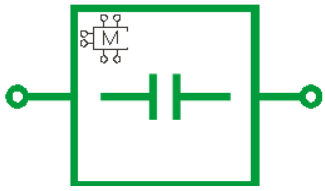
surface mount chip capacitor model

Model Features

- Broadband validation: DC – 12GHz
- Equivalent circuit based
- Substrate scalable: (1 ≤ H/Er ≤ 16)
- Part value scalable (0.1 to 150 pF)
- Land Pattern (pad) scalable
- Accurate effective series resistance
- Developed for microstrip interconnects



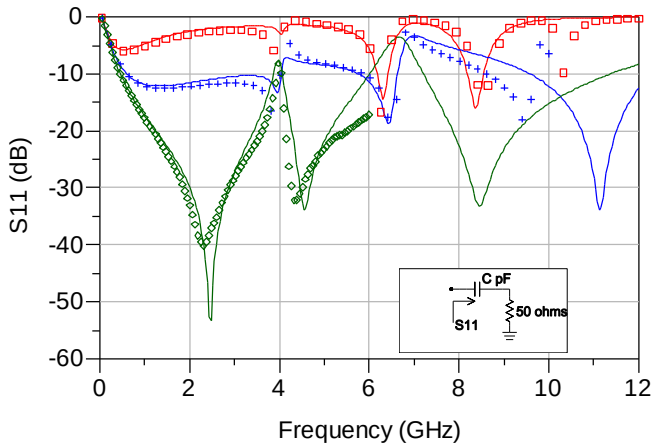
CAP-PPI-1111C-002
0.1 to 150 pF
1111 Body Style

Model Description

The CAP-PPI-1111C-002 is a substrate scalable Global Model™ for the Passive Plus P/N 1111C 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, pad length, pad width, pad gap and component tolerance 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.

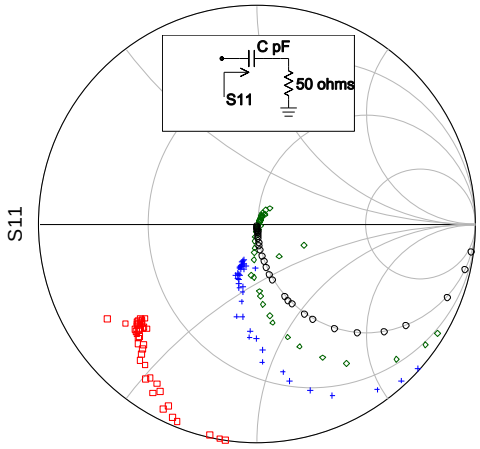
The pad dimensions used to develop datasheet plots for the model are: length = 1.25 mm, width = 3.05 mm, gap = 1.55 mm.

Frequency Sweep



Legend: □ 4mil Rogers 4350B, + 20mil Rogers 4003C, ◊ 60mil Rogers 4003C, Lines - Model, Symbols - Measured data. Measured data stops at highest valid frequency for each substrate. S11 for 10 pF capacitor mounted on various substrates from 0.045 to 12 GHz.

Part Value Sweep



Legend: □ 4mil Rogers 4350B, + 20mil Rogers 4003C, ◊ 60mil Rogers 4003C, O Ideal
Model S11 at 2 GHz for capacitor values from 0.1 to 150 pF on various substrates compared to an ideal capacitor response.

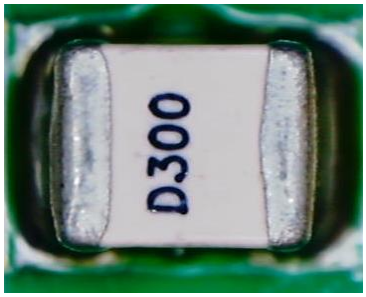
CAP-PPI-1111C-002

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 2-port series configuration using a 50-ohm microstrip test fixture. Models for alternative interconnect configurations (e.g. coplanar waveguide) are available upon request.
- The models were developed using the following land pattern dimensions: PADL= 42.21 mils, PADW = 120.08 mils, PADG = 61.02 mils. The pad scalable models are then validated with S-parameter measurements within the recommended pad range.
- Substrates used to extract the models: 4mil Rogers 4350B, 20mil Rogers 4003C, 60mil Rogers 4003C.
- Typical range of valid substrate types (substrate height H in mils and dielectric constant Er):

  1 ≤ H/Er ≤ 16.
- Effective series resistance (ESR) was measured using a 4291A Impedance Analyzer and 16197 Agilent Test Fixture.
- Highest frequency for measurement validation: 12GHz (4mil Rogers 4350B), 10GHz (20mil Rogers 4003C), 6GHz (60mil Rogers 4003C).
- Multiple simulation modes (Sim_mode) are available - full mode, ideal mode and no pad stack.

Device Image

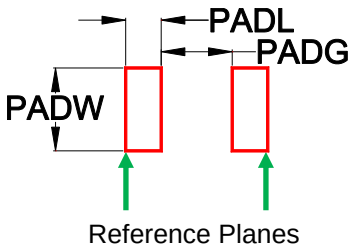


Capacitor Values (pF)

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	110
120	130	150				

Highlighted capacitor values are measurement-based models. Other models found via interpolation. Table shows 66 part values in the model range based on manufacturer's datasheet.

PC Board Footprint



18.50 (0.47) ≤ PADL ≤ 68.50 (1.74)
109.84 (2.79) ≤ PADW ≤ 124.02 (3.15)
29.92 (0.76) ≤ PADG ≤ 72.44 (1.84)

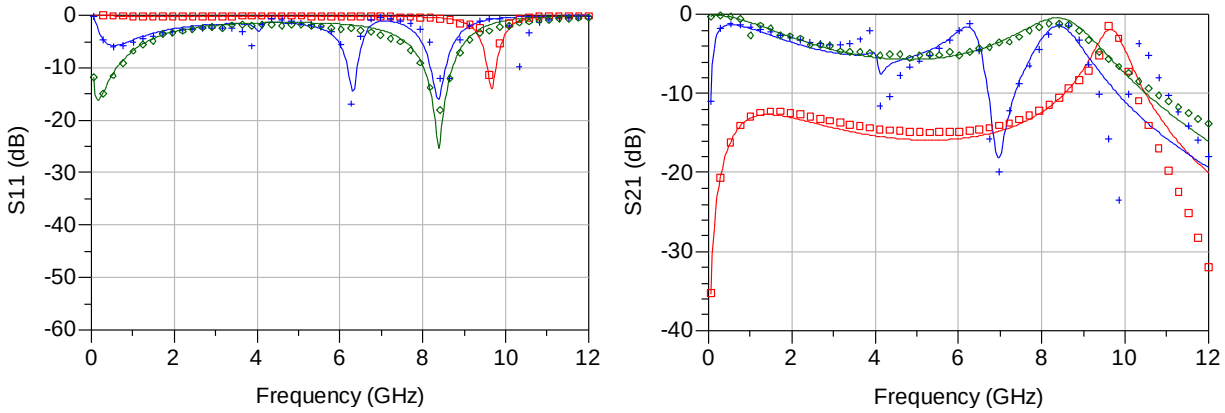
Units in mils (mm)

Model Input Parameters

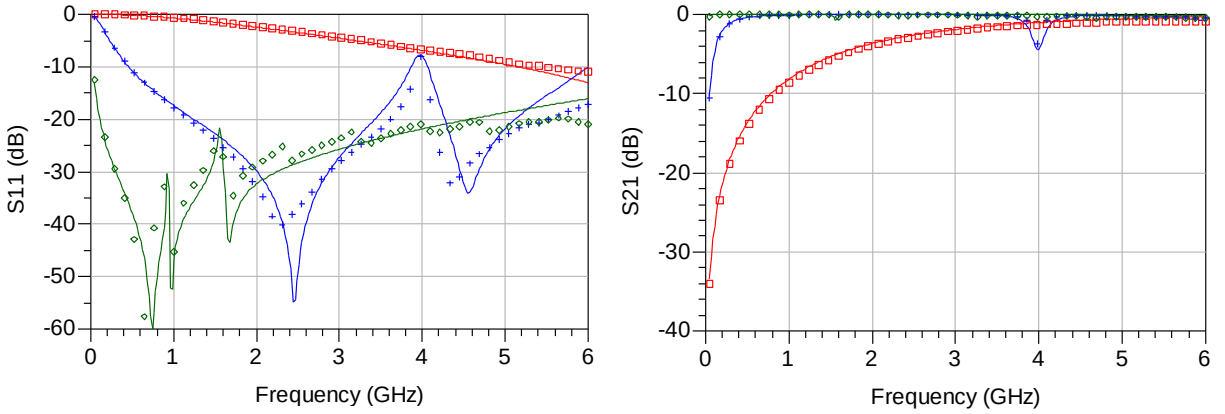
- C - Nominal component value in pF. The full parasitic model is invoked if the part value is within the valid limits of the model, otherwise an ideal element model is used.
- Subst - Microstrip substrate instance name. The model will reference the named substrate instance to obtain values for H, Er,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

4mil Rogers 4350B (H/Er=1):

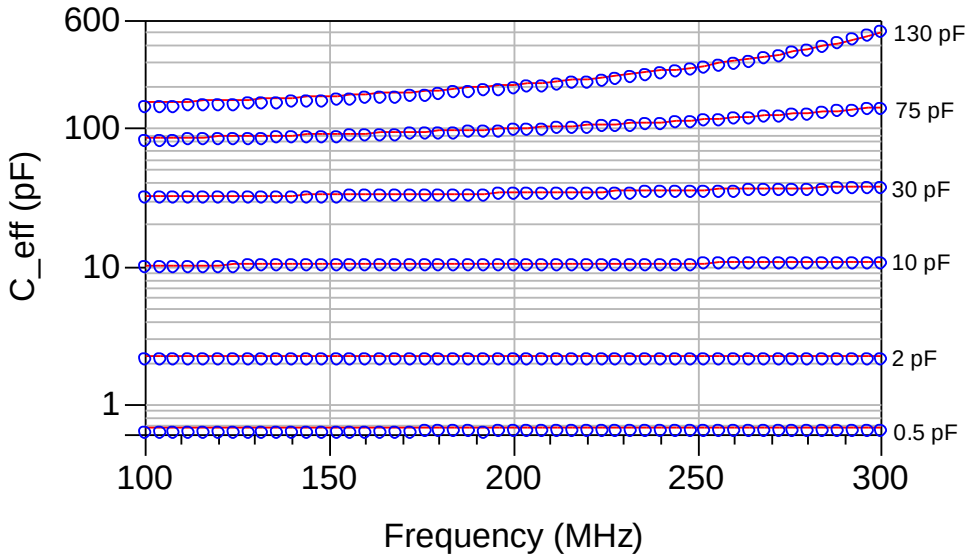


60mil Rogers 4003C (H/Er=16):



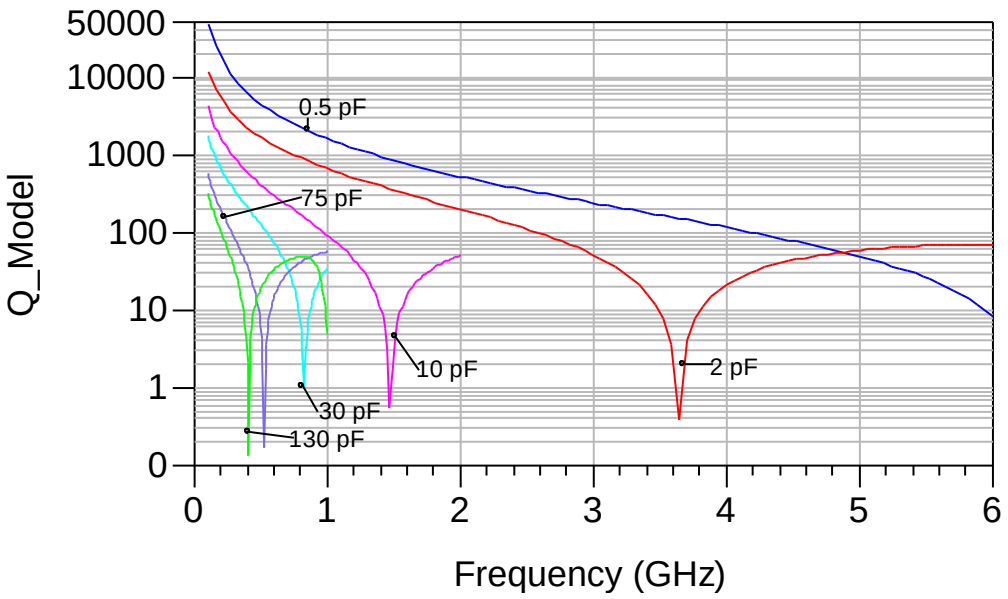
Legend: □ 0.5 pF, +10 pF, ◊130 pF, Solid lines - Model data, Symbols - Measured data

Effective Capacitance



Legend: Red solid lines - Model response on 60mil Rogers 4003C
Blue symbols - Measurement on 60mil Rogers 4003C
Note: Plot is based on randomly selected part values from 0.1-150pF.

Simulated Q-Factor

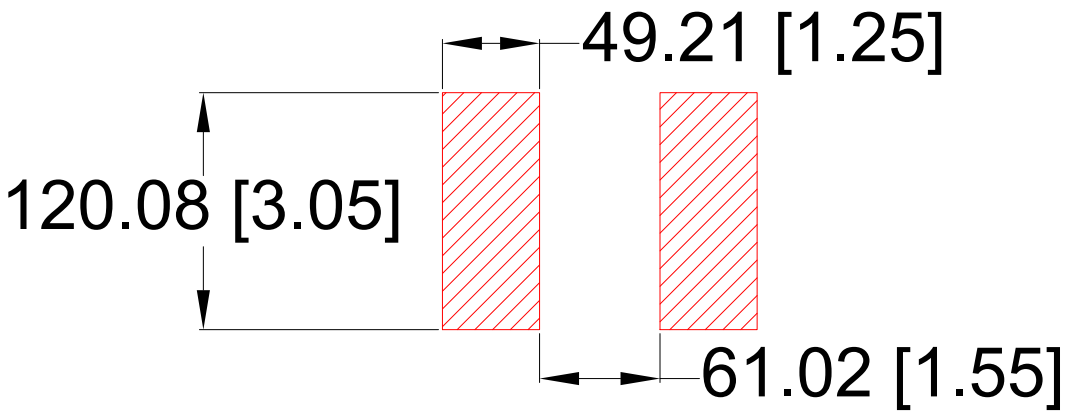


Legend: solid lines - Model response on 60mil Rogers 4003C
Note: Sim_mode = 2 used for models. Plot is based on randomly selected part values from 0.1-150pF.

Model and Datasheet Revision Notes

03/31/2014 Original model and datasheet development

Nominal Footprint



Denotes plated copper land pattern free of solder mask.

CONTROLLING DIMENSIONS - MILS (0.001")
[METRIC DIM - mm] FOR REFERENCE ONLY

Modelithics		Title: Modelithics, INC.	
Scale: NOT TO SCALE	Drawn by: MDLX	File Name: CAP-PPI-1111C-002_datasheet.dwg	Rev: 1
		Date: 03-24-14	Sheet: 1