General info for all the EE4C0 RF Track assignments

For your design you can choose between the following technologies:

1. **Rogers 3200 substrate series**

   The specifications you have to use in the ADS substrate definition are listed below.

Typical Values

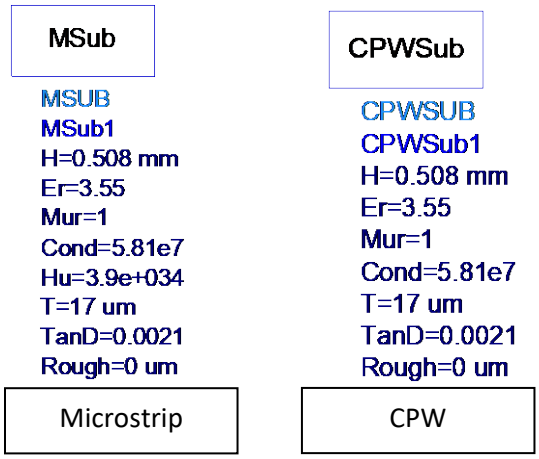
PROPERTY	TYPICAL VALUE		
	RO3203	RO3206	RO3210
Dielectric Constant, ε_r	3.02±0.040(1)	6.15± 0.15	10.2±0.50
Dissipation Factor, tan δ	0.0016	0.0027	0.0027

   Metal layers= Copper (two metals, top and bottom)
   Copper conductivity 5.8 e7 S/m
   Metal thickness=1 oz. (35 um, each metal layer)
   min line width 80um, minimum line gap 80um, minimum via hole 200um

Depending on your design you will be able to choose among the following board thicknesses.

STANDARD THICKNESS:	
RO3203:	**RO3206/RO3210:**
0.010" (0.254mm)	0.025" (0.635mm)
0.020" (0.508mm)	0.050" (1.270mm)
0.030" (0.762mm)	
0.060" (1.524mm)	

ADS substrate model example:

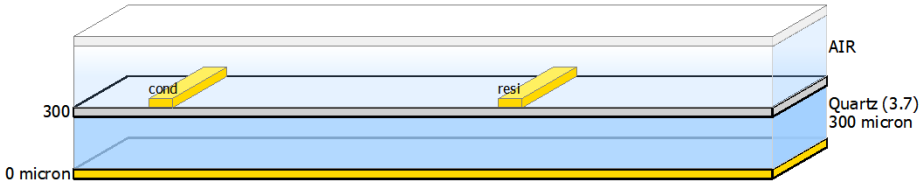


2. **Nikon Fused Silica**

   ε_r=3.7
   tan(δ)=1e-4 @ 1 MHz
   Metal layers= Aluminum (two metals, top and bottom)

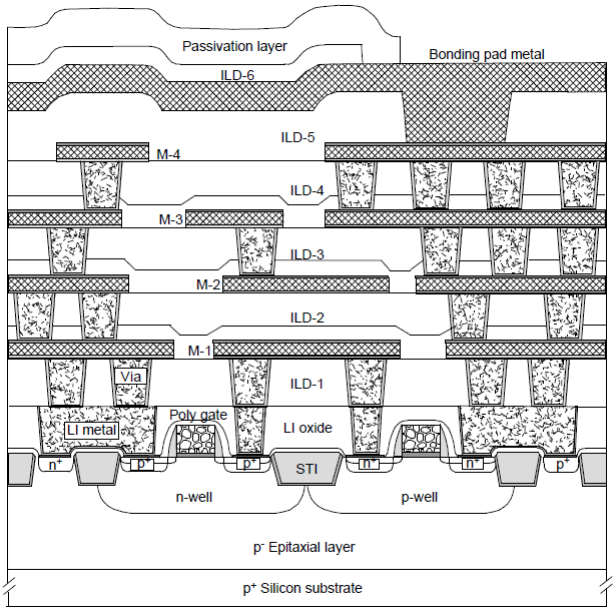
Metal thickness= (4 um, each metal layer)
min line width 1um, minimum line gap 5um, no via hole possible
Substrate thickness 200um or 300um.
Aluminum conductivity 3.7 e7 S/m
Eventual layer for integrated resistor: 6.5e5 S/m layer thickness 100nm

The R layer can be mapped in Momentum as a parallel layer to the Aluminum

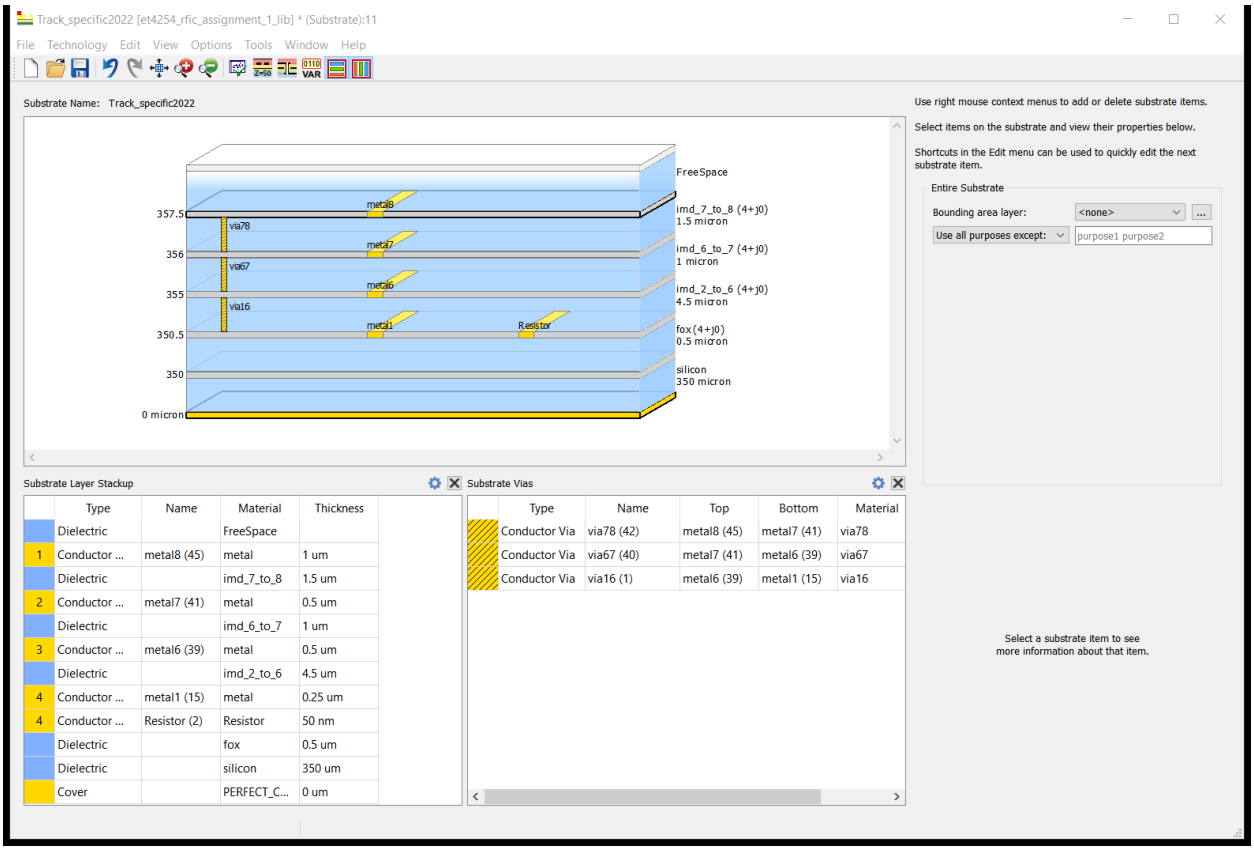


3. **IC technology**

Silicon (semiconductor) substrate with multiple metal layers back end (metallization lines). For the project you will only map in the substrate 4 metal layers (for simulation time reasons).



The Momentum substrate will be mapped as follows.



	Type	Name	Material	Thickness
	Dielectric		FreeSpace	
1	Conductor ...	metal8 (45)	metal	1 um
	Dielectric		imd_7_to_8	1.5 um
2	Conductor ...	metal7 (41)	metal	0.5 um
	Dielectric		imd_6_to_7	1 um
3	Conductor ...	metal6 (39)	metal	0.5 um
	Dielectric		imd_2_to_6	4.5 um
4	Conductor ...	metal1 (15)	metal	0.25 um
4	Conductor ...	Resistor (2)	Resistor	50 nm
	Dielectric		fox	0.5 um
	Dielectric		silicon	350 um
	Cover		PERFECT_C...	0 um

Type	Name	Top	Bottom	Material
Conductor Via	via78 (42)	metal8 (45)	metal7 (41)	via78
Conductor Via	via67 (40)	metal7 (41)	metal6 (39)	via67
Conductor Via	via16 (1)	metal6 (39)	metal1 (15)	via16

Note1: please use sheet metals definition in Momentum to reduce simulation times

Note2: the names of the layer are not important what is important is the proper electrical definition

Material Thickness:

Resistor: 50nm

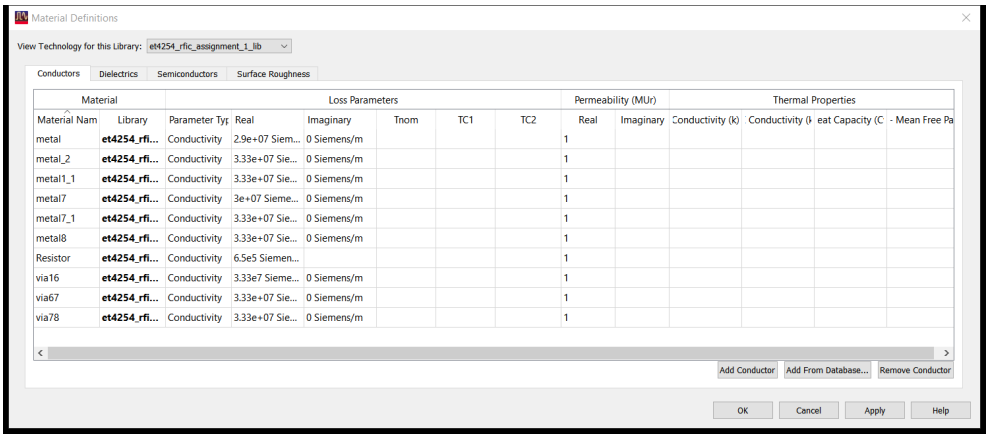
Metal1: 0.25um

Metal6: 0.5um

Metal7: 0.5um

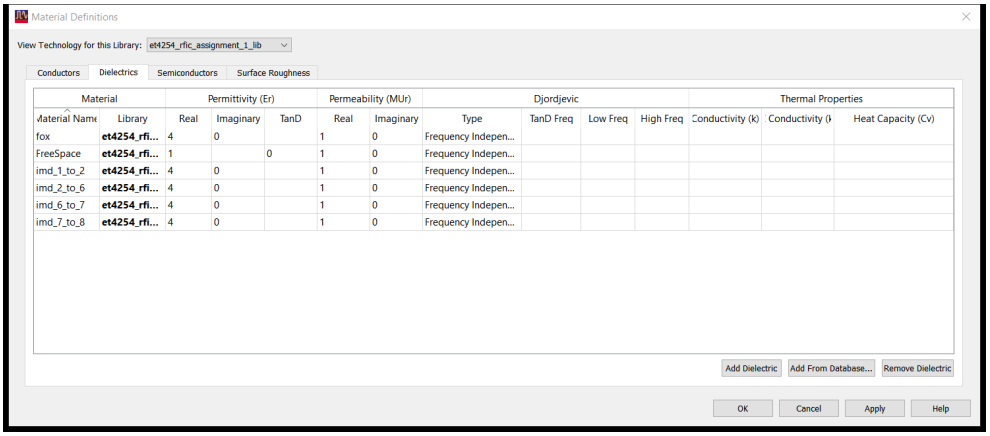
Metal8: 1um

Electrical Parameters Metals:

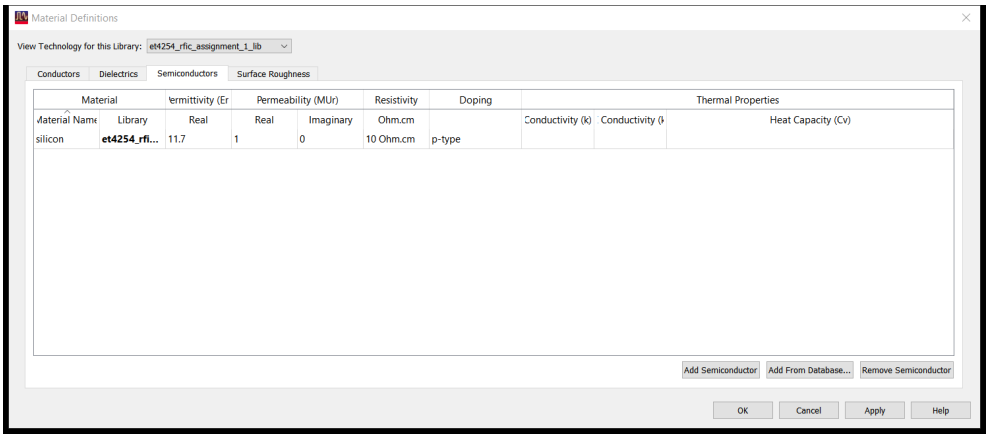


Material		Loss Parameters						Permeability (MUr)		Thermal Properties			
Material Nam	Library	Parameter Typ	Real	Imaginary	Tnom	TC1	TC2	Real	Imaginary	Conductivity (k)	Conductivity (k	eat Capacity (C	- Mean Free Pa
metal	et4254_rfi...	Conductivity	2.9e+07 Siem...	0 Siemens/m				1					
metal_2	et4254_rfi...	Conductivity	3.33e+07 Sie...	0 Siemens/m				1					
metal1_1	et4254_rfi...	Conductivity	3.33e+07 Sie...	0 Siemens/m				1					
metal7	et4254_rfi...	Conductivity	3e+07 Sieme...	0 Siemens/m				1					
metal7_1	et4254_rfi...	Conductivity	3.33e+07 Sie...	0 Siemens/m				1					
metal8	et4254_rfi...	Conductivity	3.33e+07 Sie...	0 Siemens/m				1					
Resistor	et4254_rfi...	Conductivity	6.5e5 Siemen...					1					
via16	et4254_rfi...	Conductivity	3.33e7 Sieme...	0 Siemens/m				1					
via67	et4254_rfi...	Conductivity	3.33e+07 Sie...	0 Siemens/m				1					
via78	et4254_rfi...	Conductivity	3.33e+07 Sie...	0 Siemens/m				1					

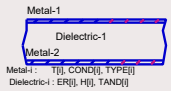
Electrical Parameters Dielectrics:



Electrical Parameters Semiconductor:



ADS schematic multilayer definition:




```
MLSUBSTRATE5
Subst2
 Er[1]=4              Er[4]=4
H[1]=1.5 um         H[4]=350 um
TanD[1]=0          TanD[4]=Convert from silicon R into Tand at f0
 T[1]=1 um           T[4]=0.25 um
Cond[1]=2.9e7      Cond[4]=2.9e7
 Er[2]=4              T[5]=0 um
 H[2]=1 um          Cond[5]=1.0E+50
TanD[2]=0       LayerName[1]="metal8:drawing"
T[2]=0.5 um     LayerName[2]="metal7:drawing"
Cond[2]=2.9e7   LayerName[3]="metal6:drawing"
 Er[3]=4          LayerName[4]="metal1:drawing"
H[3]=4.5 um          Rough=0 um
TanD[3]=0             Bbase=
T[3]=0.5 um           Dpeaks=
Cond[3]=2.9e7
```

Note1: the [1] metal in this model definition corresponds to M8, the model starts from the top metal and then defines the dielectric below.

SMT Resistors:

Allowed resistor values:

Since the resistors in a real board have to be chosen from real surface mount device (SMD) resistors, you can only use values of real resistors. Note you can use them in series/parallel combination to adapt to your needs.

The values for conventional technologies are listed below.

Resistor Values (Ohms)

0	2.4	5.6	13	33	75	180	430	1K	2.4K	5.6K
1.0	2.7	6.2	15	36	82	200	470	1.1K	2.7K	6.2K
1.2	3.0	6.8	16	39	91	220	510	1.2K	3.0K	6.8K
1.3	3.3	7.5	18	43	100	240	560	1.3K	3.3K	7.5K
1.5	3.6	8.2	20	47	110	270	620	1.5K	3.6K	8.2K
1.6	3.9	9.1	22	51	120	300	680	1.6K	3.9K	9.1K
1.8	4.3	10	24	56	130	330	750	1.8K	4.3K	10.0K
2.0	4.7	11	27	62	150	360	820	2.0K	4.7K	
2.2	5.1	12	30	68	160	390	910	2.2K	5.1K	

Resistor models:

When using the resistors in the design, you can choose between two case size (dimension of the package of the SMD resistor) 0402 and 0603. Once you choose one use the model for the resistor with the correct values for L and C shown in the table.

CASE SIZE	LENGTH (inch/ mm)	WIDTH (inch/ mm)	MODEL INTERNAL COEFFICIENTS	
			C (pF)	L (nH)
0402	0.04/ 1.02	0.02/ 0.51	0.0262	1.89×10^{-3}
0603	0.064/ 1.626	0.032/ 0.813	0.0403	0.0267