

TRX-1500

**ADS-B / FLARM® -
Trafficsensor**

User Manual Installation Manual

GARRECHT
Avionik GmbH



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Preface

Many thanks for purchasing the TRX-1500 traffic sensor.

The TRX-1500 combines a high performance ADS-B receiver with an integral FLARM(R) module. The system provides interfaces for connecting two external Displays (CDTI) and a GPS interface to be connected to a Mode-S transponder (i.e. Garrecht Avionik VT-01, VT-02, VT-2000) with ADS-B out capability.

To avoid malfunction, reading and understanding of all chapters of this manual is required.

Limitations of the system are described in the chapter „System Limitations”

A detailed data port specification is described in the “TRX Data Port Specifications” manual, which is available on request from the manufacturer.

New releases of manuals or firmware updates are published on the manufacturers website

www.garrecht.com

Your feedback or suggestions for improving the system are welcome. Please contact us via email:




info@garrecht.com

This manual provides all information, that is required for proper installation and safe operation.

For more information and additional support, please contact your TRX-1500 dealer.

To avoid damage, please do not open the system housing.

The following symbols and terms are used in this manual:

	<p>Warning <i>Warning statements identify conditions or practices that could result in injury or loss of life</i></p>
	<p>Caution <i>Caution statements identify conditions or practices that could result in damage of this product or other property.</i></p>
	<p>Important note: <i>Indicates important or useful information. It is strongly recommended to read, understand and follow the statement.</i></p>

Unpacking the unit

The TRX-1500 system is supplied with the following:

- System unit TRX-1500
- USB interface cable
- 1090 MHz antenna + antenna cable
- FLARM®- antenna + antenna cable (
- GPS antenna
- Antenna ground plane
- D-SUB 15 HD (f) connector
- Connector shell
- This manual

If one or more parts are missing, please contact your supplier of the TRX-1500.

Required parts for proper operation

- External display devices (CDTI), i.e. Butterfly, Dynon SkyView, FlymapL, Garmin GPS 39x/49x/69x, Aera, PDA with appropriate software (WinPilot, PocketStrePla, SeeYou mobile)

Options (not delivered with the TRX-1500)

- Antenna line extension
- Wiring harness (15 pol. HD)

These options will be supplied by your TRX-1500 supplier.

Important Information about integral FLARM® module

The TRX-1500 is equipped with an integral FLARM® module. FLARM is a very popular collision avoidance system for general aviation and gliders, which is installed in over 17.000 aircraft worldwide.

FLARM® features at a glance:

- Situational awareness display. Collision warning (audible and visible) if other aircraft is also FLARM® equipped.
- Obstacle warnings
- Intelligent trajectory prediction, also under unconventional conditions (i.e. thermaling gliders) to reduce pseudo warnings
- Typical range: 4-8 km
- Operating in free ISM Band

Detailed information about the FLARM® system can be obtained under

www.flarm.com



To keep all FLARM® up to date and to improve the system, mandatory updates are required from time to time (every 3 to 5 years). These updates are mandatory in order to keep your FLARM® alive. After the expiration date, FLARM(R) stops working.

Setting up the integral FLARM® module requires the use of the FLARM® tool and a microSD memory card. For transferring your personnel configuration, store the desired setup to a memory card and insert this card into your TRX-1500.



Unless otherwise stated, do not use the FLARM® tool for setting up the internal FLARM® module.

Mandatory updates are required to improve the whole FLARM® network without respecting downward compatibility. The aviation typical periodic maintenance has been extended to electronic systems.

The expiry date of the current firmware is Feb. 28 2015

Detailed information about the update process can be downloaded from

www.garrecht.com

All required files are provided via this website.

**Please do not send the device to the manufacturer
for firmware updates!!**

1. Principles

1.1. General

Automatic Dependent Surveillance – Broadcast is a modern ATC system for broadcast aircraft position data. Transponders which are connected to a GPS system transmit their own position and other flight data, like call sign, Mode-S address, speed and altitude as well as track and vertical speed. The transponder transmits these data periodically – typically once per second – like a radio station (Broadcast).

TRX-1500 contains sensitive 1090 MHz receivers with complex signal processing unit. Transponder signals broadcasted by other aircraft are received, processed and decoded.

Data from the integral FLARM® will be extended by the data received from the TRX-1500 ADS-B receiver and indicated on an external cockpit display.

To enhance display capability, traffic data will be provided via two interfaces for connecting external display devices. GPS data are provided on a dedicated port.

The presence of transponder equipped aircraft not broadcasting ADS-B output will be detected and indicated on the system display as a non directed target.

It is not essential to connect the TRX-1500 to a transponder. The system comes with its own 1090 MHz receiver. To operate a TRX-1500, no transponder installation is required.

The TRX-1500 provides GPS data received from the FLARM via a dedicated port to supply an ADS-B out capable Mode-S transponder. (e.g. Garrecht Avionik VT-01, VT-02). This device broadcasts the current position message every second - the message can be received by ADS-B receivers installed in other aircraft, as well as with receivers installed on ground.

System setup and configuration needs to be performed using a PC and the TRX-Tool. The unit needs to be connected to the USB port of your PC. Power will be supplied via the USB port.

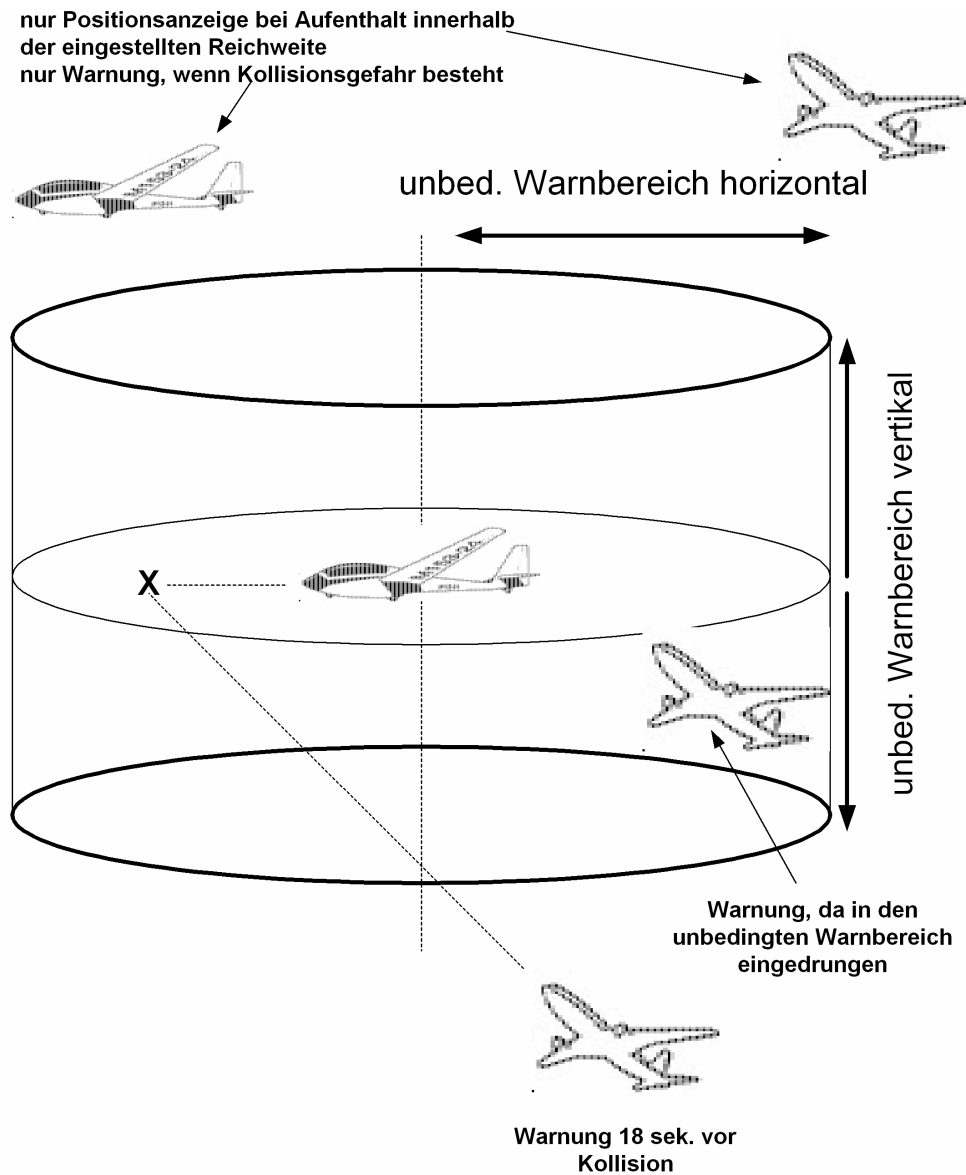


Before the first time connection of the TRX-1500 to your PC, the TRX-Tool needs to be installed properly!

In some cases, the output power of the PC USB port might be insufficient for powering the TRX-1500 and the system must be powered via an external power supply.

1.2. Output of position data and warnings

The TRX-1500 provides collision warnings and warnings to prevent dangerous situations



1.2.1. Position data:

The TRX-1500 determines position data of other aircraft and provides position data to the system LCD or connected displays, if the position is within the configured horizontal and vertical range and broadcasts ADS-B out or FLARM®.

1.2.2. Warnings:

The TRX-1500 warnings focus on different situations:

1. Entering the protection volume (ADS-B and Mode-S targets)

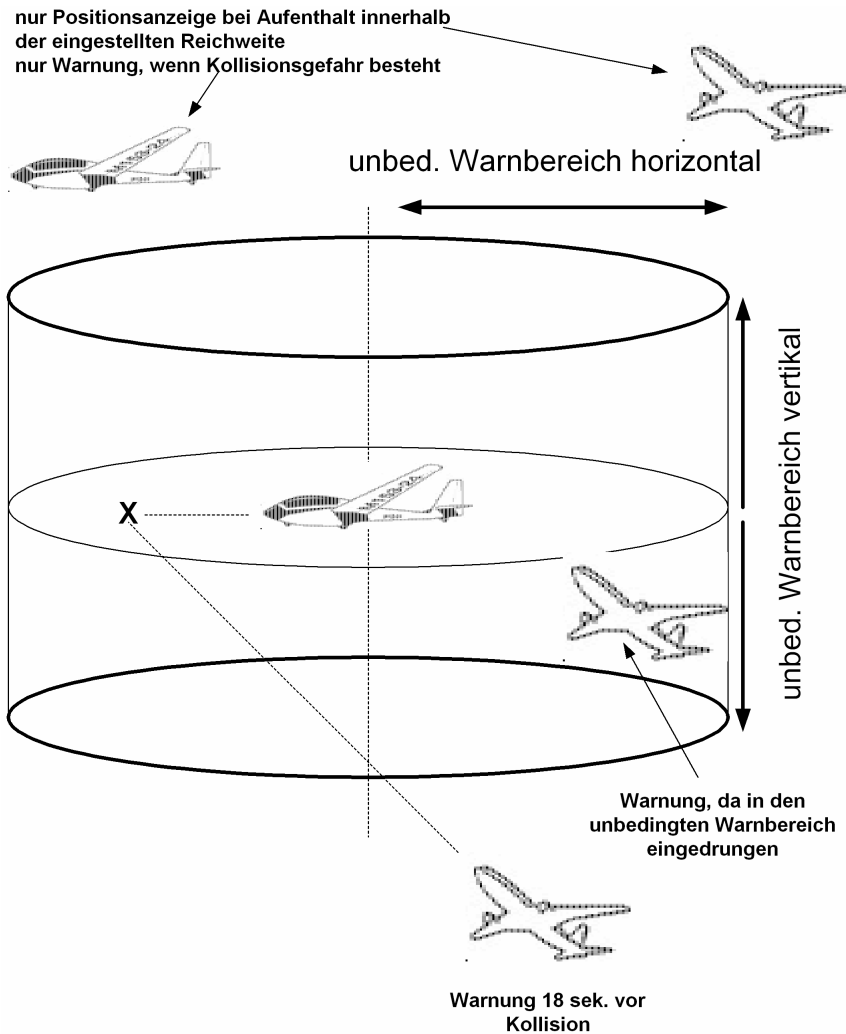
The protection volume is defined as a cylindric volume around the own position. Radius and height of the Cylinder can be configured using the TRX-Tool. The TRX-1500 generates a warning, if an aircraft violates the defined protection volume (if falling below the vertical AND horizontal limits)

2. Prediction of crossing the flight tracks (ADS-B and FLARM® targets)

Derived from the own position and trajectory data (position, speed, flight direction, vertical speed) and data from other aircraft, the TRX-1500 calculates the risk of a collision. If detecting a dangerous situation, a warning will be generated 18 sec. before collision.



WARNING: Due to sudden changes of the own or other aircraft's flight direction (track), this warning can be generated later / only few seconds before a calculated collision.



1.3. Data output (collision warnings und position indication)

As the TRX-1500 does not come with a system display, all traffic information are provided in a data stream to supply external displays (CDTIs). The manner of indicating traffic and providing warnings is always under the responsibility of the display manufacturer. Garrecht Avionik GmbH has no influence to display indication on 3rd party systems. Please consult the manufacturer of your CDTI for additional information.

Traffic information will be provided either in FLARM- oder GARMIN TIS compatible format.

1.4. Audible traffic warnings

To reduce pilot's workload and minimize head down time in dangerous situations, the TRX-1500 provides audible warnings via an audio interface.

Depending on the level of threat, acoustik signals are repeated in different intervals. Increasing threat is indicated by reduced interval of beeps.

Interval [sec.]	Meaning
3 sec.	Calculated time to collision: 30 sec.
2 sec.	Calculated time to collision: 20 sec..
1 sec.	Calculated time to collision: 10 sec., significant threat
< 1 sec.	Calculated time to collision: <10 sec, highest threat

Additionally, the elevation of the target related to the own elevation is coded in the audio signal.

Audio signal (two beeps)	Meaning
Same frequency	Target elevation in appr. Same elevation (+-200ft)
Low - high	Target elevation lower than own elevation (lower -200ft)
High - low	Target elevation higher than own elevation (higher +200ft)

1.5. Transponder signals, FLARM® signals and system behaviour

Different transponder signals (ADS-B, Mode-S Replies, Mode-S Squitters) result in different system reaction. The table below shows the different signals and the related reactions.

1.5.1. Mode-S Extended Squitter with ADS-B out

Broadcasted by	Mode-S Transponder equipped aircraft <u>WITH connected GPS</u>
Broadcast interval	1 /sek.
System reactions TRX-1500	Output of aircraft's position and altitude data via system interfaces according to interface configuration. Output of warnings (violating the protection volume, collision warning) A warning is always focussing the most dangerous aircraft. FLARM® Warnings always have higher priority. If an aircraft is equipped with FLARM® and ADS-B out, only FLARM® warnings will be processed

1.5.2. Mode-S Squitter

Broadcasted by	Mode-S Transponder equipped aircraft <u>WITHOUT connected GPS</u>
Broadcast interval	1 /sek.
System reactions TRX-1500	Detecting of horizontal approximation (analyzing the signal strength). Altitude information will not be processed.

1.5.3. Mode-S Replies

Broadcasted by	Mode-S Transponder equipped aircraft, which are interrogated by radar ground station or TCAS
Broadcast interval	Depending on external interrogation, every 4-6 sek.
System reactions TRX-1500	Detecting of horizontal approximation (analyzing the signal strength) Detecting of vertical approximation (processing the coded altitude signals)

1.5.4. FLARM®

Broadcasted by	FLARM® equipped aircraft
Broadcast interval	1 /sek.
System reactions TRX-1500	Output of aircraft's position and altitude data via system interfaces according to interface configuration Output of warnings (collision or proximity warning). Output of distance, direction, vertical distance. A warning always indicates the most dangerous target. FLARM® Warnings always have higher priority. If an aircraft is equipped with FLARM® and ADS-B out, only FLARM® warnings will be processed

1.6. Limits of the Systems

1.6.1. General



The system has been developed as a support for VFR pilots. It is not certified as a TCAS system. The data port does not provide valid data for certified hazard displays.

Observing the airspace is always the responsibility of the pilot in command. The TRX-1500 acts as a support device, which may operate wrong and generate wrong warnings or no warnings in dangerous situations.

Using the TRX-1500 and interpreting the warning generated by the device is under the sole responsibility of the pilot in command.

Displaying traffic information and providing collision avoidance information on connected 3rd party displays is under the sole responsibility of the display manufacturer. It can not be influenced by Garrecht Avionik GmbH.

Garrecht avionics GmbH assumes no liability for any direct or indirect damage to human and material arising from the use of the TRX-1500, unless grossly negligent or intentional acts of Garrecht avionics GmbH is demonstrated.

A GPS receiver is included with the internal FLARM® module. If traffic information or collision avoidance should be provided by the TRX-1500 the system must know it's position and pressure altitude information. The use of external GPS receivers is not possible.

1.6.2. The TRX-1500 system provides

- Position determination of ADS-B 1090 ES out and / or FLARM® equipped aircraft.
- Generation of directed warnings of ADS-B 1090 ES out Funktion and / or FLARM® equipped aircraft, if the configured distances (protection volume) is violated or risk of collision occurs.
- Generation of undirected warnings of Mode-S equipped aircraft without ADS-B 1090 ES out capability. Approximation of such aircraft is determined by analysing the field strength.
- Providing of FLARM® and ADS-B 1090 ES out warnings and aircraft position on two external ports for connection of appropriate 3rd party display systems.
- Visualisation of aircraft specific information (TRK, Altitude difference refered to own altitude, vertical speed, FlarmNET data.
- Obstacle warnings (data provided by FLARM® obstacle database)

1.6.3. The TRX-1500 system does **NOT** provide

- Mode-S SSR transponder capability. **The TRX-1500 is NO transponder!!!**
- Active interrogation of other SSR transponders (**TRX-1500 is NO TCAS**)
- Resolution advisory similar to TCAS
- Position determination or directed warnings of Mode-A/C and Mode-S (no ADS-B out) equipped aircraft
- Generation of traffic information or collision avoidance warning, if the internal GPS receiver does not work properly

2. Aircraft installation

2.1. General

Installation of the TRX-1500 in an aircraft needs to be performed in accordance with the applicable engineering standards by qualified personnel only.

If the required skills and tools are not available, please contact your avionic shop or maintenance organisation.

The Installation of the TRX-1500 may not influence other aircraft equipment.

Visualization of received data and audible warnings are provided by a connected 3rd party device (Butterfly, FlyMapL, V2/V3 or any Flarm(R) compatible display as well as any device with GARMIN(R) TIS compatible interface.

According to EASA decision 2006/13/R and 2006/14/R, the TRX-1500 may be considered as standard part, which can be installed in CS-22 aircraft (gliders and powered gliders).

- **For operating a TRX-1500, no transponder needs to be installed in the aircraft.**
- **Connecting a TRX-1500 and a transponder to a common antenna (transponder antenna) is not possible.**

2.2. Mechanical installation

Use the 4 mounting holes of the aluminum housing for fastening the system on a plane surface. Avoid any bending of the housing.

The system housing is not waterproof. Take this fact into consideration when choosing a place for installation.

A system exposed to water or severe humidity must not be supplied with external power or switched on. Consult your local avionics shop or maintenance organisation for further steps.

2.3. Antenna installation

2.3.1. General

Choosing an appropriate position

For best transmitting and receiving performance, ADS-B and FLARM(R) antenna must be installed in vertical position. The GPS antenna has to be installed in horizontal position.

All antenna must not be covered by conductive material (aluminium, carbon fibre). If no appropriate position can be determined, antennas need to be installed outside at appropriate position. Antennae for outside installation and antenna line extensions are not delivered with the device and must be purchased separately.

Each antenna must be installed in a manner to have free line of sight in all directions. Metal parts (i.e. engine, prop, gear) close to the antenna may reduce the device receiving and transmitting performance.

Minimum distance to NAV/COM antennas is 1m (3ft), to transponder and / or DME antenna is 2m (6ft).

Antenna ground plane

Stub antennas ($\lambda/4$ beamer) always require the use of a conductive antenna ground plane. In wooden or fibre glass made airframes, a conductive ground plane (metal film, sheet metal, size: as large as practical) has to be installed. Antennas need to be in the center of this ground plane. Too small ground plane may reduce the antenna performance. A proper conductive connection between antenna foot and groundplane is essential. Insulating covers (painted or oxidized) need to be sanded in the place of contact with the antenna foot to provide a conductive connection.

The TRX-1500 comes with a aluminum sheet ground plane for installation of Flarm- and ADS-B antenna. Do not reduce the size of this ground plane.

Important



If using antennae installed in the instrument panel cover which are part of the removable canopy (i.e. gliders), always use pull to release connectors types to avoid proper canopy release in case of emergency exit.

2.3.2. Antenne cable and connectors

Handle the antenna lines carefully and avoid sharp bends or damaging the antenna line during installation to avoid reducing system performance. Depending on the cable type, keep a minimum radius of 1-5 cm (smaller radius for smaller cables).

Line extensions have to be performed in accordance with good workmanship using appropriate connectors and cable types (Impedance: 50 Ohms). For adopting to other connector types, always use industrial made connectors to reduce attenuation.

Do not reduce the length of supplied cables. Tie unused cable in 8-shape loops.

Nuts of used SMA connectors (ADS-B antenna connector of TRX-1500) may be screwed down tight carefully only to avoid damaging the antenna connector.

2.3.3. ADS-B Antenna

Whenever possible, use the supplied $\lambda/4$ - 1090 MHz stub antenna (shorter antenna) for installation on the instrument panel cover.

An appropriate groundplane is supplied with the TRX-1500 as well as nuts for antenna installation and antenna line for connecting the antenna to the TRX-1500



The SMB type connector acts as a pull to release connector for disconnecting the antenna in case of canopy release for emergency exit. For proper disconnection in case of pulling, a loose installation of at least 0,3m (1ft) of the antenna line after the antenna connector is recommended. The remaining part of the antenna line should be tied to a fixed part.

For external ADS-B antenna installation, the use of an of-the-shelf SSR-transponder antenna (stub or fin type) is recommended.



Do not use a transponder antenna, which is used by an installed transponder already!!!



If a Mode-S transponder is installed in your aircraft, be sure to have entered the 24 Bit aircraft address into the external Flarm (if present) to avoid ghost targets.

2.3.4. FLARM TX/RX Antenna

A $\lambda/4$ - 868 MHz stub antenna (longer antenna) is supplied with the TRX-1500. All instructions for ADS-B 1090 MHz antennas shown above are mandatory for this antenna as well.

The FLARM® antenna is connected to the TRX-1500 FLARM(R) antenna socket via a MCX type connector (self locking).

For outdoor installation, appropriate 868 MHz antenna are supplied by the several companies. These antennas are designed to comply with the requirements for installation in aircraft or cars (withstanding drag, moisture etc.). For installation of this antenna type, please follow the instructions for installing external antennas (free line of sight, groundplane etc.) to avoid reducing system performance as the FLARM(R) system is sensitive against poor antenna installation.

2.3.5. GPS Antenna

For operating the TRX-1500. an active GPS antenna with MCX connector is required and supplied with the device.

All general consideration for antenna installation shown above are suitable for GPS antennas. For proper function, a GPS antenna requires free line of sight in horizontal and vertical direction.

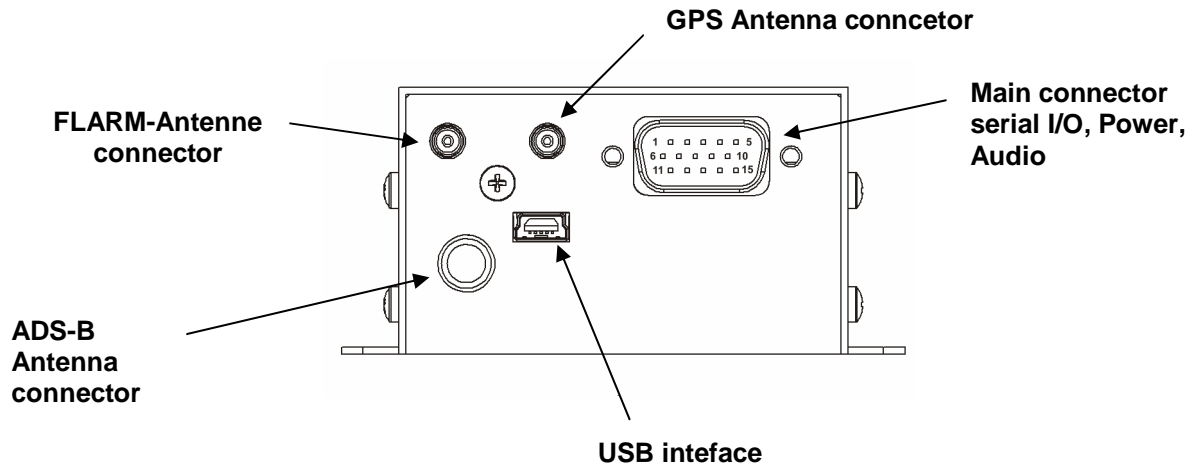
To avoid interference with other GPS antennae installed in your aircraft, make sure to keep a minimum distance of 0,6m (2ft) to other GPS antennae.

A GPS antenna must not be installed on the bottom side of the airframe nor under conductive or shielding material.

As the antenna supplied with the TRX-1500 does not provide cut off capability, it may not installed on top or bottom of an instrument panel cover, which is part of a removable canopy.

The common use of a single GPS antenna for multiple GPS receivers is not possible.

2.4. Wiring (power supply and data)



2.4.1. USB interface

The unit's USB interface is intended to be used for system configuration via PC and TRX-Tool software.



- **Before the first time connection of the TRX-1500 to your PC, the TRX-Tool needs to be installed properly!**
- **As the output power of the PC USB port might be insufficient for powering the TRX-1500, the system must be powered via an external power supply during communication with the PC. Use one of the RJ-45 connectors for supplying external power.**
- **The TRX-1500 must be switched on for communication with PC**

2.4.2. Power Supply

Electrical power (9-32 V DC) is supplied to the TRX-1500 via a common power and interface connector (TRX Main connector). To prevent damage to your aircraft installation and the TRX-1500, always install a fuse. Missing fuse or wrong fuse dimension will cause damages, which are not covered by manufacturers warranty.

2.4.3. 3V3 DC Power output

The TRX-1500 main connector provides a 3V3 DC output for supplying external displays (such as Butterfly Display or Flarm V2/V3/V4).

- Do not feed electrical power through the 3.3V pins TRX-1500 main connector to avoid damaging internal circuits of the TRX-1500.
- Max. outout current of the internal 3.3V converter: 0,5 A

2.4.4. Data interfaces (Port-1 to Port-3)

The TRX-1500 provides data interfaces, which can be configured using the TRX-Tool PC software.

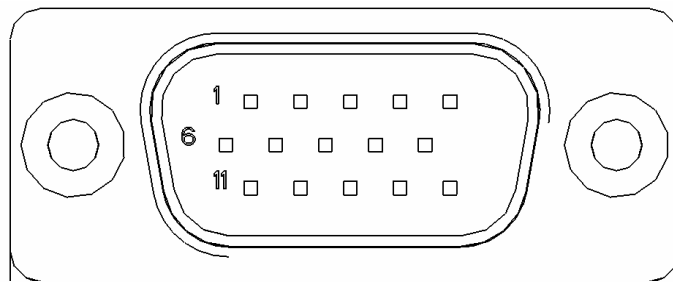
2.4.4.1. Use of interface ports

Port -#	Funktion
1	Power supply, NMEA output for supplying Mode-S transponders
2	CDTI 1, Interface 1 for cockpitdisplay (compatible to FLARM extended displays)
3	CDTI 2, Interface 1 for cockpitdisplay (compatible to FLARM extended displays or GARMIN GPS TIS compatible device), configuration via TRX-Tool

2.4.4.2. Pinout of the TRX-1500 main connector



Wiring of the 15 pin HD D-Sub connector has to be carried out properly to prevent shorts and resulting damage to the device and/or connected displays. If specific skills or required tools are missing, please consult your avionics workshop for assistance.



View TRX-1500 Main connector (pins) = view soldering female connector

Pinbelegung Sub-D 15HD Stecker (CN-1)	
Pin #	Funktion
1	+ 3V3 DC out
2	GND
3	Audio out
4	Port 3 RX
5	Port 2 RX
6	+ 3V3 DC out
7	GND
8	Port 3 TX
9	Port 2 TX
10	Port 1 TX
11	+9 ... + 32V DC, USE A FUSE (0,5 A)
12	GND
13	n.c. (reserved for future applications)
14	n.c. (reserved for future applications)
15	Port 1 RX

Factory default settings port 2 and port 3:

Port 2: preconfigured for connecting external FLARM extended displays (Butterfly, FlymapL, PDA with appropriate software)

Port 3: preconfigured for connecting FLARM® Basic Displays (V2, V3, V4)

Default settings might be changed using the TRX-Tool.

Future firmware upgrades will make the TRX-1500 compatible to other display systems.

The TRX-Tool software checks periodically for new updates. Sending the unit to your dealer for firmware upgrades is not required.

New information about firmware will be published on the manufacturers website.

www.garrecht.com

2.4.5. Audio interface

The TRX-1500 comes with an audio interface to provide audible warnings additionally.

Electrical specifications:

Impedance: 8 Ohms

Voltage Level: appr. 3 V (VSS)

A small speaker can be connected directly to this interface. If the cockpit noise level is too high and if using a headset, connecting the audio signal of the TRX-1500 to a radio panel or Line-in interface of a radio or intercom is required.

Refer to the radio's or intercom's installations manual for detailed information, how to hook up external audio sources properly.



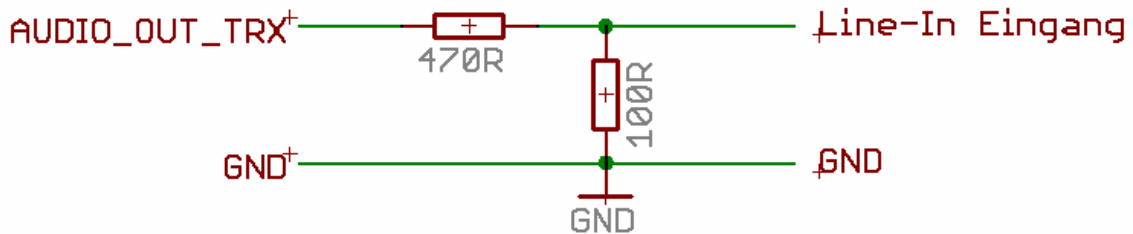
Always consult the manuals before connecting the TRX-1500 to avoid damages to the units caused by exceeding the maximum specified input level

Consult your avionics workshop for additional information.

In some cases, connection of the TRX-1500 to your audio panel or Line-in interface of your radio requires impedance matching.

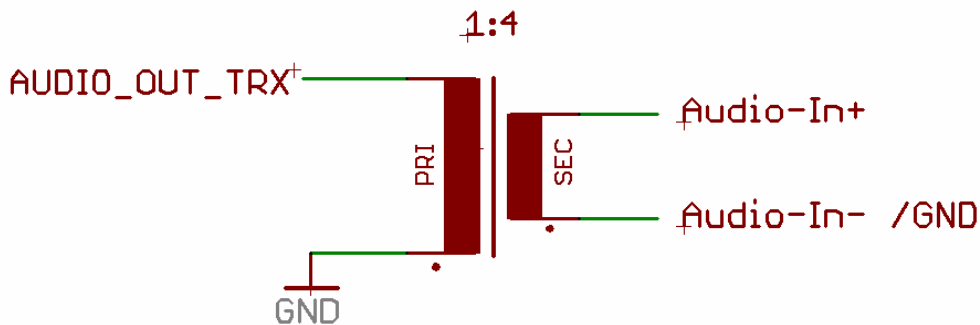
Connecting a TRX-1500 to a Line-in interface:

- Use a voltage divider



Connecting a TRX-1500 to an avionic audio panel (Input Impedance: 500 Ohms)

Units with automatic impedance matching:	direct connection (conceivably)
Units without automatic impedance matching:	Connection via impedance matching transformer (i.e. Conrad Electronic P/N 515 952)



2.5. microSD Card Slot

The TRX-1500 provides a microSD card slot for updating TRX-1500 firmware, FLARM® firmware and FLARMNet database.



Pay attention for correct insertion of the microSD card. Card labeling must show upwards. Wrong orientation may cause damages to the microSD card socket.

Additional information about handling Updatefiles (Firmware and Obstacle database) for the internal FLARM® module via microSD card can be obtained from

www.flarm.com

Additional information about handling Updatefiles (Firmware and FLARMNet database) via microSD-Card for the TRX-1500 can be obtained from

www.garrecht.com

2.5.1. System behavior with inserted memory card (microSD-Card)

1) General:

After switching on, the TRX-1500 checks, if

- an SDHC ($\geq 4\text{GB}$) or SDSC ($\leq 2\text{GB}$) memory card type is inserted
- the card is formatted with FAT16 or FAT32 file system
- a subdirectory (folder) GAV exists in the root directory of the memory card

If all conditions are valid, the system checks for existing firmware update in the GAV folder. If a newer firmware oder FLARMNet file is detected, the updates start automatically.



Refer to chap. 3 of this manual for a step by step instruction for Flarm- and TRX-Firmware updates.



Do not remove the memory card during the update process to prevent damages to the TRX-1500

If the inserted memory card is an SDSC type and it is FAT16 formatted or SDHC and internal FLARM firmware 5.x or later, the unit starts normal and FLARM® module detects the memory card. All FLARM® startup procedures with inserted memory card will be processed now: Checking for update files (Firmware, obstacle database, flight declaration, cofiguration), performing updates, copying IGC files stored in the FLARM® flash memory, which are not present on the memory card already.



Do not remove the memory card until all read / write operations are finished.
This is indicated by the system if a connected CDTI shows normal traffic information.

3. Firmware updates (FLARM + TRX-1500) via mircoSD-Card

The integral FLARM® module requires the same update procedures and interval as an original FLARM® system. In the same step, the TRX-1500 Firmware and the FLARM-Net file should be updated to the newest release.

The FLARM® firmware update is mandatory. Please read the statement of the FLARM-Team for detailed information about the 2011 update:

FLARM Software Maintenance 2011

*Every few years, all FLARM devices have to undergo a scheduled maintenance through software update. The next such free, but mandatory update is due end February 2011 for version 4; this behaviour is explained in the operating manual. **Update now for free both software version 5 and obstacle data, in any case before the next flight!***

Release 5 contains a new, higher performance FLARM engine which will be able to process more aircraft, a major redesign of the software required for integration of FLARM-features into hang-gliders and powered aircraft (PowerFLARM), its software-data-fusion with transponder-data and related requirements from regulators like EASA and FCC. This requires a modification to the radio communication amongst the units where we introduce frequency hopping to increase the radio bandwidth and reliability as well as some back-and-forth radio bursts for checking radio communication quality. In addition, version 5 accepts all sizes of microSD cards. An updated obstacle database, which has grown to over 35'000 objects is available, too.

When is the next scheduled service update due?

*Since its creation FLARM has maintained scheduled updates, initially in a one year cycle, in 2006 a two year cycle, and last time in 2008 a three year cycle. As the technology matures, we further extend this period to now four years, i.e. **version 5 expires on March 1, 2015**. This is more convenient for some users, but slows down the innovation cycle, possibly delaying the use in new applications.*

Why scheduled, mandatory updates?

The ability to update the whole network without being limited by constraints of the past is one of the key features of FLARM and has allowed it to adapt to rapidly expanding requirements. Many parts of aircraft require scheduled maintenance; this is not a concept which is new to aviation.

*Best regards
The FLARM team*

(from: www.flarm.com)

3.1. Step by step instruction

3.1.1. General information about required files

TRX-1500 related files:

TRXDB.B02: FLARM®Net database snapshot (created 02/2011)
TRXFW20.B01: TRX-1500 Firmware file, Rev. 20

Alle TRX-1500 related files are provided for download at section "Support.Downloads.TRX-1500" on www.garrecht.com.

FLARM® related files:

Flarm_50x.fw: FLARM® Firmware file, Rev. 5.0x (x may indicate a number)
alps20110124_.obs: FLARM® Obstacle database (created 24 JAN 2011)

All FLARM® related files are provided for download at section "Mandatory Update 5.0" on www.flarm.com.

3.1.2. Prepare your microSD memory card (SDSC, no SDHC type) for the update process

1. Remove all old .fw und .obs files from the memory card
2. Create the folder GAV in the root of the memory card
3. Copy the files TRXDB.B02 und TRXFW20.B01 into the subfolder GAV of the memory card
4. Copy the files flarm_50x.fw und alps20110124_.obs into the root of the memory card

3.1.3. Performe the update process

1. Switch of the TRX-1500 and disconnect the external power supply
2. Insert and lock the prepared microSD card into the microSD card slot of the TRX-1500
3. Re-establish external power supply and switch on the TRX-1500
4. The unit performs the firmware update of the TRX-1500 (not FLARM® firmware) first.
5. After performing the TRX firmware update succesffly, the device restarts and the integral FLARM® module will detect the memory card.
6. The integral FLARM® module starts the firmare update and the update of the obstacle database (NOTE: This process takes 2-3 min.)
DO NOT BREAK THE POWER SUPPLY NOR SWITCH OFF THE DEVICE DURING THE UPDATE PROCESS!!
7. After completing the firmware and file updates, the data output of the TRX-1500 restarts provinding data and connected CDTI should display traffic.

4. PC Software *TRX-TOOL*

Configuring the system interfaces requires using the TRX-TOOL PC software. Die Konfiguration der Geräteschnittstellen erfolgt über das Programm *TRX-TOOL*. A PC with Windows XP or newer is required to run the software. The TRX-1500 will be powered via USB during the configuration process.

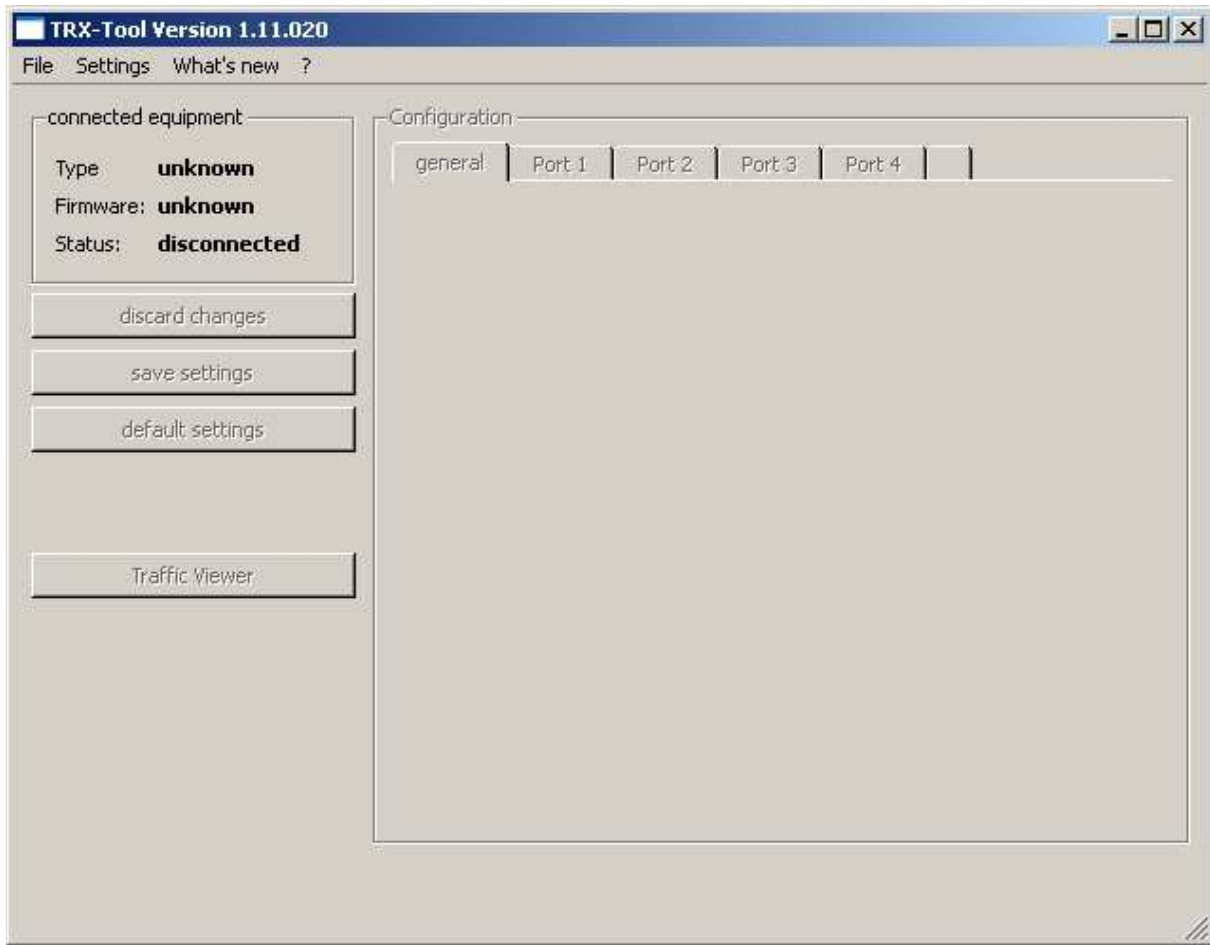
In some cases, the output power of the PC USB port might be insufficient for powering the TRX-1500 and the system must be powered via an external power supply

The newest release of the TRX-Tool is available free of charge on the manufacturer's website.

www.garrecht.com

4.1. Step by Step instruction for successfull installation process

1. Do not connect the TRX-1500 to your PC
2. Download the TRX-1500 installer from the manufacturer's website and store it on your computer
3. Start the installation by double clicking the downloaded file.
4. Follow the instructions of the installer
5. Connect the TRX-1500 to the USB port of your PC to complete the USB / FTDI driver installation and follow the instructions shown in the dialogs
6. Start the software after successfull installation to check for updates (internet connection required)
7. Updates will be installed, if available
8. After the update process, the software needs to be restarted.
9. A connection will be established now. TRX-Tool show the status of the connection
10. If an older firmware will be detected, the TRX-Tool offers to update the TRX-1500 by a newer version.
11. TRX-Tool is ready for use now.



TRX-Tool main window (no TRX connected)

4.2. Software and firmware release



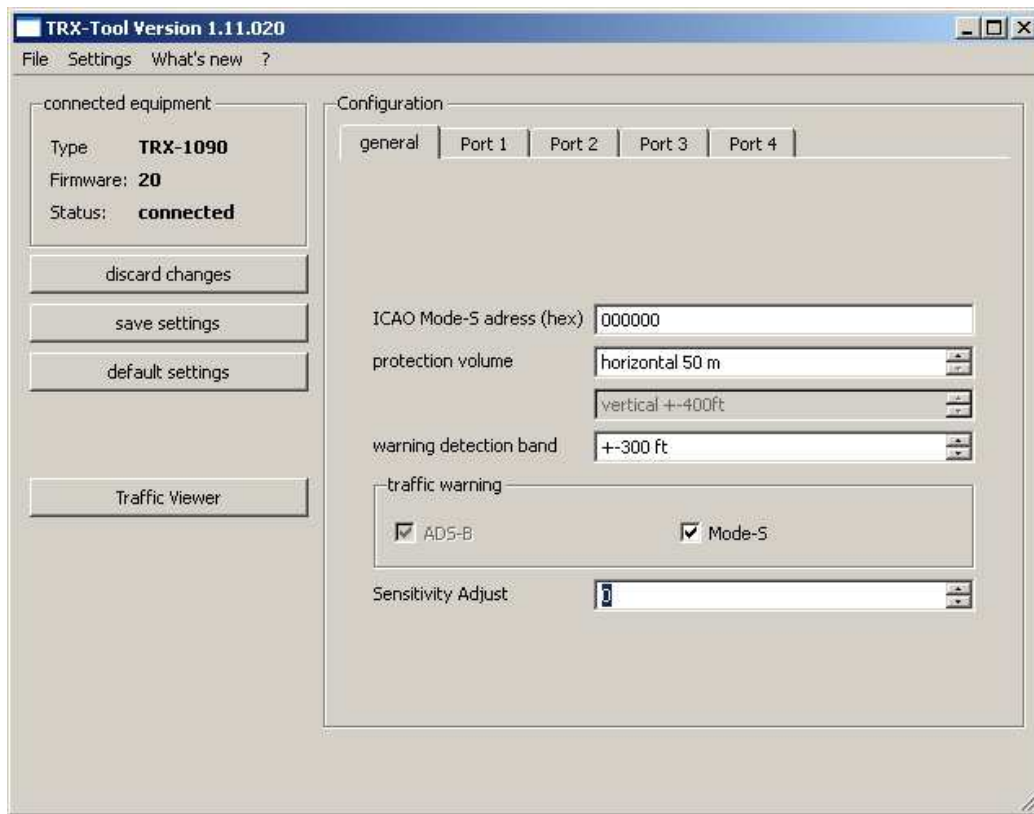
The title bar of the TRX-TOOL shows software release of the TRX-Tool (1.11) and integrated firmware release for the connected TRX device (020).

4.3. Program and firmware update via internet



The TRX-TOOL checks the web automatically for newer release. This process can be invoked manually via File.Check web for software updates.

4.4. Device configuration



TRX-Tool main window (TRX device connected)

<p>connected equipment</p> <p>Type TRX-1090</p> <p>Firmware: 20</p> <p>Status: connected</p>	<p>Type: Detected TRX device</p> <p>Firmware: Reports firmware release of connected TRX device</p> <p>Status: Reports the connection status</p> <p>If status is COMM ERROR, either the USB drivers are installed improperly, no external power is supplied to the TRX device or the system is switched off.</p>
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<p>discard changes</p> <p>save settings</p> <p>default settings</p> <p>Traffic Viewer</p>	<p>Discard changes Reloads stored configuration data from connected TRX device. Settings made in the TRX-TOOL will be overwritten without further notification.</p> <p>Save settings Transfers current configuration data made in the TRX-TOOL to the TRX device.</p> <p>Default settings Resets all user configuration in the TRX-TOOL to factory setting. Transferring the default data to the TRX device must be triggered by clicking Save Settings.</p> <p>Traffic Viewer Starts a basic traffic viewer to show live ADS-B and FLARM® traffic</p>
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ICAO Mode-S Adresse

Enter your own 24 Bit ICAO Mode-S adress to suppress warnings from own transponder

Protection volume

If falling below BOTH values, a warning will be generated to indicate dangerous situation in case of change the flight direction.

Warning detection band

Aircraft within this altitude band are considered in the collision avoidance algorithms.

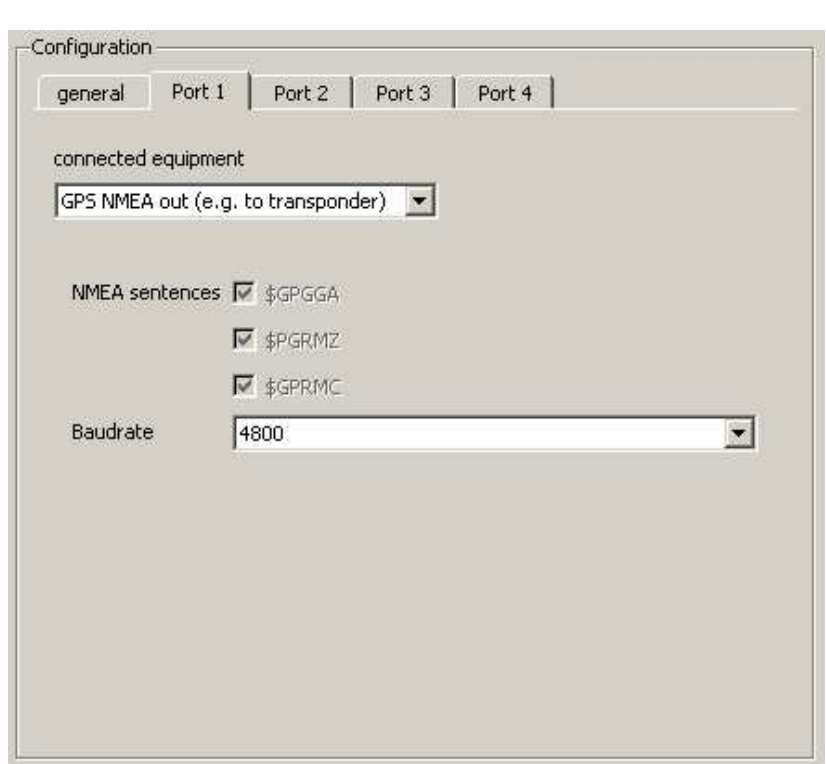
Traffic warning

ADS-B

Activates warnings of ADS-B out equipped aircraft (this feature can not be disabled)

Mode-S

Activates warnings of Mode-S equipped aircraft



Configuration Port 1

This port is preconfigured as a NMEA output (i.e. for supplying Mode-S transponders with GPS data)

Baudrate

Sets up the baudrate for the NMEA data stream.

Consult the manual of the connected device for proper settings.

Configuration

general Port 1 Port 2 Port 3 Port 4

connected equipment
Flarm-compatible custom display

horiz. Display range unlimited 20000m

vert. Display range unlimited

Baudrate 19200

display non-ADSB traffic as circling LED

GPS Data

Configuration Port 2

This port can be configured for connecting FLARM basic (LED) displays or Flarm extended devices (such as Butterfly).

Connected equipment:

Preconfigures settings depending on the chosen display type. Depending on the used display or your preferences, manual modification of the settings might be required.

Hor. + vert. Range

Sets the maximum display range for indicating aircraft position

Baudrate

Sets up the baudrate for the data stream (consult the display manual for proper setting)

Display non-ADSB traffic**No**

No warnings of aircraft without ADS-B out will be sent from the TRX device.

As circling LED

Warnings of aircraft without ADS-B out will be indicated as rotating Bearing position / LED.

With empty bearing field

Warnings of aircraft without ADS-B out are interpreted from the connected display in an own manner. Please check the display manual for detailed information.

GPS data

Activates GPS data set in the data stream (required for Flarm extended displays)

<p>Configuration</p> <p>general Port 1 Port 2 Port 3 Port 4</p> <p>connected equipment Flarm-compatible custom display</p> <p>horiz. Display range <input type="checkbox"/> unlimited 9900m</p> <p>vert. Display range <input checked="" type="checkbox"/> unlimited</p> <p>Baudrate 4800</p> <p>display non-ADSB traffic as circling LED</p> <p><input type="checkbox"/> GPS Data</p>	<p>Configuration Port 3 This port can be used for connecting Flarm basic or extended displays (see port-2) as well as for connecting display devices with GARMIN TIS compatible interface</p> <p>Anschlußnutzung Konfiguration des gewünschten Display-Typs</p> <p>Anzeigebereich Refer to port 2</p> <p>For Garmin TIS protocoll: Vertical range can be configured</p> <p>Baudrate Refer to port 2</p> <p>Nicht-ADSB Verkehrswarnungen</p> <p>Nein Refer to port 2</p> <p>Als umlaufende LED Refer to port 2</p> <p>Mit leerem Bearing Datenfeld Refer to port 2</p> <p>Displaytyp GARMIN</p> <p>As circling balls Rotating string of pearls around the own position</p>
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<p>Configuration</p> <p>general Port 1 Port 2 Port 3 Port 4</p> <p>connected equipment</p> <p>FLARM (original or compatible) ▼</p>	<p>Configuration Port 4</p> <p>This port is configured as FLARM I/O port. No change of settings are possible.</p> <p>Note: A TRX device configures a connected external FLARM® device to a 19.200 bps.</p> <p>For restoring to factory settings. press the Button on the frontpanel of the external FLARM® device at least for 20 secs.</p>
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5. Check list installation and konfiguration



Check all items of the checklist shown below in order to verify your installation.

- TRX-1500 manual **read and understood completely.**
- TRX-1500 configured (i.e. protection volume, port configuration)
- 24-Bit Mode-S aircraft adress entered in the TRX-1500 aircraft (only required, if the aircraft is Mode-S equipped)
- Device installed in suitable position.
- Connection to external displays established and tested
- All antennas installed in accordance with the instructions of the manual and connected to the device
- Shortbreaker / Fuse installed
- All cables placed in right position. Cables overlengths tied in 8-shape loops, not in ring loops.
- Final test of complete system
- Emergency canopy release tested. and not impaired by installation

6. Specifications TRX-1500

Dimensions	103 x 63 x 37,5 mm (LxBxH)
Mass	0.18 kg
Supply Voltage	9 - 32 V DC
Output voltage for external displays	3.3 V, max. 0.5A
Current consumption	Appr. 150mA @ 12V DC
Required circuit breaker	500 mA slow blow
Interfaces	3x RS-232 2x CDTI 1x NMEA out 1x USB
Operating frequencies	ADS-B: 1090 MHz (RX) FLARM: 868 MHz (TX + RX)
Temperatures	Operating -20°C - +70°C Storage -30°C - +80°C

7. Installation schematic diagram

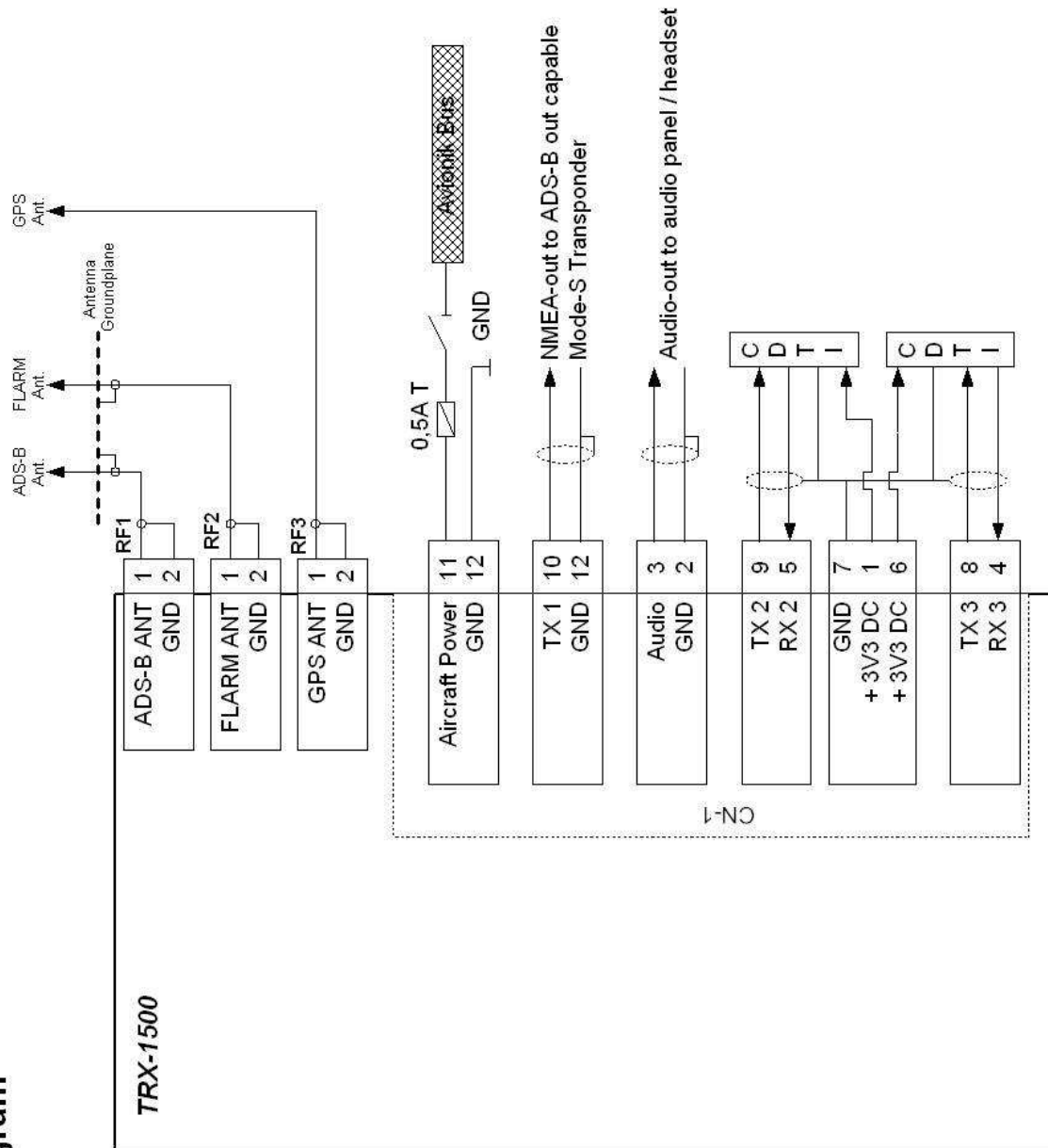
TRX-1500 Wiring Diagram

Notes:

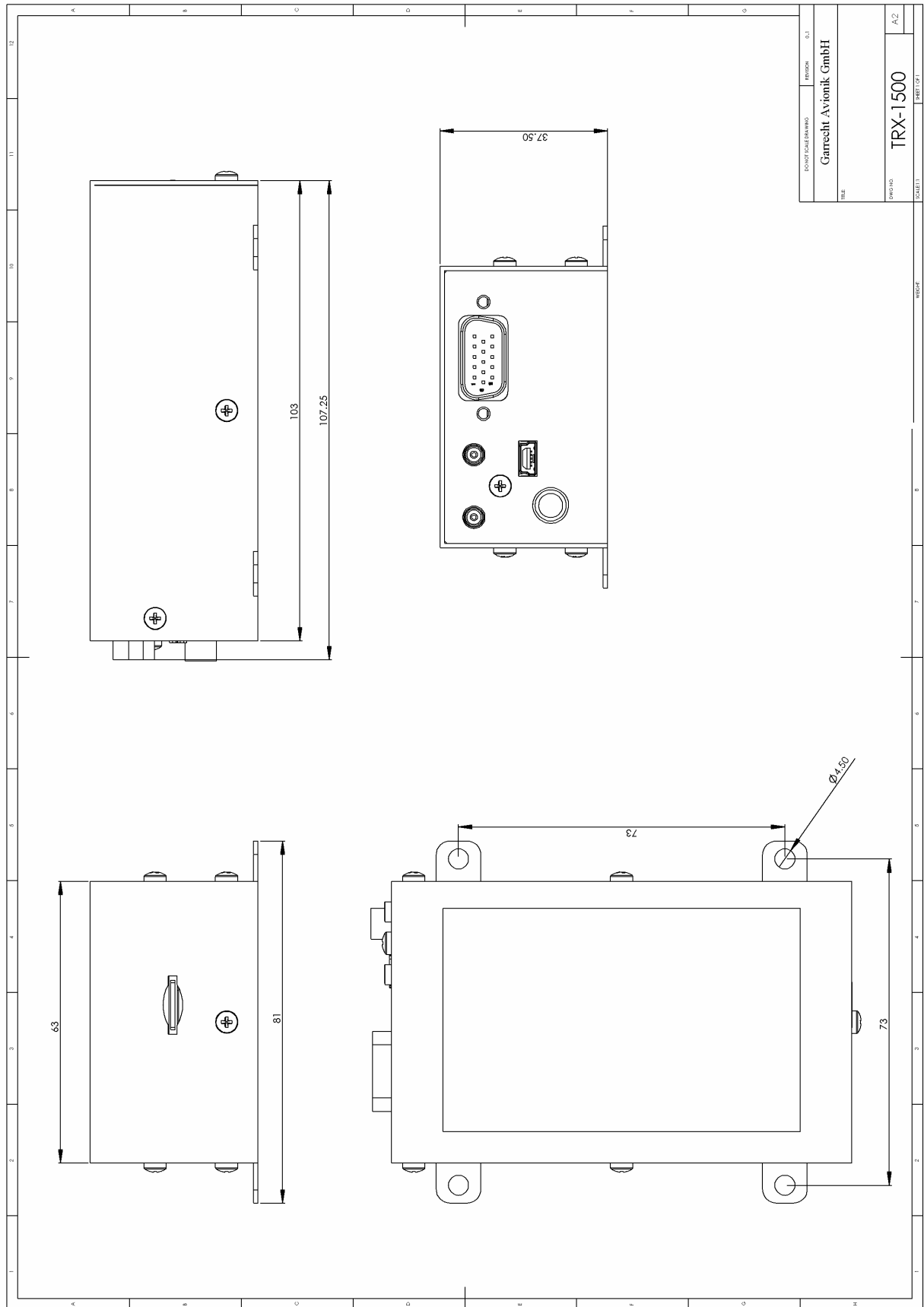
CDTI = Cockpit Display of Traffic Information

Note 1: Use 3.3V DC only for powering external CDTI

Note 2: consult the manual of your Audio panel to check compatibility



8. Dimensions



9. Traffic indication with Garmin TIS compatible devices

9.1. ADS-B and Flarm-Targets

Known aircraft positions are indicated in a style desired by the display manufacturer. So please **ALWAYS** refer to the display manufacturer's manual to learn how traffic information is indicated.

9.1.1. Dynon SkyView:



9.1.2. Garmin GPS / AERA:



9.2. Mode-S only targets

As Mode-S transponders without ADS-B out capability do not provide position information, no position of those aircraft will be indicated. If the TRX detects a dangerous situation (proximity detection and / or approximation of other aircraft) a **undirected warning** will be generated, but NO exact position is indicated. To meet the compatibility requirements of the GARMIN TIS protocol, undirected warnings are generated as a ring of targets centering to the own aircraft's position. One of this targets is carrying the altitude difference to the own altitude.

9.2.1. Dynon SkyView:

