



**NOISE** 

# **DNA Series**

## **Phase Noise and Stability Analyzer**

### **User's Manual**



---

## Notices

The information contained in this document is subject to change without notice.  
This document contains proprietary information that is protected by copyright. All rights are reserved. No part of this document may be photocopied, reproduced, or translated to another language without the prior written consent of ARCALE.

© ARCALE 2023  
ARCALE  
109 avenue du Général Eisenhower  
31100 TOULOUSE - France  
E-mail: [contact@arcale.net](mailto:contact@arcale.net)  
Internet: [www.arcale.net](http://www.arcale.net)  
NOISE XT (Trademarks of SPHEREA)

# Table of Contents

1	PREFACE	11
1.1	About this Manual	11
1.2	Documentation Overview	11
1.3	Conventions for Procedure Descriptions	12
2	PRECAUTIONS & CONDITIONS OF USE	12
2.1	Instrument damage caused by cleaning agent	12
2.2	Hazard symbols	12
2.3	Electrical safety	13
2.4	Reduction of Hazardous Substances Overview	13
2.5	Waste Electrical and Electronic Equipment (WEEE)	14
2.6	Tilt Facility	14
2.7	Risk of electrostatic discharge (ESD)	14
2.8	Risk of instrument damage during operation	15
2.9	EMI impact on measurement results	15
2.10	Calibration	15
2.11	Information Security in Highly Sensitive Areas	15
2.12	Battery Information	16
2.13	Types of Memory in your DNA and Their Security Concerns	16
2.14	Information Storage within the DNA	17
2.15	Exclusive Remedies	17
2.16	Assistance	17
3	GETTING STARTED	18
3.1	Preparing for Use	18
3.1.1	Unpacking and Checking the Instrument	18
3.1.2	Accessory List	18
3.1.3	Placing or Mounting the Instrument	18
3.1.4	Connecting the AC Power	19
3.1.5	Switching the Instrument On and Off	20
3.2	Windows Operating System	20
3.2.1	Virus Protection	21
3.2.2	Service Packs and Updates	21
3.2.3	Login	21
3.2.4	Connecting USB Devices	22

3.2.5	Connecting an External Monitor	24
3.2.6	Setting Up a Network (LAN) Connection	25
3.2.7	Connecting the Instrument to the Network	25
3.2.8	Assigning the IP Address	25
3.2.9	Using a DNS server to determine the IP address	27
3.2.10	Using computer names	27
3.2.11	Changing the Windows Firewall Settings	27
3.2.12	Setting the Date and Time	28
4	INSTRUMENT OVERVIEW	30
4.1	Front Panel View	30
4.1.1	Touchscreen	31
4.1.2	USB	32
4.1.3	Function Keys	33
4.1.4	RF INPUT	33
4.1.5	EXTERNAL/INTERNAL REFERENCE INPUT/OUTPUT CONNECTORS	34
4.1.5.1	EXTERNAL REFERENCES (DNA F or L versions)	34
4.1.5.2	Use INTERNAL REFERENCES (DNA F version only)	34
4.1.6	Rear Panel View	35
4.1.7	Computer Motherboard Connectors	36
4.1.7.1	VGA Port	36
4.1.7.2	LAN	36
4.1.7.3	USB	36
4.1.8	AC Power Supply Connection	36
4.1.9	REF 1 & 2 IN	36
4.1.10	REF CLK IN	36
4.1.11	REF CLK OUT	37
5	DNA GENERAL DESCRIPTION	38
5.1	INTRODUCTION	38
5.2	DNA GLOBAL ARCHITECTURE	38
6	DNA GUI Main Interface	40
6.1	Phase Noise Plot	42
6.2	Allan Deviation Plot	43
6.3	Fractional Frequency Plot	44
6.4	Utilities	44
6.5	Settings	44

7	UTILITIES ①	45
7.1	AXIS SETUP: SCALE ②	46
7.1.1	Set the default zoom range	46
7.1.2	Scaling using the mouse	46
7.1.2.1	Zoom with the mouse wheel	46
7.1.2.2	Zoom with mouse click and drag	47
7.1.2.3	Mouse double click	47
7.2	MARKER UTILITY: MARKERS ①	48
7.2.1	Active graph select: TRACE SELECT ①	49
7.2.2	Adding all marker with one click: ADD ALL MARKERS ②	49
7.2.3	Add only one marker: ADD ONE MARKER ③	49
7.2.4	Remove all markers: CLEAR ALL MARKERS ④	49
7.2.5	Marker position ⑤	50
7.2.5.1	Marker abscissa position widget	50
7.2.5.2	Marker abscissa position setup using the mouse	50
7.2.6	MORE ⑥	51
7.2.6.1	MARKER TYPE	51
7.2.6.2	MARKER VISIBLE	51
7.3	GRAPH UTILITY: TRACE ①	51
7.3.1	Active graph select: TRACE SELECT ②	52
7.3.2	Graph color change: TRACE COLOR ③	52
7.3.3	Save graph data to file: SAVE TRACE	53
7.3.4	Load graph data from file: LOAD TRACE	53
7.3.5	Remove a graph from a plot: CLEAR TRACE	54
7.3.6	Remove all the graphs from a plot: CLEAR ALL TRACE	54
7.4	Mathematical operations: MATH ①	55
7.4.1	RMS JITTER CALCULATION	55
7.5	Files Utility: FILE ①	56
7.5.1	Save a measurement to file: MEASURE SAVE ①	57
7.5.2	Load a measurement from file: MEASURE LOAD	58
7.5.3	Save a plot to PNG file: SAVE SCREEN TO PNG	59
7.5.4	Report editor: EDIT REPORT	60
8	SETTINGS	62
8.1	MEASURE	62
8.1.1	Measurement parameters: MEASURE PARAMS ③	62

8.1.1.1	Measurement Mode	63
8.1.1.2	Frequency offset option	63
8.1.1.3	Allan Variance mode	63
8.1.1.4	Phase noise enhanced mode	63
8.1.1.5	Spurious Detection	64
8.1.1.6	Raw Phase Data Recording	64
8.1.1.7	Auto stop parameters	64
8.1.1.8	Additional parameters	65
8.1.1.9	Sampling Frequency Override Mode	65
8.1.1.10	ADC	65
8.1.1.11	Cross Correlation Mode	65
8.1.1.12	Frequency estimation precision	65
8.1.1.13	Dark Port Compensation	65
8.1.2	Estimator select: ESTIMATOR MODULE ④	66
8.1.3	Frequency stability analysis method select: FREQ. STAB. OVERLAPPED ALLAN ⑤	66
8.1.4	Spurious visualization: SHOW SPURIOUS ⑥	67
8.1.5	Raw residual display: SMOOTHED RESIDUAL ⑦	68
8.1.6	Smoothing the noise curve: SMOOTH NOISE CURVE ⑧	69
8.2	DISPLAY	70
8.2.1	Color theme selection: LIGHT ③ / DARK ④	70
8.2.2	Display legend on display: LEGEND ⑤	70
8.2.3	Display cross correlation parameters: NB XCROSS ⑥	71
8.2.4	Set estimated Allan function: ESTIMATED ALLAN ⑦	72
8.3	RESET ⑧	73
9	GUI Taps	74
9.1	View	74
9.2	About	74
10	Start and stop measurement	76
11	DNA SPECIFICATIONS	78
12	DNA'S GUI CHART ORGANISATION	79
13	DNA CERTIFICATES	81

## TABLE OF ILLUSTRATION

Figure 1 - DNA AC power supply .....	19
Figure 2 - DNA Power ON /OFF.....	20
Figure 3 - DNA L (Lite) Front Panel View .....	30
Figure 4 - DNA F (Full) Front Panel View.....	31
Figure 5 – DUT .....	33
Figure 6 - DNA F Version .....	34
Figure 7 - DNA L Version .....	34
Figure 8 - Internal references .....	34
Figure 9 - DNA Lite Rear Panel View .....	35
Figure 10 - DNA Full Rear Panel View .....	35
Figure 11 – Global Architecture.....	38
Figure 12 – GUI main interface* .....	40
Figure 13 – Phase Noise display.....	42
Figure 14 – Frequency Stability analysis display .....	43
Figure 15 – Fractional frequency noise display .....	44
Figure 16 – Utilities menu.....	45
Figure 17 - Default Scale range setup.....	46
Figure 18 - Zoom using mouse click-drag-release operation.....	47
Figure 19 – Marker utilities menu .....	48
Figure 20 – Marker .....	49
Figure 21 - Marker Position .....	50
Figure 22 – Graph utilities menu .....	51
Figure 23 – Change the graph Color.....	52
Figure 24 - Save Graph to data file .....	53
Figure 25 – Load graph data from file .....	54
Figure 26 – Jitter calculation.....	55
Figure 27 – File utilities menu .....	56
Figure 28 – Measure save.....	57
Figure 29 - Measure Load .....	58
Figure 30 - Save to PNG .....	59
Figure 31 – Phase Noise measurement report editor .....	60
Figure 32 – Frequency stability measurement report editor.....	61
Figure 33 – Measurement parameters configuration .....	62
Figure 34 - Auto Stop configuration.....	64
Figure 35 - Additional Parameters.....	65
Figure 36 - Estimator Module .....	66
Figure 37 - Frequency Stability.....	66
Figure 38 – Show Spurious .....	67

Figure 39 - Spurious Visualization.....	67
Figure 40 – Smoother Residual.....	68
Figure 41 - Smooth curve noise .....	69
Figure 42 - Display Color.....	70
Figure 43 - Display Color.....	70
Figure 44 - Cross Correlation values.....	71
Figure 45 - Estimated Phase Noise.....	72
Figure 46 - Start.....	76
Figure 47 - Running measurement.....	77

## REVISION

16/11/2023	Version 1.0
01/12/2023	Version 1.1 Typo error on phase noise enhanced mode and load/save menu

## GLOSSARY

ADC	Analog-to-Digital Converter
DDC	Digital Down Converter
DNA	Digital Noise Analyzer
DUT	Device Under Test
dBFS	dB Full Scale
ENBW	Equivalent Noise Bandwidth
FFT	Fast Fourier Transform
FPGA	Field Programmable Gate Array
GUI	Graphical User Interface
REF	Reference

# 1 PREFACE

## 1.1 About this Manual

This User Manual describes general instrument functions and settings common to all applications and operating modes in the **ARCALE DNA Series**. Furthermore, it provides all the information specific to **RF measurements in phase noise measurement**. All other operating modes and applications are described in the specific application manuals.

The main focus in this manual is on the measurement results and the tasks required to obtain them. The following topics are included:

- **Welcome to the ARCALE DNA Series**  
Introduction to and getting familiar with the instrument.
- **Operating Modes and Applications**  
The concept of using multiple operating modes.
- **Measurement**  
Descriptions of the individual measurements in the Spectrum application, including result types and configuration settings.
- **Common Measurement Settings**  
Description of the measurement settings common to all measurement types with their corresponding remote control commands.
- **Common Measurement Analysis and Display Functions**  
Description of the settings and functions provided to analyze results independently of the measurement type with their corresponding remote control commands.

## 1.2 Documentation Overview

The user documentation for the ARCALE DNA Series consists of the following parts:

- "Getting Started" printed manual
- Online documentation ([www.arcale.net](http://www.arcale.net)) including:
  - Getting Started
  - User Manual for base unit and options
  - Programming Commands Manual

### Getting Started

This manual is delivered with the instrument in printed form and provides the information needed to set up and start working with the instrument. Basic operations and handling are described. Safety information is also included.

### User Manual for base unit and options

User manual is provided for the base unit, it's include all instrument function description. The user manuals are available in PDF format on ARCALE web page. In the user manuals, all instrument functions are described in detail.

### Programming Commands Manual

Furthermore, they provide a complete description of the remote-control commands with programming examples.

### 1.3 Conventions for Procedure Descriptions

When describing how to operate the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instrument, or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "**select**" may refer to any of the described methods, i.e., using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

## 2 PRECAUTIONS & CONDITIONS OF USE

This product is designed and tested to comply with the requirements of IEC/EN61010-1 'Safety requirements for electrical equipment for measurement, control and laboratory use', for Class I, portable equipment and is for use in a pollution degree 2 environment. The equipment is designed to operate from an installation categories I and II supply.

Equipment should be protected from the ingress of liquids and precipitation such as rain, snow, etc. When moving the equipment from a cold to a hot environment, it is important to allow the temperature of the equipment to stabilize before it is connected to the supply to avoid condensation forming. The equipment must only be operated within the environmental conditions specified in Chapter 1 'Performance data' in the Operating manual; otherwise, the protection provided by the equipment may be impaired.

This product is not approved for use in hazardous atmospheres. If the equipment is to be used in a safety-related application, e.g., avionics or military applications, the suitability of the product must be assessed and approved for use by a competent person.



### 2.1 Instrument damage caused by cleaning agent

Cleaning agents contain substances that may damage the instrument, for example cleaning agents that contain a solvent may damage the front panel labeling, plastic parts, or the display.

Never use cleaning agents such as solvents (thinners, acetone, etc.), acids, bases, or other substances. The outside of the instrument can be cleaned sufficiently using a soft, lint-free dust cloth.

### 2.2 Hazard symbols

The meaning of hazard symbols appearing on the equipment is as follows:

Symbol	Nature of hazard
	<i>Dangerous voltage</i>
	<i>General hazard</i>

## 2.3 Electrical safety

**AC supply voltage:** This equipment conforms to **IEC Safety Class 1**, meaning that it is provided with a protective grounding lead. To maintain this protection the supply lead must always be connected to the source of supply via a socket with a grounded contact.

Be aware that the supply filter contains capacitors that may remain charged after the equipment is disconnected from the supply. Although the stored energy is within the approved safety requirements, a slight shock may be felt if the plug pins are, touched immediately after removal.

**Removal of cover:** Do not remove covers, no user serviceable parts inside. See list of ARCALE Service Centers at [Contact us – Arcale](#)

**CAUTION:** If this material is used in other conditions than these specified by the manufacturer, the operator's protection is compromised.

## 2.4 Reduction of Hazardous Substances Overview

European Union legislation **2002/95/EC** (RoHS) that goes in effect on July 1, 2006, requires that manufactures of electrical and electronic equipment choose product materials with more focus on our environment and thus support recycling legislation such WEEE in the EU. The RoHS Directive will ban the placing on the EU market electrical and electronic equipment that exceeds a maximum concentration per HOMEGENEOUS substance:

- 1000 ppm or 0.1 wt% for lead
- 100 ppm or 0.01 wt% for Cadmium
- 1000 ppm or 0.1 wt% for Mercury
- 1000 ppm or 0.1 wt% Hexavalent Chromium
- 1000 ppm or 0.1 wt% for PBB and PBDE flame retardants

Many other countries and US states are implementing similar laws starting in 2006. California "RoHS" type legislation is scheduled for 2007 implementation.

RoHS substances can be found in many locations within products including:

Substance	Example Locations
<b>LEAD</b>	Solder, paints, fans, power supplies, plating, metal parts, cable, circuit breakers, electrical components, glass, fuse, flex circuit, boards
<b>CADMIUM</b>	Paints, coatings, contacts, fasteners, PVC cable, metal finishing/plating, detector/devices/LEDs, recycled plastics
<b>MERCURY</b>	Switches, lamps, paints, PVC, displays
<b>Hex CHROMIUM</b>	Aluminum conversion coating (chem. Film), metal finishing, fasteners, paints
<b>PBB &amp; PBDE</b>	Flame Retardants in plastic, cables, PCB, electrical components, paints, fans

### Applicable Categories of Electrical and Electronic Equipment

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
7. Toys, leisure and sport equipment
8. Automatic dispensers

### NOT Applicable Categories of Electrical and Electronic Equipment:

1. Medical Devices
2. Monitoring and Control Instruments

## 2.5 Waste Electrical and Electronic Equipment (WEEE)

WEEE (Waste Electrical and Electronic Equipment) is an EU directive that aims to reduce the amount of waste electrical and electronic equipment being disposed of in landfill.



When dealing with your waste electrical and electronic equipment you need to choose a vendor that not only has infrastructure to deal with your waste in accordance with the WEEE regulation – you also need to choose a vendor that understands how deal with sensitive or classified data.

---

This symbol of the crossed out wheeled bin indicates that the product (electrical and electronic equipment) should not be placed in municipal waste. Check local regulation for disposal of electronic products.

---

## 2.6 Tilt Facility

When the instrument is in the tilt position, it is advisable, for stability reasons, not to stack other instruments on top of it.

## 2.7 Risk of electrostatic discharge (ESD)



Electrostatic discharge (ESD) can cause damage to the electronic components of the instrument and the device under test (DUT). ESD is most likely to occur when you connect or disconnect a DUT or test fixture to the instrument's test ports. To prevent ESD, use a wrist strap and cord and connect yourself to the ground, or use a conductive floor mat and heel strap combination.

## 2.8 Risk of instrument damage during operation

An unsuitable operating site or test setup can cause damage to the instrument and to connected devices. Ensure the following operating conditions before you switch on the instrument:

- All fan openings are unobstructed, and the airflow perforations are unimpeded. The minimum distance from the wall is 18 cm.
- The instrument is dry and shows no sign of condensation.
- The instrument is positioned as described in the following sections.
- The ambient temperature does not exceed the range specified in the data sheet.
- Signal levels at the input connectors are all within the specified ranges.
- Signal outputs are correctly connected and are not overloaded.

## 2.9 EMI impact on measurement results

Electromagnetic interference (EMI) may affect the measurement results.

To suppress generated electromagnetic interference (EMI):

- Use suitable shielded cables of high quality. For example, use double-shielded RF and LAN cables.
- Always terminate open cable ends

## 2.10 Calibration

ARCALE®, manufacturer of DNA Series Phase Noise Measurement Systems, advises that calibration should be performed once every year (**The DNA Series chassis & Solid-State Drive are needed**).

After this maximum time the manufacturer will not approve the accuracy of measurements made by the user. The calibration of the system is performed when the latter is in good working order. The equipment will be checked before calibration. Should defective parts be found out, ARCALE® S.A.S. will issue a specific quote for the repair of the device.

## 2.11 Information Security in Highly Sensitive Areas

Since the SDRAM is erased when power is removed from the phase noise analyzer it does not pose a security risk. No user data is written to the EEPROM and FLASH memories; hence, it is deemed that they do not pose a risk either.

The REMOVABLE SOLID-STATE DRIVE\* (\* Optional) is the only device that does not lose its memory when power is removed and can contain user data. It can be removed from the phase noise analyzer leaving the customer assured that no user data is stored within the signal and phase noise analyzer.

**Note:** Optional: The ARCALE® DNA phase noise analyzer can be equipped with the REMOVABLE SOLID-STATE DRIVE address the needs of customers working in highly sensitive areas.

**CAUTION:** If your System is working in highly sensitive areas and you want to calibrate the system. Please remove the SSD from the phase noise analyzer and inform the technical support services to add a new SSD device.

## 2.12 Battery Information

Instrument Models Covered: **DNA 100 L/F, DNA 400 L/F** products.

There are no batteries in the ARCALE® DNA other than the one on the CPU board used to power the clock in the chipset.

## 2.13 Types of Memory in your DNA and Their Security Concerns

### SDRAM

The ARCALE® DNA analyzer has 2 GByte of SDRAM/DDR3 on the CPU board.

SDRAM is volatile memory, and it loses its memory as soon as power is removed. The SDRAM will be unreadable within one minute after the power is removed from the instrument. The SDRAM is not a security concern.

### SPLD

Each board assembly in the ARCALE® DNA analyzer has one parallel SPLD device. These devices hold up to 0.5 MByte and contain information related to the installed hardware, such as board serial number, hardware control, etc.

The SPLD does not hold user data, nor can the user access the SPLD storage.

The SPLD is not a security concern.

### FLASH

The CPU board of the ARCALE® DNA analyzer has 1 MByte flash memory device which contains the Motherboard BIOS.

The Flash memory does not hold user data, nor can the user access the Flash memory.

The Flash memory is not a security concern.

### Internal solid-state drive (SSD)

The DNA analyzer is equipped with a solid-state (Flash) drive. The solid-state drive is used to store:

- Instrument operating system (Windows10® 64Bit)
- Instrument Applications (measurement personalities) with option license keys
- Instrument states and setups
- Trace data
- Correction constants

The Solid-state drive content is non-volatile, so nothing is lost when power is removed from the instrument.

**Note:** The solid-state drive is not a security concern because it can be physically removed (with Option removable Drive) from the instrument and left in the secure area.

## 2.14 Information Storage within the DNA

Data	SDRAM <i>Not a security concern</i>	SPLD <i>Not a security concern</i>	FLASH <i>Not a security concern</i>	SSD <i>Can be a security concern</i>
Temporary Information storage for the CPU (CPU Cache, and Swap area) use	√			√
Hardware Info serial number, hardware control, BIOS		√		
Operating System			√	√
Instrument states, setups				√
Trace data, Measurement Results				√

## 2.15 Exclusive Remedies

The remedies provided herein are Buyer's sole and exclusive remedies. ARCALE S.A.S. shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

## 2.16 Assistance

Product maintenance agreements and other customer assistance agreements are available for ARCALE products.

For any assistance, contact your nearest ARACLE Sales and Service Office.

Addresses are provided from [Contact us – Arcale](#)

## 3 GETTING STARTED

### 3.1 Preparing for Use

This section describes the basic steps to be taken when setting up the ARCALE DNA for the first time.

#### 3.1.1 Unpacking and Checking the Instrument

Check the equipment for completeness using the delivery note and the accessory lists for the various items. Check the instrument for any damage. If there is damage, immediately contact the carrier who delivered the instrument. Make sure not to discard the box and packing material.

**Note:** *Packing material:*

Retain the original packing material. If the instrument needs to be transported or shipped later, you can use the material to protect the control elements and connectors.

**Risk of damage during transportation and shipment**

Insufficient protection against mechanical and electrostatic effects during transportation and shipment can damage the instrument.

- Always make sure that sufficient mechanical and electrostatic protection is provided.
- When shipping an instrument, the original packaging should be used. If you do not have the original packaging, use sufficient padding to prevent the instrument from moving around inside the box.
- Secure the instrument to prevent any movement and other mechanical effects during transportation.
- The carrying handles at the front of the casing are designed to lift or carry the instrument. Do not apply an excessive external force to the handles.

Observe the information on transporting heavy instruments in the basic safety instructions.

#### 3.1.2 Accessory List

The instrument comes with the following accessories:

- 1x Power supply cable (EU type Plug)
- User Documentation Getting Started

#### 3.1.3 Placing or Mounting the Instrument

The DNA is designed for use under laboratory conditions, either on a bench top or in a rack. If the DNA is operated on a bench top, the surface should be flat. The instrument can be used in horizontal position, standing on its feet.

**Risk of instrument damage in a rack:** An insufficient airflow can cause the instrument to overheat, which may disturb the operation and even cause damage.

Make sure that all fan openings are unobstructed, that the airflow perforations are unimpeded, and that the minimum distance from the wall is 10 cm.

### 3.1.4 Connecting the AC Power

The DNA can be used with different AC power voltages and adapts itself automatically to it (110 / 220V Auto-Switch). Refer to the datasheet for the requirements of voltage and frequency.

The AC power connector is located on the rear panel. (See Figure 1 - DNA AC power supply).



Figure 1 - DNA AC power supply

Connect DNA to the AC power supplies using the supplied power cables; it may only be connected to an outlet that has a ground contact.

### 3.1.5 Switching the Instrument On and Off

Press the POWER key on the front panel. The DNA switches to start mode.



Figure 2 - DNA Power ON /OFF

- Press again the POWER key on the front panel. The DNA switches to shut down mode (Figure 2). The system shut down after few seconds automatically.
- Hold on the POWER key on the front panel 1 second, for brute force shutting down your DNA (only after instrument instability).

**CAUTION:** Risk of losing data, if you switch off the running instrument when disconnecting the power cord, the instrument loses its current settings. Furthermore, program data may be lost. Press the Power key first to shut down the application properly.

## 3.2 Windows Operating System

The instrument contains the Windows 10 operating system which has been configured according to the instrument's features and needs. Changes in the system setup are only required when peripherals like keyboard or a printer are installed or if the network configuration does not comply with the default settings. After the DNA is started, the operating system boots automatically after 5 second with the default multi-boot value.

To ensure that the instrument software functions properly, certain rules must be adhered to concerning the operating system.

### Risk of causing instrument instability

The instrument is equipped with the Windows 10 operating system. Additional software can therefore be installed on the instrument. The use and installation of additional software may impair instrument function. Thus, run only programs that ARCALE® has tested for compatibility with the instrument software.

The drivers and programs used on the instrument under Windows 10 have been adapted to the instrument. Existing instrument software must always be modified using only update software released by ARCALE®.

### 3.2.1 Virus Protection

Users must take appropriate steps to protect their instruments from infection. Beside the use of strong firewall settings and regularly scanning any removable storage device used with a ARCALE® instrument, it is also recommended that anti-virus software be installed on the instrument. While ARCALE® does NOT recommend running anti-virus software in the background ("on-access" mode) on Windows-based instruments, due to potentially degrading instrument performance; it does recommend running it during non-critical hours.

### 3.2.2 Service Packs and Updates

Microsoft® regularly creates security updates and other patches to protect Windows® based operating systems. These are released through the Microsoft® Update website and associated update server. Instruments using Windows, especially those that connect to a network, should be updated regularly.

### 3.2.3 Login

Windows 10 requires that users identify themselves by entering a username and password in a login window.

For the administrator account, an automatic login function is active by default. If activated, login is carried out automatically for the administrator (with full access) in the background when the DNA is started, without having to enter a password.

On your DNA the default Password is "**Blank phrase**".

Note that this password is very weak, and it is recommended that you change the password for both users after initial login. You can change the password in Windows 7 for any user at any time via:

- Step 1.** Click on the Windows button in the bottom left corner of your screen.
- Step 2.** Click on the **Settings** gear icon.
- Step 3.** Click on **Accounts**.
- Step 4.** Click on **Sign-in options** on the left-hand side of the window.
- Step 5.** Click on **Password**.
- Step 6.** Click **Change**.

### 3.2.4 Connecting USB Devices

The USB interfaces on the front and rear panels of the DNA allow you to connect USB devices directly to the instrument. This number can be increased as necessary by using USB hubs. Due to the large number of available USB devices, there is almost no limit to the expansions that are possible with the DNA.

The following list shows various USB devices that can be useful:

- Memory sticks for easy transfer of data to/from a computer (e.g. Saves Curves).
- CD-ROM drives for easy installation of applications.
- Keyboard or mouse to simplify the entry of data, comments, files names, etc.
- Printer for printing out measurement results.

Installing USB devices is easy under Windows®, because all USB devices are plug&play. After a device is connected to the USB interface, automatically searches for a suitable device driver.

If Windows® does not find a suitable driver; it will prompt you to specify a directory that contains the driver software. If the driver software is on a CD, connect a USB CD-ROM drive to the instrument before proceeding.

When a USB device is subsequently disconnected from the DNA, Windows® immediately detects the change in hardware configuration and deactivates the corresponding driver.

All USB devices can be connected to or disconnected from the instrument during operation.

#### Connecting a memory stick or CD-ROM drive

If installation of a memory stick or CD-ROM drive is successful, Windows informs you that the device is ready to use. The device is made available as a new drive and is displayed in Windows Explorer. The name of the drive depends on the manufacturer.

#### Connecting a keyboard

The keyboard is detected automatically when it is connected. The default input language is **English – US**. However, you can also connect foreign language keyboards.

**Step 1.** Click on the Windows button in the bottom left corner of your screen.

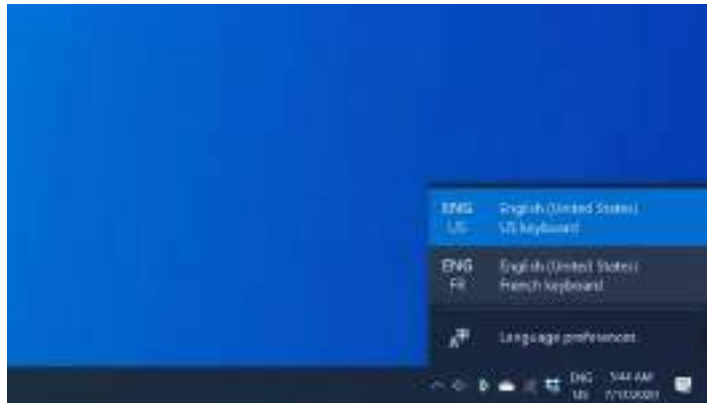
**Step 2.** Click on the **Settings** gear icon.

**Step 3.** Click on **Time & Language**.

**Step 4.** In the navigation pane on the left, click "**Language**."

**Step 5.** Scroll down to "**Keyboards**" and then click "**Add a keyboard**." In the pop-up menu, click the keyboard language you want to add.

**Step 6.** "**Close Settings**". Once you add a second keyboard language to Windows, a language control button will appear in the taskbar, in the lower-right corner of the screen. Click it, and in the pop-up menu that appears, choose the language you want to use with your keyboard.



### Connecting a mouse

The mouse is detected automatically when it is connected.

Select "**Windows > Settings > Devices > Mouse**" to configure the mouse properties. To access the Windows operating system, press the Windows® key on the external keyboard.

### Connecting printer

When printing a file, the instrument checks whether a printer is connected and turned on and whether the appropriate printer driver is installed. If required, printer driver installation is initiated. A printer driver needs to be installed only once.

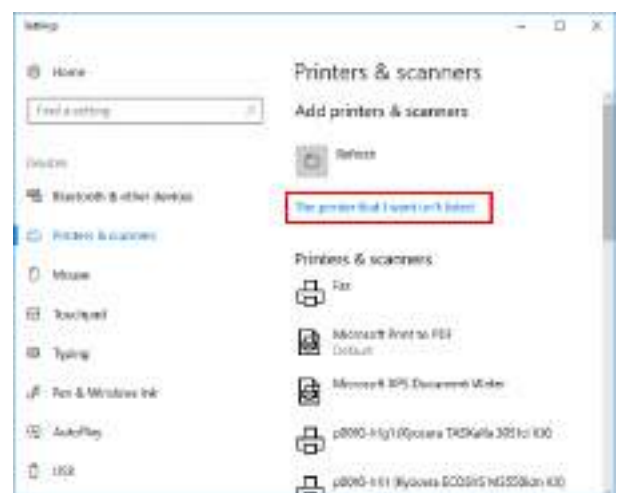
To install a printer, select "**Windows > Settings > Devices**" on the left sidebar select "**Printers & Scanners**", and click to "**Add a printer or scanner**".

**Note:** Once Windows detects your printer, all you have to do is follow the on-screen instructions for setting it up. If this is the case, you can stop at this point. However, if Windows does not auto-detect your printer, proceed to the next step.

Click "**The printer that I want isn't listed.**" Once you select this, the "**Add Printer**" screen will pop up.

Choose "**Add a local printer or network printer with manual settings,**" and click next.

You can load updated and improved driver versions or new drivers from an installation disk, USB memory stick or another external storage medium. If the instrument is integrated in a network, you can also install driver data stored in a network directory.



### 3.2.5 Connecting an External Monitor

You can connect an external monitor or other display device (e.g. projector) to the VGA connector on the instrument's rear panel, to provide an enlarged display.

#### Screen resolution and format

Monitor or projector using a different format (e.g. 4:3), the calibration will not be correct and the screen will not react to your touch actions properly.

The touchscreen has a screen resolution of 1280x800 pixels. Most external monitors have a higher screen resolution. If the screen resolution of the monitor is set higher than the instrument's resolution, the application window uses an area of 1280x800 pixels on the monitor display. For full screen display, adjust the monitor's screen resolution.

The DNA supports a maximum resolution of 1280x800 pixels.

Connect the external monitor to the DNA.

- Step 1.** Connect the external monitor to the DNA.
- Step 2.** Click on the Windows button in the bottom left corner of your screen.
- Step 3.** Click on the **Settings** gear icon.
- Step 4.** Click on **System > Display**.
- Step 5.** The standard Windows "Screen Resolution" dialog box is displayed.



- Step 6.** If necessary, change the screen resolution to be used. Consider the information in the note above.
- Step 7.** Select the instrument to be used for display:
  - **"Display 1"**: internal monitor only.
  - **"Display 2"**: external monitor only.
  - **"Duplicate"**: Secondary displays will mirror the primary monitor.
  - **"Extend"**: Both screens are combined to offer an extended desktop.
- Step 8.** Tap **"Apply"** to try out the settings before they are accepted permanently, then you can easily return to the previous settings, if necessary.
- Step 9.** Select **"OK"** if the settings are suitable.

### 3.2.6 Setting Up a Network (LAN) Connection

The DNA is equipped with a network interface and can be connected to an Ethernet LAN (local area network). Provided the appropriate rights have been assigned by the network administrator and the Windows® firewall configuration is adapted accordingly, the interface can be used, for example:

- To transfer data between a controlling device and the test device, e.g. in order to run a remote control program. See chapter "**Remote Control**"
- To access or control the measurement from a remote computer using the "**Remote Desktop**" application (or a similar tool)
- To connect external network devices (e.g. printers)
- To transfer data from a remote computer and back, e.g. using network folders

**Note:** That only user accounts with administrator rights can configure LAN networks.

### 3.2.7 Connecting the Instrument to the Network

There are two methods to establish a LAN connection to the instrument:

- A non-dedicated network (Ethernet) connection from the instrument to an existing network made with an ordinary RJ-45 network cable. The instrument is assigned an IP address and can coexist with a computer and with other hosts on the same network.
- A dedicated network connection (Point-to-point connection) between the instrument and a single computer made with a (crossover) RJ-45 network cable. The computer must be equipped with a network adapter and is directly connected to the instrument. The use of hubs, switches, or gateways is not required; however, data transfer is still performed using the TCP/IP protocol. An IP address must be assigned to the instrument and the computer, see section 3.2.8, "**Assigning the IP Address**".

**CAUTION:** Risk of network failure, before connecting the instrument to the network or configuring the network, consults your network administrator. Errors may affect the entire network.

### 3.2.8 Assigning the IP Address

Depending on the network capacities, the TCP/IP address information for the instrument can be obtained in different ways.

- If the network supports dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), all address information can be assigned automatically.
- If the network does not support DHCP, or if the instrument is set to use alternate TCP/IP configuration, the addresses must be set manually.

By default, the instrument is configured to use dynamic TCP/IP configuration and obtain all address information automatically. This means that it is safe to establish a physical connection to the LAN without any previous instrument configuration.

**CAUTION:** Risk of network errors, Connection errors can affect the entire network. If your network does not support DHCP, or if you choose to disable dynamic TCP/IP configuration, you must assign valid address information before connecting the instrument to the LAN. Contact your network administrator to obtain a valid IP address.

## Assigning the IP address on the instrument

- Step 1.** Press "**Windows > Settings**" (gear icon) > "**Network & Internet**"
- Step 2.** Press "**Ethernet**" In the navigation pane on the left.
- Step 3.** The Ethernet settings page appears, click on "**Change Adapter Options**".
- Step 4.** Select Ethernet Adapter, in contextual menu select "**Properties**".
- Step 5.** Select Tap the entry named "**Internet Protocol Version 4 (TCP / IPv4)**" and press "**Properties**" key. (See Figure 4)
- Step 6.** Toggle the "**DHCP On/Off**" with setting mode "**Obtain an IP address automatically**" or "**Use the following IP address:**".
- Step 7.** If DHCP is "**Off**" = "**Use the following IP address:**", you must enter the IP address manually, as described in the following steps.
- Step 8.** Enter the "**IP Address**", for example 192.0.2.0. The IP address consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.
- Step 9.** Enter the "**Subnet Mask**", for example 255.255.255.0. The subnet mask consists of four number blocks separated by dots. Every block contains 3 numbers in maximum. Press "**OK**". If you have entered an invalid IP address or subnet mask, the message "**The Combination of IP and subnet mask is invalid ...**" is displayed in the status line. If the settings are correct, the configuration is saved, and you are prompted to restart the instrument.

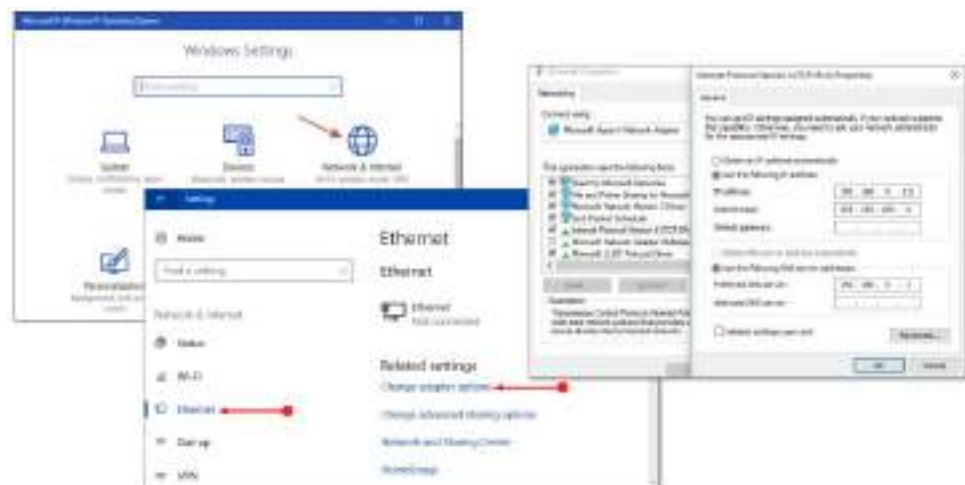


Figure 4

- Step 10.** When a DHCP server is used, a new IP address may be assigned each time the instrument is restarted with the mode "Obtain an IP address automatically" This address must first be determined on the instrument itself. Thus, when using a DHCP server, it is recommended that you use the permanent computer name, which determines the address via the DNS server (see "**Using a DNS server to determine the IP address**" section 3.2.10, "Using computer names").

### 3.2.9 Using a DNS server to determine the IP address

If a DNS server is configured on the DNA, the server can determine the current IP address for the connection using the permanent computer name.

- Step 1.** Press **"Windows > Settings"** (gear icon) > **"Network & Internet"**
- Step 2.** Press **"Ethernet"** In the navigation pane on the left.
- Step 3.** The Ethernet settings page appears, click on **"Change Adapter Options"**.
- Step 4.** Select Ethernet Adapter, in contextual menu select **"Properties"**.
- Step 5.** Select Tap the entry named **"Internet Protocol Version 4 (TCP / IPv4)"** and press **"Properties"** key. (See Figure 4)
- Step 6.** On the **"General"** tab, select **"Use the following DNS server addresses"** and enter your own DNS addresses.

For more information refer to the Windows operating system Help.

### 3.2.10 Using computer names

In a LAN that uses a DNS server (Domain Name System server), each PC or instrument connected in the LAN can be accessed via an unambiguous computer name instead of the IP address. The DNS server translates the host name to the IP address. This is especially useful when a DHCP server is used, as a new IP address may be assigned each time the instrument is restarted.

Each instrument is delivered with an assigned computer name, but this name can be changed.

#### To change the computer name

- Step 1.** Press **"Windows > Settings > System > About"**.
- Step 2.** Select **"Rename this PC"**.
- Step 3.** Enter a new name and select **"Next"**. You may be asked to sign in.
- Step 4.** Select **"Restart now"** or **"Restart later"**.

### 3.2.11 Changing the Windows Firewall Settings

A firewall protects an instrument by preventing unauthorized users from gaining access to it through a network. ARCALE® highly recommends the use of the firewall on your instrument. ARCALE® instruments are shipped with the Windows firewall enabled and preconfigured in such a way that all ports and connections for remote control are enabled.

**Note:** That changing firewall settings requires administrator rights.

### 3.2.12 Setting the Date and Time

Users with administrator rights can set the date and time for the internal real time clock as follows:

**Local solution:**

- Step 1.** Click **“Windows > Settings”** (gear icon).
- Step 2.** The Settings Panel window appears. Click **“Time & language”**.
- Step 3.** Press **“Date and Time”** In the navigation pane on the left.
- Step 4.** Turn ON **“Set time automatically”** button, Windows use the “Date and time” parameters automatically.
- Step 5.** Turn OFF **“Set time automatically”** button, for use “Date and Time” manually parameters.
  - a. If **“Set time automatically”** disabled button, it’s possible to change the date and time settings with the “Modify” button.
  - b. Enter the **“Date”** (E.g. 5, January 2018) from the drop lists and change the **“Time”**. Click **“Change”** for apply parameters.

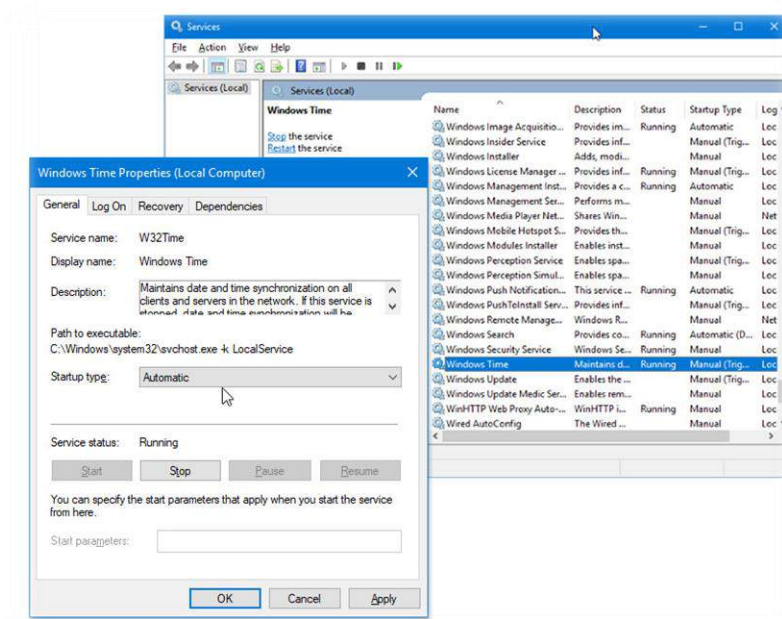


**Windows Time Service:**

If you’re still having problems changing the date and time in Windows®, go to **“Services”** Panel: Check if the Windows Time service is running.

As you know, Windows 10 has a service running in the background called Windows Time to maintain the synchronization between the date and time. To check if this service is running, follow these steps:

- Step 1.** Open the Run search box, type keywords **“services.msc”** and then press Enter to open the Services window.
- Step 2.** In the Services window, find the **“Windows Time service”** and then double-click it to open the Windows Time Properties dialog box.



**Step 3.** Make sure the service's startup type is automatic and the service status is running. If the displayed service status is stopped, click on the **“Start”** button to restart the service. Restart the DNA and see what happens.

## 4 INSTRUMENT OVERVIEW

### 4.1 Front Panel View

This chapter describes the front panel, including all function keys and connectors. All connectors are 50 Ohm impedance. RF IN and EXT RF In are N type. All others are SMA type.



Figure 3 - DNA L (Lite) Front Panel View

1. Power Switch ON/OFF ([Switching the Instrument On and Off](#))
2. Front Panel USB Connectors
3. Touchscreen
4. DUT Input
5. DUT RF Output (After internal RF Splitter)
6. External RF Input (ADC2 & ADC3 see Figure 11 – Global Architecture. )
7. External Reference Input
8. External Reference Output (After internal RF Splitter)
9. External Reference Input (ADC2 & ADC3 see Figure 11 – Global Architecture. )



Figure 4 - DNA F (Full) Front Panel View

1. Power Switch ON/OFF ([Switching the Instrument On and Off](#))
2. Front Panel USB Connectors
3. Touchscreen
4. DUT Input
5. DUT RF Output (After internal RF Splitter)
6. External RF Input (ADC2 & ADC3 see Figure 11 – Global Architecture. )
7. External Reference Input
8. External Reference Output (After internal RF Splitter)
9. External Reference Input (ADC2 & ADC3 see Figure 11 – Global Architecture. )
10. Internal References Output (REF 1 & REF 2 see Figure 11 – Global Architecture. )

#### 4.1.1 Touchscreen

All measurement results are displayed on the screen on the front panel. Additionally, the screen display provides status and setting information and allows you to switch between various measurement tasks. The screen is touch-sensitive, offering an alternative means of user interaction for quick and easy handling of the instrument.

##### **Risk of touchscreen damage during operation**

The touchscreen may be damaged by inappropriate tools or excessive force. Observe the following instructions when operating or cleaning the touchscreen:

- Never touch the screen with ball point pens or other pointed objects with sharp edges.
- It is recommended that you operate the touchscreen by finger only. As an alternative, you may use a stylus pen with a smooth soft tip.
- Never apply excessive force to the screen. Touch it gently.
- Never scratch the screen surface, for example with a fingernail. Never rub it strongly, for example with a dust cloth.

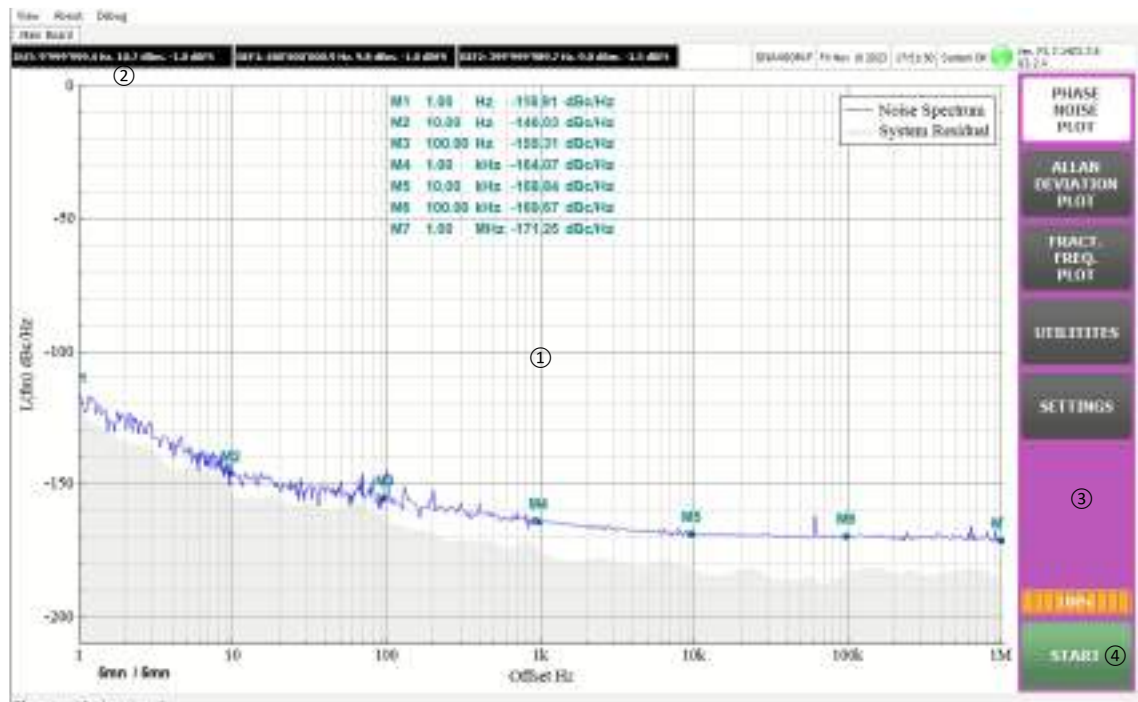


Figure 6: Touchscreen elements

- ① Measurement results area
- ② Instrument status bar
- ③ Soft keys for function access
- ④ Start Measurement Key

A touchscreen is a screen that is touch-sensitive, i.e., it reacts in a specified way when a particular element on the screen is tapped by a finger or a pointing device, for example. Any user interface elements that can be clicked on by a mouse pointer can also be tapped on the screen to trigger the same behavior, and vice versa. Using the touchscreen, the following tasks (among others) can be performed by the tap of your finger.

- Changing settings.
- Changing the display.
- Run measurements.
- Saving or printing results and settings.

#### 4.1.2 USB

The front panel provides two female USB connectors (USB-A) to connect devices like a keyboard or a mouse. In addition, a memory stick can be connected to store curves measurement data. The rear panel provides too two USB connectors. All USB ports support standard 2.0.

### 4.1.3 Function Keys

Function keys provide access to the most common measurement settings and functions.

A detailed description of the corresponding functions is provided in the table below:

Function key	Assigned functions
Basic measurement settings	
<b>PHASE NOISE PLOT</b>	Phase Noise plot button. When this button is active, the phase noise density plot is displayed on the main interface.
<b>ALLAN DEVIATION PLOT</b>	When this button is active, the frequency stability curve is displayed on the main interface. It is noted that the phase noise plot and the Allan deviation plot is auto exclusive. Only one plot can be displayed at a time.
<b>FRACT. FREQ. PLOT</b>	When this button is active, the fractional frequency noise is displayed in real time while the measurement is ongoing. It is noted that this plot can be displayed at the same time with the phase noise plot or the frequency stability plot.
<b>UTILITIES</b>	To get access to different utilities.
<b>SETTINGS</b>	To get access to measurement parameters and display settings.
<b>START</b>	Start the measurement. While a measurement is ongoing, click this button again to Stop.

### 4.1.4 RF INPUT

A device under test (DUT) can be connected to the DNA to provide RF input which is then analyzed. The DUT is connected to the instrument's RF INPUT via a cable equipped with an appropriate connector.

Connection should be made as bellow:



Figure 5 – DUT

DUT IN 1 & DUT IN 2 connectors are also the baseband direct inputs for noise measurements.

**CAUTION:** Risk of instrument damage, do not overload the input. For maximum allowed values, see the data sheet.

#### 4.1.5 EXTERNAL/INTERNAL REFERENCE INPUT/OUTPUT CONNECTORS

The REF INPUT connector is used to provide an external reference signal to the DNA.

The INT REF Output connectors can be used to provide an internal reference signal to the DNA, or to other devices that are connected to this instrument. **This possibility exists for the DNA-F Series only.**

##### 4.1.5.1 EXTERNAL REFERENCES (DNA F or L versions)

To use external references for the measurements, connect coax cables between connectors (see Figure 6 - DNA F Version & Figure 7 - DNA L Version ):

“REFERENCES 1” ↔ “OUT”  
“REFERENCES 2” ↔ “OUT”



Figure 7 - DNA L Version



Figure 6 - DNA F Version

##### 4.1.5.2 Use INTERNAL REFERENCES (DNA F version only)

For Use the Internal references for the measurements, connect Coax cables between connectors, (see Figure 8 - Internal references):

“REFERENCES IN 1” ↔ “INT REF OUT 1”  
“REFERENCES IN 2” ↔ “INT REF OUT 2”



Figure 8 - Internal references

#### 4.1.6 Rear Panel View

This figure shows the rear panel view of the DNA. The individual elements are described in more detail in the subsequent sections.



Figure 9 - DNA Lite Rear Panel View

1. Computer Motherboard Connectors
2. Labels Zone
3. AC Power Supply Connection
4. REF CLK IN : 10 MHz Input <sup>(note 1)</sup>
5. REF CLK OUT : 10 MHz output

(Note 1): DNA lite do not has internal reference. The 10 MHz is the oscillator used for all ADC.



Figure 10 - DNA Full Rear Panel View

1. Computer Motherboard Connectors
2. Labels Zone
3. AC Power Supply Connection
4. REF 1 IN : 10 MHz internal reference 1 input
5. REF CLK OUT : 10 MHz Output
6. REF 2 IN : 10 MHz internal reference 2 input

## 4.1.7 Computer Motherboard Connectors

### 4.1.7.1 VGA Port

You can connect an external monitor or other display device to the DNA to provide an enlarged display.

The VGA display interface of DNA support either VGA on rear IO and can drive a wide range of standard CRT VGA and flat panel displays.

For details refer to paragraph 3.2.5, "[Connecting an External Monitor](#)".

### 4.1.7.2 LAN

The LAN interface can be used to connect the DNA to a local network for remote control, printouts, or data transfer. The assignment of the RJ-45 connector supports twisted-pair category 5 UTP/STP cables in a star configuration (UTP stands for unshielded twisted pair, and STP for shielded twisted pair).

For details refer to paragraph 3.2.6, "[Setting Up a Network \(LAN\) Connection](#)".

### 4.1.7.3 USB

For details refer to paragraph 4.1.2, "[USB](#)".

## 4.1.8 AC Power Supply Connection

An AC power supply connector is located in a unit on the rear panel of the instrument to power most of the DNA parts.

For More details refer to paragraph 3.1.4, "[Connecting the AC Power](#)".

### 4.1.9 REF 1 & 2 IN

DNA Full versions have two internal references (REF 1 & REF2).

The references are 400 MHz coming from 10 MHz & 100 MHz OCXO's

The 10 MHz OCXO could be disciplined using an external 10 MHz signal.

No special DNA setup configuration is required to use this capability, as soon as the 10 MHz external signal is connected to rear BNC REF the internal oscillator is disciplined getting the external signal stability.

There is one per channel.

This configuration is specially recommended for frequency stability analysis.

### 4.1.10 REF CLK IN

DNA Light do not have internal reference. However, DNA Light has a basic 10 MHz oscillator uses for ADC channels.

Using this ADC 10 MHz oscillator disciplined by an external 10 MHz signal is specially recommended for frequency stability analysis.

No special DNA setup configuration is required to use this capability, as soon as the 10 MHz external signal is connected to rear BNC REF CLK IN disciplines. It is getting the external signal stability.

#### 4.1.11 REF CLK OUT

REF CLK OUT is:

- 10 MHz ADC oscillator output for DNA Light
- 10 MHz reference 1 output for DNA Full

## 5 DNA GENERAL DESCRIPTION

### 5.1 INTRODUCTION

ARCALE's new generation Digital Noise Analyzer (DNA) is a low-cost, high-speed and high-performance phase noise and frequency stability measurement instrument. With an extremely low noise floor (approximately -190 dBc/Hz) within a very short measurement time (approximately 30 seconds), the DNA is a perfect solution for a production line of industrial oscillators.

The purpose of this document is to explain to users how to use the Graphical User Interface (GUI) of the machine to carry out the measurements. Although the GUI is self-explained and very easy to use, several key measurement parameters need to be understood in order to achieve the best measurement performance.

### 5.2 DNA GLOBAL ARCHITECTURE

The DNA's global measurement architecture is described in the Figure 11 – Global Architecture.. Basically, the DNA is based on a four-ADC architecture.

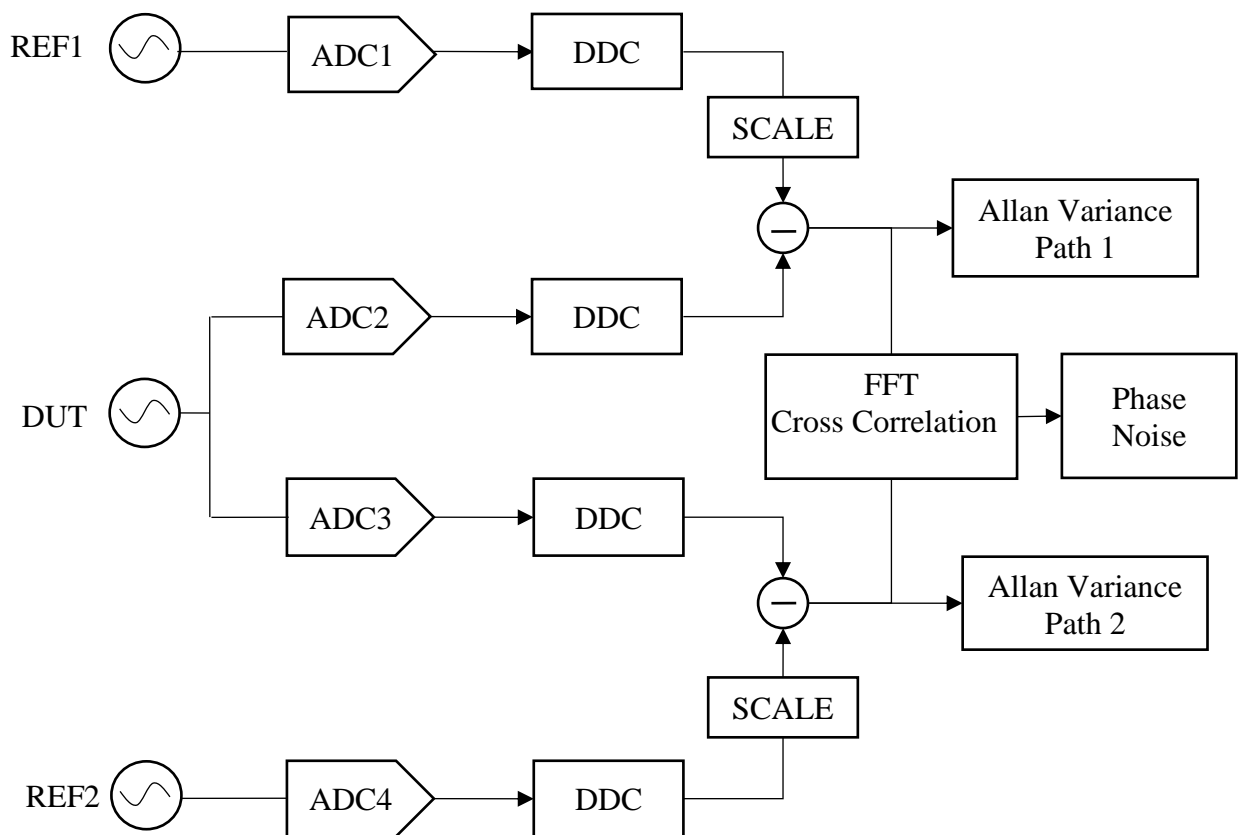


Figure 11 – Global Architecture.

This architecture allows both relative (Single channel) and absolute (Cross Correlation) phase noise measurement.

- When a same reference is split into the two channels CH1 and CH2, we have a relative measurement of the reference and the DUT. The phase noise density which is displayed by the DNA is the sum of both the DUT and the reference.
- When two independent references are given at the channels CH1 and CH2, we have an absolute phase noise measurement of the DUT. The phase noise density which is displayed by the DNA is that of the DUT.

DNA F (Full) is delivered with its internal two references and DNA L (Light) is delivered without internal reference. Hence, by default the DNA F gives an absolute phase noise measurement.

Thanks to scaling and subtraction techniques, the clock noise and a part of the system common noise are rejected. Also, the scaling technique allows that the references can be of any frequency (within the frequency range given by the datasheet) and we do not need any kind of phase lock loop between the reference and the DUT.

However, theoretically speaking, it is better to use a reference whose frequency is equal or higher than that of the DUT. This is because when the scaling is applied, the DUT's phase noise becomes dominant when compared to the reference's phase noise.

Finally, a cross-correlation technique is used to suppress the acquisition-related noise. Almost the whole digital signal processing chain is running in real time in the FPGA, which results in an outstanding performance in terms of measurement speed.

Using this technique DNA can perform:

- Absolute phase noise analysis
- Relative phase noise analysis
- Frequency stability analysis

According to the measurement mode, it is possible to measure both relative and absolute frequency stability:

- When a single path is used (it is the path1 which is used by the DNA), we measure the relative frequency stability of the reference (REF1) and the DUT. The standard deviation curve displayed by the DNA is the analysis of the sum of both the reference and the DUT frequency noise. It is also possible to setup the DNA to perform frequency stability using REF2.
- When both paths are used (cross-variance technique), the frequency noise at the first path is correlated with that of the second path. We obtain in this case an estimation of the absolute frequency stability of the DUT, given that the two references are independent.

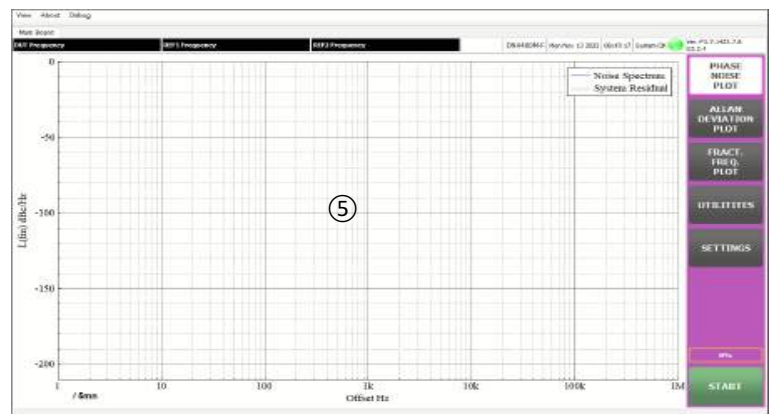
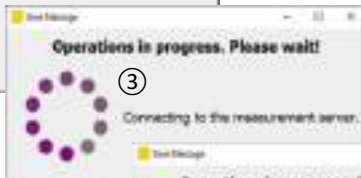
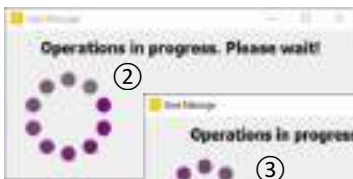
The scaled, subtracted frequency noise is transmitted in real time to the GUI where a frequency stability analysis is processed. The DNA gives four types of analysis:

- Allan variance.
- Overlapped Allan variance.
- Hadamard variance.
- Overlapped Hadamard variance.

## 6 DNA GUI Main Interface

When users push on the power button, the Windows will start, and the GUI will be automatically launched upon start up. The different initialization popup ① to ④ will be display and initialization is finished and complete when GUI ⑤ is display and the start button goes green.

At that stage DNA is ready for measurement



The GUI main interface is shown in the figure below.



Figure 12 – GUI main interface\*

The description of different fields on the GUI main interface is as follow.

- ① Main board displays measurement results and command buttons.
- ② DUT's frequency and signal level (in dBm & dBFS).
- ③ Internal reference n°1 frequency and signal level (in dBm & dBFS).
- ④ Internal reference n°2 frequency and signal level (in dBm & dBFS).
- ⑤ DNA Model number.
- ⑥ System date and time.
- ⑦ Useful user messages displayed in this field. System initialization and functioning status. It gives user's information concerning events such as input signal saturation, input signal lost, system temperature stability, system overheating event and high noise level detection.
- ⑧ System software and firmware version.
- ⑨ Phase noise, frequency stability and the real-time fractional frequency (path 1 and path 2) are displayed here.
- ⑩ Graph legend.
- ⑪ Phase Noise plot button. When this button is active, the phase noise density plot is displayed on the main interface ⑨.
- ⑫ Allan Deviation plot button. When this button is active, the frequency stability curve is displayed on the main interface ⑨. It is noted that the phase noise plot and the Allan deviation plot is auto exclusive. Only one plot can be displayed at a time (Figure 14 – Frequency Stability analysis display).
- ⑬ Fractional Frequency plot button. When this button is active, the fractional frequency noise (path 1 and path 2 shown in Figure 11) is displayed in real time while the measurement is ongoing. It is noted that this plot can be displayed at the same time with the phase noise plot or the frequency stability plot (Figure 15 – Fractional frequency noise display).
- ⑭ Click this button to get access to different utilities (Figure 16 – Utilities menu).
- ⑮ Click this button to get access to instrument setting: measurement and display. (Figure 33 – Measurement parameters configuration).
- ⑯ Measurement bar graph indicator. Shows measurement progress status.
- ⑰ Click this button to “start” the measurement. While a measurement is ongoing turns stop, click this button again “Stop” to stop.
- ⑱ Time, display after the slash character “/” the setting measurement time. Ongoing measurement time is displayed before the slash character “/”.
- ⑲ Cross-correlation number table. This table displays the number of cross-correlation and its corresponding gain ( $5 \times \log_{10}(N)$  dB) in function of frequency offset decades.

## 6.1 Phase Noise Plot

Pushing PHASE NOISE key turns DNA in phase noise measurement display.  
Utilities and Settings menu will allow user to setup the DNA in other way than default mode.  
Push Start key to process to measure.

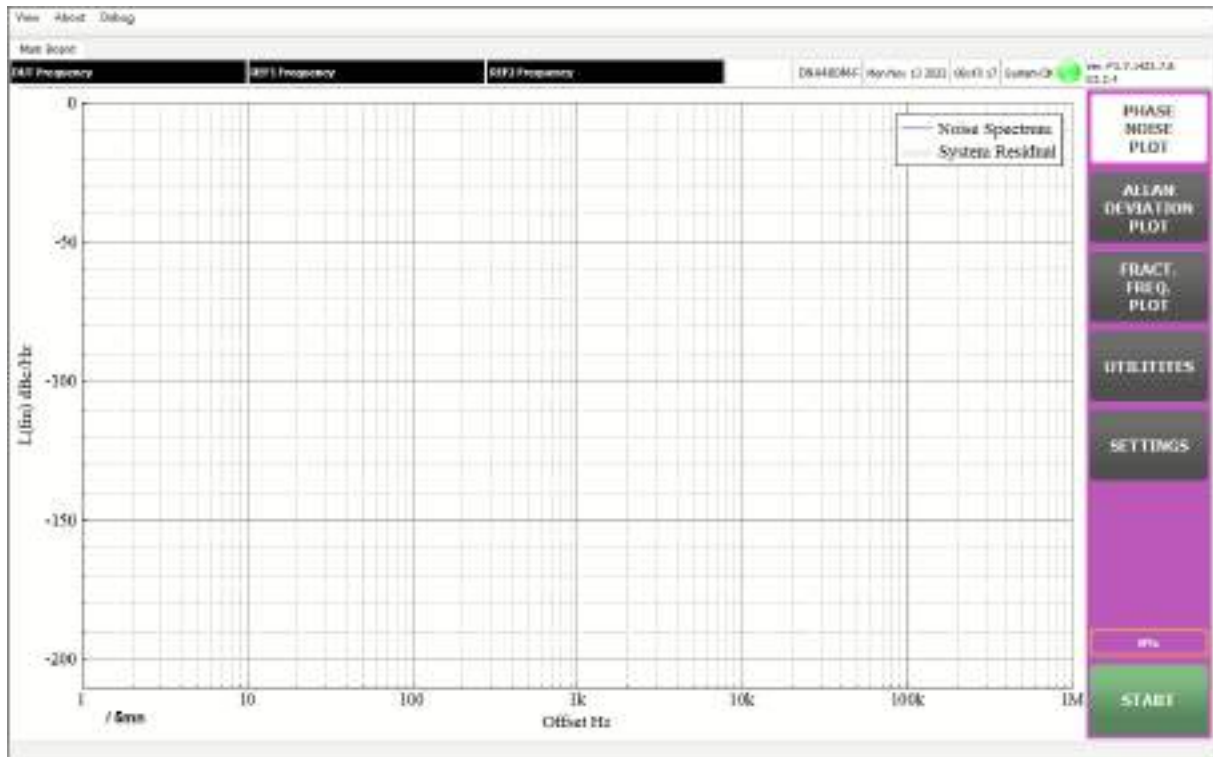


Figure 13 – Phase Noise display

## 6.2 Allan Deviation Plot

Pushing Allan Deviation Plot key turns DNA in frequency stability mode measurement display. Utilities and Settings menu will allow user to setup the DNA in other way than default mode to select the frequency stability capabilities. Push Start key to process to measure.

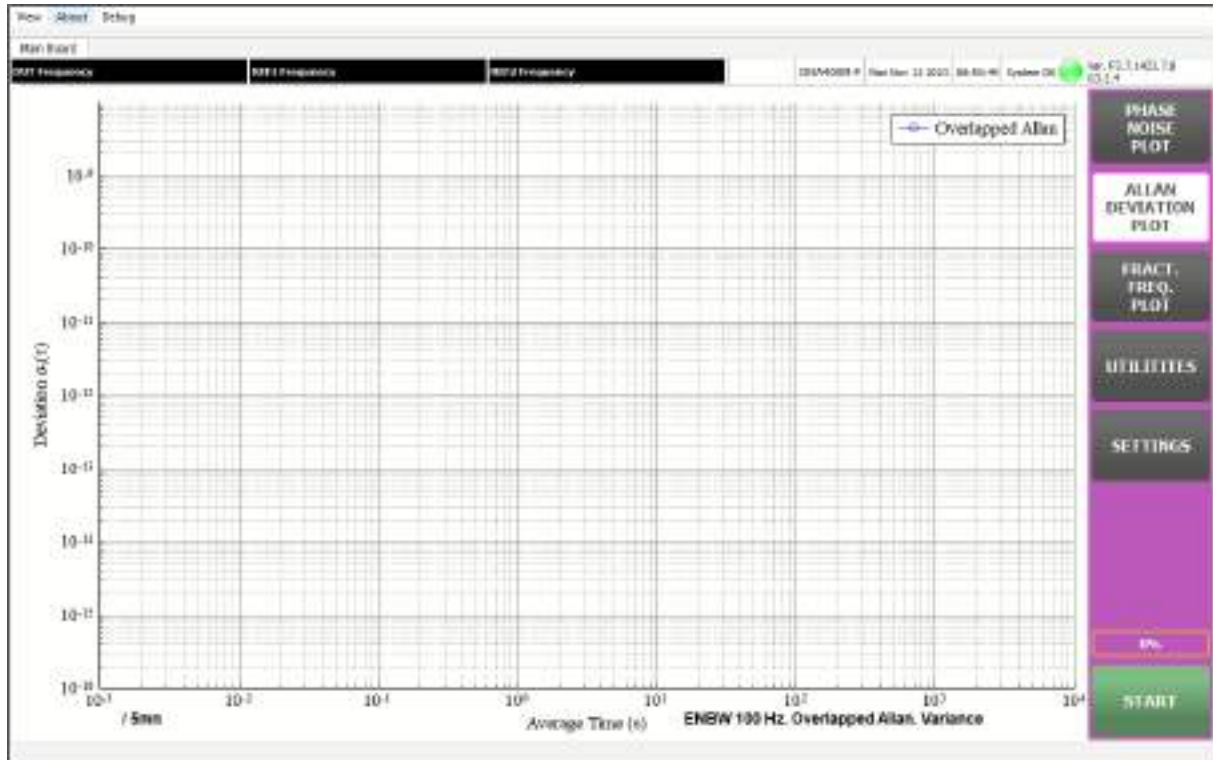


Figure 14 – Frequency Stability analysis display

## 6.3 Fractional Frequency Plot

Pushing Fractional Frequency plot splits display in two area. One for phase Noise or frequency stability based on the selected key and one for the fractional frequency graph.

When start key is pushed at the same time the phase noise or frequency stability is performed the frequency stability is displayed. This allows to user to trouble check strange behavior on measurement.

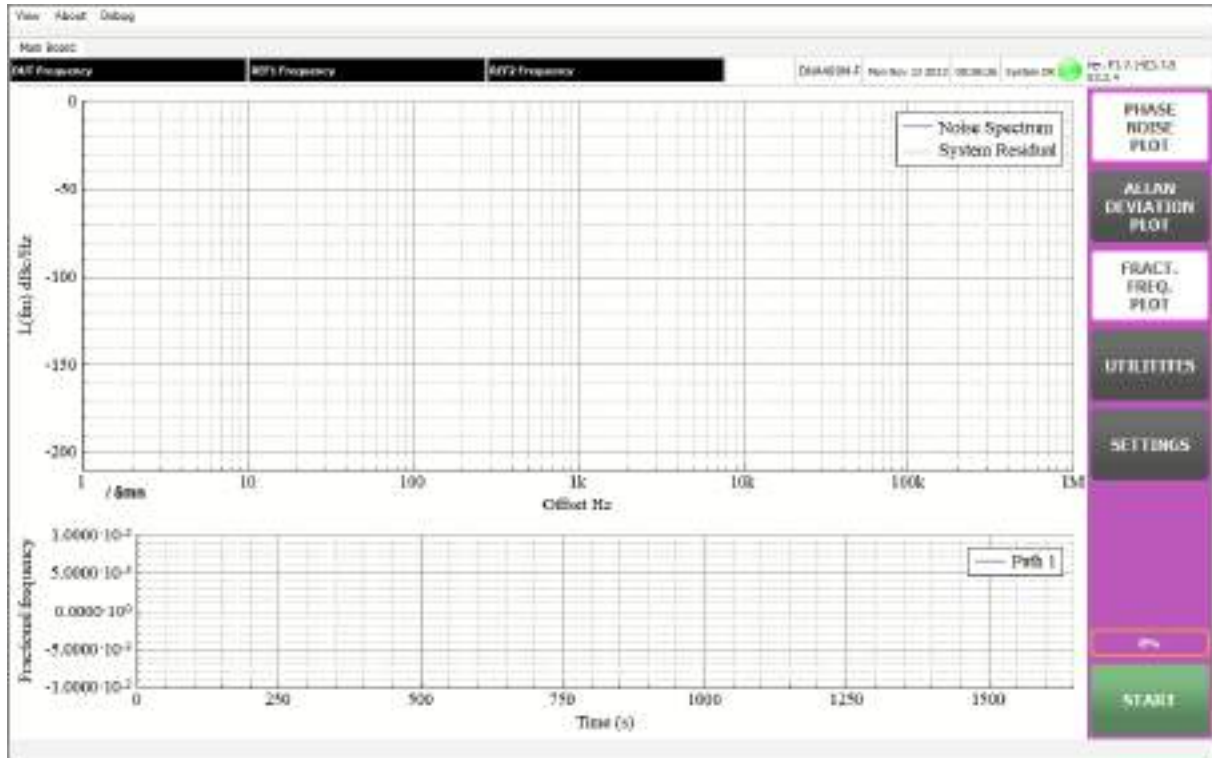


Figure 15 – Fractional frequency noise display

## 6.4 Utilities

Utilities functions are described in [section 7](#)

## 6.5 Settings

DNA settings are described in [section 8](#)

## 7 UTILITIES ①

In this section, we detail some important measurements utilities which can be useful in result analysis, measurement exploitation, record, and report. The system utilities can be accessed using the button **UTILITIES ①** from the main GUI interface.

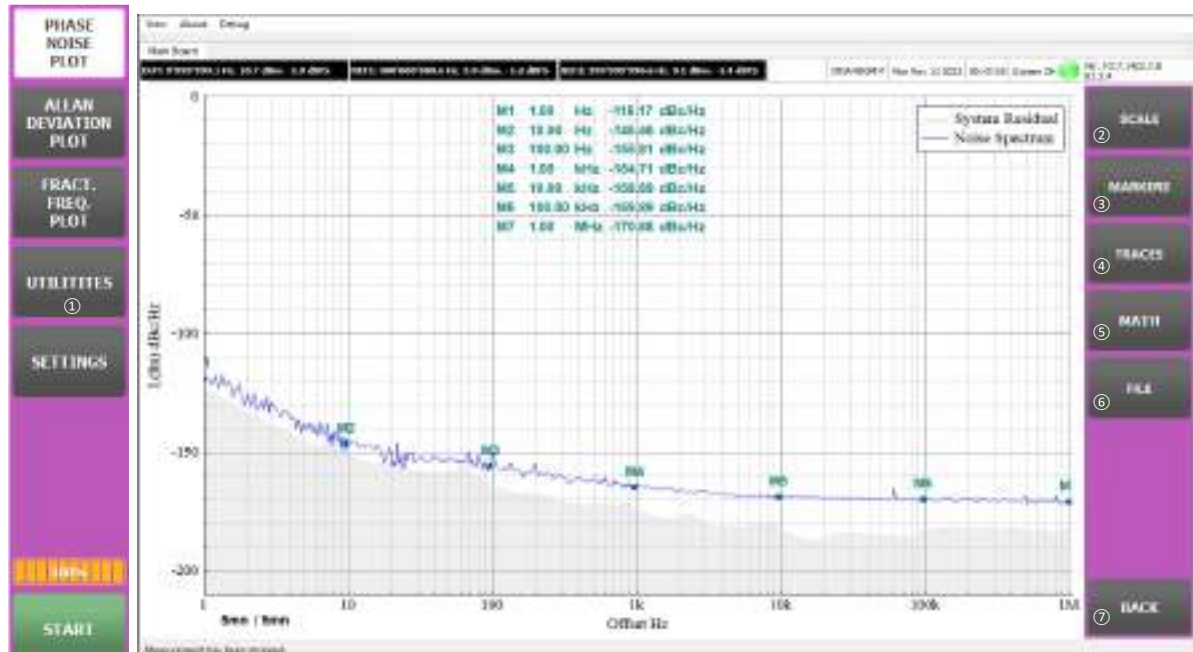


Figure 16 – Utilities menu

## 7.1 AXIS SETUP: SCALE ②

Scale key opens a pop up to set X and Y axis.

Scale is also possible using mouse.

In order to effectuate a zoom operation on a plot, users have two options: using the mouse or the **ZOOM** button.

### 7.1.1 Set the default zoom range

When the **SCALE** ② button (Figure 16 – Utilities menu) is click, a scale range widget is shown in order to setup a default scale range.

When range on both axes is defined, click on the **OK** button to finish the setup. This setup is memorized by the plot, and it also becomes the default scale range. The operation is illustrated in Figure 17 - Default Scale range setup

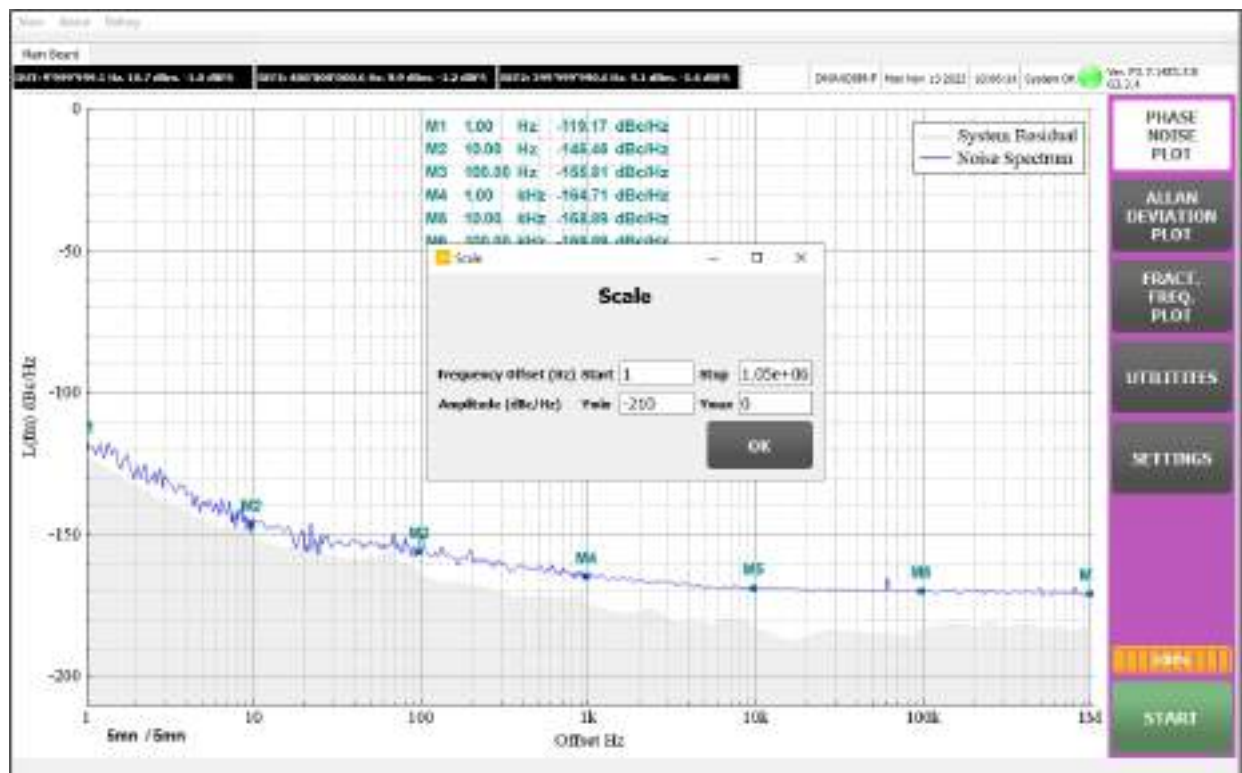


Figure 17 - Default Scale range setup

### 7.1.2 Scaling using the mouse

#### 7.1.2.1 Zoom with the mouse wheel

Using the mouse wheel is an effective way to zoom in and zoom out on a plot. When the mouse cursor is on a plot, scroll up the mouse wheel to zoom in and scroll down the mouse wheel to zoom out. It is noted that when the mouse cursor is on an axis (delimited by the axis line and the axis text), the zoom is only effective on that axis. And when the cursor is on the plot zone (delimited by the two axes and the legend), the operation is effective on both axes.

### 7.1.2.2 *Zoom with mouse click and drag*

Another practical way to zoom into a zone on a plot is to use the mouse click and drag operation. When users want to zoom into a rectangular zone on a plot, position the mouse cursor on the top-left corner of the rectangular, left click and drag the cursor to the bottom-right corner of the rectangular, and finally release the mouse. During dragging, a zoom rectangular appears on the plot to indicate the zoom rectangular. After releasing the mouse, the plot is zoomed into the zone defined by the rectangular. The zoom using mouse click-drag-release operation is illustrated in Figure 18 - Zoom using mouse click-drag-release operation.

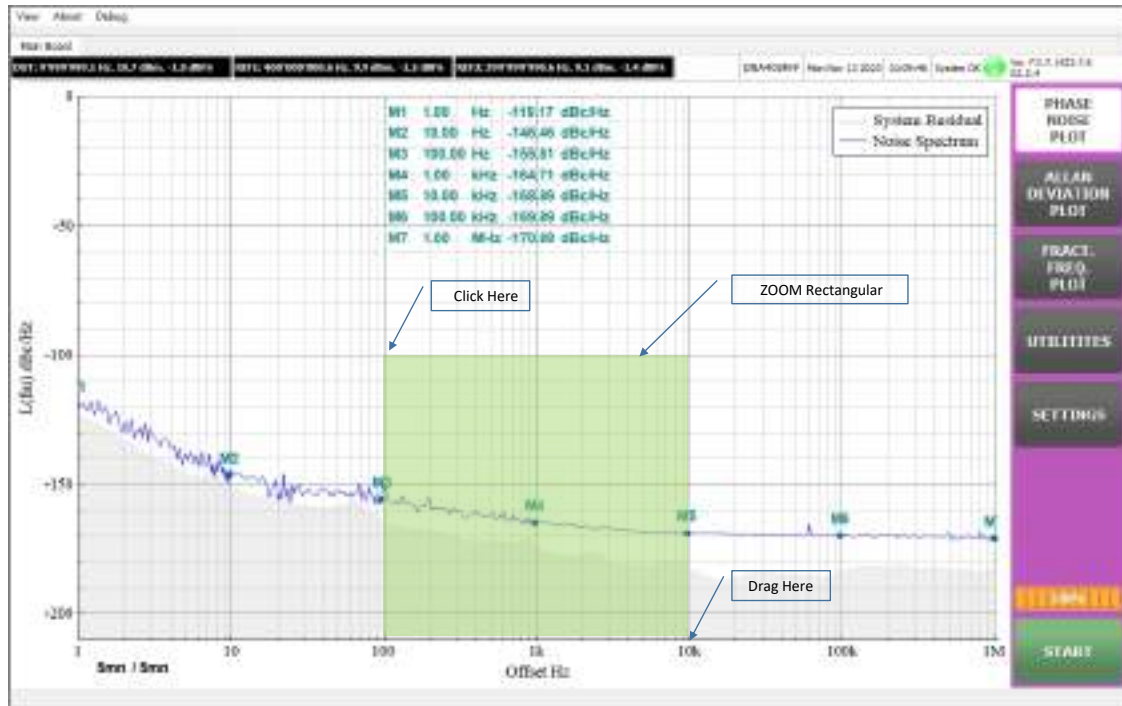


Figure 18 - Zoom using mouse click-drag-release operation.

It is noted that the plot is zoomed into the rectangular zone only when users drag the mouse from left to right. If for example users drag the mouse from the bottom-right corner to the top-left corner of the rectangular, the plot will be zoomed into the default zoom range as described in section 7.1.1. This is useful in case where users accidentally zoom into a very small area on the plot and have the impression as if everything disappears. In such a circumstance, users can click-drag-release the mouse from right to left to come back to the default zoom range.

### 7.1.2.3 *Mouse double click*

The mouse double click operation is another effective way to come back to the default range. It is useful when users accidentally zoom into a non-desired zone or when users want to return to the global view of the plot.

## 7.2 MARKER UTILITY: MARKERS ①

The markers are very useful for analyzing the performance curves. From the GUI main interface, the marker utility can be accessed by using the buttons **UTILITIES → MARKERS**.

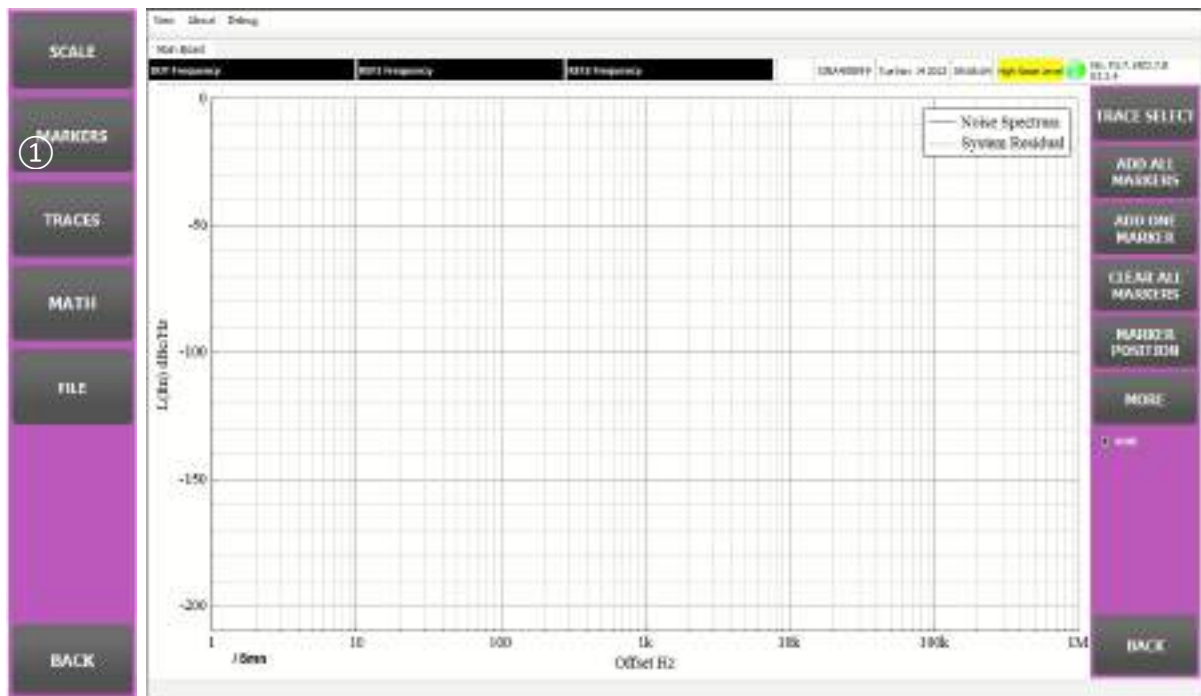


Figure 19 – Marker utilities menu

Before discussing in details different utilities concerning the graph markers, it is worth noticing some important principles of how a marker works.

- The markers can be placed on any graph which is displayed on a plot. However, they can be only placed on one graph at a time. Use the TRACE SELECT which contains the list of graph names to select the graph to be tracked.
- When a marker is placed at a point on a graph, its value could be either the value at that point, either average value of adjacent points around the marker. For averaging we use ten points at the left and ten points at the right of a marker to calculate the average value. This average gives a good approximation of the DUT's performance when the measured curve is excessively noisy. Hence, it is normal to observe that the marker does not lay exactly on the curve.
- The markers do not work on the spurious curve. This is because of the average operation described above and the fact that the spurious curve is a set of very sparse points.
- When a marker is active, its position can be set with the mouse click and the mouse click-drag-release methods, which will be described later in this section. Hence, users cannot use the mouse to carry out zoom operations anymore. When users select **NONE** (no marker is active), or when users quit the marker utilities tool bar, the zoom operations by using the mouse are available again.

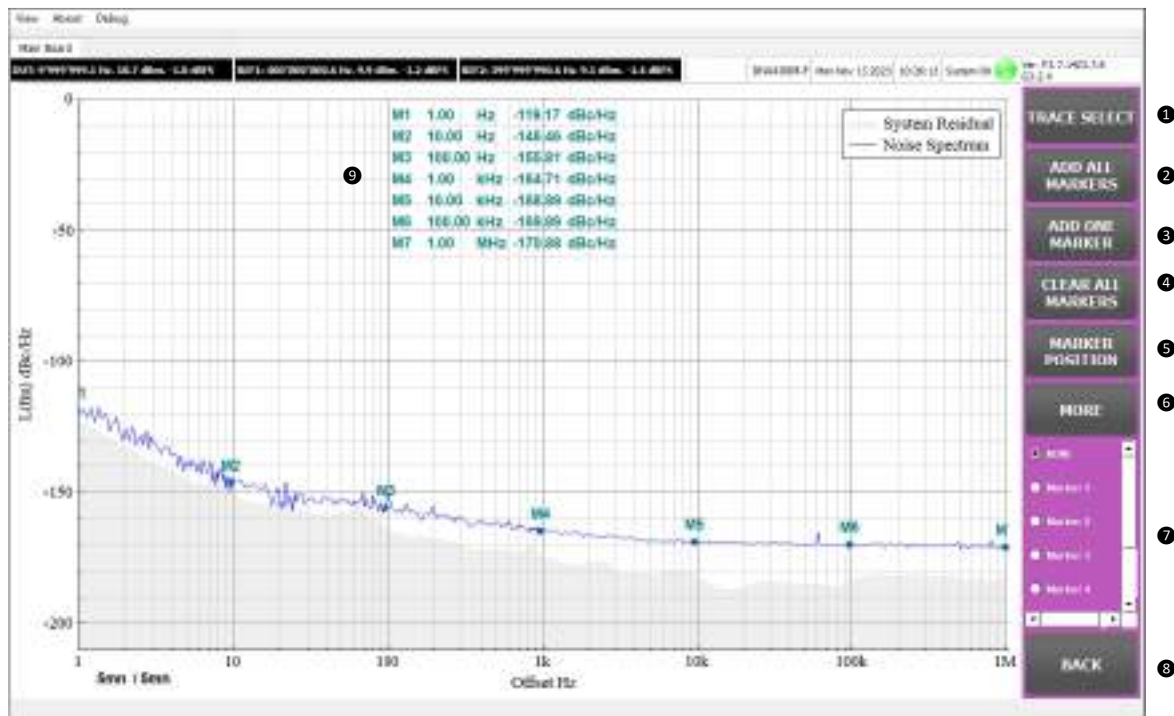


Figure 20 – Marker

### 7.2.1 Active graph select: TRACE SELECT ①

The TRACE SELECT in the graph utilities tool bar contains the name of all the graphs display on a plot, which is either the noise density plot or the frequency stability analysis plot. Use this TRACE SELECT ① to select the active graph. Only one graph is tracked by all the markers at a time.

### 7.2.2 Adding all marker with one click: ADD ALL MARKERS ②

When the **ADD ALL MARKERS** ② is clicked, markers are added to all the decades. For the phase noise density plot, markers are added at the frequency offset values: 1 Hz, 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz and 1 MHz.

For the frequency stability analysis plot, markers are added at all the decades beginning from the lowest value (depending on the equivalent noise bandwidth) up to 10000 seconds. For example, when the ENBW is equal to 10 Hz, markers are added to the abscissa values: 0.1 s, 1 s, 10 s, 100 s, 1000 s and 10000 s.

We will see later that when users generate a report for a measurement, if there is no marker added on a plot, all decade makers will be automatically added so that the DUT's performance can be reported.

### 7.2.3 Add only one marker: ADD ONE MARKER ③

If users want to add markers to the plot one by one, this **ADD ONE MARKER** ③ button can be used.

### 7.2.4 Remove all markers: CLEAR ALL MARKERS ④

Use button **CLEAR ALL MARKERS** ④ to clear all the markers on a plot.

### 7.2.5 Marker position ⑤

To move a marker to a position on a graph, there are two methods. Users can use either the button **MARKER POSITION ⑤** or the mouse.

Before, please make sure that:

- The to-be-tracked graph is correctly selected using the graph names TRACE SELECT. ①
- The active marker is correctly selected ⑦. By default, the NONE marker is selected, which means that there is no active marker.

#### 7.2.5.1 Marker abscissa position widget

When the button **MARKER POSITION** is clicked, the Marker abscissa setting widget ① is shown to setup the marker position. Pay attention marker is selected ② in the available marker list.

After inputting the marker's abscissa value, click on the button OK to apply the setup. For the phase noise density plot, the value unit is Hz. For the frequency stability analysis plot, the value unit is second. The

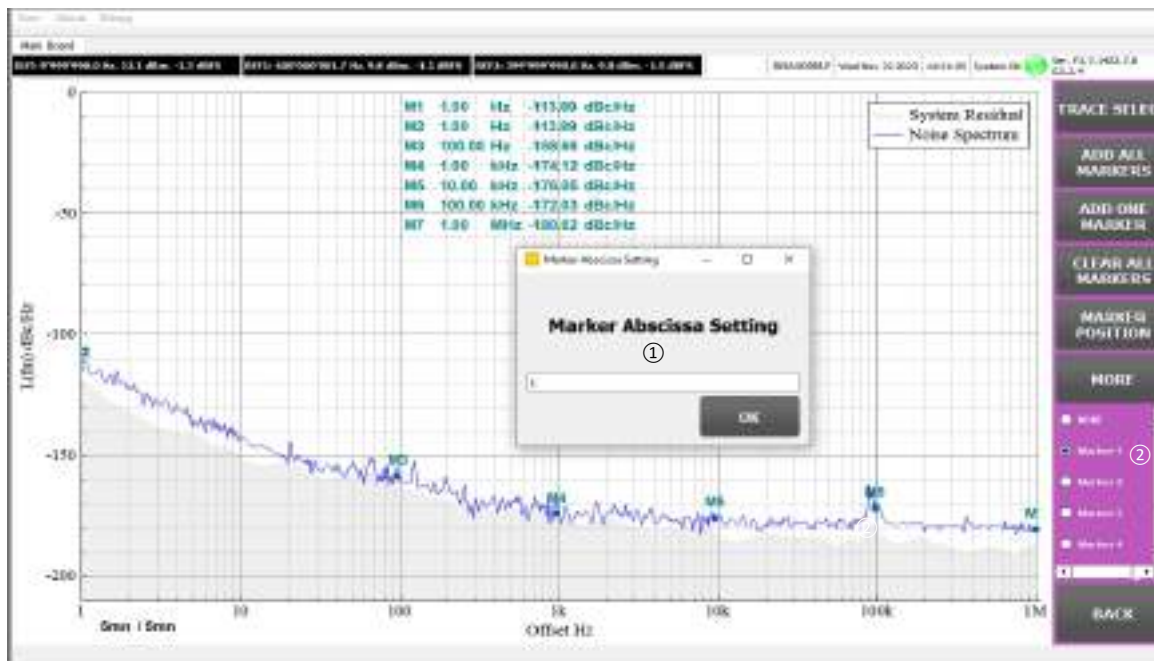


Figure 21 - Marker Position

procedure is illustrated in Figure 21 - Marker Position

#### 7.2.5.2 Marker abscissa position setup using the mouse

After selecting the to-be-tracked graph and the active marker, it is possible to move the marker along the graph by using the mouse. When users click on the plot, the active marker will move to the point whose abscissa value is nearest that of the mouse cursor. For example, when users want to examine the DUT's noise density performance at the frequency offset value of 10 Hz, a simple method is to click to a point near to the 10 Hz offset vertical grid line.

When users want to move a marker with a very fine step, first click to a point next to the desired point, then click-and-drag the mouse towards the desired point. While dragging, the marker moves with a very fine step. Release the mouse to finish the operation.

After finishing the setup, remember to select the **NONE** marker to avoid accidental mouse click on the plot, which results in unintentionally moving the marker.

## 7.2.6 MORE ⑥

Pushing MORE key offers more marker options

### 7.2.6.1 MARKER TYPE

Marker is on point on the plot, but it could be not the best position representation. Users have choice between:

- Average : Marker will be set at the define marker position with a value equal to measures averaging values of ten points at the left and ten points at the right of a marker.
- Normal : Marker will be set at the define marker position with its value.

### 7.2.6.2 MARKER VISIBLE

User can define if markers are plotted on the measurement curve.

Users have choice between:

- Visible: A small square is indicated on plot for marker position.
- Invisible: There is no marker position on plot. Only the marker table shows position and marker values.

## 7.3 GRAPH UTILITY: TRACE ①

The DNA offers several utilities to be able to manipulate graphs to be displayed on a plot.

From the GUI main interface, the graph utility can be accessed by using the buttons **UTILITIES → TRACES** ①.

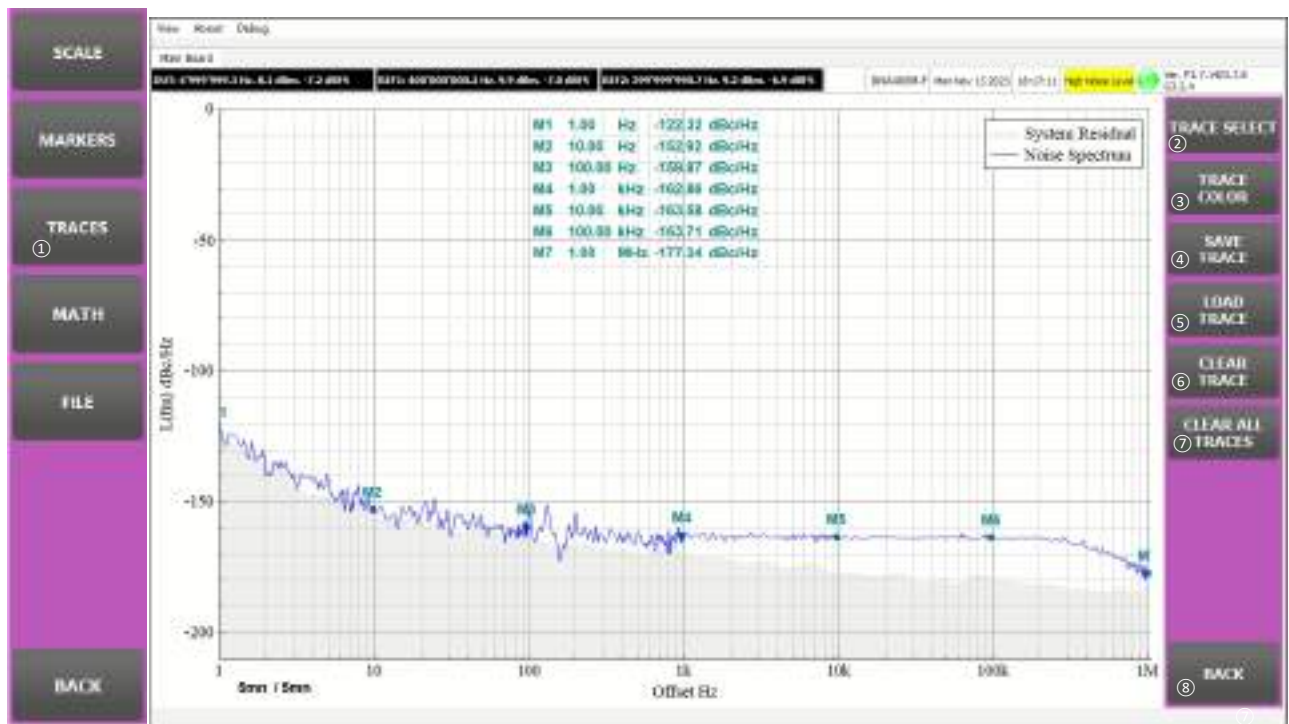


Figure 22 – Graph utilities menu

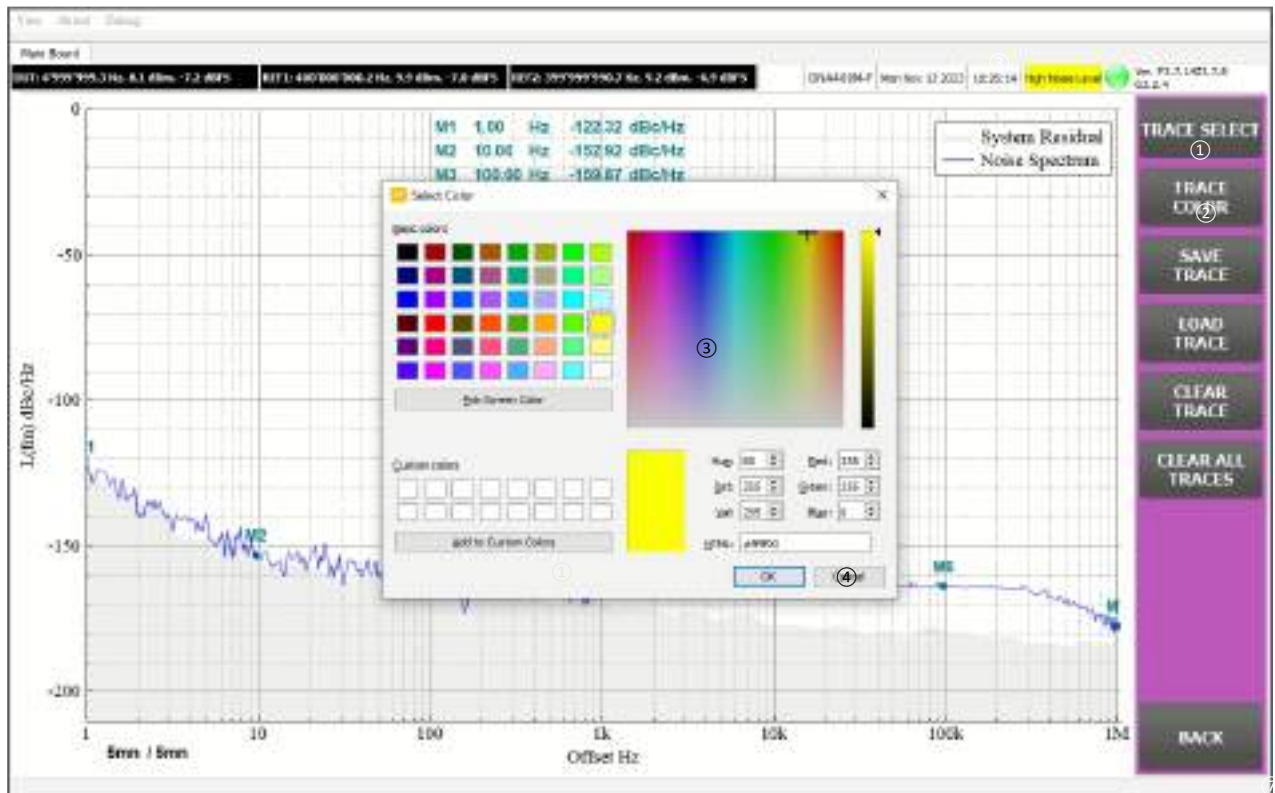
### 7.3.1 Active graph select: TRACE SELECT ②

The TRACE SELECT in the graph utilities tool bar contains the name of all the graphs display on a plot, which is either the noise density plot or the frequency stability analysis plot. Use this TRACE SELECT to select the active graph. When users execute an operation on a graph (for example changing the graph's color), it is effective only on the active graph.

### 7.3.2 Graph color change: TRACE COLOR ③

The color of a graph can be changed by using the button **TRACE COLOR** from the trace utilities tool bar. Make sure to select the concerning graph by using the graphs' names TRACE SELECT ②. After clicking on the button, a widget ③ is shown in order to select the desired color. Click on the button OK ④ to apply the change. The procedure of changing the graph color is illustrated in Figure 23 – Change the graph Color.

Figure 23 – Change the graph Color



### 7.3.3 Save graph data to file: SAVE TRACE

The data of a graph on a plot can be save into a csv file for later processing by using the **SAVE TRACE** button from the trace utilities tool bar.

Make sure to select the concerning graph by using the graphs' names **TRACE SELECT** ②

After clicking on the button ③, users are asked to browse to the to-be-saved file folder ④ and to input the file name ⑤.

Click on the **SAVE** ⑥ button to save the graph data into the file. A popup message will be display to inform to users that the operation has been successfully done.

Click on the OK ⑦ button to close the popup message. The graph data saving process is illustrated in the Figure 24 - Save Graph to data file

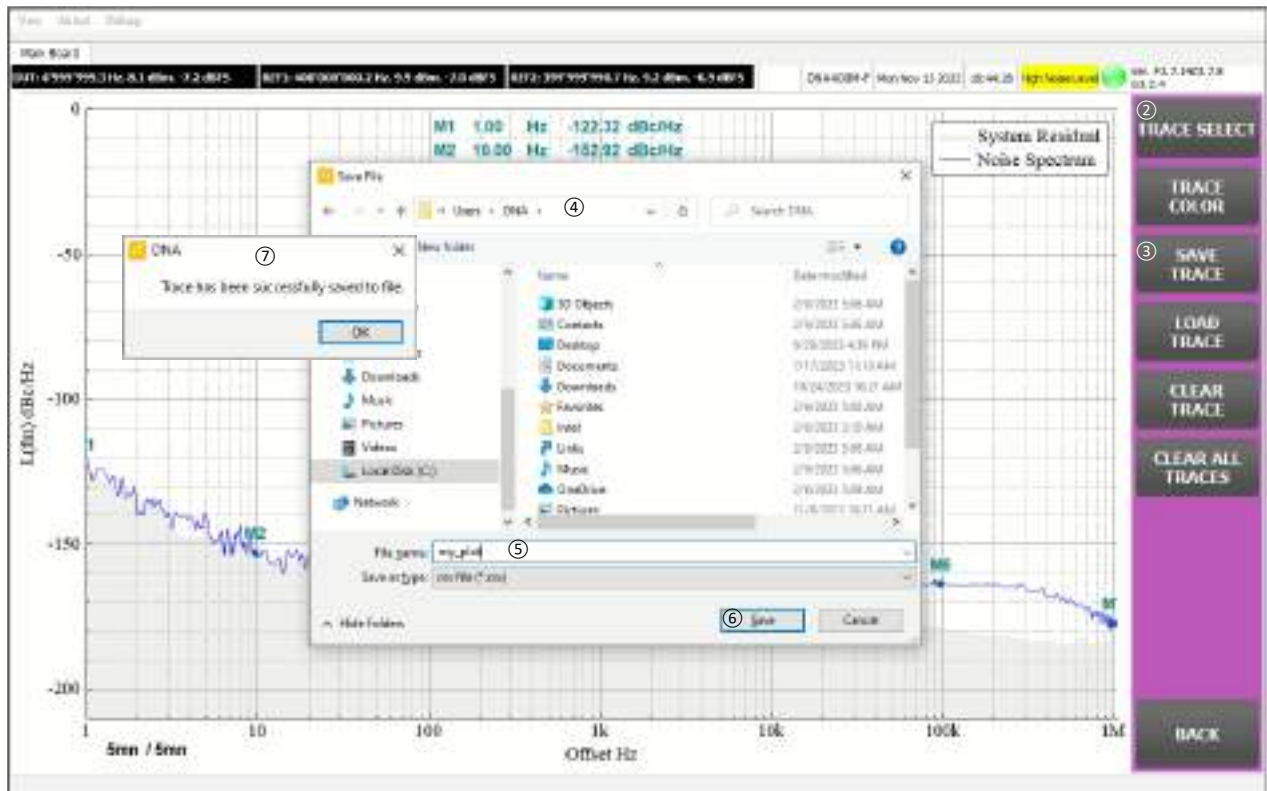


Figure 24 - Save Graph to data file

### 7.3.4 Load graph data from file: LOAD TRACE

Users can also load the graph data, which are saved earlier using the **TRACE SAVE** utility or created manually by users, into a plot. This is very useful when users want to compare different measurement curves or to the compare the DUT's measurement with a specification line.

To load the graph data into a plot, first click on the button **LOAD TRACE** ② on the trace utilities tool bar. A widget is shown and users are asked to browse ③ to the csv file ④ containing the graph data. Click on the OK ⑤ button to finish selecting the file.

The Load Trace Interface widget is then shown as illustrated in Figure 25. Input the desired graph name and select the graph color ⑥.

Click on the OK ⑦ button to close the widget and display the graph on the plot.

Concerning the graph's name, it is important to note that there are reserved names for new measurements. These are graphs which are updated during a measurement. For the phase noise density plot, the reserved names are:

- "Noise Spectrum" is used for the phase noise density graph.



## 7.4 Mathematical operations: MATH ①

### 7.4.1 RMS JITTER CALCULATION

DNA offers the RMS jitter calculation **RMS JITTER CALCULATION** on a user defined bandwidth.

Click on RMS Jitter calculation ② button, a widget jitter calculator ③ is opening.

Set the min ③ and max frequency ③ by decade or use the manual ④ frequency to enter any frequency.

Click on RMS jitter result box ④ and the calculation will be displayed in radian or Pico second.

Click Close to quit ⑦

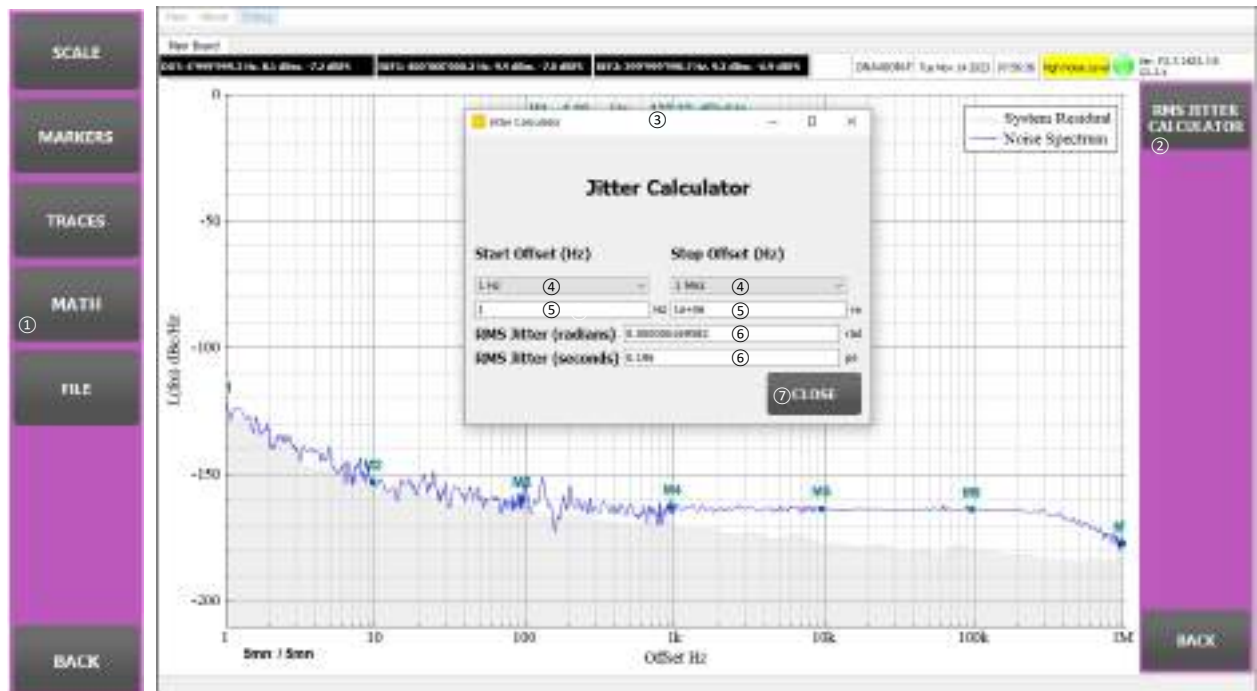


Figure 26 – Jitter calculation

## 7.5 Files Utility: FILE ①

The file utilities are dedicated for record and report purposes of a measurement. From the GUI main interface, the file utility can be accessed by using the buttons **UTILITIES** → **FILE** ①.

FILE saves data in a DNA native format with all DNA setup while TRACE is only saving plot point in a CSV format.

When FILE is selected it is possible to post display all measurements done (Frequency Stability, Residual spectrum noise ....)

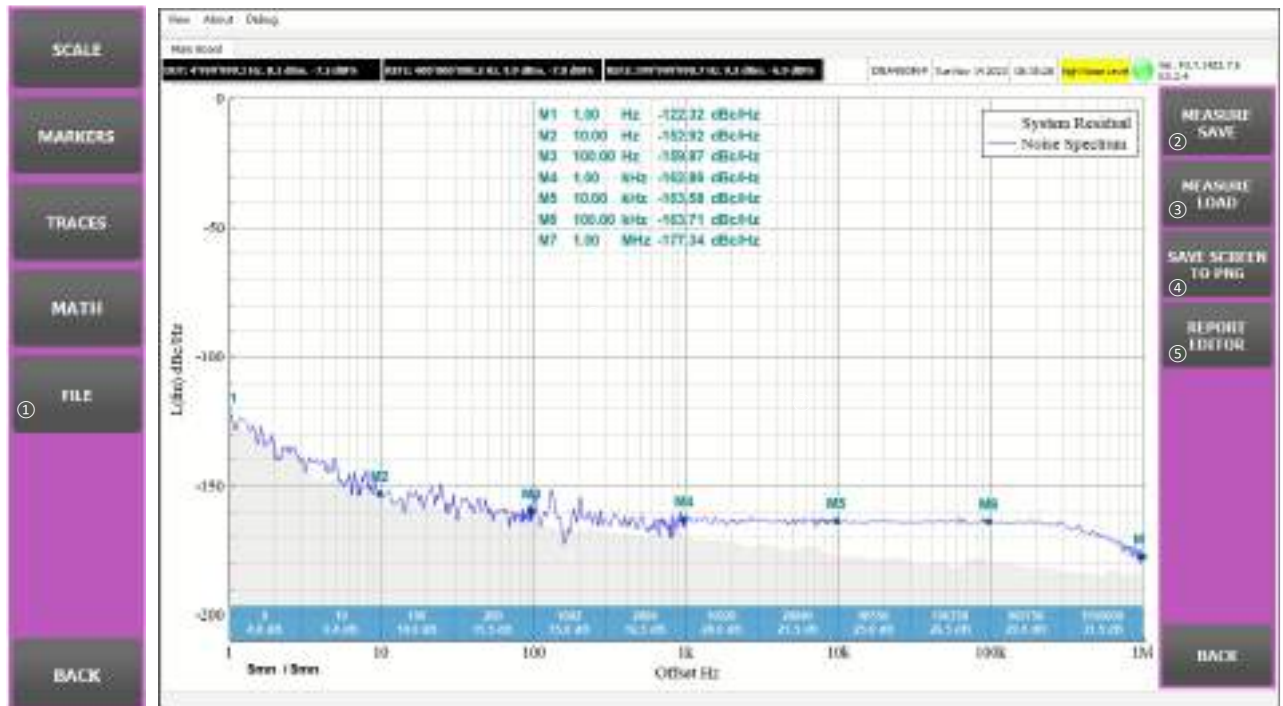


Figure 27 – File utilities menu

### 7.5.1 Save a measurement to file: MEASURE SAVE ①

A finished measurement can be saved in to a file (a file with .nse extension) so that it can be loaded later for analysis.

NSE format is the DNA native file format. Saving in this format allows to user to play with stored curves exactly the same he has just performed measure.

When users click on the **MEASURE SAVE** ① button, a popup ② is displayed requesting for the DUT and the references' names.

Click on the **OK** button after inputting the DUT and the references' name in order to browse for the to-be-save file name ③. When the operation is finished, a popup ④ is displayed to inform to users. Click on the OK button to close the popup. The whole procedure is illustrated in Figure 28 – Measure save

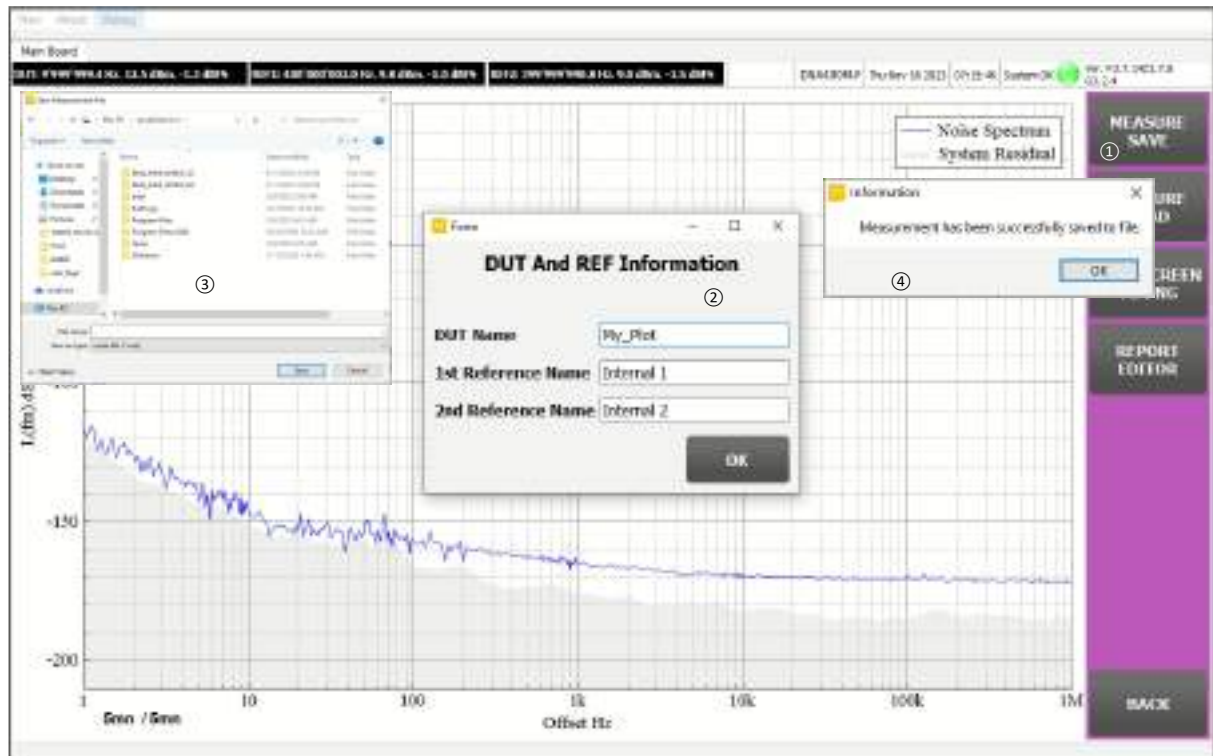


Figure 28 – Measure save.

### 7.5.2 Load a measurement from file: MEASURE LOAD

This utility is used to load a measurement saved earlier as described in the paragraph above. When users click to the **MEASURE LOAD** ① button, a browsing window ② is opened in order to browse for the file (with the extension \*.nse) ③, then click Open ④.

When a measurement file is successfully loaded, a popup is displayed to inform the users.

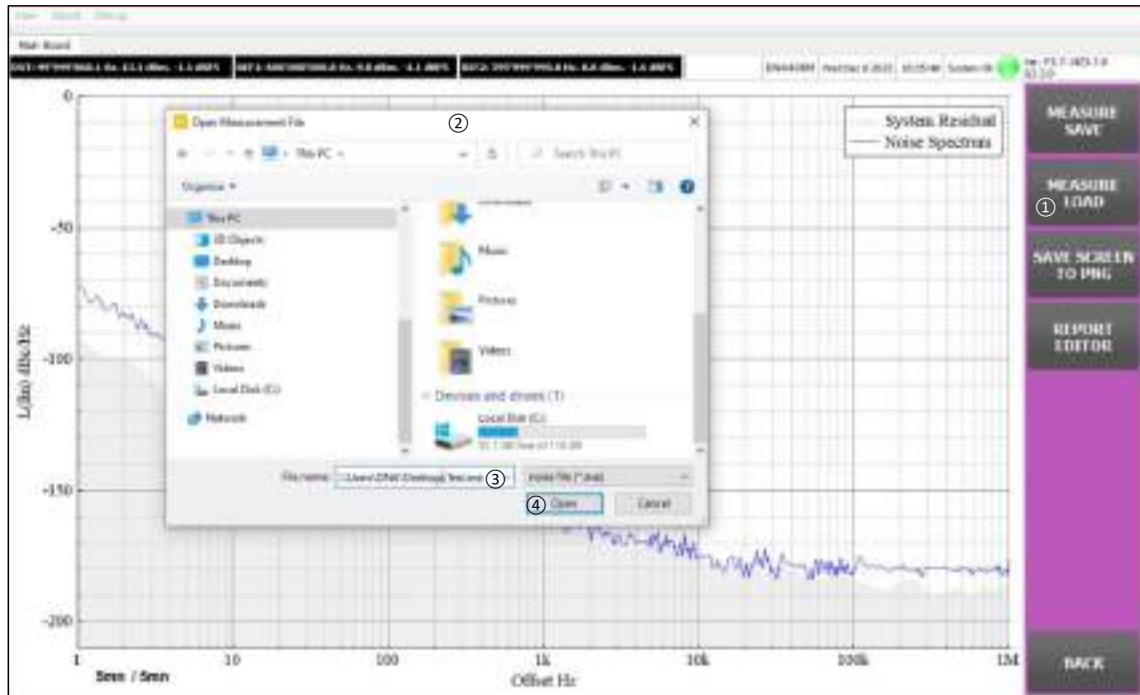


Figure 29 - Measure Load

Click on the **OK** to close the popup.

### 7.5.3 Save a plot to PNG file: SAVE SCREEN TO PNG

A plot screen can be easily saved into a PNG file using the **SAVE SCREEN TO PNG** button. This is very helpful for rapid result presentation or exploitation. After clicking on the button, users are requested for browsing for the file name to save the image. After the image is successfully saved, a popup is displayed to inform the users. Click on the **OK** button to close the popup.

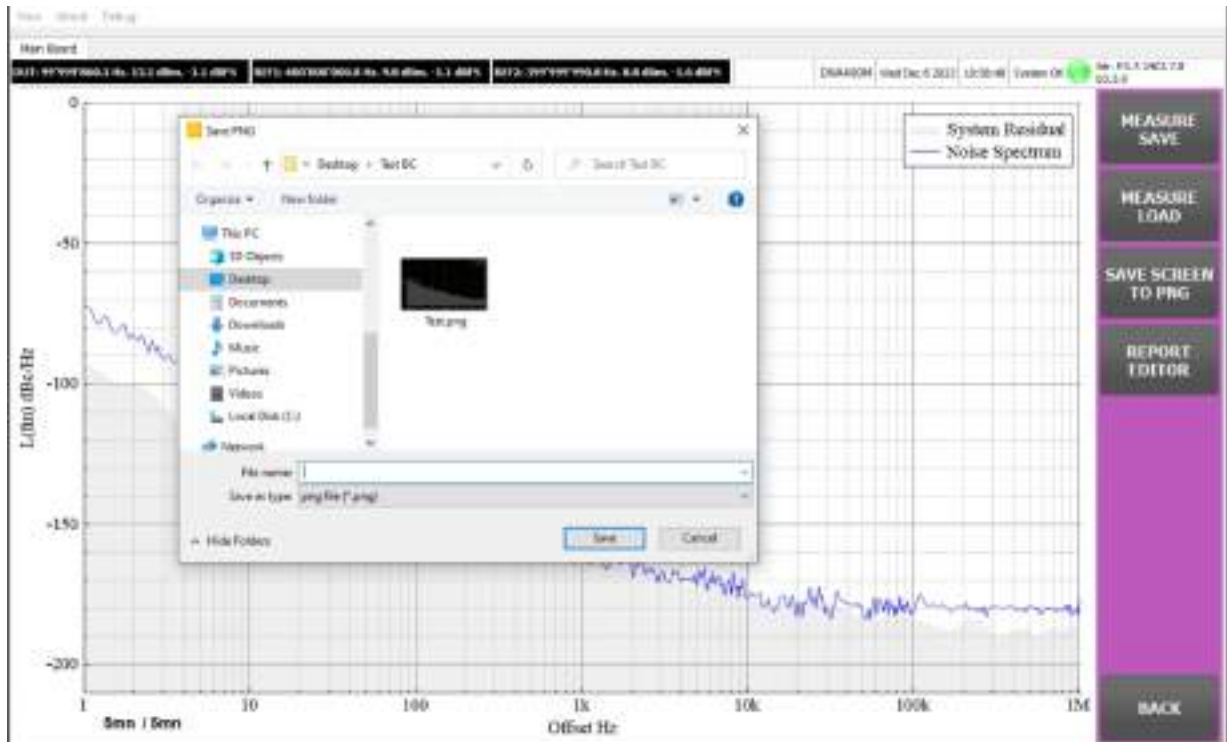


Figure 30 - Save to PNG

### 7.5.4 Report editor: EDIT REPORT

This utility is very useful when users come to report the DUT performance to a PDF file for the datasheet or for a presentation.

Click on the REPORT EDITOR button to open the editor, which is illustrated in **Erreur ! Source du renvoi introuvable.** and Figure 32 – Frequency stability measurement report editor

The measurement report editor widget can be divided into 2 zones. On the right-hand side, users can put information concerning the measurement and select several display options. On the left-hand side, a print preview of the generated report is displayed.

When there are no markers on a plot, the decade markers are automatically added so that the performance can be reported. Users can also add and manually adjust the position of the markers before opening the report editor. In this case, no additional marker will be added. As for the plot, several display options such as the background color, the legend visibility, the marker table visibility, etc. can be changed by the user. The description of different fields on the report editor is as follow.



Figure 31 – Phase Noise measurement report editor

1. **DUT & REF Information** group box: users can input the information concerning the report title, the DUT's serial number; the DUT's name and the references' name. These pieces of information are reported in the report.
2. **Display Options** group box:
  - **Dark Background:** use this checkbox to change the plot background color.
  - **Legend visible:** use this checkbox to show/hide the graph's legend.
  - **Xcorr Table Visible:** use this checkbox to show/hide the cross-correlation number table.
  - **Marker Table Visible:** use this checkbox to show/hide the marker table.

- **Marker Points Visible:** use this checkbox to show/hide the marker points which lay on the graph.
  - **Show System Residual:** use this checkbox to show/hide the System Residual graph.
  - **Show Spurious:** use this checkbox to show/hide the spurious on the phase noise density graph.
3. **Comments** group box: Users can put additional comments on the report.
  4. **User's logo:** when users want to add their company's logo on the report, copy the logo to `C:\DNA\user_logo` and change the file name to *user logo*. The DNA accepts the file extensions PNG and ICO.
  5. This zone displays the plot to be reported.
  6. This table shows the DUT and references' information, the measurement time and the system date.
  7. The marker table is reported here.
  8. Users' comments are displayed in this zone.
  9. Use the **SAVE TO PDF** button to export the report to a pdf file. After clicking on the button, users are requested to browse for the file name to save the report.
  10. If the DNA is connected to a printer, use the **PRINT** button to print the report.

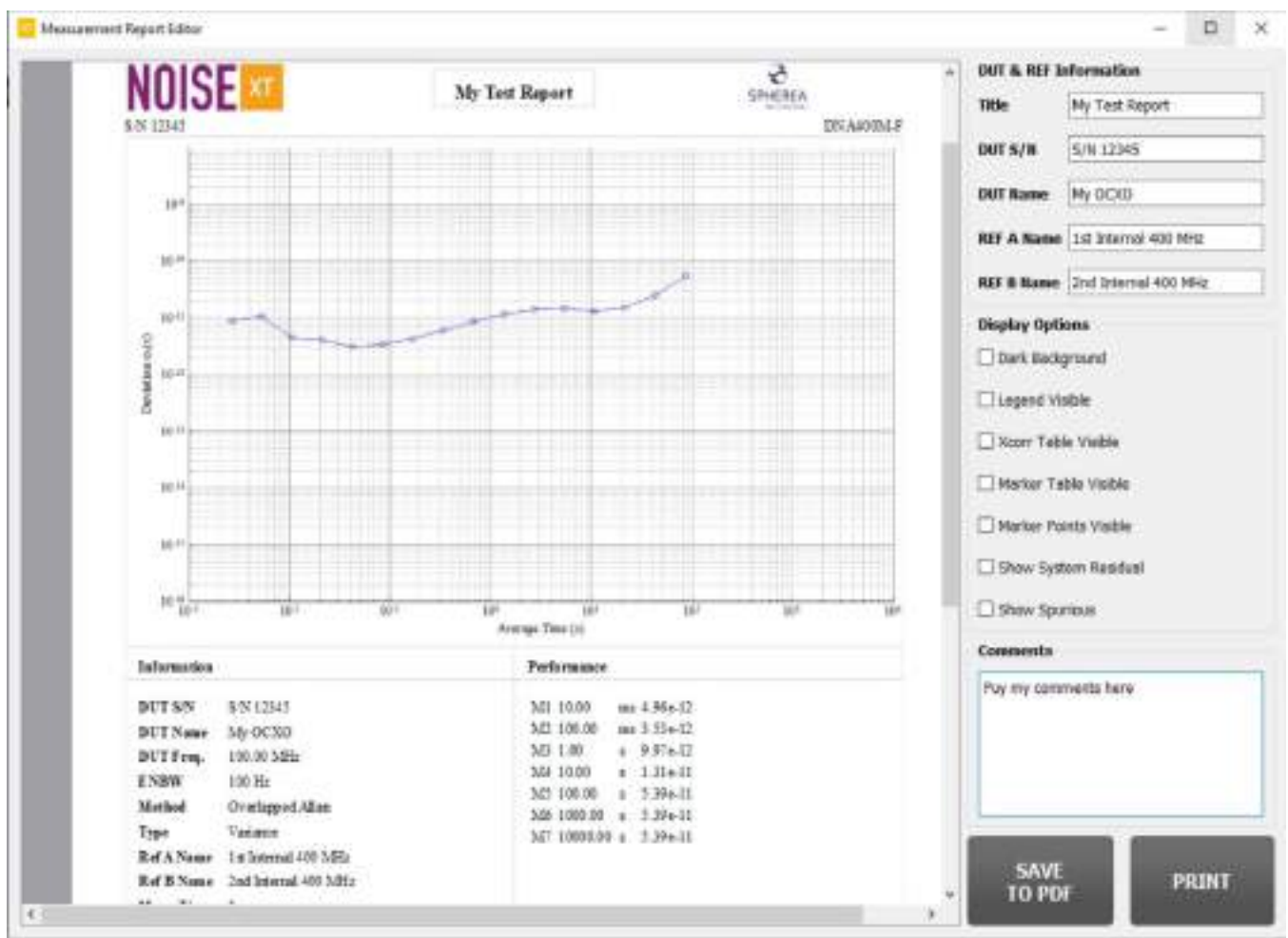


Figure 32 – Frequency stability measurement report editor

## 8 SETTINGS

### 8.1 MEASURE

#### 8.1.1 Measurement parameters: MEASURE PARAMS ③

Before starting a measurement, it is important to verify and eventually change some important measurement parameters in order to achieve best measurement performance. From the main GUI interface, click on the buttons **SETTINGS** ① → **MEASURE** ② → **MEASURE PARAMS** ③ to show the measurement parameter configuration popup.

All the measurement, Autostop, Additional parameters could be set with default value clicking **SET DEFAULT**.

User could save and recall a dedicated parameters set using **SAVE** button to store and **LOAD** to recall. The file format is .par.

This procedure is illustrated the figure below.

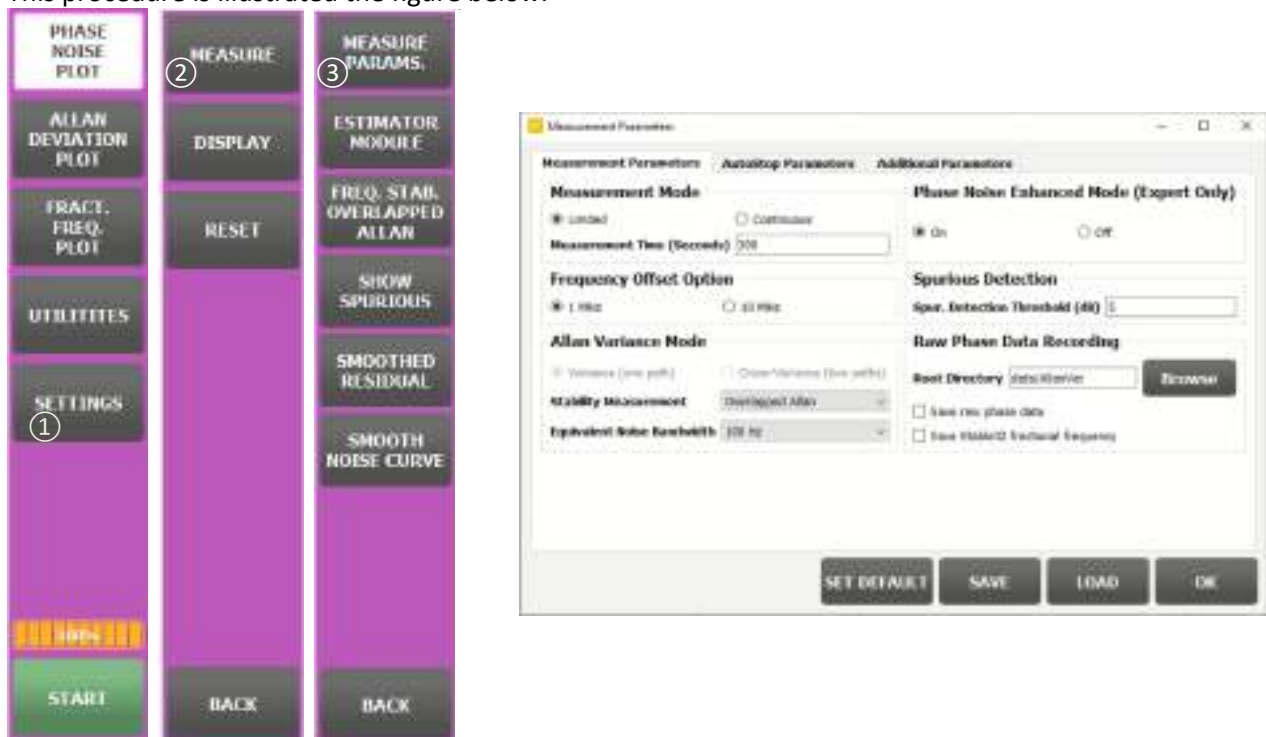


Figure 33 – Measurement parameters configuration

In the following paragraph we describe various fields of the measurement parameters taps.

3 taps are available:

- Measurement parameters to configure DNA setup measurement.
- Auto stop parameters to configure DNA stopping condition before end on measuring time.
- Additional parameters.

#### 8.1.1.1 *Measurement Mode*

Users can select either the limited mode or the continuous mode.

In the continuous mode, after starting the measurement, the DNA processes the measurement continuously. The number of cross-correlations increases infinitely without any limit. This mode is useful when the DUT performance is far below the DNA's performance specification. In order to achieve a reliable measurement result with such a DUT, logically we need a large number of cross-correlations, hence a long measurement time.

In the limited mode, users can configure the measurement time (the time unit is second). After starting, the measurement automatically stops upon timed out. By default, the DNA is in the limited mode and the measurement time is equal to 300 seconds (5 minutes). For the DUTs whose performance is not better than the DNA's specification, this measurement time is sufficient for a good measurement result.

#### 8.1.1.2 *Frequency offset option*

Select between 1 MHz and 10 MHz offset capability.

#### 8.1.1.3 *Allan Variance mode*

Users can select one among four frequency stability analysis variance types which are:

- Allan variance.
- Overlapped Allan Variance.
- Hadamard variance.
- Overlapped Hadamard variance.

The frequency stability analysis variance type can also be configured using the command bar button **SETTINGS → MEASURE → FREQ. STAB.** By default, the overlapped Allan variance type is used by the DNA. The equivalent noise bandwidth (ENBW) can also be configured as one of the following values:

- 500 Hz
- 100 Hz
- 50 Hz
- 10 Hz
- 5 Hz

By default, the (ENBW) is equal to 100 Hz.

Users can also select between the variance (One Path) technique (for a relative measurement) and the cross-variance technique (for an absolute measurement) by clicking either Variance (One Path) either cross-variance (Two Paths). In the cross-variance mode, on the frequency noise from path 1 (refer to Figure 11) is taken. Then, frequency stability analysis formulas are applied to this frequency noise series. It is worth noting that this frequency noise series contains both the frequency noise of the DUT and a scaled-version frequency noise of the first reference (CH1 in the Figure 11). This is why we give it the name "relative measurement".

In the cross-correlation mode, both frequency noise series path 1 and path 2 are used. Instead of applying the autocorrelation to just one path, we apply here a cross-correlation of the two paths. Then we take the absolute value of the results. Given that the two references are independent, all the cross-correlation terms between the references and the DUT should tend toward zero as the number of samples increases. Hence, we have a good estimation of the frequency stability of the DUT.

It is noted that the cross-variance technique is only available when users deactivate the phase noise enhancement mode, which will be explained in the next paragraphs.

#### 8.1.1.4 *Phase noise enhanced mode*

ADC sampling frequency is automatically set by DNA. This mode is optimized for phase noise measurement.

#### 8.1.1.5 *Spurious Detection*

User can define the spurious detection, threshold level value. Under this value spurious are integrated into noise, above it will be display as spurious. Default value is 5 dB.

#### 8.1.1.6 *Raw Phase Data Recording*

For post analysis with external software, raw phase data could be store into a file in internal DNA HDD or on external media.

It is also possible to save Stable32 compatible format fractional frequency information.

#### 8.1.1.7 *Auto stop parameters*

DNA measurement time is set up in the previous section by Measurement time value.

Nerveless it could be useful to decide to stop decade acquisition when a user define value between noise curve and noise residual is archived.

When this condition occurs DNA will stop data collection in the decade.

By default, there is no auto stop (Auto stop mode continuous) measurement last at the end of measurement time.

When residual offset is clicked, it is possible to enter a value in each decade box to set the value in dB between residual and phase noise.



Figure 34 - Auto Stop configuration

### 8.1.1.8 Additional parameters

Additional parameter tap allows to setup DNA for measurement optimization. Pay attention this is only for expert users.



Figure 35 - Additional Parameters

### 8.1.1.9 Sampling Frequency Override Mode

This mode (Figure 35 - Additional Parameters) reserved for advanced users to explore other aspects of the DNA. When this mode is active (the radio button **On** is selected), users can force the DNA to use a pre-defined sampling frequency. It is noted that the sampling frequency must lie in the range from 240 MHz to 250 MHz

It is important to note that in this mode, we do not guarantee a good performance of the DNA.

### 8.1.1.10 ADC

Give user the capability to define its own DBFS value

### 8.1.1.11 Cross Correlation Mode

The phase noise enhancement mode is our proprietary technique used to measure extremely low-noise DUT (e.g. noise floor below -190dBc/Hz). This mode is activated by default (XCORR checked) in order to achieve the best phase noise measurement performance.

It is noted that when this mode is activated, the cross-correlation frequency stability analysis technique is not available.

It is also possible to use DNA as a single channel phase noise analyzer and you can select reference 1 (Autocorr A checked) or select reference 2 (Autocorr B checked). When Autocorr mode is selected there is no longer residual phase noise displayed.

### 8.1.1.12 Frequency estimation precision

Frequency accuracy parameter use by DNA during the start operation, see Figure 46 - Start.

### 8.1.1.13 Dark Port Compensation

These parameters avoid cross correlation collapse.

### 8.1.2 Estimator select: ESTIMATOR MODULE ④



Figure 36 - Estimator Module

Use this button to switch among various phase noise estimators.

- **ABS (Re):** This is the widely used estimator in the literature. It takes the absolute of the real part of the result after the cross-correlation process. This is also the default estimator used by the DNA.
- **MODULE:** This gives the square root of the sum of the squares of both the real part and the imaginary part of the cross-correlation result.
- **ABS (ABS (Re) – ABS (Im)):** This gives the absolute value of the difference between the Real part and the imaginary part of the cross-correlation result. According to experimentation, this estimator allows suppressing certain systems spurious. When the measurement converges, the Imaginary part tends to zero. Hence, this estimator tends to give the same result as the ABS (Re) estimator.

### 8.1.3 Frequency stability analysis method select: FREQ. STAB. OVERLAPPED ALLAN ⑤



Figure 37 - Frequency Stability

Beside measurement parameter widget discussed in section the frequency stability analysis method can also be selected using this button. As a matter of fact, all the methods are calculated while measuring. It is the selected method is displayed to be visualized. Figure 37 - Frequency Stability

Users can select one among four frequency stability analysis variance types which are:

- Allan variance.
- Overlapped Allan Variance.
- Hadamard variance.
- Overlapped Hadamard variance.

### 8.1.4 Spurious visualization: SHOW SPURIOUS ⑥



Figure 38 – Show Spurious

The measurement system's spurious and the DUT's spurious are detected and normalized to dBc unit while the measurement is ongoing. When the button **SHOW SPURIOUS** is activated, these spurious are displayed to the screen as shown in the figure below.

It is noted that although the left-axis unit text is dBc/Hz, this is applicable only for the phase noise density plot. For the spurious plot, it is actually dBc. Figure 38 – Show Spurious & Figure 39 - Spurious Visualization.

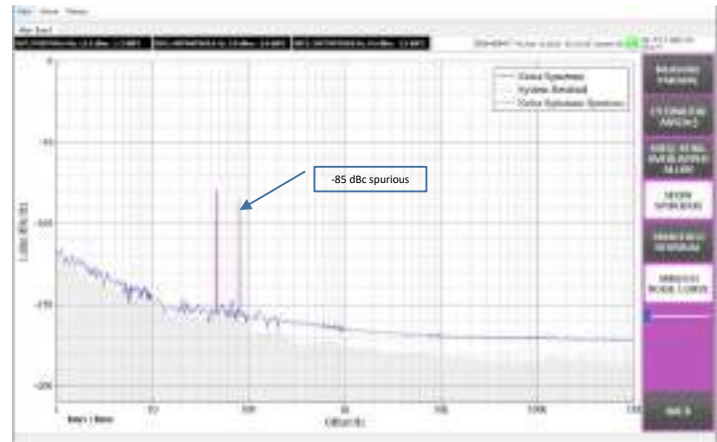
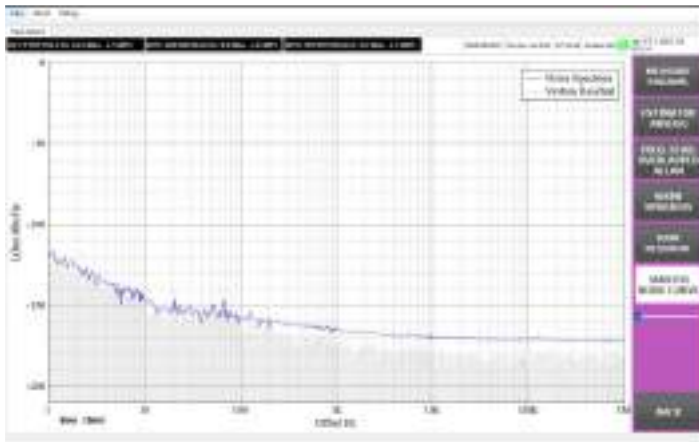


Figure 39 - Spurious Visualization

### 8.1.5 Raw residual display: SMOOTHED RESIDUAL ⑦



By default, the system residual is smoothed and displayed by a grey-filled zone under the noise density plot. The curve is smoothed for the sake of easy interpretation and visualization. However, in some circumstances the raw residual (without smoothing) can give useful information for users. One interesting usage of the raw residual is to detect the system-engendered spurious. When a spurious appears on both the noise density plot and the raw residual plot, it should be a system-engendered spurious as illustrated in Figure 40 – Smoother Residual. Residual state could be SMOOTH/RAW/INVISIBLE

Figure 40 – Smoother Residual

### 8.1.6 Smoothing the noise curve: SMOOTH NOISE CURVE ⑧



The noise-density-curve smoothing process can be useful in GO/NOGO test in case where the noise density curve is exceptionally noisy. In the DNA, a quadratic regression curve smoothing technique is implemented. This technique can be activated using the button **SMOOTH NOISE CURVE**. Upon activated, a slide bar appears just below the button so that users can change the degree of the regression. The larger the degree value is, the smoother the curve becomes. The curve smoothing result is illustrated in Figure 41 - Smooth curve noise

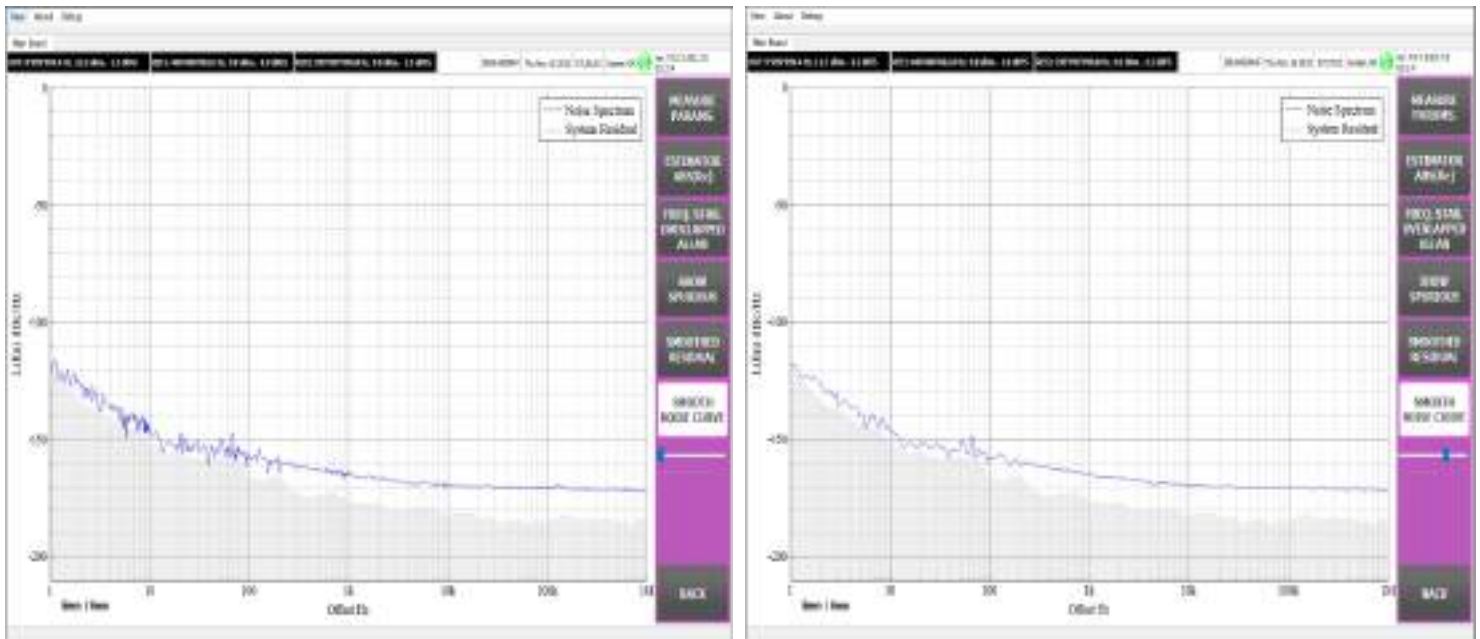


Figure 41 - Smooth curve noise

It is noted that the smoothing process is applied only on the noise-density curve (labelled “Noise Spectrum” on the plot). The smoothing process cannot be applied to any other curves.

## 8.2 DISPLAY



Figure 42 - Display Color

Setting, then Display will provide access to display function

### 8.2.1 Color theme selection: LIGHT ③ / DARK ④

User can select between a light ① and a dark ② theme

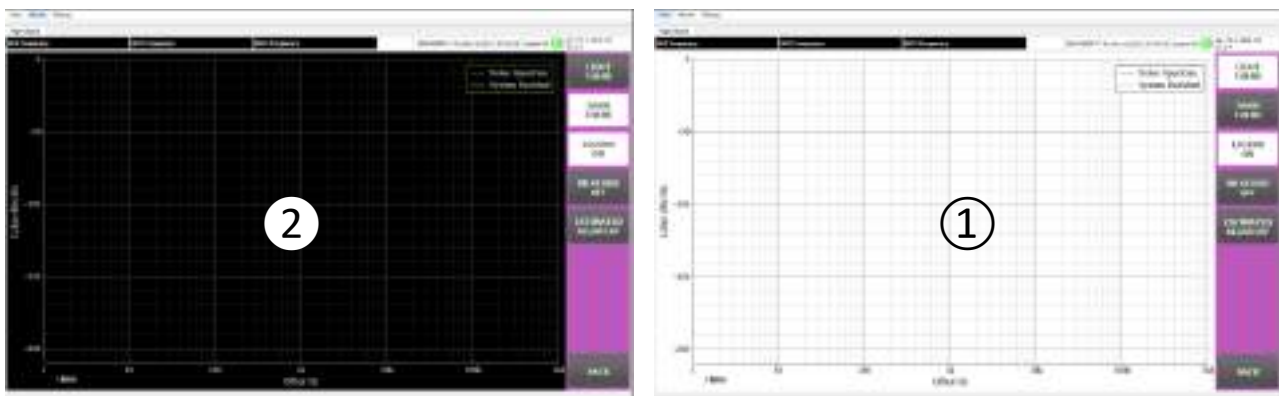


Figure 43 - Display Color

### 8.2.2 Display legend on display: LEGEND ⑤

Clicking LEGEND ⑤ button make visible the graph legends.

### 8.2.3 Display cross correlation parameters: NB XCROSS ⑥

Clicking NB XCROSS ⑥ button make visible the number cross correlation parameters ①.

This only possible if cross correlation box is checked ([Phase noise enhanced mode](#)). This setup is made by default

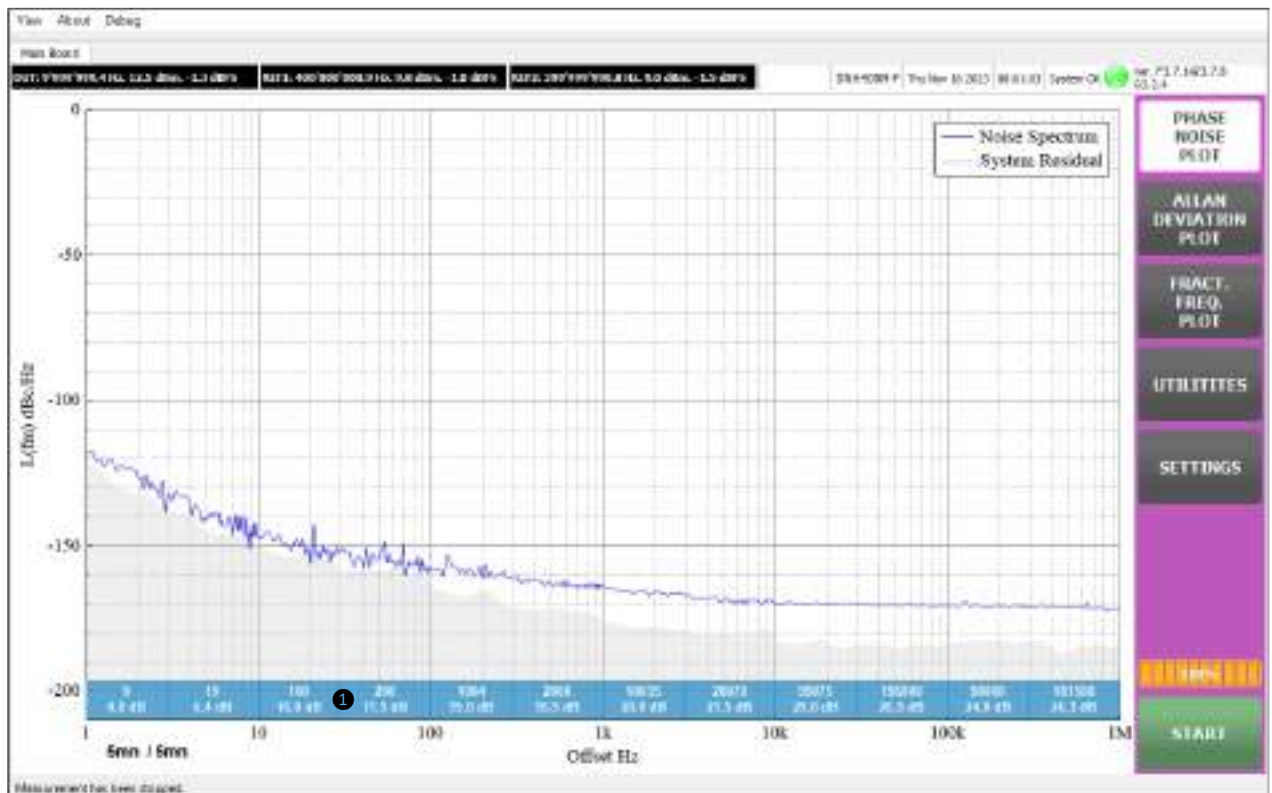


Figure 44 - Cross Correlation values

In the blue zone, the upper numbers are the number of cross correlation computed during the measurement time and below in dB the phase noise saving calculated with following formula:

Saving (dBc/Hz) =  $5 \log_{10}(\text{Number Cross Correlation})$

During the measurement time DNA automatically collects all measurement, computes and displays the phase noise saving making user life more easy.

### 8.2.4 Set estimated Allan function: ESTIMATED ALLAN ⑦

Clicking ESTIMATED ALLAN ⑦ makes DNA using the phase noise measurement to compute the frequency stability shape.

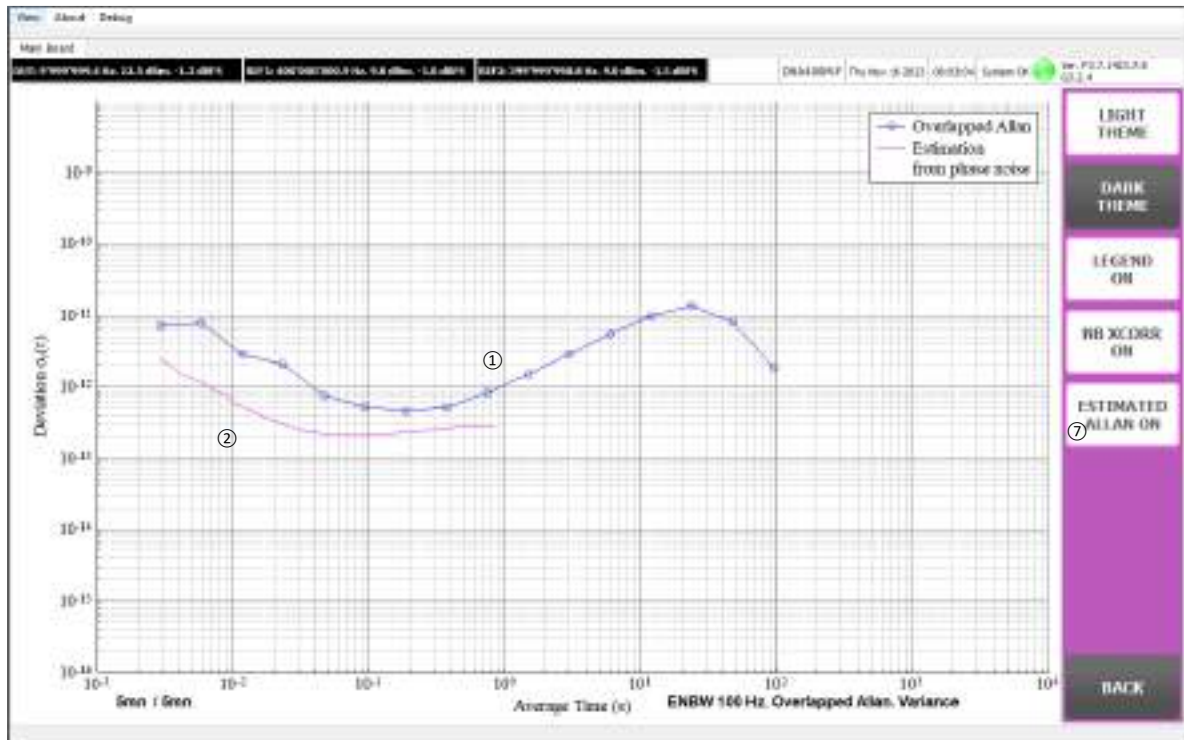


Figure 45 - Estimated Phase Noise

## 8.3 RESET ⑧

At DNA power on or after clicking on RESET ⑧ button DNA status is:

Parameter Set Up	Default Value
Frequency Offset	1 Hz to 1 MHz
Measurement Time	5 mn
Measurement	Phase Noise
Color theme	Dark
Markers	Off
Estimator	ABS(Re)
Spurious	Off
NB Xcorr display	Off
Estimated Allan	Off
Legend	On
Residual	Smooth Residual
Max offset analysis	1 MHz
ENBW	100 Hz
Spur detection	5 dB
Phase Noise extended mode	On
Auto stop	Off
Cross Correlation Mode	On
Sampling Frequency Override Mode	Off
ADC	Auto
Frequency estimation	1Hz
Dark port Compensation	On

## 9 GUI Taps

### 9.1 View

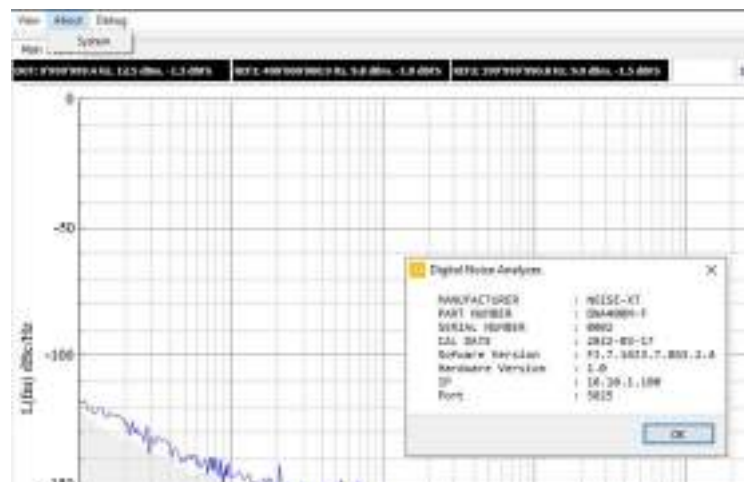
This tap allows to have full screen DNA interface or normal size.  
Full size takes all display possibility.  
Normal allows access to other windows menus.



### 9.2 About

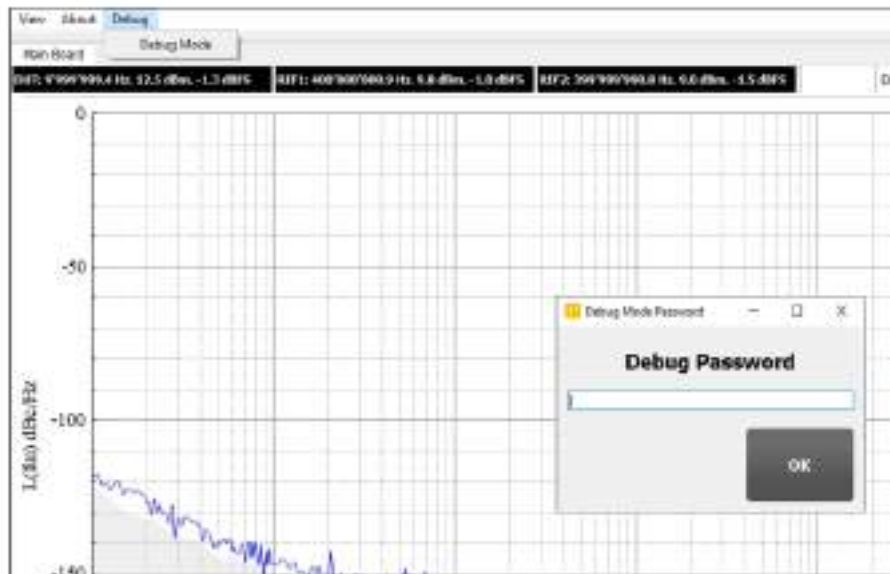
Provide DNA information's:

- Part Number
- Serial Number
- CAL Date
- Software and firmware revision
- IP information



## Debug

Tools for DNA debug, Reserved to ARCALE.



## 10 Start and stop measurement

After configuring the measurement parameters, use the BACK button to return back to the main GUI interface.

DNA is now set up and ready for measurement and can be launched by clicking on the START ① button. Before the measurement is really launched, the DNA is computing for best internal measurement parameters. During this time, a message popup is shown to inform the users. While the measurement is under progress, users should see the text “Measurement under progress ...” ② displayed on Figure 46 - Start.

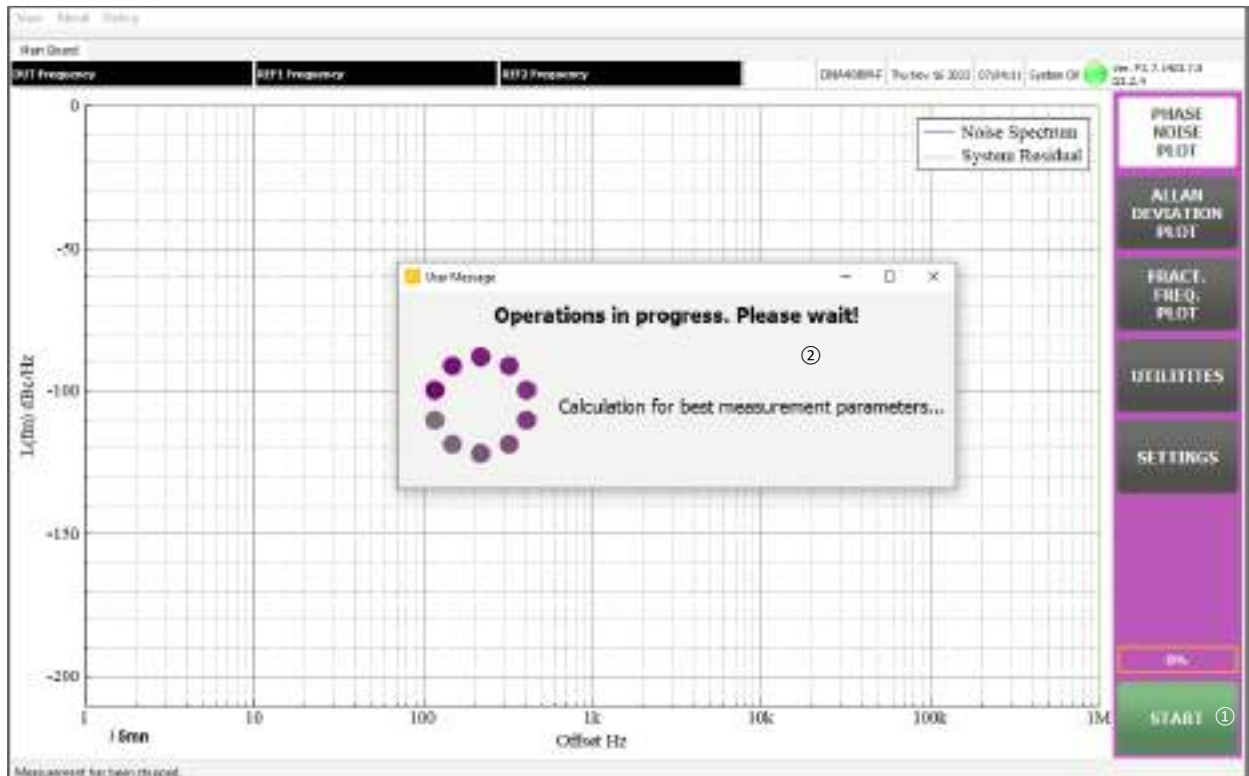


Figure 46 - Start

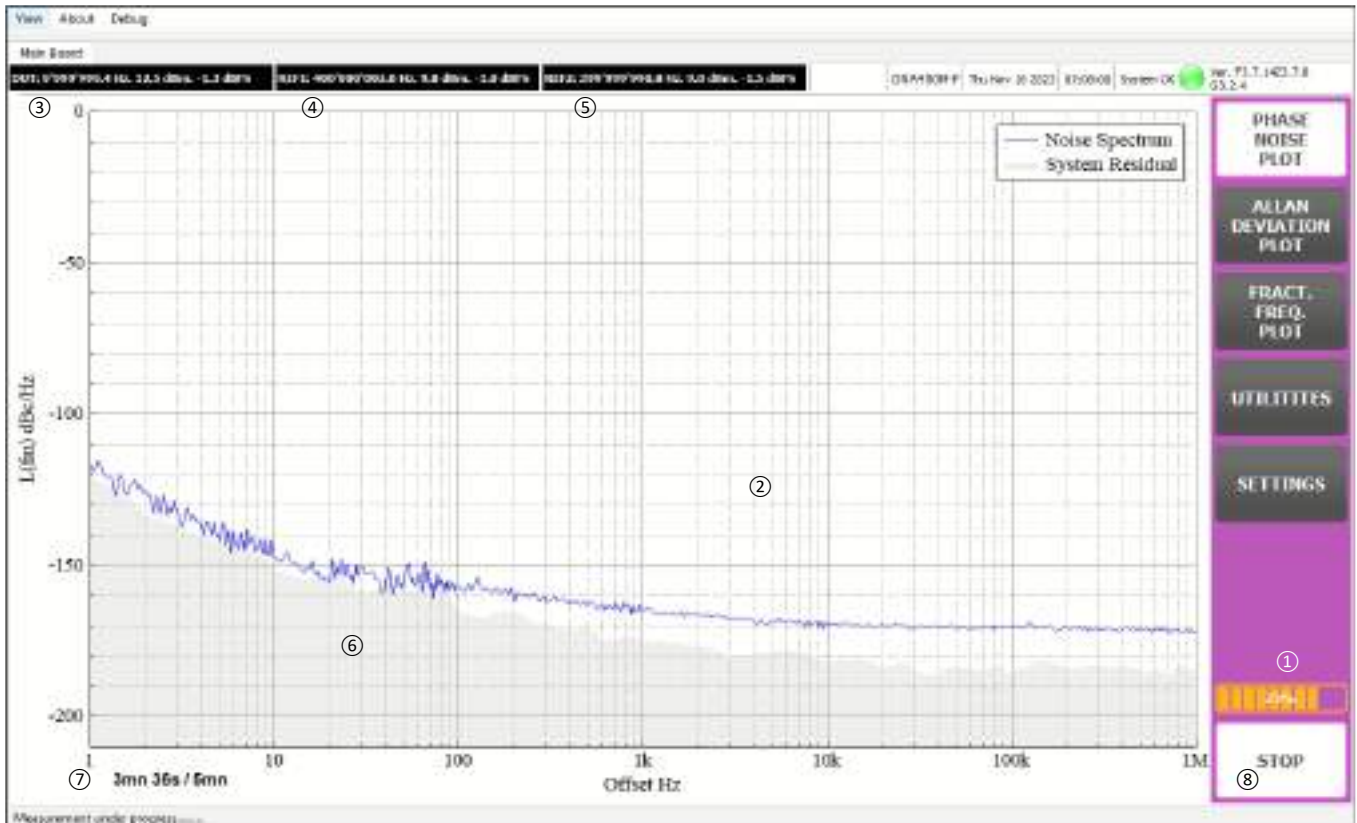


Figure 47 - Running measurement

When Best Calculation is finished (Figure 46 - Start) measurement selected is being plot (Figure 47 - Running measurement).

DUT measurement parameters ③, reference 1 ④ and reference 2 ⑤ are displayed first before plot.

Then DNA catch all data on the entire frequency offset bandwidth (1mHz to 1 MHz) even if the displayed offset is on a reduced bandwidth.

DNA displays ② in real-time as soon as it has enough data.

The result is updated in real-time, and the display refreshment frequency is about 4 times per second

1 Hz to 1 MHz plot display takes about 30 s for the first plot. The progress bar status ① shows the progression.

The system residual noise ⑥ is also computed and display.

The ongoing measurement time and measurement time are displayed ⑦ and till the time is not finished or user do not push the stop ⑧ button, DNA will continue to collect data and perform update measurement using cross correlation method.

# 11 DNA SPECIFICATIONS

Description	Specification
RF IN connector	Type-N Female, 50 ohms nominal
RF IN frequency range	2 MHz to 100 MHz (DNA 100) 2 MHz to 400 MHz (DNA 400)
RF IN measurement level	-10 dBm to +20 dBm
Input damage level	AC > +23dBm, 0V DC max

Description	Specification
RF IN frequency range	2 MHz to 100 MHz (DNA 100) 2 MHz to 400 MHz (DNA 400)
Measurement parameters	SSB noise (dBc/Hz), Spurious (dBc), Allan & overlapped Allan Variance, Hadamard & overlapped Hadamard variance. Fractional frequency noise chronogram.
Number of traces	20 data traces for SSB phase noise and Frequency stability.
Number of markers	20
Offset frequency range	1 mHz to 1 MHz, 10 MHz Typical
Phase Noise accuracy	+/- 2 dB (1 dB typical)
SSB noise sensitivity	See Table for complete values
Typical residual phase noise 15min measurement	10 MHz -137dBc/Hz@1Hz -190dBc/Hz@1MHz  100 MHz -121dBc/Hz@1Hz -194dBc/Hz@10MHz
Enhanced sensitivity	Fully continuous Cross-correlation method up to millions of averages
Frequency Reference	L version : External Sources (single or dual) F version : Internal or External Sources (single or dual)
Residual Allan deviation (5MHz to 400 MHz)	(t=1s) < 7E-14 (5Hz ENBW) (t=1000s) < 5E-16 (5Hz ENBW)
Residual spurious response level (measurement engine), excluding AC power related spurs	-50 dBc at 1 Hz offset -70 dBc at 10 Hz offset -90 dBc at 100 Hz offset <-110 dBc above 1kHz offset
Spurious detection Algorithm	Adjustable Peak detection based on noise statistical information
Resolution Bandwidth	Variable settings in each independent decade Based on 1024 FFTs in a cascaded continuous noise decimation chain
Internal Source output power (F Version only)	+10 dBm +/- 3 dB


## 12 DNA'S GUI CHART ORGANISATION

The DNA GUI organization is as follow:

PHASE NOISE PLOT			
ALLAN DEVIATION PLOT			
FRACT. FREQ.PLOT			
UTILITIES	SCALE		
	MARKERS	TRACE SELECT	
		ADD ALL MARKERS	
		ADD ONE MARKER	
		CLEAR ALL MARKERS	
		MARKER POSITION	
		MORE	MARKER TYPE AVERAGE / NORMAL
			MARKER VISIBLE/INVISIBLE
			BACK
		BACK	
	TRACES	TRACE SELECT	
		TRACE COLOR	
		SAVE TRACE	
		LOAD TRACE	
		CLEAR TRACE	
		CLEAR ALL TRACES	
		BACK	
	MATH	RMS JITTER CALCULATOR	
		BACK	
	FILE	MEASURE SAVE	
		MEASURE LOAD	
		SAVE SCREEN TO PNG	
		EDIT REPORT	
		BACK	

SETTING	MEASURE	MEASURE PARAMS
		ESTIMATOR ABS(Re)/Module/ ABS(Re)-ABS(Im)
		FREQ STAB Overlapped Allan / Allan / Hadamard / Overlapped Hadamard
		SHOW SPURIOUS
		SMOOTH RESIDUAL /RAW RESIDUAL / INVISIBLE RESIDUAL
		SMOOTH NOISE CURVE
		BACK
	DISPLAY	LIGHT
		DARK
		LEGEND ON/FF
		NB XCORR OFF/ON
		ESTIMATED ALLAN OFF/ON
	RESET	BACK
	BACK	
START / STOP		

# 13 DNA CERTIFICATES

EMC TEST REPORT	
EN 61326-1 : 2013 EN IEC 61326-1 : 2021 EN 62311 : 2008	
Company	ARCALE
Address	164 - 166 Avenue Joseph Kessel Bâtiment 15 78960 VOISINS LE BRETONNEUX FRANCE
Test item description	Digital Phase Noise and frequency analyzer
Trade Mark	Noise XT
Manufacturer	ARCALE
Model/Type reference	DNA400M
Rating	110-240Vac/50-60Hz
Testing Laboratory	Laboratory EMTECH-LE DE FRANCE
Address	35-37, avenue des 3 Pousins 75180 MONTIGNY-LE-BRETONNEUX FRANCE
Report Reference No.	RCE-EMESS22/SSARC-86A v0
Test procedure	CE Marking
Diffusion	LAURENT ADRIEN
Applicant's name	ARCALE
Date of issue	15/07/2022
Total number of pages	57
Revision	v0
Compiled by	T. TORRADO (Test Technician)
Approved by (+ signature)	 <small>Laurent Adrien Propriétaire du Laboratoire EMTECH</small>

TEST REPORT IEC 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements	
Report Number	RSE-EMESS22/SSARC-1A v0
Date of issue (yyyy-mm-dd)	26/02/2023
Total number of pages	124
Name of Testing Laboratory preparing the Report	EMTECH- Montigny le Bretonneux
Applicant's name	ARCALE
Address	164-166 Avenue Joseph Kessel Bâtiment 15 78960 VOISINS LE BRETONNEUX - France
Test specification:	
Standard	IEC 61010-1:2010, AMD1:2016
Test procedure	/
Non-standard test method	N/A
TRF template used	IECEE 00-2020-F1:2020, E4.1.3
Test Report Form No.	IEC61010_10
Test Report Form(s) Originator	VDE Prüf- und Zertifizierungsinstitut GmbH
Master TRF	2020-09-25
Copyright © 2020 IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components (IECEE System). All rights reserved. This publication may be reproduced in whole or in part for non-commercial purposes as long as the IECIE is acknowledged as copyright owner and source of the material. IECIE takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation or the reproduced material due to its placement and content. If this Test Report Form is used by non-IECEE members, the IECIE logo and the reference to the CB Scheme procedure shall be removed. This report is not valid as a CB Test Report unless signed by an approved IECIE Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECIE 82.	
General disclaimer: The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the issuing NCB. The authenticity of this Test Report and its contents can be verified by contacting the NCB responsible for this Test Report.	



109 Av. du Général Eisenhower  
31100 Toulouse

NOISE XT is a SPHEREA Group brand

User Manual revision 20231211