

iRFC



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User manual – ver1.0

iRFC - Radio Frequency Calculator - is an application dedicated to high frequency design engineers or to hobbyists that always need to have in their pocket a powerful tool to design impedance adaptation networks.

This document explains how to use the integrated Smith chart display and how to setup your network.

iRFC

GET IT AT:

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I. MAIN SCREEN – SMITH CHART AND TUNINGS

1 – Smith Chart area

- a – IN marker
- b – OUT marker
- c – cursor marker

2 – Button area

- a – cursor values
- b – background settings
- c – network IN and OUT impedance settings
- d – network tuning

The screenshot shows a mobile application interface with a Smith Chart and control buttons. The top status bar displays 'SFR', signal strength, Wi-Fi, and the time '15:41'. The Smith Chart area (1) features a red arc and a yellow dot. The button area (2) includes input fields for 'R' (40.43) and 'Z' (-68.02), mode selection buttons ('Smith', 'Inv.', 'Ortho.', 'Rad.'), and tuning controls ('#0', '+', '-', '3.285e-08', 'Auto', 'Man Set').

I.1 Smith chart area (1)

The Smith chart area is basically constituted of 4 main items:

- The background, that display axis
- The actual Smith chart of your network (when set) in RED LINES, based on a normalized R_0/F_0 that can be set as described in II.1
- The START impedance, in Smith representation, marked by a YELLOW DOT – this is always the starting point of the Smith chart representation of your network and it represents the load impedance at the entrance of your network,

- The TARGET STOP impedance, in Smith representation, marked by a LIGHT BLUE DOT – this is the equivalent impedance you would like to see when looking at the output impedance of your network. Your network is tuned WHEN the red lines end in this point
- The CURRENT impedance you are looking at – you can change this value by moving your finger on the display, the cursor will follow it

1.2 The button area (2)

1.2.1 (2-a) Cursor values

This area shows 3 main zones:

- In the middle you have a button you can click to in order to switch between a Impedance representation (when R is displayed) and a Gamma representation (when G is displayed) normalized based on the setting of R_0/F_0 that can be set as described in II.1
- On left and right side you can respectively see the real and imaginary part of the value you've chosen to display in the previous chapter

1.2.2 (2-b) Background settings

As mentioned in I.1, the background area is the one that displays axis in the Smith chart.

By clicking on the buttons of this background settings area, from left to right, you can respectively display (when button text is highlighted in Purple) or hide (when button text is in blue):

- the Smith axis,
- the inverted (Inv.) Smith axis showing the $1/Z$ values,
- the Orthonormal (Orth.) axis , showing the (Real, Imaginary) values centered in (0,0)
- The Radial axis (Rad.) also centered in (0,0)

The benefit of showing or hiding those axis is to help in understanding better how the network is tuned step by step, showing how the local impedance between 2 points of the network will evolve, depending if we talk of a Resistor, Capacitor or Inductance and if they are in series or in parallel

This topic is related to the understanding of Smith chart and this may be added as an annex later; in between the reader is encouraged to understand the use of Smith Chart on dedicated third parties courses.

1.2.3 (2-c) Network IN and OUT impedance settings

By clicking on the relevant button, you will setup the IN (Start) or OUT (End) impedance of your network as represented in I.1 to the value of the current cursor.

1.2.4 (2-d) Network tuning

Most probably the most important/useful part: tuning of the network that MUST be set upfront (see II.3) can be done manually or automatically.

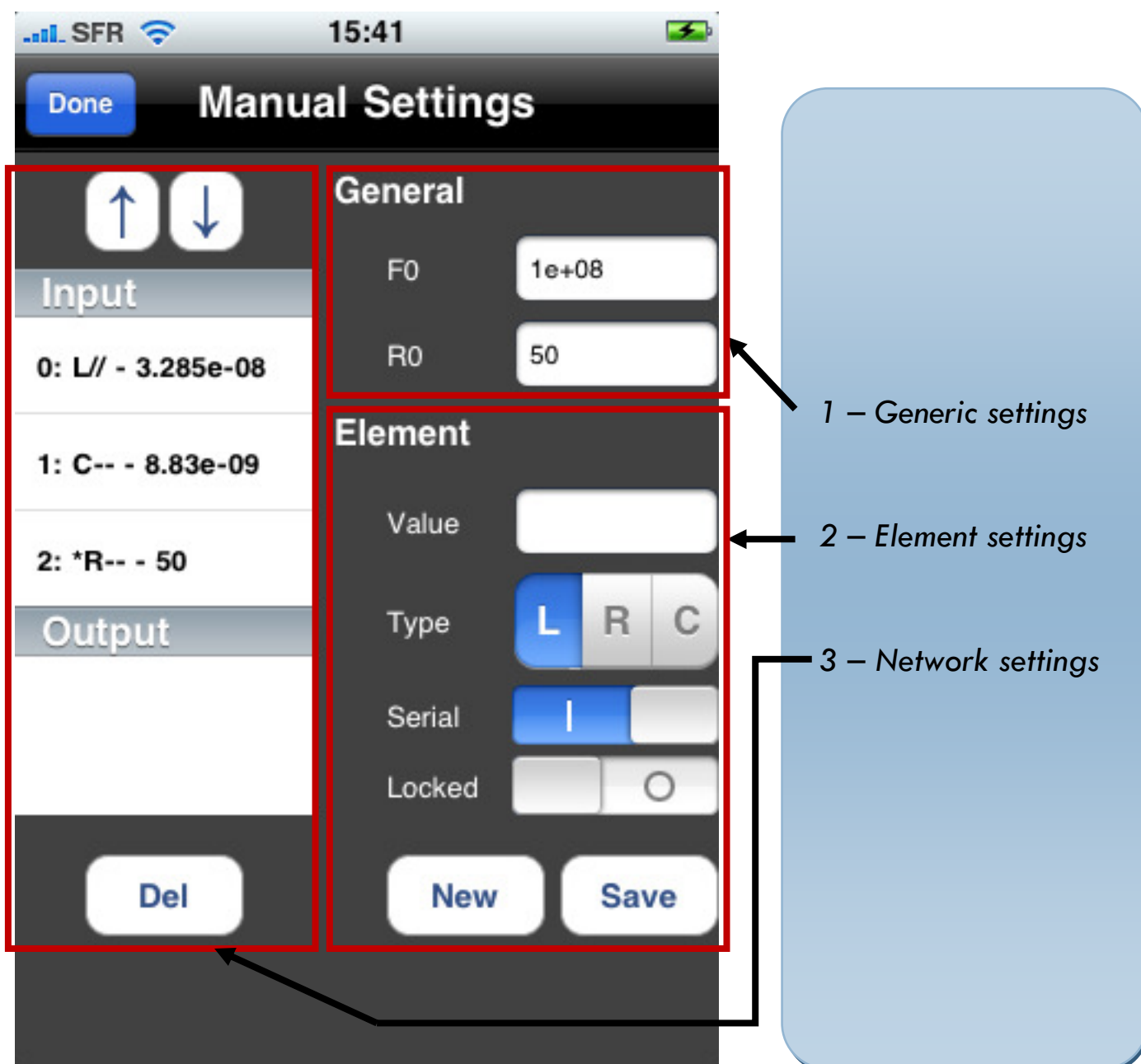
The manual tuning is done by first selecting the element number (first button on the left). Click on the button until you see the element you need to tune. Then, click on '+' or '-' button to increase or decrease the value (indicated in the middle area using the SI unit for the given type of component): please note that '+' add 10% and '-' remove 10% - this is sufficient for the majority of uses, but the value can also be setup more precisely as explained in II.2.2.

On the right, the 'Auto' button launches the process to automatically tune your network VALUES based on the network type defined in II.3 and on the IN and OUT impedance values setup. The most important

thing is that in order to prevent abnormal value in auto calculation, the tuning will stop after a given number of iteration that does not result in the proper tuning. In this case, user is highly encouraged to look at the Smith chart, use the manual method to get close to realistic values and to click 'Auto' button again. It can also happens that the values after auto tuning are shows an end impedance very close to the targeted one, then a simple other click on 'Auto' button should solve the problem.

Finally, on far right, the 'Man Set' button will switch to the detailed network settings of chapter II.

II. DETAILED NETWORK SETTINGS SCREEN



II.1 (1) Generic settings

In this area, the normalization of R_0/F_0 should be input – F_0 is in Hertz and R_0 in Ohm

II.2 (2) Element settings

II.2.1 Creation of a new component

When a new element needs to be created, no consideration of the values set should be taken into account. The user must just input the proper:

- Type of element in the network (R=Resistor, C=Capacitor or L=Inductance)

- The type of placement of this component in the network (Serial ON like on the picture mean that the component is connected between the input and output of the network. When the switch is OFF, this means a component set in parallel, thus between the node of the network and the ground)
- Value – this is the value of the component in SI units system (Ohm for resistor, Farad for capacitor, Henry for Inductor)
- The lock switch is a feature that when ON prevent the modification of the value of the component during the auto tuning process (refer to I.2.4)

When the setup is done, the user must click the 'New' button and the component will be added to the list describing the network (see II.3)

II.2.2 Modification of an existing component

In this case, the user must first select a component by clicking on it in the list of the (3) Network settings area.

Then the modification should be done as mentioned to create a new component.

When done, the user must click on the 'Save' button to ensure that the change is reported to the network. If this is not done, all modifications will be lost!

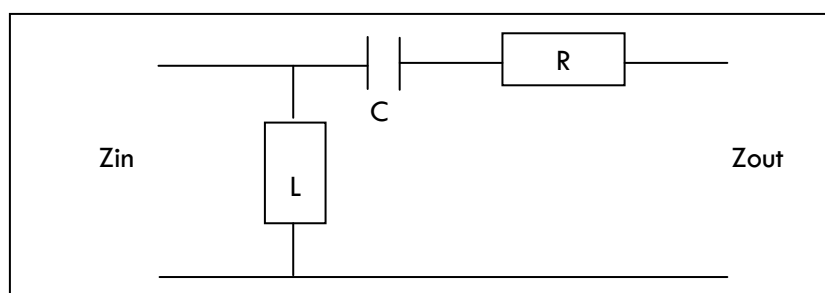
II.3 (3) Network settings

Then main part of this area is filled with the list representing the component of the network from the IN (input) node to the OUT (output) node.

Each component of the list is displayed using a shortcut representation as follow:

- Item number (that is corresponding to the one mentioned in I.2.4)
- Char ':'
- Optional '*' character to indicated locked component when relevant
- Type (L, R or C)
- // if parallel type (connected to ground), -- when the component is in series.
- char '-'
- Value of the component

As an example the list from the previous picture represents the following network where R is never tuned automatically:



When a component is not needed any more, the user must select it in the list by clicking it, then press the delete button. **This operation cannot be undone!**

When a component is not at the right location, the user must select it and click on the '↑' or '↓' button to move it in the list and thus in the network.

Note: to edit the values of the component, the user must refer to the chapter II.2.2 and use the (2) Element settings area.