

DG8SAQ Vector Network Analyzer® - VNWA 3SE 3E & 3 **"Getting Started Manual" for Windows 10 – Windows 8.1 & Windows 7**

*For VNWA
License Code
see page 2*

*VNWA
Hints
see page 10*



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1. Introduction:

Thank you for purchasing the DG8SAQ VNWA 3, 3E or 3SE Vector Network Analyzer from **SDR-Kits®**. This manual is a concise "Getting Started" guide for release **VNWA 36.7.0** onwards, showing what steps are necessary to place the DG8SAQ VNWA in operation for the **Microsoft Windows 10, Vista, Windows 8, 8.1 or Windows 7 Operating Systems using VNWA Application 36.7.0 and later**. For **Windows XP** refer to: https://sdr-kits.net/index.php?route=web/pages&page_id=30_30

The DG8SAQ VNWA has many advanced features and options, therefore VNWA Users are strongly urged to study the **VNWA pdf helpfile**: www.sdr-kits.net/documents/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 and Registered Trademarks notice

The design of the VNWA 3.x is copyright by Thomas Baier DG8SAQ & SDR-Kits - All right reserved. **SDR-Kits®**, the SDR-Kits Logo and DG8SAQ *Vector Network Analyzer®* are Registered Trademarks.

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.

https://sdr-kits.net/index.php?route=web/pages&page_id=30_30

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 known components after performing VNWA calibration.

2.3 VNWA 3, VNWA 3E and VNWA 3SE - 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 www.sdr-kits.net/documents/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. Additional instructions for **VNWA 3SE (2 Port VNWA)** are supplied as a **supplement** to this manual.

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 3.2.6 (Win7 or Vista) or in step 3.4.6 (Windows 10 & Windows 8.1)

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-bl-t-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.

Prior to installing new Computer Software it is recommended **to make suitable Backups** of your Computer files. Also ensure you have at least **50 MByte space** for installation.

Please email: Support@SDR-Kits.net to report any errors or improvements to this document.

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 10, Windows 8 or 8.1** refer to **Chapter 3.3**

Windows 7 and Vista users:

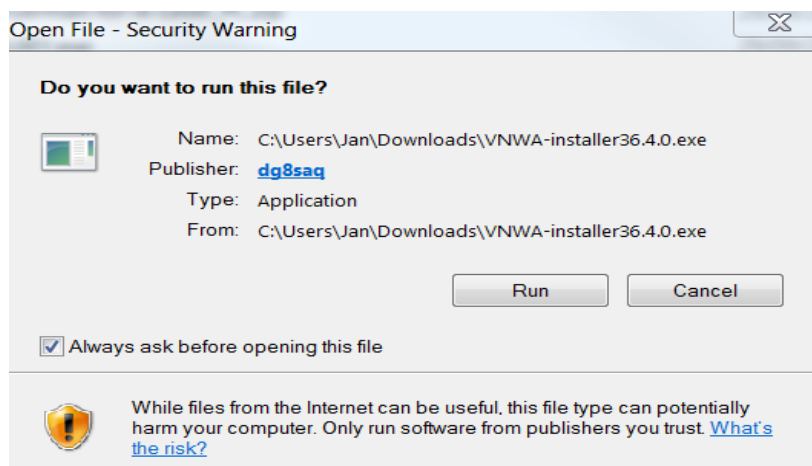
- 3.1.1 Download and save the VNWA Installation Package from the following location to your desktop or to a download folder from:

<http://www.sdr-kits.net/DG8SAQ/vnwaupdate.php?path=installer&source=Sdr-kits>

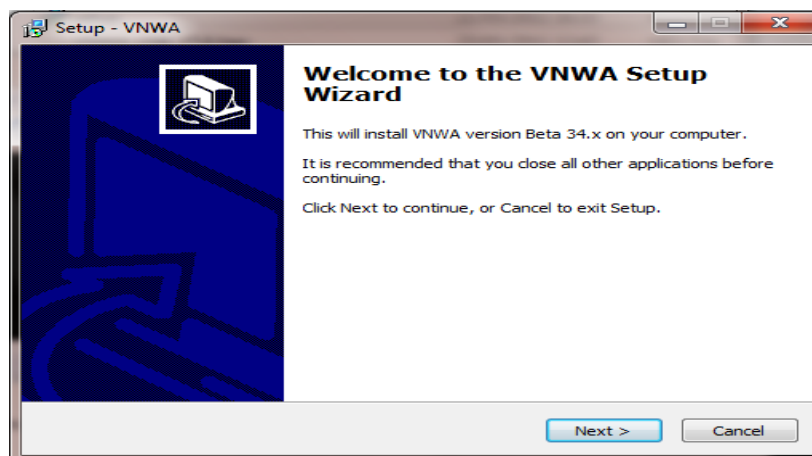
Make sure the VNWA is **NOT** connected to the Computer

- 3.1.2 Double-click on the **VNWA-installer Icon** to start the VNWA installation process.

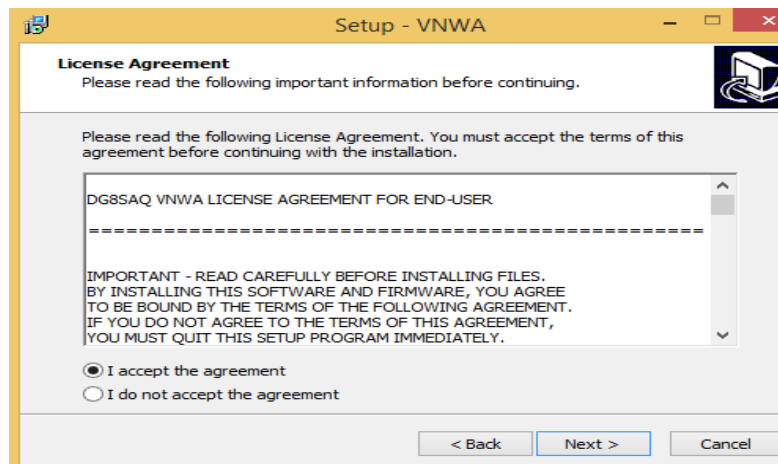
Open File – Security Warning will be displayed: Publisher: **dg8saq** type: **Application**
Confirm that you want to run this software by pressing “**RUN**”



- 3.1.3 Next **User Account Control Window** is now shown for **dg8saq setup**
Confirm the VNWA-installer can make changes to your Computer - Press “**Yes**”
then screen below is shown. Next Press “**Next >**”

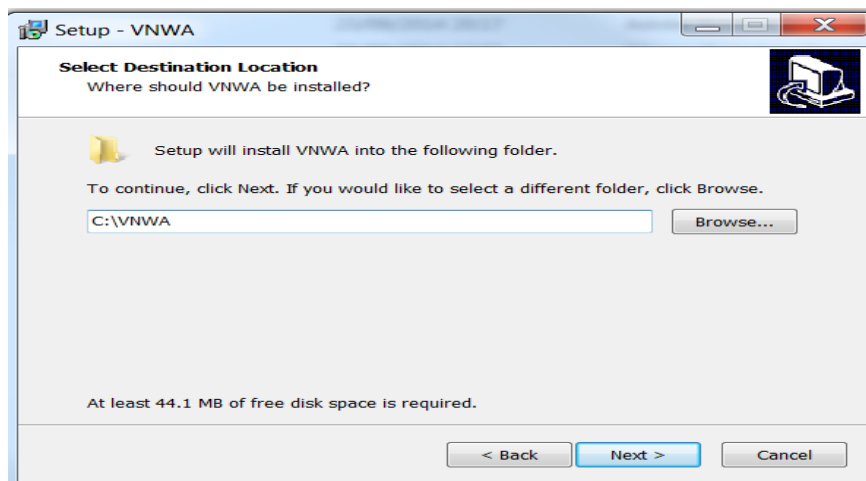


- 3.1.4 Press “**Next >**” – the VNWA License Agreement will be shown: *Please read and tick the correct box.* **Note:** the VNWA Application is **only licensed** for VNWA hardware supplied by **SDR-Kits and our authorized Resellers.**

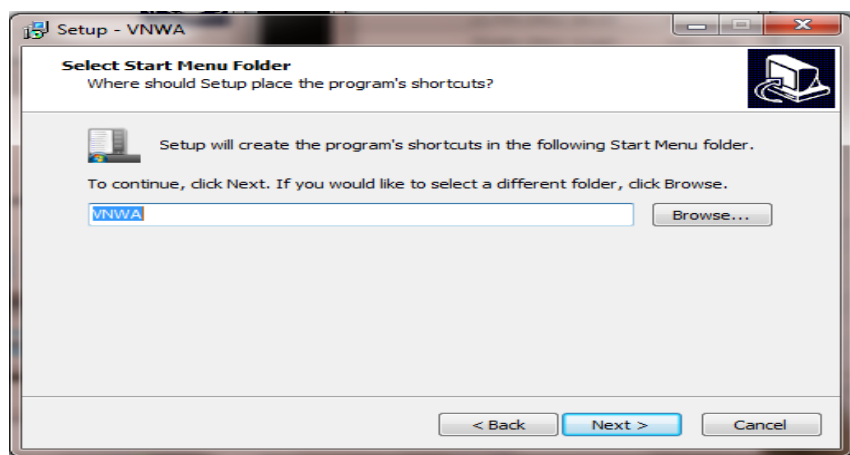


Press "Next >" The default location where VNWA will be installed will be shown:

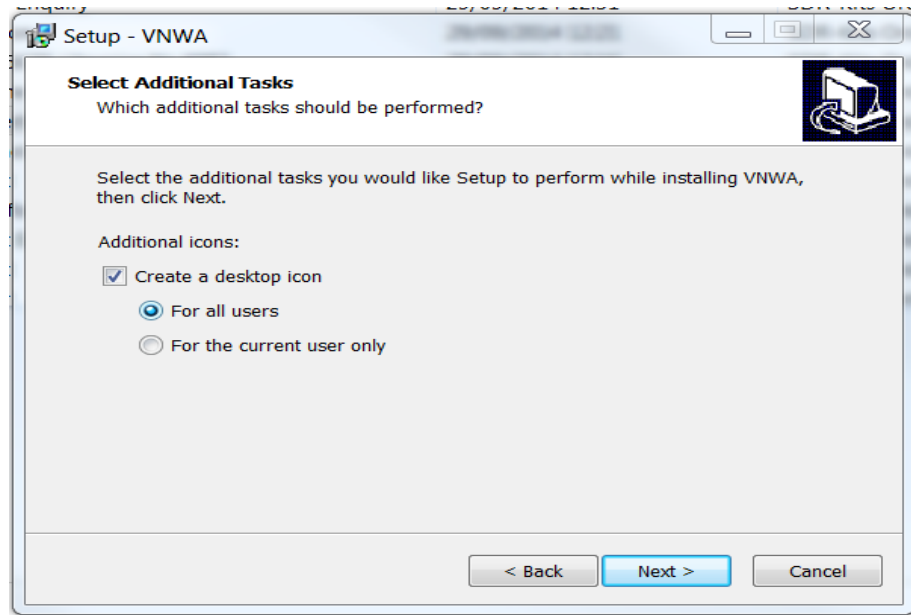
Note: Select a different Destination Location (ie C:\VNWA2) if you wish to install a second VNWA application on the same PC. This will prevent overwriting the setup files of your first VNWA application on the same PC.



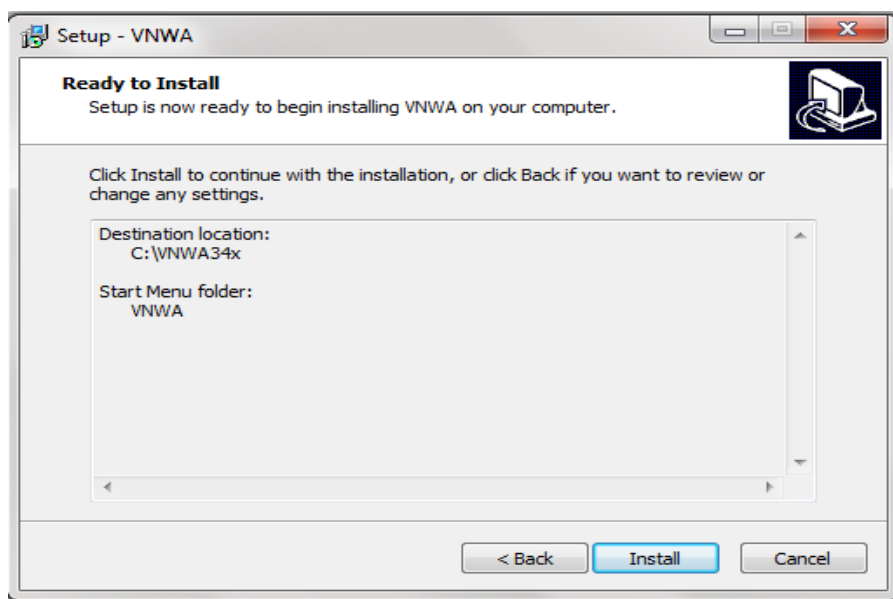
- 3.1.5 Press "Next >" – This shows the default where program **shortcuts** will be installed. Press "Next >" to continue



- 3.1.6 The screen below is now displayed to select the required additional tasks options required.

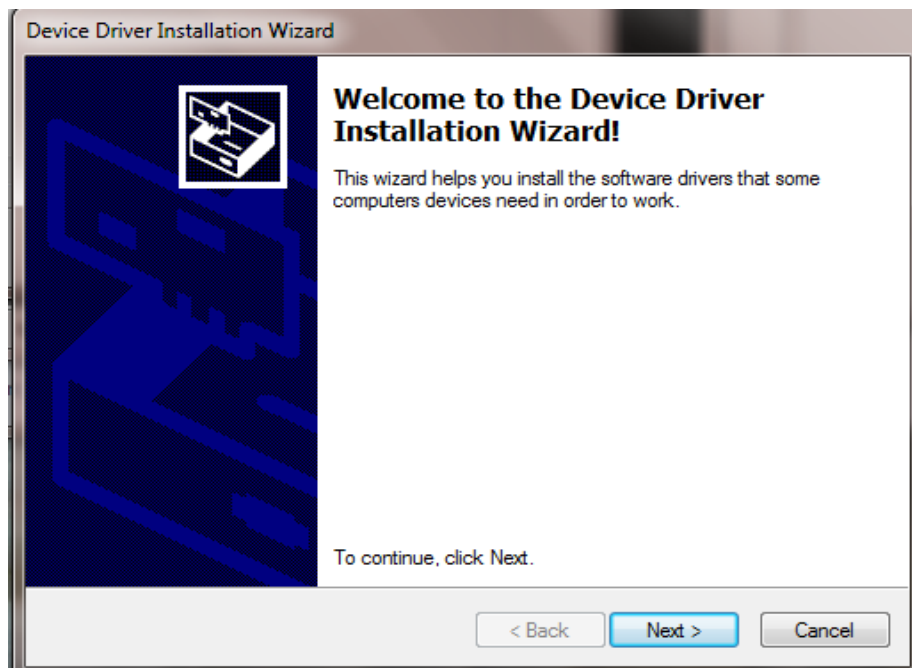


3.1.7 Press "**Next >**" and **Ready to Install** screen is displayed

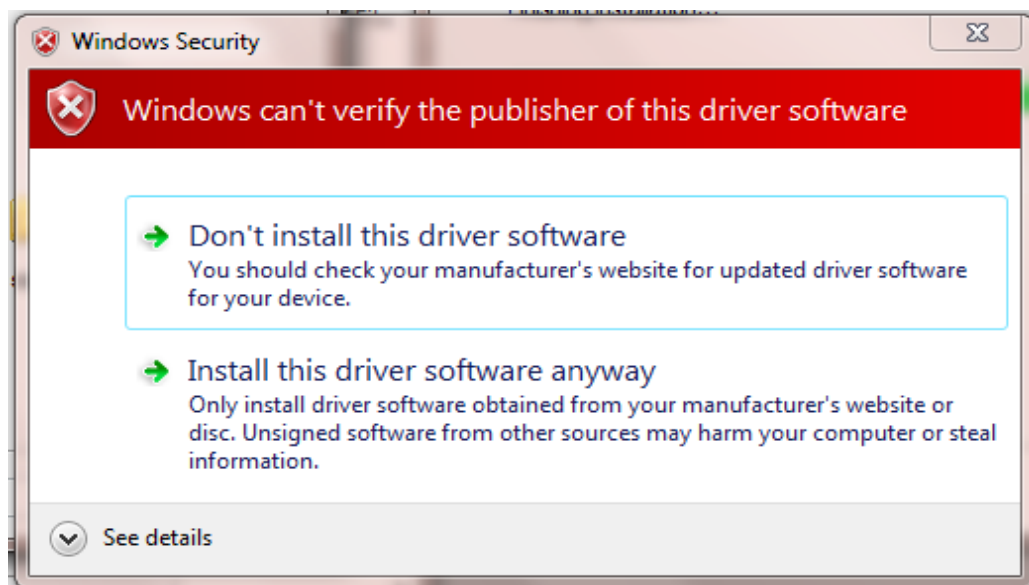


3.1.8 Press "**Install**" – VNWA Application and helpfile are now installed

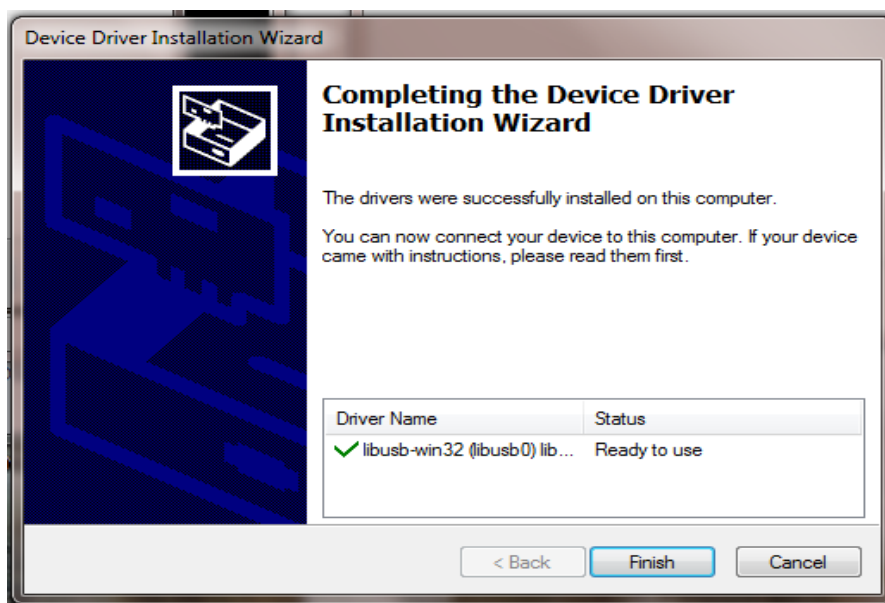
NOTE: At this point the Installer will automatically install the Digital signed **Amateur Radio Root Certificate** (ARC). This Certificate is an essential requirement for Windows 10, Windows 8.1 & 8 and Windows 7 64 bits. Please see Section **3.6** for information on the Amateur Radio Certificate installation.



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

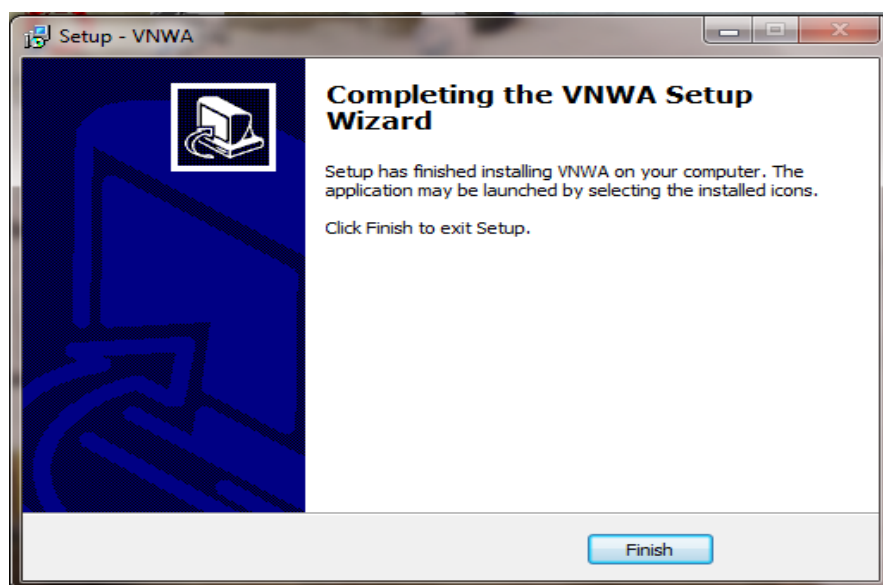


3.1.10 Press "Next >" – Driver installation will take from 10-30 seconds and screen below is displayed upon completion.



3.1.11 Press "**Finish**" – to complete the Driver Installation.

3.1.12 VNWA Setup is now complete - Press "**Finish**" to complete VNWA Installation.



END of VNWA Application and Driver Installation for Windows 7 & Vista

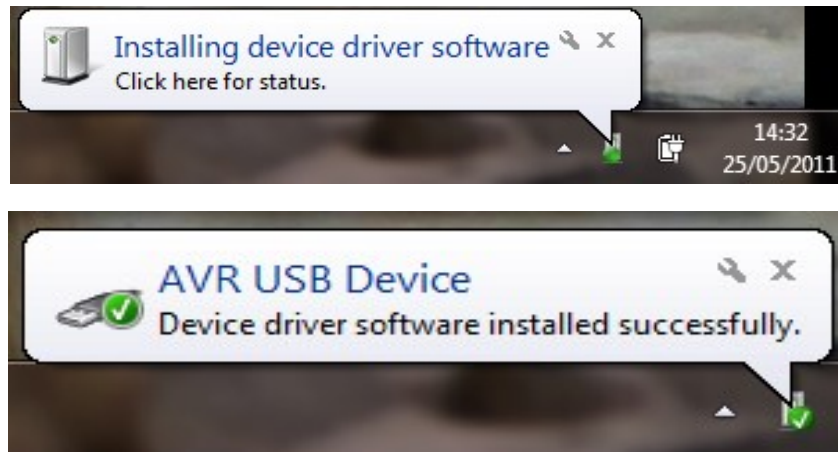
3.2 Windows 7 & Vista VNWA Application Configuration

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!

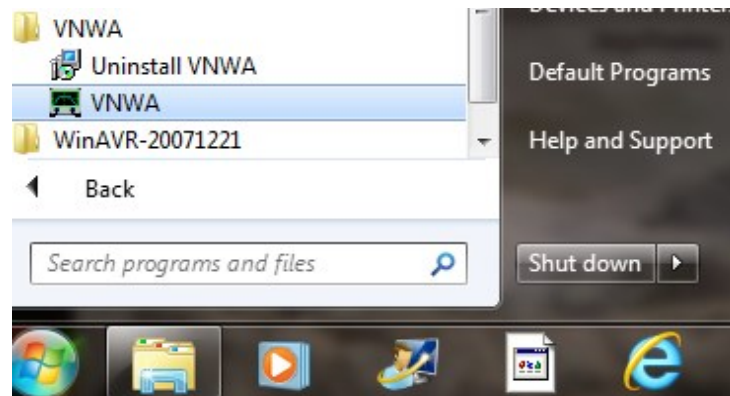
Plug in the VNWA USB cable into a USB Port of your Computer.

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.



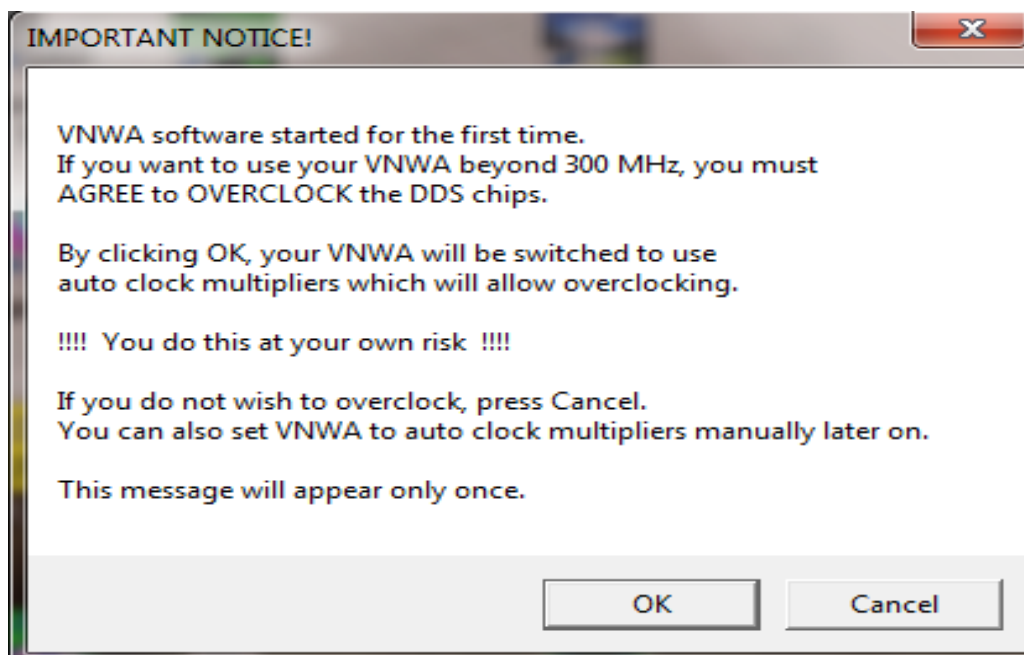
3.2.2 Depending on the options specified during the installation, start the VNWA application from the directory specified during Installation, use the Shortcut created on the Desktop or use the “Start” and “VNWA” launch button.



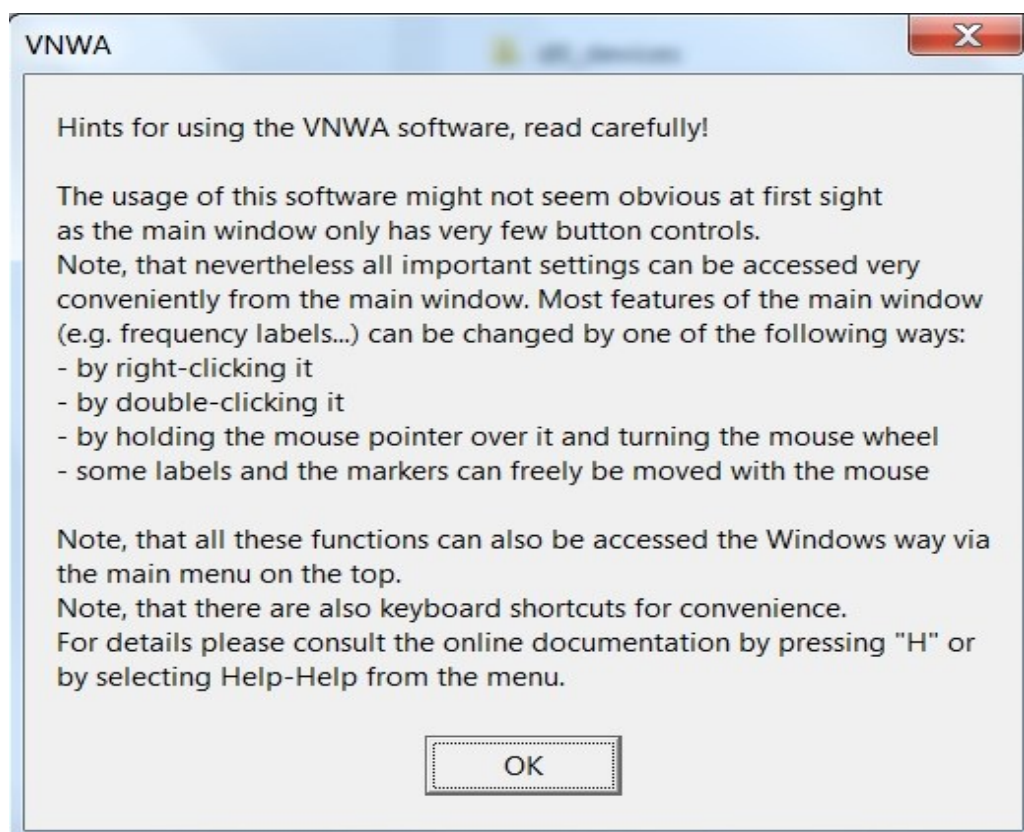
3.2.3 **Overclocking Warning may be displayed when you run VNWA Application software for the first time.**

Select "OK" to allow overclocking of the DDS chips beyond 400 MHz. (As on 15/1/2018 **no issues or damage** has been reported by overclocking the DDS chips during 8 years of use)

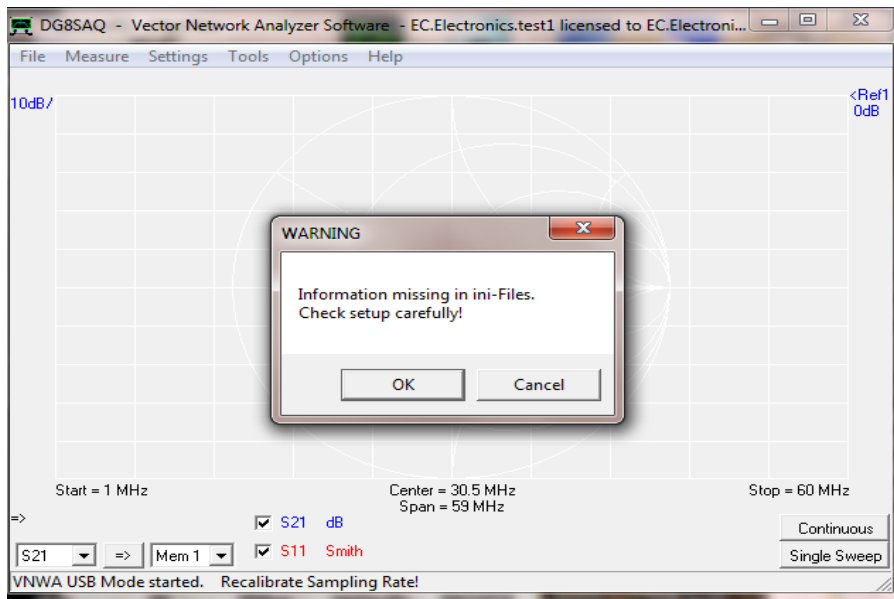
Note: VNWA performance over 500 MHz will be **adversely affected if overclocking of the DDS is not permitted.**



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

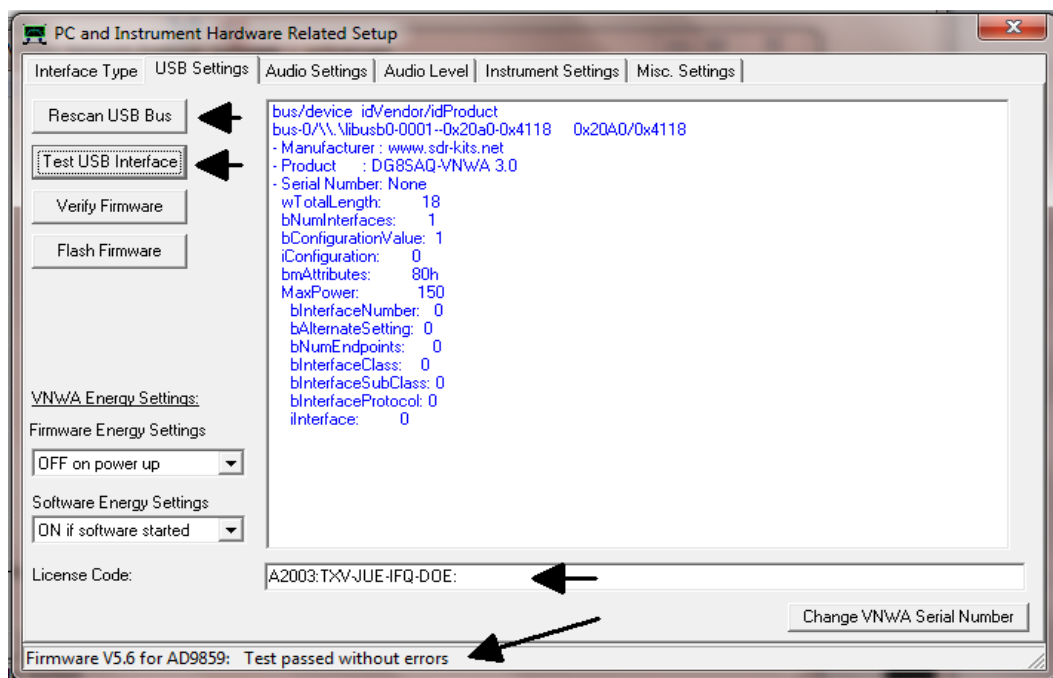


3.2.5 Press “**OK**” to continue. This will start the **VNWA** Application. Press “**OK**” again to enter VNWA auto-setup information.



- 3.2.6 The tab "USB Setting" should now be displayed. If not, click on “Options” select “Settings” A new screen appears, now select the tab “USB-Setting” and the screen below is displayed. Check whether VNWA license code is shown. If this information is missing then enter the **VNWA license code**. 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.

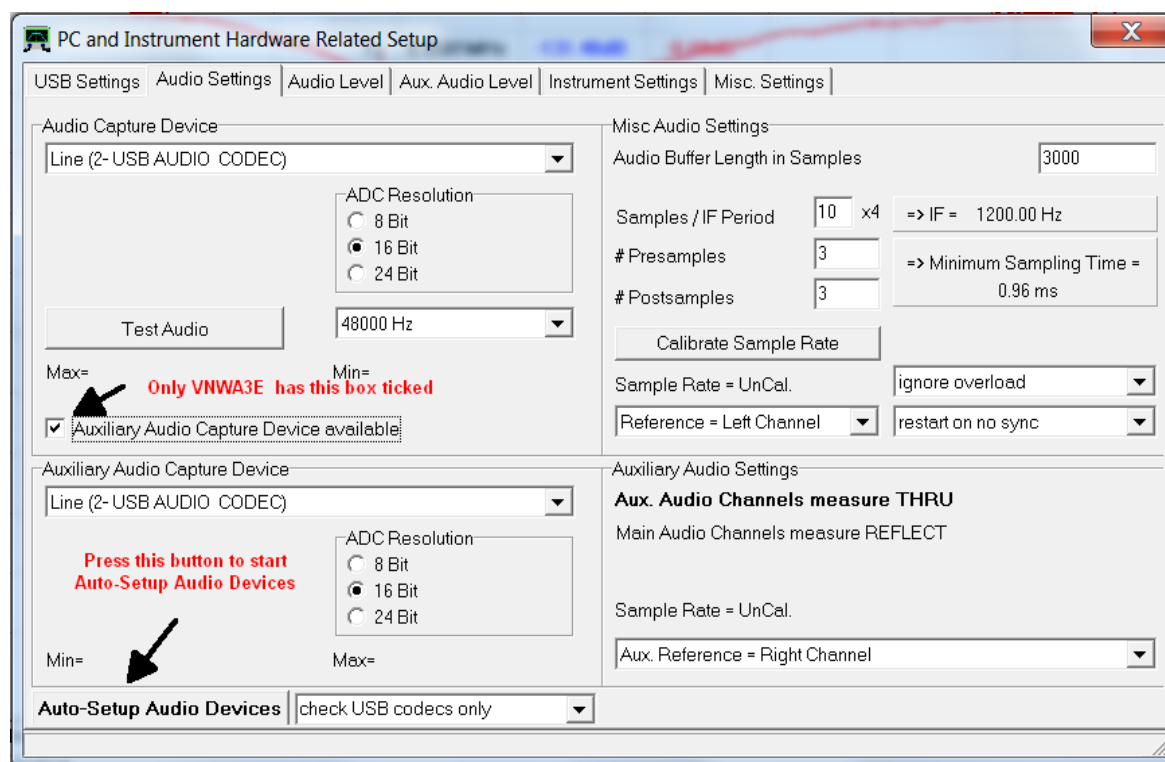


- 3.2.7 Press the Tab “Audio Settings” to display the screen below.

From Release 36.3.0 onwards, the VNWA application has a new functionality for **Auto-detection and Auto- setup of Audio devices**.

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.

To start this procedure **manually** press the Button “**Auto-Setup Audio Devices**”

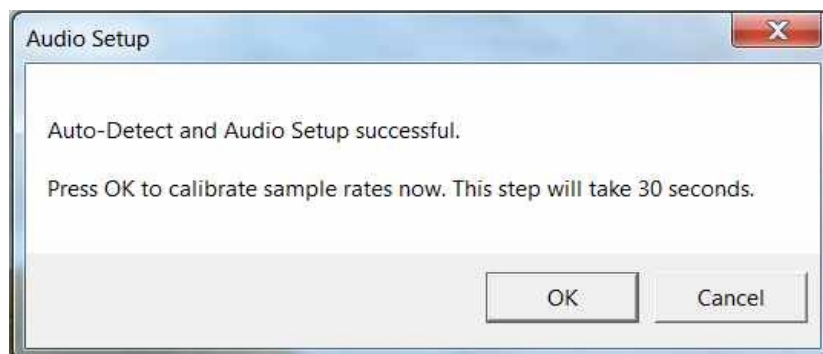


Note: The above screen shows the previous older setting for an IF Bandwidth setting of 1.2 kHz.

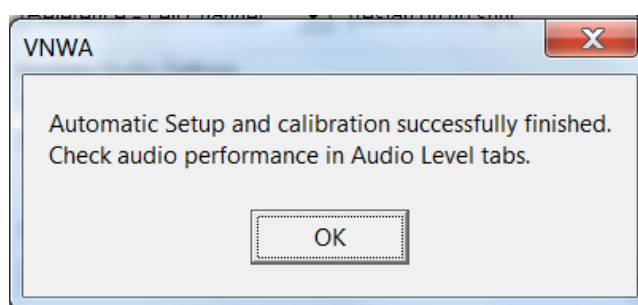
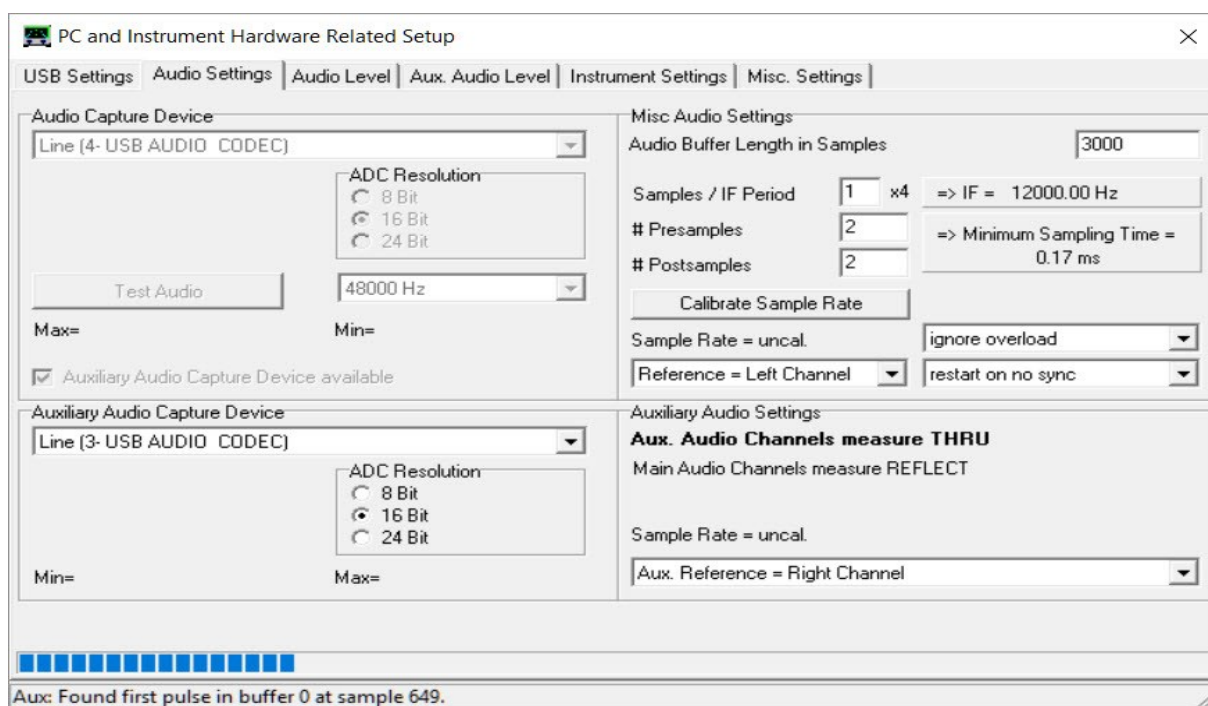
- 3.2.8 Make sure that **nothing (no cables or connectors)** are connected to VNWA RF Ports - Press “**OK**” to start the Audio Auto-detection -



- 3.2.9 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.

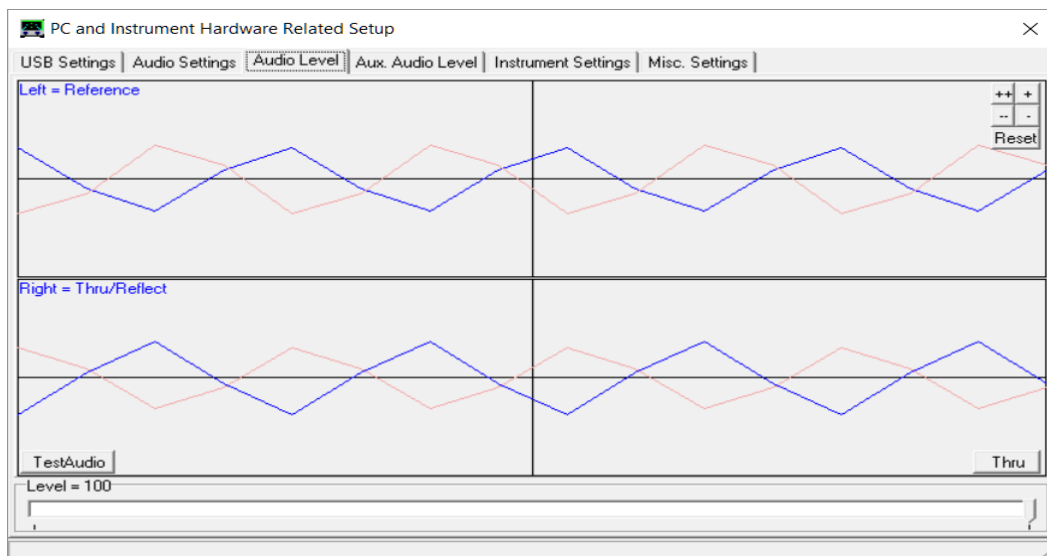


- 3.2.10 Press **“OK”** to calibrate the Audio device sampling rate. Calibration of Sample rate takes approx 30 seconds.
Note: The screen below shows the later **default** settings for an **IF Bandwidth** of 12 kHz

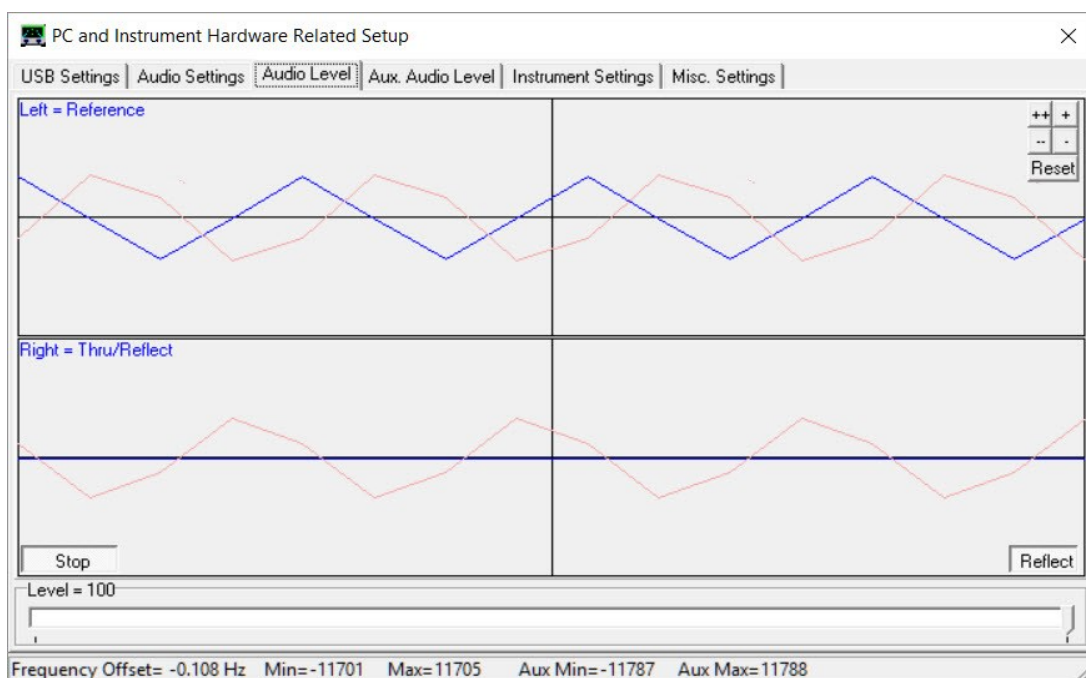


3.2.11 Next the Audio Level Screen is displayed. Select **“Reflect”** (bottom RH softbutton) and two sine-waves should be displayed. Top = Left = Reference and Right = Reflect

From 36.7.2 VNWA application, triangular waves will be shown with the default 12 kHz IF BW setting as shown below. Changing the IF to 1.2 kHz will show sine-waves instead of triangular wave below.



3.2.12 Next connect the TX port to the RX Port with a short Coax cable. The 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).



- 3.2.13 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 Triangular wave (RX port is receiving TX output via Thru coax cable).
- 3.2.14 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 setup of Auto-detection and Auto-set-up of Audio devices.

Troubleshooting: Auto-detection and Auto-set-up of Audio devices

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)

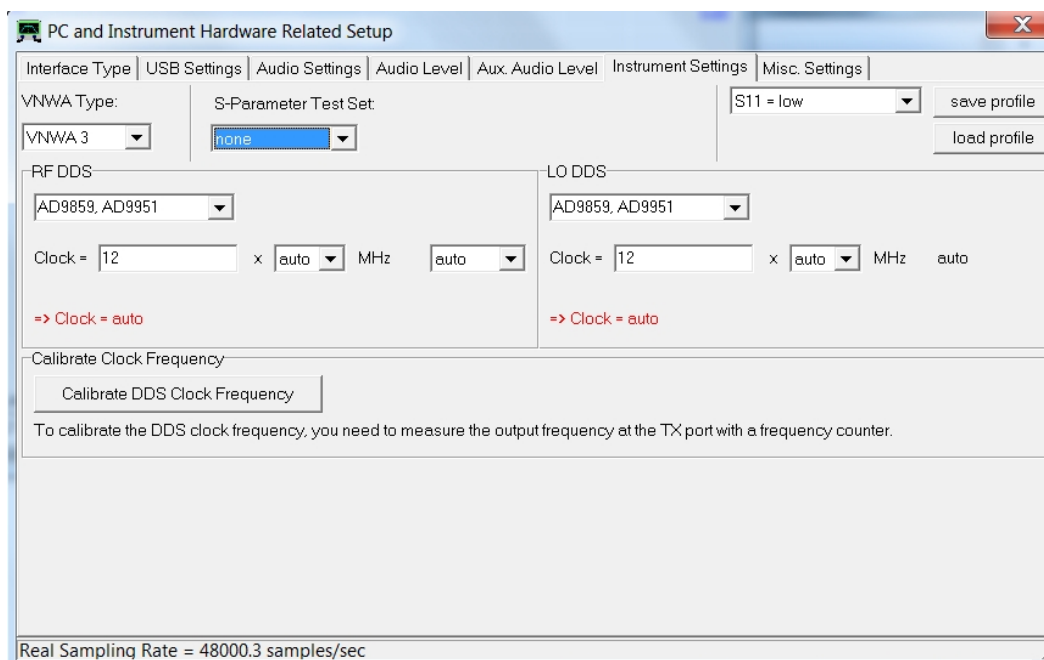
Notes: Audio Capture Devices may either be shown as “**Line**” or “**Microphone**” depending on type of USB-Codec chip fitted.

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.

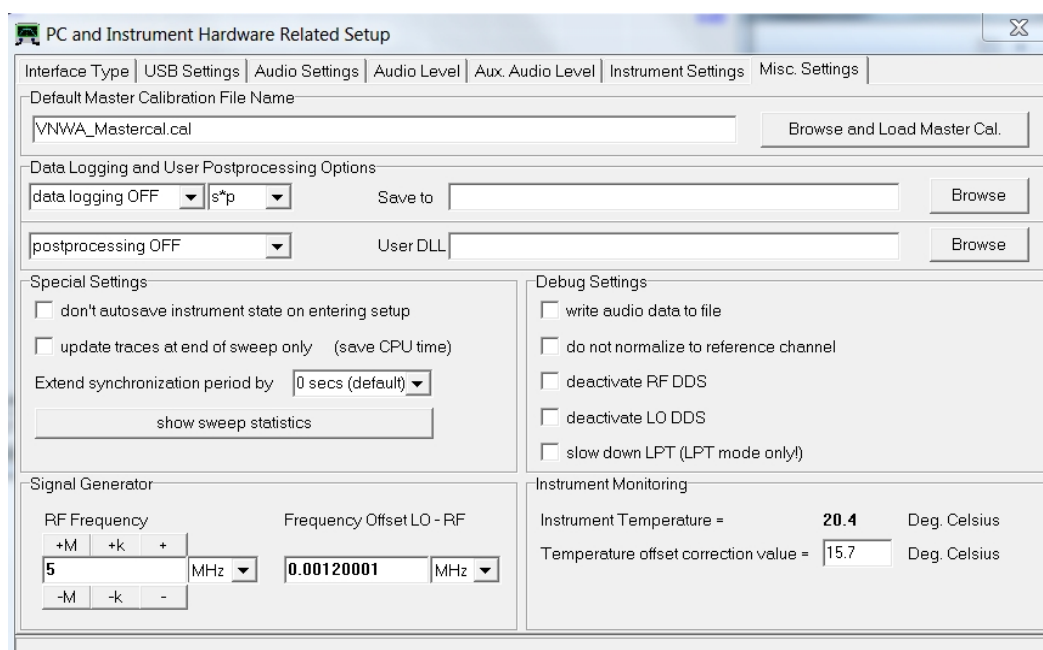
Windows 7 configures a VNWA USB Audio Capture Device by default either as a “**Microphone**” or as a “**Line**” depending on the type of USB Codec chip fitted. If the USB Codec is shown as “**Microphone**” Windows 7 will configure this as a **Mono** input with input levels set **too high** as shown below. 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 – **The correct sample rate is: 2 - channels Stereo 48000 Hz (DVD Quality)**

3.2.15 Stop the Audio test by selecting Tab “**Audio Level**” (fig 3.2.13) and click on soft-button “**Stop**“. Next click on Tab “**Instrument Settings**“. The screen below shows usual settings for normal operation.



3.2.16 Click on Tab “**Misc Settings**“. The screen below shows usual settings for normal operation. You can close this the Setup file by clicking the top right-hand button.



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.

3.2.18 VNWA Helpfile Configuration for Windows 7 and Windows Vista

Refer to **Chapter 3.5** for more information on enabling the VNWA Helpfile viewer.

End of VNWA Configuration for Windows 7 and Vista

3.3 Windows 10 & Windows 8.1 & 8 Installation

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

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. A minimum of **50 MByte** of **free disk space** is required for installation. Please email: Support@SDR-Kits.net to report any errors or improvements to this document.

Windows 10, Windows 8.1 & 8 Installation

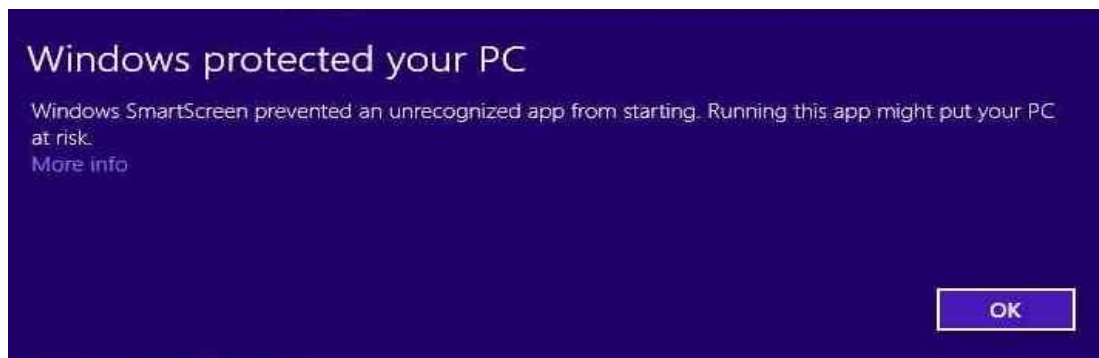
This section shows installation procedure for Windows **8.1** (Home – Professional or Enterprise) Windows 10 installation is essentially similar.

- 3.3.1 Download and save the VNWA Installation Package from the following location to your desktop or download folder:

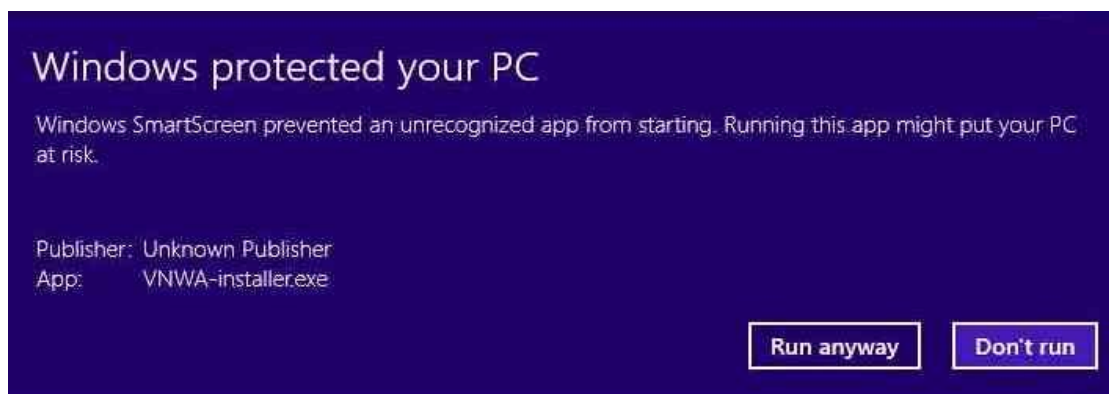
<http://www.sdr-kits.net/DG8SAQ/vnwaupdate.php?path=installer&source=Sdr-kits>

- 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.

If the VNWA installer is run for the first time the following warning is shown.
Press **“More info”**

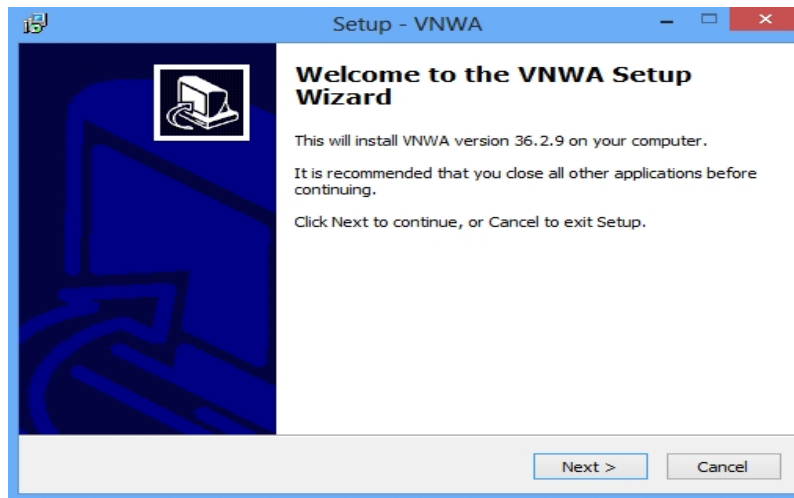


- 3.3.3 Screen below with details may now be displayed, press **“Run anyway”** to proceed with the VNWA software installation

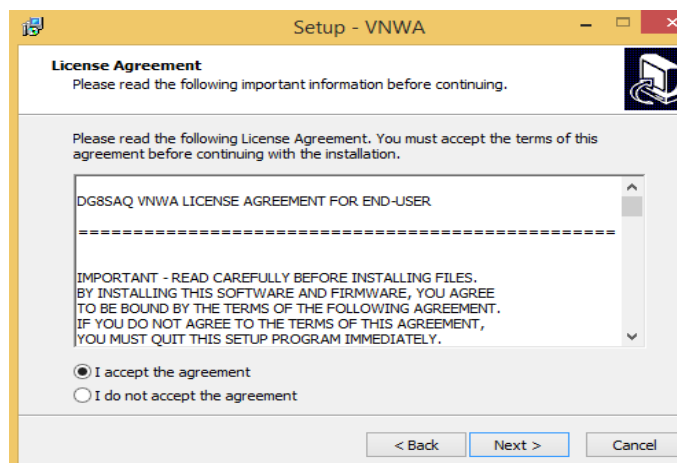


- 3.3.4 **Windows - User Account Control (UAC) Screen** may be shown:
Do you want to allow the following program to make changes to the Computer?
Program name: *VNWA Setup* Verified Publisher: *dg8saq* Press **“Yes”** to continue

- 3.3.5 **Welcome to VNWA Setup Wizard** is now displayed. Press “**Next>**” to continue!
Note: that the VNWA version number will be **different** from the one displayed because the VNWA.installer will always install the **current** General Release Software version!

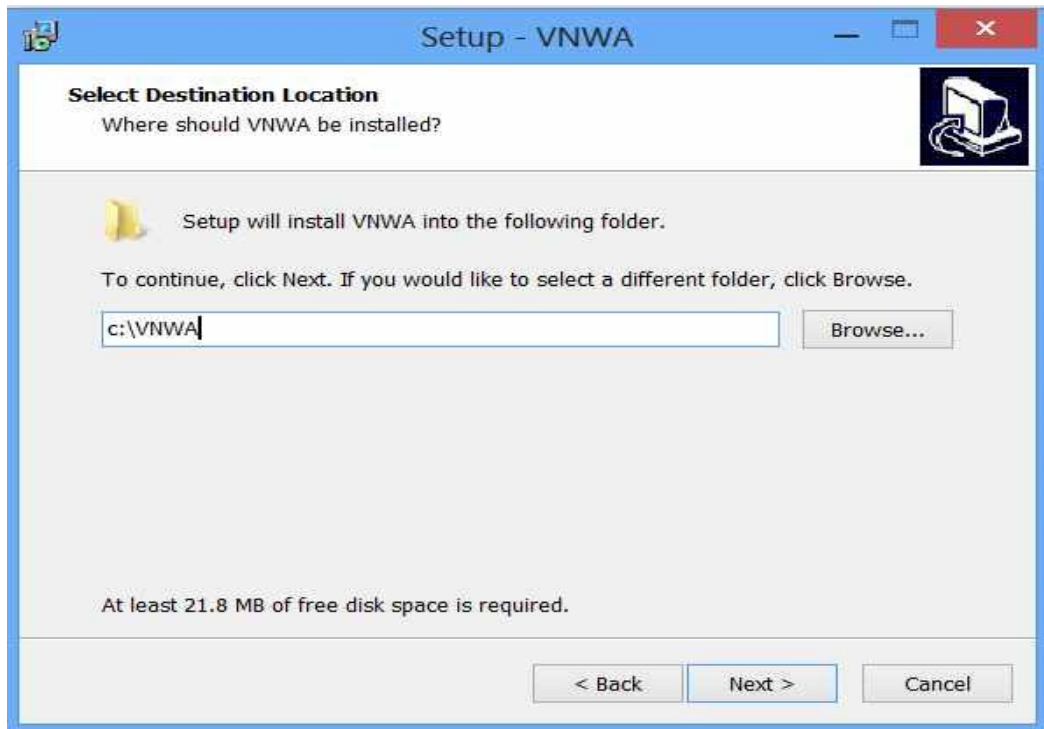


- 3.3.6 Welcome to VNWA Setup Wizard (shown in 3.3.5) is shown. Press “**Next>**” to continue
Note: that the VNWA version number will be different from the one displayed because the VNWA.installer will always install the **current** General Release Software version!
- 3.3.7 Press “**Next >**” – the VNWA License Agreement will be shown: ***Please read and tick the correct box.*** **Note:** the VNWA Application is **only licensed** for VNWA hardware supplied by **SDR-Kits and our authorized Resellers.**

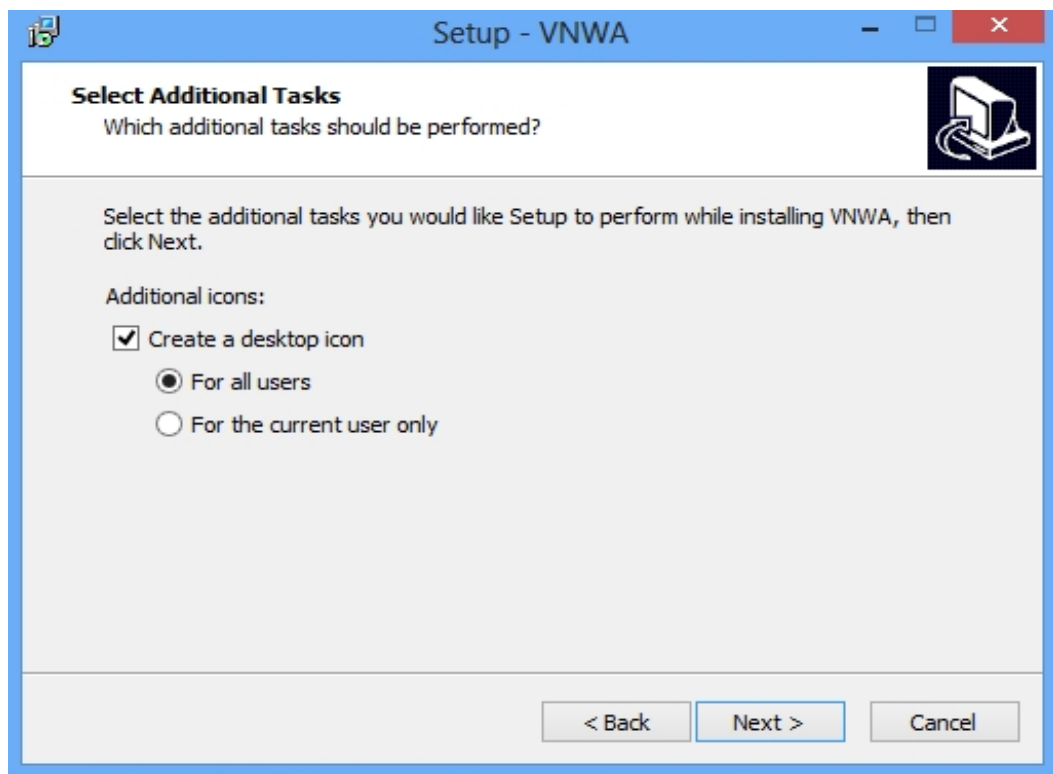


Press “**Next >**” The default location where VNWA will be installed will be shown:

- Note:** Select a different Destination Location (ie C:\VNWA2) 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:



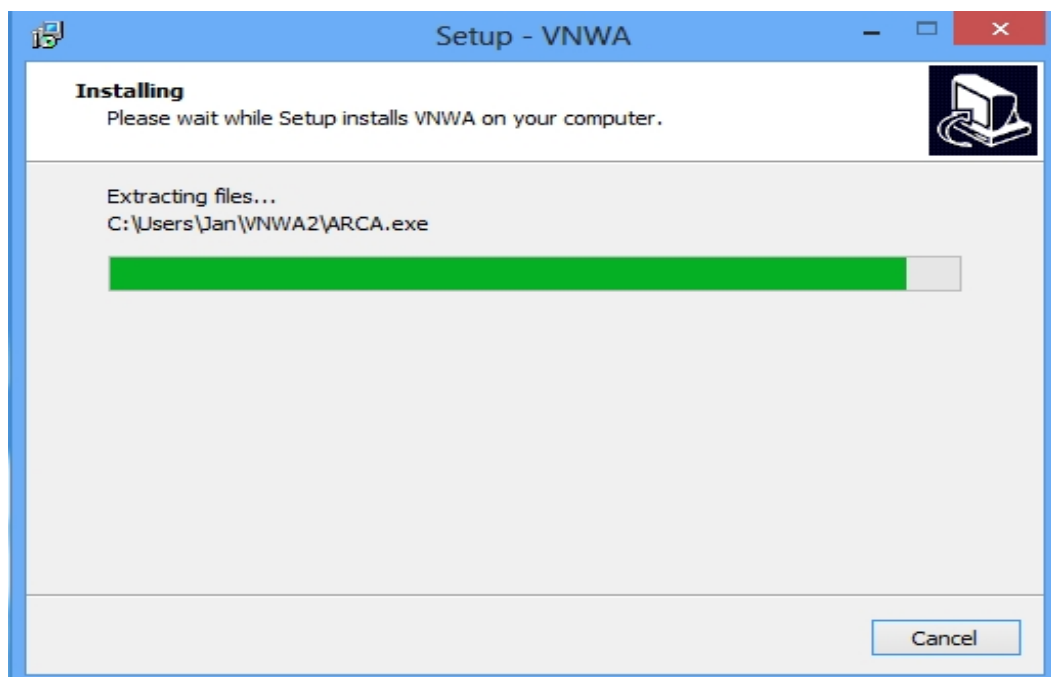
- 3.3.8 Press "**Next >**" – This shows the default where program shortcuts will be installed
A Screen is now displayed with option to create a Desktop Icon for:
a) For All users or b) For Current User only. Make your selection and press "**Next >**"



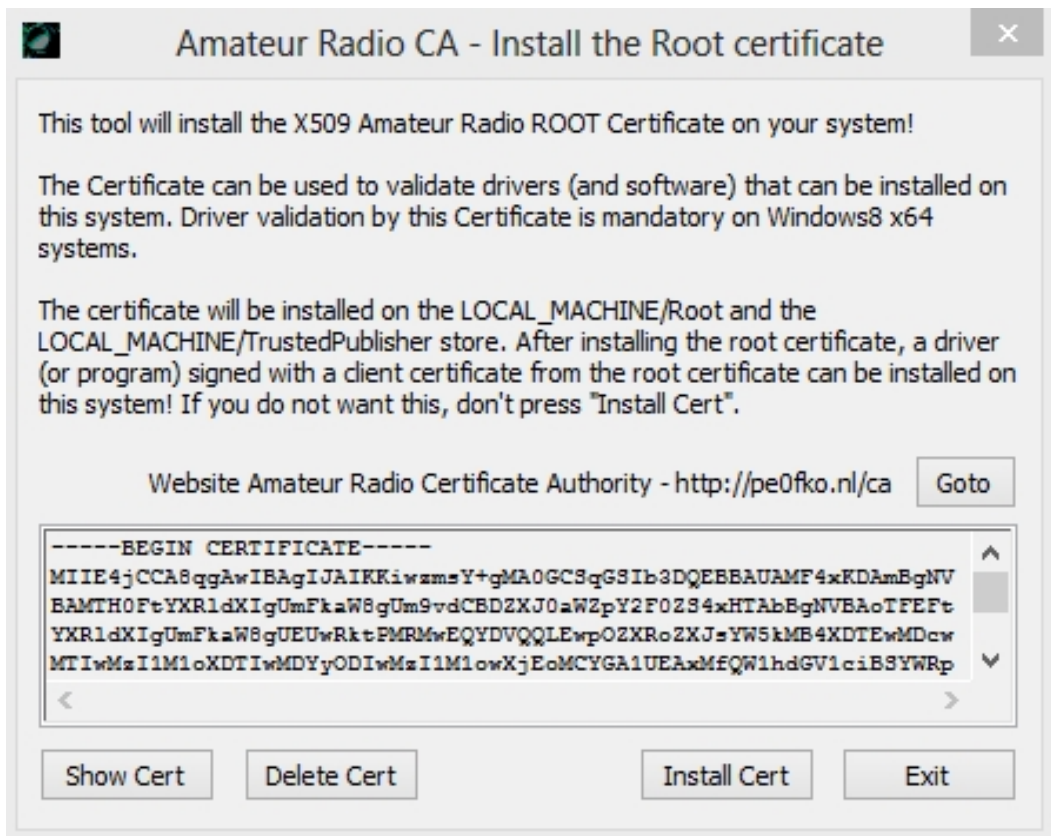
3.3.9 Press "**Next >**" and **Ready to Install** screen is displayed



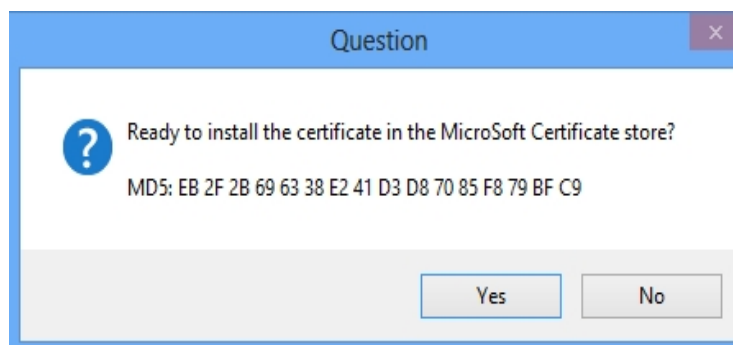
3.3.10 Press "**Install**" – VNWA Application and helpfile are now installed



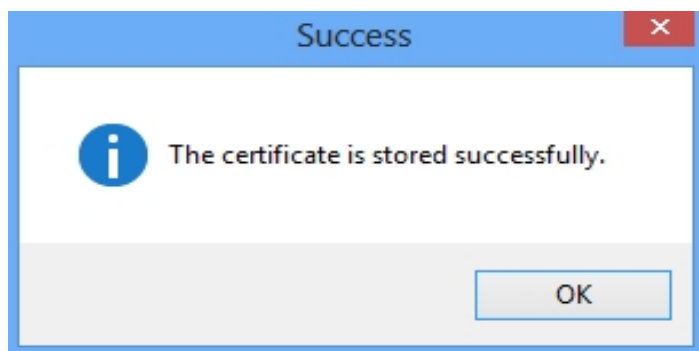
3.3.11 Next Installer will automatically install the Digital signed **Amateur Radio Root Certificate** (ARC). This Certificate is an essential requirement for Windows 10 & 8.1 Operating Systems.



3.3.12 Press **"Install Cert"** and the following Screen will be displayed



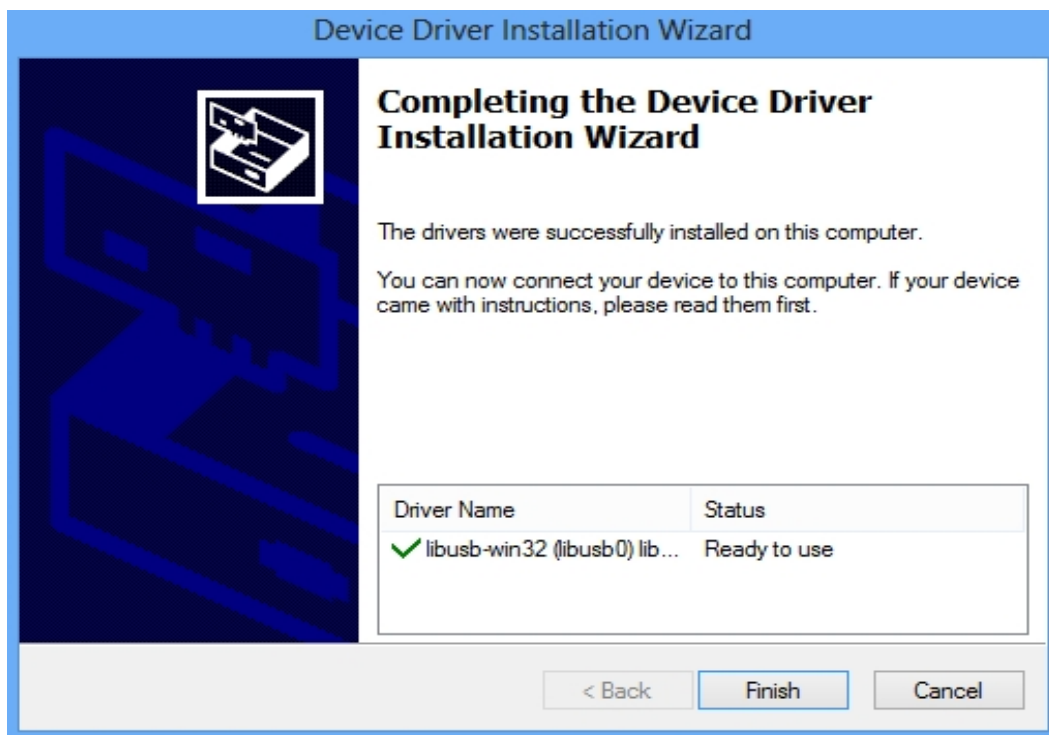
3.3.13 Press **"Yes"** and ARC installation should complete with screen below
Press **"OK"**, and **"Exit"** to continue



3.3.14 “Welcome To Device Driver Installation Wizard” is now shown.



3.3.15 Press "Next >" – Driver installation will take from 10-30 seconds and the screen below is shown. Once Status “Ready to use” is shown press “Finish” to complete Driver installation.



3.3.16 VNWA installation is now complete,
Return to the **Setup VNWA** screen and Press “Finish” to exit the Setup.



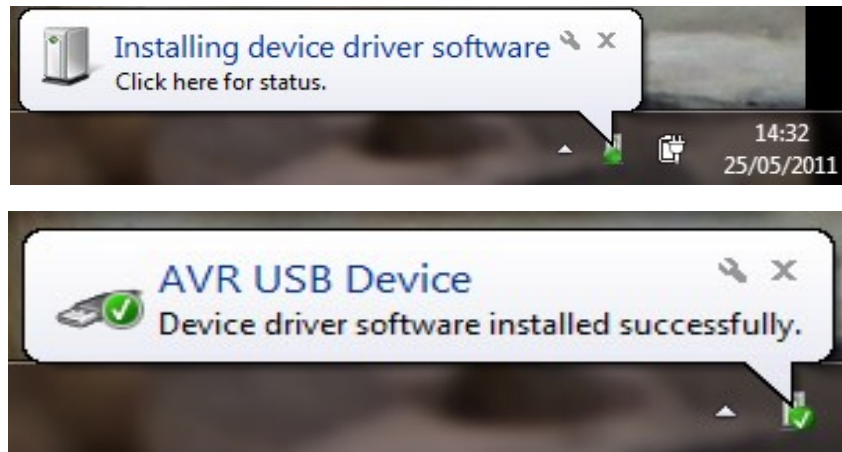
END of Windows 10 or Windows 8 or 8.1 VNWA Application & Driver Installation

3.4 Windows 10 & Windows 8, 8.1 VNWA Application Configuration

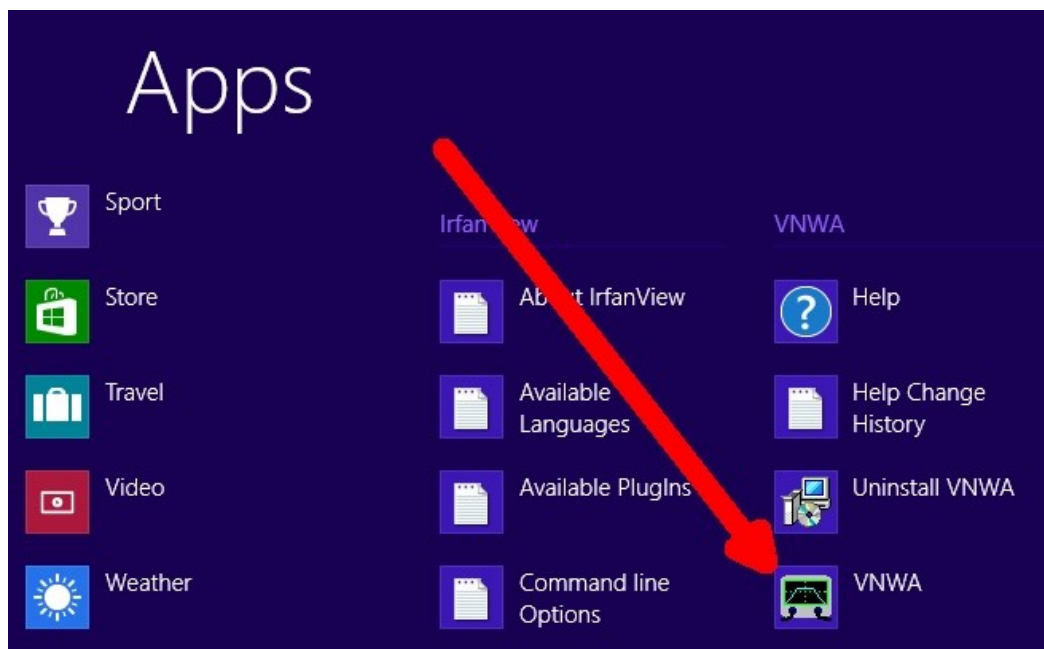
3.4.1 Plug in the VNWA USB cable into a USB Port of your Computer.

Note: It is recommended to connect the VNWA **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.



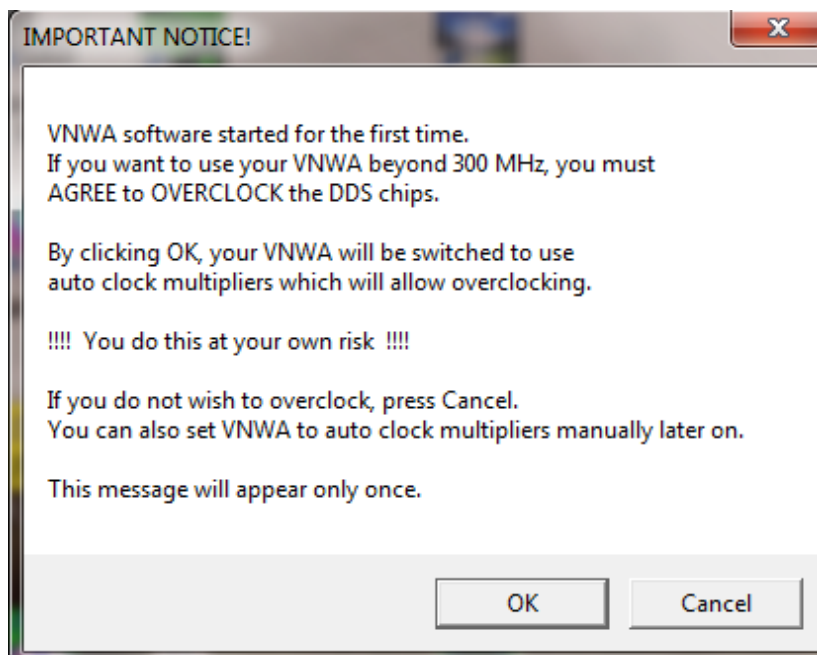
3.4.2 Depending on the options specified during the installation, start the VNWA application in the Windows 10 or 8 “Apps”, or click on the VNWA Shortcut Icon created on the Desktop.



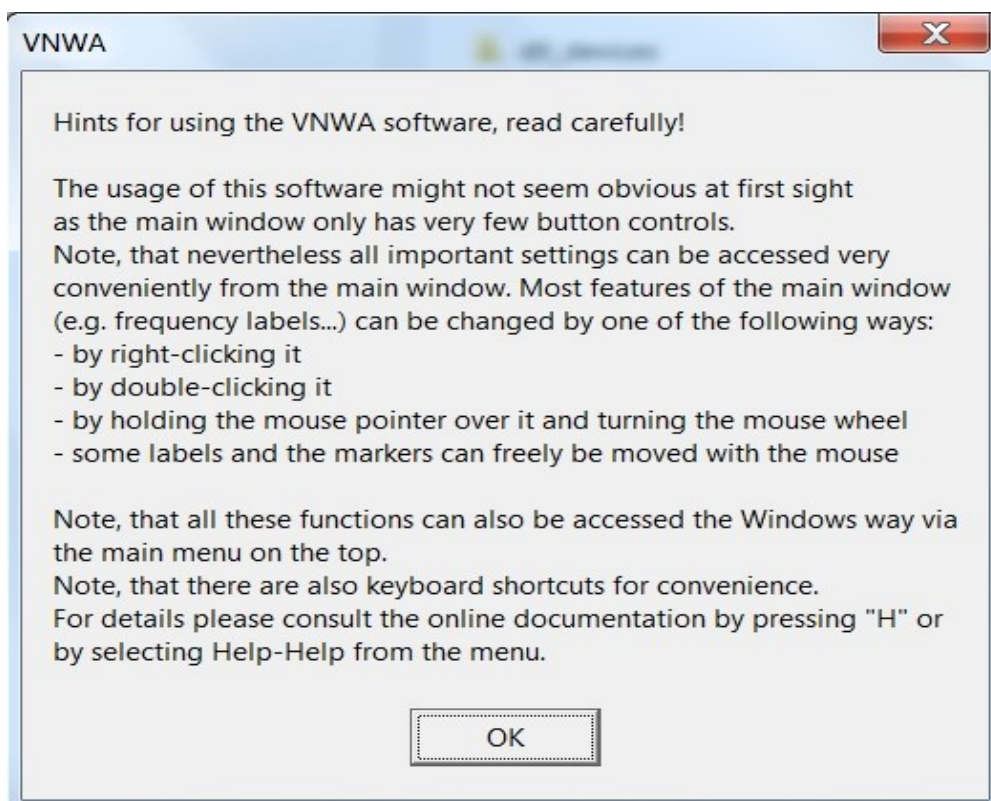
3.4.3 **Overclocking Warning** will be displayed when you run VNWA Application software for the first time.

Select "**OK**" to allow overclocking of the DDS chips beyond 400 MHz. (As on 15/1/2018 no issues or damage has been reported by overclocking the DDS chips in more than 8 years of use)

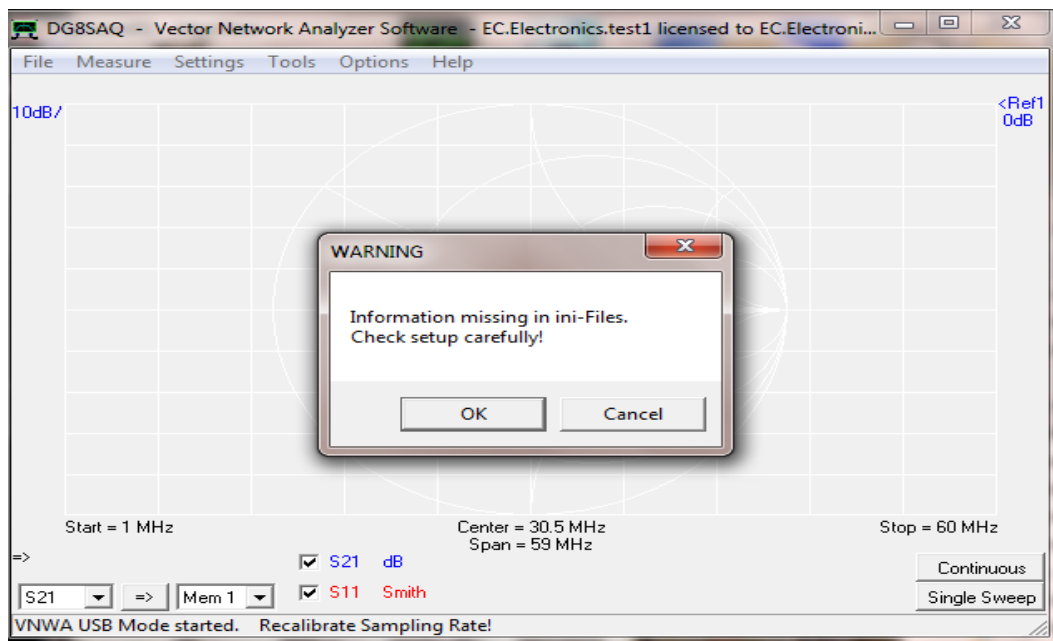
Note: VNWA performance over 500 MHz will be **adversely** affected if overclocking of the DDS is **not permitted**.



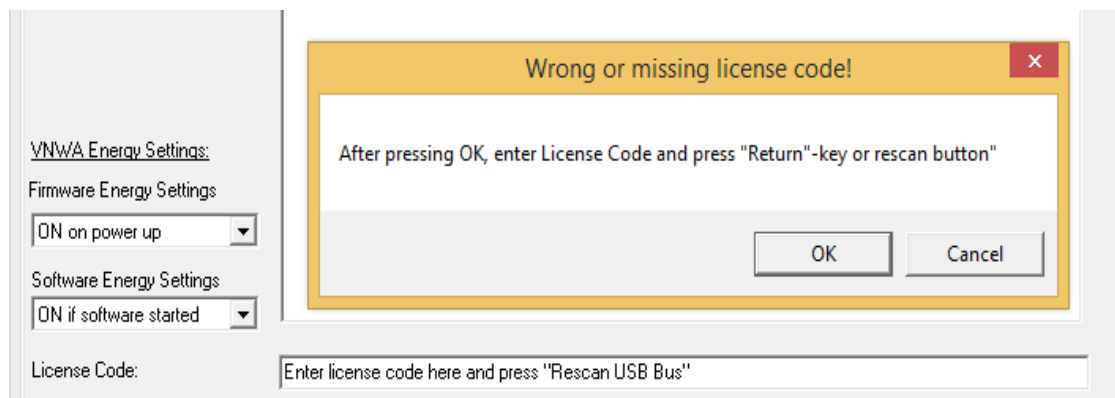
- 3.4.4 The VNWA “**Hint File**” is now displayed. Please review this information carefully! Whilst the look of the VNWA screen is “uncluttered” note however that all functions are available from the screen!. Time spent reading the Hint screen pays **BIG DIVIDENDS** later



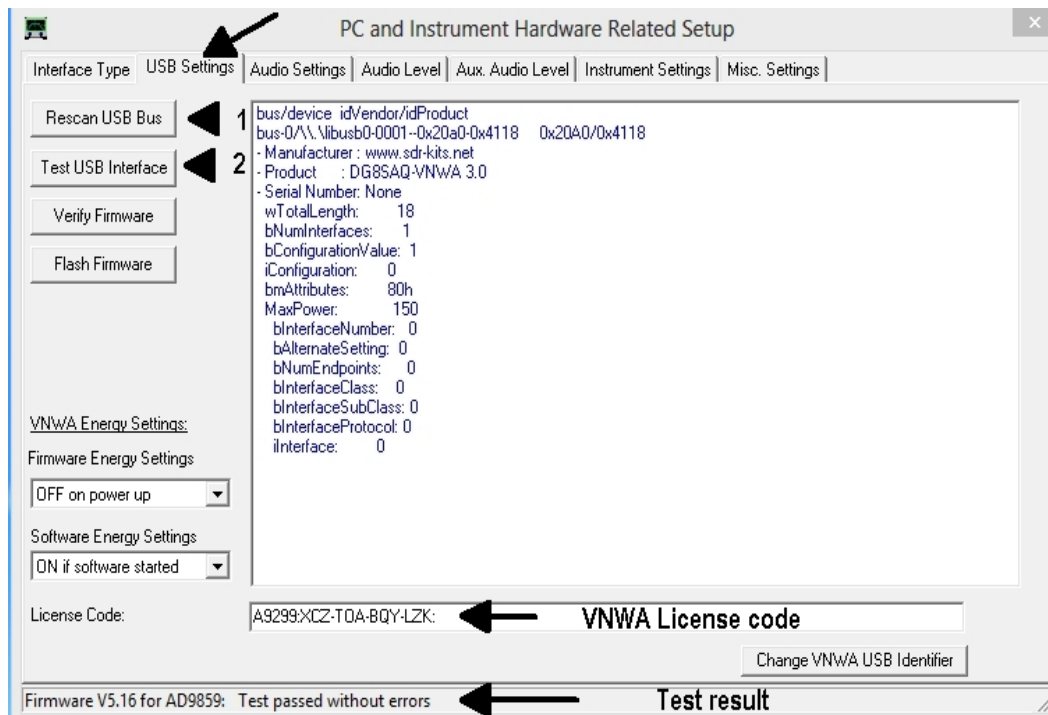
- 3.4.5 Press “OK” to continue and start the VNWA Application. Press “OK” again to enter VNWA setup information.



- 3.4.6 The tab "USB Setting" should now displayed. If not click on the tab “USB-Setting”
If this is the first VNWA setup the following screen is shown. Press “Ok” and enter the VMWA License code. (The VNWA License code is found on Page 2 of the “Getting Started Manual” shipped with the VNWA, or in the VNWA_Dispatched email with shipping information)



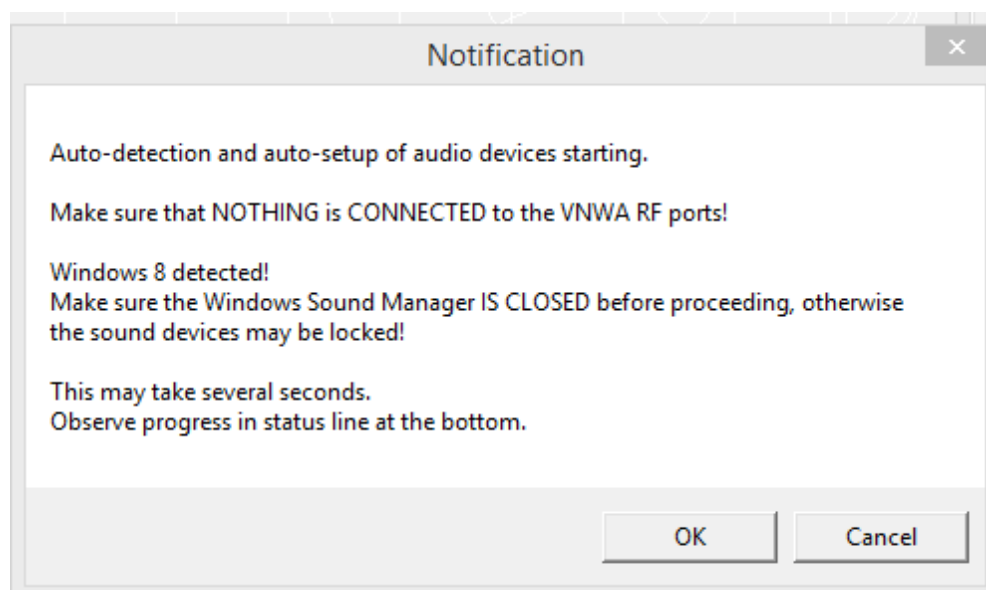
- 3.4.7 Check whether correct **VNWA license code** is shown, If this information is missing or incorrect then enter the VNWA license code. Now press “Rescan USB Bus” and “Test USB Interface” Check bottom line for message “Test passed without errors”



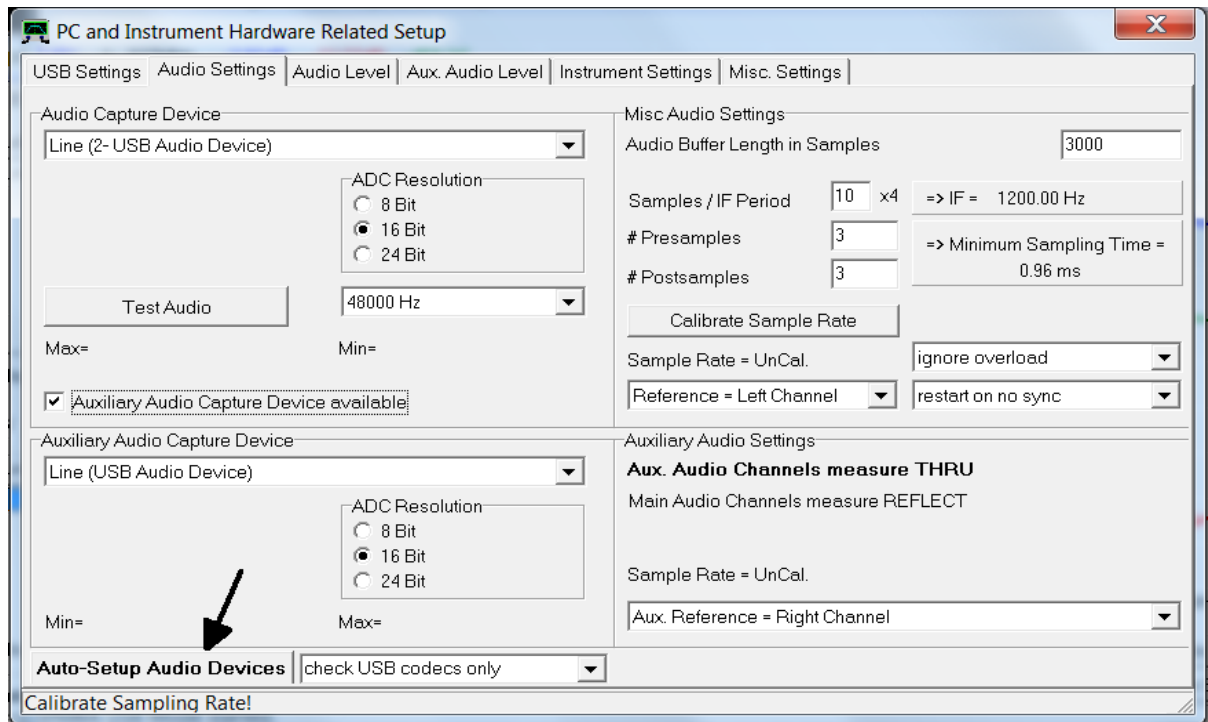
3.4.8 From Release 36.3.0 onwards, the VNWA application performs an **Auto-detection and Auto-setup of Audio devices** instead of the Manual setup which was previously required. The Auto-detection and Auto-setup procedure is executed when the VNWA application is started up for the first time – or whenever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

Make sure that Nothing is connected to VNWA RF Ports – and Windows sound manager is closed

Press **“OK”** to start the Audio Auto-detection -



Note: Click on tab “**Audio Settings**” if Audio detection is not started automatically.
Press button Auto “**Auto-Setup Audio Devices**” to start auto detection.



Note: The above screen shows the previous older setting for an IF Bandwidth setting of **1.2 kHz**.

3.4.9 Auto-detection and Auto-set-up steps through from phase 1 to 8.

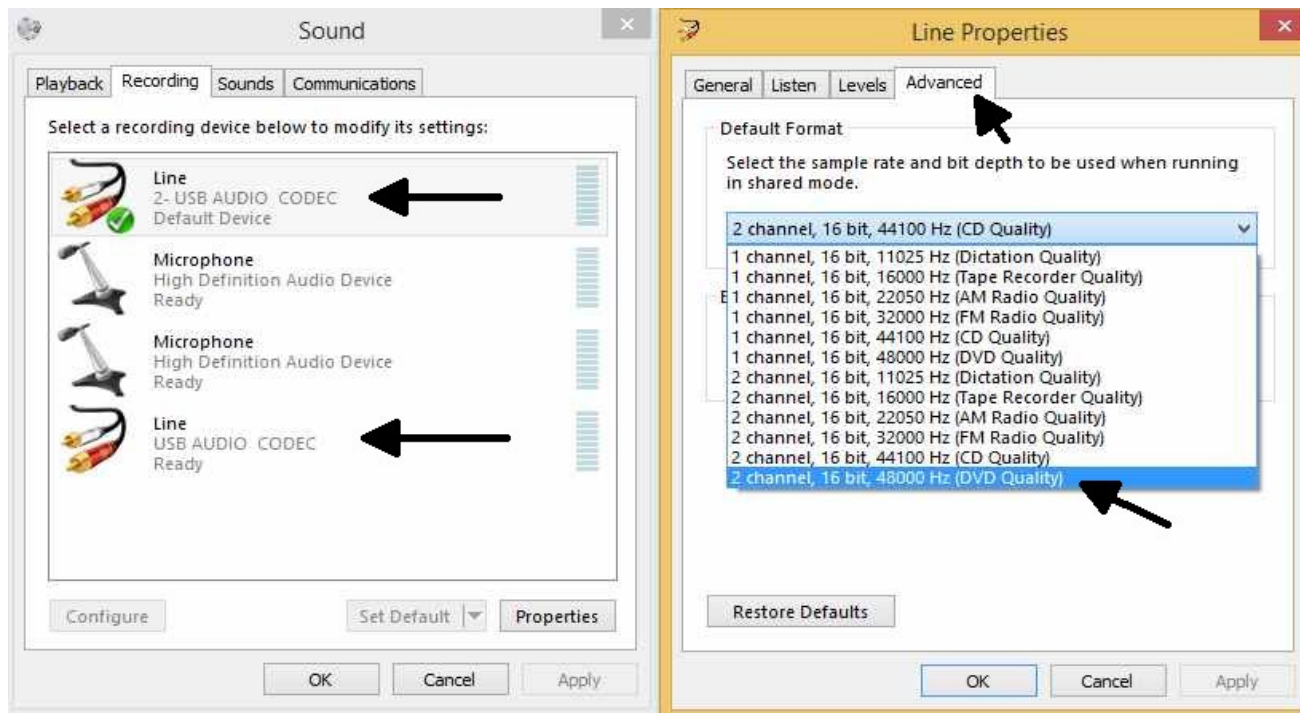
A **Wrong Sound Device settings** screen may be displayed with information how to correct the settings



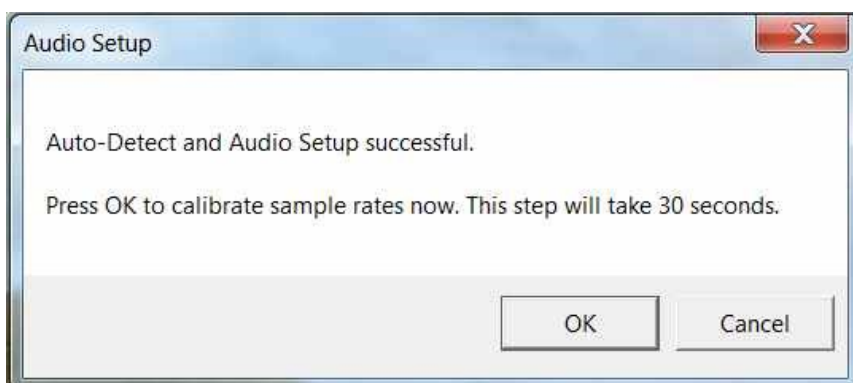
3.4.10 To correct Sound Device Configuration, click on the **USB Audio Codec** and Properties will be displayed. Select the **Advanced** Tab and set the sample and bit rate to **2 channel 16 bit 48000 Hz (DVD Quality)**. Press “Apply” and “Ok”.

3.4.11 This step is only required for VNWA 3E (VNWA with expansion board):

Select the **second USB Audio Codec** (shown below) and configure also to **2 channel 16 Bit 48000 Hz**



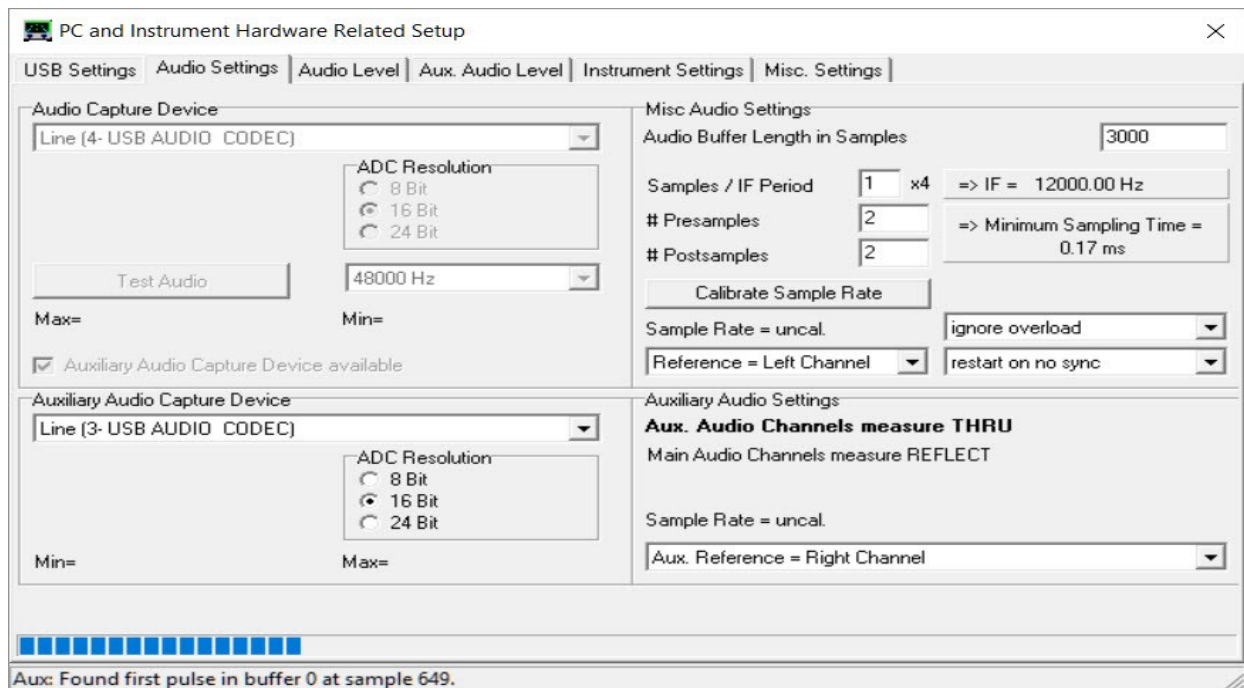
3.4.12 Press button Auto “**Auto-Setup Audio Devices**” (fig 3.4.8) to start auto detection again. Now the screen below is displayed once the process is completed successfully. Press “**OK**” to proceed to calibrate the Audio device sampling rate.



3.4.13 Calibration of Sample rate takes approx 30 seconds. A confirmation window appears to confirm that Automatic Setup and calibration is finished. Press “Ok” to proceed.

Note: If calibration fails, then exit and restart the **VNWA Application** and perform step 3.4.11 again.

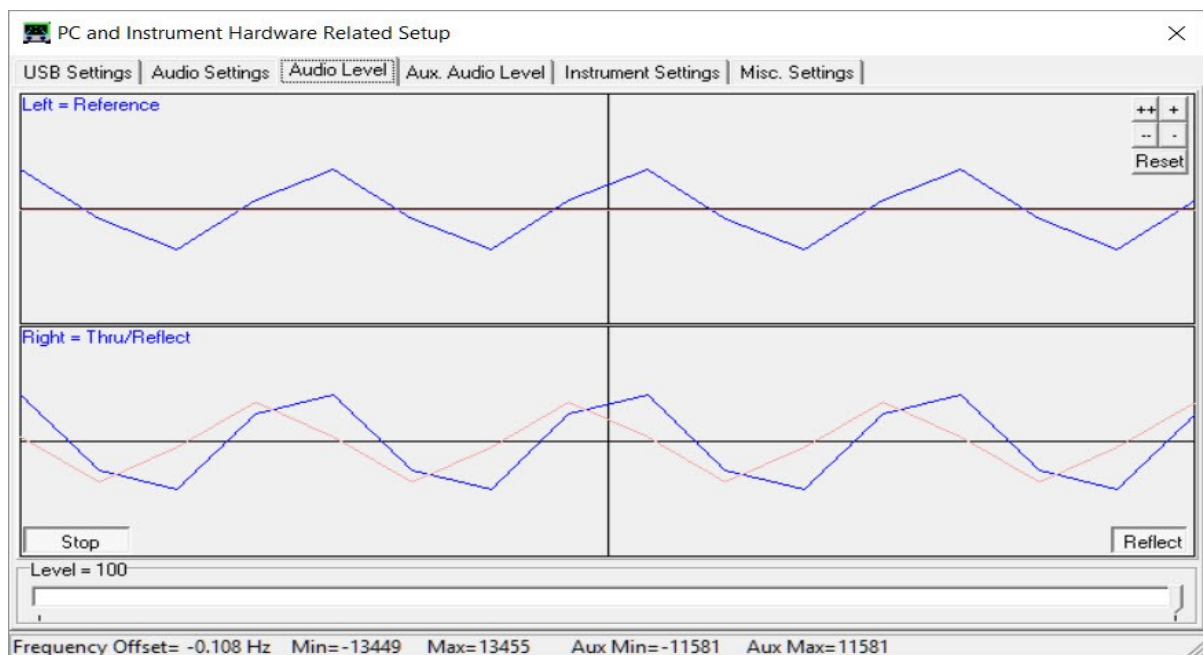
Note: The screen below shows the new default settings for an **IF Bandwidth** of **12 kHz**



3.4.14 Next the **Audio Level** Screen is displayed. Select “Reflect” (bottom RH softbutton) and two waves should be displayed. Top = **Left = Reference** and Bottom = **Right = Thru/Reflect**

Note: If **Audio Level** screen is not shown press **Tab “Audio Level”** to manually select this screen and press “**Test Audio**” to start Audio Test.

From 36.7.2 VNWA application triangular waves will be shown with the default 12 kHz IF BW setting as shown below. Changing the IF to 1.2 kHz will show sine-waves instead of triangular wave below



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



3.4.16 This step is **only for VNWA 3** (Expansion PCB not fitted) –
Select “**Thru**” (by pressing **Reflect** Softbutton in bottom RH corner in fig 3.4.10) and
Right = Thru/Reflect should now display a waveform (RX port is receiving TX output via Thru coax cable).

3.4.17 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)

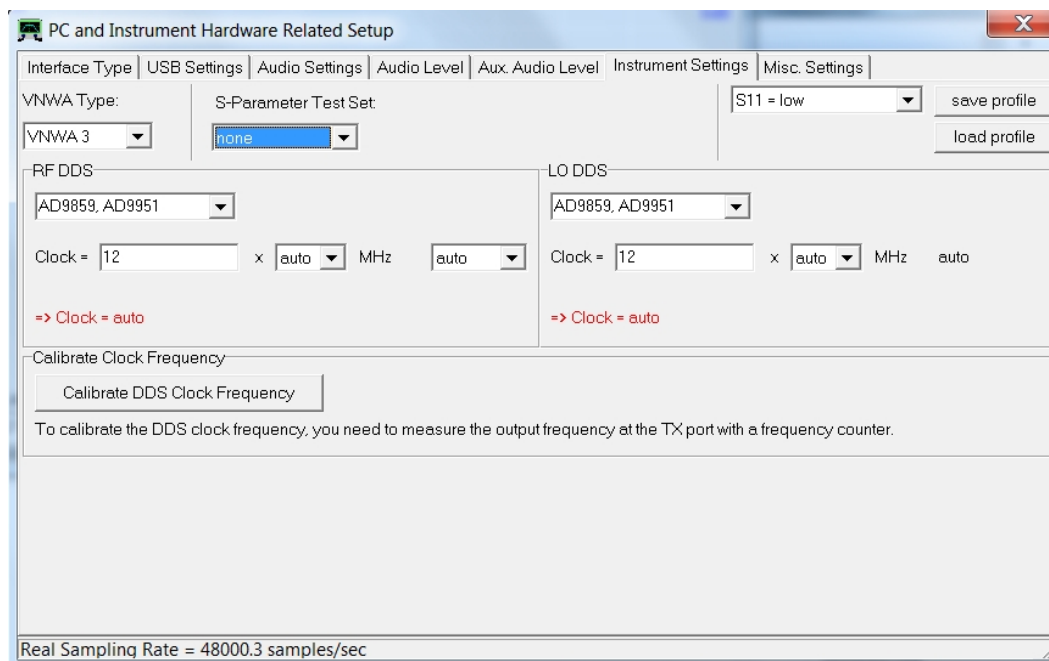


This completes Auto-detection and Auto-set-up of Audio devices.

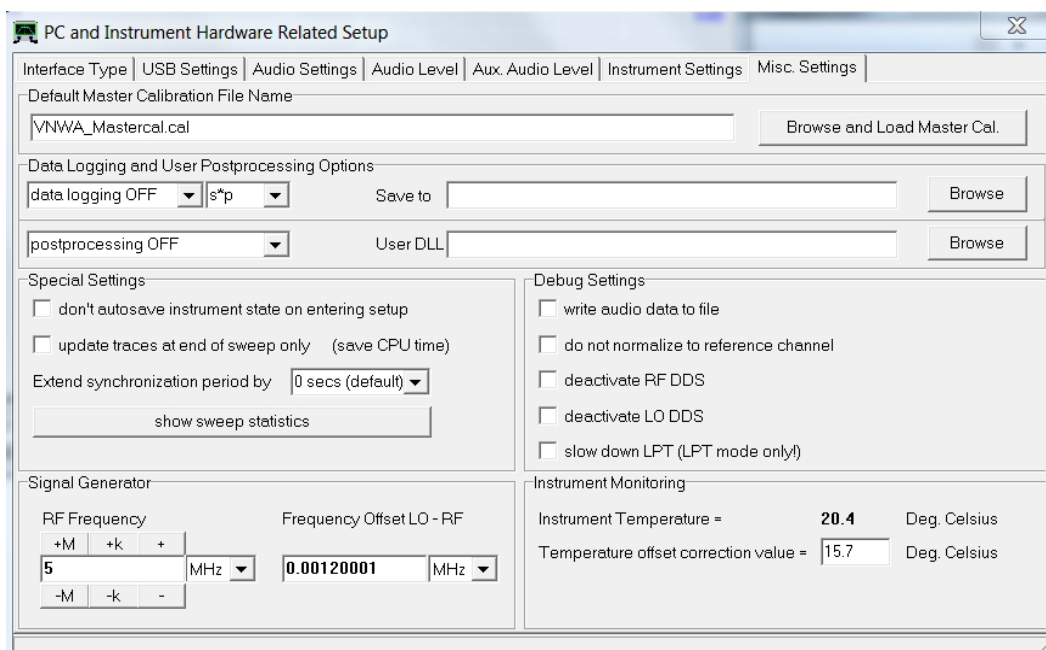
Note: In case of audio set-up problems, please consult the **VNWA helpfile** - “**Auto Set-up**”
Automatic Configuration of the Software for Usage with a DG8SAQ VNWA (Auto-Setup)

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

3.4.18 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.



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



3.4.20 **IMPORTANT:** To save the VNWA configuration (after any changes are made)
Exit the VNWA Application. This updates the VNWA configuration files with the setup information for the next time the VNWA application is started.

3.4.21 **VNWA Helpfile Configuration** for Windows 10 and Windows 8.1 & 8
 Refer to Chapter 3.5 for more information on enabling the VNWA Helpfile viewer.

End of VNWA Configuration for Windows 10 & Windows 8.1

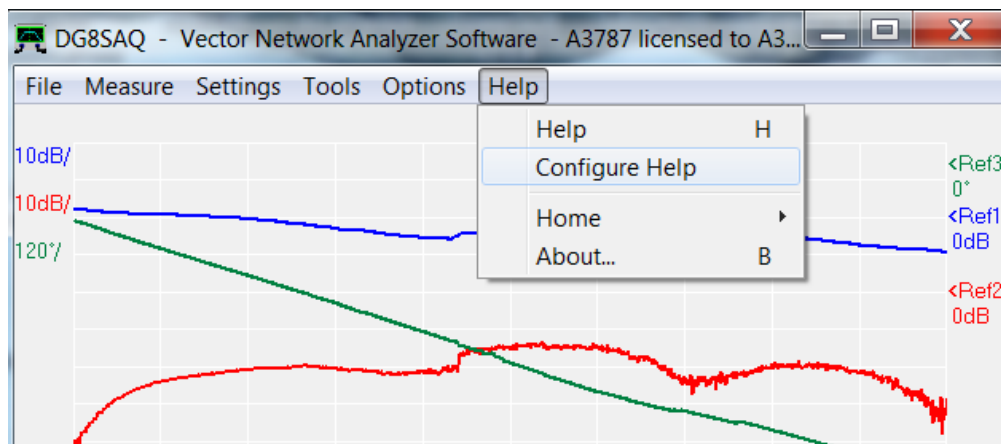
3.5 VNWA Help File Installation – Windows 10, Windows 8, 8.1 & Windows 7

Introduction As Microsoft does not provide viewers to view help files in *.hlp format for new Windows versions like Windows 10 and Windows 8.1.

You may choose to use a different viewer or use the pdf help file instead if you are unable to install the Microsoft winhlp32 viewer for the particular operating system on your Computer

A possible alternative viewer is **viewhlp** kindly provided as freeware by Alan Rowe – M0PUB under GPL. **Viewhlp** is similar to **winhlp32**, but lacks some of its features.

3.5.1 To test whether the **VNWA helpfile** is available. Select the **Help** tab and select “**Help H**” again.

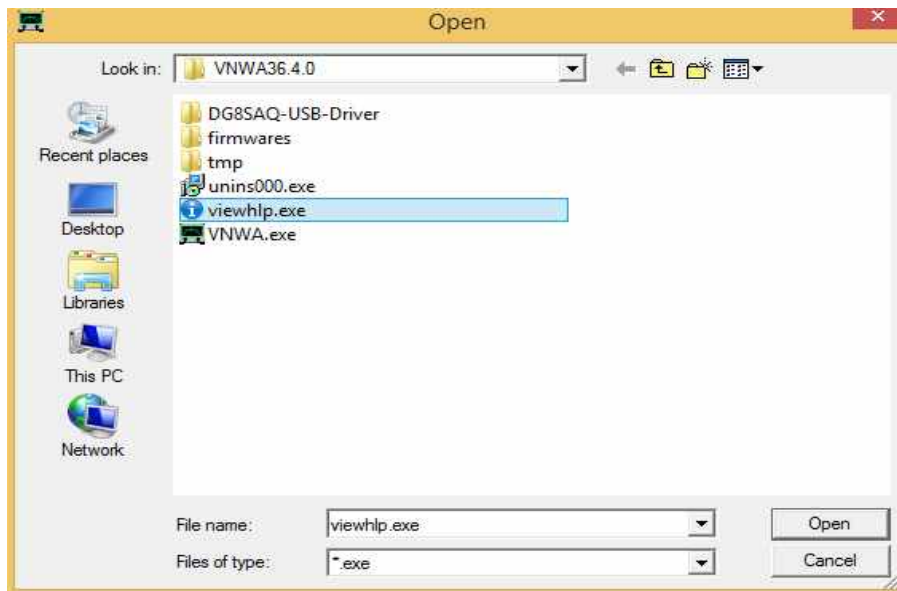


3.5.2 Select **Configure Help** – and the screen below is displayed and informs if the Microsoft **winhlp32** viewer is installed. More information about winhlp32 is shown in 3.5.5

“**Download from Microsoft**” shows that winhlp32 is **NOT** currently installed on your PC.

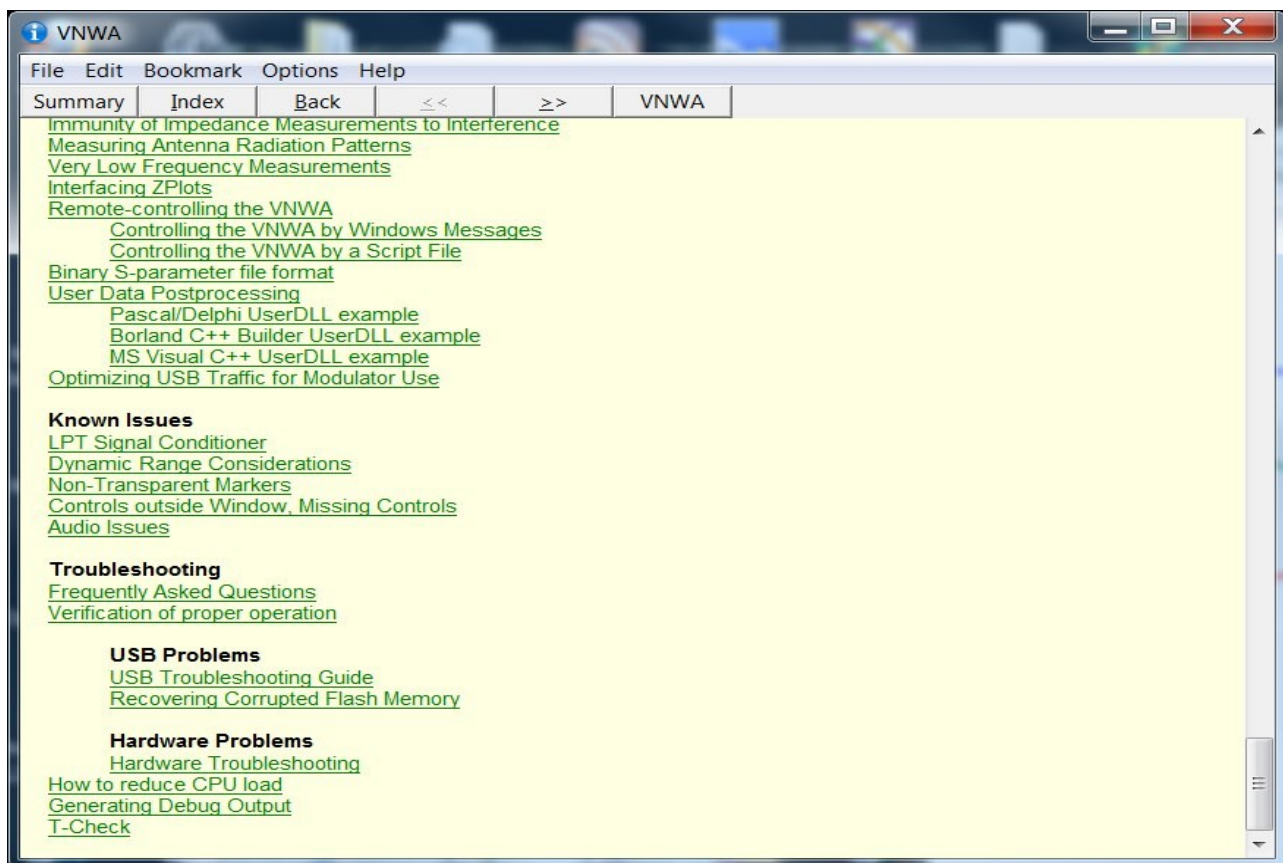


3.5.3 The **viewhlp** viewer is installed by ticking **Alternative Viewer** and “**Download viewhlp.exe**”. Save this file into the same directory as where you installed the VNWA application. Once **viewhlp** is actually installed, the blue "browse for viewer" label will indicate "**viewhlp.exe**" instead. Clicking on this label will launch a *.exe file open dialog. Here, you can select the executable of **any help file viewer** you like to use. Typing “**H**” or pressing **Help** will now display the the VNWA helpfile is by the viewhlp viewer.



- 3.5.4 Clicking on the blue "**browse for PDF**" label (Fig 3.5.3) will launch a *.pdf file open dialog. Select the pdf file, that is to be opened later when you click the Help menu. After a pdf file has been selected, the label will show its name.
- Clicking the "Download latest PFD" will launch the download of the latest PDF help file From the SDR-Kits website as a background process.
- Note**, that the download cannot be interrupted and may take several **minutes**.

The VNWA **helpfile** comprises **>500 pages** and covers numerous topics, a selection is displayed here



3.5.5 Winhlp32 Installation:

In order to view the VNWA helpfile on the Windows 7, 8, 8.1 you need to download and install the appropriate Winhlp32.exe for your operating system from Microsoft. This is because Microsoft no longer includes this file in Windows 7, 8, 8.1 and Windows 10 Operating Systems.

Note: Winhlp32 can run on Win10 but Microsoft actively blocks its installation, however a simple fix was published in the German Funkamateurl magazine in issue 10/2016. It is possible to install the Win7 winhlp32 version, provided you make the installer to believe that your Win10 is a Win7 system. The folks of Funkamateurl have done this. They provide the necessary files here:

http://www.funkamateurl.de/tl_files/downloads/hefte/2016/WinHelpWin10.zip

All you have to do is unzip into a folder and right-click the installer script Install.cmd and select run as administrator. This will install the win7 version of winhlp32 on your win10 system and it does work inside any software using the *.hlp format.

Note: No warranties are made as this method may not work in future.

3.6 Amateur Radio Root Certificate Installation (ARC)

Introduction: The libusb0.sys driver is required to enumerate the Atmel ATmega Microprocessor used in the VNWA. On Windows 10 & W8.1 & Window-7 64bit system, 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 20th 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.

- 3.6.1 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.



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



3.6.3 Press “**OK**” and 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

3.7 VNWA 3SE 2 Port VNWA User Information

3.7.1 Introduction

Thank you for purchasing the VNWA3SE 2 Port VNWA available now in SMA or N Connector versions. This leaflet contains additional user information how to configure the 2 Port VNWA and supplements the “VNWA Getting Started booklet” also supplied with the VNWA. The main source of VNWA information is the 500+ page VNWA helpfile which contains all other details how to configure and use your VNWA. The online version of the helpfile is supplied when installing the DG8SAQ VNWA software and can be accessed by selecting the “*Help*” tab in the software. A pdf version of this helpfile can be downloaded from:

http://www.sdr-kits.net/documents/VNWA_HELP.pdf

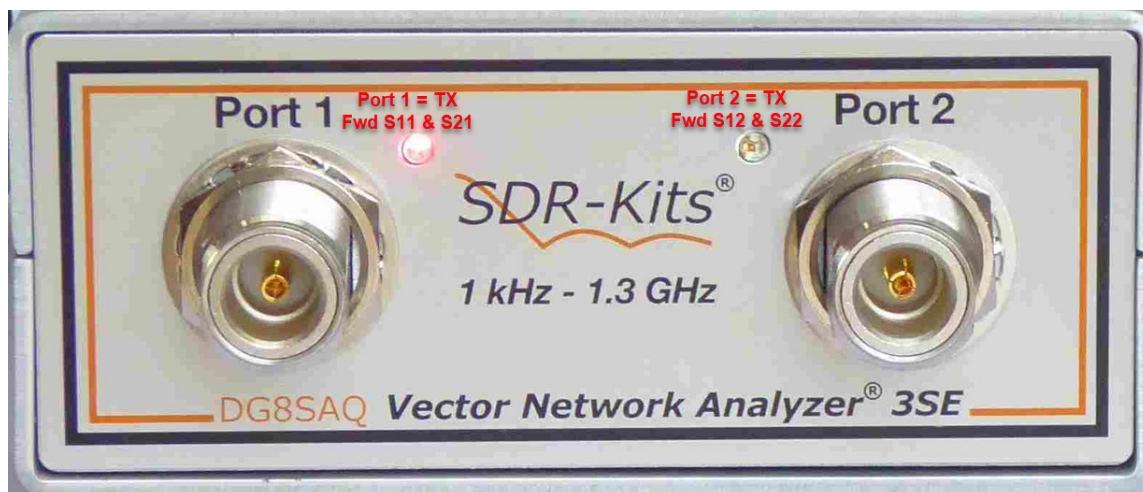
3.7.2 Important information

The design of the VNWA3 and VNWA 3SE Open Port VNWA is copyright by Thomas Baier DG8SAQ and SDR-Kits®. Reverse Engineering of the VNWA3SE 2 Port design is strictly forbidden. SDR-Kits® and the SDR-Kits Logo are Registered Trademarks. All rights reserved.

3.7.3 Hardware description VNWA 3SE 2 Port VNWA

The VNWA 3SE hardware consists of a standard VNWA3E, fitted with 2 USB Codecs and capable of making 2 measurements at the same time and a newly designed 2-port switch module fitted behind the front panel to take reverse measurements. 2 LEDs are fitted to indicate in which direction the switch is taking measurements:

Port 1 LED lit: Forward measurement Port 1 = TX and Port 2 = RX; **Port 2 LED lit:** Reverse measurement: Port 2 = TX and Port 1 is now RX.



3.7.4 Software configuration VNWA 3SE 2 Port VNWA

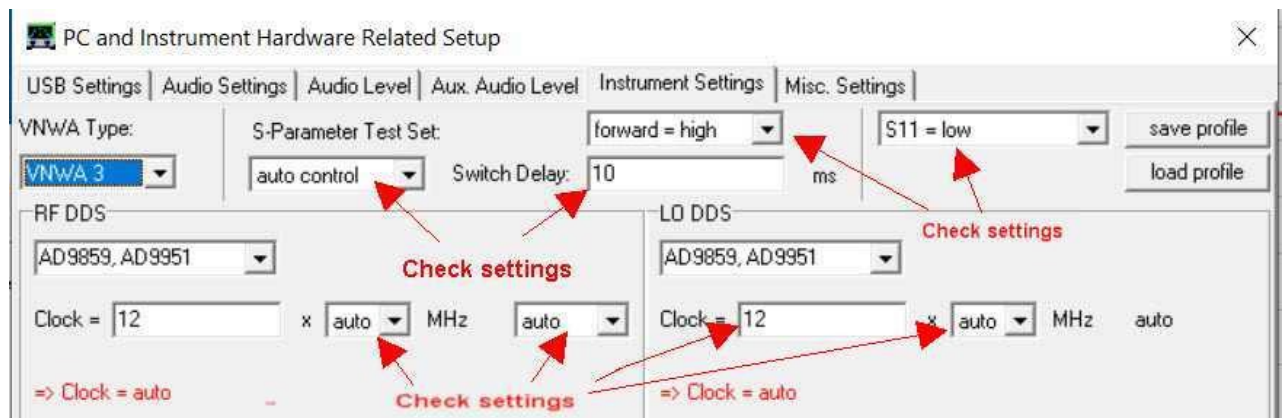
This chapter assumes that the VNWA 3E software and driver installation has been done and the VNWA application configuration has been done as described in the “VNW3E Getting Started Manual”.

- a) Start VNWA application as usual

- b) Goto tab **Options** and select **Setup**
- c) Click on Tab **USB Settings** and click on **Test USB Interface** with result "Test passed without errors" If not check if the VNWA license code is correctly entered
- d) Click on tab **Audio settings** and click on **Auto-Setup Audio Devices**. This will configure the 2 audio codecs correctly

Configuring VNWA 2 Port functionality for the first time on a VNWA:

- e) Click on tab **Instrument Settings** - the following screen should be displayed:



- f) Normally the field **S-Parameter Test Set** is set to **none**. For 2 Port operation this field must be set **auto control**. You can specify **manual control** if required
These settings are stored inside the VNWA hardware, thus the setting will be correct when the user launches the VNWA application with the VNWA3SE connected.

Note: A 2 Port VNWA will only switch to Port 2 when asked to measure S12 and S22 data.

3.7.5 VNWA 3SE Commissioning Test

Every VNWA 3SE is supplied with a commissioning graph showing the measured performance at various frequencies. All tests are done WITHOUT any calibration as calibration obscures hardware problems. The meaning of the measurements is as follows:

Column 1 = Measurement number, Column 2 = Frequency of measurement.

Column 3 = S21 & Column 4 = S12 with RG223 cable connected between Port 1 and Port 2.

Column 5 = Port 1: Dynamic Range (DR S21): Column 6 = Port 2: Dynamic Range (DR S12)

Column 7 = S21 & Column 8 = S12 measurement of noise floor with Open connectors

1: 100MHz	-1.89dB	-1.89dB	-97.46dB	-97.49dB	-99.36dB	-99.38dB
2: 500MHz	-9.62dB	-9.62dB	-73.74dB	-75.37dB	-83.37dB	-85.00dB
3: 700MHz	-8.61dB	-8.59dB	-73.09dB	-66.86dB	-81.70dB	-75.46dB
4: 1000MHz	-9.84dB	-9.82dB	-60.77dB	-62.43dB	-70.62dB	-72.25dB
5: 1200MHz	-14.36dB	-14.31dB	-61.48dB	-61.13dB	-75.83dB	-75.44dB

End of chapter

4. VNWA Calibration

IMPORTANT - VNWA Calibration is the single most important factor in obtaining accurate VNWA measurements. Please do read the Chapter "Calibration" in the VNWA helpfile to ensure you have an appreciation of the many factors affecting VNWA Calibration.

Prior to taking VNWA measurements the VNWA needs to be calibrated - Calibration uses SOLT - Short - Open - Load and Through Method.

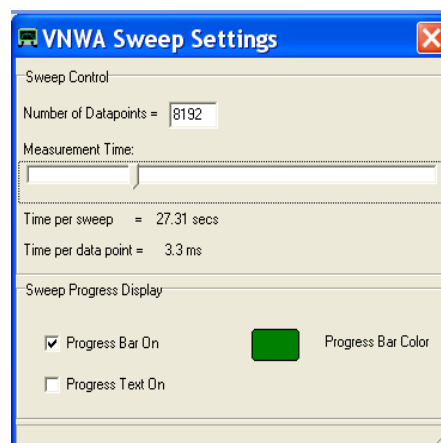
Ideal Calibration standards are used by default. High precision measurements in VHF and UHF range you need to specify a more precise model of the calibration standards used

From software version 36.7 on, the VNWA installer also installs a set of default calibration kit model files prepared by Kurt Poulsen OZ7OU corresponding to the calibration kits supplied by SDR-Kits with your VNWA. Consult the VNWA helpfile for more details

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

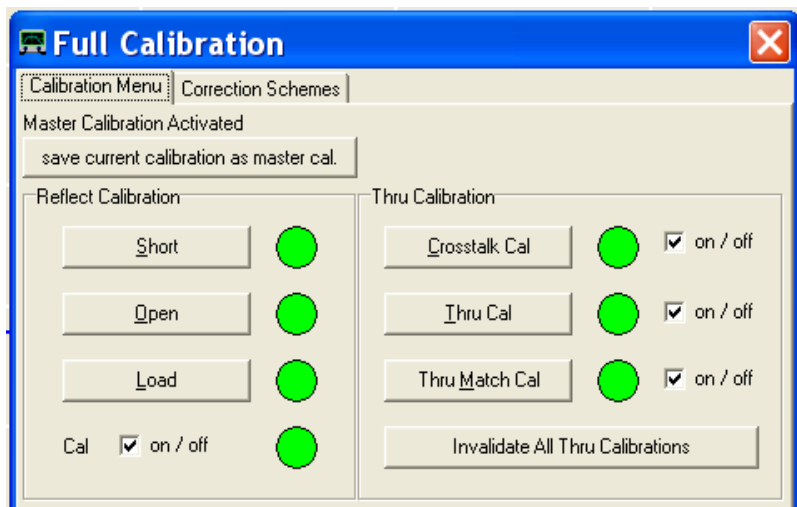
1. Set frequency range for Master Calibration (for instance 0 MHz - 500 MHz). Click on "Center=" and "Span=" and specify Start and Stop frequency of the Master Calibration.
2. From VNWA top menu select "Setting" and select "Sweep"
Specify: 8192 points
time per sample: 3.3 mS



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:

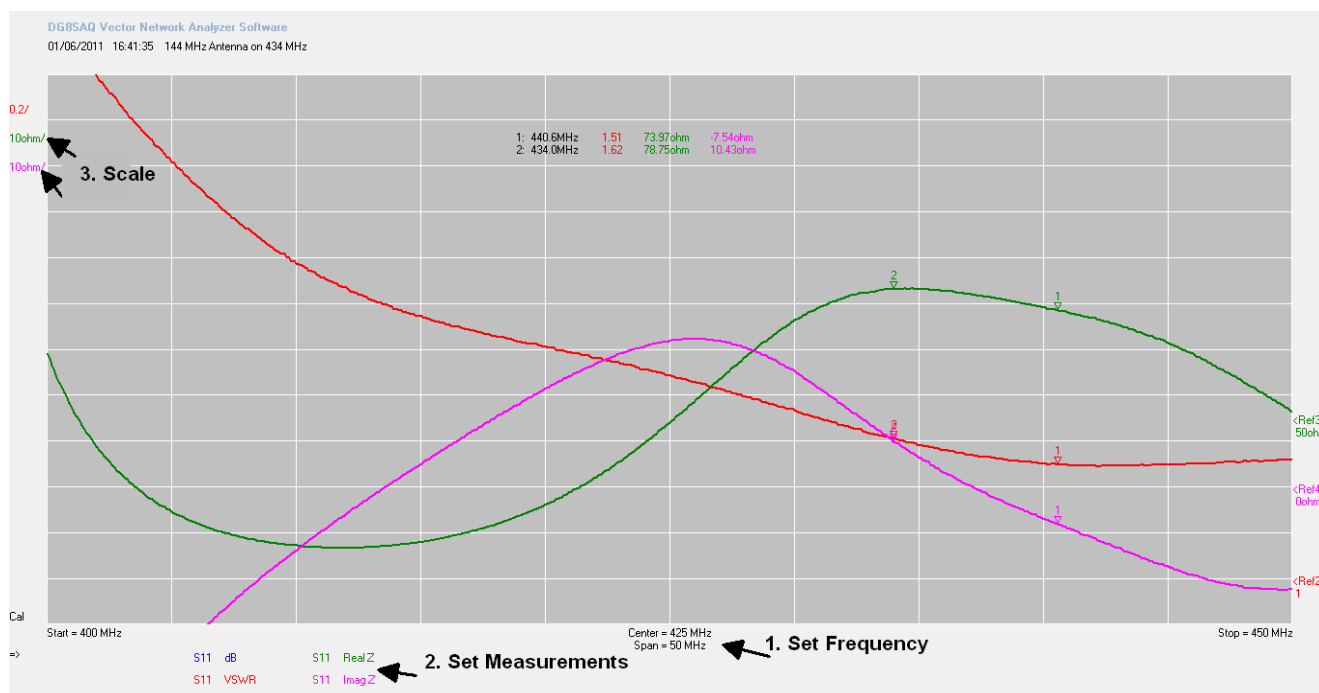
The DG8SAQ VNWA is a very capable instrument offering many options which may overwhelm first time users who may not be familiar with basic VNWA measurements.

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

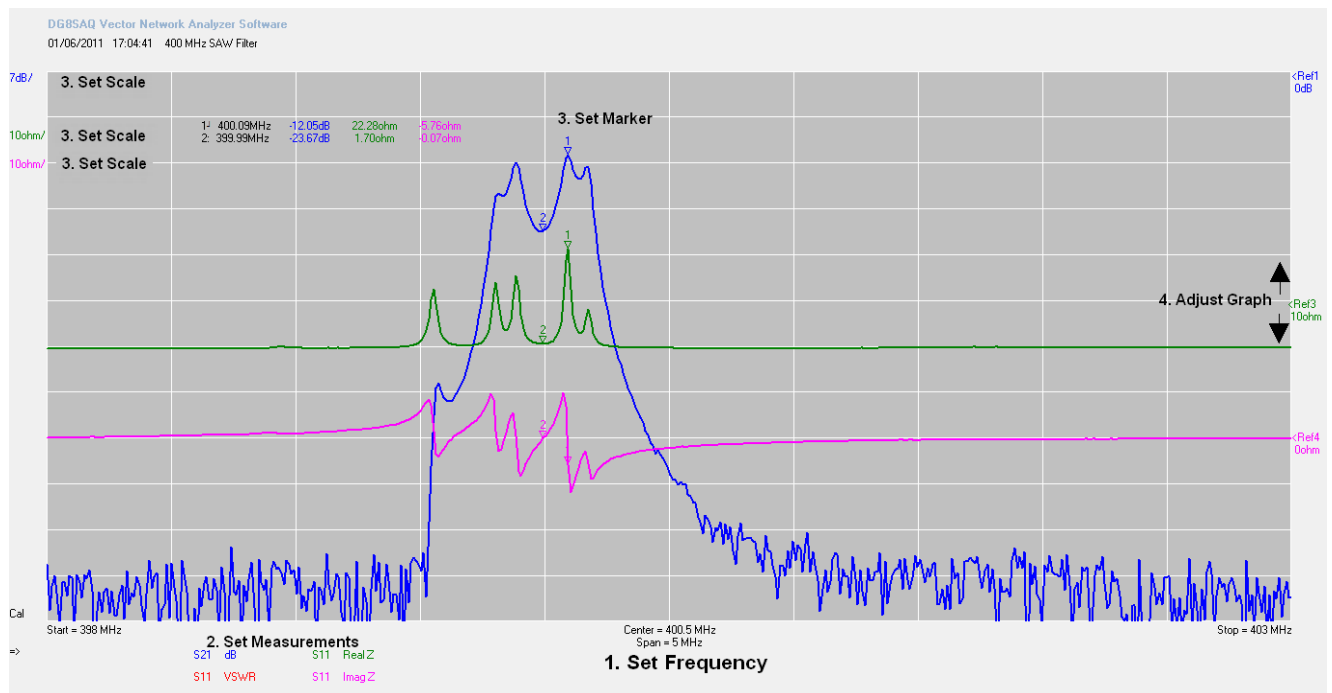
Add Marker (Right Mouse Click and select "Normal Marker") and place on point of interest.

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)

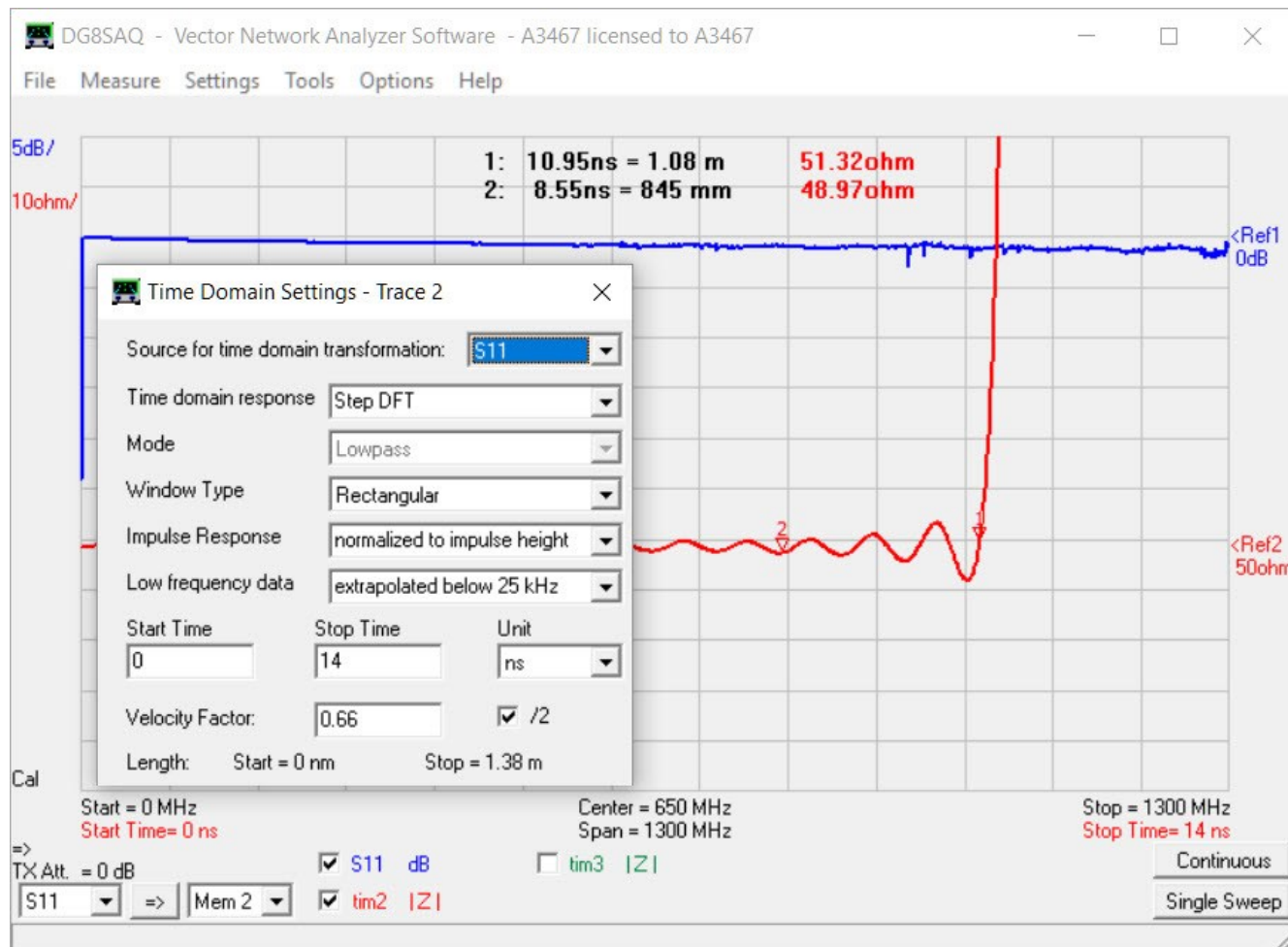
Connect Device Under Test (DUT) input to VNWA TX port and Device output to VNWA RX port

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. The other end of Coax is left unconnected.
3. Perform **S11 dB measurement** and display in **Trace 1**. (blue trace near 0dB)
4. Add a second trace type "**Time**" and open the "**Time Domain settings**" via "**Settings-Display**" menu or by the appropriate popup menu on right-clicking the display label.
5. Open the time domain setting window by activating the "**Settings-Time Domain**" menu or by double-clicking one of the time labels.
6. Select source S11, select "**Impulse DFT**", "**Lowpass**" and "**Rectangular**" for maximum time resolution and edit **start and stop times** as shown.

In the example Marker 2 in the display: the characteristic impedance as 48.97 Ohm (each division is 10 Ohm!). The total length of the coax cable shown in Marker 1 is actually 1.08m. Accuracy of this measurements depends on correct Velocity Factor of the cable type to be entered.

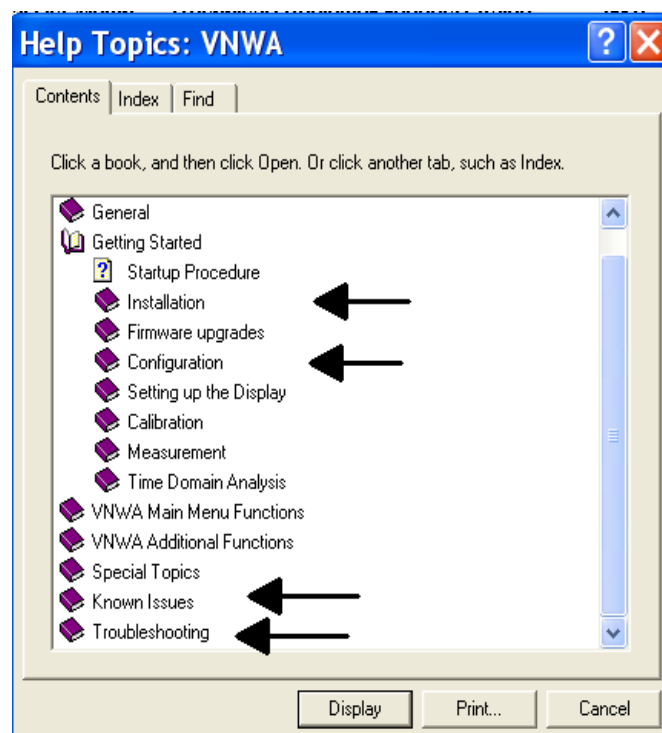
Please consult the VNWA Helpfile for further information on T D R

6. The VNWA Help file

Check you can open and read the **VNWA HELPFILE**.

See **Section 3.5** if there is a problem opening this file: It is recommended to 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:

www.SDR-Kits.net/documents/VNWA_HELP.pdf

6.1 Further Reading in the 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 VNWA Tutorial Videos and other Support Links

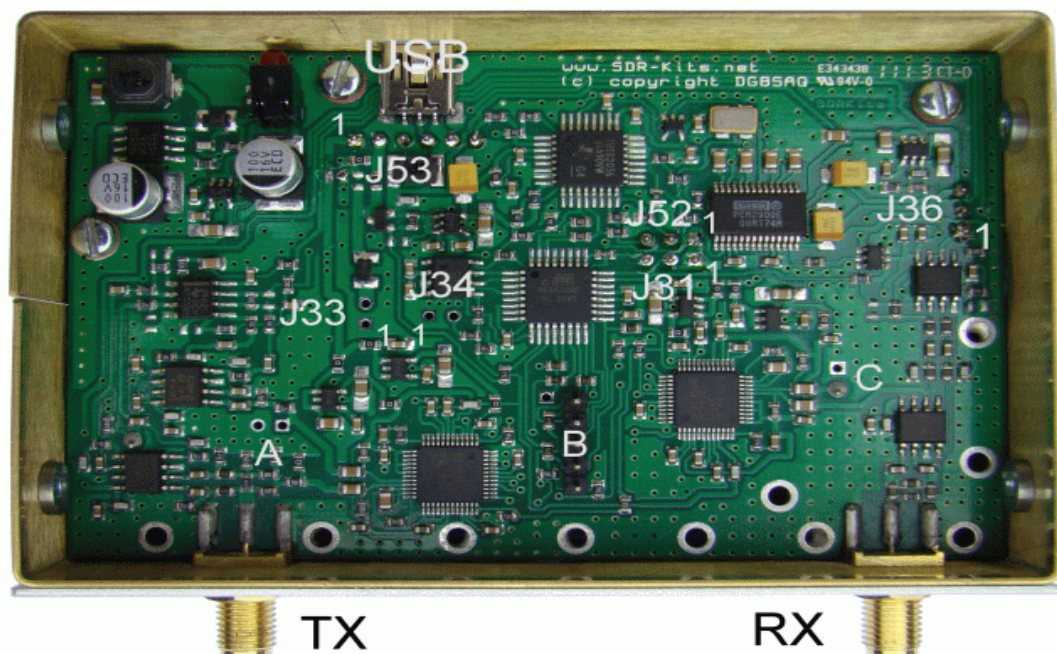
To support the VNWA software, three Videos have been produced by Kurt Poulsen OZ7OU. Viewing of these videos is particularly recommended for new VNWA users, however also existing VNWA users may benefit from viewing these videos. Thanks to Kurt for producing these Videos!

First time Installations VNWA software – duration 7min 4 sec <https://youtu.be/TOMj4jaUSKs>
First time start VNWA Software – duration 11 min 38 sec <https://youtu.be/cuLjsJYpODc>
First time VNWA calibration - duration 15 min 34 sec <https://youtu.be/gATr qw4lKT8>

- **VNA Tutorials - by Fred Schneider PA4TIM**
a beginners Guide in 8 Chapters! - **thanks Fred!!** <http://www.pa4tim.nl/?p=1594>
- **VNWA One Port Measurements**
TX Port only - Step by Step Example of Antenna Tutorial by Tom Baier -
[http://www.sdr-kits.net/DG8SAQ/VNWA/ Example A simple one port measurement.pdf](http://www.sdr-kits.net/DG8SAQ/VNWA/Example%20A%20simple%20one%20port%20measurement.pdf)
- **VNWA Two Port Measurements**
TX and RX ports - Step by Step Example of Filter Tutorial by Tom Baier -
[http://www.sdr-kits.net/DG8SAQ/VNWA/ Example 2 Port Measurement.pdf](http://www.sdr-kits.net/DG8SAQ/VNWA/Example%202%20Port%20Measurement.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

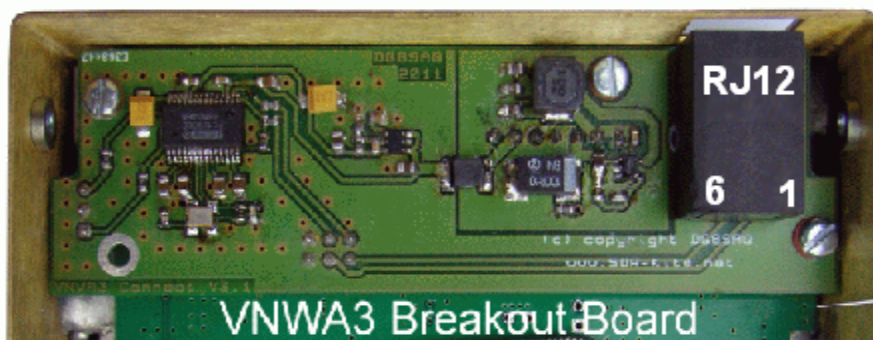
The VNWA3 3E combines the VNWA and the USB interface functionality on a single 100x60mm² board. The VNWA3 only requires a single USB cable to connect to a PC. Nevertheless, it offers many hardware interfacing options: Please refer to the VNWA Helpfile for a block diagram and details of external connections.



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: (see also VNWA helpfile for info on options)
Pin 1:	Rotor start/stop control signal 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, however Clock frequencies from 10 MHz upward to 40 MHz may be used.

SDR-Kits offers a programmable Low Jitter GPS Controlled Precision Reference Oscillator offering a stability of +/-1 ppb is recommended for use with the VNWA.

8. DG8SAQ VNWA 3 & 3E Specification

- Supported Operating Systems: Microsoft Windows 10, Windows 8.1 & 8.0, 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 (>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 +/- 0.5 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 (without presentation case)

- VNWA 3E or VNWA 3 as ordered
- Mini-USB lead
- VNWA 3 "Getting Started" Manual (this manual)
- 3 pcs Calibration kit and 1 pcs RG223 cable

8.2 DG8SAQ VNWA 3E – 3 in Presentation case or Optional Items

- Presentation case for storing VNWA and all accessories
- Rosenberger or Amphenol SDR-Kits 4 pcs Calibration Kit (SMA Short - SMA 50 Ohm Load etc) and 1 pcs RG223 thru Calibration cable.
- Low Jitter GPS Controlled Precision Reference Oscillator.

9. VNWA User Support

9.1 VNWA User group

It is recommended you become a member of the **VNWA Forum on Groups.io** where VNWA announcements and VNWA user experiences are shared. The VNWA Forum has over 3000 members and you will have the benefit of useful information including advice when new software and helpfile updates are available for download: link: <https://groups.io/g/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 **24 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 to support@sdr-kits.net 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) 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.

VNWA users of this product in European Community Countries should contact SDR-Kits (Support@SDR-Kits.net) to make specific arrangements (Take back service by Manufacturer) for disposal and recycling of this product in accordance with the relevant UK or EEC Directives.

9.5 CE & UKAS 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. Certification was carried out in 2011 by an Authorized UK Approvals Lab.



Testing for CE Certification for the VNWA3/3E was done in a UK Testlab in 2011, therefore, this product meets the requirements for UKCA approval from 1st January 2021 when UK left the European Community.

9.6 ROHS Compliance



This product is manufactured in accordance with RoHS2 (EU Directive 2011/65/EU) and RoHS 3 (EU Directive 2015/863)

9.7 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.

9.8 Notices and Acknowledgements

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Acknowledgements and thanks are due to all the Beta Testers who tested VNWA 35.x and VNWA 36.x series of VNWA releases and who patiently reported issues either direct or via the VNWA reflector. A special thanks goes to **Kurt Poulsen OZ7OU**, **Dr Eric Hecker** and **Alan Rowe M0PUB** for their sterling work in supporting the VNWA product.

Prof. Dr. Thomas Baier DGSAQ, the VNWA designer and I hereby acknowledge the contributions of **Fred Krom PE0FKO** for his kind assistance in providing the **Amateur Radio Root Certificate**.

Updated 19 November 2021

Jan Verduyn G5BBL SDR-Kits

SDR KITS LIMITED UK Company no 08668127 trading as SDR-Kits Trademark: ***SDR-Kits®***

9.9 Contact address

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Technical support email: Support@SDR-Kits.net

Email Backup sdrkits@gmail.com

Website www.SDR-Kits.net

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10 List of Contents:

- 1. Introduction**
 - 1.1 Shipment Damage
- 2. Important Information**
 - 2.1 Safety Information
 - 2.2 Accuracy of Measurements
 - 2.3 VNWA 3 and VNWA 3E Product Documentation
 - 2.4 VNWA License Code
- 3. VNWA 3 Software Driver and Helpfile Installation**
 - 3.1 Windows 7 & Vista 64 bit and 32 bit Installation
 - 3.2 Windows 7 & Vista VNWA Application Configuration**
 - 3.3 Windows 10, 8.1 & 8 Installation
 - 3.4 Windows 10, 8.1 & 8 VNWA Application Configuration**
 - 3.5 VNWA Helpfile Installation for Windows 7, Windows 8 & 8.1 and Windows 10
 - 3.6 Amateur Radio Root Certificate Installation (ARC)
 - 3.7 VNWA 3SE 2 Port VNWA (SMA or N version) User Information**
- 4. VNWA Calibration**
- 5. Some Practical VNWA Measurements**
- 6. VNWA Helpfile introduction**
- 7. VNWA 3 – 3E Hardware Description**
- 8. VNWA 3 & 3E Specifications**
- 9. VNWA User Support**
 - 9.1 VNWA User Group
 - 9.2 Warranty Information
 - 9.3 Hardware Servicing Information
 - 9.4 Disposal of Waste Electrical Equipment (WEEE)
 - 9.5 CE and UKAS Certification
 - 9.6 RoHs Statement
 - 9.7 FCC & IC Statement
 - 9.8 Acknowledgements
 - 9.9 Contact Address
 - 9.10 Ordering Terms and Conditions
- 10. List of Contents**

Notes:

VNWA 3SE User instructions are issued as chapter 3.7 to this manual.

Notes:

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