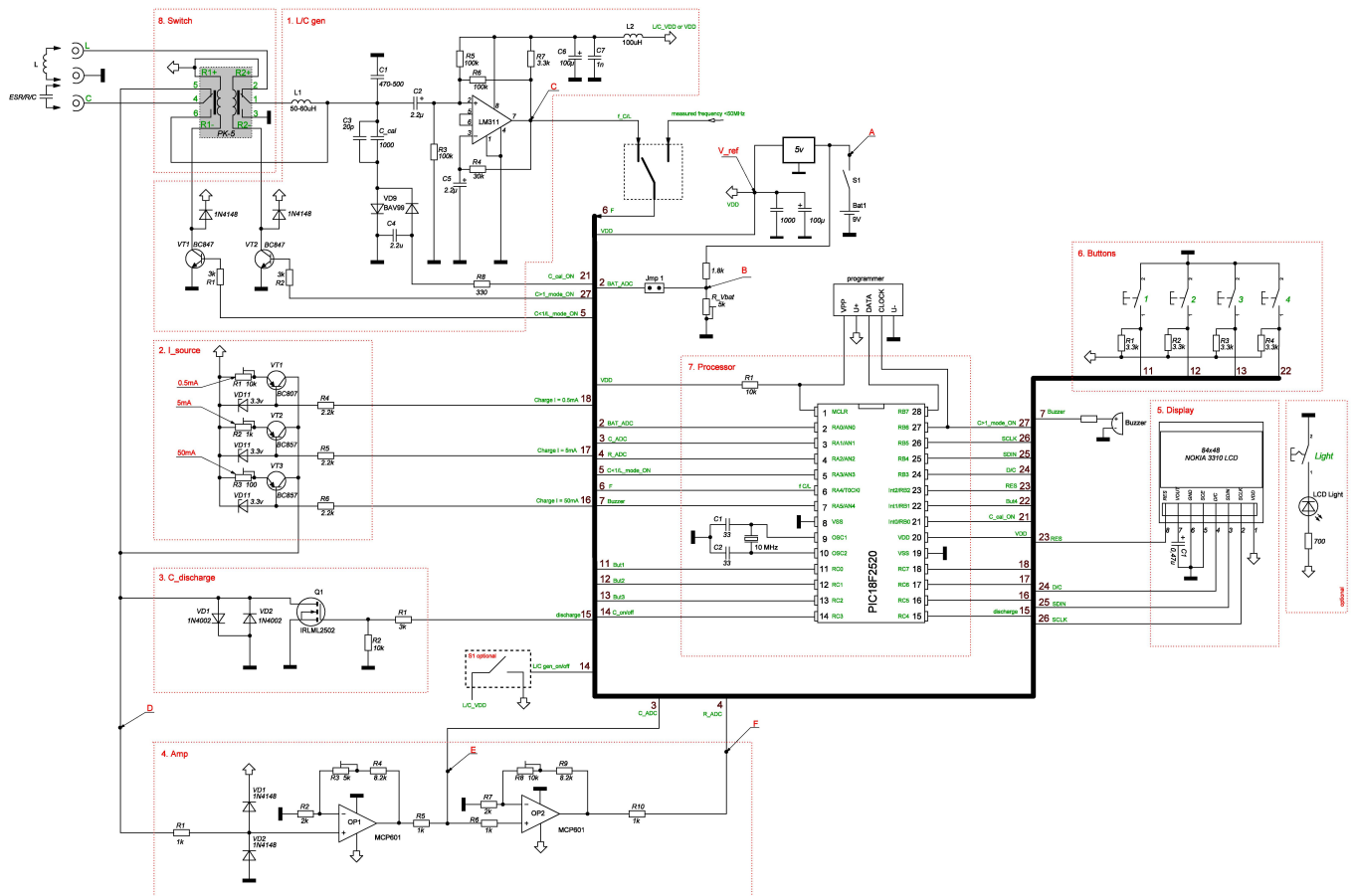


Device.

The device is intended for measuring low resistance, inductance, capacitance and ESR of capacitors.

Functionally, the scheme can be divided into eight main modules:

1. L / C Generator
2. Stable current source unit (50mA/5mA/0.5mA)
3. Unit responsible for the discharge of the test capacitor
4. Block voltage amplifiers
5. Display unit (Nokia LCD 3310)
6. buttons
7. PIC18F2520 microcontroller
8. Switch (for switching subjects components)



The principle of the LC oscillator and therefore the principle of measuring the inductance and capacitance (1p - 1uF) does not describe in detail see the point. This is detailed in the descriptions of similar devices of which the mass of the Internet. I will mention only a few features that were used in this scheme and the calculation algorithm. To measure the inductance and capacitance using different pairs of probes ... This approach has allowed more accurate measurement by organizing a permanent, automatic, partial calibration. That is, LC

oscillator frequency drift does not have such a significant impact on the accuracy measure as it was before. Also, a new approach to the calculation allowed to get rid of the influence of internal capacitance measured inductance of the measurement result (it is taken into account during calibration).

Measuring capacitance electrolytic capacitors arranged by the classical method - a charge the capacitor stable current source up to a certain voltage level (0,2 v) with a parallel counting the charging time. The scheme is implemented ff. manner. Subject connected capacitor discharges first (Q1) then it is fed stable voltage and timer countdown. At the time of reaching the level of voltage 0,2 v. triggered an internal comparator and the timer is fixed. Next is the calculation of the capacitance. To reduce the measurement time menu to select the maximum limit of the test measuring the capacitance of the capacitor (100/300/600 thousands of microfarads).

Measurement of ESR (ESR) capacitor and the measurement of small resistances is performed on the lyrics. principle. Subject to the capacitor served a short voltage pulse is formed by a stable source of supply. This causes a voltage spike, the value of is proportional to the ESR of the capacitor. Two series-connected op amp to increase the signal to the required level. Further, the output of op amp is connected to the microcontroller detects the peak of the pulse and performs the analog-digital transformation for further calculation of stress. Knowing the value of current and voltage pulse is produced calculation of the ESR.

When measuring the ESR of small vessels (<10uF) is a slight overestimation of meter readings. Despite the fact that pulse duration of 1-2uS enough to recharge the capacitor had a little bit, thus slightly overestimated the value of the measured voltage.

Details of the design.

Some design features that should be considered when repeated. Trimmer unit in the source stable current (2. I_source) should be replaced with constants, after the selection of the approximate value in the process of setting (described below)

Trimmer resistors R3 and R8 in the amplifier block (4. Amp) is recommended to use multi-turn. This will allow fine-tuning of the coefficients, enhance the value of which depends on the accuracy of the instrument (especially critical for ESR). Instead of two MCP601 op amp, you can use one MCP602. The relay in the switching unit (8. Switch) to use bistable with two windings rated at 5v.

Capacitors C2 and C5, or non-polar tantalum "ceramics." Choke L1 - such as "dumbbells." Even better, if the "dumbbells" will be in the ferrite "cup".

Block "S1 optional" is a control unit supply voltage to the LC oscillator. Optionally, there is a possibility turn off the generator in the measurement mode "electrolytic" scheme to reduce power consumption. Block S1 cannot use, by simply plugging the generator to the LC power! To prevent failure of the microcontroller, Jmp jumper should be installed only after the voltage settings in the point "B" resistor "R_Vbat" (described below). The circuit module is missing frequency (prescaler and buffer) at a frequency of program he implemented. Measured frequency (with the "correct" amplitude) must be submitted to the withdrawal of 6 MK (F). It should be understood that for modes measuring capacitance and inductance to the input of 6 MK should send a signal output from the LC oscillator. With this purpose in the scheme shows the switch. One of the possible solutions of the schematic of the module frequency (prescaler / buffer switching) is still under development. If necessary, switching can be arranged on the ordinary switches, as well as diagrams of input circuits (splitter \ buffer) using one of the many schemes available in the Internet.

Configure and work with the device.

When you first turn on the device to be reset all settings to default settings. To do this, press 3 and turn on the unit. In the future, this operation can be done from the menu «Function» section "Reset". After the reset is



Setting up stable sources of supply.

The accuracy of measurement is significantly affected by the accuracy of setting the stable sources of supply. To set up need to go to the menu «Function» and then select the section "I_50" button «OK». Then connect the terminals with the measurement / ESR milliammeter. Milliammeter will show the current value of the future to measure the pulse ESR. C using trimmer (R3) to set the current is as close as possible to the value of 50mA. Thereafter remember reading and disable the milliammeter. Next, using the + / - buttons to set the value of the device menu reflected by earlier milliammeter to decimal and save it by clicking OK. The same procedure must be run to power source 5, and Sections 0,5 mA ... "I_5" and "I_05", adjusting the current subscript corresponding resistors, while the measured value should be inserted in the device menu to accurate to hundredths / thousandths. ! It is important to remember that switching between sections should be made for disabled milliammeter. In the future, recommended to replace the trimmer with the constant and repeat the setup procedure.

Setting up the OS.

The process of configuring the OS is reduced to K tuning gain of each op amp to the value specified in sections Amp1 and Amp2. for this select the measurement mode ESR / C / R and then:

1. Connect to terminals of the electrolyte with obviously well-known capacity (it is better to take a small capacitor with a capacity of 10 - 50uF) and through a resistor R3 and variable Amp1 (~ 6.0) in the setup menu, make relevant evidence on the screen.
2. Then, connect to terminals known resistance (preferably 1 - 10 ohms) and using a resistor R8 and variable Amp2 (~6.0) in the setup menu, make relevant statements on the screen. On the accuracy of measuring the resistance will affect the accuracy of setting the value for the current current sources

0.00 -1.00 Ohm - the section "I_50"

1.00 -10.0 Ohm - the section "I_5"

10.0 -100 Ohm - the section "I_05"

Setting LC oscillator.

Setting LC oscillator is reduced to the selection of inductor L1 and capacitor C1 so that the frequency of the generator, which can be controlled by the regime "Oscillator" was in the range 900kGts. C2 and C5 should be tantalum or none polar "ceramics." Calibration capacitor can be any in the range of 500-1200pF. The main thing that it was capacitor with a minimum of TKE and the known value of your container. Very well, if it is possible to pre-measure of its real capacity on any calibrated meter. The value of the total capacity C_cal and C3 must be recorded in the section "6.Ccal". C3 cannot install (... spied in a similar decision, an option reducing the total TKE).

Battery indicator.

Setting an indicator of the charge reduced to a set point "B" voltage equal to approximately one third the battery voltage supply. For This is necessary to measure the battery voltage supply to the point "A" (when the device) U1. Then, connect the voltmeter in point "B" achieved by adjusting the resistor «R_Vbat» voltmeter U2 equal to about 1/3 of U1. Further to calculate the divider ratio $K_{div} = U1/U2$, and write the values in the menu settings in the appropriate sections. Also indicate in the settings of the voltage with a fully charged battery "V_bat" and the minimum voltage level at which the device will signal the need to replace / recharge the

battery. Also, to improve the accuracy of the ADC is desirable to specify the exact menu voltage microcontroller V_{ref} (for default is 5v) measured it when the device at the point V_{ref} .

Measurement of ESR / C / R (from 0.1 - 600 000uF)

To measure should:

1. Enable device (terminals for measuring the component free)
2. Switch the device by pressing the "Mode" (hereinafter M) in the regime of ESR / C / R
3. If necessary, perform the calibration (described below)
4. Connect to the terminals of the measured component (C)
5. The screen displays the results of measurement devices.

It should be noted that the speed of measurement affects the measured capacitance of the capacitor. Maximum limit measurements can be selected in the menu «Function» (C_{max}) (stated in thousands of microfarads)

The calibration mode ESR / C / R.

The calibration is to compensate for the effect of the length of wire terminals, and others on the measurement of internal resistance. For the calibration mode to being in the ESR / C / R button «Calibration» (hereinafter C). When the menu «Close probes» (closed probes) probes are necessary to close the device before the end of the countdown on the screen. After perform the calibration process, the information about the settings will automatically be saved in nonvolatile memory devices that will not subsequently be calibrated each time you turn on the device.

Measurement of C ($C < 1\mu F$)

To measure should:

1. Enable device (terminals for measuring the component free)
2. Switch the device by pressing the "M" mode C-meter
3. If necessary, perform the calibration (described below)
4. Connect to the terminals of the components measured
5. The screen displays the results of measurement devices.

Calibration in C mode

The calibration is to compensate for the effect of the length of wire terminals, and others the result of measuring the capacitance of the capacitor. For the calibration mode to being in C (measuring the component connection terminals are open, measured by the capacitor is disconnected) press the "C".

Measurement of L

To measure should:

1. Enable device (terminals for measuring the component free)
2. Switch the device by pressing the "M" mode L-meter
3. If necessary, perform the calibration (described below)
4. Connect to the terminals of the components measured
5. The screen displays the results of measurement devices.

6. When measuring the inductance (especially small denominations) to obtain a higher accuracy can be the measurement process (without disconnecting the measured inductance) to calibrate by pressing "C". At the same time calibrate the instrument and the screen will reflect the value of inductance is connected as close to the real.

The calibration mode L

The calibration is to compensate for the effect of the length of wire terminals, and others on the measurement of inductance. There are two types of calibration - "deep" to calculate the inductance probe and "ordinary" to correct the drift of the oscillator. Regular calibration is performed by pressing the "C" in the mode of L-meter. Calibration can be performed with the connected measured inductance of lead device.

To perform a "deep" calibration, press the button "C" and keep it pressed until you see signs «Close probes and take away hand» (closed probes and clean hands) and then close the test leads to the end of the reverse reference on the screen, remove your hands and wait for the calibration process. After calibration, unlock probes. Deep calibration cannot be conducted continuously since after performing a "deep" calibration, the values of inductance Probe connections are stored in nonvolatile memory microprocessor.

Measurement of F

To measure the frequency of need:

1. Insert the device
2. Switch the device by pressing the "M" mode F-meter
3. Select the operating mode (with or without prescaler) using the "/"
4. Apply the measured frequency of the input «F» (6th output MC).

Change the prescaler division ratio can be used by pressing the «K». After installing the coefficient and preservation of the "OK button" value will be stored in a nonvolatile memory device.

The scheme does not contain modules of the frequency (prescaler and a buffer).

Beep 'Lost'

If measurements are not conducted more than ~ 1 minute, the device begins to publish an intermittent beep. In the future, the signal repeats every ~ 20 seconds. Beep "reminder" will not be included, if the instrument is set to "Off".