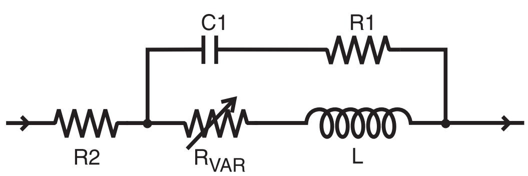
SPICE Model – 0402HP

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

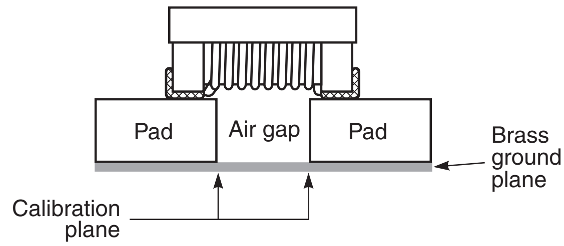


Figure 1. Test Setup

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 0402HP Chip Inductors

Part number	R1 (Ω)	R2 (Ω)	C (pF)	L (nH)	k	Upper limit (MHz)
0402HP-1N0	6	0.038	0.030	1.00	2.70E-06	20000
0402HP-2N0	5	0.038	0.050	2.00	5.22E-06	20000
0402HP-2N2	4	0.038	0.040	2.20	5.70E-06	20000
0402HP-2N4	13	0.042	0.044	2.40	6.20E-06	20000
0402HP-2N7	11	0.056	0.044	2.70	6.46E-06	20000
0402HP-3N3	15	0.045	0.032	3.30	7.80E-06	20000
0402HP-3N6	10	0.045	0.022	3.60	8.10E-06	20000
0402HP-3N9	12	0.045	0.042	3.90	9.70E-06	14000
0402HP-4N3	10	0.040	0.048	4.30	1.12E-05	12000
0402HP-4N7	13	0.060	0.052	4.70	1.29E-05	12000
0402HP-5N1	15	0.100	0.044	5.10	1.45E-05	12000
0402HP-5N6	1	0.048	0.032	5.60	1.27E-05	12000
0402HP-6N2	15	0.050	0.047	6.20	1.43E-05	12000
0402HP-6N8	15	0.055	0.049	6.80	1.65E-05	12000
0402HP-7N5	12	0.080	0.051	7.50	2.04E-05	10000
0402HP-8N2	17	0.054	0.036	8.20	2.04E-05	10000
0402HP-8N7	11	0.058	0.048	8.70	2.13E-05	10000
0402HP-9N0	18	0.070	0.039	9.00	2.21E-05	10000
0402HP-9N5	10	0.075	0.048	9.50	2.43E-05	10000
0402HP-10N	4	0.085	0.051	10.0	2.57E-05	10000
0402HP-11N	10	0.065	0.042	11.0	2.67E-05	10000
0402HP-12N	10	0.070	0.043	12.0	2.84E-05	10000
0402HP-13N	4	0.140	0.047	13.0	3.40E-05	9000
0402HP-15N	15	0.078	0.038	15.0	4.00E-05	9000
0402HP-16N	18	0.130	0.044	16.0	4.50E-05	8000
0402HP-18N	5	0.120	0.040	18.0	5.40E-05	8000
0402HP-19N	22	0.145	0.040	19.0	4.70E-05	7000
0402HP-20N	18	0.155	0.038	20.0	5.63E-05	7000
0402HP-22N	22	0.160	0.035	22.0	6.28E-05	7000
0402HP-23N	18	0.160	0.036	23.0	6.42E-05	7000
0402HP-24N	30	0.170	0.039	24.0	6.80E-05	7000
0402HP-26N	20	0.290	0.035	26.0	7.20E-05	7000
0402HP-27N	30	0.275	0.026	27.0	6.70E-05	7000
0402HP-30N	22	0.275	0.035	30.0	7.20E-05	7000
0402HP-33N	30	0.330	0.034	33.0	7.78E-05	7000
0402HP-36N	32	0.360	0.028	36.0	9.40E-05	7000
0402HP-37N	26	0.480	0.032	37.0	9.70E-05	7000
0402HP-39N	38	0.380	0.033	39.0	8.60E-05	6000
0402HP-40N	30	0.380	0.032	40.0	1.00E-04	6000
0402HP-43N	44	0.520	0.035	43.0	1.10E-04	6000
0402HP-47N	48	0.580	0.029	47.0	1.35E-04	6000
0402HP-51N	40	0.700	0.034	51.0	1.41E-04	6000
0402HPH-56N	30	1.00	0.041	56.0	1.36E-04	5000
0402HPH-68N	25	1.20	0.035	68.0	1.72E-04	5000
0402HPH-82N	40	1.25	0.035	82.0	2.28E-04	4000
0402HPH-R10	20	1.20	0.039	100	2.71E-04	4000
0402HPH-R12	20	1.20	0.038	120	3.26E-04	3000
0402HPH-R15	40	2.00	0.041	150	3.72E-04	3000
0402HPH-R18	40	2.10	0.041	180	4.20E-04	3000
0402HPH-R22	20	3.10	0.037	220	5.10E-04	3000

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