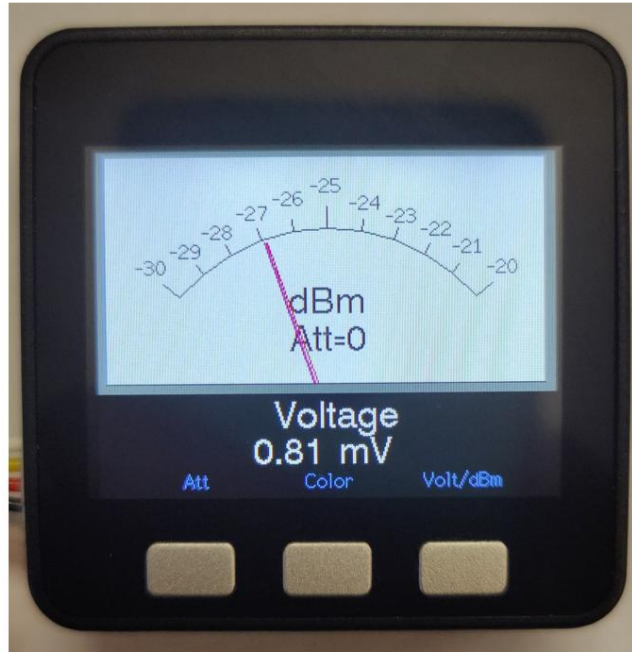


## RF power meter using HP33330B probe

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This digital power meter uses a diode detector probe from Hewlett Packard type HP33330B. This probe has a negative voltage output.

The advantage of using this probe is that the level measured is very precise and almost independent of the input frequency up to 22 GHz, which is not the case with commercial integrated circuits. The probe is given for  $\pm 0.3$  dB up to 12.5 GHz and  $\pm 0.6$  dB beyond.

This probe is available from Marcel F1GE f1ge.mg@gmail.com

The assembly includes a very low offset operational amplification mounted as a -2 gain amplifier. The output voltage of the amplifier is between 0 and 4 volts, which allows accurate measurement in the range between -30 dBm and +20 dBm, a range which can be extended with an input attenuator.

The voltage measurement is performed by an A/D converter from Texas Instruments ADS1115 which allows 32768 different measurement values in the range 0 to 4.095 Volt. The value of the low weight is of the order of 0.150 mV.

Information processing and display are carried out by an M5Stack Core (see image). **Warning: do not take the M5Stack Core2 which does not have buttons.**

## Operation When

powered up, if the electronic assembly is not powered or present, the M5Stack displays "ADS1115 "not connected".

Left button: it allows to compensate the reading when an attenuator is mounted upstream of the probe (from 0 to 40 dB) which allows a maximum of reading 100 mW full scale with 0 dB of attenuation and 1kW (60dBm) full scale with 40dB of attenuation. Attenuation is displayed behind the needle

Central button: allows you to choose different colors for text display.  
The selected mode is memorized and active on the next power-up.

Right button: It is used to read the voltage measured at the output of the OPA192 amplifier, i.e. twice the actual voltage at the terminals of the probe. The voltage is around 0mV with no input signal and around 4096 at full scale.

A second press on the key returns to dBm/mW.

Software: the program compiles with the Arduino IDE V1 or V2.03. Check during use that you have loaded the libraries, in particular M5stack and ADS1115\_WE.

For Arduino novices follow the procedure described here

[http://docs.m5stack.com/en/quick\\_start/m5core/arduino](http://docs.m5stack.com/en/quick_start/m5core/arduino)

Make sure everything is in place.

In tools, you must choose the M5Stack-Core-ESP32 card to load the libraries if you have never loaded them - ADS1115\_WE - M5Stack - EEPROM

Note: the program was calibrated with an HP 8648C generator and at a frequency of 100 MHz using a representative probe.

Between -30dBm and -10 dBm the calculation (quadratic curve) is made from the HP documentation.

Between -10dBm and +15dBm 'linear' zone the calculation is performed by linear interpolation from point measurements every 5dB. The voltage is that measured at the output of the amplifier, available by pressing the button on the right.

If you calibrate your diode, the values are to be entered in the lines in lines 55 to 61

