

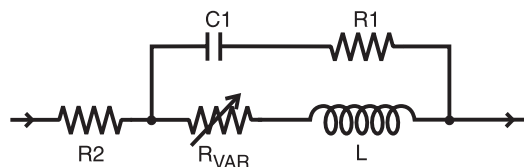
# SPICE Model – xx336RAE

This lumped-element (SPICE) model data simulates the frequency-dependent behavior of Coilcraft RF surface mount inductors from 1 MHz to the upper frequency limit shown in the accompanying table.

The equivalent lumped element model schematic is shown below. The element values R1, R2, C, and L are listed for each component value. The value of the frequency-dependent variable resistor  $R_{VAR}$  relates to the skin effect and is calculated from:

$$R_{VAR} = k * \sqrt{f}$$

- k is shown for each value in the accompanying table.
- f is the frequency in Hz



The data represents de-embedded measurements, as described below. Effects due to different customer circuit board traces, board materials, ground planes or interactions with other components are not included and can have a significant effect when comparing the simulation to measurements of the inductors using typical production verification instruments and fixtures.

Each model should only be analyzed at the input and output ports. Individual elements of the model are not determined by parameter measurement. The elements are determined by the overall performance of the lumped element model compared to the measurements taken of the component.

Typically, the Self-Resonant Frequency (SRF) of the component model will be higher than the measurement of the component mounted on a circuit board. The parasitic reactive elements of a circuit board or fixture will effectively lower the circuit resonant frequency, especially for very small inductance values. Since data sheet specifications are based on typical production measurements, and the SPICE models are based on de-embedded measurements as described below, the model results may be different from the data sheet specifications.

## Lumped Element Modeling Method

The measurements were made over a brass ground plane with each component centered over an air gap, as illustrated in Figure 1. The gap width for each size component is given in Table 1. The test pads were 30 mil

Table 1. Test Gap

Size	Gap Width (inch/mm)
0302	0.017 / 0.432
0402,0403	0.017 / 0.432
0603	0.026 / 0.660
0805	0.040 / 1.016
1008	0.060 / 1.524
1206	0.080 / 2.032
1812	0.120 / 3.048

(50 Ohm) wide traces of tinned gold over 25 mil thick alumina, and were not included in the gap. The TRL\* calibration plane is also illustrated in Figure 1.

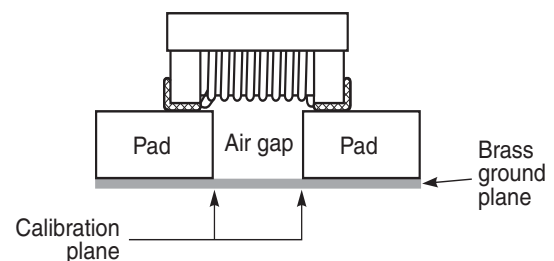


Figure 1. Test Setup

The lumped element values were determined by matching the simulation model to an average of the measurements. This method results in a model that represents as closely as possible the typical frequency-dependent behavior of the component up to a frequency just above the self-resonant frequency of the model.

The lumped element models were used to generate our 2-port S-parameters and therefore give identical results. The S-parameters are available on our web site at <http://www.coilcraft.com/models.cfm>.

## Disclaimer

Coilcraft makes every attempt to provide accurate measurement data and software, representative of our components, in a usable format. Coilcraft, however, disclaims all warrants relating to the use of its data and software, whether expressed or implied, including without limitation any implied warranties of merchantability or fitness for a particular purpose. Coilcraft cannot and will not be liable for any special, incidental, consequential, indirect or similar damages occurring with the use of the data and/or software.

# SPICE Model for Coilcraft xx336RAE Chip Inductors

Part number	R1 ( $\Omega$ )	R2 ( $\Omega$ )	C (pF)	L (nH)	k	Upper limit (MHz)
xx336RAE030	3	0.08	0.038	3.21	1.22E-05	15900
xx336RAE060	5	0.11	0.034	6.72	2.07E-05	11600
xx336RAE080	7	0.12	0.063	8.05	2.34E-05	7800
xx336RAE120	12	0.15	0.053	12.00	2.44E-05	7000
xx336RAE150	11	0.17	0.101	15.00	3.04E-05	4600
xx336RAE180	10	0.20	0.058	18.00	3.69E-05	5500
xx336RAE220	13	0.22	0.084	22.00	4.17E-05	4100
xx336RAE270	13	0.25	0.061	27.0	5.15E-05	4400
xx336RAE330	13	0.27	0.091	33.0	5.71E-05	3200
xx336RAE390	13	0.29	0.080	39.0	6.81E-05	3200
xx336RAE470	12	0.31	0.102	47.0	8.31E-05	2600
xx336RAE560	11	0.34	0.089	56.0	1.01E-04	2500
xx336RAE680	13	0.38	0.084	67.5	1.20E-04	2400
xx336RAE820	14	0.42	0.087	81.4	1.34E-04	2100
xx336RAE101	13	0.46	0.087	99.1	1.56E-04	1900
xx336RAE121	16	0.51	0.094	119.0	1.72E-04	1700
xx336RAE151	20	0.56	0.107	149.0	2.23E-04	1600
xx336RAE181	21	0.64	0.093	178.0	2.75E-04	1500
xx336RAE221	24	0.70	0.081	215.0	3.40E-04	1500