AFMS D-6709

Airplane Flight Manual Supplement

- Radio FUNKE 833-II

- ACL Anti-collision light

- Flarm

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AVIONICS GMBH

ATR833-II

VHF Communication Transceiver

OLED P/N 833-II-(C0xx)-(C0xx)
LCD P/N 833-II-(C0xx)-(C1xx)

Operation and Installation

(Document-Nr. 01.143.010.71e)

Change History

Revision	Date	Description of Change
1.00	07.06.2017	First Release OLED/LCD Head-SW 1.00 / NF-FW 2.00
1.01	29.06.2017	Separate setting for dynamic und standard microphones added
1.02	02.08.2017	Chapter 4.7.3. Cable plan BSKS833D-S removed - New document of the cable sets referenced
1.03	13.09.2017	Chapter 4.6.2. / 4.7.2. / .4.11.2. corrected
1.04	13.02.2018	Update for NF-Fw 3.00, Chap. 3.8 and 3.12 amended, Correction in Chap. 4.7.3.2
1.05	25.04.2018	Chap. 4.7.2 Pin assignment adapted to modified Hw, Chap. 3.6 and 4.6.1 newly described

List of Service Bulletins (SB)

Service-Bulletins are to be inserted in the manual and to be recorded in this table				
SB Number	Rev. No.	Date of Issue	Entry Date	Name

CONTENT

1 GENERAL

This manual contains information about the physical, mechanical and electrical characteristics, as well as information about installation and operation of the aeronautical VHF voice radio ATR833-II. The radio is available with LCD or OLED display.

1.1 Symbols

	Advices whose non-observance can cause radiation damage to the human body or ignition of combustible materials.

	Advices whose non-observance can cause damage to the device or other parts of the equipment.

	Information

1.2 Abbreviations

Abb.	Name / Subject	Definition
BRT	Brightness	Display Brightness
EXT	External Audio Input	Volume of external audio input
INT	Intercom	Volume of board-internal intercom
MIC	Microphone	Sensitivity of Microphone
PTT	Push-To-Talk	Button to activate radio transmission
SEL	Selection	Selection of value or function
SQ	Squelch	Noise suppression radio reception
VOL	Volume	Volume of radio reception
VOX	Voice activation	Volume threshold for voice-activated intercom

1.3 Customer Support

In order to facilitate a rapid return of shipments in case of repairs, please follow the instructions of the input guide “Reshipment RMA” provided at the Service-Area within the f.u.n.k.e. AVIONICS GmbH web portal www.funkeavionics.com.

	Any suggestions for improvement of our manuals are welcome. Contact: service@funkeavionics.com.

	Information on software updates is available at f.u.n.k.e. Avionics GmbH.

1.4 Equipment Characteristics

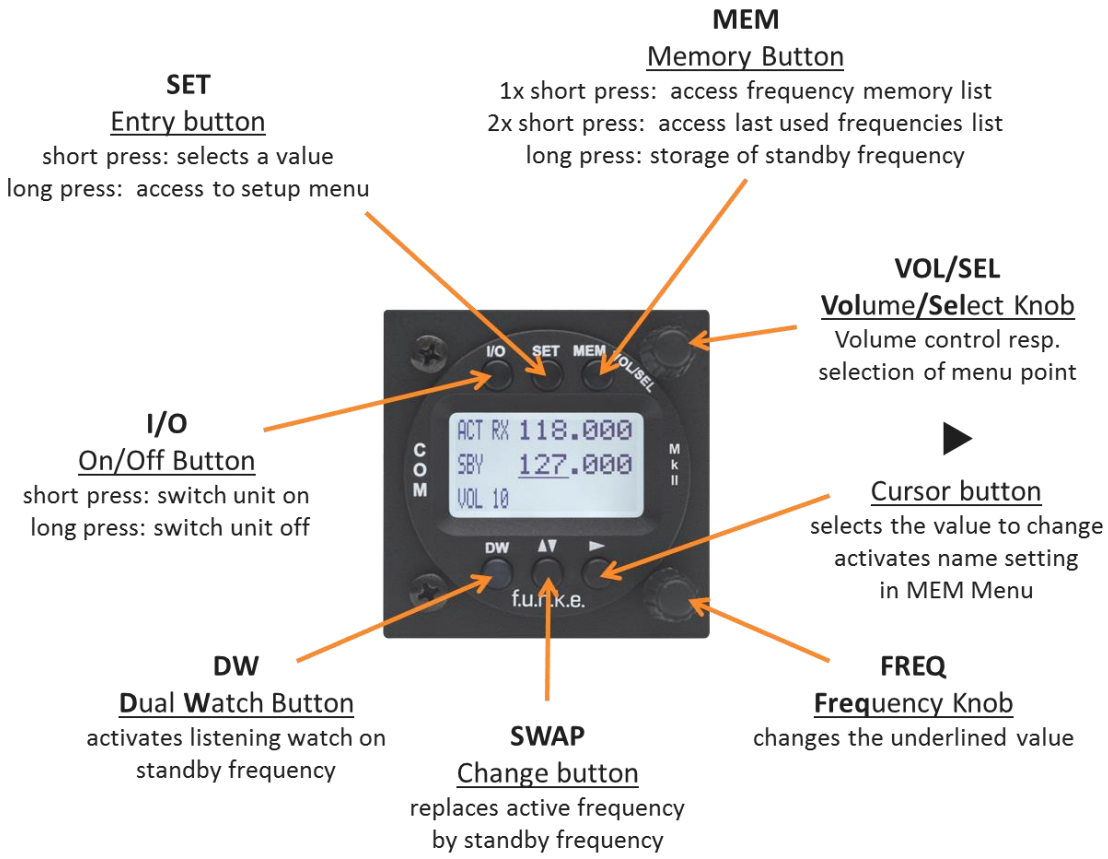
- VHF communication transceiver with 6W output power in 2 ¼” format
- Frequency range 118,000 to 136,975 MHz
- 2 microphone inputs (auto detection standard or dynamic)
- Voice controlled intercom for up to 4 microphones, can be deactivated for use with an external intercom
- Dual-watch technology, simultaneous monitoring of two frequencies
- Auxiliary audio input
- Memory for 20 user-definable named frequencies
- Easy recall of the 10 last used frequencies
- High contrast LCD / OLED display 128x64 dot matrix
- Wide range power supply 11 – 30 VDC
- Configurable energy saving mode

	To avoid unintentional permanent transmission, the transmitter automatically stops transmission after 35 seconds of uninterrupted operation.

2 OPERATION

2.1 Overview of Controls

Position and naming of control elements:



The control elements have following functionality:

I/O	ON/OFF	Switch On press button for appr. 0,5 s Swich Off press button for appr. 3 s
DW	DUAL WATCH	Activates/deactivates the mode for mutual reception of standby frequency (display shows DW instead of SBY)
SET	EINGABE	1. Navigation through the standard menu (VOL, SQL, VOX, etc.) (adjustment of value with VOL/SEL, short press of SET for next value 2. Access to setup menu → Press button for min. 5 seconds 3. Navigation through the setup menu (Spacing, backlight, DW Mute, PTT Select,.)

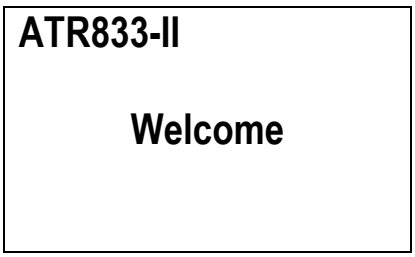
▶	CURSOR	1. Marking (underline) of value for adjustment; value changeable with FRQ or VOL/SEL → Enter and continue with Cursor Button ▶ short press 2. Activates in MEM menu the entry of names 3. Long press (>2s) activates Replay
▼▲	SWAP	Changes Active with Standby-Frequency
MEM	Memory	Access to frequency list (MEM-List) → press button shortly once
		Access list of 10 last used frequencies (LST-List) → press button shortly twice
		Stores Standby frequency to selected memory (in MEM-List) → press button for 2 seconds
 VOL/SEL	**VOL/SEL** Turn knob	1. Adjust volume or other item selected by **SET** (VOL, SQ, VOX, DIM etc.) 2. Select frequency from user memory or list of last used frequencies
 FREQ	**FREQ** Turn knob	Change the underlined value (i.e. adjust standby frequency, or input character when entering name)

2.2 ON/OFF - Commissioning

Turn the device on with **I/O.**

Switch On: **I/O** press for appr. 0.5 seconds
Switch Off: **I/O** press for appr. 3 seconds

After turning on, following information appears on the display:

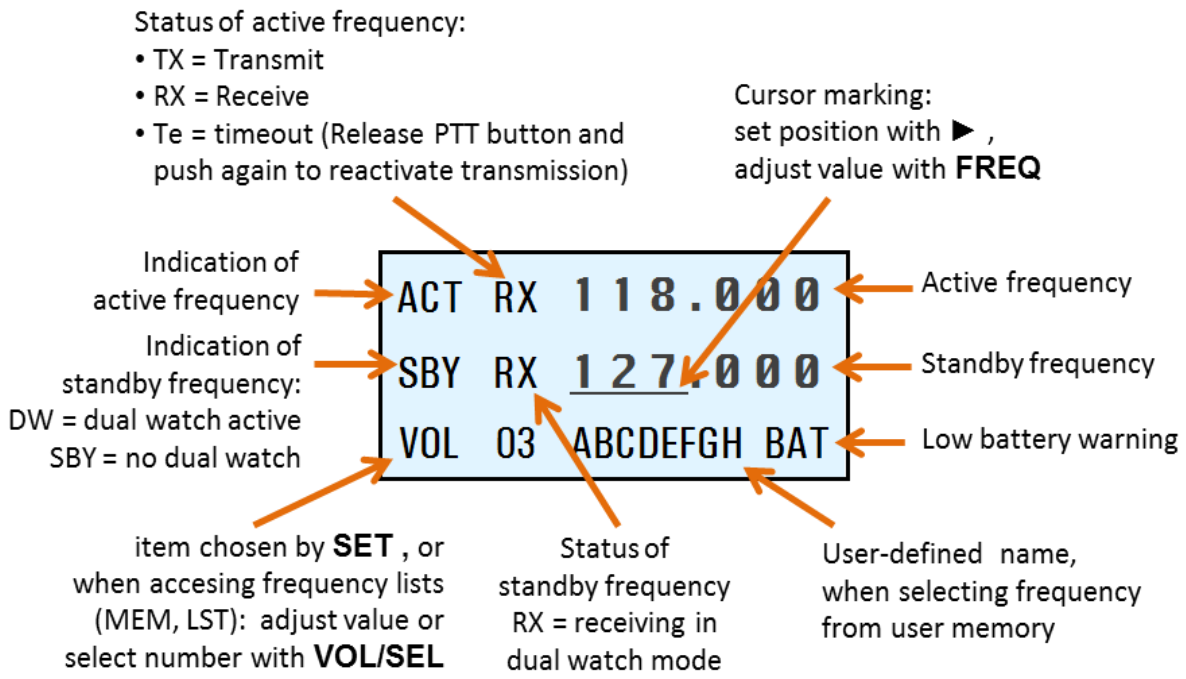


The start screen indicates device type and software version. After that screen the device changes into normal operation (direct input mode).

The radio starts with the same frequencies and settings from before being switched off.

2.3 Display

The ATR833-II shows the frequencies and the operating condition on a matrix LCD display with 128 x 64 pixels.



Display	Meaning	Remark
ACT	Fixed label for active frequency	
SBY	Label for standby frequency, when dual watch is not activated	Dual watch mode allows intermittent monitoring of standby frequency activity
DW	Label for standby frequency, when dual watch mode is activated	Dual watch mode allows intermittent monitoring of standby frequency activity
118.000	Active Frequency	Frequency used for trans-missions and receptions
124.910	Standby frequency	May be monitored in dual watch mode
RX	Receiving on this frequency	Usually on active frequen-cy; can also happen on standby frequency when DW is activated
TX	Transmitting on active frequency	PTT pressed

Display	Meaning	Remark
Te	Transmission ended automatically after 35 seconds of continuous transmission	Release PTT shortly and press again to re-enable transmission.
VOL *03*	Volume level for receiving (standard display)	If SEL was pressed, the appropriate value of the standard menu are displayed at this position (see 2.4)
SQL *03*	Squelch level	Radio signal strength threshold required for reception; suppresses noise and weak/distant transmitter
DISPLAY *on*	Timer for backlight resp. display brightness	Activates energy saving mode
VOX *05*	VOX threshold	Speech level that activates the intercom
DUOWATCH *-2*	Dual Watch Mute	Reduction in volume for dual-watch-reception on standby frequency
INT *04*	Intercom - Volume	
EXT *02*	Volume of external audio signals	Set to 00, if no external device is connected, to prevent noise pickup
BRT *07*	Brightness of display	
CON *05*	Contrast of display	only for LCD
MEM *00*	Item from user defined frequency list	Substitutes Standby Frequency; Active frequency can be stored into this entry with long press on **MEM**
LST *00*	Item from list of last used frequencies	Substitutes standby /active frequency with press of **SET** / ▼▲ button.
ABCDEFG	User-defined name in the frequency list	Displayed while selecting from user memory, when the user has assigned a name.
BAT	Very low supply voltage	Transmission only with reduced power possible (decreased radio range!)
≫REPLAY≫	Playback radio call	Replays the last radio call (max. 9 seconds)

2.4 Frequency Setting

Frequency setting is always done by the two steps of

1. Entering a new standby frequency to the desired value, and then
2. Interchanging the new standby frequency and the previous active frequency by using the swap button ▼▲.

Entering a new standby frequency can be done by

a) Manual input,

b) Recall of previously stored frequencies from the user memory (memory locations 1-20), or

c) Recall from the list of the last 10 used frequencies.

2.4.1 Automatic Selection 8.33 / 25 kHz Channel Bandwidth

Whether a frequency is used with channel width 8.33 kHz or 25 kHz, is automatically determined by the value of the frequency entered, and requires no additional user activity.

The numbering scheme that is used for distinction of the two channel widths is internationally standardized by the ICAO, and consistently used in official documents (like e.g. VFR navigation charts) as well as in the voice phraseology used by ATC radio communication.

Channels used with 25 kHz width are entered in multiples of 25kHz: 123.500, 123.525, 123.550, 123.575, 123.600 etc. These are compatible with the old 25 kHz-only radios. To use the same frequencies with 8.33 kHz width, the frequency values entered are increased by 5kHz: 123.505, 123.530, 123.555, 123.580, 123.605 etc.

For more detailed information please refer to chapter 5.1 – but as said above, for correct channel width selection this knowledge is not required.

2.4.2 Manual Frequency Input

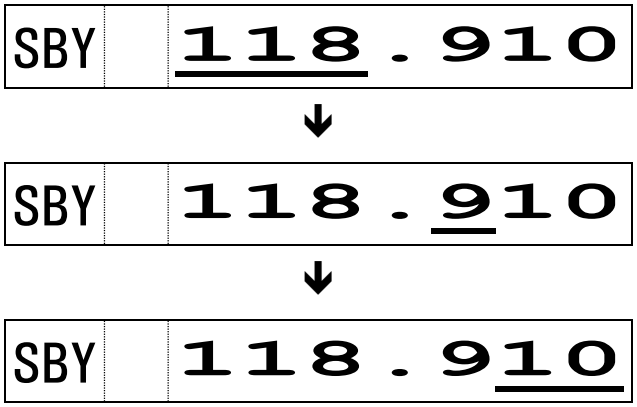
The standby frequency is input by

- Selecting with the ► button which part of the frequency to change, and
- Changing the selected part with the **FREQ** rotary knob.

The swap button ▼▲ interchanges the newly set standby frequency and the former active frequency.

	In order to speed up the entering of new frequencies, it is possible to configure the radio to allow entering of those frequencies only that are used with 25 kHz channel width. Please refer to chapter 3.1 for information on this configuration. However, when choosing this option, please keep in mind to re-enable 8.33 kHz channel selection before flying into areas where 8.33 kHz channels are used.

When having the channel selection configured for 8.33 kHz steps (see 0), the frequency is input in three steps:

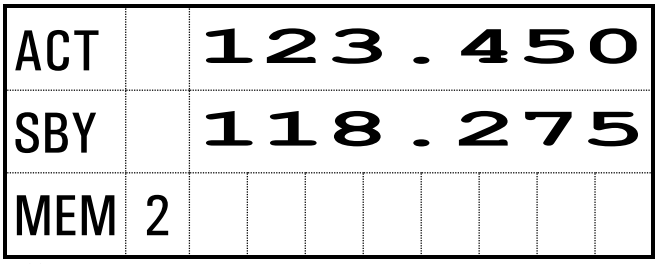


2.4.3 Recall a Frequency from the User Memory

To access the user memory frequency list, press **MEM** once, and select one of the 20 memory entries with the **VOL/SEL** turn knob.

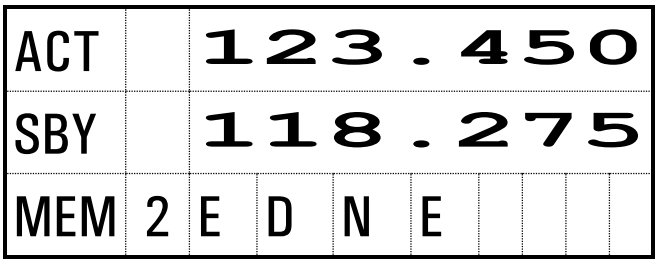
The selected memory entry is shown instead of the standby frequency.

In the lower row of the display, the number of the memory entry selected is indicated by [MEM xx] (with xx = 1 to 20); if a name has been provided by the user for this memory entry, it is displayed next to the memory entry number.



↳ Range: 01 - 20

Repectively:



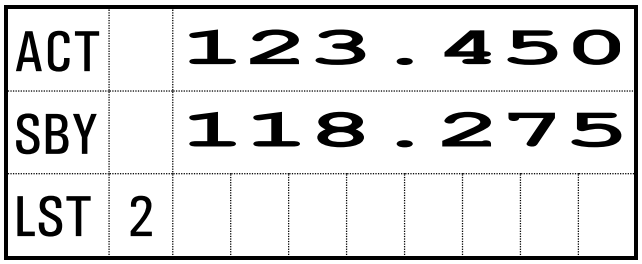
A push on the swap button ▼▲ replaces the Active Frequency, a press on the **SET** button the Standby Frequency with the selected list entry.

If no input is done for 10 seconds, the device returns to the standard view, too.

2.4.4 Recall a Frequency from the List of the 10 Last Used

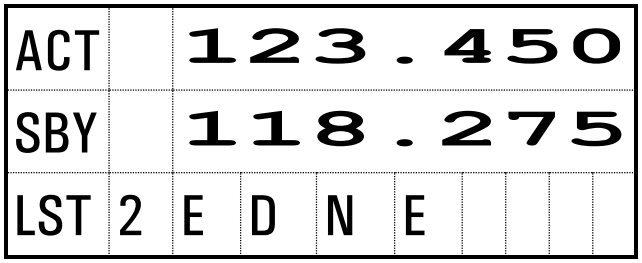
The radio automatically keeps track of the last 10 used active frequencies. To access this list, press **MEM** twice, and select one of the 10 list entries with the **VOL/SEL** turn knob. The selected memory entry substitutes the former standby frequency.

The number of the selected list entry is given in the display's lower row.



↳ Range: 1 - 10

Respectively:



↳ ↳ ↳ ↳ ↳ ↳ ↳ ↳ ↳ 8 digits A-Z, 0-9

	List entry "1" contains the last standby frequency from the MEM menu.

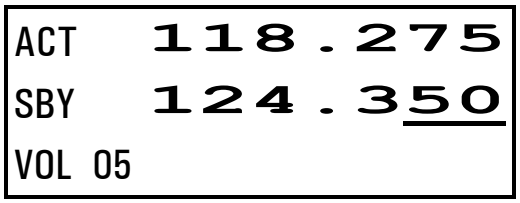
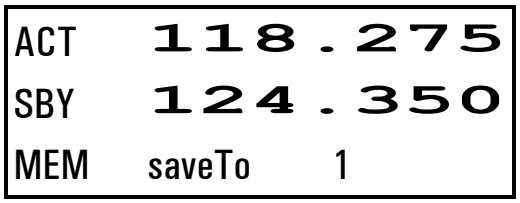
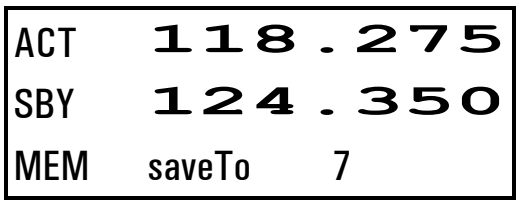
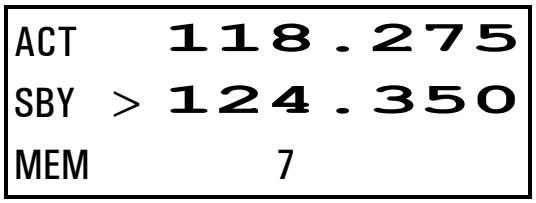
If there is no input for 10 seconds, the device returns to the standard view.

2.4.5 Storage of a Frequency into the User Memory

The active frequency can be stored into any entry of the user memory.

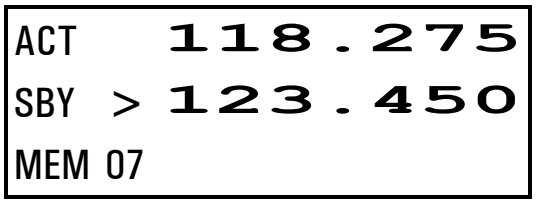
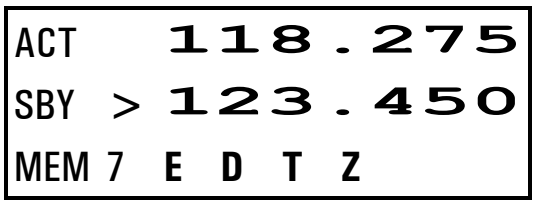
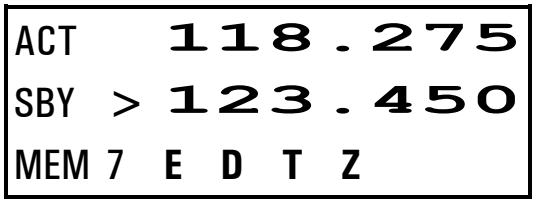
This is achieved by a long press of 1,5 seconds on **MEM.** The previous memory entry will be be overwritten.

The following example stores the frequency 124.350 MHz of KONSTANZ (EDTZ) into the user memory 7:

Step	Display (example)
1. Tune in frequency: Have frequency to be stored set as standby frequency	
2. Enter memory list: With a long press on **MEM** the frequency can be stored to the user memory.	
3. Select memory position: Selection of the decided memory position with **VOL/SEL**	
4. Overwrite the selected memory : With a **short press** of **MEM** the standby frequency is stored at the selected position. A preceding **>** shows the successful storage to the memory position.	

To exit the frequency list, press **DW** or wait 10 seconds until time-out.

To every frequency entry a name can be assigned with up to 8 characters, which is shown right of the entry.

To assign a name to a memory entry, the appropriate entry must be selected. The next steps follow directly step 4 from above. 5. <u>Change of name entry:</u> A long press of the Cursor button ▶ enables the entry of a name	
6. <u>Enter the name:</u> By changing the selected character with **FREQ**, and advancing the selection with ▶, just as when manually entering a standby frequency.	
7. <u>Store the name:</u> The new entry is either stored with a long press of **MEM** or by a short press on the Cursor button ▶.	

To exit the frequency list press the **SET** button or wait 10 seconds until time-out.

2.4.6 ATR Frequency Tool

The ATR Frequency Tool from Version 1.3 supports the ATR833-II. With the tool the frequency memory of the ATR833-II can be managed, i.e. frequencies can be added, edited and deleted. The frequency list can be stored as a file.

The ATR Frequency Tool can be downloaded from the f.u.n.k.e. AVIONICS homepage in the service area under Info / Download.

2.5 Basic Settings

To choose between the following settings, use the **SET** button:

1. VOL Volume (chosen by default)
2. SQL Squelch (noise suppression)
3. VOX Voice Activated Intercom
   (speech level required to activate the intercom)
4. INT Volume Intercom
5. STL Volume Sidetone left
6. STR Volume Sidetone right
7. EXT Volume of external audio signals
8. BRT Display brightness
9. CON Display contrast (only for devices with LCD)

… back to Volume

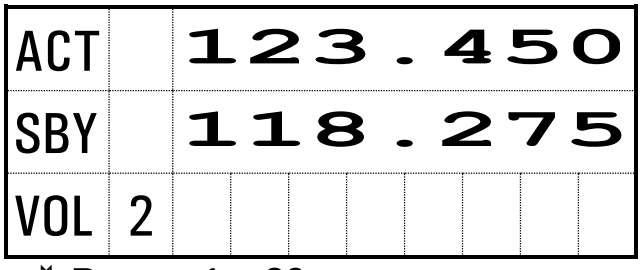
The return to the default display (VOL) is carried out by a short press on the Dualwatch button **DW** or happens automatically after 10 seconds of inactivity.

The chosen setting can be adjusted by the **VOL/SEL** rotary knob.

2.5.1 VOL – Volume

The radio returns automatically to the volume setting, when a value has been set with the VOL/SEL turn knob.

Turning the **VOL/SEL** knob adjusts the volume of received radio signals. The higher the value, the louder the reception of radio signals.



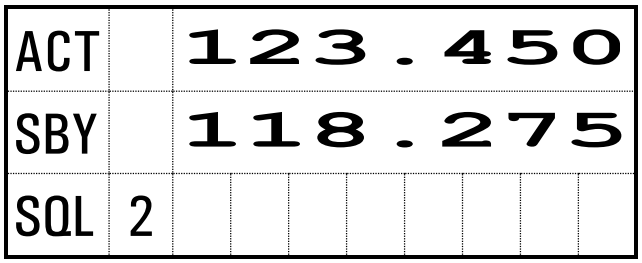
↳Range: 1 – 20

	The VOL setting controls the volume of received radio signals only, not the volume of the intercom or the external audio input – these are set separately with INT and EXT.

2.5.2 SQL – Squelch (noise barrier)

By shortly pressing the **SET** key once, with the help of the rotary knob the squelch level can be adjusted. (Note: This is not related in any way to the intercom functionality.)

This is a threshold that has to be exceeded by radio signal levels from other transmitters, in order to activate the reception circuitry. The higher the number, the stronger the radio signals have to be in order to be received.



↳Range: 0 - 9

The setting for the squelch depends on different factors. For motor aircrafts an initial higher setting is typically appropriate, gliders may use a lower value. A lower number means higher input sensitivity.

This allows reception of weaker signals (radio stations at higher distance), but can also result in pickup of own-aircraft radio interference sources (engine, strobe lights).

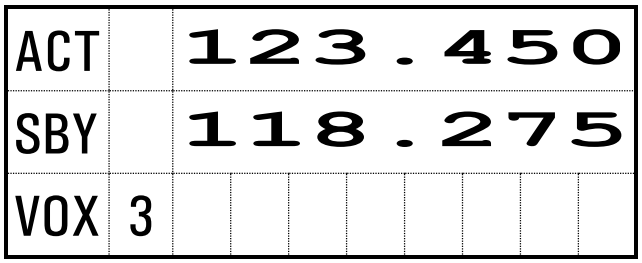
	The default squelch setting is 05. At higher values weak signals could be suppressed.

2.5.3 VOX –Voice Activated Intercom

By shortly pressing the **SET** key twice, with the help of the rotary knob, the threshold volume **VOX** for intercom voice detection can be adjusted. (Note: This is not related in any way to radio reception or squelch.)

VOX defines the crew's speech volume that is required to activate the intercom functionality. The higher the value, the louder you need to speak in order to activate the intercom.

Exception: VOX 0 corresponds to "always on"



↳Range: Off, 1 - 9

In case of very noisy backgrounds or use of uncompensated microphones, the automatic VOX functionality may not work satisfyingly.

In these cases, it is possible to deactivate the VOX automatism with VOX: 0, and to use an external intercom-switch.

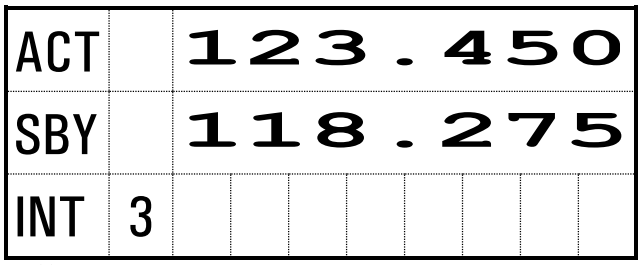
2.5.4 INT – Volume Intercom

By pressing three times the SET button, the volume of the intercom can be adjusted with the VOL/SEL turn knob.

The intercom functionality is the onboard crew-internal communication for multi-seater aircraft. A change in the intercom volume level also changes the volume of the sidetone. The sidetone is an audible feedback of the own voice to the headset, i.e. you hear yourself speak. This feature supports a natural speech behavior.

The intercom can be activated in two ways:

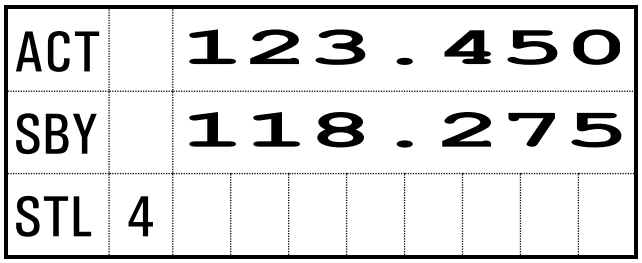
- Automatically, i.e. whenever someone speaks into a microphone (i.e. voice activated intercom = VOX, see chapter 0).
- Manually, i.e. by use of an external intercom switch.



↳Range: 0 - 20

2.5.5 STL – Volume Sidetone Left

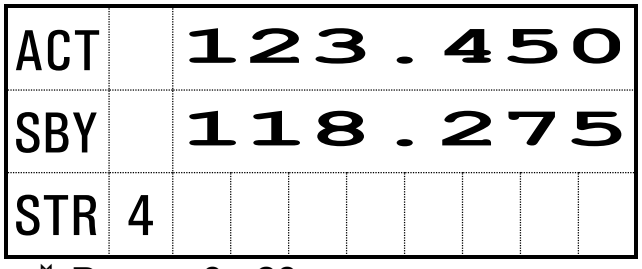
The sidetone is a self-hearing or back-hearing function during transmission. The audio signal picked up by the microphone is fed directly to the headset, which is normally perceived as pleasant. In this menu point the volume of the sidetone for the left seat can be adjusted.



↳Range: 0 - 20

2.5.6 STR – Volume Sidetone Right

By pressing the **SET** button five times you get access to the STR menu. Here the volume of the sidetone for the right seat can be adjusted.

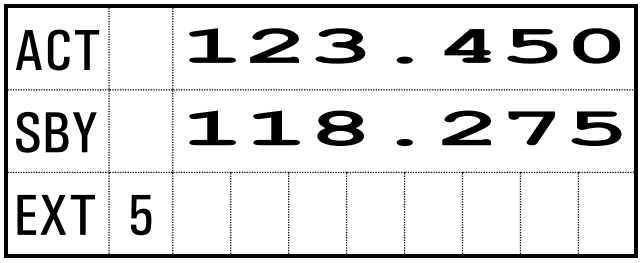


↳Range: 0 - 20

2.5.7 EXT – Volume of the external Audio Input

By shortly pressing the **SET** key six times, the volume of external audio signals (warning tones, music, etc. …) can be controlled with the rotary knob.

The higher the value, the higher is the volume of the external audio signal. A value of **EXT** = 0 deactivates the external audio input.



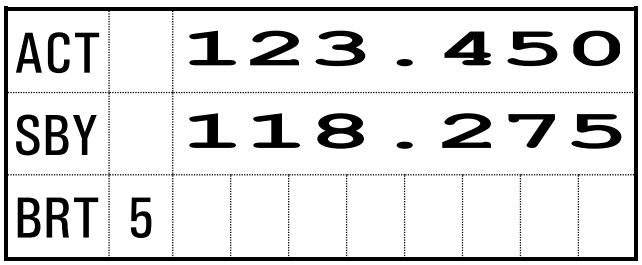
↳Range: Off, 1 - 20

	When no other device is connected to the external audio input, the input should be muted by selecting 00, in order to prevent noise by pickup of on-board interferences.

	The priority of the external audio input in comparison to radio receptions can be configured, see chapter 0)

2.5.8 BRT – Brightness

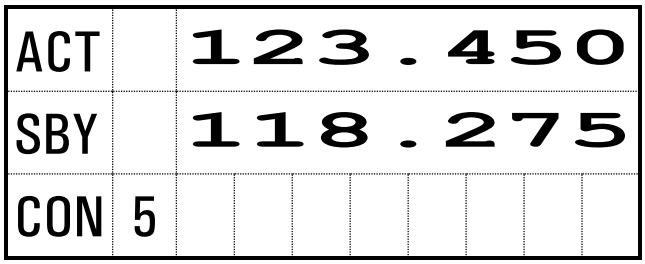
By pressing the **SET** seven times the brightness of the backlight of the LCD display can be adjusted with the VOL/SEL turn knob. For devices with an OLED display this function controls the brightness of the display.



↳Range: 0 - 9

2.5.9 CON – Contrast

By pressing the **SET** eight times the last configuration item is reached in the standard menu, where the contrast of the display can be adjusted with the **VOL/SEL** turn knob.

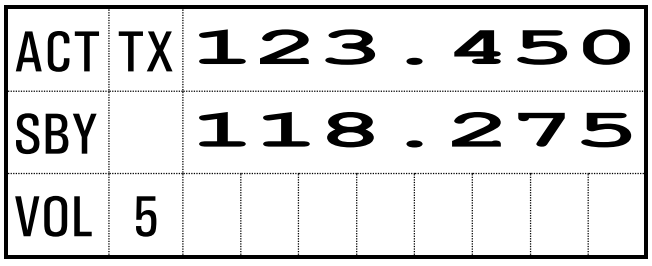


↳Range: 0 - 9

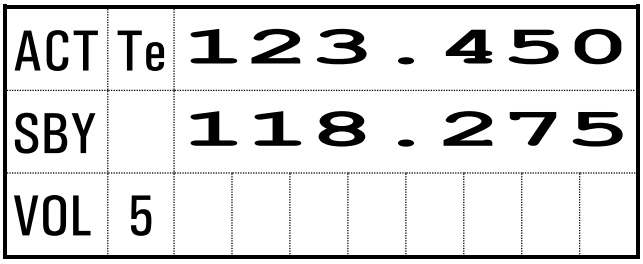
	The menu point “CON” is only available for radios with LCD display. This setting is missing for devices with an OLED display.

2.6 Transmission

By pushing the PTT button, the device starts transmission on the active frequency. The operation of the transmission is indicated by “TX” in front of the frequency used.



In order to avoid unintended transmissions, e.g. when having the PTT button stuck (“stuck mic”), the transmitter automatically stops after 35 ±5 seconds of transmission, and „TX“ is substituted by „Te“.

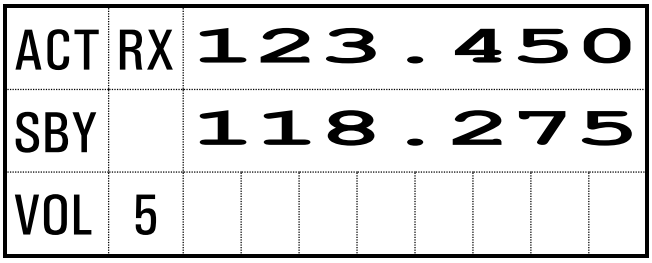


In order to re-enable transmission in this case, release PTT and push it again.

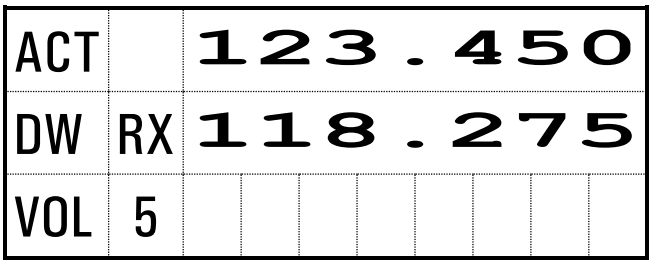
	When having more than one PTT button and microphone equipped, it can be configured (chapter 3.3) to use only one PTT button for transmissions.

2.7 Reception

When receiving, a „RX“ is shown in front of the active frequency.

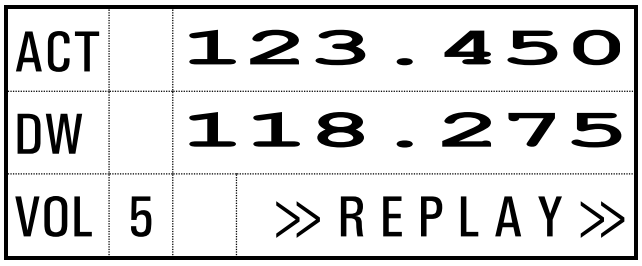


When having dual watch active (see 0) RX can be shown on the standby frequency, too.



2.8 REPLAY Funktion

The ATR833-II automatically stores the last 9 seconds of an incoming radio call. Pressing the CURSOR key ▶ will play the last received radio message. The display will show » R E P L A Y » for the duration of the playback.



As long as a radio call is received, the REPLAY function is deactivated. This also means that the squelch setting must not be zero.

2.9 DUAL WATCH Operation

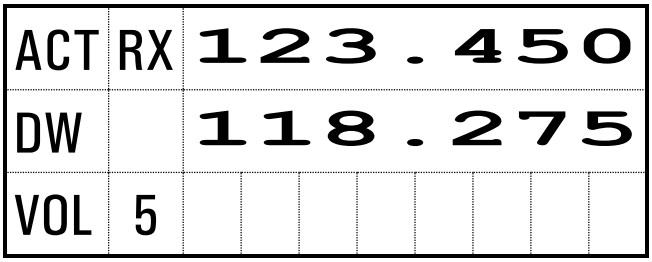
The ATR833-II comprises one receiver; therefore “dual watch” (simultaneously monitoring two frequencies) is implemented by alternating automatically between the active and the standby frequency.

With dual watch mode active, basically the standby frequency is tuned in, shortly interrupted in regular intervals by tuning in the active frequency for a fraction of a second.

Every then detected radio signal on the active frequency has priority, and pauses the dual watch monitoring of the standby frequency, as long as the reception/transmission continues on the active frequency.

Transmissions are always done one the active frequency.

The dual watch mode is activated by pressing **DW**, and indicated by a changing the “**SBY**” label for the standby frequency to “**DW**”.



The dual watch mode is deactivated by pressing **DW** again, and by any operations changing either of the frequencies.

	SQL has to be set to 01 at least, as without adequate squelch functionality the radio is not able to detect if there is a reception on the active frequency.

In order to have an audible distinction between receptions on the active and the standby frequency, it is possible to hear the receptions from the standby frequency with a lower volume. Please refer to chapter 0. for information about the feature “dual watch volume reduction”.

Quick approach:

- Select or enter a standby frequency which shall be additionally monitored.
- Set **SQL** with the **SET** button and the rotary knob to a value of at least 01.
- Activate dual watch with **DW** (**DW** is shown)
- As soon as no reception is determined on the active frequency, the mutual monitoring between active and standby frequency starts.
- In order to deactivate dual watch: press **DW** once more or change the frequency.

	Don’t forget to interchange the active and standby frequencies, before answering a call on the standby frequency.

3 CONFIGURATION

A very long press of **SET** (5 seconds) accesses the configuration menu. The configuration menu is used for fundamental settings.

To choose between the following settings, use the **SET** button:

1.	SPACING	Channel spacing
2.	DISPLAY	Display darkening (power save mode)
3.	PTT SLCT	PTT button selection
4.	DUOWATCH	Dual Watch muting
5.	EXTAUDIO	Behaviour of the external audio input
6.	MICL TYP	Microphone type left
7.	MICL std	Microphone sensitivity left (for standard mic.)
8.	MICL dyn	Microphone sensitivity left (for dynamic mic.)
9.	MICR TYP	Microphone type right
10.	MICR std	Microphone sensitivity right (for standard mic.)
11.	MICR dyn	Microphone sensitivity right (for dynamic mic.)
12.	HEAD OUT	Headset configuration
13.	AUTO ON	Automatic power on with cockpit power
14.	FW	Firmware version (Processor)
15.	SW	Software version (Control Head)

Return to the standard mode (**VOL**) is done by a short press of the **I/O**, **DW**, ▼▲ or ▶ button or automatically 10 seconds after the last entry (time-out).

The selection of the values is done with **VOL/SEL** turn knob.

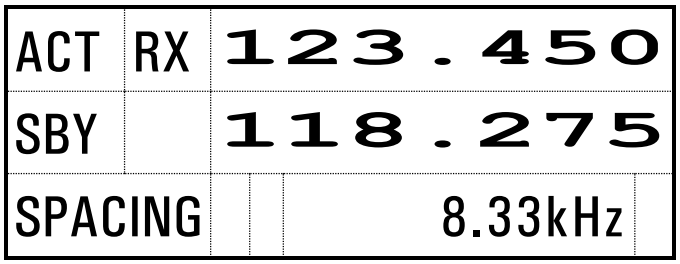
3.1 SPACING – Channel Spacing

With this setting, the ATR833 can be configured to constrain frequency selection to 25 kHz channels only. This can be used to speed up the manual frequency input in areas where no 8.33 kHz channel spacing is used.

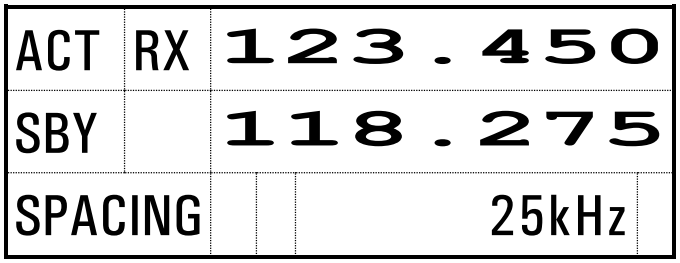
See chapter 2.4.2 for further information on manual frequency input.

Using the **VOL/SEL** turn knob following options can be selected in this submenu:

8.33 kHz: allows input of both 8.33 kHz and 25 kHz channels



25 kHz: allows input of 25 kHz channels only



A short press of SET switches to the next configuration item.

	Please keep in mind to enable 8.33 kHz channel selection before flying into areas where this channel spacing is mandatory.

3.2 DISPLAY – Energy Saving Mode (Automatic Display Darkening)

In order to minimize power consumption the backlight of the LCD display can be switched off after a selectable time period, respectively the brightness of the OLED display is reduced.

With the **VOL/SEL** turn knob following options can be selected:

always on: no display darkening at all

ACT	RX	123.450
SBY		118.275
DISPLAY		ever on

off xxx s: automatic display darkening after xxx seconds after last user interaction (xxx= 10s, 20s, 30s, 60s, 120s)

ACT	RX	123.450
SBY		118.275
DISPLAY		off 10s

Reactivation of the darkened display is done by press of any key (except key **I/O**) or turn of any knob (the action of the key pressed is performed when pressing the key again after the display turned on) or when transmitting.

A short press of **SET** switches to the next configuration item.

This feature should only be used when:

- it can be foreseen that no frequency changes will be required (i.e. when using only limited airspace near one airport, e.g. for circuit pattern training flights), and
- the crew is familiar with the energy saving mode

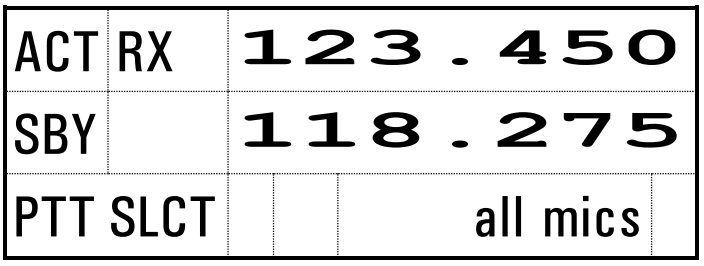
In all other cases this feature shall be deactivated, in order to prevent the usage of wrong frequencies and to avoid confusion of pilots not aware of the energy saving mode.

3.3 PTT SELECT - Button Selection

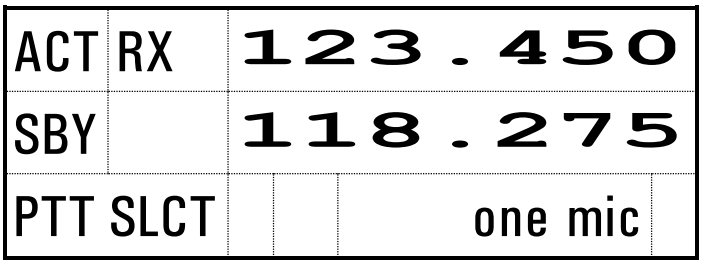
In case of using two external PTT buttons, this configuration item can be used to deactivate one PTT button – and the associated microphone(s) – from enabling transmission.

With the **VOL/SEL** rotary knob the following options can be selected:

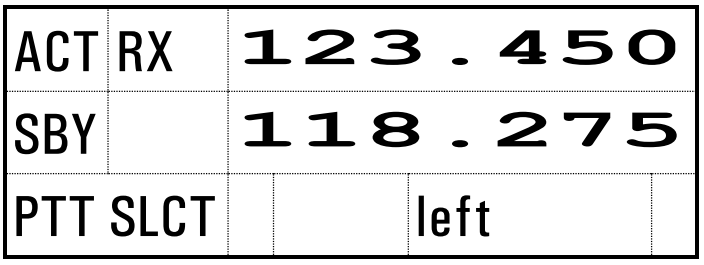
all mics: both PTT buttons and all microphones are used for transmissions, no matter what PTT button was pressed.



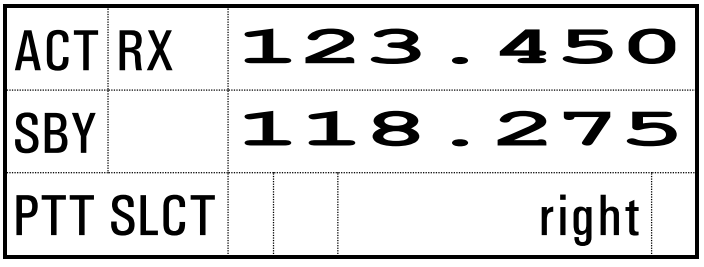
one mic: according to the PTT button pressed, the associated microphone is activated



left only: only the left PTT button and the left microphone(s) are used for transmissions



right only: only the right PTT button and the right microphone(s) are used for transmissions



The intercom functionality is not affected by this setting.

A short press of **SET** switches to the next configuration item.

	When deactivating one PTT button and microphone for transmissions, e.g. in order to keep passengers from interfering with ATC communication, don't forget to reactivate the copilot's PTT after end of the flight.

3.4 DUOWATCH – Dual-Watch Volume Reduction

By shortly pressing the **SET** button four times, with help from the **VOL/SEL** rotary knob the lowering of the volume level ("mute") for receptions on the standby frequency (when having dual watch active) can be controlled. This allows acoustic distinction between both frequencies.

For further information about the dual watch mode see 0.

ACT	RX	123.450
SBY		118.275
DUOWATCH		mute: -1

↳Wertebereich - 9 - 0

Minus 9 is the strongest reduction, i.e. the dual watch reception is much quieter.

0 means no reduction, i.e. the dual watch reception is as loud as the reception on the active frequency.

3.5 EXTAUDIO – Behaviour of External Audio Input

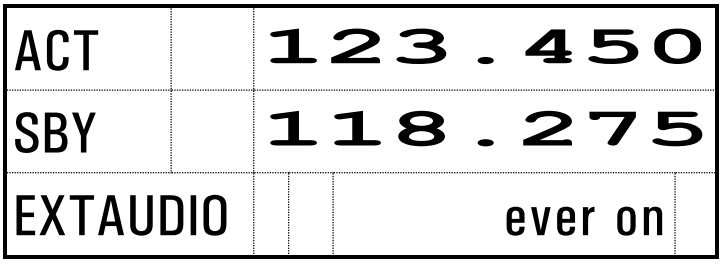
The external audio input can be used to feed a monaural audio signal to the amplifier for the headsets/speaker.

An external audio signal can be used for different purposes. E.g. it is possible to check the audio signal of a VOR receiver, to attach a traffic sensor with acoustic output, or to use the external audio input for (monaural) music input.

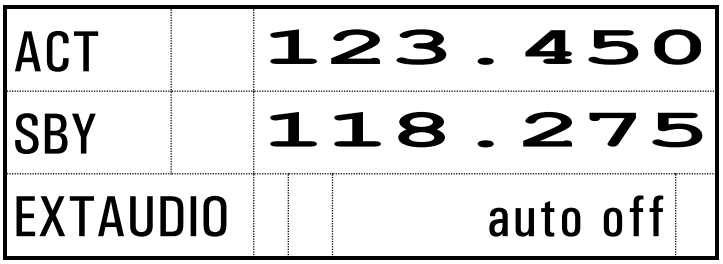
As these signals have different priorities in comparison to radio receptions, the priority of the external audio input can be configured.

With the **VOL/SEL** rotary knob the following options can be selected:

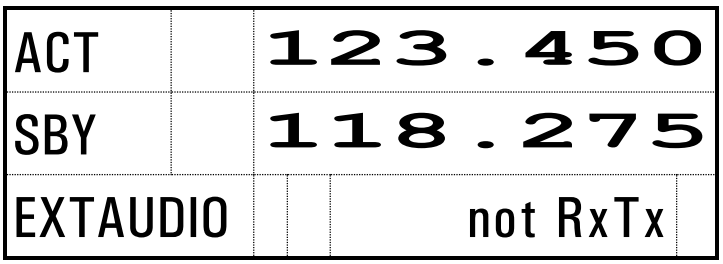
ever on: The external audio input is always on, even during radio receptions and transmit mode. Use this setting only for very high priority acoustic warnings, e.g. collision warning beep tones.



auto off: The external audio input is automatically deactivated during transmit mode, or when no external audio activity is sensed.



not RXTX: The external audio input is automatically deactivated during radio receptions or transmit mode. This setting does not use the external audio activity sensing, and therefore can introduce noise when no signal source is connected.



	Use this setting only when auto off does not react fast enough for very short external audio signals!

A short press of **SET** switches to the next configuration item.

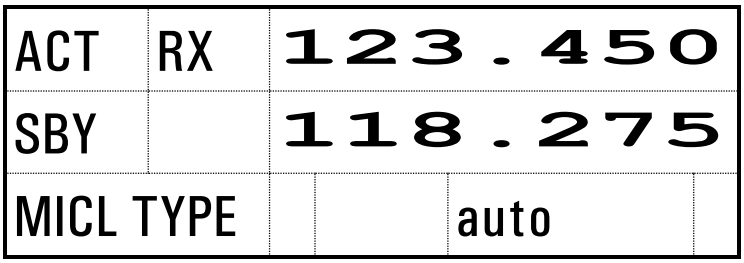
3.6 MIC TYPE – Selection Microphone Type

The next option in the configuration menu is the setting of the microphone type.

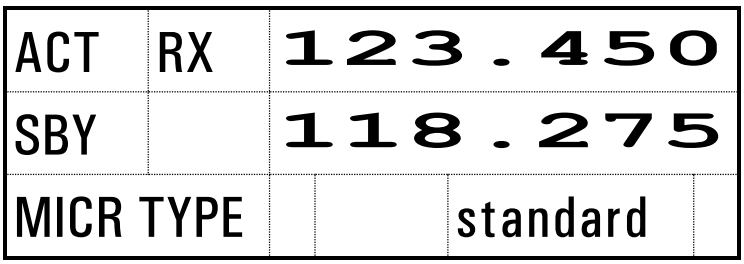
Selecting the microphone type switches the individual microphone inputs. With the setting "dynamic" the dynamic inputs MIC L dyn and MIC R dyn become active and the input for standard microphones is switched off. With the setting "standard" the inputs for standard microphones MIC L std. and MIC R std become active and the dynamic microphone inputs are deactivated. This avoids noise on unused inputs.

With setting "auto", a standard microphone works on the standard input or a dynamic microphone on the dynamic input.

If the dynamic microphone inputs are occupied, these are automatically activated and the standard inputs are switched off. If the dynamic microphones are deactivated via a switch, the standard microphone inputs are automatically activated.



↳Range: auto, standard, dynamic

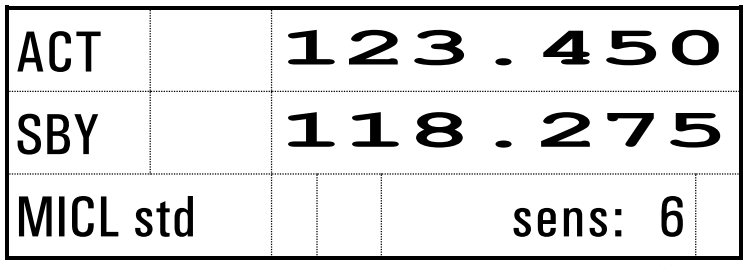


↳Range: auto, standard, dynamic

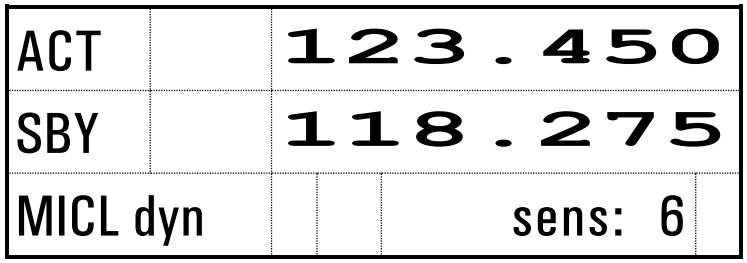
3.7 MIC LEFT / RIGHT – Microphone Input Sensitivity

The last item in the configuration menu is the setting for the microphone sensitivity.

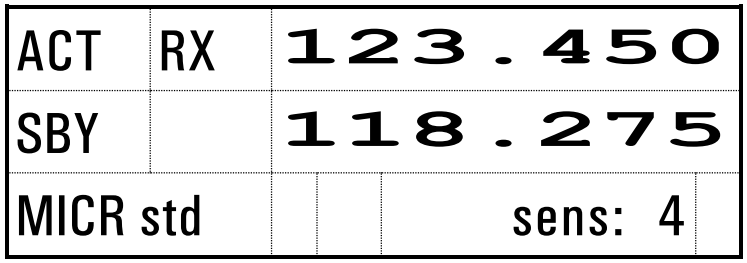
The sensitivity can be adjusted with the **VOL/SEL** turn knob. The sensitivity can be adjusted separately for the left and right microphone and for each type.



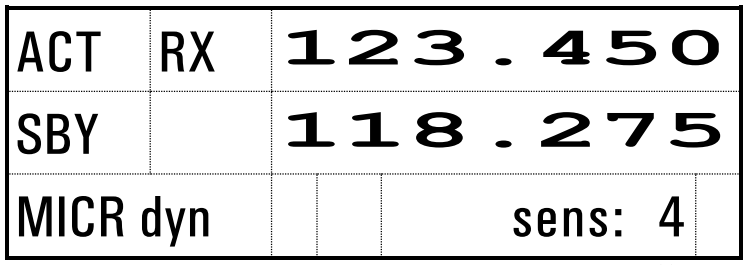
↳Range 0 – 9



↳Range 0 – 9



↳Range 0 – 9

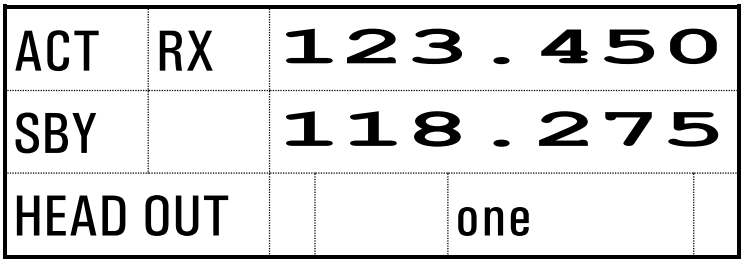


↳Range 0 – 9

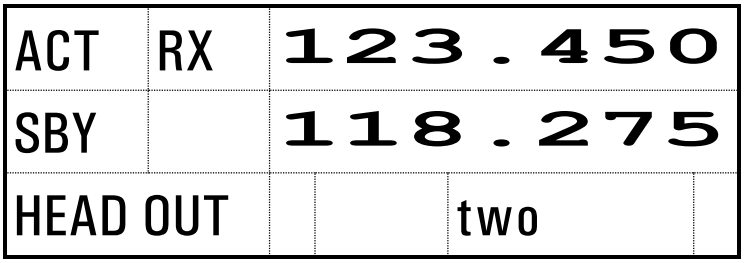
A short press on the **SET** button terminates the configuration menu.

3.8 HEAD OUT – Headset Configuration

The menu item HEAD OUT determines whether one headset output is used or whether both headset outputs are used for separate control.



The setting "one" is required when operating the transceiver with an old harness (without extension -S in the cable name). Adjusting the volume of the sidetone during transmission is then carried out via the menu item STL (Sidetone Level) and controls both headphones. The menu item STR is hidden.

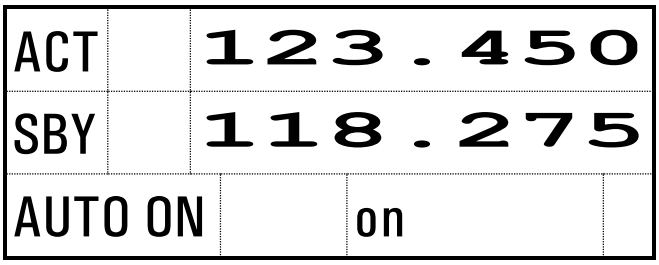


The setting "two" is required for the separate setting of the sidetone (STL and STR) of the headphones and requires the separate connection of two headphones. Cable sets with the extension "-S" provide this separate connection.

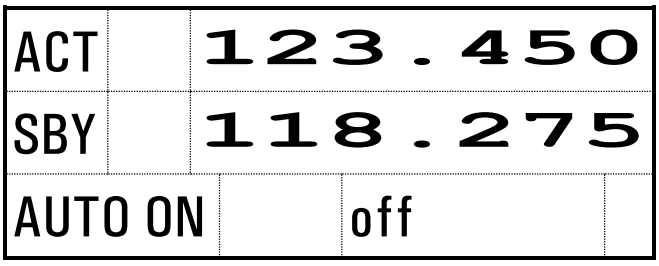
3.9 AUTO ON – Power-Up Behavior

Under the menu item AUTO ON the switch-on behavior can be adjusted with the Avionic Master Switch.

When "on" is set, the radio will start as soon as the operating voltage is supplied to the unit.



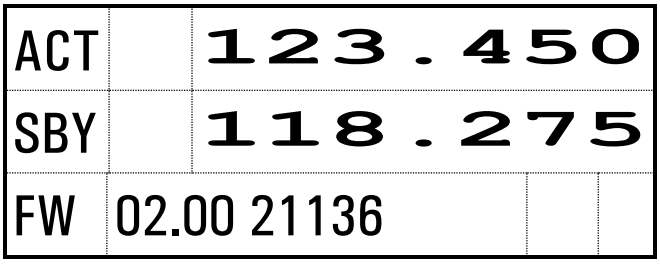
If "off" is set, the device remains switched off when the voltage is applied, no matter how switched off.



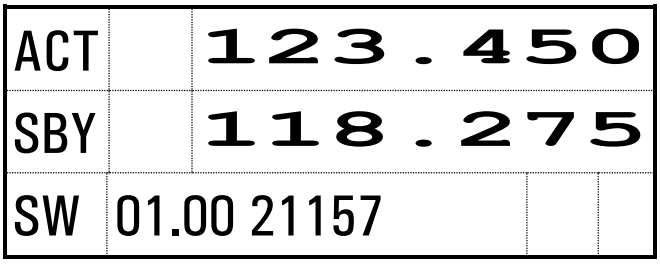
3.10 FW /SW – Firmware / Software Version

The firmware or the software version of the device is displayed here.
No settings are possible.

Display Firmware NF (example)

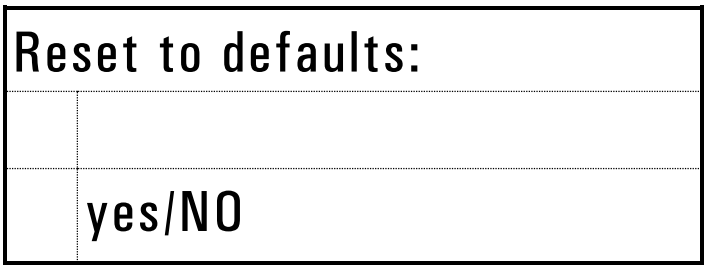


Display Software Control Head (example)

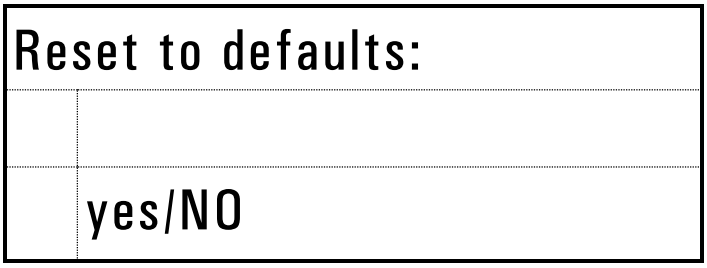


3.11 Master Reset – Reset to Factory Settings

With following procedure all configurations are reset to the factory settings. Switch of the device. Press MEM button and DW button and switch the unit on. Following screen appears after start-up:



The master reset is activated by pushing the **SET** button. the The reset carried out by confirmation with the SET key and the radio restarts automatically.



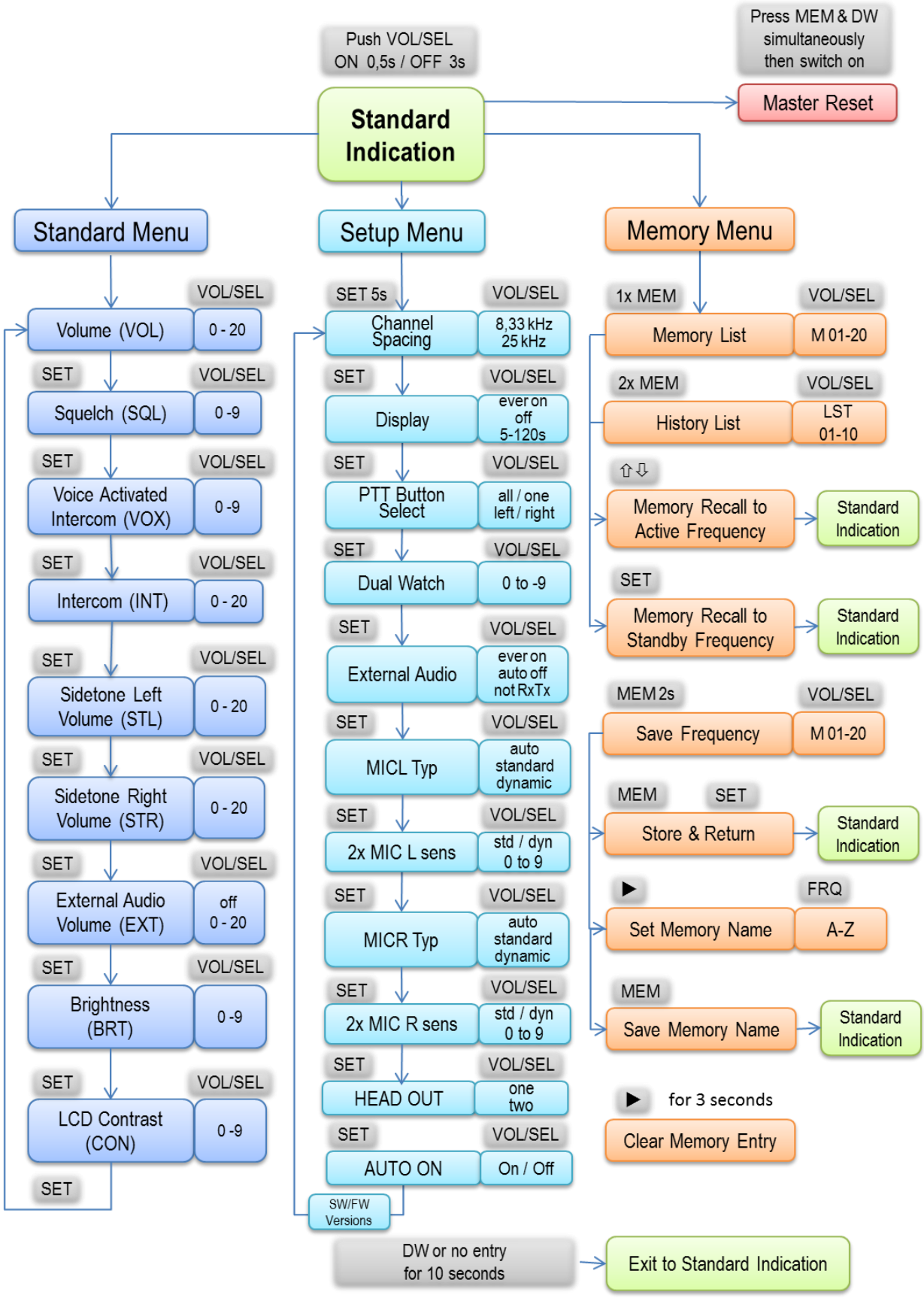
3.12 Adapter Operation

If the ATR833A-II is operated with an adapter for an older cable set, this adapter is automatically detected and the device is set into adapter mode. In adapter mode, the following settings are made automatically:

1. PTT Select is set to "all mics" because with "single mic" setting it might be that one microphone is not working. The "PTT Select" selection is therefore hidden in adapter mode.

2. Adjusting the volume of the sidetone during transmission is done via the menu STL and controls both headphones. The menu item STR is hidden. The intercom volume is adjusted via the INT setting and controls both headsets.

3.13 Overview Configuration Menu (Setup)



5 APPENDIX

5.1 Frequency/Channel-Plan

In the following table examples for operating and displayed frequencies in the range between 118.000 ... 118.100 MHz are given. This table can be continued to 136.975 MHz following the same scheme.

Operating Frequency (MHz)	Channel Width (kHz)	Displayed Frequency in 8.33/25 kHz Mode	Displayed Frequency in 25 kHz Mode
118.0000	25	118.000	118.000
118.0000	8.33		118.005
118.0083	8.33		118.010
118.0166	8.33		118.015
118.0250	25	118.025	118.025
118.0250	8.33		118.030
118.0333	8.33		118.035
118.0416	8.33		118.040
118.0500	25	118.050	118.050
118.0500	8.33		118.055
118.0583	8.33		118.060
118.0666	8.33		118.065
118.0750	25	118.075	118.075
118.0750	8.33		118.080
118.0833	8.33		118.085
118.0916	8.33		118.090
118.1000	25	118.100	118.100
118.1000	8.33		118.105
etc.	etc.		etc.

ACL

K-DUO

Operation :

Switch ON = flash active

Switch OFF = flash not active

Emergency operation :

In the event of a malfunction or failure, the system must be switched off immediately and must stay off for the remaining flight time. Never switch on the system again inflight, after or while persisting errors.

Caution, high intensity optical radiation!

Handling on ground: do not look directly into the light!

Avoid direct contact with water!

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:).

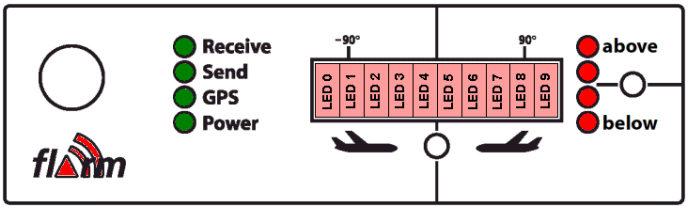
When operating in the *Warning* mode a red LED lights up only if the calculation predicts a threat. Warnings are always shown by flashing LEDs, the threat level being shown by the number of LEDs illuminated, by the frequency of flashes, and the simultaneous sound signal (beep). Selection of this mode 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.

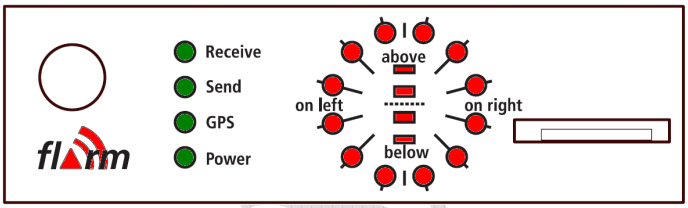
5. Front Panel

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.



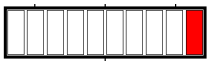
Push-button | 4 green LED (Status) | 12 LED (horizontal) 4 LED (vertical) all bicolor | microSD reader

6. Start-Up

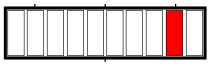
FLARM is always switched on if the unit is connected to an adequate power supply.

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)

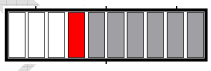


This is followed by another one-second beep, followed by a binary presentation of the Software-Version:

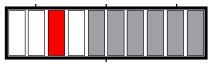
- Hardware Versions 1 and 2: LED0 to LED3 represent the major versions, LED4 to LED9 the minor versions. Everything is shown in red.

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

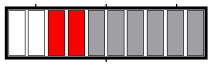
Software Version 1.xx (operational only to April 2005)



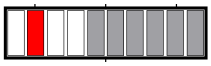
Software Version 2.xx (operational only to Feb 2006)



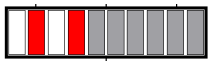
Software Version 3.xx (operational only to March 2008)



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



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

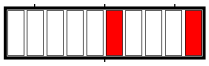
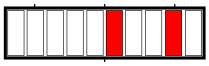
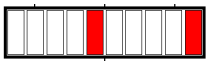
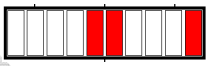
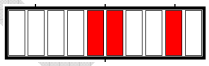
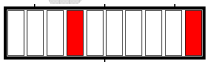
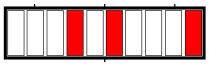
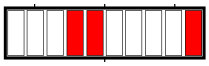
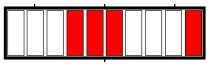
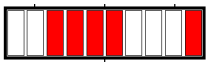
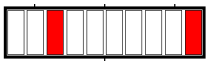
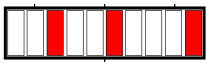
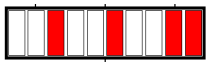
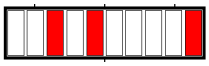


Then FLARM shifts to normal operation and waits until it has acquired an adequate GPS position fix. When switching on, this procedure can take *several minutes*. Without a proper GPS position fix, the unit is not ready for operation. **Before departure the pilot must ensure that at least the Power-, 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.

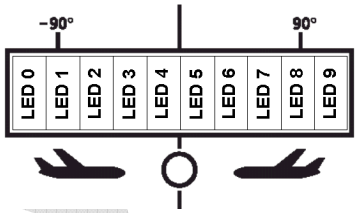
10. Aircraft Anti-Collision Warnings

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.

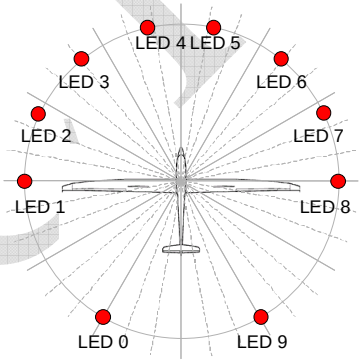
The unit emits an audio warning (beep) tone at the same time as the flashing red optical warning. The time between the warning and possible collision is brief, just a few seconds. Warnings of fixed obstacles are given slightly earlier.

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

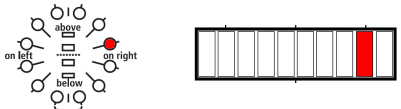
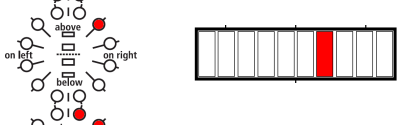
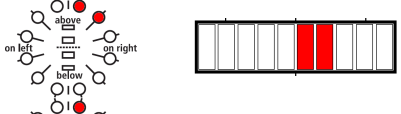
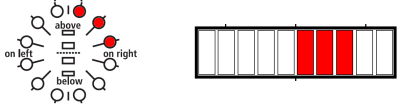


Horizontal bearing indicated on Hardware Version 3 and later

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°.

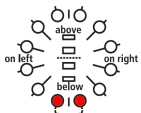
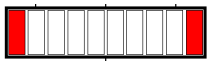
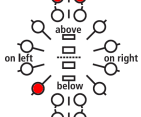
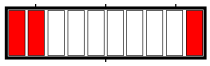
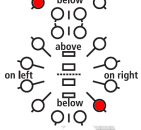
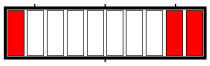
Danger from the front or side

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

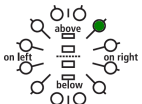
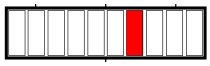
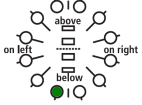
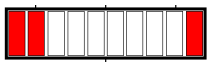
The vertical bearing is indicated by a vertical[1] line of four red LEDs and show the bearing relative to a horizontal plane. This is independent of the aircraft's climb angle. The uppermost or lowest LEDs illuminate when the bearing exceeds 14°. The LED flash frequen cy is identical and synchronous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

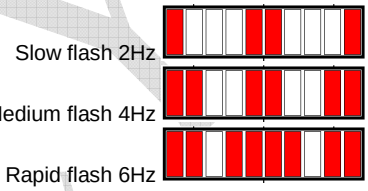
An acoustic warning (beep) is given at the same time as the flashing fixed obstacle warning. The time between warning and possible collision is brief, just a few seconds. However, warnings are given of fixed obstacles earlier than those for other aircraft.

Hardware Versions 1 and 2 show obstacles as follows:

Moderate threat
(less than 18 seconds to calculated collision)

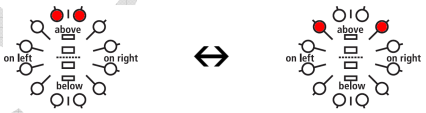
Medium threat
(less than 13 seconds)

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.