Application Report
SLVA908–July 2017

Improvements to UCD9090A and UCD90160A Devices

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ABSTRACT

The UCD9090 and UCD90160 devices are popular solutions in various applications to meet sequencing and monitoring requirements of user applications. This document details the frequently asked questions regarding the UCD9090A and UCD90160A devices to give users a jump start to migrate.

Contents

Trademarks

1 Introduction

TI's UCD9090A and UCD90160A power-supply sequencer and monitor with Advanced Configuration and Power Interface (ACPI) support can control up to 10 and 16 voltage rails (respectively), ensure correct power sequences during normal and fault conditions, and include a dedicated fault pin to easily cascade multiple devices. The A revisions of the devices are an upgrade to the UCD9090 and UCD90160 (listed as not recommended for new designs [NRND]). This application note details some frequently asked questions to give users a jump start.

2 Improvements From UCD9090 and UCD90160 Devices

Table 1 lists the improvements from the UCD9090 and UCD90160 devices to the UCD9090A and UCD90160A devices.

Table 1. Device Improvements

Features	Devices	
	UCD9090A	UCD9090
	UCD90160A	UCD90160
Fault pin (enables single to cascading multiple UCD9090A devices)	Yes	No
General Purpose Input (GPI) fault response	Yes	No
GPI debugging	Yes	No
Rail state	Yes	No
Fault and peak logging disable	Yes	No
Logic General Purpose Output (LGPO) sequence on and off dependency	Yes	No
Nonvolatile (NV) fault log	26 (UCD9090A) 18 (UCD90160A)	30 (UCD9090) 18 (UCD90160)
Rail sequence on and off timeout	140 m	32 s
Cold-boot mode	Yes	No

3 Fault Pin

The fault pin is a new feature that enables customers to cascade multiple TI UCD9090A and UCD90160A devices with fault-pin capability. The fault pin is a bidirectional signal connected to a fault bus. The fault bus is pulled up to 3.3 V by a 10-K resistor. When no fault exists on a particular UCD9090A or UCD90160A device, the fault pin is a digital input pin that monitors to the fault bus. When one or multiple UCD9090A or UCD90160A devices detect a rail fault, the corresponding fault pin turns to the active driven low state, pulling down the fault bus and informing all other UCD9090A or UCD90160A devices of the corresponding fault. Therefore, coordinated action can occur across multiple devices. After the fault is cleared, the state of the fault pin turns back to an input pin. Figure 1 shows a diagram using a fault pin.

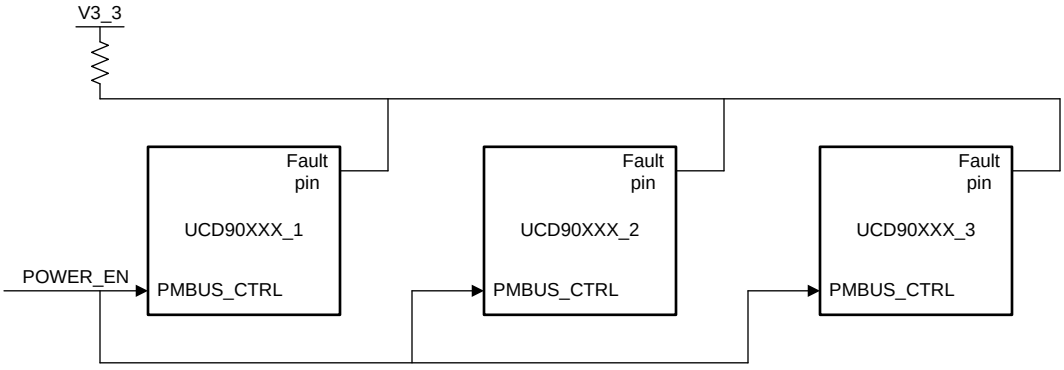

Figure 1. Example Using a Typical Fault Pin

4 GPI Fault Response

The GPI fault response feature solves the issue of limited Analog Monitor (AMON) pins. For example, in the UCD9090 and UCD90160 devices, when all monitor rails are assigned to a voltage monitor, the system does not have the capability to monitor one more external event (such as OVER_TEMP) or one more rail. With the GPI fault response feature in place, the external event or POWER_GOOD of the point-of-load (POL) could connect to the assigned GPI. When the signal changes to de-asserted, the UCD9090A and UCD90160A devices can help to shut down the rails, retry, and re-sequence the system based on how the GPI fault-response is configured.

5 GPI Debugging

Many customers have requested that they do not want the UCD9090 or UCD90160 to trigger the PMBus Alert, response fault, or continue system watchdog when performing board-level debugging or programming because these may cause some unexpected actions for the host. GPI debugging is implemented in UCD9090A and UCD90160A devices to address these triggers. One GPI pin can be assigned to perform a GPI debugging function. When asserting the assigned GPI, the device is under the GPI debug mode. The device does not activate the PMBus alert pin for any faults or warnings, and does not respond to any fault response. The device will not log any faults, suspend the system watchdog, and ignore the sequencing dependencies for rails.

6 LGPO Sequencing On and Off Dependency

The UCD9090 and UCD90160 devices only support sequencing dependencies over rail and GPI. If users want to have sequencing dependencies on the LGPO, they must physically wire the LGPO signal back to one of the GPIs. This approach uses two extra pins, which could be an issue for applications that have limited available pins. The LGPO sequencing dependency feature was introduced with the UCD9090A and UCD90160A devices to save the two extra pins for other functions.

7 Rail State

Table 2 lists the nine rail states of the devices.

Table 2. Rail State Descriptions

Rail State	Condition for Entering Rail State
INIT	Device out of reset.
IDLE	When: a TURN-ON condition is not met, the rail is shut down because of a fault, or the rail is waiting for the TURN-ON period to resequence.
SEQ_ON	Waits for the dependency to be met to assert the enable signal.
TON_DELAY	Wait TON_DELAY time expired to assert the enable signal.
RAMP_UP	Enable signal is asserted and rail is approaching the power good threshold. If the power good threshold is set to 0 V, the rail remains at this state even if the monitored voltage is greater than 0 V.
REGULATED	When the monitoring voltage is higher than the power good threshold when the enable signal is asserted, rails remain at this state even if the voltage is below the power good threshold, and continues as long as there is no fault action taken.
SEQ_OFF	Wait or the dependency to be met to de-assert the enable signal.
TOFF_DELAY	Wait TOFF_DELAY time expired to de-assert the enable signal.
RAMP_DOWN	The enable signal is de-asserted and rail is ramping down. this state is available only if TOFF_MAX_WARN_LIMIT is not set to unlimited, or if the turn-off sequence is triggered by a fault action. The rail must not be under fault retry sequence to show this RAMP_DOWN state. Otherwise, the IDLE state is present.

The state of the rail can help customers easily determine the status of the system so customers can more easily bring up or debug the power system. Figure 2 shows how the rail states are changed.

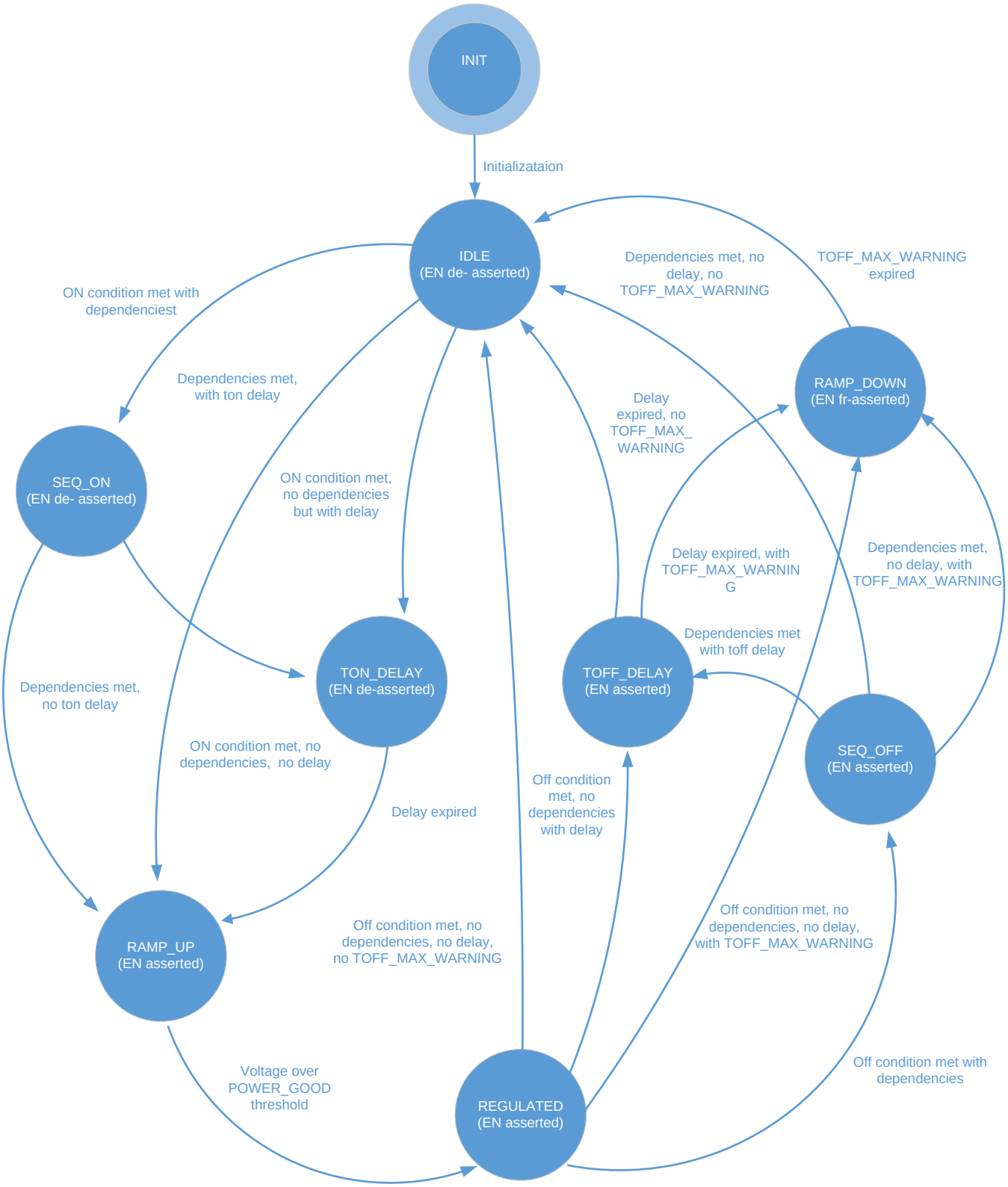

Figure 2. Diagram of Rail State Machine

8 Cold-Boot Mode

Cold boot is a feature specifically designed for cold-temperature applications like telecom. The feature has the intelligence to heat up a system by turning on the cold boot rails for specific amounts of time when the device is experiencing extremely cold temperatures. The UCD9090A and UCD90160A devices communicates with the system through a GPI called the thermal-state GPI (a digital output from a thermal sensing device). The cold boot feature is fully configurable, enabling customers to select enable or disable, the number of cold boot rails, and the timeout period. The following pseudo code is a processing call of how cold-boot is run by the device.

```
- If a system temperature is < threshold degree C (Thermal State GPI)
    ● Yes (DE_ASSERTED) :
        § Log GPI fault
        § Start Cold Boot Timeout
        § No System Watchdog output
        § Ramp up the power supplies based on ON_OFF_CONFIG
        § Wait for thermal state GPI ASSERTED OR "Cold Boot Mode Timout expired"
        § Disable the thermostat input listening mode
        § Force to shutdown down all cold boot rails with EN control immediately
        § Wait all cold boot rails with EN control below POWER_GOOD_OFF
        § Start and Wait "Normal boot Start Delay expired"
- Disable the thermostat input listening mode
- Treated Thermal State GPI as ASSERTED
- Ramp up power supplies based on ON_OFF_CONFIG
```

9 Continued Sales of UCD9090 and UCD90160 Devices

Having the new features detailed in Section 3, Section 4, Section 5, Section 6, Section 7, and Section 8 makes the UCD9090A and UCD90160A devices better candidates than the UCD9090 and UCD90160 devices for various applications, but note that Texas Instruments™ will continue supporting and building the UCD9090 and UCD90160 devices until they reach ten consecutive years of no sales.

10 Migrating From UCD9090 and UCD90160 Devices to UCD9090A and UCD90160 Devices

The UCD9090 and UCD90160, and UCD9090A and UCD90160A are pin-to-pin compatible devices, respectively. The UCD9090A and UCD90160A devices support all features of the UCD9090 and UCD90160 devices, respectively. Moving to the UCD9090A or UCD90160A devices does not require any schematic changes. Additionally, the project file (.xml) generated from the UCD9090 and UCD90160 devices can be seamlessly imported into the UCD9090A and UCD90160A devices with TI's Fusion Digital Power™ designer GUI to help reduce the migration effort.

Because of the new features, the script file (.csv) and data flash image file (.hex, .x0) are not compatible between the UCD9090 and UCD90160, and UCD9090A and UCD90160A devices, respectively. Those files generated from the UCD9090 and UCD90160 devices cannot be imported into the UCD9090A and UCD90160A devices because the devices will not function as expected.

To use script files or data flash image files on the UCD9090A or UCD90160A devices, follow these steps:

1. Install *FUSION_DIGITAL_POWER_DESIGNER* and open the latest Fusion Digital Power Designer GUI.
2. Import the old UCD9090 and UCD90160 project (.xml) into the UCD9090A and UCD90160A devices, respectively (see Figure 3).

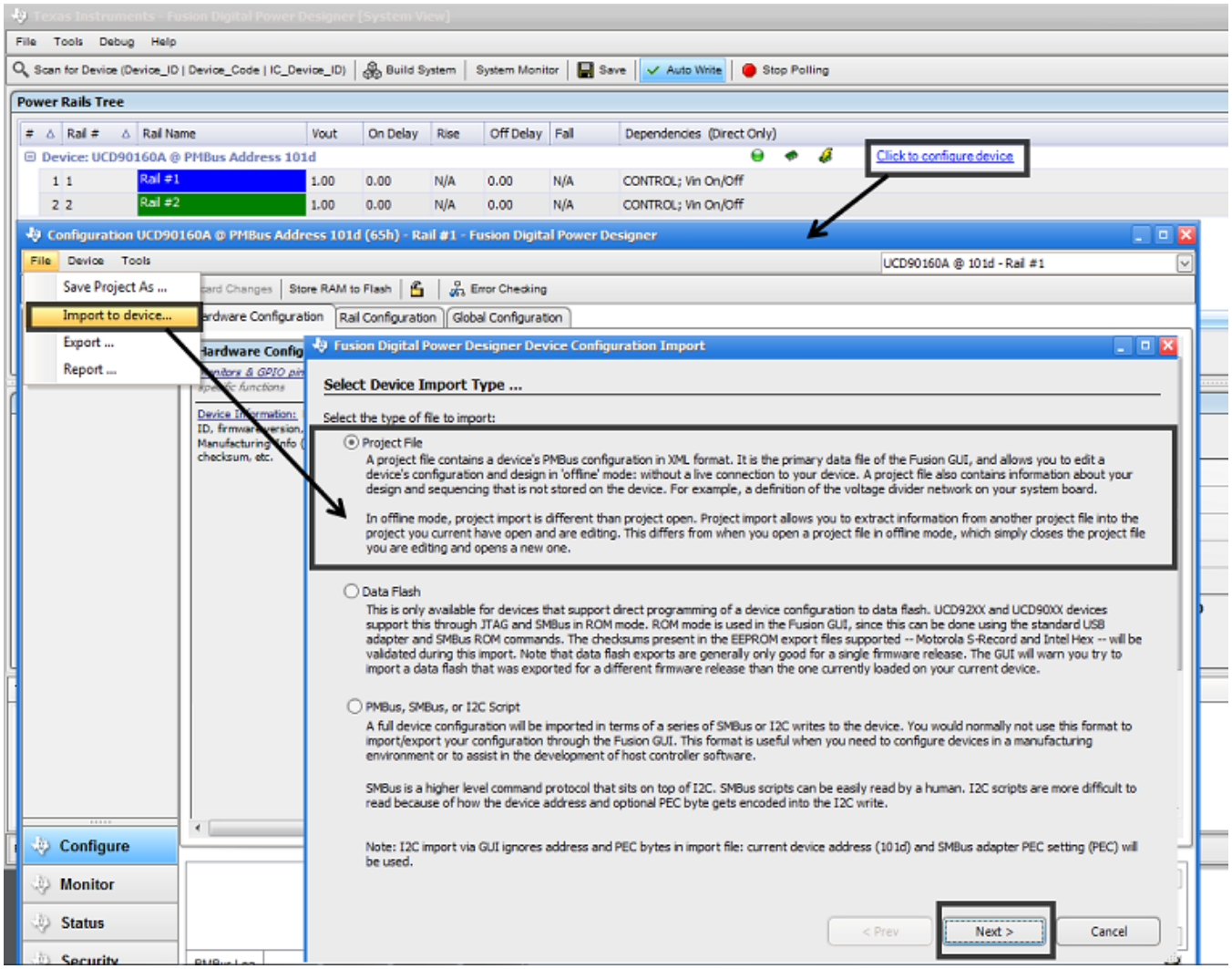

Figure 3. Importing the UCD9090 and UCD90160 Project File

3. Use the export function from the Fusion Digital Power designer GUI to regenerate the .csv and .hex file once the project has been successfully imported (see Figure 4).

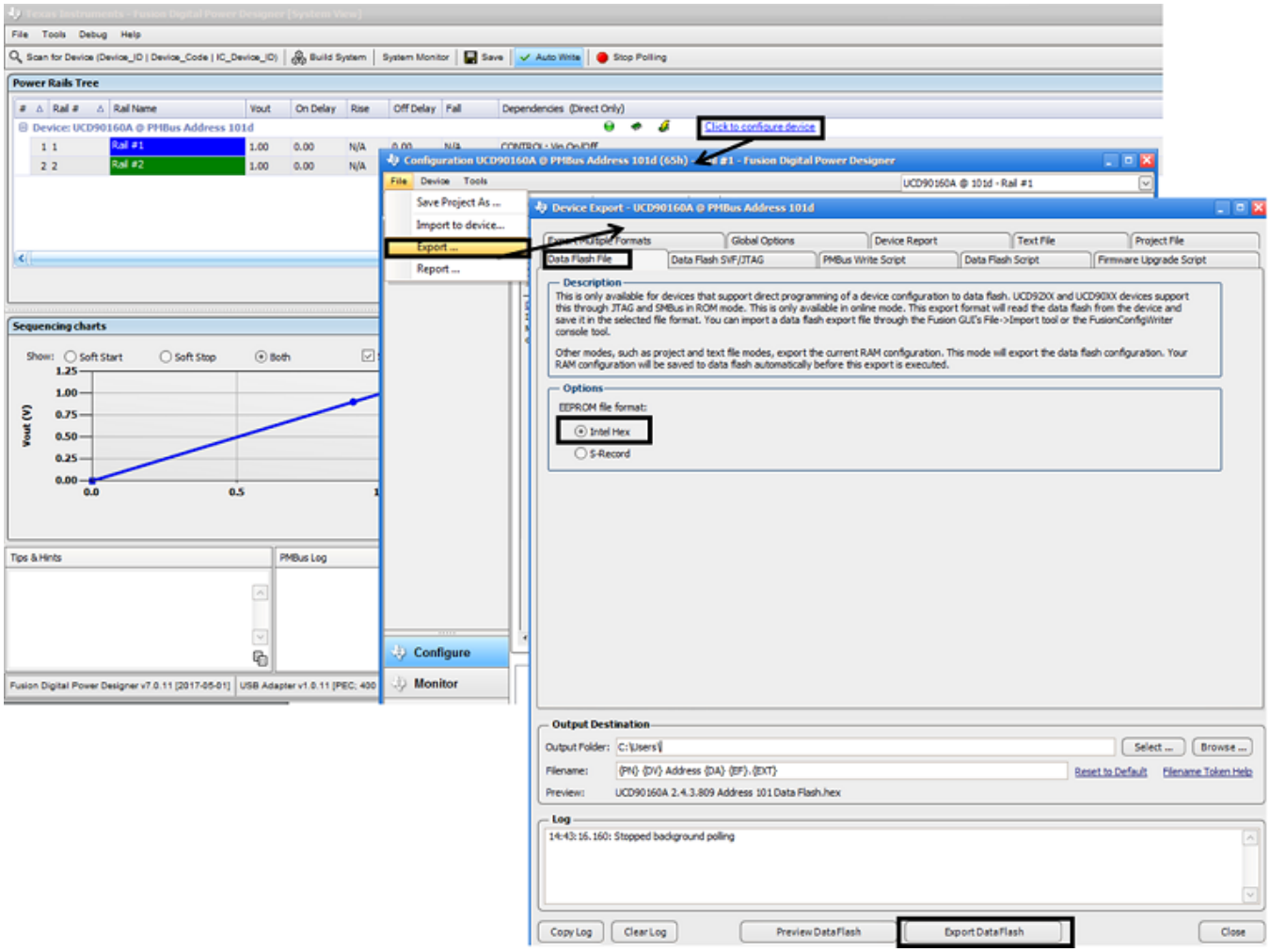

Figure 4. Export Settings of the Fusion Digital Power Designer GUI

4. Use the .csv and .hex files generated from step 3 for any programming utilities.

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Date	Revision	Description
July 2017	*	Initial Release.

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