
OVERVIEW OF DESIGNING THE LOAD MATCHING NETWORK FOR A POWER AMPLIFIER BY USING THE CIL WIZARD PROVIDED IN THE AMPSA ADW

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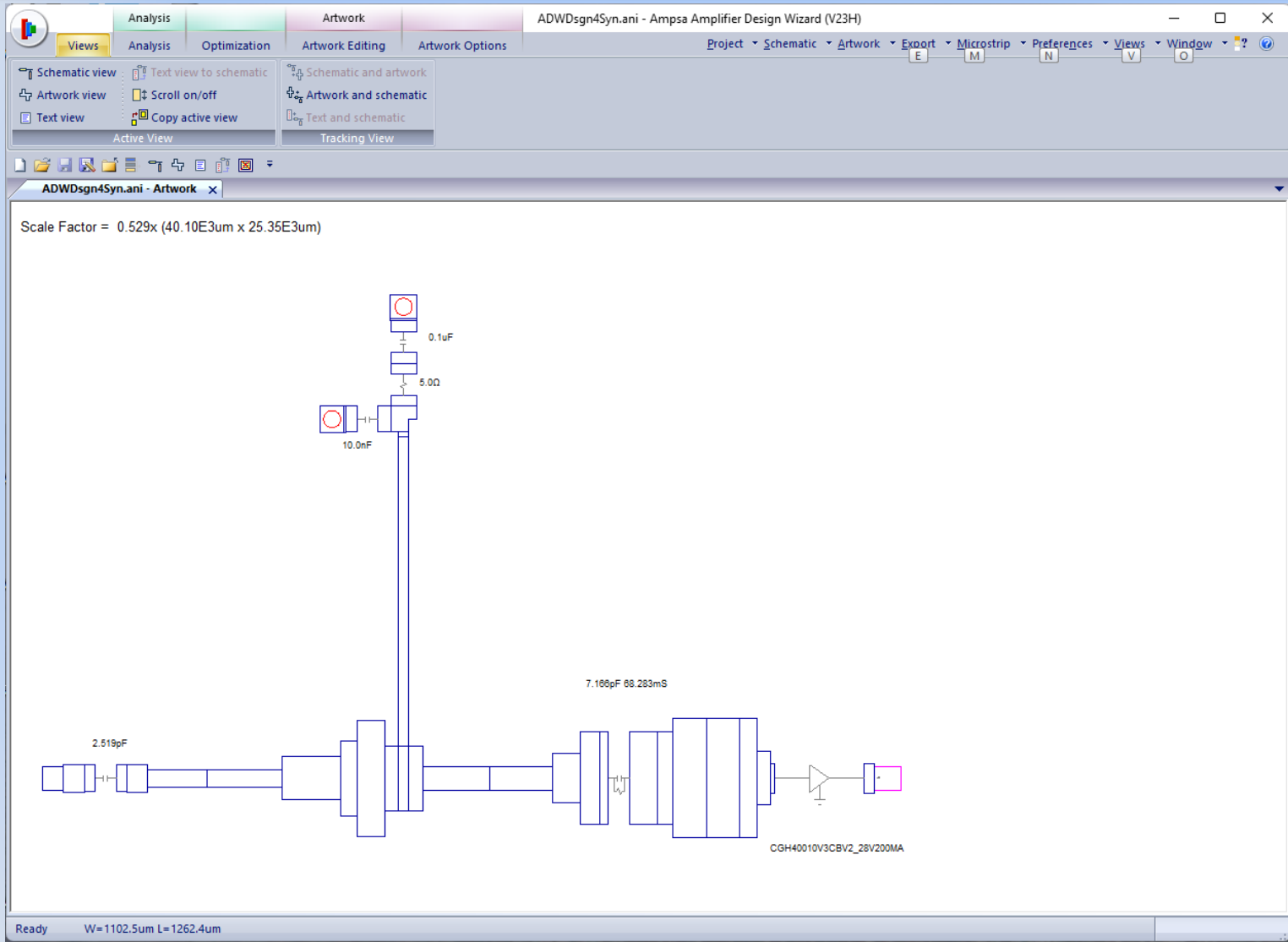
2/24/2025

The ADW is setup to design single-ended amplifiers. Note that Doherty amplifiers, balanced amplifiers, push-pull amplifiers, amplifiers with symmetrical combination networks and even some load modulated balanced amplifiers can all be converted to equivalent single-ended stages.

The Ampsa ADW CIL wizard can be used to set up a large variety of matching problems for an amplifier stage. Different classes of operation can be targeted. These include continuous modes of operation.

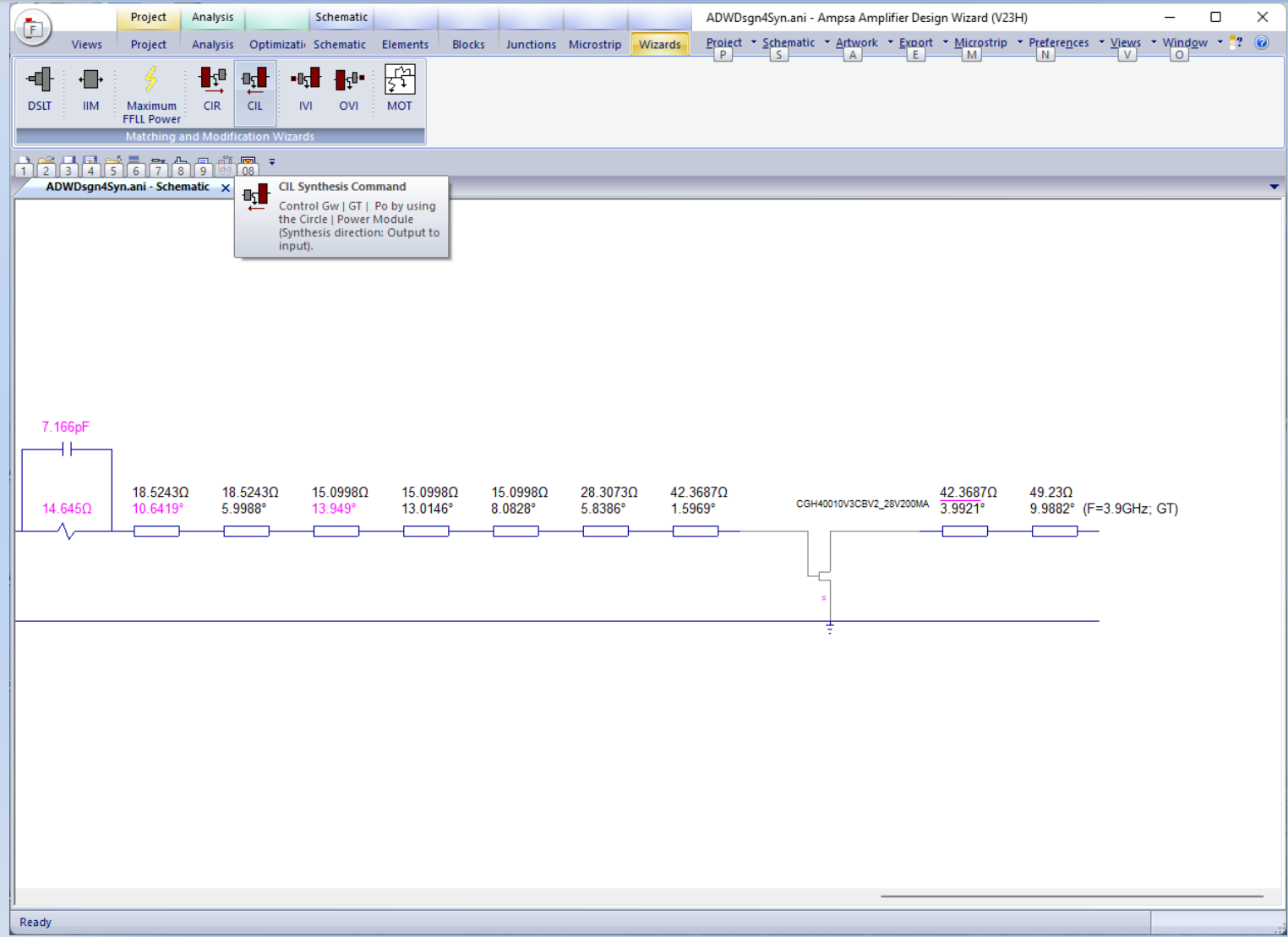
In this presentation, the CIL wizard will be used to setup the specifications for the load matching network of a 1.0 – 3.9 GHz 10W amplifier. Solutions to the defined problem will also be synthesized by using the impedance-matching wizard provided in the ADW.

The Macom CGH40010F GaN transistor will be used in this example. An ADW model was fitted to the transistor biased at 28V 200mA (Class-AB operation). Class-B operation will be targeted in this presentation, but the same design flow can be used for other classes of operation.



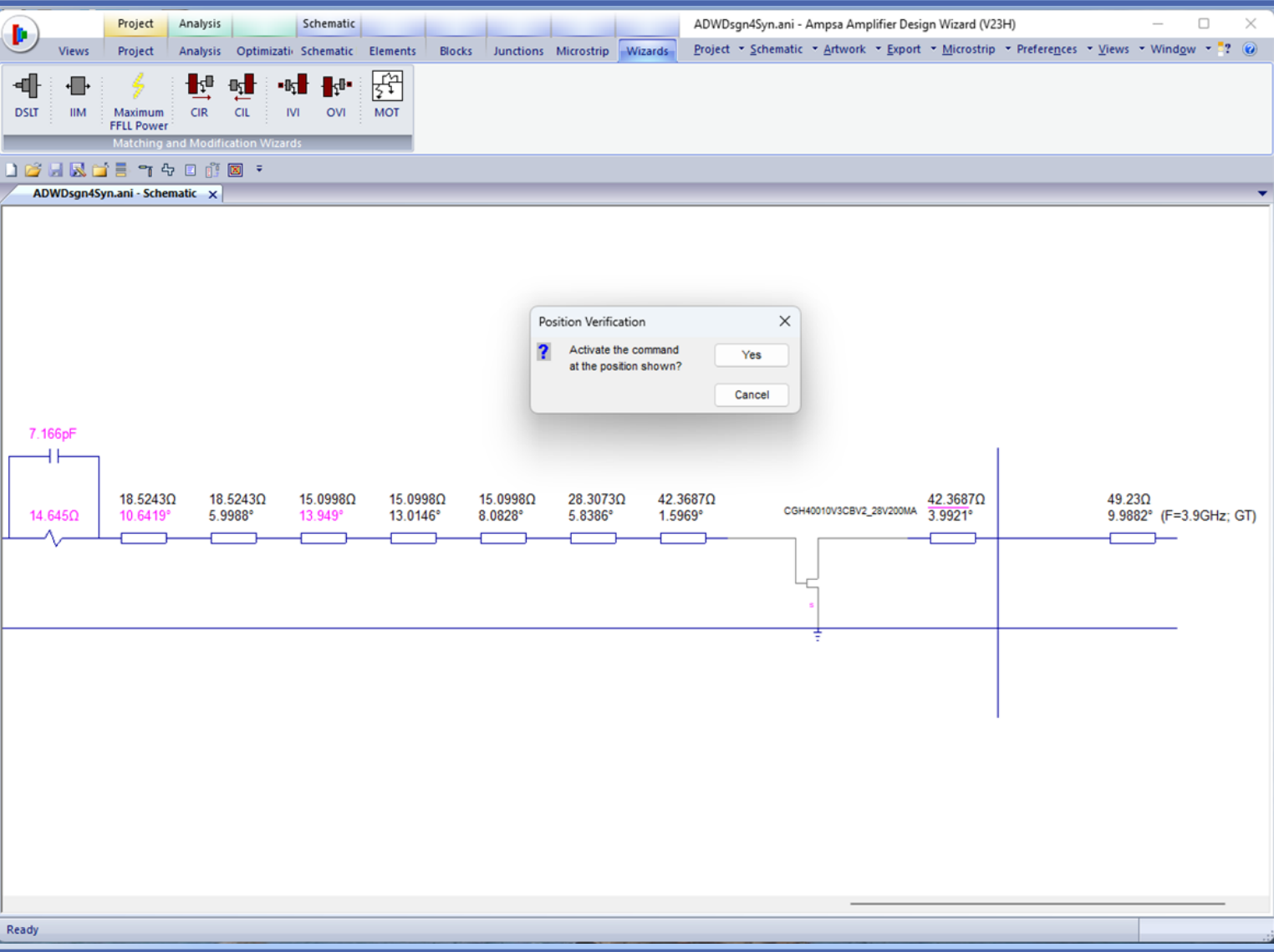
The circuit shown will be used as a starting point for the design. The input matching network is from a previous design, but the design flow is still valid without an input matching network in place. (Stabilizing the transistor, at least inside the passband is, however, advisable.) The input network can be optimised when the load network is in place.

Note that the schematic or the artwork or the text description of the circuit can be viewed. Use the commands provided on the quick access toolbar (QAT) to switch between views.



The ADW synthesis wizards must be launched with a schematic view active. The insertion point for the matching network required must be selected before launching the wizard.

Note that an element in the schematic is selected by left-clicking one of the labels associated with the schematic element. In an artwork view, the artwork element to be selected is left-clicked.



The CIL wizard was launched by selecting the Schematic | Wizards | CIL ribbon command. The schematic will be split as shown by the command.

The matching network to be designed with the CIL wizard can be the load network for the output stage or any driver stage in the amplifier. A multistage power amplifier is designed by starting with the load network.

ADWDsgn4Syn.ani - Ampsa Amplifier Design Wizard (V23H)

Views: Schematic view, Artwork view, Text view

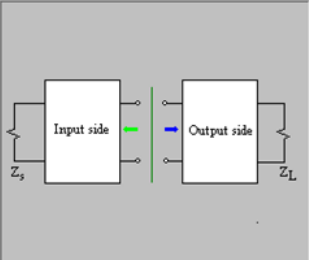
ADWDsgn4Syn.ani - Schematic

CIL/CIR Impedance-Matching Wizard

Description

More control over the specifications of a matching network is possible when the CIL or CIR commands are used. The actual specifications are then decided in the ADW Power or Circle Module. The position of the network and the passband are set at this point, and the parameters required by the Power/Circle Module are calculated.

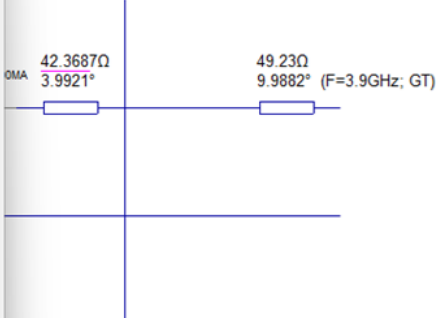
The CIL command is used when the design proceeds from the load towards the source, and vice versa for the CIR command. The output power, operating power gain or the transducer power gain can be controlled directly by using the CIL command. The CIR command is used to control the noise figure or the available power gain, and can also be used to control the transducer power gain.



< Back **Next >** Cancel Help

42.3687Ω
3.9921°

49.23Ω
9.9882° (F=3.9GHz; GT)



The first page of the CIL wizard is displayed here.

CIL/CIR Impedance-Matching Wizard - Contour Option

When the CIL command is used, the transducer power gain, the operating power gain or the output power of the stage selected can be controlled directly. The transducer power gain, the available power gain or the noise figure can be controlled directly when the CIR command is used.

Performance to be Controlled

- Operating power gain (Conjugate match required on the input side)
- Transducer power gain (Input matching network in place or not required)
- Output power

< Back Next > Cancel Help

The operating power gain or the transducer power gain or the output power of the stage designed can be controlled by the CIL wizard. The option to control the power was selected here.

When the power performance is controlled, the output power or the effective output power (Pout-Pin) can be specified. The gain calculated on the contours can also be specified to be the transducer power gain, or the available/operating power gain of the stage/section of interest (The transducer power gain option should be used when the input matching network is already in place). The option to specify the power termination or to specify the contours to be generated is also provided.

Power Option

- Control the output power (Pout)
 Control the effective output power (Pout-Pin)

Gain Control Option

- Control Gw (Conjugate match required on the input side)
 Control GT (Input matching network, if any, in place)

Specifications Option

- Specify the external load
 Specify the intrinsic load
 Specify power contours

Impedance-Matching Option

- Set ZLi as synthesis target

< Back

Next >

Cancel

Help

The output power or the effective output power can be controlled. Use the effective output power when the transistor gain is low or when a matching network for an oscillator is designed.

When an input matching network is already in place, the gain to be controlled is the transducer power gain. This option was selected here.

The power contours option was selected here. The alternatives are to control the intrinsic or external load terminations directly.

Note the option to use the intrinsic load terminations as synthesis targets. When this option is not selected, the input terminations presented by the matching network at the insertion point are used as targets.

The maximum unclipped power (dBm) required at each frequency must be specified below. The power specified must be less or equal to the maximum power. Two additional contours can also be displayed graphically. Use the error function weights and zero error points commands to define the error function used to decide the default optimum point on each power contour targeted.

Power (dBm) Required at Each Frequency

F (GHz)	PmuMax (P)	PmuRq (dBm)	PmuC2 (dBm)	PmuC3 (dBm)	Eff@PeakP	Eff@Tgt
1.0000	40.578	40.578	39.578	38.578	61.760	61.760
1.1000	40.578	40.578	39.578	38.578	61.765	61.765
1.2000	40.578	40.578	39.578	38.578	61.767	61.767
1.3000	40.578	40.578	39.578	38.578	61.761	61.761
1.4000	40.578	40.578	39.578	38.578	61.767	61.767
1.5000	40.579	40.579	39.579	38.579	61.772	61.772
1.6000	40.579	40.579	39.579	38.579	61.774	61.774
1.7000	40.579	40.579	39.579	38.579	61.777	61.777
1.8000	40.579	40.579	39.579	38.579	61.780	61.780
1.9000	40.580	40.580	39.580	38.580	61.785	61.785
2.0000	40.580	40.580	39.580	38.580	61.787	61.787
2.1000	40.580	40.580	39.580	38.580	61.792	61.792
2.2000	40.570	40.580	39.580	38.580	61.794	61.794

Maximum-Efficiency (ME) and Minimum Acceptable Efficiency (MAE) Lines

Show ME Lines

Show +X MAE Lines

Show -X MAE Lines

Number of ME Line Points: [5: 51] <15>

Minimum Acceptable Efficiency (%): 62.500 <62.5>

Classes B, F and iF Efficiency (FFLL)

Efficiency Fitting Factor: 0.000 <0.0> [0.0: 0.1]

The power levels of interest must be specified on this page. Constant power contours can also be generated at two additional power levels at each frequency.

The error function used to select the optimum point on each contour is set by using the Error Function Weights and Zero Error Points commands.

Edit Relative or Edit Absolute are used to set the contour power levels.

The efficiency associated with the peak power points and the maximum efficiency associated with the contours targeted are also listed in the table.

Note that the minimum acceptable efficiency must be specified for the efficiency lines to be displayed. (With the exception of a Class-A stage, the efficiency will vary on the circumference of each power contour.)

CIL/CIR Wizard - Power Specifications

The maximum unclipped power (dBm) required at each frequency must be specified below. The power specified must be less or equal to the maximum power. Two additional contours can also be displayed graphically. Use the error function weights and zero error points commands to define the error function used to decide the default optimum point on each power contour targeted.

Power (dBm) Required at Each Frequency

F (GHz)	PmuMax (P)	PmuReq (P)
1.0000	40.578	40.5
1.1000	40.578	40.5
1.2000	40.578	40.5
1.3000	40.578	40.5
1.4000	40.578	40.5
1.5000	40.579	40.5
1.6000	40.579	40.5
1.7000	40.579	40.5
1.8000	40.579	40.5
1.9000	40.580	40.5
2.0000	40.580	40.5
2.1000	40.580	40.5
2.2000	40.570	40.5

Weight Factors (Circles/Contours)

Gain: 0.00 K: 0.00
Noise figure: SSF: 0.000
Power: 0.00 LSF: 0.000
Efficiency: 1.00 VSWRout (D.D.): 0.00
Tunability: 0.00 VSWRin (D.D.): 0.00
VSWRa: 0.00

OK Efficiency Only
Cancel Restore Defaults
Help

EffFunc Weights Edit Relati
EffFunc Zero Points Edit Absok
PoAtPeak

Maximum-Efficiency (ME) and Minimum A

Show ME Lines Num
 Show +X MAE Lines [5
 Show -X MAE Lines 15 62.500 <62.5> Factor: 0.000 <0.0>
[0.0; 0.1]

< Back Next > Cancel Help

The option to use only the efficiency to decide the optimum point on each constant power contour targeted has been selected (Error Function Weights command).

CIL/CIR Wizard - Power Specifications

The maximum unclipped power (dBm) required at each frequency must be specified below. The power specified must be less or equal to the maximum power. Two additional contours can also be displayed graphically. Use the error function weights and zero error points commands to define the error function used to decide the default optimum point on each power contour targeted.

Power (dBm) Required at Each Frequency

F (GHz)	FmuMax (P)	FmuRq (dBm)	FmuC2 (dBm)	FmuC3 (dBm)	Eff@PeakP	Eff@Tgt
1.0000	40.578	40.578	3			
1.1000	40.578	40.578	3			
1.2000	40.578	40.578	3			
1.3000	40.578	40.578	3			
1.4000	40.578	40.578	3			
1.5000	40.579	40.579	3			
1.6000	40.579	40.579	3			
1.7000	40.579	40.579	3			
1.8000	40.579	40.579	3			
1.9000	40.580	40.580	3			
2.0000	40.580	40.580	3			
2.1000	40.580	40.580	3			
2.2000	40.570	40.580	3			

Buttons: ErrFnc Weights, Edit Relative, ErrFnc Zero Points, Edit Absolute, PoAtPeakEff

Maximum-Efficiency (ME) and Minimum Acceptable Efficiency (MAE) Lines

- Show ME Lines
- Show +X MAE Lines
- Show -X MAE Lines

Number of ME Line Points: [5; 51] <15> Minimum Acceptable Efficiency (%): 62.500 <62.5>

Classes B, F and iF Efficiency (FFLL)

Efficiency Fitting Factor: 0.000 <0.0> [0.0; 0.1]

Buttons: < Back, Next >, Cancel, Help

Power Specifications

Po Required: -0.6 dB

Po Contour #2: -0.8 dB

Po Contour #3: -1.0 dB

Buttons: OK, Cancel, Help

Specify the power values relative to the maximum (that is, specify 0 dB for maximum power).

The Edit Relative command has been selected to set the power levels for the contours to be generated. The power level targeted is 0.6 dBm below the peak power.

CIL/CIR Wizard - Power Specifications

The maximum unclipped power (dBm) required at each frequency must be specified below. The power specified must be less or equal to the maximum power. Two additional contours can also be displayed graphically. Use the error function weights and zero error points commands to define the error function used to decide the default optimum point on each power contour targeted.

Power (dBm) Required at Each Frequency

F (GHz)	FmuMax (P)	FmuRq (dBm)	FmuC2 (dBm)	FmuC3 (dBm)	Eff@PeakP	Eff@Tgt
1.0000	40.578	39.978	39.778	39.578	61.760	70.376
1.1000	40.578	39.978	39.778	39.578	61.765	70.378
1.2000	40.578	39.978	39.778	39.578	61.767	70.376
1.3000	40.578	39.978	39.778	39.578	61.761	70.365
1.4000	40.578	39.978	39.778	39.578	61.767	70.364
1.5000	40.579	39.979	39.779	39.579	61.772	70.366
1.6000	40.579	39.979	39.779	39.579	61.774	70.363
1.7000	40.579	39.979	39.779	39.579	61.777	70.358
1.8000	40.579	39.979	39.779	39.579	61.780	70.355
1.9000	40.580	39.980	39.780	39.580	61.785	70.354
2.0000	40.580	39.980	39.780	39.580	61.787	70.348
2.1000	40.580	39.980	39.780	39.580	61.792	70.343
2.2000	40.570	39.970	39.770	39.570	61.794	70.338

Maximum-Efficiency (ME) and Minimum Acceptable Efficiency (MAE) Lines

Show ME Lines
 Show +X MAE Lines
 Show -X MAE Lines

Number of ME Line Points: [5; 51] <15>
 Minimum Acceptable Efficiency (%): 60 <62.5>

Classes B, F and iF Efficiency (FLL)

Efficiency Fitting Factor: 0.000 <0.0> [0.0; 0.1]

The power listed here is the maximum unclipped output power (P_{mu}).

Efficiencies (drain efficiency) above 60% are targeted.

The List More command can be used to list the peak efficiency obtainable at different power levels.

The Display Contours command can be used to display the constant power contours and the maximum efficiency lines.

ADWDsgn4Syn.ani - Ampsa Amplifier Design Wizard (V23H)

Views: Schematic view, Text view to schematic, Schematic and artwork, Artwork view, Text view

Project | Schematic | Artwork | Export | Microstrip | Preferences | Views | Window

CIL/CIR Wizard - Power Specifications

The maximum unclipped power (dBm) required at each frequency must be specified below. The power specified must be less or equal to the maximum power. Two additional contours can also be displayed graphically. Use the error function weights and zero points to define the error function used to decide the default optimum point on each power contour targeted.

Power (dBm) Required at Each Frequency

F (GHz)	PmuMax (P)	PmuRq (dBm)	PmuC2 (dBm)	PmuC3 (dBm)	Eff@PeakP	Eff@Tgt
1.0000	40.578	39.978	39.778	39.578	61.760	70.376
1.1000	40.578	39.978	39.778	39.578	61.765	70.378
1.2000	40.578	39.978	39.778	39.578	61.767	70.376
1.3000	40.578	39.978	39.778	39.578	61.761	70.365
1.4000	40.578	39.978	39.778	39.578	61.767	70.364
1.5000	40.579	39.979	39.779	39.579	61.772	70.366
1.6000	40.579	39.979	39.779	39.579	61.774	70.363
1.7000	40.579	39.979	39.779	39.579	61.777	70.359
1.8000	40.579	39.979	39.779	39.579	61.780	70.355
1.9000	40.580	39.980	39.780	39.580	61.785	70.354
2.0000	40.580	39.980	39.780	39.580	61.787	70.348
2.1000	40.580	39.980	39.780	39.580	61.792	70.343
2.2000	40.570	39.970	39.770	39.570	61.794	70.338

Buttons: ErrFnc Weights, Edit Relative, List More .., Display Contours, ErrFnc Zero Points, Edit Absolute, Summary Table, PoAtPeakEff

Maximum-Efficiency (ME) and Minimum Acceptable Efficiency (MAE) Lines

- Show ME Lines
- Show +X MAE Lines
- Show -X MAE Lines

Number of ME Line Points: [5, 51] <15> Minimum Acceptable Efficiency (%): 60 <62.5>

Optimum Power Terminations

- ZT
- Zin Hide Trace
- Zout* Hide Trace
- s21w Hide s21w
- 1.0GHz
- 3.9GHz

Hide reactance range traces

Show Contours At: All Frequencies, Specified Frequency

1.0000

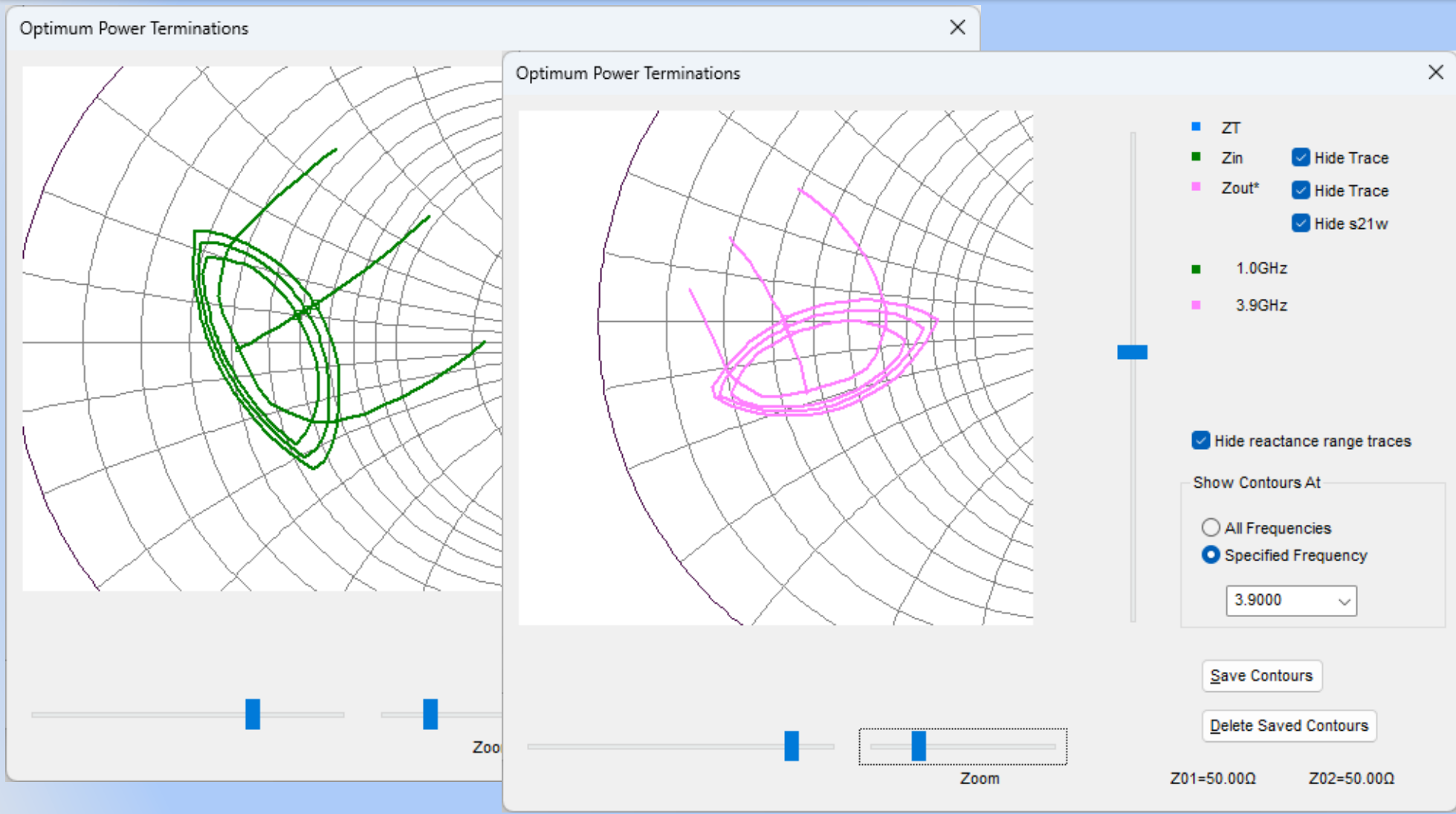
Save Contours, Delete Saved Contours

Zoom: Z01=50.00Ω, Z02=50.00Ω

The constant power contours targeted are shown here with the maximum efficiency lines.

The intrinsic load impedance is purely resistive at the maximum efficiency point on a power contour. This point is located on the voltage clipping side of the power contour.

Note the anti-clockwise rotation of the maximum efficiency lines with increasing frequency (green to magenta). Also note the area in which all the constant power contours intersect and the area in which the maximum efficiency lines intersect.



The constant power contours and the efficiency lines at 1.0 GHz and 3.9 GHz are displayed here.

Three efficiency lines are shown with the power contours at each frequency. The two lines away from the maximum efficiency line are constant efficiency lines.

Efficiencies above the targeted level can only be obtained on the contour sections defined by the two constant efficiency lines.

CIL/CIR Wizard - Potential Performance on the Selected Contours

Stage Output Power Targeted: 39.98 dBm

Angle (°)	RL (Ω)	XL (Ω)	GT (dB)	Tun	VSWRload	VSWRin	VSWRa	Eff (%)	SSF	LSF
215.317	19.1918	-j1.917	16.109	0.087	2.609	5.425	2.334	54.986	1.217	1.593
227.731	19.3623	-j2.311	16.102	0.087	2.588	5.400	2.343	54.986	1.217	1.584
240.145	19.5666	-j2.772	16.095	0.088	2.564	5.370	2.353	54.997	1.217	1.574
252.559	19.8341	-j3.377	16.084	0.088	2.534	5.332	2.367	55.001	1.217	1.561
264.972	20.2385	-j4.273	16.067	0.088	2.491	5.277	2.390	55.016	1.217	1.543
277.386	20.9605	-j5.834	16.035	0.089	2.424	5.185	2.433	55.044	1.217	1.513
289.800	22.5207	-j9.027	15.959	0.092	2.309	5.012	2.535	55.144	1.217	1.461
302.214	26.1379	-j15.681	15.772	0.097	2.159	4.713	2.788	55.481	1.217	1.378
314.628	29.3309	-j13.379	16.033	0.097	1.880	4.734	2.435	59.532	1.217	1.438
327.041	31.6348	-j10.248	16.248	0.098	1.685	4.781	2.146	63.187	1.217	1.506
339.455	32.5910	-j6.587	16.420	0.099	1.579	4.857	1.910	66.110	1.217	1.587
351.869	32.4426	-j3.150	16.544	0.100	1.551	4.947	1.731	68.134	1.217	1.675
4.283	31.7170	-j0.226	16.630	0.101	1.576	5.040	1.599	69.447	1.217	1.766
16.697	30.6180	+j2.235	16.687	0.102	1.639	5.135	1.504	70.169	1.217	1.861
29.110	29.2494	+j4.308	16.721	0.104	1.729	5.235	1.443	70.375	1.217	1.963
41.524	27.6684	+j6.069	16.736	0.105	1.846	5.343	1.416	70.094	1.217	2.073
53.938	25.8754	+j7.558	16.728	0.106	1.993	5.463	1.430	69.294	1.217	2.186

Frequency (GHz):

Impedance-Matching Target

Point selected
 Circle circumference
 Area inside circle
 Apply selection at all frequencies

Select

Circle A (Power)
 Circle B (Contour)
 Circle C (Efficiency)
 Circle D (Target)

Circle D Options

Target inductive ZLi
 Target capacitive ZLi

List

Impedance
 Admittance
 Reflection

List

Actual load
 Intrinsic load

Zoom In
 Zoom Out
 Reset

Selected angle: 29.11°

< Back Next > Cancel Help

The performance on the circumference of a constant power contour is listed here (select the frequency of interest from the list provided). The optimum point selected on the contour is high-lighted and can be changed.

A circle (fundamental frequency targets) can be fitted automatically to each contour or the optimum point on each contour for impedance-matching purposes.

The option to target circles centred on the optimum point of each contours was selected here. The area inside each of these circles will be targeted.

CIL/CIR Impedance-Matching Wizard - Performance Expected

The Performance Associated with the Optimum | Specified Terminations

F (GHz)	MAG [ΓL]	ANG [ΓL]	Pmu (dBm)	GT (dB)	VSWRload	VSWRin	Eff (%)	θopt (°)	SSF	LSF
1.0000	0.2670	165.159	39.978	16.721	1.729	5.235	70.375	29.110	1.217	1.963
1.1000	0.2746	164.528	39.978	16.967	1.758	4.048	70.378	31.966	1.299	2.001
1.2000	0.2828	164.007	39.978	17.217	1.789	3.158	70.376	34.883	1.403	2.005
1.3000	0.2909	163.714	39.978	17.420	1.821	2.537	70.365	37.676	1.516	1.974
1.4000	0.2994	163.516	39.978	17.534	1.856	2.173	70.364	40.531	1.593	1.915
1.5000	0.3082	163.470	39.979	17.536	1.892	2.075	70.366	43.386	1.574	1.831
1.6000	0.3170	163.551	39.979	17.430	1.929	2.230	70.362	46.179	1.469	1.728
1.7000	0.3259	163.727	39.979	17.238	1.968	2.588	70.357	49.034	1.343	1.613
1.8000	0.3348	164.032	39.979	16.999	2.007	3.091	70.355	51.828	1.237	1.491
1.9000	0.3435	164.430	39.980	16.752	2.048	3.690	70.353	54.559	1.156	1.370
2.0000	0.3524	164.912	39.980	16.530	2.090	4.332	70.347	57.352	1.097	1.255
2.1000	0.3612	165.472	39.980	16.355	2.132	4.961	70.343	60.083	1.053	1.150
2.2000	0.3701	166.303	39.980	16.225	2.176	5.516	70.317	62.814	1.020	1.059
2.3000	0.3786	167.017	39.981	16.159	2.220	5.952	70.313	65.545	0.994	0.983
2.4000	0.3872	167.783	39.981	16.134	2.264	6.244	70.305	68.276	0.975	0.924
2.5000	0.3953	168.604	39.981	16.128	2.308	6.395	70.301	70.945	0.960	0.882
2.6000	0.4035	169.492	39.982	16.115	2.353	6.445	70.305	73.614	0.950	0.854

Display: Impedance Reflection Intrinsic termination

Harmonic Control: Save ZLi, Set Hm_ZL, Set Hm_ZL (Asym), Harmonic Reactance, Harmonic Traps, Ignore Hm_ZL

Transmission Phase Control: NCT-Network, CT-Network, PI-Network, Stepped ML, Δθ: 0.0 [0, 360], Explore Pre-Match

Phase Control Passband Frequency: Lowest frequency, Center frequency, Highest frequency, Lowest gain frequency

Phase Control Help

< Back Next > Cancel Help

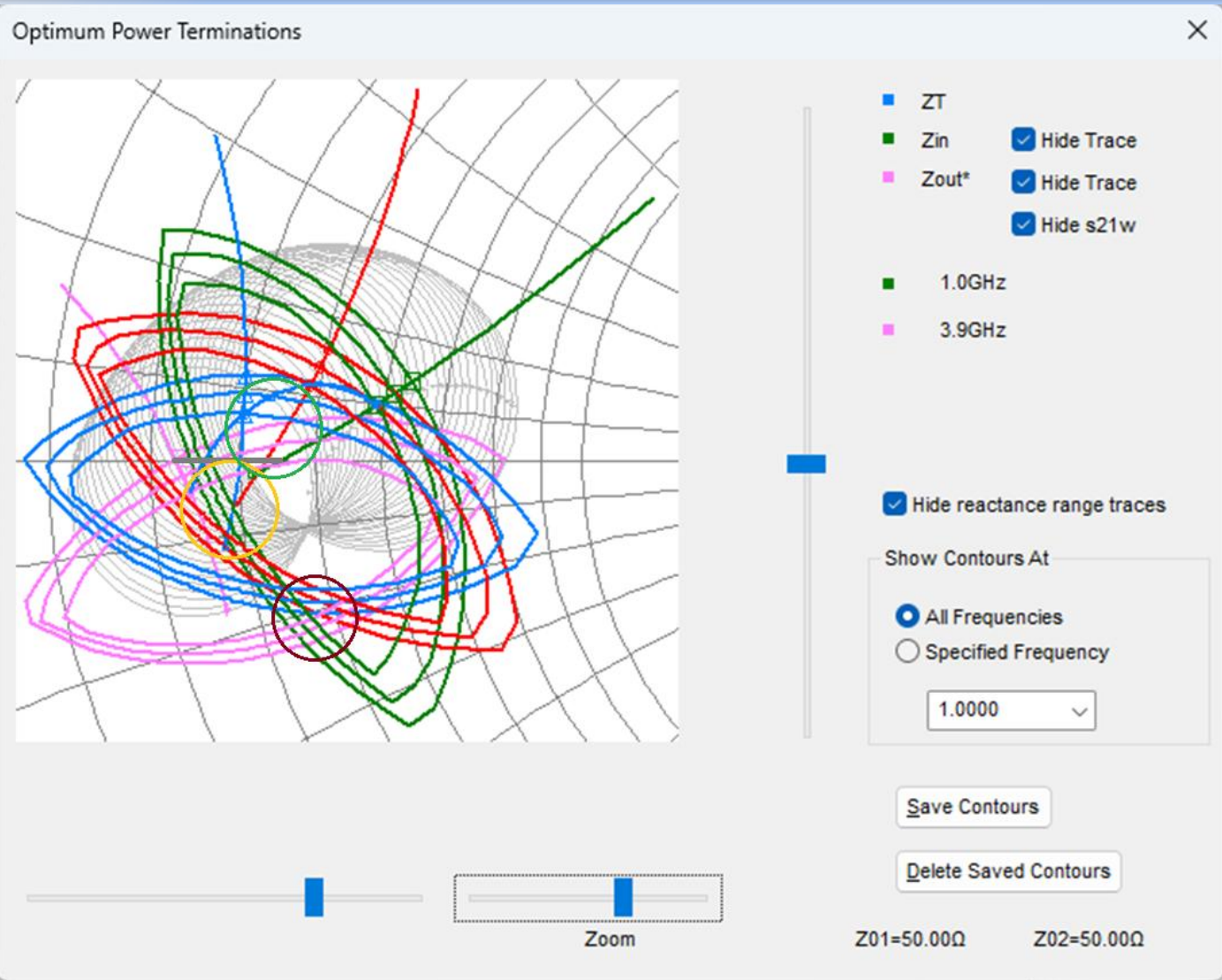
The performance at the optimum point on each power contour is listed on this page.

The Set Harmonic ZL and Set Harmonic ZL (Asymmetrical) commands can be used to set impedance-matching targets for the harmonic terminations. Class-B operation will be targeted here.

Note the Harmonic Traps command. Harmonic traps can be added to the matching networks to be synthesized as fixed elements by using this command. The option to export the traps selected directly to the circuit file is also provided.

The Explore Pre-Match option (CMA networks) provides an alternative to the Impedance-Matching module. The transmission phase-shift can be controlled directly by using this option (The CMA networks are derived from PI-networks and T-networks; two cascaded lines are also allowed). The intrinsic load terminations cannot yet be controlled directly by using this option.

The pre-match option will not be used in the presentation.



The Display Graph command provided on the wizard page was used to display the circles to be targeted in the Impedance-matching module. The constant power contours and the maximum efficiency lines are also shown.

Note that the origins of the maximum efficiency lines are located in a relatively small area. This area can be targeted by targeting power levels close to the peak levels. A good alternative is to target the line segment defined by the intersects of the maximum efficiency lines with the zero reactance line. This can be done by using a segmented taper transmission line.

Also note the eye formed by the circles targeted here. This area could also be targeted.

Power close to the targeted levels can be obtained at all of the frequencies shown by targeting the red circle at the bottom of the plot. The efficiency will, however, be lower that the level targeted.

CIL/CIR Impedance-Matching Wizard - Performance Expected

The Performance Associated with the Optimum | Specified Terminations

F (GHz)	RLi (Ω)	XLi (Ω)	Pmu (dBm)	GT (dB)	VSWRa	VSWRin	Eff (%)	Tun	SSF	LSF
1.0000	31.942	+j0.138E-3	39.978	16.721	1.443	5.235	70.375	0.104	1.217	1.963
1.1000	31.942	-j0.004	39.978	16.967	1.489	4.048	70.378	0.152	1.299	2.001
1.2000	31.944	+j0.006	39.978	17.217	1.517	3.158	70.376	0.224	1.403	2.005
1.3000	31.941	-j0.006	39.978	17.420	1.527	2.537	70.365	0.254	1.516	1.974
1.4000	31.935	-j0.004	39.978	17.534	1.518	2.173	70.364	0.231	1.593	1.915
1.5000	31.933	+j0.001	39.979	17.536	1.493	2.075	70.366	0.219	1.574	1.831
1.6000	31.930	-j0.005	39.979	17.430	1.458	2.230	70.362	0.236	1.469	1.728
1.7000	31.925	+j0.006	39.979	17.238	1.420	2.588	70.357	0.287	1.343	1.613
1.8000	31.923	+j0.006	39.979	16.999	1.384	3.091	70.355	0.347	1.237	1.491
1.9000	31.919	-j0.005	39.980	16.752	1.354	3.690	70.353	0.312	1.156	1.370
2.0000	31.915	+j0.726E-3	39.980	16.530	1.332	4.332	70.347	0.235	1.097	1.255
2.1000	31.911	-j0.005	39.980	16.355	1.318	4.961	70.343	0.190	1.053	1.150
2.2000	31.817	+j0.040E-3	39.980	16.225	1.314	5.516	70.317	0.173	1.020	1.059
2.3000	31.806	+j0.002	39.981	16.159	1.313	5.952	70.313	0.179	0.994	0.983
2.4000	31.806	+j0.006	39.981	16.134	1.314	6.244	70.305	0.213	0.975	0.924
2.5000	31.801	+j0.081E-3	39.981	16.128	1.317	6.395	70.301	0.308	0.960	0.882
2.6000	31.792	-j0.003	39.982	16.115	1.318	6.445	70.305	0.552	0.950	0.854

Display: Impedance Intrinsic termination Reflection

Harmonic Control: Save ZLi, Set Hm_ZL, Set Hm_ZL (Asym), Harmonic Reactance, Harmonic Traps, Ignore Hm_ZL

Transmission Phase Control: NCT-Network, CT-Network, PI-Network, Stepped ML, $\Delta\theta$: 0.0 [0, 360], Explore Pre-Match

Phase Control Passband Frequency: Lowest frequency, Center frequency, Highest frequency, Lowest gain frequency

Phase Control Help

< Back Next > Cancel Help

The performance at the optimum point on each power contour is listed in the table shown.

The intrinsic load impedance targeted is around 31.9 Ohm. The impedance required at the insertion point for the matching network is around 29 Ohm and lower (see the next slide). Take note of these levels. When the matching networks synthesized do not allow for biasing the transistor, fixed components can be added to the matching network. Any extra shunt elements added should ideally present impedances significantly higher than the impedances targeted (say, at least three to four times higher).

CIL/CIR Impedance-Matching Wizard - Performance Expected

The Performance Associated with the Optimum | Specified Terminations

F (GHz)	RL (Ω)	XL (Ω)	Pmu (dBm)	GT (dB)	VSWRa	VSWRin	Eff (%)	Tun	SSF	LSF
1.0000	29.249	+j4.308	39.978	16.721	1.443	5.235	70.375	0.104	1.217	1.963
1.1000	28.807	+j4.565	39.978	16.967	1.489	4.048	70.378	0.152	1.299	2.001
1.2000	28.334	+j4.798	39.978	17.217	1.517	3.158	70.376	0.224	1.403	2.005
1.3000	27.858	+j4.965	39.978	17.420	1.527	2.537	70.365	0.254	1.516	1.974
1.4000	27.355	+j5.106	39.978	17.534	1.518	2.173	70.364	0.231	1.593	1.915
1.5000	26.841	+j5.201	39.979	17.536	1.493	2.075	70.366	0.219	1.574	1.831
1.6000	26.327	+j5.253	39.979	17.430	1.458	2.230	70.362	0.236	1.469	1.728
1.7000	25.805	+j5.273	39.979	17.238	1.420	2.588	70.357	0.287	1.343	1.613
1.8000	25.286	+j5.245	39.979	16.999	1.384	3.091	70.355	0.347	1.237	1.491
1.9000	24.776	+j5.181	39.980	16.752	1.354	3.690	70.353	0.312	1.156	1.370
2.0000	24.263	+j5.083	39.980	16.530	1.332	4.332	70.347	0.235	1.097	1.255
2.1000	23.762	+j4.952	39.980	16.355	1.318	4.961	70.343	0.190	1.053	1.150
2.2000	23.248	+j4.721	39.980	16.225	1.314	5.516	70.317	0.173	1.020	1.059
2.3000	22.767	+j4.522	39.981	16.159	1.313	5.952	70.313	0.179	0.994	0.983
2.4000	22.293	+j4.297	39.981	16.134	1.314	6.244	70.305	0.213	0.975	0.924
2.5000	21.844	+j4.044	39.981	16.128	1.317	6.395	70.301	0.308	0.960	0.882
2.6000	21.399	+j3.762	39.982	16.115	1.318	6.445	70.305	0.552	0.950	0.854

Display: Impedance Reflection Intrinsic termination

Buttons: Display Graph, Display Impedances

Harmonic Control: Save ZLi, Set Hm_ZL, Set Hm_ZL (Asym), Harmonic Reactance, Harmonic Traps, Ignore Hm_ZL

Transmission Phase Control: NCT-Network, CT-Network, PI-Network, Stepped ML, Δθ: 0.0 [0, 360], Explore Pre-Match

Phase Control Passband Frequency: Lowest frequency, Center frequency, Highest frequency, Lowest gain frequency

Phase Control Help

Navigation: < Back, Next >, Cancel, Help

The impedance required at the insertion point for the matching network is around 29 Ohm and lower.

CIL/CIR Impedance-Matching Wizard - Performance Expected

The Performance Associated with the Optimum | Specified Terminations

F (GHz)	RL (Ω)	XL (Ω)	Fmu (dBm)	GT (dB)	VSWRa	VSWRin	Eff (%)	Tun	SSF	LSF
1.0000	29.249	+j4.308	39.978	16.721	1.443					
1.1000	28.807	+j4.565	39.978	16.967	1.489					
1.2000	28.334	+j4.798	39.978	17.217	1.517					
1.3000	27.858	+j4.965	39.978	17.420	1.527					
1.4000	27.355	+j5.106	39.978	17.534	1.518					
1.5000	26.841	+j5.201	39.979	17.536	1.493					
1.6000	26.327	+j5.253	39.979	17.430	1.458					
1.7000	25.805	+j5.273	39.979	17.238	1.420					
1.8000	25.286	+j5.245	39.979	16.999	1.384					
1.9000	24.776	+j5.181	39.980	16.752	1.354					
2.0000	24.263	+j5.083	39.980	16.530	1.332					
2.1000	23.762	+j4.952	39.980	16.355	1.318					
2.2000	23.248	+j4.721	39.980	16.225	1.314					
2.3000	22.767	+j4.522	39.981	16.159	1.313					
2.4000	22.293	+j4.297	39.981	16.134	1.314					
2.5000	21.844	+j4.044	39.981	16.128	1.317					
2.6000	21.399	+j3.762	39.982	16.115	1.318					

Display: Impedance Reflection Intrinsic termination

Harmonic Control: Ignore Hm_ZL

Harmonic Control Specifications

2nd Harmonic (H2)

Control 2nd harmonic terminations
 Low second-harmonic impedance $Z_{Li_2ndH} = j Z_{Li_Fund} / Z_{F_2ndH}$
 High second-harmonic impedance $Z_{Li_2ndH} = j Z_{Li_Fund} \times Z_{F_2ndH}$

ZF_2ndH: 2.50
 RangeScaFac: 1.000 [0.01; 1.0]
 AsymSpecs: 0.000 <0>
 Minimum intrinsic Q: 5.00
 Width of the H2 transition band: 0.10000 GHz

3rd Harmonic (H3)

Control 3rd harmonic terminations
 High third-harmonic impedance $Z_{Li_3rdH} = j Z_{Li_Fund} \times Z_{F_3rdH}$
 Low third-harmonic impedance $Z_{Li_3rdH} = j Z_{Li_Fund} / Z_{F_3rdH}$

ZF_3rdH: 2.50
 RangeScaFac: 1.000 [0.01; 1.0]
 AsymSpecs: 0.000 <0>
 Minimum intrinsic Q: 5.00
 Width of the H3 transition band: 0.10000 GHz

Fundamental-Frequency Terminations

Use RLi_opt
 RLi_opt scale factor: 1.000 [0.75; 1.75]

Use saved ZLi
 ZLi scale factor: 1.000 [0.75; 1.75]

Clipping Contour Option
 Use H2 clipping contours
 Reduce the assumed dc voltage by using the boundary line intercept
 Correction voltage scale factor: 0.500 <0.5> [0; 0.95]

The Set Harmonic Z_L command was selected.

Low or high impedance second or third harmonic intrinsic terminations can be targeted. Because Class-B operation is required, low harmonic impedances will be targeted (low relative to the fundamental-frequency impedances).

Harmonic Control Specifications

2nd Harmonic (H2)

Control 2nd harmonic terminations

Low second-harmonic impedance
 $Z_{Li_2ndH} = j Z_{Li_Fund} / ZF_2ndH$

High second-harmonic impedance
 $Z_{Li_2ndH} = j Z_{Li_Fund} \times ZF_2ndH$

Width of the H2 transition band: GHz

ZF_2ndH:

RangeScaFac: <1.0> [0.01; 1.0]

AsymSpes: <0>

Minimum intrinsic Q: C:1L:-1L|C:0

3rd Harmonic (H3)

Control 3rd harmonic terminations

High third-harmonic impedance
 $Z_{Li_3rdH} = j Z_{Li_Fund} \times ZF_3rdH$

Low third-harmonic impedance
 $Z_{Li_3rdH} = j Z_{Li_Fund} / ZF_3rdH$

Width of the H3 transition band: GHz

ZF_3rdH:

RangeScaFac: <1.0> [0.01; 1.0]

AsymSpes: <0>

Minimum intrinsic Q: C:1L:-1L|C:0

Fundamental-Frequency Terminations

Use RLi_opt

RLi_opt scale factor: [0.75; 1.75]

Use saved ZLi

ZLi scale factor: [0.75; 1.75]

Clipping Contour Option

Use H2 clipping contours

Reduce the assumed dc voltage by using the boundary line intercept

Correction voltage scale factor: <0.5> [0; 0.95]

OK Cancel Help Reset Class

The second and third harmonic bands in this example overlap the passband. The third harmonic band also overlaps the second harmonic band. The fundamental targets override the harmonic targets in the ADW, while the second harmonic targets generally override the third harmonic targets.

Transition bands can be defined for the second harmonics and the third harmonics. 0.4 GHz will be used for the second harmonic and 0.1 GHz will be used for the third. Because shorts are required for both harmonic bands, the transition band for the third harmonic could be set to zero.

CIL/CIR Impedance-Matching Wizard - Performance Expected

The Performance Associated with the Optimum | Specified Terminations

F (GHz)	RL (Ω)	XL (Ω)	P_{mu} (dBm)	GT (dB)	VSWR _a
1.0000	29.249	+j4.308	39.978	16.721	1.443
1.1000	28.807	+j4.565	39.978	16.967	1.489
1.2000	28.334	+j4.798	39.978	17.217	1.517
1.3000	27.858	+j4.965	39.978	17.420	1.527
1.4000	27.355	+j5.106	39.978	17.534	1.518
1.5000	26.841	+j5.201	39.979	17.536	1.493
1.6000	26.327	+j5.253	39.979	17.430	1.458
1.7000	25.805	+j5.273	39.979	17.238	1.420
1.8000	25.286	+j5.245	39.979	16.999	1.384
1.9000	24.776	+j5.181	39.980	16.752	1.354
2.0000	24.263	+j5.083	39.980	16.530	1.332
2.1000	23.762	+j4.952	39.980	16.355	1.318
2.2000	23.248	+j4.721	39.980	16.225	1.314
2.3000	22.767	+j4.522	39.981	16.159	1.313
2.4000	22.293	+j4.297	39.981	16.134	1.314
2.5000	21.844	+j4.044	39.981	16.128	1.317
2.6000	21.399	+j3.762	39.982	16.115	1.318

Display: Impedance Reflection Intrinsic termination

Buttons: Display Graph, Display Impedances

Intrinsic Harmonic Angles Targeted:
 2ndH: [180.0°, 180.0°]; $\Delta=28.7^\circ$ Z0=50.00
 3rdH: [180.0°, 180.0°]; $\Delta=28.7^\circ$ Z0=50.00

Harmonic Control:
 Save ZLI
 Set Hm_ZL
 Set Hm_ZL (Asym)
 Harmonic Reactance
 Harmonic Traps
 Ignore Hm_ZL

Optimum Power Terminations

Legend:
 ZT
 Zin Hide Trace
 Zout* Hide Trace
 Hide s21w
 1.0GHz
 3.9GHz

Options:
 Hide 2nd harmonic traces
 Hide 3rd harmonic traces
 Hide harmonic markers
 Hide reactance range traces

Show Harmonic Markers At:
 All Frequencies
 Specified Frequency
 1.0000 GHz

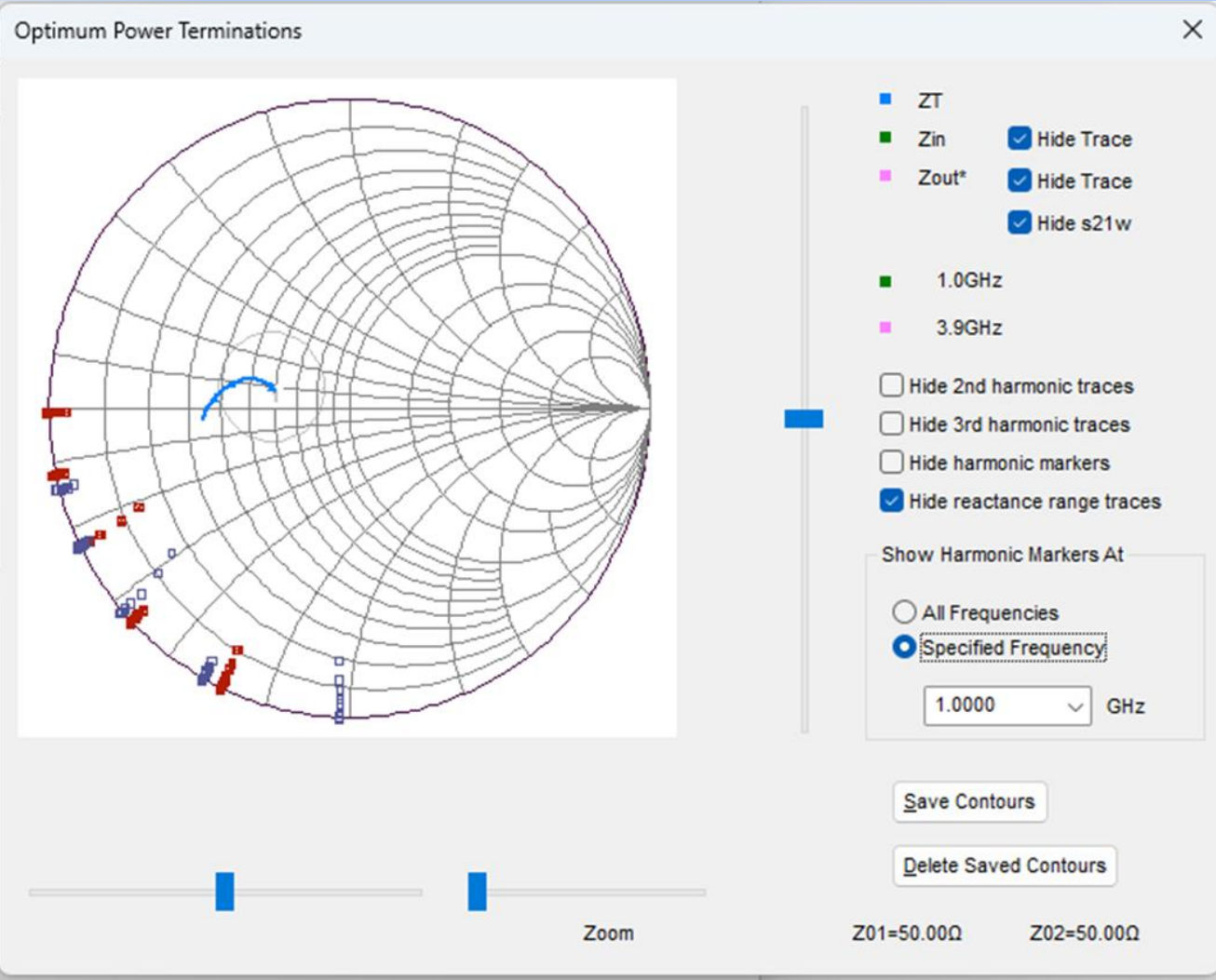
Buttons: Save Contours, Delete Saved Contours

Zoom: Z01=50.00 Ω Z02=50.00 Ω

Navigation: < Back, Next >, Cancel, Help

The fundamental-frequency and harmonic targets at the insertion point for the matching network.

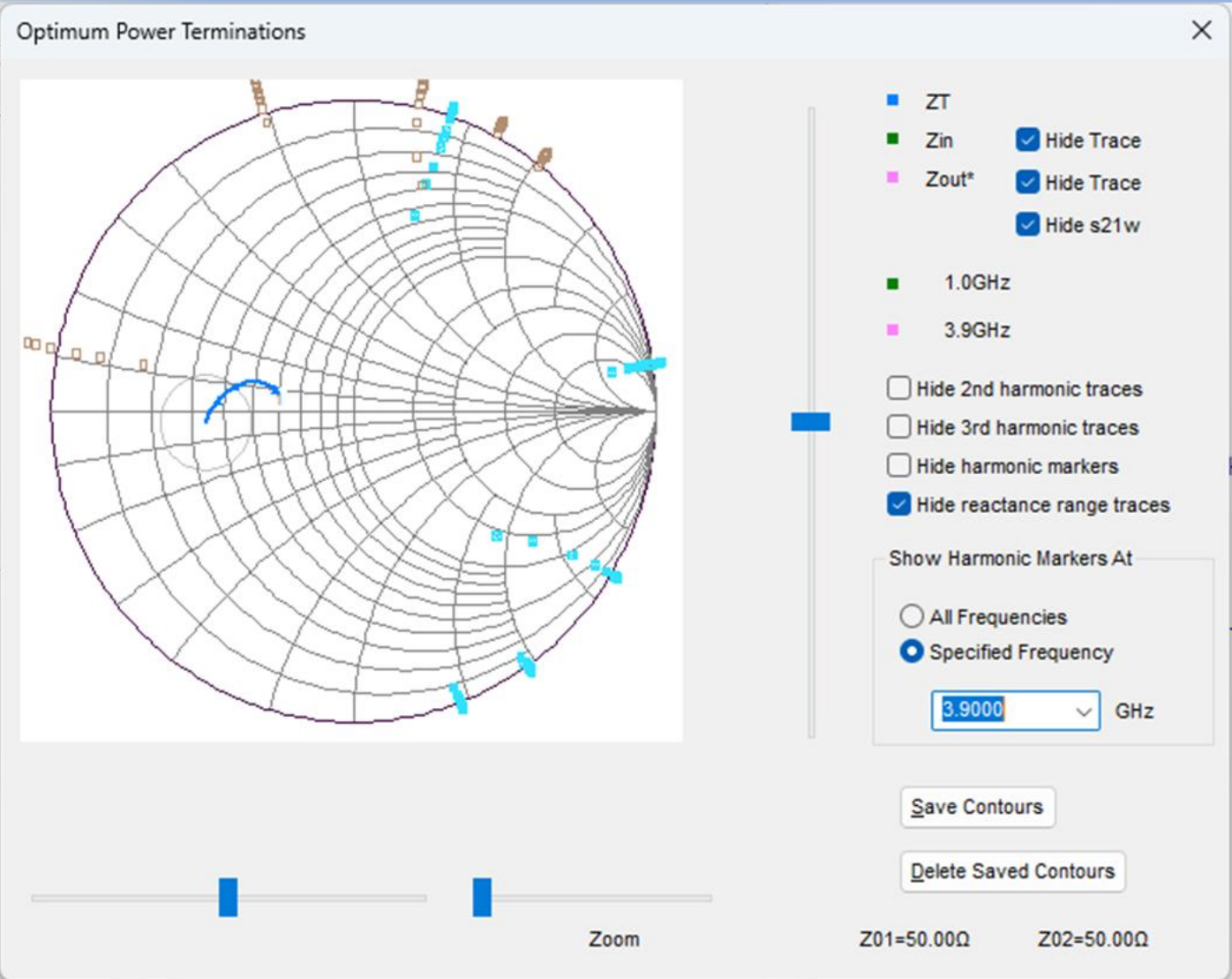
Options are provided to hide the third or the second harmonic targets.



The targets can be displayed for all the passband frequencies or for a specific passband frequency. The associated intrinsic impedances will be near shorts for terminations at the centre of the range of external reflection coefficients shown for each harmonic.

Harmonic sectors are fitted automatically to the areas defined by the harmonic markers. A sector is defined by a local origin and two intersects with the Smith chart edge.

Harmonic sectors will also be fitted to the intrinsic targets if the relevant option was selected.



The second and third harmonic targets associated with 3.9 GHz.

Note that the harmonic areas to be targeted rotate anti-clockwise with frequency. It will not be possible to obtain near shorts for all the harmonics with the passband targeted here.

Harmonic Terminations Required

Ffund (GHz)	XB_2ndH	XE_2ndH	XB_3rdH	XE_3rdH
1.0000	-31.717	-0.387	-48.367	-6.728
1.1000	-34.418	-1.636	-55.621	-8.714
1.2000	-37.377	-2.891	-64.655	-10.768
1.3000	-40.643	-4.154	-76.389	-12.911
1.4000	-44.277	-5.434	-92.242	-15.162
1.5000	-48.352	-6.730	-115.269	-17.546
1.6000	-53.020	-8.047	-152.095	-20.096
1.7000	-58.364	-9.394	-220.744	-22.849
1.8000	-64.599	-10.774	-397.504	-25.850
1.9000	-72.008	-12.191	-1.935E3	-29.156
2.0000	-80.969	-13.654	673.029	-32.846
2.1000	-92.114	-15.169	285.427	-37.018
2.2000	-105.710	-16.767	182.323	-41.846
2.3000	-124.279	-18.413	131.914	-47.440
2.4000	-150.320	-20.133	102.421	-54.095
2.5000	-189.165	-21.944	83.037	-62.204

List

- Reflection coefficients (Z0=50)
- Reflection coefficients (Z0sc)
- Reactance values

OK
Cancel
Help

The reactance ranges to be targeted for the second and third harmonics are listed here. Note the anti-clockwise rotation of the targets with increasing frequency.

Second and Third Harmonic Traps

Second-Harmonic Traps

L H2_L (OS) (wcFuQL:4.26 wcFuQs:1.27):
Null at F_H2L = 4.40000GHz.
ML: Z0=43.75Ω Ang=127.723° @ 3.90000GHz.
XfuL:-174.3Ω XfuC:-56.3Ω XfuH:-11.7Ω
Fnull_csST:15.59055GHz; wcFuX:-14.3Ω.

C H2 Gap Center (OS) (wcFuQL:1.26 wcFuQs:0.43):
Null at F_H2C = 6.00000GHz.
ML: Z0=43.75Ω Ang=82.457° @ 3.90000GHz.
XfuL:-242.6Ω XfuC:-89.5Ω XfuH:-39.8Ω
Fnull_csST:6.99029GHz; wcFuX:-35.8Ω.

H H2_H:
Null at F_H2H = 7.80000GHz.
ML: Z0=43.75Ω Ang=60.562° @ 3.90000GHz.
XfuL:-318.4Ω XfuC:-123.8Ω XfuH:-65.0Ω
Fnull_csST:7.80000GHz; wcFuX:30.3Ω.

P H2_P Trap (OS) (wcFuQL:1.17 wcFuQs:0.54):
SST_Null: H2C=6.00000GHz; OST_Null: F=7.79221GHz.
ML: Z0=43.75Ω Ang=82.457° @ 3.90000GHz.
XfuL:42.5Ω XfuC:-324.1Ω XfuH:-73.4Ω

Second-Harmonic and Third-Harmonic Trap

M H2_H and H3_L (OS) (Err:56.5°; wcFuQL:1.73 wcFuQs:0.87):
Nulls at F2=7.80000GHz and F3=8.10000GHz.
ML: Z0=43.75Ω Ang=60.562° @ 3.90000GHz.
XfuL:29.0Ω XfuG:104.9Ω XfuC:295.9Ω XfuH:-69.0Ω

Single Trap Connecting Line

Matching network connecting line length: ° at 3.90000GHz

Double Trap Options

Matching network connecting line length [5;60]: ° at 3.90000GHz

Allow OST stepped line

Matching Network Side Allocation

Maximum ML length for an input side (IS) trap [10;120] <60°>: ° at 3.90000GHz

Third-Harmonic Traps

L H3_L (IS) (wcFuQs:0.37 wcFuQL:0.73):
Null at F_H3L = 8.10000GHz.
ML: Z0=43.75Ω Ang=48.072° @ 3.90000GHz.
XfuL:-331.0Ω XfuC:-129.4Ω XfuH:-68.9Ω
Fnull_csST:8.10000GHz; wcFuX:28.9Ω.

C H3 Gap Center (IS) (wcFuQs:0.34 wcFuQL:0.55):
Null at F_H3C = 9.90000GHz.
ML: Z0=43.75Ω Ang=29.862° @ 3.90000GHz.
XfuL:-406.2Ω XfuC:-162.4Ω XfuH:-91.3Ω
Fnull_csST:9.90000GHz; wcFuX:22.5Ω.

H H3_H (IS) (wcFuQs:0.32 wcFuQL:0.44):
Null at F_H3H = 11.70000GHz.
ML: Z0=43.75Ω Ang=18.285° @ 3.90000GHz.
XfuL:-481.2Ω XfuC:-194.7Ω XfuH:-112.6Ω
Fnull_csST:11.70000GHz; wcFuX:18.6Ω.

P H3_P Trap (IS) (wcFuQs:0.87 wcFuQL:1.73):
OST_Null: H3L=8.10000GHz; SST_Null: F=8.10000GHz.
ML: Z0=43.75Ω Ang=48.072° @ 3.90000GHz.
XfuL:28.9Ω XfuC:268.3Ω XfuH:-73.4Ω

Characteristic Impedances

Double Traps

Z0ML_min:	<input type="text" value="7.50"/>	Z0ML_max:	<input type="text" value="80.00"/>
Z0ML single trap:	<input type="text" value="43.75"/>	Z0OST:	<input type="text" value="65.00"/>
Z0SST:	<input type="text" value="65.00"/>	Z0OST stepped line:	<input type="text" value="65.00"/>

(ML: Main line; OST: Open-ended stub; SST: Shorted stub.)

Target the optimum reactance with each trap wcQs_NoTraps: 0.22

Export selected traps to the circuit file wcQL_NoTraps: 0.00

Harmonic traps can be used to provide the required intrinsic impedance at specific frequencies. Potential traps are listed here for a number of second and third harmonic frequencies. When an SST option is set, the trap will be created with a shorted stub. The default is to use an open-ended stub.

When the series transmission line (ML) associated with a trap is short, the trap can be added to the circuit before a matching network is designed. Traps with longer main lines can be added on the output side of the matching network, but it is unlikely that the desired transmission phase shift required for an intrinsic short will be obtained with the matching network in place. The harmonic will, however, be filtered from the output.

Note that the traps marked with a P consist of a shorted stub in parallel with an open-ended stub.

Ideally a trap should not load the circuit significantly at the fundamental frequencies. The loading imposed is measured by calculating the worst-case fundamental-frequency source and load Qs, as well as the shunt reactance presented by the trap at a number of passband frequencies. The worst-case Qs of the terminations (no loading) are listed in the lower RHS corner of the table.

The trap with the shortest main-line length (18.285 degrees at 3.9GHz) is the 11.7 GHz trap. The loading associated with this trap will be minimal. Note that the H2_P trap may be a good option for feeding in the drain bias. The shunt impedance presented is higher than 42.5 Ohm inside the passband (still significant).

Up to two traps can be selected from the table. The selected traps can be exported directly to the circuit file or can be added as fixed components to the matching networks to be synthesized.

Second and Third Harmonic Traps

Second-Harmonic Traps

L H2_L (OS) (wcFuQL:2.06 wcFuQs:0.51):
Null at F_H2L= 4.40000GHz.
ML: Z0=43.75Ω Ang=127.723° @ 3.90000GHz.
XfuL:56.3Ω XfuC:-452.1Ω XfuH:-24.2Ω

SST

C H2 Gap Center (OS) (wcFuQL:1.33 wcFuQs:0.63):
Null at F_H2C= 6.00000GHz.
ML: Z0=43.75Ω Ang=82.457° @ 3.90000GHz.
XfuL:37.5Ω XfuC:200.0Ω XfuH:-127.6Ω
Fnull_cOST:7.79221GHz; wcFuX:42.5Ω.

SST

H H2_H:
Null at F_H2H= 7.80000GHz.
ML: Z0=43.75Ω Ang=60.562° @ 3.90000GHz.
XfuL:27.7Ω XfuC:94.2Ω XfuH:-100000000.0Ω
Fnull_cOST:7.80000GHz; wcFuX:30.3Ω.

SST

P H2_P Trap (OS) (wcFuQL:1.17 wcFuQs:0.54):
SST_Null: H2C=6.00000GHz; OST_Null: F=7.79221GHz.
ML: Z0=43.75Ω Ang=82.457° @ 3.90000GHz.
XfuL:42.5Ω XfuC:-324.1Ω XfuH:-73.4Ω

Third-Harmonic Traps

L H3_L (IS) (wcFuQs:0.95 wcFuQL:1.88):
Null at F_H3L= 8.10000GHz.
ML: Z0=43.75Ω Ang=48.072° @ 3.90000GHz.
XfuL:26.6Ω XfuC:87.3Ω XfuH:1116.0Ω
Fnull_cOST:8.10000GHz; wcFuX:28.9Ω.

SST

C H3 Gap Center (IS) (wcFuQs:1.22 wcFuQL:2.34):
Null at F_H3C= 9.90000GHz.
ML: Z0=43.75Ω Ang=29.862° @ 3.90000GHz.
XfuL:21.3Ω XfuC:62.0Ω XfuH:187.8Ω
Fnull_cOST:9.90000GHz; wcFuX:22.5Ω.

SST

H H3_H (IS) (wcFuQs:1.49 wcFuQL:2.80):
Null at F_H3H= 11.70000GHz.
ML: Z0=43.75Ω Ang=18.285° @ 3.90000GHz.
XfuL:17.9Ω XfuC:48.8Ω XfuH:112.6
Fnull_cOST:11.70000GHz; wcFuX:18.6Ω.

SST

P H3_P Trap (IS) (wcFuQs:0.87 wcFuQL:1.73):
OST_Null: H3L=8.10000GHz; SST_Null: F=8.10000GHz.
ML: Z0=43.75Ω Ang=48.072° @ 3.90000GHz.
XfuL:28.9Ω XfuC:268.3Ω XfuH:-73.4Ω

Second-Harmonic and Third-Harmonic Trap

M H2_H and H3_L (OS) (Err:56.5°; wcFuQL:1.66 wcFuQs:0.82):
Nulls at F2=7.80000GHz and F3=8.10000GHz.
ML: Z0=43.75Ω Ang=60.562° @ 3.90000GHz.
XfuL:29.0Ω XfuG:104.9Ω XfuC:295.9Ω XfuH:-69.0Ω

Single Trap Connecting Line

Matching network connecting line length: ° at 3.90000GHz

Double Trap Options

Matching network connecting line length [5;60]: ° at 3.90000GHz

Allow OST stepped line

Matching Network Side Allocation

Maximum ML length for an input side (IS) trap [10;120] <60°>: ° at 3.90000GHz

Characteristic Impedances

Double Traps			
Z0ML_min:	<input type="text" value="7.50"/>	Z0ML_max:	<input type="text" value="80.00"/>
Z0ML single trap:	<input type="text" value="43.75"/>	Z0OST:	<input type="text" value="65.00"/>
Z0SST:	<input type="text" value="65.00"/>	Z0OST stepped line:	<input type="text" value="65.00"/>

(ML: Main line; OST: Open-ended stub; SST: Shorted stub.)

Target the optimum reactance with each trap wcQs_NoTraps: 0.22
 Export selected traps to the circuit file wcQL_NoTraps: 0.00

The SST options were set here to view the loading associated with shorted stub traps. The loading of the 6.0 GHz second harmonic trap is above 37.5 Ohm in the passband, but this is not high enough to not have a degrading effect on the performance.

CIL/CIR Impedance-Matching Wizard - Performance Expected

The Performance Associated with the Optimum | Specified Terminations

F (GHz)	RL (Ω)	XL (Ω)	Pmu (dBm)	GT (dB)	VSWRa	VSWRin	Eff (%)	Tun	SSF	LSF
1.0000	29.249	+j4.308	39.978	16.721	1.443	5.235	70.375	0.104	1.217	1.963
1.1000	28.807	+j4.565	39.978	16.967	1.489	4.048	70.378	0.152	1.299	2.001
1.2000	28.334	+j4.798	39.978	17.217	1.517	3.158	70.376	0.224	1.403	2.005
1.3000	27.858	+j4.965	39.978	17.420	1.527	2.537	70.365	0.254	1.516	1.974
1.4000	27.355	+j5.106	39.978	17.534	1.518	2.173	70.364	0.231	1.593	1.915
1.5000	26.841	+j5.201	39.979	17.536	1.493	2.075	70.366	0.219	1.574	1.831
1.6000	26.327	+j5.253	39.979	17.430	1.458	2.230	70.362	0.236	1.469	1.728
1.7000	25.805	+j5.273	39.979	17.238	1.420	2.588	70.357	0.287	1.343	1.613
1.8000	25.286	+j5.245	39.979	16.999	1.384	3.091	70.355	0.347	1.237	1.491
1.9000	24.776	+j5.181	39.980	16.752	1.354	3.690	70.353	0.312	1.156	1.370
2.0000	24.263	+j5.083	39.980	16.530	1.332	4.332	70.347	0.235	1.097	1.255
2.1000	23.762	+j4.952	39.980	16.355	1.318	4.961	70.343	0.190	1.053	1.150
2.2000	23.248	+j4.721	39.980	16.225	1.314	5.516	70.317	0.173	1.020	1.059
2.3000	22.767	+j4.522	39.981	16.159	1.313	5.952	70.313	0.179	0.994	0.983
2.4000	22.293	+j4.297	39.981	16.134	1.314	6.244	70.305	0.213	0.975	0.924
2.5000	21.844	+j4.044	39.981	16.128	1.317	6.395	70.301	0.308	0.960	0.882
2.6000	21.399	+j3.762	39.982	16.115	1.318	6.445	70.305	0.552	0.950	0.854

Display: Impedance Reflection Intrinsic termination

Buttons: Display Graph, Display Impedances

Intrinsic Harmonic Angles Targeted:
 2ndH: [180.0°, 180.0°]; $\Delta=28.7^\circ$ Z0=50.00
 3rdH: [180.0°, 180.0°]; $\Delta=28.7^\circ$ Z0=50.00

Harmonic Control:
 Save ZLi
 Set Hm_ZL
 Set Hm_ZL (Asym)
 Harmonic Reactance
Harmonic Traps
 Ignore Hm_ZL

Transmission Phase Control:
 NCT-Network
 CT-Network
 PI-Network
 Stepped ML
 $\Delta\theta$: 0.0 [0, 360]
 Explore Pre-Match

Phase Control Passband Frequency:
 Lowest frequency
 Center frequency
 Highest frequency
 Lowest gain frequency

Phase Control Help

Buttons: < Back, Next >, Cancel, Help

The Next command has been selected to proceed to solving the defined matching problem.

Power Matching Wizard - Data File Name and Title

The specifications of the matching problem to be solved will be stored in a data file. The root part of the data file name and the title to be used in the file can be specified here. Note that the file type should not be specified and a file path is also not allowed.

Impedance-Matching Data File

Data file name (Type: .mmi):
ADWDSGN4SYN1

Title:
Power matching

Default Synthesis Option

Synthesize

Lumped or non-commensurate distributed solutions
 Commensurate distributed solutions

< Back Next > Cancel Help

The default name for the matching network file is shown here. The option to solve the matching problem with non-commensurate networks was selected.

CIL/CIR Impedance-Matching Wizard

You have successfully completed the steps of the CIL or CIR wizard. If the CMA command was used, or traps were selected for export, the associated schematic elements will be inserted into the circuit file next. If neither of these options were not chosen, the Impedance-Matching wizard will be launched next to solve the matching problem defined.

It is recommended that you save the circuit file after closing this wizard.

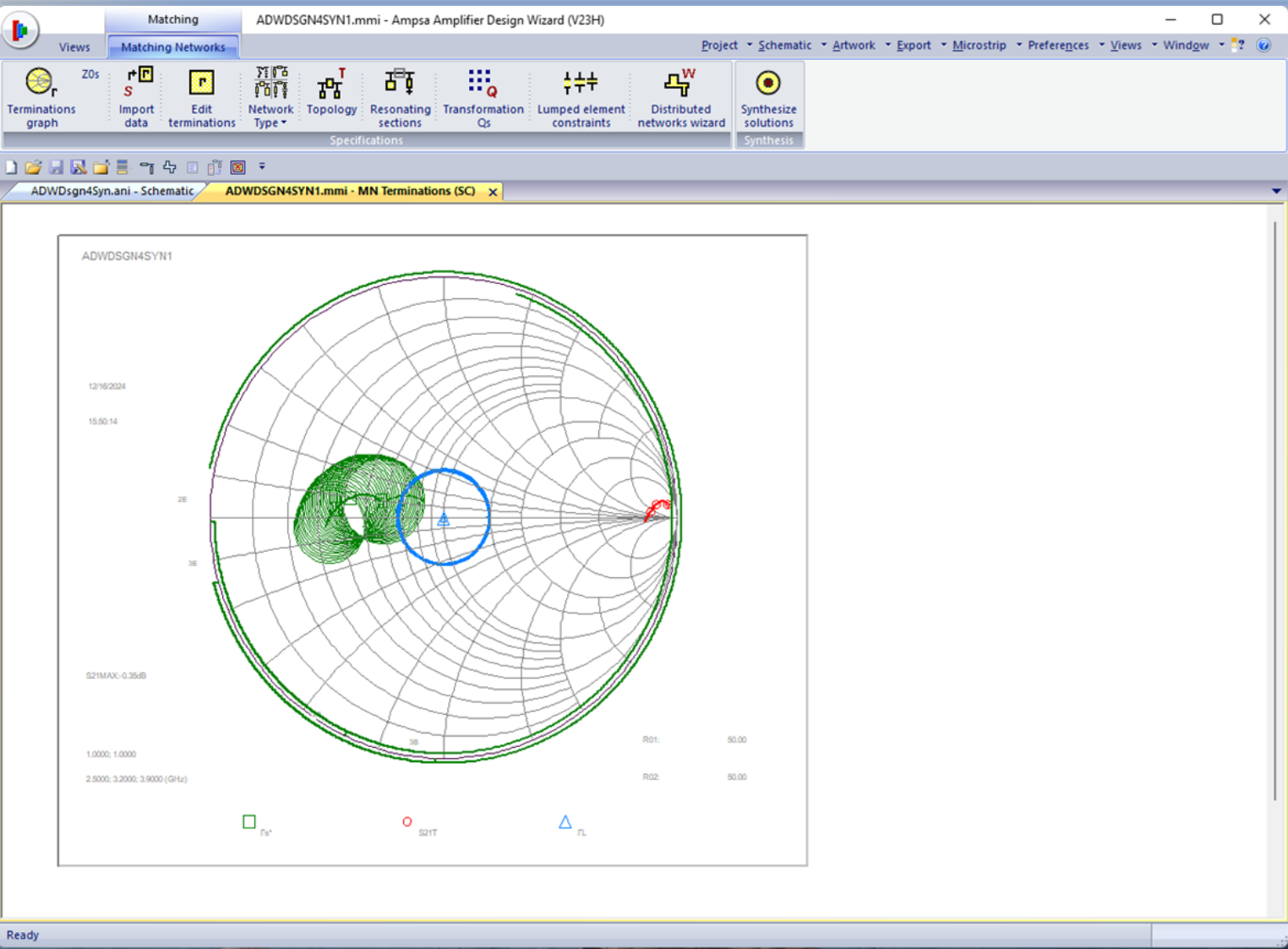
Save the circuit file automatically

C:\Users\USER\Documents\Ampsa\AmpsaADW23H\Examples\Power Amplifiers\Cree 10

Launch the Impedance-Matching Module

< Back Finish Cancel Help

The matching problem has been defined by the CIL wizard. The next step is to solve the problem.



The Matching wizard was launched and impedance-matching networks can now be synthesized.

Solutions to the matching problem will be synthesized next.

ADWDSGN4SYN1.mmi - Ampsa Amplifier Design Wizard (V23H)

Views | Chart Options | Matching Networks | Results

Project | Schematic | Artwork | Export | Microstrip | Preferences | Views | Window

First | Next | Solution in new window | Detailed schematic | Tolerances | Network terminations | Performance | VSWRs | New ADW circuit file | Touchstone file
 Last | Previous | Close results views | Artwork | Preferences | Intrinsic terminations | Impedances | Active Performance | Existing ADW circuit file | Super Compact
 Text view | Scaling | Gain plot | HC impedances | MWO script | DXF file

Solutions | Solution Views | Modify | Graphs | Tables | Export Selected Solution

ADWDSGN4SYN1.mmi - MN Terminations (SC) | ADWDSGN4SYN1.mmi - Solution 1 | ADWDSGN4SYN1.mmi - Intrinsic Load Terminations 1

Solution 1

MRD:	7.57%	Q1:	-0.26571	MRD2ndH:	74.14%
MRDf:	1.05%	Q2:	0.71682	MRD3rdH:	22.27%
MRDwc:	7.83%	Q3:	-0.21777		
		Q4:	0.80409		
		Q5:	-0.45148		
		Q6:	0.17647		

7.83 nH 0.63 nH 1.26 pF 1.40 nH 0.67 pF 6.05 pF

ADWDSGN4SYN1

Circuit 1

12/18/2024

09:28:28

1.0000; 1.0000 R01: 50.00

2.5000; 3.2000; 3.9000 (GHz) R02: 50.00

Γ_{Li} Solution 1

Ready

It is generally a good approach to try lumped solutions to a matching problem first (Use the Network Type ribbon command). Insight into the problem can be gained by doing this before proceeding to distributed solutions.

A lumped solution to the matching problem is shown here. The drain bias can be fed in through the inductor if the *dc* short is replaced with an RF short.

ADWDSGN4SYN1.mmi - Ampsa Amplifier Design Wizard (V23H)

Views: Matching Networks

Project | Schematic | Artwork | Export | Microstrip | Preferences | Views | Window

Terminations graph | Import data | Edit terminations | Network Type | Topology | Resonating sections | Transformation Qs | Lumped element constraints | Distributed networks wizard | Synthesize solutions

ADWDSGN4SYN1.mmi - MN Terminations (SC)

Topology Specifications

Number of Elements: 6

Topology Constraints:

- None
- Low-pass prototype
- High-pass prototype
- Bias-type
 - Input Side
 - Output Side
- No series capacitors
- No shunt inductors

First Element (load side):

- Series element
- Shunt element
- Series or shunt

Resonating Sections (RS):

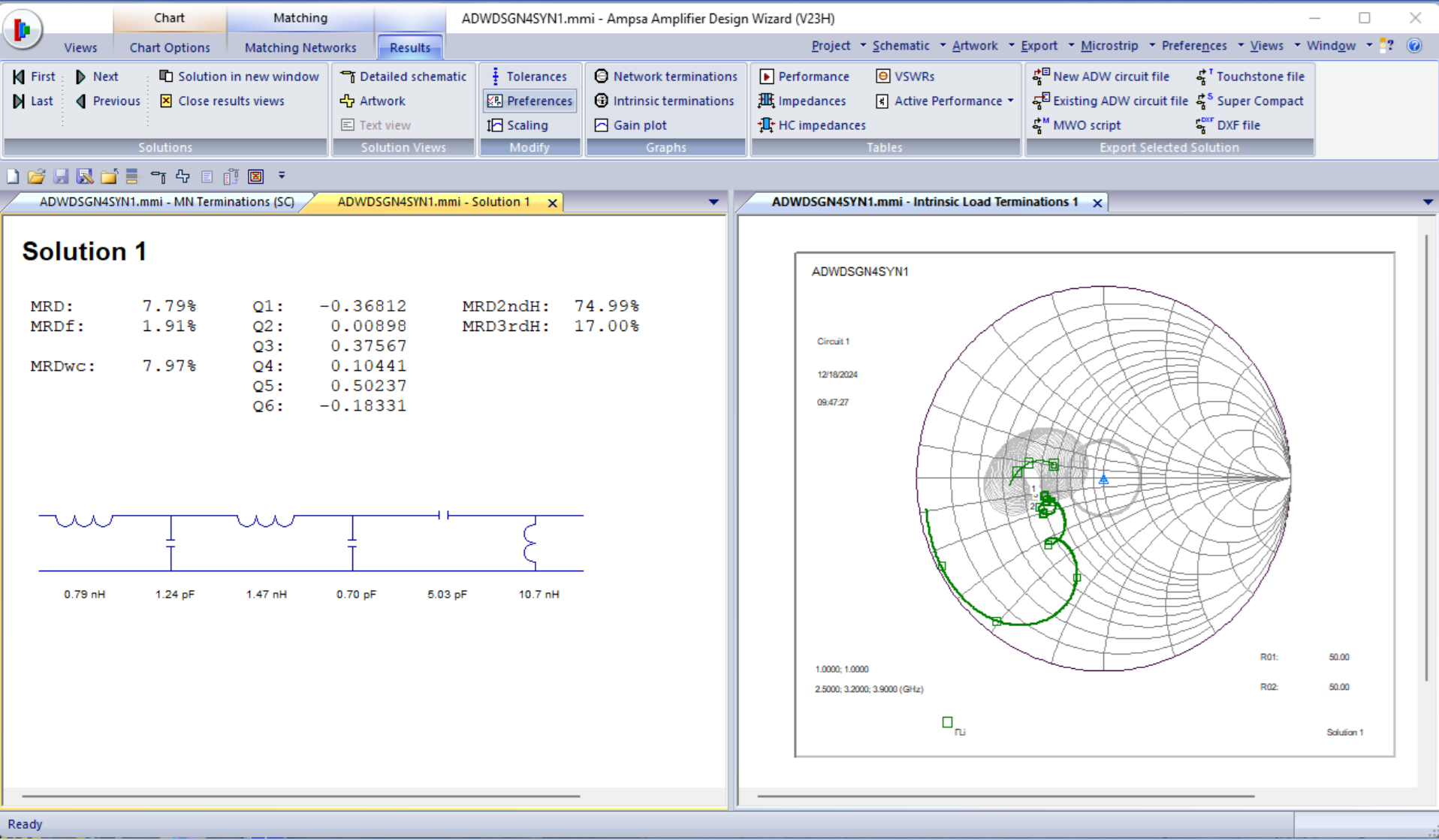
- Allow resonating sections
- Use resonating sections
- No RS or fixed topology

Number of Resonating Sections (Fixed Topology Option): 0

OK | Cancel | Help

The topology constraints used when the lumped solution shown was synthesized.

Note the bias-type option. Options are provided to synthesize networks allowing biasing on the input and/or output sides of the matching networks.



The effect of reducing the second harmonic transition band to 0.3 GHz is shown here.

A conical coil or a solenoidal coil can be used to feed in the drain bias.

ADWDSGN4SYN1.mmi - Ampsa Amplifier Design Wizard (V23H)

Views: Matching Networks, Results

Project | Schematic | Artwork | Export | Microstrip | Preferences | Views | Windg | ?

Terminations graph | Import data | Edit terminations | Network Type | Topology | Resonating sections | Transformation Qs | Lumped element constraints | Distributed networks wizard | Synthesize solutions | Synthesis

Specifications

ADWDSGN4SYN1.mmi - MN Terminations (SC)

Terminations

F (GHz)	MAG[Ss]	ANG[Ss]	MAG[SL]	ANG[SL]	GT (dB)
1.0000	0.2763	194.84	0.6900E-3	270.04	> -0.1609
1.1000	0.2842	195.47	0.7600E-3	270.04	> -0.1613
1.2000	0.2926	195.99	0.8361E-3	263.18	> -0.1620
1.3000	0.3009	196.29	0.9056E-3	263.71	> -0.1625
1.4000	0.3098	196.48	0.9752E-3	264.17	> -0.1631
1.5000	0.3188	196.53	0.0010	264.57	> -0.1636
1.6000	0.3279	196.45	0.0011	264.92	> -0.1643
1.7000	0.3371	196.27	0.0012	265.18	> -0.1650
1.8000	0.3462	195.97	0.0012	265.46	> -0.1657
1.9000	0.3553	195.57	0.0013	265.71	> -0.1664
2.0000	0.3644	195.09	0.0014	265.93	> -0.1672
2.1000	0.3734	194.53	0.0015	266.14	> -0.1680
2.2000	0.3824	193.70	0.0015	262.54	> -0.1663
2.3000	0.3912	192.98	0.0016	262.88	> -0.1670
2.4000	0.4000	192.22	0.0017	263.18	> -0.1679
2.5000	0.4083	191.40	0.0017	263.47	> -0.1687
2.6000	0.4167	190.51	0.0018	263.69	> -0.1695
2.7000	0.4250	189.55	0.0019	263.94	> -0.1704
2.8000	0.4328	188.61	0.0019	261.23	> -0.1713
2.9000	0.4404	187.60	0.0020	261.54	> -0.1721
3.0000	0.4480	186.54	0.0021	261.79	> -0.1730

Second-Harmonic Terminations

F (GHz)	MAG[Por]	ANG[Por]	AngB (°)	AngE (°)	RL (Ω)	XL (Ω)
2.0000	0.7708	204.75	244.78	180.89	49.990	-0.140
2.2000	0.7681	207.37	249.09	183.76	49.980	-0.150
2.4000	0.9439	230.08	253.66	186.62	49.980	-0.170
2.6000	0.9412	233.50	258.21	189.49	49.980	-0.180
2.8000	0.9384	237.02	263.06	192.40	49.970	-0.190
3.0000	0.9356	240.65	268.08	195.33	49.970	-0.210
3.2000	0.9323	244.39	273.36	198.29	49.970	-0.220
3.4000	0.9290	248.25	278.82	201.27	49.960	-0.230
3.6000	0.9254	252.23	284.52	204.31	49.960	-0.240
3.8000	0.9217	256.35	290.45	207.40	49.950	-0.260
4.0000	0.9179	260.62	296.61	210.54	49.950	-0.270
4.2000	0.9138	265.03	303.01	213.76	49.940	-0.280
4.4000	0.9100	269.51	309.37	217.08	49.940	-0.300
4.6000	0.9057	274.22	316.17	220.43	49.930	-0.310
4.8000	0.9013	279.10	323.20	223.86	49.930	-0.320
5.0000	0.8970	284.14	330.38	227.38	49.920	-0.330

Second-Harmonic Targets and Boundaries

- Use angles (Z0 = 50.00)
- Use reactance values
- Target purely reactive terminations (Specify Forigin)

Harmonic Terminations Specified for matching network

- Input side
- Output side

Activate Specifications At

- All frequencies
- Lowest frequency
- Center frequency
- Highest frequency
- Other frequencies

Width of H2 transition band: 0.30000 GHz

Error Function Weight Factor: 0.1000

Harmonic Control

- 2nd Harmonic Targets
- 3rd Harmonic Targets
- Use worst case error

Impedance Fit Option

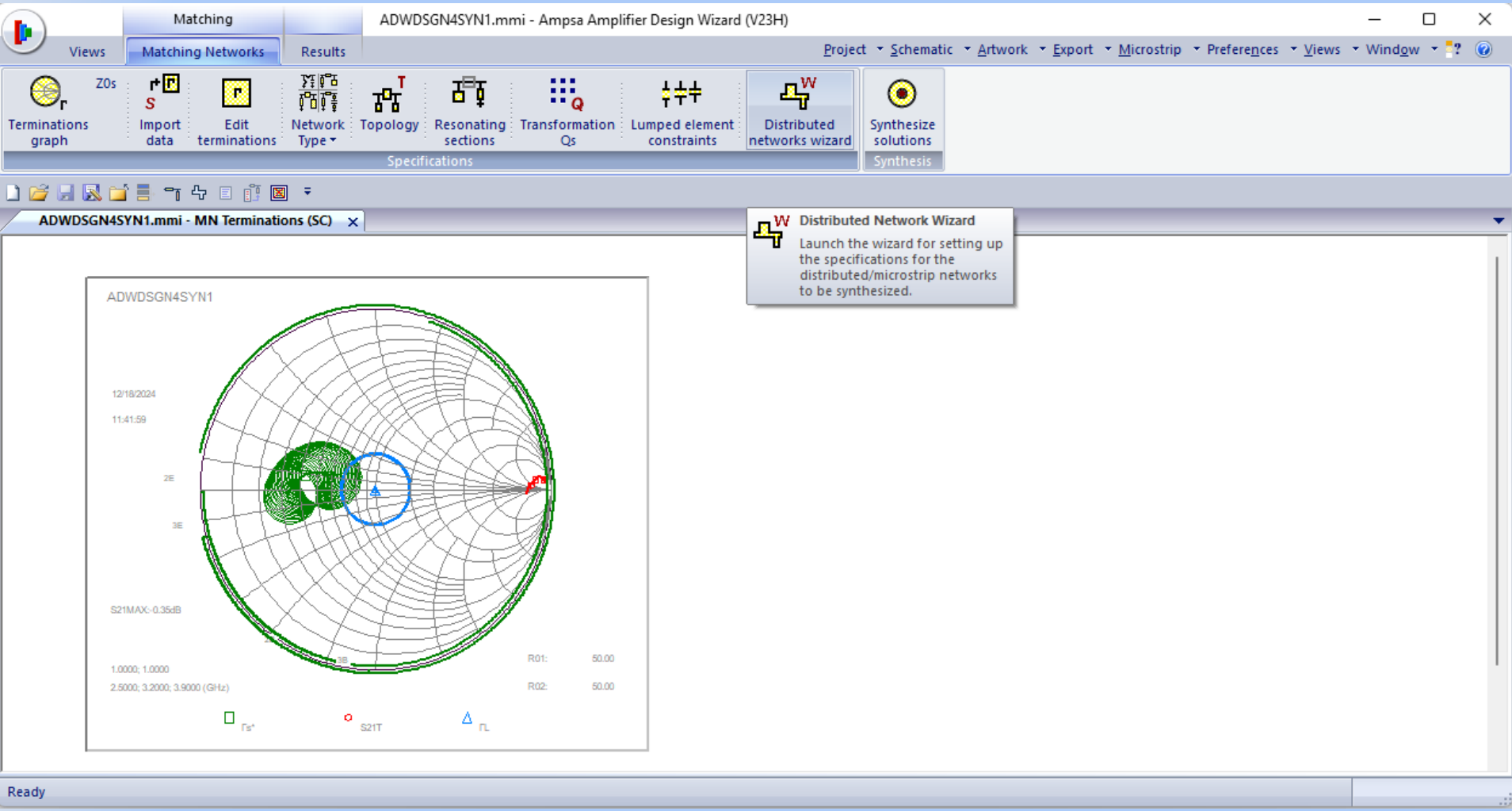
- Fit Impedance
- Weight Factor: 0.250 <0.0> [0.0; 1.0]

Edit Format

- Impedances
- Admittances
- Reflection

Buttons: OK, Cancel, Help, Insert Row, Delete Row, Paste Deleted, Intergolate, Convert Circles, Slope Gain..., Set Fixed Elements, Remove Fixed Elements

Use the Edit Terminations ribbon command and then select the 2nd Harmonic Targets command to change the transition band for the second harmonics.



Distributed networks will be synthesized next.

The Distributed Networks Wizard is used to change the specifications for distributed networks. Use the ribbon command shown to launch the wizard. Any results views must be closed before the wizard can be launched.

Distributed/Microstrip Networks Wizard - Capacitor and Inductor Options

Parasitic Components
The option to use shunt parallel-plate capacitors instead of open-ended stubs or shunt capacitors is provided here. The parasitic inductance or resonant frequency of any regular capacitors or the parasitic capacitance or resonant frequency to be used for any inductor in the matching network can also be specified here. The option to use shunt capacitors as harmonic traps is also provided.

Parasitics

Capacitor Inductance or Resonant Frequency

- Specify inductance (nH)
- Specify component resonant frequency (Fr_GHz)
- Specify trap resonant frequency (FTr_GHz) too

L_nH: 0.000 nH FTr_GHz: _____ GHz

No parasitics for series capacitors

Inductance Capacitance or Resonant Frequency

- Specify capacitance (pF)
- Specify resonant frequency (GHz)

0.000 pF

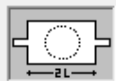
Parallel-Plate Capacitors

Use shunt parallel-plate capacitors

Pad width (um): 500.00 Pad length (L; um): 1.00E3

Pad Z0 (Ohm): 50.00 Pad length ("): 0.00

Via hole inductance: 0 nH



F = 3.900GHz

< Back Next > Cancel Help

Parasitic inductance and capacitance can be specified for capacitors and inductors on this page.

The parasitic inductance or the resonant frequency for the capacitors can be specified. The option to use the shunt capacitors as harmonic traps is also provided.

Ideal lumped components will be used in this presentation.

Distributed/Microstrip Networks Wizard - Double Stub Options

The option to use double stubs in the matching networks is provided here. If double stubs are allowed, they can be transformed to stepped main-line sections. This option is frequently used when power matching networks are synthesized.

Allow double stubs

Minimum electrical length (°) at which an open-ended stub should be converted to a double stub:

0.00

Stepped main-line sections

Transform double stubs to stepped main-line sections

Maximum width (um)	Minimum width (um)	Length (um)
0.00	0.00	0.00
Lowest Z0 (Ohm)	Highest Z0 (Ohm)	Electrical length (°)
25.00	65.00	30.00

F = 3.900GHz

Note: Not using resonating sections is usually a good option when open-ended stubs are replaced with stepped main-line sections (Allows short main-line sections).

< Back Next > Cancel Help

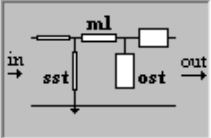
When it is possible, open-ended stubs in an ADW matching network can be transformed automatically to equivalent main-line sections.

A minimum electrical length can be set for the transformation.

The phase responses of the networks synthesized are generally better behaved when this is done.

Distributed/Microstrip Networks Wizard - Z0's

The characteristic impedance of the lines to be used are listed here. The line lengths will be used as variables. The minimum and maximum length to be used for the main line sections are listed too. The minimum length specification is important when stubs can overlap. When distributed networks are required, the characteristic impedances and line lengths should be modified on this page, if necessary. If the associated dimensions were specified previously for microstrip networks, the values listed should be inspected to ensure that the specifications made are realistic.



Main-line Sections

Input side Z0: Ohm

Output side Z0: Ohm

Minimum length: °

Maximum length: °

FpsbH = 3.900GHz

Stub Parameters

SST Z0: Ohm

SST maximum electrical length: °

OST Z0 (SST Z0Min): Ohm

OST maximum electrical length: °

Harmonic Traps

SST ResFrq (GHz):

OST ResFrq (GHz):

OST CNL length (") at FpsbH [2°, 25°]:

ZOOST Minimum:

ZOOST Maximum:

Main-line Z0 Search

Perform search ML Z0 minimum: Ohm ML Z0 maximum: Ohm ML Z0 step: Ohm

Only show optimum Z0 results

When the characteristic impedance specified for a stub allows it, the stub can be designed to provide a transmission null at a specified frequency in addition to providing the fundamental-frequency reactance required.

Different null frequencies can be set for the shorted stubs and the open-ended stubs.

If the option to transform the open-ended stubs to main-line sections was selected, the open-ended stubs will not be used to trap the harmonics.

Some experimentation with the trap frequencies is usually required. Start by setting the resonant frequencies to frequencies in the transition bands.

In this example, the transmission null frequencies were set to 11.0 GHz.

ADWDSGN4SYN1.mmi - Ampsa Amplifier Design Wizard (V23H)

Views | Chart Options | Matching Networks | Results

Project | Schematic | Artwork | Export | Microstrip | Preferences | Views | Window

First | Next | Solution in new window | Detailed schematic | Tolerances | Network terminations | Performance | VSWRs | New ADW circuit file | Touchstone file

Last | Previous | Close results views | Artwork | Preferences | Intrinsic terminations | Impedances | Active Performance | Existing ADW circuit file | Super Compact

Solutions | Solution Views | Modify | Graphs | Tables | Export Selected Solution

ADWDSGN4SYN1.mmi - MN Terminations (SC) | ADWDSGN4SYN1.mmi - Solution 2 | ADWDSGN4SYN1.mmi - Intrinsic Load Terminations 2

Solution 2

MRD:	8.27%	Q1:	-0.08335	MRD2ndH:	81.08%
MRDf:	0.76%	Q2:	0.67800	MRD3rdH:	57.79%
MRDwc:	8.41%	Q3:	-0.00579		
		Q4:	-0.39552		
		Q5:	-0.09677		
		Q6:	-0.50191		

(3.900GHz)

65.0Ω | 4.25pF | 65.0Ω | 35.0Ω | 35.0Ω | 35.0Ω | 9.86pF

70.00° | 5.00° | 64.86° | 80.90° | 0.00° | 0.00° | 5.00°

ADWDSGN4SYN1

Circuit 2

2024/12/23

13.53.09

1.0000; 1.0000

2.5000; 3.2000; 3.9000 (GHz)

R01

R02

Ready

The second solution obtained with the specifications shown.

Note that the absolute values of the transformation-Q associated with this solution is small (less than 0.68). Better solutions may be obtained by scaling the range of the systematic search done down.

ADWDSGN4SYN1.mmi - Ampsa Amplifier Design Wizard (V23H)

Views: Matching Networks

Project | Schematic | Artwork | Export | Microstrip | Preferences | Views | Window

Terminations graph | Import data | Edit terminations | Network Type | Topology | Resonating sections | Transformation Qs | Lumped element constraints | Distributed networks wizard | Synthesize solutions

ADWDSGN4SYN1.mmi - MN Terminations (SC)

Systematic Search Parameters

Gain Window
 GTmin: 0.89
 GTmax: 1

Search Option
 Number of potential solutions to be used in secondary searches: 250 <100>
 [25;6400]

Transformation Qs

Qmin	Qinc	Qmax
-1.0000	0.2500	1.0000
-1.0000	0.2500	1.0000
-1.0000	0.2500	1.0000
-1.0000	0.2500	1.0000
-1.0000	0.2500	1.0000
-1.0000	0.1300	1.0000

Q_Frequency
 1.6000
 1.7000
 1.8000
 1.9000
 2.0000

Optimize solutions

OK | Cancel | Help

Quick Edit

The range of the search was scaled down and the number of potential solutions to be used in secondary searches was increased.

The Transformation Qs ribbon command was used to open the dialog box shown.

To keep the run-time similar, the Q increment should be scaled by the same factor as the boundaries.

ADWDSGN4SYN1.mmi - Ampsa Amplifier Design Wizard (V23H)

Views | Chart Options | Matching Networks | Results

Project | Schematic | Artwork | Export | Microstrip | Preferences | Views | Window

First | Next | Solution in new window | Detailed schematic | Tolerances | Network terminations | Performance | VSWRs | New ADW circuit file | Touchstone file
 Last | Previous | Close results views | Artwork | Preferences | Intrinsic terminations | Impedances | Active Performance | Existing ADW circuit file | Super Compact
 Text view | Scaling | Gain plot | HC impedances | MWO script | DXF file
 Export Selected Solution

ADWDSGN4SYN1.mmi - MN Terminations (SC) | ADWDSGN4SYN1.mmi - Solution 4 | ADWDSGN4SYN1.mmi - Intrinsic Load Terminations 4

Solution 4

MRDz:	8.35%	Q1:	-0.28470	MRD2ndH:	77.71%
MRDf:	1.27%	Q2:	0.28470	MRD3rdH:	55.63%
MRD:	1.27%	Q3:	0.08231		
MRDwc:	8.96%	Q4:	-0.85124		
		Q5:	0.16374		
		Q6:	-0.16374		
		Q7:	0.41637		
		Q8:	-0.99102		

65.0Ω 35.0Ω 3.30pF 63.9Ω 35.0Ω 4.38pF
 65.00° 23.71° 5.00° 63.82° 61.65° 5.00°

(3.900GHz)

ADWDSGN4SYN1

Circuit 4
12/25/2024
14:42:03

1.0000; 1.0000
2.5000; 3.2000; 3.9000 (GHz)

R01: 50.00
R02: 50.00

Solution 4

Ready

The fourth solution obtained with the tighter systematic search.

The Export Selected Solution | Existing ADW Circuit File option was used to export this solution to the original circuit file.

ADWDSGN4SYN1.mmi - Ampsa Amplifier Design Wizard (V23H)

Views | Chart Options | Matching Networks | Results

Project | Schematic | Artwork | Export | Microstrip | Preferences | Views | Windgw

First | Next | Solution in new window | Detailed schematic | Tolerances | Network terminations | Performance | VSWRs | New ADW circuit file | Touchstone file
 Last | Previous | Close results views | Artwork | Preferences | Intrinsic terminations | Impedances | Active Performance | Existing ADW circuit file | Super Compact
 Text view | Scaling | Gain plot | HC impedances | MWO script | DXF file

Solutions | Solution Views | Modify | Graphs | Tables | Export Selected Solution

ADWDSGN4SYN1.mmi - MN Terminations (SC) | ADWDSGN4SYN1.mmi - Solution 4 | ADWDSGN4SYN1.mmi - Intrinsic Load Terminations 4

Solution 4

MRDz:	8.35%	Q1:	-0.28470	MRD2ndH:	77.71%
MRDf:	1.27%	Q2:	0.28470	MRD3rdH:	55.63%
MRD:	1.27%	Q3:	0.08231		
MRDwc:	8.96%	Q4:	-0.85124		
		Q5:	0.16374		

ADW Circuit File

The solution selected can be exported to an ADW circuit file, or can be inserted in an existing circuit file. The insert option will be provided if a file with the specified name already exists.

ADW Circuit File

File Name (.ani):

a:\Ampsa\ADW23H\Examples\Power Amplifiers\Cree10WTrZerDsgns\ADWDSGN4SYN1Sol4ncdANI

Browse..

ADWDSGN4SYN1

Circuit 4

12/25/2024

14:42:03

Export Options

Export the solution as a standard ADW circuit file

Setup the circuit file for impedance-matching optimization in the ADW

Setup a load-pull or source-pull file for synthesis of CMA networks

OK | Cancel | Help

Note that new circuits can be created for any of the solutions shown. The exported matching network can then be modified or tuned or optimized before it is used in the original circuit.

ADWDsgn4Syn.ani - Ampsa Amplifier Design Wizard (V23H)

Views: Analysis | Optimization | Artwork Editing | Artwork Options

Analysis Summary Table - ADWDsgn4Syn.ani

Passband: 1.000 - 3.900 GHz (Ps=30.00 dBm; HrLL)			
GTmin:	14.852 dB	GDmin:	503.474 ps
GTmax:	17.545 dB	GDmax:	1.368E3 ps
VSWRmin:	2.337	VSWROmin:	1.042
VSWRmax:	5.878	VSWROmax:	2.354
PmucMin:	36.977 dBm	TOLmin:	46.607 dBm
PmucMax:	39.138 dBm	TOLmax:	48.768 dBm
PoMin:	40.214 dBm	GComMin:	3.42 dB
PoMax:	41.814 dBm	GComMax:	6.35 dB
Effmin:	57.122 %	StgGwMin:	12.56 dB
Effmax:	63.507 %	StgGwMax:	15.44 dB

Scale Factor = 0

ADWDsgn4Syn.ani - Power and Efficiency Graph

ADWDsgn4Syn.ani - Intrinsic Load Terminations

Ready

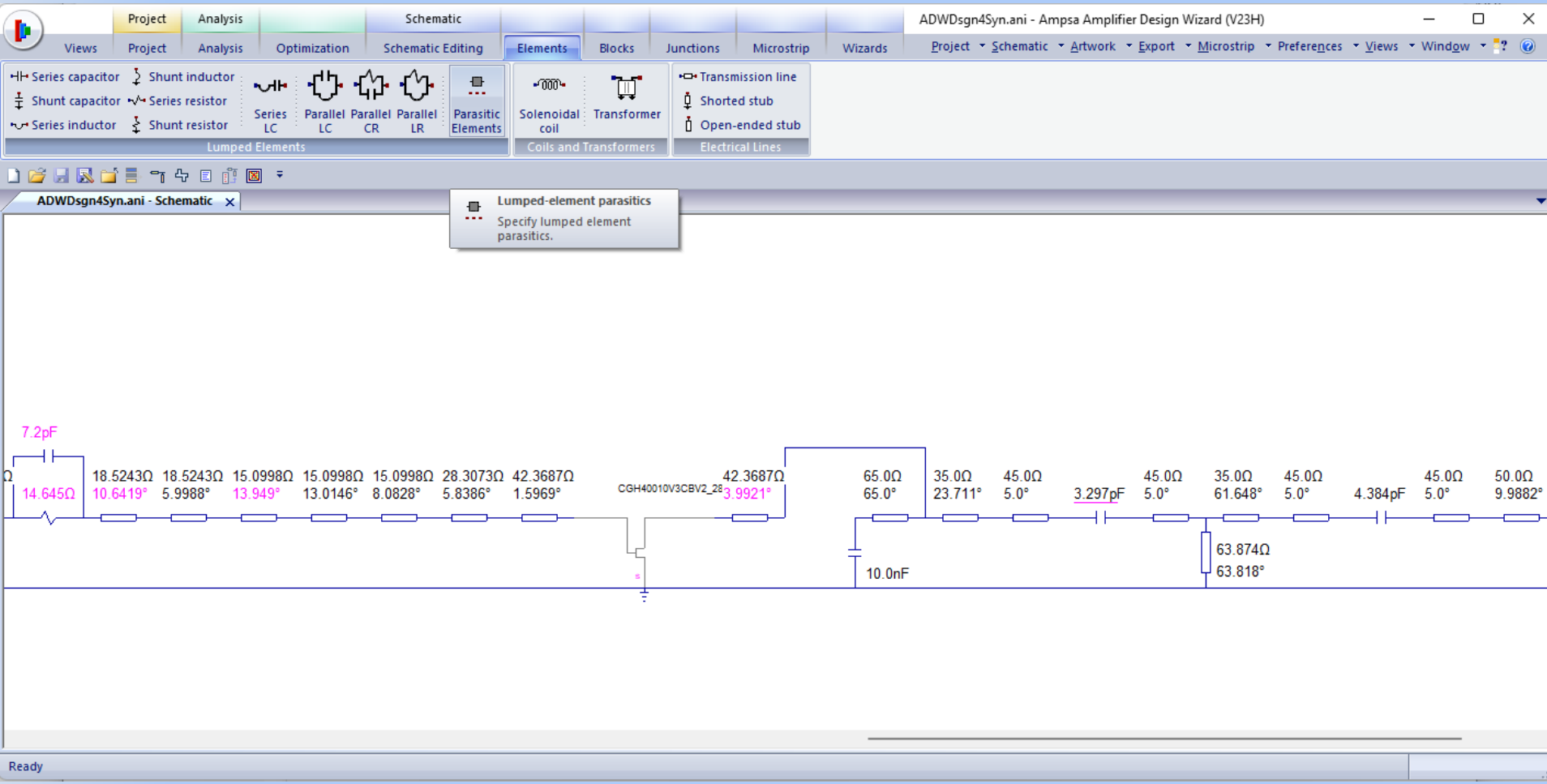
The performance obtained in the original circuit with the solution shown.

The screenshot shows the Ampsa Amplifier Design Wizard (V23H) interface. The 'Schematic Editing' tab is active, displaying a circuit diagram. A tooltip is visible over the diagram, indicating the 'Remove DC Ground Connection' command, which is used to terminate the short-circuited stub selected in a capacitor.

The circuit diagram includes the following components and values:

- 7.2pF capacitor
- 14.645Ω resistor
- 18.5243Ω resistor
- 18.5243Ω resistor
- 15.0998Ω resistor
- 15.0998Ω resistor
- 15.0998Ω resistor
- 28.3073Ω resistor
- 42.3687Ω resistor
- CGH40010V3CBV2_28 transistor
- 3.9921° phase shift
- 42.3687Ω resistor
- 35.0Ω resistor
- 23.711° phase shift
- 45.0Ω resistor
- 5.0° phase shift
- 3.297pF capacitor
- 45.0Ω resistor
- 5.0° phase shift
- 35.0Ω resistor
- 61.648° phase shift
- 45.0Ω resistor
- 5.0° phase shift
- 4.384pF capacitor
- 45.0Ω resistor
- 5.0° phase shift
- 50.0Ω resistor
- 9.9882° phase shift (F=3.9GHz; GT)
- 65.0Ω resistor
- 65.0° phase shift
- 63.874Ω resistor
- 63.818° phase shift

To allow for biasing the transistor, the schematic editing command shown will be used to convert the *dc* ground associated with the selected inductor to an *ac* ground.



The lumped-element parasitics were ignored when this matching network was synthesized. Parasitic elements can be added to a capacitor by using the command shown after selecting the capacitor. The capacitor value can then be tuned to compensate for the inductance added.

The performance of the matching network could also be improved by tuning or optimization. To tune the network, mark all the elements in the network for optimization first.

The screenshot shows the Ampsa Amplifier Design Wizard (V23H) interface. The 'Optimization' ribbon is active, displaying various optimization tools. A tooltip for 'Optimize Element' is visible, stating 'Mark the element value selected for optimization.' The circuit schematic below shows a transmission line network with several components marked for optimization in pink. The components and their values are:

- 3Ω, 18.5243Ω, 15.0998Ω, 15.0998Ω, 15.0998Ω, 28.3073Ω, 42.3687Ω
- 9°, 5.9988°, 13.949°, 13.0146°, 8.0828°, 5.8386°, 1.5969°
- CGH40010V3CBV2_28, 42.3687Ω, 3.9921°
- 65.0Ω, 65.0°
- 10.0nF
- 35.0Ω, 23.711°
- 45.0Ω, 5.0°
- 3.297pF
- 45.0Ω, 5.0°
- 35.0Ω, 61.648°
- 45.0Ω, 5.0°
- 63.874Ω, 63.818°
- 45.0Ω, 4.384pF, 5.0°
- 50.0Ω, 9.9882° (F=3.9GHz; Rs RL)

The command used to mark a variable for optimization is shown here. Note the Set Bounds command too.

If marked for optimization, the selected variable can be tuned after selecting the Analysis | Summary Table ribbon command.

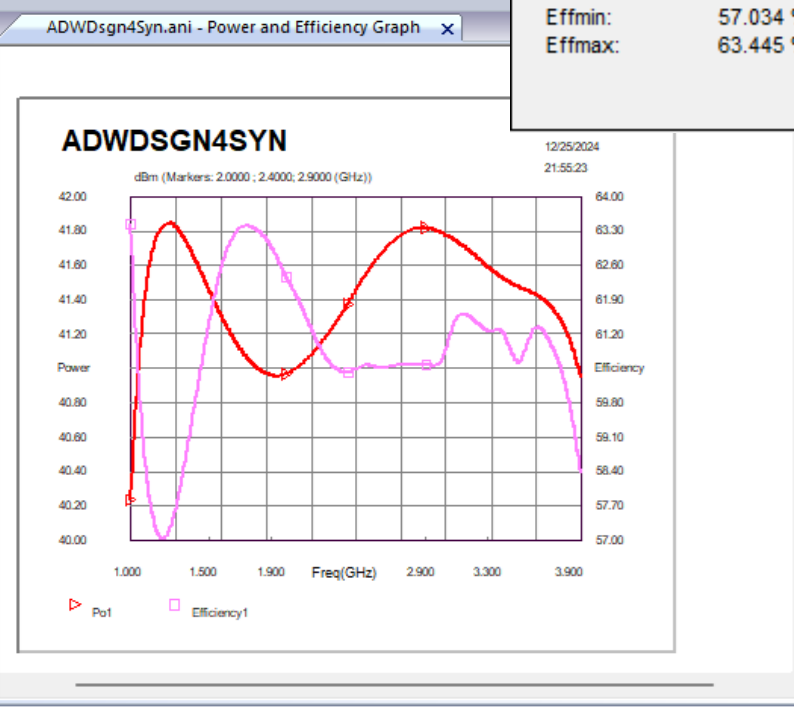
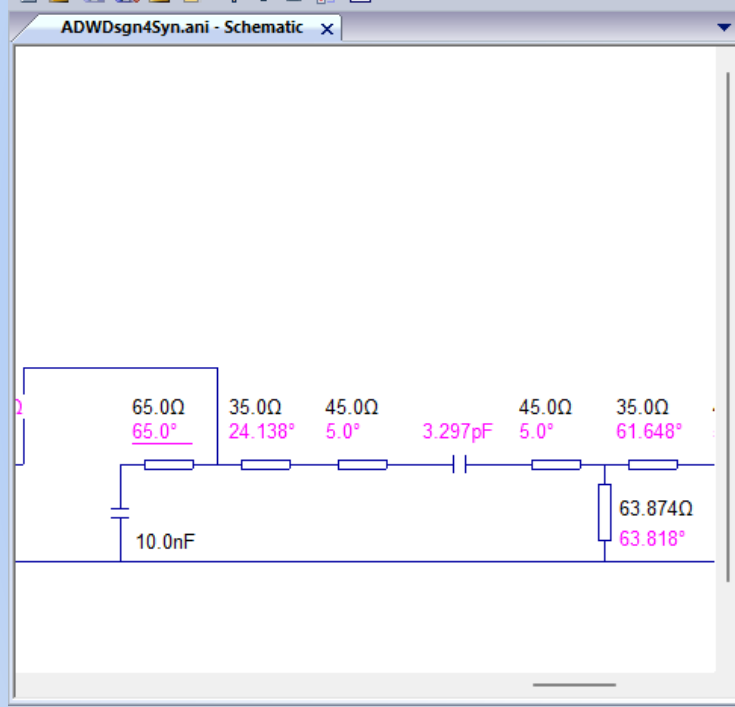
The circuit must be analysed before the element values can be tuned.

Project Analysis Schematic

Views Project Analysis Optimization Schematic Editing Elements Blocks Junctions Microstrip Wizards

Set results views Analysis options Analyse Calculate loop gain Reflection analysis Summary Table Show table Show graph Smith chart MN Smith chart MN ZLI Modify passband Remove results views ADW .spi Touch .s2 Export Optio

Analysis Options and Commands

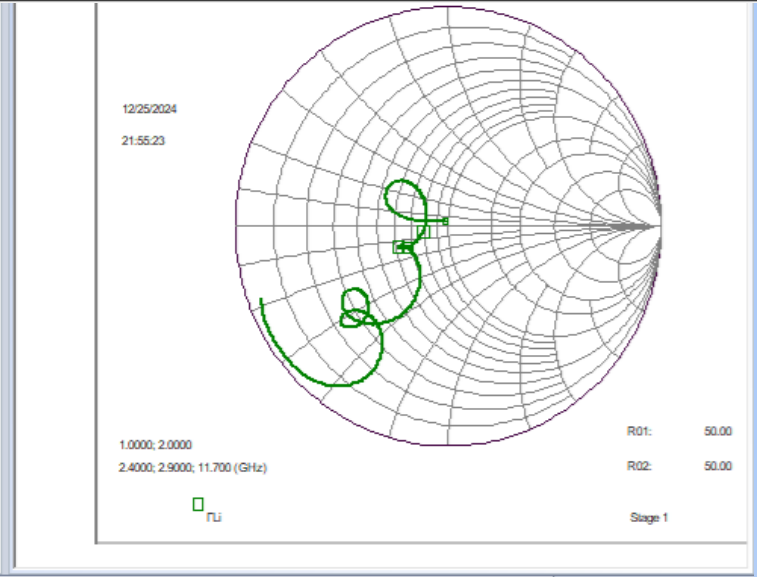


Analysis Summary Table - ADWDsgn4Syn.ani

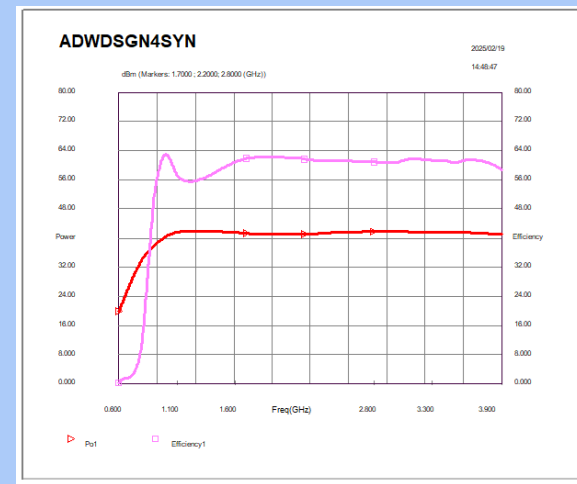
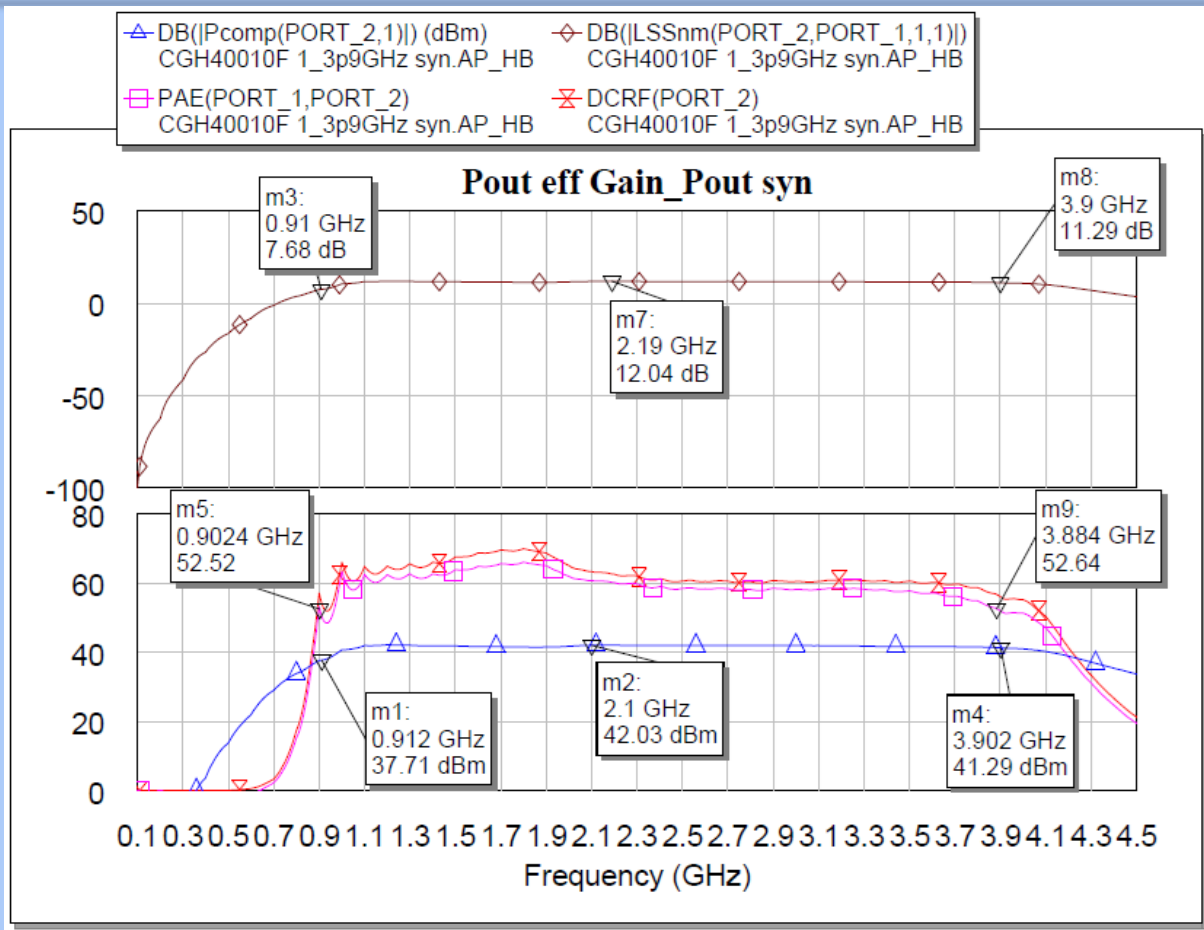
Passband: 1.000 - 3.900 GHz (Ps=30.00 dBm; HrLL)

GTmin:	14.843 dB	GDmin:	503.945 ps	kmin:	861.894E-3
GTmax:	17.544 dB	GDmax:	1.368E3 ps	kmax:	30.264E6
VSWRlmin:	2.338	VSWRlmin:	1.044	SSFmin:	949.839E-3
VSWRlmax:	5.893	VSWRlmax:	2.365	SSFmax:	3.494
PmucMin:	36.996 dBm	TOLmin:	46.626 dBm	LSFmin:	878.782E-3
PmucMax:	39.133 dBm	TOLmax:	48.763 dBm	LSFmax:	3.204
PoMin:	40.232 dBm	GComMin:	3.43 dB	StgGwMin:	12.56 dB
PoMax:	41.817 dBm	GComMax:	6.33 dB	StgGwMax:	15.45 dB
Effmin:	57.034 %				
Effmax:	63.445 %				

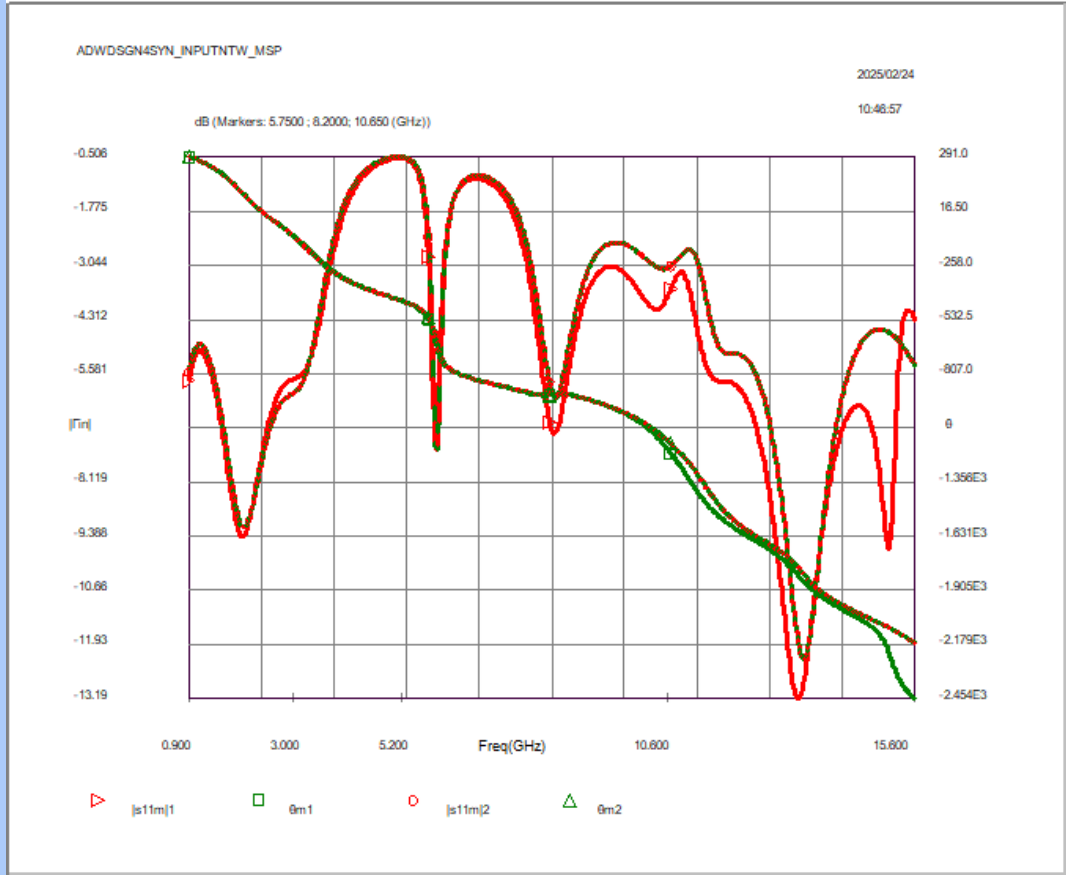
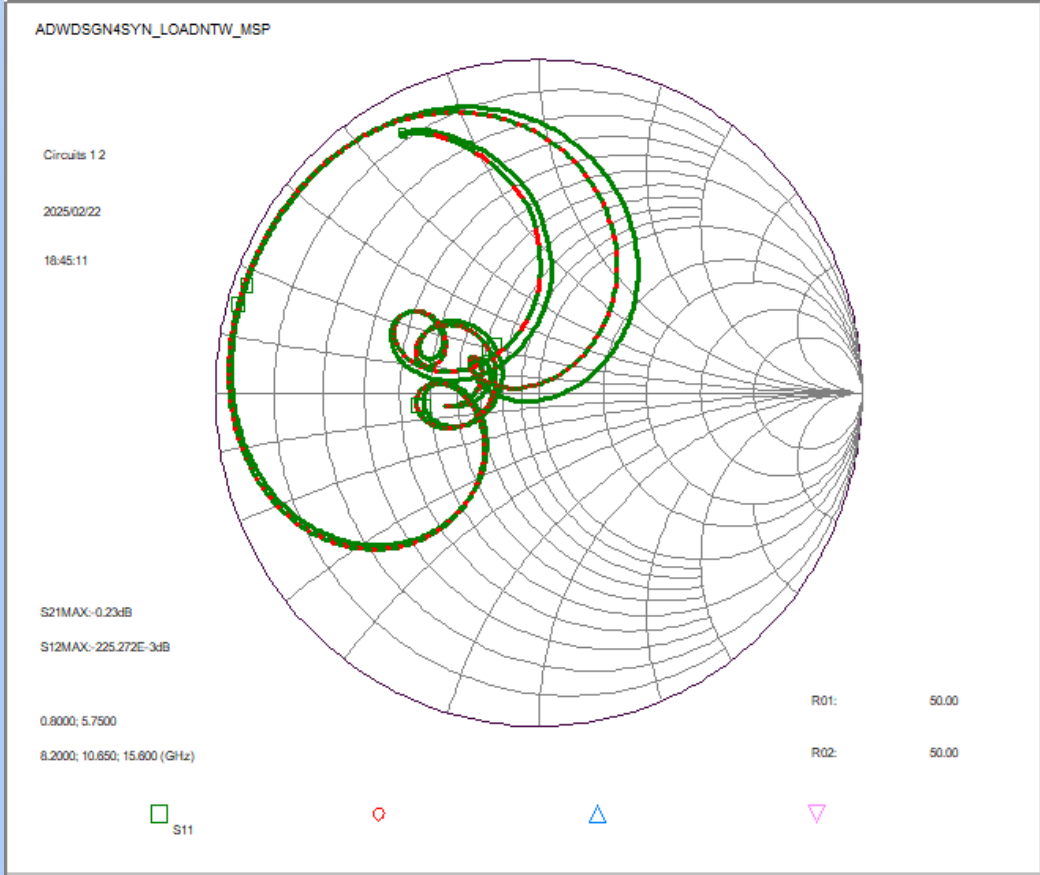
T8_2: 65.000



Use the Set Results Views command to set the views to be opened when an element value is tuned. The views can be arranged as required after using the Analyse command. The Summary Table command is used to tune the selected element value.



The performance of the ADW circuit in the previous slide as simulated in Microwave Office™. The electrical circuit (ADW schematic) was simulated here to avoid distortions associated with differences in the microstrip models. These distortions can be reduced by using S-parameter based junctions in the ADW or by optimising the ADW microstrip networks in Microwave Office™ to fit the S-parameters of the ADW matching networks.



The input reflection coefficients of the load and input networks of the amplifier with implicit junctions are compared here with the reflection coefficients of these networks with S-parameter based junctions. The efficiency of the amplifier (ADW simulation) is degraded by 1% when the junctions in the load network is upgraded and by a further 1.5% when the input network is upgraded.

Analysis Summary Table - ADWDsgn4Syn_SonJncsOptTuned.ani

Passband: 1.000 - 3.900 GHz (Ps=30.00 dBm; HrLL)

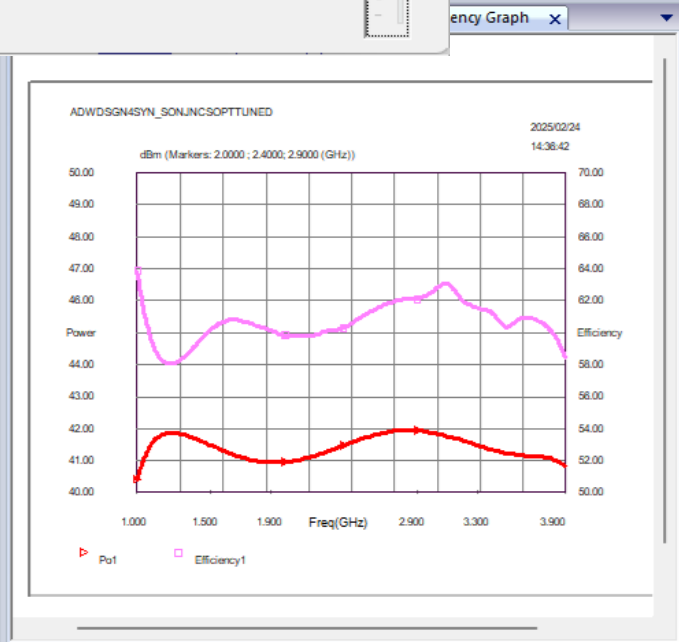
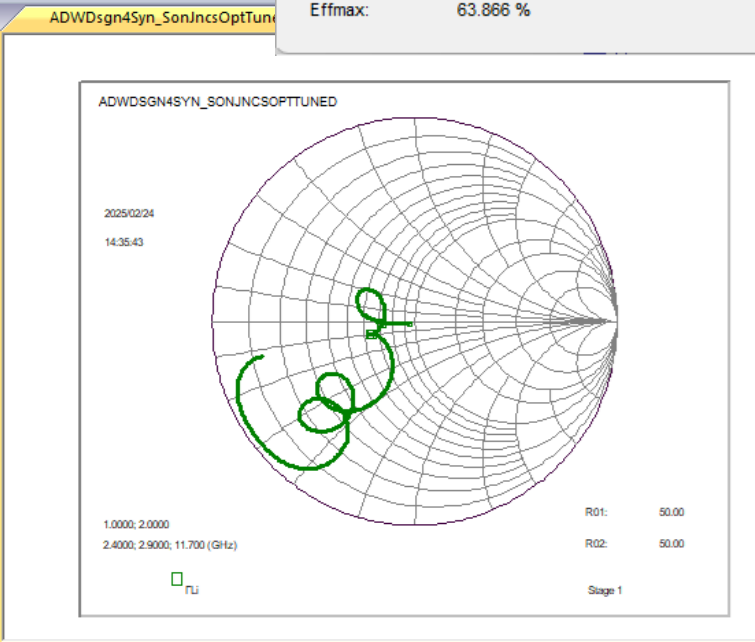
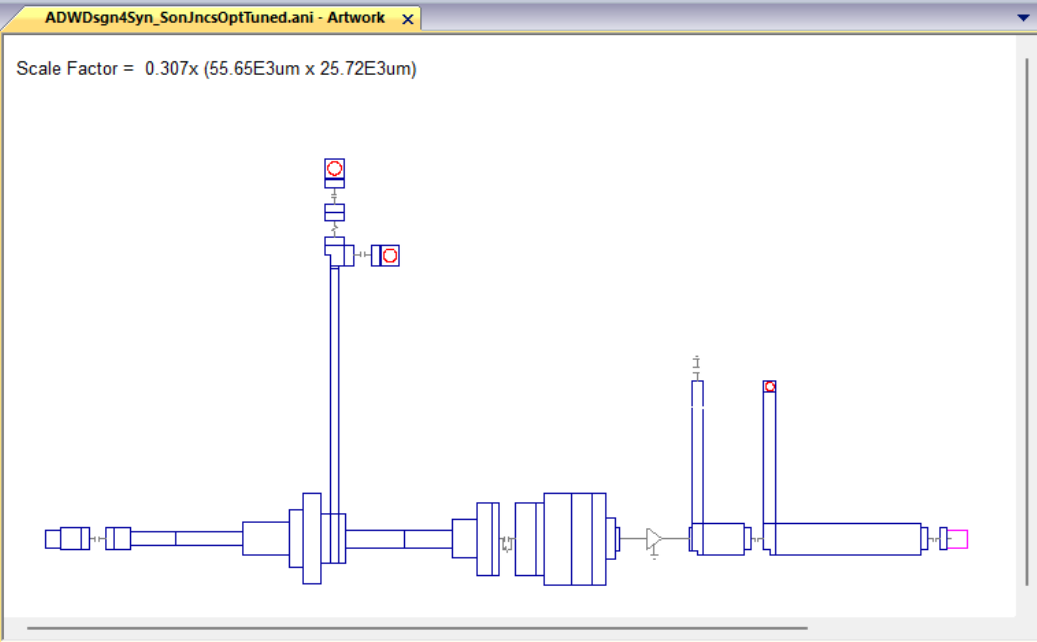
GTmin:	14.774 dB	GDmin:	509.778 ps	kmin:	948.041E-3
GTmax:	16.868 dB	GDmax:	1.323E3 ps	kmax:	22.535E6
VSWRlmin:	1.790	VSWRlmin:	1.037	SSFmin:	980.099E-3
VSWRlmax:	5.641	VSWRlmax:	2.406	SSFmax:	2.163
PmucMin:	37.176 dBm	TOLmin:	46.806 dBm	LSFmin:	949.942E-3
PmucMax:	39.145 dBm	TOLmax:	48.775 dBm	LSFmax:	3.919
PoMin:	40.410 dBm	GComMin:	3.57 dB	StgGwMin:	12.14 dB
PoMax:	41.943 dBm	GComMax:	6.29 dB	StgGwMax:	15.12 dB
Effmin:	58.090 %				
Effmax:	63.866 %				

ADWDsgn4Syn_SonJncsOptTuned.ani - Ampsa Amplifier Design Wizard (V23H)

Views: Analysis | Optimization | Artwork Editing | Artwork Options

Schematic view | Text view to schematic | Schematic and artwork
 Artwork view | Scroll on/off | Artwork and schematic
 Text view | Copy active view | Text and schematic

Active View | Tracking View



The performance of the amplifier with S-parameter based junctions. The input matching network was optimized first. The load network was then tuned to improve the efficiency without moving the intrinsic harmonic terminations away from Class-B operation and without losing power.