

## ***Evaluation Module for UCD90120 and UCD90124***

This User's Guide describes the evaluation modules (EVM) for the UCD90120 (UCD90120EVM) and UCD90124 (UCD90124EVM). The EVM contains evaluation and reference circuitry for the UCD90120 and UCD90124. UCD90120 and UCD90124 are advanced power system controllers containing sequencing, monitoring, fan control and many other power supply system support features.

### **Contents**

|   |                                                               |    |
|---|---------------------------------------------------------------|----|
| 1 | Description .....                                             | 2  |
|   | 1.1 Features .....                                            | 2  |
|   | 1.2 Applications .....                                        | 2  |
| 2 | Quick Start .....                                             | 3  |
|   | 2.1 Test Setup .....                                          | 3  |
|   | 2.2 EVM Layout View .....                                     | 4  |
|   | 2.3 EVM Block Diagram .....                                   | 5  |
| 3 | UCD90120/4 EVM GUI Setup .....                                | 6  |
|   | 3.1 UCD90120/4 EVM GUI Installation .....                     | 6  |
|   | 3.2 UCD90120/4 EVM GUI Operation .....                        | 7  |
| 4 | General Use Features .....                                    | 9  |
|   | 4.1 EVM Input/Output Connectors and Switches .....            | 9  |
|   | 4.2 EVM LEDs .....                                            | 10 |
|   | 4.3 EVM Test Points .....                                     | 11 |
|   | 4.4 EVM Test Jumpers .....                                    | 13 |
| 5 | Description .....                                             | 15 |
|   | 5.1 Communication Interfaces .....                            | 15 |
|   | 5.2 Power .....                                               | 15 |
|   | 5.3 Test/Debug and Status .....                               | 16 |
|   | 5.4 Digital I/O Terminations .....                            | 16 |
|   | 5.5 Analog Monitor Inputs .....                               | 16 |
|   | 5.6 Local Voltage Rails .....                                 | 17 |
|   | 5.7 External Temperature Sensor .....                         | 17 |
|   | 5.8 Input Current Monitoring .....                            | 21 |
|   | 5.9 Closed Loop Voltage Margining .....                       | 25 |
|   | 5.10 Fan Interface .....                                      | 30 |
| 6 | Bill of Materials .....                                       | 31 |
| 7 | Layout Guidelines, EVM Schematic, and Assembly Drawings ..... | 37 |
|   | 7.1 Layout Guidelines .....                                   | 37 |
|   | 7.2 EVM Schematic .....                                       | 37 |
|   | 7.3 Assembly Drawings .....                                   | 37 |

### **List of Figures**

|   |                                   |   |
|---|-----------------------------------|---|
| 1 | Typical Test Setup .....          | 3 |
| 2 | UCD90120/4 EVM View.....          | 4 |
| 3 | UCD90120/4 EVM Block Diagram..... | 5 |

### **List of Tables**

|   |                                                |   |
|---|------------------------------------------------|---|
| 1 | EVM Input/Output Connectors and Switches ..... | 9 |
|---|------------------------------------------------|---|

| <i>Description</i>                         | <i>www.ti.com</i>  |
|--------------------------------------------|--------------------|
| 2 EVM LED's .....                          | <a href="#">10</a> |
| 3 EVM Test Points.....                     | <a href="#">11</a> |
| 4 EVM Jumpers .....                        | <a href="#">13</a> |
| 5 Local Rail Nominal Output Voltages ..... | <a href="#">17</a> |
| 6 UCD90120/4EVM Bill of Materials .....    | <a href="#">31</a> |

## **1 Description**

The UCD90120 and UCD90124 EVM provides many sophisticated power supply system controller application capabilities. The EVM allows direct PMBus (power management bus) communication with the UCD90120 and UCD90124 via an onboard USB interface. This interface allows direct control and feedback with the UCD90120 and UCD90124 when using the TI-Fusion-Digital-Power-Designer-Graphical-User-Interface.

### **1.1 Features**

- General features
  - Single 12V supply input
  - 12 rail sequencing
  - 13 analog monitors
  - Single fan control interface
  - Status LEDs on all GPIOs
  - USB-PMBus interface for communication
- Orderable options
  - UCD90124EVM 12 channel sequencer and monitor with fan control
  - UCD90120EVM 12 channel sequencer and monitor

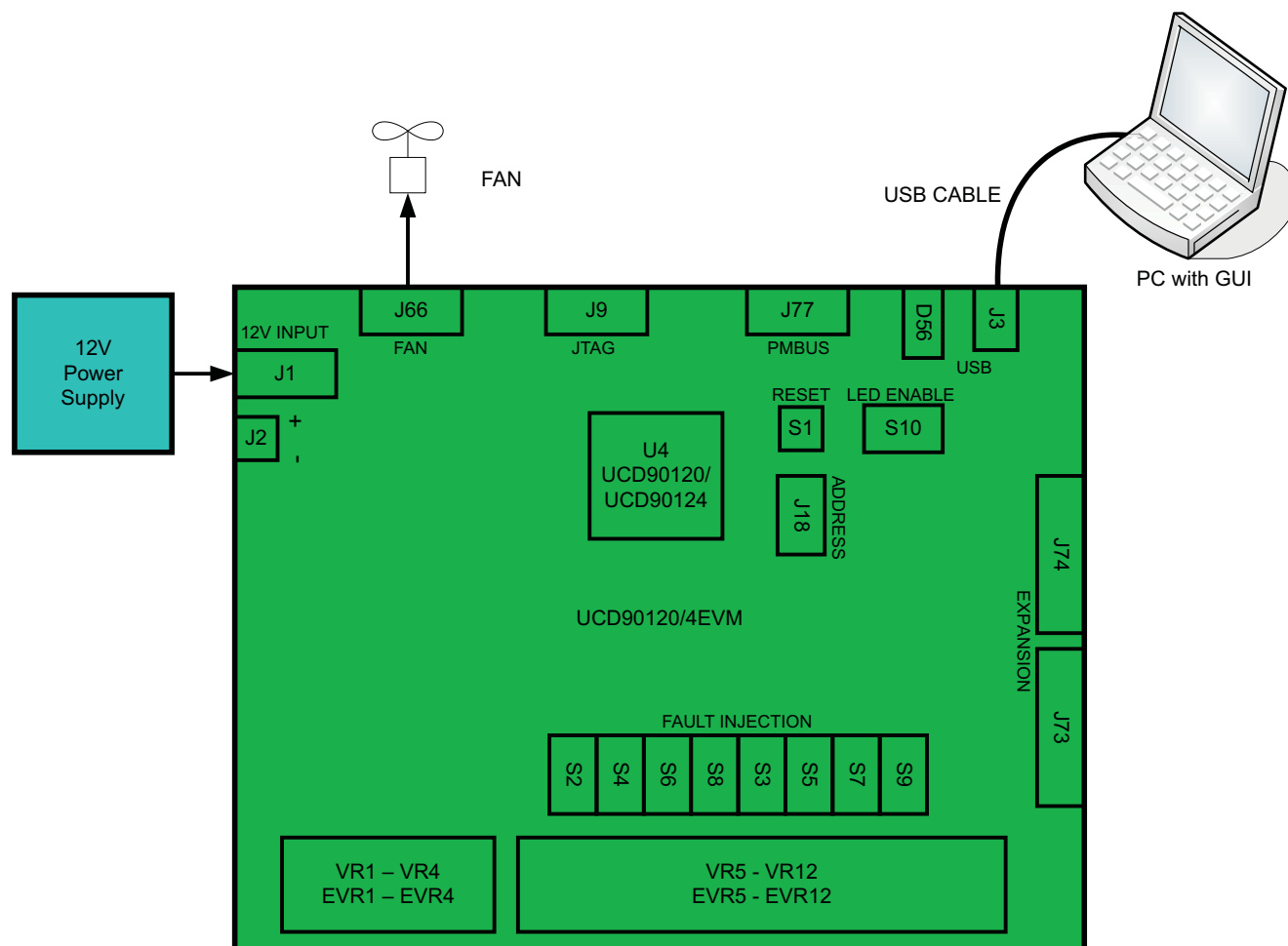
### **1.2 Applications**

- Industrial / ATE
- Telecommunications and Networking Equipment
- Servers and Storage Systems
- Any System Requiring Sequencing and Monitoring of Multiple Power Rails

## 2 Quick Start

### 2.1 Test Setup

**Figure 1** shows a typical test setup for UCD90120/4EVM. All that is required is a 12V (500mA for UCD90120EVM or 2000mA for UCD90124EVM running a fan) wall adapter/laptop power supply (see J1 BOM description for receptacle size) and a PC. The USB-EVM cable is provided with the EVM.



**Figure 1. Typical Test Setup**

## 2.2 EVM Layout View

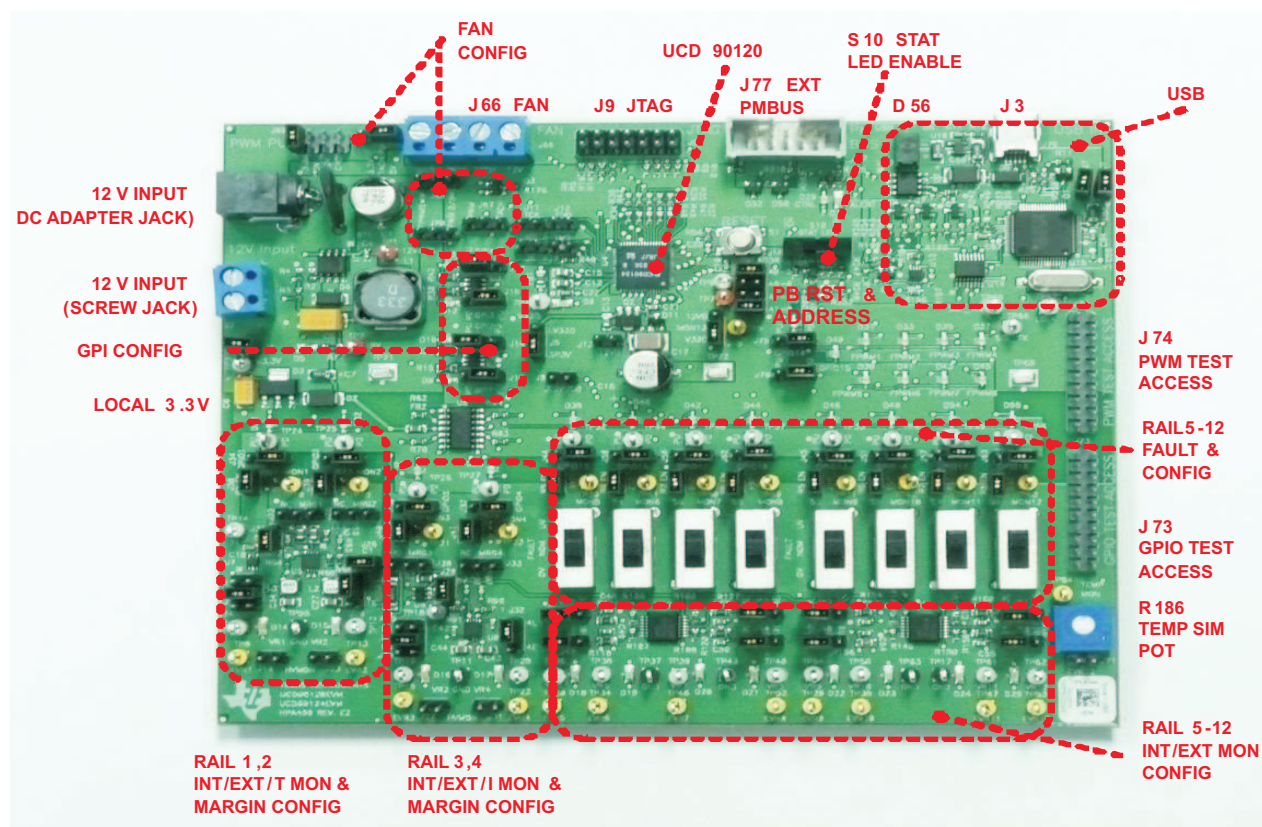


Figure 2. UCD90120/4 EVM View



### **3 UCD90120/4 EVM GUI Setup**

#### **3.1 UCD90120/4 EVM GUI Installation**

The UCD90120 and UCD90124 EVMs use the Texas Instruments Fusion Digital Power Designer graphical user interface (GUI) which may be downloaded from the following web site:

[http://focus.ti.com/docs/toolsw/folders/print/fusion\\_digital\\_power\\_designer.html](http://focus.ti.com/docs/toolsw/folders/print/fusion_digital_power_designer.html)

Place the TI-Fusion-Digital-Power-Designer-zip file in a known location on the PC. Unzip the TI-Fusion-Digital-Power-Designer-zip file.

Double click the unzipped TI-Fusion-Digital-Power-Designer-exe file. Proceed through the installation by accepting the installer prompts and the license agreement. Accept the GUI suggested default PC installation locations to complete the install.

Once the GUI completes the installation it will start. The first time the GUI is launched on a particular PC the user may be prompted to select a device. Choose UCD9xxx. Afterwards, the GUI may be closed.

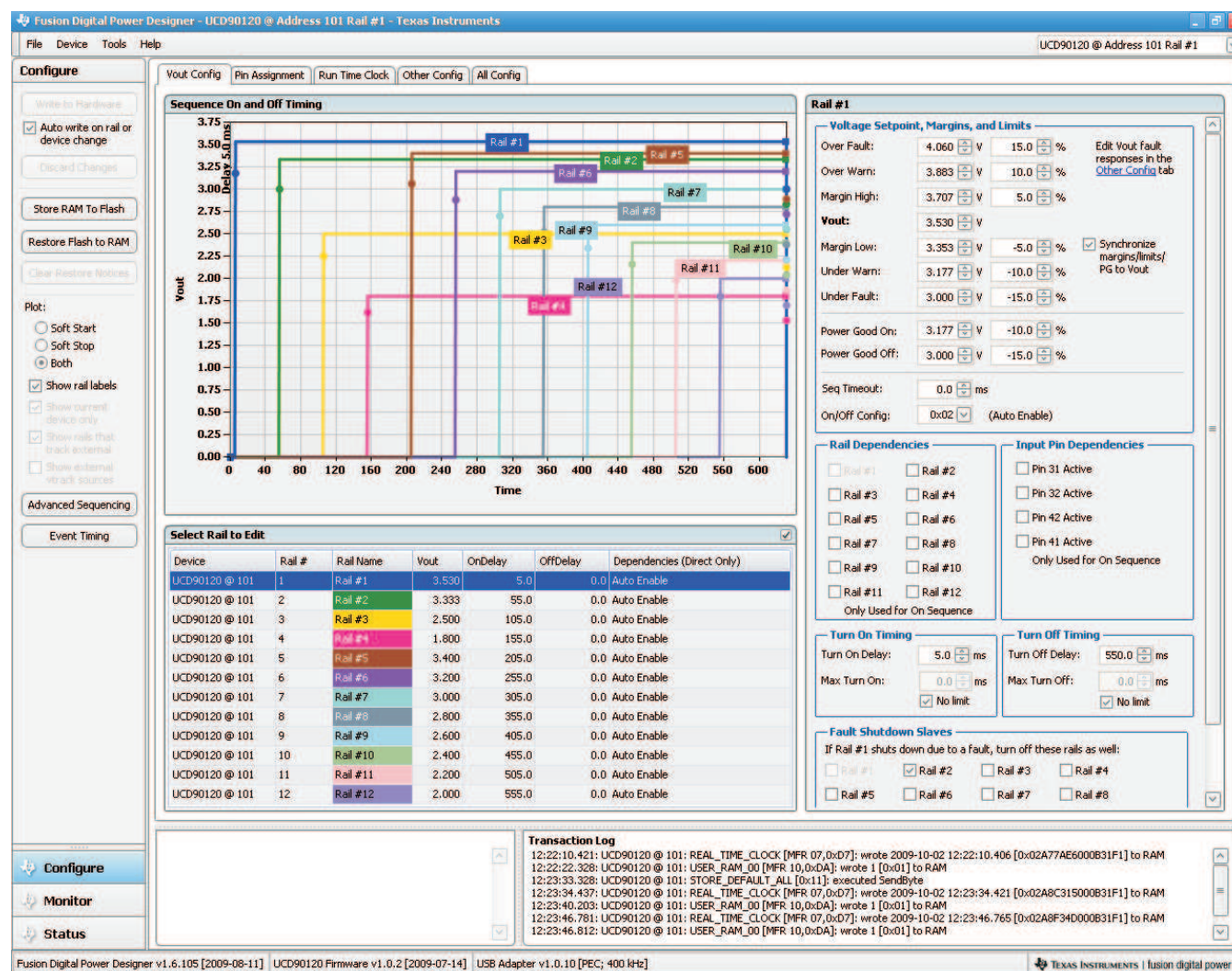
Note that the TI-Fusion-Digital-Power-Designer v1.6.105 was used for the examples to be shown later in the document.

## 3.2 UCD90120/4 EVM GUI Operation

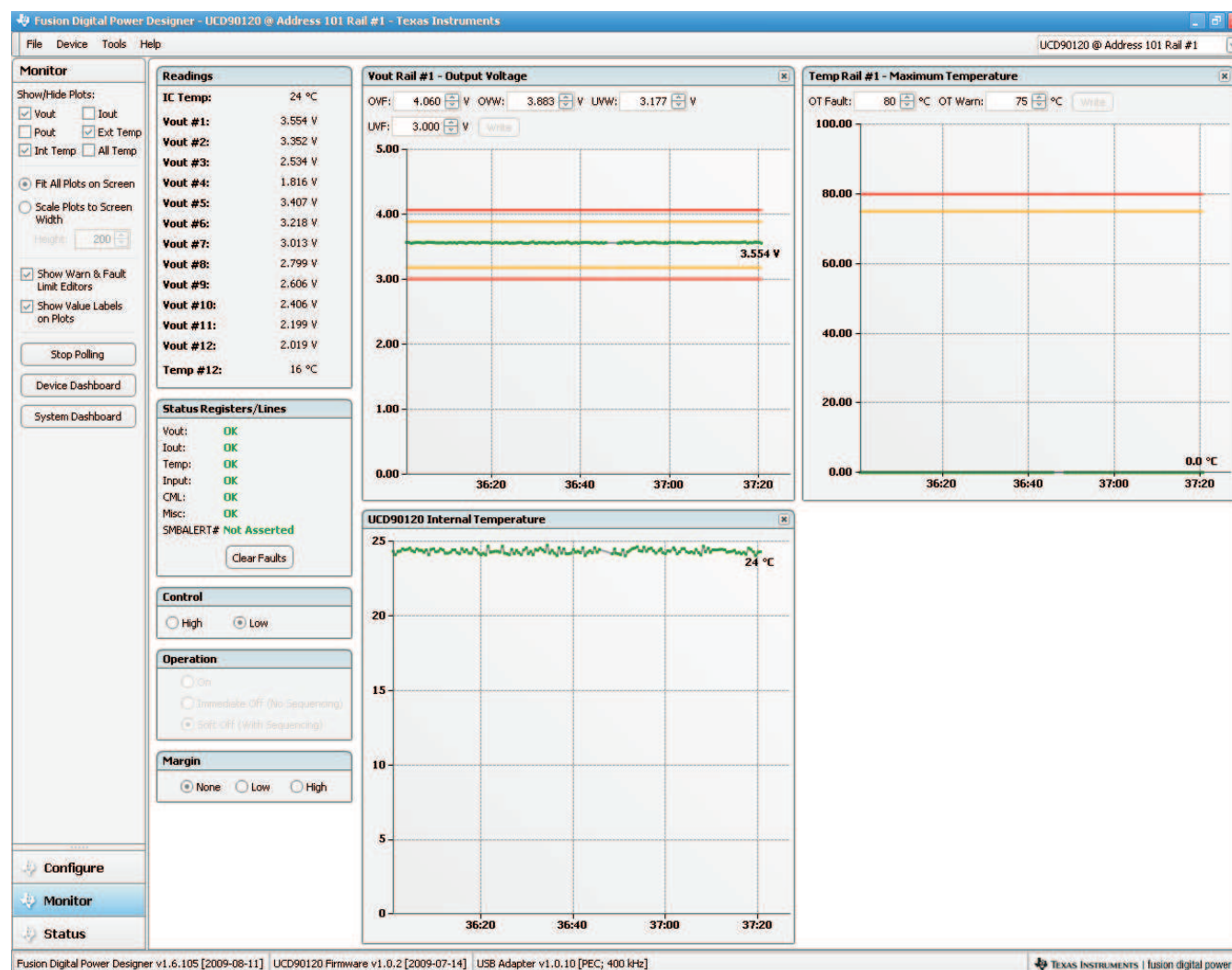
The EVM comes pre-loaded with a 12 rail default project that sequences the EVM rails on at power up. It is a good idea to export the default project to a file on the PC prior to making changes.

### 3.2.1 Launch TI-Fusion-Digital-Power-Designer

Navigate to the location where the Fusion GUI is installed and (Start, All Programs, Texas Instruments Fusion Digital Power Designer, Fusion Digital Power Designer) and start it. A window similar to the following will appear.



Most of the GUI control features are available from the Configure window. Monitor and Status information is available from the respective buttons on the GUI lower left. A typical Monitor window is shown below.



## 4 General Use Features

### 4.1 EVM Input/Output Connectors and Switches

**Table 1. EVM Input/Output Connectors and Switches**

| Connector/Switch | Label           | Description               |
|------------------|-----------------|---------------------------|
| J1               | 12V INPUT       | 12V DC jack               |
| J2               | 12V INPUT       | 12V screw jack            |
| J9               | JTAG            | JTAG Connector            |
| J66              | FAN             | Fan interface connector   |
| J73              | GPIO TESTACCESS | GPIO expansion            |
| J74              | PWM TEST ACCESS | PWM expansion             |
| J77              | PMBUS           | PMBus expansion           |
| J3               | USB IN          | USB input connector       |
| S1               | RESET           | Push button reset         |
| S10              | STAT LED        | Status LED enable switch  |
| S2               | FAULT – MON5    | MON5 fault switch         |
| S4               | FAULT – MON6    | MON6 fault switch         |
| S6               | FAULT – MON7    | MON7 fault switch         |
| S8               | FAULT – MON8    | MON8 fault switch         |
| S3               | FAULT – MON9    | MON9 fault switch         |
| S5               | FAULT – MON10   | MON10 fault switch        |
| S7               | FAULT – MON11   | MON11 fault switch        |
| S9               | FAULT – MON12   | MON12 fault switch        |
| R186             | TEMP MON        | Fan temperature simulator |

## 4.2 EVM LEDS

**Table 2. EVM LED's**

| LED | Color | Label  | Description         |
|-----|-------|--------|---------------------|
| D5  | RED   | 5V     | 5VBUS ON indicator  |
| D9  | RED   | V33D   | UCD90120/4 power ON |
| D28 | RED   | ALERT  | PMBus Alert         |
| D29 | GREEN | CTRL   | PMBus Control       |
| D56 | GREEN | USB ON | USB attached        |
| D8  | AMBER | GPI1   | GPI1 input HIGH     |
| D10 | AMBER | GPI2   | GPI2 input HIGH     |
| D12 | AMBER | GPI3   | GPI3 input HIGH     |
| D13 | AMBER | GPI4   | GPI4 input HIGH     |
| D30 | GREEN | GPIO1  | GPIO1 HIGH          |
| D32 | GREEN | GPIO2  | GPIO2 HIGH          |
| D34 | GREEN | GPIO3  | GPIO3 HIGH          |
| D36 | GREEN | GPIO4  | GPIO4 HIGH          |
| D38 | GREEN | GPIO13 | GPIO13 HIGH         |
| D47 | GREEN | GPIO14 | GPIO14 HIGH         |
| D49 | GREEN | GPIO15 | GPIO15 HIGH         |
| D40 | GREEN | GPIO16 | GPIO16 HIGH         |
| D42 | GREEN | GPIO17 | GPIO17 HIGH         |
| D44 | GREEN | GPIO18 | GPIO18 HIGH         |
| D46 | GREEN | GPIO19 | GPIO19 HIGH         |
| D48 | GREEN | GPIO20 | GPIO20 HIGH         |
| D54 | GREEN | GPIO21 | GPIO21 HIGH         |
| D55 | GREEN | GPIO22 | GPIO22 HIGH         |
| D31 | AMBER | FPWM1  | GPIO5 HIGH          |
| D33 | AMBER | FPWM2  | GPIO6 HIGH          |
| D35 | AMBER | FPWM3  | GPIO7 HIGH          |
| D37 | AMBER | FPWM4  | GPIO8 HIGH          |
| D39 | AMBER | FPWM5  | GPIO9 HIGH          |
| D41 | AMBER | FPWM6  | GPIO10 HIGH         |
| D43 | AMBER | FPWM7  | GPIO11 HIGH         |
| D45 | AMBER | FPWM8  | GPIO12 HIGH         |
| D14 | RED   | VR1    | VR1 ON              |
| D15 | RED   | VR2    | VR2 ON              |
| D16 | RED   | VR3    | VR3 ON              |
| D17 | RED   | VR4    | VR4 ON              |
| D18 | RED   | VR5    | VR5 ON              |
| D19 | RED   | VR6    | VR6 ON              |
| D20 | RED   | VR7    | VR7 ON              |
| D21 | RED   | VR8    | VR8 ON              |
| D22 | RED   | VR9    | VR9 ON              |
| D23 | RED   | VR10   | VR10 ON             |
| D24 | RED   | VR11   | VR11 ON             |
| D25 | RED   | VR12   | VR12 ON             |

### 4.3 EVM Test Points

**Table 3. EVM Test Points**

| TP   | Color | Label             |
|------|-------|-------------------|
| TP1  | RED   | 12VBUS            |
| TP2  | RED   | 5VBUS             |
| TP3  | WHT   | L3P3V             |
| TP4  | WHT   | V33D              |
| TP11 | BLK   | GND               |
| TP17 | BLK   | GND               |
| TP6  | WHT   | ADDRSENS0         |
| TP7  | ORG   | ADDRSENS1         |
| TP37 | BLK   | GND               |
| TP43 | BLK   | GND               |
| TP8  | YEL   | EVR1              |
| TP13 | YEL   | EVR2              |
| TP16 | YEL   | EVR3              |
| TP22 | YEL   | EVR4              |
| TP28 | YEL   | EVR5              |
| TP34 | YEL   | EVR6              |
| TP46 | YEL   | EVR7              |
| TP52 | YEL   | EVR8              |
| TP29 | YEL   | EVR9              |
| TP35 | YEL   | EVR10             |
| TP47 | YEL   | EVR11             |
| TP53 | YEL   | EVR12             |
| TP14 | WHT   | VR1 LOAD TEMP MON |
| TP18 | WHT   | VR1 CURRENT MON   |
| TP9  | WHT   | VR1               |
| TP12 | WHT   | VR2               |
| TP19 | WHT   | VR3               |
| TP20 | WHT   | VR4               |
| TP36 | WHT   | VR5               |
| TP38 | WHT   | VR6               |
| TP39 | WHT   | VR7               |
| TP40 | WHT   | VR8               |
| TP54 | WHT   | VR9               |
| TP56 | WHT   | VR10              |
| TP61 | WHT   | VR11              |
| TP62 | WHT   | VR12              |
| TP55 | BLK   | GND               |
| TP24 | WHT   | GPIO1             |
| TP25 | WHT   | GPIO2             |
| TP26 | WHT   | GPIO3             |
| TP27 | WHT   | GPIO4             |
| TP32 | WHT   | GPIO13            |
| TP66 | WHT   | GPIO14 (SCI-TX)   |
| TP65 | WHT   | GPIO15 (SCI-RX)   |
| TP44 | WHT   | GPIO16            |
| TP48 | WHT   | GPIO17            |

**Table 3. EVM Test Points (continued)**

| TP   | Color  | Label          |
|------|--------|----------------|
| TP33 | WHT    | GPIO19         |
| TP57 | WHT    | GPIO18         |
| TP45 | WHT    | GPIO20         |
| TP49 | WHT    | GPIO21         |
| TP58 | WHT    | GPIO22         |
| TP10 | YEL    | MON1           |
| TP15 | YEL    | MON2           |
| TP21 | YEL    | MON3           |
| TP23 | YEL    | MON4           |
| TP30 | YEL    | MON5           |
| TP41 | YEL    | MON6           |
| TP50 | YEL    | MON7           |
| TP59 | YEL    | MON8           |
| TP31 | YEL    | MON9           |
| TP42 | YEL    | MON10          |
| TP51 | YEL    | MON11          |
| TP60 | YEL    | MON12          |
| TP5  | YEL    | MON13          |
| TP63 | BLK    | GND            |
| TP64 | YEL    | TEMP POT WIPER |
| TP67 | WHT    | LA CLOCK       |
| TP68 | SM-SLV | GND            |
| TP69 | SM-SLV | GND            |
| TP70 | SM-SLV | GND            |
| TP71 | SM-SLV | GND            |
| TP72 | SM-SLV | GND            |
| TP73 | SM-SLV | GND            |

## 4.4 EVM Test Jumpers

The EVM will be equipped with shunts on the jumper positions identified in the Default Pin Position below. Shunts can be moved and removed as required during use.

**Table 4. EVM Jumpers**

| Jumper | Default Pin Position | Label    | Description                            |
|--------|----------------------|----------|----------------------------------------|
| J8     |                      | 3.3VUSB  | 3.3V USB                               |
| J78    | 1-2                  |          | EEPROM SCL                             |
| J79    | 1-2                  |          | EEPROM SDA                             |
| J69    | 1-2                  | PWM PU   | Fan PWM pullup/pulldown select         |
| J70    | 1-2                  |          | Fan PWM select (fast or slow) FPWM5    |
| J67    | 1-2                  |          | Fan tach input or slow PWM output      |
| J72    | 2-3                  | TACH PU  | Fan tach input pullup/pulldown select  |
| J71    |                      | EVR12    | Fan temperature simulator pot to MON12 |
| J68    | 2-3                  |          | Fan type select (4 or 2/3 wire)        |
| J10    | 1-2                  | GPI1     | General purpose input #1               |
| J14    | 1-2                  | GPI2     | General purpose input #2               |
| J16    | 1-2                  | GPI3     | General purpose input #3               |
| J17    | 1-2                  | GPI4     | General purpose input #4               |
| J34    | 2-3                  | GPIO1    | GPIO1 (enable #1) pullup/pulldown      |
| J35    | 2-3                  | GPIO2    | GPIO2 (enable #2) pullup/pulldown      |
| J36    | 2-3                  | GPIO3    | GPIO3 (enable #3) pullup/pulldown      |
| J37    | 2-3                  | GPIO4    | GPIO4 (enable #4) pullup/pulldown      |
| J44    | 2-3                  | GPIO13   | GPIO13 (enable #5) pullup/pulldown     |
| J45    | 2-3                  | GPIO16   | GPIO16 (enable #6) pullup/pulldown     |
| J50    | 2-3                  | GPIO17   | GPIO17 (enable #7) pullup/pulldown     |
| J51    | 2-3                  | GPIO18   | GPIO18 (enable #8) pullup/pulldown     |
| J56    | 2-3                  | GPIO19   | GPIO19 (enable #9) pullup/pulldown     |
| J57    | 2-3                  | GPIO20   | GPIO20 (enable #10) pullup/pulldown    |
| J62    | 2-3                  | GPIO21   | GPIO21 (enable #11) pullup/pulldown    |
| J63    | 2-3                  | GPIO22   | GPIO22 (enable #12) pullup/pulldown    |
| J75    | 2-3                  | GPIO14   | GPIO14 pullup/pulldown                 |
| J76    | 2-3                  | GPIO15   | GPIO15 pullup/pulldown                 |
| J18    | 1-2,7-8              | PM ADDR  | PMBus address                          |
| J11    |                      | TCK      | JTAG TCK                               |
| J6     |                      | TDI      | JTAG TDI                               |
| J12    |                      | TDO      | JTAG TDO                               |
| J7     |                      | TMS      | JTAG TMS                               |
| J4     | 1-2                  | L3.3V    | LDO 3.3V to board 3.3V                 |
| J13    |                      | 12VB     | Local 12VBUS-V33D regulator            |
| J5     | 1-2                  |          | Local or LDO 3.3V                      |
| J19    |                      | HVMON    | EVR1 monitor scaling                   |
| J23    |                      | HVMON    | EVR2 monitor scaling                   |
| J27    |                      | HVMON    | EVR3 monitor scaling                   |
| J31    |                      | HVMON    | EVR4 monitor scaling                   |
| J20    | 1-2                  | 1L 1E    | MON1 source select                     |
| J24    | 3-4                  | E2 L2 T1 | MON2 source select                     |
| J28    | 3-4                  | E3 L3 C1 | MON3 source select                     |
| J32    | 1-2                  | 4L 4E    | MON4 source select                     |

**Table 4. EVM Jumpers (continued)**

| Jumper | Default Pin Position | Label   | Description            |
|--------|----------------------|---------|------------------------|
| J42    | 1-2                  | 5L 5E   | MON5 source select     |
| J48    | 1-2                  | 6L 6E   | MON6 source select     |
| J54    | 1-2                  | 7L 7E   | MON7 source select     |
| J60    | 1-2                  | 8L 8E   | MON8 source select     |
| J43    | 1-2                  | 9L 9E   | MON9 source select     |
| J49    | 1-2                  | 10L 10E | MON10 source select    |
| J55    | 1-2                  | 11L 11E | MON11 source select    |
| J61    | 1-2                  | 12L 12E | MON12 source select    |
| J15    | 1-2                  | MON13   | MON 13 source select   |
| J26    | 1-2                  | C1      | VR1 output load        |
| J22    |                      | RC MRG1 | VR1 margining feedback |
| J25    |                      | RC MRG2 | VR2 margining feedback |
| J30    |                      | RC MRG3 | VR3 margining feedback |
| J33    |                      | RC MRG4 | VR4 margining feedback |
| J21    | 1-2                  | 5V      | VR1, VR2 5VBUS input   |
| J29    | 1-2                  | 5V      | VR3, VR4 5VBUS input   |
| J38    | 1-2                  | R1_EN   | VR1 enable             |
| J39    | 1-2                  | R2_EN   | VR2 enable             |
| J40    | 1-2                  | R3_EN   | VR3 enable             |
| J41    | 1-2                  | R4_EN   | VR4 enable             |
| J46    | 1-2                  | R5_EN   | VR5 enable             |
| J47    | 1-2                  | R6_EN   | VR6 enable             |
| J52    | 1-2                  | R7_EN   | VR7 enable             |
| J53    | 1-2                  | R8_EN   | VR8 enable             |
| J58    | 1-2                  | R9_EN   | VR9 enable             |
| J59    | 1-2                  | R10_EN  | VR10 enable            |
| J64    | 1-2                  | R11_EN  | VR11 enable            |
| J65    | 1-2                  | R12_EN  | VR12 enable            |

## 5 Description

The following paragraphs describe the UCD90120/4 EVM functionality and operation.

### 5.1 Communication Interfaces

Several communication interfaces to the UCD90120/4 are provided on the EVM.

#### 5.1.1 USB Interface

An onboard USB to PMBus interface is provided through the USB Input (J3) connector. D56 provides USB attach status. The presence of USB power at J3 activates buffer circuitry which gives control of the PMBus to the on board circuitry. The absence of USB power at J3 gives PMBus control through the Expansion PMBus (J77) connector.

#### 5.1.2 PMBus

Standard PMBus interface is provided to the UCD90120/4 through the J77 connector when the on EVM USB-PMBus interface is not used. PMBus addressing is set using the J18 jumper block for ADDRSENS1 and ADDRSENS0 respectively. ADDR<sub>x</sub>=8 and ADDR<sub>x</sub>=5 positions for each are provided. The EVM comes with PMBus address set to 101 decimal.

PMBus Address (decimal) = 12 × ADDR1 + ADDR0 jumper block setting.

#### 5.1.3 JTAG

Standard JTAG programming interface is provided to the UCD90120/4 through the J9 connector. Install J6, J7, J11, and J12 jumpers and ensure that rail 9-12 enable jumpers (J47, J53, J59, J65) are removed when using the JTAG interface.

## 5.2 Power

#### 5.2.1 Input Power

The 12VDC EVM input power is provided through J1 (standard DC jack) or J2 (screw jack). A wall or laptop adapter with 500mA (UCD90120EVM) or 2000mA (UCD90124EVM running a fan) capability and 2.5mm I.D. x 5.5mm O.D. x 9.5mm DC jack can power the EVM. Reverse voltage protection and inrush limiting is provided for 12VBUS. The 12VBUS signal is distributed for fan power and Local 3.3V supply.

#### 5.2.2 5VBUS

5VBUS is derived from 12VBUS and provides the input voltage for rails 1-12. D5 will illuminate when 5VBUS is present.

#### 5.2.3 L3P3V

L3P3V is derived from 5VBUS and provides a general purpose 3.3V supply for the common onboard functions. The L3P3V jumper (J4) is installed to provide a connection to the 3P3V node.

#### 5.2.4 V33D

The V33D node is connected to the UCD90120/4 digital and analog supply pins. V33D can be sourced by 3P3V or Local V33D using the J5 jumper. D9 will illuminate when V33D is present.

#### 5.2.5 Local 3.3V

The UCD90120/4 can be powered from 12VBUS using the local V33D supply. Install J13 (12VB) and ensure J5 is installed in the LV33D position to use the local regulator.

### 5.2.6 Local USB

When the local 12V power supply source is not available, a subset of EVM functionality is available using only power from the local USB source (3P3V\_USB). Install J8 (3.3VUSB) and remove J4 when this operation is desired. Communication to the UCD90120/4 is possible but power supply sequencing and operation is not.

## 5.3 Test/Debug and Status

### 5.3.1 GPIO Expansion

J73 and J74 provide EVM to system board expansion capability as well as an HP type logic analyzer interface.

### 5.3.2 Status LEDs

Visual status information for the GPI, GPIO, and PMBus signals (control and alert) is provided. Logic high at GPI1-4 or GPIO1-22 will illuminate the associated LED. The GPIO status LEDs can be enabled (EN) or disabled (EN bar) through the use of S10 to prevent the LED bias from affecting the logic state of the GPIO signal during device reset.

## 5.4 Digital I/O Terminations

### 5.4.1 General Purpose Input/Output Terminations

GPIO1-22 can be pulled up or down with a 10kΩ resistor using jumpers. GPIO14 and GPIO15 can also be used as voltage margining inputs.

### 5.4.2 General Purpose Input Terminations

GPI1-4 can be pulled up or down with a 10kΩ resistor using jumpers.

## 5.5 Analog Monitor Inputs

The UCD90120/4 monitor inputs MON1-13 can be used to monitor onboard or off board voltages. Jumpers are used to select the analog source.

### 5.5.1 MON1 and MON4–MON11

MON1 and MON4-11 can be sourced by the onboard rail (L#) or an external (E#) voltage.

### 5.5.2 MON2, MON3, MON12 and MON13

MON2 can be sourced by the onboard rail (L2), an external (E2) or the on board temperature sensor (T1) voltage. MON3 can be sourced by the onboard rail (L3), an external (E3) or the on board current monitor (C1) voltage. MON12 can be sourced by onboard rail (12L), an external source (12E) or the onboard fan temperature potentiometer input (TEMP MON) voltage. MON13 can be sourced by the V33D or 12VBUS voltage.

### 5.5.3 Monitor Scaling

For the external monitor jumper positions (E1-E4), the external supply can be scaled by a selectable factor of 2 for monitoring external voltages up to 5V or 6 for monitoring external voltages up to 15V. For MON13, the scale factor is 6 for the 12VB position and 2 for the V33D position. For all other MON jumper positions, the scale factor is 2.

### 5.5.4 Monitor Fault Injection

Under voltage or over voltage faults can be injected on MON 5–MON12 through the use of on board switches (S2, S4, S6, S8, S3, S5, S7, S9 respectively). The switches provide a fault bias on the nominal voltage of approximately  $\pm 20\%$

## 5.6 Local Voltage Rails

Twelve on board voltages are provided for sequencing and monitoring. Each voltage rail has an output on LED. The nominal output voltages are listed in [Table 5](#).

**Table 5. Local Rail Nominal Output Voltages**

| Local Rail     | L1   | L2   | L3   | L4   | 5L   | 6L   | 7L   | 8L   | 9L   | 10L  | 11L  | 12L  |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|
| NominalVoltage | 3.5V | 3.3V | 2.5V | 1.8V | 3.4V | 3.2V | 3.0V | 2.8V | 2.6V | 2.4V | 2.2V | 2.0V |

## 5.7 External Temperature Sensor

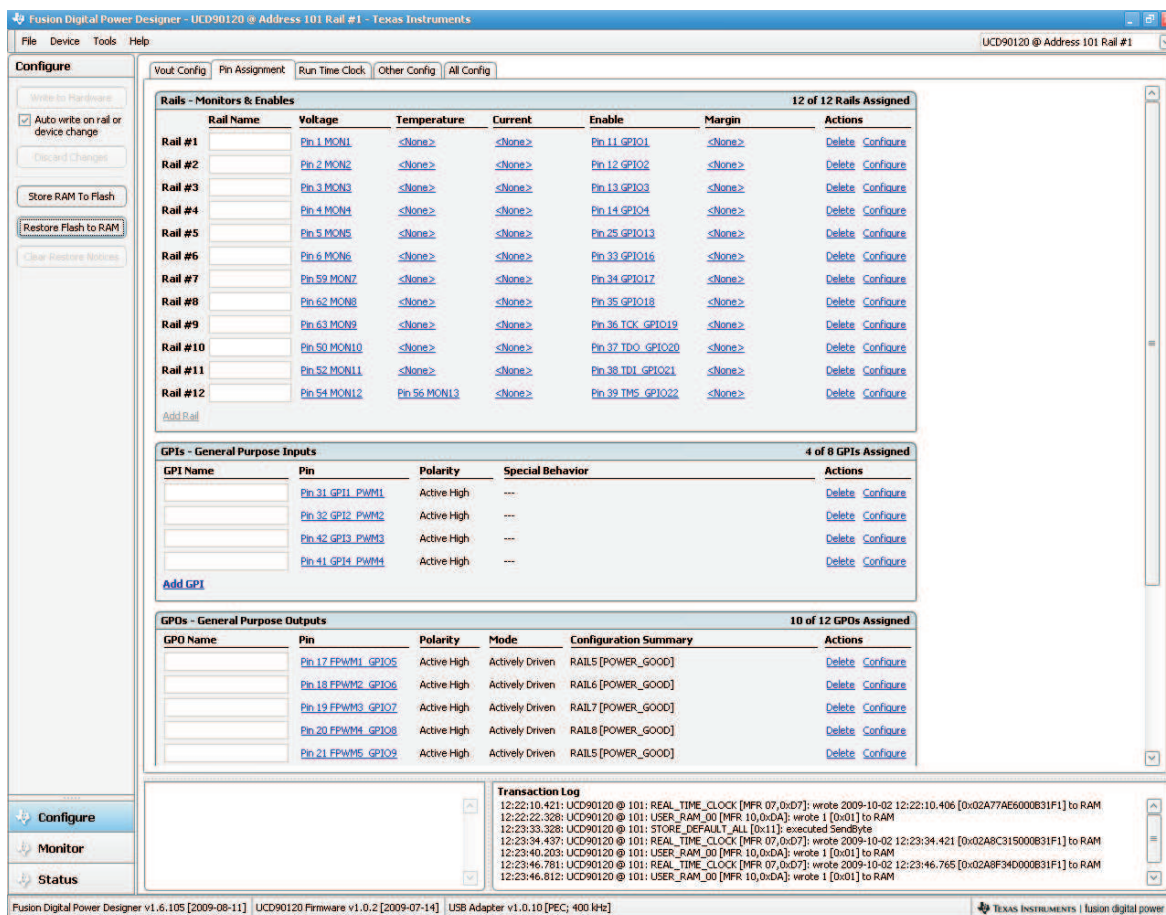
An onboard temperature sensor is provided to measure temperature rise of the VR1 output load (R74). MON2 can be used to monitor the temperature rise caused by heat up of R74 when the shunt on J24 is in the T1 position. When J26 (C1) is installed, the temperature sensor near R74 records temperature rise simulating power supply warm up.

- Use TP14 (T1) to measure the temperature sensor output voltage.
- Temperature (in degrees C) =  $100 \times VT1 - 50$  where VT1 is the voltage at TP14.
- The voltage at TP14 is scaled by a factor of 2 prior to sampling at MON2.
- Set the GUI Temp Cal Gain = 200°C/V and the Temp Cal Offset = -50°C.

### 5.7.1 Basic Process for Adding Temperature Monitoring to a Rail

A basic procedure to add temperature monitoring to rail #1, starting with the EVM default configuration will follow. Ensure that rail #1 is selected in the upper right corner.

- While in the Configure section of the GUI, select the Pin Assignment tab



**Configure**

Write to Hardware  
☒ Auto write on rail or device change  
 Discard Changes  
 Store RAM To Flash  
 Restore Flash to RAM  
 Clear Restore Notices

**Pin Assignment**

**Rails - Monitors & Enables** 12 of 12 Rails Assigned

| Rail Name | Voltage       | Temperature   | Current | Enable            | Margin | Actions          |
|-----------|---------------|---------------|---------|-------------------|--------|------------------|
| Rail #1   | Pin 1 MCON1   | <None>        | <None>  | Pin 11 GPIO1      | <None> | Delete Configure |
| Rail #2   | Pin 2 MCON2   | <None>        | <None>  | Pin 12 GPIO2      | <None> | Delete Configure |
| Rail #3   | Pin 3 MCON3   | <None>        | <None>  | Pin 13 GPIO3      | <None> | Delete Configure |
| Rail #4   | Pin 4 MCON4   | <None>        | <None>  | Pin 14 GPIO4      | <None> | Delete Configure |
| Rail #5   | Pin 5 MCON5   | <None>        | <None>  | Pin 25 GPIO13     | <None> | Delete Configure |
| Rail #6   | Pin 6 MCON6   | <None>        | <None>  | Pin 33 GPIO16     | <None> | Delete Configure |
| Rail #7   | Pin 59 MCON7  | <None>        | <None>  | Pin 34 GPIO17     | <None> | Delete Configure |
| Rail #8   | Pin 62 MCON8  | <None>        | <None>  | Pin 35 GPIO18     | <None> | Delete Configure |
| Rail #9   | Pin 63 MCON9  | <None>        | <None>  | Pin 36 TCK GPIO19 | <None> | Delete Configure |
| Rail #10  | Pin 50 MCON10 | <None>        | <None>  | Pin 37 TDO GPIO20 | <None> | Delete Configure |
| Rail #11  | Pin 52 MCON11 | <None>        | <None>  | Pin 38 TDI GPIO21 | <None> | Delete Configure |
| Rail #12  | Pin 54 MCON12 | Pin 56 MCON13 | <None>  | Pin 39 TMS GPIO22 | <None> | Delete Configure |

[Add Rail](#)

**GPIs - General Purpose Inputs** 4 of 8 GPIs Assigned

| GPI Name         | Pin              | Polarity    | Special Behavior | Actions          |
|------------------|------------------|-------------|------------------|------------------|
| Pin 31 GPI1_PWM1 | Pin 31 GPI1_PWM1 | Active High | ---              | Delete Configure |
| Pin 32 GPI2_PWM2 | Pin 32 GPI2_PWM2 | Active High | ---              | Delete Configure |
| Pin 42 GPI3_PWM3 | Pin 42 GPI3_PWM3 | Active High | ---              | Delete Configure |
| Pin 41 GPI4_PWM4 | Pin 41 GPI4_PWM4 | Active High | ---              | Delete Configure |

[Add GPI](#)

**GPOs - General Purpose Outputs** 10 of 12 GPOs Assigned

| GPO Name           | Pin                | Polarity    | Mode            | Configuration Summary | Actions          |
|--------------------|--------------------|-------------|-----------------|-----------------------|------------------|
| Pin 17 FPWM1_GPIO5 | Pin 17 FPWM1_GPIO5 | Active High | Actively Driven | RAIL5 [POWER_GOOD]    | Delete Configure |
| Pin 18 FPWM2_GPIO6 | Pin 18 FPWM2_GPIO6 | Active High | Actively Driven | RAIL6 [POWER_GOOD]    | Delete Configure |
| Pin 19 FPWM3_GPIO7 | Pin 19 FPWM3_GPIO7 | Active High | Actively Driven | RAIL7 [POWER_GOOD]    | Delete Configure |
| Pin 20 FPWM4_GPIO8 | Pin 20 FPWM4_GPIO8 | Active High | Actively Driven | RAIL8 [POWER_GOOD]    | Delete Configure |
| Pin 21 FPWM5_GPIO9 | Pin 21 FPWM5_GPIO9 | Active High | Actively Driven | RAIL5 [POWER_GOOD]    | Delete Configure |

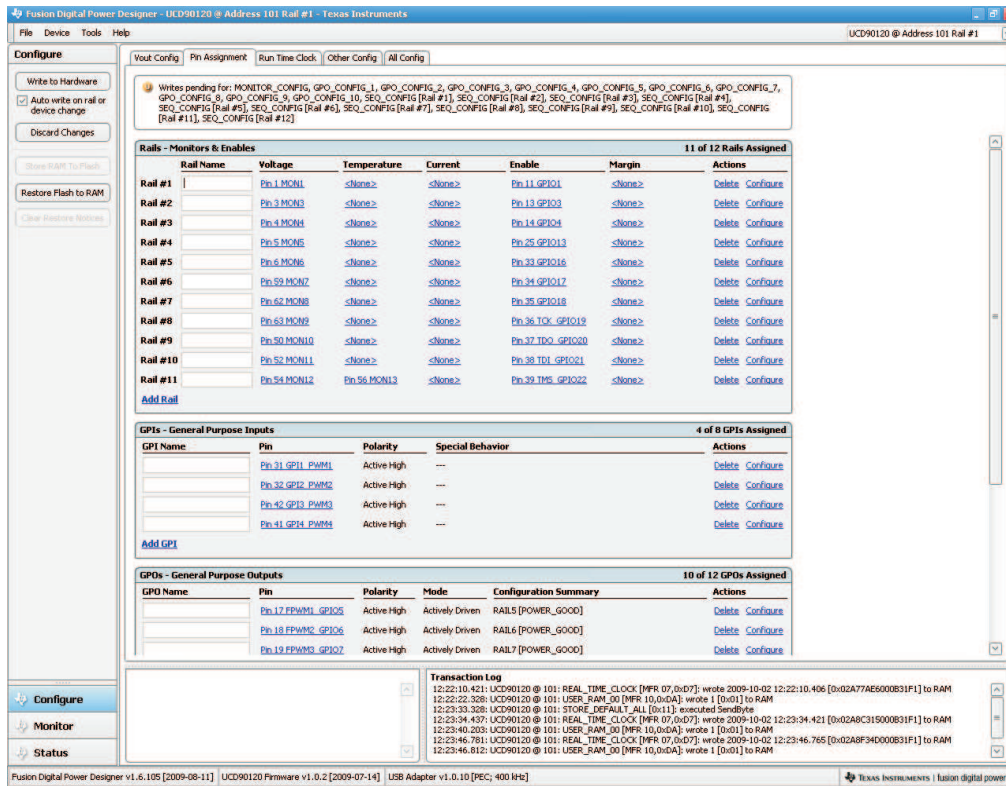
**Transaction Log**

```

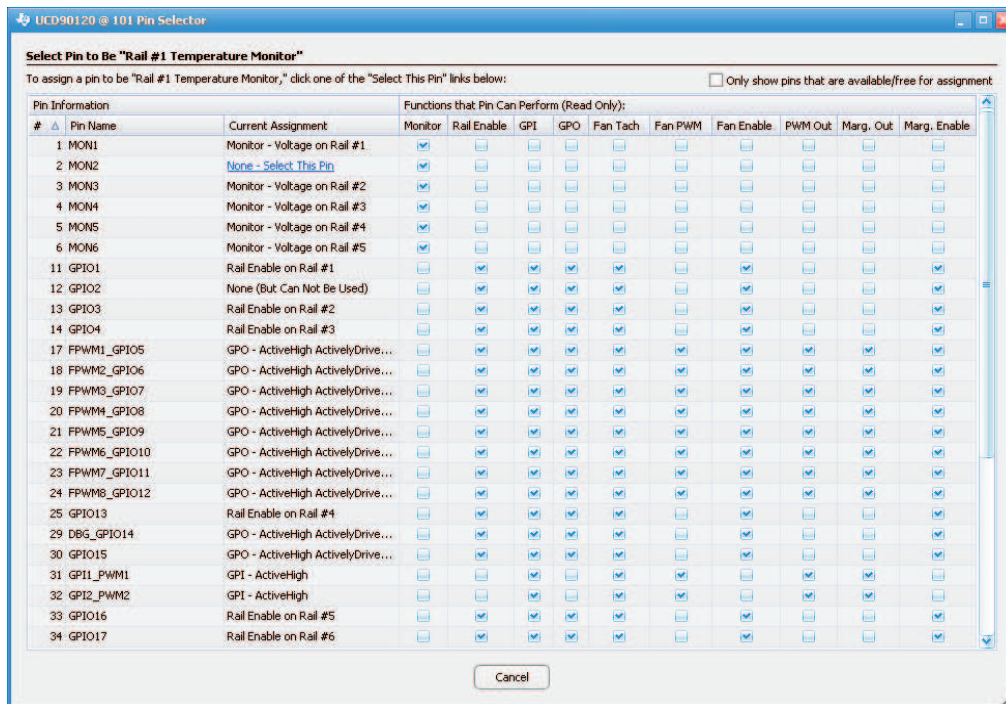
12:22:10.421: UCD90120 @ 101: REAL_TIME_CLOCK [MFR 07,0xD7]: wrote 2009-10-02 12:22:10.406 [0x02A77AE6000B31F1] to RAM
12:22:22.328: UCD90120 @ 101: USER_RAM_00 [MFR 10,0xDA]: wrote 1 [0x01] to RAM
12:23:33.328: UCD90120 @ 101: STORE_DEFAULT_ALL [0x11]: executed Sendbyte
12:23:34.437: UCD90120 @ 101: REAL_TIME_CLOCK [MFR 07,0xD7]: wrote 2009-10-02 12:23:34.421 [0x02A8C315000B31F1] to RAM
12:23:40.203: UCD90120 @ 101: USER_RAM_00 [MFR 10,0xDA]: wrote 1 [0x01] to RAM
12:23:46.781: UCD90120 @ 101: REAL_TIME_CLOCK [MFR 07,0xD7]: wrote 2009-10-02 12:23:46.765 [0x02A8F34D000B31F1] to RAM
12:23:46.812: UCD90120 @ 101: USER_RAM_00 [MFR 10,0xDA]: wrote 1 [0x01] to RAM
  
```

Fusion Digital Power Designer v1.6.105 [2009-08-11] UCD90120 Firmware v1.0.2 [2009-07-14] USB Adapter v1.0.10 [PEC: 400 kHz]  TEXAS INSTRUMENTS | fusion digital power

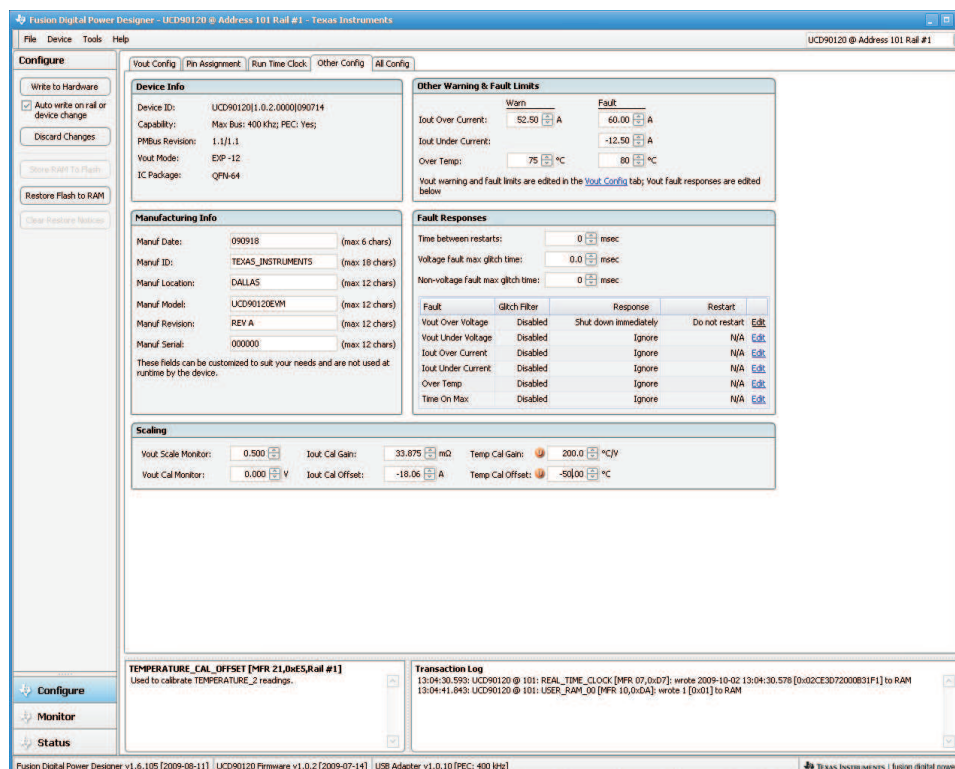
- Delete the current pin assignment for MON2, then add a temperature pin assignment to MON1



- Choose MON2 then the GUI will switch back to the Pin Assignment tab.



- Switch to the Other Config tab then enter Temp Cal Gain (200) and Temp Cal Offset (-50).

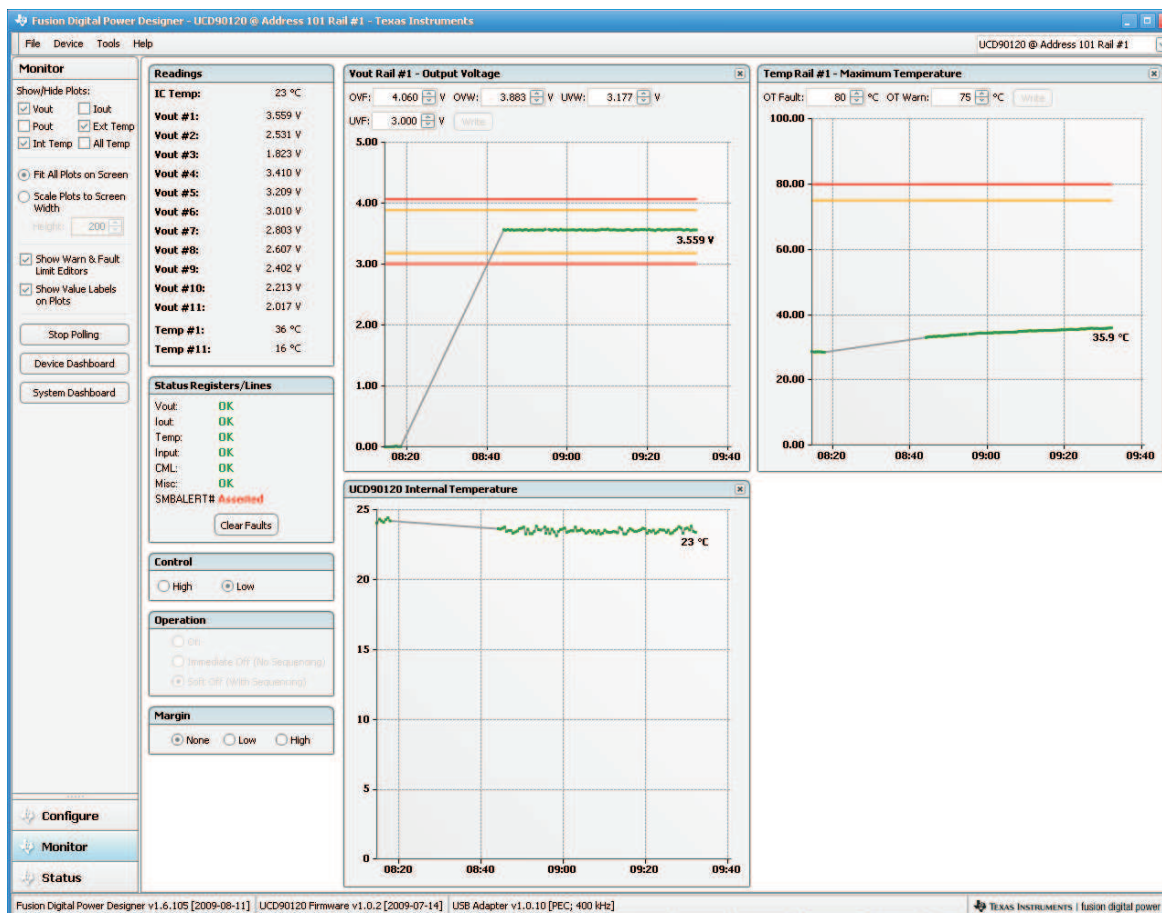


- Press the Write to Hardware Button and OK the window below. Fusion will restart.



- Once Fusion restarts, press the Store RAM to flash and accept the response.

- Press and release the EVM RESET (S1) button and the on EVM temperature sensor will provide rail #1 load temperature.



## 5.8 Input Current Monitoring

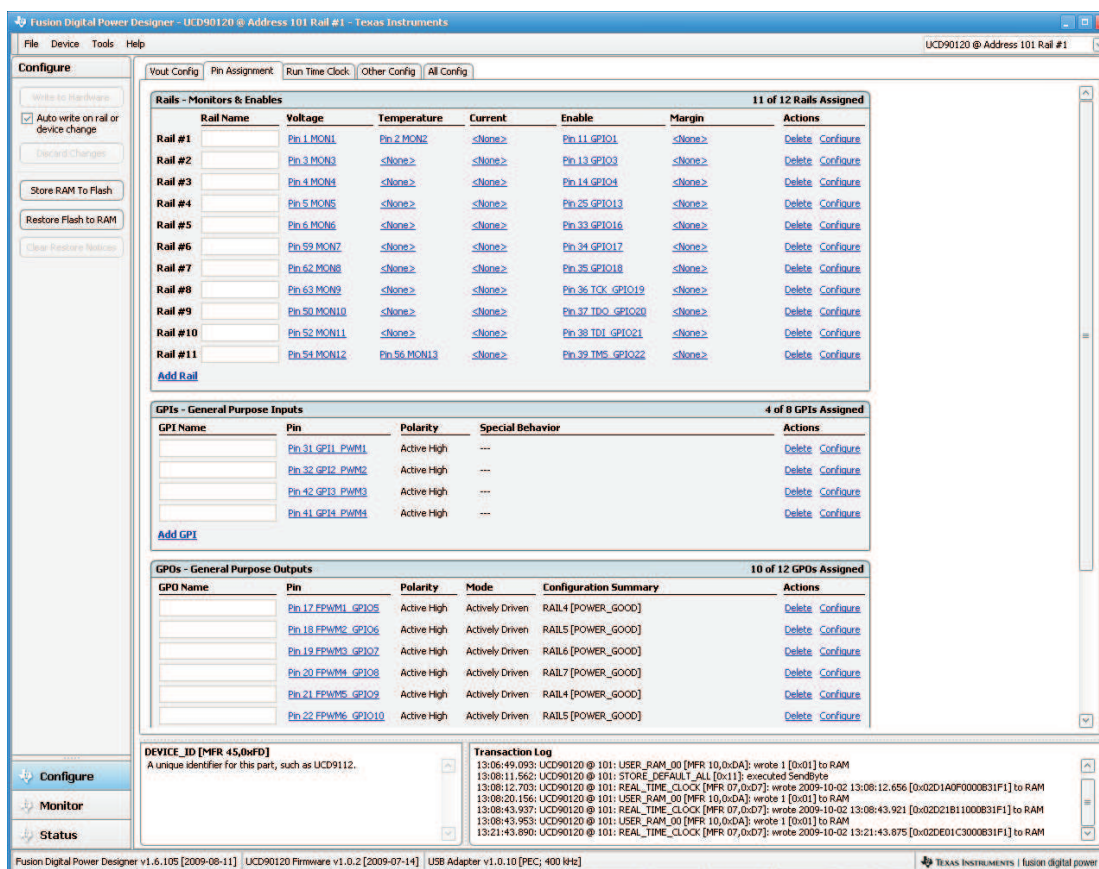
An onboard current monitor is provided to measure VR1 load current. MON3 can be used to monitor VR1 output current when the shunt on J28 is in the C1 position. When J26 (C1) is installed, VR1 output load (R74) is connected causing an increase in current which can be measured by MON3 and at TP18.

- Use TP18 (C1) to measure the current monitor output voltage.
- Current (in amperes) =  $0.5 \times VC1$  where VC1 is the voltage at TP18.
- The voltage at TP18 is scaled by a factor of 2 prior to sampling at MON3.
- Set the GUI Iout Cal Gain = 1000mΩ and the Iout Cal Offset = 0A.

### 5.8.1 Basic Process for Adding Current Monitoring to a Rail

A basic procedure to add current monitoring to rail #1, starting with the previously modified (adding temperature) configuration will follow. Ensure that rail #1 is selected in the upper right corner.

- While in the Configure section of the GUI, select the Pin Assignment tab



**Rails - Monitors & Enables** 11 of 12 Rails Assigned

| Rail Name | Voltage      | Temperature  | Current | Enable            | Margin | Actions          |
|-----------|--------------|--------------|---------|-------------------|--------|------------------|
| Rail #1   | Pin 1 MON1   | Pin 2 MON2   | <None>  | Pin 11 GPIO1      | <None> | Delete Configure |
| Rail #2   | Pin 3 MON3   | <None>       | <None>  | Pin 13 GPIO3      | <None> | Delete Configure |
| Rail #3   | Pin 4 MON4   | <None>       | <None>  | Pin 14 GPIO4      | <None> | Delete Configure |
| Rail #4   | Pin 5 MON5   | <None>       | <None>  | Pin 25 GPIO13     | <None> | Delete Configure |
| Rail #5   | Pin 6 MON6   | <None>       | <None>  | Pin 33 GPIO16     | <None> | Delete Configure |
| Rail #6   | Pin 59 MON7  | <None>       | <None>  | Pin 34 GPIO17     | <None> | Delete Configure |
| Rail #7   | Pin 62 MON8  | <None>       | <None>  | Pin 35 GPIO18     | <None> | Delete Configure |
| Rail #8   | Pin 63 MON9  | <None>       | <None>  | Pin 36 TCK GPIO19 | <None> | Delete Configure |
| Rail #9   | Pin 50 MON10 | <None>       | <None>  | Pin 37 TDO GPIO20 | <None> | Delete Configure |
| Rail #10  | Pin 52 MON11 | <None>       | <None>  | Pin 38 TDI GPIO21 | <None> | Delete Configure |
| Rail #11  | Pin 54 MON12 | Pin 56 MON13 | <None>  | Pin 39 TMS GPIO22 | <None> | Delete Configure |

**GPIs - General Purpose Inputs** 4 of 8 GPIs Assigned

| GPI Name         | Pin              | Polarity    | Special Behavior | Actions          |
|------------------|------------------|-------------|------------------|------------------|
| Pin 31 GPI1_PWM1 | Pin 31 GPI1_PWM1 | Active High | ---              | Delete Configure |
| Pin 32 GPI2_PWM2 | Pin 32 GPI2_PWM2 | Active High | ---              | Delete Configure |
| Pin 42 GPI3_PWM3 | Pin 42 GPI3_PWM3 | Active High | ---              | Delete Configure |
| Pin 41 GPI4_PWM4 | Pin 41 GPI4_PWM4 | Active High | ---              | Delete Configure |

**GPOs - General Purpose Outputs** 10 of 12 GPOs Assigned

| GPO Name            | Pin                 | Polarity    | Mode            | Configuration Summary | Actions          |
|---------------------|---------------------|-------------|-----------------|-----------------------|------------------|
| Pin 17 FPWM1_GPIO5  | Pin 17 FPWM1_GPIO5  | Active High | Actively Driven | RAIL4 [POWER_GOOD]    | Delete Configure |
| Pin 18 FPWM2_GPIO6  | Pin 18 FPWM2_GPIO6  | Active High | Actively Driven | RAIL5 [POWER_GOOD]    | Delete Configure |
| Pin 19 FPWM3_GPIO7  | Pin 19 FPWM3_GPIO7  | Active High | Actively Driven | RAIL6 [POWER_GOOD]    | Delete Configure |
| Pin 20 FPWM4_GPIO8  | Pin 20 FPWM4_GPIO8  | Active High | Actively Driven | RAIL7 [POWER_GOOD]    | Delete Configure |
| Pin 21 FPWM5_GPIO9  | Pin 21 FPWM5_GPIO9  | Active High | Actively Driven | RAIL4 [POWER_GOOD]    | Delete Configure |
| Pin 22 FPWM6_GPIO10 | Pin 22 FPWM6_GPIO10 | Active High | Actively Driven | RAIL5 [POWER_GOOD]    | Delete Configure |

**DEVICE\_ID [MFR 45,0xPD]**  
A unique identifier for this part, such as UCD9112.

**Transaction Log**

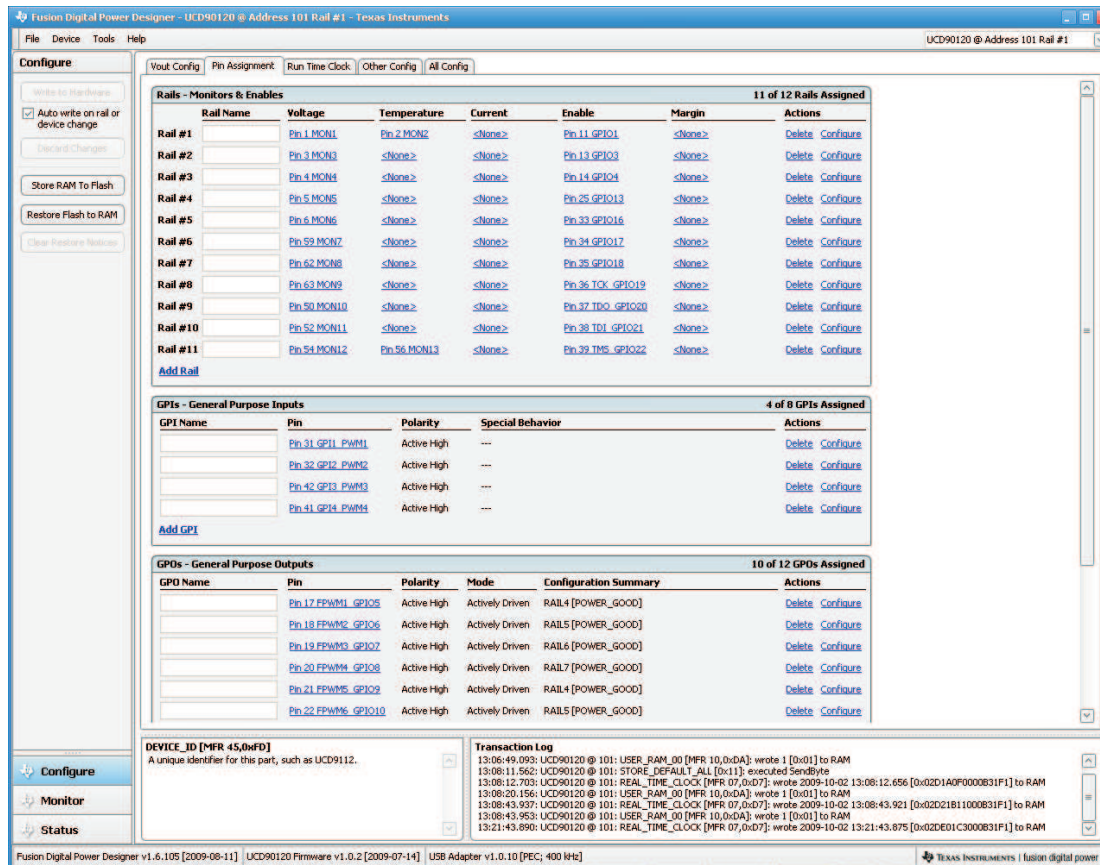
```

13:06:49.093: UCD90120 @ 101: USER_RAM_00 [MFR 10,0xDA]: wrote 1 [0x01] to RAM
13:08:11.562: UCD90120 @ 101: STORE_DEFAULT_ALL [0x11]: executed SendByte
13:08:12.703: UCD90120 @ 101: REAL_TIME_CLOCK [MFR 07,0xD7]: wrote 2009-10-02 13:08:12.656 [0x02D1A0F0000831F1] to RAM
13:08:20.156: UCD90120 @ 101: USER_RAM_00 [MFR 10,0xDA]: wrote 1 [0x01] to RAM
13:08:43.937: UCD90120 @ 101: REAL_TIME_CLOCK [MFR 07,0xD7]: wrote 2009-10-02 13:08:43.921 [0x02D21B11000831F1] to RAM
13:08:43.953: UCD90120 @ 101: USER_RAM_00 [MFR 10,0xDA]: wrote 1 [0x01] to RAM
13:21:43.890: UCD90120 @ 101: REAL_TIME_CLOCK [MFR 07,0xD7]: wrote 2009-10-02 13:21:43.875 [0x02DE01C3000831F1] to RAM

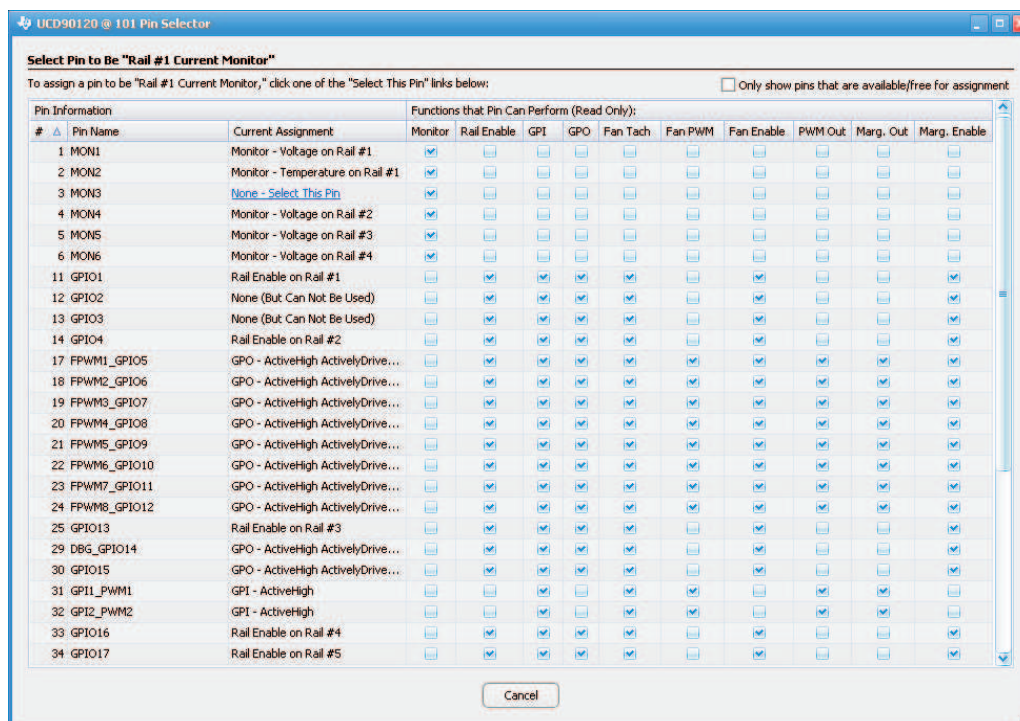
```

Fusion Digital Power Designer v1.6.105 [2009-08-11] UCD90120 Firmware v1.0.2 [2009-07-14] USB Adapter v1.0.10 [REC; 400 kHz]

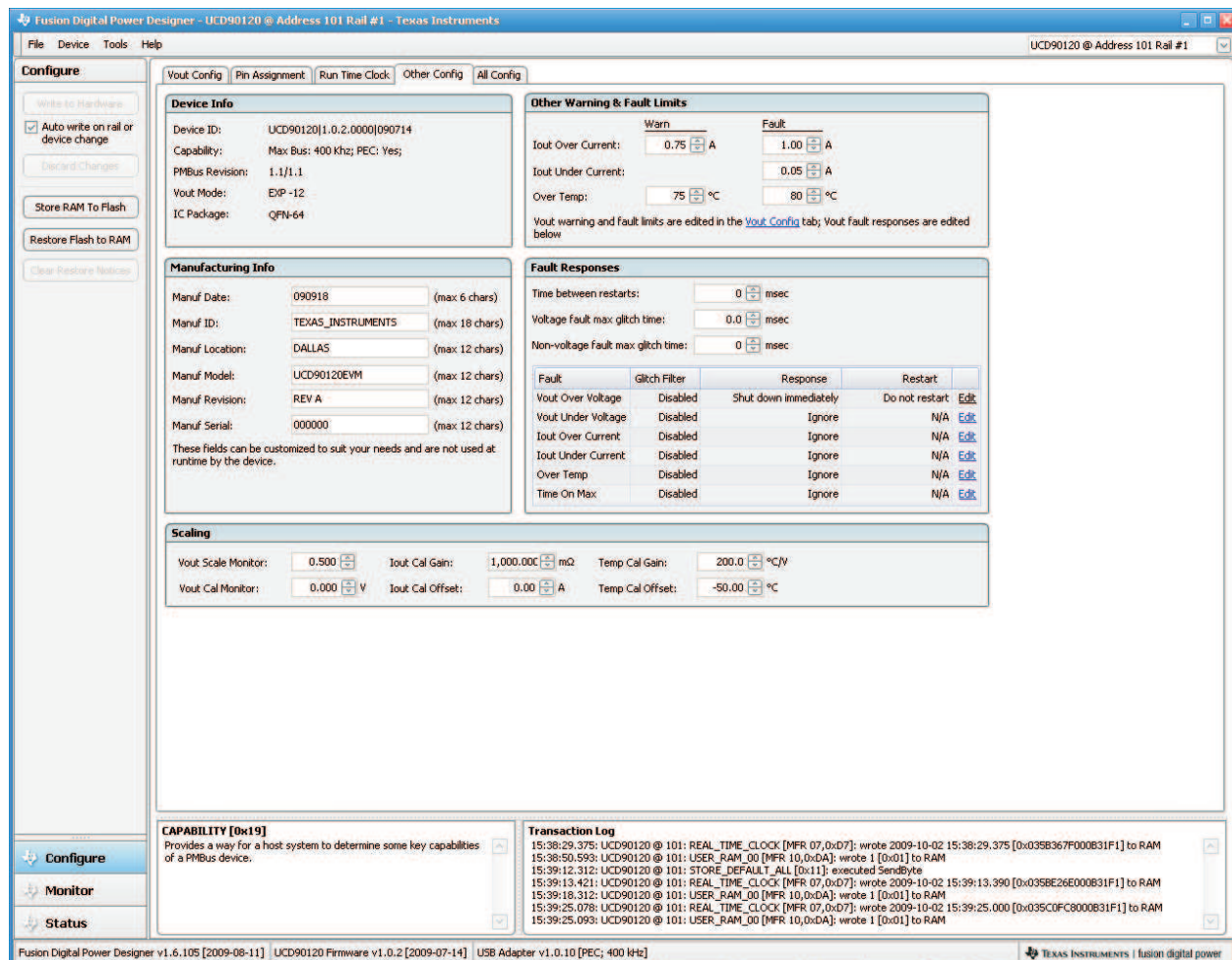
- Delete the current pin assignment for MON3 and add a current pin assignment to MON1.



- Choose MON3 then the GUI will switch back to the Pin Assignment tab.

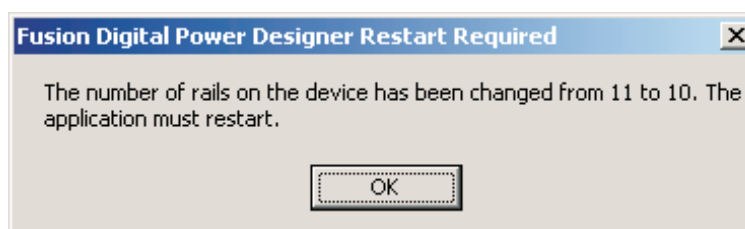


- Switch to the Other Config tab and enter Iout Cal Gain (1000) and Iout Cal Offset (0).



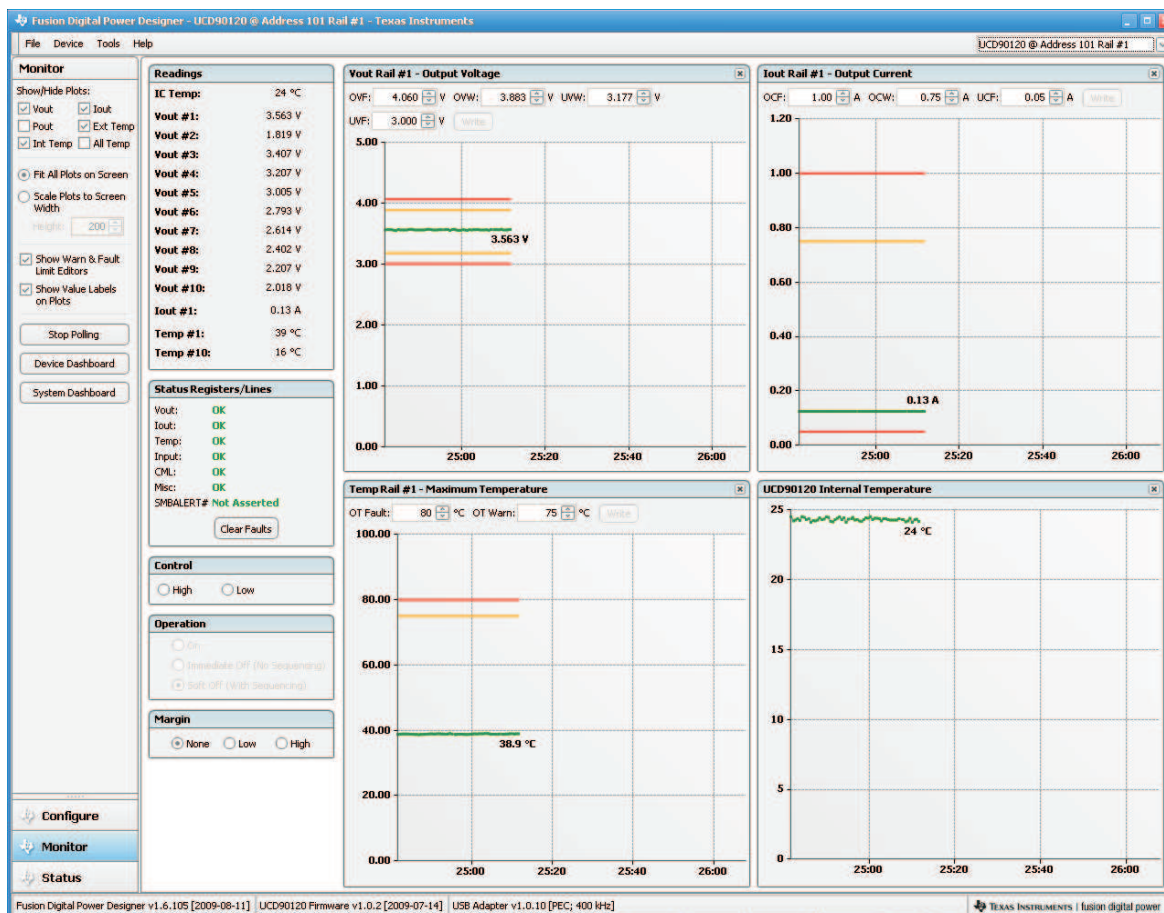
The screenshot shows the 'Fusion Digital Power Designer' software interface. The 'Other Config' tab is selected, displaying various configuration parameters for the UCD90120 device. The 'Device Info' section shows the device ID, capability, PMBus revision, Vout mode, and IC package. The 'Other Warning & Fault Limits' section shows limits for Iout Over Current, Iout Under Current, and Over Temp. The 'Fault Responses' section shows the response for various faults. The 'Scaling' section shows the Iout Cal Gain and Iout Cal Offset. The 'CAPABILITY [0x19]' section provides a way for a host system to determine some key capabilities of a PMBus device. The 'Transaction Log' section shows a list of transactions.

- Press the Write to Hardware Button and OK the window below. Fusion will restart.



- Once Fusion restarts, press the Store RAM to flash and accept the response.

- Press and release the EVM RESET (S1) button and the on EVM current monitor will provide rail #1 load current.



## 5.9 Closed Loop Voltage Margining

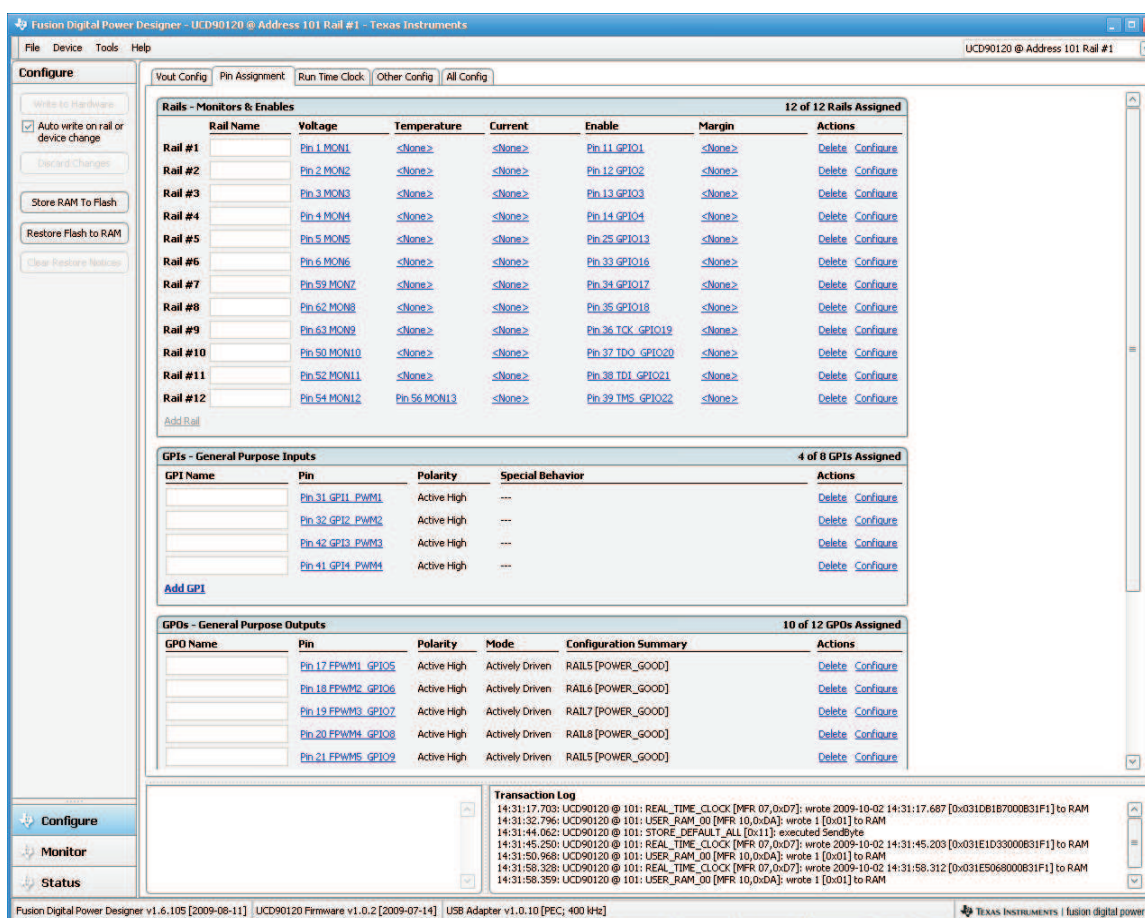
The output voltage of VR1-4 can be varied from nominal in a closed loop fashion for voltage margining. Four duty cycle modulated GPIO signals (FPWM1-4) are filtered to control the rail output voltage. Two GPIO – feedback node filter configurations are provided; simple R-C-R or R-C-buffer-R. Jumpers provide selection of either the simple or buffered method. Install J22, J25, J30, or J33 in either the RC (for R-C-R) or MRGx (for R-C-buffer-R).

### 5.9.1 Basic Process for Voltage Margining a Rail

A basic procedure to voltage margin rail #1, starting with the EVM default configuration will follow. For more information on voltage margining please refer to application note ([SLVA375](#)). Ensure that rail #1 is selected in the upper right corner.

**NOTE:** Ensure that S10 (STAT LED) is in the  $\overline{\text{EN}}$  position.

- While in the Configure section of the GUI, select the Pin Assignment tab



**Rails - Monitors & Enables** 12 of 12 Rails Assigned

| Rail Name | Voltage      | Temperature  | Current | Enable            | Margin | Actions          |
|-----------|--------------|--------------|---------|-------------------|--------|------------------|
| Rail #1   | Pin 1 MON1   | <None>       | <None>  | Pin 11 GPIO1      | <None> | Delete Configure |
| Rail #2   | Pin 2 MON2   | <None>       | <None>  | Pin 12 GPIO2      | <None> | Delete Configure |
| Rail #3   | Pin 3 MON3   | <None>       | <None>  | Pin 13 GPIO3      | <None> | Delete Configure |
| Rail #4   | Pin 4 MON4   | <None>       | <None>  | Pin 14 GPIO4      | <None> | Delete Configure |
| Rail #5   | Pin 5 MON5   | <None>       | <None>  | Pin 25 GPIO13     | <None> | Delete Configure |
| Rail #6   | Pin 6 MON6   | <None>       | <None>  | Pin 33 GPIO16     | <None> | Delete Configure |
| Rail #7   | Pin 59 MON7  | <None>       | <None>  | Pin 34 GPIO17     | <None> | Delete Configure |
| Rail #8   | Pin 62 MON8  | <None>       | <None>  | Pin 35 GPIO18     | <None> | Delete Configure |
| Rail #9   | Pin 63 MON9  | <None>       | <None>  | Pin 36 TDC GPIO19 | <None> | Delete Configure |
| Rail #10  | Pin 50 MON10 | <None>       | <None>  | Pin 37 TDC GPIO20 | <None> | Delete Configure |
| Rail #11  | Pin 52 MON11 | <None>       | <None>  | Pin 38 TDC GPIO21 | <None> | Delete Configure |
| Rail #12  | Pin 54 MON12 | Pin 56 MON13 | <None>  | Pin 39 TMS GPIO22 | <None> | Delete Configure |

[Add Rail](#)

**GPIs - General Purpose Inputs** 4 of 8 GPIs Assigned

| GPI Name | Pin              | Polarity    | Special Behavior | Actions          |
|----------|------------------|-------------|------------------|------------------|
|          | Pin 31 GPI1_PWM1 | Active High | ---              | Delete Configure |
|          | Pin 32 GPI2_PWM2 | Active High | ---              | Delete Configure |
|          | Pin 42 GPI3_PWM3 | Active High | ---              | Delete Configure |
|          | Pin 41 GPI4_PWM4 | Active High | ---              | Delete Configure |

[Add GPI](#)

**GPDs - General Purpose Outputs** 10 of 12 GPDs Assigned

| GPD Name | Pin                | Polarity    | Mode            | Configuration Summary | Actions          |
|----------|--------------------|-------------|-----------------|-----------------------|------------------|
|          | Pin 17 FFWM1_GPIO5 | Active High | Actively Driven | RAIL5 [POWER_GOOD]    | Delete Configure |
|          | Pin 18 FFWM2_GPIO6 | Active High | Actively Driven | RAIL6 [POWER_GOOD]    | Delete Configure |
|          | Pin 19 FFWM3_GPIO7 | Active High | Actively Driven | RAIL7 [POWER_GOOD]    | Delete Configure |
|          | Pin 20 FFWM4_GPIO8 | Active High | Actively Driven | RAIL8 [POWER_GOOD]    | Delete Configure |
|          | Pin 21 FFWM5_GPIO9 | Active High | Actively Driven | RAIL5 [POWER_GOOD]    | Delete Configure |

**Transaction Log**

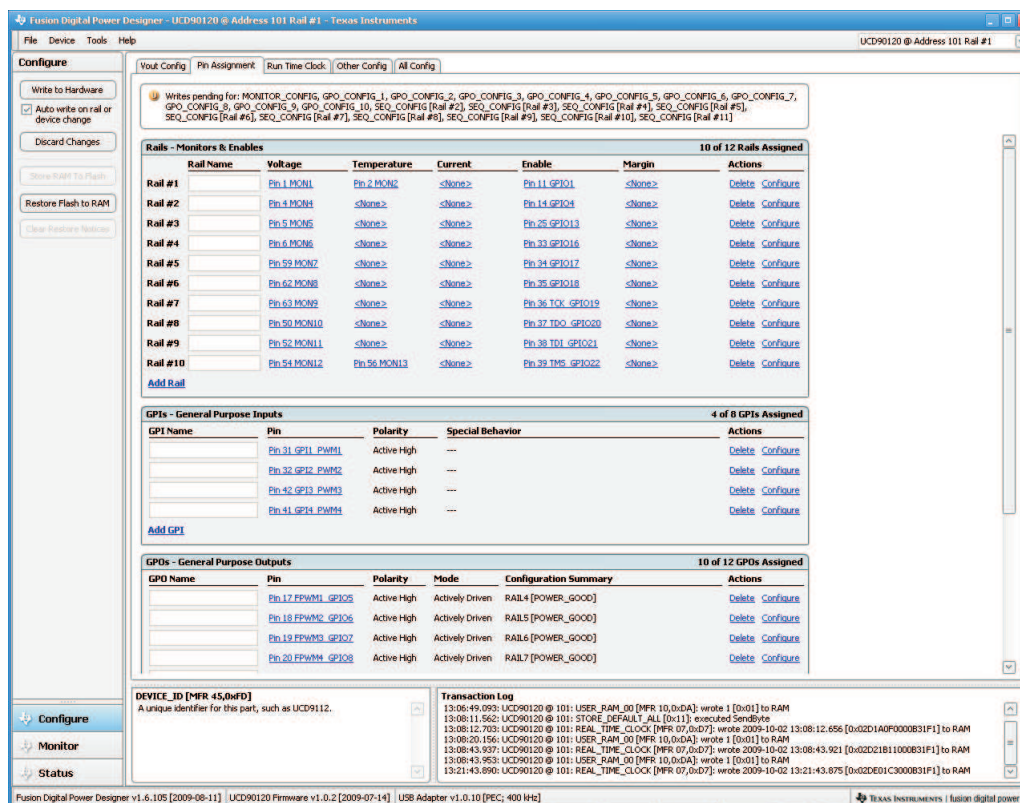
```

14:31:17.703: UCD90120 @ 101: REAL_TIME_CLOCK [MFR 07,0xD7]: wrote 2009-10-02 14:31:17.687 [0x031D61B7000B31F1] to RAM
14:31:32.796: UCD90120 @ 101: USER_RAM_00 [MFR 10,0xDA]: wrote 1 [0x01] to RAM
14:31:44.062: UCD90120 @ 101: STORE_DEFAULT_ALL [0x11]: executed SendByte
14:31:45.250: UCD90120 @ 101: REAL_TIME_CLOCK [MFR 07,0xD7]: wrote 2009-10-02 14:31:45.203 [0x031E1D33000B31F1] to RAM
14:31:50.968: UCD90120 @ 101: USER_RAM_00 [MFR 10,0xDA]: wrote 1 [0x01] to RAM
14:31:58.328: UCD90120 @ 101: REAL_TIME_CLOCK [MFR 07,0xD7]: wrote 2009-10-02 14:31:58.312 [0x031E5068000B31F1] to RAM
14:31:58.359: UCD90120 @ 101: USER_RAM_00 [MFR 10,0xDA]: wrote 1 [0x01] to RAM

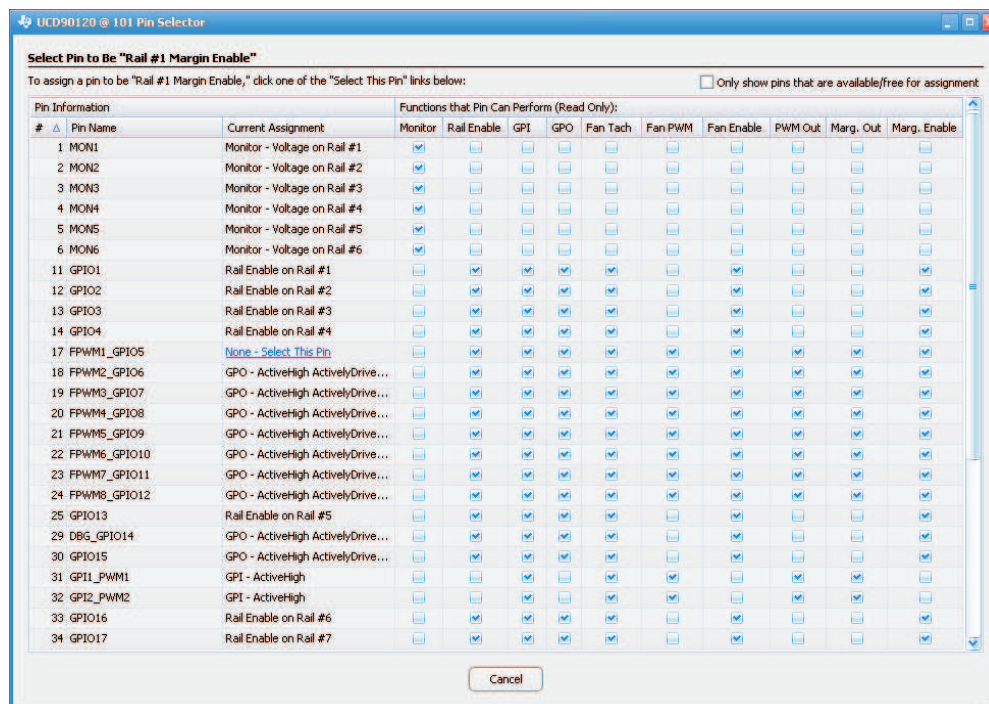
```

Fusion Digital Power Designer v1.6.105 [2009-08-11] UCD90120 Firmware v1.0.2 [2009-07-14] USB Adapter v1.0.10 [PEC; 400 MHz] TEXAS INSTRUMENTS | fusion digital power

- Delete the pin assignment for FPWM1 and select Margin on rail #1



- Choose FPWM1 then the GUI will switch back to the Pin Assignment tab.



- Click the Configure link for rail #1

**Rail #1 Voltage Monitor Type**

Voltage monitor type:

☒ Standard

☐ Hardware comparator (0 of 6 assigned)

The response time to an over/under voltage fault is faster with the hardware comparator. The hardware comparator option is only available with up to six monitored voltages. There is no glitch filtering when using the hardware comparator.

You can not use either of the "continue to operate" voltage fault responses (VOUT\_OV\_FAULT\_RESPONSE and VOUT\_UV\_FAULT\_RESPONSE) with a hardware comparator Voltage monitor.

**Rail #1 Enable Pin Configuration**

Polarity:                      Output Mode:

☐ Active Low                      ☒ Actively Driven

☒ Active High                      ☐ Open-Drain

**Rail #1 Margining**

PWM Config:

Duty Cycle:  %

Frequency:  MHz

FPWM1 shares the same frequency as FPWM2

Frequency can be 15.259 kHz to 125 MHz

Fault Config:

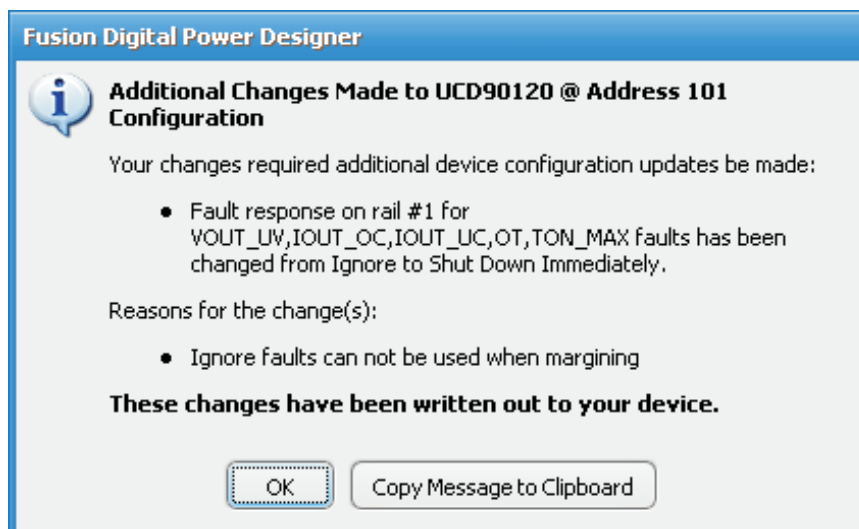
☐ Fine tune non-margining duty cycle

The first time that the rail is enabled for normal operation, the duty cycle is adjusted so that the monitored voltage is as close to VOUT\_COMMAND as possible.

☐ Ignore faults

When margining is enabled with a pin, this determines if faults (over-voltage and under-voltage) are ignored or not.

- Enter Duty Cycle in percent and Frequency.
- Press the Write to Hardware button and OK the window below (note that the window below may not always be present depending on the version of the GUI used).



- Install a shunt in the RC position of J22. Rail #1 and rail #2 may experience a fault and may turn off.
- Press the Store RAM to flash and accept the response.
- Press and release the EVM RESET (S1) button and rail #1 can now be voltage margined.
- Navigate to the GUI Monitor tab with rail #1 selected and toggle the margin window none-low-high-none switches. Note that rail #1 voltage margins.



## 5.10 Fan Interface

The UCD90124 provides support for up to four fans. The UCD90124EVM provides a single fan interface from J66. The UCD90124EVM interface can support three fan types including 2-wire, 3-wire, and 4-wire. The FAN connector has four terminals (12V, GND, Tach, and PWM).

### 5.10.1 Fan Tach Input

The fan tach signal is an input to the UCD90124 providing an indication of fan speed based on signal frequency. The EVM Tach input signal is conditioned prior to being connected to the UCD90124 and can interface with either a 3.3V or 5V signal using J72. Install a shunt in the TACH position of J67 to connect the conditioned signal to the UCD90124. The TACH signal at J66-2 is inverted by the conditioning circuitry prior to J67.

### 5.10.2 Fan PWM Output

The fan PWM signal is an output from the UCD90124 providing fan speed control using a pulse width modulated signal. The UCD90124 output signal can come from either PWM1 (J67 in the PWM position) or FPWM5 (J70 in the FPWM5 position). The PWM1 or FPWM5 output signal can directly drive the fan PWM input (four wire fan with J68 in the 4W position) or be conditioned prior the fan PWM input (two or three wire fan with J68 in the 2/3W position). When J68 is in the 2/3W position, the PWM signal at J66-3 can drive or modulate the ground of a two or three wire fan. When J68 is in the 2/3W position, the PWM signal at J66-3 can provide a 3.3V, 5V, or 12V level PWM signal with appropriately installed shunts on J69 for use with four wire fans. When J68 is in the 2/3W position, the PWM1 or FPWM5 signal at J70 is inverted by the conditioning circuitry prior to J66-3.

### 5.10.3 Fan Temperature Simulation

An onboard potentiometer (TEMP MON) can be used to simulate analog temperature when used in conjunction with the fan interface for fan speed control. The potentiometer voltage can be monitored at TP54 (TEMP MON) through MON12. Install a shunt in the 12E position of J61 and install J71 (EVR12). The potentiometer voltage can be varied from 0 to approximately 4.2V. This voltage is scaled by 2 before being sampled at MON12.

## 6 Bill of Materials

**Table 6. UCD90120/4EVM Bill of Materials**

| Count       |             | RefDes                                                                                | Value             | Description                                    | Size                      | Part Number       | MFR        |
|-------------|-------------|---------------------------------------------------------------------------------------|-------------------|------------------------------------------------|---------------------------|-------------------|------------|
| UCD90124EVM | UCD90120EVM |                                                                                       |                   |                                                |                           |                   |            |
| 2           | 2           | C1, C16                                                                               | 330 $\mu$ F       | Capacitor, Aluminum, 16V, $\pm$ 20%            | 0.328 $\times$ 0.328 inch | EEE-FK1C331P      | Panasonic  |
| 3           | 3           | C12, C13, C15                                                                         | 4.7 $\mu$ F       | Capacitor, Ceramic, 25V, X5R, 20%              | 0805                      | ECJ-2FB1E475M     | Panasonic  |
| 3           | 3           | C2, C3, C17                                                                           | 4.7 $\mu$ F       | Capacitor, Ceramic, 50V, X5R, 20%              | 1812                      | C4532X5R1H475MT   | TDK        |
| 3           | 3           | C25, C59, C65                                                                         | 1000 pF           | Capacitor, Ceramic, X7R, 16V, 10%              | 0603                      | Std               | Std        |
| 8           | 8           | C26, C27, C30, C31, C33, C34, C43, C44                                                | 10 $\mu$ F        | Capacitor, Ceramic, 10V, X5R, 10%              | 0805                      | C2012X5R1A106K    | TDK        |
| 2           | 2           | C28, C39                                                                              | 33 pF             | Capacitor, Ceramic, 50V, COG, 5%               | 0603                      | Std               | Std        |
| 4           | 4           | C32, C35, C41, C46                                                                    | 47 pF             | Capacitor, Ceramic, X7R, 16V, 10%              | 0603                      | Std               | Std        |
| 4           | 4           | C4, C23, C37, C45                                                                     | 0.01 $\mu$ F      | Capacitor, Ceramic, 50V, X7R, 10%              | 0603                      | C1608X7R1H103K    | TDK        |
| 3           | 3           | C40, C62, C63                                                                         | 22 pF             | Capacitor, Ceramic, 50V, COG, 5%               | 0603                      | Std.              | Std        |
| 9           | 9           | C42, C48, C49, C50, C51, C53–C56                                                      | 1.0 $\mu$ F       | Capacitor, Ceramic, X7R, 16V, 10%              | 0603                      | Std               | Std        |
| 1           | 1           | C5                                                                                    | 100 $\mu$ F       | Capacitor, Tantalum, 10V, 20%                  | 7343(D)                   | TPSD107M010R0080  | AVX        |
| 1           | 1           | C57                                                                                   | 1 $\mu$ F         | Capacitor, Ceramic, 25V, X7R, 20%              | 0805                      | Std               | Std        |
| 1           | 1           | C6                                                                                    | 100 $\mu$ F       | Capacitor, Tantalum, 10V, 10%                  | 6032                      | TAJC107K010R      | AVX        |
| 1           | 1           | C68                                                                                   | 1 $\mu$ F         | Capacitor, Tantalum, 16V, 20%                  | 3216                      | 293D105X0016A2T   | Vishay     |
| 3           | 3           | C7, C69, C71                                                                          | 10 $\mu$ F        | Capacitor, Tantalum, 10V, 20%                  | 3216                      | 293D106X0010A2T   | Vishay     |
| 23          | 23          | C8–C11, C14, C18–C22, C24, C29, C36, C38, C47, C52, C58, C60, C61, C64, C66, C67, C70 | 0.1 $\mu$ F       | Capacitor, Ceramic, X7R, 16V, 10%              | 0603                      | Std               | Std        |
| 2           | 2           | D1, D4                                                                                | B340A             | Diode, Schottky, 3A, 40V                       | SMA                       | B340A             | Diodes Inc |
| 1           | 1           | D11                                                                                   | BZX84B5V1LT1G     | Diode, Zener, 5.1-V, 2%, 225-mW                | SOT-23                    | BZX84B5V1LT1G     | Diodes     |
| 1           | 1           | D2                                                                                    | 10BQ015           | Diode, Schottky, 1A, 15V                       | SMB                       | 10BQ015           | IR         |
| 1           | 1           | D26                                                                                   | MMSZ5242BT1G      | Diode, Zener, 20-mA, 12-V, 0.5W                | SOD123                    | MMSZ5242BT1G      | On Semi    |
| 1           | 1           | D27                                                                                   | SMAJ24A           | Diode, Transient Voltage Suppressor, 400W, 24V | SMA                       | SMAJ24A           | Littlefuse |
| 15          | 15          | D29, D30, D32, D34, D36, D38, D40, D42, D44, D46–D49, D54, D55                        | LN1371G           | Diode, LED, Green, 20-mA, 0.9-mcd              | SMD                       | LN1371G           | Panasonic  |
| 1           | 1           | D3                                                                                    | TLV1117-33IDCY    | IC, Adj., 3.3 V, 800mA LDO Voltage Regulators  | SOT-223                   | TLV1117-33CDCY    | TI         |
| 15          | 15          | D5, D9, D14–D25, D28                                                                  | SML-LXT0805SRW-TR | Diode, LED, Red, 100 mA                        | 0805                      | SML-LXT0805SRW-TR | Lumex      |
| 4           | 4           | D50–D53                                                                               | GL05T             | Diode, TVS, Low Cap., V(RM) = 5 V, 300 W Pk.   | SOT-23                    | GL05T             | Vishay     |
| 1           | 1           | D56                                                                                   | SSF-LXH305GD-TR   | Diode, LED, Green, 20 mA, 30 mcd               | SMD                       | SSF-LXH305GD-TR   | Lumex      |

**Table 6. UCD90120/4EVM Bill of Materials (continued)**

| Count       |             | RefDes                                                                                                                                                                                      | Value         | Description                                                    | Size                | Part Number    | MFR         |
|-------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------------------------------------|---------------------|----------------|-------------|
| UCD90124EVM | UCD90120EVM |                                                                                                                                                                                             |               |                                                                |                     |                |             |
| 1           | 1           | D6                                                                                                                                                                                          | MBRA130       | Diode, Schottky, 1A, 30V                                       | SMA                 | MBRA130        | IR          |
| 1           | 1           | D7                                                                                                                                                                                          | 1SMB5922BT3G  | Diode, Zener, 7.5V, 3W                                         | SMB                 | 1SMB5922BT3G   | On Semi     |
| 12          | 12          | D8, D10, D12, D13, D31, D33, D35, D37, D39, D41, D43, D45                                                                                                                                   | LN1471Y       | Diode, LED, Amber, 20-mA, 0.4-mcd                              | 0.114 × 0.049 inch  | LN1471YTR      | Panasonic   |
| 3           | 3           | FB1, FB2, FB3                                                                                                                                                                               | 220 Ω         | Ferrite Bead, 2A, 0.050 mΩ                                     | 0805                | BLM21P221SN    | Murata      |
| 1           | 1           | J1                                                                                                                                                                                          | RAPC 712      | Connector, DC Jack, Pin dia.2.5mm, Shell dia 5.5mm             | 0.57 × 0.35 inch    | RAPC 712X      | Switchcraft |
| 2           | 2           | J18, J69                                                                                                                                                                                    | PEC04DAAN     | Header, Male 2x4-pin, 100mil spacing                           | 0.20 × 0.40 inch    | PEC04DAAN      | Sullins     |
| 1           | 1           | J2                                                                                                                                                                                          | ED120/2DS     | Terminal Block, 2-pin, 15-A, 5.1mm                             | 0.40 × 0.35 inch    | ED120/2DS      | OST         |
| 2           | 2           | J24, J28                                                                                                                                                                                    | PEC03DAAN     | Header, Male 2x3-pin, 100mil spacing                           | 0.20 inch × 0.30    | PEC03DAAN      | Sullins     |
| 1           | 1           | J3                                                                                                                                                                                          | UX60-MB-5ST   | Connector, Recpt, USB-B, Mini, 5-pins, SMT                     | 0.354in × 0.303in   | UX60-MB-5S8    | Hirose      |
| 29          | 29          | J4, J6, J7, J8, J11, J12, J13, J19, J21, J23, J26, J27, J29, J31, J38, J39, J40, J41, J46, J47, J52, J53, J58, J59, J64, J65, J71, J78, J79                                                 | PEC02SAAN     | Header, Male 2-pin, 100mil spacing,                            | 0.100 inch × 2      | PEC02SAAN      | Sullins     |
| 38          | 38          | J5, J10, J14, J15, J16, J17, J20, J22, J25, J30, J32, J33, J34, J35, J36, J37, J42, J43, J44, J45, J48, J49, J50, J51, J54, J55, J56, J57, J60, J61, J62, J63, J67, J68, J70, J72, J75, J76 | PEC03SAAN     | Header, Male 3-pin, 100mil spacing,                            | 0.100 inch × 3      | PEC03SAAN      | Sullins     |
| 1           | 1           | J66                                                                                                                                                                                         | ED120/4DS     | Terminal Block, 4-pin, 15-A, 5.1mm                             | 0.80 × 0.35 inch    | ED120/4DS      | OST         |
| 2           | 2           | J73, J74                                                                                                                                                                                    | PEC10DAAN     | Header, Male 2x10-pin, 100mil spacing                          | 0.100 inch × 10 × 2 | PEC10DAAN      | Sullins     |
| 1           | 1           | J77                                                                                                                                                                                         | N2510-6002-RB | Connector, Male Straight 2x10 pin, 100mil spacing, 4 Wall      | 0.338 × 0.788 inch  | N2510-6002-RB  | 3M          |
| 1           | 1           | J9                                                                                                                                                                                          | PEC07DAAN     | Header, Male 2x7 pin, 100mil spacing                           | 0.100 inch × 2×7    | PEC07DAAN      | Sullins     |
| 1           | 1           | L1                                                                                                                                                                                          | 33 μH         | Inductor, SMT, 2.2A, 75mΩ                                      | 0.484 × 0.484 inch  | MSS1260-333MLB | Coilcraft   |
| 2           | 2           | L2, L3                                                                                                                                                                                      | 2.2 μH        | Inductor, SMT, 1.5A, 110mΩ                                     | 0.118 × 0.118 inch  | LPS3015-222MLB | Coilcraft   |
| 1           | 1           | Q1                                                                                                                                                                                          | MMBT2222A     | Transistor, NPN, 40 V, 500 mA                                  | SOT-23              | MMBT2222A      | Fairchild   |
| 1           | 1           | Q2                                                                                                                                                                                          | FCX491A       | Transistor, NPN, 40V, 2A, 300 hfe                              | SOT89               | FCX491A        | Zetex       |
| 4           | 4           | Q3, Q4, Q11, Q12                                                                                                                                                                            | FDN5630       | MOSFET, N-ch, 60-V,1.7-A, 100-mΩ                               | SSOT3               | FDN5630        | Fairchild   |
| 1           | 1           | Q5                                                                                                                                                                                          | MMBT2907ALT1  | Transistor, PNP, -60V, -600mA, 225-W                           | SOT23               | MMBT2907ALT1   | On Semi     |
| 5           | 5           | Q6, Q7, Q8, Q9, Q10                                                                                                                                                                         | BSS84         | Transistor, PFET, -50 V, 130 mA, Rds(ON) < 10 Ω at V(gs) = 5 V | SOT-23              | BSS84          | Fairchild   |
| 1           | 1           | R1                                                                                                                                                                                          | 590           | Resistor, Chip, 1/10W, 1%                                      | 0805                | Std            | Std         |

**Table 6. UCD90120/4EVM Bill of Materials (continued)**

| Count       |             | RefDes                                                                                                                                                                   | Value | Description                         | Size          | Part Number   | MFR    |
|-------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------|---------------|---------------|--------|
| UCD90124EVM | UCD90120EVM |                                                                                                                                                                          |       |                                     |               |               |        |
| 10          | 10          | R11, R110, R111, R134, R135, R144, R145, R166, R167, R238                                                                                                                | 15.0K | Resistor, Chip, 1/16W, 1%           | 0603          | Std           | Std    |
| 1           | 1           | R116                                                                                                                                                                     | 158   | Resistor, Chip, 1/10W, 1%           | 0805          | Std           | Std    |
| 8           | 8           | R117, R119, R121, R123, R155, R157, R159, R161                                                                                                                           | 750   | Resistor, Chip, 1/10W, 1%           | 0805          | Std           | Std    |
| 1           | 1           | R118                                                                                                                                                                     | 191   | Resistor, Chip, 1/10W, 1%           | 0805          | Std           | Std    |
| 23          | 23          | R12, R17, R25, R32, R45, R59, R62, R66, R67, R70, R83, R87, R90, R91, R94, R177, R179, R235, R237, R239, R241, R251, R252                                                | 100K  | Resistor, Chip, 1/16W, 1%           | 0603          | Std           | Std    |
| 1           | 1           | R120                                                                                                                                                                     | 232   | Resistor, Chip, 1/10W, 1%           | 0805          | Std           | Std    |
| 1           | 1           | R122                                                                                                                                                                     | 280   | Resistor, Chip, 1/10W, 1%           | 0805          | Std           | Std    |
| 8           | 8           | R128, R129, R130, R131, R170, R171, R172, R173                                                                                                                           | 402   | Resistor, Chip, 1/10W, 1%           | 0805          | Std           | Std    |
| 29          | 29          | R15, R23, R30, R42, R154, R195, R203, R204, R205, R207, R208, R211, R212, R216, R217, R218, R219, R220, R221, R222, R223, R226, R227, R230, R231, R232, R233, R234, R236 | 332   | Resistor, Chip, 1/10W, 1%           | 0805          | Std           | Std    |
| 1           | 1           | R156                                                                                                                                                                     | 392   | Resistor, Chip, 1/10W, 1%           | 0805          | Std           | Std    |
| 1           | 1           | R158                                                                                                                                                                     | 464   | Resistor, Chip, 1/10W, 1%           | 0805          | Std           | Std    |
| 1           | 1           | R160                                                                                                                                                                     | 549   | Resistor, Chip, 1/10W, 1%           | 0805          | Std           | Std    |
| 1           | 1           | R186                                                                                                                                                                     | 5K    | Potentiometer, Multi-Turn, 3/8 Hole | 0.375 sq inch | 3386P-1-502LF | Bourns |
| 2           | 2           | R196, R197                                                                                                                                                               | 10K   | Resistor, Chip, 1/16 W, 5%          | 0603          | Std.          | Std.   |
| 2           | 2           | R8, R14                                                                                                                                                                  | 0     | Resistor, Chip, 1/16W, 1%           | 0603          | Std           | Std    |
| 0           | 0           | R2, R18                                                                                                                                                                  | 0     | Resistor, Chip, 1/16W, 1%           | 0603          | Std           | Std    |
| 2           | 2           | R20, R240                                                                                                                                                                | 200   | Resistor, Chip, 1/16W, 5%           | 0603          | Std           | Std    |
| 5           | 5           | R209, R210, R242, R243, R245                                                                                                                                             | 2.2K  | Resistor, Chip, 1/16 W, 5%          | 0603          | Std.          | Std.   |
| 1           | 1           | R213                                                                                                                                                                     | 1.00M | Resistor, Chip, 1/16 W, 1%          | 0603          | Std.          | Std.   |
| 3           | 3           | R214, R215, R255                                                                                                                                                         | 1.5K  | Resistor, Chip, 1/16 W, 5%          | 0603          | Std           | Std    |

**Table 6. UCD90120/4EVM Bill of Materials (continued)**

| Count       |             | RefDes                                                                                                                                                                                                                                                                            | Value | Description                | Size | Part Number | MFR  |
|-------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------------|------|-------------|------|
| UCD90124EVM | UCD90120EVM |                                                                                                                                                                                                                                                                                   |       |                            |      |             |      |
| 2           | 2           | R26, R53                                                                                                                                                                                                                                                                          | 20K   | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 2           | 2           | R27, R29                                                                                                                                                                                                                                                                          | 4.02K | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 63          | 63          | R3, R5, R6, R7, R9, R10, R13, R16, R19, R21, R22, R24, R28, R31, R33, R44, R96, R97, R98, R99–R103, R106–R109, R114, R115, R124, R125, R132, R133, R138, R139, R142, R143, R148, R149, R150–R153, R162, R163, R174–R176, R180–R182, R185, R187–R191, R194, R198, R200, R247, R248 | 10K   | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 24          | 24          | R34–R41, R43, R46–R48, R178, R224, R225, R228, R229, R249, R250, R253–R258                                                                                                                                                                                                        | 33    | Resistor, Chip, 1/16W, 5%  | 0603 | Std         | Std  |
| 1           | 1           | R4                                                                                                                                                                                                                                                                                | 3.24k | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 2           | 2           | R49, R51                                                                                                                                                                                                                                                                          | 84.5K | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 2           | 2           | R50, R52                                                                                                                                                                                                                                                                          | 36.5K | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 11          | 11          | R54, R183, R184, R192, R193, R199, R201, R202, R206, R244, R246                                                                                                                                                                                                                   | 1K    | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 6           | 6           | R55, R68, R76, R88, R89, R92                                                                                                                                                                                                                                                      | 30.1K | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 1           | 1           | R56                                                                                                                                                                                                                                                                               | 732K  | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 1           | 1           | R57                                                                                                                                                                                                                                                                               | 374   | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 24          | 24          | R58, R61, R71, R73, R79, R80, R93, R95, R104, R105, R112, R113, R126, R127, R136, R137, R140, R141, R146, R147, R164, R165, R168, R169                                                                                                                                            | 7.50K | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 2           | 2           | R60, R69                                                                                                                                                                                                                                                                          | 150K  | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 2           | 2           | R63, R72                                                                                                                                                                                                                                                                          | 1.20M | Resistor, Chip, 1/16 W, 1% | 0603 | Std.        | Std. |
| 1           | 1           | R64                                                                                                                                                                                                                                                                               | 681K  | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |
| 1           | 1           | R65                                                                                                                                                                                                                                                                               | 316   | Resistor, Chip, 1/16W, 1%  | 0603 | Std         | Std  |

**Table 6. UCD90120/4EVM Bill of Materials (continued)**

| Count       |             | RefDes                                                                                                                                                                        | Value           | Description                                   | Size               | Part Number     | MFR        |
|-------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------------------|--------------------|-----------------|------------|
| UCD90124EVM | UCD90120EVM |                                                                                                                                                                               |                 |                                               |                    |                 |            |
| 1           | 1           | R74                                                                                                                                                                           | 24              | Resistor, Chip, 1W, 5%                        | 2512               | STD             | STD        |
| 1           | 1           | R75                                                                                                                                                                           | 0.1             | Resistor, Chip, 1/2W, 1%                      | 2010               | STD             | STD        |
| 2           | 2           | R77, R78                                                                                                                                                                      | 10              | Resistor, Chip, 1/16W, 1%                     | 0603               | Std             | Std        |
| 1           | 1           | R81                                                                                                                                                                           | 31.6K           | Resistor, Chip, 1/16W, 1%                     | 0603               | Std             | Std        |
| 1           | 1           | R82                                                                                                                                                                           | 14.3K           | Resistor, Chip, 1/16W, 1%                     | 0603               | Std             | Std        |
| 1           | 1           | R84                                                                                                                                                                           | 243             | Resistor, Chip, 1/16W, 1%                     | 0603               | Std             | Std        |
| 1           | 1           | R85                                                                                                                                                                           | 49              | Resistor, Chip, 1/16W, 5%                     | 0603               | Std             | Std        |
| 1           | 1           | R86                                                                                                                                                                           | 162K            | Resistor, Chip, 1/16W, 1%                     | 0603               | Std             | Std        |
| 1           | 1           | RT1                                                                                                                                                                           | 5 Ohms          | Inrush current limiter, 4.7A, 0.11 $\Omega$   | 0.180 × 0.550      | CL-150          | GE Sensing |
| 1           | 1           | S1                                                                                                                                                                            | KT11P2JM34LFS   | Switch, SPST, PB Momentary, Sealed Washable   | 0.245 × 0.251      | KT11P2JM34LFS   | C & K      |
| 1           | 1           | S10                                                                                                                                                                           | EG1218          | Switch, 1P2T, Slide, PC-mount, 200-mA         | 0.46 × 0.16        | EQ1218          | E_Switch   |
| 8           | 8           | S2, S3, S4, S5, S6, S7, S8, S9                                                                                                                                                | MHS12304        | Switch, ON-OFF-ON Miniature Slide             | 0.268 × 0.630 inch | MHS12304        | Tyco       |
| 2           | 2           | TP1, TP2                                                                                                                                                                      | 5010            | Test Point, Red, Thru Hole                    | 0.125 × 0.125 inch | 5010            | Keystone   |
| 6           | 6           | TP11, TP17, TP37, TP43, TP55, TP63                                                                                                                                            | 5011            | Test Point, Black, Thru Hole                  | 0.125 × 0.125 inch | 5011            | Keystone   |
| 32          | 32          | TP3, TP4, TP6, TP9, TP12, TP14, TP18, TP19, TP20, TP24–TP27, TP32, TP33, TP36, TP38, TP39, TP40, TP44, TP45, TP48, TP49, TP54, TP56, TP57, TP58, TP61, TP62, TP65, TP66, TP67 | 5012            | Test Point, White, Thru Hole                  | 0.125 × 0.125 inch | 5012            | Keystone   |
| 26          | 26          | TP5, TP8, TP10, TP13, TP15, TP16, TP21, TP22, TP23, TP28, TP29, TP30, TP31, TP34, TP35, TP41, TP42, TP46, TP47, TP50, TP51, TP52, TP53, TP59, TP60, TP64                      | 5014            | Test Point, Yellow, Thru Hole                 | 0.125 × 0.125 inch | 5014            | Keystone   |
| 6           | 6           | TP68–TP73                                                                                                                                                                     | 5016            | Test Point, SM, 0.150 × 0.090"                | 0.185 × 0.135      | 5016            | Keystone   |
| 1           | 1           | TP7                                                                                                                                                                           | 5013            | Test Point, Orange, Thru Hole                 | 0.125 × 0.125 inch | 5013            | Keystone   |
| 1           | 1           | U1                                                                                                                                                                            | TPS5420D        | IC, Switching Step-Down Regulator, 36V, 2A    | SO8                | TPS5420D        | TI         |
| 2           | 2           | U10, U11                                                                                                                                                                      | SN74LV126ADBR   | IC, Quad Bus Buffer with 3-State Outputs      | VSSOP-14           | SN74LV126ADBR   | TI         |
| 1           | 1           | U12                                                                                                                                                                           | SN74LVC2G125DCU | IC, Dual Bus Buffer with 3-State Outputs      | VSSOP-8            | SN74LVC2G125DCU | TI         |
| 1           | 1           | U13                                                                                                                                                                           | 24LC64-I/SN     | IC, Serial EEPROM, 64K, 2.5-5.5V, 400 kHz Max | SO-8               | 24LC64-I/SN     | Microchip  |

**Table 6. UCD90120/4EVM Bill of Materials (continued)**

| Count       |             | RefDes | Value            | Description                                                            | Size          | Part Number      | MFR       |
|-------------|-------------|--------|------------------|------------------------------------------------------------------------|---------------|------------------|-----------|
| UCD90124EVM | UCD90120EVM |        |                  |                                                                        |               |                  |           |
| 1           | 1           | U14    | SN74CBTLV3125DBQ | IC, Low Voltage Quad FET Bus Switch                                    | TSSOP-16      | SN74CBTLV3125DBQ | TI        |
| 1           | 1           | U15    | TUSB3210PM       | IC, USB, General Purpose Device Controller                             | PQFP-64       | TUSB3210PM**     | TI        |
| 1           | 1           | U16    | TPS76333DBV      | IC, Micro-Power 100 mA LDO Regulator                                   | SOT23-5       | TPS76333DBV      | TI        |
| 2           | 2           | U2, U3 | SN74LVC2G04DBV   | IC, Dual Schmitt-Trigger Inverter                                      | SOT23-6       | SN74LVC2G04DBV   | TI        |
| 0           | 1           | U4     | UCD90120RGC      | IC, Digital PWM System Controller                                      | PFC-64        | UCD90120RGC      | TI        |
| 1           | 0           | U4     | UCD90124RGC      | IC, Digital PWM System Controller w/Fan Control                        | PFC-64        | UCD90124RGC      | TI        |
| 1           | 1           | U5     | TPS62420DRC      | IC, 2.25 MHz Dual Step Down Converter                                  | QFN10         | TPS62420DRC      | TI        |
| 1           | 1           | U6     | TLC274CD         | IC, CMOS, Quad Operational Amplifier                                   | SO14          | TLC274CD         | TI        |
| 1           | 1           | U7     | MCP9700T-E       | IC, Low-Power Voltage output Temperature Sensor                        | SC70-5        | MCP9700T-E       | Microchip |
| 1           | 1           | U8     | INA196AIDBV      | IC, Current Shunt Monitor, –16V to 80V Common-Mode Range               | SOT23-5       | INA196AIDBV      | TI        |
| 1           | 1           | U9     | TPS71202DRC      | IC, Dual 250mA Output, Ultralow Noise, High PSRR, LDO Linear Regulator | DRC10         | TPS71202DRC      | TI        |
| 1           | 1           | Y1     | 12MHZ            | Crystal, 12-MHz, 20 pF, ±50 PPM at 25C                                 | 0.185 × 0.532 | CY12BPSMD        | Crystek   |
| 57          | 57          | –      |                  | Shunt, Black                                                           | 100-mil       | 929950-00        | 3M        |
| 4           | 4           |        | SJ-5003          | BUMPON HEMISPHERE 0.44×0.20 BLACK                                      |               | SJ-5003          | 3M        |
| 1           | 1           | –      |                  | PCB, 6 In × 5 In × 0.062 In                                            |               | HPA459           | Any       |
| 1           | 1           |        |                  | USB Cable, 5-pin, B-Mini Male to Type A Male, 2m                       |               | AK672M/2-2-R     | Assman    |

## 7 Layout Guidelines, EVM Schematic, and Assembly Drawings

### 7.1 Layout Guidelines

#### Thermal pad

The thermal pad provides a thermal and mechanical interface between the device and the printed circuit board (PCB). While device power dissipation is not of primary concern, a more robust thermal interface can help the internal temperature sensor provide a better representation of PCB temperature. Connect the exposed thermal pad of the PCB to the device VSS pins and provide at least a 4 × 4 pattern of PCB vias to connect the thermal pad and VSS pins to the circuit ground on other PCB layers.

#### Supply voltage decoupling

Provide power supply pin bypass to the device as follows:

- 0.1μF, X7R ceramic in parallel with 0.01μF, X7R ceramic at pin 47 (BPCAP)
- 0.1μF, X7R ceramic in parallel with 4.7μF, X5R ceramic at pin 44 (V33D)
- 0.1μF, X7R ceramic at pin 7 (V33DIO)
- 0.1μF, X7R ceramic in parallel with 4.7μF, X5R ceramic at pin 46 (V33A)

#### Digital output signals

Depending on use and application of the various GPIO signals used as digital outputs, some impedance control may be desired to quiet fast signal edges. For example, when using the FPWM pins for fan control or voltage margining the pin will be configured as a digital *clock* signal. Route these signals away from sensitive analog signals. It is also good design practice to provide a series impedance of 20–33 Ω at the signal source to slow fast digital edges.

#### PMBus clock and data

Route PMBUS\_CLK and PMBUS\_DATA in a careful fashion away from sensitive analog signals. Provide a series impedance of 20–33 Ω at the signal source.

### 7.2 EVM Schematic

The searchable PDF of the schematic is appended to this User's Guide.

### 7.3 Assembly Drawings

The assembly drawings are appended to this User's Guide. The topside and bottomside component layouts are searchable.

## Evaluation Board/Kit Important Notice

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

**EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.**

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit [www.ti.com/esh](http://www.ti.com/esh).

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

## FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

## EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 0 V to 20 V and the output voltage range of 0 V to 5 V .

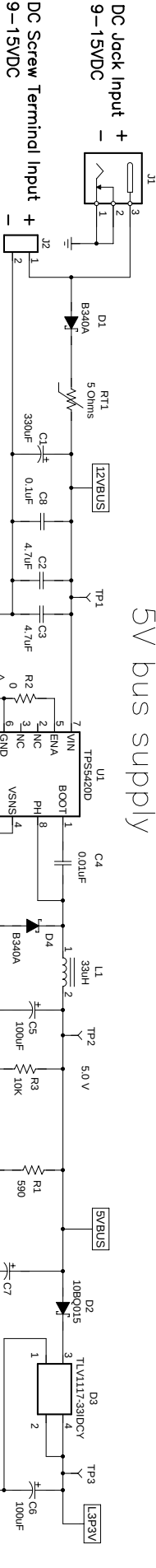
Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 85°C. The EVM is designed to operate properly with certain components above 85°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.

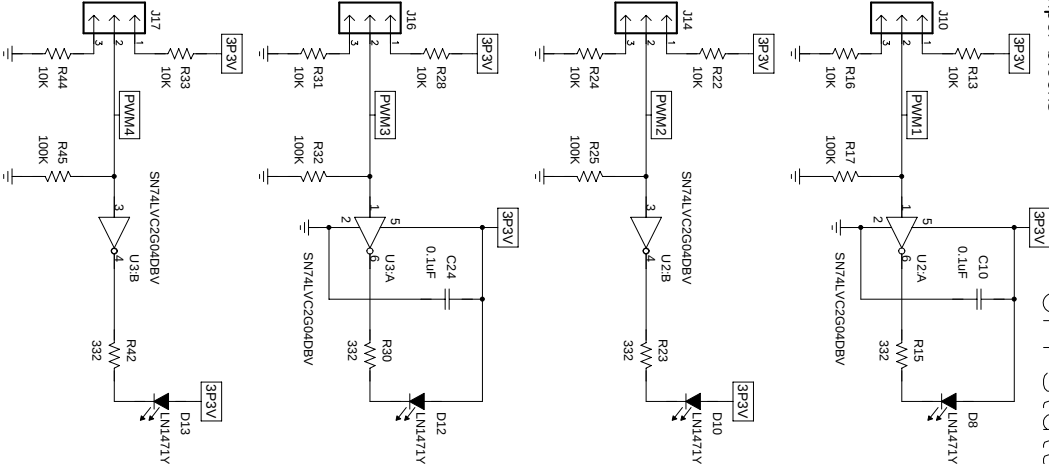
Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2010, Texas Instruments Incorporated

- UCD90120/4EVM
1. UCD90120/4
  2. Main power bus
  3. Communication (UAR/T, JTAG)



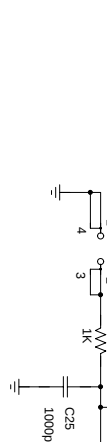
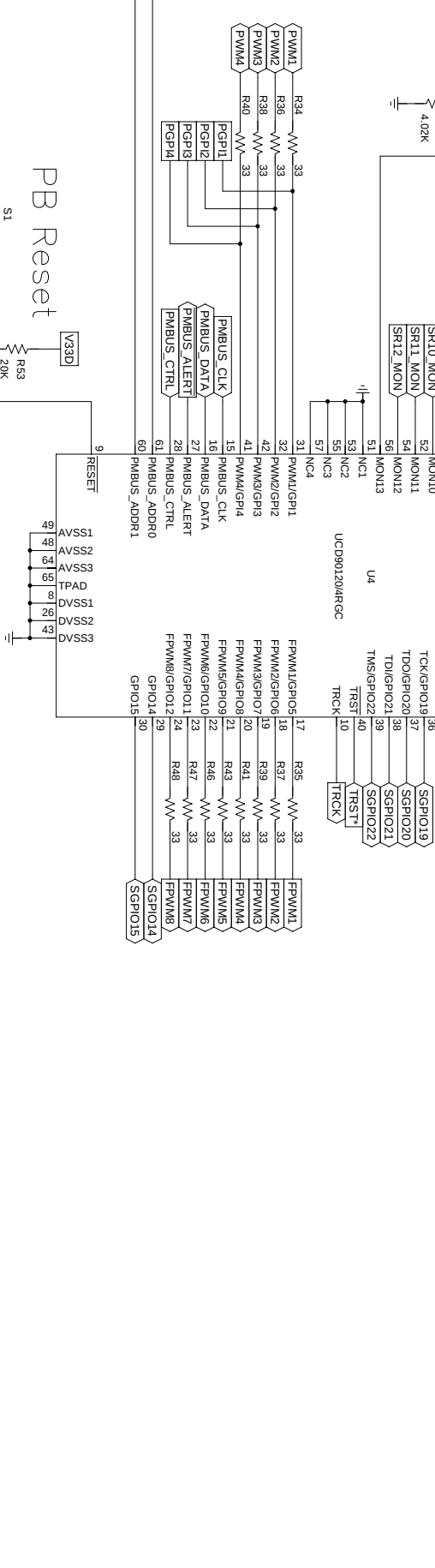
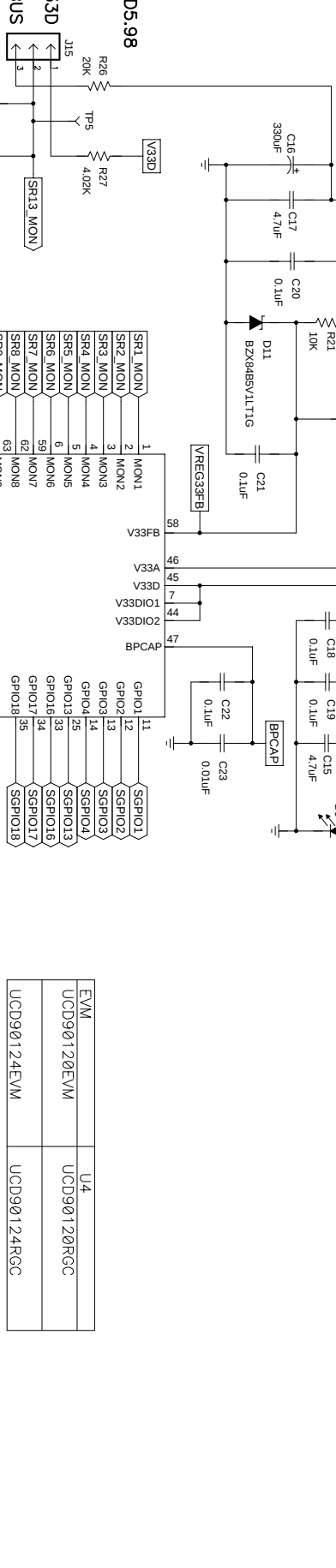
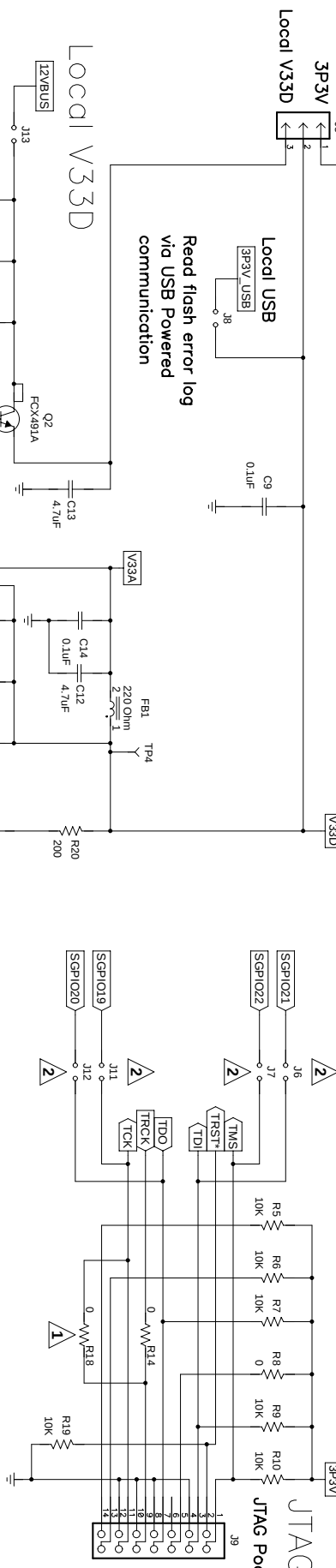
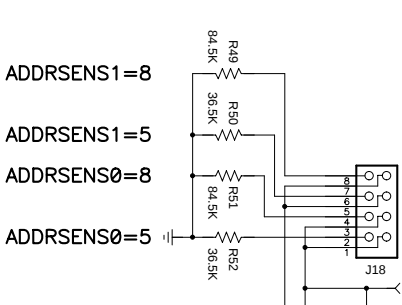
GPI pullup/pulldown jumper blocks

GPI Status LEDs



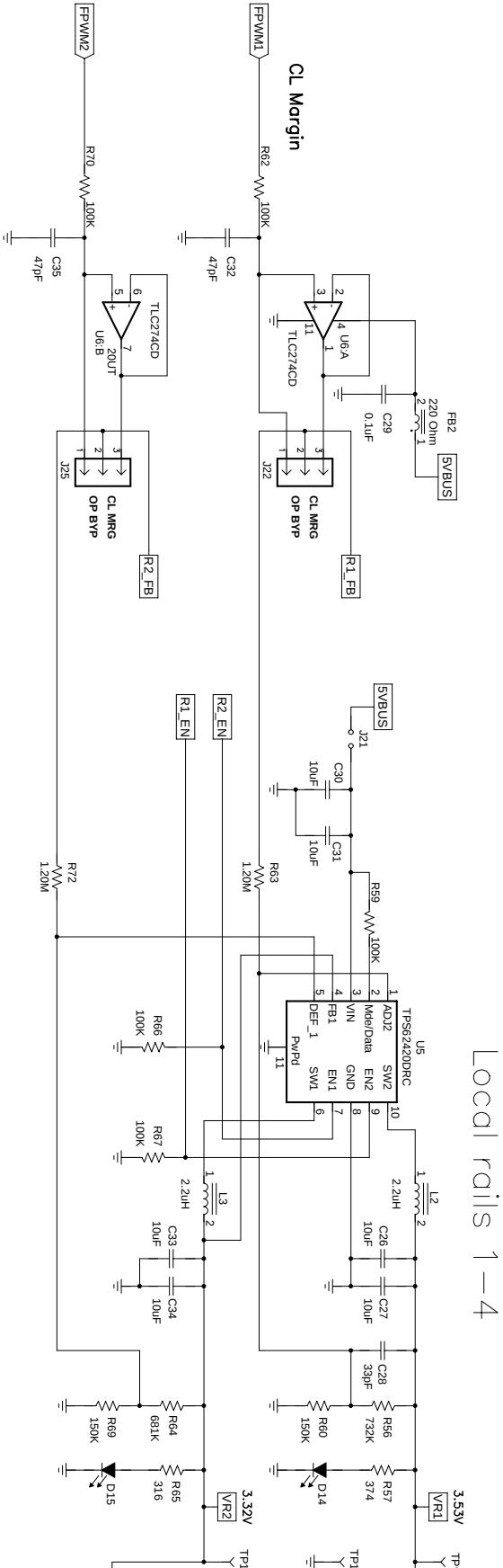
PMBus Address

12\*ADDRSENS1 + ADDRSENS0

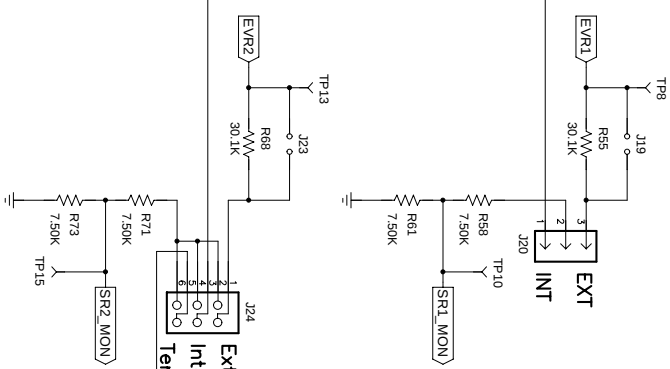


|          |                  |                      |  |               |      |
|----------|------------------|----------------------|--|---------------|------|
| Title    |                  | TEXAS INSTRUMENTS    |  | UCD90120/4EVM |      |
| Size     | Number           | HPA459               |  | Rev           |      |
| D        | HPA459           |                      |  | A             |      |
| Date     | Mon Oct 05, 2009 | Drawn by Eric Wright |  |               |      |
| Filename | HPA459A_TTFONT   | Sheet                |  | 1             | of 4 |

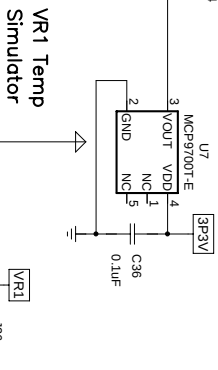
- UCD90120/4EVM
1. Local power supply rails 1–4
  2. Closed loop margining
  3. Current/temperature monitor



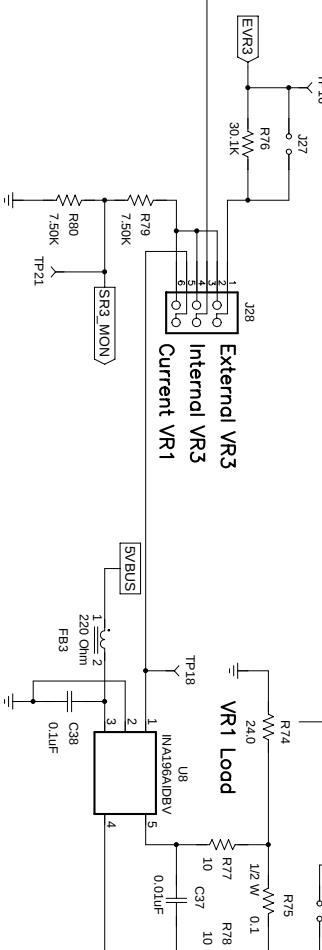
EXTERNAL PS IN  
15V MAX (/6) w/o JPR  
5V MAX (/2) w JPR



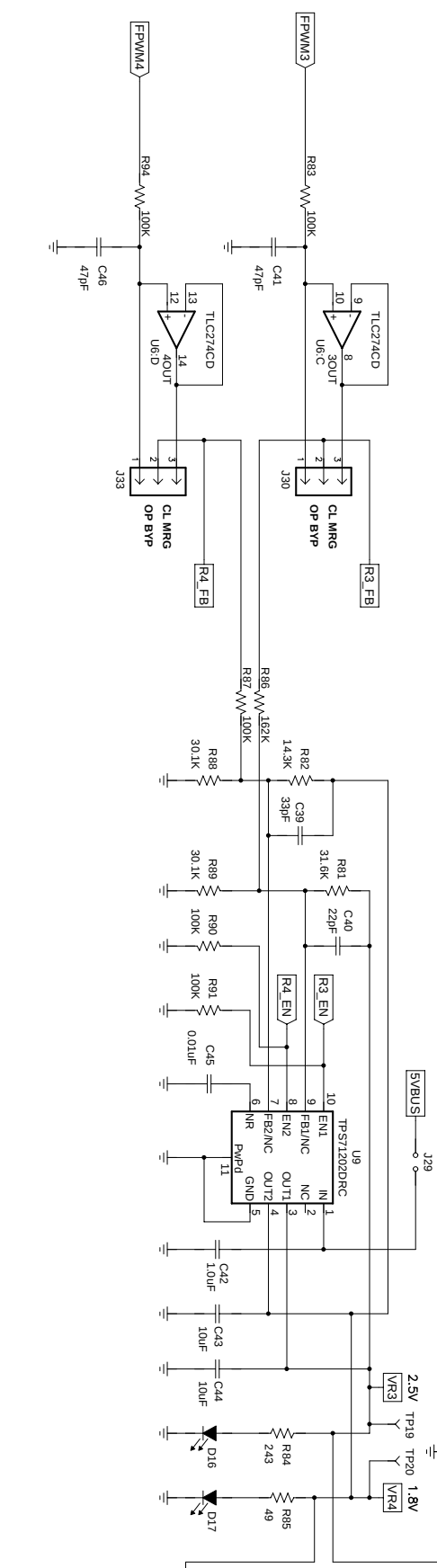
VR1 Load Temp Sensor  
Temp (C) = 100Vout-50



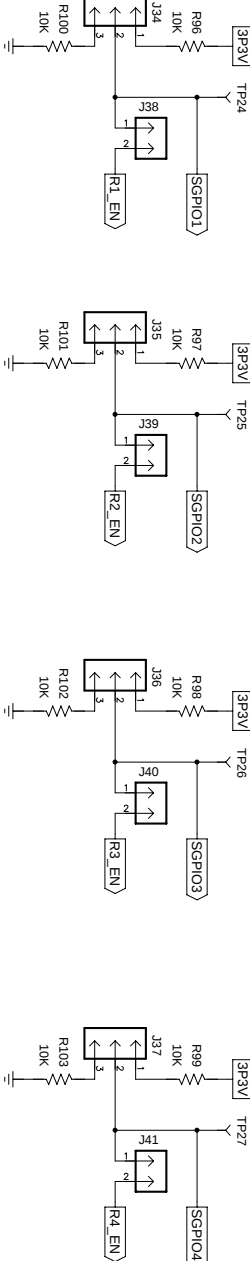
VR1 Temp Simulator



VR1 Current Monitor (2V/A)



Enable pullup/pulldown  
jumper blocks

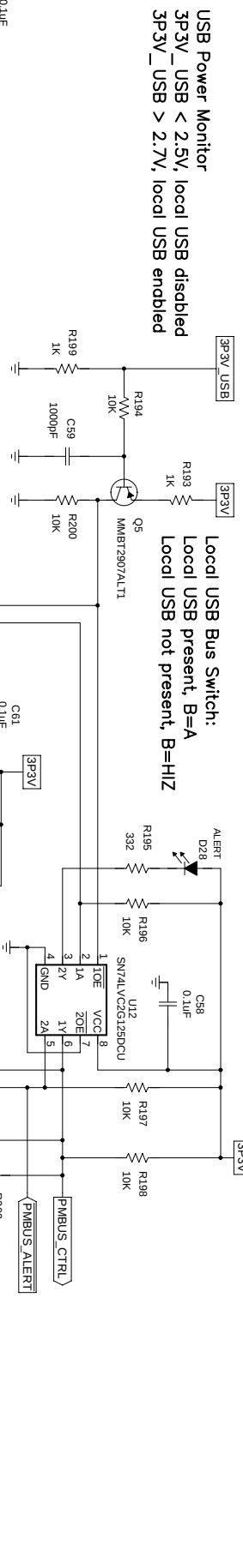
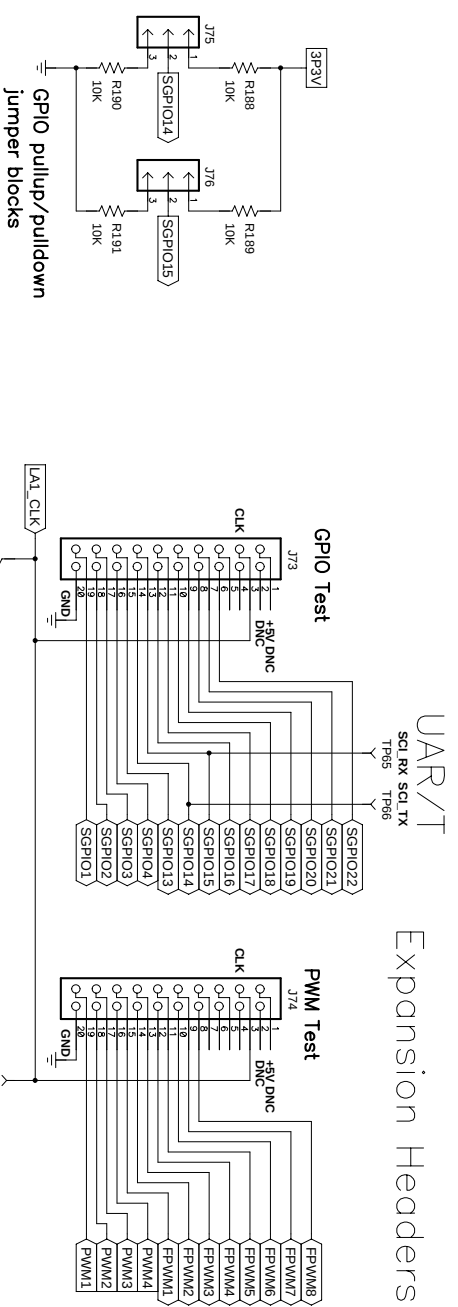


| Title    |  |                |  | TEXAS INSTRUMENTS |  |             |  | UCD90120/4EVM |  |   |  |
|----------|--|----------------|--|-------------------|--|-------------|--|---------------|--|---|--|
| Size     |  | Number         |  | Date              |  | Drawn by    |  | Rev           |  |   |  |
| D        |  | HPA459         |  | Mon Oct 05, 2009  |  | Eric Wright |  | A             |  |   |  |
| Filename |  | HPA459A_TTFONT |  | Sheet             |  | 2           |  | of            |  | 4 |  |

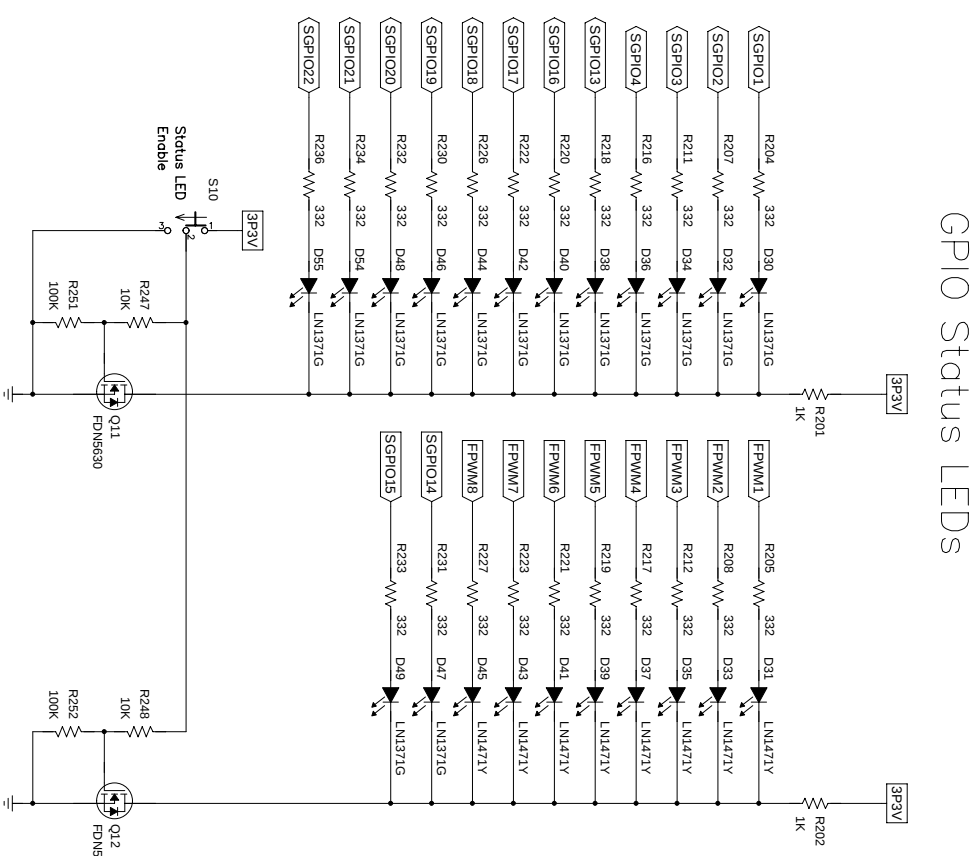
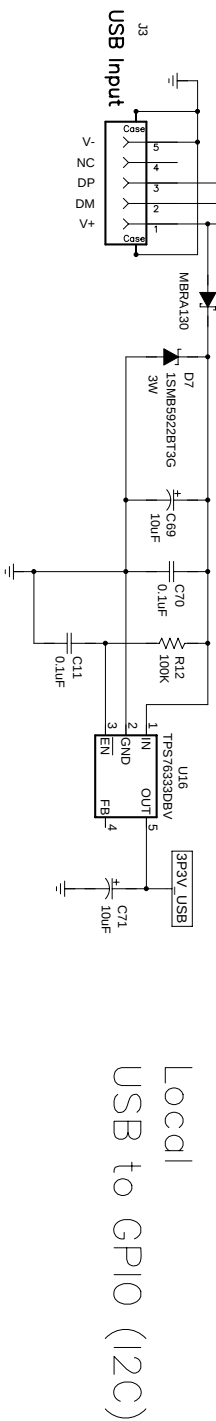
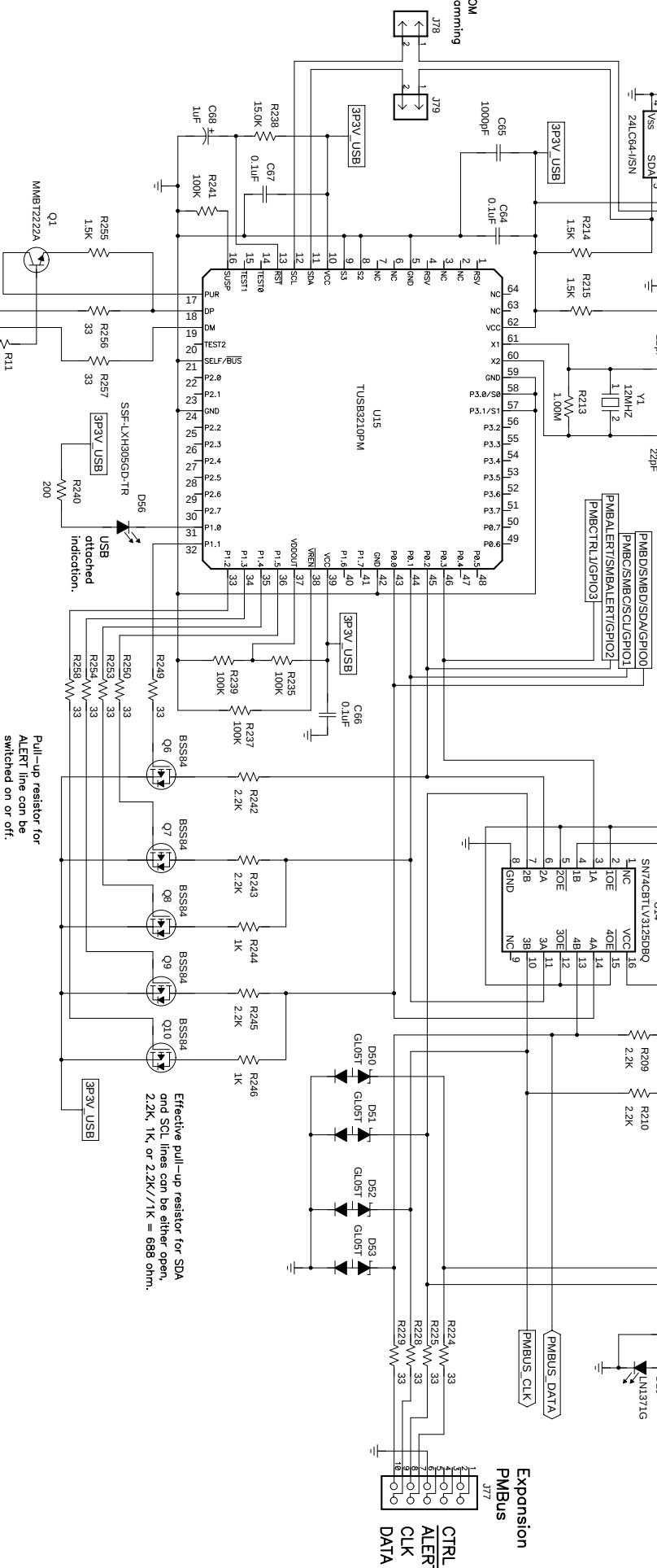


## UCD90120/4EVM

1. Expansion headers
2. Status LED's
3. Communication  
(Local/external PMBUS/USB-I2C)

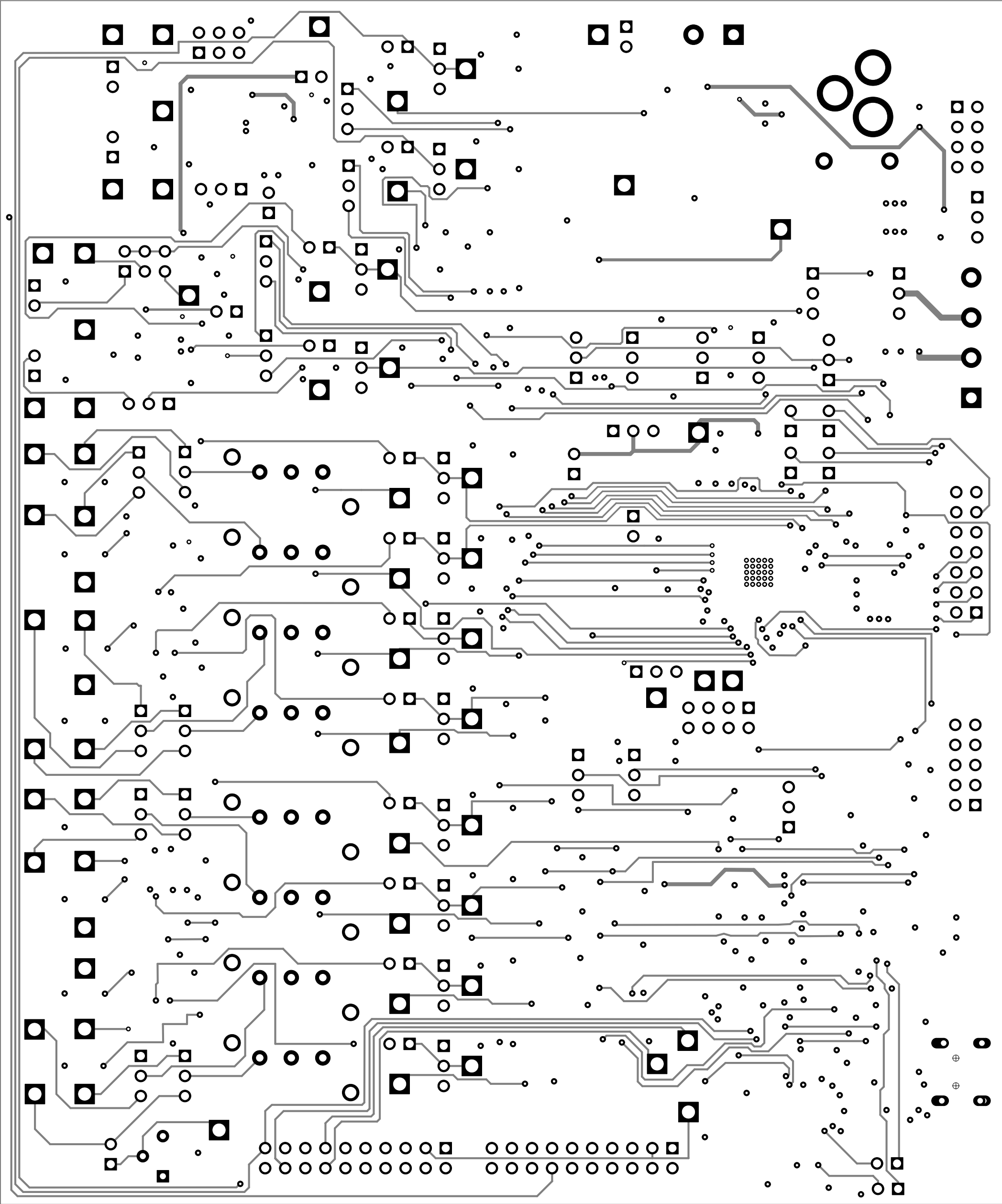


When local USB is not present,  
PMBUS\_CTRL is low (CTRL\_LED OFF)

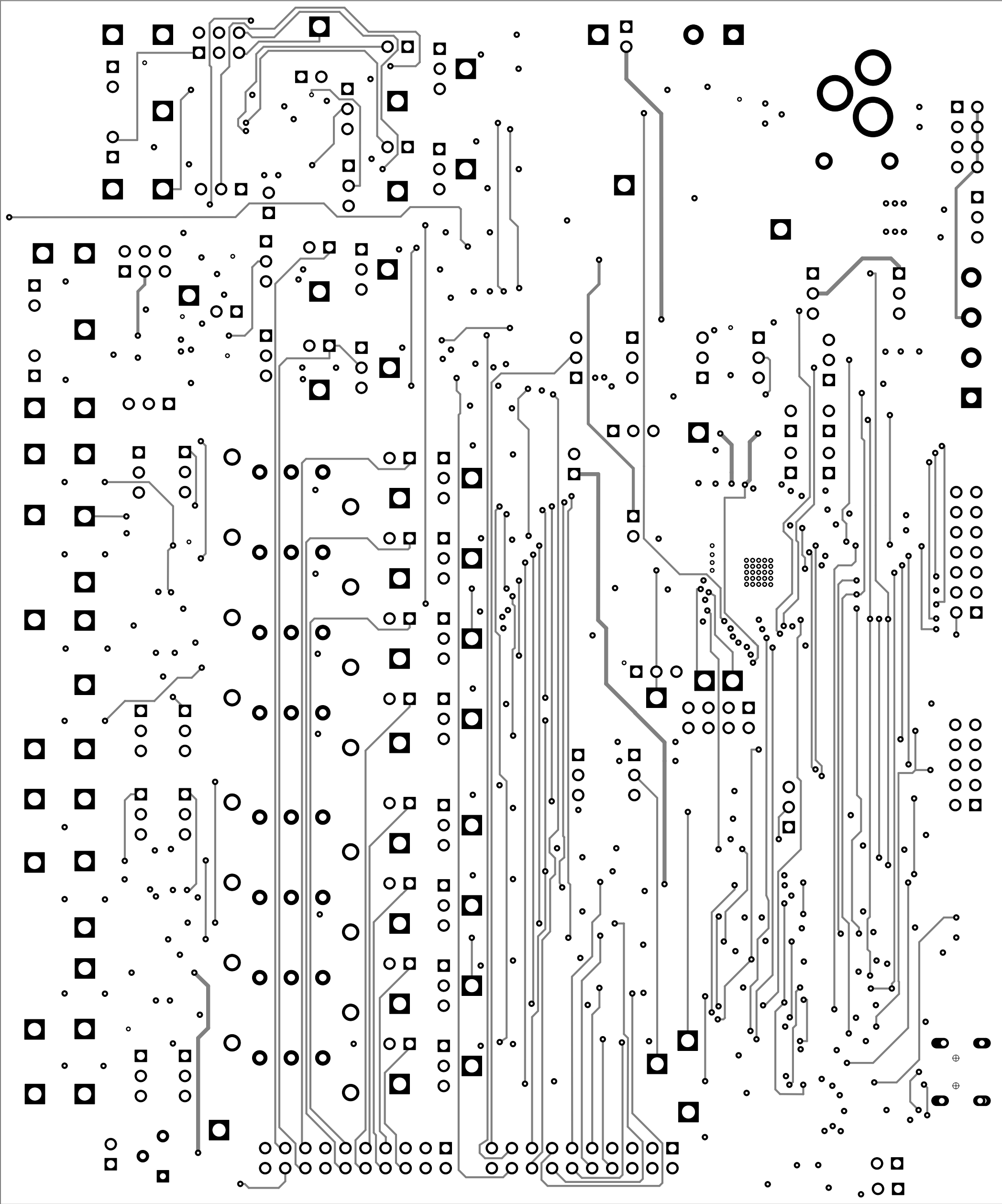


|          |                  |                      |       |               |      |
|----------|------------------|----------------------|-------|---------------|------|
| Title    |                  | TEXAS INSTRUMENTS    |       | UCD90120/4EVM |      |
| Size     | Number           |                      |       | Rev           |      |
| D        | HPA459           |                      |       | A             |      |
| Date     | Mon Oct 05, 2009 | Drawn by Eric Wright |       |               |      |
| Filename | HPA459A_TTFONT   |                      | Sheet | 4             | of 4 |



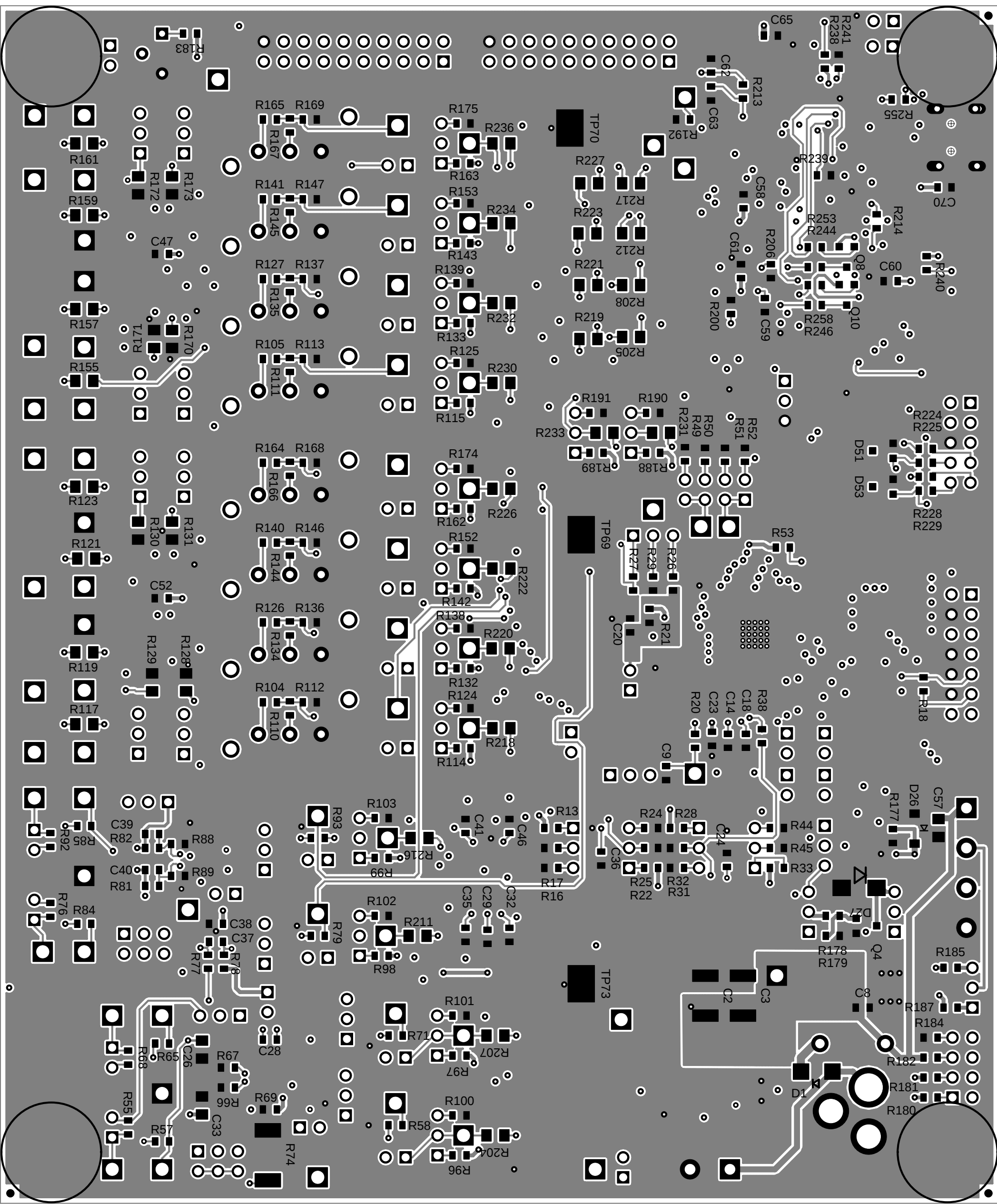


Layer 2 Routing



Layer 3 Routing

Bottom Layer  
Placement/Routing



## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

| Products                    |                                                                    | Applications               |                                                                                          |
|-----------------------------|--------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------------------|
| Amplifiers                  | <a href="http://amplifier.ti.com">amplifier.ti.com</a>             | Audio                      | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                                   |
| Data Converters             | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     | Automotive                 | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>                         |
| DLP® Products               | <a href="http://www.dlp.com">www.dlp.com</a>                       | Communications and Telecom | <a href="http://www.ti.com/communications">www.ti.com/communications</a>                 |
| DSP                         | <a href="http://dsp.ti.com">dsp.ti.com</a>                         | Computers and Peripherals  | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
| Clocks and Timers           | <a href="http://www.ti.com/clocks">www.ti.com/clocks</a>           | Consumer Electronics       | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Interface                   | <a href="http://interface.ti.com">interface.ti.com</a>             | Energy                     | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Logic                       | <a href="http://logic.ti.com">logic.ti.com</a>                     | Industrial                 | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
| Power Mgmt                  | <a href="http://power.ti.com">power.ti.com</a>                     | Medical                    | <a href="http://www.ti.com/medical">www.ti.com/medical</a>                               |
| Microcontrollers            | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> | Security                   | <a href="http://www.ti.com/security">www.ti.com/security</a>                             |
| RFID                        | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>               | Space, Avionics & Defense  | <a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a> |
| RF/IF and ZigBee® Solutions | <a href="http://www.ti.com/lprf">www.ti.com/lprf</a>               | Video and Imaging          | <a href="http://www.ti.com/video">www.ti.com/video</a>                                   |
|                             |                                                                    | Wireless                   | <a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>                   |