

Interconnects_Design_Flow

Where To Find This Example

Select **Help > Open Examples...** from the menus and type either the example name listed above or one of the keywords at the bottom of this page.

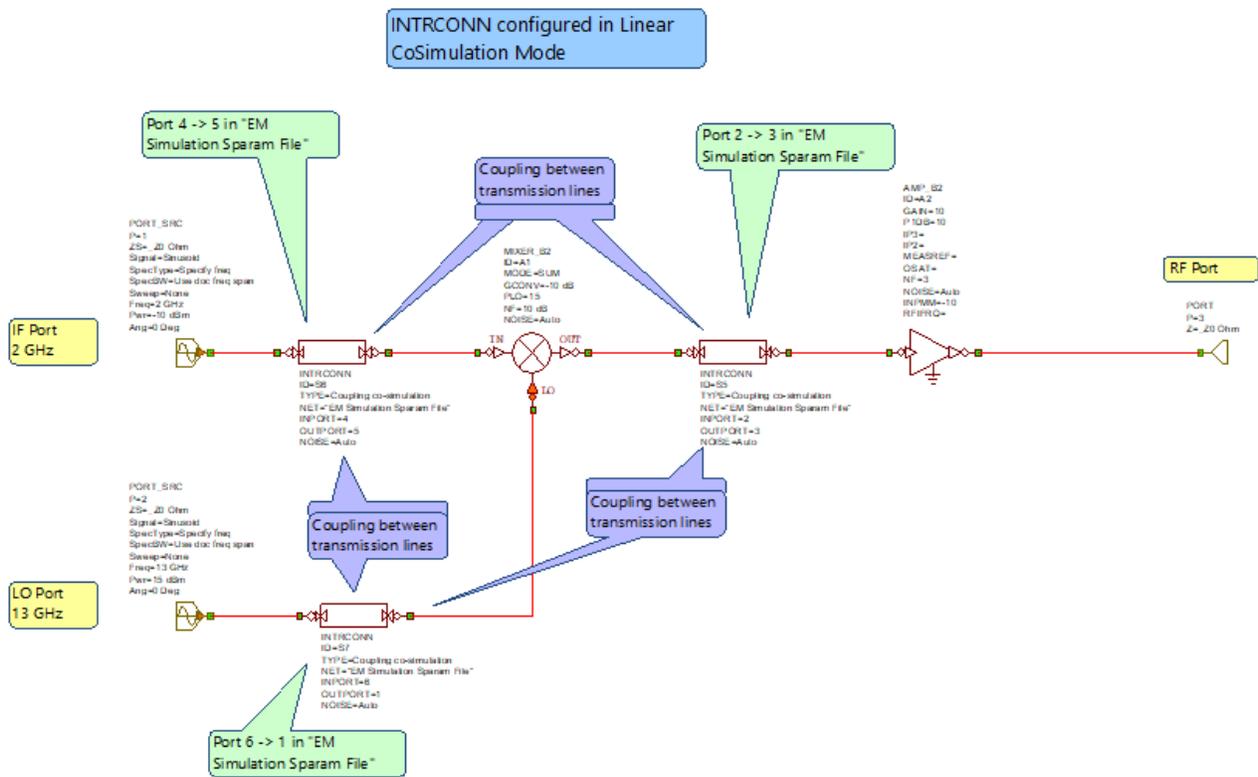
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Open Install Example

Design Notes

VSS INTRCONN Design Flow

This example demonstrates a design flow for modelling the effects of printed circuit board traces when using VSS system analysis. Transmission line effects include line loss, impedance mismatch and coupling between two or more transmission lines. This example consists of an RF chain comprised of a mixer and an amplifier separated by transmission lines.



In the system diagram, the PCB traces are modelled using the INTRCONN block. The INTRCONN block can be configured in several different modes to enable a design flow methodology as more information and refinement is gathered regarding the PCB traces. In this example, the design flow is outlined by the individual folders under "User Folders" in the project tree.

1. Attenuation Mode

At early stages of design, before the layout is known, the PCB trace losses can be estimated using INTRCONN blocks with Type = Attenuator as demonstrated in "Atten_Mode_Sys Diagram".

IF Transmission Line Loss Equations

IF Length Inches = 1.2
 IF Loss dB per Inch = 1
 IF Freqs GHz = (0, 5)
 IF Loss dB = (0.1F Loss dB per Inch/IF Length Inches)

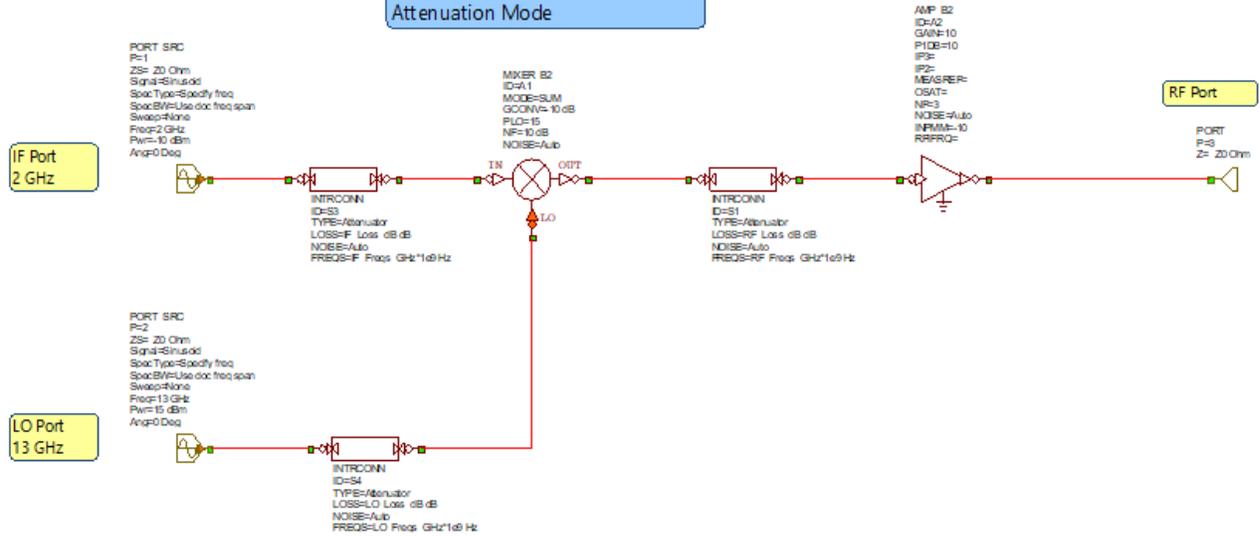
RF Transmission Line Loss Equations

RF Length Inches = 0.8
 RF Loss dB per Inch = 1
 RF Freqs GHz = (0, 15)
 RF Loss dB = (0.08F Loss dB per Inch/RF Length Inches)

LO Transmission Line Loss Equations

LO Length Inches = 0.9
 LO Loss dB per Inch = 1
 LO Freqs GHz = (0, 15)
 LO Loss dB = (0.09L Loss dB per Inch/LO Length Inches)

INTRCONN configured in Attenuation Mode

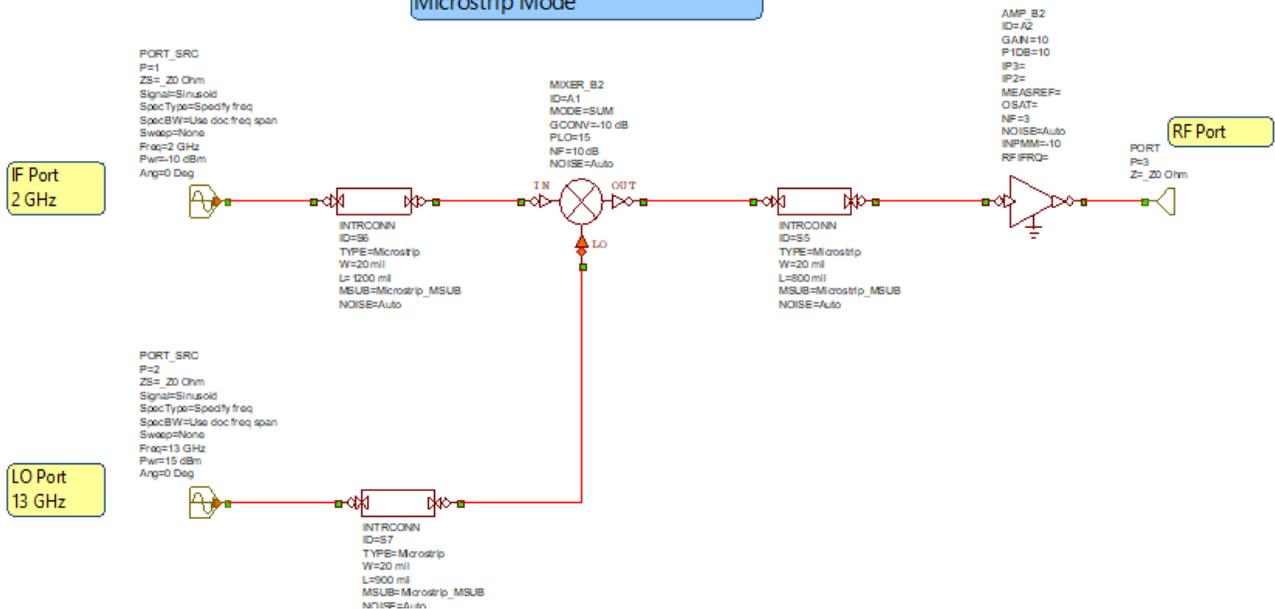


In this mode, INTRCONN is equivalent to the RFATTEN VSS block. Equations for frequency dependent loss can be written.

2. Microstrip Line Mode

The next step in the design flow may include using Microstrip or Transmission line models. Change INTRCONN Type = Microstrip or Transmission Line. In "Microstrip_Mode_Sys_Diagram." TYPE is set to Microstrip.

INTRCONN configured in Microstrip Mode

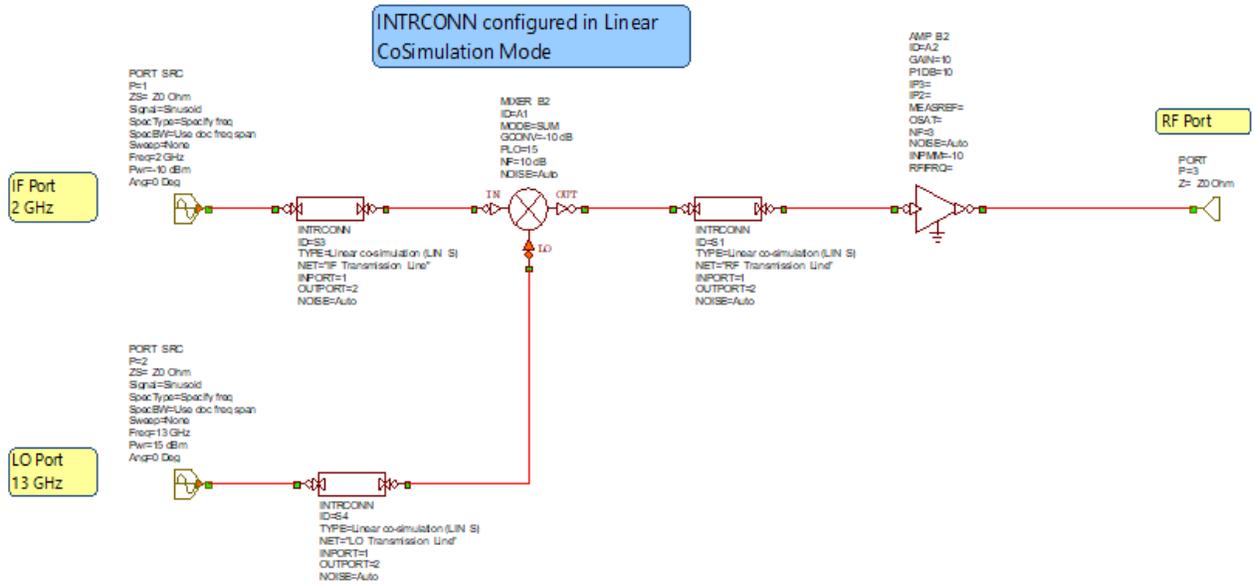


In this mode, INTRCONN is equivalent to the MWO MLIN element. The Microstrip substrate definition uses the parameter MSUB in the INTRCONN block. For this example, the MSUB substrate element is in the Global Definitions.

Alternatively, INTRCONN Type can be set to Transmission Line. In this mode, the INTRCONN is equivalent to the MWO TLIN element.

3. Linear CoSimulation Mode

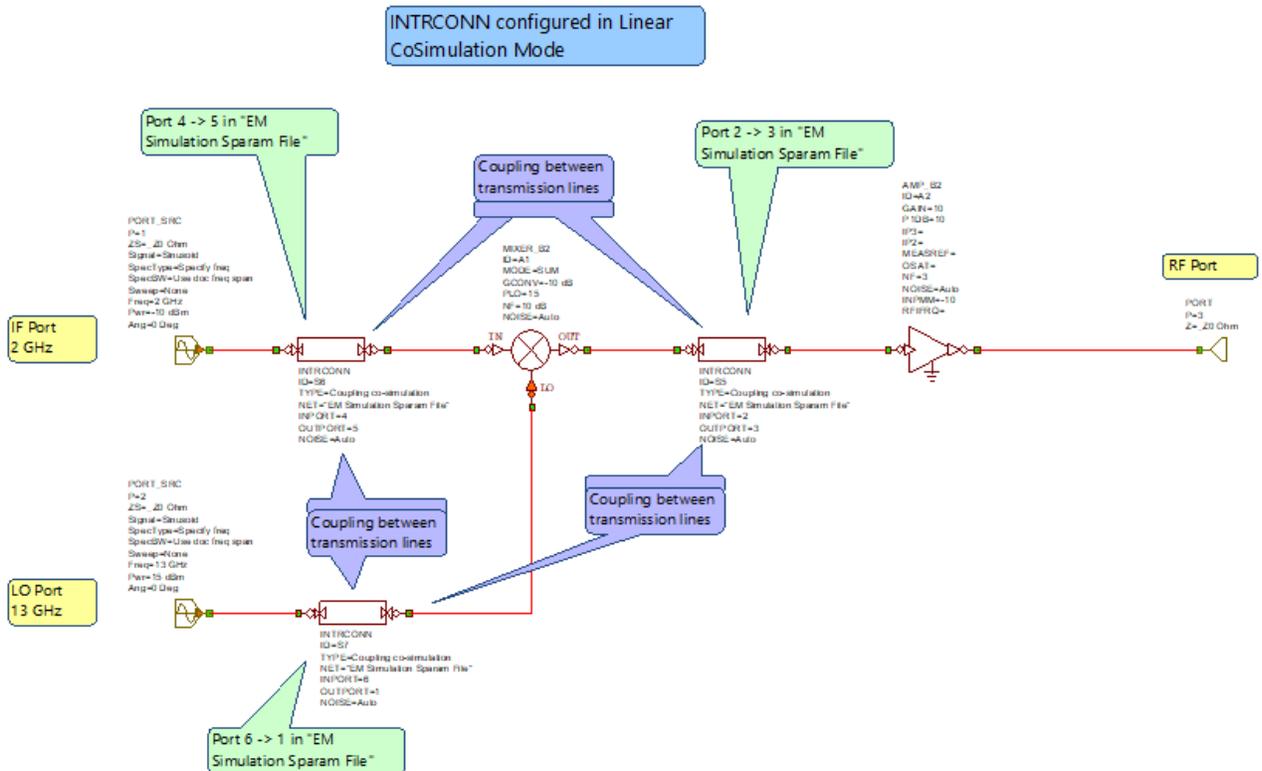
Further refinement may be to replace the microstrip MLIN model with more elaborate PCB trace models that may include bends, step in width, vias, stripline, etc. "Linear_CoSim_Mode_Sys_Diagram" shows the INTRCONN blocks set to Type = Linear co-simulation (LIN_S).



This mode is equivalent to the LIN_S VSS block where MWO co-simulation using Circuit Schematics or Touchstone data files is used. In this example, INTRCONN is referencing the circuit schematics "IF_Transmission_Line", "LO_Transmission_Line", and "RF_Transmission_Line".

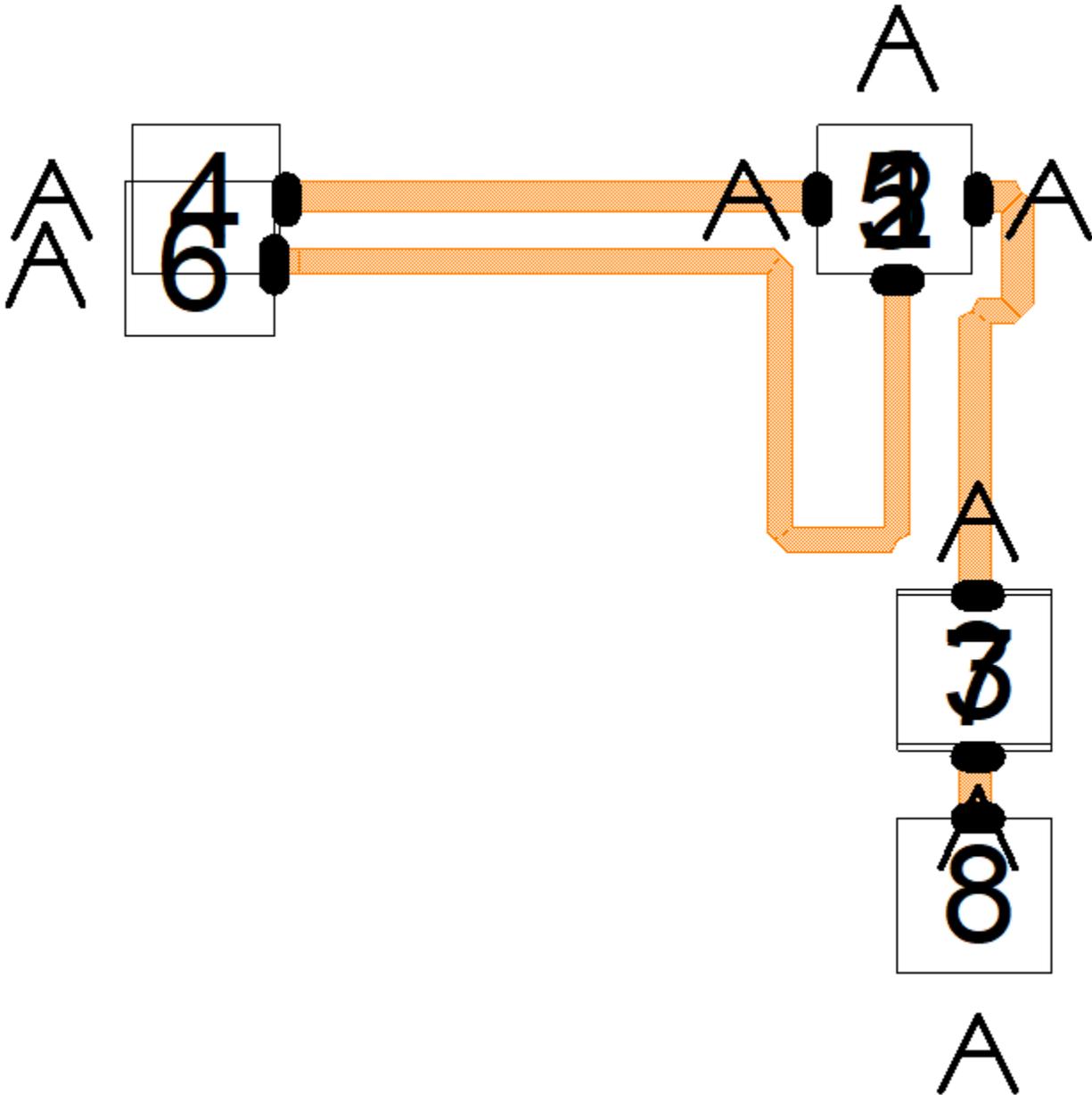
4. Coupling CoSimulation Mode

The final step in the design flow is to add coupling effects of adjacent traces. In "Coupling_CoSim_Mode_Sys_Diagram" the INTRCONN blocks are set to Type = Coupling co-simulation.



In this case, INTRCONN NET parameter points to the Touchstone data file EM Simulation Sparam File. This data file was generated from an EM simulation of the layout shown in schematic "Circuit Layout" (display the layout view of this schematic)

EM Extraction of the traces leads the EM Structure, "EM_Circuit_Layout"



Results of the EM simulation of this structure can be stored as a Touchstone formatted data file which in this case is "EM Simulation Sparam File". The port numbers in the EM Structure correspond to the port numbers in the Touchstone data file. The INPORT and OUTPORT parameters for the INTRCONN block point to these port numbers. Now coupling between all traces are included in the simulation.

5. Comparison

Spectrum Compare shows the RFI spectrum between Linear CoSimulation Mode and Coupling CoSimulation Mode. The coupling effects from IF to RF and LO to RF are apparent.

- DB(|RFI_PWR_SPEC(PORT_3,PORT_1,1,0,0,0,0)|) (dBm)
Coupling_CoSim_Mode_Sys_Diagram
- DB(|RFI_PWR_SPEC(PORT_3,PORT_1,1,0,0,0,0)|) (dBm)
Linear_CoSim_Mode_Sys_Diagram

