

Step-by-step instructions from  
First Start-up to Final Adjustments

# 2 MHz LCR Meter Kit

## Assembly & Calibration



Jean-Jacques Aubry



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# 2 MHz LCR Meter Kit

## AU2019

### Assembly and Calibration Manual

V3.3 - Last update 2021/12/13

This manual, initially printed and included in the kit, is also available as a downloadable PDF. Corrections are made as we receive feedback. We invite you to check that you are in possession of the updated version of this essential document which you can find at the following address:

[www.elektor.com/19883](http://www.elektor.com/19883)



**Note:** Small differences may exist between the kit as received compared to the version pictured. These differences are inconsequential.



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*Assembled prototype.*

Your kit has been carefully checked. Both boards have been tested individually. This manual explains how to assemble and calibrate your kit. Calibration will allow you to become familiar with the unit, and to be able to repeat it if the need arises later.

*(All photos Eurocircuits unless otherwise stated)*

## 1 • Contents of your Kit

Check that the kit as received is complete. It must include:



3. Assembled MCU board (BNC connectors not mounted).

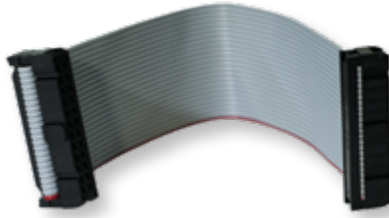


4. Assembled Display board (without the button of the rotary switch).

*Note: the LCD has a protective film so transparent that it can go unnoticed. It has no tab, but it can be easily peeled off by gently lifting it at an angle with your fingernail.*



5. Four PCB-mount BNC connectors.



6. Flatcable (reversible).



7. Button, Ø 24mm.



8. USB cable (mini-USB / USB A).



9. Test clip with two Kelvin clips and 4 BNC connectors.



10. Four jumpers for settings during calibrations.



11. Screwdriver (trimming tool).

Hammond case.

- machined body
- machined and screen-printed front panel
- machined and screen-printed BNC side
- machined and screen-printed USB side
- 2 black plastic frames [+ special screws (8) and rubber feet (4)]



12a. & b Machined and screen-printed Hammond case.



Screws and bolts.

- 5 x M3 male-female standoffs, 6 mm high
- 5 x 4 mm Pozidrive countersunk M3 screws
- 1 flat washer DM3, thickness 0.5 mm
- 5 x M3 self-locking nuts



13. Bolts & nuts etc.

And of course the User Manual you are reading right now!

**Tools needed for assembly:** Phillips screwdriver, spanner (not included).

## 2 • Let's mount the four BNC sockets

Preferably solder the sockets **one at a time**. Position each one precisely using the positioning pins, press it secure against the board, then solder the two electrical contacts.

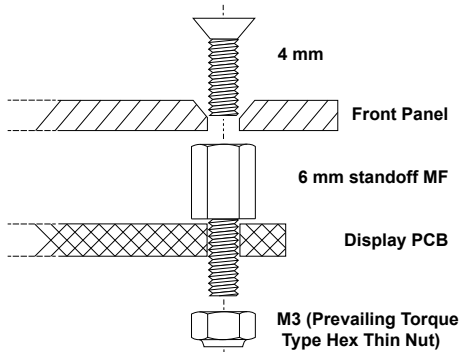
**Only one of the two positioning pins should be soldered** (unlike the video on [elektorTV!](#)). This allows you to slightly modify the position of the sockets later, if you intend to use an HP standard test accessory (designed for 22 mm distance between the BNC sockets).

**Important:** Do not use nuts to secure the BNC sockets to the side panel of the enclosure.

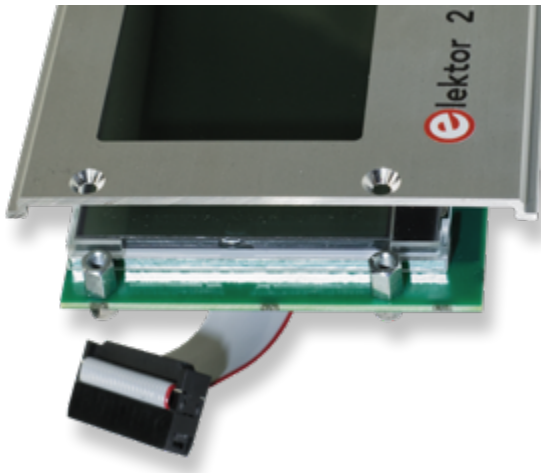
## 3 • Let's preassemble the Hammond case

Mount four 6 mm M3 male-female standoffs into the four corners of the Display PCB, without tightening the nuts.

Remove the protective film from the LCD before attaching it to the front panel. Position the front panel on the board and secure it with 4 x 4 mm countersunk screws, then tighten the nuts.



14a. Mounting of the M3 male-female standoffs.



14b. Positioning the front panel on this Display board.

Mount the knob on the rotary encoder shaft and connect the flatcable to J1 on the Display board. Slide the MCU board between the first two guide rails counting from the bottom of the case, with the front panel slid in its own guides. Then connect the second header of the flatcable to J14 on the MCU board.

**Note:** The hole in the bottom of the case must be on the side of J14.



15. Partially assembled LCR-meter during the settings.

(Photo: Jean-Jacques Aubry)

Both the front panel and the MCU board can be slid out of the case, giving access to all the adjustment points without the risk of accidental electrical contact between the two boards!

If the MCU board does not slide smoothly, it may be necessary to slightly file the edges of the PCB

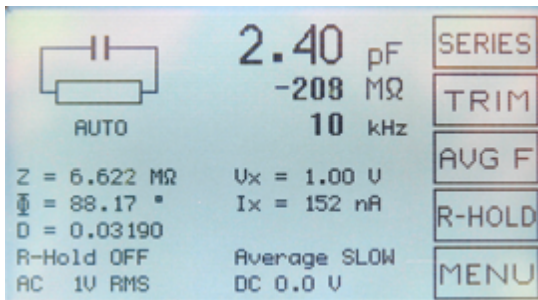
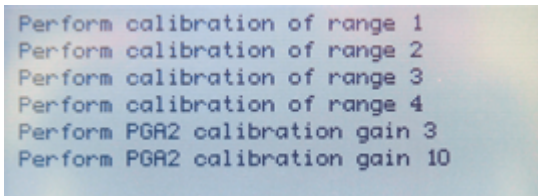
Note: Completion of the assembly takes place later (§6, p.18).

## 4 • My first start-up

On the MCU board, turn switch SW1 to the **OFF** position. Then connect the USB cable between J1 on the MCU board and a USB power supply (e.g. from your smartphone). Slide SW1 to the **ON** position. The display should light up. The message < **BOOTLOADER V1.X** > is displayed for a short time, followed by the welcome screen, the calibration prompts and the measurement screen.



(All screendumps by Jean-Jacques Aubry)

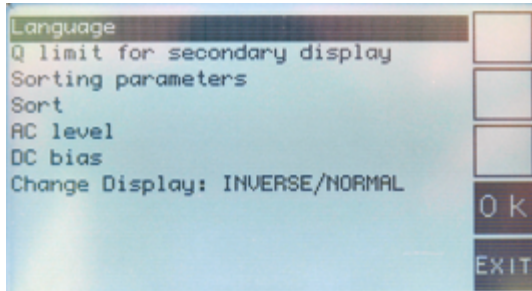


16 a-b-c-d. Different displays during the start-up of the assembled LCR Meter.

The five pushbuttons (to the right of the display) in conjunction with the rotary knob (which is also a pushbutton) allow a dialogue between the user and the device.

The [MENU] button provides access:

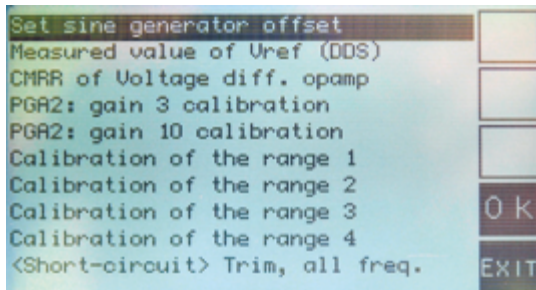
- to the user settings by a *short press*.



- 16 e. Use the rotary knob to navigate through the menus.  
 Confirm your choice by pressing the [OK] button.  
 Press the [EXIT] button to leave all settings unchanged.

Choose your language (English, German, French, Dutch) in the corresponding menu.

- to the calibration menus by a *long press* (the display responds to the long press by flashing briefly).



- 16f. Use the rotary knob to navigate through the menus.  
 Confirm your choice by pressing the [OK] button.  
 Press the [EXIT] button to leave all settings unchanged.

To get accurate measurements, the measurement circuitry must be calibrated. It is recommended to perform the calibration steps in the order of the menu.

**Note:** The menu option *Change display: INVERSE/NORMAL* (fig. 16e) which allows the display to be inverted (light/dark background) only appears once version 3 of the file *LCR6 texts v3.txt* has been loaded into the device. This update (see also §9.2.5) is described in the manual *LCR Meter AU2019 - EN Operating Instructions* (§4.2.4 et §4.2.5).

## 5 • Calibration menu

All the steps for calibrating the instrument are accessible through this menu. An external multimeter (not included in the kit) is required. **Precision resistors** (0.01% tolerance) fitted on the PCB for your convenience get connected to the measurement input via one of the jumpers on J10 to J13.

At each step, a message on the screen indicates the state required for various jumpers (i.e. closed or open).

**Do not connect anything to the BNC sockets!**  
**R\_Hold must be OFF**

### 5.1 Sinewave generator offset adjustment

Using your multimeter, measure the DC voltage at TP7 (this is the output of U26C). Using R146, adjust it as close as possible to 0 V.

*Press [OK] to exit the menu.*

### 5.2 Measured value of Vref (DDS)

Measure the DC voltage at TP6 with your multimeter. With the rotary knob, now adjust the displayed value to the measured value.

*Press [OK] to confirm the entry or [Exit] to leave the menu without changes.*

### 5.3 CMRR of the differential amplifier U7C

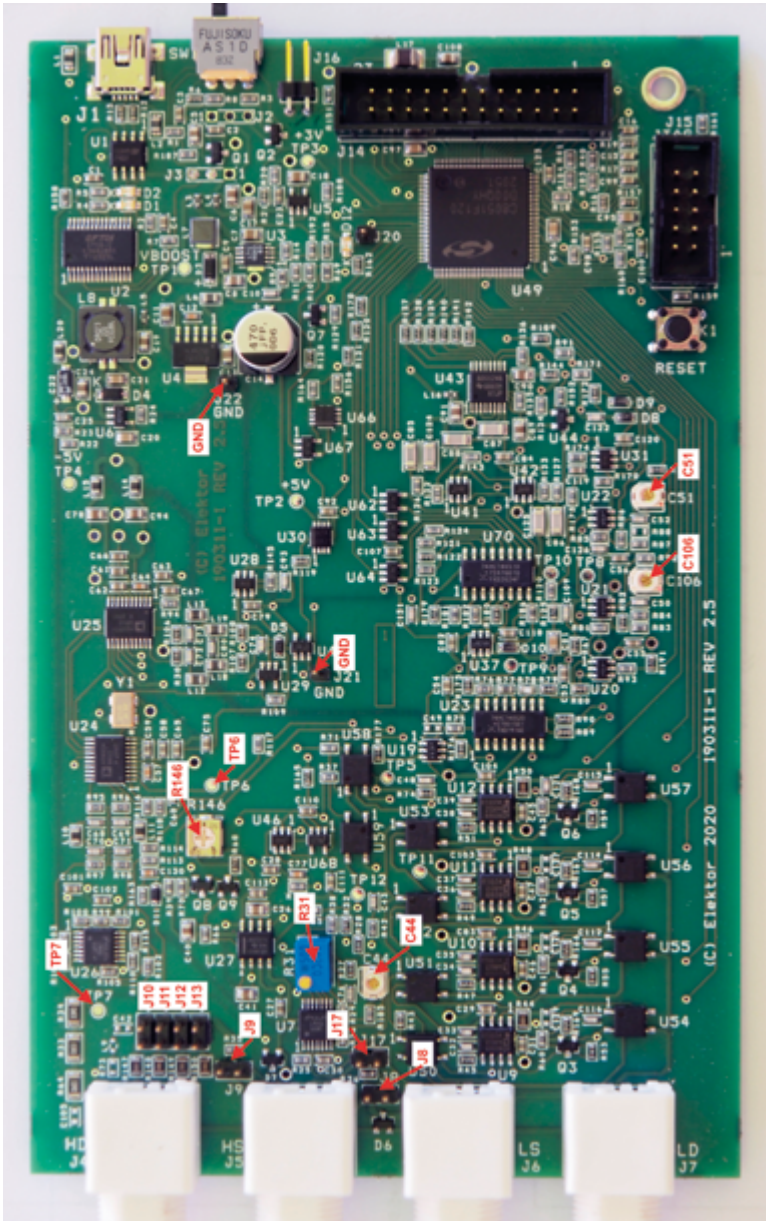
This setting provides the maximum common-mode rejection of the U7C differential amplifier.

Insert a jumper on headers J9 and J17. Adjust the displayed value to a minimum value, first R31 for low frequencies (10 kHz) and then C44 for high frequencies (1 MHz). Change the frequency with the rotary knob.

Due to a slight interaction, repeat these two settings at least once.

*Press [OK] to exit the menu.*

Any subsequent changes to these settings will require the steps in §5.4 to 5.11 to be repeated.



17. Location of the components mentioned in the instructions for calibration. (Photo by Jean-Jacques Aubry)

The device has 54 predefined measurement frequencies:

							50	60				Hz
100	120	150	200	250	300	400	500	600	700	800	900	Hz
1.0	1.2	1.5	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0	9.0	kHz
10	12	15	20	25	30	40	50	60	70	80	90	kHz
100	120	150	200	250	300	400	500	600	700	800	900	kHz
1.0	1.2	1.5	2.0									MHz

At each step of the calibration, the parameters of the measurement chain in the instrument are calculated for each of the above frequencies. This will take *a few minutes* each time!

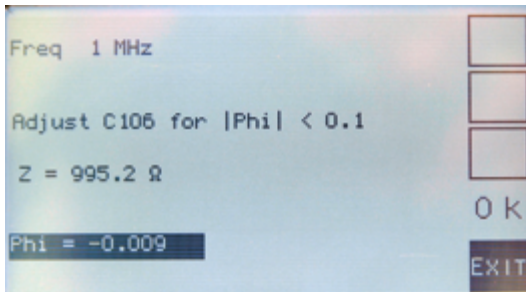
At the end of each of the following steps you will be asked to confirm to save the new values.

The old values (if any) will be deleted anyway.

### 5.4 PGA2: calibration in gain 3

Insert a jumper on headers J8, J9, and J11.

First, set C106 to have  $|\text{Phi}| < 0.1$  and, if good, press the [OK] button that will appear. If not, exit by pressing [EXIT] and correct the problem! The gain and phase for the PGA2 with a gain of 3 will then be calculated at each of the preset frequencies.



18. Display while setting the phase.



### 5.5 PGA2: Calibration at gain 10

Insert a jumper on J8, J9 and J11.

First, set C51 to have  $|\text{Phi}| < 0.3$  and, if good, press the [OK] button that will appear. If not, exit by pressing [EXIT] and correct the problem!

The gain and phase for the PGA2 (with a gain of 10) will then be calculated at each of the predefined frequencies.

### 5.6 Calibration of range 1

Install a jumper on headers J8, J9, and J10. The calibration parameters will be calculated for each of the predefined frequencies.

### 5.7 Calibration of range 2

Install a jumper on headers J8, J9, and J11. The calibration parameters will be calculated for each of the predefined frequencies.

### 5.8 Calibration of range 3

Install a jumper on headers J8, J9, and J12. The calibration parameters will be calculated for each of the predefined frequencies.

### 5.9 Calibration of range 4

Install a jumper on headers J8, J9, and J13. The calibration parameters will be calculated for each of the predefined frequencies.

### 5.10 Trim <short circuit> all frequencies

Install a jumper on headers J8, J9, and J17. The short-circuit compensation parameters will be calculated for each of the predefined frequencies.

### 5.11 Trim <open circuit> all frequencies

Install a jumper on headers J8 and J9. The open-circuit compensation parameters will be calculated for each of the preset frequencies.

Once the enclosure of the LCR Meter is fully assembled, these two trimming operations must be repeated **without** the jumpers installed.

**Remove all jumpers except J3!**

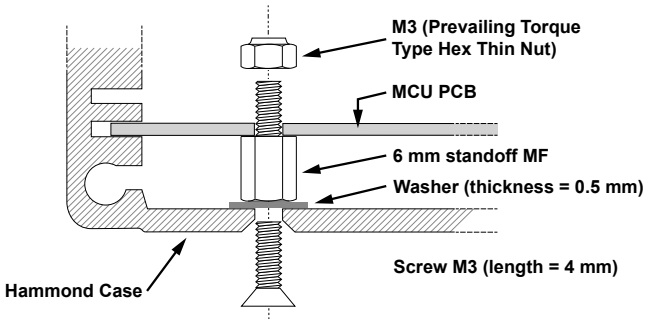
**Note:**

As long as all calibrations are not carried out at least once, no correction is made to the measured value. That's why "open-circuit" and "short-circuit" calibration should be completed without the Kelvin cables. From then on, values displayed are compensated for the internal measurement path, up to the BNC connectors!

After that, whatever external measuring device will be used, you have to repeat the "open-circuit" and "short-circuit" with this device in place.

## 6 • Final mounting in the Hammond case

Slide the MCU board slightly out of the case and fit the 6 mm M3 male-female (MF) standoff into the hole next to the "J15" marking using the last nut.



19. Final securing of the MCU PCB in the Hammond case.

Align the MCU board so that the threaded hole in the 6 mm standoff faces the hole in the bottom of the case. Slide in the 0.5 mm thick washer and secure the assembly with the 4 mm M3 countersunk screw.

**Note:** For the fixing of the main PCB to the case it is more convenient to put the 0.5 mm flat washer under the PCB (on the male part of the standoff).

Mount the USB and BNC sides using the plastic frames and the special screws. The bag usually contains a spare screw. **Pay attention to the sequence!** Mount the black frames first, then screw on the aluminum flanges. Not the other way around, otherwise tightening the screws could break the corners of the plastic frames.

**Important:** Do not use nuts to secure the BNC sockets to the side panel of the enclosure.

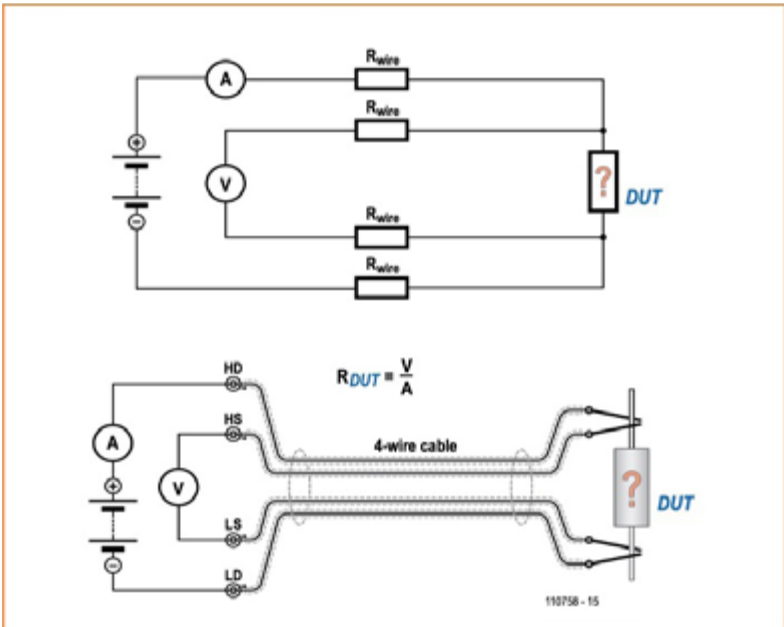
Finish the assembly by installing the four rubber feet.

## 7 • Final adjustments

Connect the Kelvin cables to the BNC connectors. Repeat the Trim procedures (§5.10 and §5.11) to compensate for the new, interfering components.

**The device is now ready for use!**

**Note:** Before a test, **at any given frequency**, it is possible and even desirable, to perform both *TRIM* corrections by pressing the corresponding button (the second from the top). The new parameters (as well as those already modified at other frequencies) can be saved by a long press on the same button. Saving is indicated on the display, e.g. by the message *Save the Trim Data...*, before returning to the measurement screen!



## 8 • Stand-alone mode

Equipped with the Display board, the device can work without a computer. This is the *stand-alone* mode. The instrument automatically starts in this mode when an external 5 V USB power supply is used. If the LCR meter is powered from a PC, it can operate in PC mode, but if you want to use it in stand-alone mode, simply **press the top button** on the front panel **while powering up the unit** (this new mode is then stored and no further action is required at the next start up). The same action is required to return to PC mode.

When the measurement screen is displayed, the rotary knob (encoder) changes the measurement frequency to one of 54 preset values (see table in §5).

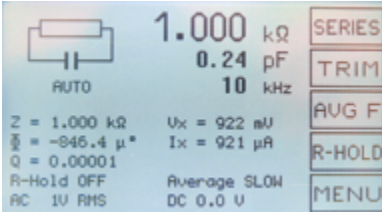
A long press on the rotary knob allows you to enter the menu for selecting a *user frequency* (from the current frequency). The number to be changed is selected with the two upper buttons while the rotary knob changes the value. After validation, this value is used. It is displayed in negative and can no longer be changed by the rotary knob. A further long press on the rotary knob is required to exit this mode. The saved value will be proposed at the next request.

The button labels are displayed on the screen and changed according to the settings you choose.

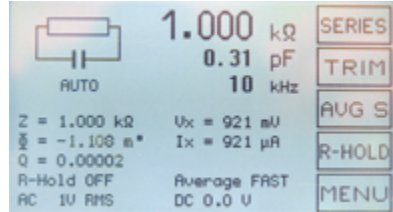
For some buttons, the action changes depending on whether the pressure is short or long. **The display flashes briefly acknowledging the long button press.**

- The first button (from the top) switches the representation of the component:
  - From *AUTO* (default) to *SERIES* or *PARALLEL*.
- The second [TRIM] button starts the TRIM procedure **for the current frequency** (*OPEN* or *SHORT* depending on the measured impedance). A long press on this button starts the procedure of saving all TRIM measurements made since the last start-up.

- The third button [AVG S] or [AVG F] changes the number of measurements used (for averaging) before the result is displayed, and thus the responsiveness of the instrument. It toggles between slow (**Average SLOW** on display) and *fast* display (**Average FAST** on display).



20a. Slow display. Pressing the [AVG F] button will switch the display to fast.



20b. Pressing the [AVG S] button will switch the display to slow.

- The fourth button [R-HOLD] is used to freeze (or not) the current range. A *long press* on this button enables/disables the display of the measurement chain parameters: Range from 1 to 4, PGA gain in voltage measurement (1 or 3 or 10), PGA gain in current measurement (1 or 3 or 10).



21. Range -> 2 (R2)  
PGA\_U -> gain of 1 (U1)  
PGA\_I -> gain of 3 (I3)

- The function of the [MENU] button is known:
  - a *short press* gives access to the user settings,
  - a *long press* gives access to the calibration menus.

## 8.1 User menu

### 8.1.1 Language

Allows the choice of the language used for the menus: English, French, German, Dutch, ....

### 8.1.2 Qlimit for secondary display

Selection of the Q value ( $= 1/D$ ) above which the secondary parameter is not displayed. The possible values are:

100 200 500 1000 2000 5000 no limit

### 8.1.3 Sorting parameters

This menu allows you to select the parameters (tolerance and value) used for sorting components. The proposed value will be the main parameter of the connected reference component **before** entering the menu mode. These parameters will be stored in memory.

The first step allows you to select the standard tolerance, from the E6 series (20%) to the E96 series (1%).

The second step allows you to select the standardized value in this series.

### 8.1.4 Sorting

This menu starts the comparison, displaying the measured value (top), the upper and lower limits, and of course the success (*PASS*) or failure (*FAIL*) of the comparison.

### 8.1.5 Sinusoid amplitude

This menu selects the RMS value, without load, of the test signal. The possible values are:

100 mV 200 mV 500 mV 1 V

### 8.1.6 Direct Current Polarisation

This menu adjusts the voltage (for a capacitor) or current (for an inductor) value of the applied DC bias. Positive polarity is on HD / HS connectors. The possible values are:

0–5.0 V in 1 V or 0.1 V steps

0–50 mA in 10 mA or 1 mA steps

Press the rotary knob to change the step value.

For inductances, after validation and a few seconds for stabilization, the real value of the current is displayed under the label <DC>, as it depends on the resistance of the DUT.

As TRIM is no longer possible, the label on the second button changes to <BIAS 0>, allowing direct return to a non-polarized measurement.

## 8.2 Error messages

During the firmware boot sequence, a few checks are performed:

### 8.2.1 Via the Bootloader

The Bootloader checks the integrity of the program in memory. If the check fails, the message *Waiting for an update...* is displayed. You have to reload a (new) program (see §9.2.4).

### 8.2.2 Checking the languages loaded in high memory

If there are no languages loaded, the following messages are displayed:

*No Language loaded. Restart in PC Mode.*

*Use the AU2019 prog. to load them*

See § 9.2.5 to load the language file.

### 8.2.3 Checking supply voltages

If a fault is detected during the power supply check, the message *"PS Test Error, code X"* is displayed and the program loops endlessly through a sequence with LED D12 on for 0.5 s and off for 1 s.

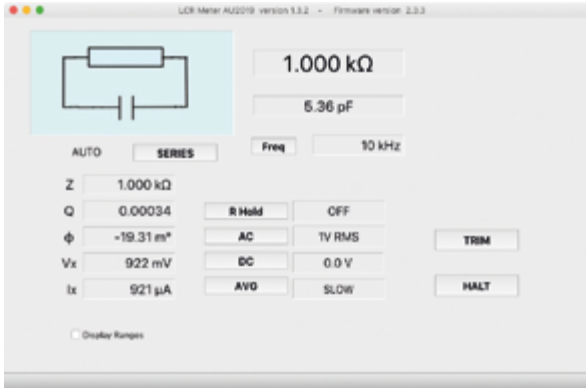
Each bit of the binary equivalent of the displayed 5-bit code X gives the state of one of the verified voltages: 0 if the voltage is correct, otherwise 1.

X is a number between 1 and 31. Example: "PS Test Error, code 3" indicates an error at the first two measured voltages (–5 V and +5 V).

Bit	U <sub>x</sub>	Bit set to 0 if the measured voltage U <sub>x</sub> is
1	–5 V	–5.3 V < U <sub>x</sub> < –4.7 V
2	+5 V	4.7 V < U <sub>x</sub> < 5.3 V
3	+3 V	2.85 V < U <sub>x</sub> < 3.15 V
4	+6.5 V	6.29 V < U <sub>x</sub> < 6.68 V
5	+7.5 V	7.30 V < U <sub>x</sub> < 7.60 V

## 9 • Use in PC mode

Start the device in PC mode (the message *Waiting for the GUI...* is displayed) and, a few seconds later, run the **AU2019** program on the PC.



22. Window for measuring a 1000-Ω resistor using the PC (MacOS) program.

In the <Port> menu, select the correct port, then click the [Open Port] button. If communication is established, the *firmware* version will be displayed to the right of the **AU2019** program version. A few seconds later, all DUT parameters will be displayed.

The port settings are saved and will be used the next time you start up. The first time a floating window appears, it is attached to the bottom of the main window. You can detach and resize it. Similarly, you can move and resize the main window. All new settings will be saved when the program is closed.

The buttons act as for the *Stand-alone* mode (long press of the [TRIM] button is taken into account).

For the frequency value ([Freq] button) or the DC bias value ([DC] button), it is possible to choose any value within the allowed range. Press the Return key on your keyboard to validate the new value.

The AC button changes the AC level in this sequence:

1 V → 0.5 V → 0.2 V → 0.1 V → 1 V ...



## 9.1 Port menu

From this menu, you can close an already open port and then choose a new port.

## 9.2 Settings menu

### 9.2.1 Sort

If the sorting parameters have already been defined, a floating window opens and displays the same information as in *Stand-alone* mode.

### 9.2.2 Set Sorting parameters...

As for the *Stand-alone* mode.

### 9.2.3 Set Sorting parameters...

As for the *Stand-alone* mode.

### 9.2.4 Firmware update...

This menu allows the firmware update. **Normally, calibration data should not be deleted (by default).** Data will only be deleted if it is mandatory for the update. In that case, it will be specified in the instructions accompanying the update.

Occasionally, after selecting the file to be loaded (*LCR6.hex*, possibly with a revision number), the update procedure does not start. If this happens, close the AU2019 program, insert a jumper on J16, restart the device, and restart the AU2019 program to repeat the update. Do not forget, at the end, to remove the jumper on J16 before restarting the device.

### 9.2.5 Texts update...

This menu permits a new set of languages used by the different menus to be loaded into the instrument. A specially formatted text file (*LCR6 Texts v3.txt* to date) must be used for this purpose (see the Appendix to this manual).

It can be downloaded from the author's updates on the project page:

<https://www.elektormagazine.com/labs/remake-lcr-meter>

### 9.2.6 Calibrations

As for the *Stand-alone* mode.

## **9.3 AU2019 menu**

### **9.3.1 About AU2019**

This window provides information about the Bootloader, Firmware and AU2019 program versions.

### **9.3.2 Qt-About**

This window provides information about the version of Qt used by the AU2019 program.

## 10 Updates **IMPORTANT!**

It is highly recommended to check the project page of the LCR meter on the the ElektorLabs website where the most recent software **190311 AU2019 Files & Code DOWNLOAD...** can be downloaded from the section "Updates from the Author":

[www.elektormagazine.com/labs/remake-lcr-meter](http://www.elektormagazine.com/labs/remake-lcr-meter)



At the date of revision of this document (V3.3) the firmware version is 2.3.6 (file LCR6.hex) and the text file is LCR6 v3.txt.

The update operation is described in the document:

LCR Meter AU2019 - EN Operating Instructions (§4.2.4 and §4.2.5).

The purchaser of the kit is provided with everything he needs to modify the programs of the device if he wishes.

**1.** The programs loaded in the device:

- The BootLoader (LCR6-Bootloader) is launched at startup to make some verifications (power supplies, program integrity...) and to determine the type of interface to use (standalone mode or PC mode) before launching the main program (LCR6 Firmware). It is also used to update the firmware.
- The LCR6 firmware. It is the heart of the device for the measurements, the results and the dialogue with the user.

**2.** The source code of these programs written in C is available in **/AU2019 - device programs 2021-10-06/Bootloader and Firmware source files** and the executable files in **/AU2019 - device programs 2021-10-06/Bootloader and Firmware Hex files**. Instructions for reading, modifying or compiling the code are described in the **LCR Meter AU2019 - EN Changing the code** file in document **190311 AU2019 DOC EN & FR 2021-01-04**

**3.** The PC programs (macOS, Windows7, Ubuntu) are written in C++ using the Qt open source libraries. Here one can read what this implies:

<https://www.qt.io/licensing/open-source-igpl-obligations>

The source files are in **/AU2019 - programs for the different platforms /AU2019 V 1-3-3 Qt source files** (macOS, Windows7, Ubuntu) and the executables for the different platforms in **AU2019 V 1-3-3 Ubuntu(18.04), AU2019 V 1-3-3 Win7-32, AU2019 V 1-3-3 Win7-64, AU2019 V 1-3-3.dmg** (MacOS).

The document **LCR Meter AU2019 - EN PC interface** describes the reading, modification and compilation for each platform.

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## Other information sources

We thank you for your confidence and wish you much pleasure and satisfaction in the realization and use of the instrument.

Despite the meticulous care taken in designing this measuring instrument and preparing your kit, you may still encounter unexpected difficulties. In this case you can contact the author and other enthusiastic readers by accessing the project page:

[www.elektormagazine.com/labs/remake-lcr-meter](http://www.elektormagazine.com/labs/remake-lcr-meter)

There you will also find the latest updates, if any.

Various information documents (*Operation, Operating instructions, PC interface, etc...*) in English and French can be downloaded from this page:

[www.elektormagazine.com/magazine/elektor-167/59255](http://www.elektormagazine.com/magazine/elektor-167/59255)

The file named 190311 AU2019 DOC EN & FR 2021-01-04.zip on the “Software” tab contains useful information.

- LCR Meter AU2019 - EN Operation Rev 6b.pdf  
*Description of the device's operation.*
- LCR Meter AU2019 - EN Operating Instructions Rev 17.pdf  
*The User Manual.*

- LCR Meter AU2019 - EN Communications Rev 6b.pdf  
*Description of the messages exchanged by the device and the PC program (AU2019).*
- LCR Meter AU2019 - EN PC interface Rev 0b.pdf  
*To view / modify the AU2019 program code.  
Description of the required tools.*
- LCR Meter AU2019 - EN Changing the code Rev 1c.pdf  
*To change the code of the Firmware or the Bootloader.  
Description of the required tools.*
- LCR Meter AU2019 - EN The text file Rev 4a.pdf  
*To change the displayed texts or add a language.  
Description of the formatting of this file.*
- Creating an AU2019 Android application\_b.pdf
- AU2019 - Building Android application with Cordova\_b.pdf  
*These two files explain how to create / modify the AU2019 application for an Android smartphone/tablet. For this purpose, a BLE interface is needed which is not part of the kit.*

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The reader interested in the subject may benefit from reading the articles devoted to the 500ppm LCR-meter by the same author published in 2013 (NB: This once popular kit is no longer available!):

### **500 ppm LCR Meter**

Part 1: The luxury of precision within everyone's reach

[www.elektormagazine.com/magazine/elektor-201303/20380](http://www.elektormagazine.com/magazine/elektor-201303/20380)

Part 2: standalone use, functionality, menus, and software

[www.elektormagazine.com/magazine/elektor-201304/20084](http://www.elektormagazine.com/magazine/elektor-201304/20084)

Part 3: PCBs, BOMs, assembly, calibration

[www.elektormagazine.com/magazine/elektor-201305/20591](http://www.elektormagazine.com/magazine/elektor-201305/20591)

## Appendix (LCR6 texts v3.txt)

Messages displayed by the LCR meter in English, French, German or Dutch depending on the user's choice.

```
// *****
:04 13 LANG_ARRAY
// -----
English
Français
Deutsch
Nederlands
// *****
:11 36 CONFIG_ARRAY
// English -----
Set sine generator offset
Measured value of Vref (DDS)
CMRR of Voltage diff. opamp
PGA2: gain 10 calibration
PGA2: gain 10 calibration
Calibration of the range 1
Calibration of the range 2
Calibration of the range 3
Calibration of the range 4
<Short-circuit> Trim, all freq.
<Open-circuit> Trim, all freq.
// French -----
Réglage offset générateur sinus
Valeur mesurée de Vref (DDS)
CMRR de l'ampli diff. de mesure U
PGA2: calibration en gain 3
PGA2: calibration en gain 10
Calibration de la gamme 1
Calibration de la gamme 2
Calibration de la gamme 3
Calibration de la gamme 4
Trim <court-circuit> toutes fréq.
Trim <circuit-ouvert> toutes fréq.
// Deutsch -----
DC-Einstellungen Sinusgenerator
Gemessene Spannung von Vref (DDS)
CMRR of Voltage diff. opamp
PGA2: Kalibrierung Verstärkung 3
PGA2: Kalibrierung Verstärkung 10
Kalibrierung Bereich 1
Kalibrierung Bereich 2
Kalibrierung Bereich 3
Kalibrierung Bereich 4
Abgleich alle Freq. <Kurzschluss>
Abgleich alle Freq. <Leerlauf>
// Nederlands -----
DC-instelling sinusgenerator
Gemeten waarde Vref (DDS)
CMRR spanningsverschilversterker
PGA2: calibratie bij 3x versterken
PGA2: calibratie bij 10x versterken
Calibratie bereik 1
Calibratie bereik 2
Calibratie bereik 3
Calibratie bereik 4
Afregeel alle freqs <kortsl.>
Afregeel alle freqs <open>
// *****
:42 36 TEXT_ARRAY
// English -----
PS Test Error, code %u
INITIALISATION, WAIT...
No jumper fitted on J10 to J13
Adjust C51 for |Phi| < 0.3
Adjust C106 for |Phi| < 0.1
Save the gain?
Select normalized value
-> Adjust R146 for DC null on TP7
Saving the Trim data...
No Trim data to save
Back up the data?
No DC bias for resistor
Calculating the gain and phase
-> Put a jumper on J10
-> Put a jumper on J11
-> Put a jumper on J12
-> Put a jumper on J13
Not the right jumper, exit
Okay, will take few minutes
Perform calibration of range 1
Perform calibration of range 2
Perform calibration of range 3
Perform calibration of range 4
Error, exit
Perform PGA2 calibration gain 3
Perform PGA2 calibration gain 10
Short circuit trim. Wait...
Open circuit trim. Wait...
Use saved frequency?
-> Open or Short the circuit
Save the frequency?
-- FAIL --
PASS
Short circuit before enter menu
Open circuit before enter menu
Adjust R31 for minimum voltage
Adjust C44 for minimum voltage
J9 & J17 closed, J8 open
DC Bias voltage: 0 to 5V
DC Bias current: 0 to 50mA
AC Drive level: 0.1V RMS to 1V RMS
Measured voltage on TP6
// French -----
Test alim.: erreur code %u
INITIALISATION EN COURS...
Aucun cavalier de J10 à J13
Régler C51 pour |Phi| < 0.3
Régler C106 pour |Phi| < 0.1
```

Sauvegarder le gain?  
 Sélectionner la valeur normalisée  
 -> Régler R146 pour 0V en TP7  
 Sauvegarde des données du Trim...  
 Pas de données Trim à sauvegarder  
 Sauvegarder les valeurs?  
 Pas polar. pour une résistance  
 Calcul du gain et de la phase  
 -> mettre un cavalier en J10  
 -> mettre un cavalier en J11  
 -> mettre un cavalier en J12  
 -> mettre un cavalier en J13  
 Pas le bon cavalier, quittez  
 OK, patientez quelques minutes  
 Faire la calibration de la gamme 1  
 Faire la calibration de la gamme 2  
 Faire la calibration de la gamme 3  
 Faire la calibration de la gamme 4  
 Erreur, quittez  
 Faire la calibration PGA2 gain 3  
 Faire la calibration PGA2 gain 10  
 Trim en court-circuit, patientez..  
 Trim en circuit ouvert, patientez..  
 Utiliser la valeur enregistrée?  
 -> Ouvrir ou Fermer le circuit  
 Enregistrer la fréquence?  
 -- Echec du TRIM --  
 OK  
 Commencer par fermer le circuit  
 Commencer par ouvrir le circuit  
 Régler R31 pour tension minimale  
 Régler C44 pour tension minimale  
 Pas J8, J9 mis, J17 mis  
 Tension de polarisation: 0 à 5V  
 Courant de polarisation: 0 à 50mA  
 Tension d'essai: 0.1 Veff à 1 Veff  
 Valeur de la tension en TP6  
 // Deutsch -----  
 PS Test Fehler, Code %u  
 INITIALISIERUNG, ETWAS GEDULD...  
 Keine Jumper auf JP10 bis JP13  
 Justiere C51 für  $|Phi| < 0.3$   
 Justiere C106 für  $|Phi| < 0.1$   
 Verstärkung speichern?  
 Normalisierten Wert wählen  
 -> R146 einstellen für 0V an TP7  
 Speichern der Abgleich-Daten  
 Keine Abgleich-Daten zum speichern  
 Daten speichern?  
 Kein DC-Bias für Widerstände  
 Berechne Gain und Phase  
 -> Jumper auf JP10 setzen  
 -> Jumper auf JP11 setzen  
 -> Jumper auf JP12 setzen  
 -> Jumper auf JP13 setzen  
 Nicht der richtige Jumper, ende  
 Okay, bitte ein paar Minuten Geduld  
 Ausführung Kalibrierung Bereich 1  
 Ausführung Kalibrierung Bereich 2  
 Ausführung Kalibrierung Bereich 3

Ausführung Kalibrierung Bereich 4  
 Fehler, Abbruch  
 Ausführung Kalibrierung PGA2 Gain3  
 Ausführung Kalibrierung PGA2 Gain10  
 Kurzschluss-Abgleich, bitte warten  
 Leerlauf-Abgleich, bitte warten  
 Gespeicherte Frequenz benutzen?  
 -> Leerlauf / Kurzschluss erzeugen  
 Frequenz speichern?  
 -- Abgleichfehler --  
 Okay  
 Kurzschliessen vor Menüauswahl  
 Leerlauf generieren vor Menüauswahl  
 R31 abgleichen für min. Spannung  
 C44 abgleichen für min. Spannung  
 JP8 offen, JP9 und JP17 schliessen  
 DC-Bias Spannung: 0 bis 5V  
 DC-Bias Strom: 0 bis 50mA  
 AC Bereich: 0.1 Veff bis 1 Veff  
 Gemessene Spannung an TP6  
 // Nederlands -----  
 PS test fout, code %u  
 INITIALISATIE, EVEN GEDULD...  
 Geen jumpers JP10 t/m JP13  
 Afregeling C51 voor  $|Phi| < 0.3$   
 Afregeling C106 voor  $|Phi| < 0.1$   
 Versterking opslaan?  
 Selecteer genormaliseerde waarde  
 -> Regel R146 af op 0 VDC op TP7  
 Opslaan afregeling...  
 Geen afregelings-gegevens  
 Gegevens opslaan?  
 Geen DC bias voor weerstand  
 Berekening versterking en fase  
 -> Plaats jumper JP10  
 -> Plaats jumper JP11  
 -> Plaats jumper JP12  
 -> Plaats jumper JP13  
 Verkeerde jumper, exit  
 Oke, dit duurt een paar minuten  
 Uitvoering calibratie bereik 1  
 Uitvoering calibratie bereik 2  
 Uitvoering calibratie bereik 3  
 Uitvoering calibratie bereik 4  
 Fout, exit  
 Uitvoering calibratie PGA2 3x  
 Uitvoering calibratie PGA2 10x  
 Afregeling kortgesloten. Wacht...  
 Afregeling open. Wacht...  
 Opgeslagen frequentie gebruiken?  
 -> open of sluit circuit kort  
 Frequentie opslaan?  
 -- MISLUKT --  
 GESLAAGD  
 Kortsluiten voor selectie menu  
 Openen voor selectie menu  
 Regel R31 af op minimale spanning  
 Regel C44 af op minimale spanning  
 JP9 en JP17 gesloten, JP8 open  
 DC Bias-spanning: 0 tot 5V

```
DC Bias-stroom: 0 tot 50mA
AC niveau: 0.1V RMS tot 1V RMS
Gemeten spanning op TP6
// *****
:07 36 MENU_ARRAY
// English -----
Language
Q limit for secondary display
Sorting parameters
Sort
AC level
DC bias
Change Display: INVERSE/NORMAL
// French -----
Langage
Q limite pour affichage secondaire
Paramètres du tri
Tri
Amplitude de la sinusoïde
Polarisation continue
Modifier Affichage: INVERSE/NORMAL
// Deutsch -----
Sprache
Q Limit für zweites Display
Sortierparameter
Sortieren
AC level
DC bias
Anzeige ändern: INVERSE/NORMAL
// Nederlands -----
Taal
Q-drempel voor extra weergave
Sorteerparameters
Sorteren
AC level
DC level
Weergave wijzigen: INVERSE/NORMAAL
```



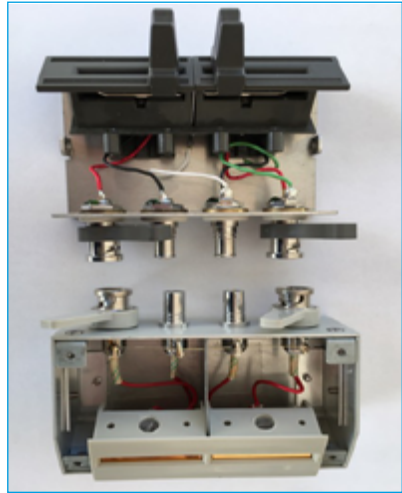
## Test Fixtures under test

To enable you to measure component characteristics with your LCR meter, the kit comes with Kelvin clamps. Other test fixtures reduce the wire length between the component under test and the measuring electronics, which in principle should help to improve the accuracy obtained. These are for example and listed in order of price

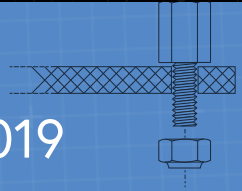
- the HZ181 from Hameg,
- the LCR-05 from GW Instek,
- the TH26001A from Tonghui.

The latter is given by the manufacturer for use from DC to 10 kHz, but it should be suitable for much higher measurement frequencies if we consider its internal wiring very similar to that of the LCR-05, usable according to its manufacturer up to 2 MHz, as confirmed by a reader on [the project page of the Elektor Labs site](#). Jean-Jacques Aubry also published [on the project page](#)

the very interesting results of his own comparative test between the (shortened) Kevin clips, the (modified) TH26001A and the LCR-05.



# 2 MHz LCR Meter Kit AU2019 Assembly & Calibration



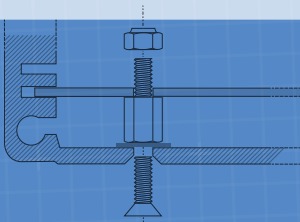
## Menu structure overview (for your reference)

[MENU] button - short press for access to user settings

- Language
- Q limit for secondary display
- Sorting parameters
- Sort
- AC level
- DC bias
- Change Display: INVERSE/NORMAL

[MENU] button - long press for access to calibration menus

- Set sine generator offset
- Measured value of  $V_{ref}$  (DDS)
- CMRR of Voltage diff. opamp
- PGA2: gain 3 calibration
- PGA2: gain 10 calibration
- Calibration of the range 1
- Calibration of the range 2
- Calibration of the range 3
- Calibration of the range 4
- <Short-circuit> Trim, all freq.
- <Open-circuit> Trim, all freq.



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