POWERNAVIGATOR 5.4

DIGITAL POINT OF LOAD USER GUIDE

MARCH 2018

BIG IDEAS
FOR EVERY SPACE

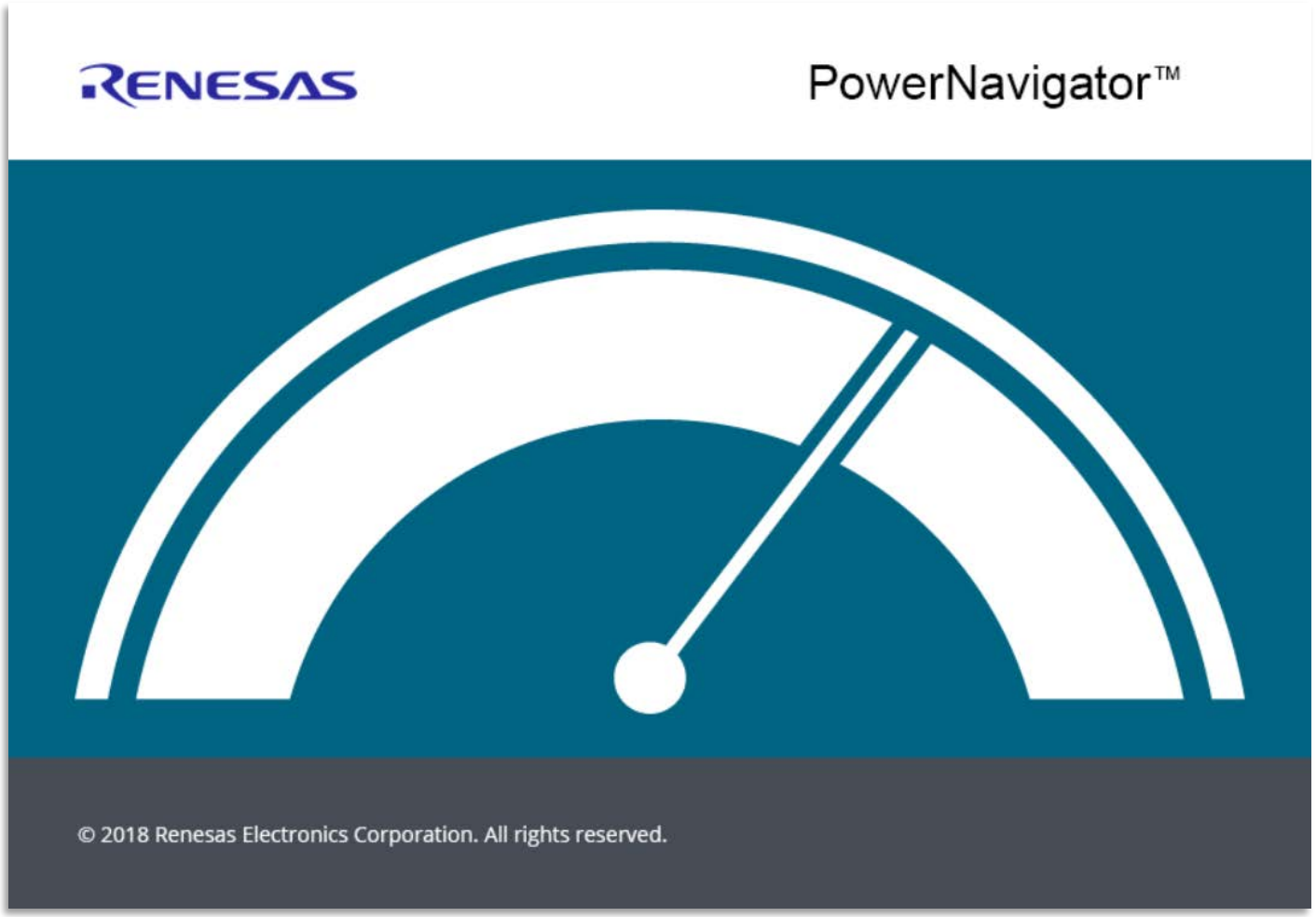
OVERVIEW

- This guide walks a user though the steps to setup and configure a digital power device using Renesas's PowerNavigator GUI.
- For Digital Multiphase products (ISL691xx and ISL681xx), please see the dedicated Digital Multiphase user guide.
- This guide assumes the user has followed the instructions on the website for downloading and installing PowerNavigator and is able to launch the program successfully.

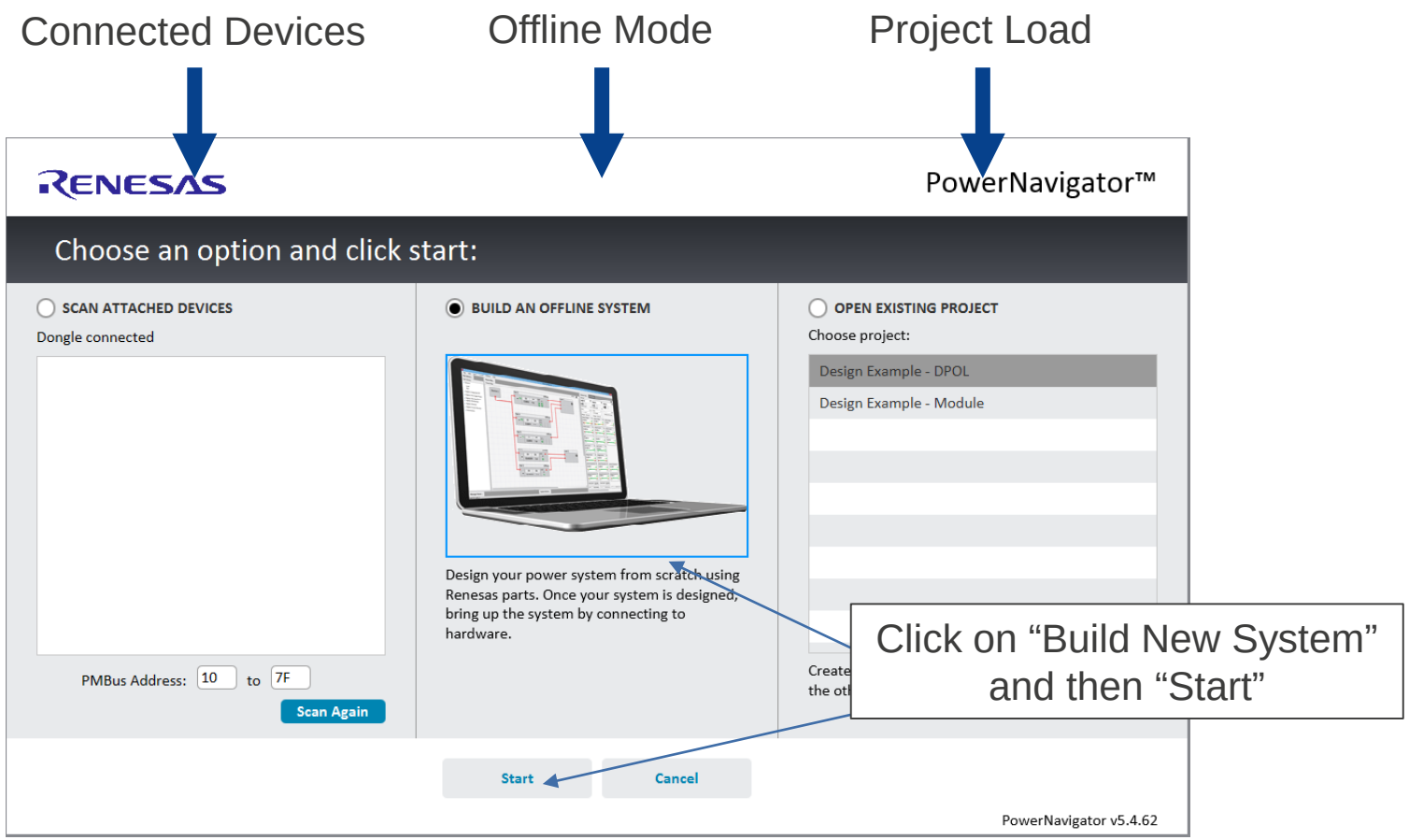
OVERVIEW

- **The following sections are shown in this guide:**
  - **Hardware free mode**
    - Selection of devices
    - Power architecture setup
    - Current sharing
  - **Connecting to hardware**
    - Auto scan of devices
  - **Device setup with Rail Inspector**
    - Changing device parameters
    - Configuration file load and save
  - **Sequencing**
    - Time based sequencing
    - Event based sequencing
  - **RailScope**
    - Adding/monitoring devices
    - Logging
  - **Production File HEX Creation**

Offline Mode (Hardware Free Mode)

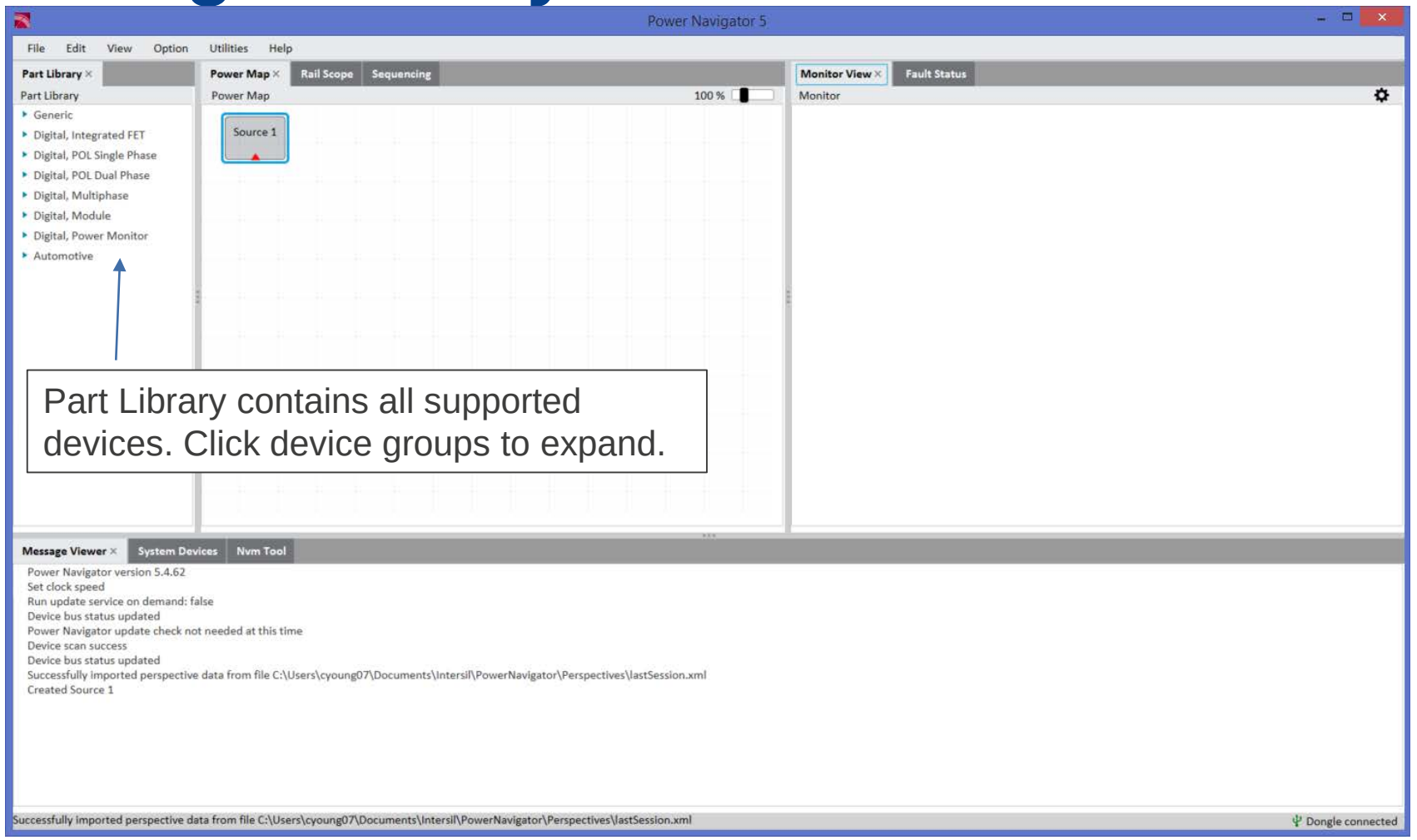


PowerNavigator Launch Screen – Offline Mode

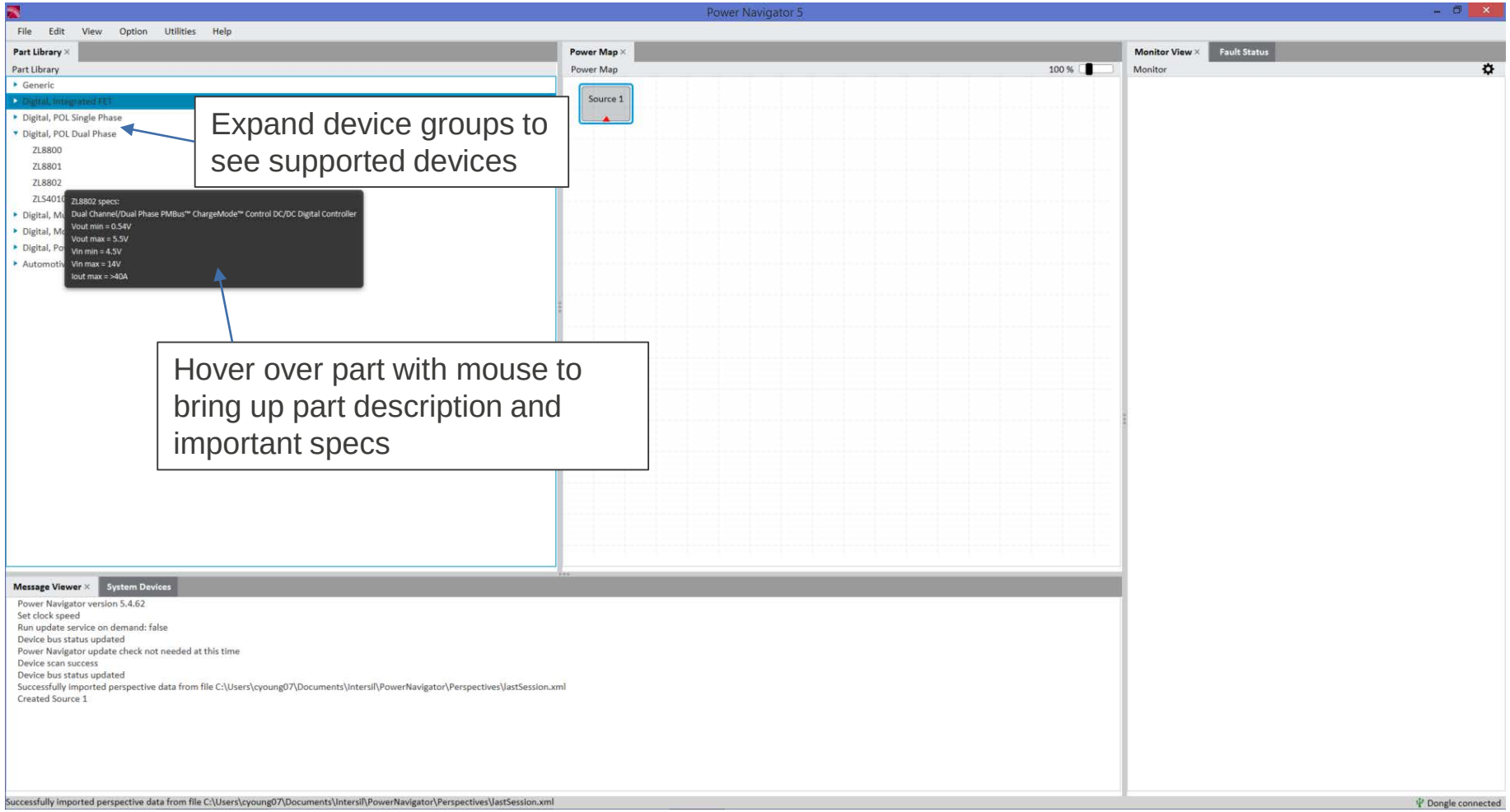


The PowerNavigator launch screen allows you to select online (hardware connected) or offline modes of operation.

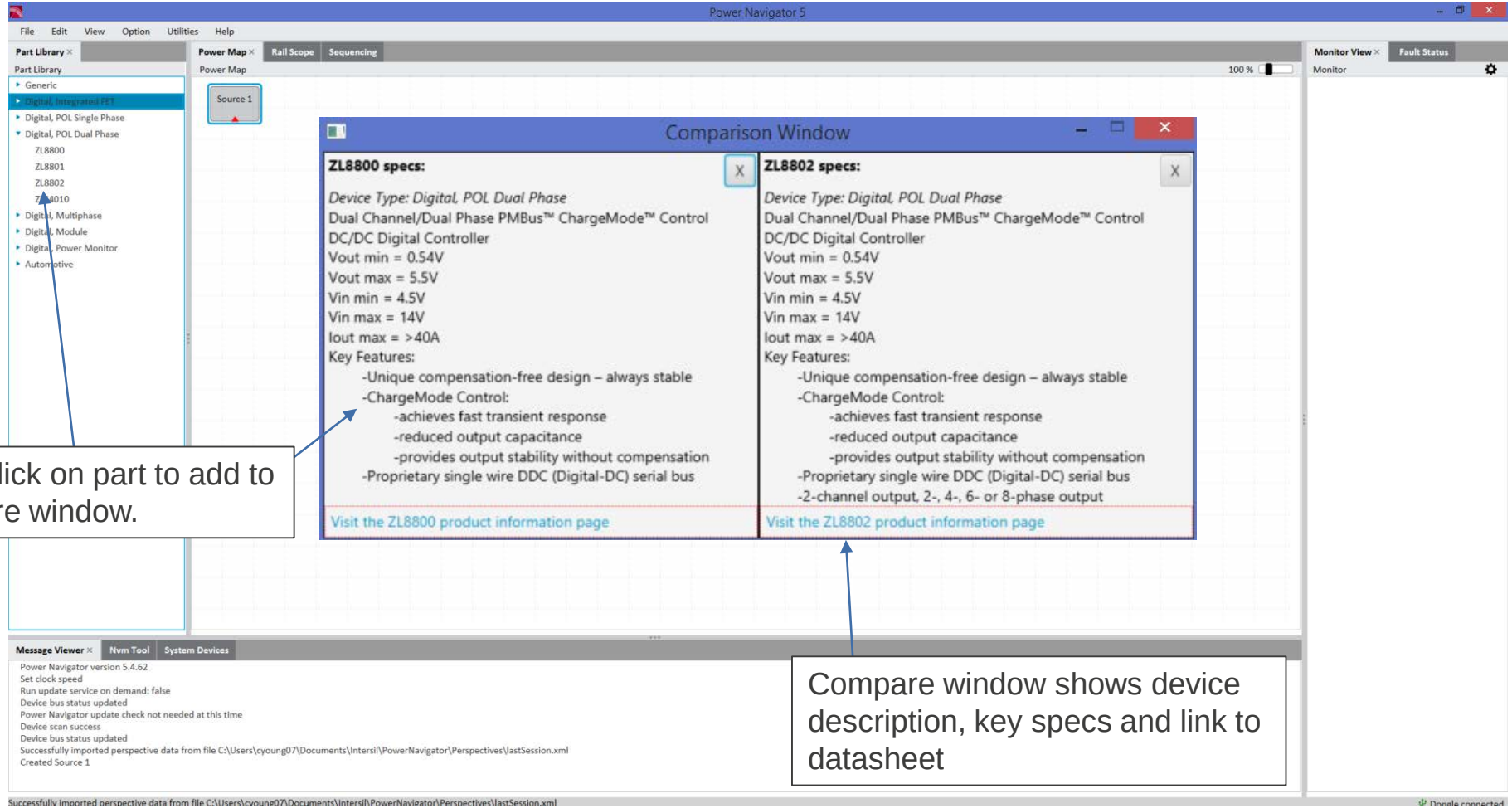
PowerNavigator – System Screen Offline Mode



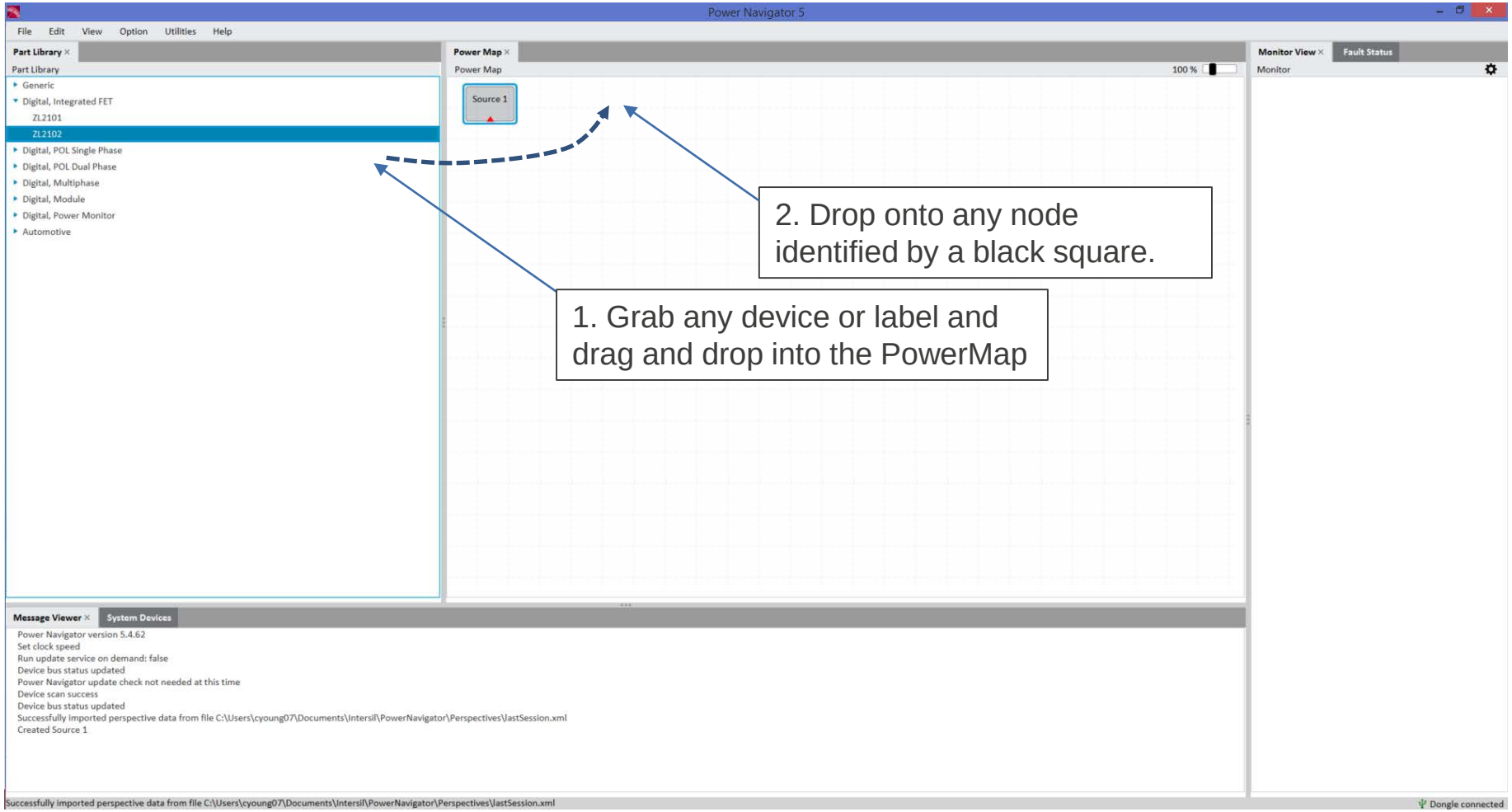
PowerNavigator – System Screen Offline Mode



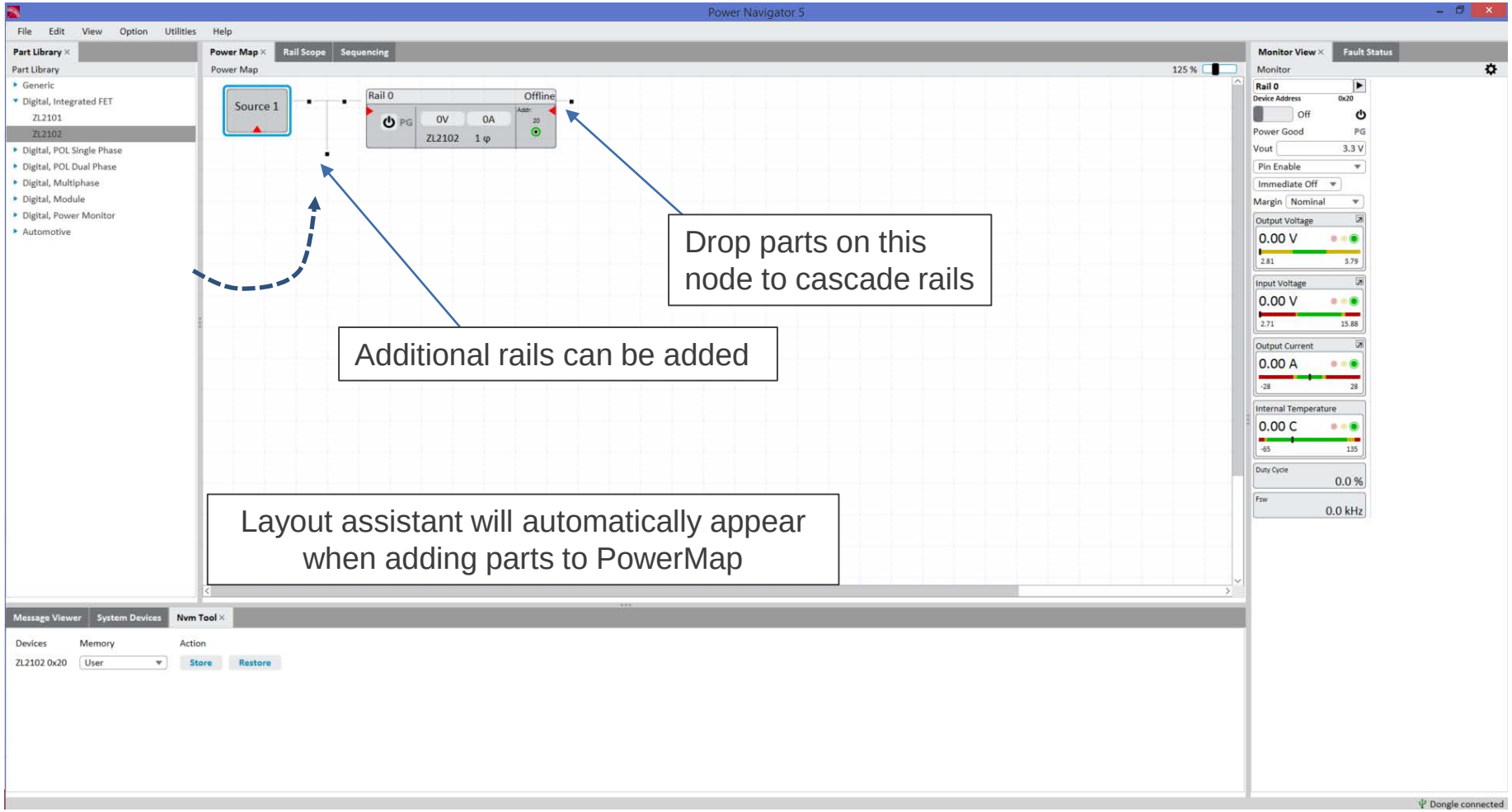
PowerNavigator – System Screen Offline Mode



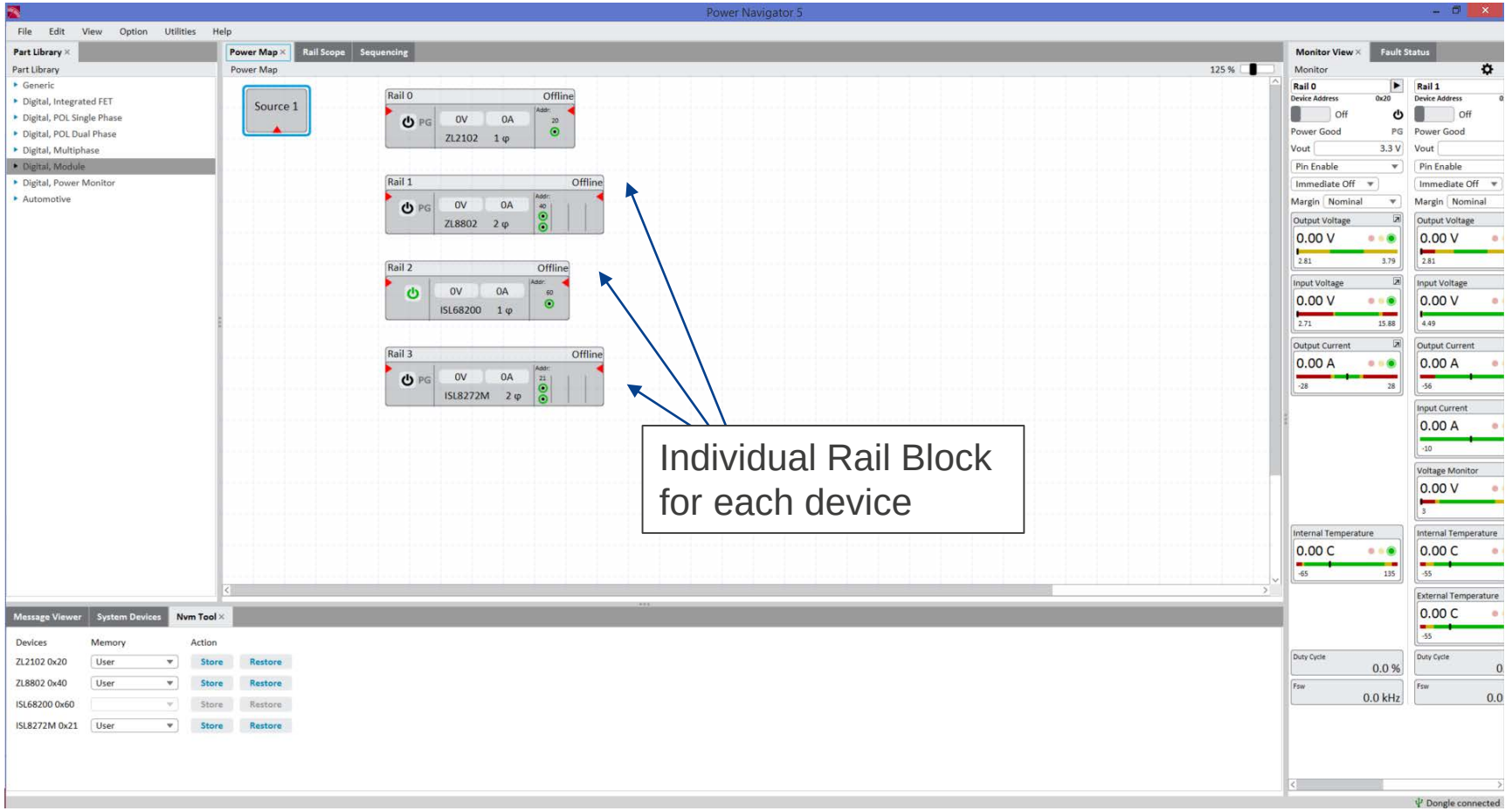
PowerNavigator – System Screen



PowerNavigator – System Screen



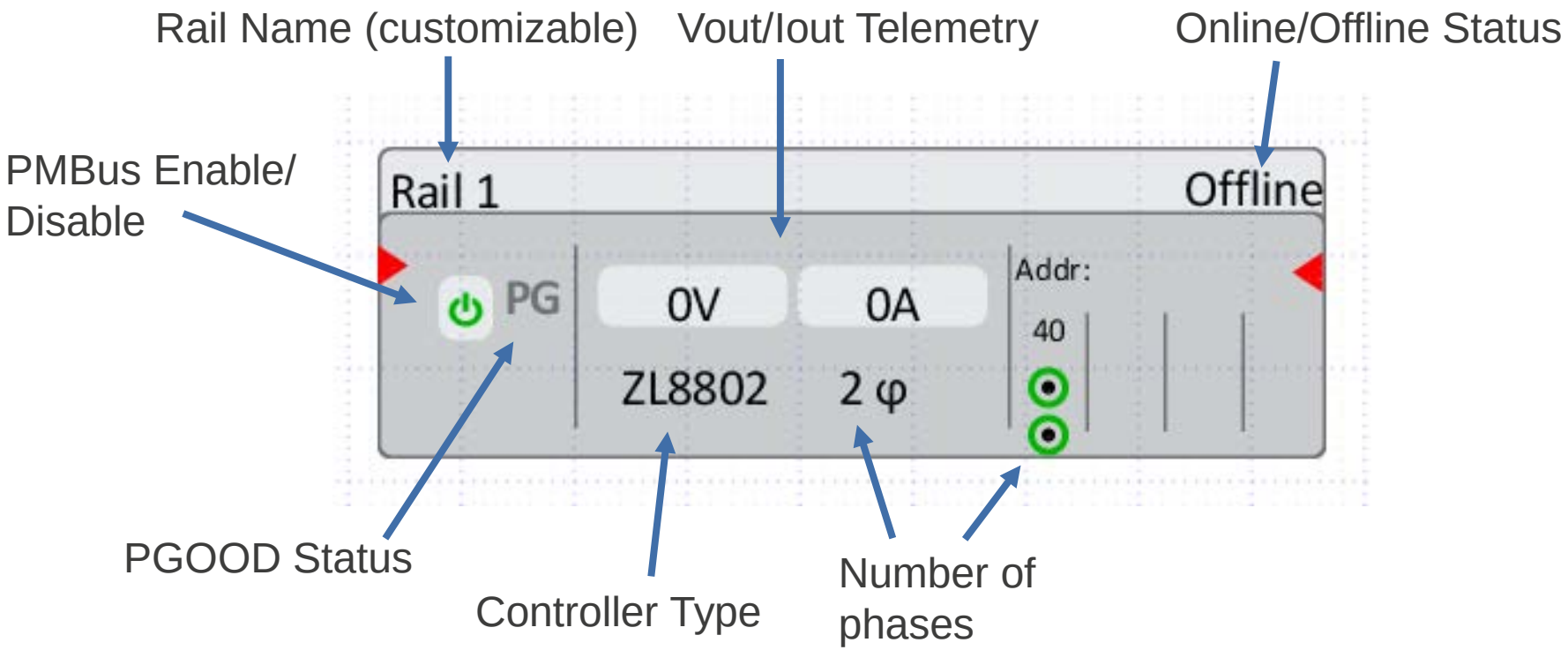
PowerNavigator – System Screen



Multiple parts can be added to PowerMap, representing system level view.

PowerMap RailBlock Overview

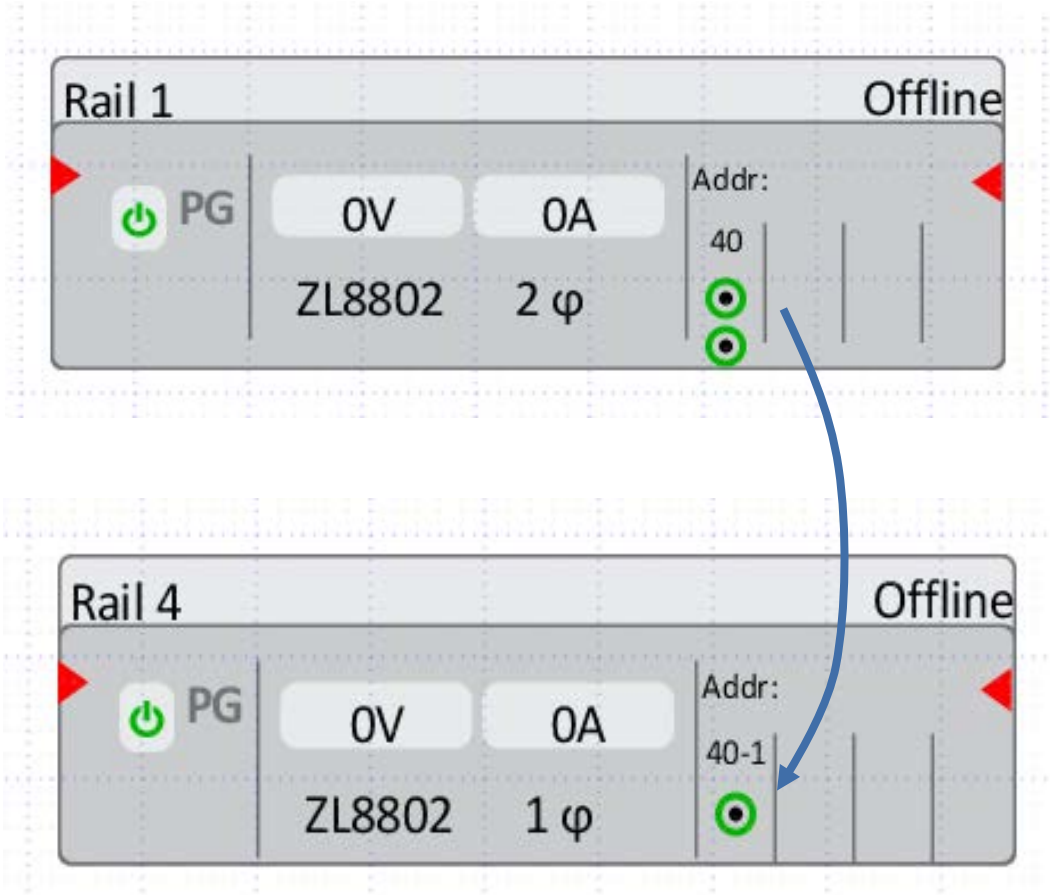
Example ZL8802 RailBlock (2-PH operation):



PowerMap RailBlock Overview

Example ZL8802 RailBlock (2-CH operation):

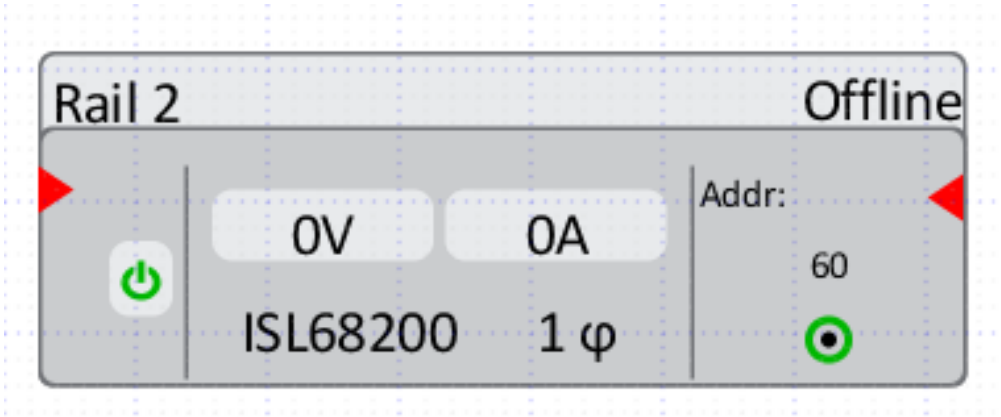
Drag and drop interface for configuration of a rail from 2-phase to dual output.



Drag “Phase Dot” to change from 2-phase to 2-Channel operation

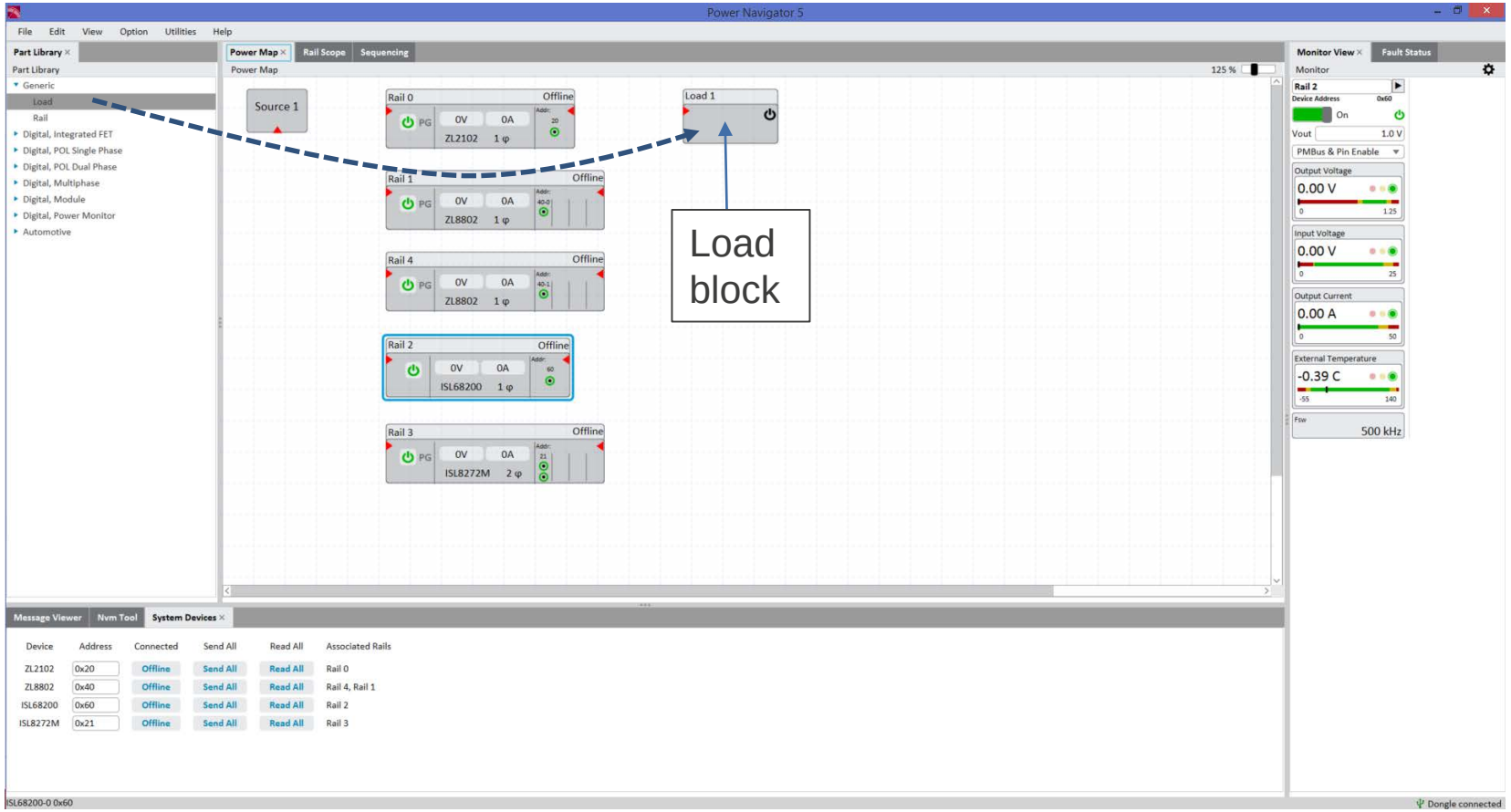
PowerMap RailBlock Overview

Example ISL68200 RailBlock:



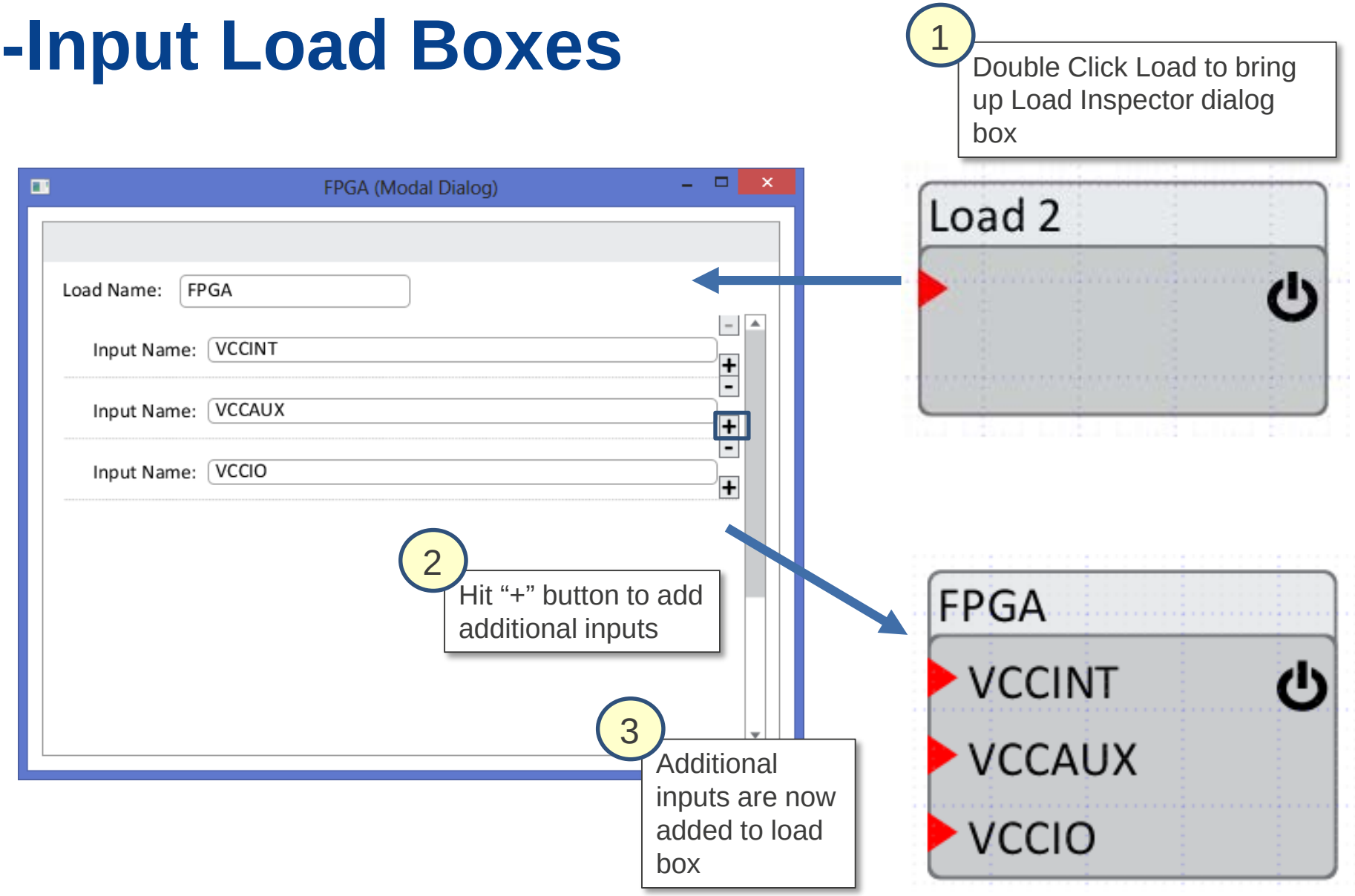
- Controllers which do not support current share will only have one “slot”.
- In this case, we have a single phase ISL68200 controller at PMBus address 0x60.

PowerNavigator – System Screen

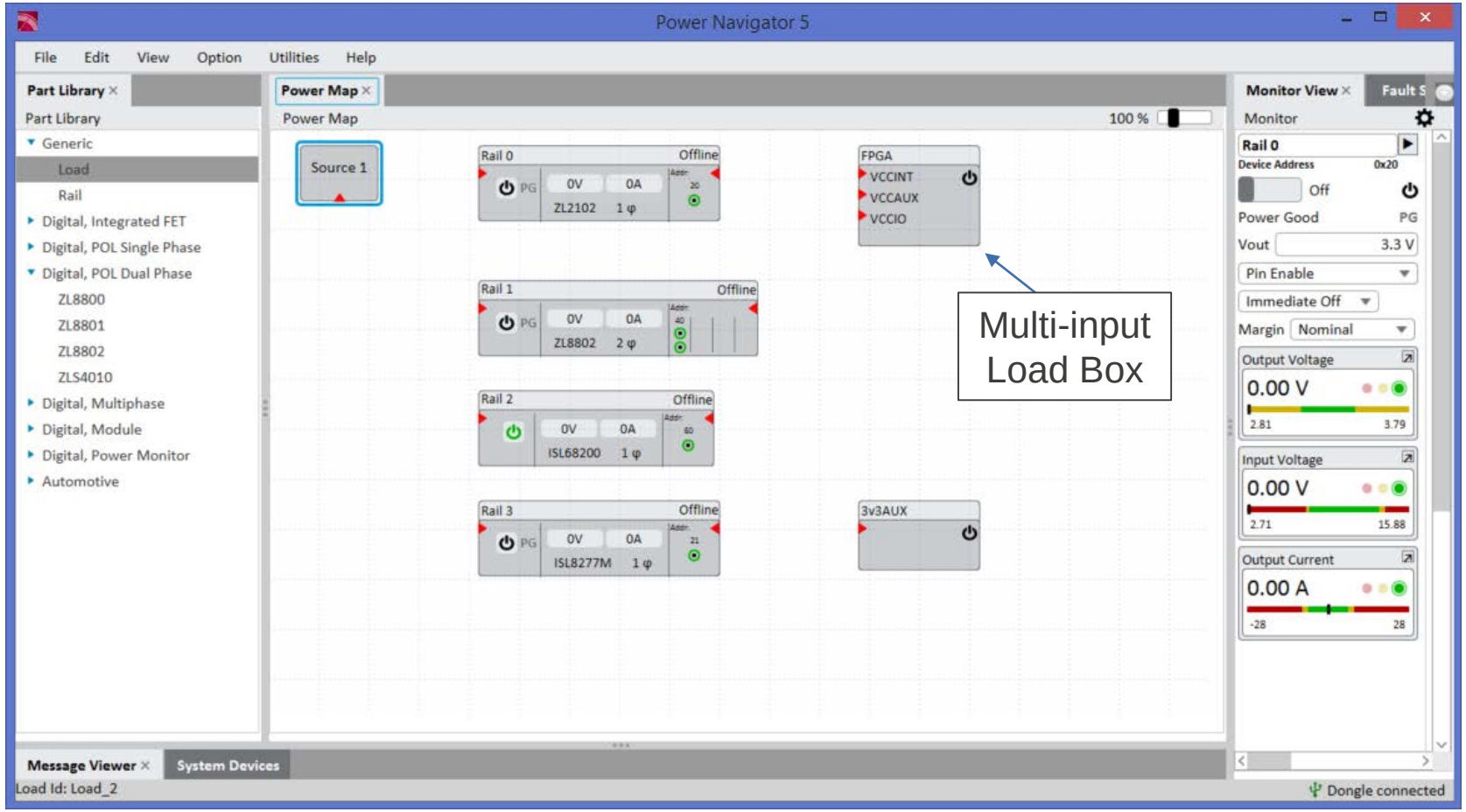


Load Blocks represent system load and can be added to the PowerMap from the Part Library.
Double Click to add additional inputs.

Multi-Input Load Boxes

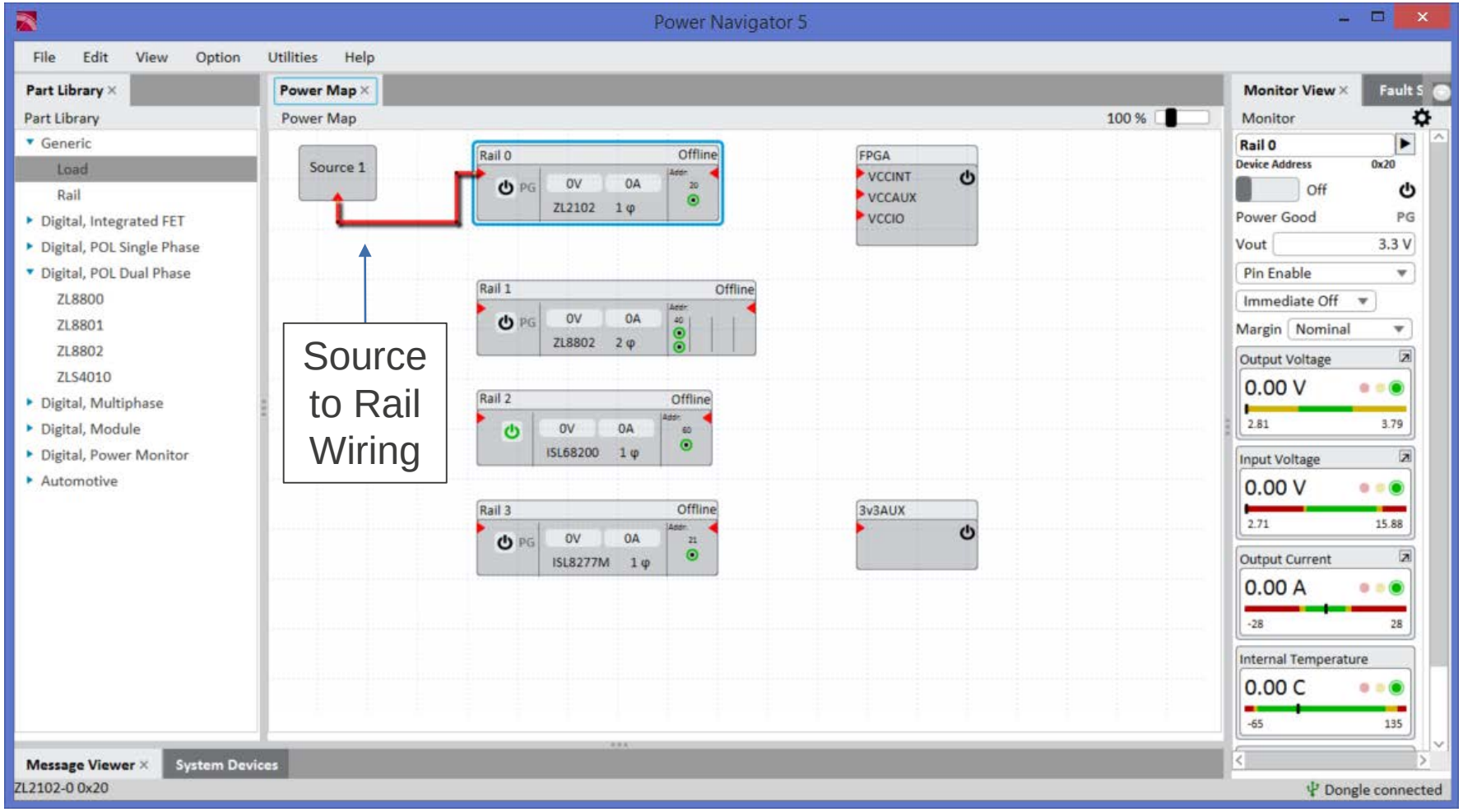


PowerNavigator 5.4 – System Screen

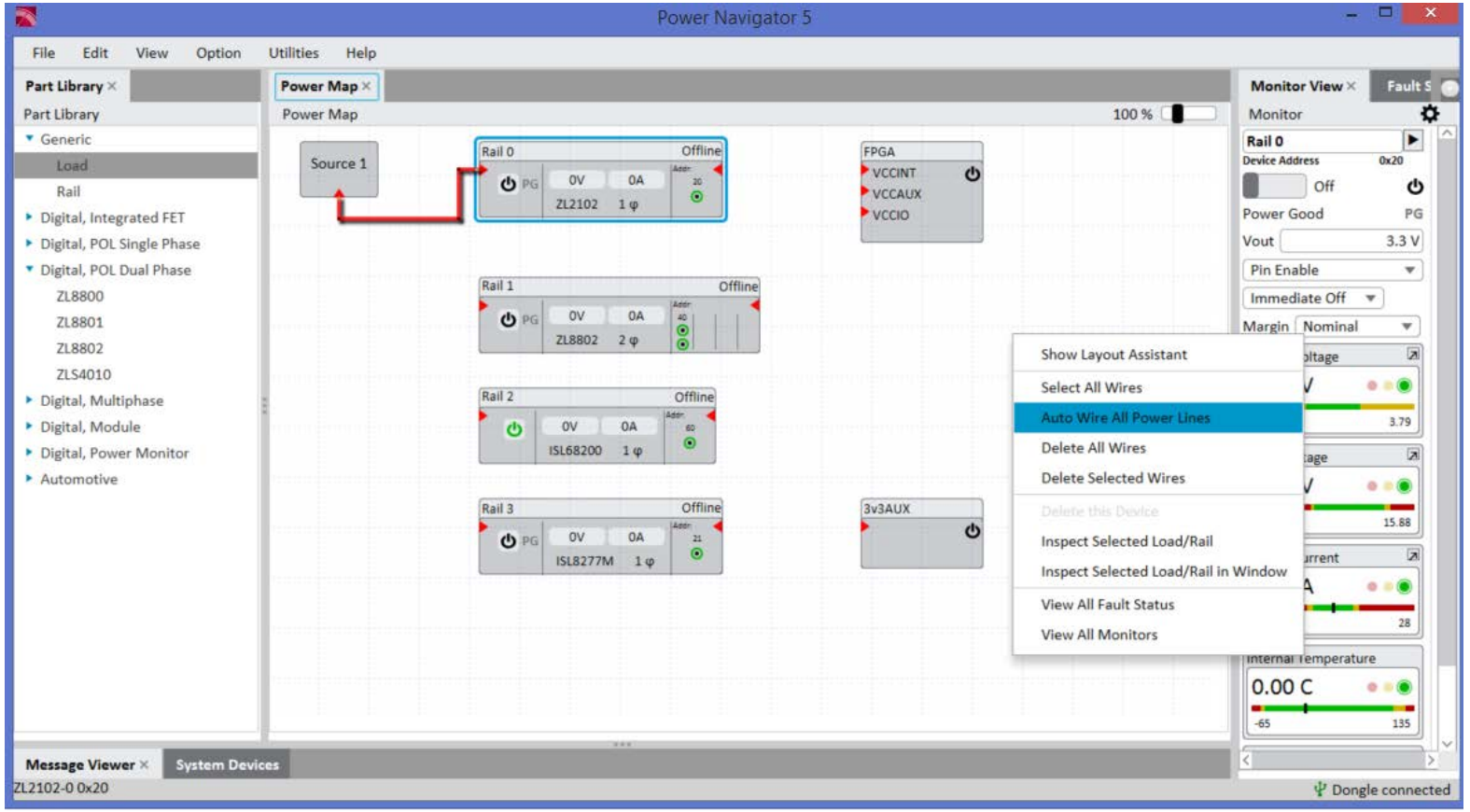


After configuring system, all sources, rails and loads can be wired together.

PowerNavigator 5.4 – System Screen

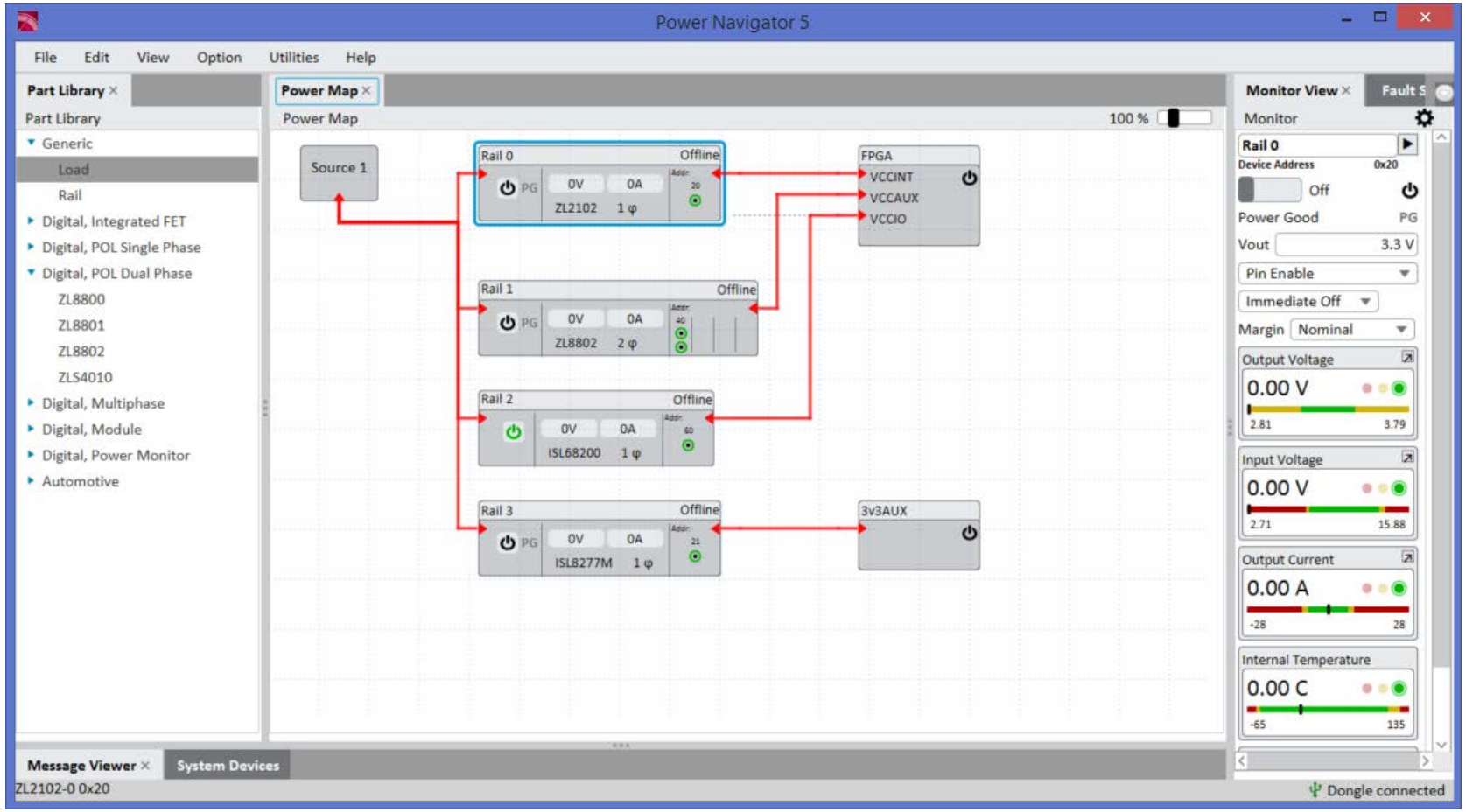


PowerNavigator 5.4 – System Screen



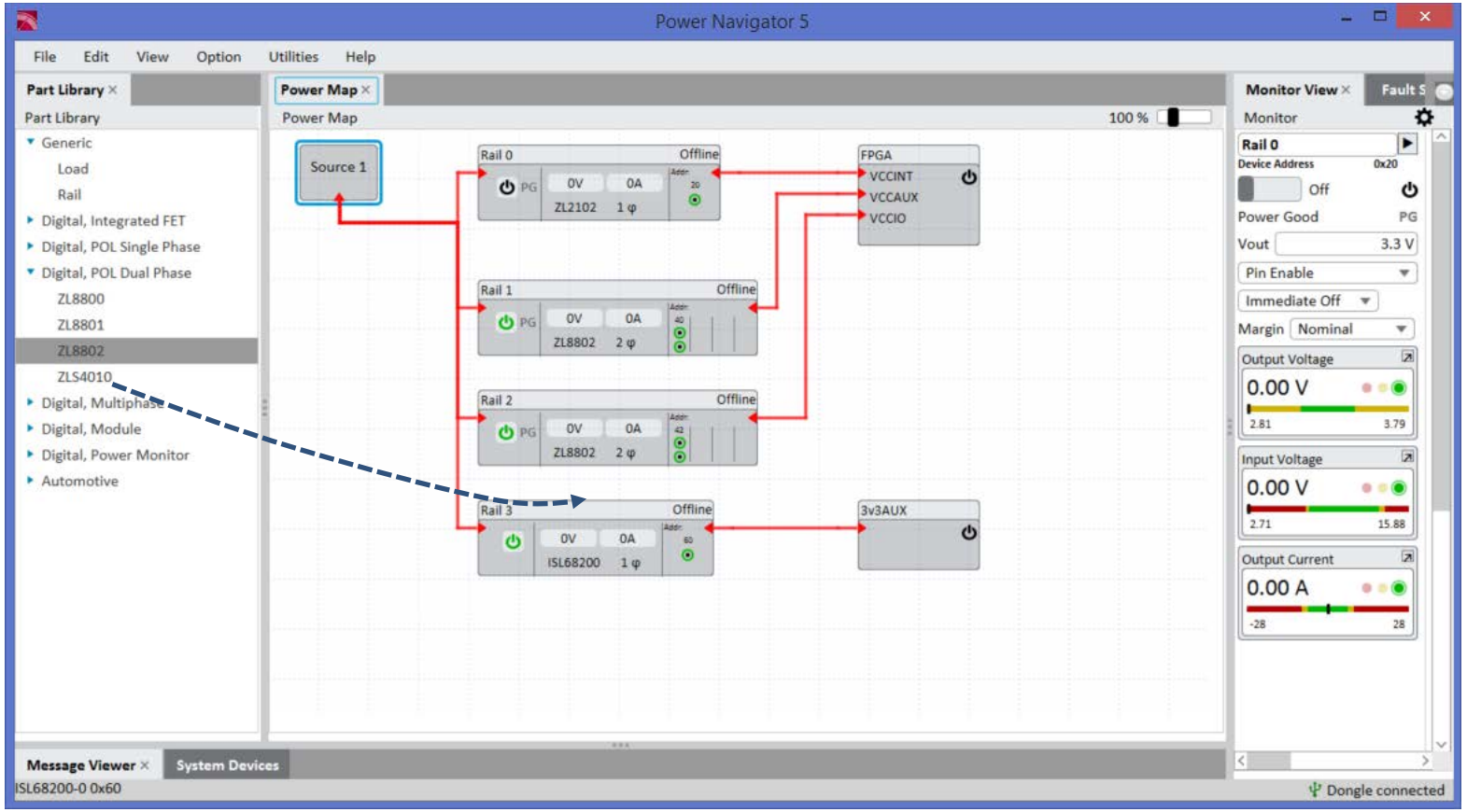
Right-click on PowerMap to bring up contextual menu.
Select “Auto Wire All Power Lines” to auto wire PowerMap.

PowerNavigator 5.4 – System Screen



Fully wired PowerMap with multi-input loads.

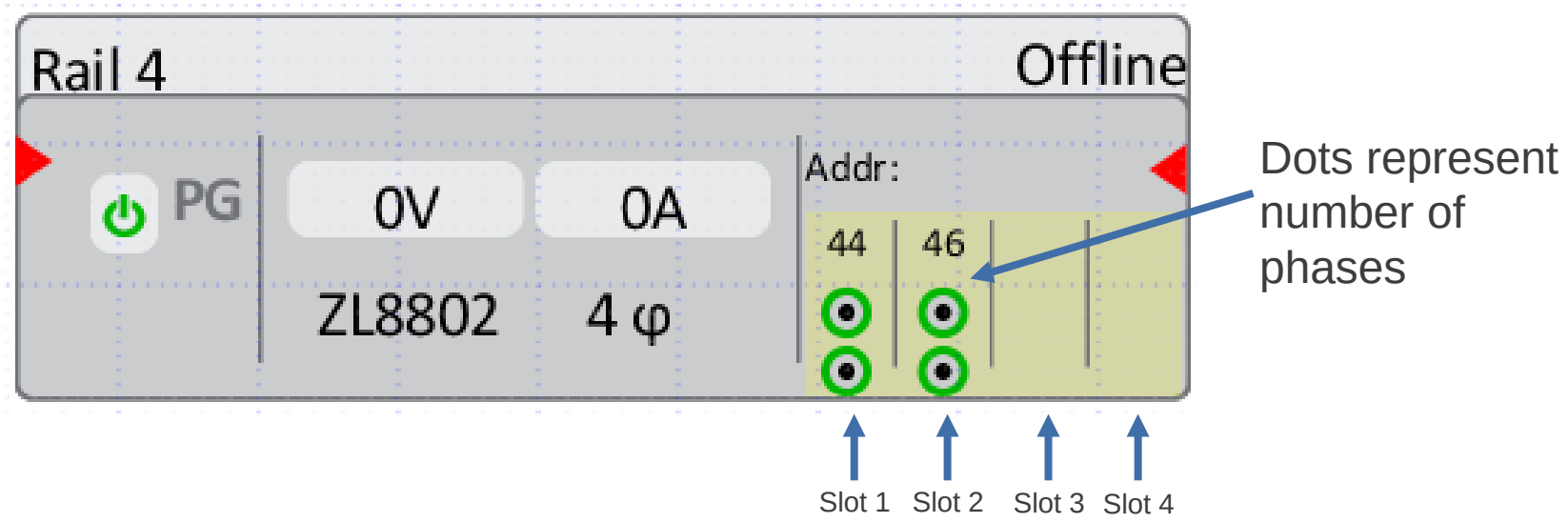
PowerNavigator 5.4 – System Screen



To implement a current sharing rail, drag a part from the part library onto an open RailBlock “slot”.

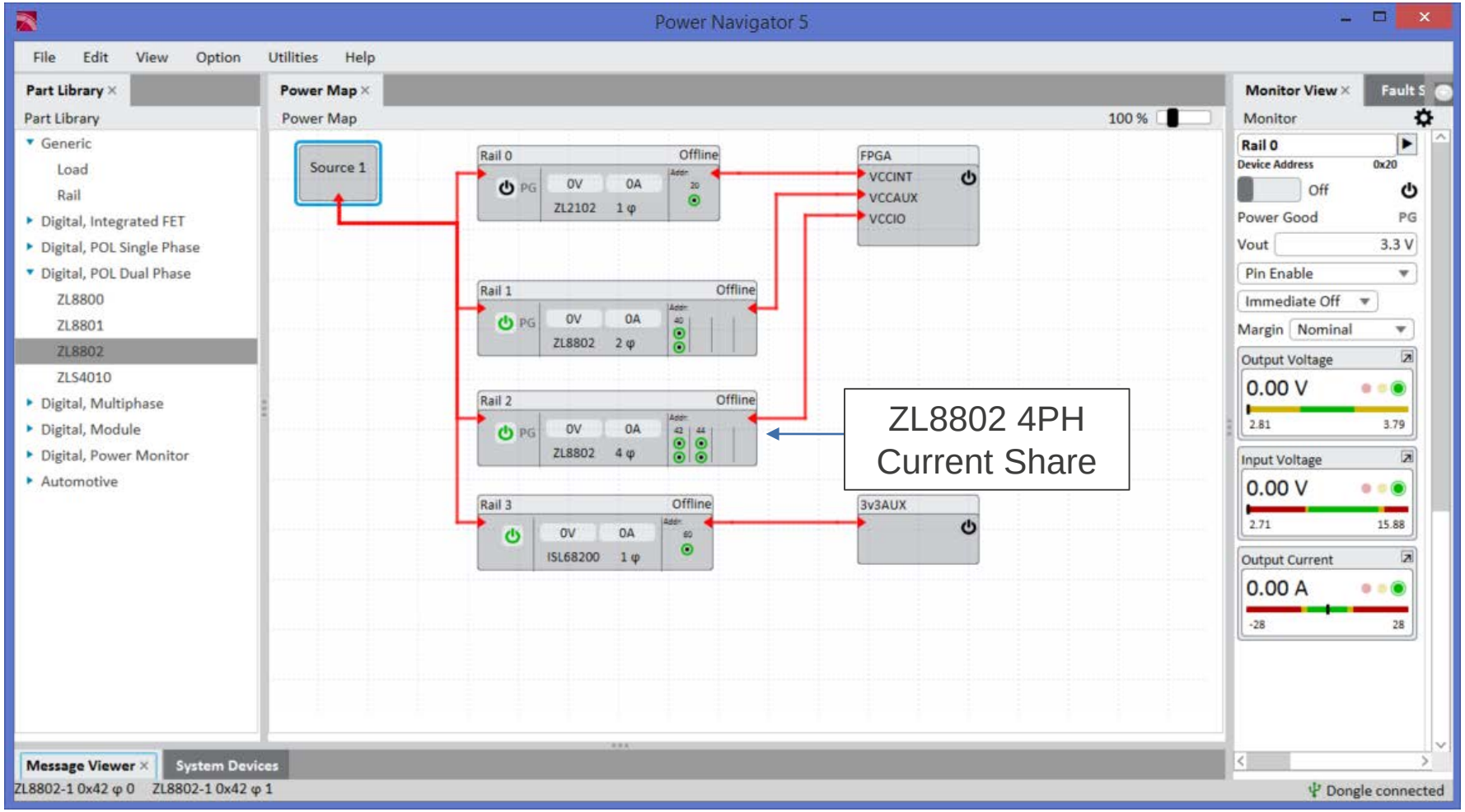
PowerMap RailBlock Overview

Example ZL8802 RailBlock (4-PH operation):



- The ZL8802 allows for 2-PH, 4-PH, 6-PH or 8-PH operation via current share.
- Each “slot” in the RailBlock represents shows how many controllers can be paralleled in a current share group.
- To create a current share group, a controller can be dragged from the part library into a “slot”, creating a current share rail.
- In this case, we have a 4-phase design, with two ZL8802 controllers – one at PMBus address 0x44 and another at 0x46.

PowerNavigator 5.4 – System Screen



Monitoring View

View configuration options

Device rail name

PGOOD indicator

Adjustment on output voltage

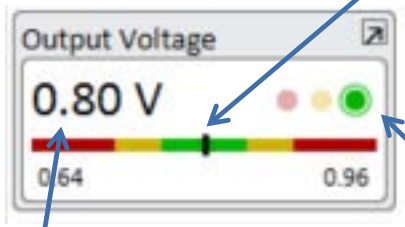
Monitoring readouts for Vout, Iout, Iin

Temperature monitors for both internal (controller junction) and external (power stage FETs)

Duty cycle and switching frequency

Readouts

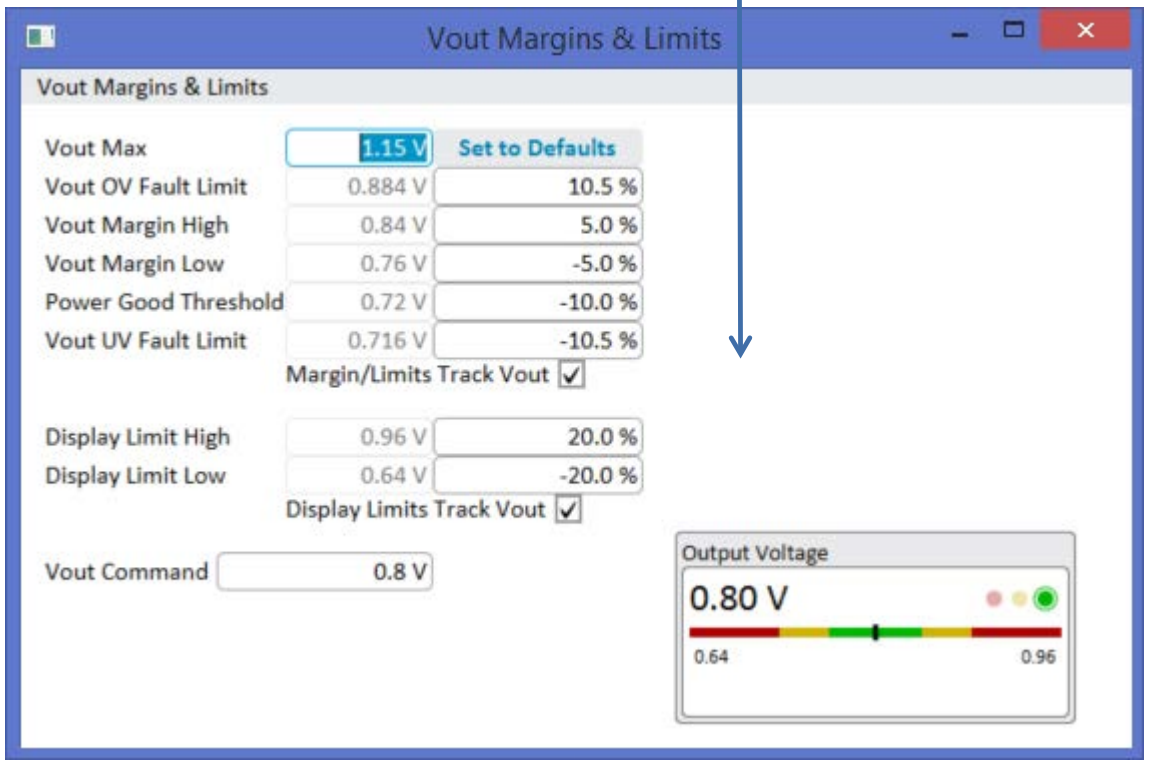
Analog sliding meter with color indicators. Green is within normal limits, yellow in PMBus warning limits, red for exceeding OVP/UVP settings.



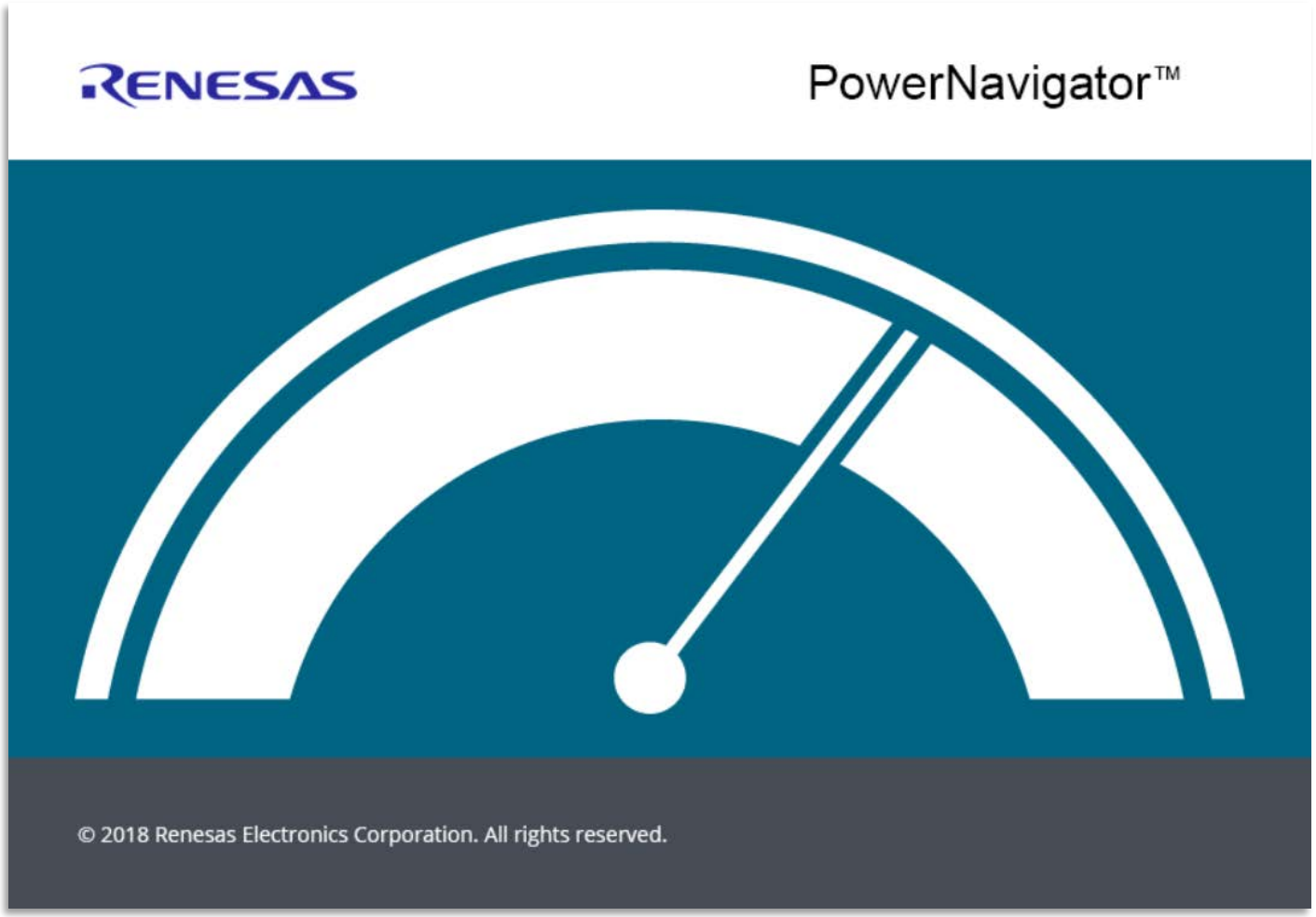
Clicking this button will open the window below allowing adjustment of limits

Operation and fault lights

Digital readout of output voltage



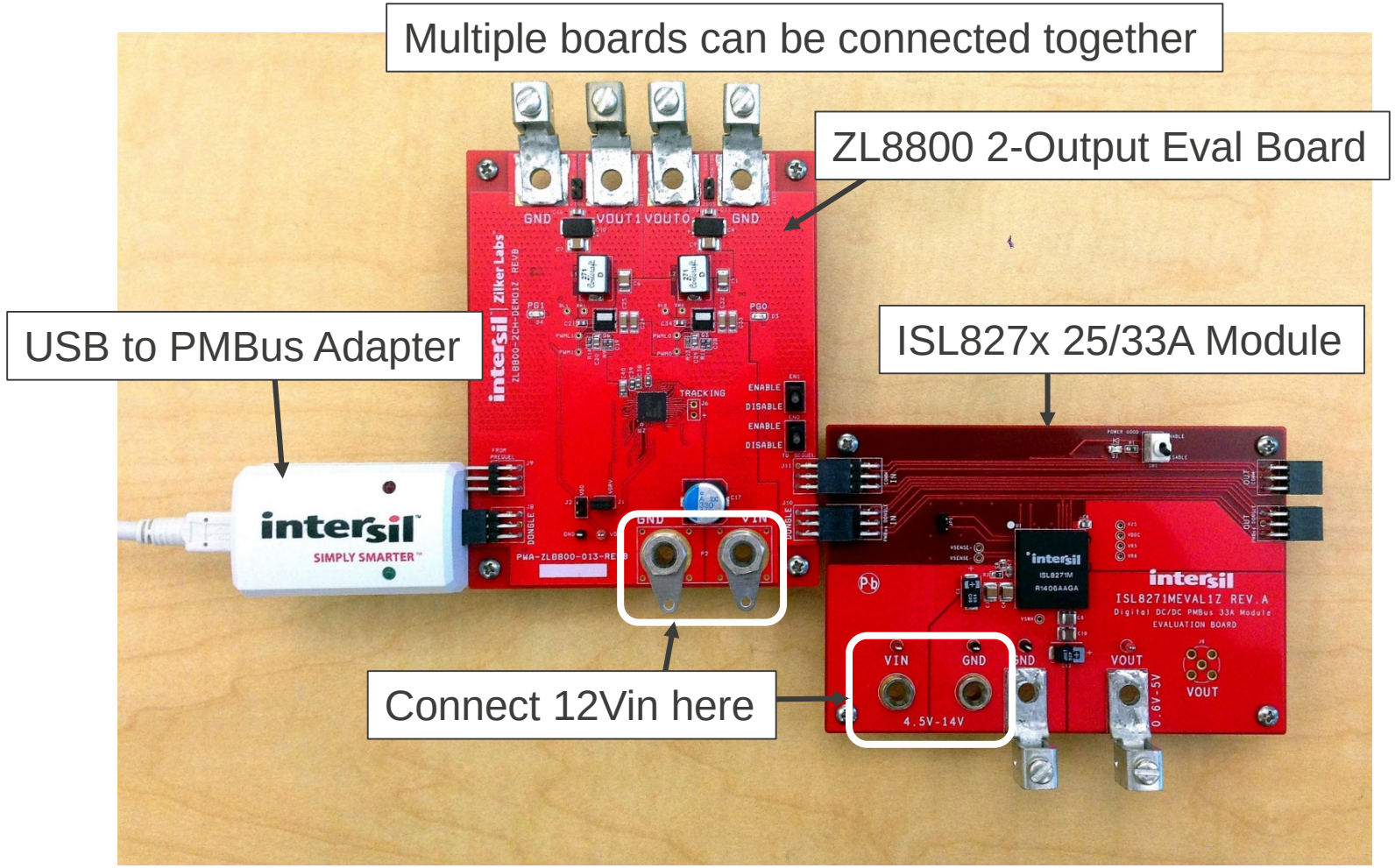
Connecting to Hardware



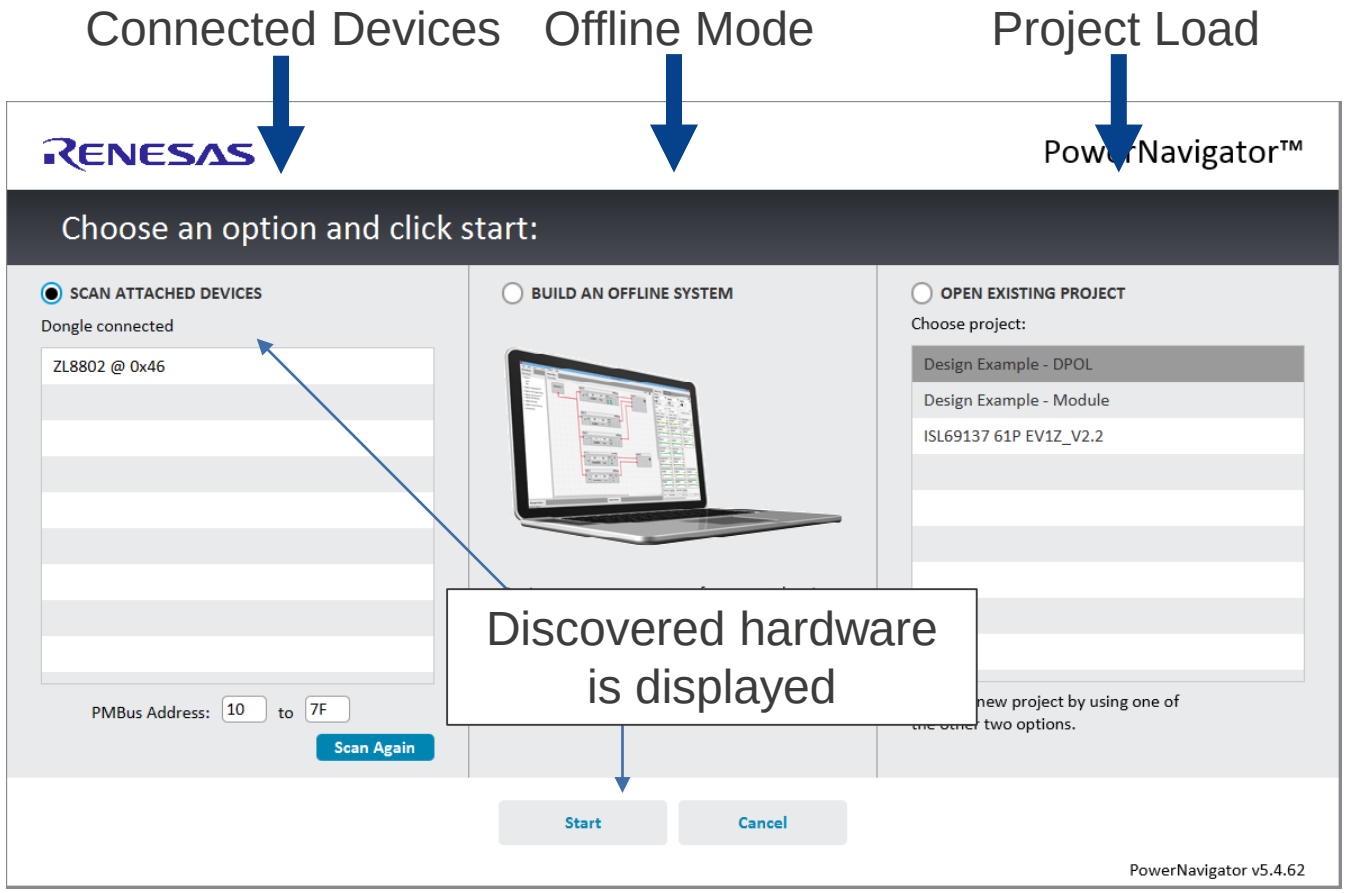
Connect to Hardware . . .

- To connect to hardware, a USB to PMBus adapter (ZLUSBEVAL3Z, included with all demo kits) is required.
- STEP 1: Connect USB cable from PC to USB adapter
- STEP 2: Connect USB to PMBus adapter to demo board hardware
- STEP 3: Power demo board
- STEP 4: Launch PowerNavigator software

Connect to Hardware . . .

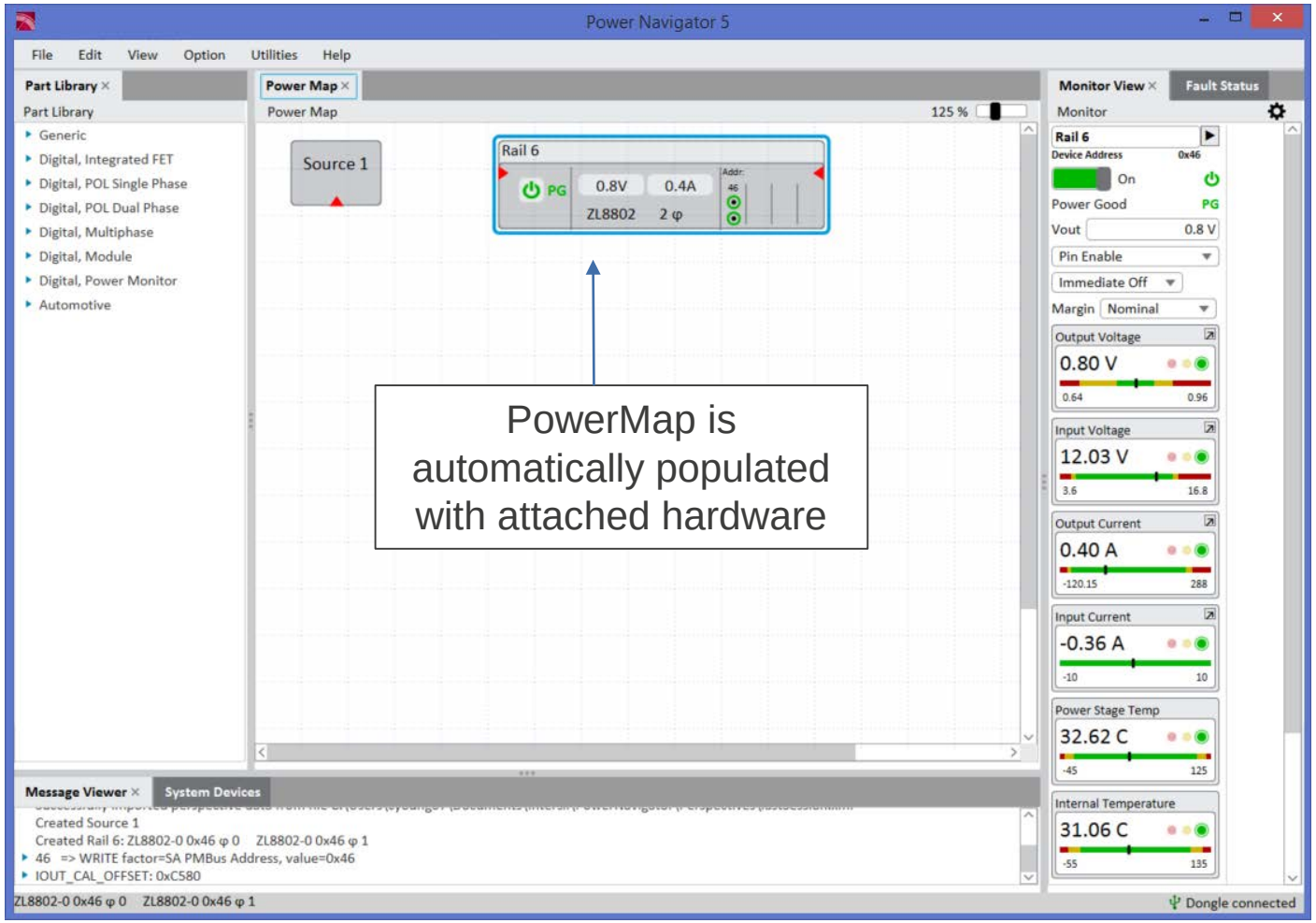


PowerNavigator Launch Screen

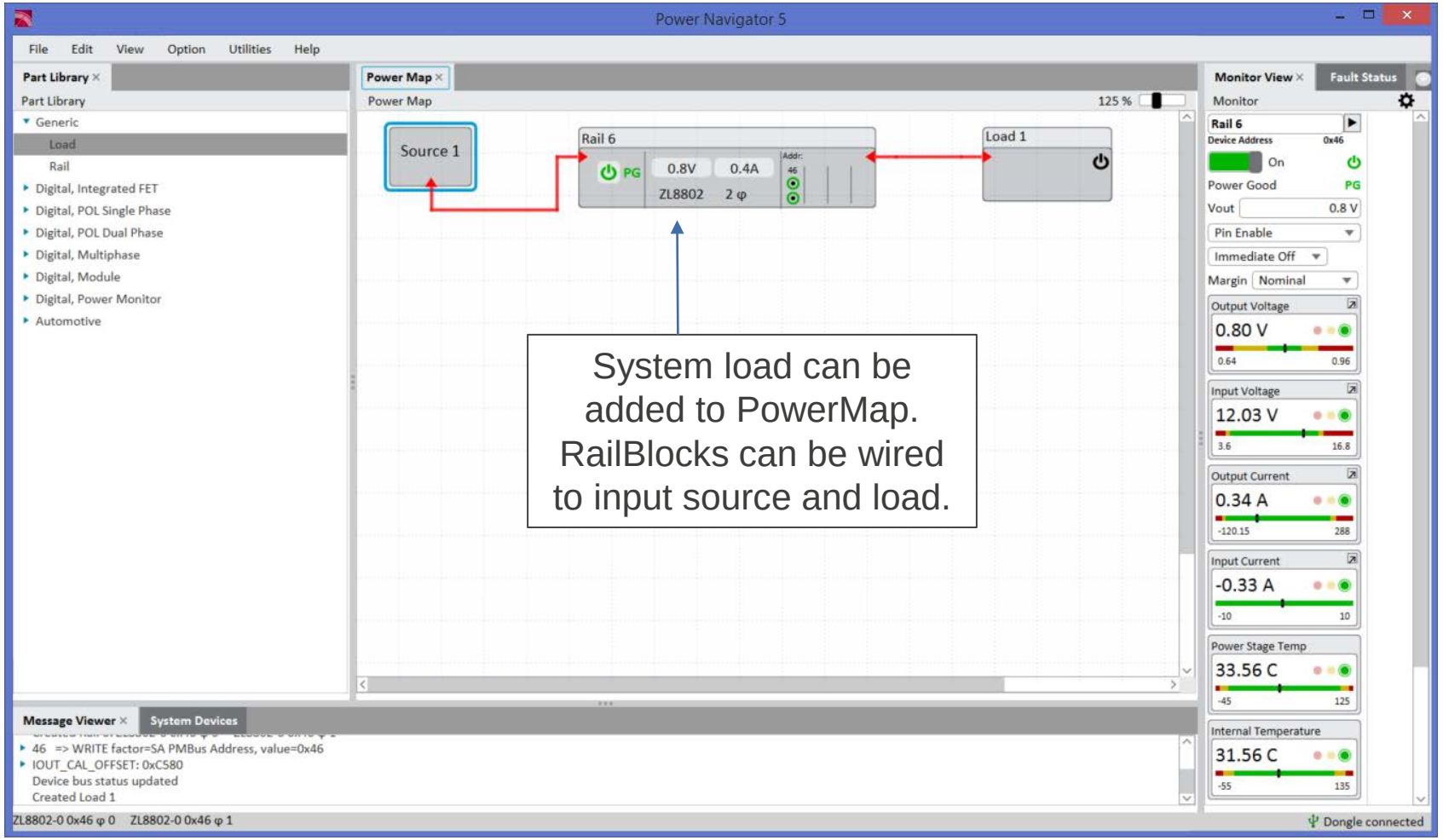


All discovered hardware is displayed in the “Scan Attached Devices” window.
The PMBus scan range can be adjust – default range is 0x10 to 0x7F.

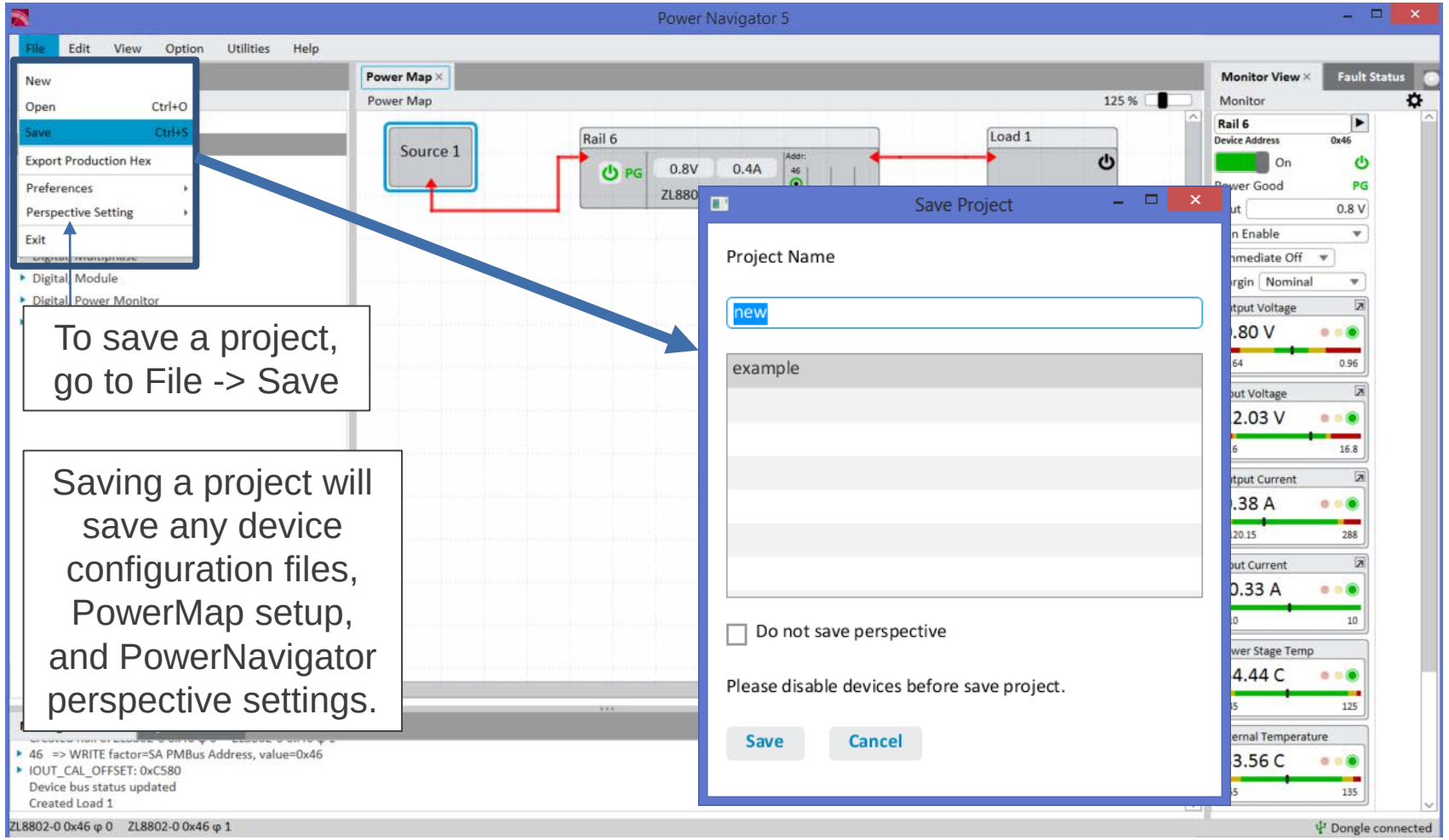
PowerNavigator 5.4 – Connect to HW



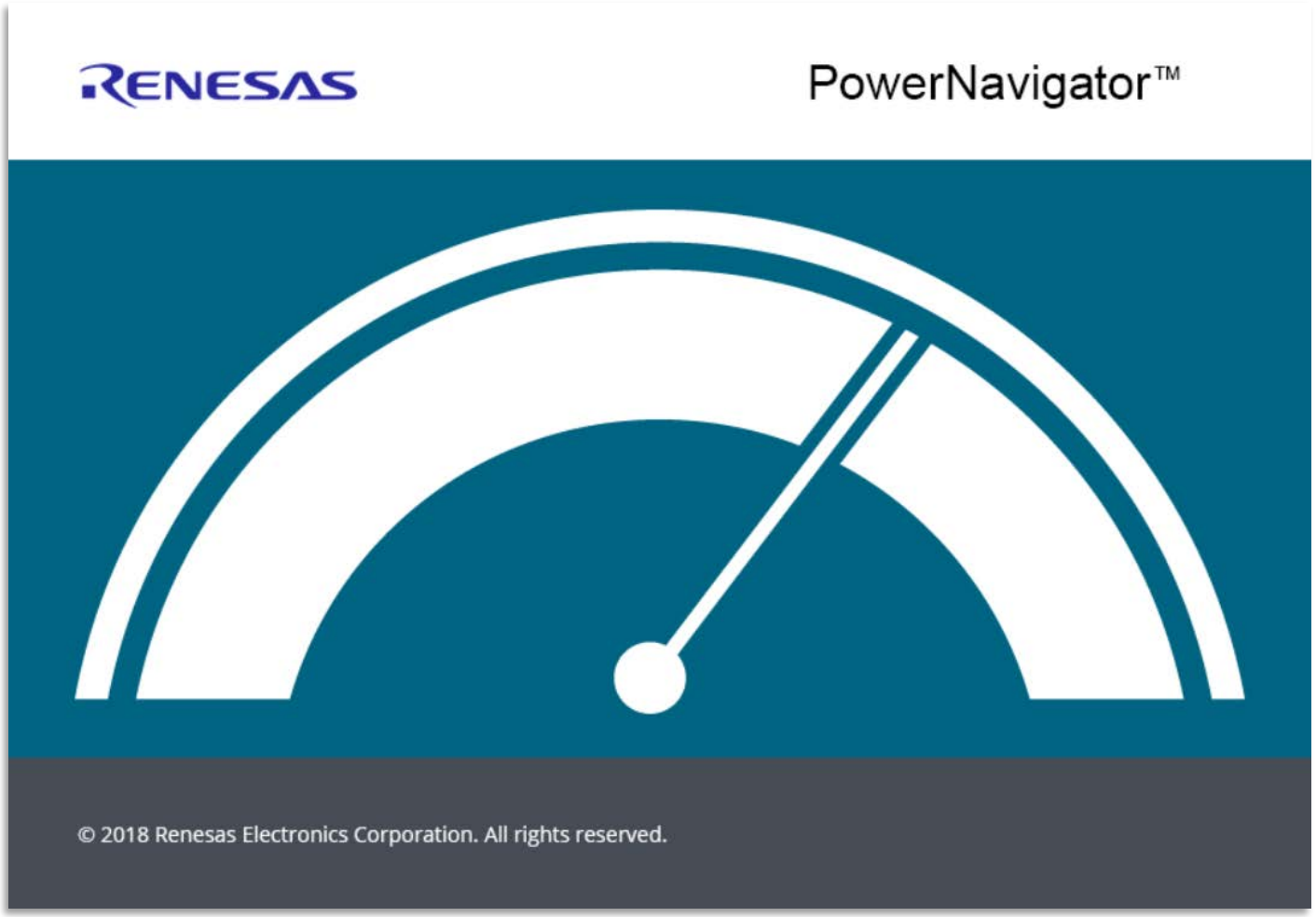
PowerNavigator 5.4 – Connect to HW



PowerNavigator 5.4 – Project Save



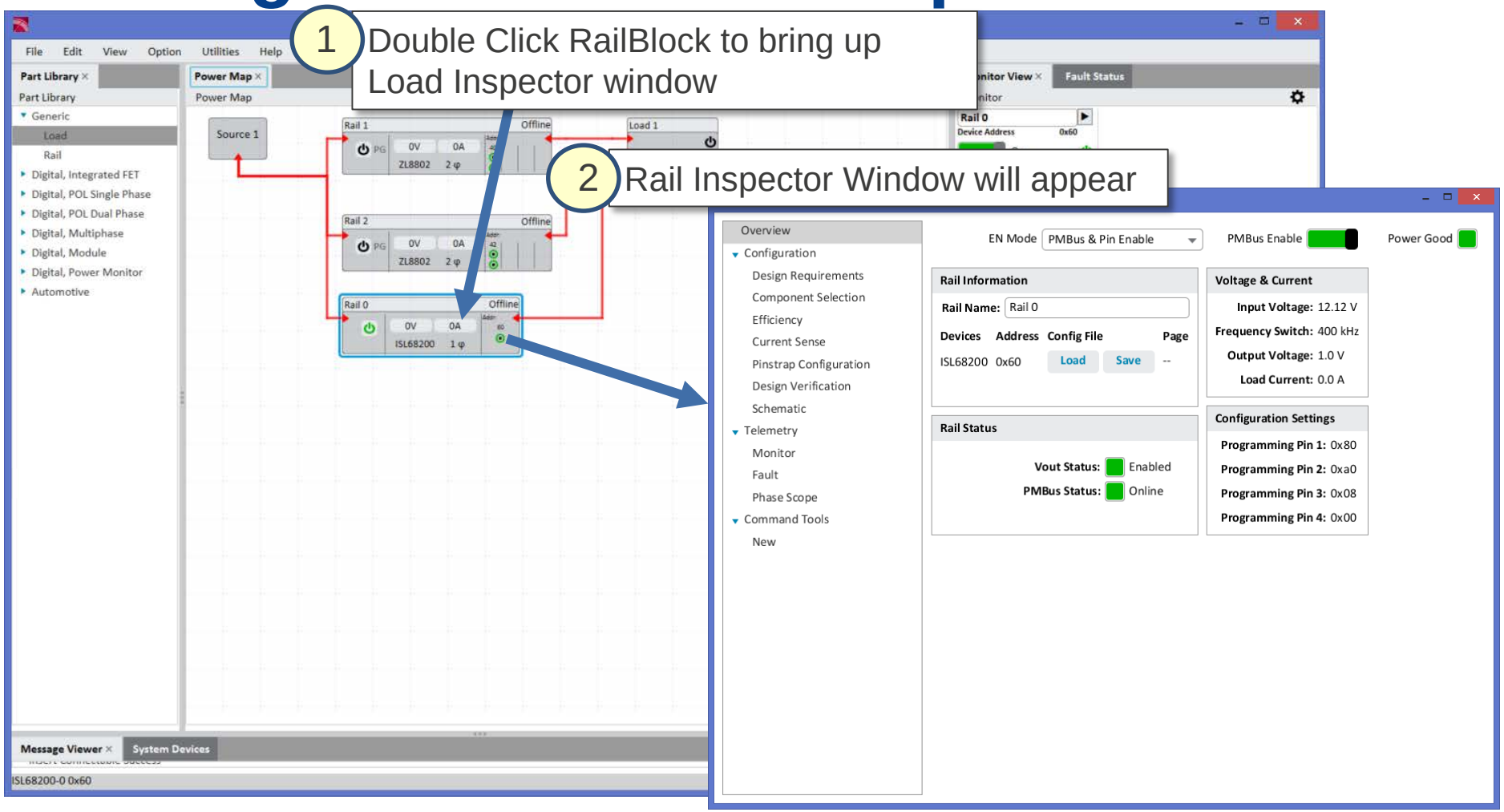
PowerNavigator – Rail Inspector



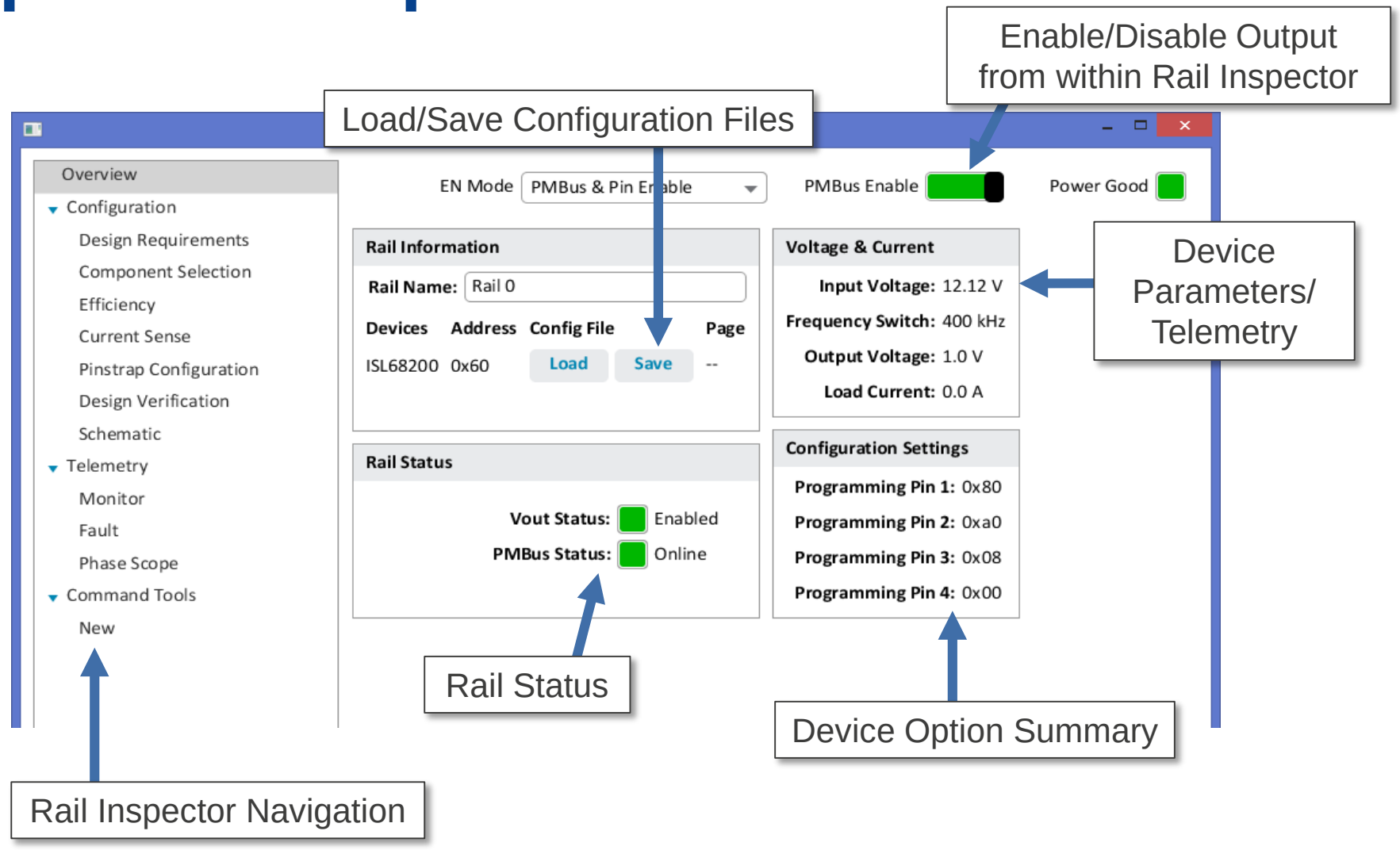
PowerNavigator 5.4 – Rail Inspector

- Rail Inspector tool eases device configuration
  - Double click on RailBlocks to bring up individual Rail Inspector for each device.
  - Each device in PowerNavigator can have its own, customized Rail Inspector.
- Rail Inspector tool can be used to:
  - Quickly see rail summary, including PMBus addresses, controller type, PMBus status, device options, fault status, etc.
  - Save/Load Configuration Files
  - Configure device using command tool
- Allows for future expandability
  - Future releases of PowerNavigator will expand Rail Inspector features

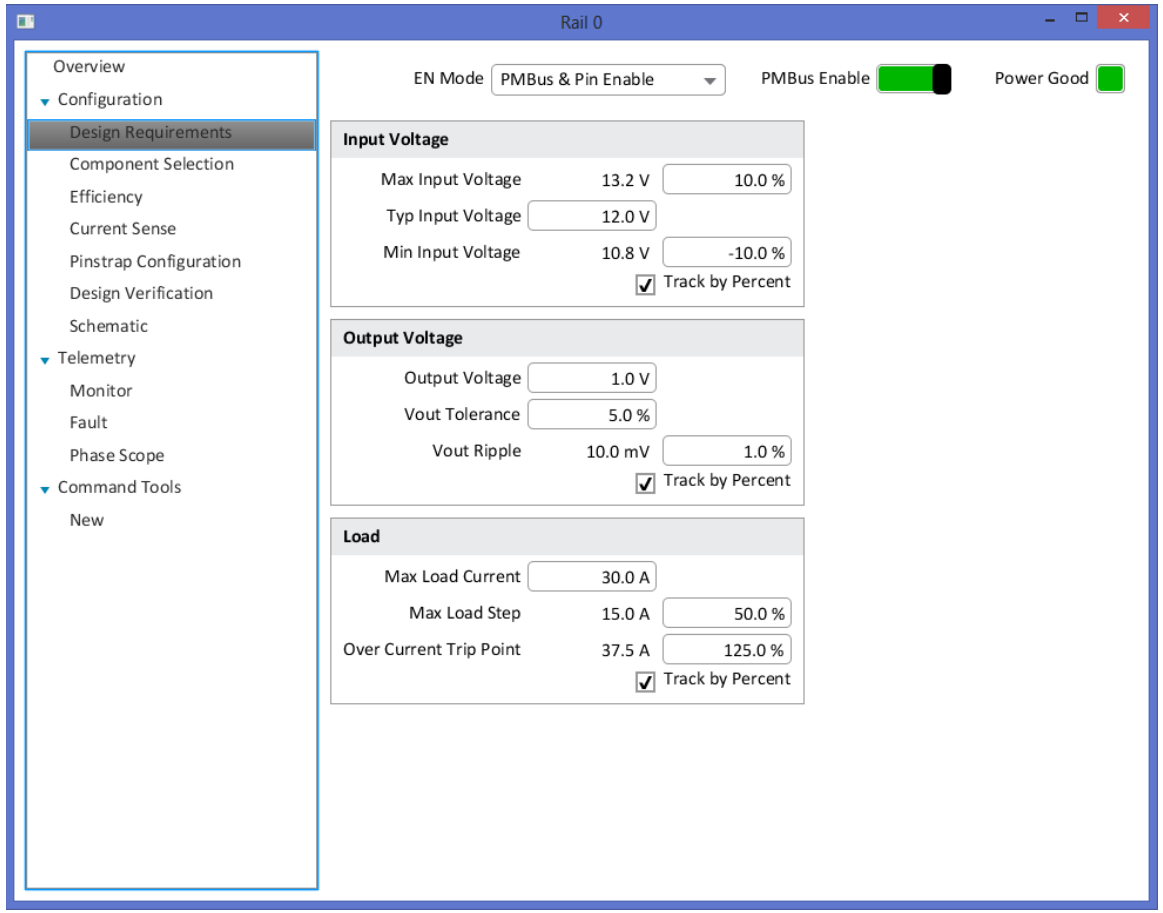
PowerNavigator 5.4 – Rail inspector



Example Rail Inspector – ISL68200

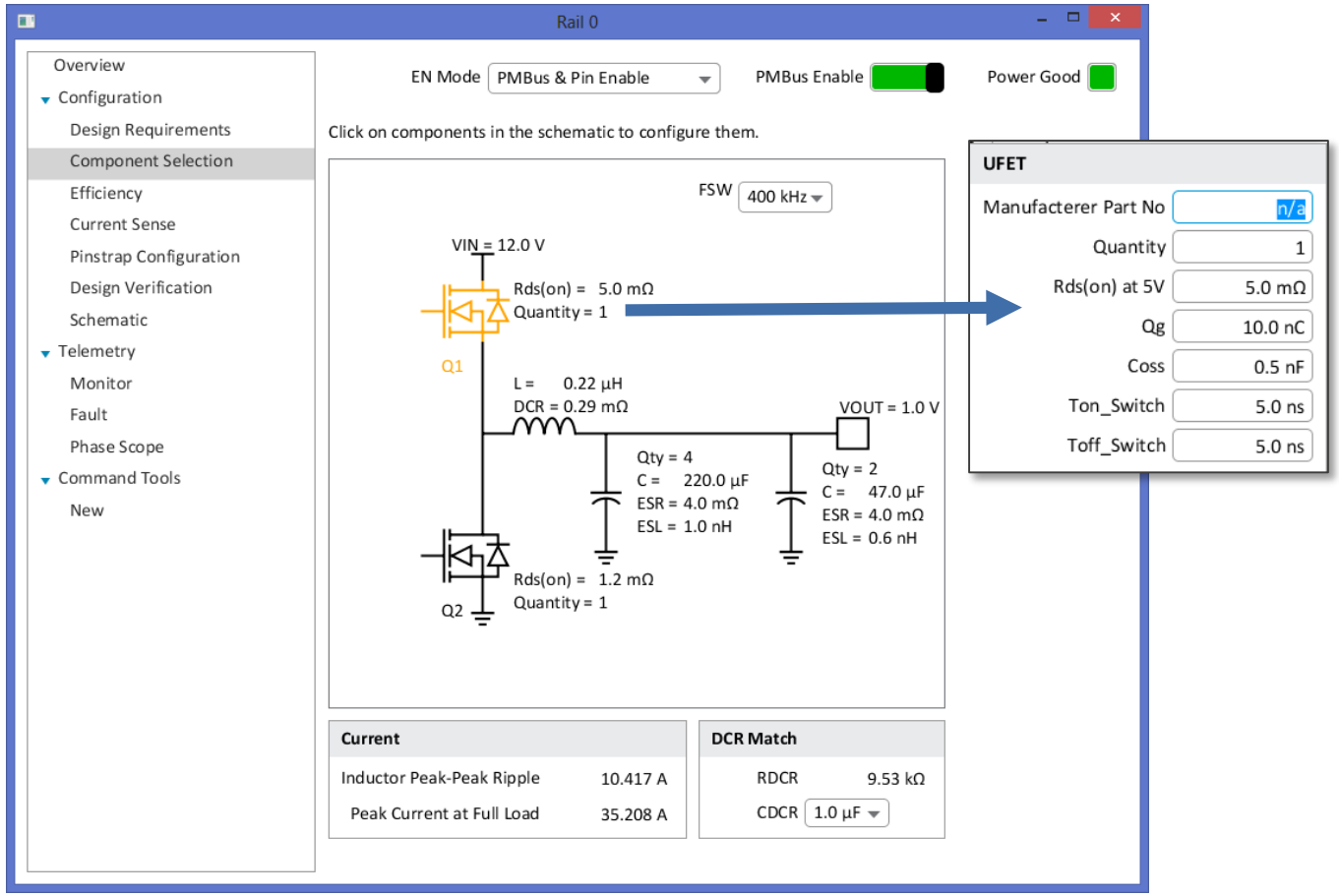


Example Rail Inspector – ISL68200



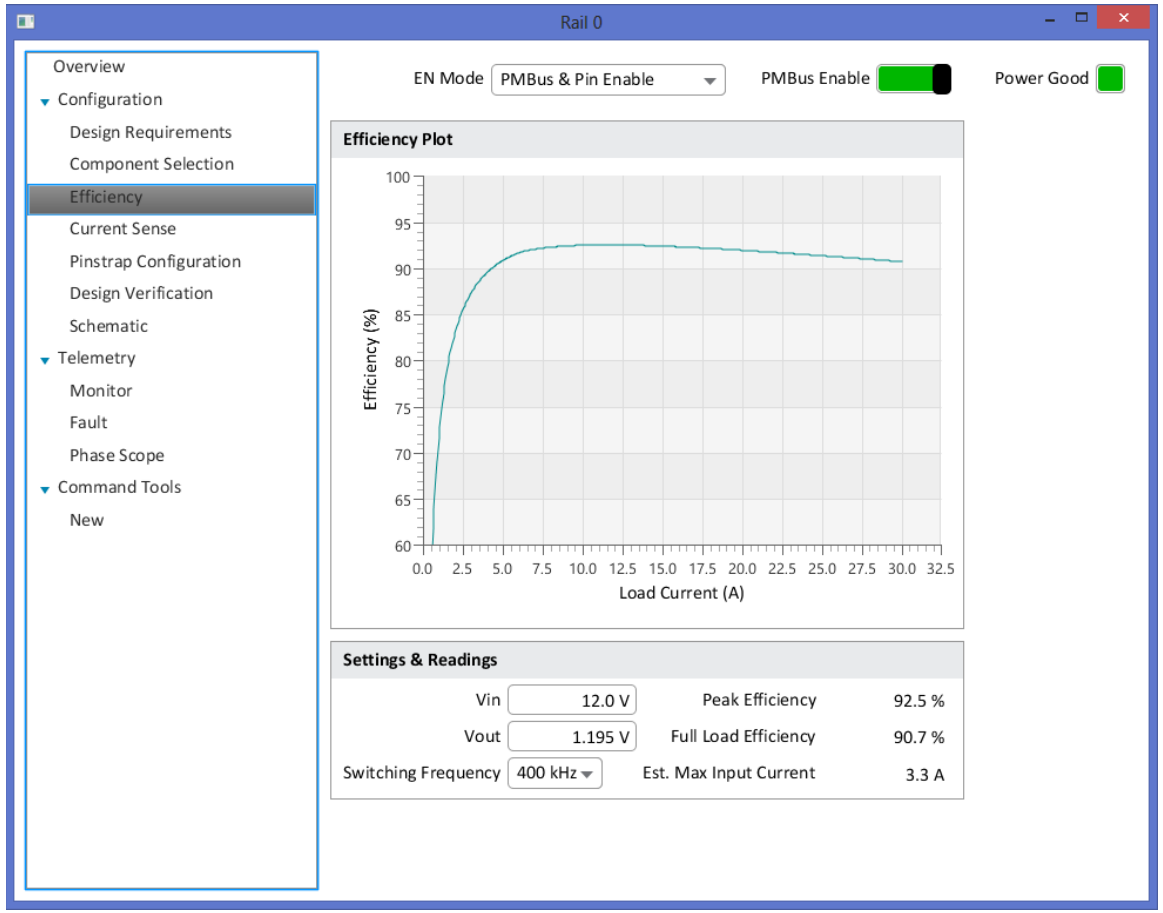
Design Requirements – Enter Vin, Vout and Iout requirements

Example Rail Inspector – ISL68200



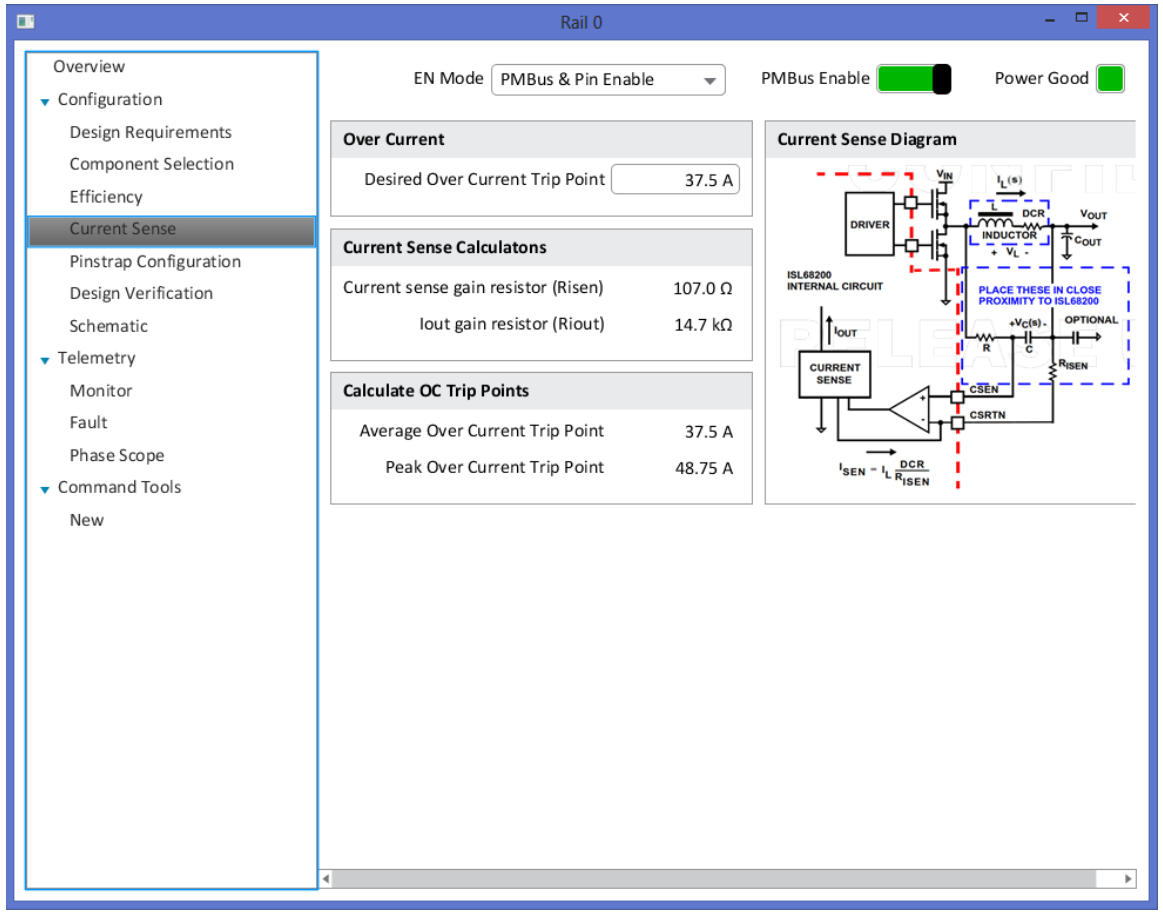
Component Selection – Enter FET, Inductor and Output Cap information

Example Rail Inspector – ISL68200



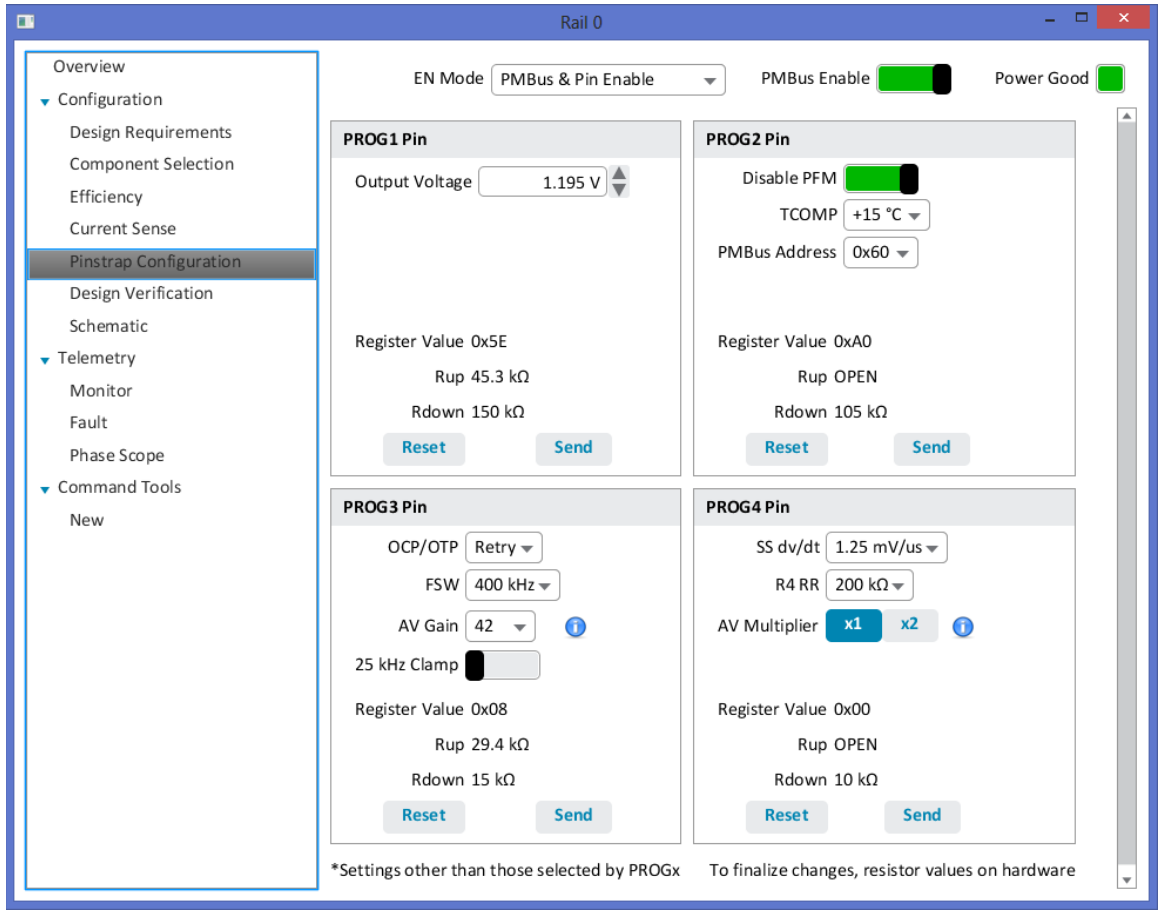
Efficiency – Real time plot of efficiency with selected components and switching frequency.

Example Rail Inspector – ISL68200



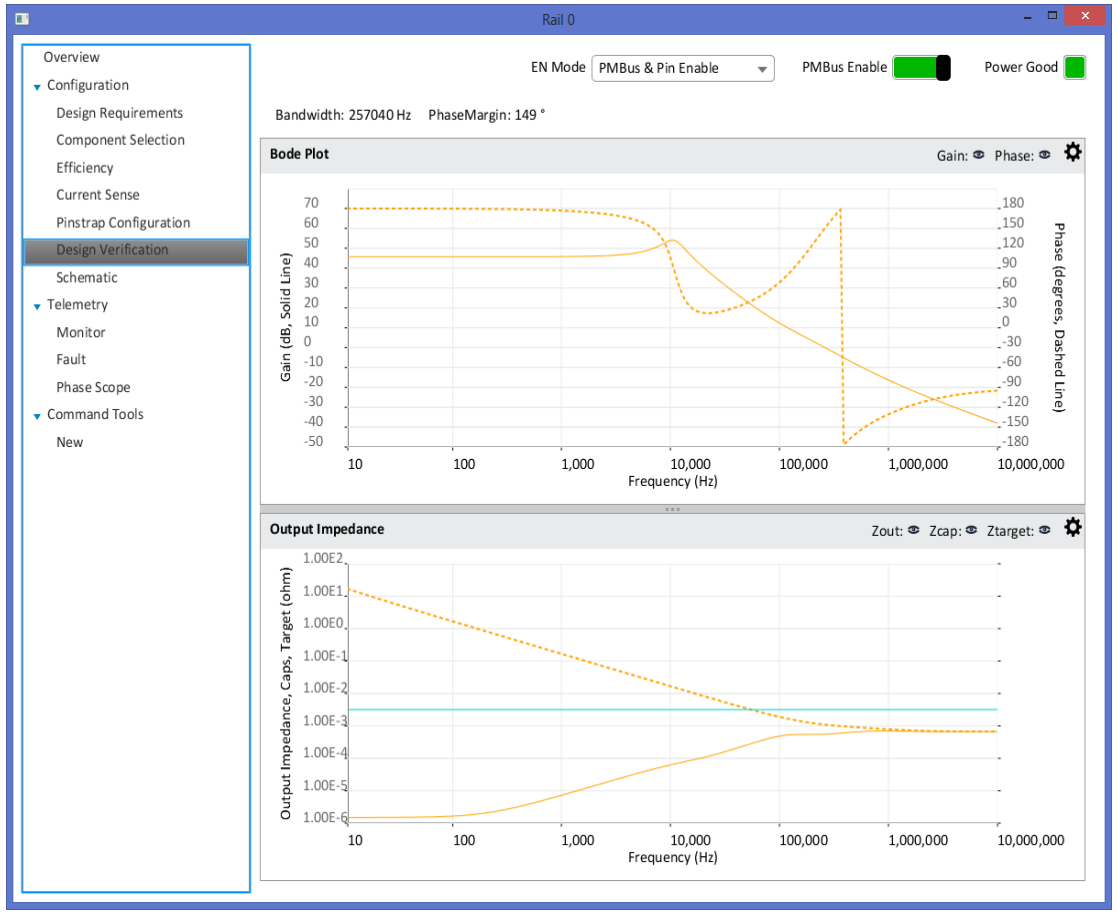
Current Sense – Automatic calculation of current sense resistor settings based on desired OC trip point.

Example Rail Inspector – ISL68200



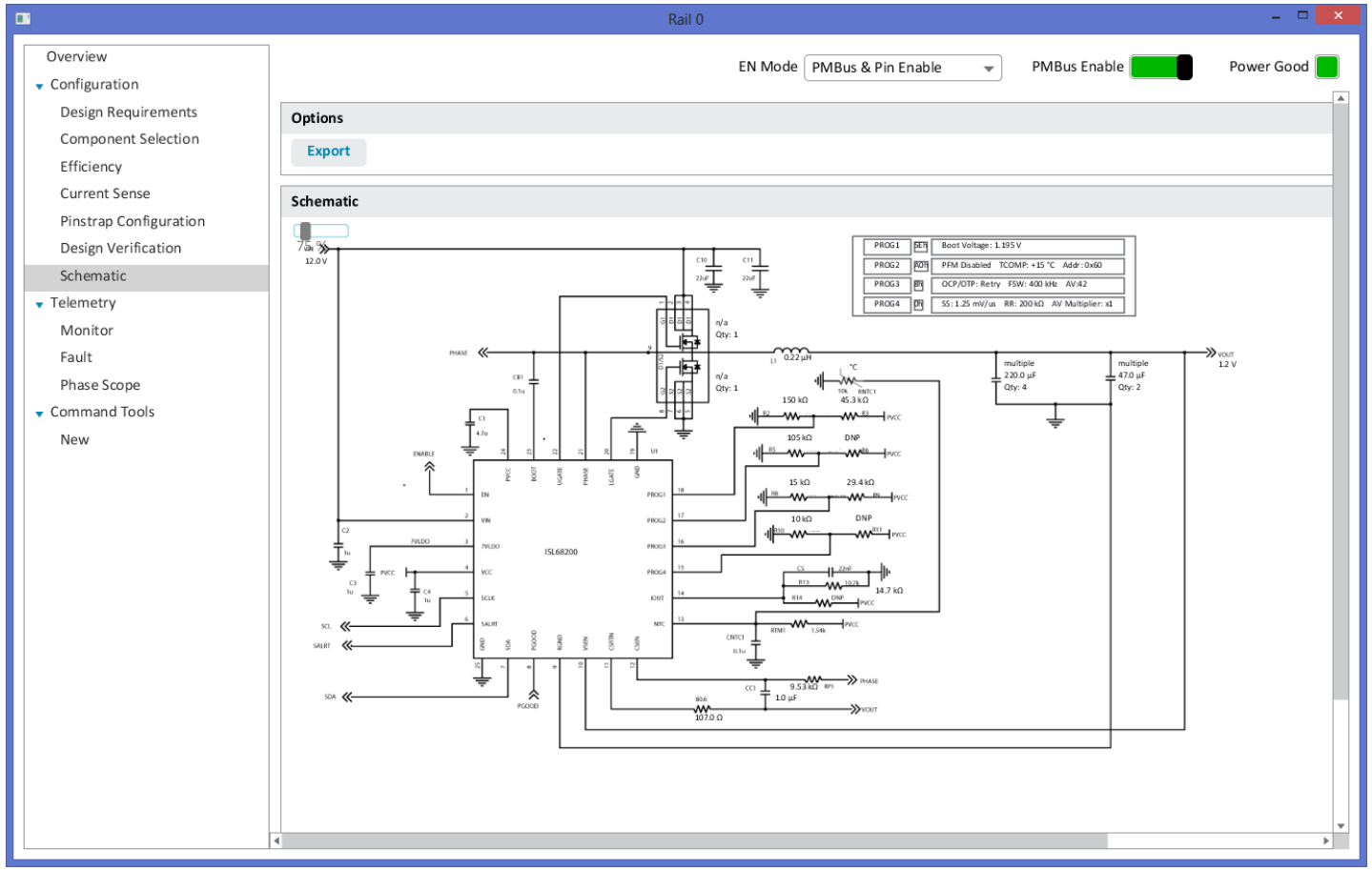
Pinstrap Configuration – Select pinstrap resistors to setup device default settings.

Example Rail Inspector – ISL68200



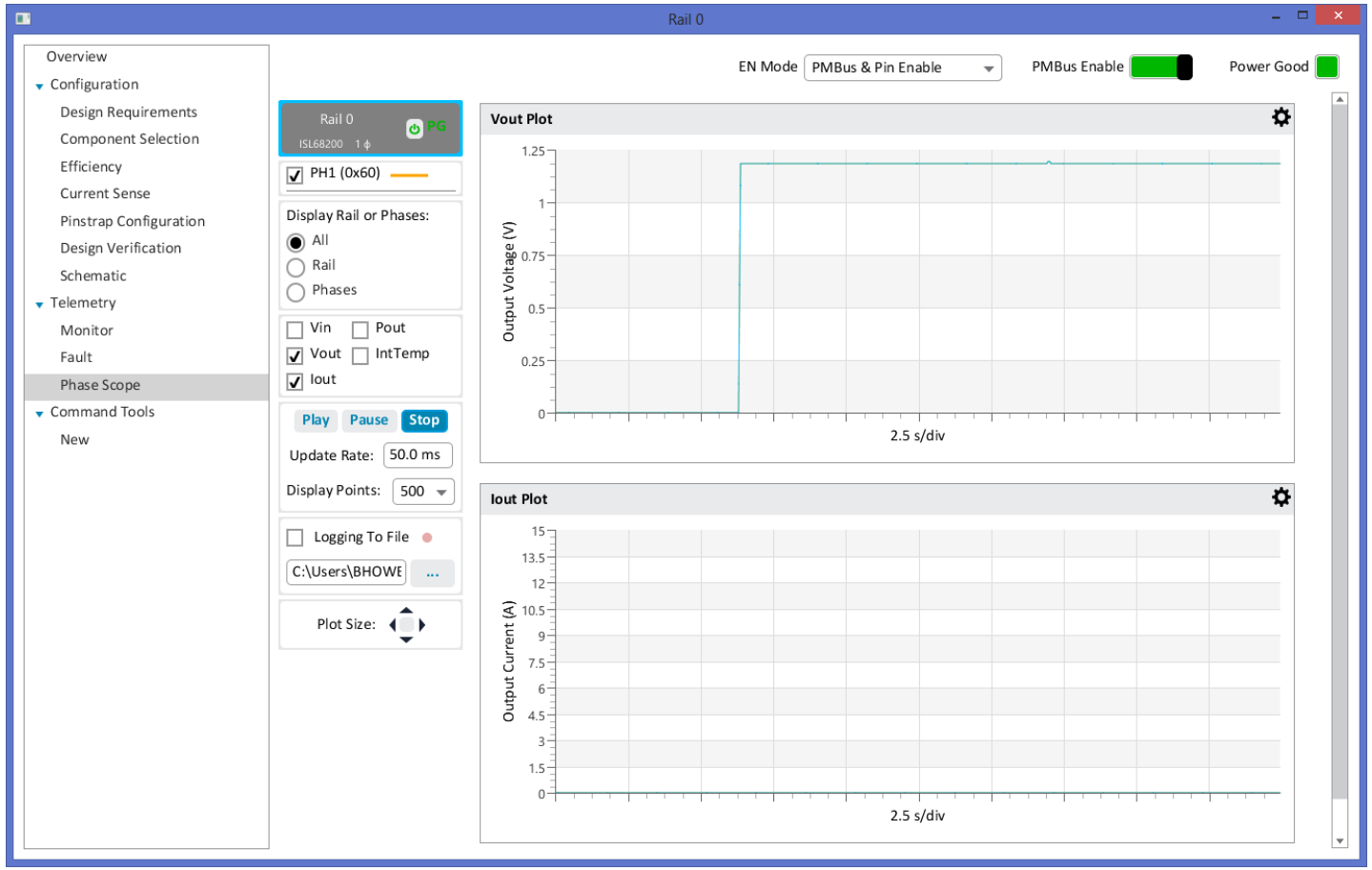
Design Verification– Bode and Output Impedance plots of design.

Example Rail Inspector – ISL68200



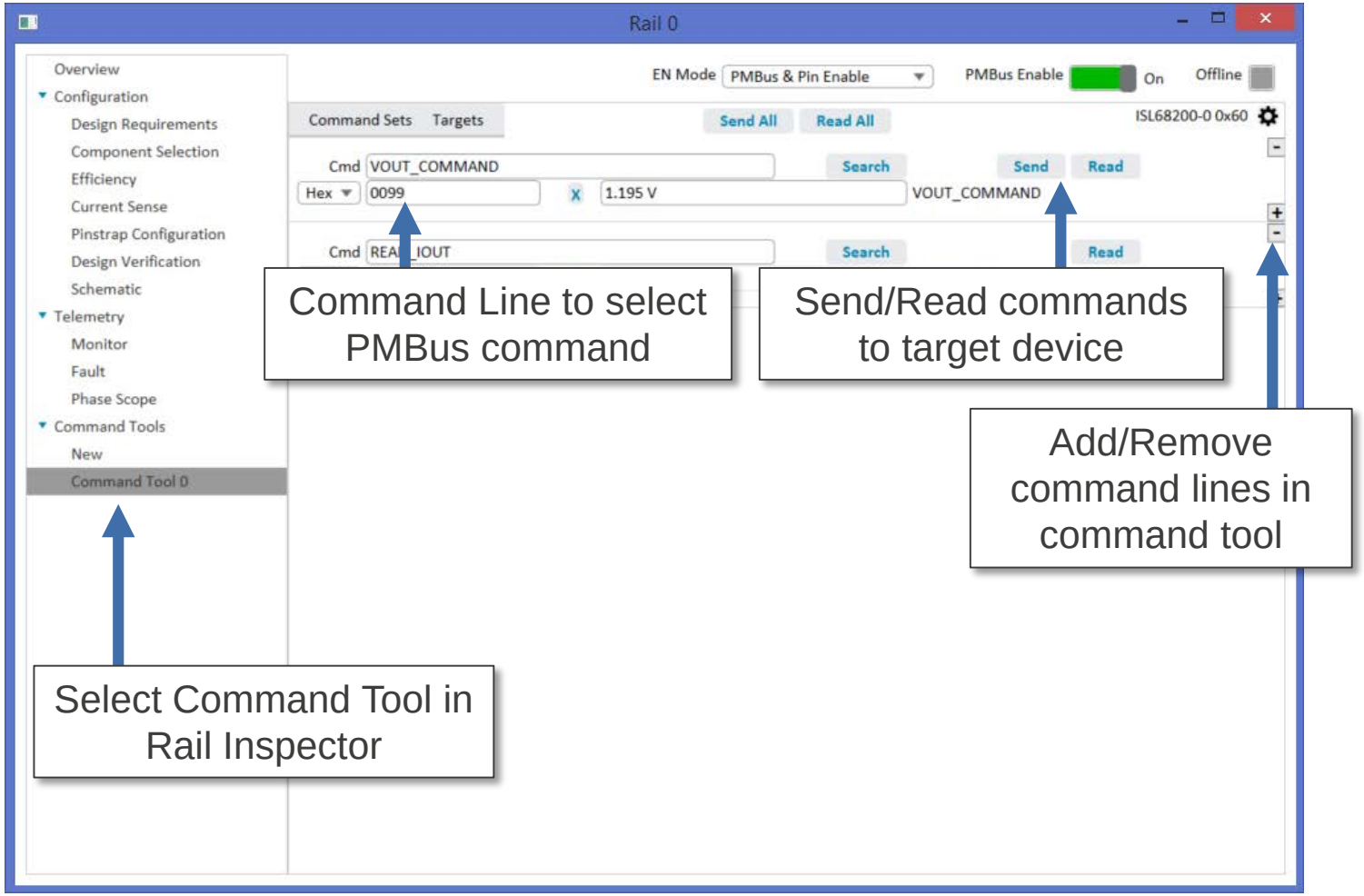
Schematic Generation – Final schematic, with customized components, generated automatically.

Example Rail Inspector – ISL68200

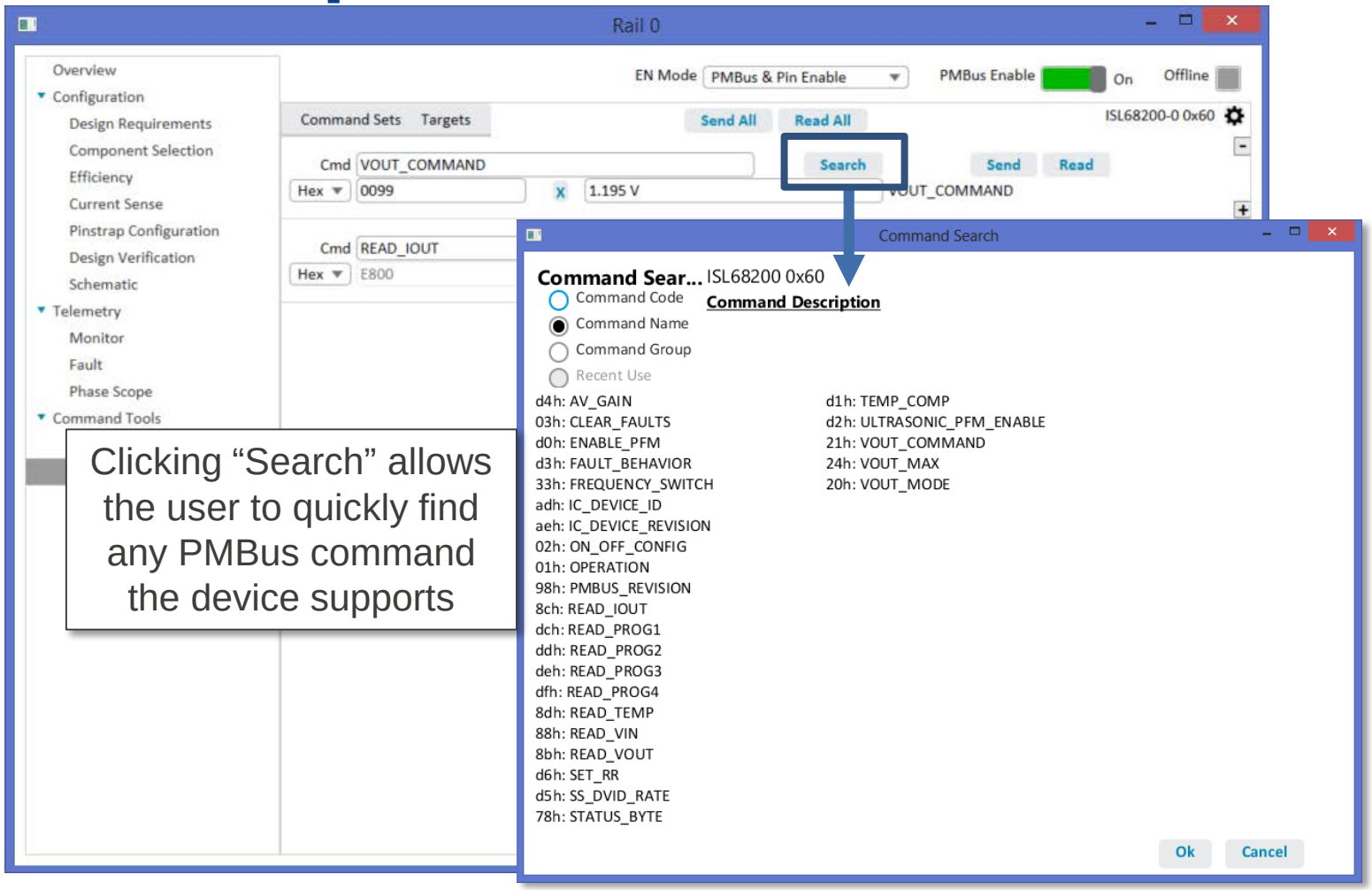


Phase Scope – Real time plotting of all telemetry parameters.

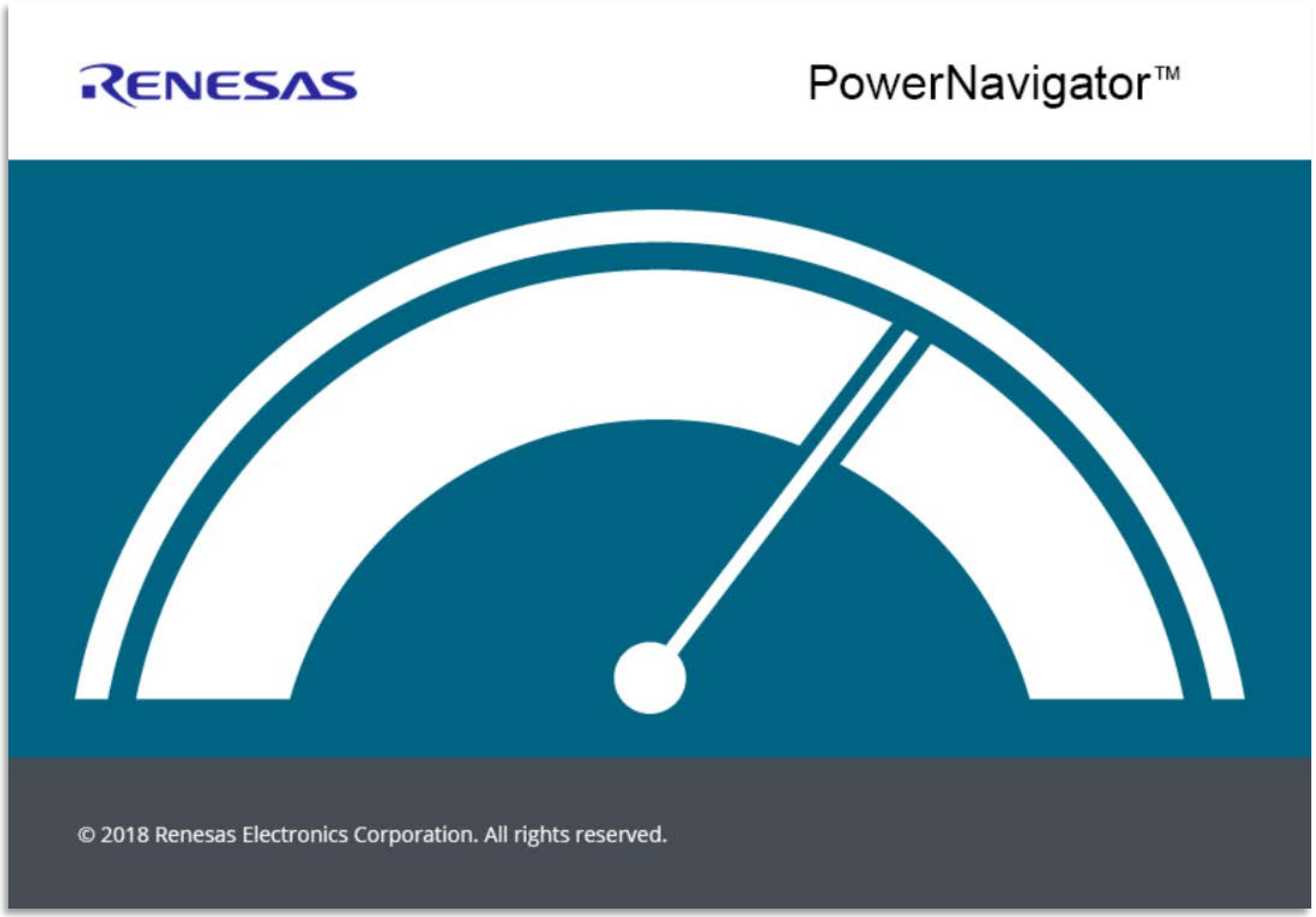
Example Rail Inspector – ISL68200



Example Rail Inspector – ISL68200



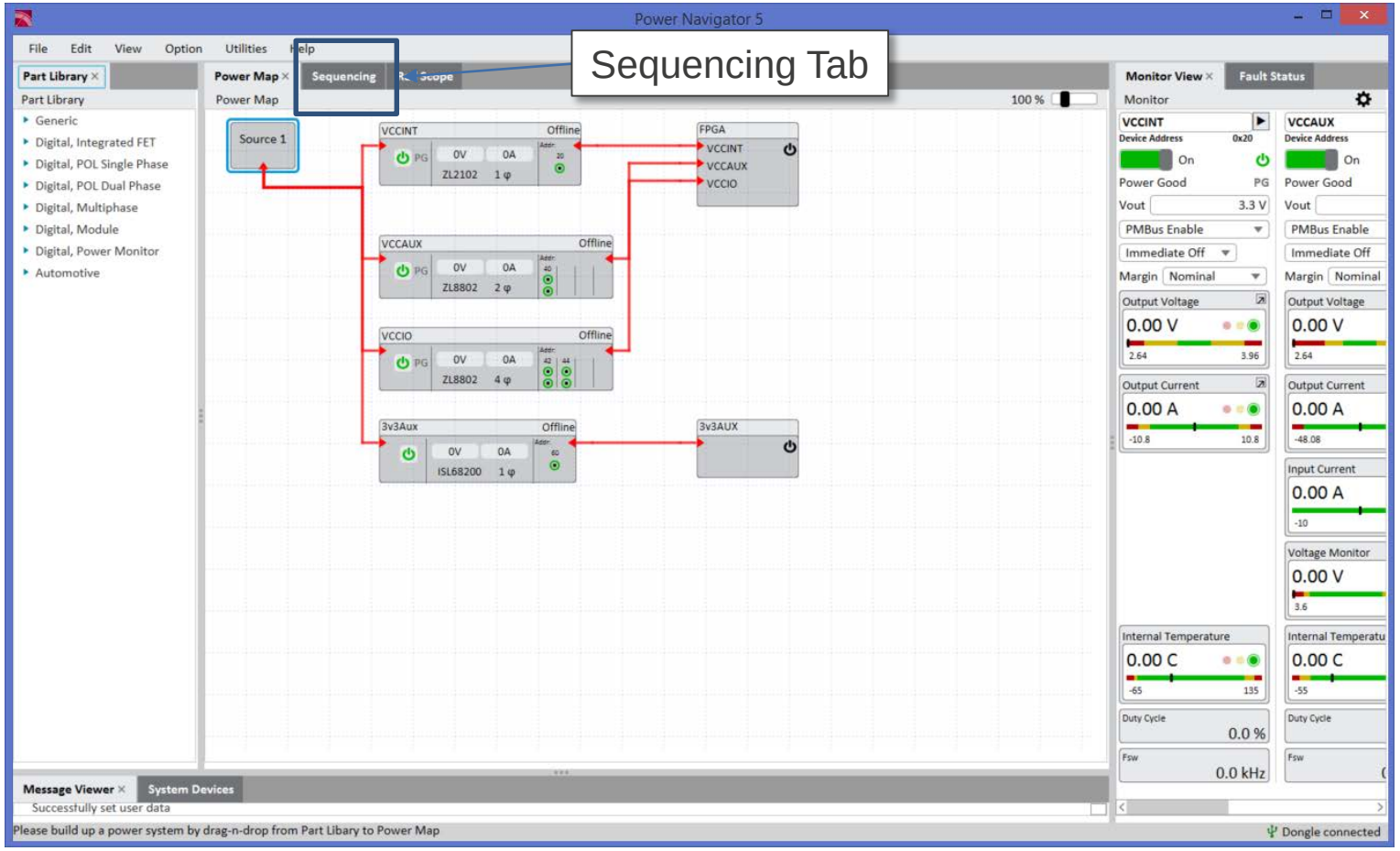
Sequencing



PowerNavigator – Sequencing

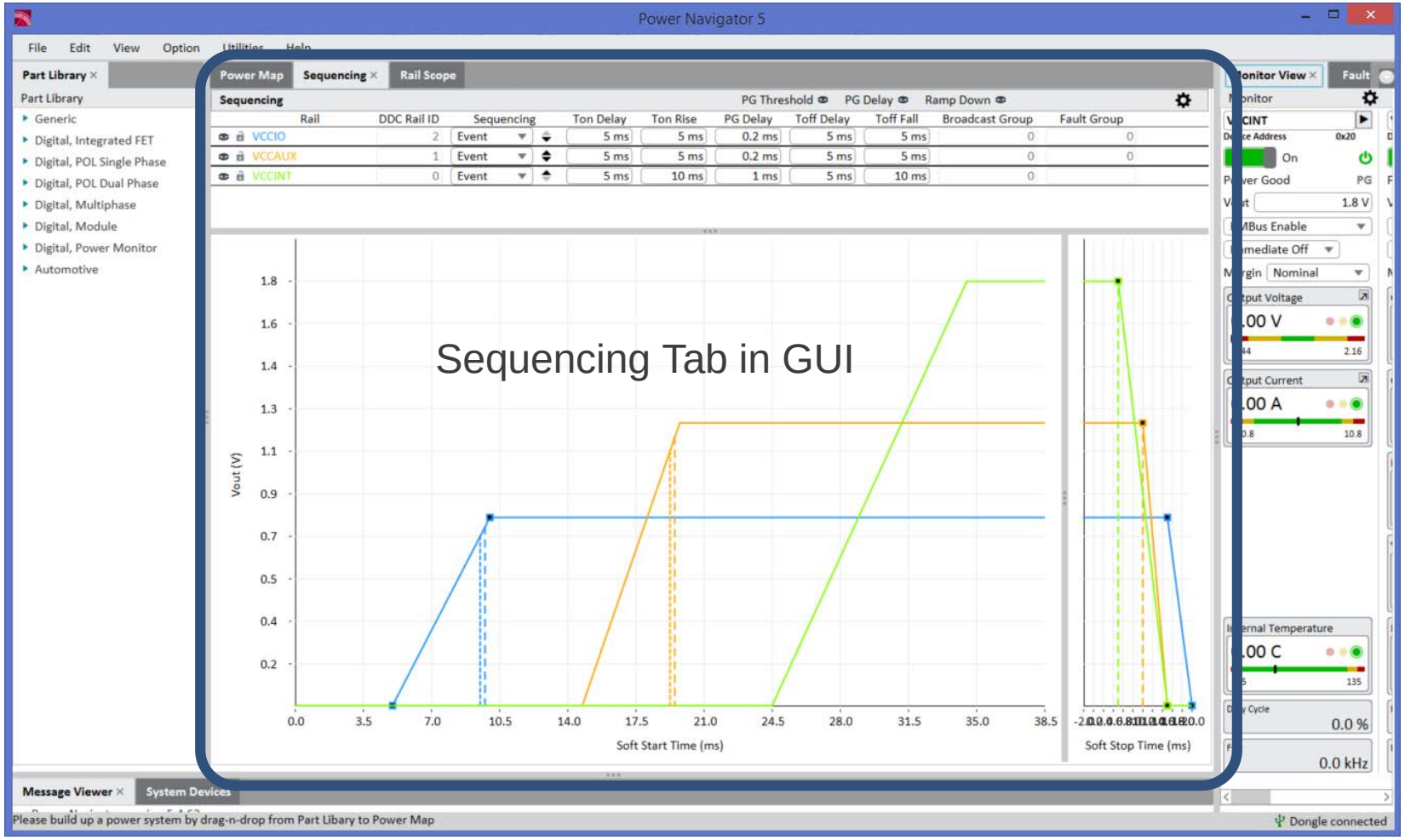
- All Renesas Digital Power Controllers and modules with a DDC bus support autonomous sequencing between rails.
- Sequencing is configured using the PowerNavigator sequencing tool.
- Once configured, all sequencing events are handled automatically using Renesas's proprietary DDC bus.
  - Controllers and/or modules will automatically communicate via DDC bus, synchronizing sequencing events.

PowerNavigator – System Screen



The sequencing tab allows for power up and power down sequencing of devices in the PowerMap.

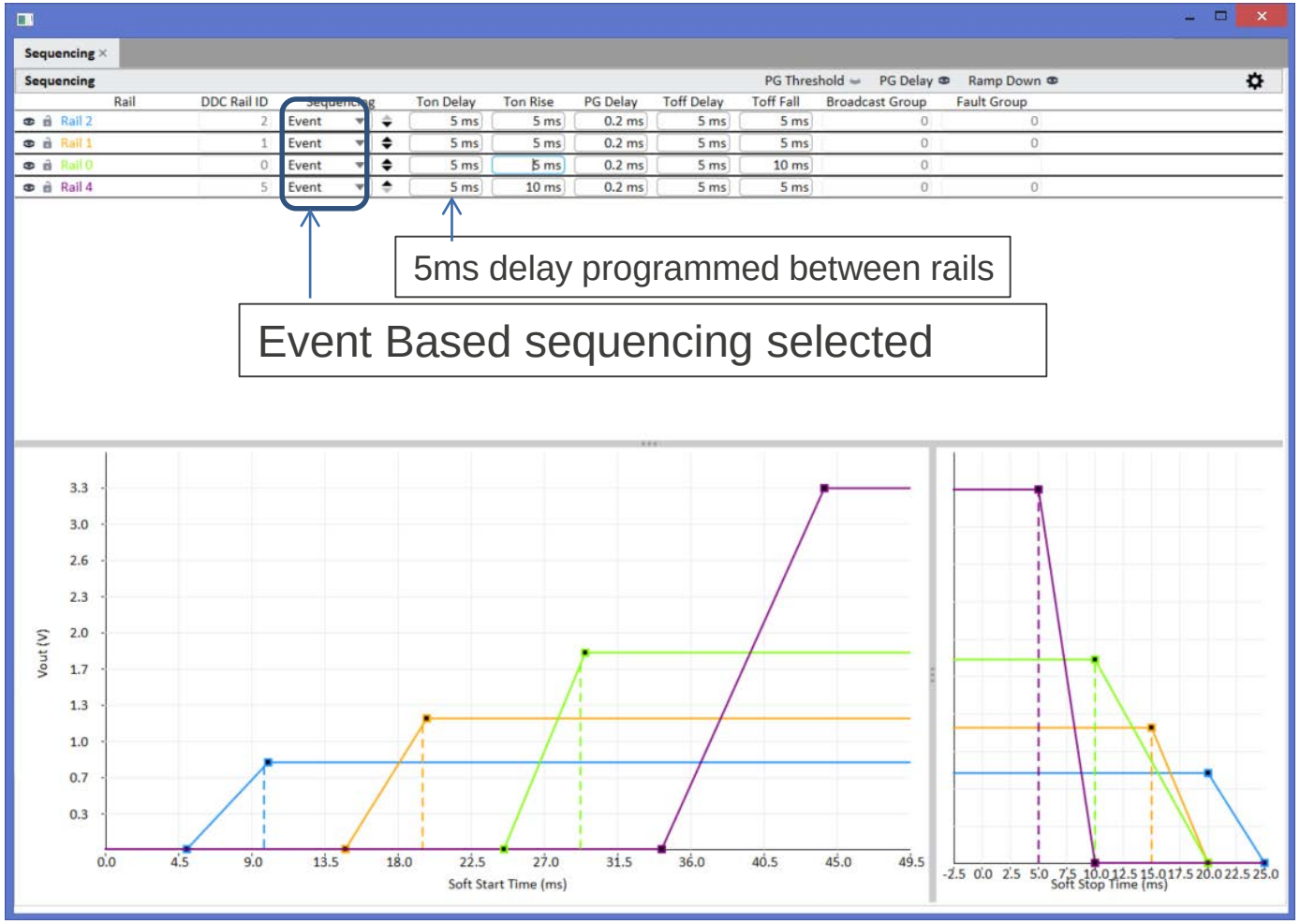
PowerNavigator GUI – Sequencing



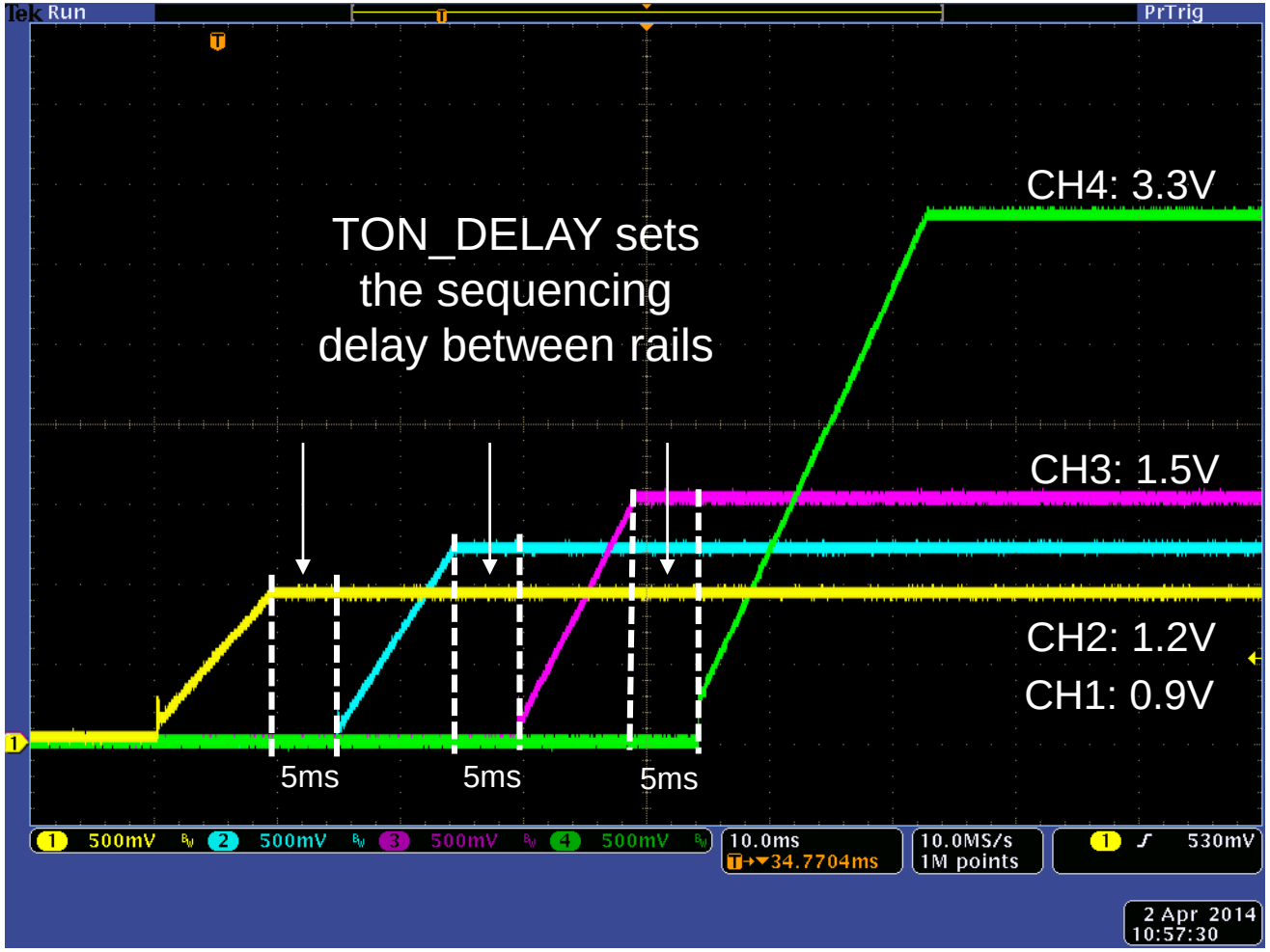
PowerNavigator – Sequencing

- Event based sequencing waits for the device PGOOD to transition high (the event) before sequential rails start-up
  - Sequence order is set by Prequel/Sequel using the SEQUENCE PMBus command
  - TON_DELAY is used to set the time delay between sequenced rails
- Timed based sequencing uses a timer from a global enable to sequence rails at start-up.
  - TON_DELAY sets the sequence order on the way up. TOFF_DELAY sets the order on the way down.

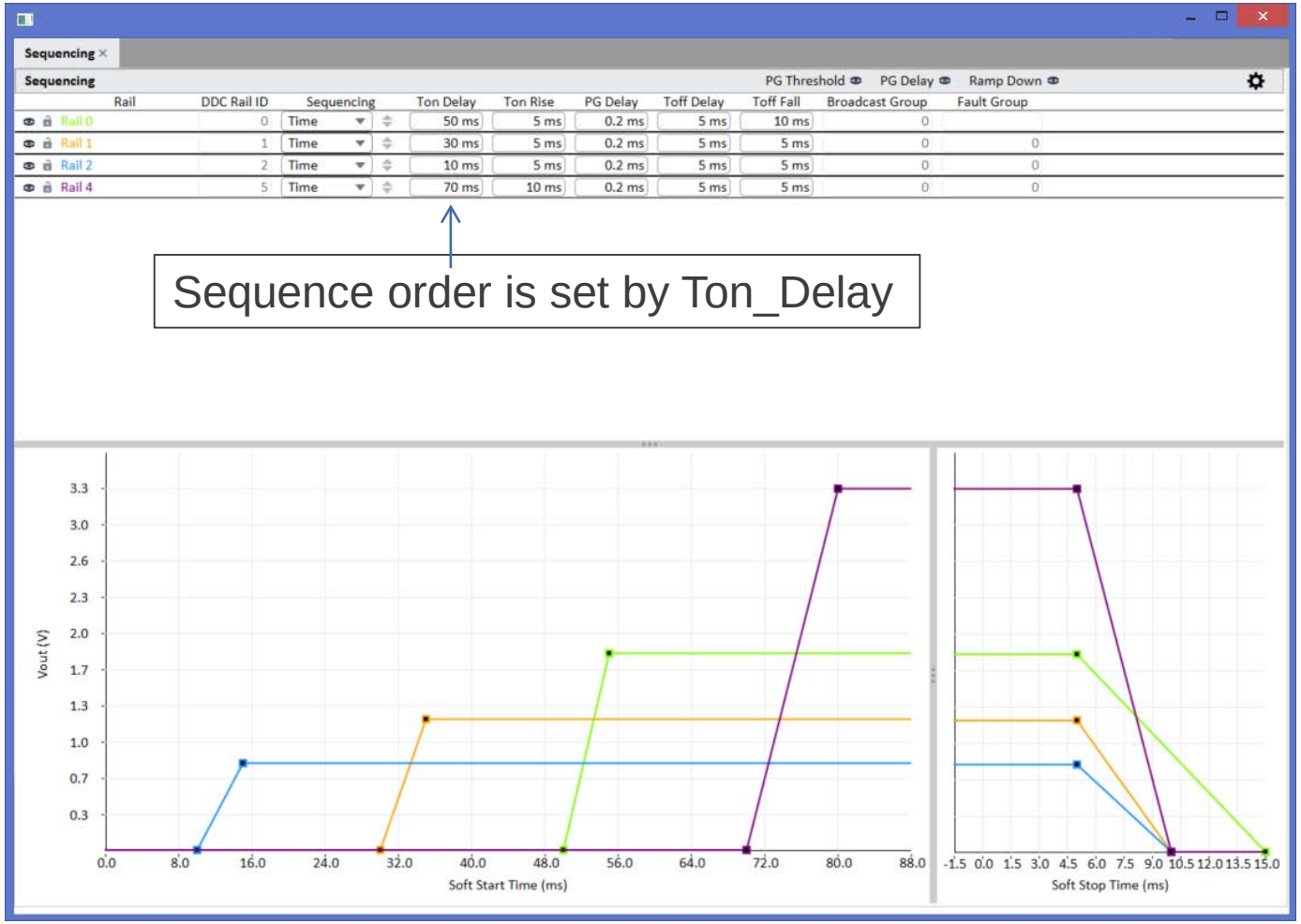
Event Based Sequence Example



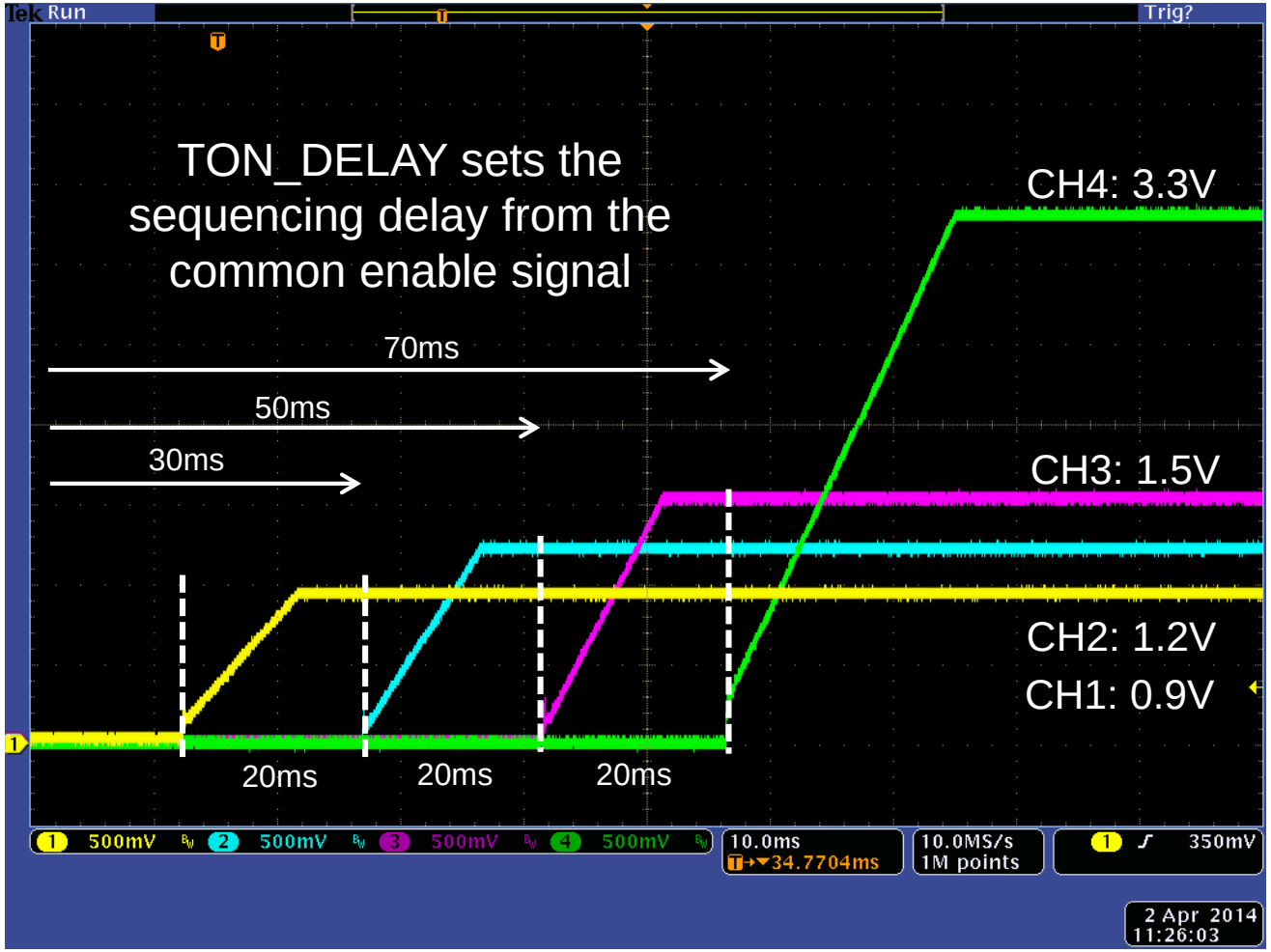
Event Based Sequence Example



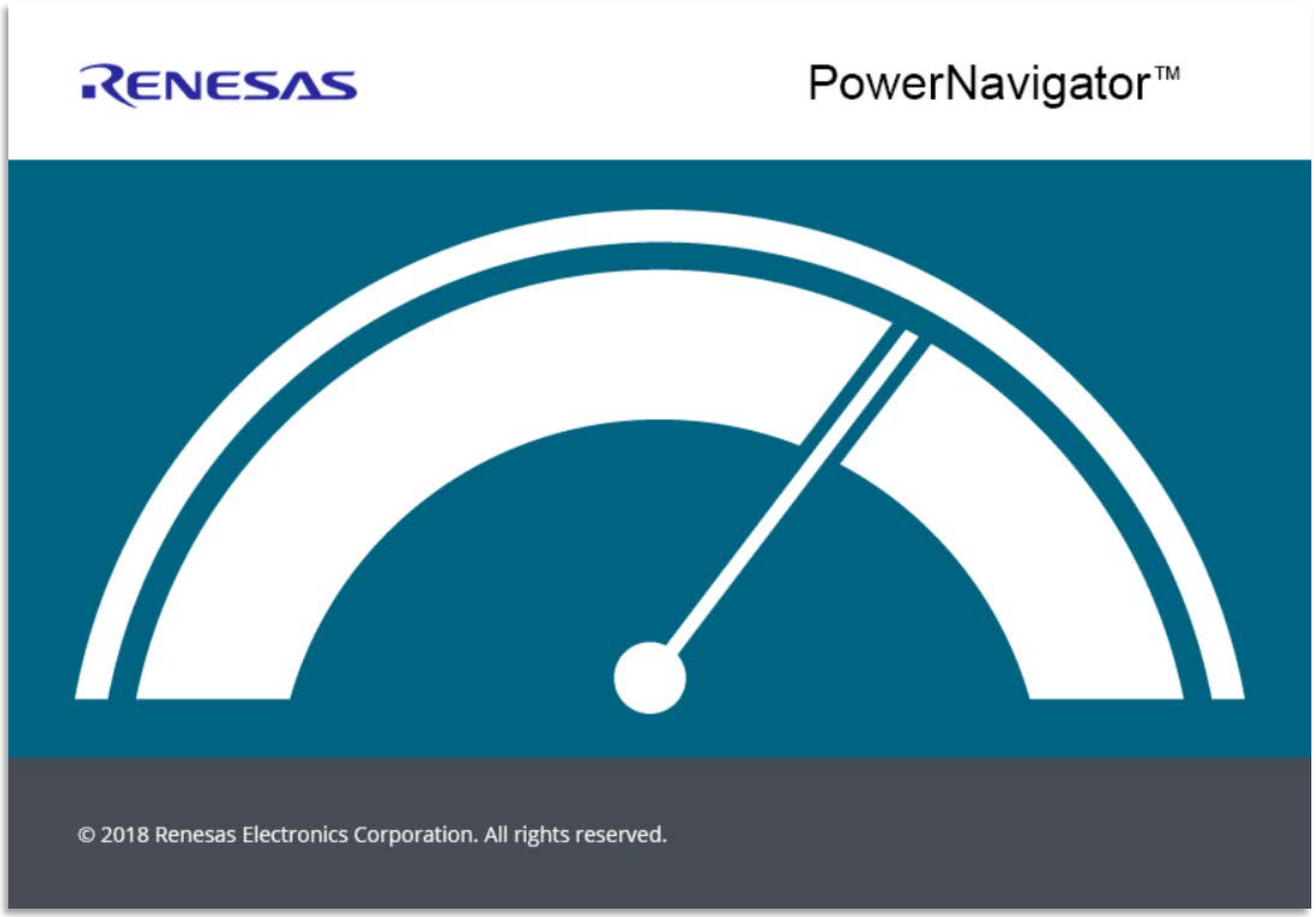
Time Based Sequence Example



Time Based Sequence Example



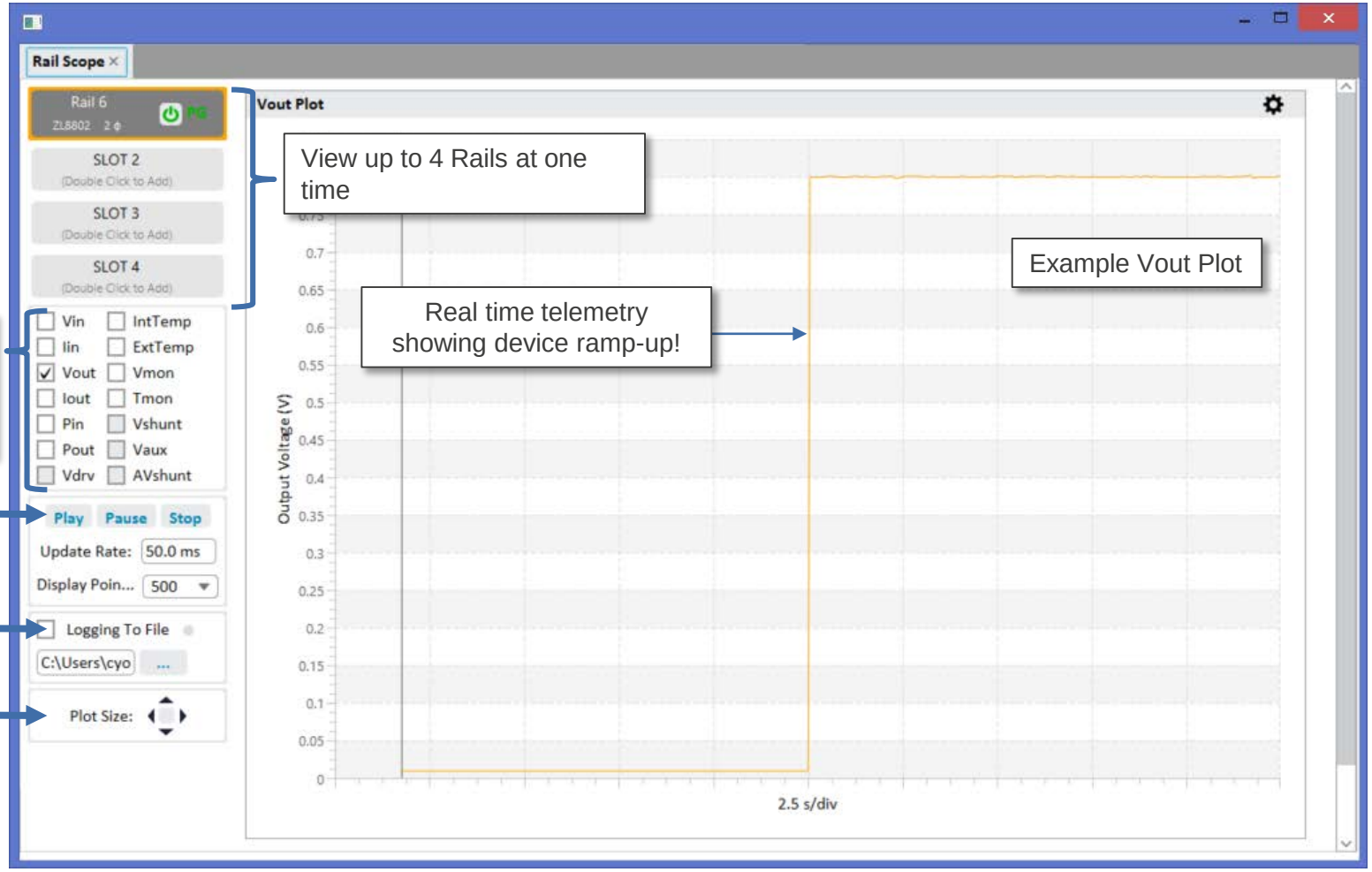
Railscope



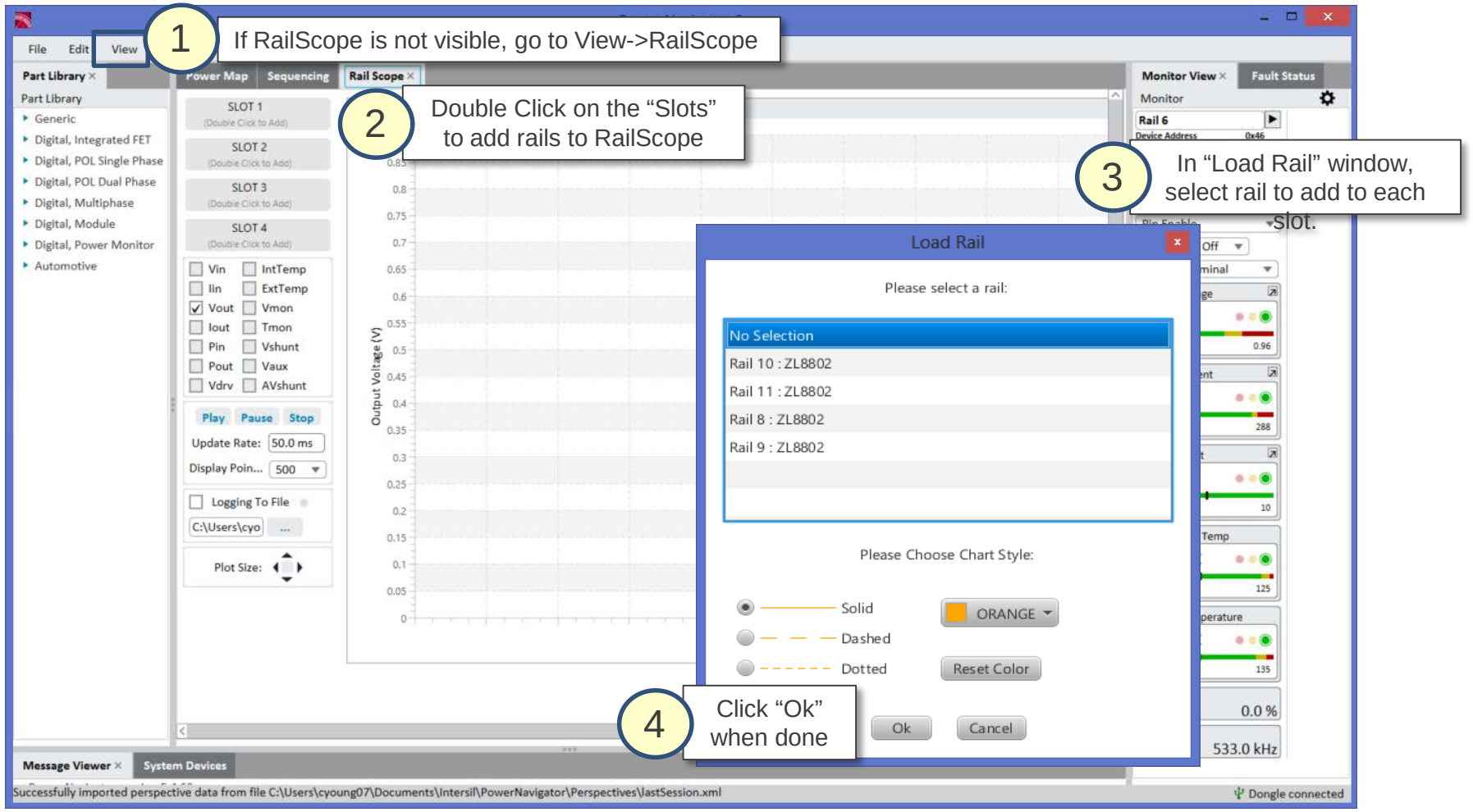
PowerNavigator 5.4 – RailScope

- New RailScope allows the user to plot telemetry parameters from up to 4 devices.
  - Similar to a Low Bandwidth Oscilloscope integrated into PowerNavigator.
  - Allows user to plot multiple telemetry values at a time.
- Logging capability is also built-in.
  - All telemetry values can be logged to a .csv file for later viewing.
  - Status registers are also logged.
- Adjustable update rate allows users to control how much data they collect.
  - Data can be updated as fast as 1ms and as slow as 1000ms.
  - Displayed points can be as few as 50 to as many as 500.

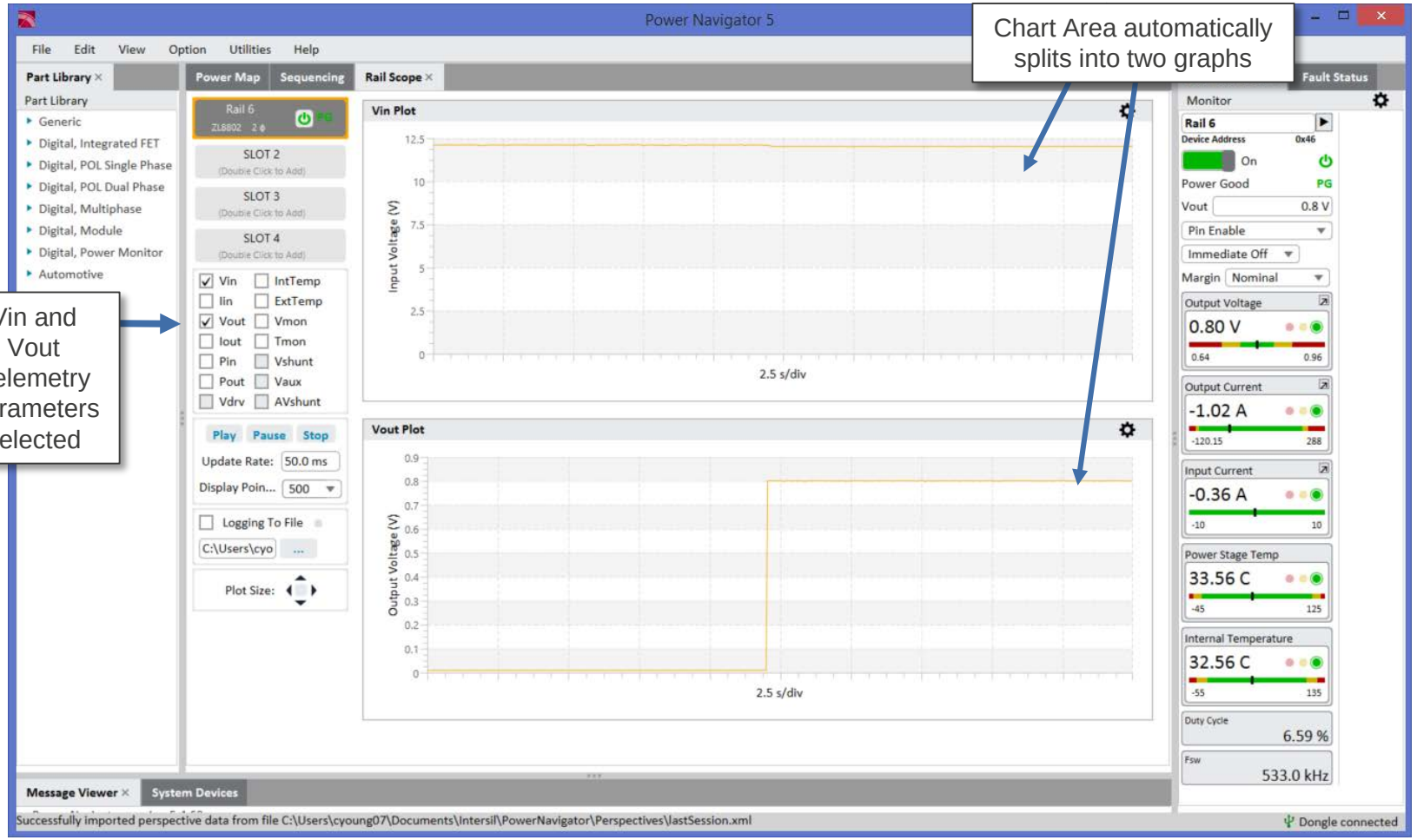
PowerNavigator – RailScope



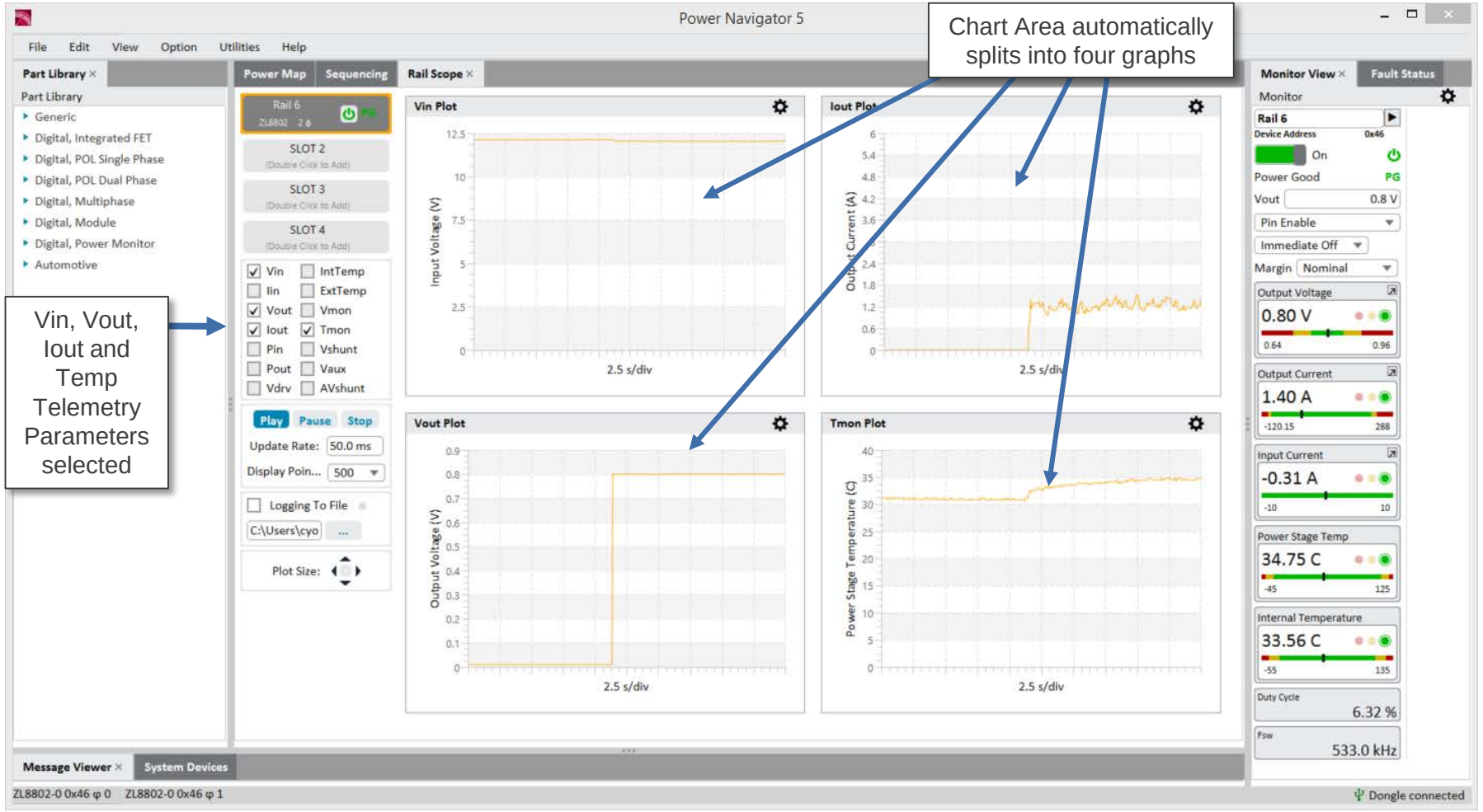
RailScope: Initial Setup



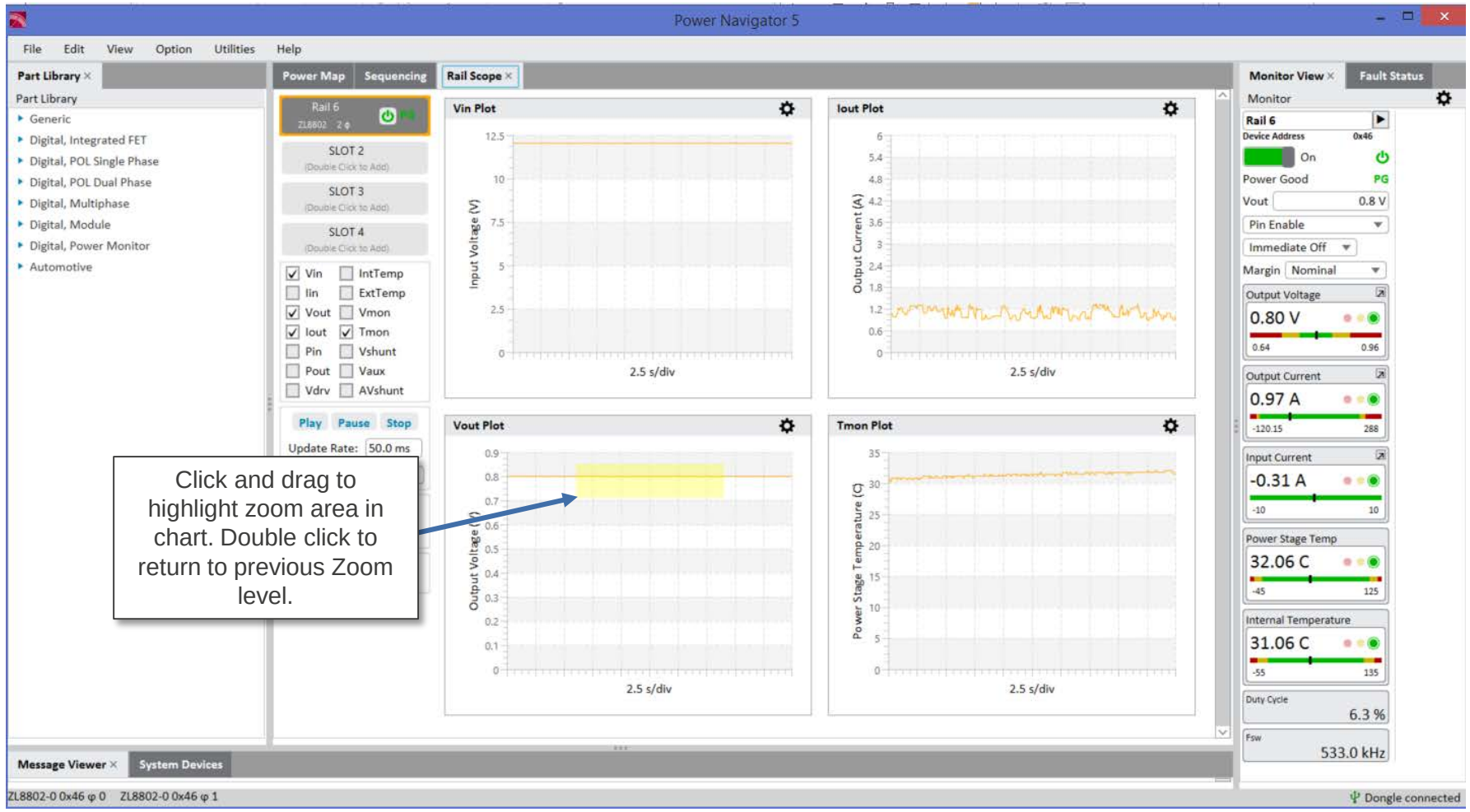
RailScope: 2 Telemetry Parameters



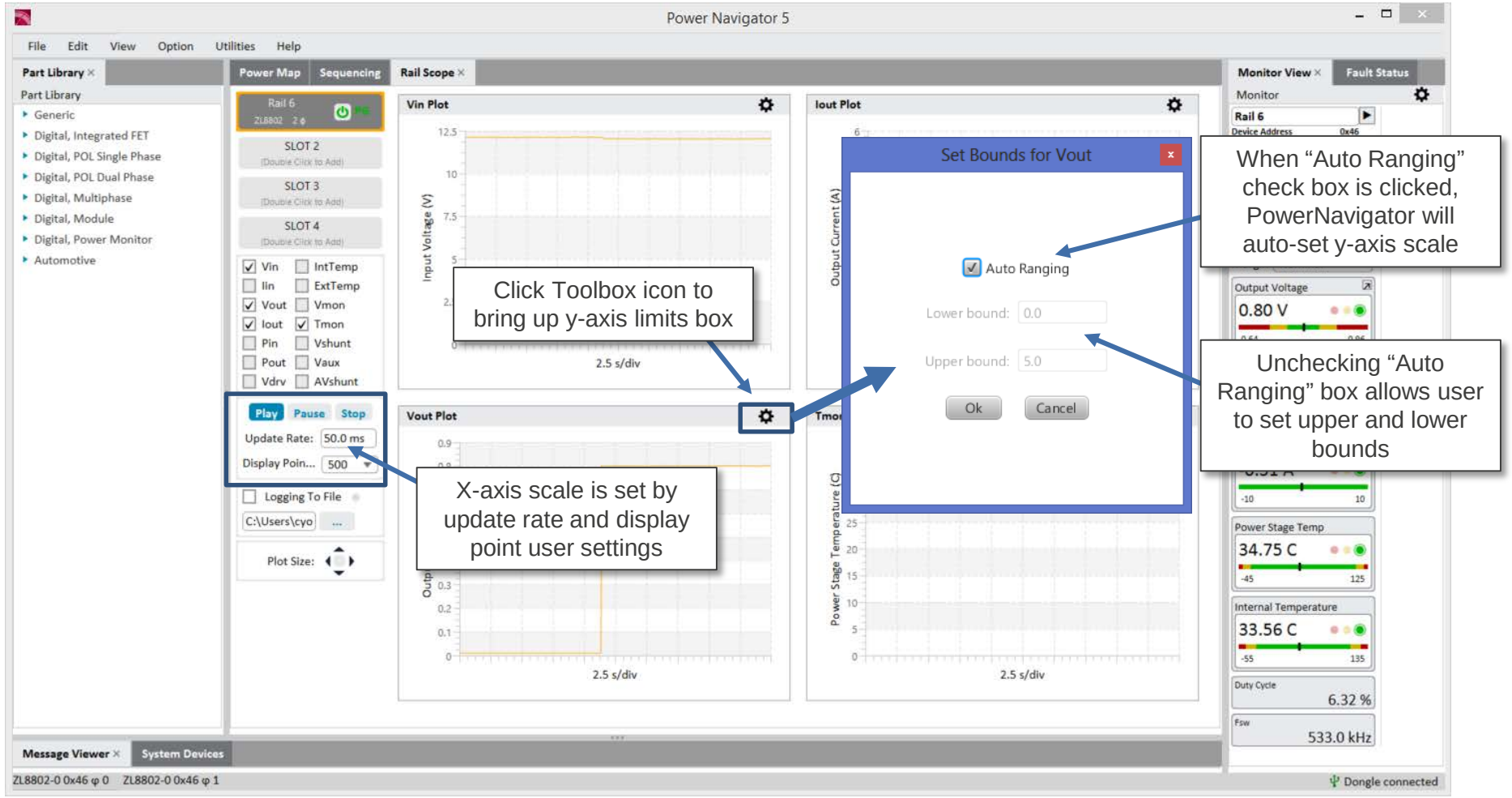
RailScope: 4 Telemetry Parameters



RailScope: Example Zoom-in



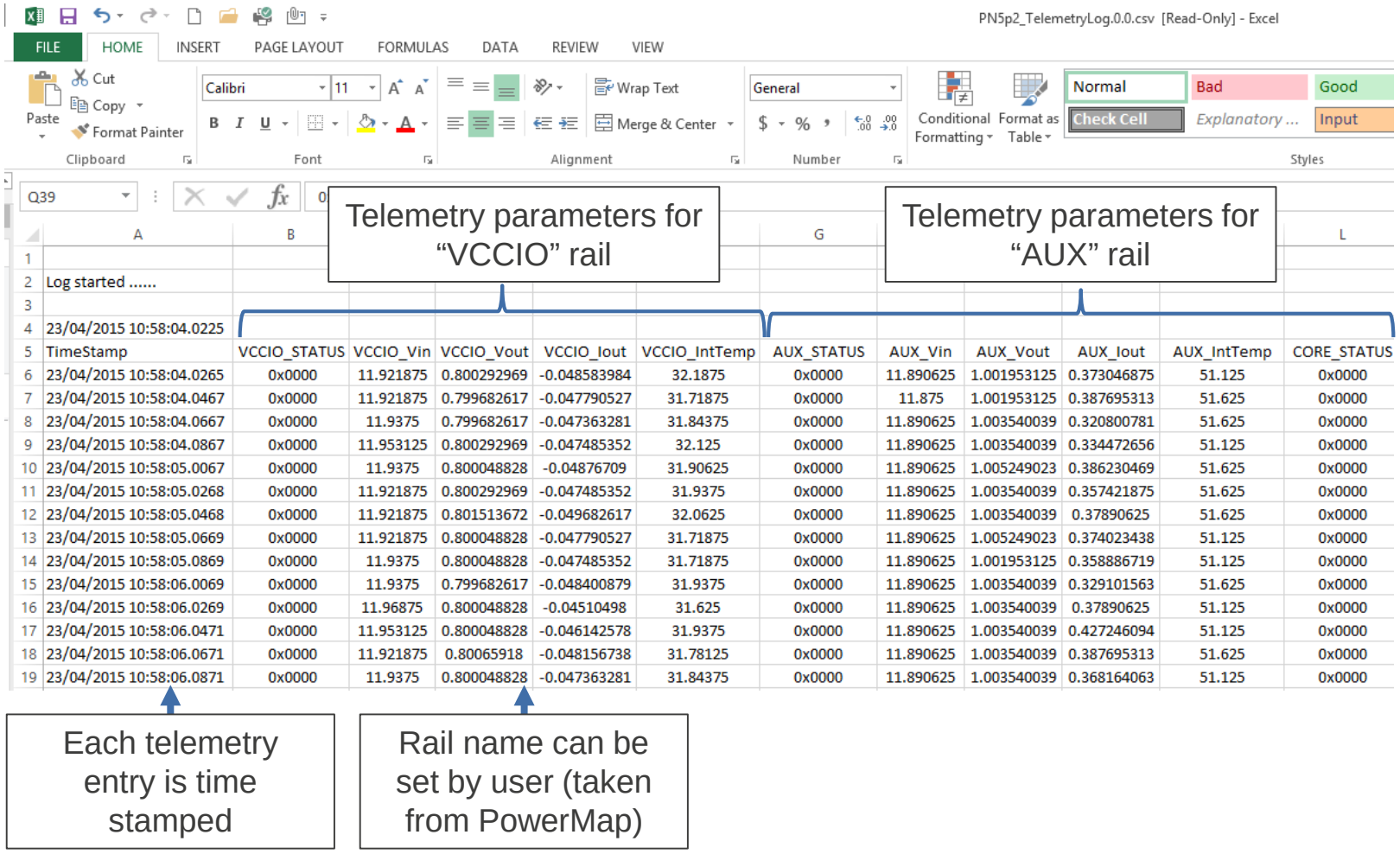
RailScope: Example X & Y-axis Scale Options



RailScope: Logging Feature

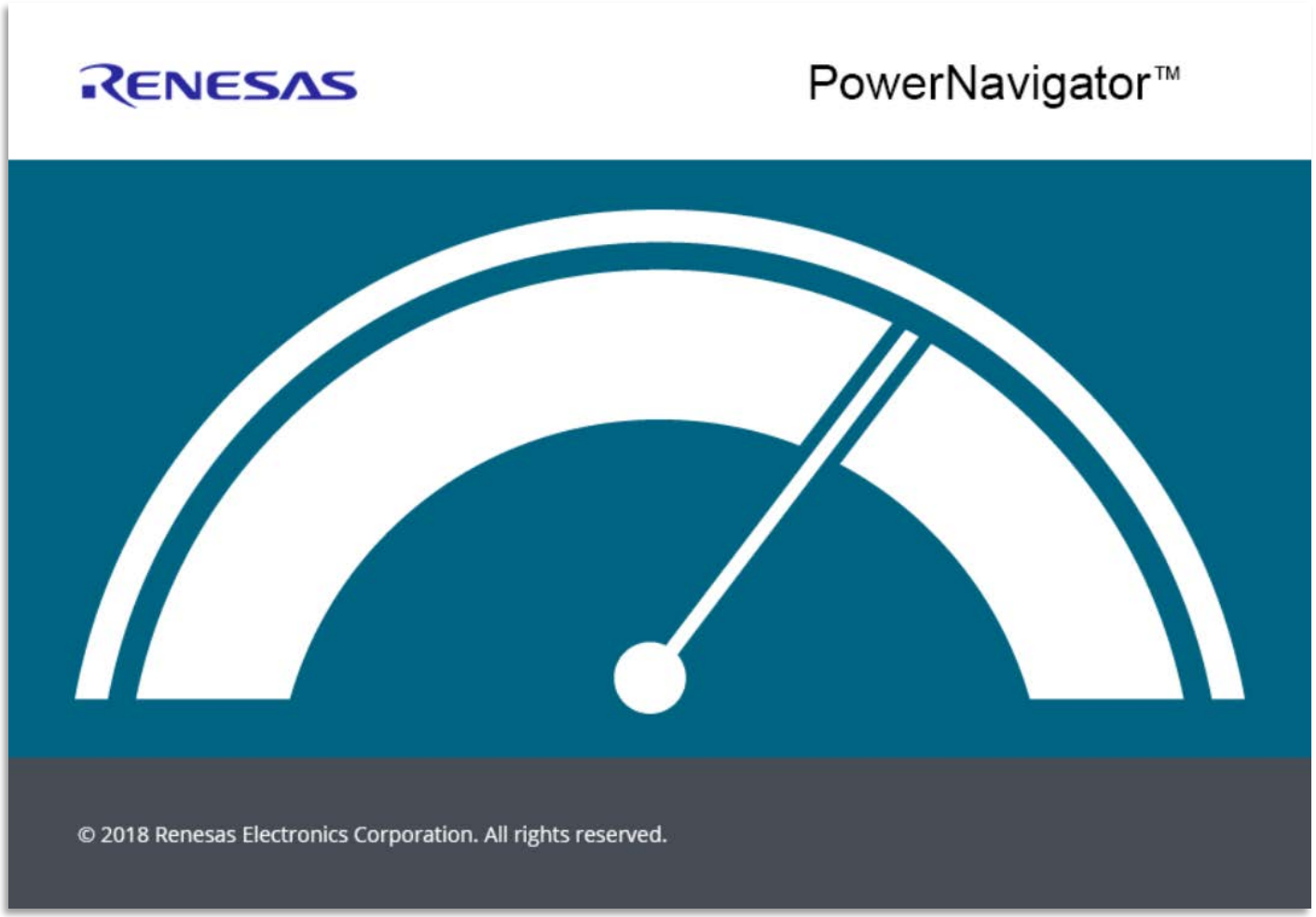
- Once enabled, logging feature will automatically log all selected telemetry parameters and the STATUS_WORD register for each device.
- All data is saved to a .csv file, which can be opened in Excel for later data analysis.
  - Once the .csv file size exceeds 50MB, a new file will automatically be created.
  - There is no limit on how long logging can run for.
- The log file name and path can be changed by the end user.

RailScope: Example Log File



	A	B	C	D	E	F	G	H	I	J	K	L
1												
2	Log started											
3												
4	23/04/2015 10:58:04.0225											
5	TimeStamp	VCCIO_STATUS	VCCIO_Vin	VCCIO_Vout	VCCIO_Iout	VCCIO_IntTemp	AUX_STATUS	AUX_Vin	AUX_Vout	AUX_Iout	AUX_IntTemp	CORE_STATUS
6	23/04/2015 10:58:04.0265	0x0000	11.921875	0.800292969	-0.048583984	32.1875	0x0000	11.890625	1.001953125	0.373046875	51.125	0x0000
7	23/04/2015 10:58:04.0467	0x0000	11.921875	0.799682617	-0.047790527	31.71875	0x0000	11.875	1.001953125	0.387695313	51.625	0x0000
8	23/04/2015 10:58:04.0667	0x0000	11.9375	0.799682617	-0.047363281	31.84375	0x0000	11.890625	1.003540039	0.320800781	51.625	0x0000
9	23/04/2015 10:58:04.0867	0x0000	11.953125	0.800292969	-0.047485352	32.125	0x0000	11.890625	1.003540039	0.334472656	51.125	0x0000
10	23/04/2015 10:58:05.0067	0x0000	11.9375	0.800048828	-0.04876709	31.90625	0x0000	11.890625	1.005249023	0.386230469	51.625	0x0000
11	23/04/2015 10:58:05.0268	0x0000	11.921875	0.800292969	-0.047485352	31.9375	0x0000	11.890625	1.003540039	0.357421875	51.625	0x0000
12	23/04/2015 10:58:05.0468	0x0000	11.921875	0.801513672	-0.049682617	32.0625	0x0000	11.890625	1.003540039	0.37890625	51.625	0x0000
13	23/04/2015 10:58:05.0669	0x0000	11.921875	0.800048828	-0.047790527	31.71875	0x0000	11.890625	1.005249023	0.374023438	51.125	0x0000
14	23/04/2015 10:58:05.0869	0x0000	11.9375	0.800048828	-0.047485352	31.71875	0x0000	11.890625	1.001953125	0.358886719	51.125	0x0000
15	23/04/2015 10:58:06.0069	0x0000	11.9375	0.799682617	-0.048400879	31.9375	0x0000	11.890625	1.003540039	0.329101563	51.625	0x0000
16	23/04/2015 10:58:06.0269	0x0000	11.96875	0.800048828	-0.04510498	31.625	0x0000	11.890625	1.003540039	0.37890625	51.125	0x0000
17	23/04/2015 10:58:06.0471	0x0000	11.953125	0.800048828	-0.046142578	31.9375	0x0000	11.890625	1.003540039	0.427246094	51.125	0x0000
18	23/04/2015 10:58:06.0671	0x0000	11.921875	0.80065918	-0.048156738	31.78125	0x0000	11.890625	1.003540039	0.387695313	51.625	0x0000
19	23/04/2015 10:58:06.0871	0x0000	11.9375	0.800048828	-0.047363281	31.84375	0x0000	11.890625	1.003540039	0.368164063	51.125	0x0000

HEX File Creation



Configuration File Overview

- Renesas Digital Power controllers use configuration files to program important device parameters.
  - Configuration files are basically a list of PMBus commands defining device operation. i.e. Vout_Command = 1.0V, Iout_Cal_Gain = 0.5mV/A, etc.
- Device configuration only needs to be done one time – programmed parameters are stored inside non-volatile memory for future use. NVM supports multiple writes and is re-programmable.
- Several Options are available for programming devices in a production environment.

Programming Devices in Manufacturing Environment

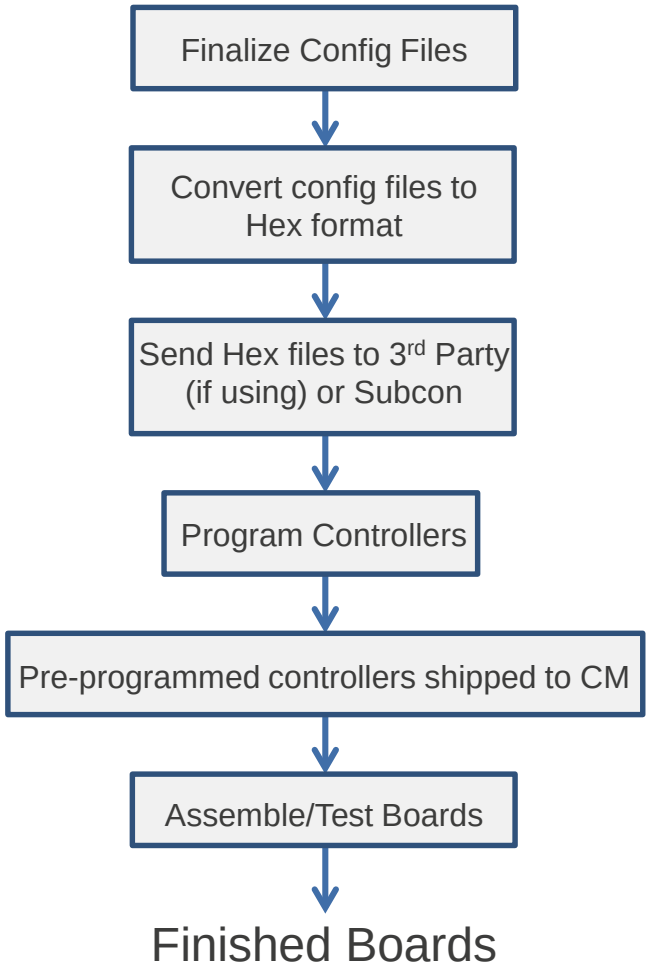
Option 1: Program controllers pre-board assembly

- Devices are programmed on a high speed production programmer before being assembled on a board.
- Can use a supported 3rd party programming house OR offline programmer at sub-contractor.

Option 2: Program controllers after board assembly

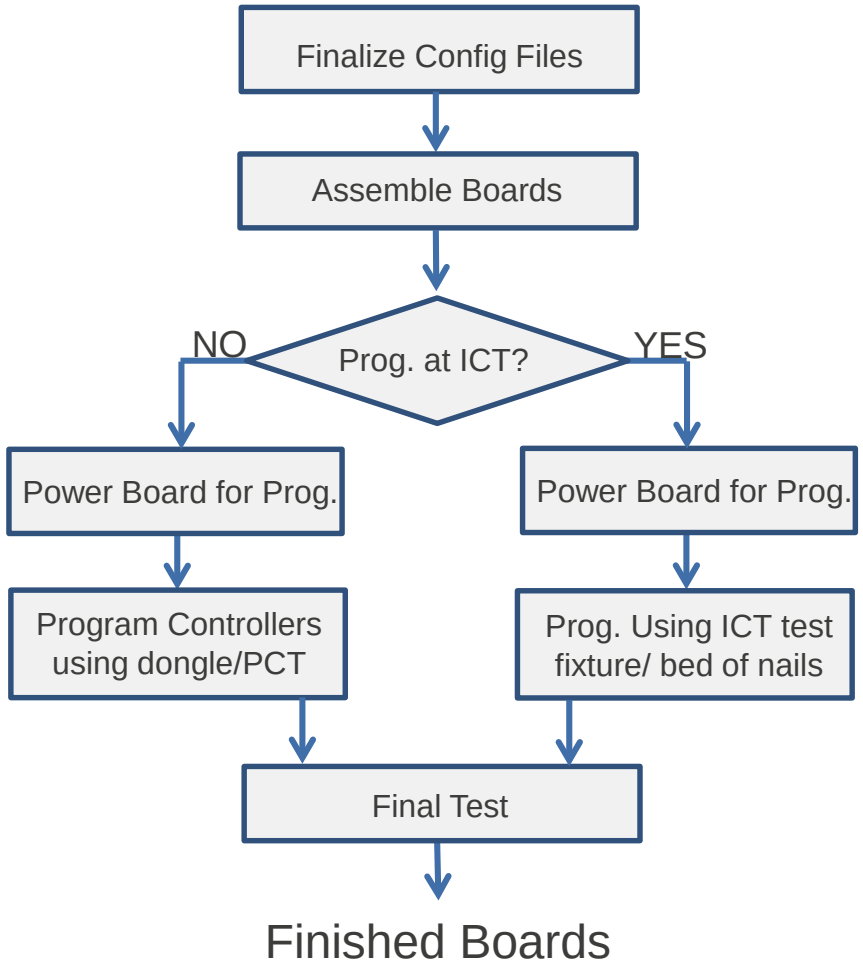
- Devices are programmed on PCB post board assembly
- Can be done at ICT (using a bed of nails approach or onboard microcontroller) OR using Renesas dongle and Production Configuration Tool (PCT).
- Requires board to be powered up with all controllers DISABLED until they are fully programmed.

Typical Flow – Pre-Programmed Devices



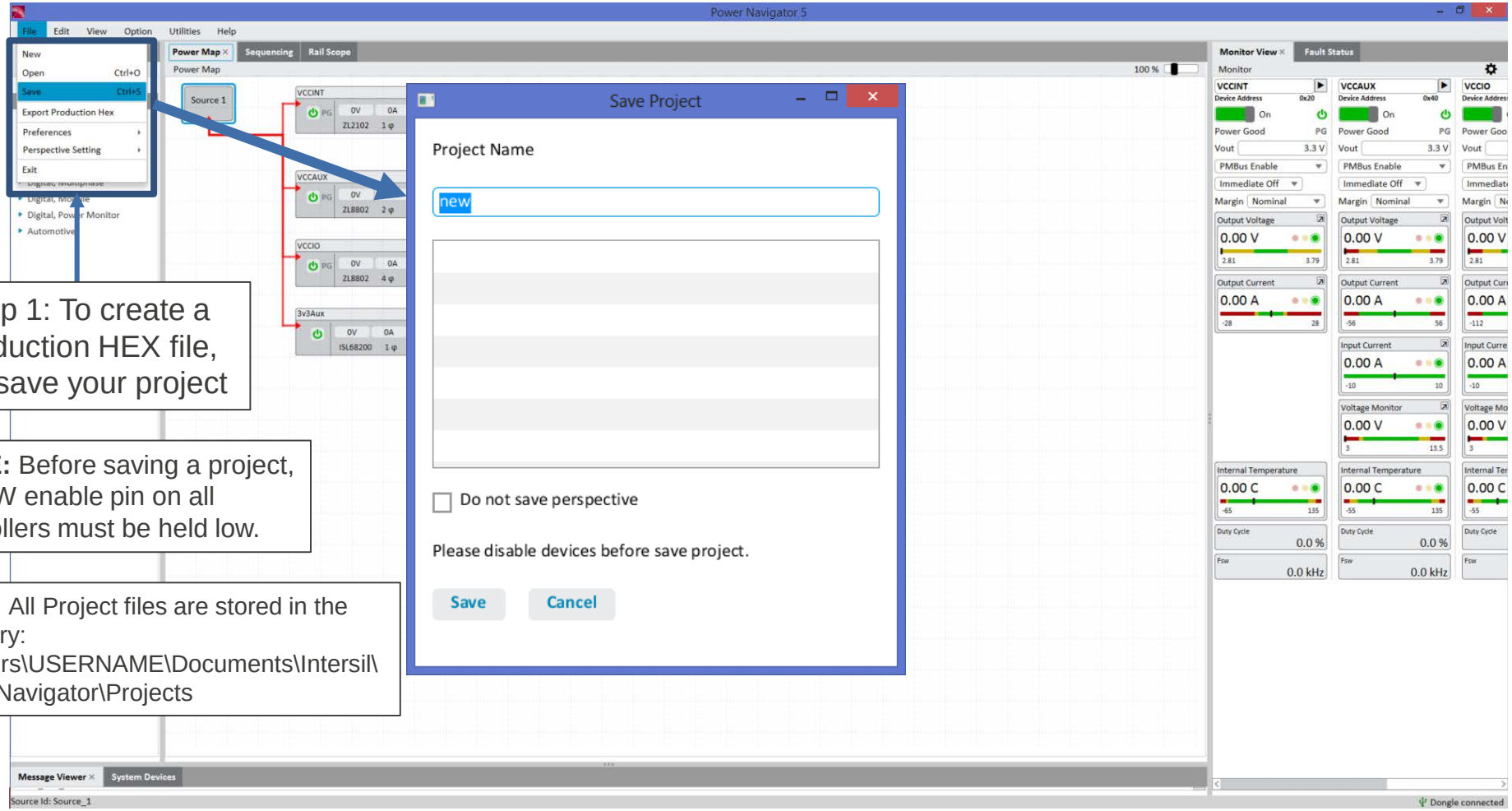
- Controllers are programmed prior to PCB manufacture.
- Hex files are created using PowerNavigator software (File->Export Production Hex).
- Programming is done either with a 3rd party or using offline programmer at subcon.
- Typical programming time: 4-7 seconds per device.
- Individual part numbers are assigned to each device after programming to make sure boards are assembled correctly.

Typical Flow – Programming Parts on Board



- Controllers are programmed after board assembly.
- Typical Programming time: 5-10s per device.
- Simplified inventory and configuration file management.
- Controllers must be powered to program, but output must remain disabled until part is fully programmed.
- Special attention to sequencing must be made when using self-enabled parts.

HEX File Creation – Step 1, Project Save

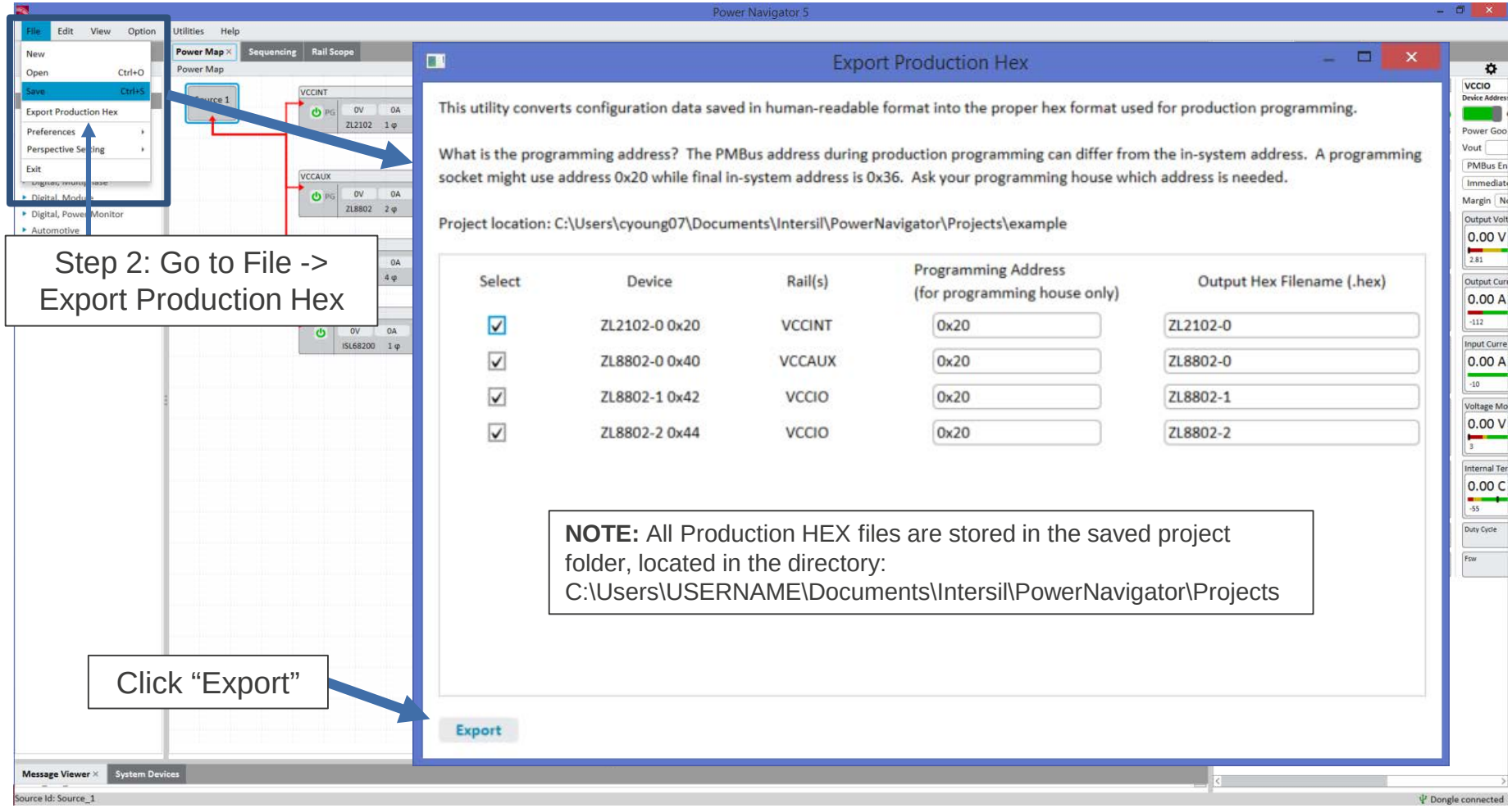


Step 1: To create a production HEX file, first save your project

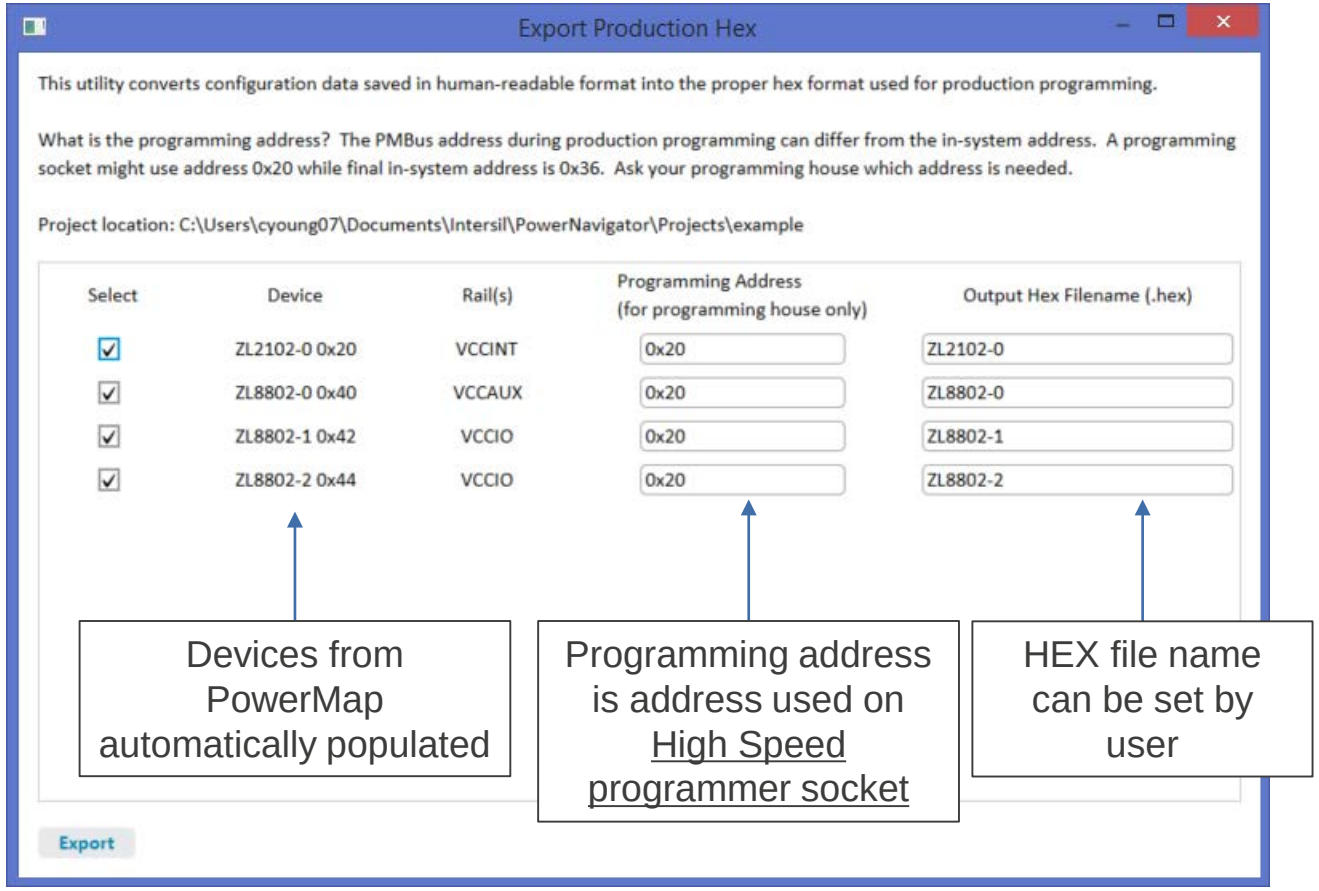
NOTE: Before saving a project, the HW enable pin on all controllers must be held low.

NOTE: All Project files are stored in the directory: C:\Users\USERNAME\Documents\Intersil\PowerNavigator\Projects

HEX File Creation – Step 2, Export HEX Files



Example HEX File Creation



Example Configuration File

```
# ZL8800-0 0x28
# connected: true
# DEVICE_ID                     ZL8800----01.04
# IC_DEVICE_ID                  0x49A02400
# IC_DEVICE_REV                 0x01040000

# 2014/01/16 17:55:45000
RESTORE_FACTORY
STORE_DEFAULT_ALL
STORE_USER_ALL

### Begin User Store
RESTORE_USER_ALL

# Global commands
FREQUENCY_SWITCH              0xfa50          # 296 kHz
VIN_OV_FAULT_LIMIT            0xd380          # 14 V
VIN_OV_FAULT_RESPONSE         0x80
VIN_OV_WARN_LIMIT             0xd360          # 13.5 V
VIN_UV_WARN_LIMIT             0xca5e          # 4.734 V
VIN_UV_FAULT_LIMIT            0xca4c          # 4.594 V
VIN_UV_FAULT_RESPONSE         0x80
IIN_CAL_GAIN                  0xba00          # 1 mV/A
USER_GLOBAL_CONFIG            0x80
VMON_OV_FAULT_RESPONSE        0x80
VMON_UV_FAULT_RESPONSE        0x80
PRIVATE_PASSWORD
PUBLIC_PASSWORD
```

Header information with device type, FW version, creation date, etc.

This sequence of commands is used to clear contents of NVM.

Programmed device parameters

Example HEX File

```
000340F499
000440F10087
0003401530
000440F10087
000340112C
000440F10087
00054046C0DB82
0005404B80D562
000540E720DBE2
000540E800D628
000440D80193
00054038E9C295
0005403924C4E8
000540D0C0AB01
000440DCAC8D
000D40D50940CC7BF0AEFC60997B74
000540D750A2C9
000340112C
000440F10087
0003401225
000440F10087
```

Configuration file translated into machine readable HEX format.

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