The SDR Network Control Box software – short user manual (v020 and up).

1. Generic information about software.

The "SDR Network Control Box" software it is program that allows user to control over next parameters of AFEDRI SDR-NET:

- Central receive frequency

- Gain of Digital Down Converter channel (DDC)

- Gain of input Variable Gain Amplifier (VGA).

- To display real receive frequency in the case of using SDR together with external transverter adapter.

- Control over data transmission trough two alternative communication interfaces (USB network - LAN)

- When network connection is used for communication between SDR and PC, and when "SDR Network Control Box" is running as plug-in for Winrad (HDSDR, WRplus) software, the program receives complex (I/Q) data stream, that was sent from AFEDRI SDR-NET using UDP protocol, and routes data stream to main program (Winrad), for further digital signal processing.

Also software allows to save in SDR's internal EEPROM next "default" parameters :

- Central RX frequency after Power Up of SDR

- Gain of input VGA.

- Gain of DDC.

- Main clock oscillator's frequency

- Parameters of network connection (SDR IP Address, IP Mask, Gateway IP, port number)

After default parameters was saved in EEPROM and the SDR was reconnected to Personal Computer (PC), SDR is starting with saved in EEPROM default parameters.

This option allows, in some cases, to use AFEDRI SDR-NET without need to run "SDR Network Control Box". For example, in the case when AFEDRI SDR-NET is used as panoramic adapter for brand name transceiver, or when network interface is used to connect receiver to PC, in this case it is enough to run "SDR Network Control Box" only once – to save needed default parameters.

2. Installation and running of "SDR Network Control Box" software

2.1. Installation of software under Windows

It is possible to download latest version of "SDR Network Control Box" software (also source code is available) on web site http://4z5lv.net . The software can be used both or independently, or as plug-in for different SDR software, like Winrad, HDSDR other "clones" that are using ExtIO_ interface for Winrad.

The next file is included in downloaded archive file:

- ExtIO_AFEDRI_SDR.dll – it is Windows dll that contain plug-in and user interface.

- SDR_Control.exe – it is additional program that is running SDR Network Control Box software independently of external software (without Winrad or so).

- QtCore4.dll –dll from Qt development tools

- QtGui4.dll – dll from Qt development tools

- QtNetwork4.dll –dll from Qt development tools

- libgcc_s_dw2-1.dll – dll from MinGW package (Windows version of gcc compiler)

- mingwm10.dll – dll from MinGW package (Windows version of gcc compiler)

2.1.1. *Using "SDR Network Control Box" with Winrad software, as plug-in*

To use "SDR Network Control Box" software as plug-in, you need extract files included in archive that was downloaded from my site, in same directory where Winrad is installed. Further you need continue according Winrad (or other software) instructions.

2.1.2. *Running "SDR Network Control Box" standalone.*

It is possible to use "SDR Network Control Box" software as standalone application, but it is possible and useful only for USB connection!

To run "SDR Network Control Box" software standalone, i.e. without running Winrad (for example for some experiments or to use "SDR Network Control Box" with different software that does not support plug-in interface), you need to extract file archive to any folder you like and run executable - SDR_Control.exe.

2.1.3. *Using "SDR Network Control Box" with SDR-Radio*

You can run SDR-Radio and AFEDRI SDR-net together using network interface, so you don't need any additional software (including "SDR Network Control Box"). In this case you need only to configure AFEDRI SDR-Net to right IP address, IP Mask, Gateway IP, port number and to configure SDR-Radio software to use SDR-IP receiver as input device. Further information about SDR-Radio configuration you can find in its user manual

2.1.4. *Using "SDR Network Control Box" with Linrad*

To run Linrad and AFEDRI SDR-net together using network interface, you don't need any additional software (including "SDR Network Control Box"). In this case you need only to configure AFEDRI SDR-Net to right IP address, IP Mask, Gateway IP, port number and to configure Linrad to use SDR-IP receiver as input device.

If you are planning to connect AFEDRI SDR-Net to PC using USB interface, so beginning from Linrad 3.25 the Linrad software is supporting Winrad's ExtIO plugin interface. Please read Linrad 3.25 description to get more information. To use "SDR Network Control Box" as ExtIO plugin together with Linrad, you need to do next:

- Copy all files from SDR Network Control Box archive in same directory, where Linrad binary are installed

- Start Linrad, in menu of audio card configuration choose option "F" – libExt IO hardware.

More information about Linrad configuration for both cases, can be found on SM5BSZ web pages http://www.sm5bsz.com/linuxdsp/linrad.htm.

3. Graphical User Interface (GUI)

SDR Network Control Box software contains four Tab screens:

- "SDR Network Control Box" ("Frequency Control" in old versions)

- "Command shell"

- "Network"

- "Filter Tools"

- "About"

Desired tab screen can be chosen pressing according tab in upper part of application window.

3.1.   The SDR Control tab

You can see screenshot of the SDR Control tab screen on Figure 1 .

Functional description of tab screen is listed below:

3.1.1. The indication gadget "FE Frequency"- shows real frequency of internal NCO of Front End chip (AFEDRI8201).

3.1.2. The indication gadget "Central (LO) Frequency" – shows central **receive** frequency of SDR. In regular mode it is same, as "FE Frequency", or can be different, if the SDR is configured to work in transverter or alias modes (transverter and alias modes are described below).

3.1.3. The indication gadget "Tune frequency" – shows information about frequency of "software" receive frequency. This information is sent to SDR Network Control Box from external software (Winrad, HDSDR, Linrad) using plig-in interface. The displayed number on this gadget is valid only, when SDR Network Control Box software is running in plug-in mode. When SDR Network Control Box is running standalone, the gadget «Tune frequency» shows «0».
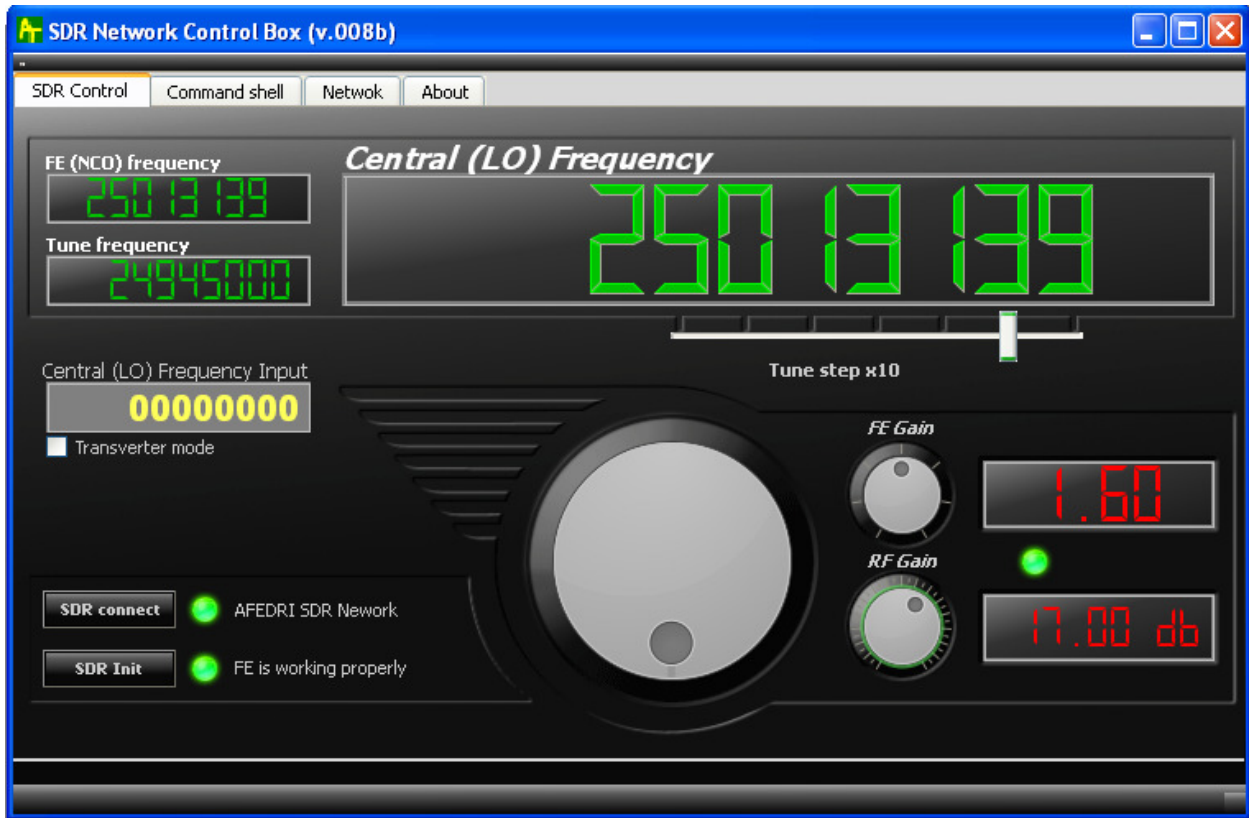
Figure 1 The "SDR Control" tab screen

3.1.4. The slider "Tune step x10" - defines minimal tune step, when the tuning is done by virtual tune knob (located in central bottom part application window, described below). The current tune step is displayed in text form «Tune step x10…» or alternatively it defined by position of slider under according number position of «Central (LO) Frequency» Indication gadget.

3.1.5. The text input gadget «Central (LO) Frequency input» - allows quick keyboard input of receive frequency from. To change frequency, user must input desired frequency and press key "Enter".

3.1.6. The button «SDR connect» - when pressed, provides reconnection to AFEDRI SDR-NET using USB interface and processes software "reset" of SDR hardware. In latest SDR Network Control Box software version this procedure is done automatically when PC finds, that SDR was connected (reconnected) to USB. I.e. software is scanning USB ports, testing for AFEDRI SDR-NET existence, when SDR connection was found software is beginning "SDR Connect" procedure. Used need use this button also, to reload the new parameters, that was saved before in internal SDR's EEPROM, this process is done from "Command shell" tab (see below).

3.1.7. The virtual LED indicator (green/red) and text message (on right side of button «SDR connect») – shows initialization status of SDR. If SDR was found and firmware started successfully, then indication color is - green and text message is a name of USB device, that was found (for example – "AFEDRI-SDR Audio"). If the SDR is not connected to the PC or there is some fault, the indicator color will be red and error message will be shown (see. Figure 2.).
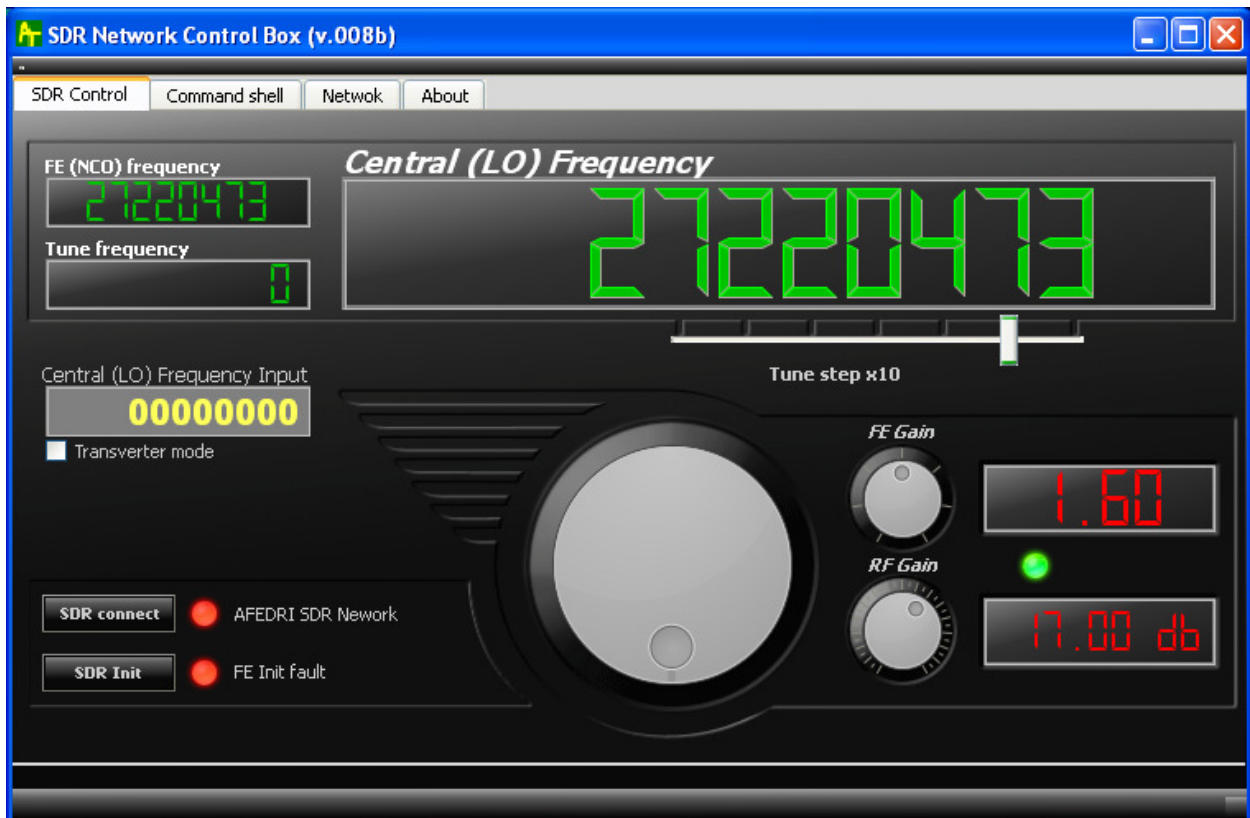

Figure 2 The "SDR Network Control Box" screen when AFEDRI SDR-NET disconnected from PC

3.1.8. The button «SDR Init» - when it is pressed, SDR provides re-initialization of Front End chip (AFEDRI8201).

3.1.9. The virtual LED indicator (green/red) and text message (on right side of button «SDR Init») – shows initialization status of Front End chip inside of SDR. If Front End was initialized successfully, the indicator color is green and there is a text message on right side of the indicator. If a fault occurs in the time of Front End initialization, the indicator color is red, and error message is shown (см. Figure 2.).

3.1.10. The "Tuning" knob – is used to change central RX frequency of SDR, with minimal step, that is defined by "Tune step x10" slider.

3.1.11. The "FE Gain" knob – is controlling "digital" gain of DDC (inside AFEDRI8201 chip). It has regulated range from 1 to 4. Indication gadget on right side shows current digital gain value.

3.1.12. The "RF Gain" knob – is controlling gain of an input Variable Gain Amplifier (VGA) of SDR. Indication gadget on right side shows current gain of VGA in dB.

3.1.13. The check Box – "Transverter mode", if this Box is checked - transverter mode is enabled. Transverter mode means next: central RX frequency that displayed in the indication gadget "Central (LO) Frequency" is calculated with addition of 1-st heterodyne frequency (frequency shift). When the "Transverter mode" is checked, additional Test Box is shown - "1-st Heterodyne Frequency".

3.1.14. The Text Box – "1-st Heterodyne Frequency", shows and allows keyboard input of 1-st heterodyne frequency. By default it is 1268000000 Hz (to use with 1296MHz/28MHz transverter).
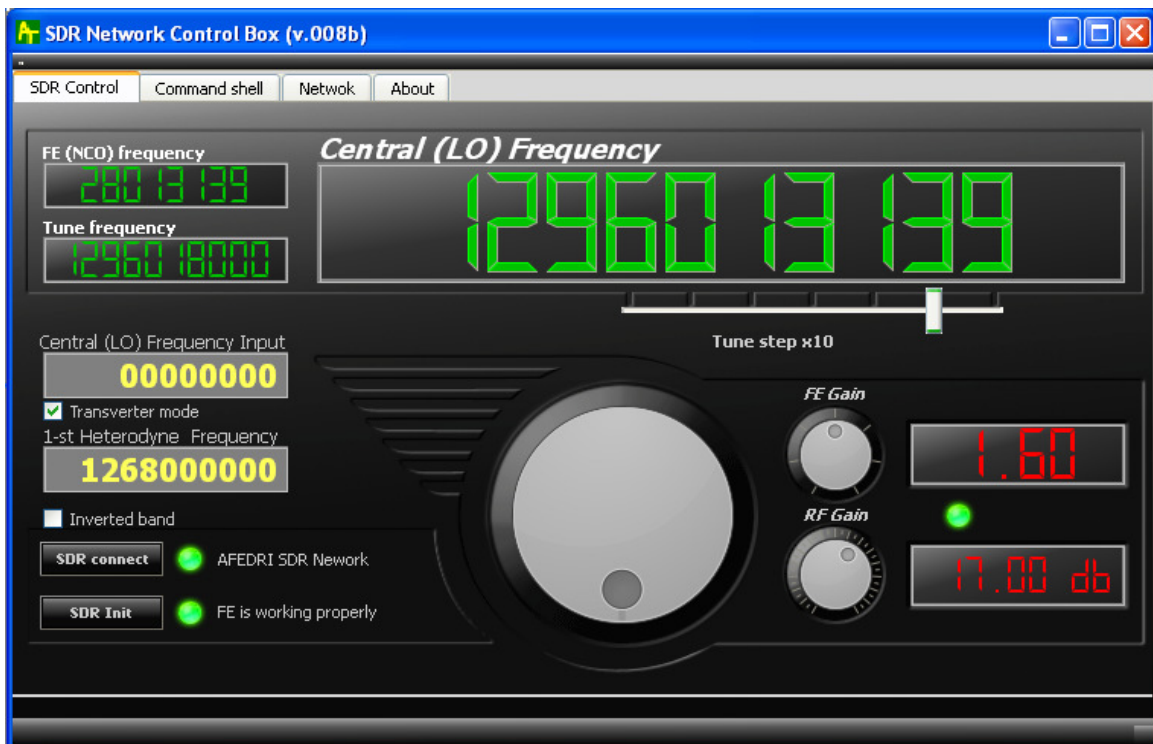

Figure 3 Transverter mode

7

3.2.   The "Command shell" Tab

Screenshot of "Command shell" tab is shown on Figure 4.

3.2.1. The Check Box "Route console output to HID interface" – is not used in current version.

3.2.2. The Text Box "Command Input" – is used to input new Sample Rate Frequency.

3.2.2.1.   Sample Rate Calculation rules:

The real value of possible sample rate depends on the Main Clock Frequency value and possible decimation rate of AFEDRI8201, it can be calculated using next rules:

- We are choosing desired sample rate (250000Hz for example)

- Dividing the Main Clock Frequency by desired sample rate multiplied by 4 (calculating CIC decimation rate):

  DecRate = Fmain / (4 * SampleRate);

  Example: for Fmain = 76800000 Hz ,

  DecRate = 76800000/ (4*250000) = 76.8,

  We need to choose closest integer value i.e. for our example DecRate = 77

- Calculating real sample rate:

  SampleRate = Fmain/(4*DecRate), for our example

  SampleRate = 76800000/(4*77) = 249350.6 (Hz)

- So we can use closest integer value to write it as new Sample Rate value to be used by AFEDRI SDR-NET after next reconnection to USB line. (249351Hz in our example)

For sure you can write to the AFEDRI SDR-NET "wrong" calculated value like 250000Hz in our example, but the AFEDRI SDR-NET in reality will send data with sample rate calculated above.

Please remember sample rate cannot be higher that 1333.333kHz in network mode for the AFEDRI SDR-Net Rev. 2.0 and 500kHz for the AFEDRI SDR-Net Rev. 0.0 and/or 1.0!

Please remember sample rate cannot be higher that 250kHz in USB mode!

For receivers that support Dual Channel Mode, sample rate of ""Dual Channel mode" cannot be higher than 125KHz.

3.2.3. The Button "Change Sample Rate" - when this button is pressed, the software sends new Sample Rate value (read from "Command Input") to the SDR, and the SDR saves this value in internal EEPROM. This value will be used as default value after startup and as current value when the AFEDRI SDR-Net connected to PC using USB interface. This value usually is not used when SDR connected using Network interface, because in Network mode the AFEDRI SDR-Net allows sample rate changing "in real time" and using controls located on the "Network" tab.

3.2.4. The Check Box "Single Channel RX Mode" or "Dual Channel RX mode" – is used for Dual channel Receiver configuration only! When this box is checked it shows text: "Dual Channel RX mode", and when it is unchecked it shows: "Single Channel RX Mode". Must not be checked for Single channel SDR!

3.2.5. The button "Change RX mode" – when this button is pressed, the software read "Single Channel RX Mode" check box status and sends new mode, to be saved in internal EEPROM. Single channel AFEDRI SDR-NET have to be configured to "Single Channel RX Mode" only.

3.2.6. The Text Box "Main clock Input" – is used to input main clock oscillator frequency of AFEDRI SDR-NET, after program start and SDR reconnection it contains value that is saved in EEPROM of SDR.

3.2.7. The button "Change Main clock" – when this button is pressed, the software sends new main clock frequency value (read from "Main clock Input Text Box") to the SDR, and SDR saves this value in internal EEPROM.

Attention!!! User need to check the real frequency of oscillator that is used in AFEDRI-SDR-Net (oscillator U4 - assembled on SDR PCB). It is recommended to change this frequency, only in situation, when crystal oscillator of different frequency was replaced on PCB. The main clock frequency of the SDR can have different value.

3.2.8. The "Get Sync State" button – is used for the SDR testing procedures, is not needed in regular use.

3.2.9. The "Frequency compensation DAC value" window – is used on specially assembled AFEDRI SDR-Net receivers, that have Voltage Controlled Crystal Oscillator (VCXO) inside. So it is used to set control voltage for this VCXO for precision main clock frequency tuning. Any time that the value in this window was changed, new value is

sent to the SDR, that allows real time frequency tuning, looking for reference signal on SDR software waterfall.

This function is not available in the AFEDRI SDR-Net of standard assembly.

3.2.10.   The "Gain Table" group – is used for definition of gain translation table, that is targeted for translation of SDR-IP attenuation value to AFEDRI SDR-Net gain, this table is need when AFEDRI SDR-Net is used with software that supports SDR-IP protocol. This table can be easily adopted by user to his working conditions and saved in internal EEPROM of AFEDRI SDR-Net

3.2.11.   The button "Save Gain Table" – is used to save the user defined gain translation table in the internal EEPROM of SDR.

3.2.12.   The Group Box "Calibration" – (see Figure 4 and 5), is used for calibration (calculation) precision value of the main clock oscillator. The calibration process is very simple.

- You need run Winrad (HDSDR) application.

- Connect reference signal to SDR's input.

- In the text window "Test signal frequency" input the reference generator frequency   value (see Figure 5).

- In the text window "Measured signal frequency"   insert measured using SDR application waterfall value (see Figure 5).

- Press the button "Calculate Main Clock frequency" to calculate real main clock frequency value. The result is shown in the "Command input" window (see Figure 5).

- In the end of this process user can save calculated value into the internal EEPROM of AFEDRI SDR-Net pressing the "Save Main Clock" button.

To get minimum error in the calculations it is recommended to choose central frequency of reception as close as possible to the reference signal (i.e. reference signal carrier is located in the middle of the spectrum waterfall). For more correct frequency measurements on the edges of bandwidth user needs also to correct sample rate value (more information about sample rate calculation please see on the "Network" tab description).

3.2.13.　　The button "Calculate sample rate" – when this button is pressed, the application is calculating real main clock frequency value and printing it in the "Command Input" window.

3.2.14.　　The Central Text Box is used to print debug messages.

3.2.15.　　The button "Save defaults" – when this button is pressed by user the software sends to SDR command to save current working parameters to internal EEPROM, as default parameters. The SDR saves in EEPROM next parameters:

- Central RX (LO) frequency

- Variable Gain Amplifier's (VGA), default gain

- Digital gain of DDC

SDR will use those saved parameters as "default", after power up or software reset, when SDR is connected to Personal Computer using USB cable.
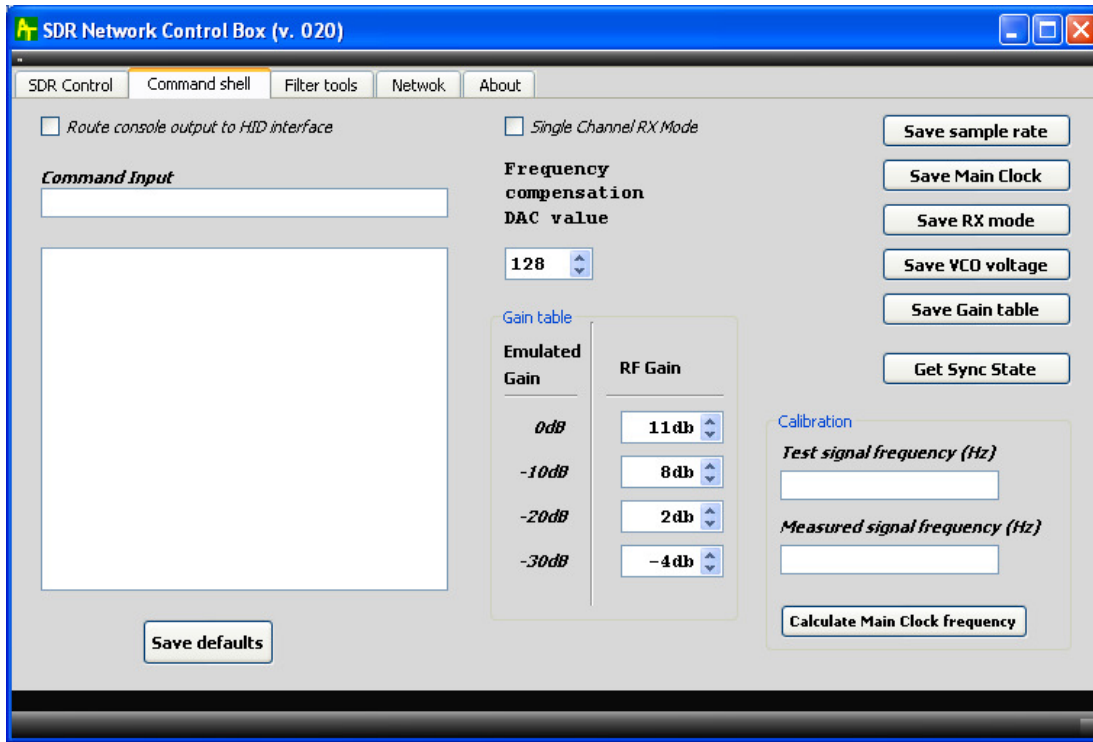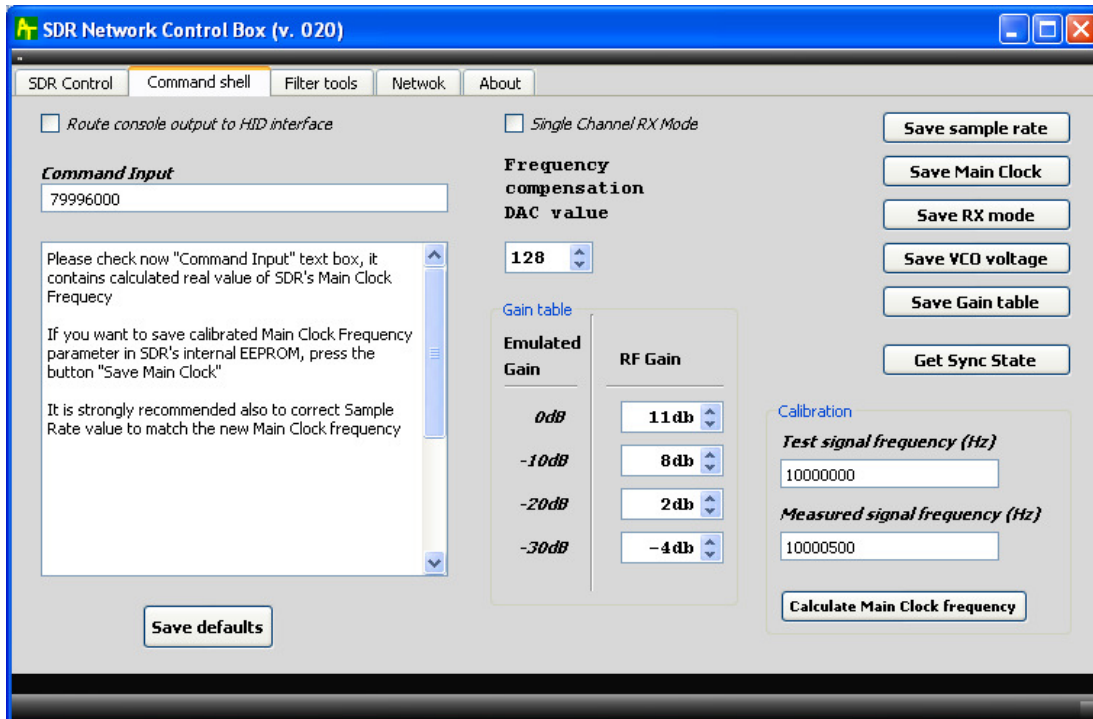
Figure 4 Command shell tab

Figure 5

3.3.   "Network" tab

  "**Network**" tab screen shot is shown on **Figure 6.** and **Figure 7.** there is concentrated all parameters that are needed to provide network functionality of SDR Network Control Box when it is used as Winrad plug-in, when receiver AFEDRI SDR-Net is connected to PC using network interface. You can see screen shot of "**Network**" tab on Figure 6. The functionality of all user interface elements (tabs, text windows, check boxes) that located on this tab very depends on type of connection between PC and SDR - USB or Network.
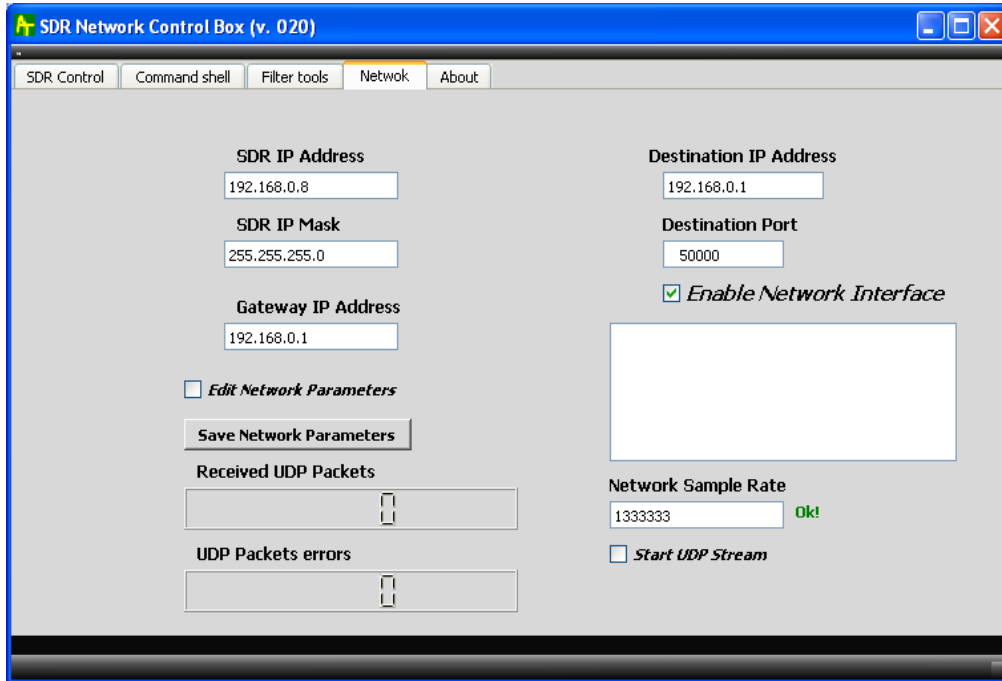

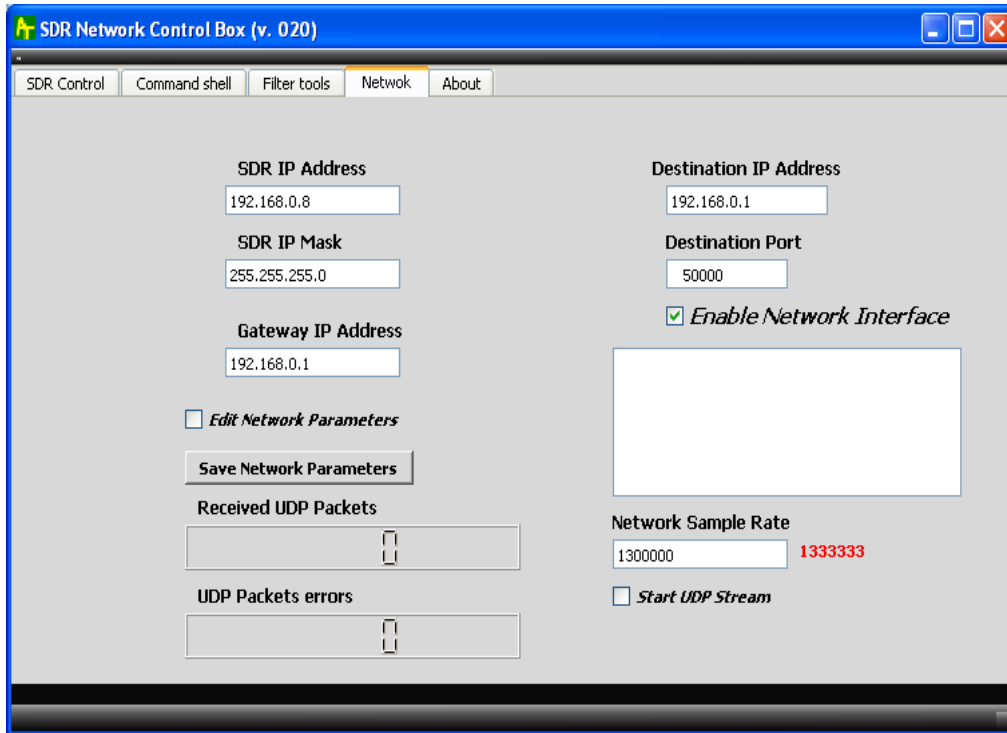**Figure 6 Network tab (correct sample rate value).**

Figure 7 Network Tab (non correct sample rate value)

"Network" tab user interface functionality is described further for both cases of connection of SDR to PC:

3.3.1.   Check box **«Enable Network Interface»** - is used to choose communication interface (Network or USB) and to change plug-in behavior, accordingly. The initial state of this check box is read once at plug-in loading. If SDR Network Control Box program starts when this check box is checked, so all data and command exchange, between PC and AFEDRI SDR-Net, will be processed using network connection only. Opposite, if SDR Network Control Box program starts, when check box is unchecked, so all data/command communication will be processed using USB connection (HID emulation). Similar rules are applied to all information about network interface that are displayed in text boxes on **"Network"** tab. When plug-in starts in network mode, most parameters that displayed on **"Network"** tab are taken from sdr_config.ini file, that is located in same directory, where Winrad application executable located. If SDR Network Control Box plug-in was started in USB connection mode, most parameters that displayed on **"Network"** tab, are taken from internal eeprom of AFEDRI SDR-Net receiver. All network parameters are saved using similar rules, i.e. when plug-in is using network connection all parameters are saved in sdr_config.ini file, and all parameters are saved in internal eeprom of AFEDRI SDR-Net receiver when using USB connection.

14

This "strange" algorithm allows to configure network connection parameters of AFEDRi SDR-Net using USB connection only, in the moment when SDR's network configuration contains wrong parameters (IP address, IP Mask, Gateway IP , Port number) and network communication is impossible.

Attention!!! When state of check box **"Enable Network Interface"** was changed (check box was checked or unchecked), you need to reload Winrad application, to make new mode active, and read configuration parameters from the right place.

3.3.1.1. Text Box **"SDR IP Address"** - are used to set/change network IP address of AFEDRI SDR-NET receiver. Right after plug-in load it contains value that was read from configuration file sdr_config.ini, when using network connection, or alternatively value that was read from internal eeprom of SDR, when USB connection is used.

3.3.2. Text Box "**SDR IP Mask"** - are used to set/change network IP Mask of AFEDRI SDR-NET receiver. Right after plug-in load it contains value that was read from configuration file sdr_config.ini, when using network connection, or alternatively value that was read from internal eeprom of SDR, when USB connection is used.

3.3.2.1. Text Box **"Gateway IP Address"** - are used to set/change Gateway IP address of network, where AFEDRI SDR-NET receiver connected. Right after plug-in load it contains value that was read from configuration file sdr_config.ini, when using network connection, or alternatively value that was read from internal eeprom of SDR, when USB connection is used.

3.3.2.2. Text Box **"DST IP Address"** - are used to indicate only network IP address of PC that connected to AFEDRI SDR-Net. This value is sent from AFEDRI SDR-Net receiver to PC. This information is used for plug-in testing/debugging only.

3.3.2.3. Text Box **"Destination port"** - are used to set/change TCP/UDP port number of network connection between SDR and PC. Right after plug-in load it contains value that was read from configuration file sdr_config.ini, when using network connection, or alternatively value that was read from internal eeprom of SDR, when USB connection is used.

3.3.2.4. The next parameters: "SDR IP address", "Gateway IP address", "SDR IP Mask" and "Destination port". By default this parameters are protected against unintended edition, to escape unwanted changes of network parameters when plug-in is running. If you want edit one or all of network parameters, you need set check box **"Edit Network Parameters"**.

3.3.2.5. Button **"Save Network Parameters"** – are used to save the parameters that listed below in sdr_config.ini or SDR's internal eeprom, depending on type of connection mode (Network or USB):

- "SDR IP address"

- "SDR IP Mask"

- "Gateway IP address"

- "Destination port"

3.3.3. Text Box **"Network Sample Rate"** - is used to change current sample rate of SDR when network connection is used. The new value is sent to AFEDIR SDR-Net immediately after "Enter" button is pressed. There is implemented Sample Rate value check procedure, since ver.020 of "SDR Network Control Box" application. Any sample rate value that was entered in this window is checked for correct value that can be achieved in AFEDRI SDR-Net hardware, the real value depends also on "Main Clock Oscillator frequency" so it has to be corrected if "Main Clock Oscillator frequency" was changed due to calibration procedure (see paragraph 3.2.12). If sample rate value is correct, application will show green colored "Ok" message on right side of the "Network Sample Rate" text window (see figure 6.). If sample rate value is not correct, application will show red colored precision value of sample rate. So user can correct sample rate accordingly.

"Network Sample Rate" parameter is not in use when SDR connected to PC trough USB interface.

3.3.4. Text Area that located under **"Enable Network Interface"** check box – are used for network service/error messages displaying only.

3.3.5. User Interface elements of **"Network" tab**, that was not listed above ("Received UDP Packets", "UDP Packets errors", "Start UDP Stream") are used for application debugging purposes only.

3.4.   "About" tab

Shows some common information and configuration information received from AFERDI-SDR (см. Figure 7.),

- The "Firmware Upgrade" button – when it is pressed the AFEDRi SDR-Net enter to firmware upgrade mode. After this button was pressed user have to wait till SDR will reboot in firmware upgrade mode, the two constantly lighting two, red and blue, LEDs is sign that SDR is ready for firmware upgrade, after this the "SDR Network Control Box" can be closed, because in firmware upgrade mode the "SDR Network Control Box" protocol is not supported. To get more information about firmware upgrade procedure , please read "AFEDRI-SDR-Net-user-manual.pdf" document.

- Shows firmware version, that programmed in AFEDRI SDR-NET

- Shows serial number of AFEDRI SDR-Net receiver (it is individual for every SDR)

- Shows HW/CPLD version number

- Shows main clock frequency of AFEDRI SDR-NET, this is the value that was read from EEPROM after SDR reboot (power up).

- Shows current Sample Rate of SDR

- Show current RX mode (Single Channel Mode or Dual Channel mode)

Figure 7 About tab