

# 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.

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#### 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.

	Devices			
Features	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		

#### **Table 1. Device Improvements**

# 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.



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#### 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.

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.

#### Table 2. Rail State Descriptions

З



expired

Dependencies met,

no delay, with

TOFF\_MAX\_WARNING

RAMP\_DOWN (EN fr-asserted)

SEQ\_OFF (EN asserted)

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ON condition met with

dependenciest

SEQ\_ON

Dependencies met, no ton delay

Dependencies met,

with ton delay

ON condition met, no

dependencies, no delay

RAMP\_UP

ON condition met,

no dependencies but with delay

TON\_DELAY

**Delay expired** 

Off condition met, no

dependencies, no delay,

no TOFF\_MAX\_WARNING



delay, no

TOFF\_MAX\_WARNING

Delay expired, with

TOFF\_MAX\_WARNIN

Dependencies met with toff delay

Off condition met, no

dependencies, no delay,

with TOFF\_MAX\_WARNING

Delay expired, no TOFF\_MAX\_ WARNING

TOFF\_DELAY

Off condition met, no

dependencies with delay

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REGULATED (EN asserted)

Voltage over

POWER\_GOOD

threshold

Off condition met with

dependencies



#### 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
    - $\ensuremath{\mathtt{S}}$  Force to shutdown down all cold boot rails with EN control immediately
    - $\$  Wait all cold boot rails with EN control below <code>POWER\_GOOD\_OFF</code>
    - § 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<sup>™</sup> 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<sup>™</sup> 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.

Cold-Boot Mode

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

- 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).

🏘 Texas Instruments - Fusion Digital Power Designer [System View]								
File Tools Debug Help								
Q Scan for Device (Device_ID   Device_ID   Device_ID   Device	vice_Code   IC_Device_ID)	🛞 Build System	System Monitor	Save 🗸 Auto Write	🥚 Stop Polling			
Power Rails Tree								
# 🛆 Rail # 🛆 Rail Name	Vout	On Delay Rise	Off Delay Fall	Dependencies (Dire	ct Only)		-	
Device: UCD90160A @ PM	Bus Address 101d				Θ 🛷 🎜	Click to configure device		
1 1 Ral #1	1.00	0.00 N/A	0.00 N/A	CONTROL; Vin On/O	ff	7	-	
2 2 Ral #2	1.00	0.00 N/A	0.00 N/A	CONTROL; Vin On/O	"			
Configuration UCD90160.	A @ PMBus Address 101	i (65h) - Rail #1 -	Fusion Digital Pow	ver Designer	¥			2 🔀
File Device Tools						UCD90160A @ 101d - R	ail #1	$\overline{}$
Save Project As	ard Changes Store RAM to	Flash 🔓 🖓	Error Checking					
Import to device	ardware Configuration Ra	Configuration Glo	bal Configuration					
Export	lardware Config 🖑 Fus	ion Digital Power I	esigner Device C	onfiguration Import				<b>X</b>
Report	enitors & GPIO pin	t Device Import	Тупе					
	peace functions Ociec	c bevice import	1100					
T T	D, firmwareversion, Select	the type of file to im	port:					
M c	tanufacturing info ( ( ( ) hecksum, etc.	Project File A project file conta	ins a device's PMBus	configuration in XML format.	It is the primary data	a file of the Fusion GUI, and alk	ows you to edit a	
	X	device's configurat	on and design in 'off	ine' mode: without a live con	nection to your devic	e. A project file also contains in	nformation about your	
		design and sequen	ang that is not store	u on the device. For example	e, a definition of the v	ronage unider network on you	system board.	
		In offline mode, pro project you current	explore the second s	nt than project open. Projec editing. This differs from wh	t import allows you to en you open a project	extract information from anot t file in offline mode, which sime	her project file into the oly closes the project file	
	you are editing and opens a new one.							
		Data Slash						
		Data Flash This is only available for devices that support direct programming of a device configuration to data flash. UCD92XX and UCD90XX devices						
	support this through JTAG and SMBus in ROM mode. ROM mode is used in the Fusion GUI, since this can be done using the standard US8							
		validated during th	s import. Note that d	lata flash exports are gener	ally only good for a si	ngle firmware release. The GUI	will warn you try to	
1		import a data flash	that was exported for	or a different firmware relea	se than the one curre	intly loaded on your current de	wice.	
H	0	) PMBus, SMBus, or 1	2C Script					
	A full device configuration will be imported in terms of a series of SMBus or 12C writes to the device. You would normally not use this format to							
		environment or to a	issist in the develop	ment of host controller softw	are.	need to configure devices in a	inder to rest con a reg	
		SMBus is a higher k	vel command protoc	ol that sits on top of I2C. SN	Bus scripts can be ea	silv read by a human. I2C scrip	ots are more difficult to	
		read because of ho	w the device addres	s and optional PEC byte gets	s encoded into the I20	C write.		
Configure		Notes 100 incention	. CITI	er and OEC but a in largest 6		(1014) and PMD and ante-	- DEC	
Connigure		be used.	a out ignores addres	ia and PEU bytes in import fil	e: current device add	ress (1010) and swous adapte	Fee setting (Fee) will	5-
Monitor								
③ Status								
						< Prév Next >	Cancel	
Security e	MBurles							<u> </u>

Figure 3. Importing the UCD9090 and UCD90160 Project File

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

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.

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Revision History

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# **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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