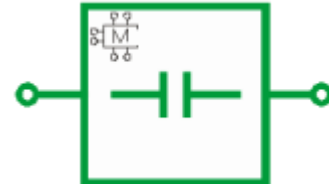


Model Features

- Broadband validation: DC - 20GHz
- Equivalent circuit based
- Substrate scalable: ($1 \leq H/Er \leq 16$)
- Part value scalable (0.1 to 33 pF)
- Land Pattern (Pad) scalable
- Accurate effective series resistance
- Developed for microstrip interconnects



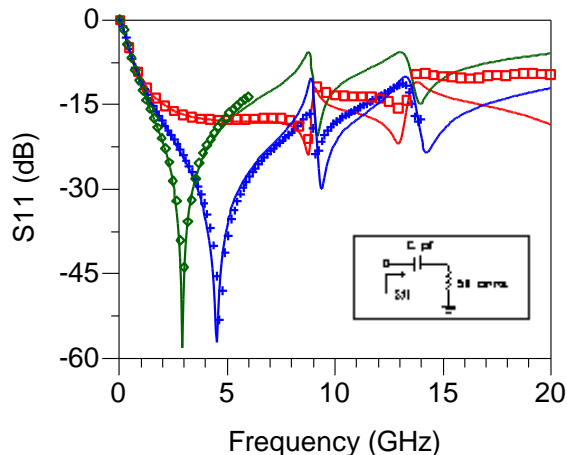
CAP-PPI-0402N-001
0.1 to 33 pF
0402 Body Style

Model Description

The CAP-PPI-0402N-001 is a substrate scalable Global Model™ for the Passive Plus P/N 0402N surface mount chip capacitor family (additional information is available at www.passiveplus.com). The models are for use with microstrip applications and account for substrate (or printed circuit board) related parasitic effects. Substrate height, dielectric constant, loss tangent, interconnect metal thickness, component tolerance, pad width, pad length and pad gap are model input parameters. Models account for up to two higher-order resonant frequency pairs beyond the fundamental series resonant frequency. Accurate effective series resistance (ESR) is modeled over the frequency range. A single, substrate scalable and pad scalable Global Model™ is available that accurately emulate all capacitor values within the valid capacitance range. A Sim_mode switch allows pad stack effects to be disabled.

The pad dimensions used to develop datasheet plots for the model are: length = 0.4 mm, width = 0.5 mm, gap = 0.4 mm.

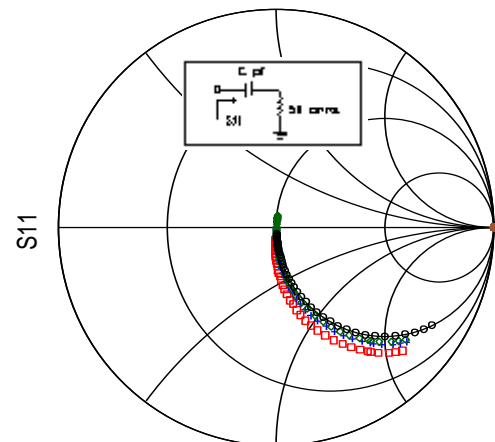
Frequency Sweep



Legend: □ 4mil Rogers 4350B, + 16mil Rogers 4003, ◇ 60mil Rogers 4003, Lines - Model, Symbols - Measured data. Measured data stops at highest valid frequency for each substrate.

S11 for 5.1 pF capacitor mounted on various substrates from 0.04 to 20 GHz.

Part Value Sweep



Legend: □ 4mil Rogers 4350B, + 16mil Rogers 4003, ◇ 60mil Rogers 4003, O Ideal

Model S11 at 2 GHz for capacitor values from 0.1 to 33 pF on various Rogers substrates compared to an ideal capacitor response.

Technical Notes

- Two-port S-parameters were measured using a vector network analyzer and on-board probing with calibration referenced to the outside edges of the component pad stack.
- Capacitors were measured in a series microstrip configuration. Models for alternative interconnect configurations (e.g. coplanar waveguide) are available upon request.
- Substrates used to extract the models: 4 mil Rogers 4350B, 16mil Rogers 4003, and 60mil Rogers 4003.
- Typical range of valid substrate types (substrate height H in mils and dielectric constant Er):
 $1 \leq H/Er \leq 16$.
- Effective series resistance (ESR) was measured using a 34A Boonton Coaxial Resonator Line.
- Highest frequency for measurement validation: 6GHz (60 mil RO4003), 14 GHz (16 mil RO4003), and 20 GHz (4 mil RO4350B)
- Multiple simulation modes (Sim_mode) are available - full mode, ideal mode and no pad stack.

Device in Position

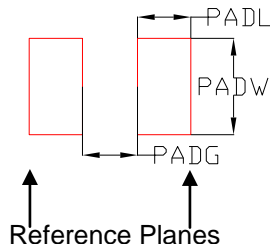


Capacitor Values (pF)

0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8
1.9	2	2.1	2.2	2.4	2.7	3	3.3	3.6
3.9	4.3	4.7	5.1	5.6	6.2	6.8	7.5	8.2
9.1	10	11	12	13	15	16	18	20
22	24	27	30	33				

Highlighted capacitor values are measurement-based models. Other models found via interpolation. Table shows 50 part values in the model range based on manufacturer's datasheet.

PC Board Footprint



$$13.78(0.35) \leq PADL \leq 27.17(0.69)$$

$$19.68(0.5) \leq PADW \leq 32.28(0.82)$$

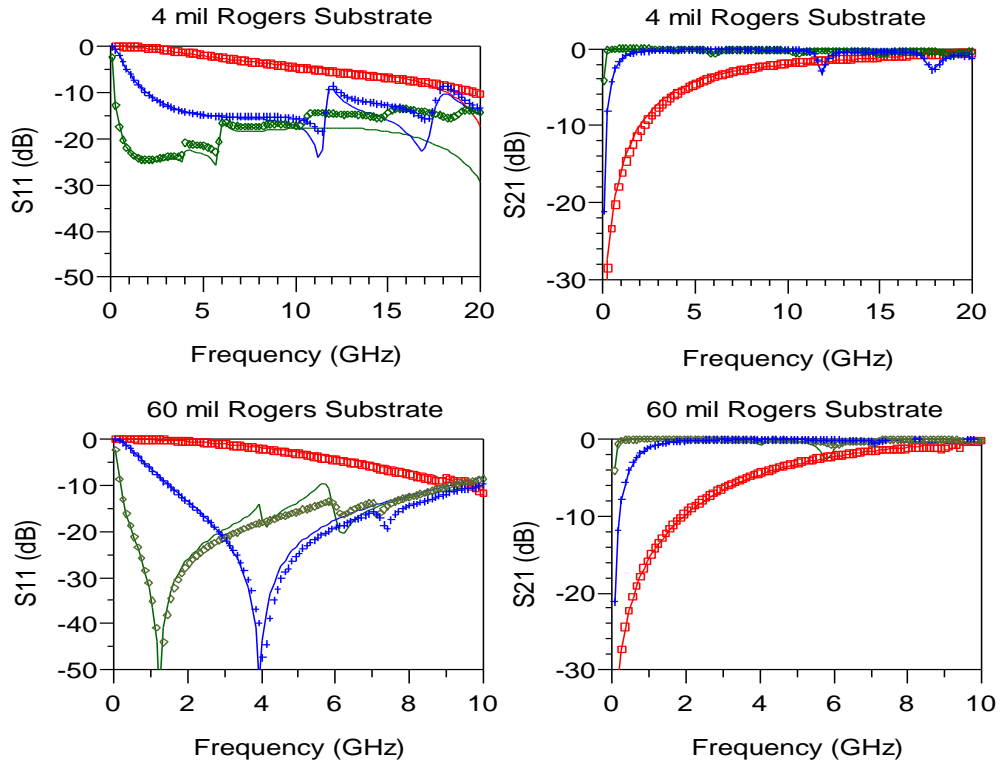
$$13.78(0.35) \leq PADG \leq 17.72(0.45)$$

Units in mils (mm)

Model Input Parameters

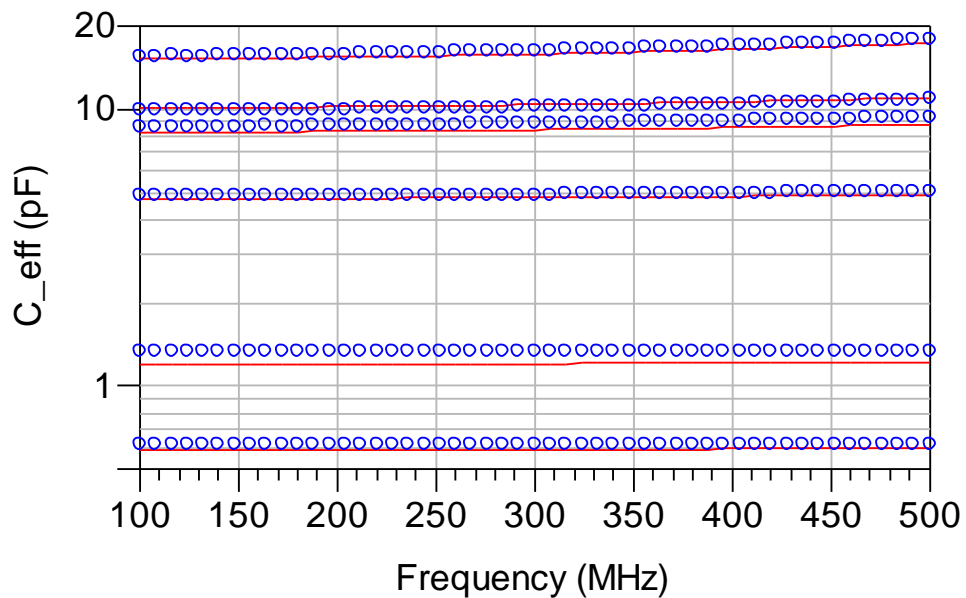
- C - Nominal component value in pF. The full parasitic model is invoked if the part value is within the valid limits of the model, otherwise an ideal element model is used.
- Subst - Microstrip substrate instance name. The model will reference the named substrate instance to obtain values for H, Er, T and TanD.
- Sim_mode - 0 for full parasitic model, 1 for ideal element, 2 for removing pad effects.
- Pad_mode - 0 for default to Sim_mode, 1 for pads always in layout, 2 for pads never in layout
- Tolerance - Tolerance of the part value. The nominal value for this parameter should be set to 1. Use for statistical distribution.
- Pad_Width - Width of land pattern footprint
- Pad_Length - Length of land pattern footprint
- Pad_Gap - Gap between land pattern footprint

Typical Measured Series 2-port S-parameter Data vs. Simulated Data



Legend: \square 0.2 pF, $+$ 2.7 pF, \diamond 27 pF, Solid lines - Model data, Symbols - Measured data

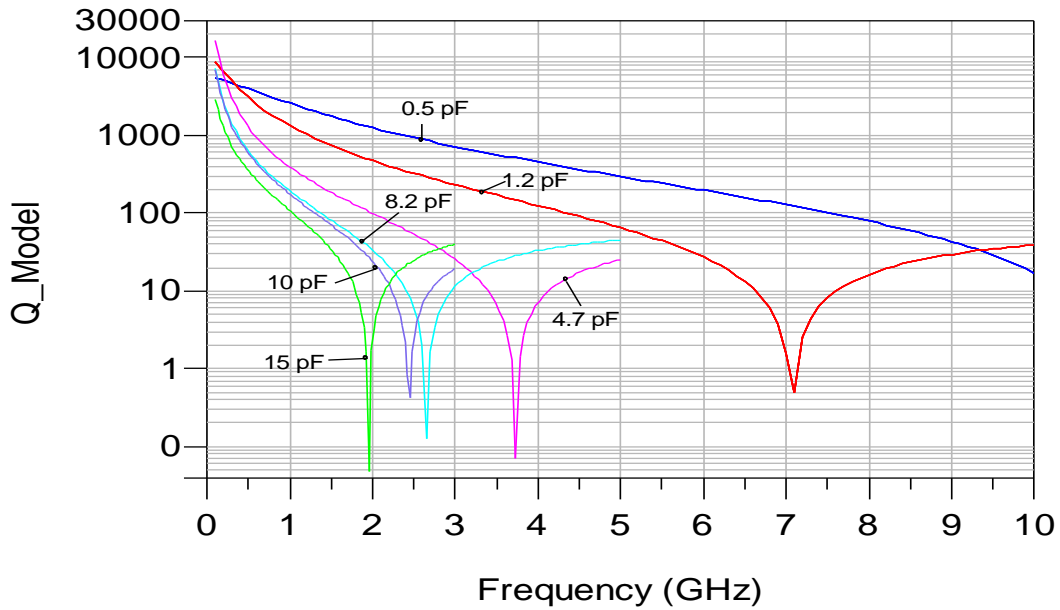
Effective Capacitance



Legend: Red solid lines - Model response on 60 mil Rogers 4003
Blue symbols - Measurement on 60 mil Rogers 4003

Note: Plot is based on selected part values from 0.1-33pF from the manufacturer's Q-factor plot in their part's datasheet.

Simulated Q-Factor



Legend: solid lines - Model response on 60 mil Rogers 4003

Note: Plot is based on selected part values from 0.1-33pF from the manufacturer's Q-factor plot in their part's datasheet.

Model and Datasheet Revision Notes

- 12/17/2012 Original model and datasheet development
- 01/30/2013 Datasheet format change