

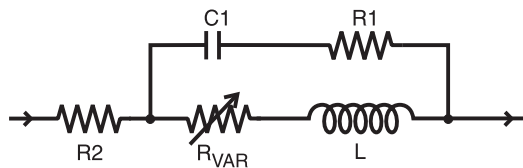
SPICE Model – 0402DC

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)
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

(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.

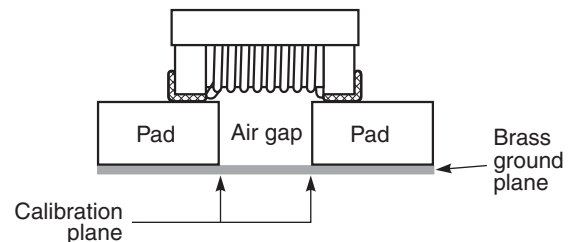


Figure 1. Test Setup

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>.

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SPICE Model for Coilcraft 0402DC Chip Inductors

Part number	R1 (Ω)	R2 (Ω)	C (pF)	L (nH)	k	Upper limit (GHz)	Part number	R1 (Ω)	R2 (Ω)	C (pF)	L (nH)	k	Upper limit (GHz)
0402DC-0N8	10.150	0.025	0.0270	0.8	1.890E-06	26	0402DC-7N1	13.550	0.063	0.0372	7.1	1.310E-05	12
0402DC-0N9	12.350	0.030	0.0237	0.9	2.610E-06	26	0402DC-7N2	8.150	0.063	0.0495	7.2	1.300E-05	10
0402DC-1N0	10.650	0.045	0.0177	1.0	2.520E-06	26	0402DC-7N3	12.650	0.063	0.0488	7.3	1.290E-05	10
0402DC-1N2	27.300	0.125	0.0222	1.2	4.500E-06	26	0402DC-7N4	6.325	0.063	0.0481	7.4	1.360E-05	10
0402DC-1N7	22.200	0.035	0.0258	1.7	2.940E-06	25	0402DC-7N5	5.335	0.063	0.0475	7.5	1.360E-05	10
0402DC-1N8	15.000	0.035	0.0294	1.8	3.440E-06	24	0402DC-7N6	7.336	0.063	0.0469	7.6	1.340E-05	10
0402DC-1N9	19.800	0.035	0.0275	1.9	3.490E-06	24	0402DC-7N7	5.035	0.070	0.0463	7.7	1.460E-05	10
0402DC-2N0	16.200	0.035	0.0263	2.0	4.270E-06	24	0402DC-7N8	7.485	0.070	0.0457	7.8	1.430E-05	10
0402DC-2N1	18.000	0.048	0.0250	2.1	5.870E-06	24	0402DC-7N9	7.285	0.070	0.0451	7.9	1.450E-05	10
0402DC-2N2	19.000	0.090	0.0242	2.2	5.590E-06	23	0402DC-8N0	5.585	0.070	0.0540	8.0	1.430E-05	10
0402DC-2N3	19.000	0.110	0.0231	2.3	6.040E-06	23	0402DC-8N1	7.505	0.070	0.0440	8.1	1.510E-05	10
0402DC-2N4	16.600	0.170	0.0223	2.4	5.800E-06	22	0402DC-8N2	7.105	0.070	0.0435	8.2	1.470E-05	10
0402DC-2N5	15.800	0.210	0.0257	2.5	8.300E-06	22	0402DC-8N3	7.405	0.070	0.0429	8.3	1.530E-05	10
0402DC-2N8	33.160	0.037	0.0278	2.8	6.110E-06	20	0402DC-8N4	5.005	0.070	0.0513	8.4	1.470E-05	10
0402DC-2N9	26.500	0.037	0.0264	2.9	6.440E-06	20	0402DC-8N5	5.645	0.070	0.0508	8.5	1.490E-05	10
0402DC-3N0	17.200	0.037	0.0316	3.0	5.460E-06	18	0402DC-8N6	4.765	0.070	0.0502	8.6	1.510E-05	10
0402DC-3N1	30.600	0.037	0.0250	3.1	6.140E-06	18	0402DC-8N7	5.255	0.070	0.0496	8.7	1.510E-05	10
0402DC-3N2	18.500	0.037	0.0356	3.2	5.700E-06	16	0402DC-8N8	2.628	0.070	0.0491	8.8	1.570E-05	10
0402DC-3N3	18.800	0.037	0.0347	3.3	5.600E-06	16	0402DC-8N9	5.728	0.070	0.0485	8.9	1.550E-05	10
0402DC-3N4	13.980	0.046	0.0328	3.4	5.820E-06	16	0402DC-9N0	4.528	0.070	0.0480	9.0	1.570E-05	10
0402DC-3N5	16.640	0.046	0.0394	3.5	5.950E-06	15	0402DC-9N1	4.108	0.070	0.0574	9.1	1.530E-05	10
0402DC-3N6	5.860	0.046	0.0313	3.6	6.280E-06	16	0402DC-9N2	4.168	0.070	0.0568	9.2	1.550E-05	10
0402DC-3N7	23.620	0.046	0.0445	3.7	6.160E-06	15	0402DC-9N3	9.956	0.073	0.0383	9.3	1.750E-05	10
0402DC-3N8	31.400	0.046	0.0362	3.8	6.050E-06	14	0402DC-9N4	10.860	0.073	0.0460	9.4	1.630E-05	10
0402DC-3N9	26.000	0.046	0.0426	3.9	6.500E-06	14	0402DC-9N5	8.160	0.073	0.0375	9.5	1.650E-05	10
0402DC-4N0	32.500	0.046	0.0408	4.0	6.600E-06	14	0402DC-9N6	7.060	0.073	0.0450	9.6	1.630E-05	10
0402DC-4N1	6.940	0.046	0.0495	4.1	6.900E-06	14	0402DC-9N7	5.460	0.073	0.0445	9.7	1.650E-05	10
0402DC-4N2	13.400	0.046	0.0583	4.2	6.850E-06	15	0402DC-9N8	6.020	0.073	0.0440	9.8	1.630E-05	10
0402DC-4N3	30.000	0.048	0.0318	4.3	8.200E-06	15	0402DC-9N9	6.380	0.073	0.0436	9.9	1.630E-05	10
0402DC-4N4	44.500	0.048	0.0252	4.4	7.850E-06	16	0402DC-10N	7.320	0.073	0.0431	10.0	1.620E-05	10
0402DC-4N5	11.000	0.048	0.0304	4.5	8.350E-06	15	0402DC-11N	4.920	0.078	0.0475	11.0	2.100E-05	10
0402DC-4N6	16.780	0.048	0.0300	4.6	8.350E-06	15	0402DC-12N	7.580	0.081	0.0526	12.0	2.670E-05	10
0402DC-4N7	24.360	0.048	0.0353	4.7	7.900E-06	15	0402DC-15N	7.780	0.115	0.0421	15.0	3.250E-05	9
0402DC-4N8	13.960	0.048	0.0348	4.8	8.450E-06	15	0402DC-16N	11.380	0.120	0.0395	16.0	3.530E-05	9
0402DC-4N9	15.880	0.048	0.0338	4.9	8.500E-06	15	0402DC-18N	7.580	0.138	0.0425	18.0	4.100E-05	8
0402DC-5N0	21.080	0.048	0.0400	5.0	8.400E-06	14	0402DC-20N	3.790	0.163	0.0463	20.0	4.640E-05	8
0402DC-5N1	13.280	0.048	0.0393	5.1	8.800E-06	15	0402DC-22N	10.580	0.190	0.0421	22.0	5.230E-05	7
0402DC-5N2	24.340	0.048	0.0385	5.2	8.550E-06	14	0402DC-23N	14.480	0.177	0.0403	23.0	5.350E-05	7
0402DC-5N3	12.040	0.057	0.0378	5.3	9.450E-06	13	0402DC-24N	9.640	0.185	0.0466	24.0	5.990E-05	7
0402DC-5N4	16.270	0.057	0.0309	5.4	9.550E-06	13	0402DC-27N	16.640	0.193	0.0414	27.0	6.550E-05	7
0402DC-5N5	29.270	0.057	0.0365	5.5	8.850E-06	13	0402DC-30N	16.840	0.245	0.0452	30.0	7.450E-05	7
0402DC-5N6	10.070	0.057	0.0360	5.6	9.780E-06	15	0402DC-33N	12.500	0.288	0.0411	33.0	8.300E-05	6
0402DC-5N7	16.270	0.057	0.0358	5.7	1.000E-05	14	0402DC-36N	7.500	0.320	0.0455	36.0	9.500E-05	6
0402DC-5N8	22.070	0.057	0.0426	5.8	9.100E-06	14	0402DC-39N	12.000	0.375	0.0420	39.0	1.035E-04	6
0402DC-5N9	26.570	0.057	0.0414	5.9	9.300E-06	14	0402DC-43N	27.600	0.430	0.0381	43.0	1.135E-04	5
0402DC-6N0	32.570	0.057	0.0402	6.0	8.900E-06	14	0402DC-47N	15.600	0.427	0.0511	47.0	1.295E-04	5
0402DC-6N1	16.280	0.057	0.0492	6.1	1.300E-05	14	0402DC-51N	19.600	0.432	0.0470	51.0	1.415E-04	5
0402DC-6N2	12.080	0.057	0.0470	6.2	1.065E-05	14	0402DC-56N	30.600	0.690	0.0425	56.0	1.550E-04	5
0402DC-6N3	10.580	0.057	0.0484	6.3	1.035E-05	12	0402DC-62N	32.200	0.756	0.0377	62.0	1.790E-04	5
0402DC-6N4	7.300	0.057	0.0526	6.4	1.165E-05	12	0402DC-68N	64.200	0.943	0.0450	68.0	1.690E-04	5
0402DC-6N5	3.650	0.057	0.0663	6.5	1.085E-05	12	0402DC-72N	40.200	0.787	0.0410	72.0	1.930E-04	4
0402DC-6N6	20.000	0.063	0.0305	6.6	1.305E-05	12	0402DC-75N	50.700	0.882	0.0393	75.0	2.070E-04	4
0402DC-6N7	25.800	0.063	0.0305	6.7	1.285E-05	12	0402DC-82N	28.300	1.057	0.0430	82.0	2.310E-04	4
0402DC-6N8	13.600	0.063	0.0388	6.8	1.265E-05	12	0402DC-91N	50.000	1.119	0.0396	91.0	2.640E-04	4
0402DC-6N9	13.000	0.063	0.0353	6.9	1.265E-05	12	0402DC-R10	25.000	1.507	0.0425	100.0	2.670E-04	4
0402DC-7N0	11.250	0.063	0.0348	7.0	1.330E-05	12	0402DC-R12	20.750	1.600	0.0429	120.0	3.470E-04	3



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