Lattice Migration Tool User Guide

User Guide

FPGA-UG-02249-1.0

December 2025

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Inclusive Language

This document was created consistent with Lattice Semiconductor’s inclusive language policy. In some cases, the language in underlying tools and other items may not yet have been updated. Please refer to Lattice’s inclusive language FAQ 6878 for a cross reference of terms. Note in some cases such as register names and state names it has been necessary to continue to utilize older terminology for compatibility.

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Abbreviations in This Document

A list of abbreviations used in this document.

Abbreviation	Definition
FPGA	Field-Programmable Gate Array
GUI	Graphical User Interface
IP	Intellectual Property
OS	Operating System
RTL	Register-Transfer Level
TCL	Tool Command Language

1. Introduction

Migrating FPGA designs to a new device family often involves several manual steps, requiring you to update your project to migrate it successfully to a new architecture. The purpose of the Lattice Migration tool is to assist you with this migration process by automating several steps in the development flow. Additionally, the migration tool outputs a report outlining the remaining steps required for complete migration.

At a high level, the migration process from MachXO2™ or MachXO3™ devices to MachXO4™ devices requires updates to three main parts of your design: primitives, IP, and constraints. The first step is to determine whether your project is portable by analyzing the primitives and IP to see if an equivalent exists for the MachXO4 device. The migration tool handles this initial step and provides a quick report indicating whether or not a design is portable.

Aside from that, primitive migration requires you to review the primitives in your original design and update your designs to the MachXO4 device equivalent. Regarding primitives, the main required changes are mapping the primitive name to the new equivalent, correcting parameter setting names, and adjusting setting values to be compatible with the MachXO4 device in Radiant software. The migration tool provides automatic assistance for this step, enabling full automatic primitive migration if the corresponding setting is enabled in the migration assistant tool.

Next are IP, generated using a different platform for the MachXO4 device in Radiant software compared to the MachXO2 or MachXO3 device in the Lattice Diamond™ software. As a result, this step requires you to manually generate the equivalent MachXO4 IP for your project in the Radiant software. Although there is no direct or automatic way to streamline this part of the migration process, the migration tool analyzes the original design to inform you where IP are instantiated, so you know what RTL updates are required after IP generation. Aside from that, the migration tool extracts the settings from the original Diamond IP to help guide you on the correct settings to input during IP generation.

Lastly are constraints. The migration tool analyzes constraints from the original Diamond design and proposes equivalent templates for use in the Radiant software. However, because of significant differences in constraint methodology between Diamond and the Radiant software, not all constraints can be ported automatically. As a result, this step requires you to manually review the migration tool–generated constraint file and make some edits to complete design migration.

2. Objectives

The Lattice Migration tool enables you to quickly analyze your MachXO2 and MachXO3 designs in the Diamond software to determine if they are portable to the MachXO4 device in the Radiant software. If your design is portable, the migration tool can continue the migration process, completing several steps automatically and guiding you on the remaining manual steps required to finish migration.

3. Installation Requirements

This section describes the requirements and installation package for installing the Lattice Migration tool.

3.1. Software Requirements

- Lattice Diamond software (optional) – any version works, only required if you want to open your original design
- Lattice Radiant software 2025.2 or later
- Python3 programming language

3.2. Installation Package Contents

The Lattice Migration tool contains two main files:

- LatticeMigrationTool.exe
  - Main GUI executable
  - Windows OS only
- LatticeMigrationTool.py
  - Source code for migration tool
  - Supports command-line usage
  - Windows or Linux OS supported

4. Migration Tool Usage

There are two main ways to use the Lattice Migration tool: the GUI and the command line. Both modes support the same migration features, so the two main factors to consider when determining which mode to use are your operating system and ease of use. If you are using the Windows operating system, you can either use the GUI or command-line mode. If you are using the Linux operating system, you must use the command-line Python script. The GUI executable allows you to configure settings as you go whereas the command-line mode requires you to define settings and options in advance.

4.1. Running the Python Script

The Python programming language version of the migration tool can be used by invoking the script in a command-line environment using the command options in Table 4.1.

Table 4.1. Command Options

Command	Description
-src <Diamond LDF>	• Source LDF for the original MachXO2 or MachXO3 Diamond design • Required
-dir <Directory>	• Location to generate the converted MachXO4 design • Required
-name <Project Name>	• Name of the new MachXO4 project in the Radiant software • Required
-dev <MachXO4 Part number>	• Target MachXO4 device in the Radiant software • Required
-os <Windows or Linux>	• Target operating system • Supported options: Windows, Linux • Optional, default is Windows
-d <Diamond directory>	• Diamond installation directory • Optional, default is /lscc/diamond/3.14/
-r <Radiant directory>	• Radiant installation directory • Optional, default is /lscc/radiant/2025.2/
-t	• Launch the Radiant software and create the MachXO4 design • Radiant project is not created unless this option is included, otherwise you need to run the generated TCL script directly in the Radiant software • Optional, default behavior is to not invoke the Radiant software
-p	• Enable automatic primitive migration • Optional, default behavior is to not automatically migrate primitives

Sample command usage

```
python3 /home/projects/XO4/XO4_migration.py \
-src "/home/projects/XO3/phase_convert/phase_convert.ldf" \
-name "phase _XO4" \
-dir "/home/projects/XO4" \
-dev "LFMXO4-080HE-6BBG400C" \
-os "Linux" \
-d "/home/lscc/diamond/3.14" \
-r "/home/lscc/radiant/2025.2" \
-p \
-t
```

The above command runs the migration tool for the phase_convert.ldf MachXO3 design in the Diamond software. After confirming the design is portable, it automatically updates all primitives in the original design and launches the Radiant software to generate the new MachXO4 project.

4.2. Running the Lattice Migration Tool Executable

To start the application:

1. Double click the LatticeMigrationTool.exe.
2. Click **Get Started** to begin using the application. To access this user guide, click **First time user** below the **Get Started** button.

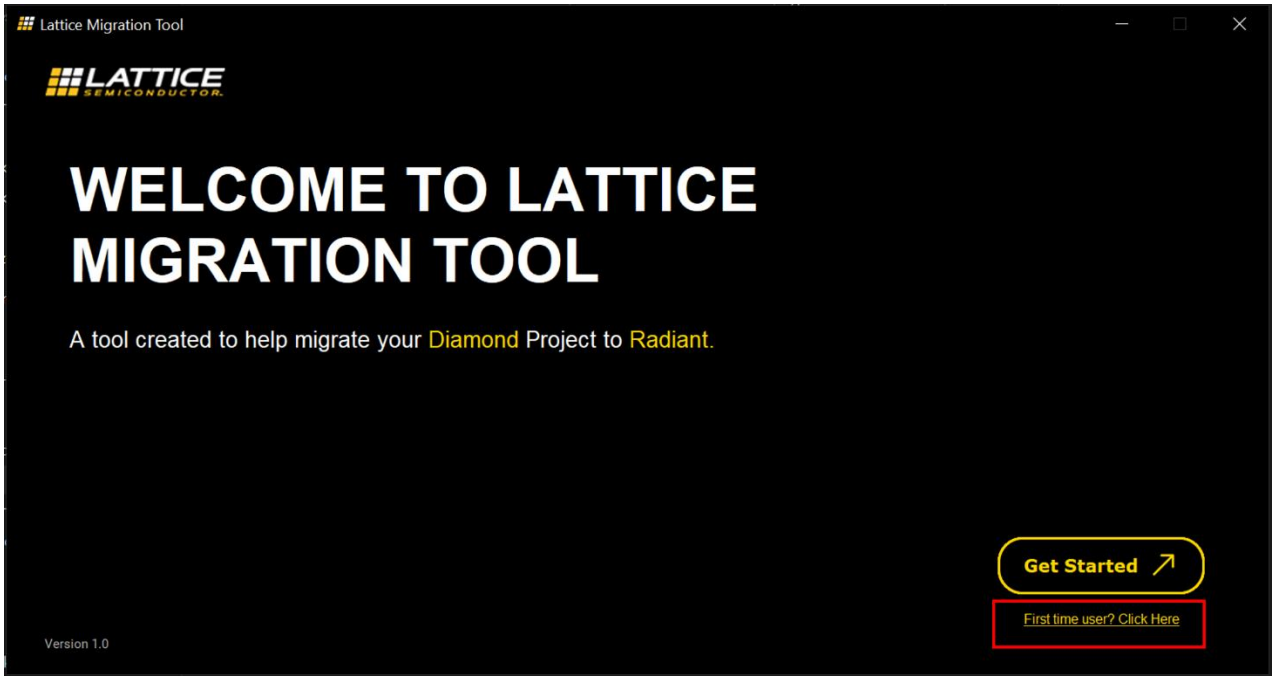


Figure 4.1. Welcome Page

4.2.1. Configuring Initial Project Settings

1. Click **Browse** to locate your Diamond project (.ldf) for conversion to MachXO4 device.
2. Click **Browse** to select the output directory for the generated Diamond project.
3. Enter the desired Radiant project name. A new project directory will be created at **<Output Directory>/<Radiant Project Name>**.
4. Select your target MachXO4 device using the **Device**, **Package**, and **Speed Grade** options.
5. Update the primitives automatically or manually. By default, the **Update Primitives Automatically (Recommended)** checkbox is selected; to manually review and update the primitive, clear the checkbox.
6. View past converted projects by clicking the **View Past Summary** button.

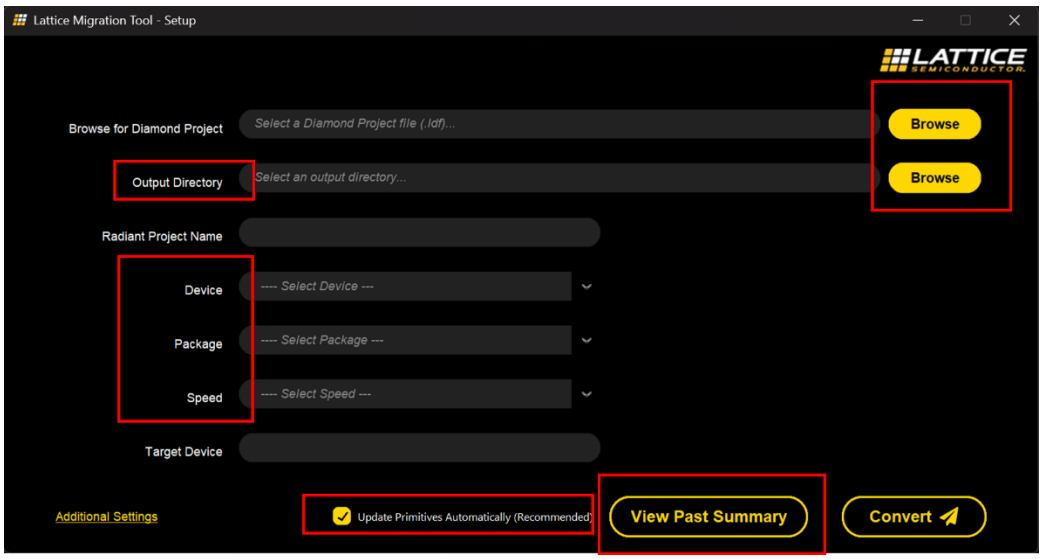


Figure 4.2. Project Configuration Page

4.2.2. Setting Alternative Radiant and Diamond Installation Directories

The Diamond and Radiant software are installed by default at this path. Refer to Figure 4.3.

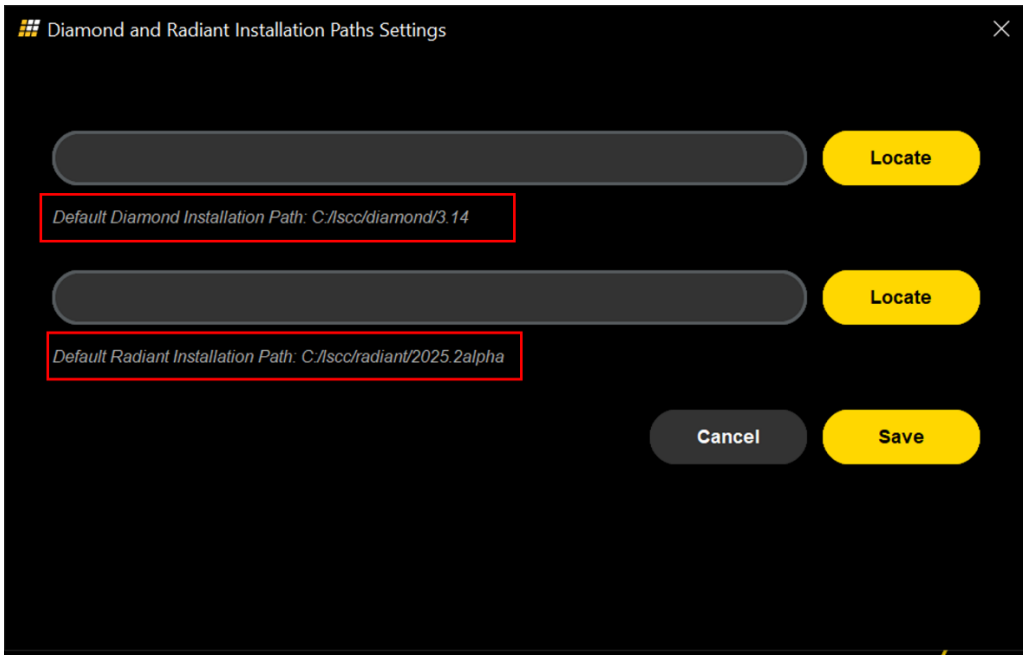


Figure 4.3. Installation Path Settings

To start setting up an alternative installation directory, follow these steps.

1. Click **Additional Settings**.
2. Click **Locate** to choose the Diamond installation path.
3. Enter the desired Radiant project name.
4. Click **Save** to update the path.
5. Click **Cancel** if you do not want to make any changes.
6. Click **Convert** after you finish to save the new installation path settings.

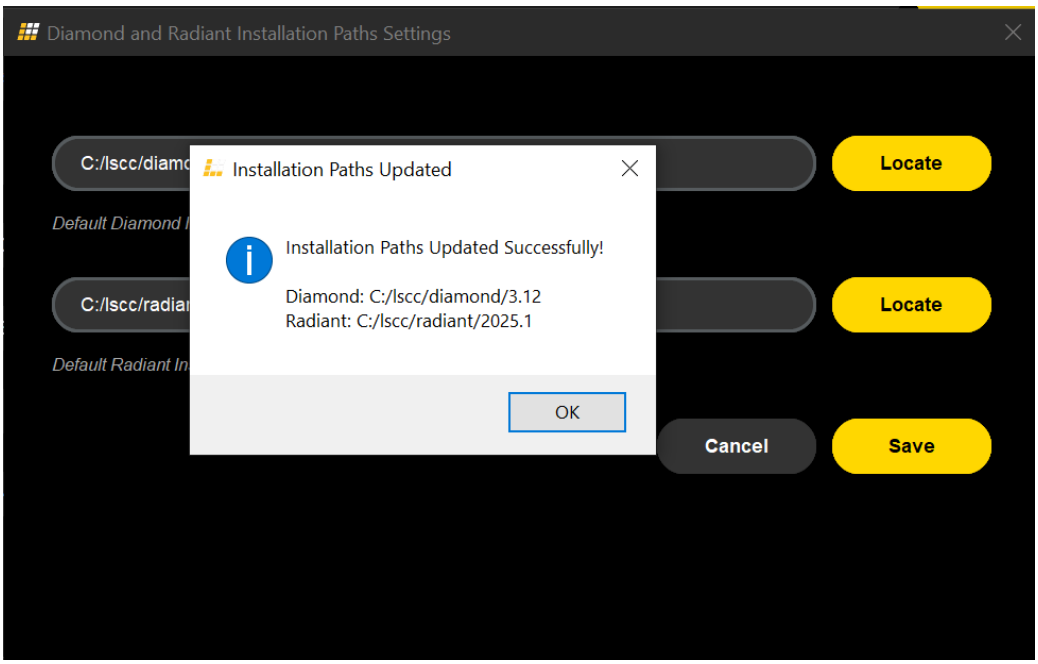


Figure 4.4. Installation Paths Updated

4.2.3. Opening an Existing Migrated Project

1. Click the **View Past Summary** button if you have completed a migration and would like to open an existing result.

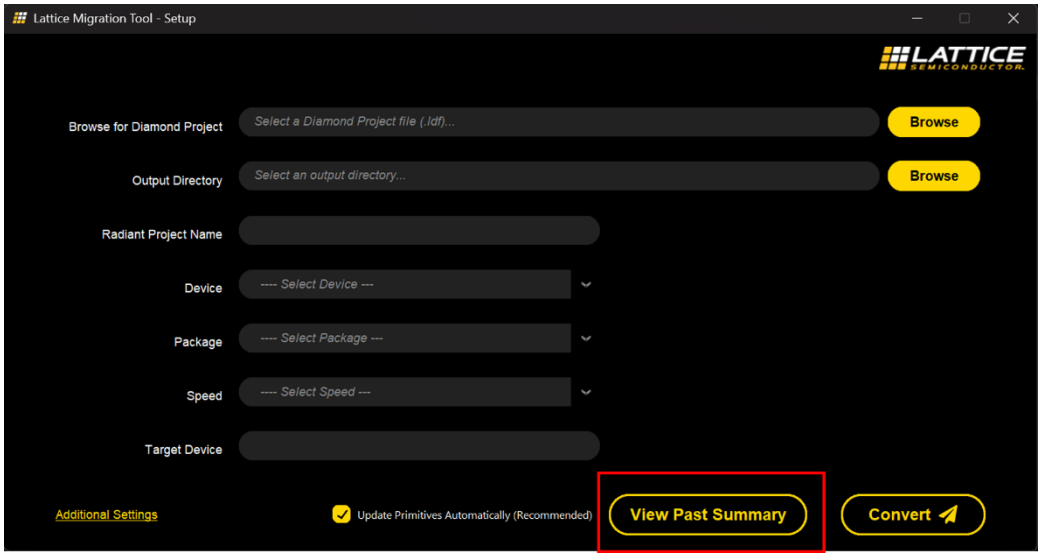


Figure 4.5. View Past Summary

2. Click **Locate** to find your project folder that was converted using this tool.
3. Click **Open**. This will take you directly to the **Results Summary Dashboard**.

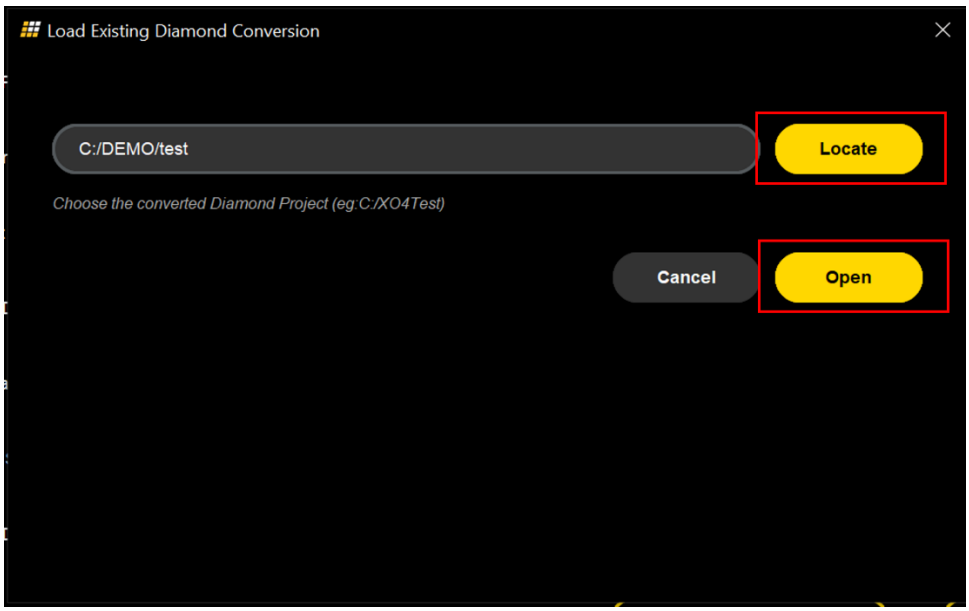


Figure 4.6. Opening an Existing Converted Project

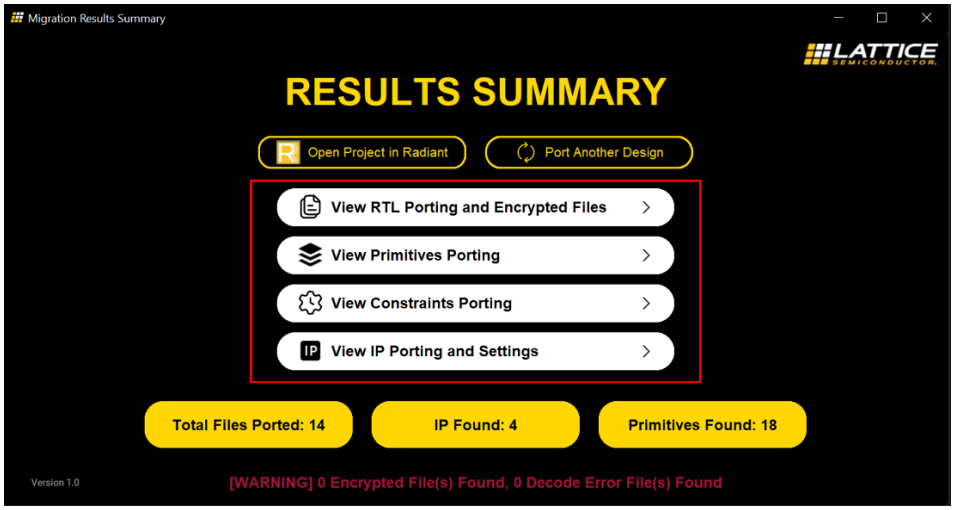


Figure 4.7. Results Summary Dashboard

4.2.4. Migrating the Design Successfully – Window

The following window will appear when your conversion is successfully completed (Figure 4.8). You can locate the generated Radiant project folder by its path. Click **View Results Summary** to open the **Results Summary Dashboard**.

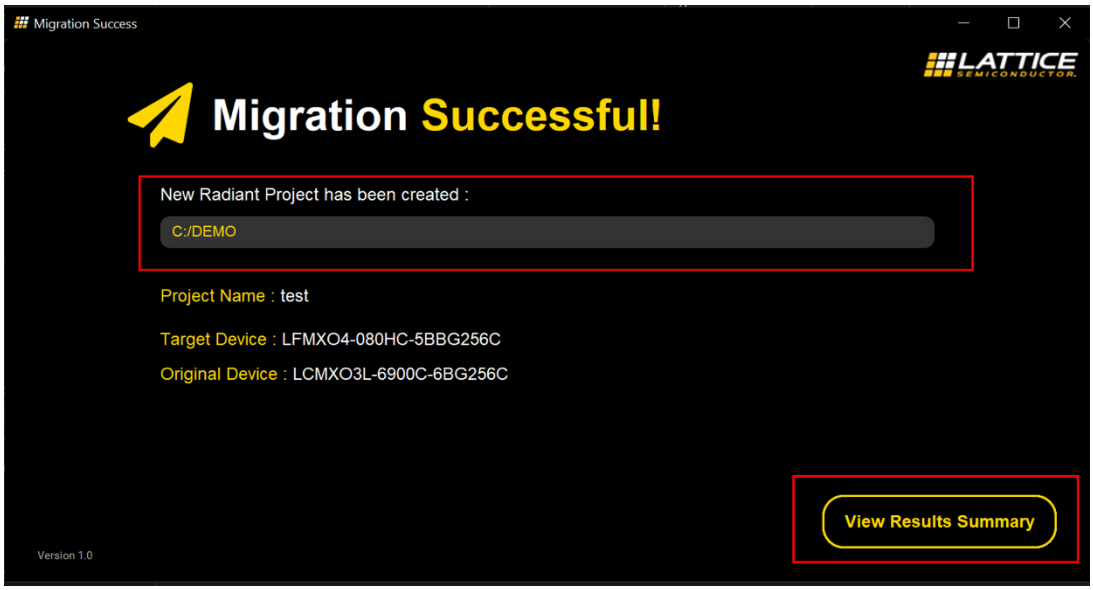


Figure 4.8. Design Migration Successful

If your original device appears empty, the conversion will not execute. Make sure to cross-check this path with the Radiant installation path you set in the **Additional Settings**.

4.2.5. Reviewing the Migration Results

If the design migration is successful, the next page will be organized into several main sections that correspond to each main step of the migration process. Click each of the sections below to review what the migration tool accomplished and what the remaining steps are.

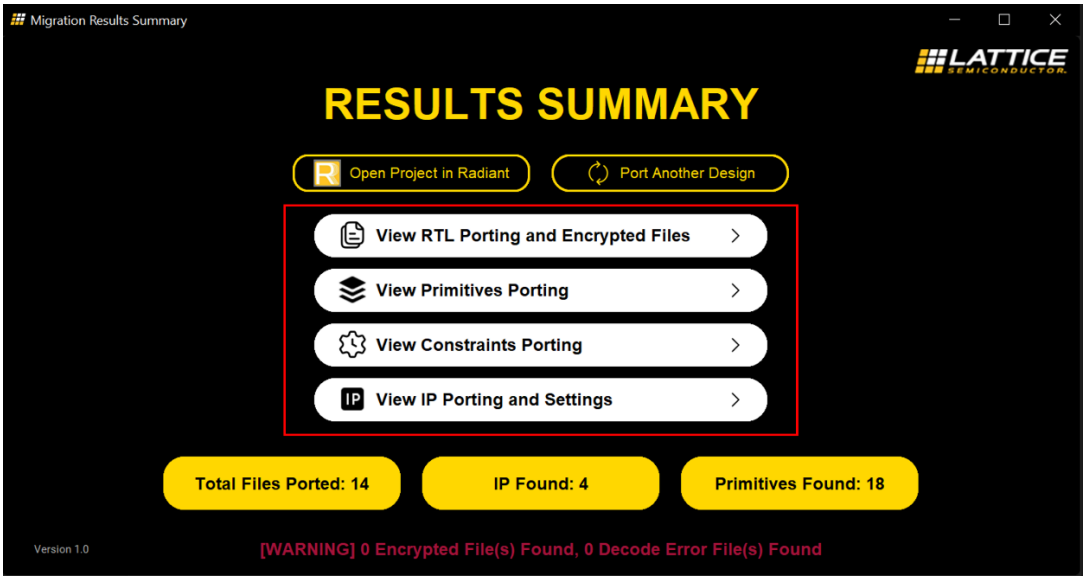


Figure 4.9. Result Summary Dashboard

4.2.6. Reviewing RTL File Porting

- **File porting status**: The primary function is to display the status of all files added from the original project.
- **File type breakdown**: You receive a quick summary of the different types of files processed. The yellow tabs at the top provide a count for each category:
  - **RTL file**: The number of Register-Transfer Level (RTL) files.
  - **IP file**: The number of Intellectual Property (IP) files.
  - **Primitive**: The number of primitive files.
  - **Encrypted ile**: The number of encrypted files, currently zero.
  - **Decode error file**: The number of files with decoding errors, currently zero.
  - **Excluded**: The number of files excluded from implementation in the Diamond software.
- **Detailed file list**: The main table provides a detailed list of all the files. For each file, you can see:
  - **File path**: The complete path of the file, which helps identify the exact location of the file within the project directory structure (e.g., C:/DEMO/Test/source/…).
  - **Status**: The status of the file, indicating whether it has been ported or excluded.
- **Search functionality**: You can quickly find specific files using the search bar in the top right corner. This is useful for large projects with many files.

In summary, this window (Figure 4.10) provides a comprehensive and organized view of the file porting process, giving you both a high-level summary and detailed, file-by-file information about the status of your migration project.

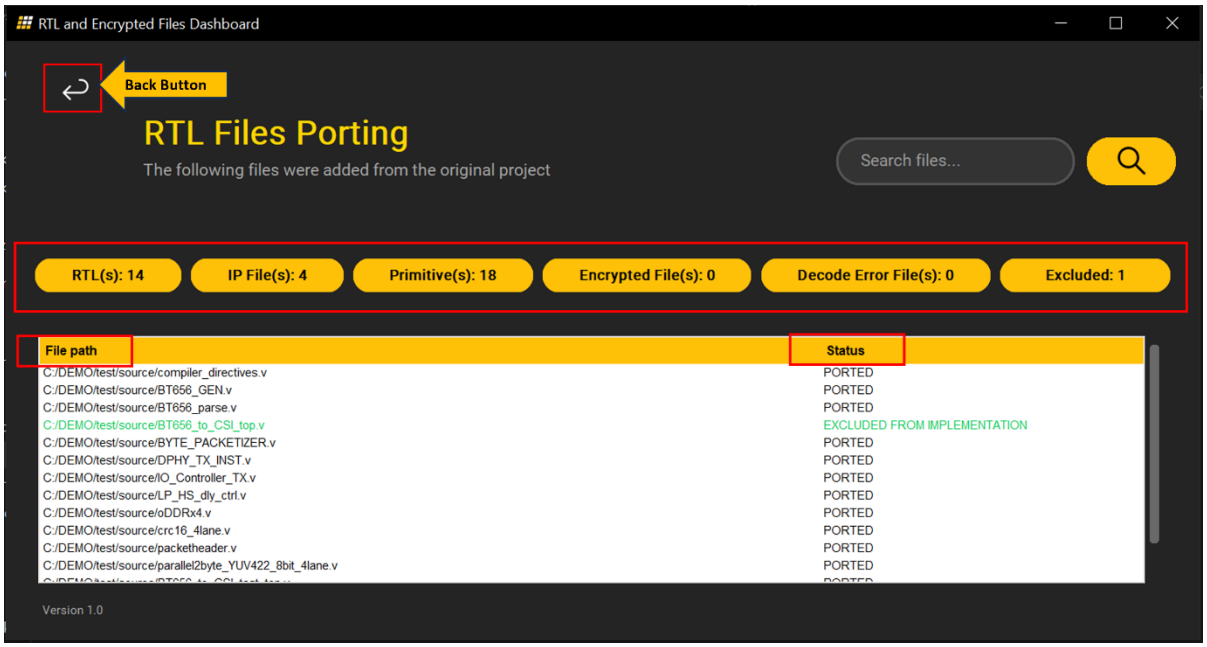
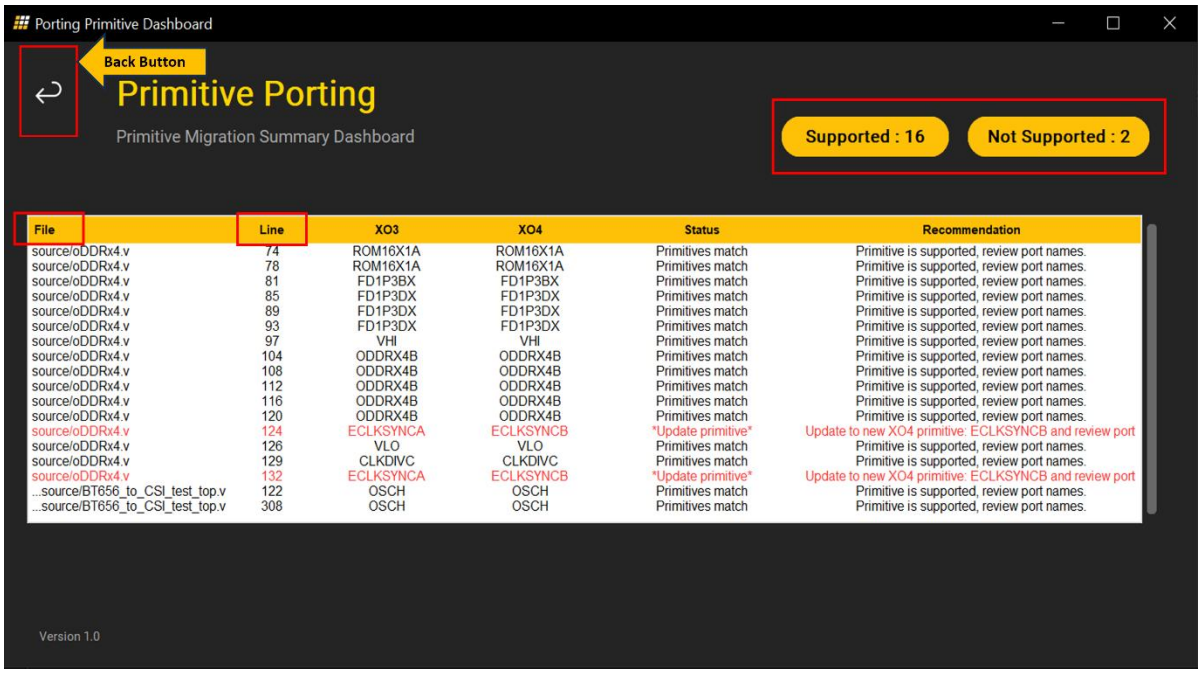


Figure 4.10. RTL and Encrypted Files Dashboard

Click the **Back** button to return to the **Results Summary Dashboard**.

4.2.7. Reviewing the Primitive Migration Results

View all the primitives detected in the Diamond project. In this window (Figure 4.11), a migration checklist confirms which primitives were converted automatically and flags that require manual updating.



File	Line	XO3	XO4	Status	Recommendation
source/oDDRx4.v	74	ROM16X1A	ROM16X1A	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	78	ROM16X1A	ROM16X1A	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	81	FD1P3BX	FD1P3BX	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	85	FD1P3DX	FD1P3DX	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	89	FD1P3DX	FD1P3DX	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	93	FD1P3DX	FD1P3DX	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	97	VHI	VHI	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	104	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	108	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	112	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	116	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	120	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	124	ECLKSYNCA	ECLKSYNCB	*Update primitive*	Update to new XO4 primitive: ECLKSYNCB and review port
source/oDDRx4.v	126	VLO	VLO	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	129	CLKDIVC	CLKDIVC	Primitives match	Primitive is supported, review port names.
source/oDDRx4.v	132	ECLKSYNCA	ECLKSYNCB	*Update primitive*	Update to new XO4 primitive: ECLKSYNCB and review port
...source/BT656_to_CSI_test_top.v	122	OSCH	OSCH	Primitives match	Primitive is supported, review port names.
...source/BT656_to_CSI_test_top.v	308	OSCH	OSCH	Primitives match	Primitive is supported, review port names.

Figure 4.11. RTL and Encrypted Files

- **Overall status**: At the top right, the dashboard shows the number of **supported** and **not supported** primitives during the conversion.
- **File** and **location**: The first two columns identify the **File** and **Line** number where each primitive is used in the source code.
- **Primitive mapping**: The report tracks the component names, showing the MachXO3 primitive name and the corresponding MachXO4 primitive name. Refer to Figure 4.12 and Figure 4.13.

Primitive Migration Summary (XO3 to XO4):

File	Line	XO3 Primitive	XO4 Primitive	Status	Recommendation
C:/DEMO/BTUPDATE/source/oDDRx4.v	74	ROM16X1A	ROM16X1A	Primitives match	Primitive supported, parameter name/value change
C:/DEMO/BTUPDATE/source/oDDRx4.v	78	ROM16X1A	ROM16X1A	Primitives match	Primitive supported, parameter name/value change
C:/DEMO/BTUPDATE/source/oDDRx4.v	81	FD1P3BX	FD1P3BX	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	85	FD1P3DX	FD1P3DX	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	89	FD1P3DX	FD1P3DX	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	93	FD1P3DX	FD1P3DX	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	97	VHI	VHI	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	104	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	108	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	112	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	116	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	120	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	124	ECLKSYNCA	ECLKSYNCB	*Update primitive*	Update to new XO4 primitive: ECLKSYNCB and review port names
C:/DEMO/BTUPDATE/source/oDDRx4.v	126	VLO	VLO	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	129	CLKDIVC	CLKDIVC	Primitives match	Primitive is supported, review port names.
C:/DEMO/BTUPDATE/source/oDDRx4.v	132	ECLKSYNCA	ECLKSYNCB	*Update primitive*	Update to new XO4 primitive: ECLKSYNCB and review port names
...source/BT656_to_CSI_test_top.v	122	OSCH	OSCH	Primitives match	Primitive is supported, review port names.
...source/BT656_to_CSI_test_top.v	308	OSCH	OSCH	Primitives match	Primitive is supported, review port names.

Note: The primitives available in this project have been UPDATED AUTOMATICALLY.

Figure 4.12. Primitive Migration Summary – Automatically Updated by the Tool

Primitive Migration Summary (XO3 to XO4):

File	Line	XO3 Primitive	XO4 Primitive	Status	Recommendation
...EMO/BTNOUPDATE/source/oDDRx4.v	74	ROM16X1A	ROM16X1A	Primitives match	Primitive supported, parameter name/value change
...EMO/BTNOUPDATE/source/oDDRx4.v	78	ROM16X1A	ROM16X1A	Primitives match	Primitive supported, parameter name/value change
...EMO/BTNOUPDATE/source/oDDRx4.v	81	FD1P3BX	FD1P3BX	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	85	FD1P3DX	FD1P3DX	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	89	FD1P3DX	FD1P3DX	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	93	FD1P3DX	FD1P3DX	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	97	VHI	VHI	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	104	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	108	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	112	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	116	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	120	ODDRX4B	ODDRX4B	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	124	ECLKSYNCA	ECLKSYNCB	*Update primitive*	Update to new XO4 primitive: ECLKSYNCB and review port names
...EMO/BTNOUPDATE/source/oDDRx4.v	126	VLO	VLO	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	129	CLKDIVC	CLKDIVC	Primitives match	Primitive is supported, review port names.
...EMO/BTNOUPDATE/source/oDDRx4.v	132	ECLKSYNCA	ECLKSYNCB	*Update primitive*	Update to new XO4 primitive: ECLKSYNCB and review port names
...source/BT656_to_CSI_test_top.v	122	OSCH	OSCH	Primitives match	Primitive is supported, review port names.
...source/BT656_to_CSI_test_top.v	308	OSCH	OSCH	Primitives match	Primitive is supported, review port names.

Note: The primitives available in this project are NOT UPDATED and require a manual review.

Figure 4.13. Primitive Migration Summary – Manual Update

Figure 4.12 and Figure 4.13 shows the message in the results.log file, indicating whether the primitives were updated automatically by the tool or needs a manual update.

Click the **Back** button to return to the **Results Summary Dashboard**.

4.2.8. Reviewing the Migrated Constraints

In this window (Figure 4.14), a **constraints** folder is created within the project folder. All constraints detected in the Diamond project (**.lpc**) are converted to the **.pdc** format when opened in the Radiant software. Open the generated **.pdc** file to view these constraints.

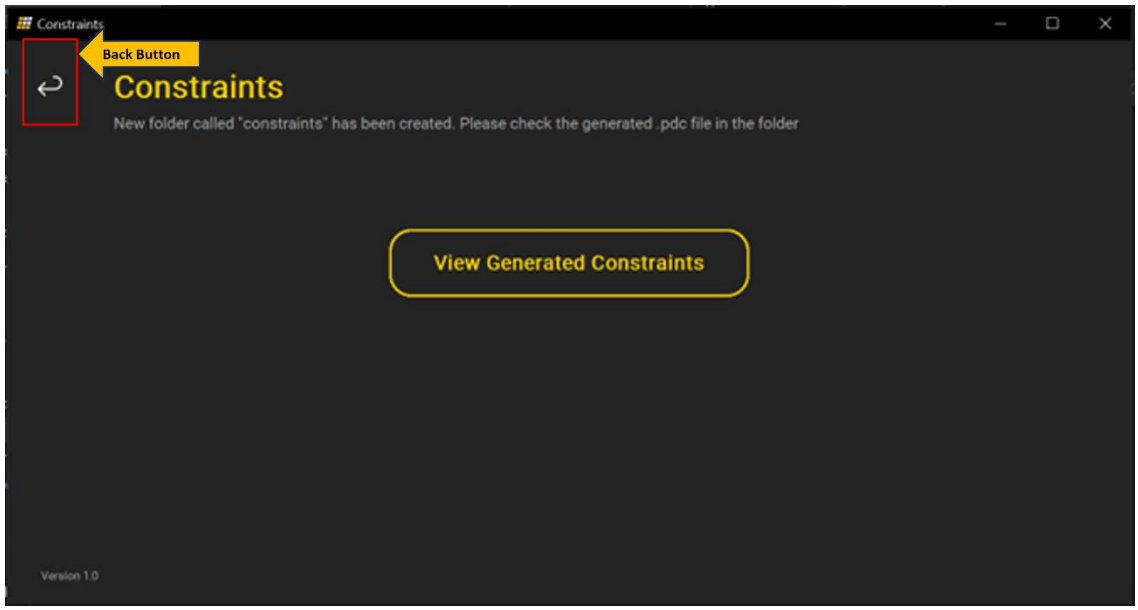


Figure 4.14. View Generated Constraints Button

Click the **Back** button to return to the **Results Summary Dashboard.**

4.2.9. Reviewing IP Migration Results

In this window (Figure 4.15), you can see a quick analysis that indicates the IP located in their original design by the migration tool. This analysis shows whether there is an equivalent MachXO4 IP in the Radiant software, as well as the file and line where each IP is instantiated.

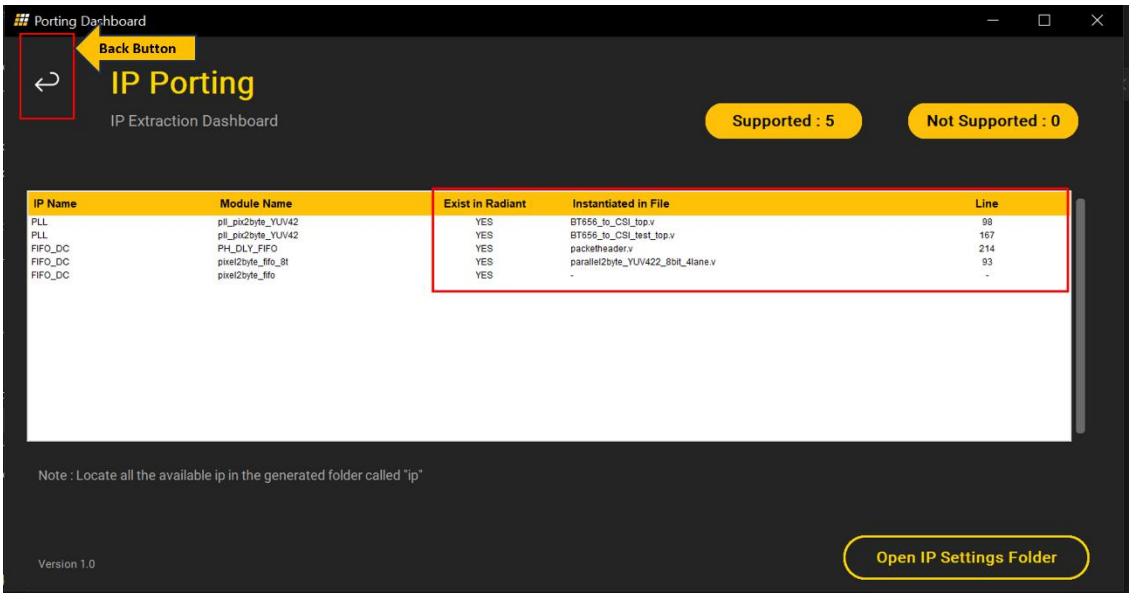


Figure 4.15. IP Porting Dashboard

Aside from that, a **/ip** directory is created in the new the MachXO4 project directory that contains log files for each IP from the original Diamond project. These log files contain the extracted IP settings from the original Diamond design, so you can determine which settings to configure in your Radiant project without needing to open your Diamond project.

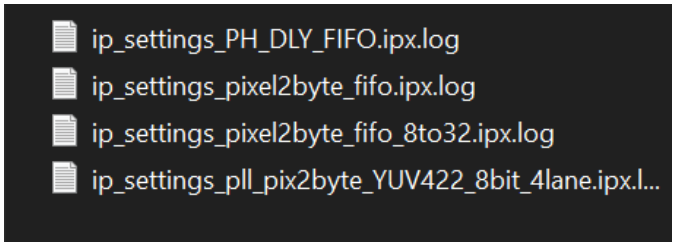


Figure 4.16. Generated IP

Click the **Back** button to return to the **Results Summary Dashboard**.

4.2.10. Launching Radiant software

You can open the converted project directly in the Radiant software by clicking the **Open Project in Radiant** button. Clicking this button automatically launches the Radiant software and invokes the migration tool–generated TCL script to create the MachXO4 project.

Note: The MachXO4 project in the Radiant software is not created unless this button is clicked.

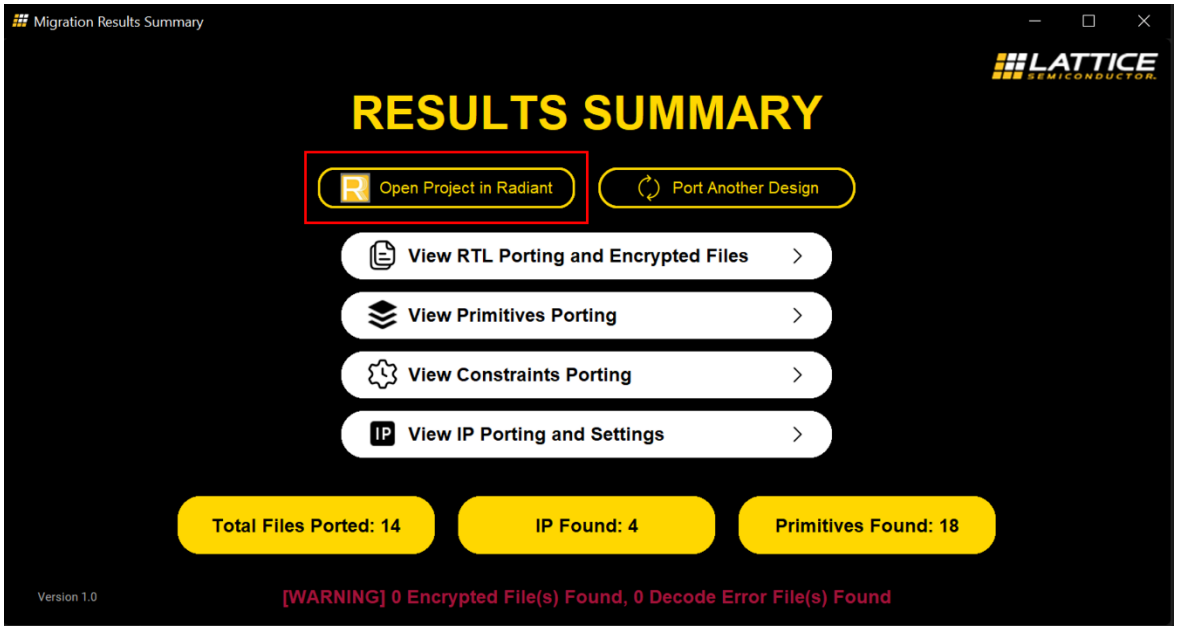


Figure 4.17. Open Project in Radiant Button

References

- MachXO3 web page
- MachXO4 web page
- Lattice Diamond FPGA design software web page
- Lattice Radiant FPGA design software web page
- Lattice Diamond Software User Guide
- Lattice Radiant Software User Guide
- Lattice Radiant Timing Constraints Methodology (FPGA-AN-02059)
- Lattice Insights for Lattice Semiconductor training courses and learning plans

Technical Support Assistance

Submit a technical support case through www.latticesemi.com/techsupport.

For frequently asked questions, please refer to the Lattice Answer Database at www.latticesemi.com/Support/AnswerDatabase.

Revision History

Revision 1.0, December 2025

Section	Change Summary
All	Initial release.

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