

Introduction

This ULP assists within creating circular arrays of pads or circle shapes in the package editor. The pads may encompass the entire circle or a portion of it. i.e. an arc of pads.

The ULP removes much of the manual work involved when working with package elements based on circles. In most cases transcribing from the datasheet to the ULP will be sufficient. A strength of the ULP is it addresses pad numbering “up front” thus negating the otherwise onerous task of re-numbering a large number of pads later.

Fig 1 illustrates most of the abilities of the ULP. It was used 7 times to achieve this montage with all the placement and numbering being specified from within the ULP.

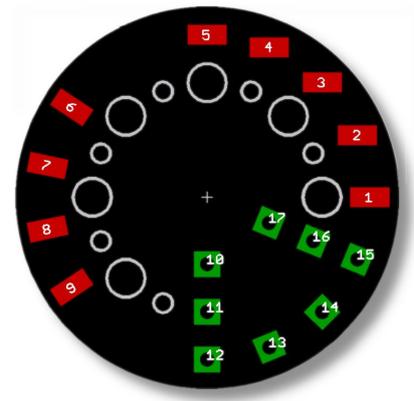


Fig 1

Features

The ULP gives you the options to:

- Layout a complete circle or part of a circle
- Draw
 - SMD pads
 - PTH pads
 - Circle shapes
- Rotate the array
- Have 'Eagle' decide what each pad is named
- Force numeric naming
 - Set the direction in which incrementing occurs. Counter Clockwise (CCW) or Clockwise (CW)
 - Set the starting number
 - Set the increment between successive pads
 - Set which pad the numbering starts from
- Leave each drawn pad un-rotated
- Turn On/Off Pad names
- Select the drawing layer for the circle shapes

Use

How the pads are laid out is mainly influenced by the areas

- Rotate Anchor
- Pad Numbering
- Inter-Pad Angle

Used together these areas achieve the desired result.

The other options within the ULP are self-evident and won't be explained here.

Rotate Anchor

“Rotate Anchor” rotates the array as a whole from the default state.

By default the circular array is created with the first pad in the 3 o'clock position. **Fig 2(a)**. Here we will call it the “Anchor” pad or pad “1” as depicted in the images on each tab page in the ULP.

For values entered into the 'Degrees (A)' field, the rotation is CCW for positive numbers or CW for negative numbers.

If you rotate the "Anchor" + 90°, pad "1" is now in the 12 o'clock position and all the other pads have also advanced 90°. **Fig 2(c)**.

"Rotate Anchor is the way to get the array rotated to achieve the pad positioning you desire.

Example 1:

Suppose you wish to have a 5 pad circle array orientated so there is a pad at the 12 o'clock position.

Fig 2 (b) or (c). By default there will not be one there. The closest one will be pad "2", off by 18 degrees. See **Fig 2(a)**

There are two ways to correct this.

- Rotate the 'Anchor' (18° here) to cause the nearest pad (pad "2") to be at 12 o'clock **Fig 2(b)**
- Rotate the 'Anchor' (pad "1") 90° to place the 'Anchor' pad at 12 o'clock. **Fig 2(c)**

The second option is the easiest as you do not have to first calculate the angle needed as you would with the first option.

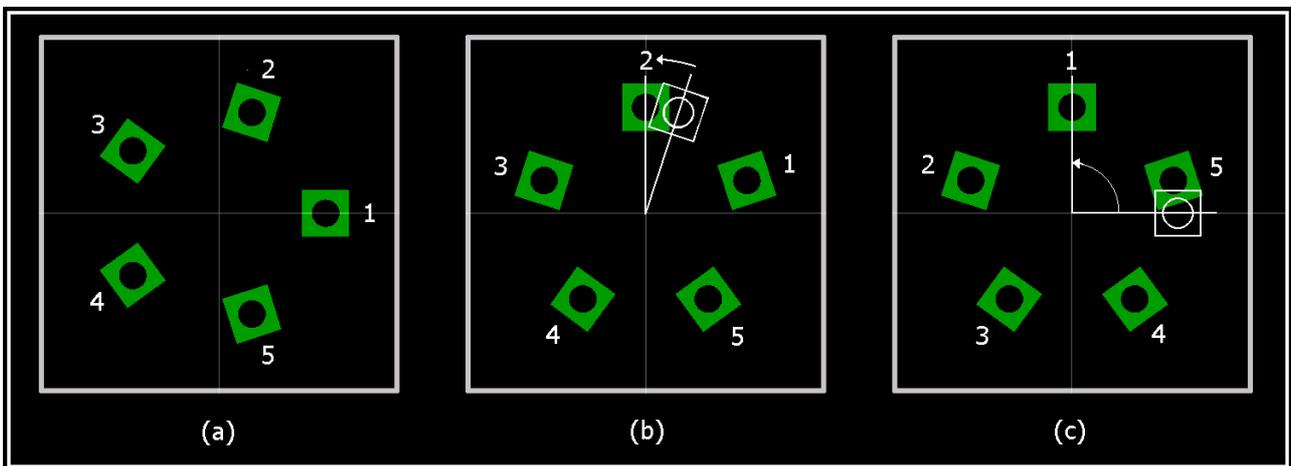


Fig 2

Note: The resulting pad numbering will be different dependant on the method used.

Further control of the pad numbering is addressed in the "Pad Numbering" group. You need to take into this group an understanding of where pad"1" is located based on any anchor rotation you will apply.

Pad Numbering

To apply your numbering to the naming of the pads, the check box "Number Pads" must be ticked **Fig 3**. Without this, the pad naming will be as determined by Eagle.

The possible selections are self-evident but some additional words will assist.

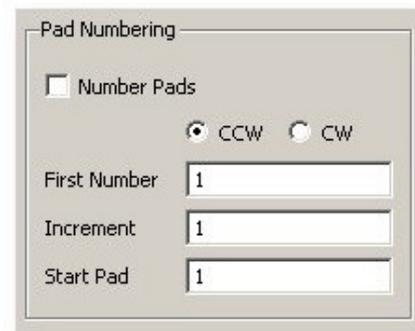


Fig 3

First Num

Usually this will be “1” but with some package designs you will need to run the ULP twice, or more, and you cannot use the same numbers twice. If you were to draw two circles of, say, 8 pads.

- On the first pass: “First Num” would be set to 1 (for pads 1-8),
- On the second pass: “First Num” would be set to 9 (for pads 9-16).

Increment

“Increment” works hand in hand with “First Num” and is best explained with an example consisting of two concentric circles. We want the inner pads to be odd numbered and the outer circle of pads to be even numbered. **Fig 4** shows one quadrant of the result.

We use an increment of 2 and adjust the first number appropriately.

Inner Circle (First Pass)

- First Num = 1
- Increment = 2 - (pads are named 1, 3, 5 etc.)
- Start Pad = 1

Outer Circle (Second Pass)

- First Num = 2
- Increment = 2 - (pads are named 2, 4, 6 etc.)
- Start Pad = 1

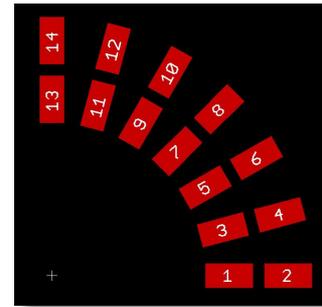


Fig 4

Note: To create the second outer circle of pads, correctly numbered, we only needed to change 2 values the second time we ran the ULP.

- ▶ Radius
- First Num

Start Pad

The “Start Pad” entry is why we need to remember where the “Rotate Anchor” action will leave the default pad “1”.

By knowing this you can identify the default pad number your numbering should start from once the pads have been rotated to the desired position.

Example 2

The TO-99 requires 8 equally spaced pads and the ULP will, by default, place them as per **Fig 5b**.

We don’t need to specify any rotation this time, as there are pads on the cardinal points, which matches our need.

The datasheet reveals we need pin 1 to be where pin 4 defaults to so we enter 4 into the “Start Pad” field as that pad should be named “1”. The direction CCW takes care of the where successive numbers are assigned. The resulting final numbering is shown in **Fig 5c**

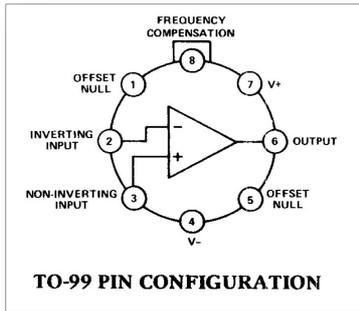


Fig 5a

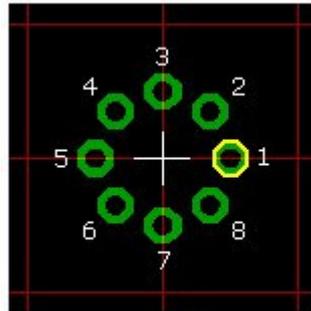


Fig 5b



Fig 5c

The yellow highlighting on pad “1” is to illustrate that the pad does not move. This time the naming changed.

In this simple CCW example an alternative method is to rotate pin 1 into position with “Rotate Anchor (135°)”. The result would be the same.

To illustrate the use of “Rotate Anchor” and “Pad Numbering” being used together, the same result can also be achieved by rotating the anchor 225° and selecting the start pin to be “7”.

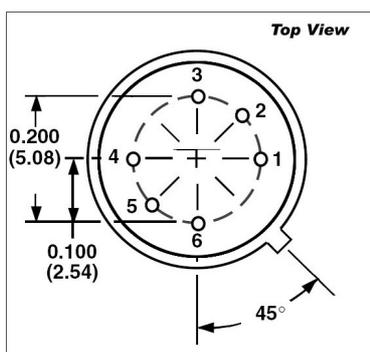
The rule: Get the pads placed correctly and then address their numbering.

Inter-Pad Angle

This important group determines whether the number of pads you draw are evenly distributed around 360° or whether you wish to specify the inter-pad angle. An ARC of pads can be effectively drawn when specifying the “Inter-Pad Angle” because you have normally drawn all the pads before all 360 degrees have been used up.

Example 3

(An arc of 3 pads - twice)



From the data sheet **Fig 6a** you can see the pad requirements are 2 sets of 3 pads with inter-pad angles of 45°.

While you could simply make 8 pads and delete the 2 unwanted ones, you would be left with renaming pads 5-7 as 4-6. Something this ULP was created to avoid. The approach here is to run the ULP twice.

Drawing pads 1-3 is a simple as it gets. Essentially the default arrangement.

Fig 6a

- ▶ Enter the Radius
- Set “Number of Pads” = 3
- Select “Custom Angle” and set it to = 45°
- Check the “Number Pads” check box so all the items (■) within the group have effect.
- Select “CCW” for the pin numbering direction
- “First Num” = 1
- “Increment” = 1
- “Start Pad” = 1
- “Rotate Array” = None (0°)

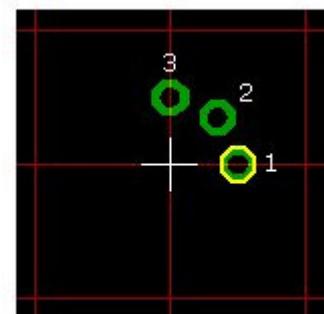


Fig 6b

Fig 6b shows the 3 pads drawn at this point.

Run the ULP a second time. Your previous settings have been retained so it's only a matter of making 2 changes to get pads 4-6 drawn.

In the "Pad Numbering" box:

- "First Num" = 4

If that were all we did, pads 4-6 would be placed on top of pads 1-3. Remember, the first pad is placed in the 3 o'clock position. Eagle won't permit a pad to be placed exactly on top of another.

We need to rotate these next 3 pads into their correct position, which in this case is 180° CCW (CW would also work in this case also).

In the "Rotate Array" box:

- Set "Degrees (A)" = 180°

The yellow highlighting in **Fig 6c** shows the array rotation of 180° CCW for the three pads which have been 'named' 4-6.

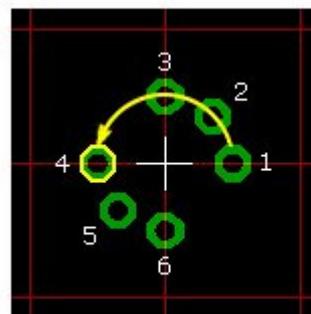


Fig 6c

Summary

Building arcs of pads is the process of specifying:

- The number of pads
- The angle between the pads
- The amount of rotation and direction for the pad arc, from the default 3 o'clock position

Numbering the pads requires

- Specifying the starting number
- Specifying the starting pad from the default numbering (1....n)
- Specify the direction of the numbering, CW or CCW.

Use considerations

Trial and error

Initially there may be a measure of trial and error getting the numbering correct.

You may find it convenient to provide the Package Editor with a Text Menu button to run this ULP rather than repeatedly digging it out from the command line.

Tab

If you use the TAB key to move around each page it will move in an order that should assist you with your approach to filling the fields.

Circle Shape Drawing Layers

A selection of the most likely layers to be required is provided from the combo box on the "Circles" tab. For the open library, the used layers are first determined and then the some are hidden.

You may change the hidden list by altering the ULP variable 'NotLayer[]'

Wire Widths

A selection of common wire widths has been provided. Many of these are sizes that successfully convert between "mm" and "mil". Should you require other sizes add them to the ULP.

They are entered in "mm" in the variable 'WireWidths[]'

User Settings

On first use the ULP will start with some default settings. Within the current Eagle session, subsequent use of the ULP will cause your most recently used values to be restored as the ULP saves your settings in a file. This negates the need to re-enter all you settings should you and need to run the ULP a second time.

This setting file will be deleted when you close Eagle.

You can modify the ULP so that it never deletes this file once created. Search the ULP for (SaveFile,"wtD") and change it to (SaveFile,"wt")

Display Pad Names

The ULP will set or un-set the display of pad names as determined by the use of the "Display Pad Names" check box. Accordingly the setting will be left as set by the last use of the ULP and not returned to the setting in place prior to the use of the ULP.

To manually change the Eagle setting, go to
 OPTIONS | SET | MISC | Display Pad Names
Or in the command line
 SET PAD_NAMES OFF(or ON);
Followed by F2 to refresh the screen.

Known Issues

Units

The value fields are converted as you change between measurement "Units". This enables you to mix measurements if needed when datasheets mix the values they provide. Due to the issues mentioned below, staying with one measurement unit is advised.

There are known issues when using the edit boxes (input fields) of the ULP language.

When changing between measurement units you may observe a loss of precision. 5mm becomes 196.85mil which later displays as 4.99999mm

When 4.99999 is passed through to the drawing it is rounded by Eagle back to 5mm again and so has no impact.

Acknowledgements

Analog Devices: Datasheet images.

History

Version	Date	Comment
1.0	6 July 2010	Initial Release (created in v4)
1.1	1 March 2011	ULP changes to correct v5 issues Replaced Fig.3 to reflect new look