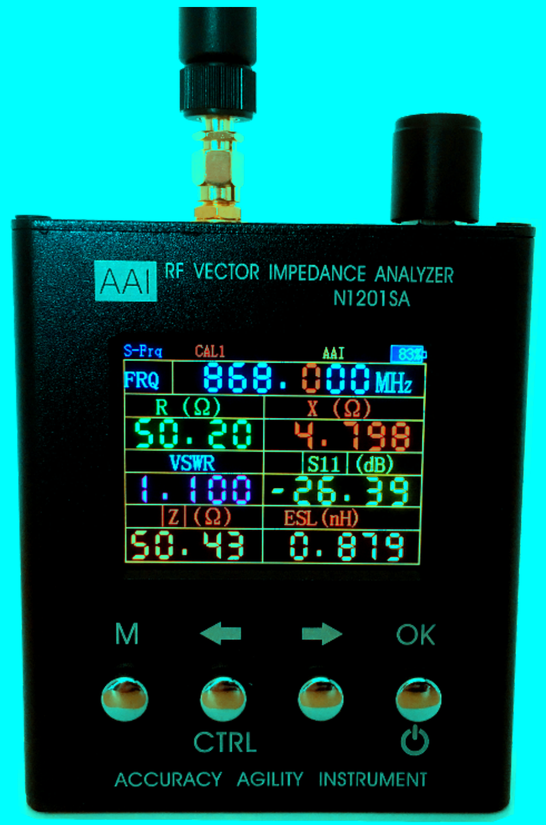
LORA / LORAWAN TUTORIAL 40

N1201SA Vector Impedance Analyser



INTRO

- In this tutorial I will demonstrate the use of the N1201SA Vector Impedance Analyser.

WHY IS AN ANTENNA ANALYSER NEEDED

- The antenna used by the gateway or end device plays an important role which should not be under estimated.
- That is why I am making many videos about this subject.
- The VSWR and S11 are the two most important antenna parameters which you can measure with an antenna analyser. These parameters determines how well an antenna performs.
- If you buy devices which includes antennas or you buy the antennas separately, I strongly recommend to measure the antenna parameters. I have noticed that you can not trust the specified antenna parameters.

WHY IS AN ANTENNA ANALYSER NEEDED

- If you build your own antenna, you need to measure the antenna parameters.
- I have build several antennas for this video series, and more often than not the self build antennas had a VSWR greater than 2.
- If I did not had an antenna analyser I would not have know this.
- I bought the N1201SA Vector Impedance Analyser because it had good reviews. There could be better and cheaper antenna analysers out there. Do your own research!
- The N1201SA is presumably made by a Chinese manufacturer called "Accuracy Agility Instrument". However I could not find any information about this manufacturer.

N1201SA

- The N1201SA Vector Impedance Analyser measures the following antenna parameters: VSWR, S11, resistance (R), reactance (X) and impedance (Z).
- The N1201SA series has several models: N1201SA, N1201SAC and N1201SA+.
- The N1201SA is the basic model which will be demonstrated in this tutorial.
- The working frequency of this model is between 137.5 MHz and 2700 MHz.
- The analyser has a built-in high capacity lithium ion battery which can be charged using the micro USB port.
- The user connects an antenna to the SMA port.

N1201SA

- The analyser sends a signal to the antenna.
  The analyser measures how much power is reflected back at various frequencies.

- As explained in tutorial 33 an antenna with a VSWR < 2 is considered to be a good antenna.

- This corresponds to an S11< -9.5 dB, which means less than 11.1% of the power is reflected back.

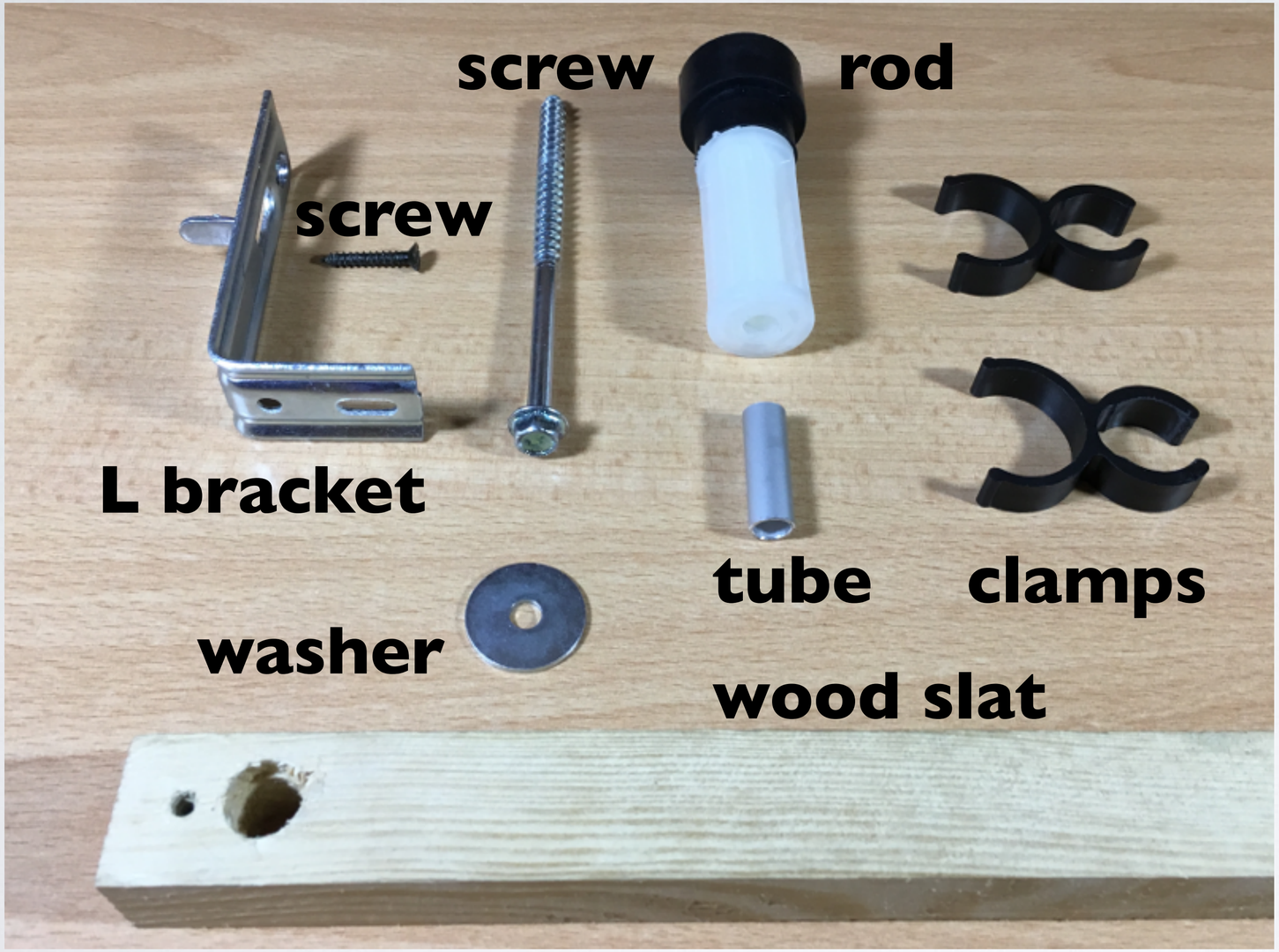
N1201SA

- The antenna and the N1201SA are sensitive to its environment:
  - Avoid nearby walls and objects.
  - Avoid nearby electrical equipments (eg: lamps, laptops, mobile phones).
  - Place the analyser on a non conductive table.
  - Do not touch the analyser, antenna or the cable during measurements.
  - Measure the antenna in its final enclosure.
  - Preferably measure the antenna parameters at the location where it is used.

TEST RIG

- To avoid touching the analyser or the antenna during measurements I have build a simple test rig to hold the antenna when measuring the antenna parameters.
- The antenna is clamped at the type N plug to SMA connector with coaxial cable.
- The clamps are made of plastic.
- I use the same test rig when connecting an antenna to my end node.
- I have build the test rig with random parts found in my toolbox.

TEST RIG PARTS



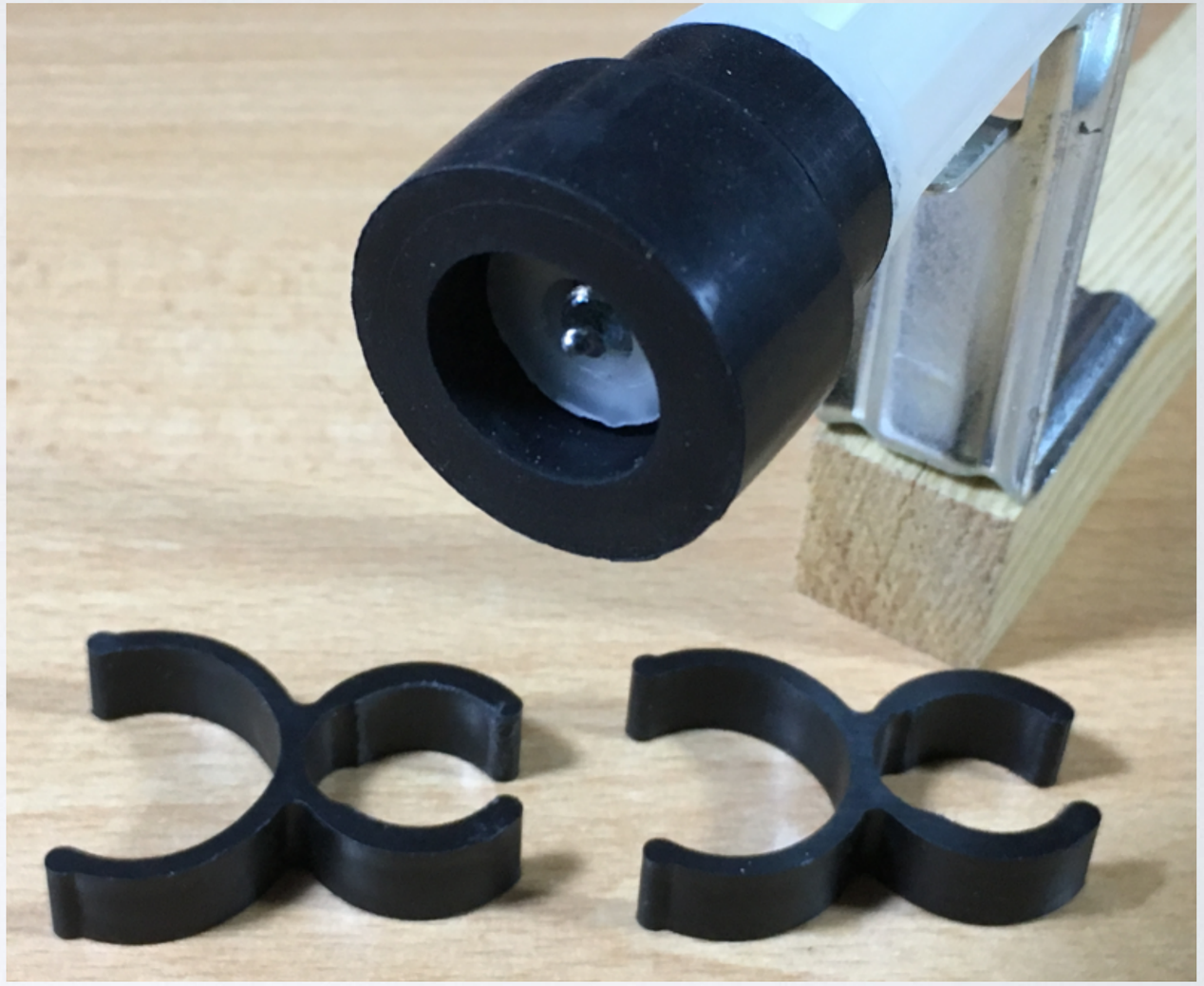
All test rig parts.

The clamps are made of plastic.
The rod is part plastic and rubber.

TEST RIG IN HORIZONTAL POSITION

To use the test rig horizontally, first attach the L bracket.

TEST RIG IN HORIZONTAL POSITION

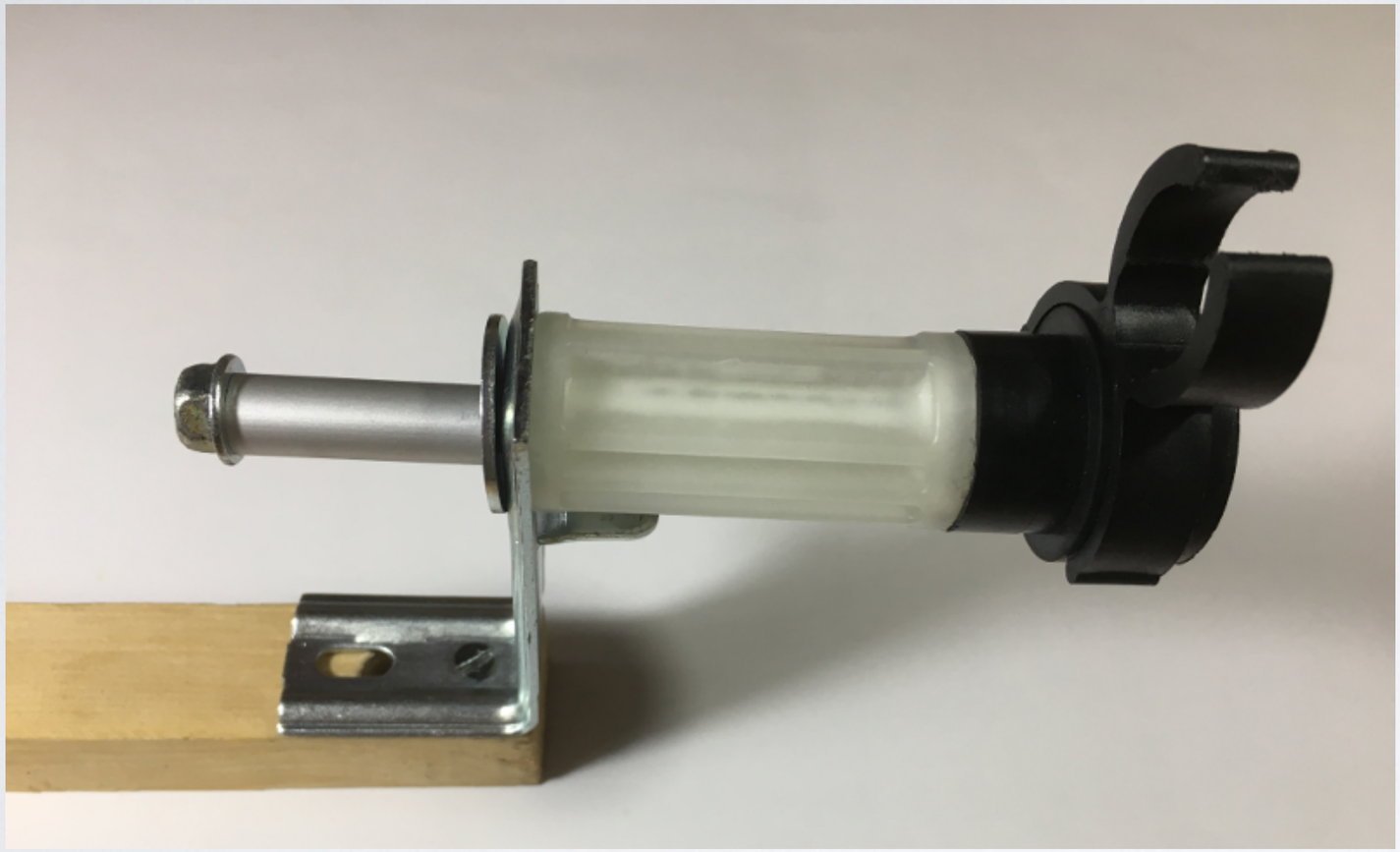


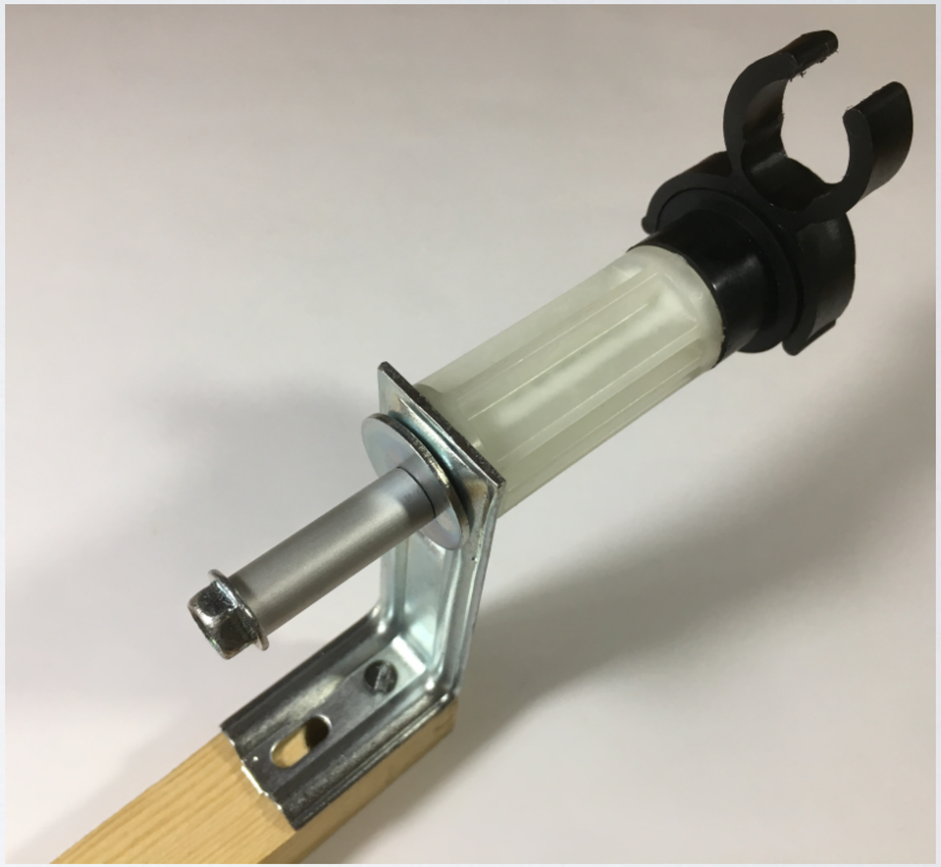
Then attach the other parts.

TEST RIG IN HORIZONTAL POSITION

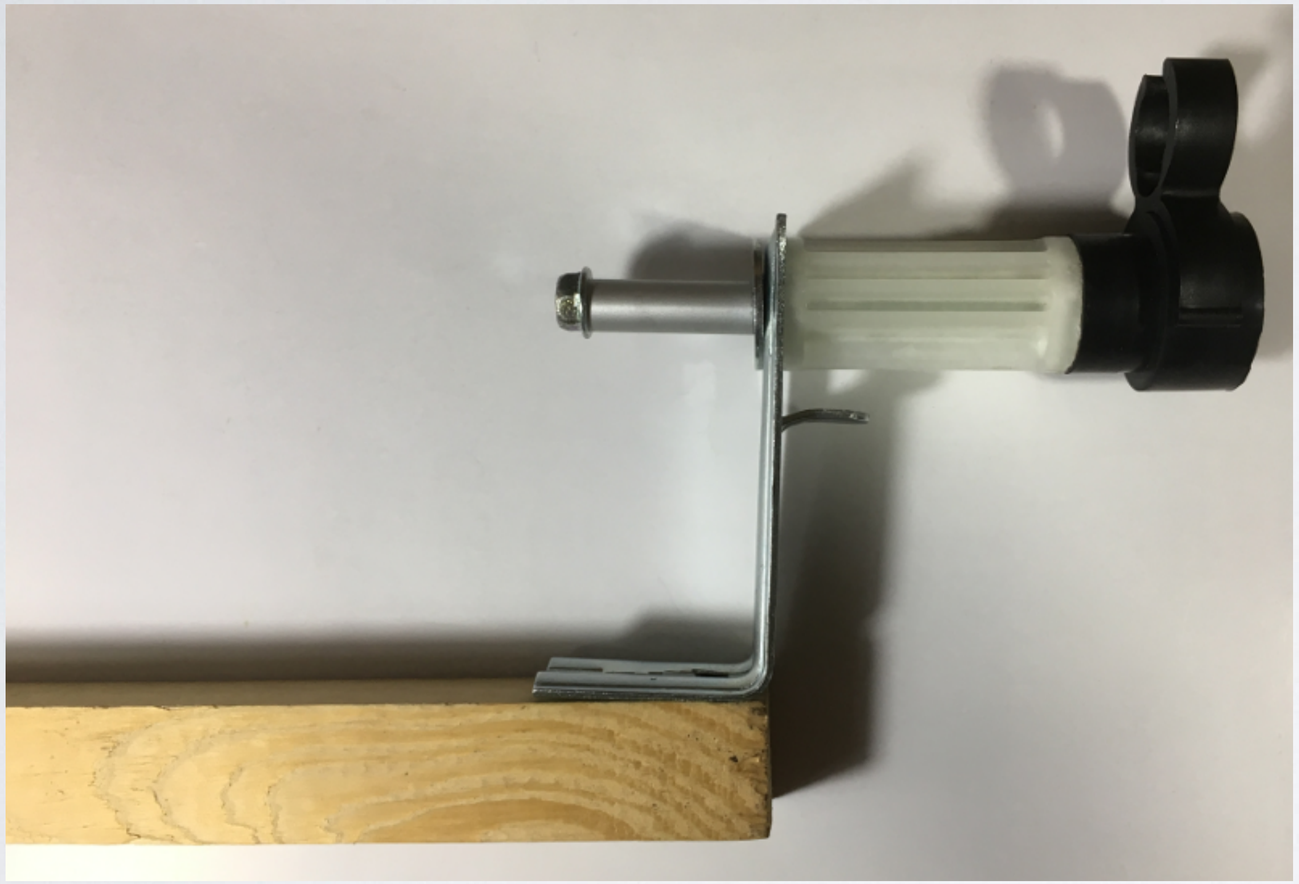
Use one or both clamps.

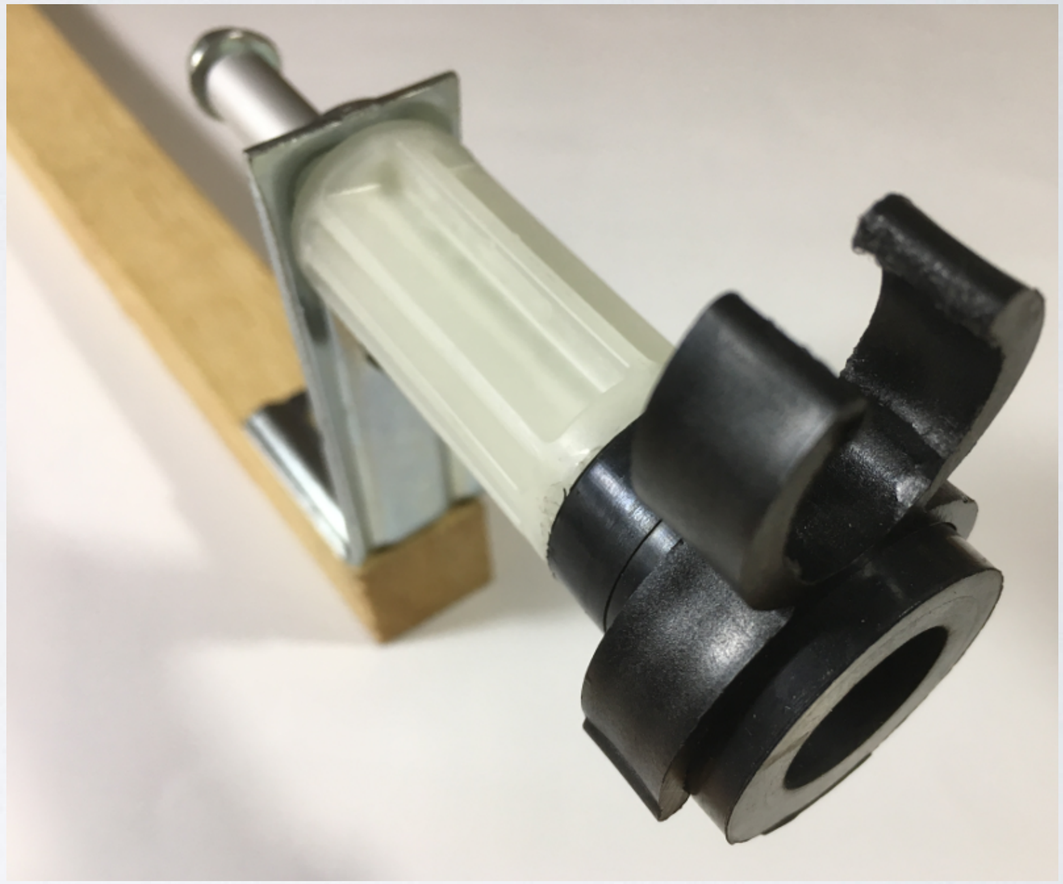
TEST RIG IN HORIZONTAL POSITION



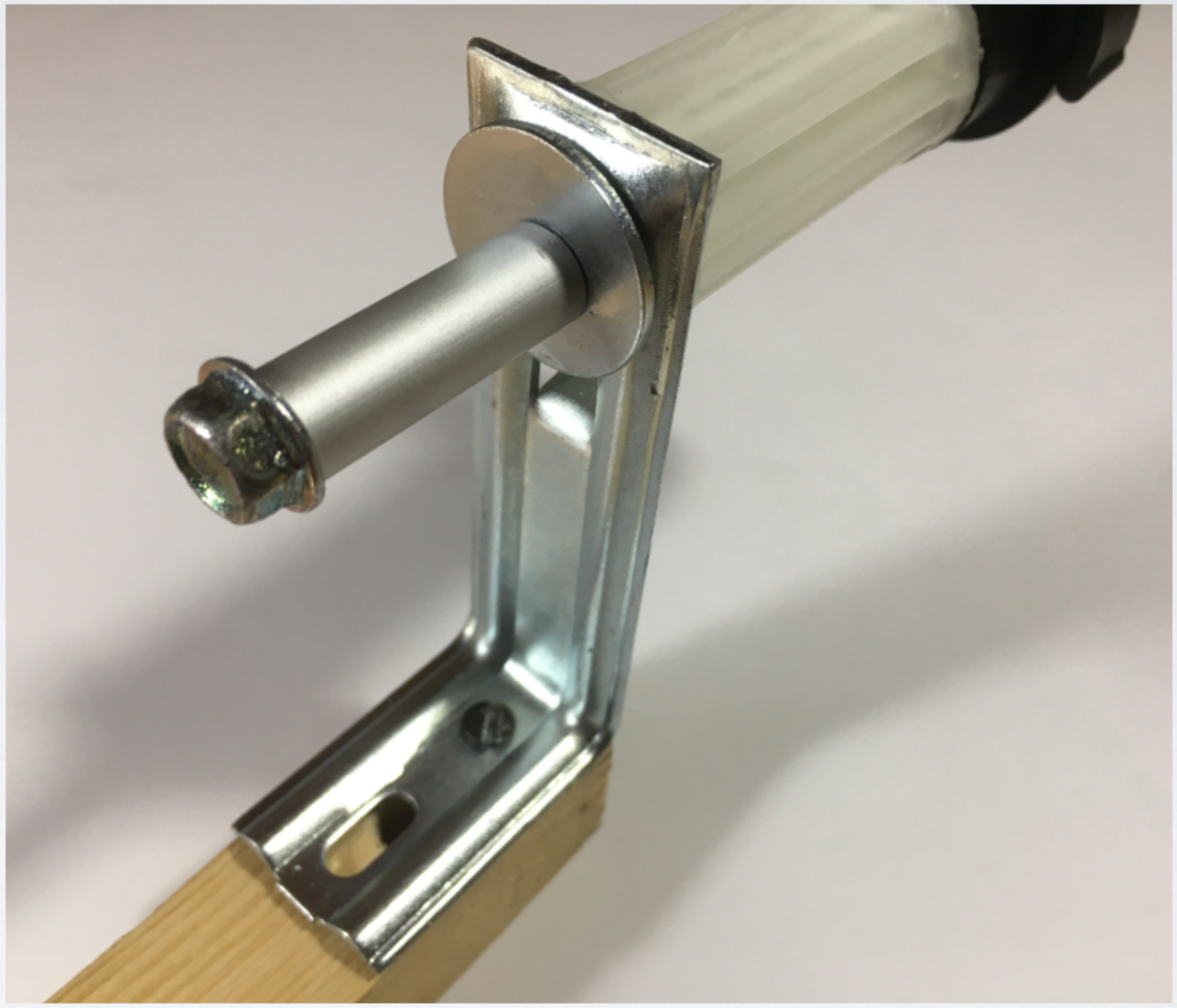


TEST RIG IN HORIZONTAL POSITION

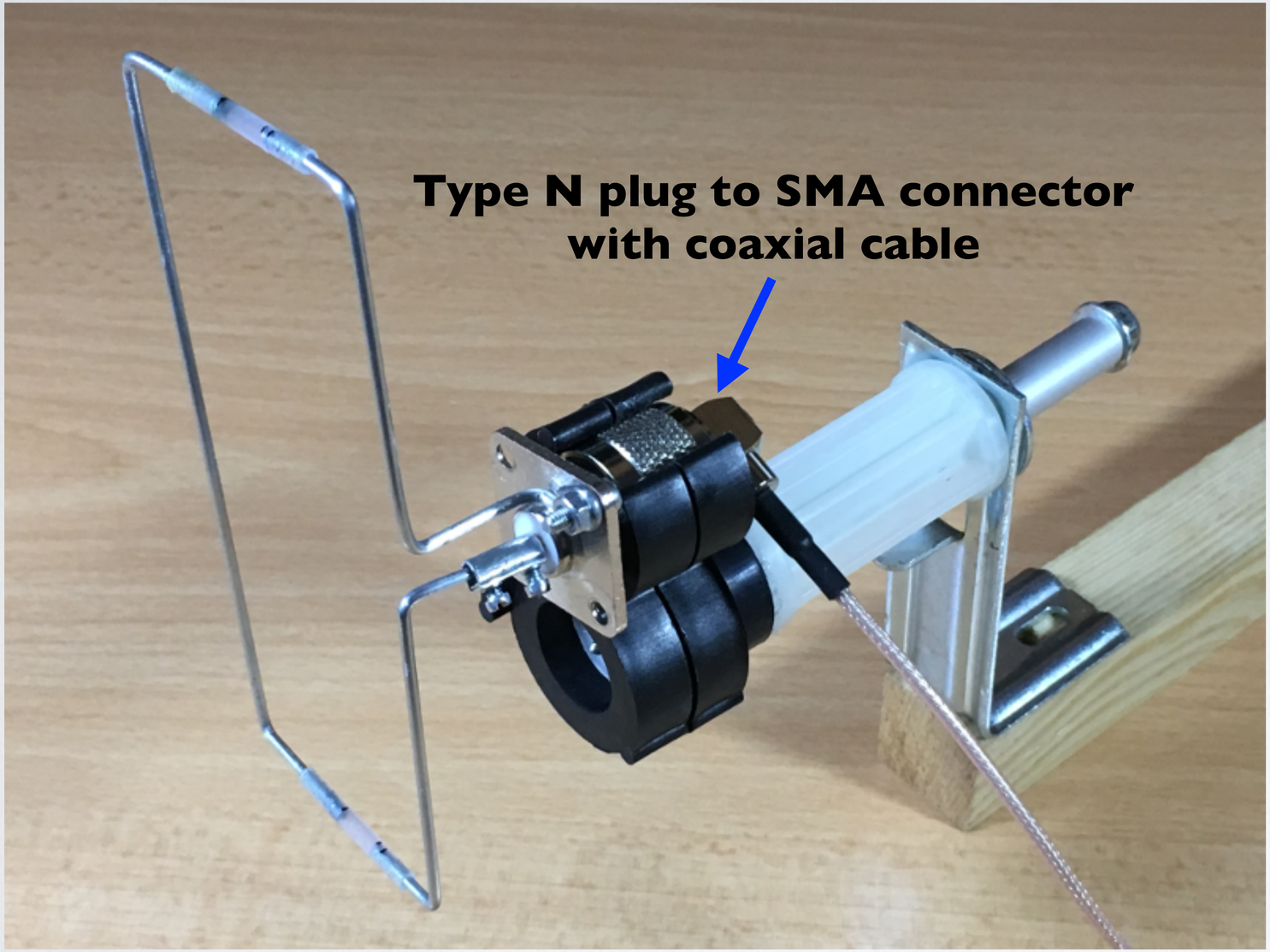




TEST RIG IN HORIZONTAL POSITION



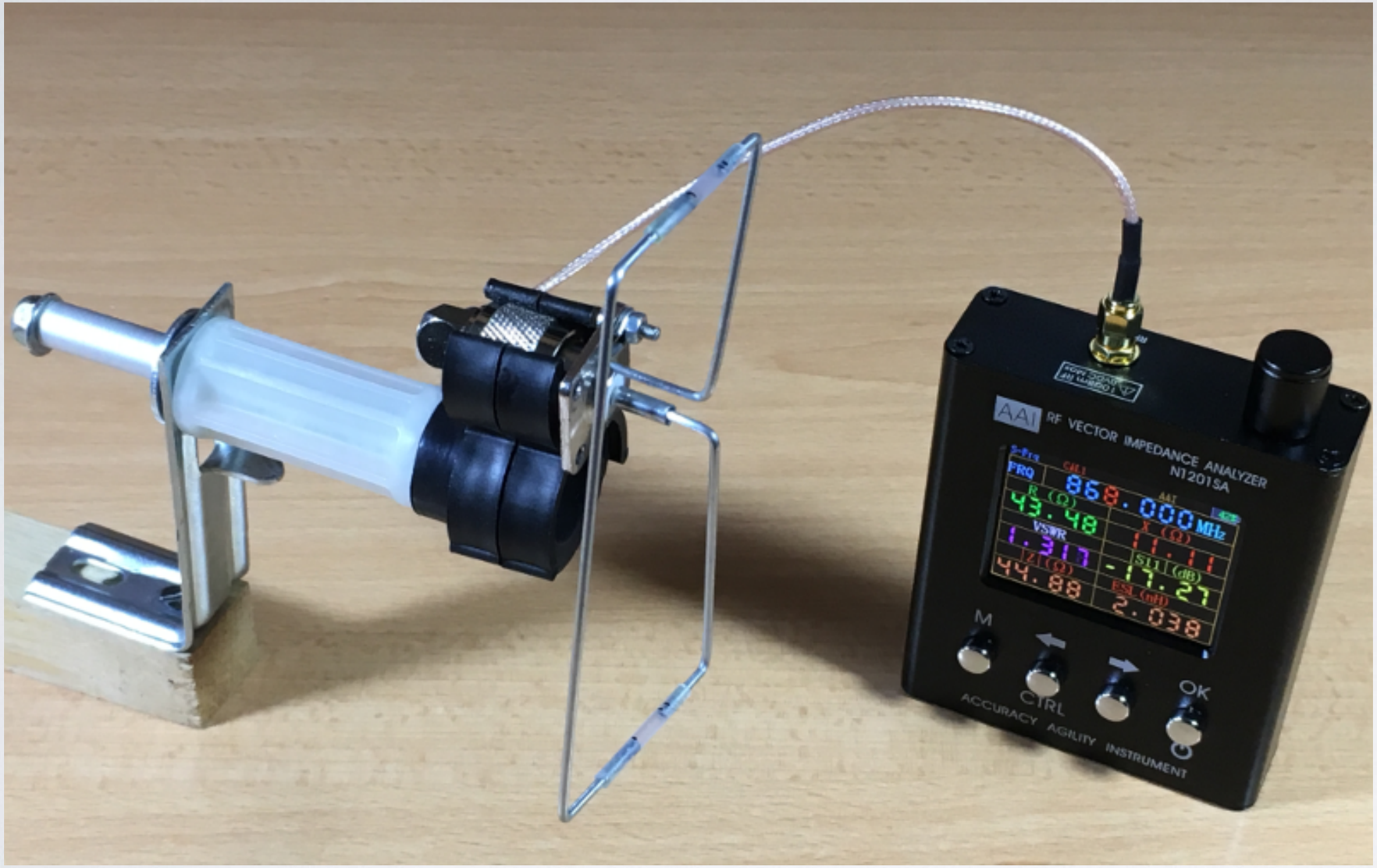
TEST RIG IN HORIZONTAL POSITION



Clamp the antenna.

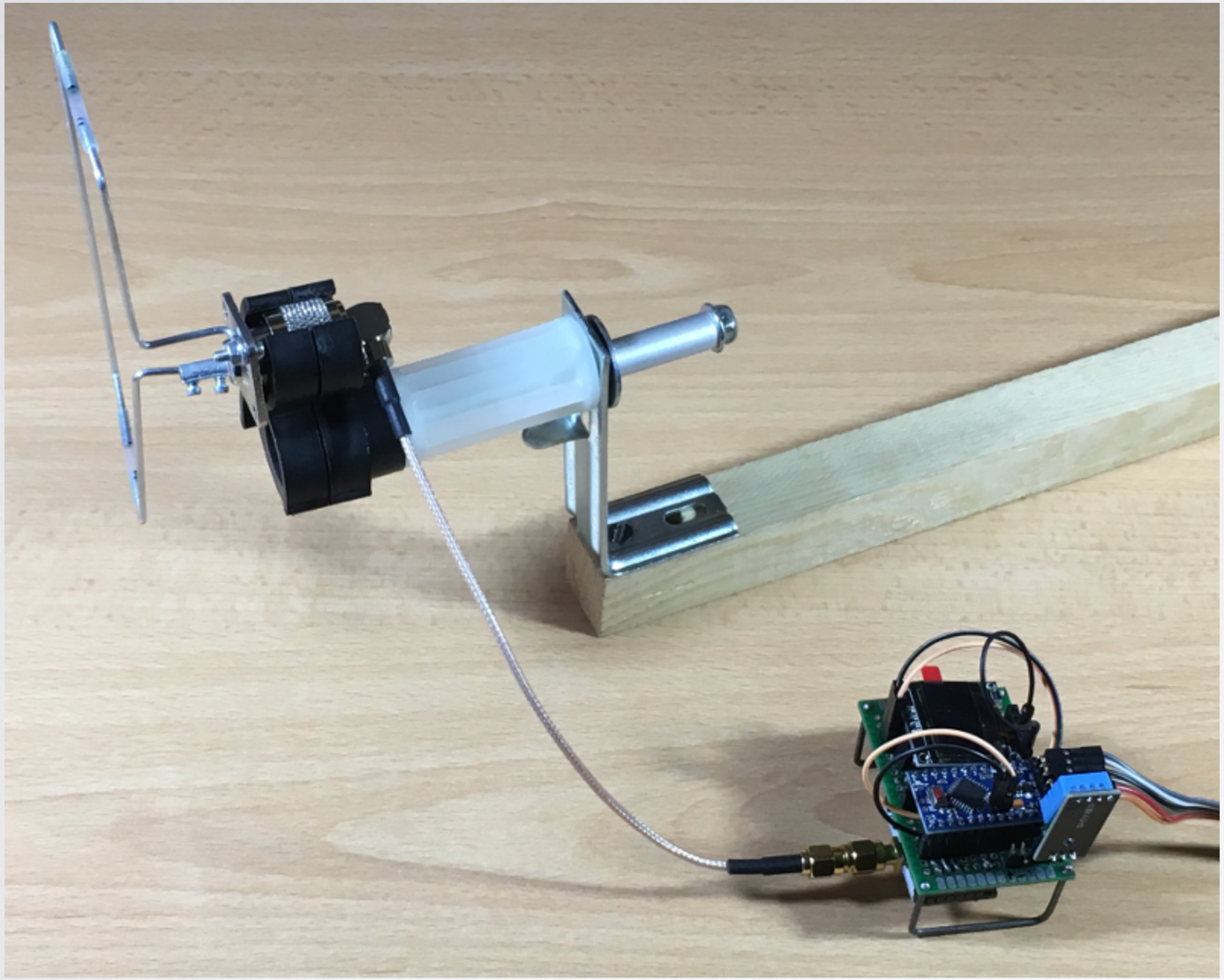
In this example a Moxon antenna is clamped.

TEST RIG IN HORIZONTAL POSITION



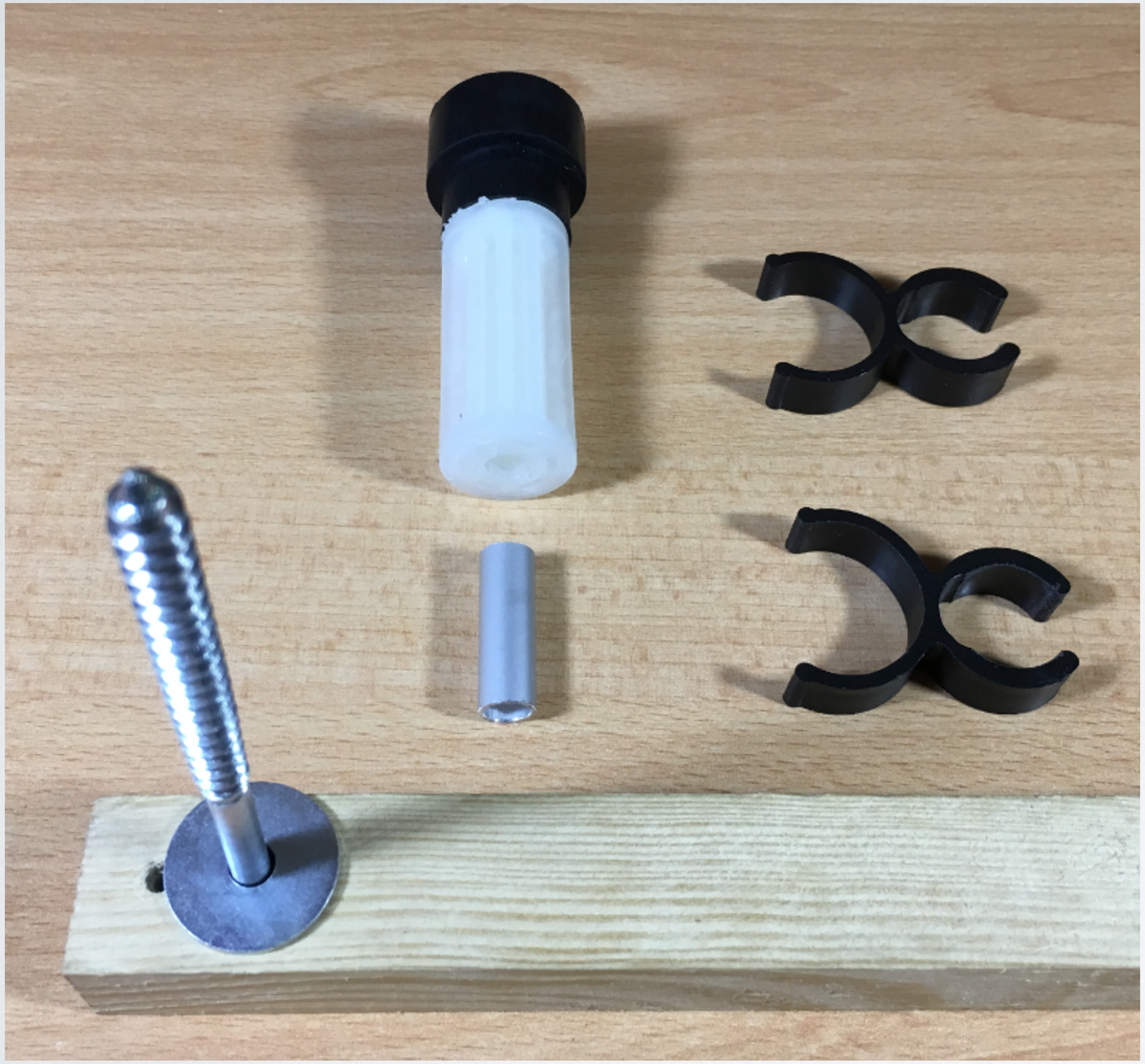
Connect the N1201SA.

TEST RIG IN HORIZONTAL POSITION



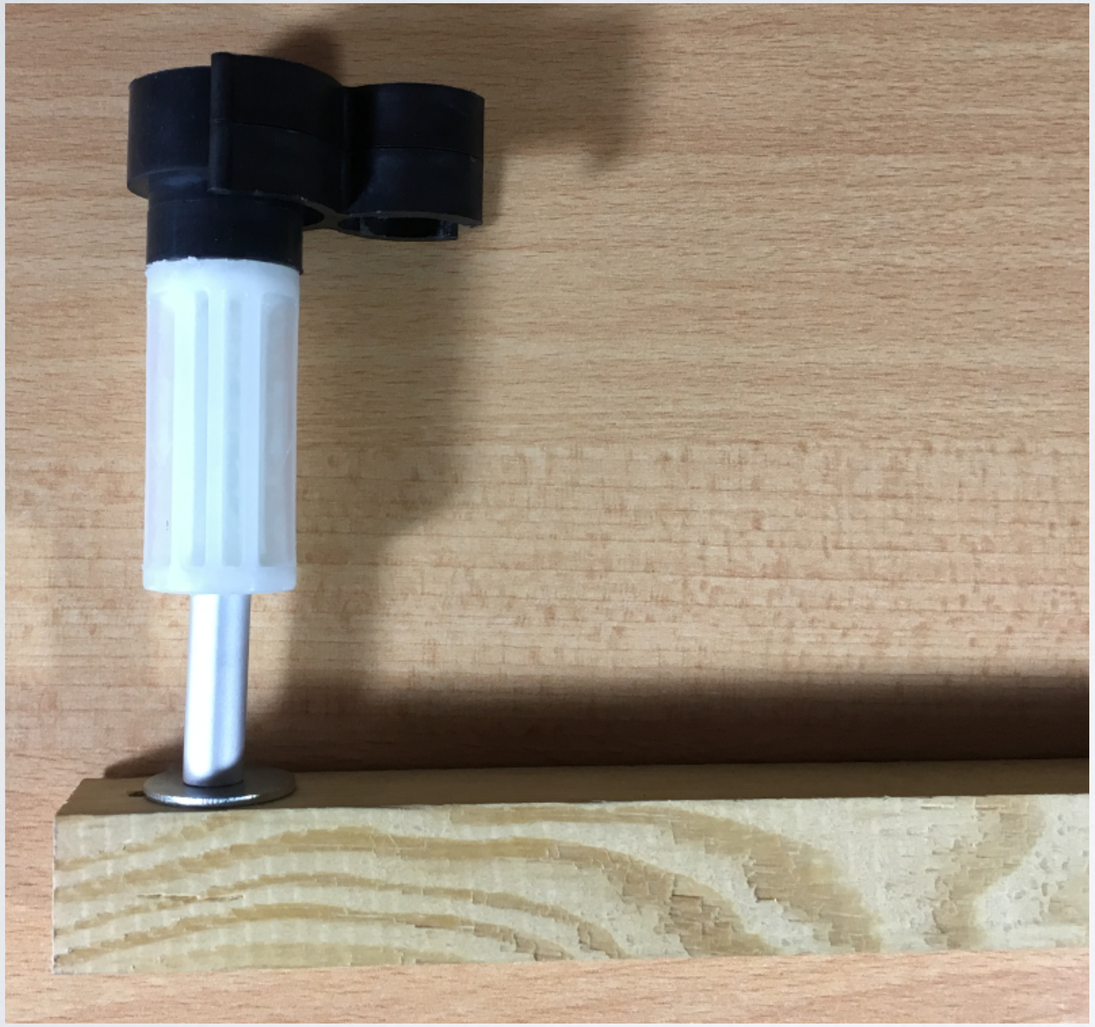
Connect the end node.

TEST RIG IN VERTICAL POSITION



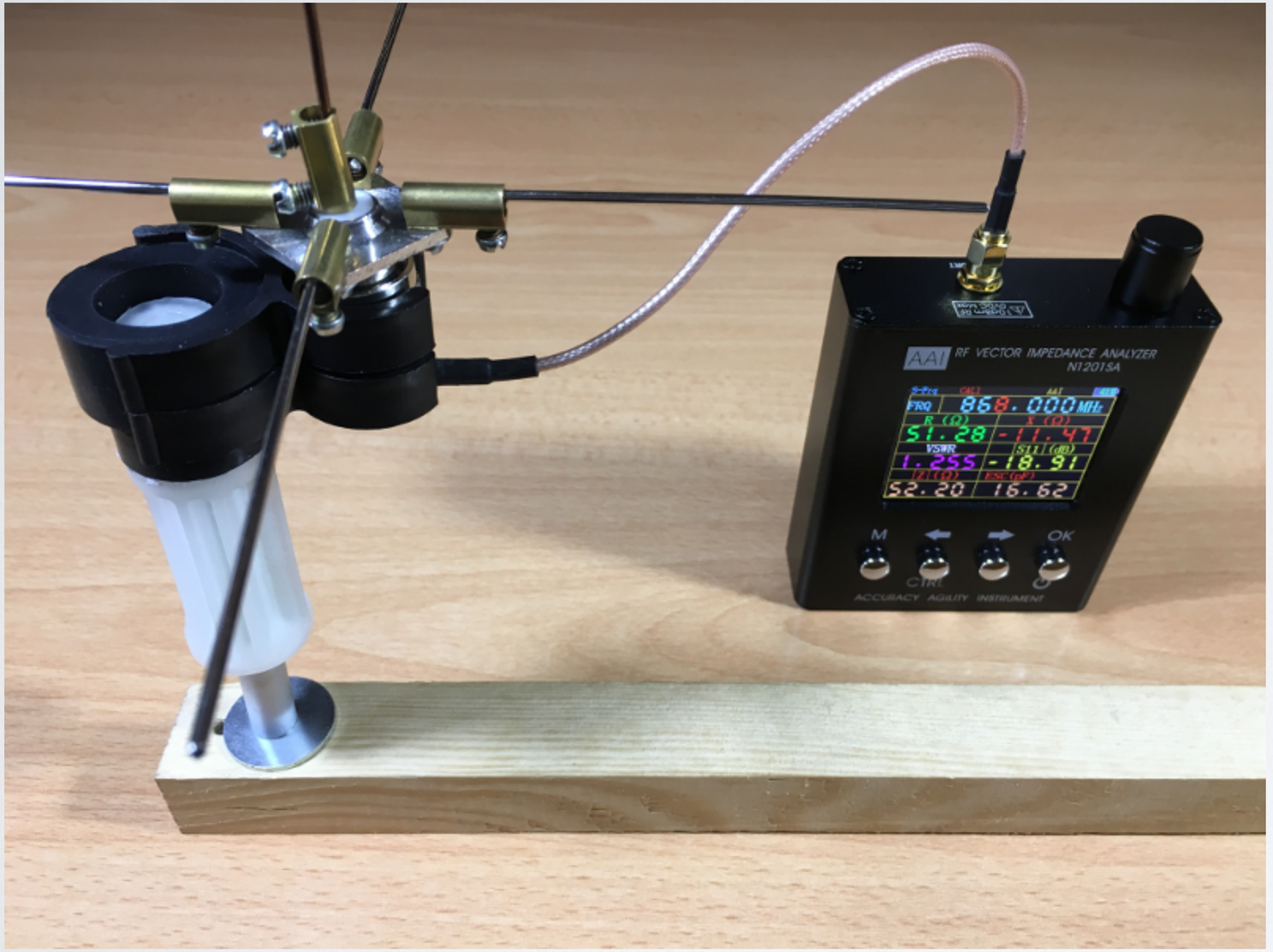
To use the test rig vertically,
first attach the screw and washer.

TEST RIG IN VERTICAL POSITION



Then attach the other parts.

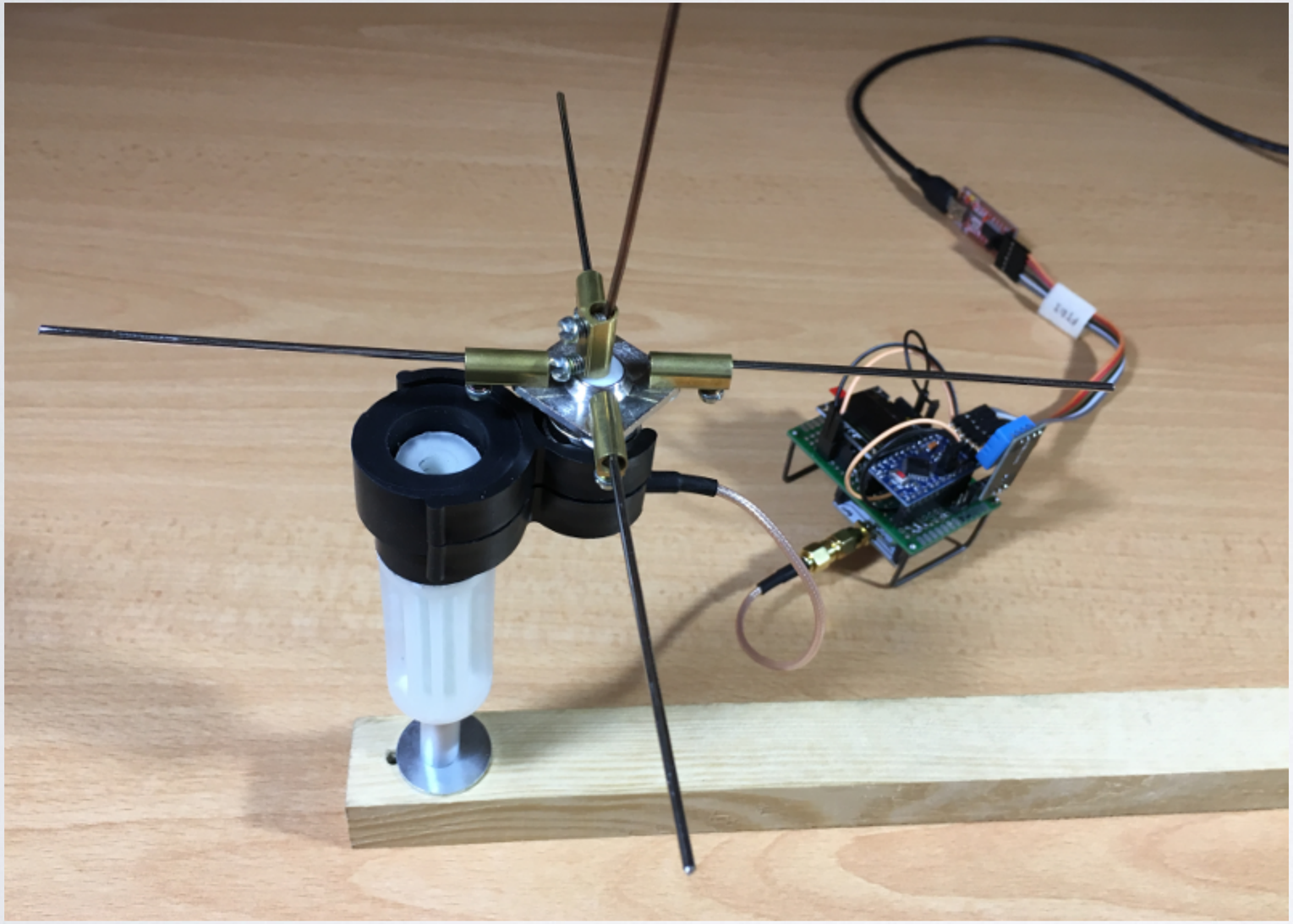
TEST RIG IN VERTICAL POSITION



Connect the N1201SA.

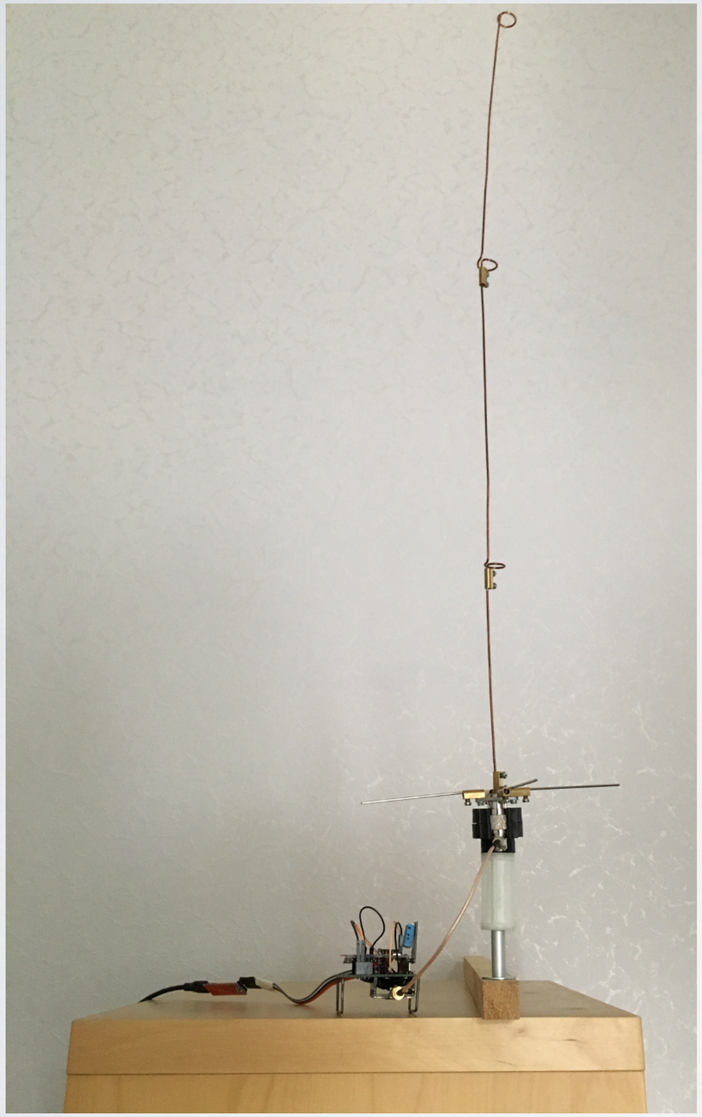
In this example a collinear antenna is clamped.

TEST RIG IN VERTICAL POSITION



Connect the end node.

TEST RIG IN VERTICAL POSITION



End node, collinear antenna and test rig.

N1201SA

- The N1201SA Vector Impedance Analyser can be calibrated using an OSL calibration kit. The OSL calibration kit need to be purchased separately.

- OSL stands for Open, Short and Load.

Load (up to 3 GHz)

Short
(with centre pin)

Open
(no centre pin)

In this tutorial I will not demonstrate how to calibrate the analyser.

N1201SA

SMA Female

Adjustment knob

Metal housing (aluminium)

LCD screen

4 buttons to operate the device

Main menu button

N1201SA

LED on: device is charging
LED off: device is charged

Charging LED

Micro USB B female charging port

Instrument reset when analyser gets stuck

Serial data output (only N1201SAC models)

NI201SA

NI201SA

N1201SA

Charger (not included)
Current > 1 A required

I am using a 2.4 A iPhone charger.

Do not use the computer USB port because it does not provide sufficient current to charge the vector analyser.

Micro USB B male to USB A male charging cable (included), length =120 cm

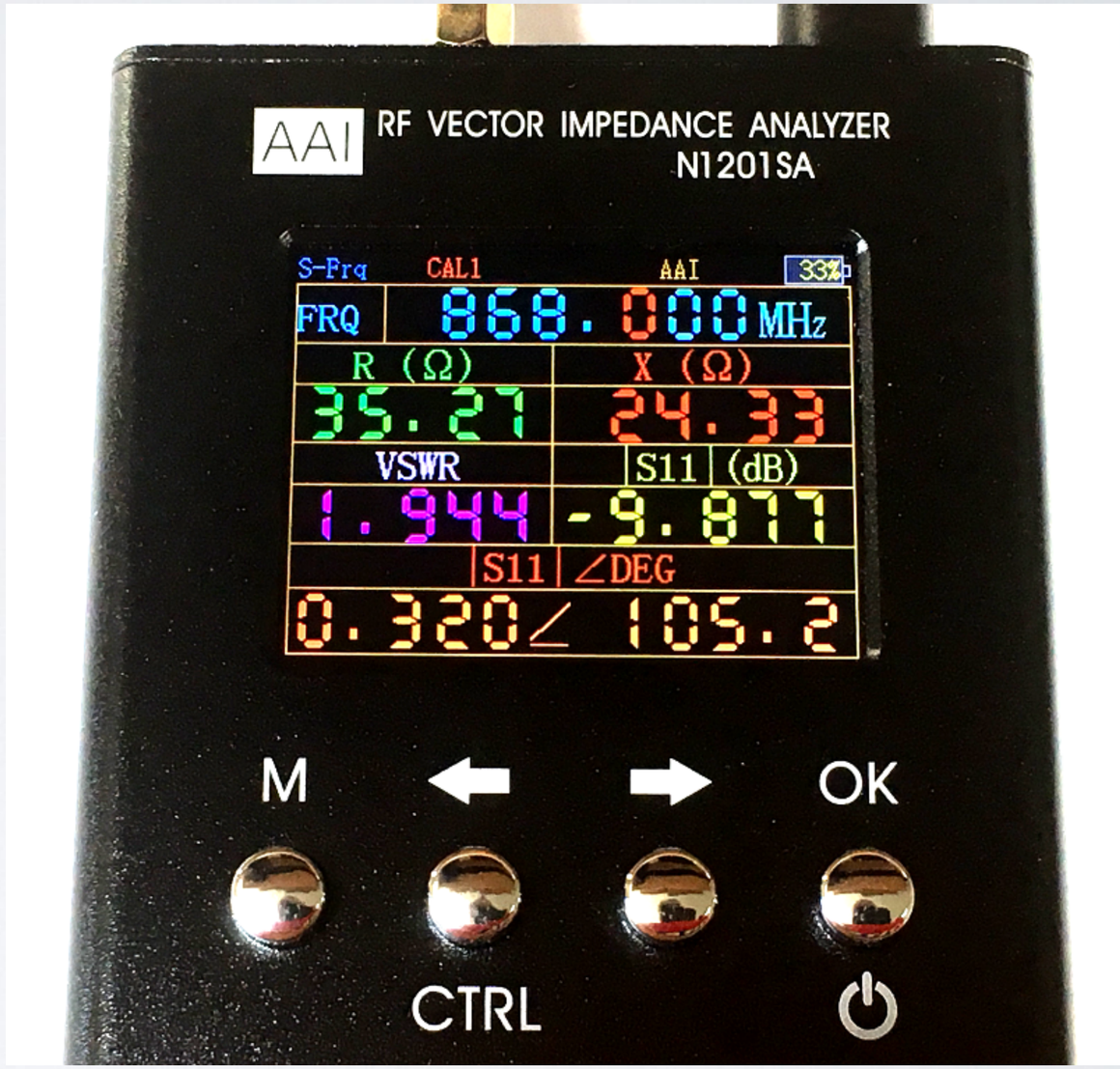
NI201SA

- Switch on device: Press **CTRL + OK**
- The analyser can be used in four operation modes with it corresponding screens:
  - The single point measurement mode (the default power-on screen, **CTRL + OK**)
  - The scan function mode (Press **M** button)
  - The system information mode (Press **CTRL + M**)
  - The calibration mode (**2x CTRL + M**)
- Switch off device: Press **OK** button for 3 seconds

SINGLE POINT MEASUREMENT MODE

(CTRL + OK)

(OK)



SCAN FUNCTION MODE

ant. parameter:
VSWR, S11, R, X, Z

scaling factor (Y-axis)
0.1, 0.2, 0.5, 1, 2, 3 and 10

marker freq.

marker measurement

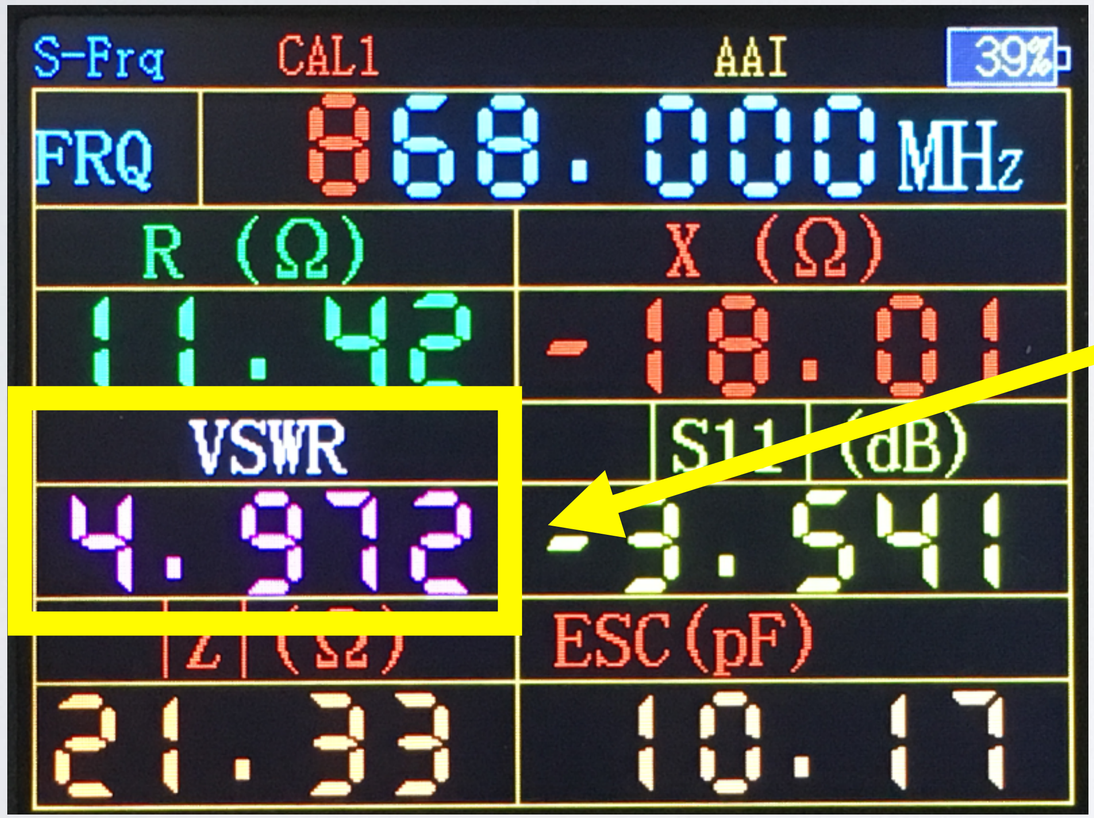
battery charge level

start freq. sweep = 237.5 MHz
Minimum = 137.5 MHz

end freq. sweep = 1237.56 MHz
Maximum = 2700 MHz

SCAN FUNCTION MODE

- You can see a discrepancy in values between the single point measurement screen and scan function screen.



N1201SA

- If the sweep frequency range is large, the measurement value at the specified marker frequency deviates more from the actual value.

- If you want a more accurate value reduce the sweep frequency range or use the single point mode.

- In single point mode the measured value is always correct for the specified frequency.

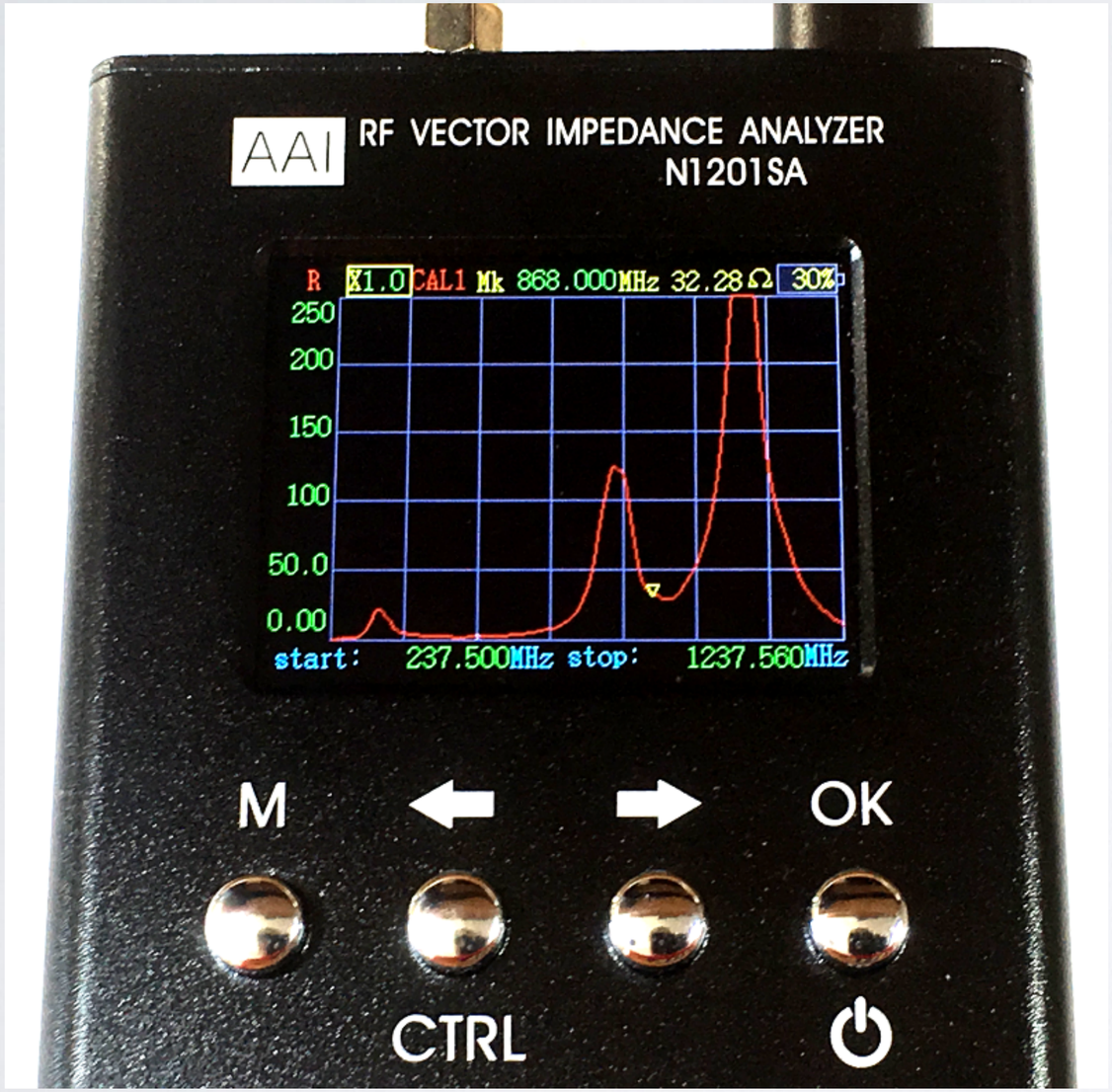
SCAN FUNCTION MODE

VSWR plot

S11 plot

SCAN FUNCTION MODE

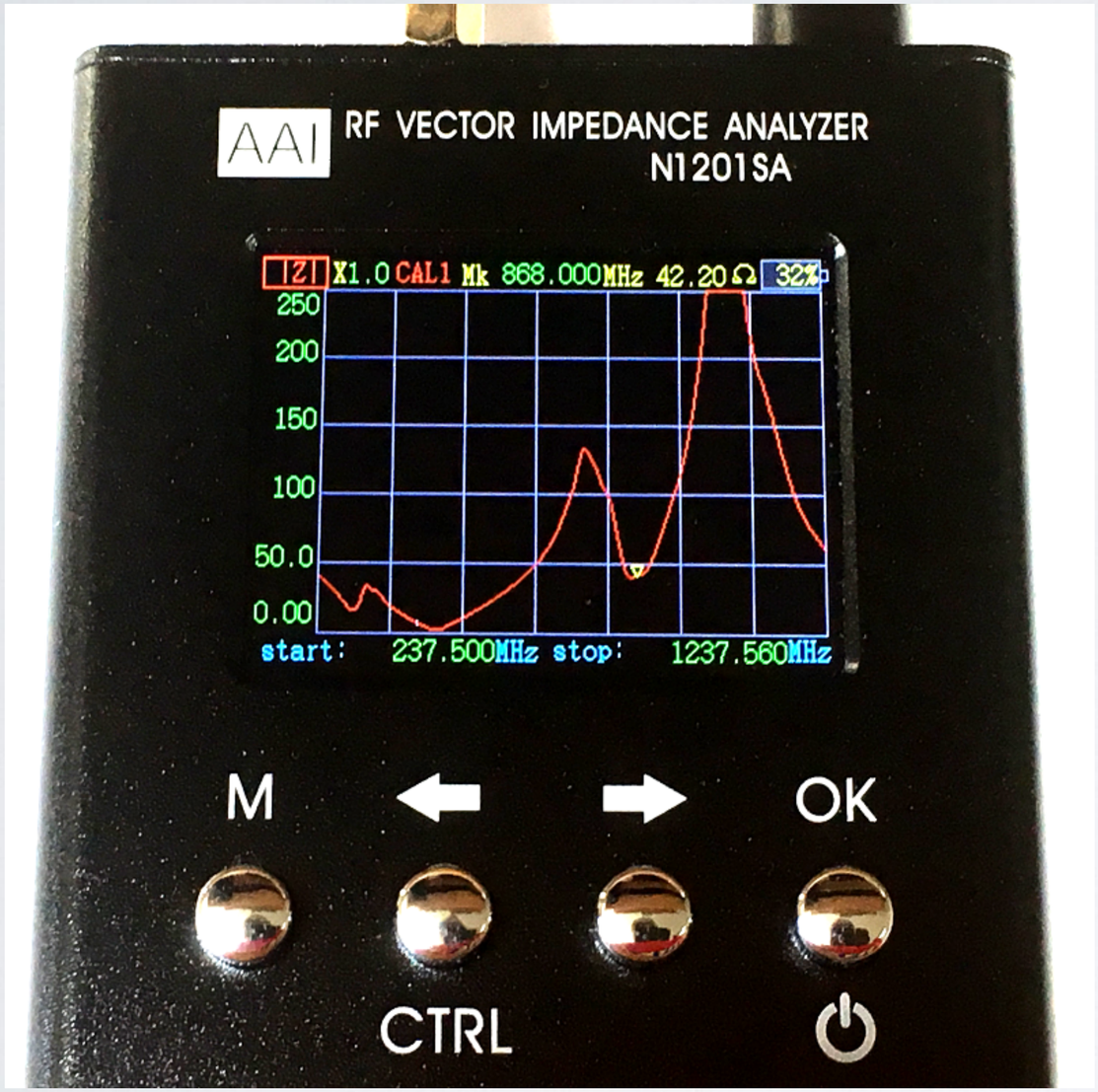
Resistance (R) plot



Reactance (X) plot

SCAN FUNCTION MODE

Impedance (Z) plot



System Information screen (CTRL+M)

SCAN FUNCTION MODE

Impedance (Z) plot

CALIBRATION MODE

Calibration screen (2x CTRL+M)

ANTENNA A, B, C

- In the beginning of this video I have shown you antenna A, B and C.
  The same antennas were also mentioned in tutorial 33 but they had different VSWRs.

	VSWR tutorial 33	VSWR tutorial 40
Antenna A	6.8	5.7
Antenna B	1.9	2.4
Antenna C	1.3	1.2

- What might cause these differences?

- I have opened these antennas multiple times and have been poking around which might have caused some slight changes. But I have some ideas how to fix/improve antenna B.

ANTENNA A, B, C

- But that is a nice subject for a future video…

Antenna B: Sleeve dipole antenna