EE 433 – Fall 2008
Laboratory 3, Measurement of Passive Components

Objectives:

- *To expand the student's familiarity with VNA measurement.*
- *To examine the electrical response of real components (with parasitics)*
- *To promote an understanding of the usefulness of microwave simulation.*
- *To derive several component models from actual test data.*

Background/Introduction:

This lab will use the VNA to measure the impedance v.s. frequency characteristics of a chip inductor, resistor, and capacitor mounted on an SMA connector as a test fixture. This data will then be used to optimize the ADS component models developed in lab 2. Note that the chip inductor has been changed to a Toko inductor. (This is what I had in my lab)

TOKO

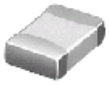
LL2012-F Series

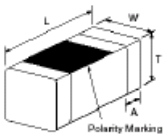
Multilayer Chip Inductors

DESCRIPTION

The LL2012-F Series is a miniature multilayer ceramic chip inductor in a standard 0805 package. Toko's proprietary laminated ceramic material provides high SRF, excellent Q, and superior reliability. These inductors are an ideal solution for signal shaping, or RF filtering for high frequency RF and wireless communication devices.

DIMENSIONS



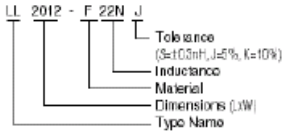


Type	L (mm)	W (mm)	T (mm)	A (mm)
LL2012	2.0±0.2	1.25±0.2	0.60±0.2	0.5±0.3
			0.85±0.3	
			1.00±0.3	
			1.10±0.3	

FEATURES

- Inductance range: 1.5-470nH
- Temperature Coefficient: +250ppm/°C
- Temperature Range: –40°C +100°C
- Miniature size: 0805 footprint (2.0mm x 1.2mm)
- Laminated ceramic allows high SRF over 6 GHz
- Q: 50 Typical (at 800MHz)
- S-parameter data available upon request
- Packaged on tape and reel in 3,000 & 4,000 piece quantity

PART NUMBERING



STANDARD PART NUMBERS

TOKO Part Number	Lo (nH)	L Tol.(1)	Q 100MHz (typ) (1)	Q 800MHz (typ) (1)	SRF MHz (typ) (2)	RDCΩ (max) (3)	IDC mA (max)	Height T (mm)	Qty/reel
LL2012-F1N5S	1.5	S	13	40	>8000	0.10	300	0.60± 0.2	4000
LL2012-F1N8S	1.8	S	13	46	>8000	0.10	300	0.60± 0.2	4000
LL2012-F2N2S	2.2	S	13	48	>8000	0.10	300	0.60± 0.2	4000
LL2012-F2N7S	2.7	S	12	36	>8000	0.10	300	0.60± 0.2	4000
LL2012-F3N3_*	3.3	S,K	13	56	>8000	0.13	300	0.60± 0.2	4000
LL2012-F3N9_*	3.9	S,K	15	54	8400	0.18	300	0.60± 0.2	4000
LL2012-F4N7_*	4.7	S,K	15	50	4800	0.20	300	0.60± 0.2	4000
LL2012-F5N6_*	5.6	S,K	15	53	4000	0.23	300	0.60± 0.2	4000
LL2012-F6N8_*	6.8	J,K	15	51	3660	0.25	300	0.60± 0.2	4000
LL2012-F8N2_*	8.2	J,K	15	53	3000	0.28	300	0.60± 0.2	4000
LL2012-F10N_*	10.0	J,K	16	46	2600	0.30	300	0.85± 0.3	4000
LL2012-F12N_*	12.0	J,K	16	48	2460	0.35	300	0.85± 0.3	4000
LL2012-F15N_*	15.0	J,K	17	48	2000	0.40	300	0.85± 0.3	4000
LL2012-F18N_*	18.0	J,K	17	43	1750	0.48	300	0.85± 0.3	4000
LL2012-F22N_*	22.0	J,K	17	47	1700	0.50	300	0.85± 0.3	4000

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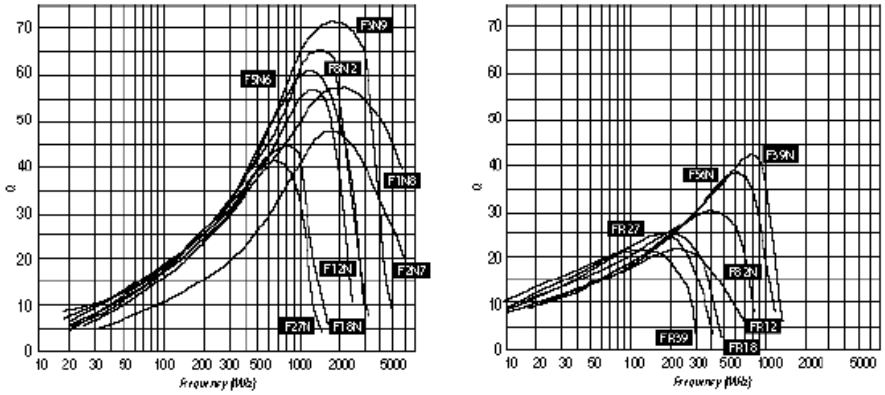
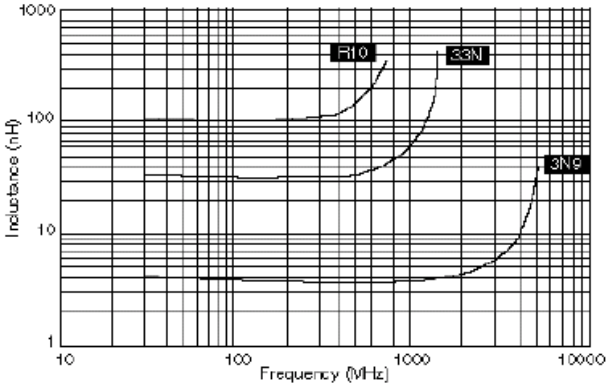
LL2012-F Series

ELECTRICAL CHARACTERISTICS

Q vs. Frequency



Inductance vs. Frequency



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Panasonic Multilayer Ceramic Capacitors(For General)

Multilayer Ceramic Chip Capacitors (For General Electronic Equipment)

Series: **ECJ**

■ Features

- Small size and wide capacitance range
- Superior humidity characteristics and long life due to the monolithic construction
- Excellent solderability and resistance to soldering heat due to terminals with three layers of silver, nickel and solder
- Low self-inductance and excellent frequency characteristics

■ Recommended Applications

Class 1 (T.C. Type)
Temperature compensations, tuned circuits and filter circuits, where low loss and high stability of capacitance and high insulation resistance are required
Class 2 (HI-K Type)
Coupling and By-pass, where low loss and high stability of capacitance are not so important

■ Explanation of Part Numbers

ECJ Series

1	2	3	4	5	6	7	8	9	10	11	12	
E	C	J	2	V	C	1	H	1	0	1	J	(Example)

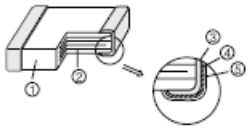
①Product Code
②Size Code
③Packaging Styles
④Temperature Characteristics
⑤Rated Voltage
⑥Nominal Capacitance
⑦Capacitance Tolerance

■ Product Code

ECJ : Multilayer Ceramic Chip Capacitors

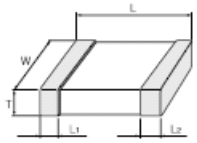
■ Handling Precautions

■ Construction



No	Name
①	Ceramic dielectric
②	Inner electrode
③	Substrate electrode
④	Intermediate electrode
⑤	External electrode

■ Dimensions in mm (not to scale)



Unit : mm

Code	Size Code (EIA)	L	W	T	L1, L2
Z	"06" Type 0201	0.60±0.03	0.30±0.03	0.30±0.03	0.15±0.05
0	"10" Type 0402	1.00±0.05	0.50±0.05	0.50±0.05	0.2±0.1
1	"11" Type 0603	1.6±0.1	0.8±0.1	0.8±0.1	0.3±0.2
2	"12" Type 0805	2.0±0.1	1.25±0.10	0.6±0.1 0.85±0.10 1.25±0.10	0.50±0.25
3	"13" Type 1206	3.20±0.15	1.60±0.15	0.6±0.1 0.85±0.10 1.15±0.10	0.6±0.3
		3.2±0.2	1.6±0.2	1.6±0.2	
4	"23" Type 1210	3.2±0.3	2.5±0.2	2.0±0.2	0.6±0.3

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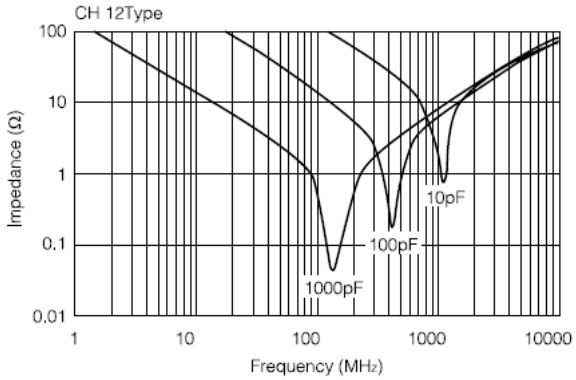
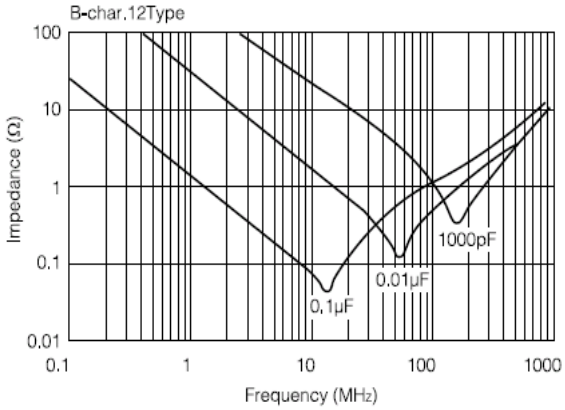
● Impedance-Frequency





Laboratory Procedures

(1) Calibrate the VNA S11 for a frequency range of 50 MHz to 10GHz
   a. Use a N to SMA-female adaptor right on the input port for the calibration
   b. Display the smith chart form for S11 with a shorted sma connector attached
   c. Rotate in enough delay to display the 0 impedance on the Smith chart. Record this value for later use.
   d. Q- Explain what the purpose of this procedure is as discussed in class
   e. Q- Can you get the short to look like a dot (0 ohms at all frequencies)? Explain why not!

(2) Connect the 10pF capacitor/SMA to the VNA. What is the measured SRF of the capacitor? Does it agree with the datasheet? Change the display type of the VNA to impedance. See if you can recreate the capacitor impedance curve as shown in the data sheet. Plot the impedance curve of the capacitor and see how close it comes to the above plot.

(3) Repeat step 2) for the inductor and resistor. (you will have to find how to model a real resistor)

(4) Post lab- import the S- parameter data files into the ADS project from Lab 2. Plot the measured data and the model data for the capacitor on the same graphs. Adjust your capacitor model values for a best fit to the actual data. Discuss the differences you see.

(5) Repeat 4) for the inductor.

Data Analysis and Reporting

Write a summary report as you did for the first lab.