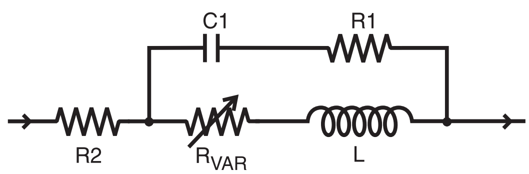
SPICE Model – 0603CS

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.

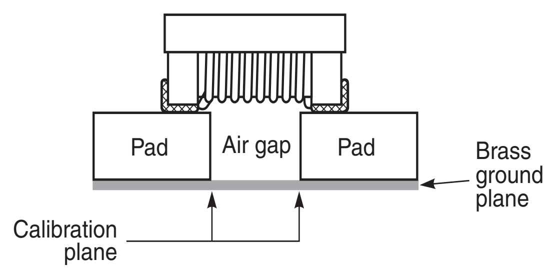


Figure 1. Test Setup

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 0603CS Chip Inductors

Part number	R1 (Ω)	R2 (Ω)	C (pF)	L (nH)	k	Upper limit (MHz)
0603CS-1N6	2	0.001	0.030	1.6	6.50E-06	25300
0603CS-1N8	2	0.001	0.035	1.8	1.00E-05	22100
0603CS-2N2	23	0.070	0.024	2.2	11.22E-06	23000
0603CS-3N3	12	0.002	0.032	3.3	8.90E-06	17100
0603CS-3N6	9	0.002	0.040	3.6	1.25E-05	14600
0603CS-3N9	9	0.002	0.042	3.9	1.40E-05	13700
0603CS-4N3	9	0.003	0.043	4.3	1.31E-05	12900
0603CS-4N7	10	0.003	0.042	4.7	1.99E-05	12500
0603CS-5N1	12	0.004	0.053	5.1	2.08E-05	10700
0603CS-5N6	5	0.075	0.029	5.6	1.62E-05	10600
0603CS-6N8	11	0.005	0.041	6.8	1.89E-05	10500
0603CS-7N5	12	0.006	0.045	7.5	2.04E-05	9600
0603CS-8N2	16	0.008	0.059	8.0	2.18E-05	8100
0603CS-8N7	5	0.011	0.069	8.7	2.40E-05	7200
0603CS-9N5	10	0.011	0.038	9.5	2.96E-05	9300
0603CS-10N	35	0.010	0.043	10.0	2.64E-05	8500
0603CS-11N	25	0.013	0.046	11.0	2.88E-05	7800
0603CS-12N	9	0.013	0.058	12.0	3.20E-05	6700
0603CS-15N	10	0.040	0.049	15.0	3.60E-05	6500
0603CS-16N	11	0.050	0.050	16.0	3.80E-05	6200
0603CS-18N	11	0.050	0.071	18.0	4.10E-05	5400
0603CS-22N	13	0.050	0.054	21.9	4.80E-05	5600
0603CS-23N	18	0.050	0.054	23.0	4.91E-05	5500
0603CS-24N	15	0.040	0.068	24.0	5.03E-05	4800

Part number	R1 (Ω)	R2 (Ω)	C (pF)	L (nH)	k	Upper limit (MHz)
0603CS-27N	17	0.030	0.049	27.0	5.75E-05	5300
0603CS-30N	19	0.020	0.062	30.0	6.13E-05	4500
0603CS-33N	16	0.010	0.081	33.0	8.00E-05	3700
0603CS-36N	23	0.010	0.059	35.7	7.22E-05	4200
0603CS-39N	17	0.010	0.066	39	9.00E-05	3800
0603CS-43N	27	0.010	0.055	43	9.50E-05	4000
0603CS-47N	17	0.010	0.071	47	1.03E-04	3400
0603CS-51N	30	0.010	0.050	51	1.17E-04	3800
0603CS-56N	17	0.010	0.065	56	1.18E-04	3200
0603CS-68N	17	0.010	0.073	67	1.45E-04	2800
0603CS-72N	20	0.010	0.054	72	1.60E-04	3100
0603CS-82N	20	0.010	0.056	81	1.65E-04	2900
0603CS-R10	25	0.010	0.060	100	2.34E-04	2500
0603CS-R11	21	0.010	0.060	109	2.57E-04	2400
0603CS-R12	26	0.010	0.063	119	2.70E-04	2300
0603CS-R15	30	0.025	0.068	148	3.57E-04	2000
0603CS-R18	33	0.050	0.061	179	3.87E-04	1900
0603CS-R20	20	0.125	0.048	198	4.17E-04	2000
0603CS-R21	22	0.150	0.045	208	4.29E-04	2000
0603CS-R22	28	0.168	0.058	219	4.53E-04	1700
0603CS-R25	33	0.200	0.044	246	4.22E-04	1700
0603CS-R27	34	0.300	0.054	268	5.30E-04	1600
0603CS-R33	37	0.676	0.059	327	7.19E-04	1400
0603CS-R39	41	1.052	0.059	386	7.69E-04	1300

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