

## **DG8SAQ VNWA 3 & 3E - Vector Network Analyzer - "Getting Started Manual" for Windows 7, Vista and Windows XP**

*For VNWA  
License Code  
see page 2*

*VNWA  
Hints  
see page 10*



### **1. Introduction:**

Thank you for purchasing the DG8SAQ VNWA 3 or VNWA 3E Vector Network Analyzer from **SDR-Kits**. This manual is a concise "Getting Started" guide for release **VNWA 36.3.0** onwards, showing what steps are necessary to place the DG8SAQ VNWA in operation for the *Microsoft Windows 7, Windows Vista and Windows XP Operating Systems using VNWA Application 36.3.0 and later.*

*For Windows 8 refer to: <http://www.sdr-kits.net/vnwasoftware/>*

The DG8SAQ VNWA has many advanced features and options, therefore VNWA Users are strongly urged to study the current VNWA helpfile: [http://sdr-kits.net/DG8SAQ/VNWA/VNWA\\_HELP.pdf](http://sdr-kits.net/DG8SAQ/VNWA/VNWA_HELP.pdf)

#### **1.1 Shipment Damage:**

You should receive the VNWA in good order, however in event of visible damage of the parcel, please notify in first instance your Carrier or the Postal Service who delivered the shipment to you.

### **2. Important Information**

#### **Copyright notice**

The design of the VNWA 3.x is copyright by Thomas Baier DG8SAQ & SDR-Kits - All right reserved.

#### **2.1 Caution - Safety Information:**

1. The VNWA 3 or 3E is powered and controlled through the USB-cable supplied. The USB-cable should be connected to the USB port of a Personal Computer capable of supplying +5V DC at 500mA maximum.
2. **Do NOT apply any DC Voltages** to the RF Ports. The **maximum safe input voltage** into the TX-out and Rx-in ports is an **RF Voltage of 0dBm (225mV RMS with a frequency between 1 kHz up to 1300 MHz)**. Exceeding this value may cause damage to the VNWA and may invalidate product warranty.
3. Always check the SDR-Kits Website for current Product information including Safety Information and latest Product Updates.

<http://www.sdr-kits.net/vnwasoftware/?20>

## 2.2 Accuracy of Measurements

This product is designed for Educational, Amateur Radio and Hobbyist use. No warranties are made whatsoever as to the stability and suitability of the design in extended periods/continuous operation or operation outside components' specifications. No responsibility will be accepted for accuracy of measurements or performance either short term or long term. It is recommended that VNWA users check proper operation of VNWA at regular intervals by measuring parameters of components after performing VNWA calibration.

## 2.3 VNWA 3 and VNWA 3E - Product Documentation:

The documentation of the VNWA 3 is supplied as a VNWA Application Helpfile, which is available when the VNWA Application is installed using the VNWA Installer. A PDF version of this help file may be downloaded from the Internet from [http://sdr-kits.net/DG8SAQ/VNWA/VNWA\\_HELP.pdf](http://sdr-kits.net/DG8SAQ/VNWA/VNWA_HELP.pdf)

**Note:** The VNWA 3E is a VNWA 3 with the optional VNWA Expansion board containing a second Audio Codec fitted. This Booklet shows configuration of both VNWA 3E and VNWA 3. Note that a few steps in the VNWA Application setup procedure are only required for VNWA 3E.

## 2.4 VNWA License code:

The VNWA License code for your VNWA is shown below:

The license code must be entered exactly as shown in step 3.1.6 (Win7 or Vista) or in step 3.3.5 (XP)

**Axxxx:ABC-DE-FGH-IJK:**

**Note:** Optionally the name of the VNWA user may be added after the VNWA license code within double quotes:

**for example: A1999:kzl-blk-qua-lzt:"DG8SAQ"**

The VNWA application will now display the VNWA serial number (A1999) and the VNWA User name as

***Vector Network Analyzer Software - A1999 licensed to DG8SAQ***

## 3. VNWA Driver - Software and Helpfile Installation

**Caution:** Although the installation package is provided for easy installation, it is recommended that the appropriate installation procedure for your Operating System is reviewed before starting the installer. The procedure below assumes that VNWA package has **NOT** been installed previously on the Computer in question.

Please email: [Support@SDR-Kits.net](mailto:Support@SDR-Kits.net) to report any errors or improvements to this document – Thanks

### 3.1 Windows 7 & Vista 64 bit and 32 bit Installation

This section shows installation procedure for Windows 7 (64 or 32 bits) – Vista procedure is similar.

**Note:** For Installation on **Windows XP** refer to Section 3.3  
**IMPORTANT: Information for Windows 7 and Vista users:**

If you are installing the VNWA application for the **first time**, the VNWA Setup program will guide you to install an application Winhlp32.exe from the Microsoft website. The **Winhlp32.exe** program is required to display the VNWA help file. However Microsoft license conditions does not allow the Winhlp32.exe to be distributed as part of the VNWA setup program.

VNWA installation is easier and friendlier if Winhlp32.exe application is already installed beforehand. It is therefore recommend to install Winhlp32.exe from the link:

<http://support.microsoft.com/kb/917607> prior to starting the VNWA installation program.

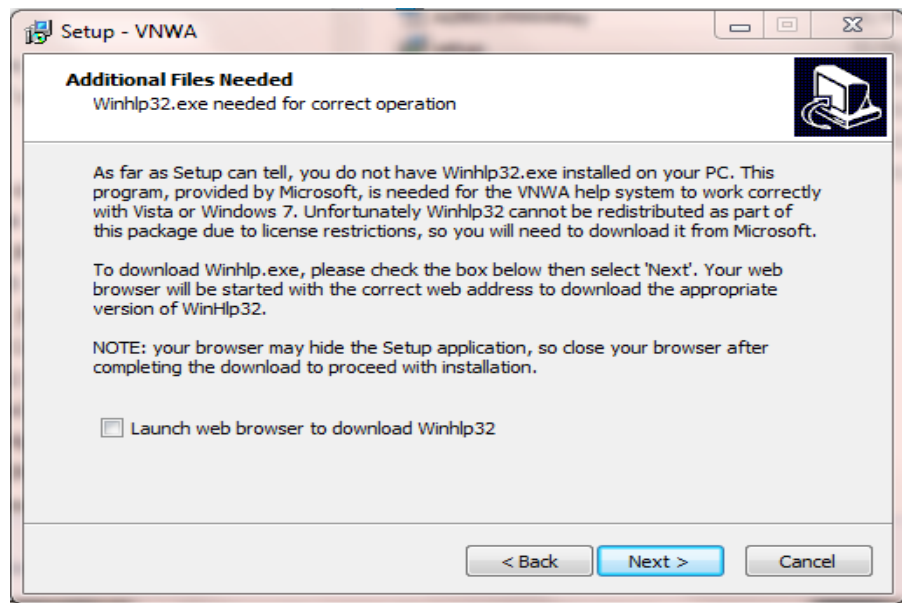
You can always check if **Winhlp32.exe** is already installed by inspecting the **file size** of this file in **C:\windows**. If file size of Winhlp32.exe is **290 KBytes** then the application is already installed. If this file is present but it is only **9Kbytes** in size then Winhlp32.exe should be installed first:

- 3.1.1 Download and save the VNWA Installation Package from the following location to your desktop or download folder: <http://www.sdr-kits.net/DG8SAQ/VNWA-installer.exe>
- 3.1.2 Make sure the VNWA is **NOT** connected to the PC  
Double Click on the VNWA-installer Icon to start the VNWA installation process.  
Confirm that you want to run this software by pressing "RUN"  
Confirm the VNWA-installer can make changes to your Computer, then screen below is shown.  
Press "Next >"



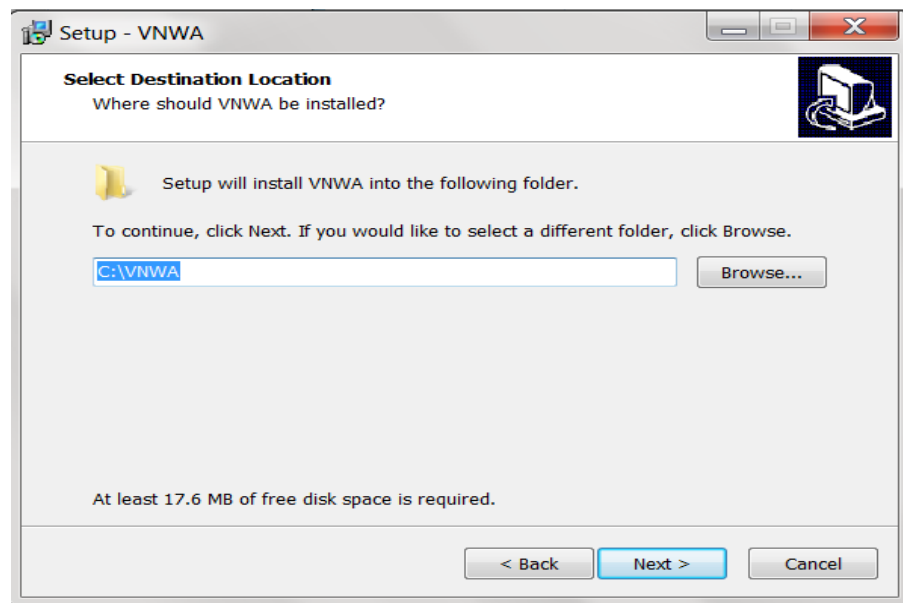
- 3.1.3 If the file Winhlp32.exe is **NOT** installed on the Computer, the screen below is shown. Winhlp32.exe file should be installed otherwise VNWA helpfile will not be displayed. If you click the box the Web browser will be launched. Follow the instructions on the Microsoft Website to download winhlp32.exe.  
**Note:** For 64 bit Operating Systems the filename ending in -x64.msu should be downloaded and -x86.msu for 32 bit Operating Systems.

**Note:** The link to the Microsoft winhlp32.exe support is: <http://support.microsoft.com/kb/917607>

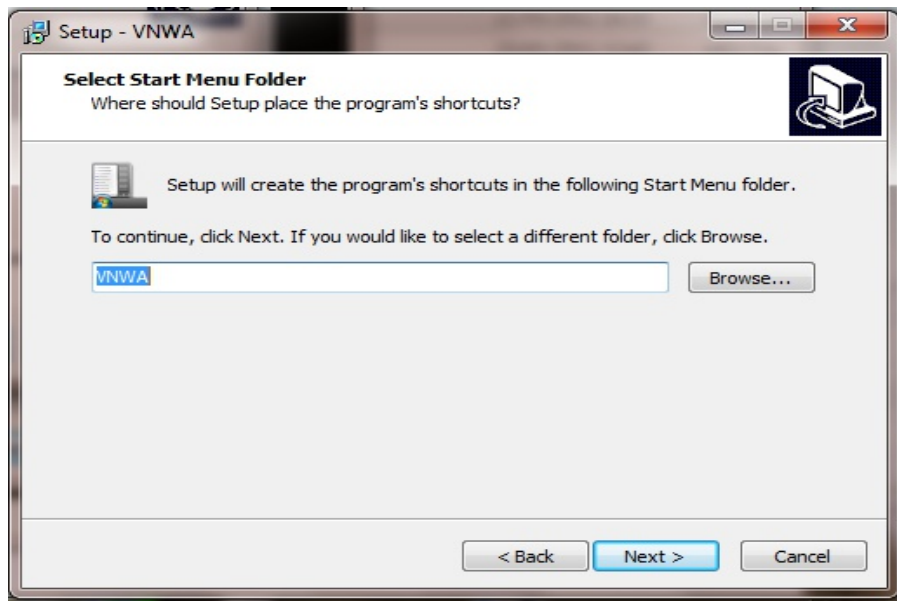


3.1.4 Press "**Next >**" – The default location where VNWA will be installed will be shown:

**Note:** Select a different Destination Location (ie C:\VNWA\_2) if you wish to install a second VNWA application on the same PC. This will prevent overwriting the setup files of your first VNWA application:

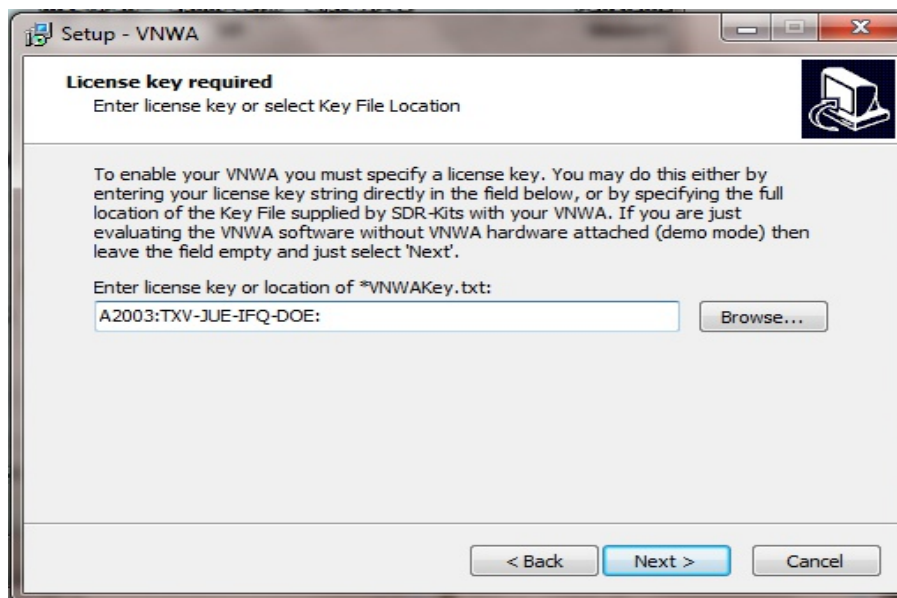


3.1.5 Press "**Next >**" – This shows the default where program shortcuts will be installed



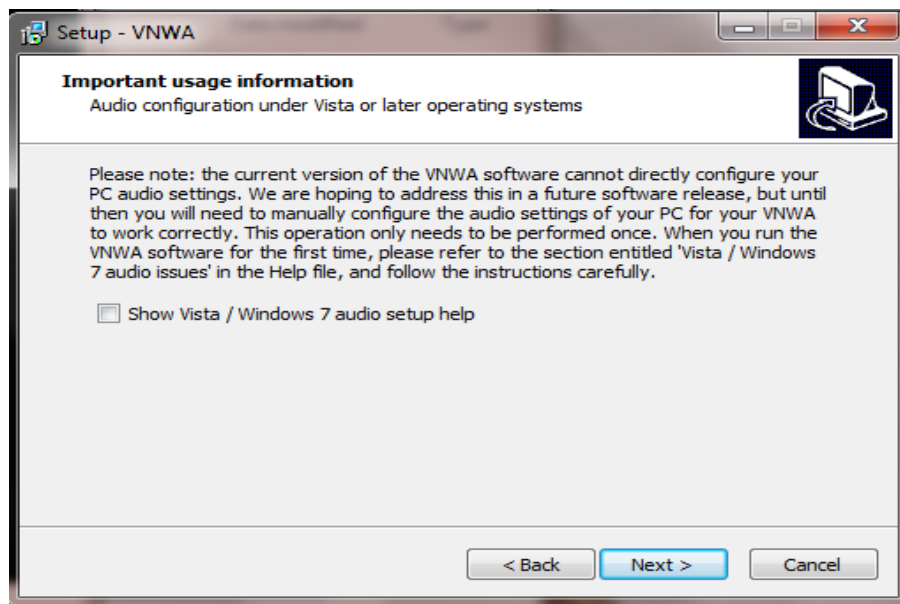
3.1.6 Press "**Next >**" – Screen to enter VNWA license key is now displayed as shown below:  
There are two options to enter the VNWA license key for your VNWA:

1. Directly enter the VNWA license code **exactly** as shown on page 2, paragraph 2.4 (with or without the name option). **Note:** The VNWA license code is also shown in the VNWA shipping advice email. **Note:** the colon is the last character of the license code and must also be entered.
2. Specify the location of the VNWA License key **file** which may be emailed.

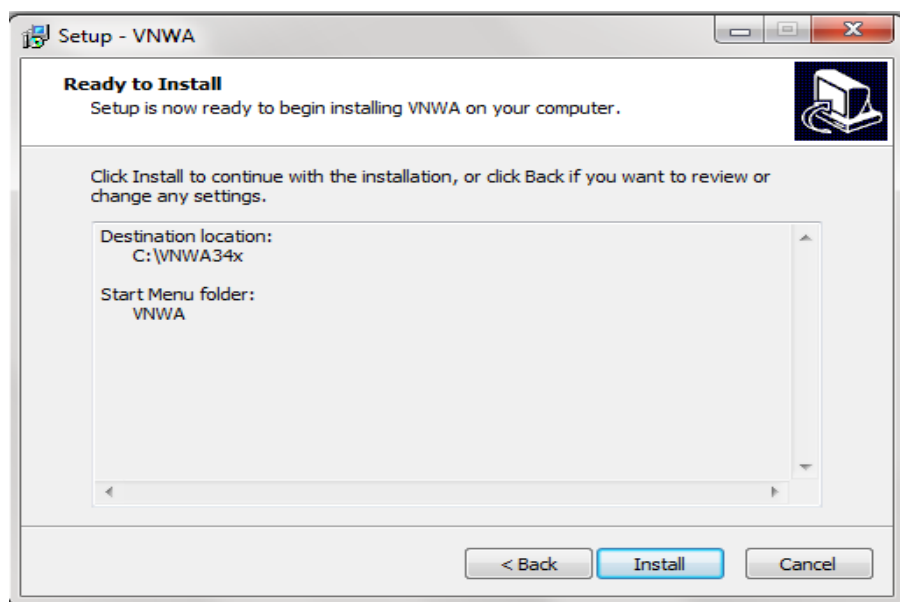


**Note:** A Screen (not shown) is now displayed with option to create a Desktop Icon for:  
A) All users or                      B) For Current User only.      Make your selection and press "**Next >**"

### 3.1.7 Information on Audio Configuration is displayed



### 3.1.8 Press "Next >" and Ready to Install screen is displayed

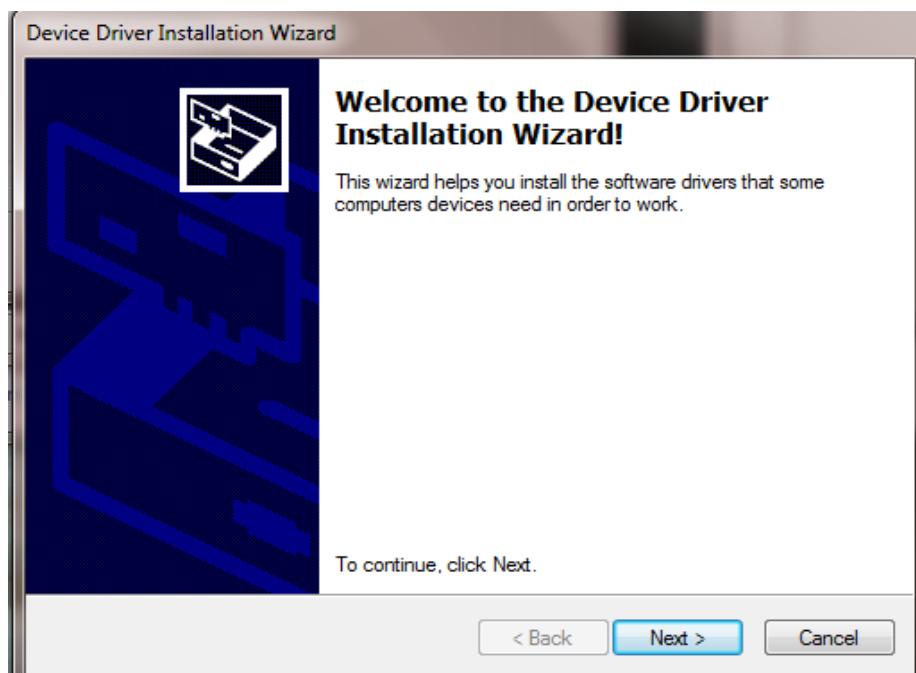


### 3.1.9 Press "Install" – VNWA Application and helpfile are now installed

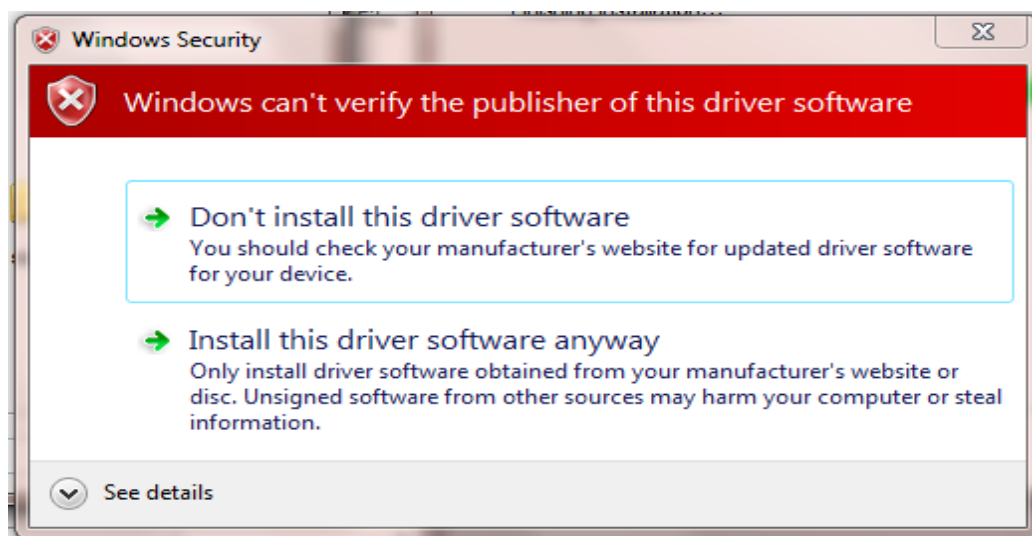


**NOTE:** At this point the Installer for VNWA 36.2.3 (available from 20<sup>th</sup> November 2012 onwards) will automatically install the Digital signed **Amateur Radio Root Certificate** (ARC). This Certificate is an essential requirement for Windows 7 64 bits and Windows 8 Enterprise OS – Please see Section **3.5** for information on the Amateur Radio Certificate installation.

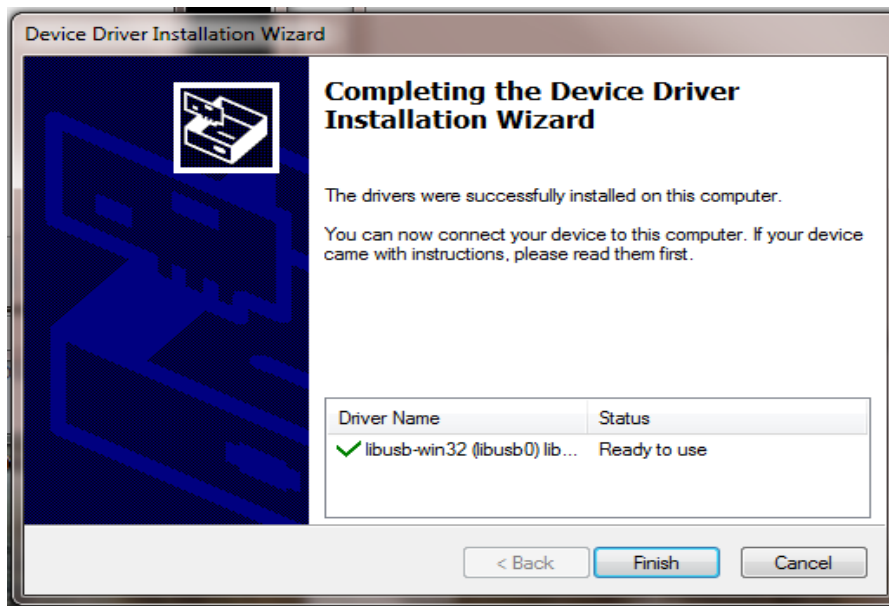
Using previous VNWA installer **v36.0 or older** the Amateur Radio Certificate will **NOT** be installed and the Driver Installation will now proceed displaying the following screen shots:



3.1.10 Press "Next >" – Following screen **may be displayed** – Select **"Install this driver software anyway"**



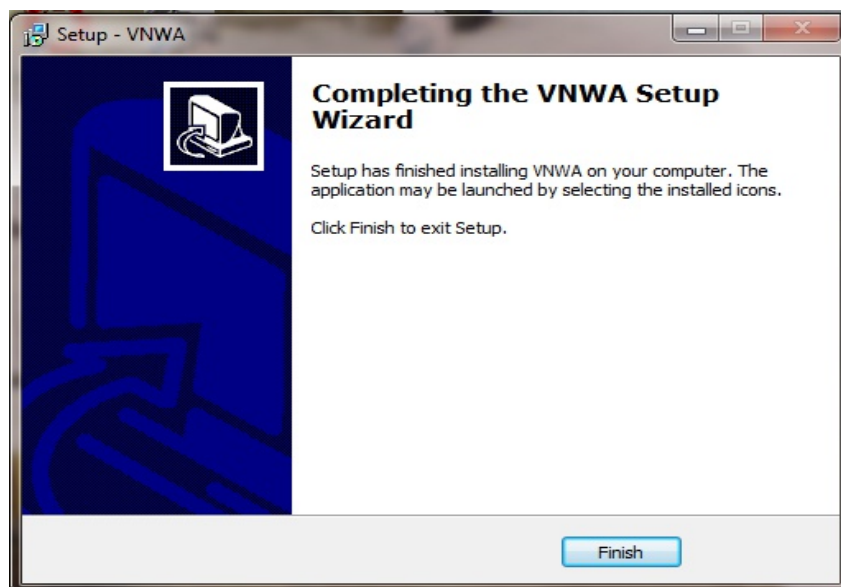
3.1.11 Press "Next >" – Driver installation will take from 10-30 seconds and screen below is displayed



3.1.12 Press "**Finish**" -

3.1.13 If you have selected to view the "**Show Vista/Windows 7 Audio setup help**" in point 3.1.7 read the information and close the window prior to next step.

3.1.14 Press "**Finish**" to complete installation.



**END OF VNWA Installation**

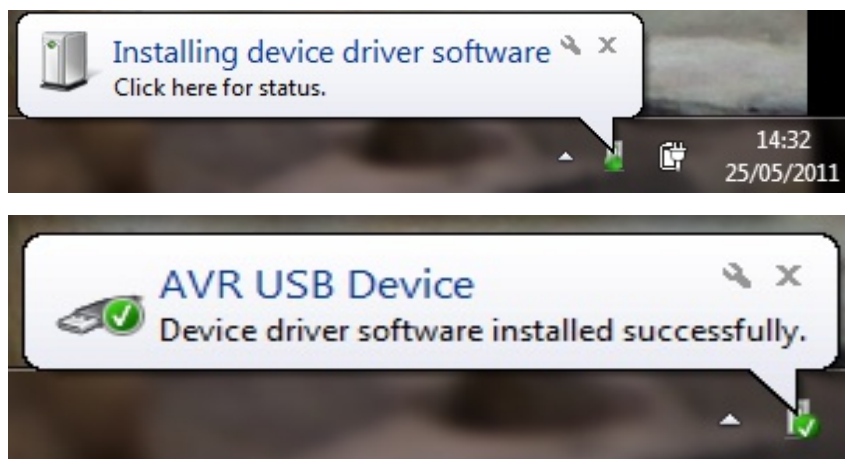


## 3.2 Windows 7 & Vista 64 bit and 32 bit Application Configuration as from Release 36.3.0

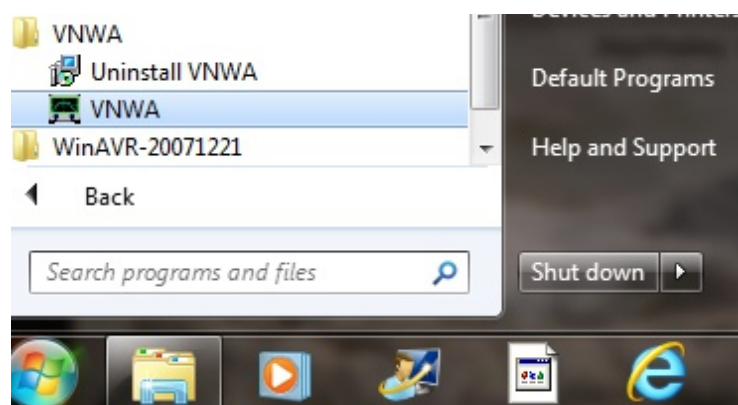
3.2.1 This section shows first-time installation of a VNWA - or when VNWA application is started for the first time from a new Directory! Plug in the VNWA USB cable into USB Port of your Computer.

**Note:** It is recommended to connect the VNWA **into the same USB** Port next time you use the VNWA.

When connecting the VNWA for the **first time** after Driver installation, the VNWA will be recognized and device driver installation should complete automatically.



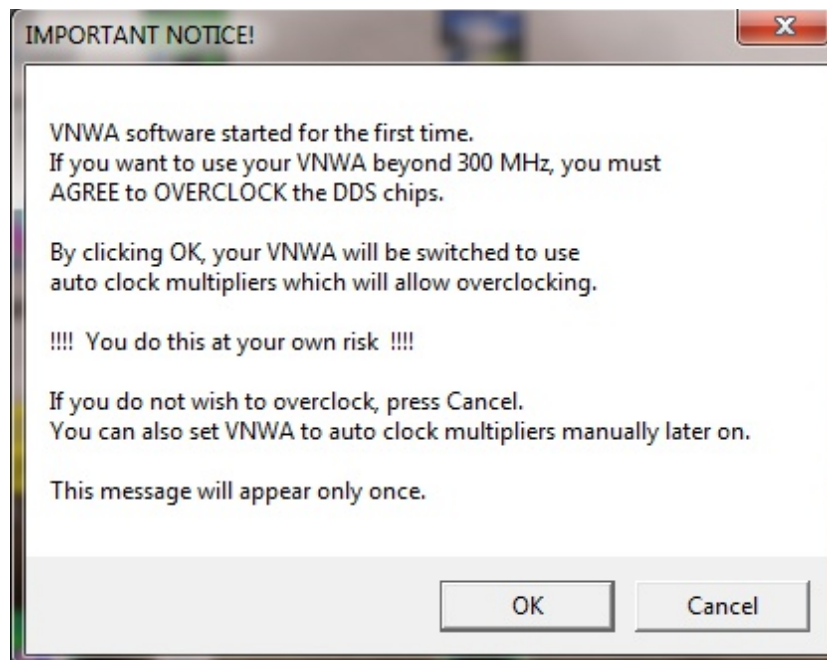
3.2.2 Depending on the options specified during the installation, start the VNWA application from the directory specified during Installation, use the Shortcut created on the Desktop or use the “Start” and “VNWA” launch button.



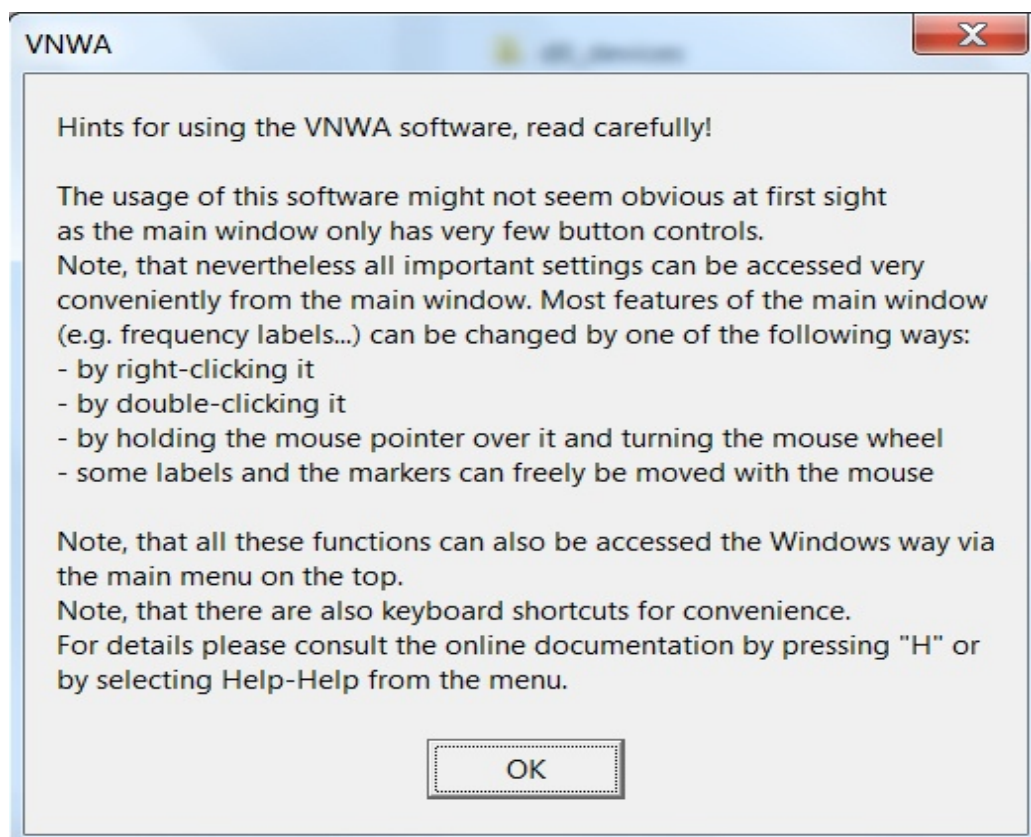
3.2.3 **Overclocking Warning may be displayed when you run VNWA Application software for the first time.**

Select "OK" to allow overclocking of the DDS chips beyond 400 MHz.

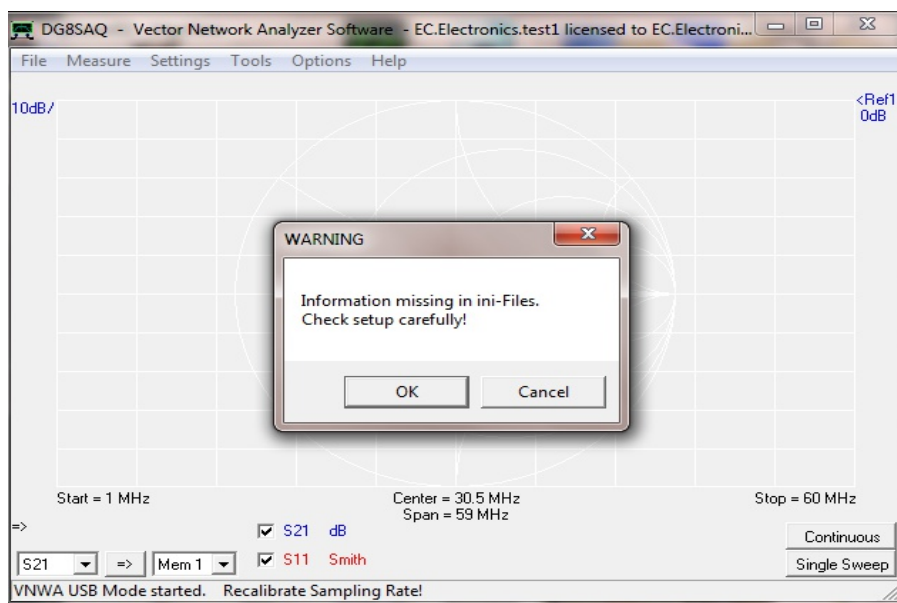
**Note:** VNWA performance over 500 MHz will be negatively affected if overclocking of the DDS is not permitted.



3.2.4 The VNWA “**Hint File**” is now displayed. Please review this information **carefully**!

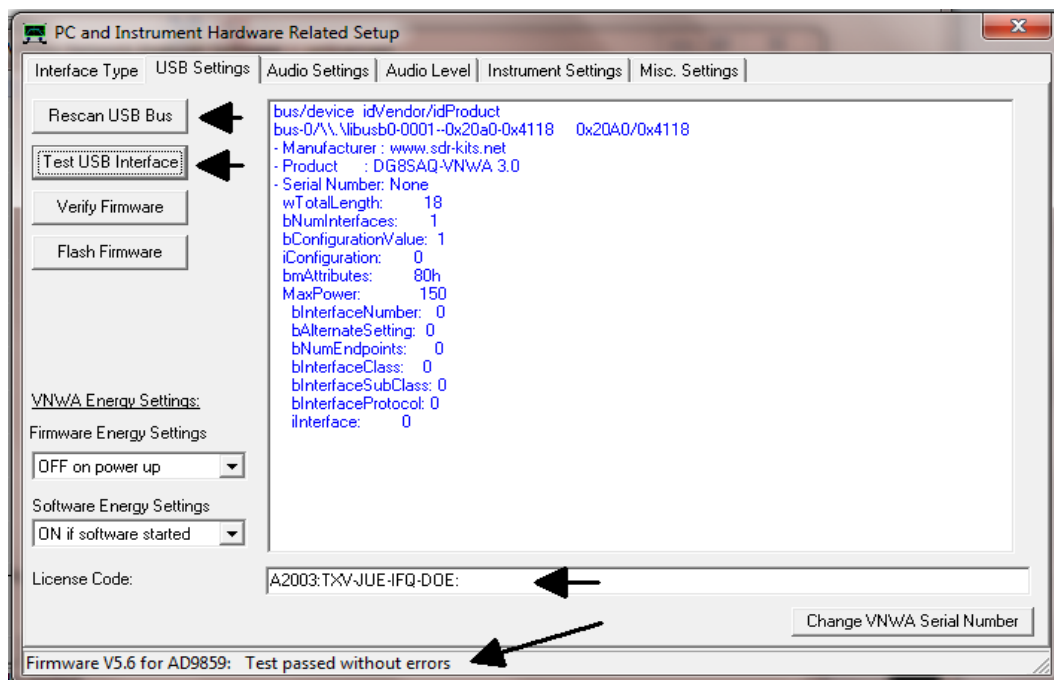


Press “OK” to continue. This will start the VNWA Application. Press “OK” again to enter VNWA auto-setup information.



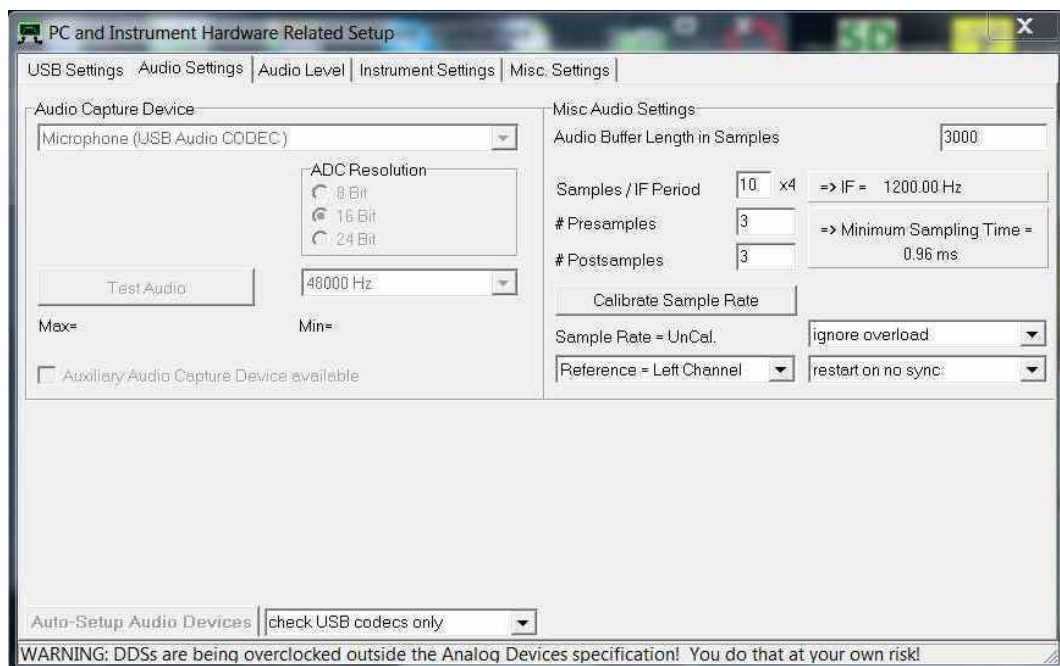
3.2.5 The tab “USB Setting” should now be displayed. If not, click on the tab “USB-Setting”. Check whether VNWA license code is shown. If this information is missing then enter the VNWA license code again. Now press “Rescan USB Bus” and “Test USB Interface”. Check bottom line for message “Test passed without errors”.

**Note:** The VNWA License code is shown on page 2 of the “Getting Started” Manual shipped with your VNWA – It is also shown in the VNWA\_Delivered – shipping email.

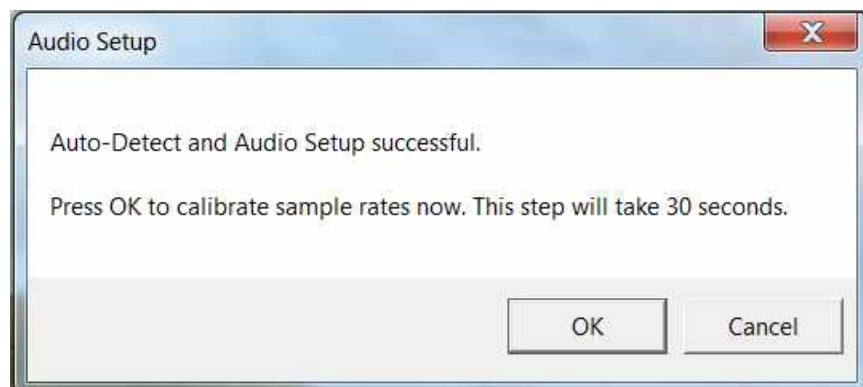


- 3.2.6 From Release 36.3.0 onwards, the VNWA application performs an **Auto-detection and Auto-setup of Audio devices** instead of the Manual setup which was previously required. The Auto-detection and Auto-setup procedure is executed when the VNWA application is started up for the first time – or whenever the VNWA Application (VNWA.exe) is run from an empty directory.

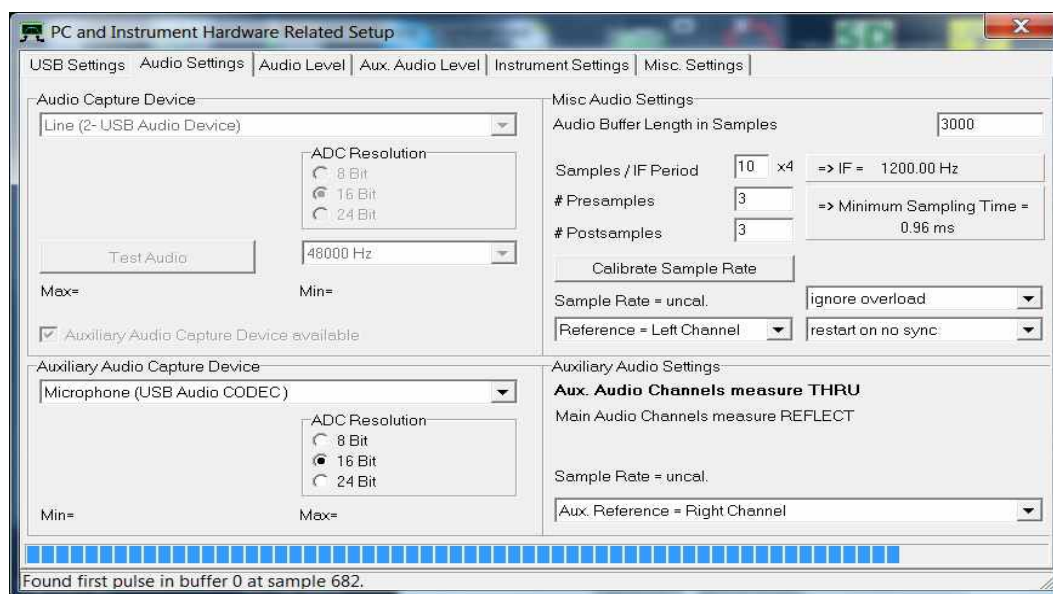
Make sure that **Nothing** is connected to VNWA RF Ports -  
Press **“OK”** to start the Audio Auto-detection -



- 3.2.7 Auto-detection and Auto-set-up steps through from phase 1 to 8.  
The screen below is displayed once the process is completed.  
Press **“OK”** to calibrate the Audio device sampling rate.

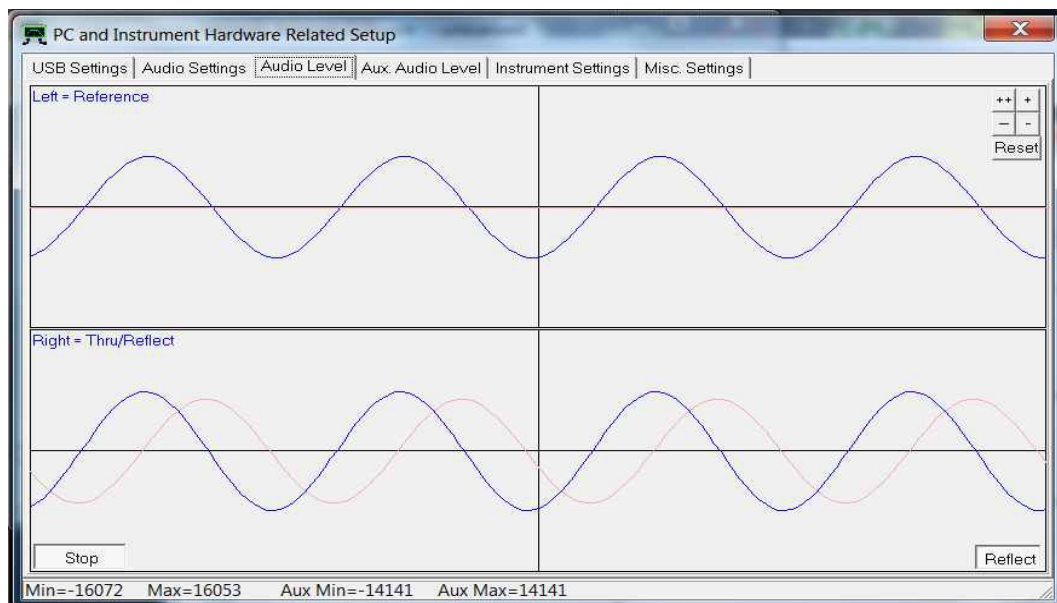


- 3.2.8 Press **“OK”** to calibrate the Audio device sampling rate. Calibration of Sample rate takes approx 30 seconds.

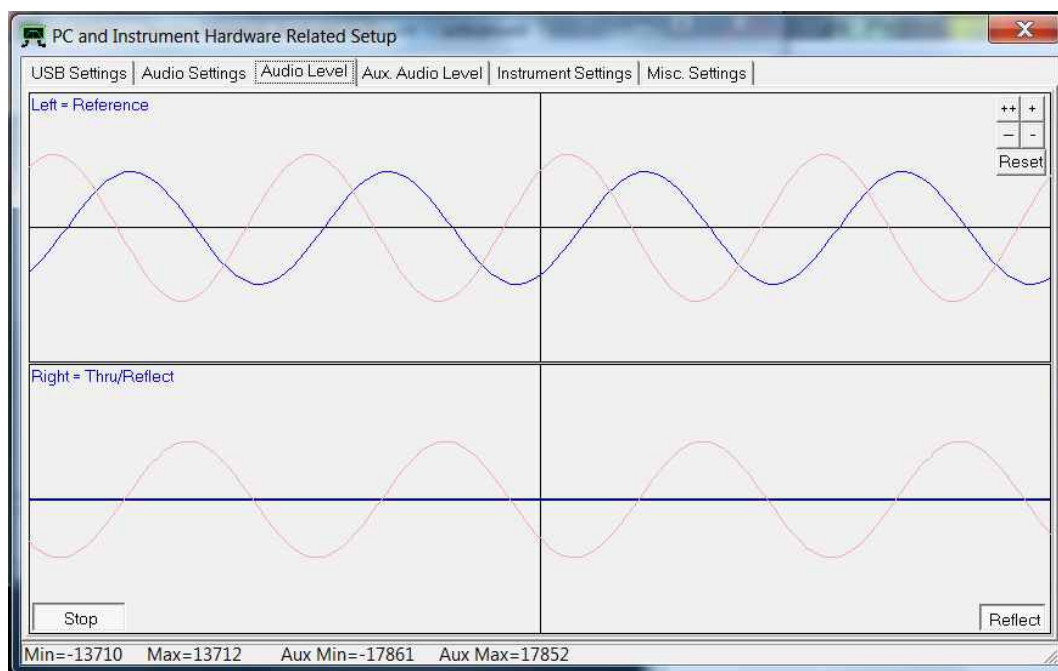




3.2.9 Next the Audio Level Screen is displayed. Select “Reflect” (bottom RH softbutton) and two sine-waves should be displayed. Top = Left = Reference and Right = Reflect

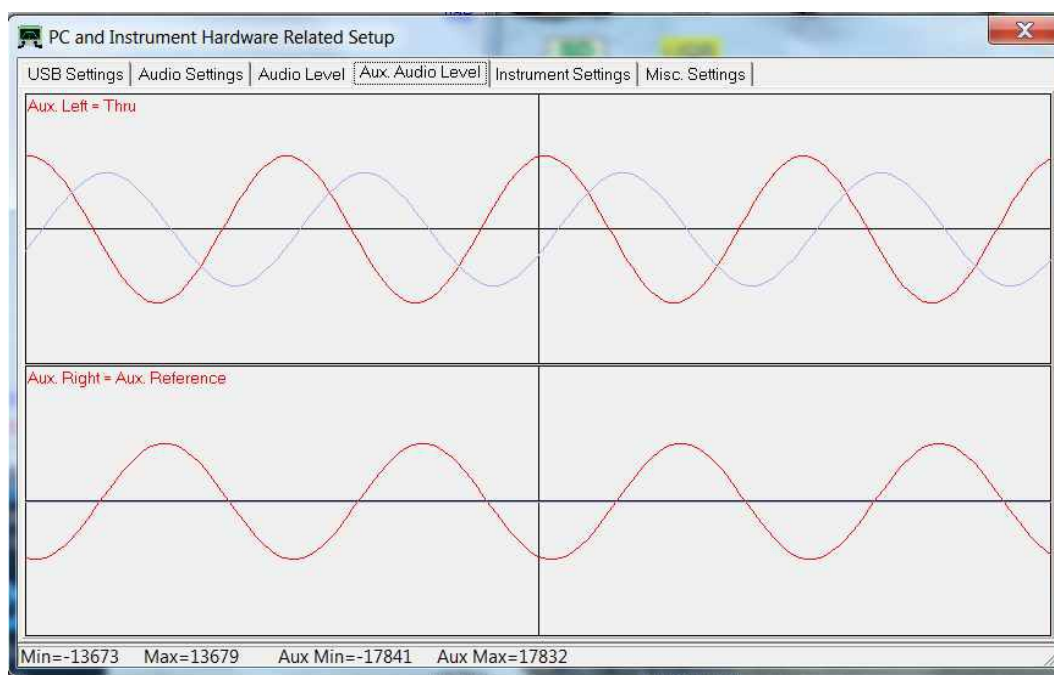


3.2.10 Next connect the TX port to the RX Port with a short Coax cable. The sine-wave on the Right = Thru/Reflect should now disappear (because the TX port is now terminated with a 50 Ohm load from the RX port).





- 3.2.11 This step is **only for VNWA 3** (Expansion PCB not fitted) –  
Select “**Thru**” (Softbutton in bottom RH corner) and Right = Thru/Reflect should now display a sine- wave (RX port is receiving TX output via Thru coax cable).
- 3.2.12 This step is **only for VNWA 3E** with fitted expansion board:  
Select Tab “**Aux Audio Level**” and screen below should be displayed.  
(RX port is receiving TX output via Thru coax cable)



This completes Auto-detection and Auto-set-up of Audio devices.

#### Troubleshooting:

In case of audio set-up problems, please consult the **VNWA helpfile - “Auto Set-up”**  
*Automatic Configuration of the Software for Usage with a DG8SAQ VNWA (Auto-Setup)*

**Notes:** Audio Capture Devices may either be shown as “**Line**” or “**Microphone**” depending on type of USB-Codec chip fitted.

**Troubleshooting:** If "Auxiliary Audio Capture Device available" is **NOT** shown, then exit VNWA application and add the line **AuxAudio=1** to the file VNWA.ini with a text editor and restart the VNWA Application. See also VNWA helpfile for further information.

Windows 7 configures a VNWA USB Audio Capture Device by default either as a “**Microphone**” or as a “**Line**” depending on the type of USB Codec chip fitted. If the USB Codec is shown as “**Microphone**” Windows 7 will configure this as a **Mono** input with input levels set **too high** as shown below. This will prevent VNWA application from functioning. Later VNWAs are fitted with PCM2900C chip which Windows configures as a “Stereo **Line** input” device but at the **wrong sample rate**.

3.2.13 Stop the Audio test by selecting Tab “**Audio Level**” and click on softbutton “**Stop**”. Next click on Tab “**Instrument Settings**”. The screen below shows usual settings for normal operation.

The screenshot shows the 'PC and Instrument Hardware Related Setup' window with the 'Instrument Settings' tab selected. The window has a tabbed interface with tabs: Interface Type, USB Settings, Audio Settings, Audio Level, Aux. Audio Level, Instrument Settings, and Misc. Settings. The 'Instrument Settings' tab contains the following elements:

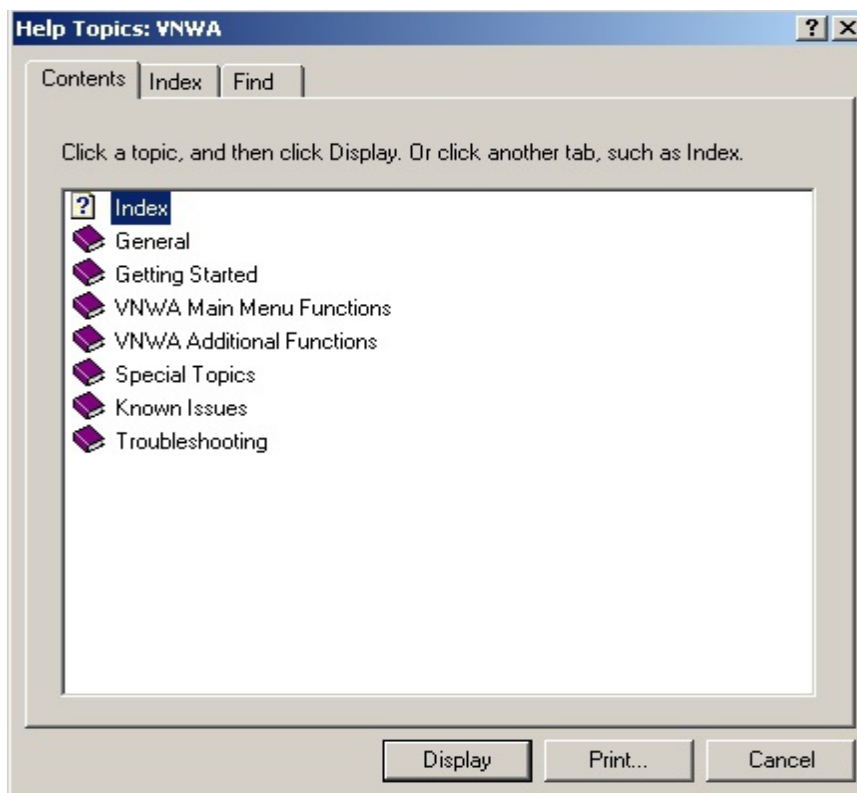
- VNWA Type:** A dropdown menu set to 'VNWA 3'.
- S-Parameter Test Set:** A dropdown menu set to 'none'.
- S11 = low** with 'save profile' and 'load profile' buttons.
- RF DDS:** A dropdown menu set to 'AD9859, AD9951'. Below it, 'Clock = 12' x 'auto' MHz 'auto'. A red text label below says '=> Clock = auto'.
- LO DDS:** A dropdown menu set to 'AD9859, AD9951'. Below it, 'Clock = 12' x 'auto' MHz 'auto'. A red text label below says '=> Clock = auto'.
- Calibrate Clock Frequency:** A button labeled 'Calibrate DDS Clock Frequency'.
- A text instruction: 'To calibrate the DDS clock frequency, you need to measure the output frequency at the TX port with a frequency counter.'
- Real Sampling Rate = 48000.3 samples/sec** at the bottom.

3.2.14 Click on Tab “**Misc Settings**”. The screen below shows usual settings for normal operation.

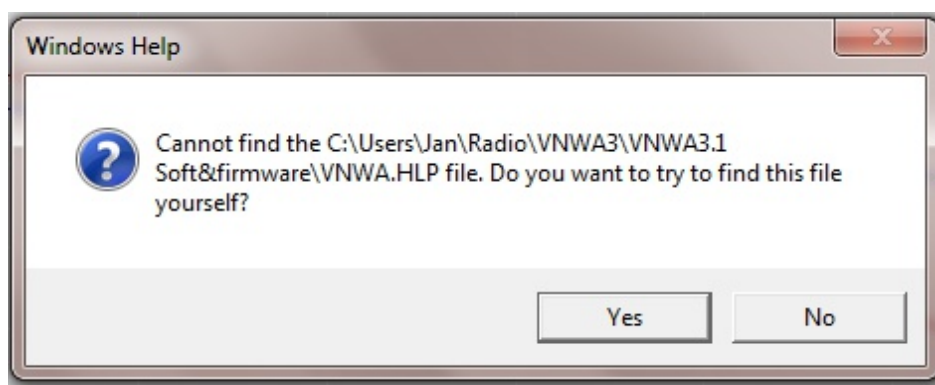
The screenshot shows the 'PC and Instrument Hardware Related Setup' window with the 'Misc Settings' tab selected. The window has a tabbed interface with tabs: Interface Type, USB Settings, Audio Settings, Audio Level, Aux. Audio Level, Instrument Settings, and Misc. Settings. The 'Misc Settings' tab contains the following elements:

- Default Master Calibration File Name:** A text field containing 'VNWA\_Mastercal.cal' and a 'Browse and Load Master Cal.' button.
- Data Logging and User Postprocessing Options:**
  - 'data logging OFF' with a dropdown set to 's\*p' and a 'Save to' text field with a 'Browse' button.
  - 'postprocessing OFF' with a dropdown and a 'User DLL' text field with a 'Browse' button.
- Special Settings:**
  - ☐ don't autosave instrument state on entering setup
  - ☐ update traces at end of sweep only (save CPU time)
  - 'Extend synchronization period by' dropdown set to '0 secs (default)' and a 'show sweep statistics' button.
- Debug Settings:**
  - ☐ write audio data to file
  - ☐ do not normalize to reference channel
  - ☐ deactivate RF DDS
  - ☐ deactivate LO DDS
  - ☐ slow down LPT (LPT mode only!)
- Signal Generator:**
  - RF Frequency:** A numeric field set to '5' with units 'MHz' and frequency offset buttons (+M, +k, +, -M, -k, -).
  - Frequency Offset LO - RF:** A numeric field set to '0.00120001' with units 'MHz'.
- Instrument Monitoring:**
  - Instrument Temperature = 20.4** Deg. Celsius
  - Temperature offset correction value = 15.7** Deg. Celsius

3.2.15 Close the VNWA Set-up screen by pressing top right hand button. Next we test whether the VNWA helpfile is available. Press “Help” and select “Help” again.



3.2.16 The screen below may be shown. Press “Yes” and “Browse” to select where the Helpfile is located. If standard VNWA installation defaults were selected then the default path will be:  
**My Computer C:\VNWA\VNWA.hlp**



3.2.17 **IMPORTANT:** To save the VNWA configuration (after any changes are made) exit the VNWA Application. This updates the VNWA configuration files for the next time the VNWA application is started.

### End of VNWA Configuration for Windows 7 and Vista

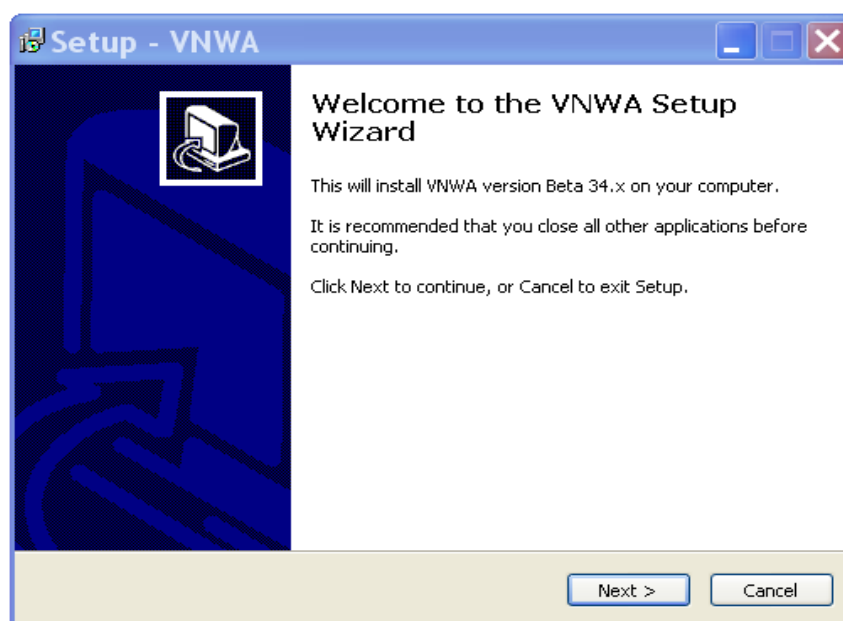
### 3.3 Windows XP Installation

**Note:** For Installation on **Windows 7 and Vista** refer to section 3.1

This section shows installation procedure for Windows XP Operating System.

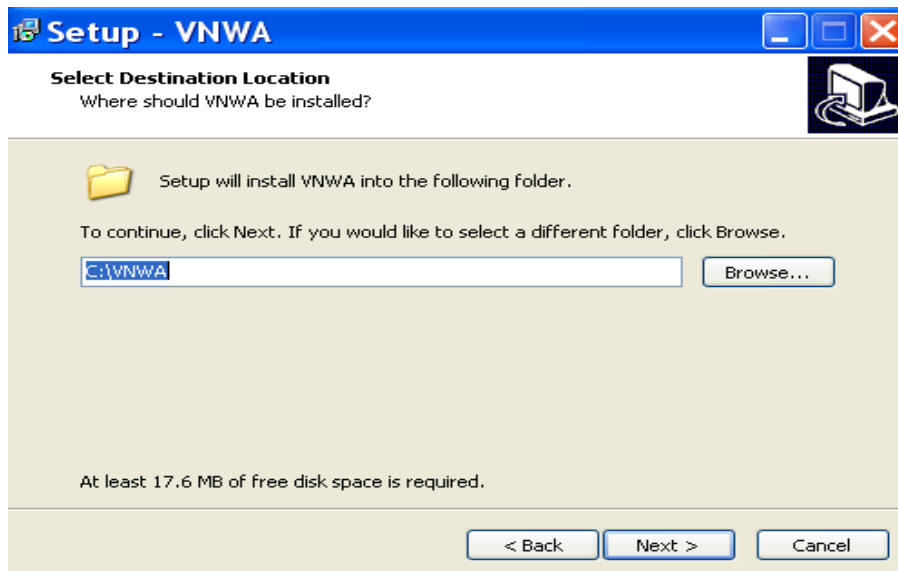
3.3.1 Download and save the Installation Package from the following location to your desktop  
<http://www.sdr-kits.net/DG8SAQ/VNWA-installer.exe>

3.3.2 Make sure the VNWA is **NOT** connected to the PC.  
Double Click on the VNWA-installer Icon to start the VNWA installation process.  
Open File Security Warning screen is displayed next, Press “**RUN**” to confirm you want to install the VNWA-installer.  
Confirm that the VNWA-installer can make changes to your Computer.

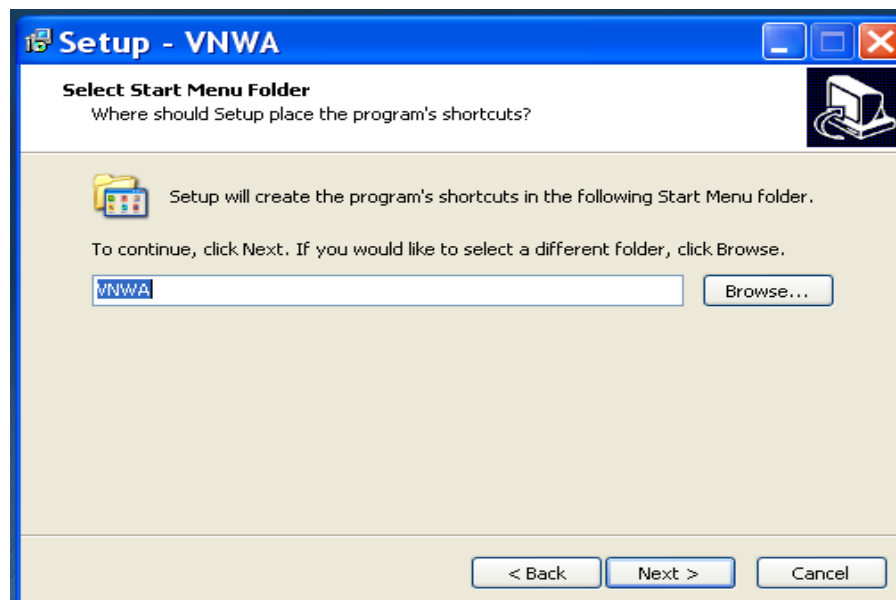


3.3.3 Press “**Next >**” – The default location where VNWA will be installed will be shown:

**Note:** Select a different Destination Location (ie C:\VNWA\_2) if you want to install a second VNWA application on the same PC. This prevents overwriting the set-up files of your first VNWA application.

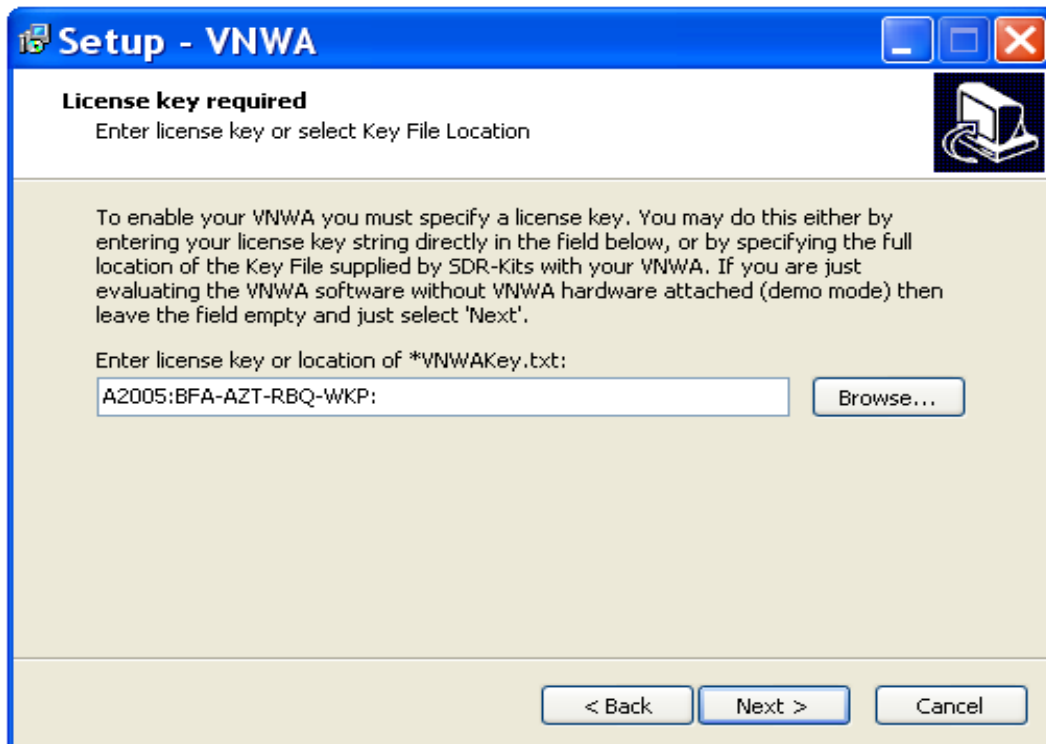


3.3.4 Press Next – Default Location where VNWA program shortcuts will be installed



3.3.5 Press Next – Screen to enter VNWA license key is now displayed as shown below:  
There are two options to enter the VNWA license key for your VNWA:

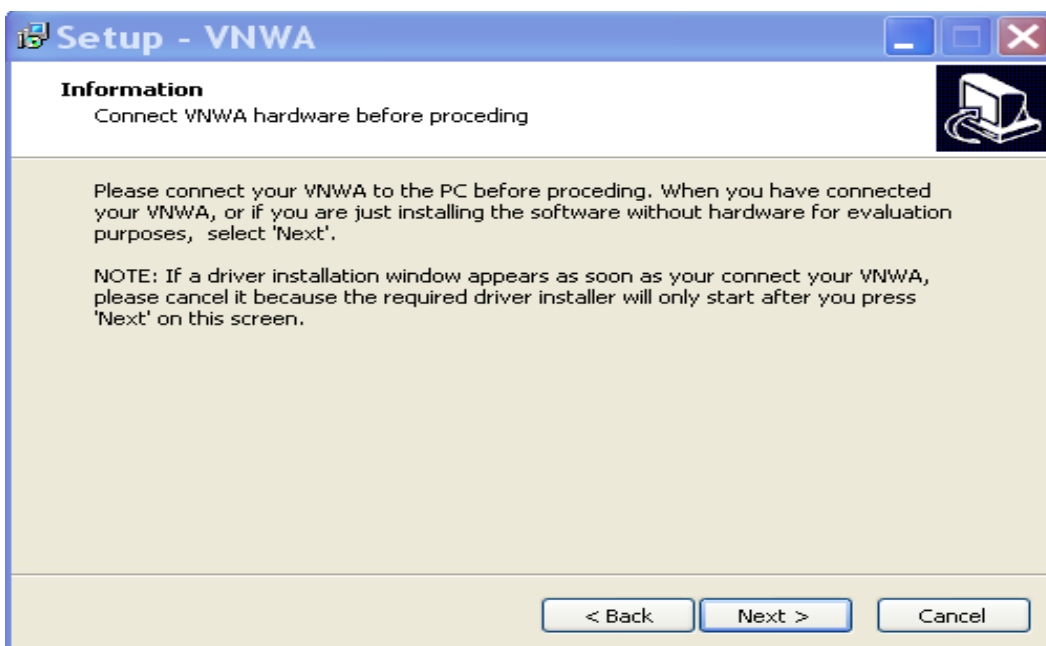
- A) Directly enter the VNWA license code exactly as shown in page 2, paragraph 2.4 (with or without the name option).  
**Note:** The VNWA license code is also shown in the VNWA shipping advice email.  
**Note:** the colon is the last character of the license code and must also be entered.
- B) Specify the VNWA License key file which may be emailed to VNWA users as an attachment of the VNWA shipping advice email.



**Note:** A screen (not shown) is now displayed with option to create a **Desktop Icon** for:  
A) All users or B) For Current User only. Make your selection and press "Next"

3.3.6 Press "Next" - Read and execute the instructions displayed on the screen below:

**Note:** The VNWA hardware **must now be connected to the USB Port** of the PC in this step otherwise driver installation may fail.

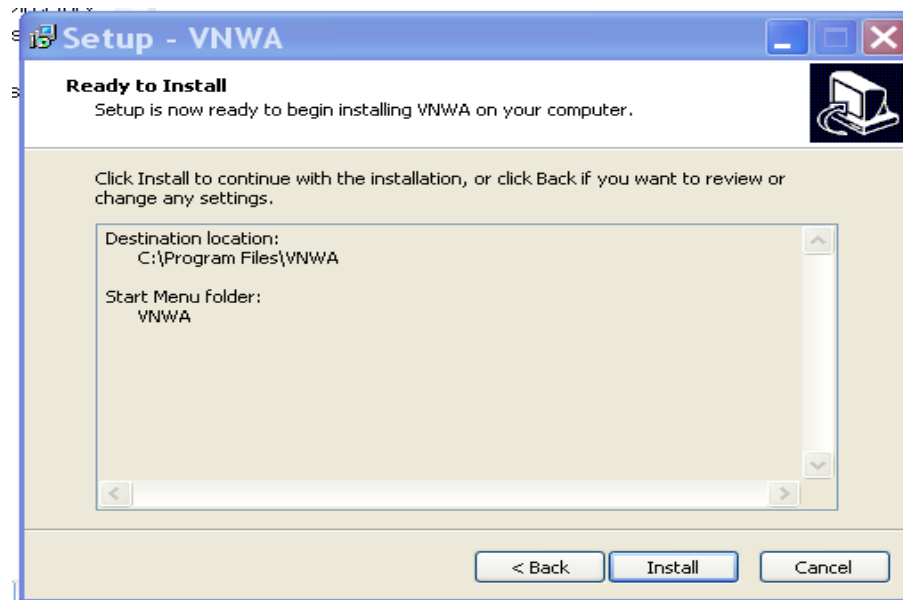




3.3.7 If the screen below is displayed after plugging in VNWA then press **"Cancel"** button on this screen.



3.3.8 The screen displayed below will be displayed. Press **"Install"** on this screen. The Installation of VNWA Application and Driver will now start.



3.3.9 The Installation of VNWA Application and Helpfile is now complete. The installation of the Driver is next!

**NOTE:** At this point the VNWA Installer v36.2.3 (available from 20<sup>th</sup> November 2012 onwards) will

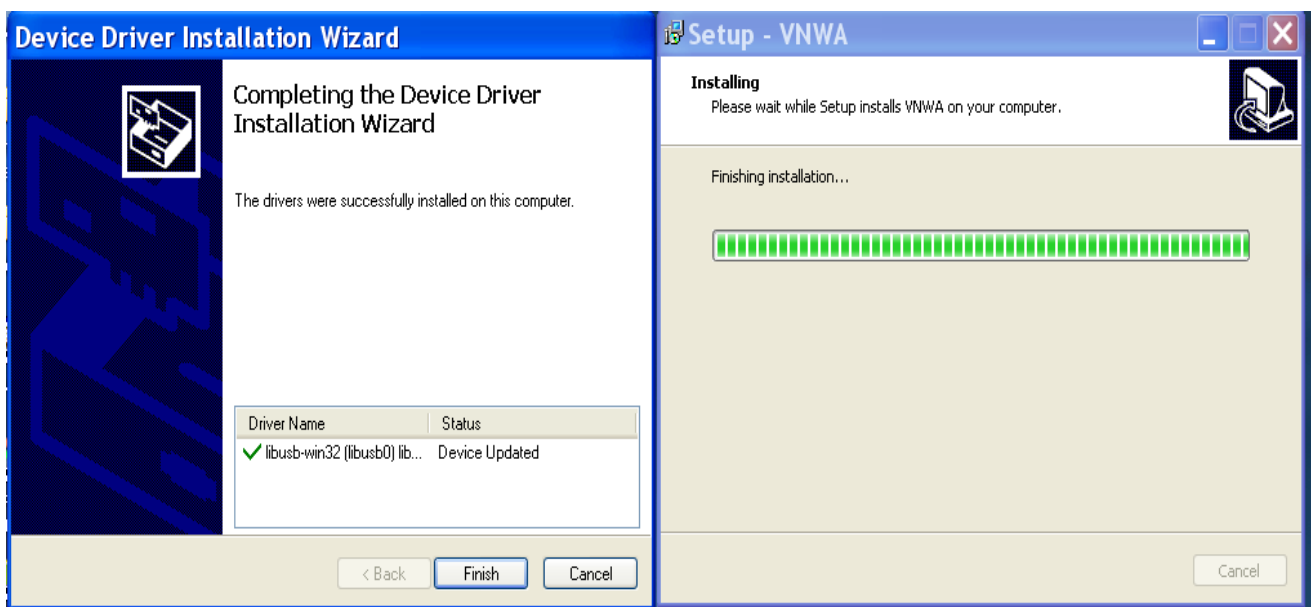
*SDR-Kits VNWA 3 & 3E "Getting Started" Manual W7 - XP v2.04 - copyright 2013 by SDR-Kits Page 21 of 48*

automatically install the Digitally Signed **Amateur Radio Certificate** (ARC). This Certificate is an essential requirement for Windows 7 64 bits (and Windows 8 Enterprise OS) – Driver Installation  
Now go to Section 3.5 for information on the Amateur Radio Certificate installation.

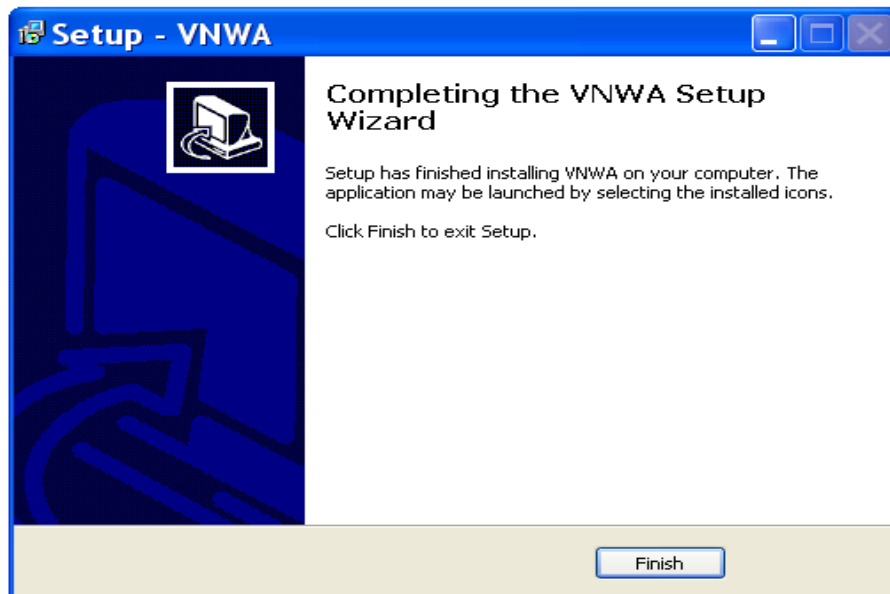
After installation of the ARC, the following screen will be displayed. Press “**Next>**” to install the driver



3.3.10 Driver installation is now complete - Press "**Finish**"



3.3.11 Press "**Finish**" - to exit the VNWA installation routine.



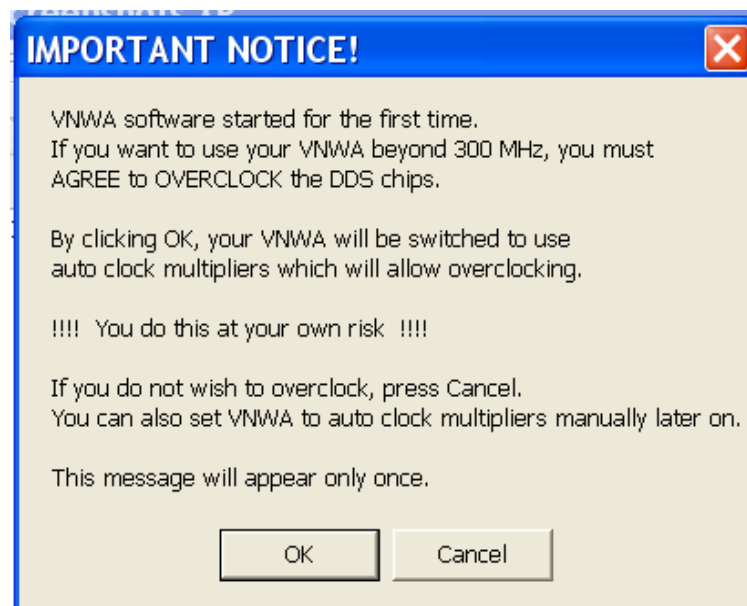
**END of Windows XP Installation**

### 3.4 Windows XP VNWA Application Configuration

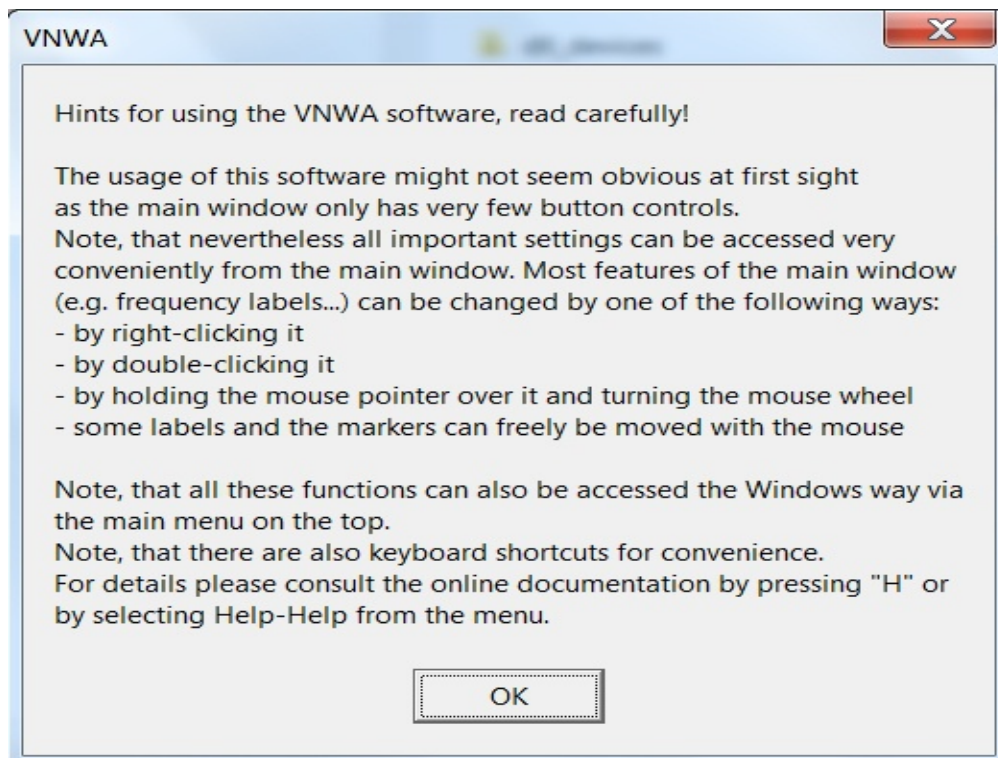
- 3.4.1 Ensure the VNWA is connected to a USB Port on your Computer.
- 3.4.2. Click “**Start**” “**All Programs**” “**VNWA**” and “**VNWA**” to start the VNWA application, use the Short cut created on the Desktop, or click on the VNWA Application in the directory specified during VNWA installation.



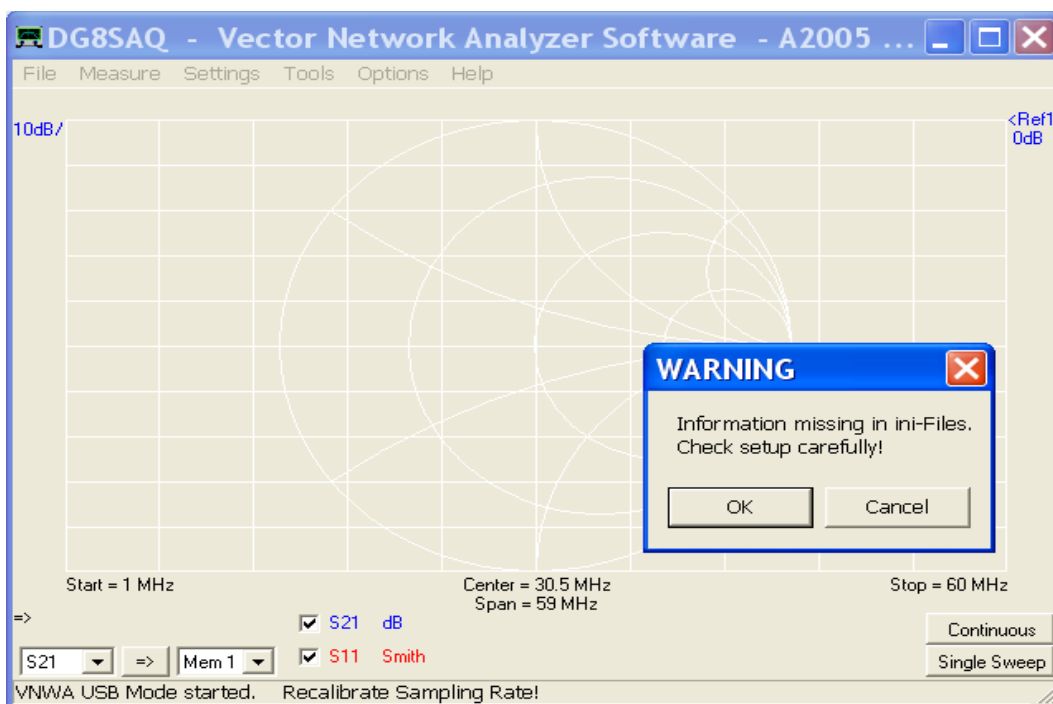
- 3.4.3 VNWA Application is started.  
**Overclocking Warning may be displayed when you run VNWA Application**  
Select "OK" to allow overclocking of the DDS chips beyond 400 MHz.  
**Note:** VNWA performance over 500 MHz will be negatively affected if overclocking of the DDS is not permitted.



3.4.4 The VNWA “**Hint File**” is now displayed. Please review this information carefully!



3.4.5 Press “OK” to continue and start the VNWA Application.

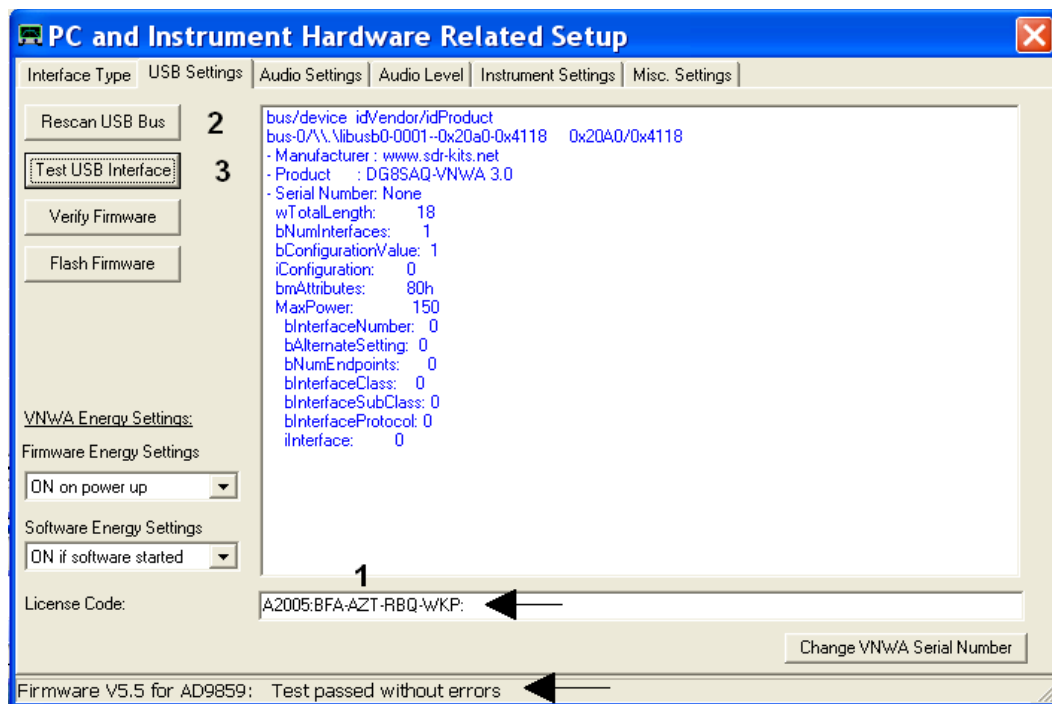


3.4.6 Press “OK” again to enter VNWA set-up information.

The Tab "USB Setting" should be displayed. If not then select this Tab.

Check whether VNWA license code is shown, In event this information is missing then enter the VNWA license code shown on page 2, paragraph 2.4. Next press “Rescan USB Bus” and “Test USB Interface” Check bottom line for message “Test passed without errors”

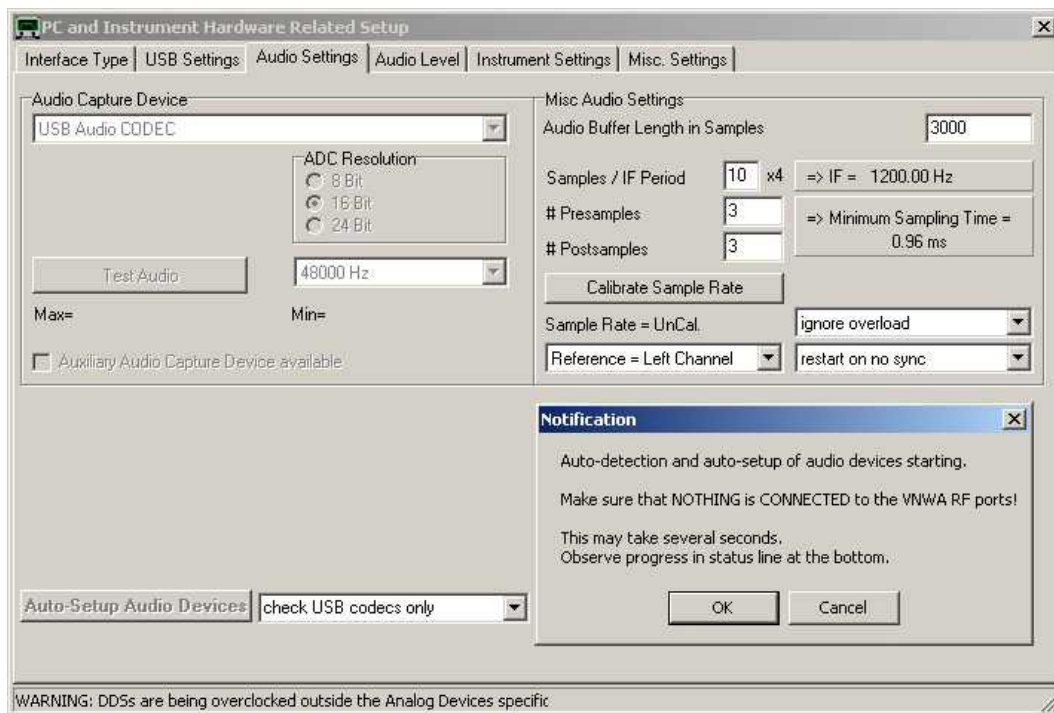
**Note:** The VNWA License code is shown on page 2 of the “Getting Started” Manual shipped with your VNWA – It is also shown in the **VNWA\_Delivered** – shipping email.



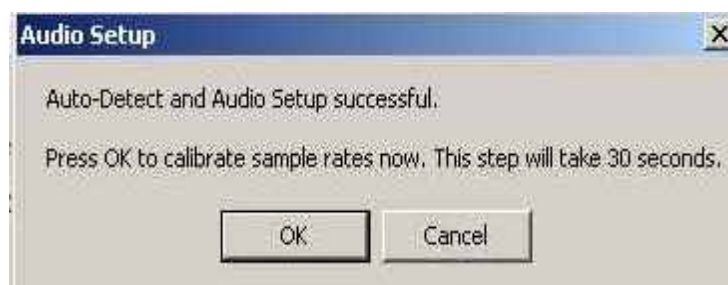
3.4.7 From Release 36.3.0 onwards, the VNWA application performs an **Auto-detection and Auto-set-up of Audio devices** instead of the Manual set-up which was previously required. The Auto-detection and Auto-setup procedure is executed when the VNWA application is started up for the first time – or whenever the VNWA Application (VNWA.exe) is run from an empty directory.

Make sure that **Nothing** is connected to VNWA RF Ports -  
Press “OK” to start the Audio Auto-detection -

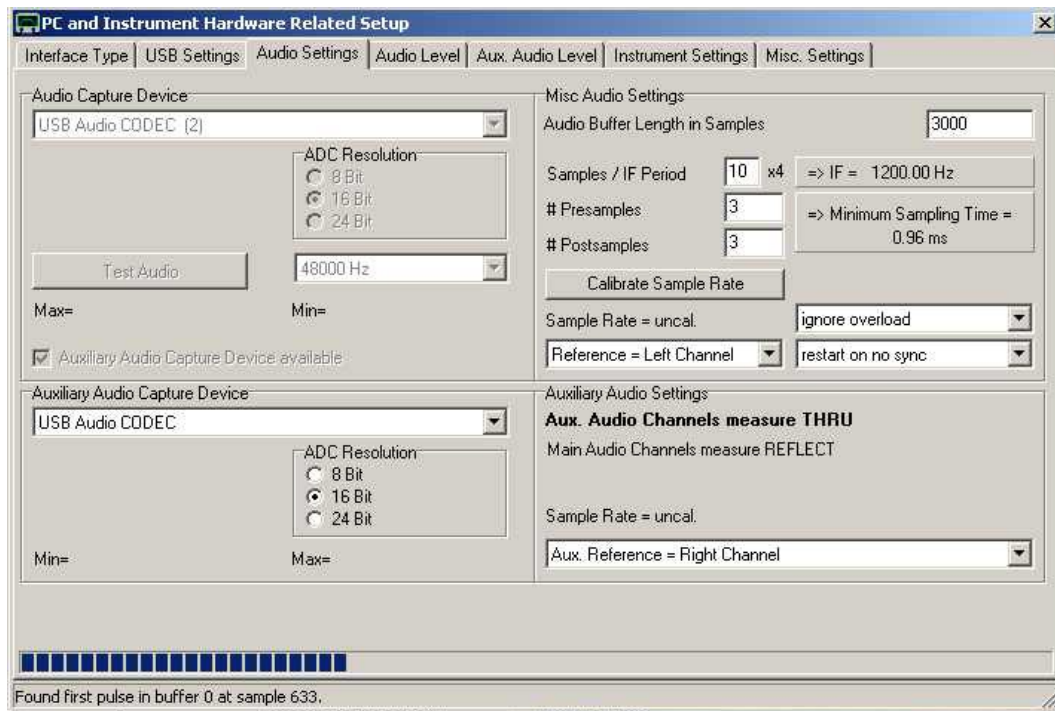




- 3.4.8 Auto-detection and Auto-set-up steps through from phase 1 to 8. The screen below is displayed once the process is completed. Press **“OK”** to calibrate the Audio device sampling rate.



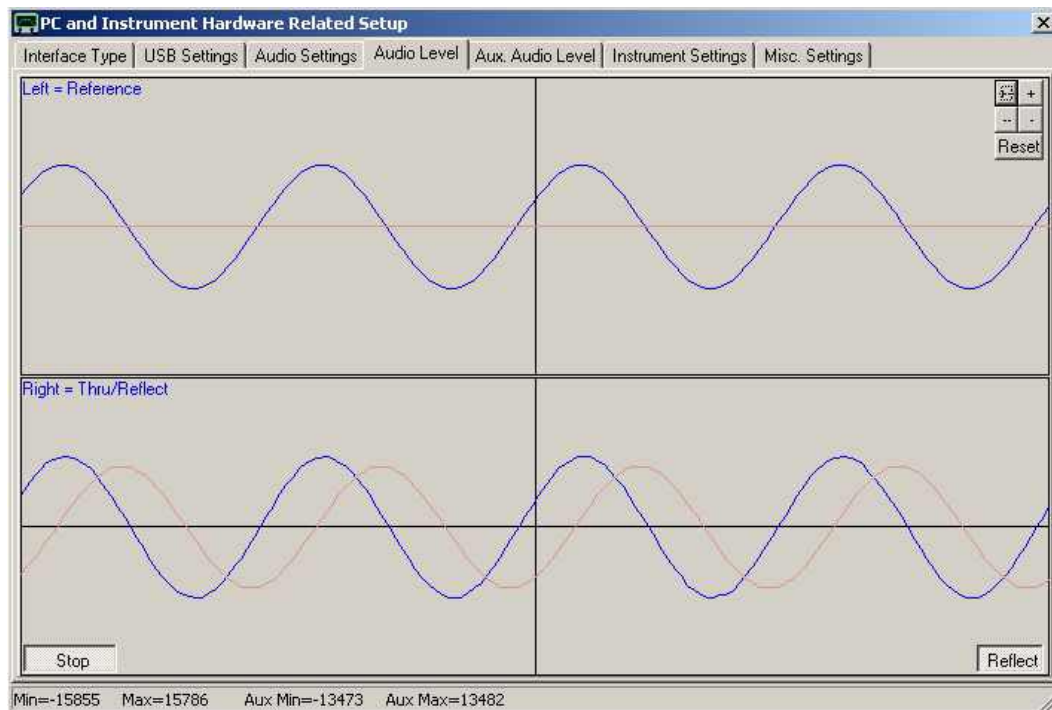
3.4.9 Press “OK” to calibrate the Audio device sampling rate. Calibration of Sample rate takes approx 30 seconds



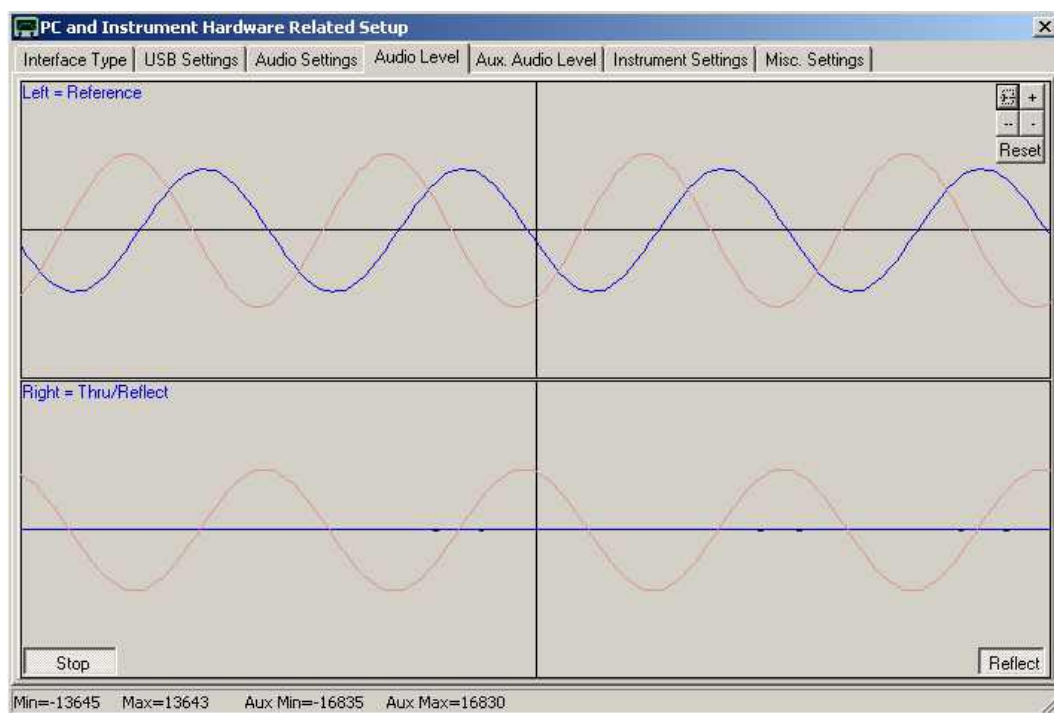
3.4.10 Sample Rate Calibration completed – press “OK” to continue



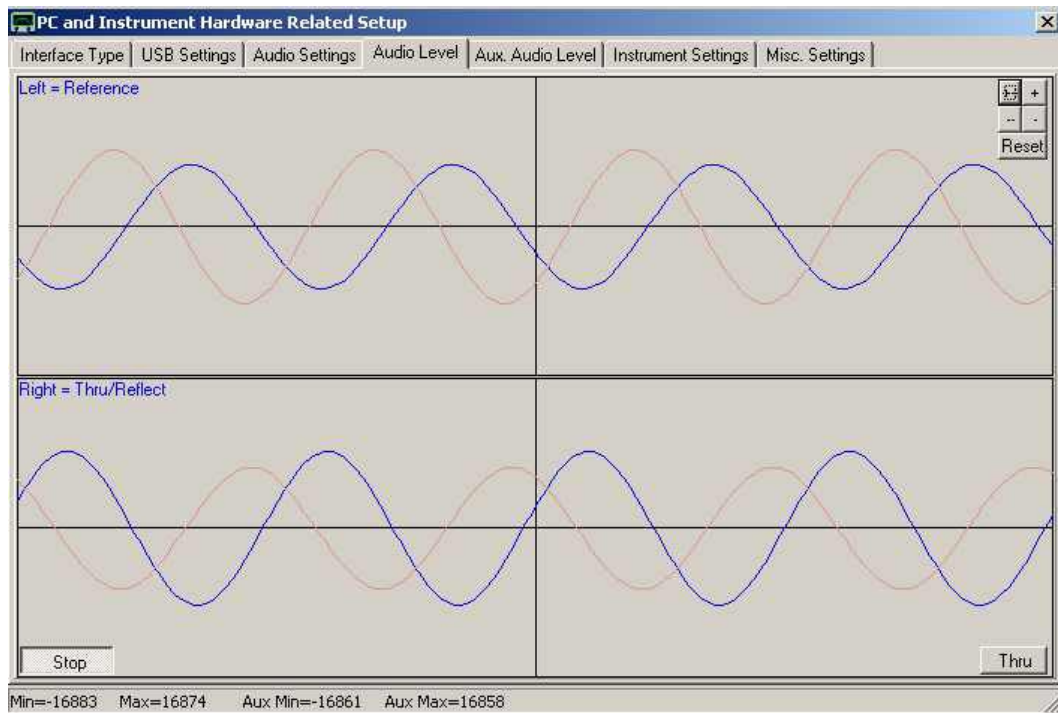
3.4.11 Next the Audio Level Screen is displayed. Select “Reflect” (bottom RH softbutton) and two sine-waves should be displayed. Top = Left = Reference and Right = Reflect.



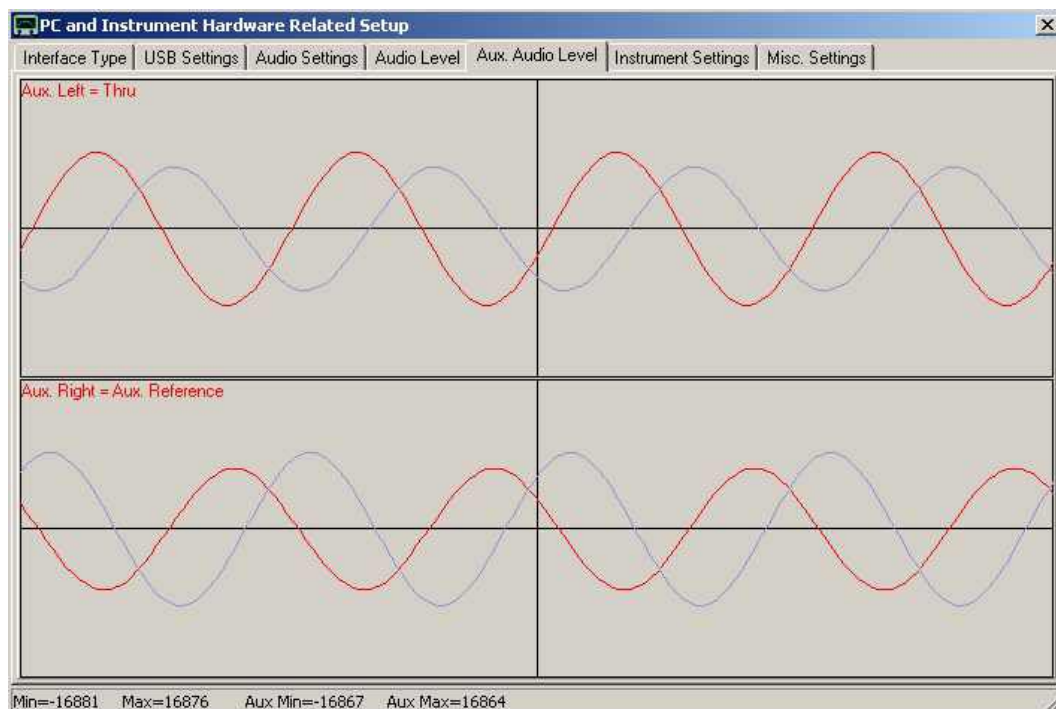
3.4.12 Next connect the TX port to the RX Port with a short Coax cable. The sine-wave on the Right = Thru/Reflect should now disappear (because the TX port is now terminated with a 50 Ohm load from the RX port).



- 3.4.13 This step is **only for VNWA 3** (Expansion PCB not fitted) –  
Select “**Thru**” (Softbutton in bottom RH corner) and Right = Thru/Reflect should now display a sine- wave (RX port is receiving TX output via Thru coax cable)



- 3.4.14 This step is **only for VNWA 3E** with fitted expansion board:  
Select Tab “**Aux Audio Level**” and screen below should be displayed.  
(RX port is receiving TX output via Thru coax cable).



This completes Auto-detection and auto-set-up of Audio devices.

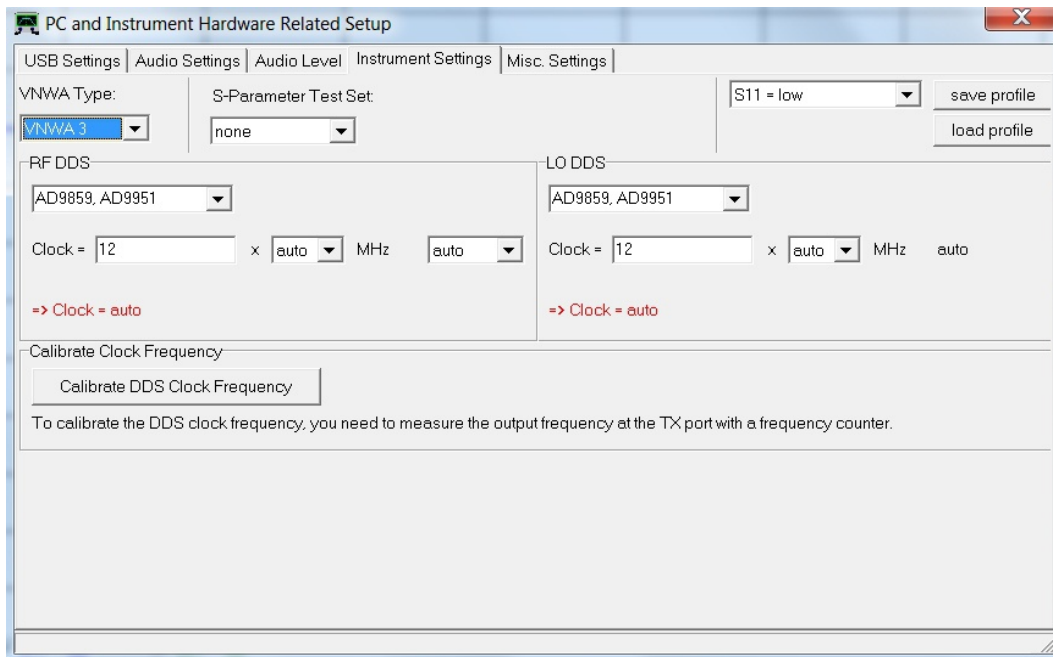
**Troubleshooting:**

In case of audio set-up problems, please consult the **VNWA helpfile - “Auto-Set-up”**  
*Automatic Configuration of the Software for Usage with a DG8SAQ VNWA (Auto-Setup).*

**Notes:** Audio Capture Devices may either be shown as “**Line**” or “**Microphone**” depending on type of USB-Codec chip fitted.

**Troubleshooting:** If "Auxiliary Audio Capture Device available" is **NOT** shown, then exit VNWA application and add the line ***AuxAudio=1*** to the file VNWA.ini with a text editor and restart the VNWA Application. See also VNWA helpfile for further information.

- 3.4.15 Click on Tab “**Audio Level**” and press on softbutton “**Stop**” to cease the Audio test.  
Next click on Tab “**Instrument Settings**”.  
For reference: settings valid for VNWA release 36.2.9 are shown below.

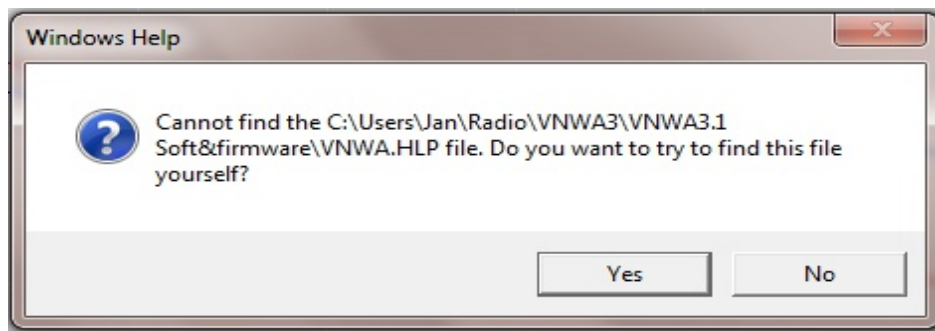


3.4.16 Press the top right button to close the VNWA Set-up screen. Next we test whether the VNWA helpfile is available. Press “**Help**” and select “**Help**” again. (see section 6. Helpfile).

If the Helpfile is not found, the screen below may be shown.

Press “**Yes**” and “**Browse**” to select the location where the Helpfile is located. If standard VNWA installation defaults were selected then the default path will be:

**My Computer    C:\VNWA\VNWA.hlp**



3.4.17 **IMPORTANT:** To save the VNWA configuration (after any changes are made) exit the VNWA Application. This **updates** the VNWA configuration files for the next time the VNWA application is started.

**End of VNWA Configuration for Windows XP**



### 3.5 Amateur Radio Root Certificate Installation (ARC)

**Introduction:** The libusb0.sys driver is required to enumerate the Atmel ATMega Microprocessor used in the VNWA. On Window-7 64bit system and Windows 8, kernel-mode drivers can only be installed if the Driver is signed by a certificate from Microsoft (or a derivative certificate). From VNWA installer v36.2.3 available after 20<sup>th</sup> November 2012 or later, the Amateur Radio Root Certificate is automatically installed, thanks to Fred Krom PE0FKO for making this certificate available. ARC installation is a simple procedure as follows:

**Note:** Installation of the root certificate only happens once. Subsequent installer runs won't show it any more when the certificate is already found installed.

- 3.5.1 After installing the VNWA Application and Helpfile but prior to installing the Libusb0 driver, the following screen will be displayed on VNWA selfinstaller V 36.2.3 or later. Press “**Install Cert**” to continue.



- 3.5.2 Next the Installation Confirmation screen is displayed – press - “**Continue**”. The Amateur Radio Certificate installation should now complete and the following screen displayed.



- 3.5.3 Press “**Exit**” button in step 3.5.1 and the VNWA Installer will proceed to install the Driver. **For Windows 7 & Vista** refer to para 3.1.9 onward to finish the installation. **For Windows XP** refer to step 3.3.9 onwards to finish the installation.

**End of Amateur Radio Certificate Installation**

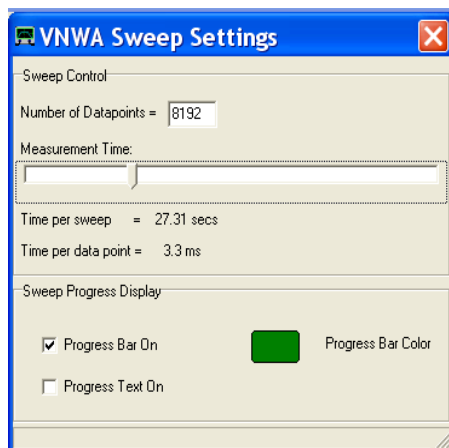
## 4. VNWA Master Calibration

Prior to taking VNWA measurements the VNWA needs to be calibrated - Calibration uses SOLT - Short - Open - Load and Through Method. Ideal Calibration standards are used by default. For High precision measurements in VHF and UHF range you need to specify a more precise model of the calibration standards used - please consult the VNWA helpfile.

To calibrate the TX port (One Port) you need an SMA Short connector and a SMA 50 Ohm Termination. For RX port (Two Port) calibration a short SMA to SMA cable is also required.

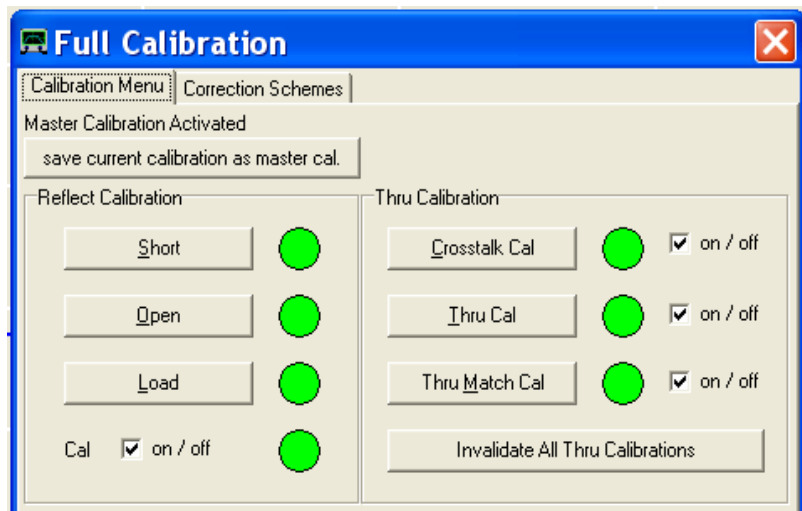
### 4.1 Master Calibration procedure

1. Set frequency range for Master Calibration (for instance 0 MHz - 500 MHz). Click on "Center=" and "Span=" and specify Start and Stop frequency of the Master Calibration.
2. From VNWA top menu select "Setting" and select "Sweep"  
Specify: 8192 points  
time per sample: 3.3 mS



3. From VNWA top menu select "Measure" and "Calibrate" and select Short - Open - Load for TX calibration and follow the instructions shown on screen. For 2 Port Thru calibration "Crosstalk Cal - Thru Cal - Thru Match Cal" steps also need to be done using a short cable.
4. Once Calibration has been done, save the results in a Master Cal file: for instance with filename: **Master Cal 0-500Mhz**. Note: you may save any number of cal files.

**Note:** It is generally recommended to skip the crosstalk cal. It has benefits only in very special circumstances.



## 4.2 Reloading saved Master Calibration File

To load a previously saved Master Calibration File:

1. From Top Menu select **"File"** - **"Retrieve"** and select **"Mastercalibration"**
2. Now select the required Calibration file for loading

**End of VNWA Master Calibration**

## 5. Some Practical VNWA Measurements

### Introduction:

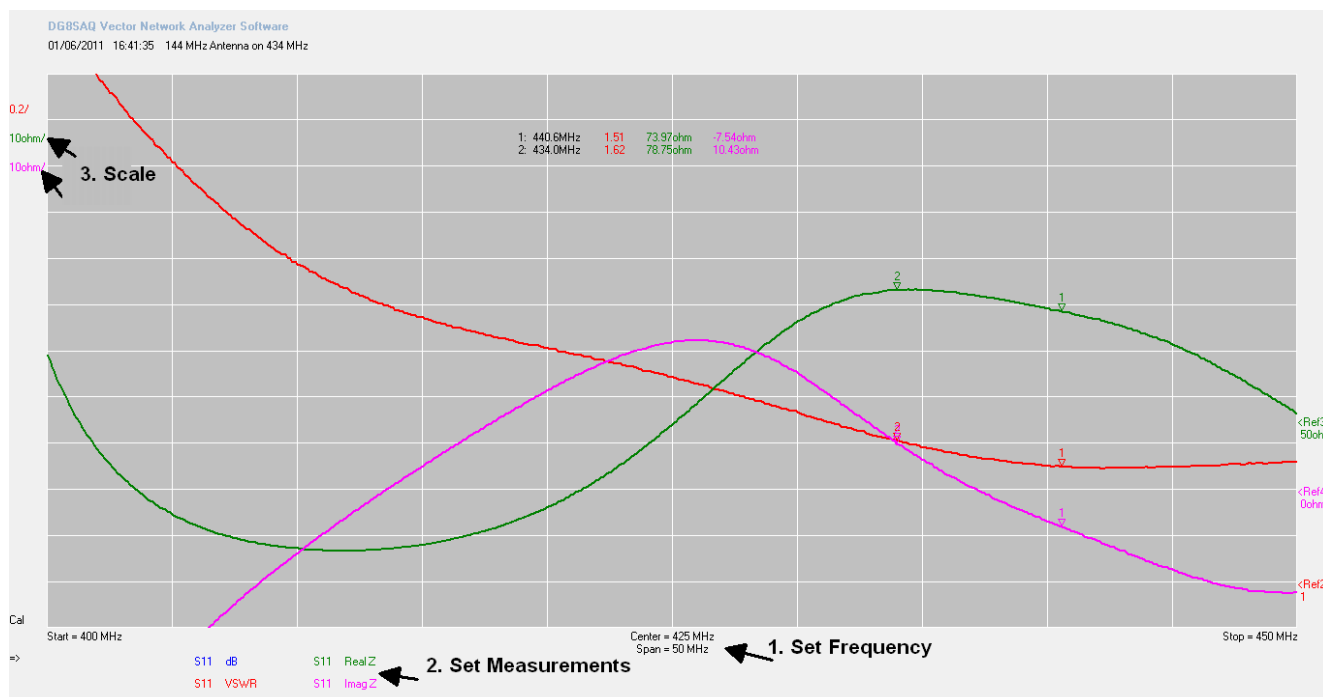
The DG8SAQ VNWA is a very capable instrument offering many options which may overwhelm first time users who may not be familiar with basic VNWA measurements.

A good introduction is to start with some simple measurements as shown below.

For more information including VNWA Tutorials - see section 6.2 - Other Links

### 5.1 Antenna VSWR and Impedance (S11 - 1 Port Device)

Antenna VSWR or Impedance measurements are typical examples of VNWA "One Port Measurements" The example below illustrates how VSWR measurement is obtained of an (144 MHz) Antenna from 400MHz to 450MHz (2 Meter Antenna used on 70 cm Band)



**Method:** (assume VNWA has been calibrated before)

Connect Device Under Test (DUT) ie Antenna to the VNWA TX Socket

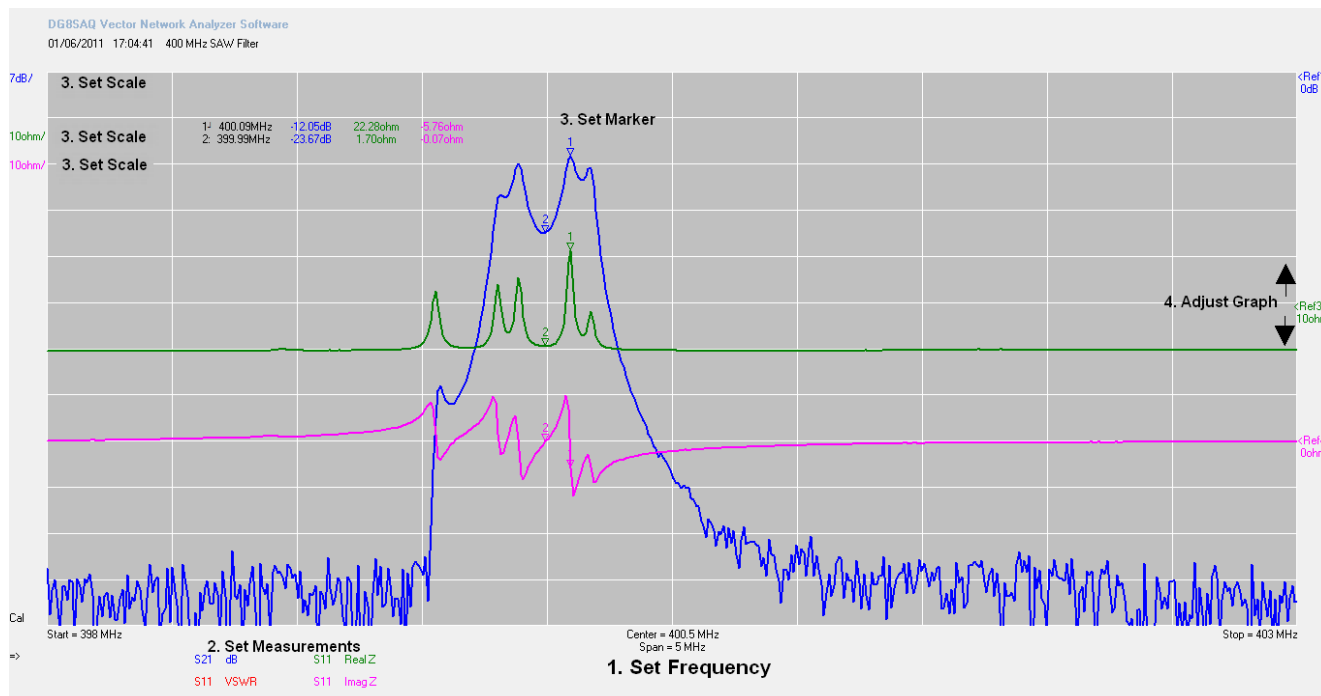
1. Set Frequency Start and Stop frequency
2. Set Measurements - select measurements to be displayed  
(S11, dB), (S11, Real Z), (S11, Imag Z)  
Press "Single Sweep" - results are now displayed
3. Adjust the measurement scale if required to improve the graph appearance  
Add Marker (Right Mouse Click and select "Normal Marker") and place on point of interest.

In the example the Marker displays: Frequency = 434 MHz, VSWR = 1.61 Real Z = 78.75 Ohm and Imag Z = 10.43 Ohm (Inductive)

## 5.2 VNWA Transmission Measurements (2 Port Measurement)

Filter Attenuation measurement is an example of VNWA "Two Port Measurements"

The measurements of attenuation (S21 dB) and input impedance (S11 Z) of a 400 MHz Surface Acoustic Wave (SAW filter)



**Method:** (assume VNWA has been calibrated before)

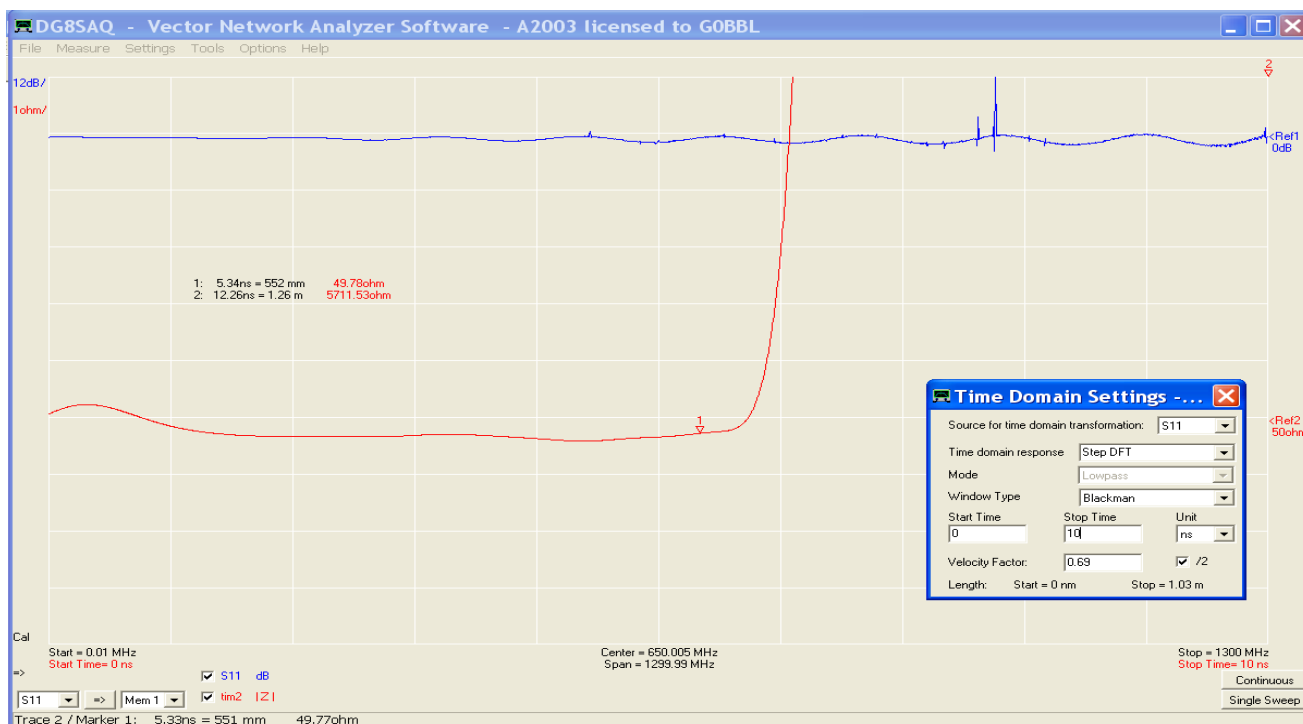
Connect Device Under Test (DUT) input to VNWA TX port and Device output to VNWA RX port

1. Set Start and Stop frequency
2. Select measurements to be displayed (S21, dB), (S11, Real Z), (S11, ImagZ)  
Press "Single Sweep" Results should be displayed
3. You can change the measurement scale if required to improve graph appearance
4. Add Marker (Right Mouse Click and select "Normal Marker") and place on point of interest
5. Graph position may be adjusted by placing cursor here and dragging graph up or down.

In the example Marker 1 displays: Frequency = 400.09 MHz Attenuation = -12.05dB Input RealZ = 22.28 Ohm and Input imagZ = -5.76 Ohm (capacitive). Note: SAW filter is not matched to 50 Ohm impedance of VNWA TX and RX port.

### 5.3 Time Domain Reflectometry Measurement (TDR)

Below is an example of using the TDR capability of the VNWA to determine the characteristic impedance (and length) of a coaxial cable.



#### Method:

1. Calibrate VNWA between 0 kHz and 1300 MHz with sweep of 2000 points and 4mS
2. Connect the Coax cable to VNWA TX port. Other end of Coax is left unconnected.
3. Perform S11 dB measurement as (shown as Trace 1)
4. Add Trace 2 as S11 |Z| (Use right hand mouse click and select "Trace Options")
5. Move cursor over Trace 2 (shown as S11 |Z|), Next do right hand mouse click and select "Other" and "Time Domain". Time domain Setting window now appears as in picture.
6. Change the settings as shown in the example, - Select "Stop Time" to be a little longer than the length of your coax cable. (10ns shown - for measuring cable length up to 1m)

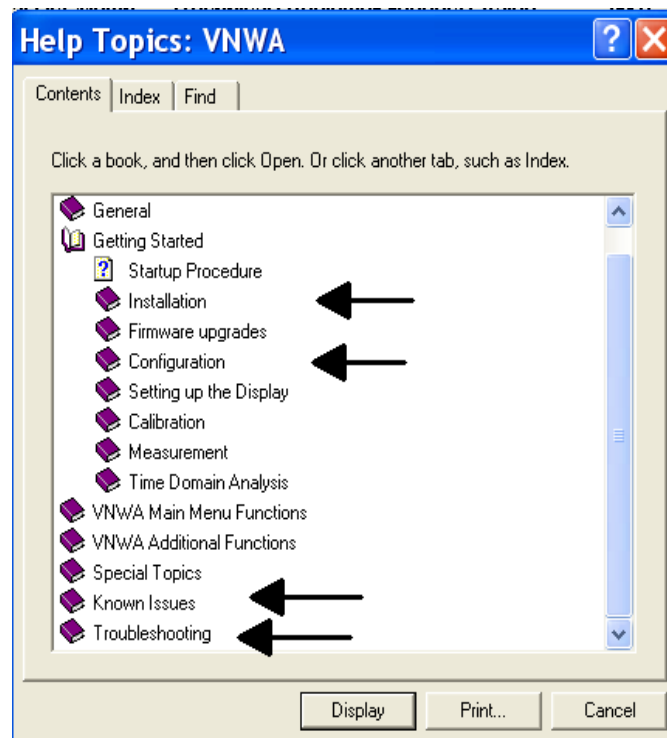
In the example Marker 1 displays: the characteristic impedance as 49.78 Ohm (each division is 1 Ohm!). The total length of the coax cable is actually 0.63m. Accuracy of this measurements depends on correct Velocity Factor of the cable type to be entered.



## 6. VNWA Help file

Check you can open and read the VNWA HELPFILE. Open the VNWA Helpfile and take out time to familiarize yourself with the VNWA application: particularly with sections such as:

- Installation & Configuration
- Calibration
- Known Issues
- Verification of Proper Operation (Troubleshooting section)



Note: a PDF version of the latest helpfile may be downloaded from:

[http://sdr-kits.net/DG8SAQ/VNWA/VNWA\\_HELP.pdf](http://sdr-kits.net/DG8SAQ/VNWA/VNWA_HELP.pdf)

## 6.1 Further Reading VNWA Helpfile

By the time you read this, you should have a fully functioning VNWA and start to explore some of the capabilities and measurements. However, do try to explore some of the more advanced capabilities mentioned in the **VNWA helpfile** such as:

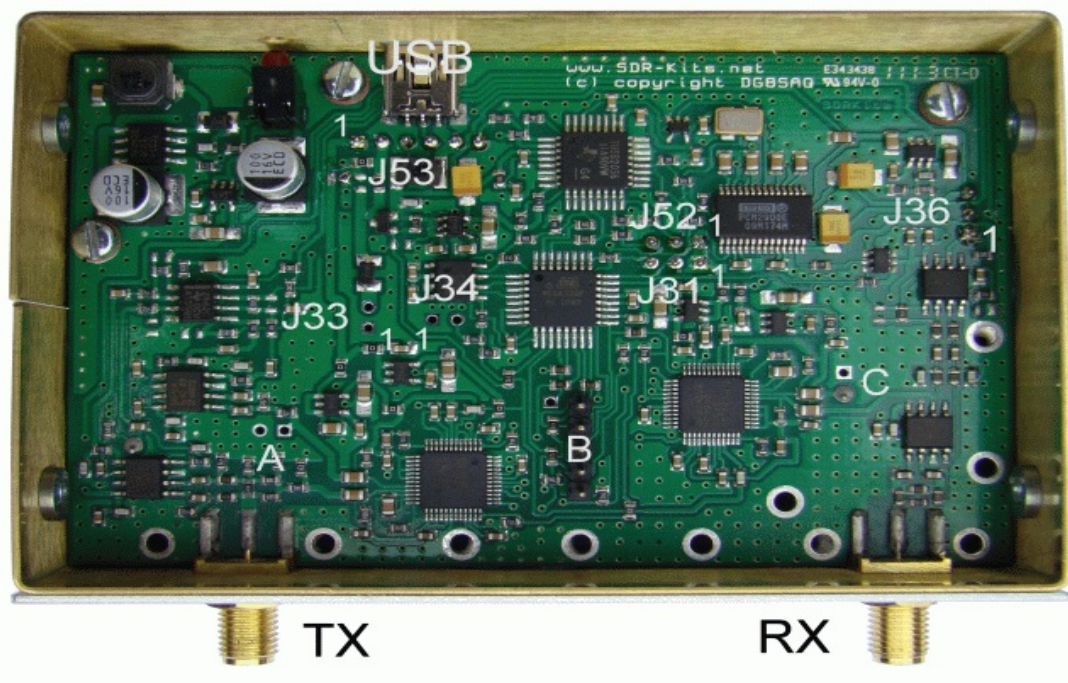
- **Built-in Matching tool** - allows to simulate the 2 port DUT transfer characteristics under a chosen impedance termination conditions and to calculate matching networks for optimum power transfer.
- **Touchstone Files** - VNWA can import and export certain S-parameter files in **Touchstone** format (s1p, s2p, s3p)
- **Custom Back ground Options** - The custom background options allow to load an image to appear as background on the VNWA main window. Scalable vector graphics files (.svg) and Pixel Graphics (jpeg, png) are supported.
- **Crystal analyzer tool** - allows to extract equivalent circuit model parameters direct from the measured reflection coefficient of a crystal resonator or similar resonator (SAW, ceramic Resonator)

## 6.2 Tutorials and Other links

- [VNA Tutorials - by Fred Schneider PA4TIM a beginners Guide in 8 Chapters! - thanks Fred!!](http://www.pa4tim.nl/?p=1594) <http://www.pa4tim.nl/?p=1594>
- [VNWA One Port Measurements \(TX Port only Step by Step Example of Antenna\)](#) Tutorial by Tom Baier -
- [http://sdr-kits.net/DG8SAQ/VNWA/\\_Example\\_A\\_simple\\_one\\_port\\_measurement.pdf](http://sdr-kits.net/DG8SAQ/VNWA/_Example_A_simple_one_port_measurement.pdf)
- [VNWA Two Port Measurements \(TX and RX port Step by Step Example of Filter\)](#) Tutorial by Tom Baier -
- [http://sdr-kits.net/DG8SAQ/VNWA/\\_Example\\_2\\_Port\\_Measurement.pdf](http://sdr-kits.net/DG8SAQ/VNWA/_Example_2_Port_Measurement.pdf)
- **Introduction to S-Parameters** - A good Introduction to S-Parameters is the following Application Note published by Hewlett Packard: <http://sss-mag.com/pdf/an-95-1.pdf>
- **Zplots** - Dan, AC6LA, has written Zplots <http://ac6la.com/zplots.html> , a wonderful Excel application that uses the power of the Excel charting engine to neatly plot and analyze S-parameters like the ones generated during a VNWA measurement. See also the VNWA helpfile how to use Zplots in the VNWA Application.

## 7.0 VNWA 3 - 3E Hardware Description

The VNWA3 3E combines the VNWA and the USB interface functionality on a single 100x60mm<sup>2</sup> board: The VNWA3 only requires a single USB cable to connect to a PC. Nevertheless, it offers many hardware interfacing options: Please refer to the VNWA Helpfile for a block diagram and details of external connections



### 7.1 VNWA 3E - Fitted Expansion Printed circuit board

The VNWA 3E is fitted with VNWA 3 Expansion Board which provides additional functionality as follows:

**Note:** VNWA 3E was formerly named VNWA 3+ but these are the same products

- 2nd Audio Codec allowing S11 and S21 measurements to be performed in a single sweep instead of 2 sweeps.
- USB power consumption reduced to from 0.41 Amp without Expansion board to 0.33 Amp despite additional power consumption of 2nd Audio Codec on the Expansion board.
- RJ12 connector making the VNWA3 control signals and power accessible to the outside world
- Optional SMA connector to obtain the multiplied 12 MHz internal TCXO clock or to feed in an external 36 MHz clock source.



### 7.1.1 VNWA 3 E - Expansion Board - External Connections

| RJ12 pin | Signal Description  | Cable colour | Remarks:<br>(see also VNWA helpfile for info on options)   |
|----------|---|--------------|--|
| Pin 1:   | Rotor start/stop control signal<br>Output 0V or 3.3V DC - 680 Ohm Series Resistor | white        | Output signal, normally +0V. When VNWA sweep is active Output signal is +3.3V DC – This signal can be used to start and stop Rotor Engine. |
| Pin 2:   | Not Connected   | black        |  |
| Pin 3:   | S-Parameter Test set Control Signal (output)                                      | red          | 0 or 3.3V Logic DC Signal from AVR via 680 Ohm series resistor. See Helpfile for configuration details                                     |
| Pin 4:   | Not Connected   | green        |  |
| Pin 5:   | Internal 5V DC Power out or External 5V Power In (See Note 1)                     | yellow       | A maximum of about 100mA may be drawn from internal power provided PC USB Hub can supply 500mA. See Note 1; when using external power      |
| Pin 6    | Ground  | blue         | VNWA Ground Connection   |

**Note 1:** For operating the VNWA3 from an external 5V DC power supply, a zero Ohm resistor must be removed as detailed in VNWA Helpfile section “General”, page "VNWA3E"

**Note 2:** Cable colour refers to the colours of the optional RJ12 cable available from SDR-Kits

### 7.1.2 VNWA 3E Optional External Clock input/Output

An Optional SMA connector may be fitted for connecting an External 36 MHz Clock output or to tap the internal multiplied System clock. After the VNWA 3 Expansion Board is fitted, the SMA connector is fitted in the 8mm round hole provided only in VNWA3 with **s/n 2201 and higher** as shown in fig 1.

1. With a scalpel cut a round hole in the rear panel label and fit the SMA connector.
2. solder a short wire between the SMA center connector to the PCB track. Soldering of ground connections is not required.

If the SMA connector is not used then it is recommended to fit an SMA Screening cap to prevent radiation from and damage to the SMA connector.

### 7.1.3 Specification of the VNWA Reference Clock output or External Clock input:

- Internal Clock Output: TCXO 12 MHz\*x (x=2....8) 2ppm Out - 1kOhm impedance, 150mVpp output
- External Reference Clock: ideally 36 MHz with level of between -6dBm...+3dBm / 50 Ohms

## 8. DG8SAQ VNWA 3 & 3E Specification

- Supported Operating Systems: Microsoft Windows Windows 8, Windows 7, Vista, (64 and 32 bits) and Windows XP.
- Coverage from 1 kHz to 500 MHz with dynamic range of over 90dB – Useful performance of up to 1.3 GHz with reduced dynamic range (over 50dB) and accuracy.
- S-Parameter S11, S12, S21 & S22, VSWR
- Component Measurements – Resistance, Admittance Capacitance, Inductance & Quality Factor (Q)
- Time domain & Gating in Time domain - Distance to Fault (DTF) measurement.
- Import and Export of Touchstone files (S1P - S2P - S3P)
- Logarithmic and Listed sweep: up to 8192 points with sampling time adjustable from 0.2mS to 100mS
- Matching Tool, Complex Calculator & Crystal Parameter tool
- User defined S-parameter calculator - Zplot & Excel application Support
- Basic Spectrum Analyzer - useful up to 100 MHz
- Basic Signal Generator TX-Out max RF Output as signal generator -17dBm - no harmonic filtering
- Power requirement - USB 1.1 or USB 2 Interface 5V DC max 400mA
- 12 MHz TCXO Master Clock - stability of +/- 2 ppm
- Microprocessor: Atmel ATmega 328P with - 16K Flash memory - clocked at 12 MHz
- Connectors: SMA x 2, Mini USB-B
- Power requirement - USB 1.1 or USB 2 Interface 5V DC max 400mA
- Dimensions: Width 10.4 cm, Depth 8.0 cm, Height 4.6 cm, Weight 0.35 Kg
- RoHS Compliant
- VNWA 3 E is factory fitted with Expansion Printed Circuit Board offering S11 and S12 measurements in a single sweep instead of 2 sequential sweeps.

### 8.1 DG8SAQ VNWA 3E – VNWA 3 Deliverables

- VNWA 3E or VNWA 3 as ordered
- Mini-USB lead
- VNWA 3 "Getting Started Manual (this manual)
- Presentation-Storage case with 4 pcs Calibration kit and RG223 cable (**Order Option**)

### 8.2 Optional Items

- Presentation case
- SDR-Kits Calibration Kit (SMA Short - SMA 50 Ohm Load - SMA cable)
- Various adapters
- VNWA Expansion Board

## 9. VNWA User Support

### 9.1 VNWA User group

It is recommended you become a member of the DG8SAQ VNWA Forum on Yahoo where VNWA announcements and VNWA user experiences are shared. You will have the benefit of useful information including advice when new software and helpfile updates are available for download.

<http://groups.yahoo.com/group/VNWA/>

Please use the DG8SAQ VNWA Forum to check for important announcements, documentation updates and to share your experiences building and using the DG8SAQ VNWA 3 Vector Network Analyser.

### 9.2 Warranty information

A 12 month return to base Warranty from date of Shipment date is applicable to the VNWA 3.x on condition the product is unmodified, not misused or damaged and the maximum permissible ratings have not been exceeded. Warranty claims should be made by contacting SDR-Kits by email in first instance with a description of the issue. Customer is responsible for return of the VNWA to SDR-Kits by tracked shipment. SDR-Kits will pay for outbound shipping cost of the repaired unit or for the supply of a replacement VNWA in similar condition as the VNWA received.

### 9.3 Hardware Servicing information

If an hardware issue is suspected then refer to the VNWA Helpfile section "**Verifying Proper Operation**" and report which step your VNWA is failing and contact SDR-Kits (email [Support@SDR-Kits.net](mailto:Support@SDR-Kits.net)) for advice and service assistance. Service documentation of the VNWA 3 or 3E is **not** available - there are **no user serviceable parts** used in the design.

### 9.4 WEEE, Disposal of Waste Electrical Equipment



This symbol on the product indicates that this product should not be treated as household waste. Instead it should be handed over to a suitable collection point for the recycling of electrical and electronic equipment. Users of this product in the European Community should contact SDR-Kits to specific arrangements for the disposal and recycling of this product in accordance with the relevant EEC Directives.

### 9.5 CE Certification,



This product is CE certified according to the provisions of 2004/108/EC and 1995/5/EC relating to the Radio and Telecommunications Terminal Equipment (R&TTE) is in compliance with the essential requirements of these directives.



## 9.6 FCC & IC Statement

This product complies to FCC Part 15 for Class B devices. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Note: The manufacturer is not responsible for ANY interference, for example RADIO or TV interference, caused by unauthorized modifications to this equipment.

Such modifications could void the user's authority to operate the equipment.

## 9.7 Acknowledgements

Acknowledgements and thanks are due to the VNWA3 Beta testers and to all the VNWA 2.x owners who tested VNWA 34.x and VNWA 35 releases and patiently reported issues via the VNWA reflector. A special thanks for **Kurt Poulsen OZ7OU** for his diligent review of the this manual and for his sterling work on the VNWA Calibration Standards supplied by SDR-Kits.

Tom Baier and I acknowledge the contribution of **Alan Rowe M0PUB** for his expertise and efforts in providing the **VNWA Installer package** and to **Fred Krom PE0FKO** for his kind assistance in providing the **Amateur Radio Root Certificate**

Updated 24<sup>th</sup> July 2013

Jan Verduyn  
SDR KITS LIMITED UK Company no 08668127  
Trading as SDR-Kits

## 9.8 Contact address

SDR Kits Limited (Internet & mail order only)  
Grangeside Business Centre  
129 Devizes Road  
Trowbridge, Wilts BA14-7SZ  
United Kingdom

|                                 |  |
|---------------------------------|--|
| <b>Orders:</b>                  | <a href="mailto:Orders@SDR-Kits.net">Orders@SDR-Kits.net</a>   |
| <b>Technical support email:</b> | <a href="mailto:Support@SDR-Kits.net">Support@SDR-Kits.net</a> |
| <b>Email Backup</b>             | <a href="mailto:sdrkits@gmail.com">sdrkits@gmail.com</a>       |
| <b>Website</b>                  | <a href="http://www.SDR-Kits.net">www.SDR-Kits.net</a>         |

## **Ordering Terms and Conditions**

1. All products supplied by SDR-Kits are subject to these Ordering Terms and Conditions as from 1st October 2013.
2. Customers should ascertain whether a product meets their specific requirements, prior to placing an order. Customers should determine whether they have the appropriate knowledge and skills to assemble or operate a product supplied by SDR-Kits. Documentation of products supplied by SDR-Kits are provided only in the English language unless otherwise stated otherwise.
3. Orders are placed by opening an account on the SDR-kits Webshop, and dropping the required goods into the Web basket. Payment should be made at the time of ordering via Paypal or by requesting a Pro Forma invoice.
4. When requesting a Pro Forma invoice, SDR-Kits will email an invoice within 3 working days, showing the total price in GBP or EUROS and relevant Bank details (IBAN and BIC) to where payment should be made. Goods are only shipped once Payment is received in full. Paypal accepts most payment methods (Credit Cards) from Customers and opening of a Paypal account is not required to make a payment.
5. SDR-Kits reserves the right to modify or withdraw any product including pricing without giving prior notice.
6. SDR-Kits warrants that unless stated otherwise, all products are new and sourced from reputable Suppliers. SDR-Kits should be notified of any defective or missing items within 90 days from date of shipment. Assembled products carry a 12 month "return to base" warranty which excludes user damage, misuse or unauthorised modifications.
7. SDR-Kits accepts no responsibility for kit assembly errors by kit buyers, for repairs due to non-operation, misuse, inadequate kit-building skills, unauthorised product modification or lack of performance.
8. Reasonable efforts will be made to investigate and resolve systematic products issues reported by multiple users, No obligation shall exist to support products, product modifications, firmware or software not supplied by SDR-kits.
9. Software or firmware is provided "as is" and no warranties or indemnities are made. Reasonable endeavours shall be made to resolve reported systematic product issues found on unmodified hardware supplied by SDR-Kits.
10. Liability of SDR-Kits shall be strictly limited to the amount paid for the product. No liability is accepted for indirect or consequential damages, which may be attributed to any product supplied by SDR-Kits.
11. Products supplied by SDR-Kits are designed for and supplied for Educational, Amateur Radio and Hobbyist use. SDR-Kits Product are not designed for use in Commercial, Professional, Airborne, Medical or Mission Critical applications and SDR-Kits shall not be held responsible if products are used in these applications. No warranties are made whatsoever as to the stability and suitability of the design, during continuous operation or operation outside components' specifications. No liability is accepted for accuracy of measurements or performance either short term or long term.
12. The design of the DG8SAQ VNA is property of Thomas Baier DG8SAQ. Any technical information supplied with the VNA or VNA kit is for personal use of the buyer for the purpose of assembling, operation, fault diagnosis and (self) education. Such information should not be put in the public domain.
13. Intellectual property of products supplied by SDR-Kits including printed circuit boards, product and kit assembly and operation manuals do not transfer to the buyer through the sale of the product. Software and firmware made available by SDR-Kits shall remain the property of the original author.
14. For orders placed via Paypal, the Paypal Buyer and Seller Protection rules shall be applicable. English Law shall be applicable to the Terms and Conditions to orders not placed via Paypal. Any dispute arising shall be under the sole jurisdiction of English Courts.
15. SDR-Kits may change these Ordering Terms and Conditions without giving notice. Changes to Terms and Conditions will only be applicable to new orders. Terms and Conditions shall not affect your statutory rights under UK Law.

## Notes:

