



## **A10-RTK**

### **Instruction Manual**

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### **Revision History**

<b>Version</b>	<b>Date</b>	<b>Description of the changes</b>
0.9	19.12.2018	Preliminary version



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## 1 Safety instructions

### **Warning!**

When using electrical equipment, basic safety precautions must always be followed, including the following, to reduce the risk of fire, electric shock and personal injury.

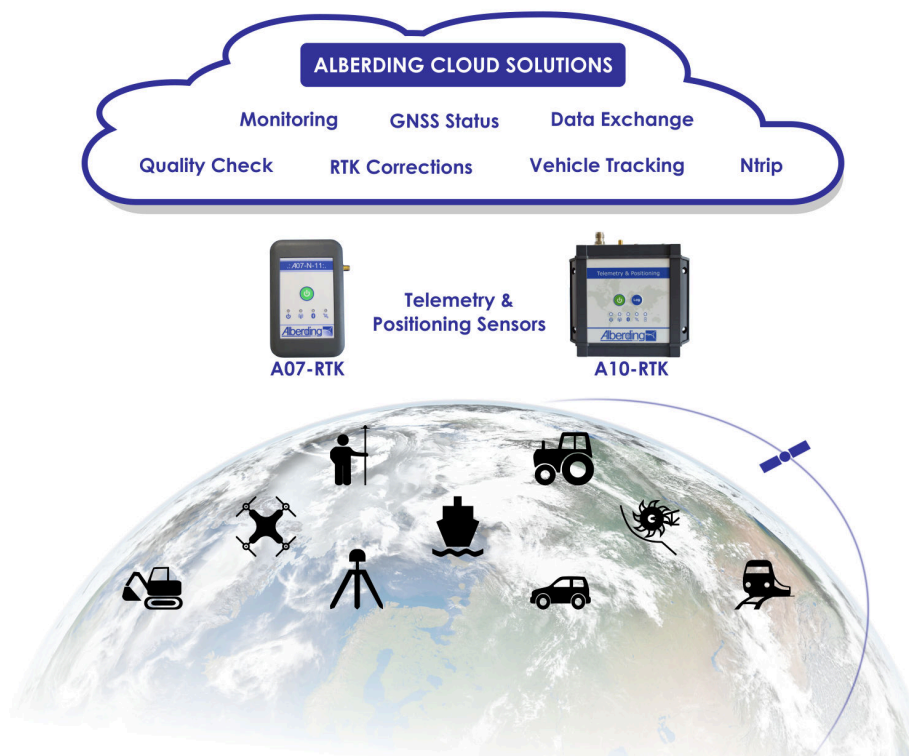
1. Before using the device, read this manual carefully.
2. Only clean with a dry cloth.
3. Install according to the manufacturer's instructions.
4. Do not install the device near any heat sources such as radiators, heat registers, ovens, or other apparatus (including amplifiers) that generate heat.
5. Do not heat or throw the device into fire.
6. Only use attachments or accessories specified by the manufacturer.
7. Do not open or modify the casing.
8. Do not allow liquids to enter the device.



## 2 System specifications

### 2.1 A10-RTK system approach

Alberding *A07-RTK* and *A10-RTK* telemetry and positioning systems are designed for precise positioning, data acquisition and data transmission. Both sensors combine centimetre-level accurate GNSS Real-Time Kinematic (RTK) boards with built-in mobile wireless data modem and programmable computers in a single housing. The pre-configuration of the functionality and the data flow via the Alberding configurator software enables an autonomous operation of the “intelligent sensors” in the field. In combination with Alberding cloud solutions, the mobile systems can be customised for multiple server/client digitisation and automation applications.



The Alberding *A10-RTK* sensor is a further development of the initial model *A07-RTK*, which is successfully used for a wide range of applications (agriculture, forestry, vehicle tracking, GIS, surveying, etc.). The core of the system is an integrated processor with the Alberding data management software, which controls all sensor components and the internal data transmission. The desired settings can be selected in the configurator software and transferred to the sensors so that they automatically operate with the pre-set configuration when the system is started up (by the power button or by supplying power).



Unlike the *A07-RTK*, the *A10-RTK* sensor integrates an LTE modem and a scalable GNSS board. Compared to the GPRS modem in the *A07-RTK*, the LTE modem offers a higher data rate and a future-proof perspective for mobile data transmission from/to the server.

The integration of scalable GNSS boards enables the adaptation of the positioning quality to the customer's requirements. The Trimble MB-Two board can be software upgraded from L1 RTK (GPS-only) to L1/L2 RTK (GPS/GLONASS/Galileo/BeiDou + heading). The capability of low-cost L1/L2 RTK boards is currently being evaluated.

The *A10-RTK* sensor provides additional flexibility and functionality through the integration of an embedded PC with Linux operating system. While the integrated Cortex processor takes over the data management, the application software can run on the Linux PC within the sensor, so that the connection of an external computer can be omitted.

### **A10-RTK system features:**

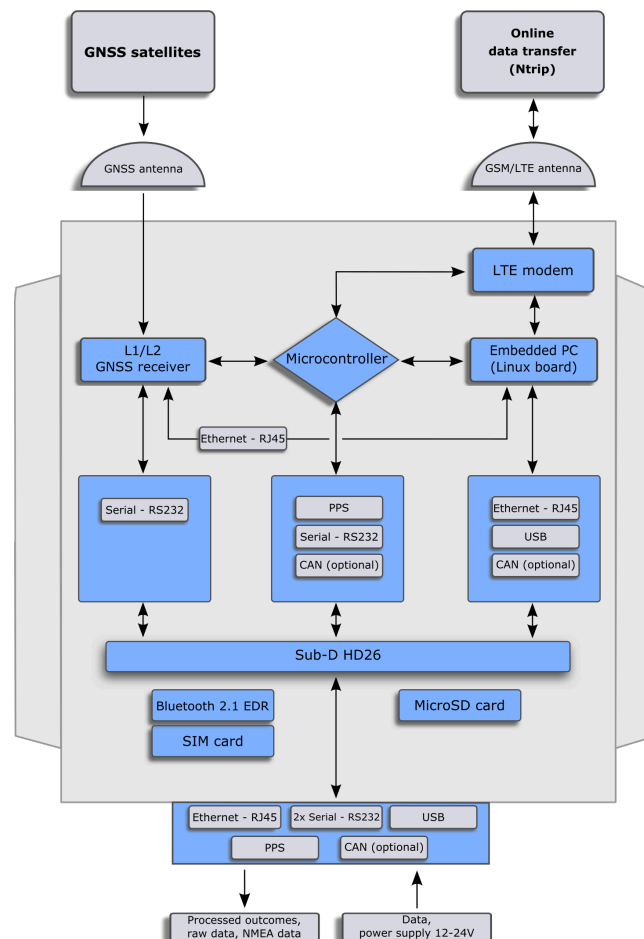
- Use of scalable GNSS hardware (from L1 RTK to L1/L2 RTK + heading)
- Logging of RTK positions and raw data to internal memory
- Server/client communication (LTE modem)
- Integrated Bluetooth module
- Integrated Cortex processor for data management
- Embedded PC with Linux operating system (optional)
- Integration of application software
- Customisable configuration
- Automatic data transfer
- Autonomous operation through pre-configuration



## 2.2 A10-RTK sensor with Trimble MB-Two board and embedded PC

The current version of the Alberding *A10-RTK* sensor comes with a Trimble MB-Two GNSS board and an embedded PC with Linux operating system. The positioning performance depends on the configuration of the Trimble board (see chapter 4), the GNSS antenna used and the measurement conditions. The functionality of the system can be defined by the pre-configuration of the microcontroller (configuration software) and the software on the embedded PC.

All important system components and connections of the *A10-RTK* sensor are shown in the following block diagram (see Fig. 1). The GNSS antenna is connected to the *A10-RTK* sensor with an antenna cable using the TNC connector and the external GSM antenna through the SMA connector. To facilitate the system installation, all connections are located on one side of the *A10-RTK* sensor. In the block diagram, the connections to the antennas were drawn on the other side for visualisation reasons.

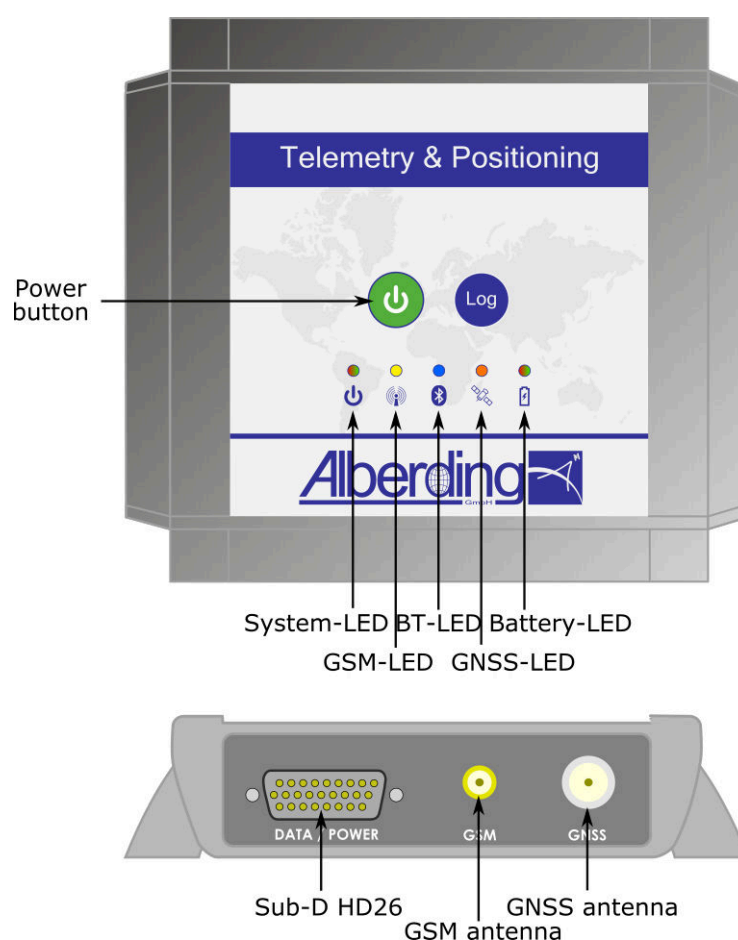


**Figure 1:** Block diagram of the A10-RTK with Linux board



Since an external power supply is usually available for many applications (e.g. machine operation), the *A10-RTK* does not integrate a lithium polymer battery. The power supply of the sensor (12-24V DC) is provided with the communication cable via the 26 pin connector of the *A10-RTK*. On this connector, 1 Ethernet port, 2 serial RS232 and 1 USB port, as well as an optional, CAN port are available.

On the top side of the *A10-RTK* sensor, you can find the power button, the log button and five LED status lamps. The Log button currently has no function. The following ports are available on the front panel: GNSS antenna, GSM antenna, as well as a serial port (Sub-D HD26) (see Fig. 2). The factory default configuration settings of the serial port are 115200 baud 8-N-1.



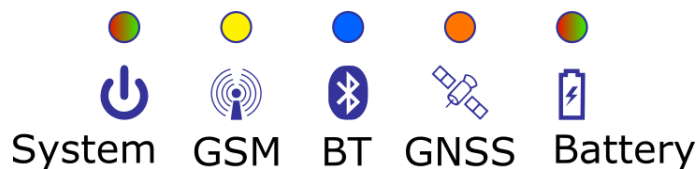
**Figure 2:** Schematic structure of the A10-RTK





## 2.3 LED indicators

The following table explains all possible LED indicators of the *A10-RTK* (see Fig. 3).

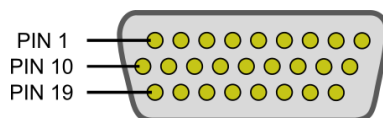


**Figure 3:** LED indicators

LED	Colour and property	Explanation
LED 1 System	Green/Red flashing	System is running
LED 2 GSM	off Yellow flashing every 1s flashing every 3s flashing every 0,5s	Wireless modem disabled Initialisation Dial-up operation Data transfer active SIM Error
LED 3 Bluetooth	off Blue flashing every 1s flashing every 3s	Bluetooth disabled Initialisation Ready for connecting Data transfer active
LED 4 GNSS	off Orange flashing every 1s flashing every 3s double flashing every 3s	GNSS disabled Initialisation Standalone RTK-Float RTK-Fix
LED 5 Battery	/	Currently not in use



## 2.4 Pin assignment of the Sub-D HD26 port



**Figure 4:** Pin assignment of the Sub-D HD26 port

PIN	Description	Remarks
1	reserved	/
2	CAN L	Either Linux board or microcontroller (optional)
3	reserved	/
4	reserved	/
5	reserved	/
6	GND	/
7	TX3 (RS232) to Trimble MB-Two	Connection to Trimble MB-Two
8	RX3 (RS232) to Trimble MB-Two	Connection to Trimble MB-Two
9	USB D+	Linux board by default; Trimble MB-Two optional
10	reserved	/
11	CAN H	Either Linux board or microcontroller (optional)
12	TX2 (RS232)	Microcontroller (data distribution configurable)
13	reserved	/
14	reserved	/
15	reserved	/
16	Network (RJ45) RX-	Linux board / Trimble MB-Two
17	Network (RJ45) TX-	Linux board / Trimble MB-Two
18	USB D-	Linux board by default; Trimble MB-Two optional
19	reserved	/
20	GPIO	Microcontroller (optional)
21	RX2 (RS232)	Microcontroller (data distribution configurable)
22	reserved	/
23	Power GND	/
24	Power IN DC	DC 12-24V
25	Network (RJ45) RX+	Linux board / Trimble MB-Two
26	Network (RJ45) TX+	Linux board / Trimble MB-Two



## 2.5 A10-RTK technical specifications

### Data and memory

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Data storage:	Integrated memory card
Wireless data output:	Bluetooth, mobile Internet
Wireless data input:	Bluetooth, mobile Internet
Wired data output:	LAN, serial RS232, serial USB, PPS out
Wired data input:	LAN, serial RS232, serial USB, Event In

### Communication

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Bluetooth 2.1 + EDR:	Class 2, range:~5 m, SPP protocol
Cellular:	LTE (800/850/900/1800/2100/2600 MHz)
Data/Power:	Sub-D HD26

### Physical properties

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Dimensions (LxWxH):	13.0 cm x 15.3 cm x 3.3 cm (5.12" x 6.02" x 1.30")
Weight:	656 g (1.45 lb)
Status indicators (LEDs):	System, GSM, Bluetooth, GNSS status, battery
Buttons:	Power, Log
Antenna connectors:	GNSS: TNC female GSM: SMA female

### Environmental compatibility

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Operating temperature:	-20 °C to +55 °C (-4 °F to +131 °F)
Humidity:	up to 80%
Ingress protection:	IP67
Enclosure material:	metal (AlMgSi 0.5) powder-coated
Compliance:	CE, RoHS and lead-free

**Electrical properties**

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External power supply:	12 - 24 V DC
Power consumption:	Depending on configuration, up to 5 W with Linux board and mobile Internet (data streaming)
Protections:	Short circuit Overcurrent charge and discharge Overvoltage charge (overcharge) Temperature

**Optional accessories**

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Multiport adapter (LAN, RS232, Power)

Power supply unit with power cable

Octopus cable (LAN, RS232 female, RS232 male, PSS out, Event In, USB, Power)

External GNSS antenna

External GSM antenna



### 3 Start-up procedure

For the start-up procedure, the *A10-RTK* sensor needs an external power supply. The standard delivery includes a power supply unit with a power cable and a multiport adapter (see Fig. 5).

Connect the power supply unit to the multiport adapter and plug it into the 26-pin port (Sub-D HD26) of the *A10-RTK* (see Fig. 2). When the power supply is connected, all LEDs flash. The *A10-RTK* sensor can be switched on either by pressing the power button or by activating the Auto-Power-On function. The flashing system LED indicates the starting process, which is completed after approx. 30 seconds.

Connect the GNSS antenna (TNC connector) and the GSM antenna (SMA connector) to the sensor (see Fig. 2).

**Warning:** The *A10-RTK* automatically performs a pin request of the SIM card during start-up. Before the first operation, use the configuration software to configure the different mobile settings (SIM card PIN, server, etc.).

The selected configuration (mobile network settings, data stream) is now stored in the *A10-RTK* so that the sensor will automatically work with these settings the next time it is used. Pressing the power button turns off the *A10-RTK*.



**Figure 5:** A10-RTK with multiport adapter, power supply unit, GSM antenna and GNSS antenna (standard delivery)



## 4 Trimble MB-Two GNSS board

### 4.1 Description

The Trimble MB-Two board has 240 channels for tracking satellites of up to 5 GNSS constellations (GPS, GLONASS, Galileo, BeiDou, QZSS) on two frequencies (L1, L2). Position determination can be carried out either with all activated GNSS systems (primary system selectable) or only with one GNSS system (e.g. Galileo only). Additionally to the position, the heading can be determined by connecting a second GNSS antenna. In the standard configuration of the *A10-RTK* sensor, the second antenna connection is not provided.

The GNSS board is configured via the integrated web interface. The Ethernet port of the MB-Two is accessible via the Ethernet interface of the Linux PC in the *A10-RTK*. The web interface is described in detail in the Reference Manual of the MB-Two ([https://www.alberding.eu/pdf/ReferenceManual\\_MB-TWO\\_US.pdf](https://www.alberding.eu/pdf/ReferenceManual_MB-TWO_US.pdf)).

RTK correction data can be supplied to the MB-Two board in the *A10-RTK* using cable connection through the serial port or the Ethernet port, or wireless via mobile Internet connection (Ntrip) or Bluetooth. These connections are also used to output precise position data (in NMEA format).

### 4.2 Software options

In the basic version, the MB-Two board is delivered with GPS L1 only option. Among others the following firmware options are available:

GNSS:	GPS, GLONASS, Galileo, Beidou, QZSS
Frequencies:	L1, L2
RTK accuracy (horizontal/vertical):	30cm/30cm, 10cm/10cm, 10cm/2cm, 1cm/2cm
Update rate:	2Hz, 5Hz, 20Hz, 50Hz
Heading:	Activation of the second GNSS antenna
RTX:	Activation of Trimble RTX service
Firmware Updates	

An upgrade of the GNSS boards is possible for a fee-based firmware activation.



## 4.3 Technical specifications

### Scalable tracking

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GNSS signals:	
GPS	L1 + L2
GLONASS	G1 + G2 FDMA
BeiDou	B1 + B2
Galileo	E1 + E5b
QZSS	L1 + L2
SBAS	L1
Channels:	240
Update rate:	RTK: up to 50 Hz

### Horizontal accuracy (RMS)<sup>1</sup>

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Autonomous:	0.5 m
RTK L1 only <sup>2</sup> :	< 0.012 m + 1.5 ppm
RTK L1/L2 <sup>3</sup> :	< 0.008 m + 1 ppm
Heading <sup>4,5,6</sup> :	0.2° per 1 m of baseline length

### Convergence time<sup>1</sup>

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RTK L1 only:	< 10 min
RTK L1/L2:	< 1 min
Heading <sup>4</sup> :	< 10 s

### Time to First Fix

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Cold start:	< 60 s
Warm start:	< 45 s
Signal re-acquisition:	< 2 s

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<sup>1</sup>Depends on baseline length, number of satellites in view, satellite geometry, GNSS antenna, multipath effects and atmospheric conditions

<sup>2</sup>ppm limited for baselines up to 10 km

<sup>3</sup>ppm even for baselines greater than 40 km

<sup>4</sup>Limited for baselines up to 100 m

<sup>5</sup>Optional

<sup>6</sup>Additional TNC female connector for Heading

**I/O interface**

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USB:	USB 2.0 OTG (USB/ Serial Link, USB memory stick)
I/O:	1 PPS out / Event In
LAN:	HTTP (web GUI), NTP server, NTripCaster, dynamic DNS

**Data formats**

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Real-time data output:	NMEA-0183, RTCM version 3.x, ATOM <sup>7</sup> , CMR <sup>8</sup>
Real-time data input:	RTCM version 3.x, ATOM

**Receiver dynamics**

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<b>Modes</b>	<b>Description</b>
1	Static
2	Quasi-static
3	Walking
4	Ship
5	Automobile
6	Aircraft
7	Unlimited
8	Adaptive

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<sup>7</sup>ATOM: Open Ashtech file format

<sup>8</sup>CMR: A Trimble proprietary file format





## 5 Embedded PC in the A10-RTK sensor

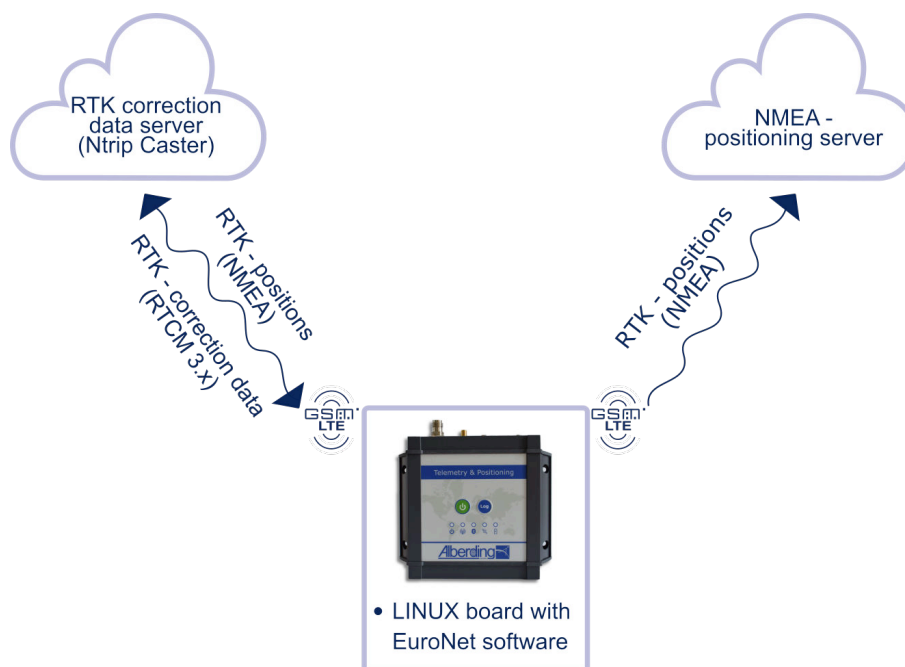
The integration of an embedded PC in the *A10-RTK* sensor is the key for flexible system customisation for diverse digitisation and automation tasks. While the integrated microprocessor controls the data transfer in the *A10-RTK* sensor, the software can perform more extensive calculations on the embedded PC. Currently, both software solutions from Alberding GmbH (e.g. EuroRef, EuroNet) and external software (e.g. BNC from the Federal Agency for Cartography and Geodesy, SSR2OSR converter from Geo++ GmbH) are supported.

### Some examples of software applications on the integrated embedded PC:

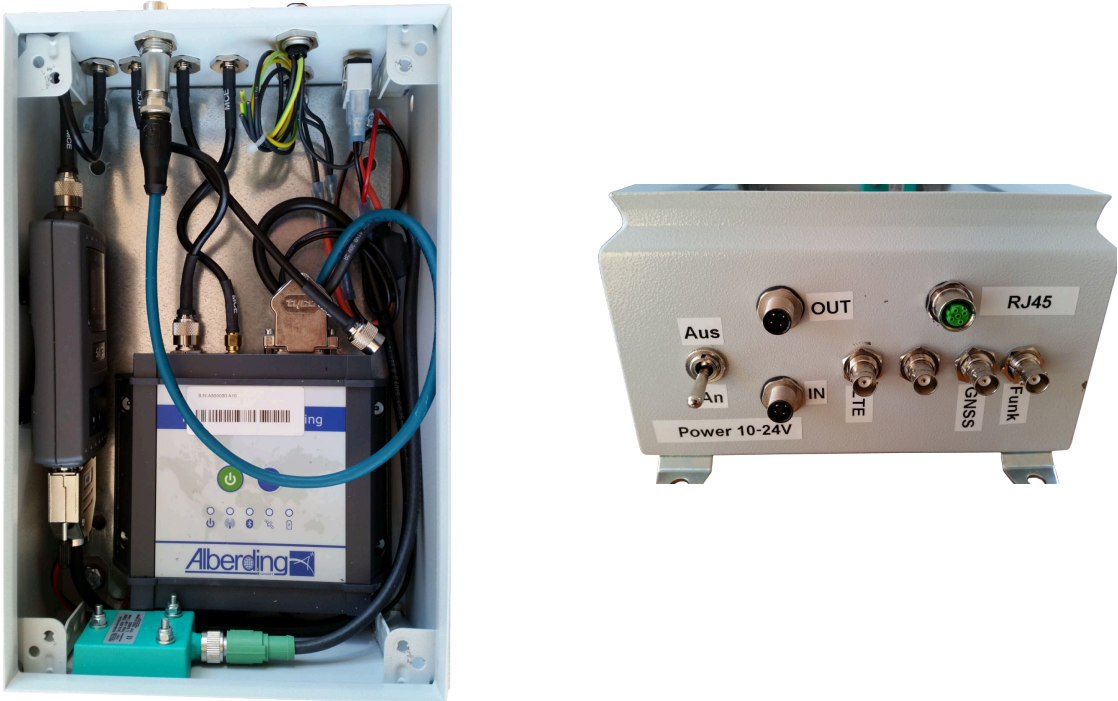
- Autonomously operated GNSS reference station and monitoring station
  - Providing RTK correction data and GNSS raw data
  - Monitoring RTK services in the field
- Enhanced GNSS rover functionality
  - Support of 2 different IP address domains, one for RTK correction data and another for GNSS positioning data (see Fig. 6)
  - Switching between 2 correction data sources (e.g. mobile Internet and radio data transmission in the UHF band)
- Integration of GNSS algorithms
  - GNSS data conversion (SSR->OSR, DataConv)
  - GNSS positioning algorithms (BNC, RTKLib)
- Monitoring objects, buildings and embankments
  - Geo-monitoring in engineering technology
  - Geofencing, vehicle tracking and fleet management
- Sensor fusion
  - Combined acquisition of GNSS and external sensors (EuroNet)
  - Combined analysis of GNSS and external sensor data



- Transmission of project data from and to the server
  - Transmission of engineering project data (digital terrain model, station coordinates)
  - Transmission of agricultural management data (site-specific fertilisation)
- Telemetry module with RTK
  - Data retrieval and transmission from agricultural and construction machines
  - Combination of telemetry and RTK



**Figure 6:** Support of 2 different IP address domains



**Figure 7:** Example of a machine installation



## 6 Connections

### 6.1 Wired connections

#### Serial port:

If your PC does not have a serial port, you must use a USB-RS232 adapter. When purchasing, make sure that the USB-RS232 adapter is compatible with your operating system (e.g. Windows 10) and that the manufacturer offers suitable drivers.

To connect the USB-RS232 adapter (PC) to the multiport adapter (*A10-RTK*), a gender changer and a null modem adapter must be used.

Connect all cables and plug them into the PC. You will find the appropriate COM port for Windows operating systems as follows:

Windows 7:

*Control Panel > Device Manager > Ports (COM & LPT)*

Windows 10:

*Settings > Devices > Device Manager > Ports (COM & LPT)*

#### Ethernet:

It requires an Ethernet cable connected directly to the computer.

The IP address of the *A10-RTK* sensor is determined by Alberding GmbH and depends on the serial number of the *A10-RTK*:

#### **Examples:**

S/N A10-RTK	IP address (Alberding GmbH)
A10-50010	10.50.0.10
A10-50110	10.50.1.10
A10-50223	10.50.2.23

Independently of this, you have to assign the PC an IP address in the same subnet. To do this, the first three sections of the IP address must be identical.



### Examples:

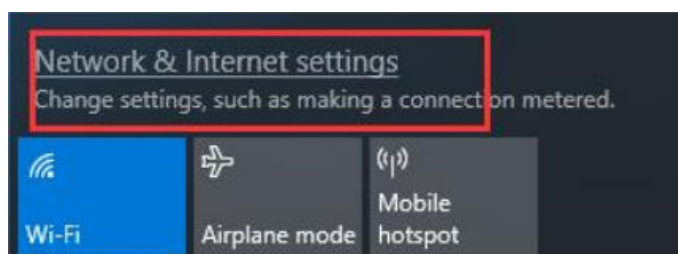
S/N A10-RTK	IP address (Alberding GmbH)	IP address (Customer)
A10-50010	10.50.0.10	10.50.0.101
A10-50110	10.50.1.10	10.50.1.101
A10-50223	10.50.2.23	10.50.2.101

This assignment can be performed by the network administrator or you can use the following steps for **Linux**:

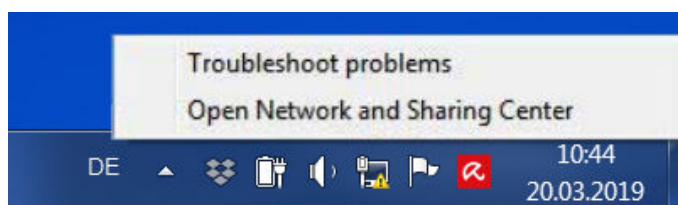
1. Launch the *Terminal* or *Console*.
2. `sudo ip addr add <IP address (customer)>/24 dev eth0`
3. Attention: After executing the following command line, a password is requested. Alberding GmbH will provide you with this password.
4. `ssh euronav@10.50.X.XX` (IP address (Alberding GmbH))

This assignment can be performed by the network administrator or you can use the following steps for **Windows 7** or **Windows 10**:

1. Left-click on the network icon and press “Network & Internet settings” (Windows 10) or “Open Network and Sharing Center” (Windows 7) (see Figs. 8 and 9).



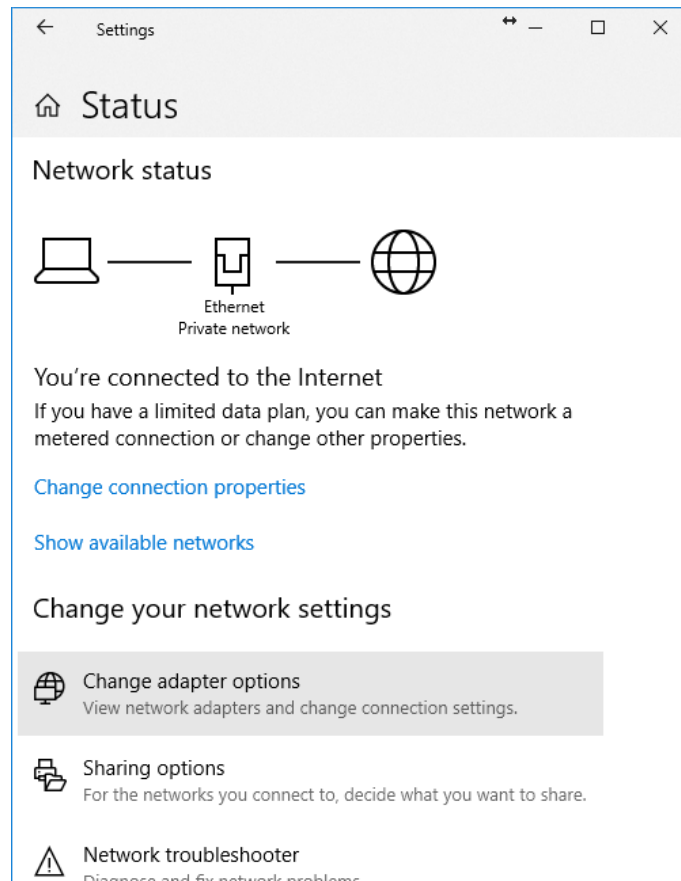
**Figure 8:** Network and Internet Settings (Windows 10)



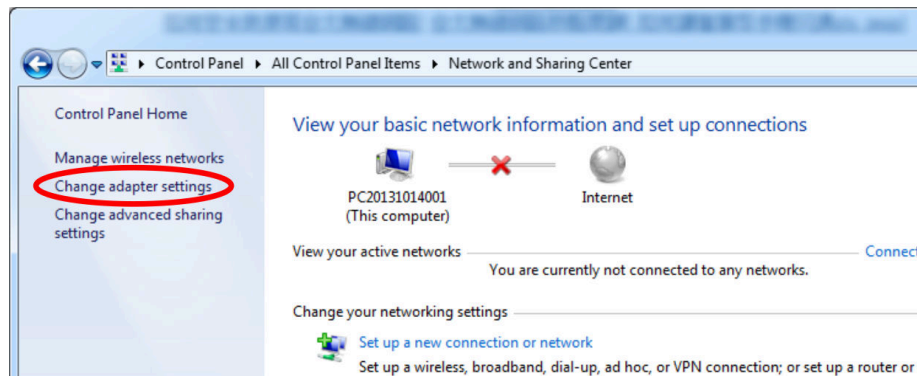
**Figure 9:** Open Network and Sharing Center (Windows 7)



2. Then click on “Change adapter options” (see Fig. 10) in Windows 10 or on “Change adapter settings” (see Fig. 11) in Windows 7.

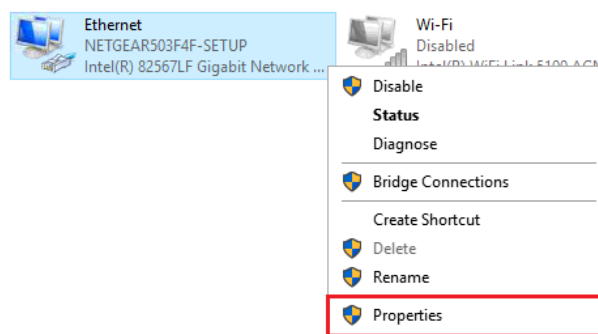


**Figure 10:** Change adapter options (Windows 10)



**Figure 11:** Change adapter settings (Windows 7)

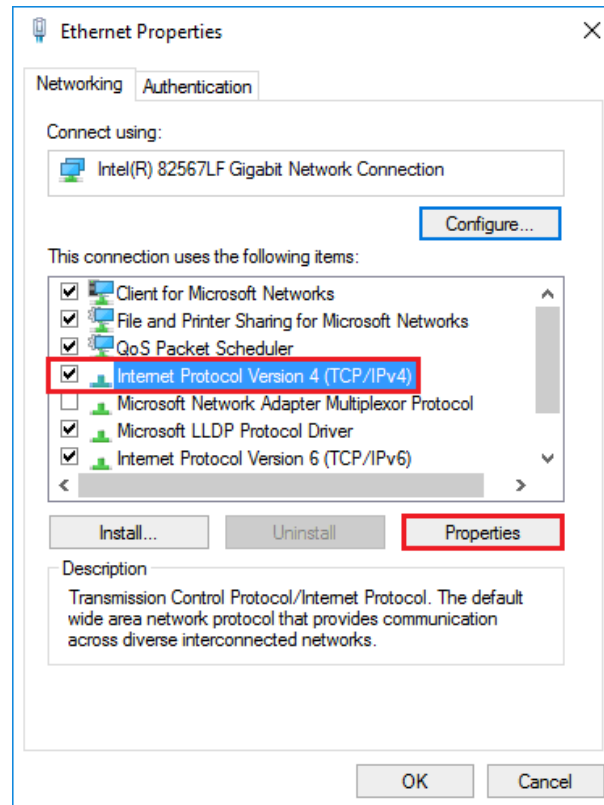
3. The following window opens (see Fig. 12). Select the Ethernet connection and right-click on “Properties”.



**Figure 12:** Ethernet connection



4. Select “Internet Protocol Version 4 (TCP/IPv4)” and press “Properties” (see Fig. 13).

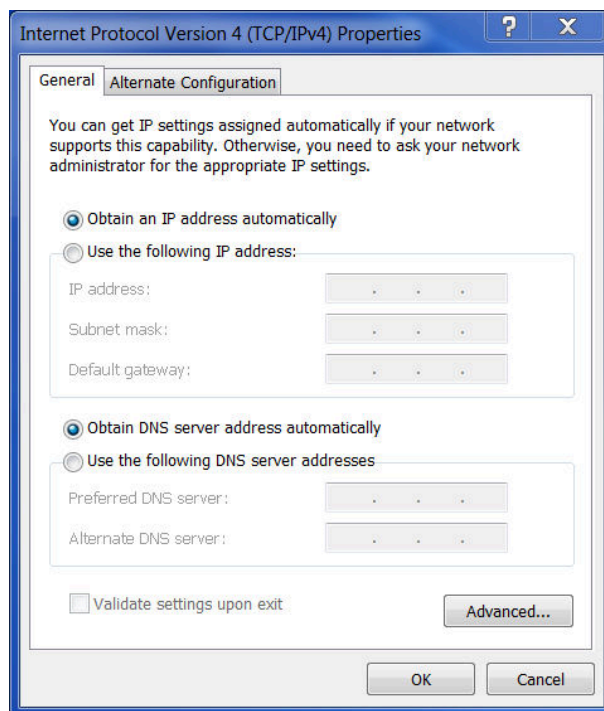


**Figure 13:** Internet Protocol Version 4 (TCP/IPv4)





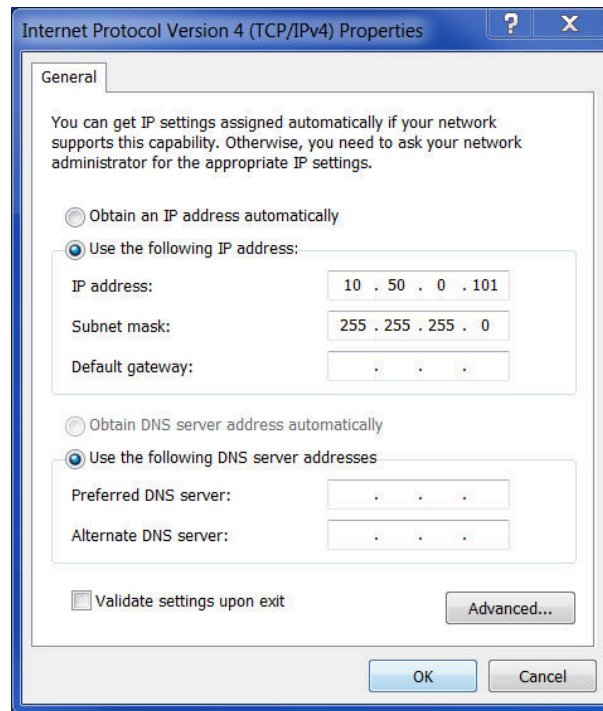
5. The “Internet Protocol Version 4 (TCP/IPv4) Properties” window displays the current configuration. Please take a screenshot or note the information contained in this window. You will need this information to re-establish the Internet connection at the end of the connection with the *A10-RTK* sensor (see Fig. 14).



**Figure 14:** Internet Protocol Version 4 (TCP/IPv4) Properties



6. To specify the IP address (customer), enter the IP address information in the IP address and Subnet mask (255.255.255.0) fields (see Figure 15).



**Figure 15:** IP address

By pressing “OK” the connection between the *A10-RTK* and the PC is established.

7. To restore your computer’s Internet connection, repeat steps 1 to 4 and change the information in the “Internet Protocol Version 4 (TCP/IPv4) Properties” window back to how it was in step 5 (see Figure 14).



## 6.2 Bluetooth connection

Once the *A10-RTK* is operational, the *A10-RTK* will be displayed in the Bluetooth range. Pair the *A10-RTK* with your device using the PIN “0000” (see User manual configurator.pdf). The *A10-RTK* installs itself as a serial port (COM port, 115200, 8-N-1). No further drivers are required.

You will find the appropriate COM port for Windows operating systems as follows:

Windows 7:

*Control Panel > Devices and Printers > A10 (Right Click) > Properties > Services*

Windows 10:

*Start > Settings > Devices > More Bluetooth Options > COM Ports (Tab) > A10 # 'SPP'*

Supported devices:

- Devices from the Bluetooth 2.0 standard onwards
- Apple systems
- Android systems



## 7 Configuration

### 7.1 Alberding Configurator software

To configure the *A10-RTK* sensor with the Alberding Configurator software, the *A10-RTK* must be connected to the PC via the serial port or Bluetooth (see chapter 6.2).

The configuration software Alberding Configurator is available for download under the following link and includes the configuration tool as well as the required USB driver for Windows systems (see User manual configurator.pdf):

*[https://www.alberding.eu/programs/A07\\_Konfigurator.exe](https://www.alberding.eu/programs/A07_Konfigurator.exe)*

### 7.2 Linux board

In order to communicate with the Linux board on the *A10-RTK*, the *A10-RTK* sensor must be connected to the PC via Ethernet. Then programs or scripts can be installed.

This connection can be performed by the network administrator or you can use the following steps for **Windows**:

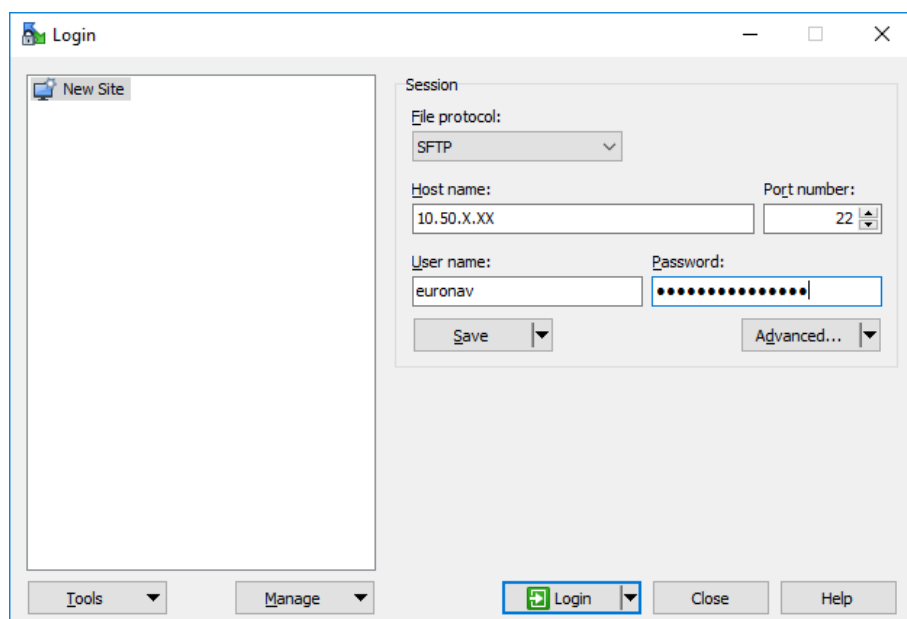
1. With the free and open-source software *PuTTY*, a connection to the *A10-RTK* can now be established: `ssh euronav@10.50.X.XX` (IP address (Alberding GmbH))
2. Attention: A password is requested to establish an SSH connection. Alberding GmbH will provide you with this password.



## 8 Data transmission

To access the file system of the embedded PC Linux OS, the *A10-RTK* sensor must be connected to the PC via Ethernet. To transfer data from the *A10-RTK* sensor to your computer use WinSCP and follow these steps.

1. A connection to the *A10-RTK* can now be established with the free software WinSCP. Set the File protocol to SFTP. For the Host name, use the IP address 10.50.X.XX (IP address - Alberding GmbH) from the table (see above). User name and Password are provided by Alberding GmbH (see Fig. 16).



**Figure 16:** WinSCP configuration



2. By default, the connection is established in the “/home/euronav/” folder. To access the sensor data, go up two levels by clicking on “...” (see Fig. 17).

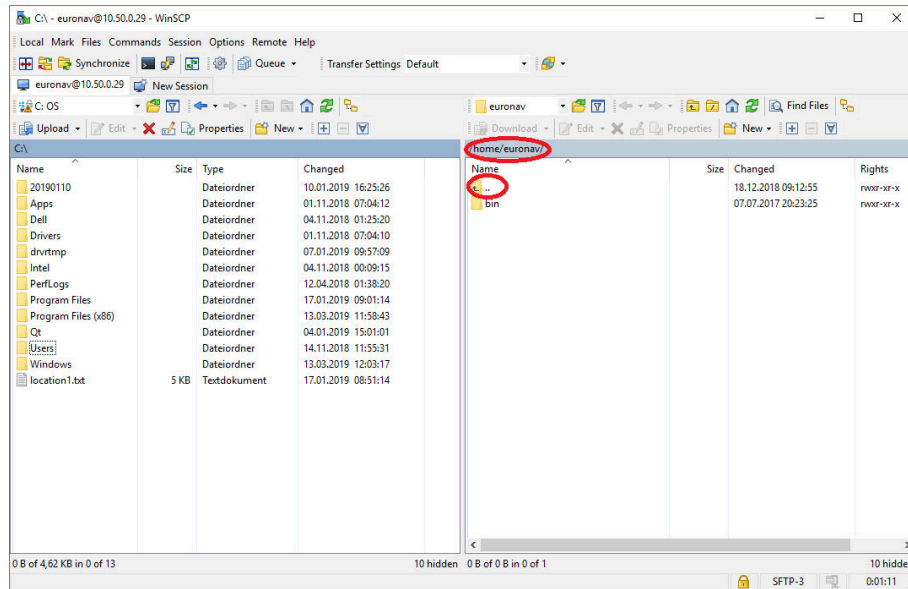


Figure 17: WinSCP connection

3. Then navigate to the “/var/euronav/data/” directory of the A10-RTK (see Fig. 18).

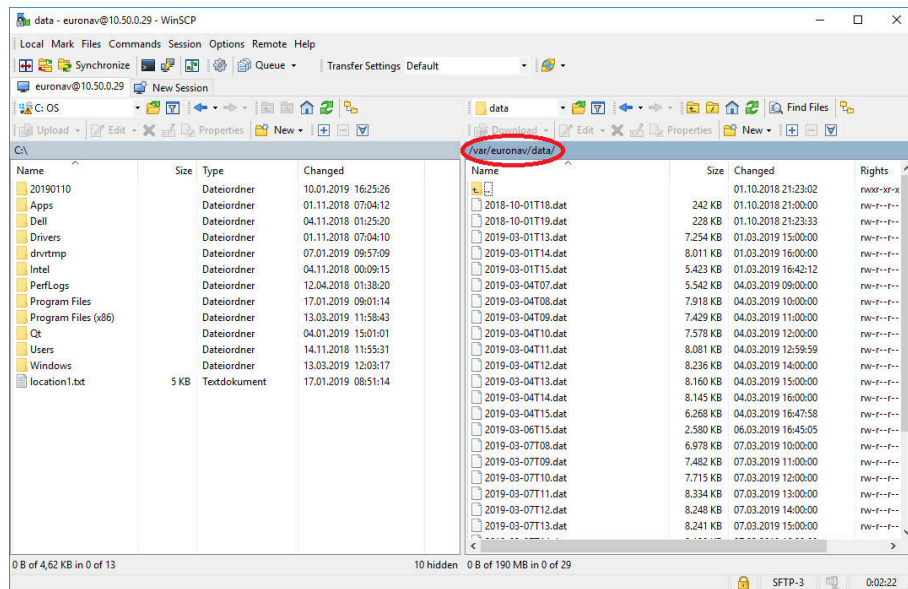


Figure 18: WinSCP data directory

Now you can transfer the data from the A10-RTK sensor to your computer.



## 9 Disclaimer of liability

Alberding GmbH has developed with the *A10-RTK* sensor an innovative system for various precise positioning applications. The *A10-RTK* sensor integrates components of different manufacturers in one housing. The sensors have been tested by Alberding GmbH for their suitability. However, there is still a remaining risk that either individual components or the entire composition of the system may not work correctly.

Alberding GmbH does not assume any liability or responsibility for direct or indirect costs arising from the use of the Alberding telemetry and positioning systems *A07-RTK* and *A10-RTK*. The manufacturer reserves the right to make changes to the product, technical data or user manual without prior notice.