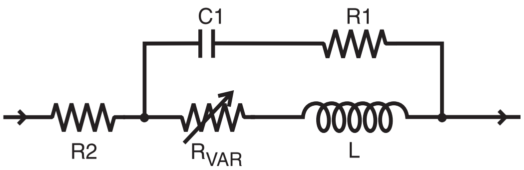
SPICE Model – xx235RAG

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.

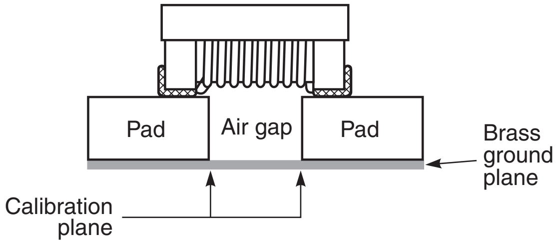


Figure 1. Test Setup

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 xx235RAG Chip Inductors

Part number	R1 (Ω)	R2 (Ω)	C (pF)	L (nH)	k	Upper limit (MHz)
xx235RAG1N0	6	0.038	0.030	1.00	2.70E-06	20000
xx235RAG2N0	5	0.038	0.050	2.00	5.22E-06	20000
xx235RAG2N2	4	0.038	0.040	2.20	5.70E-06	20000
xx235RAG2N4	13	0.042	0.044	2.40	6.20E-06	20000
xx235RAG2N7	11	0.056	0.044	2.70	6.46E-06	20000
xx235RAG3N3	15	0.045	0.032	3.30	7.80E-06	20000
xx235RAG3N6	10	0.045	0.022	3.60	8.10E-06	20000
xx235RAG3N9	12	0.045	0.042	3.90	9.70E-06	14000
xx235RAG4N3	10	0.040	0.048	4.30	1.12E-05	12000
xx235RAG4N7	13	0.060	0.052	4.70	1.29E-05	12000
xx235RAG5N1	15	0.100	0.044	5.10	1.45E-05	12000
xx235RAG5N6	1	0.048	0.032	5.60	1.27E-05	12000
xx235RAG6N2	15	0.050	0.047	6.20	1.43E-05	12000
xx235RAG6N8	15	0.055	0.049	6.80	1.65E-05	12000
xx235RAG7N5	12	0.080	0.051	7.50	2.04E-05	10000
xx235RAG8N2	17	0.054	0.036	8.20	2.04E-05	10000
xx235RAG8N7	11	0.058	0.048	8.70	2.13E-05	10000
xx235RAG9N0	18	0.070	0.039	9.00	2.21E-05	10000
xx235RAG9N5	10	0.075	0.048	9.50	2.43E-05	10000
xx235RAG10N	4	0.085	0.051	10.0	2.57E-05	10000
xx235RAG11N	10	0.065	0.042	11.0	2.67E-05	10000
xx235RAG12N	10	0.070	0.043	12.0	2.84E-05	10000
xx235RAG13N	4	0.140	0.047	13.0	3.40E-05	9000
xx235RAG15N	15	0.078	0.038	15.0	4.00E-05	9000
xx235RAG16N	18	0.130	0.044	16.0	4.50E-05	8000

Part number	R1 (Ω)	R2 (Ω)	C (pF)	L (nH)	k	Upper limit (MHz)
xx235RAG18N	5	0.120	0.040	18.0	5.40E-05	8000
xx235RAG19N	22	0.145	0.040	19.0	4.70E-05	7000
xx235RAG20N	18	0.155	0.038	20.0	5.63E-05	7000
xx235RAG22N	22	0.160	0.035	22.0	6.28E-05	7000
xx235RAG23N	18	0.160	0.036	23.0	6.42E-05	7000
xx235RAG24N	30	0.170	0.039	24.0	6.80E-05	7000
xx235RAG27N	30	0.275	0.026	27.0	6.70E-05	7000
xx235RAG30N	22	0.275	0.035	30.0	7.20E-05	7000
xx235RAG33N	30	0.330	0.034	33.0	7.78E-05	7000
xx235RAG36N	32	0.360	0.028	36.0	9.40E-05	7000
xx235RAG37N	26	0.480	0.032	37.0	9.70E-05	7000
xx235RAG39N	38	0.380	0.033	39.0	8.60E-05	6000
xx235RAG40N	30	0.380	0.032	40.0	1.00E-04	6000
xx235RAG43N	44	0.520	0.035	43.0	1.10E-04	6000
xx235RAG47N	48	0.580	0.029	47.0	1.35E-04	6000
xx235RAG51N	40	0.700	0.034	51.0	1.41E-04	6000
xx235RAG56N	30	1.00	0.041	56.0	1.36E-04	5000
xx235RAG68N	25	1.20	0.035	68.0	1.72E-04	5000
xx235RAG82N	40	1.25	0.035	82.0	2.28E-04	4000
xx235RAGR10	20	1.20	0.039	100	2.71E-04	4000
xx235RAGR12	20	1.20	0.038	120	3.26E-04	3000
xx235RAGR15	40	2.00	0.041	150	3.72E-04	3000
xx235RAGR18	40	2.10	0.041	180	4.20E-04	3000
xx235RAGR22	20	3.10	0.037	220	5.10E-04	3000

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