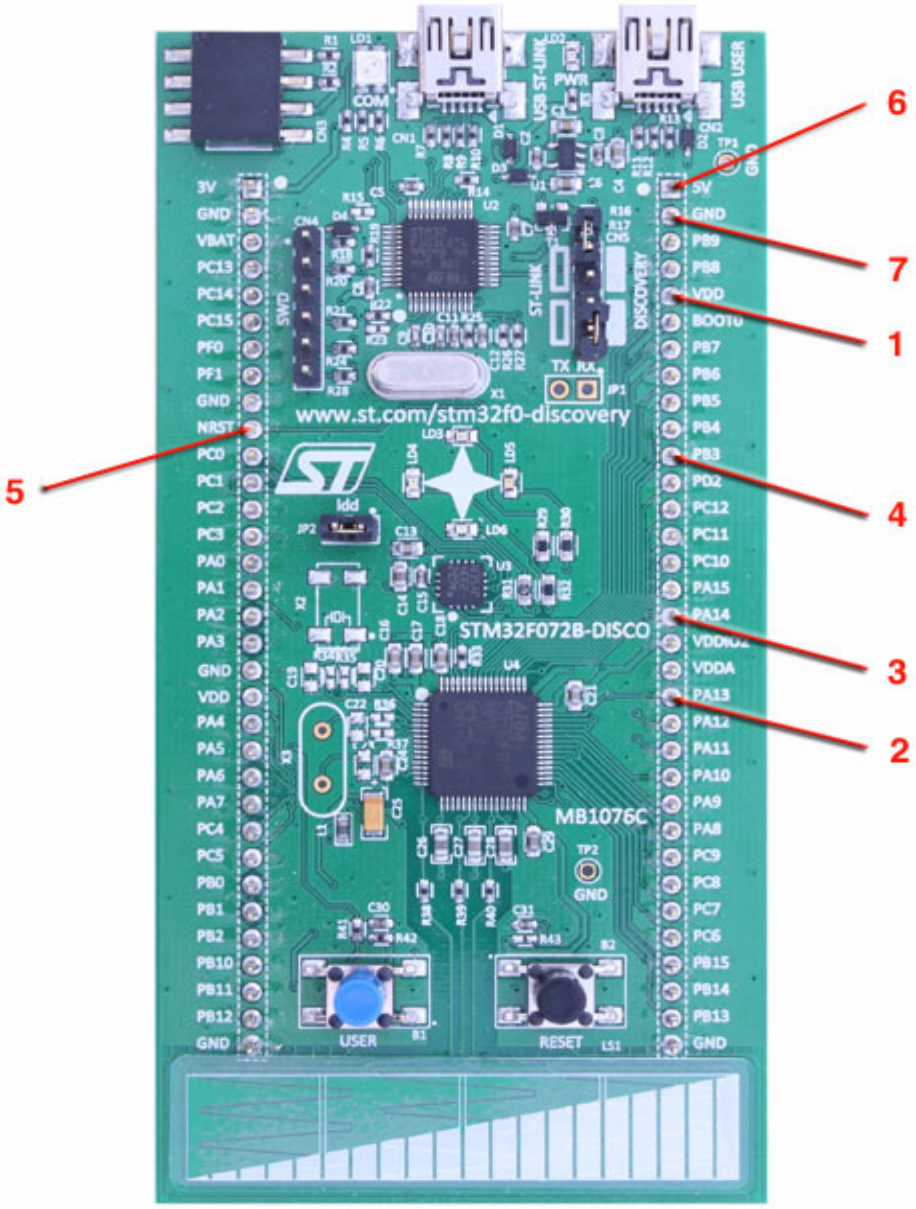
2.4 Connect J-Link to STM32F072B

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN5 (ST-Link) must be removed for external debug to work.

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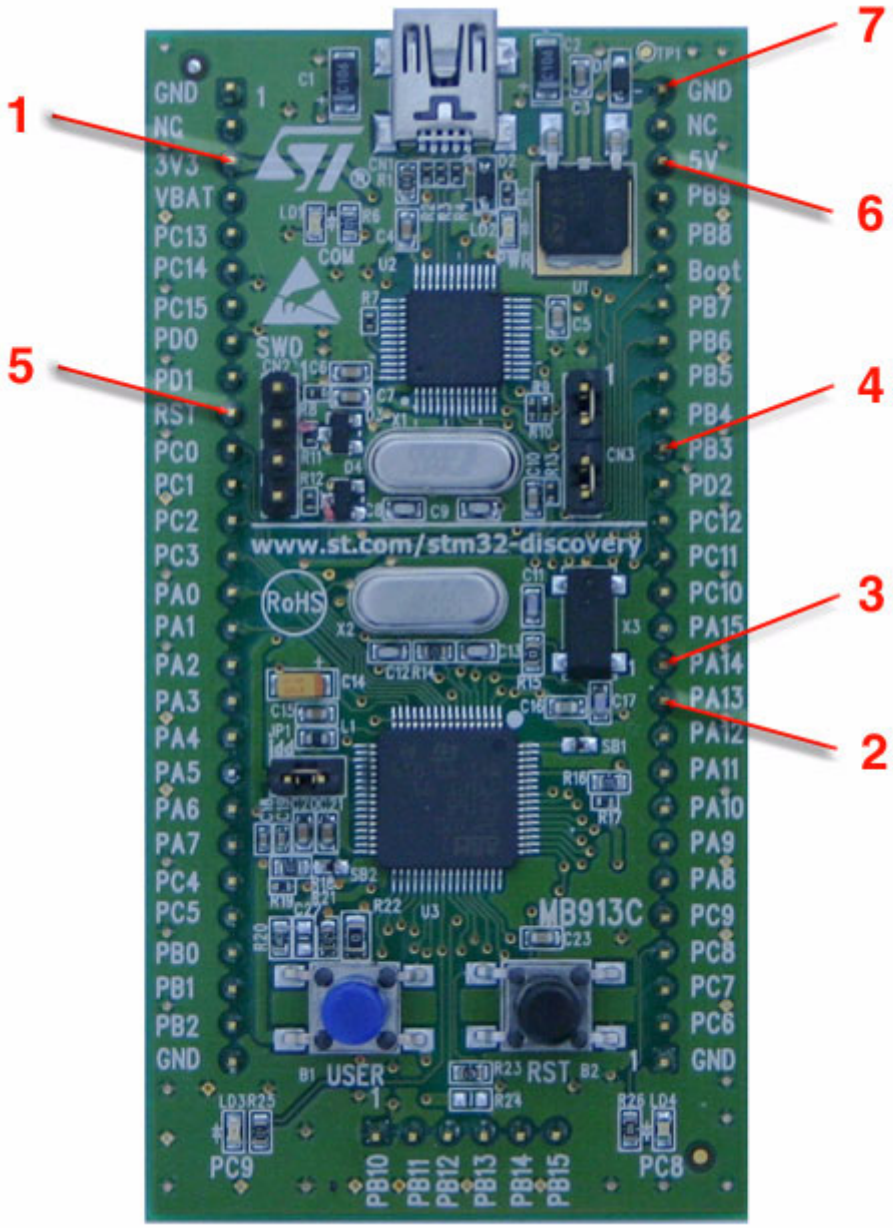
2.5 Connect J-Link to STM32F100

1. Connect J-Link pin VTref (1) to pin 3V3
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin RST
6. Connect J-Link pin 5V-Supply (19) to pin 5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN3 (ST-Link) must be removed for external debug to work.

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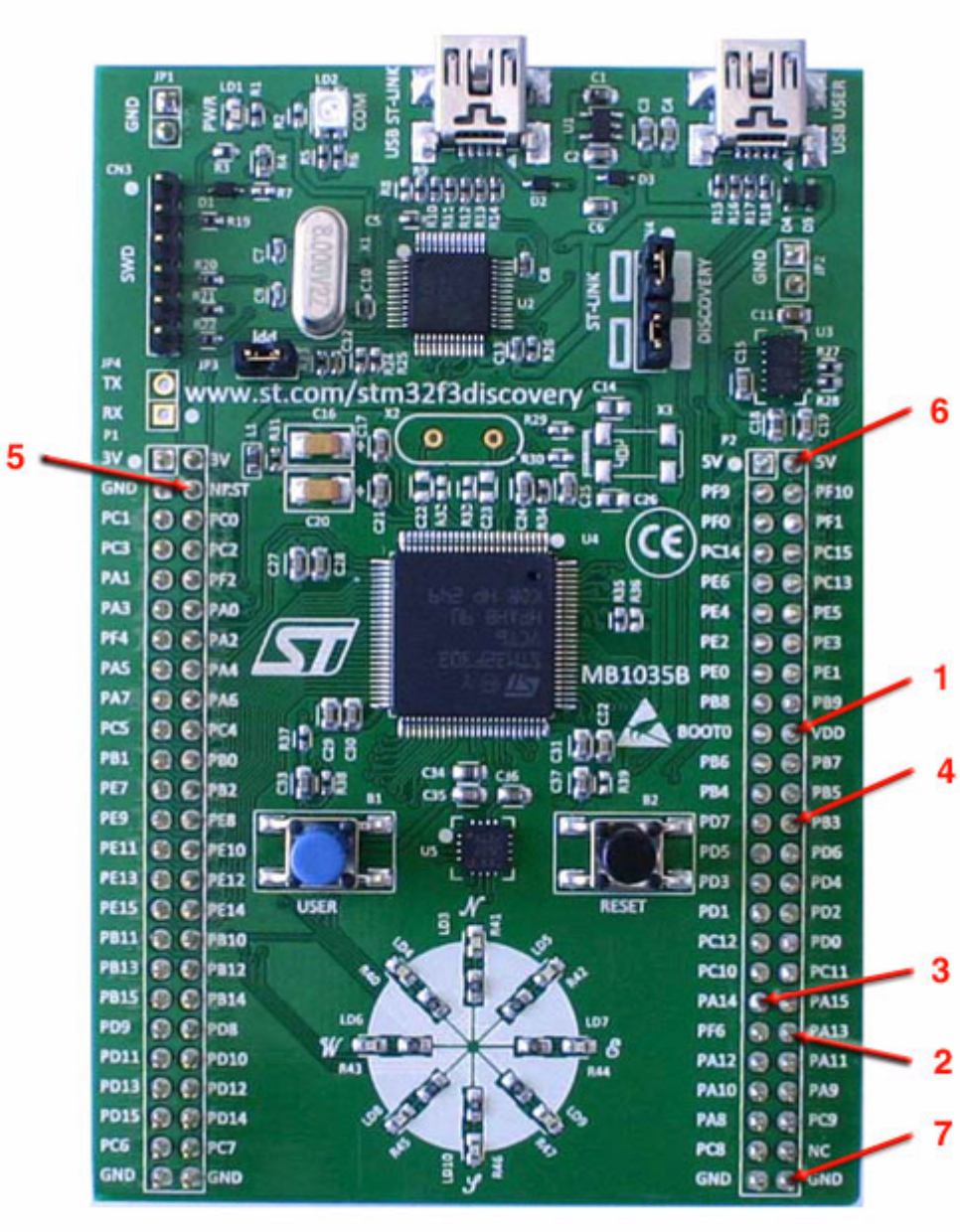
2.6 Connect J-Link to STM32F3

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN4 (ST-Link) must be removed for external debug to work.

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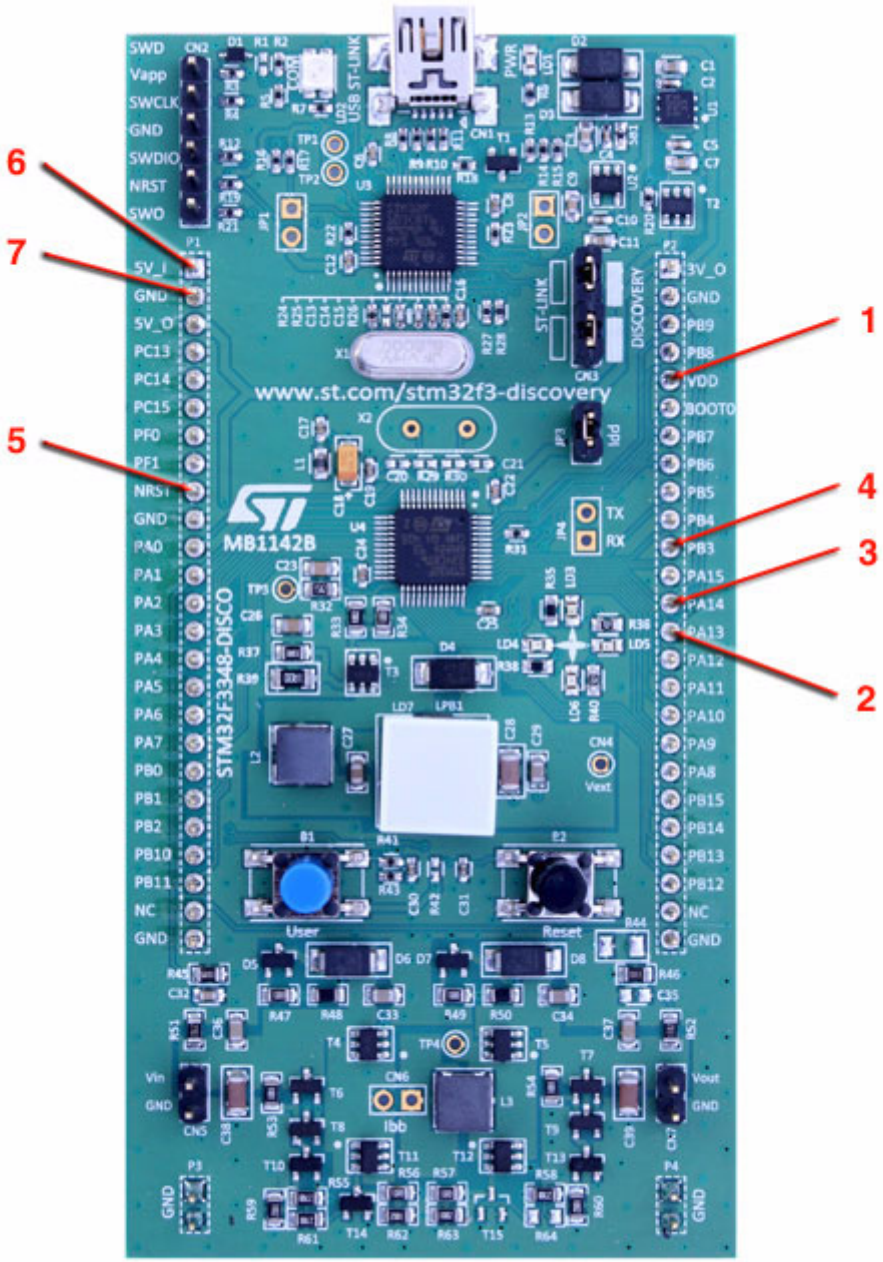
2.7 Connect J-Link to STM32F3348

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V_I
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN3 (ST-Link) must be removed for external debug to work.

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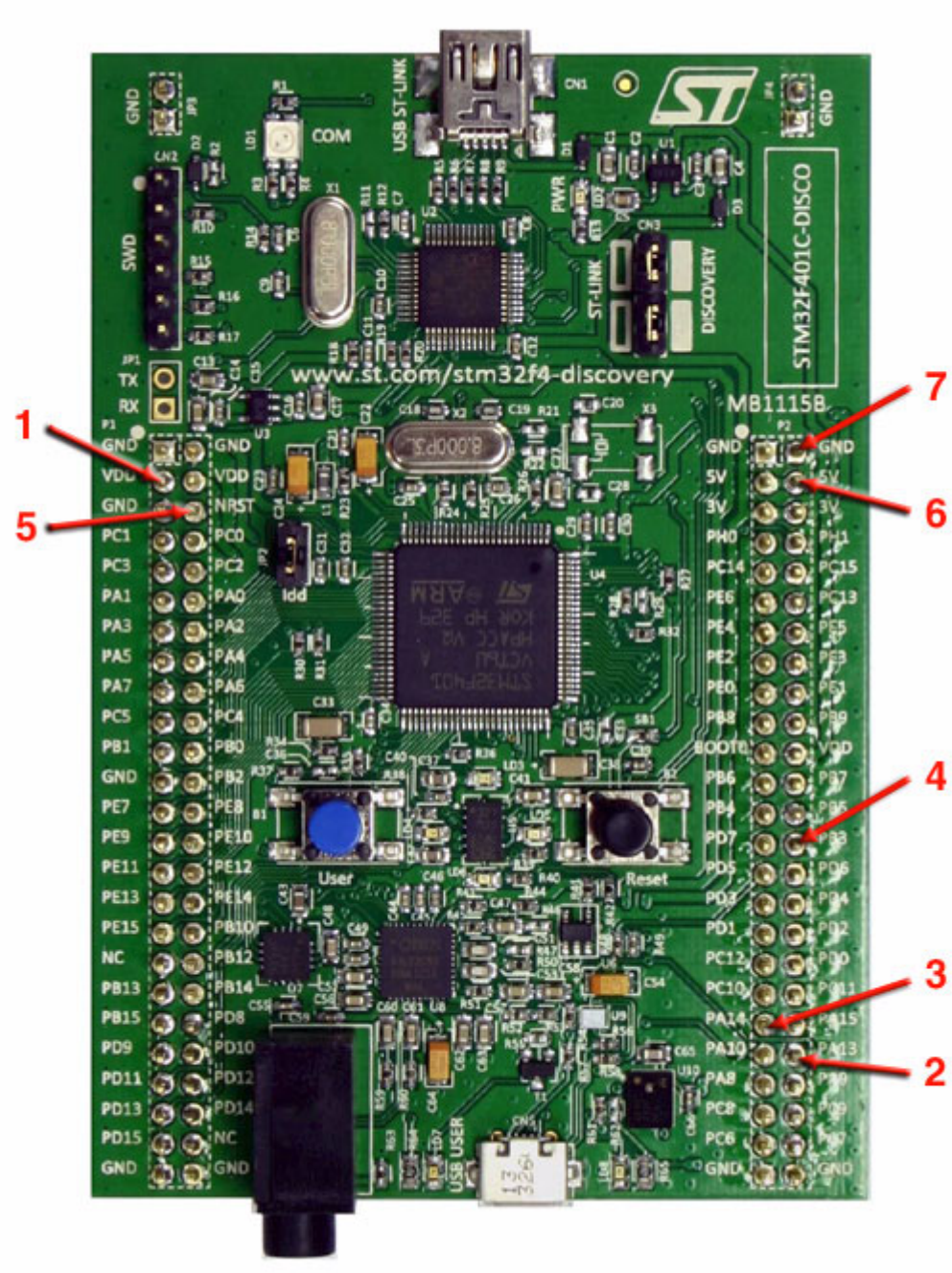
2.8 Connect J-Link to STM32F401C

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN3 (ST-Link) must be removed for external debug to work.

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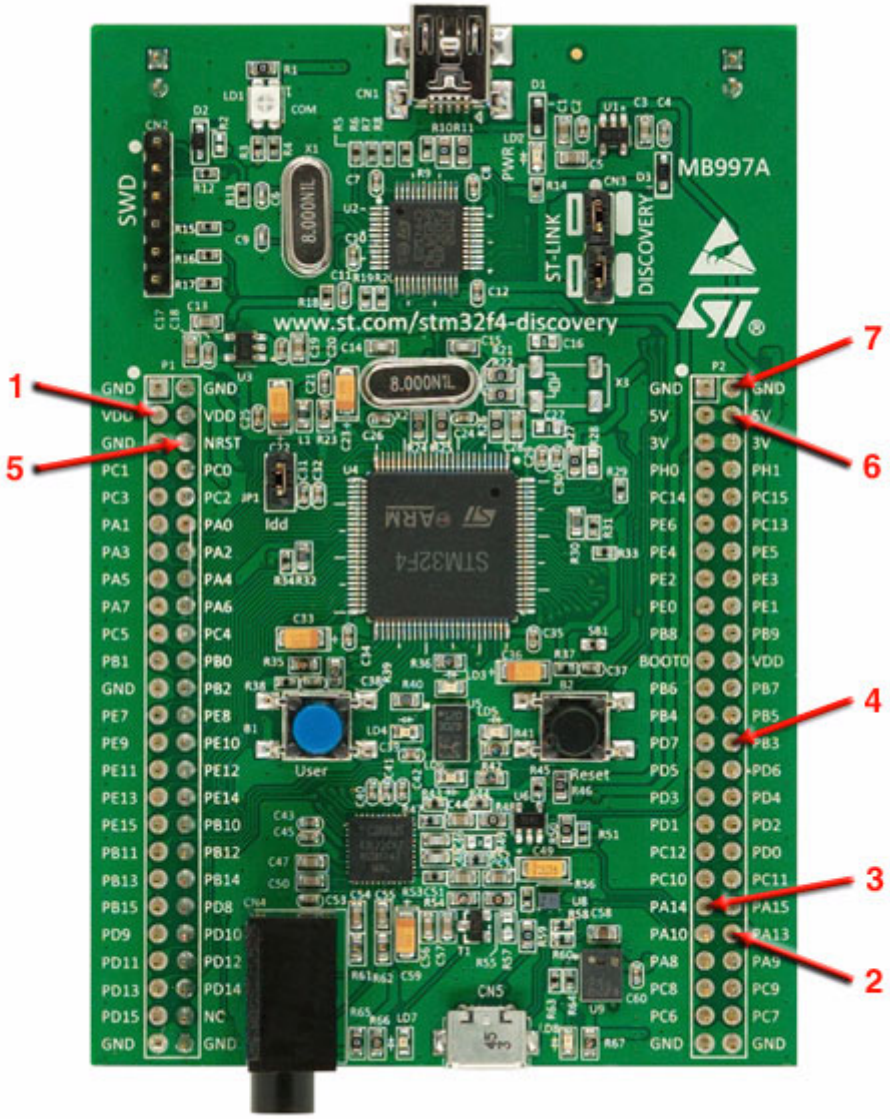
2.9 Connect J-Link to STM32F407

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN3 (ST-Link) must be removed for external debug to work.

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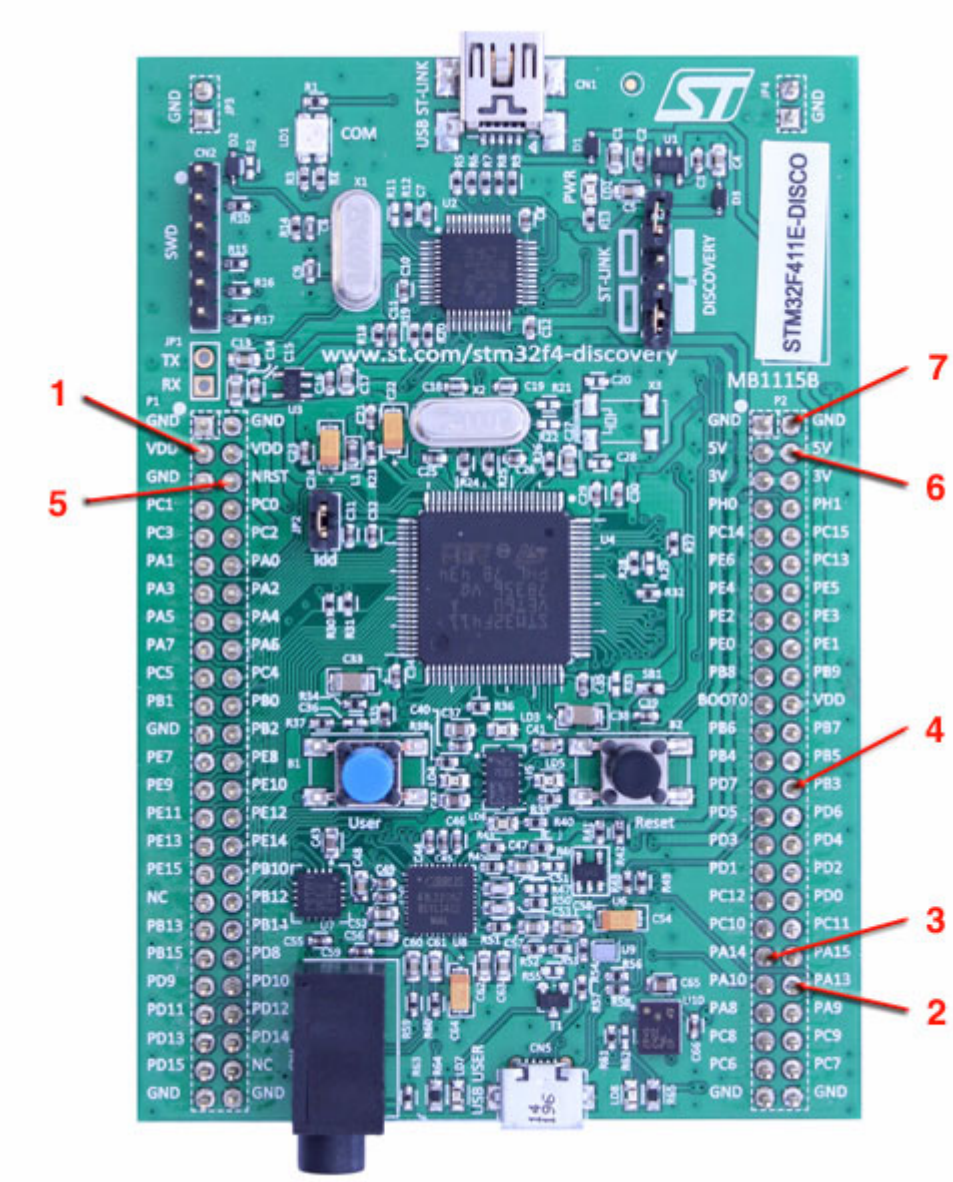
2.10 Connect J-Link to STM32F411E

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN3 (ST-Link) must be removed for external debug to work.

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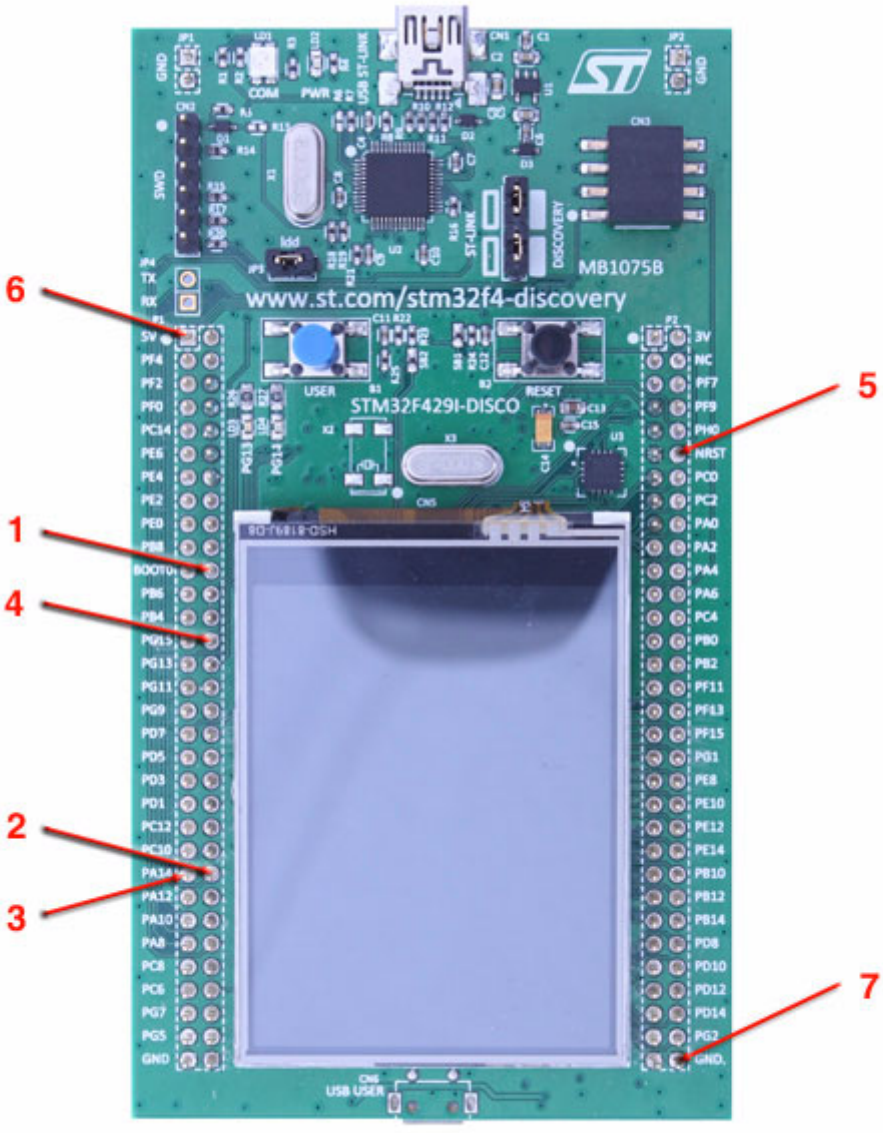
2.11 Connect J-Link to STM32F429I

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN4 (ST-Link) must be removed for external debug to work.

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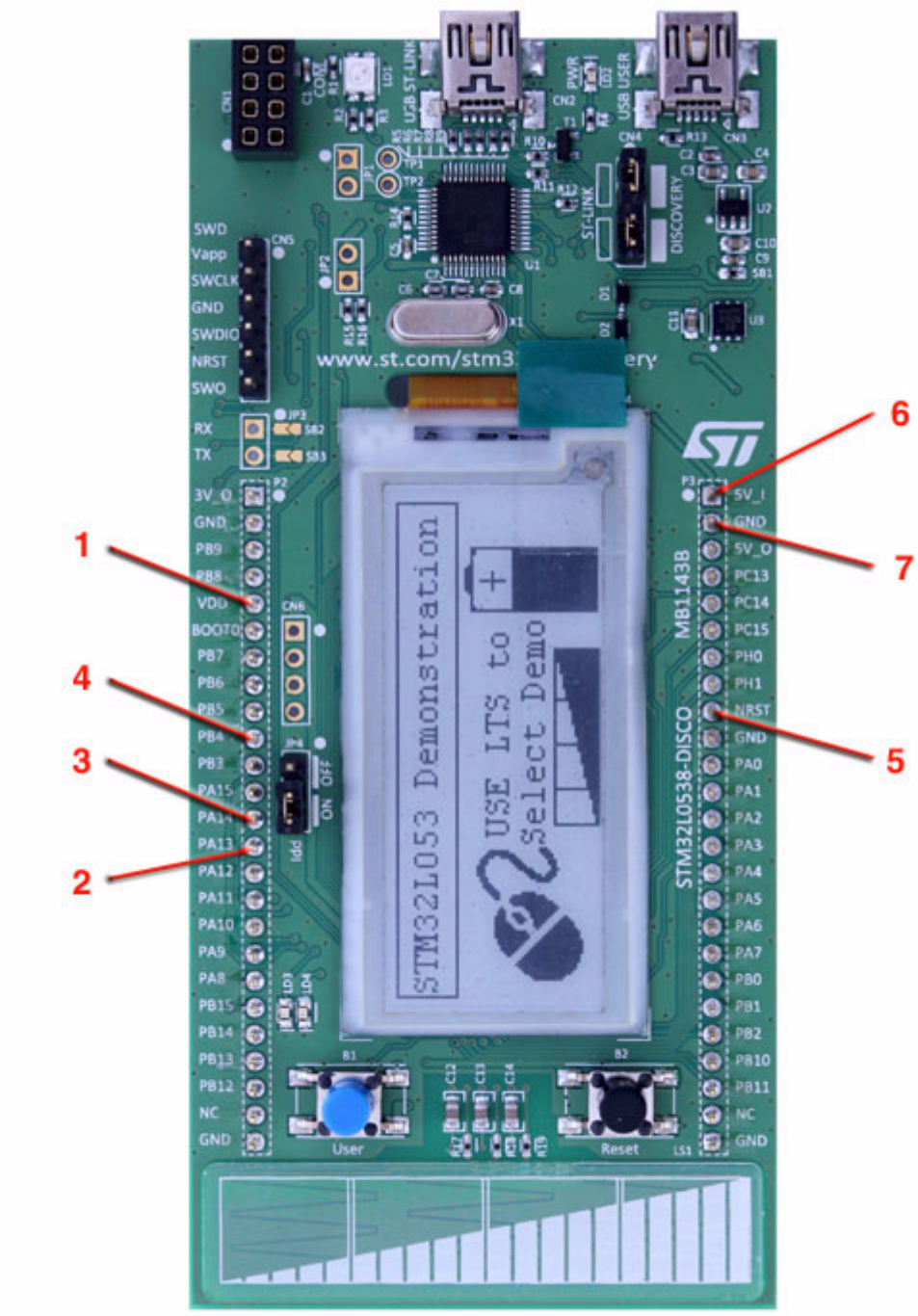
2.12 Connect J-Link to STM32L0538

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V_I
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN4 (ST-Link) must be removed for external debug to work.

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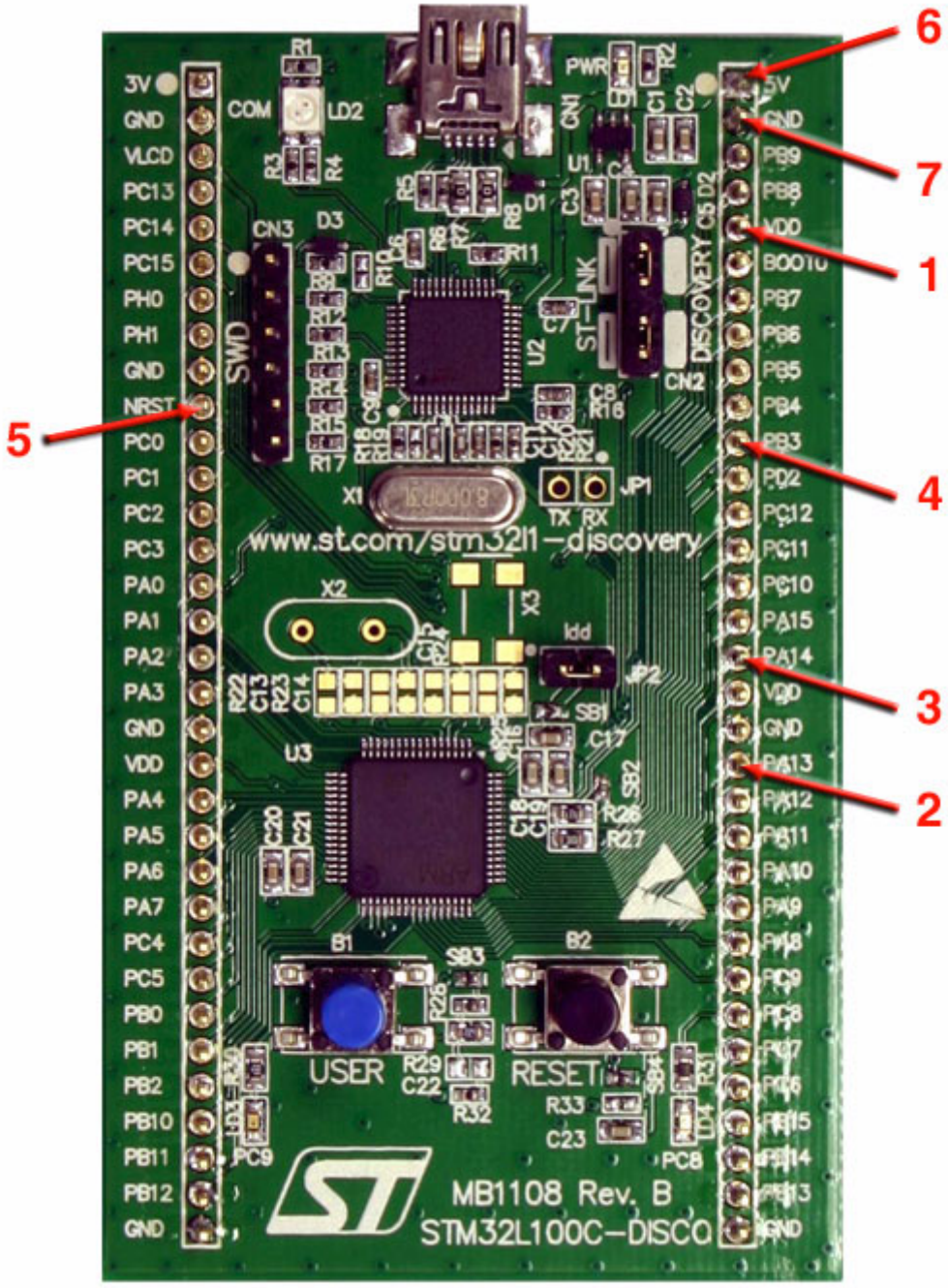
2.13 Connect J-Link to STM32L100C

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin 5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN2 (ST-Link) must be removed for external debug to work.

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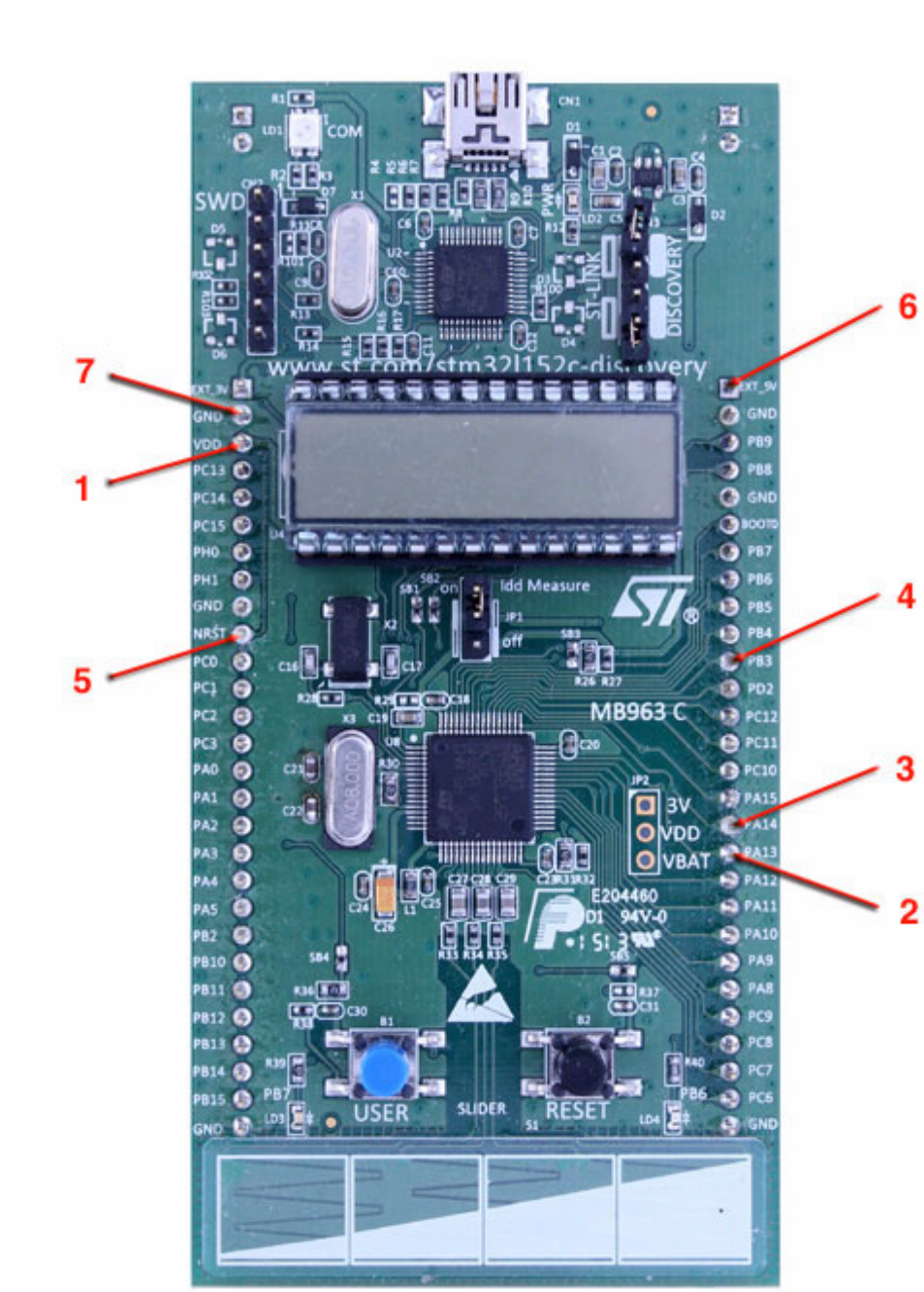
2.14 Connect J-Link to STM32L152

1. Connect J-Link pin VTref (1) to pin VDD
2. Connect J-Link pin SWDIO (7) to pin PA13
3. Connect J-Link pin SWCLK (9) to pin PA14
4. Connect J-Link pin SWO (13) to pin PB3
5. Connect J-Link pin RESET (15) to pin NRST
6. Connect J-Link pin 5V-Supply (19) to pin EXT_5V
7. Connect J-Link pin GND (4) to pin GND



Note: Jumpers on CN3 (ST-Link) must be removed for external debug to work.

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2.15 Target power supply

Pin 19 of the connector can be used to supply power to the target hardware. Supply voltage is 5V, max. current is 300mA. The output current is monitored and protected against overload and short-circuit.

Power can be controlled via the J-Link commander. The following commands are available to control power:

PIN	Description
`power on`	Switch target power on
`power off`	Switch target power off
`power on perm`	Set target power supply default to "on"
`power off perm`	Set target power supply default to "off"

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Chapter 3

Alternative: Converting ST-Link on-board into a J-Link

This chapter describes how to convert the ST-Link on board into a J-Link for STM32-Discovery boards.

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3.1 Firmware for ST-Link on-board

SEGGER offers a firmware upgrading the ST-LINK on-board on the Nucleo and Discovery Boards. This firmware makes the ST-LINK on-board compatible to J-Link OB, allowing users to take advantage of most J-Link features like the ultra fast flash download and debugging speed or the free-to-use GDBServer.

3.1.1 Features

- Fully compatible to and same features as J-Link OB
- Wide range of IDEs are supported
- Virtual COM port (VCOM) support

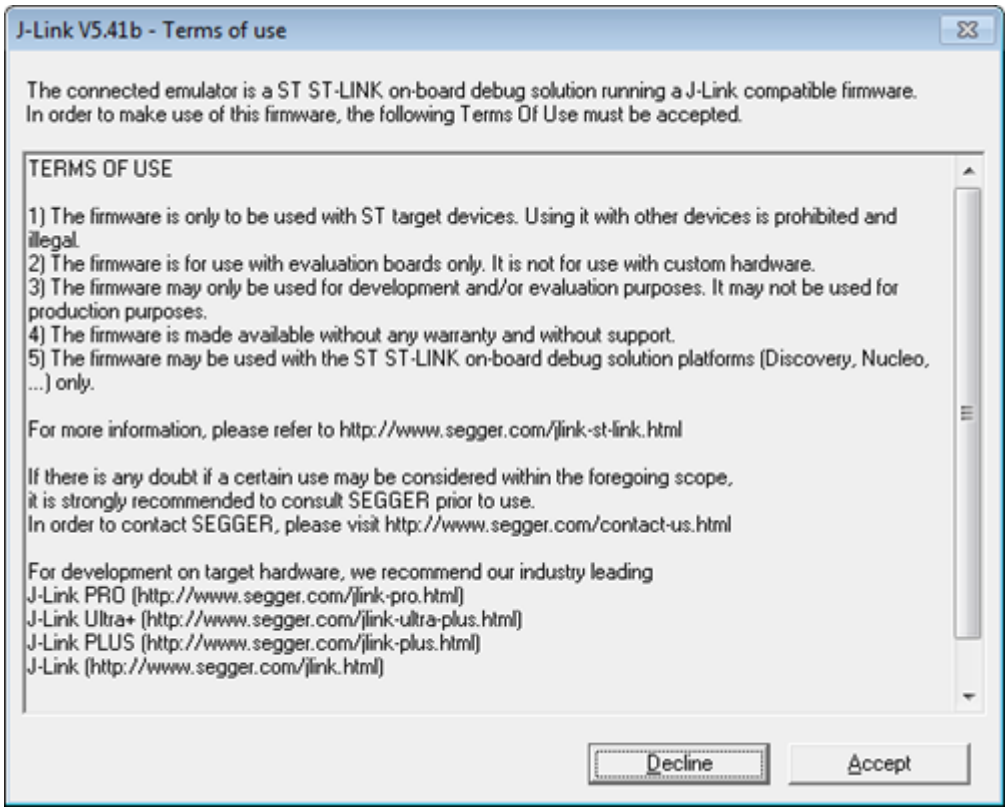
3.1.2 Licensing

SEGGER created a firmware which runs on the ST-LINK on-board, making it J-Link compatible. In order to make use of this firmware, the following Terms Of Use must be accepted:

- The firmware is only to be used with ST target devices. Using it with other devices is prohibited and illegal.
- The firmware is for use with evaluation boards only. It is not for use with custom hardware.
- The firmware may only be used for development and/or evaluation purposes. It may not be used for production purposes.
- The firmware is made available without any warranty and without support.

If there is any doubt if a certain use may be considered within the foregoing scope it is strongly recommended to consult SEGGER prior to use.

When starting a debug session, the following license dialog shows up which must be accepted in order to be able to work with ST-LINK on-board:



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3.1.3 Limitations

The firmware making the ST-LINK on-board J-Link compatible has some limitations in contrast to an original, industry leading SEGGER J-Link:

- May be used with ARM based ST devices only
- Only debugging on evaluation boards is allowed. Debugging on custom hardware is not supported and not allowed
- No production flash programming support
- Unlimited breakpoints in flash available for evaluation only
- No support is given

By using an original SEGGER J-Link PRO, J-Link ULTRA+ or J-Link PLUS, all these limitations will be gone. Learn more about J-Link.

3.1.4 Compatible Evaluation Boards

The following eval boards have been tested with the J-Link OB firmware and are known to be working. Other eval board may work as well but are not guaranteed to do so. In case of doubt, please contact us:

- NUCLEO-F030R8
- NUCLEO-F031K6
- NUCLEO-F042K6
- NUCLEO-F070RB
- NUCLEO-F072RB
- NUCLEO-F091RC
- NUCLEO-F103RB
- NUCLEO-F207ZG
- NUCLEO-F302R8
- NUCLEO-F303K8
- NUCLEO-F303RE
- NUCLEO-F303ZE
- NUCLEO-F334R8
- NUCLEO-F401RE
- NUCLEO-F410RB
- NUCLEO-F411RE
- NUCLEO-F429ZI
- NUCLEO-F446RE
- NUCLEO-F446ZE
- NUCLEO-F746ZG
- NUCLEO-L031K6
- NUCLEO-L053R8
- NUCLEO-L073RZ
- NUCLEO-L152RE
- STM32F0308-DISCO
- STM32F0DISCOVERY
- STM32F3348-DISCO (32F3348DISCOVERY)
- STM32F3DISCOVERY
- STM32F411E-DISCO
- STM32F429I-DISCO
- STM32F469I-DISCO
- STM32F746G-DISCO
- STM32L0538-DISCO (32L0538DISCOVERY)
- STM32L100C-DISCO
- STM32L476-DISCO

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3.2 Download necessary software

In order to get started with ST-LINK on-board and upgrade it to a J-Link OB, just download the necessary Software:

- Make sure that the ST-LINK USB drivers are installed:
  Download
- Make sure that the J-Link software package V5.12b or later is installed:
  Download
- Download the SEGGER STLinkReflash utility:
  Download

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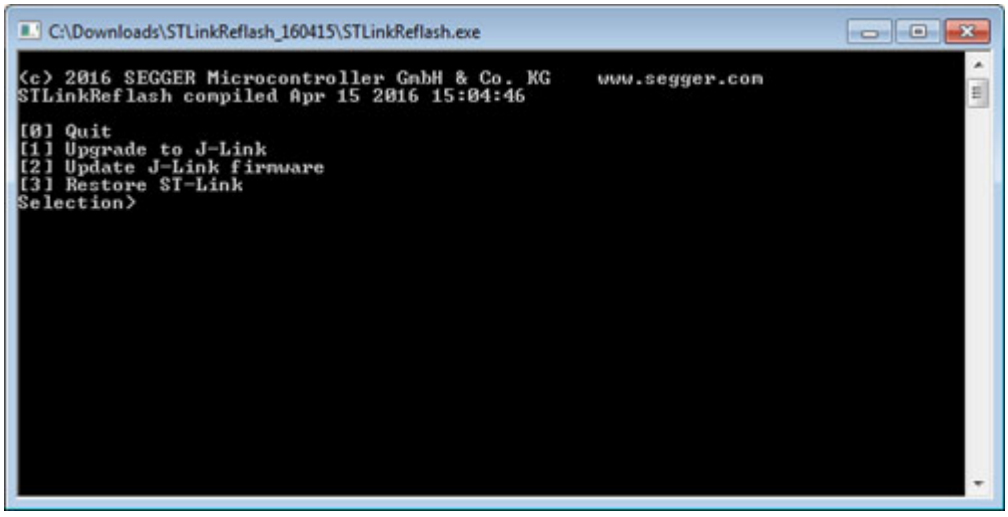
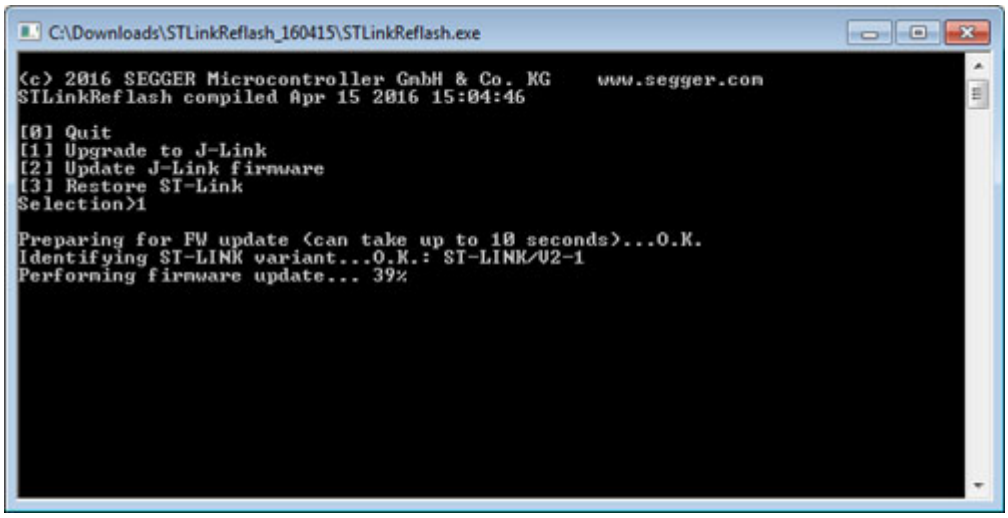
3.3 Upgrade ST to J-Link (Step by Step)

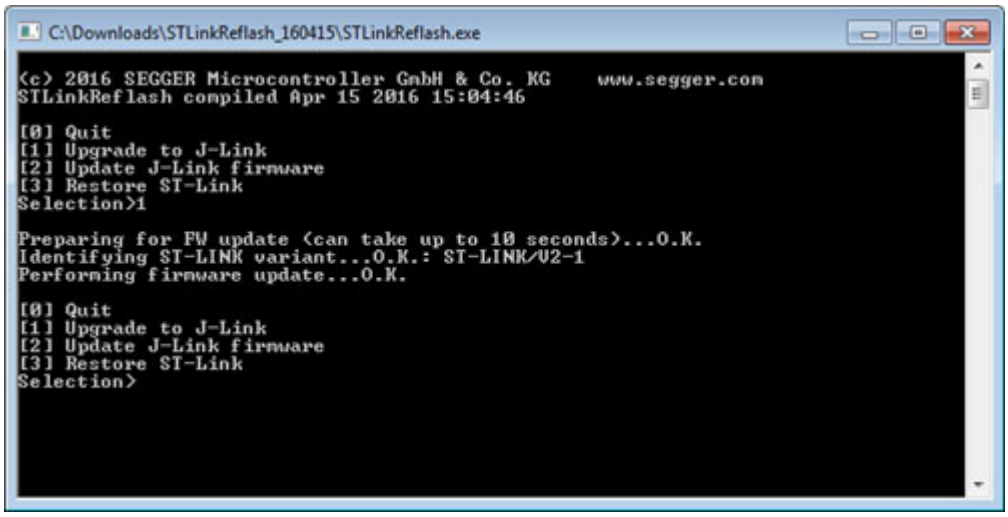
- Start the STLinkReflash utility



- Connect ST-LINK on-board to PC
- Select "Upgrade to J-Link"



- Wait for operation to complete



- Quit the STLinkReflash utility

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