



KTX2

Mode-S Transponder Standard



KTX2-S (Standard) with ADS-B with Part-No 304110

Operation and Installation Manual



Revision List

Revision	Date	Topic
0100	2017-03-24	Initial Release
0101	2018-02-20	Amendments for extended Squitter and maintenance
0201	2019-04-10	Change due to new microcontroller and new functionalities according to EUROCAE ED-102A / RTCA DO-260B
0202	2019-04-17	Amendment of Software License Clearing and added Cap. 10
0203	2021-12-02	Complete rework (Add detailed content, references, updates of various screens) Added chapter about handling enable (unlock) ADS-B out feature for devices with "BASIC" functionality Added description about antenna connectors at the rear side Added improved drawings
0204	2023-09-06	Small additions to the descriptions and notes on "BASIC" functionality, which extend the validity of the manual to earlier software versions without "BASIC" functionality as well (before software release "0102") Support for additional non certified GPS receiver (Table 7)

Service Bulletins (SB)

Service Bulletins must be inserted in the manual and added to this table.

No SB	No Rev.	Release date	Date Added	Name



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1. General

1.1 Purpose

This manual contains information about the physical, mechanical and electrical characteristics, installation and operation for the KTX2 Mode S Transponder. Additionally it describes the ADS-B functionality for a compliant ADS-B Out installation using Extended Squitter (ES).

1.2 Scope

This manual applies to the operation and installation of the KTX2 Mode S Transponder.

At the publication date of this manual the software version is 0101 and the FPGA version is 0042. The software and FPGA versions are subject to change without further notice.

1.3 Terminology

Except where specifically noted, references made to “the Unit” or “the Installation” will apply to the transponder defined in 1.2.




Referenced Documents where the respective document is identified by document number, document title and issue.

- The word **MUST** in the text denotes a mandatory instruction. A deviation is not permissible.
- The word **SHOULD** in the text denotes a recommendation or advice. Such recommendations or advice is expected to be followed unless good reasons are stated for not doing so.
- The word **MAY** in the text denotes a permissible practice or action.

Note:

Background information contained in this document is always indicated by using an italic character font.

1.4 Symbols

	<p>DANGER Advices whose non-observance can cause radiation damage to the human body or ignition of combustible materials.</p>
	<p>ATTENTION Advices whose non-observance can cause damage to the device or other parts of the equipment or reduce the correct functionality of the device.</p>
	<p>INFORMATION Supplemental information for operating the device.</p>



1.5 Abbreviations

Abbr.	Meaning	Explanation
AA	Aircraft Address	Assigned ICAO 24 bit address
AC	Advisory Circular	Information and guidance publication
ADC	Analog Digital Converter	
ADF	Automatic Direction Finder	Navigation equipment
ADS-B	Automatic Dependent Surveillance Broadcast	
ALT	Altitude	The transponder will respond to all interrogations and transmits ADS-B messages.
ATC	Air Traffic Control	
ATCRBS	Air Traffic Control Radar Beacon System	
BAT	Battery	
BNC	Bayonet Neill-Concelman	A RF connector type.
CFR	Code of Federal Regulations	
COMM	Communication(s)	
CRC	Cyclical Redundancy Check(s)	
DME	Distance Measuring Equipment	
EASA	European Aviation Safety Agency	
ECR	Engineering Change Request	
EEPROM	Electrically Erasable Programmable Read-Only Memory	
ENV	Environment	
ES	Extended Squitter	
ETSO	European Technical Standard Order	
FAA	Federal Aviation Administration	



Abbr.	Meaning	Explanation
FCC	Federal Communications Commission	
FID	Flight ID	Number of flight plan if assigned, else Registration number of aircraft
FLY	Flight	The aircraft is in "Flight Mode"
FPGA	Field-Programmable Gate Array	
GND	Ground	The transponder will respond to Mode S ground interrogations from surface movement radar. ABS-B messages are transmitted (Surface messages).
GNSS	Global Navigation Satellite System	
GPS	Global Positioning System	
ICAO	International Civil Aviation Organization	
IDT	Identify	
LSA	Light Sport Aircraft	
MAN	Manual	
MCU	Microcontroller Unit	
MIL	Military	
MTL	Minimum Triggering Level	
NMEA	National Marine Electronics Association	
ON	Transponder Mode "On"	The transponder will respond to all interrogations, but altitude reporting is suppressed. ABS-B messages are transmitted.
RMC	Recommended Minimum Sentence C	NMEA sentence
RSS	Radio Standards Specifications (Canada)	
RTCA	Radio Technical Commission for Aeronautics	




Abbr.	Meaning	Explanation
SAE	Society of Automotive Engineers	
SMA	Sub-Miniature A Connector	
SPI	Special Position Identification (ID)	If activated on request by air traffic controller („Squawk Ident“) a SPI Pulse is transmitted for 18 seconds. This highlights the respective traffic item on the radar screen of the air traffic controller.
STBY	Standby	The transponder is on, but will not reply to any interrogations or transmit any ADS-B out messages.
SUB	Subminiature	e.g. “D-SUB” means a D-shaped subminiature connector
SUPP	Suppression	
TNC	Threaded Neill-Concelman	A RF connector type.
TSO	Technical Standard Order[
USA	United States of America	
VFR	Visual Flight Rules	
VSWR	Voltage Standing Wave Ratio	
WAAS	Wide Area Augmentation System (GPS)	



1.6 Customer Support

In order to facilitate a rapid handling of returned shipments, please send your request to the email address below. Additional information can be found on the TQ Avionics web portal:

<https://www.tq-avionics.com/>

	<p>Any suggestions for improvement of our manuals are welcome. Contact: info@tq-avionics.com</p>
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	<p>Information on software updates are available at TQ. https://www.tq-avionics.com/</p>
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1.7 Features



In order to operate the Mode-S transponder it is necessary to request an ICAO 24-Bit Aircraft Address at the responsible National Aviation Authorities. The received code must be configured within the transponder (see chapter 3.4.2.1.2).

- Class 1 Level 2els Non-Diversity Mode S Transponder for ground based interrogations at 1030 MHz and response at 1090 MHz
- Replies to Secondary Radar Interrogations
 - Mode A replies with a Squawk (one of 4096 possible codes; e.g. flight plan number, Squawk assigned by a controller or the VFR Squawk).
 - Mode C replies, including encoded Flight Level.
 - Mode S replies, including Aircraft Address and Flight Level.
 - IDENT capability for activating the “Special Position Identification“ pulse (SPI) for 18 seconds, which is requested by the controller “Squawk Ident”
- Extended Squitter ADS-B out:
 - Airborne Position
 - Identification and Category
 - Airborne Velocity
 - Operational Status
 - Extended Squitter Aircraft Status
- Maximum flight level 30 000ft; maximum airspeed 250kt
- Display information contains Squawk code, mode of operation and Flight level (pressure altitude)
- Temperature compensated high precision piezo-resistive pressure sensor
- RS-232 data port for connecting GNSS receiver for ADS-B feature
- Digital I/O port for mutual suppression
- Digital input port for “Ground-Switch” support (weight on wheels)
- 8 storable entries for AA-/Aircraft-Code, FID




Since software release “0102” the feature “Extended Squitter ADS-B out” is optional.
To make the feature usable an unlock code must be purchased (see chapter 3.4.6).



1.8 Safety-Conscious Utilization

For safe operation of the transponder the following notices have to be observed:

- The installation of the transponder into an aircraft should be carried out only by an authorized installation company. The country regulations always have to be observed.
- Use the transponder only within the specified conditions, see chapter 7.

	<p>Power supply:</p> <ul style="list-style-type: none">• Do not connect the transponder to AC sources!• Do not connect the transponder with reversed polarity to the DC source!• Make sure that the transponder is connected to the mandatory DC source, see chapter 7.
---	---

Circuit breaker:

- The transponder should be protected from the aircraft power supply by a dedicated 3 A circuit breaker or fuse (slow-blow).

Excessive pulses on the DC bus of the aircraft may cause damage on electrical circuits of any installed instrument.

Do not switch ON the transponder during engine start or shutdown.

1.9 Restriction for Use

The transponder is to be used only inside the declared limits.



2. Operation

2.1 Controls and Display

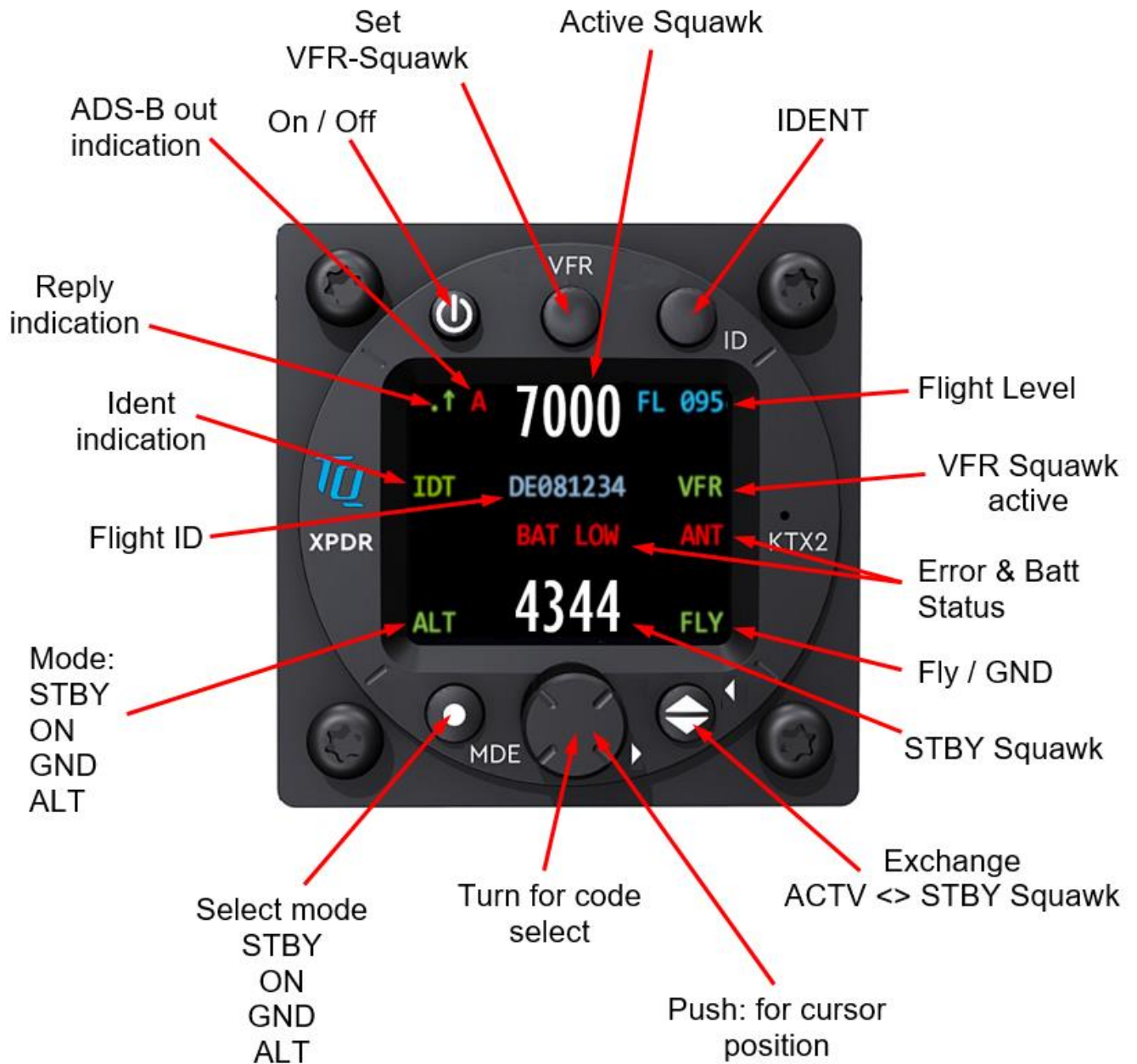


Figure 1: Operating and display elements

2.1.1 Controls

This chapter describes the use of the buttons and knobs during normal operation.

The usage while in setup mode is described in chapter 3.3.







Button	Designation	Function
	ON/OFF	Press to switch the transponder on and off. This switch is mechanically locked until it is pressed a second time
	VFR	<ol style="list-style-type: none"> 1. Activate/deactivate VFR Squawk 2. Pressing the button for more than 3 seconds will show the brightness menu (see chapter 2.2.8.2)
	CHANGE	<ol style="list-style-type: none"> 1. Exchange of the active and Standby Squawk 2. Pressing the button for more than 3 seconds will show the GNSS data menu (see chapter 2.2.9)
	IDENT	<ol style="list-style-type: none"> 1. „Squawk Ident“, a SPI Pulse is transmitted for 18 seconds (in normal mode). 2. Pressing the button for more than 3 seconds will show the Flight ID menu (see chapter 2.2.8.1)
	MODE	<ol style="list-style-type: none"> 1. Select Transponder-Mode STBY, GND, ON or ALT. 2. Pressing the button for more than 3 seconds will toggle the ADS-B mode (On/Off)
	Rotary knob	<ol style="list-style-type: none"> 1. Enter a new Squawk (see chapter 2.2.2) 2. Enter values and select options in submenus (see chapter 3.3) 3. Confirm warnings and notifications

Table 1: Control Elements

2.1.2 Display Indications
















Indication	Meaning	Remark
	Transponder is transmitting Mode A/C Replies on interrogations	Appears per reply and persists for some time
	Transponder is transmitting Mode S Replies on interrogations	Appears per reply and persists for some time
	Transponder is locked by a ground station and will be directly addressed	Appears at every addressed reply and persists for some time
	ADS-B out status	Status of ADS-B transmission, For more information see chapter 2.2.7
	Active Squawk	Is shown at upper position
	Battery power too low	Appears above Standby Squawk
	Failure indication	Indication for the last occurred and confirmed severe error. For more information see chapter 4.1.1
	IDENT- Marking is transmitted	ID („Squawk Ident“) has been pressed – active for 18s
	Current Flight Level	Flight Level (in 100ft steps)
	Mode display (STBY, ON, GND, ALT)	See chapter 2.2.2
	Standby Squawk	Is shown at lower position. Can be exchanged with Active Squawk by pressing the “CHANGE” button
	Flight ID	Only shown if a Flight ID is configured with a valid Aircraft Address
	VFR indication	Shown while VFR Squawk is used
	Transponder is in airborne mode	Only shown if Ground-Switch support is configured.
	Transponder is in ground mode	Only shown if Ground-Switch support is configured.

Table 2: Screen display elements and indicators



2.2 Normal Operation Menu Structure

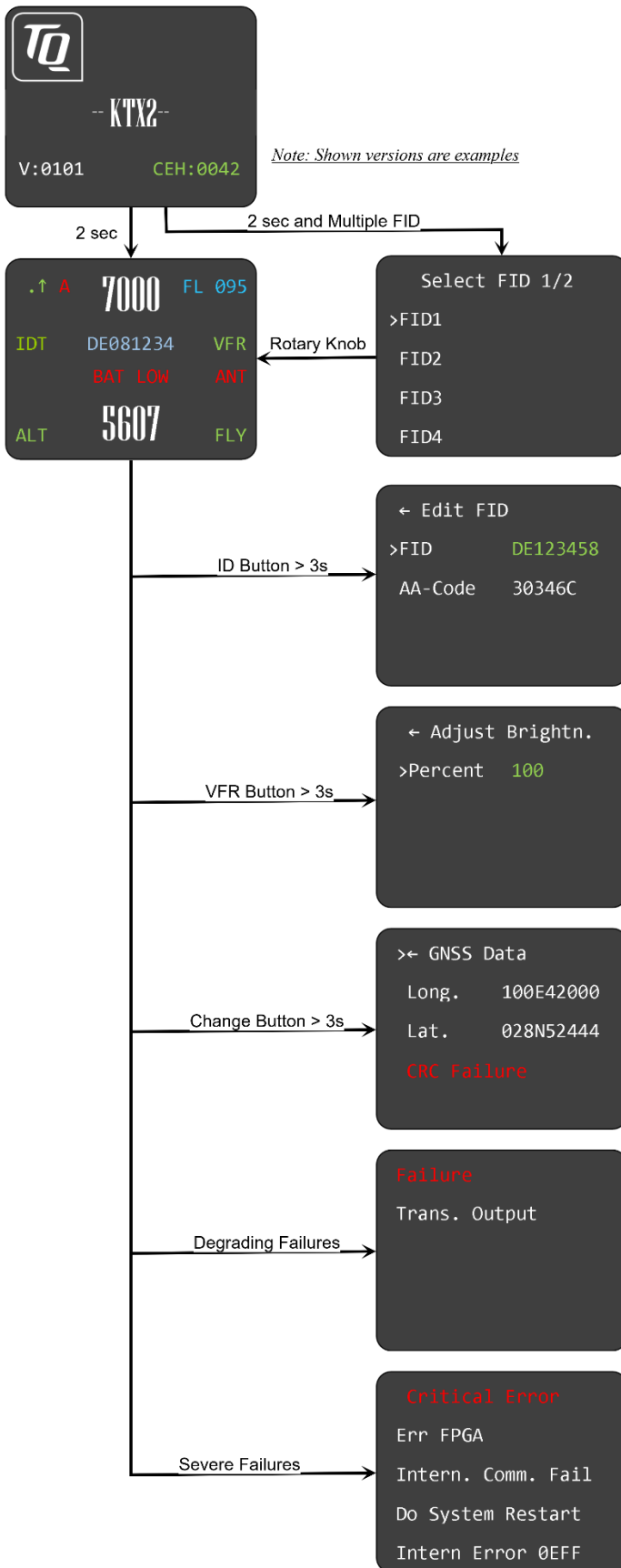


Figure 2: Operational screen and menu structure



2.2.1 ON/OFF Switching

To switch on the transponder, press the "ON/OFF" button once. The button will be locked in the "ON" position. Press the button again to switch it off.

The start screen is displayed immediately after the transponder is switched on (see figure below).

The screen displays the current version of the running software and the FPGA revision.



Figure 3: Start screen of a device with enabled "Extended Squitter ADS-B out" feature



Figure 4: Start screen of a device that supports "BASIC" functionality (Mode A/C/S only)

After approx. two (2) seconds the transponder switches either to its normal operation display or a selection menu is shown if multiple Flight IDs are configured.

	If a failure is detected during start-up a fault notification is displayed. In that case see chapter 4 for details.
--	---

2.2.1.1 Multiple Flight ID selection

If multiple Flight IDs are configured a selection menu is displayed.

2.2.1.2 Normal operation

The normal operation always starts in standby mode. The normal operation display is shown as follows:

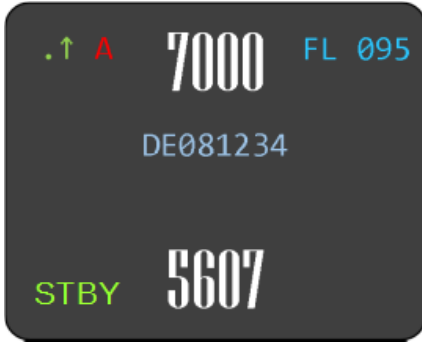


Figure 5: Normal Operation screen

Note:

The Flight ID is not shown if no valid Flight ID was configured.

2.2.2 Transponder-Modes

The currently active mode is displayed at the lower left corner of the display.

Note:

ADS-B out is only supported if “Extended Squitter ADS-B out” feature is enabled (unlocked).

This applies to devices that support “BASIC” functionality (since software release “0102”).

For information on enabling (unlocking) “Extended Squitter ADS-B out”: see chapter 3.4.6.

The ADS-B out function is automatically enabled if a GNSS device is configured (see chapter 3.4.2.1.3.4).

Mode	Explanation
STBY	Transponder is switched on but does not respond to any interrogation. ADS-B out is inactive.
GND	Transponder responds to Mode S interrogations. ADS-B out is active (Surface Squitter).
ON	Transponder responds to all interrogations, but altitude is not transmitted. ADS-B out is active.
ALT	Transponder responds to all interrogations. ADS-B out is active.

Table 3: Transponder Modes

During the flight the Mode “ALT” should always be set, unless the ATC gives other instructions.



While rolling on the ground the transponder should be set to “GND”.

If the installation includes a weight on wheels switch and it is correctly configured then the mode is changed automatically.

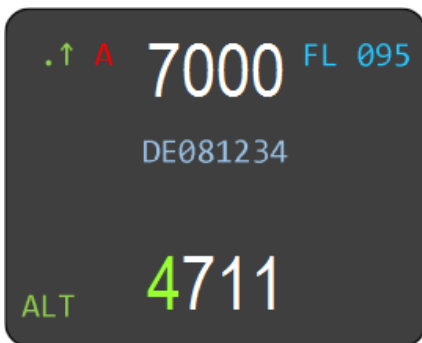
To change the mode press the “MODE” button until the desired mode is displayed.

The “MODE” button is also used to activate or deactivate the ADS-B out function. Press the “MODE” button for at least 3 seconds until the ADS-B indication changes (see chapter 2.2.7).

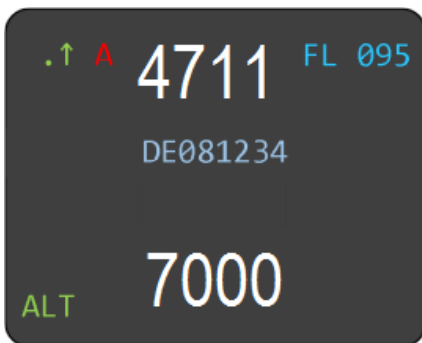
2.2.3 Squawk Code Change

To change the Squawk code perform the following procedure:

1. Press the rotary knob. The first digit of the Standby Squawk turns green.



2. Turn the rotary knob to change the value.
3. Press the rotary knob again to save the selected digit. The next digit turns green.
4. Repeat steps 2 and 3 until all four (4) digits are set to desired Squawk code.
5. Press the “CHANGE” button. The Standby Squawk code is exchanged with the currently Active Squawk code.



Note:

The top line shows always the Active Squawk.

2.2.4 VFR Squawk

To set the Active Squawk to a predefined code press the “VFR” button. The VFR Squawk code is now shown as Active Squawk. “VFR” is indicated on the right hand side of the display and the former Active Squawk becomes the Standby Squawk.

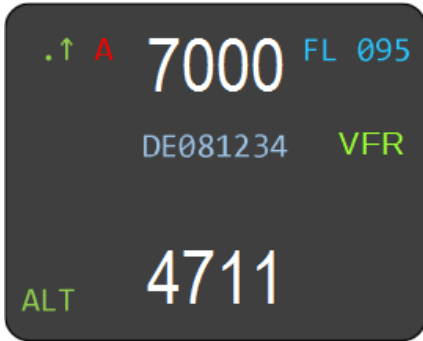


Figure 6: VFR Squawk

Press the “VFR” button again to restore the previous Squawk code as Active Squawk. The “VFR” indication disappears.

The factory setting of the VFR Squawk code is “7000”. The VFR Squawk code can be configured in accordance with local requirements using the setup mode (see chapter 3.4.3).

2.2.5 Squawk Ident (ID, SPI)

Press the “IDENT” button if the ATC requests you to send “Ident” or “Squawk Ident”.

For 18 seconds the ident pulse is activated in the transponder replies. This is indicated by “IDT” on the left hand side of the display.

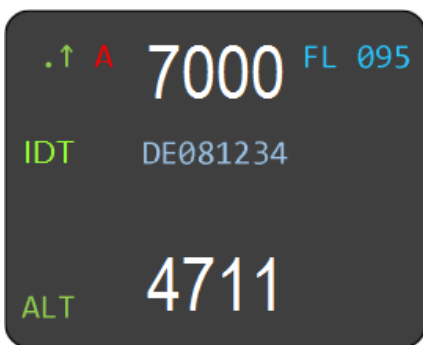


Figure 7: Squawk Ident

2.2.6 Airborne/Ground Indication

If the aircraft is equipped with a “weight on wheels” switch or has an automatic air/ground system the transponder can be configured to use it for Airborne/Ground mode switching (see chapter 2.2.2 and 3.4.2.1.3.1).

Depending on the status either “FLY” (Flight) or “GND” (Ground) is shown on the display in the lower right corner.

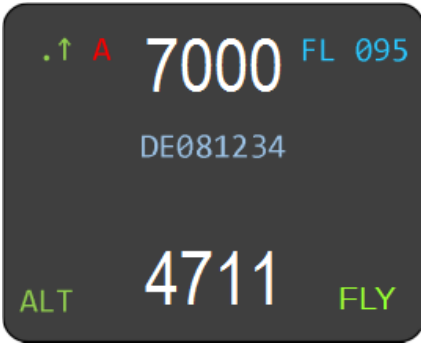


Figure 8: Airborne/Ground Indication "FLY"

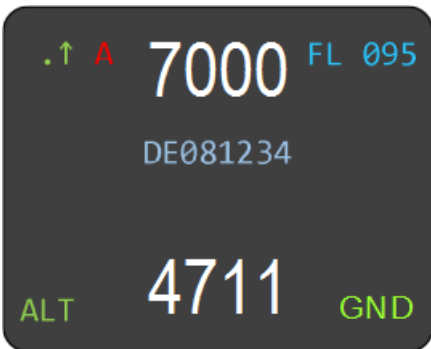


Figure 9: Airborne/Ground Indication "GND"

Note:

If this function is not activated, no indications are displayed and the mode must be manually selected (see chapter 2.2.2).

2.2.7 ADS-B Status Indication

The current operational status of the ADS-B is shown on the display as follows:

Note:

If the device has “Extended Squitter ADS-B out” feature disabled, it will only operate in Mode A/C/S (see chapter 1.7 and 2.2.2).

The "A" symbol in the display appears only if the ADS-B out is enabled and activated.

To enable (unlock) the “Extended Squitter ADS-B out” feature see chapter 3.4.6.





Indication	Function	Description
	ADS-B active. Letter “A” appears in white color.	ADS-B out function is active and transmitting messages.
	ADS-B active. Letter “A” appears in yellow color.	ADS-B out function is active, but no messages are sent because there is no information about valid position data yet.
	ADS-B active. Letter “A” appears in red color.	ADS-B out function is active and transmitting type ZERO position messages or no position messages due to missing position data (longitude, latitude, altitude).
	ADS-B inactive. No letter “A” displayed.	No ADS-B data is transmitted.

Table 4: ADS-B Indication Symbols

Note:

The above images are from the upper left display area.



2.2.8 Adjustable parameters in normal operation mode

Some parameters can be changed during in normal operation mode. The changes are effective immediately after confirmation, but will remain only until the transponder is powered off.

Note:

To make changes permanently the parameters have to be changed in setup mode (see chapter 3).

2.2.8.1 Flight ID

To modify the Flight ID press the “IDENT” button for at least 3 seconds.



Figure 10: Change Flight ID

The Flight ID can be adjusted in the same way as described in chapter 0.

Note:

The AA-Code is shown for information only and cannot be changed.

2.2.8.2 Display Brightness

To modify the display brightness press the “VFR” button for at least 3 seconds.

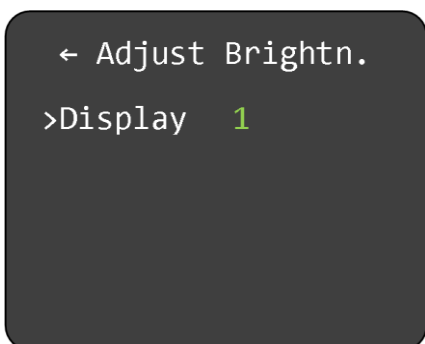


Figure 11: Adjust Display Brightness Menu

To change the display brightness select “Display” and press the rotary knob.

Turn the rotary knob to change the value for brightness level between 1 (lowest) to 5 (highest). Press the rotary knob to use the new value.



2.2.9 GNSS Position Data

Press the “CHANGE” button for at least 3 seconds to display the actual GNSS position data.

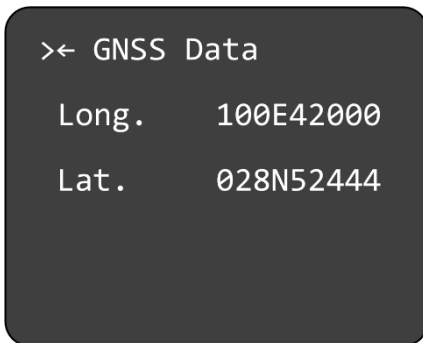


Figure 12: GNSS Position Data display

Press the rotary knob to return to the normal operation display.

Note:

Display of position data only possible if a GNSS device has been configured in the setup and is connected.

3. Setup Mode

	Do not use Setup Mode in flight. Check with your avionics installer before changing the configuration.
--	---

3.1 Controls and Display

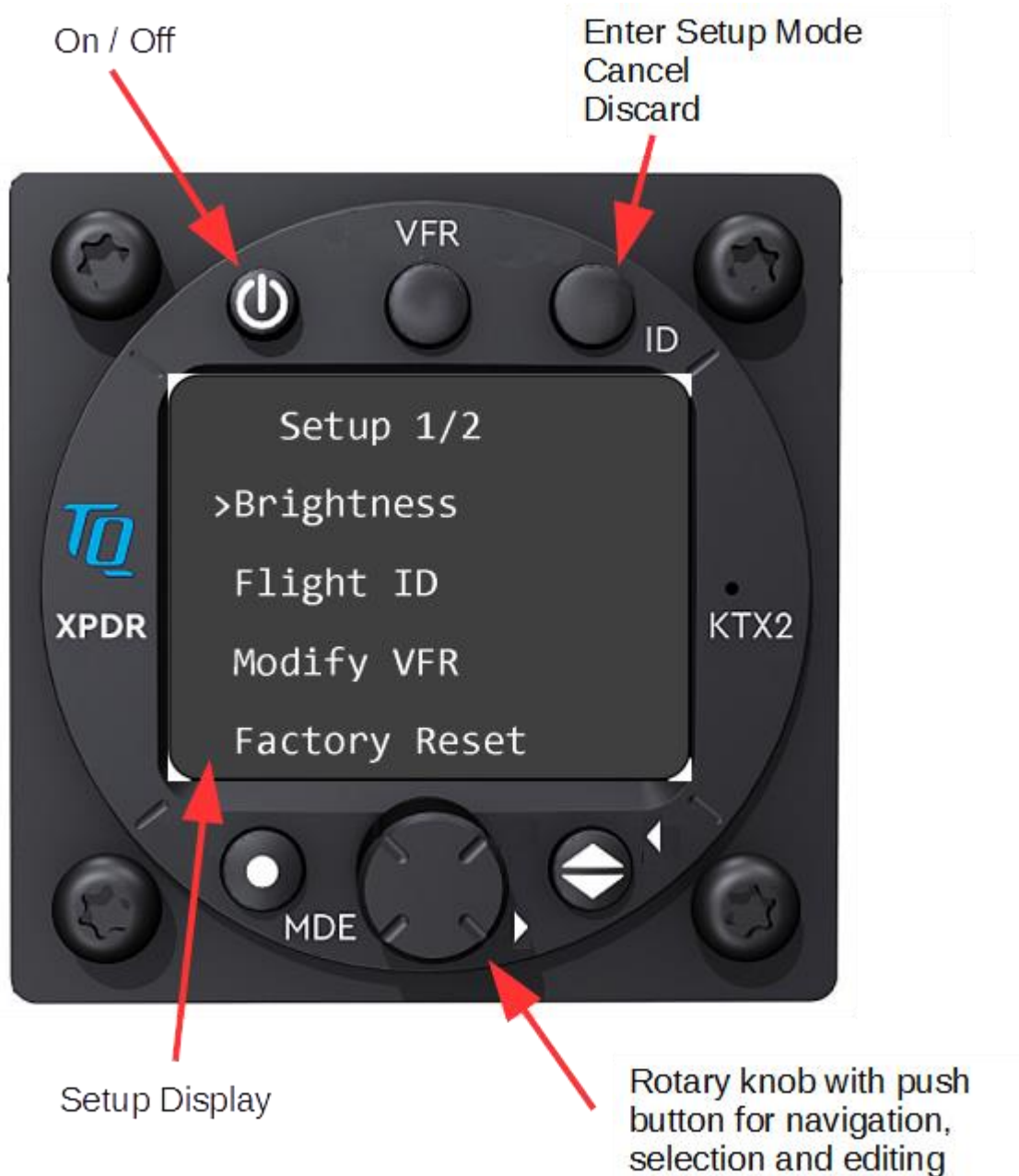


Figure 13: Button functionality for Setup Mode

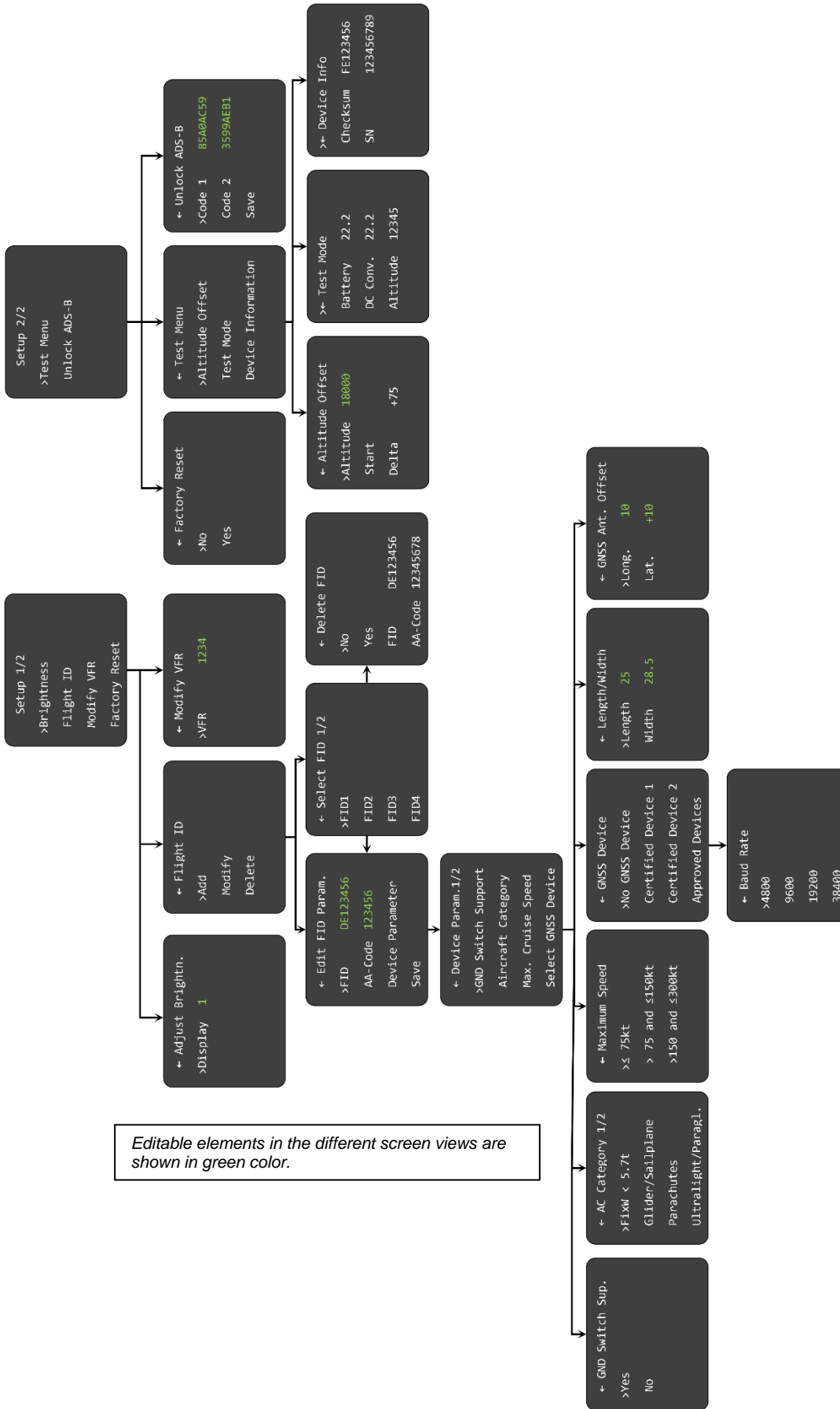


Figure 14: Setup mode menu structure



3.2 Entering Set Up

To enter the setup mode, press the “IDENT” button while switching on the transponder and the setup menu appears as shown below.

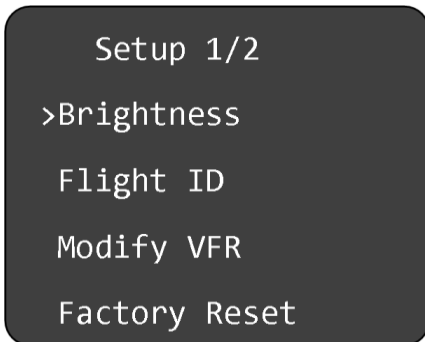


Figure 15: Setup Menu page 1

3.3 Controls

3.3.1 Selection

Turning the rotary knob moves to the desired menu item.

Press the rotary knob to select the desired parameter for configuration or to enter a submenu.

If a menu consists of several pages, e.g. the setup menu, the next page can be accessed by turning the rotary knob clockwise until the next page is shown. To go back turn the rotary knob counterclockwise until the previous page is displayed.

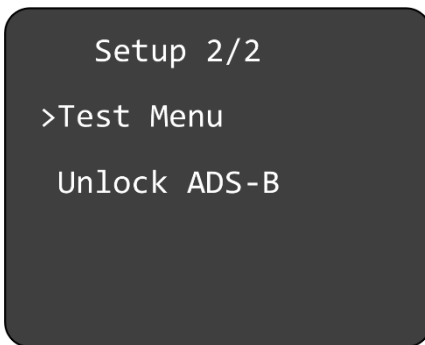


Figure 16: Setup Menu page 2

3.3.2 Return to parent menu

Any menu showing an arrow left of the headline can be left by selecting the headline and pressing the rotary knob. The previous menu will be displayed.

3.3.3 Cancel/Discard

The “IDENT” button can be used for cancelling, discarding or returning.

While editing pressing the “IDENT” button briefly will cancel the current editing. The previous configuration value is restored.

While in a submenu pressing the “IDENT” button briefly will return to the previous menu.



Pressing the “IDENT” button for at least 3 seconds will discard any unsaved changes and return to the main setup menu.

3.4 Setup Menus

3.4.1 Display Brightness

To change the display brightness select “Display” and press the rotary knob.

The display brightness is set in the same way as described in chapter 2.2.8.2, but the value is stored permanently.

3.4.2 Flight Identifier (Flight ID)

The transponder can store up to eight Flight IDs for multiple aircraft configurations (e.g. in a portable station as used in hot-air/gas filled balloons).

For multiple Flight IDs, an appropriate Aircraft Address must be assigned to each of the Flight IDs.

See chapter 3.4.2.4 for details.

Note:

ICAO regulations require Mode S data to contain a valid flight identification (FID), to ensure automatic exchange of flight plan and radar data. Commercial flights usually have their own FIDs. General aviation FIDs should be the registration letters or numbers of the aircraft. The FID must not be confused with the 24-bit Aircraft Address. The FID is left aligned and shown in green characters. The FID may not contain any blanks.

To configure a Flight ID configuration select “Flight ID” and press the rotary knob. A menu for adding, modifying and deleting a Flight ID configuration is displayed.

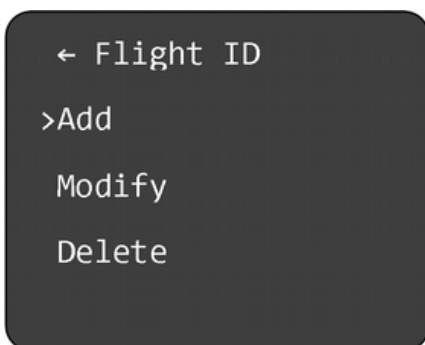


Figure 17: Flight ID configuration

Select “Add” to add a Flight ID, “Modify” to modify a Flight ID or “Delete” to delete a Flight ID and press the rotary knob.



3.4.2.1 Add/Edit Flight ID

To add a Flight ID select “Add” and press the rotary knob.

If all eight possible IDs are already configured the following notification is displayed.

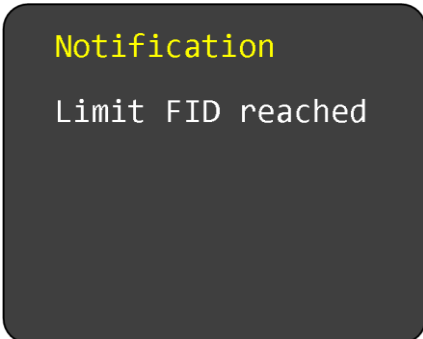


Figure 18: FID Limitation Notification

If this message appears you can either modify an existing entry (see chapter 3.4.2.2) or delete an existing entry (see chapter 3.4.2.3) and add a new one as shown below.

If a new Flight ID can be added a submenu “Edit FID Param.” is displayed.

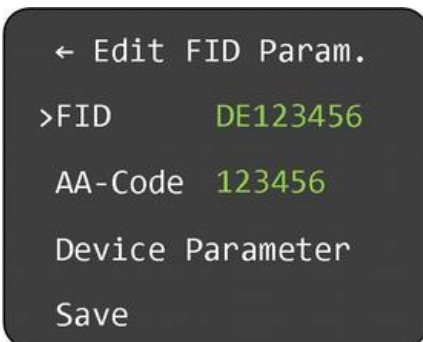


Figure 19: Flight ID Edit Menu

Note:

All configuration settings of a new Flight ID are set to their default values.




3.4.2.1.1 Flight ID Value


To configure the Flight ID perform the following procedure:

1. Select "FID" and press the rotary knob to start editing a Flight ID. The first character turns yellow.
2. Turn the rotary knob to change the value.
3. Press the rotary knob again to save the selected character. The next character turns yellow.
4. Repeat steps 2 and 3 until all characters (max. 8) are set to desired value.
5. Saving the 8th character will end the editing. If the Flight ID contains less than 8 characters then enter a space as last character to end the editing.

Note:

After editing the changed value is not saved automatically! You have to select "Save" once all data have been configured (see chapter 3.4.2.1.4).

	Enter the FID left-aligned, without any blanks or dashes (!), e.g. DENWS for the marking D-ENWS.
--	--

	A missing FID disables Mode S operation and Mode A/C only will be engaged. See chapter "Errors, Warnings and Notifications"
---	--



3.4.2.1.2 Aircraft Address (AA) Value

To configure the Aircraft Address (AA) perform the following procedure:

1. Select “AA” and press the rotary knob to start editing the AA. The first digit turns yellow.
2. Turn the rotary knob to change the value.
3. Press the rotary knob again to save the selected digit. The next character turns yellow.
4. Repeat steps 2 and 3 until all digits are set to desired value.

Note:

After editing the changed value is not saved automatically! You have to select “Save” once all data have been configured (see chapter 3.4.2.1.4).

Note:

Before you can enter the Aircraft Address, the Flight ID needs to be defined.

Note:

All values except “000000” and “FFFFFF” are valid. The transponder accepts all values but if an invalid value is used as Aircraft Address the transponder will show a failure and the transponder switches to Mode A/C only.

3.4.2.1.3 Device Parameter

To configure the parameters associated to a Flight ID select “Device Parameter” and press the rotary knob. A submenu “Device Param.” is displayed which consist of two pages.

Note:

If the device only covers the "BASIC" functionality (disabled “Extended Squitter ADS-B out” feature), then only the entries "GND Switch Support", "Aircraft Category" and "Max. Cruise Speed" can be selected in the menu.



Figure 20: Device Parameter Configuration Menu

Note:

After changing any parameter the new value is not saved automatically! You have to select “Save” once all data have been configured (see chapter 3.4.2.1.4).



3.4.2.1.3.1 Ground Switch Support

To activate or deactivate the Airborne/Ground switch function select “GND Switch Support” and press the rotary knob. A submenu “GND Switch Sup.” is displayed.

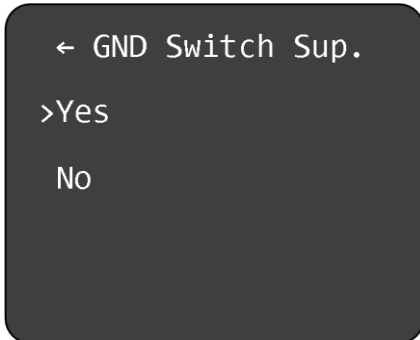


Figure 21: Ground Switch Support Menu

Turn the rotary knob to select Yes or No and press the rotary knob to confirm.

GND Switch Support	Explanation
Yes	The Airborne/Ground switch function is enabled. The transponder switches the Airborne/Ground mode automatically depending on the status of the Ground Switch input (see chapter 5.1.3).
No	The Airborne/Ground switch function is disabled. Airborne/Ground mode has to be switched manually using the “MODE” button (see chapter 2.2.2).

Table 5: GND Switch Support

3.4.2.1.3.2 Aircraft Category

To configure the aircraft category select “Aircraft Category” and press the rotary knob. A submenu “AC Category” is displayed.

Note:

The submenu “Device Parameter” consists of two (2) pages.

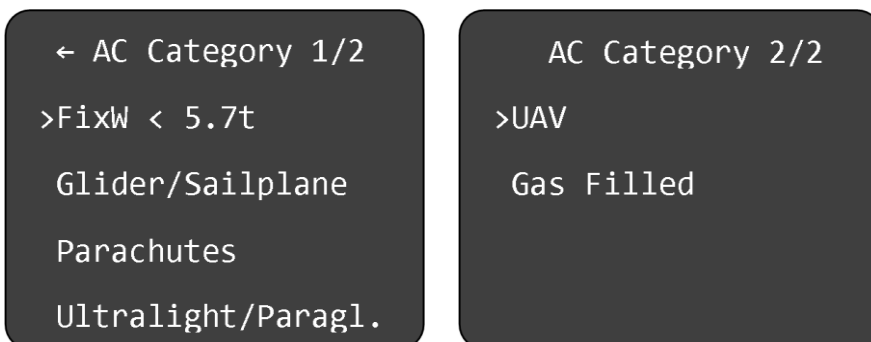


Figure 22: Aircraft Category Selection Menu



Turn the rotary switch to select the desired aircraft category and press the rotary knob to confirm.

Note:

The transponder is not yet certified for A/C FixW > 5.7t, speed > 250kts and helicopters (RotorCr). Therefore, these items are not yet selectable.

3.4.2.1.3.3 Speed Category

To configure the maximum speed category select "Max. Cruise Speed" and press the rotary knob. A submenu "Maximum Speed" is displayed.

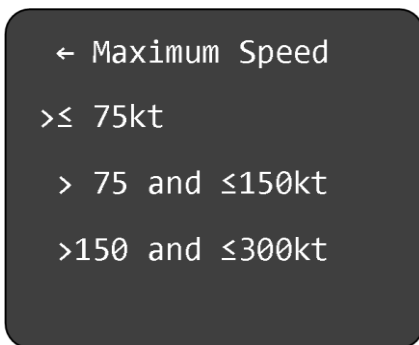


Figure 23: Maximum Speed Category Selection Menu

Turn the rotary switch to select the desired speed category and press the rotary knob to confirm.

3.4.2.1.3.4 GNSS Device Selection

If the ADS-B function is used, an appropriate WAAS GNSS source needs to be connected (see chapter 5.1.5).

This transponder is certified to TSO-C166b and meets the requirements of AC 20-165B when directly connected to one of the certified or approved GNSS units listed below.

This will form the basis of a 14 CFR 91.227 compliant ADS-B installation.

Certified GNSS Unit	Remarks
NexNav Mini WAAS GPS Receiver Part Number 21000	


Table 6: Certified GNSS Units

Other aircraft voluntarily equipped with ADS-B like experimental aircrafts, gliders, ultralights etc. may be equipped with an appropriate low-cost WAAS GNSS source.

It is encouraged to use only GNSS receivers recommended by TQ.

Approved GNSS Unit	Remarks
Holux GPS Receiver Model: M-215+	
GPS Receiver Model : GM-48W	Distributor TecSys GmbH www.tecsys.de
TQ ADS-B Out KIT 2 Model GPS Source: NaviLock NL-8339P	<ul style="list-style-type: none"> • waterproof GPS receiver • DC/DC converter integrated • external mounting • including connection cable KBSX1
TQ ADS-B Out KIT 3 Model GPS Source: NaviLock NL-3330	<ul style="list-style-type: none"> • DC/DC converter integrated • including connection cable KBSX1

Table 7: Approved GNSS Units

	<p>If other than a recommended GNSS receiver is used the following shall be observed:</p> <ul style="list-style-type: none"> • Standard NMEA0183 protocol (\$GPRMC message required) • Update Rate from 5 to 0.5 Hz (0.2 to 2 seconds)
---	--

To configure the GNSS Device select "Select GNSS Device" and press the rotary knob. A submenu "GNSS Device" is displayed.



Figure 24: GNSS Device Selection Menu



Turn the rotary switch to select the desired GNSS device and press the rotary knob to confirm.

GNSS Device	Explanation
No GNSS Device	No WAAS GNSS device is used. The ADS-B function is disabled.
NexNav mini	A NexNav mini device is used. The ADS-B function is enabled.
Approved Device	A recommended NMEA WAAS GNSS device is used. The device must support at least the \$GxRMC-sentence (as defined in the NMEA 0183 protocol). The ADS-B function is enabled.

Table 8: List of supported GNSS Devices

If an “Approved Device” is selected a submenu is displayed for configuring the baud rate.

Turn the rotary switch to select the appropriate baud rate and press the rotary knob to confirm.

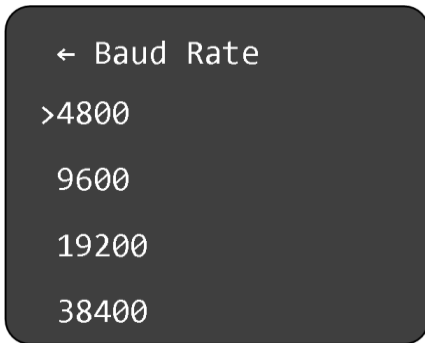


Figure 25: Baud Rate Selection Menu

3.4.2.1.3.5 Select Length/Width

On the ground, ADS-B transmits encoded aircraft size information which is used by ATC to identify taxiing routes and potential conflicts.

To configure the length and width of the aircraft select "Length/Width" and press the rotary knob. A submenu "Length/Width" is displayed.

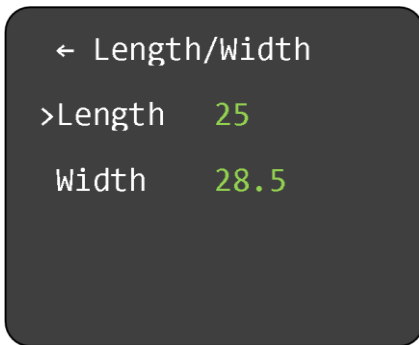


Figure 26: Aircraft Length/Width Configuration Menu

To configure the length of the aircraft perform the following procedure:

1. Select "Length" and press the rotary knob. The first digit of the length value turns yellow.
2. Turn the rotary knob to change the value.
3. Press the rotary knob again to save the selected digit. The next digit turns yellow.
4. Turn the rotary knob to change the value.
5. Press the rotary knob again to save the selected digit. The length value turns green.

Note:

*The aircraft length has to be entered in meters rounded to next full meter.
E.g.: If the length is 7.2 m, the value must be 08.*

To configure the width of the aircraft (wingspan) perform the following procedure:

1. Select "Width" and press the rotary knob. The first digit of the width value turns yellow.
2. Turn the rotary knob to change the value.
3. Press the rotary knob again to save the selected digit. The next digit turns yellow.
4. Turn the rotary knob to change the value.
5. Press the rotary knob again to save the selected digit. The next digit turns yellow.
6. Turn the rotary knob to change the value.
7. Press the rotary knob again to save the selected digit. The width value turns green.

Note:

*The aircraft width has to be entered in meters rounded to the next 1/10 meter.
E.g.: If the width is 9.31 m, the value must be 09.4*

3.4.2.1.3.6 GNSS Antenna Offset

The GNSS antenna offset is used together with the aircraft length and width to manage taxiway conflicts. Within the GNSS antenna offset menu, the longitudinal and lateral position offset of the GNSS antenna can be entered. While mainly important for large aircraft, the values can be entered for small aircraft as well.

To configure the GNSS antenna offset select “GNSS Ant. Offset” and press the rotary knob. A submenu “GNSS Ant. Offset” is displayed.

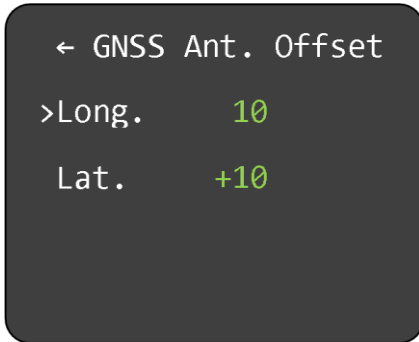


Figure 27: GNSS Antenna Offset Configuration Menu

To configure the longitudinal offset of the GNSS antenna perform the following procedure:

1. Select “Long.” and press the rotary knob. The first digit of the offset value turns yellow.
2. Turn the rotary knob to change the value.
3. Press the rotary knob again to save the selected digit. The next digit turns yellow.
4. Turn the rotary knob to change the value.
5. Press the rotary knob again to save the selected digit. The offset value turns green.

Note:

The longitudinal offset has to be entered in meters measured from the nose of the aircraft. E.g.: If the offset is 3.2 m, the value must be 04.

To configure the lateral offset of the GNSS antenna perform the following procedure:

1. Select “Lat.” and press the rotary knob. The “+/-” sign of the offset value turns yellow.
2. Turn the rotary knob to change the sign.
3. Press the rotary knob again to save sign value. The first digit of the offset value turns yellow.
4. Turn the rotary knob to change the value.
5. Press the rotary knob again to save the selected digit. The next digit turns yellow.
6. Turn the rotary knob to change the value.
7. Press the rotary knob again to save the selected digit. The offset value turns green.

Note:

For most small aircraft a value of “00” is adequate. In case an antenna offset is applicable, the position to the left side of the aircraft will require a negative sign, to the right a positive sign. The lateral offset has to be entered in meters measured from longitudinal (Roll) axis of the aircraft. E.g.: If the offset is 1.3 m to left side, the value must be -02.



3.4.2.1.4 Save Flight ID

To save a Flight ID configuration select “Save” and press the rotary knob. The “Flight ID” menu for adding, modifying and deleting a Flight ID configuration will be displayed after the configuration is saved.

3.4.2.2 Modify Flight IDs

To modify a Flight ID select “Modify” and press the rotary knob. A submenu “Select FID” is displayed. See chapter 3.4.2.4 for details.

After the desired Flight ID is selected the submenu “Edit FID Param.” is displayed and the parameters of the Flight ID can be modified (see chapter 0).

3.4.2.3 Delete Flight IDs

To delete a Flight ID select “Delete” and press the rotary knob. A submenu “Select FID” is displayed. See chapter 3.4.2.4 for details.

After the desired Flight ID is selected the submenu “Delete FID” is displayed.

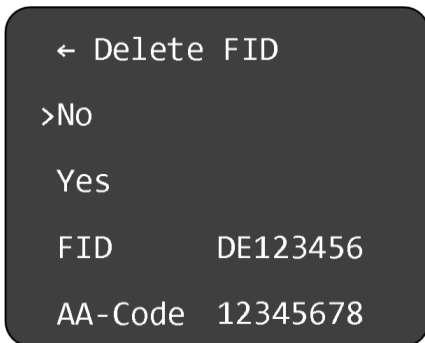


Figure 28: Delete Flight ID Menu

To delete the Flight ID turn the rotary knob to select “Yes” and press the rotary knob. The Flight ID is deleted and the “Flight ID” menu is displayed.

If you select “No” and press the rotary knob the Flight ID is not deleted and the “Flight ID” menu is displayed.

The “FID” and “AA-Code” are only displayed for information purposes.

3.4.2.4 Multiple Flight IDs

In case multiple Flight IDs are configured a selection menu is displayed where necessary.

The selection menu for multiple Flight IDs allows the selection of an already configured Flight ID (see chapter 0) for the operation or configuration of the transponder. The selection menu may consist of two pages (see note below).

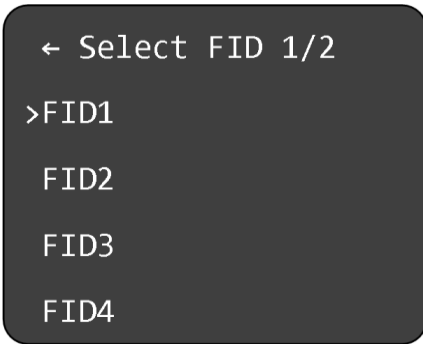


Figure 29: Multiple Flight ID Selection Menu

Turn the rotary knob to select the desired Flight ID. Press the rotary knob to confirm the selection. The transponder will then use the selected configuration.

Note:

If more than four Flight IDs are configured turn the rotary knob clockwise until the next page is shown. To go back to the previous page turn the rotary knob counterclockwise.

3.4.3 Modify VFR

To configure the VFR Squawk code "Modify VFR" and press the rotary knob. A submenu "Modify VFR" is displayed.

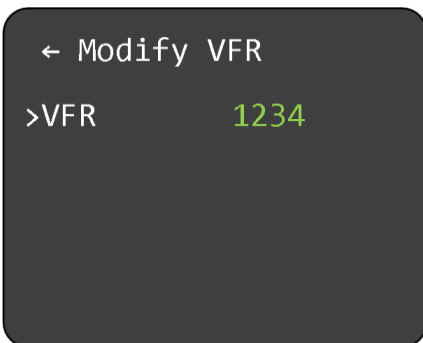


Figure 30: Modify VFR Code Menu

To change the VFR Squawk code perform the following procedure:

1. Press the rotary knob. The first digit of the Standby Squawk turns yellow.
2. Turn the rotary knob to change the value.
3. Press the rotary knob again to save the selected digit. The next digit turns yellow.
4. Repeat steps 2 and 3 until all four (4) digits are set to desired VFR Squawk code.

Note:

Make sure, that you enter the correct VFR Squawk code for the particular country where your aircraft is operated.

Examples:

Germany: VFR Squawk = 7000

USA: VFR Squawk = 1200

3.4.4 Factory Reset

In certain cases it may be necessary to perform a factory reset. Performing a factory reset will reset all settings to their factory defaults.

To perform a factory reset select “Factory Reset” and press the rotary knob. A submenu “Factory Reset” is displayed.

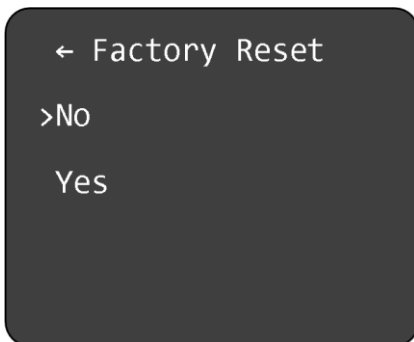



Figure 31: Factory Reset menu


To perform a factory reset turn the rotary knob to select “Yes” and press the rotary knob. A notification is displayed which requests a restart of the transponder.

	<p>Attention!</p> <p>If the device is reset to factory settings, all user and device settings are lost and set to their default values!</p>
---	---

Note:

Default values are as follows:

- all configured Flight IDs and their associated device parameters such as AC category, GNSS device selection etc. are deleted
- AA code is set to invalid (zero)
- Display brightness is set to level 5
- VFR Squawk is set to the default value “7000”
- Active and Standby Squawk are set to “0000”

	<p>Attention!</p> <p>The device functionality is downgraded to basic functionality without “Extended Squitter ADS-B out” feature. This applies to devices that support “BASIC” functionality (since software release “0102”).</p>
---	---

Note:

For devices that support “BASIC” functionality, ADS-B unlock code will be set to “00000000 00000000”. Information on activating (unlocking) “Extended Squitter ADS-B out” feature: see chapter 3.4.6.

3.4.5 Test Menu

The second page of the setup menu contains the test menu only.

The entries in this menu offer the possibility to query some useful device information and to calibrate the altitude offset.

To enter this menu, select "Test Menu" and press the rotary knob. The "Test Menu" submenu is displayed.

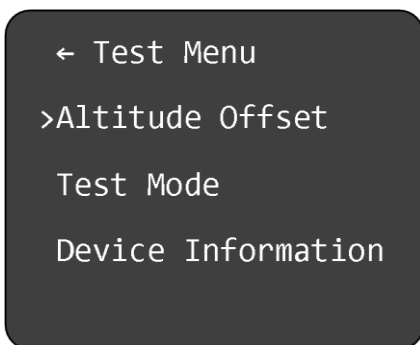


Figure 32: Test Menu

To calibrate the altitude offset select “Altitude Offset” and press the rotary knob. A submenu “Altitude Offset” is displayed (see chapter 3.4.5.1).

To enter the test mode select “Test Mode” and press the rotary knob. A submenu “Test Mode” is displayed (see chapter 3.4.5.2).

To show some device information select “Device Information” and press the rotary knob. A submenu “Device Info” is displayed (see chapter 3.4.5.3).

3.4.5.1 Altitude Offset Calibration

The Altitude Offset Calibration allows you to adjust the built-in altitude encoder to ensure that the Flight Level transmitted by the transponder complies with all relevant standards.



This process is normally carried out every 24 months, as part of the altimeter checks on the aircraft. The maximum allowed difference between the primary altimeter and the altitude encoder is 125 feet according to ETSO C88a.

The altitude encoder in the transponder is extremely accurate, has an excellent long-term stability and is accurately calibrated during manufacture. But it is possible that a combination of allowed accuracy deviations in the altitude encoder and the primary altimeter may show an altitude difference exceeding 125 feet. In that case it is recommend to perform an altitude offset calibration.

3.4.5.1.1 Calibration Equipment

To perform the altitude offset calibration the transponder needs to be powered up. Additionally a pitot static test set (e.g. PACE6000) is needed together with the appropriate adapters to connect to the static port on the aircraft. The pitot static test set should be able to drive the altitude from sea level to above the service ceiling of the aircraft.

Note:

For the calibration procedure no transponder test set is required. During the calibration procedure all necessary information is displayed. Nevertheless a transponder test set can be used to verify the transmissions of the transponder.

3.4.5.1.2 Calibration Procedure

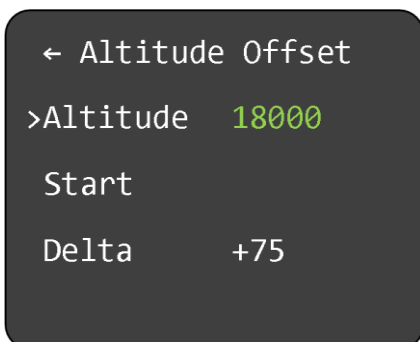


Figure 33: Altitude Offset Calibration Menu

To perform the altitude offset calibration perform the following procedure:

1. Select “Altitude” and press the rotary knob. The first digit of the altitude set point turns yellow.
2. Turn the rotary knob to change the value.
3. Press the rotary knob again to save the selected digit. The next digit turns yellow.
4. Repeat steps 2 and 3 until all digits are set to desired altitude set point.

Note: *It is recommended to use 18000 ft as altitude set point.*

5. On the pitot static test set drive the altitude to the set point value as entered before and wait until the pressure has stabilized.
6. Select “Start” and press the rotary knob. The calibration procedures is started. During the “Delta” value shows three dashes (“---”).



7. After a few seconds either the “Delta” value is showing the altitude offset value or a notification is displayed.

In a normal case the calibration procedure was successfully performed and the new altitude offset value is stored.

In a rare case the offset value determined by the calibration procedure is beyond the limits.

Possible reasons can be:

- Altitude set point values of transponder and static test set do not match.
=> Check the settings.
- Failure in the static port connection from the static test set to the transponder.
=> Check the installation.
- Failure of the altitude encoder.
=> Send the unit for servicing.

To verify the altitude measurement the following procedure must be performed:

1. Switch off the transponder.
2. Switch on the transponder in “Setup Mode” and enter the “Test Mode” (see chapter 3.4.5)
3. On the pitot static test set drive the altitude to -1000 feet.
4. Verify that the altitude displayed on the transponder correspond within the 125 foot tolerance. Additionally verify the altitude value transmitter by the transponder.
5. Repeat this procedure for all altitudes to the service ceiling of the aircraft in steps of 1000 feet.



3.4.5.2 Test Mode

The submenu “Test Mode” displays the following internal measurements:

- Operating voltage (Battery)
- DC Converter voltage (power supply for the transmitter)
- Altitude (in feet)

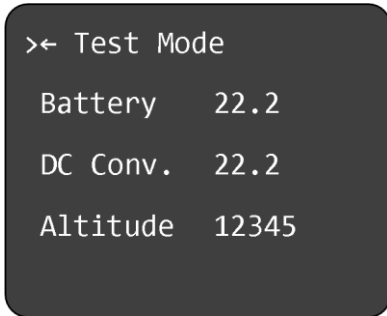


Figure 34: Test Mode Menu

3.4.5.3 Device Info

The submenu “Device Info” displays the checksum of the software and the serial number of the device.

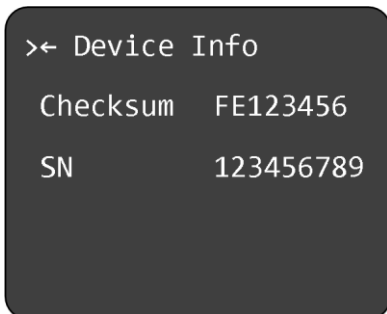


Figure 35: Device Info Menu



3.4.6 ADS-B Unlock Menu

This chapter applies to devices that support the "BASIC" functionality, starting with device software release "0102".

An activation code is required to enable (unlock) the "Extended Squitter ADS-B out" feature.

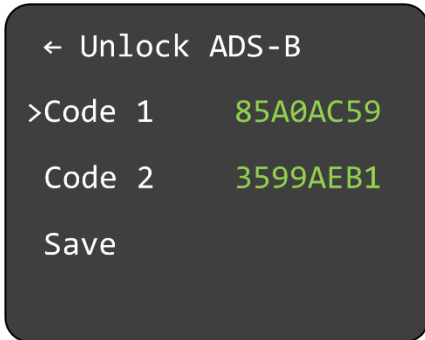


Figure 36: Unlock ADS-B menu

To enter the ADS-B unlock code perform the following procedure:

1. Select "Code 1" and press the rotary knob to start editing the first part of the unlock code. The first digit turns yellow.
2. Turn the rotary knob to change the value.
3. Press the rotary knob again to save the selected value. The next digit turns yellow.
4. Repeat steps 2 and 3 to complete the entry of the desired code.
5. Select "Code 2" and repeat step 2 to 4 for enter the second part of the unlock code.
6. Finally, select "Save" to save the unlock code permanently.

Note:

When saving, the entered code is checked and a warning "Wrong Unlock Code" is issued if the code is incorrect (see Figure 18: FID Limitation Notification for an adequate example).

Note:

A code "00000000 00000000" is also accepted as a valid code, since this value also corresponds to the default value in the factory setting for a device with disabled "Extended Squitter ADS-B out" feature.

	<p>To upgrade your KTX2-S Basic device for the ADS-B feature just get in contact with one of our TQ distribution partner.</p> <p>You can find one near you with the link below:</p> <p>https://www.tq-group.com/en/distributors-partners/tq-aviation/</p>
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4. Errors, Warnings and Notifications

The transponder distinguishes 3 types of faults:

- Degrading failures
- Limiting failures
- Severe failures

Additionally notifications are displayed where appropriate.

In order to be serviced, a defective transponder needs to be shipped to the nearest service station. For addresses see the TQ General Aviation website:

<https://www.tq-general-aviation.com/en/Service>

4.1 Degrading Failures

If a degrading failure is detected the transponder continues to operate. But its performance may be reduced. Once detected a warning message is displayed.

This message can be confirmed by pressing the rotary knob.

The normal operation display will be shown again but with a corresponding failure indication.



To handle a nonrecurring cause the transponder can be switched off and on again. If the error reoccurs the transponder can be operated as usual but with reduced performance.

Note:

With the exception of the battery voltage warning (see the following chapters), only the last error that occurred is displayed.



4.1.1 Overview

The following table shows a list of all degrading failures of the transponder.

Failure	Display Indicator	Explanation	Degradation	Action / Remark
DC converter	PWR	TX supply voltage is low	TX output power is reduced.	Send unit for servicing.
Bad antenna	ANT	Antenna VSWR is bad (very high)	TX output power is reduced.	Check antenna installation (cable, connectors etc.) to resolve the problem before next flight. If no root cause can be discovered, send unit for servicing.
Transmitter weak	TRX	TX output power is too low	TX output power is reduced.	Check antenna installation (cable, connectors etc.) to resolve the problem before next flight. If no root cause can be discovered, send unit for servicing.
Flight Level	FLx	The altimeter reports a failure	No barometric altitude information is sent.	Check the static port connection for the pressure sensor and the function of the pressure sensor before the next flight. If no root cause can be discovered, send unit for servicing.
Low battery voltage	See below	Battery voltage is below 11 Volts	See below.	See below.
Very low battery voltage	See below	Battery voltage is below 7.5 Volts	See below.	See below.

Table 9: Degrading Failures



4.1.2 Low Battery Voltage

If the supply voltage of the transponder drops below 11 V DC, a yellow "BAT LOW" indicator is shown in the center of the display. The indicator is shown as long as the voltage is too low.

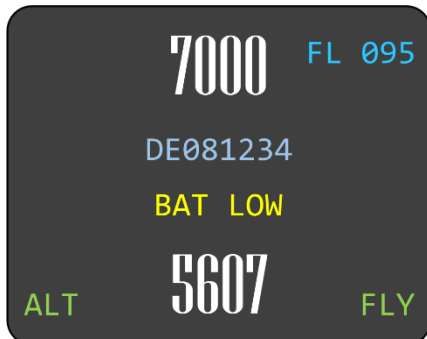


Figure 37: Indication for Low Battery Voltage

Note:

The transponder is designed to operate above 9 V DC. Do not operate the unit below 9 volts.

Degradation:

TX output power may be reduced.

Possible Reasons:

1. Battery exhausted.
2. Voltage of electric generator is low.

Actions:

1. Exchange or charge the battery.
2. Check electric generator.

4.1.3 Very Low Battery Voltage

If the supply voltage of the transponder drops below 7.5 V DC, a red "BAT LOW" indicator is shown in the center of the display. The indicator remains as long as the device is switched on and regardless of whether the voltage rises again to a regular value.

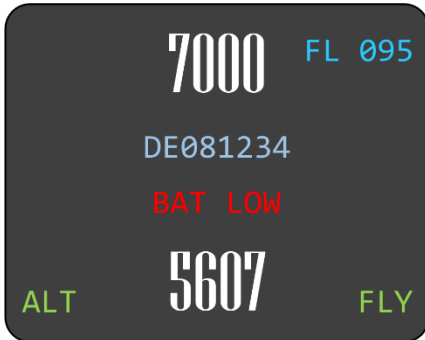


Figure 38: Indication for Very Low Battery Voltage

Degradation:

Transponder is switched into "STBY" mode. No further operation possible.

Possible Reasons:

1. Battery exhausted.
2. Voltage of electric generator is very low.

Actions:

1. Exchange or charge the battery.
2. Check electric generator.

4.2 Limiting Failures

If no FID code (Flight ID) is entered or if the corresponding Aircraft Address (AA code) is missing or incomplete, the following failure is displayed after switching on the transponder.

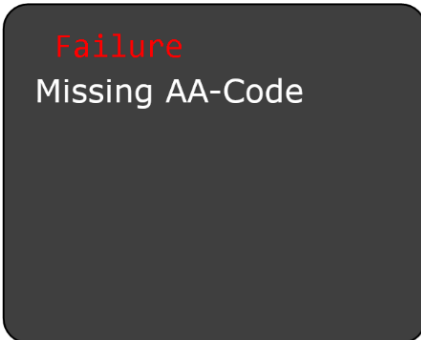


Figure 39: Missing AA Code

To fix this error an appropriate FID and AA code has to be configured as described in chapter 3.4.2.

Note:

This message can be cleared by pressing the rotary knob. The transponder will then operate in Mode A/C only.

Note:

If the message was confirmed, a failure indication remains at the Normal Operation screen (see Figure 1 and Table 2: Screen display elements and indicators.)

4.3 Severe Failures

In case a severe failure is detected, a message (example) as shown below is displayed. No further operation of the transponder is possible. No replies will be made to interrogations and ADS-B out is deactivated.

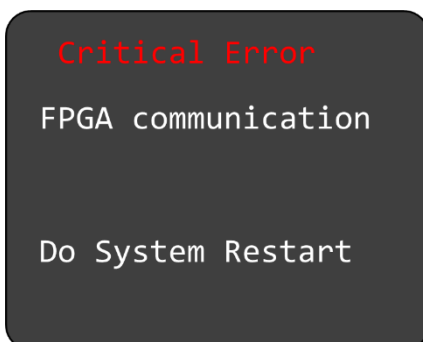



Figure 40: Critical Error (Example)

	<p>To handle a nonrecurring cause the transponder can be switched off and on again. But if the error reoccurs the transponder must be switched off.</p>
---	---

The following table shows a list of all severe failures of the transponder.

Displayed Error	Explanation	Remarks
EEPROM access	Severe operation error. No access to EEPROM.	Send unit for servicing.
FPGA communication	Severe operation error. No access to FPGA.	Send unit for servicing.
FPGA internal	Severe operation error. FPGA internal failure.	Send unit for servicing.
ADC	Severe operation error. No access to ADC.	Send unit for servicing.
Trans. out. power	Severe operation error. No or very low TX output power.	Check installation (power cable, antenna cable, etc.). If no root cause can be discovered, send unit for servicing.
Antenna failure	Severe operation error. Antenna not connected or Antenna VSWR is very high.	Check installation (power cable, antenna cable, etc.). If no root cause can be discovered, send unit for servicing.
MCU	Severe operation error. MCU internal failure.	Send unit for servicing.
Unknown Error	Severe operation error.	Check installation (power cable, antenna cable, etc.). If no root cause can be discovered, send unit for servicing.

Table 10: Severe Failures

4.4 Notifications

4.4.1 GNSS Data CRC Failure

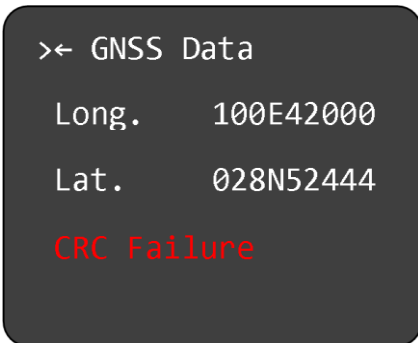


Figure 41: GNSS CRC Failure

Possible Reasons:

Invalid data from GNSS source.

Actions:

Check installation, cable, connections and configuration of the installed GNSS source.

4.4.2 Do System Restart

The following message is displayed if a restart of transponder is necessary.

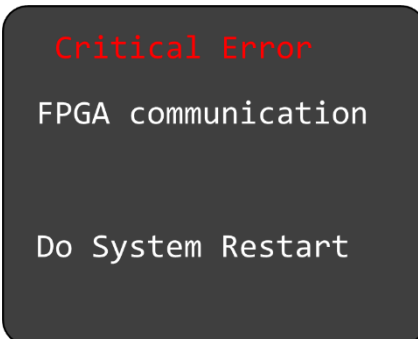


Figure 42: System Restart (Example)

Actions:

Switch the transponder off and on again

5. Installation

5.1 Equipment Connections

5.1.1 Electrical Connections

The 15pin D-SUB connector at the rear side of the unit includes all electrical connections, except for the antenna, see chapter 5.2.2 for details.



The positive supply line needs to be protected by a 3A slow blow fuse!



The transponder should be connected to an uninterruptible power supply as short power interrupts may cause the transponder to restart in "STBY" Mode or in Multiple Flight ID selection.

5.1.2 Mutual Suppression

Other equipment on board (e.g. DME) may transmit in the same frequency band as the transponder. If such a device is installed a single wire bus (Suppression = active at +12V) must be installed in order to protect the receiving parts of the different devices from in-band transmissions.

Mutual suppression is a pulse that is sent to the other equipment to suppress transmission of a competing transmitter for the duration of the pulse train transmission. The transponder transmission may be suppressed by an external source and vice versa.

To activate mutual suppression the SUPP_I/O requires a +12V source from the other equipment, see chapter 5.2.2.



All equipment connected to the suppression line must be re-inspected and reapproved from a qualified avionic technician before operation.
Use only shielded lines.

5.1.3 Ground Switch

If a Ground Switch is connected (and activated in the Setup), the transponder is enabled to distinguish between weight-on-wheel (On the Ground) and no-weight-on-wheel (In-Flight) conditions. In the weight-on-wheel condition the transponder automatically enters the Standby mode.

In order to complete this installation the input "FLY-GND" must be connected to a switch, which connects the input with "GND" in case there is weight on wheels, or remains open during flight, see chapter 5.2.2.



This option must additionally be activated in the Setup. For details on configuration please refer to chapter 3.4.2.1.3.1.

5.1.4 Static Air Port

The transponder has a built-in altitude encoder which must be connected to the same source of static pressure as the primary altimeter on the aircraft.

For this purpose the transponder has a hose connection at its rear side for nominal 5mm or 3/16 inch tubing (inside diameter).

Connect the static air connection to the static pressure port and ensure a tight connection with a suitable hose clamp.

5.1.5 GNSS Interface

A GNSS source can be connected to the serial interface (RS232) providing GNSS position data for use of ADS-B out.

Requirements:

- Required GNSS hardware:
 - NexNav Mini (Part-No. 21.000) which turns the transponder into a 14 CFR 91.227 compliant device as required for TC'd aircraft (FAA 2020 mandate).
 - or
 - Standard NMEA0183 RMC data stream including the RMC-sub-format (4800/9600/19200/38400 Baud) for aircrafts which do not require the ADS-B requirements defined in 14 CFR 91.227.
- GNSS hardware needs to be connected to pin 13 (RX-RS232) and optionally pin 2 (TX-RS232) of the D-SUB connector (see chapter 5.2.2). Power supply needs to be provided separately considering the required operating voltage for the GNSS hardware.

The WAAS GNSS device needs to be selected in the setup menu (see chapter 3.1.4.4).

Note:

For connection to the NexNav Mini device, a proprietary cable is available from TQ. Please contact your dealer for more information.

If a standard NMEA0183 WAAS GNSS source is sufficient for your aircraft (LSA, Experimental, Ultralight etc.) you should consider brands recommended by TQ to avoid incompatibilities or malfunctions.

Note:

For correct function of the movement detection an update rate of 5 Hz is recommended for NMEA devices.

5.1.6 Antenna Connector

The antenna is connected to a single coaxial connector (SMA) at the rear side of the transponder.

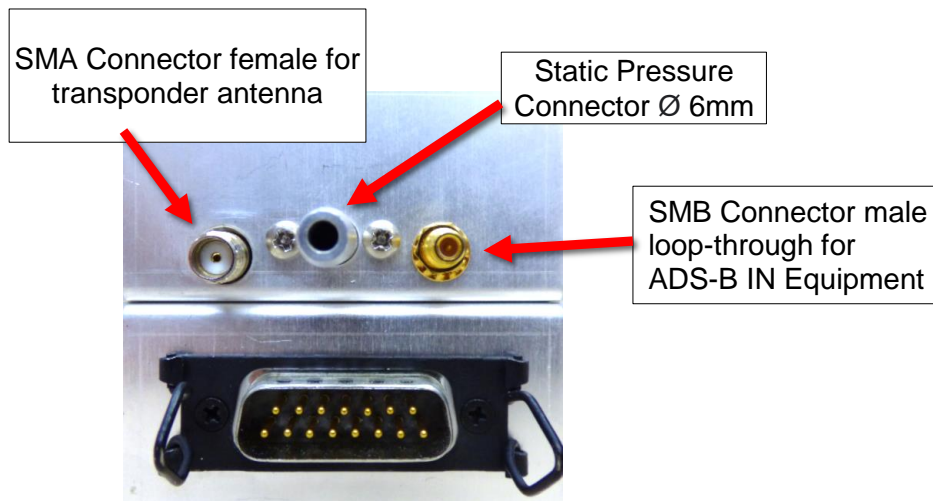


Figure 43: View of the rear panel with connections

Note:

Using the loop-through connection function results in a signal attenuation of approx. 6 dB.

5.1.6.1 L-Band ADS-B Antennas

The L-Band antenna used with the KTX2 must fulfil to the following specifications:

- Standard 50 Ω, vertically polarized antenna with a VSWR < 1.7:1 at 1090 MHz.
- TSO-C66(), TSO-C74(), TSO-C112() , or TSO-154c antennas that also meet the VSWR specification.

Only the L-Band antennas listed in the table below have been tested for compatibility with transponder installations.

Manufacturer	Part Number	Connector Type	Remarks
RAMI	AV-74	BNC	
Comant	CI-105	BNC	
Comant	CI-105-11	TNC	

Table 11: L-Band Antennas

5.1.6.2 Antenna Installation

The antenna should be installed according to the manufacturer's instructions.

The following considerations should be taken into account for the antenna installation:

- The antenna should be placed not directly near any projections, the engine(s) and propeller(s). It should also be placed not directly near landing gear doors, access doors or others openings which will break the ground plane for the antenna.



- The antenna should be mounted on the bottom surface of the aircraft and in a vertical position when the aircraft is in level flight.
- The antenna should not be mounted within 3 feet of the ADF sense antenna or any COMM antenna and 6 feet from the transponder to the DME antenna.
- Where practical, the antenna location should be chosen to keep the cable lengths as short as possible and to avoid sharp bends in the cable to minimize the VSWR.
- To prevent RF interference, the antenna must be physically mounted at a minimum distance of 3 feet from the transponder.

Electrical connection to the antenna should be dust and water proof to avoid loss of efficiency as a result of the presence of liquids or moisture. All antenna feeders must be installed in such a way that a minimum of RF energy is radiated inside the aircraft.

5.1.6.3 Antenna Cable

The transponder is designed to fulfil the ADS-B Class 1 requirements allowing a maximum loss of 2 dB in the connectors and cable used to connect it to the antenna. Exceeding this loss will degrade the transmitter output power and receiver sensitivity.

A typical installation needs two (2) connectors at each end of the antenna cable.

Calculating a loss of 0.25dB for each connector allows a loss of 1.5dB for the cable itself.

An acceptable cable must have the following characteristics:

- Less than 1.5dB loss for the cable length needed.
- Characteristic impedance of 50 Ohms.
- Double braid screens or a foil and braid screen.

Once the cable length from the transponder to the antenna is known, a cable type can be chosen which has a loss per meter low enough to meet the above requirements (see table below).

Note:

Low loss cable typically uses foamed or cellular dielectrics and foil screens. These make such cables especially prone to damage from too-tight bends or from momentary kinking during installation. Once kinked, these cables do not return to full performance when straightened.



The following table is shows a list of some common cable types and the maximum usable lengths.

Cable Type	Max Length in meters (feet)	Insertion Loss dB/meter (db/100ft) ¹	Remarks
RG-400 M17/128-RG400	2.5 (8' 2")	0.6 (18.5)	
RG-304 M17/112-RG304	4.2 (13' 9")	0.36 (11.1)	
RG-393 M17/127-RG393	5 (16' 5")	0.3 (9.2)	
Carlisle IT Type 3C142B	3.1 (10' 2")	0.48 (14.5)	
Carlisle IT Type 311601	5.2 (17' 1")	0.29 (8.7)	
Carlisle IT Type 311501	6.5 (21' 4")	0.23 (7.1)	
Carlisle IT Type 311201	8.3 (27' 4")	0.18 (5.6)	
Carlisle IT Type 310801	12.5 (41')	0.12 (3.6)	

Table 12: Common Antenna Cables

¹ RG type coaxial cable insertion loss can vary significantly between manufacturers. The insertion loss for RG type cables shown in this column is considered 'worst case'. Refer to the cable manufacturer's specification sheet for actual attenuation (insertion loss) for the cable being used.



When routing the cable, ensure that you:

- Keep the cable length as short as possible.
- Avoid routing the cable round tight bends.
- Avoid kinking the cable, even temporarily during installation.
- Secure the cable so that it cannot interfere with other systems.
- Route the cable away from any heat sources.
- Route the cable away from potential interference sources such as ignition wiring, 400Hz generators, fluorescent lighting and electric motors.
- Allow a minimum separation of 300mm (12 inches) from an ADF antenna cable.

Note:

In case an already installed antenna can be further used (old transponder is replaced) and the existing connector does not fit, it is recommended to replace the connector. Alternatively, an adapter from the existing connector to a SMA male type connector can be used. But this will add an additional loss of typical 0.1 – 0.2 dB to the installation which must be considered. If the total loss of 2 dB is exceeded the cable must be replaced.

Note:

A SMA<->TNC adapter is included from TQ.

5.2 Wiring

5.2.1 Conductor Cross Section

Power Supply (Batt. Plus, GND): AWG20 (0.62 mm²)
Signals: AWG22 (0.38 mm²)

The conductors must be approved for aircraft use. Recommended Quality:

MIL-Spec 22759/34, (Spec 55) 20AWG / 22AWG

Crimped D-SUB connector is always preferred against soldered connectors. Original TQ harness comply with common aviation wiring standards. Consult your approved aviation shop for installation details.

5.2.2 Wiring Scheme

The following wiring diagram shows a typical wiring.

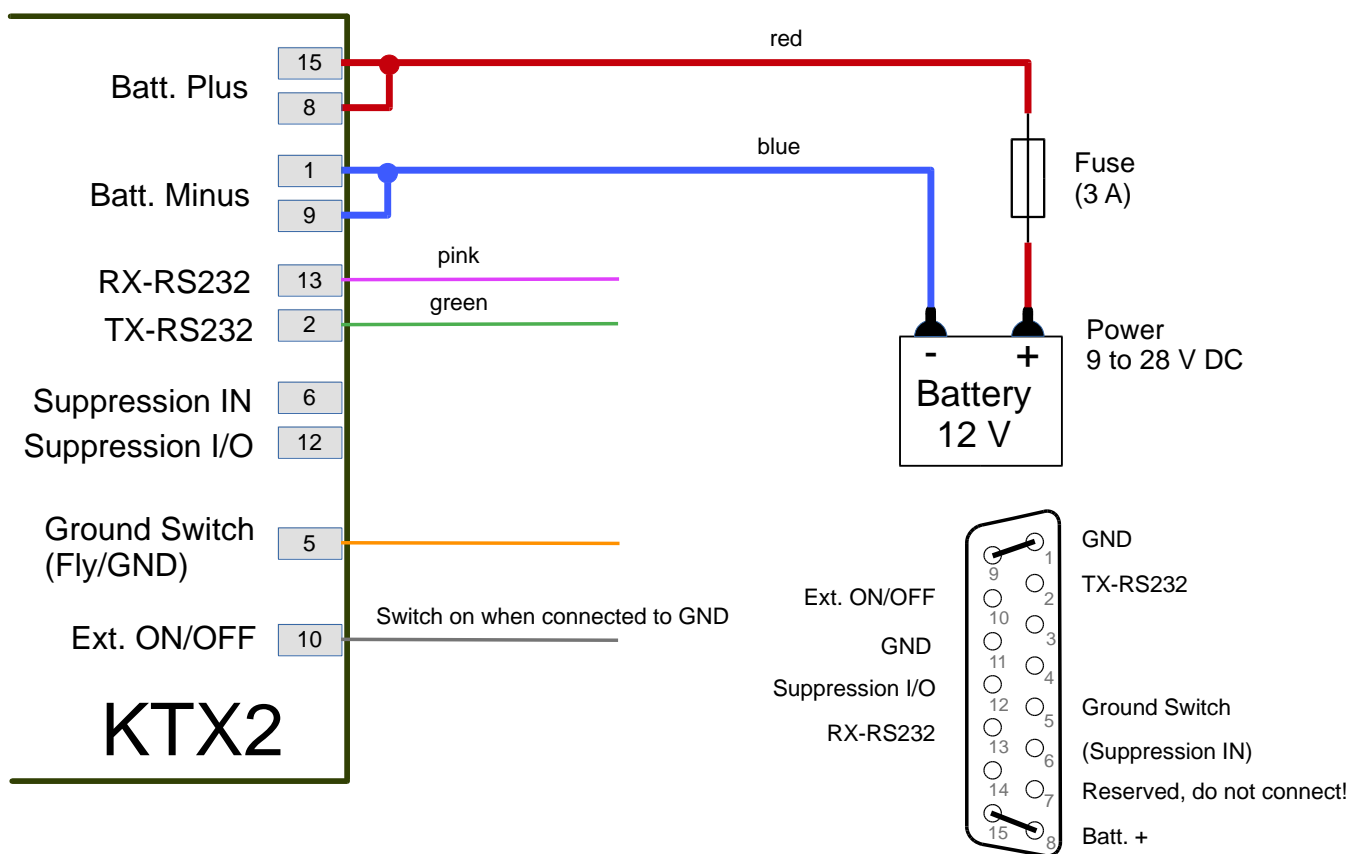


Figure 44: Wiring diagram

6. Drawings

Followed figures showing the drawings with dimensions in Millimeter for the KTX2-S Standard transponder.

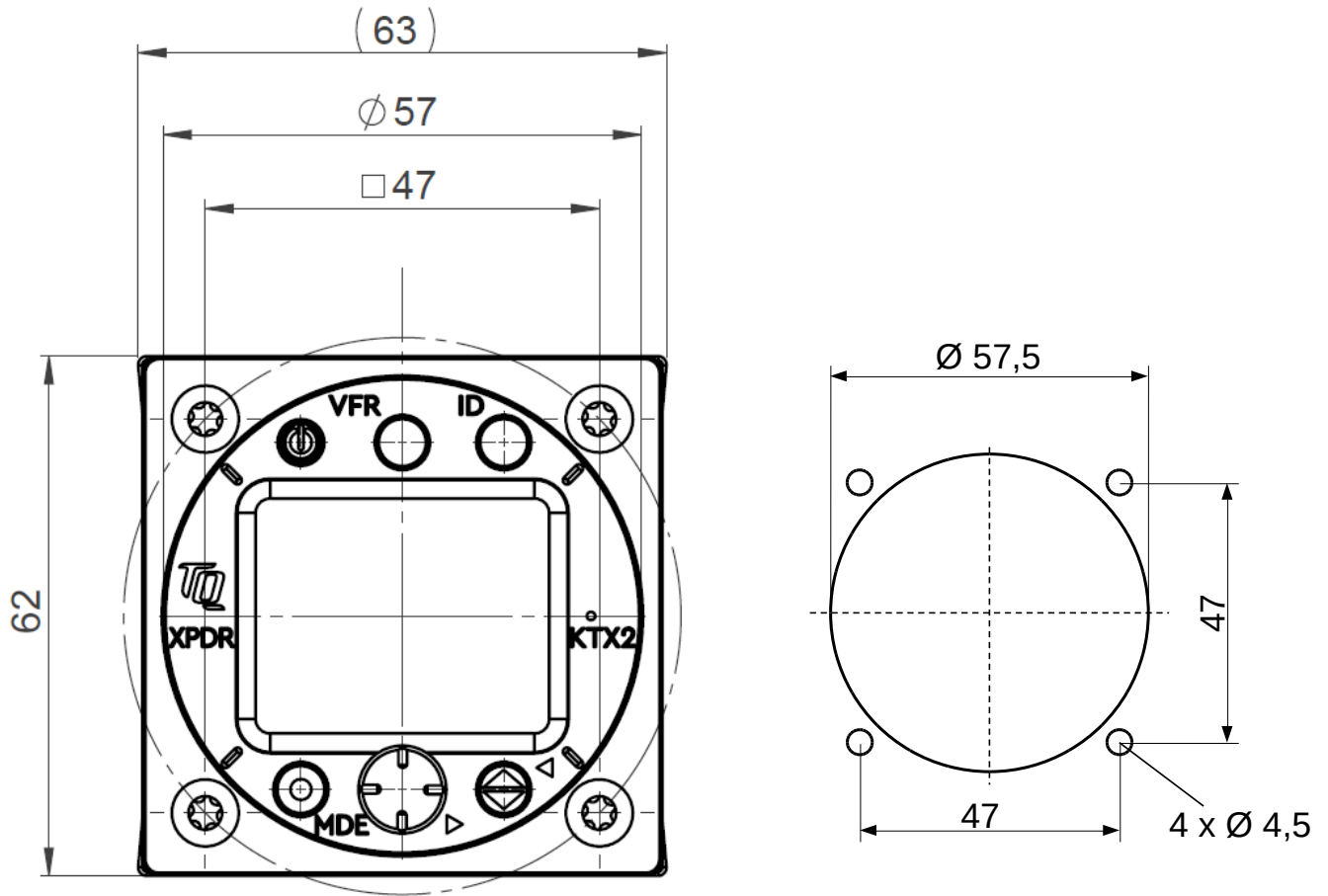


Figure 45: Front view and panel cut-off

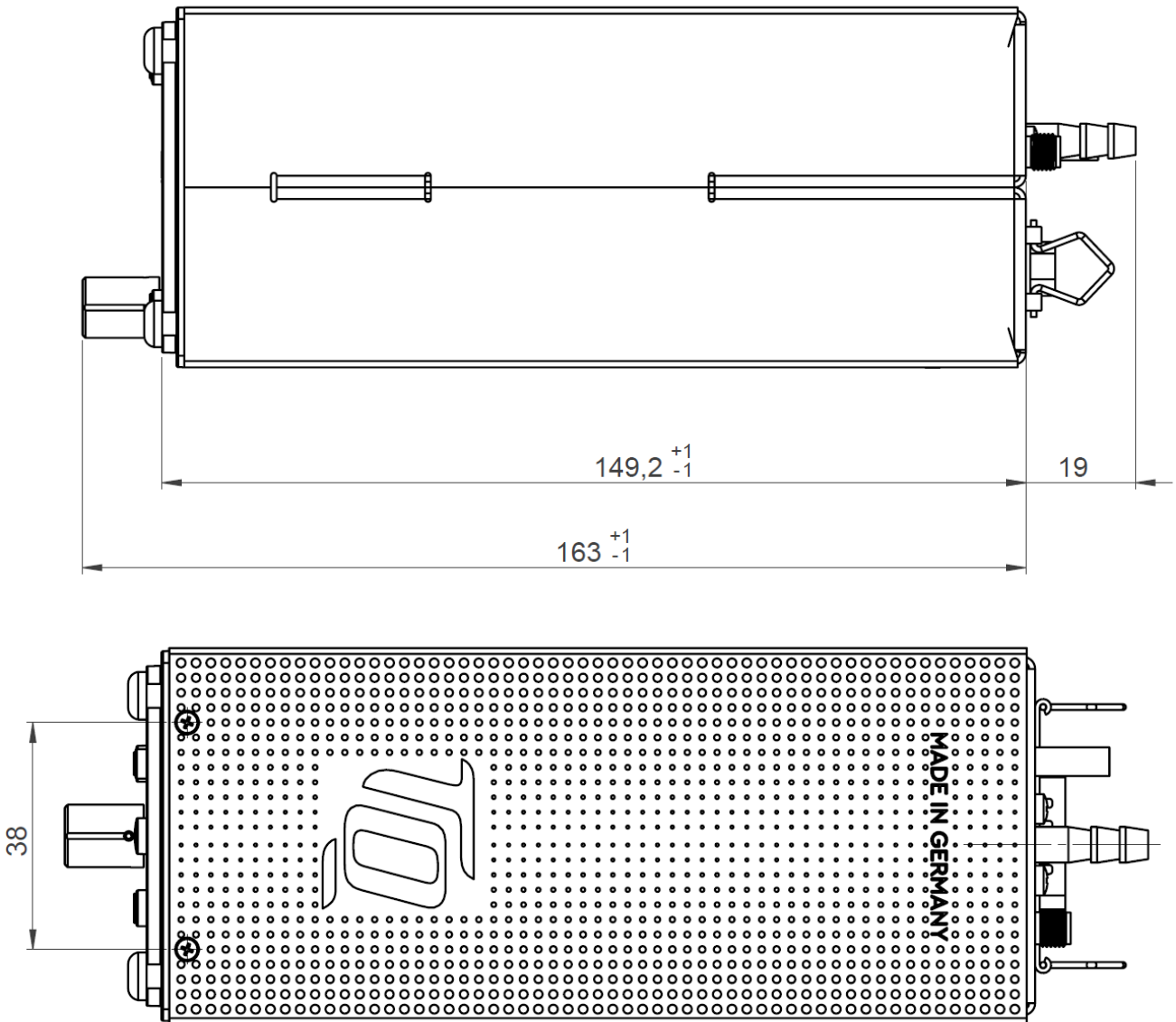


Figure 46: Side view and top view

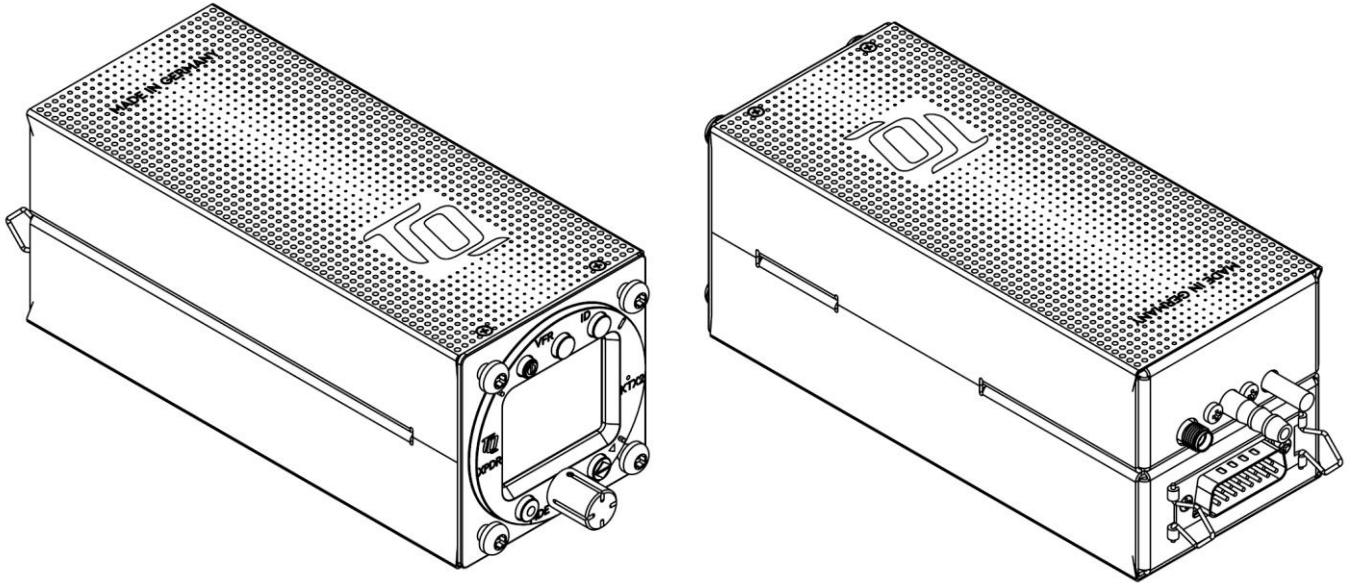


Figure 47: Perspective view of the transponder device



7. Technical Data

7.1 General

Designation	
Authorization	EASA.21O.10069784
Certification	ETSO-C112d / TSO-C112d ETSO-C88a / TSO-C88a ETSO-C166b / TSO-C166b
Compliance	RTCA DO-181E / ED-73E / Level 2els, Class 1 RTCA DO-178C / ED-12C Level D RTCA DO-254 / ED80 Level C RTCA DO-160G / ED-14G RTCA DO-260B / ED102A Class B1S SAE AS8003 FCC ID: 2ANFFKTX2-S
Dimensions	63 x 62 x 149 (2.48" x 2.44" x 5.86") pure housing
Weight	KTX2 0.381 kg
Mounting	KTX2: cut-out Ø 57 mm (2¼")
Temperature ranges:	
Operation	-20 °C to +55 °C
Storage	-55 °C to +85 °C
Maximum flight level	30 000ft
Vibration	DO-160G, Cat. S, Vibration Curve M
Humidity	RTCA DO-160G, Cat. A
Shock	6G operation 20G crash safety
RTCA DO-160F ENV. Category	[C4Z]CAB[SM]XXXXXXXXZ[BBB][AC]TB[B2F2]XXAX
Software Category	ED-12C (RTCA DO-178C) Level C
Hardware Category	DO-254 Level C
Power supply	9 V DC to 33V DC
Power consumption	<ul style="list-style-type: none"> depending on the number of requests = 0.2 to 1.0A (@ 12V DC) Illumination 0.02A (@ 12V DC)
Fuse	External fuse required: 3A, slow-blow
Compass security distance	300 mm (12")

Table 13: Technical Data



7.2 Transmitter – Receiver

TRANSMITTER	
Reply transmission frequency	1090 ± 1MHz
RF Peak Power Output	≥ 54dBm (250 W) nominal at antenna connector, ≥ 51dBm (125 W) minimum at antenna base (allowing 0.5dB connector loss and 1.5dB cable loss)
Squitter	Transmitted periodically at random intervals, full self-verification of data and occurrence

Table 14: Transmitter Data

RECEIVER	
Receiving frequency	1030 ± 1MHz
Receiver Characteristics: Sensitivity	RF input power level resulting in a 90 % reply rate: <ul style="list-style-type: none"> ■ MTL for ATCRBS and ATCRBS/Mode S All-Call interrogations: -74dBm ±3dB. ■ MTL for Mode S interrogations: -74dBm ± 3dB.

Table 15: Receiver Data

General	
ICAO 24-bit Aircraft Address (Hex-Code)	Aircraft Address as assigned by National Aviation Authority
FID	Flight ID: Flight Plan call sign or aircraft registration marking
Pressure Altitude	Up to 30 000ft in 25ft increments in-flight / on-ground
Flight Status	Reports the available data and means by which the transponder can report.

Table 16: General Data



8. FCC related issues

8.1 Radiofrequency radiation exposure Information:

This transponder complies with FCC radiation exposure limits set forth for an uncontrolled environment. This transponder should be installed and operated with minimum distance of 200 mm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

8.2 Compliance

Notice: This device complies with Part 15 of the FCC Rules and with Industry Canada license-exempt RSS standard(s).

Operation is subject to the following two conditions:

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

8.3 Modifications

Note:

Changes or modifications made to this transponder not expressly approved by TQ-Systems GmbH may void the FCC authorization to operate this equipment.



9. Maintenance

9.1 Periodic Maintenance

This transponder has been designed and manufactured to allow “on condition maintenance”. This means that there are no periodic service requirements necessary to maintain continued airworthiness, and no maintenance is required as long as it does properly perform its intended function. When service is required, a complete performance test must be accomplished following any repair action. Repairs must only be carried out in accordance with TQ-Systems GmbH service procedures.

9.2 Repair

Only exchange and flat repair of the equipment is permitted. In case of equipment malfunction, the unit must be sent to the manufacturer. Refer to section “1.2 Customer Service”.

9.3 Cleaning

Clean the display only with, lint-free cloth and an eyeglass lens cleaner that is specified as safe for anti-reflective coatings.



10. EXCLUSIVE LIMITED WARRANTY and LIMITATIONS ON LIABILITY

1. Our warranty and liability is based on legal provisions, provided nothing else has been agreed.
2. Delivery items may differ from product illustrations, especially in regard with color and weight. Such differences do not constitute a defect of quality which is relevant for warranty claims.
3. The Customer's warranty rights are subject to the fact that the Customer has properly fulfilled its obligations of examination and notification of defects under § 377 HGB (Commercial Code).

Inasmuch as the Customer is a consumer, the delivery will be considered as approved if written notice of defects is not received within a period of ten (10) working days after arrival of the goods. If the defect was not noticeable in an ordinary inspection the period is extended to four (4) weeks.

If the claim for defects is not files in good times, warranty shall be excluded.

4. Our warranty obligation to the Customer ends 36 months after delivery to the Customer or 24 months after delivery to the end customer, whichever period expires first. The warranty obligation for claims for subsequent performance, replacement deliveries or replacement performance after a substitute performance, replacement delivery or replacement performance exist within the scope of the remaining period of the warranty term as stated above.
5. The warranty period expires prematurely, however, if repair attempts or other modifications are made to the contractual objects by the Customer or agents it has commissioned without the prior agreement.
6. Our liability for damages attributable to it or its agents is, in cases of gross negligence or damage with negligence, an obligation that is significant for achieving the purpose of the contract and is financially and materially limited to the business and product liability insurance cover concluded. Any further liability is excluded.



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