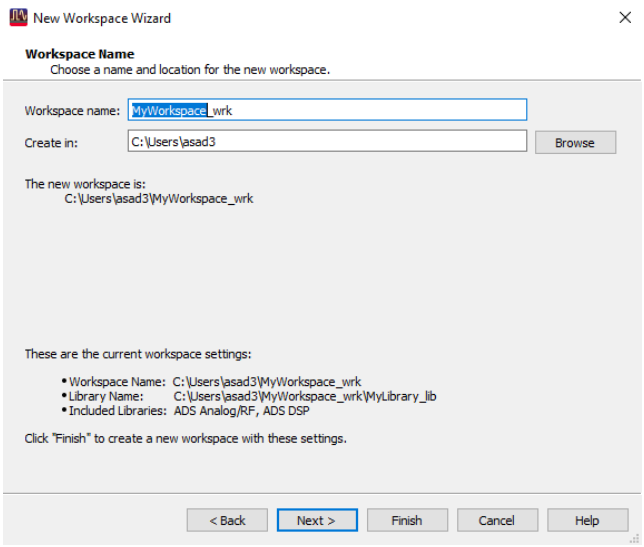
Getting Started with ADS

1. Launch ADS and from the main window select **File → New → Workspace**. Click **Next**…

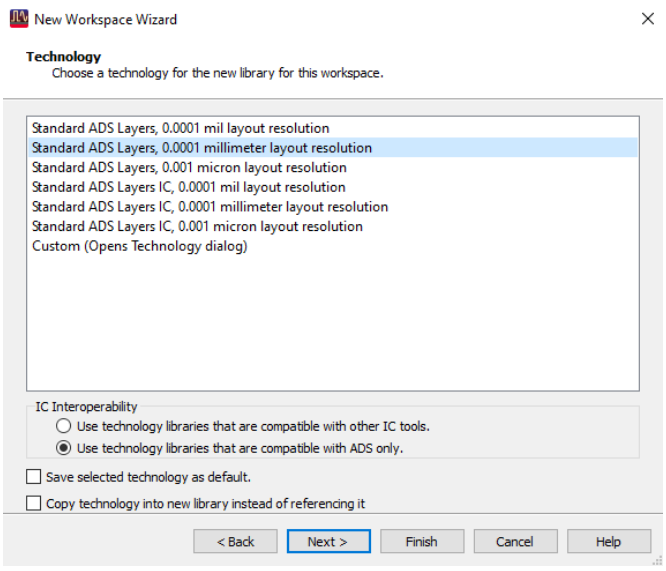
2. Enter workspace name as desired, please note that workspace name and path to the workspace location should not contain any spaces. Click **Next**…



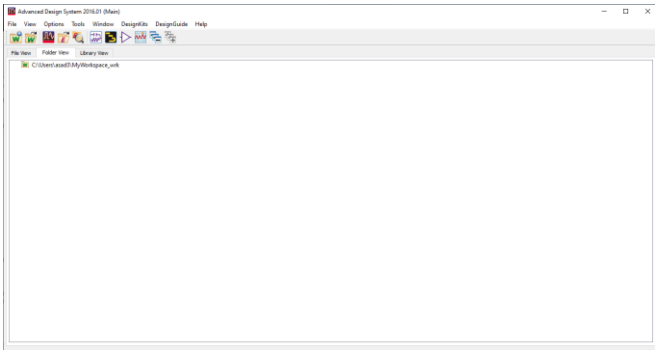
3. Select the libraries to be included in the workspace. In present example click **Next** without any change…

4. Provide the library name under which user would like to organize the work. In present example click **Next** without any change…

5. Select the preferred units to be used during the design. In present example we select **millimeter** with **0.0001 millimeter layout resolution**. Click **Next**…



6. See the summary of the workspace and click on **Finish** and blank workspace as shown in the figure will appear and we are ready to create our schematic or layout designs in the newly created workspace.



Design and Simulation of Patch Antenna

Theory:

A microstrip antenna in its simplest configuration consists of a radiating patch on one side of a dielectric substrate, which has a ground plane on the other side. The patch conductors usually made of copper or gold can be virtually assumed to be of any shape. However, conventional shapes are normally used to simplify analysis and performance prediction. The radiating elements and the feed lines are usually photo etched on the dielectric substrate. The basic configuration of a microstrip patch antenna is shown in Fig. 1.

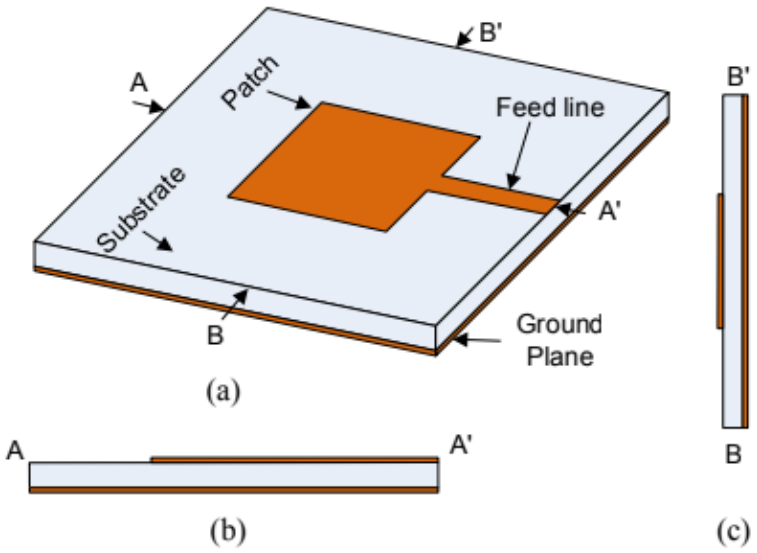


Fig. 1 Microstrip patch antenna. (a) Basic configuration. (b) Cross sectional view (AA'). (b) Cross sectional view (BB').

The radiating patch may be square, rectangular, circular elliptical or any other configuration. Square, rectangular and circular shapes are the most common because of ease of analysis and fabrication. Some of the advantages of the microstrip antennas compared to conventional microwave antennas are

- Low weight, low volume
- Low fabrication cost
- Easy mass production
- Linear and circular polarization are possible with simple feed
- Easily integrated with MIC
- Feed lines and matching networks can be fabricated simultaneously with antenna structures

Patch antennas find various applications stating from military to commercial, because of their ease of design and fabrication. Patch arrays are extensively used in phased array radar applications and in applications requiring high directivity and narrow beamwidth.

Objective:

To design a Patch antenna at 2.4 GHz and simulate the performance using ADS

Step-1: Calculating Patch Antenna Dimensions

1. Select an appropriate substrate of thickness (h) and dielectric constant (ε_r) for the design of the patch antenna. In present case, we shall use following Dielectric for design:

   a. Height: 1.6 mm
   b. Metal Thickness: 0.7 mil (Copper)
   c. ε_r: 4.6
   d. TanD: 0.001
   e. Conductivity: 5.8E7 S/m

2. Calculate the physical parameters of the patch antenna as shown in the geometry in Fig. 2 using the given formula.

   The width and length of the radiating surface is given by,

$$W = L = \frac{c}{2f\sqrt{\varepsilon_r}} = 29.2 \text{ mm}$$

   where,

   velocity of light $c = 3\times10^8$ m/s^2

   Frequency, $f = 2.4$ GHz

   Relative Permittivity $\varepsilon_r = 4.6$

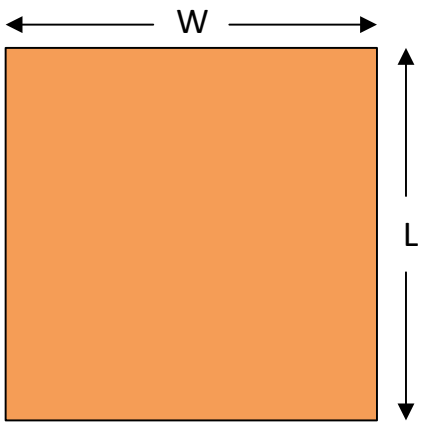


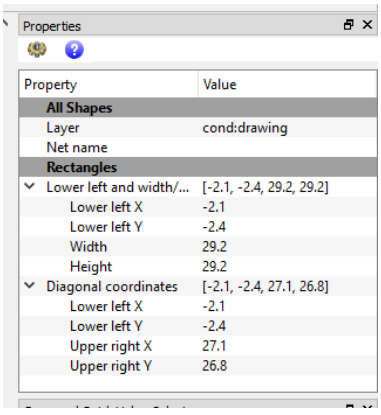
Fig. 2

Step-2: Creating Patch Antenna Geometry

1. Create a new workspace, name it as **Lab1_PatchAntenna_wrk**

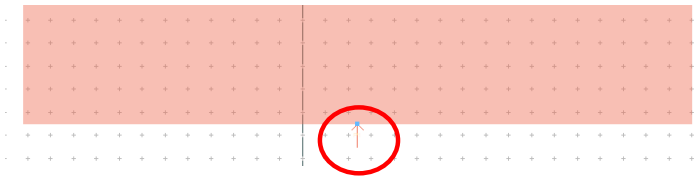
2. From the main window, select **Window → New Layout**. Open the new layout cell and name it as **Patch_Antenna**. Click **Ok** ….

3. Use **Insert → Rectangle** and draw a rectangle randomly. Click on the rectangle to select it and change the **Width** (W) and **Height** (L) from the **Properties** window as per calculation.

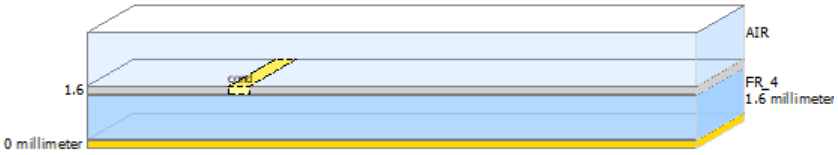


Step-3: Antenna Simulation

1. Select **Insert → Pin** and connect a pin at the center of the lower horizontal edge of the antenna as feed point.



2. Go to the **EM** setup window and click on **Substrate** and click on **New** to accept the 25 mil Alumina template. Select material by clicking on the substrate structure [left side] to change the parameters shown on the right side. If desired material name is not available in **Material** drop down list, to add new material, click on **Edit Materials** tab [right of the **Material** option] and select it from **Add from Database** list.

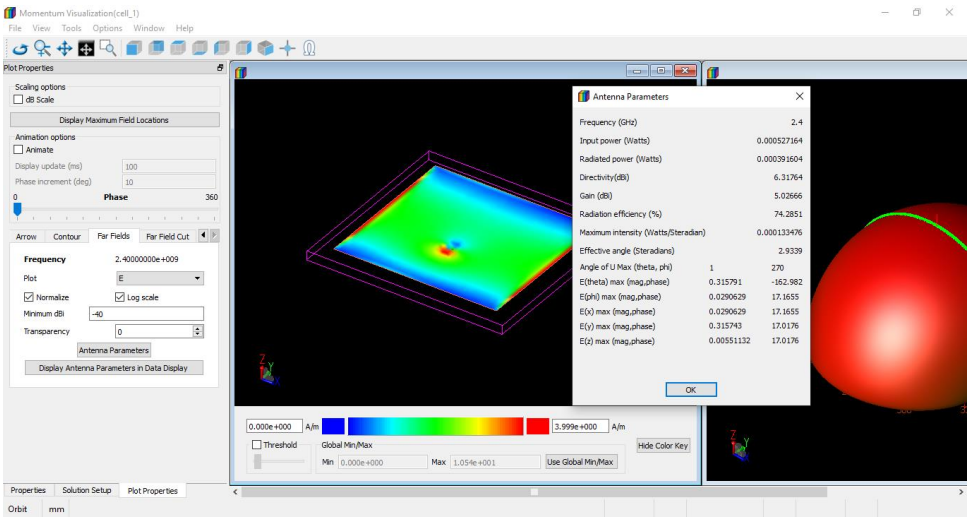


Define the substrate as below, modify the default substrate height, ε_r, TanD and conductor height and define it as Copper. Changing name of the dielectric is optional as it has no bearing on the simulation.

3. Go to the **EM** and click on **Simulation Setup**. Set the simulation frequency range as 2.1 GHz – 2.7 GHz (adaptive sweep) from **Frequency plan**. Go to **Options → Mesh**. Assign **Cells/Wavelength** value 80 and put a tick mark in **Edge mes**h option. Click on **Simulate** and wait to observe the simulation results in data display.

Step-4: Antenna Radiation Pattern

1. For Far-Field Antenna Pattern, go to **EM → Post Processing → Far Field**. Select **Solution Setup** (from the bottom tabs) and click on the desired frequency from **Frequency**. Far field computation will be done and results will be displayed in the post processing window as shown below. We can use **Window → Tile** and then go to **Plot Properties** (from the bottom tabs) and then select **Far Field → Antenna Parameters** to see all the required data.



2. To show the 2-D radiation pattern of the antenna, go to **Plot Properties → Far Field Cut** and click on the **Enable** option. Select **Phi** and click on **Display Cut in Data Display** button. Once done, we will be able to see far field cut in the regular data display.

Task:

Change the position of the input pin along positive y-axis direction keeping it in center position. Consider the following advanced position along the y-direction with respect to initial position: 2 mm, 4 mm, 6 mm, 8 mm, 10 mm, 12 mm, 14 mm.

1. Do you observe any changes in S-parameter?
2. If the answer of the 1st question is 'yes', why this kind of changes are occurred?
3. Which position is optimum for your antenna and why-explain?