

KIO positioning system



User manual

Thank you for purchasing Eliko's ultra-wide band (UWB) radio based real time location system (RTLS) KIO.

The KIO system is intended for 2D or 3D indoor positioning of mobile UWB tags in relation to fixed position UWB anchors. Due to the low intensity of emitted radio signals, KIO devices may be used for human tracking. KIO is not an UWB communication system.

WARNING: According to FCC UWB radio regulations KIO system may be used indoors only. The user is responsible for turning off KIO tags when leaving an area covered by KIO RTLS anchors.

NOTE: Current radio regulations limit the transmission time of the UWB devices. Therefore, the maximum positioning frequency of a KIO tag is 4.5Hz. To preserve the regulatory compliance, the positioning frequency decreases when the number of active tags increases.

KIO device labeling

Kio front side label with controls is shown in Figure 1.

KIO RTLS setup may consist of different anchors and tags according to the data connectivity and power source requirements. The label on the back of the KIO device includes information about the device type and the unique hardware serial number.

- KIO Anchor CS4 – Cable powered anchor with 3.3V UART communication interface.
- KIO Anchor C4 – Cable powered anchor with USB 2.0 device communication interface.
- KIO Tag CS4 – Cable powered tag with TTL UART communication interface.
- KIO Tag C4 – Cable powered tag with USB 2.0 device communication interface.
- KIO Tag B4 – Internal battery powered tag without an external communication interface.

Anchors and tags have identical radio circuitry. However, anchors steadily operate in radio receiving mode during the absence of tags.

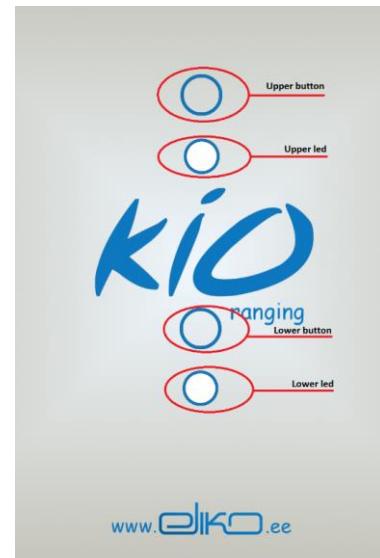


Fig. 1: KIO device controls

Principle of the operation of the KIO RTLS system

KIO operation is based on time of flight measurements of radio pulses traveling between tags and anchors. KIO installation consists of at least 3 fixed position wall powered anchors and one or more mobile tags. KIO anchors operate as associated receivers for any KIO tag on a distance of 20-50 meters (65-165 ft).

Getting started with KIO RTLS

1. Anchor installation
 - a. Fix the KIO anchors to the walls or ceiling to form a RTLS cell. We recommend using adhesive tape for attaching the anchors.
 - b. Each RTLS cell has to contain at least 3 different anchors factory labeled as A, B, C for 2D positioning and 4 different anchors labeled as A, B, C, D for 3D positioning. This character is the last symbol in the device serial number. For improved positioning accuracy and reliability it is recommendable to use 4 anchors for 2D positioning as well.
 - c. The placement of anchors should follow a triangular or rectangular pattern shape (Fig. 2, 3). The line of sight distance between devices should not exceed 20-25 meters (65-80 ft.).
 - d. For 3D positioning the anchors shall be installed on different heights. We recommend placing 2 anchors in high and two in low elevation.
 - e. Depending on particular environmental conditions, e.g. walls or large metal objects additional anchors may be required for the reliable RTLS operation. KIO tags automatically select anchors with the best reception quality. Additional anchors increase the positioning frequency by the presence of multiple tags. The number of anchors in a cell is not limited.
 - f. Correct calculation of tag position assumes precise measurements of anchor X, Y, Z coordinates. The error should not exceed 2-3cm (1").
 - g. Power up the anchors from 5 VDC \pm 10% micro USB wall power supplies capable of delivering 500mA. During boot-up red and green lights will blink. Device is ready for operation when the green light remains continuously on.
 - h. Anchors B, C and D may be used for collecting distance measurement data of all the tags in the vicinity over the USB 2.0 interface (Anchor C4) or the TTL level UART interface (Anchor CS4). Connect one or more anchors to the host device and use any serial port communication software to collect the distance measurement data. Please note that the USB ports of some computers do not provide enough supply current in the battery-powered mode.
 - i. Anchors stay in silent receiving radio mode if no tags are present.
2. Installation of externally powered tags C4 and CS4
 - a. Attach tags to the traceable object (mobile robot, equipment). For the best performance be sure that the upper third of KIO tag where the radio antenna is situated is kept apart from metal surfaces.
 - b. Power up the tags using 5 VDC \pm 10% power supply delivering 500mA. After the boot-up, tags will blink green LED during the ranging procedure. During ranging, the tag transmits 2-3 radio messages to each anchor that act as associated receivers and collect their radio responses.

- c. The distance measurement data of all tags can be acquired over the USB (Tag C4) or TTL UART (Tag CS4) interfaces. The port settings for the UART interface are: baud rate 230400, no flow control.
- 3. Installation and use of battery powered B4 tags
 - a. Attach the battery-powered tags to the traceable persons and goods. Due to energy savings, the battery powered tags do not provide external data interfaces. Positioning data of B4 tags can be acquired from anchors B, C, D or from the externally powered tags as described. The latter method is developed for use by mobile robots.
 - b. Turn the battery-powered tag on by pressing the upper button until the upper red led turns, and then release the button. Green LED starts blinking which means ongoing ranging. The ranging frequency of B4 tags is 1Hz.
 - c. To turn off the battery powered tag, push the upper button until the upper red LED turns on, and then release the button.
 - d. Tags must be turned off exiting the area covered by KIO anchors. Then all LEDs are off.
- 4. Charging the battery powered B4 tags
 - a. If battery powered tag won't start or automatically switch off, the battery is empty.
 - b. Use a standard micro USB charger to charge the device. The lower red LED is on when the battery is charging and turns off if the battery is fully charged.
 - c. The device may work during charging. In this condition the lower LED is blinking red and orange. Turning the device on and off, please follow the instructions given above.
- 5. Using the Java evaluation software.
 - a. Start the software on a Windows PC.
 - b. Locate the ranging menu and select the COM port assigned to the attached KIO anchor or tag.
 - c. Fill in the coordinates of 3 or 4 anchors in meters according to the measurements.
 - d. Press the start button to track a tag.
 - e. For more detailed instructions read the KIO software manual.

Anchor installation example

The operation accuracy of the KIO RTLS system relies on a reliable radio signal reception and proper placement of anchors as intentional UWB receivers. Anchors should be placed in the perimeter of small rooms. For large rooms, several RTLS cells have to be installed. It is recommended to place anchors above major obstacles in the room, for example furniture. The anchors may be installed on the same height for 2D positioning (Fig. 2). For accurate 3D positioning, anchors A and D should be installed higher (for example close to the ceiling) and B, C lower (for example on the floor level). For shown current $30m^2$ (330 sq ft) 2D test site has 4 C4 KIO anchors and 1 battery powered tag (KIO Tag B4). Anchors are mounted 1.2m (4 ft) from the floor. Anchors A, C, D are powered from USB wall supplies. Anchor B is connected to a PC and is used for collecting the tag ranging data.

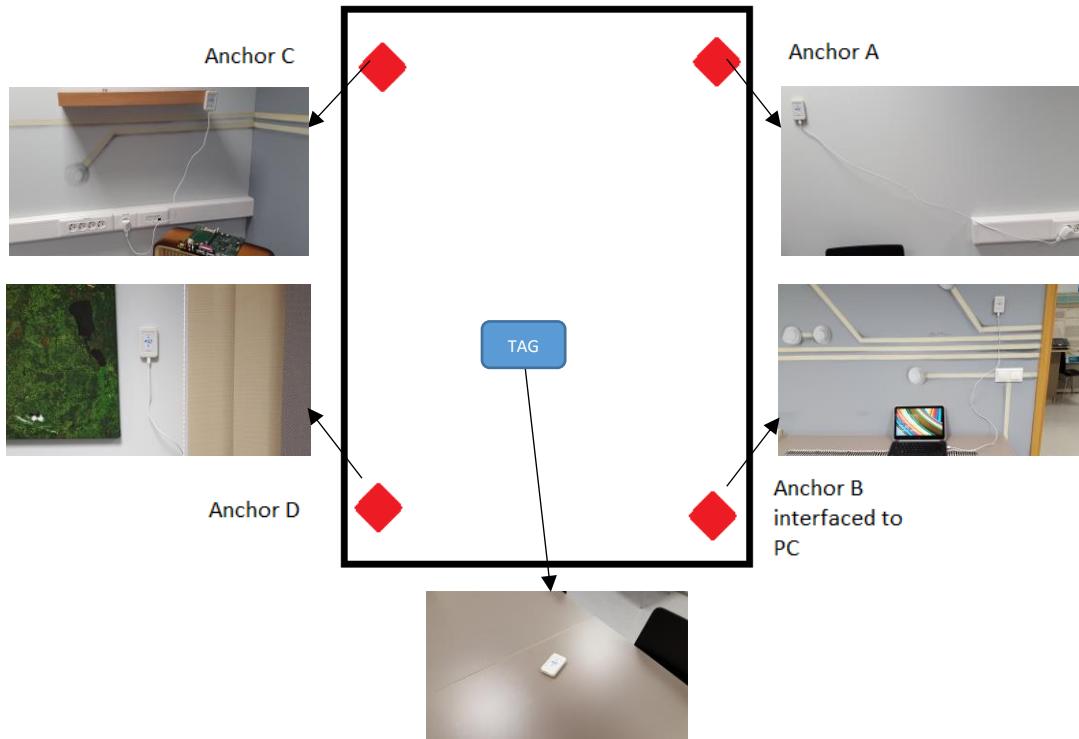


Fig. 2: Installation example of anchors for 2D positioning

Federal Communications Commission (FCC) Radio Frequency Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

NOTICE:

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- (2) this device may not cause harmful interference, and
- (3) this device must accept any interference received, including interference that may cause undesired operation.

NOTICE:

Changes or modifications made to this equipment not expressly approved by Eliko may void the FCC authorization to operate this equipment.

Radiofrequency radiation exposure Information:

The radiated output power of the device is far below the FCC radio frequency exposure limits. Nevertheless, the device shall be used in such a manner that the potential for human contact during normal operation is minimized.