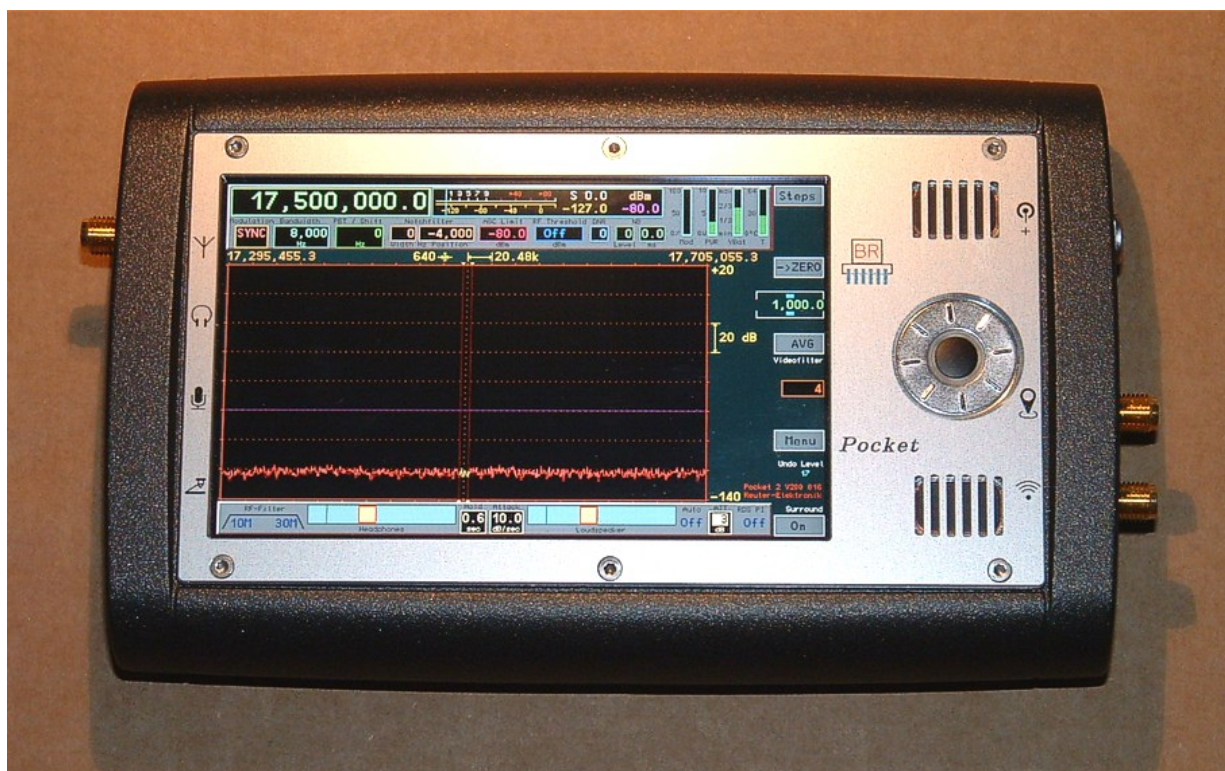


# Operator Manual

Digital and Mobile Receiver / Transceiver

## Reuter Pocket



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# 1. Overview

The Reuter Digital Receiver "Pocket" (factory designation "RDR51") is a receiver for amplitude and frequency modulated signals in the range from 1 kHz to a maximum of 156 MHz (depending on the configuration). It operates on a completely new principle, Spectrum-Based Signal Processing (SBSP). It allows for an extremely selective filtering and low-noise demodulation with finely tunable parameters without the use of internal or external computers.

The basic concept of the Pocket is based on fully digital signal processing. The amplified and filtered antenna signal is digitized directly (DSR: Direct Sampling Receiver). There is no preceding frequency transformation ("mixing"), no adjustable frequency processing (PLL, VCO, DDS or similar) and no conventional filters (Quartz, Piezo, LC or similar). This results in an extremely linear phase response without additional phase noise or mixing interference, a prerequisite for clean, trouble-free and low-distortion demodulation.

The Pocket's frequency selection ("tuning") is purely computational without any change of frequencies within the device. There is only one free running-, very low-noise fixed frequency oscillator. A GPS-based measurement system determines all frequency deviations to within 1 Hz and corrects them without interfering with frequency generation.

The digitized received signals are not processed by a processor by software. The Pocket does not have a DSP, built-in PC or similar high-speed CPUs. PCs or PC accessories (monitor, keyboard, mouse...) can not be connected to the Pocket. All signal processing occurs internally with a maximum of 167 MHz clock frequency in dedicated, parallel-working hardware ("FPGA"). It is programmable by a special firmware ("Configuration") and thus alterable by updates.

The Pocket consists of the basic unit with the possibility to install an expansion board. This results in various device configurations, for example: Pure SW receiver, SW receiver with transmitter or SW plus FM receiver.

User guidance within the Reuter Pocket is provided by a modern user interface. On a vivid WVGA display (800 x 480 pixels) a variety of elements are displayed, which are operated by touch screen. A small rotary encoder ("scroll wheel") to change set values (for example, tuning or volume) is additionally provided.

The installation of a high-resolution display with very fast graphical processing introduces possibilities that were previously not or only partially available for small mobile devices (for example spectrum and waterfall display). Digital signal processing enables high-accuracy data. As a result, the representations on the Pocket's display actually achieve measuring device quality.

The Pocket's spectrum-based signal processing performs 4 times faster than the well-known FFT (used within spectrum analyzers or SDR receivers with a PC). In addition, high priority was given to an artifact-free image display. Even with extreme settings, there is no flickering of the display (as often seen with very expensive measuring devices). The presentation is always smooth with a high frame rate.

The Pocket is able to receive the entire LMK or FM range. There are various preselections with low or high pass filters below and above 10 MHz, bandpass filters from 50 to 71 MHz (6 m and 4 m) and 2 broadband but highly selective band filters (SAW) for 87.5-108 and 136-151 MHz. On the digital level, the selection of a single station occurs by phase-linear filters ("FIR filters") or highly selective using SBSP.

The audio signals are converted into the analog domain by a 24 bit stereo DAC with an 81.92 kSp/s sampling rate. 2 built-in miniature speakers allow for playback in quiet environments. The stereo headphone jack provides a high-quality audio signal for headphones or for forwarding to external amplifiers (like a stereo rack).

WiFi and Bluetooth transceivers for connection to external devices are integrated into the Pocket. The WiFi connection allows data to be exchanged with personal computers or tablets / smartphones (depending on available software for these devices). The firmware of the Pocket can also be updated via WiFi. The Bluetooth connection allows wireless connection to external speakers and headsets (software-dependent).

## 2. Safety precautions

**Please always keep the following safety precautions in mind!**

The device contains lithium-ion batteries. These batteries may only be operated under very specific conditions. In particular, complying to the upper operating temperature is relevant for safety. Never expose the device to temperatures higher than the maximum temperatures given in the specifications for the respective application!

If the device has been exposed to a higher than the permitted temperature under any conditions (for example accidents, fires, etc.), it must immediately be locked away in a fireproof and largely airtight container (like a safe, earthenware / concrete / metal container, etc.)! The device may only be removed from it after cooling to the permitted temperature!

Burning devices may only be extinguished with permissible methods (like powder or CO2 extinguishers)!

Do not open the device. The unit contains no user-serviceable components for replacement (such as bulbs or fuses). The replacement of components, in particular batteries, may only be carried out by the manufacturer or persons authorized by him.

The device is intended for use indoors or outdoors without moisture. Do not expose it to moisture, never put liquid-filled containers on top of the unit. Do not allow frost, dew, condensation or rain reach the device! If moisture (like rainwater) came in contact or has accidentally entered the device, switch it off immediately! Send the device to the manufacturer for inspection!

Always provide a safe placement on a flat, straight and solid base of sufficient carrying capacity! Transport the device only in either solid boxes or crates (for example the shipping container), or transport it by firmly grasping the sides with both hands! The unit can cause an injury in case of a drop under its own weight!

Do not expose this equipment to mechanical stress caused by impact, pressure, vibration or shock which exceed that commonly used in the home with the use of electronic devices! The control elements and specifically the front window of the display are very sensitive to pressure or impact. Never press a control with a force beyond the extent necessary and never press the front screen more than is necessary to trigger the touch screen!

If you notice any damage to the device, stop the operation immediately! Send it in for repair to the supplier if necessary.

Would you like to dispose the device due to damage or no more usability, send it back to the supplier or return it to your local waste collection center. Never dispose of the appliance elsewhere, such as household waste. It pollutes our environment!

Only use soft, lint-free and dry cloths to care for and clean the device! Be especially careful when cleaning the front screen of the display, as it is very sensitive to scratching. For stubborn dirt, do not use any solvents, but at most a slight moistening of the cleaning rag with distilled water! Make sure that no moisture reaches the inside of the device!

The device requires the connection of antennas. Please observe the relevant safety regulations when installing antennas! Particular attention must be paid to lightning and surge protection. If possible, hire a specialist company! If necessary, disconnect all antennas from the device when a thunderstorm approaches!

The device possesses a high-level headphone jack. Never set the volume too high!

### 3. First steps

After you have received the device and carefully read the operator manual (especially the above safety precautions!), you can now put it into operation.

#### 3.1 Unpacking and first-time operation

Please unpack the device carefully and place it on a hard, flat surface. If you have just moved the device from a cooler to a warmer environment, please leave it switched off for a while to avoid any possible condensation moisture. By placing a hand on the top or bottom of the case, you can determine whether the device has approximately reached the ambient temperature.

Check the device's scope of delivery as indicated on the invoice and / or delivery note. At least one power cable is always provided with the Reuter Pocket. In case of absence, request it immediately! The Pocket may only be charged with the corresponding power cable!

Connect the power cable now. The coaxial plug (standard "Lemo") must be plugged into the DC jack of the Pocket (see description of Controls). The banana plugs should be connected to a suitable power source (e.g., 12 V laboratory or 13.8 V amateur radio power supply). Pay attention to the polarity (red = plus +, blue or black = minus -). The "Lemo" plug of the power cable is self-locking. It can only be removed from the socket by pulling on the plug, but not (non-destructively) by pulling on the cable.

For safety reasons, the Pocket will only be delivered with minimally charged batteries. Let the device recharge itself for some time (about 2 - 3 hours) at the charging power source. Afterwards, the device is fully charged when switched off. The application of charging voltage is always indicated by illumination of the rotary encoder. The illumination gives no information about the state of charge, only about the availability of charging current.

The device can remain at charging voltage indefinitely without damage. The integrated charger automatically regulates the required currents. It is also possible to switch on the Pocket with applied charging current (to conserve the internal battery capacity) at any time. For reasons of environmental protection (unnecessary energy consumption) and unnecessary heating (active operation with charging current), the Pocket should only be connected to the charging current source to charge the batteries.

You can now switch on the Pocket immediately (active operation with charging current). The power consumption of the device is at the expense of the possible charging current. In other words, if the batteries are not fully charged and require charging current, the current is reduced by the current power consumption of the switched-on device. Charging then takes longer. The integrated charger is always capable of providing the required operating current except for an active full power transmission (transceiver operation). As long as the device is connected to a charging current source and does not transmit constantly, the batteries can never be depleted, but can also be charged only slightly. The indicators on the display provide information about the current power consumption and state of charge.

#### 3.2 General information on operation

In order to receive any signal with the Pocket, you need an external antenna. Connect it to the SMA input socket. Usually, you can connect your antenna using one of the supplied adapter cables from SMA to the widely used BNC standard connector. Avoid mechanical stress to the socket! Note the **maximum input level** of the Reuter Pocket! If the device is equipped with a telescopic antenna, it can be used for simple reception attempts. Due to the need for direct mounting on the housing, the reception is not optimal due to the influence of the Pocket's digital units, especially the integrated display in the housing. The Pocket achieves full reception performance only by connecting a (possibly galvanically isolated) remote antenna via a 50 ohm cable.

To monitor the received signal or to constantly listen to the stations either the built-in speakers can be used, or a headphone can be connected (3.5 mm jack). The display presents the received signals in the spectrum display as a continuous sequence of new spectrograms.

**Note:** If the device is not in delivery state or default factory setting (for example because you received it from another owner), settings may be present that prevent audio output and / or spectrum display. If necessary, reset the Pocket to the factory defaultss (see section 7.2).

If you want to use the GPS correction option, connect the GPS antenna to the corresponding socket and place it in a location (for example in the window) with good reception. A check is possible via the GPS dialog (wait a few minutes until the receiver can receive satellites).

You can now configure the Reuter Pocket to your liking. An option is selected by tapping on it (it is then highlighted). To tune to a station, use the scroll wheel, the touch screen "swipe" function, or direct decimal frequency entry. To change the volume, use the display's touch slider. All other setting options are described in detail in Chapter 5 "Operation".

Due to the high concentration of displayed values and the relatively small display, using the touch screen is not always easy. The Pocket is usually enclosed with a stylus for operation. This allows a specific point (set value) on the display to be tapped exactly. There can be accuracy difficulties when using your fingertip. It is best to use your fingernail to tap values. Never use harder objects!

### 3.3 Battery management

Two lithium-ion batteries are installed in the Reuter Pocket. The two batteries together provide the Pocket's operating power and are charged when the charging voltage is applied with the same current. The voltage of each individual battery is displayed in the Power dialog. Usually, a difference between the two batteries can be observed. On the one hand, this results from deviations in the measurement (the measurement error of the voltage measurement is a maximum of 0.2 V) and, on the other hand, from specimen deviations of the batteries themselves. No 2 identical batteries exist.

Since the batteries are always (dis-)charged with the same current, one of the batteries is always fully charged or empty first due to capacity differences. That is the one with the lower capacity. When discharging, the Pocket is switched off as soon as the battery with the lower voltage has reached a minimum voltage of 3.2 V (emergency shutdown). When charging, the charging current is reduced as soon as the battery with the higher voltage reaches a maximum voltage of 4.3 V.

**Caution!** The Pocket should never be held switched on until it shuts off itself! This reduces the life of the batteries. Switch off the Pocket or apply the charging voltage as soon as the weaker battery has reached a lower value of approx. 3.5 V.

**Note!** The Pocket **should** be disconnected from the charging voltage as soon as the stronger battery reaches an upper limit of approximately 4.3 V.

The generally always existing difference between the batteries reduces the theoretically possible operating time of the Pocket with battery power. To compensate for this to some extent, the Pocket has a so-called balancer circuit. This circuit prefers the battery with the lower voltage when charging, so that it receives more charge during the charging process and thus approaches the "stronger" battery. This circuit is controlled by the Pocket's software and is therefore only in operation when the Pocket is turned on when loading! Therefore, charge the Pocket in switched-on state as often as possible. If you do not want to operate it at the same time, you can activate all power saving options (volume to 0, ADC off, GPS off, transmitter off, display off ...).

Devices as of serial number 060 have a downwards extended input voltage range of the charge controller. The batteries can be charged with a voltage of 5.0 V or more. However, this is the absolute lowest limit and the charging then requires very stable (low-impedance) power sources (at least 1.5 A without any voltage drop even with peaks to over 2 A!) as well as a short and thick charging cable. As soon as the voltage drops below 4.8 V directly at the device socket, the controller shuts down the current all the way. If the voltage then rises to 5.0 V or above, the controller switches on again. This effect can lead to constant fast switching and thus unreliable charging. In this case, a power source with lower internal resistance or higher voltage must be used!

The charging at 5 V also generates higher losses (increased warming of the Pocket). Optimum efficiency results with charging voltages of 9 V (from S/N 060) or 12 V (S/N 010 ... 059).

## 4. Device description

### 4.1 Mechanics

The Pocket consists of a half-shell housing made of a lightweight and high-strength aluminum-magnesium alloy. The two shells are connected by 4 screws, which are located under the rubber feet of the lower half shell. An internal rubber seal protects against the ingress of moisture.

The lower (rear) half shell possesses 2 B600B 3.7 V / 2600 mAh Li-Ion batteries inside, as well as an expansion board (for example FM RX or transmitter) or a blank board to hold the batteries.

The upper (front) half-shell contains the display, the rotary encoder ("scroll wheel"), the RF connectors and the charging socket. A front panel is mounted on the shell in which the speakers are installed. The device's motherboard is located inside. It also carries the 3.5 mm jack sockets for headphones, microphone and morse key, which are accessible through side holes.

Speaker (plastic membrane), display and sockets are sealed and thus partially protected against the ingress of dust and moisture.

**Caution!** The Pocket is **not waterproof!** Spraying with liquids (for example, rain) or immersion or even submersion inevitably leads to ingress of the liquid. In such a case, the device must immediately be taken out of service and enclosed in a non-flammable container. A possible short circuit inside the device can lead to overheating of the batteries and thus to the emergence of a fire!

### 4.2 Electronics

The motherboard and possibly an expansion board carry all electronic units of the Pocket. Both boards are interconnected by pluggable RF cables (standard "U.FL") and a foil cable. Display, rotary encoder, speakers and batteries are also connected via plug-in connectors. The SMA sockets for the antennas possess U.FL cables with corresponding connectors on the motherboard.

The core of the Pocket's electronics is a highly integrated FPGA (Field Programmable Gate Array). This circuit is programmed by special software (called "Configuration") to generate all the modules for basic signal processing. Those are:

- 32 bit microcontroller with 2 cores (user guidance / device control and graphic processor with hardware accelerator)
- Downconverter with filter for the ADC data
- Broadband spectrum analyzer (only for special versions)
- Narrow Band Spectrum Generation and Processing for Audio and Video (SBSP)
- Broadband FM demodulator with RDS decoder (installed only with optional equipment)
- Time-based demodulators with filter
- Audio generation from spectrum data (back transformation into audible signal)
- Various modules such as interfaces (memory, I<sup>2</sup>C, I<sup>2</sup>S, graphics ...) and clock generation.

Thus, the FPGA realizes all receiver functions by hardware. There is no processor, DSP or similar. The Pocket can therefore not run SDR software or other computer programs.

In addition to the FPGA, there are several other modules. The most important are:

- Analog signal processing (preamplifier and filter, switch, attenuator)
- Analog-to-digital converter (ADC, 2x 14 or 16 bit)
- Low-noise main clock oscillator
- Digital-to-analog converter (DAC, 2x 24 bit) for audio output, ADC for microphone signal
- 2 to 8 Gbit flash memory
- 2 pieces of LPDDR4 memory (SBSP and graphics)
- Various DC / DC converters and linear regulators for display lighting, operating voltages and battery charge controller)
- WLAN controller with memory and analog circuits
- GPS module

For extensions, the following modules are added to the expansion board:

- Microprocessor for transmitter control (transmitter)
- PWM amplifier for transmission power (transmitter)
- Digital RF signal generator (transmitter)
- GaN-FET Transmitter Class E / F (Transmitter)
- Preamp and filter for band III and extended 2 m band (FM)
- DAB + module.

### 4.3 Firmware

The firmware (internal operating software) of the Pocket is programmed into a non-volatile memory (Flash). Each time the Pocket is switched on, the firmware is loaded into the FPGA and configures it according to the necessary units. In addition, the configuration contains the software of the generated microcontroller for the user guidance and the graphics of the device.

This software essentially determines the device functions, e.g. what can be seen on the display, what settings are available, etc. Because it is stored together with the FPGA configuration (which defines the capabilities of the hardware), both can be updated together, allowing for new device functions. The flashing of new firmware (FPGA configuration controller software) is accomplished via a WiFi connection ("WiFi") to a personal computer. In addition to the WiFi capability, the PC must have a Windows operating system. A loader exists for this operating system, with which (among other things) new firmware can be flashed into the device.

The Pocket has an independent controller for the WLAN and Bluetooth functionality. It possesses its own memory and own software. This software can also be updated via a PC.

The following description applies to configurations as of version V200 (device "Pocket") or V01 (WLAN).

## 5. Operation

### 5.1 Connectors

The following operating and connection options are available for the Pocket.



Right side of the Pocket, sockets from right to left:

- 12 V charging voltage ("Lemo" socket)

Connect the device with the associated connecting cable to a charging voltage in the range of 11 ... 14.5 V here. At the other end, the cable occupies banana plugs for conventional power supply units (for example laboratory or 13.8 V amateur radio power supply). The red plug is the positive pole! **In the event of incorrect polarity, a short circuit occurs due to a protective diode in the device! This can cause high currents to flow, which can lead to the destruction of the cable or charging plug / socket !** If you have ordered the Pocket with power supply, it is provided with a suitable charging cable.

The Lemo plug of the charging cable self-locks itself in the socket. It can not be removed by pulling on the cable, but only by pulling on the handle sleeve from the socket. An accidental drop out by pulling on the cable (for example, when moving the device) is therefore not possible. On the other hand, the cable can be damaged by accidentally pulling it hard. Make sure that the charging cable is never under effect of any tractive forces!

- GPS antenna and WLAN antenna (SMA)

Connect the provided antennas here.

The GPS antenna only needs to be connected if the frequency stabilization function is to be used or the position data is to be displayed. The Pocket possesses no internal GPS antenna, because it would have no reception due to the high shielding effect of the metal housing.

The WLAN antenna is only needed if the Pocket is to connect to a personal computer. The Pocket also has an internal wireless antenna. However, it can only establish a connection at a very short distance (max a few meters). Often, the data rate is severely limited or there are many disconnections. Use of internal or external antenna depends on user environment (can be adjusted in the WiFi dialog).



Left side of the Pocket, sockets from left to right:

- Antenna input / output (SMA)

Connect the antenna for the needed frequency here. The Pocket comes with an adapter cable from SMA to the usual BNC standard.

- Headphones (3.5 mm stereo jack)

A stereo headphone can be connected here.

- Microphone (3.5 mm stereo jack)

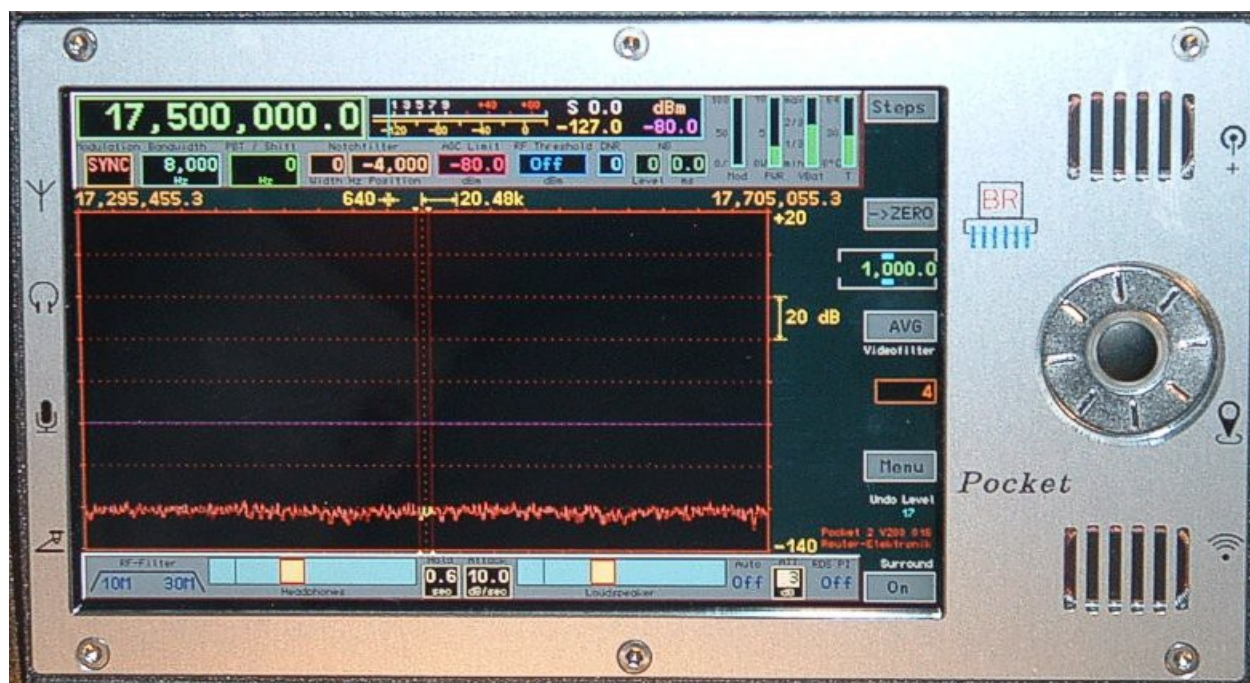
A microphone can be connected here. The tip is signal, the sleeve can be used as a PTT input (connect contact to ground). A 5 V bias voltage can be connected to the signal connector ("Microphone" dialog).

- Morse key (3.5 mm stereo jack)

A morse key can be connected here (connect tip to ground). Sleeve is connected in parallel with the microphone jack (PTT). If the microphone used does not have a built-in PTT button or if an additional one is to be used (like a foot switch), then a PTT button can be connected here with contact to ground.

**Caution!** Only "thin" jacks with a maximum of 6.3 mm diameter directly at the plug fit into the sockets!

## 5.2 Controls



Front panel of the Pocket, right and left the symbols for the connection sockets described above

- On / off switch with control LED (center right)

The black button in the middle of the rotary encoder is used to switch the Pocket on and off. The button must be pressed for at least 3 s for the Power On function to take place. After that you also have to wait at least 3 s until the button can be pressed again. These long delay times are present so that the unit does not switch on or off immediately if the button is accidentally touched.

A narrow LED ring is located around the button. It lights up as soon as the device is connected to a charging voltage.

**Caution!** The button has a certain touch sensitivity. It may even be triggered by mere touch when you are charged statically. In this case, the state of operation is uncertain (possibly switched off display but active device)! Always make sure whether the device is really switched on or off by pressing firmly for at least 3 s!

- Rotary encoder (scroll wheel, right center)

The rotary encoder (ring around the button) allows the continuous adjustment of set values. Each rotation will cause an advancement (clockwise rotation) or reversal (counterclockwise rotation) of the currently selected value.

*Note!* In addition to the sockets, the rotary encoder is the main penetration point at the device for dust and / or liquids. Protect it especially against dirt and moisture.

- Loudspeakers (top right and bottom)

The two speakers reproduce the received signal. They have low performance and a limited frequency range. In FM-W stereo mode, modest stereo playback is possible. Increasing the base width beyond the value 100 % can be advantageous (see set value "Width").

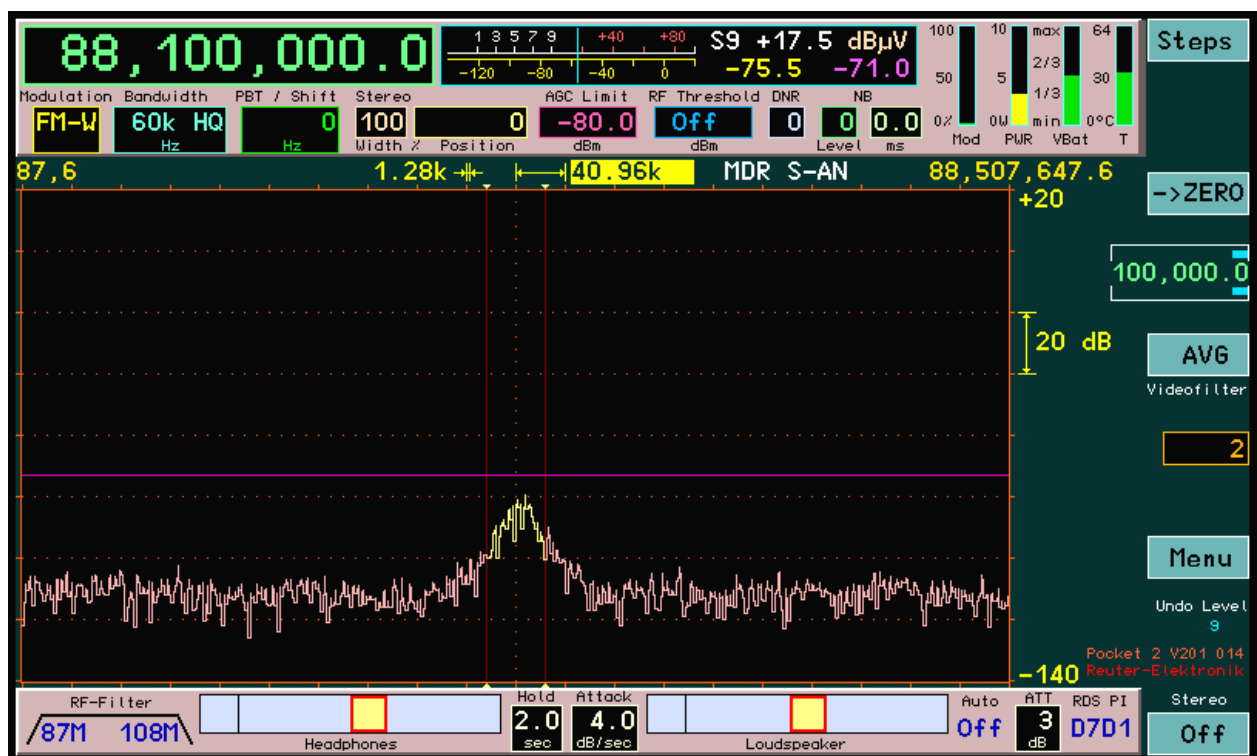
- Display

The display has WVGA resolution of 800 x 480 pixels. It has a touch-sensitive surface ("touchscreen"). All adjustments are triggered by selecting ("tapping") a displayed graphic symbol. You can then change the selected value by turning the scroll wheel. In addition, most adjustment values can be changed by swiping the display of the spectrogram (to the right → increase value, to the left → decrease value).

The Reuter Pocket possesses a position sensor. If the device is tilted to vertical, the position of the display image on the right ↔ left or vice versa is adjusted automatically. In a horizontal position, the display is undefined (depending on the last determined position).

The selection or activation of a value for inputs is signaled by highlighting the otherwise dark background of the value. In dialogs, the coloring is reversed: Not selected = light background, selected = dark background.

### 5.3 Set values



User interface of the Pocket with set values

- Frequency (large at the top left)

Selecting the frequency display as the active input value (1x tap) allows the tuning of the reception frequency. Each locking step of the rotary encoder changes the frequency by the value of the set step size. Direct entry via a virtual numeric keypad (Direct input dialog) is also possible.

The display of the frequency has a special function: When the maximum processable input level is

exceeded, the box lights up red. In this case, you have to turn on the attenuator (see "Setup" dialog) and / or decrease the input voltage to the device input!

Settings can be made with an accuracy of 0.5 Hz. There are different setting limits, depending on the selected filters (see description in "Setup" dialog). Direct entries are rounded to the possible maximum or minimum value. Rotation of the scroll wheel at the region boundaries has no effect.

Double-tapping the frequency display opens the "Direct Input" dialog (see there).

- Tuning grid (virtual button top right "Steps")

The step grid, in which the reception frequency can be adjusted, can be configured via the virtual "Steps" button. When tapping, the step size shown below (value in the white rectangle) becomes the active input point.

The step size can now be changed with the rotary encoder. To simplify the setting, you can set the point at which it changes up or down. It is characterized by two horizontal bars above and below the selected digit. These bars (and thus the lowest order active input point) can be moved to the left and right by dragging on the touch screen.

Tapping on "Steps" returns you to the previously selected set value (with active step size adjustment, this is labeled "Escape" = leaving this setting). From now on the frequency setting always adds or subtracts the new value to the frequency.

Quick selection of common step sizes is possible by double tapping on the inactive setting. To do this, the frequency setting must be active (tap, if not active). Tapping once activates the grid setting briefly. Tapping again while it is active displays a selection of different step sizes. Tapping a value closes the selection dialog and returns to the frequency setting.

- Button "->ZERO"

The adjustment of frequencies and the corresponding steps can cause slightly offset settings. In this case, by tapping the "->ZERO" button, an update can be achieved as follows:

- Frequency values are always set to the nearest lower integer multiples of the corresponding step size, unless a range limitation is set.
- When adjusting the step size, all digits right from the selection bar are set to zero or it will be set to the lowest or highest possible value of the increment.

This function allows you to easily correct frequency values after changing the step size or automatic adjustment to the field boundaries.

Example (the "Hz" is not displayed):

Current frequency setting 1,124,550.0 (Hz), the corresponding current step size is set to 10.0 (Hz).

→ New setting of step size to 1.000 (Hz). If the frequency is now adjusted, it is always changed in 1000 Hz steps, e.g. in clockwise rotation: 1,125,550.0 ... 1,126,550.0 ... 1,127,550.0 and so on.

However, your intention in choosing the step size was probably the desire to tune the frequency to rounded thousands. You would now have to set such a "straight" frequency by direct input, would have to set it exactly before choosing the new step size, or again adjust the step size to initially 10 Hz (50 Hz, 150 Hz or 450 Hz would be more effective) and adjust it "smoothly".

This effort can be avoided by tapping the "->ZERO" button after adjusting the step size to 1,000 (Hz). The frequency is now automatically set to the next lower multiple of 1000 Hz, e.g. 1,124,000.0 (Hz).

The "zeroing out" of the lower digits also works with the frequency setting itself. It should be noted that it is always set to multiples of the currently valid grid value. If it is "crooked", the frequency is also set to a matching "crooked" value.

- Modulation

The type of acoustic playback of the received signal ("mode") is determined by the demodulators. They generate the audible signal from the spectra of the received signal ("SYNC" to "CW"), or from the signal

itself (all other demodulators) according to the desired type of modulation. The following options are available.

#### Spectrum-based:

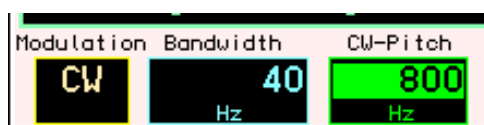
- **SYNC:** Automatic detection of an amplitude-modulated double-sideband signal with carrier (A3E, AM radio stations).  
The demodulator continuously determines the spectral line with the highest level within the audible range and interprets it as a carrier. The associated frequency is defined as the carrier frequency of the entire signal within the passband display; all other signals are viewed as sidebands and processed accordingly. Once a carrier is detected it is approximately 1.5 second "held", even if other signals reach temporarily higher values. Carrier frequency changes will be immediately "rejected" and resynchronized.

The demodulator "SYNC" also allows single-sideband demodulation of an A3E signal. When activated, the caption of the virtual button "->ZERO" changes to "SyncSB". Thus, the selection of the desired sideband is now possible: LLSB (left / lower side of the spectrum), USSB (right / upper side) or SYNC (both sidebands). The values for bandwidth and shift are set accordingly. It should be noted that the carrier of the AM signal must always be present in the yellow (demodulated) listening area. Further manual adjustment of bandwidth and / or shift such that the carrier is no longer within the audible range prevents demodulation.

- **DSB:** Double sideband signal with no carrier evaluation (A3E).  
The channel processes all signals such as the carrier would be exactly on the center line of the spectrogram and generates the audio signals corresponding to the distance and level of the spectral lines from the center line.
- **LSB:** "Lower Side Band", lower sideband of a SSB signal (J3E):  
The demodulator generates audio signals corresponding to the distance and level of the spectral lines from the center of the spectrogram to the left boundary line of the bandwidth.
- **USB:** "Upper Side Band", upper sideband of a SSB signal (J3E):  
The demodulator generates audio signals corresponding to the distance and level of the spectral lines from the center of the spectrogram to the right boundary line of the bandwidth.
- **EUSB:** This is an extension of the USB demodulator (Extended Upper Side Band). An imaginary carrier frequency is assumed at the left side of the spectrum and not in the middle. The entire spectrum width is then available to the right (with appropriate adjustment of the frequency resolution) and not only the right half. The maximum bandwidth limit + shift is set to 15 kHz audio frequency.

The importance of this demodulator is particularly given at very low frequencies (ELF) such as lightning observations, "Whistler" reception, submarine or radio observations of the Earth's magnetosphere. As a result, a frequency setting down to 0 Hz is possible. This mode produces a reproduction of the received EM waves with exactly the same audio frequency without any conversion or shift. As soon as the receive frequency is increased (the left edge spectrum higher than 0 Hz), a corresponding frequency conversion will happen so that the reception frequency at the left edge of the spectrum resembles an audio frequency of 0 Hz.

- **SBCW:** "Single Side Band + CW", automatic selection of the sidebands at 10 MHz:  
The demodulator generates audio signals corresponding to the distance and level of the spectral lines from the center of the spectrogram to the left (receive frequency below 10 MHz) or to the right (receive frequency greater than or equal to 10 MHz) boundary line of the bandwidth. At the same time when operating as a SSB-transmitter (with expansion module) the emission of a keyed CW signal within the sideband is possible.
- **CW:** "Continuous Wave" Morse (A1A):  
The demodulator produces an audio tone with the level of the spectral line directly on the spectrogram's centerline and a frequency that is adjustable via the "Shift" value (now "CW tone" / "Pitch").



For CW, the set value changes from "Shift" to "CW Pitch."

Time-based::

- **FM-N: Narrow Frequency Modulation (F3E):**  
The demodulator directly generates a frequency-demodulated signal from the signal of the ADC with a maximum bandwidth of 20 kHz. Suitable for FM signals with a deviation up to  $\pm 7$  kHz.
- **FM-W: Wide Frequency Modulation, with optional stereo multiplex decoder (F3H, only with optional equipment):**  
The demodulator directly generates a frequency-demodulated signal from the ADC's signal with a maximum bandwidth of 300 kHz. Suitable for FM signals with a deviation up to  $\pm 80$  kHz. With this demodulator a stereo decoder for FM broadcast signals can be activated via the "Surround" button (labeled "Stereo" in FM-W).

*Note:* The stereo decoder generates the left and right audio channel from the spectrum of the demodulated FM (MPX) signal. Therefore, in stereo no view of the RF signal in the narrow band spectrogram is possible. Instead, the MPX signal is presented in the spectrogram. If the Pocket is fitted with the broadband spectrum analyzer (optional equipment), the RF spectrum is also displayed when setting a resolution greater than 320 Hz / line.

- **LSBQ / USBQ / DSBQ: Single sideband (LSB and USB) as well as double sideband (DSB without carrier).**

Demodulators that are modeled after the operation of analog technology. Just like AM-E, they provide higher audio signal quality over their spectrum-based counterparts. However, they offer a lower functionality of the setting options such as lower selectivity, no notch filter and no DNR.

- **DIGI: Special USB demodulator for receiving / transmitting RTTY, PSK, Weatherfax, SSTV and similar.** DIGI is a counterpart to CW and also possesses an adjustable signal pitch. This allows you to set the signal tones of the "Digi modes" to the frequencies required by the PC software. The pitch can also be set to negative values. This corresponds to a permutation of the sidebands (LSB receiving) and thus an inversion of the pitch or the bits in the decoding.

- **AM-E: Double-sideband AM with carrier (A3E):**  
The demodulator directly generates an audio signal from the ADC's signal whose amplitude curve corresponds to the course of the envelope curve (peak amplitude, magnitude, envelope). With good reception, it allows a demodulation as in old tube / transistor radios with similar sound.

Compared to their spectrum-based counterparts, the time-based demodulators are distinguished above all by lower harmonic distortion, constant group delay in the pass band and significantly lower signal delay during reception (only a few ms compared to about 100 ms for SBSP). This makes them especially suitable for signal output to the sound card of a PC. The output is sent to the two channels of the headphone jack as a separate I and Q signal. This enables the use of common SDR software for further processing. Especially in DSBQ mode with 12 kHz bandwidth, the signal is similar to that of simple receivers with direct mixers (but with much higher signal quality). The Pocket can thus be used as a high quality SDR.

These demodulators can also be used to receive normal SSB and CW signals. The IQ output to the headset then generates a "quasi-spatial" listening experience. The I and Q signals are assigned to the right and left headphones so that a location of the frequency position is possible. A signal in LSB is perceived as being on the left, a signal in USB as being on the right.

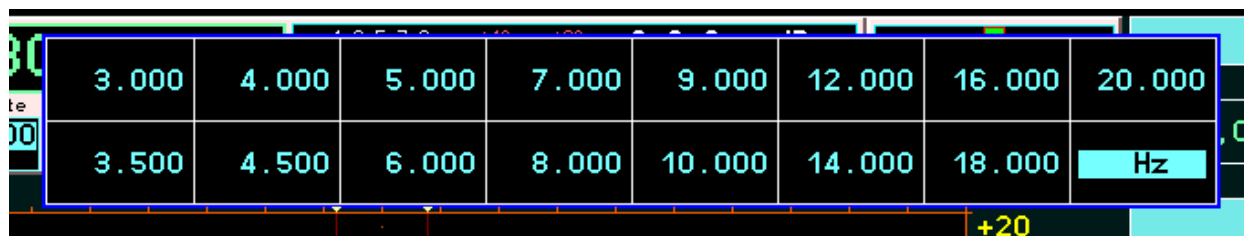
Double tapping on the display (or just once on an active display) opens a menu for quick selection of possible demodulators:



- Bandwidth and shift (PBT)

Bandwidth and shift can be adjusted in increments and limits that depend on the particular demodulator and the selected audio resolution (Setup). A fine-level adjustment in wide ranges is possible thanks to the spectrum based demodulators (filtering takes place "only" by selection of spectral lines). The time-based demodulators (except FM-W: optional equipment) require a dedicated filter for each bandwidth and are therefore limited in the number of filter options.

If a time-based demodulator is selected, double tapping on the bandwidth setting will open a menu for selecting the possible values (example AM-E):



*Note:* Depending on the modulation type, bandwidth and shift can only be adjusted as far as the selected sideband position permits. For example, no adjustment is possible for LSB where signals to the right of the center line of the spectrogram (in USB, the wrong sideband) could become audible.

#### - Notch filter

The notch filter is used to filter-out one narrow band signal within the passband for the suppression of interfering signals. The width of the filter and its position can be adjusted relative to the receive frequency. The notched-out frequency range is shown as a blue color column in the spectrum.



Settings and display of the notch filter.

The relative position is converted into the absolute frequency in the passband and then stored. It remains when adjusting the receiver frequency, even if the filter area (relative position) falls outside the passband. In this case the setting of the position is limited to the maximum positive or negative value corresponding to the bandwidth. Due to storage of the absolute frequency, the setting can be automatically restored if the receiver is tuned so that the notch filter falls in the audible range again ("semi automatic" filter, tracking of relative position).

For FM stereo, the width setting is used to set the stereo base width.

#### - Control limit (AGC Limit) and hearing threshold (RF Threshold)

When the spectrogram is displayed, 2 horizontal marker lines appear in the display. Their position refers the values of the "RF Gain" (manual gain control) or "AGC Limit" (automatic gain control), and "RF Threshold".



Setting and display of the lowest and highest audible level.

The lower marker (blue) indicates the signal threshold above which a signal is audible. All signals whose level is less are inaudible.

The upper marker (purple) indicates the signal level that produces the maximum level of the audio signal. Signals above this marker are limited (or distorted). Internally, the Reuter Pocket operates with a 6 dB safety margin ("headroom"), so that in case of low clipping distortion does not occur immediately.

The marker can be moved by selecting its value. Direct input via the virtual numeric keypad is also possible.

Since the upper marker can be seen as the RF gain of the receiver (compared to analog receivers), it can be adjusted by manual operation, or as an Automatic Gain Control level. The mode is selectable in the Setup dialog. In automatic mode, the hold time used to set the marker position lower and the speed of the marker shifting downwards after the holding time (compares to "Decay" in an analog receiver) can be varied within wide limits. The movement upwards (= "Attack" / "Desensitization") always happens immediately upon detection of a higher level and the associated signals are processed only after the shift. The automatic mode thus prevents clipping.

**Caution!** The automatic control responds only to signals which are inside the passband (yellow lines in the spectrum)! Signals shown in red, (that is outside the passband or within the notch filter) will not affect the marker position. However, since these signals are not processed, they can not cause clipping.

When manual control is selected the top marker describes by how many dBs a received signal on the marker line has to be amplified to reach 0 dB (full scale) of the audio signal. This "0 dB" audio level relation to the 0 dBm RF level is not an absolute value in dBm or dBμV because the audio signal is not generated in a well-defined impedance environment and amounts to far more than 1 mW (0 dB audio = about 5 Vpp at headphone and 10 Vpp at speaker output). The gain value of the upper marker is to be considered a relative value.

In automatic mode, this marker is moved by the Reuter Pocket itself. It automates the process of gain regulation. As a result, the AGC level is closely monitored and provides usable adjustments of the control parameters. The setting for the upper marker is a control limit (maximum gain) to prevent excessive gain. This limit can be set directly in dBm / dBμV as it relates to the received signal.

When using the FM demodulators, the markers work differently:

- FM-N: The signal for the narrow FM demodulator is used under the following scheme:

The lower marker receives the sum of all the audible signal spectral lines. It must be positioned above the visible signal spectra lines for its function. The upper marker determines gain / control limit. However, since FM is an amplitude suppression modulation scheme, the gain is not critical to the demodulation process. Only when there is too little gain (near the top marker, signal is very small) the demodulation will be aborted. The top marker can thus be used as a "noise gate" or "squelch". Set it so that unmodulated noise is not demodulated and the demodulation starts only at useful signals.

- FM-W: The signal for the wide FM demodulator is used prior to gain regulation.

The FM-W demodulator has a special algorithm for very high amplitude suppression and therefore requires no gain control. The lower marker can be used for a "Mute" or "Squelch" function. The effect depends on whether the stereo decoder is on or off.

- Mono: There is an RF level dependent muting corresponding to the selected level for the hearing threshold.

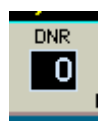
- Stereo: There is a noise-dependent muting. For this, the signal-to-noise ratio of the pilot signal in the MPX signal is selectively measured. If it falls below about 24 dB, it will be muted. If it rises above about 30 dB, it will be switched to loud. The hearing threshold setting has only one on / off function (all values except "Off" turn the function on).

The muting of FM-W does not completely suppress the signal. It is only lowered by about 42 dB. Even when the receiver is muted, it can so be determined if reception is available.

**Caution!** Do not increase the volume so far that the muted signal is easy audible! As soon as the receiver engages, an accordingly high volume is available! This can lead to hearing damage when using headphones or connecting powerful amplifiers!

- DNR

"DNR" stands for "Dynamic Noise Reduction", the noise reduction system of the Pocket.

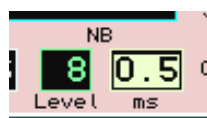


A setting other than zero sets various algorithms with different levels of efficiency in operation. Values up to approx. 4 can be used for high-quality audio playback. At higher values, artifacts are noticeable depending on the signal content. Values of 10 or above are only useful for CW.

**Caution!** The setting of the noise reduction system has a major impact on audio quality! In addition to the planned reduction of noise the quality of usable signals is also affected. Only set the noise reduction system to values above 0 if necessary and try to find a setting that best suits your needs.

- NB

In addition to the dynamic noise reduction system "DNR" the "NB" (Noise Blanker) is available for impulse noise reduction. This system recognizes signal glitches (like discharge, ignition interferences, voltage spikes caused by switching, ...) by their typical fast signal rise and their broadband frequency spectra respond.



The noise blanker benefits from the spectrum-based operation of the Pocket. The signal evaluation takes place in the entire simultaneously received spectral range with approximately 164 kHz width.

If a glitch is detected, instead of the desired data signal, a special identification signal is forwarded to the audio module. This adds a replacement signal instead of the glitch in the generation of audio for speakers and headphones. There is no processing to decrease or mute the original (faulty) signals.

A replacement signal which is inserted in place of the faulty original signal can be calculated, because at the time of interference occurrence the complete spectrum of the useful signal is known. The last

undisturbed spectrum contains all the signal components to continue the production of the currently active audio signal, including all frequencies and amplitudes. After the end of the interference pulse the signal generating proceeds with the calculation of the audio frequencies from the first click-free available spectrum again.

The substitute signal does contain all signal frequencies and their amplitudes at the beginning of the disturbance. This spectrum is put out statically for the duration of the disturbance. On the other hand a "normal" signal is a dynamic ever-changing spectrum. The replacement bridges the glitch thus; although this signal is a signal similar to the wanted signal, this similarity is reduced with the increased backup time. It is therefore all the more (annoying) audible, the longer the glitch. A particularly good replacement coverage results for in spectra with few, slowly changing signals (ideally sinusoidal tones such as CW, less dynamic music), and is not as so good for at speech or noise.

The noise blanker has two settings:

- Level: This value with a variable 0 to 15 defines the threshold level and the signal slew rate at which a signal is to be classified as a glitch.
- ms: Duration of inserting a substitute signal in place of the original signal.

The level value is a level setting of the noise blanker sensitivity. It displays in red during blanking. The higher the score, the more sensitive the blanker classifies signals as a nuisance. "0" is no blanking and at "15" already increased noise or a weak signal with a wideband modulation is defined as a disturbance.

The "ms" value specifies the duration in milliseconds, during which a replacement signal is inserted in place of a detected fault. It is limited to 9.9. At the latest, after 9.9 ms a spectrum from the received signal will be generated before re-inserting a replacement signal is possible ("not re-triggerable" noise blanker).

Follow these steps to set the best functionality as follows:

- Place a temporary blanking setting: Usual disturbances last approx. 0.5 ms.
- Increase the level value from 0 to such an extent that the instantaneous received signal triggers the noise blanker. You can see this on the flashing red digits of the level value and the audible signals from substituting the original signal ("machine noise" from fast following blankings).
- Now reduce the level value by a few steps, so that an undisturbed useful signal no longer triggers blanking.

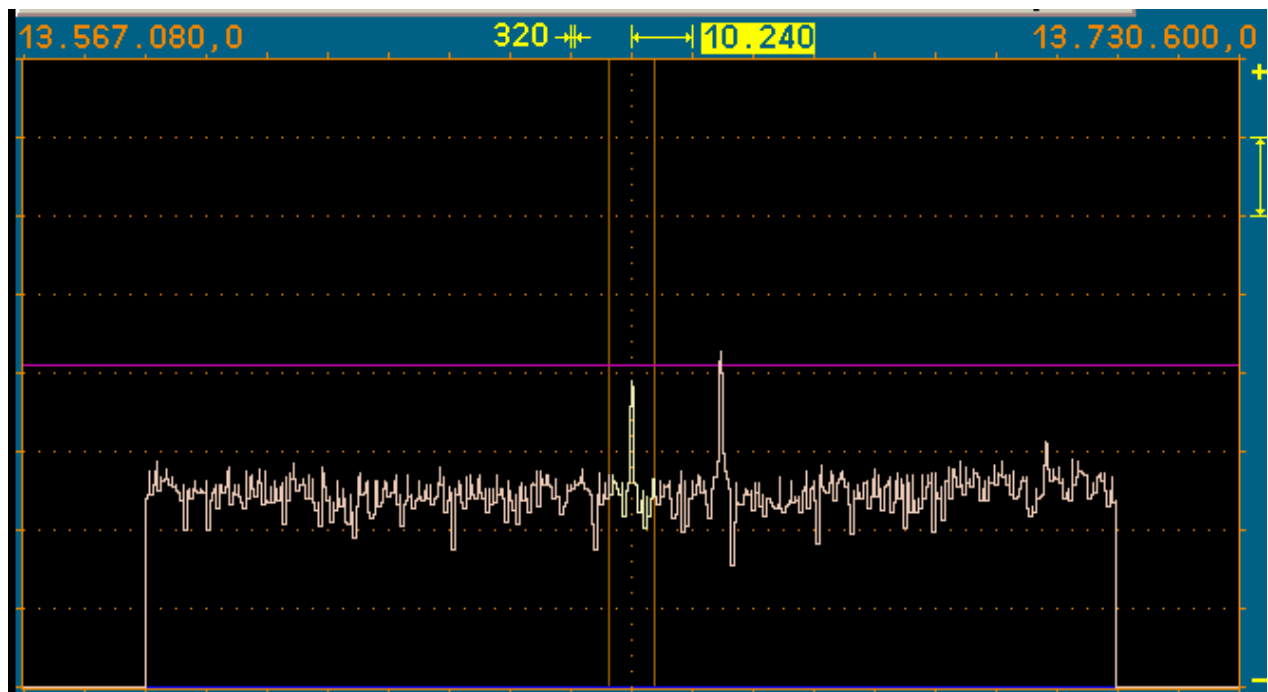
Depending on the type and strength of impulse noise the duration may be adjusted. It should be as short as possible to just bypass the glitch. The level value may need to be changed slightly depending on the received signal, because of the many simultaneous signals in the total range of 164 kHz (like tuning the receiver to the middle of a heavily occupied broadcast band) can cause unwanted triggering of the blanker.

The noise blanker also protects the system from interference signals. If the blanking time is set correctly, after the glitch the full receiver sensitivity is immediately available again .

The FM demodulators can not generate substitute signals. Naturally, interference in FM mode has little effect on the signal quality. By using the system as an FM squelch unwanted noise can cause an increase in the squelch sensitivity. In this case use the AGC manual control or the lower marker ("threshold") for reducing audio noise.

- Spectrum display width

The central element of the display is the representation of the spectrum ("spectrogram": diagram image of the spectrum) of the received signals in a selectable frequency width. The Reuter Pocket transfers a 163.84 kHz wide frequency band from the time domain into the frequency domain thus generating the spectra.



Setting the constantly visible width of the spectrum is accomplished by tapping the set value for the width of a spectral line or for the horizontal subunits, in the example shown above 320 (Hz) or 10,240 (Hz).

(Only optional equipment "Broadband Spectrum Analyzer"): 2 independently adjustable resolutions are always kept ready internally. You can switch between both with a tap on the active resolution setting (double-tap if not active yet). If the chosen sightline is smaller or the same as the alternative setting, then the left value is pointed out (Hz / line), in case of the larger width the right value (Hz / div). As an example, this can be used with FM-W to quickly switch between MPX and RF view.

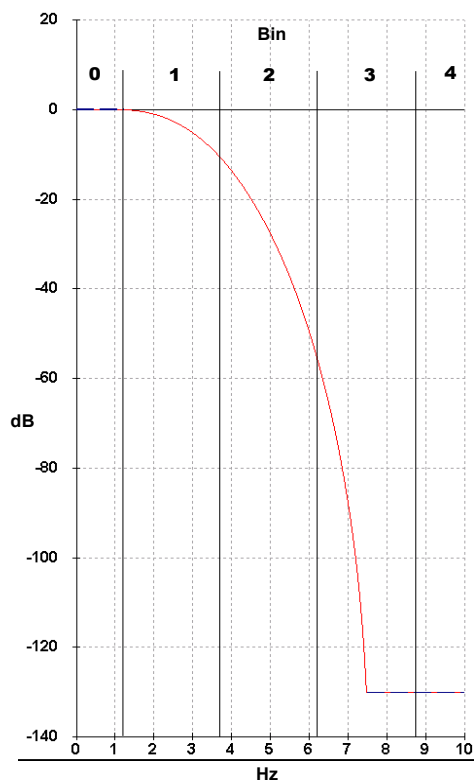
On the WVGA display 20 sub-units of each 32 lines (pixels) are available. Accordingly, this represents the overall width of the display. The frequencies of the first and last line are shown on the top left and right of the spectrogram. The reception frequency usually always refers to the center of the spectrogram. Only when a limitation of the spectrum is required for extreme display widths, the reception frequency is relocated from the center, so that the largest possible spectral range can be displayed.

The visible width can be set to a maximum of the width of the spectrum-based DSP (SBSP, approx. 164 kHz) (see picture above). In this case the frequencies represent the left and the right side of the spectrum (only 512 lines wide). Any reduction in the width range is done by bisecting the current width. The minimum width is given by the minimum possible width of the spectral lines (= highest possible resolution) of 10 Hz.

With existing broadband analyzer (optional), the viewing width can be increased beyond the SBSP range. Again, a change occurs when doubling / halving the width. A maximum of around 54.2 MHz can be displayed simultaneously. However, such a large area is limited to the respective receivable area by different prefilters.

Within a spectral line, the amplitude attenuation is less than 0.2 dB. The line width of -0.2 dB corresponds to the distance between the vertical display lines. Thus, despite frequency discretion, no signal can remain "invisible". If a signal is exactly "between" 2 lines, it is shown as two lines of equal size and with a maximum of 0.2 dB attenuation. There is virtually no "picket fence effect" or similar artifacts commonly found at spectra generated by Fourier transforms.

Outside of a spectral line, the attenuation increases rapidly and reaches 120 dB at the third line left and right from the selected frequency. This attenuation is maintained across all lines, there are no spurious resonances ("leakage") or similar artifacts of the Fourier transform.



Filter curve of a spectral line width of 2.5 Hz

The lines of the graph of the spectrogram are always drawn so that its visible height exactly equals the value of the corresponding spectral component. There are no oblique lines drawn (intermediate values with undefined "interpolated" level).

The frame rate of the spectrogram is directly dependent of the selected resolution. The Reuter Pocket uses 4x oversampling, so the spectra are calculated with a time sequence 4 times the frequency resolution.

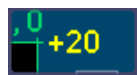
Example:

Resolution 5 (Hz) = 160 Hz / sub-unit spectrum display frame rate = 20 Hz (images / s = frame rate). When switching to 2.5 Hz only 10 frames / s are achieved, when switching to 10 Hz, however, 40 frames / s. The maximum possible display frequency is equal to the frame rate of the display of around 58 Hz. Higher transformation rates of the spectrum are not limited internally (up to 1280 spectra / s) but used for further processing (audio generation or retention of maximum values) for example.

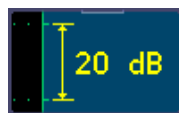
The maximum spectral width of 163.84 kHz is the constant time-frequency transformed bandwidth of the Reuter Pocket. All further signal processing (except for FM-W) is done within this range. The width of the audible bandwidth inside this spectrum is determined by setting the demodulation filter bandwidth.

- Level scaling and gain adjustment

The level scaling of the spectrum is displayed on the right side of the spectrum diagram.



Set value for the upper limit of the spectrum.



Set value for scaling per subunit (resolution is always 40 display lines / sub).



Display for the lower limit of the spectrum and the unit of measure.

The vertical position of the spectrum can be changed by selecting and changing the value for the upper limit and the value of the resolution for the scaling per sub-unit. The unit of measurements can be switched in the Setup dialog between dBm and dBμV.

If the waterfall diagram is displayed, the level scaling and level settings will move to the waterfall color table

(see description in the "Setup" dialog). Instead of the level scaling, the set value for the waterfall's speed appears.

#### - Video filter

The "Videofilter" button is used to activate a filter function in the image processing of the spectrum display. To do this, you can switch between no filtering, average value filtering, maximum or minimum value filtering by continuously tapping the button.

- No filter: In case a high temporal resolution of the display is needed, the video filter should be switched off. The display will show a very highly dynamic image, with every change in the level (noise) displayed exactly as recorded.
- Average: Average of the spectral curves of multiple images. The displayed noise will be reduced as short-term maximum and minimum values do not appear in the display.
- Min / Max: The spectrum always displays the highest or lowest value measured since the last time the display was reset. Here all the detected values are recorded at full processing speed, even if this is above the frame rate (vertical period) of the display, so the actual maximum value might normally not be seen in the display. Setting for measurement and monitoring purposes.

The reset rate of the min / max value filter can be changed via a setting that becomes visible below the button when this filter is selected. It can range from 0 (= reset for each new spectrum) up to 9.8 s and then can be set to "infinite".

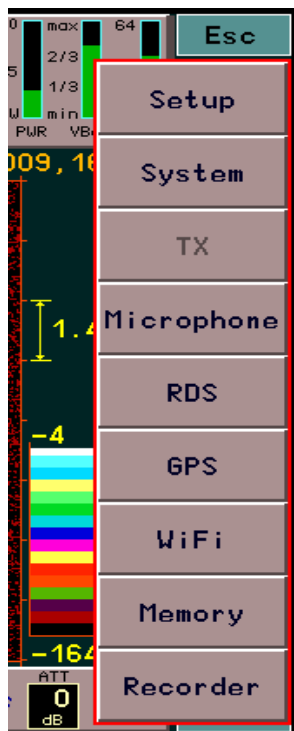


Defines the maximum hold time for an unlimited measurement.

The unlimited measurement time allows the detection of transient signals (monitoring function), which are then displayed as long as desired.

**Caution!** Any change in the measurement period or the filter function leads immediately to a reset of the display!

#### - Menu



Tapping the virtual "Menu" button opens a selection (menu) of various other settings (so-called "dialogs"). The menu can be closed again via "Esc", without a dialog being called. A dialog is opened by tapping the corresponding area. Depending on the device and software version, different dialogs are available (see section "Dialogs").

#### - Surround sound

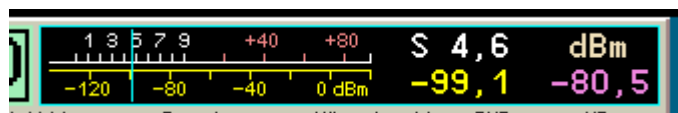
The Pocket possesses 2 audio channels that can operate independently within the 164 kHz SBSP reception bandwidth. Internally, channel 2 is programmed for phase-shifted reception of the same signal as channel 1 (which can be heard on both channels without surround sound).

With FM-W, the two channels carry the left and right stereo signals (when turned on). All other time-based demodulators do not have a pronounced surround sound function. For DSBQ, L/USBQ and DIGI, the signal is instead output as an IQ signal. Thus, it is suitable for feeding it into the sound card of a PC, whereby the Pocket can serve as a high-quality SDR receiver. (However, the reception then deteriorates to "SDR level" by the inevitable interference of the PC.) In terms of hearing, the location of the sideband position (LSB = left, USB = right) is determined by the IQ output.

The effect of the "surround sound" function while using the SBSP modes is highly dependent on the settings. In certain settings, a good effect can be achieved. In addition to bandwidth and shift the exact tuning is primarily of importance. Even a small change in the reception frequency can change the effect, just as the change in the frequency position of the calibration (see the "Memory" dialog). Try different settings if necessary.

#### - S-Meter

In the upper panel of the display there is a S-Meter, which is similar to those in analog receivers.



The instrument shows (above S values with decimals, and S9 +xdB or S0 -xdB, down scaling in dBm or dBμV) the current level on two scales inside the audible frequency range with a fast "pointer". To the right there are the smoothed averages (0.8 s) displayed as a digital value. The purple number value indicates the current position of the control / gain setting (upper horizontal line marker). The current unit of the numerical values is also displayed; they can be selected in the "Setup" dialog.

The measured values for the S-Meter can be derived directly from the spectrum. The video filtering is also regarded. Unfiltered values, average values or the currently accumulated maximum / minimum value are displayed.

When selecting a CW or SSB demodulator, however, it is always a "quasi-peak" reading. Each detected peak value is displayed for a short time, then the value slowly fades down to the current signal level.

#### - Volume control

The lower panel has 2 virtual sliders for adjusting the headphone (left) and speaker volume (right). Tapping on the yellow slider activates it (red) and it can now be dragged to the desired position. You can also tap directly to the desired position. At low levels, the setting is then immediately changed, at higher values, the position moves slowly out to it to avoid a sudden high volume.

An activated slider can also be adjusted by turning the scroll wheel. Thus, bigger jumps due to the inaccuracies of the touchscreen operation are avoidable.

The left marked position of the slider mutes the respective output. The entire loudspeaker amplifier (switching D amplifier) is then shut off (power saving).

#### - Parameters holding time and rate of increase (Hold and Attack)

The automatic regulation of the Pocket (see description "Control Limit" / "AGC Limit") can increase the volume of the reception level so far that a signal at the control limit reaches full volume. As long as this limit is not reached (purple marker / displays in the S-meter are above the control limit) and the levels in the audible range are below the marker line, the automatic will continue to increase the volume. The speed with which this happens is adjustable with the value "Attack".

The increase ends when the signal level is reached (and always at the AGC limit). If the level falls, the regulation begins only after a waiting time ("hanging" control). The waiting time can be set with the value "Hold".

*Note:* The reception level within the listening area is measured in the SBSP modes for each yellow spectral line individually. The highest line is used. The control therefore moves to the top of the highest signal. Only with very unsteady signals (for example noise), a certain addition and averaging of several lines take place. In this case, the control does not go all the way to the highest peak. The same happens within the time-based operating modes, wherever the overall summed level within the listening area is evaluated broadband.

*Note:* The measured values are also used for the display of the S meter (scale and yellow value). This means that a very narrow-band measurement in the SBSP operating modes takes place, in the time-based operating modes a broadband. This affects the display when measuring non-sinusoidal signals (especially with noise).

The setting of the 3 control parameters AGC limit, hold time and control speed has a great influence on the listening quality. Here are some tips:

- A suspension control is needed especially for the reception of SSB signals. Here, the hold time should serve to bridge the speech pauses within a passage. For this purpose, holding times of one to several seconds should be selected. The control speed should be low (a few dB / s).
- With AM broadcast reception, the control responds to the carrier height. As long as no strong fading occurs, hold time and speed can be set to low values. With stronger fading the speed can be increased.
- The control speed can theoretically be set very high (max 99 dB/s). But do not succumb to the temptation to "rule out" any fading with a high control speed! Often, strong fading is also very selective. That means that the carrier varies differently than the modulation sidebands. If the control follows immediately and exactly to the carrier, the modulation is "tamped".
- **Important:** The control limit should not be far below the current reception level. In longer speech pauses (SSB) or when tuning, the AGC otherwise moves uncomfortably far into the noise. Compared to an analog device, the Pocket has an extremely high "gain". It is thus able (with a correspondingly low setting of the AGC limit) to even reproduce his own low intrinsic noise even at maximum volume. The control limit should therefore always be at least 10 - 15 dB above the noise line.
- As always: The best automatic is the one that you can switch off! For borderline reception, the control should be switched to "manual" (Setup). With the control limit (now called "Gain") you can now adjust the volume yourself.

#### - Attenuator (ATT)

The Pocket possesses a highly sensitive preamplifier. It determines the limit sensitivity / minimum noise of the device. The dynamic range is therefore shifted to low signal levels. The maximum possible reception level is determined by the onset of clipping in the ADC (IM and reciprocal mixing neglected). In order to shift the dynamic range to higher levels as required, an attenuator is installed. It can be set in 1 dB steps from 0 to 31 dB.

The setting of the attenuator has a key role in the receiver's adjustment to the input level (antenna, location, ambient noise / interference, ...). It should only be set to small values or even zero if the external noise (antenna noise) is equal to or less than the receiver's inherent noise. Usually it is significantly higher.

A good setting would be a value where further reduction does not increase the audible signal-to-noise ratio. If no signal is received, the attenuator can be adjusted appropriately by observing the noise line in the spectrum and / or the S meter display. The value is correct if a further decrease does not result in a reduction of the noise level.

If very strong signals are received, an ADC overload of the device may occur (frequency indication lights up red). The attenuator must then be increased until the overload stops. If this can not be achieved even with the maximum setting, the permissible input level of the Pocket is exceeded and must be reduced externally!

For devices with an FM receiver, the attenuator is located after the FM preamplifier in the signal path. Thus, it hardly reduces the sensitivity with small settings. But it can not avoid the overmodulation of the preamplifier, only that of the ADC. Overload of the preamplifier generates strong distortions (IM). If the attenuator has to be set to high values while being in the FM range, it is better to reduce the antenna voltage externally.

**Note:** Do not succumb to the temptation to achieve a high signal-to-noise ratio while using very small attenuator settings! This is almost always determined by the antenna noise and interference picked up by the antenna. Unnecessarily small settings instead diminish the Pocket's ability to suppress distortion (IM) and overload (peaks in the antenna's summing level).

## 5.4 Other displays

On the right side of the upper panel are various bar displays for the Pocket's internal values.

- Mod (modulation level): The level of the microphone channel for modulating the transmitter.
- PWR (Power): Current power consumption of the Pocket.
- Vbat (battery voltage): Voltage of the internal batteries between permissible minimum value (cut-off value) and highest charging voltage. Indication of the batteries' state of charge.
- T (temperature): Temperature of the motherboard or the transmitter board (the higher one).

A tip on the panel area of the bars opens the "Power Management" dialog for more precise observation of some values and for setting various power-saving measures (see there).

Depending on the parameter and value, the colors of the bars change between green (all in limit), yellow and orange (borderline) or red (out of limit). A red indicator normally results in the shut down of the unit. This does not apply to microphone overmodulation (bar mod).



Especially with undervoltage (bar Vbat) and overtemperature (bar T), a warning is first issued by a flashing display between the video filter and the menu button. After 60 seconds the Pocket will be switched off.

Above the button "Surround" ("Stereo"), the currently active software version and the serial number of the device as well as the manufacturer name are displayed.

Above it is a display value for the current undo level (see description "System" dialog).

The left side of the lower panel shows the currently active RF filter (analog, before attenuator, preamplifier and ADC). In automatic filter mode, the required filter is automatically activated, otherwise manually in the Setup dialog (see there).

The selected level of the handwheel automatic tuning ("Setup" dialog) is displayed between the volume control for the loudspeakers and the set value of the attenuator.

On the right side of the lower panel, when receiving a FM broadcast station with RDS signal, the station's PI code is displayed.

Above the spectrum, program name and program type are displayed between the frequency displays and the spectrum width set values when receiving an FM broadcast station with RDS. Tapping a display opens the RDS dialog.

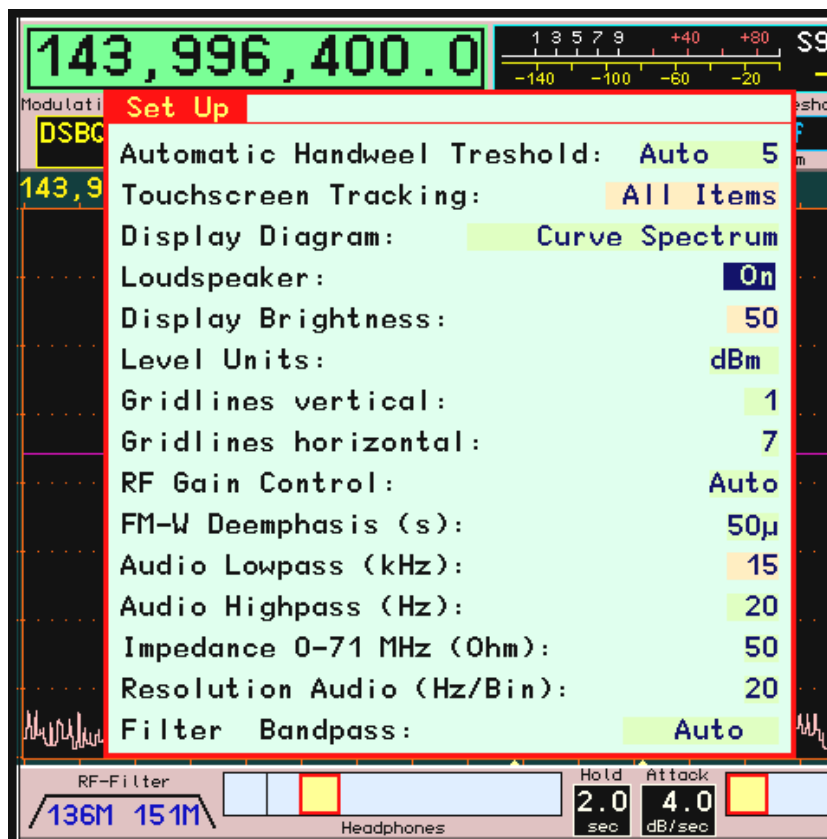
## 6. Dialogs

In addition to the permanently displayed user interface, different "windows" or "menus" are available, in which further additional options can be chosen. These temporary displays are called "dialogs" in the Pocket. These can be accessed by tapping the "Menu" button and via the selection that pops up. Some dialogs can also be opened directly by tapping specific set values (such as "Memory" when tapping on the frequency).

In contrast to the normal display window color scheme, colors in dialogs are inverted once they have been chosen. Color highlighted values allow an adjustment via the encoder automatic (see description in "Setup dialog").

### 6.1 Setup dialog

Opening the Setup dialog will pause the spectrum display and show the dialog within the display.



Most basic settings of the device's functionality can be adjusted in the Setup dialog, their adjustment during normal operation is rarely necessary. However, the current setting of some values can always be observed in the user interface on the panel at the bottom of the screen.

The individual values are as follows:

#### Handwheel Automatic

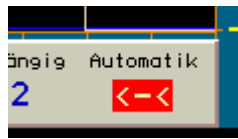
A value from 0 ("Off") to 14 sets the rotational speed of the tuning knob and automatically forces the adjustment without the need of user intervention. 0 is OFF, "1" is the lowest speed (very slow rotation) and 14 the highest speed required to trigger the automatic mode.

The system monitors the movement of the scroll wheel and takes over its function, once a certain minimum number of pulses per second is detected. If this detection threshold is exceeded, the automatic system inserts virtual encoder pulses as sent by the keyboards operating system. These pulses cause exactly the same function (adjustment of a setting) as the operator would do using the scroll wheel. Tuning a frequency, for example, will have a flywheel effect.

The effect is a continuation of the adjustment process, even if the operator no longer turns the scroll wheel. It tries to automatically detect the rate of adjustment in accordance to the measured rotational speed of the

wheel which is turned by the operator. Basically, only the rotary encoder has to be "pushed" with a few steps, after which the adjustment of the selected value automatically continues.

Once the automatic adjustment has taken over the wheel function, it clearly indicates this by flashing a red icon in the lower panel of the display:



The encoder automatic is active.

The arrows to the left and a minus sign indicate the direction of the ongoing adjustment towards lower values (scroll wheel was turned counter-clockwise), and a ">" character and "+" symbol accordingly to higher values (scroll wheel was turned clockwise).

At low values of the auto setting (activation already at low rotational speeds), first a small increment is set, at higher values of the automatic accordingly a higher increment (values will change faster).

During the automatic adjustment, the operator can always increase the adjustment velocity by further rotation of the scroll wheel in the current direction. The automatic mode detects these pulses and correspondingly increases the speed up to a maximum specified by the device (depending on the setting about 10 - 100 pulses per second).

If the operator moves the scroll wheel in the opposite direction, the automatic will be stopped immediately and the user's adjustment in the opposite direction will be executed. Therefore, the last automatic pulse is reversed effectively.

The automatic mode is also stopped under the following circumstances:

- A value on the touchscreen is tapped.
- The final value of a set value is reached (not fully apparent, although some final values prevent adjustment beyond this, but the automatic remains active and must be terminated by the operator).
- The upper horizontal marker (manual gain control or automatic gain control) is moved at least one position up or the received signal exceeds the marker within the audible area. This is especially useful when tuning, as it switches off immediately when a strong signal enters the audible reception area (station search function).
- Requesting a display scan via WLAN or Bluetooth.

The scroll wheel automatic mode is not available for all adjustments, but only for those with more than about 20 possible values. In dialogs, these values are highlighted in color.

There is a speed-dependent acceleration function when adjusting the frequency, which is also controlled by the encoder automatic. It increases the tuning step size with fast turning. The tuning acceleration effect is adjustable if no "Auto" is displayed before the value. (A value with "Auto" generates the automatic tuning.) The display of the automatic in the lower panel shows the active tuning acceleration in green (red shows the normal automatic tuning).

## Touchscreen Tracking

Selection of whether all set values of the user interface can be changed by "swiping" within the spectrum diagram, or only the frequency.

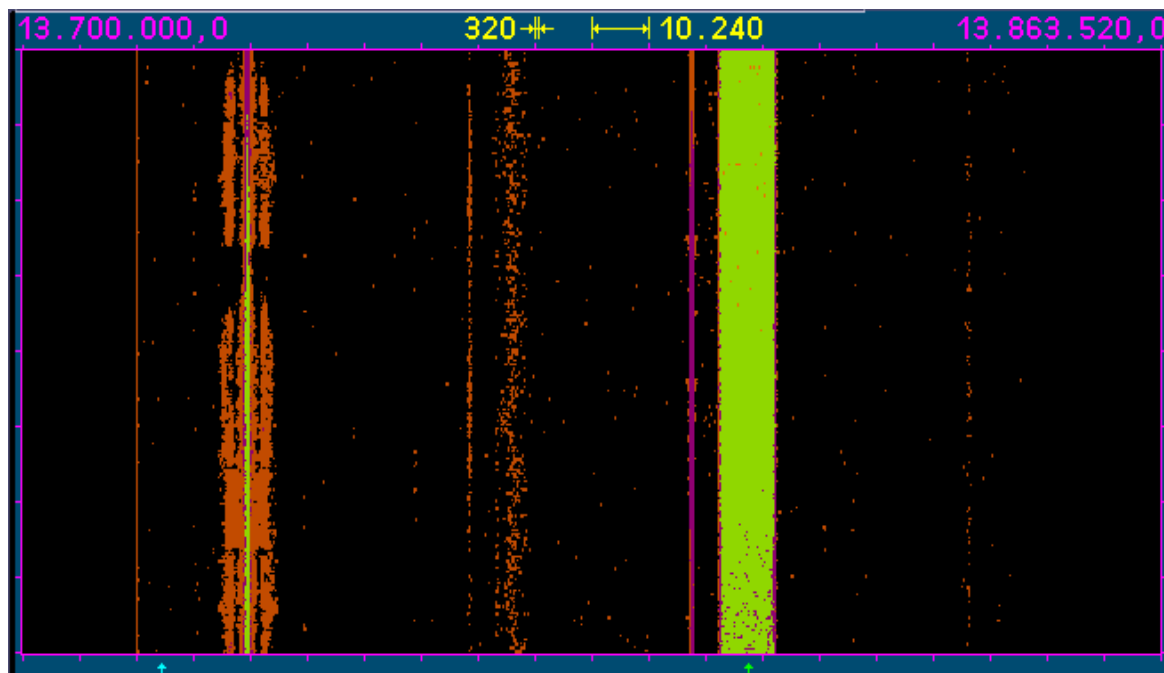
## Display Diagram

- Curve Spectrum: The spectrum is shown as a connecting line between the level values in each spectral line. The usual representation of a spectrum.
- Line Spectrum: Each spectral line is drawn from the lower boundary up to its level value (equivalent to "fill" the display below the curve spectrum).
- Waterfall: The spectrum is shown as a waterfall diagram ("sonagram").

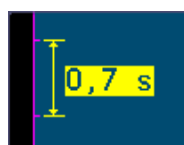
So-called "waterfall plots" are an important tool for recording and documenting signal changes over time. Thus, each recorded two-dimensional spectrograph will not be displayed with the frequency on the x-axis (horizontal) and the signal level on the y-axis (vertical), each new plot overwrites the old one immediately and irrevocably. Rather, the signal level will now be scaled to almost the depth level (z-direction). Since this third dimension in a graph is not possible or representable, the level is now coded in colors and the spectrum is written as a one-dimensional line in the diagram.

Imagine you would take the usual spectrum display into your hands, turn it by 90° around the horizontal axis with its "peaks" directed to you.

Now look down to the edge of a thin "spectrum-slice" where the peaks closer to you are bright and the valleys further away from you are in darker color. This slices are now continuously drawn in the display, older slices moving downwards, while newer slices appear at the top of the display. The newest one is always drawn on top, the oldest slice disappears below the diagram.



The effect corresponds to a visual impression of a waterfall, hence the name of this display. The "fall velocity" can be selected in three steps.

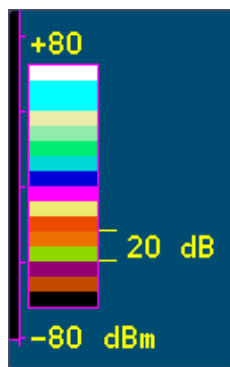


The diagram moves at a speed of  
 $0.7 \text{ s} / \text{part} = 17.5 \text{ ms} / \text{line (spectrum)}$ .

*Note:* The calculation speed of the spectra is independent of the selected running speed and always equal to 4 times that of the selected spectral line width, in the example shown, ie  $1280 \text{ spectra} / \text{s} = 0.78125 \text{ ms} / \text{spectrum}$ . To prevent data loss, select the mean or at very high data rates (for example) the maximum value for the video filter. Set the refresh rate to somewhat higher values than the line speed of the waterfall's one. If necessary, increase the line speed to the maximum value ( $0.35 \text{ s} / \text{unit} = 8.75 \text{ ms} / \text{line}$ ).

Conversely, at high resolution and correspondingly lower spectra rate per second, possibly less calculated spectra are plotted as lines have to be drawn. That causes no data loss, but the plot is less informative, as more and more lines are drawn with the same content in succession until a new spectrum is available. In this case, reduce the speed of the Waterfall chart and / or turn off the video filter.

The view of the waterfall is heavily dependent on the "viewing depth" of the underlying level position in the diagram. The indication of the level takes place as color coding. Which colors are used for each level is shown in the color chart.



The color chart shows the representation of the signal level in color steps.

The colors displayed correspond exactly to the magnitude of the normal spectrum display and can be altered as well. The colors themselves can not be changed.

*Note:* Select the level position of the spectra (selecting the upper set value) for the highest possible contrast so that the area of your level of interest is displayed in large color differences. For example, the noise threshold should be adjusted so that already little peaks of a signal are coded as a next color step. This way even low signal levels result in a clearly visibility trace above the noise floor.

### **Loudspeaker**

Setting "On" or "Off". Same as dragging the volume control to the mute field (far left) or just beyond.

### **Display brightness (%)**

Adjustment of the display's brightness in increments of 0 - 100.

*Note:* When changing the display brightness, very low values can be set (display nearly off). However, these are set to at least 10% after the device is switched off and on again.

### **Level Units**

Scaling (y-axis) of the spectrum or waterfall chart and the S-Meter in dBm or dBμV.

### **Vertical and horizontal grid lines**

Dotted lines in the spectrum graph to better view the sub-units.

### **RF Gain Control**

Adjustment of the the automatic control to "Auto" or "Manual".

### **FM-W Deemphasis (s)**

The correction of the emphasis of FM radio stations. "Off" for linear demodulation (only for measurement purposes), "50 μ" for the European standard, "75 μ" for the American standard.

### **Audio low pass (kHz)**

The signals pass through a digital low pass filter for filtering unwanted higher-frequency components before audio playback. Here, the cutoff frequency of this filter can be adjusted. Thus, if necessary, a reduction of high frequencies can be achieved, e.g. with strong noise in the signal.

### **Audio high pass (Hz)**

All signal processing in the Pocket is "DC-coupled", meaning there is no lower limit frequency (or it is 0 Hz). Mismatches, low frequency deviations of the transmitter and receiver, interference, etc. could lead to the generation of DC voltage or low-frequency noise at the output. A digital high pass filter before D / A conversion prevents that from happening. Here, the cutoff frequency of this filter can be adjusted.

### **Impedance 0-71 MHz (ohm)**

The preamplifier's input impedance can be changed. In addition to the standard 50 ohm setting, 0 ohm and

infinite ("~~" is displayed) are possible. These values are to be regarded as idealized. In fact, they are very frequency dependent.

The 0 ohm setting results in a broadband low-impedance input ("current input"). It is suitable for connecting small auxiliary antennas, like loops. At higher frequencies, even short rod antennas (like telescopic antennas) can be operated advantageously in this setting. If a resistor is connected externally directly in front of the antenna connection, an input adaptation with this value can be achieved. An additional gain of 470 ohm divided by the resistor value can be achieved.

The "infinite" setting achieves an input resistance of a few kohm at very low frequencies. Due to internal parallel capacitances in the size of 100 pF, the impedance drops rapidly at higher frequencies. This setting is useful for short antennas (like telescopic antennas) at low frequencies. The gain is about 14 dB at low frequencies.

*Note:* The high-impedance antenna input can also be used as a measuring input (note the level!). Because the Pocket already has a high sensitivity below 1 kHz, this results in e.g. a high-quality audio spectrum analyzer (use demodulator "EUSB" and reception frequency 0.0).

### Audio resolution (Hz / Bin)

This setting affects the sound and adjustment options of the spectrum-based demodulators. It determines which spectral lines are made audible from the time-frequency conversion of the SBSP. 3 settings are possible:

- 10 Hz: Fine resolution with low ripple and distortion of audio generation. Spectrum update rate only 40 Hz, therefore large signal delay. Limited bandwidths of the demodulators (maximum audio frequency that can be generated is 5.1 kHz).
- 20 Hz: Medium resolution with low frequency ripple and normal harmonic distortion. Spectrum update rate 80 Hz, moderate signal delay. Bandwidths of the demodulators corresponding to maximum audio frequency of 10.2 kHz.
- 40 Hz: Coarser resolution with higher ripple and fluctuating distortion of audio generation. Spectrum update rate 160 Hz, short passage delay of the signal. Extended bandwidths of the demodulators up to the maximum producible audio frequency 20.4 kHz.

The setting should be made according to existing requirements (like fast signal passage in CW or Digimodes), according to the desired setting options (maximum bandwidth, granularity of the bandwidth's adjustment, shift, notch filter, etc.), as well as personal taste ("softness" or "clarity" of the audio playback).

### Filter bandpass

Adjustment of the RF prefilter. With "Auto", the filters are automatically switched according to the reception frequency. That way, the tuning above the filter or band boundaries is possible. For example, a skip from 30 MHz to 50 MHz is performed as soon as it is tuned beyond 30 MHz.

Setting a fixed filter / band limits the frequency setting to that band. An exception is the transition at 10 MHz. Here, both the lower and the upper range can be selected, tuning is always allowed between minimum possible frequency (demodulator and spectrum display-dependent) and 30 MHz. Keep in mind that tuning into the filtered-out region results in attenuation of the received signal.

If a filter is selected that is outside the current reception frequency, it will be set to the lowest or highest filter frequency (depending on where the frequency currently is in relation to the filter).

## 6.2 System dialog

When the dialog is open, the spectrum display continues.

System			
Oscillator Calibration	+ 149	Level (dB)	0.0
Undo to level	13	available	AF Level % 100
Frequency auto. activ	PH+SPK		FM Dev. kHz 75
Delay to auto. activ (s)	6	Half for HP+LSP	Freq L 0
			Freq R 0

The following settings are available:

## Oscillator Calibration

The main oscillator of the Pocket is a temperature compensated crystal oscillator (TCXO) without any influence by a control, PLL or similar. As a result, it achieves extremely low phase noise (important for high RF sensitivity and audio signal quality). On the other hand, it always possesses a certain deviation from the nominal frequency. That is, the frequency setting has some error.

This error can be corrected in 2 ways:

- Manual calibration: When selecting the set value in the System dialog, the frequency deviation in Hz can be compensated by setting an opposite (compensating) value. This requires the awareness of the current deviation. The deviation may be obtained by e.g. observing a very frequency-accurate signal (beacon, measuring transmitter, ...) in the spectrum. The calibration then takes place on the exact center position in the spectrum or "zero beat" with a DSB or SSB demodulator.

- Automatic calibration by GPS: If the GPS receiver is activated (see "GPS" dialog), the GPS receiver can determine the current deviation and write the required correction value into the dialog. For this purpose, the set value must **NOT** be selected when the dialog is closed!

The distinction between value selected / not selected decides whether the device works with manual or with GPS calibration. Of course, the latter is only successful with activated GPS.

## Level (dB)

An adjustment of this value causes a vertical shift of the display in all spectrograms by the set value and therefore a change of level readings. Use it when you need to make an accurate level setting using an external reference. Permanently connected preamplifiers or attenuators with their associated values can be specified here so that the correct level is always displayed within the Pocket even despite preamplification / attenuation.

## Undo to Level

The device constantly saves the last 28 operating steps that have been made. These settings can be recalled at any time (see description in Special features "Undo function").

Setting "0" always contains an unchangeable factory setting (defaults). It can be selected when the Pocket is in an undefined state, which can not be remedied by switching it off and on again (it always saves all settings and returns there when switched on).

## Frequency auto. active

The frequency setting can be activated automatically when another setting is active. The 3 settings of this value are:

- Never: Each setting remains active until another value is selected by tapping.
- PH+SPK: After tapping a volume control, the "Time until automatic active (s)" (see below) is waited for (here: only half of the time), if a further adjustment is made. If not, the volume setting is disabled and the frequency becomes the active setting.
- Always: As „PH+SPK“, but for all adjustments and with full wait time.

## Delay to auto. active (s)

Time in seconds after which the unit is switched to activate the frequency when the currently active setting is not further changed.

## AF Level (%)

If the test generator has been activated by setting calibration "+1995" or "+2000", the amplitude of the test signals can be set here. For further information see section 10.2 and 11.2 "Special features".

## FM Dev. (kHz)

When the test generator has been activated, the deviation of the frequency modulation can be set here. For further information see section 10.2 and 11.2 "Special features".

## Freq L

When the test generator has been activated, the frequency of the first audio signal (normally used for left stereo channel) can be set here. For further information see section 10.2 and 11.2 "Special features".

## Freq R

When the test generator has been activated, the frequency of the second audio signal (normally used for right stereo channel) can be set here. For further information see section 10.2 and 11.2 "Special features".

The System dialog must be closed either with the "Esc" or the "OK" button. By tapping the "Esc" button, no further function is executed. However, calibration of the oscillator and level or frequency settings are always executed immediately after a change of setting inside the opened dialog and stored permanently.

When you tap "OK" and choose the current undo setting, the required function is always executed: The current device setting is completely replaced by a saved (if valid!) setting.

## 6.3 Transmitter dialog (only devices with transmitter or exciter)

When the dialog is open, the spectrum display continues.

Transmitter		Offset Level	-6	Mike Ring	PTT In
Shift TX	0	Offset Phase	0	Key Tip	KEY In
PEP dBm	30.0	Minimum SFDR	80	Key Ring	PTT Out
Delay RF ms	20	RX Delay ms	110	Baudrate	9600
Risetime RF ms	1.0	SSB Shift Hz	100	Limiter %	50

The parameters have the following meanings:

- "Shift TX" Shift of transmission frequency from the set reception frequency (main frequency of the user interface) with positive or negative values up to  $\pm 19,999,999$  Hz. The transmitter can only be switched on if the main frequency  $\pm$  of the TX shift lies within the permitted ranges. The TX frequency is always changed with the main frequency. In case the frequency is outside the valid ranges, the transmitter will be turned off.

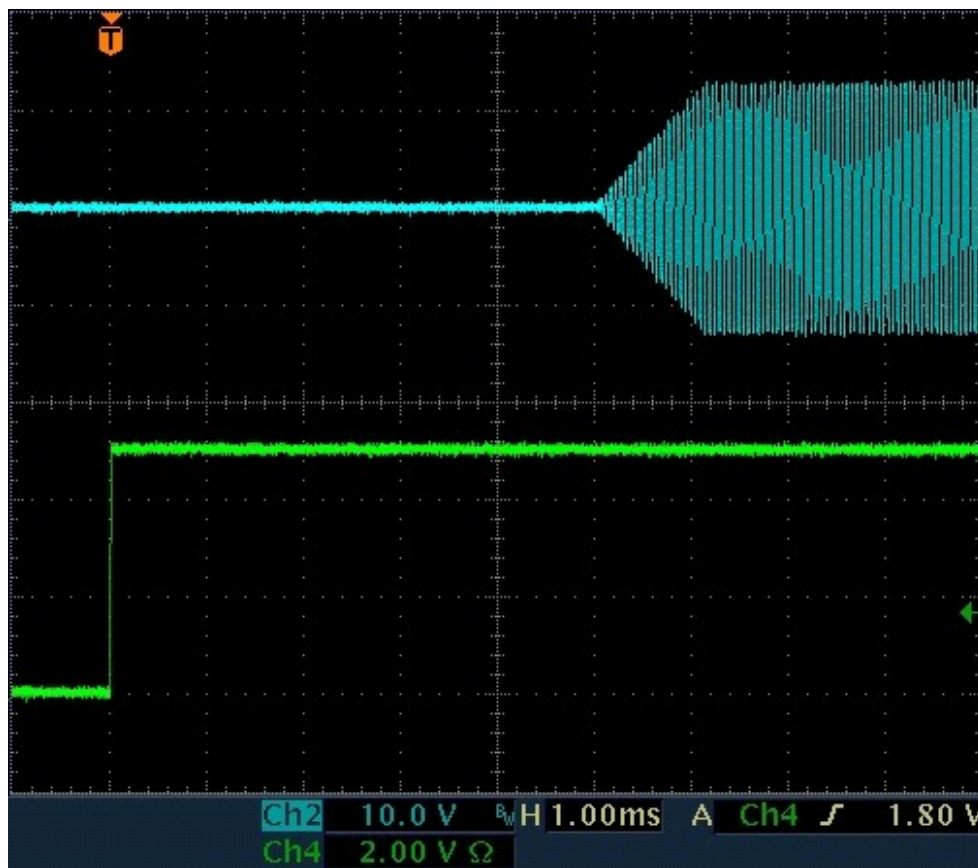
*Note:* The adjustment of the TX frequency happens always with the same step size which is selected in the user interface for the main frequency. Similarly, the "->ZERO" button again has the function of setting to whole-numbered frequencies according to the step size.

"PEP dBm" Sets the output power of the transmitter depending on the version.

**Caution!** If the battery voltage is low and the transmitter power is set to maximum, the device may shut down without warning!

- "Delay RF ms:" The PTT-Out switching output becomes active immediately with PTT In. The RF power is generated only after the time set here (allowing RX / TX switching of external PAs).

Example in the picture below: Delay time PTT  $\rightarrow$  RF output = 5 ms (rf risetime set to 1 ms):



- "Risetime RF ms" Rise / fall time of the RF power out of the transmitter (see picture above with rise time = 1 ms). Increase or decrease of power are strictly linear with no overshooting of any kind. In AM modulation (carrier on / off) or at an emergency shutdown of the transmitter the edges can be reduced to zero risetime and overshoots can occur.

- "Offset Level" adjustment option of the modulator for minimal IM (not for exciter).

- "Offset Phase" matching ability of the modulator for minimal IM (not for exciter).

*Note:* The signal quality in terms of IM headroom is dependent on frequency, modulation and manufacturing tolerances of the transmitter's components. The two offset adjustment possibilities allow a specific setting for one specific operating point of the transmitter, wherein a maximum IM headroom is possible.

- "Minimum SFDR" Adjustment to maximum spurious free dynamic range (not for exciter). Adjustment to the largest spurious suppression. This setting is mostly unit dependent and only slightly temperature dependent in terms of spurious attenuation of the transmitted signal.

The adjustment should be performed at normal operating temperature and high frequency (after warm-up). A good frequency is, for example, 29.18 MHz. In the case of a large spectrum viewing width, interference frequencies can then be seen to the right and left of the carrier. These can be adjusted to minimum.

*Note:* When updating the software, or when loading the default settings ("Memory" dialog, Undo operation # 0), the calibration will be lost. However, they are always stored within a memory slot. The calibrations can therefore be easily restored from any memory slot.

- "RX Delay ms" Immediately after switching on the transmitter, the receiver is set to minimum gain (equivalent to "Manual" with -19.5 dB). After switching off the transmitter, it is hold in an insensitive state for the time of the "RX Delay" in order to suppress transients. After that time it is immediately put back to the sensitivity before starting transmission. Should the received signal now be stronger, the AGC is adjusted immediately.

**Caution!** The value "0 ms" has a special meaning in connection with the monitoring (see "Microphone" dialog). In this setting, there is no switching of the AGC to the lowest gain value. The self-received transmission signal is therefore just as audible as any other received signal. For this purpose, no additional sidetone will be generated.

**Note:** The "RX Delay" is the relevant parameter for the time needed from switching off the transmitter up to full sensitivity of the receiver. This time may be minimal if the TX signal is outside the reception bandwidth. However in case it is within (extreme: TX Shift = 0), it will be self-received. It will therefore trigger the gain control to decrease rx gain. The gain control would increase gain only after the AGC hold time and only with the defined gain control speed. This way it would keep the receiver at low sensitivity for a while. However, using appropriate RX delay will protect the AGC from regulating to the self generated signal.

**Note:** The parameter "RX Delay" is in the CW operation of particular importance, especially on CW VOX (VOX = 10 ms). With each trigger of the transmitter, the following sequence is started: TX-ON Signal (PTT / button / VOX) → Delay RF → Start rising edge RF → End edge RF → Signal → Start falling edge RF → End falling edge RF → Signal TX OFF (Switching output off / trigger RX Delay) → RX Delay → Set gain RX and falling signal PTT Out. By choosing an appropriate RX Delay the operator can either opt for the fastest possible activation of the RX (and accept some switching noise) or chose minimal noise at the cost of extended delays.

- "SSB Shift Hz": This value determines the position of the transmitted signal relative to the (suppressed) carrier in the SSB modes. The effect is exactly the same as the effect of setting "shift" at reception. In all other modes, SSB-Shift has no effect.

### Extensions

Starting at serial number 060, the Pocket has freely configurable ports for the microphone (Mike) jack and morse key (key) socket. Thus, these sockets can also take over the function of the additional socket on the earlier C3 devices.

**Caution!** From S / N 067 the socket in the lower housing shell of the Pocket C3 is omitted.

To adjust the configuration of the sockets, the Transmitter dialog has been expanded. Some parameters received different designations (abbreviations) compared to the original TX dialog. For the microphone jack, the middle contact ("Ring", right channel with stereo) can be assigned with different functions. The front contact ("Tip", left channel with stereo) always carries the microphone signal. The socket for the Morse key can be used to configure both contacts.

For devices prior to S / N 060, the socket configuration boxes are blank.

The individual contacts "Mike Ring", "Key Tip" and "Key Ring" of the sockets can be assigned with the following signals.

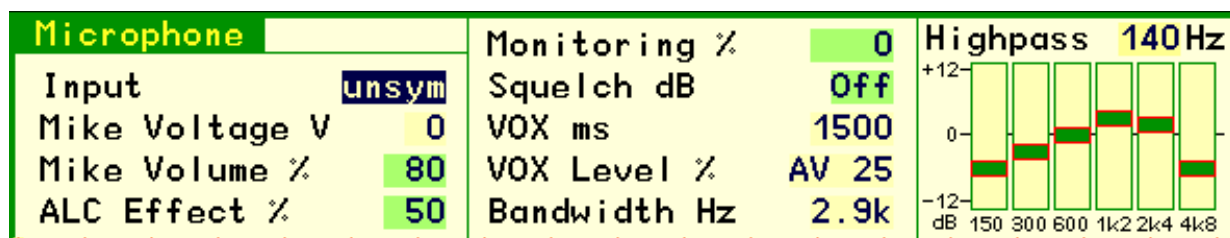
- **PTT In:** The contact receives the PTT signal to turn on the transmitter. To accomplish this, the contact, which has a high internal resistance to 2.5 V, must be grounded by a switch or PTT switching output of other devices (< 0.4 V).
- **PTT Out:** The contact issues a signal to control additional devices. It is activated (+2.5 V) immediately on activation of a connection assigned with "PTT In" or with "KEY In" and deactivated only after its deactivation plus set value "RX Delay ms". This can be used to control an external PA.
- **KEY In:** The contact receives the signal from a single-pole morse key to turn on the transmitter. To accomplish this, the contact, which has a high resistance to 2.5 V, must be grounded by the key contact (< 0.4 V).
- **CAT Out:** The connector outputs a serial data word (standard "RS-232") for controlling external devices (like PA). The data rate of the signal can be changed via the set value "**Baudrate**".

**Caution!** The signals "PTT Out" and "CAT Out" are 2.5 V CMOS level with approx. 700 ohm internal resistance! Especially the signal "PTT Out" is not a switching contact, open collector or similar with active "low" level! For use in common low-active interconnections, the signal must be converted by means of an external amplifier (transistor or IC)!

The generation of an RS-232 signal to control other devices is software-dependent (optional activation). By default, this signal is inactive (2.5V "high" level).

## **6.4 Microphone dialog**

When opening the Microphone dialog, the spectrum display is switched to display the signals at the microphone input (audio spectrum analyzer)



The parameters have the following meanings:

- "Input" The microphone input is always unsymmetric at the Pocket. This setting can not be changed.
- "Mike Voltage V" For active microphones 5 V can be selected as the bias voltage.
- "Mike Volume %" Volume setting of the microphone.
- "ALC Effect %" The microphone amplifier is equipped with an automatic level control (ALC). It reduces the gain at high levels to avoid clipping. The effect of the regulation can be adjusted here.
- "Monitoring %" When transmitting, the receiver is set to minimum sensitivity, so that the transmitted signal is not heard in the normal case. When set otherwise (not "0"), a sidetone of the modulation of the transmitter signal is audible. In CW, a sinewave is generated, which corresponds to the setting "CW tone" in the user interface. Negative values of the sidetone settings create a phase shift of 180° in order to dampen any feedback which can occur.

**Note:** If no RX Delay is set (see above "Transmitter" dialog), there is no reduction in receiver sensitivity. Thus even the received own transmitting signal is audible (if in range) and there is no side tone generated!

**Note:** In mode "SBCW" (combined SSB / CW mode), when pressing the PTT key the SSB sidetone (microphone signal) will be generated; when keying with the Morse key the appropriate sideband tone ("L Freq" according to Memory dialog). Even if a double tone signal is sent into the sideband ("Freq L" and "Freq R" not equal to 0), only "Freq L" will be generated as a sidetone. In case "Freq L" = 0, then no sidetone will be generated, but a short-pulse (DC impulse).

- "Squelch dB" Below the squelch level the microphone will be switched off. Only levels above this threshold generate modulation signals.

- "VOX ms" hold time of the VOX (voice operated transmitter switching). When VOX is enabled (value > "off"), the transmitter is accessed as soon as the modulation depth exceeds the value "VOX level". The transmitter is switched off if the modulation level was below the VOX level for at least the set time.

**Caution!** The VOX can be switched off directly in the user interface if the "Stereo" button is set to "On". This allows a quick deactivation in case of disturbance (like a telephone call) to protect the VOX from getting unintentionally activated.

- "VOX level %" The VOX threshold can be selected as a percentage of full scale. The full scale itself is adjustable with the microphone level setting and is indicated by the modulation bar in the transmitter display panel of the user interface. The VOX activates the transmitter when the modulation bar reaches the set threshold.

Setting a value with "AV" before the percentage will activate an anti-VOX circuit. This always sets the internal threshold to 99 % when a received signal in the demodulation range (yellow spectrum area) reaches the AGC threshold (setting "AGC Limit"). In the case of receiving a stronger signal the VOX is "deaf" and can only be enabled by a very high microphone level (full scale modulation). If the signal falls below the AGC gain limit (channel free), the VOX works with the set sensitivity.

**Note:** By selecting the AGC threshold, ie the point at which regulation begins, the allowable reception level can influence the threshold of the VOX. If one drives the system gain as high as into the noise, the anti-VOX is almost always active. The higher the AGC threshold, the stronger the signals that may be present in the channel without activating the anti-VOX.

The anti-VOX does not respond when the VOX has turned on the transmitter. During the transmission period, the VOX checks microphone signals always to the set level. Only when the Pocket goes back to reception, the anti-VOX monitors the signals in the reception band again and is able to "deaf" the VOX.

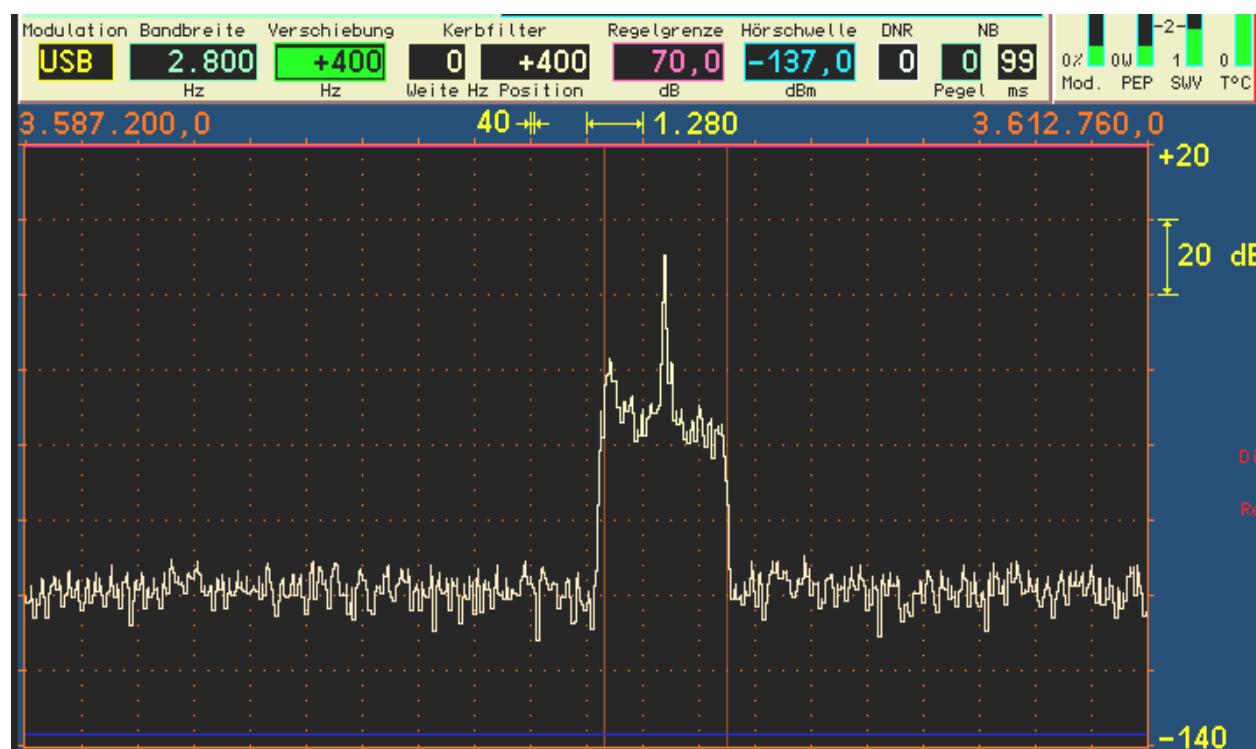
In split mode (TX Shift in Transmitter dialog does not equal to 0), the anti-VOX can only monitor signals on the RX frequency. Strong signals on a frequency outside the RX band (on the shifted TX frequency) have no effect on the anti-VOX.

- "Bandwidth Hz" Bandwidth of the transmission signal. In FM it represents the cutoff frequency for the modulating signal. Selectable in different levels depending on the operating mode.

**Caution!** The transmission bandwidth extends for AM and DSB on both sidebands. The highest modulation frequency which will be transmitted is only **half the size** as the set bandwidth range. In case of SSB the transmission bandwidth corresponds to the transmitted **AF bandwidth**. For CW, the bandwidth setting has **no effect**. For FM, the transmission bandwidth corresponds to a value that results from the set **bandwidth and** deviation (see "System" dialog) according to the theory of frequency modulation.

**Caution!** In an SSB mode, the position of the bandwidth within the AF spectrum is determined by the set value "SSB Shift" in the Transmitter dialog! The lowest transmitted frequency therefore results from the value of the SSB Shift, the top AF frequency of SSB Shift + bandwidth. This corresponds exactly to the conditions when receiving an SSB signal.

**Caution!** In SSB, the position of the filter must be defined relative to the carrier by means of the setting "SSB Shift" in the Transmitter dialog! If the value is set to small, the transmitted signal interferes into the wrong side band due to the finite slope of the filter (150 Hz for 60 dB attenuation)! At least 100 Hz should be chosen as a shift, so that no strong signal is generated in the wrong sideband.



Example SSB transmission bandwidth 2.7 kHz at 400 Hz SSB Shift (to provide a better view, RX shift was selected to be exactly the same here): The transmitted AF frequency ranges from 0.4 to 3.1 kHz.

- "Highpass" High pass filter to block DC voltage and attenuation of very low modulation frequencies. Can be adjusted in different levels. The high pass filter can be set to "Off". The microphone signal is then passed to the modulator inside the transmitter module without any influence. The bandwidth is about 80 Hz - 10 kHz. The bandwidth of the transmitted signal is then only determined by the transmitter filter ("Bandwidth Hz" setting).

*Note:* By bypassing the filter ("Off" setting), the transmitted AF bandwidth can be extended slightly downwards. The signal then contains quite low frequencies of a broad-band and frequency linear modulation, for example in the AM or FM mode. For normal voice transmission in SSB radio mode, however, the high pass filter should always be switched on (prevention of low-frequency transmissions in the wrong sideband). The equalizer can then be used to set the frequency response for good speech intelligibility.

- "Equalizer" Slider for setting the AF frequency response. A multi-channel tone control network ("Equalizer") is installed in the microphone circuit. The appropriate frequency range's level can be raised or lowered with the sliders. The bandwidth of each range is designed so that adjacent frequencies can be influenced with a maximum of 3 dB.

Extreme example: all settings at maximum. Then, for any frequency other than the lowest and the highest, an increase of +18 dB is possible (+12 dB boost on their own, plus each of the adjacent frequencies +3 dB). The lowest and the highest channel will have +15 dB boost.

**Caution!** The equalizer is located behind the ALC in terms of signal flow! An amplification (increase) of the modulation signal can therefore not be compensated by the ALC and can cause overloading of the modulator with a hard clipping (distortion) of the signal. In this case unwanted spurious emissions rise over the allowed values of the transmitter! Adjust the settings of the equalizer in the positive range (increase) very carefully!

*Note:* The settings of the equalizer can be heard via monitoring, or via the spectrum during opened Microphone dialog. In this case the sidetone does **not represent the bandwidth limitation** according to the Microphone dialog! The exact transmission signal can only be monitored by self-reception when the setting "RX Delay" in the Transmitter dialog is set to 0.

### Operation of the test generator

In the System dialog, a test generator for the transmitter can be activated. The test generator is installed in the transmitter's modulator. It is activated as soon as a frequency setting of a test signal (Freq L and / or Freq R) greater than 0 is present.

The test generator is especially useful to test and calibrate the transmitter. The generated signals have a very high quality (distortion level well below 0.01% THD, SNR > 100 dB) and do not intermodulate with each other. In SSB modes, the transmitter's intermodulation can be measured in two-tone modulation and calibrated via the "Transmitter" dialog.

- "AF Level %": Level of the test generator. It affects both frequencies equally. The full output of the modulator is achieved with 100% level, regardless of whether both or only one test signals are activated.

*Note:* The various filters in the transmitter have a certain amount of ripple in the passband (0.3 dB). At 100% level, it may come to clipping at certain frequencies. Then reduce the level set by a few steps.

- "FM deviation kHz": In case FM modulation is selected (set value "Demodulator" in the user interface), the deviation can be set here. The value is for a modulation level of 100%. Depending of the demodulator (FM narrow or wide) both modulation types are stored separately and always used for the modulation of the transmitter. Common positions are 2.5 kHz for FM-N and 75 kHz for FM-W.
- "Freq L" and "Freq R": Independent frequency settings of the test generator. If set to "0" for both frequencies, the test generator is turned off. The frequencies are added in the transmitter's modulator. If both are active, each signal will be used with only 50% level to avoid clipping. The frequencies can be set in 10 Hz increments up to 1 kHz and above (up to max. 15 kHz) in 100 Hz steps.

*Note:* The terms "L" and "R" have no meaning for the transmitter.

*Note:* The test generator is not affected by filter settings for the microphone channel. In the FM modes the chosen bandwidth serves as upper limit.

### Mode "SBCW"

Besides being able to generate a test signal with the tuning operation ("Tune" button), the test generator has an additional task:

- Generate a sideband signal by pressing the morse key.

By pressing the PTT in mode "SBCW" normal SSB operation is established (automatic switching of the sidebands at / above 10 MHz). However, with (sole or additional) actuation of the morse key, an audio frequency within the sideband is generated whose frequency corresponds to the frequency setting of the test generator. With the level setting of the test generator, the volume can be influenced. It is also possible

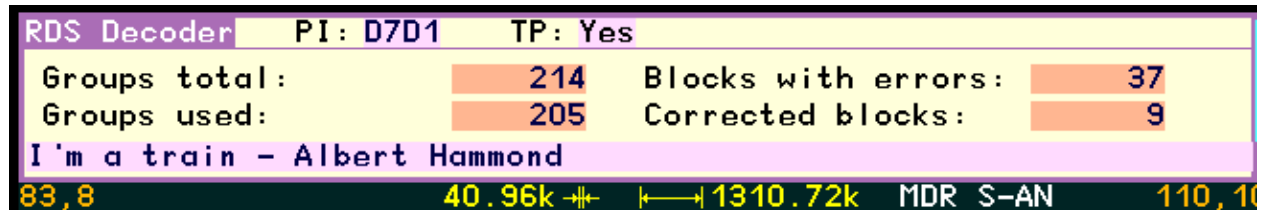
to activate both frequencies and to generate a two-tone signal within the SSB sideband.

**Caution!** The generated signal is not subject to the bandwidth limit of the transmission bandwidth (setting "Bandwidth" in the Microphone dialog)! Don't select a frequency setting that is outside of your desired SSB transmit bandwidth!

**Caution!** If at least one frequency setting of the test generator is greater than 0, the generator signal is also output in tuning mode ("Tune!" button) instead of the carrier frequency. **In AM mode the AM carrier will be immediately turned on to full level and will use the generator's signal only as a modulation signal!**

## 6.5 RDS dialog

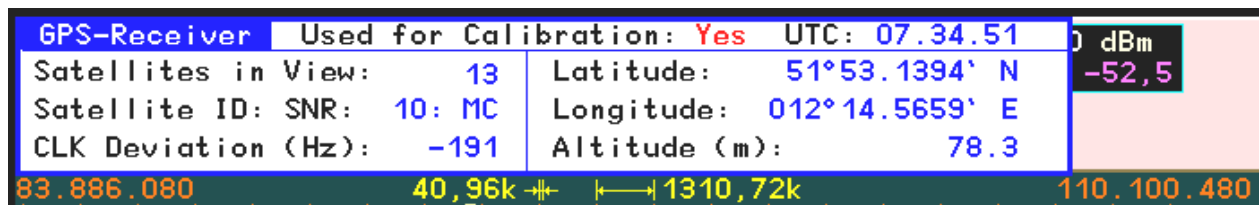
The RDS dialog can be opened via the menu or by tapping the program name or program type display. When the dialog is open, the spectrum display continues.



The RDS dialog contains various displays on the operation of the decoder. In the bottom line the radio text (RT) is displayed. No adjustments can be made in the RDS dialog. It can be closed either with the "Esc" or the "OK" button. The device setting is not changed thereby.

## 6.6 GPS dialog

When the dialog is open, the spectrum display continues.



The GPS dialog contains various displays of the GPS receiver. Most values are only available when the GPS receiver correctly receives the satellites and can calculate the data. For this the antenna must be connected and have reception (direct view to satellites). In addition, the GPS receiver must be switched on in the "Power Management" dialog.

The following displays are available in the GPS dialog (no adjustments possible):

- **Satellites in View:** Number of currently available satellites. For operation at least 5 satellites must be receivable, highly accurate position calculations and frequency measurements are possible from 10 satellites.
- **Satellite ID: SNR:** The SNR of different satellites is displayed here in no particular order.
- **CLK Deviation (Hz):** The current measured deviation of the main oscillator from target frequency.

The GPS receiver enables the use of the atomic clock time base in the satellites as a reference for time and / or frequency measurements (using the 1 PPS signal). This 1 second signal serves as a time base for measuring the frequency of the main oscillator in the Pocket. It has a maximum deviation of  $\pm 12$  ns (if at least 5 satellites can be received). The clock period of the Pocket oscillator is also around 12 ns. Thus the maximum measurement error is 2 periods = 24 ns / second =  $2,4 \cdot 10^{-8}$  (0.024 ppm). This corresponds to a maximum measurement error of approximately 2 Hz with respect to the oscillator frequency. The average measurement error when reception is good ( $\geq 10$  satellites) is below 1 Hz.

The measured frequency deviation can be used to automatically calibrate the Pocket. For this, the calibration for manual input must **NOT** be selected in the System dialog (see there). The use of automatic

calibration is indicated by "Yes" in the title bar of the GPS dialog. With active manual calibration it will show "No" and the measured deviation is displayed but ignored.

During auto calibration, the current calibration value is constantly calculated from the measured deviation and used for the correction of all frequency settings and displays. There is no direct intervention in the control of the oscillator. This maintains the high phase purity of the free running crystal oscillator.

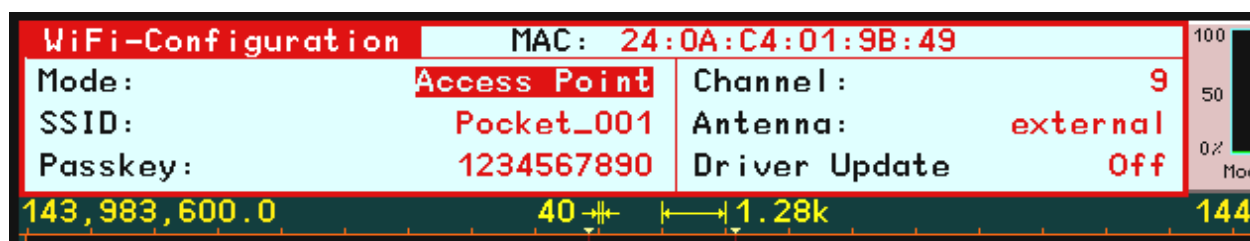
The automatic calibration calculates the value internally to 0.5 Hz precisely and can adjust it by a maximum of one step each second. When the oscillator frequency changes (for example by temperature changes), the readjusting speed is thus max. 0.5 Hz / sec. If the oscillator frequency deviates too far from the nominal value (for example, in cold state after switching on or manually adjusting the calibration over larger ranges), it will take a long time for the system to readjust to an error <1 Hz.

- **"Latitude, Longitude, Altitude (m):"** Latitude and longitude and altitude above normal zero.

No adjustments can be made in the RDS dialog. It can be closed either with the "Esc" or the "OK" button. The device setting is not changed thereby.

## 6.7 WiFi dialog

When the dialog is open, the spectrum display continues.



The title field displays the MAC address of the network processor when the network is active. The set values have the following meaning:

- **"Mode:"** Operating mode of the network processor. "Off" and "Access Point" can be chosen. When the access point is switched on, the Pocket will set up a WiFi network (server) in which other computers (clients) can log in to exchange data.

**Caution!** Even if "Access Point" is selected in the dialog, this is not automatically switched on after each restart of the user interface! To activate the access point, the dialog must be opened and the mode must be switched to "Access Point" after each restart.

- **"SSID:"** The name of the generated network. This always consists of the word "Pocket" and a hyphenated 3-digit number. The number can be changed (only if Mode is set to "Off").

- **"Passkey:"** Password (BSSID) for access to the network. The Pocket WiFi network uses "WPA / WPA2-PSK" encryption. To be able to log in to the network, a client must transmit a password and a network name. The password always consists of 10 digits for the Pocket. The digits can be changed (only if Mode is set to "Off").

**Note:** Encryption with only 10 digits is not very secure. Since the Pocket does not have any "usual" operating system (for example, Windows or Linux), no malicious code (viruses, trojans, etc.) can be active in the Pocket. An attacker can however intercept the transmitted data packets.

- **"Channel:"** Radio channel in the 2.4 GHz band on which the Pocket builds its network. The channel can be selected in the European range between 1 and 13. Choose a channel that is used as little as possible by other nearby access points (like wireless routers) and is not disturbed (for example by microwave ovens). The beginning of the band channel 1 and the band end channel 13 are usually favorable.

- **"Antenna:"** The Pocket has an internal antenna and a connector for an external antenna. The internal antenna has only a very limited range (up to a few meters) due to the strong shielding case. To bridge longer distances to the clients, an external antenna (SMA plug) should be connected and switched on here (only switchable if the access point is active).

- **"Driver Update:"** The software of the network processor (also called firmware or "driver") can be updated independently of the device. For this the access from a network client must be enabled here (setting to "On", only possible with active access point).

**Caution!** Never switch on the access during normal operation! Accidental modification of the software can lead to the complete loss of functionality of the WiFi network! No new downloading of the driver is possible afterwards! In such a case, the device must be reprogrammed by the manufacturer.

For more information about operating the network and transferring data, see section "Software Update".

## 6.8 Memory dialog

The dialog for directly entering values and managing the memory slots can be opened by tapping the frequency display or via the menu. Opening the dialog will pause the spectrum display and show the dialog within the display.



The left side always shows 11 memory slots as an extract of the freely available 199 slots. This extract window can be scrolled up and down by turning the scroll wheel.

Tapping a slot name (demodulator + frequency) closes the dialog and immediately configures the Pocket with the data from that slot.

If you tap on the "S" in a line, the current setting of the device is immediately written to the appropriate slot. There is no further warning or consultation!

Tapping "C" clears the data of the memory slot. Again, without further warning! A deleted slot is "empty" and selecting it has no effect, the current setting of the device is not changed.

The virtual buttons "MHz OK" and "kHz OK" allow the input of frequency times multiplied by the corresponding power of ten, whereby in each case a maximum of one decimal place can be entered.

Example:

Input sequence "1 → 0 → , → 1 → MHz OK" with direct frequency input results in an adoption of the frequency 10.100.000.0 MHz into the frequency setting. It should be noted that entries that are too large or too small are limited to valid values, or a change to the relevant area takes place (pre-filter automatic mode).

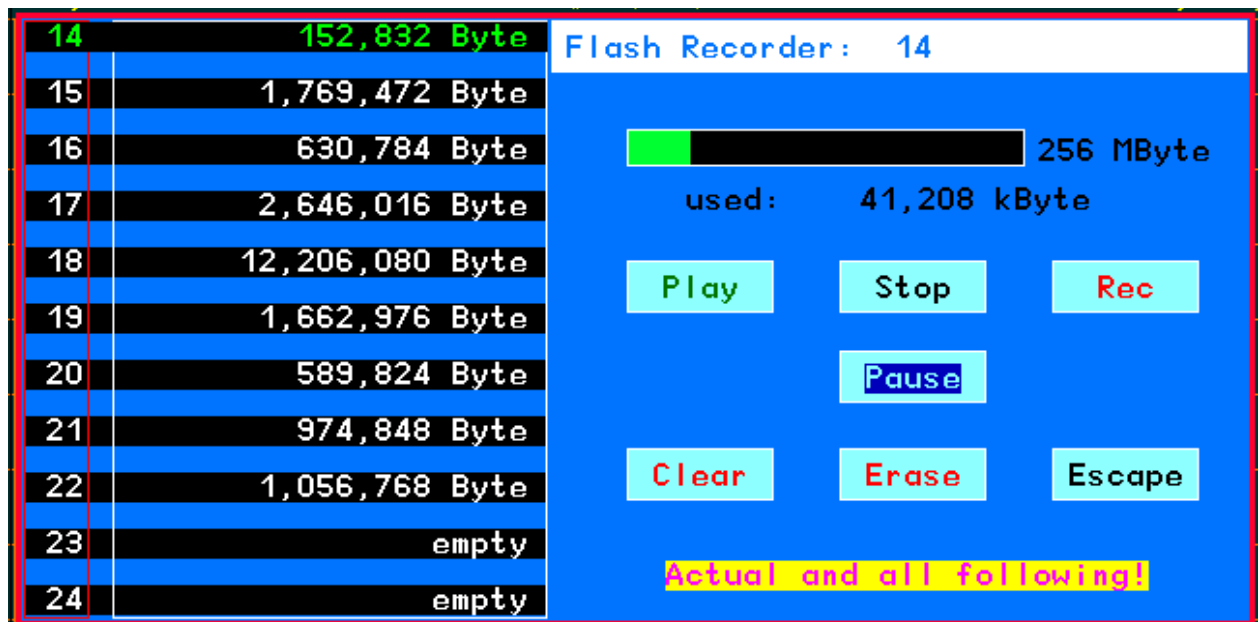
The "<-" button deletes the last digit entered or the comma.

Various other set values besides the frequency can also be changed via the direct entry. For example, you can set a shift in the listening area (PBT) in the SBSP modes by directly entering numbers and tapping the "OK" button. This is faster for larger changes than for the encoder or swiping over the spectrogram.

The dialog must be closed with one of the OK buttons or the ESC button within the dialog. When a memory slot is called, the dialog is also closed immediately.

## 6.9 Recorder dialog

Opening the dialog will pause the spectrum display and show the dialog within the display.



The Pocket has a fast flash memory for real-time recording of the two audio channels. The recording is performed with 24-bit resolution for each channel at a sampling rate of 44.1 kHz. Depending on the model, the Pocket is equipped with 2 Gbit (256 MB) or 4 Gbit (512 MB) or 8 Gbit (1024 MB) maximum storage space. The available memory size is displayed next to the bar graph of the current usage.

On the left side of the dialog, a list of 11 files out of 256 possible files for recording appears. The list can be scrolled up and down with the rotary encoder. The filenames simply consist of their number in the list. After the number, the file size in the memory is displayed. Free slots are marked with "empty".

Recording is performed by tapping the virtual "Rec" button. Starting with 0 byte, the next free file slot is then filled with data. The amount of data is displayed continuously in the file field, as well as the total used storage capacity with a bar graph and as a numerical value.

If the recording length has reached the total memory capacity, it is automatically canceled. A limitation within the files does not exist. The entire memory capacity can be used for a single file, or distributed to multiple files.

A file can be played back using the "Play" button. The file in the topmost displayed slot will be played. The progress count is made by counting the amount of data from 0 byte and changing the color to green. The capacity indicator on the right side remains unchanged.

Tapping the "Stop" button aborts the recording or playback process. Tapping the "Pause" button interrupts or resumes the recording or playback process.

Deleting files can be triggered by tapping the "Clear" key. The label "Actual and all following!" (Current file and all following in the list) will then be displayed inverted (red with yellow text). Tapping this label will irreversibly start the deletion process. If nothing is to be deleted, the process can be aborted with the "Escape" button. When deleting, the file slots are set to "empty" and the capacity display is updated.

**Caution!** Always all files displayed **AND** all in the list, possibly following up to slot 256, will be deleted! If only the last file(s) is to be deleted, the list must be scrolled to the point where the first file to be deleted is at the top. Individual files within the list can not be deleted selectively.

The "Erase" button deletes the complete memory. The information text indicates the duration since the deletion started. It can take up to 20 minutes depending on the memory size.

The dialog can only be closed by tapping the "Escape" button. Closing is not possible when recording or

playback is in progress or when a deletion has been initiated.

## 6.10 Power Management dialog

Tapping the upper panel area with the bar displays opens this dialog. When the dialog is open, the spectrum display continues.

Power Management			
Device Current (A):	0,49	ADC 2 activ:	Off
Charge Current (A):	0,00	GPS activ:	Off
Voltage Batt 1 (V):	3,62	Display activ (sec):	Always
Voltage Batt 2 (V):	3,65	Spread Spectrum	Off

The values on the left of the dialog show pure display values. The values on the right of the dialog can be adjusted.

- "**Device Current (A):**" The current drawn from the batteries.

- "**Charge Current (A):**" The current flowing into the batteries from the charging port.

*Note:* Both currents refer to different voltage levels and therefore can not be simply added together to get the resulting current into / out of the battery.

- "**Voltage Batt 1 (V):**" The voltage of battery number 1.

- "**Voltage Batt 2 (V):**" The voltage of battery number 2.

*Note:* The voltages can be added together to calculate the total voltage for operating the Pocket. Multiplied by the current from the batteries, this results in the current power consumption of the Pocket.

- "**ADC 2 activ:**" Switching the 2nd ADC On / Off. The Pocket has 2 analog-to-digital converters (ADC) to digitize the received signal. It achieves his good technical data thanks to them. To save electricity, the 2nd ADC can be switched off. However, some data is then inaccessible, e.g. the inherent noise increases and the measuring accuracy (level displays / height of the spectral lines) decreases. Rather, overmodulation and secondary reception (IM, aliasing) occurs. The changes are heavily frequency and level dependent. Often, good reception can be achieved with only one ADC, but for maximum reception quality, two active ADCs are required.

- "**GPS activ:**" Switching the GPS receiver on / off. If the automatic calibration function and the position data are not required, or if no GPS antenna is connected, the GPS receiver can be switched to a standby mode to save power.

- "**Display activ (sec):**" The display can be switched off after a set time. Every tap on the touch screen or the movement of the rotary encoder activates the display immediately.

**Caution!** If the display is switched off and there is no sound playback or connection to a PC, no control over the switch-on status of the entire device is possible! Do not forget to turn off the Pocket if you do not need reception!

- "**Spread Spectrum:**" The display is the main source of interference in the device. Due to its large area and the powerful and high-frequency control, it emits some interference despite good shielding and grounding. Especially the horizontal frequency of approx. 46 kHz makes itself noticeable in the FM range as a "line grid" with a range of around 46 kHz. These discrete noise lines can be "blurred" by spread-spectrum modulation. The interference energy concentrated in the lines is distributed over several kHz width. The width of the distribution and thus the magnitude of the reduction on the discrete frequencies can be changed from "low" to "mid" to "high".

*Note:* The spread spectrum modulation of the display reduces the discrete noise lines at the expense of the background noise between the interference lines! This increases with the degree of modulation.

## 7. Special features

All previously described device settings and functions are more or less often required for the intended use of the Reuter Pocket. However, some functions are rarely or never necessary. These are described below.

The variety of possible settings and operating modes of the Pocket may lead to incomprehensible settings. Switching the device off and on again does not help in this case: All device settings are saved. After switching on, the Pocket is in exactly the same operating state as when it was switched off, even after a long break in operation or without built-in or empty batteries.

There are several possibilities to set the device to a known operating state:

- The "Undo" function.
- The initialization of a default status, called the "Factory setting".
- The complete deletion of almost all software in the device and the re-saving of other (new) software ("Software Update").

## 7.1 Undo function

Use this function if you have performed only a few operations that have led to an unsatisfactory or confusing setting state of the device. You can return the setting state of the device to one of the last maximum of 28 operating states. Note the current status of the undo level, which always appears in the lower right corner of the user interface:



The device is currently in state "4".

Now try to define a certain number of operating steps from where you want to undo the settings and subtract this number from the current state. Subtract this number from the displayed undo state, calculating a possible "underflow" to 0 or negative values as a count back to the highest possible value of 28:

*Example:* Current state 4, desired return of the device setting by 5 operating steps:

$$4 - 5 = -1 \diamond (0 \text{ equals } 28) \diamond 28 - 1 = 27.$$

Open the System dialog. Select the setting "Undo Level:" and set it to the desired undo state (as per example "27"). Close the dialog by tapping the "OK" button. The device is set to the state that existed when the undo state "27" was last seen in the display (i.e. before 5 operating steps).

**Note:** The undo value is always counted when buttons are pressed (the state of the device is saved again). At any time, you can completely store the device setting by tapping any non-active setting. Remember or write down the displayed undo state if you think you possibly want to reverse the next device settings.

**Note:** At switch-on the setting of the device is restored to the level displayed when switching it off. If you make a note of the displayed value immediately after switching on, you can return to this power-on state up to the undo-system overflow (i.e. the automatic reuse of this space after 28 new savings).

## 7.2 Factory setting

Position 0 of the undo function always refers to a non-erasable basic setting (factory setting / defaults). When it is called up, the device is set to a basic state with defined set values (such as frequency 81.92 kHz, demodulator SYNC, shift 0, etc.).

**Note:** You can also use the manually allocated memory slots (see "Memory" dialog) to load defined settings that you have stored yourself in a specific slot. These memory slots are not changed by the undo function or the factory setting.

## 7.3 Software Update

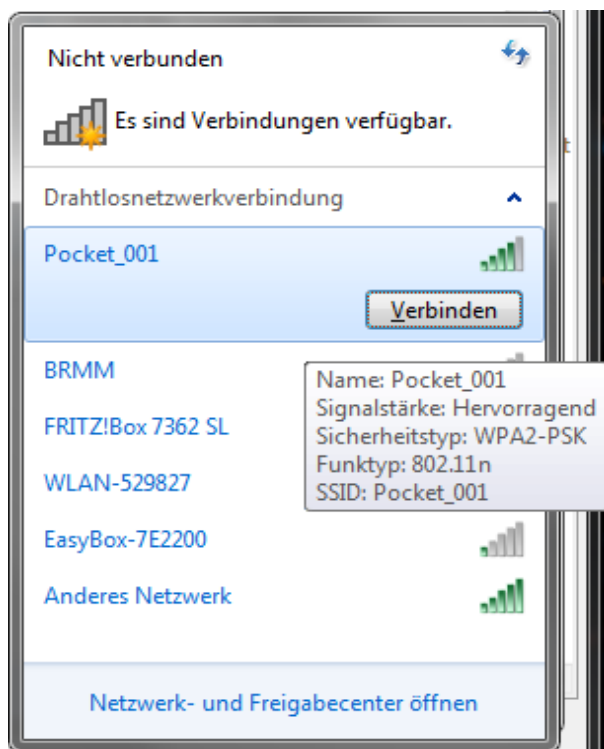
The Pocket allows a change of its functionality by the programmed software ("Firmware"). It can be re-loaded at any time by connection to a personal computer (PC). The firmware determines not only the programs of microprocessors commonly referred to as "software", but also the existence of specific units such as processors or interfaces within the device (so-called "Softcores") by the configuration files of the programmable logic circuits used ("FPGA" = Field Programmable Gate Array) as a whole.

### Connecting the Reuter Pocket with an external computer

The connection with a computer is established via WLAN ("WiFi network", see "WiFi" dialog). If possible, use a suitable 2.4 GHz antenna on the external connector. Position the Pocket near the computer that will connect to it. Pay attention not to overload the Pocket's and / or PC's transceiver! In this case use the internal antenna of the Pocket and / or increase the distance.

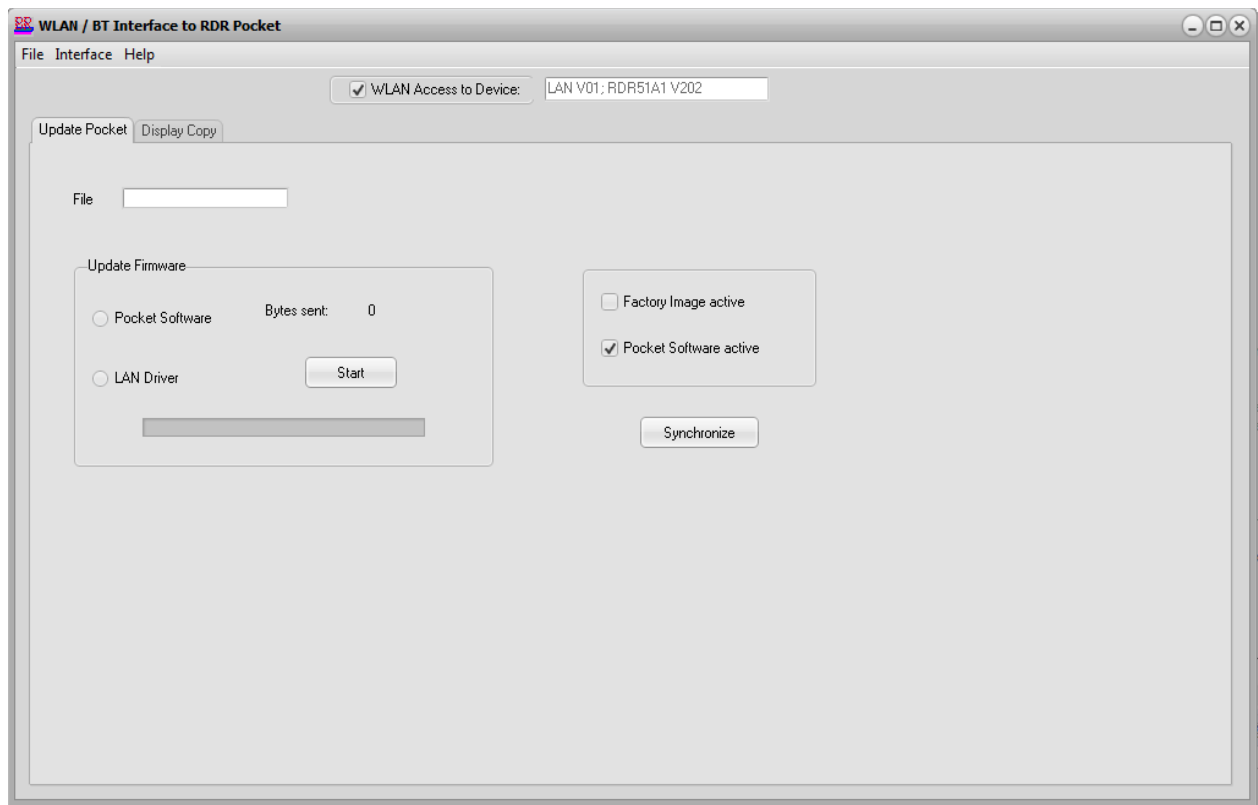
A connection to the Pocket always requires the beforehand login of the computer into the active access point of the Pocket. This process depends on the computer and its operating system. The Pocket supports DNS with automatic assignment of a network address to the connecting computer.

The following describes the procedure for a typical installation of Windows 7 or 10 on a personal computer / notebook (recommended computer for software update). The computer must have a wireless module installed or plugged in (i.e. USB module). The operating system then sets up appropriate software to detect active networks ("WiFi network", "access point", "hot spot" or similar wording) and to connect with them. The found networks are displayed in a list as shown here:



Select the network with the name set in the Pocket (SSID) and start a connection. The first time you login you usually will be asked for the encryption and the appropriate key (password / key ...). Select AES (WPA2) and enter the 10-digit Passkey as set / displayed in the Pocket. Thereafter, the computer should have established a connection (display "Connected" or similar). In case of errors, consult the operating manual of the computer / operating system and check whether the Pocket is still running correctly.

Once the computer is connected to the Pocket, a service software on the PC can perform all desired functions. The Pocket is provided with a CD-ROM with the program "RDR51B.EXE". Start the program and after some searches and possible notifications the user interface will appear as shown below.



If there is no WLAN connection, the message "Access Point not found!" appears. In this case, check whether the PC is correctly logged in (connected) and possibly repeat the process. In case of bad connection (unfavorable channel with many interferences) or weak signal (long distance between PC and Pocket or use of the internal antenna) the connection can break up occasionally.

If the program is already running and the Pocket is restarted or the connection is re-established, access may be re-established via the menu Interface → Find WLAN Connection. Naturally, the computer always has to log into the Pocket network first!

A correct data connection from the service program to the Pocket is only available if the version numbers of the Pocket appear in the field behind "WLAN Access to Device:" and a tick can be seen in the field above the "Synchronize" button. If the version numbers have been recognized, but no tick is visible, the "Synchronize" button can establish the connection. It may also be necessary to quit and restart the program in order to detect a newly established network connection.

**Caution!** Each time the Pocket is switched off, the Wi-Fi connection is interrupted. The computer will only log in automatically, if so provided in the operating system. Set this appropriately or re-log the computer manually each time!

## Software Upload

2 different units of the Pocket can be updated with new software:

- The FPGA of the Pocket with its configuration of all circuits and the user interface.
- The software of the network processor (LAN driver).

The software to be loaded is selected on the left side of the program in the field "Update Firmware". **Be sure to make the right choice and open the appropriate files as described below!**

The software of the Pocket always has the name extension ".RPD", e.g. "RDR51DV200.RPD". The provided CD contains at least one such file (the software that was uploaded in the delivery state). To load an RPD file into the Pocket, proceed as follows (assuming correct connection):

- Select the item "Pocket Software".
- Open the desired file via the menu item "File" → "File Open" (".RPD" is always the default). The file name must now be displayed in the "File" field.
- Click on the "Start" button. The "Bytes sent" display must now count the number of bytes transferred consecutively.

- At the end of the transmission, a window appears indicating the successful transmission.
- For errors, a message window appears with a note on the error (e.g. "Device not responding"). Check the WLAN connection and re-establish it if necessary.
- If no upload is possible after several attempts, stop the service program, switch the Pocket off and on again and repeat the entire procedure.

**Caution!** Never switch off the device or the PC during the upload process and never disconnect the WLAN connection!

*Note:* After a successful upload, the Pocket must be turned off and on again to start the new software. Check the successful start by noting the version number displayed in the user interface. It must match the number in the file name. If a wrong version number is displayed instead, upload and / or restart were unsuccessful. Repeat the upload and pay attention to loading the correct file.

An update of the network driver is only necessary in rare cases. The process corresponds to the previously described upload of the Pocket software. Select the item "LAN Driver" and open the corresponding file. The driver's extension is always ".BIN". In order for the driver to be uploaded into the Pocket, this process must first be enabled in the WiFi dialog (see there). **As long as the activation is set to "On" or the update is running, the WiFi dialog must not be closed or anything be adjusted on the Pocket!** Now click on "Start".

Updating the LAN driver is performed in 2 steps:

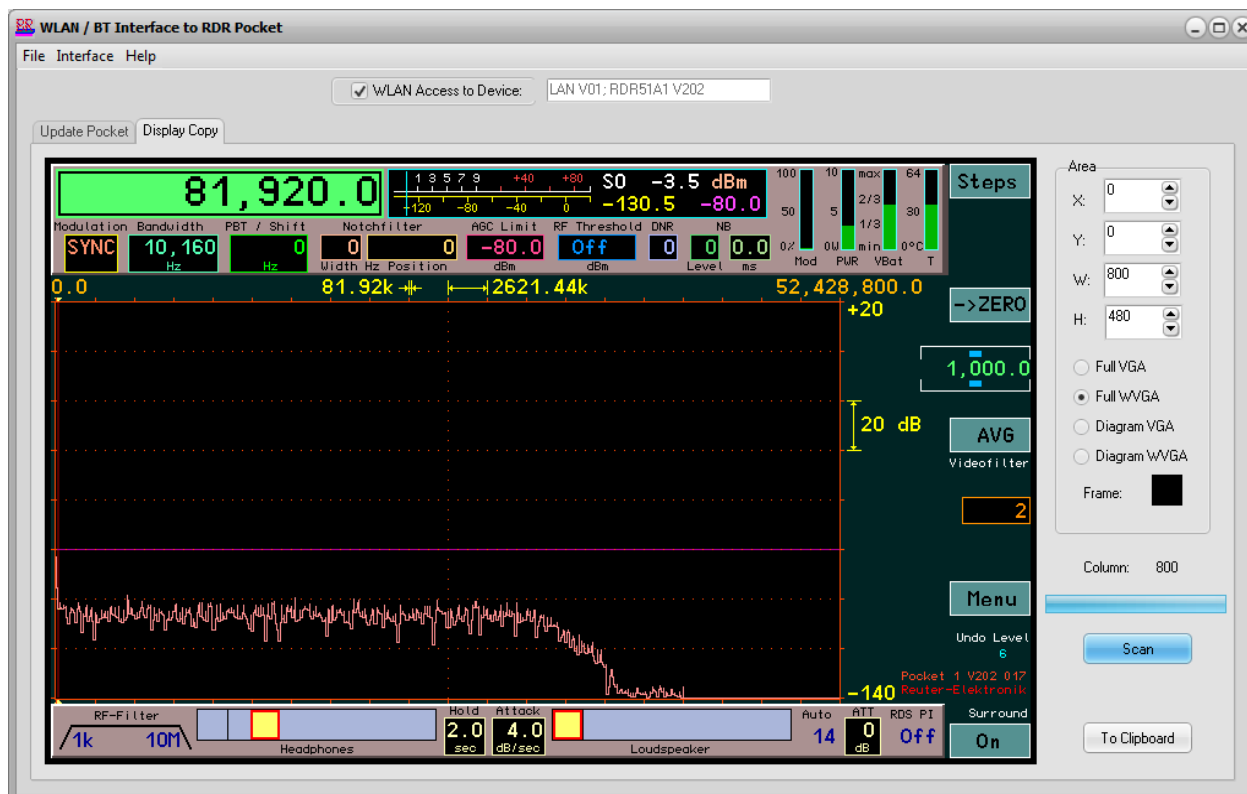
- Upload of the file as with the Pocket software. The file transfer is displayed instead of "On" in the WiFi dialog as a counter of the received data blocks. After a message displayed on the PC about the end of the transmission (or an error message), the WLAN connection is aborted. The program RDR51B.EXE must be closed.
- The Pocket programs the received data into the memory of the network processor. The process is again indicated by counting the data blocks. After programming has finished, the message "OK" or "Fail" appears. Now set this display by tapping (if not still active from the activation to "On", nothing should be adjusted on the Pocket afterwards!) to "Off". The access point must then be switched off ("Mode" setting). Close the WiFi dialog afterwards

The updated driver is now loaded each time the access point is powered up. A check of the version number is possible when establishing the connection with a PC and starting the service program RDR51B.EXE (see above).

**Caution!** A new driver usually requires an update of the Pocket software. The order of what has to be loaded first is crucial! Follow exactly the instructions that come with new software!

## 7.4 Display Copy

The Pocket also allows you to download data from the device via the WiFi connection. This refers to the output of the display content ("Print" function). Saving and printing of display content is often desirable to document reception conditions and measurement results. This function is also available in the service program. Simply click on the tab "Display Copy".



You can select any section of the Pocket's screen to be copied and transferred to the PC. Select it using the pixel coordinates of the upper left corner of the area (X and Y, starting with 0 from top left). Set the desired width (W) and height (H) of the section to copy one. If useful select a suitable preset setting and the color of the background (click on the color box behind "Frame"). The visible blank image is adjusted according to your choice in size and color.

Start the copy process by clicking the button "Scan". The screen content of the unit's display is now transmitted column by column from the left and afterwards appears in the image. In this case, a frame around the transferred image is maintained by each 5 pixels after the final scan on all sides. During the operation of the transmission it is not possible to control the Pocket and no screen updates occur. In the readout "Column" the current progress of the transmission can be seen. It ends with a success message or aborts with an error message. If necessary, restart the scan after aborting. Wait until the Pocket reacts to input!

**Caution!** You should use a PC with enough processing power and configure it that no application software (close running programs) or operating system is blocking the data transfer. If the PC is unable to process the data sent by the Pocket in a timely manner, the scan aborts. The transmission also aborts easily with poor Wi-Fi connection quality (low data rate).

The image can be saved in BMP format for further processing via the "File" menu  $\diamond$  "File Save", or transferred directly to the Windows clipboard by clicking the "To Clipboard" button.

## 7.5 DAB reception

The Pocket is equipped with an independent receiver module, which allows the reception of DAB / DAB + broadcasts. No signal processing of the Pocket is used in the process, only the audio output and the operation via the Pocket user interface. Accordingly, almost all functions of the Pocket are disabled, whether spectrum-based or time-based.

The DAB module is located on the FM extension board behind the first prefilter / preamplifier in the signal path. It thus benefits from the low input noise of the Pocket and allows good reception. However, the prerequisite is always the **connection of a suitable antenna**. A simple telescopic antenna or similar usually only allows the reception of a few low quality stations.

DAB or DAB + are digital modulation types. The information is transmitted in the form of bits which are coded, compressed, interleaved and modulated in a variety of ways. The reception of such transmission types differs fundamentally from, for example, AM or FM transmissions. The Pocket has thus (unfortunately) no influence on the quality of the received broadcasts (except in the AF range, which is designed with 24 bit / 81.92 kHz with very high quality in mind).

To receive a DAB (+) station, follow these steps:

- Switch the reception range in the Setup dialog (value "Filter bandpass") to 174 - 240 MHz. Alternatively, tune the frequency from 151 MHz to higher values (filter to automatic), or select a slot in the Memory dialog where the DAB program is stored.
- A message appears in the frequency display: „Search DAB...“. You can not receive DAB stations "just like that" indiscriminately. The receiver module first has to scan all sorts of program data. For this purpose, it searches the entire frequency range (band III) for active stations and their program content (transmitted data streams).
- The result is a list of receivable stations and their program content. The frequency display shows the number of receivable programs. If this list contains at least one program, the first program in the list is selected for reception. Otherwise, the message "DAB Failed!" appears.
- No station frequency is displayed, only the program number in the list. There is no frequency tuning. Only the program list can be scrolled with the wheel. A maximum of 256 programs are possible. If the number is lower, the corresponding places in the list will be empty.
- A program can be selected by tapping the list entry. The list entry is then surrounded by a yellow frame. To the right of the list are some more information about the selected program.



The program of a station is not always audible. For this 2 further requirements must be met:

- The program must transmit an audio stream. Programs with pure data services are not audible.
- The reception quality must be sufficient to be able to demodulate, decode and decompress the program ("Quality" indicator bar at least 1/3 green).

Especially the last case can cause unpredictable dropouts, fragmentations or total failure of the program due to fluctuating reception conditions. Borderline conditions result in peculiar distortions similar to the audio "quality" of mobile phones in poor connection. Therefore, ensure stable reception with a good antenna and by locating the Pocket in a low-noise environment.

The 2-line entries in the program list contain various information. These are (order from upper left row to lower right row):

- Channel number from 5A to 13F.
- Name of the ensemble (the "multiplex", the summary of various programs on a station).
- Program type (same name as RDS program type on FM).
- Service type: DAB, DAB+, DATA or DMB. DAB and DAB+ are audible.
- Program name.
- Service component number.
- Service component ID.

- Service ID.
- Ensemble ID.

To the right of the list, the following information is available, each updated for the selected program:

- Sample rate of the audio signal: 24, 32 or 48 kHz.
- Bit rate of the compressed data stream: The higher the value, the lower the compression factor / higher the audio quality.
- Quality of the data stream from 0 - 100%: The display is based on an internal calculation of the bit error rate. 100% quality = no errors, 0% = no data decodable. Values of less than approx. 60% result in dropouts in the audio signal. Below about 30%, nothing is audible.
- MOT 1 / 2: Type of multimedia data sent. Possible are: Sl(ide) Show (SLS), BWS, TPEG, EPG, DGPS, TMC, Java, DMB, Push(Data), Journal(ine) or unknown.

To evaluate the MOT data, additional decoders are required. Depending on the software version or type and equipment of the Pocket, these can be supplied or additionally installed. Depending on the MOT data type, the decoded data will appear in the black window to the right of the DAB dialog (for example, as an image or as a text).

Below the MOT window, the program text of the selected program is displayed, if available (transmitted).

As long as the Pocket is operating in DAB mode, not all Pocket functions are available. However, most of the dialogs can be opened and operated via the "Menu" virtual button. The Transmitter dialog is always locked (in DAB mode no transmission is possible)..

Tapping the frequency display (DAB: display of the program number) opens the Memory dialog as usual. DAB programs can be saved or called like other memory entries. For a DAB program no frequency is stored but only the number of the program in the list. Direct entries of numerical values (frequencies) via the virtual keyboard are not possible.

*Note:* When a DAB program is called from another currently active frequency range, a new DAB scan only starts if no scan has been performed since the device was switched on. Otherwise, after initializing the DAB module (1 s waiting time), the program with the stored list number is chosen immediately. If the sorting has changed in the meantime (for example, because the device can now receive other stations), the program is not correct. In this case, perform a new DAB scan (switch device off / on again or change range via the Setup dialog).

## 8. Specifications

Frequency range (version B / C 1/3):	0 - 30 MHz, 50 - 71 MHz
Frequency range (version B / C 2):	0 - 30 MHz, 50 - 71 MHz, 87.5 MHz - 108.0 MHz, 136 - 151 MHz, 174 – 240 MHz (only DAB reception)
Frequency adjustment:	Rotary encoder with increments of 0.5 Hz to 999.999.5 Hz, direct input via virtual keyboard, via touchscreen
Frequency deviation internal oscillator: at active GPS with at least 7 satellites:	<± 5 ppm max after 10 min, internal manual calibration <± 1 Hz on oscillator clock 83.88608 MHz
Input impedance (Ohm):	50, 0-71 MHz can be switched to zero or high impedance
max. processable input level ≤ 71 MHz:	-6 dBm, with attenuator: up to +13 dBm
max. processable input level > 71 MHz:	-30 dBm, with attenuator: up to +1 dBm
Level of inaccuracy:	<= ± 3 dB
Inherent noise (MDS) ≤ 71 MHz:	<= 163 dBm/Hz
Inherent noise (MDS) ≥ 87.5 MHz <136 MHz:	<= 171 dBm/Hz
Inherent noise (MDS) ≥ 136 MHz:	<= 168 dBm/Hz
Intermodulation distortion ≤ 71 MHz:	IP3 ≥ +20 dBm, 2x -12 dBm at 10 MHz
Intermodulation distortion > 71 MHz:	IP3 ≥ -4 dBm, 2x -36 dBm at 100 MHz
Filter bandwidth (SBSP):	10 Hz - 20.4 kHz depending on settings
Filter bandwidth (time-based):	125 Hz - 20 kHz depending on settings
Stereo crosstalk:	≥ 80 dB, 0 ... 15 kHz, bandwidth 300 kHz HQ
Audio output:	Headphone: Stereo DAC 24 bit, max. 1.5 Vrms on 32 ohm speakers: D amplifier, max. 2x 0.7 W to 8 ohm
Memory slots:	28 for undo function, 199 freely assignable
Display:	TFT 4.3" (109 mm) diagonal, WVGA 800 x 480 pixels, 256 colors, brightness max. 300 cd/m², viewing angle (horizontal / vertical) 130 °/120 °, contrast (black/white) 400, response time 30 ms, resistive touch screen
Connectors:	SMA socket for receiving antenna, SMA socket for GPS antenna, SMA socket for WLAN antenna, 3.5 mm stereo jack sockets for headphone, microphone and morse key, Lemo socket type 00 for charging current
Power supply:	2 fixed batteries B600B 3.8 V / 2600 mAh, externally chargeable with 11.5 - 14.5 V / max 6.0 W (from serial number 060 onward 5.0 - 14.5 V)
Size (width / height / depth without connectors):	158 mm / 110 mm / 30 mm
Weight:	max. approximately 0.7 kg, depending on the version / equipment
Operating conditions:	0 ... +35 °C ambient temperature, ≤ 99% rel. non-condensing humidity, IP 40, pollution class 2
Compliance:	CE according to DIN EN 55013, EN 55020, EN 60065 (Consumer electronics and related equipment), RoHS / WEEE Directive, ear-Reg. 27676700

Changes are reserved in the course of technical development!

## 9. Brief introduction to SBSP

The SBSP "Spectrum Based Signal Processing" is a novel principle in the processing of radio signals. This principle has long been known in measurement tech as well as commercial, military and space applications and is used for various applications, for example:

- Spectrum analyzers
- Digital telecommunications networks
- Sonar equipment
- Radio astronomy
- Broadband radio monitoring

Furthermore, it is also used in the private sector in the form of SDR "Software Defined Receiver". In this case, an attachment receives the RF signals and, where appropriate, converts them into digital signals and forwards them to a PC, or feeds the analog signals into the sound card of the PC. Software running on the PC then takes over the function of the receiver by "simulating" the usual analogue processing stages as a program sequence on one (or more) powerful processors.

All these applications share the following characteristics (with rare exceptions):

- Using the FFT algorithm to transform the time-based data ("oscillogram") into frequency-based data ("spectrogram").
- Use of spectrograms only for measurements and visual representations.
- No use of the spectrograms to directly process the modulated information (filtering, demodulation, audio generation).

The latter does not apply to special modulation processes (e.g., digital voice transmission in telecommunication networks) which have been developed specifically for the use of the FFT algorithm. All other common "analogue" modulation types like AM, SSB or FM are not processed spectrum-based. The reasons for this are, among others:

- High effort for simultaneous application in measurement / image display and signal processing.
- Lack of software (programs to imitate the analog principles are freely available, proprietary software development for SBSP is complicated, time-consuming and expensive).
- **The FFT algorithm is NOT SUITED for good results.**

Since the FFT is otherwise used everywhere, the last statement should be briefly clarified. "FFT" is a binary calculation rule ("algorithm") optimized for the digital execution in clocked systems ("processor"), which performs the mathematical process of the Fourier transformation of a signal of specific length (duration). The execution of this "analogue" transformation (consisting of a theoretically infinite variety of signal states) based on discrete (finite amount) digital samples of the signal (the samples from the ADC) leads to significant limitations in the achievable results.

This is similar(!) to the well-known Nyquist theorem: A signal can only be uniquely (re)produced if its bandwidth is less than half the sampling frequency. For the FFT one could say: It is only possible to calculate a unique spectrum from a certain number of samples whose resolution reaches at most the reciprocal of the signal duration (number of samples times sampling period). For example, to get a spectrum with a resolution of 1 Hz (the distance of the spectral lines, i.e. the smallest possible separability of two frequencies), a signal duration of at least 1 s is necessary. Or in other words: At 1 Hz resolution, you can only get a unique spectrum once per second.

In addition, there are further limitations (disturbing artifacts) such as side resonances or level errors of the spectral lines ("picket fence effect"). All this makes the FFT unusable for direct signal processing of analogue modulations. Experiments have shown that for a usable signal quality resolutions of the spectra of at least 10 Hz are required. Experienced ears can hear even 1 Hz difference at higher frequencies. On the other hand, (apparently) continuous tone generation requires a spectral rate of at least 50 S/s (spectra per second). That compares most fittingly with image processing. There, too, the eye sees individual images only at about 50 Hz as a continuous movement.

In order to be able to use the advantages of SBSP nevertheless, another algorithm than the FFT must be used. The Pocket introduces a scalable time-frequency transformation that works 4 times faster than the FFT. In the example, error-free spectra with 1 Hz resolution could be generated from a signal duration of 0.25 s. Or 10 Hz resolution with 40 S/s, 20 Hz with 80 S/s etc. This roughly corresponds to the requirements for a sufficient signal quality.

Thus, this algorithm can be used for signal processing (filtering, demodulation) in devices that do not require Hi-Fi audio quality (hand-held radios, amateur radios, simple AM radio receivers, etc.). It offers enormous advantages in terms of selectivity and flexibility (fine-tuned and far-reaching parameter adjustability and easy implementation of additional functions such as notch and noise filters).

However, it is not (yet) applicable for direct signal processing of FM-modulated signals. This would require much higher spectral rates with much higher resolution. An issue for the future. Filtering and FM demodulation are therefore performed in the usual time domain on the basis of individual samples in the Pocket.

However, the SBSP can also be used advantageously in the stereo decoder and in the RDS decoder. Here, the most popular use case is the processing of narrowband signals without high data rates (with the exception of the difference signal).

### **Stereo decoder**

The task of the stereo decoder is actually not decoding, but a demodulation. The difference signal present in the MPX signal in the form of a two-sideband modulation with suppressed carrier at 38 kHz must be demodulated and offset with the sum signal. This then results in the left and right audio channels.

The main problem is the absence of the carrier (called "subcarrier") for AM demodulation of the difference signal. Instead, the so-called pilot tone is contained in the MPX signal (always clearly visible in the Pocket's MPX spectrogram). Its frequency is exactly half of that of the necessary subcarrier and its phase (time of zero crossings) corresponds exactly to that of the necessary subcarrier. This can therefore be generated ("regenerated") from the pilot tone.

The exact regeneration of the subcarrier in terms of frequency, phase and amplitude is essential for the accuracy of the difference signal's demodulation and thus the quality of the L / R stereo signal. (Of course, the exactness of the demodulation and the difference signal itself, too. The latter is strongly dependent on the filter and FM demodulator.)

All current regeneration methods produce more or less strong errors of the 3 parameters. They mainly result from having to work on different frequencies (19 kHz → 38 kHz, mixing to 0 Hz) and using different filters (bandpass, lowpass). These introduce deviating phase and amplitude responses. A digitally processing system can avoid some of these errors. Above all, they are constant and predictable and therefore can be stably corrected by compensations.

The Pocket's SBSP operation allows differential signal demodulation without any artificial regeneration of a carrier signal. Only the original pilot tone is required. The pilot tone can advantageously be taken out of the SBSP in extremely narrow band and with very low noise. It represents "only" a single spectral line that should be used. Everything else around it is simply omitted (numerical selection principle instead of filter specifications).

Furthermore, the "spectral line" pilot tone is no longer a specific frequency, but a so-called IQ signal (mathematical signal in the form of complex numbers) with the target frequency 0 Hz. Also, the difference signal can be taken from the SBSP so that its center is around 0 Hz. (In contrast to real signals, IQ signals can represent negative frequencies, so the lower sideband is negative, the upper positive is around zero.) Thus, both signals match without subcarrier generation and are already demodulated. Only the phase synchronization remains, which is performed as a simple phase shift of the differential signal depending on the phase of the pilot tone.

The amplitudes also match exactly due to the relative level accuracy of the SBSP of the Pocket ( $\pm 0.1$  dB) and to the sum signal. A correction of the absolute values can be carried out easily and stably. This makes channel separations well over 80 dB achievable. Incidentally, at this point, the base width adjustment is made. Only the level of the difference signal is changed from 0 to 200%.

### **RDS decoder**

The RDS decoder operates similar to the stereo decoder in its first stages. Again, a demodulation ("mix") with a non-existent subcarrier is necessary again, this time at 52 kHz. As with the stereo decoder, the spectral line of the pilot tone is used immediately and the RDS sidebands are taken from the SBSP in the correct frequency, phase and amplitude. The subsequent stages correspond to the usual decoding of the RDS data with error correction.

The Pocket's RDS decoder allows one wrong bit per block. This enables a fast response of the decoder (DX operation). However, occasionally erroneous characters appear at a too low signal-to-noise ratio. The RDS dialog provides information about the current error rate.

A disadvantage of the SBSP in conjunction with the RDS decoder is the necessity of the pilot tone in the MPX spectrum. RDS signals from stations that do not transmit a pilot tone (i.e. that only transmit in mono) can not be demodulated. However, these are very rare cases.

## 10. Transmitter

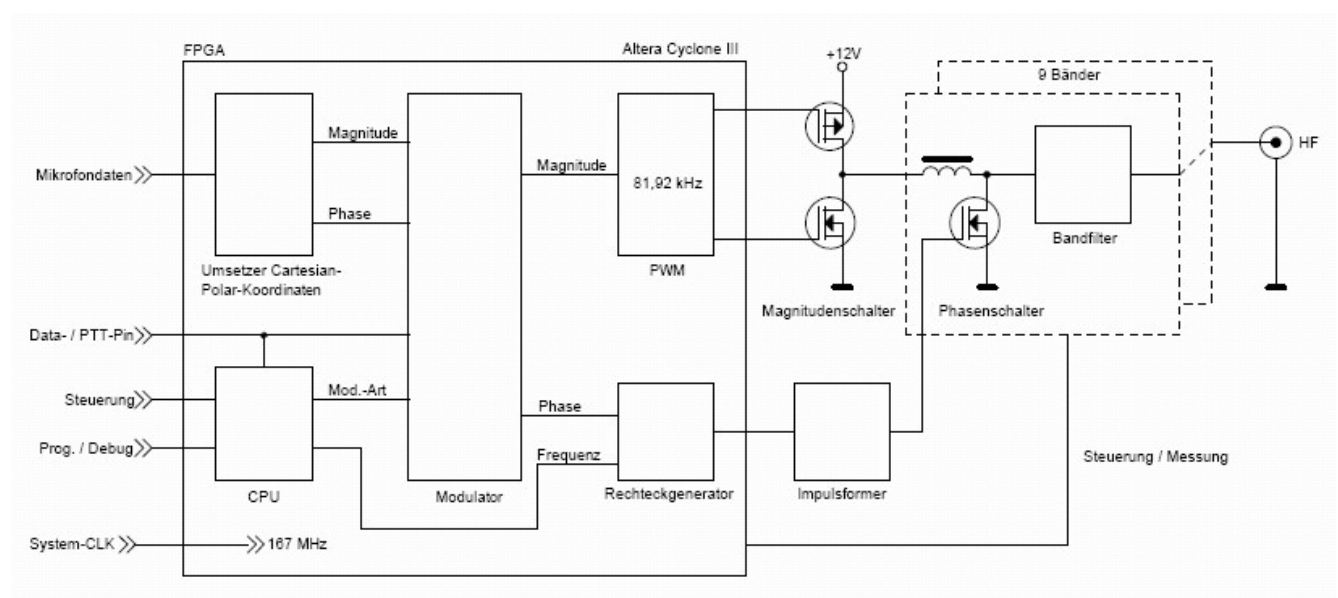
The Pocket can be equipped with a transmitter. It is located on the circuit board in the lower housing shell. It contains a complete transmitter for 11 amateur radio bands from 160 m to 6 m including a power output stage with a maximum output power (PEP) of 5 W.

### 10.1 Overview

Like its receiver, the Pocket's transmitter operates all-digital using partially radical new functional principles. While these provide the receiver with a newly developed time-frequency transformation without FFT for outstanding reception, the principle of digital polar coordinate modulation is used in the transmitter.

Seen just for the power amplifier (PA), this corresponds to the familiar "envelope" method. Here, a Class C or E / F amplifier is operating (not linear) with a modulated power supply, where the current peak corresponds to the envelope of the generated signal. The amplifier must be phase modulated. An output filter suppresses the harmonics of the nonlinear amplifier. The necessary signals for the modulation of the supply voltage and the phase modulation of the amplifier are extracted in other devices from an analog signal (SDR conventional transmitter or transmitter with digital to analog converter).

In the Pocket, the generation and modulation of all signals basically takes place at the level of phase and magnitude information (polar coordinates). Therefore, all the signals required for the power amplifiers are available from the beginning, thus no D / A converter is necessary. The signals have a high accuracy and thus allow good characteristics of modulation and signal quality of the high-frequency transmission signal.



### Block diagram of the polar transmitter

The statement: "no D / A converter" is of course not entirely accurate. Ultimately, however, a sinusoidal, analog transmit signal with the respective modulation is generated. The transformation of the rectangular, digital control signals into the analog transmission signal is done at the polar transmitter but not by a semiconductor device with subsequent amplification. Rather, the powerful high-frequency oscillation occurs directly inside the reactance of the output filter. Here a relatively high reactive power oscillates, controlled by phase and magnitude switches whose filtered-out real part (with some reactive component, depending on the alignment) creates the analog transmission signal.

The magnitude switch for the modulation of the envelope is present only once, while there are separate phase switches and output filters for each band. However, 17 m and 15 m band, and 12 m and 10 m band share one stage with another. The band switching or release of the modulation is done electronically at the sender without the use of a relay. Exception is the transmit / receive switching to disconnect the RX during transmission (silent reed relay).

For the achievable signal quality the properties of the switch and filter components and the accuracy of the control signals are of crucial importance. Here are some examples of the resolution obtained with regard to bit-width and frequency / time resolution:

- Magnitude and phase: 18-bit with kSps 81.92
- PWM Clock: 334 MHz + DDR (=double data rate) -> 13 bit resolution, 1.5 ns accuracy of the control signals of the magnitude switch
- Square wave generator frequency setting: 0.625 Hz resolution, 6 ns time resolution of the flanks
- Pulse shaper: Increasing the time resolution for both flanks to 10 ps accuracy of the control signal for the phase switch.
- Phase switch: ZVS switch (=zero voltage switching) for up to 50 VA reactive power.

The highly accurate and jitter-free adjustment of both flanks of the control pulse of the phase switch is essential for the CW quality of the generated signal. The achieved 10 ps correspond at a 40ns signal period approximately a resolution of 12 bits. The quality of the output signal resembles the one coming from a DDS generators with similar DAC resolution, their spurious and noise spectrum are quite similar. The characteristics of analog components, including the switches and the accurate reproduction of the envelope are critical factors for the resulting intermodulation products in AM, SSB and DSB.

A big advantage of the "polar method" is the high possible efficiency (active elements only in switching mode). In this regard, the Pocket's transmitter is optimized for maximum effectiveness. In normal SSB or CW operation, the device heats up just a little more at 5 W PEP, as when it is receiving. For CW continuous wave or FM, however, maximum power is not permanently possible.

Installing the transmitter will affect the reception performance of the Reuter Pocket. Above the 6 m band (highest achievable transmitter band), the sensitivity continuously decreases up to the maximum frequency of 71 MHz. In the shortwave range, the measurement error of the spectrum / S meter increases to +2 .. -6 dB.

## 10.2 Technical data

Frequency ranges (band number):

160 m band (No. 1): 1.81 ... 2.0 MHz  
80 m band (No. 2): 3.5 ... 3.8 MHz  
60 m band (No. 10): 5.250 ... 5.450 MHz  
40 m band (No. 3): 7.0 ... 7.2 MHz  
30 m band (No. 4): 10.1 ... 10.15 MHz  
20 m band (No. 5): 14.0 ... 14.35 MHz  
17 m band (No. 6): 18.068 ... 18.168 MHz  
15 m band (No. 7): 21.0 ... 21.45 MHz  
12 m band (No. 8): 24.89 ... 24.99 MHz  
10 m band (No. 9): 28.0 ... 29.7 MHz  
6 m band (No. 11): 50.0 ... 52.0 MHz

Output power (at 50 ohm, PEP at full battery):	30 ... 37 dBm +1 -2 dB (6 m: -4 dB)
Efficiency:	> 0.75
VSWR (at 50 ohm real):	<= 2
Upper / secondary wave attenuation to 50 MHz:	>= 45 dB
Upper / secondary wave attenuation from 50 MHz:	>= 60 dB
Intermodulation third and higher order: (fmod 1.0 kHz + 1.5 kHz, @ 7.1 MHz @ 4 W PEP)	>= 35 dB (PEP)
Modulation types:	AM, DSB, SSB, CW, FM-N
Modulation bandwidth:	1.8 ... 9.6 kHz depending on the operating mode
Rise / fall time of RF signal (CW / FM):	0.1 ... 9.9 ms selectable
Switch-on delay PTT / button ◊ HF Out:	2 ... 255 ms selectable
Switch-off delay PTT / button ◊ HF Out:	< 2 ms + release time
Muting delay PTT / button off ◊ RX:	0 ... 630 ms selectable
Shift TX / RX frequency:	0 ... ± 9,999,999 Hz adjustable (1 Hz)
VOX holding time:	OFF, 10 ms, 250 ms, 500 ms ... 2500 ms selectable
Squelch / Anti-VOX:	From -82, ... -34 dB adjustable
ALC:	0 (off) ... 100% action set

### Special features:

- Adjustment option for maximum SFDR (Spurious Free Dynamic Range)
- Adjustment option for minimal IM
- CW keying possible with VOX (setting 10 ms)
- Combined SSB / CW (SBCW) with the possibility of sending CW in SSB sideband
- Adjustable FM deviation
- Two-tone test generator with adjustable frequency and level
- Modulation / power and temperature measurement
- Internal transmit / receive switch
- Protection circuits for overcurrent, overvoltage, overtemperature (> 55 °C)
- Switching output "Open collector" for PTT, RS-232 signal (TTL) for band
- Equalizer and adjustable sidetone for microphone channel
- Automatic adaptation to impedance of the antenna

### 10.3 Operation

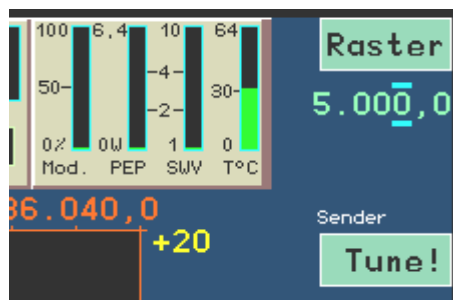
Transmission mode is only available with user interface version 300 or higher. The bar graphs in the upper panel show some parameters for the transmitter:

- "Mod.": Modulation degree in %. This display shows the instantaneous modulation voltage from the microphone input. It is always active, regardless of whether the transmitter is working or not. Thus a permanent control of the microphone setting and its operation is possible. The bar turns from green to red when the modulation level reaches 100% (limit of the signal).
- "PWR": Power in watt. Average power consumption of the Pocket over a period of 0.8 s including effective output power and power dissipation. The bar graph turns yellow when the transmitter starts to emit power.
- "T": Temperature of the transmitter board or motherboard (whichever is higher). When reaching 55 °C the transmitter is shut off.

*Note:* The labeling of the bar graphs may vary depending on the software version. Some of the displays are also used for other parameters (for example, PEP = PWR for the total power consumption display and SWV = BATT for the battery voltage).

The transmitter can be switched on only by PTT, KEY, VOX or TUNE, in case its frequency lies within the specified frequency bands. The PTT, KEY and VOX signals are generated via connected switches or the VOX function. The signal Tune can be generated via the virtual key of the same name if the active setting function of the user interface is the frequency.

**With active frequency setting = function "Tune!".**



Tapping the button will trigger the tuning function. The transmitter will be switched on with 0% modulation and minimum power. It generates a CW carrier at the set frequency.

**Caution!** If the test generator is activated, a carrier with 25% of the transmitter set power will be created in the AM mode immediately. In modes without generating a carrier, a signal will be created with the test frequencies as modulating frequencies.

The active function changes from the frequency to the bar graph of the modulation (inversion of the colors). This indicator is now used to adjust the transmit power or modulation level when the test generator is active. The transmit power can be varied; the modulation display shows the set value from 0% (minimum possible power) to 100% (according to power setting in the Transmitter dialog). As long as the tuning function is active, no other setting can be selected. Only the Transmitter dialog can be opened. Tapping the tune button again (now labeled "Off!") will cancel the tuning function and return to normal operation.

**Caution!** Never switch on the transmitter without a connected and at least reasonably tuned antenna or 50 ohm terminating resistor ("dummy load")!

Operation of the transmitter on loads with very bad SWV (open circuit or short circuit) will cause the transmitter to switch off immediately if the power set is high enough. **When the transmitter is set to full power (+37 dBm, CW, FM or Tune at 100%), operation at unconnected load or a short can cause damage to the transmitter!**

The transmitter of the Pocket has no internal antenna tuner. An antenna with a correspondingly low SWV must thus be connected to get a good RF transmission (radiation). However, the transmitter is tolerant of poor antenna adjustment. It has a limited variable internal resistance for this case. This flexibility results

from the transmitter's fundamentally different operating principle to linear (analog) power amplifiers. In a range of SWV from 1 (ideal match) to about 2.5, the transmitter changes its output impedance so that most of the power goes to the antenna.

However, this automatic impedance matching is very frequency (band) dependent and is also affected by the reactances of a non-ideal (to real 50 ohm) configured antenna. In general, however, it usually does not require the use of an external antenna tuner. Especially not when highly effective and well tuned antennas are used, which should always be the case with such low power.

Impedance readjustment operates closely in conjunction with the internal protection circuits. As long as the permissible values for output voltage (approx. 18 Vrms) and internal transmitter current from the battery (1.5 A) are not exceeded, almost any antenna can be connected.

In case of very bad SWV, the power in the Transmitter dialog may not be adjusted beyond 30 dBm. At this level, the transmitter will not turn off even when open or short-circuiting (you should still avoid these extremes!). This allows e.g. even an RF emission only with a telescopic antenna, a short wire or a passive loop without adaptation. However, due to the low efficiency of such designs, only little RF power is actually radiated. Nevertheless, this can still be used for communication over short distances ("SW phone" with telescopic antenna).

Via the callable dialogues (see section 6. "Dialogs") the configuration of the transmitter and the microphone input are possible within wide limits. Both dialogs are integrated with the spectrum display and the transmitter display panel, making precise control of settings possible.

The transmitter has an additional stereo jack in the lower case (below SMA connector for GPS) for controlling external power amplifiers. The occupancy is as follows:

- Tip: TTL / 3.3V CMOS signal with RS-232 protocol 8N1 9600 baud. Each band switch outputs a byte with the band number (see technical data). If tuning outside of a band, "0" is output.
- Sleeve: PTT-Out signal low-active (open collector).

**Caution!** Only "thin" jacks with a maximum of 6.3 mm diameter directly on the connector shank fit into the socket!

For devices with serial numbers from 067, the socket is omitted. However, the signals can be output from the configurable connectors of the microphone and morse key jacks (see page 36). The PTT signal is then inverted and not an open collector!

# 11. Exciter

The Pocket can be equipped with a customizable signal generator ("Exciter"). It is located on the FM / DAB receiver's board in the lower case.

## 11.1 Overview

The Exciter consists of a digital sine generator according to the DDS (Direct Digital Synthesis) principle, a quadrature modulator and a DAC for converting the digital values into an analogue output voltage. It can generate all modulation schemes (except DAB) that can be received by the Pocket in broadband and high quality. The modulation can occur by an internal test generator or by the microphone signal. Keying with a manual button is also possible (CW operation).

In conjunction with an external power amplifier, the exciter can be used as a transmitter. However, it does not have control signals for controlling a PA (PTT, band switching). These must be generated externally (from PTT switch / button, manual band switching or by measuring the frequency within the PA).

*Note:* From serial number 060, control signals can be output at the microphone and / or the morse key socket.

## 11.2 Technical data

Frequency range:	100 kHz – 151 MHz
Power output (into 50 ohm, PEP):	-3 ... +4 dBm, +1 ... -2 dB, 0.1 – 71 MHz -1 ... -4 dB 87.5 – 151 MHz
VSWR (into 50 ohm real):	<= 1.5
Harmonics attenuation to 50 MHz:	>= 50 dB
Harmonics attenuation from 50 MHz:	>= 60 dB
Intermodulation suppression third and higher order: (fmod 1.0 kHz + 1.5 kHz, @ 7.1 MHz @ 5 W PEP)	>= 60 dB (PEP)
Modulation types:	AM, DSB, SSB, CW, FM-N, FM-W
Modulation bandwidth:	1.8 ... 9.6 kHz depending on the operating mode
Rise / fall time of RF signal (CW / FM):	0.1 ... 9.9 ms selectable
Switch-on delay PTT / button -> HF Out:	2 ... 255 ms selectable
Switch-off delay PTT / button -> HF Out:	< 1 ms + release time
Muting delay PTT / button off -> RX:	0 ... 630 ms selectable
Shift TX / RX frequency:	0 ... ± 19,999,999 Hz adjustable (1 Hz)
VOX holding time:	OFF, 10 ms, 250 ms, 500 ms ... 2500 ms selectable
Squelch / Anti-VOX:	From -82, ... -34 dB adjustable
ALC:	0 (off) ... 100% action set
Limiter / compressor:	100% (off), 50%, 25% modulation

### Special features:

- CW keying possible with VOX (setting 10 ms)
- Combined SSB / CW (SBCW) with the possibility of sending CW in SSB sideband
- Adjustable FM deviation
- Two-tone test generator with adjustable frequency and level
- Internal transmit / receive switch
- Equalizer and adjustable sidetone for microphone channel
- Dynamic compressor / distortion-free limiter

### 11.3 Operation

Transmission mode is only available with user interface version 400 or higher.

The operation of the Exciter is analogous to that of the transmitter (see section 10 "Transmitter"). Some functions of the Transmitter dialog are not available or changed as follows.

- I- "**Offset SSB Level, SSB Phase, SFDR:**" not available (internally optimized)
- "**Limiter Mod. %:**" Configuration of distortion-free audio limiter

This set value can be changed to 25%, 50% or 100%. The value indicates at which level of the microphone voltage (left bar in the upper panel) the modulation is limited. At the same time, the full output power is generated from the beginning of the limitation. Effectively, at 25% this means an additional amplification of the modulation voltage by a factor of 4 (12 dB), at 50% by a factor of 2 (6 dB). These are the values by which the dynamic range of the modulation is compressed.

The limiter threshold and thus the point of full modulation is displayed in yellow in the modulation bar.

The use of the limiter / dynamic compressor allows a higher efficiency of the modulator and thus a higher average output power in SSB operation. At the same time, distortions and overmodulations ("splatter") are effectively avoided. The limiter operates distortion-free between limiter threshold (yellow modulation bar) and overmodulation of the microphone input (red bar). In conjunction with the ALC of the microphone amplifier in low levels (only to prevent overmodulation) an optimal modulation can thus be achieved.

## 12. Tips and tricks

Below are some hints and more in-depth descriptions for using the Pocket.

### 12.1 Device connectors

In addition to the RF sockets (all SMA) and the charging socket (Lemo 00 1-pin), the Pocket has 3 stereo jacks for audio signals. Due to the thick-walled housing (inserted rubber seal), the sockets are slightly recessed in the device. This complicates the insertion of jack plugs with a diameter greater than 6.3 mm.

High-quality accessories (such as headphones or microphones) often have connectors with a much thicker case. If the plug shank with the contact area is sufficiently long, or the transition to the handle has a collar not thicker than 6.3 mm, such plugs can still give secure contact. However, this is usually not guaranteed. The plug can then not be inserted far enough into the sockets and has no proper contact or falls out easily.

You should use a short adapter cable with "thin" plug and free jack in this case. Such adapters are available in any well-stocked audio / video market, unfortunately often at random and by changing manufacturers. The picture below shows an example.

At the same time, this adapter has the advantage of acting as a "Y-cable" and thus offering parallel access from 2 plugs to a socket. This can e.g. be necessary if a PTT signal is to be connected to several devices, or the signal from the PTT button / morse key is to be forwarded directly to the PA. In addition, the angled plug allows a space-saving connection. Thus, the Pocket can e.g. remain in the protective bag and the audio cables can still be led out.



**Example of an adapter cable for connecting the jack sockets**

### 12.2 CW operation

In CW operation, the Pocket offers a number of setting options. The different variants and associated functions of the Pocket will be explained in more detail below.

#### Basic information

For receiving (and for devices with transmitter or exciter also transmitting) Morse code, hereafter simply called "CW operation", the Pocket offers three independent demodulators:

- "CW": Spectrum-based directly at the set frequency with adjustable pitch (CW shift).
- "SBCW": Spectrum-based as adjustable tone in the sideband (LSB below 10 MHz, USB from 10 MHz).
- "DIGI": Time-based with adjustable pitch at the set frequency.

Each of the demodulators has its own characteristics. They will be explained in more detail below. Fundamentally, the properties of the respective signal processing also apply:

- Spectrum-based: Fine tuning of bandwidth and its shift, extremely high selectivity, auxiliary tools such as notch filters, noise reduction, noise blanker and mute / squelch available, higher signal throughput time, low signal distortion possible.
- Time-based: Few levels for bandwidth available, moderate selectivity, sometimes coarser frequency settings, no helper tools, low signal turnaround time, very low signal distortion.

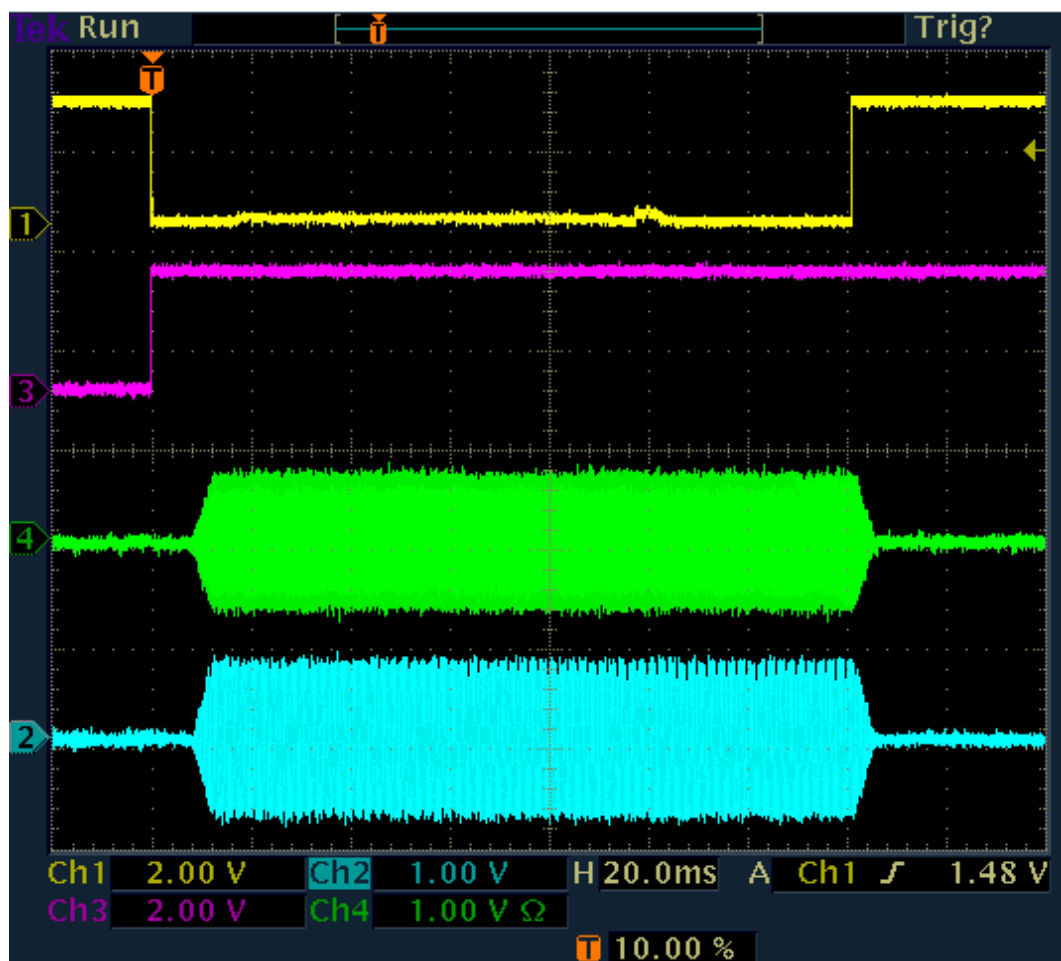
Just these properties can decide the choice of demodulator, for example, if a very low signal propagation time is required (DIGI) or an extreme selection against adjacent channel interference (CW / SBCW).

CW operation at the Pocket is always carried out with a single-pole morse key. It must be connected to a freely configurable connector of one of the sockets KEY or MIKE to ground of the socket. See also "Transmitter" dialog. An internal keyer does not exist. The selected connector must be assigned the signal "KEY In" in the TX dialog. If an external PA is connected, a connector should also be assigned the signal "PTT Out" and connected to the PTT input of the PA (**Attention!** A level converter is usually necessary!). Thus, the internal timing controller can be used as described below.

#### Time behaviour of the signal generation

The generation of clean signals with well defined and not (noticeably) fluctuating delay times is essential for efficient CW operation. The picture below shows the basic procedure when generating a single CW pulse. The assignment of the signals to the oscillograms applies from top to bottom as follows:

- PTT In (yellow): The signal at the input, generated by the contact of the morse key (l-active).
- PTT Out (red): The PTT output signal for controlling the PA (h-active).
- RF Out (green): The high frequency signal generated at the antenna output.
- Audio Out (blue): The audio output to headphones and speakers.



**A CW pulse**

The generation of a CW pulse (dot or dash) starts when the key is pressed (yellow line goes from high to low). At the same time, the PTT signal is activated for an external PA (red line from l to h). At the same time, the receiver (RX) of the Pocket will also be muted.

The generation of the RF pulse (green) starts after the time "Delay RF ms" has elapsed (TX dialog, set to 10 ms in the picture). At the same time, an audio signal is generated (sidetone, blue) if the sidetone is activated in the Microphone dialog. Both signals are increased from 0 to the defined levels in a linear "ramp" (rising edge) (setting in TX dialog, value "Risetime RF ms", here set to 4 ms). The signals are generated as long as the key is pressed.

After releasing the key and a short debouncing time (about 0.5 ms), the signal generation ends. The levels are again reduced to 0 in a linear ramp.

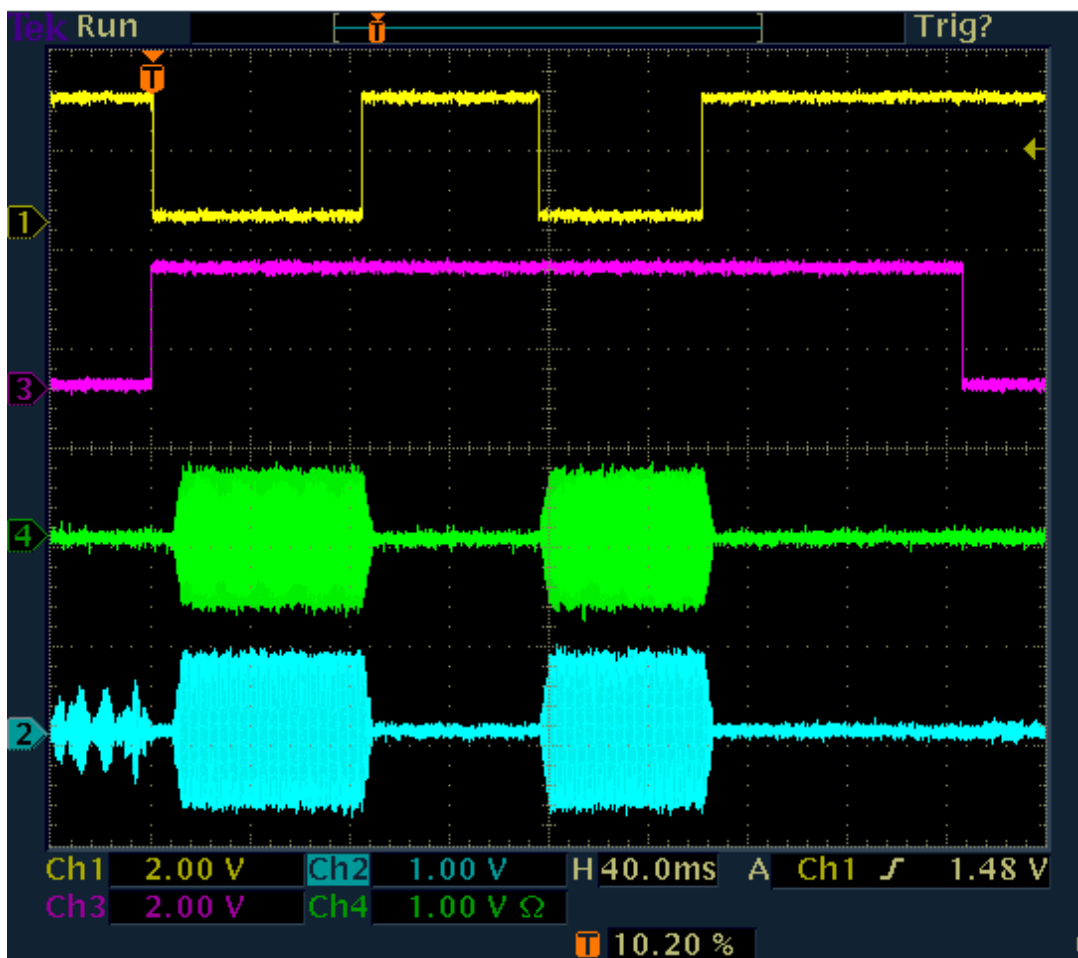
The PTT Out signal remains active for a while, at least until the end of the signal edge (key on h + debouncing time + signal edge duration).

It is still active in the example (end not visible). The additional time corresponds to the setting "RX Delay ms" in the TX dialog. For this time span, the receiver is also kept muted. The meaning behind this is the suppression of audible remnants of the own transmission signal due to the signal propagation times and the transient effects of spectrum and control.

When PTT Out goes low again (inactive), the PA is turned off and the RX is re-engaged. If the RX Delay time is set long enough, the RX will not receive any signal and the AGC will return to the level at the time of muting (or possibly higher, if higher reception levels occurred in the meantime). This means that the RX has full sensitivity immediately after switching off the PA (or switching the antenna relay).

#### CW character sequence with RX Delay ("semi-BK")

Usually, not just a single dot or dash is sent, but a more or less continuous sequence (complete letters and words).



**Sequence of CW pulses without "intermittent listening" (RX Delay > character pitch)**

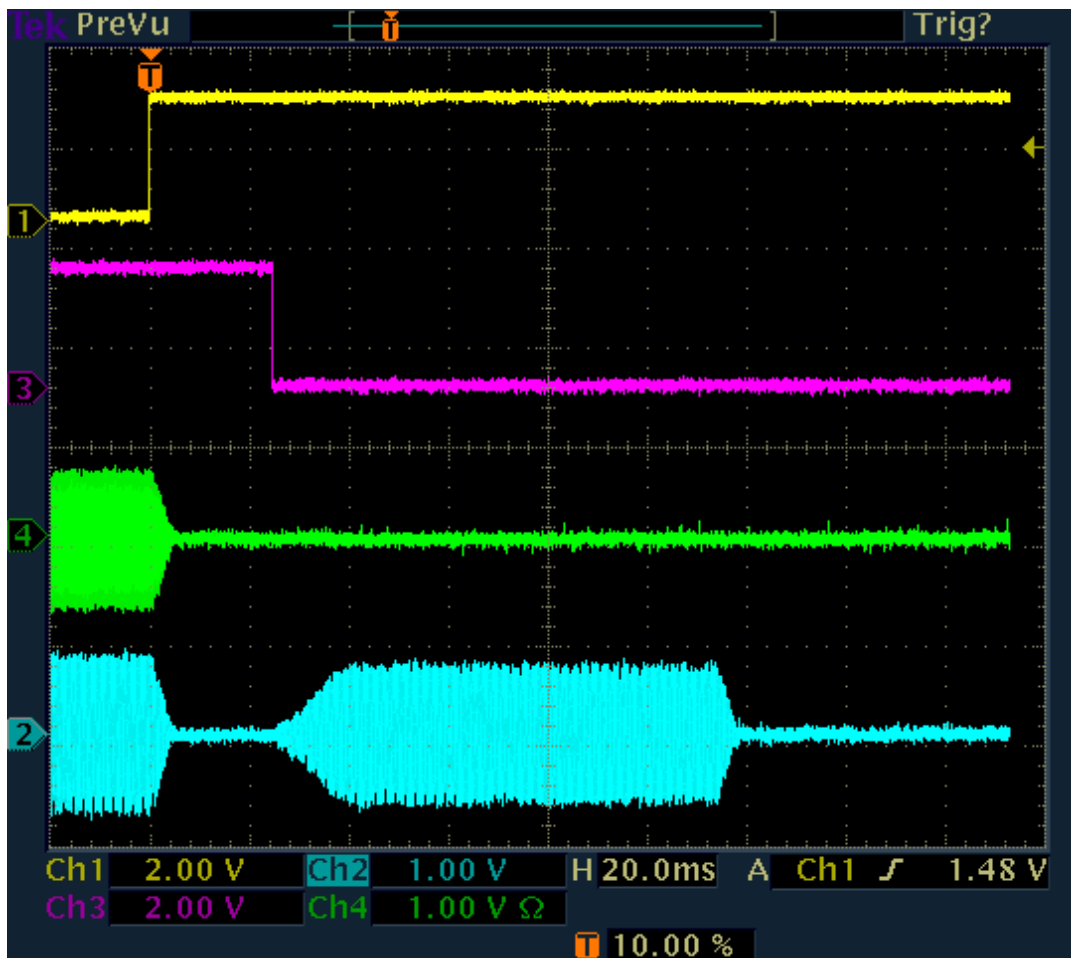
Whereas: As long as PTT Out is active, the signal is generated immediately with KEY In. There is no time lag "Delay RF" between key and signal generation. Thus, the RF pulses (and the sidetone when active) follow exactly the keystrokes.

Only when PTT Out has dropped and then / again a keystroke occurs, the RF delay is again "included". It follows: **Compared to the keystroke, the first impulse is always shortened by the time "Delay RF"!** **All the following impulses are exactly correct.** If the first impulse is also to be largely accurate, the Delay RF must be set very small (at least 0.1 ms are possible).

**Caution!** The delay time between PTT Out and the onset of high frequency generation protects the PA (antenna relay). It must not be too short (please note the PA's specifications)!

Throughout the complete character sequence, the PA stays on and the RX mutes as long as no pause is greater than the RX Delay time.

If the RX Delay time is set very low, the PA shuts off between the characters and the RX is engaged. Depending on the other settings, a more or less long reception of your own transmission takes place. The onset of reception and the duration of self-reception are mainly dependent on the cycle time of the selected demodulator including the filter.



### Self reception of the transmission with a short RX Delay

In the example, RX Delay is set to 20 ms. 20 ms after the end of the pulse edge PTT Out drops and the RX becomes active again. It reproduces the self-received transmission signal stored in the signal path. Playback ends after the signal propagation time of self-receipt through the entire receiver block.

In the example, the propagation time is about 115 ms (end of RF transmission until the end of playback of the RX). This is a typical value for the spectrum-based demodulators when setting the audio resolution (Setup dialog) to 20 Hz. At 40 Hz, the time is reduced, at 10 Hz it is longer.

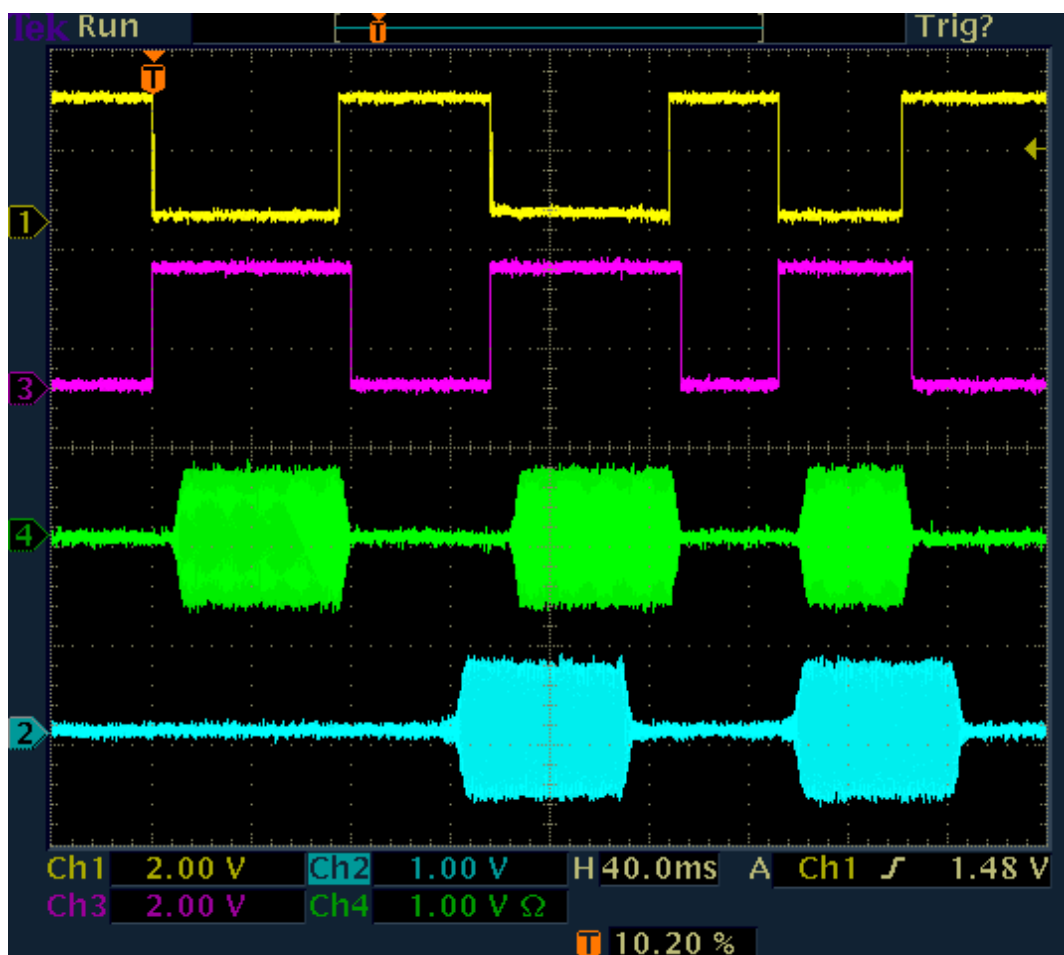
The self reception possibly conceals received signals. Particularly disturbing is that it also sets the AGC on the value of the self-reception level. This is usually higher (corresponding to the blocking attenuation of the

TX / RX switching) than weak received signals. Depending on the AGC setting (speed), the receiver therefore takes a while to again possess full sensitivity for weak received signals.

You should always set the RX Delay to at least as long as the self reception passes through the RX block, so in the case shown to 120 ms. Then no own signal (disturbing) is audible or drives the RX to low sensitivity by modulation of the AGC.

#### CW character sequence without RX Delay ("full-BK")

In the extreme case RX Delay = 0 the Pocket never mutes the receiver. It remains active during the entire duration of the transmission (PTT Out high). Thus, a self reception of the transmission is always present. It also does not start until after the end of the broadcast. Instead, the RX always returns a complete picture of what happened at the antenna connector (own signal attenuated). The signal propagation time of the RX is of course retained and thus determines the meaningfulness of this operating state.

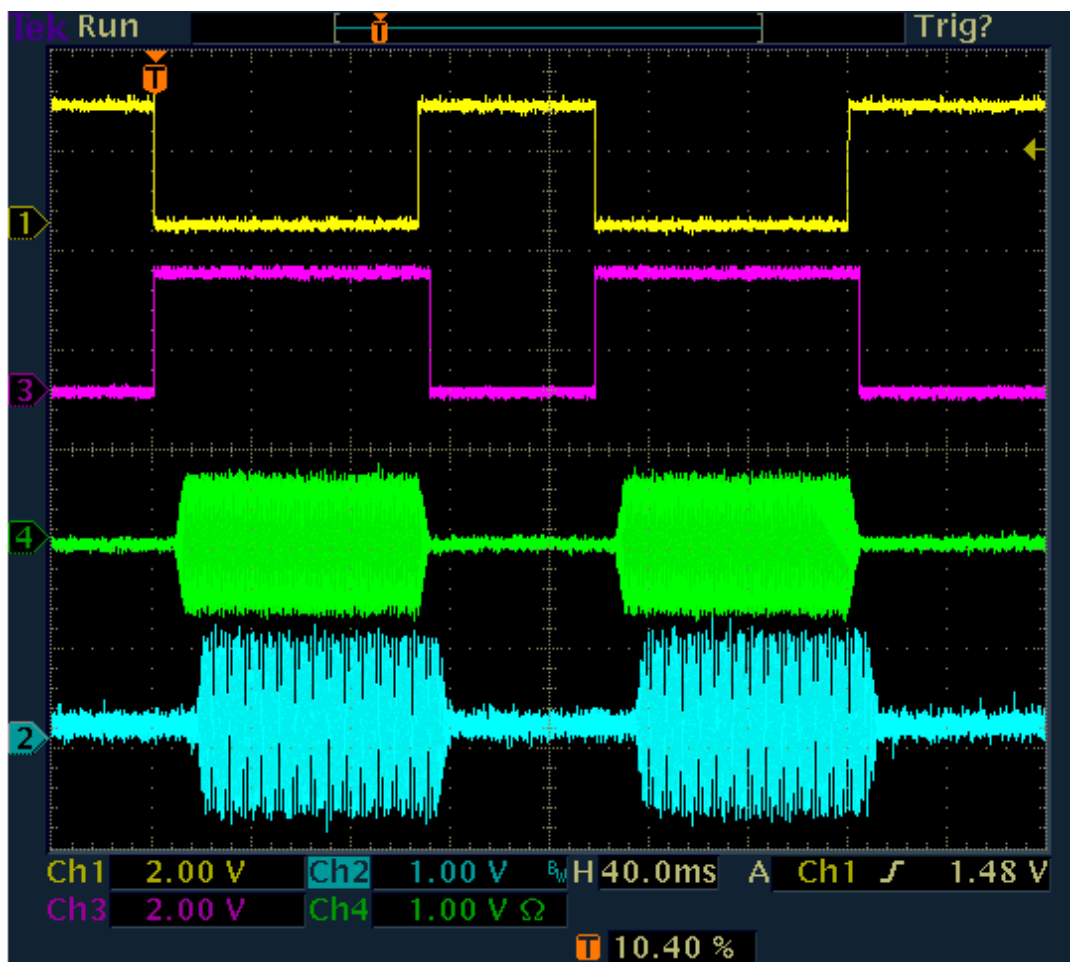


#### **Full-BK for spectrum-based demodulators**

Because the RX is always active, no sidetone (if set) is generated. So you only hear the (delayed) own transmission and the received signals, if strong enough (AGC always adjusts to the level of self reception). In the picture above, the RX cycle time is in turn approx. 115 ms.

**Caution!** At full-BK, all characters are always shortened by the time "Delay RF".

The picture below shows a full-BK operation with time-based demodulator (DIGI). Here the signal propagation times are much shorter. They depend on the filter bandwidth. It is 500 Hz in the example, resulting in a propagation time of approx. 7.5 ms. When increasing or decreasing the bandwidth, it decreases or increases approximately reciprocally (at 250 Hz for about 15 ms, etc.).



### Full-BK for time-based demodulators

In the case of full-BK with DIGI, setting the AGC to the self reception level may be annoying. If the other received signals are much weaker, they are barely audible. You should choose semi-BK with low RX Delay (and sidetone) in this case. The RX is then indeed disabled during the transmission and shortly thereafter, but immediately after a (short) RX Delay fully sensitive again.

*Note:* Using a TX shift ("Split Operation") to set the transmission frequency outside the receiving bandwidth protects the receiver from becoming insensitive and from covering weak signals by self-receiving.

### Comparison of the demodulators

CW:

- Functionality according to the pictures for operation with spectrum-based demodulator.
- Pitch on reception and sidetone on transmission directly result from the set value "CW Pitch".
- Transmission frequency is always the reception frequency (usually in the center of the display)  $\pm$  TX Shift (TX dialog).
- Processing time depends on audio resolution (Setup dialog).
- Extremely narrow and steep-edged bandwidths down to 10 Hz can be realized.
- DNR, NB and notch filter available.
- "Absolutely noise-free" reception possible by setting the demodulator threshold between noise and signal.

SBCW:

- Functionality according to the pictures for operation with spectrum-based demodulator.
- Pitch on reception results from shifting the received signal towards the center of the display ("SSB mode").
- Sidetone during transmission results from the "Freq L" setting in the System dialog.
- Transmission frequency is always the reception frequency (usually in the center of the display)  $\pm$  Freq L (thus in the upper or lower SSB-sideband)  $\pm$  TX Shift.
- A two-tone signal can be sent (Freq L and Freq R > 0).
- Processing time depends on audio resolution (Setup dialog).

- Bandwidths according to the set SSB bandwidth.
- DNR, NB and notch filter available.
- "Absolutely noise-free" reception possible by setting the demodulator threshold between noise and signal (if no SSB signal is present).

#### DIGI:

- Functionality according to the pictures for operation with time-based demodulator.
- Pitch on reception directly results from the set value "CW Pitch".
- Sidetone during transmission results from the "Freq L" setting in the System dialog.
- Transmission frequency is the reception frequency (usually in the center of the display)  $\pm \text{Freq L} \pm \text{CW Pitch} \pm \text{TX Shift}$ .
- A two-tone signal can be sent (Freq L **and** Freq R > 0).
- Processing time depends on bandwidth.

The frequency of the transmitted signal with DIGI depends, among other things, on both the CW Pitch and the selected audio test frequency (similar to SBCW). To transmit exactly at the reception frequency, CW Pitch and Freq L must be exactly the same. CW Pitch (change of the receive pitch) or Freq L (change of the sidetone pitch) can be used as "XIT" for exact pitch tuning to the frequency of the QSO partner.

#### Sidetone

While transmitting, the Pocket allows the playback of a sidetone through the audio outputs next to operating the RX (full-BK only with RX Delay = 0). The sidetone is set in the Microphone dialog (value "Monitoring" = volume setting). When the dialog is opened and when transmitting in a mode other than CW (or SBCW or DIGI with activation of the "KEY In" input), the microphone signal is always audible.

The CW sidetone is heard only when the morse key is pressed (regardless of the status of the transmitter). To do this, the value "Monitoring" in the Microphone dialog must not be set to 0 **and** the RX Delay in the TX dialog must be greater than 0 (otherwise the RX is always receiving during transmission).

The sidetone is generated in the Pocket by bypassing (almost) all signal processing units. It has no noticeable delay to the direct transmission signal. But it also suffers from the shortening of the first CW pulse by the RF Delay when switching on the transmitter! The edge shaping corresponds to that of the RF transmission signal. In doing so, it produces an exact (temporal) replica of what the receiver of his own broadcast hears.

The frequency of the sidetone depends on different settings. It largely corresponds to the frequency that a receiver of the broadcast hears with the same setting of his RX (i.e. exactly the same frequency setting / CW Pitch, etc.) or the frequency that is heard even during reception. The setting is also customizable to your own habits or frequency inaccuracies.

## 13. Further developments

### 13.1 Hardware

During the course of manufacturing, small improvements of the circuit are made. This results in different layout versions of the built-in printed circuit board(s). These are usually recognized and taken into account by the firmware based on the permanently assigned serial number. For certain changes, however, a fundamental further development of the software may be necessary. The software's designation then contains the hardware's version number for which it is **exclusively** intended.

**Caution!** Software for a specific hardware must never be uploaded into a device with different hardware!

The following explanation shows the development of the hardware and the corresponding description of the programmed software. When updating the software, the version matching the device (serial number) must be uploaded!

*Note:* The here mentioned hardware version is an internal version of the production status. It has nothing to do with the device variant. It declares the equipment of the devices with different features, e.g. with transmitter (C3) or with FM + exciter (C4). The equipment variant is indicated as a digit directly behind the "V" of the software designation (see also section 13.2 "Software").

Hardware version	Serial number from	to	Software from	version
RDR Pocket <b>D</b> Version with max. 4 GBit NOR Flash.	0	59	RDR51 <b>D</b>	Vxx6
RDR Pocket <b>E</b> Version with max. 8 GBit NAND Flash.	60	190	RDR51 <b>E</b>	Vxx8
RDR Pocket <b>E</b> Version with additional input circuit for VHF devices.	191	199	RDR51 <b>E</b>	Vxx9
RDR Pocket <b>E</b> Version with supply and control option for active antennas, improved Li-Ion charger.	200	...	RDR51 <b>E</b>	Vx10

### 13.2 Software

The software (also called firmware, which also includes the LAN driver) of the Pocket determines the device function. Further developments of the software thereby serve the purpose of improving existing and introducing new functionalities. A change of the software can also be made to support changed hardware (see section 13.1 "Hardware").

The designation of the Pocket's software basically consists of the designation of the hardware for which it is intended and the version of the software development.

RDR51aVxyz:

- RDR51 = Manufacturer's designation of the "Reuter Digital Receiver Pocket" or "Pocket" for short.
- a = Version of the installed hardware (printed circuit boards) as described in section 13.1.
- V = "Version".
- x = Equipment variant of the device: 2 to 4 (2 also applies to Pocket variant 1).
- y = First digit of the software version number.
- z = Second digit of the software version number.

Software for the Pocket is always supplied as an encrypted configuration file for the built-in FPGA circuit (file extension RPD). It contains all necessary components of the FPGA units to be generated ("IP" or "soft core") as well as the operating system and the application program of the integrated microcontroller and the graphics controller. Furthermore, any activation codes for special functions.

The software file (\*.RPD) must be uploaded into the device as "Pocket Software" as described in section 7.3 "Software Update".

The "LAN driver" part of the firmware contains the driver (basic, hardware-related control program) for the built-in network processor. This allows the wireless connection of the Pocket to WiFi networks and the handling of data transmission. Due to the independence of this processor, the FPGA can be updated with new software at any time. Furthermore, a Bluetooth connection with wireless loudspeakers or headsets is possible via the network processor (from software Vx09 / driver V03).

The driver software is included in a binary executable directly from the processor (\*.BIN). The designation is carried out continuously according to the scheme:

RDRWLANVxx

xx = from 01 continuous version number.

Driver software must be uploaded into the device independently of the Pocket software, as described in section 7.3 "Software Update" as "LAN driver".

**Caution!** If a new LAN driver is available, it always has to be uploaded **before** uploading a possible new Pocket software!

### 13.3 New versions

The description of the Reuter Pocket's functionality so far corresponds to the software version up to RDR51Vx08. Below are the changes and enhancements according to the further development of hard- and software.

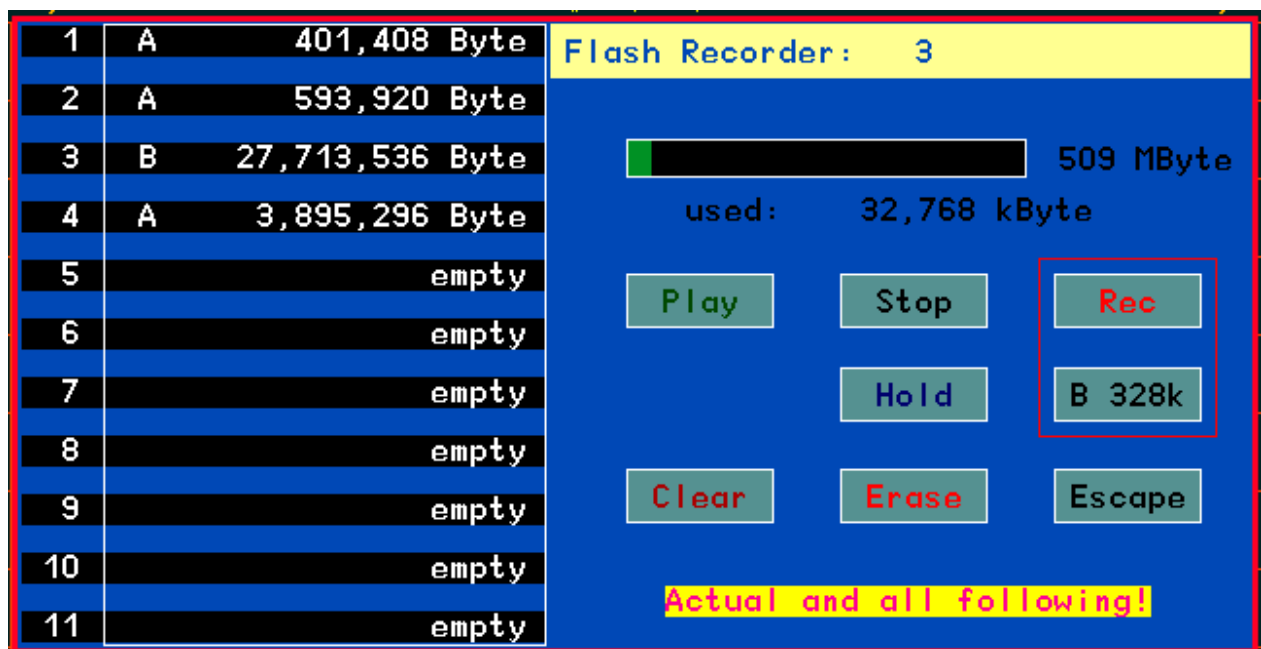
#### RDRWLANV02 / RDR51VxE8

Version 2E8 (Pocket B1, B2, C2) or 4E8 (Pocket C4) serve as an "interim version" between Vx08 and Vx09. They contain some new features for the Pocket. Including a new LAN driver V02. Bluetooth drivers from the network processor's manufacturer are still missing. These are only available by use of RDRWLANV03. The following functions of the Pocket are changed or realized by software version VxE8:

- Frequency extension of the FM band to 87.0 MHz - 110 MHz (FM broadcast band) and 130 MHz - 156 MHz (2 m band). The ranges can be fully used from Pocket serial number 122 (extended hardware). These devices now also have a switchable attenuator of 20 dB for DAB! For devices with earlier serial numbers, increased attenuation outside the passband is part of the factory default hard- and software. Nevertheless, the extended ranges are well operable, since the noise is increasingly attenuated. However, the displays of spectrum and S-Meter are outside the allowable tolerance!
- Extension of the adjustment range of the TX Shift (only C4) from  $\pm 9,999,999$  Hz to  $\pm 19,999,999$  Hz.
- Additional button "Discover DAB" within the memory dialog (only for devices with option "FM"). Tapping this button starts a full DAB search without having to turn the Pocket off and on again.
- Order of memory slots by frequency. As soon as the memory dialog is called up by tapping on the frequency setting, the memory slots are sorted in ascending frequency order. In case the dialog is opened via the menu, the previous order remains according to slot numbers.
- Partial call of memory slots. The memory entries in the memory dialog are separated by a yellow line in between the demodulator type and the frequency. If a slot is called up by tapping on the frequency window (larger box), then the complete device setting is set to the same values of the memory as before. If, on the other hand, the demodulator name is tapped (smaller box), only the frequency, the demodulator and the bandwidth (possibly with dependent parameters such as shift) are set according to the memory. All other parameters such as volume or display brightness... are kept.
- Fast switching of the spectrum display. After tapping on the active setting of the diagram's level

location (yellow set value on the top right of the spectrogram or directly above the color table of the waterfall), the diagram is continuously switched between the curve spectrum, line spectrum and waterfall.

- Auto notch. The notch filter in (spectrum-based modes only) can be switched to full automatic mode (and back to semi-automatic mode) by tapping on the active notch position indicator. The message "Aut" followed by a set value appears. It can be changed by the scroll wheel and determines the holding time (in tenths of a second) of the filter on a given blanking signal. This changes the "agility" of the filter when searching for interfering signals. Low holding time = high agility causes a quick detection of disturbing carriers, but also a quick misinterpretation, say from AM modulation signals as interferers. Long hold time = low agility reduces the misinterpretations, but increases the time it takes to locate any interferers.
- Baseband recording (I / Q). In addition to audio signals, the Flash recorder can now also record baseband signals in I / Q format (complex signal) with 3 different sampling rates. For this feature, a button for switching the sampling rates (sample rate in kSamples/sec) is available in the Recorder dialog below the Rec button. When engaged, the button continuously switches through 4 options:
  - A 41k: Audio with 40.96 kSps
  - B 82k: Baseband with 81.92 kSps
  - B 164k: Baseband with 163.84 kSps
  - B 328k: Baseband with 327.68 kSps



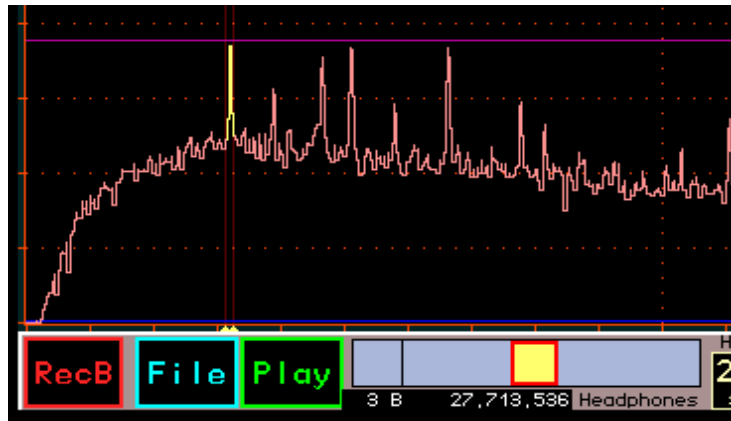
There are some fundamental differences between audio recording or playback and baseband recording / playback. The type of recording is represented by "A" (audio) or "B" (baseband) in front of the file size.

- Audio files are always created directly from the data stream to the loudspeaker / headphones and are also routed directly there during playback. When recording, any change to the unit's setting (except volume) is recorded. On the other hand, changing the device setting (except volume) has no effect during playback.
- Baseband recordings are made directly from the ADC data after conversion to baseband (down-conversion). Most device settings do not affect this data, just the tuning and switching before the ADC (filter, attenuator ...). However, the choice of demodulator also has a great influence. For most demodulators, the reception data is **NOT** centered in the baseband! That is, the center of the baseband (frequency 0 Hz) does not correspond to the reception frequency. The baseband is more or less (depending on demodulator and filter bandwidth) unbalanced to 0 Hz. Only the FM-W demodulator works exactly symmetrical. When using the recordings for other purposes (transfer to PC) later, FM-W should always be set during recording.
- When playing back the I / Q data in the Pocket, the same demodulator must be selected as when recording, otherwise the received signal will not be in the filter range of the demodulator. With time-based demodulators, the bandwidth selection also has an influence on the position of the baseband.

- The baseband is filtered before recording to prevent aliasing. Due to the limited steepness of the filters, the following alias-free bandwidths are achieved depending on the sample rate:
  - B 82k: 60 kHz
  - B 164k: 140 kHz
  - B 328k: 300 kHz

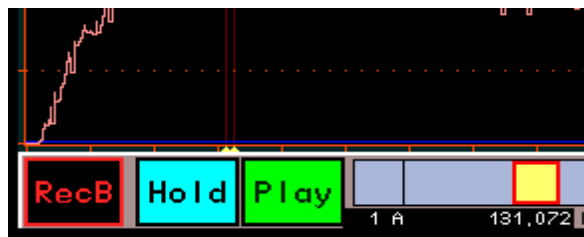
The filters of the FM-W demodulator are used for filtering. These are therefore adjusted accordingly.

- Control of the recorder by buttons in the main display. The flash recorder can now also be started directly in the main screen. Opening the Recorder dialog is not required. In the lower panel of the user interface there are 3 buttons for control:



- **RecA(B)**: Start / end of recording. "A" or "B" indicate the type of recording (audio or baseband).
- **File**: Tap this button to place the current input position on it (just like any change to the active input position). You can then change the current file with the scroll wheel. It is displayed in a similar way to the entries in the Recorder menu as a small line below the headphone volume control. "File" can be disabled by tapping any other input position (e.g. frequency or volume), by the auto return function to frequency, or by tapping Rec or Play.
- **Play**: Start / end of playback of the displayed file.

While recording or playback is in progress, the File button changes its function. It is now called "Hold" and serves to pause recording or playback. As long as the function pauses, Hold is displayed as activated (as well as the current function). Tapping Hold continues the function, tapping the current function button ends the function.



When the recorder's functions are initiated directly in the user interface (without opening the Recorder dialog), various operations of the Pocket remain possible, others are locked. For example, no dialog can be opened. Note that changing the settings will affect the recorded or played back data differently depending on the type of recording (audio or baseband).

The versions 209 (Pocket B1, B2, C2), 309 (Pocket B3, C3) or 409 (Pocket C4) in conjunction with the network driver RDRWLANV03, enable audio output to Bluetooth devices. In addition, some smaller enhancements were implemented. The software update is performed as described in Section 7.3 "Software Update" (Page 45).

**Attention!** The WLAN driver must always be updated before updating the actual software! The new software as of version Vx09 is not compatible to the old WLAN driver. If it is updated without having previously updated the WLAN driver, the WLAN (or Bluetooth) functionality may no longer work properly! Newer software can then only be updated at the manufacturer (fee required).

The most important innovation in Vx09 is the connection to Bluetooth audio devices and the output of the headphone signal on such devices (speakers, headphones). The playback of audio sources (like smartphones or microphones) with the Pocket is not yet possible in Vx09. The Bluetooth function is activated by an extension of the "WiFi" dialog (now "WiFi / BT").

WiFi/BT-Configuration		Bluetooth Device	
MAC:	D8:A0:1D:40:7B:D9		
Mode:	Access Point	Channel:	13
SSID:	Pocket_001	Antenna:	internal
Passkey:	1234567890	Driver Update	OFF
			no device
			no device
			no device

### WiFi/BT dialog as of software Vx09

The Bluetooth controller is activated by selecting the set value "Mode" and turning the scroll wheel to the left from the "Off" state (instead of to the right to activate the WiFi access point). If WiFi is active, it must first be turned off. Parallel operation of WiFi and Bluetooth is not possible. After switching off an active mode there is a 2 second delay until a new mode can be selected.

If Bluetooth (subsequently called as "BT") has been activated, the Pocket first searches for BT-capable audio devices ("Wait ..." appears briefly during the controller's initialization). The devices to be connected must therefore be switched on at the latest now, preferably before the BT activation of the Pocket. The search phase is indicated by the message "DiscoverBT .." in the Mode setting.

Detected devices are displayed on the right side of the dialog. The name of the device is displayed together with the reception level of the BT connection. The lower the values ("more" negative), the weaker the connection. Values down to approx. -75 dBm are sufficient for a stable connection. If the values are lower, or if a device is not found, it must be positioned closer to the Pocket, or the Pocket's antenna setting must be adjusted.

The Pocket's utilized antenna (along with the capabilities of the BT device) decides about the possibility of a stable audio connection. In addition to the displayed reception level, experimenting with the antenna orientation and the positioning of the BT device to the Pocket may be required. The following general circumstances should be kept in mind:

- **Internal Pocket antenna:** Operating ranges of a few meters, with insensitive / low-performance BT devices ranges of even less than one meter are possible. Ideally used with (fixed) speakers directly next to the Pocket.
- **External Pocket antenna** (supplied antenna connected): The operating range to standard BT devices amounts to a few meters to over 10 meters. For sensitive / high-performance devices, connection through a wall to the next room (depending on the character of the wall) might also be possible. Used for remote speakers or headphones when the user moves away from the Pocket.

**Attention!** Using the external antenna while devices are very closely positioned to the Pocket may lead to RF overmodulation (poor connection despite high levels)! Switching to the internal antenna or positioning the BT device further away from the Pocket should be considered.

Like Wi-Fi, Bluetooth is a broadband radio connection, of which the frequency (2.4 GHz band) is often used by several devices at the same time (like wireless routers, wireless headphones, wireless mouse / keyboards, microwave ovens, ...). If too many devices are operating at the same time, a stable connection may not be possible despite a good reception level. Switching off other devices or positioning the Pocket and the connected audio devices out of range of these interfering devices may help.

After locating the first device, the Pocket's search phase for BT audio devices takes a maximum of about 10 seconds. If no device is found, the Pocket remains in the search phase. If a third device is found, the search stops immediately. More than 3 devices can not be managed by the Pocket at the same time.

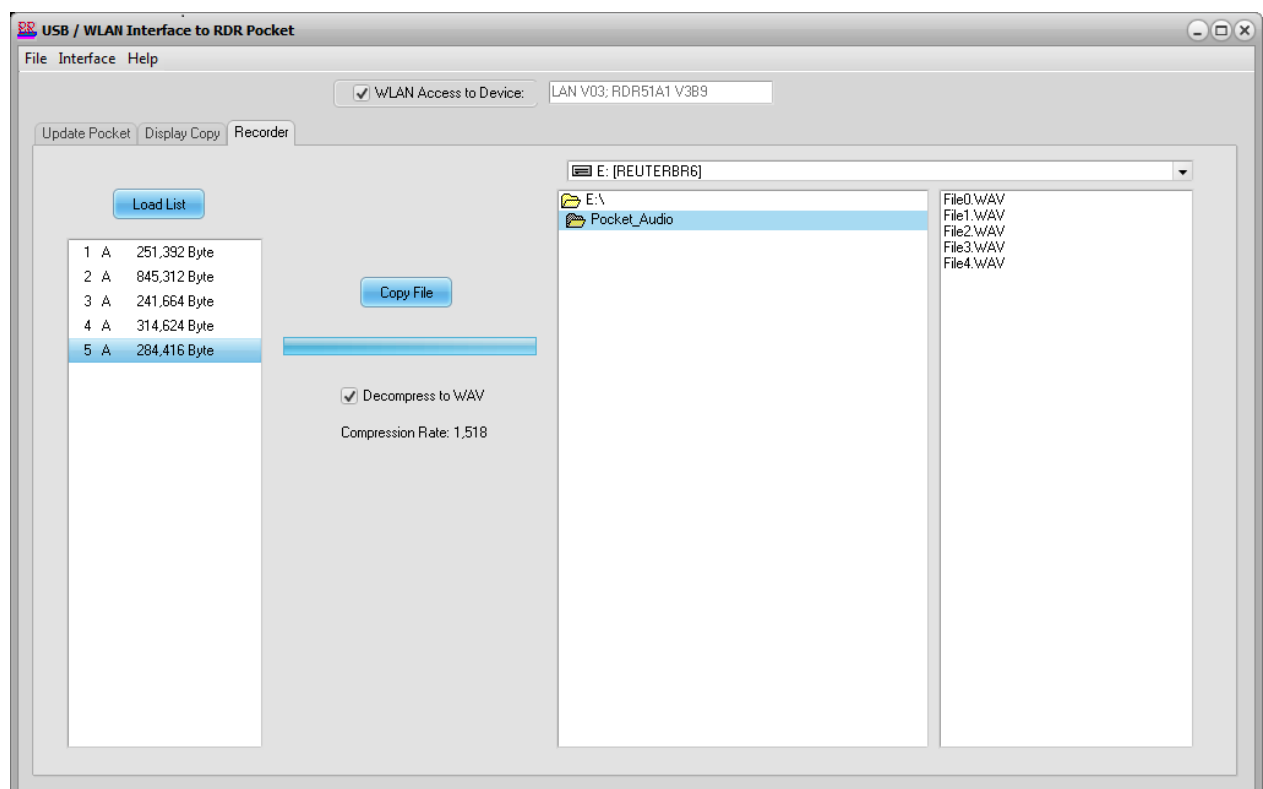
After completing the search phase, one of the located devices can be selected for audio output ("Start Device" appears in the Mode setting). To do this, the entry for the desired device can be tapped in the dialog. The Pocket will then try to connect to the device. If a stable connection can be accomplished, the audio signal is transmitted and can now be heard on the device. "Play!" is displayed in the Pocket's dialog during the transmission to the corresponding device. The dialog can now be closed and the Pocket can be operated as usual.

The volume level can often be adjusted directly at the utilized loudspeakers and headphones. However, this can be cumbersome, for example when the speakers are positioned further away. In this case, the devices should be set to full volume and adjusted via the Pocket's headphone volume control. On the other hand, it is possible to move away from the Pocket with worn headphones. In this case, the Pocket's volume level should be set just short of maximum volume (depending on the audio signal, full volume might already cause overmodulation) and the headphone's volume control should be used.

The located devices can be switched in the WiFi / BT dialog by simply tapping on the desired output device. The currently connected one is then decoupled and the desired connected. If less than 3 devices are listed, the transmission to the currently used device can be interrupted by tapping an empty entry ("no device"). Switching off the Bluetooth function (turning the Mode setting clockwise to "Off" with the scroll wheel) decouples the current device and switches off the WiFi controller. A restart will initiate a new search. Previously found devices are not saved, the controller always restarts completely clean.

Additional features in version Vx09:

- The recorder files stored in the Pocket can be transferred to a computer via WiFi. To do this, the PC service software RDR51B.EXE has been updated to version RDR51C.EXE. It now contains the new "Recorder" tab. Similar to screen dumps under "Display Copy", the contents of the recorder can be transferred to the PC on this tab.



First of all, the Pocket's list of recorder files must be checked by clicking on "Load List". It appears in the left window similar to how it is displayed in the Pocket's Recorder dialog. From this list, one file can now be selected. Multiple files can not be selected at the same time. Clicking on "Copy File" transfers the file from the Pocket into the PC. It is stored on the drive and in the directory selected by the program window on the right. The file's name results from the word "File" plus the number in the Pocket minus one (starting with zero instead of one as in the Pocket).

The Pocket's files are stored in a special format that only the Pocket itself can use. By selecting the option "Decompress to Wave" (default), the data can be saved in the Windows compatible WAV format (uncompressed audio data). If the transferred files are audio recordings (defined by the corresponding setting in the Pocket when recording), the files can be played and listened to with the preferred software on the PC.

Baseband mode recordings ("B" after the file number) are not "real" audio files. They contain the Pocket's baseband data according to the selected settings during recording with the associated sample rate. "Real" audio data ("A" after the file number) is always stored at 40.96 kSpl as a stereo stream. The baseband data can only be displayed and played back with a suitable software ("SDR program").

The files can also be stored in the Pocket's original format (deselect "Decompress to Wave"). By using this method, the files can be transferred faster to the PC and less storage space is needed. Files with the extension "HEX" are created. These contain compressed data that can only be converted to WAV audio or baseband data using suitable software (optional).

- Activation codes can also be activated retrospectively. Devices as of hardware E (from SN 060) do not use hard-coded activations for options anymore.

This allows the activation of certain additional options such as broadband spectrum, FM filter or extension of the flash recorder memory regardless of the software installed at the time of purchase or a later update. To activate one or more options (fee required), a specific code must be entered in the frequency setting of the Memory dialog. This code only applies to a specific device with its permanently burned serial number. Thus, the activation is permanently bound to this device and can never be deleted (except at the manufacturer).



#### Memory dialog after entering the code and activation of an option

The code must be entered as a frequency input with a comma before the last digit and confirmed with "MHz OK". If it corresponds to the device and was authorized by the manufacturer, "OK" appears in the frequency display. After switching the Pocket off and on again, the corresponding option(s) can be used.

This update introduces various experimental innovations. The individual functions are provisional and not yet fully implemented or tested.

## DAB Slideshow

The window already provided for the slideshow images in the DAB operating mode is now filled with data (images), provided the program provider is transmitting the corresponding data ("MOT").



The slideshow images can be transmitted to the Pocket in various PC-compatible formats (compressed JPG and PNG). Unfortunately, this data requires a corresponding decoder (PC software) and display units (min. QVGA monitor or newer formats such as HD). In the absence of a PC-compatible processor including the usual memory (many MB RAM), decoding places considerable demands on the Pocket's resources. A PC-independent decoder had to be designed for the microcontroller of the display operation (touch and graphics operation) with minimal memory requirements (still in further development). Therefore, the following restrictions apply in firmware Vxa9:

- Only JPG with baseline DCT (compression process) and chrominance sampling rates of 4:4:4, 4:4:0, 4:2:2 and 4:2:0 can be decoded. These formats are used by many programs. For example, almost all of the programs in the "Federal mix" 5C transmit such images.
- Image build up line by line with overwriting of the old image with a new one from top to bottom.
- No saving of image content. The current picture content is lost when performing different operations (e.g. calling up dialogs).
- The decoding only takes place when there are no other important tasks to be performed. Image data can be lost during many operating processes with a high load on the microcontroller (e.g. scrolling the program list). Then the image appears distorted or completely corrupted.
- No error checking or correction of the received image data. Reception errors lead to distorted or completely corrupted image content.
- Only 256 colors can be displayed.

The images are retained even after the program has been switched until data is received from the newly selected program or operations delete the image content.

**Attention!** In the beta version Vxa9 memory errors may occur with certain image data. Then the Pocket stops reacting (no operation possible) or switches itself off or restarts automatically. If this occurs frequently with a certain program, please stop the reception of the program for the time being and report the error to the manufacturer.

## Memory preview

Edition	Date	Name
3.10.00	10.09.2020	B. Reuter

The Pocket's memory allows device settings to be saved on up to 199 memory slots. A memory slot is called up by selecting (tapping) a slot, whereupon the Memory dialog is closed and the device is set to the stored set values. The dialog must be reopened for a subsequent memory call.

The Memory dialog can be opened in 2 ways:

- Tapping the active frequency display (double tap if frequency is not active) → Slots are sorted by frequency.
- Selection from the menu → Slots are sorted by slot number.

To make working with the memory easier, when using the 2nd method (selection from the menu), a memory preview can be activated by calling up the memory slots without tapping a location and closing the menu. When scrolling through the memory slots, it is always the 2nd slot from the top that will be loaded into the receiver settings. Loading is done via the partial method (like tapping the demodulator name to the left of the yellow dividing line). That means, only the frequency, the demodulator and the bandwidth with dependent values (Shift, Notch filter, ...) are set. All other values such as volume, display resolution or screen brightness are not loaded and are retained.

*Exception:* The stored value for the control threshold (violet line) is also restored so that it can be quickly adjusted to the current level.

The signal from the memory slot can be heard immediately. With the Pocket, however, the spectrum is also a very important criterion for assessing reception. In the spectrum-based operating modes, it is actually absolutely necessary to make the signal audible. That is why the spectrum is activated when the 2nd slot is called up. The result is a "transparent" display of the memory dialog with the spectrum visible in the background.



The list of memory slots with the 2nd (now active) entry highlighted in yellow is "eaten up" by the spectrum. However, since the spectrum does not normally extend to the top of the diagram, the entries visible there are retained. (Otherwise the spectrum height should be adjusted accordingly before calling up the dialog.) With each scroll step the list is moved as usual and rewritten over the spectrum. Empty entries or entries for DAB programs are not called. The memory preview does not work in DAB mode.

To stop the preview, a slot must be permanently called up (tapping the desired line). As long as the preview is active, no further settings in the dialog can be made (no direct entries or calling up DAB or canceling with Escape). The corresponding buttons are therefore not even displayed. Editing of the memory (deleting or programming of slots) is possible.

If the slots are to be sorted according to frequency and not according to slot number in the memory preview

(as is usually the case when calling from the menu), this can be enforced by an active frequency setting before the dialog is called. If any other set value is active, sorting according to slot numbers takes place.

### **S-meter bar**

For better visibility, the S-meter has a bar display that follows the pointer. Below S9 +40 dB the bar is white, above it is yellow, and at "End stop" it is red.

The version 210 (Pocket B1, B2, C2) or 410 (Pocket C4) provides the features of the previous partial versions for all devices (as far as possible in terms of hardware). In addition, the SBSP (Spectrum Based Signal Processing) kernel has been fundamentally revised and now offers greater accuracy in converting the spectrum bins into visible lines on the display and into audible audio signals.

In particular, the assignment of the bins to the audio frequencies depending on the spectrum resolution and demodulator is now exactly the same as the representation in the spectrum diagram. If the resolution of the spectrum visible on the display (left yellow set value above the diagram) is set equal to the audio resolution (Setup), the result is an exact match between the display and the audio tone (WYSIWYG). There is (largely) no frequency discretion in the audio signal. The position of frequencies is visible in the display within a bin by the deviation of the height of the line and its neighbors (overlapping of the bins) and audible in the audio signal by the constant change of the bin frequency according to the deviation from the bin center.

This results in a much more accurate reproduction of the audio signal despite frequency-discrete signal processing (division into bins and separate tone generation for each bin). This strongly approaches analog signal processing or its digital imitation (time-discrete signal processing in conventional SDR). Accordingly, the audio signal contains hardly audible artifacts from the underlying frequency-discrete signal processing. The sound becomes "more analog" with less distortion and "softer" noise.

However, the advantages of the SBSB remain, above all the extreme selectivity. The increased accuracy of the spectrum → audio display results in a filter curve with very steep slopes that exactly matches the settings (visible band limits of the yellow listening area in the spectrum), especially with very low bandwidths. Narrow-band operating modes such as CW or Digimodes can be demodulated with only 2 bins.

The bins (lines in the spectrum) are assigned alternately to the left and right audio channel. When "Stereo" is activated (real stereo only with FM-W and DAB) it is, in extreme cases, possible to only use one bin for demodulation. With the minimum bandwidth setting (audible area 2 bins wide), the left bin is made audible in the left channel and the right bin in the right channel. If the bandwidth is expanded, the bins added to the listening area are alternately added to the left and right channels. The result is a "quasi-spatial" hearing impression.

Without a stereo effect, the summed signal of the individual channels is generated in both channels. This results in an envelope curve for the filter curve of the overall signal, which corresponds to the superposition of all audible bins. This compensates for slight differences between the channels due to the frequency discretion (accuracy increases from 1 bin to  $\frac{1}{2}$  bin) even further. At the hearing limits (corresponds to the filter edge of analog / time-discrete filters), the steepness of the signal drop doubles from 3 dB attenuation. This results in an overall filter curve that is "rounded" by up to 3 dB for a pleasant hearing impression and at the same time a very high level of selectivity against nearby signals.

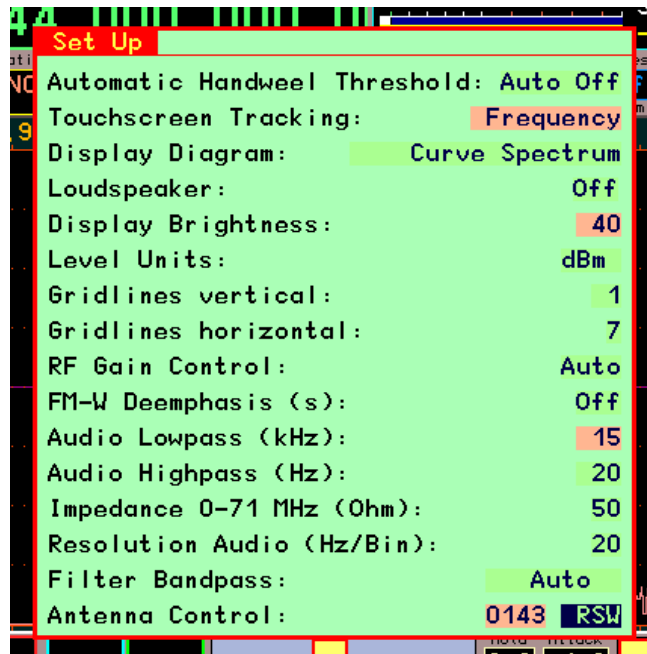
A significant extension of the functionality results when using version x10 on Pockets from serial number 200. The hardware of these devices is prepared for the supply and control of active antennas. This enables a supply voltage to be output on the antenna connection. Suitable active antennas can be operated directly from the Pocket without an additional remote feeder or external power supply.

**Attention!** The power supply for an active antenna that is remotely fed by the Pocket is provided by the Pocket's accumulators! This results in a shorter battery life due to the additional power consumption.

The supply voltage can be modulated with a binary signal according to the RS-232 standard. This enables direct control of the antennas RLA4 and RFA1. An RSW control unit is not required in this case.

Devices prior to S/N 200 do not have a built-in control unit. With the Vx10 software, however, they can be connected to an RSW3 or RSW4 control unit via WiFi and then take over the remote control of the control unit (similar to the remote control software on PC, Tablet, ...).

A setting option is available in the Setup to select the antenna control options.



In the bottom line, the following selections can be made using the "Antenna Control" setting:

- Off: No remote power supply or control of antennas.
- RSW: WiFi connection to an antenna control unit (further notes below).
- 5.7V: Fixed remote power supply with 5.7V at the antenna socket
- 6.8V: Fixed remote power supply with 6.8 V at the antenna socket
- RLA: Control of the RLA4 (version D to G and following)
- RFA: Control of the RFA1 (version A and following)

The first two settings can be made with every Pocket, the others only for devices with a serial number  $\geq 200$ .

When selecting the settings with fixed supply voltage, any suitable antenna can be supplied via the connection cable ("remote supply"). The current consumption must not exceed 100 mA. The current is limited from approx. 120 mA. This means that the supply is short-circuit proof. Fixed voltage operation is shown in the top right of the display with the following symbol:



**Attention!** In the case of permanent current limitation, the Pocket heats up considerably! After a while the heat will be so strong that the protective shutdown responds due to excess temperature. This emergency measure protects the device, but is harmful to the electronics and especially to the built-in batteries. Only operate the Pocket under supervision when remote powering an antenna and switch off the remote power supply or the entire device when the antenna current exceeds 100 mA! These instructions also apply to the "RLA" and "RFA" settings!

The voltage is provided with a linear regulator directly from the Pocket's battery voltage. The power loss resulting from the voltage difference times the flowing current is converted into heat in the Pocket. If possible, the higher voltage should therefore always be given preference. If the battery voltage (sum of both cells in the "Power Management" dialog) falls below the supply voltage plus 0.1V, the controller can no longer maintain stability and the supply voltage drops with the battery voltage. However, this is only possible shortly before the batteries are completely empty. This cannot happen with the setting of the lower voltage, since the Pocket will switch itself off beforehand due to insufficient battery charge.

The direct control of the antennas RLA or RFA (from the specified versions) is possible by selecting the appropriate setting. In this case the Pocket functions as an RSW control unit (see description of the RSW3

or RSW4 control units). As with the RSW, the connected antenna is fed with the low supply voltage and adjusted with pulses from the higher supply voltage. If the batteries are almost empty (falling below the 6.8 V for the higher voltage), correct control may no longer be possible.

The RLA can be adjusted in the receiving direction at an angle between 0° and 180°. The setting is made using the icon that can now be activated (can be tapped like any other set value) at the top right (current display only when an RSW is connected in between, see below):



The RFA has 2 setting options: Frequency and resonant circuit quality. The setting of the quality in % takes place via the same value as the position setting of the RLA:



The frequency setting of the RFA occurs automatically concurrently with the frequency display of the Pocket. Each time the reception frequency is changed (coordination with the scroll wheel, dragging on the spectrum, calling up a memory slot, ...) the corresponding control word is transferred to the RFA.

The Pocket can also connect to a WiFi-capable control unit RSW3 (from version B) and RSW4 (from version A) via its WiFi interface. If the connection is successful, the control unit, and thus the antenna connected there, can be wirelessly remote controlled. Pocket and control unit must be within WiFi range of each other.

The Pocket takes on the position of the access point ("Access Point") similar to a WiFi router and the RSW takes over the position of the station that logs into the access point. A number of requirements must be met in order to log in successfully (see description of control units RSW3 and 4).

If the unit has been successfully logged in once (you may have to press the button on the RSW to start the process), the control can be set up at any time as follows:

- Set value Antenna Control in Setup to "RSW".
- Set the then visible serial number to that of the logged in RSW.
- Call up the "WiFi" dialog and activate the access point (if already active, deactivate it beforehand).
- Close the dialog, wait for the control unit to establish a connection.

After switching on the Pocket access point, the RSW first logs in (display "L" on the RSW display). The user interface of the Pocket then tries to establish a data connection to the processor of the control unit. During this time, the following notification appears in the antenna control field:



If the connection was successful, the present measured current value and the position or quality setting of the antenna appear in the display (as shown above). "S" is displayed on the RSW. The set values are now exchanged bidirectionally between the devices. An adjustment of a setting on the Pocket also appears in the RSW display (and is used there to adjust the antenna) and vice versa.

*Note:* The data transfer between Pocket and RSW is very fast (a few ms) with a stable connection. However, the data transmission from the RSW to the antenna is slow (several 100 ms). This means that if the set values are changed quickly, the adjustment of the antenna is delayed (this also applies to direct control of an antenna from the Pocket without RSW). However, the feedback of the values from the RSW to the Pocket always shows the value last used by the antenna.

**Attention!** The frequency setting of the RFA is **not** bidirectional. This would hinder the Pocket's rapid frequency tuning. Therefore, the transmitted frequency values are only used by the antenna as its tuning

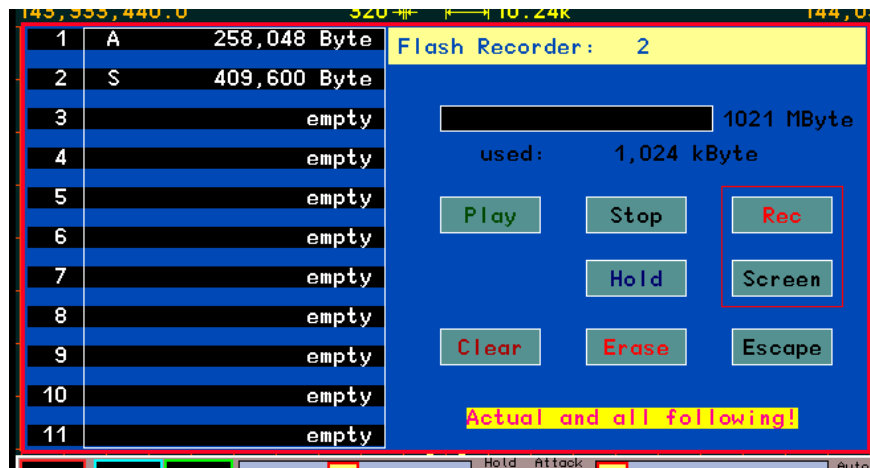
speed allows. It is possible that the last step was not processed in the antenna when the adjustment was completed. Observe the tuning in the spectrum display and / or via the S-meter and switch the frequency one step back and forth if there are any deviations so that the antenna can also process this data. Deviations are also visible in the antenna's display (version with built-in control unit) or in the RSW.

*Note:* If the data connection is interrupted (e.g. switching off the RSW), no further changes to the value in the antenna control field are possible (no more feedback from the RSW). However, adjusting the frequency is still possible due to the lack of a return connection.

The Vx10 software includes the following additional changes and extensions:

- Display of PNG slide show images in DAB mode (not with Pocket C4). There are size restrictions and not all sub-formats can be decoded.
- 
- Change of the switch-off thresholds for overtemperature and undervoltage for better protection of the batteries.
- 
- Bugfixes for minor bugs in earlier versions.
- 
- "Camera" function for flash recorders.

The camera function enables display images ("Screen dumps") to be saved in the audio recorder. This function is a paid extension. After the function has been activated, the sample rate of the recording can be switched to "Screen" in the Recorder dialog. A screen dump takes place the same way as an audio recording by pressing the "Rec" button. The corresponding file is given the identifier "S" in the list.



The scanning of an image is carried out in the same way as scanning from a PC via the WiFi connection. However, a WiFi connection is not required for the screen dump. During the scanning process, operation of the device including the spectrum display is stopped and the still image is transferred to the recorder's flash memory. After successful saving, the Pocket can be operated normally again. The storage process is started in the user interface via the Rec button. If you select "Screen" in the Recorder dialog, it is labeled "Dump".



The saved images cannot be displayed again on the Pocket itself ("Play" has no function). They are intended for documentation purposes after being transferred to a PC. The transfer takes place in the same way as that of audio files (see page 74). When you select an image file (code "S") the decompression button changes to "Decompress to BMP". After the transfer, the image is visible on the "Display Copy" tab and can be transferred to the clipboard or saved as a BMP file. Without decompression, a file is created with the raw data (pixels as byte values in columns from top left to bottom right).

*Note:* The connection software for Windows PCs version "E" or higher must be used to transfer the image data (RDR51E.EXE)

## Installation of version Vx10

Attention! The update to version Vx10 requires that at least version x07 or higher is already installed! All devices have a basic version that cannot be deleted, which maintains the operation of the device in the event of a failed update. This "emergency software" has version numbers from x00 to x05. Never try to update from such a version to version Vx10! A successful update to at least the software available on delivery of the device ( $\geq$  x07) must always be carried out first!

Older software is available on the data mediums supplied or on the manufacturer's website. If not included / no longer available, please contact the supplier of the device.

- Download the RPD file suitable for your device from the Internet ([www.Reuter-Elektronik.com](http://www.Reuter-Elektronik.com)).
- Download the network driver RDRWLANV52 (or higher) from the Internet.
- Download the connection software RDR51E.EXE (or higher) from the Internet.
- Switch on the Pocket (ensure sufficient battery charge or connection of charging voltage) and activate the access point.
- Deactivate any activated data connection to other devices (RSW) or switch off the connected devices.
- Log into the Pocket on a Windows PC (with the downloaded files) (note the information in the section "Software update").
- Start RDR51E.EXE and check the stable connection (check display of version numbers, execution of a display scan).
- Activate "LAN-Driver" and open the file RDRWLANV05.
- Activate the clearance of the driver update in the WiFi dialog of the Pocket.
- Transfer the file by pressing Start.
- The update is finished when "OK!" Is displayed in the clearance field in the Pocket.
- Switch the access point off and then on again after a few seconds.
- If necessary, log in the PC again and activate and test the connection in RDR51E.EXE again (menu "Interface" and button "Synchronize", or restart the program).
- Activate "Pocket Software" and open the RPD file.
- Transfer the file by pressing Start.
- The update is finished when the message window indicating the end of the transfer appears.
- Switch off the Pocket and switch it on again after a few seconds.
- V210 or V410 (only C4) must be shown in the small red version display at the bottom right of the display.
- If the display is incorrect (older version still active) or other errors during the transfer, the process must be repeated completely. Any successfully loaded network drivers do not have to be reloaded before the software update.