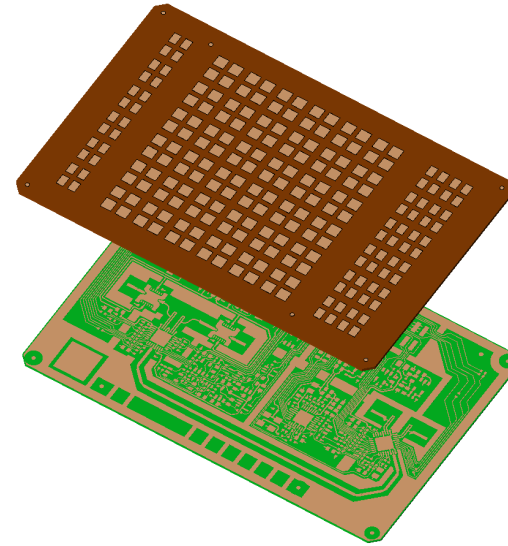# XFdtd's Schematic Editor for Matching Networks
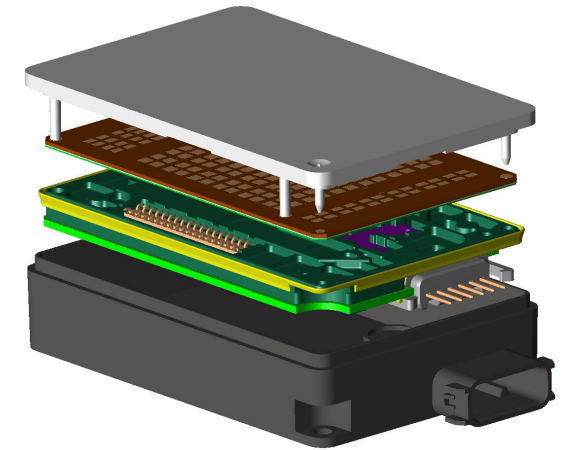
XFdtd Full-Wave Simulation
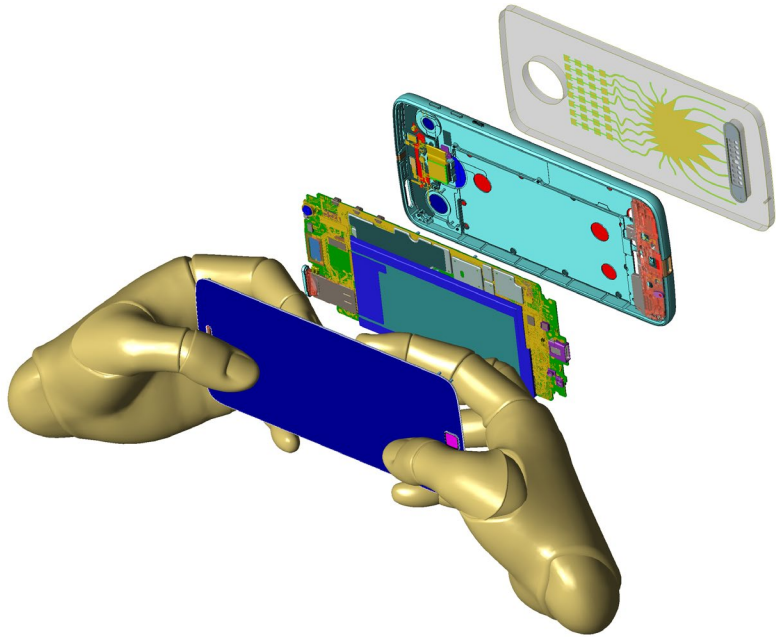
Smartphone

- LTE antennas w/ carrier aggregation
- Diversity, WiFi, BlueTooth, GPS antennas
- 5G FR2 in mmWave bands
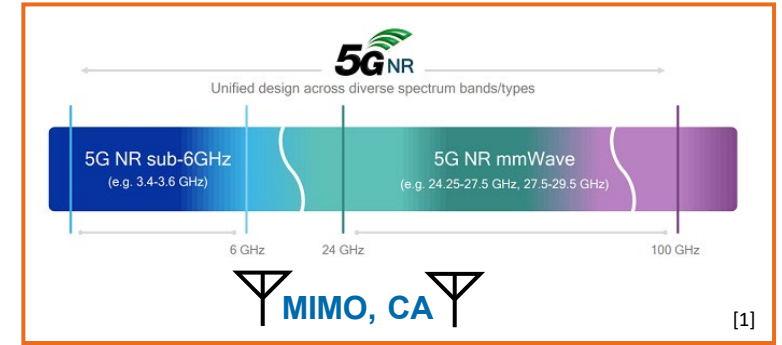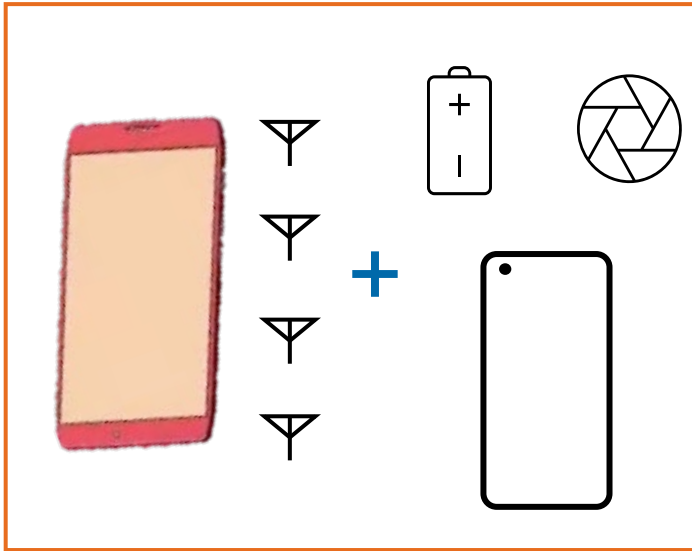- Compliance testing for human exposure (SAR)

Automotive Radar

- 24-81 GHz bands
- Antenna, feeding network, LO design and coupling
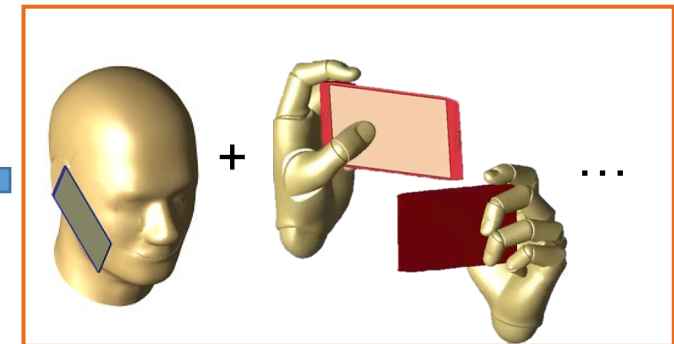- Radome, mounting bracket, fascia attenuation analysis

The Need for a Schematic Editor

Industrial Design

Bands & Standards

5G NR
Unified design across diverse spectrum bands/types

5G NR sub-6GHz
(e.g. 3.4-3.6 GHz)

5G NR mmWave
(e.g. 24.25-27.5 GHz, 27.5-29.5 GHz)

6 GHz   24 GHz   100 GHz

MIMO, CA   [1]

Use cases

Reduced Area + Additional Antennas + Antenna loading = Tougher Challenge to Antenna Engineers

*Motorola Mobility provided the 3-D CAD model of the phone, which was then modified for demonstration purposes to include an external floating antenna

[1] https://www.rfpage.com/what-are-5g-frequency-bands/

Schematic Editor and Frequency-Domain Circuit Solver
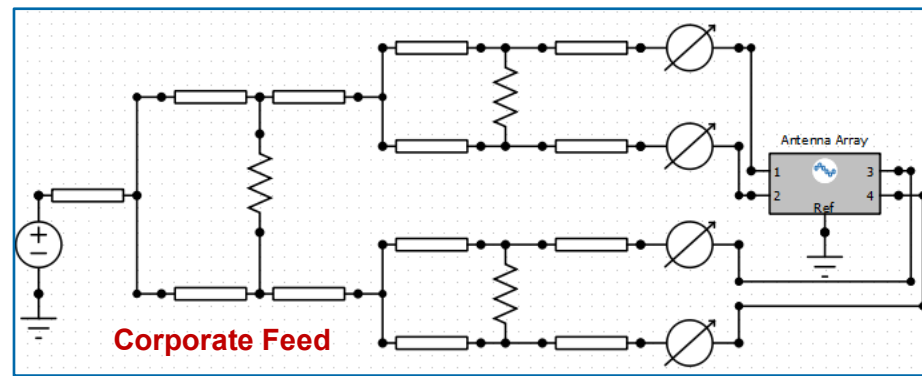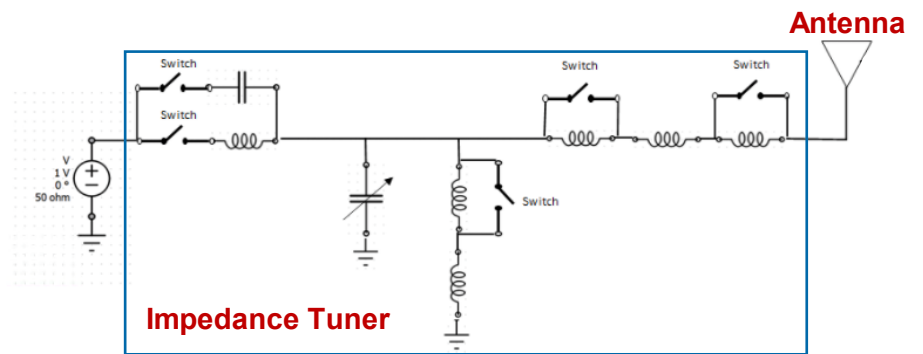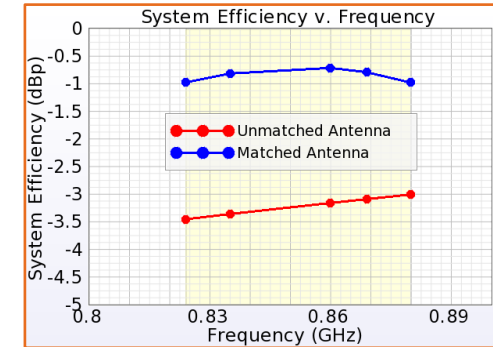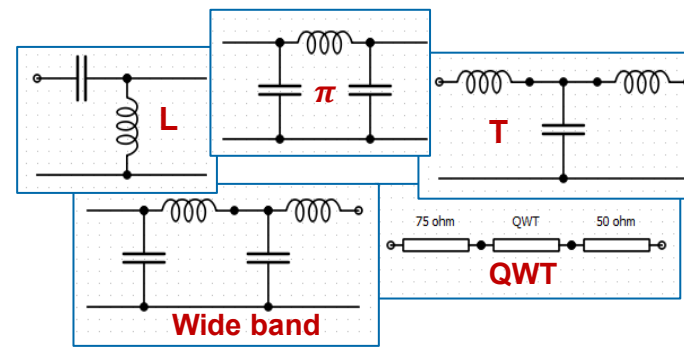
- ☐ Schematic Editor
  - Matching networks & passive devices
- ☐ Operating modes
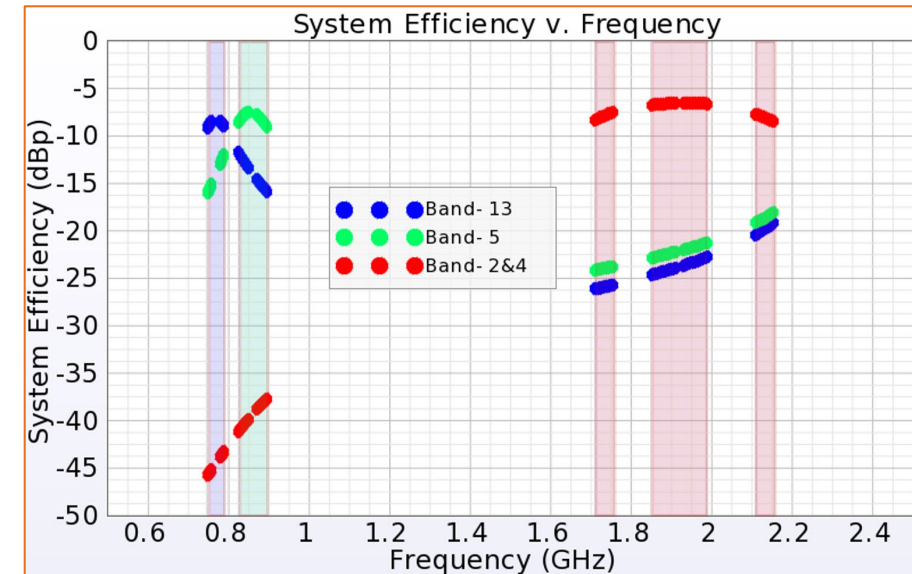 - Multistate and multiport devices
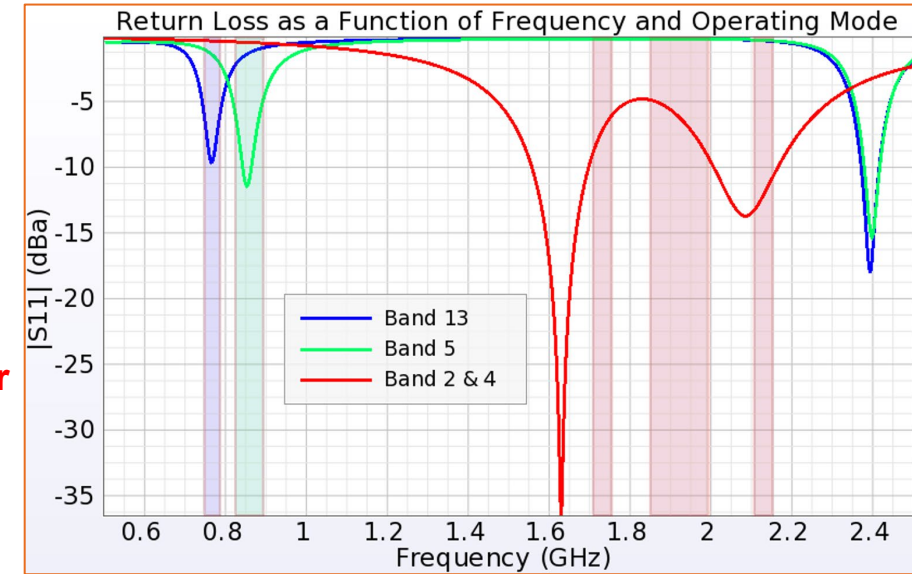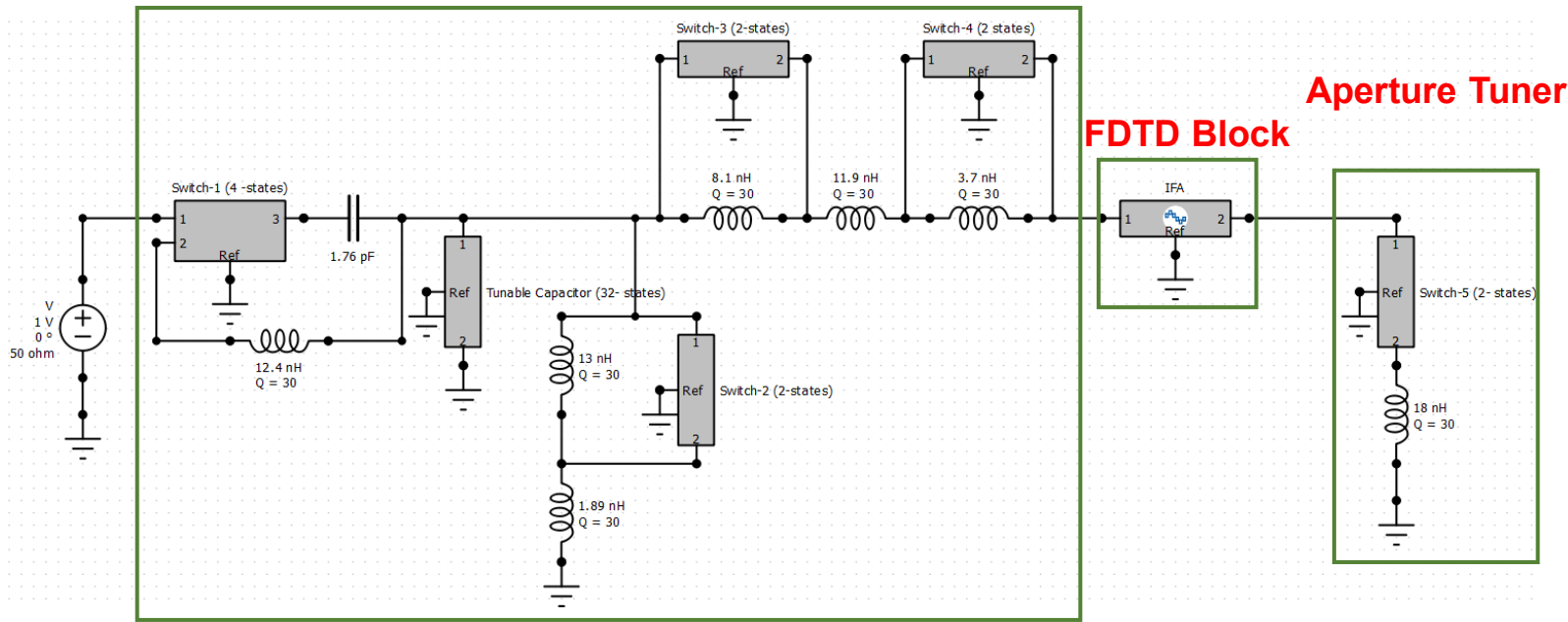 - Corporate feed networks
- ☐ Apply schematic to FDTD Simulation
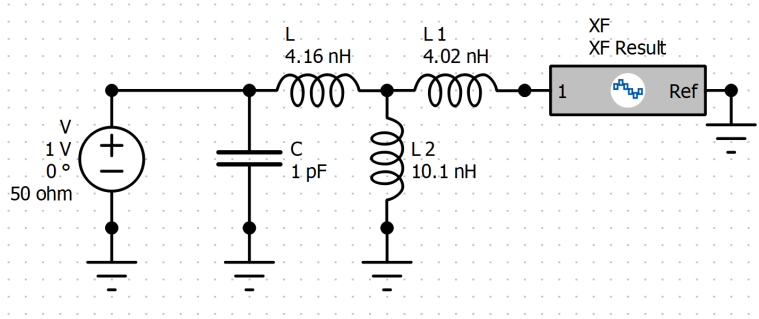 - Near-field results
  - Far-field results
  - System efficiency
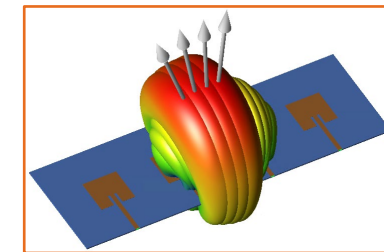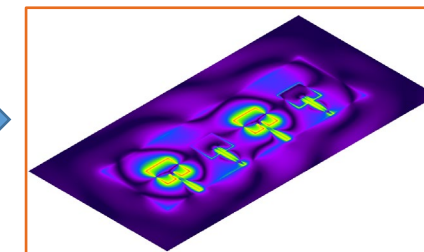
Aperture and Impedance Tuners with Operating Modes

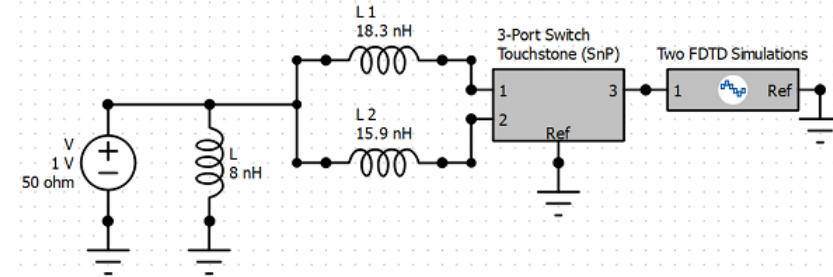# Schematics in XF

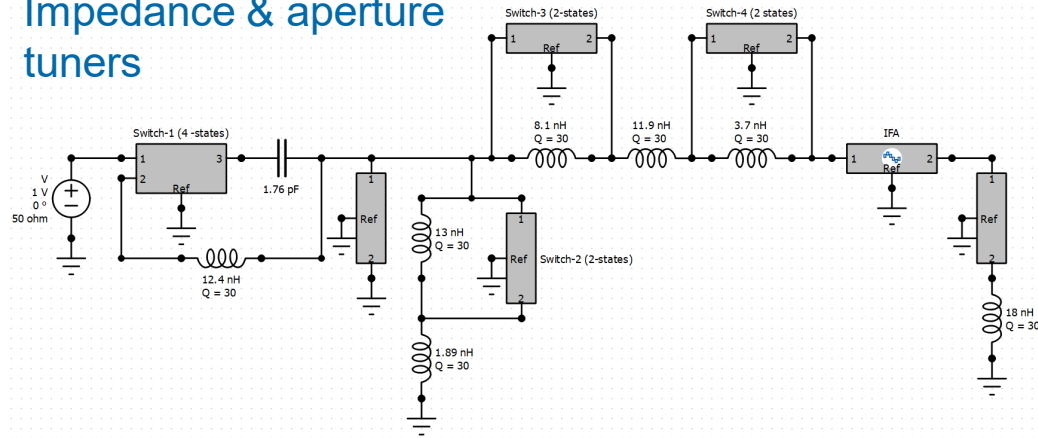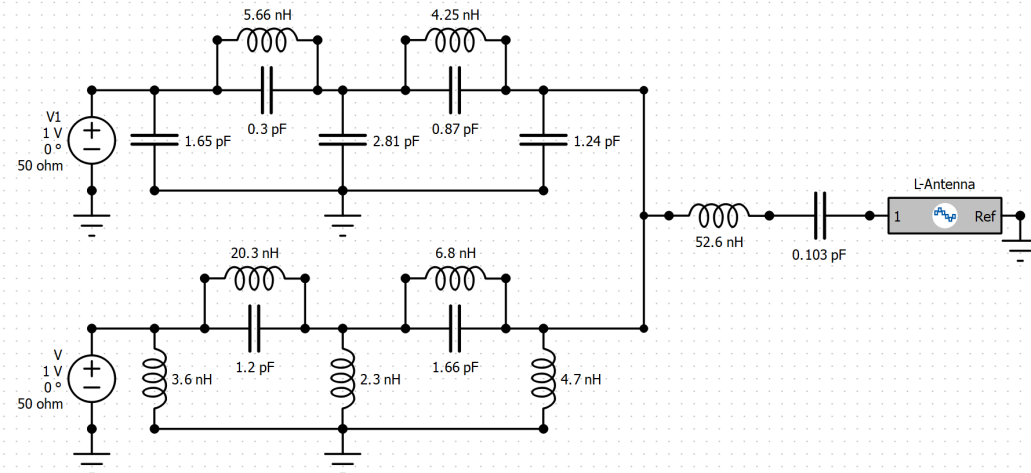**Simple match**

Phone in free space + against head

Impedance & aperture tuners

GPS/WIFI Diplex Match

Schematics can be applied to the FDTD simulation so all full-wave results can be analyzed.

Workflow for Matching Network of DILA Antenna

Step 1

Determine Intrinsic Antenna Impedance

Step 2

Determine Circuit Schematic
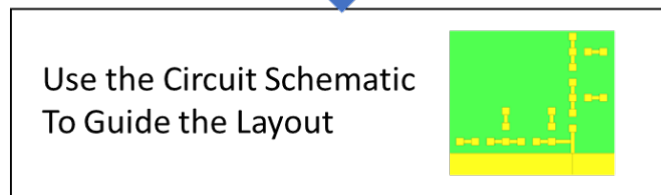
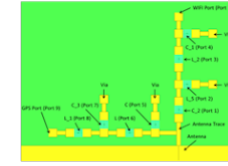**Step 3**

Use the Circuit Schematic To Guide the Layout
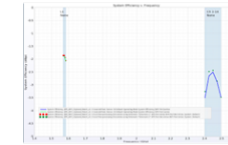
Simulate the Response Matrix

Step 4

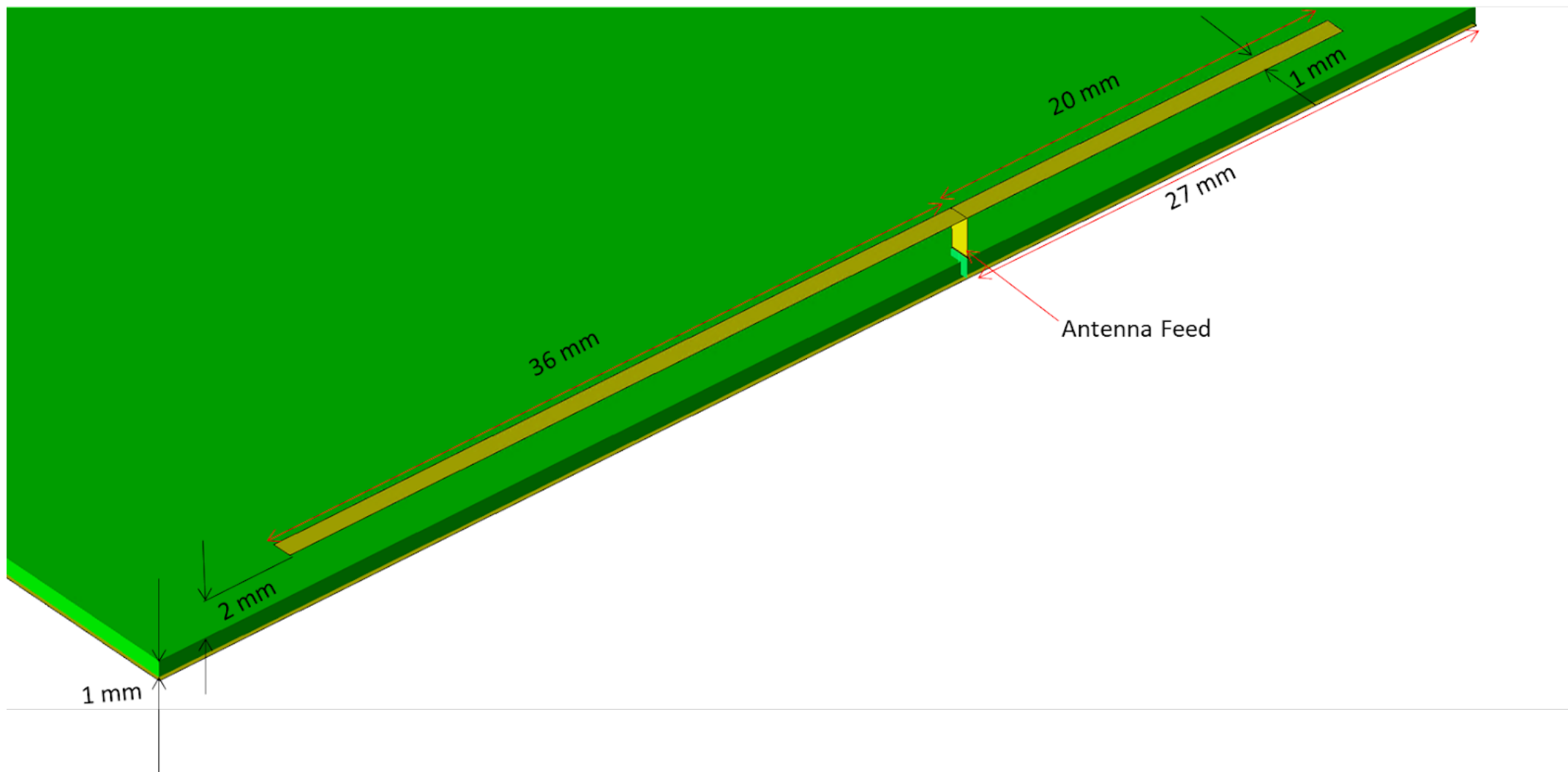Use CEO to Optimize The component Types and Values of The Diplex Match

Review Results !

Step 1: Characterize DILA Antenna

20 mm

1 mm

27 mm

36 mm

Antenna Feed

2 mm

1 mm

S11 of Unmatched DILA Antenna
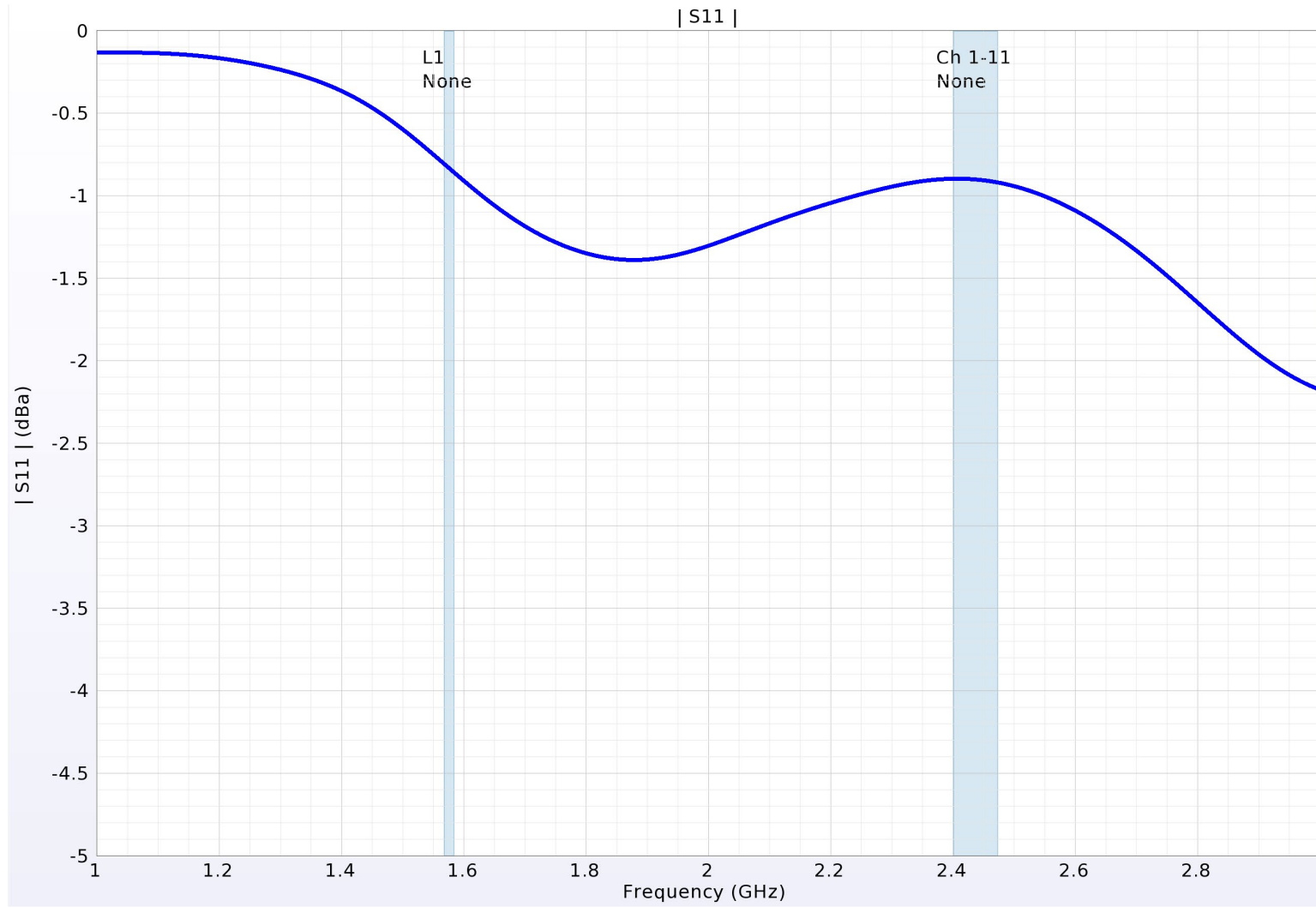
Step 2: Schematic of GPS/WIFI Diplex Circuit
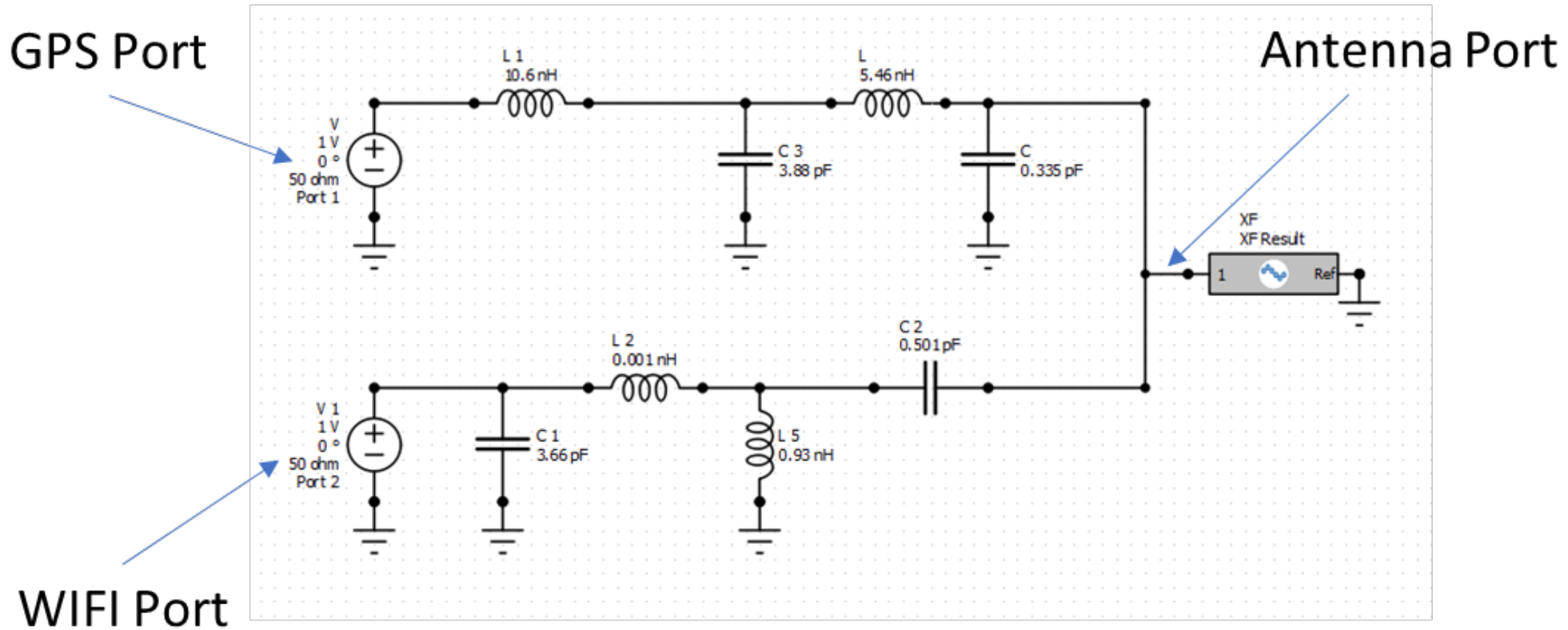
S-Parameters of Diplex Circuit

Parasitics of the Matching Network

Physical Layout with Schematic Component Values

Step 3: Physical Layout and Response Matrix

Step 4: Run CEO on the Physical Layout

Optimized Circuit Output for GPS_WIFI_Diplexed_Match_v3 : 000015 : 1

File

Circuit Optimization Component Value Results for:
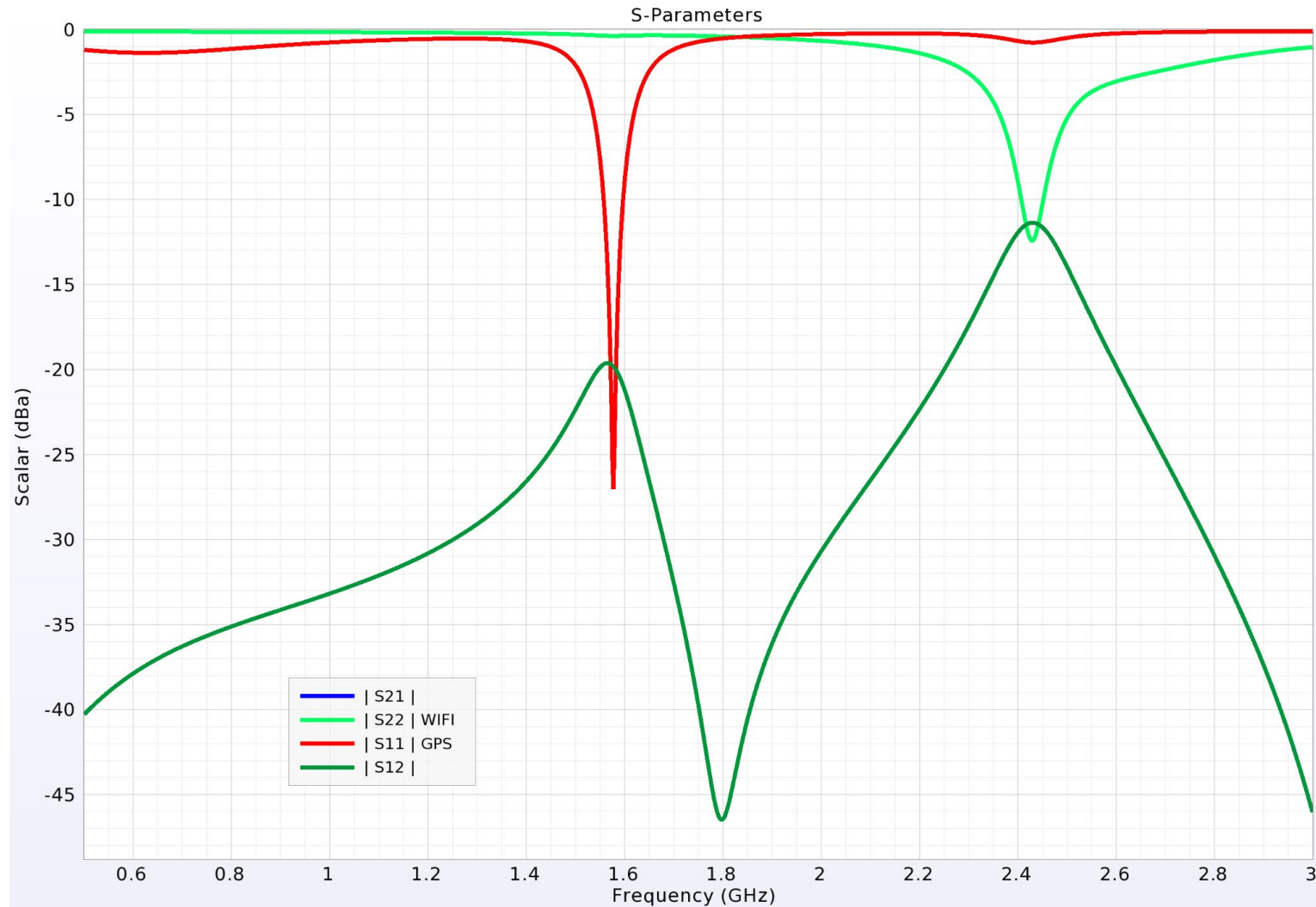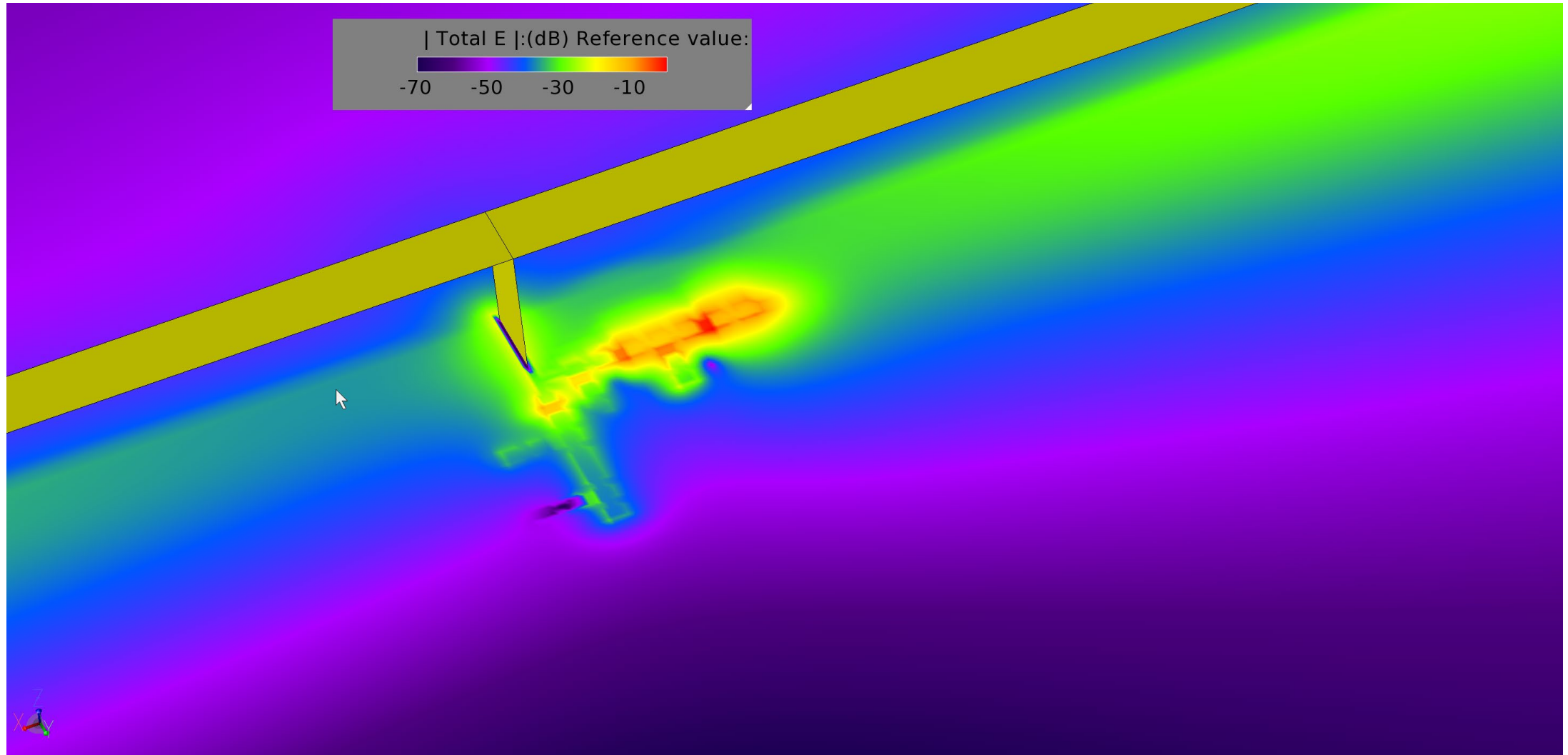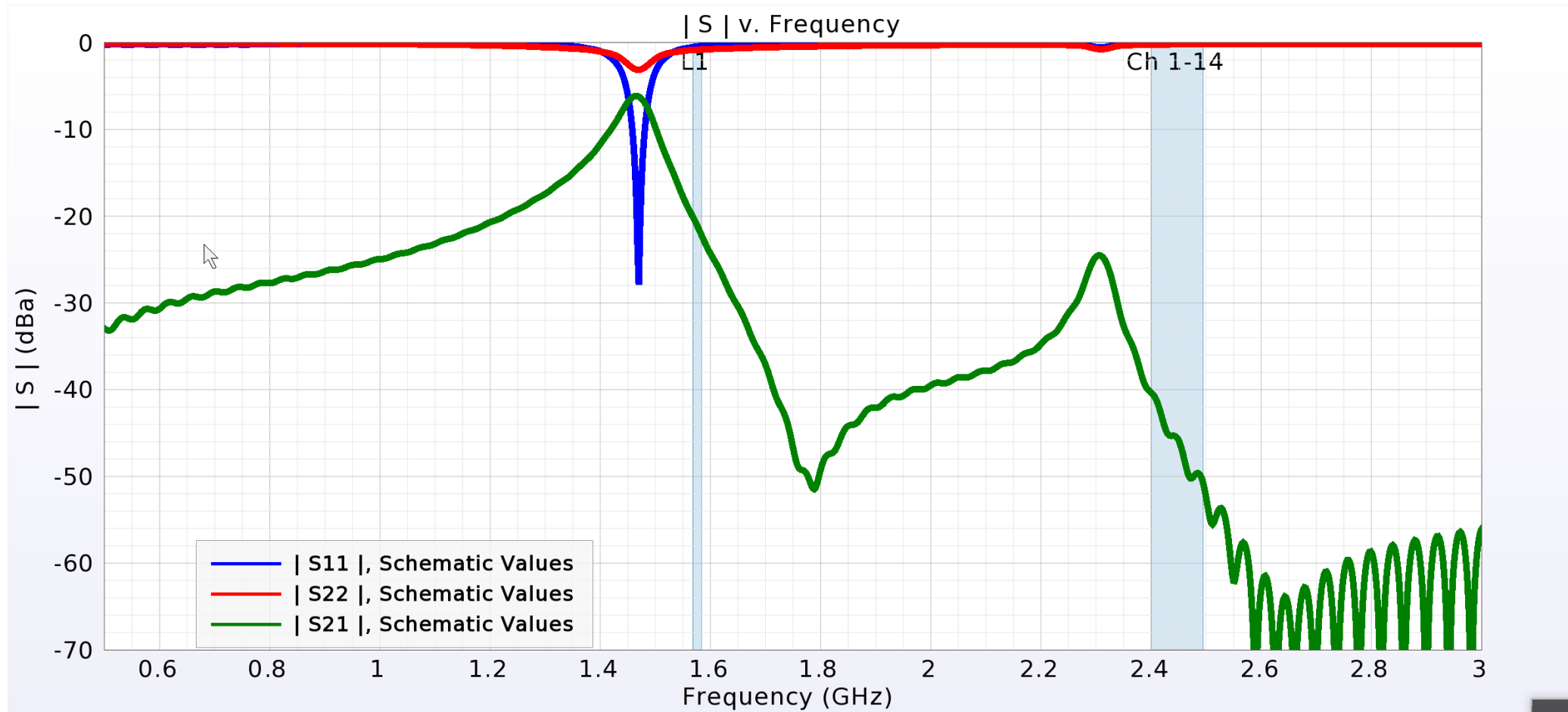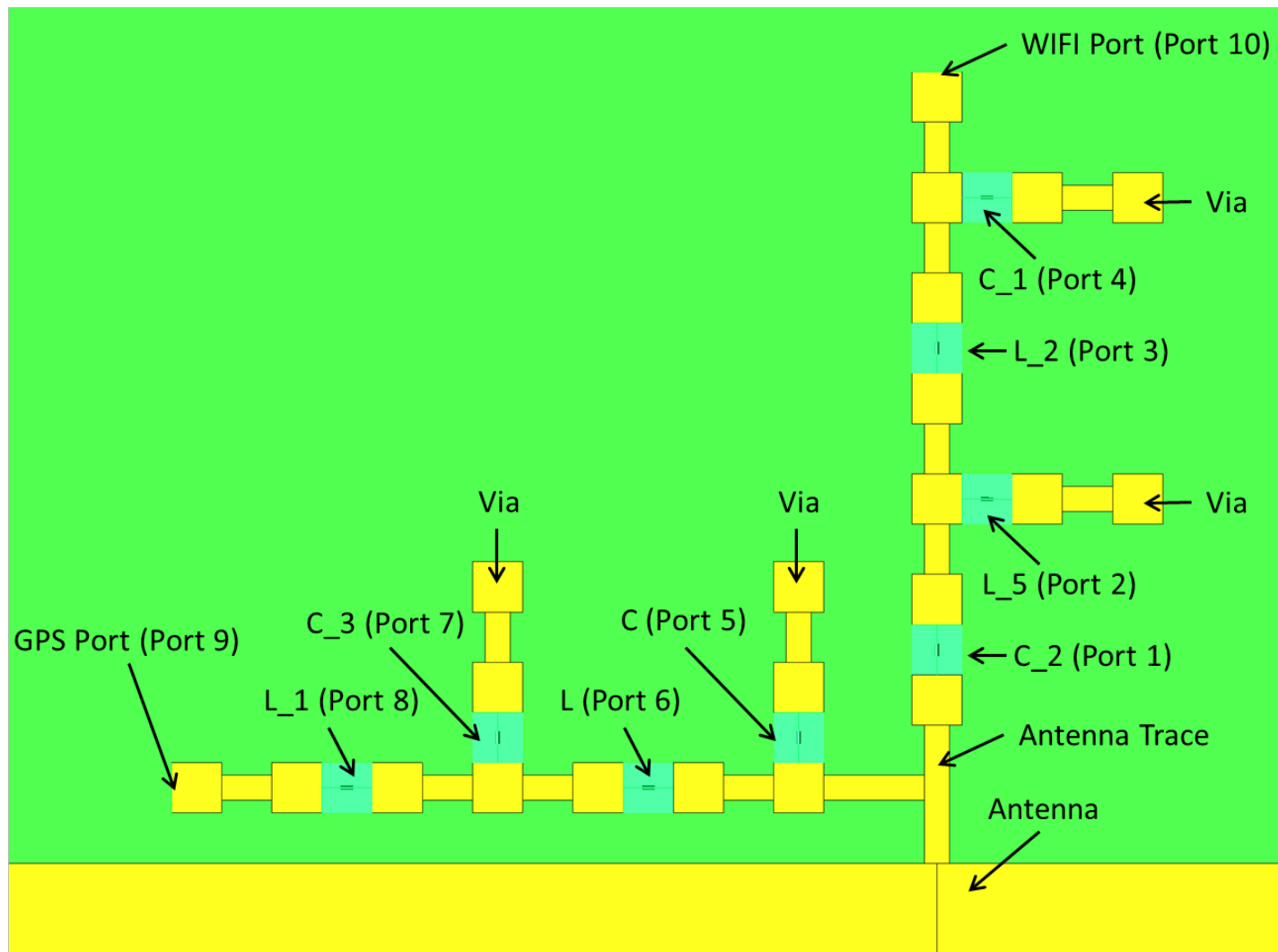
Project Name: GPS_WIFI_Diplexed_Match_v3
Simulation: 3 Goals defined
Run Number: 1
Operating Mode: Default Operating Mode

Run Details

Name	Device	Arrangement	Resistor	Capacitor	Inductor	Additional Variables
C_2	C	Series	0.2 ohm	0.6 pF	--	--
L_5	C	Series	0.2 ohm	80 pF	--	--
L_2	C	Series	0.2 ohm	9.1 pF	--	--
C_1	C	Series	0.2 ohm	2.4 pF	--	--
C	L	Series	0.2 ohm	--	47 nH	--
L	L	Series	0.2 ohm	--	3.8 nH	--
C_3	C	Series	0.2 ohm	4.1 pF	--	--
L_1	L	Series	0.2 ohm	--	3.5 nH	--
GPS Port	--	--	50 ohm	--	--	--
WIFI Port	--	--	50 ohm	--	--	--

Apply Component Values to Project   Create a Schematic

Physical Layout with Optimized Components
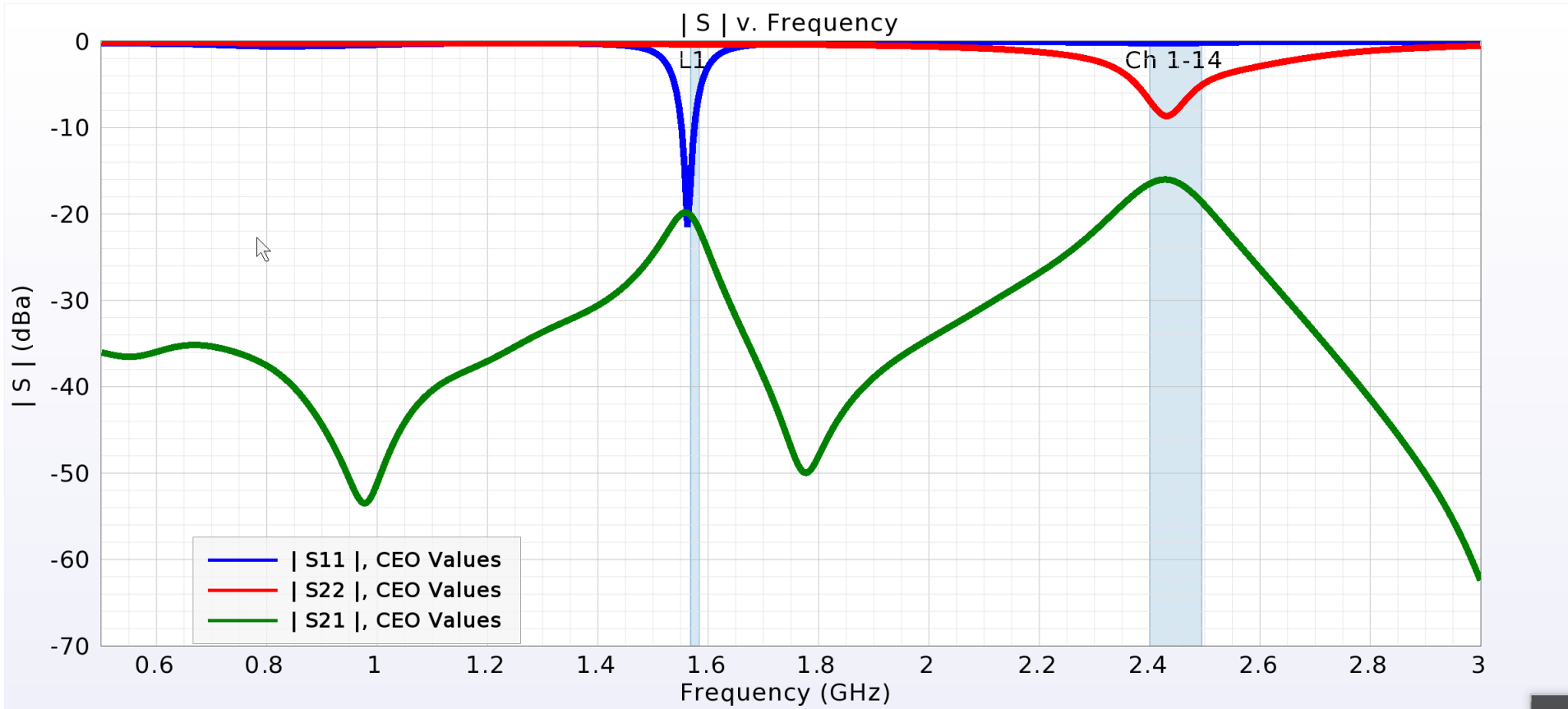
System Efficiency of Optimized Physical Layout
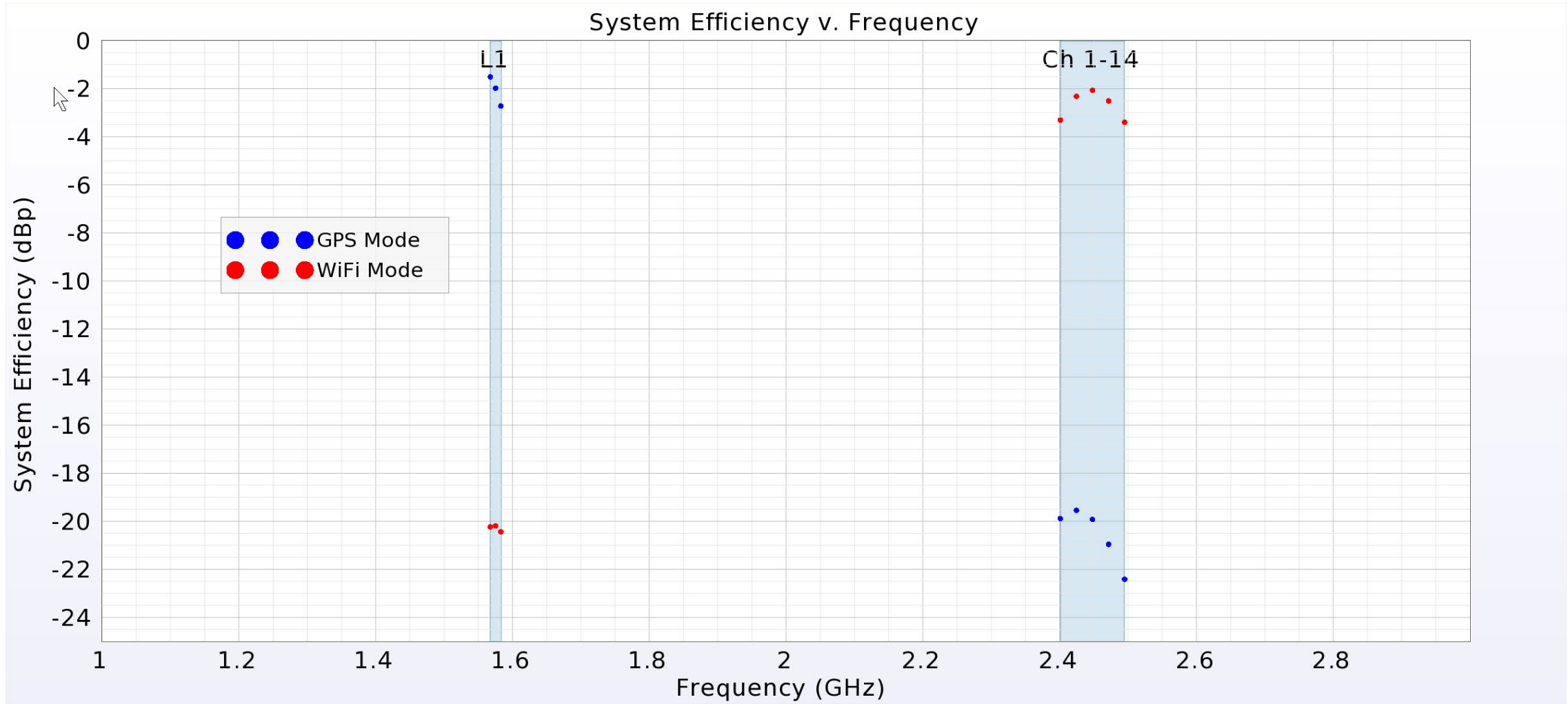
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