

Bias-T Inductor Design Support Tool Operation Manual



May 2020

Murata Manufacturing Co., Ltd.

Tool Overview

Find optimal products combination for PoC bias-T inductors by simple operations.

Operations

- setting conditions (circuit, criteria, current, cable (In case selected “with cable ”))
- pressing the Optimize button to discover

Result

- optimal products combination
- the graph display of S21 (IL), S11 (RL), S21/S11, Z
- Pass/Fail for standards that are to be cleared
- the smallest margin, total DCR/area of filters, largest height

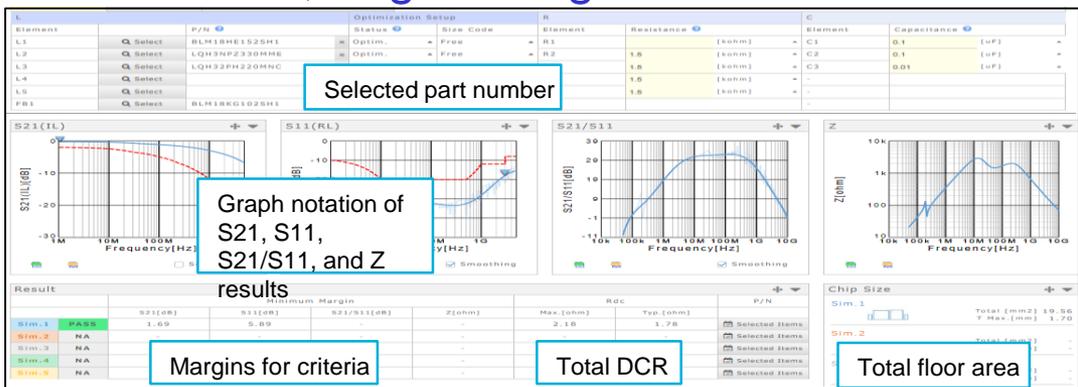
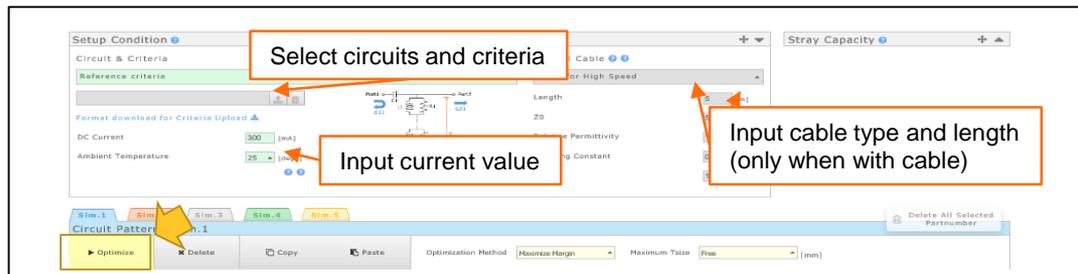


Table of Contents

1, Introduction

1. What Is PoC
2. Typical Circuit Diagram of PoC Systems
3. Effects Bias-T Inductor Characteristics Apply on Signal Quality
4. Importance of PoC Bias-T Filter Selection

2, Tool Functions

1. Circuits That Can Be Simulated
2. Criteria
3. Cables
4. Stray Capacitance Settings of the Board
5. Selection of Automatic Optimization

3, Tool Overview

1. User Interface
2. Details of each sections

4, Tool Use Cases

1. Use Case 1 (Automatic selection with “with cable” circuit)
2. Use Case 2 (Automatic selection with “without cable” circuit)
3. Use Case 3 (Change optimization method and Compare)
4. Use Case 4 (Reselect L from inductor list)
5. Use Case 5 (Relax the set up condition after the result become “Fail”)
6. Use Case 6 (Reduce parallel R)

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3. Cables
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Back to the table
of contents

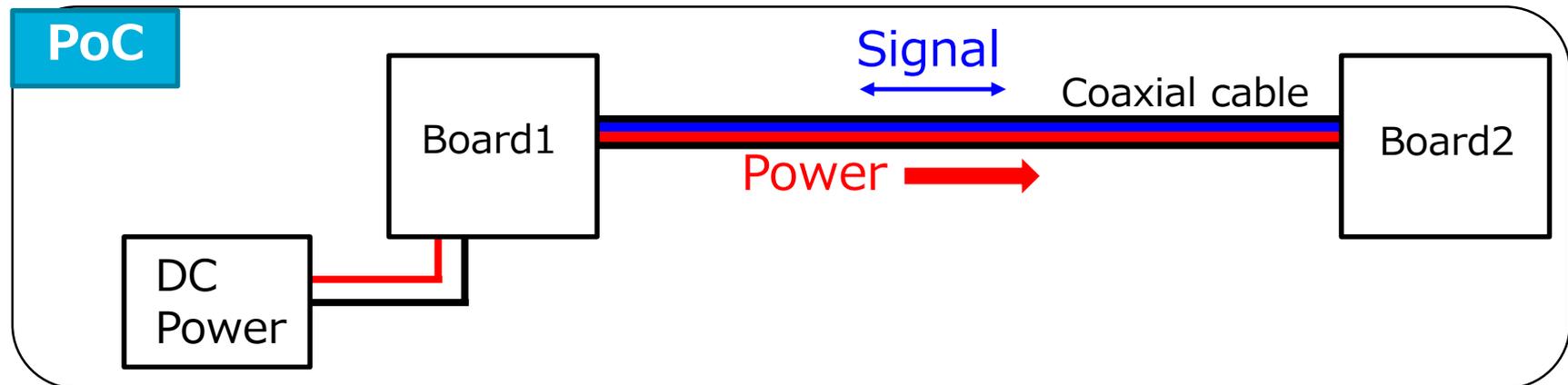
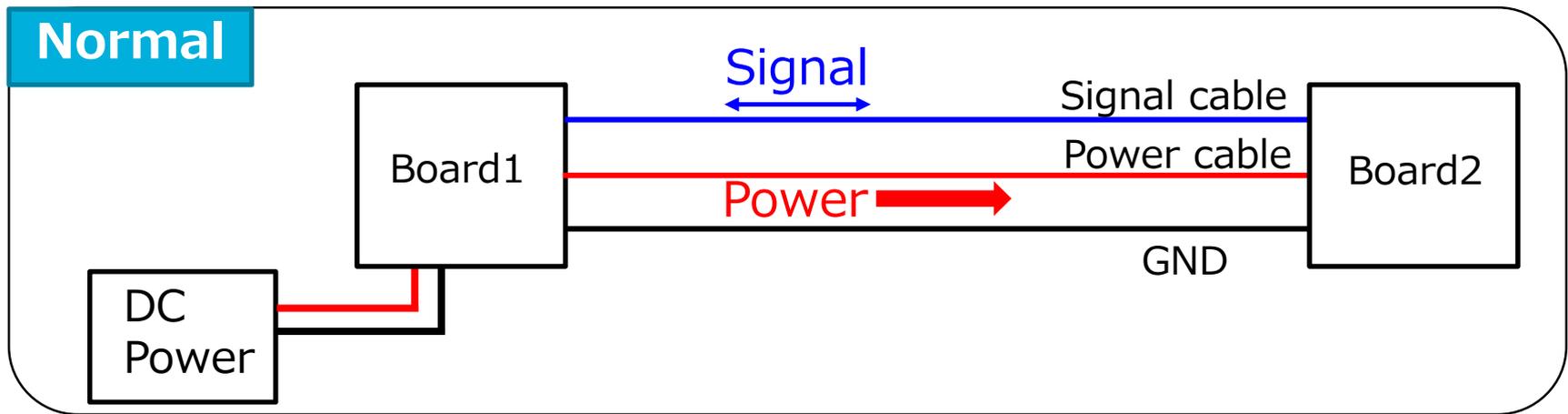
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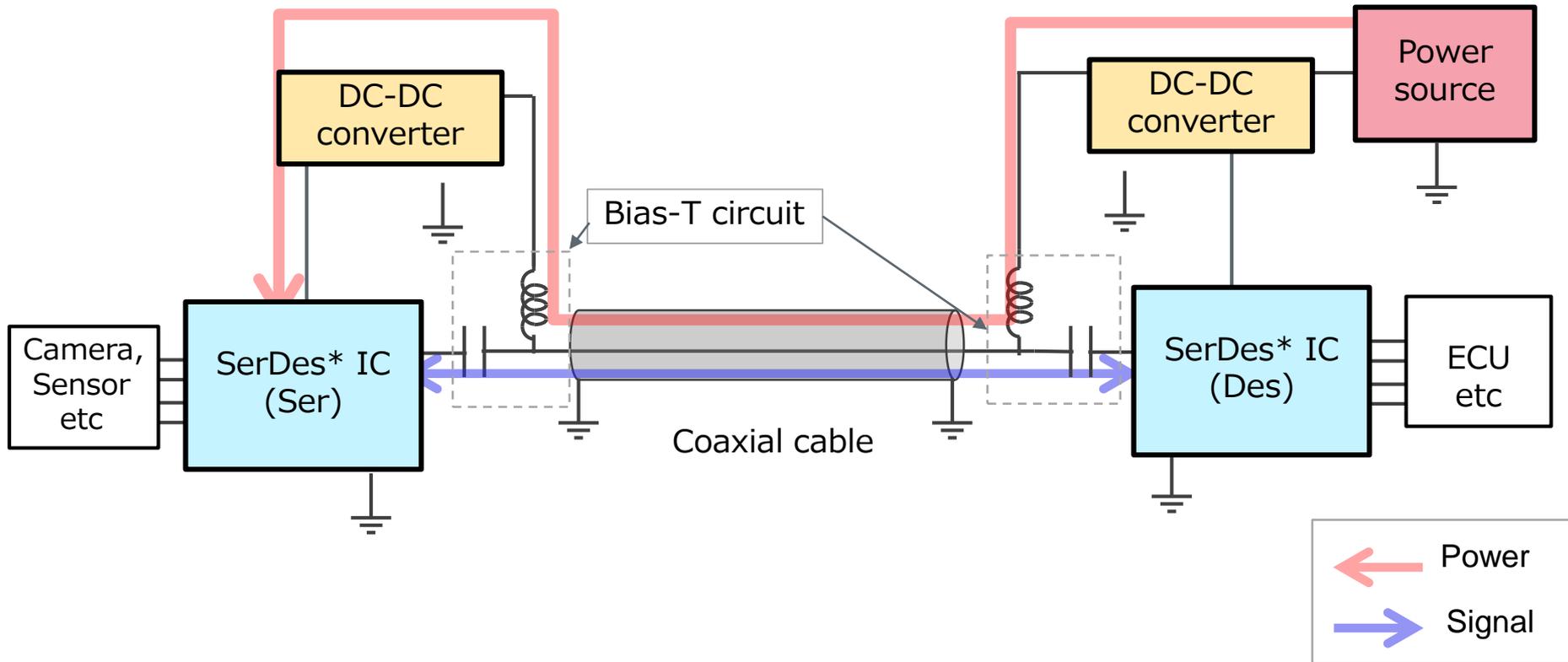
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1-1, What Is PoC



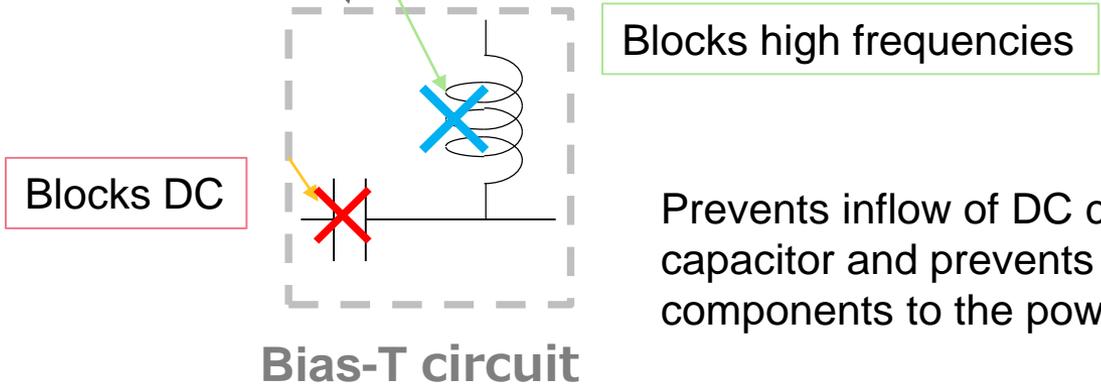
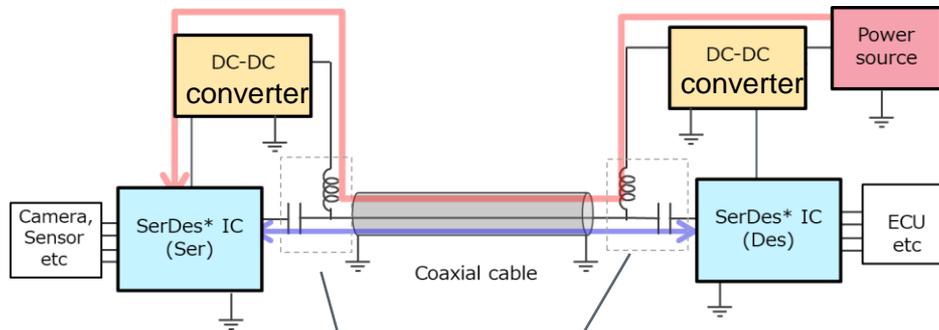
PoC (power over coaxial) is a technology that transmits both power and signal simultaneously through 1 coaxial cable. (This contributes to reduce the number of cables)

1-2, Typical Circuit Diagram of PoC Systems



The high frequency signal and DC power are separated through the Bias-T circuit.

1-3, Roles of PoC System Bias-T Inductors

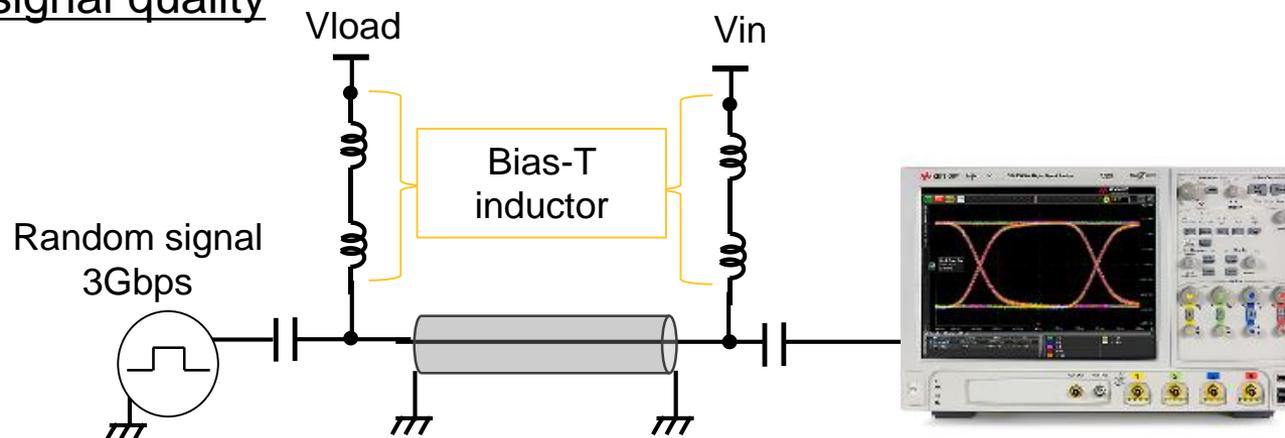


Prevents inflow of DC components to the IC with the capacitor and prevents inflow of high frequency components to the power line with the inductor.

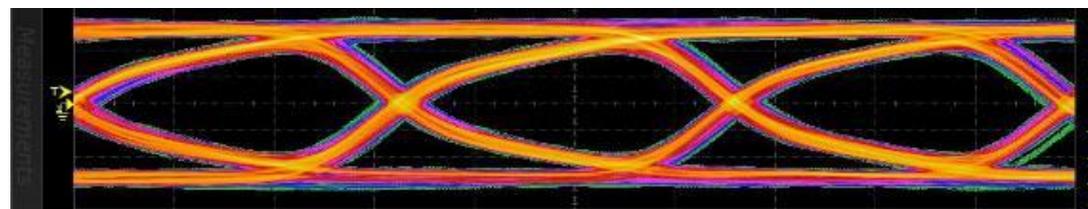
It is particularly necessary to select a Bias-T inductor since it greatly affects transmission characteristics.

1-4, Effects Bias-T Inductor Characteristics Apply on Signal Quality

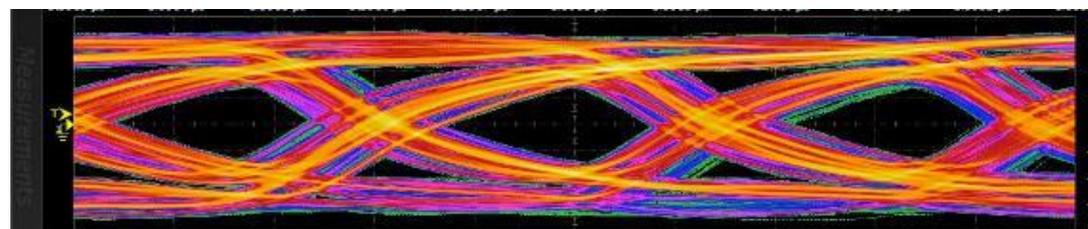
Measuring signal quality



Bias-T inductor
with good
characteristics



Bias-T inductor
with insufficient
characteristics



It is required to select a Bias-T inductor that can ensure signal quality.

1, Introduction

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2, Tool Functions

- 1. Circuits That Can Be Simulated**
- 2. Criteria**
- 3. Cables**
- 4. Stray Capacitance Settings of the Board**
- 5. Selection of Automatic Optimization**

3, Tool Overview

1. User Interface
2. Details of each sections

4, Tool Use Cases

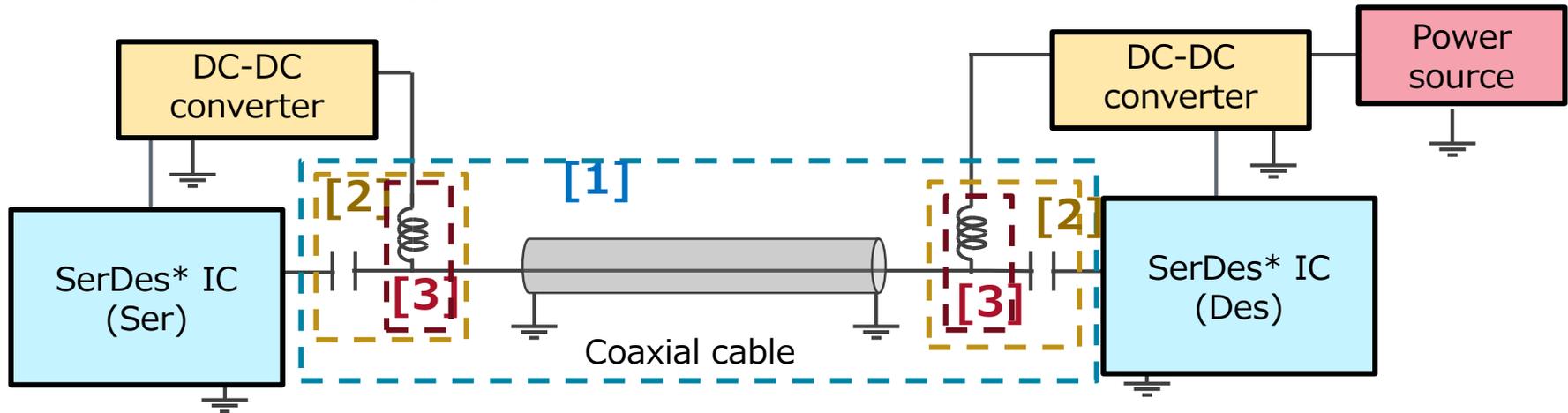
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Back to the table
of contents

2-1, Circuits That Can Be Simulated

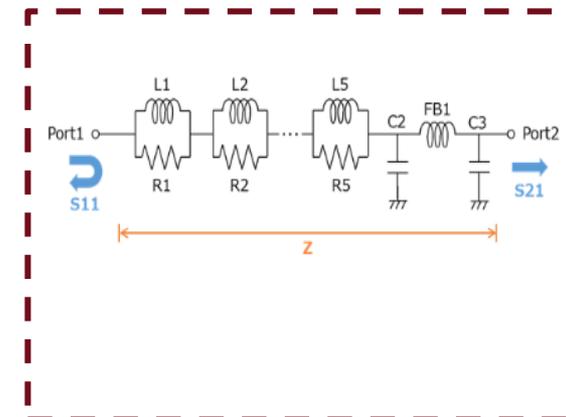
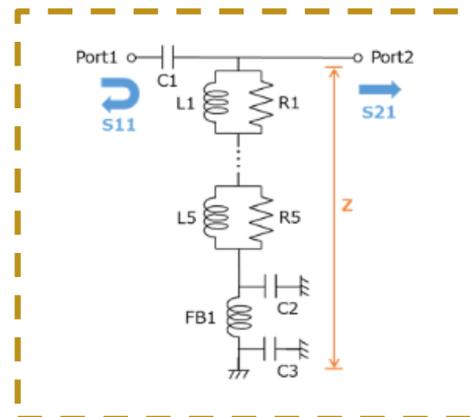
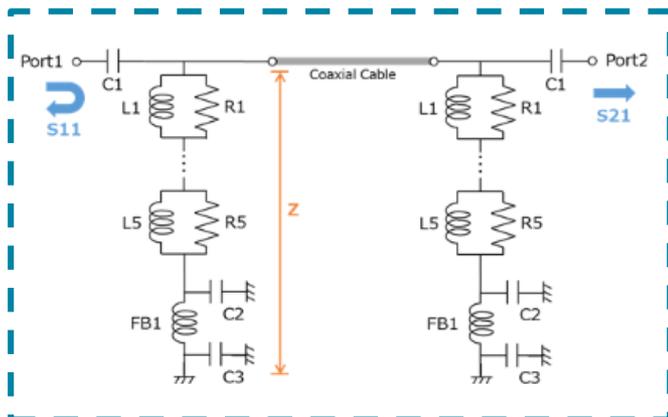
Simulation with 3 types of circuits available.



[1] With cable

[2] Without cable

[3] Only circuit



2-2, Criteria

S21, S11, S21/S11 criteria values that must be cleared to ensure signal quality are set by each IC manufacturers or customers.

Automatically selects products combinations that clear these criteria.

This tool can be selected from the following.

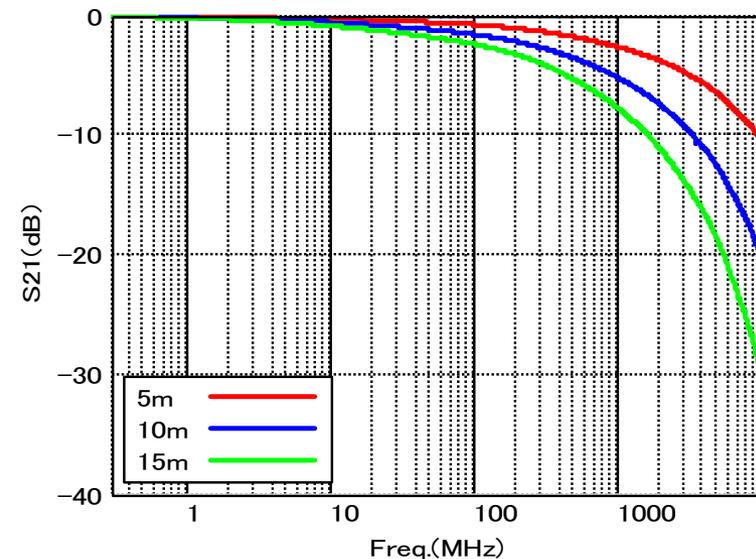
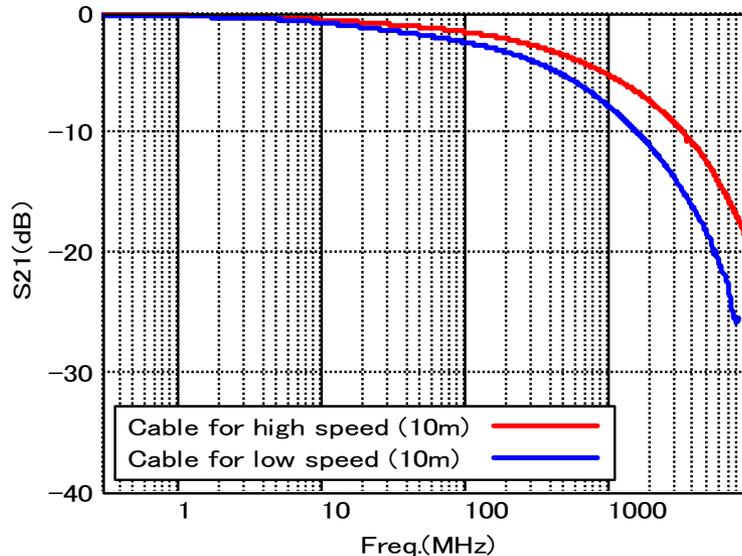
- Select the IC manufacturer recommended criteria
- Select the criteria set by MURATA
- Upload your criteria

2-3, Coaxial Cable

Loss varies by cable type and length.

To run simulations on circuits with cables, settings considering cable characteristics must be applied.

Relationship between cable length and S-parameter



2 types of cables can be selected on this simulator.

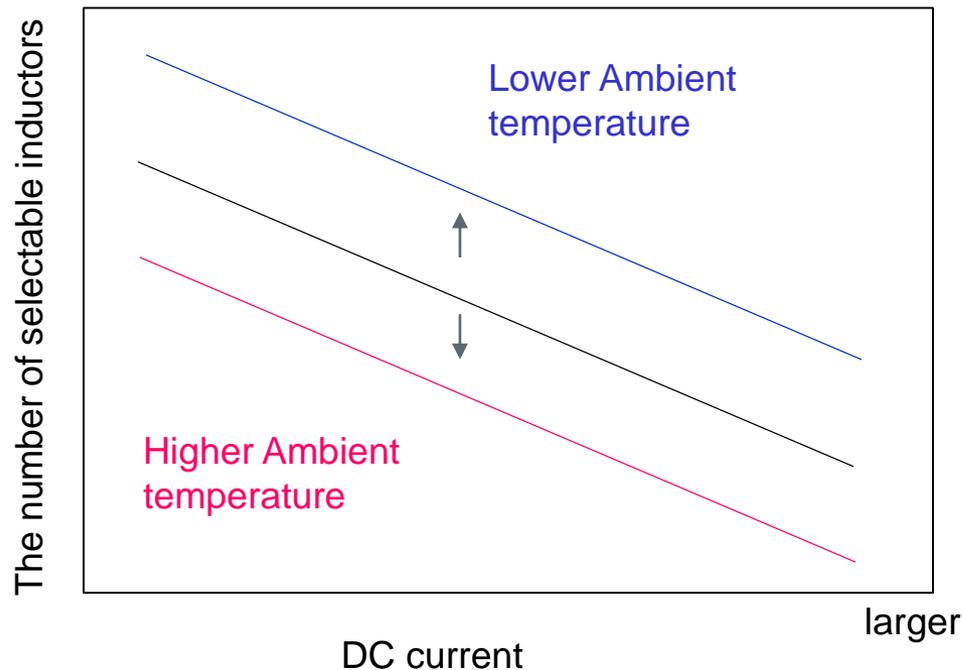
Input an applicable value for cable length.
(Usually about 15 m or less)

2-4, Current, Temperature, and Size Settings *muRata*

INNOVATOR IN ELECTRONICS

Inductors that match the conditions set in condition settings are provided.

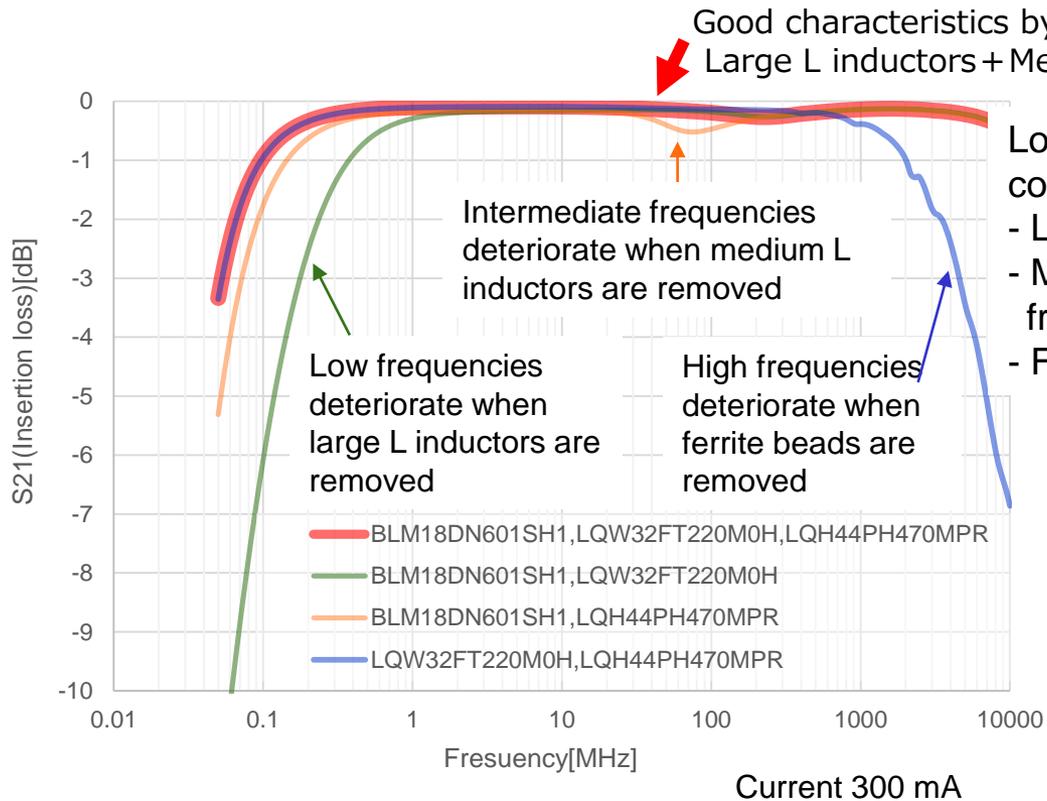
Applying less options for ambient temperature conditions and current conditions provide more inductors that can be selected.



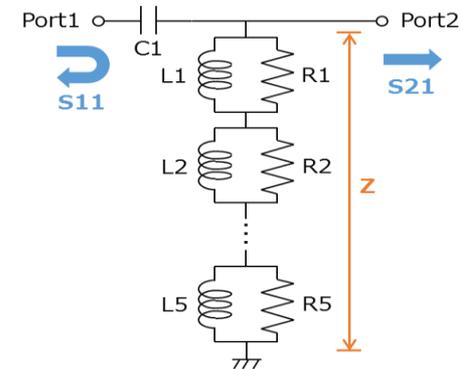
2-5, Serial Connection of Bias-T Inductors



In Bias-T circuits, to ensure signal quality by reducing loss in wide bandwidths ranging from low frequencies to high frequencies, **Multiple inductors must be used in series.**



- Loss in wide bandwidths can be reduced by combining the following:
- Large L inductors that cover low frequencies
 - Medium L inductors that cover intermediate frequencies
 - Ferrite beads that cover high frequencies



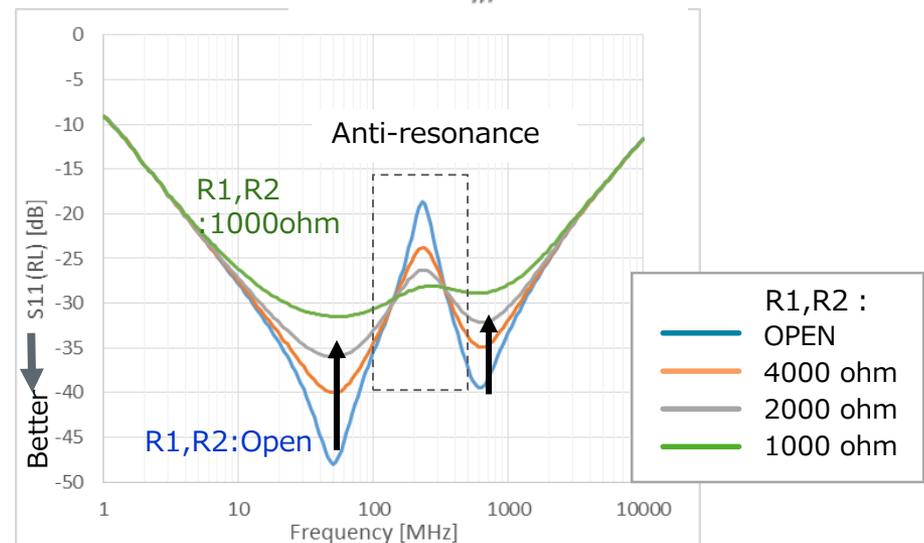
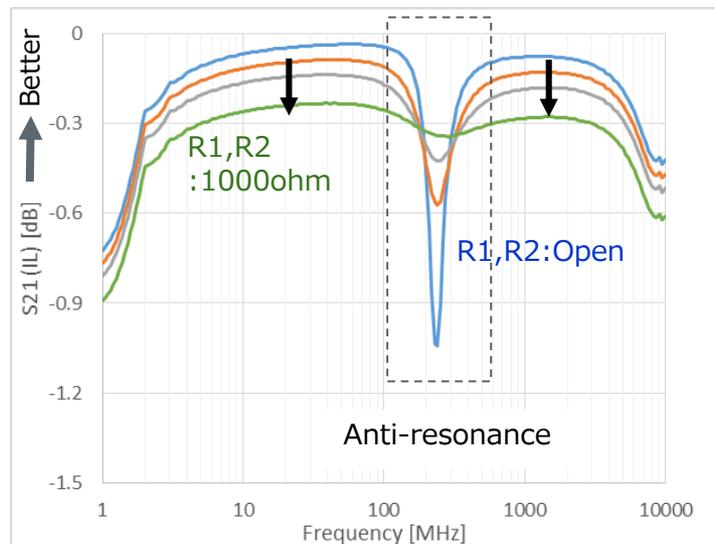
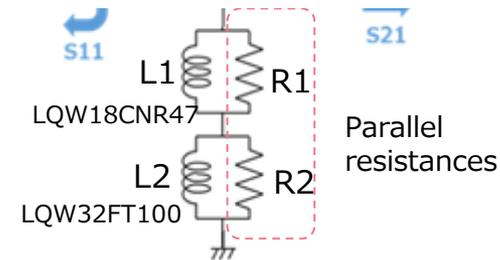
Simulations with up to 5 parallelly connected inductors are available on this tool. Bias-T inductors are automatically selected.

2-6, How to Select Parallel Resistances

Anti-resonance will occur when several Bias-T inductors are connected serially. **By adding a parallel resistance to each inductor, anti-resonance can be suppressed.**

On the other hand, **characteristics other than anti-resonance will deteriorate.** **By selecting a suitable resistance value, a filter characteristic that fulfills the target characteristic will be achieved.**

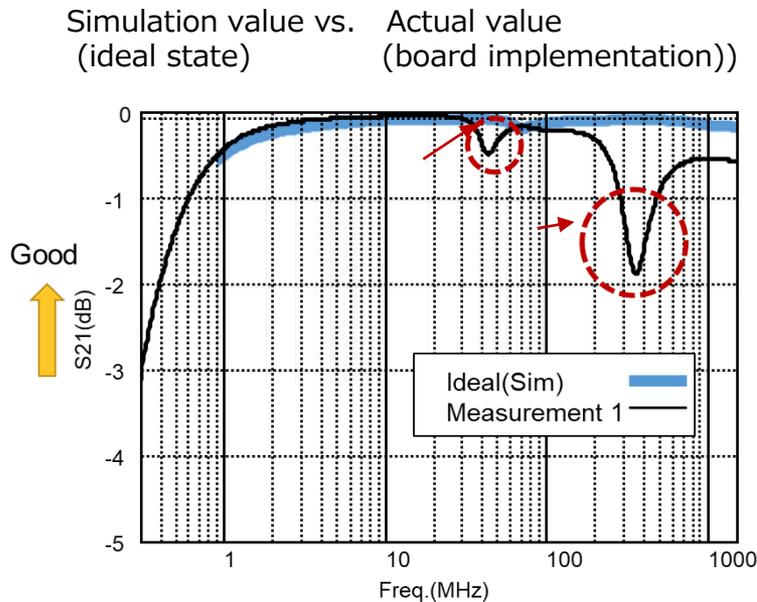
The following are results when “L1: LQW18CNR47” and “L2: LQW32FT100” are used, and their parallel resistances R1 and R2 are Open, 1000 ohm, 2000 ohm, or 4000 ohm.



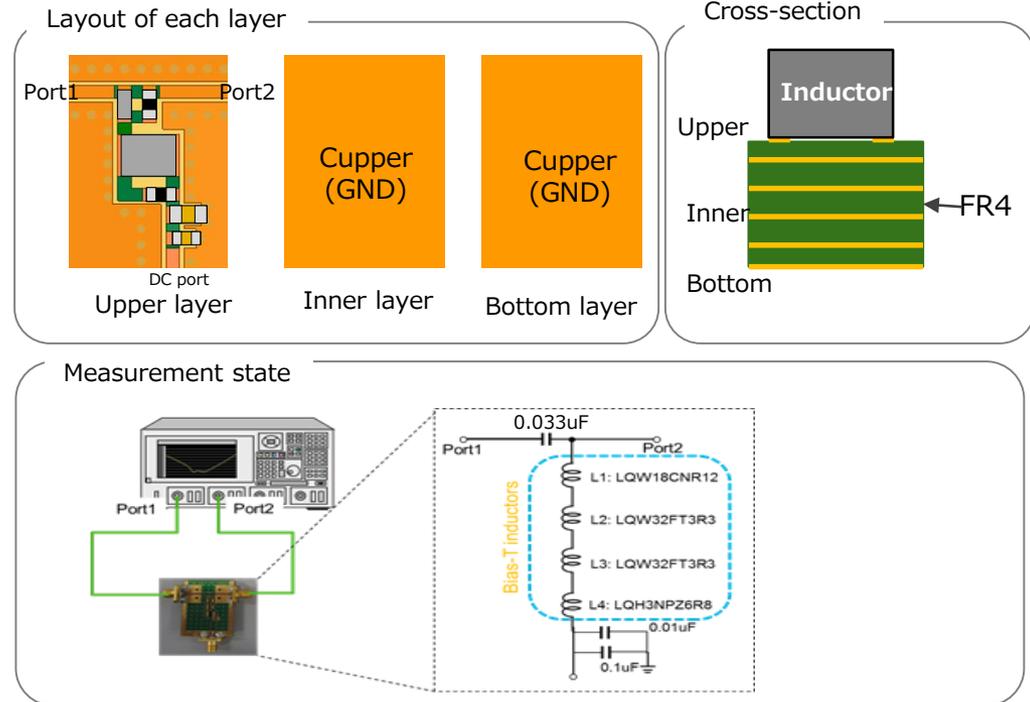
2-7, Effects of Board Stray Capacitance 1

A difference in characteristic results occurs between the simulation value (ideal state) and actual value (board implementation).

Anti-resonance is present more noticeably in the actual value.



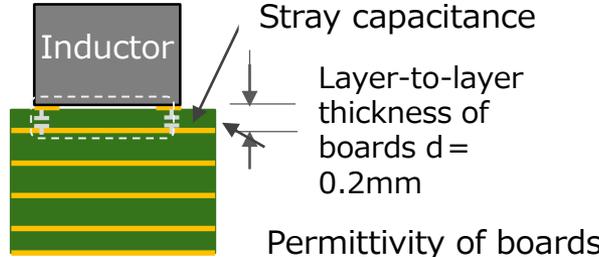
Actual board layout and measurement state



2-7, Effects of Board Stray Capacitance 1

In the actual state, the stray capacitance that occurs between the inductor and inner layer of PCB is present on the characteristic.

If simulations are performed considering the stray capacitance, the calculated value becomes closer to the actual value.



Calculating the stray capacitance from the part size and board information.
[$C = \epsilon \times S / d$] (S: area)

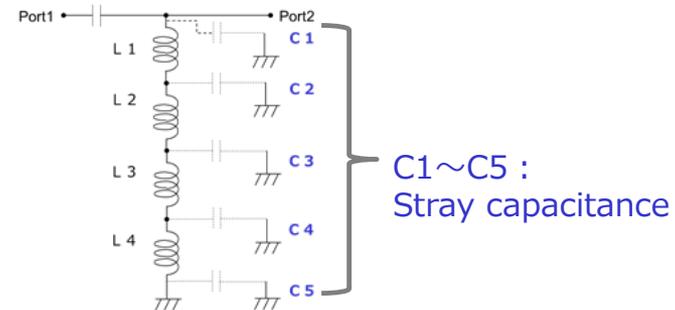
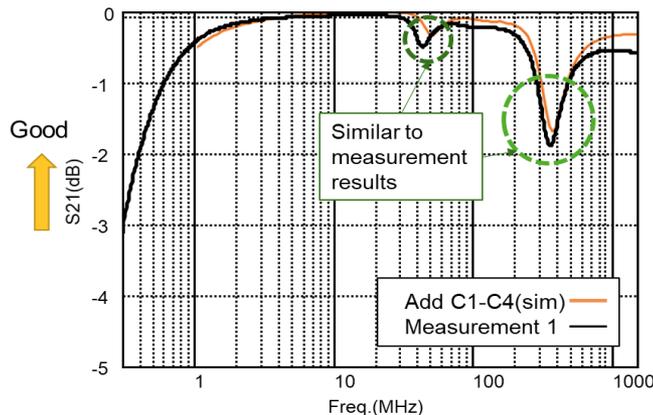
In this case

C1	C2	C3	C4
0.25pF	1.6pF	1.6pF	1.8pF



Reflected on the simulation

Simulation value (including stray capacitance) versus actual value (board implementation)

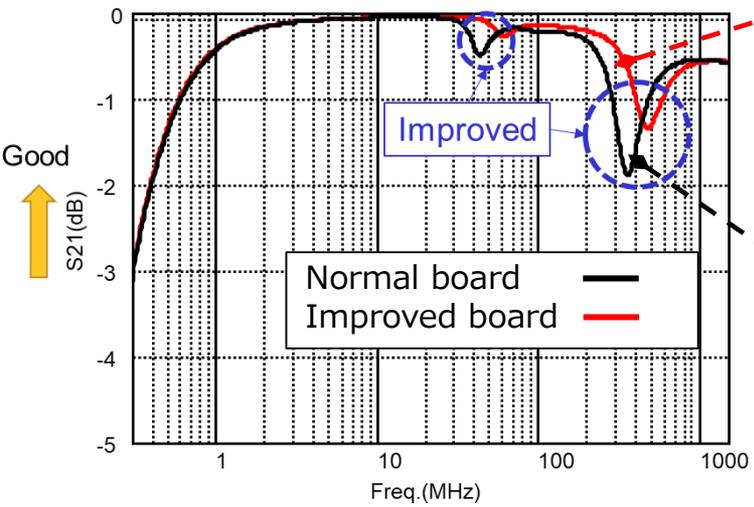


This simulator enables stray capacitance setting that allows calculation of results close to the actual characteristic.

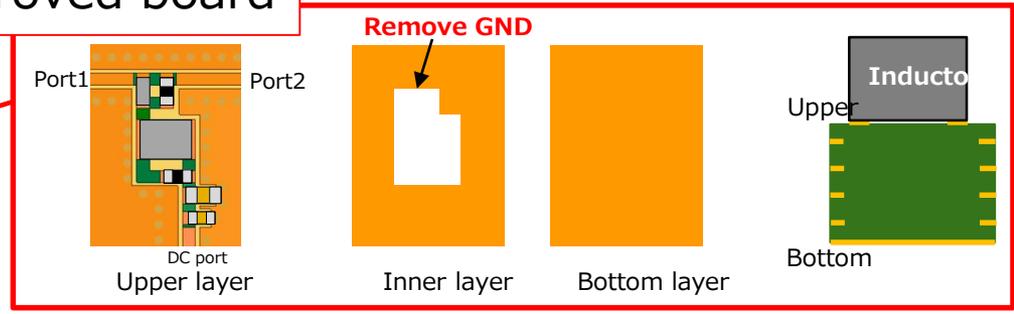
2-7, Effects of Board Stray Capacitance 2

The smaller stray capacitance is, anti-resonance becomes smaller as well.
Deleting the interior ground of the board suppresses anti-resonance.

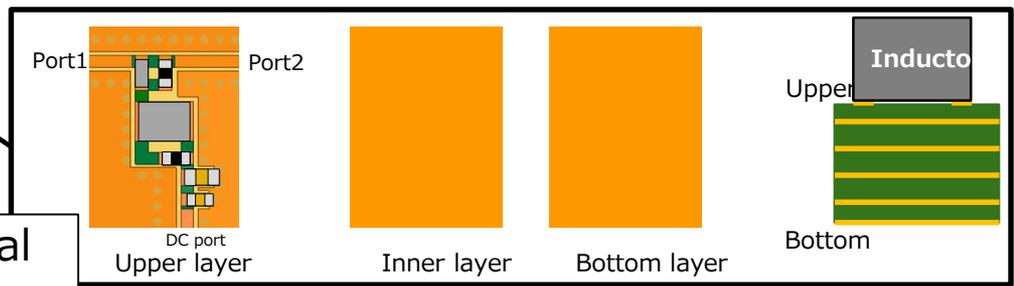
Normal board (actual measurement) versus improved board (actual measurement)



Improved board



Normal board



The stray capacitance value of the improved board is set as the default value on this simulator. Since the values change depending on the part size and board characteristics, simulations can be performed with the users freely changing the values.

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2. Details of each sections



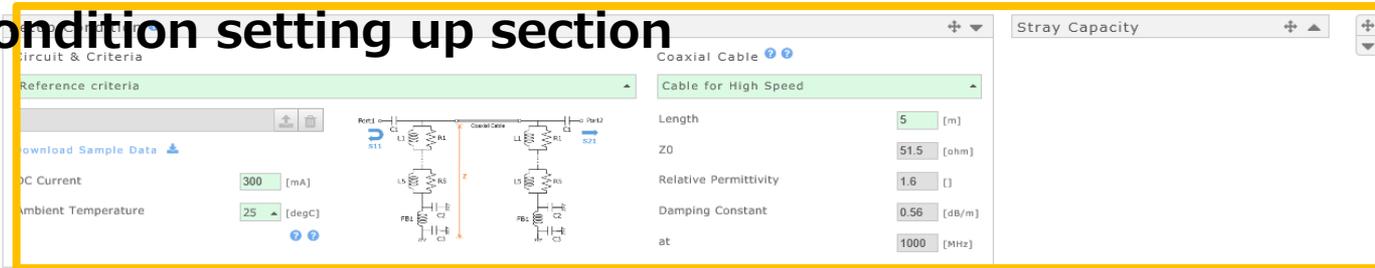
Back to the table
of contents

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3-1, User Interface

Condition setting up section



Circuit & Criteria

Reference criteria: Coaxial Cable

Download Sample Data

DC Current: 300 [mA]

Ambient Temperature: 25 [degC]

Coaxial Cable Parameters:

- Length: 5 [m]
- Z0: 51.5 [ohm]
- Relative Permittivity: 1.6 []
- Damping Constant: 0.56 [dB/m]
- at: 1000 [MHz]

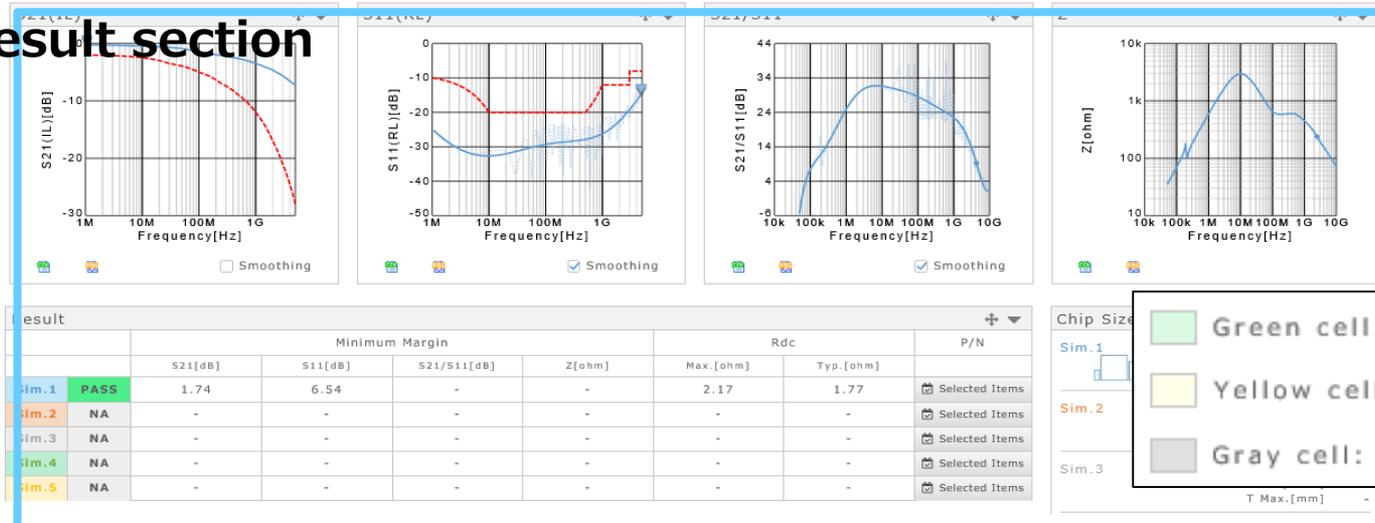
Each elements setting and selected part number displaying section



Optimize | Delete | Copy | Paste | Optimization Method: Maximize Margin | Maximum Tsize: Free [mm]

L				Optimization Setup			R		C	
Element		P/N	Status	Size Code (mm/inch)	Element	Resistance	Element	Capacitance		
L1	Q Select	BLM18EG471SH1	Optim.	Free	R1	[kohm]	C1	0.1 [uF]		
L2	Q Select	LQH44PH470MPR	Optim.	Free	R2	1.5 [kohm]	C2	0.1 [uF]		
L3	Q Select	LQH3NPZ470MME	Optim.	Free	R3	1.5 [kohm]	C3	0.01 [uF]		
L4	Q Select		None	Free	R4	1.5 [kohm]	-			
L5	Q Select		None	Free	R5	1.5 [kohm]	-			
FB1	Q Select	BLM18KG102SH1	Optim.	Free	-		-			

Result section



Graphs showing S21, S11, S21/S11, and Z[ohm] vs Frequency [Hz].

Summary Table:

result		Minimum Margin				Rdc		P/N
		S21[dB]	S11[dB]	S21/S11[dB]	Z[ohm]	Max.[ohm]	Typ.[ohm]	
Sim.1	PASS	1.74	6.54	-	-	2.17	1.77	Selected Items
Sim.2	NA	-	-	-	-	-	-	Selected Items
Sim.3	NA	-	-	-	-	-	-	Selected Items
Sim.4	NA	-	-	-	-	-	-	Selected Items
Sim.5	NA	-	-	-	-	-	-	Selected Items

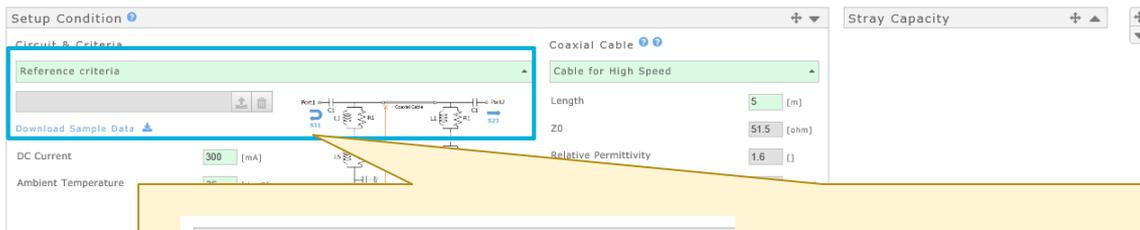
Legend:

- Green cell: Required
- Yellow cell: Editable
- Gray cell: Uneditable

3-2, Details of each sections

Condition setting up section

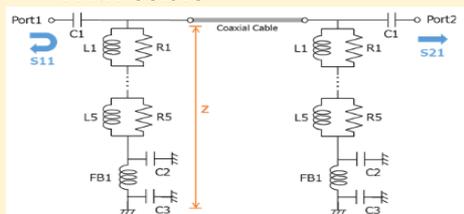
Circuit and criteria



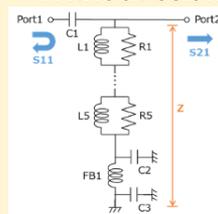
Circuits and criteria can be selected from the pull-down menu

◆ Selectable circuit

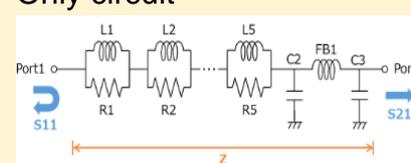
- With cable



- Without cable



- Only circuit



◆ Selectable criteria

- The IC manufacturer recommended criteria
- The criteria set by MURATA
- Upload your criteria

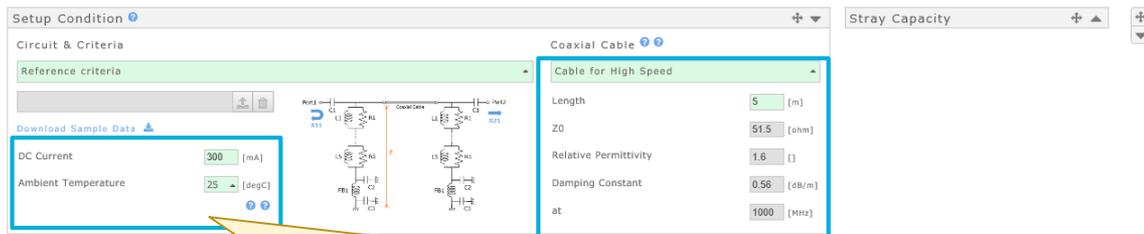


Result	
Sim.1	PASS
Sim.2	NA
Sim.3	NA
Sim.4	NA
Sim.5	NA

3-2, Details of each sections

Condition setting up section

Current and Ambient temperature, cable conditions

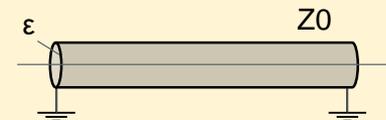


DC Current: 500 [mA] <- Input a rated current value required for parts
Ambient Temperature: 25 [degC] <- Select Ambient temperature
(selectable from 25, 85, 105, 115, 125°C)

In case selected "with cable " as the circuit



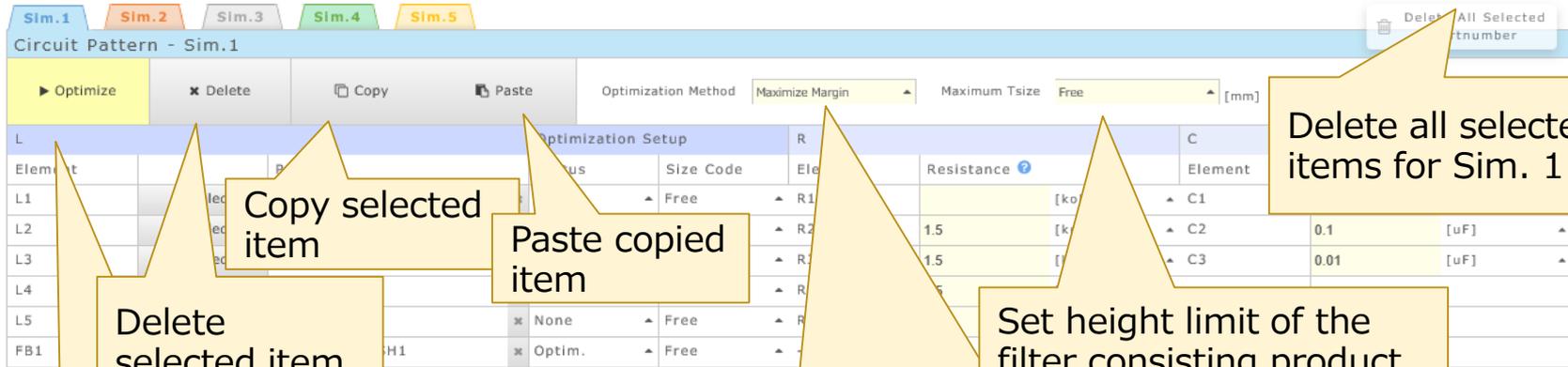
- < Select cable (High speed:Max20GHz、 Low speed:Max8.5GHz)
- < Input cable length
- Cable factor (editing available if "Edit" is selected in cable selection)
 - Z0: Characteristic impedance
 - Relative permittivity: Cable permittivity
 - Damping constant: Cable loss



Damping constant

3-2, Details of each sections

Each elements setting and selected part number displaying section



Delete all selected items for Sim. 1 to 5

Copy selected item

Paste copied item

Delete selected item

Set height limit of the filter consisting product

Perform automatic selection of optimal part number combinations

Optimization method
-Maximize Margin :
Find the part numbers combination that provides the best characteristics
-Minimize Size :
Find a combination of parts numbers with the smallest size that meets the criteria.

3-2, Details of each sections

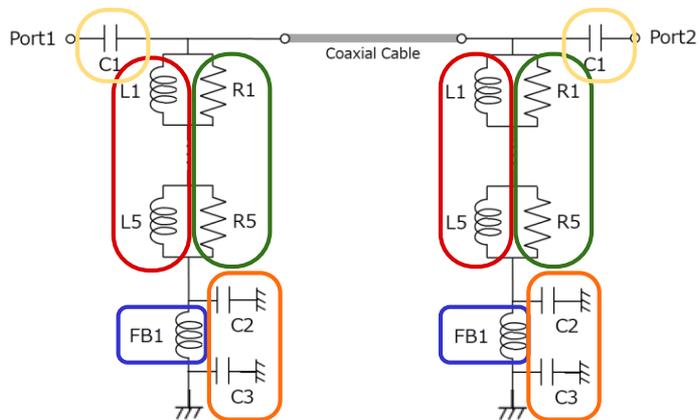


Each elements setting and selected part number displaying section

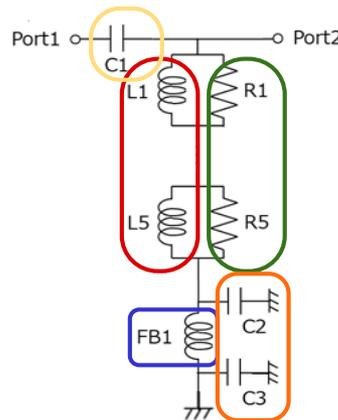
L					R			C	
Element		P/N	Status	Size Code	Element	Resistance	Element	Capacitance	
L1	Q Select	BLM18AG102SH1	Optim.	Free	R1	[kohm]	C1	0.1 [uF]	
L2	Q Select	LQW32FT100M0H	Optim.	Free	R2	1.5 [kohm]	C2	0.1 [uF]	
L3	Q Select	LQH3NPZ680MME	Optim.	Free	R3	1.5 [kohm]	C3	0.01 [uF]	
L4	Q Select		None	Free	R4	1.5 [kohm]	-	-	
L5	Q Select		None	Free	R5	1.5 [kohm]	-	-	
FB1	Q Select	BLM18KG102SH1	Optim.	Free	-	-	-	-	

- L1 - L5 : Part number that consist of the Bias-T filter
- R1 - R5 : Parallel resistance
- C1 : DC cut capacitor
- C2, C3 : Decoupling capacitor
- FB : Ferrite Beads as a noise filter

With cable



Without cable



3-2, Details of each sections



Each elements setting and selected part number displaying section

L			Optimization Setup		R			C	
Element		P/N	Status	Size Code	Element	Resistance		Element	Capacitance
L1	Q Select	BLM18AG102SH1	Optim.	Free	R1	[kohm]		C1	0.1 [uF]
L2	Q Select	LQW32FT100M0H	Optim.		R2	1.5 [kohm]		C2	0.1 [uF]
L3	Q Select	LQH3NP2680MME	Optim.		R3	[kohm]		C3	0.0 [uF]
L4	Q Select		None		R4	1.5 [kohm]		-	
L5	Q Select		None		R5	1.5 [kohm]			
FB1	Q Select	BLM18KG100SH1	Optim.						

Select Product

Display selected part number

Input parallel resistance value

Input capacitance value

Circuit Pattern - Sim.1

Element - L1

Reset Close

1608/0603
2012/0805
3030/1212

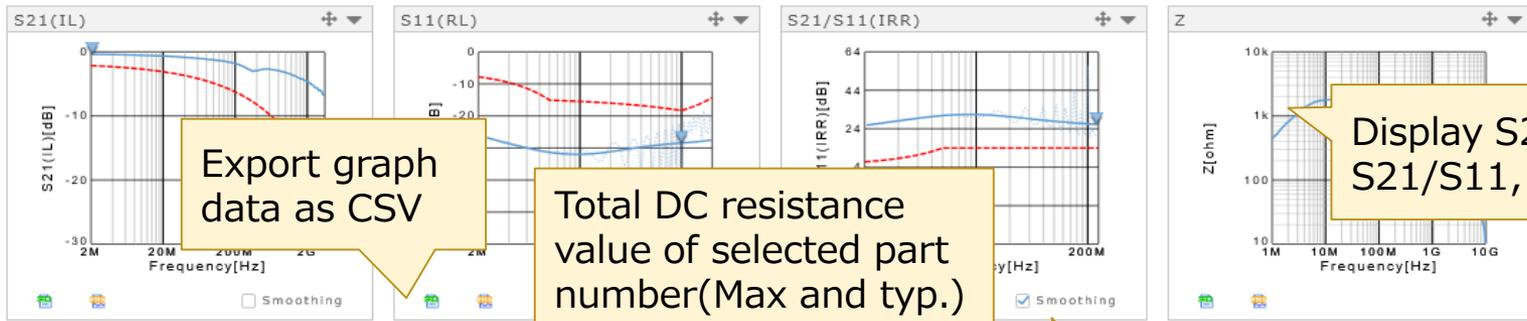
Partnumber Search	Inductor Search	Impedance Search	Size Code	T (Max.)	Isat
part_number	Inductance	Impedance			
BLM18PG121SH1		120ohm@100MHz	1608/0603	0.95	2000
BLM18PG181SH1		180ohm@100MHz	1608/0603	0.95	1500
BLM18PG221SH1		220ohm@100MHz	1608/0603	0.95	1400
BLM18PG300SH1		30ohm@100MHz	1608/0603	0.95	1000
BLM18PG330SH1		33ohm@100MHz	1608/0603	0.95	3000
BLM18PG331SH1		330ohm@100MHz	1608/0603	0.95	1200
BLM18PG471SH1		470ohm@100MHz	1608/0603	0.95	1000
BLM18PG600SH1		60ohm@100MHz	1608/0603	0.95	1000
LQH32PH100MNC	10uH@1MHz		3225/1210	1.7	1000
LQH32PH150MNC	15uH@1MHz		3225/1210	1.7	800
LQH32PH1R0NCC	1uH@1MHz		3225/1210	1.7	3000
LQH32PH220MNC	22uH@1MHz		3225/1210	1.7	650
LQH32PH2R2NCC	2.2uH@1MHz		3225/1210	1.7	2000
LQH32PH3R3NCC	3.3uH@1MHz		3225/1210	1.7	1900
LQH32PH4R7NCC	4.7uH@1MHz		3225/1210	1.7	1600
LQH32PH6R8NCC	6.8uH@1MHz		3225/1210	1.7	1300
LQH32PHR47NCC	0.47uH@1MHz		3225/1210	1.7	4400
LQH3NP2100MME	10uH@1MHz		3030/1212	1.5	810
LQH3NP2150MME	15uH@1MHz		3030/1212	1.5	660

Optimization setup

- ◎ Status ⇒ Select the status of each elements
 - Optim.: Automatically select the optimum product for this element by pressing the "Optimize" button.
 - Fix. : Fix product even if the Optimize button is pressed
 - None : Does not select automatically
- ◎ Size code ⇒ Select the size of each elements.

3-2, Details of each sections

Result section



Result		Minimum Margin				Rdc	
		IL[dB]	RL[dB]	IRR[dB]	Z[ohm]	Max.[ohm]	Typ.[ohm]
Sim.1	PASS	1.78	10	12.26	-	2.48	1.98
Sim.2	NA	-	-	-	-	-	-
Sim.3	NA	-	-	-	-	-	-
Sim.4	NA	-	-	-	-	-	-
Sim.5	NA	-	-	-	-	-	-

Judgment (Pass/Fail) for criteria

Minimum margin value against the criteria (Displaying markers in a graph)

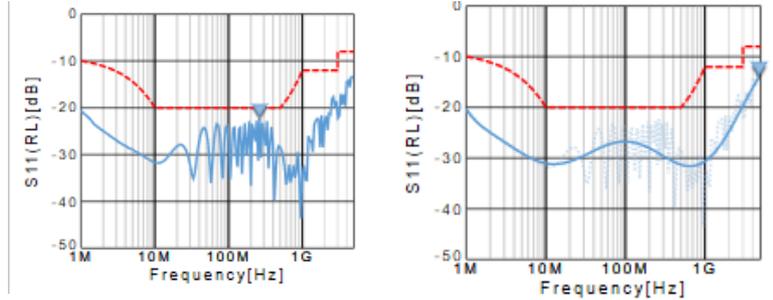
Total size and maximum height of selected part numbers

Graph smoothing function
When "With cable" is selected, the influence of the reflection due to the cable is applied on the calculation result graph. The graph can be smoothed with the smoothing button.

List of selected part numbers and links

Circuit Pattern - Sim.1		
Element	P/N	Link
L1	BLM18AG102SH1	Reference Spec Product Detail SimSurfing
L2	LQW32FT10	
L3	LQH3NPZ6E	
L4		
L5		
FB1	BLM18KG10	

Like to selected art number
- Reference spec
- Product detail page
- SimSurfing (enables characteristic confirmation of single parts)



3-2, Details of each sections

Other features

 Move by section

 Open and close sections

DC Current: 300 [mA]

Ambient Temperature: 25 [degC]

Coaxial Cable

Cable for High Speed

Length: 5 [m]

Z0: 51.5 [ohm]

Relative Permittivity: 1.0

Damping Constant: 0.56 [dB/m]

lc: 1998 [ps]

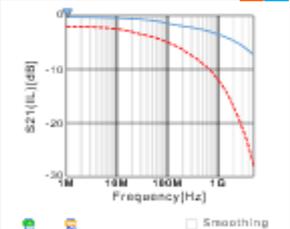
Stray Capacity

Simulation: Sim.1

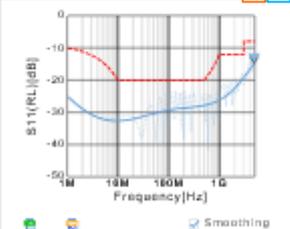
Optimize | Delete | Copy | Paste

L				Optimization Setup			R		C	
Element	P/N	Status	Size Code (mm/size)	Element	Resistance	Element	Capacitance			
L1	Q Select BLM18BG471SH1	Optim.	Free	R1	[ohm]	C1	0.1 [uF]			
L2	Q Select LQH44PH470MPE	Optim.	Free	R2	1.5 [ohm]	C2	0.1 [uF]			
L3	Q Select LQH3NP2470MHE	Optim.	Free	R3	1.5 [ohm]	C3	0.05 [uF]			
L4	Q Select	None	Free	R4	1.5 [ohm]	-	-			
L5	Q Select	None	Free	R5	1.5 [ohm]	-	-			
FB1	Q Select BLM18KG1025H1	Optim.	Free	-	-	-	-			

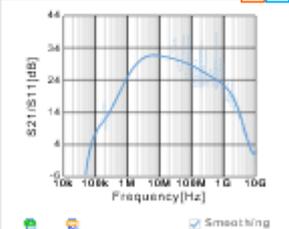
S21(IL)



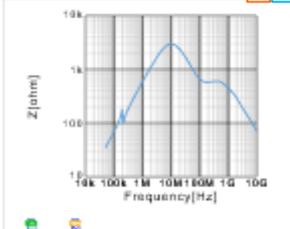
S11(RL)



S21/S11



Z



Result

		Minimum Margin			Rdc [ohm]	Tsp [uH]	P/N
		S21[dB]	S11[dB]	S22/S11[dB]			
Sim.1	PASS	1.74	6.54	-	2.17	1.77	SELECTED ITEM
Sim.2	NA	-	-	-	-	-	SELECTED ITEM
Sim.3	NA	-	-	-	-	-	SELECTED ITEM
Sim.4	NA	-	-	-	-	-	SELECTED ITEM
Sim.5	NA	-	-	-	-	-	SELECTED ITEM

Chip Size

Sim.	Total [mm2]	T Max. [mm]
Sim.1	27.56	1.80
Sim.2	-	-
Sim.3	-	-

1, Introduction

1. What Is PoC
2. Typical Circuit Diagram of PoC Systems
3. Effects Bias-T Inductor Characteristics Apply on Signal Quality
4. Importance of PoC Bias-T Filter Selection

2, Tool Functions

1. Circuits That Can Be Simulated
2. Criteria
3. Cables
4. Stray Capacitance Settings of the Board
5. Selection of Automatic Optimization

3, Tool Overview

1. User Interface
2. Details of each sections

4, Tool Use Cases

- 1. Use Case 1 (Automatic selection with “with cable” circuit)**
- 2. Use Case 2 (Automatic selection with “without cable” circuit)**
- 3. Use Case 3 (Change optimization method and Compare)**
- 4. Use Case 4 (Reselect L from inductor list)**
- 5. Use Case 5 (Relax the set up condition after the result become “Fail”)**
- 6. Use Case 6 (Reduce parallel R)**



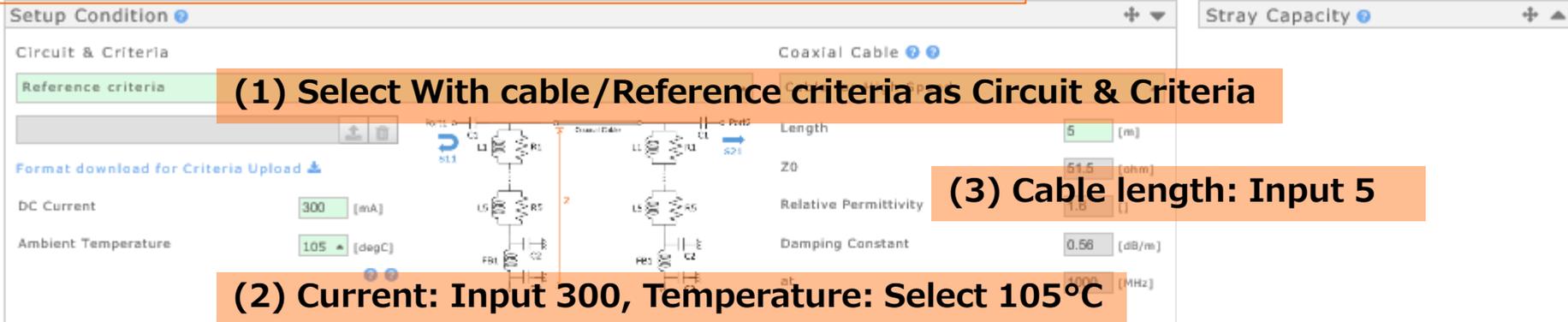
Back to the table
of contents

Use Case 1

(Automatic selection with “with cable” circuit) 1/2

PoC Bias-T filter design for ADAS cameras (With cable)

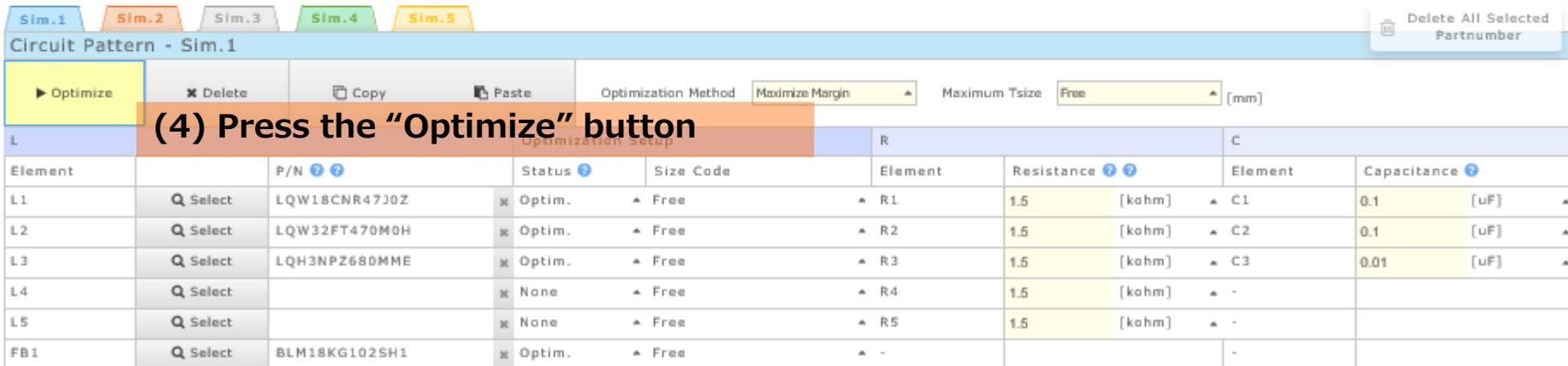
- Current : 300 mA
 - Ambient temperature : 105°C
 - Cable length : 5 m
 - Criteria : Reference criteria
- Perform automatic selection



(1) Select With cable/Reference criteria as Circuit & Criteria

(2) Current: Input 300, Temperature: Select 105°C

(3) Cable length: Input 5



(4) Press the “Optimize” button

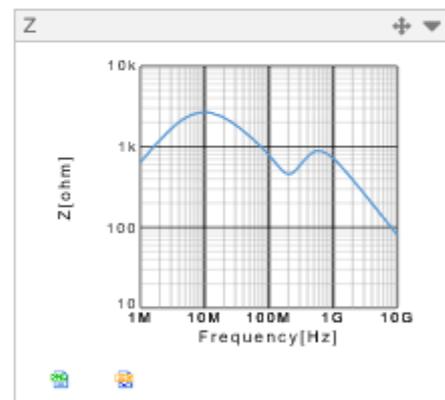
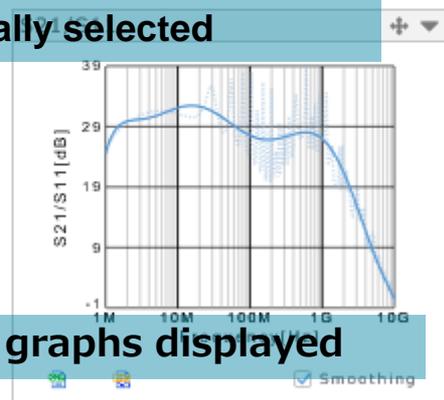
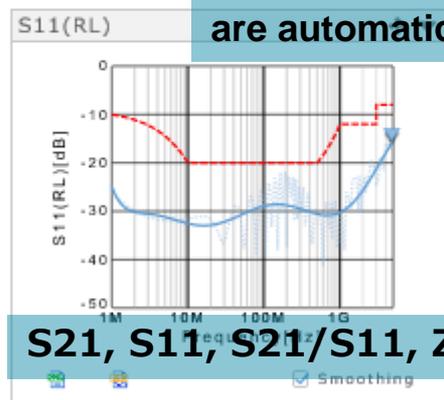
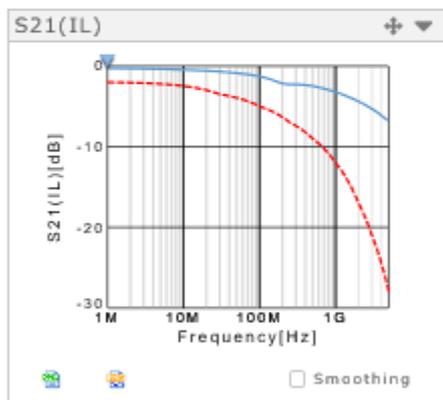
Element	P/N	Status	Size Code	Element	Resistance	Element	Capacitance
L1	LQW18CNR47J0Z	Optim.	Free	R1	1.5 [kohm]	C1	0.1 [uF]
L2	LQW32FT470M0H	Optim.	Free	R2	1.5 [kohm]	C2	0.1 [uF]
L3	LQH3NPZ680MME	Optim.	Free	R3	1.5 [kohm]	C3	0.01 [uF]
L4		None	Free	R4	1.5 [kohm]	-	
L5		None	Free	R5	1.5 [kohm]	-	
FB1	BLM18KG102SH1	Optim.	Free	-		-	

Use Case 1

(Automatic selection with “with cable” circuit) 2/2

L			Optimization Setup			R			C		
Element		P/N	Status	Size Code	Element	Resistance		Element	Capacitance		
L1	Q Select	LQW18CNR47J0Z	Optim.	Free	R1	1.5	[kohm]	C1	0.1	[uF]	
L2	Q Select	LQW32FT470M0H	Optim.	Free	R2	1.5	[kohm]	C2	0.1	[uF]	
L3	Q Select	LQH3NPZ680MME	Optim.	Free		1.5	[kohm]	C3	0.01	[uF]	
L4	Q Select		None	Free		1.5	[kohm]	-			
L5	Q Select		None	Free		1.5	[kohm]	-			
FB1	Q Select	BLM18KG102SH1	Optim.	Free				-			

(5) Results are displayed
In this case
L1 : LQW18CNR47J0Z
L2 : LQW32FT470M0H
L3 : LQH3NPZ680MME
FB : BLM18KG102SH1
are automatically selected



S21, S11, S21/S11, Z graphs displayed

Result		Minimum Margin			Rdc		P/N
		S21[dB]	S11[dB]	S21/S11[dB]	Max.[ohm]	Typ.[ohm]	
Sim.1	PASS	1.73	7.51	-	2.93	2.47	Selected Items

Chip Size

Sim.1



Total [mm²] 19.56
T Max.[mm] 2.50

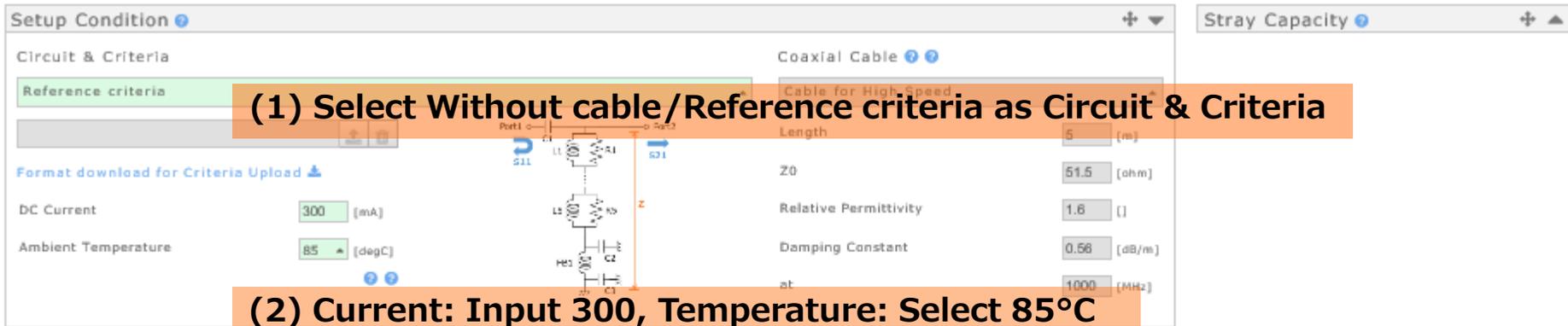
Pass or Fail against selected criteria, minimum margin value, total DCR, and total area are displayed

Use Case 2

(Automatic selection with “without cable” circuit) 1/2

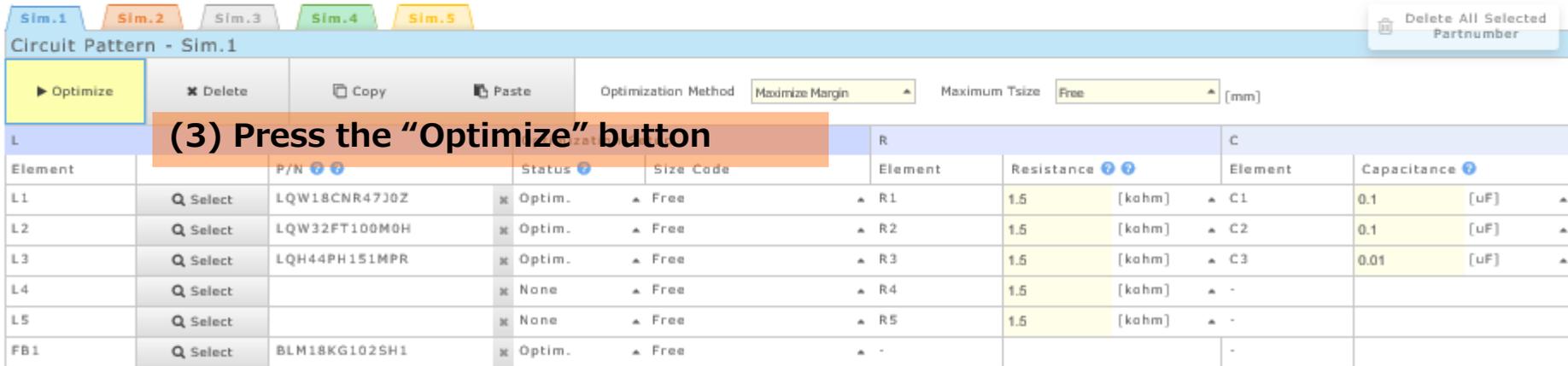
PoC Bias-T filter design for ADAS cameras (Without cable)

- Current : 300 mA
 - Ambient temperature : 85°C
 - Criteria : Reference criteria
- Perform automatic selection



(1) Select Without cable/Reference criteria as Circuit & Criteria

(2) Current: Input 300, Temperature: Select 85°C



(3) Press the “Optimize” button

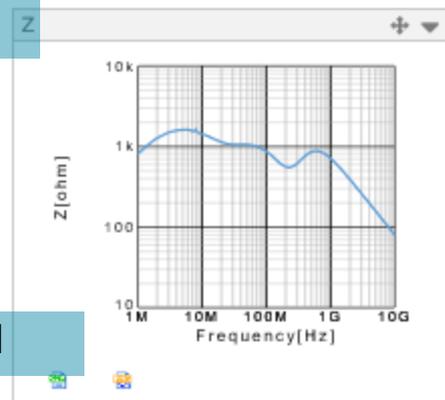
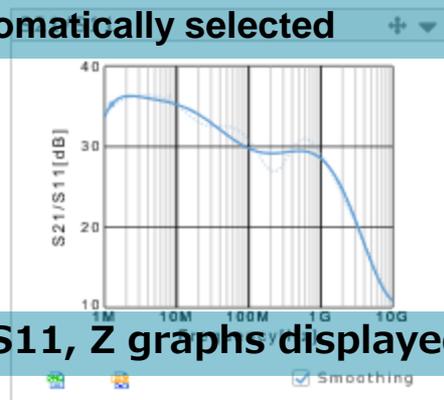
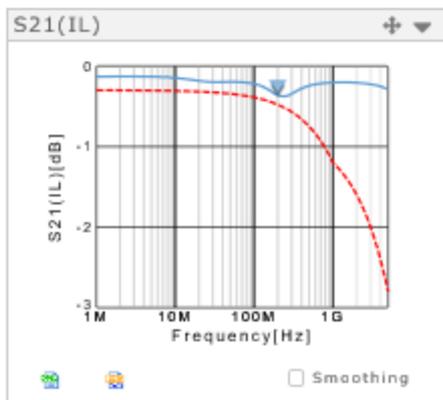
Element	P/N	Status	Size Code	Element	Resistance	Element	Capacitance
L1	LQW18CNR47J0Z	Optim.	Free	R1	1.5 [kohm]	C1	0.1 [uF]
L2	LQW32FT100M0H	Optim.	Free	R2	1.5 [kohm]	C2	0.1 [uF]
L3	LQH44PH151MPR	Optim.	Free	R3	1.5 [kohm]	C3	0.01 [uF]
L4		None	Free	R4	1.5 [kohm]	-	
L5		None	Free	R5	1.5 [kohm]	-	
FB1	BLM18KG1025H1	Optim.	Free	-		-	

Use Case 2

(Automatic selection with “without cable” circuit) 2/2

L		Optimization Setup				R		C	
Element	P/N	Status	Size	Value	Element	Capacitance			
L1	LQW18CNR47J0Z	Optim.	Free	1.5 [kohm]	C1	0.1 [uF]			
L2	LQW32FT100M0H	Optim.	Free	1.5 [kohm]	C2	0.1 [uF]			
L3	LQH44PH151MPR	Optim.	Free	1.5 [kohm]	C3	0.01 [uF]			
L4		None	Free		-				
L5		None	Free		-				
FB1	BLM18KG102SH1	Optim.	Free		-				

(4) Results are displayed
In this case
L1 : LQW18CNR47J0Z
L2 : LQW32FT100M0H
L3 : LQH44PH151HPR
FB : BLM18KG102SH1
are automatically selected



S21, S11, S21/S11, Z graphs displayed

Result		Minimum Margin				Rdc		P/N
		S21[dB]	S11[dB]	S21/S11[dB]	Z[ohm]	Max.[ohm]	Typ.[ohm]	
Sim.1	PASS	0.12	7.91	-	-	3.69	3.06	Selected Items

Chip Size

Sim.1



Total [mm²] 26.56
T Max.[mm] 2.50

Pass or Fail against selected criteria, minimum margin value, total DCR, and total area are displayed

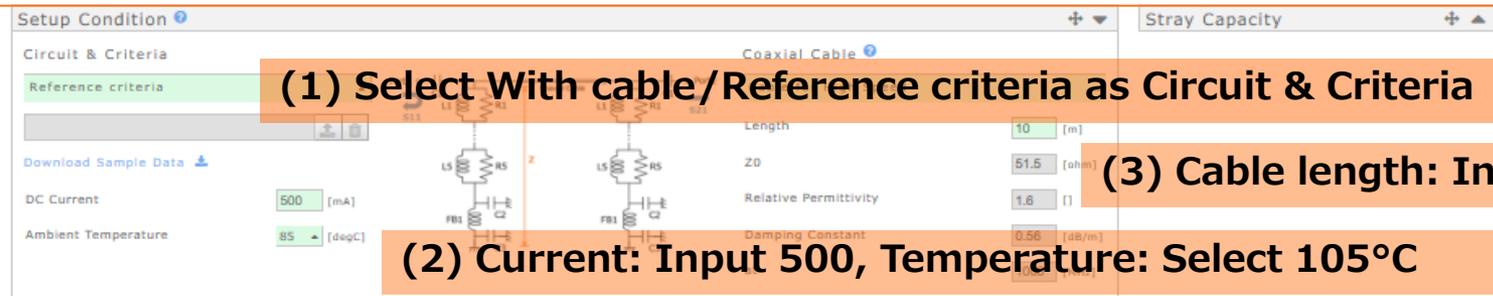
Use Case 3

(Change optimization method and Compare) 1/2

PoC Bias-T filter design for ADAS cameras (with cable)

- Current :500 mA
- Ambient temperature : 105°C
- Cable length : 10 m
- Criteria : Reference criteria

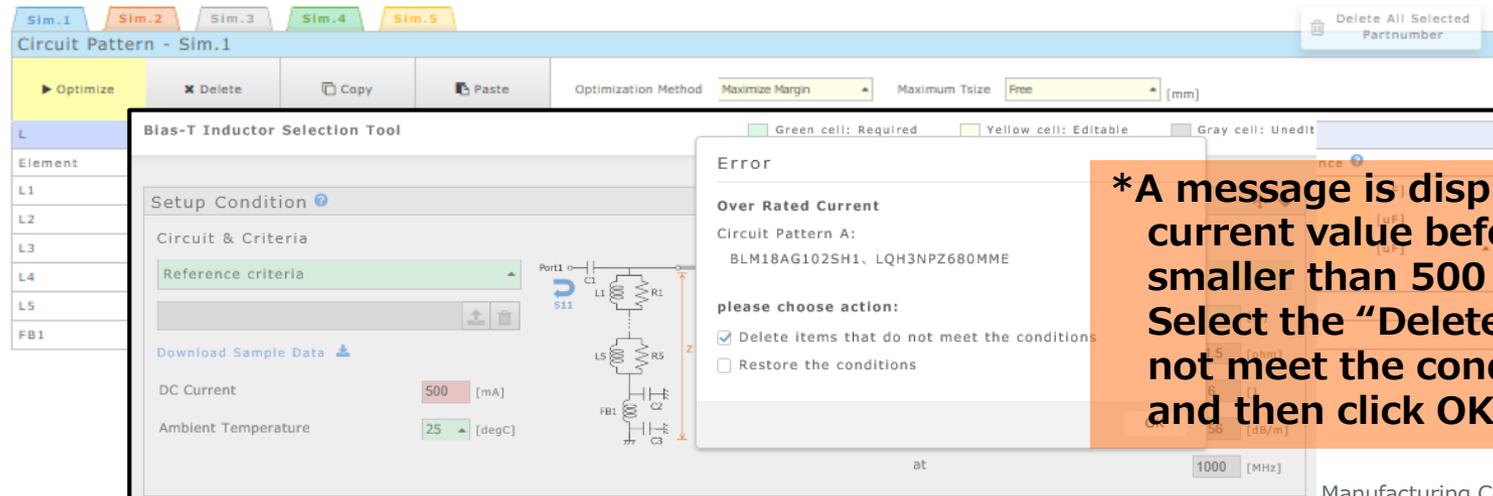
Compare the results when “maximum margin” and “minimum size” are selected as the "Optimization method “



(1) Select With cable/Reference criteria as Circuit & Criteria

(2) Current: Input 500, Temperature: Select 105°C

(3) Cable length: Input 10



*A message is displayed if the current value before input is smaller than 500 mA. Select the “Delete items that do not meet the condition” option and then click OK.

Use Case 3

(Change optimization method and Compare) 2/2

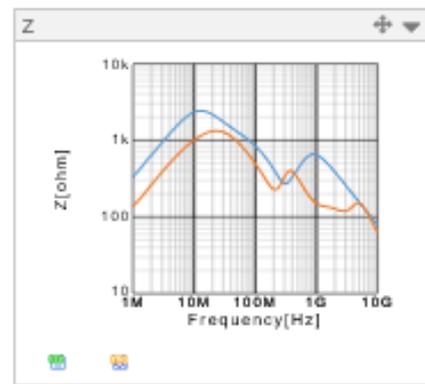
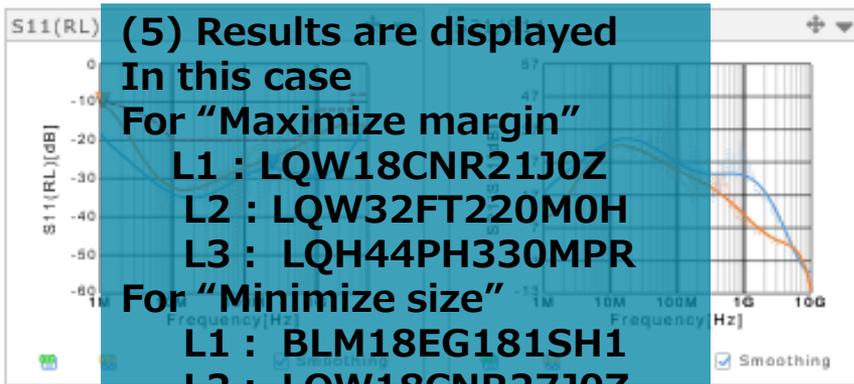
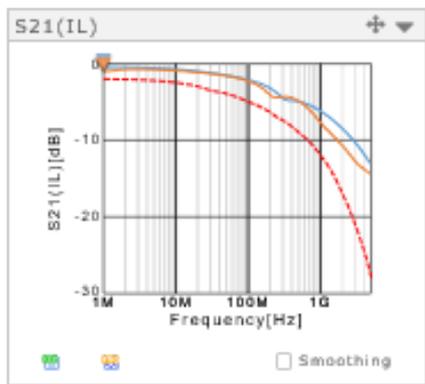
Sim.1 Sim.2 Sim.3 Sim.4 Sim.5

Circuit Pattern - Sim.2

Optimize Delete Copy Paste Optimization Method: Minimize Size Maximum Tsize: Free [mm]

L			Optimization Setup		R		C	
Element	P/N	Status	Size Code	Element	Resistance	Element	Capacitance	
L1	BLM18EG181SH1	Optim.	Free	R1	1.5 [kohm]	C1	0.1 [uF]	
L2	LQW18CNR27J0Z	Optim.	Free	R2	1.5 [kohm]	C2	0.1 [uF]	
L3	LQW32FT220M0H	Optim.	Free	R3	1.5 [kohm]			
L4		None		R4	1.5 [kohm]			
L5		None		R5	1.5 [kohm]			
FB1	BLM18KG102SH1	Optim.	Free					

(4) Click the Optimize button with
 Sim1 Optimization method: Maximize margin
 Sim2 Optimization method: Minimize size



(5) Results are displayed
 In this case
 For "Maximize margin"
 L1 : LQW18CNR21J0Z
 L2 : LQW32FT220M0H
 L3 : LQH44PH330MPR
 For "Minimize size"
 L1 : BLM18EG181SH1
 L2 : LQW18CNR27J0Z
 L3 : LQW32FT220M0H
 are automatically selected

Result		Minimum Margin				P/N	
		S21[dB]	S11[dB]	S21[S11]			
Sim.1	PASS	1.56	7.36	-	1.52	1.28	Selected Items
Sim.2	PASS	0.95	1.00	-	1.03	0.87	Selected Items
Sim.3	NA	-	-	-	-	-	Selected Items

Chip Size

Sim.1
 Total [mm2] 26.56
 T Max. [mm] 2.50

Sim.2
 Total [mm2] 11.84
 T Max. [mm] 2.50

Graphs, margin values, size images, total DCR values, and total size values can be compared

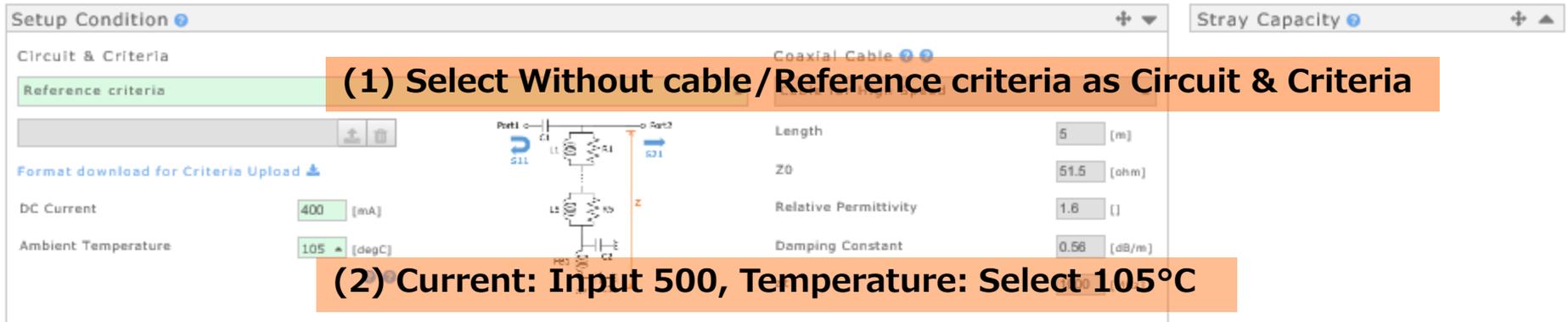
Use Case 4

(Reselect L from inductor list) 1/3

PoC Bias-T filter design for ADAS cameras (without cable)

- Current : 400mA
- Ambient temperature :105°C
- Criteria : Reference Criteria

Reselect the L1 element after automatic selection and compare.

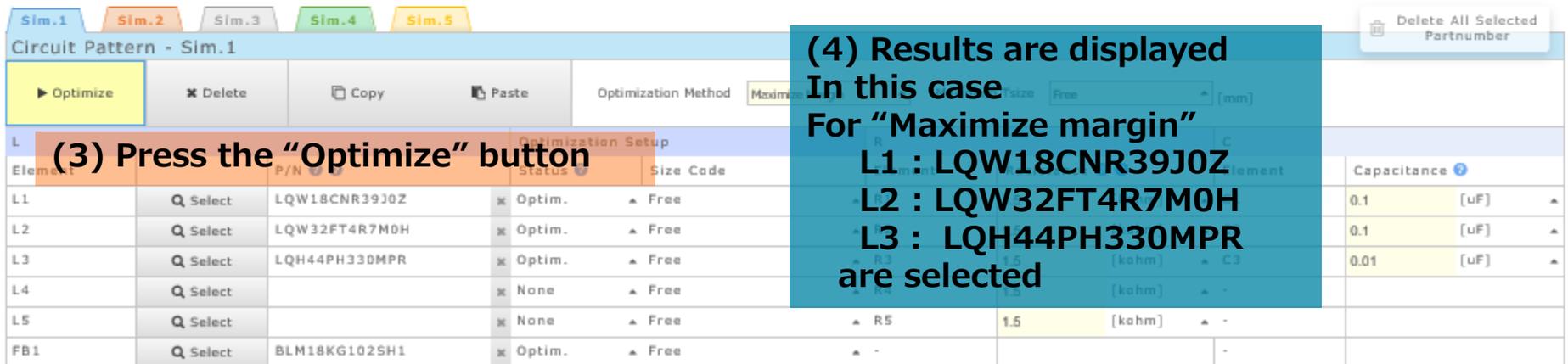


(1) Select Without cable/Reference criteria as Circuit & Criteria

(2) Current: Input 500, Temperature: Select 105°C

Coaxial Cable

Length	5 [m]
Z0	51.5 [ohm]
Relative Permittivity	1.8 []
Damping Constant	0.56 [dB/m]



(3) Press the "Optimize" button

(4) Results are displayed In this case For "Maximize margin"

L1 : LQW18CNR39J0Z
L2 : LQW32FT4R7M0H
L3 : LQH44PH330MPR
are selected

Element	Q Select	P/N	Status	Size Code	Capacitance
L1	Q Select	LQW18CNR39J0Z	Optim.	Free	0.1 [uF]
L2	Q Select	LQW32FT4R7M0H	Optim.	Free	0.1 [uF]
L3	Q Select	LQH44PH330MPR	Optim.	Free	0.01 [uF]
L4	Q Select		None	Free	
L5	Q Select		None	Free	
FB1	Q Select	BLM18KG102SH1	Optim.	Free	

Use Case 4

(Reselect L from inductor list) 2/3

Sim.1 Sim.2 Sim.3 Sim.4 Sim.5

Circuit Pattern - Sim.1

Optimize Delete Copy Paste Optimization Method Maximize Margin Maximum Tsize Free (mm)

(5) Copy product names selected in "Sim1"

Element	Q Select	P/N	Status	Size	Element	Resistance	Element	Capacitance
L1	Q Select	BLM18HE102SH1	Optim.	Free	R1	[kohm]	C1	0.1 [uF]
L2	Q Select	LQW32FT220M0H	Optim.	Free	R2	1.5 [kohm]	C2	0.1 [uF]
L3	Q Select	LQH3NPZ220MME	Optim.	Free	R3	1.5 [kohm]	C3	0.01 [uF]
L4	Q Select		None	Free	R4	1.5 [kohm]	-	
L5	Q Select		None	Free	R5	1.5 [kohm]	-	
FB1	Q Select	BLM18KG102SH1	Optim.	Free	-		-	

Sim.1 Sim.2 Sim.3 Sim.4 Sim.5

Circuit Pattern - Sim.2

Optimize Delete Copy Paste Optimization Method Minimize Size Maximum Tsize Free (mm)

(6) Select "Sim2"

(7) Attach the Sim1 part number by clicking Paste

Sim.1 Sim.2 Sim.3 Sim.4 Sim.5

Circuit Pattern - Sim.2

Optimize Delete Copy Paste Optimization Method Minimize Size Maximum Tsize Free (mm)

(8) Click "Select" of L1

Element	Q Select	P/N	Status	Size
L1	Q Select	BLM18HE102SH1	Optim.	Free
L2	Q Select		None	Free
L3	Q Select	LQH3NPZ220MME	Optim.	Free
L4	Q Select		None	Free
L5	Q Select		None	Free
FB1	Q Select	BLM18KG102SH1	Optim.	Free

Circuit Pattern - Sim.2

Element - L3

Reset Close

1608/0603 2012/0805 3030/1212

DC Current 500 [mA] Temperature 105 [degC]

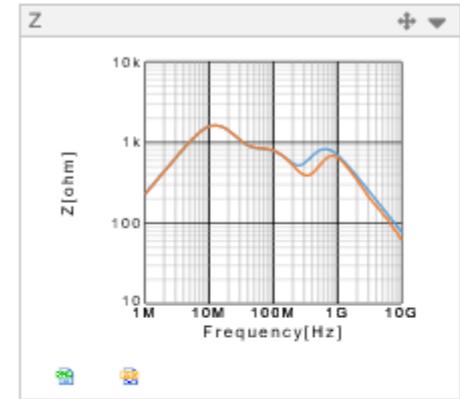
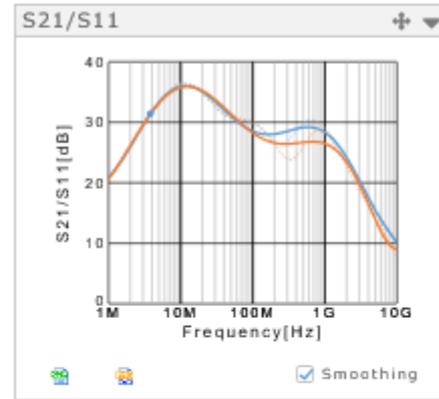
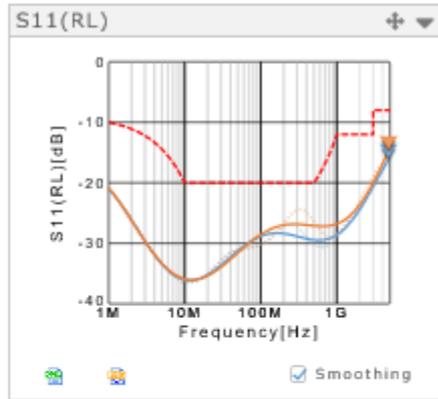
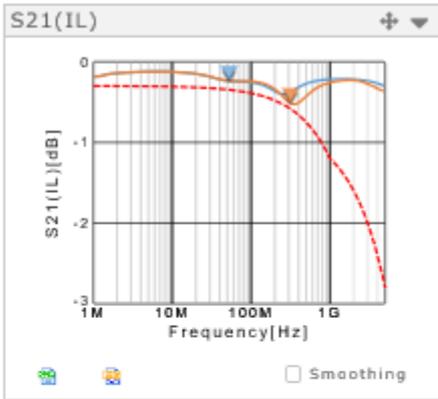
(9) Select an inductor

Change LQW18CNR39J0Z to BLM18HE152SH1

Partnumber	Search	Inductance	Code	Max. Inductance	Max. Current	Temp. (125degC)	Rdc (Max.)	Operating Temp. (Min)	Operating Temp. (Max)	Application		
BLM18PG300SH1	300ohm@100MHz	1608/0603	0.95	1000	1000	1000	0.05	0.02	-55	125	Powertrain/Safety	
BLM18PG330SH1	330ohm@100MHz	1608/0603	0.95	3000	3000	2000	0.025	0.01	-55	125	Powertrain/Safety	
BLM18PG331SH1	330ohm@100MHz	1608/0603	0.95	1200	1200	1100	0.050	0.08	-55	125	Powertrain/Safety	
BLM18PG471SH1	470ohm@100MHz	1608/0603	0.95	1000	1000	1000	0.2	0.12	-55	125	Powertrain/Safety	
BLM18PG600SH1	600ohm@100MHz	1608/0603	0.95	1000	1000	1000	0.1	0.04	-55	125	Powertrain/Safety	
LQH32PH1R0NNC	1uH@1MHz	3225/1210	1.7	1000	2500	1380	0.0432	0.036	-40	105	Powertrain/Safety	
LQH32PH2R2NNC	2.2uH@1MHz	3225/1210	1.7	1600	1300	630	0.064	-40	105	Powertrain/Safety		
LQH32PH3R3NNC	3.3uH@1MHz	3225/1210	1.7	1600	1300	630	0.1	-40	105	Powertrain/Safety		
LQH32PH4R7NNC	4.7uH@1MHz	3225/1210	1.7	1600	1300	630	0.186	0.155	-40	105	Powertrain/Safety	
LQH32PH6R8NNC	6.8uH@1MHz	3225/1210	1.7	1600	1300	630	0.264	0.22	-40	105	Powertrain/Safety	
LQH32PHR47NNC	0.47uH@1MHz	3225/1210	1.7	1600	1300	630	0.0288	-40	105	Powertrain/Safety		
LQH3NPZ100MME	10uH@1MHz	3030/1212	1.5	810	1280	800	0.228	0.19	-40	105	Infotainment	
LQH3NPZ150MME	15uH@1MHz	3030/1212	1.5	660	1020	620	0.348	0.29	-40	105	Infotainment	
LQH3NPZ1R0MME	1uH@1MHz	3030/1212	1.5	2350	3000	1600	800	0.03	0.025	-40	105	Infotainment
LQH3NPZ220MME	22uH@1MHz	3030/1212	1.5	570	860	540	270	0.48	0.4	-40	105	Infotainment
LQH3NPZ2R2MME	2.2uH@1MHz	3030/1212	1.5	1800	2100	1220	610	0.078	0.065	-40	105	Infotainment
LQH3NPZ3R3MME	3.3uH@1MHz	3030/1212	1.5	1520	1900	1150	575	0.1008	0.084	-40	105	Infotainment
LQH3NPZ4R7MME	4.7uH@1MHz	3030/1212	1.5	1300	1700	1000	500	0.12	0.1	-40	105	Infotainment

Use Case 4

(Reselect L from inductor list) 3/3



Result		Minimum Margin				Rdc		P/N
		S21[dB]	S11[dB]	S21/S11[dB]	Z[ohm]	Max.[ohm]	Typ.[ohm]	
Sim.1	PASS	0.11	7.75	-	-	1.31	1.09	Selected Items
Sim.2	PASS	0.07	6.31	-	-	1.53	1.26	Selected Items
Sim.3	NA	-	-	-	-	-	-	Selected Items
Sim.4	NA	-	-	-	-	-	-	Selected Items
Sim.5	NA	-	-	-	-	-	-	Selected Items

Chip Size		
Sim.1		Total [mm2] 26.56 T Max.[mm] 2.50
Sim.2		Total [mm2] 26.56 T Max.[mm] 2.50
Sim.3		Total [mm2] - T Max.[mm] -

(10) Results are displayed
Comparison of results when
LQW18CNR39J0Z or BLM18HE152SH1
is used for L1

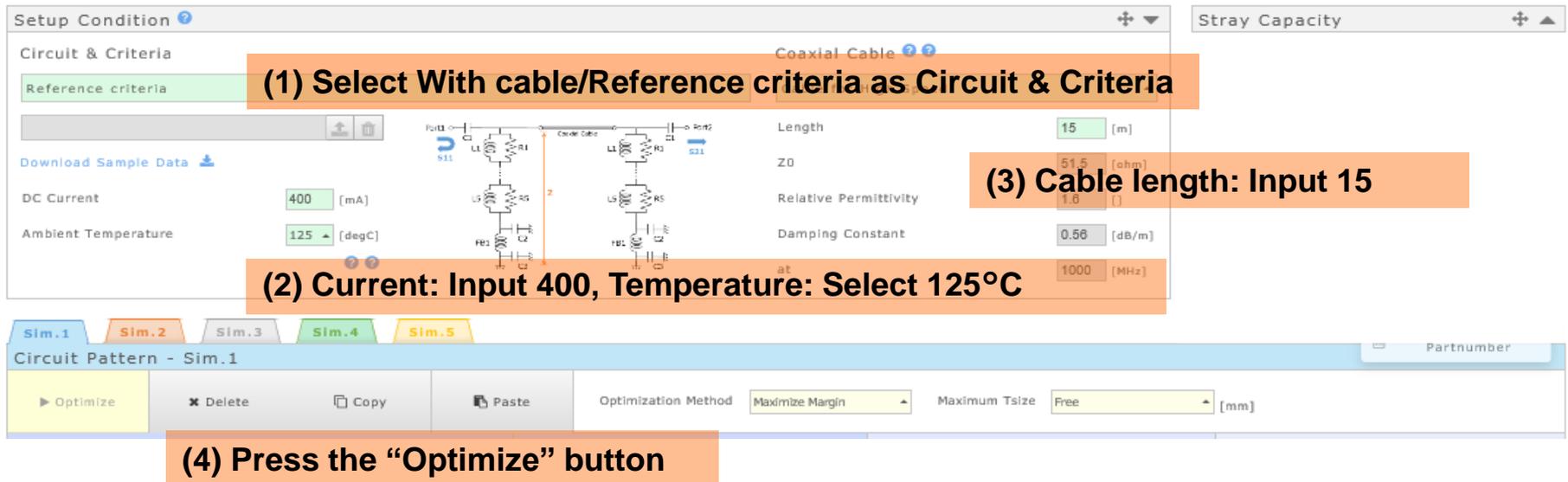
Use Case 5

(Relax the set up condition after the result become “Fail”) 1/3

PoC Bias-T filter design for ADAS cameras (With cable)

- Current : 400 mA
- Ambient temperature : 125°C
- Cable length : 15 m
- Criteria : Reference criteria

Relax the set up condition after the result become “Fail”

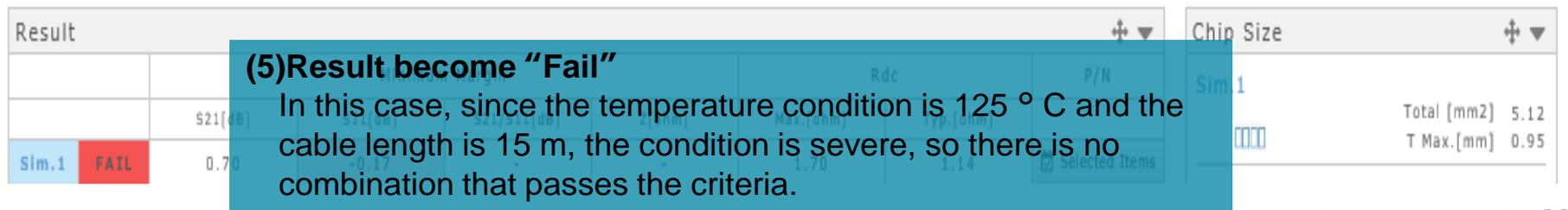


(1) Select With cable/Reference criteria as Circuit & Criteria

(2) Current: Input 400, Temperature: Select 125°C

(3) Cable length: Input 15

(4) Press the “Optimize” button



(5) Result become “Fail”

In this case, since the temperature condition is 125 ° C and the cable length is 15 m, the condition is severe, so there is no combination that passes the criteria.

Use Case 5

(Relax the set up condition after the result become "Fail") 2/3



i , Relax the temperature condition (125°C->105°C)

DC Current: 400 [mA]

Ambient Temperature: 105 [degC]

Relative Permittivity: 1.6 []

Damping Constant: 0.56 [dB/m]

at: 1000 [MHz]

(6) Relax the temperature from 125C to 105C

(7) Press the "Optimize" button

Circuit Pattern - Sim.1

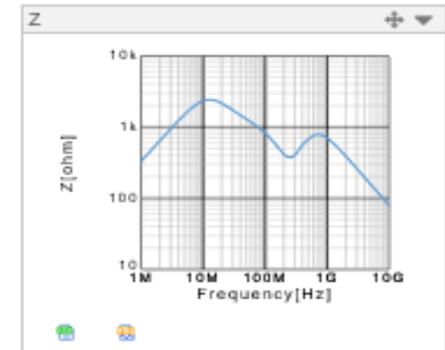
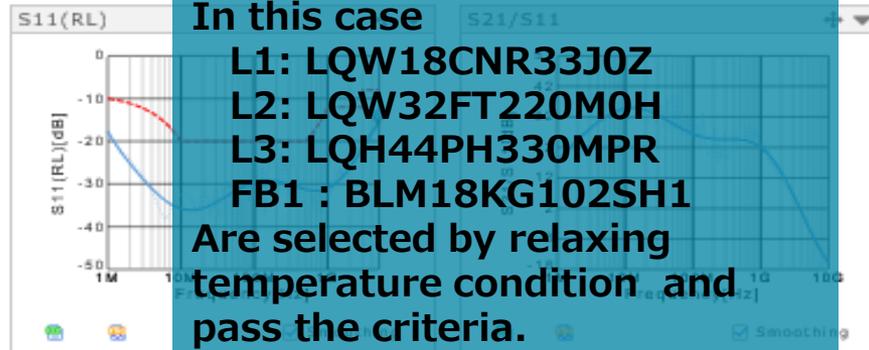
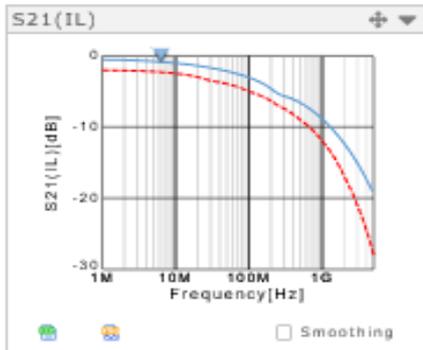
Optimize [X] Delete [X] Copy [X] Paste [X] Optimization Method: Maximize Margin Maximum Size: Free [mm]

L				Optimization Setup			R		C	
Element		P/N	Status	Size Code	Element	Resistance	Element	Capacitance		
L1	Q Select	LQW18CNR33J0Z	Optim.	Free	R1	1.5 [kohm]	C1	0.1 [uF]		
L2	Q Select	LQW32FT220M0H	Optim.	Free	R2	1.5 [kohm]	C2	0.1 [uF]		
L3	Q Select	LQH44PH330MPR	Optim.	Free	R3	1.5 [kohm]	C3	0.01 [uF]		
L4	Q Select		None	Free	R4	1.5 [kohm]	-			
L5	Q Select		None	Free	R5	1.5 [kohm]	-			
FB1	Q Select	BLM18KG102SH1	Optim.							

(8) Results are displayed

In this case

- L1: LQW18CNR33J0Z
 - L2: LQW32FT220M0H
 - L3: LQH44PH330MPR
 - FB1 : BLM18KG102SH1
- Are selected by relaxing temperature condition and pass the criteria.



Result

Sim.	Status	Minimum Margin				Rdc		P/N
		S21[dB]	S11[dB]	S21/S11[dB]	Z[ohm]	Max.[ohm]	Typ.[ohm]	
Sim.1	PASS	1.44	7.42	-	-	1.62	1.37	Selected Items

Chip Size

Sim.1

Total [mm2] 26.56

T Max.[mm] 2.50

Use Case 5

(Relax the set up condition after the result become "Fail") 3/3

ii, Relax the temperature condition (125°C->105°C) + add element in series

DC Current: 400 [mA]
Ambient Temperature: 115 [degC]
Relative Permittivity: 1.6 [1]
Damping Constant: 0.99 [1]

**(6) Relax the temperature from 125C to 115C
(There is no combination that pass the criteria just by relaxing at 115 °C.)**

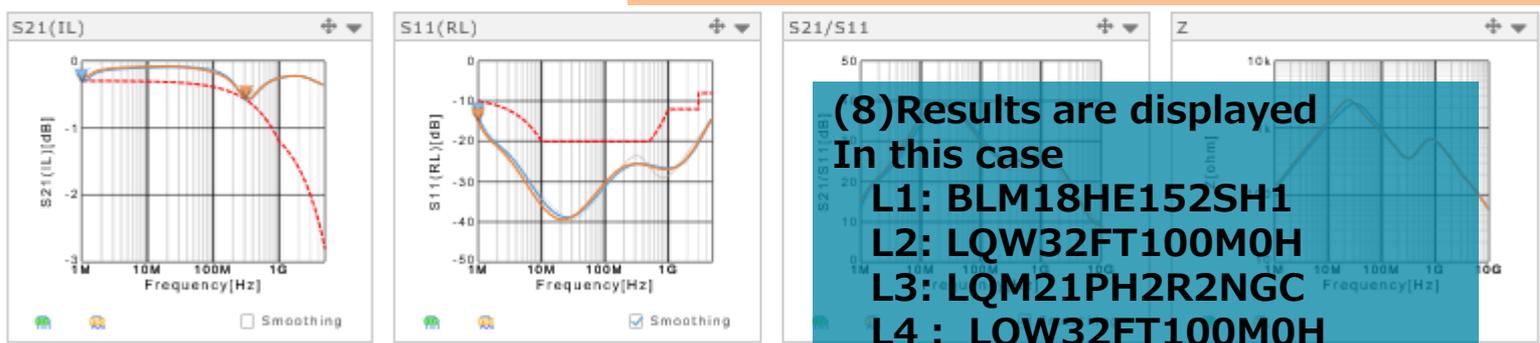
Circuit Pattern - Sim.2

Optimize [X] Delete [X] Copy [X] Paste [X] Optimization Method: Minimize Size Maximum Tsize: Free [mm]

(8) Press the "Optimize" button

Element	P/N	Status	Size Code	Element	Resistance	Element	Capacitance
L1	BLM18HE152SH1	Optim.	Free	R1	1.5 [kohm]	C1	0.1 [uF]
L2	LQW32FT100M0H	Optim.	Free	R2	1.5 [kohm]	C2	0.1 [uF]
L3	LQM21PH2R2NGC	Optim.	Free	R3	1.5 [kohm]	C3	0.01 [uF]
L4	LQW32FT100M0H	Optim.	Free	R4	1.5 [kohm]		
L5		None	Free	R5	1.5 [kohm]		
FB1	BLM18KG102SH1	Optim.	Free				

**(7) Select "Optim." as L4 status
(Series elements number become 4pcs)**



**(8) Results are displayed
In this case**

- L1: BLM18HE152SH1
- L2: LQW32FT100M0H
- L3: LQM21PH2R2NGC
- L4: LQW32FT100M0H

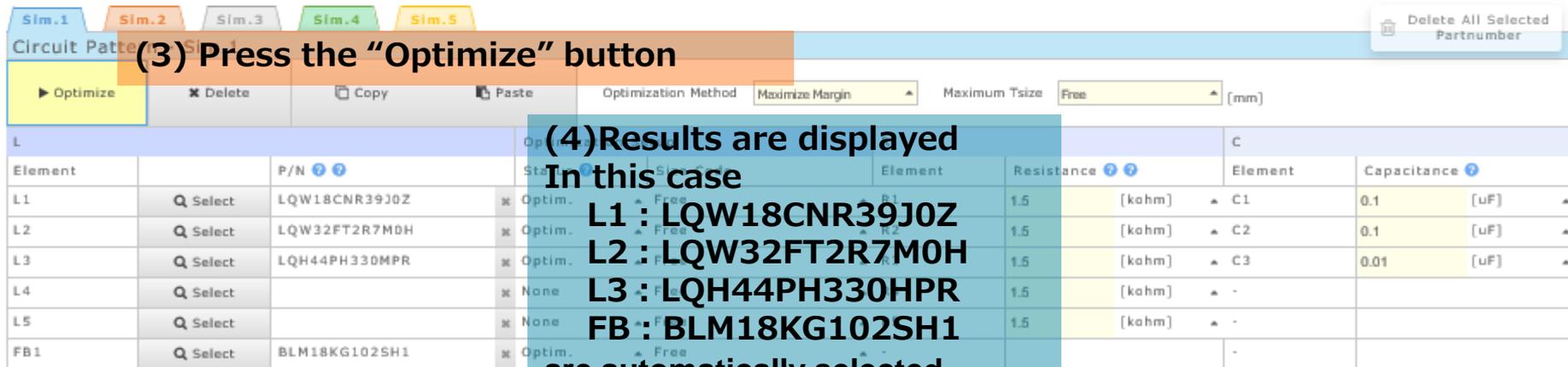
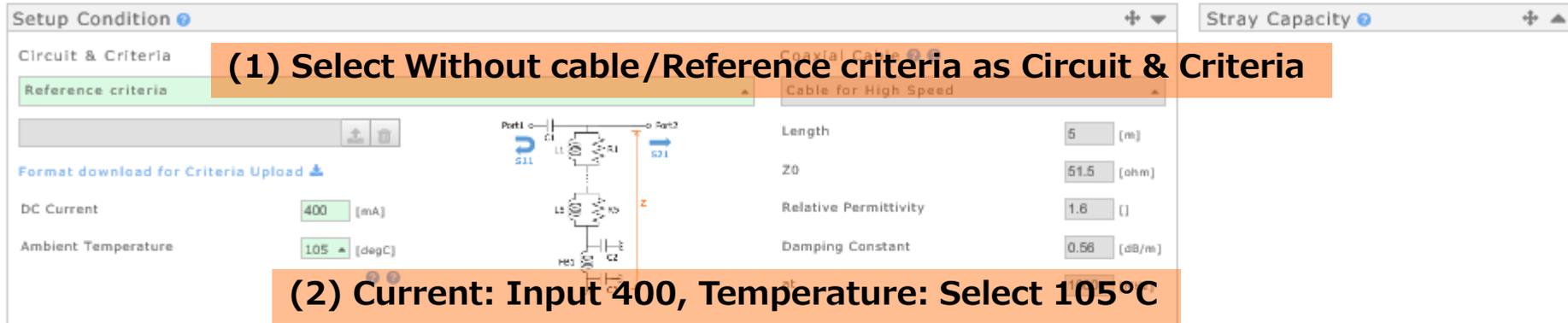
Are selected by relaxing temperature condition and pass the criteria

Result		Minimum Margin					
		S21[dB]	S11[dB]	S21/S11[dB]	Z[ohm]	Max.[ohm]	Total [mm2]
Sim.1	FAIL	-0.01	3.43	-	-	1.50	18.56
Sim.2	PASS	0.02	4.93	-	-	1.70	2.50
Sim.3	NA	-	-	-	-	-	20.96
							T Max.[mm]

Use Case 6 (Reduce parallel R) 1/2

PoC Bias-T filter design for ADAS cameras (Without cable)

- Current : 400 mA
 - Ambient temperature : 105°C
 - Criteria : Reference criteria
- Reduce parallel R



Element	P/N	Optimization Method	Resistance	Element	Capacitance
L1	LQW18CNR39J0Z	Optim.	1.5 [kohm]	C1	0.1 [uF]
L2	LQW32FT2R7M0H	Optim.	1.5 [kohm]	C2	0.1 [uF]
L3	LQH44PH330MPR	Optim.	1.5 [kohm]	C3	0.01 [uF]
L4		None	1.5 [kohm]	-	
L5		None	1.5 [kohm]	-	
FB1	BLM18KG102SH1	Optim.	1.5 [kohm]	-	

Use Case 6 (Reduce parallel R) 2/2

(5) Select Sim2

Sim.1 Sim.2 (5) Select Sim2

Circuit Pattern - Sim.2

Optimize Delete Copy Paste Optimization Method Maximize Margin Maximum Tsize Free [mm]

Element	Optimization Setup	Status	Size Code	Element	Resistance	Element	Capacitance
L1	Q Select	Optim.	Free	R1	1.5 [kohm]	C1	0.1 [uF]
L2	Q Select	Optim.	Free	R2	1.5 [kohm]	C2	0.1 [uF]
L3	Q Select	Optim.	Free	R3	1.5 [kohm]	C3	0.01 [uF]
L4	Q Select	None	Free				
L5	Q Select	None	Free	R5	1.5 [kohm]		
FB1	Q Select	Optim.	Free				

(8) Press the "Optimize" button

(7) Select "Maximize margin" as optimization method

(6) Delete the value of R1

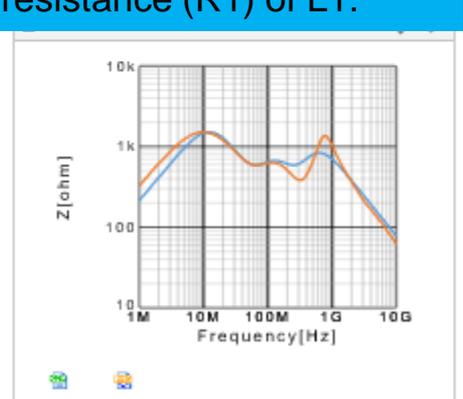
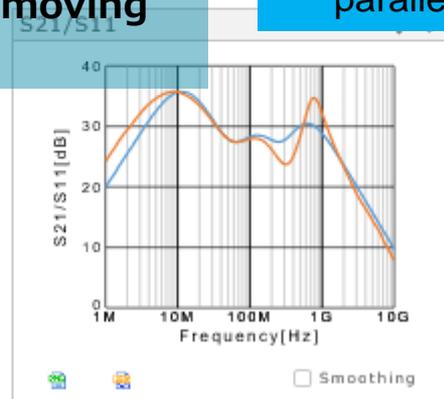
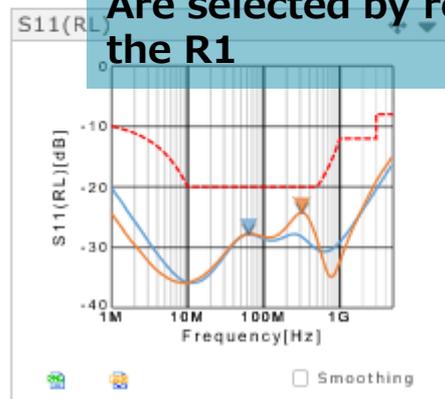
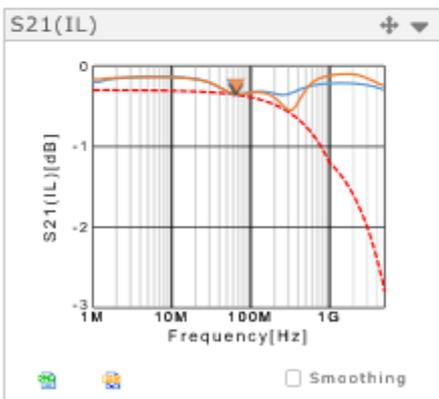
Element	P/N	Element	Resistance	Element	Capacitance
L1	BLM18HE152SH1	R1	1.5 [kohm]	C1	0.1 [uF]
L2	LQW32FT2R7M0H	R2	1.5 [kohm]	C2	0.1 [uF]
L3	LQH44PH470M0H	R3	1.5 [kohm]	C3	0.01 [uF]
L4					
L5					
FB1	BLM18KG102SH1				

(4) Results are displayed
In this case

- L1 : BLM18HE152SH1
- L2 : LQW32FT2R7M0H
- L3 : LQH44PH470HPR
- FB : BLM18KG102SH1

Are selected by removing the R1

(*) In some cases, selecting ferrite beads for L1 can reduce the parallel resistance (R1) of L1.



End