

Industrial & Automotive use

LC Filter Simulator Instruction Manual

ver 1.1

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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.
- Data download of configured parts and simulation results are available.

3. Overall Site Structure

The screenshot displays the Panasonic Industrial & Automotive use LC Filter Simulator interface. It is divided into three main sections, each with a 'Page jump' button and a 'Simulation Results' button.

- (a) Simulation Condition:** This section allows users to configure simulation parameters. It includes a table for 'Filter Circuit' with columns for 'Filter Type', 'Inductor', and 'Capacitor'. The 'Filter Type' dropdown is set to 'π Type'. The 'Inductor' and 'Capacitor' dropdowns are set to 'C Single Run'. The 'Simulation Results' button is located at the top right of this section.
- (b) Part selection:** This section allows users to select components for the filter. It includes a circuit diagram showing a π type filter with components C11, L21, and C21. The 'Part selection' button is located at the top right of this section.
- (c) Simulation Results:** This section displays the simulation results. It includes a table for 'Filter Characteristics' with columns for 'Filter Type', 'Inductor', and 'Capacitor'. The 'Filter Type' dropdown is set to 'π Type'. The 'Inductor' and 'Capacitor' dropdowns are set to 'C Single Run'. The 'Simulation Results' button is located at the top right of this section.

The simulator consists of the following three items

(a) Simulation conditions

(b) Part selection

(c) Simulation results

In addition, the "Part selection" allows you to view a single component impedance characteristic graph of the selected components.

A page jump function is provided at the right end of each of the three items.

You can scroll to the place you want to browse with a single click.

The following page describes how to use it.

4. How to Use

[4-1] How to set the simulation conditions

The LC Filter Simulator allows you to set simulation conditions for up to 5 circuits (Sim1 to Sim5).

1. Press the Sim1 radio button to configure settings from Sim1.
2. Select the basic configuration of the filter circuit from "π-type", "T-type", and "L-type".
3. Enter the impedance value numerically in the "Input Z" and "Output Z" fields. (Initial value is 50)
4. Set the part configuration ①, ②, and ③. Select each part configuration from the pull-down menu.

Filter circuit	Part 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 series22	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 Condition

(1)

(2)

(3)

(4)

	Filter Circuit	Input Z	Output Z	Part Structure		
				①	②	③
Sim1 ●	π-Type ▼	50	50	C Single Item ▼	L Single Item ▼	C Single Item ▼
Sim2 ○	π-Type ▼	50	50	C Single Item ▼	L Single Item ▼	C Single Item ▼
Sim3 ○	π-Type ▼	50	50	C Single Item ▼	L Single Item ▼	C Single Item ▼
Sim4 ○	π-Type ▼	50	50	C Single Item ▼	L Single Item ▼	C Single Item ▼
Sim5 ○	π-Type ▼	50	50	C Single Item ▼	L Single Item ▼	C Single Item ▼

Select the Component

Simulation Condition : Sim1

<π-Type>

Part Structure①

Part Structure②

Part Structure③

*Displays a schematic diagram according to the selected simulation conditions.

5. To set multiple simulation conditions, return to step (1). Be sure to set simulation conditions in the order of Sim1, Sim2, Sim3, and so on.

[4-2] How to set up the components

All the parts displayed on the schematic can be set using either "Selected Parts", "User Defined Parts" or "Recommended Parts". "Recommended Parts" can be used only when "User Defined" is selected.

Select the Component

Simulation Condition: Sim1

< π -Type>

Part Structure 1: C11

Part Structure 2: L21

Part Structure 3: C31

List

Part Structure 1

Part Structure 2

Part Structure 3

Circuit Number	Part Number
C11	EEETP1A221AV

Part Selection or User Defined

Recommended Parts

Circuit Number	Part Number
L21	▲ETQP3M1R5YFP

Part Selection or User Defined

Recommended Parts

Circuit Number	Part Number
C31	EEETP1A471AV

Part Selection or User Defined

Recommended Parts

I . The "Parts Selection" is set by the Panasonic part number.

II . "User-defined" is set by entering your own numerical values.

III . The "Recommended Parts" are Panasonic part numbers are set based on the values set in "User Defined".

The following pages explain how to set the parts (the following three types).

- I . How to set up by "Part Selection" (P.5)
- II . How to set up by "User-defined" (P.6)
- III . How to set up by "Recommended Parts" (P.7~8)

I. How to set up by "Part Selection"

(1) Click "Select Parts" to display the setting screen. Click "close" in the upper right corner to close the setting screen.

- ③The search results table displays all parts (You can narrow down your search by ① and ②.)
- Part numbers with ▲ at the beginning of the part number in the search result table are under development. *1

<Inductor Parts List>

Series Name :
Inductance[μH] :

Rated Current[A] :
W Size[mm] :

L Size[mm] :

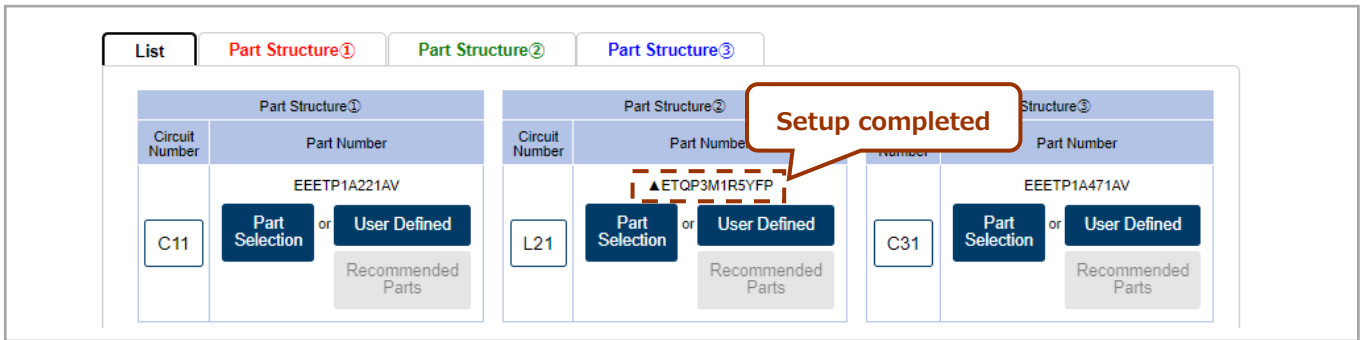
Part Number :

Search Results : 139Items ▲ : Under Development

	Series Name	Part Number	Inductance [μH]	Tolerance [%]	Rated Current [A]	DC Resistance [mΩ]	Dimention[mm]	
							LxW	H
<input type="button" value="Select"/>	PCC-M0530M	*1 ▲ETQP3M1R0YFP	1	±20	6.6	12	5 × 5.5	3
<input type="button" value="Select"/>	PCC-M0530M	▲ETQP3M1R5YFP	1.5	±20	5.6	16.7	5 × 5.5	3
<input type="button" value="Select"/>	PCC-M0530M	ETQP3M2R2YFP	2.2	±20	4.8	22.6	5 × 5.5	3
<input type="button" value="Select"/>	PCC-M0530M	ETQP3M3R3YFP	3.3	±20	4.1	31.3	5 × 5.5	3
<input type="button" value="Select"/>	PCC-M0530M-H	ETQP3M2R2HFP	2.2	±20	5.2	19.5	5 × 5.5	3
<input type="button" value="Select"/>	PCC-M0530M-LP	ETQP3MR47KVP	0.47	±20	9.6	5.8	5 × 5.5	3

- (2) You can narrow down the ③"Search Results and List" by setting the series name, size, etc. in the drop-down menu in ①. Search for part numbers by entering one-byte alphanumeric characters in ②. Partial match search is available.
- (3) By entering ①"Refine" and ②"Part No. Search", the ③"Number of search results and list" will change. Click "Select" of the part you want to use from the list.

(4) The selected part number will be displayed.



II. How to set up by "User-defined"

- (1) Press "User Defined" to display the settings screen.
- (2) For capacitors, enter "Capacitance," "ESL," and "ESR" in one-byte numbers and press "Setting". For inductors, enter "L value," "Parasitic Capacitance," "DCR," and "ACR" in one-byte numbers, and press "Setting".

<User Defined> C11

(Example) Capacitance=200uF, ESL=3nH, ESR=50mΩ

Capacitance

uF

ESL

nH

ESR

mΩ

Setting

<User Defined> L21

(Example) L-Value=45uH, Cp=20pF, DCR=100mΩ, ACR=4000Ω

L

DCR

ACR

L-Value

uH

Parasitic Capacity

pF

DC Resistance

mΩ

AC Resistance

Ω

Setting

(3) The set value and unit are displayed on the part number.
 Since "user-defined" is set, "recommended parts" can be used.

Setup completed

Recommended parts are become available

III. How to set up by "Recommended Parts"

- (1) After setting "User Defined", click "Recommended Parts" to display the setting screen.
- (2) Enter the "Rated voltage" for capacitors and the "Rated current" for inductors using one-byte numbers, and click "Setting".

<Recommended Parts> C11

Capacitance 200 uF ESL 3 nH ESR 50 mΩ

Rated Voltage V **Setting**

Rated Voltage is a required item. ▲ : Under Development

Series Name	Part Number	Rated Voltage(V)	Capacitance (uF)	Tolerance	Characteristic			Dimension(mm)	
					Ripple Current	ESR	tanδ	φ	L

<Recommended Parts> L21

L-Value 45 uH Parasitic Capacity 20 pF DC Resistance 100 mΩ

AC Resistance 4000 Ω

Rated Current A **Setting**

Rated Current is a required item. ▲ : Under Development

Series Name	Part Number	Inductance (uH)	Tolerance (%)	Rated Current (A)	DC Resistance (mΩ)	Dimension(mm)	
						LxW	H

(3) Click "Select" of the part you want to use from the list of search results.

<Recommended Parts> C11

Capacitance uF ESL nH ESR mΩ

Rated Voltage V

Search Results : 4Items ▲ : Under Development

	Series Name	Part Number	Rated Voltage[V]	Capacitance [μF]	Tolerance	Characteristic			Dimenton[mm]		
						Ripple Current	ESR	tanδ	φ	L	A×B
<input type="button" value="Select"/>	ZA-A	EEHAZA1E221B	25.00	220	±20%	2300	27	0.14	8	9.5	-

(4) Displays the part number of the selected recommended part.

Part Structure①

Circuit Number	Part Number
C11	EEHAZA1E221B

Part Structure②

Circuit Number	Part Number
L21	Please Select

Part Structure③

Circuit Number	Part Number
C31	Please Select

Set up completed

[4-3] View the part information you have set up

- (1) There are two ways to view the part information you have set up.
 - Viewing method 1: By pressing the "Part Structure" tab.
 - Viewing method 2: Press "Circuit No. (button)" or "Part No. (text link)" to display.

《Viewing method 1: By pressing the "Part Structure" tab》

Example: Click the tab "Part Structure③" to display "Part Structure③".

The screenshot illustrates the process of viewing part structure data. At the top, there are three tabs: 'Part Structure①' (red), 'Part Structure②' (green), and 'Part Structure③' (blue). A hand icon points to the 'Part Structure③' tab, which is highlighted by a dashed orange box and labeled 'Method 1 . part structure③ tab'. Below the tabs, the 'Part Structure③' view is displayed, showing a table with columns for 'Circuit Number', 'Part Number', and 'Parts Information'. The table lists two parts: C31 (EEHAZS1J101B) and C32 (EETP1A221AP). Each part has a 'Part Selection' or 'User Defined' button and a 'Recommended Parts' button. To the right of the table, there is a graph titled 'EEHAZS1J101B' showing the impedance (Z) and equivalent series resistance (ESR) versus frequency (f). The graph has a logarithmic scale for both axes. The ESR curve (blue) starts at approximately 0.015 ohms at 0.01 MHz, dips to a minimum of about 0.01 ohms at 0.1 MHz, and then rises to about 0.02 ohms at 100 MHz. The impedance curve (orange) starts at approximately 0.1 ohms at 0.01 MHz, dips to a minimum of about 0.01 ohms at 0.1 MHz, and then rises to about 1.0 ohms at 100 MHz. Below the graph, there is a note: 'The results of this simulation are calculated based on input data and assumptions. They are reference data and do not guarantee product characteristics.' At the bottom, there are four buttons: 'PDF', 'Excel', 'Catalog', and 'Sim Model'.

《Viewing Method 2: Click on the "Circuit No. (button)" or "Part No. (text link)" 》

- When a part number is set, "Circuit No." changes to a button and "Part No." changes to a text link.
- The "Circuit No." and "Part No. (Please select)" with no part number set will not respond even if they are pressed.
 - For example, L22 does not respond when "Circuit No." or "Part No." is pressed because the part has not yet been set.
 - For other than L22, parts have already been set, so pressing the "Circuit No." and "Part No." will change the display.

Method 2. Circuit No. button

Method 2. Part number link

Since no parts are set, pressing "Circuit No." or "Part No." does not respond.

Display C32 in the part structure③.

Setting

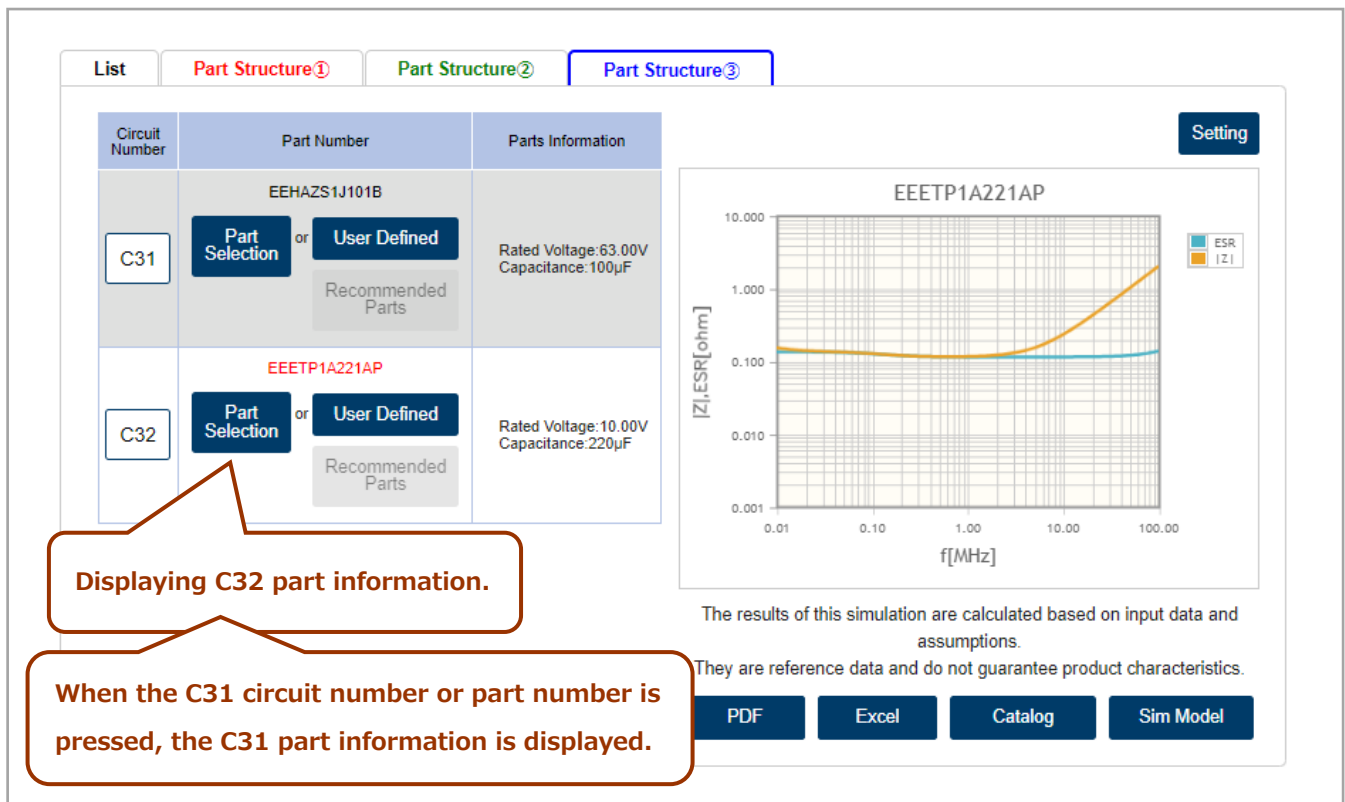
PDF Excel Catalog Sim Model

[4-3] View the part information you have set up

(2) The part being viewed is displayed with a white background and the part number in red.

(2-1) Pressing "Circuit No." or "Part No." toggles the display of the part to be viewed.

(2-2) To view part information for a different part structure, click the "Part Structure" tab, or click the "List" tab, and then click the "Circuit Number" or "Part Number" of the part you want to view. Click the "Circuit No." or "Part No." of the component you want to view to switch the display.



(3) You can change the display scale of the horizontal and vertical axis of the graph by clicking "Setting" in the upper right corner of the impedance graph.

The settable range differs between capacitors and inductors.

《For capacitors》

The screenshot shows the "X Axis" and "Y Axis" settings for capacitors. The "X Axis" section has "Linear" and "Log" radio buttons, with "Log" selected. Below are "Default" (checked), "Minimum Value" (0.01), and "Maximum Value" (100) options. The "Y Axis" section also has "Linear" and "Log" radio buttons, with "Log" selected. Below are "Default" (checked), "Minimum Value" (0.001), and "Maximum Value" (10) options. At the bottom are "Reset" and "OK" buttons.

Horizontal axis (X Axis)

Linear : Displays the scale at equal intervals.

Log : Set the scale to logarithmic.

Default (checked) : Initial value (min. 0, max. 100)

Default (unchecked) : Minimum and maximum values can be entered

→Minimum Value: 0.01

→Maximum Value: 1000

Vertical axis (Y Axis)

Linear : Displays the scale at equal intervals.

Log : Set the scale to logarithmic.

Default (checked) : Initial value (min. 0.001, max. 10)

Default (unchecked) : Minimum and maximum values can be entered

→Minimum Value: 0.001

→Maximum Value: 10

Reset : Restore the impedance graph to the display before the Setting operation.

OK : Change the graph X-axis and Y-axis to the setting values and display them.

《For inductor》

X Axis

☐ Linear ☒ Log

☒ Default

Minimum Value
0.01

Maximum Value
100

Y Axis

☐ Linear ☒ Log

☒ Default

Minimum Value
0.001

Maximum Value
10

Reset OK

Horizontal axis (X Axis)

Linear : Displays the scale at equal intervals.

Log : Set the scale to logarithmic.

Default (checked) : Initial value (min. 0.01, max. 100)

Default (unchecked) : Minimum and maximum values can be entered

→Minimum Value : 0.01

→Maximum Value : 1000

Vertical axis (Y Axis)

Linear : Displays the scale at equal intervals.

Log : Set the scale to logarithmic.

Default (checked) : Initial value (min. 0.01, max. 100000)

Default (unchecked) : Minimum and maximum values can be entered

→Minimum Value : 0.01

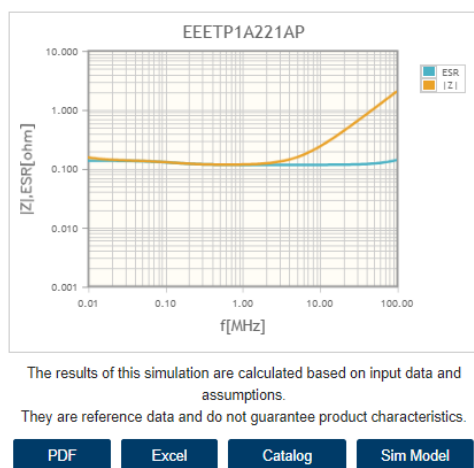
→Maximum Value : 100000

Reset : Restore the impedance graph to the display before the Setting operation.

OK : Change the graph X-axis and Y-axis to the setting values and display them.

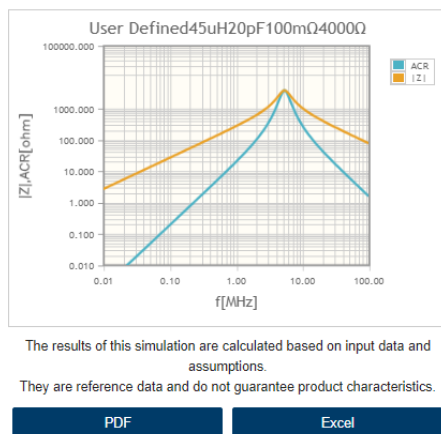
(4) A button for downloading data is displayed below the graph. (The contents of the display will vary depending on how the component is set up.)

《For "Parts Selection" and "Recommended Parts"》



PDF	Outputs a graph image of the configured parts in PDF format.
Excel	Outputs numerical data of configured parts in Excel format.
Catalog	Displays the catalog for configuration parts in a separate tab.*Part numbers under development are displayed on the Product Under Development page instead of the catalog page.
Sim model	Outputs simulation models (S-parameters, etc.) of configuration parts in Zip format.

《For "user-defined"》



PDF	Outputs a graph image of the configured parts in PDF format.
Excel	Outputs numerical data of configured parts in Excel format.

[4-4] View Simulation Results

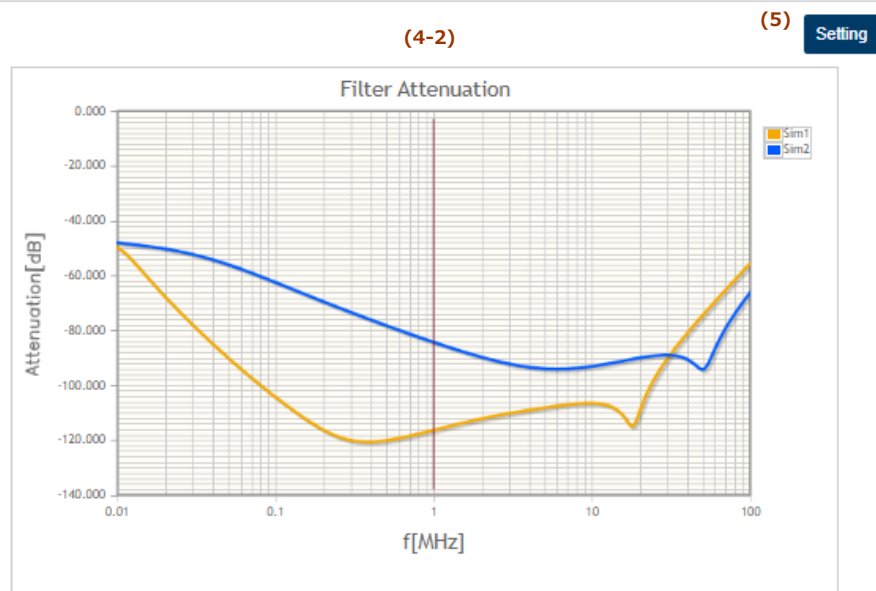
After setting all the components, simulation results (list) and filter attenuation graphs are displayed.

- (1) Circuits with graph display ON checked are displayed in the filter attenuation graph.
- (2) The parts set in the simulation conditions and the selection of parts to be used are displayed.
- (3) Displays the part proprietary surface (sum of all parts). Items containing user definitions are displayed with a hyphen. *1
- (4-1) Attenuation is displayed at 1 MHz as default, and the frequency can be changed by pull-down.
- (4-2) Draws a vertical line on the X axis where the frequency selected for attenuation and the filter attenuation graph intersect.
- (5) The display range of the filter attenuation graph can be changed by "Setting". *2
- (6) A button for data download is displayed below the graph. *3

Simulation Results

(1) Graph Display ON	Filter Circuit	Input Z	Output Z	(2) Part Structure			(3) Simulation Condition	(4-1) Select the Component	Attenuation Amount[dB]
				①	②	③	Parts Occupied Area [mm ²]		
Sim1 <input checked="" type="checkbox"/>	π-Type	50	50	C Single Item C11:EEHAZA1E221B	L Parallel2 L21:45uH 20pF 100mΩ 4000Ω L22:ETQP3M3R3YFP	C Parallel2 C31:EEHAZS1J101B C32:EEETP1A221AP	※1	-	-116
Sim2 <input checked="" type="checkbox"/>	π-Type	50	50	C Single Item C11:EEETP1A221AV	L Single Item L21:▲ETQP3M1R5YFP	C Single Item C31:EEETP1E101AP	165.3		-83.7
Sim3 <input checked="" type="checkbox"/>	π-Type	50	50	C Single Item	L Single Item	C Single Item			
Sim4 <input checked="" type="checkbox"/>	π-Type	50	50	C Single Item	L Single Item	C Single Item			
Sim5 <input checked="" type="checkbox"/>	π-Type	50	50	C Single Item	L Single Item	C Single Item			

Filter Characteristic



The results of this simulation are calculated based on input data and assumptions.
They are reference data and do not guarantee product characteristics.

(6)

[PDF](#) [Excel](#)

- *2. The display range of the filter attenuation graph can be changed by "Setting".
"Setting" is a function to change the display scale of the horizontal axis (X Axis) and the vertical axis (Y Axis) of the graph.

《Filter attenuation》

X Axis

Linear

Log

Default

Minimum Value

0.01

Maximum Value

100

Y Axis

Linear

Log

Default

Minimum Value

0.001

Maximum Value

10

Reset

OK

Horizontal Axis (X Axis)

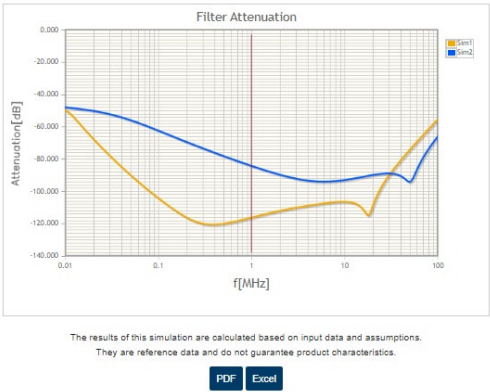
Linear : Displays the scale at equal intervals.
Log : Set the scale to logarithmic.
Default (checked) : Initial value (min. 0.01, max. 100)
Default (unchecked) : Minimum and maximum values can be entered
→Minimum Value: 0.01
→Maximum Value:1000

Vertical Axis (Y Axis)

Linear : Displays the scale at equal intervals.
Log : Set the scale to logarithmic.
Default (checked) : Initial value (min. -140.0, max. 0)
Default (unchecked) : Minimum and maximum values can be entered
→Minimum Value : -200.0
→Maximum Value : 0
Reset : Restore the impedance graph to the display before the Setting operation.
OK : Change the graph X-axis and Y-axis to the setting values and display them.

*3. Displays a button for downloading data below the graph

《filter attenuation》



PDF	Output filter attenuation graph images in PDF format.
Excel	Output numerical data of simulation results in Excel format.