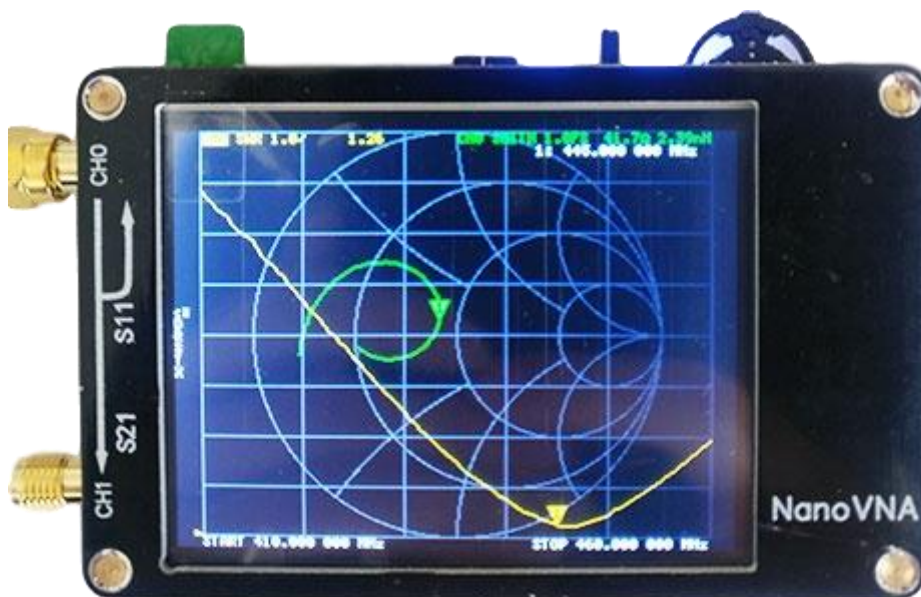




# NanoVNA

## handheld Vector Network Analyzer User Guide



gen111.taobao.com

2019-05-24



## Overview:

NanoVNA is a small handheld Vector Network Analyzer (VNA). It is equipped with lcd display, portable device with battery(battery not included). This project aim to provide an RF gadget but useful instrument for enthusiast. DIY's vector network analyzer, with reference to the related design of edy555 (<https://twitter.com/edy555>), modified some circuits, added battery management circuits, and redesigned the PCB. Designed with simple and practical PC control software, you can export Touchstone (snp) files for various radio design and simulation software through PC software. The improved frequency algorithm can use the odd harmonic extension of si5351 to support the measurement frequency up to 900MHz. The metal shield is designed to reduce the external interference and improve the measurement accuracy. The 50k-300MHz frequency range of the si5351 direct output provides better than 70dB dynamic. The extended 300M-600MHz band provides better than 60dB of dynamics, and the 600M-900M band is better than 50dB of dynamics.

We provide 3 firmware on the network hard drive, you can choose the appropriate brush in accordance with the relevant tutorials, 3 firmware differences are as follows:

nanoVNA\_300\_ch: 50K-300MHz, 5\*7 Bitmap font, 4 tracks

nanoVNA\_900\_ch: 50K-900MHz, 5\*7 Bitmap font, 4 tracks

nanoVNA\_900\_aa: 50K-900MHz, 7\*13 Bitmap font, 2 tracks (Antenna Analyzer)

## Basic operations:

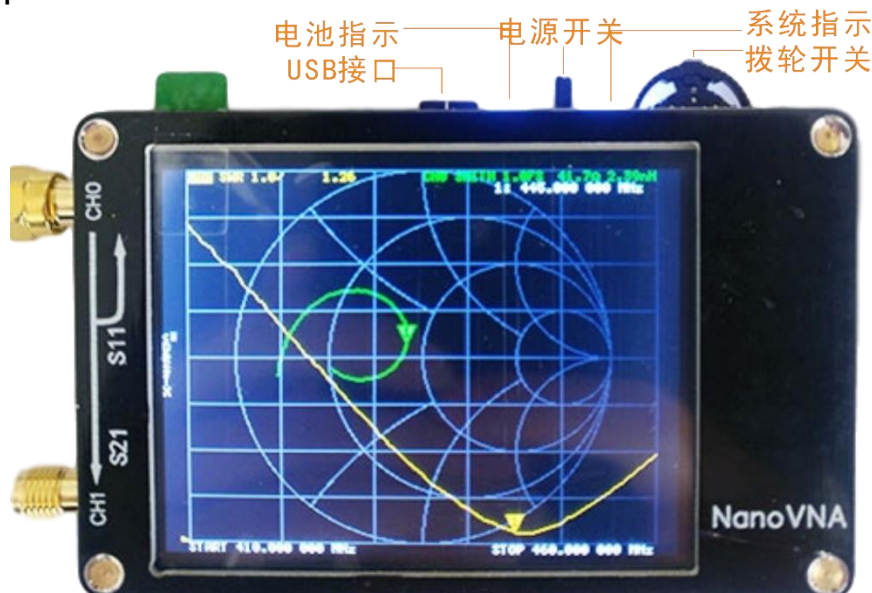
1. Set the frequency range (STIMULUS>START/STOP or CENTER/SPAN)
2. Calibration (CAL)
3. Select display format and channel (DISPLAY)
4. Save(SAVE)

You can change the display format and channel selection at any time. In the normal test mode, tap the right area of the screen or press the dial switch to call up the menu. Tap the screen or turn the wheel switch to select a menu item.

The initial state of NanoVNA (no data is stored in 0)  
Scan range: 50KHz ~ 300MHz (50KHz ~ 900MHz if it is 900M firmware)  
Track 1: LOGMAG CH0 (reflection) (default firmware)  
Track 2: SMITH CH0 (reflection) (default firmware)  
Track 3: LOGMAG CH1 (pass) (requires flash nanoVNA\_900\_4ch.dfu firmware)  
Track 4: CH1 stage (pass) (requires flash nanoVNA\_900\_4ch.dfu firmware)  
-Mark 1: Activated  
Uncalibrated.

**We will test before shipment and connect directly to the SMA port for calibration, the calibration data is stored in state 0, and the boot will load the status 0 data directly.**

### Front panel

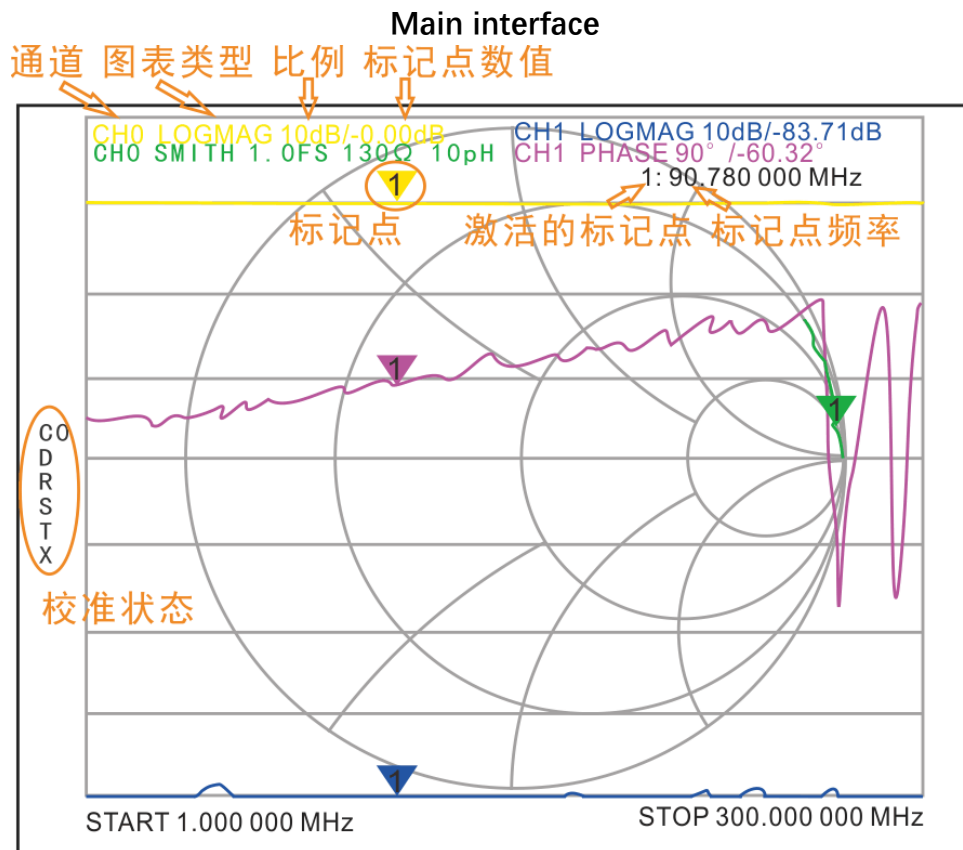


You can use the USB interface to connect to computer communications or connect standard 5V charger charging.

When charging the battery indicates that the LED flashes in charge, the constant light indicates full. When discharging the battery indicator Led constant light indicates normal discharge, LED flicker indicates low power, please connect the charger in time to charge.

Toggle the power switch can switch the machine, the battery indicates that the Led needs to be turned off after 40 seconds of shutdown.

The system indicates the change of the Led light and dark when the system is properly scanned. You can move the mark Point or perform a menu operation via the dial switch, or you can use the touchscreen operation directly.



## Calibration and Normalization:

The VNA Master is a field portable unit operating in the rigors of the test environment. In order to ensure measurement accuracy, RF calibration (OSLT) must be performed prior to making a measurement in the field. Calibrating with the specified mechanical calibration requires three loads, open, short, and match(load). Calibration data is saved as user calibration data. It can be saved to status 0 and can be automatically loaded at the next boot, It can be also saved to status 1-4 and can be loaded via the RECALL menu.

Click the CAL→CALIBRATE menu to open the calibration interface, then connect open, short and load three loads in turn, wait for the screen to stabilize and click on the menu corresponding to calibrate CH 0. The machine is accompanied by a calibration piece, for the public head calibration parts inside the needle copper is short-circuited, the interior with a needle white plastic and stainless steel shell connected to the (LOAD) 50 ohm load, the internal empty for the open. For the head calibrator, the back uses solder short circuit for short, welding two 100 ohms resistor for 50 ohm load, open circuit for open.

Isolation calibration of CH 1 requires two load loads to connect CH 0 and CH 1, respectively, to obtain the best isolation, usually with only one set of calibration loads for port 0, and to connect the load Calibrator to CH 1, CH 0 to remain open, and then press the ISOLN menu to calibrate.



Connect the ch0 and ch1 of the analyzer with an optional Through Adapter, and then press the ISOLN menu to calibrate. The normalization operation moves the measurement reference plane to both ends of the Through Adapter. This function is only available when the measurement item is S21.

After the calibration is complete, press the Done button, eject the Save screen to select the required status to save. Once the calibration is complete, the three calibrators can be connected to port 0 again, and the correct calibration should be based on the SMITH chart, which should be: when connected to open, the curves should be concentrated on the far right of the SMITH chart, and when connecting short, the curves should be concentrated on the leftmost side of the SMITH chart, When connecting LOAD, the curves should all be concentrated in the middle of the SMITH chart. Using RF cables to connect Port 0 and port 1, view S21 curve errors should not exceed 0.5dB. If calibration data abnormalities are found, they should be re-calibrated.

**Note: If the calibrated status recalibration requires first in the calibration menu press Reset to clear the calibration data and then recalibrate!**

If the calibration has been applied, CAL status is displayed.

It is hidden in a state that has not been applied. C \* is the state in which the unsaved calibration value is applied (it disappears when the power is turned off). C0 ~ C4 0 to 4 indicates that a saved calibration value has been applied to one of the save locations.

SAVE Unsaved

It changes to this state when saving by an operation. Each of the characters shown below C indicates that the following error terms are applied:

D: Directivity, R: Reflection Tracking, S: Source Match, T: Transmission Tracking, X: Isolation

## **Select the display trace and display format:**

The DISPLAY→TRACE item of the menu can choose to turn the corresponding display curve on or off, showing that the curve color is consistent with the color of the interface curve, and the display curve of the final operation is the active tracking curve, when the menu FORMAT, the SCALE, CHANNEL operation is valid for the display curve.

The display type can be modified by the DISPLAY→FORMAT of the menu, DISPLAY→SCALE can adjust the scale scale, DISPLAY→CHANNEL can select the measured port.

## Setting the frequency range:

The frequency range of a channel can be expressed by three groups of parameters: Start Frequency, Center Frequency and Stop Frequency. If any of the parameters change, the others will be adjusted automatically in order to ensure the coupling relationship among them

$$f_{\text{center}} = (f_{\text{start}} + f_{\text{stop}}) / 2$$

$$f_{\text{span}} = f_{\text{stop}} - f_{\text{start}}$$

Where  $f_{\text{span}}$  is the span.

Set the center frequency point of the current screen through the STIMULUS→CENTER of the menu, and display the values of the center frequency and sweep span, respectively, to the left and right of the bottom of the grid. **In the lower-right corner of the pop-up Settings value screen, click to eject the soft keyboard and enter the frequency value via the soft keyboard.**

Please pay attention to the following points:

The start and stop frequencies will vary with changes to the center frequency when the span is constant.

In Zero Span, the start frequency, stop frequency and center frequency are always set to the same value. Now, you can use port 0 as a signal source for a fixed output amplitude, but it is important to note that this machine uses the clock signal generator S5351 as the signal source, the output signal is square wave, contains a larger odd harmonic.

Set the frequency range through the STIMULUS→SPAN of the menu, display the center frequency and sweep span values on the left and right sides of the grid, and click on the lower right corner of the pop-up settings value screen to eject the soft keyboard and enter the frequency values through the soft keyboard.

Please pay attention to the following points:

The start and stop frequency vary with the span when the center frequency is constant.

When the span is set to the maximum, the analyzer enters full span mode.

In Zero Span, the start frequency, stop frequency and center frequency are always set to the same value.

Set the start frequency through the STIMULUS→START of the menu and display the start frequency and stop frequency values on the left and right sides of the grid, respectively. Click on the bottom right corner of the pop-up settings screen to eject the soft keyboard and enter the frequency value through the soft keyboard.

Please pay attention to the following points:

The span and center frequency vary with the start frequency when the Span

does not reach the minimum (The parameters vary with the span, please refer to “Span”);

In Zero Span, the start frequency, stop frequency and center frequency are always the same value.

Set the stop frequency through the STIMULUS→STOP of the menu, and display the start frequency and stop frequency values on the left and right sides of the grid, respectively, in the lower right corner of the pop-up Settings screen, click to eject the soft keyboard and enter the frequency value through the soft keyboard. Please pay attention to the following points:

The span and center frequency vary with the stop frequency. The change of the span will affect other system parameters. For more details, please refer to “Span”.

In Zero Span, the start frequency, stop frequency and center frequency are always the same value.

## Menu items:

### DISPLAY

#### TRACE

- 0
- 1
- 2
- 3

#### FORMAT

- LOGMAG
- PHASE
- DELAY (Not implemented, computer software provides Group delay functionality)
- SMITH
- SWR
- MORE)
  - POLAR
  - LINEAR

#### SCALE

- SCALE/DIV
- REFERENCE POSITION
- ELECTRICAL DELAY

#### CHANNEL

- CH0 REFLECT
- CH1 THROUGH

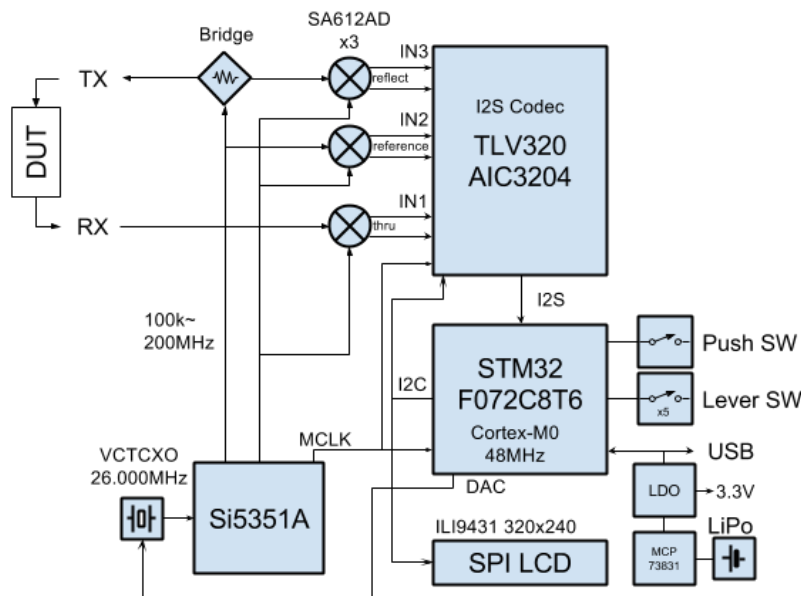
- MARKER
  - SELECT
    - 1
    - 2
    - 3
    - 4
  - MARKER→START
  - MARKER→STOP
  - MARKER→CENTER
  - MARKER→SPAN (Not implemented.)
- STIMULUS
  - STAR
  - STOP
  - CENTER
  - SPAN
  - CW FREQ (
- CAL
  - CALIBRATE
    - OPEN
    - SHORT
    - LOAD
    - ISOLN
    - THRU
    - DONE
    - SAVE
  - RESET
  - CORRECTION
- RECALL/SAVE
  - 0 (Default)
  - 1
  - 2
  - 3
  - 4
- CLOSE

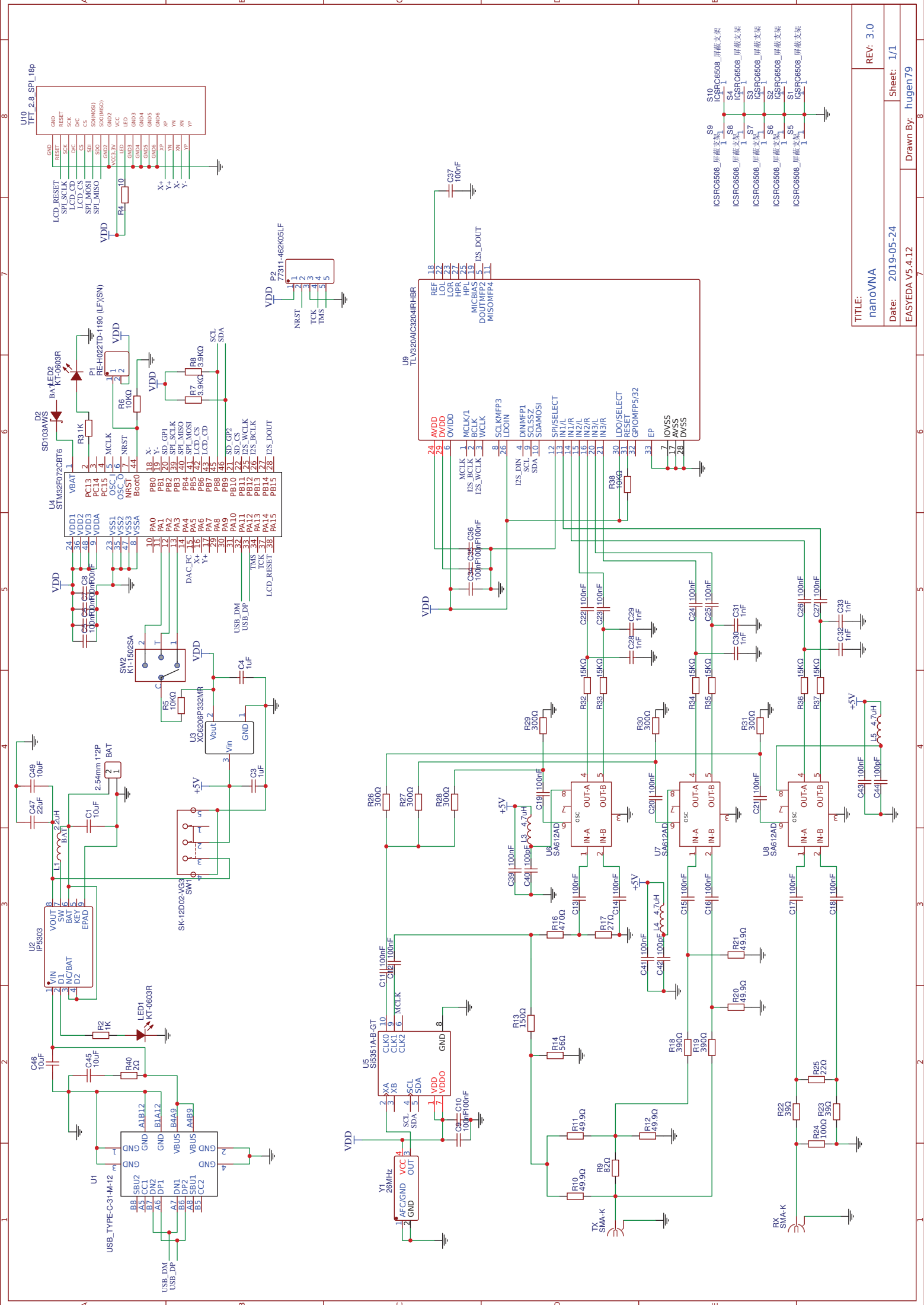


Basic performance:

- PCB: 54mm x 85.5mm x 11mm (without connectors, switches)
- Measurement frequency: 50KHz ~ 300MHz (50KHz -900MHz, enable extended firmware)
- RF output: -13dbm (maximum -9dbm)
- Measurement range: 70dB (50kHz-300MHz), 60dB (300M-600MHz), 50dB (600M-900MHz) enable extended firmware);
- Port SWR: < 1.1
- Display: 2.8 inch TFT (320 x240)
- USB interface: USB type-C communication mode: CDC (serial)
- Power: USB 5V 120mA, built-in 400mAh battery, maximum charging current 0.8A
- Number of scanning points: 101 (fixed)
- Display Tracking: 4, Marking: 4, Setting Save: 5
- Frequency error:<0.5ppm

Block diagram :





TITLE:	nanoVNA	REV: 3.0
Date:	2019-05-24	Sheet: 1/1
EASYEDA V5.4.12	Drawn By: hugen79	