IO Ninja Hardware Manual

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Introduction

This Manual covers IO Ninja-compatible hardware:

- Serial Tap

Other types of hardware sniffers will be available in the near future.

Serial Tap

IO NINJA Serial Tap is an affordable serial sniffer that can monitor RS232, RS485, and TTL-level UART communications. The Tap connects to your PC via a USB cable and is compatible with IO Ninja terminal/sniffer software for Windows.

Features

- The Serial Tap is designed for use with IO Ninja software (http://ioninja.com/).
- Monitors TX, RX, RTS, CTS, DTR, and DSR lines [Note 1] of serial ports.

- Has three operating modes: RS232, RS485 [Note 2], and UART (TTL [Note 3]), selectable via a slide switch.
- All inputs are connected to an 18-position, quick-release terminal block.
  - RS232 mode:
    - Two onboard DB9 connectors — male and female — offer true "cable wedge" sniffing [Note 4];
    - Six jumpers for swapping and loopbacking signals within RX/TX, RTS/CTS, and DTR/DSR pairs [Note 5];
    - Six bi-color LEDs indicate the status of monitored lines and allow distinguishing between the positive voltage (red), negative voltage (green), and zero voltage (off) states [Note 5];
    - DB9 connectors additionally pass through DCD and RI signals (without monitoring them).
  - RS485 mode:
    - Only TX and RX line pairs are monitored.
  - TTL UART mode:
    - Can monitor UARTs of IC chips using logic levels from 5V down to 1.8V.
- Full-speed (12Mhz) USB2.0 interface on a USB-C connector.
- Six yellow LEDs indicate the state of six monitored lines as they enter the USB controller (these LEDs turn on on HIGH logic level).
- USB-powered, no additional external power necessary.
- Compact, outside dimensions only 82 x 74 x 30 mm.
- Supplied with a USB-C cable and two DB9 gender changers.

Note 1

A more accurate version of this statement would be: "Monitors two TX, two RTS, and two DTR lines," but that would be somewhat confusing to the reader. For clarity, we chose to list the lines as they are commonly known: TX, RX, RTS, CTS, DTR, and DSR. Keep in mind, however, that when it comes to sniffers, these names are relative and depend on the view. For two interconnected serial devices, a TX line on one end is an RX line on the other end. If so, which line is a "TX" and which line is an "RX" from the sniffer's point of view? Only you can answer this question. The Serial Tap itself has two inputs capable of monitoring serial data lines. Although they are both identical inputs, one is marked "TX" and another one is marked "RX." The same goes for other signals — RTS, CTS, DTR, and DSR. All these lines are inputs of the Tap. We gave them "regular" names to make the use of the Serial Tap intuitively easier. The same goes for RS485 lines. RX+/- and TX+/- pairs are both inputs of the Serial Tap.

This said, the Serial Tap incorporates two DB9 connectors, for which the distinction between TX and RX lines, RTS and CTS lines, and DTR and DSR lines is real. To give our terminology an anchored point of view, we have decided that the DB9-M connector on the left of the Tap is our "primary side" RS232 connector. For the entire board, all signal names are consistent with the standard pin assignment of this primary DB9-M connector. Of course, all "anchoring" disappears as soon as you abandon DB9s and plug into the terminal block lines.

Note 2

These inputs can also be used for monitoring RS422 communications.

Note 3

"TTL" here means "digital signals of microcontrollers, microprocessors, and other ICs." TTL inputs of the Serial Tap are also compatible with CMOS circuitry. Most importantly, "TTL" serial signals are usually inverted with respect to RS232 signals: a LOW (negative voltage) on an RS232 line corresponds to a HIGH level on a serial TTL (CMOS) line, and HIGH (positive voltage) on an RS232 line corresponds to a LOW level on a serial TTL (CMOS) line.

Note 4

TX, RX, RTS, CTS, DTR, and DSR lines of the primary DB9 connector located on the left of the Serial Tap are connected in parallel with RS232 inputs on the terminal block. This can be seen on the Block Diagram of the Serial Tap.

Note 5

Jumpers and bi-color LEDs on RS232 lines give the Serial Tap the second use as a simple mating and signal checking tool for serial devices.

Block Diagram

IO Ninja Serial Tap
Block Diagram
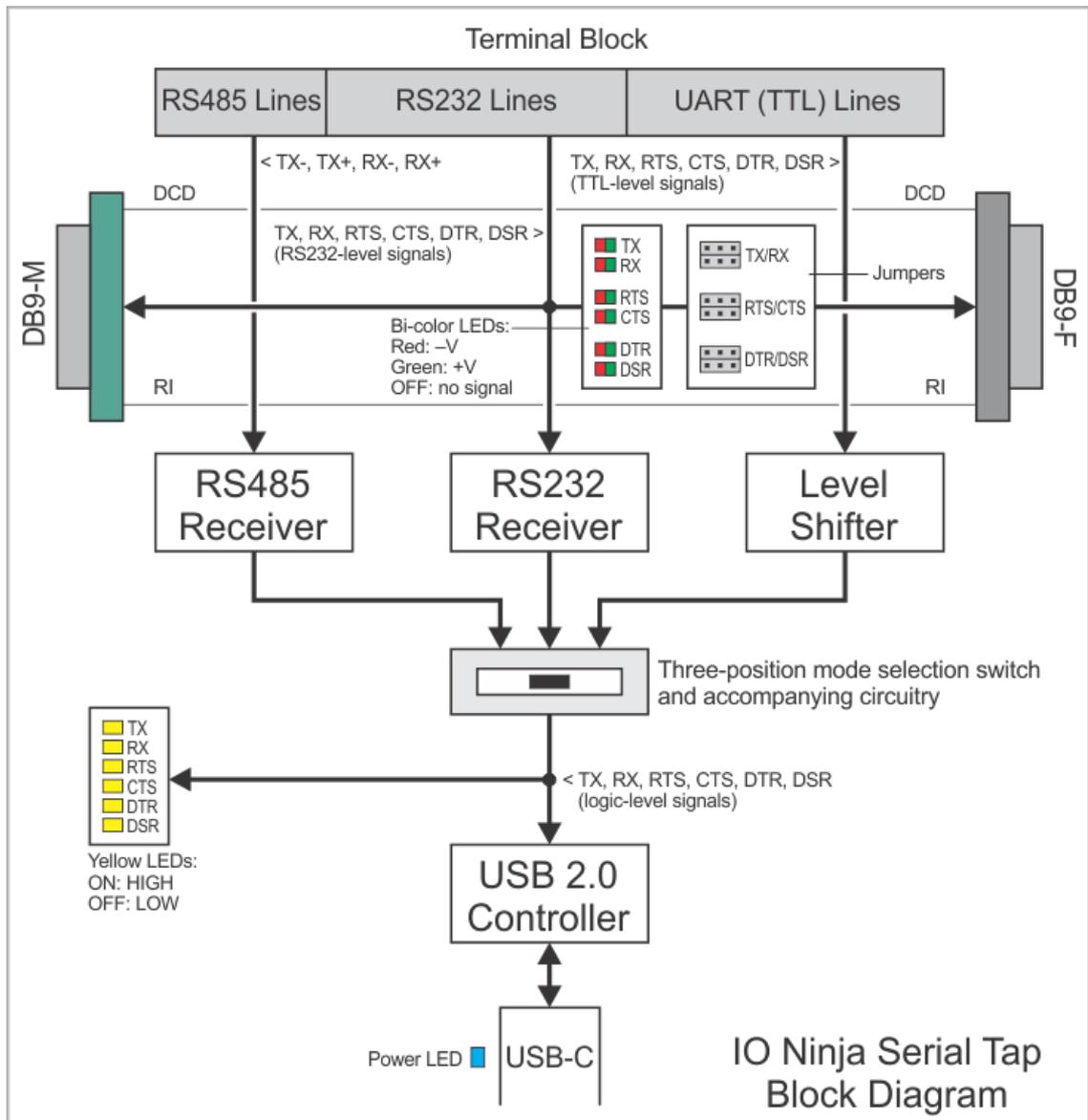
Using the Serial Tap

To start using the Serial Tap:

- Install IO Ninja software (http://ioninja.com/).
- On the Serial Tap, slide the mode selection switch into the desired position depending on what interface you will be using — RS485, RS232, or UART (TTL).
- Connect into the corresponding group of terminals on the terminal block. When in the RS232 mode, you can also employ wedge RS232 monitoring method.
- Plug the Serial Tap into the USB port of your PC.
- Launch the **Serial Tap** plugin.

- Click on the **Tap** dropdown and select the Serial tap. Note: you can connect several Serial Taps to one PC. If necessary, refresh the list of available Taps.

- Set the baudrate and click the **Listen** button to start the data acquisition.
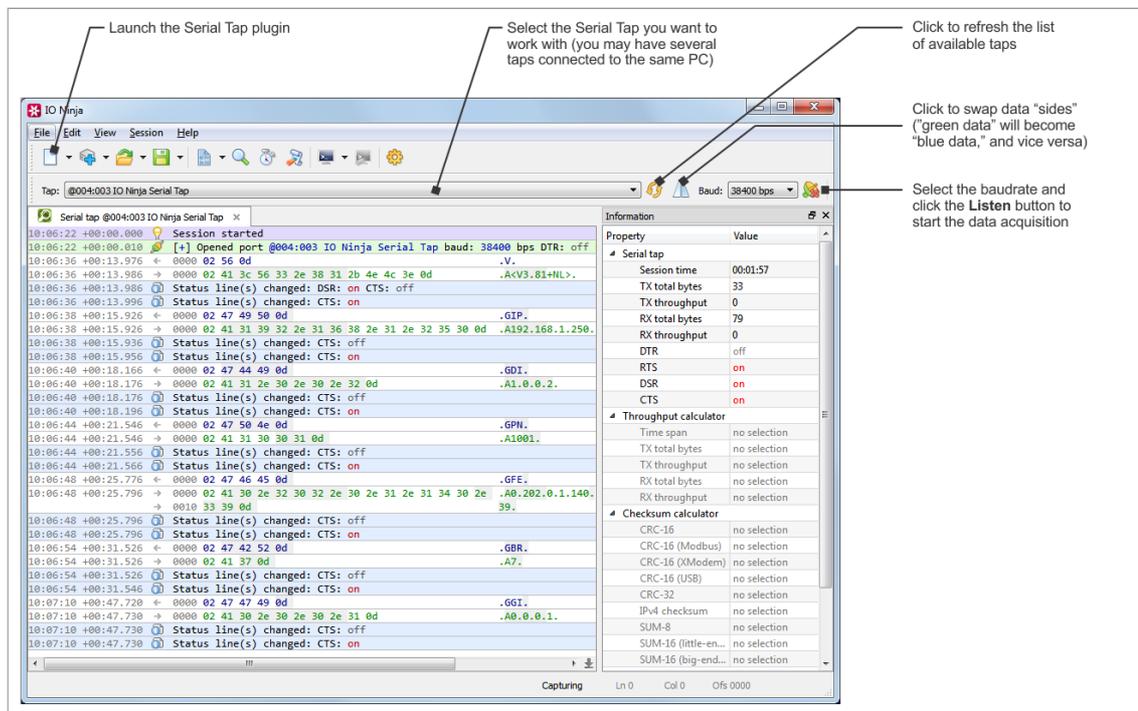
A note on the Serial Tap limitations

Please note that the Tap monitors serial traffic through two independent serial-over-USB channels. The first channel monitors TX, RTS, and DTR lines, while the second channel deals with RX, CTS, and DSR lines. Because these serial-over-USB channels are independent of each other, respective timing errors are always introduced on Windows and IO Ninja levels when receiving and recording the serial data and signal state changes.

For example, let's suppose that you are monitoring serial communications between two interconnected serial devices and both devices have sent out some data at the same time. One of the USB channels will be luckier and get service first, while the other USB channel will experience a slight delay in service. IO Ninja, therefore, will show the data from one of the devices as having arrived first, and the data from the second device as having arrived second... while in reality, both devices have transmitted at the same time.

Wedge RS232 monitoring

The Serial Tap allows you to insert (wedge) it in between two RS232 devices. Here is how this is done.

Let's suppose that two serial devices are interconnected by a serial cable. Let's also suppose that the first device has a DB9-F connector, while the second device has a DB9-M connector. The serial cable is, therefore, of the M-to-F type.

To wedge the Serial Tap between these two devices, you will need the second M-to-F cable:
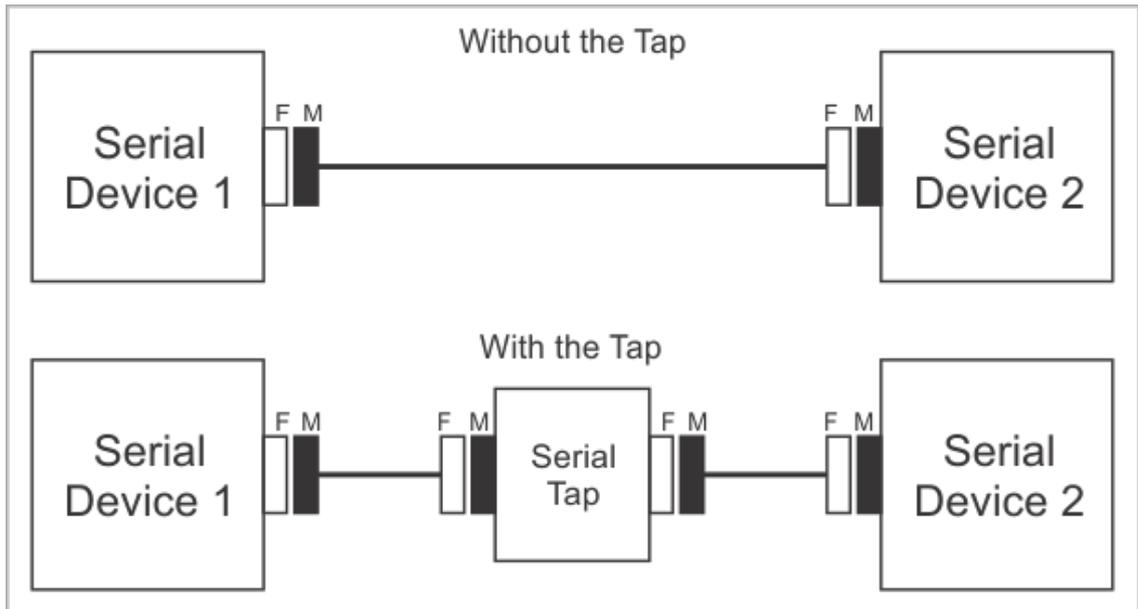
Of course, DB9 genders on the serial devices may differ from the above example, and so your serial arrangement may be different. To aid you in the "wedging process," each Serial Tap comes with two DB9 gender changers.

Jumper pairs

The Serial Tap has an additional useful feature allowing you to swap and loopback the signals in TX/RX, RTS/CTS, and DTR/DSR signal pairs. To achieve this, two jumpers are provided for each of the three pairs. There are three standard jumper configurations:

- **Normal** — In this position, the lines are arranged in such a way that wedging the Tap between the serial devices does not change anything. Meaning, TX on one end goes to RX on another end, and vice versa.

- **Swapped** — This swaps signals in a pair. Meaning, TX goes to TX, and RX goes to RX.

- **Loopbacked** — Both serial devices "receive back" their own signals. Meaning, the TX line on each side "comes back" through the RX line.

The following diagram illustrates the jumper arrangements. The diagram shows the jumpers for the TX and RX signal pair. RTS/CTS and DTR/DSR jumpers work in the same way.
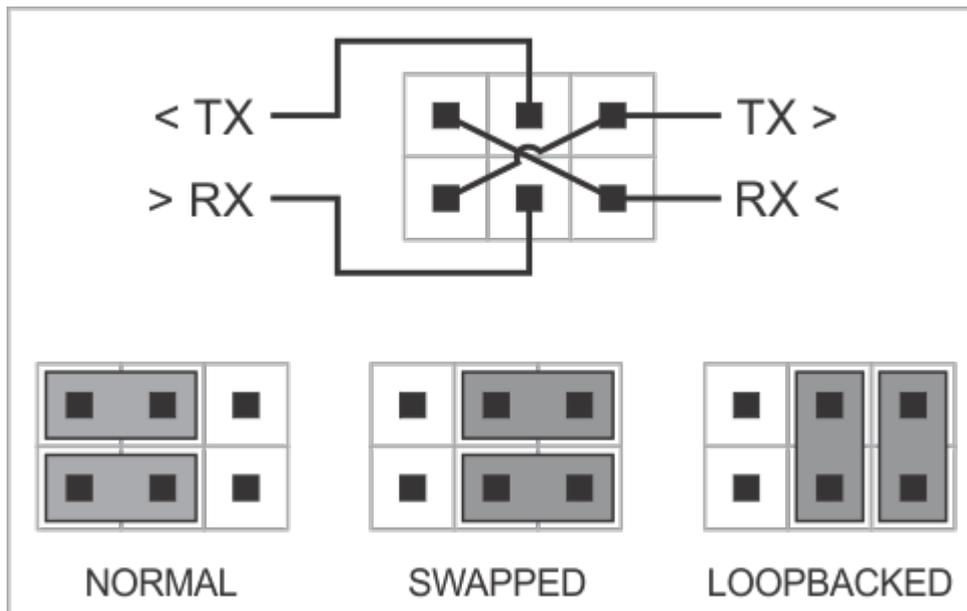
Ordering and Specifications

The Serial Tap is supplied with a USB cable and two DB9 gender changers.

Hardware specifications

USB port	USB 2.0, full-speed (12MHz), USB-C connector
Maximum baudrate	2,764,800 bps
Operating temperature	0 to +60 degrees C
Operating relative humidity	10-90%
Mechanical dimensions	82 x 74 x 30 mm

All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors in this Manual, and does not make any commitment to update the information contained herein.

Think the above table should contain additional data? Do not just assume that you know the answer — talk to Tibbo! Remember, that the ultimate responsibility for all decisions you make regarding the use and the mode of use of Tibbo products lies with you, our Customer.

Update history

03JUL2018

- Documented the Serial Tap.