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ST-LINK-V2 In Circuit Debugger Programmer User Manual

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UM1075
User manual
ST-LINK/V2 in-circuit debugger/programmer for STM8 and STM32

Contents

Introduction

The ST-LINK/V2 is an in-circuit debugger/programmer for the STM8 and STM32 microcontrollers. The single wire interface module (SWIM) and the JTAG/serial wire debugging (SWD) interfaces facilitate communication with any STM8 or STM32 microcontroller operating on an application board.
In addition to providing the same functionalities of the ST-LINK/V2, the ST-LINK/V2-ISOL features digital isolation between the PC and the target application board. It also withstands voltages of up to 1000 V RMS.
The USB full-speed interface enables communication with a PC and:

- STM8 devices via ST Visual Develop (STVD) or ST Visual Program (STVP) software (available from STMicroelectronics)

- STM32 devices via IAR™, Keil ® , STM32CubeIDE, STM32CubeProgrammer, and STM32CubeMonitor integrated development environments.

Figure 1. ST-LINK/V2 and ST-LINK/V2-ISOL

ST-LINK/V2

ST-LINK/V2-ISOL

Features

- 5 V power supplied by a USB connector
- USB 2.0 full-speed compatible interface
- USB standard-A to Mini-B cable
- SWIM-specific features
  – 1.65 to 5.5 V application voltage supported on the SWIM interface
  – SWIM low-speed and high-speed modes supported
  – SWIM programming speed rate: 9.7 and 12.8 Kbytes/s, respectively, for low and high speed
  – SWIM cable for connection to the application via an ERNI standard vertical (ref: 284697 or 214017) or horizontal (ref: 214012) connector
  – SWIM cable for connection to the application via a pin header or a 2.54 mm pitch connector
- JTAG/SWD (Serial Wire Debug) specific features
  – 1.65 to 3.6 V application voltage supported on the JTAG/SWD interface and 5 V tolerant inputs (a)
  – JTAG cable for connection to a standard JTAG 20-pin pitch 2.54 mm connector
  – Supports JTAG communication, up to 9 MHz (default: 1.125 MHz)
  – Supports serial wire debug (SWD) up to 4 MHz (default: 1.8 MHz), and serial wire viewer (SWV) communication, up to 2 MHz
- Direct firmware update feature supported (DFU)
- Status LED, blinking during communication with the PC
- 1000 V RMS high isolation voltage (ST-LINK/V2-ISOL only)
- Operating temperature from 0 to 50 degrees Celsius

Ordering information

To order the ST-LINK/V2, refer to Tab l e 1.
Table 1. List of the order codes

Order code	ST-LINK description
ST-LINK/V2	In-circuit debugger/programmer
ST-LINK/V2-ISOL	In-circuit debugger/programmer with digital isolation

a. The ST-LINK/V2 can communicate with targets operating below 3.3 V but generates output signals at this voltage level. STM32 targets are tolerant to this overvoltage. If some other components of the target board are sensible, use ST-LINK/V2-ISOL, STLINK-V3MINIE, or STLINK-V3SET with a B-STLINK-VOLT adapter to avoid the impact of overvoltage injection on the board.

Product contents

The cables delivered within the product are shown in Figure 2 and Figure 3. They include (from left to right):

- USB standard-A to Mini-B cable (A)
- ST-LINK/V2 debugging and programming (B)
- SWIM low-cost connector (C)
- SWIM flat ribbon with a standard ERNI connector at one end (D)
- JTAG or SWD and SWV flat ribbon with a 20-pin connector (E)

Figure 2. ST-LINK/V2 product contents

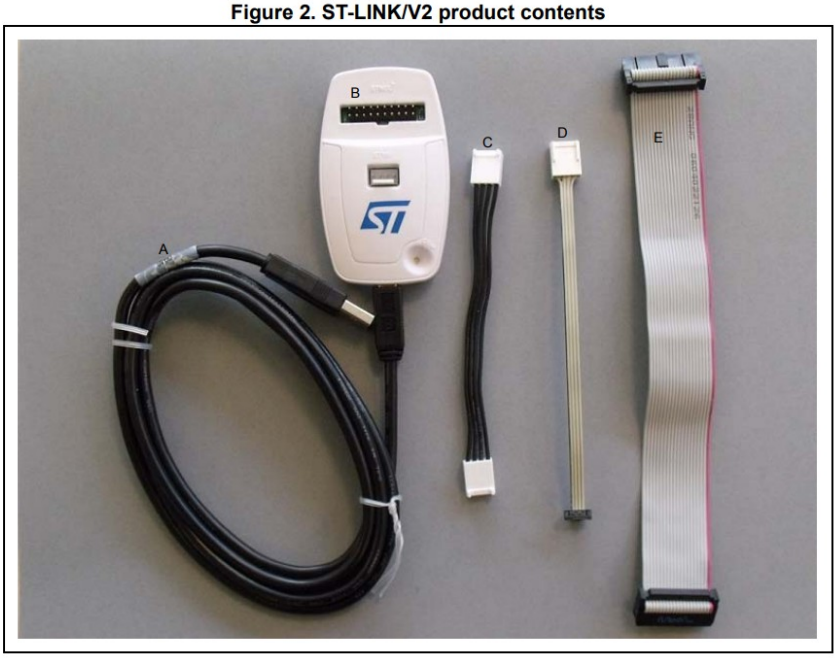


Figure 3. ST-LINK/V2-ISOL product contents

Hardware configuration

The ST-LINK/V2 is designed around the STM32F103C8 device, which incorporates the high-performance Arm ®(a) Cortex®
-M3 core. It is available in a TQFP48 package.
As shown in Figure 4, the ST-LINK/V2 provides two connectors:

- An STM32 connector for the JTAG/SWD and SWV interface
- An STM8 connector for the SWIM interface

The ST-LINK/V2-ISOL provides one connector for the STM8 SWIM, STM32 JTAG/SWD, and SWV interfaces.

Figure 4. ST-LINK/V2 (on the left) and ST-LINK/V2-ISOL (on the right) connectors

1. A = STM32 JTAG and SWD target connector
2. B = STM8 SWIM target connector
3. C = STM8 SWIM, STM32 JTAG, and SWD target connector
4. D = Communication activity LED

4.1 Connection with STM8

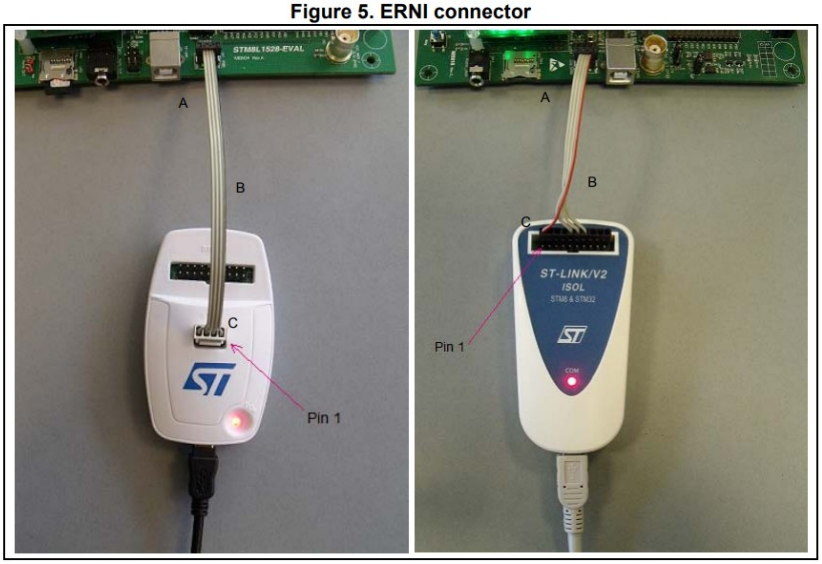
For the development of applications based on STM8 microcontrollers, the ST-LINK/V2 can be connected to the target board by two different cables, depending upon the connector available on the application board.
These cables are:

- A SWIM flat ribbon with a standard ERNI connector at one end
- A SWIM cable with two 4-pin, 2.54 mm connectors or SWIM separate-wire cables

4.1.1 Standard ERNI connection with SWIM flat ribbon

Figure 5 shows how to connect the ST-LINK/V2 if a standard ERNI 4-pin SWIM connector is present on the application board.

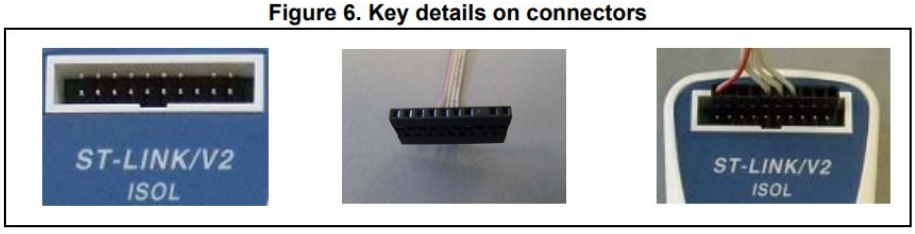
Figure 5. ERNI connector



1. A = Target application board with ERNI connector
2. B = Wire cable with ERNI connector at one end
3. C = STM8 SWIM target connector
4. See Figure 11

Figure 6 shows that pin 16 is missing on the ST-LINK/V2-ISOL target connector. This missing pin is used as a safety key on the cable connector, to guarantee the correct position of the SWIM cable on the target connector even pins used for both SWIM and JTAG cables.

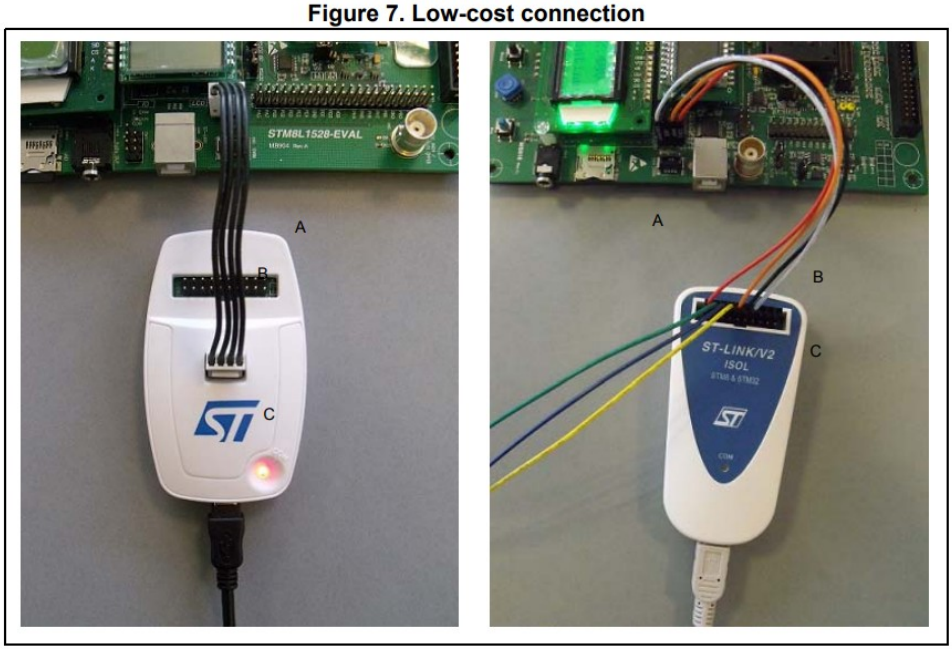
Figure 6. Key details on connectors



4.1.2 Low-cost SWIM connection

Figure 7 shows how to connect the ST-LINK/V2 if a 4-pin, 2.54 mm, low-cost SWIM connector is present on the application board.

Figure 7. Low-cost connection



1. A = Target application board with 4-pin, 2.54 mm, low-cost connector
2. B = Wire cable with a 4-pin connector or separate-wire cable
3. C = STM8 SWIM target connector
4. See Figure 12

4.1.3 SWIM signals and connections

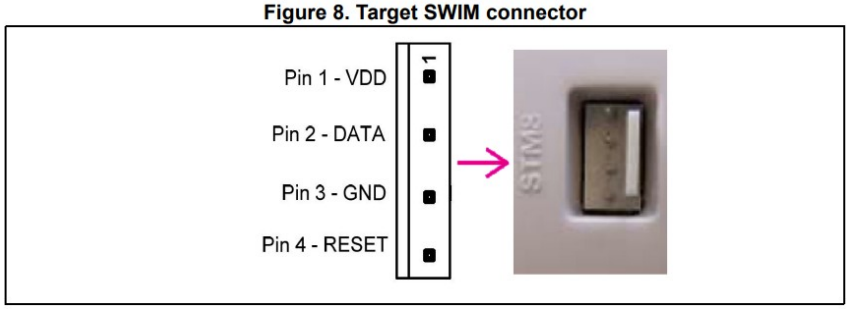
Tab l e 2 summarizes the signal names, functions, and target connection signals when using the wire cable with a 4-pin connector.

Table 2. SWIM flat ribbon connections for ST-LINK/V2

Pin no.	Name	Function	Target connection
1	VDD	Target VCC(1)	MCU VCC
2	DATA	SWIM	MCU SWIM pin
3	GND	GROUND	GND
4	RESET	RESET	MCU RESET pin

1. The power supply from the application board is connected to the ST-LINK/V2 debugging and programming board to ensure signal compatibility between both boards.

Figure 8. Target SWIM connector



Tab l e 3 summarizes the signal names, functions, and target connection signals using the separate-wires cable. As the SWIM separate-wire cable has independent connectors for all pins on one side, it is possible to connect the ST-LINK/V2-ISOL to an application board without a standard SWIM connector. On this flat ribbon, a specific color and a label to ease the connection on target references all the signals.

Table 3. SWIM low-cost cable connections for ST-LINK/V2-ISOL

Color	Cable pin name	Function	Target connection
Red	TVCC	Target VCC(1)	MCU VCC
Green	UART-RX	Unused	Reserved (2) (not connected to the target board)
Blue	UART-TX		
Yellow	BOOTO		
Orange	SWIM	SWIM	MCU SWIM pin
Black	GND	GROUND	GND
White	SWIM-RST	RESET	MCU RESET pin

1. The power supply from the application board is connected to the ST-LINK/V2 debugging and programming board to ensure signal compatibility between both boards.
2. BOOT0, UART-TX, and UART-RX are reserved for future developments.
TVCC, SWIM, GND, and SWIM-RST can be connected to a low-cost 2.54 mm pitch connector or to pin headers available on the target board.

4.2 Connection with STM32

For the development of applications based on STM32 microcontrollers, the ST-LINK/V2 must be connected to the application using the standard 20-pin JTAG flat ribbon provided.
Tab l e 4 summarizes the signal names, functions, and target connection signals of the standard 20-pin JTAG flat ribbon on ST-LINK/V2.
Table 5 summarizes the signal names, functions, and target connection signals of the standard 20-pin JTAG flat ribbon on ST-LINK/V2-ISOL.
Table 4. JTAG/SWD cable connections on STLINK-V2

Pin no.	ST-LINK/V2 connector (CN3)	ST-LINKN2 function	Target connection (JTAG)	Target connection (SWD)
1	VAPP	Target VCC	MCU VDD(1)	MCU VDD(1)
2				
3	TRST	JTAG TRST	NJTRST	GND(2)
4	GND	GND	GNDK3)	GND(3)
5	TDI	JTAG TDO	JTDI	GND(2)
6	GND	GND	GND(3)	GND(3)
7	TMS SWDIO	JTAG TMS, SW 10	JTMS	SWDIO
8	GND	GND	GND(3)	GND(3)
9	TCK SWCLK	JTAG TCK, SW CLK	JTCK	SWCLK
10	GND	GND	GND(3)	GND(3)
11	Not connected	Not connected	Not connected	Not connected
12	GND	GND	GND(3)	GND(3)
13	TDO SWO	JTAG TDI. SWO	JTDO	TRACESWOO)
14	GND	GND	GND(3)	GND(3)
15	NRST	NRST	NRST	NRST
16	GND	GND	GNDK3)	GND(3)
17	Not connected	Not connected	Not connected	Not connected
18	GND	GND	GND(3)	GND(3)
19	VDD	VDD (3.3 V)	Not connected	Not connected
20	GND	GND	GND(3)	GND(3)

1. The power supply from the application board is connected to the ST-LINK/V2 debugging and programming board to ensure signal compatibility between the boards.
2. Connect to GND for noise reduction on the ribbon.
3. At least one of these pins must be connected to the ground for correct behavior. It is recommended to connect all of them.
4. Optional: For Serial Wire Viewer (SWV) trace.

Table 5. JTAG/SWD cable connections on STLINK-V2-ISOL

Pin no.	ST-LINK/V2 connector (CN3)	ST-LINKN2 function	Target connection(JTAG)	Target connection (SWD)
1	VAPP	Target VCC	MCU VDD(1)	MCU VDD(1)
2				
3	TRST	JTAG TRST	NJTRST	GND(2)
4	Not connected	Not connected	Not connected	Not connected
5	TDI	JTAG TDO	JTDI	GND(2)
6	Not connected	Not connected	Not connected	Not connected
7	TMS SWDIO	JTAG TMS. SW 10	JTMS	SWDIO
8	Not connected	Not connected	Not connected	Not connected
9	TCK SWCLK	JTAG TCK, SW CLK	JTCK	SWCLK
10	Not used(5)	Not used(5)	Not connected(5)	Not connected(5)
11	Not connected	Not connected	Not connected	Not connected
12	GND	GND	GND(3)	GND(3)
13	TDO SWO	JTAG TDI, SWO	JTDO	TRACESW0(4)
14	Not used(5)	Not used(5)	Not connected(5)	Not connected(5)
15	NRST	NRST	NRST	NRST
16	Not connected	Not connected	Not connected	Not connected
17	Not connected	Not connected	Not connected	Not connected
18	GND	GND	GND(3)	GND(3)
19	Not connected	Not connected	Not connected	Not connected
20	GND	GND	GND(3)	GND(3)

1. The power supply from the application board is connected to the ST-LINK/V2 debugging and programming board to ensure signal compatibility between the boards.
2. Connect to GND for noise reduction on the ribbon.
3. At least one of these pins must be connected to the ground for correct behavior. It is recommended to connect all of them.
4. Optional: For Serial Wire Viewer (SWV) trace.

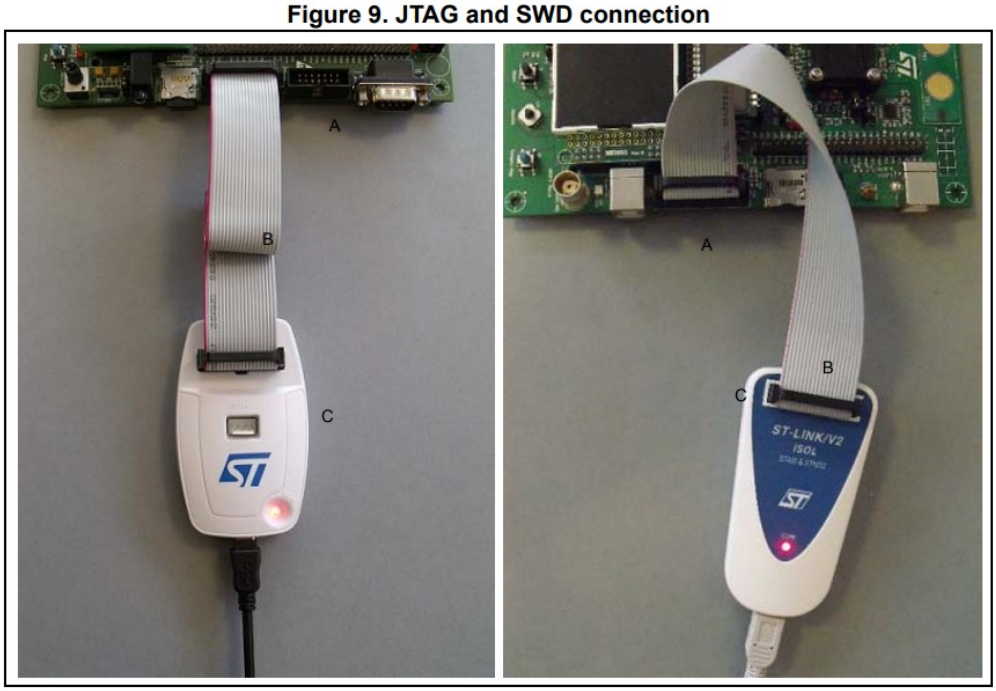
Table 5. JTAG/SWD cable connections on STLINK-V2-ISOL

Pin no.	ST-LINK/V2 connector (CN3)	ST-LINKN2 function	Target connection (JTAG)	Target connection (SWD)
1	VAPP	Target VCC	MCU VDD(1)	MCU VDD(1)
2				
3	TRST	JTAG TRST	NJTRST	GND(2)
4	Not connected	Not connected	Not connected	Not connected
5	TDI	JTAG TDO	JTDI	GND(2)
6	Not connected	Not connected	Not connected	Not connected
7	TMS SWDIO	JTAG TMS. SW 10	JTMS	SWDIO
8	Not connected	Not connected	Not connected	Not connected
9	TCK SWCLK	JTAG TCK. SW CLK	JTCK	SWCLK
10	Not used(5)	Not used(5)	Not connected(5)	Not connected(5)
11	Not connected	Not connected	Not connected	Not connected
12	GND	GND	GND(3)	GND(3)
13	TDO SWO	JTAG TDI. SWO	JTDO	TRACESW0(4)
14	Not used(5)	Not used(5)	Not connected(5)	Not connected(5)
15	NRST	NRST	NRST	NRST
16	Not connected	Not connected	Not connected	Not connected
17	Not connected	Not connected	Not connected	Not connected
18	GND	GND	GND(3)	GND(3)
19	Not connected	Not connected	Not connected	Not connected
20	GND	GND	GND(3)	GND(3)

1. The power supply from the application board is connected to the ST-LINK/V2 debugging and programming board to ensure signal compatibility between the boards.
2. Connect to GND for noise reduction on the ribbon.
3. At least one of these pins must be connected to the ground for correct behavior. It is recommended to connect all of them.
4. Optional: For Serial Wire Viewer (SWV) trace.
5. Used by SWIM on ST-LINK/V2-ISOL (see Table 3).

Figure 9 shows how to connect the ST-LINK/V2 to a target using the JTAG cable.

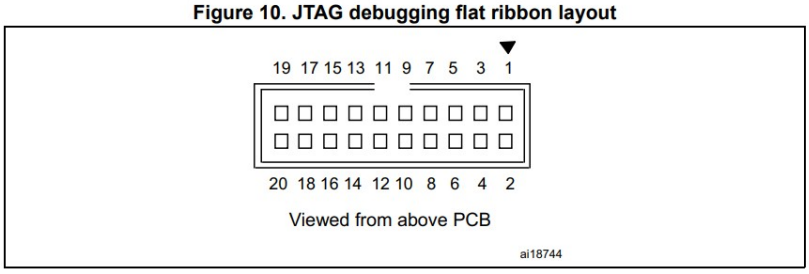
Figure 9. JTAG and SWD connection



1. A = Target application board with JTAG connector
2. B = JTAG/SWD 20-wire flat cable
3. C = STM32 JTAG and SWD target connector

The reference of the connector needed on the target application board is: 2x10C header wrapping 2x40C H3/9.5 (pitch 2.54) – HED20 SCOTT **PHSD80.**

Figure 10. JTAG debugging flat ribbon layout



Note: For low-cost applications, or when the standard 20-pin 2.54 mm-pitch connector footprint is too large, it is possible to implement the TAG-Connect solution. The TAG-Connect adapter and cable provide a simple and reliable means of connecting ST-LINK/V2 or ST-LINK/V2ISOL to the PCB without requiring a mating component on the application PCB.
For more details on this solution and application-PCB-footprint information, visit **www.tag-connect.com**.
The references of components compatible with the JTAG and SWD interfaces are:
a) TC2050-ARM2010 adapter (20-pin- to 10-pin-interface board)
b) TC2050-IDC or TC2050-IDC-NL (No legs) (10-pin cable)
c) TC2050-CLIP retaining clip for use with TC2050-IDC-NL (optional)

4.3 ST-LINK/V2 status LED

The LED labeled COM on top of the ST-LINK/V2 shows the ST-LINK/V2 status (whatever the connection type). In detail:

- The LED blinks red: the first USB enumeration with the PC is taking place
- The LED is red: communication between the PC and ST-LINK/V2 is established (end of enumeration)
- The LED blinks green/red: Data are exchanged between the target and the PC
- The LED is green: the last communication has been successful
- The LED is orange: ST-LINK/V2 communication with the target has failed.

Software configuration

5.1 ST-LINK/V2 firmware upgrade

The ST-LINK/V2 embeds a firmware upgrade mechanism for in-place upgrades through the USB port. As the firmware can evolve during the life of the ST-LINK/V2 product (new functionality, bug fixes, support for new microcontroller families), it is recommended to visit periodically the dedicated pages on **www.st.com** to stay up-to-date with the latest version.

5.2 STM8 application development

Refer to ST toolset Pack24 with patch 1 or more recent, which includes ST Visual Develop (STVD) and ST Visual Programmer (STVP).

5.3 STM32 application development and flash programming

Third-party toolchains (IAR ™ EWARM, Keil ® MDK-ARM ™) support ST-LINK/V2 according to the versions given in Tab l e 6 or the most recent version available.

Table 6. How third-party toolchains support ST-LINK/V2

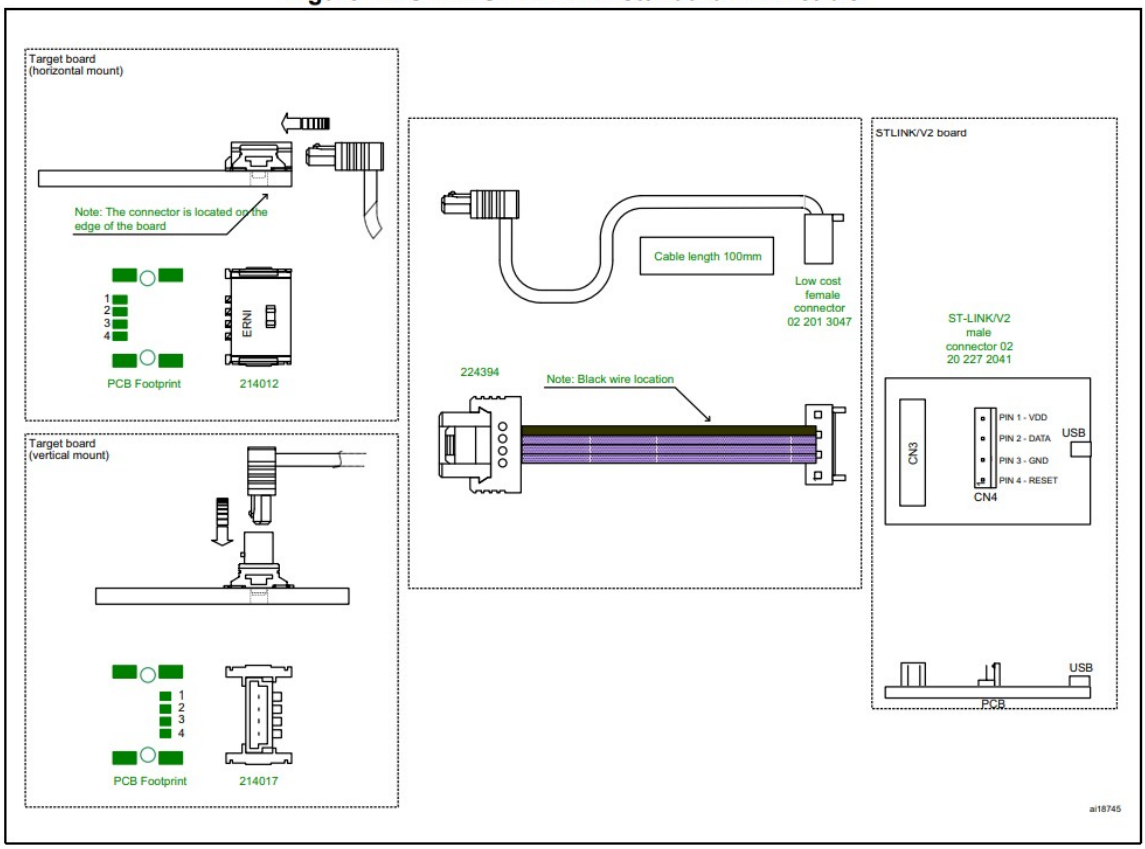
Third party	Toolchain	Version
IAR™	EWARM	6.2
Keil®	MDK-ARM™	4.2

The ST-LINK/V2 requires a dedicated USB driver. If the toolset setup does not install it automatically, the driver can be found on **www.st.com** under the name STSW-LINK009.
For more information on third-party tools, visit the following websites:

- **www.iar.com**
- **www.keil.com**

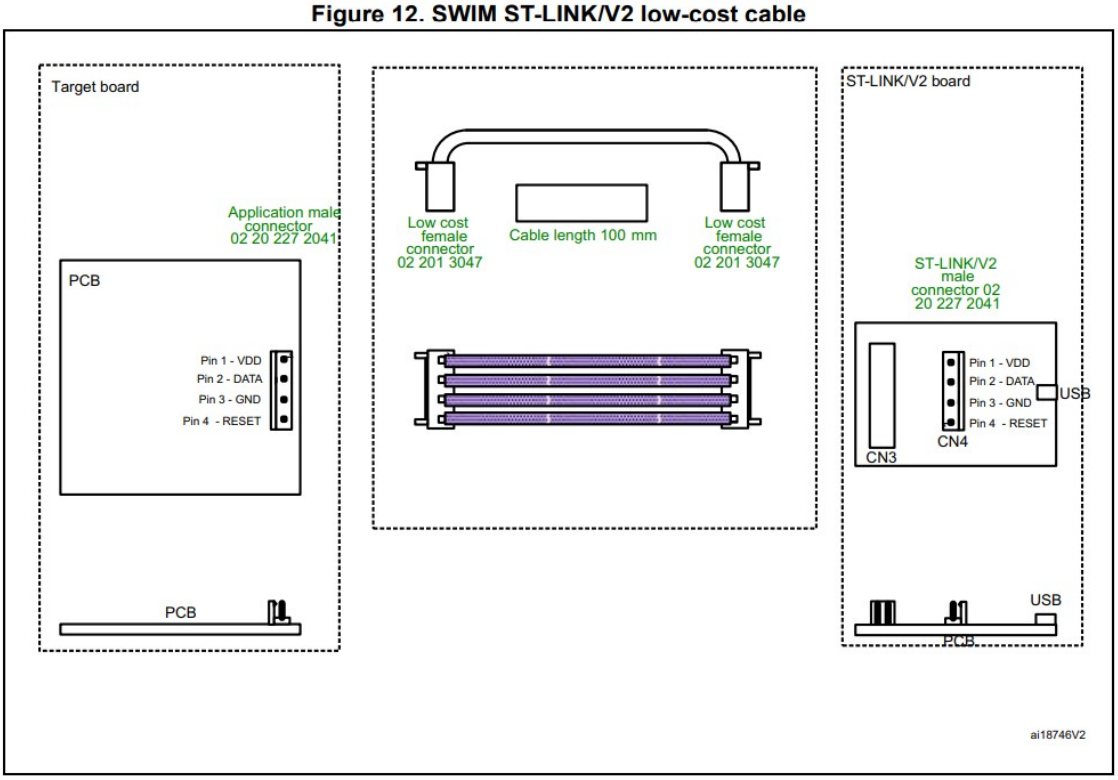
Schematics

Figure 11. SWIM ST-LINK/V2 standard ERNI cable



Legend for pin descriptions:
VDD = Target voltage sense
DATA = SWIM DATA line between target and debug tool
GND = Ground voltage
RESET = Target system reset

Figure 12. SWIM ST-LINK/V2 low-cost cable



Legend for pin descriptions:
VDD = Target voltage sense
DATA = SWIM DATA line between target and debug tool
GND = Ground voltage
RESET = Target system reset

Revision history

Table 7. Document revision history

Date	Revision	Changes
22-Apr-11	1	Initial release.
3-Jun-11	2	Table 2: SWIM flat ribbon connections for ST-LINK/V2: added footnote 1 to the function “Target VCC”. Table 4: JTAG/SWD cable connections: added a footnote to the function “Target VCC”. Table 5: How third-party toolchains support ST-LINK/V2: updated the “Versions” of IAR and Keil.
19-Aug-11	3	Added USB driver details to Section 5.3.
11-May-12	4	Added SWD and SWV to JTAG connection features. Modified Table 4: JTAG/SWD cable connections.
13-Sep-12	5	Added ST-LINKN2-ISOL order code. Updated Section 4.1: STM8 application development on page 15. Added Note 6 in Table 4. Added Note “For low-cost applications…” before Section 3.3: STLINK/V2 status LEDs on page 14.
18-Oct-12	6	Added Section 5.1: ST-LINK/V2 firmware upgrade on page 15.
25-Mar-16	7	Updated VRMS value in Introduction and Features.
18-Oct-18	8	Updated Table 4: JTAG/SWD cable connections and its footnotes. Minor text edits across the whole document.
9-Jan-23	9	Updated Introduction, Features, and Section 5.3: STM32 application development and flash programming. Updated Table 5: How third-party toolchains support ST-LINK/V2. Minor text edits across the whole document.
3-Apr-24	10	Former Table 4 JTAG/SWD cable connections splitted in Table 4: JTAG/SWD cable connections on STLINK-V2 and Table 5: JTAG/SWD cable connections on STLINK-V2-ISOL.

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Documents / Resources

	ST ST-LINK-V2 In Circuit Debugger Programmer [pdf] User Manual ST-LINK-V2, ST-LINK-V2-ISOL, ST-LINK-V2 In Circuit Debugger Programmer, ST-LINK-V2, In Circuit Debugger Programmer, Circuit Debugger Programmer, Debugger Programmer

References

- Keil Embedded Development Tools for Arm, Cortex-M, Cortex-R4, 8051, C166, and 251 processor families.
- Tag-Connect | Tag-Connect
- User Manual

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