Some hints to operate the program “Tuning Range Calculator“

Introduction

There are different methods to adjust the capacitance (tuning-) range for a given variable capacitor to achieve a desired frequency range (“bandspread“):

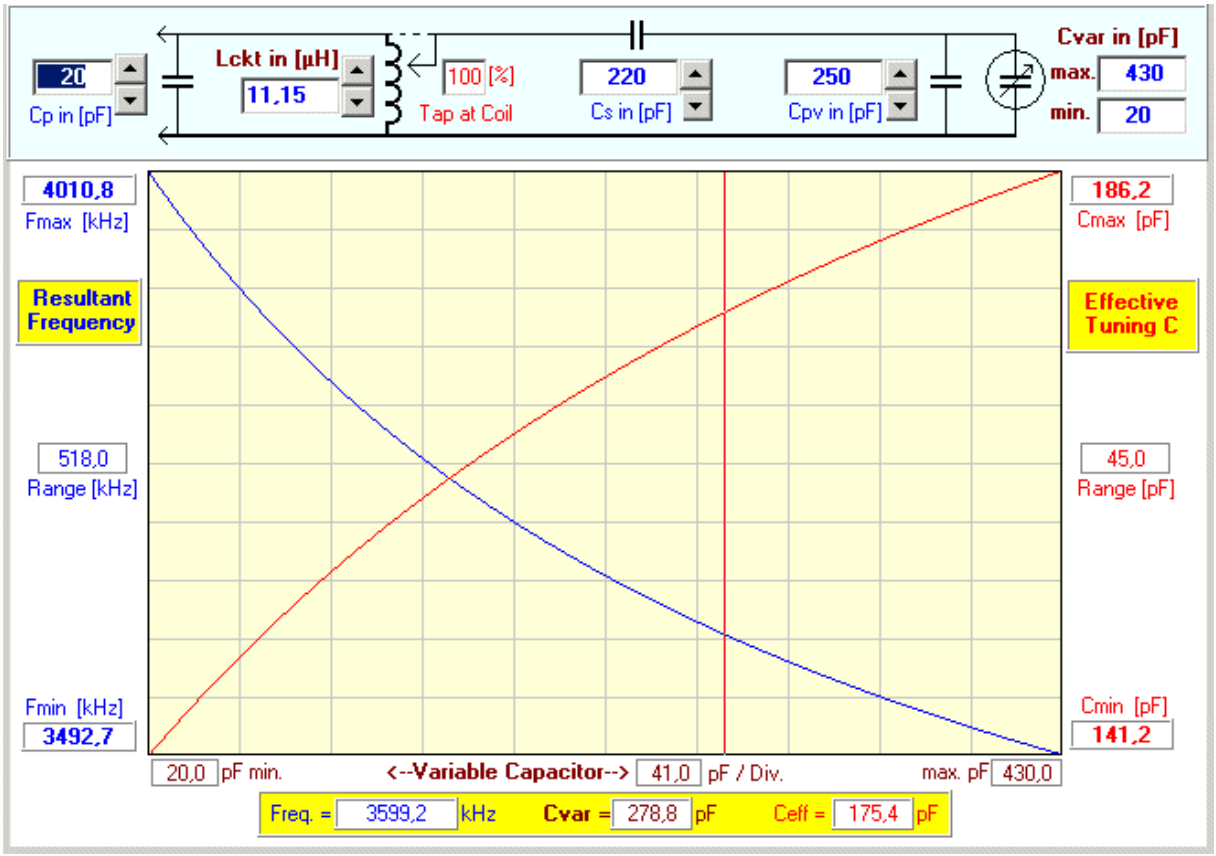
a) by adding a parallel capacitance to the variable cap
b) by inserting a series capacitance
c) by reducing the effective capacitance range through a tap on the inductance
d) and, last but not least, combinations of the above methods.

All of the above methods do have their advantages and disadvantages which affect the linearity of the frequency tuning curve. It requires a lot of tedious calculations to achieve a certain tuning range with an acceptable L/C ratio, and to get an information about the effective tuning curve.
This program does all this – the user only has to change the parameters and immediately can see the results in numeric and graphic form.

The user interface

Because a Help file is not yet available, here some explanations of the many functions of this program.

This is a Screenshot of the User interface:



The light blue-green area at the top contains all input fields which can be changed by the user. They are arranged in form of a circuit diagram to make the relations visible.

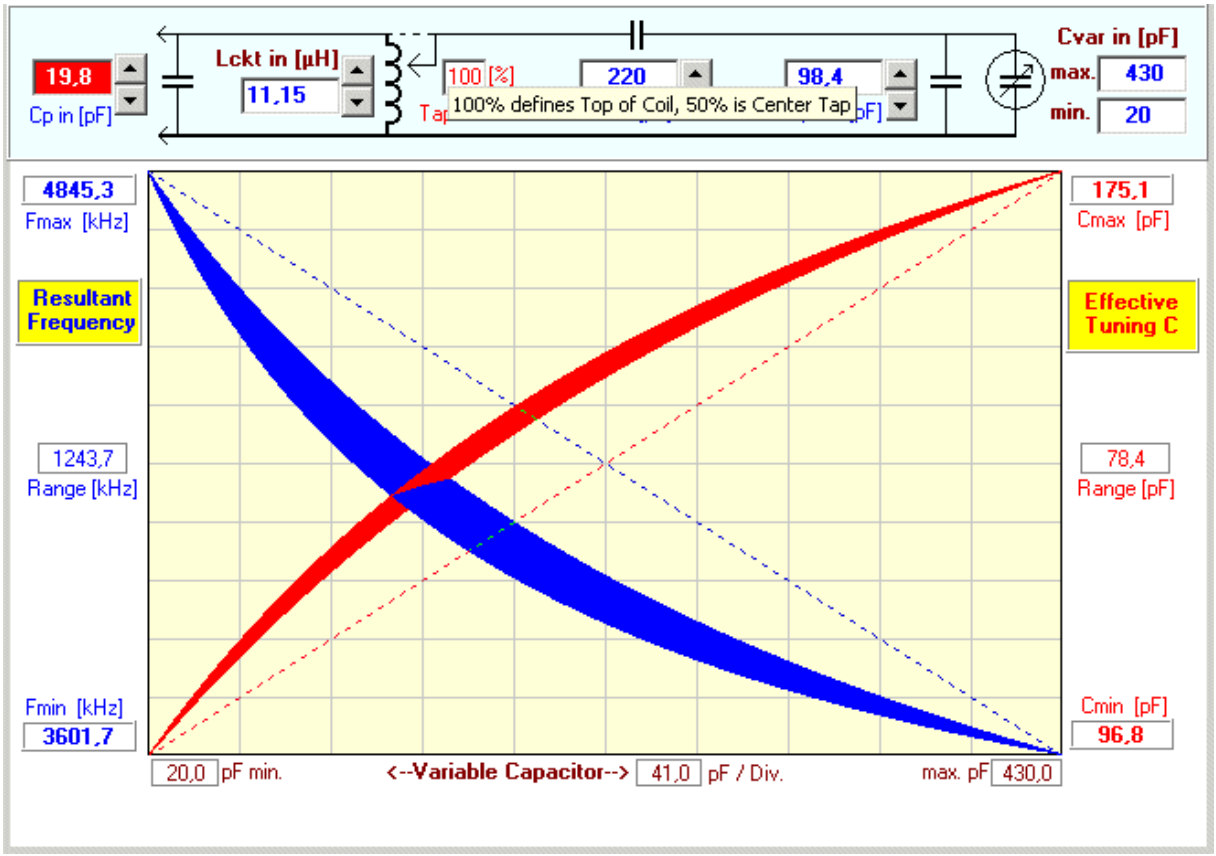
Below that is the result area which contains the numeric results for the frequency range and the effective capacitance of the whole circuit. The frequency is shown as the blue curve, and the capacitance range as the red curve. The x-axis is defined as the capacitance range of the variable capacitor in linear form.

When the Mouse is moved into the graphics field a vertical hairline is shown which can be moved across this area. The yellow field below the graphics field appears and displays the resulting frequency and effective total capacitance as a function of the capacitance of the variable capacitor.

The input fields

1. Parallel capacitance **Cp**, always connected to the top of the inductance (includes stray cap.)
2. Circuit inductance **Lckt**
3. **"Tap"** on the inductance (100% defines top of inductance, 50% → center tap)
4. Series capacitance **Cs**. If set to Zero, this is interpreted as a through connection (the colour of the "zero" changes to green).
5. Parallel capacitance **Cpv**, directly connected to the variable capacitor.
6. The variable capacitor **Cvar**.

Beside the fields **Cp, Lckt, Cs,** and **Cpv** there are Up-Down buttons which can be used to "adjust" the parameters with an immediate effect on the display. This is shown in the picture below:



Several effects can be seen:
Changing one ore more of the above parameters via the Up-Down buttons adds the new responses to the old curves, thus creating the above appearance. However, pressing either the <Return/Enter> or the <Tab> button, or a Mouse click into one of the input fields erases this "history" and leaves single lines for the last settings.

You can also see two dotted diagonals. These show the linear references for frequency and capacitance. This can help to get a feeling about the deviation from linearity. To avoid overloading the display on the graphics, these lines are only displayed by a Mouse click while the Mouse is within the graphics field. A second click erases these lines.

Also, the field for **Cp** turns red when the capacitance goes below 20pF. This is an indication that this capacitance approaches the inevitable stray capacitance. No warning message is issued.

Some additional Notes

The program struggles with the fact that the variable capacitor can only be modelled with a linear capacitance change vs. tuning angle.

The tuning characteristics of real-world variable capacitors can normally not be covered by any general mathematical equation. The capacitance change vs. angle can therefore only be acquired with point-by-point measurements.

However, this programs can speed up the design of the desired circuit and it's responses, using the following approach:

Input the measured Cmax and Cmin of the variable capacitor into the program.

With the moving hairline one can then set the respective capacitance value of **Cvar** for each measured point and directly read the resulting frequency. Getting those results manually in tabular form can be done very rapidly – also the adjustments of the other cap values and for Lckt can easily be conducted. All the many calculations are done by the program, and thus speed up any design considerably (and error-free!).

Limits of the Up-Down buttons:

The step size for the values is a compromise between resolution and speed of the change. This speed is not dependent on the calculations but on the repeat speed (defined by Windows) when one of the buttons is pressed for longer periods.

Therefore, the selected step sizes are 0.25% of the current value for the inductivity **Lckt**, and 0.5% for the other values.