
Overview of the ST-LINK embedded in STM32 MCU Nucleo, Discovery Kits and Eval Boards

Introduction

ST-LINK is an in-circuit debugger/programmer for ST microcontrollers.

This technical note provides an overview of the ST-LINK versions embedded in the following development boards: STM32 MCU Nucleo, STM32 MCU Discovery Kits, STM32 MCU Eval Boards.

ST-LINK and ST-LINK/V2 exist either embedded in development boards or as standalone hardware probes, that are connected to an external development board. Those two probes are not the focus of this technical note, that only describes the embedded ST-LINK versions.

1 Overview of the ST-LINK versions

1.1 Brief history of the embedded ST-LINK versions

There is several versions of the embedded ST-LINK because new functionalities have been incrementally added from the first version named ST-LINK. Here is a brief history of the incremental changes on the naming of the versions.

The first two versions of the ST-LINK, embedded in ST discovery boards and in ST evaluation boards, are:

- the ST-LINK version
- the ST-LINK/V2 version

A third version of the ST-LINK, the ST-LINK/V2-1 version, is an evolution of the ST-LINK/V2 version, adding the USB interface (mass storage interface and Virtual-COM-port) and enabling better control of the power management for the STM32 embedded in the application board. The ST-LINK/V2-1 is deployed on the most recent ST discovery boards, ST evaluation boards and ST Nucleo boards.

Two others versions, derivatives of the ST-LINK/V2 version, have been implemented afterwards, in order to support some of the functionalities newly added with the ST-LINK/V2-1:

- the ST-LINK/V2-A version, for mass storage functionality.
- the ST-LINK/V2-B version, for mass storage and Virtual-COM-port.

1.2 ST-LINK USB interfaces

The ST-LINK and the ST-LINK/V2 embed a unique interface (ST debug) with the USB. At power-on, the boards are in firmware-upgrade mode (also called DFU for "Device Firmware Upgrade"), allowing the firmware to be updated through the USB. Some commands allow to switch the ST-LINK from firmware-upgrade mode to STM8 debug mode or to STM32 debug mode (depending on firmware capacity), but there is no command to switch back to firmware-upgrade mode (a power cycle is required).

ST-LINK/V2-1, ST-LINK/V2-A and ST-LINK/V2-B are composite USB devices presenting a mass storage interface and a virtual-COM-port interface to the USB, in addition to the ST debug interface. They directly run their firmware at power-on. Firmware-upgrade mode is entered through a dedicated command managed by the ST-LINK upgrade applications.

2 Overview of features

For a given board (Nucleo, discovery and evaluation boards), the user manual is the reference document to know which version of the ST-LINK is embedded in the board.

Below is the overview of the features supported by each of the ST-LINK versions.

2.1 The ST-LINK key features

Here are the key features of the ST-LINK:

- 5V power supplied by USB connector.
- USB 2.0 full speed interface compatible.
- USB standard A to Mini-B cable provided.
- SWIM specific features: 1.65 V to 5.5 V application voltage supported on SWIM interface.
- SWIM Low-speed and High-speed modes supported.
- SWIM programming speed rates of 9.7 K bytes/s in Low-speed, 12.8 Kbytes/s in High-speed.
- SWIM cable for connection to an application with an ERNI standard connector vertical (ref: 284697 or 214017) or horizontal (ref: 214012).
- SWIM cable for connection to an application with pin headers or 2.54 mm pitch connector.
- JTAG/SWD specific features: 3 V to 3.6 V application voltage supported on JTAG/SWD interface and 5 V tolerant inputs.
- JTAG/SWD cable provided for connection to a standard JTAG 20-pin pitch 2.54 mm connector.
- Direct firmware update feature supported.
- Status LED which blinks during communication with PC.
- Operating temperature 0 to 50 °C.

2.2 The ST-LINK/V2 key features

Here are the key features of the ST-LINK/V2:

- 5V 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 V to 5.5 V application voltage supported on SWIM interface.
- SWIM low-speed and high-speed modes supported.
- SWIM programming speed rate: 9.7 Kbytes/s in Low-speed and 12.8 Kbytes/s in High-speed.
- SWIM cable for connection to the application via an ERNI standard vertical connector (ref: 284697 or 214017) or horizontal connector (ref: 214012).

- SWIM cable for connection to the application via a pin header or a 2.54 mm pitch connector.
- JTAG/serial wire debugging (SWD) specific features: 1.65 V to 3.6 V application voltage supported on the JTAG/SWD interface and 5 V tolerant inputs.
- JTAG cable for connection to a standard JTAG 20-pin pitch 2.54 mm connector.
- JTAG supported.
- SWD and serial wire viewer (SWV) communication supported.
- Direct firmware update feature supported (DFU).
- Status LED which blinks during communication with the PC.
- Operating temperature 0 to 50 °C.
- 1000 Vrms high isolation voltage (ST-LINK/V2-ISOL only).

2.3 The ST-LINK/V2-1 key features

The changes versus the ST-LINK/V2 version are listed below.

- New features supported on the ST-LINK/V2-1:
 - USB software re-enumeration.
 - Virtual-COM-port interface on USB.
 - Mass storage interface on USB.
 - USB power management request for more than 100 mA power-on USB.
- Features not supported on the ST-LINK/V2-1:
 - SWIM interface.
 - Minimum supported application voltage depends on hardware implementation. For details, refer to the user manual of the board.

2.4 The ST-LINK/V2-A key features

The changes versus the ST-LINK/V2 version are listed below.

- New features supported on the ST-LINK/V2-A:
 - Virtual-COM-port interface on USB, under conditions: refer to the user manual of the board for details.
 - Mass storage interface on USB.
- Features not supported on the ST-LINK/V2-A:
 - SWIM interface.
 - Minimum supported application voltage limited to 3 V.
 - USB power management request for more than 100 mA power-on USB.

2.5 The ST-LINK/V2-B key features

The changes versus the ST-LINK/V2 version are listed below.

- New features supported on the ST-LINK/V2-B are:
 - Virtual-COM-port interface on USB.
 - Mass storage interface on USB.
- Features not supported on the ST-LINK/V2-B are:
 - SWIM interface.
 - Minimum supported application voltage limited to 3 V.
 - USB power management request for more than 100 mA power-on USB.

3 Firmware naming rules

There is a multiplicity of ST-LINK firmwares, because of the multiplicity of hardware boards and functionalities.

The firmware version gives an indication of supported functionalities, according to the following rules:

- V: major version ID. 1 for ST-LINK, 2 for ST-LINK/V2, ST-LINK/V2-1, ST-LINK/V2-A, ST-LINK/V2-B.
- J: version for STM32 debug interface (JTAG and SWD protocols). A value of 0 means that the interface is not supported (case of STM8 discovery boards).
- S: version for STM8 debug interface (SWIM protocol). A value of 0 means that the interface is not supported (case of some STM32 discovery and evaluation boards).
- M: version for mass storage + Virtual-COM-port interfaces.

For example:

- V1J13S4 is a version for the ST-LINK standalone probe.
- V2J27S6 is a version for the ST-LINK/V2 standalone probe (STM32 and STM8 debug interfaces).
- V2J27S0 is a version for the 32F401CDISCOVERY board (STM32 debug interface, no STM8 debug interface, no mass storage interface and no Virtual-COM-port).
- V2J27M15 is a version for Nucleo boards and other ST-LINK/V2-1, ST-LINK/V2-A, ST-LINK/V2-B boards (STM32 debug interface, mass storage interface, Virtual-COM-port).

The type of firmware is closely linked to the hardware; that is why for a given board it is not possible to change the type of firmware (from V2J27S6 to V2J27M15 for instance). It is just possible to update the version of the same type of firmware (V2J25M14 to V2J27M15 for instance).

4 ST-LINK firmware upgrade

ST-LINK firmware upgrade is possible through USB, thanks to two dedicated applications:

- STLinkUpgrade.exe: historical version for Windows.
- STLinkUpgrade.jar: java version for Windows, Linux and MacOS.

Both applications contain the last version of all ST-LINK firmware types. They identify the connected board and they automatically select the corresponding firmware. Any issue or tentative of falsification, or both, during this phase may have unpredictable results, making the board arduously recoverable, or even at worst unusable.

5 **Revision history**

Table 1. Document revision history

Date	Revision	Changes
16-Nov-2016	1	Initial release.



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