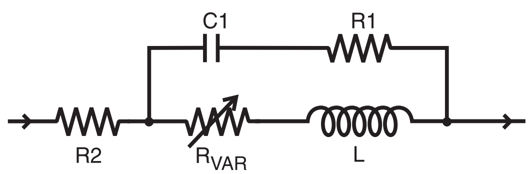
SPICE Model – xx413RAA

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.

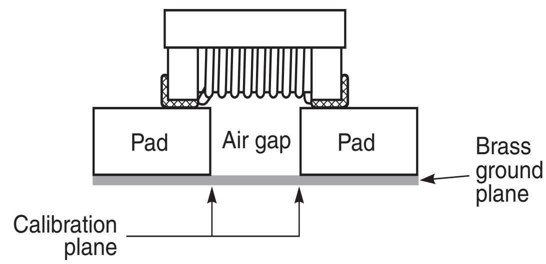


Figure 1. Test Setup

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

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SPICE Model for Coilcraft xx413RAA Chip Inductors

Part number	R1 (Ω)	R2 (Ω)	C (pF)	L (nH)	k	Upper limit (MHz)
xx413RAA100	8	0.10	0.065	9.8	1.96E-05	6700
xx413RAA120	7	0.10	0.100	12.0	2.40E-05	4900
xx413RAA150	7	0.10	0.153	15.0	3.12E-05	3700
xx413RAA180	7	0.10	0.083	18.0	3.16E-05	4600
xx413RAA220	8	0.10	0.124	22.0	3.69E-05	3400
xx413RAA270	8	0.10	0.185	27.0	4.41E-05	2500
xx413RAA330	9	0.10	0.117	33.0	5.18E-05	2900
xx413RAA390	9	0.20	0.149	39.0	5.50E-05	2300
xx413RAA470	9	0.20	0.118	47.0	6.40E-05	2400
xx413RAA560	7	0.20	0.160	56.0	7.40E-05	1900
xx413RAA680	6	0.20	0.137	68.0	9.20E-05	1900
xx413RAA820	12	0.20	0.179	81.0	1.15E-04	1500
xx413RAA101	13	0.60	0.135	100	1.25E-04	1600
xx413RAA121	13	0.60	0.136	120	1.51E-04	1400
xx413RAA151	14	0.70	0.136	150	1.10E-04	1300
xx413RAA181	18	0.80	0.130	180	1.40E-04	1200
xx413RAA221	18	0.80	0.147	224	1.90E-04	1000
xx413RAA271	19	0.90	0.144	265	2.32E-04	900
xx413RAA331	20	1.10	0.132	330	2.84E-04	900
xx413RAA391	27	1.10	0.138	380	3.49E-04	800
xx413RAA471	31	1.20	0.156	465	4.27E-04	700
xx413RAA561	36	1.30	0.172	550	5.18E-04	600
xx413RAA621	37	1.40	0.143	615	5.74E-04	600
xx413RAA681	37	1.50	0.139	665	6.10E-04	600
xx413RAA751	44	1.50	0.138	740	6.90E-04	600
xx413RAA821	41	1.60	0.135	810	8.10E-04	600
xx413RAA911	53	1.70	0.155	895	7.80E-04	500
xx413RAA102	90	1.80	0.209	975	8.20E-04	400
xx413RAA122	73	2.00	0.201	1215	1.05E-03	400
xx413RAA152	83	2.30	0.249	1515	1.71E-03	300
xx413RAA182	85	2.60	0.278	1825	2.04E-03	300
xx413RAA222	84	2.80	0.258	2200	2.46E-03	300
xx413RAA272	112	3.20	0.398	2700	2.55E-03	200
xx413RAA332	134	3.40	0.285	3300	3.27E-03	200
xx413RAA392	121	3.60	0.401	3900	4.23E-03	200
xx413RAA472	163	4.00	0.381	4600	5.00E-03	200
xx413RAA562	64	4.00	5.304	5250	3.04E-03	100
xx413RAA682	148	4.90	1.357	6800	3.54E-03	100
xx413RAA822	134	6.00	2.911	8200	4.38E-03	100

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