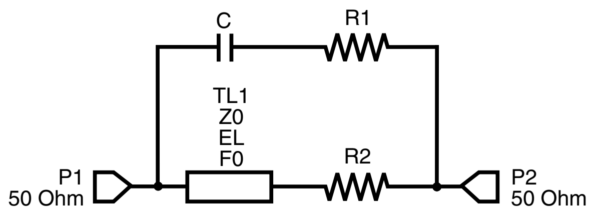
# Transmission Line Model Midi Springs®

These transmission line models accurately simulate the frequency-dependent behavior of Coilcraft surface mount “Spring” air core inductors within the frequency limits shown in the accompanying table for each individual inductor. They are based on de-embedded measurements using a 2-port network analyzer.

The model schematic, shown below, combines an ideal transmission line model with lumped elements. Each model should be analyzed only as a whole at the input and output ports. Conclusions based on individual lumped element values may be erroneous. The individual element values R1, R2, C, Z0, EL, and F0 are listed in the table for each individual spring inductor.




Effects due to different circuit board traces, board materials, ground planes or interactions with other components are not included. They *will* have a significant effect when comparing the simulation to measurements of the individual inductors using other production verification instruments and fixtures.

Typically, the Self-Resonant Frequency (SRF) of the inductor model will be higher than a 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. Data sheet specifications are based on typical production measurements. These models are based on de-embedded 2-port measurements as described below, so 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 the Midi Spring is 0.097 in. (2,464 mm). 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.

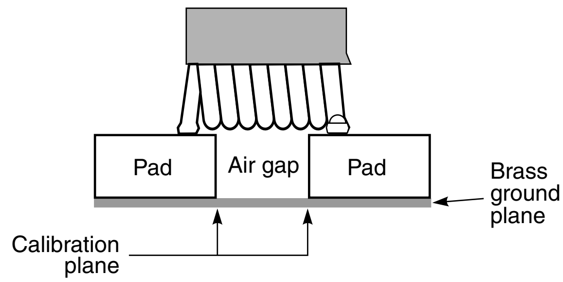



**Figure 1. Test Setup**

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 within the specified frequency limits of the model. The lumped element models were used to generate our 2-port S-parameters and therefore give identical results with the same number of simulation frequency points. 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.

Coilcraft®
Specifications subject to change without notice. Document 346-1 Revised 09/08/17
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# Transmission Line Model for Coilcraft Midi Springs®

| Part number | Frequency limit of Model (MHz) Lower | Frequency limit of Model (MHz) Upper | R1 (Ω) | R2 (Ω) | C (pF) | TL1 Z0 (Ω) | TL1 EL (degrees) | TL1 F0 (MHz) |
|---|---|---|---|---|---|---|---|---|
| 1812SMS-22N | 1 | 3500 | 2.278 | 0.1502 | 0.1721 | 209.0 | 45.12 | 1198 |
| 1812SMS-27N | 1 | 2800 | 4.288 | 0.1842 | 0.1781 | 256.5 | 45.12 | 1198 |
| 1812SMS-33N | 1 | 2500 | 8.126 | 0.2307 | 0.1754 | 245.2 | 65.80 | 1370 |
| 1812SMS-39N | 1 | 2300 | 5.948 | 0.2628 | 0.2379 | 267.5 | 58.07 | 1121 |
| 1812SMS-47N | 1 | 2000 | 1.208 | 0.3135 | 0.2342 | 307.5 | 63.68 | 1177 |
| 1812SMS-56N | 1 | 1800 | 1.208 | 0.4015 | 0.2312 | 366.1 | 63.68 | 1177 |
| 1812SMS-68N | 1 | 1800 | 1.736 | 0.4991 | 0.2483 | 342.5 | 72.92 | 1047 |
| 1812SMS-82N | 1 | 1500 | 1.736 | 0.5971 | 0.2483 | 411.5 | 72.92 | 1047 |
| 1812SMS-R10 | 1 | 1300 | 2.409 | 0.7310 | 0.3140 | 385.0 | 79.49 | 886 |
| 1812SMS-R12 | 1 | 1200 | 3.129 | 1.0100 | 0.1893 | 458.0 | 100.90 | 1102 |
| 1812SMS-R15 | 1 | 1100 | 5.000 | 0.8600 | 0.1323 | 567.0 | 100.90 | 1102 |


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