LCFesR 4.5 meter installation

The meter should be installed and checked by carrying out the following steps successfully:

- ***LCD functionality:*** The software can work with various types of HD44780 compatible LCD. However, if a problem seems to be with LCD (no letters on display) and you have burned yourself the software downloaded from http://lcfesr.atwebpages.com/en , it may be that you have forgotten to burn in the content of the lcfe_eeprom.hex file or not have set the fuse bits correctly. If these are not the case, you can try to rotate the trimmer potentiometer, check the ribbon cables, check the circuit for short-circuit, check for the presence of a frequency of 16 MHz at processor's PIN 9 or 10. If you can see letters on display but they are displaying slowly, it's because of that you did not set the fuse bits correctly.

  In case of KIT, the processor and the display can not be a problem because they are tested thoroughly before packing – if problem exists (very rarely), it is surely because of short-circuit or bad soldering on PCB or on ribbon cables, or aside soldering ribbon cables. You can download the next documentation for more details of what and how to check if the display does not show any text: http://lcfesr.atwebpages.com/en/Check_for_no_LCD_text.pdf .
  You can download the next file too, if you'd like to see through PCB, namely when examining / checking components on the top side of PCB you can see the tracks on the bottom side of PCB, that is you do not have to reverse the PCB to see them:
  http://lcfesr.atwebpages.com/en/For_checking_components.pdf .

  Of course you can send an e-mail to hutale@gmail.com for suggestion.

Note:

By push and release the button a few times or pushing and holding it, the actual value is changeable in steps or continually. Now in the LCFesR 4.5 version **we can increase or decrease the value**. We do this by **choosing the operation in 2 s**, when meter asks us to do. Meter will shows **text "++>"** that means: the "next operation will be the **summation**" or the **text "--<"** that means: the "next operation will be the **subtraction**". By pushing right away the button we can change the operation. If we do not touch button in 2 s, then meter proceeds and shows the value. Here if **we push button** then meter **will add or reduce** the value **according to what operation we have chosen.**

- **L> (*200mH – 30H) measuring mode:*** If meter can not measure any inductor (measuring cables are open), or if meter senses low frequency (when measuring very big inductance), it displays **"Cyc.T?"** and **"L>!"** text alternately. Then simply **start to measure** any inductor or when measuring very big inductor **press the button once** to start measuring the time period! At small (<0.2H) inductance's measurement or when closing measuring cables, it outputs "**L <0.2H**". When measuring bigger inductor (>200mH) meter displays the right value. If meter does not work like these it should be examined to find the source of error: Cables are OK? Connection is OK? The LC circuit is resonating at the **4093 IC's PIN 3?** If that is the IC-problem, trying another one helps? If there is a sign at **4093 IC's PIN 3**, is it there at **4093 IC's PIN 11 and 10 too?** Is there any short-circuit? In this mode, because of measuring big inductor, there is no need to zero the measuring cables!
  - **Calibration**: (*In KIT 5% capacitors are used so the measuring accuracy without calibration can be <5%*). If we know the precise value (eg. 1H, 4 H) of an inductor, the meter can be calibrated by pushing and holding the button for 7-11 s and changing the **Ref_C+ = 235 nF** value in small scale to set the result of the measurement to the value we should measure (IC's properties may vary so we may need calibration).

- **L< (10*nH – 4H) measuring mode:*** If meter can not measure any inductor (measuring cables are open), or if meter senses low frequency (when measuring big inductance), it displays **"Cyc.T?"** and **"L<!"** text alternately. By **closing the measuring cables** the meter should show approx. 2-

3uH. If the meter does not measure anything then we need to examine whether the measuring cables have been opened inadvertently. If this is not the case, the circuit should be examined for short-circuit or be sure that the LC circuit is resonating at the **LM311 IC's PIN 7.** If that is the IC-problem, trying another one helps? If there is a sign at **LM311 IC's PIN 7**, is it there at **4093 IC's PIN 8 and 10 too?** If all goes well then by **leaving the measuring cables closed, push and hold the button for 4-6 s to zero** the meter's cables. It should now show 0 nH, and later 0 nH or a few nH can be measured. The stability depends on how much the used components are heat-stable. *In the kit a good heat-stable components are used, so the NULL value is expected to be stable. However to get the best performance in measurement of nH range, we should use the possibly **shortest (only a few cm)** and **best quality** (eg, silicon) measuring cables and probe (eg, copper)!*

- ***Calibration:*** *(In case of KIT, calibration is not needed or only little calibration should be done*). If we know the precise value (eg. 68uH, 100 uH etc.) of an inductor, the meter can be calibrated by pushing and holding the button for 7-11 s and changing the **Ref_C= 13.3 nF** value in small scale to set the result of the measurement to the value we should measure (IC's properties may vary so we may need calibration). The point is that, after calibration and zeroing the cables the meter is showing as much as close to the values of the known inductor.
- ***Why does the meter show negative value?*** When zeroing the meter's cables the software take the actual measured value as the base and subtracts it from the value of the following measurement results. The extraction result may be a small negative value but this is not a problem.

- Low value of inductor can be measured accurately, if we zero the meter immediately before measurement, or more ***simply:*** measure the inductance of the **closed-cables**, and subtracts this value from the next measurement result (eg. closed-cables's inductance is 5 nH and 110 nH is measured, the inductance is: 110 nH - 5 nH = 105 nH).

- ***C measurement (1 pF – 100000 uF):*** The measuring cables should be ***left open*** and the meter should display approx. 2.8 nF (a little more than the value of the capacitor that had been soldered). If the meter is continually metering and 6 minutes later it's showing "???" message, or it shows a lot more, then we need to examine whether the measuring cables have been closed inadvertently. If this is not the case, the circuit should be examined for short-circuit or we should be sure that the RC circuit is resonating at the **4093 IC's PIN 4**. If that is the IC-problem, trying another one helps? If there is a sign at **4093 IC's PIN 4**, is it there at **4093 IC's PIN 11 and 10 too?** If all goes well then by **leaving the measuring cables open, push the button for 4-6 s to zero** the meter's cables. It should now show 0 pF, and later 0 pF or a few pF can be measured. The stability depends on how much the used components are heat-stable. *In the kit a good heat-stable components are used, so the NULL value is expected to be stable.*

  - ***Calibration in nF range:*** *(In case of KIT, calibration is not needed or only little calibration should be done*). If we know the precise value of a capacitor (eg. 10 nF, 20 nF, etc.), we can calibrate the meter by pushing and holding the button for 7-11 s and changing the **Ref_R = 997 Ohm value** in small scale to set the result of the measurement to the value we should measure (IC's properties within one type may vary a little each other but can vary much from another type). The point is that, after calibration and zeroing of the cables, the meter is showing as much as close to the value of the known capacitor. *(In case of ST HCF4093 we must set about REF_R = 1045!!!)*
  - ***Calibration in uF range:*** *(In case of KIT, calibration is not needed, that is the 4093IC parameter is set to the correct value*). In case of use of another type 4093 IC we have to measure a known capacitor of value about 10-1000 uF, counting how much % correction we need. We set this value in the 4093IC parameter (for example in case of 5%, set 4093IC = 5). Then by checking, changing the values of

parameters, calibrate the meter finally! *(In case of ST HCF4093 we must set about 4093IC = 5!!!). The calibration of the pF range is happening automatically!*

- ***Why does the meter show negative value?*** When zeroing the meter's cables the software take the actual measured value as the base and subtracts it from the value of the following measurement results. The extraction result may be a small negative value but this is not a problem.
- Low value of capacitor can be measured accurately, if we zero the meter immediately before measurement, or more ***simply:*** measure the capacity of the **open-cables** and subtracts this from the next measurement result (eg. open-cables's capacity is 5 pF and 28 pF is measured, the capacity is: 28 pF - 5 pF = 23 pF).

- ***ESR* (0 – 30 Ω) *measurement:*** **ESR-measurement should be taken with the use of short straight measuring cables!** When measuring ESR the processor is measuring small voltages (0-150 mV), so by using long cables a bit too much resistance results in less accurate measurements of low-value ESR capacitor. *It is recommended to use 2 x 30-40 cm silicone wires and copper probes*. ***The ESR measurement mode can be activated from C measurement mode by pressing and holding the button for 2-3 seconds.*** Just do the same to get back to C mode from ESR mode! In ESR mode, when cables are left open, the meter should show **ESR > 30 Ω** and when closing them it shows a few 100 mΩ (the resistance of the cables). If it does not work like this, the circuit should be examined (short-circuit, transistor's functionality, 1.16 V at CPU's 21 PIN?). If the meter works OK, we should close the measuring cables together and **push and hold the button for 4-6 s** to **zero the cables**. So the meter saves the actual measured value and subtracts it from the following measurement results. Warning! T*he software will not allow to zero 1 Ohm or bigger value (it shows "???") so that the value of cable's resistance can not be greater than 1 Ohm!*

  - ***Calibration with 1 Ohm 1%, 5.1 Ohm 1% resistors:*** *(In case of KIT, calibration is not needed or only little calibration should be done*) Press and hold the button for 7-11 s to enter the ESR calibration mode. By modifying the **ESR_REF=100 and ESR_REF = 1000** values the ESR measurement result can be set exactly or close to 1 or 5.1 Ohms. Read the documentation to know how to do this! *(If you do not know for what is ESR_Cal parameter (see document), do not change it's default value:ESR_Cal = 1!)*
  - ***Why does the meter show negative value?*** When zeroing the meter, the actual measured ESR value is saved and this will be subtracted from the following measurement results. The subtraction result can be a very small negative value and this is not a problem: just zero the meter again or add this value to the next measuring values. Big negative value can be seen if measurement is taken with reversed polarities of charged capacitors. In this case, for fast measurement discharge the capacitor, or wait until the meter discharges it!
  - ***Why does the ESR value vary continuously at the beginning of measurement?*** The ESR measurement is based on voltage measurement (ADC). If the capacitor is charged (this may happen even during the C measurement), the processor measures the voltage of the ESR and the voltage of the capacitor together **until the capacitor is discharged totally**. So while it and C7, C9 capacitors (these are charged up from the charge of capacitor under measurement – this way protecting the meter) are discharging, the ESR value of the measurement is changing and after a while it will be stable. The meter has fast discharging circuit so this occurs in a few seconds. But in case of **big capacitors (>10000 uF) to speed up the ESR measurement it is worth discharging** the capacitor before measuring it**.** Practice of **discharging capacitor** before measuring has another **advantage:** we are protecting 100% the meter from possible large surge current (in ESR measurement mode meter is protected from capacitor charged up to 100 V but can be destroyed if we by chance try to measure capacitor charged up to bigger voltage).
  - ***How to make ESR measurement more stable?*** **Solder** measuring cables **directly to PIN-s** of ESR_CON connector**!**

- ***F* (0.01 Hz – 8 MHz) *measurement*:** AVR processor gives very good accuracy so we don't need any calibration. **Be sure to use the correct poles!** If meter can not measure any frequency (measuring cables are open), or if meter senses low frequency (<40 Hz), it displays **"Cyc.T?"** and **"F!"** text alternately. Then simply **start to measure** any frequency or when measuring low frequency **press the button once** to start measuring the time-period!

- **Other management information:**

    - **What to do if the LCD shows "Cyc.T?" and "L<!" or "L>!" or "H!" text alternately?** The meter can not measure or it has detected small frequency. In this case **try to measure something** (inductance, frequency) or **press the button** to let the meter start to measure the time-period (case of measurement of big value inductance or small value frequency).
    - **What to do if the LCD shows "Cyc.T ..." text and it takes a long time?** The meter is busy of measuring time-period. In capacitor measurement mode (case of measuring big capacitor) you should wait until the meter finishes the measurement, but you can **press the button** to stop it. In inductance, frequency measurement mode, try to measure / re-measure or **press the button** to stop it.
    - **What to do if the LCD backlight has been set "turned off"?** The LCD backlight can be **switched on/off**: **hold the button for 12-15 seconds!**
    - **How to reduce the amperage consumption of the meter?** If you use battery and maybe you want to reduce the consumption of the LCD display backlight then you can exchange the R6 resistance (300 Ohm) for a bigger value one (1-2KOhm). The consumption of LCD display will reduce (from 15 mA to 1-5 mA) but the backlight will be somewhat fainter too.

- **Attention!**
    - **When meter is zeroing, it checks the zeroing value:**
        - If this value <5nH or <5pF or <5mΩ, the meter temporarily stores the value only, so meter works with this till the meter is on.
        - If this value >5nH or >5pF or >5mΩ, the meter stores the value in permanent memory too, so it will be used the next time the meter is switched on!