

---

# In-System Debug for GreenPAK™ Devices with I2C Serial Communication

## SLG46537

---

The application note describes a In-System Debug for debugging of the GreenPAK configuration at the same time as the debug of the overall system.

### Contents

1. Terms and Definitions .....	2
2. References .....	2
3. Introduction .....	3
4. In-System Debug (ISD) .....	3
5. Conclusion .....	5
6. Revision History .....	6

### Figures

Figure 1. Latch configuration during Power-On Reset .....	3
Figure 2. Latch configuration during Power-On Reset .....	4
Figure 3. I2C In-System Debug capability .....	4

## 1. Terms and Definitions

GUI	Graphical User Interface
ISD	In-System Debug
LUT	Look-up Table
NVM	Non-Volatile Memory

## 2. References

For related documents and software, please visit:

[GreenPAK Programmable Mixed-Signal Products | Renesas](#)

Download our free Go Configure Software Hub [1] and use the GreenPAK development tools [2] to freeze the design into your own customized IC in a matter of minutes. Renesas provides a complete library of application notes [3] featuring design examples as well as explanations of features and blocks within the Renesas IC.

[1] [Go Configure Software Hub](#), Software Download and User Guide, Renesas Electronics

[2] [GreenPAK Development Tools](#), GreenPAK Development Tools Webpage, Renesas Electronics

[3] [Application Notes](#), GreenPAK Application Notes Webpage, Renesas Electronics

[4] [SLG46537 Datasheet](#), Renesas Electronics

### 3. Introduction

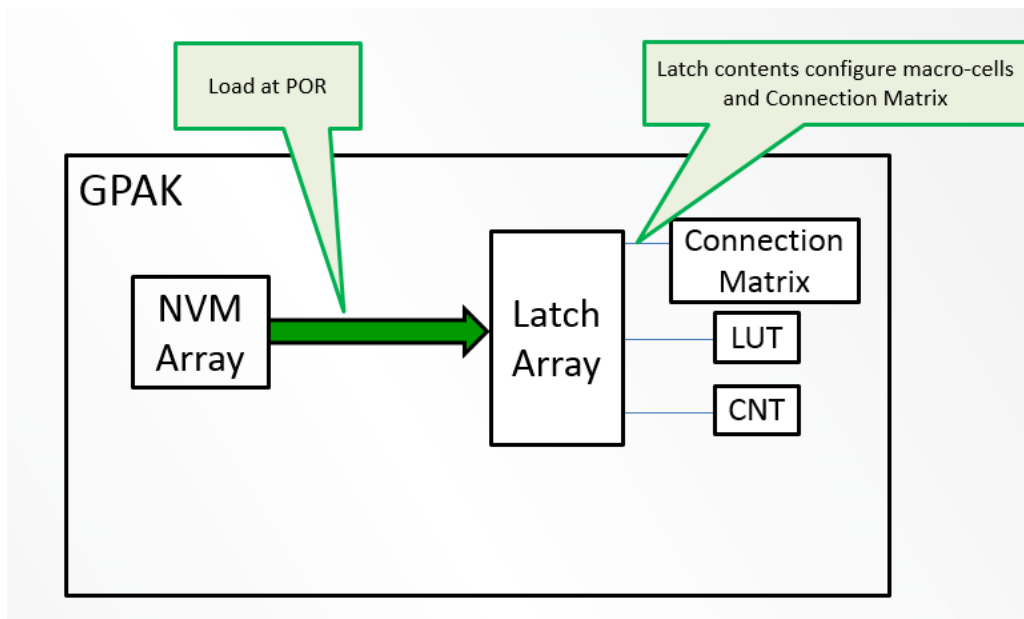
Traditionally, the development cycle for the GreenPAK devices has included debugging sessions that would take place on the GreenPAK Universal Development Board, and include the option to test and debug multiple versions of the customer configuration quickly. Because the debugging could take place without the need to program individual devices, it would significantly increase the speed of development. Once the configuration is sufficiently verified as a stand-alone function, the user can program some number of devices and place on their board for further debug in a system environment.

### 4. In-System Debug (ISD)

Some of the newest GreenPAK devices have I2C communication capability, which can be useful as a function in the end-user system.

The I2C communication macrocell in these devices can also serve as a portal to allow the designer to migrate their GreenPAK debug from the Universal Development Board to their project PCB for In-System Debug (ISD). This new ISD capability allows designers to speed up their already fast GreenPAK development cycle.

GreenPAK is composed of functional macrocells (such as Look Up Tables, Timer/Counters, Oscillators, etc.) that are configured by the designer using the GreenPAK Designer software. The choices made by the designer in the GreenPAK Designer GUI are translated into register values that both configure the individual macrocells, and establish the signal connections and routing through the Connection Matrix on the GreenPAK device. The resulting register values are programmed into Non-Volatile Memory (NVM) on the GreenPAK device. Each GreenPAK device is designed to load this information into latches on the device during Power-On Reset (see [Figure 1](#) below). The latches are what actually control the configuration of the device, but they are volatile, and lose their stored information when power is removed.



**Figure 1. Latch configuration during Power-On Reset**

One advantage of this architecture is the ability to write other register values via I2C into the latches during operation. This provides the mechanism to support debugging multiple user configurations without programming the NVM. In previous GreenPAK devices, this step could only take place with the device placed in a socket on the Universal Development Board. The communication between the Universal Development Board and the GreenPAK to set the latch values in previous devices used multiple pins and special signal sequences (see [Figure 2](#) below), including an overvoltage (~7V) signal on one of the pins. This is the same communication required to program the NVM on a GreenPAK device.

The GreenPAK devices which include the I2C communication macrocell have an alternative way to load this information into the latches. As stated above, the latches will always be loaded on POR from the NVM, but this information can be modified after POR takes place on. This can serve as a convenient “debug port” to allow modification of GreenPAK device configuration. Modifying the latches (and therefore changing the configuration) via I2C commands can take place either on the development board, or even when the GreenPAK device is mounted on the target hardware, allowing for In-System Debug capability (see Figure 3).

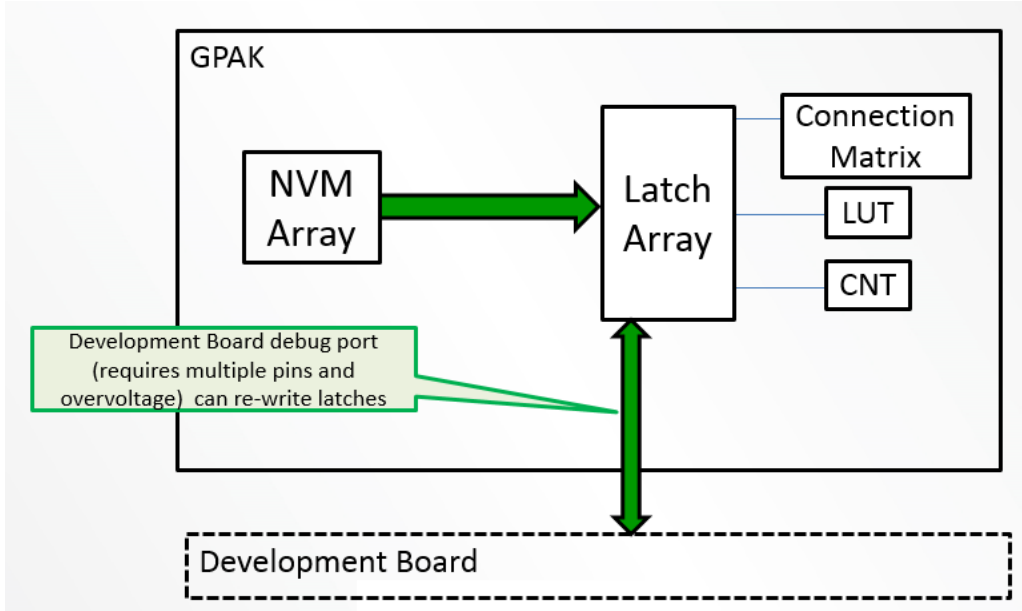


Figure 2. Latch configuration during Power-On Reset

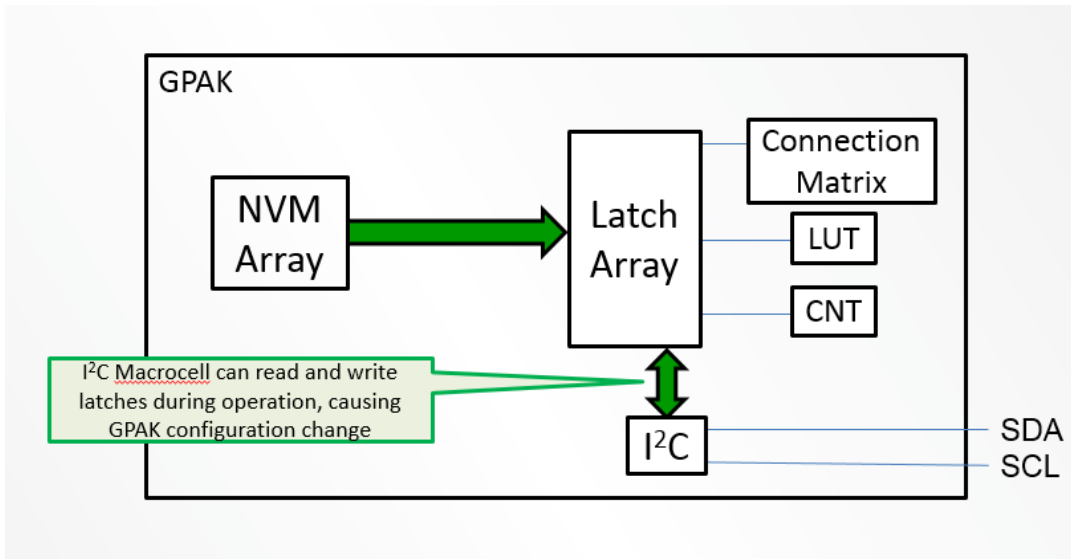


Figure 3. I2C In-System Debug capability

If the user selects one of the 16 possible wake-up addresses, this tells the development hardware that the user wants to do In-System Debug on their target board via I2C commands.

By default, the GreenPAK device will wake up to address 0000b. If there is only one GreenPAK device on the target board (and no other I2C slave devices that could cause address contention), this default address can be used with no extra programming step.

If, however there are other I2C slave devices on the target board, or if the user would like to have more than one GreenPAK device on the same I2C bus, the user will need to pre-program the slave address into the GreenPAK before mounting on their board.

When the user pushes the “Device Onboard” button and selects a wakeup address, the Development Board becomes a USB to I2C bridge, and will execute all GUI commands to the remote GreenPAK device. When this selection is made, and the user pushes the “Emulation” button, the system will automatically download the entire set of data for a particular configuration, which will enable that configuration, once the I2C write commands are complete.

However, before this can take place, the user must connect the appropriate terminals on the Development Board for the SDA and SCL signals, to their target board, as well as establish a common ground between the Development Board and the target board. Note that some of the Development Board functions, such as signal generators and LEDs, will not function when working in this ISD mode.

It is important to re-iterate that the GreenPAK device, when first powered up on the target board, will go through a standard POR cycle which will include doing an initial load of configuration information from NVM to the latches. This highlights one area where ISD may not be too effective, which is to do debug of the behavior of the GreenPAK device during the POR period.

This is the case because the GreenPAK device on the target board will first exhibit the behavior based on the internal NVM configuration, before it is re-configured through I2C commands to the configuration under test. To test POR operation and performance, it may be better to program actual GreenPAK devices and test directly on the target board.

It is also important to note that GreenPAK devices offer the option to lock some or all of the access to the latches, and this locking mechanism will prevent ISD (or any access to the stored configuration for design security).

## 5. Conclusion

In-System Debug can allow the designer to do the debug of the GreenPAK configuration at the same time as the debug of the overall system. This approach is more flexible, and can result in a reduction in the total amount of time required to bring your product that includes GreenPAK from concept to production.

## 6. Revision History

Revision	Date	Description
1.00	October 18, 2016	Initial release.
2.00	May 5, 2026	The part number has been changed from SLG46531V to SLG46537V.

## IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers who are designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only to develop an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising from your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.01)

### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

### Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

### Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit [www.renesas.com/contact-us/](http://www.renesas.com/contact-us/).