

RF Toolbox

Version 3.2.0

January 27, 2005

Hi, and thanks for giving RF Toolbox a try!

First things first... What is it?

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.

Why? Well, it's a lot faster for one (I'd say by a factor of several hundred times). That's the big benefit.

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

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

You can't design an antenna of an arbitrary design. Of course, I hope to be adding many more types of antennas, in the future.

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.

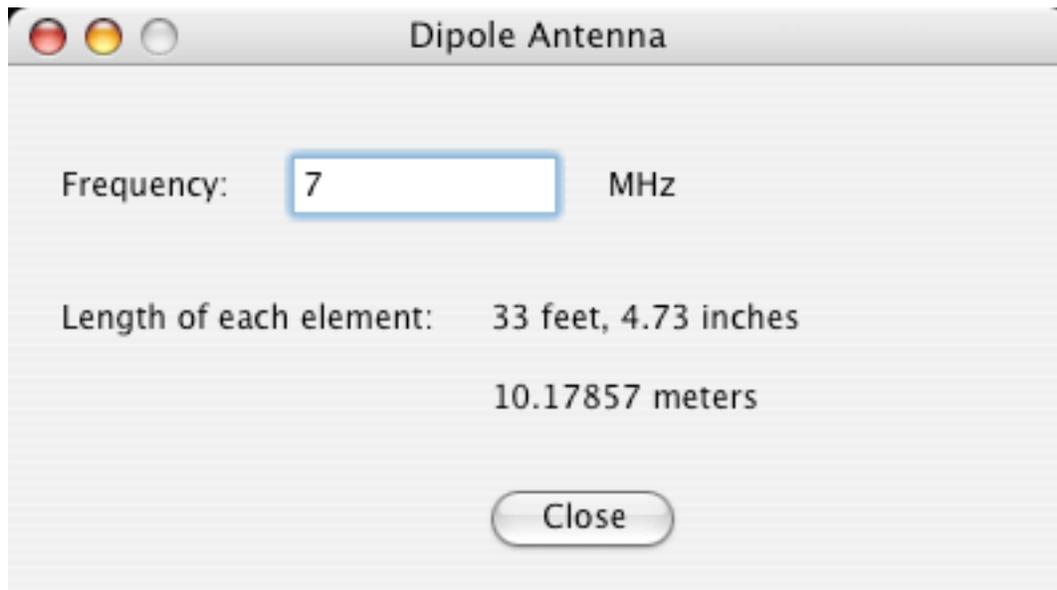
Use:

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



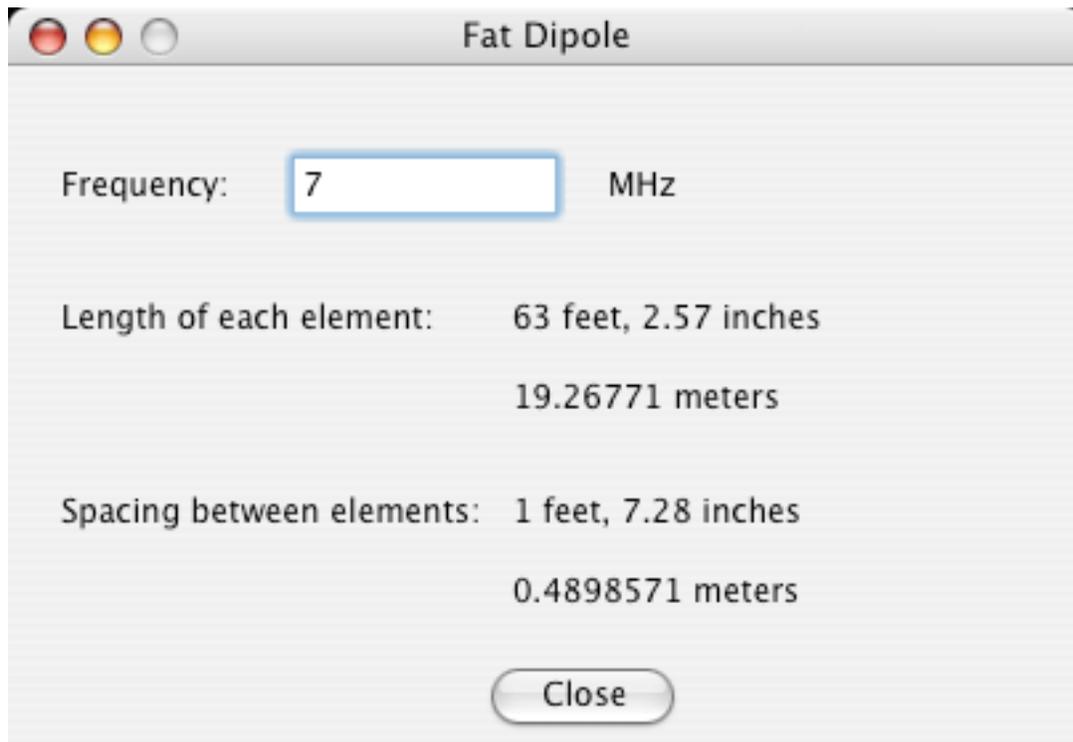
Frequency: MHz

Length of each element: 33 feet, 4.73 inches
10.17857 meters

Close

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

Fat Dipole Antenna Calculator



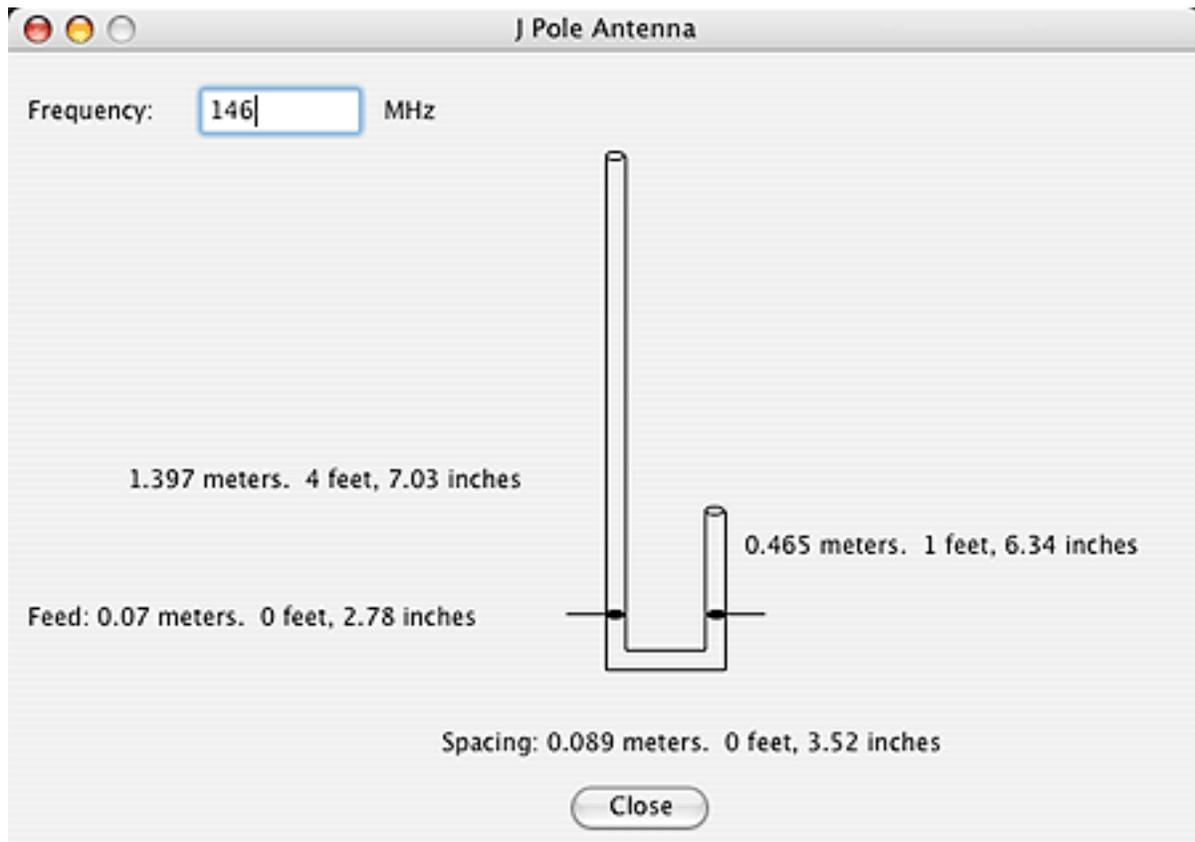
The image shows a window titled "Fat Dipole" with a standard macOS-style title bar (red, yellow, and green buttons). The window contains a text input field for "Frequency:" with the value "7" and the unit "MHz". Below this, the results are displayed: "Length of each element:" is "63 feet, 2.57 inches" and "19.26771 meters"; "Spacing between elements:" is "1 feet, 7.28 inches" and "0.4898571 meters". At the bottom center is a "Close" button.

Frequency:	<input type="text" value="7"/>	MHz
Length of each element:	63 feet, 2.57 inches 19.26771 meters	
Spacing between elements:	1 feet, 7.28 inches 0.4898571 meters	

Close

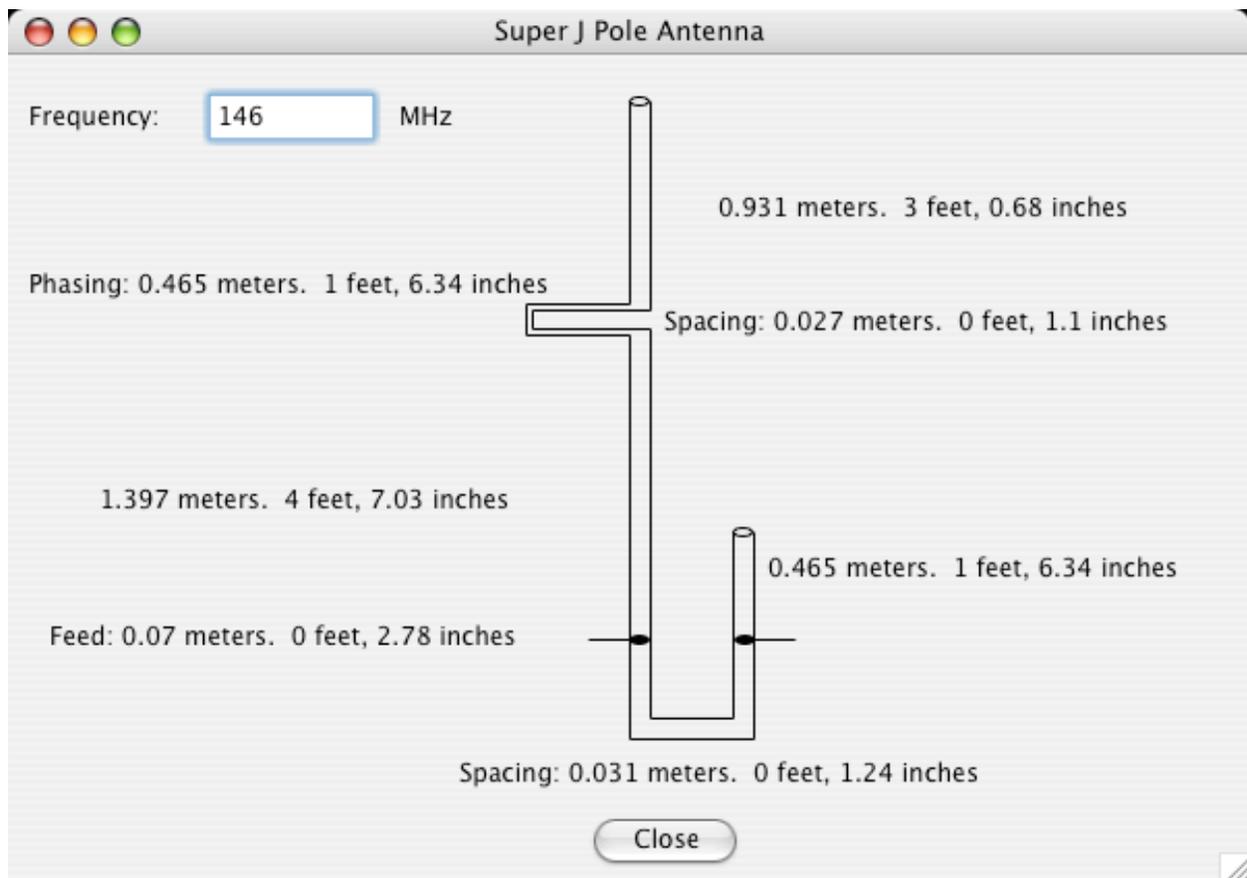
Enter in the desired resonant frequency in MHz, and the length of each element (side) is computed and displayed, as well as the necessary spacing between each element.

J Pole Antenna Calculator



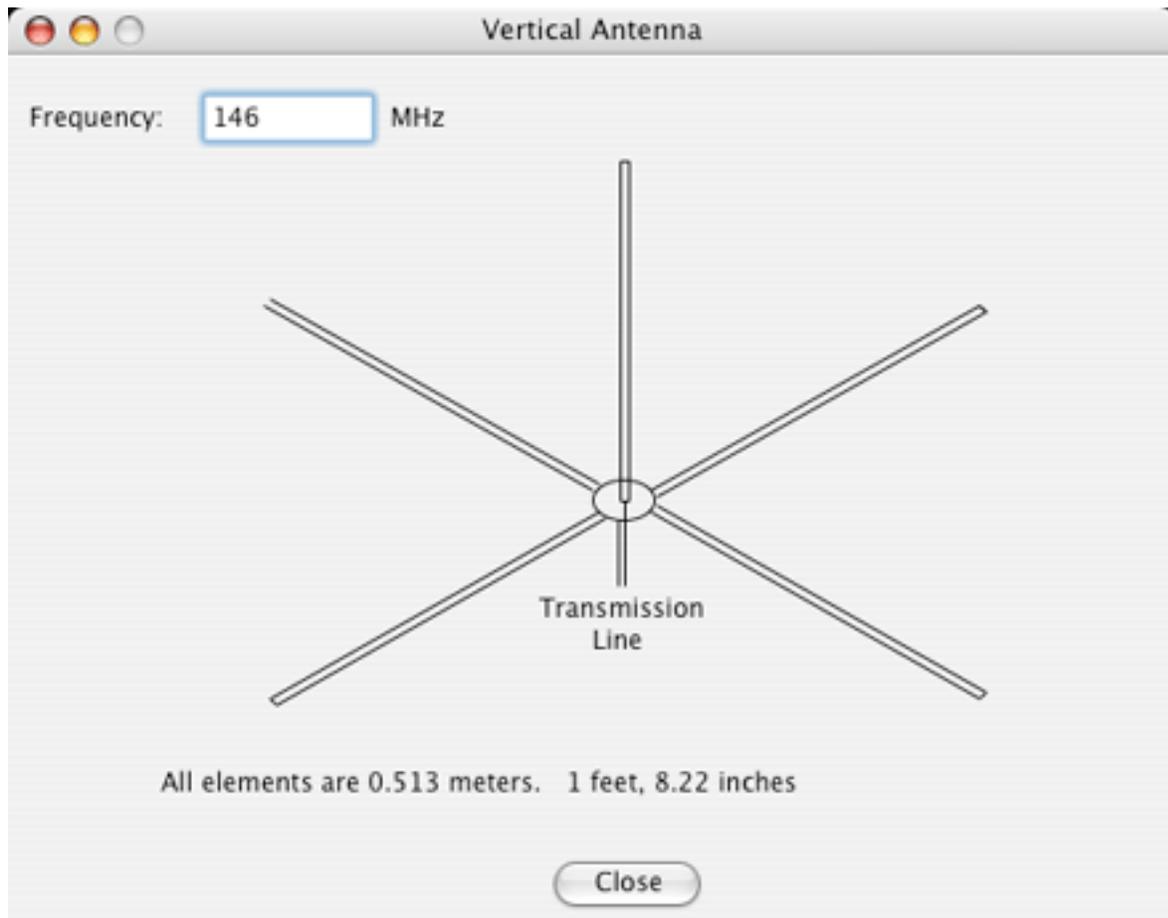
Enter in the desired operating frequency in MHz. The dimensions for the antenna elements are calculated and displayed.

Super J Pole Antenna Calculator



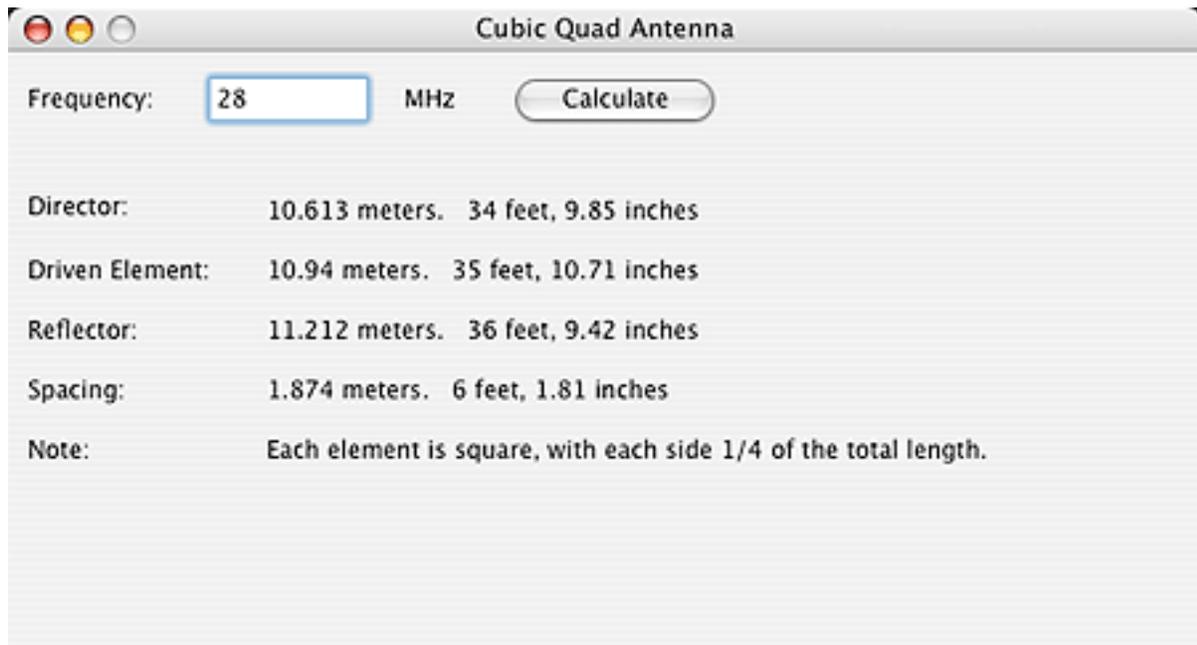
Enter in the desired operating frequency in MHz. The dimensions for the antenna elements are calculated and displayed.

Vertical (Ground Plane) Antenna Calculator



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

Cubic Quad Antenna Calculator



The image shows a software window titled "Cubic Quad Antenna". It features a text input field for "Frequency:" containing the number "28", followed by the unit "MHz" and a "Calculate" button. Below the input, the calculated dimensions are listed for four antenna elements: Director, Driven Element, Reflector, and Spacing. Each element's length is given in both meters and feet/inches. A "Note:" at the bottom states that each element is square, with each side being 1/4 of the total length.

Element	Meters	Feet	Inches
Director:	10.613	34	9.85
Driven Element:	10.94	35	10.71
Reflector:	11.212	36	9.42
Spacing:	1.874	6	1.81

Note: Each element is square, with each side 1/4 of the total length.

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

Yagi Antenna Calculator

Element Type	Length (meters)	Length (feet, inches)	Spacing (meters)	Spacing (feet, inches)
Director	0.92	3 feet, 0.23 inches	0.306	1 feet, 0.08 inches
Director	0.92	3 feet, 0.23 inches	0.306	1 feet, 0.08 inches
Director	0.92	3 feet, 0.23 inches	0.306	1 feet, 0.08 inches
Director	0.92	3 feet, 0.23 inches	0.306	1 feet, 0.08 inches
Driven Element	0.986	3 feet, 2.84 inches	0.306	1 feet, 0.08 inches
Reflector	1.017	3 feet, 4.06 inches	-	-

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

Log Periodic Antenna Calculator

Length	Diameter	Spacing
16 feet, 4.85 inches	0.34 inches	4 feet, 11.05 inches
14 feet, 5.22 inches	0.3 inches	4 feet, 3.96 inches
12 feet, 8.44 inches	0.26 inches	3 feet, 9.73 inches
11 feet, 2.14 inches	0.23 inches	3 feet, 4.24 inches
9 feet, 10.05 inches	0.2 inches	2 feet, 11.41 inches
8 feet, 7.88 inches	0.18 inches	2 feet, 7.16 inches
7 feet, 7.41 inches	0.16 inches	2 feet, 3.42 inches
6 feet, 8.44 inches	0.14 inches	2 feet, 0.13 inches
5 feet, 10.79 inches	0.12 inches	

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

The image shows a software window titled "Helical" with a standard macOS-style title bar. The window contains a form with input fields on the left and output fields on the right. A "Calculate" button is located below the input fields.

Input	Value	Output	Value
Frequency (MHz):	2400	Wavelength:	12.500 cm
Turns:	10	Spacing:	3.125 cm
Diameter Ratio:	1	Diameter:	3.979 cm
Pitch:	0.25	Gain:	15.8 dBi
		Impedance:	140 ohms
		Length:	28.1 cm

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.

Transmission Line Calculator

Transmission Line Calculator

Cable: Belden 9258 (RG-8X) Ohms: 50 VF: 0.78

Freq: 7 MHz Band: 40m

Matched Loss: 0.752 dB/100 ft

Length: 50 ft Attenuation: 0.376 dB

Electrical Length **Modulo 1/2 Wavelength** 0.4602 wavelengths 165.68 °

0 1/4 1/2

Load Resistance: 73 Impedance: 0

	Input	Load
R	68.274 ohms	73.000 ohms
X	12.681 ohms	0.000 ohms
Z	69.442 ohms	73.000 ohms

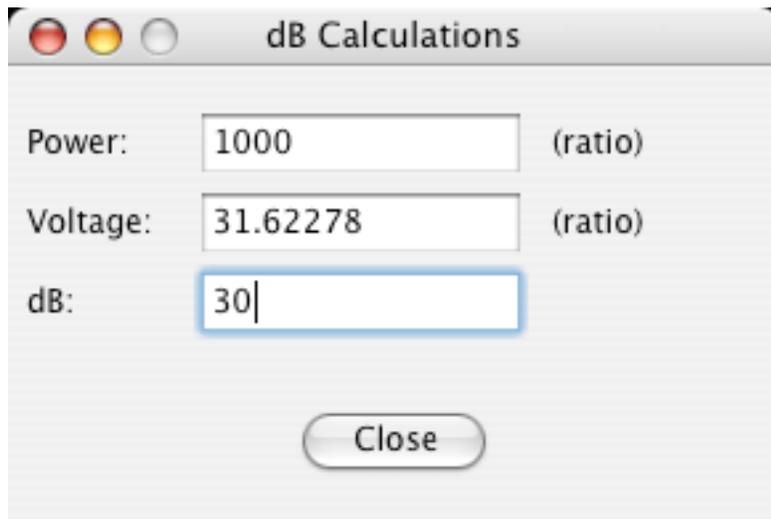
SWR: 1.46 Attenuation due to SWR: 0.024 dB Total Loss: 0.4 dB

Input Watts: 100 Cable Loss: 8.29W SWR Loss: 0.51W Power Out: 91.2W

Close

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



The image shows a window titled "dB Calculations" with three input fields and a "Close" button. The "Power:" field contains the value "1000" and is labeled "(ratio)". The "Voltage:" field contains the value "31.62278" and is labeled "(ratio)". The "dB:" field contains the value "30" and is currently selected with a blue border. The "Close" button is located at the bottom center of the window.

Field	Value	Unit/Label
Power:	1000	(ratio)
Voltage:	31.62278	(ratio)
dB:	30	

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

Gauge: 20 (Select from table below)

Length:

Resistance: 0.2538 ohms

Current: Amps Voltage Drop: 0.254 V

AWG	Diameter (inch)	Area (circular mil)	Resistance per 1000 ft
11	0.090742	8234.111	1.259517
12	0.0808081	6529.947	1.588221
13	0.0719617	5178.483	2.00271
14	0.0640837	4106.724	2.525371
15	0.0570682	3256.78	3.184434
16	0.0508207	2582.744	4.015497
17	0.0452571	2048.209	5.063448
18	0.0403027	1624.304	6.38489
19	0.0358905	1288.131	8.051197
20	0.0319615	1021.535	10.15237
21	0.0284625	810.1138	12.80191
22	0.0253466	642.4494	16.1429
23	0.0225718	509.4856	20.35583

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

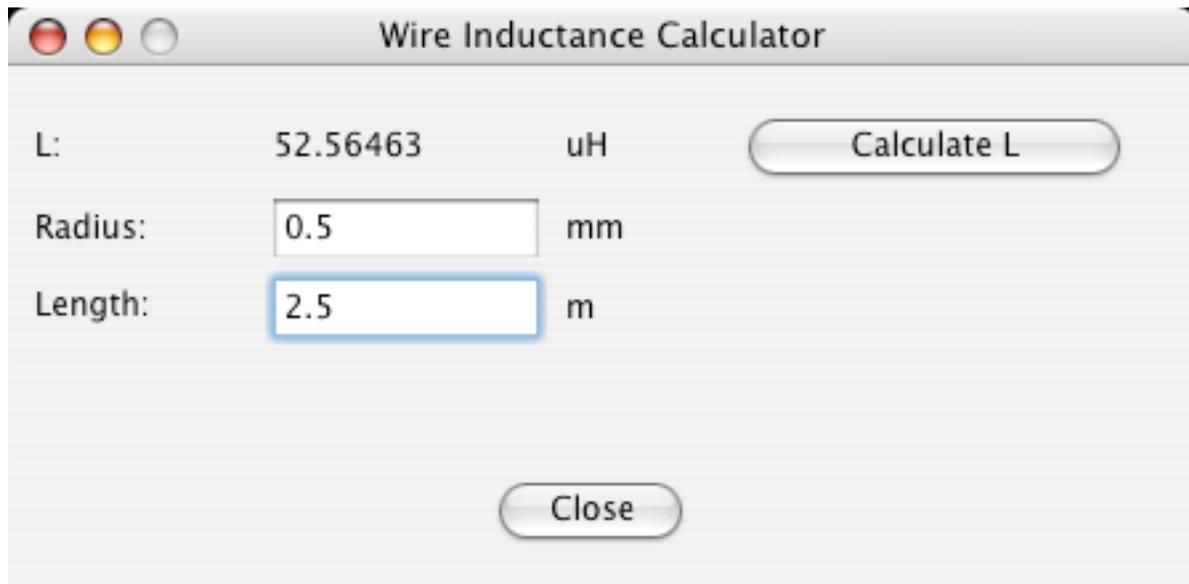
Frequency: MHz

Inductance: uH Z: 3958.403 ohms

Capacitance: pF Z: 568.411 ohms

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



Wire Inductance Calculator

L: 52.56463 uH Calculate L

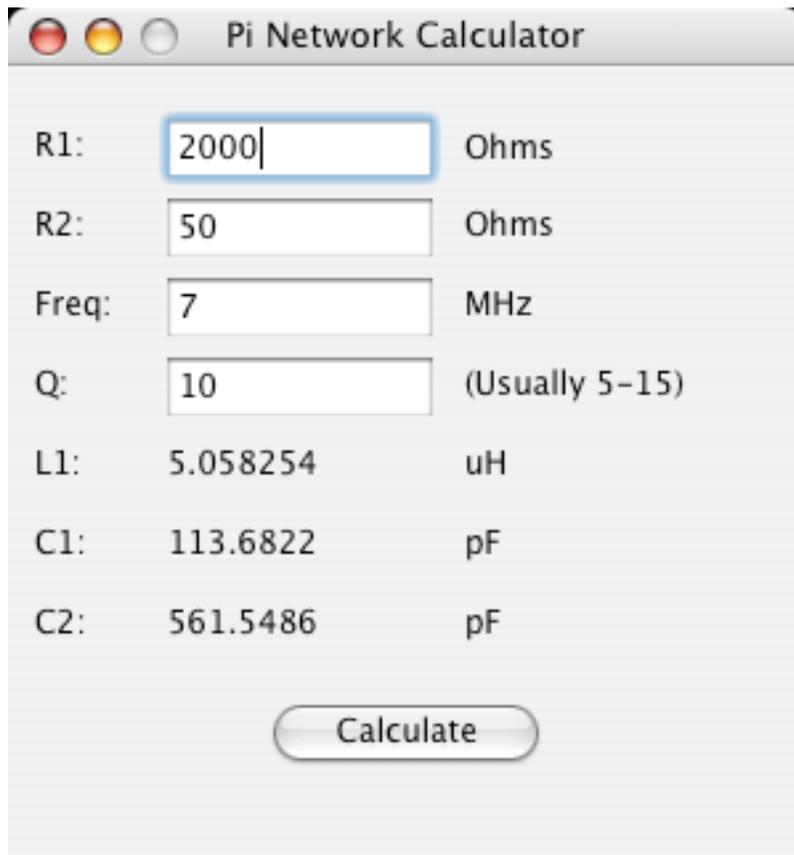
Radius: 0.5 mm

Length: 2.5 m

Close

Enter in a the radius (in millimeters) 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

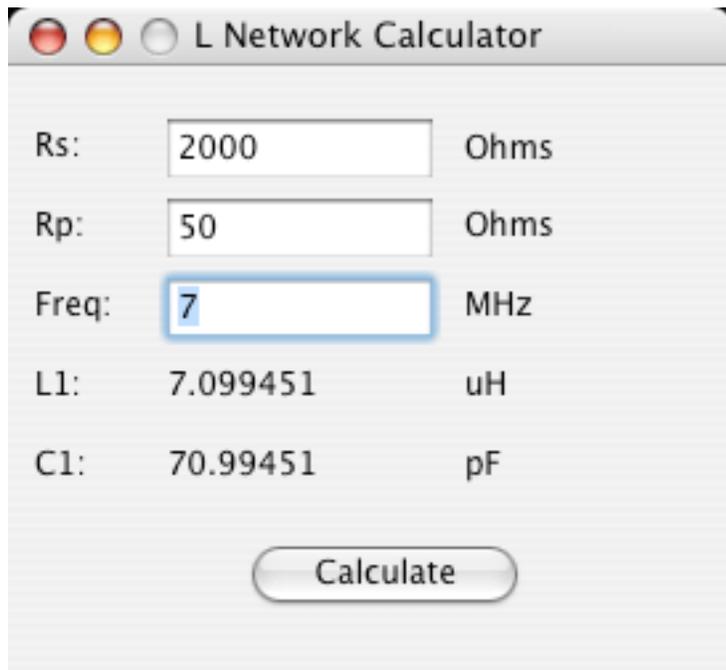


The image shows a screenshot of a software application window titled "Pi Network Calculator". The window has a standard macOS-style title bar with three colored buttons (red, yellow, grey) on the left. The main content area is a light grey background with several input fields and a button. The input fields are arranged vertically, each with a label on the left, a text box in the middle, and a unit or note on the right. The labels are R1, R2, Freq, Q, L1, C1, and C2. The units are Ohms, Ohms, MHz, (Usually 5-15), uH, pF, and pF respectively. A "Calculate" button is located at the bottom center of the window.

R1:	<input type="text" value="2000"/>	Ohms
R2:	<input type="text" value="50"/>	Ohms
Freq:	<input type="text" value="7"/>	MHz
Q:	<input type="text" value="10"/>	(Usually 5-15)
L1:	5.058254	uH
C1:	113.6822	pF
C2:	561.5486	pF

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

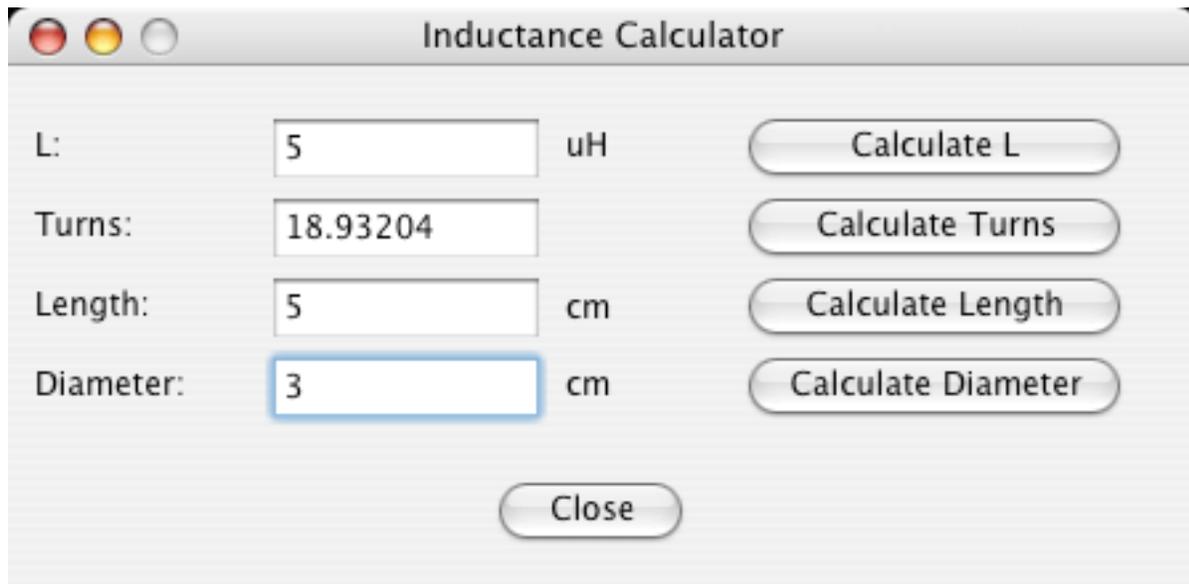


The image shows a screenshot of a software application window titled "L Network Calculator". The window has a standard macOS-style title bar with three colored buttons (red, yellow, grey) on the left. Below the title bar, there are five rows of input fields and labels. The first row is "Rs:" with a text box containing "2000" and the label "Ohms". The second row is "Rp:" with a text box containing "50" and the label "Ohms". The third row is "Freq:" with a text box containing "7" and the label "MHz". The fourth row is "L1:" with a text box containing "7.099451" and the label "uH". The fifth row is "C1:" with a text box containing "70.99451" and the label "pF". At the bottom center of the window is a button labeled "Calculate".

Rs:	<input type="text" value="2000"/>	Ohms
Rp:	<input type="text" value="50"/>	Ohms
Freq:	<input type="text" value="7"/>	MHz
L1:	<input type="text" value="7.099451"/>	uH
C1:	<input type="text" value="70.99451"/>	pF

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



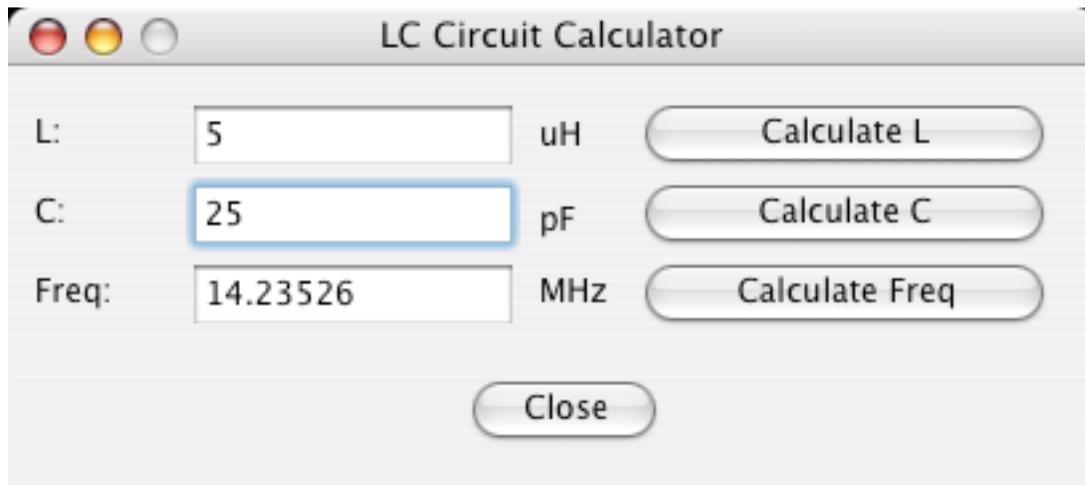
The image shows a window titled "Inductance Calculator" with a standard macOS-style title bar (red, yellow, and grey buttons). The window contains four rows of input fields and corresponding buttons:

Field Label	Value	Unit	Button Label
L:	5	uH	Calculate L
Turns:	18.93204		Calculate Turns
Length:	5	cm	Calculate Length
Diameter:	3	cm	Calculate Diameter

At the bottom center of the window is a "Close" button. The "Diameter" input field is highlighted with a blue border.

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.

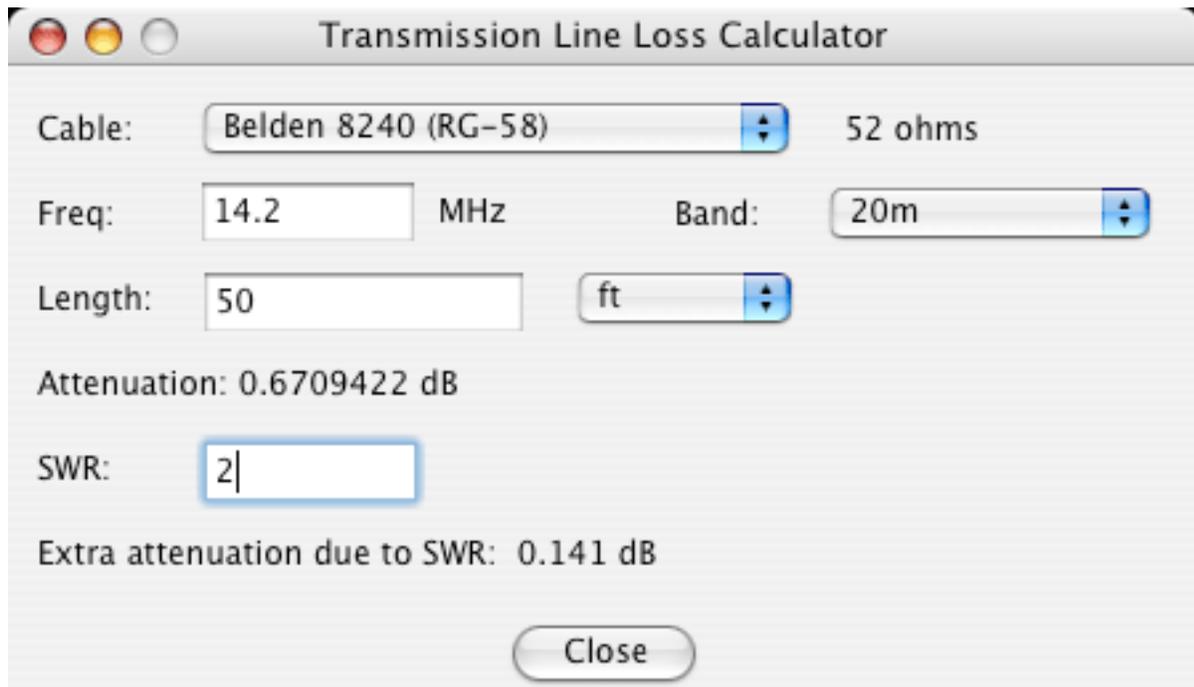
LC Circuit Calculator



The image shows a screenshot of a software application window titled "LC Circuit Calculator". The window has a standard macOS-style title bar with three colored buttons (red, yellow, grey) on the left. Below the title bar, there are three rows of input fields and buttons. The first row is labeled "L:" and has a text box containing the number "5", followed by the unit "uH" and a button labeled "Calculate L". The second row is labeled "C:" and has a text box containing the number "25", followed by the unit "pF" and a button labeled "Calculate C". The third row is labeled "Freq:" and has a text box containing the number "14.23526", followed by the unit "MHz" and a button labeled "Calculate Freq". At the bottom center of the window is a button labeled "Close".

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

Transmission Line Loss Calculator



The screenshot shows a window titled "Transmission Line Loss Calculator" with a standard macOS title bar. The interface includes several input fields and dropdown menus:

- Cable:** A dropdown menu set to "Belden 8240 (RG-58)" with a "52 ohms" label to its right.
- Freq:** A text input field containing "14.2" followed by the unit "MHz".
- Band:** A dropdown menu set to "20m".
- Length:** A text input field containing "50" followed by a dropdown menu set to "ft".

Below the input fields, the calculated results are displayed:

- Attenuation:** 0.6709422 dB
- SWR:** A text input field containing "2".
- Extra attenuation due to SWR:** 0.141 dB

A "Close" button is located at the bottom center of the window.

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

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

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.

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

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Chris Smolinski, N3JLY
4708 Trail Court
Westminster, MD 21158

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My snail mail address for directly sending your registration fees (please use email for any questions you want answered) is:

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Westminster, MD 21158 USA

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Thanks again for giving RF Toolbox a try.

Chris Smolinski, N3JLY
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Westminster, MD 21158

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Revision History

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

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