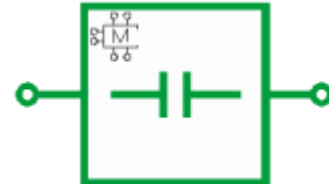


Model Features

- Broadband validation: DC to 6 GHz
- Equivalent circuit based
- Substrate scalable: ($1 \leq H/Er \leq 16$)
- Part value scalable (0.2 to 1000 pF)
- Land Pattern (Pad) scalable
- Accurate effective series resistance
- Orientation selectable (H/V)
- Developed for microstrip interconnects



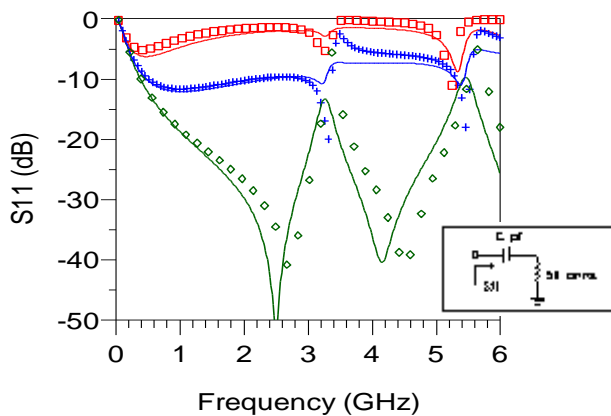
CAP-PPI-1111N-001
0.2 to 1000 pF
1111 Body Style

Model Description

The CAP-PPI-1111N-001 is a substrate scalable Global Model™ for the Passive Plus P/N 1111N 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. An orientation switch is used in the model to select between the horizontal and vertical configurations. A Sim_mode switch allows pad stack effects to be disabled.

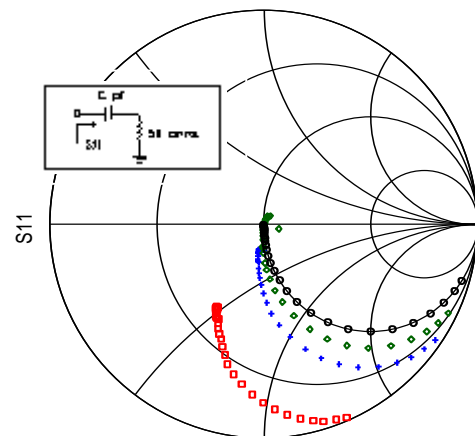
The pad dimensions used to develop datasheet plots for horizontal orientation of the model are: length = 1.3 mm, width = 3.3 mm, gap = 1.9 mm. The vertical pad dimensions used are: length = 1.15 mm, width = 2.65 mm, gap = 1.55 mm.

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 a 12 pF capacitor mounted on various substrates from 0.045 to 6 GHz. Parts are mounted in horizontal orientation.

Part Value Sweep



Legend: □ 4mil Rogers 4350B, + 16mil Rogers 4003, ◇ 60mil Rogers 4003, O Ideal
 Model S11 at 1 GHz for capacitor values from 0.2 to 1000 pF on various Rogers substrates compared to an ideal capacitor response. Parts are mounted in horizontal orientation.

Technical Notes

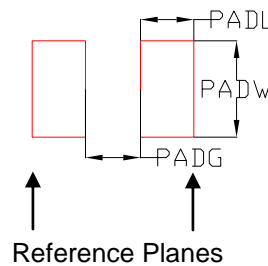
- Two-port S-parameters were measured using a vector network analyzer and on-board probing with calibration referenced to the outside edges of the component pad stack.
- Capacitors were measured in a series microstrip configuration. Models for alternative interconnect configurations (e.g. coplanar waveguide) 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), 12 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.

Capacitor Values (pF)

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	36	39	43	47	51
56	62	68	75	82	91	100	110	120
130	150	160	180	200	220	240	270	300
330	360	390	430	470	510	560	620	680
750	820	910	1000					

Highlighted capacitor values are measurement-based models. Other models found via interpolation. Table shows 85 part values in the model range based on manufacturer's datasheet.

PC Board Footprint

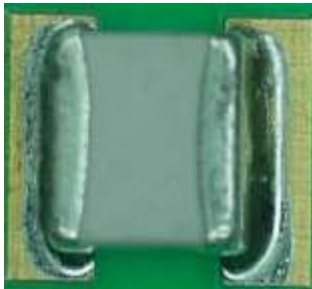


Horizontal Orientation
 $37.4(0.95) \leq PADL \leq 57.1(1.45)$
 $122.1(3.1) \leq PADW \leq 129.9(3.3)$
 $61.0(1.55) \leq PADG \leq 74.8(1.9)$

Vertical Orientation
 $37.4(0.95) \leq PADL \leq 53.2(1.35)$
 $100.4(2.55) \leq PADW \leq 108.3(2.75)$
 $PADG = 61.0(1.55)$

Units in mils (mm)

Device in Horizontal orientation



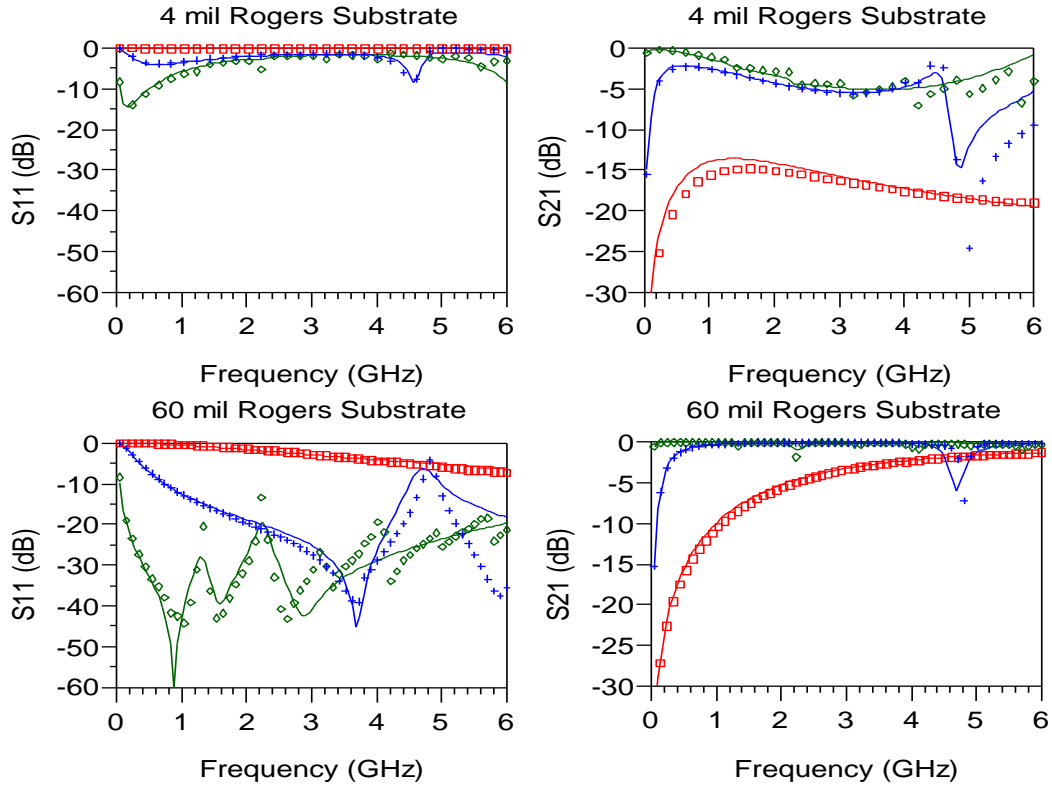
Device in Vertical orientation



Model Input Parameters

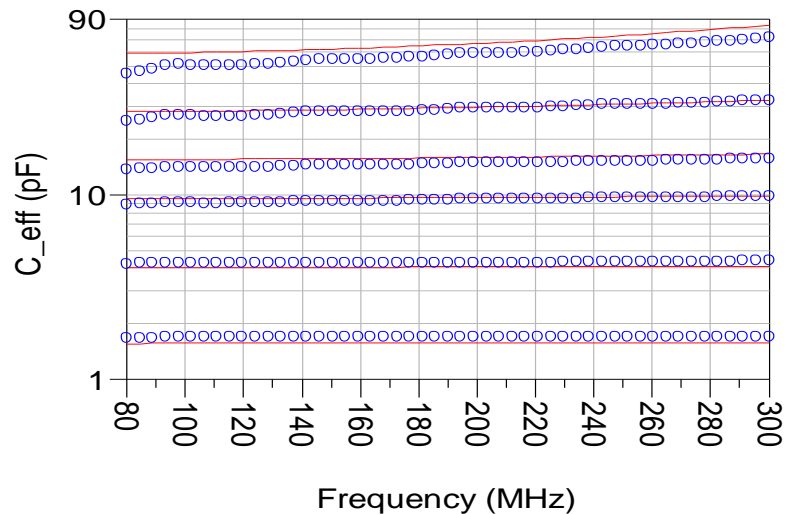
- C - Nominal component value in pF. The full parasitic model is invoked if the part value is within the valid limits of the model, otherwise an ideal element model is used.
- Subst - Microstrip substrate instance name. The model will reference the named substrate instance to obtain values for H, Er, 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
- Orient - Part orientation; 0 for horizontal, 1 for vertical.

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



Legend: □ 0.5 pF, + 6.2 pF, ◇ 100 pF, Solid lines - Model data, Symbols - Measured data

Effective Capacitance

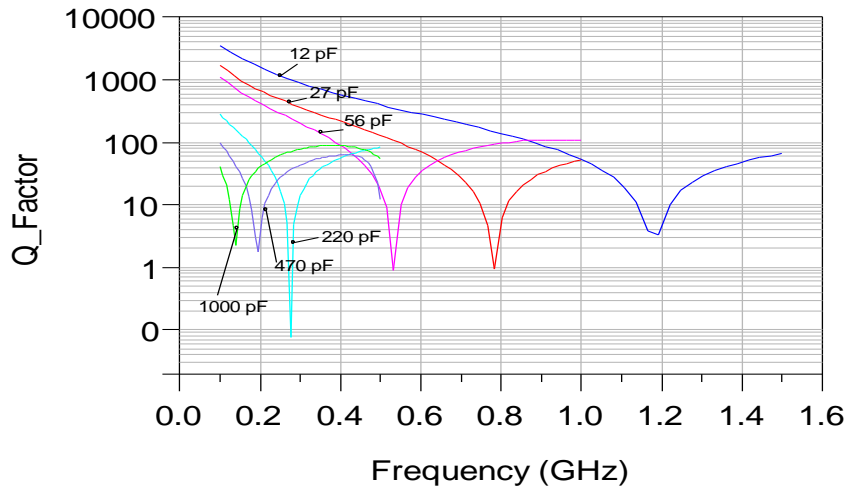


Legend: — Model response on 60 mil Rogers 4003

○ Measurement on 60 mil Rogers 4003

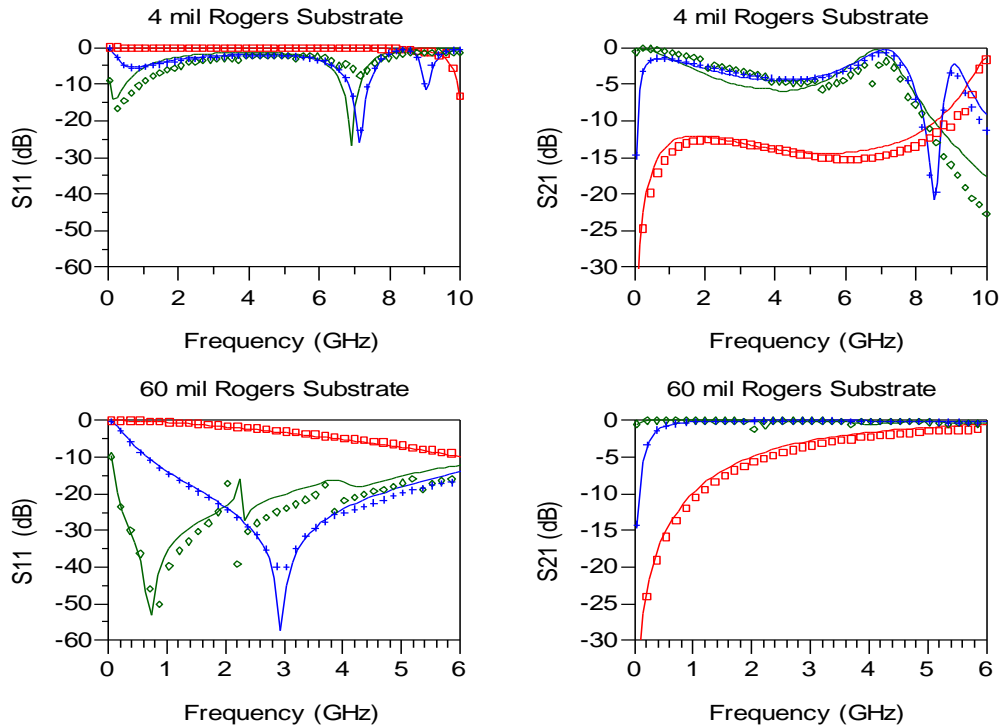
Note: Plot is based on randomly selected part values from 0.2-56pF for horizontal mount parts.

Simulated Q-Factor



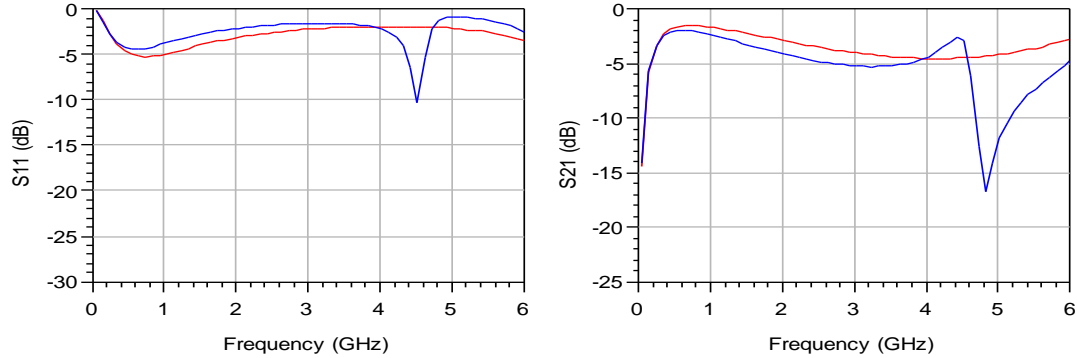
Legend: solid lines - Model response on 60 mil Rogers 4003
 Note: Plot is based on randomly selected part values from 0.2-1000pF for horizontal orientation of the model.

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



Legend: \square 0.5 pF, $+$ 6.8 pF, \diamond 100 pF, Solid lines - Model data, Symbols - Measured data

Horizontal vs. Vertical Model Comparison



Legend: 6.8pF Capacitor. Blue line - Horizontal Model performance, Red Line - Vertical Model performance

Model and Datasheet Revision Notes

- 10/17/2012 Original model and datasheet development
- 01/29/2013 Datasheet format change