RF Toolbox

Version 5.2.0 May 9, 2018

RF Toolbox is a program that allows you to quickly design antennas, as well as perform many useful RF, electronics, and electrical calculations.

It is not an antenna analysis package (like MININEC) in that it doesn't determine how an antenna design performs. Instead, you select the type of antenna and the desired characteristics, and RF Toolbox gives you the suggested design for the described antenna.

You can design several types of antennas. These types include:

- Dipole
- Fat Dipole
- Yagi
- Loop
- Long Yagi
- J-Pole
- Super J-Pole
- Log Periodic • Cubic Quad
- Vertical (over a ground plane)
- Helical

You can also perform the following additional calculations:

- LC calculations - by entering two of the following: L, C, frequency, the third is calculated.

- Coil design - by entering three of the following: L, diameter, length, number of turns, the fourth is calculated

- Transmission line loss - given the type of cable, length, and band, computes the loss in dB, also computes the additional loss caused by SWR.

- L Network - L matching network

- Pi Network - Pi matching network

- Impedance - Calculate the impedance of a capacitor or inductor at a given frequency

- Wire inductance - Calculate the inductance of a straight piece of wire

- Wire resistance - Calculate the resistance of a length of wire, as well as the voltage drop

- Transmission Line Calculator - Handles many transmission line related calculations, including SWR and impedance transformations.

- dB Calculator - Convert between dB and voltage/power ratios.

- Resistor Calculator - Calculate Required Series/Parallel Combinations

- Resistor Color Code Calculator - Determine the color code for a resistor • Thermal Noise Calculator

- Pi Network Attenuator Calculator
- Tee Network Attenuator Calculator
- 555 Timer Oscillator Calculator
- RF Link Budget Calculator
- Skin Depth Calculator
- Gamma Match Calculator
- Zener Diode Calculator
- Parallel Line / Ladder Line Calculator
- Toroid Core Calculator

Use:

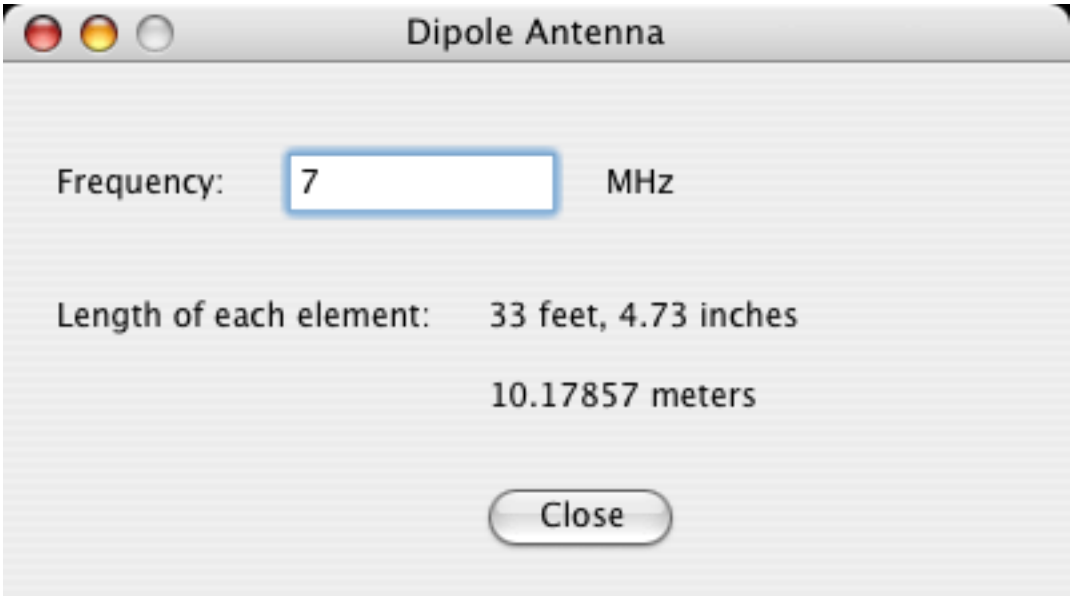
Just select the desired antenna type from the Antennas menu, or calculation type from the Tool menu, and fill in the requested information.

That's it! It's really that simple.

The following pages show the design window for each of the calculators, and give a brief description of how to use them.

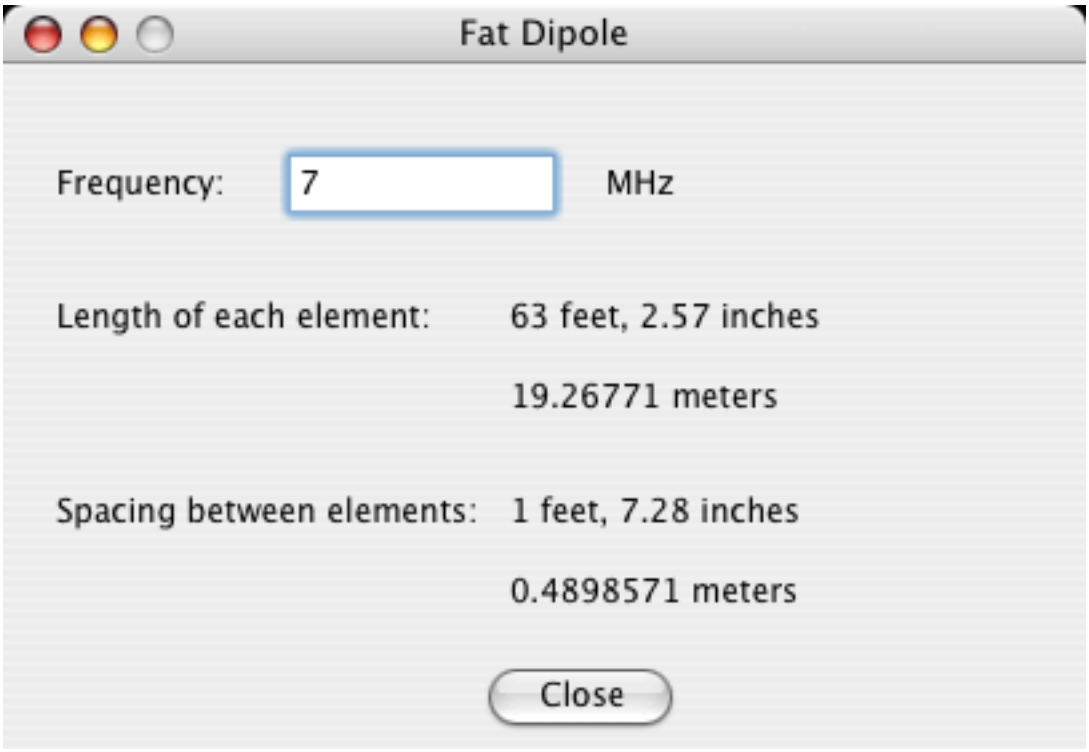
Dipole Antenna Calculator

Enter in the desired resonant frequency in MHz, and the length of each element (side) is computed and displayed.

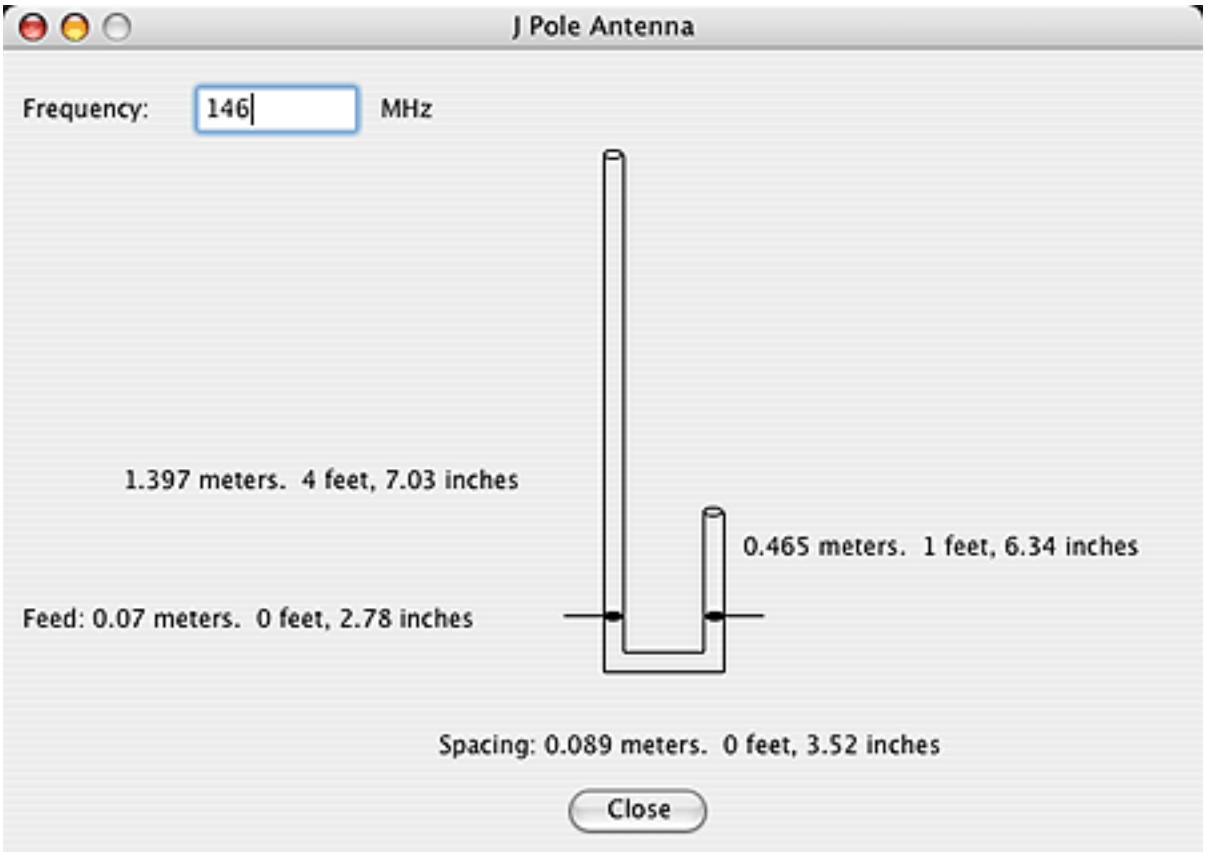


Fat Dipole Antenna Calculator

Enter in the desired resonant frequency in MHz, and the length of each element (side) is computed and displayed, as well as the necessary spacing between each element.

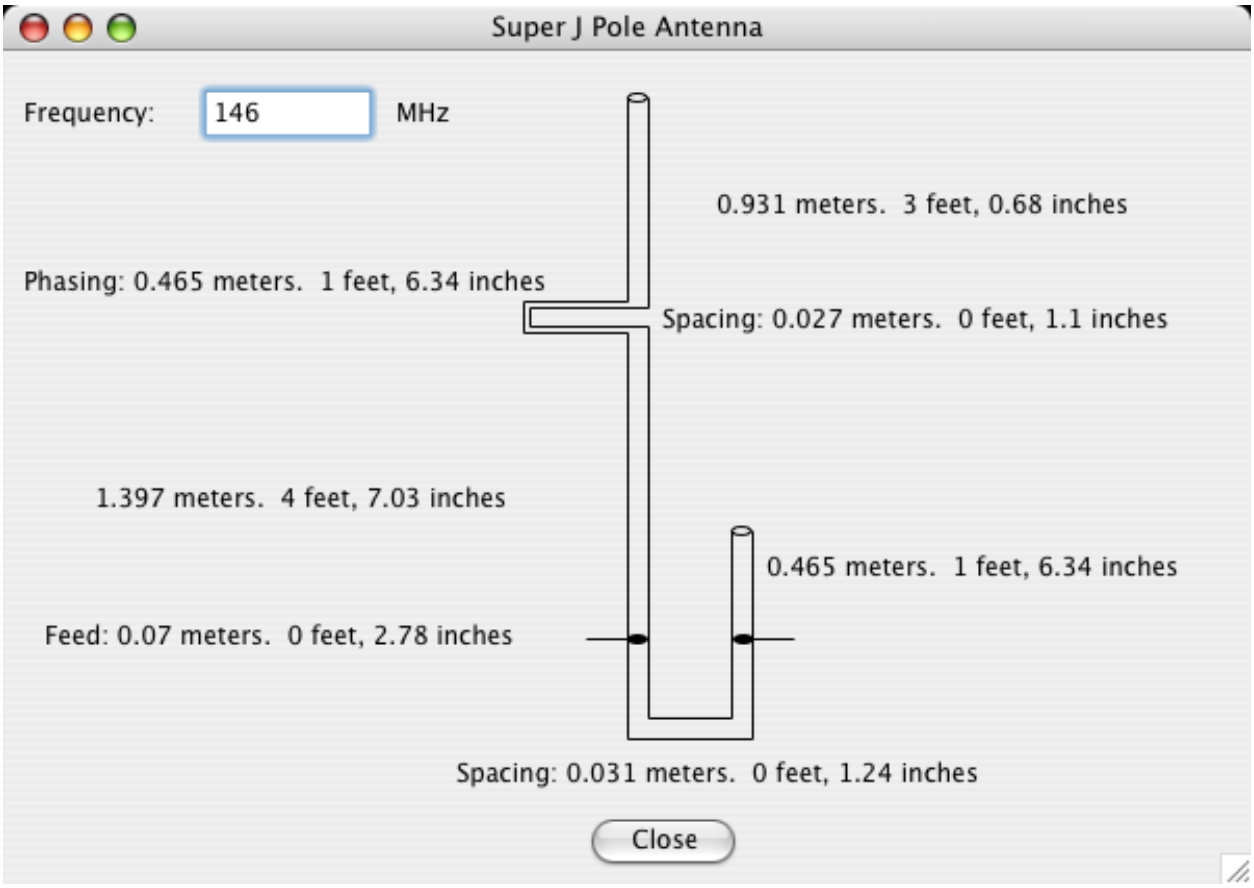


J Pole Antenna Calculator



Enter in the desired operating frequency in MHz. The dimensions for the antenna elements are calculated and displayed.

Super J Pole Antenna Calculator

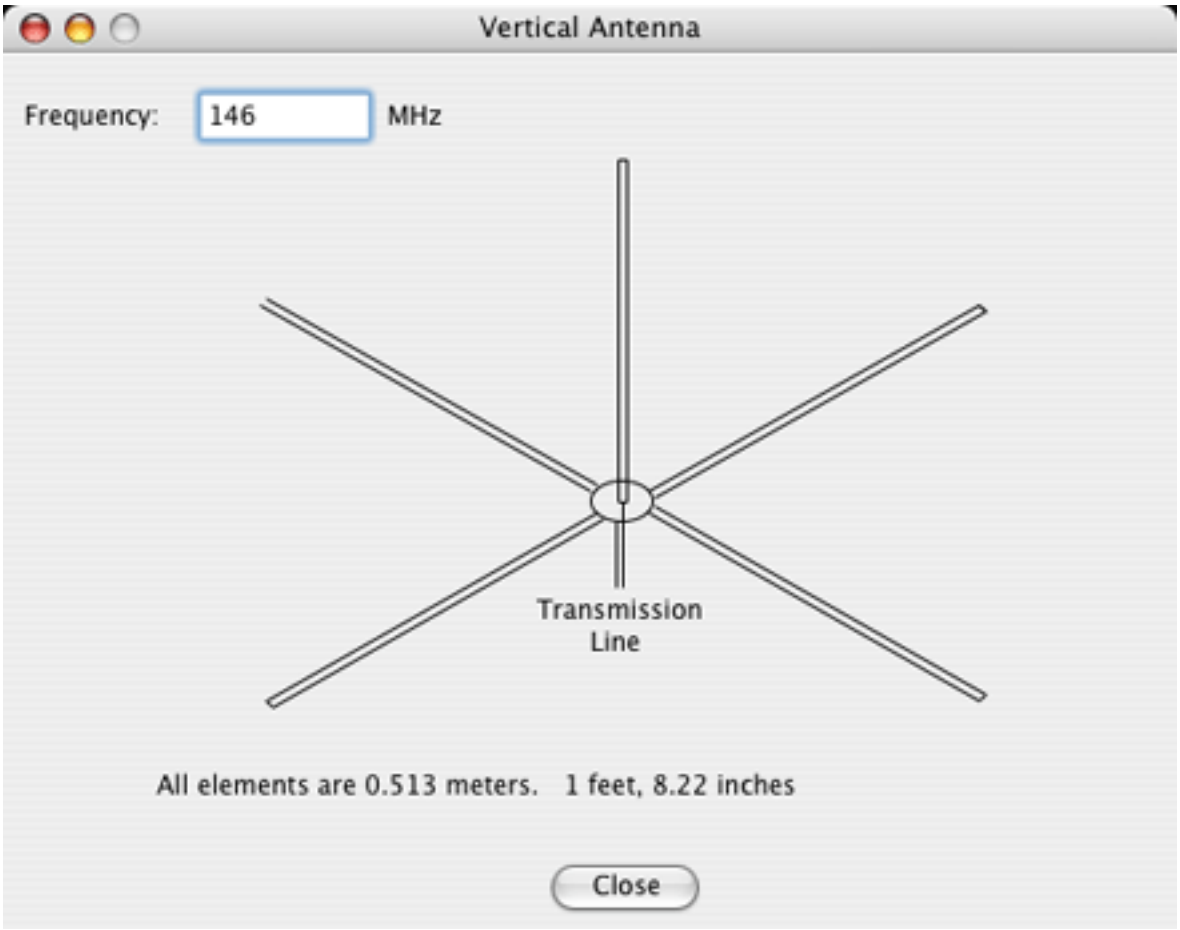


Enter in the desired operating frequency in MHz. The dimensions for the antenna elements are calculated and displayed.

Vertical (Ground Plane) Antenna Calculator

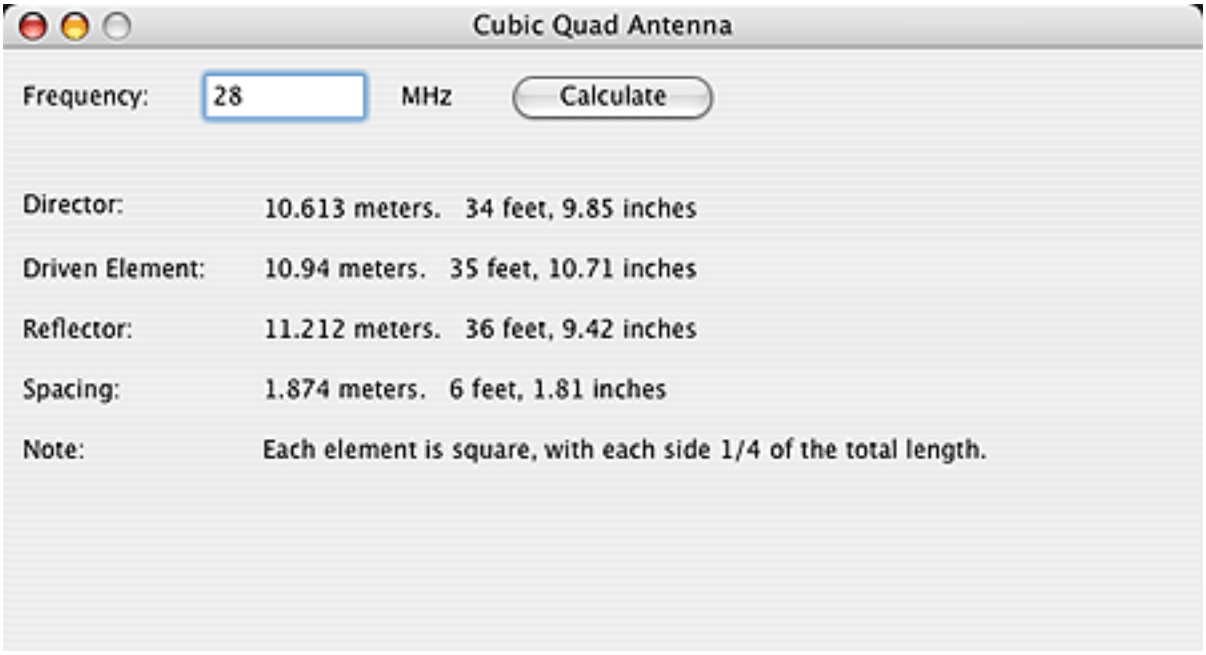
Enter in the desired operating frequency in MHz. The dimensions for the antenna elements are calculated and displayed. You can also change the type of antenna from the popup menu:

1/8 wavelength 1/4 wavelength 3/8 wavelength 1/2 wavelength 5/8 wavelength 3/4 wavelength 7/8 wavelength Full wavelength



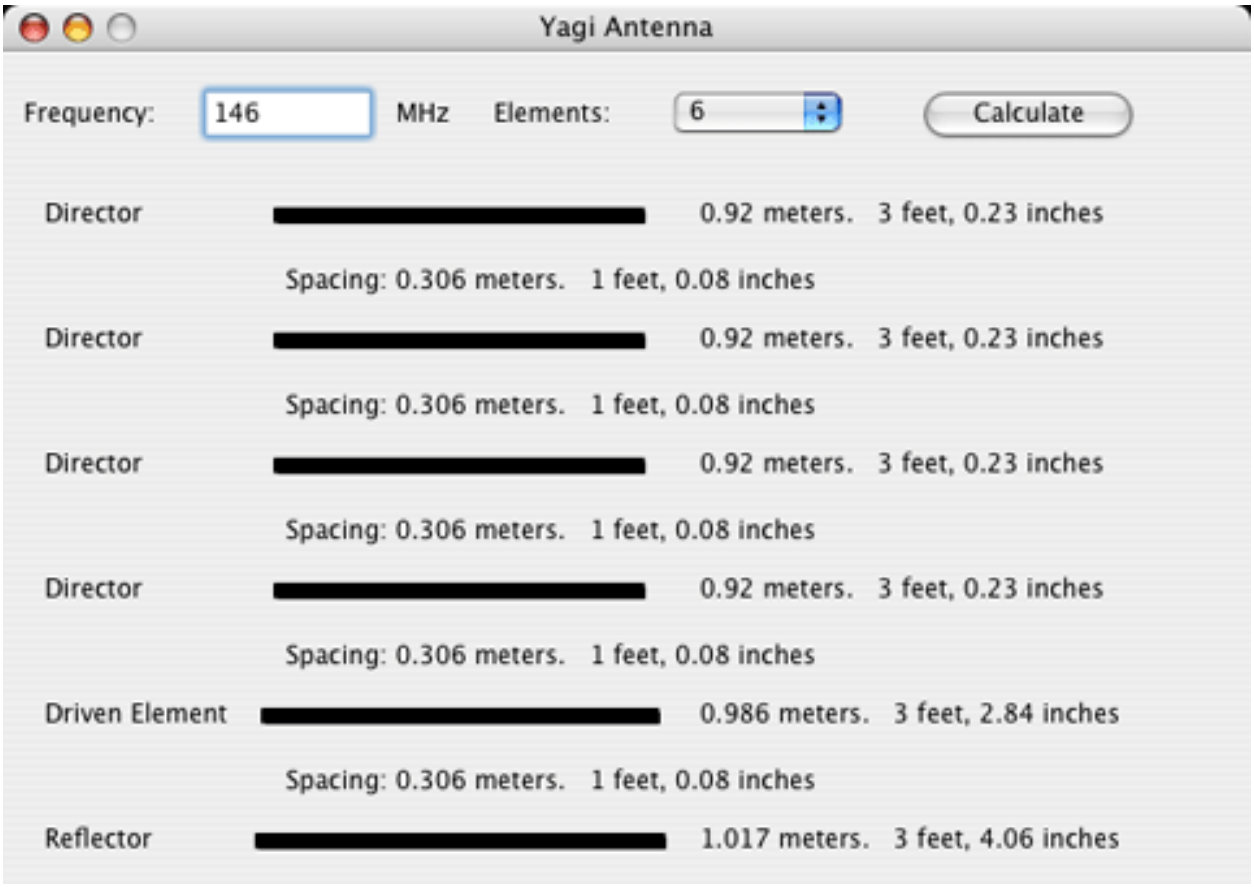
Cubic Quad Antenna Calculator

Enter in the desired operating frequency in MHz. The dimensions and spacings for the antenna elements are calculated and displayed.



Yagi Antenna Calculator

Enter in the desired operating frequency in MHz. The dimensions and spacings for the antenna elements are calculated and displayed.



Long Yagi Design

This window allows you to design long Yagi antennas, up to 99 elements, using the DL6WU formula.

Select whether you would like to use mm or inches for dimensions. Enter in the frequency in MHz.

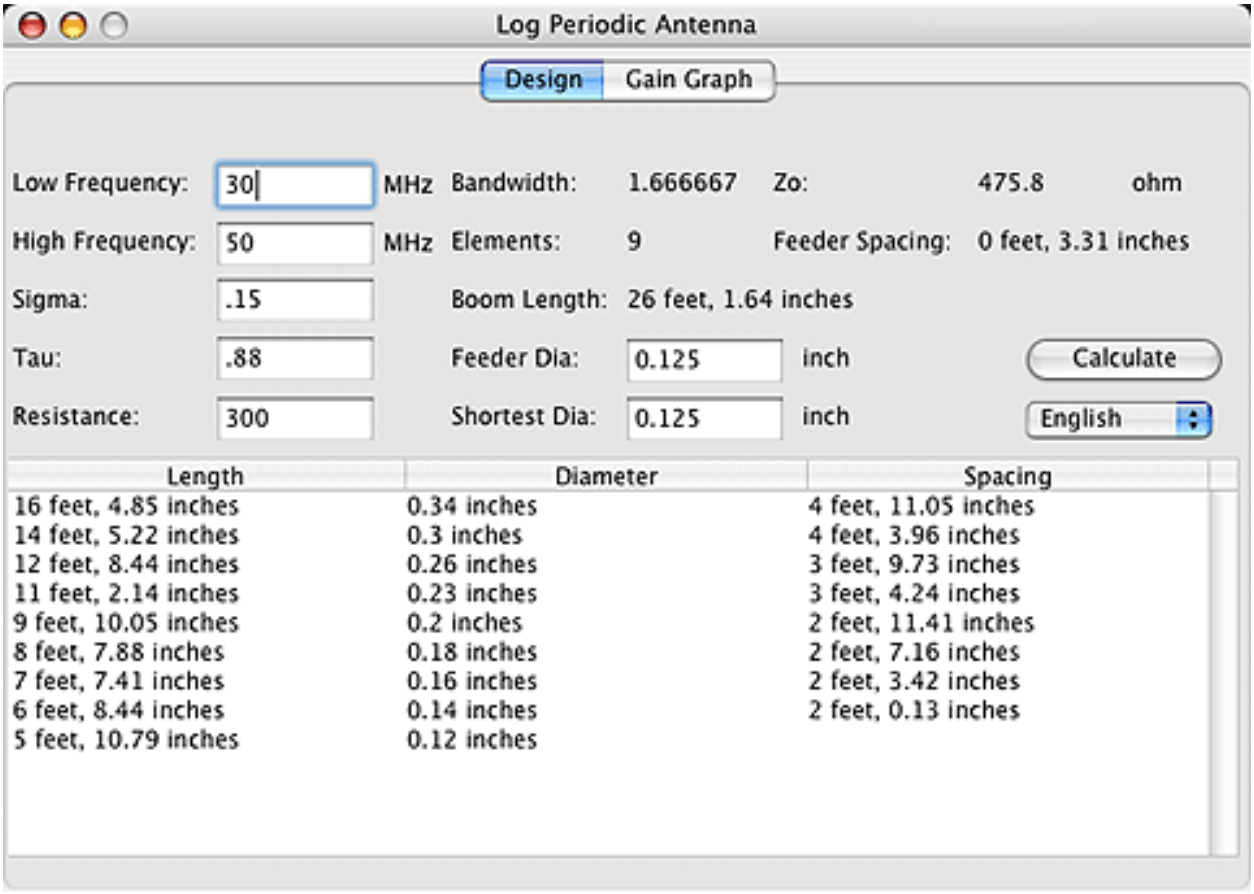
Select whether you want to specify the gain in dB, or the length of the antenna from the popup menu, then enter in that value.

Choose one of three boom types:
Metal with bonded (electrically attached) elements Metal with insulated elements
Non metallic

Enter in the diameter of the boom as well as the driven and parasitic elements.

Click Calculate, and the element information will be generated and displayed. You can print the results, or save them to a MININECPro format file for analysis.

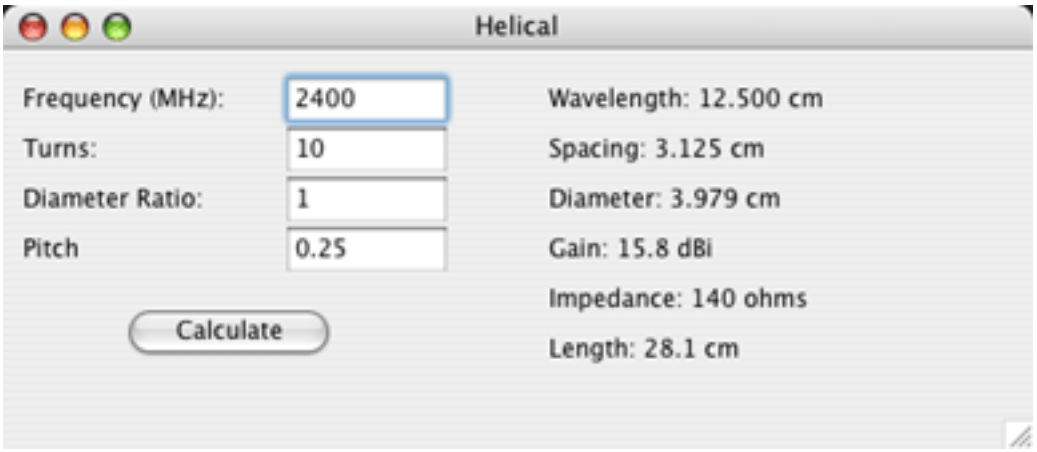
Log Periodic Antenna Calculator



Enter in the frequency range as well as the sigma and tau design parameters (look at the Gain Graph in the window for suggested values), and the design resistance, as well as the diameter of the feeder and shortest elements. Click on the calculate button, and the lengths, diameters, and spacings for each element will be computed and displayed.

Helical Antenna Calculator

Enter in the desired frequency in MHz, and the number of turns. You can leave the diameter ratio and pitch at the default values, or edit them. Click the calculate button, and the antenna parameters are computed.

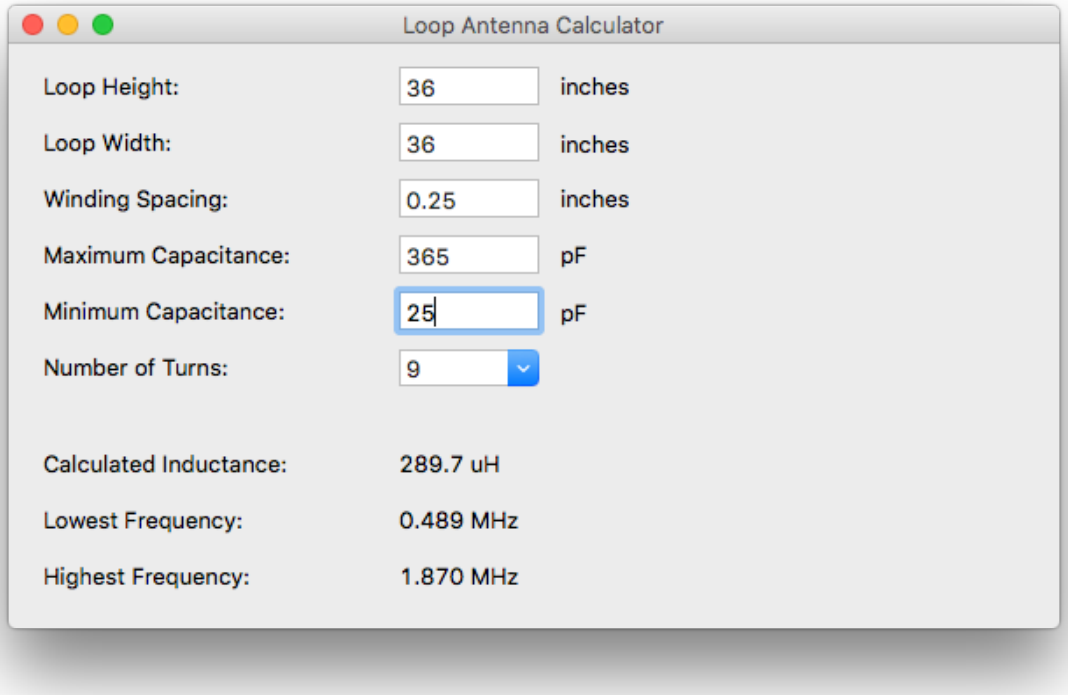


Loop Antenna Calculator

This is for calculating the frequency range of a square (box) loop antenna, with a parallel tuning capacitor.

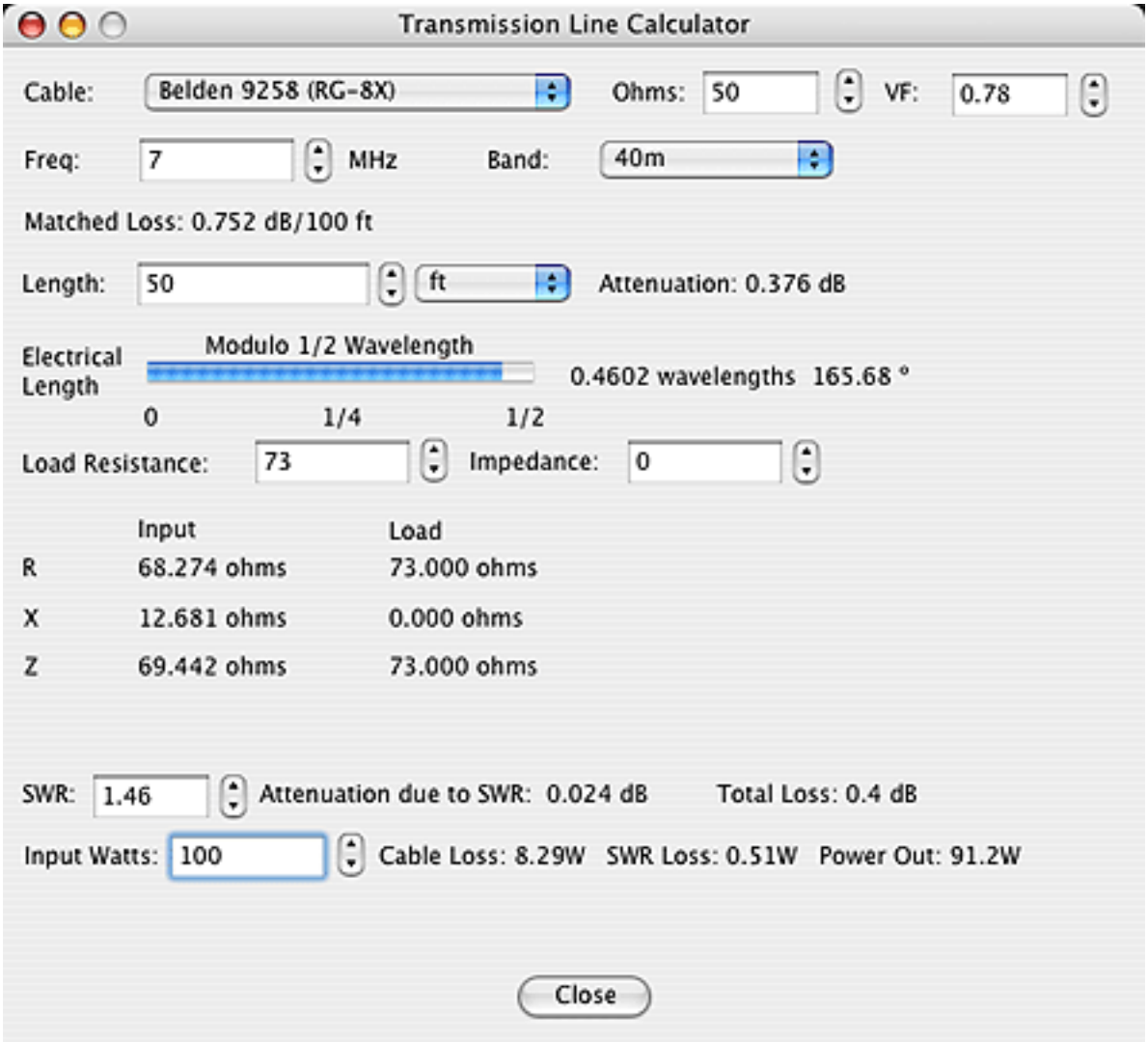
Enter in the loop height and width in inches, along with the maximum and minimum capacitance values of the variable tuning capacitor, and the number of turns.

The lowest and highest resonate frequencies will be calculated.



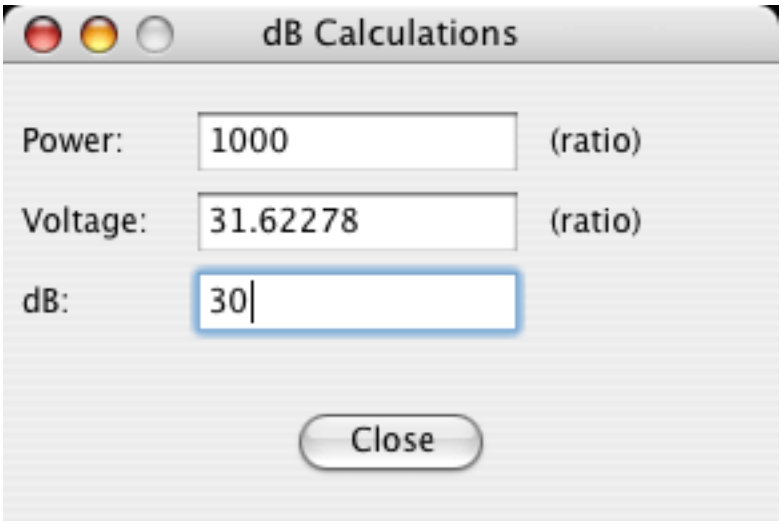
Transmission Line Calculator

This calculator may be used to compute the losses caused by the transmission line (coax or open wire), as well as the SWR from a mismatched load, and the power loss. Select the cable type from the popup menu, as well as the length and operating frequency. Enter in the impedance of the load (antenna). The SWR is calculated, as well as the losses in the cable, both matched and due to the SWR. You can also enter in the transmitter power, and the lost and output power are calculated and displayed.

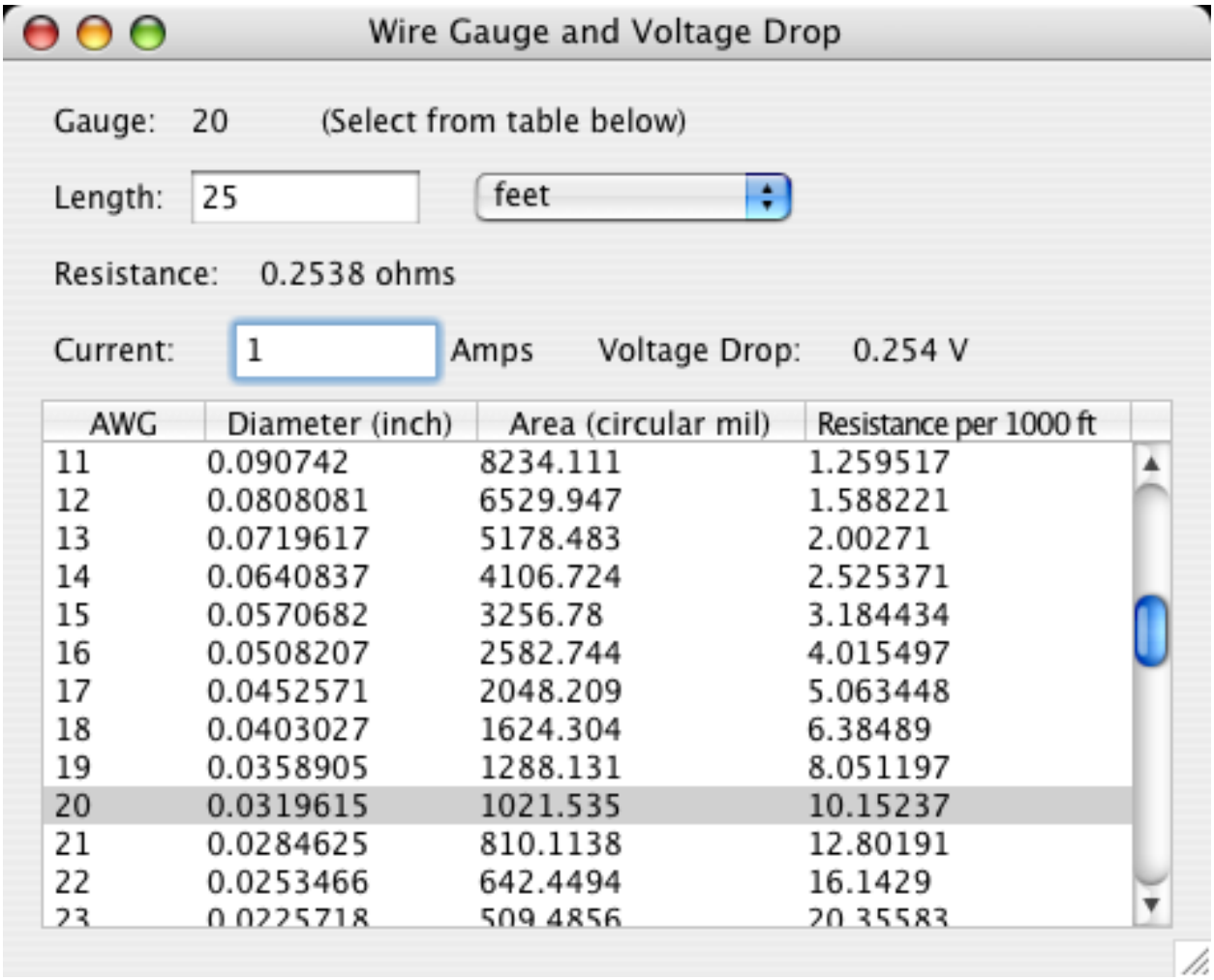


db Calculator

This calculator is used to convert between dB (decibels) and both power and voltage ratios. Type a number into any of the fields, and the values for the other two fields will be automatically computed.

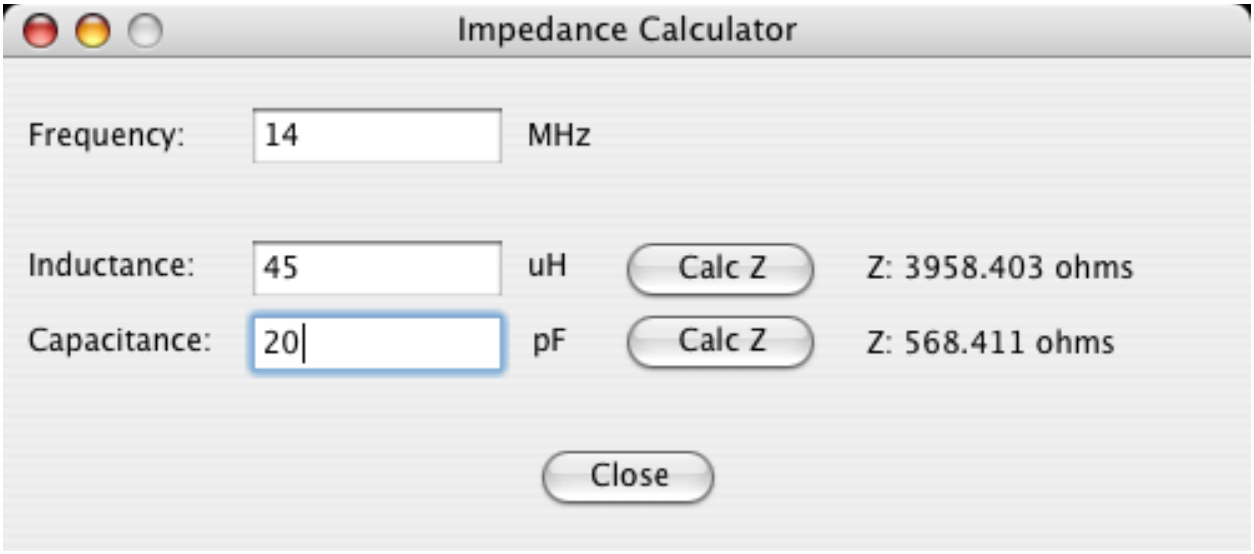


Wire Gauge and Voltage Drop Calculator



Select a wire gauge from the list at the bottom of the window (which also contains useful information about each gauge). Enter in the length of the wire, and the resistance will be displayed. Enter in the current, and the voltage drop will be displayed.

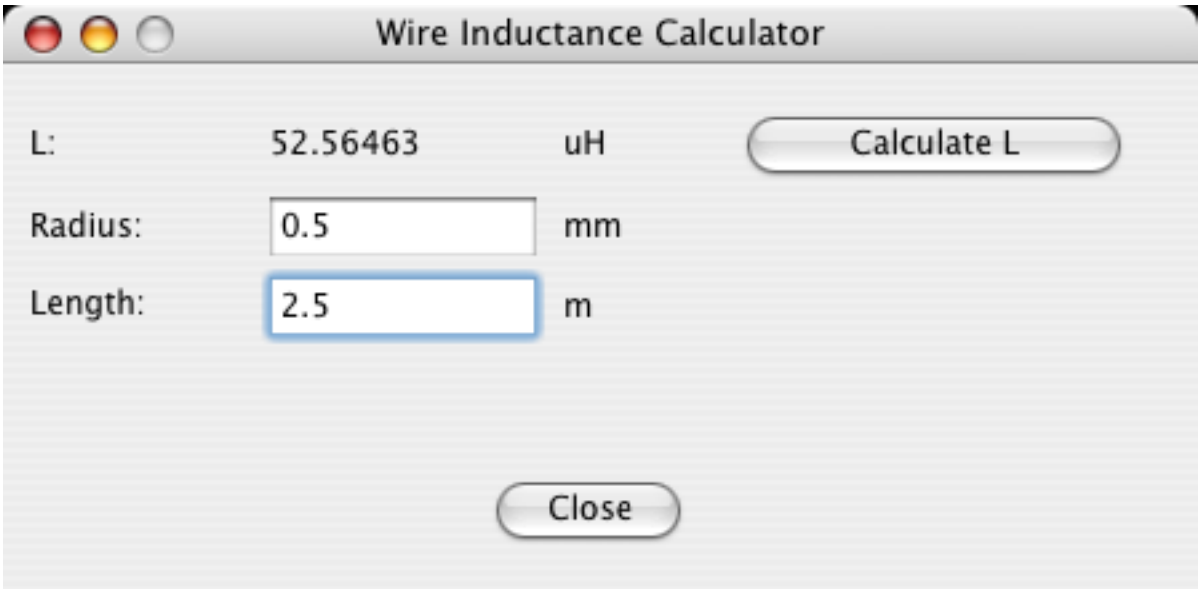
Impedance Calculator



Enter in a frequency in MHz, and either an inductance in uH or a capacitance in pF (or both), click on the Calc Z button, and the impedance in ohms will be calculated.

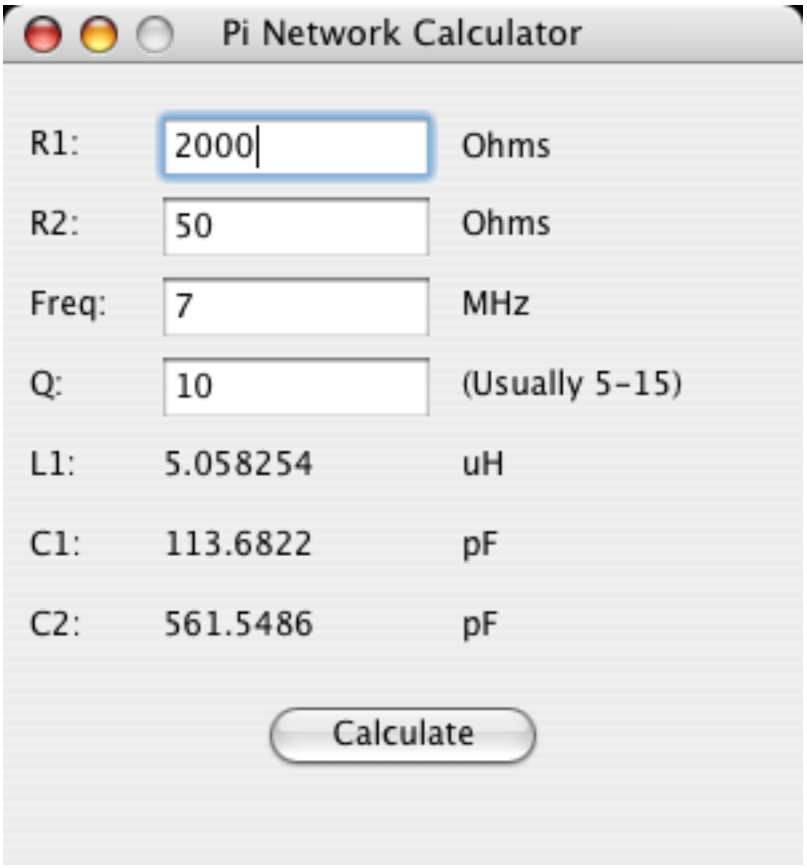
Wire Inductance Calculator

Enter in a the radius (in milimeters) and length (in meters) of a piece of straight wire, click the Calculate L button, and the inductance (in uH) will be computed and displayed.



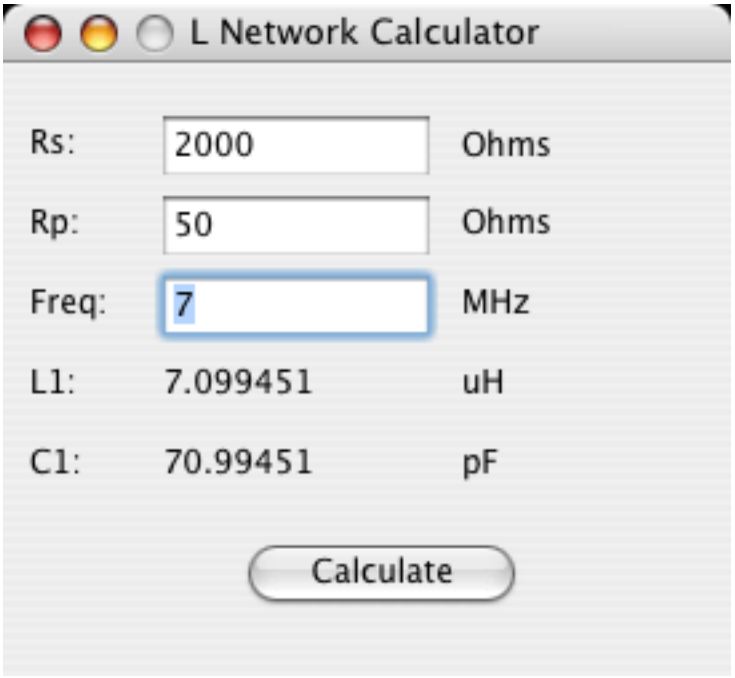
Pi Network Calculator

The inductor and two capacitor values for a Pi Network can be quickly and easily calculated. Enter in the input and output impedance, as well as the operating frequency and desired Q, and click the calculate button.



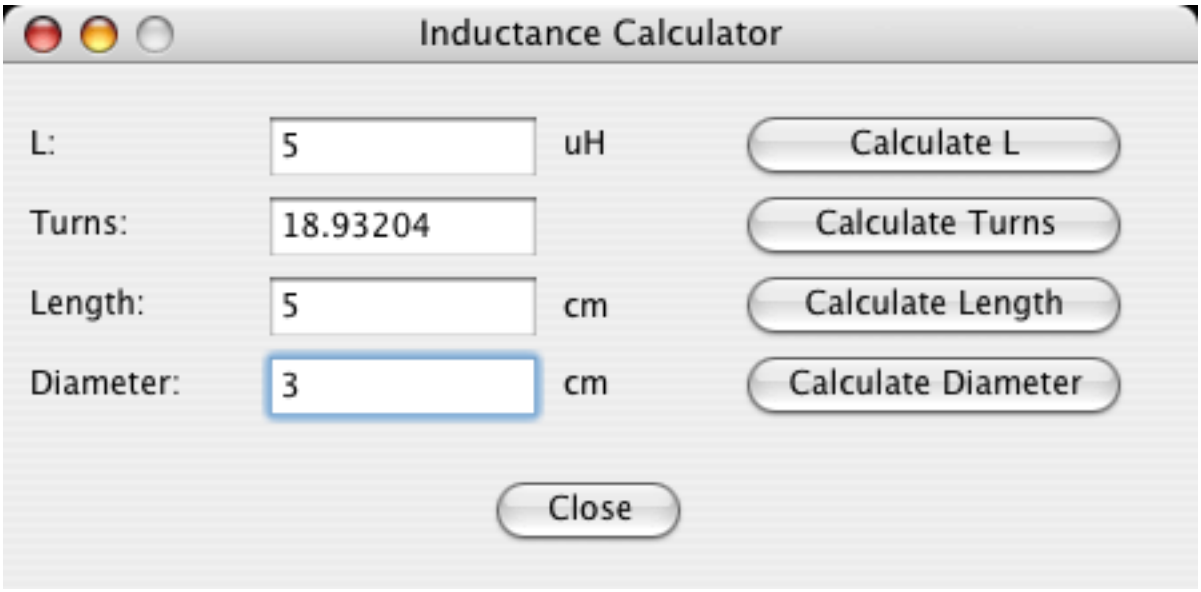
L Network Calculator

The inductor and capacitor values for an L Network can be quickly and easily calculated. Enter in the input and output impedance, as well as the operating frequency and desired Q, and click the calculate button.



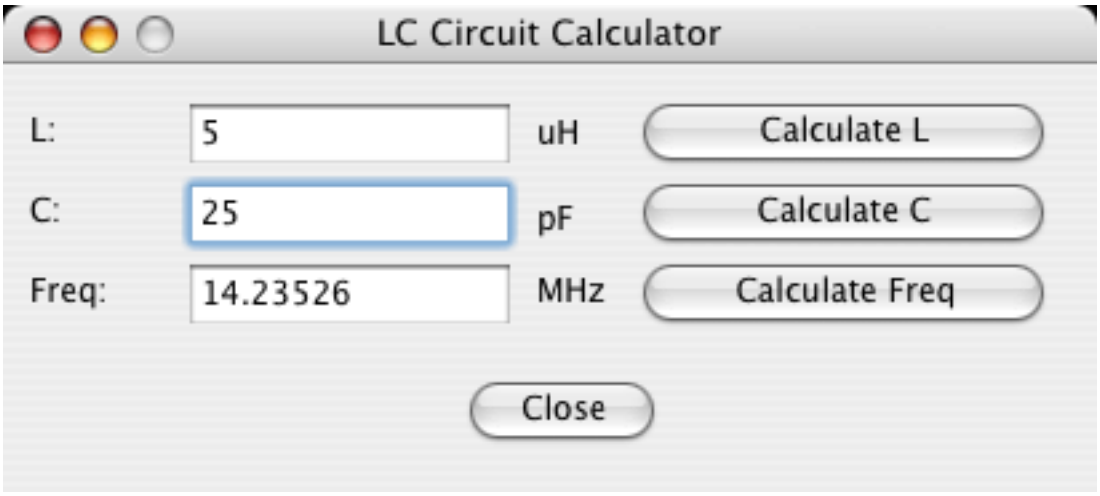
Coil Inductance Calculator

Enter in values for three of the four fields (inductance, turns, length, diameter), and click on the Calculate button for the fourth value, and it will be computed and displayed.



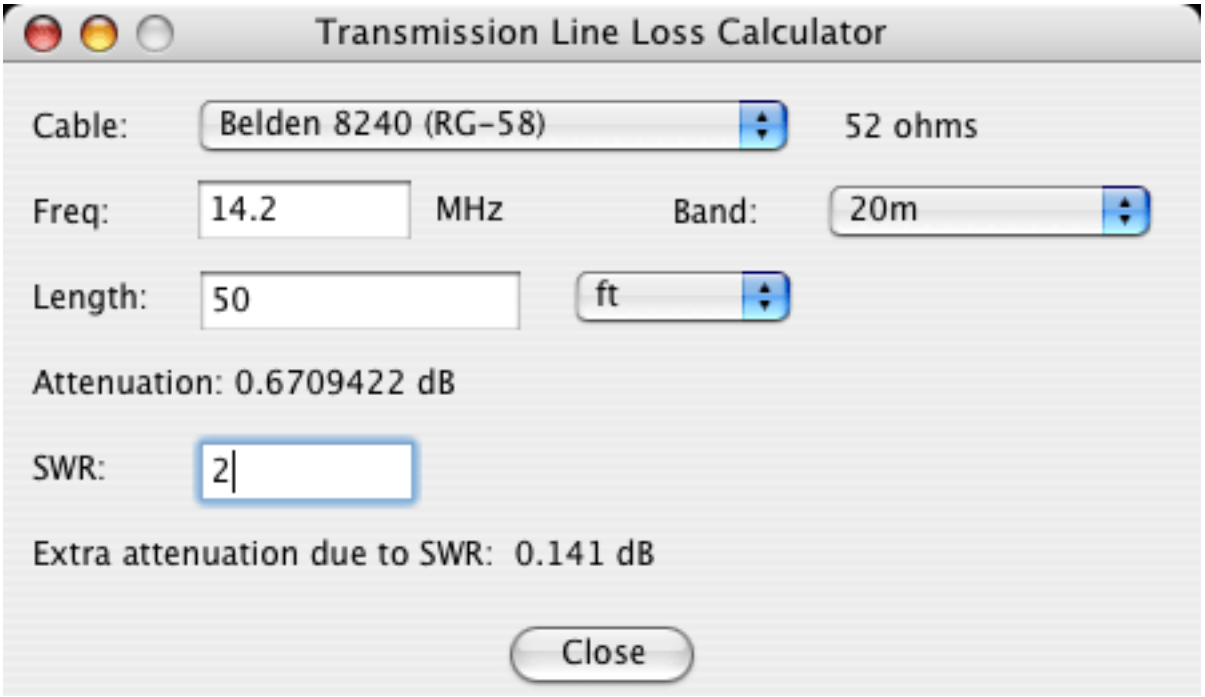
LC Circuit Calculator

This calculates resonant values for the LC circuit. Enter in two of the three values (inductance, capacitance, reasonant frequency), click the appropriate calculate button, and the third value is computed and displayed.



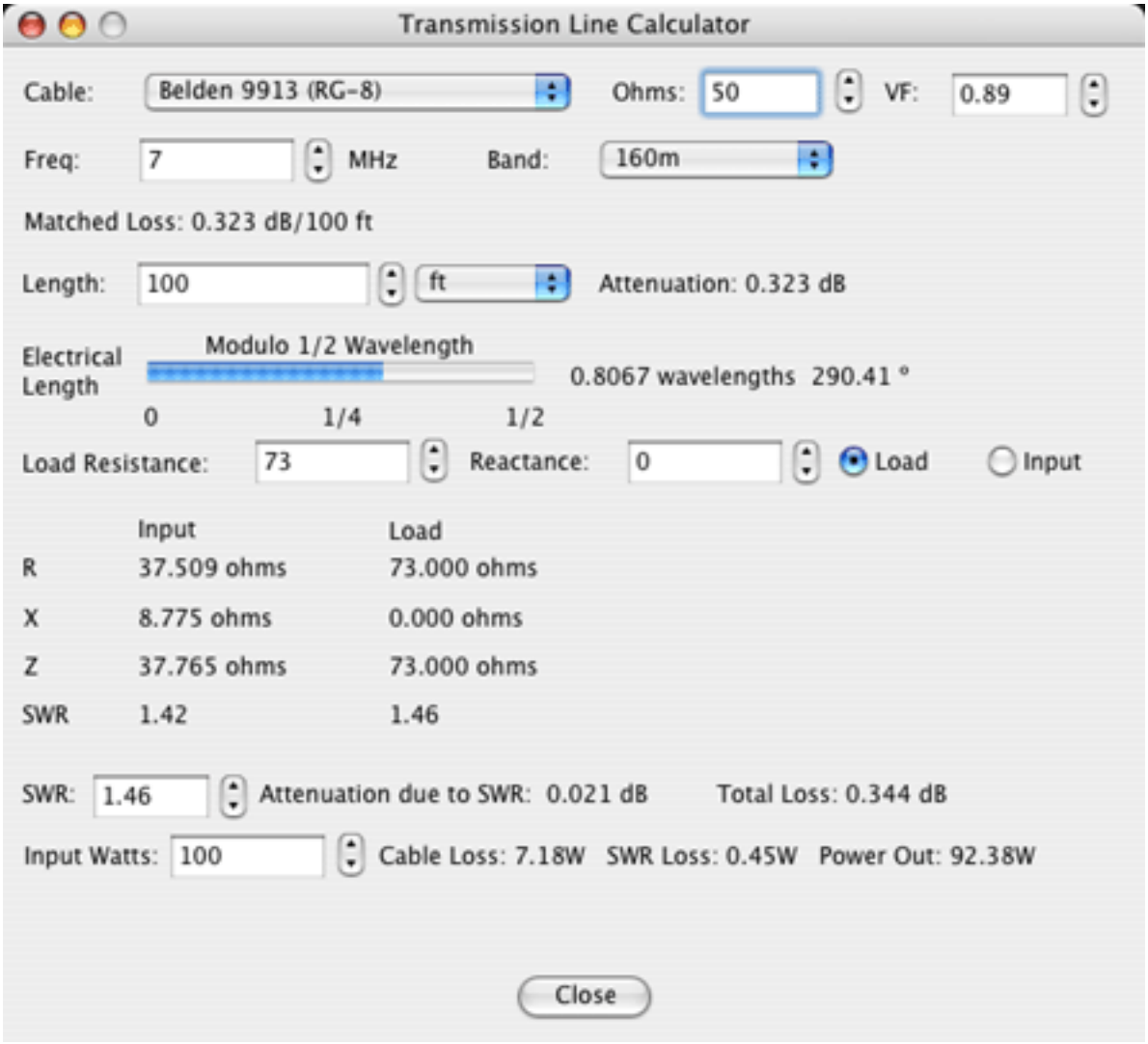
Transmission Line Loss Calculator

Select the cable type from the popup menu, enter in the length and frequency (or select a band from the popup menu), and the cable attenuation in dB is computed. Enter in the Standing Wave Ratio (SWR) and the extra attenuation due to the SWR is also computed and displayed.

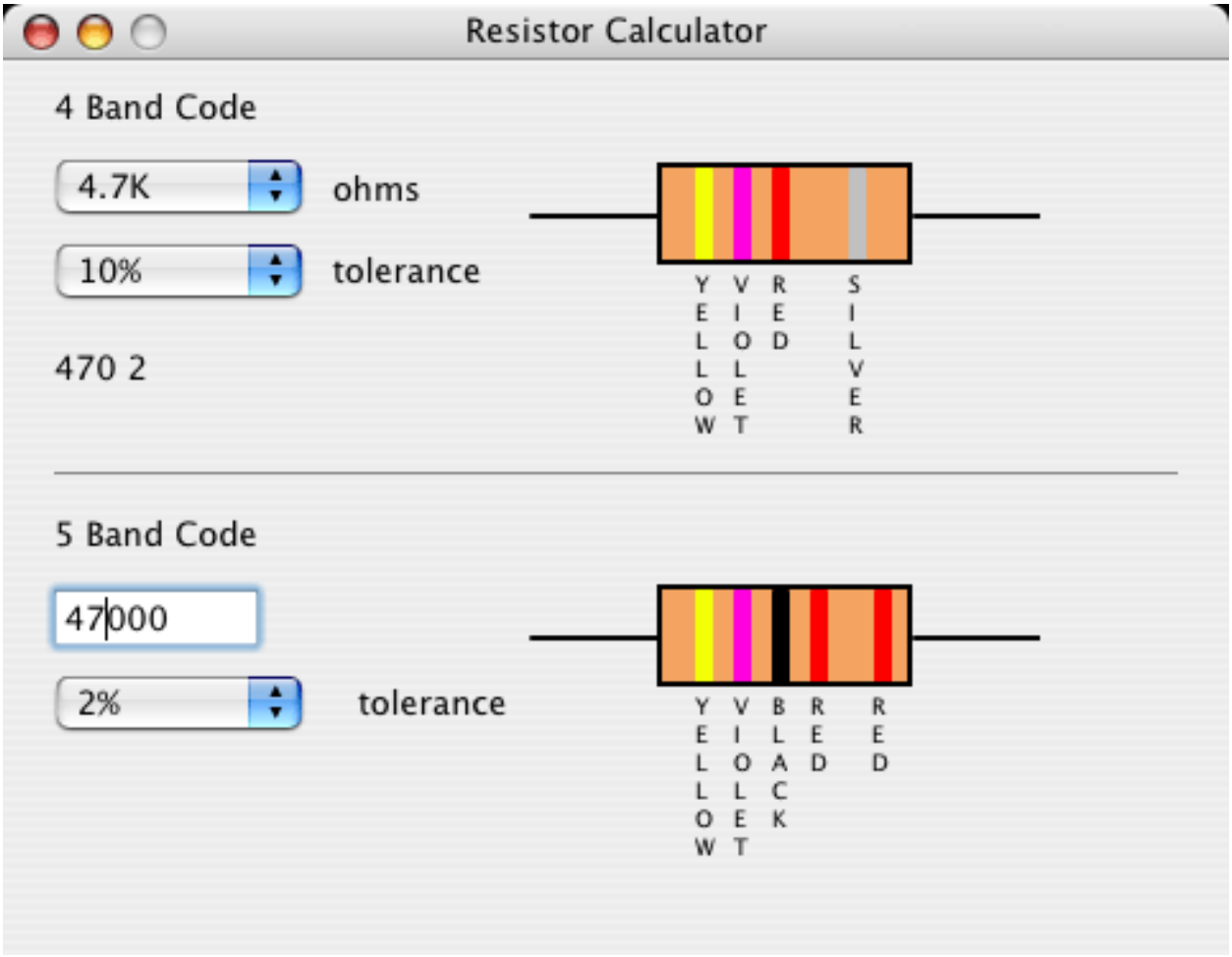


Transmission Line Calculator

This calculator allows you to compute several parameters for a transmission line installation. Select the cable type from the popup menu. The impedance and velocity factor are automatically set, you can change them if you wish. Then select the frequency, either directly in MHz, or by selecting the appropriate ham band. Enter the length of the cable run, and select the units of feet or meters. The attenuation and electrical length are computed. Enter the load resistance and reactance and check the Load radio button, or enter the values as seen at the input end of the cable and select the Input radio button. The Input and Load resistance, reactance, impedance, and SWR are calculated, as well as the extra loss due to SWR. Enter the input power in watts, and the loss in watts is also calculated.


Transmission Line Calculator
Cable:
Belden 9913 (RG-8)
Ohms:
50
VF:
0.89
Freq:
7
MHz
Band:
160m
Matched Loss: 0.323 dB/100 ft
Length:
100
ft
Attenuation: 0.323 dB
Electrical Length
Modulo 1/2 Wavelength
0.8067 wavelengths 290.41 °
0
1/4
1/2
Load Resistance:
73
Reactance:
0
Load
Input
Input
Load
R
37.509 ohms
73.000 ohms
X
8.775 ohms
0.000 ohms
Z
37.765 ohms
73.000 ohms
SWR
1.42
1.46
SWR:
1.46
Attenuation due to SWR: 0.021 dB
Total Loss: 0.344 dB
Input Watts:
100
Cable Loss: 7.18W
SWR Loss: 0.45W
Power Out: 92.38W
Close

Resistor Color Code Calculator



The resistor color code calculator allows you to determine the color code for both 4 and 5 band resistors. For 4 band resistors, select the resistance and tolerance from the popup menus. For 5 band resistors, type in the resistance in ohms, and select the tolerance from the popup menu.

The resistor color codes are displayed, along with the name of each color under the band, since some colors may be difficult to distinguish.

Resistor Calculator

The resistor calculator allows you to perform four calculations:

1. Display the values for a resistor series.

2. Find the nearest resistor to a specified value.

3. Find the nearest series combination of resistors to a specified value.

4. Find the nearest parallel combination of resistors to a specified value.

For each of these, you can select which resistor series to use: E6, E12, E24, E48, E96, and S192

Select the series to use by clicking on the series, multiple series can be

selected.

Butterworth and Chebyshev Low and High Pass Filter Design

This window allows you to design a filter. You have two sets of choices, either low or high pass, and either Butterworth of Chebyshev.

A low pass filter attenuates frequencies above the cutoff frequency, while a high pass filter attenuates frequencies below the cutoff frequency.

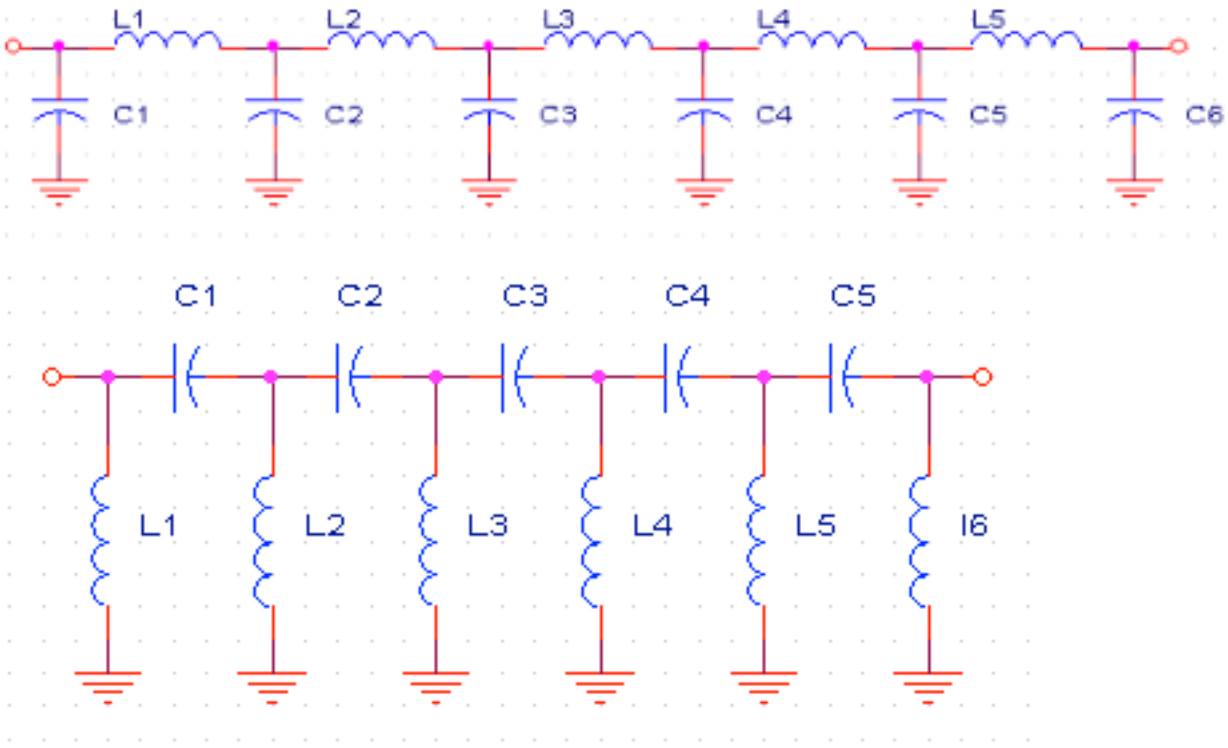
A Butterworth filter has a flat response in the passband and a constant 20 dB per decade attenuation for each pole of the circuit (equal to the order). The attenuation is -3 dB at the cutoff frequency.

A Chebyshev filter has a sharper rate of attenuation than a Butterworth filter, at the expense of ripple in the passband. You specify the amount of ripple allowed in the Ripple box, in dB. Chebyshev filters must have an odd order.

Low Pass Filter:

High Pass Filter:

Enter in the cutoff frequency, impedance, and number of components (order) of the filter, select the unit types and filter type, and click on the



Calculate button. The component values will be displayed. You can change the units for inductance and capacitance, and the values will adjust, accordingly.

RF Link Budget Calculator

This window allows you to perform calculations related to an RF link. You can calculate the required transmitter power, gain margin, or maximum distance, based on two of these parameters as well the frequency, transmit and receive antenna gains, cable losses, and receiver sensitivity.

To use the calculator, select the units (miles or km) as well as which parameter you wish to calculate. Then enter in the other parameters, the calculation will update as you each each parameter.

Skin Depth Calculator

Enter in the frequency in MHz, the Resistivity in micro-ohm per cm, and the Relative Permeability. Click Calculate, and the skin depth in both micrometers and microinches will be calculated.

At the bottom of the window is a table of Resistivity and Relative

Permeability values for common metals.

Gamma Match Calculator

This allows you to calculate the performance of a gamma match, which is typically used to transform the impedance of a yagi or other antenna to match the impedance of the transmission line connected to it.

The gamma match consists of a short rod which is parallel to the driven element. The length of the rod, as well as the spacing and relative diameters of the rod and driven element determine the impedance transformation. By entering in these dimensions, as well as the input impedance of the antenna, the input inpedance of the gamma match can be determined.

The goal is to produce a gamma match input impedance with a real component equal to the characteristic impedance of the transmission line (typically 52 or 75 ohms). There will also be a reactive component, this is cancelled by putting a capacitor in series with the connection to the center conductor of the coax, RF ToolBox converts the impedance to a capacitance for the design frequency.

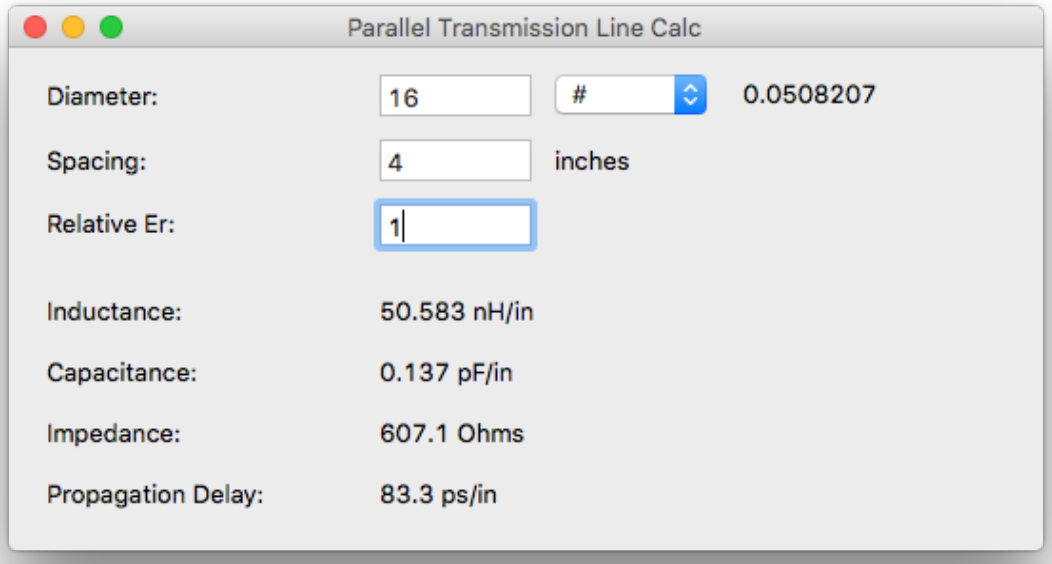
Parallel Transmission Line / Ladder Line Calculator

This tool calculates the impedance of a parallel wire / ladder line style transmission line, as well as the line's inductance, capacitance, and propagation delay per inch or meter.

From the popup menu, select the units for the wire diameter, either inches, mm, or wire gauge. If wire gauge is selected, then the units for the spacing will be inches, otherwise it will be whichever units were selected for the gauge.

Enter in the wire spacing, along with the Relative dielectric constant (Er) which is 1 for free space.

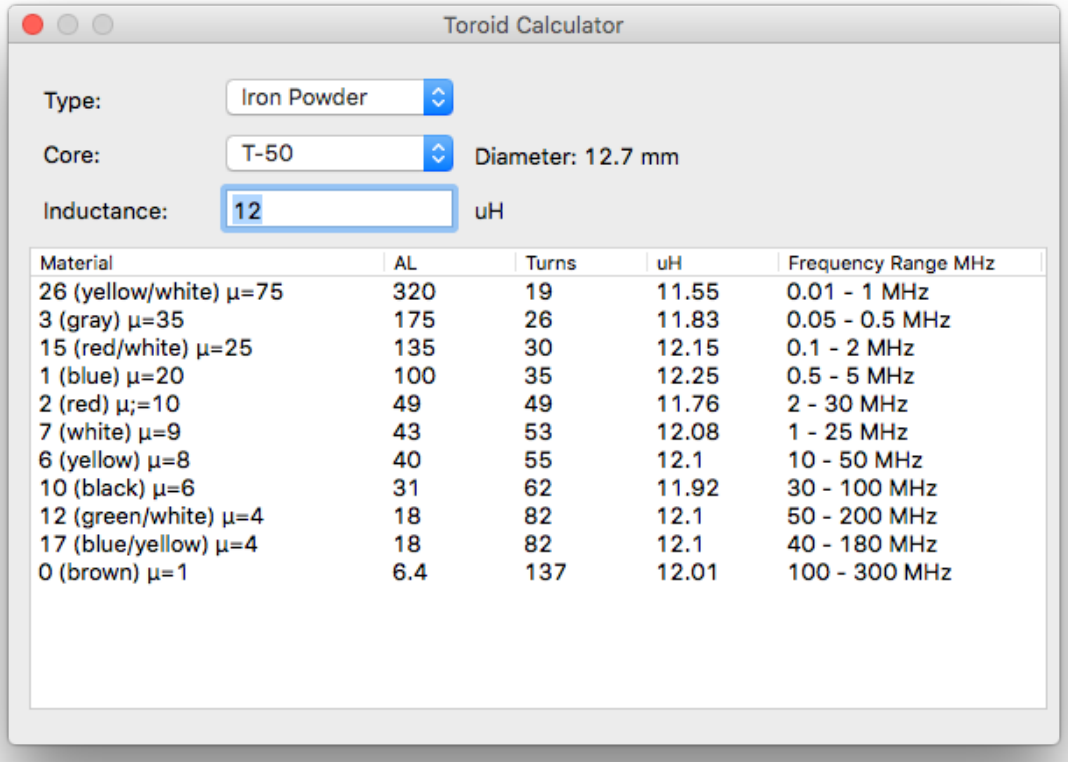
The various values will be computed as you make changes to any of the inputs.



Toroid Core Calculator

This tool calculates the number of turns required for a particular inductance on many commonly available iron powder and ferrite toroid cores.

Select the type of material, and then the core size, and enter in the desired inductance. The calculator will compute the number of turns required for more materials available in that size. The nearest integer number of turns will be displayed, along with the actual inductance for that number.



Material	AL	Turns	uH	Frequency Range MHz
26 (yellow/white) μ=75	320	19	11.55	0.01 - 1 MHz
3 (gray) μ=35	175	26	11.83	0.05 - 0.5 MHz
15 (red/white) μ=25	135	30	12.15	0.1 - 2 MHz
1 (blue) μ=20	100	35	12.25	0.5 - 5 MHz
2 (red) μ;=10	49	49	11.76	2 - 30 MHz
7 (white) μ=9	43	53	12.08	1 - 25 MHz
6 (yellow) μ=8	40	55	12.1	10 - 50 MHz
10 (black) μ=6	31	62	11.92	30 - 100 MHz
12 (green/white) μ=4	18	82	12.1	50 - 200 MHz
17 (blue/yellow) μ=4	18	82	12.1	40 - 180 MHz
0 (brown) μ=1	6.4	137	12.01	100 - 300 MHz

Terms:

If you find RF Toolbox useful, please buy your copy, the price is only $19.99. This will help encourage the development of future versions of this program.

Please also write me with your comments and suggestions, and any bugs you may find.

Paying for RF Toolbox is fairly simple.

To buy RF Toolbox on the web with a credit card, go to the following URL and select a payment option: http://www.blackcatsystems.com/register/rftoolbox.html

You'll need to enter your name, email address, and mailing address, and select the program(s) you want to buy (in this case RF Toolbox). Then click the continue button to enter your credit card information (you can use a secure version of the form).

If you want to pay by check, money order or cash, you can fill out the Cash/Check/Money Order Form, and mail it directly to us, along with your payment:

Black Cat Systems 4708 Trail Court Westminster, MD 21158

You can always find the latest version of RF Toolbox at this URL: http://www.blackcatsystems.com/software/rftoolbox.html

If you have any questions, comments, suggestions, or bug reports, please email them to:

info@blackcatsystems.com
Web: http://www.blackcatsystems.com/software/rftoolbox.html

Thanks again for giving RF Toolbox a try!

Ordering by Check or Money Order Form

To order by check, please fill out and mail the following form, along with your payment. You can pay with a wide variety of cash from different countries but at present if you pay via check, it must be a check or money order drawn in US Dollars. While there is the risk of loss in the mail, currency is also OK, including foreign currency.

Please make sure you include your email address with your payment. That way we can send the registration code to you. If you do not send us a valid email address, we have no way to send you the code.

I would like to order _____ copies of RF Toolbox at $19.99 US each.

Name:

_____

Address:

_____

City: _____

State/Province:_____ ZIP/Postal Code: _____

Country: _____

Email Address:

_____

Enclosed, please find my check / money order / cash in the amount of $_____ Maryland residents please add 6% sales tax.

Mail this form, along with payment, to:

Black Cat Systems
4708 Trail Court
Westminster, MD 21158 USA

Ordering By Credit Card Online

To order online with a credit card, go to the following URL:

http://www.blackcatsystems.com/register/rftoolox.html

You will be sent to our order page at PayPal. They handle our credit card payment processing.

Please make sure you include your email address when you order online. That way we can send the registration code to you. If you do not send us a valid email address, we have no way to send you the code.

Revision History

5.2.0:
Updated to 64 bit application for macOS.
Added Toroid Core Calculator

5.0.0:
Added Parallel Wire / Ladder Line Calculator.
Several bug fixes and user interface improvements.

4.0.0:
Added a tool selection window.
Several bug fixes and user interface improvements.

3.9.0:
Added Skin Depth Calculator.
Corrected a bug with the input impedance in the Transmission Line Calc.

3.7.0:
Added Long Yagi Antenna Design.
Added Gamma Match Calculator

3.6.0:
Added RF Link Budget Calculator.

3.5.0:
Added Tee Attenuaton Calculator.
Added Zener Diode Calculator.
Added 555 Timer Oscillator Calculator.
Added Thermal Noise Calculator.
Added Pl Attenuation Calculator.

3.4.0:
Added Butterworth and Chebyshev Low and High Pass Filter Design.
Fixed a bug with the wire inductance calculator.

3.3.0:
Added resistor color code calculator.

3.2.0:
Added helical antenna calculations.

3.1.0:
Added Transmission Line calculator. Added dB calculator.

3.0.0:
Changed name to RF Toolbox
Added impedance calculator. Added wire inductance calculator. Added wire resistance calculator.

2.0.1:
Fixed a calculation error in the inductor design tool. Fixed a calculation error in Yagi antenna design

2.0.0:
Complete re-write, also first OSX and Windows versions.

1.4.0:
Added L and Pi network calculations

1.3.0:
Added transmission line loss calculator

1.2.1:
Fixed bug in Cubic Quad design

1.2.0:
Added Cubic Quad antenna Fixed bug in Log Periodic display

1.1.0:
Bug fix. Bug caused heap errors on some systems resulting in System Error 33.

1.0.0:
Initial release.

Software License Agreement

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