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A World-Wide Low-Cost Community-Based Time-of-Arrival Lightning Detection and Lightning Location Network

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(System Blue assembly)

This document will continually change due to further developments and improvements. Please send your remarks to info@blitzortung.org.

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1 System Blue assembly

The main difference between System Blue and previous systems is that System Blue has partly pre-fabricated circuit boards. All surface-mount devices (SMD) are already soldered. However, there are still some components with leads that have to be inserted into holes drilled in the printed circuit boards and soldered to pads on the back side by manual assembly. For soldering you should use a soldering iron with a 1mm tip and thin solder wire. Do not try to solder these components if you do not have any experiences with soldering.

The System Blue PCB 20.x panel consists of a main board PCB 19.x, an H-field pre-amplifier board PCB 16.x, and an E-fiel pre-amplifier board PCB 17.

1.1 Main board PCB 19.x

The main board PCB 19.x has the following through-hole technology (THT) components.

3	DA103C - Transformer - Murata Power Solutions
1	Inductor - 3.3 mH - Taiyo Yuden
1	USB-B Connector, PCB mounting, 90°
1	1x4 Header, straight, Pitch 2,54
1	1x5 Header, straight, Pitch 2,54
1	2x3 Header, straight, Pitch 2,54
1	Piezo Audio Indicator
1	Crystal, 8,0000000 MHz
1	Crystal, 25,000000 MHz
3	Pushbutton 6x6mm, height: 4,3mm, vertical
1	RJ45 Modular Connector
1	HanRun RJ45 network connector with integrated magnetics
1	F-Connector, PCB mounting, 90°
1	SMA Connector, PCB mounting, 90°

Some of the THT components may have been soldered because they were required to install the initial firmware.

The DA103C Transformers have a white dot at one corner. On the main board, there are white dots printed at the placeholders for the transformers TR1, TR2, and TR3. The white dots at the transformers must match the white dots at the main board.

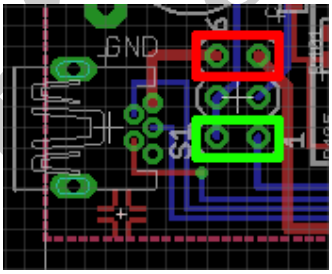
The 3.3mH inductor is L403.

Crystal Q1 has a frequency of 25 MHz, crystal Q2 has a frequency of 8 MHz.

The Piezo Audio Indicator has a '+'-mark, which should match the '+'-mark on the board. Remove the glued paper label after soldering. If the label is lost, you can solder the buzzer as you want. It does not really matter.

All other components can not be soldered at wrong places because of their physical layout.

The main board is supplied with a 5V USB power adapter. The plug must fit into the SUB-B jack. The power supply is not part of the kit. It must be purchased separately.



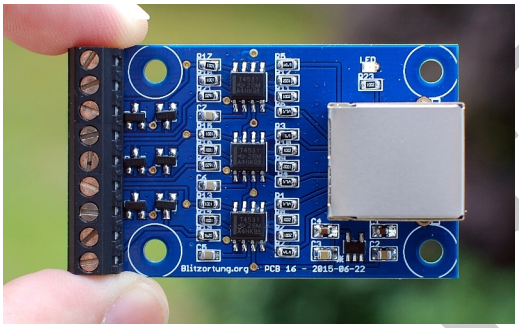
At switch S1 on PCB 19.2 you have to connect pin 5 and pin 6 by a jumper. This turns the board on, if an USB power supply is connected, the red rectangle in the image above. You have also to connect pin 1 and pin 2 by a jumper such that the pre-amplifiers get power, the green rectangle in the image above. Note that these jumper settings are different at the early board PCB 19.1. Please refer to the circuit diagrams.

The router is connected at the RJ45 network port with a CAT cable.

1.2 H-field pre-amplifier PCB 16.x

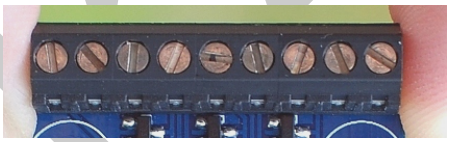
The H-field pre-amplifier board PCB 16.x has the following THT components whose placement is obvious.

1 Header 3-pin, Pitch 3,5
1 Header 6-pin, Pitch 3,5
1 RJ45 Modular Connector

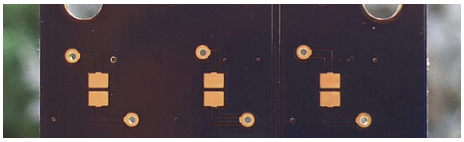


The antennas are connected to the pre-amplifier as follows from left to right if viewed from above if the terminal block is directed upwards. Any polarity between A1/A2, B1/B2, and C1/C2 does not matter.

A-1	A-2	GND	B-1	B-2	GND	C-1	C-2	GND



The H-field pre-amplifier is connected with a shielded CAT cable to the main board. This cable should not be placed next to the network cable. Please keep a distance of at least 10 cm. The cable may have a length of up to 20 meters.



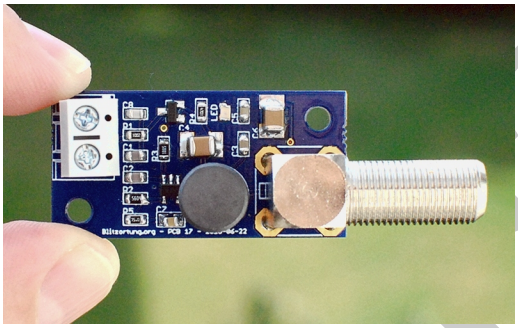
If you use loop antennas and not ferrite rod antennas, than you should close the jumper for the corresponding channels at the back side of the board.

If the pre-amplifier is powered, the red LED should light.

1.3 E-field pre-amplifier PCB 17.x

The E-field pre-amplifier board PCB 17.x has the following THT components whose placement is obvious.

1 Inductor - 3.3 mH - Taiyo Yuden
1 Header 2-pin, Pitch 5,08
1 F-Connector, PCB mounting



At PCB 20.1 and subsequent boards the free board space at PCB 20.x next to PCB 17.x is used as an experimental electrical antenna. This antenna is designed only for testing purposes. You can also bend these aerial and connect a long wire antenna at the two pin header. The external connection point is ground, the central connection point is the antenna. Note that any electrical antenna must be placed outside far away from from buildings and electrical interference sources.

The E-field pre-amplifier is connected with 75 Ω double shielded coaxial cable to the main board. The cable may have a length of up to 20 meters. The ends are attached to F-connector.

If the pre-amplifier is powered, the red LED should light. At the early pre-amplifier board 16.1 a green LED probably lights very weak at a supply voltage of 3.3 volts. However, this is not a defect but normal.

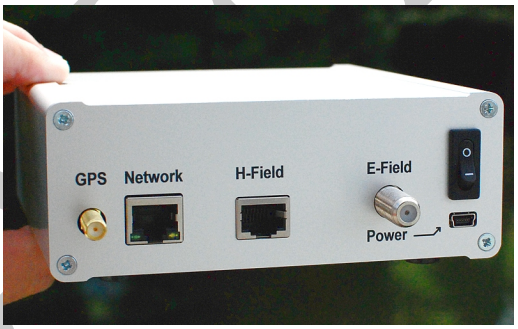
1.4 GPS antenna

You can use any GPS antenna operating with 3.5 Volts. The Antenna is connected via an SMA connector with the main board. The built GPS module is very sensitive and also works with antennas connected by lines of up to 10 meters.

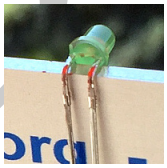
1.5 Housing option

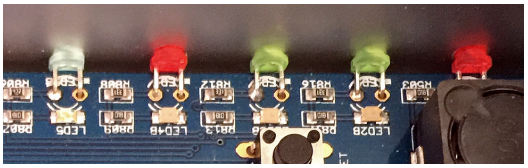
The housing option consists of the following parts.

1 aluminum enclosure
1 front panel
1 back panel
1 rocker switch
4 screw M3 10mm
3 LED red
2 LED green
1 LED yellow
1 LED blue



The housing is made for boards of size 130.0 mm x 140.0 mm. The main board PCB 19 has the dimension 130.0 mm x 138.5 mm. It is slightly shorter than the housing. The LEDs on the front panel are soldered with an angle of 90 degrees. The overlapping edge of the LED housing closes the gap between the board and the front panel. In this construction, the LED can not be crushed by pressure from outside at the front panel. That's the reason for the difference in size between the housing and the main board.





The connecting wires of the LEDs can easily be bend 90 degrees using the front panel that has a width of 2 mm. On the main board there are white stars printed near the LEDs. In these holes the short ends of the wires have to be inserted. This is the cathode (-) of the diodes.

At the back panel, the rocker switch can be inserted to turn the power on and off. It has to be connected to pin 5 and 6 of S1.

The rubber feet can be stuck under the housing.

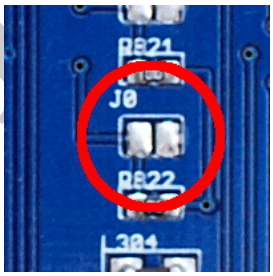
1.6 Digital filter option

The complete digital filter option consists of the following parts.

4 digital filter ICs
8 SMA connector straight

In general, it is not necessary to install the digital high pass filter ICs. The system also operates without these filters. However, if you want to experiment, or if you have extremely strong interferences at frequencies above 50kHz, you can try to get better signals with the digital high pass filter ICs. Since the digital filter ICs are relatively expensive, you should test one filter IC at one channel. If the desired effect is achieved, the other channels can be upgraded.

The digital filter ICs have a point at one corner of the housing. This point identifies Pin 1. It must match the white dot on the main board. You need a soldering iron with a small tip to solder the SOIC-8 package.



You have to close Jumper J1, otherwise the firmware will not recognize the filter ICs, and thus will not offer you the possibility to adjust them.

At the SMA connectors, the signal can be tapped before and after the amplifiers. The output signals of the amplifiers can then easily be connected to an oscilloscope for analysis. It is also possible to connect the output signals to a PC in order to generate a spectrum.

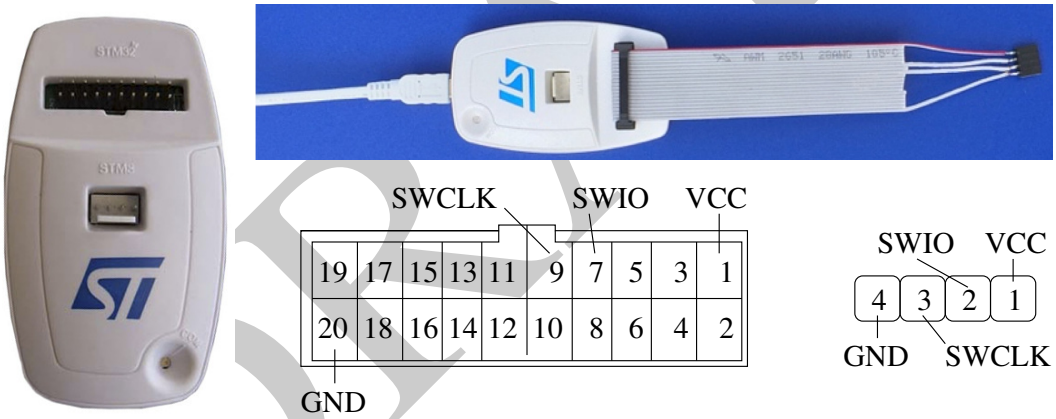
1.7 Firmware

The firmware of the controller is preinstalled. When the device is turned on and is connected to a router, then it gets an IP address via DHCP. You must check your router which IP address this is. Typically, the detector gets the same IP address after a reboot.

The firmware can be updated in three different ways,

1. via the web interface of the firmware,
2. via the Single Wire Debug (SWD) interface using a programming device, and
3. via the USB interface using the Device firmware upgrade STMicroelectronics Extension) (DfuSe) interface.

For the update via the SWD interface, the ST-LINK/V2 in-circuit debugger/programmer is required. It is also available on the STM32F4DISCOVERY board. The programming device is connected to the SWD interface as follows.



ST Link V2 ST Link Connector SWD Connector

The software for programming the controller with STLINK can be found on the website of STMicroelectronics.

http://www.st.com/

The firmware can be downloaded from

http://tracker.blitzortung.org/red/beta/