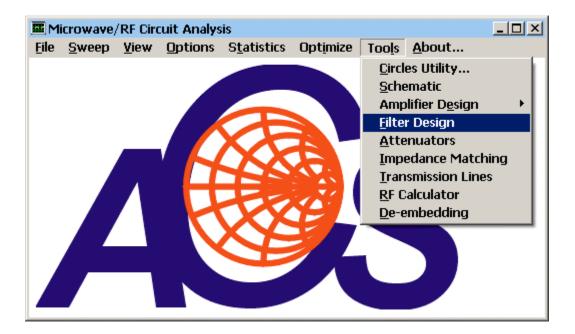
## **LINC2 FILTER Synthesis**



The LINC2 filter synthesis program is started by selecting **Filter Design** from the main LINC2 **Tools** menu as shown above.

The initial filter synthesis process usually generates an ideal electrical schematic. When the schematic (with ideal elements) is converted to a physical layout, non-ideal attributes are often introduced that alter the desired filter characteristics. EM simulation can help the designer understand these changes so they can be compensated for in the original design (such as a shift in the frequency specification).

The following example will demonstrate how a 7<sup>th</sup> order distributed Chebyshev lowpass filter can be specified, synthesized, and exported to the Sonnet<sup>®</sup> EM simulator for analysis in a matter of minutes with only a few menu clicks and keystrokes.

SLINC2 Filter Sy	ynthesis -	Schema	ntic]					- U ×
👘 File Edit P	arts Set	Filter	Analyze	View	Auto	Layout	About	_ 8 ×
		Lun	iped Elema iped <u>D</u> iffei ributed ( <u>S</u>	rential	nded)			4
		Dist	ributed (C	ifferen	tial)			
Select Distributed (Single-ended) from the Filter menu.								

First, select **Distributed** (Single-ended) from the Filter menu:

	)esign Specif	fications	×
[	-Filter Param	eters	
	Topolog	Parameters   Layout   Other	
		Transmission Response	
		C Lowpass	
		C Highpass	
		C Bandpass	
		© Bandstop	
		Shape Function	
		C Butterworth	
		Chebyshev	
		O Bessel	
		Synthesize Filter EXIT CANCEL	
		Click the <b>Topology</b> tab and Select <b>Lowpass</b> and <b>Chebyshev</b> .	

Click **Topology** and Select **Chebyshev Lowpass**.

Enter the detailed filter specifications:

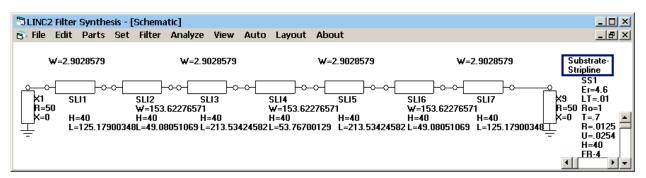
Desigr	n Specifi	ications			×
Filte	r Parame	eters			
ſ	Topolog	y Parameters Layout O	ther		
Filter Specifications					
		Cutoff Frequency	5000	MHz	
		Attenuation at Cutoff	3.0103	dB	
		Passband Ripple	0.150	dB	
		Filter Order	7		
		Source Impedance	50	Ohms	
Synthesize Filter EXIT CANCEL					
Click the <b>Parameters</b> tab and fill in the filter specifications as shown ( <b>Cutoff</b>					
Fre	quency	r = 5000, <b>Passband Rip</b>	ple = 0.15, Filter Order =	= 7).	

Design Specifications	×
Filter Parameters	
Topology Parameters Layout Other	
Additional Specifications Series Element First, Minimum Capacitor	
Shunt Element First, Minimum Inductor	
TLine, Resonator Impedance: 50 Ohms	
TLine, Minimum Impedance: 10 Ohms	
TLine, Maximum Impedance: 90 Ohms	
Synthesize Filter EXIT CANCEL	

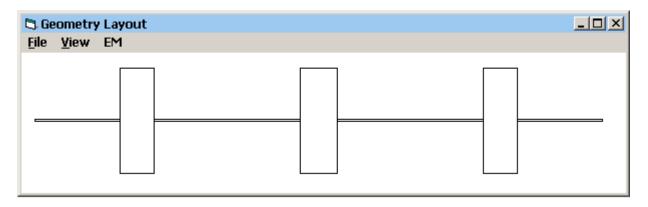
Click the **Other** tab and change the TLine (transmission line) minimum and maximum impedances to 10 and 90 ohms respectively. The filter specifications are now complete. Click the **Synthesize Filter** button and **Exit** to see the filter schematic (below).

SLINC2 Filter Synthesis - [Schematic]	
🖻 Eile Edit Parts Set Filter Analyze View Auto Layout Abouts	\LINC\FLT_LPDisSch.SCH _Ē×
X1 X2 X3 X4 X5 X6 R=50 Z=10 Z=10 X=0 L=40.9445275 L=16.0536373 L=69.8444512 L=17.5865313 L=69.844	$ \begin{array}{c}             Z=90 \\                                    $
Reference Designator:       SS1       Tune?         Dielectric Constant, Er:       4.6       I         Substrate Loss Tan, LT:       .01       I         Metal Resistivity, Rho:       1       Gold=1         Metal Thickness, T:       .7       I         Metal Roughness, R:       .0125       I         Units Factor, U:       .0254       mm=1         Substrate Height, H:       40       I	
Comment: FR-4 From File Save File OK	Then click <b>OK</b> to covert all lines to physical lines (see schematic below).

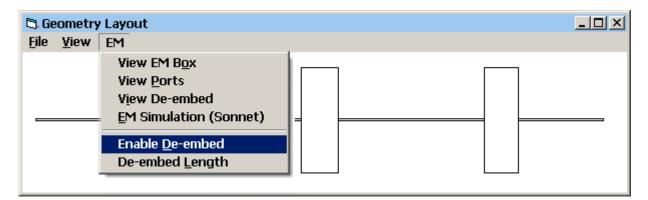
3



The resulting schematic is converted to all physical T-lines. Click **Layout** to see the layout geometry (below).

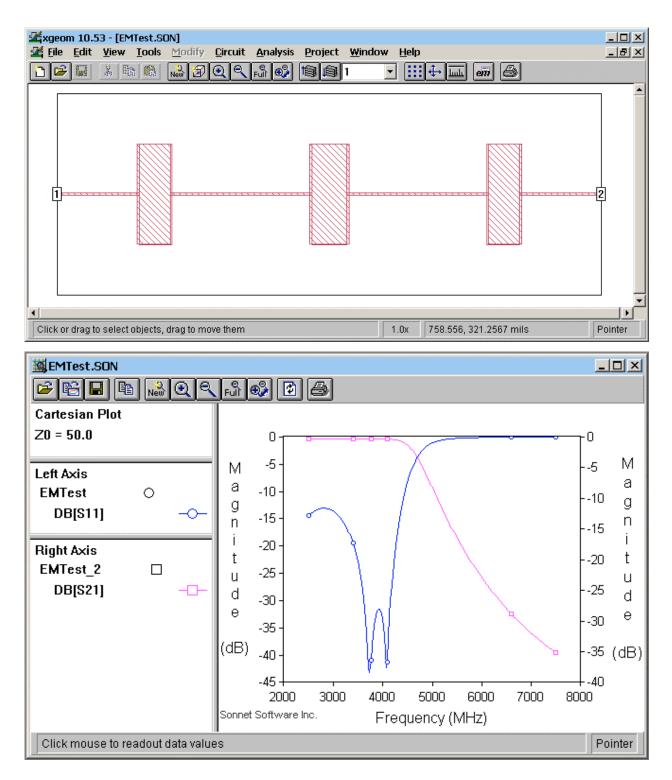


For this example, remove the de-embedding option by un-checking **De-embed Enabled** from the EM menu as shown below. Then select **EM Simulation (Sonnet)** from the EM menu.



When EM Simulation (Sonnet) is selected, the file EMTest.SON is created and automatically exported to the Sonnet<sup>®</sup> xgeom project editor ready for analysis. The EM box, metal and substrate layers and frequency parameters are already loaded. The layout in Sonnet<sup>®</sup> is shown below.

Simply select **Analyze** from the Sonnet<sup>®</sup> project menu to run the simulation. When the simulation is complete, select **Project** | **View Response** | **New Graph** to get the response plots shown below.



The plot of S21 shows that the filter response is lowpass with a cutoff frequency slightly ahead of the 5000 MHz design goal. The insertion loss in the passband ranges between 0.3 and 0.4 dB, which is very close to the 0.15 dB passband ripple specified.

This filter example ran in a Sonnet<sup>®</sup> simulation using only 6 Mbytes of memory, which means that it would be able to run in all versions of Sonnet, including Sonnet Lite<sup>®</sup>.

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