cadence™

Virtuoso® Fluid Guard Ring Frequently Asked Questions

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Preface

The Virtuoso® Layout Suite L (Layout L) provides an innovative infrastructure with capabilities to create and implement layout designs. One of the important offerings of Layout L includes a menu-driven programmable feature for installing, creating, and editing fluid guard ring (FGR) devices, which are a type of fluid Pcells.

This user guide covers information about how to create and manage FGR devices. For information about how to use the Layout L tool, refer to the *Virtuoso Layout Suite L User Guide*.

You can also refer to the *Virtuoso Fluid Guard Ring Frequently Asked Questions* manual.

This user guide is aimed at developers and designers of integrated circuits who want to harness the usability and productivity benefits of FGR devices in Layout L. It assumes that you are familiar with:

- Virtuoso design environment and application infrastructure mechanisms designed to support consistent operations between all Cadence® tools
- Applications used to design and develop integrated circuits in the Virtuoso design environment, notably Virtuoso Layout Suite and Virtuoso Schematic Editor
- Design and use of parameterized cells
- OpenAccess version 2.2 technology file
- Component description format (CDF)

Virtuoso automatically loads a set of implementation files (`vfo*.ils`) at the time of initialization. These files provide the Virtuoso Fluid Object (VFO) infrastructure that enables you to install, create, and edit ***VLS-based FGRs*** as described in this user guide.

In addition, Virtuoso allows you to work with ***customized FGRs*** developed using the VFO infrastructure that adheres to the added or modified user-defined capabilities or features. In other words, the customized FGRs are based on capabilities that are not shipped as part of Virtuoso.

As it is difficult to ascertain the scope of customizations done by a PDK developer, which can differ from PDK to PDK, this user guide covers ***only*** the information about ***VLS-based FGRs***. The information about ***customized FGRs*** pertains only to ‘how to customize an

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FGR'. If you are using the customized FGRs and need assistance in configuring or troubleshooting, contact your PDK provider for information.

This preface contains the following topics:

- Scope
- Licensing Requirements
- Related Documentation
- Additional Learning Resources
- Customer Support
- Feedback about Documentation
- Typographic and Syntax Conventions

Scope

Unless otherwise noted, the functionality described in this guide can be used in both mature node (for example, IC6.1.8) and advanced node and methodologies (for example, ICADVM20.1) releases.

Label	Meaning
(ICADVM20.1 Only)	Features supported only in ICADVM20.1 advanced nodes and advanced methodologies releases.
(IC6.1.8 Only)	Features supported only in mature node releases.

Licensing Requirements

For using the FGR capabilities, you need to have a licensed Layout L installation.

For information about licensing in the Virtuoso design environment, see *Virtuoso Software Licensing and Configuration Guide*.

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Related Documentation

What's New and KPNS

- *Virtuoso Fluid Guard Ring What's New*.
- *Virtuoso Fluid Guard Ring Known Problems and Solutions*

Installation, Environment, and Infrastructure

- *Cadence Installation Guide*
- *Virtuoso Design Environment User Guide*
- *Virtuoso Design Environment SKILL Reference*
- *Cadence Application Infrastructure User Guide*

Technology Information

- *Virtuoso Technology Data User Guide*
- *Virtuoso Technology Data ASCII Files Reference*
- *Virtuoso Technology Data SKILL Reference*

Virtuoso Tools

- *Virtuoso Layout Suite SKILL Reference*
- *Virtuoso Layout Suite XL User Guide*
- *Virtuoso Schematic Editor L User Guide*
- *irtuoso Space-based Router User Guide*
- *Virtuoso Design Rule Driven Editing User Guide*
- *Virtuoso Relative Object Design User Guide*
- *Virtuoso Parameterized Cell Reference*
- *Design Data Translator's Reference*

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SKILL Documents

- The SKILL programming language is documented in the following manuals:
  - *Virtuoso Design Environment SKILL Reference*
  - *Cadence SKILL Language User Guide*
  - *Cadence SKILL Language Reference*
  - *Cadence SKILL Development Reference*
  - *Cadence SKILL IDE User Guide*
- SKILL access to other applications is provided in the following manuals:
  - *Virtuoso Technology Data SKILL Reference*
  - *Virtuoso Layout Suite SKILL Reference*
  - *Virtuoso Schematic Editor SKILL Reference*
  - *Cadence User Interface SKILL Reference*
  - *Cadence Interprocess Communication SKILL Reference*

Relative Object Design and Inherited Connections

- *Virtuoso Relative Object Design User Guide*
- *Virtuoso Schematic Editor L User Guide*

Application Notes

The following FGR-specific application notes that are available on the Cadence Online Support website provide some useful additional information:

- Customizing Create Guard Ring Form

  This document explains how the Create Guard Ring form can be customized using specific triggers and SKILL APIs.

- Adding and Managing CDF Parameters for Fluid Guard Rings

  The document shows how to add and update the CDF parameters and attributes that affect the geometry of a fluid guard ring instance.

- Adding User-Defined Capabilities to Fluid Guard Rings

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This document shows how to add user-defined capabilities or features to FGRs that are currently not supported using the supplied Install Guard Ring form.

- Creating Fluid SKILL Pcells

  This document explains the features of fluid SKILL Pcells.

Additional Learning Resources

Video Library

The Video Library on the Cadence Online Support website provides a comprehensive list of videos on various Cadence products.

To view a list of videos related to a specific product, you can use the *Filter Results* feature available in the pane on the left. For example, click the *Virtuoso Layout Suite* product link to view a list of videos available for the product.

You can also save your product preferences in the Product Selection form, which opens when you click the *Edit* icon located next to *My Products*.

Virtuoso Videos Book

You can access certain videos directly from Cadence Help. To learn more about this feature and to access the list of available videos, see Virtuoso Videos.

Rapid Adoption Kits

Cadence provides a number of Rapid Adoption Kits that demonstrate how to use Virtuoso applications in your design flows. These kits contain design databases and instructions on how to run the design flow.

In addition, Cadence offers the following training courses on Virtuoso fluid guard ring functionality and related Virtuoso tools:

- Virtuoso Layout Design Basics
- Virtuoso Layout Pro: T1 Environment and Basic Commands (L)
- Virtuoso Layout Pro: T2 Create and Edit Commands (L)
- Virtuoso Layout Pro: T3 Basic Commands (XL)

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- Virtuoso Connectivity-Driven Layout Transition
- Virtuoso Layout for Advanced Nodes (Advanced Nodes Only)

Cadence also offers the following training courses on the SKILL programming language, which you can use to customize, extend, and automate your design environment:

- SKILL Language Programming Introduction
- SKILL Language Programming
- Advanced SKILL Language Programming

To explore the full range of training courses provided by Cadence in your region, visit Cadence Training or write to training_enroll@cadence.com.

Note: The links in this section open in a separate web browser window when clicked in Cadence Help.

Help and Support Facilities

Virtuoso offers several built-in features to let you access help and support directly from the software.

- The Virtuoso *Help* menu provides consistent help system access across Virtuoso tools and applications. The standard Virtuoso *Help* menu lets you access the most useful help and support resources from the Cadence support and corporate websites directly from the CIW or any Virtuoso application.
- The Virtuoso Welcome Page is a self-help launch pad offering access to a host of useful knowledge resources, including quick links to content available within the Virtuoso installation as well as to other popular online content.

  The Welcome Page is displayed by default when you open Cadence Help in standalone mode from a Virtuoso installation. You can also access it at any time by selecting *Help – Virtuoso Documentation Library* from any application window, or by clicking the *Home* button on the Cadence Help toolbar (provided you have not set a custom home page).

For more information, see Getting Help in *Virtuoso Design Environment User Guide.*

Customer Support

For assistance with Cadence products:

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- Contact Cadence Customer Support

  Cadence is committed to keeping your design teams productive by providing answers to technical questions and to any queries about the latest software updates and training needs. For more information, visit https://www.cadence.com/support.

- Log on to Cadence Online Support

  Customers with a maintenance contract with Cadence can obtain the latest information about various tools at https://support.cadence.com.

Feedback about Documentation

You can contact Cadence Customer Support to open a service request if you:

- Find erroneous information in a product manual
- Cannot find in a product manual the information you are looking for
- Face an issue while accessing documentation by using Cadence Help

You can also submit feedback by using the following methods:

- In the Cadence Help window, click the *Feedback* button and follow instructions.
- On the Cadence Online Support Product Manuals page, select the required product and submit your feedback by using the *Provide Feedback* box.

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Typographic and Syntax Conventions

The following typographic and syntax conventions are used in this manual.

text	Indicates names of manuals, menu commands, buttons, and fields.
`text`	Indicates text that you must type exactly as presented. Typically used to denote command, function, routine, or argument names that must be typed literally.
`z_argument`	Indicates text that you must replace with an appropriate argument value. The prefix (in this example, *`z_`*) indicates the data type the argument can accept and must not be typed.
|	Separates a choice of options.
`{ }`	Encloses a list of choices, separated by vertical bars, from which you **must** choose one.
`[ ]`	Encloses an optional argument or a list of choices separated by vertical bars, from which you **may** choose one.
`[ ?argName` *`t_arg`* `]`	Denotes a *key argument*. The question mark and argument name must be typed as they appear in the syntax and must be followed by the required value for that argument.
`...`	Indicates that you can repeat the previous argument.
	Used with brackets to indicate that you can specify zero or more arguments.
	Used without brackets to indicate that you must specify at least one argument.
`,...`	Indicates that multiple arguments must be separated by commas.
`=>`	Indicates the values returned by a Cadence® SKILL® language function.
`/`	Separates the values that can be returned by a Cadence SKILL language function.

If a command-line or SKILL expression is too long to fit within the paragraph margins of this document, the remainder of the expression is moved to the next line and indented. In code excerpts, a backslash (\ ) indicates that the current line continues on to the next line.

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Fluid Guard Ring Frequently Asked Questions

This document contains the following frequently asked questions and answers related to fluid guard ring (FGR):

- Which technology rules are used for installing FGRs?
- Which technology rules are used for creating FGRs?
- Which technology rules are used while editing FGRs?
- How can geometry changes be avoided when existing FGRs are opened in a new Virtuoso release?
- Why do contacts at the corners of an FGR instance disappear in releases above IC6.1.5 ISR14?
- Why are the contacts inconsistently distributed in some areas when two or more FGRs are merged?
- Can an FGR device hidden from the Install Guard Ring form be re-installed?
- Can an FGR device hidden from the Create Guard Ring form be re-installed from the Install Guard Ring form?
- Is it possible to install an FGR device with implant layer enclosure value less than technology default?
- What should I do if a third party tool issues error and warning messages while using a customized FGR?
- Can I make changes to the procedure for initializing customized FGR devices?
- Is it acceptable to call the procedure for initializing customized FGR devices from a file other than libInit.il?
- Do the fields displayed on the Create Guard Ring form have corresponding prompt names?

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Advanced Nodes Only Features

- Can a newly created FGR for a FinFET device snap to the fin grids?

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Which technology rules are used for installing FGRs?

The following table lists the technology rules that are applicable during FGR installation:

Install Guard Ring Form Field	**Applicable Technology Rule(s)**
Contact Dimension	`minWidth` and `maxWidth` of Cut layer
Contact Spacing	`viaSpacing`(4 ...) `viaSpacing`(3 ...) `minSpacing(One layer)`(...)
Diffusion Over Contact(W) (Diffusion, Cut)	Maximum of `minOppExtension` rule (a, b) `minExtensionDistance`
Diffusion Over Contact(L) (Diffusion, Cut)	Minimum of `minOppExtension` rule (a, b) `minExtensionDistance`
Metal Over Contact(W) (Metal, Cut)	Maximum of `minOppExtension` rule (a, b) `minExtensionDistance`
Metal Over Contact(L) (Metal, Cut)	Minimum of `minOppExtension` rule (a, b) `minExtensionDistance`
Implant/Well Over Diffusion (Implant, Diffusion)	Maximum of `minOppExtension` rule (a, b) `minExtensionDistance`

Which technology rules are used for creating FGRs?

The following table lists the technology rules that are applicable during the creation of an FGR:

Create Guard Ring Form Field	**Applicable Technology Rule(s)**
Contact Spacing	`viaSpacing`(4 ...) `viaSpacing`(3 ...) `minSpacing(One layer`(...)
Contact Dimension	`minWidth` and `maxWidth` of Cut layer
Diffusion Over Contact (Diffusion, Cut)	`minOppExtension` rule (a, b) `minExtensionDistance`
Metal Over Contact (Metal, Cut)	`minOppExtension` rule (a, b) `minExtensionDistance`

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Implant/Well Over Diffusion (Implant, Diffusion)	Max of `minOppExtension` rule (a, b) `minExtensionDistance`

The other technology rules that are considered while creating a FGR include:

- `minWidth` of Diffusion layer
- `minWidth` of Metal layer
- `minWidth` of Implant/Well layer

For more details on the technology rules considered for creating the FGR instances, refer to the *Technology Rules Considered During Fluid Guard Ring Creation* section in the *Creating Fluid Guard Rings* chapter of the *Virtuoso Fluid Guard Ring User Guide*.

Which technology rules are used while editing FGRs?

While editing an FGR, the following technology rules, which are also applicable during FGR creation, are used:

`viaSpacing` of Cut layer
`minSpacing(One layer` of Cut layer
`minWidth` of Cut layer
`minWidth` of Diffusion layer
`minWidth` of Metal layer
`minWidth` of Implant/Well layer
`maxWidth` of Cut layer
`minOppExtension`
`minExtensionDistance`

In addition, while using an *overlapping shape* to create a tunnel through an FGR, the following table rules are considered:

- One-dimensional `minSpacing` table rule
- Two-dimensional `minSpacing` table rule

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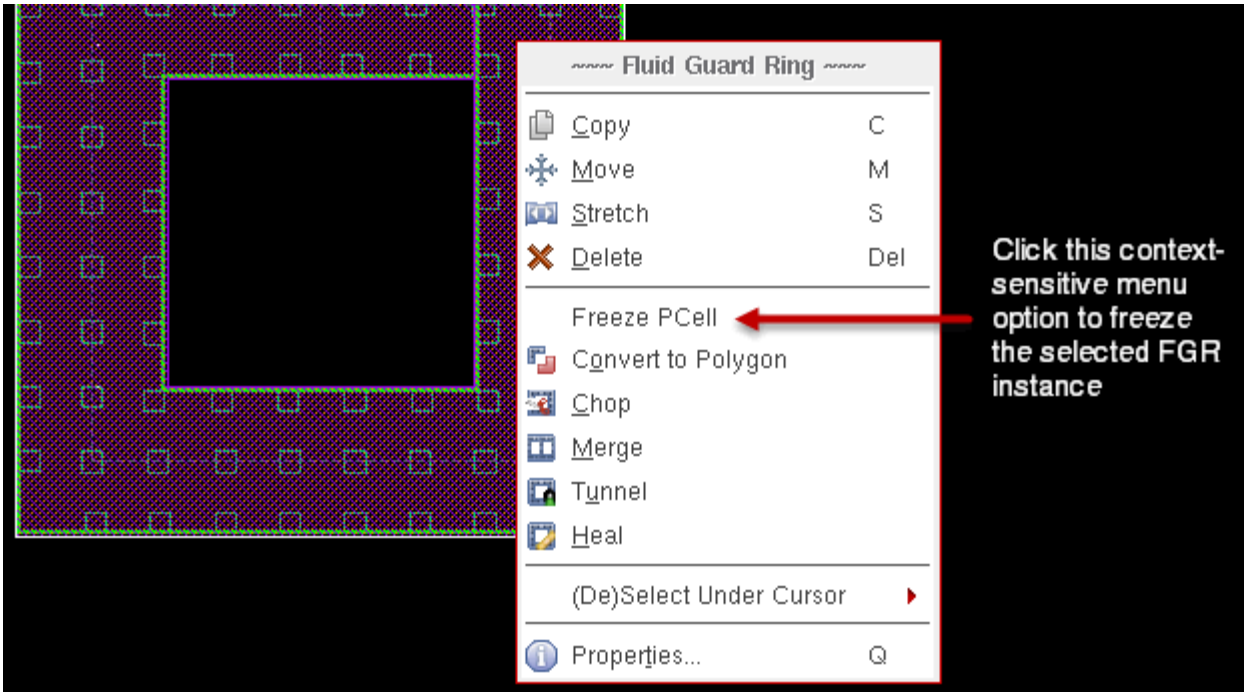
For detailed information, refer to the *Creating Tunnel By Using an Overlapping Shape* section in the *Editing Fluid Guard Rings* chapter of the *Virtuoso Fluid Guard Ring User Guide*.

How can geometry changes be avoided when existing FGRs are opened in a new Virtuoso release?

Virtuoso evaluates FGRs, which are fluid pcells, dynamically. Opening a layout containing FGRs in a newer release of Virtuoso may result in geometry changes in the existing FGRs, due to bug fixes or enhancements implemented in the FGR code of the newer release of Virtuoso.

To avoid such geometry changes, you can use the `leFreezeInst` function to convert an FGR instance to a non-fluid pcell instance of a new master created on the disk. Alternatively, you can achieve this by choosing *Freeze PCell* from the context-sensitive menu displayed when you select an FGR instance and right-click on it.



Why do contacts at the corners of an FGR instance disappear in releases above IC6.1.5 ISR14?

Until IC6.1.5 ISR14, you could see the contacts placed at the corners of all FGR instances in the design. This is because if rules similar to the following were found in the technology file,

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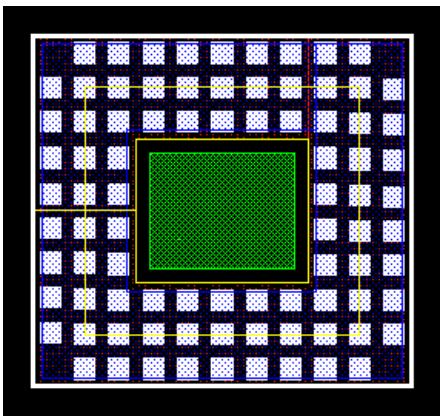
the FGR instance was not created using the smaller of the two `minOppExtension` values for its enclosure:

```
(minOppExtension "Metal1" "Cont" (0.01 0.06))
```

However, from IC6.1.5 ISR15 onwards, you might not see the contacts at the corners of newly created FGR instances. The following image illustrates an FGR where the contacts from the corners were removed:



For detailed information, refer to the *Using minOppExtension for Placing Contacts in the Corners of a Fluid Guard Ring* section in the *Creating Fluid Guard Rings* chapter of the *Virtuoso Fluid Guard Ring User Guide*.

Why are the contacts inconsistently distributed in some areas when two or more FGRs are merged?

Suppose, you have two identical FGRs with three rows of contacts each. When you superimpose these (as shown in the figure below), you can see some contacts that coincide partially or wholly.

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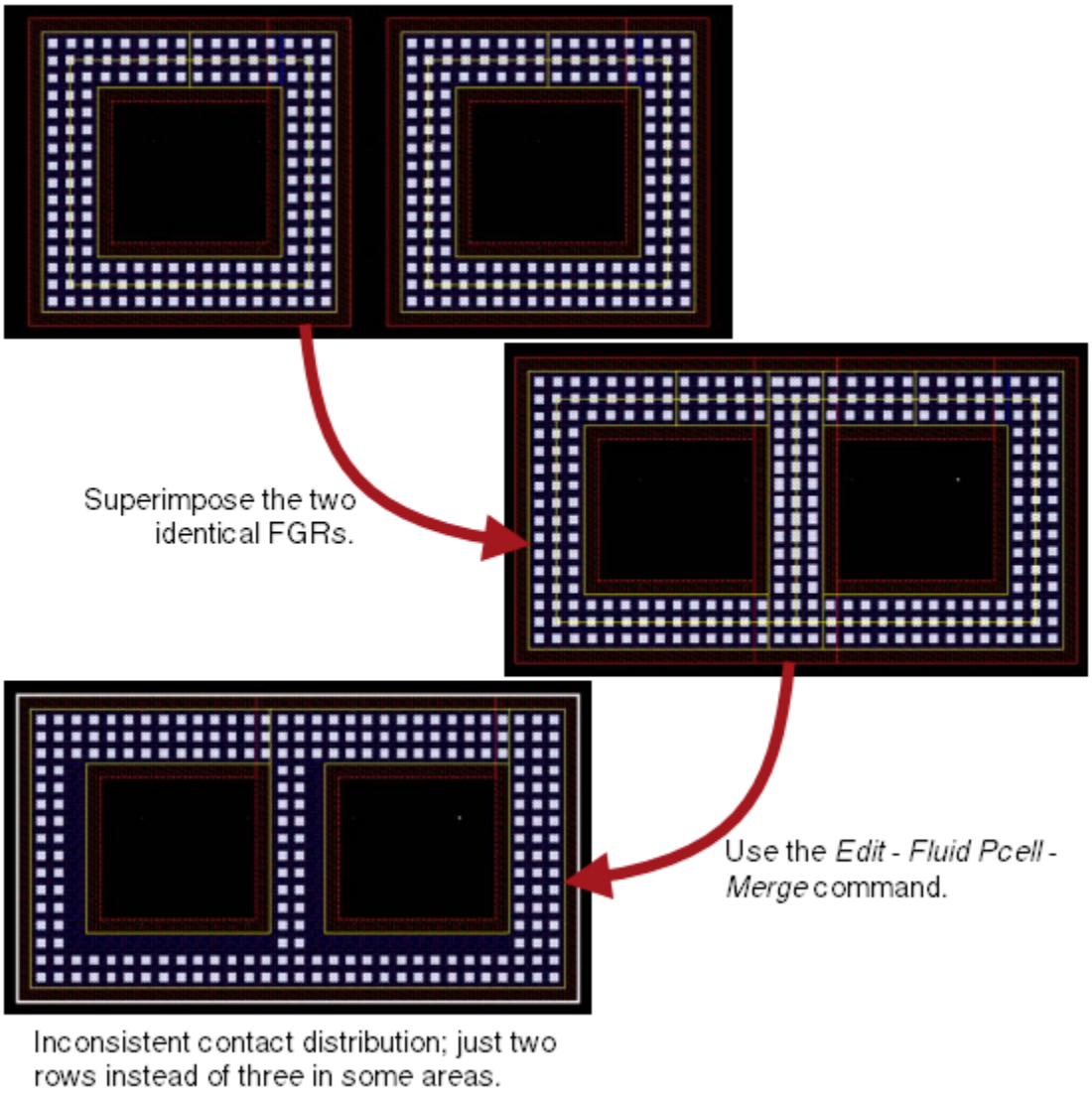
If you use the *Edit – Fluid Pcell – Merge* command on these superimposed FGRs, some sections of the resulting merged FGR have only two columns of contacts in some sections.



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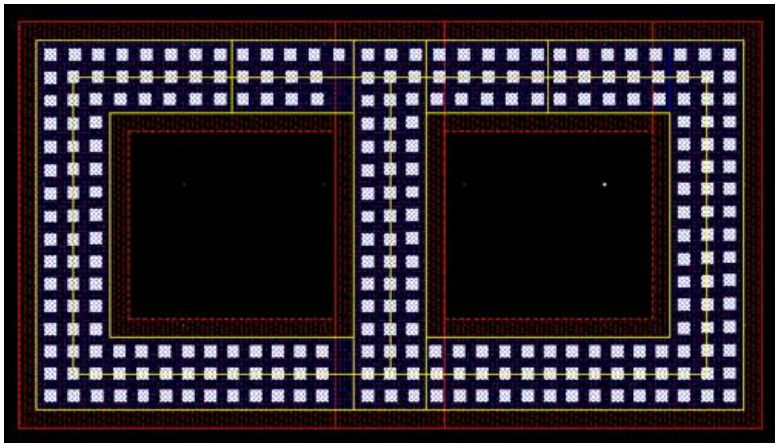
In such scenarios, to get the correct contact distribution as shown below, it is recommended you use the *Edit – Fluid Pcell – Clean Overlapping Contacts* command instead.



Can an FGR device hidden from the Install Guard Ring form be re-installed?

FGR devices can be hidden from the *Install Guard Ring* form using the device hiding techniques described in the *Hiding Fluid Guard Ring Devices* appendix of *Virtuoso Fluid Guard Ring User Guide*.

While trying to install a hidden FGR device, the following happens:

- A prompt message is displayed stating that the FGR device is already installed and is hidden.
- You are not allowed to re-install the hidden FGR device.

To re-install such FGR devices, first remove the associated `vfoGRHideDeviceInForms` property from the technology file and then reload the file in Virtuoso. Alternatively, you can use the `dbDeletePropByName` SKILL function in the CIW and then run the `dbSave` SKILL function to set the modified setting.

Can an FGR device hidden from the Create Guard Ring form be re-installed from the Install Guard Ring form?

You can re-install an FGR device that was initially hidden from the *Create Guard Ring* form, but this makes it visible on the form once again. In addition, this might result in geometry changes to the existing instances of the FGR device in the layout. A question message is

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displayed seeking your confirmation to continue updating the FGR device. You can choose to click the *Yes* or *No* button on the message.

Is it possible to install an FGR device with implant layer enclosure value less than technology default?

You can install an FGR with the implant layer enclosure value less than the default set in the technology file.

What should I do if a third party tool issues error and warning messages while using a customized FGR?

A third party tool issues error and warning messages when it is unable to access SKILL and SKILL++ code files written for a customized FGR and thus fails to evaluate it. To allow use of customized FGRs in third party tools, you need to manually load the `.il` and context files that have the VFO infrastructure definitions as explained in the *Loading VFO Infrastructure in Third Party Tools* appendix of *Virtuoso Fluid Guard Ring User Guide*.

Can I make changes to the procedure for initializing customized FGR devices?

The procedure for initializing customized FGR devices should not be changed. Use it exactly as given in the *Procedure for Initializing Customized FGR Devices* section of the *Loading VFO Infrastructure in Third Party Tools* appendix.

Is it acceptable to call the procedure for initializing customized FGR devices from a file other than libInit.il?

Ensure the procedure for initializing customized FGR devices is called only from the `libInit.il` file.

Do the fields displayed on the Create Guard Ring form have corresponding prompt names?

The fields displayed on the Create Guard Ring form have associated prompt names that can be used with the `promptName` argument of the `vfoGRSetCreateFormFieldProp` and `vfoGRGetCreateFormFieldProp` SKILL functions. For a list of valid prompt names, refer to the *Create Guard Ring Form Field Names and Associated Prompt Names* section

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of the Customizing Create Guard Ring Form application note available on the Cadence Online Support website.

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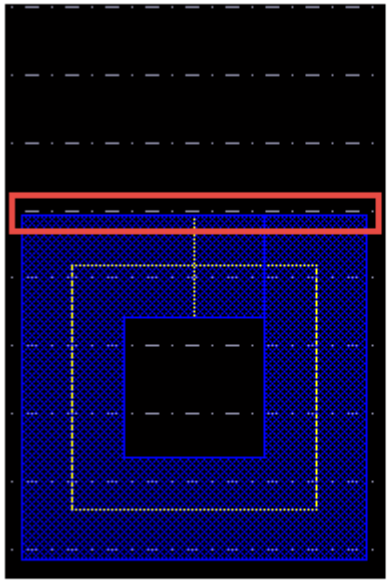
Advanced Node Features (Advanced Nodes Only)

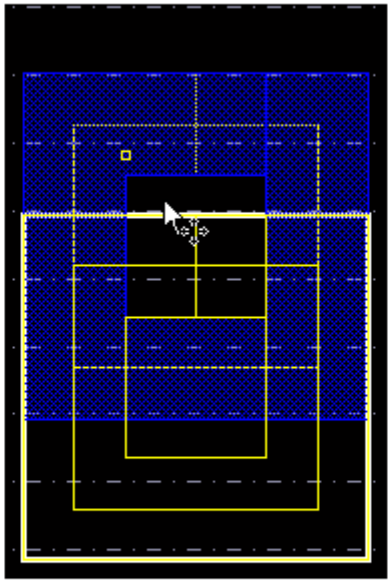
Can a newly created FGR for a FinFET device snap to the fin grids?

Before creating an FGR for a FinFET device, if you select the *Snap Pattern Snapping* check box in the Layout Editor Options form and relevant snap patterns are available on the canvas (just like snapping is available for any other instance in Layout L), the FGR instance automatically snaps to the closest snap pattern fin grid. For detailed information about snap pattern grids in the layout canvas, refer to the FinFET Support in Layout L chapter of the *Virtuoso Layout Suite L User Guide*. The following images illustrate this difference in creating an FGR instance when automatic snapping is enabled or disabled in Layout L:

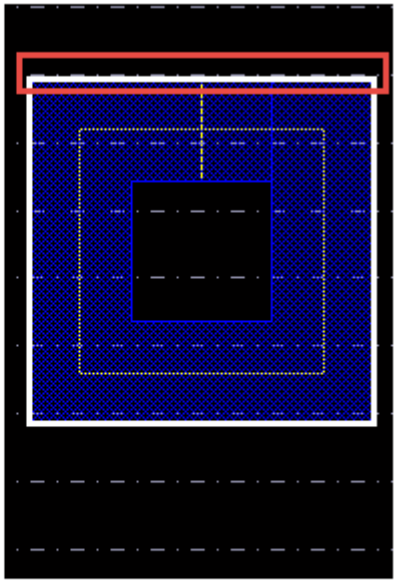
Automatic snapping to snap pattern grid is *enabled*



1. When an FGR instance is created, it snaps to the closest snap pattern grid.



2. Drag the FGR instance to move it to a different snap pattern grid.



3. The FGR instance again snaps to the underlying snap pattern grid that is closest to the new position on the layout.

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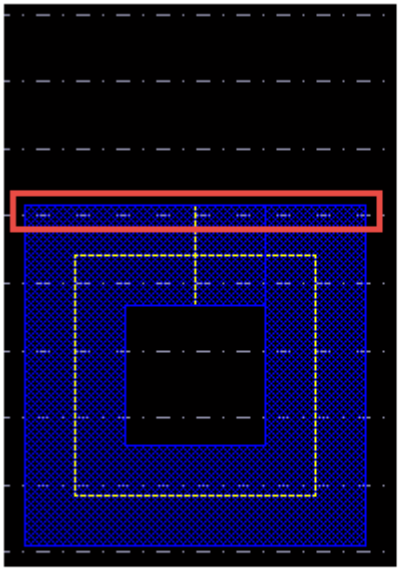
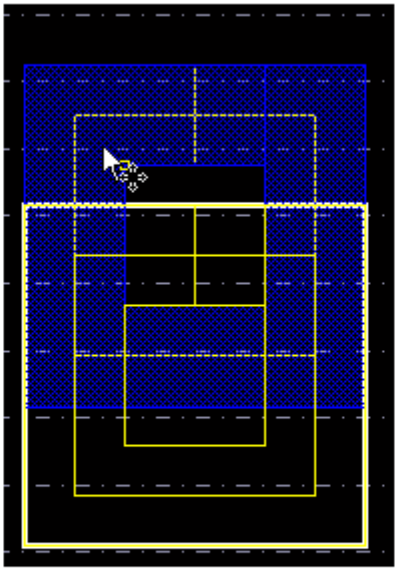
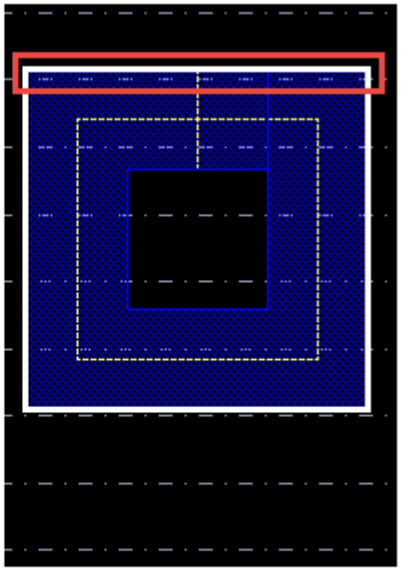
Automatic snapping to snap pattern grid is *disabled*



1. When an FGR instance is created, it does not snap to the closest snap pattern grid.



2. Drag the FGR instance to move it to a different snap pattern grid.



3. The FGR instance again does not snap to the underlying snap pattern grid that is closest to the new position on the layout.

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