LinNWT/WinNWT V4.xx

Andreas Lindenau DL4JAL

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Contents

1

List of Figures

Chapter 1

foreword

For some years there is the NWT by Bernd core tree. First, in the DOS version and later a version that runs on Windows. Bernd developed a new network tester with a more modern DDS the AD9951, which employ enables it to work up to about 150MHz. This DDS has better technical parameters than previous types of the D / A converter has 14 bit Aufl ¨ solution. Based on a kit for a 0.1 to 160 MHz measured network tester "FA-NWT" was developed during RADIOAMATEUR hobby.

I've been working for several years with Linux and had begun a Linux software development. I did not want the great measurement technique that Bernd has developed without. By another protocol sequence on the serial interface, it was necessary to redesign the FW in the PIC. Basis of the Linux programming is C + +, which was used also for this software. In addition I have used the program library QT3 Trolltech for programming. Meanwhile, I have ported the source code to the new QTVersion QT4.3. From this version, there is also an open source version of QT4 on Windows. Only then it was impossible to port the programs that have been developed under Linux on the Windows interface and compile. Thus, a Linux and Windows version originated this program.

Chapter 2

Notes on installation

2.1 The Software

2.1.1 Installation on Linux

On Linux, you have to compile the program yourself. Just so you have the guarantee that all appropriate LIBs be involved and the program runs safely. Condition that is the compiler are installed plus compiler environment of Linux. Used the header files from the system. Experience has shown that it is best to install the package "KDevelop". With this package, all packages to be installed to compile. The second step is the open source package download v. 4.X by "Trolltech" and install. "Www.dl4jal.eu" Download Now from my side, the source package and unpack. Either with the "mc" ¨ open and copy uncompressed or with the command

DL4JAL @ radio space: ~> tar-xvf linnwt-3.xx.tar.gz (CR) unpack

DL4JAL @ radio space: ~ linnwt> cd (CR) change to the directory

With the command

DL4JAL @ radio space: ~> qmake or qmake-qt4 (under UBUNTU) (CR)

generates a new makefile. This will then otigt for compilation ben ¨. Does not work that should be queried only once the QT version. Many distributions have set as default QT3. If incorrect call is first command

DL4JAL @ radio space: ~> qmake-v or qmake-qt4-v (under UBUNTU) (CR) installed QT version queried. The version must start with 4.xx. The command

DL4JAL @ radio space: ~> make (CR)

generates an executable file. Now we just need rename the directory and the file

/ usr / local / bin

to copy. The rights to access the serial port must also be set. For testing you can program so times start with "root privileges" to see if it works.

2.1.2 Installation on Windows

The program winnwt setup.exe installs all YEARS version origen files. It ranges within a version even if only an update is installed. All required DLLs and program parts are installed. As of version 3.xx installing on multiple languages is possible. Therefore, first select the appropriate language. It is also possible to sequentially install different languages . Then come the usual queries. Because there is actually nothing to further explain. The translated texts are in the file with the extension "*. Sqm" included. These files are appended with the command as an argument with a space in between. And already appear all relevant texts in the corresponding language. Setting up the program icons takes over the setup program, depending on the selected language.

Chapter 3

The software "LinNWT / WinNWT "

3.1 Directories and files

In the "HOME" directory of the user are two directories "/ hfm9" and created "/ curves". In the "/ hfm9" are all configuration files from the program. This applies to Linux and also for Windows. On Windows, this directory is created in "Documents and Einstellungen/USER/hfm9". Important! the configuration and the measuring head files are always stored in the directory "HOME/hfm9". While it is possible that m ¨ files temporarily store some where else, but the LinNWT / WinNWT always look for the files at the above address. The default directory "/ curves" is used as the directory for the trace files and is provided as standard from version 4.xx. The curves k ¨ Onnen but also be saved in any other directory. The cam directory is stored in the configuration file, so that always the last used directory is the current one.

Here are the file types that are used by the program:

Sufix Description

¤.hfc   Configuration file of the program
¤.hfd   Curve file with data from channel 1 +2
¤.hfm   Measuring head file with the properties of the measuring head
¤.hfe   mathematical correction file with data (frequency-¨ AngiG)
¤.hfs   SWV calibration file   with data (frequency-¨ AngiG)

printing
Expression of the displayed graph window. The contents of the information window is formatted bit and also printed. Unfortunately, the info window

not editable. To create a header, the menu item "Layout label type" is provided. It is normal if the Gr ¨ automatically size of the graphics window when printing adjusts to the Druckgr ¨ size. This happens only during the term.

Print PDF

Expression of the displayed graphic in a PDF file.

Enter LayoutLabel

In this menu item, a description of the printed graphic is entered. As of version 2.03, the label is also stored with the Sweep curve ndaten.

break up

The program is closed and closed. All important settings are stored in the configuration file.

3.2.2 Load Settings

With this menu item you can invite special settings that were previously stored. As of version 1.07, it is also possible to load the appropriate configuration ¨ m equal to at startup. For this, the file name is written (without directory) as first or second argument after the program name. For the configuration file "*. Hfc" is always the extension used. The default configuration file is named "hfm9.hfc". The default name is also used when the program starts if no other file is specified as a 1st or 2nd argument with the command line.

secure

All mentioned in the previous point k ¨ Onnen settings are stored in a file. The file name extension *. Hfc is used. When the program starts but the configuration is always searched in the directory "hfm9".

info

Indication of the software version, etc. ...

firmware version

Query the firmware into the module in the PIC. This will display a number, the FW is> 100 3.xx From the SW version is displayed in the header of the program. In addition, a variant number is not provided with. The version query is performed automatically by the program in the background. This version number is from the many different hardware variants emerged which can drive my program. There are now about 9 different

9
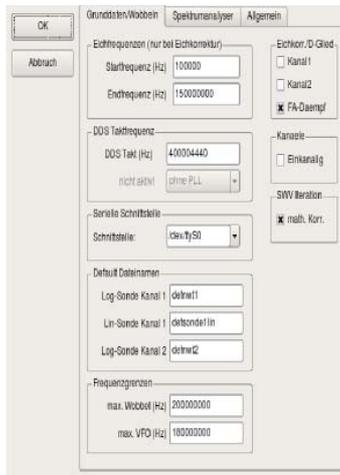
Figure 3.1: View of the menu item "option Basic Data / Sweep"

HW variants, each variant a different FW were needed to the different DDSoder other HW parts to control. To me it was too difficult to keep m ¨ possible the overview of the various assembler source code. Even more difficult it was to correct all variants of errors found. Therefore I have brought together in painstaking detail all variants into a code. An example: I set the version number 1 Kompilierungsschalter settings are made via the Kompilierungsresultat generated as a HEX file for the "FA-NWT-400MHz PLL without directly". But this is not relevant for the user. I just wanted to explain why the variant number was introduced by me.

option

Basic Data / Sweep A view of the "option Basic Data" can be seen in Figure 3.1 on page 10 with this menu item settings are adjusted. The Einstellm ¨ possibilities have become more and more extensive. Therefore, there are now 3 worksheets. The first sheet "Basic Data / Sweep" has the following meaning:

Point	Value	Description
Calibration frequencies in Math correction	Longint	Start + end
DDS clock frequency	Longint	accurate timing
PLLmode	unsigned int	Setting of the PLL in the DDS is not used in the FA-NWT
Serial interface	selection	Windows: Predefined selection
Serial interface	input	Linux: Editable
Log probe channel 1	string	probe file
Lin probe channel 1	string	probe file
Log probe channel 2	string	probe file
max. sweep	float	maximum sweep frequency FA-NWT = 200000000
max. VFO	float	NWT500 = 550 million NWT7 = 90000000 maximum VFO frequency
Kalibrierkorr. channel1	(yes / no)	Setting s top
Kalibrierkorr. Channel 2	(yes / no)	math. Correspondent for Channel 1
FA ATT.	(yes / no)	math. Correspondent for Channel 2 Activate attenuator from the FA
Single-channel	(yes / no)	Working with 2 or 1 Messköpfen Enable for FA-NWT
SWV iteration math. Corr	(yes / no)	SWV smooth curve

Ab der Version 1.09 sind die 2 Punkte maxvfo und maxsweep hinzugekommen. Hintergrund dieser Erweiterung ist die Nutzung dieser Programmes für verschiedene Hardware. Wird der ältere NWT7 von Bernd Kernbaum benutzt, können die maximalen Grenzfrequenzen anders festgelegt werden. Es gibt auch schon eine Hardware die mit dem AD9858 arbeitet und Frequenzen bis etwa 560MHz erzeugen kann. Auch diese Hardware kann mit diesen 2 Einstellungen angepasst werden, indem die Grenzfrequenzen entsprechend erhöht werden.

Spektrumanalyser Eine Ansicht der „Option Spektrumanalyser" sieht man in Abbildung 3.2 auf Seite 12.

Das zweite Arbeitsblatt „Spektrumanalyser" hat folgende Bedeutung:

Allgemein		
point	value	description
HW feedback	yes/no	Message from SAV to the SW Switch position of the HW from the SAV
Automatic Schrittkorr.	yes/no	in HW-feedback, the step number is obtained according öht depending on the selected bandwidth at the SAV

Figure 3.2: view of the menu item "option spectrum analyzer"

Range 1/3	KW Worth	description
	Float	
point	Float	upper Frequence limit
lower Frequenz upper	Float	lower Frequence limit
Frequenz ZF	Float	between frequency
Shift		Shift of the frequency display
		in the mode-shift Spek.FRQ

Range 2	2m worth	description
Point	Float	
under Frequenz upper	Float	lower Frequence limit
Frequenz ZF	Float	upper Frequence limit
		between frequency

The first two check boxes in the picture are active only by recognizing the right firmware in the PIC. The IF must be calibrated according to the deviation of the 2.Oszillators in SAV. The first step is to calibrate the frequency of the DDS clock durchzuf ¨ watches. We described this process in chapter 3.5.1 on page 29, then you can determine the deviation of the SAV, and accordingly the ZF others around the different figure ¨. Right are three groups of settings been added. From the SW-4.04, the level is displayed directly in dBm on the display. For this, a calibration is necessary.

Level corr. For the	dBm	display
Point	value	description
Area1 (dB) Area2 (dB) Area3 (dB) B300Hz (dB) B7kHz (dB) B30kHz (dB)	Float Float Float Float Float Float	Total variation in the range 1 Total variation in the range 2 Total variation in the range 3 Spek.FRQ-shift Level deviation BW 300Hz Level deviation BW 7KHz Level deviation 30kHz BW

Info window	cursor	display
Punkt	Wert	description
dBm dBuV Volt Watt	Yes/no Yes/no Yes/no Yes/no	Display the cursor value Display the cursor value Display the cursor value Display the cursor value

measurement accuracy limit

exactly max (dBm)	Integer	Graueinf ¨ coloration of the inaccurate measurement range
exactly min (dBm)	Integer	Graueinf ¨ coloration of the inaccurate measurement range
min step number	Integer	minimal number of steps Automatic correction at step
Point	value	Description

Here under there are 3 Button. Here the description:

• Defaults to reset all settings to sensible values.

• Kal = 0.0 Kalibrierarray set the value to 0.0.

• Calibration Additional calibration with the dB deviations of the SAV-input low-pass filter in the range 1 and SAV-band-pass filter in the range 2

A detailed description of how the Spektrumanalyservorsatz is calibrated in more detail later in this document.
General view of the "General Options" you can see in Figure 3.3 on page 14

The third "tab", "General" has the following meaning:

Point	Value	Description
Color background Color channel1 Color Kanlal2 font size	dialogue dialogue dialogue integer	Farbeinstellung Farbeinstellung Kanal1 Farbeinstellung Kanal2 Schriftgröße des Programmes
Focus switch		
button sweep button once button Stop	yes / no yes / no yes / no	Focus automatically switching to the graphic Focus automatically switching to the graphic Focus automatically switching to the graphic

Figure 3.3: View of the menu item "General option"

Since the separation of the graph in a separate window there are the last three checkboxes. This determines whether, after pressing the button once to move the graphic window to the front, which means in technical language, the focus goes to the graphics window. Everyone can choose his attitude here.

Firmware Update (depending on the bootloader)

This paragraph is only valid with the appropriate boot loader. It is loading a new firmware into the PIC. In this case, the first rule, the communication with the NWT must work. Here you can not afford any experiments. If the bridge PortB.0 enabled to earth and it was PowerON is necessarily to load a new firmware. In PIC namely the following happens:

PORTB.0 = 5V (normal operation):

After PowerON a jump to bootloader. There will be checked whether PORTB.0 has 5V. If YES jumped into the internals of the NWT and the module operates normally.

PORTB.0 = 0V (bootloader is active):

After PowerON a jump to bootloader. There will be checked whether PORTB.0 0V has. If YES is selected, the firmware for updating and there is no turning back. The boot loader will wait until the new firmware "depends".

What to do in sequence is explained in dialog boxes. However, this function is only m ¨ possible with the bootloader from me or from the FA-NWT.

When the FW renew in all other hard goods must to get all information beforehand!

3.2.3 curves

As of version 4.xx each curve newly created file gets a version stamp, so that the software can recognize the format of the Messondenparameter. If an old version is detected, the parameters are automatically converted. Whether a load in the main program curve has the new version, you can see in the header of the graph window. Since the uploaded file name and the new file version is available as statements of string "# V3.05". In "Sweep manager", no version identification.

shop

A saved graph file can be loaded with this menu item again in the main program. The previous settings in the program are not overwritten. The characteristic of the measuring head used to the layout label with loaded and as of version 2.03. The file extension *. Hfd is used. The used directory is stored in the software and then automatically offered (version 4.xx).

secure

Swept curve is stored in a file. The properties of the measuring head used to the layout label also stored and from version 2.03. The "mathematical calibration correction" is not stored in the trace file. Here, the same explanation applies as in "Sweep manager" see paragraph 3.4 on page 26 for the trace file with the extension ". * Hfd" is used. The used directory is stored in the configuration and then automatically offered (version 4.xx).

3.2.4 wobble wobble

Sweep is started. The same function can be started by clicking the "wobble".
From software version 3.xx l ¨ press the "W" east in the graphics window and the sweep of.

one time

The Sweep durchlauf is traversed only once. The button "once" causes as same. From software version 3.xx l ¨ the "E" key east in the graphics window and the sweep of.

Stop

The Sweep lauf is stopped. The full cycle is continued until the end. There is also a "Stop" button. From software version 3.xx the "S" button in the graphics window stops the sweep.

Calibration Channel1

As of version 4.xx, it is possible ¨ m the top and bottom "dB line" set in value. This feature made a total conversion of math in the display representation is required. Calibration of the measuring probes I also had to re-shape mathematically. If an old calibration detected, expects the new software to the parameters and it appears an additional information window. The software version 4.xx is therefore backward compatible.

But it k ¨ Onnen not created with version 4.xx measuring head files "*. HRM" and curve files "*. Hfd" used in the old software versions.

Each probe has to be calibrated in order to achieve accurate measurements. The first query is the type of the sensor lin / log. Subsequently, an attenuator -6db/-40dB must be looped. At the end of VFOOutput with the channel 1 is directly connected. For all of two measurement series two Konstanden be calculated that the "RF level -> output voltage" describe the probe. This function is always "linear" and can be described with only two Konstanden. The result is in the menu item "Properties measuring probe channel 1 Save" are saved, but when calibrating the Save dialog is available immediately. Owner of a connected attenuator need to insert any additional attenuators, here automatically assumes the software inserting the attenuator. This applies to the full extent (linear measuring probe needs-6dBGlied) only when FA-attenuator. It just needs a connection cable between the two RCA sockets are plugged. When determining the second reference line which should normally be 0 dB, even a small attenuator can be used with looped. This is for measuring probes which do not tolerate the level of +4 dBm and are inaccurate in this area. But these are special cases, we use the submitted 0dB transmission loss.

Mathematical calibration correction when using the log. Measuring probe. Consider our calibration result "if we take the output of the oscillator to the measuring input" connect directly. It can be seen that the calibration curve in accordance with the high frequency drops. When FA-NWT we're lucky, by the good design, the 0dB line of house is very straight. But we match the deviation from mathematical, can we correct the path of the line. This creates a file in which each frequency deviation in "dB" is stored. Our measurement curves can we compensate with this file. The measurement accuracy increases over the entire range of + / - 0.5 dB. In order to compensate for the entire range of being calibrated frequency range specified in the configuration data and can only via the menu item "setting; Option "be changed. In the file with the calibration filename-kx.hfe the correction values are stored. This change also applies to the second channel, the linear measuring sensor is not considered. If the calibration correction enabled for a channel, the color of the label of the checkbutton changes in the color "RED".

There are at the "mathematical calibration correction" one problem, however. Once a stored Kuvendatei is loaded into the Sweep curve nmanager, which is not shown "mathematical calibration correction" in the curve. Accordingly, there is a deviation between the curve shown at the moment and the curve in the "manager". Therefore, I have a warning

note inserted into the program, which it employ enables this "calibration correction" while reloading curve files off. The only way to error-free work with the "Sweep curve nmanager". Therefore, I propose to dispense with this correction and dear once more the particular frequency range to calibrate.

Calibrate Channel 2

Here we proceed as described in the first channel, however, has sense only if a measuring probe was additionally connected.

Selection measuring probe channel 1

Data of the measuring probe on channel 1 k ¨ Onnen be charged with this menu item. The Messondendatei has the file extension "*. HRM". From 4.xx version of the file has different parameters. Converting the old parameters is done automatically and a message appears on the screen, with a request to re-calibrate everything.

Selection measuring probe channel 2

Data of the measuring probe on Channel 2 k ¨ Onnen be charged with this menu item. The Messondendatei has the file extension "*. HRM". From 4.xx version of the file has different parameters. Converting the old parameters is done automatically and a message appears on the screen, with a request to re-calibrate everything.

Save properties measuring probe channel 1

The measured data of the used measuring probe channel 1 are stored with the menu item. In addition, the data from the calibration in the wattmeter are also stored. What file is automatically loaded when the program starts, we put in the "Option" fixed. The Messondendateien must always be stored in the directory "/ hfm9" "HOME" area. As of version 4.xx Messondendatei each newly created version is given a stamp so that the software can recognize the format of the parameters.

Save properties measuring probe channel 2

The measured data of the used measuring probe channel 2 is stored with the menu item. In addition, the data from the calibration in the wattmeter are also stored. What file is automatically loaded when the program starts, we put in the "Option" fixed. The Messondendateien must always be stored in the directory "/ hfm9" "HOME" area. As of version 4.xx Messondendatei each newly created version is given a stamp so that the software can recognize the format of the parameters.

reset cursor

The cursor in the graphics window is cleared.

Setting font in the Info window

Setting the font in the info window of the Sweep bereiches.

frequency markers

As of version 1.08 it is possible m ¨ frequency markers display in the Sweep fenster as frequency orientation. The bands 160m to 2m are predefined and in addition k ¨ Onnen 3 pairs of frequencies even be defined. All settings are stored in the "Application Configuration file".

profiles

In this menu item, the profiles are processed. Start frequency, end frequency and steps are stored together under a single name. The "default" profile is not displayed. All defined profiles are stored in the configuration.

Change window width

In version 3.xx is m ¨ possible hide the info window. As for the graphical display is now a separate window has been programmed, it is n ¨ otig to reduce the width of the window to display useful on PCs with low Aufl ¨ Sweep fenster the solution and the operating windows side by side. To this menu item to the erm ¨ oglichen is provided. The operating window is set to minimum. With this setting, it is even possible to operate m ¨ the program on the eeePC 701.

3.2.5 Measure (wattmeter) Setting font

Font settings in the measuring window.

Calibrating channel 1

Calibration of the sensor according to dBm. To this end, we need an accurate HFPegel, which must be known. Since the AD8307 provides a linear DC voltage depending on the applied dBm value, suffice here 2 points for the determination of the data. There the well-known level is set and an attenuator equal-20dBm were needed as the second measuring point is greater than once. The default value corresponds to about the actual dBm level of the NWT from RADIOAMATEUR. Are stored the results of calibrating the power meter area in the same probe file as was sweep. It is the same offered the appropriate file to save after calibration. It is to use the file name offered low at the first calibration. This comes from the "Option". Since we have the guarantee that the right Messondendaten are automatically loaded at startup.

Calibrate Channel 2

Calibration of the sensor according to dBm. See channel 1

Write to Measurement Table

Currently displayed values are written to the table. The button "measured value acquisition" does the same.

save table

The tables values k ¨ Onnen are stored in a file. "Save" - Button makes it also.

Set damping to default

Performing this item resets the box "damping" on default. That said there are any additional values entered from the box away. The importance of this box will be described later.

Editing probe 1/2

In this menu item, a table may be created which describes deviations dB depending on the frequency. Result is the M ¨ To enable the fix data which are described herein possibility of a ComboBox. This makes it possible for m ¨ heights according to the measurement results obtained ¨. The indicated values are stored in the probe file. A view of the dialog you see in Figure 3.12 on page 32

3.2.6 Help Tip

Here you can activate the tip. I have written to almost all the main controls called a "tooltip". This appears when the tip is activated and one remains with the mouse for a while in the appropriate place.

3.3 The worksheet "sweep"

Here we begin to me the description of the user interface of the program. The worksheet "wobble" was totally redesigned in version 3.xx. See Figure 3.4 on page 20 It was to bring no more m ¨ ¨ Einstellm possible all possibilities on this sheet. Therefore, the graphs have been east of this sheet herausgel ¨ and created space for new functions. The Sweep grafic was programmed in a separate window. See Figure 3.5 on page 20 for this description, I'll come back later. I have summarized all the functions in small groups.

3.3.1 Sweep einstellungen beginning, end, measuring points

In the editing window "beginning" the start frequency is entered and the "end" of the end frequency. The number of measurement points is still firmly placed as financial statements. The step size is determined from this information itself. The labeling of the

Calibrate Channel 2

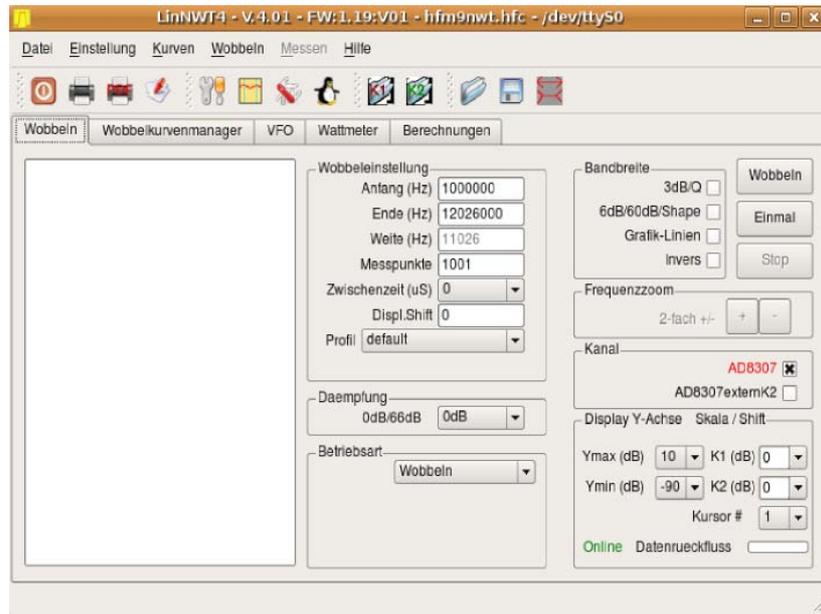Calibration of the sensor according to dBm. See channel 1

Figure 3.4: View of the worksheet
"sweep"

Figure 3.5: View of the leached graphics

X-axis is also independent from these frequency data. In addition, the distance of the X-grid is shown below as a value in Sweep fenster. This should serve for better orientation. Input values can Hz, kHz or MHz are used according to the following format: 3m5 3.5m 3.5m = 3500000 Hz

interim

In the version 4.xx and the corresponding FW, it is possible to design a Sweep durchlauf slower. In the NWT each measuring point takes time for the program execution in the Pic. It is composed of 1 DDS frequency calculate and adjust and second measuring channel 1 and channel 2 and transferred to the PC. I have this maturity time optimized in PIC that a faster Sweep durchlauf is achieved and a filter matching is almost directly promptly visible (setting about 401 measurement points). However, it has been found that for the representation of curves must be longer with steep edges, low level, the time between measurement points. Therefore, it was of me the "meantime" is programmed as a feature. This is an additional time between the measurements at Sweep durchlauf. If the software detects the correct firmware in the NWT, so the selection of the "meantime" is active and can be adjusted. Maximum can be adjusted 999 usec. Is the meantime, greater than zero another transmission protocol on the RS232 is used for the meantime with the NWT transfer (hence the matching FW is needed in the PIC). Currently, the FW 1.18 currently. An increase in the number of steps to the maximum of 9999 brings some not so good results such as increasing the scan time. It is worthwhile therefore to experimentation.

display Shift

This point does not exist for long. Through this entry the zero line will be moved in steps of 10. A small example: The output of the NWT is used to a transmitter output stage to drive. At the output of the transmitter output stage we close a performance degree from a measurement output of-40dB. Does the PA has a gain of 15dB so would a Line at about-25dB arise and I would have to completely convert the resulting curve. With "Display Shift" and "Shift X-axis" can I change the label so that the "dB" values can be interpreted as "dBm" values. I have swept this way some self-made power amplifiers. My conclusion power (200 watts from the FA) works throughout the short-wave range with a good SWV. But there are also other applications for "Display Shift" conceivable.

profile

In this ComboBox predefined profiles can be selected. Start frequency, end frequency and steps are stored together under this name. For establishing and modifying the profiles there is a menu item under "wobble". The "default" profile is created automatically and contains the last used frequency data. All defined profiles are stored in the configuration.

3.3.2 attenuator 0dB/50dB or 0db/66dB

This is the ComboBox for the controllable attenuator. If a max-50dB attenuator connected to port B may be controlled by the program, the relay for the "damping". As of version 2.xx also the attenuator from RADIOAMATEUR can be controlled. This attenuator has a better resolution (2dB per step and a range of -4 dB to-66dB). When calibrating both attenuators are switched automatically according to, the only one connecting cable between the generator and the measuring probe must be inserted. Changed to the FA member is in the option under "Cal corr. D-link. "

3.3.3 mode

"Ant sweep, SWV, SWV and Z-impedance" for the modes, "SA area 1" and "2 SA area", the frequency settings memorized and stored separately. So when switching the mode, the old frequency setting is reloaded. These settings are also written with the configuration and are available the next time the program is started.

sweep

This is the mode for the normal sweep. The result is shown in the graphic window. Need to obtain accurate results only be carried out a calibration. The result of the calibration is stored for each probe in a separate file. As a "default" name "option" uses the entry in the. This file their data is automatically loaded at startup. But I can always download another file, for example if separately Calibrated was in particular frequency ranges. Switching to the linear-measuring probe is also provided by reloading a corresponding probe file. The name is now also in the "Option" and is used for template name in calibrating the linear internal probe used.

SWV

In this operating mode can be displayed in the graphics window SWV. For accurate measurement, a calibration process is required. But first, a calibration in the "wobble" must be performed. This calibration procedure is the basis of the calibration for the SWV mode. The "SWV resolution" can be adjusted accordingly.

SWV ant

This mode also enables the removal Convert the cable loss to the point of SWV calculation. Here, no calibration is required.

Z-impedance

If a resistance of 50 Ohms in series with the measuring object, it is possible to represent the real Z value. The trick here is that we add to the end 50Ohm 50Ohm again what a SWV results of 2.0. The 2.0 SWV line is for 50ohm line. Unfortunately, only real values can be represented. Here, no calibration is required.

spectrum analyzer

As of software version 4.xx, it is possible to connect a spectrum analyzer attachment to the FA-NWT. This SAV has two measuring ranges of the first range is from 72 MHz to kHz range and the second range is from 135MHz to 149MHz and is suitable for measurements in the 2m band. The RF output of the FA-NWT is used as a VFO for the SAV. The measuring input of the NWT is connected to the measuring output of the SAV. All required information, "Spectrum" is entered in the "Option". The IF is automatically taken into account when this mode is selected, depending on the area, the IF is added or subtracted. If the "option" of the item "HW feedback from SA" is activated, the corresponding switch position of the SA will automatically be reported and displayed for SW. In addition, the software monitors some Sweep einstellungen and responds accordingly with incorrect values. Through the "HW feedback from SA" the measuring range changeover is automatic. Nor was the "automatic correction step" enabled the adjustment of the step size according to the bandwidth setting on SAV, by a corresponding increase in the number of steps. From the SW V4.04, the step number is again reduced automatically. The minimal number of steps can be set in "min number of steps". The point "HW feedback from SA" and "Automatic step correction" is only enabled if the correct FW is detected in FA-NWT.

Spek.FRQ-shift

This additional mode is also intended for spectrum analyzer. In addition, the frequency display by an adjustable amount is "option", "Spectrum", "Shift" moved. But only the display. Thought this mode is for the use of a frequency converter in front of the SA.

3.3.4 bandwidth

This area is used for automatic determination of several bands from the Sweep curve . The plan is to check button "3dB bandwidth / Q" and "bandwidth 6/60dB/Shape". An activation causes a calculation of the bandwidth and the output in the info window. In 3dB range also the exact center frequency is written with. In addition, the quality is, and if the 60dB sideband attenuation is achieved and the shape factor is calculated and displayed in the Info window. If the check button "Graphics" occurs activates a display of the bandwidth in the graphics window by vertical lines.
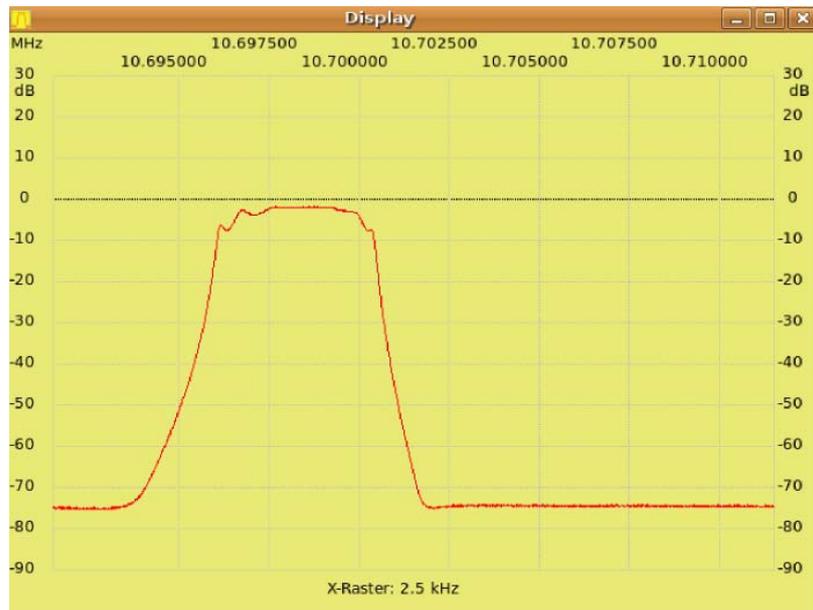
Figure 3.6: View of the Maximum dB range

The point "inverse" is used to determine the above values in the inverse response curve, which applies only to the 3 dB range.

3.3.5 Frequency Motion

Setting the cursor activates the "frequency motion". I remembered no better name. The purpose is starting to shrink from the cursor to the frequency or expand without having to make new frequency inputs for start and end frequency. After each increase or decrease a Sweep durchlauf started at the modified Sweep fenster is to make it visible. The center frequency is about the cursor. Moreover, the boundaries of the frequency change, the frequency values are used to calibration correction in the option. The frequency of magnifying glass can now also be used by the graphics window. See Section 3.8 on page 33

3.3.6 channel

Here the 2 checkbutton. They are for display channel 1 and channel 2, the measurement data of both channels are always transmitted to the PC, it can only display the channels on / off can be switched. Is in the "Option" "Single channel" is enabled, only the channel 1 is activated / deactivated. An additional measuring probe is available from the "RADIO AMATEUR". Is the mathematical calibration correction enabled the label to the color "RED" appears.
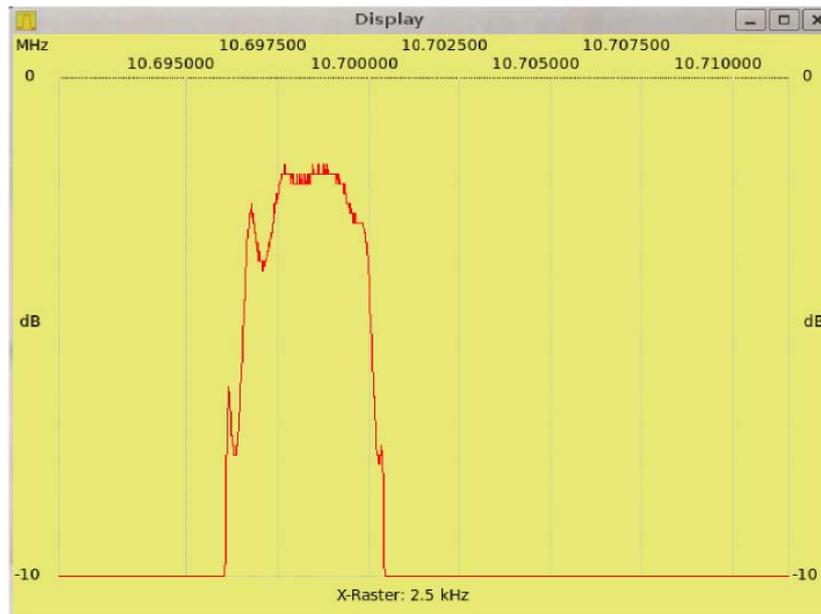
Figure 3.7: View of the same curve in the range 0dB to-10dB

3.3.7 Ymax, Ymin

As of version 4.xx the scaling of the Y-range is possible. Serve these 2 settings. It is set the upper-dB line, and the lower dBLinie. In Figures 3.6 on page 24 and Figure 3.7 on page 25 we see two adjustment of the Y-dB range.

3.3.8 Shift Y axis

This ComboBox allows the curve on the Y-axis shift. The smallest unit is 1 dB. The easiest way is with the mouse wheel by holding the mouse is placed in the ComboBox and using the mouse wheel, we make the setting. The displacement range is from-10dB to +20 dB, which is sufficient for most applications. If the shift value other than 0 changes the label of the Y-axis in the graphics window of the color "Black" in the color "red". This serves as a reminder that something has changed.

3.3.9 cursor

As of version 2.00 it is possible to set up to 5 cursor. They work independently.

3.3.10 data reflux

Here is a progress bar for the reception of the Sweep messdaten. At this progress bar the return of data from the module is displayed on the PC. If you are working with a large number of steps which is an additional way to see if the network tester is still working. The Sweep fortschritt is displayed continuously. As of version 3.xx is displayed if a connection via the RS232 exists. From the specified firmware version, the version number is also displayed with read and in the header. To see this is in Figure 3.4 on page 20 The variant number corresponds to the hardware used.

3.3.11 Info text window

On the left is the info window for text output. For each displayed channel, the maximum value and minimum value is determined. In the info window can through the "File" menu; A description header to be entered "LayoutLabel enter". This label is possibly important for an expression and is written from the version 2.03 with in the trace file. A direct entry in the info window is not output when printing! Appear also find the information for each set cursor. Ending of sweep though the information from the cursor 2 to 5 are hidden. This is done for performance reasons in the text output. The info window is described elsewhere too fast with useless text output. Causes the "Stop" button that all information reappear.

3.4 The worksheet "Sweep curve nmanager"

As of version 2.xx, there is the Sweep curve nmanager. With him it is possible to display stored curves and also just swept curves in the background of Sweep window as a vector graphic. The use of Sweep manageres makes it necessary to disable the "mathematical calibration correction". Note this one gets when using the software. The reason for this is quite simple. When saving the file, the curve characteristics of the measuring head currently used are saved with the file, but not the values of the mathematical calibration correction of the probe used. Unfortunately this is not possible. We store the file in the Sweep curve nmanager lack the Kalibrierkorrekturen per frequency and the measured curve is shown as it would have been included without "mathematical calibration correction". That's not bad, but these deviations are visible. Therefore my advice, dear once more without calibrating "mathematical calibration correction" and the representation is real accurate. Accurate enough for our amateur purposes in all cases. It is important that one really only used in the frequency range to calibrate. This method provides the most accurate results. A view of the worksheet you can see in Figure 3.8 on page 27
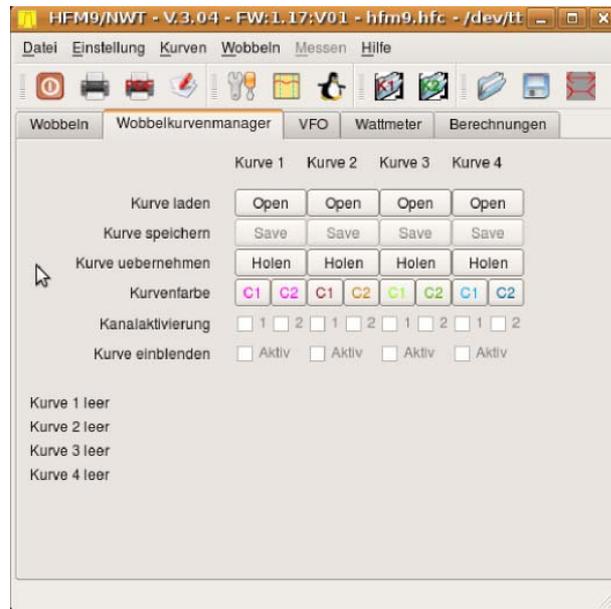
Figure 3.8: View of the curve Manager

3.4.1 Load curve

With the "Open" button, you can load a stored curve in the background. It does not matter what resolution, which start frequency and end frequency which the data was stored. When going to represent the curve, it is also shown. Here, the curve represents the characteristics of the measuring probe, which were used for the recording of the curve. So we are back to the point that the calibration in the frequency range currently used is very important for an accurate representation without mathematical calibration correction.

3.4.2 Save Curve

You item "Save" is used for subsequent save a trace file if you have loaded a graph in the background, for example, by clicking the button "Get" and has continued to wobble merrily. So you can save the trace file subsequently.

Get 3.4.3 curve

The button "Get" get me the curve data from the main program in the Sweep manager without which I must cache the data only. The mathematical calibration correction as described above not taken into account.
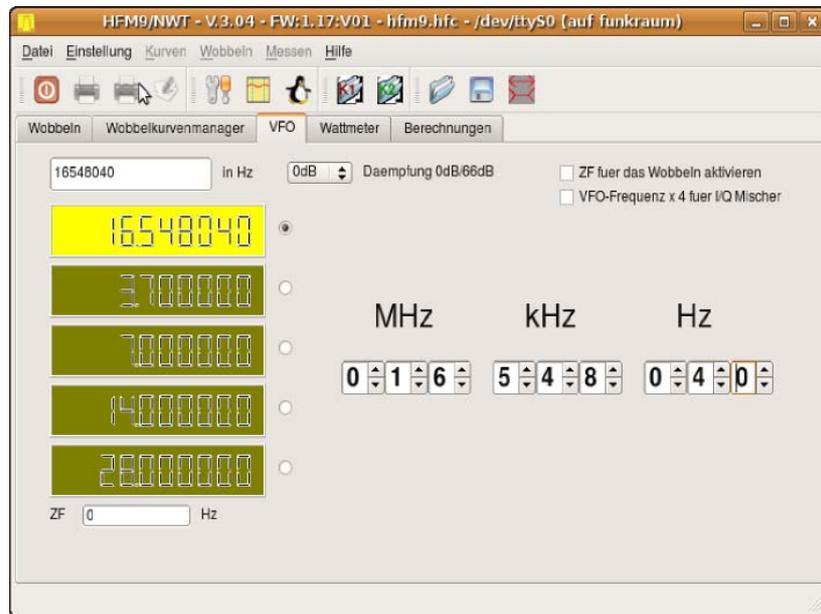
Figure 3.9: View of the worksheet VFO

3.4.4 Curve color

The buttons are "C1" and "C2" to set the colors for the lines in the background. Where C1 is for Channel 1 and Channel 2 for C2. The color settings are stored "wkm.cfg" in the file.

3.4.5 channel activation

As the name suggests, the individual channels can be activated here.

Show 3.4.6 curves

With this activation you can complete the data or hide from the light. Which is useful in the preparation of both Sweep curve n channel 1 + channel 2

3.4.7 Curve Info

Here you can see an info to the curve. The "Get" only the date is displayed and when "downloading" the file with the complete path + LayoutLabel.

3.5 The worksheet "VFO"

A view of this range we see in Figure 3.9 on page 28

3.5.1 frequency calibration of the VFO

The frequency accuracy of the VFO is dependent on the frequency accuracy of the clock generator in the NWT. I would like to explain that the FA-NWT. When FA-NWT is the DDSTaktfrequenz 400MHz. This frequency is in the "Option, Basic Data / wobble" under "DDS clock frequency" set. We now need an accurate reference frequency for calibration. Either a frequency standard or is it possible the comparison with a radio transmitter such as "German Wave" on 6.075 MHz. This transmitter frequency is very precisely. Here I the VFO on 6.075 MHz and coupling the VFO signal quite easily in the KW-receiver with, then the frequency deviation between the VFO and the AMTräger the "Deutsche Welle" audible, may it also helps the AF signal in a oscilloscope to make visible. Now you will adjust the VFO to exactly zero beat of the two frequencies achieved so long. From the selected VFO frequency to the exact frequency can be calculated. Suppose the VFO frequency is 6075120 Hz as the frequency re-set is calculated with the formula:

new clock frequency = 6075000

6075120 ¤ 400000000

As a result we obtain in our example 399992099 Hz, this frequency we are in the "Option" and confirm with "OK". The program calculates the new DDS Konstande and transfers it to the NWT. Then the new value in the EEPROM of PIC is saved and the NWT performs a "warm start". After the "warm start" as "default" is back at 4MHz on NWTOutput. Only a second command to the RS232 from the program adjusts the frequency. So now set the VFO frequency exactly at 6,075 MHz and it would have to be zero beat reached.

3.5.2 Controls Worksheet "VFO"

The VFO frequency is only true when the carrier frequency was previously calibrated precisely. In the "VFO", a frequency of 1 Hz to "maxvfo" (the "option") MHz can be set. The setting of the frequency I have divided into three groups so that it is clearer. It is best to operate with the mouse wheel. It can be any decimal point should be adjusted individually. In the ZFZeile the ZF can be entered. If the VFO will swing below the displayed frequency entered the sign is negative. As of version 1.09 it is possible to use the IF for the sweep with. The background is that there are OMs use the NWT as a VFO for a good HF receiver. The KW-receiver is used as a spectrum analyzer by the IF signal is fed to the measuring input. It is better to use the "Option Settings" for the use of the spectrum analyzer. In the upper input line, the frequency may be entered directly. The VFO frequency can also be adjusted from version V1.09 with the keyboard (see table).

PLUS	Q	W	E	R	T	Z
	10MHz	1MHz	10kHz	1kHz	10Hz	1Hz
MINUS	A	S	D	F	G	H

The selection of different attenuators can now additionally
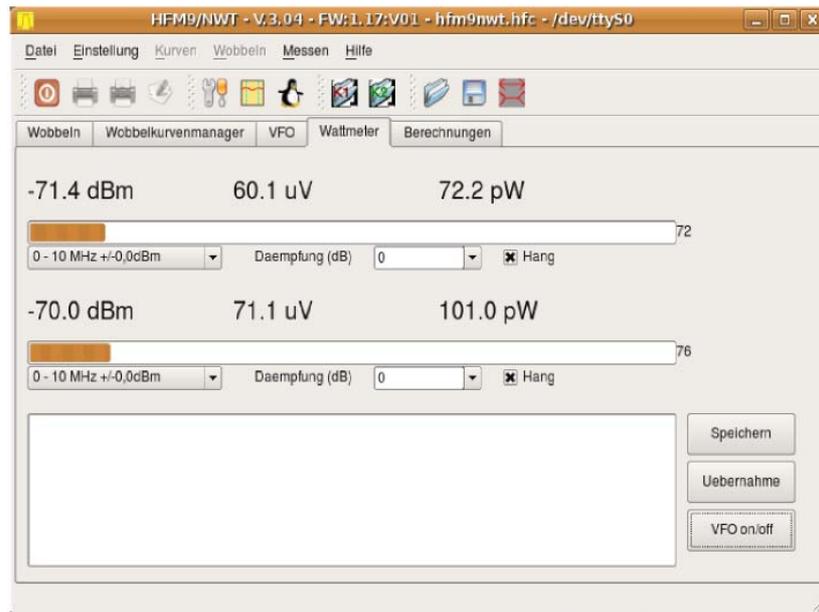
Figure 3.10: View of the wattmeter worksheet without VFO

be set in this worksheet. In the "option" is set to the corresponding attenuator switch (0-50dB or 66dB of 4-FA), at the point "FA-steam.".

3.6 The worksheet "wattmeter"

A view of the worksheet you can see in Figure 3.10 on page 30 The "watt meter" shows in the use of logarithmic probes the adjacent level in "dBm", "V" and "W" to. "Volt" and "watts" are calculated from the dBm values and displayed in the appropriate unit of measure. The calculated values for "V" and "W" appear somewhat coarse, this is due to the resolution of the AD converter of 10 bits and the measured value is logarithmic. Is calculated from dBm values, the voltage arising additionally large measurement range jumps. Therefore, the trick has been used several measurements to form a mean of me. In addition, an increasing value will be displayed immediately and a decreasing measured value is displayed delayed, similar to a hanging regulation at the AGC of a RX. With the CheckBox "hang" you can disable the suspension function. There are all formed from the 100mSekunden incurred measured values of the mean value. Default setting is a split of 20mSekunden between each measurement. This means that there is a measurement portion of 5 measurements.

Right above each of the two measurement channels are 2 combo boxes at the right display correction when using attenuators to suggest and old countries
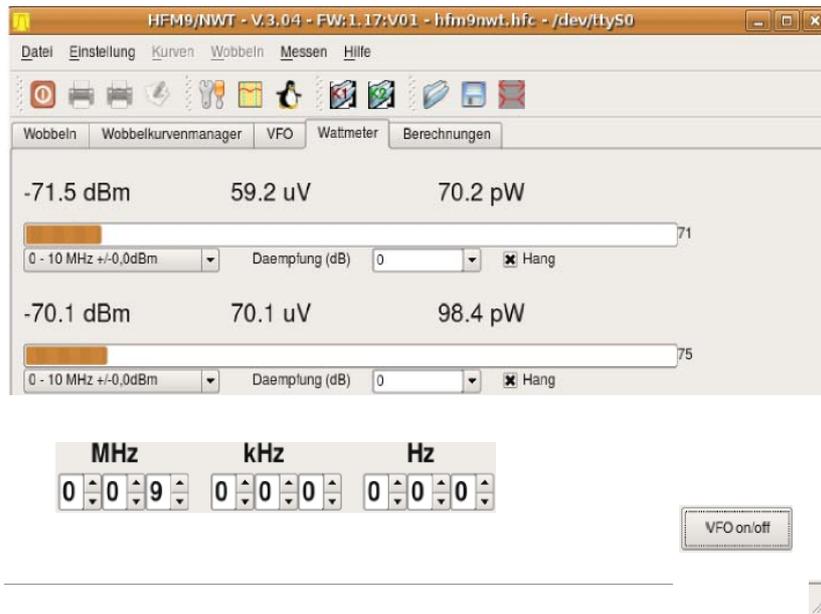
Figure 3.11: View of the wattmeter worksheet with VFO
(Performance measurement). Links among the indicator bar is the combo box for
the frequency correction of the dBm readings. This was necessary to compensate
for the dB drop by high frequencies. This is especially important when using the
"AD8307". These settings can also be edited from the version 2.03 itself. The
editability is necessary when using other ICs in the measuring heads. For editing,
the menu item "Edit Sensor 1 / Sensor 2". A view of the dialog you see in Figure
3.12 on page 32
The displayed values of the two channels are transmitted in the table by clicking
the "measured value acquisition". In this text window can now be edited. You can
enter as a short description of the measurement point. This is related to the text file,
which can be saved with the "Save" button. In addition, a button for switching to an
additional VFO is from version 3.xx added. This VFO is useful in balancing work eg
to tape passes. The switched-on state and the set values are stored in the
configuration file.
3.7 The worksheet "Calculations"
A view of the worksheet you can see in Figure 3.13 on page 32

Figure 3.12: View of the dialog to edit the dBm-deviation

Figure 3.13: View of the calculation worksheet

3.7.1 resonant circuit calculation capacity

For the frequency input there is the possibility the value directly from the graphics window (right mouse button menu) to assign or simply returns the value with the hand one. Both are possible. The inductance and frequency in use must be known.

3.7.2 resonant circuit calculation ind. AL-value

For the frequency input it is possible to assign the value directly from the graphics window or you simply returns the value with the hand one. Both are possible. In addition, the AL value can still be calculated. I need it only specify the number of turns of the test circuit. The AL value is automatically calculated and transmitted in addition to the next group box. Here the capacity and frequency must be known, is additionally given the number of turns, the AL value is automatically calculated.

3.7.3 turns calculated from AL value

Either the AL value has already been transferred from the resonant circuit calculation or simply indicates the number it self. Calculated the number of turns.

3.8 The extra window for the graphic

In version 3.xx more controls had to be placed in the worksheet "wobble". This was no longer possible. Therefore, I have programmed a graphical representation of Sweep curve in a separate window. After some initial problems with the new service, that was the right decision. In the "Options" in the tab "General" one can determine in which of the Focus button to automatically switch to the graphics window. Another relief is to reduce the width of the main window with the menu item "wobble, change window width" or the corresponding icon button in the icon bar (far right). In addition, it is possible to control some functions in the graphics window with the keyboard. Here is a list of possibilities.

Button	Function
Return	place the cursor
Space	einmal Sweep n bei gesetzten Kursor, der Kursorpunkt wird die Frequenzmitte im Sweep fenster und die anschliessende die Fenstermitte
Up	Kursor in die Mitte und Lupeplus einmal Sweep n Down Kursor in die Mitte und Lupeminus einmal Sweep n
Left	Kursor 5 Pixel nach links
Right	Kursor 5 Pixel nach rechts
1	Umschalten auf Kursor 1 mit Return setzen des Kursors
2	Umschalten auf Kursor 2 mit Return setzen des Kursors
3	Umschalten auf Kursor 3 mit Return setzen des Kursors
4	Umschalten auf Kursor 4 mit Return setzen des Kursors
5	Umschalten auf Kursor 5 mit Return setzen des Kursors
0	alle Kursor loeschen
E	Einmal (wie Button)
W	Sweep n (wie Button)
S	Stop (wie Button)

3.8.1 Mouse function "left button" in the Sweep grafic

After the presentation of the Sweep curve can be performed with the mouse, a curve analysis. Simply click the "left mouse button" on the appropriate place. In the "Info Window" to display the data.

3.8.2 Mouse function "right button" in the Sweep grafic

With the "right mouse button" a small additional menu is displayed. I can either accept the frequency values as initial or final frequency or even delete the cursor.

Another additional item on the menu is based on the resonance frequency of the cable to calculate the exact cable length. The description appears in a dialog box. The following is a menu item with which you can calculate the electrical data of the cable from the cable length. The last menu item, the handover of the frequency is in the calculation worksheet.

3.8.3 Resizing the Sweep window

The size of the Sweep fenster can change arbitrarily. The minimum is set, so that's even possible a meaningful representation. The maximum is determined by the screen resolution. When you print the Sweep fenster is briefly brought to a defined size. This is necessary for the correct display when printed. After printing the previous window size is adjusted again. The size of the Kursordreiecks is also changed with, when you resize the Sweep window.

3.9 The calibration

1. Thus, the HW is a precise instrument, it is necessary to calibrate. In the following chapters, the correct description is supplied to it. The correct order of the calibration also plays an important role. The following sequence is recommended.

2. First calibrate the exact frequency of the DDS output. This depends on the exact DDS clock.

3. 2 exact 0dB line in the sweep mode. This depends on the hardware of the NWT kit (frequency response of the generator output and the RF sensitivity of the measuring head input)

4. 3 Calibration of the HW of SWV measurement head in the SWV mode.

5. 4 The calibration of the exact dBm display in the spectrum analyzer mode. This calibration is divided into two areas. The first section describes the calibration method for beginners and is purely independent of the frequency of use. The second portion is intended for experts. In the expert section, the frequency-dependent variations of the input low-pass filter in the range 1 and the input bandpass filter are included in the category 2 with the calibration. Thus we reach the limits of accuracy of the HW of the SA-module, which are quite remarkable for this device.

3.9.1 Calibration of the DDS clock

This calibration has already been described in paragraph 3.5.1 on page 29 and repeated once more. The frequency accuracy of the VFO is dependent on the frequency accuracy of the clock generator in the NWT. I would like to explain that the FA-NWT. When FA-NWT is the DDSTaktfrequenz 400MHz. This frequency is in the "Option, Basic Data / wobble" under "DDS clock frequency" set. We now need an accurate reference frequency for calibration. Either a frequency standard or is it possible the comparison with a radio transmitter such as "German Wave" on 6.075 MHz. This transmitter frequency is very precisely. Here I the VFO on 6.075 MHz and couples all the VFO signal quite easily in KW receiver with one, then the frequency deviation between the VFO and the AM carrier of the "Deutsche Welle" audible, may it also helps the AF signal to make them visible in an oscilloscope. Now you will adjust the VFO to exactly zero beat of the two frequencies achieved so long. From the selected VFO frequency to the exact frequency can be calculated. Suppose the VFO frequency is 6075120 Hz as the frequency re-set is calculated with the formula:

new clock frequency = 6075000

6075120 ¤ 400000000

As a result we obtain in our example 399992099 Hz, this frequency we are in the "Option" and confirm with "OK". The program calculates the new DDS constant, and transmits them to the NWT. Then, the

new value stored in the EEPROM of the PIC and the NWT performs a "warm start". After the "warm start" as "default" is back at 4MHz on NWTOutput. Only a second command to the RS232 from the program adjusts the frequency. So now set the VFO frequency exactly at 6,075 MHz and it would have to be reached zero beat.

3.9.2 Calibration of the Sweep bereiches

This calibration has already been described in paragraph 3.2.4 on page 16 and repeated once more. Each probe has to be calibrated in order to achieve accurate measurements. The first query is the type of the sensor lin / log. Subsequently, an attenuator -6db/-40dB must be looped. At the end of the VFO output is directly connected to the channel 1. For all of two measurement series two constants are calculated, the function "HFPegel -> output voltage" describe the probe. This function is always "linear" and can be described with just two constants. The result is in the menu item "Properties measuring probe channel 1 Save" are saved, but when calibrating the Save dialog is available immediately. Owner of a connected attenuator need to insert any additional attenuators, here automatically assumes the software inserting the attenuator. This applies to the full extent (linear measuring probe needs-6dB element) only when FA-attenuator. It just needs a connection cable between the two RCA sockets are plugged. When determining the second reference line which should normally be 0 dB, even a small attenuator can be used with looped. This is for measuring probes which do not tolerate the level of +4 dBm and are inaccurate in this area. But these are special cases, we use the submitted 0dB transmission loss.

Mathematical calibration correction when using the log. Measuring probe.

Consider our calibration result "if we take the output of the oscillator to the measuring input" connect directly. It can be seen that the calibration curve in accordance with the high frequency drops. When FA-NWT we're lucky, by the good design, the 0dB line of house is very straight. But we match the deviation from mathematically, we can correct the path of the line. This creates a file in which each frequency deviation in "dB" is stored. Our measurement curves, we can compensate with this file. The measurement accuracy increases over the entire range of + / - 0.5 dB. In order to compensate for the entire range of being calibrated frequency range specified in the configuration data and can only via the menu item "setting; Option "be changed. In the file with the calibration filename-kx.hfe the correction values are stored. This change also applies to the second channel, the linear measuring sensor is not considered. If the calibration correction enabled for a channel, the color of the label of the checkbutton changes in the color "RED".

There are at the "mathematical calibration correction" one problem, however. Once a saved trace file is loaded into the Sweep curve nmanager, which is not shown "mathematical calibration correction" in the curve. Accordingly, there is a deviation between the curve shown at the moment and the curve in the "manager". Therefore, I have inserted a warning into the program, which allows these "calibration correction"

off while reloading curve files. The only way to error-free work with the "Sweep curve nmanager". Therefore, I propose to dispense with this correction and dear once more the particular frequency range to calibrate.

3.9.3 Calibration of the Spektrumanalyservorsatzes

Calibration of the SSV is divided into three areas

First calibrating the exact frequency by adaptation of the intermediate frequency of the SAV.

Second approximation of the levels displayed in the various set bandwidths.

3 Setting the dBm level in the range 1 and range 2

4 inclusion of frequency-dependent transmission curve of the input filter of the SAV-HW. See these curves at each SAV different. This is to be compensated.

The frequency calibration

In SAV, we dine in input a generator level with a known frequency. The SAV we provide to 300Hz and control the frequency in the display. We can correct the line displayed by changing the IF in the corresponding region 1 or 2 point "setting; option; Frequency range from 1/2; IF "

The basic calibration of the dBm display

This calibration is divided into 2 areas. First, we will match the levels of the different band widths. But this purpose, the level in the HW of SAV are first attempts to equalize just after assembly instructions. Only if this is not possible, the remaining level difference in the SW is adjusted. We lay at the entrance of SAV us to a known level and record the levels displayed in the display with the different band widths. The level differences, we can now by correcting values in "setting; option; Pegelkorr. dBm for display; B300/B7kHz/B30kHz ". After the correction, we control the display and possibly take once corrections to the deviations before. Is an approximation achieved this we can calculate the total level by entries in "setting; option; Pegelkorr. dBm for display; Area 1 / area 2 "still correct. This is separate for the region 1 and 2 are possible. The area 3 is designed for the operating mode Sek.FRQ shift and is added in addition to the region 1 or 2.

The extended calibration of the dBm display

Once the basic calibration is successful, we can still increase the readability. To this end, the transmission curves of the two entrances of the SAV must be included. Important in the absorption of the the Sweep curve

mathematical calibration correction is active. So first again calibrate the sweep with the activated mathematical calibration correction. Then, we conduct put the balance measurement cables as shown in the Baumappe described the transmission curve of area 1 and area 2 setting when sweeping: Meanwhile, on "9990" and measuring points "9999". Each calculated curve is stored in a trace file, and records the file name. Now we put the bridges in the SAV again, so that the SAV is ready for use again. This curve files we use for calibration. We go to "setting; option; Spectrum analyzer "and press the button" Calibrate ". It will ask for the trace file. The curve file for Domain 1, we first have to activate. The start frequency and end frequency is adopted and confirmed from the option. By reading the trace file and the mathematical calibration correction data, a SAV Kalibrierarray is filled, the frequency-dependent compensated us the dBm display. After leaving the option we see our calibration result at the SAV baseline. This now has the mirror image of the recorded history Sweep curve . For the area 2 can now also the correction with the second curve file done. Here now the mirror image over the Sweep curve in the base line must be visible. As a final level correction, the total level "setting; option; Pegelkorr. dBm for display; Area 1 / area 2 "yet adjusted. The frequency-dependent level values for the calibration correction are "sav.cal" stored in the file. Now we are done with the calibration and use the SAV for our measurements. A picture of the fundamental line in the area of my SAV 1, we see in Figure 3.14 on page 39 The spikes in the baseline arise at 30kHz bandwidth and are DDS spikes and mixed products in SAV. These can be overcome only with very great effort. Another SAV measurement curve with 300Hz bandwidth can be seen in Figure 4.2 on page 44.
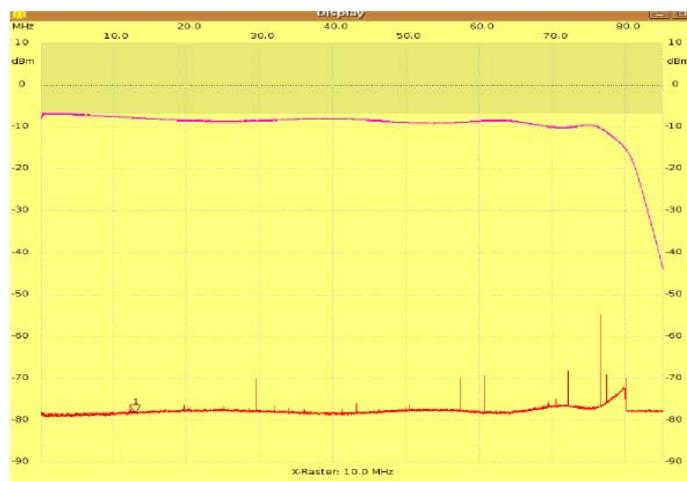
Figure 3.14: View of the baseline with a mirror-image sweep curve in the background

Chapter 4

The NWT-Hardware

4.1 The firmware generally

4.1.1 NWT7 / FA-NWT / HFM9 / NWT500

For the exchange of data, I use a protocol other than Bernd. It was therefore necessary to rewrite the firmware in the PIC 16F876/873. Located in the PIC software with bootloader from the FA or from me, the software can be updated via the serial interface. This only works if the appropriate boot loader on the PIC is available. DL1ALT uses a different boot loader, the other "strings" used for control. Therefore, it is necessary to inform accordingly before you upgrade the firmware and "nothing works". A brief outline of how the FW is played followed by yet another section. Further information can be found in chapter 3.2.2 on page 14.

4.1.2 RADIOAMATEUR-NWT

The FA-NWT is delivered with the appropriate firmware since 2006. One firmware renovation needs it the "FA-NWT" normally so do not! An exception is a series of extensions and add-on modules offered by the magazine "RADIO AMATEUR". In general, a suitable PIC is included. But here also applies, more details you can find in chapter 3.2.2 on page 14

4.2 FA-NWT 4.2.1 Firmware

The current firmware is at this time the version 1.18. Renewing the firmware can be found in chapter 3.2.2.

Firmware Version 1

This firmware is for the FA-NWT with direct generation of the 400MHz clock frequency. It is not in the firmware in the PLL IC AD9951 activated and

is the cleanest output signal to be expected at the output of AD9951. This variant is also used in the latest hardware version of the FA-NWT.

Firmware Version 2

This firmware is for the FA-NWT with 20MHz clock frequency. In the firmware, the PLL is initialized in the IC AD9951 with a factor of 20 and also results in 400 MHz clock frequency. However, it is not as clean by the PLL output signal. This variant is used in the older HW versions of the FA-NWT.

4.2.2 The pin of the PIC 16F876 Below is a table of the pin assignment:

Port-Pin	IC-PIN	Richtung	Funktion
A-0	2	input	AN0 A / D converter for lin probe 1
A-1	3	input	AN1 A / D converter for log. Probe 1
A-2	4	input	AN2 A / D converter for status SAV
A-3	5	input	AN3 A / D converter free
A-4	6	input	free
A-5	7	input	AN4 A / D converter for probe 2 external
B-0	21	Input-output	Query FW update in bootloader
B-1	22	output	Control attenuator
B-2	23	output	Control attenuator
B-3	24	output	Control attenuator
B-4	25	output	Control attenuator
B-5	26	output	Control attenuator
B-6	27	output	Control attenuator
B-7	28	output	Control attenuator
C-0	11	output	DDS data
C-1	12	output	free
C-2	13	output	FQUD DDS
C-3	14	output	DDS clock
C-4	15	output	RS232 RTS for bootloader
C-5	16	input	RS232 CTS for bootloader
C-6	17	output	RS232 TX
C-7	18	input	RS232 RX

4.2.3 Connection of a second probe
In the software always of two measurement channels measured values can be read even if the second channel is not used. If the second analog measurement input still wired with an AD3807, we can simultaneously represent a second curve. So there are 2 measuring inputs on the PIC available. Used is the PIC pin 7 AN4 for the 2nd measuring input. The use of two probes has the advantage that the same two curves are shown (in sweep mode). I have observed during calibration, for example, with my K2, the band filter and the SWV at the antenna input is always the same. Thus, the matching was optimal thing. An additional sensor is the "RADIO AMATEUR" as a kit

41

available. If you switch the input resistance gone, it is possible to make the measurement input of the probe slightly higher impedance. It is possible to measure directly in active circuits (within certain limits). In my measurements on homemade receivers, the impedance change was minimal (RX train is almost always in 50 ohms technique).

4.2.4 Connection attenuator 10-50 dB

The connection of the damping member of DK3WX depends on the FW in the PIC.
FW to 1:09 for FA-NWT and HFM9:
PIN B3 = 10 dB attenuator PIN B4 = 20 dB attenuator PIN B5 = 20 dB attenuator
FW 1.10 and for FA-NWT and HFM9 with adjustment for the FADämpfungsglied:
PIN B1 = 10 dB attenuator PIN B2 = 20 dB attenuator PIN B3 = 20 dB attenuator

4.2.5 Connecting attenuator from RADIO AMATEUR 4-66dB

The attenuator works only with firmware 1.10 and software 2.03. The advantage of this attenuator is the fine gradation of 2dB. Furthermore, it is fairly linear up to 500MHz.
FW from 1.10 for FA-NWT and HFM9: PIN B1 = 2 dB electronic attenuator PIN B2 = 4 dB electronic attenuator PIN B3 = 8 dB electronic attenuator
PIN B4 = 4 dB attenuation basic electronic attenuator
PIN B5 = 16 dB resistance member
PIN B6 = 32 dB resistance member

4.2.6 Connecting the Spektrumanalyservorsatzes - FA

In the SW version 3.xx using the Spektrumanalyservorsatzes by the magazine "RADIO AMATEUR" with already programmed. The operation of the SAV is rounded 4.xx. in the current version The SAV has 2 switches. Once the range switch with 2 positions of the measured frequency ranges and then a switch for the bandwidth (30 kHz, 7 kHz, 300 Hz). With the matching FW in Pic the switching states of SAV to the SW are transmitted and
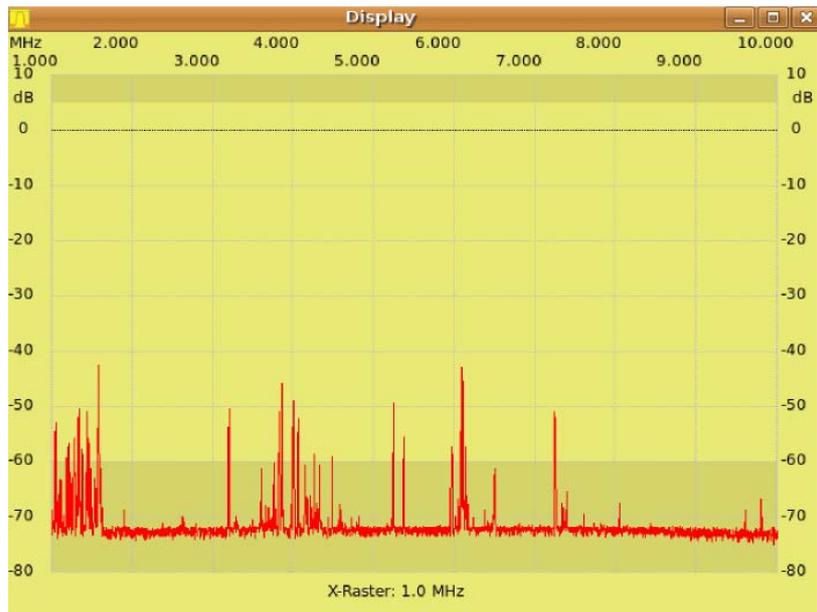
Figure 4.1: View of the operating mode "Spectrum" affiliated with SA-module represented there. This makes it possible to automatically switch the frequency to be measured areas and to respond to some false operation. As an example here would be a too narrow bandwidth setting on SAV in a large increment in the NWT. A corresponding instructions for the installation of the return channel is the SAV at. For users of the NWT500 feedback is also included in the FW. However, there is also the possibility of the scan areas of SAV with the SW switch directly. However, the disadvantage is that the software does not "know" what kind of switch position of the SAV. The inaccurate portrayal of area of SAV is shown angegraut the display. A view of a scan with the connected SAV can be seen on Figure 4.1 on page 43 Attached is my 2x26m dipole. You can clearly see the medium wave radio stations and also some KW radio transmitter.

4.3 HFM9

4.3.1 firmware

The current firmware is at this time the version 1.18. Renewing the firmware can be found in chapter 3.2.2. In HFM9 variant 1 can be used to 3.

Figure 4.2: SAV-view. My PA PicAStar, Z weitonan control 500Hz distance, almost full scale.

Firmware Version 1

This firmware is for the HFM9 with direct generation of the 400MHz clock frequency. There is no PLL in the IC AD9951 enabled in the firmware and it is expected the cleanest output signal at the output of the AD9951.

Firmware Version 2

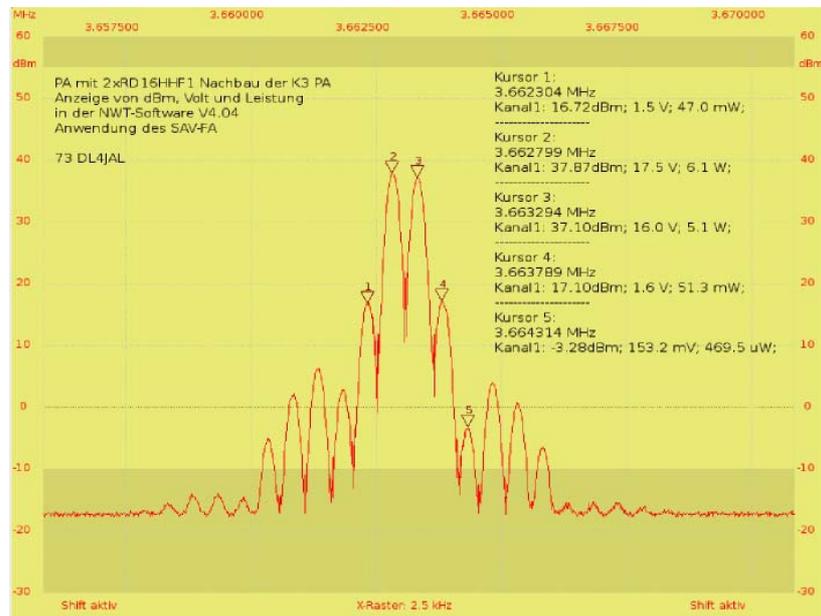This firmware is for the HFM9 with 20MHz clock frequency. In the firmware, the PLL is initialized in the IC AD9951 with a factor of 20 and also results in 400 MHz clock frequency. However, it is not as clean by the PLL output signal. If the HFM9 not used as a VFO for an RX, the purity of the RF signal is sufficient.

Firmware Version 3

This firmware is not used in the FA-NWT. The firmware can set the PLL divider in the AD9951 flexible. The command to do this comes from the software and there are all division factors that are allowed for the AD9951, possible. This set point is located in the "Setup" and "default" locked. Only one entry with a UNIX editor in the "configuration file" enables the adjustment. The following line is in the "Configuration File" insert:

pllmodeenable = 1

This entry is the "ComboBox" in the "Setup" menu commands. This setting is favorable for the use of other oscillators for clock generation of the AD9951. As an example here would be a Cmososzillator 80MHz or 100MHz mentioned. To get to 400MHz internal clock, we in the "Setup" a "5x" or "4x".

4.3.2 The pin of the PIC 16F876

The pin assignment is as in FA-NWT see chapter 4.2.2 on page 41

4.3.3 Connection of a second probe

Here, the same as in Section 4.2.3 applies on page 41

4.3.4 Connection attenuator 10-50 dB

Here, the same as in Section 4.2.4 applies on page 42

4.3.5 Connection attenuator from RADIO AMATEUR 4-66dB

Here, the same as in Section 4.2.5 applies on page 42

4.3.6 Connecting the Spektrumanalyservorsatzes - FA

Here the same applies as in section 4.2.6 on page 42, it is possible with the feedback of the status of SAV to work.

4.4 NWT7

My SW can also be used for the NWT7 with the AD9851. I have replaced all the routines in the firmware for the drive of the AD9951 against routines for driving the AD9851. I have also adjusted the baud rate on my SW, but it can also be the Pictakt be increased to 20MHz. Corresponding variants of the FW are. See the following section 4.4.1.

4.4.1 firmware versions and pin 16F876

For this hardware there is the firmware in the versions 4 to 7 versions 4 and 6 works with the PIC clock speed of 10MHz. The variants 5 and 7 are designed for a PIC clock speed of 20MHz. The advantage is the faster sweep n The sweep speed reaches the same speed as the FA-NWT. Below is a table of the pin assignment:

Port-Pin	IC-PIN	direction	function
			Variant 4 and 5
A-0	2	Input	
A-1	3	Input	AN0 A / D converter for log. Probe 1
			AN1 A / D converter for lin probe 1
A-0	2	Input	internal
A-1	3	Input	Version 6 and 7
A-2	4	Output	AN0 A / D converter for lin probe 1
A-3	5	Input	AN1 A / D converter for log. Probe 1
A-4	6	Output	20dB attenuator relay
A-5	7	Output	AN3 A / D converter for probe 2 external
B-0	21	in-Output	10dB attenuator relay
C-0	11	Output	20dB attenuator relay
C-1	12	Output	Query FW update in bootloader
C-2	13	Output	DDS data
C-3	14	Output	reset DDS
C-4	15	Output	FQUD DDS
C-5	16	Input	DDS clock
C-6	17	Output	RS232 RTS for bootloader
C-7	18	Input	RS232 CTS for bootloader

4.4.2 Connection of a second probe

The connection point of the second probe is on the table in chapter 4.4.1 on page 46 Same here what was written in chapter 4.2.3 on page 41.

4.4.3 Connection attenuator 10-50 dB

The connection points for the relay control of the attenuator are shown in the table in section 4.4.1 on page 46.

4.4.4 Connecting the Spektrumanalyservorsatzes - FA

Unfortunately it is not possible to connect this header to the NWT7 because the maximum output frequency of the NWT7 is not sufficient.

4.5 NWT500

Helmut DL1ALT has developed a NWT500 which allows up to the range of 500MHz to sweep n NWT This cooperates with the IC AD9858 DDS. Thus it is another drive in the firmware required. In addition, the firmware still has the task of a PLL IC to drive, with the clock frequency of 1200 MHz for the DDS is generated.

4.5.1 firmware versions and pin 16F876

For this hardware there is the firmware in the versions 10, 11 and 12 The variant 10 has a reference frequency for the clock generation 12.8 MHz. The variant 11 has a Ansteuerpin for a relay. This relay is activated in the SWV modes (see Table PIN). Below is a table of the pin assignment:

Port-Pin	IC-PIN	Richtung	Funktion
			Version 6 and 7
A-0	2	Input	
A-1	3	Input	AN0 A / D converter for lin probe 1
A-2	4	Input	AN1 A / D converter for log. Probe 1
A-3	5	Input	AN2 feedback SAV status
A-4	6	Input	AN3 free
A-5	7	Input	free
B-0	21	Input	AN4 A / D converter for probe 2 external
B-0	21	Output	Query FW update in bootloader
B-1	22	Output	Control LMX enable
B-2	23	Output	Control LMX data
B-3	24	Output	Control LMX clock
B-4	25	Output	Control Attenuator-10dB
B-5	26	Output	Control Attenuator-20dB
			Control Attenuator-20dB
B-6	27	Output	
B-7	28	Output	only variant 11
C-0	11	Output	SWR control relay
C-1	12	Output	free
C-2	13	Output	DDS data
C-3	14	Output	reset DDS
C-4	15	Output	FQUD DDS
C-5	16	Input	DDS clock
C-6	17	Output	RS232 RTS for bootloader
C-7	18	Input	RS232 CTS for bootloader

4.5.2 Connection of a second probe

The connection point of the second probe is on the table in chapter 4.5.1 on page 47 Same here what was written in chapter 4.2.3 on page 41.

4.5.3 Connecting attenuator 10-50 dB

The connection points for the relay control of the attenuator are shown in the table in section 4.5.1 on page 47.

4.5.4 Connecting the Spektrumanalyservorsatzes - FA

Here the same applies as in section 4.2.6 on page 42, it is possible with the feedback of the status of SAV to work.

Chapter 5

Miscellaneous

5.1 Programmaufrufmit arguments in the command line

5.1.1 Program start with a different configuration

As of version 1.07 it is possible behind the program name as an argument to specify the configuration file. Without a statement after the program name is displayed as "Default configuration" file "hfm9.hfc" loaded. But if you want to start immediately with a different configuration, the program, the name of the configuration file is written after the program name. Thus, it is possible on the desktop several "Icon" to create, each with different configuration settings. These configuration files must be in the HOMEVERZEICHNIS/hfm9. This procedure is recommended if several network analyzers are available (eg 1x FA-NWT, 1x HFM9, the NWT7 with the AD9851 and the NWT500 of DL1ALT). So you can create a separate configuration for each HW. It should be re-assigned the file name of the default special files. With the loading of configuration the matching probe files are identical with recharged. Also, the operation of several NWTS with a PC on different serial interfaces is possible.

5.1.2 Program start with a different language

Thanks to some OMs (Laszlo Rusvai DL2JTE, HA7MAC and G0UEN) the main texts were translated in the program in Hungarian and English. The se-translated tion file can be appended as an argument when calling the program. Once the program detects a valid file appears the appropriate language. I have already incorporated the language in Windows Setup. But to work under Linux, as described above. See section 2.1.1 on page 6

5.2 Description of all parameters in the configuration file

5.3   Beschreibung.

Name	Funktion
serial line edita catch editende	serial port COM1 to COM256 in Windows content of the input frequency beginning
editschritte	Content of the input frequency end
editdisplay graphic focus sweep n graphic focus once graphic focus stop	Contents of the input for the number of steps shift the 0dB line in 10dB steps Yes / No whether the focus should switch Yes / No whether the focus should switch Yes / No whether the focus should switch data for a profile entry
profilnameXX	Data for a profile entry
profilanfangXX	Data for a profile entry
profilendeXX	Data for a profile entry
profilschritteXX	Size of the font in the program
program fontSize	Flag for sweep settings
mwanfang Mwende	Flag for sweep settings
mwschritte	Flag for sweep settings
msa1anfang msa1ende msa1schritte msa2anfang msa2ende msa2schritte sa1anfang sa1ende sa2anfang sa2ende sazf1 sazf2	Flag for spectrum analyzer range 1 flag for spectrum analyzer range 1 flag for spectrum analyzer range 1 flag for spectrum analyzer range 2 flag for spectrum analyzer region 2 region 2 spectrum analyzer spectrum analyzer flag for setting the spectrum analyzer option setting in the option setting in the spectrum analyzer spectrum analyzer option setting in the option spectrum analyzer spectrum analyzer setting in the option setting in the option

Name	Funktion
sastatus	Yes / No spectrum analyzer
saschrittkorr	HW status message in the Yes / No option spectrum analyzer automatic correction step in the option
messlabelfont	Writing of the wattmeter display
eichanfangsfrequenz	Kalibrieranfangsfrequenz in Kalibrierendfrequenz
eichendfrequenz	option of calibration option
eichschritte	Meanwhile, the wattmeter measurements in
messtime	mSekunden
messvfoaktiv	Yes / No whether VFO frequency of the VFO in the
messvfo	watt meter accurate clock frequency of the DDS in
DDStakt	the NWT number of the PLL setting is active when
PLLMode	pllmodeenable active in the wattmeter
	Yes / No PLL setting
pllmodeenable	in option is enabled
	Yes / No attenuator from the FA font size of the
faeichglied	wattmeter display font in the notification text
messlabelfontsize	Font size in the info text
infofont	ZF in VFO
infofontsize	Default name of the probe 1 in the option Default
editzf	Name of the probe 2 in the options Yes / No active
namesonde1	only when a probe is connected
namesonde2	Yes / No math. Calibration correction Yes / No math.
Einkanalig	Calibration correction Yes / No math. Curve nglättung at SWV Yes / No Special NWT500
eichkorrk1	with Tastkopfumschaltung SWV Inverse 3dB
eichkorrk2	bandwidth determining color for channel 1 and 2
SWRIteration	Color for the background
SWRRelais	maximum frequency for the sweep n maximum frequency of the VFO
bandbreiteinvers	Display channel 1
colorXr,colorXg,colorXb,colorXa	Display channel 2
colorhr,colorhg,colorhb,colorha	Additional entries of the damping in the 05-09 watt
maxsweep	meter vertical blue markings frequency vertical blue
maxvfo	pitch marks Yes / No frequency markers
k1checked	Flag for mode
k2checked	Flag for max dB in the display
powerkXX	Flag for min dB in the display
a160m - a2m, au1 - au3	
b160m - b2m, bu1 - bu3	
160m - 2m, zusatz1 - zusatz3	
betriebsart	
ydbmax	
ydbmin	

Chapter 6
The Protocol on the
serial interface

To maximize the speed of the sweep ns I programmed the following sequence. Each command in the direction NWT-Pic is initiated with a small letter. On the basis of the letter gives the length of the data telegram.

Important! Each command byte "8F hex" prefix.

On the basis of this byte branched the firmware in my implemented routines and the SW by Bernd Kernbaum can still be used. However, the board with "Power ON" must be restarted when the SW is changed. Since the Rambereich the PIC is used twice, a re-initialization of the firmware is required (by "Power ON").

The following commands are implemented:

6.1 commands to PIC FW Version 1.13

The PIC firmware is backward compatible. Here is the description of the commands.

6.1.1 "w" Sweep n with the AD8361 10-bit from the A / D converter, data length 22 bytes.

w Byte1

Start frequency bytes 2-10 increment bytes 11-18 number of bytes 19-22

A small example:

Data to the PIC: w 001000000 00007000 2000   Initial frequency:
1,000,000 Hz

Increment: 7000 Hz   Number of measurement points: 2000

Data to the PIC: w   Initial frequency: 1,000,000 Hz

Increment: 7000 Hz   Number of measurement points: 2000

Data from the PIC: 8000 bytes are given in response to the PC. Per measurement point and channel is 2 byte result as a return value. 2000 measured points times 2 channels results in 8000 bytes of data, which sends the module to the PC.

FROM A/D

6.1.2 "x" Sweep n with the AD8307 10-bit converters, data length 22 bytes.

x Byte1

Start frequency bytes 2-10 increment bytes 11-18 number of bytes 19-22

A small example:

Data to the PIC: x 002000000 00014000 2000

Initial frequency: 2,000,000 Hz increment: 14000 Hz Number of measurement points: 2000

Data from the PIC: 8000 bytes are given in response to the PC. Per measurement point and channel is 2 byte result as a return value. 2000 measured points times 2 channels results in 8000 bytes of data, which sends the module to the PC.

6.1.3 Setting the "f" VFO, data length of 10 bytes. No Byterückgabe.

an example:
f 007030000 VFO is set to 7:03 MHz.

6.1.4 retrieve "m" measured value, data length 1 byte. Return 4 bytes.

This command is used to query the measurement channels. It will be returned to the PC per channel 2 bytes. They contain the 10 bit A / D conversion results of the Measurement channels.

53

6.1.5 "e" oaks, data length of 13 bytes, no Byterückgabe.
This command allows an exact adjustment made to the clock frequency. The "e" followed by 10 Char. 2 Char yield a HEX number. All letters must be capitalized, except the command e!. The last byte is the setting of the PLL in the DDS. In byte interleaved, the multiplier of the PLL and the steepness of the power source in the control loop. For these settings you have to look at the datasheet of the AD9951 accurately. The PLL byte is loaded from firmware version 104 in PIC at PowerON, but in the data telegram of the command it has to be sent, otherwise the calibration does not work. From the FW version 1.14 the PLLByte is only considered in the FW version 3.
for example:
e 0ABCC77 11800 corresponds to a clock frequency of 400.000000 MHz exactly
e 0ABCC6BCF300 corresponds to a clock frequency of 400.000400 MHz exactly

Calculates this constant is represented by the formula:
Constant = 264
clock speed
or
Constant = 232
Clock frequency ¤ 232
The second formula can control himself a little better. But you need not worry about this formula, the calculation assumes the PCProgramm when the menu item "Option" is used.
6.1.6 "v" Query version of the firmware, data length 1 byte, return 1 byte.
This command displays the number of the currently used firmware is read in the PIC. Start with the number 100 which means version 1.00.
6.1.7 "r" switching of the attenuators, data length 2 bytes, return 0 bytes.
This command outputs for the various attenuators are switched. As of firmware version 1.10 and also the attenuator from the AMATEUR RADIO is driven. There are the following wirings:
FW to 1:09 for FA-NWT and HFM9:
PIN B3 = 10 dB attenuator PIN B4 = 20 dB attenuator PIN B5 = 20 dB attenuator

- FW 1.10 and for FA-NWT and HFM9:

- PIN B1 = 10 dB attenuator PIN B2 = 20 dB attenuator PIN B3 = 20 dB attenuator

- FW 1.10 and for FA-NWT and HFM9 for the FA Attenuator: PIN B1 = 2 dB electronic attenuator PIN B2 = 4 dB electronic attenuator PIN B3 = 8 dB electronic attenuator PIN B4 = 4 dB attenuation basic electronic attenuator

- PIN B5 = 16 dB resistance member

- PIN B6 = 32 dB resistance member

- FW for NWT7:

- PIC PIN 6 = 10 dB attenuator PIC PIN 7 = 20 dB attenuator PIC PIN 4 = 20 dB attenuator

- Note the data byte from FW version 1.10. It is not converted from char to byte, but is immediately evaluated as a hexadecimal byte. The BITs B1, B2, B3 be sent is 0x07 set.

- B1 = 20

- B2 = 21

- B3 = 22

- B4 = 23

- B5 = 24

- B6 = 25

- 6.2 Additional commands from PIC FW version 1.14

- The PIC FW is still backward compatible. As of firmware version 1.14 all the different hardware setups with the same FW version are operated. The difference caused by the different types and used DDS HWVarianten is marked with a variant number. Here the list of the different variant numbers and the assignment to the hardware used:

- FW version and assignment to HW:

- • 1 = FA-NWT without PLL 400MHz is fed directly

- • 2 = FA-NWT with PLL x20 with 20MHz clock

• 3 = HFM9 with adjustable PLL

• 4 = old NWT7 with PIC clock 10MHz and AD9851, AD8307 to AN0, AN1 to AD8361, Ch2 to AN3

• 5 = old NWT7 with PIC clock 20MHz and AD9851, AD8307 to AN0, AN1 to AD8361, Ch2 to AN3

• 6 = old NWT7 with PIC clock 10MHz and AD9851, AD8307 to AN1, AN0 to AD8361, Ch2 to AN3

• 7 = old NWT7 with PIC clock 20MHz and AD9851, AD8307 to AN1, AN0 to AD8361, Ch2 to AN3

• 10 = NWT500 with LMX2330 and 12.8 MHz reference frequency AD9858 1200MHz, 20MHz PICtakt

• 11 = NWT500 with LMX2330 and 12.8 MHz reference frequency AD9858 1200MHz, 20MHz PICtakt, SWV relay switching to PORTB6

• 12 = NWT500 with LMX2330 and 10MHz reference frequency AD9858 1200MHz, 20MHz PICtakt

If the version detected greater 1:13 in the automatic version query the variant number is then queried and this is then in the header of the main window. As of version 1.14 there are more commands to their description we are now.

6.2.1 "a" sweep n with the AD8307 10-bit from the A / D converter, data length 25 bytes.

This command is similar to the x command. Here a time value in uSekunden for the time between each measurement, but in addition also made. This also very critical curves can sweep n

a byte 1
Start frequency Byte 2-10
Increment bytes 11-18
Number of bytes 19-22
Scan Time Byte 23-25

A small example:

Data to the PIC: a 002000000 00014000 2000Initial frequency:
100   2,000,000 Hz

Increment: 14,000 Hz   Number of measurement points: 2000

Meanwhile, per measurement:
100 usec

Data to the PIC: a 002000000   Initial frequency: 2,000,000 Hz
00014000 2000 100

Increment: 14,000 Hz   Number of measurement points: 2000

Data from the PIC: 8000 bytes are given in response to the PC. Per
measurement point and channel is 2 byte result as a return value. 2000
measured points times 2 channels results in 8000 bytes of data, which sends the
module to the PC.

6.2.2 "b" Sweep n with the AD8361 10-bit from the A / D converter, data length 25
bytes.

This command is similar to the w command. Here a time value in uSekunden for
the time between each measurement, but in addition also made. This also very
critical curves can sweep n

b byte 1
Start frequency Byte 2-10
Increment bytes 11-18
Number of bytes 19-22
Scan Time Byte 23-25

A small example: 2000 100
Data to the PIC: b 002000000 00014000
Initial frequency: 2,000,000 Hz
Increment: 14,000 Hz
Number of measurement points: 2000
Meanwhile, per measurement: 100 usec

Data from the PIC: 8000 bytes are given in response to the PC. Per measurement point and channel is 2 byte result as a return value. 2000 measured points times 2 channels results in 8000 bytes of data, which sends the module to the PC.

6.2.3 "o" Turn of the SWV relay in NWT500 (Special Version), data length 1 byte, return 0 bytes.

With this command a relay in NWT500-special is switched. This NWT is an extra version with a relay which einschleift the SWV measurement head. With "0" it is turned on and off again with "1". Condition, the FW version 11 is PIC.

6.2.4 's "status query the NWT, data length 1 byte, 4-byte return.

With this command, 4 bytes are expected to be returned:

• 1 byte containing the version number

• 2nd byte contains the setting of the attenuator. With this feedback, the attenuator is adjusted in the software as it is connected in NWT. This is required if the SW was stopped and restarted without the NWT-HW has been restarted.

• Byte 3 & 4 are the result of A / D converter query on AN2 PIN4 the PIC. Byte 3 is LOW and HIGH byte 4 is the measurement result. With this measured value that the switch on Spektrumanalyservorsatz is reported back by FA in the SW. In the FW version 4 to 7 of the command returns in byte 3 +4 the value "0".

Chapter 7
conclusion
7.0.5 Conclusion for version 2.xx
I think we have now reached a good Final and thank you for the sensible legwork to this project. I turn now again other things in our beautiful hobby turn. Error corrections are of course still performed.
7.0.6 Conclusion
We can see it, is to recognize no real end of the software development. Furthermore, I make the evolution of the SW much joy and I would like to take this opportunity to thank all the users of the software to thank for the suggestions. As far as my time permits, further new ideas in the SW will be included. Current learn her about my website "http://www.dl4jal.eu".
vy 73 Andreas DL4JAL) DL4JAL@darc.de