

# SPICE Model—xx450PHA

This lumped-element (SPICE) model data simulates the frequency-dependent behavior of Coilcraft ferrite surface mount inductors within the frequency range shown in the accompanying table.

The equivalent lumped element model schematic is shown below. The element values R1, R2, C, L, k1 and k2 are listed in the table for each component value. The value of the frequency-dependent variable resistor  $R_{VAR1}$  relates to the skin effect and is calculated from:

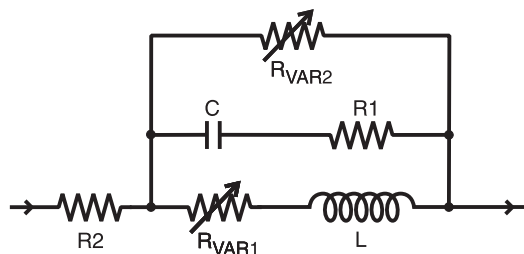
$$R_{VAR1} = k1 * \sqrt{f}$$

- k1 is shown for each value in the accompanying table.
- f is the frequency in Hz

The value of the frequency-dependent variable resistor  $R_{VAR2}$  relates to core losses and is calculated from:

$$R_{VAR2} = k2 * \sqrt{f}$$

- k2 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

Measurements were made using a 50 Ohm Agilent/HP 4395A impedance analyzer with an Agilent/HP 16193 test fixture. Calibration was performed using open/short/load standards. Fixture compensation was performed using open and short standards.

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 within the model frequency range.

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

Coilcraft makes every attempt to provide accurate measurement data and software, representative of our components, in a usable format. Coilcraft, however, disclaims all warrants relating to the use of its data and software, whether expressed or implied, including without limitation any implied warranties of merchantability or fitness for a particular purpose. Coilcraft cannot and will not be liable for any special, incidental, consequential, indirect or similar damages occurring with the use of the data and/or software.

# SPICE Model for Coilcraft xx450PHA Power Inductors

Part number	Frequency limit of model (MHz)		R1	R2	C (pF)	L (μH)	k1	k2
	Lower	Upper						
xx450PHA102M	0.1	300	608	0.054	137	1.0	7.60E-07	2.29
xx450PHA152M	0.1	60	840	0.054	93	1.5	3.75E-07	1.25
xx450PHA222M	0.1	60	1600	0.072	93	2.2	7.50E-07	1.89
xx450PHA272M	0.1	55	1540	0.072	79	2.7	7.50E-07	1.89
xx450PHA332M	0.1	50	1690	0.120	107	3.3	8.53E-07	3.56
xx450PHA392M	0.1	50	2630	0.104	103	3.9	2.30E-05	4.21
xx450PHA472M	0.1	50	3320	0.095	37.5	4.7	4.50E-05	3.31
xx450PHA562M	0.1	45	3160	0.097	152	5.6	5.68E-05	7.35
xx450PHA682M	0.1	40	3910	0.124	206	6.8	1.48E-05	8.05
xx450PHA103M	0.1	40	6080	0.154	273	10	2.96E-05	32.2
xx450PHA153M	0.1	35	8370	0.326	137	15	1.00E-07	33.7
xx450PHA223M	0.1	25	7160	0.314	0.615	22	3.98E-07	11.2
xx450PHA333M	0.1	20	4160	0.418	0.903	33	2.38E-07	14.6
xx450PHA393M	0.1	20	4640	0.622	0.763	39	2.38E-07	18.6
xx450PHA473M	0.1	18	5110	0.883	0.833	47	1.51E-04	31.8
xx450PHA683M	0.1	13	2090	1.19	1.47	68	3.50E-05	37.9
xx450PHA823M	0.1	11	4010	1.24	1.38	82	3.50E-05	59.9
xx450PHA104M	0.1	11	2390	1.39	1.40	100	1.75E-05	71.1
xx450PHA124M	0.1	9.0	2660	1.39	1.74	120	1.49E-05	76.9
xx450PHA154M	0.1	8.0	1650	1.97	2.12	150	2.51E-05	108
xx450PHA224M	0.1	6.0	1060	2.61	2.63	220	6.77E-05	139
xx450PHA334M	0.1	4.0	1280	4.08	2.36	330	1.23E-04	231
xx450PHA474M	0.1	3.0	1180	5.28	2.99	470	7.20E-05	342
xx450PHA564M	0.1	1.5	1040	6.61	5.86	560	7.20E-05	342
xx450PHA684M	0.1	1.0	1120	6.61	5.30	680	1.02E-04	412
xx450PHA824M	0.1	1.0	620	8.41	8.52	818	1.02E-04	388
xx450PHA105M	0.1	1.0	674	9.11	11.0	997	1.57E-04	503