AOR®

AR2300 BLACK-BOX RECEIVER

"I/Q SPECIAL EDITION"

OPERATING MANUAL
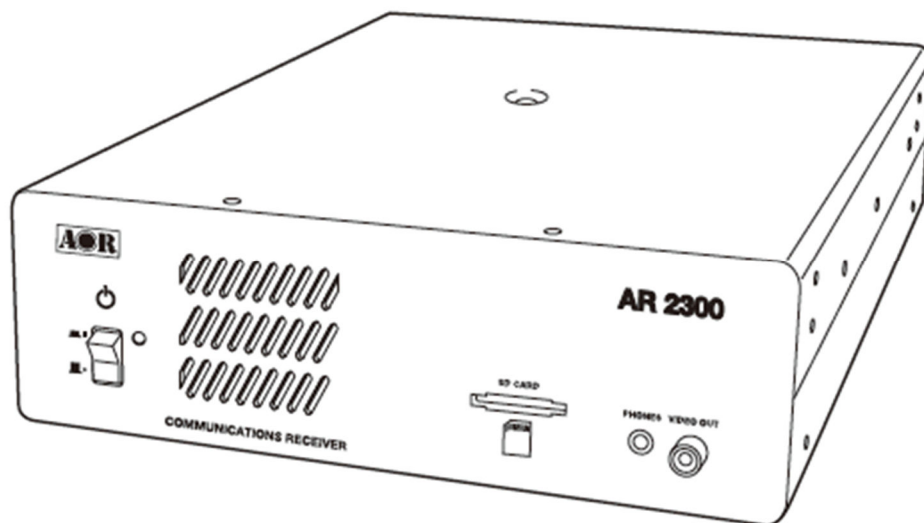
INTRODUCTION

Thank you for purchasing the AR2300.

AR2300 is a high-end black-box type receiver with wide band coverage between 40kHz and 3.15GHz. Some of its outstanding features are:

1) **Digital signal processing:**
   Input signals after the 45.05MHz IF are converted from analog to digital by a DSP processor. There is no AGC in the analog processing unit, as all processing, including AGC, is done by DSP.

2) **High-performance analog front-end:**
   Analog signal processing is performed by a computer simulated, high-performance distribution constant filter.

3) **DDS local oscillator:**
   Instead of the conventional PLL method, the first local frequency is produced by direct digital synthesis. That method allows frequency switching at high speed.

4) **IF output:**
   An analog IF of 15MHz (+/-7.5MHz) bandwidth is output.

5) **Digital I/Q output:**
   A digital I/Q signal of 0.9MHz is output via a USB 2.0 interface.

6) **High precision frequency reference:**
   0.01ppm frequency stability of the 10MHz internal master oscillator is achieved when using the optional GPS receiver unit.

7) **FFT analyzer:**
   Thanks to the onboard FFT processor, 10MHz wide spectrum data can be output at high speed via serial.

8) **Optional APCO25 Phase 1 digital voice demodulation**

9) **Video demodulation**
   By connecting and external TV monitor, it is possible to demodulate the signal of FM modulation security cameras and analog TV broadcasts. When you connect the TV monitor, you can check the demodulated video. Not compatible with digital terrestrial television.

10) **Simultaneous monitoring**
    2 band reception, offset reception, triple reception (restrictions apply).

11) **SD card slot**
    You can record the received audio on SD, as well as backing up receiver settings and memory data.

12) **12kHz analog I/Q output**
    Allows DRM broadcasts decoding via a PC and dedicated 3rd party software.

13) **HF direct sampling**
    When receiving HF signals, the signals are converted directly to digital without entering the mixer. This allows very good linearity characteristics.

14) **Control via LAN/Internet with optional ARL2300 Ethernet Controller**

Please read this operating manual carefully. This information will allow you to enjoy maximum performance from your receiver. Due to continuous developments of the receiver, firmware and software, we acknowledge that there might be some changes, errors or omissions.

We sincerely hope that the AR2300 will be your monitoring companion for many years to come.

SAFETY PRECAUTIONS

DO NOT operate the receiver near unshielded electrical blasting caps or in an explosive atmosphere. This could cause an explosion and death.

DO NOT operate the receiver with a headset or other audio accessories at high volume levels. If you experience a ringing in your ears, reduce the volume or discontinue use.

DO NOT directly apply AC power to the DC socket on the receiver rear panel. This could cause a fire or damage the receiver.

DO NOT apply more than 16 V to the DC socket on the receiver rear panel. This could cause a fire or damage the receiver.

DO NOT reverse the DC power cable polarity. This could cause a fire or damage the receiver.

DO NOT let metal, wire or other objects contact the inside of the receiver, or make incorrect contact with connectors on the rear panel. This could cause an electric shock or damage the receiver.

DO NOT operate or touch the receiver with wet hands. This could cause an electric shock or damage to the receiver.

Immediately turn OFF the receiver power and remove the power cable from the receiver if it emits an abnormal odor, sound or smoke. Contact your AOR dealer or distributor for advice.

DO NOT put the receiver on an unstable place where the receiver may suddenly move or fall. This could cause an injury or damage the receiver.

DO NOT operate the receiver during a lightning storm. It may result in an electric shock, cause a fire or damage the receiver. Always disconnect the power source and antenna before a storm.

DO NOT expose the receiver to rain, snow or any liquids.

DO NOT change the internal settings of the receiver. This could reduce receiver performance and / or damage the receiver. The receiver warranty does not cover any problems caused by unauthorized internal adjustments.

DO NOT install or place the receiver in a place without adequate ventilation.

DO NOT use harsh solvents such as Benzine or alcohol when cleaning, as they will damage the receiver surfaces.

DO NOT leave the receiver in areas with temperatures below 0°C or above +50°C.

DO NOT place the receiver in excessively dusty environments. This could damage the receiver.

DO NOT place the receiver against walls or put anything on top of the receiver. This may overheat the receiver. The receiver will become hot when operating the receiver continuously for long periods of time.

Turn OFF the receiver's power and / or disconnect the DC power cable when you will not use the receiver for a long period of time.

The AR2300 may receive its own oscillated frequency, resulting in no reception or only noise reception including on the spectrum displayed by control software, on some frequencies.

TABLE OF CONTENTS

1.   SUPPLIED ITEMS

- AR2300 receiver _____ 1
- IQ5001 I/Q output board (pre-installed)_____ 1
- AC power adapter _____ 1
- Printed user manual _____ 1
- SD card _____ 1
- USB cable _____ 2
- USB license dongle with software suite & drivers _ 1

A list of optional accessories is available at:

http://www.aorja.com/accessories/receiver_accessories.html

The full control command set pdf for system integrators can be downloaded at:

http://www.aorja.com/support/manuals2/AR2300_command_list.html

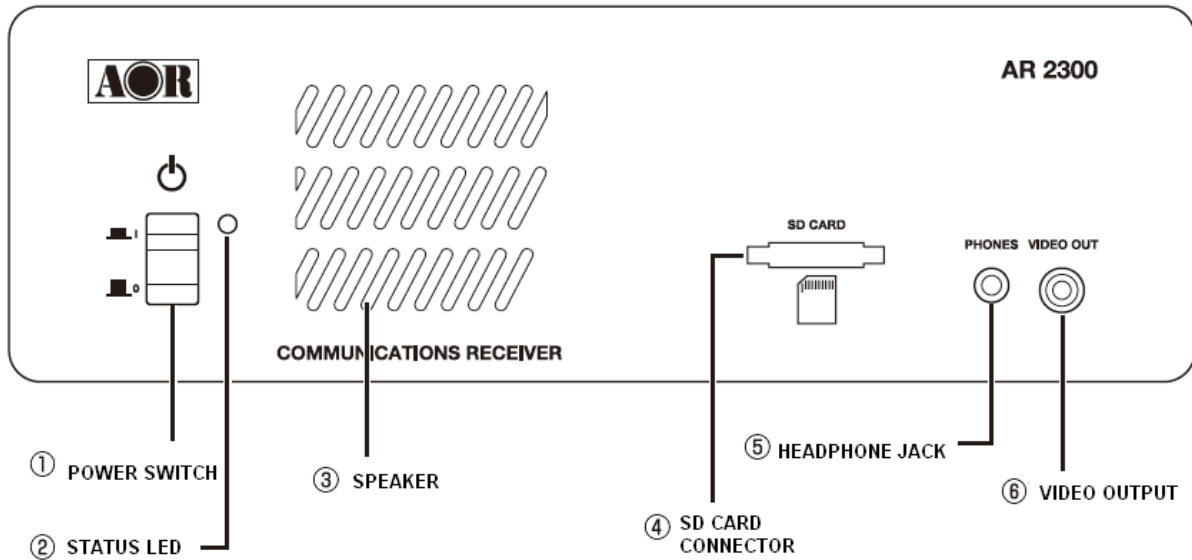AOR software and utilities are listed at:

http://www.aorja.com/support/software.html

A list of 3rd party software solutions is available at:

http://www.aorja.com/support/third_party_sw.html

2. FRONT/REAR PANEL DESCRIPTION
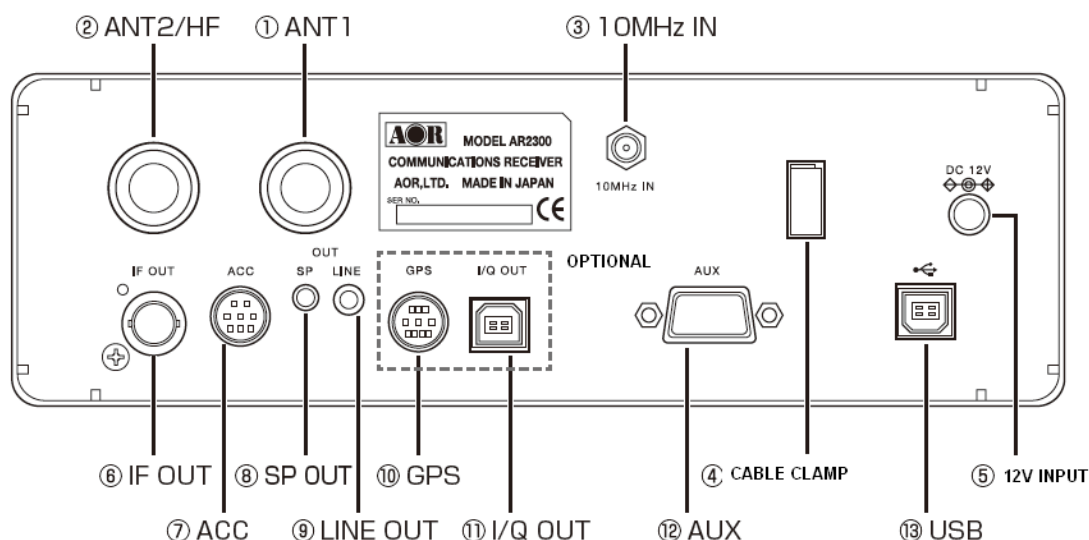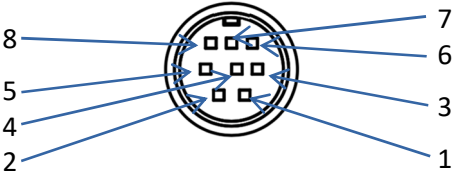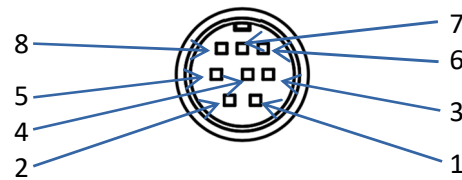
2.1. Front panel

①	Power switch	If you need to disconnect the AC power adapter, make sure that the receiver is shut down before.
②	Status LED	Green: Power on and receiving, Orange/yellow: Stand-by, Not lit: Off
③	Speaker	To mute the speaker audio while setting up the receiver and control software, simply plug in a headphone.
④	SD card connector	Standard size SD Card Connector You can record and playback received audio, backup and restore memory data and receiver settings. Insert the SD card face down. For microSD cards, use an SD card adapter.
⑤	Headphone jack	Three pin 3.5mm, stereo output. For stereo broadcasts, use the FMST receive mode with 100kHz or 200kHz bandwidth. In dual-band reception, the main frequency is audible on the right channel, and the sub-frequency on the left channel.
⑥	Video output	RCA type socket (75Ω 1 V p-p) to output the image of a demodulated analog video signal.

2.2. Rear panel

①	ANT 1	Type N socket (50Ω) for frequencies over 25MHz only.
②	ANT2/HF	Type N socket (50Ω) for all frequencies, including HF.
③	10MHz IN	SMA type socket (50Ω) External reference clock input of 10MHz (2dBm±2dB). When a valid 10MHz is entered, it automatically switches to that external input.
④	CABLE CLAMP	Secure the DC cable with this clamp to avoid the DC connector to be pulled out accidentally.
⑤	12V INPUT	DC barrel socket (5.5/2.1mm), center positive, for power input. DC10.7V～16V (2.0A@12V).
⑥	IF OUT	BNC type socket (50Ω) Outputs analog IF at 45.05MHz with a bandwidth of +/- 7.5MHz. (Output level is +10dBm relative to antenna input)
⑦	ACC	Mini-DIN-8 socket pinout description:

1	12V DC output. No current limitation. Both voltage and amperage depend on power supply DC input.
2	Discriminator output Unfiltered audio limited to the NFM receive mode. 0.78V p-pEMF 10kΩ (NFM deviation 3kHz, audio 1kHz)
3	External mute input. Short this terminal to the ground to mute the receiver's audio output. Remember that this function does not protect the high frequency circuitry from strong nearby transmissions.
4,5	Control 1,2 When busy (squelch is open) the control closes between 1 and 2 terminals. Uses non-polar photo MOS relays. Up to 350mA on-resistance 2Ω or less, load voltage 40V)
6	GPS time pulse input
7	Low level audio output (2.5mV@600Ω) Not affected by changes in AF GAIN.
8	Ground

⑧	SP OUT	Φ3.5mm monaural jack (Up to 2W with 8Ω load) To connect to an external speaker.
⑨	LINE OUT	Φ3.5mm stereo jack (600Ω -10dBm) To connect to an external recording device, or an audio amplifier. Can be switched to output a 12kHz wide analog I/Q signal. In dual-band reception, the main frequency is audible at the right side and the sub-frequency at the left side.
⑩	GPS (not compatible with the GP5001 GPS antenna unit) For future applications.	Mini-DIN-8 socket pinout description: <table><tr><td>1</td><td>GPS TXD</td></tr><tr><td>2</td><td>GPS 1Hz Pulse</td></tr><tr><td>3</td><td>12V</td></tr><tr><td>4</td><td>GND</td></tr><tr><td>5</td><td>GPS RXD</td></tr><tr><td>6</td><td>RTS</td></tr><tr><td>7</td><td>CTS</td></tr><tr><td>8</td><td>NC</td></tr></table>
⑪	I/Q OUT	USB type B socket which outputs digital I/Q data (bandwidth 0.9MHz) for PC.
⑫	AUX	D-SUB 9 male socket for receiver serial control or to connect the optional Ethernet Controller unit.
⑬	USB socket	USB Type B socket for receiver control by PC.

3. PREPARING FOR PC CONTROL

➢ The supplied **AR2300 CONTROLSOFT** software features complete receiver control, audio recording/playback and memory bank management for the AR2300 receiver.

3.1 PC requirements

Minimum PC system:
- Supported OS: Windows 7/8.1/10
- 2GHz Dual Core CPU
- 2 GHz RAM
- 1024 x 768 resolution monitor
- One available USB 2.0 port
- Free USB port for software installation

3.2 Connecting the receiver to the PC

Connect the supplied USB cable as follows:

Receiver's USB socket (labelled with USB logo) on the back of the receiver, to PC.

- Some type of USB 3 ports can be incompatible due to the particular chipset they use. If that occurs, use a USB 2.0 port instead.

3.3 Installing the USB driver

Providing that your PC is connected to the Internet, you do not need to manually install the supplied USB driver.

(All following instructions and screenshots are based on the Windows 10 operating system)

1. Make sure the USB cable is connected.

2. To check the driver status, open WINDOWS DEVICE MANAGER (Press simultaneously the Windows key and the X key, then select "Device Manager")

3. Windows will first detect the USB connection as pictured:

5
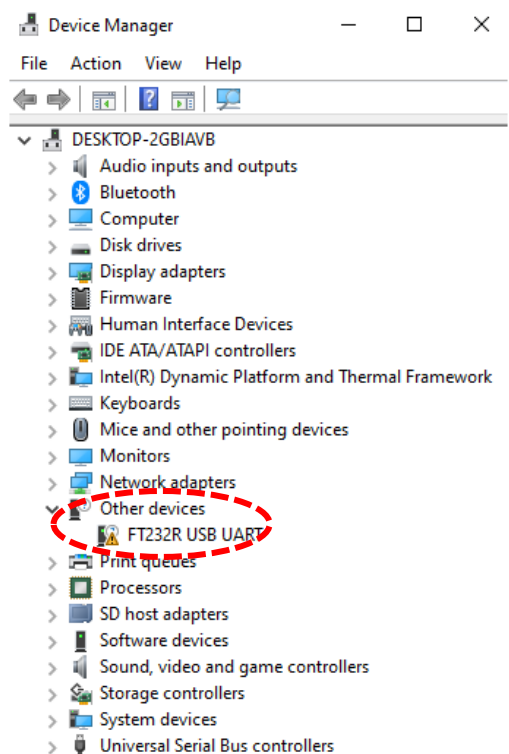
4. After Windows has automatically downloaded and installed the driver, Device Manager will list it as pictured:

   The auto-assigned COM number depends on your PC configuration.
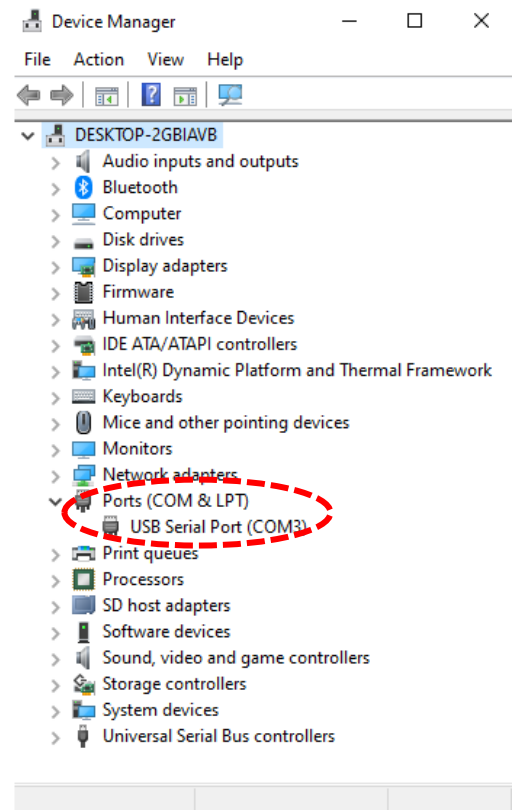
If manual USB driver installation is required, you will find it in the supplied USB key in the following directory:

(your USB key) > DRIVERS > USB DRIVER x.xx.xx.x

4.   CONTROL SOFTWARE OPERATION

4.1   Connecting power

Connect the supplied AC power adapter. If using another power supply, make sure it provides DC10.7V～16V with at least 2 A of power.

4.2   Power on

Push the power switch on the receiver's front panel. The LED will turn orange/yellow, indicating the stand-by mode.

4.3   Starting the control software

- Copy the folder "Ctrlsoft v.x.x.x.x" from inside the USB key (navigate to WINDOWS>Control & memory management) to any folder on your PC. The software does not need to be installed; it can be run as is.
- Double click "AR2300ControlSoft.exe" to start the software.
- When you start the software for the first time, Windows might ask you to which COM PORT the receiver is connected. Providing the correct number is entered, it will be saved in the registry, therefore you should not need to enter it again. Nevertheless, after connecting the receiver to a different USB port on your PC, the COM port number might change.
- When you start the software for the first time, a message might ask you to create a ".arc" memory database file. Don't worry, you will be able to do it later in chapter 4.4.3, so the software doesn't ask for it again, every time you start it. For now, just click **OK**.
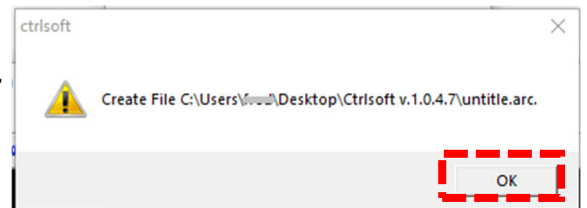
Default software layout

4.4   Software windows description

Any or all of the following windows can be displayed.

Main Control
Spectrum display / Menu bar / database
Ctrl1   S-Meter
Ctrl2   Mode etc.
Ctrl3   AF, RF, SQL control
Ctrl4   FFT control
Ctrl5   Option settings
Ctrl6   Frequency panel

In the menu bar, go to WINDOW to select your choice of windows to display.

Layout with all windows displayed:

HINT! Whereas all individual windows can be placed anywhere on the screen, to automatically place windows as on the above picture, in the menu bar go to WINDOW > GATHER WINDOW.

4.4.1 MAIN CONTROL WINDOW DESCRIPTION

Main Control

AUTO   Ant 1   IF +0
BUSY   **0123.000000 MHz**
VFO-A   _____   Offset
MODE:AM(IF6k)   IF BAND:6k   STEP:100.000k
AF:021   SQL:000   RF Amp:ON Att:0dB
TEXT   :
TEXT(RCV) :
LAST HIT   :   PASS :
LAST LEVEL :dB   TONE:
HIT COUNT   :
SEL   DTMF:
PR   :

FREQUENCY

(Min.: 0000.040000 MHz, max.: 3150.000000 MHz)
Change the receive frequency by either:
-Hovering with the mouse over each digit and scrolling the mouse wheel up or down.
-Entering the frequency via the PC keyboard + ENTER key for MHz.
-Entering the frequency via the PC keyboard + K key for kHz.
-Using the left and right arrow key of the PC keyboard.

To set an OFFSET frequency, enter it via the PC keyboard and validate with the SPACE BAR.

MODE

Left-click to manually select one of the 24 available modes. Selecting AUTO is also possible.
Auto does also automatically select the IF BAND and STEP values.

IF BAND

Left-click to manually select one of the 10 available IF filter bandwidths.

STEP

Manually change the frequency step by hovering the mouse over each digit and increasing or decreasing the value with the mouse scroll wheel.
Min: 000.010k
Max:999.990k

MAIN DIAL / OFFSET DIAL

Tune the frequency up or down by hovering the mouse over either symbol and scrolling the mouse wheel up or down.

Frequency step will be as set in the STEP menu.

The OFFSET symbol only appears if the offset function is active.

AF

Adjust the volume from 000 to 255 by:
-Hovering your mouse over the 3 digits and scrolling the mouse wheel up or down.
-Left-click on the 3 digits to adjust the AF slider and set the audio channel balance when in OFFSET or DUAL BAND mode.

SQL

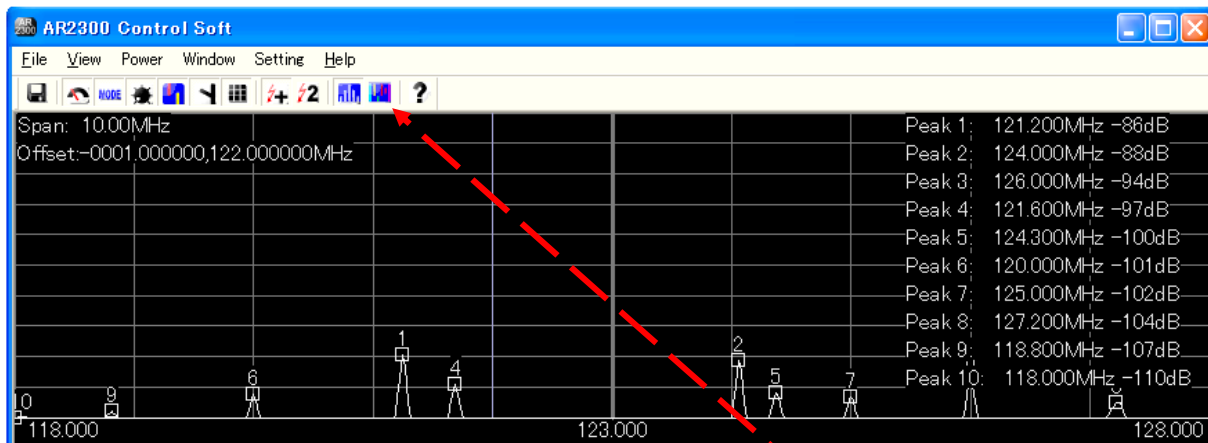Adjust the squelch level from 000 to 255 by:
-Hovering your mouse over the 3 digits and scrolling the mouse wheel up or down.
-Use the keyboard up and down arrows.

RF Amp / Att

Left-click to select either:
-RF Amp: ON or OFF
-Att: 0, -10, or -20dB
-AUTO

4.4.2 SPECTRUM DISPLAY DESCRIPTION

SPECTRUM DISPLAY
Spectrum displayed in real time. Receive frequency is the center frequency.
Left (single) click on spectrum: Receiver is tuned to the clicked frequency.
Right click on spectrum: OFFSET frequency is set and marked by a vertical blue line.
Mouse wheel: Each scroll step increases or decreases the frequency by a value 1/10 of the spectrum width.
For ex.: Spectrum bandwidth = 800kHz =>each wheel step = 80kHz

Click the ▮▮▮ icon to switch to waterfall display.

A waterfall display is the variation of signal strength in conjunction with the time elapsed. The color will vary depending on the signal amplitude.

4.4.3 MENU BAR DESCRIPTION
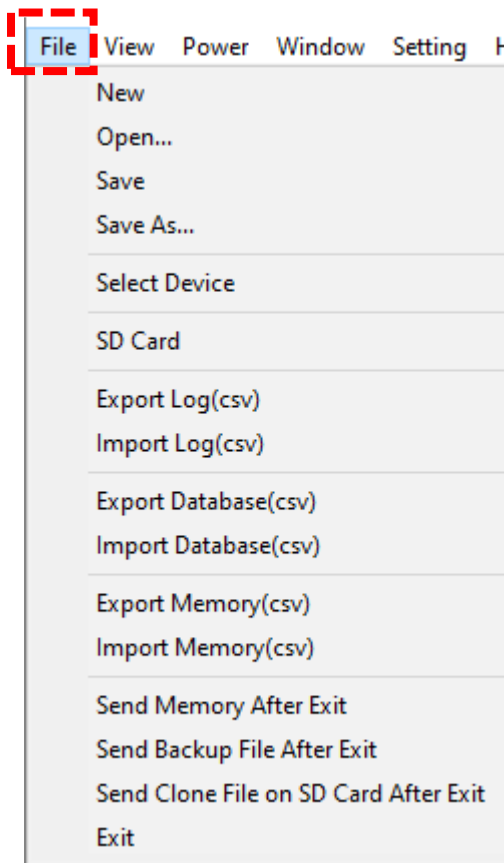
New/Open/Save/Save As concerns ".arc" extension files which represent a PC based database backup of memory channels, banks, search/scan, antenna settings, recordings, scheduling and logs. These ".arc" files are saved in the same folder than the software executable.

Select Device: Allows to manually select a receiver to connect to, if more than one receiver is connected to your PC.

SD Card: Manually record and playback audio files, from the SD card inserted into the receiver.

Export / Import Log(csv): Export and import PC based log files of all scan and search hits, including time stamp, signal level, mode, RF amp and ATT settings, and hit counts.

Export / Import Database(csv): Export and import a PC based database with info limited to frequency, mode and text.

Export / Import Memory(csv): Export and import PC based memory content (frequency, bank, channel, mode, tone, ATT, ANT, priority, select, REC, memo, pass, voice SQL)

Send Memory After Exit: Uploads the currently active (PC based) MEMORY content to the receiver, then closes the software.

Send Backup File After Exit: Uploads a selectable (PC based) backup text file to the receiver, then closes the software. This backup text file is sent by the receiver every time the software is started and saved inside the software folder.

Send Clone File on SD After Exit: Uploads a complete receiver clone file, from the SD card inside the receiver, to the receiver. (To create clone files, go to MENU BAR > SETTING > OPTION)

4.4.3 MENU BAR DESCRIPTION (continued)
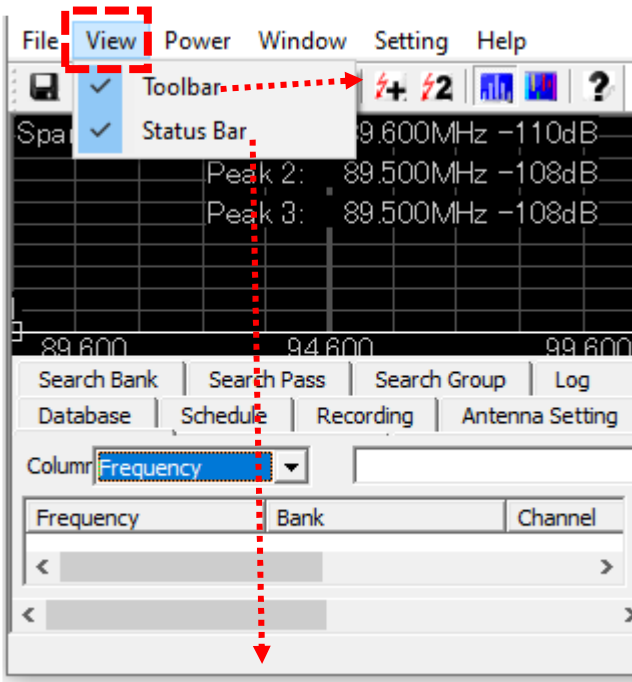
Here you can select whether or not to display the toolbar and status bar, depending on the available desktop space.
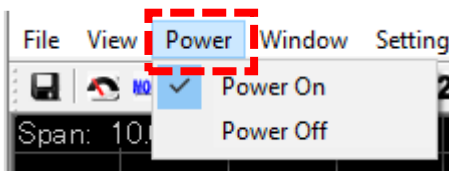
Power the receiver **ON** or **OFF**.
Power off does actually put the receiver in standby mode, as to be completely off, the receiver's front panel switch has to be used.
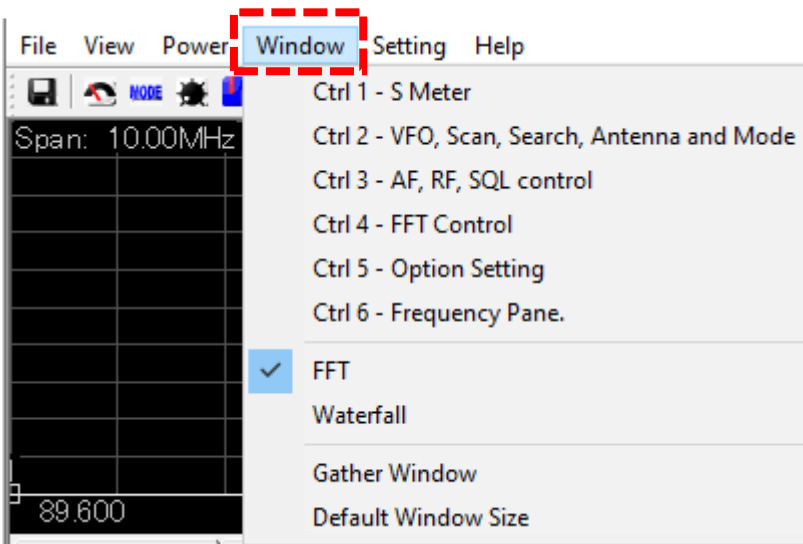
Ctrl 1 to Ctrl 6: Select here which of the windows you would like to display for convenient receiver operation.

FFT (default) displays the frequency and signal spectrum.
A **waterfall** display is the variation of signal strength in conjunction with the time elapsed. The color will vary depending on the signal amplitude.

Whereas all individual windows can be placed anywhere on the screen, to automatically place windows on a default layout, select **Gather Window**.

Default Window Size: (No function)

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4.4.3 MENU BAR DESCRIPTION (continued)
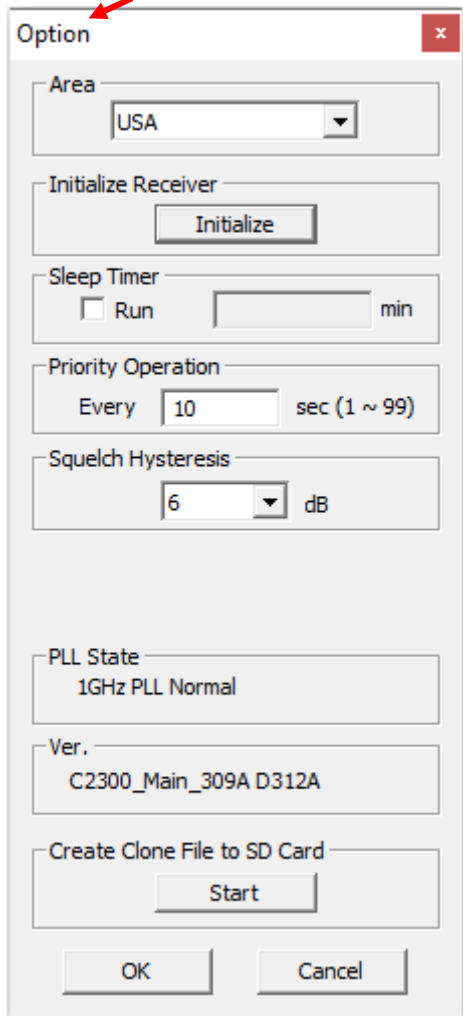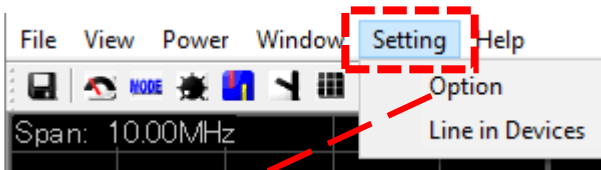
Area: Select the band plan region (USA, Japan or Europe).

Initialize Receiver: This will revert all settings to factory default and erase ALL memory data. It is advised to do a backup to SD before using this function.

Sleep Timer: Check the RUN box to activate, and set the number of minutes before the receiver goes to sleep.

Priority Operation: The priority feature permits checking for activity on one of the 2000 memory channels, while the AR2300 continues scanning, searching or monitoring. The receiver is momentarily tuned to the priority channel frequency to listen for any signal. If activity is found, the receiver will remain on the active frequency until the signal disappears.

Squelch Hysteresis: Sets the squelch hysteresis depth. For ex.: When squelch is -100dB and hysteresis is 6dB, the squelch opens when the reception level exceeds -100dB. The squelch does not close until the reception level is -106dB or less.

Create Clone File to SD Card: Saves all receiver settings and memory data to the SD card which is inside the receiver.
To restore such a backup to a receiver, from the MENU BAR go to FILE > SEND CLONE FILE ON SD CARD AFTER EXIT.
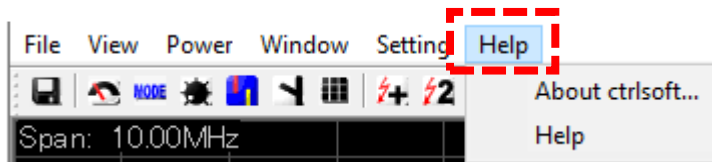
About ctrlsoft: Displays the software version. (Version 1.0.4.7 is final)

Help: Accesses the inline help file for this software. The content is outdated and supplied for reference only. The printed or pdf manual you are reading now is up to date.

4.4.4 DATABASE WINDOW DESCRIPTION

Frequency	Bank	Channel	Mode	Tone	Attenuator	Antenna	Priority	Select	Recording	Memo	Database	Bank Title	Pass	Voice SQL
0118.225000	00	010	AM(IF6k)	OFF	RF Amp:ON Att:0dB	Ant 1	OFF	OFF	OFF	air 1		Feb.16	OFF	ON
0119.100000	00	001	AM(IF6k)	OFF	RF Amp:ON Att:0dB	Ant 1	OFF	OFF	OFF	air 2		Feb.16	OFF	ON
0120.000000	00	002	AM(IF6k)	OFF	RF Amp:ON Att:0dB	Ant 1	OFF	OFF	OFF	air 3		Feb.16	OFF	ON
0121.250000	00	003	AM(IF6k)	OFF	RF Amp:ON Att:0dB	Ant 1	OFF	OFF	OFF	air 4		Feb.16	OFF	ON
0121.700000	00	004	AM(IF6k)	OFF	RF Amp:ON Att:0dB	Ant 1	OFF	OFF	OFF	air 5		Feb.16	OFF	ON
0121.825000	00	005	AM(IF6k)	OFF	RF Amp:ON Att:0dB	Ant 1	OFF	ON	OFF	air 6		Feb.16	OFF	ON
0124.200000	00	006	AM(IF6k)	OFF	RF Amp:ON Att:0dB	Ant 1	OFF	ON	OFF	air 7		Feb.16	OFF	ON
0125.000000	00	007	AM(IF6k)	OFF	RF Amp:ON Att:0dB	Ant 1	OFF	OFF	OFF	air 8		Feb.16	OFF	ON
0127.250000	00	008	AM(IF6k)	OFF	RF Amp:ON Att:0dB	Ant 1	OFF	OFF	OFF	air 9		Feb.16	ON	ON
0127.350000	00	009	AM(IF6k)	OFF	RF Amp:ON Att:0dB	Ant 1	OFF	OFF	OFF	air 10		Feb.16	ON	ON

MAIN MEMORY LIST
Single left click: Highlights the line
Left double click: Activates the related function
Slow left double click: Edits the content of this cell
Right click: Opens a sub-menu related to this line

PC keyboard P key: Tunes to the frequency of the upper line
PC keyboard N key: Tunes to the frequency of the lower line
PC keyboard + key: Sets the upper line as a sub-band frequency
PC keyboard - key: Sets the lower line as a sub-band frequency

SEARCH BOX
Allows incremental and case sensitive word search, narrows down to the column selected on the left side of the box.

MEMORY tab
List-up of all stored memory channels. Can be edited, increased and erased. Max. 2000 channels

MEMORY GROUP tab
Settings for each memory bank:
-Scan delay time (after signal is gone)
-Free time (arbitrary time for each signal)
-Bank enable / disable
-Bank linking

MEM BANK TITLE tab
Assign or edit a title for each of the 40 memory banks.

SEARCH BANK tab
Create, edit, erase search banks (max.40). Individually set the frequency, mode, step, RF amp and ATT values.

SEARCH PASS tab
Lists all pass frequencies created during a bank search. Each entry can be enabled, disabled or erased. Max. 30 pass frequencies per bank.

SEARCH GROUP tab
Settings for each search bank:
-Scan delay time (after signal is gone)
-Free time (arbitrary time for each signal)
-Bank enable / disable & linking

LOG TAB
Log file of all scan and search hits, including time stamp, signal level, mode, RF amp and ATT settings, and hit counts.
Each hit can be copied to a bank / channel.

DATABASE tab
List-up of the database which can be imported as a ".csv" file. Information is limited to frequency, receive mode and text. The descriptive text appears on the "main control" panel whenever a signal is received on a frequency stored in the database.

SCHEDULE tab
Schedule multiple events such as scan, search, VFO reception and audio recordings.

RECORDING tab
List-up of all audio recordings in "wav" format.
(AR2300 line-out needs to be connected to line-in of PC audio card)

ANT. SETTING tab
For frequencies over 25 MHz you can program an automatic selection between 2 antennas. Multiple band selections are possible.

4.4.5 DESCRIPTION OF CONTROL WINDOWS 1 AND 2

CONTROL 1
(S-meter)

CONTROL 2
(receive mode, etc)

The S-meter indicator shows the relative strength for the received signal in dB.

VFO
Stored tunable data that contains frequency, step, attenuator, etc. Each click on this icon toggles between the 4 available VFOs (A~D).

SEARCH
The receiver sweeps between previously set start and end frequencies, in search of active frequencies. Each click toggles to the next previously set search bank.

SCAN
The receivers checks a list (bank) of frequencies, in search of active frequencies. Each click toggles to the next previously set scan bank.

S.SCAN
The receiver checks a list of memory channels tagged as "select", in search of active frequencies. Maximum of 100 select scan channels throughout all 40 memory banks.

L.SCAN
The receiver checks ALL memory channels listed in the MEMORY tab, in search of active frequencies.

MONI
Click to temporarily set the squelch threshold level to 0 (open). Any signal level will be audible as a result. Click again to return to the previous squelch value.

+MEM
Click to add the currently received frequency to the main memory list tab. You will be able to specify the bank, channel, mode, antenna, RF Amp and ATT settings.

+PASS
While scanning or searching, the frequency received at the time you click this button will be excluded from your next scan / search.

OFFSET
To set an offset frequency, enter it via the PC keyboard and validate with the SPACE BAR. Click this button to tune the receiver to the offset frequency. Click again to return to the main frequency. Limitations: Only works for frequencies over 25MHz and IF filter max. 100kHz. Offset frequency must be withing +/-5MHz from the main frequency.

DUAL
To enter dual band reception mode. One band must be below, the other over 25MHz. To set the audio channel balance, left click on the 3 digits of the AF indicator in the MAIN CONTROL panel.

ANTENNA
"PRG" automatically switches to antenna 1 or 2 according to the programmable settings in the "Antenna Setting" tab.
You can also manually select the antenna by clicking "1" or "2".

MODE (AUTO IF BAND) / MODE
By clicking AUTO, the receive mode and IF filter bandwidth are chosen automatically by the receiver depending on the frequency. The "Auto IF Band" buttons allow you to manually select a mode, but the receiver sets the IF filter bandwidth automatically depending on the frequency. With the simple "Mode" buttons you can manually select the mode. IF filter bandwidth has to be selected manually.

4.4.6 DESCRIPTION OF CONTROL WINDOWS 3 AND 4

CONTROL 3
(AF, RF, SQL, etc...)

STEP
This is the frequency increment used when selecting a frequency using the blue tuning dial, or the PC keyboard's left and right arrows.
0.001kHz to 999.999kHz in 0.001kHz increments.

AF GAIN
Speaker and headphone volume slider.

ATTENUATOR and RF AMP
With the slider select either RF Amp: ON or OFF, Att:0, -10, -20dB, or AUTO. Refer to the Main Control window for selection indication.

AGC
The AGC function controls receiver gain to produce a constant audio output level even when the received signal strength is varied by fading, etc. Select either FAST, MID, SLOW or MANUAL (adjust the AGC level with the slider).

SQL (noise squelch)
Use the slide to adjust the squelch threshold level. The squelch removes noise output from the speaker (closed condition) when no signal is received.

VOICE SQL
This function opens the squelch only when receiving a modulated voice signal. Adjust aggressiveness and delay (time until squelch opens) with the slide bars.

IF BAND
Use the slide bar to select one of the 10 available IF bandwidth filters. Refer to the Main Control window for exact values.

IF SHIFT
The IF shift function changes the center of the IF (intermediate frequency) passband frequency to reject interference.
+/-1200Hz
Refer to the main control window for exact values.
Not active in FM modes.

CONTROL 4
(FFT Spectrum)

SPAN
Control the displayed spectrum bandwidth from 0.8MHz to 10MHz. The top left corner of the spectrum indicates the exact span value.

CALC
The calculation function offers 2 alternative spectrum modes:
MAXIMUM: Each sweep is retained as data and built-up on screen.
AVERAGE: Signal averaging over the sampling cycle. A stable pattern is produced even if the signal is fluctuating.

PEAKS
This function searches for the strongest signals in real time, in the displayed spectrum, above a threshold level you can set with the slide bar.
10 peaks maximum. Select 0 to erase all peaks.
You can tune to the strongest signal in the spectrum with MAX, or only in one half of the spectrum with LEFT or RIGHT.
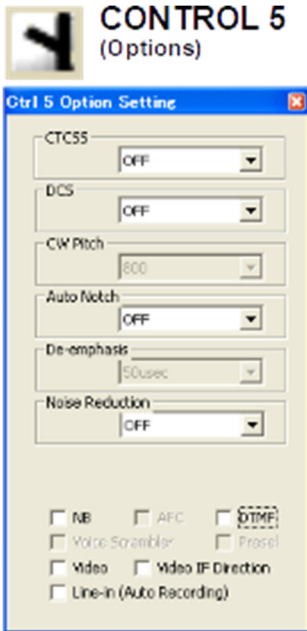
WATER FALL SPEED
Control the waterfall speed by moving the slider.

WATER FALL COLOR
Control the waterfall color codes depending on the signal strength between -30 and -110dB.

4.4.7 DESCRIPTION OF CONTROL WINDOW 5

CTCSS
Select a CTCSS tone frequency between 60 and 254.1Hz. The squelch will only open if that tone is received on the audio signal.

DCS
Set a code between 017 and 754 (or all). The squelch will only open if this signal code is received.

CW PITCH
Change the CW audio pitch from 300 to 900Hz in 50Hz steps.

AUTO NOTCH
Automatically attenuates beat tones, tuning signals, etc., even if they are moving. 3 levels of aggressiveness.

DE-EMPHASIS
Decrease the magnitude of higher frequencies for a better signal to noise ratio. WFM and FM only. Default: 50 μ sec.

NOISE REDUCTION
Reduces noise components and picks out desired signals which are buried in noise. Audio signal masking may occur. Set the level for maximum readability.

NB
Removes pulse-type noise. Not effective against natural noise such as atmospheric static.

AFC
Tunes the IF filter's center freq. automatically when an unstable frequency is received. (Changes not visible on spectrum!)

DTMF
If DTMF tones are present in a transmission, the decoded letters, numbers and symbols will be displayed in the main control window.

VOICE SCRAMBLER
Decodes voice inverted signals. The carrier frequency can be adjusted between 2kHz and 7kHz, in SETTING > OPTION.

PRESEL
RF preselection filters help to prevent overloading caused by strong out of band interfering signals. Only for frequencies below 25MHz.

VIDEO
Enables the video-out on the AR2300 front panel. Decodes and displays only analog video signals. Standard of the video display connected must match the video standard of the transmission.

VIDEO IF DIRECTION
Changes the video IF direction. Mostly used to receive analog wireless camera signals.

LINE-IN (AUTO RECORDING)
Check the box to start audio recording of the frequency actually received. A ".wav" file will be saved on your PC in the same folder than this program.
Note: AR2300 line-out needs to be connected to line-in of the PC audio card.
(To record to SD card, go to FILE > SD CARD)

4.4.8 DESCRIPTION OF CONTROL WINDOW 6

CONTROL 6
(Frequency input)

Ctrl 6 Frequency Pane.	❌

1	2	3
4	5	6
7	8	9
0	.	CLR
Close	kHz	MHz

To input a frequency, click on the ten-key digits and validate with kHz or MHz.
To cancel the last entered digit, click the CLR key.

5. AR2300 "I/Q SPECIAL EDITION" SPECIFICATIONS

GENERAL

Frequency range	40kHz to 3.15GHz
Frequency resolution	1Hz
Tuning steps - program	1Hz to 999.999kHz in 0.001kHz increments
Receiving mode	USB/LSB(J3E), CW(A1A), AM(A3E), FM(F3E), WFM(F3E), FM-Stereo(F8E), APCO P-25(D3E) Optional
Number of VFO	5 (A through E)
Memory channel	2,000 channels (50 channels x 40 Memory banks)
Memory bank	40 banks (each bank can be customized between 5 to 95 channels)
Pass frequencies	1,200 frequencies or 1,200 frequency ranges 30 frequencies(ranges) x 40 banks
Priority channel	1 (one)
Selected memory channel	100 channels through memory banks
Typical scanning speed	Approx. 100 channels/steps per second
Antenna impedance	50Ω
Operating temperature range	0°C to +50°C / 32°F to 122°F
Frequency stability	Less than ±0.1ppm after warm-up (5 minutes). Less than ±0.01ppm with optional GPS unit.
Power supply requirement	DC 10.7V to 16V, 2.0A @ 12V
Audio output	> 2W into 8Ω load
Power consumption*	Stand-by : 200mA, Max. Audio : 1.5A
Ground system	Negative ground
Dimensions*	285mm(D) x 220mm(W) x 70mm(H) 11¼" (D) x 8½" (W) x 2¾ (H)
Weight*	3kg. (6.6 lb.)

RECEIVER

Receiver system

40kHz - 25MHz	Direct conversion
25MHz - 220MHz	Double super-heterodyne
220MHz - 360MHz	Triple super-heterodyne
360MHz - 3.15GHz	Double super-heterodyne

Intermediate frequencies

1st	-	294.5MHz / 1.7045GHz
2nd	-	45.05MHz / 294.5MHz
3rd	-	45.05MHz

Third-order IMD

> +20 dBm	at	14.1MHz
> +9 dBm	at	50MHz
> +5 dBm	at	620MHz

Spurious and image rejection

> 70dB :	40kHz - 25MHz
> 50dB :	25MHz - 2GHz
> 40dB :	2.0GHz - 3.15GHz

Digital IF filter bandwidth
200Hz, 500Hz, 1kHz, 3kHz, 6kHz, 15kHz, 30kHz, 100kHz, 200kHz - Receiving mode dependant

Selectivity

CW - 500Hz	-3dB: > 380Hz -80dB: > 500Hz
AM - 6kHz	-3dB: > 5.5kHz -80dB: > 6.9kHz
SSB - 3kHz	-3dB: > 2.7kHz -80dB: > 3.1kHz
NFM - 15kHz	-3dB: > 14.2kHz -80dB: > 15.6kHz
WFM - 200kHz	-3dB: > 200kHz -80dB: > 250kHz

Sensitivity

Mode	SSB, CW	AM	FM	WFM
Test Method	10dB S/N	10dB S/N	12dB SINAD	12dB SINAD
Filter B/W	3kHz	6kHz	15kHz	200kHz
40kHz to 100kHz	2.0μV	4.0μV		
100kHz to 1.8MHz	1.2μV	2.0μV		
1.8MHz to 25MHz	1.0μV	2.0μV		
25MHz to 1GHz	0.25μV	1.0μV	0.5μV	1.5μV
1GHz to 2.4GHz	0.3μV	1.0μV	0.5μV	1.5μV
2.4GHz to 3GHz	0.5μV	1.7μV	0.5μV	2.5μV
3GHz to 3.15GHz	1.0μV	2.0μV	0.8μV	3.5μV

AUXILIARY FUNCTIONS

Simultaneous reception	Two types of simultaneous reception (dual-watch) are possible.
2 band reception	One HF (40kHz-25MHz) frequency plus one VHF/UHF(25MHz and above) frequency.
Offset reception	Main frequency plus sub-frequency (within ±5MHz from the center frequency) Offset reception is possible only for VHF/UHF.
Triple reception	Triple receptions are possible by combining simultaneous reception mode. I.E. One HF frequency plus offset reception.
Squelch system	CTCSS, DCS
Demodulation Aid	Auto Notch Filter(NOTCH), De-Noiser(NR), Noise Blanker, IF Shift, CW Pitch, AGC, AFC, DTMF APCO P-25 Digital voice decoder (option)

AUDIO RECORDING

Type of recording	Record/Playback function through SD or SDHC
SD card type	SD or SDHC card per SD Card Association More than 256MB is required. Use card adapter for miniSD and microSD cards. FAT16 and 32 only.
File Format	Windows compatible WAV file format. RIFF (little-endian) data, WAVE audio, Microsoft PCM, 16-bit mono 17.578kHz
Recording time	Approximately 8 hours of continuous recording by 1GB SD Card. Squelch synchronization is possible to eliminate inactive time.

INPUT & OUTPUT

Antenna Input	ANT 1: 25MHz - 3.15GHz, N-J connector ANT 2: 40kHz - 3.15GHz, N-J connector
10MHz reference input	SMA-J connector, Typical input: -2dBm±2dBm for 50Ω
45.05MHz Analog IF output	BNC-J connector, 45.05MHz±7.5MHz Typical output: Antenna input +10dBm for 50Ω Frequency range 25MHz - 3.15GHz only.
Digital I/Q output	USB2.0 compatible isochronous transfer Digital I/Q output through USB Type-A Jack. 0.9MHz bandwidth.
12kHz offset output	12kHz offset analog I/Q through 3.5mmΦ stereo-phone jack.
Line output	3.5mmΦ stereo-phone jack. (3-wire)
Accessory	8-pin miniature DIN
DC Power Input	EIAJ MP-121C (5.5 x 2.1mm) plug. Positive center.
External speaker	3.5mmΦ miniature phone jack (2-wire)
RS-232C	9-pin D-subminiature type (Male) - Firmware update and remote control by PC.
USB	USB Type-A; USB 1.1/2.0 Jack for PC control.
VIDEO output (Front Panel)	RCA Jack, 75Ω 1V p-p

Specifications subject to change without prior notice for product improvement or modification. * Power consumptions, size and dimensions are only approximate value. Dimensions does not include projections. E. & O. E.

SUPPLIED ACCESSORIES

AC power adapter, SD card, two USB cables, printed operating manual

WINDOWS software: "AR-IQ-III" with USB license dongle, "AR2300 Controlsoft", "IQ converter for GNURadio on Windows", "AR2300 Editing Software".

LINUX software: "ARL2300 local", "REL".

6.   WINDOWS SOFTWARE

6.1   AR-IQ-III (Receiver control, I/Q REC & playback)

1. Introduction and software description

To obtain the best possible results from your receiver, we strongly recommend that you read these instructions entirely. Every effort has been made to make this manual correct and up to date. Due to continuous developments of the receivers and this software, we acknowledge that there might be some changes, errors or omissions.

The AR-IQ-III software allows direct control of the receiver through a graphical interface. The I/Q digital output of the IQ5001 board represents the actual signal used after digital processing in the receiver. The digital I/Q output interface streams I/Q data to the PC through USB2.0 isochronous mode, at 72Mbit/sec with a sampling rate of 1.125Msample/sec. All commands are sent to the receiver through the receiver's remote control USB port.
Compared to a regular AF, which only allows recording one frequency at a time, I/Q allows you to store and playback a full 0.9MHz bandwidth with no loss of quality!
This 0.9MHz bandwidth can be anywhere within the receiving range of the receiver.
Off-line, you can listen and decode within the recorded 0.9MHz range, tuning any frequency as you would in real time. You can even loop a particular time frame to listen repeatedly to a signal received in difficult conditions, or search for and analyze hard to catch signals bursts.
It is also possible to move the I/Q data to another PC and to listen/decode it off line, provided the USB license dongle is inserted into that PC.
Please note that there is no inter-compatibility of wav files recorded with AR-IQ I, AR-IQ II and AR-IQ III, as they all use different headers.

2. PC requirements

Suggested PC system:
Supported OS: Win 7/8.1/10
Intel I7 CPU
16 GHz RAM
HDMI resolution monitor
Large size HDD for record/playback operations
Three available USB 2.0 ports are required (one for the I/Q stream, one for receiver control, one for the license dongle)

If you notice "audio stuttering" due to insufficient PC resources, it is possible to adjust the software's "Buffer Reads/Interval" to match your PC's specifications, as described in chapter 9 "ADVANCED PARAMETERS"

.3. Connecting the receiver to the PC

Connect the two supplied USB cables as pictured here. One cable is for the I/Q data output and the other for receiver control.
*   Make sure to connect the I/Q stream USB cable to a direct USB socket connection on your PC. Avoid using a USB hub.
*   Some type of USB 3 ports can be incompatible due to the particular chipset they use. If that occurs, use a USB 2.0 port instead.

（AR2300 rear panel）

I/Q output
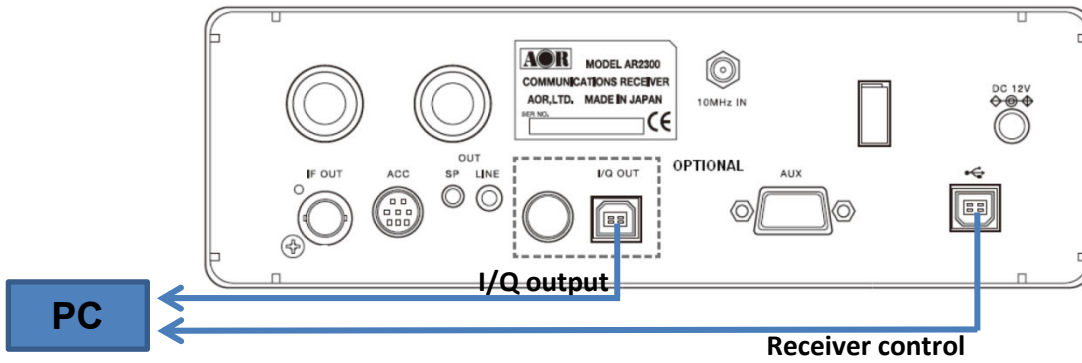
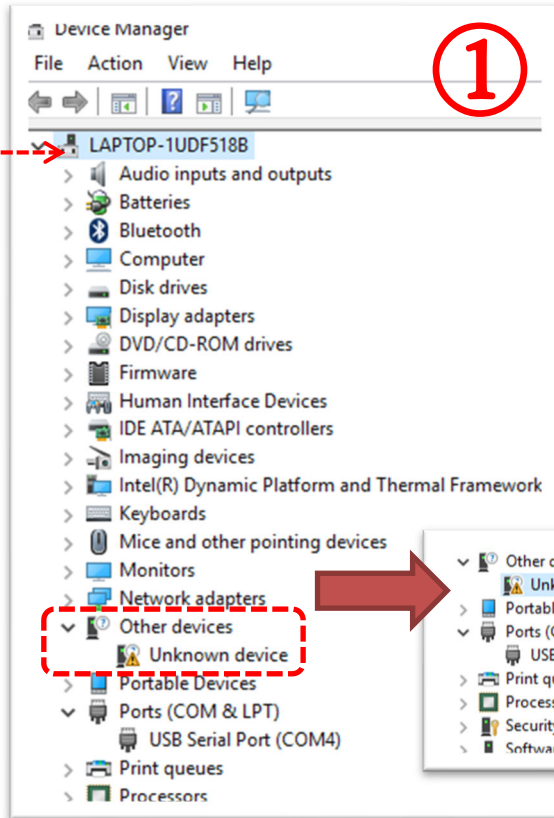Receiver control

4. Installing the drivers

There are 2 drivers to install: One for the I/Q output and one for the receiver control.
(All following instructions and screenshots are based on the Windows 10 operating system)

- Switch the receiver ON.

Depending on your Windows version and whether or not you have already installed the drivers on your PC before, it is possible that Windows automatically installs the drivers for you.
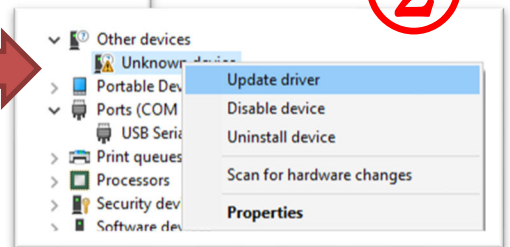
- To check the driver status, open WINDOWS DEVICE MANAGER (press simultaneously the Windows key and the X key, then select "Device Manager")

4-1 I/Q OUTPUT DRIVER INSTALL PROCEDURE:

⑦

LAPTOP-1UDF518B
  AOR
    AR-ALPHA
  Audio inputs and outputs

This is how the I/Q driver will appear in device manager, once the driver is installed.

⑥

Update Drivers - AR-ALPHA

Windows has successfully updated your drivers

Windows has finished installing the drivers for this device:

AR-ALPHA

① Device Manager

File   Action   View   Help

LAPTOP-1UDF518B
  > Audio inputs and outputs
  > Batteries
  > Bluetooth
  > Computer
  > Disk drives
  > Display adapters
  > DVD/CD-ROM drives
  > Firmware
  > Human Interface Devices
  > IDE ATA/ATAPI controllers
  > Imaging devices
  > Intel(R) Dynamic Platform and Thermal Framework
  > Keyboards
  > Mice and other pointing devices
  > Monitors
  > Network adapters
  > Other devices
      Unknown device
  > Portable Devices
  > Ports (COM & LPT)
      USB Serial Port (COM4)
  > Print queues
  > Processors

Other devices
  Unknown device
Portable Dev
Ports (COM
  USB Seri
Print queues
Processors
Security dev
Software dev

| Update driver |
| Disable device |
| Uninstall device |
| Scan for hardware changes |
| **Properties** |

②

The I/Q connection will first be detected as an "unknown device".

Right-click it and select "update driver"

③

How do you want to search for drivers?

→ Search automatically for updated driver software
Windows will search your computer and the Internet for the latest driver software for your device, unless you've disabled this feature in your device installation settings.

→ Browse my computer for driver software
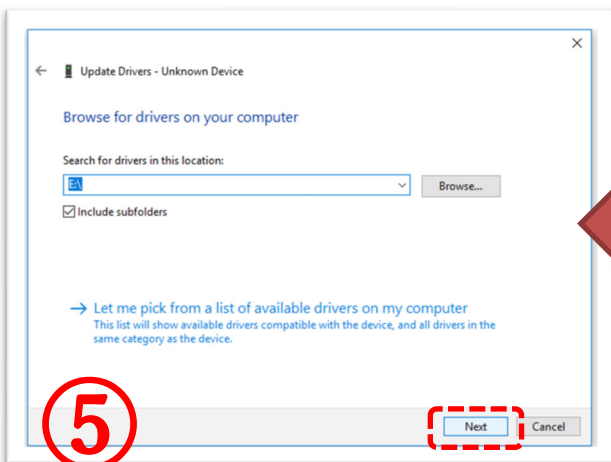Locate and install driver software manually.

Insert the supplied USB key into your computer. Navigate to:

(the USB key drive)> DRIVERS

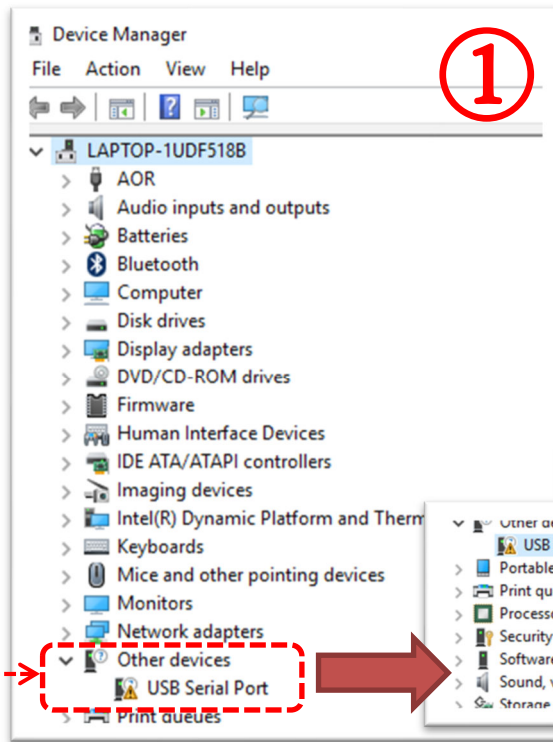and select the IQ DRIVER folder corresponding to your Windows operating system version.

④

Update Drivers - Unknown Device

Browse for drivers on your computer

Search for drivers in this location:

[E:\]   [Browse...]

☑ Include subfolders

→ Let me pick from a list of available drivers on my computer
This list will show available drivers compatible with the device, and all drivers in the same category as the device.

[Next]   [Cancel]

⑤

"Next" will load and install the driver.
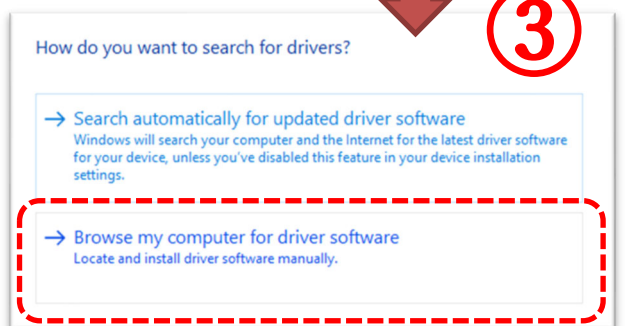
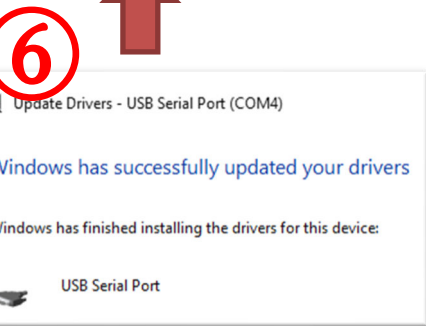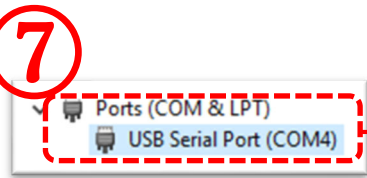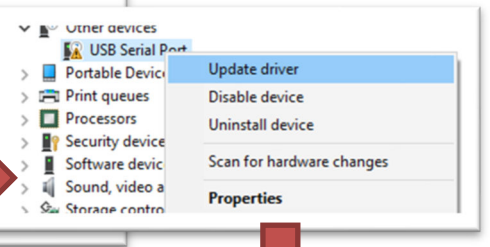## 4-2 RECEIVER CONTROL USB DRIVER INSTALL PROCEDURE:

Only necessary if for some reason the USB SERIAL PORT driver has not been automatically installed by Windows or your PC is not connected to Internet and you need to manually install the driver from the supplied CD.

① The connection has been flagged with a yellow exclamation mark under "Other devices"

This is how the USB SERIAL PORT driver will appear in device manager, once the driver is installed. The COM number (4 in this example) is automatically assigned by Windows

② Right-click it and select "update driver"

③

Insert the supplied USB key into your computer. Navigate to:

④

(the USB key drive)>DRIVERS>USB DRIVER x.xxx

⑤ "Next" will load and install the driver.

⑥

⑦
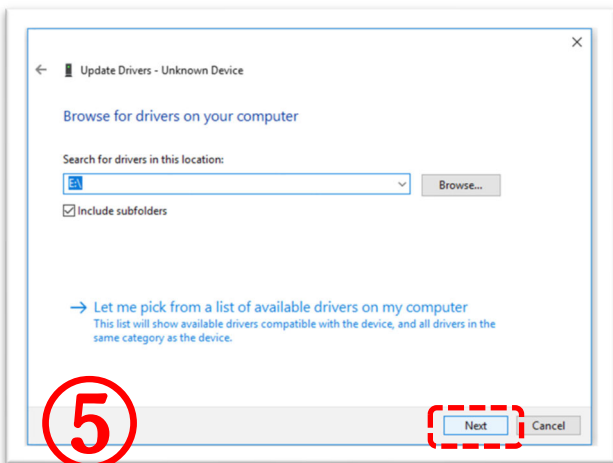
5. License dongle

① Insert the supplied USB license dongle in an available USB port of your PC. Windows will automatically install a driver, recognize it as a common USB flash drive and assign a drive letter such as "D:", "E:" etc.…

(Design may change)

WARNING: Our USB dongles are guaranteed without virus infection, nevertheless some virus detection software may incorrectly detect some of its files as a virus (or Trojan). This is called a false-positive alarm and does not mean that files are indeed infected. Whenever your virus detection software informs you about a possible threat, it usually gives you a choice of options about what to do next. Be sure to flag those files as SAFE files, otherwise the dongle's files might be rendered unusable or even deleted by the virus detection software, and the AR-IQ III software will not run. It is your responsibility to make sure that your virus detection software does not accidentally render the USB license dongle and I/Q software unusable. The license information data inside the USB dongle is unique and cannot be copied or backed-up. If you damage the USB license dongle, a new one needs to be purchased.

② Inside the USB dongle's main directory, locate the software's executable "ariq3.exe" and double click it to start the software. The software runs directly from the USB dongle.

③ When you start the software for the first time, Windows will ask you to which COM PORT the receiver is connected. Providing the correct number is entered, it will be saved in the registry, therefore you should not need to enter it again. Nevertheless, after connecting the receiver to a different USB port on your PC, the COM port number will change. If the com port number you entered is incorrect, the following error message will appear:
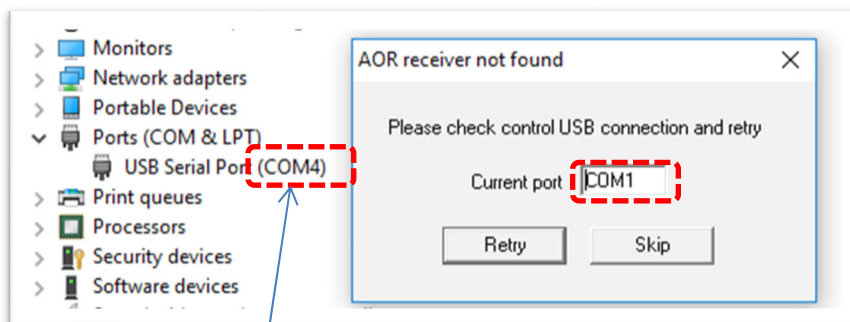

The COM PORT number is the one Windows automatically assigned in DEVICE MANAGER.

Note: ● The license information data inside the USB dongle is unique and cannot be backed-up, copied or moved. If you lose or damage the USB dongle, a new USB dongle needs to be purchased.
● Do not record I/Q data to this dongle and do not use the dongle to store any data.
● Formatting the USB dongle, overwriting or deleting its content will destroy the licensing system, and another USB dongle would have to be purchased.

6. AR-IQ III software operation

AR-IQ III interface:
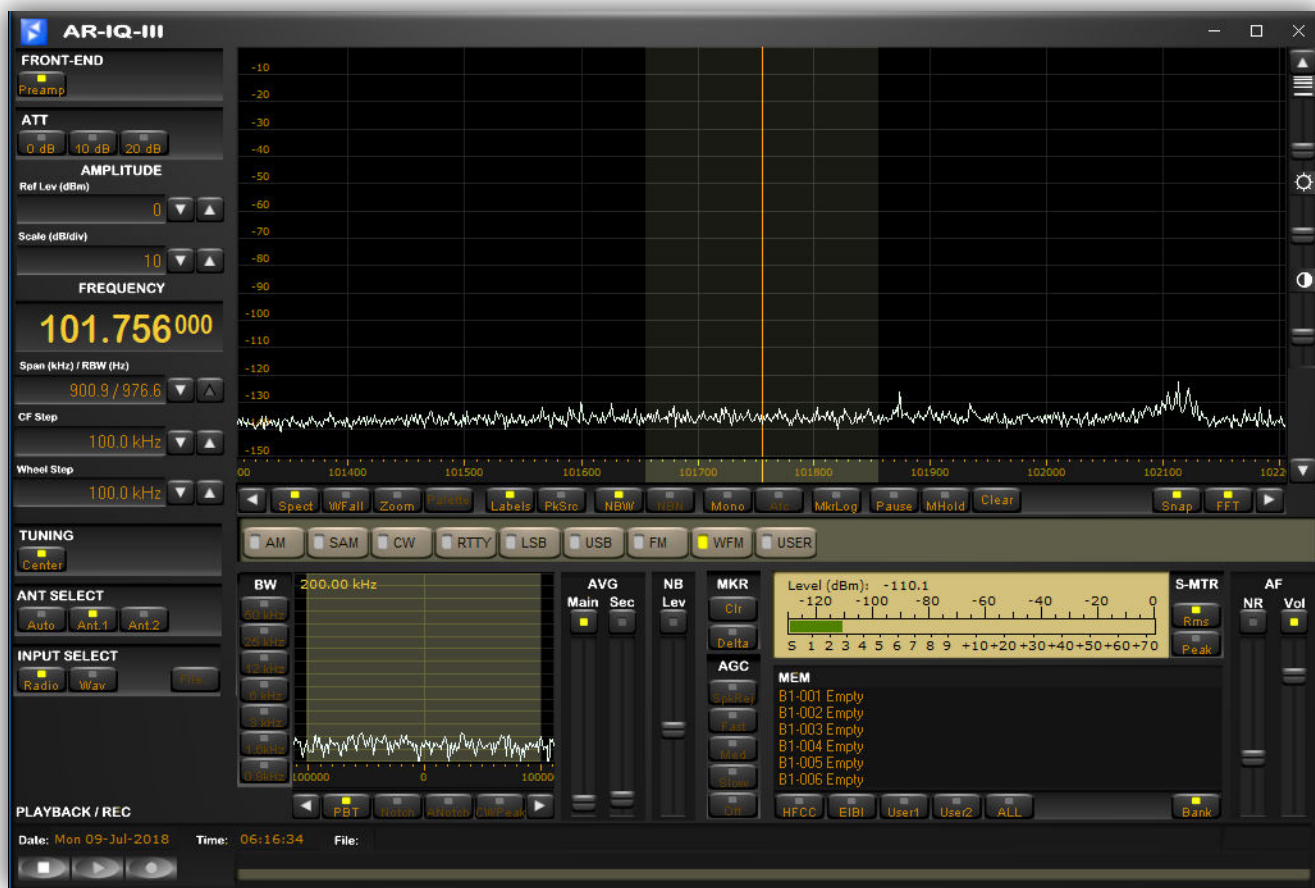
6-1 Frequency tuning

6-1-1 Frequency tuning with mouse wheel

Tuning with mouse wheel while hovering on the digits of the frequency indicator panel. The digit of the currently tuned frequency will be shifted upwards or downwards depending on wheel rotation direction.
Example: Let's say you are tuned to 101.756 MHz and you hover the mouse over the third digit "1". Then by scrolling up or down you will change the tuned frequency of 1 MHz for each scroll increment.

If you wish to tune by increments of 100 kHz, hover the mouse over the digit "7". Then by scrolling up or down you will change the tuned frequency of 100 kHz for each scroll increment.
To tune by increments of 10 kHz, hover the mouse over the digit "5". Then by scrolling up or down you will change the tuned frequency of 10 kHz for each scroll increment.
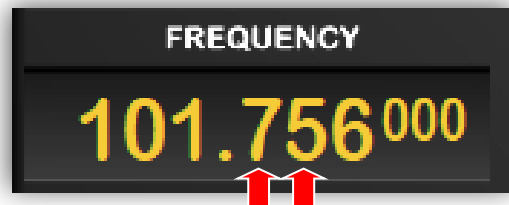
6-1-2 Frequency tuning by ten-key input

- Double click on the marked frequency indicator panel to display the ten-key window. This allows direct frequency input.
- Enter the desired frequency by clicking on the digits of the ten-key, including the [.] if necessary.
- Select [kHz] or [MHz]. The receiver will then be tuned to this frequency.
- Click on "Close" when that panel is not needed anymore.

.
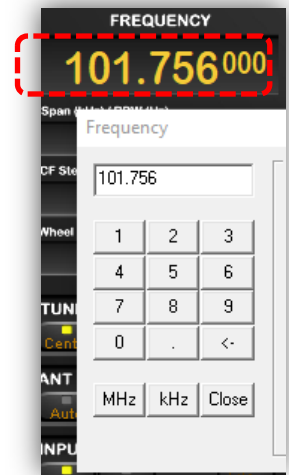
6-1-3 Frequency tuning by CF step

Clicking on the buttons with the white triangle, on either side of the main spectrum control bar does increment or decrement the frequency by the step size set in the CF STEP indicator panel.

(Main spectrum control bar)
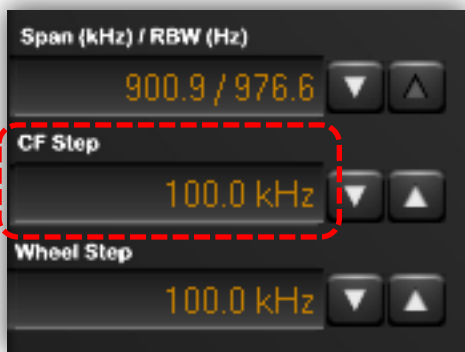
(Span, CF Step, Wheel Step indicator panel)

6-1-4 Frequency tuning with the frequency bar

A) Drag the frequency bar left or right while pressing the left mouse button.

B) Hover with the mouse over the frequency bar and scroll the mouse wheel up or down, at increments as set in the WHEEL STEP indicator panel.

25

6-1-5 Frequency tuning with the secondary spectrum window

Allows to fine-tune the filter passband in 3 modes: PBT, NOTCH and AMREJ.

a) PBT mode (Passband tuning)
Centers the carrier frequency you have double clicked on the secondary spectrum.
Press the left mouse button while dragging left or right does retune the center frequency.
Adjust the filter bandwidth with the mouse scroll. (30 Hz to 225 kHz, IF mode and BW dependent.)
Drag either filter edge. Hover with the mouse over the filter edge until a horizontal double arrow appears, then drag the filter edge while left-clicking.
Clicking on the white arrows does increase/decrease the frequency by the value set in WHEEL STEP.
Shift the entire filter by dragging it left or right, while pressing the right mouse button. This is an actual software emulation, therefore the received frequency and the frequency on the frequency panel do not change. Convenient for co-channel interference removal.
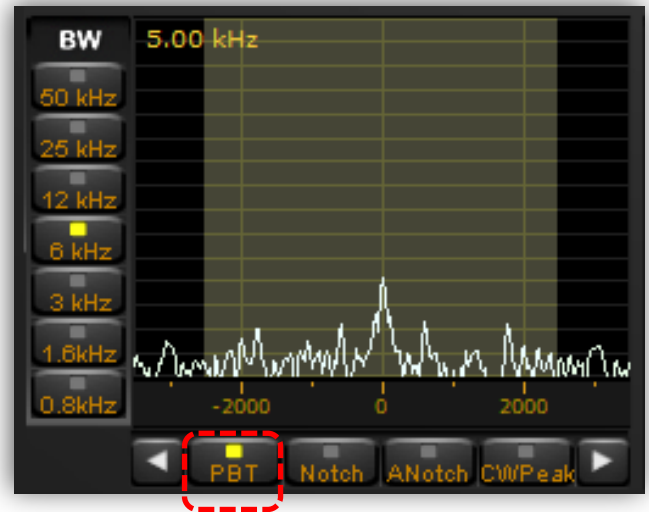
b) Notch mode (not active in WFM mode)
The notch function is effective for cycle noise on the receive signal.
To activate it, double click the offending signal on the spectrum.
Attenuation is tunable using the mouse wheel.
Filter signal can be dragged with the left mouse button.
The notch function is also accessible in the PBT mode, by pressing the CTRL key.
Deactivate the notch by right clicking on it.
The vertical yellow bar does mark the place where the notch has been applied. The frequency is displayed at the top of the bar (5.00 kHz in this example)
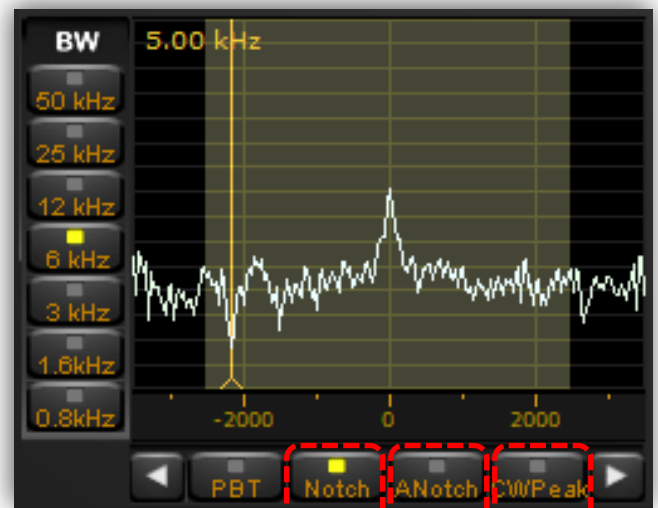
**c) ANotch (auto-notch) mode (not active in WFM mode)**
Automatically detects cycle noise and applies a notch on it. The slider with "Slow" to "Fast" markings determines the speed at which the notch is applied.

d) CWPeak filter
This is an adaptive filter for CW signals. It only works if there is a carrier. The slider with "Slow" to "Fast" markings determines the speed at which the filter adaptation takes place.

6-2 The main spectrum / waterfall window

Displays the spectrum with a bandwidth of up to 900 kHz. (+/- 450 kHz around the center frequency).
You can choose between spectrum view and waterfall view.
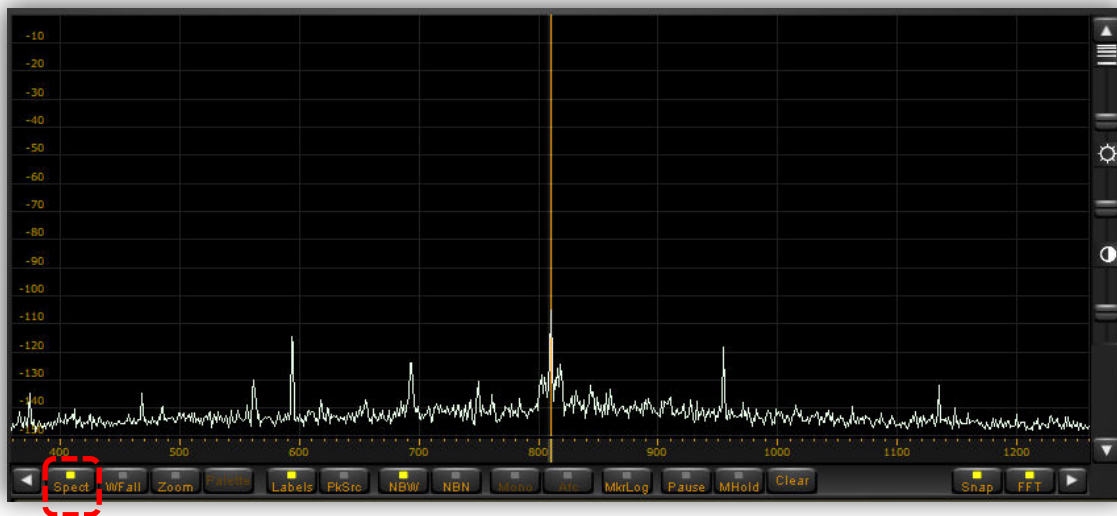
(Main spectrum view)
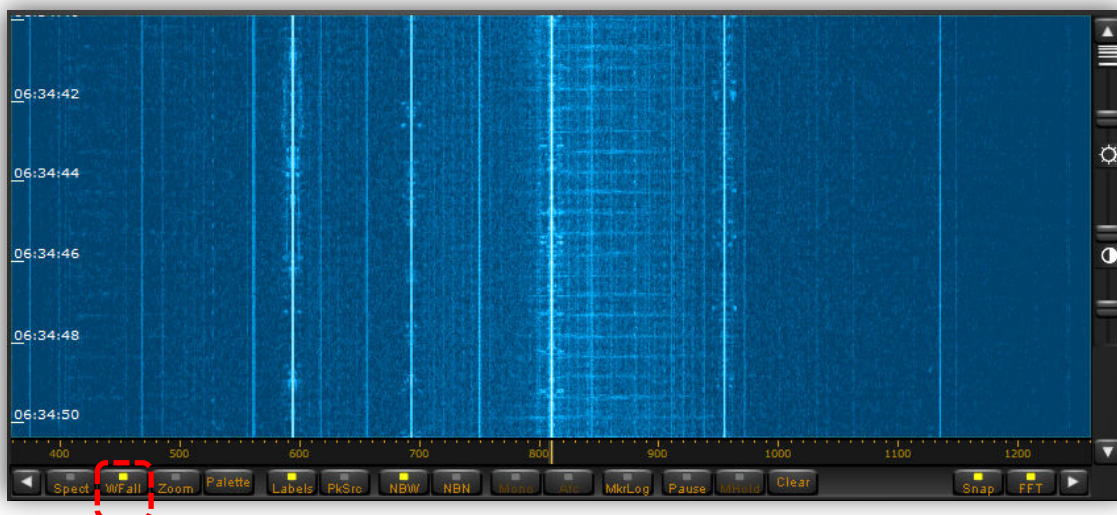
(Waterfall view)

6-2-1 Wheel step

This is the value by which the spectrum will be shifted by scrolling the mouse wheel, when the mouse is hovered anywhere over the spectrum or waterfall.
Possible steps are:
500kHz, 100, 50, 25, 12.5, 10, 9, 5, 1kHz, 100, 10Hz, 1Hz.

6-2-2 Frequency tuning by double click on spectrum

It is possible to "visually" decide to which frequency you would like to tune the receiver by double-clicking directly on the spectrum or waterfall. The minimum resolution is 1 kHz.

6-2-3 Frequency tuning by mouse drag on spectrum

Note: CENTER button in TUNING panel must be unchecked.
A faster way to quickly change frequencies "visually" on the spectrum is to hover your mouse inside the grayed-out range of the IF filter until the mouse pointer changes to a horizontal double arrow, then drag the mouse either left or right on to the spectrum while pressing the left mouse button.
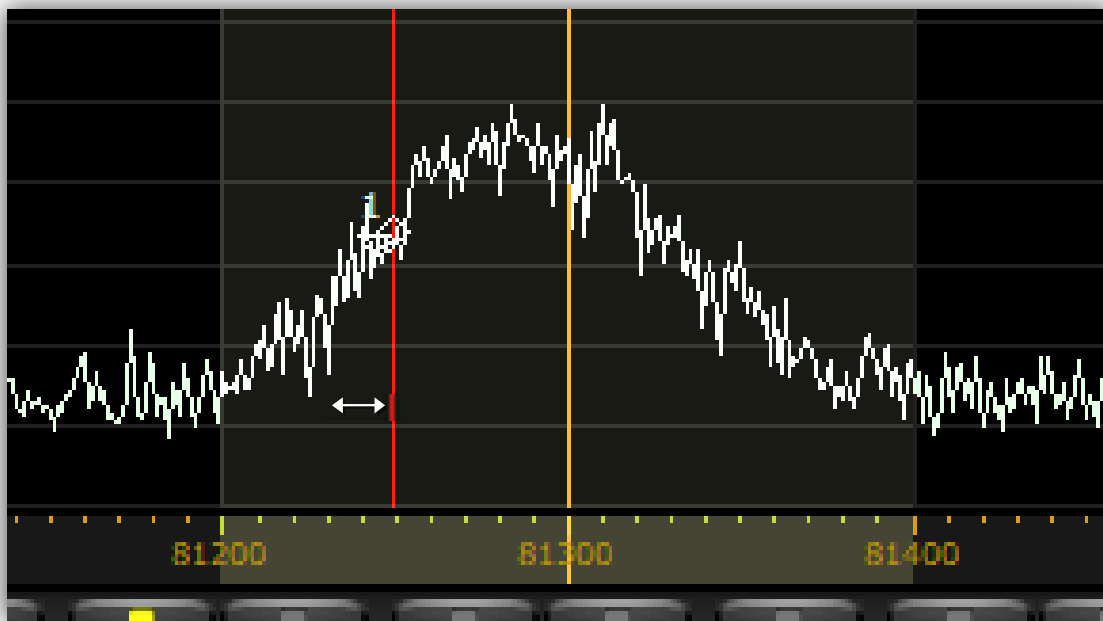

(Tuning by mouse drag)

6-2-4 Frequency tuning with "center" button ON

With this setting, the yellow tuning dial line will always represent the center of the frequency scale. Double clicking somewhere on the spectrum will shift the whole spectrum to the double-clicked frequency being the new center of the frequency scale. Doing so while in waterfall mode, will be the easiest way to understand the procedure.
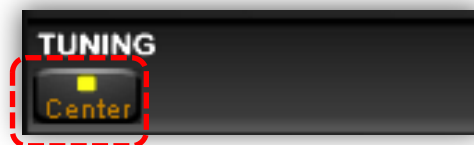
6-2-5 Frequency tuning with "center" button OFF

With this setting, the spectrum remains fixed, whereas the yellow tuning dial will jump to whatever frequency you double clicked on the spectrum. This mode is convenient if you want to search through frequencies between a fixed start and end frequency. Also, in the waterfall mode (see image below), you can keep track of active frequencies (vertical lines) no matter what frequency you are actually listening to.
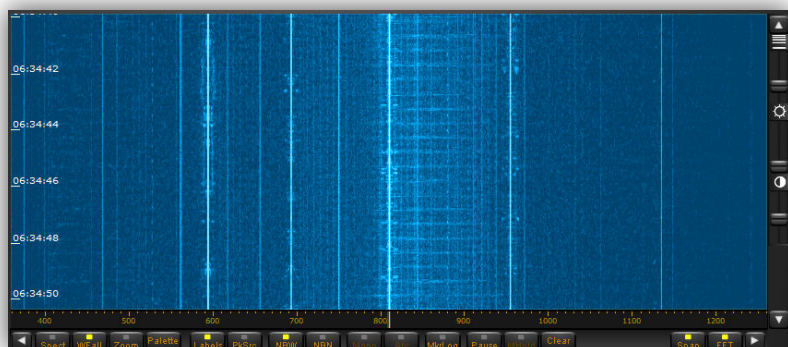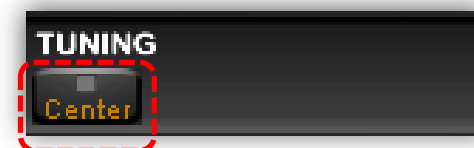
6-2-6 Span

The span is the width of the main spectrum window. You can choose between 900.9kHz, 450.4kHz, 225.2kHz, 112.6kHz, 56.3kHz, 28.2kHz, 14.1kHz, 7.0kHz, 3.5kHz.
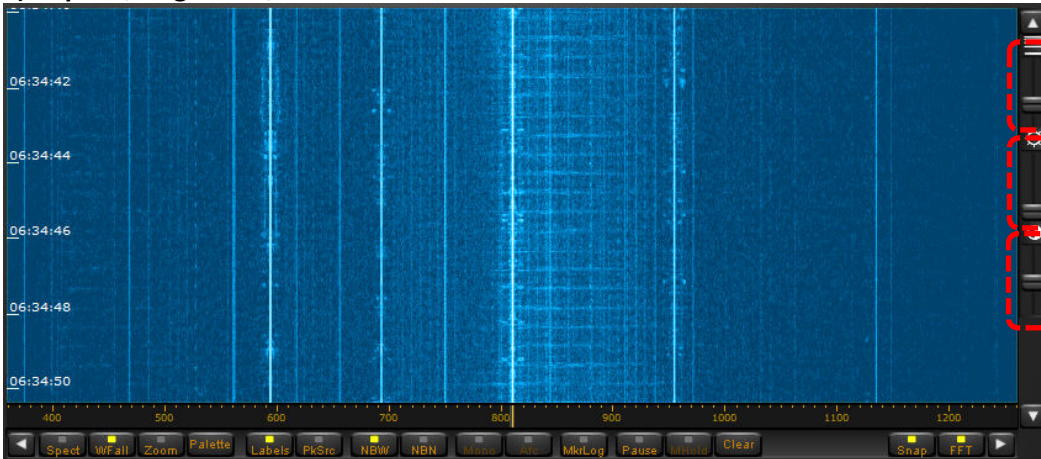
Used in both live reception and playback.

Please note that in order to provide the best possible spectrum accuracy, as per the rule 1FFT bin = 1 pixel, and to avoid resampling the spectral data, the full bandwidth of 900kHz can only be displayed when the program window is shrinked to its minimum width.
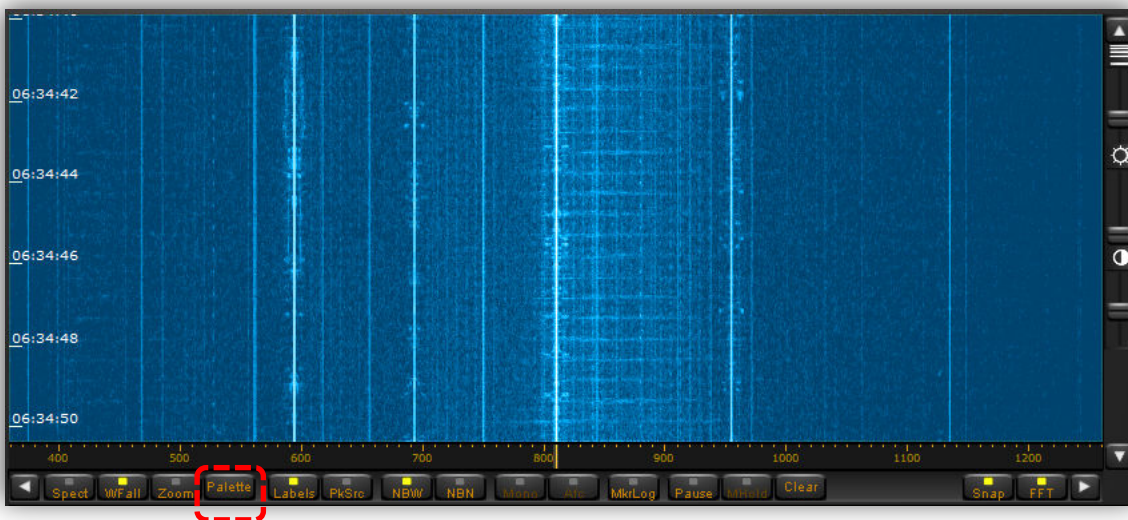
6-2-7 Waterfall control
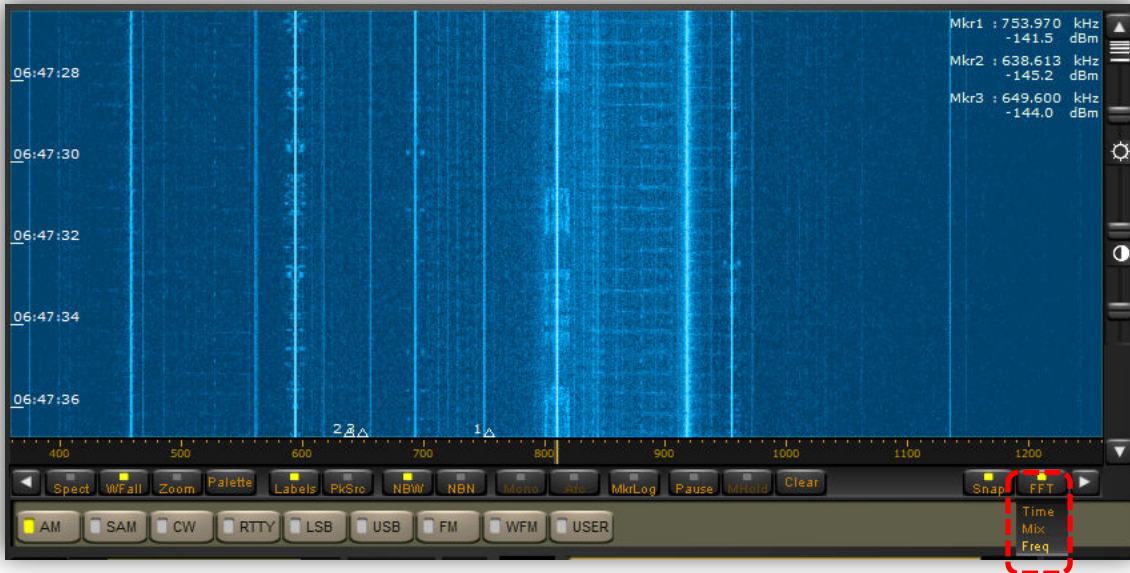
a) Speed, brightness, contrast

The 3 sliders on the far-right side of the spectrum window allow adjusting of the waterfall's speed, brightness and contrast for optimal viewing.

b) Color palette

Here you can decide which colors are displayed depending on the signal strength. Not active for regular spectrum view.

c) FFT resolution

The FFT sharpness (spectral resolution) can be improved at the expense of refresh rate. This function is particularly useful when analyzing strong carrier signals and carrier feed-through on adjacent bins has to be reduced at minimum.

Freq: offers the best performance at the expense of a slight degradation of the signal amplitude accuracy and refresh rate.

Time: Selects the FFT algorithm of previous software versions (FFT with Hann window)

Mix: Selects a polyphase FFT analysis with increasing window length (Polyphase FFT with quasi-flat-top amplitude response)

6-3 Marker

A right mouse click feature is available within the spectrum / waterfall panel. Right click on up to eight frequencies, and a small arrow appears. In waterfall mode, the arrow is situated where the signal waveform would be on the spectrum view. On the spectrum view, the arrows are located where the mouse was right clicked. The screenshot below shows the numbered arrows, relating to Mkr1-Mkr8 in small text on the top right. The frequency and signal intensity in dBm is also given.
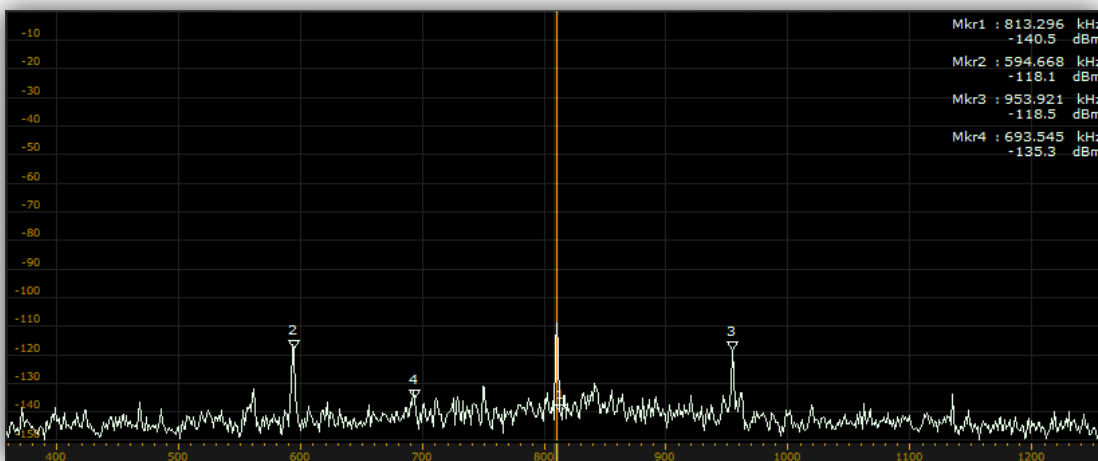
(Spectrum view with MARKER function enabled)

【Clr】 button: Clears the marker arrows from the spectrum / waterfall display.

【Delta】 button: This button changes the values from the markers 2 to 8 to delta values (different from MRK 1)

【Labels】 button: Activates a vertical scale at the left side of the spectrum window. When the scale is activated, the value of the frequency and of the amplitude of the signal at the frequency pointed by the mouse (indicated by the reference red line) will be shown.

【PeakSrc】 button: When activated, the frequency and the amplitude of the signal peak nearest to the reference line will be shown.
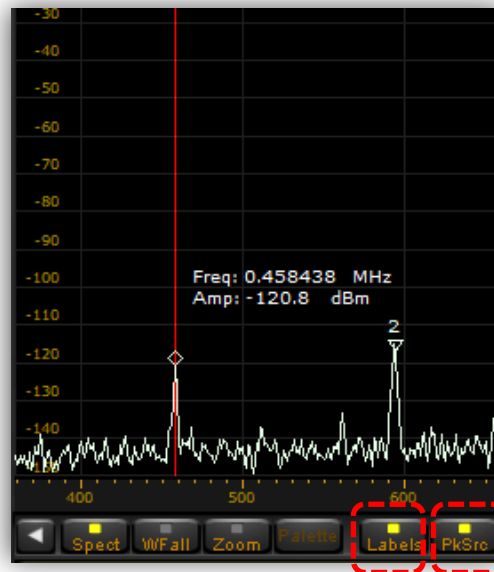
6-4 Spectrum average (AVG)
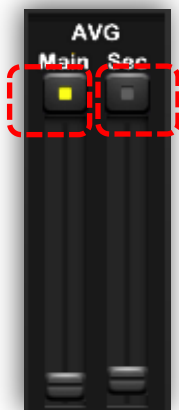
AVG Main: Stabilizes the spectrum waveform in the main spectrum / waterfall display. Will also stabilize the waterfall mode. The main spectrum average function and its slider control are active only when the enable button above the slider is enabled.

AVG Sec: Stabilizes the spectrum waveform in the secondary "bandwidth" display/panel. The secondary spectrum average function and its slider control are active only when the enable button above the slider is enabled.

7. I/Q recording & playback

AR-IQ III allows to record 900kHz of the RF spectrum directly to the PC's hard drive, and to play back the file at a convenient time, while having all features such as bandwidth, mode, passband tuning, etc....available as in a live reception situation.

The software will automatically divide the recording into "wav" files of approx. 2GB, which corresponds to approx. 4 minutes of recording. Although a recording is divided into multiple files, the playback will be without any interruptions. Every 4 minutes, a new .wav file will be created of which the 3 last digits will be automatically incremented.

For example:

XXX_000.wav

XXX is the file name you chose

After 4 minutes, the next file will be:

XXX_001.wav

And then every 4 minutes:

XXXXXX_002.wav

XXXXXX_003.wav   etc....

- The resulting .wav file can only be played back with the AR-IQ III software! It will not work in other media player software.

Controls:

Recording date   Recording time (UTC)

Stop Play Record   Progress bar   File location & name Available disk space

The recording date is based on your PC's system date; however the recording time is UTC.

7-1 Recording

To record, first select the center frequency of your choice.
Click on the record button at the bottom left of the window.
A new window pops up asking for a user defined file name and folder location to store the file. For ease of use it is advised to create a file name which includes the date, such as 180622 for June 22, 2018. The software will amend this file name with _000 to become 180622_000.
Note: During recording and playback, the frequency range (start and end frequency) cannot be changed.

7-2 Playback

To play back a file which has been recorded at an earlier time, click on the "Wav" button, within the "INPUT SELECT" panel.

The receiver stops receiving live signals and the "Wav" and "File" buttons are now activated. Click "File" and browse on the PC to the location of the pre-recorded file(s).
If your previous recording has created numerous automatically named files, the software will playback the whole series of files if required. This playback should be continuous and flawless, even during track / file change.
During playback, the software will display date and time in the same format as during recording.
Note: Playback of a .wav file will also work if the receiver is not connected to the PC.
- Playback will only work properly if the data is read off an internal HDD, or SSD. It is unlikely to function well off a USB key, USB hard-drive, DVD disk, or any networked storage device.

7-3 Fast forward & rewind

Left click anywhere on the progress bar to advance to a chosen point of the recording.

Actual playback point

Looped selection

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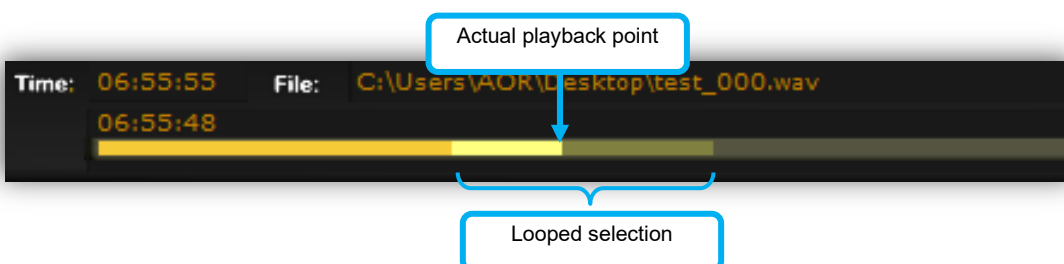
To loop the playback over a smaller selection, simply left click and hold at the desired spot on the progress bar. Drag the mouse pointer along to the right to create a new line, which will be a much paler shade of yellow. Release the mouse button to start playback immediately from the new desired spot. This should be flawless and instant. The player will repeat the new selected section only, over and over, until manually stopped. This may be useful if the user wishes to repeat a possible station ID over and over again.
A left click on the line cancels the new selection, and continues playback normally.

Troubleshooting: If the user fails to create a new line, but only "clicks" to attempt to advance playback by a few minutes, the software may seem to "stick". The player is probably only playing back a very small selected area over and over again, hence the impression of "stuttering and jamming".

8. Other controls

8-1 Antenna input

Allows manual or automatic antenna selection.

- Note regarding HF reception:

When receiving frequencies below 25MHz through the AR-IQ-III software, the HF antenna should be physically connected to the antenna socket #1, even though it's usually #2 when the receiver is used "stand-alone". This is due to the fact that the receiver's internal antenna wiring is different when used "stand-alone" vs controlled by software.

8-2 Pre-amp

Switches the receiver's front-end pre-amplification on. When in the ON position, the attenuator level is set to 0dB.

8-3 Attenuator

Like on a conventional receiver, the attenuator reduces signal input. This may be useful if a user has problems with strong local signals appearing on frequencies other than their own.
Possible selections: 【0dB】【10dB】【20dB】
Whichever selected, the "Pre-amp" is switched off.

8-4 Amplitude (reference level & scale)
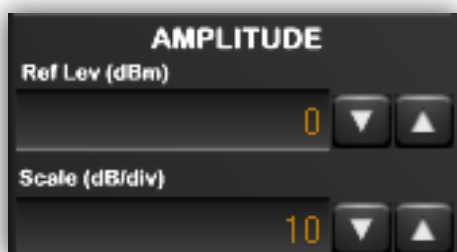
Both "Ref Level" and "Scale" alter the height and position of the spectrum waveform displayed when the spectrum mode on the main panel is selected, as well as the spectrum waveform in the secondary "bandwidth" window.

8-5 Demodulation modes

The following modes can be used:
AM, SAM (SYNC AM), CW, RTTY, LSB, USB, FM, WFM, USER (no function)

8-6 Volume & mute

Volume control is on the bottom right of the software, though many users prefer to use the volume on their external amplifiers. The button above the volume slider enables the audio output and mutes it when disabled.

8-7 Noise reduction

The NR control reduces background noise and is activated by the button above its slider control. The NR slider controls the amount of noise reduction. The noise reduction can be activated in all modes except with the USER demodulator.

8-8 Noise blanker (NB)

The NB control reduces impulsive noise and is activated by the button above its slider control. The NB slider sets the threshold of the noise blanker. Care should be exercised when strong signals are present in the band where the receiver is tuned. A too low NB threshold (NB slider at or near its maximum position) may affect the quality of the tuned signal and introduce intermodulation distortions.
Two noise blankers can be selected with the two buttons "NBW" (Wide) and "NBN" (Narrow).

The Narrow NB, operates on the bandwidth selected with the BW buttons (50 kHz, 25 kHz, 12 kHz, etc.).
The Wide NB is more effective when there are no strong signals in the bandwidth the DDC is tuned to.
The Narrow NB is more effective in all other cases.

8-9 S-meter

The signal strength meter (S-meter) is marked in both S points and dBm (S9=-73 dBm input). The S-meter response is very linear thorough all its scale and accurate to within less than 1 dB across the range.
LOCK indication: When operating in Sync AM mode (SAM), a small "LOCK" display appears at the top right of the meter, when the demodulator locks on to the AM carrier.
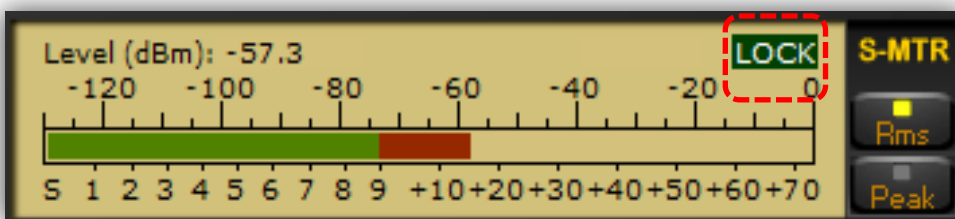
STEREO indication:
Whenever a stereo signal is decoded in WFM mode, a small "STEREO" display appears at the top right of the S-meter.
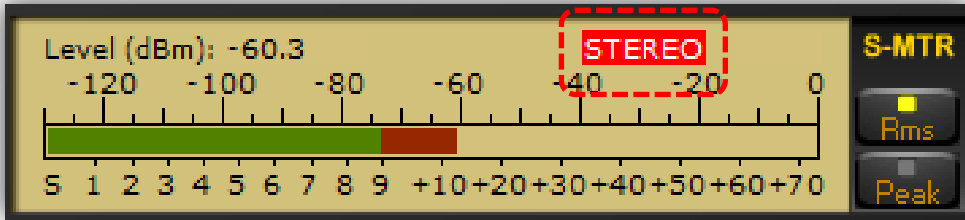
You can also force MONO reception by clicking the "Mono" button as follows:

The S-meter can be operated in RMS mode (input signal RMS power displayed) or in Peak mode (input signal peak power displayed) clicking the "RMS" or "Peak" at the right side of the S-meter.

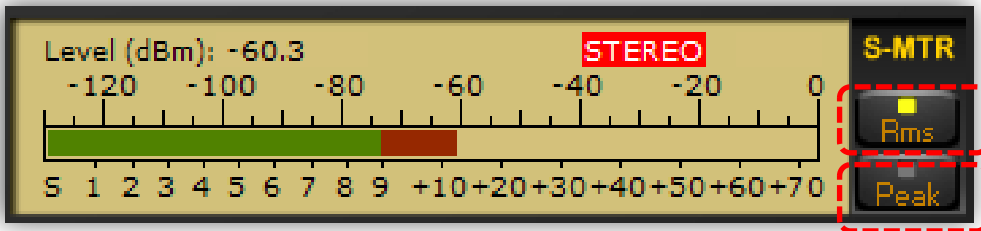**8-10 Squelch & auto-mute**

Squelch and Auto-Mute threshold levels can be controlled clicking the desired value in the S-Meter bar with the left button of the mouse.
The Auto-Mute function works in the opposite way of the squelch block. It mutes the audio when the RF input level is GREATER than the desired threshold.
The squelch level is set clicking the S-Meter bar in the S1-S9 zone. A triangle with a left oriented vertical side in the S-Meter bar indicates the selected squelch threshold.
The Auto-Mute level is set clicking the S-Meter bar in the S9 - S9+70 zone. A triangle with a right oriented vertical side in the S-Meter bar indicates the selected Auto-Mute threshold.
To disable the squelch and/or the Auto-Mute functions, right click the appropriate S-Meter zone.
The hysteresis of the squelch and Auto-Mute functions is approximately 6 dB.
The selected thresholds are peak values.


Squelch   Auto-mute

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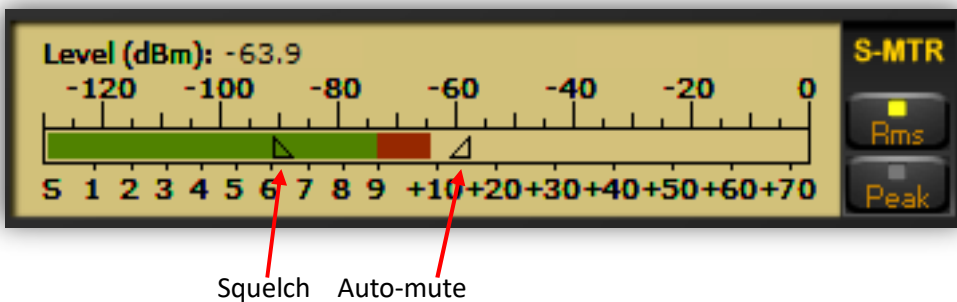
8-11 AGC (automatic gain control)

The Automatic Gain Control keeps the audio output at a constant output level, disregarding the input signal power. Three-time decay constants can be selected with the buttons "Fast", "Med", and "Low" in the AGC control bar.

The AGC can be excluded with the "Off" button. In this case the audio output level is controlled by the VOLUME slider. When the AGC is off, large input signals can cause the saturation of the audio output.

8-12 AGC spike rejection
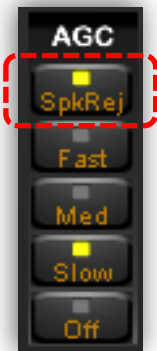
The Spike Rejection function emulates the behavior of the AGC of old analog receivers with a relatively long attach time constant. When this function is selected the AGC circuit is much less sensitive to impulse noise which can completely close the receiver gain and affect negatively the receiver performance.

NOTE: The Spike Rejection function introduces a small amount of (soft) audio distortion which is tolerable in SSB/CW communications and should not be activated for digital modes which may be far more sensitive than human hear to nonlinear distortions. Use this function only when required.
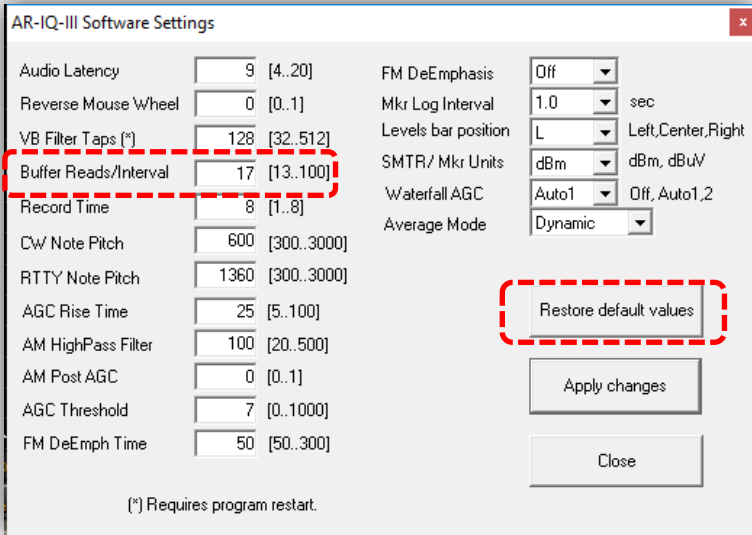
9. Advanced parameters & reset

Advanced settings are only for advanced users. Do only change its values if you really know what you are doing!

To access:
- Click on the blue icon
- Click on the "Software Settings" tab.

RESET:
To restore default values, click this button followed by the "apply changes" button.

Troubleshooting "audio stuttering":

If you notice "audio stuttering" due to insufficient PC resources, it is possible to adjust the software's **"Buffer Reads/Interval"** to match your PC's specifications.

This parameter controls the amount of data that the software reads from its data queue in a given time interval. If you increase it you will allow the software to read more data from the queue and this will prevent that the queue overflows causing audio stuttering.

Possible values are from 13 to 100. Default is 17. The higher the value, the less CPU power is needed, however it also degrades the vide refresh rate. If audio stuttering is noticed, try to increment this value by 1 and press "Apply changes" and continue to increment until audio is normal.

6.2   IQ for GNURadio (I/Q converter for use with GNURadio on Windows)

Tools to convert an AR-IQ3 recording made with the AR5700D receiver, to make it compatible with GNU RADIO on WINDOWS.
GNU Radio is a free & open-source software development toolkit that provides signal processing blocks to implement software radios.
Also works with recordings made via AR2300 / AR5001D / AR6000 equipped with the IQ5001 option.

Tested and confirmed to work on: Windows 10
It is very likely to work on WIN 7 and 8.1 as well, maybe with some slight differences. The best way to know is to try it out yourself!

Required Windows knowledge: Medium
You must be comfortable with operating the AR-IQ3 software, running scripts via the command prompt, and have basic knowledge about signal processing principles.

AR5700D, AR2300 / AR5001D / AR6000 + IQ5001 will simply be described as "receiver".

<supplied files>
* 00README.txt --- Japanese instructions
* ariq3_to_rawIQ.py --- Python script to convert an AR-IQ3 wav (I/Q) recording for GNU Radio (WIN) compatibility
* iq_IntInput.grc, iq_IntInput.py, grc-sample.png --- Sample GNU Radio (WIN) files (Minimum required version to load this grc file is 3.8. For version 3.7, build the blocks as depicted on grc-sample.png)

<How to use>

1. Preparations
1.1
An updated Windows 10 system with AR-IQ3 installed and ready to use, and a receiver connected to the PC via two USB cables.
1.2
Copy the folder "IQ for GNURadio Windows v.xxx" to your desktop. This folder is located in the following directory inside the supplied USB dongle: WINDOWS>IQ conversion for GNURadio
For making further steps easier, remove the version number from the folder name, so it is simply "IQ for GNURadio Windows".
The following instructions are based on a desktop location.
1.3
Install following software:
Gnu Radio (v3.8 or newer) for Windows. Binary installer download page:
http://www.gcndevelopment.com/gnuradio/index.htm

2. Record I/Q data
2.1
For your first test via the supplied GNU Radio template (iq_IntInput.grc), make a short FM broadcast (I/Q) recording with AR-IQ3, as described in the receiver manual. Once the recording is made, the receiver is not required anymore and you can also disconnect the USB cables.
2.2
Copy the I/Q data to the "IQ for GNURadio Windows" folder you created in step 1.2. (You can copy it to any folder you like, however the instructions here are based on that location)

3. Convert the I/Q data
(There are many ways to run a Python script, the below is just one example.)
Open a command prompt (Type cmd in the search box, then press Enter to open the highlighted Command Prompt shortcut.)
You will see something like this:

C:\Users\AOR>   ("AOR" will obviously be something else on your PC)

Now you have to change the current working directory to the "IQ for GNURadio Windows" folder on your desktop. Type as follows:

cd C:\Users\AOR\Desktop\IQ for GNURadio Windows

Press Enter

You will then see:

C:\Users\AOR\Desktop\IQ for GNURadio Windows>

Now we will run the supplied Python script "ariq3_to_rawIQ.py" to convert your I/Q recording which is "REC_000.wav" in this example. Type:

(We assume here GNU Radio is installed in its default directory.)

"C:\Program Files\GNURadio-3.8\tools\python3\python.exe" ariq3_to_rawIQ.py REC_000.wav

Press Enter

Be patient as the conversion process can take a while, about 90 seconds for 400MB recording on an Intel I5 system.

Once done, the following two files will be created in your "IQ for GNURadio Windows" folder:

REC_000_transI.raw

REC_000_transQ.raw

These are the two files to be used in GNU Radio for Windows.

4. Run GNU Radio

Double click the GNU Radio icon on your desktop.

It will take about a minute to start. You can ignore the scary warnings in command prompt but you have to keep that black window open for GNURadio to function.

GNU Radio opened for the 1st time:
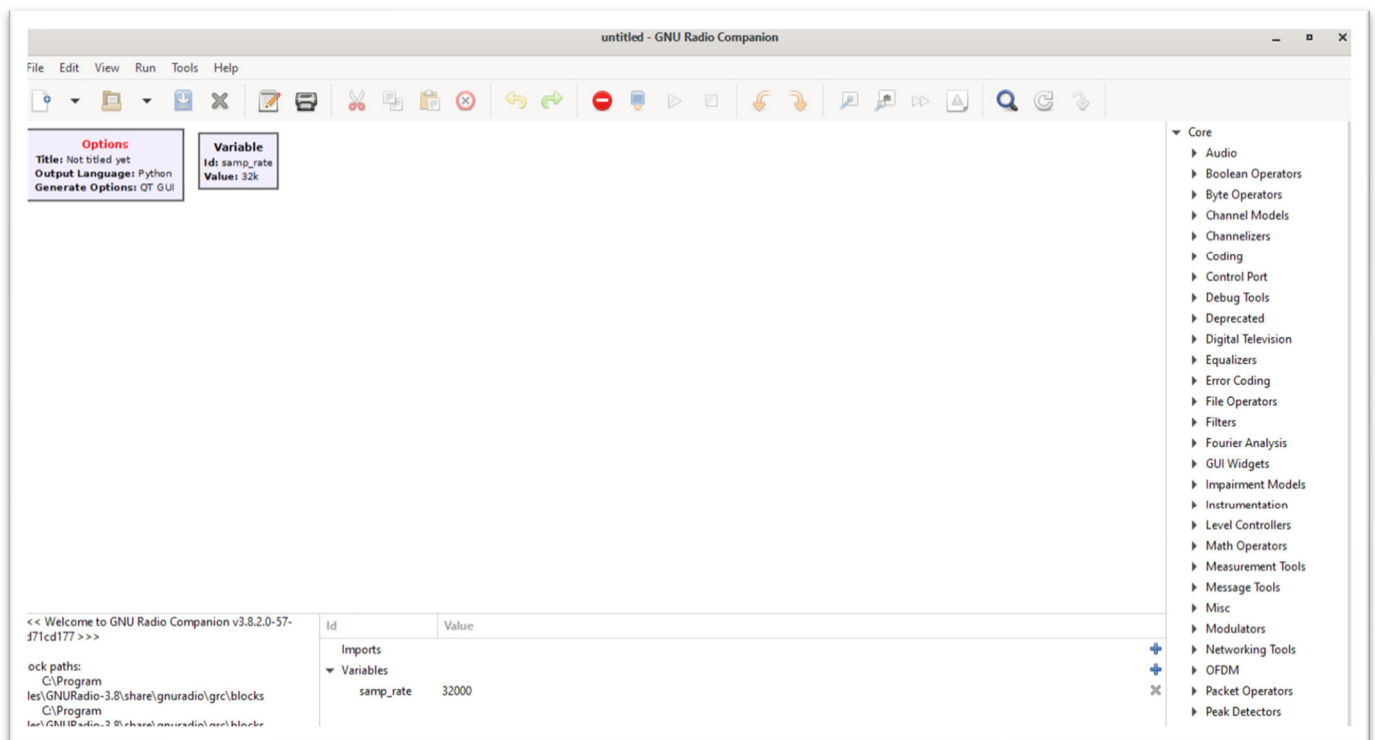
Now go to FILE > OPEN and open the supplied template "iq_IntInput.grc" located in the "IQ for GNURadio Windows" folder on your desktop.

It will look like this:
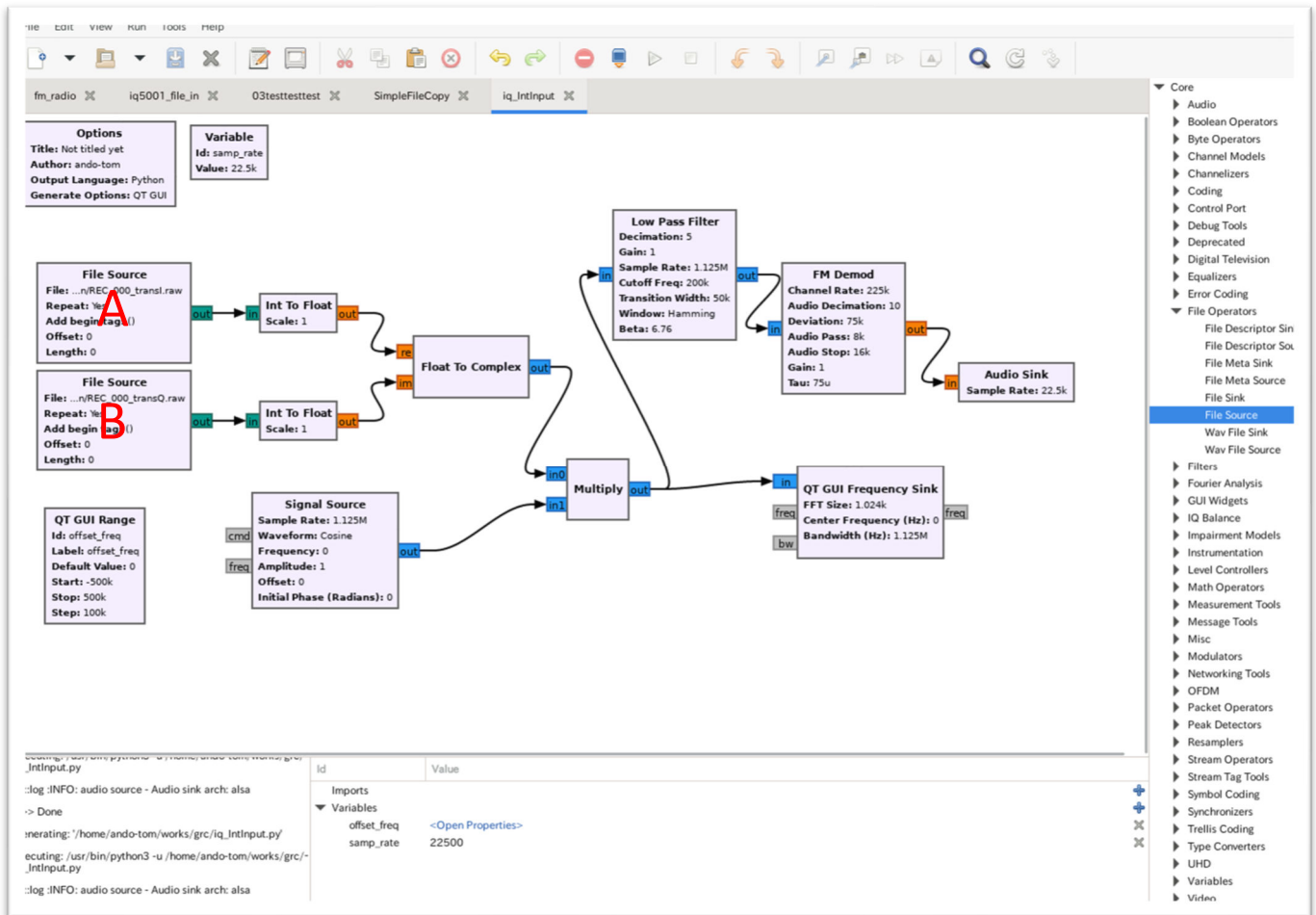
You are almost done. The last thing to do is to teach GNU Radio where you have placed your converted *.raw files. Right click the FILE SOURCE block marked "A" and select PROPERTIES.
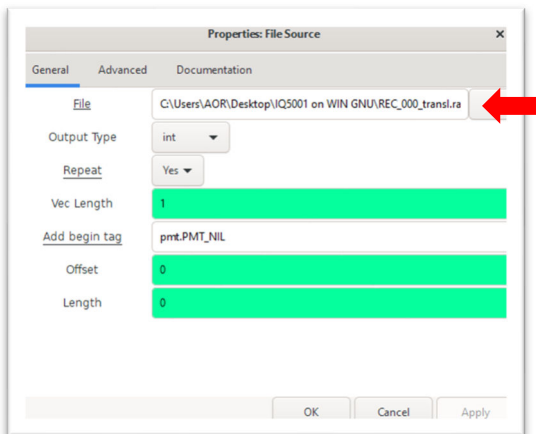
Click the box marked by the red arrow and select the "REC_000_transI.raw" file.
Now proceed likewise for the FILE SOURCE block marked "B" and select the "REC_000_transQ.raw" file.

You can now activate the template by clicking the play button:
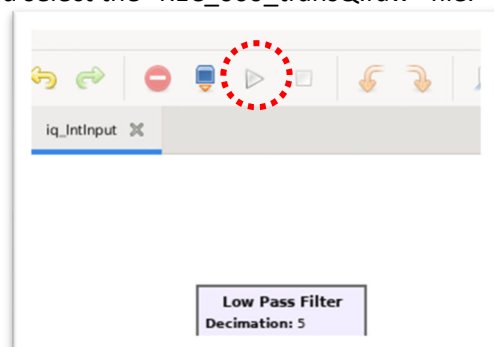
You should now hear the FM broadcast audio, and see the spectrum display being played back as follows:
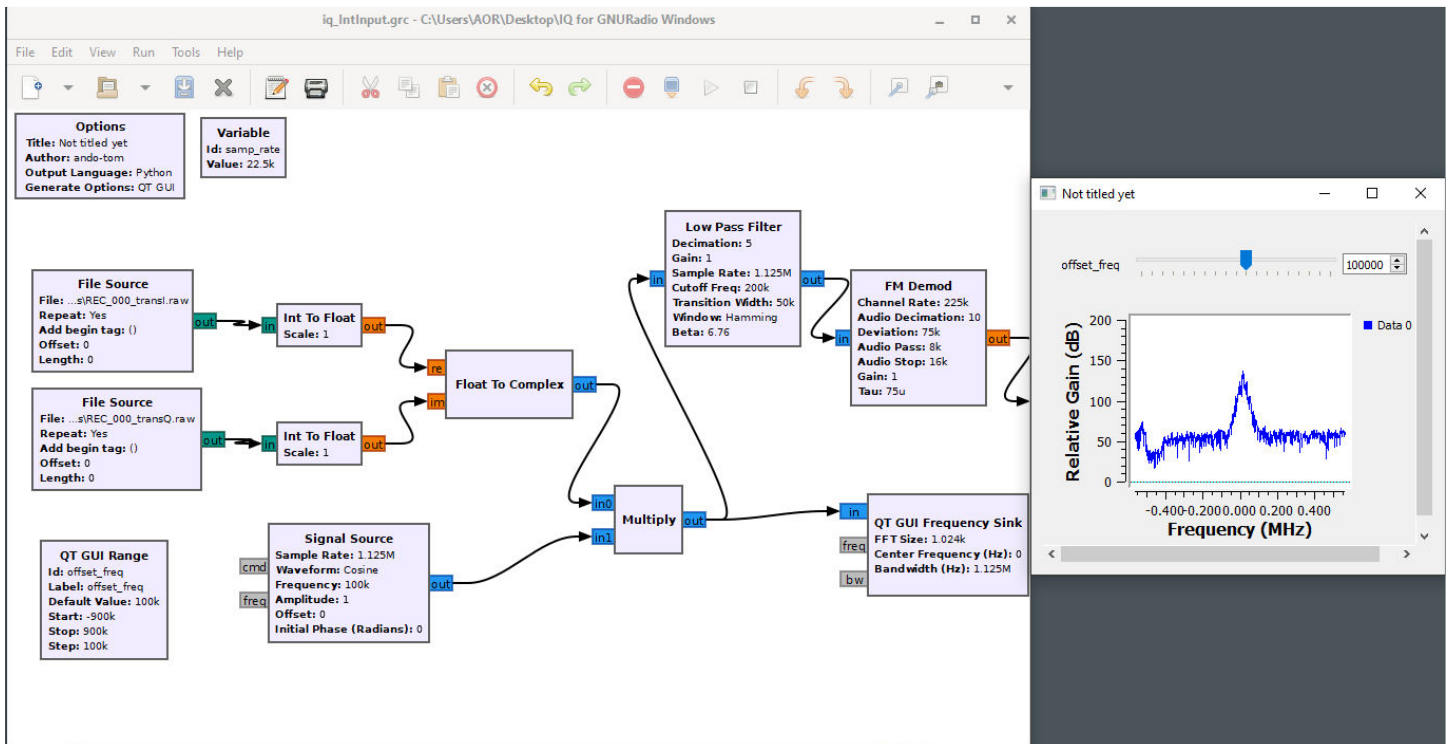
5. What next?

The supplied GNU Radio template is just a demonstration of the numerous and exciting things which can be done with an I/Q source file in GNU Radio.

If you want to learn more, visit the official GNU Radio website at https://www.gnuradio.org/ . They have numerous tutorials and a very extensive documentation available.

Have fun experimenting!

6.3   AR2300 Editing Software (Memory channel editor)

Conveniently manage memory channels, memory banks, search banks, scan groups and search groups.

1. Connect the hardware:
- Push the power switch on the receiver's front panel. The LED will turn orange/yellow, indicating the stand-by mode.
- Use one USB cable to connect the receiver's USB socket (labelled with a USB logo) on the back of the receiver, to the PC. (The I/Q connection USB cable is not required here)
  Providing that your PC is connected to the Internet, you do not need to manually install the supplied USB driver.

2. Check the driver status:
- Open WINDOWS DEVICE MANAGER
  (Press simultaneously the Windows key and the X key, then select "Device Manager")

Upon connecting the USB cable for the first time, Windows will first detect the USB connection as pictured:
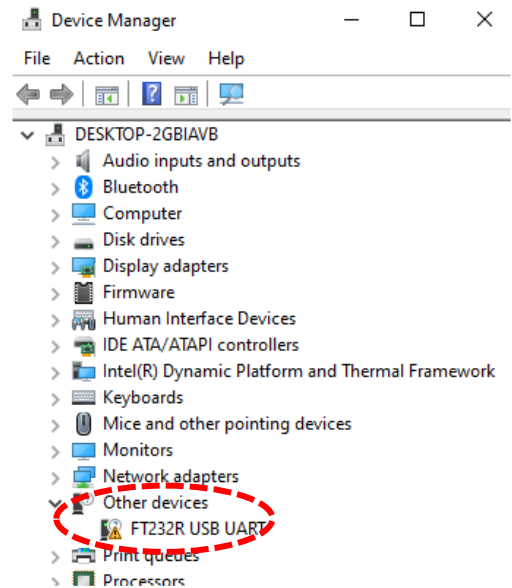
After Windows has automatically downloaded and installed the driver, Device Manager will list it as pictured:

(The auto-assigned COM number depends on your PC configuration.)

If manual USB driver installation is required, you will find it in the supplied USB key in the following directory:

(your USB key) > DRIVERS > USB DRIVER x.xx.xx.x

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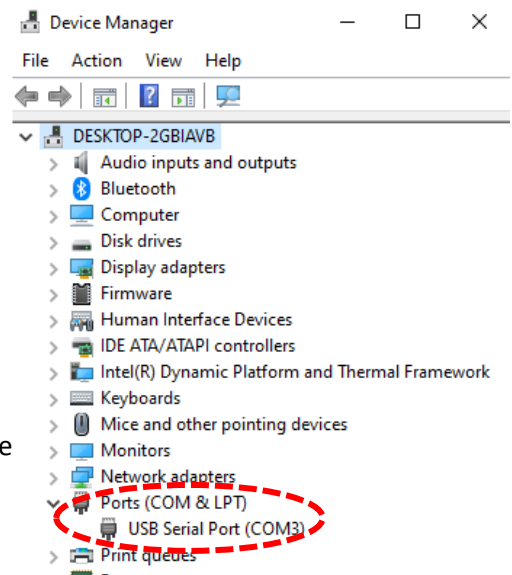
3. Using the software:

- Copy the file "AR2300 editing software v.x.x.x.x.exe" from inside the USB key (navigate to WINDOWS>Memory management) to any folder on your PC. The software does not need to be installed; it can be run as is.
- Double click "AR2300 editing software v.x.x.x.x.exe" to start the software.
- Click on the "Open" tab to connect the software to the receiver. Under normal conditions, the COM port to which Windows assigned the receiver's USB connection, should be detected automatically. If not, you can also select it manually (dotted selection).
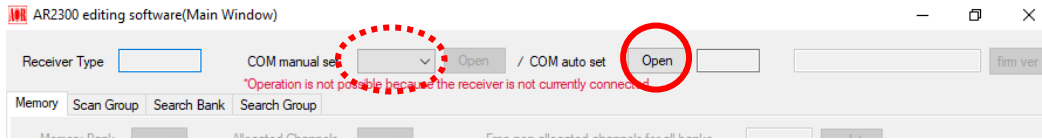
Software structure:

Memory tab: Read and edit the content of memory banks/channels.

Scan Group tab: Link memory banks

Search Bank tab: Create search banks

Search Group tab: Link search banks

Memory

Memory channel edit

Scan Group   Search Bank   Search Group

7. LINUX SOFTWARE

7.1 ARL2300 Local (Receiver control for Linux)

Following instructions are based on version 4.0.10.

Confirmed to work on:
Raspberry Pi O.S on RPI3/RPI4/RPI400
Linux MINT 20 on Intel Celeron PC
Ubuntu 18 on Atom PC
Ubuntu 20 on Intel I5 PC.
It is likely to work on any recent version of DEBIAN, UBUNTU and RASPBIAN.

Required Linux knowledge: Even beginners should be fine

<Supplied file>
* ARL2300LOCALv4.0.10.jar--- The software executable based on JAVA.

<Features>
* Local receiver control via USB, memory management, scan, search, basic spectrum display, audio recording to SD. Received audio via receiver audio outputs only. Simultaneous multi-receiver control on the same PC!
* The software can be used and shared freely, however the source code is not public.
* The software is supplied "as is" without any obligation of support.

<Preparing for receiver control>
1.
Install following packages:
$ sudo apt install openjdk-11-jre librxtx-java

2.
Set the login user name in vigr:
$ sudo vigr
(You can find out your login username by opening a command window. It will indicate for example "pi@raspberrypi". In this case, "pi" is the user name.)
In the vigr window, find the "dialout" line and make sure your login username is set. For example: **dialout:x:20:pi**
("pi" would be the login user name)
Save changes with CTRL+O and ENTER.
Close vigr with CTRL+X.
Set the login user name in vigr -s:
$ sudo vigr -s
In the vigr -s window, find the "dialout" line and make sure your login username is set. For example: **dialout:*::pi**
("pi" would be the login user name)
Save changes with CTRL+O and ENTER.
Close vigr -s with CTRL+X.

3.
Connect the receiver to the PC via USB. Beware that on the receiver the USB socket to be used is the one below the 12V DC socket. The other USB socket for I/Q is not used here!
Prefer a USB2.0 port as 3.0 sometimes might create problems.
Disconnect other USB peripherals (mouse & keyboard can stay connected) to avoid USB number allocation complications.
Now you can switch on the receiver.

4.

Check if the USB connection is correctly detected:

$ ls -l /dev |egrep ttyUSB0

If the reply is terminated by "ttyUSB0" as below, then it is detected correctly.

crw-rw---- 1 root dialout 188,   <date & time stamp> ttyUSB0

5.

Copy "ARL2300LOCALv.x.x.xx.jar" (located in the supplied USB key at LINUX > Receiver control) to your LINUX computer.

Go to the directory where you saved "ARL2300LOCALv4.0.10.jar". If it's into "Downloads", that would be:

$ cd Downloads

6.

Execute the program:

$ java -jar ARL2300LOCALv4.0.10.jar

(Some operating systems such as Linux MINT might require sudo)

Wait a few seconds until the program is launched.

If you can see "/dev/ttyUSB0" in the PORT section top left of the program window, then everything is OK and you can click CONNECT.

(Leave the command window open during use.)

For simultaneous multi-receiver control, launch another session of ARL2300LOCALv4.0.10.jar. in the PORT section top left of the program window, there should be a drop-down menu where you can select the USB port corresponding to the other receiver(s).

Known limitations:

-The spectrum display is basic.

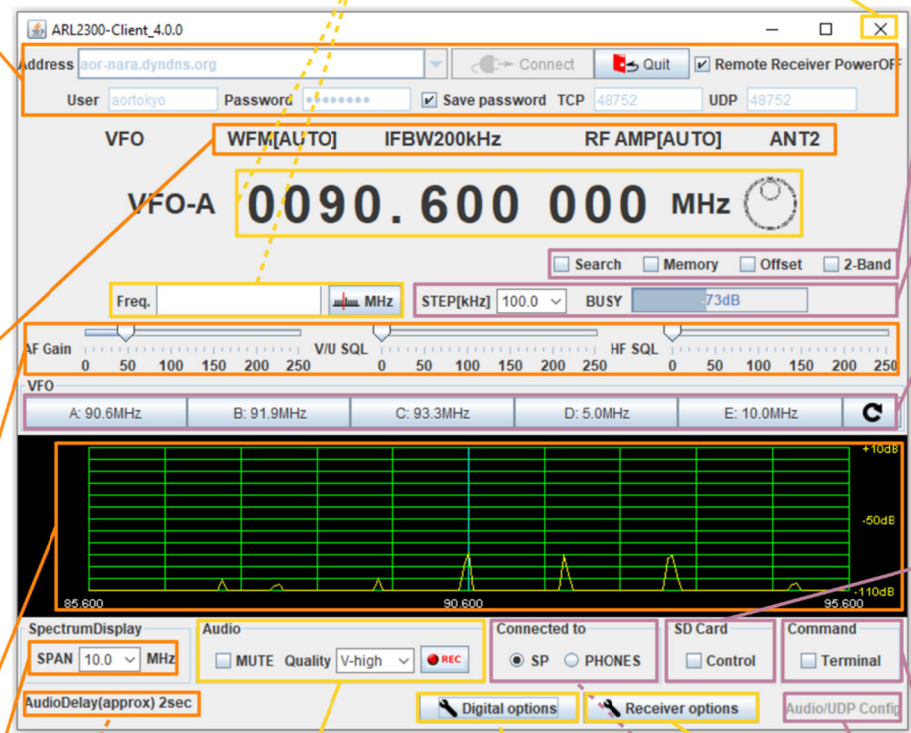-Audio recording to receiver SD card only.

ARL2300 CLIENT SOFTWARE

July 30, 2020

●Address
Enter the IP address or hostname of the ARL2300 Ethernet controller. Factory default hostname is: http://arlan-0.local

●User, Password
Enter the username and password assigned to the ARL2300 Ethernet Controller. Factory defaults:
User: arl2300x
Password: Arl_2300Q

●TCP, UDP
Enter the TCP and UDP port numbers assigned to the ARL2300 Ethernet Controller. Factory default is 48752 for both.

●Connect
Click the Connect button to connect to your ARL2300 Ethernet Controller and control the receiver.

●Quit
Click Quit button to disconnect from the ARL2300 Ethernet Controller. Setttings will be saved.

●Remote Receiver Power OFF
If checked, upon disconnection the remote receiver is also turned off.

●MODE
Select receiver demodulation mode. AUTO enables automatic mode selection of IF-BW and STEP. (AR5700D: Tetra GSSI group filtering not supported due to hardware limitation)

●IF-BW
Select IF bandwidth manually.

●ATT/AMP
Select input signal attenuation level or RF-Amp. AUTO enables automatic selection.

●ANT
Select an antenna, or ANT-PRG.

●AF Gain
Adjust the volume by dragging the slider or hovering the mouse over the slider and scrolling the mouse wheel up or down.

●V/U SQL, HF SQL
Adjust the squelch level: Use HF SQL for frequencies below 25 MHz, and V/U SQL for over 25MHz.

●Spectrum Display
Spectrum displayed in real time. Receive frequency is the center frequency.
Click on spectrum: Receiver is tuned to the clicked frequency.
Mouse wheel:
Change span of spectrum display (400kHz to 10MHz).

●SPAN
Select span of spectrum display (400kHz to 10MHz).

●AudioDelay
Shows audio output delay time between receiver and client.

●Frequency
Change the receive frequency by either:
- Hovering with the mouse over each digit and scrolling the mouse wheel up or down.
- Entering the frequency via the PC keyboard + ENTER key or click [MHz] button.
- Hovering with the mouse over the dial symbol and scrolling the mouse wheel up or down.

●Close button (X)
Closes this software window. However click the QUIT button first, otherwise settings will not be saved.

●Search
Tunes through all frequencies between 2 specified frequency limits. Search instructions may be programmed into linkable "search banks".

●Memory
Create and scan banks of memory channels. Banks can also be linked.

●Offset
Simultaneously receive one main frequency and one sub-frequency within +/-5MHz from the main frequency. (Above 25MHz only)

●2-Band
Simultaneously receive one frequency below and one frequency above 25MHz.

●STEP [kHz]
To manually select a frequency step from the dropdown list.

●BUSY
Shows an open squelch. Grayed out when squelch is closed.

●S-Meter
Shows received signal level in dB.

●VFO-A, B, C, D, E
Select a VFO to operate on.
The curved arrow sign button does import all VFO content from the receiver.

●SD Card Control
When a SD card is inserted in the receiver, you can activate recording, play back and delete audio files.

●REC
Click REC button to start recording.File name format according to date and time; "MMDDhhmm.WAV". Note: Same file names are overwritten.

●PLAY
Select a file and click PLAY button to start play back of the selected file.

●DEL
Select a file and click DEL button to delete the selected audio file.

●STOP
Click STOP button to stop recording or play back.

●Command Terminal
Enable the terminal window for sending commands to the receiver. (Details chapter 7.3 in the ARL2300 user manual.)

●Audio/UDP Config
(Can only be changed at client start, before the connection) Manually set the audio delay and UDP length.

●SP / PHONES
Choose audio source of the ARL2300.
Either SP OUT or PHONES socket of the receiver.

ARL2300-Client_4.0.0

Address: aor-nara.dyndns.org | Connect | Quit | ☑ Remote Receiver PowerOFF

User: aortokyo | Password: ●●●●●●● | ☑ Save password | TCP: 48752 | UDP: 48752

VFO | WFM[AUTO] | IFBW200kHz | RF AMP[AUTO] | ANT2

VFO-A **0090.600 000** MHz

☐ Search ☐ Memory ☐ Offset ☐ 2-Band

Freq. | [MHz] | STEP[kHz] 100.0 | BUSY -73dB

AF Gain 0 50 100 150 200 250 | V/U SQL 0 50 100 150 200 250 | HF SQL 0 50 100 150 200 250

VFO
A: 90.6MHz | B: 91.9MHz | C: 93.3MHz | D: 5.0MHz | E: 10.0MHz | ↻

+10dB
-50dB
-110dB
85.600 | 90.600 | 95.600

SpectrumDisplay: SPAN 10.0 MHz
AudioDelay(approx) 2sec

Audio: ☐ MUTE Quality V-high ● REC

Connected to: ● SP ○ PHONES

SD Card: ☐ Control

Command: ☐ Terminal

Digital options | Receiver options | Audio/UDP Config

●MUTE
Check to mute audio of this client.

●Quality
Adjust streaming and recording audio quality (MONO ONLY):

SETTING	LIVE SOUND	RECORDING TO PC
V-LOW	ADPCM 4bits/8kHz	16bits/8kHz/128kb/s
LOW	u-law 8bits/8kHz	16bits/8kHz/128kb/s
MIDDLE	PCM 16bits/8kHz	16bits/8kHz/128kb/s
HIGH	PCM 16bits/16kHz	16bits/16kHz/256kb/s
V-HIGH	PCM 16bits/22.05kHz	16bits/22.05kHz/352kb/s

●REC
Click to record audio on the client PC. Wav files are saved in the same folder than the client program.

●Receiver options
For various settings regarding CTCSS, DCS, voice squelch, noise reduction, notch, noise blanker, AFC, HF preselection filter, AGC, RF gain, IF shift and analog voice descrambler.

●Digital options
(Only with AR5700D receiver) Various settings regarding NXDN/DCR, DMR, P25 and TETRA signal decoding.

SUB-MENU STRUCTURE OF THE ARL2300 CLIENT SOFTWARE

SEARCH BANK

SEARCH GROUP

SD CARD

AUDIO

SCAN GROUP

MEMORY BANK

MEMORY BANK SETTINGS

RECEIVER OPTIONS

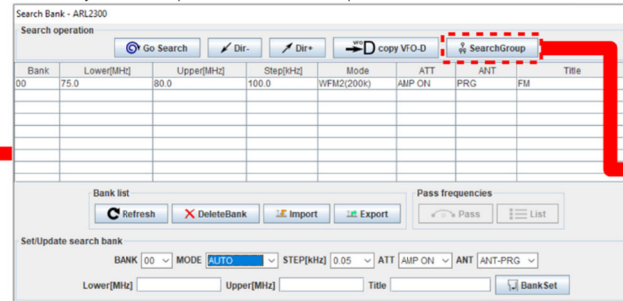**COMMAND OUTPUT**

2BAND

DIGITAL OPTIONS

OFFSET
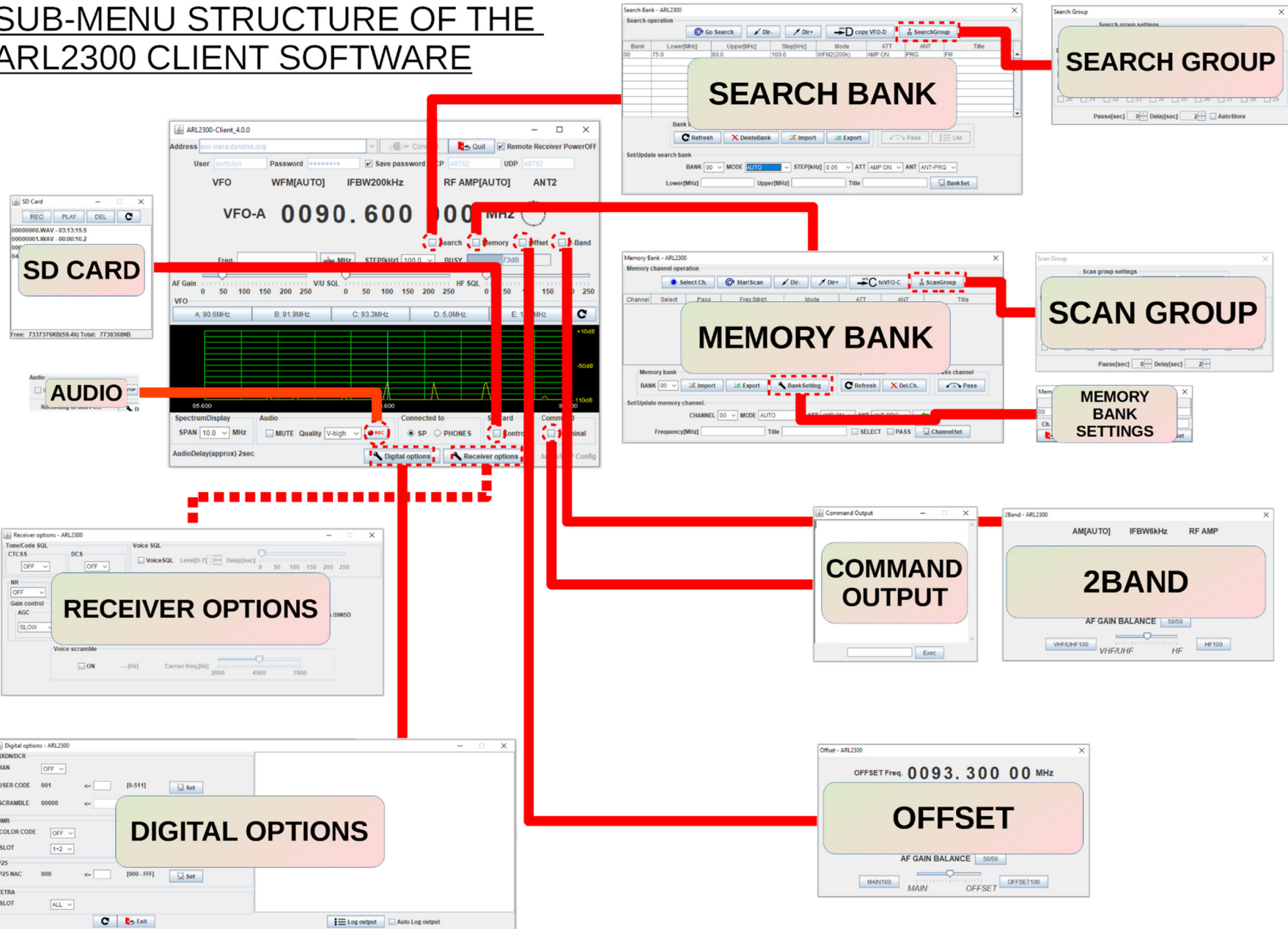
MEMORY CHANNELS
SCAN BANKS
SEARCH BANKS

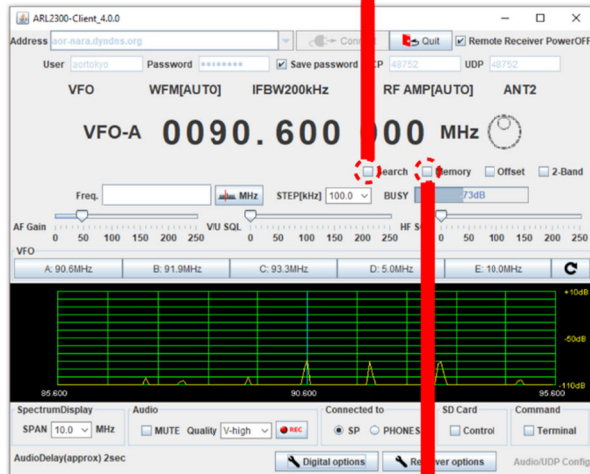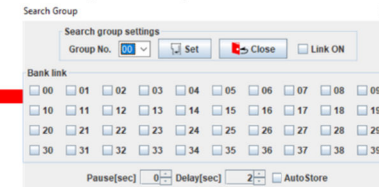## HOW TO SCAN A SEARCH BANK:
- Select the bank number.
- Click Go Search.
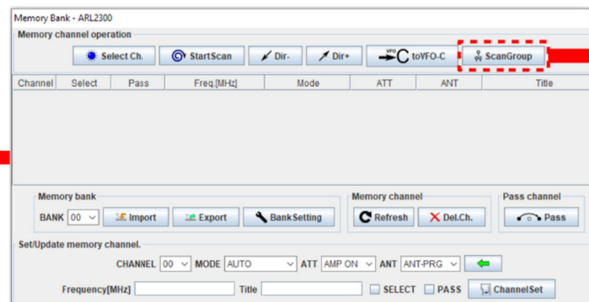- Adjust the squelch level at the previous window.

HOW TO CREATE A SEARCH BANK:
- Select a bank number.
- Set the lowest frequency.
- Set the highest frequency.
- Write a name describing this search bank.
- Set the receive mode, frequency step, amp/attenuator and antenna choice.
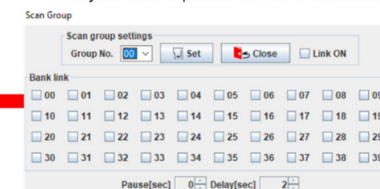- Validate with "BankSet".

CREATE A GROUP OF LINKED SEARCH BANKS:
- Select the Group No. to assign (except Group 00 for the AR2300 receiver).
- Check the bank number boxes you want to link.
- Check the LINK ON box.
- Click Set to start search.
- Adjust the squelch level if needed.

HOW TO SCAN A MEMORY BANK:
- Select the bank number.
- Click StartScan.
- Adjust the squelch level at the previous window.

HOW SAVE A FREQUENCY INTO A MEMORY CHANNEL:
- Enter a frequency.
- Select a bank number.
- Select a channel number.
- Write a title describing this frequency.
- Set the receive mode, amp/attenuator and antenna choice.
- Validate with "ChannelSet".

CREATE A GROUP OF LINKED MEMORY BANKS:
- Select the Group No. to assign (except Group 00 for the AR2300 receiver).
- Check the bank number boxes you want to link.
- Check the LINK ON box.
- Click Set to start the scan.
- Adjust the squelch level if needed.

7.2 REL (I/Q capture for Linux)

GNU/Linux OS I/Q recording program for AOR AR5700D as well as AR2300 / AR5001D / AR6000 equipped with the IQ5001 option.
Instructions for data version "rel_210601". Some instructions have changed, please read this manual again thoroughly.
Sound and spectrum quality improved compared to previous release "rel_210203".

Confirmed to work on:
Raspberry Pi O.S on RPI400/RPI4B
UBUNTU 20.10 on X86(Intel) 64bit PC
It is likely to work on most modern Linux based hardware, with recent Linux distributions, as long as the packages described section 1.2 are installed. However, some systems might require adjustments. The best way to know is to try it out yourself!

Confirmed not to work on:
Raspberry Pi O.S on Raspberry Pi zero,1/2/3 series

Required Linux knowledge: Medium to advanced
You must be comfortable with Linux operating systems, know how to install software packages, manage folder permissions and compile data.

AR5700D, AR2300 / AR5001D / AR6000 + IQ5001 will simply be described as "receiver".

<supplied files>
* 98-iqfk.rules --- File for udev
* Makefile --- Used to compile ariq_rcv.cc
* ariq_rcv.cc --- The source code of the recording program
* iqwr.sh --- Firmware download executable file
* fx2fw.hex --- Firmware file
* iq5001_file_in.grc, iq5001_file_in.py, grc-sample.png --- Sample GNU Radio files (Minimum required version to load this grc file is 3.8)
* iq5001_file_in_RPI.grc, iq5001_file_in_RPI.py, grc-sample_RPI.png --- Sample GNU Radio files for version 3.7 (for example on a Raspberry Pi which still uses v.3.7)

<Features>
* By using this program, I/Q data can be saved on a system running GNU / Linux OS. The data is stored as a ".bin" file. Format: 32bit floating point (numpy.float32)
* The recorded files can be used with GNU Radio.
* The recorded files can be played back with GQRX (some limitations apply).
* The source code is released under GPLv3 (or a later version), so anyone can use it freely.
<How to use>
1. Preparations
1.1
Have an updated GNU / Linux system ready to use.
1.2
Install following packages:
cycfx2prog - Cypress EZ-USB FX2 (LP) programmer
usbutils - Linux USB utilities
libusb-1.0-0 - userspace USB programming library
libusb-1.0-0-dev (required to compile files)
clang - Compiler
gnuradio (v3.7 or newer)

1.3

Copy 98-iqfk.rules to

/etc/udev/rules.d/

Execute the following command in terminal:

$ sudo udevadm control -R

1.4

Power on the receiver, connect the I/Q output USB cable to the PC. (The receiver's second USB connection for receiver control is not required)

Run the following command to download the firmware to the receiver.

$ source iqwr.sh

REMEMBER: This command must be executed every time the receiver is turned on!

1.5

ariq_rcv.cc needs to be compiled on each PC hardware/operating system you want to use.

Execute the following command in terminal:

$ make clean

$ make

The resulting ariq_rcv is now ready to use.

2. Record I/Q data

Copy the file ariq_rcv to the directory where you want to save your I/Q data.

Important note for RPI400 and RPI4B users: Due to SD card WRITE speed limitations and the receiver I/Q being output at 72Mbit/sec (9Mbyte/sec), be sure to save the I/Q stream to an external USB drive connected via USB 3.0. SD cards are just too slow and are very likely to create capture errors and/or abnormal audio and spectrum playback.

The following command will start the recording.

$ ./ariq_rcv

This will create the I/Q capture file "iqdatIQ.bin".

If it starts normally, the following 5 lines will be displayed while it is capturing data:

Version: rel210601-0f

Send capture start command.

6

FirstAbandoned

FirstContacted, bf=2

Note on the bf value: It can be 0,2,4,6 and informs data leakage. 0 is the least leaked data, and 2,4,6 means some higher leakage. The cause of the leak is unknown at this time but it should have little impact for GQRX or GNU Radio use. This bf number changes when the receiver is powered on, and it has also been confirmed that it changes from time to time by repeating the end and start of data reception.

To stop the capture, press Ctrl-C. (Alternatively you can also send SIGINT, SIGTERM or SIGQUIT signals to ariq_rcv.

If successful, the program will exit after the following eight lines are displayed:

Capture done.

6

Sent capture end command.

canceled

freed

released

closed

exit

3. Q&A

Q.

The capture file cannot be generated. Why?

A.

There are several possible causes.

1. The firmware may not have been downloaded to the receiver. The receiver being switched on and the I/Q output cable being connected to the PC, enter the following command:

$ lsusb -d 08d0:a001

The command's output should be as follows:

Bus 001 Device 007: ID 08d0:a001 AOR, LTD. DIGI-RECEIVER

(Bus and Device number will depend on your system and are not important here.)

However, if "AOR, LTD. DIGI-RECEIVER" is missing, then the firmware download has failed.

2. If you entered the following command:

$ lsusb -d 08d0: a001

and there is no response at all, then the system is unaware of the receiver. Check the USB cable connection and confirm that the receiver is turned on.

3. The udev settings (step 1.3) may not have completed successfully. Please check.

4. Check if the permissions of the directory where you are recording the file are correct.

Q.

How much data is the AOR I/Q file?

A.

The sampling rate is 1.125MSps and the data length per sample is 64 bits. The transfer rate is 9 Mbytes / sec (72 Mbit / sec). In other words, the I and Q files will be 270MB per minute each, and the combined I/Q file 540MB per minute.

Q.

Can it be run on a Raspberry Pi?

A.

Yes. However, only on the RPI400 and RPI 4B. Also, as SD card WRITE speeds are too slow, I/Q data must be saved to an external USB memory or drive, connected via USB 3.0.

Q.

Can it be run on Windows?

A.

No. However our receivers featuring I/Q output are supplied with the AR-IQ3 Windows software which allows I/Q capture and playback.

Q.

Can I use libusb-0.1 instead of libusb-1.0-0?

A.

No because libusb-0.1 does not support isochronous transfers.

Q.

Can I rewrite the program in Python?

A.

There is a libusb-1.0-0 wrapper for Python3.

Q.

Why can't I use a "live" I/Q stream in GNU Radio, only a captured file?

A.

We are considering it in a future version. Check http://www.aorja.com/support/software.html from time to time.

Q.

What is the "device string" to use in GQRX?

A.

Device= Other

file=(path to your iqdatIQ.bin file),rate=1.125e6,repeat=true,throttle=true

Q.

I recorded I/Q on H.F, but when played back in GQRX or GNU Radio, there seem to be no signal. Why is that?

A.

Remember that as described in the AR-IQ3 manual, when using the I/Q stream and receiving frequencies below 25MHz, the HF antenna should be physically connected to the antenna socket #1, even though it's usually #2 when the receiver is used "stand-alone". This is due to the fact that the receiver's internal antenna wiring is different when used "stand-alone" vs controlled by software. It also means that for pure I/Q capture you won't be able to hear via the receiver what you are receiving. A workaround is to connect an antenna to both socket #1 and socket#2, during the capture.

4. Known limitations in GQRX

-The displayed center frequency is zero, which is incorrect. However, you can change it manually via the digits.

-The receive frequency cannot be changed via the digits, only by dragging the vertical bar on the spectrum with your mouse.