User Manual

GreenPAK Serial Debugger
UM-GP-004
1 Terms and Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FET</td>
<td>Field-Effect Transistor</td>
</tr>
<tr>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>HID</td>
<td>Human Interface Device</td>
</tr>
<tr>
<td>ISP</td>
<td>In-System Programming</td>
</tr>
<tr>
<td>LDO</td>
<td>Low Dropout Voltage Regulator</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>NVM</td>
<td>Non-Volatile Memory</td>
</tr>
<tr>
<td>OCP</td>
<td>Over-Current Protection</td>
</tr>
<tr>
<td>OTP</td>
<td>Over-Temperature Protection</td>
</tr>
<tr>
<td>OVP</td>
<td>Overvoltage Protection</td>
</tr>
<tr>
<td>PCB</td>
<td>Printed Circuit Board</td>
</tr>
<tr>
<td>PTC</td>
<td>Positive Temperature Coefficient Resistor</td>
</tr>
<tr>
<td>SCL</td>
<td>I²C Clock Input</td>
</tr>
<tr>
<td>SCP</td>
<td>Short Circuit Protection</td>
</tr>
<tr>
<td>SDA</td>
<td>I²C Data Input/Output</td>
</tr>
<tr>
<td>USB</td>
<td>Universal Serial Bus</td>
</tr>
<tr>
<td>VDD</td>
<td>Power Supply</td>
</tr>
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</table>
2 Description

GreenPAK Serial Debugger (GSD) device can be used for programming GreenPAK products with multiple time Non-Volatile Memory (NVM) or for configuring the interconnect logic, the IOs, and the macrocells of all GreenPAK chips with I²C interface.

The GSD works with the GreenPAK Designer version 6.xx and above. Select the GSD in the “Development Platform Selector” window and click on the “Program” or “Emulate” button.

Supported operational systems:

- Windows - XP (SP3), Vista, 7, 8, and 8.1, 10
- Linux - any distribution with support for CDC and HID classes
- Mac OS - all versions starting from 10.7

GSD is the Human Interface Device (HID) and does not require any additional drivers.

The device runs as an I²C Master. The Data to read/write on the I²C Bus is conveyed by the USB interface with a speed of 12 Mb/s. I²C interface clock rate of GreenPAK Serial Debugger is up to 100 kHz.

Chip programming/emulation/debugging is done through the I²C protocol via four chip pins: VDD, SCL, SDA, and GND.

When the GSD is connected to USB, the “Power” LED turns on. The connected chip can be powered from the GSD or from an external power. GSD can deliver voltage from 0.9 V to 5.0 V with a maximum output current of up to 50 mA.

GSD detects the external power and switches off its VDD line (in this case, I²C pull-up resistors will be connected to the external power supply).

### Table 1: GreenPAK Serial Debugger LED Indicators

<table>
<thead>
<tr>
<th>GSD State</th>
<th>Power LED</th>
<th>Status LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standby mode</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>Emulation mode</td>
<td>On</td>
<td>Blink</td>
</tr>
<tr>
<td>Program mode</td>
<td>On</td>
<td>Blink</td>
</tr>
<tr>
<td>Overvoltage protection at VDD line</td>
<td>Blink</td>
<td>Off</td>
</tr>
<tr>
<td>Over-temperature protection</td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>

### Table 2: GreenPAK Serial Debugger On-Board Protection

<table>
<thead>
<tr>
<th>Protection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over-current protection (OCP)</td>
<td>PTC limits maximum VDD current equals 50 mA.</td>
</tr>
<tr>
<td>Short circuit protection (SCP)</td>
<td>PTC limits maximum VDD current equals 50 mA.</td>
</tr>
<tr>
<td>Overvoltage protection (OVP)</td>
<td>When the external power supply voltage exceeded 5.6 V, FET U1 and power supply LDO IC2 are turned off and Power LED starts to blink.</td>
</tr>
<tr>
<td>Over-temperature protection (OTP)</td>
<td>When the IC2 temperature exceeds 75 °C, FET U1 and power supply LDO IC2 are turned off and Power and Status LEDs are also turned off.</td>
</tr>
</tbody>
</table>
Figure 1: GreenPAK Serial Debugger Top View

Figure 2: PCB

Note 1  All sizes in inches.
3 Using GreenPAK Serial Debugger

3.1 In-System Programming

The GSD allows emulating and programming chips with multiple time programmable Non-Volatile Memory only. The chip is programmed/emulated through the I²C protocol via four pins: VDD, SCL, SDA, and GND.

When the GSD is connected to the USB port, the “Power” LED turns on. The ISP connector (J2 or J3) should be connected to the external board. The programmed chip can be powered from the GSD or from the external power supply. The GSD detects the external power and switches off its VDD line (in this case, I²C pull-up resistors are connected to the external power supply).

There are two options for the User to make a connection between the GSD and their target board:

- The J2 connector has four signals for SDA, SCL, power, and ground. This connector can be used to make physical and electrical connection to the target board. To enable this, the User should place a duplicate of this connector on the target board. The part number of this connector is Molex Connector Corporation 0022152046. This connector was chosen for its small physical size.

- The J3 connector also has the same four signals for SDA, SCL, power, and ground. This connector has 0.1” spacing, which will support a variety of industry-standard cabling options. Additionally, Target Board Cable is included with the GSD. If the User prefers to use this option, the cabling mating connector on the target board must be chosen. The part number for this connector is BM04B-SRSS-TB(LF)(SN).

The GSD is equipped with on-board protection and LED indicators, please refer to Table 1 and Table 2 for more information.

For a more detailed description of the programming/emulating procedure please refer to the In-System Programming Guide.

3.2 In-System Debugging

GreenPAK Serial Debugger can be used for debugging/emulating any pre-programmed or blank GreenPAK chips that support I²C interface. It is possible to reconfigure the interconnect logic, the IOs, and the macrocells. However, all NVM changes cannot be saved and will be discarded after power off. The debugging/emulating process is done through the I²C protocol via four chip pins: VDD, SCL, SDA, and GND.

When the GSD is connected to the USB port, the “Power” LED turns on. The ISP connector (J2 or J3) should be connected to the external board. The debugged/emulated chip can be powered from the GSD or from the external power supply. The GSD detects the external power and switches off its VDD line (in this case, I²C pull-up resistors are connected to the external power supply).

See Section 3.1 for physical connections between the GSD and the target board.
3.3 Operation Examples

1. Internal VDD.

GreenPAK SLG46826V directly supplied only from GreenPAK Serial Debugger R2.0.

2. External VDD.

GreenPAK SLG46826V supplied from EXTERNAL VDD, but it must be connect to GreenPAK Serial Debugger 2.0.
### BOM

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<tr>
<th>#</th>
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<td>150060BS75000</td>
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<td>D3</td>
<td>SML-D12D1WT86</td>
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<td>1</td>
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<td>11</td>
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<td>12</td>
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<td>0022152046</td>
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<td>13</td>
<td>J3</td>
<td>BM04B-SRSS-TB(LF)(SN)</td>
<td>SH SMD Header, V, 4-pins</td>
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<tr>
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<td>L1</td>
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<td>16</td>
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<td>RC0402JR-072KL</td>
<td>R0402</td>
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<td>20</td>
<td>R10</td>
<td>RC0402JR-0710KL</td>
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<td>R18</td>
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<td>PTC1206</td>
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<td>23</td>
<td>RT2</td>
<td>0ZCJ0005FF2E</td>
<td>PTC1206</td>
<td>1</td>
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<tr>
<td>24</td>
<td>TVS1, TVS2</td>
<td>AOZ8904CIL</td>
<td>SOT-23, 6-Leads</td>
<td>2</td>
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<tr>
<td>25</td>
<td>U1</td>
<td>MCP2221A-I/ML</td>
<td>QFN-16, 4x4mm</td>
<td>1</td>
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<tr>
<td>26</td>
<td>U2, U3</td>
<td>PCA9306DC1,125</td>
<td>VSSOP-8, 1.95x2.30mm</td>
<td>2</td>
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<td>27</td>
<td>U4</td>
<td>SLG59M1563V</td>
<td>STDFN_1.0X1.6-8L</td>
<td>1</td>
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<td>28</td>
<td>U5</td>
<td>SLG46582V</td>
<td>STQFN-20.0X3.0-B</td>
<td>1</td>
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</tbody>
</table>
Appendix C ERRATA

1. Previous revisions: In System Programming (ISP) Board and GreenPAK Serial Debugger R1.0 stable functionality guaranteed on voltage range **from 3.3 to 5.0V** with a maximum output current of up to 50 mA.
# Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Description</th>
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<tr>
<td>2.1</td>
<td>16-Jun-2023</td>
<td>Fixed typos</td>
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<tr>
<td>1.2</td>
<td>13-Mar-2023</td>
<td>Updated to revision 2.0</td>
</tr>
<tr>
<td>1.1</td>
<td>22-Mar-2022</td>
<td>Renesas rebranding</td>
</tr>
<tr>
<td>1.0</td>
<td>20-Oct-2020</td>
<td>Initial version</td>
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</table>
Status Definitions

<table>
<thead>
<tr>
<th>Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRAFT</td>
<td>The content of this document is under review and subject to formal approval, which may result in modifications or additions.</td>
</tr>
<tr>
<td>APPROVED</td>
<td>The content of this document has been approved for publication.</td>
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