iRiser™ Family User Guide

Intelligent Riser

Gen5 SBExpress Riser Precision Signal Control and Power Measurement

Version 3.7

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Table of Contents

Introduction

The iRiser family of NVMe test tools from SANBlaze – consisting of iRiser5, iRiser5+ iRiser6 and iRiser6SE – provide precision control of PCIe/NVMe power and control signals while continuously monitoring the power of each device under test (DUT):

iRiser Type	Description	SANBlaze System HW Compatibility	SANBlaze Minimum SW Support
iRiser5	• First iRiser for SBExpress-DT5 and RM5 systems • PCIe Gen5 lane control and glitching capability	DT5, RM5	10.8
iRiser5+	• Adds support for SANBlaze 660 M.2 Adapter for DMA power reading and 3.3V margin capability	DT5, RM5	11.0-Build2
iRiser6	• PCIe Gen6 iRiser with PCI lane control and glitching capability • Also supports SANBlaze 660 M.2 Adapter	RM5+ only	11.0-Build3
iRiser6SE	• Standard Edition PCIe Gen6 iRiser without PCI lane control or glitching capability • Also supports SANBlaze 660 M.2 Adapter	RM5+ only	11.0-Build7

Power sampling is possible at rates of up to ~1 Million samples per second (actual maximum rate is 961,538 samples/second), placing data in host memory with zero host CPU overhead.

A Sequence of events can be scheduled on each signal line with up to 10 nanoseconds (nS) precision, each with intervals from 10nS to hours. Simple or complex sequences can be defined and loaded to the iRiser from the host system.

This document describes how to install iRiser cards into the SBExpress-DT5, RM5 or RM5+ chassis, building and loading sequences to the iRiser and executing them, and provides examples of typical sequences.

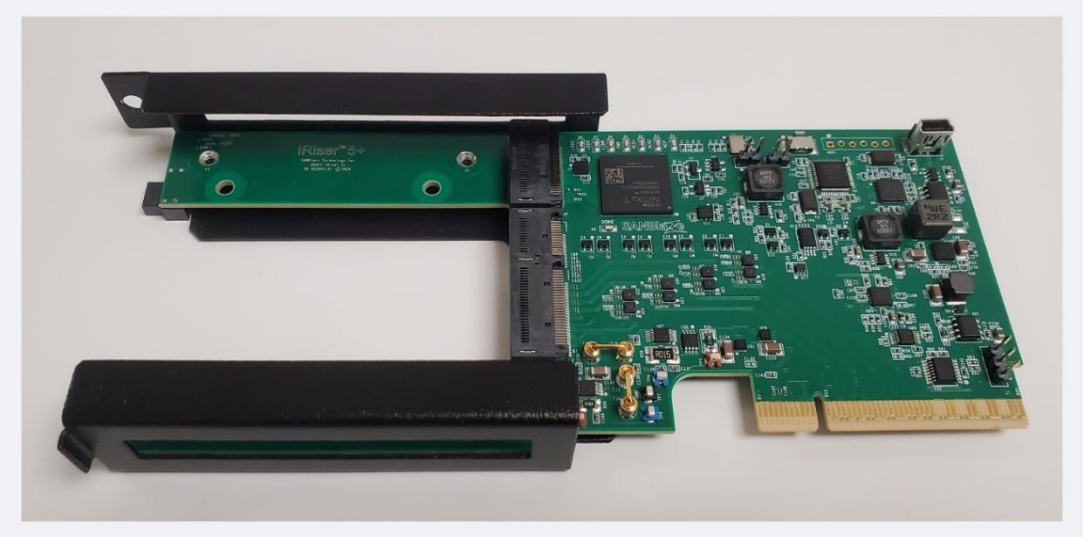


Figure 1: SANBlaze iRiser5+ Device

Note: iRiser 5+, iRiser6 and iRiser6SE devices can be paired with an optional **660 EDSFF-to-M.2 Adapter**, which enables additional test capabilities for M.2 form-factor devices:

- Adds ultra-precise power monitoring for M.2 3.3V and 1.8V power rails - with 20-bit precision (up to 78.125nV/bit)
- Adds voltage margining capability of +/- 20% on M.2 3.3V power rail
- Provides access to all other iRiser5+ / iRiser6 / iRiser6SE features for M.2 Devices, including:
    - Precise Control of Power, Data Path and Sideband Signals (CLKREQ, RESET, PERST, PLN/PLA)
    - PCIe lane glitching (available for iRiser5+ and iRiser6 only)

Figure 2: iRiser5+ device shown with optional 660 EDSFF-to-M.2 adapter and sample M.2 SSD installed

Overview of the Installation and Configuration Steps

The software upgrade requires the following items to proceed in the following order:

1. Update the system software to one of the minimum versions as indicated above.
    - Contact sales@sanblaze.com for the latest software

2. Verify that the Serial Boot Records (SBR) bridge firmware is upgraded to the latest, as shown in the **Verifying the SBR Images** section of the iRiser Family User Guide.

3. Power on the machine and verify the Software and SBR versions, using the following commands:
    - **`grep Version= /proc/vlun/config`** - to check the software version
    - **`sb_flash show`** - to check the SBR version

4. Power off the machine using the `poweroff` command.

5. Prepare to install the iRiser hardware into the RM5, DT5 or RM5+ chassis, noting the following:
   - For SBExpress-RM5:
     - Only iRiser5 and iRiser5+ devices can be installed in RM5
     - A maximum of four iRiser devices are supported and can be installed in slots 6, 7, 8 or 9

   - For SBExpress-DT5:
     - Only iRiser5 and iRiser5+ devices can be installed DT5
     - A maximum of three iRiser devices are supported and can be installed in slots 0, 1, or 2

   - For SBExpress-RM5+:
     - Only iRiser6 and iRiser6SE devices can be installed in RM5+
     - Up to 16 iRiser devices are supported

6. Install the iRiser into the appropriate RM5, DT5 or RM5+ chassis. Refer to the SB-Express Installation Guides for details.

7. Power on the RM5, DT5 or RM5+.

8. Verify the correct operation of the iRiser hardware, using the following command:
   - **`lspci |grep SANBlaze`**

   In RM5 or DT5 only
   - iRiser5 is Device 2015, revision d1 or higher
   - iRiser5+ is Device 2035, revision fe or higher
   - DT5 Motherboard is Device 2004
   - RM5 Motherboard is Device 2005

   For example:
   `lspci |grep SANBlaze`

```
20:00.0 Signal processing management: SANBlaze Technology, Inc. Device 2004 (rev af)
                                                                    ^ DT5
22:00.0 Signal processing management: SANBlaze Technology, Inc. Device 2015 (rev d1)
                                                                    ^ iRiser5
23:00.0 Signal processing management: SANBlaze Technology, Inc. Device 2035 (rev fe)
                                                                    ^ iRiser5+
```

In RM5+ only

- iRiser6 is Device 2016, revision b2 or higher
- iRiser6SE is Device 2026, revision e2 or higher
- RM5+ Motherboard (MI5) is Device 2045
- RM6 Motherboard (MI6) is Device 2046

For example:

lspci |grep SANBlaze

```
31:00.0 Signal processing management: SANBlaze Technology, Inc. Device 2016 (rev b2)
                                                                    ^ iRiser6
4b:00.0 Signal processing management: SANBlaze Technology, Inc. Device 2045 (rev 6e)
                                                                    ^ RM5+
```

9. **Note:** If a 660 M.2 Adapter is installed within any iRiser5+ / iRiser6 / iRiser6SE device being configured, the user must enable the adapter using the following command:

   - **sb_i2c2 -d <slot> -f 3V3M2 -w 1**

   where: <slot> is the slot number of the iRiser5+ / iRiser6 / iRiser6SE device installed

10. This completes the iRiser installation.

11. If it becomes necessary to reset an iRiser device back to the factory default state, use the init command:
    - **iriser -d <slot> init**

    After the init command is used, the drive under test should re-link on PCIe and power up ready.

Updating and Configuring DT5/RM5/RM5+ Systems

This section describes how to update and configure DT5/RM5/RM5+ software and firmware for iRiser testing.

Updating the System Software

You must use one of these minimum system software versions to ensure there is proper iRiser hardware recognition:

- iRiser5: Version 10.8
- iRiser5+: Version 11.0-Build2
- iRiser6: Version 11.0-Build3
- iRiser6SE: Version 11.0-Build7

Contact sales@sanblaze.com for the latest software

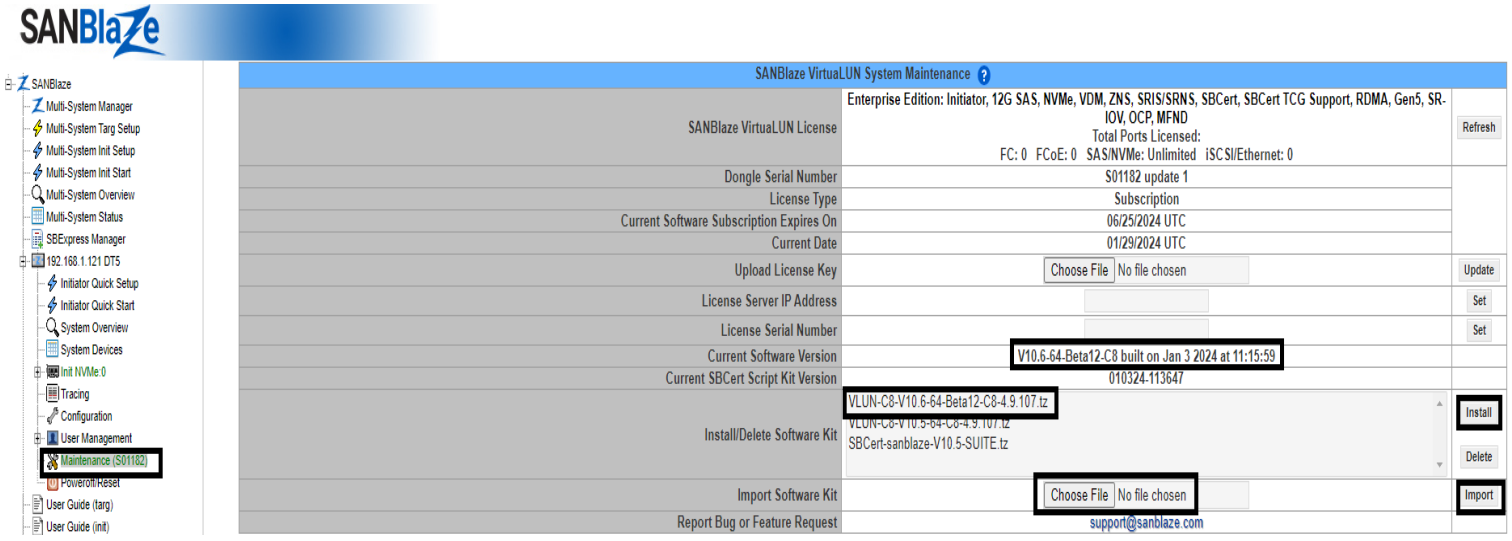
If you need to update your system software:

1. Download the share file provided to you by SANBlaze**.** This file has a **.tz** extension. For example:

   `VLUN-C8-V11.0-64-dev-C8-4.9.107.tz`

2. Open the SANBlaze SBExpress GUI by entering the **IP address** displayed on the front of your system into a web browser.

3. Within the GUI, select the **Maintenance** page located on the left-hand side menu, as shown below.

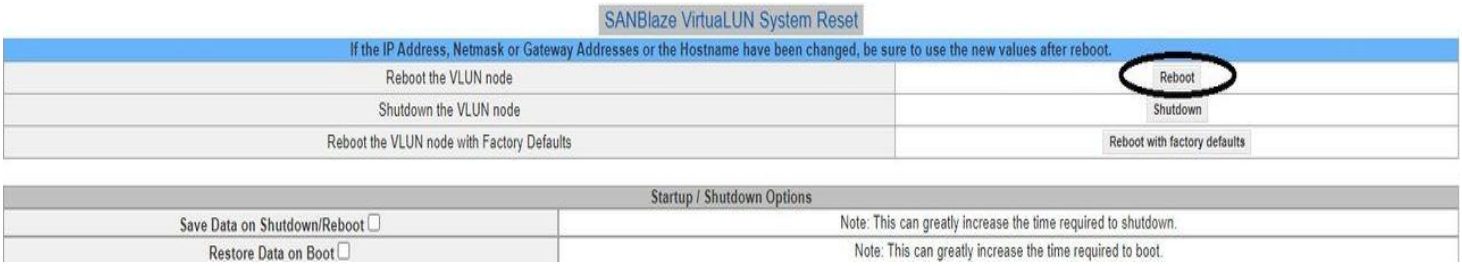


4. Within the Maintenance page, click the **Choose File** button located on the **Import Software Kit** row.

5. Select the **.tz** file provided to you by SANBlaze and then select **Import**. Importing the file may take a few minutes.

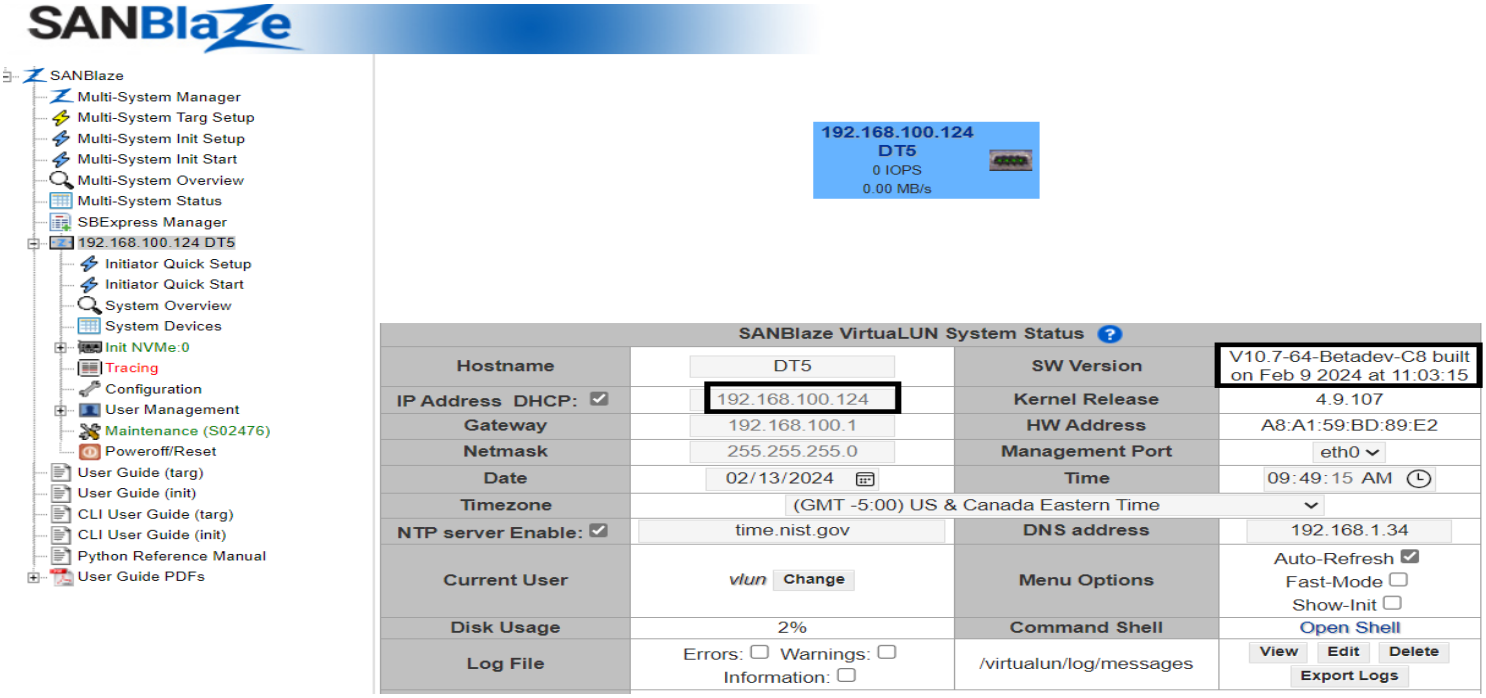
6. When the import has finished, highlight the new filename that is listed on the screen and select **Install**; a pop-up appears. Select **OK**. The installation begins; this may take a few minutes.

7. Upon completion, a **SANBlaze VirtuaLUN System Reset** page appears. For example:



8. Click on the **Reboot** button. After the system has rebooted, the SBExpress page is displayed**,** showing the current software version that is associated with the IP address of the system. In the GUI example below, the software version is shown on the top of the right-hand column from the IP address (left-hand column) on the main page. In this example, the software version is V10.8-64-Betadev-C8; your version may vary but must be Version 11.0 or later.

NOTE: If you have Version 10.6 or lower on your system, the iRiser hardware will not work. Please update to one of the minimum software versions as previously described in this section for the version of iRiser you are using.



9. To check the software version from the CLI, use the following command:

```
grep Version= /proc/vlun/config
```

Verifying the SBR Images

Using your telnet or ssh session, verify that the required Serial Boot Records (SBRs) are present on the system.

The following SBR images are the minimum revisions required for iRiser support:

RM5 V2/V3 (A0)	RM5 V2/V3 (B0)	RM5 V4	DT5	Description
03b60505	03b71009	03b72105	03c01016	Default
03B60201	03b71200	03b72204	03c02004	SRIS/SRNS

To determine your system version, use the following pair of commands:

```
sb_i2c2 -d -3 -e | grep Device
lspci | egrep "(DT|RM)[45]" -m 1
```

The last digit of the first command is the version number: i.e., 1, 2, 3, etc.

The last few characters of the second command will show if the rev is a0 or b0.

To get help for sb_flash

```
[root@RM5-100-164-IPMI-153 ~]# sb_flash -help
  INFO: Found Atlas-A0
 USAGE: sb_flash [show] [select N] [image [index|imageID]] [-r] [-l]
        -r Force recovery mode (g4Xrecovery)
        -l Force legacy mode (SwApps)
Examples:
    Show the available images and currently selected flash:
       sb_flash show
    Select next boot flash image:
       sb_flash select N (N = 0 - 3)
    Flash an image by ImageID (see ImageID from show):
       sb_flash show select N image ID
    Flash an image by Index Number (see Index from show):
       sb_flash show select N image I
[root@RM5-100-164-IPMI-153 ~]#
```

Display SBR image configuration

To display the SBR image configuration for the system use: **`sb_flash show`**

```
[root@DT5 ~]# sb_flash show
  INFO: Found 3c01016 flash image 0 at available_images 57
  INFO: Found 3c01016 flash image 1 at available_images 57
  INFO: Found 3c01016 flash image 2 at available_images 57
  INFO: Found 3c01016 flash image 3 at available_images 57
  INFO: System = DT5B0 sdb port=/dev/ttyACM0 Selected SBR Flash=0 Showing compatible images
     Index  ImageID  Type  Ver  Mode  UpLNK  SSC/CFC  Clock  System  Description
Active: 58 03c01016    10   16  Base     10      CFC     CC   DT5B0  DT5 Default
        60 03c01202    12   02  Base     10      CFC     CC   DT5B0  DT5 Default
        64 03c02004    20   04  Base     10      SSC   SRIS   DT5B0  DT5 SRIS
        66 03c02100    21   00  Base     10      CFC     CC   DT5B0  DT5 DPR Off; Dual Port
        67 03c02200    22   00  Base     10      CFC     CC   DT5B0  DT5 DPR Off; Single Port
  INFO: Current Active Images:
     Index  ImageID  Type  Ver  Mode  UpLNK  SSC/CFC  Clock  System  Description
Active:  0 03c01016    10   16  Base     10      CFC     CC   DT5B0  DT5 Default
         1 03c01016    10   16  Base     10      CFC     CC   DT5B0  DT5 Default
         2 03c01016    10   16  Base     10      CFC     CC   DT5B0  DT5 Default
         3 03c01016    10   16  Base     10      CFC     CC   DT5B0  DT5 Default
[root@DT5 ~]#
```

In the above example, the DT5 default **SBR 03c01016** is in eeprom index 0 and is active. This is the SBR image that is needed for the DT5. If your SBR image is not the default, follow the steps below.

If you want to upgrade the default SBR from **03c01016** to **03c01202**:

```
[root@DT5 ~]# sb_flash select 0 image 60
  INFO: Selecting flashindex=0
  INFO: Found 3c01016 flash image 0 at available_images 57
  INFO: Found 3c01016 flash image 1 at available_images 57
  INFO: Found 3c01016 flash image 2 at available_images 57
  INFO: Found 3c01016 flash image 3 at available_images 57
  INFO: System = DT5B0 sdb port=/dev/ttyACM0 Selected SBR Flash=0 Showing compatible images
  INFO: Selecting Flash Index=0, Image Index=59 Write File
filename=RDK_B0.RC.pre_15_Sblz_DT5_03C01202.signe
d.bin
  INFO: readFlash successfully read 2156 bytes
  INFO: Doing cmd=diff -q /tmp/firmware/0/write_test.sbr /tmp/firmware/0/
  write_test.sbr.unsigned
  INFO: Successfully uploaded Flash at Index=0 from file /virtualun/firmware/atlas/
  sbr_images/B0/DT5/RDK_B0.
RC.pre_15_Sblz_DT5_03C01202.signed.bin
  INFO: Found 3c01202 flash image 0 at available_images 59
  INFO: Found 3c01202 flash image 1 at available_images 59
  INFO: Found 3c01202 flash image 2 at available_images 59
  INFO: Found 3c01202 flash image 3 at available_images 59
  INFO: Current Active Images:
     Index  ImageID  Type  Ver  Mode  UpLNK  SSC/CFC  Clock  System  Description
Active:  0 03c01202    12   02  Base     10      CFC     CC   DT5B0  DT5 Default
         1 03c01202    12   02  Base     10      CFC     CC   DT5B0  DT5 Default
         2 03c01202    12   02  Base     10      CFC     CC   DT5B0  DT5 Default
         3 03c01202    12   02  Base     10      CFC     CC   DT5B0  DT5 Default
[root@DT5 ~]#
```

The word **Next** appears near the selected Default SBR.

1. After the Default SBR has been selected, power cycle the system using the following command:

   [root@DT5 ~**]#** **poweroff**

2. Wait 30 seconds, then turn the unit back on by pressing the checkmark button on the front of the DT5.

Verify that the Default SBR is Active

After the SBExpress-DT5 is back up and running, use the **sb_flash show** command to verify that the active SBR image 03c01016 is the Default SBR. For example:

```
[root@DT5 ~]# sb_flash show
  INFO: Found 3c01202 flash image 0 at available_images 59
  INFO: Found 3c01202 flash image 1 at available_images 59
  INFO: Found 3c01202 flash image 2 at available_images 59
  INFO: Found 3c01202 flash image 3 at available_images 59
  INFO: System = DT5B0 sdb port=/dev/ttyACM0 Selected SBR Flash=0 Showing compatible images
     Index   ImageID  Type  Ver  Mode  UpLNK  SSC/CFC  Clock  System  Description
Active: 58 03c01016    10   16  Base     10      CFC     CC   DT5B0  DT5 Default
        60 03c01202    12   02  Base     10      CFC     CC   DT5B0  DT5 Default
        64 03c02004    20   04  Base     10      SSC   SRIS   DT5B0  DT5 SRIS
        66 03c02100    21   00  Base     10      CFC     CC   DT5B0  DT5 DPR Off; Dual Port
        67 03c02200    22   00  Base     10      CFC     CC   DT5B0  DT5 DPR Off;
Single Port
  INFO: Current Active Images:
     Index  ImageID  Type  Ver  Mode  UpLNK  SSC/CFC  Clock  System  Description
  Next:  0 03c01202    12   02  Base     10      CFC     CC   DT5B0  DT5 Default
         1 03c01202    12   02  Base     10      CFC     CC   DT5B0  DT5 Default
         2 03c01202    12   02  Base     10      CFC     CC   DT5B0  DT5 Default
         3 03c01202    12   02  Base     10      CFC     CC   DT5B0  DT5 Default
  WARN: System is booted using unknown SBR image, next boot will select SBR flash 0
[root@DT5 ~]#
```

NOTE: Using **-3** in this command specifies that changes should be written to the motherboard.

You can issue any of the following commands to return the GPIOs back to their default settings:

```
iriser -d -3 set sw7
iriser -d -3c clear sw6
iriser -d -3 set sw2
iriser -d -3c clear sw1
```

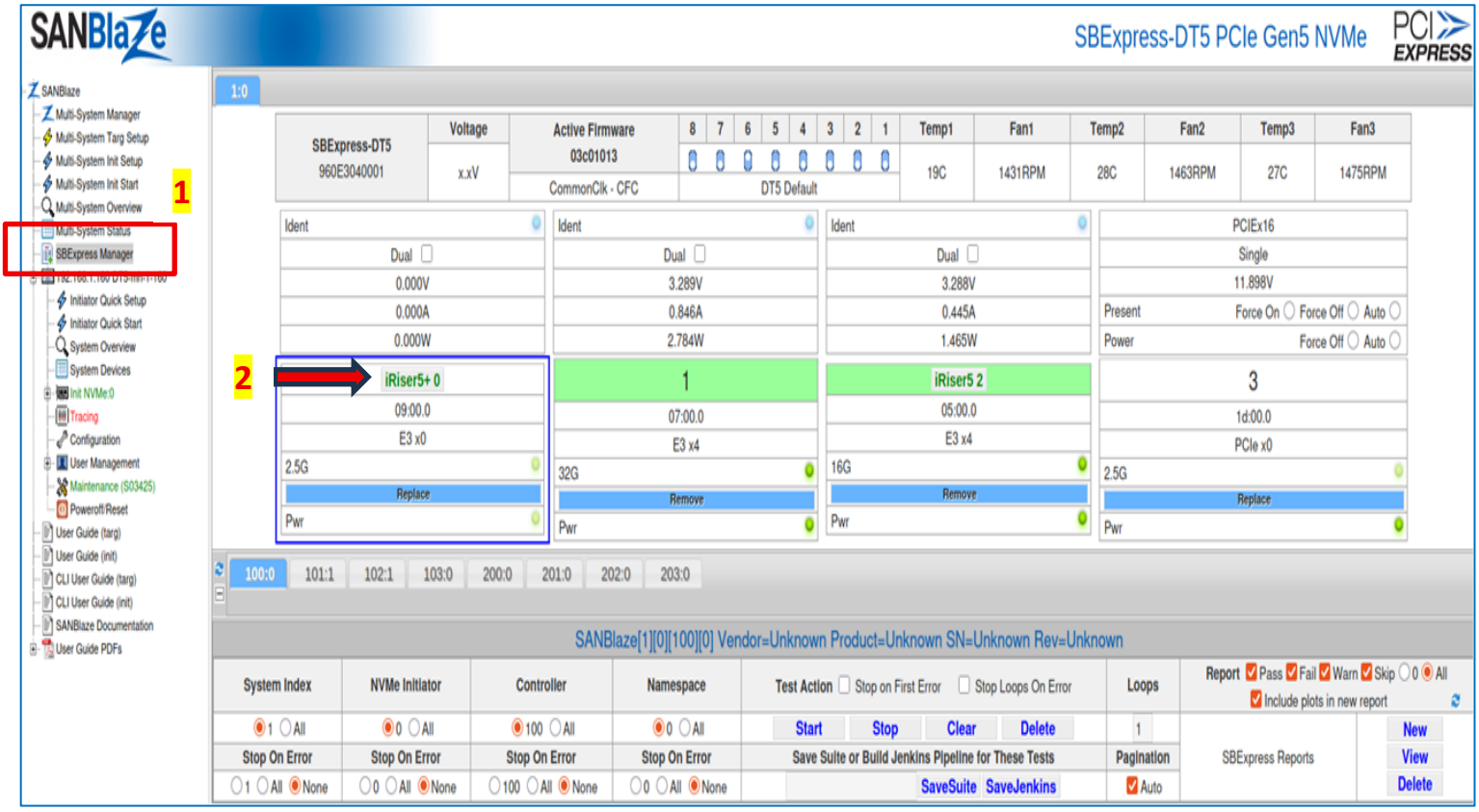
Getting Started with the GUI

You can access iRiser commands via the Graphical User Interface through the SBExpress menu to change settings in the GPIO and Signals tabs.

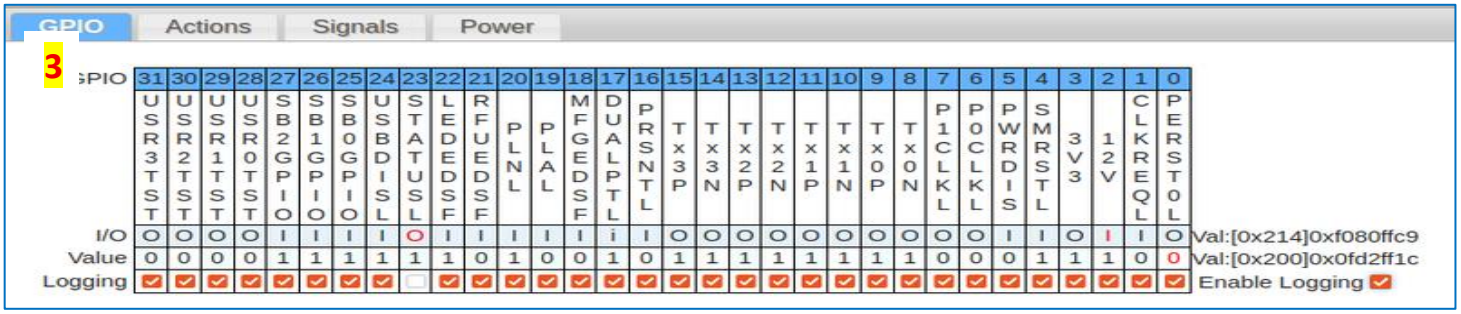
From the SBExpress Manager menu, follow these steps:

1. Click on SBExpress Manager in the left-hand menu

2. Locate the slot(s) that have an iRiser device populated and click on the grey identifier (e.g., “iRiser5+ 0” or “iRiser5 2”)

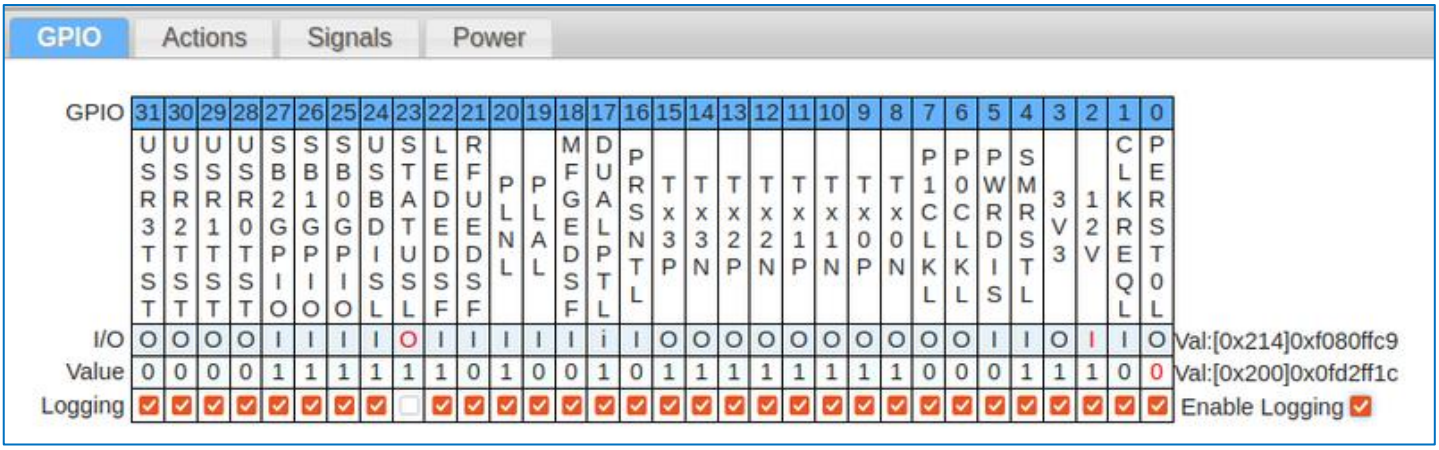


3. A pop-up window appears showing the GPIO signals for the iRiser device selected**:**



iRiser GPIO Tab

The GPIO tab is the first tab available in the iRiser GUI. This tab is designed to be a live graphical view of the current iRiser signals. It allows the user to interact with the signals, turning them on and off with the click of a button. Below you can see a screenshot of the page.

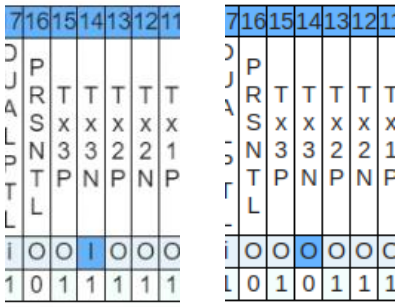


Starting from the top, you can see the table shows the GPIO number of each signal on the iRiser. Underneath, you can see which signal name corresponds to this GPIO number. As iRisers are updated in the future, these values will automatically reflect the signals of whichever iRiser is currently being looked at.

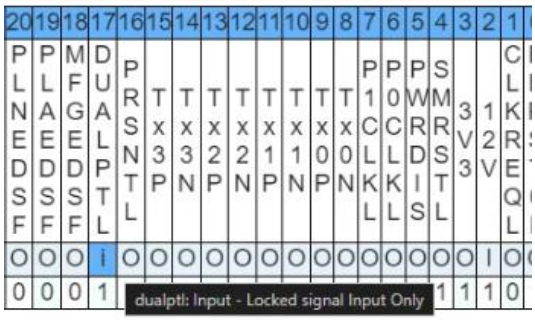
Moving down a little, you can see a row for I/O values. This row shows the signal's direction:

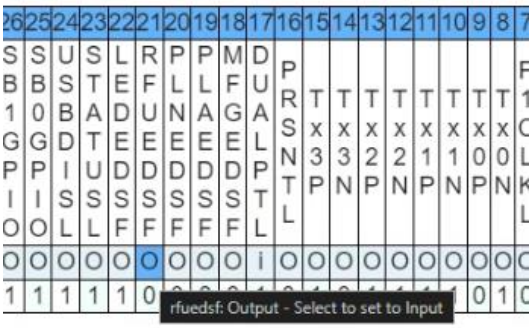
'I' corresponds to 'Input' and 'O' for 'Output'

If a signal's I/O value is marked with a lower case 'i' or 'o', this means the signal is locked to that direction and cannot be changed. Clicking on an element in this row will send the request to the iRiser to change that signal's I/O direction to the opposite of what it is currently set to. Take the signal "Tx3N" below:



Hovering over a value in this row will also provide additional information about the signal.

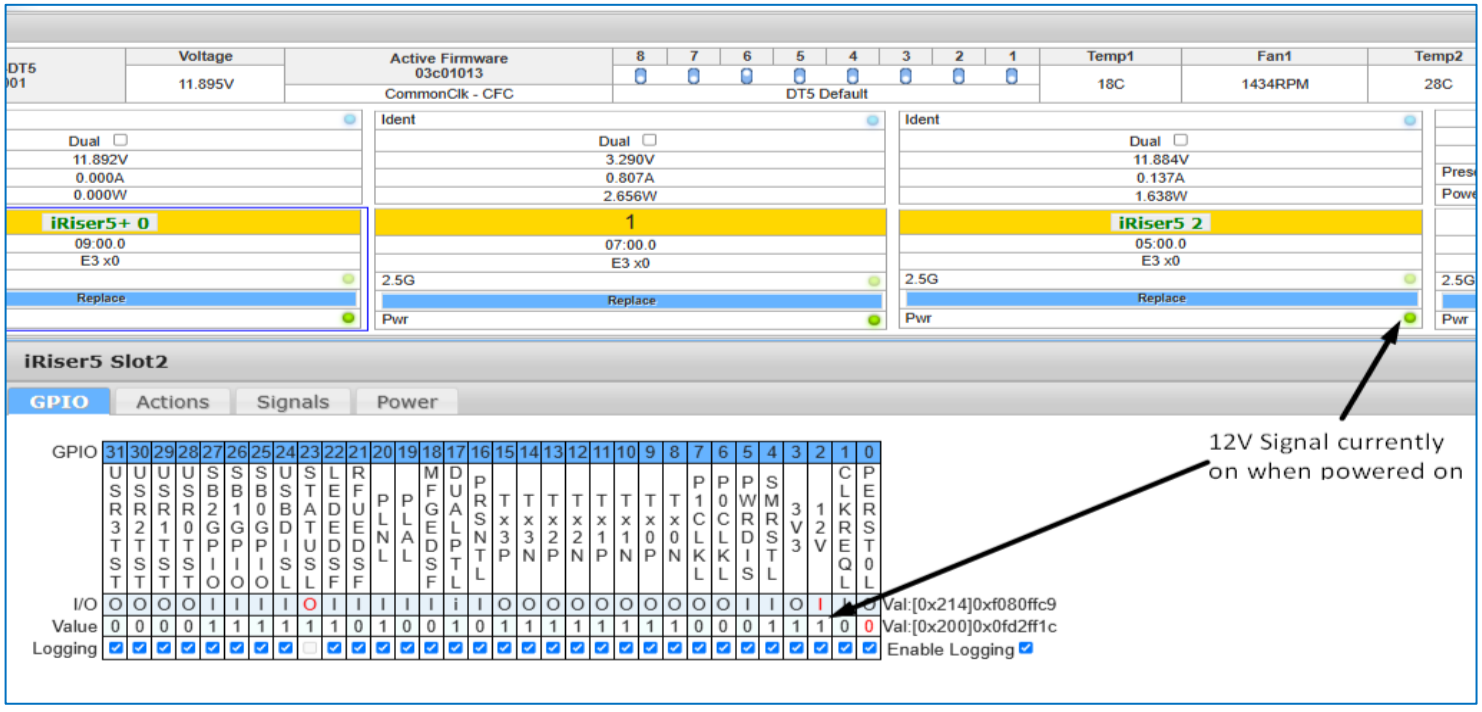




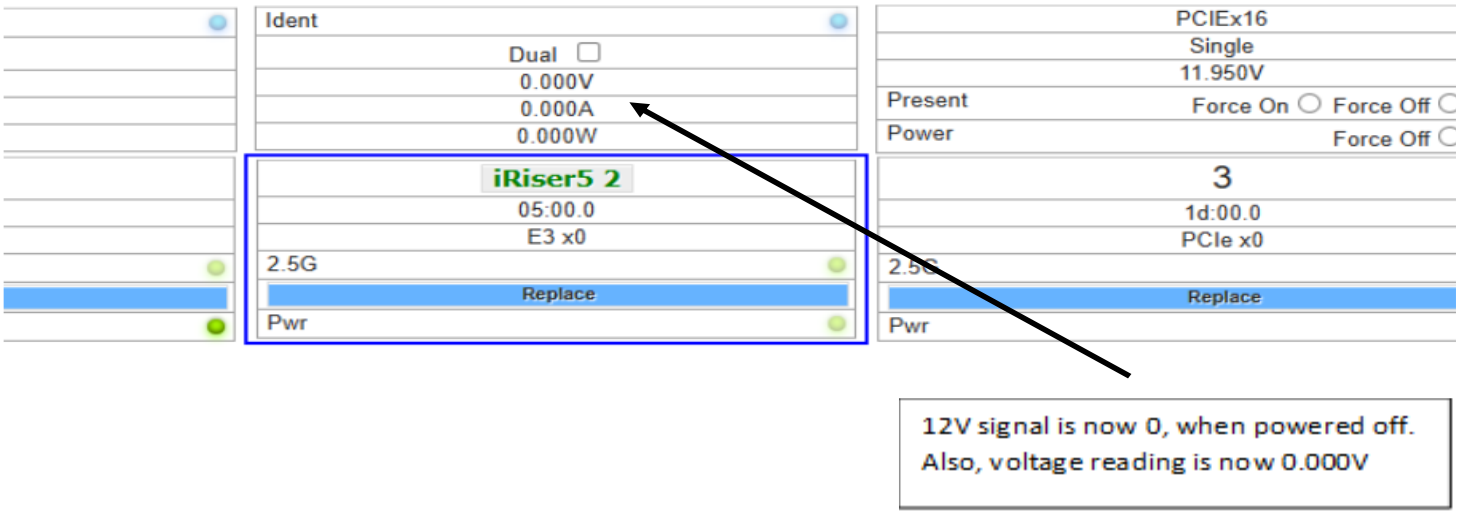
The next row of the table is the ‘value’ row. This is the current state of the signal. ‘1’ indicates the signal is on, ‘0’ indicates it is off. Like the ‘I/O’ row above, clicking any of the elements in this row will automatically set this value to the opposite of what is currently on screen and update the iRiser accordingly.

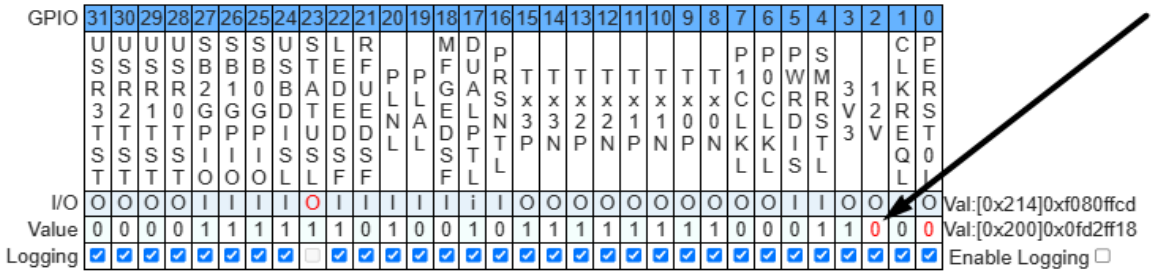
As mentioned previously, this page is a live view of the signals. When interacting with the drive outside of the iRiser (e.g. powering it on or off), these signals will automatically change in order to reflect the current state. This may take a few seconds to do so.

Here is an example showing the 12V signal while the device is powered on:



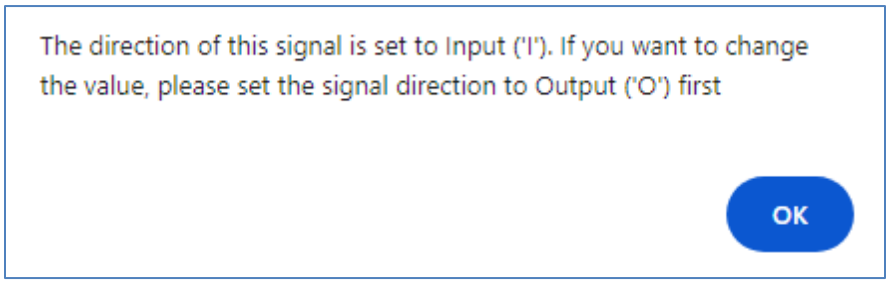
After clicking the power off button in the SANBlaze GUI, the 12V value is automatically updated to reflect the 12V power state and is switched to a ‘0’ value.





Note: You can’t change the value if the direction is an input; you would need to change it to an output first, then you can change the value.

If you try to change the value on an input, this message will pop up:

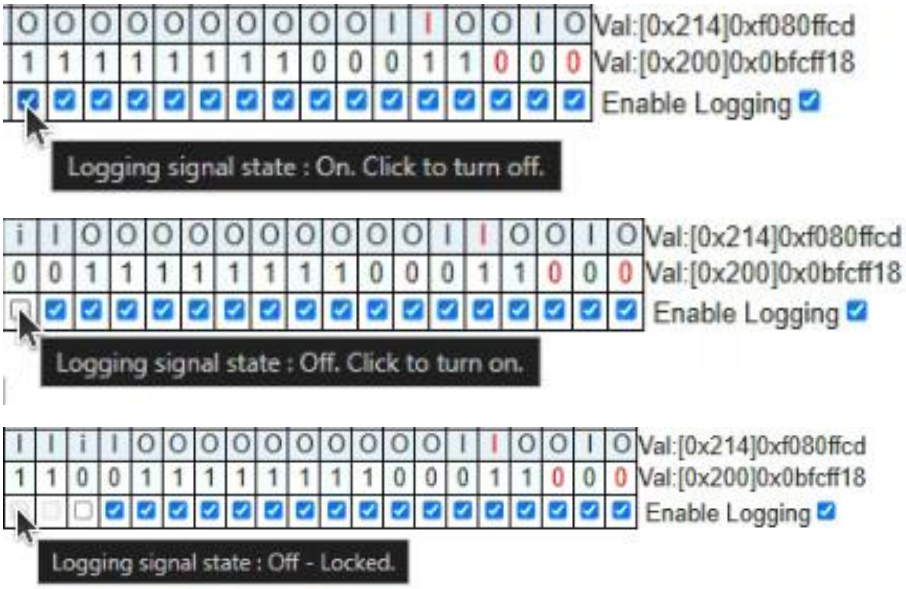


GPIO Logging

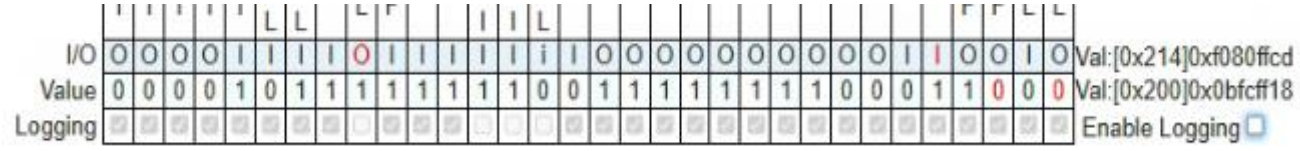
The iRiser GPIO GUI tab provides a visual representation of the current GPIO logging status. That tab also contains a bottom row for GPIO logging.

Each signal contains a checkbox. If a checkbox is checked, GPIO logging is turned on for this signal. If it is left unchecked, GPIO logging is turned off for this signal.

Some signals may have their checkboxes disabled; this indicates the signal's GPIO logging cannot be turned on. You can view the status of a signal by moving the cursor over the checkbox.



At the right-hand side of the logging row, you can see one additional checkbox. This is to enable and disable the logging functionality in its entirety. If this checkbox is unchecked, the logging functionality will be turned off which in turn also disabled every checkbox on this row.



iRiser Actions Tab

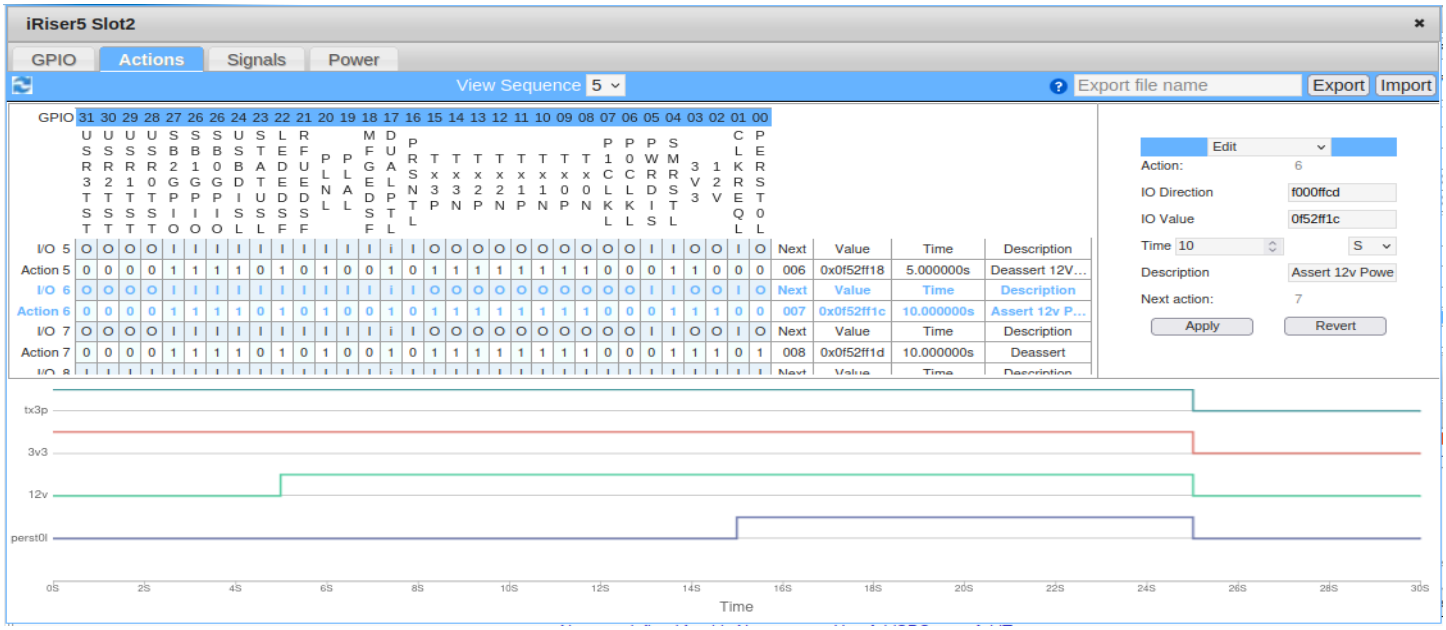
The Actions tab is designed to enable a user to create “Actions” and “Sequences” from a graphical user interface.

The iRiser is programmed by means of loading Actions and Sequences of Actions to the device which are then executed changing the specified GPIO signals. Sequences are simply defined as groups of Actions that are linked together and either end in a "stop" (Sequence will run once and stop) or the index of another Action. If an Action points to the first Action in the Sequence, the Sequence will loop until stopped.

If the Sequence is a loop and the system reboots, after the system comes back up, the Sequence will continue running. The blue status LED on the front of the iRiser will be blinking. If the Sequence is not a loop, after it stops running, the blue status LED on the front of the iRiser will stop blinking.

There are 128 "slots", each of which can hold an Action, and a Sequence can be one or more Actions; up to 128 Actions can be defined in a Sequence.

This page aims to make it simpler to create and modify Sequences with a clear visual representation of what the signal states looks like for each Action *(both direction and value)*; which Actions are in the Sequence and a chart showing how the Sequence looks in its timeline.



There are 3 main segments to this Actions tab that we will cover in this documentation:

- A table showing Signals and Actions
- A chart showing Signal state vs. time
- A section to edit, delete and add new Actions

Starting from the top

At the top of the page, you'll notice a light blue bar, shown below.
This bar holds 2 elements of the page: a 'refresh' button and a 'Refresh View Sequence' drop-down:

On the left-hand side, you'll see a 'refresh' button. When clicked, this button will refresh all elements on this page. It also updates the drop-down in this top bar if you do not want to wait the 10 seconds it takes to refresh.

The refresh button itself is useful if you use scripts or commands to modify Sequences from the cli and want to quickly update what is on screen to represent the new state of the current selected Sequence.

In the center of that bar, you'll see a 'Refresh View Sequence' drop-down menu. This drop-down includes all the currently active Sequences on the current iRiser. This drop-down is automatically updated every 10 seconds to add or remove Sequences, based on which Sequences are on the iRiser.

GPIO Signal Table

The Signal Table is an interactive table that shows all the Actions of the Sequence selected.

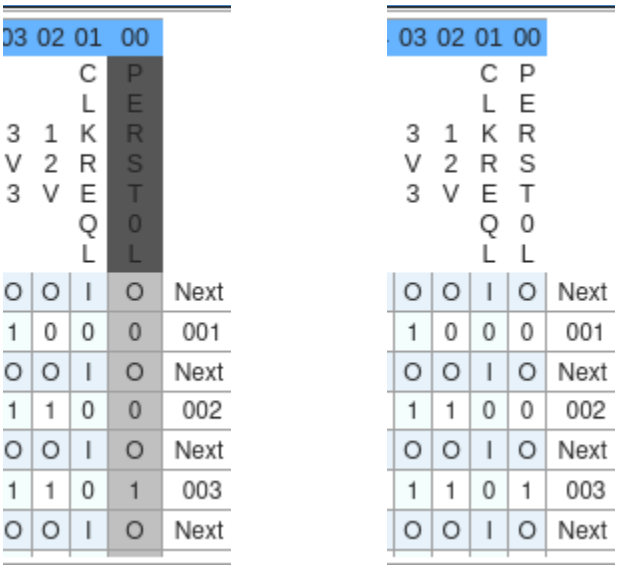
GPIO	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00				
	USR3TST	USR2TST	USR1TST	USR0TST	SB2GPIO	SB1GPIO	SB0GPIO	USBDISL	STATUSL	LEDDESF	RFUDDSF	PLNEDSF	PLAEDSF	MFGEDSF	DUALPTL	PRSNTL	Tx3P	Tx3N	Tx2P	Tx2N	Tx1P	Tx1N	Tx0P	Tx0N	P1CLKLL	P0CLKLL	PWRDIS	SMRSTL	3V3	12V	CLKREQL	PERST0L				
I/O 0	O	O	O	O	I	I	I	I	I	I	I	I	I	I	i	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value	Time	Description
Action 0	0	0	0	0	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	0	0	0	001	0x0f52ff18	1.000000s	Deassert 12V...
I/O 1	O	O	O	O	I	I	I	I	I	I	I	I	I	I	i	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value	Time	Description
Action 1	0	0	0	0	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	0	002	0x0f52ff1c	2.000000s	Assert 12v Po..
I/O 2	O	O	O	O	I	I	I	I	I	I	I	I	I	I	i	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value	Time	Description
Action 2	0	0	0	0	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	1	003	0x0f52ff1d	200.000000ms	Deassert PE...
I/O 3	O	O	O	O	I	I	I	I	I	I	I	I	I	I	i	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value	Time	Description

What you see above is a similar layout to the output from the cli command:

```
iriser -d <slot> show sequence {sequenceNumber}
```

In blue at the top is each GPIO bit number for the signal it represents. Directly underneath is the full string name of that signal.

Clicking on either of these 2 elements will highlight the column. Clicking on the column again will remove the highlight. Only 1 column may be highlighted at a time. This is a useful way to visually distinguish the values for the signal highlighted.

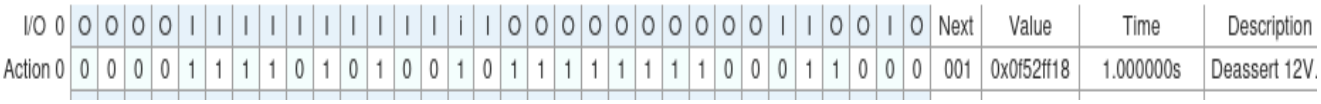


03	02	01	00	
		CLKREQL	PERST0L	
3V3	12V			
O	O	I	O	Next
1	0	0	0	001
O	O	I	O	Next
1	1	0	0	002
O	O	I	O	Next
1	1	0	1	003
O	O	I	O	Next

03	02	01	00	
		CLKREQL	PERST0L	
3V3	12V			
O	O	I	O	Next
1	0	0	0	001
O	O	I	O	Next
1	1	0	0	002
O	O	I	O	Next
1	1	0	1	003
O	O	I	O	Next

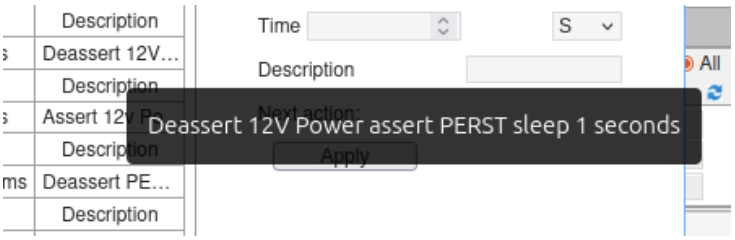
User interaction with the GPIO Signal Table

Below the GPIO signal name row are each of the Actions included within this currently selected Sequence. Each Action has 2 rows, the upper one that represents the direction of signals in the Action and the lower represents the state (*value*) of the signals in the Action.

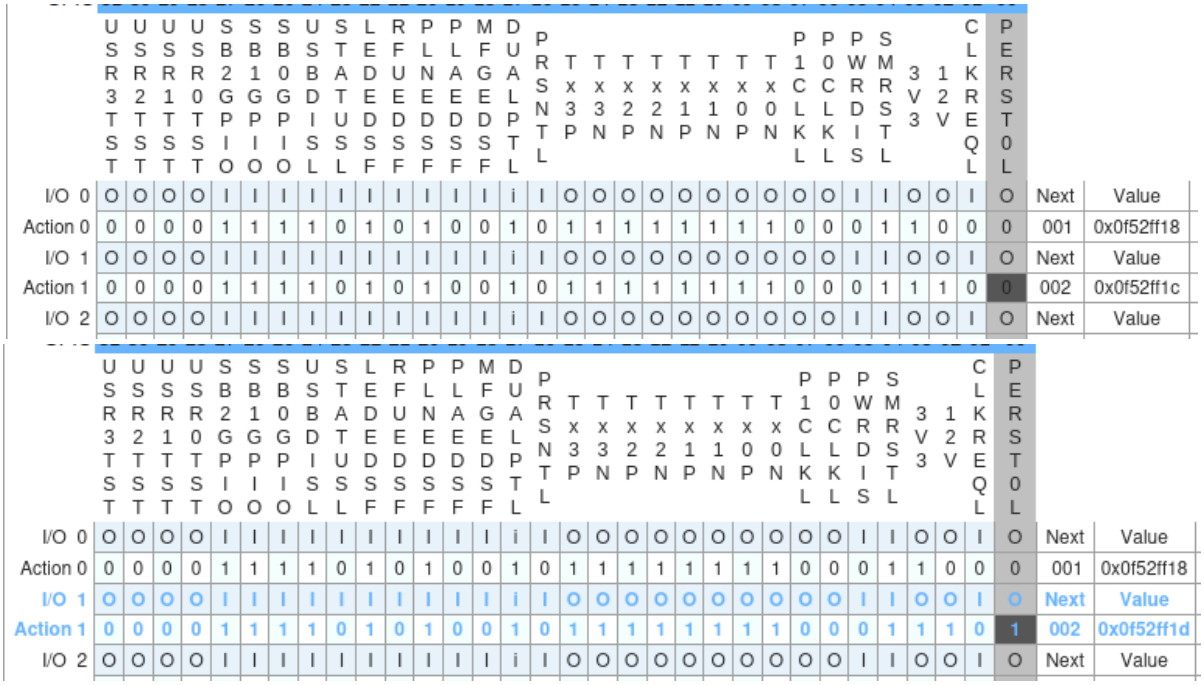


I/O 0	O	O	O	O	I	I	I	I	I	I	I	I	I	I	i	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value	Time	Description
Action 0	0	0	0	0	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	0	0	0	001	0x0f52ff18	1.000000s	Deassert 12V.

To the right most side of the table, you'll see each Action also contains columns that represent which Action it points to next, what this Action value is as a hex value, the time the Action will run for, and any description / name associated with that Action. Actions that have too large a description contain a hover over text to fully show what the description is.



You can click on an element in the table to change it. For example, if you wanted to change the signal state of Perst in Action 1, you could find the column and row associated with this signal and Action and click it to change the value. See below:



	USR3TST	USR2TST	USR1TST	USR0TST	SBG2PIO	SBG1PIO	SBG0PIO	USBDISL	USTAUSL	LEDESF	RFUEDSF	PLNEDSF	PLAEDSF	MFGEDSF	DUALPTL	PRSNTL	Tx3PN	Tx3NP	Tx2PP	Tx2NN	Tx1PP	Tx1NP	Tx0PP	Tx0NN	P1CLKL	P0CLKL	PWRDIS	SMRSTL	3V3	12V	CLKREQL	PERST0L		
I/O 0	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value
Action 0	0	0	0	0	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	0	0	0	001	0x0f52ff18
I/O 1	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value
Action 1	0	0	0	0	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	0	002	0x0f52ff1c
I/O 2	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value

	USR3TST	USR2TST	USR1TST	USR0TST	SBG2PIO	SBG1PIO	SBG0PIO	USBDISL	USTAUSL	LEDESF	RFUEDSF	PLNEDSF	PLAEDSF	MFGEDSF	DUALPTL	PRSNTL	Tx3PN	Tx3NP	Tx2PP	Tx2NN	Tx1PP	Tx1NP	Tx0PP	Tx0NN	P1CLKL	P0CLKL	PWRDIS	SMRSTL	3V3	12V	CLKREQL	PERST0L		
I/O 0	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value
Action 0	0	0	0	0	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	0	0	0	001	0x0f52ff18
I/O 1	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value
Action 1	0	0	0	0	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	1	002	0x0f52ff1d
I/O 2	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	O	Next	Value

Before the change, the signal was set to be off at Action 1 in the Sequence. represented by the value"0". After the change the signal now has a value of "1" showing the signal will be turned on for this Action.

This value change is instantly applied upon click!

(*Note – For the image above, the column highlight was on to help show what was changed)*

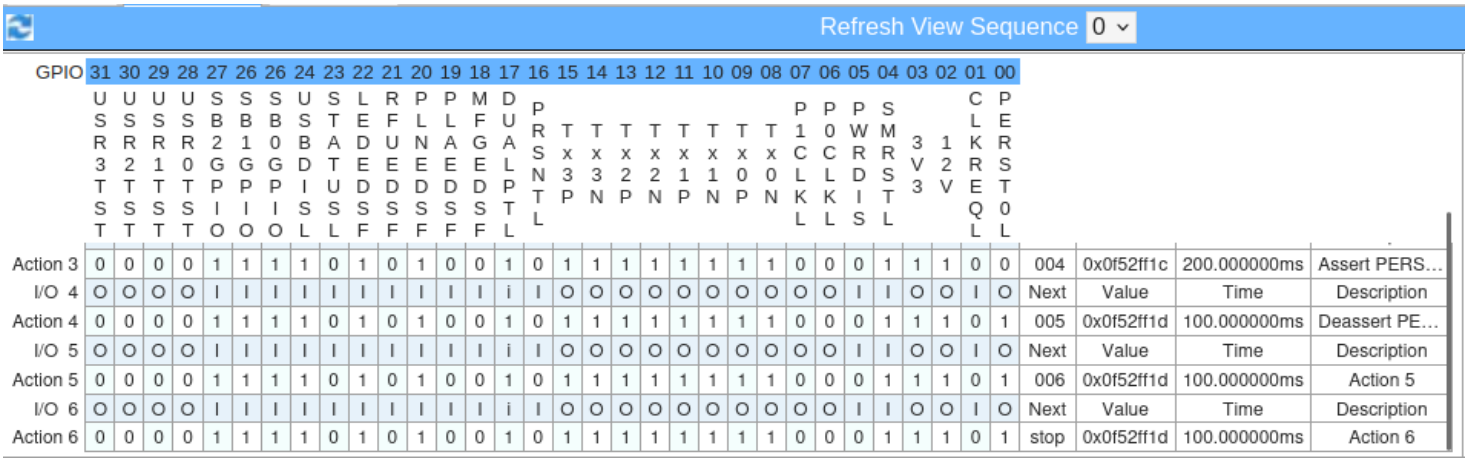
Please use this table below to check what each value character in the chart represents.

Character	Row	Meaning
0	Direction	The Direction of the signal is set as an output
I	Direction	The Direction of the signal is set as an input
i	Direction	The Direction of the signal is locked to input and can't be changed
o	Direction	The Direction of the signal is locked to output and can't be changed
0	Value (state)	The State of the signal is OFF for this Action
1	Value (state)	The State of the signal is ON for this Action

Note – If you attempt to change a locked bit, the GUI will alert you with a reason why this value will not be changed.

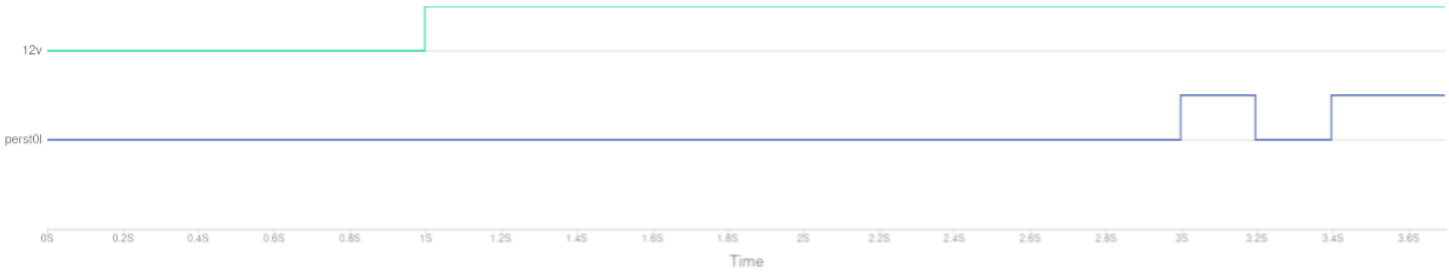
You may have noticed; the Action row has now turned blue. This serves a purpose, but we'll go over this in more detail when talking about the editing, adding and deleting Actions later.

For larger Sequences, the number of Actions may exceed the boundaries of the table. However, the table is scrollable, and for convenience, the header rows are static so you can always see the signal name of each column.



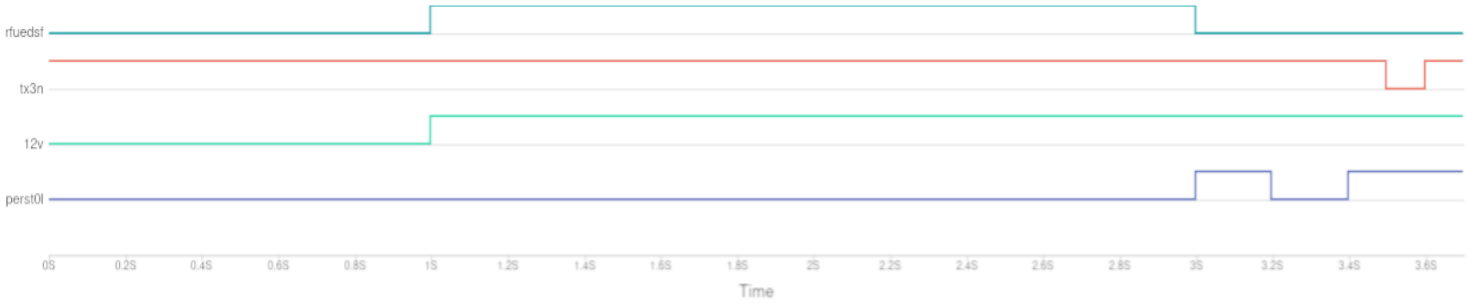
Signal chart

Below this table is a chart that represents the signal state vs. time. This chart is a step-line graph that shows only the signals that change in the Sequence and at what time in the Sequence they will change.



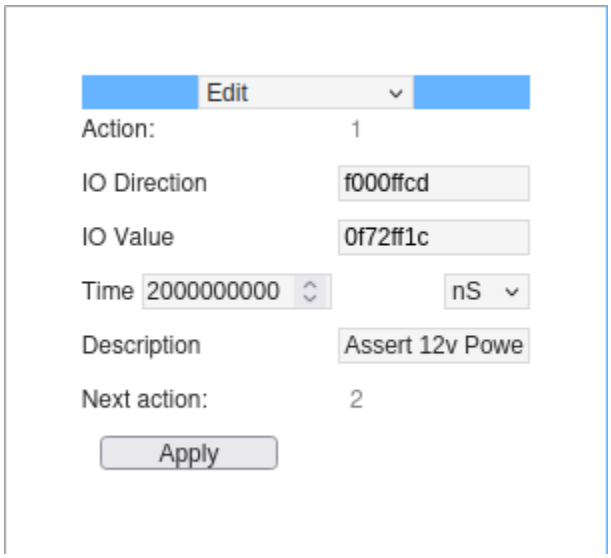
For example, in the image above, the ”Perst0l” signal is off up until 3 seconds, where it is turned on for 0.2 seconds, turned off for another 0.2 seconds and turned on for the remainder of the Sequence.

This chart will automatically update when changes are made to the Sequence via the signal table. If more signals are changed throughout the Sequence, more lines appear on the graph to represent these changes.



Editing, adding and removing Actions using the GUI

The last segment on this page is a table that allows you to quickly edit, delete and add new Actions to the currently selected Sequence. At the top of the section is a blue bar with a drop-down. In this drop-down there are 3 choices: Edit, Delete and Add new Action. Selecting an option from this drop-down will update the segment with new GUI elements based off of the item selected.



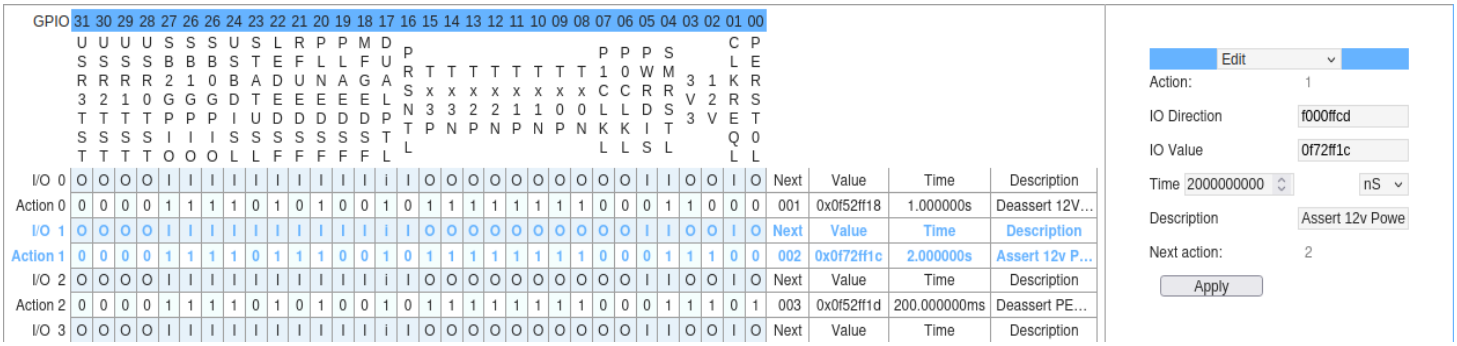
Editing Actions

As editing an Action is the first item to appear, we will cover this first. Above, you'll see a small table with the following items:

- **Action: (Locked)** The number of the Action currently being edited
- **IO Direction:** Hex value representation of the signal directions for this Action
- **IO Value:** Hex value representation of the signal states for this Action
- **Time:** The time this Action will run for. This has a box for a numeric value, followed by a drop-down to indicate if this value is in Nanoseconds, Microseconds, Milliseconds, or Seconds.
- **Description:** A description for the Action
- **Next Action:** The next Action this Action points to

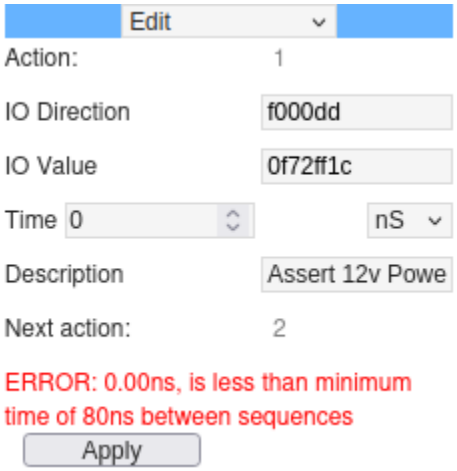
For the last Action in any Sequence, this next Action will instead be a drop-down that allows the user to select if they want the Sequence to stop after this Action is complete, or loop to another Action within the Sequence.

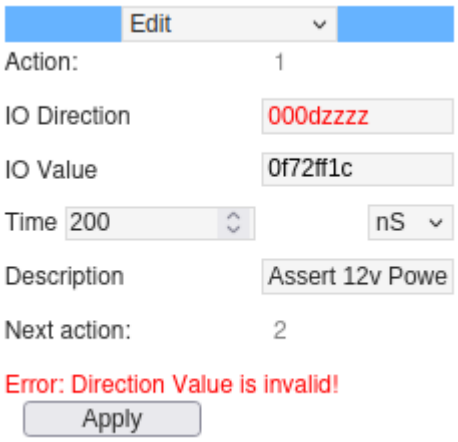
To select an Action to be edited, the user needs to click on an item in the signal table to the left. As hinted earlier, this turns the Action rows blue which indicates that Action is currently being edited.



Clicking the Action will automatically populate the edit segment with the current values of that Action. If you change values by clicking within the signal table, these changes are automatically updated in the edit segment too.

Once the values have been populated into the edit segment, you can manually change them to fit your desired needs. For the changes in this edit segment to be applied, you must hit the “apply” button. If an error occurs during the application of the new values, an error will show, and no change will be made until this error is corrected and the user hit “Apply”.

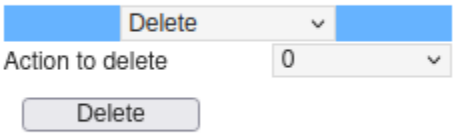




Re-clicking the Action from the Action table will re-populate and override this edit segment with the current values of the Action clicked.

Deleting Actions

Selecting “Delete” from the drop-down menu in this segment will display new GUI elements to allow you to delete Actions.



This “Delete” view only contains 2 items: A drop-down to select the Action you wish to delete and a Delete button to delete the current Action selected in the drop-down.

The Actions listed here are only for the Sequence currently selected on screen. Changing to another Sequence or adding new Actions to the current Sequence will automatically re-populate this drop-down with the current Actions in this Sequence.

Every time the user presses the delete button, it will prompt the user with a confirmation dialog to confirm whether they really want to delete the Action. Deleting an Action mid-Sequence will make the Action prior to the deleted Action point to the Action following the deleted Action (if applicable).

For example, you select Sequence 0. It has 5 Actions.

Action 0 --> Action 1 --> Action 2 --> Action 3 --> Action 4 --> Stop

You choose to delete Action 2 from the Sequence. The Sequence now looks like this.

Action 0 --> Action 1 --> Action 3 --> Action 4 --> Stop

Deleting an Action at the start of the Sequence is slightly different in that the Sequence will now be renamed to the second Action in the Sequence or should there not be a second Action, the Sequence will be deleted.

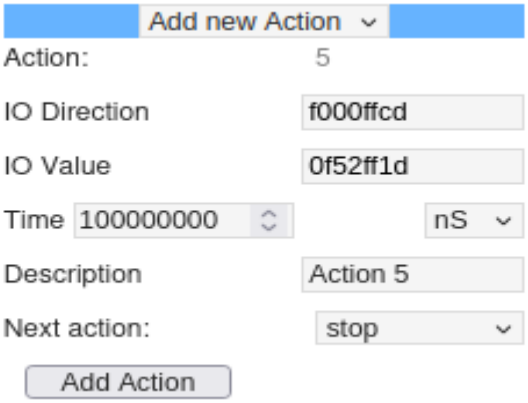
For example, if you select Sequence 0 from before, it has 5 Actions. You delete Action 0. The Sequence is now called Sequence 1 and contains the rest of the Actions.

Action 1 --> Action 2 --> Action 3 --> Action 4 --> Stop

Adding Actions

The last segment / view to talk about is the “Add new Action”. This segment is designed to make it as simple as possible to add new Actions to the currently selected Sequence.

It should be noted that users can only add new Actions to the end of Sequences, not mid-way through.



This layout is very similar to the Edit Action layout, however there are a few distinct differences.

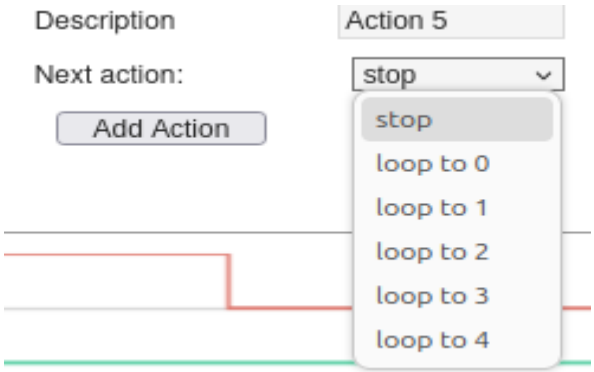
Firstly, the Action number of the new Action is chosen for you. While you can choose an Action number in the CLI, the GUI automatically assigns the next suggested ‘best’ Action number for you. This is chosen to be the next numerical incremented value to whatever the last Action in the Sequence is.

For example, if you have a Sequence that consists of Actions numbered 1, 2 and 3 the newly suggested Action number is 4. If 4 is unavailable it goes to 5 and so on.

If you have a Sequence that consists of Actions 20, 30 and 40, the newly suggested will be 41.

If you have a Sequence that consists of Actions 20, 10, and 5, the newly suggested Actions number will be 6.

Second, the ‘Next Action’ value is a drop-down to allow you to choose if the Sequence should stop after this Action or loop to another Action. Remember, when this Action is added, it will be the new last Action in the Sequence.

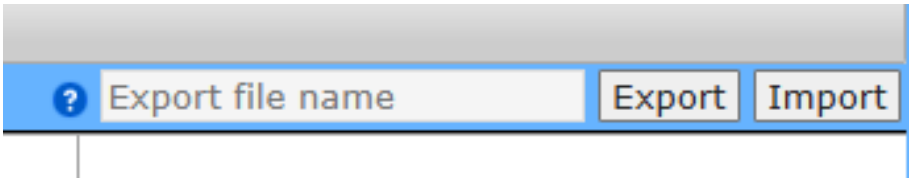


Third, when selecting the 'add new Action' from the drop-down, it will automatically populate the fields using the current last Action's fields. For example, if the last Action currently has a time of 100mS, the add Action will automatically populate with 100mS. If the last Action has an IO direction hex value of "f000ffcd", the add Action will automatically populate with an IO direction hex value of "f000ffcd".

Lastly, instead of an 'Apply' button you now have an 'Add Action' button. This button will create the new Action, with the values specified, and add it to the end of the current selected Sequence. Once the Action is added, the other elements on screen will update to show this newly added Action. Additionally, this "Add new Action" segment will re-populate with the suggested next Action number after the one that was just added.

Import and Export Configuration Files

In the top right-hand corner of the Actions tab are two buttons to import and export config files. A config file is a file that contains the current state of the iRiser Sequences and Actions when the config file was produced.



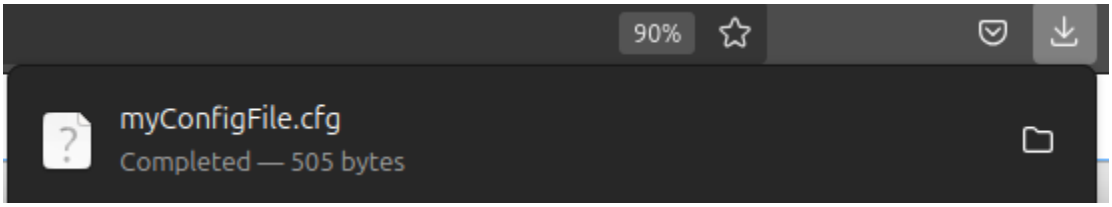
This allows you to create a Sequence layout on one iRiser, save it, and then easily upload it to many other iRisers. This can be useful for setting up new iRisers in a system or sending the configuration of your iRiser to a colleague in order to run a Sequence that might be causing your drive issues.

The text box allows you to write a name for the config file to be saved as. **Note**: the filename is limited to 64 characters. If no name is specified, the file will be named "iRiserConfig-YY-MM-DD-HH-MM-SS.cfg" according to the current date and time the config file was created. Please note, while the name of the config file can be altered, we recommend you do not edit the contents as malformed config files will not be loaded onto the iRiser.

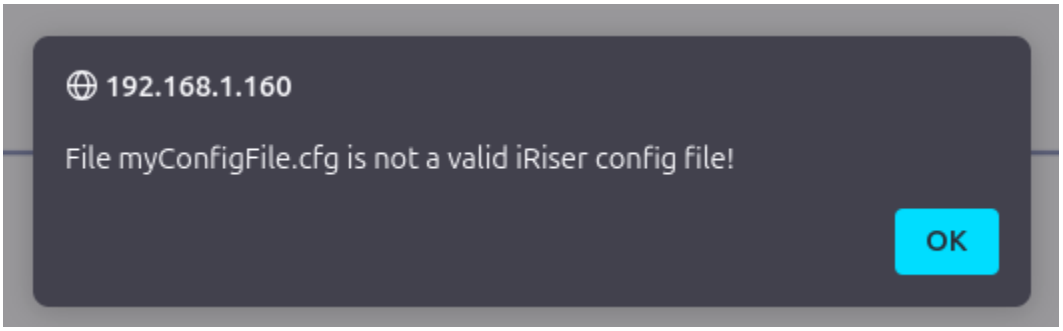
Note: The following special characters cannot be used in the exported file name. Doing so will automatically replace these characters with the underscore character.

> Special characters not allowed: | \ / : * ? " > <
>
> If used, they will be automatically replaced with the _ (underscore) character.

Clicking the export button will then download the newly created config file to your system, as seen below.

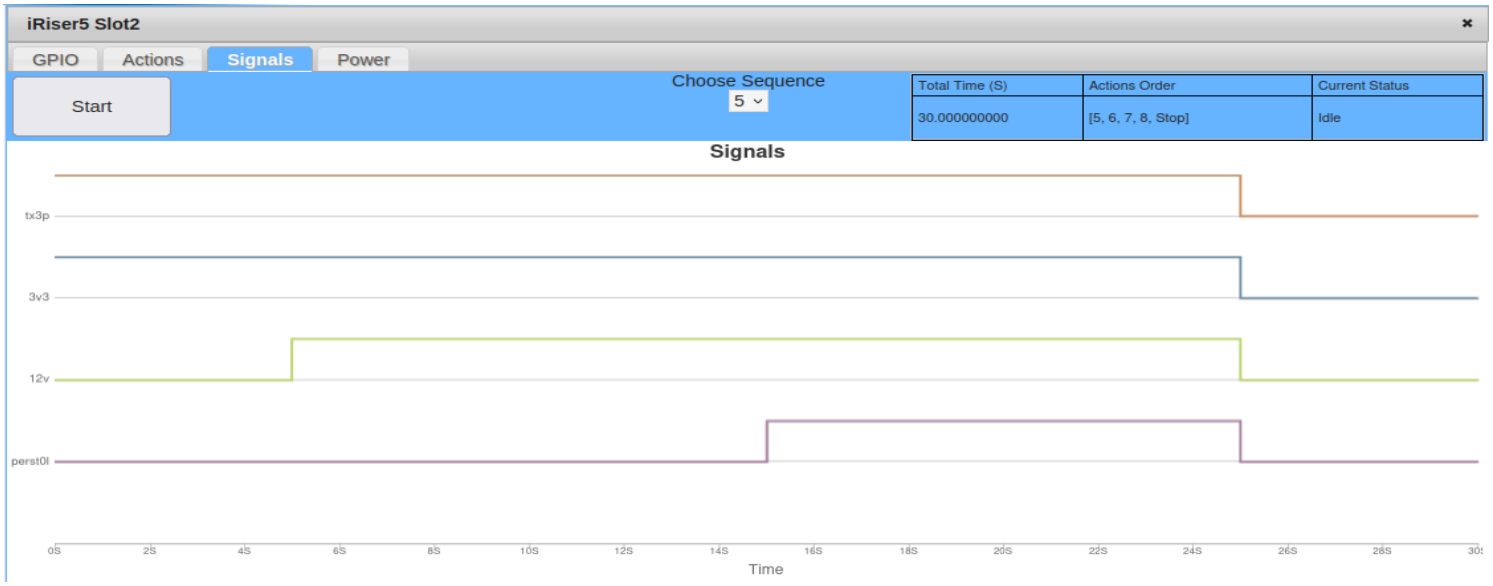


The import button is used to import config files onto the iRiser. Clicking this button opens a file explorer to allow you to select the config file. Once selected, it will automatically upload the file and refresh the Actions tab accordingly to reflect the changes. If the config file is bad, the page will alert you that the config file has not been accepted.



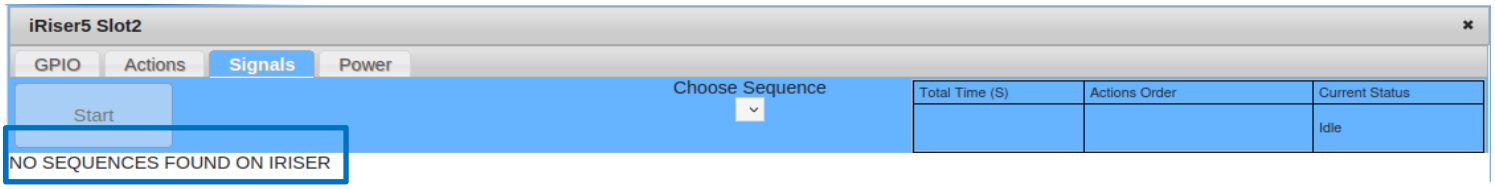
iRiser Signals Tab

The Signals tab is designed to visualize Sequences on the iRiser as a chart of “signal state” vs. time. To do this, the page automatically requests information from the iRiser in the background that is used to update current Sequences found, whether a Sequence is running, and when a Sequence is updated.

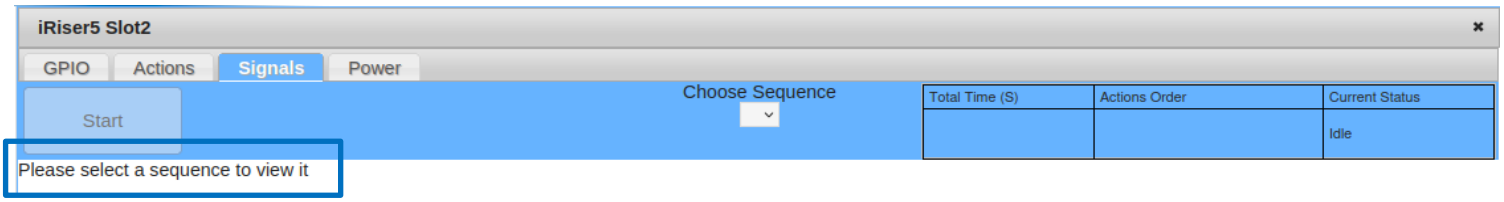


When first navigating to the tab, you’ll be presented with one of the 2 states below.

This first state informs the user that there are no Sequences currently found on the iRiser. To add new Sequences, the user must use the iRiser program on the CLI (see next section):



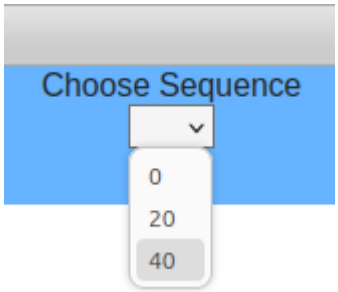
Once a new Sequence is added, this page will automatically update within a few seconds and show the new state as seen in the image below:



In the second state above, the page informs us there is at least 1 Sequence on the iRiser and it can be selected to view it.

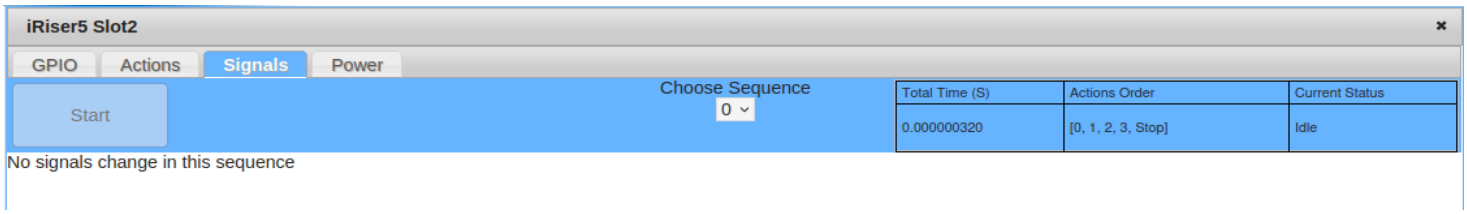
Selecting a Sequence

To select a Sequence to view, click on the “Choose Sequence” drop-down. Here you’ll find all the current Sequences discovered on the iRiser. If the user has recently added one or more additional Sequences, these may take up to 30 seconds to be added to the drop-down list.



Upon selecting a Sequence from the drop-down, the page will automatically update to show a new chart with “signals state” vs time, alongside updating the table in the top right-hand corner to show some additional information about the Sequence.

As the table headers read, the first column shows the total time of the selected Sequence in seconds, the second column displays a list of all the Actions within the Sequence and the third column shows the current state of the iRiser itself.



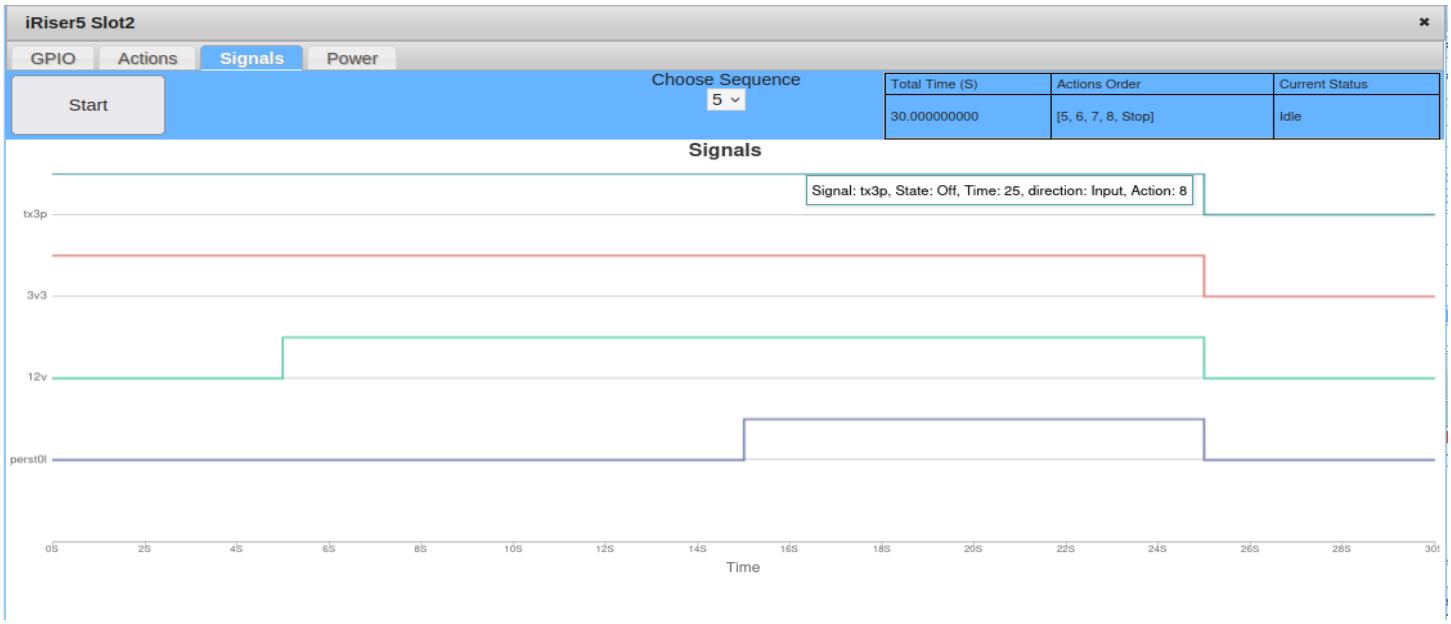
As you can see above, this selected Sequence is a total of 0.000000320 seconds long (3.2uS) long and contains Actions 0, 1, 2 & 3. The Actions order will also contain either a “Stop” Action, indicating this Sequence stops after this Action is complete, or a “Loop” Action that indicates this Sequence loops after the last Action.

This Sequence contains a set of Actions that do not change any signal states; therefore, the page is now displaying a “No signals change in this sequence” instead of a graph.

Explaining the graph

As mentioned previously, the signal tab step-line graph shows signal state against time. This graph only shows the signals that change in the current Sequence to not over-populate the graph with signals. All signals that do not appear in this graph do not change state throughout the selected Sequence.

When hovering over the graph, a mouse-over label is visible at the Action and signals closest to the mouse cursor. This label shows the intended state of that signal at that Action, the time that the Action occurs within the Sequence, and the Action number.



Starting a Sequence

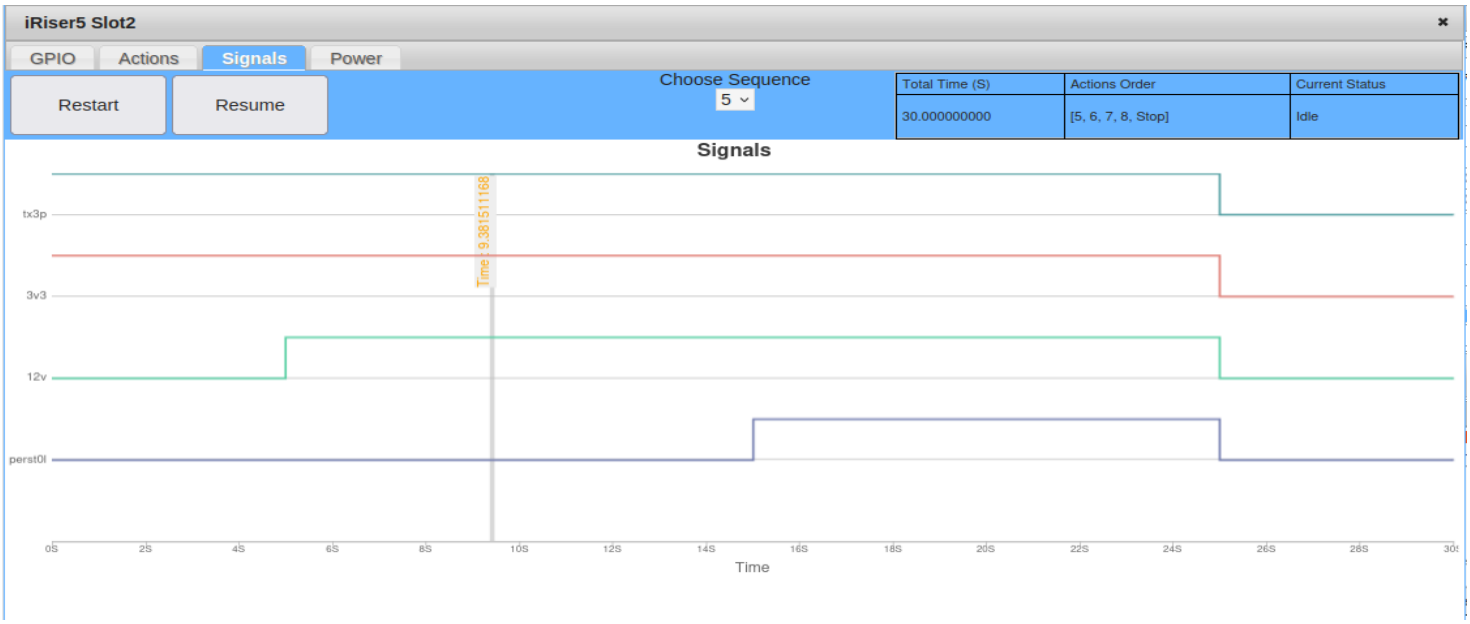
The last item on this tab is the “start” button. This is self-explanatory in that it is used to start the current selected Sequence. If the Sequence is started, this button changes to a “Stop” button. Pressing the “stop” button will stop the current Sequence at that point in the Sequence.

If a Sequence is stopped mid-Sequence, the “stop” button will now show a “restart” and a new “resume” button is shown alongside this. The restart button will now restart the Sequence from the first Action in the Sequence. The resume button will continue the Sequence from where it was last stopped.

A user can also start and stop a Sequence from the CLI. If a Sequence is started from the CLI, the signals tab will automatically retrieve this information and update the UI on screen to reflect this. If the user starts a Sequence different to that which is currently being shown on screen, the GUI will automatically select the running Sequence and show it on screen instead. While a Sequence is running, no other Sequence can be selected as the drop-down will be disabled until the Sequence is stopped.

Additionally, when the user starts a Sequence, the graph will display a red/grey (browser dependent) colored, horizontally scrolling strip-line. This will scroll in close to real time to give a +/- 100mS view of what / where in the Sequence is currently being executed.

This may drift slightly more of sync if left to run on long Sequences (10 minutes or more) but will re-sync when the Sequence is stopped. When the user stops the Sequence, it will jump to the exact place in the Sequence that it was stopped.



iRiser Power tab

UPDATE - 11.0-Build5 - Live power recordings are now live, read more below.

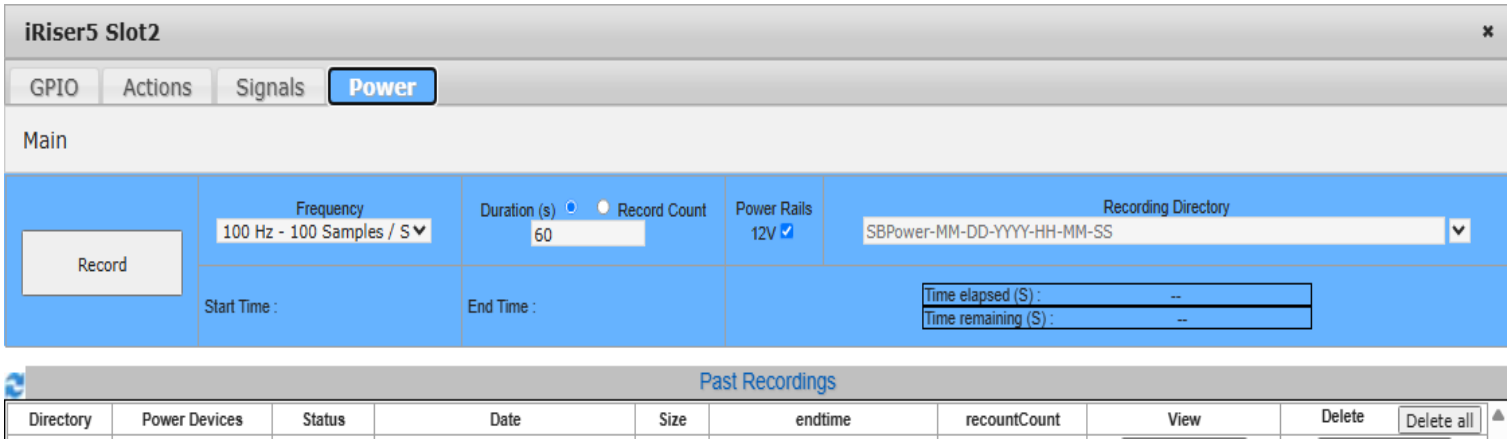
This last iRiser GUI tab allows recording of power traces on the iRiser power rails, allowing the user to view the recording in real time or at a later date.

The recordings are saved to the directory specified when the recording is started. If the same name is used for multiple recordings, the GUI first prompts the user to confirm you wish to overwrite the older recording. If the user confirms this, the older recording will be overwritten in place of the new recording.

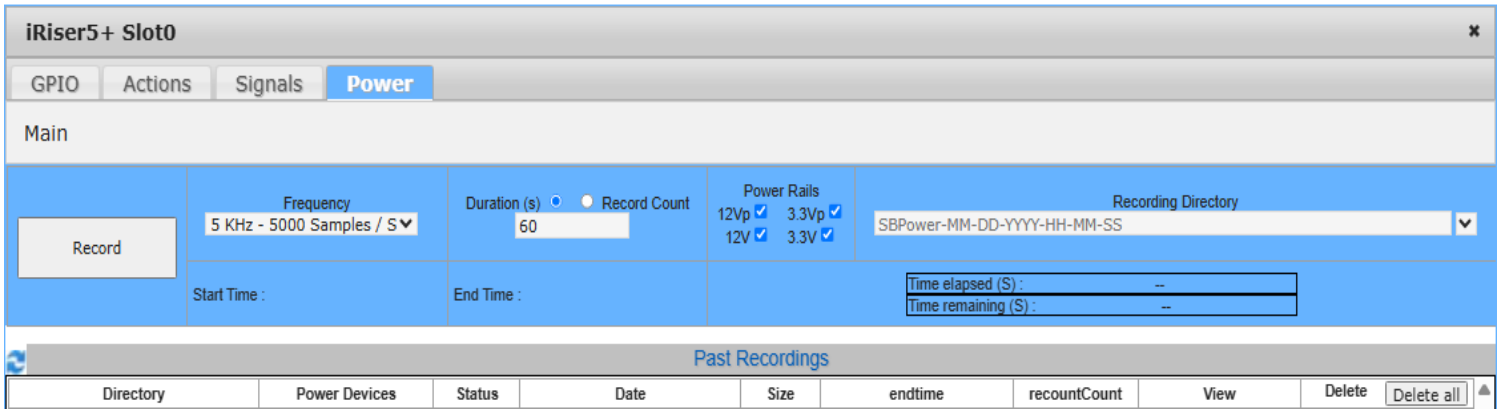
The first screen of the Power tab is shown below.

Please note that the display will differ slightly if iRiser5 is selected vs. iRiser5+ / iRiser6 / iRiser6SE.

iRiser5 view:

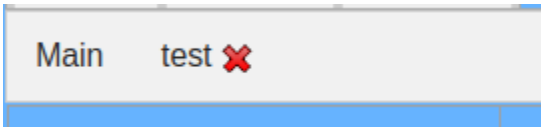


iRiser5+ view (iRiser6 and iRiser6SE view will be very similar):



This guide will start from the top and work down the page to explain each section.

At the top of the page, you will see a tab labeled ‘Main’. This is for the main power page which you can see in the above image. Tabs are used for navigating between recordings and back to this main page.



The Main tab is the only tab you cannot close on this page. Every other tab created while navigating through recordings will contain a red 'X' symbol. Clicking this will close the tab.

Creating Recordings

The main tab of this power display serves two functions.

The first is for creating new power recordings, the second is a table in which to see a summary table view of previous recordings.

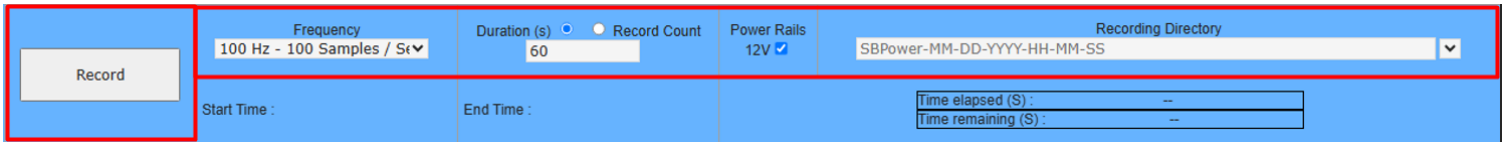
When a recording is first started, the view will change to a live recording as of 11.0-Build5 release. This viewing live recordings functionality is described later in the documentation. However, before the recording is started the user has the option to change some recording variables, changing what is recorded and how long it’s recorded for.

Recording Variables

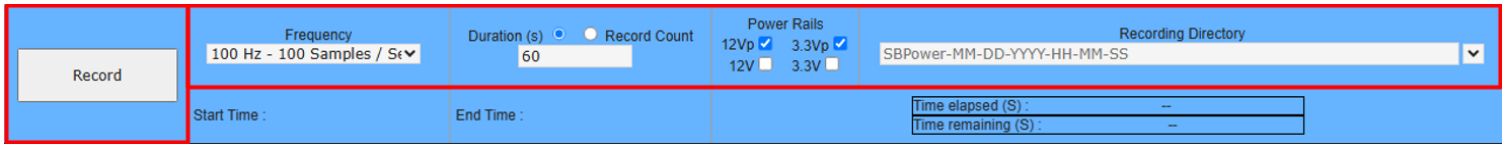
Directly under the recording tabs is a blue table containing elements that are used to make and view an ongoing recording. Along the top is a **Frequency** drop down (# of samples to be recording per second), a **Duration** (recording time limit) and **Record Count** limit, checkboxes used to select **Power rails** to record with and a **Recording Directory** text box with history drop down.
To the left-hand side is a record button that uses the values inside these table elements to start a power recording.
Lastly, at the bottom row of the table are **Start Time**, **End Time** and **time elapsed / remaining** table elements. These are used to provide the user data about any ongoing recordings and when they will finish.

Please note that the display will differ slightly if iRiser5 is selected vs. iRiser5+ / iRiser6 / iRiser6SE.

iRiser5 view:



iRiser5+ view (iRiser6 and iRiser6SE view will be very similar):



The **Frequency** drop-down is listed in both Hz and the equivalent samples per second value. This offers a set selection of options ranging from 1Hz to the max frequency that the currently selected iRiser is capable of. See below for max values:

- iRiser5
  - 12V : 1MHz - ~1,000,000 samples / second
- iRiser5+ / iRiser6 / iRiser6SE
  - 3.3V / 12V : 500Khz - 500,000 samples / second
  - 3.3Vp / 12Vp : 2900Hz - 2900 samples / second
  - 1.8Vpa / 3.3Vpa : 2900Hz - 2900 samples / second

Where:

- V (with no 'p' or 'a'): power rail measured at 12-bit precision
  - Example: 3.3V is 3.3V measured at 12-bit precision
- Vp : p = precise power rail; measured at 20-bit precision
  - Example: 3.3Vp is 3.3V measured at 20-bit precision
- Vpa : p = precise power rail; measured at 20-bit precision and a = adapter
  - Example: 1.8Vpa, is 1.8V measured at 20-bit precision on the 660 M.2 adapter

Though the GUI only offers a set selection of options within those frequency ranges, the iRiser is capable of running at significantly slower frequencies than 1Hz. Additionally, a user can run at frequencies differing to those shown on the GUI *(e.g. 200Hz, 150Hz, 20Hz are all acceptable values on the CLI but are not listed in the GUI due to space constrictions).*

The **Duration (s)** and **Record Count** radio buttons are used for selecting the recording limit. Only one of these radio buttons can be selected at any time, and which one you pick determines when the recording will stop. The value specified in the text box below these radio buttons will be used as the corresponding value to whichever radio button option was picked. For example, if the "duration" radio button is checked, then the value specified in the text area will be time in seconds.

The **Duration (s)** radio button also allows you to input a total time for the recording in seconds. Once the recording hits this time limit, it will automatically stop recording. While the GUI only allows you to specify seconds, recording from the cli can be specified in microseconds (us) for recordings that need to be more precise.

The **Record Count** specifies the total number of records you wish to record before stopping. An example of this might be a recording that records at 100 samples per second (100Hz) and for 1250 record count. For this, once the ongoing trace has taken 1250 samples the recording will automatically stop. You can calculate the time taken for this by dividing record count by frequency (1250 / 100 = 12.5 seconds).

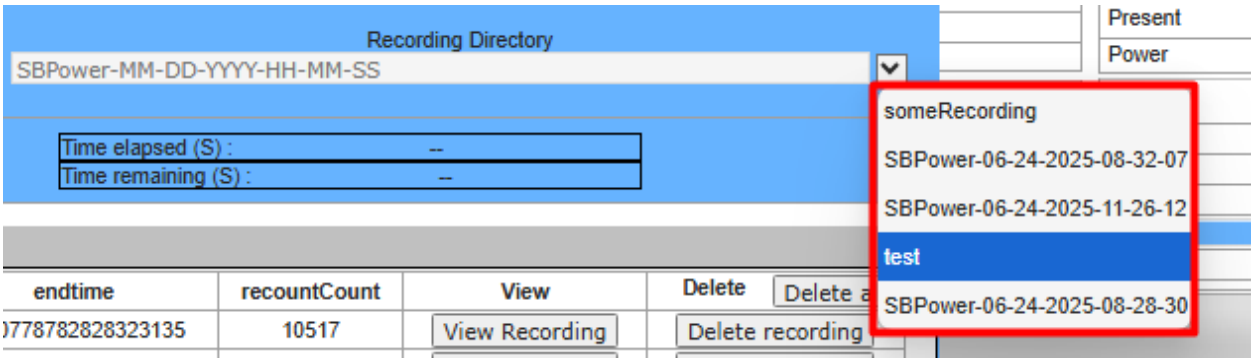
The **Power Rails** selection area is comprised of checkboxes representing the equivalent power rail on the iRiser. The available power rails represented here will change based on what is available on the currently selected iRiser.

To see what power rails are available on the current selected iRiser from the CLI, enter the command:

```
iriser -d <slot> show power available
```

The **Recording directory** text area is the name of the recording. If this is left blank, a recording directory will be automatically added for you in the format "SBPower-MM-DD-YYYY-HH-MM-SS". This recording directory will contain all of the power / voltage / current data for the recording.

To the right-hand side of the recording directory text box is a drop-down menu. This contains a list of all the names of previous recordings on the system. Selecting one of these items from the drop-down will replace the text inside the 'recording directory' text box with the drop-down element selected.



The **<Record>** button is used to start the recording. It will take whatever values are currently set in the other 4 GUI elements and use them to start the recording.

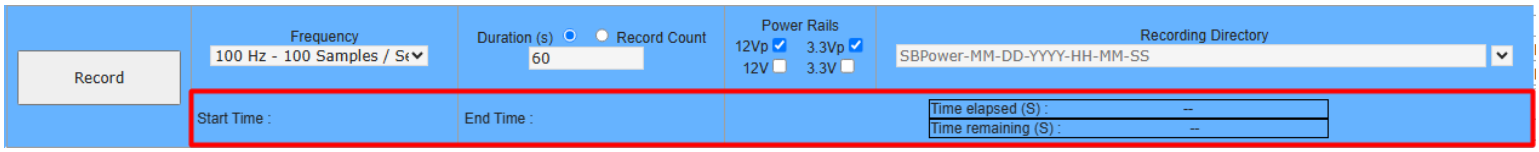
Once the recording is started, the page will change to show the recording view showing the ongoing live recording. Additionally, in the background on this main tab, this button will change to show a 'stop' value instead.

When a recording is in progress, the iRiser recording status section of the page will also be updated in background, at a rate of once per second to show start, end and record count / time elapsed for the ongoing recording.

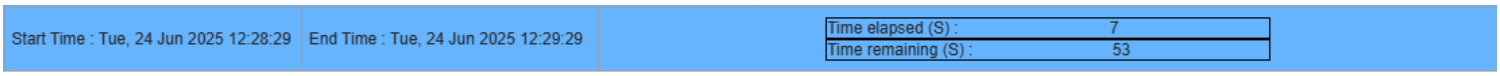
After the recording has reached its full allotted time (*set in the duration / record count text area)* or the recording has stopped for another reason, this button will change back to 'record'.

iRiser recording status

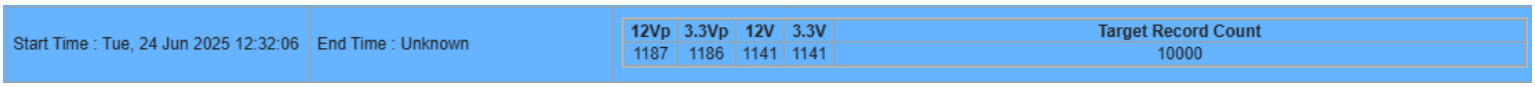
In the lower row of the table is the recording status for any ongoing recording. This section gets updated when a recording is started from the GUI or CLI to show the user the state of the current recording. The "start time" is the start time of the power recording, the "end time" is when the recording finished.



For recordings started using the 'duration' option, the GUI will display a "time elapsed" and "time remaining" table that helps the user keep track of how long the recording has left. These values are updated every second. Additionally, for the recordings using "duration", the recording's End Time will be calculated immediately and shown on screen in the "end time" element.



For the recordings started using the 'record count' option, the GUI will instead show a current record count for all power rails. These values are also updated automatically every second. The power rails shown are the ones currently being used in the recording. Once every power rail used in the recording has recorded the 'target record count' number of records, the recording will finish. As the end time for these types of recordings is unknown, the "end time" element will display as 'Unknown' until the recording has finished, where it will be automatically updated to show the real end time.

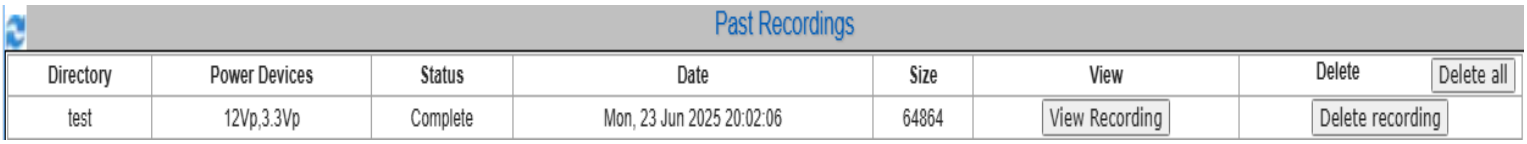


Past recordings table

This recording table is used to list all the past recordings saved to disk for this iRiser. The table is automatically updated when a recording is finished. You will know when a recording was added to the table as it will fade from blue to white. This is also automatically updated when the iRiser dialog is closed and re-opened. Inside the table are six columns.

- Directory → This column contains the name of the directory the recording was saved to
- Power devices → This column lists the voltage rails used for this recording
- Status → Tells the current status of the recording
- Date → When the recording was started.
- Size → Size of the recording in bytes.
- View → Populated with a button that, when clicked, loads the recording it is associated with.
- Delete → Populated with a button that, when clicked, deleted the corresponding recording.

When a recording is added, the table is populated with the recording's variables as seen below.



Refresh icon

At the top left-hand side of this table is a refresh icon. Pressing it will refresh the table to check for new and updated recordings. This is useful if the user is recording using a test, or via the CLI and wants to re-update the GUI in order to view the recording. It will also delete recordings from this table and the tabs at the top of the page if the corresponding recording no longer exists.

A note on showing ongoing recordings

This page will check for ongoing recordings when any of the Actions below are performed:

1. The user closed and opened the page

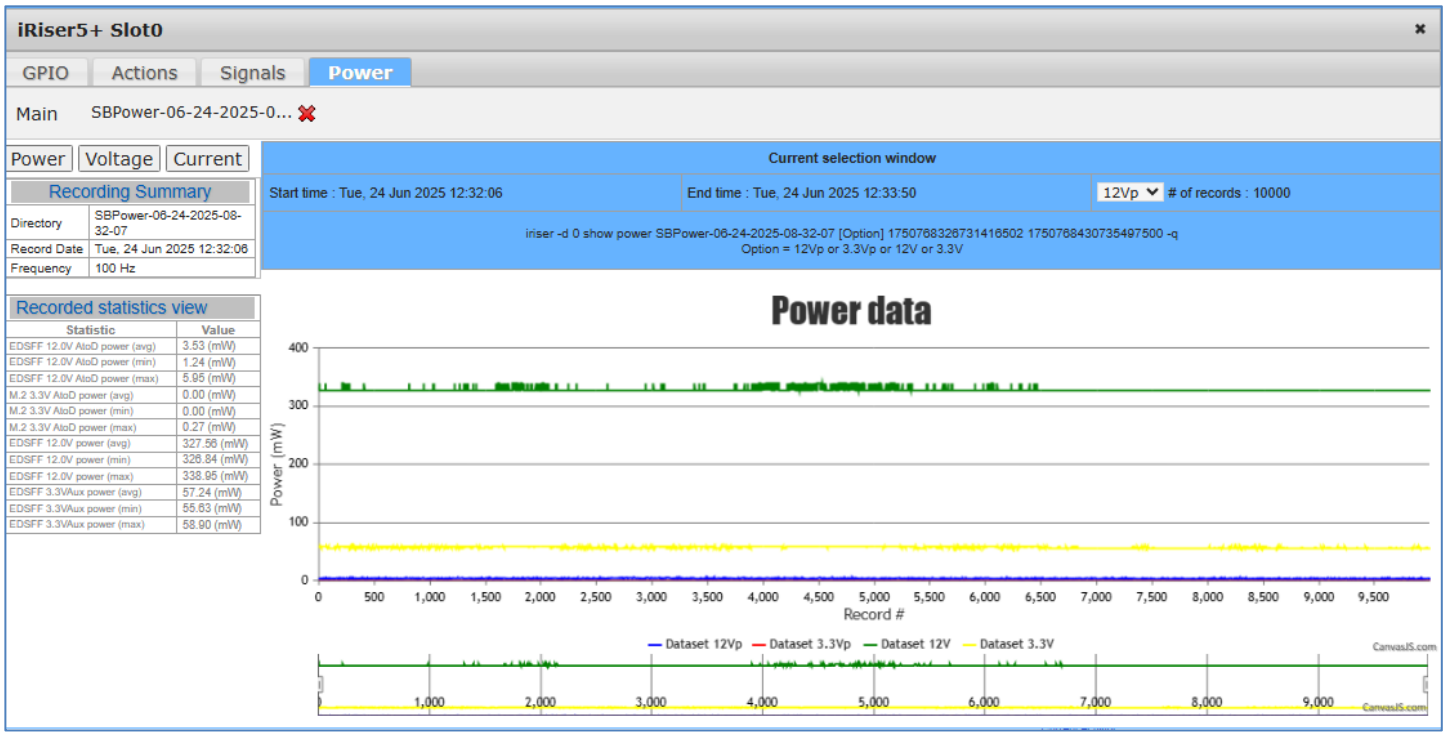
2. The user hits the record button:
   - If there is already an ongoing recording when the user hits this button, an alert will appear on screen letting the user know a recording is already in progress.
     - Pressing 'record' will not stop the current recording, or start a new recording if one is ongoing.

3. The user hits the 'refresh' icon at the top of the past recordings table

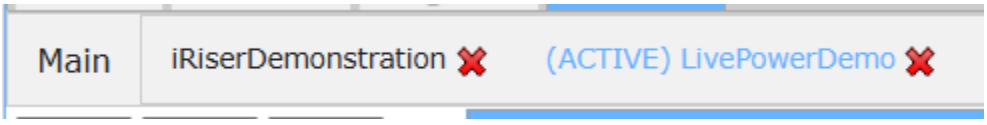
Viewing recordings

The second view of this power tab is the recording view. This view is for displaying live recordings and past recordings in a navigable chart, while displaying additional useful information such as statistics about the data being displayed.

This page will automatically be brought into view when the user starts a new recording. Alternatively, the user can click 'View Recording' in a row of the past recordings table to view an older recording.



At the top of the page, there will now be a newly opened tab with the name of this recording as the text in the tab. If the recording is live, the tab will also be prefixed with the string "(ACTIVE)" to show this tab is for the live recording, along with a blue text. In order to navigate back to the main page, hit the 'main' tab at the top of the page.

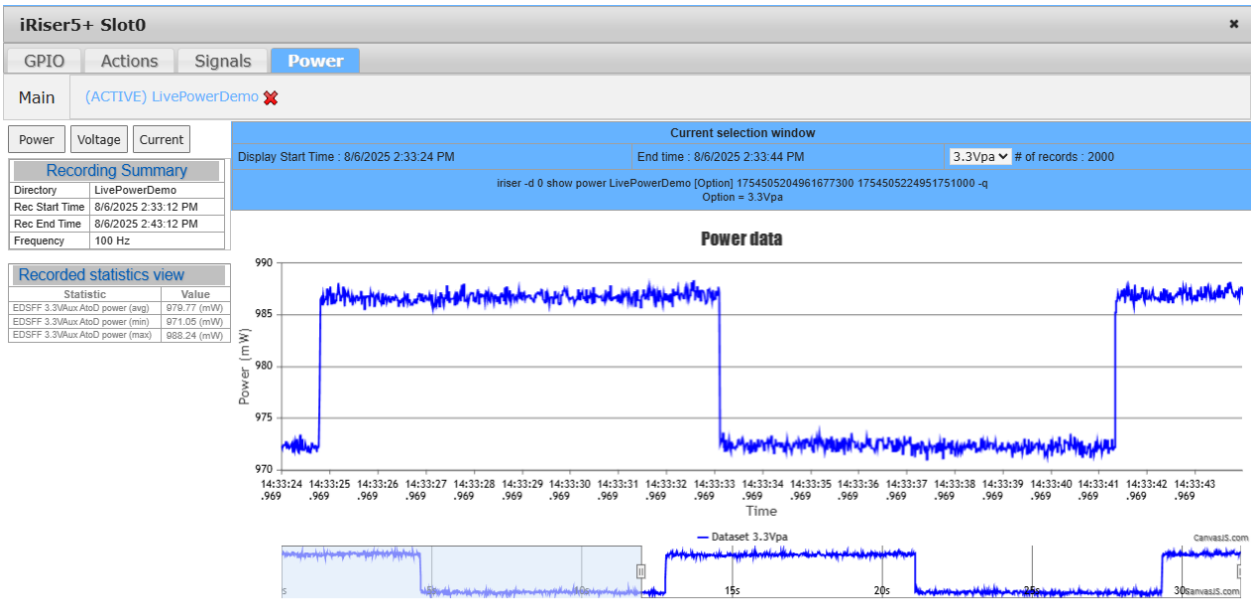


For live recordings, once the recording is finished, the page will automatically remove the prefix "(ACTIVE)" and change the text from blue back to black.

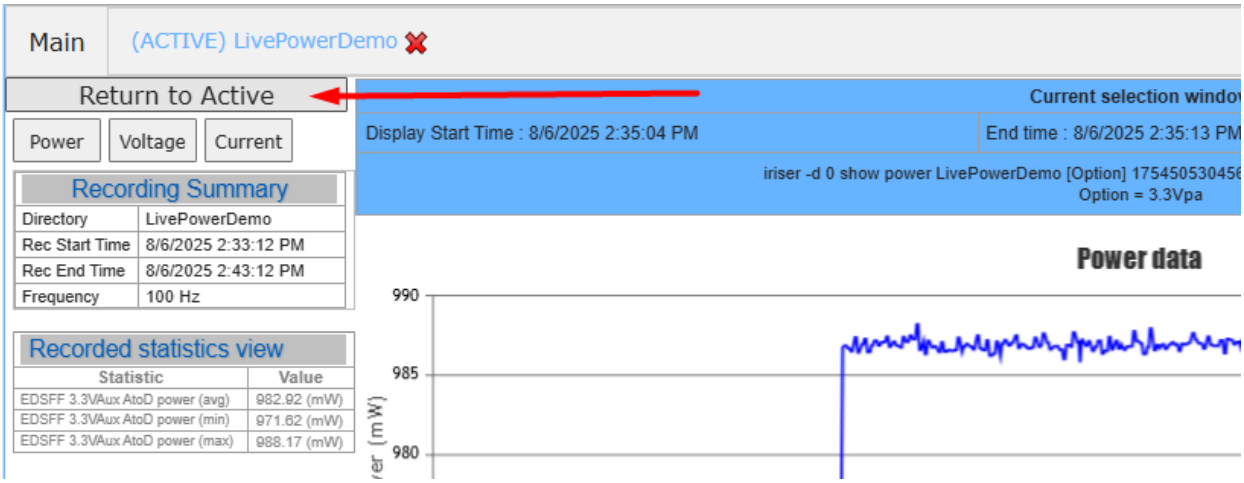
Live recordings

Live recordings are started immediately after the user hits ‘Record’ on the main tab, or if the user refreshes the page or opens the iRiser dialog whilst an ongoing recording is ongoing.

This live recording will pull down the last x amount of data at approximately 1 second intervals, and display this data on screen in the main chart. This will also update everything in the current selection window and recorded statistics view to this new data (more on this later).



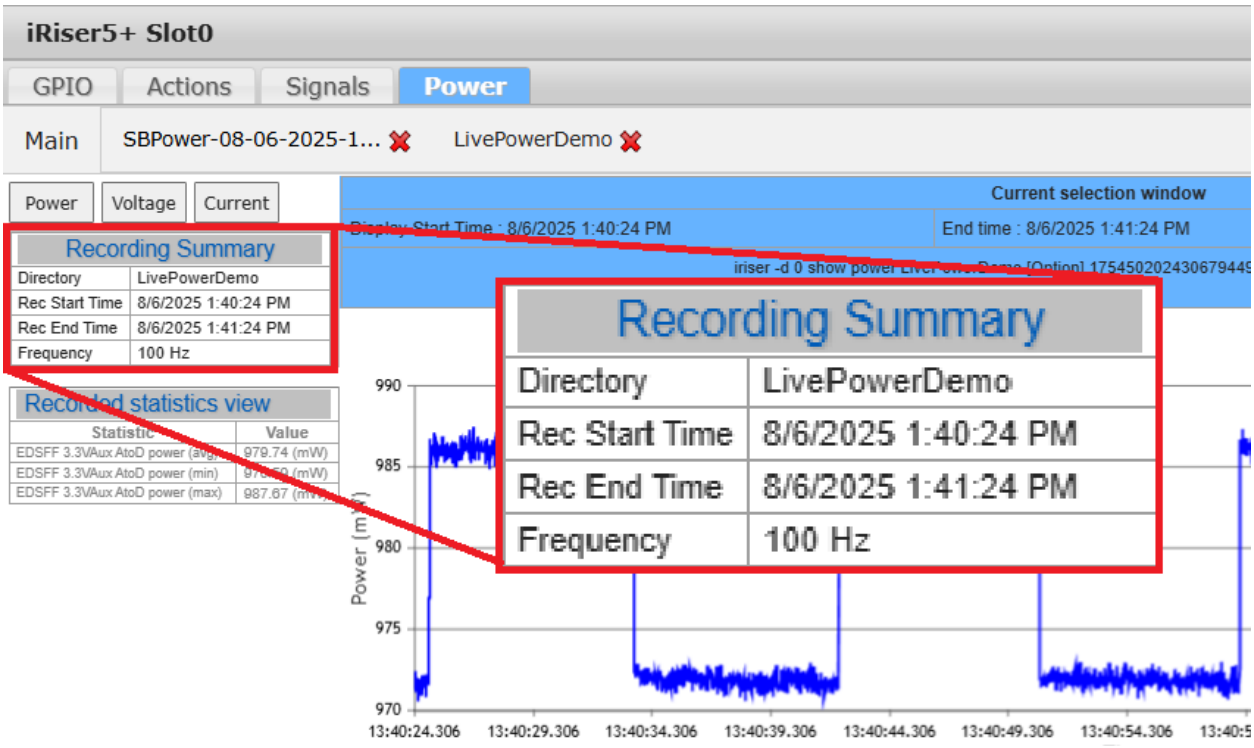
If a user chooses to zoom in on a section of the live recording, a new button will appear in the top left hand corner called “Return to Active”. This will reset what’s on screen to continue viewing live data, instead of the section that was just zoomed in on.



Once the live recording is complete, the page will update to show the recording as if it was a regular recording. This includes updating the data on screen to show data from the start of the recording as opposed to the last x amount of data from the live recording. This effect will not take place if the user was zoomed into a section on the chart before the live recording finished.

Recording summary

At the top left corner of the page is the Recording Summary table. In here is the recording's directory name, the date and time the recording was taken and the sampling frequency this recording was taken at. This is automatically populated when a recording is viewed on screen:



Current Selection window

This Current Selection window differs slightly from the recording summary window as it gives information on what data is currently displayed on screen. It will dynamically change with the data shown in the chart. This provides some useful information including the start and end time of the current selection window, the number of samples contained within this window and in the last row an iRiser command that you can copy and paste onto the cli to get this CSV data. The command requires you to replace the "[Option]" with one of the options displayed below.

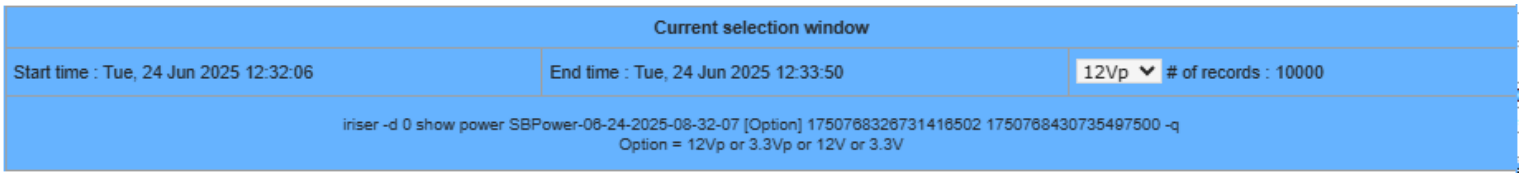
For example, in this recording, the only options available are 12Vp, 3.3Vp, 12V and 3.3V. So, the command for getting the 12V data for this section would look like:

```
iriser -d 0 show power SBPower-06-24-2025-08-32-07 12V 1750768326731416502
1750768430735497500 -q
```

Or for 3.3V, the command would be:

```
iriser -d 0 show power SBPower-06-24-2025-08-32-07 3.3V 1750768326731416502
1750768430735497500 -q
```

The drop down next to '# of records' provides an option to view the number of records for every power rail used in the recording. This is useful if you're recording on an iRiser using 'duration' as the power rails being recorded may differ in the number of samples they record per second. Selecting an item from the drop down will automatically populate the value on screen.



Recorded Statistics View

At the left-hand side of the page, there is a table labeled "Recorded statistics view". This is a dynamically updating view containing statistics about the current selection window's data.

This will automatically update every time a new selection is made in the chart. This happens when a user zooms in / navigates around the data using the timeline, or when the data is updated on screen during live recordings. It will display information about all the power rails used within the recording and give an average, max and min value for the measurement type currently in view.

Recorded statistics view

Statistic	Value
EDSFF 12.0V AtoD power (avg)	3.53 (mW)
EDSFF 12.0V AtoD power (min)	1.24 (mW)
EDSFF 12.0V AtoD power (max)	5.95 (mW)
M.2 3.3V AtoD power (avg)	0.00 (mW)
M.2 3.3V AtoD power (min)	0.00 (mW)
M.2 3.3V AtoD power (max)	0.27 (mW)
EDSFF 12.0V power (avg)	327.56 (mW)
EDSFF 12.0V power (min)	326.84 (mW)
EDSFF 12.0V power (max)	338.95 (mW)
EDSFF 3.3VAux power (avg)	57.24 (mW)
EDSFF 3.3VAux power (min)	55.63 (mW)
EDSFF 3.3VAux power (max)	58.90 (mW)

Recorded statistics view

Statistic	Value
EDSFF 12.0V AtoD voltage (avg)	11894.96 (mV)
EDSFF 12.0V AtoD voltage (min)	11886.91 (mV)
EDSFF 12.0V AtoD voltage (max)	11899.81 (mV)
M.2 3.3V AtoD voltage (avg)	3217.78 (mV)
M.2 3.3V AtoD voltage (min)	3215.82 (mV)
M.2 3.3V AtoD voltage (max)	3219.53 (mV)
EDSFF 12.0V voltage (avg)	11895.81 (mV)
EDSFF 12.0V voltage (min)	11897.00 (mV)
EDSFF 12.0V voltage (max)	11897.00 (mV)
EDSFF 3.3VAux voltage (avg)	3215.68 (mV)
EDSFF 3.3VAux voltage (min)	3216.00 (mV)
EDSFF 3.3VAux voltage (max)	3216.00 (mV)

Recorded statistics view

Statistic	Value
EDSFF 12.0V AtoD current (avg)	0.30 (mA)
EDSFF 12.0V AtoD current (min)	0.10 (mA)
EDSFF 12.0V AtoD current (max)	0.50 (mA)
M.2 3.3V AtoD current (avg)	0.00 (mA)
M.2 3.3V AtoD current (min)	0.00 (mA)
M.2 3.3V AtoD current (max)	0.08 (mA)
EDSFF 12.0V current (avg)	27.53 (mA)
EDSFF 12.0V current (min)	27.47 (mA)
EDSFF 12.0V current (max)	28.49 (mA)
EDSFF 3.3VAux current (avg)	17.80 (mA)
EDSFF 3.3VAux current (min)	17.30 (mA)
EDSFF 3.3VAux current (max)	18.32 (mA)

Recorded data charts

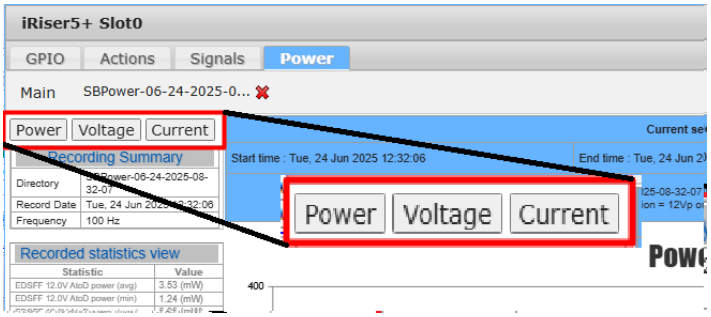
The last and main part of this view is the data chart. This chart displays the CSV data collected during the recording in a navigable chart.

There are 2 sections to each chart, a timeline view across the bottom 1/4 and the main view spanning the rest of the space. This type of chart is used as some recordings may be many millions of samples in size and the webpage would be unable to load all of these samples into memory.

Depending on the type of recording used, the chart will be created using either ‘record numbers’ or ‘time’ as the x-axis:

- If a recording was complete using the ‘record count’ option, the chart will be displayed using record number as the x-axis.
- If the recording is completed using a ‘duration’ option, the chart will display with a time-based x-axis.

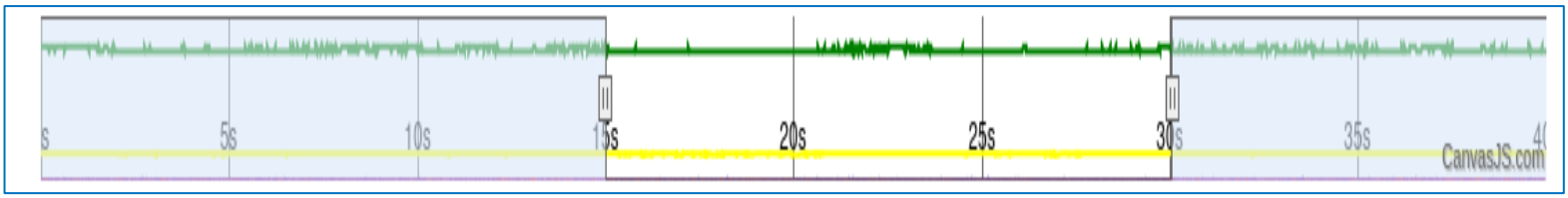
At the top left corner of the page are 3 buttons: Power, Voltage and Current. Clicking any of these will change to the corresponding power/current/voltage chart.



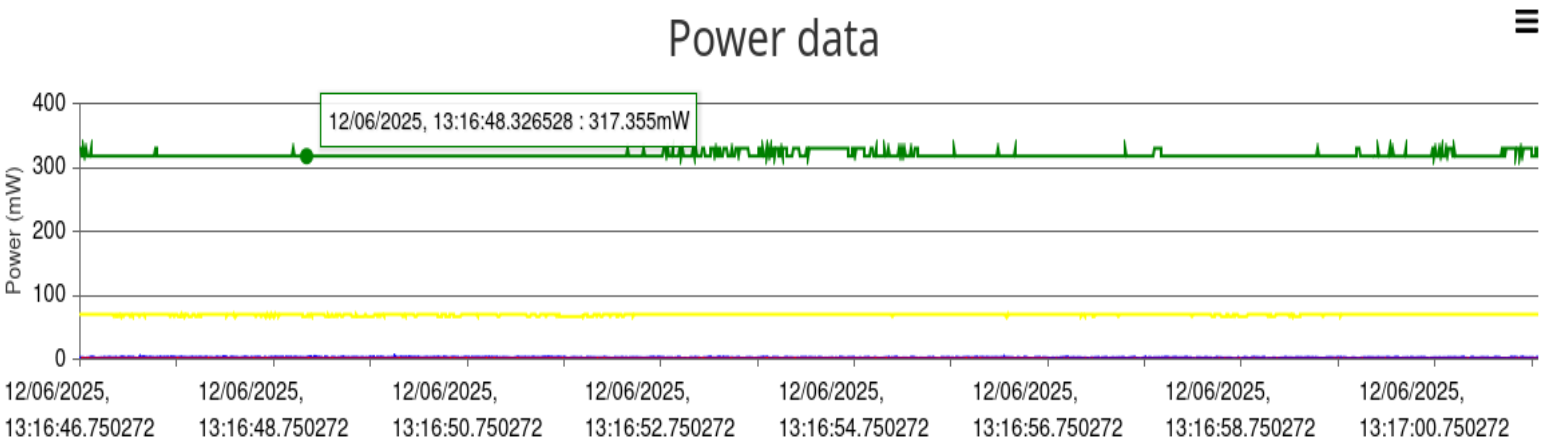
Timeline view and navigation

The timeline view is a down-sampled overview of the entire recording. It is used to navigate through the full recording. To change what section you are currently viewing on screen, you can either left-click a section of the timeline view that is shaded over, or move one of the vertical sliders (*seen on the screenshot below at 15 and 30 seconds respectively)*. The area between the sliders is what will be shown on the main chart.

If the area selected on the timeline exceeds a maximum limit of onscreen samples set by SANBlaze, the sliders may move automatically to re-align with what is actually displayed on screen. As mentioned previously, this is a restriction put in place as the GUI can only safely handle a certain number of samples on screen due to memory restrictions.



Main chart



As mentioned above, the main chart is a full, non-down sampled view of the data within the selected window on the timeline. The axes ranges are automatically set via the CanvasJS rendering functionality to best suit what is on screen.

To zoom in to this chart, the user can either left-click and drag on one of the sliders on the timeline, or alternatively left-click and drag on the main chart to zoom in on that current section. Zooming out however, can only be done using the sliders on the timeline.

Mousing over the chart will display information about the data sample closest to the cursor. On the screenshot above, the charts using ‘time’ as an x-axis will display the time of the current moused over sample and its value at that moment. For charts using ‘record number’ as the x-axis, the mouse over tooltip will show record number and value.

Getting Started with the CLI

This section describes:

- Identifying the slots containing an iRiser.
- Populating slots with iRiser hardware
- Command Structure used.
- Displaying the iRiser current state of signals.
- Manually setting or clearing a control signal.
- How to Save, Store, and Share .cfg and .sh Files.
- Find iRisers on PCIe.
- Using Read and Write commands.
- Setting the GPIOs to Initial Default State.
- Writing the GPIO Registers as 32-bit Values.
- Setting I/O and GPIO Values from a File.
- Verify the Device Under Test is Linked Correctly.

Identifying Slots Containing an iRiser

Because iRisers can coexist with standard SANBlaze risers, use the following command to identify which slots contain an iRiser:

```
sb_i2c2 -d a -i
```

```
INFO: System 01[MB] SBExpress SN=64fc8ad9 Rev=R01 i2c=/dev/i2c-0 SDB=/dev/ttyACM0  VLUN=0
INFO:  Slot Main  MI  Priv   p   t   l    PCIe Prsnt Latch Width Speed Power BlueLED   RiserID
INFO:  ---- ---- ---- ---- --- --- --- ------- ----- ----- ----- ----- ----- ------- ---------
INFO:     0    0    1 none   0 100   1 09:00.0     1     0     4     5     1       1 600952000
INFO:     1    0    1 none   0 101   1 07:00.0     1     0     4     4     1       0 600952000
INFO:     2    0    1    3   0 102   1 05:00.0     1     0     4     4     1       0 600957003
```

In the above example, the iRisers are located in slots 0 and 1, and are identified by the RiserID of 600952xxx.

Populating Slots with iRiser Hardware

- For SBExpress-RM5:
  - Only iRiser5 and iRiser5+ devices can be installed in RM5
  - A maximum of four iRiser devices are supported and can be installed in slots 6, 7, 8 or 9

- For SBExpress-DT5:
  - Only iRiser5 and iRiser5+ devices can be installed DT5
  - A maximum of three iRiser devices are supported and can be installed in slots 0, 1, or 2

- For SBExpress-RM5+:
  - Only iRiser6 and iRiser6SE devices can be installed in RM5+
  - Up to 16 iRiser devices are supported

Command Structure

iRiser commands use the following structure:

`iriser <-d> <slot# of the iRiser> <action> [feature]`

Where: < > = required and [ ] = optional

Help is available and is context sensitive to the -d # of the device:

`iriser -d <slot> help` : for iRiser device installed in chassis slot 0

Additionally, help can be displayed for specific Actions and/or features:

1. **`iriser -d <slot> help <action>`** **:** shows help for the Action specified

   Available Actions:
   `[read]|[write]|[show]|[dump]|{set]|[clear]|[start]|[stop]|[reset]|[init]|[status]|[config]|[edit]|[mirror]|[unmirror}|[input]|[output]|[direction]`

   Note that the parameter [dump] prints the FPGA registers and is mostly for internal use.

2. **`iriser -d help <slot> <feature>`** : shows help for the feature specified

   Available features : `[action|sequence|logging|power]`

3. **`iriser -d <slot> help <action> <feature>`** : shows help for the Action on a specified feature that is supported by that Action

Specific commands and examples are shown below.

Checking the Current State of Signals

The following command shows the names and state of the signals under iRiser control:

`iriser -d <slot> show gpio`

(Default GPIO settings shown below)

```
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31           24|23           16|15            8|7             0|
    |USR3TST|USR2TST|USR1TST|USR0TST|SBGPIO3|SBGPIO2|SBGPIO1|SBGPIO0|STATUSL|LEDEDSF|RFUEDSF|PLNEDSF|PLAEDSF|MFGEDSF|DUALPTL|PRSNTL|Tx3P|Tx3N|Tx2P|Tx2N|Tx1P|Tx1N|Tx0P|Tx0N|P1CLKL|P0CLKL|PWRDIS|SMRSTL|3V3|12V|CLKREQL|PERST0L|
    |   O   |   O   |   O   |   O   |   I   |   I   |   I   |   I   |   I   |   I   |   I   |   I   |   I   |   I   |   i   |   I  |  O |  O |  O |  O |  O |  O |  O |  O |  O   |  O   |  I   |  I   |  O|  O|   I   |   O   | Dir:[0x214]0xf000ffcd
    |   0   |   0   |   0   |   0   |   1   |   1   |   1   |   1   |   1   |   1   |   0   |   1   |   0   |   0   |   1   |   0  |  1 |  1 |  1 |  1 |  1 |  1 |  1 |  1 |  0   |  0   |  0   |  1   |  1|  1|   0   |   1   | Val:[0x200]0x0fd2ff1d
```

Alternative format for the same output:

`iriser -d <slot> show gpio2` (or gpio1)

```
Bit        Name Val Description
---        ---- --- -----------
00[I]   PERST0L   1 Setting low asserts perst
01[I]   CLKREQL   0 Setting low asserts clkreq
02[O]       12V   1 Setting low disables 12V
03[O]       3V3   1 Setting low disables 3V3
04[I]    SMRSTL   1 Setting low resets SMBus
05[I]    PWRDIS   0 Setting high sets PWRDIS signal to EDSFF
06[O]    P0CLKL   0 Setting low enables P0 clock
07[O]    P1CLKL   0 Setting low enables P1 clock
08[O]       Tx0N   1 Setting low disables Tx[0]-
09[O]       Tx0P   1 Setting low disables Tx[0]+
10[O]       Tx1N   1 Setting low disables Tx[0]-
11[O]       Tx1P   1 Setting low disables Tx[0]+
12[O]       Tx2N   1 Setting low disables Tx[0]-
13[O]       Tx2P   1 Setting low disables Tx[0]+
14[O]       Tx3N   1 Setting low disables Tx[0]-
15[O]       Tx3P   1 Setting low disables Tx[0]+
16[I]    PRSNTL   0 Setting low forces PRSNT, normally input from drive
17[O]   DUALPTL   1 Setting low forces Dual Port signal to drive
18[I]   MFGEDSF   0 EDSFF MFG signal
19[I]   PLAEDSF   0 EDSFF PLA (Power Loss Ack) normally input from drive
20[I]   PLNEDSF   1 EDSFF PLN (Power Loss Notification)
21[I]   RFUEDSF   0 EDSFF RFU (Reserved Future Use) pin
22[I]   LEDEDSF   1 EDSFF LED low enables LED
23[I]   STATUSL   0 Setting low enables blue status LED at front
24[I]   SBGPIO0   1 Spare GPIO wired to TP on DT5 "A" board
25[I]   SBGPIO1   1 Spare GPIO wired to TP on DT5 "A" board
26[I]   SBGPIO2   1 Spare GPIO wired to TP on DT5 "A" board
27[I]   SBGPIO3   1 Spare GPIO wired to TP on DT5 "A" board
28[O]   USR0TST   0 User monitor connector on iRiser5
29[O]   USR1TST   0 User monitor connector on iRiser5
30[O]   USR2TST   0 User monitor connector on iRiser5
31[O]   USR3TST   0 User monitor connector on iRiser5
```

Notes from the previous output:

For Direction (0x214), certain signals may be locked by SANBlaze. These cannot be changed or sequenced.

- O – A Signal that can be sequenced.
- o – A Signal that cannot be sequenced.
- 1 – Signal is "set".
- 0 – Signal is "clear".

Note also that reading and writing the iRiser register at 0x210 is the Setting Register for the GPIO; the actual Signal value (which may differ from the SET value in the case of a Wired OR signal) can be read from register 0x200.

The following is an example of reading a SET value versus a Current IO value:

Set Value

```
iriser -d <slot> 0x210
00000210: ebfdffff
```

Current Value

```
iriser -d <slot> 0x200
00000210: ebfdffff
```

Manually Setting or Clearing a Signal Control

Each Signal can be "set" or "cleared" by bit location or by Signal name. Use either of the following syntax examples to set or clear a Signal control:

- Setting by Signal name (from the show GPIO table above):

  ```
  iriser -d <slot> set dual001
  ```

- Clearing by bit location [0:31]

  ```
  iriser -d <slot> clear 0
  ```

Note that Signal names are not case sensitive. The commands above both operate on the same bit[0].

How to Save, Store, and Share .cfg and .sh Files

To save iRiser information to the current directory, store to a specified path, or share the .cfg and .sh files, use the following command:

```
iriser -d <to slot> -f /etc/iRiser/<system>/<from slot>/active.cfg
```

For example, if you want slot 1 to have the same active.cfg file as slot 2:

```
iriser -d -1 -f /etc/iRiser/<system>/2/active.cfg
```

Configuration Files

The commands to create and upload a config file are below:

Create:

```
iRiser -d <slot> write -f [configFileName.cfg]
```

Import:

```
iRiser -d <slot> -f [configFileName.cfg]
```

Find iRisers on PCIe

To find an iRiser on PCIe, use the following command:

```
lspci |grep SANBlaze
```

In RM5 or DT5 only

- iRiser5 is Device 2015, revision d1 or higher
- iRiser5+ is Device 2035, revision fe or higher
- DT5 Motherboard is Device 2004
- RM5 Motherboard is Device 2005

For example:

```
lspci |grep SANBlaze
```

```
20:00.0 Signal processing management: SANBlaze Technology, Inc. Device 2004 (rev af)
                                                                    ^ DT5
22:00.0 Signal processing management: SANBlaze Technology, Inc. Device 2015 (rev d1)
                                                                    ^ iRiser5
23:00.0 Signal processing management: SANBlaze Technology, Inc. Device 2035 (rev fe)
                                                                    ^ iRiser5+
```

In RM5+ only

- iRiser6 is Device 2016, revision b2 or higher
- iRiser6SE is Device 2026, revision e2 or higher
- RM5+ Motherboard (MI5) is Device 2045
- RM6 Motherboard (MI6) is Device 2046

For example:

```
lspci |grep SANBlaze
```

```
31:00.0 Signal processing management: SANBlaze Technology, Inc. Device 2016 (rev b2)
                                                                    ^ iRiser6
4b:00.0 Signal processing management: SANBlaze Technology, Inc. Device 2045 (rev 6e)
                                                                    ^ RM5+
```

The program “find_iRiser_USB” can be used to locate the USB connection to the iRiser. This program is needed by the openocd flash procedure, which now finds the iRiser hardware to program by slot/USB.

Using Read and Write Functions

You can write to a script using -s or write to a file using -f. Note that the read function however, can only be used on a file. For example:

```
[root@DT5 ~]# iriser -d <slot> write -s testcfg.sh
```

This builds a new script *testcfg.sh* from the current configuration.

```
[root@VLUN-QA-100-104-IPMI-149 ~]# iriser -d <slot> write -f testcfg.txt
```

Write user configuration file *testcfg.txt* and exit.

```
[root@VLUN-QA-100-104-IPMI-149 ~]# iriser -d <slot> read -f testcfg.txt
```

Restores iRiser from configuration file *testcfg.txt* and activates.

Setting the GPIOs to Initial Default State

There are two commands which reset the GPIOs to the default state:

- init
- reset

To set an iRiser device to the factory default state, use the init command.

```
iriser -d <slot> init
```

This:

- Stops the sequencer at <slot> if running.
- Writes the default value to the GPIO output register at 0x210.
- Writes the default value to the GPIO direction register at 0x214.
- Clears the sequence memory to zero.

After the init command is used, the drive under test should re-link on PCIe and power up ready and the sequencer is stopped.

```
iriser -d <slot> reset
```

To set the GPIOs to default state but leave the iRiser sequencer memory intact, use the reset command.

This:

- Stops the sequencer at <slot> if running.
- Writes the default value to the GPIO output register at 0x210.
- Writes the default value to the GPIO direction register at 0x214.
- Leaves the sequencer memory as currently programmed.

After the reset command is used, the drive under test should re-link on PCIe and power up ready and the sequencer is stopped.

You can verify the current status at any time with the following command:

```
iriser -d <slot> show gpio
```

```
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31          24|23          16|15           8|7           0|
    |USR3TST       |               |               |PCLKL      |
    |USR2TST       |               |               |P0CLKL     |
    |USR1TST       |               |               |PWRDIS     |
    |USR0TST       |               |               |SMRST      |
    |SBGPIO3       |               |               |3V3        |
    |SBGPIO2       |               |               |12V        |
    |SBGPIO1       |               |               |CLKREQL    |
    |SBGPIO0       |STAT USL       |               |PERST0L    |
    |              |LED DSF        |               |           |
    |              |RFU EDSF       |               |           |
    |              |PLN EDSF       |               |           |
    |              |PLA EDSF       |               |           |
    |              |MFG EDSF       |               |           |
    |              |DUAL PTL       |               |           |
    |              |PRSNTL         |               |           |
    |              |               |Tx3P           |           |
    |              |               |Tx3N           |           |
    |              |               |Tx2P           |           |
    |              |               |Tx2N           |           |
    |              |               |Tx1P           |           |
    |              |               |Tx1N           |           |
    |              |               |Tx0P           |           |
    |              |               |Tx0N           |           |
    |O O O O I I I I|I I I I I I i I|O O O O O O O O|O O I I O O I O|Dir:[0x214]0xf000ffcd
    |0 0 0 0 1 1 1 1|1 1 0 1 0 0 1 0|1 1 1 1 1 1 1 1|0 0 0 1 1 1 0 1|Val:[0x200]0x0fd2ff1d
```

Writing the GPIO Registers as 32-bit Values

You can set the I/O direction register (at 0x214) as a 32 bit write, as follows:

```
iriser -d <slot> 214 0x00000000
```

Where zero is input, 1 is output. The command above sets all GPIOs to input and is a good debug tool to prove the hardware sets the correct default state.

You can set the I/O Value register (at 0x210) as a 32 bit write, as follows:

```
iriser -d <slot> 210 0xffffffff
```

Where zero is clear, 1 is set. The command above sets all GPIOs to level 1.

The above commands will render the device under test (DUT) disconnected. You can use the init command to recover any unwanted configuration.

NOTE: Some GPIOs are masked off by SANBlaze and are not settable by the user.

Setting I/O and GPIO Values from a File

Using the example “configFileName.cfg” file created in the Configuration Files section above, the following command can be used to load a saved GPIO configuration:

```
iriser -d <slot> -f configFileName.cfg
```

Use the following command to view GPIO settings loaded from that saved configuration file:

`iriser -d <slot> show gpio`

(example GPIO table shown below -- your table view may vary)

```
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31          24|23          16|15           8|7            0|
    |USR3TST|USR2TST|USR1TST|USR0TST|SBGPIO3|SBGPIO2|SBGPIO1|SBGPIO0|STATUSL|LEDEDSF|RFUEDSF|PLNEDSF|PLAEDSF|MFGEDSF|DUALPTL|PRSNTL|Tx3PP|Tx3NP|Tx2PP|Tx2NP|Tx1PP|Tx1NP|Tx0PP|Tx0NP|P1CLKL|P0CLKL|PWRDISL|SMRSTL|3V3|12V|CLKREQL|PERST0L|
    | O |  O  |  O  |  O  |  I  |  I  |  I  |  I  |  I  |  I  |  I  |  I  |  I  |  I  |  O  |  I   |  O  |  O  |  O  |  O  |  O  |  O  |  O  |  O  |  O  |  O  |  I  |  I  |  O  |  O  |  I  |  I  | Dir:[0x214]0xf002ffcc
    | 0 |  0  |  0  |  0  |  1  |  1  |  1  |  1  |  0  |  1  |  0  |  1  |  0  |  0  |  1  |  0   |  1  |  1  |  1  |  1  |  1  |  1  |  1  |  0  |  0  |  0  |  1  |  1  |  1  |  0  |  1  | Val:[0x210]0x0f52ff1d
```

Description of the GPIO Signals for iRiser

Signal names should always be checked by the **iriser show gpio** command. Currently, iRiser Signals are named as described below, but may change during qualification. Bit numbers are fixed in hardware but may vary between designs and revisions.

All Signals below are accessible by the sequencer and can be changed in 10nS intervals. This will be described later in this document. You can manually set or clear any bit by number or name using the following command:

```
iriser -d N <name || bit> <set || clear>
```

Showing the State of a Signal

GPIO bits can be inspected by name or bit number using the `show` command:

```
iriser -d <slot> show perst
200:[00] 1

iriser -d <slot> show 0
200:[00] 1

iriser -d <slot> show perst -q
1

iriser -d <slot> show 12v
200:[02] 1

iriser -d <slot> show 2
200:[02] 1

iriser -d <slot> show 12v -q
1
```

In the output above, the syntax used is:

```
input Reg 0x200:[bit] value
```

Adding the -q (quiet) parameter will return only the state of the bit and may be more helpful for scripting.

show <signal> -qq

Using the -qq flag to the show signal command will suppress all output and exit with 0, if the Signal is clear or 1 if the Signal is set. The exit value can then be used by the caller. Examples:

```
iriser -d <slot> show 12v -qq

echo $?
1

iriser -d <slot> show 12v -qq && echo signal is clear || echo signal is
set
signal is set

iriser -d <slot> clear 12v

iriser -d <slot> show 12v -qq && echo signal is clear || echo signal is
set
signal is clear
```

Signals Available to Control

The Signals under control are as follows and will differ slightly between iRiser5 and iRiser5+ / iRiser6 / iRiser6SE.

iRiser5 Signals

Issue the following CLI command to show all available signals:

`iriser -d <slot> show gpio2`

```
Bit          Name Val Description
---          ---- --- -----------
00[O]     PERST0L   1 Setting low asserts perst
01[I]     CLKREQL   0 Setting low asserts clkreq
02[O]         12V   1 Setting low disables 12V
03[O]         3V3   1 Setting low disables 3V3
04[I]      SMRSTL   1 Setting low resets SMBus
05[I]      PWRDIS   0 Setting high sets PWRDIS signal to EDSFF
06[O]      P0CLKL   0 Setting low enables P0 clock
07[O]      P1CLKL   0 Setting low enables P1 clock
08[O]        Tx0N   1 Setting low disables Tx[0]-
09[O]        Tx0P   1 Setting low disables Tx[0]+
10[O]        Tx1N   1 Setting low disables Tx[0]-
11[O]        Tx1P   1 Setting low disables Tx[0]+
12[O]        Tx2N   1 Setting low disables Tx[0]-
13[O]        Tx2P   1 Setting low disables Tx[0]+
14[O]        Tx3N   1 Setting low disables Tx[0]-
15[O]        Tx3P   1 Setting low disables Tx[0]+
16[I]      PRSNTL   0 Setting low forces PRSNT, normally input from drive
17[i]     DUALPTL   1 Setting low forces Dual Port signal to drive
18[I]     MFGEDSF   0 EDSFF MFG signal
19[I]        PLAL   0 PLA_L (Power Loss Ack) normally input from drive
20[I]        PLNL   1 PLN_L (Power Loss Notification)
21[I]     RFUEDSF   0 EDSFF RFU (Reserved Future Use) pin
22[I]     LEDEDSF   1 EDSFF LED low enables LED
23[I]     STATUSL   1 Setting low enables blue status LED
24[I]     USBDISL   1 Disable USB used to update FW SANBlaze use only
25[I]     SB0GPIO   1 Spare GPIO reserved for future use
26[I]     SB1GPIO   1 Spare GPIO reserved for future use
27[I]     SB2GPIO   1 Spare GPIO reserved for future use
28[O]     USR0TST   0 Mirror connector on iRiser5 Bit[0]
29[O]     USR1TST   0 Mirror connector on iRiser5 Bit[1]
30[O]     USR2TST   0 Mirror connector on iRiser5 Bit[2]
31[O]     USR3TST   0 Mirror connector on iRiser5 Bit[3]
```

iRiser5+ / iRiser6 / iRiser6SE Signals:

Issue the following CLI command to show all available signals:

iriser -d <slot> show gpio2

```
Bit          Name Val Description
---          ---- --- -----------
00[O]     PERST0L   1 Setting low asserts perst
01[I]     CLKREQL   0 Setting low asserts clkreq
02[O]     12VEDSF   0 Setting low disables 12V to EDSFF
03[O]     3V3EDSF   1 Setting low disables 3V3 to EDSFF
04[O]       3V3M2   0 Setting low disables 3V3 to M.2
05[I]      PWRDIS   0 Setting high sets PWRDIS signal to EDSFF
06[O]      P0CLKL   0 Setting low enables P0 clock
07[O]      P1CLKL   0 Setting low enables P1 clock
08[O]        Tx0N   1 Setting low disables Tx[0]-
09[O]        Tx0P   1 Setting low disables Tx[0]+
10[O]        Tx1N   1 Setting low disables Tx[0]-
11[O]        Tx1P   1 Setting low disables Tx[0]+
12[O]        Tx2N   1 Setting low disables Tx[0]-
13[O]        Tx2P   1 Setting low disables Tx[0]+
14[O]        Tx3N   1 Setting low disables Tx[0]-
15[O]        Tx3P   1 Setting low disables Tx[0]+
16[I]      PRSNTL   1 Setting low forces PRSNT, normally input from drive
17[i]    ADPRSNTL   1 Reading low indicates presence of M.2 adapter
18[i]    SCLI2CMI   1 SCL from MI I2C
19[i]    SDAI2CMI   1 SDA from MI I2C
20[I]        PLNL   1 PLN_L (Power Loss Notification)
21[I]        PLAL   1 PLA_L (Power Loss Acknowledge)
22[I]     LEDEDSF   1 EDSFF LED low enables LED
23[I]     STATUSL   1 Setting low enables blue status LED
24[I]      SMRSTL   1 Setting low resets SMBus
25[I]    SMBALRTL   1 SMB Alert
26[I]    ADPINITL   1 Reading low indicates M.2 adapter is initialized and ready
27[I]     FPGARST   1 Input High holds FPGA in Reset, removes from PCIe bus
28[O]     USR0TST   0 Mirror connector on iRiser5+ Bit[0]
29[O]     USR1TST   0 Mirror connector on iRiser5+ Bit[1]
30[O]     USR2TST   0 Mirror connector on iRiser5+ Bit[2]
31[O]     USR3TST   0 Mirror connector on iRiser5+ Bit[3]
```

Setting GPIO Direction and Value

You can set any bit with the name of the Signal, and you only need enough text to be unique. You can set the direction or the value of each bit. Note that the case used is insensitive.

Also, if an Action sequence is running, the GPIOs are under control of the Action sequence and may change.

Use the `show gpio` command to read Signal names and determine if the sequencer is running or stopped. For example:

```
iriser -d <slot> show gpio
GPIO|31            24|23            16|15             8|7              0|
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | | |L|L|
    |O|O|O|O|O|O|O|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O|Dir:[0x214]0xfe02ffcd
    |0|0|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1|Val:[0x200]0x3f52ff1d
Mirroring GPIO: perst0l[0]->usr0tst[28] 12v[2]->usr1tst[29]
      Sequencer: Stopped
```

Signal Access by Name

```
iriser -d <slot> out usr0
iriser -d <slot> set usr0
iriser -d <slot> clear usr0
iriser -d <slot> in usr0
```

Signal Access by Bit Location

```
iriser -d <slot> out 28
iriser -d <slot> set 28
iriser -d <slot> clear 28
iriser -d <slot> in 28
```

Note: While it may seem easier to use bit number, SANBlaze recommends that you use names when scripting because the bit locations may change from one design to the next, whereas the names will stay consistent.

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Measuring Power

There are two distinct ways iRiser devices measures power:

- Backward-Compatible Power Measurement
- Power Measurement via Analog-to-Digital and DMA-to-Host Memory

Backward-Compatible Power Measurement

For backward compatibility, the iRiser5 contains the same power circuitry as the 959 EDSFF riser. Power currently displayed on the GUI and recorded in the .csv files is based on the INA228 I2C A-to-D and is accessed with the following command:

```
sb_i2c2 -d 0 -m
```

```
INFO: System 01[00] SBExpress SN=64fc8ad9 Rev=R01 i2c_main=i2c-0 i2c_mi=i2c-1 SDB=/dev/ttyACM0
INFO: 01[00] Vload=11896.250mV, Iload=310.362mA, Pload=3692.142mW
```

Power Measurement via A-to-D and DMA-to-Host Memory

The iRiser hardware can sample power ~1M times/second (actual maximum rate is 961,538 samples/second) or average up to 1M samples.

Note: Although the hardware can support sampling 12V power at ~1M samples per second, it is recommended to limit the sampling rate to no greater than 250k for best results. OCP also recommends 250k as the maximum sampling rate.

3.3V Margining

Note: To margin the 3.3V power rail on a device under test, the iRiser 5+ must be paired with a **660 EDSFF-to-M.2 Adapter.**

Show range of margining support

To show the range of voltage adjustment supported by the 660 M.2 adapter, use the following command:

```
sb_i2c2 -d <slot> -U -r
```

```
INFO: System 01[00] SBExpress SN=960E3040001 Rev=R01 i2c_main=i2c-0
i2c_mi=i2c-1 SDB=/dev/ttyACM0  VLUN=0

  INFO: 01[00] 3.3V adjustable range - min=2.630V, max=3.990V
```

3.3V margining adjustment

To margin the 3.3V power rail on the 660 M.2 adapter, use the following command:

sb_i2c2 -d <slot> -U -v XXXX

where: the XXXX value after -v is the voltage level in millivolts you want to set

For example, to margin the 3.3V rail to 3.1V (-6%):

sb_i2c2 -d 0 -U -v 3100

```
INFO: System 01[00] SBExpress SN=960E3040001 Rev=R01 i2c_main=i2c-0
i2c_mi=i2c-1 SDB=/dev/ttyACM0  VLUN=0
INFO: 01[00] Vload=3095.898mV
```

Reset the margining level to the default value for the M.2 adapter

To reset the default voltage level for the 660 M.2 adapter, use the following command:

sb_i2c2 -d <slot> -U -v 0

For example:

sb_i2c2 -d 0 -U -v 0

```
INFO: System 01[00] SBExpress SN=960E3040001 Rev=R01 i2c_main=i2c-0
i2c_mi=i2c-1 SDB=/dev/ttyACM0  VLUN=0
INFO: 01[00] 0V specified for 3V3M2 voltage, reset to nominal 3.3V
INFO: 01[00] Vload=3296.289mV
```

Power Monitoring

The iRiser CLI program has been modified to allow recording power readings on the 12V rail of the iRiser and allow playback of the recording at a later date.

The recordings are saved to one unique directory which is specified when the recording is started. If same name is used for multiple recordings, the contents of previous records are replaced with the new.

The following commands are available from the CLI to control/monitor this feature:

Starting a power recording

To start a power recording, the **start power** CLI command is used.

The command starts the DMA engine to collect power data and samples can be taken as fast as ~1M samples/second (Maximum rate 961,538 samples/second).

```
iRiser -d <slot> start power <recording> <4|12V> <samples> <duration|recordcnt>
```

Where:

- **Recording** - name of the directory which will contain the recorded power measurements for the devices specified
- **Samples** - Set the number of 1.04us delays between collecting samples by value (1 - 1.04us, 2 - 2.08us, 8 - 8.32us) or period (2s, 4ms, 5us).
- **Duration** - time the monitoring will execute for. The value can be specified in seconds (i.e. 5s), milliseconds (i.e. 10ms) or microseconds (i.e. 600us)
- **Recordcnt** - if a "rc=" precedes the value, the value corresponds to the number of records to collect

  Example:

  ```
  iriser -d <slot> start power testcapture 12V 10us 5000s
  ```

Stopping a power recording

To stop or abort an active power recording, the **stop power** CLI command is used. The command stops the DMA engine from collecting power data.

The format is:

```
iRiser -d <slot> stop power
```

Showing devices available for recording power

Currently only the 12V source on the iRiser can be monitored for power. However, this may change in the future. As such, a command to show the available device(s) can be monitored is provided.

The format for the command is:

iRiser -d <slot> show power available

```
INFO: Slot[1] Devices which can be currently monitored: 12V
```

Displaying power recordings available

All the available recordings for an iRiser can be obtained by issuing the show power command.

The command format is:

iriser -d <slot> show power

```
INFO: Slot[1] Power Monitor "Test" recorded devices :
12V: State="Complete" RecordSize=16 RecordCnt=15 SampleRate=  1 per 1.000000 seconds
StartTime=Wed Apr 16 11:51:20 2025.303034085 EndTime=Wed Apr 16 11:51:36 2025.909068085
```

To show the power recorded for a particular recording, specify the recording directory.
The command format is:

iRiser -d <slot> show power <recording>

Displaying power recording content

To show the output of a recordings:

iRiser -d <slot> show power <recording> <powerdevice> [<starttime>] [<endtime>] [maxrecords]

Where:

- Recording - name of the directory which will contain the recorded power measurements for the device specified
- powerdevice is 4 or 12V (EDSFF 12.0V 12bit)
- starttime - specifies the starting time in the recording to report. If not specified or -1, shows first and last accessible data, e.g.:
- INFO: First time record[0] = 1727865253940590794 Oct 02,2024 06:34:13.940590794 last time record[1094] = 1727866391701728554 Oct 02,2024 06:53:11.701728554
- endtime - specifies the ending time in the recording to report. If not specified or -1, reports to the end of the recording
- maxrecord - if specified, indicates the maximum number of records to return in the range specified. For example, if there are 2000 records and the maxrecord is 100, every 10 records in the trace reported

Output will look similar to the following when a range is specified:

```
Time(ns),PowerIndex,ADC Gain,ADC Value,RShunt,Vbus(mV),Ibus(mA),Pbus(mW)
1740611167296809688,4,20,16,12000,11939,0.022,267.255
1740611169376811768,4,20,16,12000,11939,0.022,267.255
1740611171456813848,4,20,16,12000,11939,0.022,267.255
```

Removing power recordings

All the power recordings or a specific power recording can be removed using the **clear power** CLI command.

The format for the commands are:

```
iRiser -d <slot> clear power all
iRiser -d <slot> clear power recording
```

Checking current status of power monitoring

To check the status of power monitoring use the status power cli command.

The format for the command is:

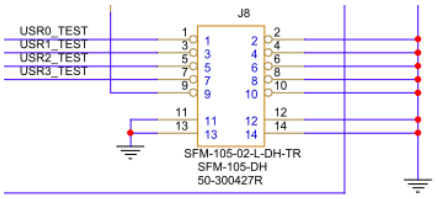
```
iRiser -d <slot> status power
```

Mirroring GPIO Bits

USR0TST - USR3TST can be mapped to any other GPIO Signal for the purpose of connecting a scope to monitor the Signals or to use any Signal as a trigger. Up to four Signals can be "mirrored" in this manner.

J8 - User Signal Connector

A ten-pin connector is available on the front of iRiser devices for the purpose of accessing the four mirror Signals. The connector is wired as follows:



- Pin1 - USR0TST GPIO28
- Pin3 - USR1TST GPIO29
- Pin5 - USR2TST GPIO30
- Pin7 - USR3TST GPIO31
- Pin9 - N/C (no connect)
- All other pins are ground

A cable is included in the iRiser kit for access to these Signals.

Mirroring Example:

A scope is placed on USR0 and USR1 which is used to monitor POWER (12V) and PCIe RESET (PERST).

Mirroring can be set up using bit location or name, and the current configuration is displayed using the show gpio command. For example:

show gpio

GPIO	31							24	23							16	15							8	7							0	
	USR3TST	USR2TST	USR1TST	USR0TST	SB2GPIO	SB1GPIO	SB0GPIO	USBDISL	STATUSL	LEDEDSF	RFUEDSF	PLNEDSF	PLAEDSF	MFGEDSF	DUALPTL	PRSNTL	Tx3P	Tx3N	Tx2P	Tx2N	Tx1P	Tx1N	Tx0P	Tx0N	P1CLKL	P0CLKL	PWRDISL	SMRSTL	3V3	12V	CLKREQL	PERST0L	
Dir:	O	O	O	O	I	I	I	I	I	I	I	I	I	I	O	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	I	[0x214]0xf002ffcc
Val:	0	0	0	0	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	1	[0x200]0x0f52ff1d

In the above configuration, no mirroring has been established.

To set up the example of mirroring PERST to USR0TST and 12V to USR1TST, use the following commands (assumes iRiser5 is in slot 1):

iriser -d <slot> mirror perst usr0

```
INFO: Mirror[0] from perst0l[0] to usr0tst[28]
```

iriser -d <slot> mirror 12v usr1

```
INFO: Mirror[1] from 12v[2] to usr1tst[29]
```

Issue the show GPIO command to inspect the mirror configuration:

iriser -d <slot> show gpio

GPIO	31							24	23							16	15							8	7							0	
	USR3TST	USR2TST	USR1TST	USR0TST	SB2GPIO	SB1GPIO	SB0GPIO	USBDISL	STATUSL	LEDUEDSF	RFUEDSF	PLNEDSF	PLAEDSF	MFGEDSF	DUALPTL	PRSNTL	Tx3P	Tx3N	Tx2P	Tx2N	Tx1P	Tx1N	Tx0P	Tx0N	P1CLKL	P0CLKL	PWRDIS	SMRSTL	3V3	12V	CLKREQL	PERST0L	
	O	O	O	O	I	I	I	I	I	I	I	I	I	I	O	I	O	O	O	O	O	O	O	O	O	O	I	I	O	O	I	I	Dir:[0x214]0xf002ffcc
	0	0	1	1	1	1	1	1	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	1	Val:[0x200]0x3f52ff1d

Mirroring GPIO: perst0l[0]->usr0tst[28] 12v[2]->usr1tst[29]

A show mirror has been added to the iRiser program to show any mirroring settings:

iriser -d <slot> show mirror

If no signal mirroring is enabled, the output will read as this:

```
Slot[x] Mirror Bits are not configured.
```

For an example of mirroring PERST to USR0TST and CLKREQ to USR1TST, the show mirror output would look like this:

```
Mirroring GPIO: perst0l[0]->usr0tst[28] clkreql[1]->usr1tst[29].
```

Unmirror Command

To remove the mirroring, issue the unmirror command:

iriser -d <slot> unmirror

Monitoring GPIO Signals with Mirroring

Once mirroring is established between the USRnTST Signals and any of the lower 28 GPIO bits, a change to the "from" bit will be reflected by the "to" bit for the purpose of externally monitoring that Signal.

Sequences and Actions

iRiser devices are programmed by means of loading Actions and Sequences of Actions to the device which are then executed by changing the specified GPIO Signals. Sequences are simply defined as groups of Actions that are linked together and either end in a "stop" (Sequence will run once and stop) or the index of another Action. If an Action points to the first Action in the Sequence, the Sequence will loop until the "stop" command is issued at the CLI.

If the Sequence is a loop and the system reboots, after the system comes back up, the Sequence will continue running. The blue status LED on the front of the iRiser will be blinking. If the Sequence is not a loop, after it stops running, the blue status LED on the front of the iRiser will stop blinking.

There are 128 "slots", each of which can hold an Action, and a Sequence can be one or more Actions; up to 128 Actions can be defined in a Sequence.

Examples of a Sequence of Actions

To illustrate the use case of Actions and Sequences, see the two example test scenarios below. Note the following:

s = seconds
ms = milliseconds
us = microseconds
ns = nanoseconds

Example 1: Run Once and Stop Sequence

In this example, a user wants to see the effect of a glitch on PERST (reset) on the device under test exactly 5S after a clean power up. You may want to describe the following Actions:

- Action 0 - Starting state: Deassert 12V Power, assert PERST, sleep 10 seconds
- Action 1 - Assert 12v Power, sleep 250mS
- Action 2 - Deassert PERST, sleep 5S
- Action 3 - Assert PERST, sleep 100nS
- Action 4 - Deassert PERST, and stop

Example 2: Run until Stopped (loop)

In this example, a user wants to repeat the test created above, but run it continuously every 15 seconds until stopped. Add an additional Action to the Actions above that loops back to Action 0.

- Action 0 - Starting state: Deassert 12V Power, assert PERST, sleep 10 seconds
- Action 1 - Assert 12v Power, sleep 250mS
- Action 2 - deassert PERST, sleep 5S
- Action 3 - assert PERST, sleep 100nS
- Action 4 - deassert PERST, sleep 15S then return to Action 0

Defining Actions from CLI Command

The two examples above are built using the 'iriser -d <slot> edit action <action>' command, which can be run from a single CLI command or interactively. First build the first example using the CLI command and then modify it interactively to demonstrate both methods.

Start with the iRiser device in Initial State:

```
iriser -d <slot> init
```

Program the 5 actions described for Example 1:

```
#
# Commands to configure iRiser5 sequencer
#
iriser -d <slot> edit action   0 0xf002ffcd 0x0f52ff18 10.000000s      1 Deassert 12V Power assert PERST sleep 10
seconds
iriser -d <slot> edit action   1 0xf002ffcd 0x0f52ff1c 250.000000ms    2 Assert 12v Power sleep 250
iriser -d <slot> edit action   2 0xf002ffcd 0x0f52ff1d 5.000000s       3 Deassert PERST sleep 5S
iriser -d <slot> edit action   3 0xf002ffcd 0x0f52ff1c 100.000000ns    4 Assert PERST sleep 100nS
iriser -d <slot> edit action   4 0xf002ffcd 0x0f52ff1d 100.000000ns stop Deassert PERST sleep 100nS and stop
sequencer
```

iriser -d <slot> Edit Action

The iRiser is designed to be able to control Signals to a device under test at precise intervals. For example, an Action sequence could enable power to a device, 100mS later release PERST, and then 100mS after that assert PERST for 100nS and release it. Any combination of controlled Signals can be programmed in this manner.

```
iRiser -d <slot> edit action <action number> <direction> <value> <time>
<next action> [name]
```

Where:

- <slot> - Physical slot number of the iRiser.
- <action number> - Action number, use show actions for list.
- <direction> - 32 bits of GPIO direction 1=output,0=input (use show gpio for Signal names).
  - Certain I/O direction bits may be locked by SANBlaze depending on configuration.
- <value> - 32 bits of GPIO Signal values.
  - All Signals MUST be defined, for a Signal that will not change on this Action you must specify same value as the preceding Action.
- <time> - Time specified as s (seconds), ms (milliseconds), us (microseconds), ns (nanoseconds) (e.g. 25.2ms).
  - Minimum time between Actions is 10nS.

- <next> - Next Action in the sequence.
  - If next = Usually current Action number +1 - Continue execution at that Action.
  - If next = "stop" - Stop execution (values in GPIO will remain at last Action values).
  - Valid range [0 - 127].
  - If next points to existing Action execution will jump to that Action.
  - If next points to an Action within the same Sequence, it will begin looping.

- <name> - Optional name for Action. These are stored in the .cfg and .sh files described elsewhere in this document. Special characters are only allowed in the Action name if you use quotation marks. Currently, 126 characters is the limit in length. Optionally, if not provided will be assigned to "Action <action number>".

  Note: When setting the name, it should be encased by a ‘ or “”. Otherwise, if the name has fields which can be interpreted as commands, the edit may fail. The quotes ensure that the string is treated as a string and not a set of separate commands.

Initializing the Action Memory

All Actions can be cleared with a single command.

WARNING - Use with caution.

```
iriser -d <slot> init
```

For the scenario described above, start with power disabled and PERST enabled and wait 1s.

Show Current Actions

Once the Actions in Example 1 above have been programmed, you may show any one Action, all the Actions, or all the Actions in a given sequence with the following commands:

```
iriser -d <slot> show action <number>
iriser -d <slot> show actions
iriser -d <slot> show sequence <number>
iriser -d <slot> show sequences
```

For Example 1:

```
  INFO: Action 0 Sequence 0
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31          24|23          16|15           8|7            0|
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | | |L|L|
    |O|O|O|O|I|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O|Dir:[0x804]0xf002ffcd
Act                                                                 Next|GPIO Value|Time
000 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|0|0|0| 001|0x0f52ff18|10.000000s
001 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0| 002|0x0f52ff1c|250.000000ms
002 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 003|0x0f52ff1d|5.000000s
003 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0| 004|0x0f52ff1c|100.000000ns
004 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 004|0x0f52ff1d|100.000000ns
Stop
```

Starting a Sequence

Sequences are groups of Actions that terminate (stop) or loop (jump back to start). Sequence numbers begin at zero and are assigned automatically. You cannot re-number Sequences. To find all currently programmed Sequences, use the show Sequences command.

Start the Sequence defined in Example 1 above with the command:

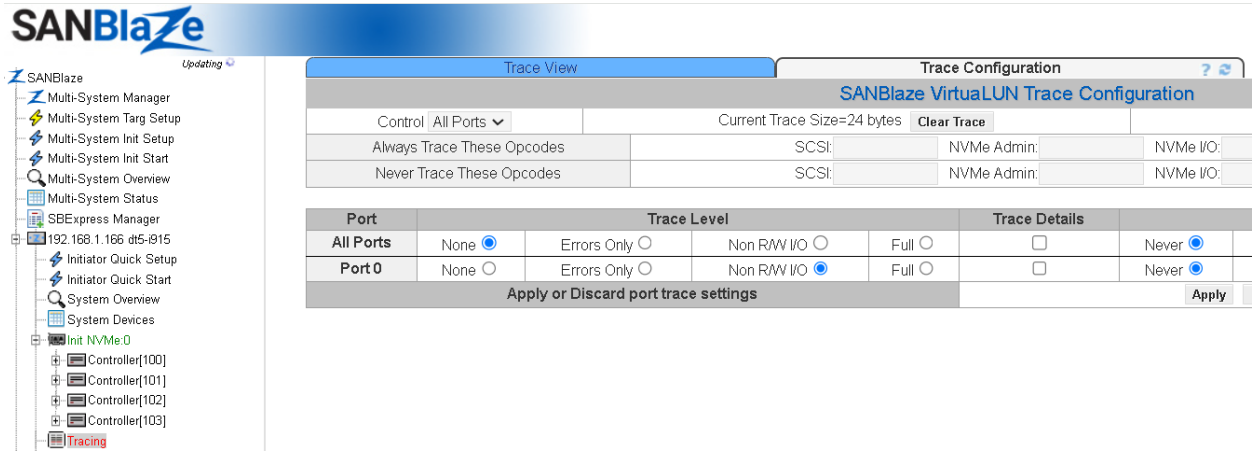
iriser -d <slot> start sequence 0

Because the Sequence is set to stop, using the show Sequence 0 command will first show the Sequence as running, and then stopped.

What happens while the Sequence is running?

Monitoring your device using the SANBlaze built-in "tracing" will show the NVMe activity as the Sequence executes.

Monitor Activity with Tracing




```
Jan 22 05:40:05.693219 P0:T100: 0000:09:00.0: trigger with error 09061ae3
Jan 22 05:40:05.693222 P0:T100: 0000:09:00.0: trigger with error 09001ae3
Jan 22 05:40:05.693223 P0:T100: 0000:09:00.0: Device is gone, deleting
Jan 22 05:40:05.693224 P0:T100: controller gone reported
Jan 22 05:40:05.715258 P0:T100: logout with 0000:09:00.0
Jan 22 05:40:16.015336 P0: adding NVMe device 0000:09:00.0
Jan 22 05:40:16.117096 P0:T100: 0000:09:00.0: reset start
Jan 22 05:40:16.453719 P0:T100: 0000:09:00.0: Controller Probe to Controller Enable took 102265 usec
Jan 22 05:40:16.453732 P0:T100: 0000:09:00.0: Controller Enable (CC.EN=1) to Controller Ready (CSTS.RDY=1) took 336310 usec
Jan 22 05:40:16.453995 P0:T100: qid:0 cid:14a IdentifyController
Jan 22 05:40:16.454196 P0:T100: qid:0 cid:14a IdentifyController success (192 usec)
Jan 22 05:40:16.454201 P0:T100: 0000:09:00.0: Controller Ready to Identify Successful took 484 usec
Jan 22 05:40:16.454237 P0:T100: qid:0 cid:14a SetFeatures NSID=0x0 FID=0xe SV=0x0
Jan 22 05:40:16.454265 P0:T100: qid:0 cid:14a SetFeatures NSID=0x0 FID=0xe SV=0x0 success, result 0h (23 usec)
Jan 22 05:40:16.454269 P0:T100: qid:0 cid:14a GetFeatures NSID=0x0 FID=0x7 SEL=0x0
Jan 22 05:40:16.454302 P0:T100: qid:0 cid:14a GetFeatures NSID=0x0 FID=0x7 SEL=0x0 success, result 7F007Fh (23 usec)
Jan 22 05:40:16.454305 P0:T100: qid:0 cid:14a SetFeatures NSID=0x0 FID=0x7 SV=0x0
Jan 22 05:40:16.454331 P0:T100: qid:0 cid:14a SetFeatures NSID=0x0 FID=0x7 SV=0x0 success, result 7F007Fh (17 usec)
Jan 22 05:40:16.457972 P0:T100: qid:0 cid:14a CreateCompletionQueue QID=0x1 QSIZE=0x3fff
```

Monitoring Activity with sb_logger

A CLI program sb_logger is provided with all SANBlaze systems, which continuously monitors all relevant log files on the system.

It is common (and best) practice to leave the sb_logger program running in a CLI window while executing Sequences to see how the Sequence is affecting your device.

The following is an example of sb_logger session:

sb_logger

```
==> /virtualun/log/iriser <==
Mon Jan 22 05:45:31 2024:   INFO: Starting sequencer at action location action=0

==> /virtualun/log/sb_i2c2 <==
Mon Jan 22 05:45:31 2024: sb_i2c2 -d 0 -f STATUS_BLUE_LED_L -w 3 -q

==> /var/log/messages <==
Jan 22 05:45:31 dt5-i915 kernel: [81541.435244] nvme: DPC: link to bus 09 is now DOWN
Jan 22 05:45:31 dt5-i915 kernel: [81541.435250] nvme: HP: Slot(0): status 0108/4001 for bus 09
Jan 22 05:45:31 dt5-i915 kernel: [81541.435252] nvme: HP: Slot(0): Presence Not Detected on bus
09
Jan 22 05:45:31 dt5-i915 kernel: [81541.435253] nvme: HP: Slot(0): Link Down on bus 09
Jan 22 05:45:31 dt5-i915 kernel: [81541.435258] nvme: DPC status 0009 for bus 09
Jan 22 05:45:31 dt5-i915 kernel: [81541.435267] nvme: HP: Slot(0): link to bus 09 is DOWN
Jan 22 05:45:31 dt5-i915 kernel: [81541.435270] nvme_vlun_hp_down@15229: 0000:04:08.0
0000:09:00.0
Jan 22 05:45:31 dt5-i915 kernel: [81541.435272] nvme_vlun_hp_remove@15212: echo 1 >
/sys/bus/pci/devices/0000:09:00.0/remove
Jan 22 05:45:31 dt5-i915 kernel: [81541.435291] remove PCI device 0000:09:00.0 start
Jan 22 05:45:31 dt5-i915 kernel: [81541.435292] pci_stop_bus_device@101: 0000:09:00.0:
ffff88107241d800 0000:09
Jan 22 05:45:31 dt5-i915 kernel: [81541.435297] nvme: 0000:09:00.0: code 6
Jan 22 05:45:31 dt5-i915 kernel: [81541.435304] nvme_remove@7993: 0000:09:00.0: cfg rd 0004 ffff
Jan 22 05:45:31 dt5-i915 kernel: [81541.435305] nvme_remove@7994: 0000:09:00.0: cfg rd 0006 ffff
Jan 22 05:45:31 dt5-i915 kernel: [81541.435312] 0000:09:00.0: trigger with error 09061ae3
Jan 22 05:45:31 dt5-i915 kernel: [81541.435314] 0000:09:00.0: trigger with error 09001ae3
Jan 22 05:45:31 dt5-i915 kernel: [81541.435315] 0000:09:00.0: Device is gone, deleting
Jan 22 05:45:31 dt5-i915 kernel: [81541.435317] pci 0000:09:00.0: vendor/device ffffffff
Jan 22 05:45:31 dt5-i915 kernel: [81541.435321] nvme_dev_dis@6091: 0000:09:00.0: rd 1c ffffffff
Jan 22 05:45:31 dt5-i915 kernel: [81541.435531] nvme_disable_admin_queue@4253: 0000:09:00.0: rd
00 ffffffffffffffff
Jan 22 05:45:31 dt5-i915 kernel: [81541.435552] nvme_pci_disable@6055: 0000:09:00.0: cfg rd 0004
ffff
Jan 22 05:45:31 dt5-i915 kernel: [81541.456799] nvme: removing device 0000:09:00.0
Jan 22 05:45:31 dt5-i915 kernel: [81541.457152] nvme_pci_free_ctrl@6181: dev<ffff88106019e000>
pdev<ffff880f6e8d6000>
Jan 22 05:45:31 dt5-i915 kernel: [81541.457153] nvme_pci_free_ctrl@6190: dev<ffff88106019e000>
Jan 22 05:45:31 dt5-i915 kernel: [81541.457166] nvme: 0000:09:00.0: code 7
Jan 22 05:45:31 dt5-i915 kernel: [81541.457174] _pci_remove_bus_device@136: 0000:09:00.0:
ffff88107241d800 0000:09
Jan 22 05:45:31 dt5-i915 kernel: [81541.457174] nvme: 0000:09:00.0: code 2
Jan 22 05:45:31 dt5-i915 kernel: [81541.457183] nvme: 0000:09:00.0: code 3
Jan 22 05:45:31 dt5-i915 kernel: [81541.457193] remove PCI device 0000:09:00.0 end
Jan 22 05:45:31 dt5-i915 kernel: [81541.457196] pci: free ffff880f6e8d6000 0000:09:00.0 1bb1:5018
```

Interactive Action Editing

An interactive method for editing Actions is built into the system. Editing Actions interactively provides built-in help and makes the process easier to visualize.

To illustrate this, we will modify Example 1 above using interactive edits to change the Sequence from a "run once and stop" to a "loop" Sequence, which then runs until stopped by the **iriser -d <slot> stop** command.

Starting Point

As shown above, we created Sequence 0 which runs once and stops. For example:

```
 INFO: Action 0 Sequence 0
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31          24|23          16|15           8|7             0
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | | |L|L
    |O|O|O|O|I|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O| Dir:[0x804]0xf002ffcd
Act                                                                 Next|GPIO Value|Time
000 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|0|0|0| 001 |0x0f52ff18|10.000000s
001 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0| 002 |0x0f52ff1c|250.000000ms
002 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 003 |0x0f52ff1d|5.000000s
003 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0| 004 |0x0f52ff1c|100.000000ns
004 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 004 |0x0f52ff1d|100.000000ns Stop

     Sequencer: Stopped
```

We modify Action 4 to sleep for 10 seconds and then loop back to Action 0, thus looping indefinitely until stopped.

The interactive session is shown below:

```
iriser -d <slot> edit action 4
Prior action points to me, use GPIO_dir from prior action
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31          24|23          16|15           8|7             0
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | | |L|L
    |O|O|O|O|I|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O| Dir:[0x844]0xf002ffcd
Act                                                                 Next|GPIO Value|Time
004 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0| 004 |0x0f52ff1c|100.000000ns

Enter 32bit hex or bit name/number or h for help. DIRECTION:[0xf002ffcd]:
```

We do not want to change DIRECTION and therefore we type <cr> to take the default which advances the editor to ask for VALUE.

```
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31            24|23            16|15             8|7             0|
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | | |L|L|
    |O|O|O|O|I|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O|Dir:[0x844]0xf002ffcd
Act |                                                               |Next|GPIO Value|Time
004 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0| 000|0x0f52ff1c|10.000000s
```

```
Prior action points to me, use GPIO_out from prior action
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31            24|23            16|15             8|7             0|
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | | |L|L|
    |O|O|O|O|I|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O|Dir:[0x844]0xf002ffcd
Act |                                                               |Next|GPIO Value|Time
004 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0| 004|0x0f52ff1c|100.000000ns
Enter 32bit hex or bit name/number or h for help. VALUE:[0x0f52ff1c]: perst
```

We want to leave PERST de-asserted, and see that the default for Action 4 is zero (asserted). At this point we have three options in the editor. We can toggle a single bit by name, by bit location, or we can write the entire 32bit output value. We choose toggle by name. The three input options are as follows:

- Change bit value by name - perst
- Change bit value by location - 0
- Change entire GPIO register - 0x0f52ff1d

```
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31            24|23            16|15             8|7             0|
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | | |L|L|
    |O|O|O|O|I|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O|Dir:[0x844]0xf002ffcd
Act |                                                               |Next|GPIO Value|Time
004 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 000|0x0f52ff1d|10.000000s
Enter 32bit hex or bit name/number or h for help. VALUE:[0x0f52ff1d]:
```

You can toggle as many bits as you want using this method. When satisfied with the VALUE bits, simply accept the current value using <cr>, and the editor will move on to ask for TIME.

```
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31           24|23           16|15            8|7             0|
    |USR3TST|USR2TST|USR1TST|USR0TST|SB2GPIO|SB1GPIO|SB0GPIO|USBDISL|
    |STATUSL|LEDEDSF|RFUEDSF|PLNEDSF|PLAEDSF|MFGEDSF|DUALPTL|PRSNTL|
    |Tx3P|Tx3N|Tx2P|Tx2N|Tx1P|Tx1N|Tx0P|Tx0N|P1CLKL|P0CLKL|PWRDISL|SMRSTL|3V3|12V|CLKREQL|PERST0L|
    |O|O|O|O|I|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O| Dir:[0x844]0xf002ffcd
Act                                                                       Next|GPIO Value|Time
004 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1|  000|0x0f52ff1d|10.000000s
Specify time in s, ms, us, ns (e.g. 25.2ms). Time [10.00s]:
```

We want to leave the device under test (DUT) time to stabilize before starting the loop over, so we enter a reasonable time of 10 seconds. The editor will move to ask for label.

Note: The minimum time between Actions, and therefore the minimum time between changing the state of a Signal is 10ns. If you enter a value less than 10ns you will be prompted to correct.

```
Sequence label for Action 4 [Action 4]: Sleep 10s and loop to action 0
```

We reject the default label of "Action 4" and provide our own label. The editor moves to ask for "next action".

```
Next Action (0=loop, s=stop, w=write, q=quit) [  5]: 0
```

The editor provides us with four choices and a default. The default is Action + 1, so in our case 5. If you take the default, the editing session will continue and you can define Action 5, but we want to loop at this point, so select 0. The "loop" index will be the first index in the current Sequence and may not be zero.

Next Action Options

- loop - An Action within the Sequence will loop back into the Sequence and run until manually stopped. The loop default is the first Action in the current Sequence.
- s - Stop Sequence leaving Signal states at the currently defined I/O and value.
- w - Write the changes to the given Action or Actions and exit interactive editor.
- q - Abandon the changes to the give Action or Actions and quit the interactive editor.

At this point entering "s" will make the current Action last and stop the Sequencer. Be sure to leave all GPIO bits in the state you wish them to remain once the Sequence stops.

For example, if you leave power (12V) at zero or PERST at 0 your DUT will not be accessible.

```
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31            24|23            16|15             8|7              0
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | | |L|L|

    |O|O|O|O|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O| Dir:[0x844]0xf002ffcd
Act                                                                   Next|GPIO Value|Time
004 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1|  000|0x0f52ff1d|10.000000s

     Sequencer: Stopped
  INFO: Action edit complete, use iriser -d <slot> start action 4 to start
[root@dt5-i915 iRiser]# iriser -d <slot> show sequence 0

  INFO: Action 0 Sequence 0
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31            24|23            16|15             8|7              0
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | | |L|L|

    |O|O|O|O|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O| Dir:[0x804]0xf002ffcd
Act                                                                   Next|GPIO Value|Time
000 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|0|0|0|  001|0x0f52ff18|10.000000s
001 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0|  002|0x0f52ff1c|250.000000ms
002 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1|  003|0x0f52ff1d|5.000000s
003 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0|  004|0x0f52ff1c|100.000000ns
004 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1|  000|0x0f52ff1d|10.000000s

     Sequencer: Stopped
```

Now when you start sequence 0 it will continue running and will loop back, turn off the DUT and start again.

```
iriser -d <slot> start sequence 0
iriser -d <slot> show sequence 0
```

```
  INFO: Action 0 Sequence 0
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31            24|23            16|15             8|7              0
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | | |L|L|

    |O|O|O|O|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|O| Dir:[0x804]0xf002ffcd
Act                                                                   Next|GPIO Value|Time
000 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|0|0|0|  001|0x0f52ff18|10.000000s
001 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0|  002|0x0f52ff1c|250.000000ms
002 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1|  003|0x0f52ff1d|5.000000s
003 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|0|  004|0x0f52ff1c|100.000000ns
004 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1|  000|0x0f52ff1d|10.000000s

     Sequencer: Running
iriser -d <slot> show sequences
```

Additional notes on Adding new Actions

If there are no Sequences currently on the iRiser, the IO direction and IO Value hex values will be generated from the GPIO defaults.

GPIO defaults can be found by using the command:

iriser -d <slot> show gpio defaults

```
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31           24|23           16|15            8|7             0|
    |USR3TST|USR2TST|USR1TST|USR0TST|SBGPIO3|SBGPIO2|SBGPIO1|SBGPIO0|STATUSL|LEDUESF|RFUESF|PLNESF|PLAESF|MFGESF|DUALPTL|PRSNTL|Tx3PRSN|Tx3N|Tx2PRSN|Tx2N|Tx1PRSN|Tx1N|Tx0PRSN|Tx0N|P1CLKL|P0CLKL|PWRDIS|SMRST|3V3|12V|CLKREQL|PERST0L|
    |O|O|O|O|I|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|I| Dir:[0x214]0xf002ffcc
    |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| Val:[0x210]0x0f52ff1d
```

If none of the 128 available Actions are left on the iRiser, the GUI will return an error when you try to add another indicating there are no Actions left.

Showing Status of Sequences

To show Sequences use the command:

iriser -d status

```
INFO: Action 0 Sequence 0
Direction: I/O (UC) user writable signal, i/o (LC) signal locked
GPIO|31           24|23           16|15            8|7             0|
    |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | |L|L|
    |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|
    |O|O|O|O|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|I|Dir:[0x804]0xf002ffcc
Act |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|Next|GPIO Value|Time
000 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 001|0x0f52ff1d|250.000000ms
001 |0|0|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 002|0x1f52ff1d|250.000000ms
002 |0|0|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 003|0x2f52ff1d|250.000000ms
003 |0|0|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 004|0x3f52ff1d|250.000000ms
004 |0|1|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 005|0x4f52ff1d|250.000000ms
005 |0|1|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 006|0x5f52ff1d|250.000000ms
006 |0|1|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 007|0x6f52ff1d|250.000000ms
```

```
007 |0|1|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 008|0x7f52ff1d|250.000000ms
008 |1|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 009|0x8f52ff1d|250.000000ms
009 |1|0|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 010|0x9f52ff1d|250.000000ms
010 |1|0|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 011|0xaf52ff1d|250.000000ms
011 |1|0|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 012|0xbf52ff1d|250.000000ms
012 |1|1|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 013|0xcf52ff1d|250.000000ms
013 |1|1|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 014|0xdf52ff1d|250.000000ms
014 |1|1|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 015|0xef52ff1d|250.000000ms
015 |1|1|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 000|0xff52ff1d|250.000000ms
    └─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┘

INFO: Action 20 Sequence 1

Direction: I/O (UC) user writable signal, i/o (LC) signal locked

GPIO|31           24|23           16|15            8|7             0|
    ├─┬─┬─┬─┬─┬─┬─┬─┼─┬─┬─┬─┬─┬─┬─┬─┼─┬─┬─┬─┬─┬─┬─┬─┼─┬─┬─┬─┬─┬─┬─┬─┤
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|D|P|T| | | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|S|T|L| | | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|F|L| | | | | | | | | | | | | | |L|L|
    ├─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┤
    |O|O|O|O|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|I|I|O|O|I|I|Dir:[0x944]0xf002ffcc
Act ├─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┤Next|GPIO Value|Time
020 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 021|0x0f52ff1d|125.000000ms
021 |0|0|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 022|0x1f52ff1d|125.000000ms
022 |0|0|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 023|0x2f52ff1d|125.000000ms
023 |0|0|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 024|0x3f52ff1d|125.000000ms
024 |0|1|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 025|0x4f52ff1d|125.000000ms
025 |0|1|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 026|0x5f52ff1d|125.000000ms
026 |0|1|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 027|0x6f52ff1d|125.000000ms
027 |0|1|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 028|0x7f52ff1d|125.000000ms
028 |1|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 029|0x8f52ff1d|125.000000ms
029 |1|0|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 030|0x9f52ff1d|125.000000ms
030 |1|0|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 031|0xaf52ff1d|125.000000ms
031 |1|0|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 032|0xbf52ff1d|125.000000ms
032 |1|1|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 033|0xcf52ff1d|125.000000ms
033 |1|1|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 034|0xdf52ff1d|125.000000ms
034 |1|1|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 035|0xef52ff1d|125.000000ms
035 |1|1|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 020|0xff52ff1d|125.000000ms
    └─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┘
```

```
INFO: Action 40 Sequence 2

Direction: I/O (UC) user writable signal, i/o (LC) signal locked

GPIO|31           24|23           16|15            8|7             0|
    ├─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┤
    |U|U|U|U|S|S|S|U|S|L|R|P|P|M|D|P|T|T|T|T|T|T|T|T|P|P|P|S|3|1|C|P|
    |S|S|S|S|B|B|B|S|T|E|F|L|L|F|U|R|x|x|x|x|x|x|x|x|1|0|W|M|V|2|L|E|
    |R|R|R|2|1|0|B|A|D|U|N|A|G|A|S|3|3|2|2|1|1|0|0|C|C|R|R|3|V|K|R|
    |3|2|1|0|G|G|G|D|T|E|E|E|E|L|N|P|N|P|N|P|N|P|N|L|L|D|S| | |R|S|
    |T|T|T|T|P|P|P|I|U|D|D|D|D|P|T| | | | | | | |K|K|I|T| | |E|T|
    |S|S|S|S|I|I|I|S|S|S|S|S|S|T|L| | | | | | | |L|L|S|L| | |Q|0|
    |T|T|T|T|O|O|O|L|L|F|F|F|F|L| | | | | | | | | | | | | |L|L|
    ├─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┤
    |O|O|O|O|I|I|I|I|I|I|I|I|I|O|I|O|O|O|O|O|O|O|O|O|O|I|I|O|O|I|I|Dir:[0xa84]0xf002ffcc
Act ├─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┼─┤Next|GPIO Value|Time
040 |0|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 041|0x0f52ff1d|1.000000s
041 |0|0|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 042|0x1f52ff1d|1.000000s
042 |0|0|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 043|0x2f52ff1d|1.000000s
043 |0|0|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 044|0x3f52ff1d|1.000000s
044 |0|1|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 045|0x4f52ff1d|1.000000s
045 |0|1|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 046|0x5f52ff1d|1.000000s
046 |0|1|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 047|0x6f52ff1d|1.000000s
047 |0|1|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 048|0x7f52ff1d|1.000000s
048 |1|0|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 049|0x8f52ff1d|1.000000s
049 |1|0|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 050|0x9f52ff1d|1.000000s
050 |1|0|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 051|0xaf52ff1d|1.000000s
051 |1|0|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 052|0xbf52ff1d|1.000000s
052 |1|1|0|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 053|0xcf52ff1d|1.000000s
053 |1|1|0|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 054|0xdf52ff1d|1.000000s
054 |1|1|1|0|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 055|0xef52ff1d|1.000000s
055 |1|1|1|1|1|1|1|1|0|1|0|1|0|0|1|0|1|1|1|1|1|1|1|1|0|0|0|1|1|1|0|1| 055|0xff52ff1d|1.000000s
Stop
    └─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┘

    Sequencer is running current action 33 sequence 1
```

Known issues

As of the 11.0-Build2 software release, there are known iRiser issues that will be fixed in a later release:

- When starting a Sequence from the CLI while the iRiser GUI is not active, the GUI will not know the exact location of the Sequence running and will display an “out of sync” error to clearly indicate this.
- A rare known issue may display the wrong Sequence when starting a Sequence from the CLI that is different from the one currently displayed on screen.
- A rare known issue may show a Sequence as still running, when manually stopping the Sequence at the end of a Sequence.
- Power tab: if user closes and re-opens the power tab while a recording is in progress, system might show end time as a negative number or undefined

Appendix A: Programming the FPGA Code

If your iRiser hardware is not up to date or not showing up, here is how to program the FPGA (you need a tip kit).

For iRiser5:

```
iRiser5_flash_VD1_SPIx4.sh -d 0
Open On-Chip Debugger 0.12.0+dev-01243-g24b656bff (2025-06-09-12:18)
...
Info : sector 16 took 122 ms
...
shutdown
Using config file /etc/iRiser/iRiser5_flash_VD1_SPIx4.cfg
INFO: Wrote image iRiser5_VD1_SPIx4.bin SPI set to x4
```

For iRiser5+:

```
iRiser5+_flash_VFE_SPIx4.sh -d 0
Open On-Chip Debugger 0.12.0+dev-01243-g24b656bff (2025-06-09-12:30)
...
Info : sector 16 took 122 ms
...
shutdown
Using config file /etc/iRiser/iRiser5+_flash_VFE_SPIx4.cfg
INFO: Wrote image iRiser5+_VFE_SPIx4.bin SPI set to x4
```

For iRiser6

```
iRiser6_flash_VB2_SPIx4.sh -d 0
Open On-Chip Debugger 0.12.0+dev-01243-g24b656bff (2025-06-09-12:42)
...
Info : sector 16 took 122 ms
...
shutdown
Using config file /etc/iRiser/iRiser6_flash_VB2_SPIx4.cfg
INFO: Wrote image iRiser6_VB2_SPIx4.bin SPI set to x4
```

You must reboot after programming the iRiser(s) FPGA.

Appendix B: FAQs

Currently the FAQs are simply a current list of questions the developers think MAY come up but have not technically been frequently asked as the iRiser hardware and software are new.

Question: Can I glitch or shut off PCIe lanes to my device to test its response to losing or noisy PCIe lanes?

Answer: Yes. Use the sequencer as described above to set the state of any of the following Signals to zero (clear):

- TX0N
- TX0P
- TX1N
- TX1P
- TX2N
- TX2P
- TX3N
- TX3P

Note: the above is applicable only to iRiser5, iRiser5+, iRiser6; iRiser6SE does not support the above functionality.

Question: How are Sequence numbers assigned?

Answer: Sequence numbers start at zero, are contiguous, and are assigned in order to a maximum of 127.

Question: Can I change Sequence numbers?

Answer: No, but you can use show Sequences to list them, and for any given group of Actions (restored from a file for example), they will always be assigned in the same order.

Question: I'm doing SRIS and SRNS testing on my machine. Will iRiser continue to function in a SRIS/SRNS configuration?

Answer: Yes. But certain clock/clock spectrum combinations will cause the iRiser to lose the private link from the FPGA to the host and must be avoided. Future SW releases will guard against allowing the user to select combinations that won't work, but currently please contact SANBlaze technical support before changing the SBR image to SRIS or the spread spectrum/common clock and clock source switches.

On an SBExpress-DT5 system, the iRiser cannot be configured to perform Signal glitching under the hardware configuration Altclock (SW6) = 1, SSC (SW7) = 1. This means that for 2 of the 4 clocking modes – SRNS, and common clocking with no spreading (no SSC) – Signal glitching is not supported. The other 2 clocking modes – common clocking with spreading (SSC) and SRIS – are fully supported by the iRiser. To overcome this limitation, we recommend separating clocking tests from Signal glitching tests or using one of our other systems such as the SBEpress-RM5 or RM5+ test system which supports this specific combination of hardware settings.

Question: What is the maximum number of iRiser cards you can support in a DT5, RM5 or RM5+ system?

Answer:

- For SBExpress-RM5:
  - Only iRiser5 and iRiser5+ devices can be installed in RM5
  - A maximum of four iRiser devices are supported and can be installed in slots 6, 7, 8 or 9

- For SBExpress-DT5:
  - Only iRiser5 and iRiser5+ devices can be installed DT5
  - A maximum of three iRiser devices are supported and can be installed in slots 0, 1, or 2

- For SBExpress-RM5+:
  - Only iRiser6 and iRiser6SE devices can be installed in RM5+
  - Up to 16 iRiser devices are supported

Also, some system BIOSes hang when the total number of PCIe devices exceeds a threshold. We are working with BIOS companies on this issue, but it will restrict the number of iRisers in a given system to the above numbers for the time being.

Question: Can the FPGA FW code be updated in the field by the user as functionality is added?

Answer: Yes. It is a straightforward process to update the FPGA code in place in the field. There is no need at this point as there is only one version shipping, but if the need arises firmware will be provided along with an update procedure.