AFMS F-CHCR

Airplane Flight Manual Supplement

- Air Control Display

- Flarm

Annexe 1

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RÉPUBLIQUE FRANÇAISE

Cet intercalaire doit obligatoirement être inséré devant la page de garde d'un manuel de vol en langue anglaise

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air avionics

AIR Control Display 57

Pilot's Manual

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Important

Please read this manual carefully before using the device.

Observe limitations and safety instructions.

This manual is an essential portion of the device and must be kept in a safe place.

Articles Covered

This manual covers the following articles:

- ACD-57 "AIR Control Display 57"

Revision History

Rev.	*Date*	*Status*	*Author*	*Changes*	*Approved*
1.0	2017/04/06	Release	M. Förderer	Initial release	J. Garrecht
1.1	2017/06/27	Release	H. Hoeth	Revised list of limitations	J. Garrecht
1.2	2017/08/25	Release	H. Hoeth	Inactivity timeout in menus Squelch on/off button for Becker radios Startup time of connected devices	J. Garrecht
1.3	2018/01/19	–	H. Hoeth	Preset VFR squawk softkey QNE softkey	
2.0	2018/03/29	Release	H. Hoeth	Update manual for SW version 0.42: Explain new features Update softkey menu diagram Emphesize 8.33 channel selection Clarify transponder mode selection	J. Garrecht

Product Support

If you have questions, our product support team will be happy to help you. Contact us via support@air-avionics.com or by phone. Please find details about our hotlines and availability online at *http://www.air-avionics.com*

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1.1 Introduction

ACD-57 is a small multi-function control display intended for controlling ATC radar beacon systems (transponder, XPDR) and airborne VHF transceivers (COM). Furthermore the system is capable of determining and displaying a precise pressure altitude (altimeter). The system is connected to transponder and COM devices using standardized interfaces.

The small outline and multifunctional software of the device allow for better system integration in space constrained environments. The pilot-centered user interface aims at reducing crew workload, increasing crew efficiency and improving flight safety.

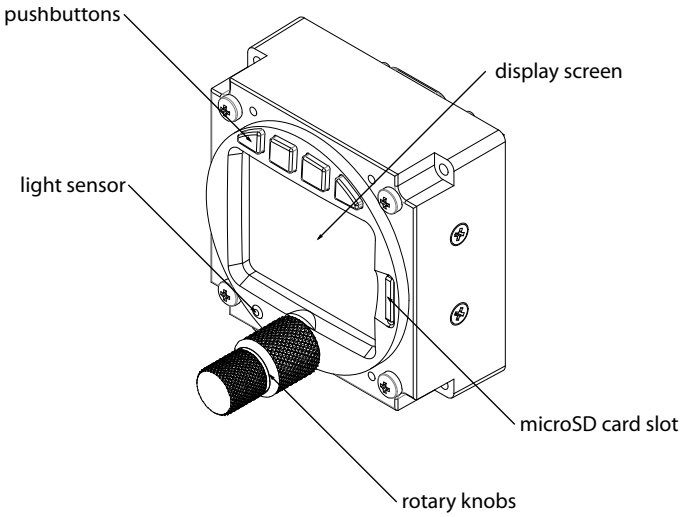


Figure 1.1.: ACD-57 front panel overview

1.2 Limitations and Safety Instructions

1.2.1 Safety

ACD-57 shall never distract from general practices of safe airmanship. Using ACD-57 may impose significant workload on the flight crew if not adequately familiar with ACD-57 and trained on its operation. In order to use ACD-57 effectively, familiarization with the unit is essential.

We recommend a thorough study of this manual and extensive familiarization on ground.

Do not fly with ACD-57 if you are unfamiliar with its operation and limitations

Installations in which ACD-57 devices are used may be complex. Familiarization of specific installation conditions in an aircraft, for example the number, type, and configuration of connected systems is essential before using ACD-57.

ACD-57 installation requires several forms such as checkout forms and configuration logs to be filled out by installation personell. These documents are stored in the aircraft's documentation and are a viable resource for pilots who wish to study installation specifics of an ACD-57 in an aircraft.

1.2.2 Regulatory Requirements

It is the responsibility of those using this article to determine that the installation and working conditions are within required standards.

Independently from ETSO authorizations, depending on aircraft type and certification base, ACD-57 may not be suitable as a primary altimeter, COM control, or XPDR control unit.

1.2.3 Screen Shots

All screen shots used in this document are current at the time of publication.

Screen shots are intended to provide visual reference only. All information depicted in screen shots, including software file names, versions, and part numbers, is subject to change and may not be up to date.

1.2.4 Function Licensing and Database Expiry

Certain functionality is subject to a software licensing model and has to be unlocked during installation. This manual assumes that all required licenses have been installed during installation. Details can be found in the ACD-57 Installation Manual [1].

Some software features such as databases have expiration dates and may become unavailable as they expire. Validity is checked regularly. After the underlying database has expired, some functions may become unusable.

1.2.5 Liability

IN NO EVENT WILL AIR AVIONICS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE OR INABILITY TO USE THE PRODUCT OR FROM DEFECTS IN THE PRODUCT.

1.2.6 Limitations

1. Using the alticoder of ACD-57 is limited to 40,000ft (FL400).
2. Using the altimeter of ACD-57 is limited to 40,000ft (FL400).
3. Use of the device is limited to class II aircraft (MRE, MTE and STE), which includes class I aircraft (SRE), both with MTOW of 6000 pounds or less as per definition of AC23.1309-1E.
4. Use of ACD-57 as primary and only altitude measurement device of the aircraft is excluded, if loss of functions or misleading information is assessed higher than Minor.
5. The operator must verify that the installation meets the airspace requirements where the flights are intended.
6. The device does not provide static error correction. Therefore installation is limited to aircraft where static error correction is not required.

1.2.7 Low Temperature Operations

If the temperature is below –10°C, the ACD-57 must be powered on at least 5 minutes before flight, in order to warm up the display.

1.3 Pilot Controls

Inner and outer knobs have 16 detents per revolution and can be rotated clockwise and counter-clockwise. The inner knob has a pushbutton. Four softkey pushbuttons are located on the bezel along the top of the TFT display screen.

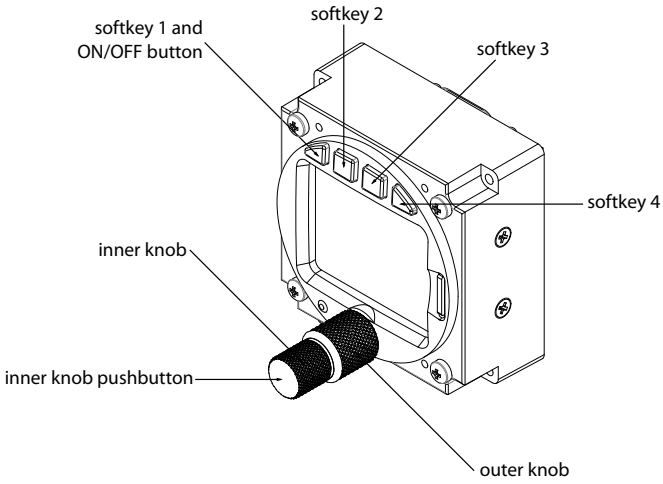


Figure 1.2.: ACD-57 pilot controls

1.3.1 Inner Knob Functions

- In the menu, the inner knob controls the position of the menu focus.
- On the main page, the inner knob opens the volume control page if a VHF transceiver is controlled.
- If only a Mode-S transponder system is controlled (and no VHF transceiver), on the main page, the inner knob opens the XPDR page.
- If only altimeter functions are used (and no VHF transceiver or XPDR is controlled), on the main page, the inner knob opens the barometric reference selection page.
- On the COM channel selection page, the inner knob goes through the channels in in 25kHz steps. To select 8.33kHz channels, push and turn the inner knob.
- On the volume control page, the inner knob controls the ACTIVE channel volume.
- On text input pages, the inner knob controls the text character.

1.3.2 Inner Knob Pushbutton Functions

- On the main page, the inner knob pushbutton is used to toggle ACTIVE and STANDBY channels of a connected COM unit (short push) and for opening the menu (long push).
- In the Menu, the inner knob pushbutton is used for menu item execution/ENTER (short push), for toggling ON/OFF setting menu items (short push), or for closing the menu (long push).

1.3.3 Combined Inner Knob and Inner Knob Pushbutton Functions

By simultaneously pushing/holding the inner knob pushbutton and rotating the inner knob, special functions are controlled.

- On the COM channel memory page, stored channels can be sorted.
- On the COM channel selection page, channels (kHz) are changed in the smallest increments[1].

1.3.4 Outer Knob Functions

- In the menu, the outer knob controls the position of the menu focus as well.
- On the main page, the outer knob opens the volume control page if a VHF transceiver is controlled.
- If only a Mode-S transponder system is controlled (and no VHF transceiver), on the main page, the outer knob opens the XPDR page.
- If only altimeter functions are used (and no VHF transceiver or XPDR is controlled), on the main page, the outer knob opens the barometric reference selection page.
- On the volume control page, the outer knob controls the STANDBY channel volume.
- On the COM channel tuning page, the outer knob controls the channel (MHz).
- On text input pages, the outer knob controls the input position (cursor).

1.3.5 Inactivity Timeout

The user interface consists of several different screen views (pages). If on any page (other than the main page or the configuration menu) no user input occurred for more than 10 seconds, the ACD-57 automatically switches back to the main page.

1.3.6 Softkeys

Four “softkey” pushbuttons are located on the top of the front bezel of the device. The softkey designators on top of the TFT display screen show the softkey’s current function. Softkey functions change depending on menu level and context.

[1] Steps can be setup to *8.33kHz and 25kHz* and *8.33kHz* or *25kHz* only

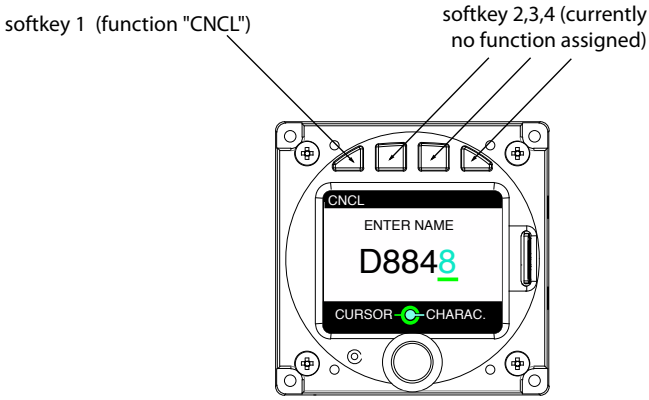


Figure 1.3.: Text input page. The leftmost softkey has a function (CNCL means cancel)

As an addition to its normal softkey functions, softkey 1 can be used for switching ACD-57 on or off with a long push. This function has to be activated by setting a configuration parameter during installation (not the default configuration).

1.3.7 Display Color Coding

If visible, all functions the outer knob controls are kept in the color *green*, all functions the inner knob controls are kept in the color *cyan*.

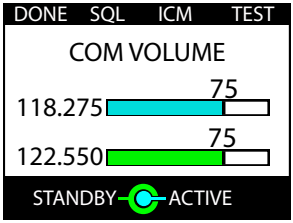


Figure 1.4.: COM volume control page. The inner knob always controls the cyan-colored elements, outer knob the green-colored elements.

1.3.8 Light Sensor

A sensor detecting ambient lighting conditions is placed on the left side of the concentric rotary knobs. User interface illumination, that is display backlight and softkey illumination, can be automatically adjusted using information from the light sensor. This function has to be activated by setting a configuration parameter during installation.

A filter is used to slow down changes in user interface illumination. This prevents the

illumination level from changing too quickly, for example when shadowing the sensor with your hands during operation of the knobs.

> If the user interface illumination is controlled by the aircraft's lighting bus, the ACD-57 uses the light sensor for plausibility checks to prevent blinding the flight crew at night. If the light sensor detects low ambient lighting conditions, but the lighting bus is set to a high brightness, the ACD-57 issues a warning and switches into manual illumination override mode. Details on the illumination override mode can be found in the section "Illumination Override" on page 31.

1.4 General Considerations

1.4.1 User Interface and Softkeys

The ACD-57 system software is configurable and can be adapted to the requirements of an individual installation. For example it is capable of interfacing and controlling different COM and XPDR systems from various manufacturers and optionally displaying altitude functions. Hence the user interface, softkey structure, and configuration menu are flexible and dynamic.

This manual covers the operation of COM control, XPDR control, and altimeter separately. Yet these functions can also be combined. Chapter 5 shows user interfaces for all combinations possible.

Appendix C holds a diagram of all available softkeys depending on device configuration.

1.4.2 Limitations of Connected Devices

Please be aware that not all functions supported by ACD-57 may be supported by connected COM devices. Carefully observe limitations and functions of connected COM devices in order to assess system limitations that apply to your aircraft. The following table gives an overview on functions not supported by all connectable COM systems and other limitations thereof:

Function	*AIR COM VHF Transceiver*	*Becker 620X VHF Transceiver*	*DITTEL/TQ KRT2 VHF Transceiver*
Say Again Function	●	–	–
Standby COM channel independent volume level possible	●	–	–
VHF transceiver system configuration during installation	●	●	–
Interface speed from ACD-57 to VHF transceiver	fast (nearly in real time)	normal (sometimes delays are recognizable)	slow (up to half a second delay)

1.4.3 Connected Devices Parameter Changes

Whenever a parameter in an external system such as a COM or XPDR device is changed, ACD-57 sends a change request to the COM or XPDR device through a data interface. Information is only updated on the display screen of the ACD-57 if the change has been acknowledged and transferred back to ACD-57 by the COM or XPDR device.

Therefore a delay (normally less than half a second) can be visible, depending on the type of the connected device, the data interface, and the parameters changed.

Some elements of the user interface, for example on the volume control page, present the value the parameter shall be changed to and the current value active in the connected system.

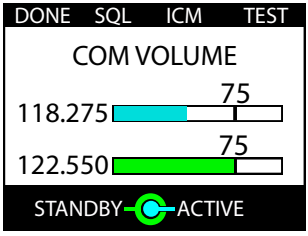


Figure 1.5.: Volume control page. The cyan colored bar indicates the value currently active in the connected COM unit, the little black pointer and numerical value show the value currently set in ACD-57. Normally this discrepancy disappears within half a second.

1.4.4 Connected Devices Startup Time

Some connected devices may need a significantly longer time than ACD-57 to power up. For example, a connected KRT-2 COM unit needs up to 20 seconds before it starts to send data to the ACD-57. While the ACD-57 is not yet receiving data from a connected system, the connected system's status is not known and therefore red crosses are shown on the parts of the display referring to the connected system.

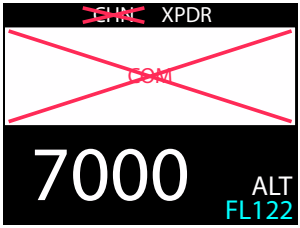


Figure 1.6.: No data from connected COM system after power up. This condition may last up to 30 seconds after power up.

1.5 Switching On and Off

1.5.1 Power On

By default the ACD-57 switches on automatically if sufficient supply power is present. ACD-57 switches on at 9V DC.

In order to switch ACD-57 on manually, *POWER ON MODE* can be deactivated in the *CONFIGURATION MENU*. For details, please consult the ACD-57 Installation Manual [1]. If *POWER ON MODE* is deactivated and if the ACD-57 has been manually switched off before, ACD-57 is powered on by pushing softkey 1 for at least 0.5 seconds.

The boot phase of ACD-57 takes less than one second. No special boot screen is shown.

When turned on, ACD-57 powers up all connected avionics systems (such as COM or XPDR) if they have not been powered up already.

1.5.2 Power Off

If *POWER ON MODE* is active (default), ACD-57 is switched off by taking away power. ACD-57 switches off if the supply voltage drops below 8V DC. In this mode, ACD-57 can not be switched off manually using softkey 1 .

If *POWER ON MODE* is deactivated, push softkey 1 longer than 4 seconds to switch ACD-57 off.

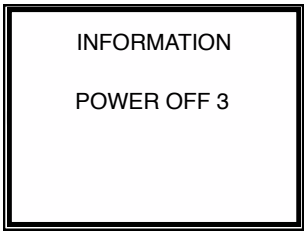


Figure 1.7.: Power off screen. The countdown timer on the right (here 3 seconds) counts down until the unit is switched off.

2 COM Operation

2.1 Introduction

ACD-57 is capable of controlling a connected VHF transceiver (COM). ACD-57 can serve as primary means for control of a COM unit including COM unit setup, channel selection, and audio control.

Multiple ACD-57 can be installed on one COM unit and control the COM unit simultaneously. This is especially used in large aircraft or aircraft with tandem seating configurations.

2.1.1 COM User Interface

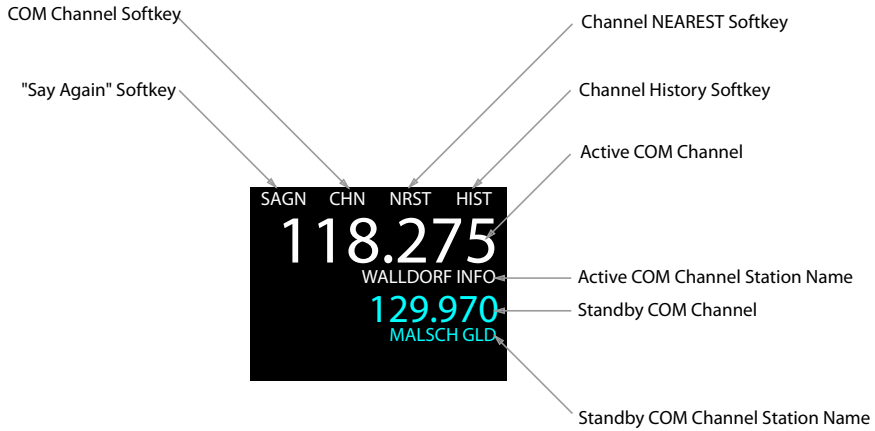


Figure 2.1.: COM user interface on main page explained.

ACTIVE and STANDBY channels are displayed on the main page.

Depending on configuration and database/position availability, channel names may be displayed on the main page. The nearest station name will be shown for the selected channel.

> Station names are only shown for stations within a distance of approx. 20 miles from the aircraft's current position.

> The display of station names in ACD-57 requires GPS position data from an external source that needs to be connected and configured during installation. Furthermore a valid station database (microSD card) is required. If no GPS position data or no station database is present, the function is not available and station names are not shown.

2.2 Audio Control

2.2.1 Volume Control

To enter the volume control page, rotate the inner knob or the outer knob on the main page.

In the volume control page, you can use the inner knob to adjust ACTIVE channel volume. Use the outer knob to adjust STANDBY channel volume.

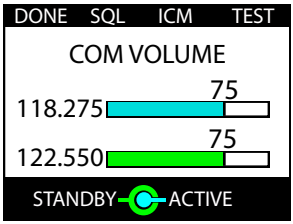


Figure 2.2.: Volume control page

If the connected COM unit does not support individual volumes for ACTIVE and STANDBY channel (Dittel/TQ KRT2 or Becker 620X), outer knob switches DUAL/SCAN mode on or off.

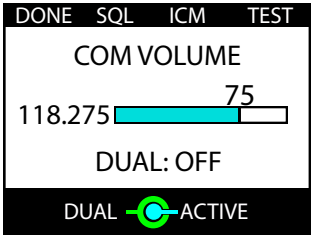


Figure 2.3.: Volume control page for KRT2 COM unit. outer knob switches DUAL mode on or off.

On the volume control page, as long as pushed the TEST softkey will open the squelch for some seconds in order to test the audio output. Testing the audio output before each flight is recommended.

If the *KNOB USE* parameter in the configuration menu is set to *CHANNEL*, rotating the knobs changes channels. To access the volume control page in this configuration, please push the VOL softkey on the main page. Details on the *KNOB USE* parameter can be found in the section "Knob Use" on page 35.

2.2.2 Monitoring the STANDBY COM Channel

The STANDBY COM channel monitoring function (also known as "DUAL WATCH" or "SCAN") is always active, when the STANDBY channel volume is set to a value above zero. If set to zero, the STANDBY COM channel monitoring is deactivated.

Some COM units (currently only DITTEL/TQ KRT2) do not support individual values for the volume of the standby COM channel. If such a COM unit is used, the volume value for the standby COM channel is synced with the value for the active COM channel. In this case, rotating the outer knob only activates or deactivates standby COM channel monitoring entirely.

2.2.3 Squelch Level Control

The squelch level control page is accessed by pushing the SQL softkey on the volume control page. It is recommended to keep the squelch level at the lowest value required for filtering white noise.

If the connected COM system doesn't completely open the squelch at the "zero" setting (e.g. Becker radios), the squelch can be turned on and off with the softkey 4.

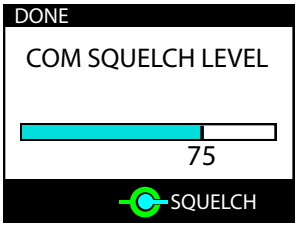


Figure 2.4.: Squelch control page

2.2.4 Intercom Control

The intercom control page can be accessed by pushing the ICM softkey on the volume control page.

Intercom volume and intercom VOX level can be individually configured. Intercom volume is the audio volume of the intercom audio output. Intercom VOX level is the sound level at which the intercom function is engaged / opened.

Use the inner knob to adjust intercom volume and the outer knob to adjust intercom VOX level.

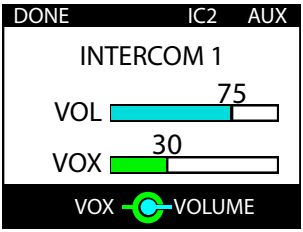


Figure 2.5.: Intercom control page

If the connected COM system features two independent intercoms, the second intercom can be accessed by psuhing the IC2 softkey softkey.

2.2.5 AUX Volume Control

Aux volume can be individually adjusted. The aux input can for example be used to connect an audio player, mobile phone, or external avionics system to the connected COM unit.

The aux input level control page can be accessed by pushing the AUX softkey on the intercom control page.

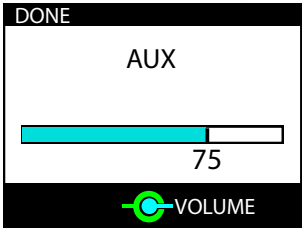


Figure 2.6.: Aux input level control page

2.3 Selecting a COM Channel

Channel selection always selects the STANDBY channel. In order to change the ACTIVE channel, the STANDBY and ACTIVE channel must be toggled.

2.3.1 Toggling STANDBY and ACTIVE Channel

To switch between ACTIVE and STANDBY COM channel (toggle), push the inner knob pushbutton on the main page.

2.3.2 Manual Channel Selection

To open the channel selection page, push the CHN softkey.

If the *KNOB USE* parameter in the configuration menu is set to *CHANNEL*, you can rotate the inner knob or the outer knob on the main page to access the channel selection page. Details on this parameter can be found in the section "Knob Use" on page 35.

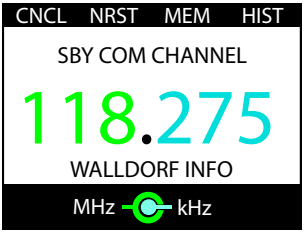


Figure 2.7.: Channel Selection Page

1. To open the channel selection page, push the CHN softkey on the main page.
2. To select a channel, use the inner knob for kHz selection and the outer knob for MHz selection.
3. Push the inner knob pushbutton to execute the channel selection and to exit the channel selection page to the main page.

You can exit the selection process, discard the selection, and return to the main page by pushing the CNCL softkey.

The inner knob always uses 25kHz steps for faster channel selection. To change the channel in 8.33kHz increments, you can push the inner knob pushbutton and simultaneously turn the inner knob.

2.4 Nearest and History Functions

2.4.1 Nearest Station Selection

The selection of nearest stations in ACD-57 requires GPS position data. Furthermore an installed station database (microSD card) is required. If no GPS position is available or no database is installed, the function is not available and the NRST softkey is not shown.

The nearest station list can be opened by pushing the NRST softkey. The NRST softkey is available on the channel selection page. In COM-only configuration, the NRST softkey is also available on the main page.

1. To open the channel selection page, push the CHN softkey on the main page.
2. To access the NEAREST station list, push the NRST softkey.
3. Use the inner knob to select a station.

4. Push the inner knob pushbutton to select the channel of the selected station and to exit the channel selection page to the main page.

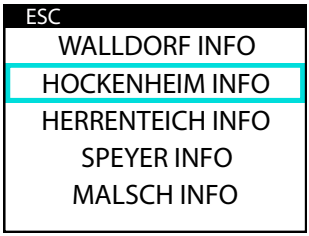


Figure 2.8.: NEAREST station list

You can exit the selection process, discard the selection, and return to the last page by pushing the ESC softkey.

2.4.2 Channel History

ACD-57 stores a history of selected channels in a recently-selected-channels list. Channels can be selected from this list.

The channel history list can be opened by pushing the HIST softkey. The HIST softkey is always available on the channel selection page. In COM-only configuration, the HIST softkey is also available on the main page.

1. To open the channel selection page, push the CHN softkey on the main page.
2. To access the history list, push the HIST softkey.
3. Use the inner knob to select a channel from the recently-selected-channels list.
4. Push the inner knob pushbutton to execute the channel selection and to exit the channel selection page to the main page.

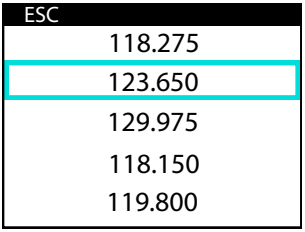


Figure 2.9.: Channel History List

You can exit the selection process, discard the selection, and return to the last page by pushing the ESC softkey.

2.5 Channel Memory

ACD-57 features a user-configurable channel memory. Fifteen COM user channels can be saved including an optional text name/identifier.

2.5.1 Select a Channel from Memory

The channel memory list can be opened by pushing the MEM softkey. The MEM softkey is available on the channel selection page.

1. To open the channel selection page, push the CHN softkey on the main page.
2. To access the memory list, push the MEM softkey on the channel selection page.
3. Use the inner knob to select a position / identifier from the memory list.
4. Push the inner knob pushbutton to execute the selection and to exit to the main page.

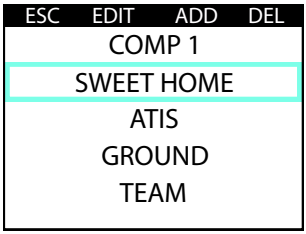


Figure 2.10.: Channel memory list

You can exit the selection process, discard the selection, and return to the last page by pushing the ESC softkey.

2.5.2 Store a Channel in Memory

1. To store a channel, enter the channel memory list and push the ADD softkey.
2. Select the desired channel using the inner knob (kHz) and outer knob (MHz). Push the inner knob pushbutton to execute the channel selection and to get to a text input page where you can enter an identifier for the stored channel.
3. Use the outer knob to select a position in the text and the inner knob to select a character. Push the inner knob pushbutton to execute the identifier text input and to store the channel to the memory list.

Figure 2.11.: Channel storing process in channel memory list

You can undo the storing process and return to the last page by pushing the CNCL softkey.

2.5.3 Editing a Stored Channel

1. To edit a stored channel, enter the channel memory list, use the inner knob to select a position/identifier, and push the EDIT softkey to edit the selected position/identifier.
2. Select the desired channel by using the inner knob (kHz) and outer knob (MHz). Push the inner knob pushbutton to execute the channel selection and to get to a text input page where you can edit the name for the stored channel.
3. Use the outer knob to select a position in the name and the inner knob to select a character. Push the inner knob pushbutton to execute the name selection and to store the channel in the memory list.

Figure 2.12.: Channel editing process in channel memory list

You can undo the selection/editing process and return to the main page by pushing the CNCL softkey.

2.5.4 Sorting the Channel Memory List

1. To sort the channel memory list, enter the channel memory list, use the inner knob to select a position/identifier that shall be repositioned in the list.
2. Push the inner knob pushbutton, hold and simultaneously rotate inner knob to move the position/identifier within the list.
3. Release the inner knob pushbutton as soon as the position/identifier is in the desired place in the list.

2.5.5 Deleting a Stored Channel

1. To delete a stored channel, enter the channel memory list, use the inner knob to select a position, and push the DEL softkey to delete the selected position.

> The position is instantly deleted, there is no way to undo the process.

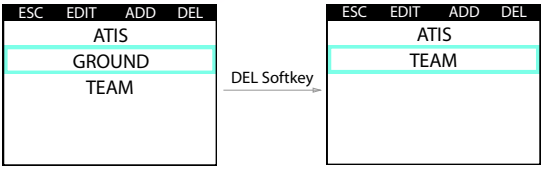


Figure 2.13.: Channel deletion process in channel memory list

2.6 RX/TX Indication and Stuck PTT Function

2.6.1 RX/TX Indication

The current receiver/transmitter status is shown on the main page. If radio messages are sent or received, a little indicator is shown.

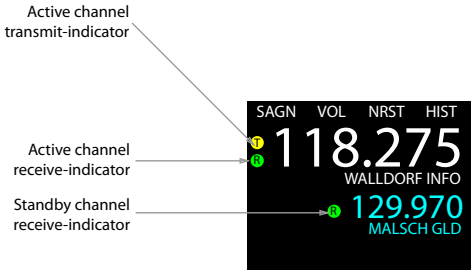


Figure 2.14.: RX and TX indicators explained

2.6.2 Last RX Indication

To indicate the channel on which the last transmission was received, a little indicator is shown next to that channel for a duration of 50 seconds after the end of the last incoming transmission or until another transmission is received.

Figure 2.15.: Last RX indicator

2.6.3 Stuck PTT Indication

If the connected COM unit features a “stuck PTT detection” or a “stuck PTT timeout”, the status of a “stuck PTT” being detected is indicated on the main page by a crossed-out transmitter symbol as shown below or by an COM error message (depending on the type of the connected COM device).

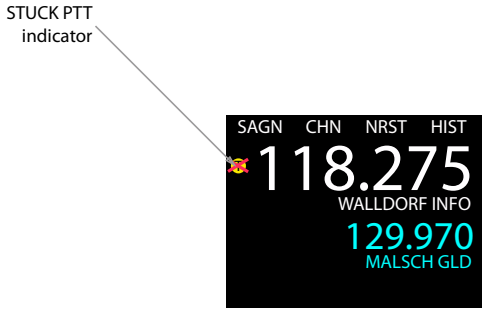


Figure 2.16.: Stuck PTT indicator

2.7 Say Again Function

If the connected COM unit features a recording or “say again”-function, the function is accessed through the SAGN softkey on the main page.

If the SAGN softkey on the main page is pushed (short push), the last recorded transmission is replayed. A replay indicator appears on the main page while the replay is active.

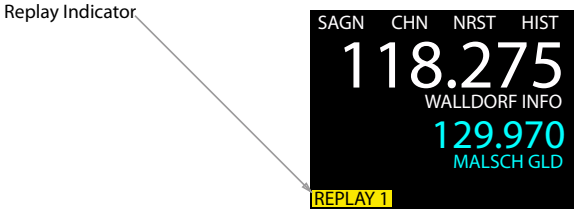


Figure 2.17.: SAGN softkey has been pushed, replay function is active

> The replay can be interrupted by a received transmission. Actual transmissions normally have priority. This however depends on the setup of the connected COM system. Please inform yourself on ground about the configuration and behavior of the connected COM system before using the function in flight.

ACD-57 supports replay of several transmissions (depends on capacity of connected COM system). By pushing the SAGN softkey again, you can replay earlier transmissions. The number on the replay indicator shows the current position.

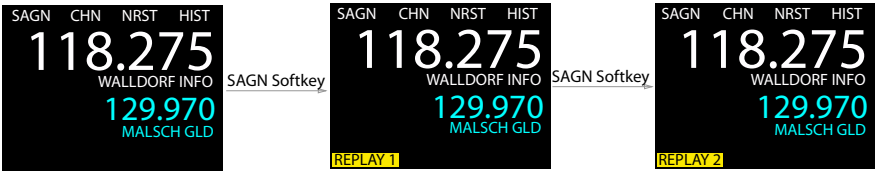


Figure 2.18.: SAGN softkey has been pushed, replay function is active and SAGN softkey is pushed again to replay an earlier transmission.

3 XPDR Operation

3.1 Introduction

ACD-57 is capable of controlling a connected XPDR unit. ACD-57 can serve as primary means for control of a XPDR unit including XPDR unit setup, squawk code selection and mode control.

Multiple ACD-57 can be installed on one XPDR unit.

> Familiarization of specific installation conditions in an aircraft, e.g. number of connected devices and topology is recommended before using ACD-57.

3.1.1 XPDR user interface

Squawk code[1], XPDR mode and transferred altitude (i.e. the altitude sent out by the connected XPDR system when replying) are displayed on the main page. Additionally a reply indicator shows if the transponder is currently replying to an interrogation.

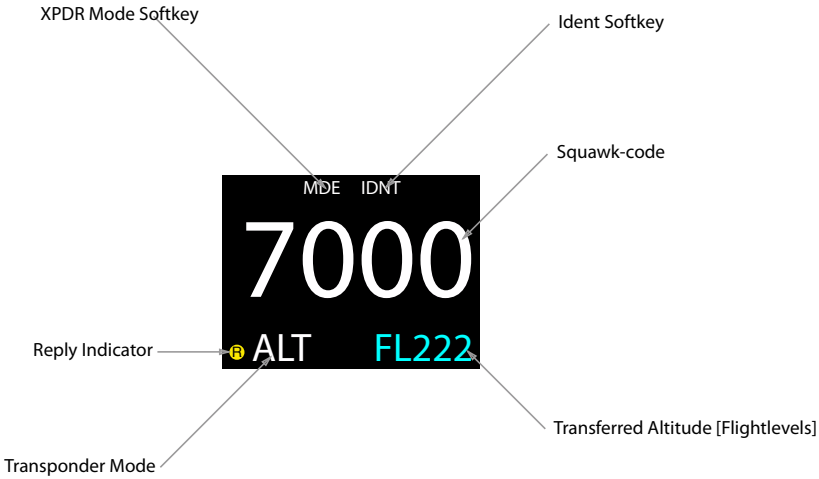


Figure 3.1.: XPDR user interface on Main Page

[1] "Squawk Code" here refers to the ATCRBS 4096 reply code. Details on the terminus "squawk" can be found here: https://en.wikipedia.org/wiki/Transponder_(aeronautics)

3.2 Selecting a Squawk Code

To enter the XPDR page, rotate the inner knob or the outer knob on the main page (in XPDR-only configuration) or push the XPDR softkey (in a configuration with VHF transceiver and XPDR).

1. on the main page, rotate the inner knob or push the XPDR softkey to enter the XPDR page.
2. Use the outer knob to select a position in the squawk code and use the inner knob to adjust the selected position's value.
3. Push the inner knob pushbutton to execute the selected squawk code and to exit to the main page.

Alternatively, you can use the softkey 2 to toggle between the preset VFR squawk and the last non-VFR squawk. Then push the inner knob pushbutton to confirm the squawk code.

> You can undo the squawk code selection and return to the main page by pushing the CNCL softkey

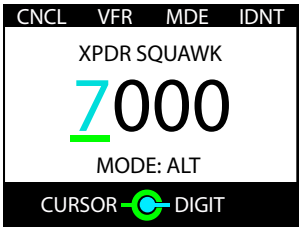


Figure 3.2.: XPDR page: Squawk code selection and other options for the transponder

3.3 Using the Ident Function

Push the IDNT softkey to initiate the ident function. This also confirms the currently selected squawk code. The IDNT softkey is always available on the XPDR page. In XPDR-only configuration, the IDNT softkey is also available on the main page.

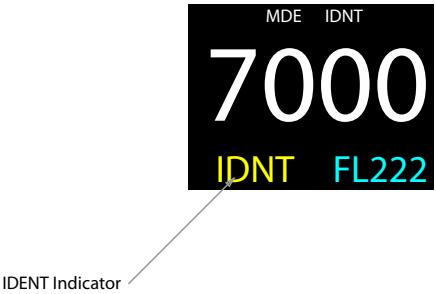


Figure 3.3.: Ident function is active. *IDNT* is shown instead of the normal mode indication as long as the ident feature is active.

3.4 Changing XPDR Mode

ACD-57 supports selection of the following XPDR Modes by the flight crew:

- SBY – XPDR is inactive. In this mode it does not draw power.
- ALT – Active Mode, also called "Altitude Mode". This is the normal mode in flight.
- ON – Alt Inhibit Mode, no altitude data is transmitted.

3.4.1 Normal Mode Selection

A short push on the MDE softkey switches between SBY (Standby Mode) and ALT (Active Mode). It also confirms the currently selected squawk code. The MDE softkey is always available on the XPDR page. In XPDR-only configuration, the MDE softkey is also available on the main page.

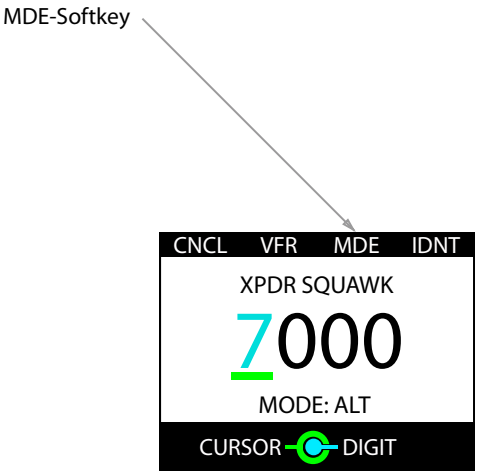


Figure 3.4.: MDE softkey on the XPDR page

3.4.2 Altitude Inhibit Mode

A long push on the MDE softkey switches to ON (ALT Inhibit Mode). In this mode, no altitude information is transmitted.

> The use of this mode is only recommended if requested by air traffic control.

Another long push on the MDE softkey switches from ON (ALT Inhibit Mode) to SBY (Standby).

3.4.3 GND Mode

GND mode (All Call Inhibit Mode) is an optional, special XPDR mode that is automatically engaged if the aircraft is on ground. The installation and correct configuration of an On-Ground-Switch is required. To indicate this mode, a special GND flag is shown.

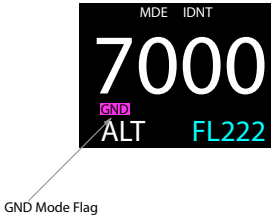


Figure 3.5.: GND mode flag. On-Ground-Switch is required. Due to regulatory requirements, GND mode can not be selected manually.

4 Altimeter Operation

ACD-57 is capable of determining and displaying a precise pressure altitude and can be used as primary means of altimetry.

4.1 Altimeter User Interface

The current altitude is displayed numerically and with a tape-style indicator, or trend indicator. Depending on device configuration and other display content, the size of the altitude display may vary.

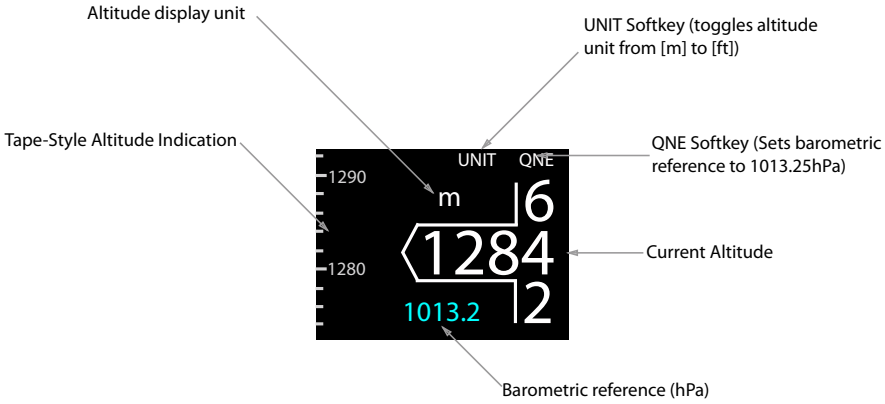


Figure 4.1.: Altimeter user interface

Units to display altitude and barometric pressure are user configurable. Altitude can be displayed in feet or meters, barometric pressure can be displayed in inches mercury or hectopascals (which equals millibars).

4.2 Adjusting Barometric Reference

To enter the barometric reference selection page, rotate the inner knob or the outer knob on the main page (In altimeter-only configuration) or push the BARO softkey (if additionally a VHF transceiver and/or a XPDR is controlled).

1. on the main page, rotate the inner knob or push the BARO softkey to enter the barometric reference selection page.
2. Use the inner knob and outer knob to adjust the current barometric reference.

3. Push the inner knob pushbutton to save the setting and to exit to the main page.

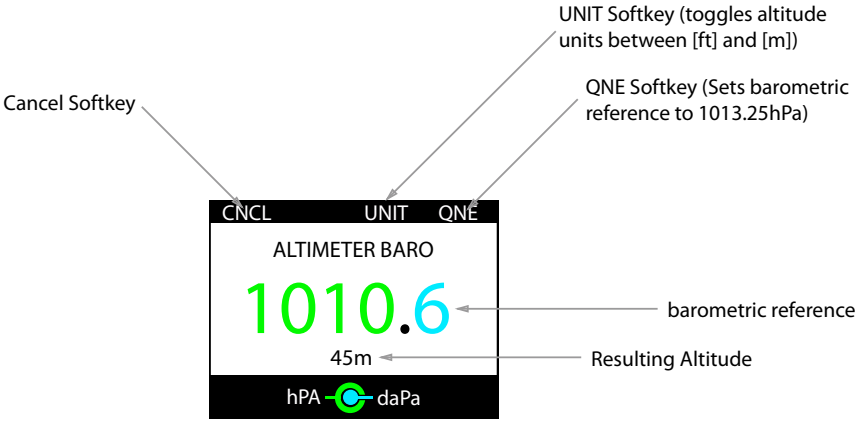


Figure 4.2.: Barometric reference selection page

The QNE softkey can be used to set the barometric reference to standard pressure (1013.25 hPa or 29.92 inHG). If the altimeter is already set to standard pressure, the softkey 4 will instead show the last non-standard barometric reference, so that the pilot can quickly toggle between standard pressure and some other reference.

4.3 Altitude Display Unit

With the UNIT softkey it is possible to toggle quickly between feet and meters as altitude display unit.

5 Combined Functions

ACD-57 can be used to control a VHF transceiver and an ATC Radar Beacon System (XPDR) at the same time. Additionally it can display altitude. Any combination of these three functions is possible and depends on configuration and connected subsystems.

5.1 COM, Transponder, and Altimeter Combined

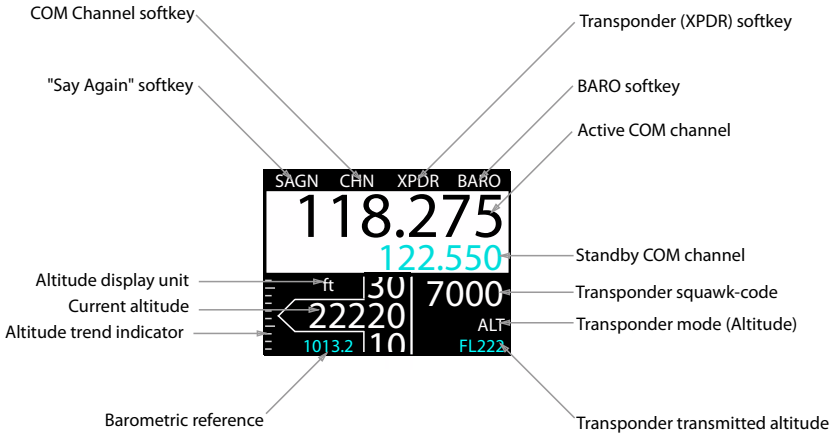


Figure 5.1.: User interface with COM, transponder, and altimeter functions combined.

5.2 COM and XPDR Combined

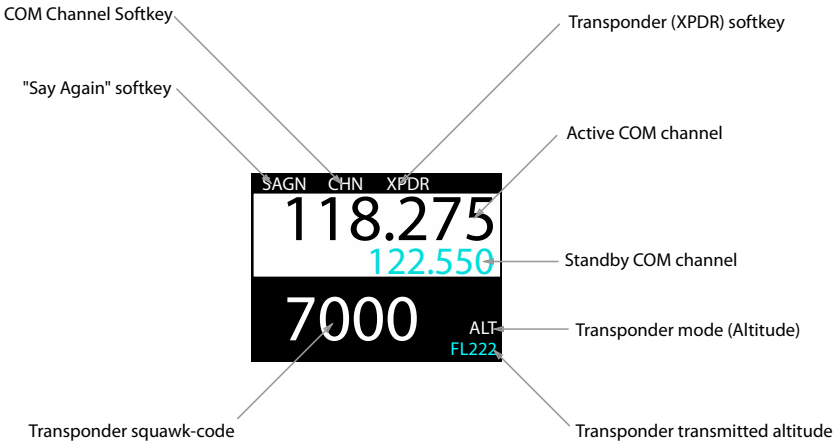


Figure 5.2.: User interface with COM and transponder functions combined.

5.3 COM and Altimeter Combined

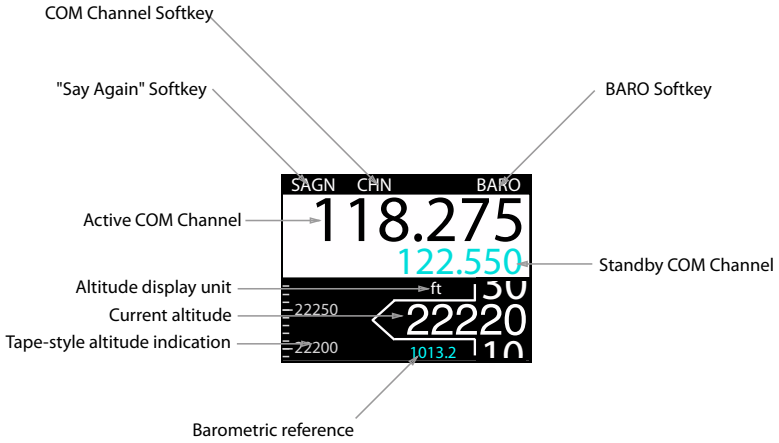


Figure 5.3.: User interface with COM and altimeter functions combined.

5.4 XPDR and Altimeter Combined

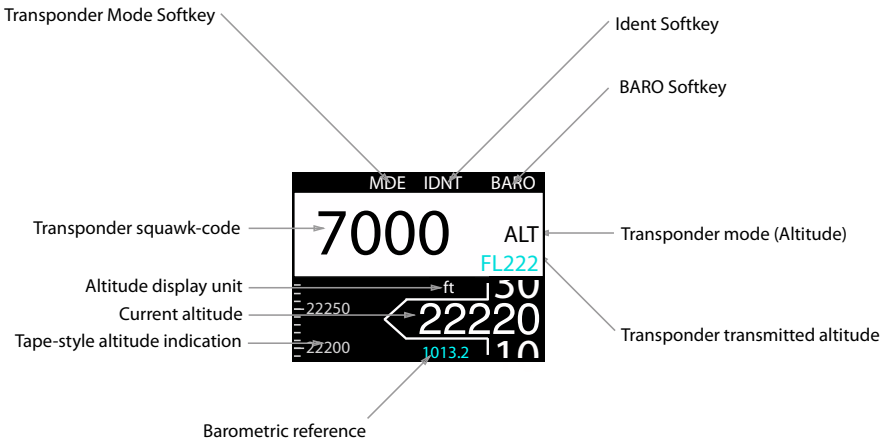


Figure 5.4.: User interface with transponder and altimeter functions combined.

6.1 Configuration Operations

6.1.1 Configuration Menu

ACD-57 is configured in the configuration menu. To enter the configuration menu, push the inner knob pushbutton for at least 2 seconds (long push). The menu contains several configuration options and informations about ACD-57 and connected systems.

Please find a menu diagram in appendix B

6.1.2 Pin Code Protection

This manual contains only a few configurable parameters. These parameters are always accessible to the flight crew. The ACD-57 has many more configurable parameters and a large configuration menu. Due to safety reasons and regulatory requirements, not all configuration parameters are readily accessible. Many configuration menu levels require the entry of a pin code before they can be accessed. Pin codes can be entered in *CONFIGURATION MENU → PIN CODE*.

For a detailed overview of all configurable parameters and their recommended values, please consult the ACD-57 installation manual.

6.2 Device Configuration

In the configuration menu, *DEVICE* contains information about the ACD-57 device itself.

6.2.1 Info

In the *DEVICE* menu, *INFO* contains specific information about the ACD-57 device such as hardware and software version information.

6.2.2 Status

In the *DEVICE* menu, *STATUS* contains information about the power supply voltage, the position data source, and the pressure data source.

6.2.3 Illumination Override

In the *DEVICE* menu, *ILLUMIN OVERRIDE* the current display and knob illumination level can be manually set.

Until the next restart of the ACD-57, this setting overrides the current illumination configu-

ration that has been entered during device installation. After a restart, the illumination configuration that has been entered during installation is restored.

To override the illumination configuration, please carry out the following steps:

1. Open the menu with a long push on the inner knob pushbutton.
2. Use the inner knob to navigate to *DEVICE → ILLUMIN OVERRIDE*
3. Once the illumination override page is entered, the illumination configuration is shown. Use the inner knob to override the illumination configuration and to enter a manual value.
4. Push the inner knob pushbutton to execute your selection.
5. Push the ESC softkey to leave the menu.

To reset the override and get back to the illumnation configiuration entered during installation, push the RESET softkey.

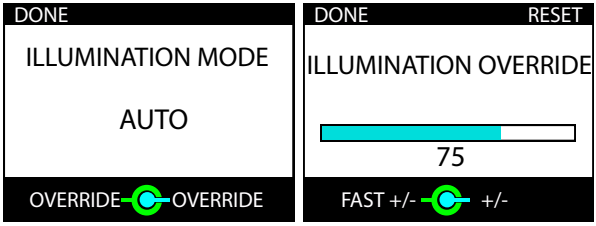


Figure 6.1.: Illumination override page. On the left the automatic illumination configuration is active, current illumination mode is shown. On the right the override is active.

6.3 Altimeter Configuration

The *ALTIMETER* menu section contains specific configuration parameters for the integrated altimeter.

6.3.1 Units

Units for altitude and pressure are user configurable.

- Altitude units configurable to meters or feet
- Pressure units configurable to hectopascals (millibars) or inches of mercury

The default settings are *meters* and *hectopascals*. To change the altimeter units configuration, please carry out the following steps:

1. Open the menu with a long push on the inner knob pushbutton.
2. Use the inner knob to navigate to *ALTIMETER* → *UNITS*.
3. Use the inner knob to navigate to a unit category, use the inner knob pushbutton to enter the menu.
4. Use the inner knob to select the desired unit.
5. Push the inner knob pushbutton to execute your selection.
6. Push the ESC softkey to leave the menu.

6.4 ACD-57 COM Control Configuration

The *COM CONTROL* menu section contains setup parameters for the control of a connected COM system.

6.4.1 Channel Spacing

The current channel spacing used in the ACD-57 can be selected in this parameter. It can be set to both, 25kHz, or 8.33kHz. If set to 25kHz, on the channel selection page, one inner knob rotation increment will change kHz in 25kHz steps. If set to 8.33kHz, one inner knob rotation increment will select every third channel (25kHz increments), and simultaneously pushing the inner knob pushbutton and rotating the inner knob will change kHz in 8.33kHz steps. If set to *BOTH*, all channels (those in the 8.33kHz channel definition and 25kHz frequencies) are selectable. The default setting for this parameter is *BOTH*.

> This parameter only sets the displayed channel naming in ACD-57. It does not affect physical frequencies or separation transferred to the connected COM system.

To change the channel spacing configuration, please carry out the following steps:

1. Open the menu with a long push on the inner knob pushbutton.
2. Use the inner knob to navigate to *COM CONTROL* → *CHN SPACING*.
3. Use the inner knob to select a desired spacing (*BOTH*, *25kHz*, or *8.3kHz*).
4. Push the inner knob pushbutton to execute your selection.
5. Push the ESC softkey to leave the menu.

6.4.2 Station Names

This parameter can be switched to *ON* in order to show station names on the main page of the COM user interface. If set to *OFF*, station names are not shown on the main page, but are still shown and used on other pages. The default setting for this parameter is *ON*.

> The display of station names in ACD-57 requires GPS position data and an installed station database (microSD card). If no GPS position data or no station database is available, station names are not shown and position based radio channel selection is disabled.

> Station names are only shown for stations within a distance of approx. 20 miles from the aircraft's current position.

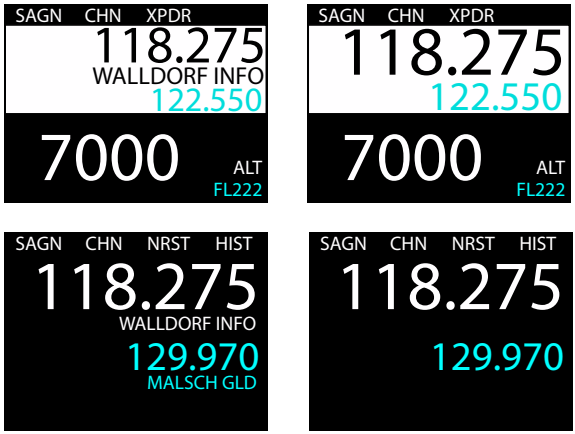


Figure 6.2.: COM main page with *STATION NAMES* parameter set to *ON* on the left and to *OFF* on the right. Please note that in COM only configuration, station names for both standby and active channel are shown. In all other configurations, only the active channel station name is shown.

To change this configuration, please carry out the following steps:

1. Open the menu with a long push on the inner knob pushbutton.
2. Use the inner knob to navigate to *COM CONTROL* → *STATION NAMES*.
3. Push the inner knob pushbutton to toggle between YES and NO.
4. Push the ESC softkey to leave the menu.

6.4.3 Knob Use

With this parameter the primary use of the inner knob and outer knob on the main page can be selected. The inner knob pushbutton function remains unaffected of this setting (always toggles active/standby channels). The default setting for this parameter is *VOLUME*.

It can be set to *VOLUME* in order to open the volume control page when turning the inner knob or the outer knob. In this case softkey 2 will have the function to open the channel selection page.

It can also be set to *CHANNEL* in order to open the channel selection page when turning the inner knob or the outer knob. In this case softkey 2 will have the function to open the volume control page.

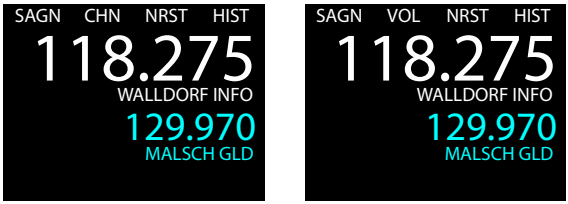


Figure 6.3.: COM main page with *KNOB USE* parameter set to *VOLUME* on the left and to *CHANNEL* on the right.

> In aircraft with no audio panel or intercom, we recommend to use the default setting (*KNOB USE* set to *VOLUME*). If an audio panel/intercom is used, it may not be required to change COM volume frequently. In this case, setting the *KNOB USE* parameter to *CHANNEL* is recommended for easier channel selection.

To change the knob use configuration, please carry out the following steps:

1. Open the menu with a long push on the inner knob pushbutton.
2. Use the inner knob to navigate to *COM CONTROL* → *KNOB USE*.
3. Use the inner knob to to select a desired option (*VOLUME* or *CHANNEL*).
4. Push the inner knob pushbutton to execute your selection.
5. Push the ESC softkey to leave the menu.

6.5 Connected COM System Configuration

The *COM SYSTEM* section contains setup parameters for a connected VHF transceiver. Depending on the type of connected VHF transceiver, different parameters are available. Where possible, menu parameter names are consistent to parameter names in the VHF transceiver's documentation.

> Please note that in dual ACD-57 installations that if a Becker 620X or Dittel/TQ KRT2 is controlled, the *COM SYSTEM* menu section is only available on the display the VHF transceiver is directly connected to.

Please consult the VHF transceiver's documentation for details on parameters and recommended values.

6.6 ACD-57 XPDR Control Configuration

The *XPDR CONTROL* section contains setup parameters for the control of a connected XPDR system.

6.6.1 VFR Preset

Here a preset value for the VFR squawk code can be entered. This value is used when the *VFR Softkey* is pressed on the XPDR page.

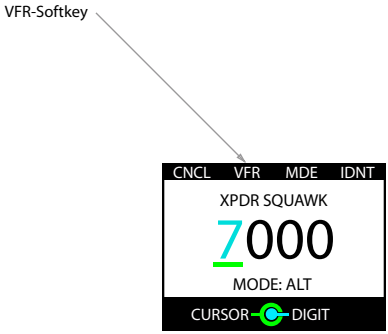


Figure 6.4.: VFR softkey on the XPDR page. The squawk code entered in the *VFR PRESET* parameter is set if the softkey is pushed.

To change the VFR squawk code preset, please carry out the following steps:

1. Open the menu with a long push on the inner knob pushbutton.
2. Use the inner knob to navigate to *XPDR CONTROL* → *VFR PRESET*.
3. Use the outer knob to select a position/digit and the inner knob to change the value at this position.
4. Push the inner knob pushbutton to execute your selection.
5. Push the ESC softkey to leave the menu.

6.7 Connected XPDR System Configuration

The *XPDR SYSTEM* section contains setup parameters for a connected XPDR system. Please consult the XPDR system's documentation for details on parameters and recommended values.

Note that for the VT-01, the system state, software versions, and configuration is not known to the ACD-57 unless the VT-01 has been set to ALT mode at least once during the runtime of the ACD-57.

6.7.1 Flight ID

In this menu, a flight ID can be entered. The flight ID must correspond to the aircraft identification specified in item 7 of the ICAO flight plan, or, when no flight plan has been filed, the aircraft registration.

To enter a flight ID, please carry out the following steps:

1. Open the menu with a long push on the inner knob pushbutton.
2. Use the inner knob to navigate to *XPDR SYSTEM* → *FLIGHT ID*.
3. Use the outer knob to select a position/digit and the inner knob to change the value at this position.
4. Push the inner knob pushbutton to execute your selection.
5. Push the ESC softkey to leave the menu.

7 Software and Station Database Updates

7.1 Version Identification

The software version can be reviewed in *CONFIGURATION MENU* → *DEVICE* → *INFO*.

7.2 Software/Database Loading

Software updates and the station database are loaded using the integrated microSD card slot and a microSD memory card.

While the software is actually loaded onto the device, the station database remains on the microSD card. Therefore database information is only accessible if the microSD card is installed.

> If the microSD card is not installed, database functions will not be available.

> Never remove the microSD card while the device is in operation. If the microSD card is removed from the device during runtime, the device's software may stop working. In this case a system restart would be required.

7.2.1 microSD Card Slot

A microSD card slot is located on the right side of the unit's front panel. A microSD memory card can be inserted and removed from the device.

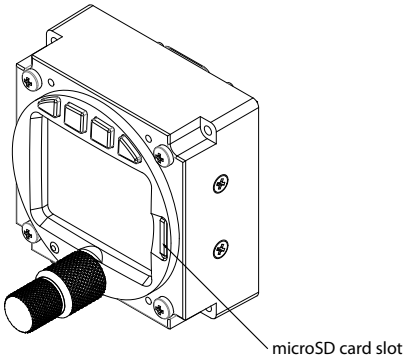


Figure 7.1.: microSD Card Slot

To insert a microSD card, insert the card into the slot, print facing to the display, little nose facing upwards and gently push the card until it clicks in.

Inserting the microSD card in the wrong orientation may damage the slot.

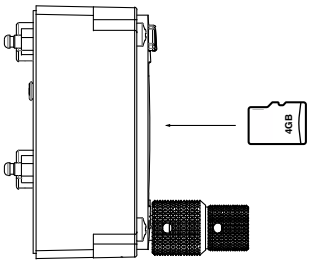


Figure 7.2.: microSD card in correct orientation

To remove an inserted microSD card, use your fingernail to gently push on the card until a click is audible. The card will be released following the click. Use your fingernail to remove the card.

Be careful. Application of too much force may damage the slot.

ACD-57 is compatible to all FAT or FAT32 formatted microSD cards. It has been successfully tested with microSD cards with a storage size of 2 to 64 gigabytes.

7.2.2 Using a Station Database

To use a database, please carry out the following steps:

1. Purchase a valid station database file in the *AIR Avionics License Store*. Please visit *http://www.air-avionics.com/license* for details.
2. Load the station database file onto a microSD card.
3. Insert the microSD card into the ACD-57.
4. Power the unit on.
5. Open the menu with a long push on the inner knob pushbutton.
6. Use the inner knob to navigate to *CONFIGURATION MENU* → *DEVICE* → *INFO* → *DATABASES*.
7. Verify correct installation in the databases list.
8. Push the ESC softkey to leave the menu.

When the database license expires, the database can no longer be used and database functions are no longer available.

The station database and related functions are only available while the microSD card holding the station database file is inserted. If the microSD card is removed, the database and all related functions are unavailable.

7.2.3 Loading Software to ACD-57

For details on loading new software onto ACD-57, please consult the ACD-57 Installation Manual [1].

ACD-57 features a range of built-in self test features that continuously monitor system state and the state of connected systems to detect failures.

8.1 Failures

The detection of a failure is always annunciated to the flight crew on the display.

Depending on detected failure and failure severity, the system may seize to function or functionality may be limited. Failure messages either close automatically, can be closed by the flight crew, or can not be closed at all depending on failure severity.

Figure 8.1.: Major internal failure annunciation

8.2 Insufficient Data Failure Modes

8.2.1 No data from connected systems or internal systems

ACD-57 continuously monitors data from connected systems or its own internal hardware and software systems. If data is not regularly updated, it is no longer displayed. Instead the corresponding value is “crossed out” by a red cross (in case of entire systems that fail to respond) or yellow crosses (if single datasets in the menu expire).

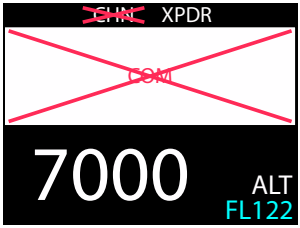


Figure 8.2.: No data/communication with connected COM system.

8.2.2 No GPS Data and/or No Database Installed

Some functions require a Database on an inserted microSD memory card and valid GPS position data. These are:

- Display of station names on the main page or the channel selection page.
- Nearest station list functions

If no GPS position data or database is available, station names are not displayed on the main page or the channel selection page. If trying to access the nearest station list by pushing the NRST softkey, an information message appears indicating that this function is not available. The message can be acknowledged by pushing the inner knob pushbutton.

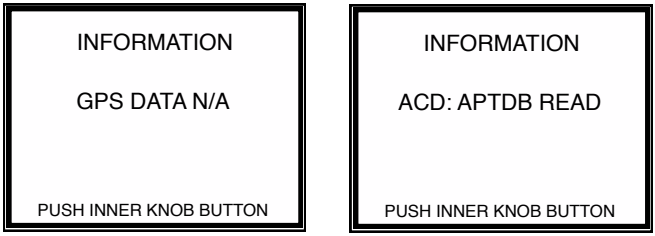


Figure 8.3.: Message indicating that database is not available (right) and GPS data is not available (left)

8.3 Systems Failures

8.3.1 Failure Condition Classification

Depending on failure severity and its consequences for the operational state of the system, ACD-57 distinguishes between two following failure classifications:

- Fatal Failure
- Reduced Function Failure

8.3.2 Fatal Failures

In case of a fatal failure, the failed system has seized operation. This can not be recovered during runtime, a restart is required.

A fatal failure message is displayed in *red* color and will remain visible for the rest of the runtime of the system.

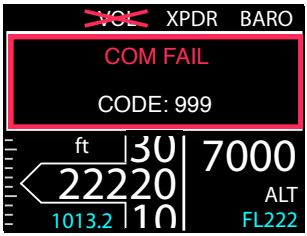


Figure 8.4.: Connected COM system has detected a fatal failure, failure code is displayed. Unaffected systems remain functional.

8.3.3 Reduced Function Failures

In case of a fatal failure, the failed system has an issue and functionality is limited/reduced. Some functions of the system may still be available.

A reduced function failure message is displayed in *amber* color and will disappear within 5 seconds. After that, the failed system will be enframed by an *amber* rectangle.

Figure 8.5.: Reduced function failure message (left) and system with reduced function after failure message has disappeared (right)

8.3.4 Failure Codes

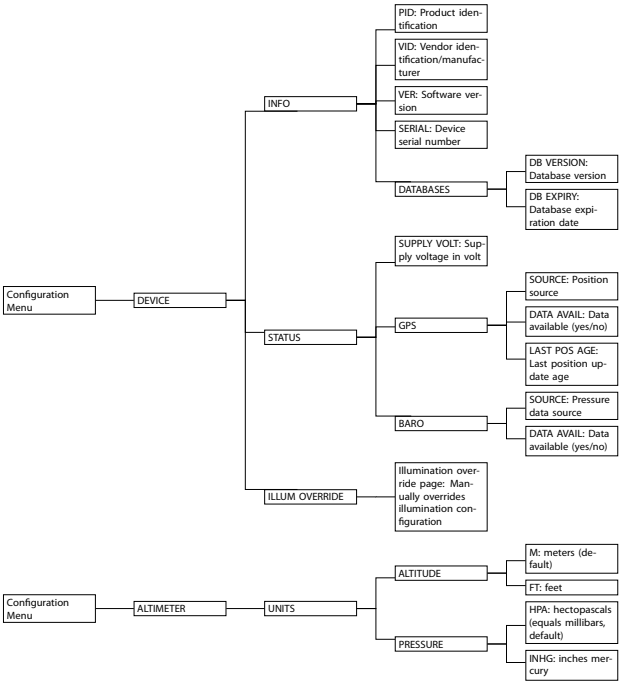
Whenever available, failure codes are shown. All current failure codes and overall system state can be reviewed in *CONFIGURATION MENU* → *FAILURES*.

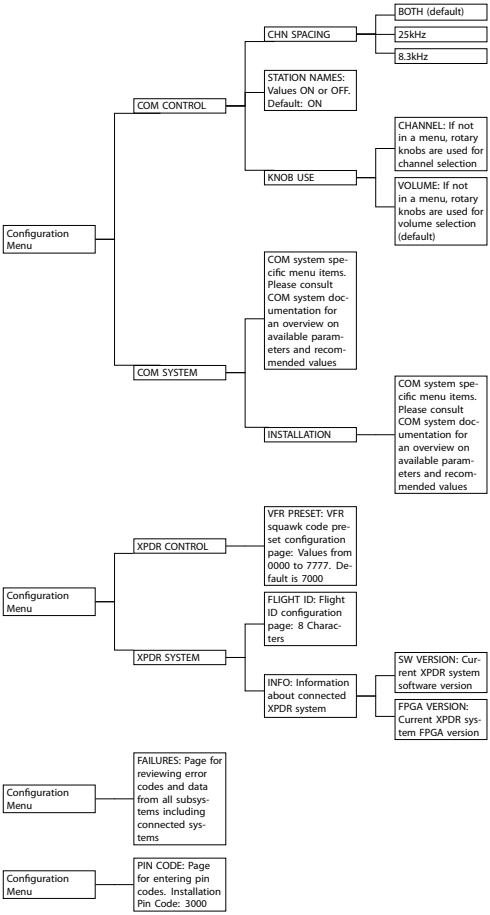
> For failure code identification, please consult the manual of the affected system

A Bibliography

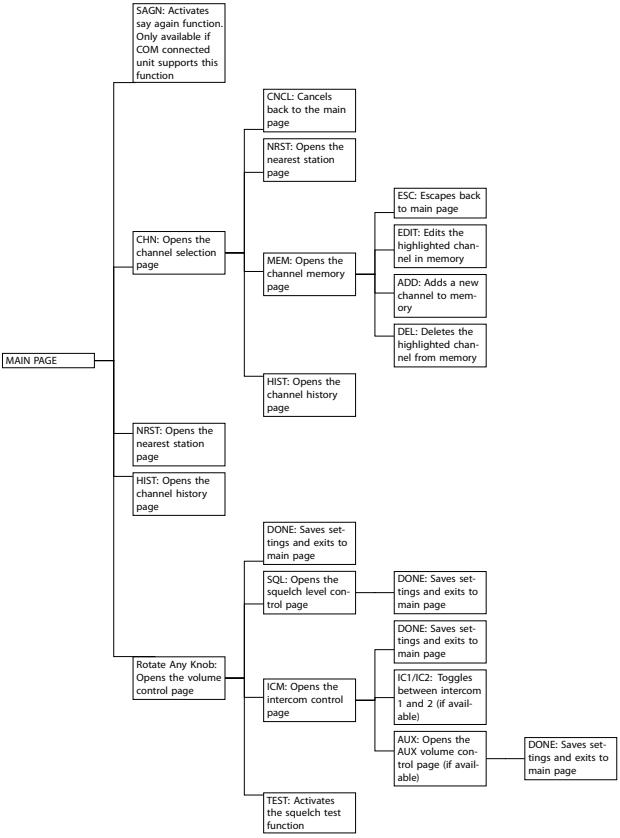
[1] AIR Avionics, *ACD-57: Installation Manual*, March 2018.

This menu diagram only shows the basic configuration parameters accessible to the flight crew. For a complete menu diagram including all pin code protected parameters, please consult the ACD-57 Installation Manual [1].



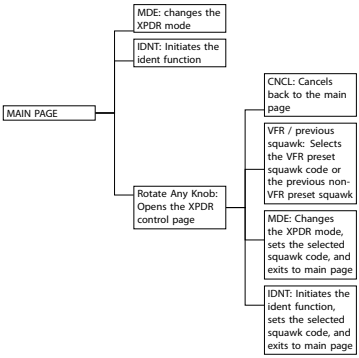

Configuration Menu
COM CONTROL
CHN SPACING
BOTH (default)
25kHz
8.3kHz
STATION NAMES: Values ON or OFF. Default: ON
KNOB USE
CHANNEL: If not in a menu, rotary knobs are used for channel selection
VOLUME: If not in a menu, rotary knobs are used for volume selection (default)
COM SYSTEM
COM system specific menu items. Please consult COM system documentation for an overview on available parameters and recommended values
INSTALLATION
COM system specific menu items. Please consult COM system documentation for an overview on available parameters and recommended values
Configuration Menu
XPDR CONTROL
VFR PRESET: VFR squawk code preset configuration page: Values from 0000 to 7777. Default is 7000
XPDR SYSTEM
FLIGHT ID: Flight ID configuration page: 8 Characters
INFO: Information about connected XPDR system
SW VERSION: Current XPDR system software version
FPGA VERSION: Current XPDR system FPGA version
Configuration Menu
FAILURES: Page for reviewing error codes and data from all subsystems including connected systems
Configuration Menu
PIN CODE: Page for entering pin codes. Installation Pin Code: 3000

C.1 COM Control Only Softkeys

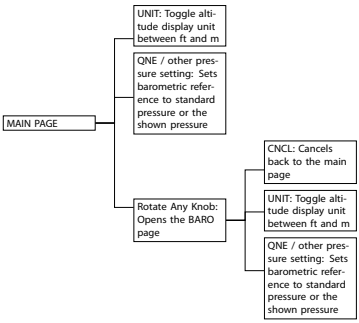


Please note that depending on the setup of the *KNOB USE* parameter, the CHN softkey on the main page may be replaced by a VOL softkey (volume control) and rotation of inner knob or outer knob will open the channel selection page.

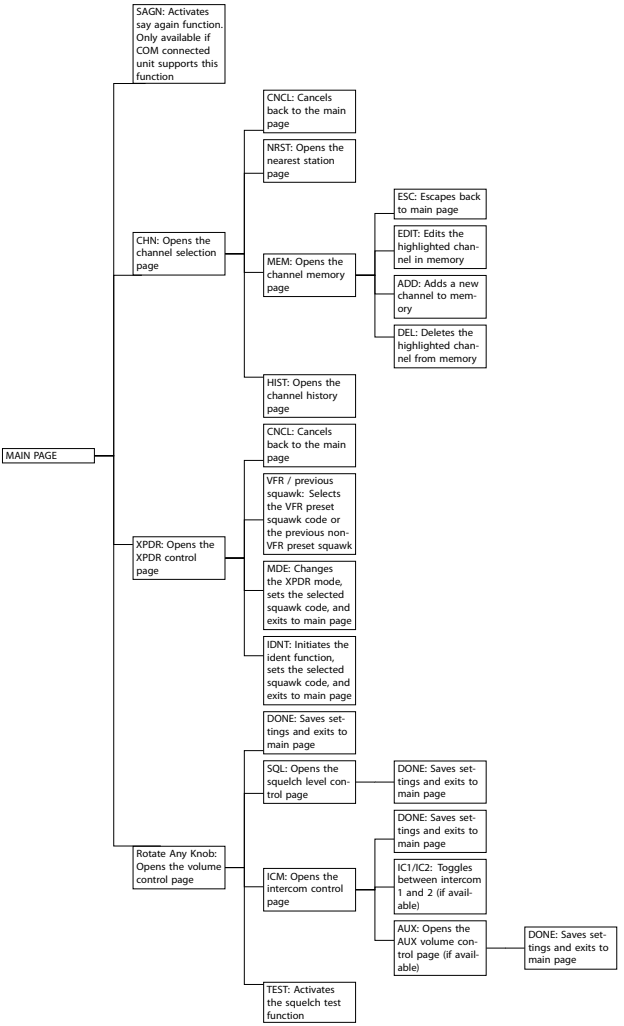
C.2 XPDR Control Only Softkeys



C.3 Altimeter Only Softkeys

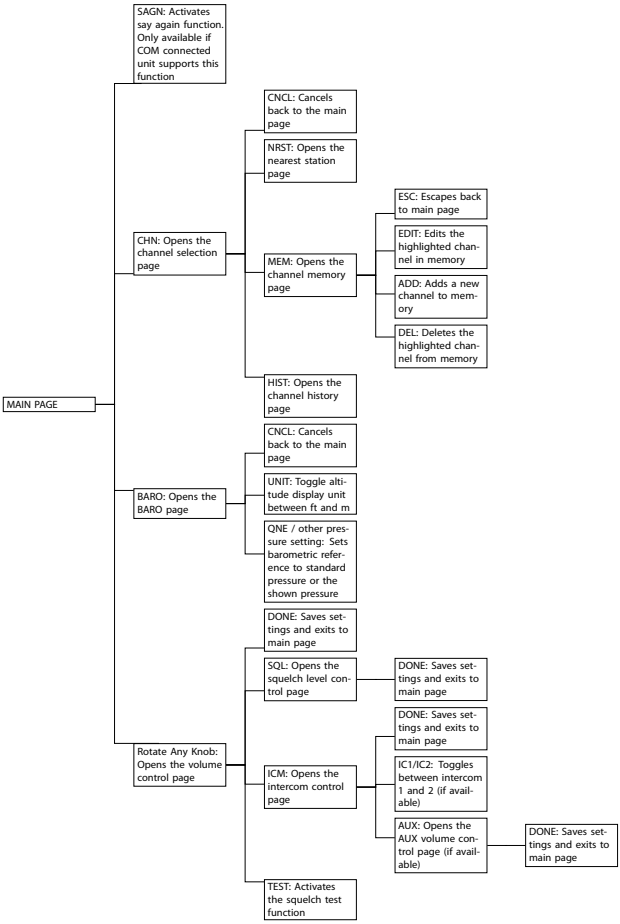


C.4 COM and XPDR Control Softkeys



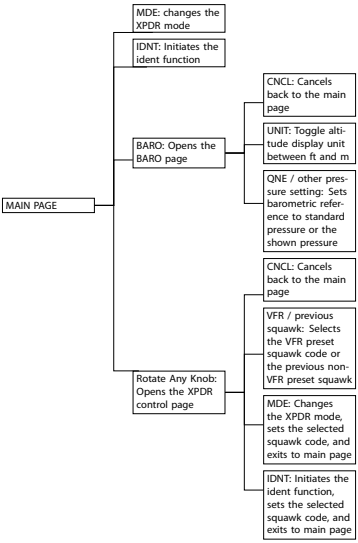
Please note that depending on the setup of the *KNOB USE* parameter, the CHN softkey on the main page may be replaced by a VOL softkey (volume control) and rotation of inner knob or outer knob will open the channel selection page.

C.5 COM and Altimeter Control Softkeys

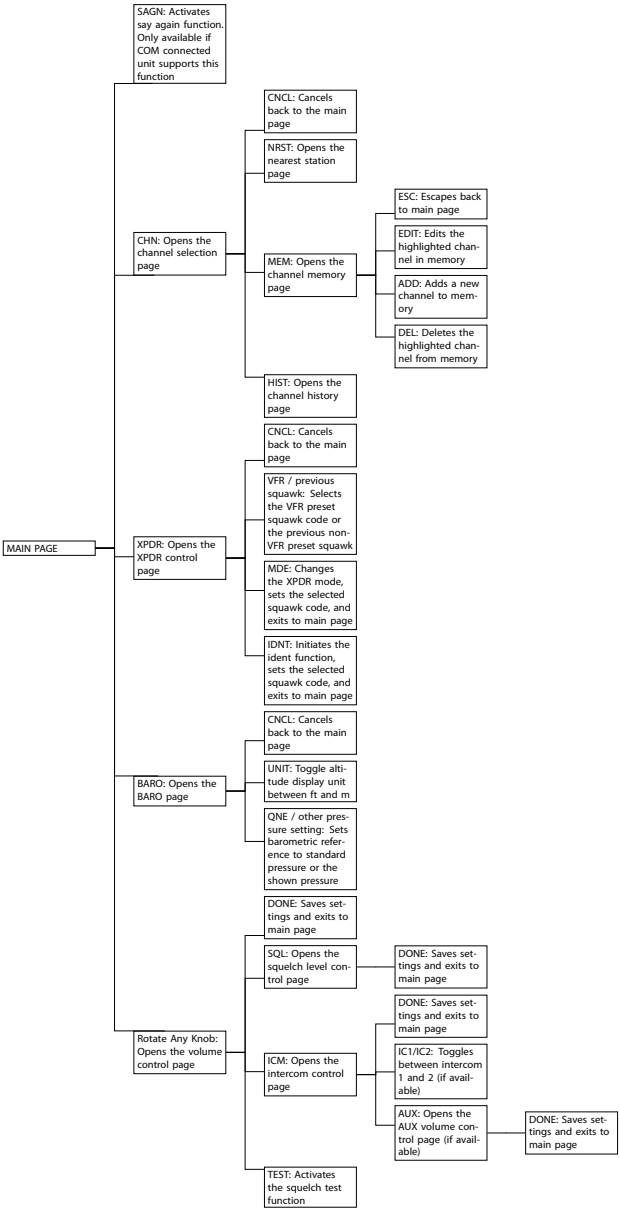


Please note that depending on the setup of the *KNOB USE* parameter, the CHN softkey on the main page may be replaced by a VOL softkey (volume control) and rotation of inner knob or outer knob will open the channel selection page.

C.6 XPDR Control and Altimeter Softkeys



C.7 COM, XPDR Control, and Altimeter Softkeys



Please note that depending on the setup of the *KNOB USE* parameter, the CHN softkey on the main page may be replaced by a VOL softkey (volume control) and rotation of inner knob or outer knob will open the channel selection page.

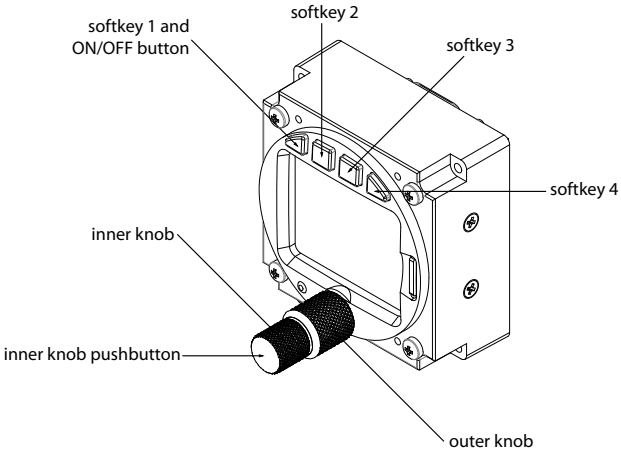


Figure D.1.: ACD-57 pilot controls

D.1 Switch On or Off

If not switching on automatically, push softkey 1 , the leftmost button on top of the display, to switch the unit on. To switch the unit off, push softkey 1 longer than 4 seconds.

D.2 COM Operation

D.2.1 Volume Control

On the main page, the inner knob opens the volume control page. On the volume control page, the inner knob controls the ACTIVE channel volume, the outer knob controls the STANDBY channel volume.

D.2.2 Channel Selection

On the main page, a short push on the CHN softkey opens the channel selection page. On the channel selection page, the inner knob controls the kHz, the outer knob controls the MHz.

> To select 8.33kHz channels, push and turn the inner knob .

D.3 XPDR Operation

D.3.1 Squawk Code Entry

The squawk code is entered in the XPDR page. The XPDR page is opened by pushing the XPDR softkey on the main page. On the XPDR page, use the outer knob to select a position in the squawk code and use the inner knob to adjust the selected position's value. Push the inner knob pushbutton to confirm the squawk code.

D.3.2 XPDR Mode Change

To change the XPDR mode from SBY (Standby) to ALT (Active) or back, please push the MDE softkey on the XPDR page. This also confirms the currently selected squawk code.

D.3.3 XPDR Ident Function

To use the XPDR ident function, please push the IDNT softkey on the XPDR page. This also confirms the currently selected squawk code.

D.4 Altimeter Operation

To adjust the barometric reference, please push the BARO softkey on the main page. On the baro input page, use the outer knob to adjust hPa and the inner knob to adjust daPa. Push the QNE softkey to use standard pressure.

To toggle between feet and meters, use the UNIT softkey.

OPERATING MANUAL
FLARM COLLISION WARNING UNIT

Status
Software Version 5.00 (March 01, 2011)

This is a translation of the German manual.

Baar-Switzerland
www.flarm.com
info@flarm.com

1. Welcome to the FLARM user community

Thank you for purchasing FLARM, a modern low-cost collision-warning unit for sailplanes and light aircraft. The main task for FLARM is to support the pilot, while he scans the airspace ahead with his own eyes. FLARM is simple to use and does not distract the pilot from the main business in hand.

Sport flying is an activity that is associated with considerable risks for crew, passengers, third parties and other objects. **In order to make full and safe use of FLARM, it is absolutely essential to be fully aware of the risks, operating conditions, restrictions and limitations associated with the use of FLARM, ensure a proper installation and do regular software updates. This includes familiarity with and observance of this Operating Manual and the Installation Manual.** Additional configuration information can be found in the 'Data Port Specifications' document, e.g. how to suppress additional data at the serial port what might be required in international championships.

We welcome user feedback and reports, suggestions for improvements, and pictures that will help us make further improvements to FLARM. Feedback reports should give a detailed description of the situation, quoting the Hardware and Software versions used, plus the flight data records in IGC format with short time recording intervals.

The latest version of this handbook and other related documents can be found at the Website www.flarm.com. This Website also has answers to Frequently Asked Questions.

This Website also carries announcements when new software versions or functions become available. If you enter your name on the mailing list, you will automatically receive notification of changes as and when they happen: https://lists.flarm.com/mailman/listinfo/user-list_flarm.com

To use existing devices in March 2011 or later, it is required to update the software to version 4.00 or higher. Use the free PC installation software available at www.flarm.com. You need a PC with Windows 98 / ME / 2000 / XP with a serial port or a suited USB-serial converter plus a data-power cable like the one used for most IGC flight recorders. This cable connects the PC to FLARM and supplies FLARM with power. Ensure you have configured the correct PC COM-port, only use the Power/Data-port on FLARM (not the Extension-port) and know the printed device serial number. After completion of the software update, use the same PC software to load the most recent obstacle file to FLARM; this file is available on www.flarm.com as well. Then use the PC software to configure the flight recording functionality accordingly. In case of questions, contact your FLARM dealer.

Software-Versions 5.x must not be used after **March 01, 2015**. Before this date, you must update the device in order to use it in the air.

2. How it works

FLARM receives position and movement information from an internal 16 channel GPS receiver with an external antenna. A pressure sensor[1] further enhances the accuracy of position measurements. The predicted flight path is calculated by FLARM and the information - including a unique identifier - transmitted by radio as low-power digital burst signals at one-second intervals. Provided they are within receiving range, the signals are almost at the same time received by further aircraft also equipped with FLARM. The incoming signal is compared with the flight path predicted by calculation for the second aircraft. At the same time, FLARM compares the predicted flight path with known data on obstacles, including electric power lines, radio masts and cable cars.

If FLARM determines the risk of dangerous proximity to one or more aircraft or obstacles, the unit gives the pilot warning of the greatest danger at that moment. The warning is given by a whistle sound (beep) and bright light emitting diodes (LED). The display also gives indication of the threat level, plus the horizontal and vertical[1] bearing to the threat. During circling flight different methods of calculation are employed to those used during straight flight.

The GPS and collision information received from other aircraft can also be made available for third party equipment (e.g. external display, speech synthesizer, PDA) via a serial data output. Such equipment is available from a number of manufacturers.

[1] Requires Hardware Version 2 or higher. However, the vertical bearing on the serial data output is also available to third-party equipment on Hardware Version 1.

The operating range is very dependent upon the antenna installation in the aircraft. The normal range is about 2 km. In individual cases the range may be up to 5 km, which can be valuable for fast sailplanes with a speed of up to 250 kt, providing the pilots in both aircraft with a warning enabling visual identification and reaction to the potential hazard. The effective range can easily be verified with an online tool[2]. Warnings are given in order of the time remaining before a potential collision, not the geometrical distance. The first warning level for another aircraft or an obstacle is delivered when less than 18 seconds remain to the possible collision; the second warning level is delivered when less than 13 seconds remains; the third level when less than 8 seconds remains.

The warnings continue as long as FLARM calculates a threat of collision. The warning level may decline or be cancelled, depending upon the prediction. The warnings are selective; they are only issued if the calculation reveals a high probability of collision in the near future. The alarm sensitivity can be configured with the PC.

In addition, FLARM operates as an IGC-file compatible flight recorder including the G-record. Flight logs can be read out either via the SD-card or via the data port and a suitable cable. The SD card does not need to be carried on during the flight. FLARM is optionally also available as diamond-level IGC-*approved* Flight Recorder, optionally with Engine Noise Level sensor (ENL).

With the standard April 2008 obstacle databank there is memory for more than 50 hrs of flight recording at a 4s interval. Use the free PC-software to download flights to your PC and to properly configure your device for flight recording. Flight recording automatically starts when the aircraft is moving and ends when the unit is switched off. Switching off the device during the flight for a longer period results in separate flight record files. Allow at least 2 minutes (if the interval is 4s, our recommended value) after landing before you switch off the device else you loose the last part of the flight. Allow more time after landing if the interval is higher. When the memory is full, the oldest data is overwritten. Always download you flight data before you update the obstacle databank or the software.

FLARM applies for the radio communication between the units a proprietary patent- and copyright-protected protocol. It is not public, but FLARM Technology offers a license contract where it is accessible in the form of a compatible core design ready for integration into 3rd party systems. These systems are officially declared as FLARM-compatible. Any non-licensed use, dissemination, copying, implementation or reverse engineering of the FLARM radio communication protocol, the FLARM hardware and software or parts of it is forbidden by law and will be prosecuted. FLARM is a registered trademark and can not be used without license.

3. General Advice on Operation

This Manual must be carried on board the aircraft. When permanently installed in an aircraft, the 'AFM Supplement' must also be carried in the aircraft.

In flight the pilot must have direct sight of and immediate access to a switch or circuit breaker that disconnects FLARM from the aircraft electrical power supply, without affecting other essential aircraft systems. This might be necessary if the pilot suspects that FLARM may be interfering with another on-board system, the suspected presence of smoke, the smell of smoke, or flying in a country where the use of FLARM is not permitted.

FLARM must not be operated at night or with night vision systems.

FLARM will not operate without adequate GPS signal strength. Correct antenna installation has a great effect on the transmission/receiving range.

FLARM is not able to measure its own RF-receiver sensitivity. When the pilot detects that other aircraft are received only when very close or not at all and when the RF-antenna's positioning is clearly not the cause of it, the device must be checked by the manufacturer.

[2] www.flarm.com/support/analyze

Installation and operation must be on the basis of non-interference with and no hazard to the existing suite of other certified equipment necessary for safe flying operation, or installed to comply with official requirements. Installation and operation must comply with official regulations and requirements. It is recommended that the FLARM, GPS and radio antennae are all installed as far away as practicable - but at least 25 cm from - susceptible aircraft systems such as GPS antennae and the magnetic compass.

The unit must be protected from solid particles or liquids, should not be exposed in use to temperatures below –10℃ or above +60 ℃ , or stored at temperat ures –20℃ or above +70 ℃, because this may cause irreparable damage. On the ground, the unit should be protected from exposure to long periods of direct sunlight, because it is likely to be overheated. Also avoid static discharges to the radio antenna.

Details on correct installation will be found in the Installation Manual.

4. Operating Modes

FLARM operates in two modes, *Nearest* and *Collision*. The change from one mode to the other is effected by a two-second push on a button followed by a brief visual confirmation from the unit. After the change has been signalled, the current mode selected is not displayed. When switched on, the unit is in *Nearest* mode.

The warnings given are identical in both modes, and generally relate to an immediate threat to which the pilot should make an immediate and appropriate reaction. The assumption has been made that following a warning it will take up to 12.5 seconds from the time that the other aircraft is seen, until a change in flight path has removed the threat[3].

When operating in the *Nearest* mode, the unit also reports the presence of other aircraft operating in the vicinity, even though calculations indicate that they do not represent a threat. The information displayed is limited to a configurable radius (default is three kilometres) and a vertical separation of 500 m. When no aircraft was displayed so far but one is received now, this is signalled with a click-sound. Only one single aircraft is indicated, with Hardware Version 3 or later in green. The optical signal is static (no flashing); the threat intensity is not indicated and there is no sound warning. As soon as FLARM detects the risk of a collision it automatically switches to *Collision* mode, followed by automatic reversion to *Nearest*. The choice of mode is presented, such that immediately after pressing the key, the display presents a diverging pattern (Hardware Version 1 and 2: ←→ ; version 3:).

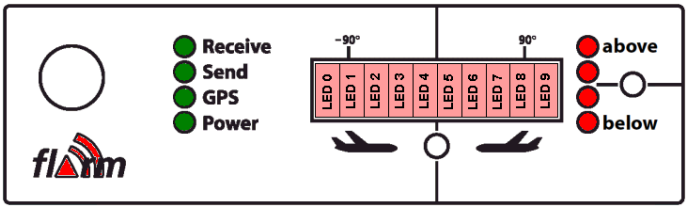
When operating in the *Warning* mode a red LED lights up only if the calculation predicts a threat. Warnings are always shown by flashing LEDs, the threat level being shown by the number of LEDs illuminated, by the frequency of flashes, and the simultaneous sound signal (beep). Selection of this mode is indicated by a upwards converging pattern (Hardware Version 1 and 2: →← ; Version 3:) immediately after pressing the selector key.

In both modes the pilot can **suppress the display and the acoustic warning**: after a double push FLARM will suppress all visual and acoustic signals relating to traffic, obstacles or other threats. The act of selecting suppression is followed by a descending tone. A further double-push reinstates the *Collision* mode at once and is followed by a rising tone. While warnings are suppressed, FLARM nevertheless continues to transmit signals for reception by other aircraft.

[3] These times were published in 1983 FAA Advisory Circular 90-48-C and were based on military data. They relate to fast jet pilots with no on-board warning systems for other traffic and hazards. The assumption was made that only one aircraft takes avoiding action. Of the 12.5 seconds, five seconds were to recognise the threat of collision and four seconds were required to decide upon avoiding action. No information is available as to whether these times are applicable to light aircraft, sailplanes or helicopters, when using a warning system.

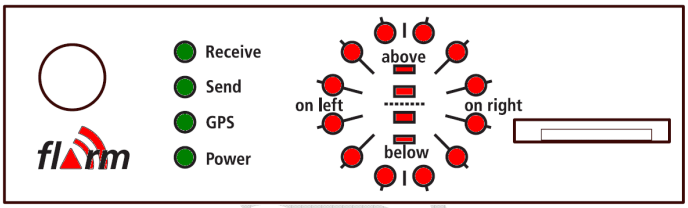
5. Front Panel

The dark grey front panel of Hardware Versions 1 and 2 has a push-button, four green Status-LEDs, ten red collision warning LEDs and four red LEDs for vertical[1] position indication.



Push-button | 4 green LED (Status) | 10 red LED (horizontal) | 4 red LED (vertical[1])

The front panel of Hardware Version 3 has a push-button, four green Status-LED, twelve bicolour LED for horizontal and four bicolour LED for vertical position indication. Depending on the threat caused by other aircraft or obstacles the LED show up red or green. Also included is a microSD-reader which can be used for updates, downloads and configurations. microSD cards are not included, but widely available in electronic and mobile phone shops.



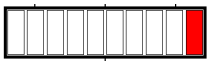
Push-button | 4 green LED (Status) | 12 LED (horizontal) 4 LED (vertical) all bicolor | microSD reader

6. Start-Up

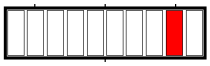
FLARM is always switched on if the unit is connected to an adequate power supply.

Immediately after it has been switched on there follows a one-second long beep while a start-up pattern might be shown on the LED, followed by a binary presentation of the Hardware-Version installed during the system self-test. The self-test mode lasts around 8 seconds, depending upon the size of the obstacle data bank.

`0x01` Hardware Version 1 (only red)



`0x02` Hardware Version 2 (only red)

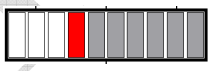


This is followed by another one-second beep, followed by a binary presentation of the Software-Version:

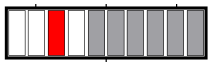
- Hardware Versions 1 and 2: LED0 to LED3 represent the major versions, LED4 to LED9 the minor versions. Everything is shown in red.

If the Software Version is not indicated and the beep sound is not emitted, the unit is not ready for operation.

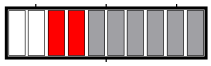
Software Version 1.xx (operational only to April 2005)



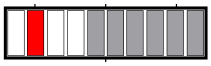
Software Version 2.xx (operational only to Feb 2006)



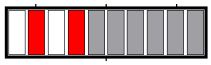
Software Version 3.xx (operational only to March 2008)



Software Version 4.xx (operational only to Feb 2011)



Software Version 5.xx (till March 01, 2015)

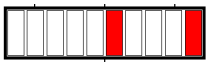
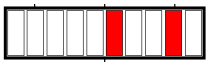
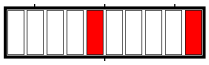
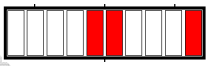
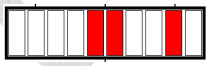
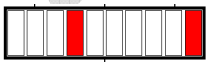
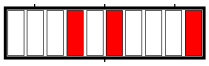
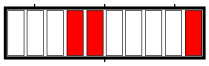
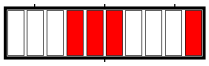
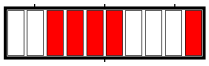
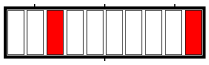
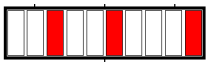
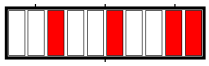
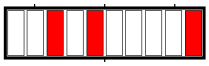


Then FLARM shifts to normal operation and waits until it has acquired an adequate GPS position fix. When switching on, this procedure can take *several minutes*. Without a proper GPS position fix, the unit is not ready for operation. **Before departure the pilot must ensure that at least the Power-, GPS- and Send-LED are all continuously on**. This state must be preserved during the whole flight to ensure correct operation.

7. Fault Finding

If a fault should occur during start-up self-test or subsequent operation, then all four green status LEDs will flash in unison for 30 seconds, while the red collision LEDs will give a binary indication of the most serious fault. The fault display can be stopped before 30 seconds has elapsed by pushing the button.

For safety reasons FLARM will not start up if there is a fault. FLARM may not be used if a fault has been reported or indicated. Limited operation is possible if there is an indication of a problem with the obstacle data bank or data recorder.

0x11	Fault: Software out of date (needs GPS reception)	*No operation*	
0x12	Fault: Software integrity violation (only IGC-units on F5)	*No operation*	
0x21	Fault: Low Voltage	*No operation*	
0x31	Fault: Internal GPS communication	*No operation*	
0x32	Fault: Faulty GPS configuration	*No operation*	
0x41	Fault: Internal radio communication	*No operation*	
0x51	Fault: General internal communication	*No operation*	
0x61	Fault: Flash memory	*No operation*	
0x71	Fault: Pressure sensor	*No operation*	
0xF1	Fault: Other fault	*No operation*	
0x81	Indication: No obstacle data bank	Operation possible	
0x91	Indication: Flight recording not possible	Operation possible	
0x93	Indication: ENL recording not possible (only IGC-units on F5)	Operation possible	
0xA1	Indication: Error with SD-card configuration file	Operation possible	

The communications faults itemised above indicate if internal modules within FLARM are not communicating correctly with each other. For reasons associated with the system, reduced radio range cannot be detected by a single unit alone.

Software-Versions 5.x must not be used after March 01, 2015. Before this date, you must update the device in order to use it in the air. An update with the same functionality can be downloaded free of charge. Users will be able to load the software with the aid of a suitable power supply/data cable (not supplied). This operation requires the user to have the unit Serial Number to hand. Software validity has to be time-limited to ensure that all FLARM units are mutually compatible and that updates include the latest obstacle data.

8. Status-Display

The green Status Display LEDs operate as follows; normal operating mode is underlined:

- **Receive**: Lights up when a signal is detected from another aircraft less than the configured range (default is 3 km) away, with a height separation of less than 500 m; otherwise the LED is dark. If the warning is temporarily suppressed (see below) but signals are still received from other aircraft, then the LED flashes.
- **Send**: Lights constantly during operation and indicates that the on-board FLARM is transmitting. Transmission requires GPS reception.
- **GPS**: Lights constantly during operation (with very brief interruptions once per second). If the LED is constantly dark and flashes briefly once per second, then there is no GPS reception. When switching on this condition can take several minutes.
- **Power**: Lights constantly during operation. If the LED flashes, then the power supply has dropped below 8 V. FLARM will not operate below 8 V DC.

The 'Receive' and 'Send' LEDs give no indication of FLARM's transceiver range.

9. Push Button[4]

The push button can be used to select the following functions:

- **Brief Push** (<0.8 s) changes the volume from <*loud*> to <*medium*> to <*quiet*> to <*silent*> (and <*loud*> again). A short sound is emitted at the new volume selected. The default setting is <*loud*>.
- **Longer Push** (2 s) changes mode between <*Nearest*> and <*Collision*> when airborne. Visual confirmation. Default setting <*Nearest*>.
- **Longer Push (5 - 8 s, only on the ground)** activates the receiver self-test: Two seconds after the button is released, FLARM will show how many other FLARM are received with reduced sensitivity (50% of the normal range). It will then emit a long beep and light one vertical LED for every 10 and a short beep and one horizontal LED for every single received aircraft (e.g. 14 received FLARM is: "beeeeep bep bep bep bep", with one vertical and 4 horizontal LED's). After the self-test, FLARM switches back to normal operations. Note that for other units to be displayed these must be running.
- **Double Push** suppresses optical and acoustic warnings for five minutes. Suppression is followed by declining melody, normal setting followed by a rising melody. A double push terminates the suppressed operation at once.
- **Long Push** (>8 s): Re-boot. This procedure is recommended if a fault is apparent. No confirmatory sound signal.
- **Very long push** (>20 s) brings FLARM back to the factory settings. The very long push deletes all configurations that have been loaded by the user. No confirmatory sound signal.

[4] Activate the external display update by pushing the button four times in rapid succession. For details see the Installation Manual.

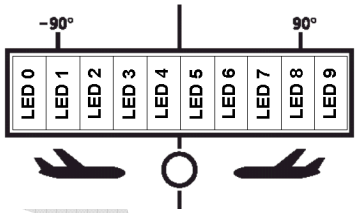
10. Aircraft Anti-Collision Warnings

An illuminated red LED indicates the approximate bearing to an aircraft currently posing the biggest threat of collision. The bearing is *relative to the track*. This indication is inaccurate if there is a strong wind, if the aircraft is in a sideways yaw, or if ground speed is very low (e.g. when a helicopter is in the hover). The display is refreshed every second.

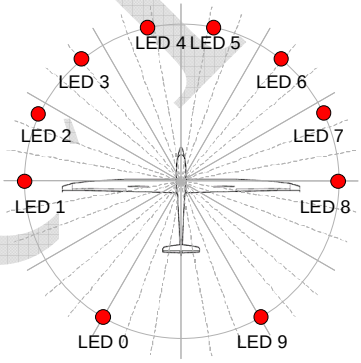
The unit emits an audio warning (beep) tone at the same time as the flashing red optical warning. The time between the warning and possible collision is brief, just a few seconds. Warnings of fixed obstacles are given slightly earlier.

Horizontal bearing indicated on Hardware Versions 1 and 2

Each red LED is allocated to a sector of sky around the aircraft horizontal plane in a side view. The aircraft centreline is indicated by a white line above and below the mid point (between LED4 and LED5). A short white line is located above LED1 and LED8, marking 90° left and right.



- LED 0 ~210° quadrant rear left
- LED 1 270° hard left 9 o'clock
- LED 2 296° left 10 o'clock
- LED 3 321° left 10-11 o'clock
- LED 4 347° front left 11-12 o'clock
- LED 5 13° front right 12-1 o'clock
- LED 6 39° right 1-2 o'clock
- LED 7 64° right 2 o'clock
- LED 8 90° hard right 3 o'clock
- LED 9 ~150° quadrant rear right

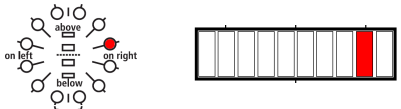
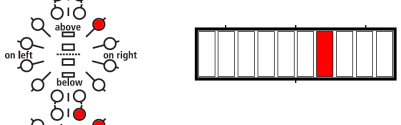
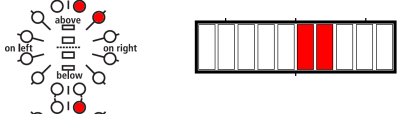
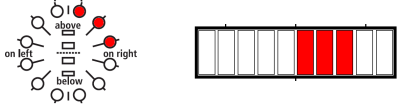


Horizontal bearing indicated on Hardware Version 3 and later

The twelve bicolour LED show a compass rose, i.e. the birds view on the traffic situation. 'Top' is track-up according the own aircraft. Each LED covers an equal-sized horizontal sector of 30°.

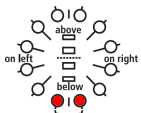
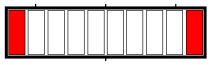
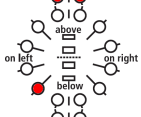
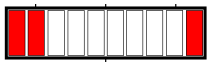
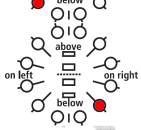
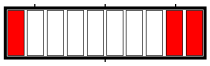
Danger from the front or side

If the threat of collision with another aircraft is from the front or side, but not from the rear, then the threat level will be flagged up by the display. If the threat is moderate (less than 18 seconds to possible collision), a single LED lights up; in the case of a medium threat (less than 13 seconds) then two diodes light up; if the threat is imminent (less than 8 seconds) three LEDs. The threat is at the centre of the illuminated block. The flash and beep frequency increases with the threat.

Moderate threat from ca. 3 o'clock (less than 18 seconds to calculated collision)	Slow flash at 2Hz	
Moderate threat from 1 to 2 o'clock (less than 18 seconds)	Slow flash at 2Hz	
Medium threat from 1 o'clock (less than 13 seconds)	Medium flash at 4Hz	
Immediate threat from 1 to 2 o'clock (less than 8 seconds)	Rapid flash at 6Hz	

Danger from the rear

If the threat is from behind, then the threat level on Hardware Version 1 and 2 is given only by the frequency of LED flashes, not the number of LEDs activated.

Danger from the rear, 5 to 7 o'clock	Flashing *(H/W Version 3 example shows medium threat from 6 o'clock)*		
Danger from the rear left, 8 to 7 o'clock	Flashing		
Danger from the rear right, 4 to 5 o'clock	Flashing		

Vertical indication

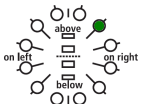
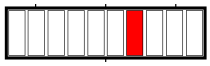
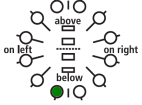
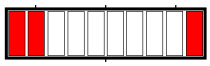
The vertical bearing is indicated by a vertical[1] line of four red LEDs and show the bearing relative to a horizontal plane. This is independent of the aircraft's climb angle. The uppermost or lowest LEDs illuminate when the bearing exceeds 14°. The LED flash frequen cy is identical and synchronous with that of the horizontal display.

H/W Version 3

H/W Version 2

Traffic indication (only in Nearest-mode)

In Nearest-mode the closest aircraft is shown as long as no warning is necessary. Traffic indications don't flash, there is no sound and the distance is not shown. Hardware Version 3 and higher show traffic indications in green.

Traffic around 2 o'clock	No flashing		
Traffic around 7 o'clock	No flashing		

11. Obstacle Warnings

The standard obstacle data bank (as of Feb 2011) has about 35,000 coordinates locating about 11,000 Alpine obstacles[5]. This data bank is loaded by FLARM at manufacture; subsequently the user may upload but not alter up-dated information via a PC. Special data banks, corrections and amendments can be reported to us.

The FLARM display flashes when there is warning of obstacles. The warning always relates to obstacles straight in-line with the current flight heading. In other words there is no horizontal or vertical bearing given to the obstacle. The threat level depends upon the time remaining to impact; the flash and beep frequency increases with reducing distance from the obstacle. The display is refreshed every second.

A warning is given if an aircraft flies under a cable or power line.

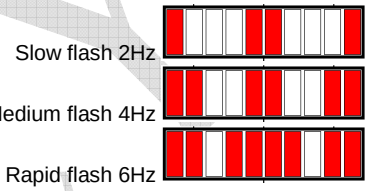
An acoustic warning (beep) is given at the same time as the flashing fixed obstacle warning. The time between warning and possible collision is brief, just a few seconds. However, warnings are given of fixed obstacles earlier than those for other aircraft.

Hardware Versions 1 and 2 show obstacles as follows:

Moderate threat
(less than 18 seconds to calculated collision)

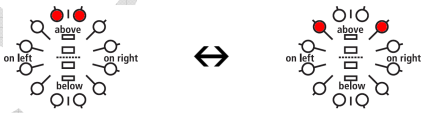
Medium threat
(less than 13 seconds)

Immediate threat
(less than 8 seconds)



Hardware Versions 3 and later show obstacles as follows:

A toggling pair of two LED's is shown, with the toggle frequency depending on the threat.



[5] For details on the data sources and status, consult the ‚Obstacle Data Format Specifications' manual.
Neither FLARM Technology nor these organisations accept any responsibility for the accuracy, completeness or up-to-date status of the data or any direct or indirect damage resulting from using such data. Official data sources only collect data which have been reported by those who own, construct or operate constructions which represent an obstacle, and do not check these reports.

12. Operating Limitations

FLARM is designed and built as a non-essential 'situation awareness only' unit to only support the pilot, and cannot always provide reliable warnings. In particular, FLARM does not give any guidance on avoiding action. Under no circumstances should a pilot or crewmember adopt different tactics or deviate from the normal principles of safe airmanship. Even with FLARM installed, you remain responsible for flying the aircraft and ensure the safety of passengers and other traffic. The use of FLARM is solely at the discretion of the commander and his delegated crew member. Operation must be preceded by thorough familiarisation by the commander or his delegated crew member with the Operating Manual.

FLARM will only give warnings of other aircraft that are likewise equipped with a compatible unit. FLARM does *not* communicate with Mode A/C/S transponders and is not detected by ACAS/TCAS/TPAS or Air Traffic Control. Likewise FLARM does not communicate with FIS-B, TIS-B or ADS-B.

Compatible FLARM units must be within range in order to provide a warning. The range is very much determined by the type, installation and position of the radio antennae, plus the relative positions of the two aircraft. Under *optimum* conditions the internal antennae can give a head-on range of up to 5 km; normally, range is about 2 km, which is adequate for light aircraft and sailplanes. The radio signals can only be received by *line of sight*. There is no FLARM signal between two aircraft on opposite sides of the same mountain.

FLARM has to know its *current* position in order to operate. For this reason, FLARM will only operate in the presence of good quality three-dimensional GPS reception. GPS reception is greatly influenced by the installation and position of the antenna, and aircraft attitude; furthermore, it requires that the US-american GPS-system is fully operational. This is particularly true during turns, when flying close to mountain slopes and in areas known for poor reception. If the installation is poor the GPS signal quality may be reduced. In particular, there can be rapid degradation of height calculations. FLARM resumes operation as soon as the GPS reception quality is adequate.

Movements calculated by the GPS relate to a fixed system of *terrestrial* coordinates. In strong wind there may be a substantial difference between aircraft heading and track, leading to a distortion of the threat bearing. If the wind speed is one third of True Airspeed (TAS) and the yaw-free aircraft Heading is 90° out of wind, then the threat indication displayed has an error of about 18°. If the wind is very strong, the Track can deviate up to 180° from Heading. Under such circumstances and when circling, the calculation and warnings given are unusable.

When close up, when two aircraft are at the same or similar height, or GPS reception is poor, the vertical bearing indication is imprecise and fluctuates.

FLARM calculates the predicted flight path of the aircraft to which it is fitted for less than the next 20 seconds. This prediction is based on immediate past data, current position- and movement data, plus a movement prediction model that is *optimised for the respective user*. This forecast is associated with a number of uncertainties that increase with an extension of the forecast time. There is no guarantee that an aircraft will actually follow the predicted flight path. For this reason, the warning issued will not be accurate in all cases. In sport flying flight path predictions of more than 30 seconds are *unusable*. This is particularly true for sailplanes and hang gliders. For this reason, the radio range is generally adequate.

Warnings are given at *very short notice*, i.e. the warning is given within a time frame of from a few seconds to 18 seconds, depending upon the closest predicted proximity, as calculated. The threat intensity (pitch of the warning tone, LED block width, flash interval) flags up the threat (collision time point), but not the geometric distance. FLARM only issues a warning if the calculation forecasts a *considerable* threat. For this reason, it is usual - depending upon the mode selected - that no warning is given about the presence of other aircraft, in spite of the fact that signals have been correctly received.

When a number of moving threats or fixed objects are within range, then FLARM gives warning *only* of the most dangerous *in accordance with the threat calculation algorithm.* The pilot is unable to confirm receipt of this warning, nor is he able to call for presentation of further threats. In spite of the warning issued for one other aircraft or fixed objects, it is quite possible that there are several further aircraft or fixed objects that represent a greater threat than that which has been signalled. When the unit simultaneously detects a threat from moving and fixed obstacles, then the warning issued relates to the earliest likely collision.

FLARM indicates the rough position of the aircraft or obstacle that currently represents the biggest threat, in accordance with the algorithmic calculation; FLARM Hardware Version 2 (and onwards) also displays a vertical bearing. In the case of fixed obstacles, the unit does not signal a bearing. FLARM does not indicate where the closest proximity may occur, nor does it signal avoiding action. Whether and how avoiding action is taken is solely a matter for the pilot, who must base his decision on his own observation of the airspace. In taking his decision, he must comply with the Rules of The Air and ensure that no additional hazard is caused by his action. Depending upon the phase of the flight, FLARM uses different forecasting methods, movement models and warning calculations, to provide the pilot with the best possible support without causing a distraction. For example, when a sailplane is circling, the system sensitivity is reduced. These models and processes are optimised, but are nevertheless a compromise. As seen by the pilot these models are the source of 'false alarms'; i.e. FLARM would give warnings of 'threats' that would not subjectively be regarded as a real danger. It is quite possible that FLARM will not give warning of the highest threat, or will give any warning at all.

Obstacle warnings (e.g. cables, antenna masts, cable cars, avalanche dynamite wires, power lines) are dependent on the information having been stored *correctly* in the internal data bank. The unit cannot give warning of any fixed object that has either been incorrectly stored, or not stored at all. No data bank is complete, up-to-date and correct. Obstacle information stored has usually been simplified; for example, FLARM assumes that a power wire is slung absolutely straight between two fixed points with no sag. Likewise, data for power lines and cable cars does not include all intermediate masts. In addition, FLARM data does not include terrain data and no such warnings are possible.

FLARM radio communications take place in a license-free band in which there is general freedom to transmit and receive. This means that the band is also available to a number of other uncoordinated users. FLARM has no exclusive right to the use of this band and there is no guarantee that FLARM will not be subject to interference by third parties.

There are national differences in frequency allocation and operating conditions between countries. The aircraft commander and user are solely responsible for ensuring that their use of FLARM conforms with local regulations. No radio licence is required for FLARM in Switzerland, Germany and France.

The radio transmission protocol employed places *no limit* on the number of units that may be operated within a given range. However, an increasing number of units within range is associated with a reduction in the probability that a single coded signal will be received ('graceful degradation'). The probability is small that subsequent signals will not be received from the same transmitter. FLARM is designed to receive and process signals from up to 50 aircraft within range. A high number of FLARM units within range has no effect on range.

The transmitter has ***no effect*** on what the receiver in the other aircraft does with the data. It is possible that this data may be captured and stored by other aircraft, or by ground stations, or used for other purposes. This opens up a range of possibilities, some of which may be in the pilot's own interest, (e.g. automated generation of an sailplane launch logging system, aircraft tracking, last position recovery), while others may not be (e.g. detecting tailing of other aircraft, airspace infringements, failure to take avoiding action prior to a collision). When FLARM makes a transmission, the signal also bears a unique identification code that can trace to the pilot or aircraft registration. The user can - even though this is not recommended - configure the unit so that identification is generated randomly and alters at one-minute intervals, making a back-trace difficult.

Operation of FLARM is limited to non-commercial day VFR flights. FLARM may not be used for navigational purposes or aerobatics.

At present FLARM has not been certified or tested in line with the usual aviation procedures (e.g. DO-160E). The FLARM software development is *roughly* in-line with Level E of DO-178B; i.e. a partial or total failure of FLARM will have no effect upon the safe operation of the aircraft, nor does it increase crew workload.

Operation of FLARM is forbidden in the USA or Canada or in aircraft registered in the USA or Canada.

The association FLARM Technology, FLARM Technology GmbH, its associates, owners, staff, management, development team, suppliers, manufacturers and data suppliers accept no responsibility for any damage or claims that may arise from use of FLARM.