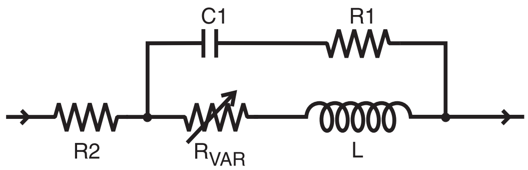
SPICE Model – 0302CS

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.

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)
016008	0.0055 / 0.140
0201	0.010 / 0.254
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

Lumped Element Modeling

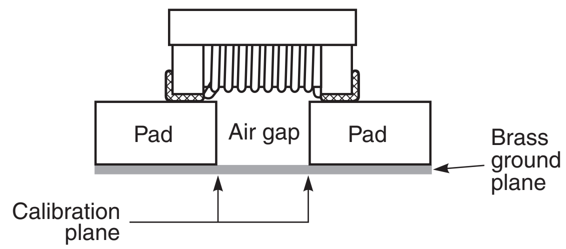


Figure 1. Test Setup

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 **https://www.coilcraft.com/en-us/models/spice**.

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SPICE Model for Coilcraft 0302CS Chip Inductors

Part number	R1 (Ω)	R2 (Ω)	C (pF)	L (nH)	k	Upper limit (MHz)
0302CS-N67	1.89	0.005	0.032	0.67	2.88E-06	26000
0302CS-1N7	8.23	0.022	0.057	1.70	4.88E-06	18000
0302CS-1N9	11.24	0.065	0.020	1.90	5.66E-06	18000
0302CS-2N1	12.16	0.126	0.047	2.10	6.23E-06	18000
0302CS-3N0	9.07	0.250	0.037	3.00	1.93E-06	16500
0302CS-3N3	6.14	0.264	0.057	3.30	2.43E-06	13000
0302CS-3N5	7.11	0.132	0.054	3.50	6.78E-06	13000
0302CS-3N8	7.84	0.107	0.058	3.80	8.23E-06	12500
0302CS-4N0	9.07	0.284	0.051	4.00	4.16E-06	13000
0302CS-4N7	5.85	0.329	0.037	4.70	5.30E-06	13500
0302CS-5N1	11.03	0.251	0.054	5.10	7.10E-06	11000
0302CS-5N6	8.00	0.080	0.110	5.60	1.70E-05	11000
0302CS-6N0	12.76	0.299	0.057	6.00	9.52E-06	10000
0302CS-6N3	14.07	0.295	0.046	6.30	1.14E-05	11000
0302CS-6N5	14.07	0.359	0.058	6.50	9.80E-06	9500
0302CS-7N0	15.51	0.367	0.050	7.00	1.00E-05	9500
0302CS-7N2	17.10	0.323	0.042	7.20	1.19E-05	10500
0302CS-7N4	12.16	0.385	0.054	7.40	1.04E-05	9500
0302CS-8N3	19.80	0.579	0.045	8.30	1.00E-05	9500
0302CS-9N2	14.00	0.120	0.044	9.20	2.90E-05	9500
0302CS-10N	10.77	0.534	0.046	10.0	1.33E-05	8500
0302CS-11N	10.26	0.560	0.049	11.0	1.70E-05	7800
0302CS-12N	10.50	0.672	0.045	12.0	1.63E-05	7800
0302CS-13N	11.02	0.817	0.041	13.0	1.80E-05	8000
0302CS-15N	17.10	1.207	0.044	15.0	1.16E-05	7000
0302CS-16N	17.46	1.229	0.042	16.0	1.48E-05	7000
0302CS-17N	17.46	1.647	0.038	17.0	8.24E-06	7000
0302CS-18N	20.79	1.698	0.039	18.0	7.97E-06	7000
0302CS-19N	18.86	1.698	0.040	19.0	1.18E-05	7000
0302CS-20N	18.86	0.300	0.039	20.0	1.24E-05	6200
0302CS-21N	18.86	1.966	0.045	21.0	1.07E-05	6000
0302CS-22N	18.86	2.390	0.047	22.0	5.25E-06	6000
0302CS-23N	19.80	1.966	0.041	23.0	1.61E-05	6000
0302CS-29N	26.53	3.202	0.037	29.0	7.39E-06	5700
0302CS-34N	30.00	3.473	0.038	34.0	1.06E-05	5500
0302CS-36N	32.00	0.600	0.048	36.0	1.10E-04	5500
0302CS-39N	35.00	0.760	0.050	39.0	1.30E-04	5500
0302CS-43N	38.00	0.820	0.046	43.0	1.30E-04	5500
0302CS-51N	36.00	0.970	0.051	51.0	1.60E-04	5500
0302CS-56N	30.00	1.200	0.052	56.0	1.90E-04	5500
0302CS-62N	29.00	1.000	0.050	62.0	2.20E-04	5500
0302CS-75N	30.00	1.800	0.048	75.0	2.60E-04	5500
0302CS-82N	29.00	1.800	0.050	82.0	2.60E-04	5500
0302CS-91N	36.00	2.000	0.048	91.0	3.40E-04	5500
0302CS-101	20.00	2.000	0.045	100.0	4.00E-04	5500

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