

# **UCD9080 Power Supply Sequencer and Monitor Evaluation Module**

This user's guide describes how to install and operate the UCD9080 Power Supply Sequencer evaluation module (EVM) and graphical user interface (GUI) application. The guide covers the UCD9080EVM board functionality and installation, the I<sup>2</sup>C adapter, plus how to install and use the application software.

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## **1 Hardware Overview**

The UCD9080 Power Supply Sequencer EVM is an evaluation module from Texas Instruments for the UCD9080 Power Supply Sequencer and Monitor. The UCD9080 is a highly configurable, 8-channel power supply sequencer (see [SLVS692](#) data sheet) with four additional general-purpose digital outputs.

The hardware can be configured and monitored through a Windows™ interface running on a PC. The GUI communicates with the hardware through the provided USB Interface Adapter, which acts as an I<sup>2</sup>C master for the board.

This UCD9080EVM has this functionality:

- Sequencing for up to eight power supplies on the board using digital enable signals
- Monitoring for up to eight voltage rails on the board using analog signals
- Power supply enables can be sent off board via a header for sequencing external power supplies (controlled using jumpers for each rail)
- External voltage rails can be connected to a header on the board for monitoring external power supplies (controlled using jumpers for each rail)
- Sequencing for up to four digital outputs for reset circuits, etc.
- Jumpers for configuring the I<sup>2</sup>C address of the UCD9080 (detected at start-up)
- Standard 100-kHz I<sup>2</sup>C communication via I<sup>2</sup>C connector to USB adapter for connection to

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Windows is a trademark of Microsoft Corporation.

Windows-based PC

- LEDs for board power and power supply enables for quick visible indication of power supply status
- Eight onboard LDOs and power supplies for sequencing and monitoring testing

The eight power supplies, provided on the UCD9080EVM, are a combination of low-dropout regulators (LDO), power converter ICs, and power converter modules, all from Texas Instruments.

Rails 1-6 have a TI TPS76901 LDO for generating voltages from 1.4 V to 2.4 V. Rail 7 has a TI PTH04070 switching power supply IC for generating a 2.6 V output. Rail 8 has a TI PTH05050 power module used for generating a 2.8 V output. This set of power supplies are provided for generating different output voltages on the board for testing of different sequencing and monitoring conditions.

Users can communicate with the board using the I<sup>2</sup>C protocol through the supplied USB Interface Adapter and GUI. The GUI helps users to change the sequencer configuration, plus monitor voltage and device status from a Windows PC.

## 1.1 Voltage Reference

Because the UCD9080 monitors analog signals (voltage), its ability to accurately convert the value of the rail voltages to digital values (for conversion to volts for the user) is a function of the quality of the voltage reference on the device.

The UCD9080 IC can run in one of two modes: internal reference or external reference (selectable via the GUI). When operating with the internally generated 2.5-V reference, the sampling accuracy is not as good as is possible with the external reference (see data sheet [SLVS692](#) for details). If measuring voltage accurately to 5 mV is not required, then the internal reference is sufficient.

If the application requires better voltage monitoring accuracy, then the external reference (derived from the UCD9080 VCC pin) should be used. This EVM uses a shunt regulator that produces a clean 3.3-V supply voltage to the UCD9080. This regulator is only required to supply the UCD9080 VCC pin if the voltage reference is set to internal.

The default behavior of the device (and EVM) is for an external voltage reference.

## 1.2 EVM Operation

The UCD9080EVM requires power from an AC wall adapter through J1 or from a laboratory power supply through J5. This provides 5 V to power the LEDs, power supplies, and the UCD9080 (using a 3.3-V board regulator). The UCD9080 begins operation as soon as power is applied to the EVM. The UCD9080EVM has several LEDs to indicate board power and active enables for each onboard power supply.

Connect the power source to the board and enable the power source. The red LED labeled D4 illuminates to indicate that the board has power. You should then observe D1 and D5–D11 illuminate, indicating the application is running.

Next, connect the USB interface adapter to the UCD9080EVM via the provided ribbon cable. Plug the USB cable into the adapter and the other end into your PC. Instructions about how to run the GUI appear in a later section in this document.

Before power up, remove the jumper JP29. This jumper disconnects the I<sup>2</sup>C addresses from being changed during start-up. (This is one of the signals that the UCD9080 uses to detect and learn its I<sup>2</sup>C addresses.)

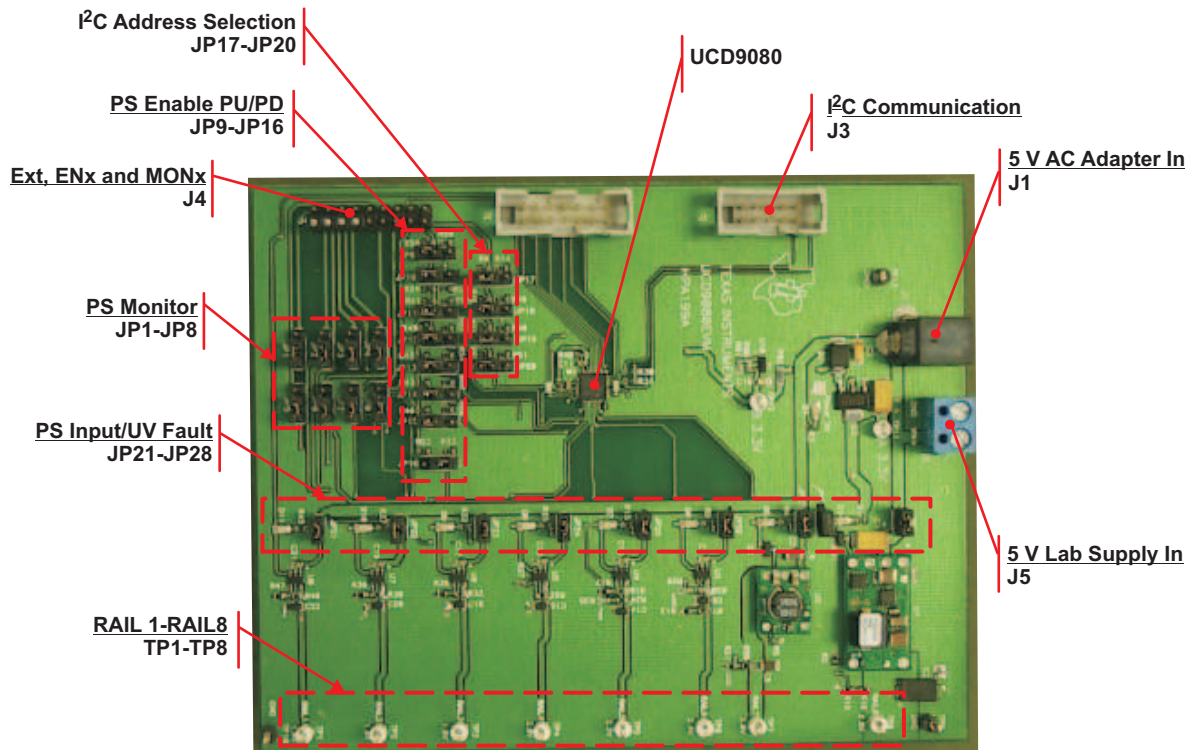


Figure 1. UCD9080EVM

### 1.3 Connectors

The UCD9080EVM has connectors for power and I<sup>2</sup>C communications. J1 is the connector for the external 5-V AC adapter. The J5 connector provides a laboratory power supply to power the EVM.

Connector J3 is for the I<sup>2</sup>C communication provided by the USB Interface Adapter included with this EVM kit. The USB Interface Adapter includes a ribbon cable that can be connected to J3. The adapter is connected to a Windows-based PC via USB protocol.

The J4 header allows users to be able to sequence and monitor their own external power supplies, rather than the eight supplies provided on this board. Each of the eight power supply rails supported by the UCD9080 has an enable and a monitoring pin. Connect the power supply that you want to monitor to the appropriate enable and monitoring pins on this header. Then, move the corresponding jumpers (described in the next section) so that the power supply rail is monitored using this header, instead of on the board.

#### CAUTION

Ensure that if you are configuring the UCD9080EVM to monitor an external power supply, the voltage is appropriately scaled down to between 0 V – 2.5 V (if using the internal reference) or between 0 V – 3.3 V (if using the external reference).

## 1.4 Jumpers

The UCD9080 EVM operation can be configured with different jumpers, that include these functions:

- Monitoring onboard or external power supply voltages
- Generating enable signals for driving onboard or external power supplies
- Setting of the I<sup>2</sup>C address for the system
- Creating undervoltage faults for the onboard power supplies

See [Table 1](#) for descriptions and default settings of all jumpers included on the UCD9080EVM.

**Table 1. UCD9080 Jumpers**

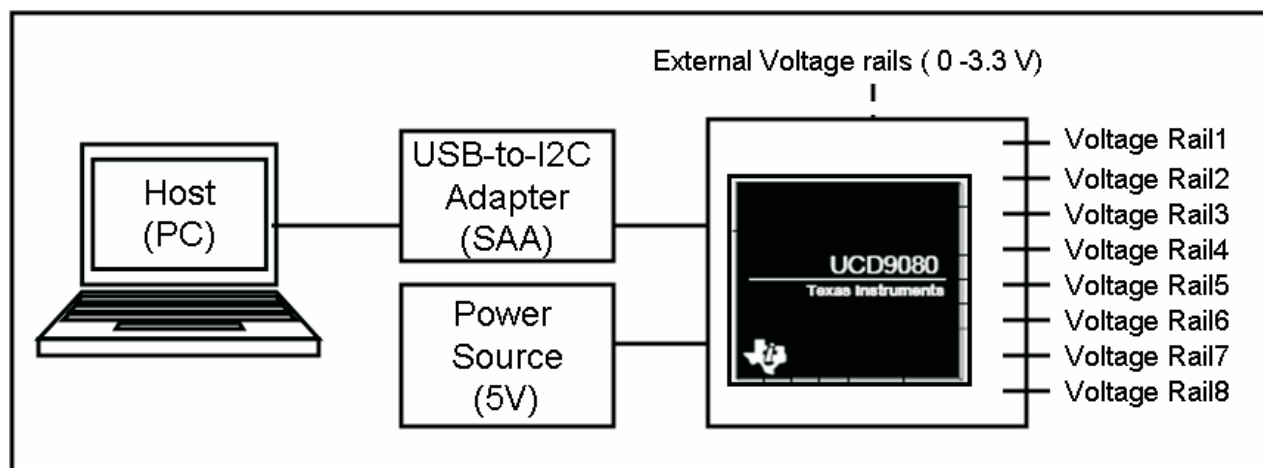
Number	Function	Default Setting
JP1–JP8	Power supply monitoring through onboard power supplies or externally connected. Connect to pins 1-2 for monitoring onboard supplies and pins 2-3 for external supplies via connector J4.	Pins 1-2 (onboard supplies)
JP9–JP16	Power supply enable signal configuration ( pullup or pulldown). Enable pins for each of the channels can be either pulled up to 3.3 V or down to ground to support power supplies that have either active-high or active-low enables. Connect to pins 1-2 for pulling up to 3.3 V and connect to pins 2-3 for pulling down to ground.	Pins 1-2 (pullup to 3.3 V for active-low supply enables).
JP17–JP20	I <sup>2</sup> C address detection. Four digital signals on the UCD9080 are sampled at start-up to determine its I <sup>2</sup> C address. These four jumpers control, if the signals are pulled up to 3.3 V or down to ground. Connect to pins 1-2 for 3.3 V and connect to pins 2-3 for ground.	Pins 2-3 (pulldown to ground for all zero).
JP21–JP28	Undervoltage fault. For each rail, you can generate an undervoltage fault by removing this jumper. Removal of these jumpers removes input from the power supplies, causing the output voltage being monitored by the UCD9080 to fall below the configured undervoltage threshold. If the UV threshold is zero, no undervoltage occurs.	Jumper on pins 1-2 for no undervoltage fault.
JP29	Enable8 shared with I <sup>2</sup> C address detection. Remove this jumper when communicating with the GUI.	Jumper on pins 1-2.

## 1.5 Test Points

The UCD9080EVM comes with a set of test points that can be used for evaluation. All eight power supply rails have test points on the right side of the board for monitoring the power supply voltages and the UCD9080EVM supply voltage (3.3 V).

## 2 System Overview

The system block diagram is shown in [Figure 2](#).



**Figure 2. System Block Diagram**

The system consists of these components:

- **Host (PC)**—a Windows PC – used to configure and monitor the UCD9080EVM. The GUI (explained in the GUI section) runs on the host. For the GUI to execute properly, the host needs to have the Windows .NET v2.0 Framework installed.
- **USB-to-I<sup>2</sup>C adapter**—UCD9080EVM uses the I<sup>2</sup>C interface for communication with the host. The TI-supplied USB-to-I<sup>2</sup>C adapter does the appropriate conversion so the host can use the USB interface for communication.
- **Power source**—UCD9080EVM needs 5-V power source to drive. This power is used by the UCD9080 (by regulating to 3.3 V), LEDs, as well as the onboard rails, if used.
- **External voltage rails**—when configured properly, UCD9080EVM can sequence and monitor external voltage source as well.
- **UCD9080EVM**—EVM board that houses the UCD9080 and peripheral circuits. The EVM can sequence and monitor onboard as well as external voltage rails, as previously explained.

### 3 GUI Overview

The UCD9080EVM comes with a Windows application that can be used to configure and monitor the EVM. The GUI can be used to configure all available options of the EVM such as sequencing and shutdown order, over/undervoltage timing, etc. It also can be used to monitor the operation of the sequencer by reporting current readings of voltage and error conditions on all the rails.

#### 3.1 Installing the GUI

Before running the GUI application, ensure that the target hardware is connected and that the Microsoft libraries are up-to-date.

1. Remove JP29 and ensure that the EVM is powered on by connecting the power source to the board and then enabling the power source.
2. Connect the ribbon cable from the USB Interface adapter to the EVM board connector.
3. Connect the PC USB cable to the USB Interface Adapter.

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**Note:** The UCD9080EVM application GUI is written using Microsoft .NET version 2 software and therefore requires the .NET Framework installed on the PC to run the application. No other drivers or libraries are required to run the application.

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4. To determine the .NET Framework software version you must use the *Windows Control Panel* and select *Add/Remove Programs*. The Control Panel lists all the installed PC software and you can determine if the proper Microsoft .NET Framework version is installed.

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**Note:** To update your .NET Framework to version 2.0, go this URL:

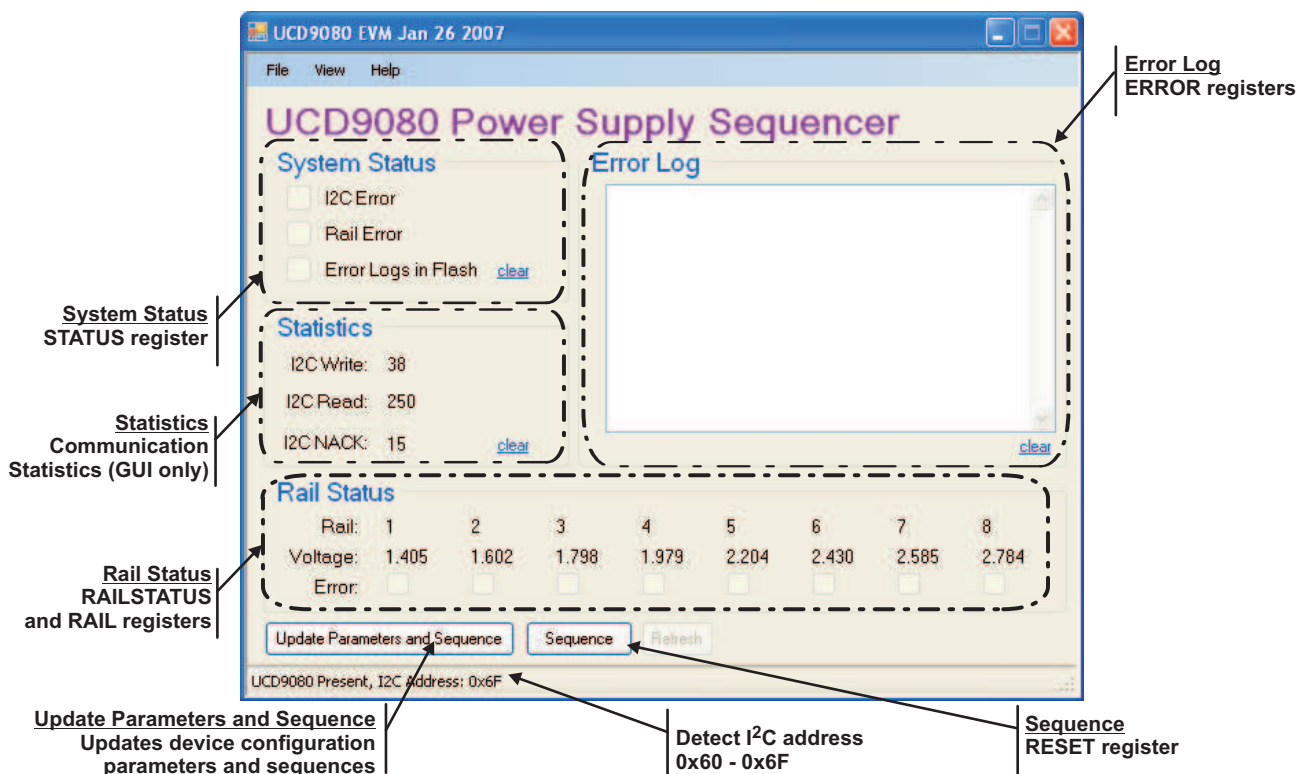
<http://www.microsoft.com/downloads/details.aspx?FamilyID=0856EACB-4362-4B0D-8EDD-AAB15C5E04F5&displaylang=en>

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5. To install the GUI, unzip the zip file that containing the GUI binary onto your PC. You must have at least version 2.0 of the Microsoft .NET Framework installed on your PC in order to run the GUI.
6. Once you have installed the .NET Framework and the UCD9080EVM GUI, you can launch the application.

### 3.2 UCD9080 GUI Main Window

The GUI main window helps you monitor the EVM sequencer status and configure the EVM sequencer through the **File** and **View** menus.



**Figure 3. GUI Main Window**

The UCD9080 EVM main window GUI has these areas:

- **System Status**—parameters including I2C Error, Rail Error, and Error Logs in Flash indication. Red box fill indicates an error.
- **Error Log**—contains error messages that inform the user about the operation of the sequencer.
- **Rail Status**—information including monitored voltage (scaled to user-entered divider ratios) and rail error status.
- **Statistics**—I2C communication statistics.
- **Update Parameters and Sequence button**—Updates buffer-stored GUI information to device user flash memory and initiates a device sequence. This process takes a couple seconds, and then the sequencer is able to be monitored again.
- **Sequence button**—causes the system sequence.
- **Menu bar**—selects File and View menu items

The **File** menu includes these commands:

- **Load Configuration**—loads a previously saved parameter (\*.par) file.
- **Save Configuration**—saves the current GUI configuration to a user parameter file.
- **Save I2C Transactions**—generates an ASCII text file containing configuration-specific I2C transactions (to be used by a master host to configure the UCD9080).
- **Auto-Refresh**—refresh the window contents periodically, if selected. If you want to refresh the window contents manually, click the Refresh button (not available when auto-refresh is enabled).
- **Discover**—discover the slave (EVM as jumper-configured) I2C address (displayed at the bottom of the form).
- **Exit**—stop the GUI application

The **View** menu includes these commands:

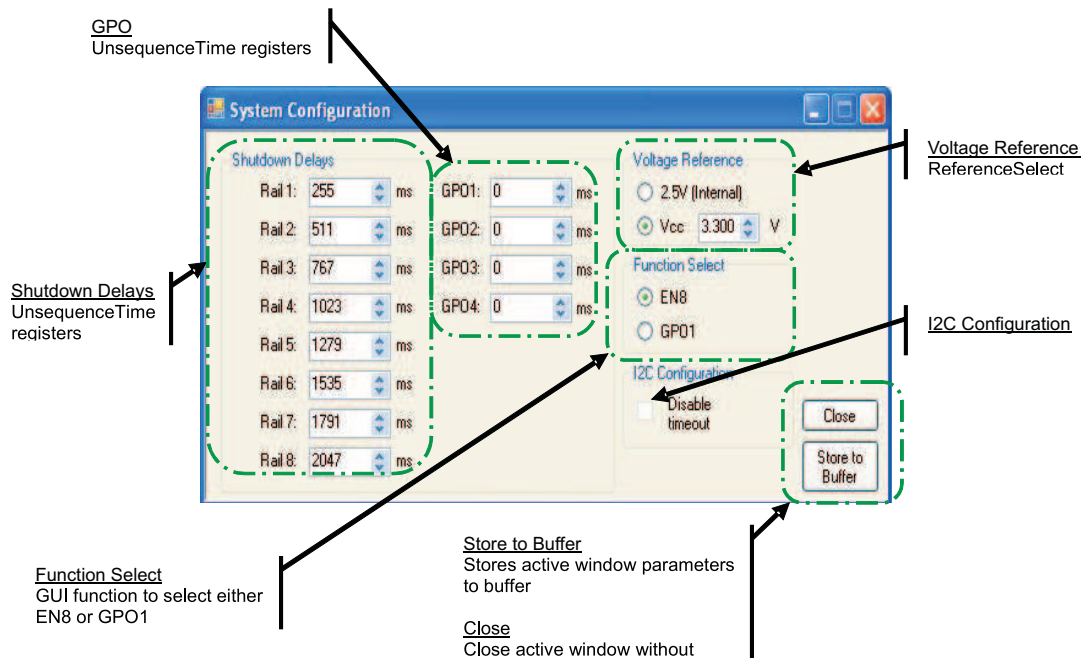
- **System Configuration**—provides system voltage reference and shutdown delay field entries.
- **Rail Configuration**—provides rail configuration field entries. All Rails simultaneously opens all rail forms for comparison setup.
- **GPO Configuration**—provides GPO configuration field entries. All general-purpose outputs (GPOs) simultaneously open all GPO windows for setup comparisons.
- **User Data**—provides specific user data to be uploaded to the device, such as customer specific identification.

### 3.2.1 I<sup>2</sup>C Addresses

Users can change the detected I<sup>2</sup>C address on the EVM by modifying the state of jumpers JP17–JP20. If the jumpers are changed during GUI operation, the user has to perform an I<sup>2</sup>C Discover command, as previously described.

### 3.3 GUI System Configuration Window

The System Configuration window on the GUI is shown in [Figure 4](#) and allows the following to be configured in the UCD9080:



**Figure 4. GUI System Configuration Window**

- **Shutdown Delays**—specify shutdown delays for rails and GPOs. If a rail or GPO is marked to shut down, then it shuts down according to the shutdown delays entered here. These shutdown delay fields correspond to the UnsequenceTime registers in the UCD9080 device data sheet ([SLVS692](#)).
- **Voltage Reference**—selects the device voltage reference. The UCD9080EVM is configured by default to use the external reference (VCC supply for the sequencer). When VCC is selected as the reference, the GUI provides for actual VCC calibration to be entered. For example, if the actual device VCC voltage is 3.1 V the GUI can use this to properly scale the displayed voltages.

**Note:** When the reference is changed and stored to the GUI buffer, the displayed rail voltages are incorrectly scaled, until the device parameters are updated.

- **Function Select**—helps you select the EN8 or GPO1 function. The function selected disables the other function from being configured.

- **Store to Buffer and Close Buttons**—The Store to Buffer button saves the current window entries to a GUI buffer and the Close button closes the window without saving the form entries.

### 3.4 GUI Rail Configuration Window

The Rail Configuration window on the GUI is shown in Figure 5 and permits you to configure these UCD9080 items:

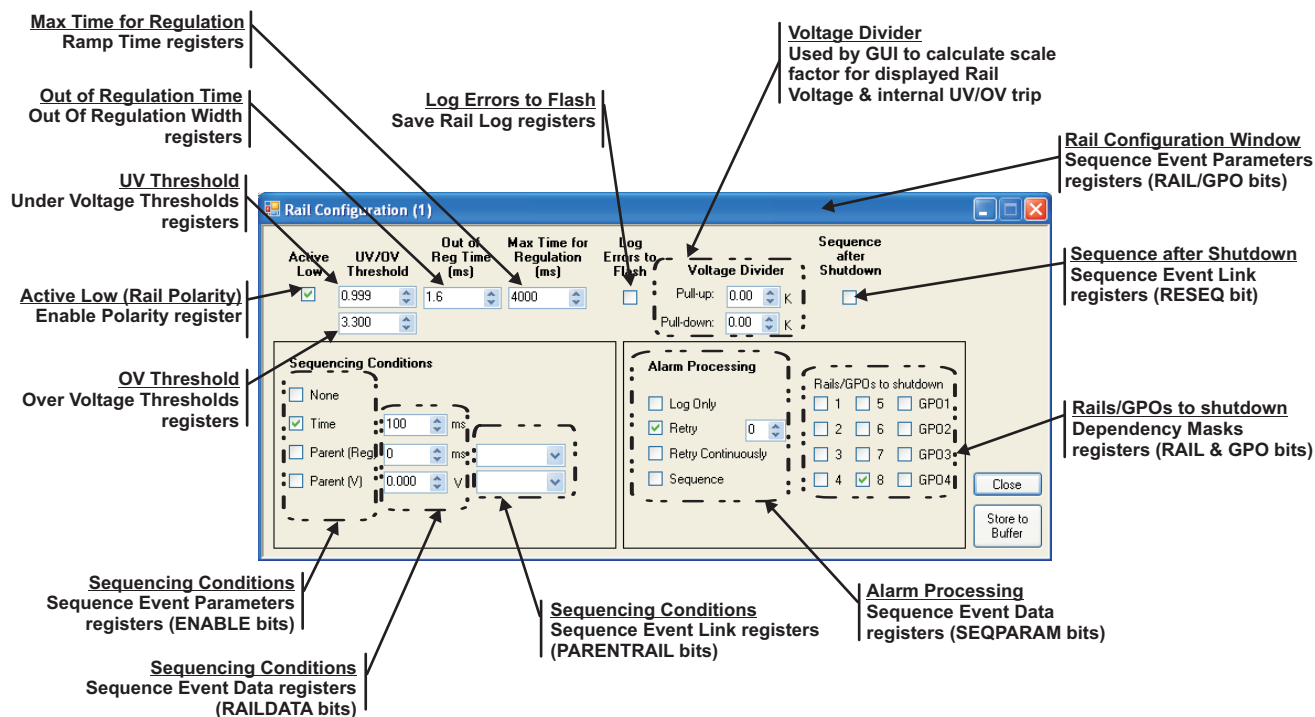


Figure 5. GUI Rail Configuration Window

#### 3.4.1 General Rail Windows Selections

- **Active Low (Polarity)**—specify enable pin polarity.
- **UV/OV Threshold**—specify undervoltage and overvoltage trip points. Note that UV values of zero essentially cause the device to ignore any undervoltage conditions and that OV values which are excessively high cause the device to ignore any undervoltage conditions.
- **Out of Reg Time (ms)**—specify the maximum amount of time (or glitch width) that the rail can be out of the UV/OV range before an alarm is declared.
- **Max Time for Regulation (ms)**—specify the maximum amount of time a rail is allowed to achieve regulation (rail voltage must be within the UV/OV range) before an alarm is declared.
- **Log Errors to Flash**—log rail errors to nonvolatile memory for later evaluation.
- **Voltage Divider**—specify the user rail voltage divider values. The GUI uses these values to properly scale and display the voltages received through the UCD9080 monitors. Note that zero value divider resistor values cause the divider ratio to be evaluated as unity (no scaling).
- **Sequence after Shutdown**—specify the UCD9080 ENx and GPOx output to be marked to re-sequence the system (as defined by the current sequencer configuration) if they are specified as a dependency in the DependencyMasks register.



### 3.4.2 Sequencing Conditions Selections

Voltage rail sequencing conditions are:

- **None**—rail is not sequenced.
- **Time**—number of milliseconds before this rail is enabled.
- **Parent (Reg)**—number of milliseconds to delay after the parent rail achieves regulation before enabling this rail.
- **Parent (V)**—voltage at which the parent rail should be before this rail is enabled

### 3.4.3 Alarm Actions

The alarm actions are:

- **Log Only**—ignore any failures on this rail, and keep it enabled.
- **Retry**—continue to retry a configurable number of times ( $n = 0, 1, 2, 3, 4$ ), then shut down according to the DependencyMasks and UnsequenceTime registers.
- **Retry Continuously**—when an error on the selected rail happens, a retry occurs. A retry is an attempt by the UCD9080 to restart the corresponding power supply by disabling the rail (with ENx pin) and then re-enabling the rail. This repeats until the power supply rail alarm clears.
- **Sequence**—when there is an error on this rail, resequence the system according to the current sequencer configuration.

## 3.5 GUI GPO Configuration Window

The GPO Configuration windows displays in Figure 6 and provides for these UCD9080 configuration settings:

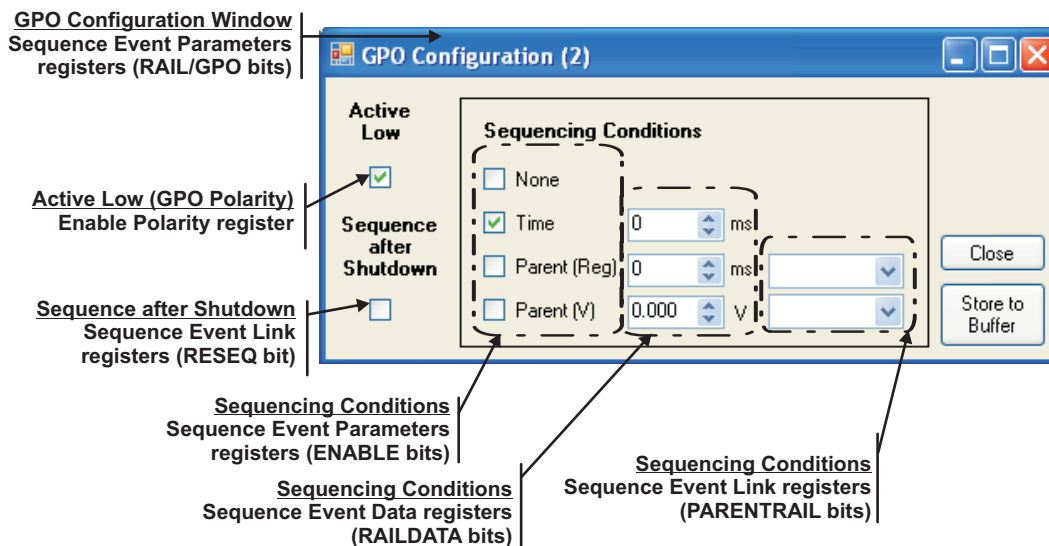


Figure 6. GUI GPO Configuration Window

### 3.5.1 General GPO Window Selections

- **Active Low (Polarity)**—specifies GPO pin polarity
- **Sequence after Shutdown**—UCD9080 ENx and GPOs output can be marked to re-sequence the system (as defined by the current sequencer configuration) if they are specified as a dependency in the DependencyMasks register.

### 3.5.2 Sequencing Conditions Selections

Sequencing conditions for a GPO

- **None**—GPO is not sequenced
- **Time**—number of milliseconds before this GPO is enabled
- **Parent (Reg)**—number of milliseconds to delay after the parent rail achieves regulation before enabling this GPO
- **Parent (V)**—voltage at which the parent rail should be before this GPO is enabled

## 4 EVM Design Configuration Information

### 4.1 Voltage Rail Set Points

The EVM rail output voltage Set points are configurable by changing the output voltage set-point resistors. RAIL1, RAIL2, RAIL3, and RAIL4 are monitored directly by the UCD9080 (no feedback divider resistors) and these rail output voltages should never be set above the reference voltage being used. RAIL5, RAIL6, RAIL7, and RAIL8 have the feedback divider resistors present and as such, these rail output voltages can be higher than the currently used voltage reference.

- RAIL1 through RAIL6: TPS76201 100-mA LDO

$$V_{\text{RAILx}} = V_{\text{REF}} \times \left( 1 + \frac{R_{\text{UP}}}{R_{\text{DN}}} \right); V_{\text{REF}} = 0.6663 \text{ typical for TPS76201}$$

$$\text{Set } R_{\text{DN}} = 66.5 \text{ k}\Omega(\text{max}); R_{\text{UP}} = \left( \frac{V_{\text{RAILx}}}{V_{\text{REF}}} - 1 \right) \times R_{\text{DN}} \quad (1)$$

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**Note:**  $R_{\text{DN}}$  has been set to 49.9  $\Omega$  on the EVM to more quickly discharge the rails during shutdown (see the rail bleed down considerations section).

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- RAIL7: PTH04070 3A Switching Regulator

$$\text{Set } R5 = 10 \text{ k}\Omega \times \frac{0.891}{V_{\text{RAIL7}} - 0.891} - 3.24 \text{ k}\Omega \quad (2)$$

- RAIL8: PTH05050 6A Switching Regulator

$$\text{Set } R2 = 10 \text{ k}\Omega \times \frac{0.8}{V_{\text{RAIL8}} - 0.8} - 2.49 \text{ k}\Omega \quad (3)$$

### 4.2 Rail Bleed-Down Considerations

When considering system shutdown (or unsequence time), loading on the power supply rails must be taken into account. The rail bleed-down times are a function of the loading and the total (load and power supply) output capacitance. As previously noted for RAIL1-RAIL6, the output voltage set-point resistors have been chosen to provide a much quicker bleed-down time than could be achieved with a light load. For RAIL7 and RAIL8, the feedback divider resistors have been sized to provide more loading for the same reasons. If the user chooses to provide external rail loading, the output voltage set-point resistor values can be adjusted. The EVM rail bleed-down times using the values shown in the BOM are on the order of <10 ms, whereas for no-load conditions the rail bleed-down times can approach several seconds.

### 4.3 Rail and GUI Divider Selection

Use these equations to choose the external Rail and GUI divider resistor values.

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**Note:** Setting  $R_{\text{pullup}}$  and  $R_{\text{pulldown}}$  to 0 in the GUI yields a  $D_G$  value of 1.

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- To accurately calculate the correct EVM divider ratio  $D_E$  the rail, divider resistor, and reference voltage tolerances must be taken into account so that the monitor input voltage does not exceed the device reference voltage.

- Use the following equations to calculate the minimum divider ratio,  $D_E$  :

$$\text{Required } D_E = \frac{\left(1 + \frac{\text{TOL}_R}{100}\right) \times V_{\text{RAILE}} \times \left(1 + \frac{\text{TOL}_{\text{RAILE}}}{100}\right)}{V_{\text{REF}} \times \left(1 + \frac{\text{TOL}_{\text{REF}}}{100}\right)}$$

$\text{TOL}_R$  = Divider resistor tolerance

$\text{TOL}_{\text{RAILE}}$  =  $V_{\text{RAILE}}$  tolerance

$\text{TOL}_{\text{REF}}$  =  $V_{\text{REF}}$  tolerance

$V_{\text{RAILE}}$  = Rail voltage being monitored via divider

$V_{\text{REF}}$  = Reference voltage

$R_{\text{PU}} = R_{\text{PD}} \times (D_E - 1)$ ; Choose  $R_{\text{PD}} \leq 10 \text{ k}\Omega$

- EVM Actual Voltages:
  - EVM divider,  $D_E = (R_{\text{HI}} + R_{\text{LO}}) / R_{\text{LO}} = 2$
  - RAIL1 through RAIL4: No dividers;  $V_{\text{MON}} = V_{\text{RAILE}}$ ;  $V_{\text{MON}} = \text{MONx pin voltage}$ ,  $V_{\text{RAILE}} = \text{EVM RAILx voltage}$
  - RAIL 5 through RAIL8: Divider,  $D_E = 2$ ;  $V_{\text{MON}} = V_{\text{RAIL}} / 2$
- GUI Calculated Voltages:
  - GUI divider,  $D_G = (R_{\text{PULLDOWN}} + R_{\text{PULLUP}}) / R_{\text{PULLDOWN}}$
  - Displayed rail voltages,  $V_{\text{RAILG}} = V_{\text{MON}} \times D_G = V_{\text{RAILE}} \times D_G / D_E$ ;  $V_{\text{RAILG}} = \text{GUI displayed voltage}$

### 4.4 ENx and GPOx Pin Default Voltage Levels

When the device is reset (see the Reset section), the ENx and GPOx outputs go to a high-impedance state (3-state). Pullup or pulldown resistors on these signals are recommended to cause the signals to go to the desired voltage level during reset. For example, if it is desired to keep a RAILx enabled during reset and the enable is active-low, then a pulldown resistor should be located on the corresponding ENx output. Note that on the EVM, the ENx and GPOx outputs have selectable pullup or pulldown jumpers installed. Also note that for the ENx outputs, the ENx status LEDs provide a stronger pullup current than the jumper pulldowns so that the power supplies become disabled during reset.

### 4.5 Reset

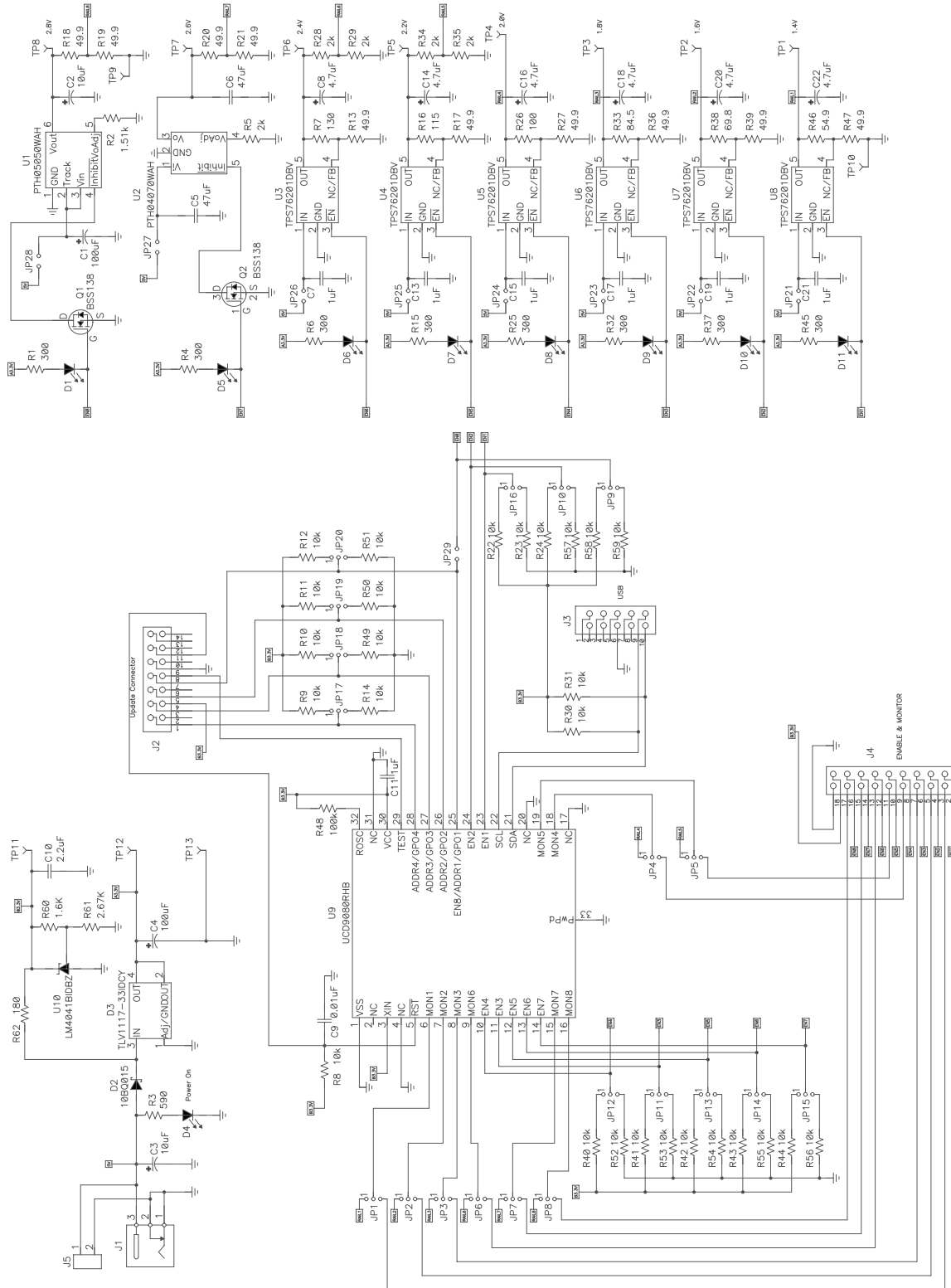
Device reset occurs when:

- Power is applied to the device (power on reset) or power is cycled.
- The external  $\overline{\text{RST}}$  pin is driven low.
- The GUI Update Parameters and Sequence button is pressed, causing new configuration data to be written to the device.
- The GUI Sequence button is pressed, causing the device to sequence.
- A Sequence occurs as a result of a configured rails alarm event.

Any of these reset conditions causes the device I<sup>2</sup>C address to be re-evaluated. Keep in mind that the EN8/GPO1 pin, as well as GPO2, GPO3, and GPO4 pins, provide the I<sup>2</sup>C address inputs that are sampled during device reset. If the pin pullup/pulldown configuration jumpers are changed while the GUI is operating and a device reset occurs, then the GUI communication may be affected (perform Discover to re-acquire the EVM I<sup>2</sup>C address).

## 5 EVM Schematic and Bill of Materials

### 5.1 EVM Schematic



## 5.2 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
2	C1, C4	100 $\mu$ F	Capacitor, Tantalum, 10V, 10%	6032	TAJC107K010R	AVX
1	C10	2.2 $\mu$ F	Capacitor, Ceramic, 6.3V, X7R, 20%	0805	STD	Murata
1	C11	1 $\mu$ F	Capacitor, Ceramic, 10V, X7R, 20%	0603	STD	Murata
1	C2	10 $\mu$ F	Capacitor, Tantalum, 16V, 10%	6032	TAJC106K016R	AVX
1	C3	10 $\mu$ F	Capacitor, Tantalum, 10V, 10%	3216	T491A106K010AT	KEMET
2	C5, C6	47 $\mu$ F	Capacitor, Ceramic, 6.3V, X5R, 20%	1206	C3216X5R0J476M	TDK
6	C7, C13, C15, C17, C19, C21	1 $\mu$ F	Capacitor, Ceramic, 10V, X7R, 20%	0603	STD	Murata
6	C8, C14, C16, C18, C20, C22	4.7 $\mu$ F	Capacitor, Tantalum, 6.3V, 20%	0805	TCP0J475M8R	Rohm
1	C9	0.01 $\mu$ F	Capacitor, Ceramic, 10V, X7R, 20%	0603	STD	Murata
9	D1, D4–D11		Diode, LED, Red, 100 mA	0805	SML-LXT0805SRW-TR	Lumex
1	D2		Diode, Schottky, 1A, 15V	SMB	10BQ015	IR
1	D3		IC, Adj., 3.3 V, 800mA LDO Voltage Regulators	SOT-223	TLV1117-33CDCY	TI
1	J1		Connector, Pin diameter 2,5 mm, DC Jack	0.57 $\times$ 0.35 inch	RAPC 712	Switchcraft
1	J2		Connector, Male Straight 2 $\times$ 7 pin, 100 mil spacing, 4 Wall	0.100 inch $\times$ 2X7	2514-6002UB	3M
1	J3		Connector, Male Straight 2 $\times$ 10 pin, 100 mil spacing, 4 Wall	0.338 $\times$ 0.788 inch	2510-6002UB	3M
1	J4		Header, 2 $\times$ 9 pin, 100 mil spacing (36 pin strip)	0.100 $\times$ 2 $\times$ 9 inch	PTC36DAAN	Sullins
1	J5		Terminal Block, 2-pin, 15-A, 5,1 mm	0.40 $\times$ 0.35 inch	ED1609	OST
20	JP1–JP20		Header, 3-pin, 100 mil spacing, (36-pin strip)	0.100 inch $\times$ 3	PTC36SAAN	Sullins
9	JP21–JP29		Header, 2-pin, 100 mil spacing, (36-pin strip)	0.100 inch $\times$ 2	PTC36SAAN	Sullins
2	Q1, Q2		MOSFET, Nch, 50V, 0.22A, 3.5 $\Omega$	SOT23	BSS138	Fairchild
8	R1, R4, R6, R15, R25, R32, R37, R45	300	Resistor, Chip, 1/16W, 5%	0603	Std	Std
10	R13, R17, R18–R21, R27, R36, R39, R47	49.9	Resistor, Chip, 1/10W, 1%	0603	Std	Std
1	R16	115	Resistor, Chip, 1/10W, 1%	0603	Std	Std
1	R2	1.50k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R26	100	Resistor, Chip, 1/10W, 1%	0603	Std	Std
1	R3	590	Resistor, Chip, 1/16W, 5%	0603	Std	Std
1	R33	84.5	Resistor, Chip, 1/10W, 1%	0603	Std	Std
1	R38	69.8	Resistor, Chip, 1/10W, 1%	0603	Std	Std
1	R46	54.9	Resistor, Chip, 1/10W, 1%	0603	Std	Std
1	R48	100k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
5	R5, R28, R29, R34, R35	2k	Resistor, Chip, 0.05W, 1%	0603	Std	Std
1	R60	1.6K	Resistor, Chip, 1/16W, 0.1%	0603	Std	Std
1	R61	2.67K	Resistor, Chip, 1/16W, 0.1%	0603	Std	Std
1	R62	180	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	R7	130	Resistor, Chip, 1/10W, 1%	0603	Std	Std
27	R8–R12, R14, R22–R24, R30, R31, R40–R44, R49–R59	10k	Resistor, Chip, 1/16W, 5%	0603	Std	Std
10	TP1–TP8, TP11, TP12	5012	Test Point, White, Thru Hole	0.125 x 0.125 inch	5012	Keystone
3	TP9, TP10, TP13	5011	Test Point, Black, Thru Hole	0.125 $\times$ 0.125 inch	5011	Keystone
1	U1		Module, Wide Output Adj, 6A, 0.8V to 3.6V, 5V Input	0.870 $\times$ 0.495	PTH05050WAH	TI
1	U10		IC, Micropower Shunt Voltage Reference 100 ppm/ $^{\circ}$ C, 45 $\mu$ A-12 mA, Adjustable	SOT23	LM4041BIDBZ	TI
1	U2		Module, 3A, 3.3/5V Input Adjustable Switching Regulator	0.400 $\times$ 0.495 inch	PTH04070WAH	TI
6	U3–U8		IC, Micro-Power 100 mA LDO Regulator	SOT23-5	TPS76201DBV	TI

*Related Documentation From Texas Instruments*

Count	RefDes	Value	Description	Size	Part Number	MFR
1	U9		IC, Power Supply Sequencer and Monitor	QFN-32	UCD9080RHB	TI
29	—		Shunt, 100-mil, Black	0.1	929950-00	3M
1	—		PCB, 5.3 In × 4.2 In × 0.062 Inch		HPA199	Any
4			Bumpons		2567	SPC

## 6 Related Documentation From Texas Instruments

- *USB Interface Adapter User's Guide* ([SLLU093](#))
- *UCD9080, 8-Channel Power Supply Sequencer and Monitor* data sheet ([SLVS692](#))
- *TPS76901, Ultralow-Power 100-mA Low-Dropout Linear Regulator* data sheet ([SLVS203](#))
- *PTH04070W, 3-A, 3.3/5-V Input Adjustable Switching Regulator* data sheet ([SLTS227](#))
- *PTH05050, 6-A, 5-V Input Non-Isolated Wide-Output Adjust Power Module* data sheet ([SLTS213](#))

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### EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 0 V to 5 V and the output voltage range of 0 V to 3.3 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

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During normal operation, some circuit components may have case temperatures greater than 50°C. The EVM is designed to operate properly with certain components above 50°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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