

Industrial & Automotive use **LC Filter Simulator Instruction Manual**

ver 1.1

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Device Solutions Business Division
Industrial Solutions Company
Panasonic Corporation

1. What is the Industrial & Automotive use LC Filter Simulator?

The Industrial & Automotive use LC filter simulator enables the simulation of attenuation amounts when configuring a filter using Panasonic's power inductor and aluminum electrolytic capacitor suitable for industrial & automotive use.

2. Features

- π type, T-type, and L-type filter circuits can be simulated.
- Five circuits can be compared at the same time.
- Parallel and series connections of components can also be simulated.
- Graph and CSV outputs for simulation results (attenuation characteristics) are available.

3. Overall Site Structure

The simulator interface is divided into three main sections, each with a 'jumping within the site' button in the top right corner:

- Simulation conditions:** A table for configuring simulation parameters.

Filter circuit	Input Z[Ω]	Output Z[Ω]	Parts structure		
Sim1	50	50	C Single item	L Single item	C Single item
Sim2	50	50	C Single item	L Single item	C Single item
Sim3	50	50	C Single item	L Single item	C Single item
Sim4	50	50	C Single item	L Single item	C Single item
Sim5	50	50	C Single item	L Single item	C Single item
- Component selection:** A circuit diagram and a table for selecting components.

(Circuit diagram / part number display part)

Circuit number	Part number	Circuit number	Part number	Circuit number	Part number
G11	Please select	L21	Please select	G31	Please select

Component selection part)

(Individual component impedance graph display part)
- Simulation result:** A table showing simulation results and filter characteristics.

Filter circuit	Input Z[Ω]	Output Z[Ω]	Parts structure	Parts occupied area (mm²)	Attenuation amount[dB]			Graph display ON
					1MHz	10MHz	100MHz	
Sim1	50	50	C Single item L Single item C Single item				<input checked="" type="checkbox"/>	
Sim2	50	50	C Single item L Single item C Single item				<input checked="" type="checkbox"/>	
Sim3	50	50	C Single item L Single item C Single item				<input checked="" type="checkbox"/>	
Sim4	50	50	C Single item L Single item C Single item				<input checked="" type="checkbox"/>	
Sim5	50	50	C Single item L Single item C Single item				<input checked="" type="checkbox"/>	

(Filter characteristic display part)

(1) Select the circuit

(2) Select the component

(3) Display the simulation results

The simulator consists of the following three items, and the basic flow of simulation is (1) -> (2) -> (3).

- (1) Select the circuit
- (2) Select the component
- (3) Display the simulation results

The window is portrait-oriented. You can switch between the three items by jumping within the site using the buttons provided on the upper right of each item.

Please note that the “Select the component” item allows you to see the selected component’s individual impedance characteristic graph.

Specific explanations on how to use the simulator are available starting on the next page.

4. How to Use

1) Select the circuit

This simulator allows you to specify five circuits (Sim1 to Sim5) separately for conducting a simulation.

Here, Sim1 is used as an example to explain how to specify simulation conditions.

(1) Select either the “ π -type,” “T-type,” or “L-type” filter circuit basic structure from the pull-down menu.

(2) Directly input the impedance values in the “Input Z” and “Output Z” fields.

(3) Select either part structure (1), (2), or (3) from the pull-down menu.

You can specify Sim2 to Sim5 in the same manner.

(Selectable items)

Filter circuit	Parts structure		
	①	②	③
π type	C Single item C parallel2~5	L Single item L parallel2, L series2	C Single item C parallel2~5
T type	L Single item L parallel2, L series2	C Single item C parallel2~5	L Single item L parallel2, L series2
L type	-	L Single item L parallel2, L series2	C Single item C parallel2~5

Simulation conditions

[Select the component](#)
[Result of the simulation](#)

(1)
(2)
(3)

	Filter circuit	Input Z[Ω]	Output Z[Ω]	Parts structure		
				①	②	③
Sim1 <input checked="" type="radio"/>	π type	50	50	C parallel2	L series2	C Single item
Sim2 <input type="radio"/>	π type	50	50	C Single item	L Single item	C Single item
Sim3 <input type="radio"/>	π type	50	50	C Single item	L Single item	C Single item
Sim4 <input type="radio"/>	π type	50	50	C Single item	L Single item	C Single item
Sim5 <input type="radio"/>	π type	50	50	C Single item	L Single item	C Single item

Select the component

[Simulation Conditions](#)
[Result of the simulation](#)

Simulation conditions: Sim1

< π type>
Parts structure①
Parts structure②
Parts structure③

* A circuit diagram in accordance with the selected circuit structure will be displayed.

2) Select the component

In the “Select the component” item, select a part number for each component indicated in the circuit diagram out of the Panasonic part numbers indicated as candidates.

Select the component
Simulation Conditions
Result of the simulation

Simulation conditions: Sim1

< π type>

Parts structure①

Circuit number	Part number
C11	Please select
C12	Please select

Parts structure②

Circuit number	Part number
L21	Please select
L22	Please select

Parts structure③

Circuit number	Part number
C31	Please select

Here, C11 is used as an example to explain how to select. You can select other components in the same manner.

(1) Click part number “C11” in the list window to display the “Capacitor parts list”.

<Capacitor parts list>

Series name:

Capacitance[μ F]:

ϕ size[mm]:

Rated voltage[V]:

L size[mm]:

Part number:

Search results:57

Selection	Series name	Part number	Rated voltage[V]	Capacitance [μ F]	Tolerance	Characteristic			Dimensions[mm]		
						Ripple current	ESR	tan δ	ϕ	L	AxB
<input type="checkbox"/>	TP	EEETP1A221AP	10	220	$\pm 20\%$	270	0.2	0.30	8	10.2	8.3x8.3
<input type="checkbox"/>	TP	EEETPA331UAP	10	330	$\pm 20\%$	270	0.2	0.30	8	10.2	8.3x8.3
<input type="checkbox"/>	TP	EEETP1A331AP	10	330	$\pm 20\%$	500	0.15	0.30	10	10.2	10.3x10.3
<input type="checkbox"/>	TP	EEETP1A471AP	10	470	$\pm 20\%$	500	0.15	0.30	10	10.2	10.3x10.3
<input type="checkbox"/>	TP	EEETPC101XAP	16	100	$\pm 20\%$	197	0.45	0.23	6.3	7.7	6.6x6.6
<input type="checkbox"/>	TP	EEETP1C101AP	16	100	$\pm 20\%$	270	0.2	0.23	8	10.2	8.3x8.3

(2) Select and specify parameters such as the series name and capacitance from pull-down menus to narrow down part numbers indicated in the search results. You can also narrow them down by directly inputting a part number.

(3) You can select a part number from the list of narrowed-down candidates by clicking a selection tab.

After the selection, the “Capacitor parts list” will disappear, and the selected part number will be indicated in the “C11” field in the initial window.

Parts structure①

Circuit number	Part number
C11	EEHZA1E330R
C12	Please select

Parts structure②

Circuit number	Part number
L21	Please select
L22	Please select

Parts structure③

Circuit number	Part number
C31	Please select

3) See the parts information

You can download catalogs and simulation models (S parameter, etc.) of the selected component.

- (1) Click the tab of the parts structure you want to see, out of the tabs in the parts number table.
- (2) Click the name corresponding to the parts number you want to see.
(Clicked name will turn red.)
- (3) Then, the impedance characteristic graph corresponding to the selected parts number will be displayed.
- (4) At the same time, "Graph," "CSV," "Catalog," and "Sim model" icons will be displayed below the graph, indicating the download availability.
 - Graph : You can download the displayed graph as a bitmap.
 - CSV : You can download the numerical data of the displayed graph in CSV format.
 - Catalog : Catalog of the selected component will be displayed.
 - Sim model: You can download the Sim model of the selected component.

The screenshot shows the Panasonic website interface. At the top, there are three tabs: "List", "Parts structure①", "Parts structure②", and "Parts structure③". The "Parts structure①" tab is selected and highlighted with a red dashed box labeled (1). Below the tabs is a table with columns "Circuit number", "Part number", and "Parts information". The table contains two rows: C11 with part number EEHZA1E330R (highlighted in red and labeled (2)) and C12 with part number EEHZA1E560P. To the right of the table is a graph titled "EEHZA1E330R" (labeled (3)). The graph plots impedance |Z|, ESR [ohm] on a logarithmic y-axis (0.01 to 10000) against frequency f [MHz] on a logarithmic x-axis (0.01 to 110). Two curves are shown: ESR (blue) and |Z| (orange). Below the graph, there are four buttons: "Graph", "CSV", "Catalog", and "Sim model", all enclosed in a red dashed box labeled (4). A red arrow points from the "Catalog" button down towards the text below.

* About catalogs

For some power inductor's parts numbers, catalogs are not available as the products are currently under development.

Part numbers of mass-produced products
-> Catalog will be opened.

The screenshot shows the Panasonic website page for a Power Inductor. The title is "Power Inductors" and the subtitle is "Power Choke Coil for Automotive application". The series listed are: PCC-M0530M (MC), PCC-M0540M (MC), PCC-M0630M (MC), PCC-M0645M (MC), PCC-M0754M (MC), PCC-M0854M (MC), PCC-M0850M (MC), PCC-M1054M (MC), PCC-M1050M (MC), PCC-M1050ML (MC), and PCC-M1060ML (MC). There are two images of the inductor. The page includes a "Features" section with bullet points: High heat resistance (Operation up to 150 °C), High-reliability (High vibration resistance), High bias current (Excellent inductance stability), Temp. stability (Excellent inductance stability), Low buzz noise (New metal composite core technology), High efficiency (Low Rsc of winding), and AEC-Q200 qualified. There is also a graph showing Inductance [mH] vs. DC current [A] for ETQPM470YM (reference).

Part numbers of products under development
-> The following website will be displayed.

The screenshot shows the Panasonic website page for a Power Inductor under development. The title is "Power Inductors" and the subtitle is "Power Inductors for Automotive application (Under development products)". The page includes a search bar and a message: "There is no catalog for this product for it is under development. Please contact us for product details and samples." There is a button labeled "Inquiries about products".

4) See the simulation result

The simulation results will be displayed after all the components in the structure have been determined.

- (1) A projected area (total of all components) and the attenuation amounts (1MHz, 10MHz, 100MHz) are listed.
- (2) Attenuation characteristics are graphed.
- (3) You can download the attenuation characteristics in graph form or as CSV data.

Simulation result

▶ Simulation Conditions (1)
▶ Select the component (1)

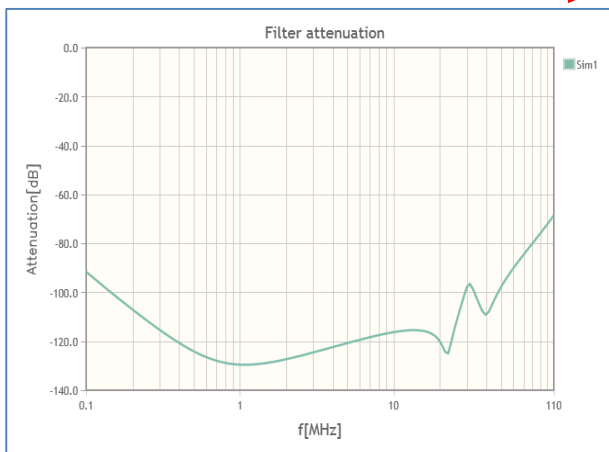
	Filter circuit	Input Z[Ω]	Output Z[Ω]	Parts structure			Parts occupied area [mm ²]	Attenuation amount[dB]			Graph display ON
				①	②	③		1MHz	10MHz	100MHz	
Sim1	π type	50	50	C parallel2	L series2	C Single item	313.7	-129.6	-116.2	-72	<input checked="" type="checkbox"/>
Sim2	π type	50	50	C Single item	L Single item	C Single item					<input checked="" type="checkbox"/>
Sim3	π type	50	50	C Single item	L Single item	C Single item					<input checked="" type="checkbox"/>
Sim4	π type	50	50	C Single item	L Single item	C Single item					<input checked="" type="checkbox"/>
Sim5	π type	50	50	C Single item	L Single item	C Single item					<input checked="" type="checkbox"/>

Filter characteristics

(2) Filter attenuation

(3)

Graph
CSV



	A	B	C	D
	f [MHz]	Sim1		
1				
2	0.01	-47.01205557		
3	0.0104763	-47.1498786		
4	0.0109752	-47.27566315		
5	0.011498	-47.3994128		
6	0.0120456	-47.51917687		
7	0.0126193	-47.63326688		
8	0.0132203	-47.75754872		
9	0.01385	-47.8789511		
10	0.0145096	-48.00784483		
11	0.0152007	-48.15668824		
12	0.0159246	-48.2937829		
13	0.0166831	-48.44692771		
14	0.0174777	-48.62633623		
15	0.0183101	-48.79953614		
16	0.0191822	-49.01833287		
17	0.0200958	-49.22468042		
18	0.0210529	-49.4494346		
19	0.0220556	-49.72144132		
20	0.023106	-50.00502817		
21	0.0242065	-50.31788962		
22	0.0253594	-50.66620686		
23	0.0265672	-51.02469712		
24	0.0278326	-51.43228587		

5) See the simulation results (Multiple circuits)

In the explanation above, only Sim1 is specified as the simulation condition. If you specify multiple circuits, simulation results for all the conditions will be displayed at the same time. You can select graphs to be indicated using "Graph display ON". (Remove the check mark for the graphs not to be indicated)

Simulation result

[Simulation Conditions](#)
[Select the component](#)

	Filter circuit	Input Z[Ω]	Output Z[Ω]	Parts structure			Parts occupied area [mm ²]	Attenuation amount[dB]			Graph display ON
				①	②	③		1MHz	10MHz	100MHz	
Sim1	π type	50	50	C parallel2	L series2	C Single item	313.7	-129.6	-116.2	-72	<input checked="" type="checkbox"/>
Sim2	T-type	50	50	L parallel2	C Single item	L Single item	354.9	-46.5	-44.7	-37.4	<input checked="" type="checkbox"/>
Sim3	π type	50	50	C Single item	L Single item	C Single item	188.7	-117.5	-116.3	-50.5	<input checked="" type="checkbox"/>
Sim4	L-type	50	50		L Single item	C Single item	55.6	-65.3	-71.1	-30.7	<input checked="" type="checkbox"/>
Sim5	π type	50	50	C Single item	L Single item	C Single item	194.1	-139.7	-122.7	-53.8	<input checked="" type="checkbox"/>

Filter characteristics

Graph
CSV