

TRX-1090

ADS-B Traffic Receiver

Operation Manual Installation Manual

GARRECHT
Avionik GmbH



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Preface

Many thanks for purchasing the TRX-1090 ADS-B Receiver.

The unit has been developed to include the very popular FLARM collision warning system, which is installed in more than 13.000 aircraft worldwide. It will be connected between FLARM and external FLARM compatible display units to simultaneously show FLARM targets and Mode-S transponder equipped aircraft.

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

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 manufacturer's 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, please contact your TRX-1090 dealer.

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-1090 system is supplied with the following:

- System unit TRX-1090
- 1:1 Patch cable (shielded) with RJ-45 connectors, length: 0,5m
- USB cable
- 1090 MHz antenna
- this manual

If one or more parts are missing, please contact the supplier of the TRX-1090.

Required parts for proper operation

- Original FLARM® bzw. licenced 3rd party system (i.e. LX RedBox, ECW100)
- External display unit (CDTI), i.e. Butterfly, FlymapL, Garmin GPS 296/495/496, PDA with appropriate software (i.e. Seeyou mobile, pocket Strepla, WinPilot)
- Interconnection cable for external display unit (CDTI)

Options (not delivered with the TRX-1090)

- Antenna line extension
- Interconnection cable to GARMIN GPS series 39x/49x or 69x

These options will be supplied by the your TRX-1090 supplier.

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

The unit will be connected between FLARM and a FLARM® compatible external display unit, to simultaneously show FLARM targets and Mode-S transponder equipped aircraft with ADS-B output capability.

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

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

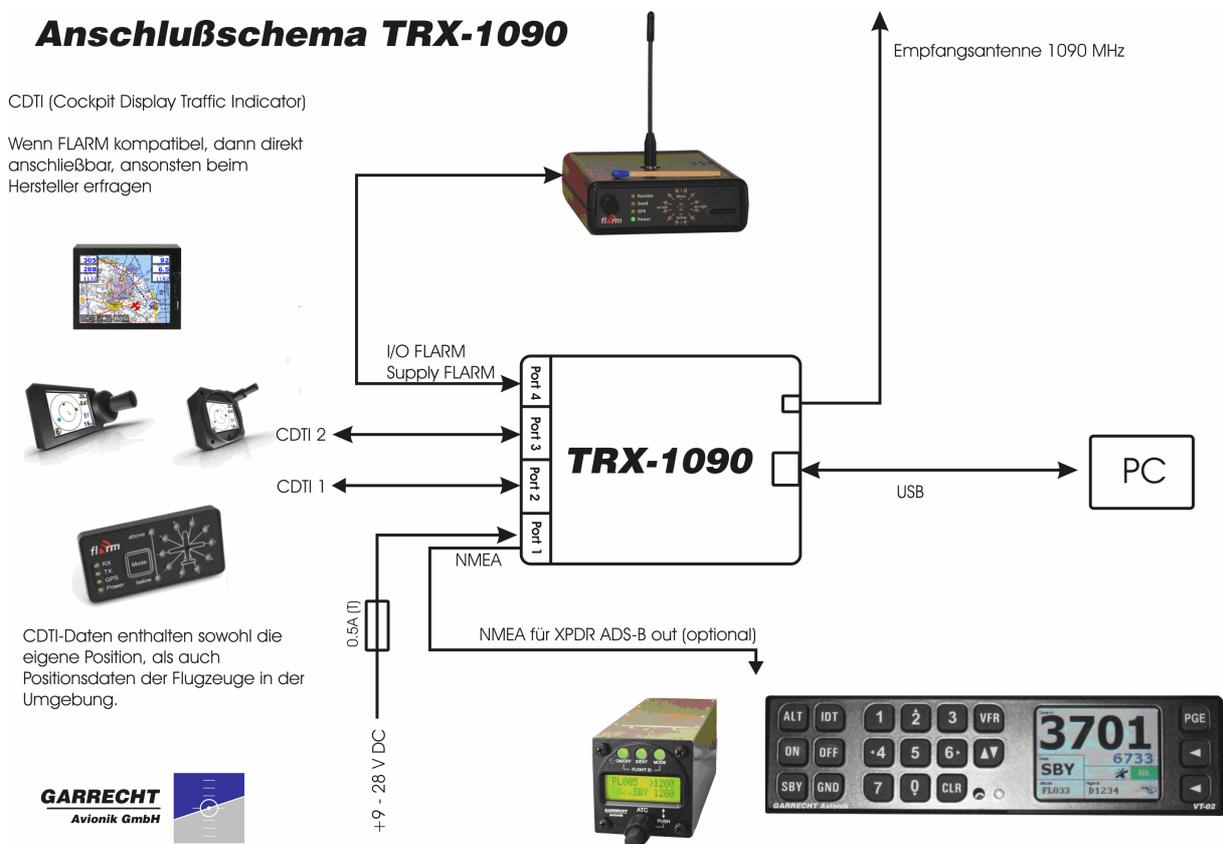
The TRX-1090 provides GPS data received from the FLARM via a dedicated port to supply an ADS-B out capable Mode-S transponder. (e.g. Garrecht Avionic VT-01, VT-02). This device broadcasts the current position message every second - the message can be received by ADS-B receivers installed in other aircraft, as well as with receivers installed on ground.

The schematic below shows the basics of a TRX-1090 installation

Anschlußschema TRX-1090

CDTI (Cockpit Display Traffic Indicator)

Wenn FLARM kompatibel, dann direkt anschließbar, ansonsten beim Hersteller erfragen



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-1090 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-1090 and the system must be powered via an external power supply.

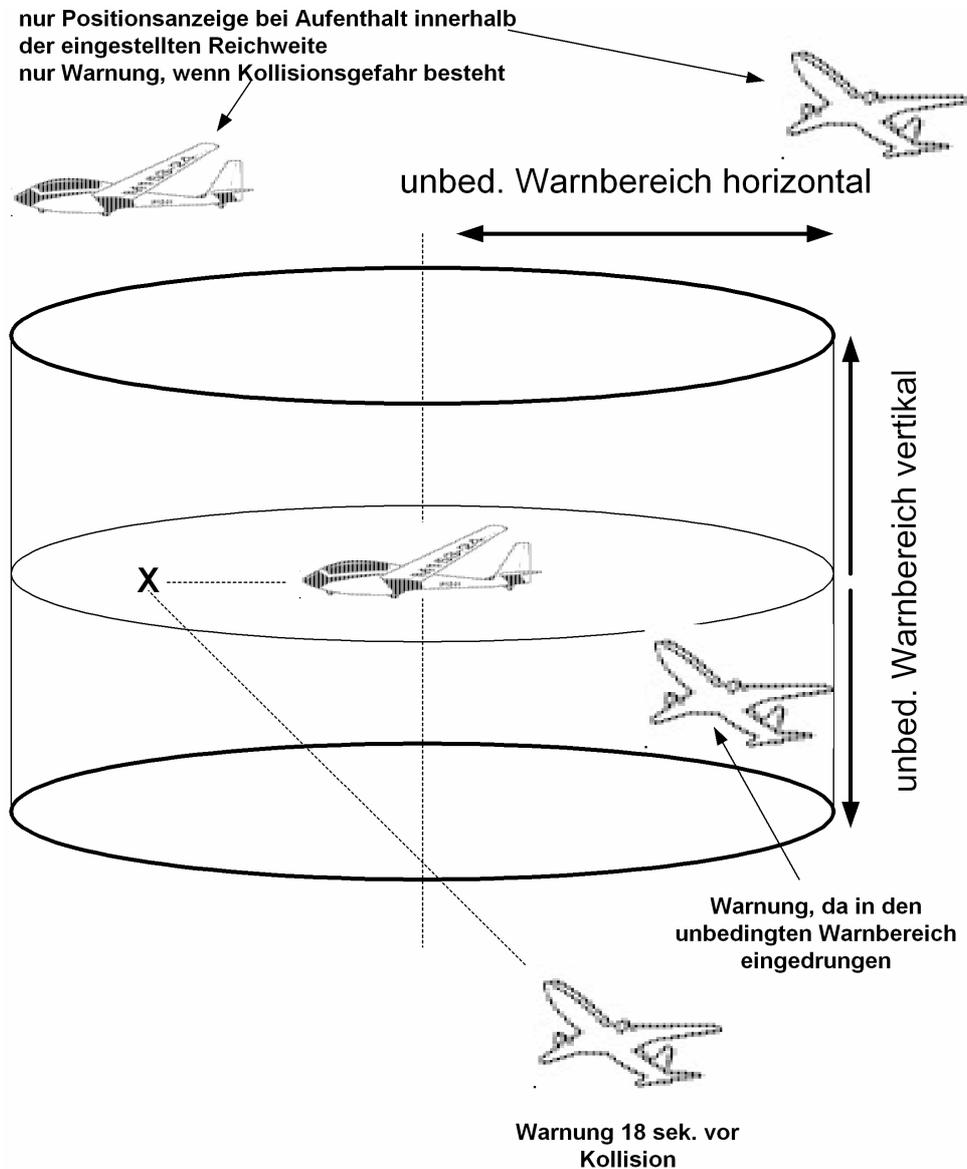
If connecting the TRX-1090 to your PC, the unit will be set into the On-Ground mode automatically. The sensitivity will be increased to a maximum value to provide a maximum receiving range (up to 300km, depending on antenna and antenna position).

Signals received from aircraft broadcasting ADS-B messages can be displayed on your PC (virtual radar).

To prevent a data overflow and jamming the connected displays, the airborne mode provides a maximum receiving range of 20km.

1.2. Output of position data and warnings

The TRX-1090 provides collision warnings and warnings to prevent dangerous situations



Position data:

The TRX-1090 determines position data of other aircraft and provides position data to connected displays, if the position is within the configured horizontal and vertical range.

Warnings:

The TRX-1090 warnings focus on different situations:

1. Entering the protection volume

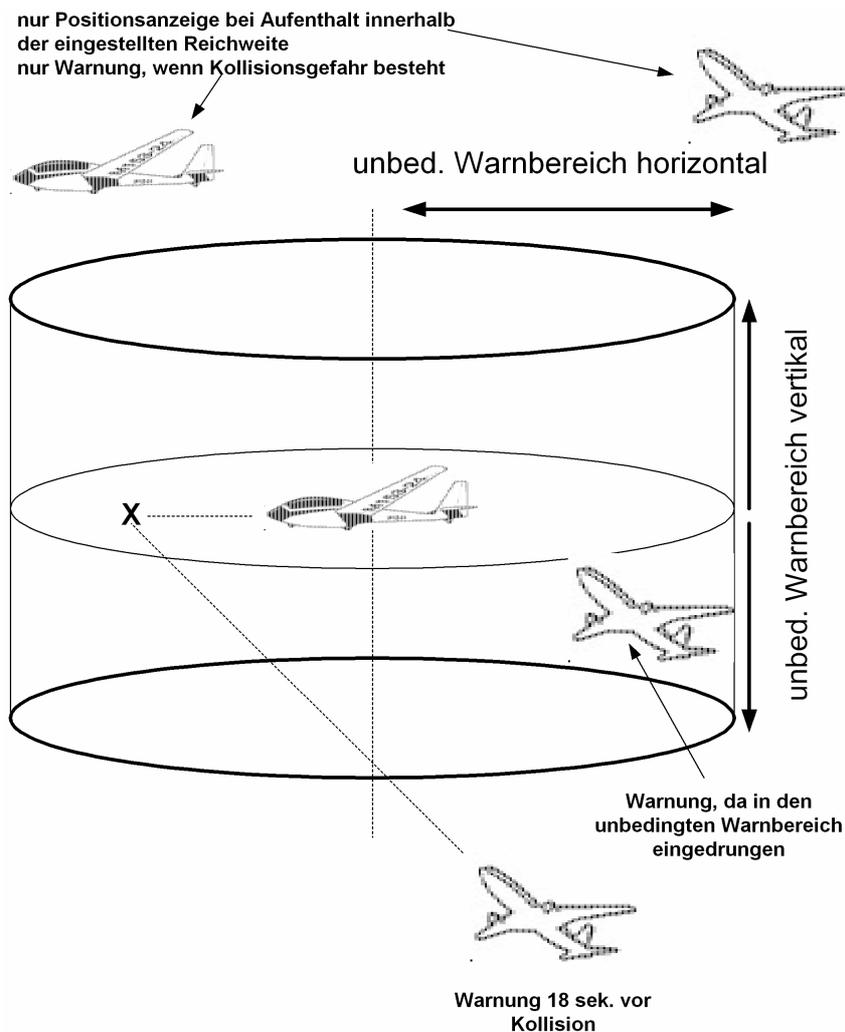
The protection volume is defined as a cylindric volume around the own position. Radius and height of the Cylinder can be configured using the TRX-Tool. A warning will be generated if an aircraft violates the defined protection volume (if falling below the vertical AND horizontal limits)

2. Prediction of crossing the flight tracks

Derived from the own position and trajectory data (position, speed, flight direction, vertical speed) and data from other aircraft, the TRX-1090 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.



1.2.1. Transponder signals and system reaction

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.

1.2.1. 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-1090	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 have always higher priority. If an aircraft is equipped with FLARM® and ADS-B out, only FLARM® warnings will be processed.

1.2.2. Mode-S Squitter

Broadcasted by	Mode-S Transponder equipped aircraft <u>WITHOUT connected GPS</u>
Broadcast interval	1 /sek.
System reactions TRX-1090	Detecting of horizontal approximation (analyzing the signal strength). Altitude information will not be processed.

1.2.3. 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-1090	Detecting of horizontal approximation (analyzing the signal strength) Detecting of vertical approximation (processing the coded altitude signals)

1.3. Limits of the Systems

1.3.1. 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 under responsibility of the pilot in command. The TRX-1090 acts as a support device, which may operate wrong and generate wrong warnings or no warnings in dangerous situations.

Using the TRX-1090 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 Avionik GmbH assumes no liability for any direct or indirect damage to human and material arising from the use of the TRX-1090, unless grossly negligent or intentional acts of Garrecht Avionik GmbH is demonstrated.

If traffic information or collision avoidance should be provided by the TRX-1090, the system must know it's position and pressure altitude information. Thus an external operating FLARM® must be present and connected.

1.3.2. The TRX-1090 system provides

- Position determination and visualisation 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.

1.3.3. The TRX-1090 system does NOT provide

- Mode-S SSR transponder capability. **The TRX-1090 is NO transponder!!!**
- Active interrogation of other SSR transponders (TRX-1090 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 no internal FLARM® is present and no external FLARM® is connected.

2. Installation

2.1. General

The installation has to be carried out following the instructions of this manual by a qualified person in accordance with the appropriate standards. Please contact a qualified person or aircraft maintenance organisation, if required tools or specific skills are not available.

Be sure, that the installed TRX-1090 does not reduce the performance of other instruments.

The TRX-1090 has been developed to include the popular FLARM system. An installed and operating original FLARM or 3rd party licenced product (i.e. LX Red Box) is required for a proper installation. The FLARM provides the GPS data, which are essential for the operation of the TRX-1090.

Received data and warnings will be provided optically and audible via external FLARM compatible displays (z.B. Butterfly, FlymapL o.ä.) or PDA with appropriate software or GPS with TIS interface.

According to EASA Decision 2006/13/R and 2006/14/R the TRX-1090 is a standard part. The installation in CS-22 aircraft (gliders and powered gliders) does not require additional approval or paperwork.

Operating the TRX-1090 does not require an on board installed transponder

The TRX-1090 provides interfacing via four RJ-45 connectors. To prevent interference with the radio, it is strongly recommended to use shielded cables.

2.2. Mechanical installation

The powder coated aluminum housing provides 4 mounting holes (see sketch in the appendix for dimensions). Install the TRX-1090 on a plane surface without bending the unit

The housing is not water proof. Please choose an appropriate place for installation.

After water contact, the unit may not be powered to prevent internal damage. Please send the unit to your dealer for maintenance in this case.

2.3. Antenna installation

The stub antenne provided with the TRX-1090 needs to be installed in manner not to be covered by conductive or shielding material (metal, carbon fibre). If required, use an antenna line extension for remote antenna installation.

For external antenna installation, a standard transponder antenna can used. The installation position needs to be choosen carefully. The antenna needs a free line of sight in horizontal direction. Metal parts (engine, prop, undercarriage) close to the antenna may influence the performance of the antenna.

Minimum distance to radio antenna is 1m, to transponder and/or DME antenna is 2m.

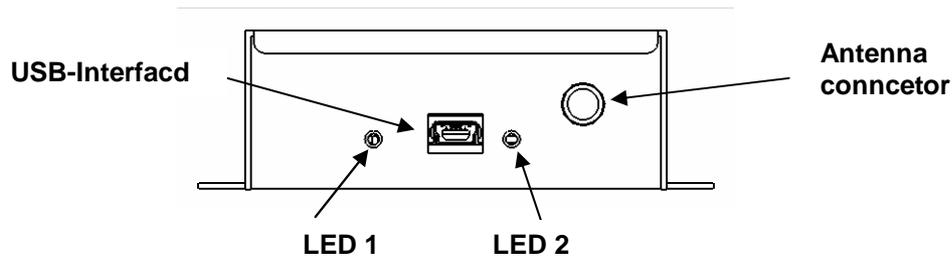
A stub antenna or fin antenna requires the installation of a ground plane. In composite airframes, the ground plane should be made of a conductive sheet of metal (size 30x30cm). Install the antenna in the center of this ground plane. Wrong dimensions of the ground plane of bad contact between antenna foot and ground plane and antenna line ground may reduce the performance of the antenna. Always remove isolating coatings between antenna and ground plane.



If a Mode-S transponder is installed in the aircraft, it is required to set up your FLARM with the same Mode-S address (see FLARM instructions and FLARM Tool for further details) to prevent confusing caused by double targeting.

2.4. electrical installation (power supply and data interfaces)

The unit provides an USB interface and an SMA antenna connector on the front side. Two LEDs indicate the system status.



2.4.1. Antenna connector

Connect the receiving antenna to the antenna connector. If required, use an appropriate antenna line extensions for remote antenna installation.

Fasten the antenna nut by hand only to prevent damaging the antenna connector (not covered by manufacturer's warranty).

2.4.2. USB connector

The USB interface is intended to be used to connect the TRX-1090 to your PC for configuration purposes.



Before the first time connection of the TRX-1090 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-1090 and the system must be powered via an external power supply

If connecting the TRX-1090 to your PC, the unit will be set into the On-Ground mode automatically. The sensitivity will be increases to a maximum value to provide a maximum receiving range (up to 300km, depending on antenna and antenna position) to use the unit as a on ground ADS-B receiver for real time flight tracking.

2.4.3. LEDs

Two LEDs indicate the status of the TRX-1090:

LED 1: on : USB connection established successfully
 Flashing periodically: -
 Flashing short: -

LED 2: on : -
 blinkt regelmäßig: Sending and receivind data via USB
 Flashing short: -

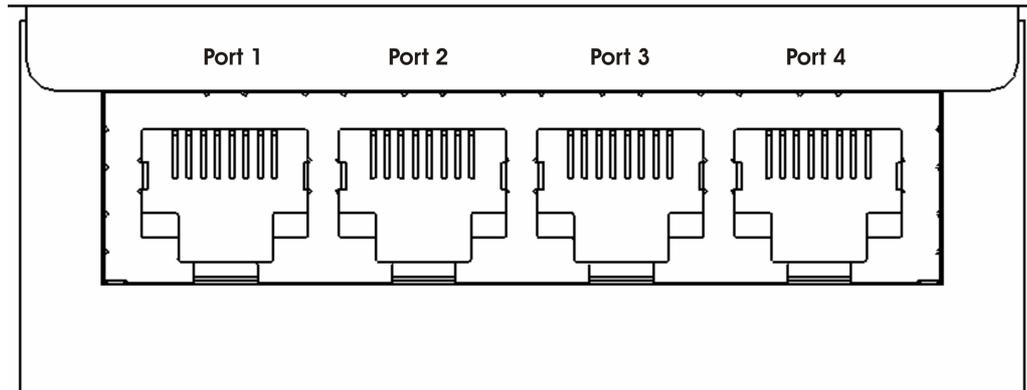
2.4.4. Data interfaces (Port-1 to Port-4)

4 interface connectors are located on the backside of the TRX-1090. Each port can be configured separately using the TRX-Tool.



If using standard patchkabel, be sure to use 1:1 cable.

DO NOT use crossover cable to prevent injury of FLARM, TRX-1090 or connected display units.



View TRX-1090 backside

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 (kompatibel zu FLARM extended Displays)
3	CDTI 2, Schnittstelle 2 zu Cockpitdisplay (compatibel zu FLARM basic Display oder GARMIN GPS series 39x, 49x, 69x), configuration via TRX-Tool
4	FLARM® I/O, interface to FLARM®

- External power can be supplied using each of the 4 ports. Using a fuse is required to prevent damages. Missing fuse or wrong fuse dimension can cause damages, which are not covered by manufacturers warranty.
- Do not feed electrical power through the 3.3V pins of the CDTI interfaces (port 2 and port 3) to prevent damaging internal circuits of the TRX-1090.
- Max. output current of the internal 3.3V converter: 0,5 A
- The use of 6 pin connectors (RJ-12) is possible in an 8 pin RJ-45 connector, but connector lifetime will be reduced. So the use of 8 pin RJ-45 connectors is strongly recommended.
- If connecting a GARMIN GPS series 39x, 49x, 69x, the TIS interface needs to be activated (consult the user manual of the GARMIN GPS).

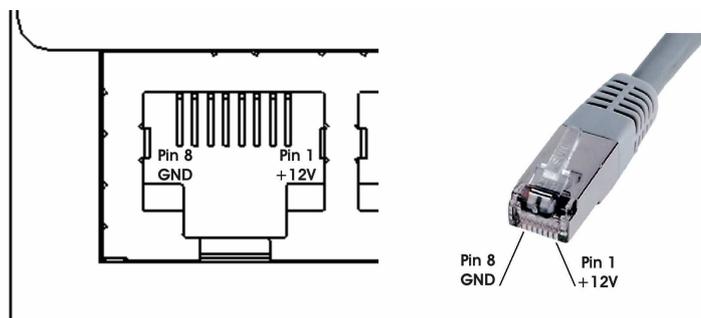
2.4.4.2. Pinout of the RJ-45 connectors



The pinout complies with the standards of the International Gliding Commission (IGC) for flight recorders. The pin numbering is reversed to the industrial standard.

Remind, that the TX/RX lines of port 2 and port 3 (CDTI interfaces) are reversed to the IGC standard. Pin 3 provides a 3.3V DC power supply for powering external FLARM displays. This makes the interface compatible to existing external FLARM compatible displays.

Power can be supplied via each port. Be sure to power only FLARM and TRX-1090 via this lines to prevent exceeding the maximum current.



Pin out RJ-45 connector

Pin out Port 1	
Pin #	Function
1	+ 9 - +28 V DC
2	+ 9 - +28 V DC
3	n.c. (not connected)
4	n.c. (not connected)
5	RX 1 (Data input 1)
6	TX 1 (Data output 1)
7	GND
8	GND

It is recommended to power the TRX-1090 via port 1. Use the NMEA data provided on port 1 to feed your Mode-S transponder for ADS-B out purposes. The baudrate can be set up using the TRX-Tool.

Pin out Port 4	
Pin #	Funktion
1	+ 9 - +28 V DC
2	+ 9 - +28 V DC
3	n.c. (not connected)
4	n.c. (not connected)
5	RX 4
6	TX 4
7	GND
8	GND

Connect your FLARM to port 4 to establish connection to power supply and interfaces. Use a 1:1 RJ-45 patchcable (delivered with the TRX-1090)

Pin out port 2 and port 3 (CDTI 1, CDTI 2)

Pin out port 2 and Port 3	
Pin #	Funktion
1	+ 9 - +28 V DC
2	+ 9 - +28 V DC
3	3,3V Supply for external displays
4	GND
5	TX 2 / TX 3
6	RX 2 / RX 3
7	GND
8	GND

Connect existing CDTI to port 2 or port 3. 3.3V DC power will be supplied by the TRX-1090

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-1090 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

3. 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-1090 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-1090 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

3.1. Step by Step instruction for successfull installation process

1. Do not connect the TRX-1090 to your PC
2. Download the TRX-TOOL 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-1090 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-1090 by a newer version.
11. TRX-Tool is ready for use now.

TRX-Tool main window (no TRX connected)

3.2. Software and firmware release



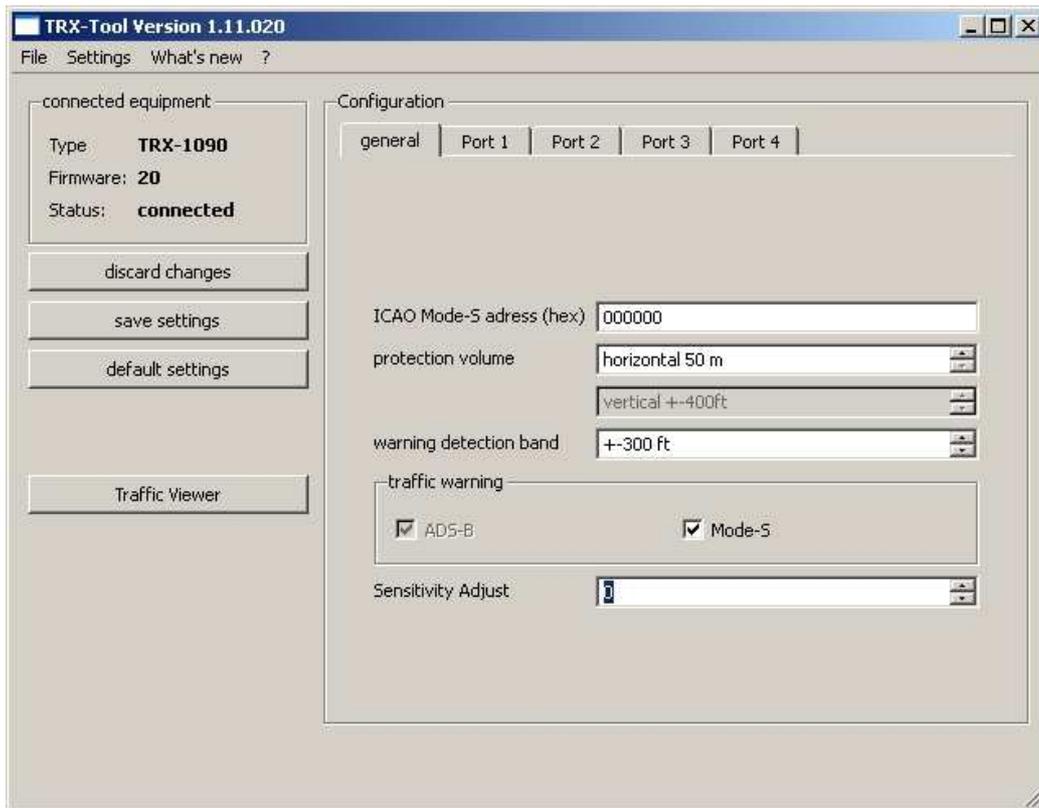
The title bar of the TRX-TOOL shows software release of the TRX-Tool (1.11) and integrated firmware release for the connected TRX device (020).

3.3. 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.

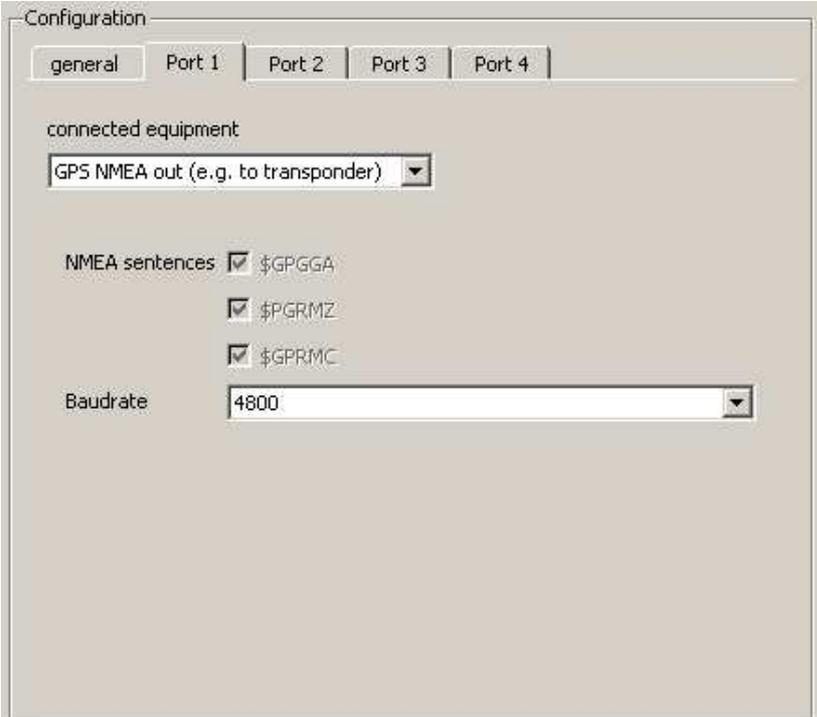
3.4. Device configuration



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>
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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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	<p>ICAO Mode-S Adresse Enter your own 24 Bit ICAO Mode-S address to suppress warnings from own transponder</p> <p>Protection volume If falling below BOTH values, a warning will be generated to indicate dangerous situation in case of change the flight direction.</p> <p>Warning detection band Aircraft within this altitude band are considered in the collision avoidance algorithms.</p> <p>Traffic warning</p> <p>ADS-B Activates warnings of ADS-B out equipped aircraft (this feature can not be disabled)</p> <p>Mode-S Activates warnings of Mode-S equipped aircraft</p>
	<p>Configuration Port 1</p> <p>This port is preconfigured as a NMEA output (i.e. for supplying Mode-S transponders with GPS data)</p> <p>Baudrate</p> <p>Sets up the baudrate for the NMEA data stream.</p> <p>Consult the manual of the connected device for proper settings.</p>

	<p>Configuration Port 2 This port can be configured for connecting FLARM basic (LED) displays or Flarm extended devices (such as Butterfly).</p> <p>Connected equipment:</p> <p>Preconfigures settings depending on the chosen display type. Depending on the used display or your preferences, manual modification of the settings might be required.</p> <p>Hor. + vert. Range Sets the maximum display range for indicating aircraft position</p> <p>Baudrate Sets up the baudrate for the data stream (consult the display manual for proper setting)</p> <p>Display non-ADSB traffic</p> <p>No No warnings of aircraft without ADS-B out will be sent from the TRX device.</p> <p>As circling LED Warnings of aircraft without ADS-B out will be indicated as rotating Bearing position / LED.</p> <p>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.</p> <p>GPS data Activates GPS data set in the data stream (required for Flarm extended displays)</p>
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	<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 protocol: 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>
--	---

	<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 38.400 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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4. Check list installation and konfiguration



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

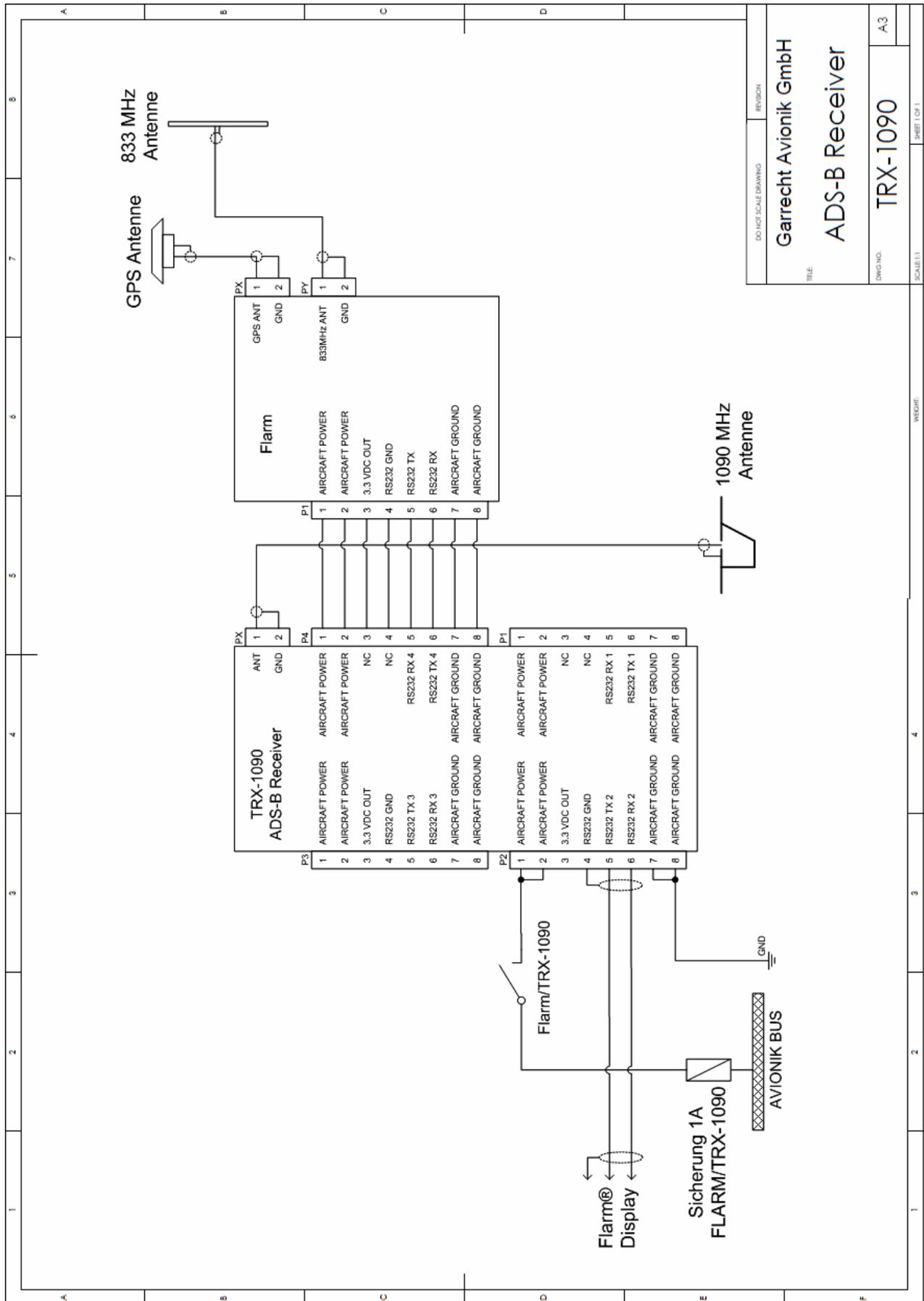
- TRX-1090 manual **read and understood completely.**
- TRX-1090 configured (i.e. protection volume, port configuration)
- 24 Bit Mode-S aircraft address entered in the TRX-1090 aircraft (only required, if the aircraft is Mode-S equipped)
- Device installed in suitable position.
- Connection to external displays established and tested
- All antennas installed in accordance with the instructions of the manual and connected to the device

- Shortbreaker 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

5. Specifications TRX-1090

Dimensions	115 x 73 x 27.5mm (LxWxH)
Mass	0.18 kg
Supply Voltage	9 - 16 V DC
Output voltage for external displays	3.3 V, max. 0.5A
Current consumption	Appr.. 80mA @ 12V DC
Required circuit breaker	500 mA (slow blow) or 1A w. Flarm
Interfaces	4x RS-232 1x USB
Operating frequencies	1090 MHz
Temperatures	
Operating	-20°C - +70°C
Storage	-30°C - +80°C

6. Installation schematic diagram



DO NOT SCALE DRAWING	REVISION
Garrecht Avionik GmbH	
ADS-B Receiver	
DWG NO. TRX-1090	SHEET 1 OF 1
A3	

6.1. Dimensions

