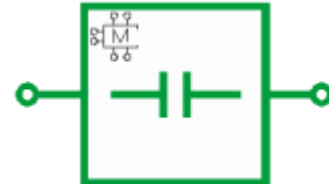


## Model Features

- Broadband validation: DC – 10GHz
- Equivalent circuit based
- Substrate scalable: ( $1 \leq H/Er \leq 16$ )
- Part value scalable (0.1 to 100 pF)
- Land Pattern (Pad) scalable
- Accurate effective series resistance
- Developed for microstrip interconnects



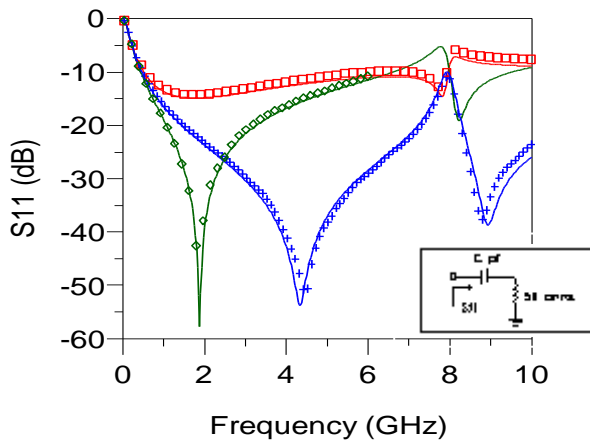
**CAP-PPI-0603N-001**  
**0.1 to 100 pF**  
**0603 Body Style**

## Model Description

The CAP-PPI-0603N-001 is a substrate scalable Global Model™ for the Passive Plus P/N 0603N surface mount chip capacitor family (additional information is available at [www.passiveplus.com](http://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.

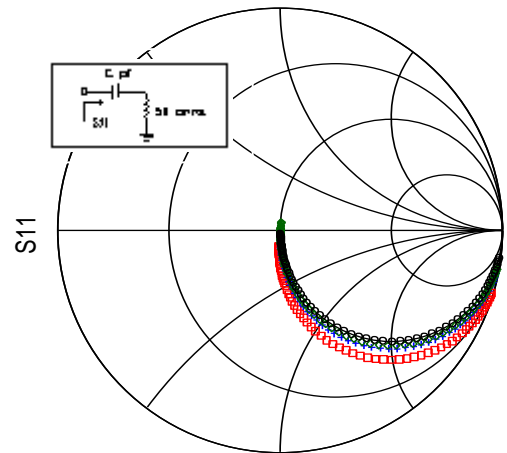
The pad dimensions used to develop datasheet plots for the model are: length = 0.65 mm, width = 0.7 mm, gap = 0.7 mm.

### 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 10 pF capacitor mounted on various substrates from 0.04 to 10 GHz. Parts are mounted in horizontal orientation.

### Part Value Sweep

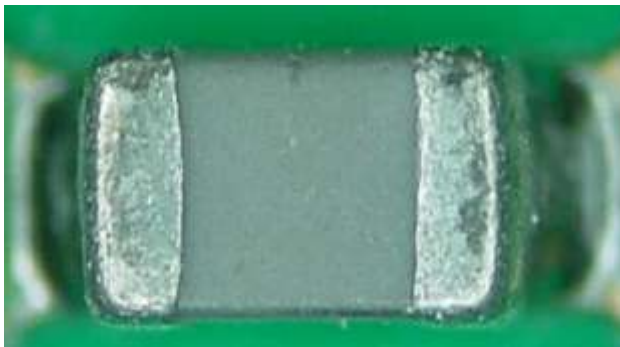


Legend: □ 4mil Rogers 4350B, + 16mil Rogers 4003, ◇ 60mil Rogers 4003, O Ideal  
 Model S11 at 1 GHz for capacitor values from 0.1 to 100 pF on various Rogers substrates compared to an ideal capacitor response. Parts are mounted in horizontal orientation.

## 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), 10 GHz (16 mil RO4003), and 10 GHz (4 mil RO4350B)
- Multiple simulation modes (Sim\_mode) are available - full mode, ideal mode and no pad stack.

## Device in Position

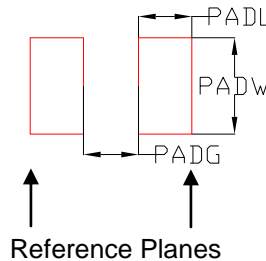


## Capacitor Values (pF)

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	36	39	43	47
51	56	62	68	75	82	91	100	

Highlighted capacitor values are measurement-based models. Other models found via interpolation. Table shows 62 part values in the model range based on manufacturer's datasheet.

## PC Board Footprint



$$23.62(0.6) \leq \text{PADL} \leq 35.43(0.9)$$

$$27.56(0.7) \leq \text{PADW} \leq 45.28(1.15)$$

$$15.75(0.4) \leq \text{PADG} \leq 27.56(0.7)$$

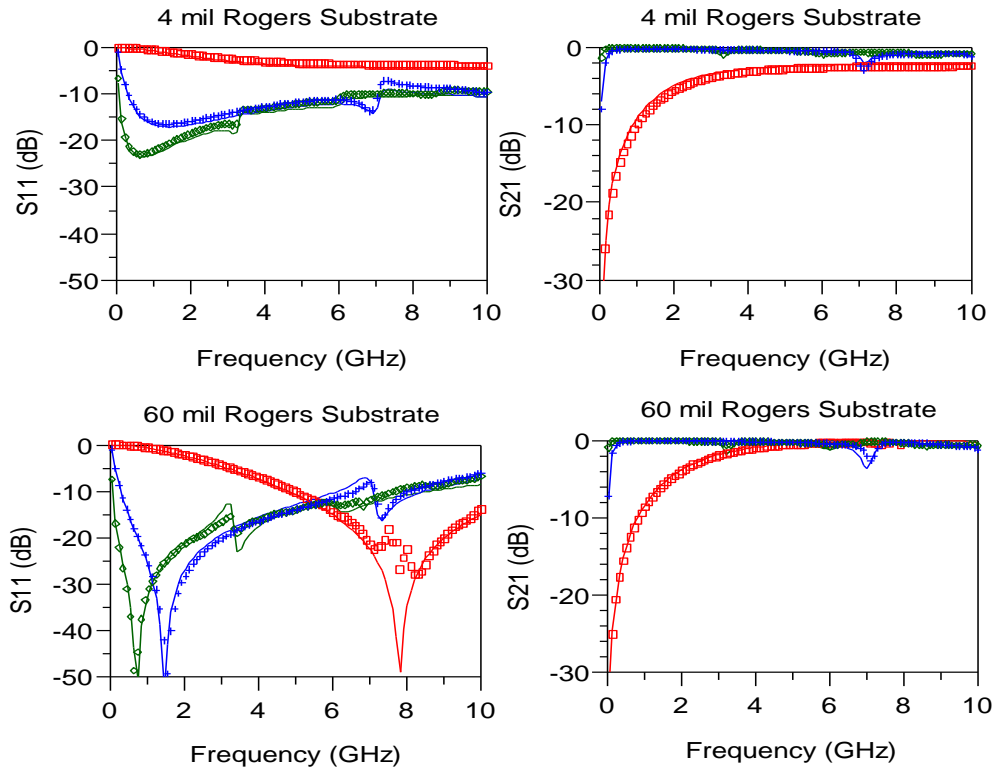
Units in mils (mm)

Reference Planes

## Model Input Parameters

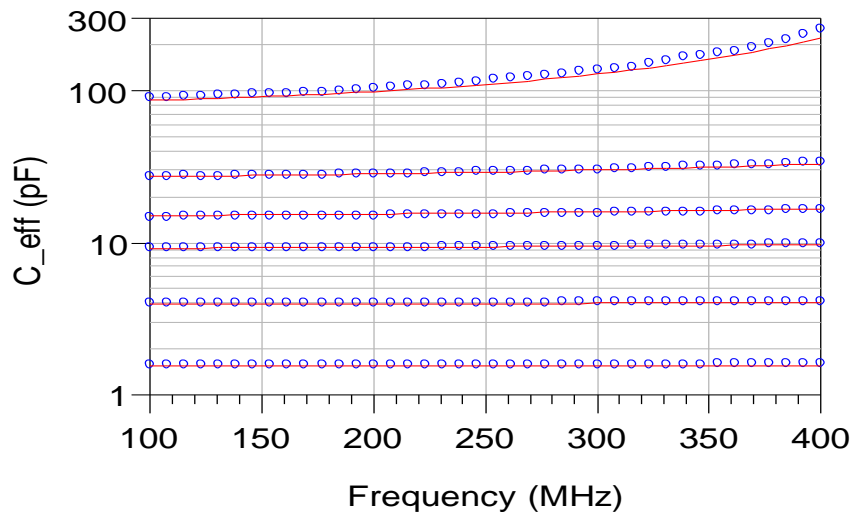
- C - Nominal component value in pF. The full parasitic model is invoked if the part value is within the valid limits of the model, otherwise an ideal element model is used.
- Subst - Microstrip substrate instance name. The model will reference the named substrate instance to obtain values for H, Er, 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:  $\square$  0.6 pF,  $+$  16 pF,  $\diamond$  68 pF, Solid lines - Model data, Symbols - Measured data

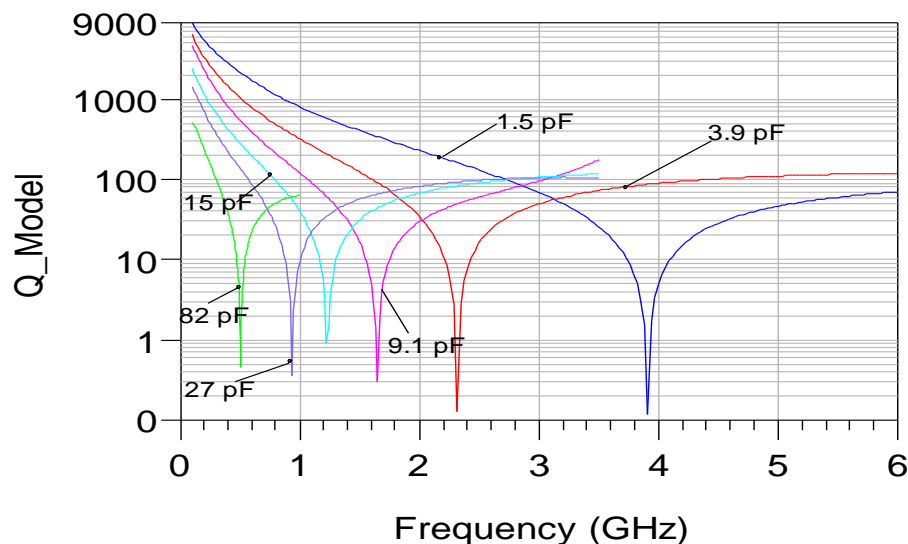
## Effective Capacitance



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 0.1-100pF 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 0.1-100pF from the manufacturer's Q-factor plot in their part's datasheet.

## Model and Datasheet Revision Notes

- 10/17/2012 Original model and datasheet development
- 01/30/2013 Datasheet format change