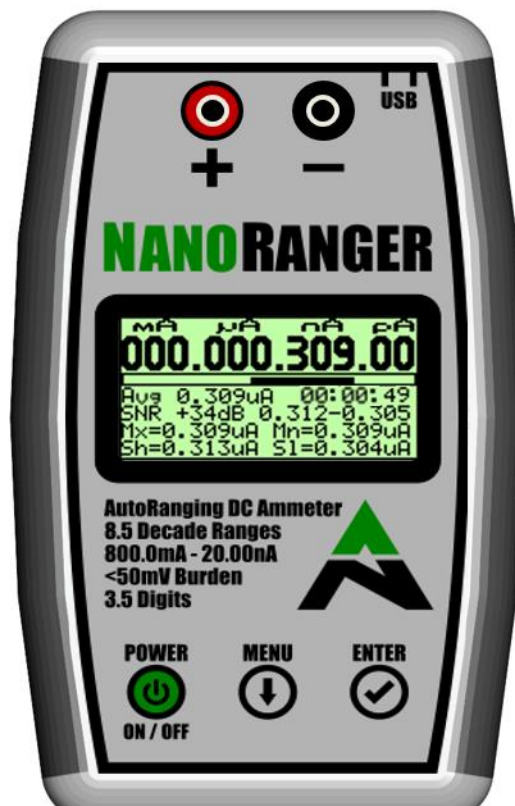# Instruction Manual

NANORANGER®

NR-01 Auto-Ranging Direct Current (DC) Ammeter

Disclaimer

NanoRanger® is a factory-calibrated, highly accurate ammeter, intended for measuring low levels of current. It is aimed at the hobbyist and professional User. NanoRanger® is not intended to replicate the full functionality of bench equipment. Instead, it aims to provide a portable and affordable means of measuring low current levels, during the development of power-efficient designs. It is not intended to and should NOT be used to measure current levels above 0.8A.

If used in any manner other than that expressly set out in AltoNovus product documentation, warranties granted by AltoNovus shall be deemed void and AltoNovus shall not be liable for any claims or damages arising out of product use or malfunction.

Although every effort is made to ensure the accuracy of NanoRanger®, no guarantee of accuracy is given or implied, or responsibility accepted for consequential loss. Users may reproduce and store this document for personal use. For wider permission requests, email the publisher, addressed "Attention: Permissions Coordinator," at info@altonovus.com. The name **NanoRanger®** is a Registered Trademark of AltoNovus Limited.

Document Revisions

DATE	VERSION NUMBER	DOCUMENT CHANGES
15 Nov 19	2.2 (Software Release 1.12)	Launch Release
05 Jan 20	2.3 (Software Release 1.12)	Added notes to Section 5
08 Mar 20	2.4 (Software Release 1.12)	Added notes to Section 2
10 Mar 20	2.5 (Software Release 1.12)	Added notes, Sections 2, 4
28 May 20	2.6 (Software Release 1.12)	Added notes to Section 5
14 Nov 20	2.7 (Software Release 1.12)	Added notes to Section 4
20 Feb 21	2.8 (Software Release 2.01)	Wider updates to document
08 Jun 21	2.9 (Software Release 2.10)	Added notes to Section 5

Approvals - Release / amendment of this document requires the following approvals:

NAME	ROLE TITLE
Geoff Dean	Managing Director
Steve Thickett	Technical Director

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TABLE OF CONTENTS

Preface

1.1　The User

NanoRanger® is not a toy. It is a precision instrument and should be treated accordingly. It is aimed at the hobbyist, maker and professional User community. This Manual assumes a level of technical expertise on the User's part. NanoRanger® should not be used by those without a knowledge of safe working on electronics. This Manual covers the use and operation of NanoRanger®. It does NOT cover calibration or maintenance, as these are not activities that the User can perform.

1.2　Conventions Used in This Manual

The following style conventions are used in this document:

```
Courier New
SCPI System control inputs and outputs.
```

User input variables
< >　　Angle brackets surround User-supplied values.

1.3　Explanation of Safety Warnings

CAUTION! Indicates a hazard with a low level of risk which, if not avoided, could result in damage to NanoRanger® and / or minor injury to Users.

1.4　Obtaining Documentation and Information

1.4.1　Internet

The latest version of the documentation is available at the following address: http://www.altonovus.com.

1.4.2　Ordering Documentation

Documentation, User instructions and technical information can be ordered by emailing: info@altonovus.com.

1.4.3　Documentation Feedback

We welcome your comments and ideas, which may be incorporated in our NanoRanger® FAQs page. Any comments, requests for clarification, or suggestions for future Versions of this document can be submitted to: info@altonovus.com.

2   NanoRanger®

2.1   Utility and Employment

NanoRanger® is an accurate, affordable, auto-ranging DC ammeter for the measurement of very low currents. As people strive for more efficiency from new and existing products, the measurement of current consumption of devices is becoming more critical. Previous solutions to this challenge ranged from very expensive ammeters (thousands of pounds), to cheaper solutions that only have limited manual ranges.

The NanoRanger® is a solution to these challenges, as it provides a 3.5-digit, 9 range ammeter that can switch over 8.5 decades (from 800mA to 1nA), with resolutions down to 10pA. It features:

- A 128 x 64mm LCD display, giving a wealth of information about the User's current readings.
- This large 11-digit display shows the User mA, uA, nA, pA, all on one line.
- A running Average of current readings over the whole measurement period is displayed, along with the measurement duration.
- A SNR display shows how much noise, or AC, is present on the current signal.
- A range bar shows which range the User is in, plus the minimum / maximum range settings.
- Minimum and maximum ranges can be adjusted to limit the auto-ranging, or just to fix it at 1 range.
- An automatic **Power Off** timer, and configurable **LED backlight**, enables the User to maximise battery life.

Readings are completed approximately every 300mS and the display is updated, with samples collected over 832uS periods and averaged out to remove most of the mains noise associated with circuits (50Hz and 60Hz).

The Average (Avg) current displayed on the main screen shows the User a running Average of the readings taken during the continuing measurement period (the duration of which is also shown). The calculation is performed both while NanoRanger® is Auto-Ranging, and when it's range has been restricted. This enables the User to use NanoRanger® to measure the average current associated with specific events; e.g. a device coming out of **Standby** to make a radio transmission, and therefore to calculate the Charge. The time period can be reset by pressing **Enter**.

2.2   Theory of Operation

NanoRanger® is powered by 2 x AA batteries (not supplied), generating approximately 3V. This is fed into a buck-boost power converter to produce 3.3V that powers the system. NanoRanger® will continue to work down to approximately 2V on the batteries.

Pressing the **Power On** button starts the NanoRanger®. Pressing the **Power On** button *again* powers off the NanoRanger®. Standby current, when powered off, is approximately 10nA.

The current to be measured is connected through the Positive and Negative terminals of the NanoRanger®. Current *must* flow from the Positive terminal to the Negative terminal.

A switch bank selects the appropriate load resistor to put across the terminals. The current flowing through the terminals generates a voltage across the resistor. If the voltage increases beyond 45mV, then the load resistor is switched to a higher current resistor and the readings are restarted.

The voltage across the load resistor is amplified by a x50 amplifier and filter, before entering an Analogue to Digital Converter (ADC).

The ADC is 12-bit, which then oversamples and automatically averages to produce a 16-bit result. Samples are taken over periods of 832uS, interleaved with other system processes, and 180 samples are built up over a period of 300mS to average out and eliminate most mains-based noise (50 and 60Hz). The reading is displayed on the LCD and a new reading is then started. Factory set calibration compensation is applied to the result, to give an accurate reading.

A range produces readings up to approximately 2500. If the reading is below 150, then the range is switched down before starting the next reading. If the reading is above 2150 at any time, then the range switches up immediately and the reading is restarted.

Fast up-range switching is needed when a Device Under Test (DUT) comes out of Standby mode. NanoRanger® can switch up a range in less than 30uS and change from the lowest to the highest range in approximately 200uS.

Down-range switching is initiated after a reading has been completed and when the reading is below the down-range threshold. This is so that the User achieves a complete reading if the current is switching quickly between ranges (fast up, slow down).

The Maximum (**Range Max**) and Minimum (**Range Min**) range settings can be adjusted, so that no range switching (down or up) will occur.

2.3   Technical Data

UNIT	PHYSICAL PARAMETERS
Weight (incl batteries)	Approximately 200g
Length x Width x Depth	148 x 90 x 30 mm

Accuracy specifications +/- % of range:

RANGE	RESOLUTION	BURDEN VOLTAGE	RESISTANCE	ACCURACY
20.00nA	10pA	< 0.05V	2M	< 1%
200.0nA	100pA	< 0.05V	200K	< 0.5%

2.000uA	1nA	< 0.05V	20K	< 0.3%
20.00uA	10nA	< 0.05V	2K	< 0.3%
200.0uA	100nA	< 0.05V	200R	< 0.3%
2.000mA	1uA	< 0.05V	20R	< 0.3%
20.00mA	10uA	< 0.05V	2R	< 0.3%
200.0mA	100uA	< 0.05V	0R2	< 0.3%
800mA	1mA	< 0.05V	0R05	< 0.5%

- Burden voltage is for full 2500 fixed range. Range switching occurs at around 0.045V.
- Current consumption **LCD Light on** < 15mA.
- Current consumption **LCD Light off** < 10mA.
- Current consumption **Powered-off** < 10nA.
- Typical operating time on one set of 2 x AA batteries is > 150 hours.

UNIT	OPERATIONAL PARAMETERS
Temperature	0 – 50C
Humidity	10 – 90% Non-Condensing

2.4 Compliance

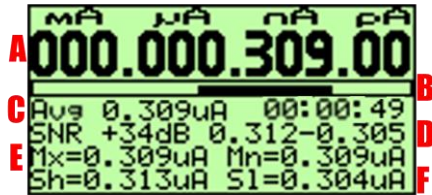NanoRanger® is certified CE and FCC compliant. A supporting Technical File is available to Competent Authorities.

2.5 Guide to Product

A - Positive Terminal

B - Negative Terminal

C - Display Screen

D - On / Off Button

E - Menu Navigation

F - Select Button

G - Isolated USB Interface

H - Battery Compartment

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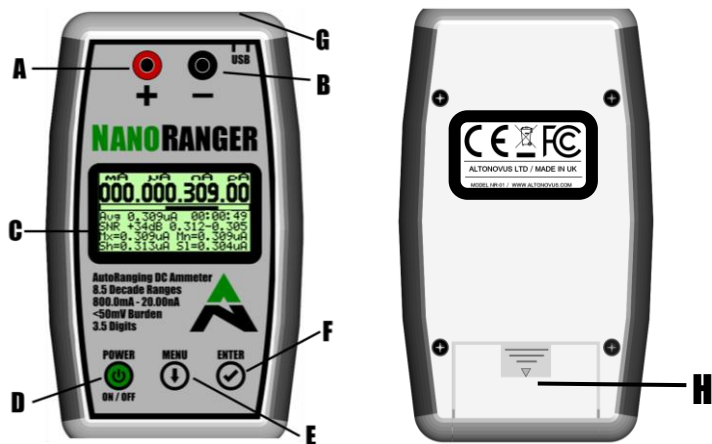
2.6 Understanding the User Interface

A - The current reading, displayed in mA, uA, nA, and pA. In this example, 0.309uA.

B - The small, lower Range Bar shows which ranges are in use. The upper, longer Range Coverage Bar shows movement across the ranges during the reading. The box surrounding both shows what range constraint has been input via the menu. In this example, none.

C - A running Average of current readings over the whole measurement period, along with the measurement duration.

D - The Signal to Noise Ratio (SNR). The SNR indicates how much (Min and Max) noise, variation, and AC components are in the signal, followed by Maximum and Minimum samples during the reading.

E - Maximum (Mx) and Minimum (Mn). The Mx and Mn Readings shown are those that have occurred since this measurement started.

F - The highest (Sh) and lowest (Sl) Samples are shown, from which the Readings have been derived.

2.7 Device Set-Up

2.7.1 Fitting 2 x AA Batteries

1. Remove battery compartment cover, by applying gentle pressure to the finger pad.

2. Ensure clean contacts on batteries.

3. Insert new batteries, observing polarity instructions in battery compartment:
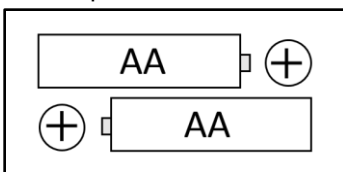
4. Replace battery compartment cover.

Note: 2 x AA alkaline batteries will give in excess of 150 hours of continuous operation. Treat and dispose of all batteries in accordance with manufacturer's instructions.

2.7.2 Removing the Protective Film

If desired, remove the protective film from the front of the NanoRanger® unit.
Peel carefully from below the Positive and Negative terminals.
NanoRanger® will still function normally if the User chooses to leave the film in place.

2.7.3   Attach Feet (if desired)

NanoRanger® is supplied with 4 rubber feet, for Users requiring added stability. Attach these with due regard to the areas that will experience pressure during normal use; i.e. the Keypad buttons and Terminals. Attaching the Feet as shown below will improve the stability of NanoRanger® during use.

2.7.4 Connecting User Probes

Using User Probes (not supplied), connect the Positive terminal (RED) to the higher voltage side of the current to be measured. Connect the Negative terminal (BLACK) to the lower voltage side of the current to be measured. Current *must* flow from Positive to Negative, for the NanoRanger® to function. Leads should be industry standard, uninsulated, 4mm banana plug type. As short a lead as practicable (0.3M) will help minimise noise during low current measurement.
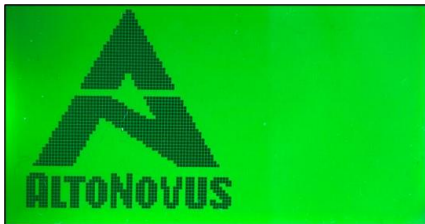
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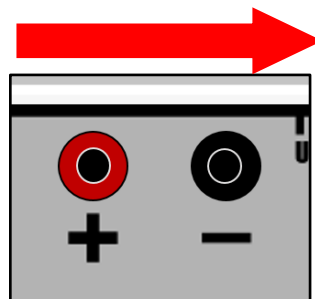
2.7.5   Controls

Firstly, ensure batteries are fitted in accordance with 2.7.1 (above). Three buttons control the operation of the NanoRanger®; **Power**, **Menu**, and **Select**. Pressing the **Power** button will start the NanoRanger®. Two start-up screens will display whilst loading the code:

The first screen shows the AltoNovus logo:

Then a second screen, shown below, will appear briefly,with the serial number of your NanoRanger® (here 1933099), the software release (here ALT-2.01), calibration date and calibration load status. Measurement can then commence (See Section 4). An indication of remaining battery life is shown device **Powerdown**.

2.8   NanoRanger® Menu Structure

NanoRanger® has several features accessible through the **Menu**. Press the **Menu** button to exit measuring and enter the **Menu**. The screen below will appear:
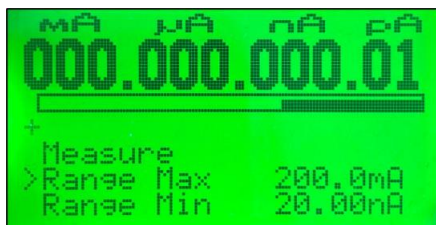
Selecting **Measure** will take the User back to measuring mode. Pressing the **Menu** button will scroll through the menu options. The **Menu** options are *currently*:

- Measure
- Range Max
- Range Min

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- Powerdown
- LCD Light
- Details

These **Menu** options *may* change in the future. NanoRanger® software updates are available from time to time. Register for notifications at info@altonovus.com.

2.8.1   Measure

The Measure feature performs a measurement, as described in Section 4.
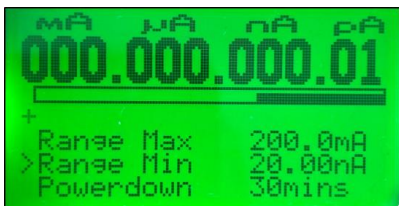
2.8.2   Range Max

This feature sets the maximum range to move up to. Press the **Select** button to scroll through the ranges.
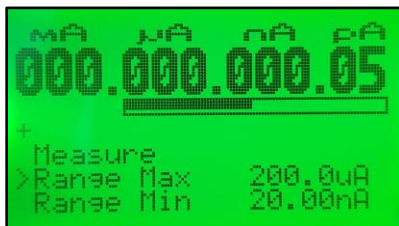
2.8.3   Range Min

This feature sets the minimum range to move down to. Press the **Select** button to scroll through the ranges.

2.8.4   Powerdown

This feature enables the automatic **Power Off** timer. The timer starts at the most recent interaction with NanoRanger® (the last key press). Options are; Off, 30mins, 1hr (Default), 2hrs, 4hrs, and 8hrs. Configuration is saved to Non-Volatile memory and restored on **Power Up**.

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2.8.5   LCD Light

This feature enables / disables the LCD backlight. Configuration is saved to Non-Volatile memory and restored on **Power Up**.

2.8.6   Details

Under this Menu option, the User can find information about your NanoRanger®:

- Software version
- Serial number
- Calibration date
- Calibration status

2.9   Exiting the Menu and Clearing Readings

Select **Measure** to exit the **Menu** and return to the Measure screen. While on the Measure screen, pressing the **Select** key will clear the current Reading from NanoRanger®.
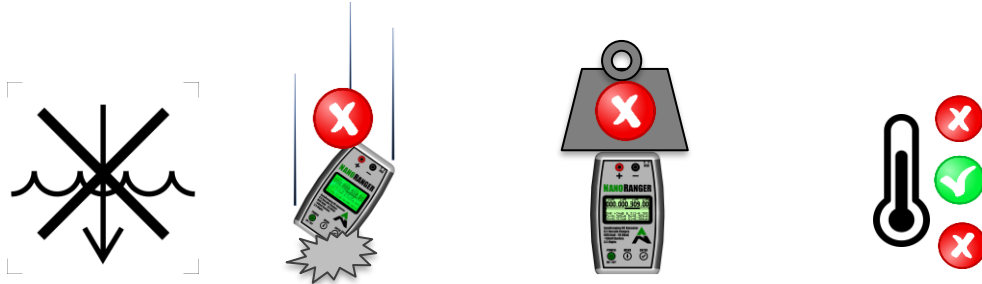
3   Safety

> **CAUTION!** NanoRanger® is designed to measure low levels of current. Do *not* expose to excess load. Excess load can result in component failure.

3.1   Using NanoRanger® Safely

3.1.1 Environmental Conditions:

- NanoRanger® is *not* intrinsically hazardous. Users should take the same care when using NanoRanger® as they would with any other device that measures live electric currents.
- NanoRanger® should *not* be connected to leads (USB, probe) greater than **3M** in length.
- NanoRanger® should *not* be exposed to:
    - Excess moisture, condensing humidity, liquid or excessive dust
    - Shock
    - Excess Load
    - Heavy weights
    - Pressure to the screen area
    - Extremes of temperature (accuracy will be impacted)

3.1.2 Technical Life Span:

- NanoRanger® is guaranteed for a period of 2 years from the date of purchase.
- Periodic (every 1 year) recalibration is recommended to ensure continuing maximum accuracy (see Section 7.3 'Recalibration').

3.1.3 General Safety Information:

- Users should continue to observe usual safe working practices when using NanoRanger®.
- NanoRanger® is intended to be used in a controlled environment, to measure levels of current within its operating range (<800mA).
- If in doubt, Users should check current levels with another instrument before employing NanoRanger® to obtain higher accuracy readings. NanoRanger® does *not* incorporate overcurrent protection, as this would inhibit accuracy at low current levels.
- NanoRanger® uses a flame-retardant enclosure (Hammond 1553 series), Fire Class UL 94 HB.

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- NanoRanger® meets CE and FCC standards for radiated emissions and susceptibility to emissions.

3.1.4 Product Limitations and Restrictions:

- NanoRanger® is a cost-effective means of obtaining highly accurate readings of current. However, while every care is taken to ensure accuracy, no guarantee of accuracy is given or implied.

3.1.5 Installation Safety Information:

- NanoRanger® is delivered ready for use. With temperature variation in transit, Users should allow the device to acclimatise to the operating environment before use.

3.1.6 Maintenance Safety Information:

- NanoRanger® is *not* User-serviceable, or repairable. If NanoRanger® should fail to operate satisfactorily during its warranty period, please contact AltoNovus through the website to arrange repair or replacement.

3.2   Guide to Graphical Symbols

3.2.1 Explanation of Safety Information on the Packaging and Product

SYMBOL	MEANING
	Waste of Electrical and Electronic Equipment (WEEE) recycling. Dispose of electronics correctly.
	Mark of compliance with European Union legislation and regulations.
	Mark of compliance with Federal Communications Commission requirements.
	Battery polarity indicator. The User's serial number is also on this label, which is foun the battery compartment.

3.2.2 Explanation of Graphical Symbols in this Instruction Manual

SYMBOL	MEANING
	Do not immerse in, or expose to, liquid or dust.
	Avoid extremes of temperature.
	Precision electronic instrument. Do not drop.
	Do not subject to heavy weights or excess pressure.
	No User-serviceable parts. Do not open unit.
<=1.0A >1.0A	Do not exceed maximum load.
	Only use a clean, dry cloth to clean unit.

4 **Taking Manual Readings**

The following section explains how to take readings.

4.1 **Switch NanoRanger® ON**

Fit the batteries and connect User-supplied probes in accordance with the instructions at Section 2 above. Pressing the **Power** button will start the NanoRanger®.
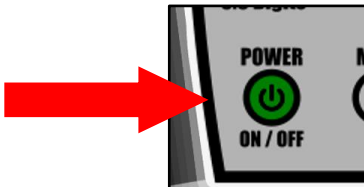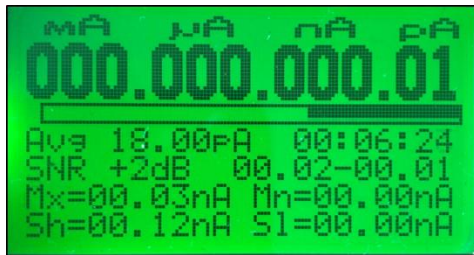
Following Power Up, NanoRanger® will take 180 samples to build up an reading over 300mS. This is undertaken to eliminate mains noise at both 50Hz and 60Hz and to give an accurate Average over the period. By the time processing and displaying this information on the LCD is completed, the NanoRanger® takes about 3 Readings per second.

Looking at the screen above, the User can see that it displays the current in mA, uA, nA, and pA.

4.2 Automatic Range-Switching

The range switches up (to a higher range) in approximately 30uS. When the current rises above 2150 in whatever range the User is in, then the reading is immediately aborted, and the range increased. This cycle is repeated until the range covers the input current. **Note:** *If the maximum range is set, the range will not automatically increase.*

CAUTION! Care must be taken, as the burden voltage will increase and may result in damage, if excessive voltages are encountered across the input terminals.

The range switches down when the completed reading is below 150. This is achieved so swiftly that range switching does not occur going down ranges, but the User will see that the range has changed because of a low value. For example, on powering up, the User will see the range bar move down over 2 seconds to the bottom range, when nothing is plugged into the NanoRanger®.

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4.3 Setting the Range Limit

Via the **Menu**, it is possible to define the range across which NanoRanger® will operate. The Range Bar underneath the Reading shows which ranges are currently in use, moving left and right to confirm the range. The Range Bar oscillates vertically after each reading to show how fast readings are occurring and to provide visual confirmation that the device is functioning properly.

The rectangle around the Range Bar shows how far the range *can* move. In this example, it can cover all possible ranges, but it is configurable with the **Range Max** (maximum) and **Range Min** (minimum) range functions and so the User can fix and limit the degree to which NanoRanger® can Auto-Range.

4.4 The Signal to Noise Ratio (SNR)

The **SNR** indicates how much noise, variation, and AC components are in the signal. It shows the largest and the smallest samples that occurred whilst the NanoRanger® was building up the reading. Here for example, the largest sample is 31.8nA and the smallest is 30.3nA. In this case, the current is constant. The explanation for *noise* is mains power at 50Hz being picked up by the test leads. When the minimum sample hits **0** then the reading may be invalid, due to missing data. If this happens, the **SNR** will change to a negative contrast, as shown in the screen below:
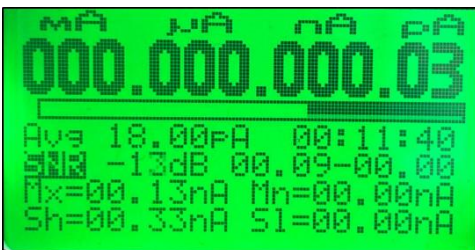
## 4.5 Maximum and Minimum Readings (Mx and Mn)

The **Mx** and **Mn** readings are the maximum and minimum readings that have occurred since the User started measuring; e.g. maximum 00.13nA and minimum 0.00nA. These values will be reset on exiting the measuring function. **Sh** and **Sl** shown above are the highest and lowest Samples respectively. Each Measurement is build from 180 Samples.

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4.6 Switching NanoRanger® OFF
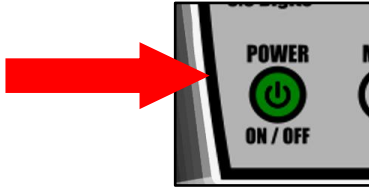
Press the **POWER** button again, once readings are complete, to return NanoRanger® to **Standby** mode. Failing this, the automatic **Power Off Timer** will do so, according to the timeframe that the User has specified via the **Menu**.

5   Getting Connected - taking PC-Controlled Readings & SCPI Commands:

To connect NanoRanger® to your computer, you will require a **terminal programme** to log data. A useful programme is **RealTerm**.

- When you plug your NanoRanger® in, it should install the device driver for the FT230X. This should then be seen by your system as a **COM port.**

- **Right click** on your **Windows icon**, select **Device Manager**, then select **Ports (COM & LPT)**. You should then see the **COM port with the port number** (e.g. USB Serial Port (COM3)).

- **Plug and Unplug** your NanoRanger®, to check that you are operating through the appropriate **COM port**.

- Select the correct **COM port** in the **terminal programme.**

- Please note that the **port** may appear as **\VCPn port** under the port selection in **RealTerm**.

While NanoRanger® is USB *enabled*, the chip it uses converts output to Rs232. Set the baud rate to 57K6 on the port.

NanoRanger® is SCPI *compatible*, but with limited functionality. Hence, it is *not SCPI compliant* and cannot process commands whilst performing measurements. When entering SCPI commands, indicated by `Courier New` font, only the portions with capital letters MUST be entered; the remainder can be left out. The commands below can be entered through the USB interface, via a COM port on a simple terminal programme. Commands / responses are terminated with a Line Feed.

5.1   SCPI Mandated Commands:

`*CLS`   This command clears the event registers and queues.
`*ESE`   This command sets bits in the Status Enable Register of the Standard Event Register.
`*ESE?` This command queries bits in the Status Enable Register of the Standard Event Register.
`*ESR`   This command reads and clears the contents of the Standard Event Status Register.

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`*IDN?` This command retrieves the identification string of the device:

AltoNovus,NanoRanger®,nnnnnnn,yyyy
Where nnnnnnn = serial number
yyyy = software version

`*OPC` This command sets the operation complete (OPC) bit after all pending commands have been executed.

`*OPC?` This command queries the OPC bit.

`*RST` This command resets the device settings to their default values.

`*SRE` This command sets or clears the bits of the Service Request Enable Register.

`*SRE?` This command queries the bits of the Service Request Enable Register.

`*STB?` This command collects the status byte of the device.

`*WAI` This command postpones the execution of subsequent commands, until all previous overlapped commands are finished (Not Used).

5.2 SCPI Required Commands:

`SYSTem:ERRor[:NEXT]?` This command returns the oldest unread error message from the event log and removes it from the log.

`SYSTem:ERRor:COUNt?` This command returns the number of errors in the event log.

`SYSTem:VERSion?` This command queries the present SCPI version.

`STATus:QUEStionable[:EVENt]?` This command reads the Questionable Event Register.

`STATus:QUEStionable:ENABle` This command sets the contents of the Questionable Event Register.

`STATus:QUEStionable:ENABle?` This command reads the contents of the Questionable Event Register.

`STATus:PRESet` This command resets all bits in the status model.

5.3 Device Commands:

The commands below are used to control the functionality of the NanoRanger®. When a NanoRanger® is powered up, it is controlled via the front panel buttons. In this mode, it will output its measurement through the USB in the form below. All currents are in units of Amperes and all power measurements in units of Ampere Hours:

+6.4E-10<CR><LF>

This will be output continuously. In the example above, it is **0.64nA**.

To enable the device to be controlled via SCPI, a ***RST** command must be issued. This will stop all output and the operation of the device until it receives commands telling it what to do.

5.3.1 Save (`*SAV`) and Recall (`*RCL`)

`*SAV` This command will save all the changes the User has made into flash memory, so that they can be recalled at a later time.

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`*RCL` This command will retrieve the saved changes made. When entering SCPI mode with ***RST** the device will be in its default state.

5.3.2   Power OFF (`SYSTem:POWer`)

`SYSTem:POWer` This command will turn the NanoRanger® OFF, similar to the power button on the front panel.

5.3.3   LCD Backlight (`CONFigure:LED`)

`CONFigure:LED` **<0,1>** This command will turn the LCD backlight LED **On** or **Off**. 0 = off, 1= On. For example:

  `CONFigure:LED 0` This command turns the backlight LED **Off**.

`CONFigure:LED?` This command returns the backlight LED status. For example:

  `CONFigure:LED?`
  1

5.3.4   Powerdown Settings (`CONFigure:POWerdown`)

`CONFigure:POWerdown` **<0..5>** This command sets the timer to automatically **Powerdown**. Any command received through the USB interface will restart the timer. The options are:

  0 = Off
  1 = 30 minutes
  2 = 1 hour
  3 = 2 hours
  4 = 4 hours
  5 = 8 hours

`CONFigure:POWerdown?` This command will return the current **Powerdown** timer setting.

5.3.5   Range Settings (`CONFigure:RANge`)

`CONFigure:RANge` **<0..8>** This command sets the range of the NanoRanger®. There are **9** ranges, as detailed below. Do Not subject the NanoRanger® to currents above the selected range, as this may damage the device:

  0 = 20.00nA
  1 = 200.0nA
  2 = 2.000uA
  3 = 20.00uA

4 = 200.0uA
5 = 2.000mA
6 = 20.00mA
7 = 200.0mA
8 = 800mA

`CONFigure:RANge?` This command returns the current range setting of the NanoRanger®, as well as the maximum and the minimum ranges. For example:

> `CONFigure:RANge?` **7,8,7**
> Current range is **7**, maximum range is **8**, minimum range is **7**.

`CONFigure:RANge:MAXimum` **<0..8>**   This command sets the maximum range of the NanoRanger®. On Powerup, or `*RST` the maximum range will be **8**.

`CONFigure:RANge:MAXimum?` This command returns the current maximum range setting of the NanoRanger®.

`CONFigure:RANge:MINimum` **<0..8>** This command sets the minimum range of the NanoRanger®. On Powerup, or `*RST` the maximum range will be **0**.

`CONFigure:RANge:MINimum?` This command returns the current minimum range setting of the NanoRanger®.

5.3.6   Samples (`CONFigure:SAMples`)

`CONFigure:SAMples` **<0,1>** This command enables/disables the sending of sample information with the main current measurement. **0** = off, **1**= On.

The sample information will be added to the main measurement with maximum sample during the measurement first, and minimum sample during the measurement last. For example:

> **+6.4E-10,+2.71E-09,+0**<CR><LF>

Measurement **0.64nA**, maximum sample **2.71nA**, minimum sample **0**.

`CONFigure:SAMples?` This command returns the sample sending status.

5.3.7 Reset Readings (`CONFigure:CURRent`)

`CONFigure:CURRent` This command resets the currently held minimum/maximum measurement values and the minimum/maximum sample values. This command also resets the Measurement's running Average current calculation and time count.

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5.3.8   Maximum/Minimum Current (`MEASure:CURRent:Maximum?`**)**

`MEASure:CURRent:MAXimum?` This command displays the maximum and minimum current readings since Powerup, or issues the `CONFigure:CURRent` command. For example:

+3.1E-06,+2.71E-09<CR><LF>

Maximum measurement **3.1uA**, minimum measurement **2.71nA**.

5.3.9   Maximum/Minimum current samples (`MEASure:SAMples:Maximum?`**)**

`MEASure:SAMples:MAXimum?` This command displays the maximum and minimum samples taken since Powerup, or issues the `CONFigure:CURRent` command. For example:

+3.1E-06,+2.71E-09<CR><LF>

Maximum sample **3.1uA**, minimum sample **2.71nA**.

5.3.10   Reading (`READ?`**,** `MEASure?`**,** `INITiate`**)**
`READ?` This command initiates a reading. It is the same as `MEASure?` and `INITiate`. For example:

+3.1E-06<CR><LF>

Measurement is **3.1uA**.

5.3.11   Triggering (`TRIGger:COUnt`**)**

`TRIGger:COUnt` This command sets the number of triggers for a measurement. Each measurement takes 200mS. Setting a trigger count of **5** and the issuing a `READ?` command will result in **5** measurements being taken. When not in SCPI mode, the trigger count is essentially set to *infinite*, with measurements being taken continuously.

`TRIGger:COUnt?` This displays the number of triggers. When used with the `MEASure:AVERage` command, it sets the time for measurement in units of 200mS, 5 counts per second.

5.3.12   Show Average Power (`MEASure:AVERage?`**)**

`MEASure:AVERage?` This command displays the Average current and time elapsed in seconds. This runs continually and can be reset using the **Reset Readings** command at **5.3.7** (above). For example:

+3.1E-06,134

Average is 3.1uA over 134 seconds.

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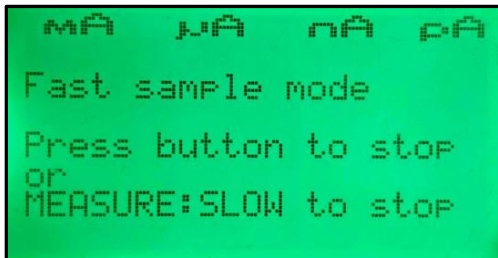**5.3.13 Fast Sample Mode (**`MEASURE:FASt, MEASURE:SLOw`**)**

`MEASURE:FASt` This command interrupts NanoRanger®'s standard measurement mode and gives the User access to 150 readings per second, output via the USB. This is to enable the User to investigate current profiles over short periods of time.

In Fast Sample Mode, each reading is built of 4 samples, instead of the usual 180 samples. ***Readings in Fast Sample Mode may therefore be more susceptible to 'Noise'*** (e.g. from Mains electricity).

Each reading is prefixed with a timestamp consisting of 5 digits for seconds and, after the decimal point, 3 digits for thousandths of seconds. For example:

==00082.460==**:+6.4E-10**

Fast Sample Mode is enabled with the command `MEASURE:FASt`. When placed in this mode, the LCD screen will show:

Fast Sample Mode can be stopped with the command `MEASURE:SLOw` or pressing a front panel button.

NB. There is no separate MENU option to enter Fast Sample Mode as a terminal interface is needed to access the output.

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6   Storage, Transportation and Disposal

Instructions for storage, transportation and safe disposal of NanoRanger® follow.

6.3 Storage:

- AltoNovus recommends that the User removes the batteries prior to any prolonged period of storage.
- Avoid storage in areas of high humidity.

6.2   Packaging and Transportation:

- Batteries should be removed prior to commercial transportation.
- Ensure NanoRanger® is well insulated against shocks during transportation.

6.3   Disposal:

Disposal instructions follow.

6.3.1 Disposal of Electronic Components:

- NanoRanger® should be disposed of safely, in accordance with local regulations for electronic products.
- NanoRanger® can be returned to the manufacturer for safe recycling and disposal.

6.3.2 Disposal of Packaging Waste:

- A high proportion of NanoRanger®'s packaging is recyclable. Please recycle where possible.

6.3.3 Disposal of Batteries:

- Dispose of batteries in accordance with local regulations and manufacturer's instructions.

7   Maintenance

CAUTION! NanoRanger® has no User-serviceable parts. Users should *not* attempt maintenance beyond routine battery replacement and surface cleaning (as necessary).

7.1   Replacing the Batteries:

- NanoRanger® uses 2 x AA batteries, which should give over 150 hours of normal operation, before requiring replacement. To replace the batteries, follow the instructions at Section 2.7.1. Batteries should be stored and disposed of in accordance with manufacturer's instructions.

7.2   Cleaning:

- Should NanoRanger® need its surface cleaning, only use a soft, dry cloth and avoid the application of excessive pressure, particularly in the area of the screen.

7.3   Recalibration:

- Each NanoRanger® is calibrated shortly before its despatch to the User and should remain highly accurate over time (12+ months). However, a recalibration service is available. Please contact AltoNovus at info@altonovus.com for details.

DOCUMENT ENDS