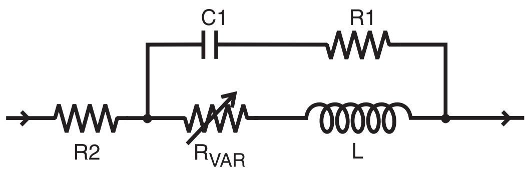
SPICE Model – 0402CS

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 (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.

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

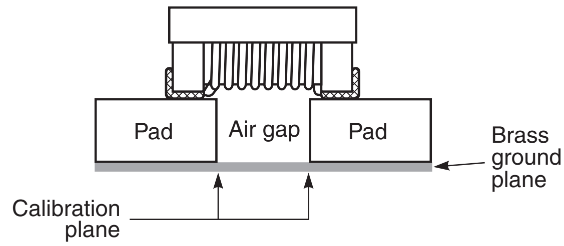


Figure 1. Test Setup

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 0402CS Chip Inductors

Part number	R1 (Ω)	R2 (Ω)	C (pF)	L (nH)	k	Upper limit (MHz)
0402CS-1N0	6.0	0.045	0.166	1.0	1.00E-06	21300
0402CS-1N2	5.78	0.090	0.014	1.2	5.90E-06	21300
0402CS-1N8	7.3	0.070	0.027	1.8	9.42E-06	21300
0402CS-1N9	12	0.002	0.036	1.9	1.01E-05	21200
0402CS-2N0	12	0.002	0.047	2.0	8.70E-06	18100
0402CS-2N2	12	0.002	0.044	2.2	7.40E-06	17900
0402CS-2N4	13	0.003	0.038	2.4	1.28E-05	17900
0402CS-2N7	13	0.003	0.036	2.6	1.38E-05	17900
0402CS-3N3	14	0.003	0.043	3.3	1.21E-05	14800
0402CS-3N6	26	0.003	0.040	3.6	1.28E-05	14700
0402CS-3N9	26	0.004	0.037	3.9	1.79E-05	14700
0402CS-4N3	25	0.004	0.032	4.3	1.76E-05	14700
0402CS-4N7	25	0.004	0.032	4.7	2.45E-05	14400
0402CS-5N1	24	0.004	0.035	5.1	1.81E-05	13200
0402CS-5N6	20	0.004	0.039	5.6	1.85E-05	11900
0402CS-6N2	18	0.005	0.041	6.2	2.23E-05	11000
0402CS-6N8	18	0.005	0.048	6.7	2.81E-05	10700
0402CS-7N5	18	0.005	0.036	7.5	2.68E-05	10700
0402CS-8N2	16	0.005	0.043	8.2	3.12E-05	9400
0402CS-8N7	20	0.005	0.032	8.7	3.90E-05	9900
0402CS-9N0	25	0.006	0.046	9.0	2.96E-05	8700
0402CS-9N5	20	0.006	0.044	9.5	4.26E-05	8600
0402CS-10N	30	0.006	0.046	10	3.88E-05	8300
0402CS-11N	20	0.008	0.038	11	3.63E-05	8600
0402CS-12N	10	0.008	0.050	12	3.93E-05	7200
0402CS-13N	20	0.009	0.046	13	4.38E-05	7200
0402CS-15N	40	0.010	0.039	15	4.73E-05	7300
0402CS-16N	15	0.010	0.049	16	5.50E-05	7300
0402CS-18N	26	0.010	0.031	18	6.31E-05	7300
0402CS-19N	14	0.010	0.036	19	5.71E-05	6700
0402CS-20N	18	0.010	0.043	20	7.01E-05	6700
0402CS-22N	21	0.011	0.034	22	7.81E-05	6700
0402CS-23N	20	0.012	0.036	23	7.47E-05	6700
0402CS-24N	20	0.012	0.045	24	8.51E-05	6200
0402CS-27N	22	0.012	0.036	27	8.75E-05	6200
0402CS-30N	26	0.013	0.044	30	1.02E-04	5300
0402CS-33N	29	0.013	0.045	33	1.16E-04	5000
0402CS-36N	28	0.014	0.041	36	1.28E-04	5000
0402CS-39N	36	0.014	0.031	39	1.29E-04	5200
0402CS-40N	35	0.014	0.040	40	1.30E-04	4800
0402CS-43N	35	0.015	0.033	43	1.43E-04	5100
0402CS-47N	44	0.016	0.035	47	1.40E-04	4800
0402CS-51N	44	0.017	0.034	51	1.79E-04	4600
0402CS-56N	53	0.018	0.035	56	2.16E-04	4400
0402CS-68N	60	0.020	0.034	68	2.67E-04	4000
0402CS-82N	40	1.550	0.176	82	1.59E-04	2900
0402CS-R10	86	2.000	0.030	100	2.03E-04	2900
0402CS-R12	67	2.200	0.030	120	3.23E-04	2500

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