

# DS90Ux947-Q1EVM User's Guide

## User's Guide



Literature Number: SNLU140A  
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## DS90Ux947-Q1EVM User's Guide

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### 1.1 General Description

The DS90Ux947-Q1EVM (Evaluation Module) converts OpenLDI to FPD-Link III. This kit will demonstrate the functionality and operation of the DS90Ux947-Q1. The DS90Ux947-Q1 is an OpenLDI to FPD-Link III Serializer which, in conjunction with the DS90Ux940-Q1/DS90Ux948-Q1 Deserializers, takes the data from OpenLDI serial stream and translates it into either single- or dual-lane FPD-Link III interface. The DS90Ux947-Q1 supports video resolutions up to WUXGA and 1080p60 with 24-bit color depth.

The FPD-Link III interface supports video and audio data transmission and full duplex control, including I2C and SPI communication, over the same differential link. In backward compatible mode, the device supports up to WXGA and 720p resolutions with 24-bit color depth over a single differential link.

The device supports up to 7.1 audio channels. Audio data received from external I2S is encrypted, serialized, and sent out on the FPD-Link III stream to a compatible deserializer. Up to 8-channel I2S interface with maximum bit rate of 192 kHz.

**The demo board is not intended for EMI testing. The demo board was designed for easy accessibility to device pins with tap points for monitoring or applying signals, additional pads for termination, and multiple connector options.**

### 1.2 Features

- Supports Pixel Clock Frequency up to 170 MHz for WUXGA (1920x1200) and 1080p60 resolutions with 24-bit Color Depth
- OpenLDI Receiver to accept OpenLDI as input
- Dual FPD-Link III output interface
  - Single Channel: Up to 96 MHz Pixel Clock
  - Dual Channel: Up to 170 MHz Pixel Clock
- Up to 15 meters over Single-Ended Coaxial or Differential Shielded Twisted-Pair (STP) cable
- Backwards Compatible with DS90Ux926Q-Q1 and DS90Ux928Q-Q1 FPD-Link III Deserializers
- @Speed BIST
- Supports 7.1 multiple I2S (4 data) channels
- Single +12V power supply for EVM
- 1.8V LVCMOS I/O interface
- 1.8V or 3.3V compatible LVCMOS I<sup>2</sup>C interface
- Automotive grade product: AEC-Q100 Grade 2 qualified

### 1.3 System Requirements

In order to demonstrate, the following is required:

1. FPD-Link III compatible Deserializer
  - (a) DS90Ux940-Q1, DS90Ux948-Q1 up to 1080p60
  - (b) DS90Ux926Q-Q1, DS90Ux928Q-Q1 up to 720p60
2. OpenLDI source
3. Optional I<sup>2</sup>C controller
4. Power supply for 12V @ 1A (required)

### 1.4 Contents of the Demo Evaluation Kit

1. One EVM board with the DS90Ux947-Q1

### 1.5 Applications Diagram

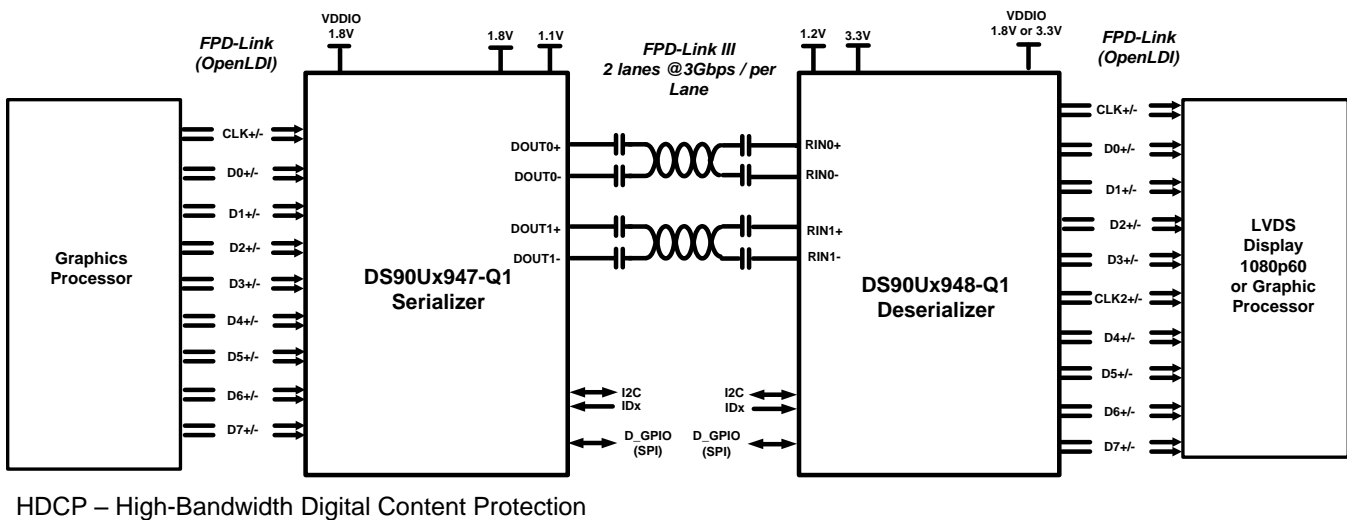


Figure 1-1. Applications Diagram

### 1.6 Typical Configuration

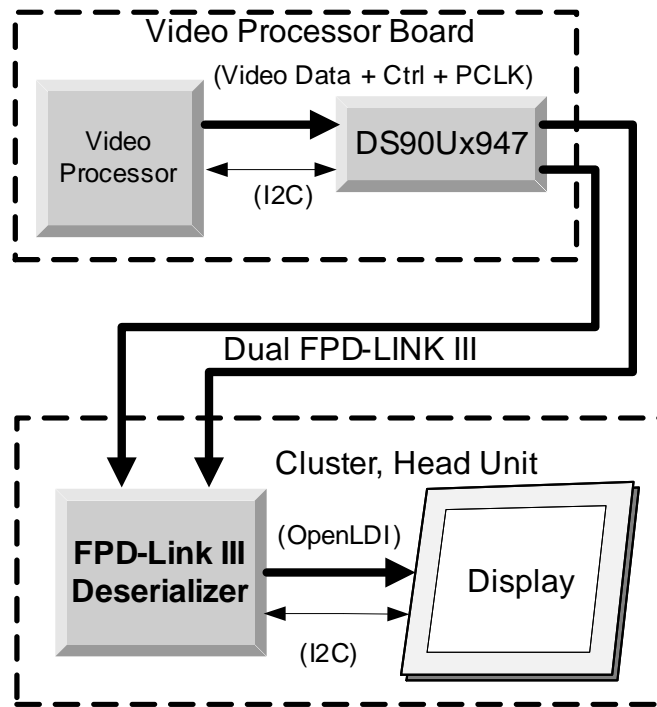


Figure 1-2. Typical Configuration

Figure 1-1 and Figure 1-2 illustrate the use of the chipset in a display application.

## 1.7 Quick Start Guide

1. Configure switches S2, S3, and S6 to set device's operating modes
  - S2: MODE\_SEL0 = 1 (default factory setting)
  - S3: IDx = 0x18 (default factory setting)
  - S6: MODE\_SEL1 = 1 (default factory setting)
2. Connect P1 (DOUT[1:0] +/-) to compatible Deserializer e.g. DS90Ux940-Q1/DS90Ux948-Q1 using STP cable (default)
3. Connect J36 to 12V.
  - (a) Optional power options available (see [Table 1-3](#))
4. Plug in OpenLDI source
5. Connect J29 with miniUSB (5-pin\_ to USB A (4-pin) cable to PC USB port

For details of pin-names and pin-functions, please refer to the DS90Ux947Q datasheet.



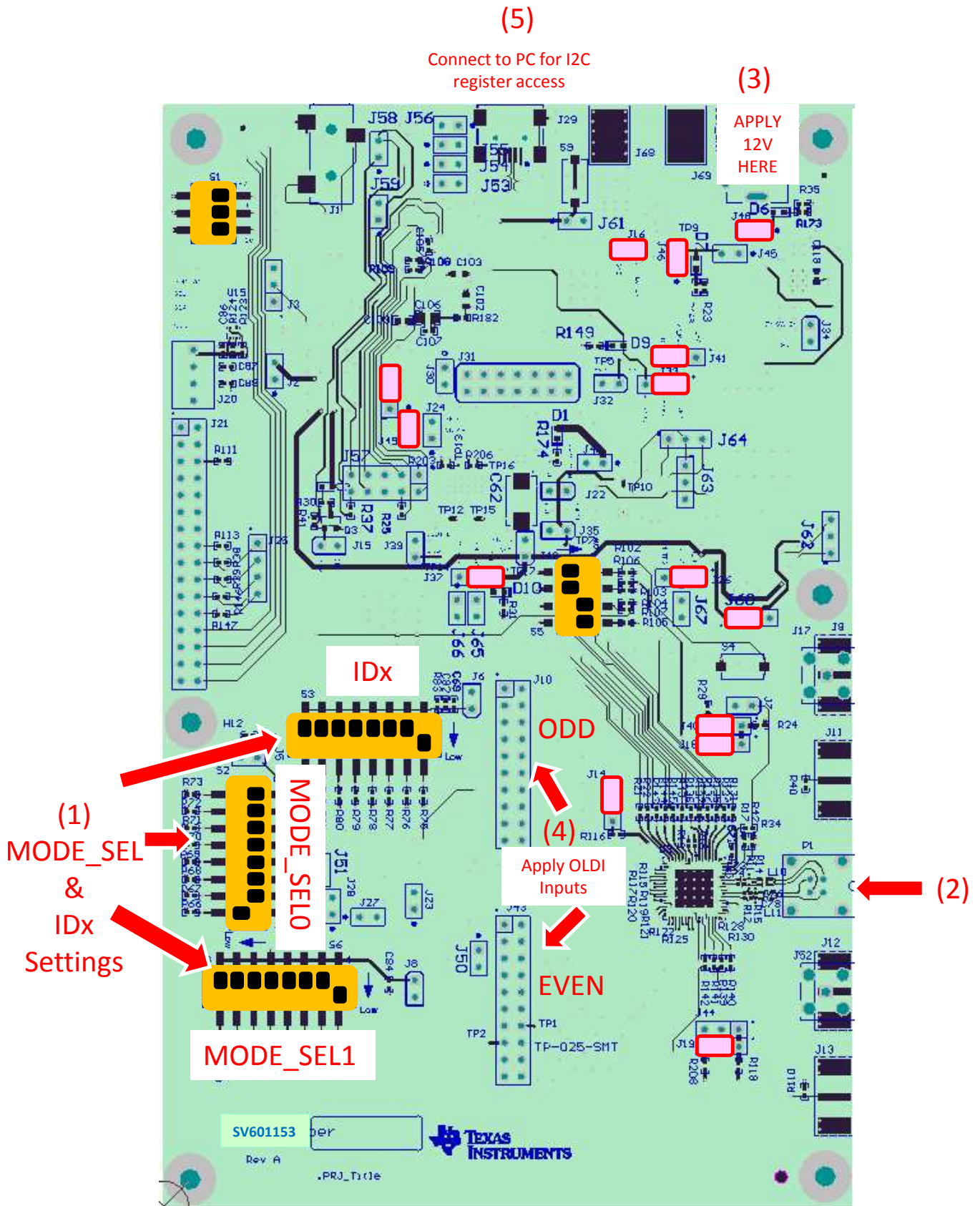


Figure 1-3. Interfacing to the EVM

## 1.8 Default Jumper Settings

Ensure that the board has the default board jumper settings:

**Table 1-1. Default Board Jumper Settings**

Jumper	Jumper Settings
J48	Connect 1 and 2
J16	Connect 1 and 2
J46	Connect 1 and 2
J41	Connect 2 and 3
J33	Connect 1 and 2
J4	Connect 2 and 3
J49	Connect 1 and 2
J37	Connect 1 and 2
J26	Connect 1 and 2
J60	Connect 1 and 2
J40	Connect 2 and 3
J18	Connect 2 and 3
J14	Connect 2 and 3
J19	Connect 2 and 3

## 1.9 Default Switch Settings

Ensure that the board has the default board switch settings:

**Table 1-2. Default Board Switch Settings**

Switch	Switch Settings
S1	1 to 3 ON
S2	1 ON, 2-8 OFF
S3	1 ON, 2-8 OFF
S5	1 ON, 2-8 OFF
S6	1-2 OFF, 3-4 ON

## 1.10 Demo Board Connections

**Table 1-3. Power Supply**

Designator	Signal	Description
J36	+12V	12V $\pm$ 5% Main Power Single +12V power connector that supplies power to the entire board.
J26.2 (Optional)	+1.1V	1.1V $\pm$ 5% Alternative to Main Power. <b>If used, remove jumper on J26.</b>
J39.1 (Optional)	+1.8V	1.8V $\pm$ 5% Alternative to Main Power. <b>If used, remove R204.</b>
J42.1 (Optional)	+3.3V	3.3V $\pm$ 5% Alternative to Main Power. <b>If used, remove R207.</b>
J33.2 (Optional)	+5V	5V $\pm$ 5% Alternative to Main Power. <b>If used, remove jumper on J41.</b>

**Table 1-4. FPD-Link III Output Signals P1**

Designator	Port	Signal
P1.1	FPD-Link III Port 0	DOU0-
P1.3		DOU0+
P1.2	FPD-Link III Port 1	DOU1-
P1.4		DOU1+

**Table 1-5. Alternative FPD-Link III Output Signals**

Designator	Port	Signal
J11	FPD-Link III Port 0	DOU0-
J9		DOU0+
J13	FPD-Link III Port 1	DOU1-
J12		DOU1+

**Table 1-6. OpenLDI Input Signals**

Designator	Signal	Description
J10.2 J10.3	D0- D0+	OpenLDI D0 input
J10.6 J10.7	D1- D1+	OpenLDI D1 input
J10.10 J10.11	D2- D2+	OpenLDI D2 input
J10.14 J10.15	CLK- CLK+	OpenLDI CLK input
J10.18 J10.19	D3- D3+	OpenLDI D3 input
J43.2 J43.3	D4- D4+	OpenLDI D4 input
J43.6 J43.7	D5- D5+	OpenLDI D5 input
J43.10 J43.11	D6- D6+	OpenLDI D6 input
J43.18 J43.19	D7- D7+	OpenLDI D7 input

**Table 1-7. USB2ANY Connector**

Designator	Description
J29	mini USB 5 pin

**Table 1-8. I2C/CCI Interface Header J20**

Designator	Signal
J20.1	VDDI2C
J20.2	SCL
J20.3	SDA
J20.4	GND

**Table 1-9. GPIO/Audio Interface**

Designator	Signal	Description
J21.18	GPIO0	Remote or Local I/O
J21.20	GPIO1	Remote or Local I/O
J21.2	I2S_DC/GPIO2	I2S Data Input / Remote or Local I/O
J21.4	I2S_DD/GPIO3	I2S Data Input / Remote or Local I/O
J21.6	VDDIO	GPIO Voltage Level 1.8V
J21.8	I2S_DB/GPIO5_RE G	I2S Data Input / Local only I/O
J21.10	I2S_DA/GPIO6_RE G	I2S Data Input / Local only I/O
J21.12	I2S_WC/GPIO7_RE G	I2S Word Clock Input / Local only I/O
J21.14	I2S_CLK/GPIO8_RE G	I2S Clock Input / Local only I/O

**Table 1-10. SPI/D\_GPIO Interface**

Designator	Signal	Description
J21.6	VDDIO	GPIO Voltage Level 1.8V
J21.32	D_GPIO3/SS	I/O in Dual FPD-Link III mode / Slave Select
J21.30	D_GPIO2/SCLK	I/O in Dual FPD-Link III mode / Serial Clock
J21.28	D_GPIO1/MISO	I/O in Dual FPD-Link III mode / Master In, Slave Out
J21.26	D_GPIO0/MOSI	I/O in Dual FPD-Link III mode / Master Out, Slave In

Configuration of the device may be done via the MODE\_SEL[1:0]. These modes are latched into register location during power-up:

**Table 1-11. MODE\_SEL[1:0] Settings**

Mode	Setting	Function
OLDI_DUAL: OpenLDI Interface	0	Single-pixel OpenLDI interface.
	1	Dual-pixel OpenLDI interface.
AUTO_SS: Auto Sleep-State	0	Disable.
	1	Enable.
REPEATER: Configure Repeater	0	Disable repeater mode.
	1	Enable repeater mode.
MAPSEL: OpenLDI Bit Mapping	0	OpenLDI bit mapping.
	1	SPWG bit mapping.

**Table 1-11. MODE\_SEL[1:0] Settings (continued)**

Mode	Setting	Function
COAX: Cable Type	0	Enable FPD-Link III for twisted pair cabling.
	1	Enable FPD-Link III for coaxial cabling.

**Table 1-12. Configuration Select (MODE\_SEL0) - SW-DIP8 - S2<sup>(1)</sup>**

#	Ratio $V_{R4}/V_{DD18}$	Target $V_{R4}$ (V)	Suggested Resistor Pull-Up R3 k $\Omega$ (1% tol)	Suggested Resistor Pull-Down R4 k $\Omega$ (1% tol)	OLDI_DUAL	AUTO_SS	REPEATER
1	0	0	OPEN	40.2	0	0	0
2	0.213	0.383	115	30.9	0	0	1
3	0.328	0.591	107	52.3	0	1	0
4	0.444	0.799	113	90.9	0	1	1
5	0.560	1.008	82.5	105	1	0	0
6	0.676	1.216	51.1	107	1	0	1
7	0.792	1.425	30.9	118	1	1	0
8	1	1.8	40.2	OPEN	1	1	1

<sup>(1)</sup> Only set one high**Table 1-13. Configuration Select (MODE\_SEL1) - SW-DIP8 - S6<sup>(1)</sup>**

#	Ratio $V_{R6}/V_{DD18}$	Target $V_{R6}$ (V)	Suggested Resistor Pull-Up R5 k $\Omega$ (1% tol)	Suggested Resistor Pull-Down R6 k $\Omega$ (1% tol)	MAPSEL	COAX
1	0	0	OPEN	40.2	0	0
2	0.213	0.383	115	30.9	0	0
3	0.328	0.591	107	52.3	0	1
4	0.444	0.799	113	90.9	0	1
5	0.560	1.008	82.5	105	1	0
6	0.676	1.216	51.1	107	1	0
7	0.792	1.425	30.9	118	1	1
8	1	1.8	40.2	OPEN	1	1

<sup>(1)</sup> Only set one high

The strapped values can be viewed and/or modified in the following locations:

- OLDI\_DUAL : Latched into OLDI\_IN\_MODE (0x4F[6], inverted from strap value).
- AUTO\_SS : Latched into SOFT\_SLEEP (0x01[7]).
- REPEATER : Latched into TX\_RPTR (0xC2[5]).
- MAPSEL : Latched into OLDI\_MAPSEL (0x4F[7]).
- COAX : Latched into DUAL\_CTL1[7], COAX\_MODE (0x5B[7]).

**Table 1-14. IDx SW-DIP8 - S3<sup>(1)</sup>**

Designator	7-Bit Address	8-Bit Address
S1.1 (Default)	0x0C	0x18
S1.2	0x0E	0x1C
S1.3	0x10	0x20
S1.4	0x12	0x24
S1.5	0x14	0x28

<sup>(1)</sup> Only set one high.

**Table 1-14. IDx SW-DIP8 - S3<sup>(1)</sup> (continued)**

<b>Designator</b>	<b>7-Bit Address</b>	<b>8-Bit Address</b>
S1.6	0x16	0x2C
S1.7	0x18	0x30
S1.8	0x1A	0x34

## 1.11 ALP Software Setup

### 1.11.1 System Requirements

<b>Operating System:</b>	Windows 7 64-bit
<b>USB:</b>	USB2ANY
<b>USB2ANY Firmware Version:</b>	2.5.2.0

### 1.11.2 Download Contents

TI Analog LaunchPAD can be downloaded from: <http://www.ti.com/tool/alp>.

Download and extract the “snlc048.zip” file to a temporary location that can be deleted later.

**Make sure J29 on the DS90Ux947 is connected to a PC USB port with USB cable and power is applied to the DS90Ux947 EVM.**

The following installation instructions are for the Windows 7 64-bit Operating System.

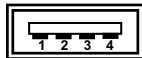
### 1.11.3 Installation of the ALP Software

Execute the ALP Setup Wizard program called “ALPF\_setup\_v\_x\_x\_x.exe” that was extracted to a temporary location on the local drive of your PC.

There are 7 steps to the installation once the setup wizard is started:

1. Select the “Next” button.
2. Select “I accept the agreement” and then select the “Next” button.
3. Select the location to install the ALP software and then select the “Next” button.
4. Select the location for the start menu shortcut and then select the “Next” button.
5. There will then be a screen that allows the creation of a desktop icon. After selecting the desired choices select the “Next” button.
6. Select the “Install” button, and the software will then be installed to the selected location.
7. Uncheck “Launch Analog LaunchPAD” and select the “Finish” button. The ALP software will start if “Launch Analog LaunchPAD” is checked, but it will not be useful until the USB driver is installed and board is attached.

Connect J29 USB jack of the DS90Ux947Q EVM board to a PC/laptop USB port using a Type A



**A**



MINI

USB cable. Power the DS90Ux947Q EVB board with a 12 VDC power supply. The “Found New Hardware Wizard” will open on the PC/laptop.

### 1.11.4 Installation of the Device Profiles

There are 2 steps to add the DS90Ux947 profile:

1. Contact TI for the DS90Ux947 profile
2. Extract the “DS90Ux947.zip” to ALP’s profile folder. The profile folder can be found at: C:\Program Files (x64)\Texas Instruments\Analog LaunchPAD vx.x.x\Profiles\

### 1.11.5 Startup - Software Description

Make sure all the software has been installed and the hardware is powered on and connected to the PC. Execute “Analog LaunchPAD” shortcut from the start menu. The default start menu location is under All Programs > Texas Instruments > Analog LaunchPAD vx.x.x > Analog LaunchPAD to start MainGUI.exe.





Figure 1-4. Launching ALP

The application should come up in the state shown in the figure below. If it does not, see [Section 1.12](#), “Troubleshooting ALP Software”.

Under the Devices tab click on “DS90Ux947” to select the device and open up the device profile and its associated tabs.

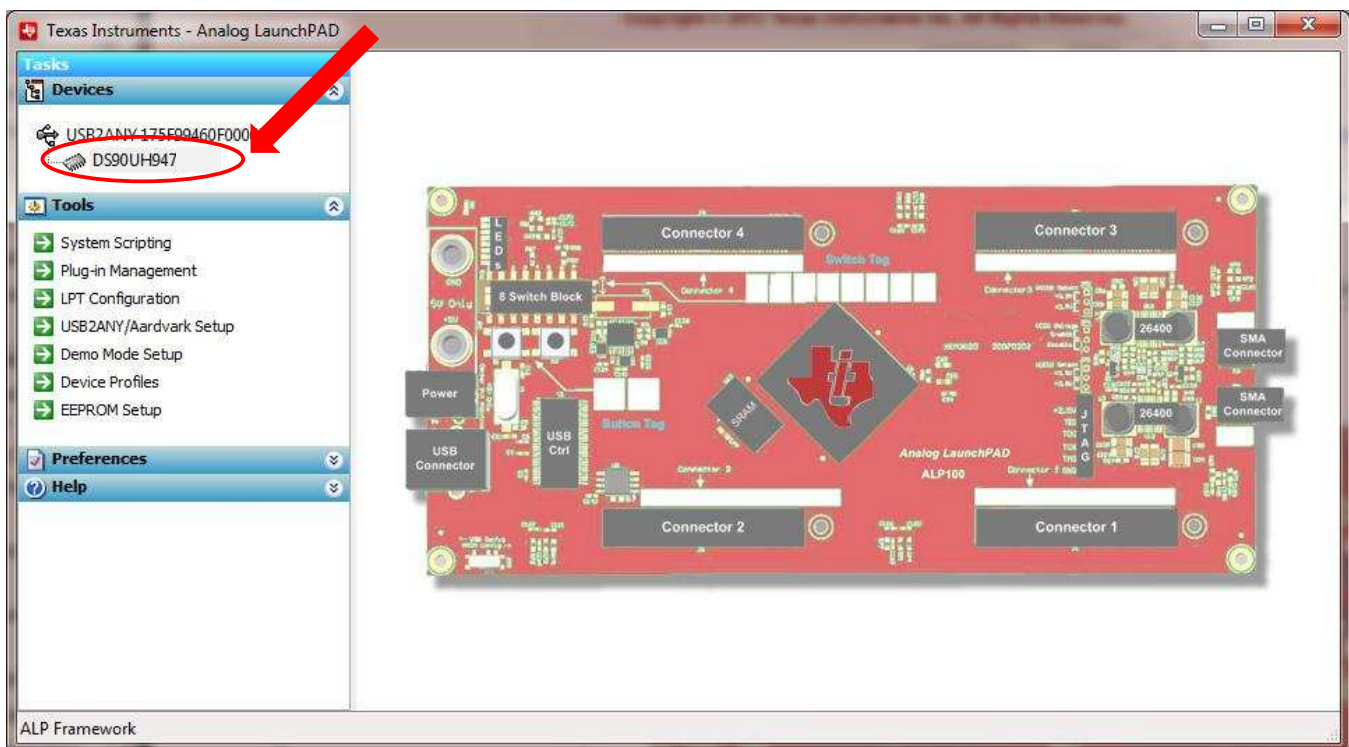


Figure 1-5. Initial ALP Screen

After selecting the DS90Ux947, the following screen should appear.



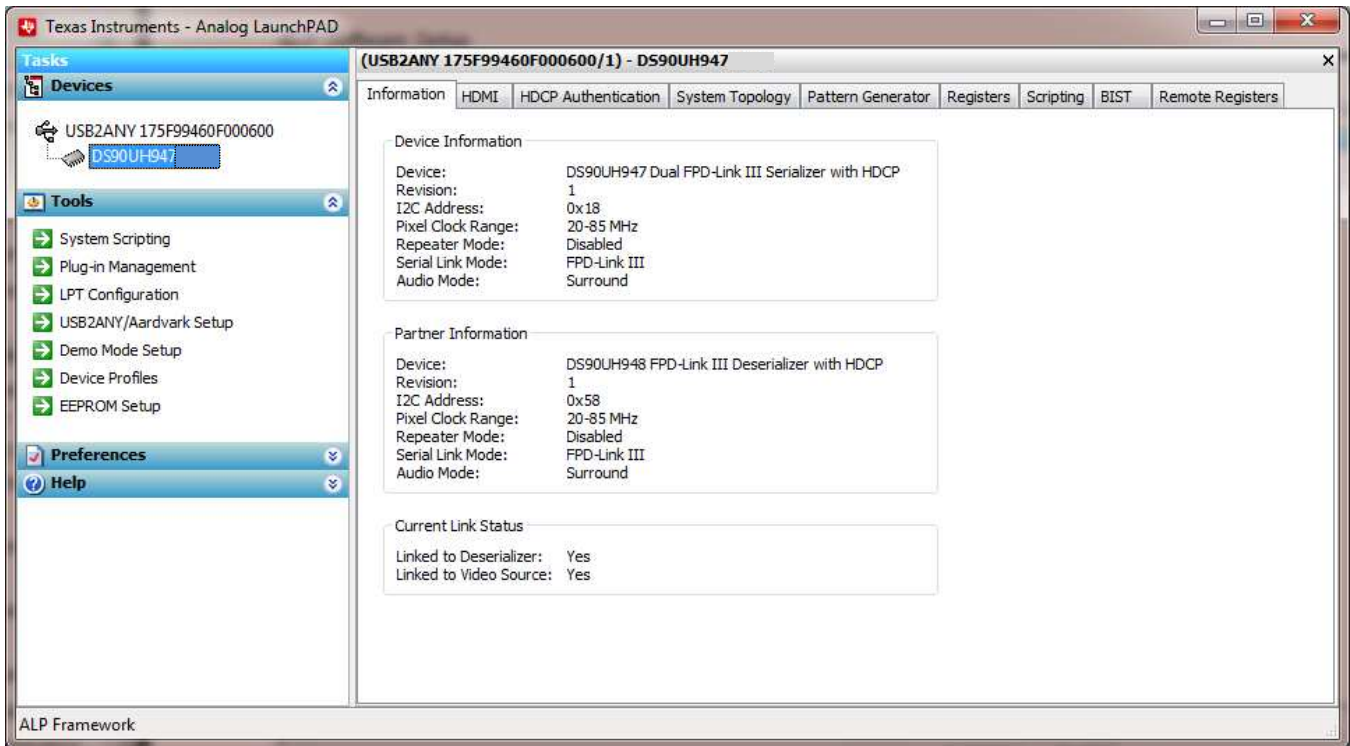


Figure 1-6. Follow-up Screen

### 1.11.6 Information Tab

The Information tab is shown below. Please note the device revision could be different.

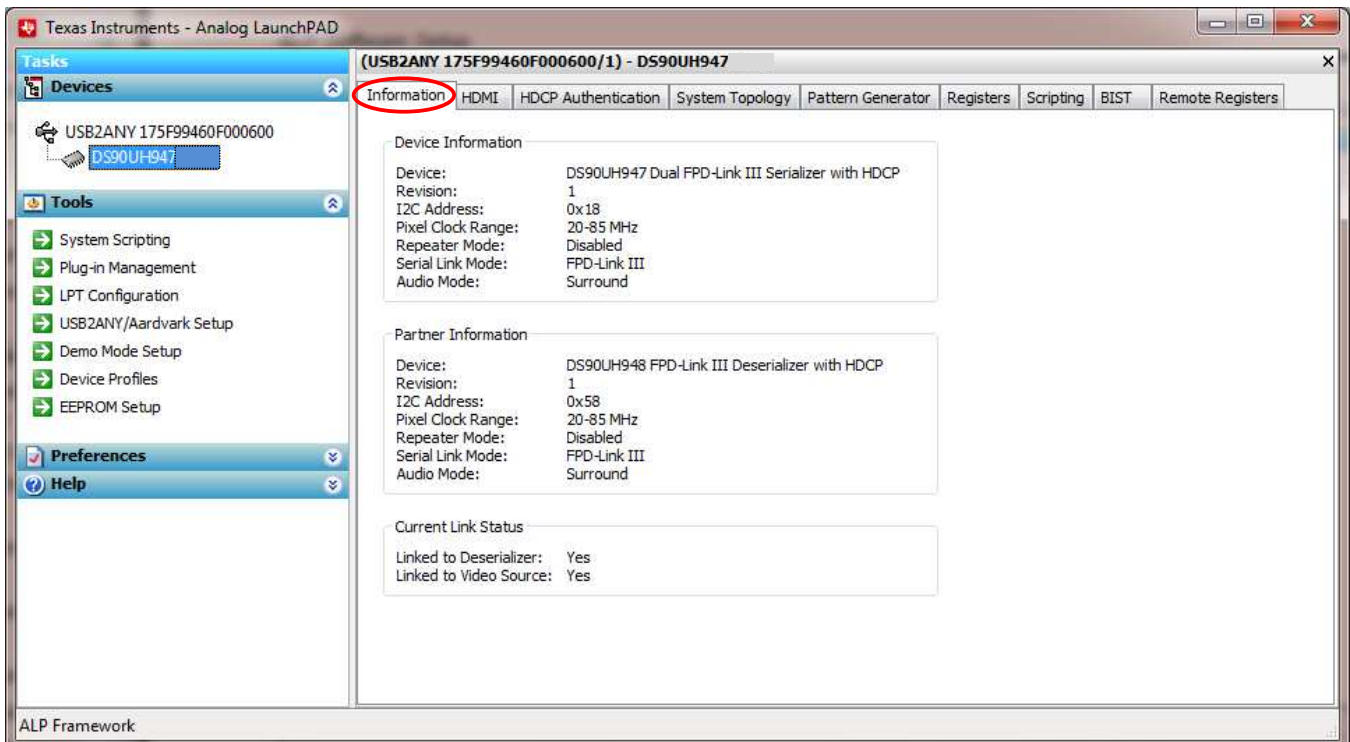


Figure 1-7. ALP Information Tab

### 1.11.7 Pattern Generator Tab

The SER Pattern Generator tab is shown below.

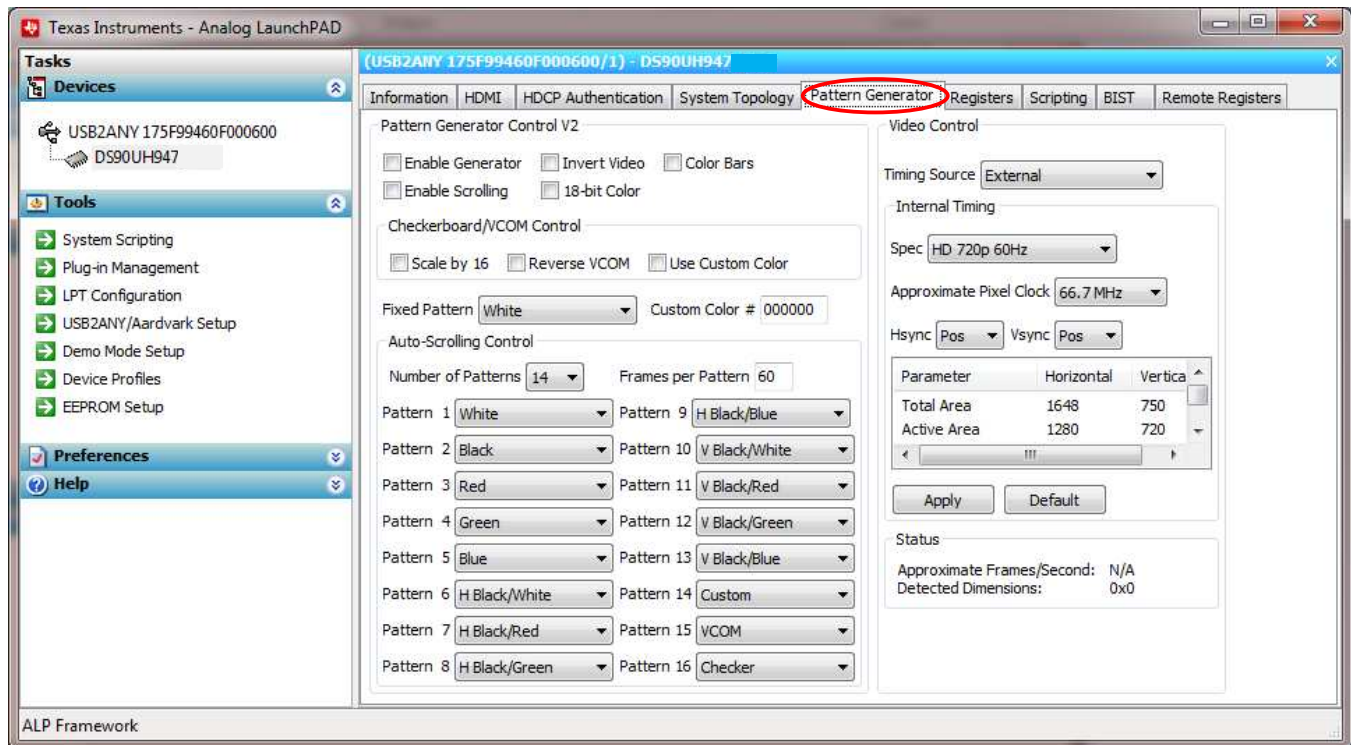


Figure 1-8. ALP Pattern Generator Tab

### 1.11.8 Registers Tab

The Register tab is shown below.

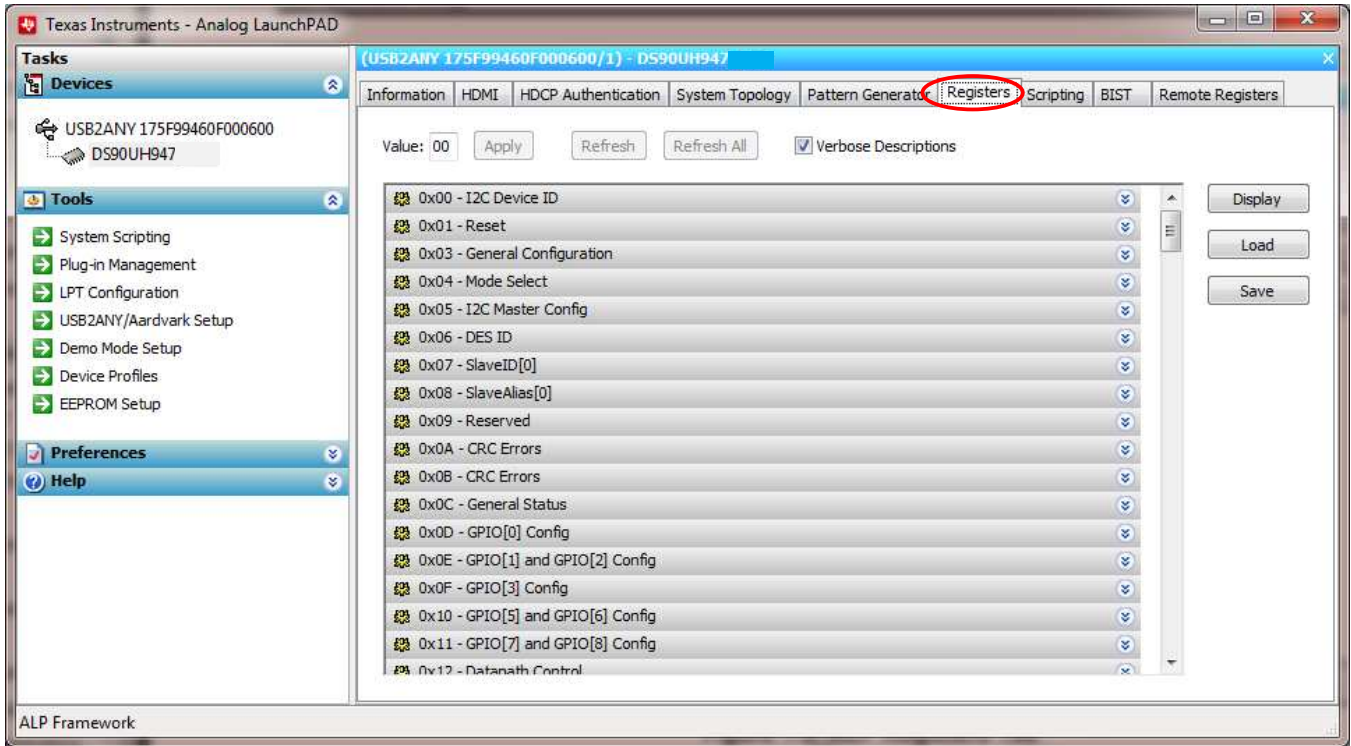
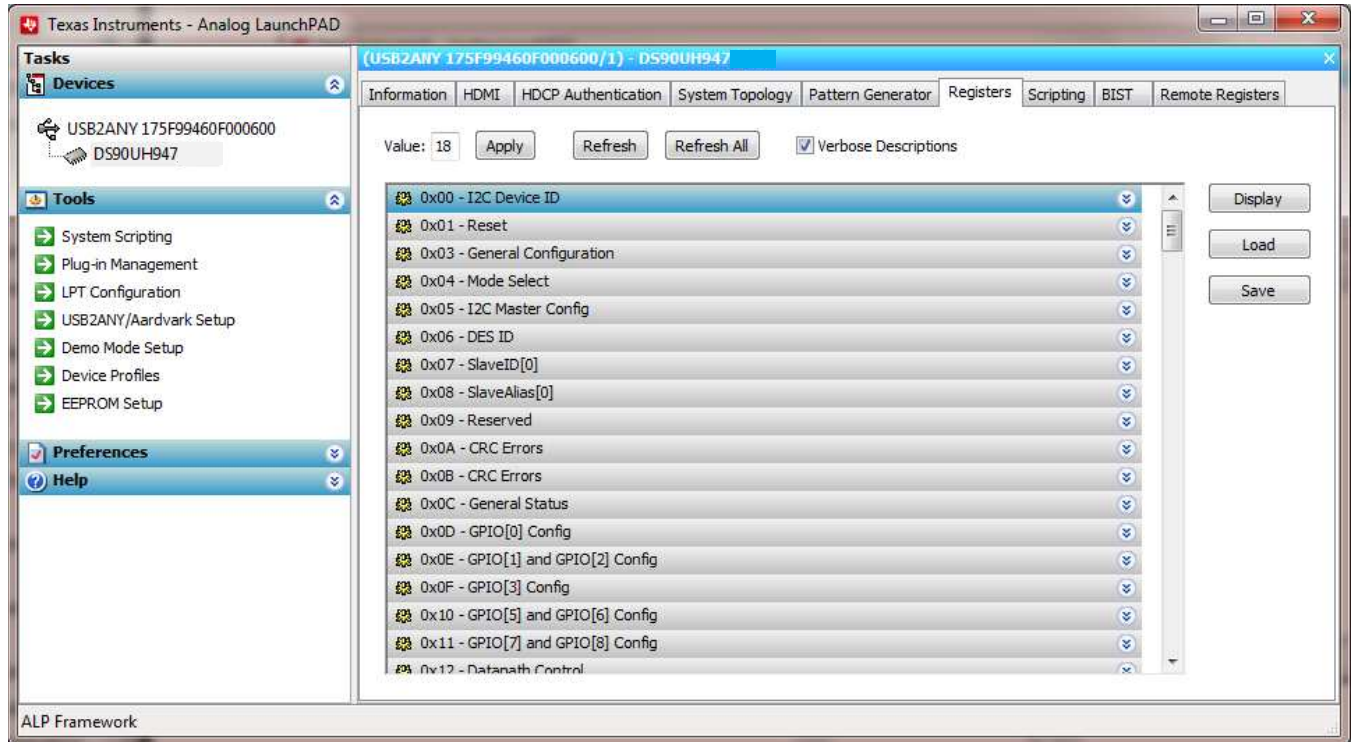


Figure 1-9. ALP Registers Tab

### 1.11.9 Registers Tab - Address 0x00 selected

Address 0x00 selected as shown below. Note that the “Value:” box, Value: 18, will now show the hex value of that register.




**Figure 1-10. ALP Device ID Selected**

### 1.11.10 Registers Tab - Address 0x00 expanded

By double clicking on the Address bar



or a single click on . Address 0x00 expanded reveals contents by bits. Any register address displayed can be expanded.

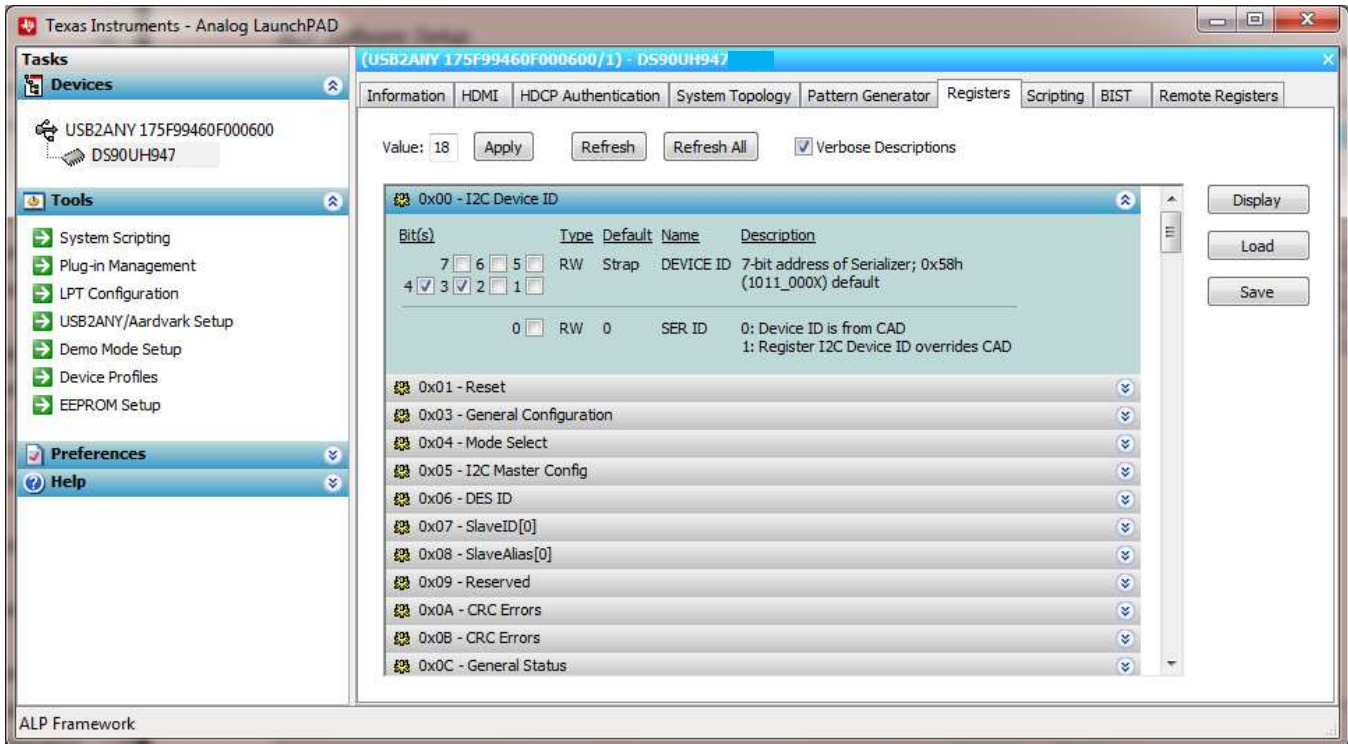
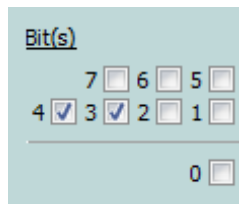


Figure 1-11. ALP Device ID Expanded

#### Type

Any RW Type register, **RW**, can be written into by writing the hex value into the “Value:” box, **Value: 00**, or putting the pointer into the individual register bit(s) box by a left mouse click to put a check mark (indicating a “1”) or unchecking to remove the check mark (indicating a “0”). Click the “Apply” button to write to the register, and “refresh” to see the new value of the selected (highlighted) register.

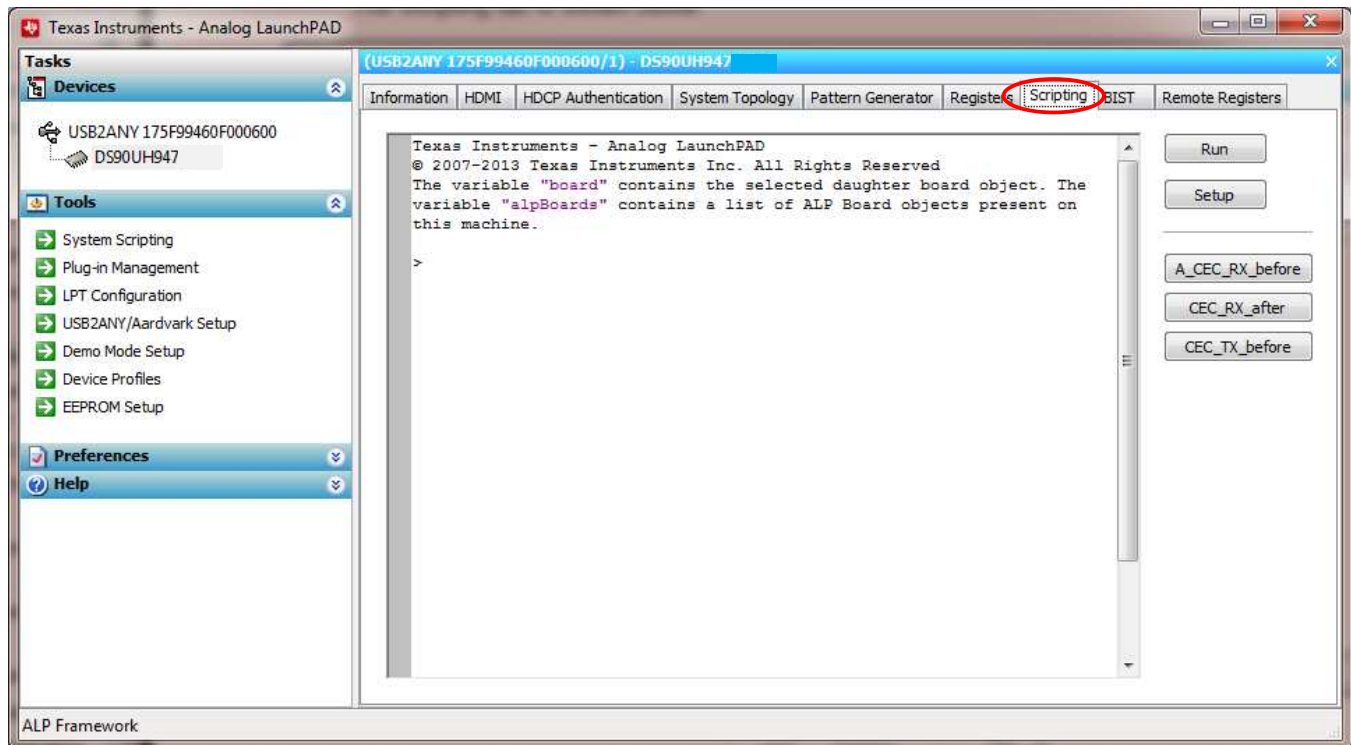


The box toggles on every mouse click.



### 1.11.11 Scripting Tab

The Scripting tab is shown below.



**Figure 1-12. ALP Scripting Tab**

The script window provides a full Python scripting environment which can be for running scripts and interacting with the device in an interactive or automated fashion.

#### **WARNING**

**Directly interacting with devices either through register modifications or calling device support library functions can effect the performance and/or functionality of the user interface and may even crash the ALP Framework application.**

## 1.12 Troubleshooting ALP Software

### 1.12.1 ALP Loads the Incorrect Profile

If ALP opens with the incorrect profile loaded the correct profile can be loaded from the USB2ANY/Aardvark Setup found under the tools menu.

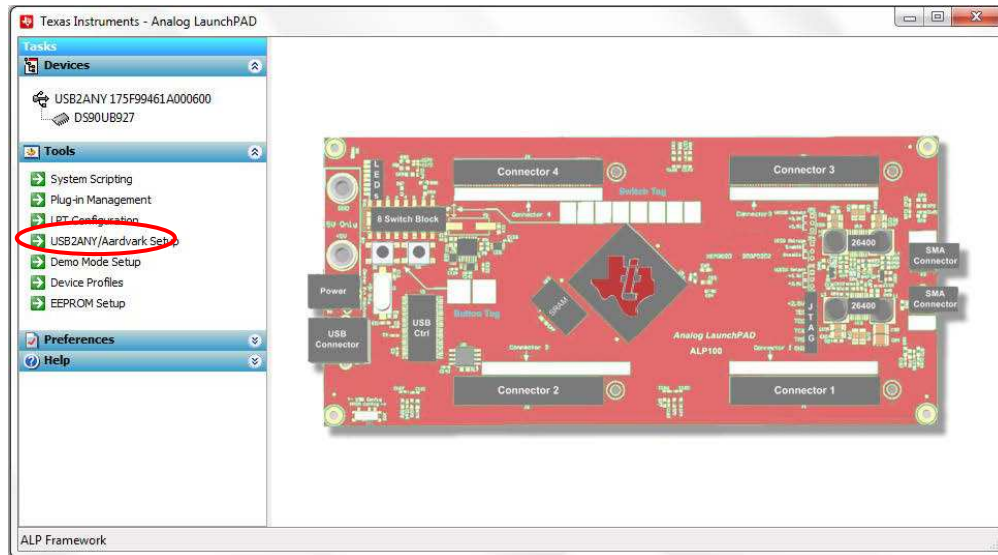


Figure 1-13. USB2ANY Setup

Highlight the incorrect profile in the Defined ALP Devices list and press the remove button.

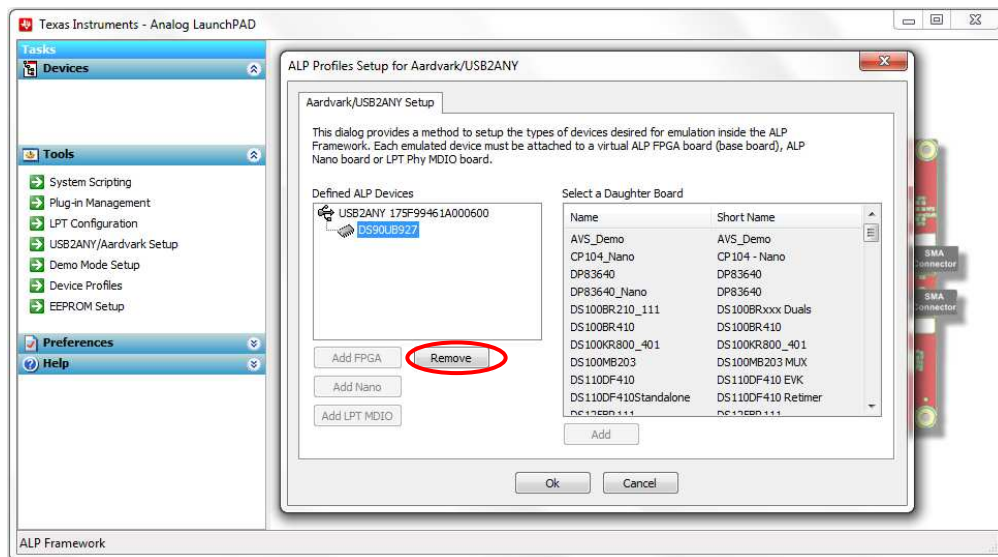


Figure 1-14. Remove Incorrect Profile

Find the correct profile under the Select a Daughter Board list, highlight the profile and press Add.

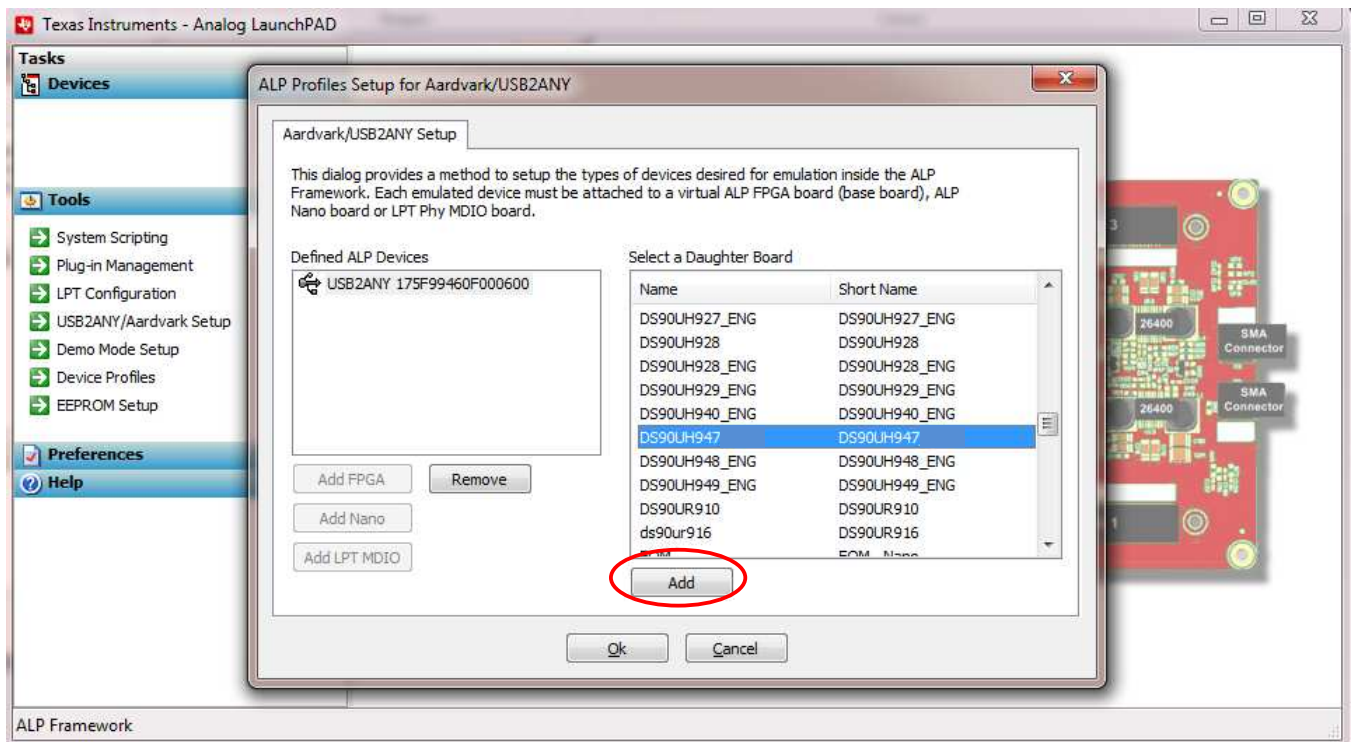


Figure 1-15. Add Correct Profile

Select Ok and the correct profile should now be loaded.

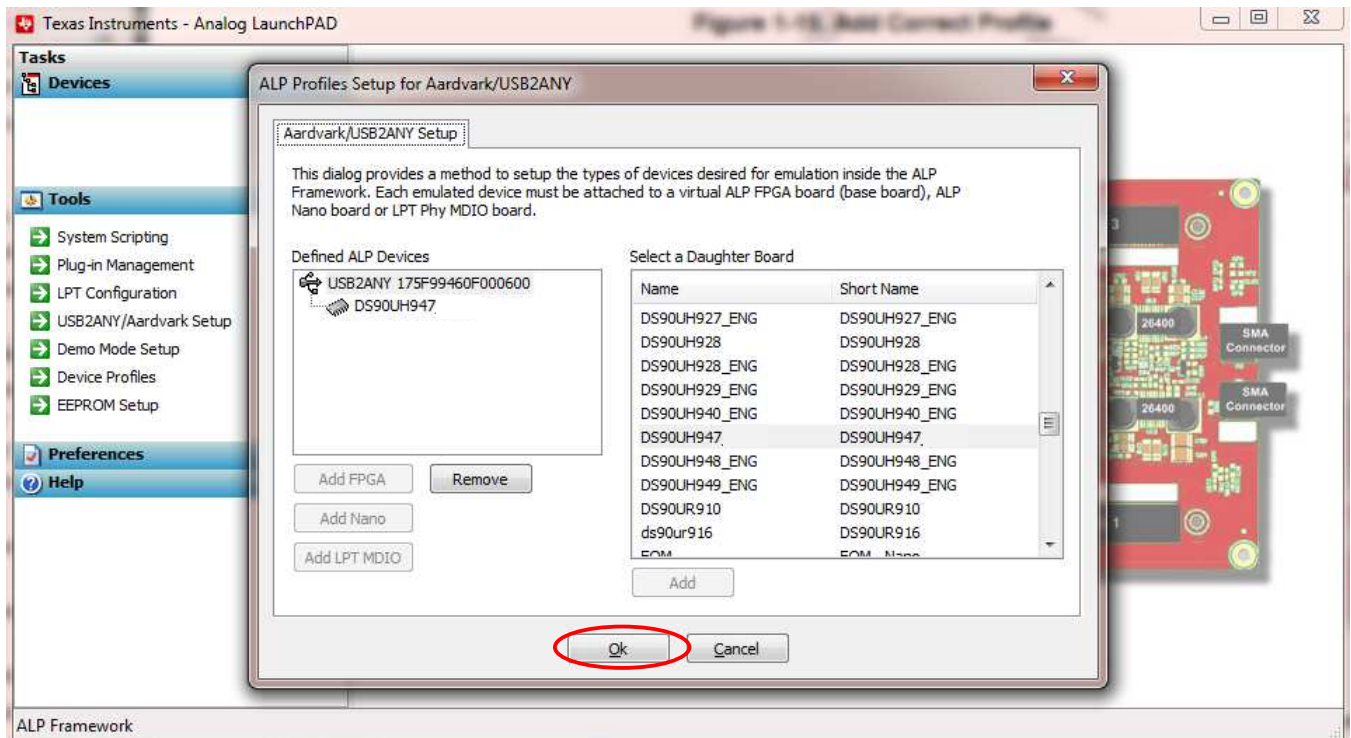


Figure 1-16. Finish Setup



### 1.12.2 ALP does not detect the EVM

If the following window opens after starting the ALP software, double check the hardware setup.

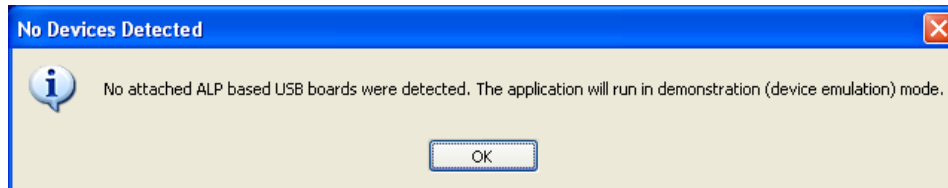


Figure 1-17. ALP No Devices Error

It may also be that the USB driver is not installed. Check the device manager. There should be a “HID-compliant device” under the “Human Interface Devices” as shown below.

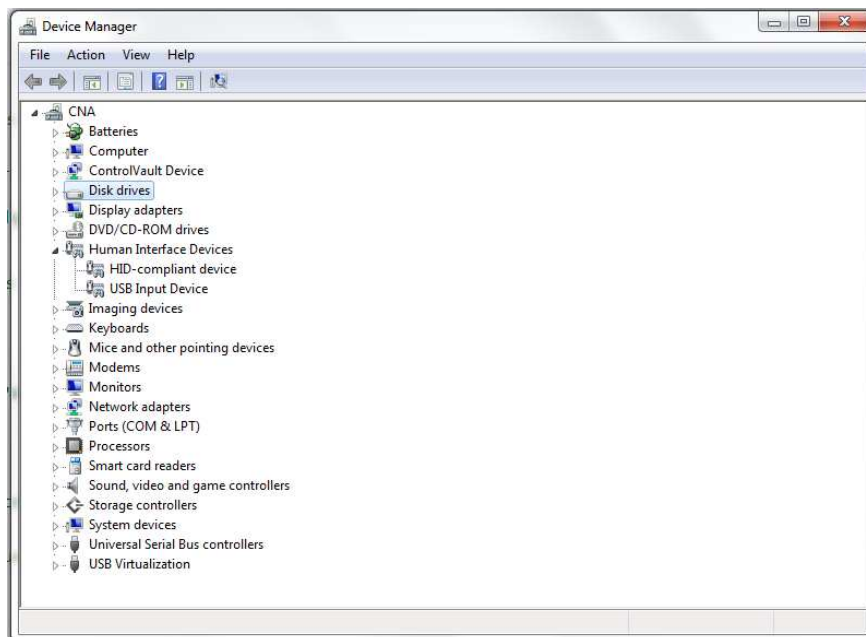
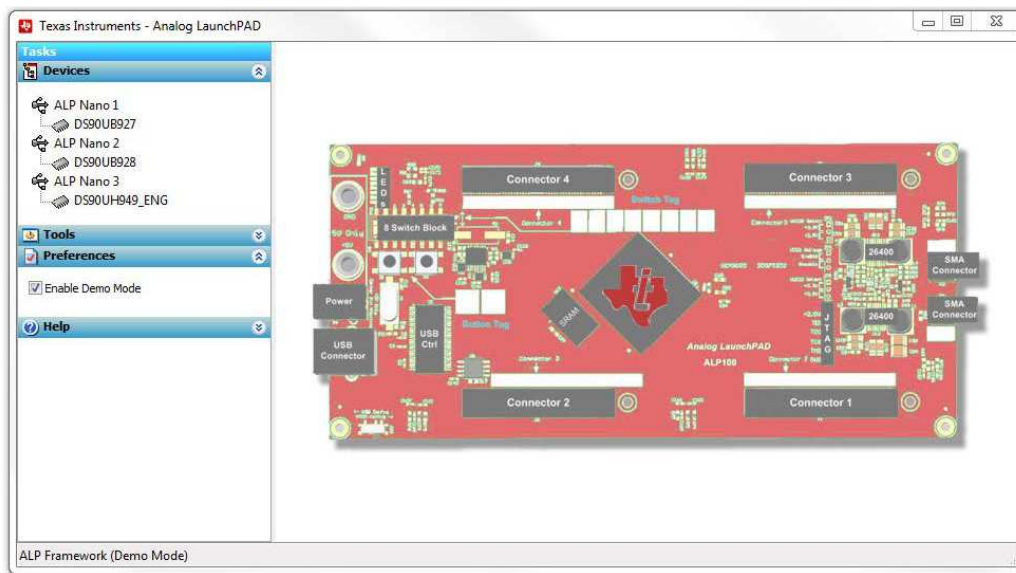


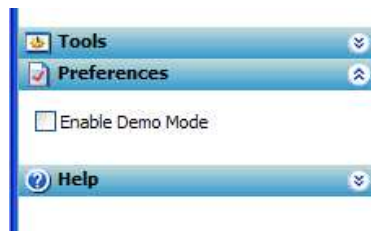
Figure 1-18. Windows 7, ALP USB Driver

The software should start with only “DS90Ux947” in the “Devices” pull down menu. If there are more devices then the software is most likely in demo mode. When the ALP is operating in demo mode there is a “(Demo Mode)” indication in the lower left of the application status bar as shown below.



**Figure 1-19. ALP in Demo Mode**

Disable the demo mode by selecting the “Preferences” pull down menu and un-checking “Enable Demo Mode”.



**Figure 1-20. ALP Preferences Menu**

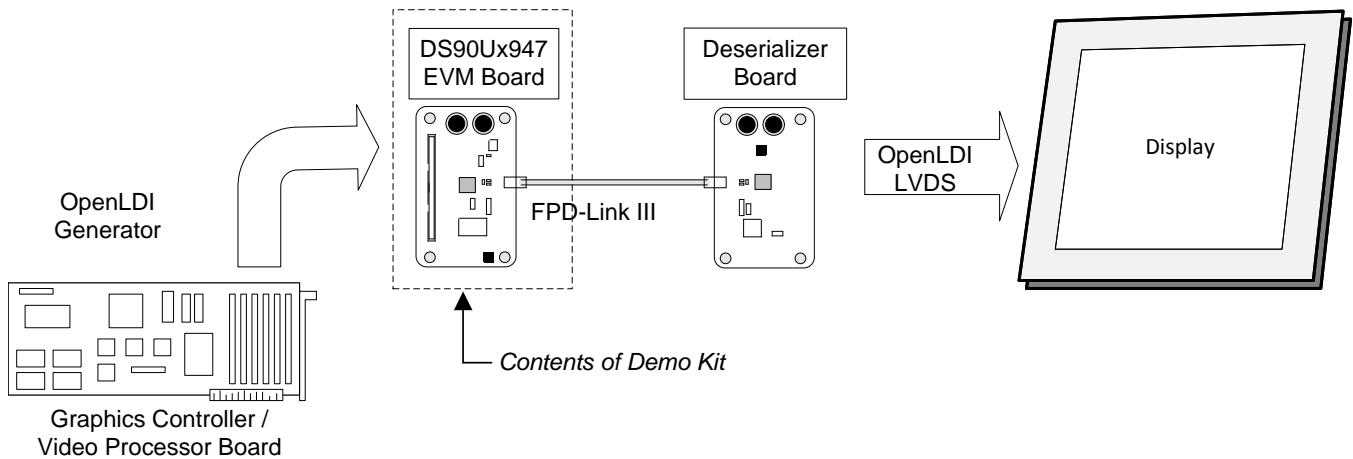
After demo mode is disabled, the ALP software will poll the ALP hardware. The ALP software will update and have only “DS90Ux947” under the “Devices” pull down menu.

### 1.13 Typical Connection and Test Equipment

The following is a list of typical test equipment that may be used to generate signals for the Serializer inputs:

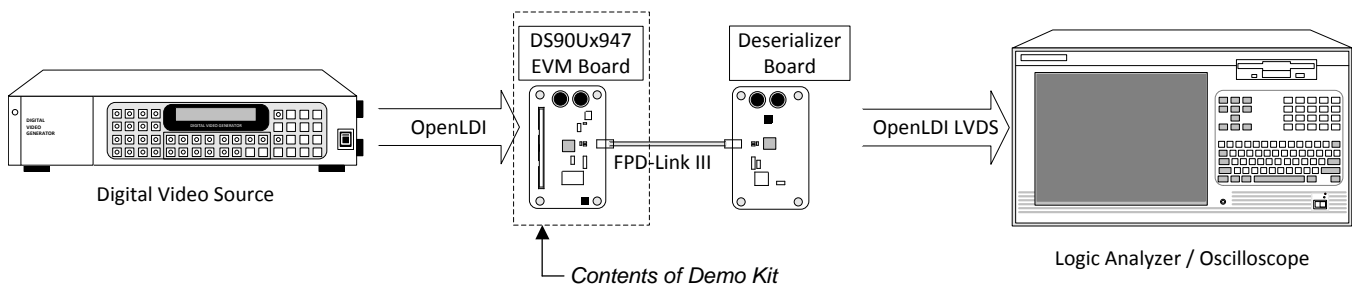
1. Digital Video Source – for generation of specific display timing such as Digital Video Processor or Graphics Controller (GPU) with OpenLDI output.
2. Any other signal generator / video source - This video generator may be used for video signal sources for DVI or DP++
3. Any other signal / video generator that provides the correct input levels as specified in the datasheet.

The picture below shows a typical test set up using a Graphics Controller and display.



**Figure 1-21. Typical Test Setup for Video Application**

The picture below shows a typical test set up using a video generator and logic analyzer.



**Figure 1-22. Typical Test Setup for Evaluation**

## 1.14 Equipment References

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**NOTE:** Please note that the following references are supplied only as a courtesy to our valued customers. It is not intended to be an endorsement of any particular equipment or supplier.

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### Digital Video Pattern Generator:

Astrodesign

[www.astro-americas.com](http://www.astro-americas.com)

### Logic Analyzer:

Keysight

[www.keysight.com](http://www.keysight.com)

### Corelis CAS-1000-I2C/E I2C Bus Analyzer and Exerciser Products:

[www.corelis.com/products/I2C-Analyzer.htm](http://www.corelis.com/products/I2C-Analyzer.htm)

### Aardvark I2C/SPI Host Adapter Part Number: TP240141

[www.totalphase.com/products/aardvark\\_i2cspi](http://www.totalphase.com/products/aardvark_i2cspi)

## 1.15 Cable References

For optimal performance, we recommend Shielded Twisted Pair (STP) 100ohm differential impedance and 24 AWG (or larger diameter) cable for high-speed data applications.

### Leoni Dacar 538 series cable:

[www.leoni-automotive-cables.com](http://www.leoni-automotive-cables.com)

### Rosenberger HSD connector:

[www.rosenberger.de/en/Products/35\\_Automotive\\_HSD.php](http://www.rosenberger.de/en/Products/35_Automotive_HSD.php)

## Bill of Materials

**Table 2-1. Bill of Materials**

ITEM	DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
1	!PCB1	Printed Circuit Board	Any	SV601153	1
2	C1, C2, C3, C4, C6, C15, C25, C32, C39, C56	CAP, CERM, 10 $\mu$ F, 25 V, +/- 10%, X5R, 0805	Samsung	CL21A106KAFN3NE	10
3	C5, C21, C29, C43, C45, C47, C50, C51, C83, C106, C116, C123, C133, C137	CAP, CERM, 10 $\mu$ F, 10V, +/-10%, X7R, 0805	MuRata	GRM21BR71A106KE51L	14
4	C7, C14, C23, C46, C54, C55, C69, C70, C71, C81, C82, C84, C86, C96, C97, C98, C104, C105, C107, C108, C110, C111, C113, C117, C121, C122, C126, C129, C131, C132, C135, C136	CAP, CERM, 0.1 $\mu$ F, 16V, +/-10%, X7R, 0402	MuRata	GRM155R71C104KA88D	32
5	C8, C24	CAP, TA, 1 $\mu$ F, 16V, +/-10%, 9.3 ohm, SMD	Vishay-Sprague	293D105X9016A2TE3	2
6	C9, C124	CAP, TA, 22 $\mu$ F, 25V, +/-20%, 0.7 ohm, SMD	Vishay-Sprague	293D226X0025D2TE3	2
7	C10, C127, C130, C134	CAP, CERM, 4.7 $\mu$ F, 16V, +/-10%, X7R, 0805	MuRata	GRM21BR71C475KA73L	4
8	C11, C13, C20, C31, C128	CAP, CERM, 0.01 $\mu$ F, 100V, +/-5%, X7R, 0603	AVX	06031C103JAT2A	5
9	C12	CAP, CERM, 0.1 $\mu$ F, 25V, +/-5%, X7R, 0603	Kemet	C0603C104J3RAC	1
10	C16, C17, C18, C26, C27, C33, C34, C40, C41, C42, C57, C58, C59, C67, C68, C77, C80	CAP, CERM, 0.01 $\mu$ F, 50V, +/-10%, C0G/NP0, 0402	MuRata	GCM155R71H103KA55D	17
11	C19, C28, C35, C36, C44, C60	CAP, CERM, 0.1 $\mu$ F, 50V, +/-10%, X7R, 0402	TDK	CGA2B3X7R1H104K050BB	6
12	C22, C30, C37, C38, C48, C63, C120	CAP, CERM, 1 $\mu$ F, 35 V, +/- 10%, JB, 0402	TDK	C1005JB1V105K050BC	7
13	C49	CAP, CERM, 150pF, 50V, +/-5%, C0G/NP0, 0402	MuRata	GRM1555C1H151JA01D	1
14	C52, C61, C119	CAP, CERM, 1 $\mu$ F, 16V, +/-10%, X7R, 0603	TDK	C1608X7R1C105K	3
15	C53, C112	CAP, CERM, 10pF, 50V, +/-5%, C0G/NP0, 0402	MuRata	GRM1555C1H100JA01D	2
16	C62	CAP, TA, 22 $\mu$ F, 20V, +/-20%, 0.7 ohm, SMD	Vishay-Sprague	293D226X0020D2TE3	1
17	C64	CAP, CERM, 1 $\mu$ F, 6.3V, +/-20%, X5R, 0402	TDK	C1005X5R0J105M	1
18	C65	CAP, TA, 2.2 $\mu$ F, 25V, +/-10%, 3.8 ohm, SMD	Vishay-Sprague	293D225X9025B2TE3	1
19	C66	CAP, CERM, 0.01 $\mu$ F, 100V, +/-10%, X7R, 0805	AVX	08051C103KAT2A	1

**Table 2-1. Bill of Materials (continued)**

ITEM	DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
20	C73, C74, C76, C78	CAP, CERM, 0.1 $\mu$ F, 50 V, +/- 10%, C0G/NP0, 0402	TDK	C1005X7R1H104K	4
21	C87, C88	CAP, CERM, 4.7pF, 25V, +/-5%, C0G/NP0, 0402	MuRata	GRM1555C1E4R7CA01D	2
22	C99, C103	CAP, CERM, 220pF, 50V, +/-1%, C0G/NP0, 0603	AVX	06035A221FAT2A	2
23	C100, C101	CAP, CERM, 20 pF, 100 V, +/- 5%, C0G/NP0, 0603	MuRata	GRM1885C2A200JA01D	2
24	C102	CAP, CERM, 2200pF, 50V, +/- 10%, X7R, 0603	Kemet	C0603X222K5RACTU	1
25	C109	CAP, CERM, 0.47uF, 16V, +/-10%, X7R, 0603	MuRata	GRM188R71C474KA88D	1
26	C114	CAP, TA, 100uF, 16V, +/-20%, 0.1 ohm, SMD	Kemet	T495D107M016ATE100	1
27	C115	CAP, CERM, 47uF, 16V, +/-20%, X5R, 1210	MuRata	GRM32ER61C476ME15L	1
28	C118	CAP, CERM, 3300pF, 50V, +/- 10%, X7R, 0402	MuRata	GRM155R71H332KA01D	1
29	C125	CAP, TA, 2.2uF, 25V, +/-10%, 6.3 ohm, SMD	Vishay-Sprague	293D225X9025A2TE3	1
30	D1, D6, D7, D9, D10	LED, Green, SMD	Würth Elektronik eiSos	150060VS75000	5
31	D3	LED, Orange, SMD	Lite-On	LTST-C190KFKT	1
32	D4	LED, Green, SMD	Lite-On	LTST-C190GKT	1
33	D8	Diode, Schottky, 40V, 1A, SOD-123	Diodes Inc.	1N5819HW-7-F	1
34	D11	Diode, Zener, 7.5V, 550mW, SMB	ON Semiconductor	1SMB5922BT3G	1
35	F1	Fuse, 7 A, 24 V, SMD	Littelfuse	0429007.WRML	1
36	FID1, FID2, FID3	Fiducial mark. There is nothing to buy or mount.	N/A	N/A	3
37	H1, H2, H5, H6, H9, H11	Standoff, Hex, 0.5"L #4-40 Nylon	Keystone	1902C	6
38	J1	Connector, Audio Jack, 3.5mm, Stereo, SMD	CUI Inc.	SJ-3523-SMT	1

Table 2-1. Bill of Materials (continued)

ITEM	DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
39	J2, J5, J6, J7, J8, J15, J16, J22, J23, J24, J27, J28, J30, J32, J35, J39, J42, J45, J46, J47, J48, J49, J50, J51, J53, J54, J55, J56, J58, J59, J61, J65, J66, J67	Header, 100mil, 2x1, Gold plated, TH, Header, 100mil, 2x1, Gold, TH, Header, 100mil, 2x1, Gold, TH, Header, 100mil, 2x1, Gold, TH, Header, 100mil, 2x1, Gold, TH, Header, 100mil, 2x1, Gold, TH, Header, 100mil, 2x1, Gold, TH, Header, 100mil, 2x1, Gold, TH, Header, 100mil, 2x1, Gold plated, TH, Header, 100mil, 2x1, Gold, TH (UNSTUFF), Header, 100mil, 2x1, Gold, TH (UNSTUFF), Header, 100mil, 2x1, Gold, TH (UNSTUFF)	TE Connectivity	5-146261-1	34
40	J3, J14, J18, J19, J26, J33, J37, J40, J41, J44, J60	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator, Header, 100mil, 3x1, Gold, TH	Samtec, Inc., Samtec, Inc., Samtec, Inc., Samtec, Inc., Samtec, Inc., Samtec, Inc., Samtec, Inc., Samtec	TSW-103-07-G-S	11
41	J4, J62, J63, J64	Header, 100mil, 3x1, Tin, TH	TE Connectivity	5-146278-3	4
42	J9, J11, J12, J13	Connector, End launch SMA, 50 ohm, SMT	Emerson Network Power	142-0701-851	4
43	J10, J43	Header, TH, 100mil, 10x2, Gold plated, 230 mil above insulator	Samtec	TSW-110-07-G-D	2
44	J17, J52	RIGHT ANGLE PLUG FOR PCB	Rosenberger	59S20X-400L5-Y	2

**Table 2-1. Bill of Materials (continued)**

ITEM	DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
45	J20	Header, 100mil, 4x1, White, TH	Molex	0022112042	1
46	J21	Header, TH, 100mil, 16x2, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-116-07-G-D	1
47	J25	Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-104-07-G-S	1
48	J29	Connector, Receptacle, Mini-USB Type B, R/A, Top Mount SMT	TE Connectivity	1734035-2	1
49	J31	Header, 100mil, 7x2, Tin, TH	Sullins Connector Solutions	PEC07DAAN	1
50	J36	Connector, DC Jack 2.1X5.5 mm, TH	CUI Inc.	PJ-102A	1
51	J57	Header, 100mil, 5x2, Tin, TH	Sullins Connector Solutions	PEC05DAAN	1
52	J68	Standard Banana Jack, Insulated, Black	Keystone	6092	1
53	J69	Standard Banana Jack, Insulated, Red	Keystone	6091	1
54	L1, L7, L13	1.5A Ferrite Bead, 330 ohm @ 100MHz, SMD	MuRata	BLM18SG331TN1D	3
55	L2	EMI Filter	Murata	BLM15AX102SN1D	1
56	L3, L5	1.5A Ferrite Bead, 330 ohm @ 100MHz, SMD	TDK	MPZ1608S102A	2
57	L4, L6, L8	1.5A Ferrite Bead, 330 ohm @ 100MHz, SMD	MuRata	BLM18SG121TN1D	3
58	L9	Ferrite Bead, 60 ohm @ 100MHz, 0.8A, 0603	Taiyo Yuden	BK1608HS600-T	1
59	L10, L11	Coupled inductor, 0.28 A, 0.41 ohm, +/- 25%, SMD	MuRata	DLW21SN900HQ2L	2
60	L14	Inductor, Shielded Drum Core, Ferrite, 4.7uH, 4.2A, 0.02 ohm, SMD	Würth Elektronik eiSos	7440650047	1
61	LBL1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10	1
62	P1	HSD Right Angle Plug for PCB, TH	Rosenberger	D4S20D-40ML5-Z	1
63	Q3, Q4	MOSFET, N-CH, 50 V, 0.22 A, SOT-23	Fairchild Semiconductor	BSS138	2
64	R1, R2	RES, 100 ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW0402100RFKED	2
65	R3, R7, R9, R10, R16, R20, R21, R22, R32, R34, R38, R39, R42, R43, R73, R82, R106, R107, R111, R113, R126, R127, R131, R134, R135, R136, R137, R138, R139, R140, R141, R143, R144, R145, R146, R147, R163, R198, R203, R206	RES, 0 ohm, 5%, 0.063W, 0402	Panasonic	ERJ-2GE0R00X	40





**Table 2-1. Bill of Materials (continued)**

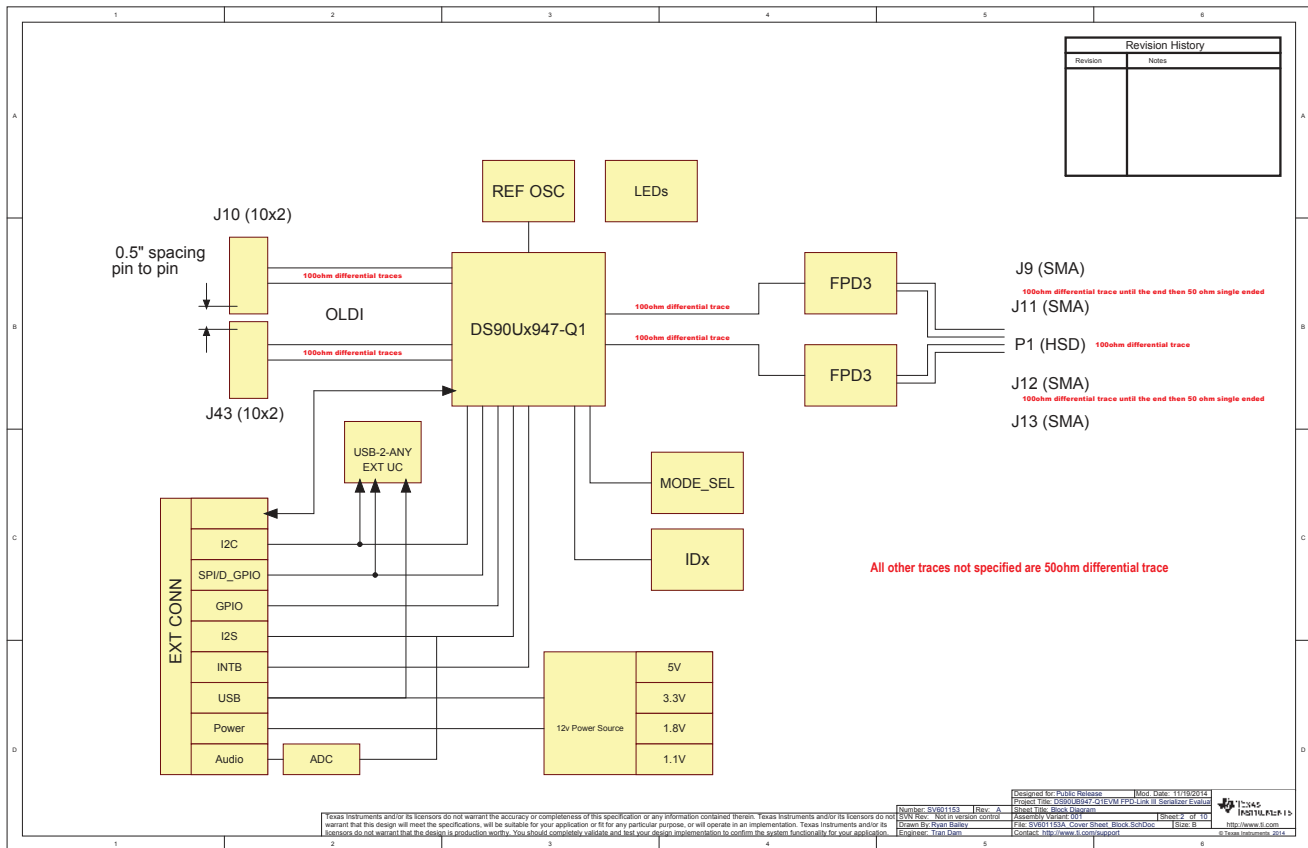
ITEM	DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
94	R81	RES, 80.6 k, 1%, 0.063 W, 0402	Vishay-Dale	CRCW040280K6FKED	1
95	R102	RES, 1.0 k, 5%, 0.063 W, 0402	Vishay-Dale	CRCW04021K00JNED	1
96	R108, R109	RES, 1.50k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW04021K50FKED	2
97	R115, R117, R119, R120, R121, R122, R125, R128, R130	RES, 100, 1%, 0.05 W, 0201	Panasonic	ERJ-1GEF1000C	9
98	R132	RES, 0.51 ohm, 1%, 0.1W, 0603	Panasonic	ERJ-3RQFR51V	1
99	R133, R157, R159	RES, 3.24k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW04023K24FKED	3
100	R149, R174	RES, 220, 5%, 0.063 W, 0402	Vishay-Dale	CRCW0402220RJNED	2
101	R153, R178	RES, 1.5 k, 5%, 0.063 W, 0402	Vishay-Dale	CRCW04021K50JNED	2
102	R155	RES, 3.0 k, 5%, 0.063 W, 0402	Vishay-Dale	CRCW04023K00JNED	1
103	R161	RES, 1.65k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW04021K65FKED	1
104	R162	RES, 1.37k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW04021K37FKED	1
105	R176, R177	RES, 33 ohm, 5%, 0.063W, 0402	Vishay-Dale	CRCW040233R0JNED	2
106	R179, R182	RES, 33k ohm, 5%, 0.063W, 0402	Vishay-Dale	CRCW040233K0JNED	2
107	R180	RES, 1.2Meg ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW06031M20JNEA	1
108	R183	RES, 200 ohm, 5%, 0.063W, 0402	Vishay-Dale	CRCW0402200RJNED	1
109	R187	RES, 22.1k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW040222K1FKED	1
110	R188	RES, 124k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW0402124KFKED	1
111	R197	RES, 1.87k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW04021K87FKED	1
112	R199	RES, 4.99k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW04024K99FKED	1
113	R209	RES, 0, 5%, 0.063 W, 0402	Vishay-Dale	CRCW04020000Z0ED	1
114	S1	Switch, Slide, SPST 3 poles, SMT	CTS Electrocomponents	219-3LPST	1
115	S2, S3, S6	Switch, Slide, SPST 8 poles, SMT	CTS Electrocomponents	219-8MST	3
116	S4, S9	Switch, Normally open, 2.3N force, 200k operations, SMD	C and K Components	KSR221GLFS	2
117	S5	DIP Switch, 4 position slide actuator, SPST, SMD	Omron Electronic Components	A6S-4104-H	1
118	SH-J4, SH-J14, SH-J16, SH-J18, SH-J19, SH-J26, SH-J33, SH-J37, SH-J40, SH-J41, SH-J46, SH-J48, SH-J49, SH-J60	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA	14
119	U2	1080p OpenLDI to FPD-Link III Serializer, RGC0064K	Texas Instruments	DS90Ux947RGCCQ1	1
120	U3	Single-ended, Analog-input 24-BIT, 96-kHz Stereo A/D Converter, PW0014A	Texas Instruments	PCM1808PW	1
121	U4	IC, Automotive LDO Positive Voltage Regulators, 5V	Texas Instruments	TL751M05QKVURQ1	1
122	U5	4-channel ESD-Protection Array For high-speed Data Interfaces, DRY006A	Texas Instruments	TPD4E004DRY	1

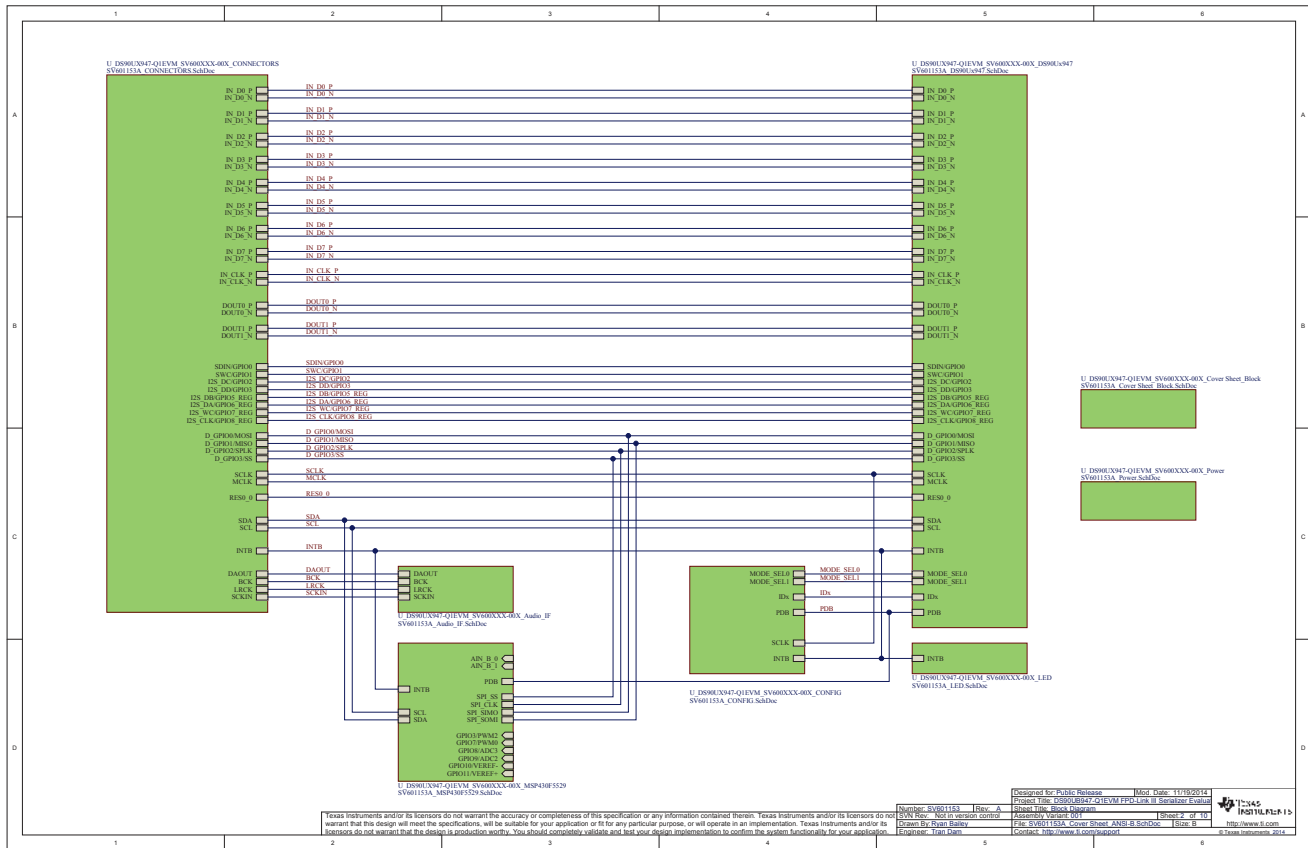
**Table 2-1. Bill of Materials (continued)**

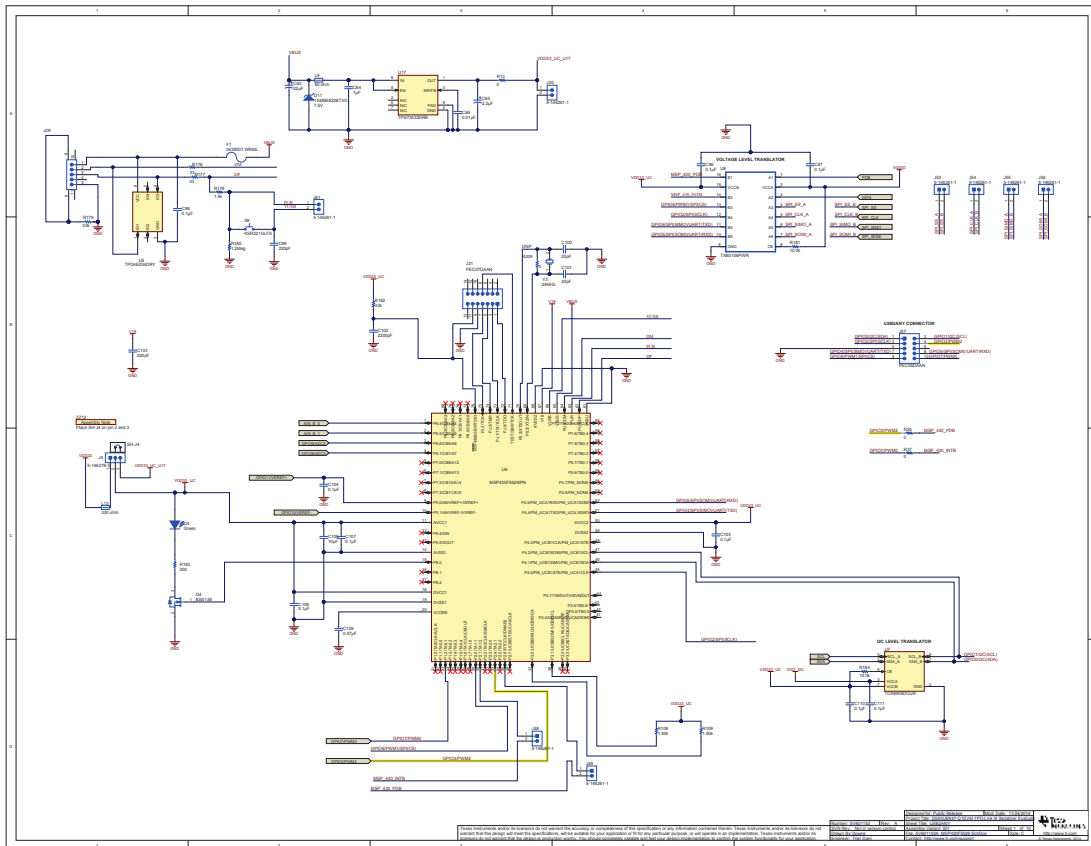
ITEM	DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
123	U6	Mixed Signal MicroController, PN0080A	Texas Instruments	MSP430F5529IPN	1
124	U7	TCA9406 Dual Bidirectional 1-MHz I2C-BUS and SMBus Voltage Level-Translator, 1.65 to 3.6 V, -40 to 85 degC, 8-pin US8 (DCU), Green (RoHS & no Sb/Br)	Texas Instruments	TCA9406DCUR	1
125	U8	IC, 6-BIT Bidirectional Voltage-level translator	Texas Instruments	TXB0106PWR	1
126	U10	IC, 1.5A LDO Regulator with Soft-Start	Texas Instruments	TPS74701DRC	1
127	U11	Dual Output LDO, 1 A, Fixed 1.8, 3.3 V Output, 2.7 to 10 V Input, 28-pin HTSSOP (PWP), -40 to 125 degC, Green (RoHS & no Sb/Br)	Texas Instruments	TPS767D318PWP	1
128	U12	800 mA Fast-Response High-Accuracy Adjustable LDO Linear Regulator with Enable and Soft-Start, 7-pin TO-263	Texas Instruments	LP38851S-ADJ	1
129	U17	500mA, Low Quiescent Current, Ultra-Low Noise, High PSRR Low-Dropout Linear Regulator, DRB0008A	Texas Instruments	TPS73533DRB	1
130	X2	OSC, 170 MHz, 3.3 Vdc, SMD	Fox Electronics	FXO-LC735R-170	1
131	Y1	OSC, 12.288 MHz, 3.3 Vdc, SMD	ECS Inc.	ECS-8FA3X-122.8-TR	1
132	Y2	OSC, 96 MHz, 3.3 Vdc, SMD	Fox Electronics	FXO-HC736R-96	1
133	Y3	Crystal, 24.000MHz, 20pF, SMD	ECS Inc.	ECS-240-20-5PX-TR	1
134	J34	Header, 100mil, 2x1, Gold plated, TH	TE Connectivity	5-146261-1	0
135	R11, R12, R14, R15	RES, 0, 5%, 0.05 W, 0201	Panasonic	ERJ-1GE0R00C	0
136	R26, R28, R150, R151	RES, 0 ohm, 5%, 0.1W, 0603, RES, 0 ohm, 5%, 0.1W, 0603, RES, 0 ohm, 5%, 0.1W, 0603 (UNSTUFF), RES, 0 ohm, 5%, 0.1W, 0603 (UNSTUFF)	Vishay-Dale	CRCW06030000Z0EA	0
137	R44, R45, R46, R47, R165, R166, R167, R168, R169, R170, R171, R172, R190, R191	RES, 51, 5%, 0.063 W, 0402	Vishay-Dale	CRCW040251R0JNED	0
138	R48, R56, R57, R65, R74, R83, R84, R92, R100, R101, R142, R192	RES, 0 ohm, 5%, 0.063W, 0402 (UNSTUFF)	Panasonic	ERJ-2GE0R00X	0
139	R105	RES, 10.0k ohm, 1%, 0.063W, 0402 (UNSTUFF)	Vishay-Dale	CRCW040210K0FKED	0
140	R114, R164	RES, 3.24k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW04023K24FKED	0
141	U1	Single High Speed Differential Driver, 8-pin Narrow SOIC	National Semiconductor	DS90LV017ATM	0
142	U9	IC, 4.5V-18V Input, 2-A Sync. Step-Down SWIFT Converter	TI	TPS54225PWP	0
143	U15	Low-Capacitance + / - 15 kV ESD-Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85 degC, 5-pin SOT (DRL), Green (RoHS & no Sb/Br)	Texas Instruments	TPD2E001DRLR	0
144	H3, H4, H7, H8, H10, H12	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	B&F Fastener Supply	NY PMS 440 0025 PH	6

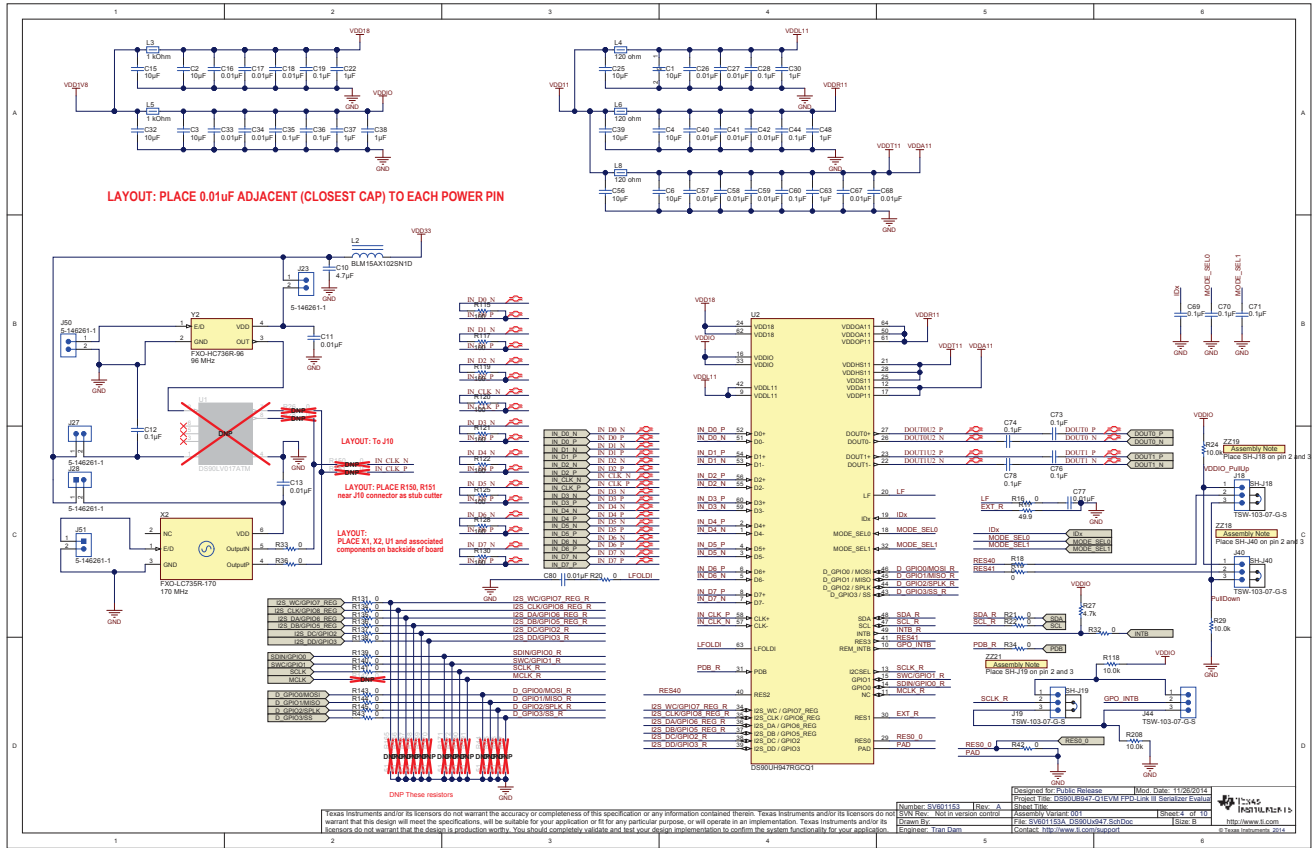


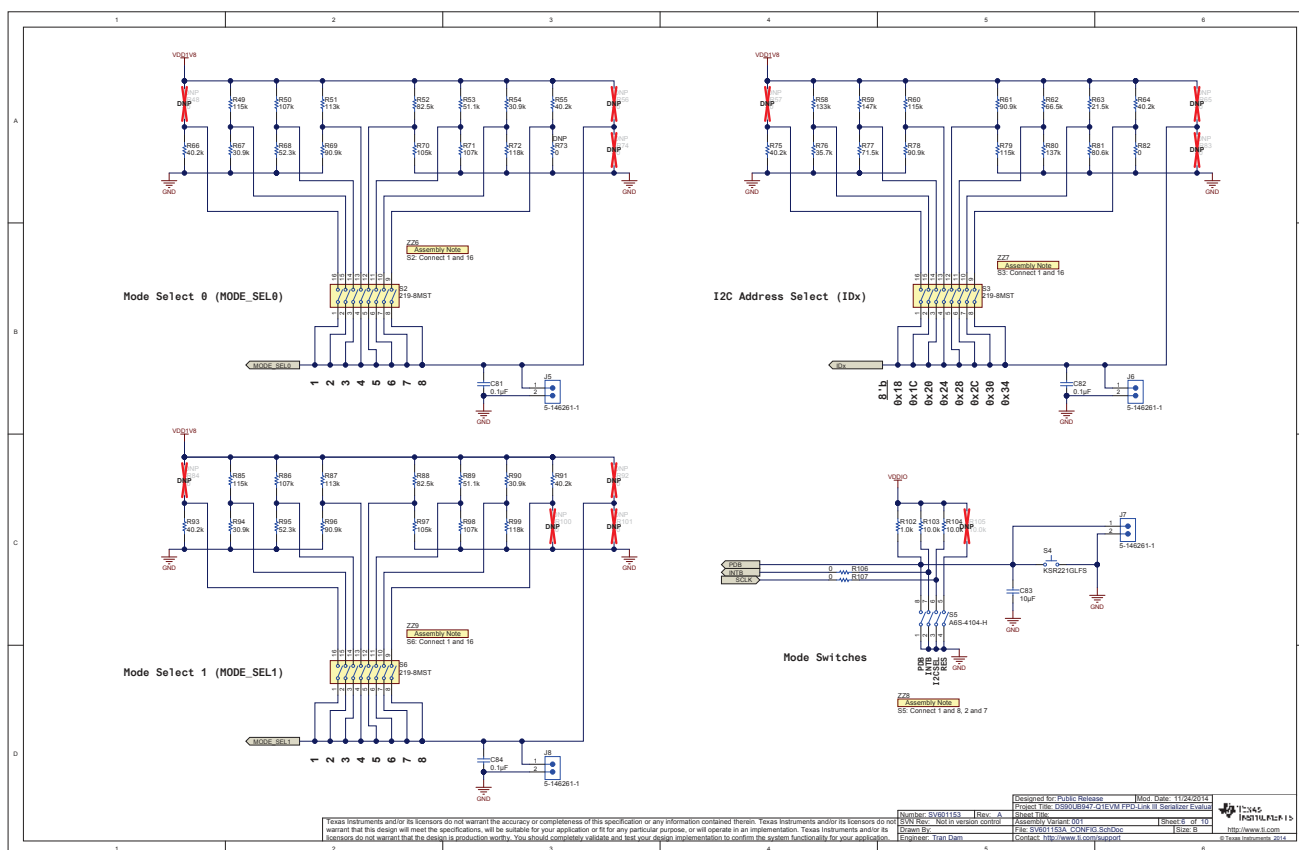
# EVM PCB Schematics



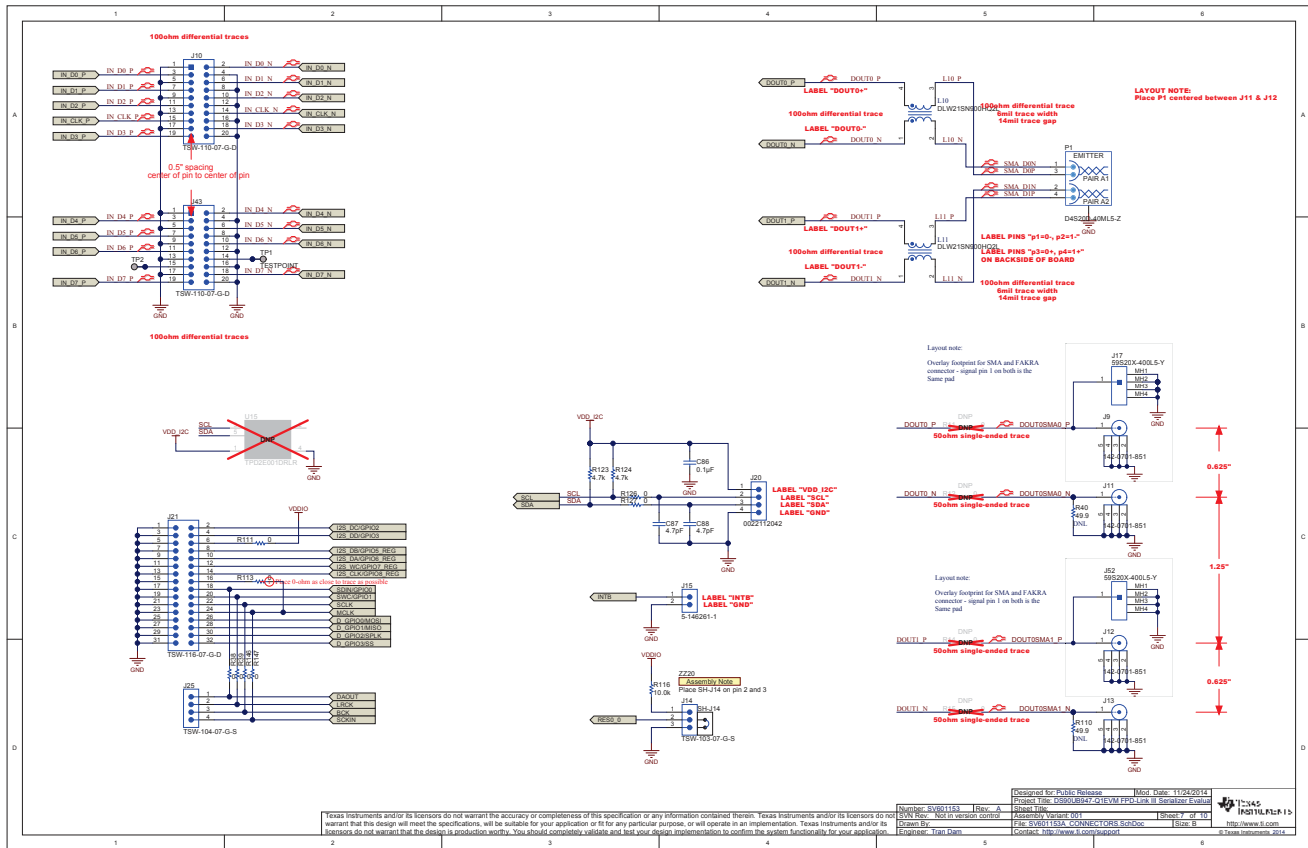


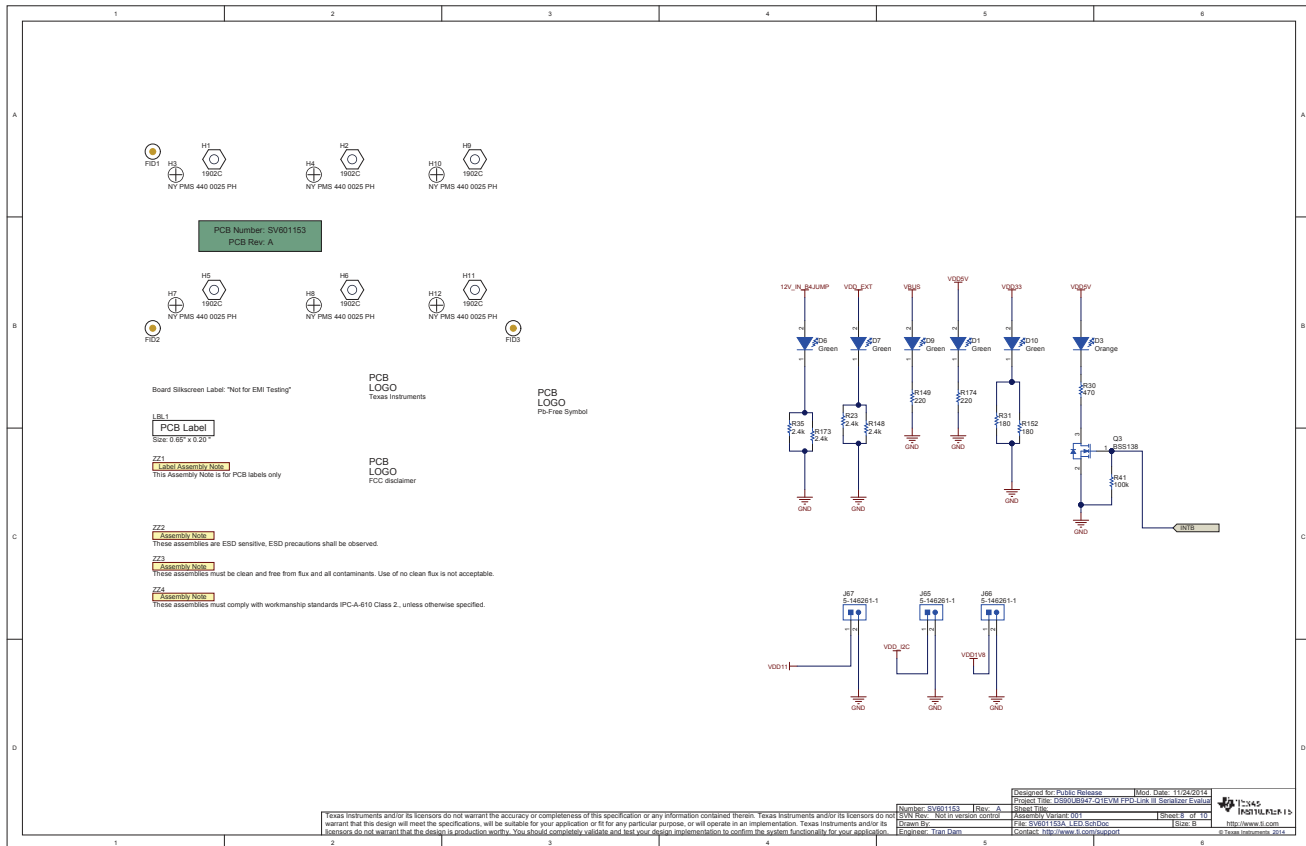


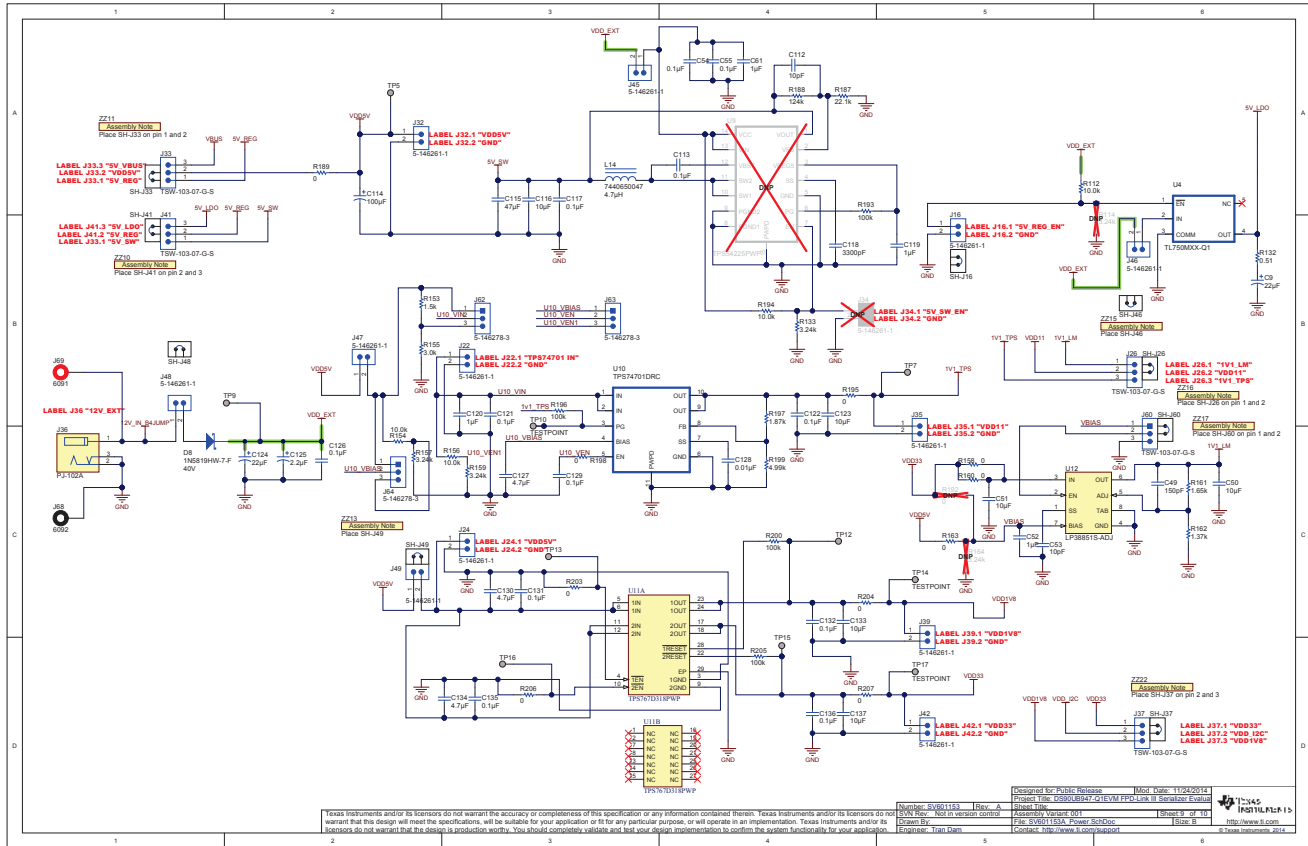


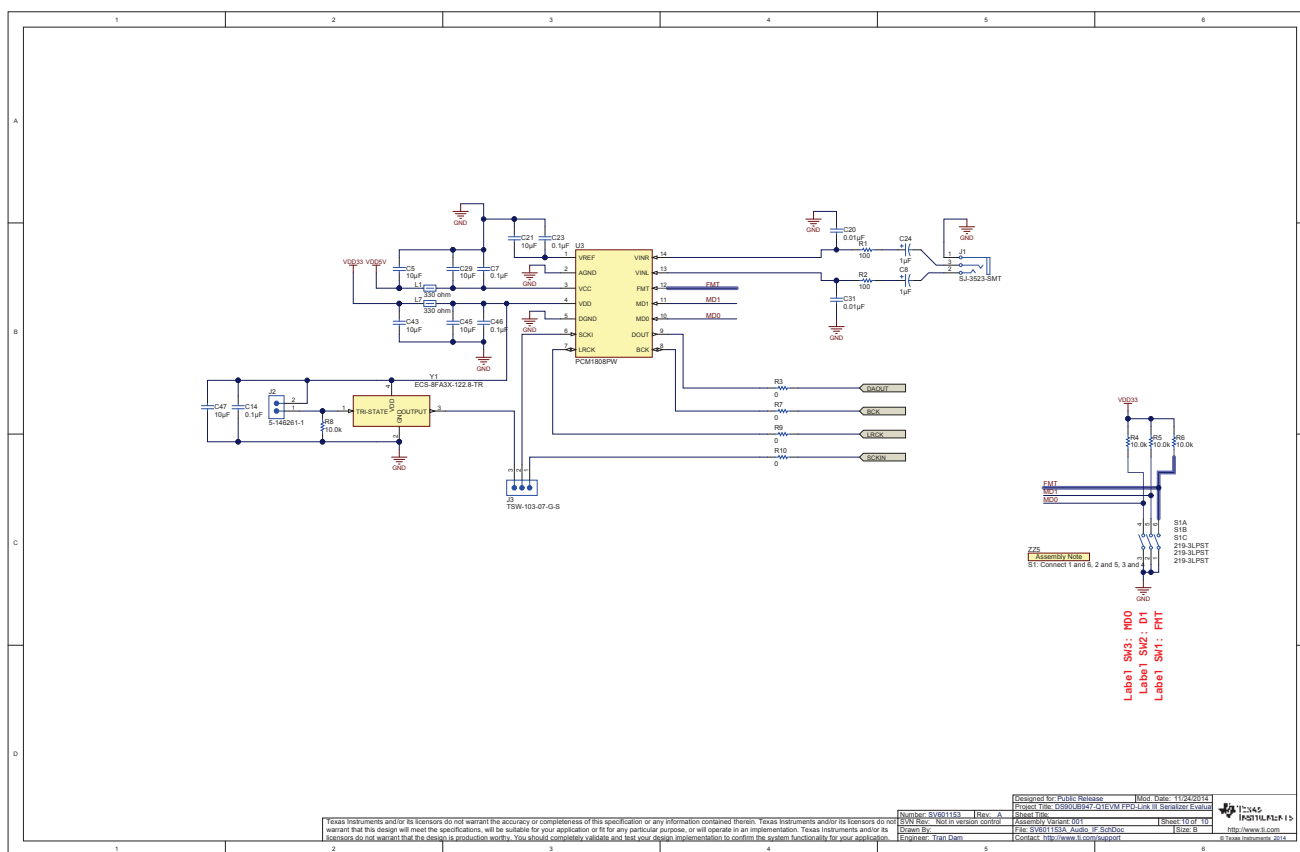










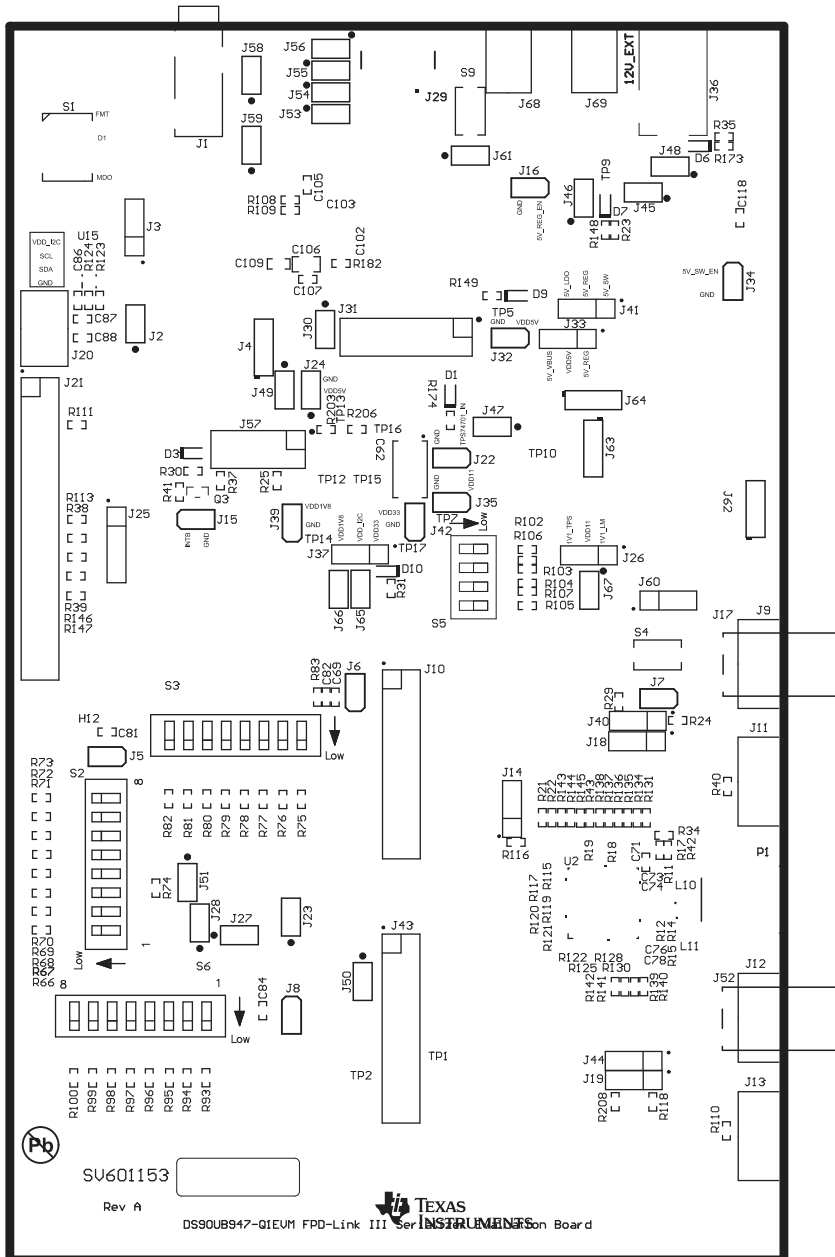


## ***Board Layout***

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SU601153

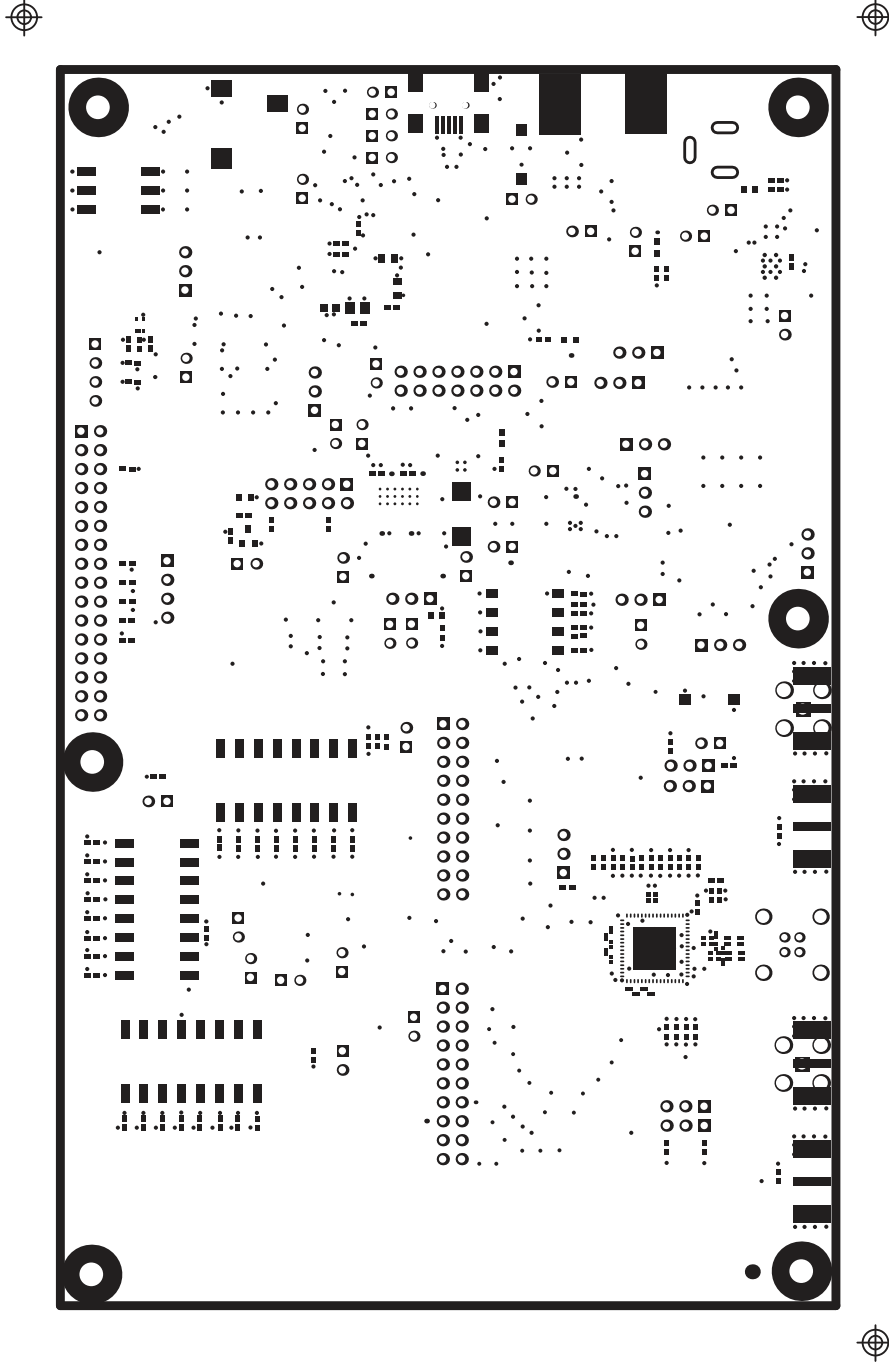
Rev A



DS90UB947-GIEUM FPD-Link III SerDes Transceiver Board

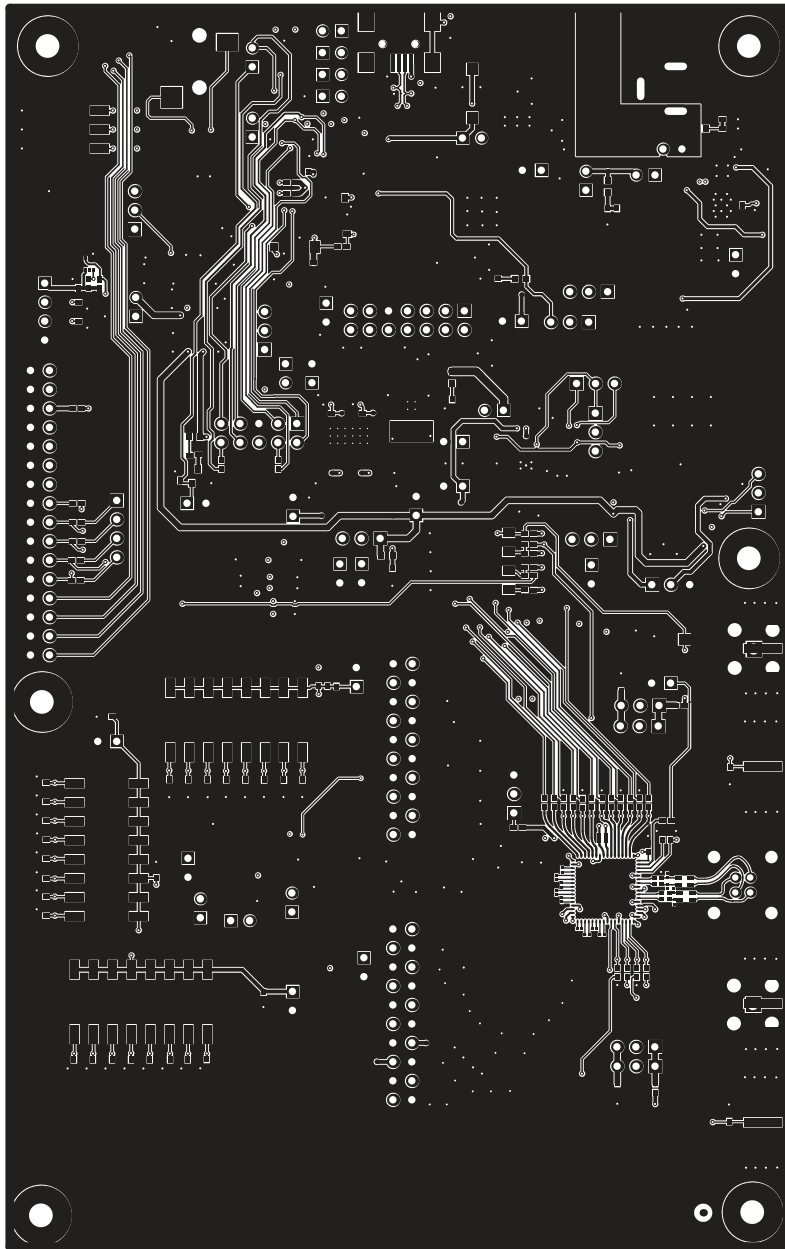
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ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #:	REV: A	SUN REV: Not In VersionControl
PLOT NAME =			
Top Overlay		GENERATED : 11/26/2014 3:36:12 PM	TEXAS INSTRUMENTS

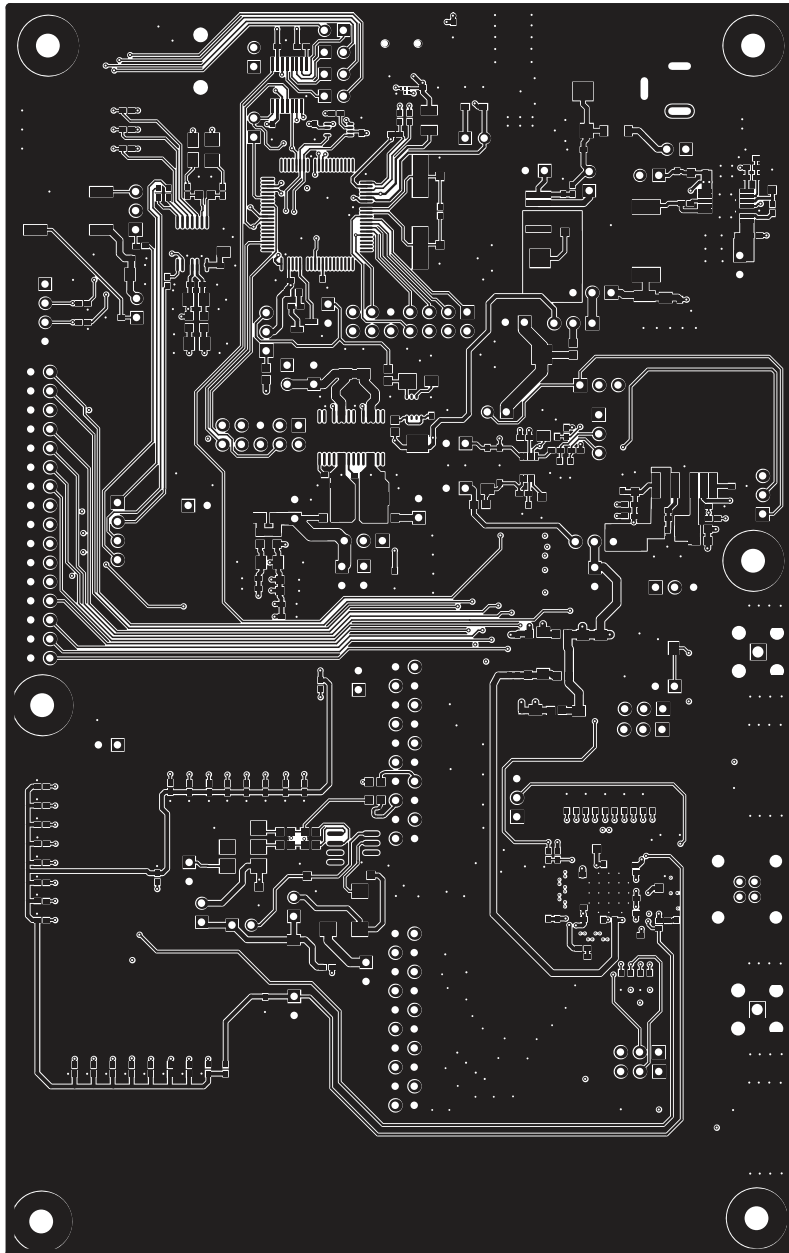


ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #:	REV: A	SUN REV: Not In VersionControl
PLOT NAME = SOLDERMASK <PRIMARY SIDE>			
Top Solder Mask	GENERATED : 11/26/2014 3:36:13 PM	TEXAS INSTRUMENTS	

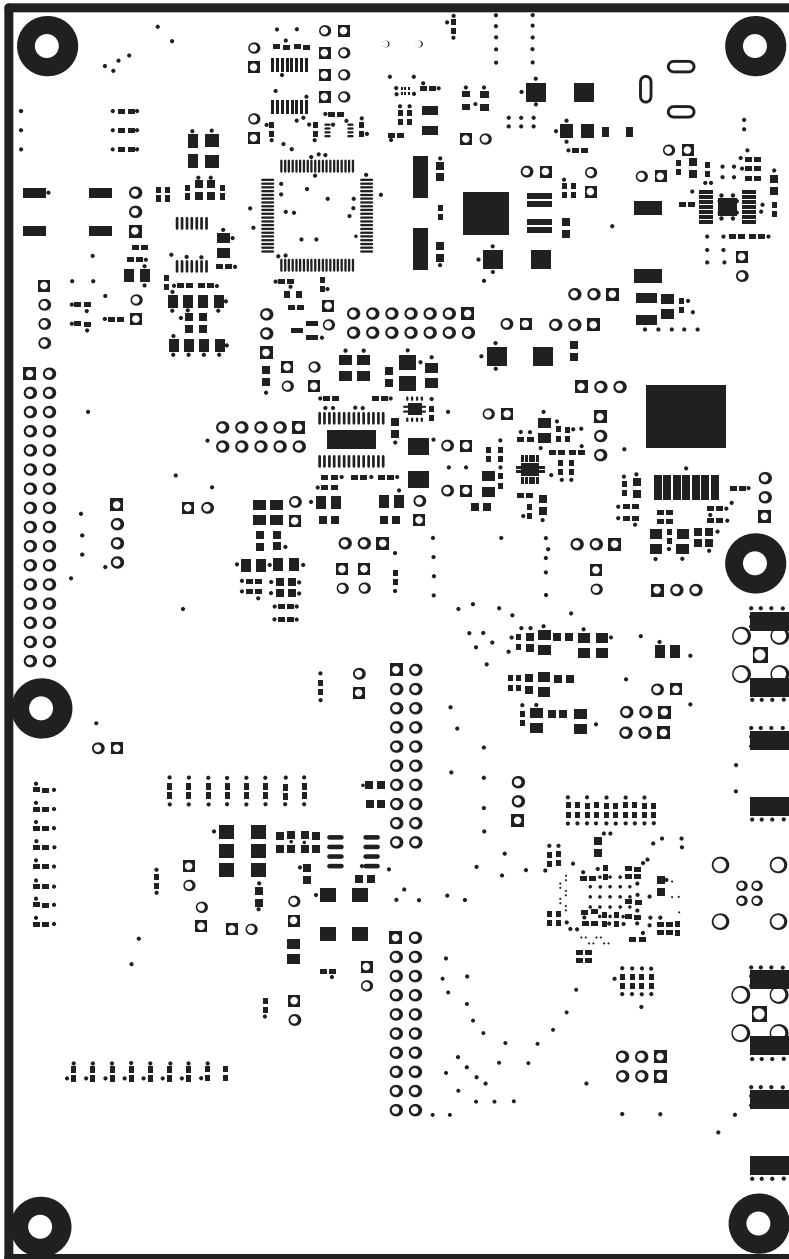




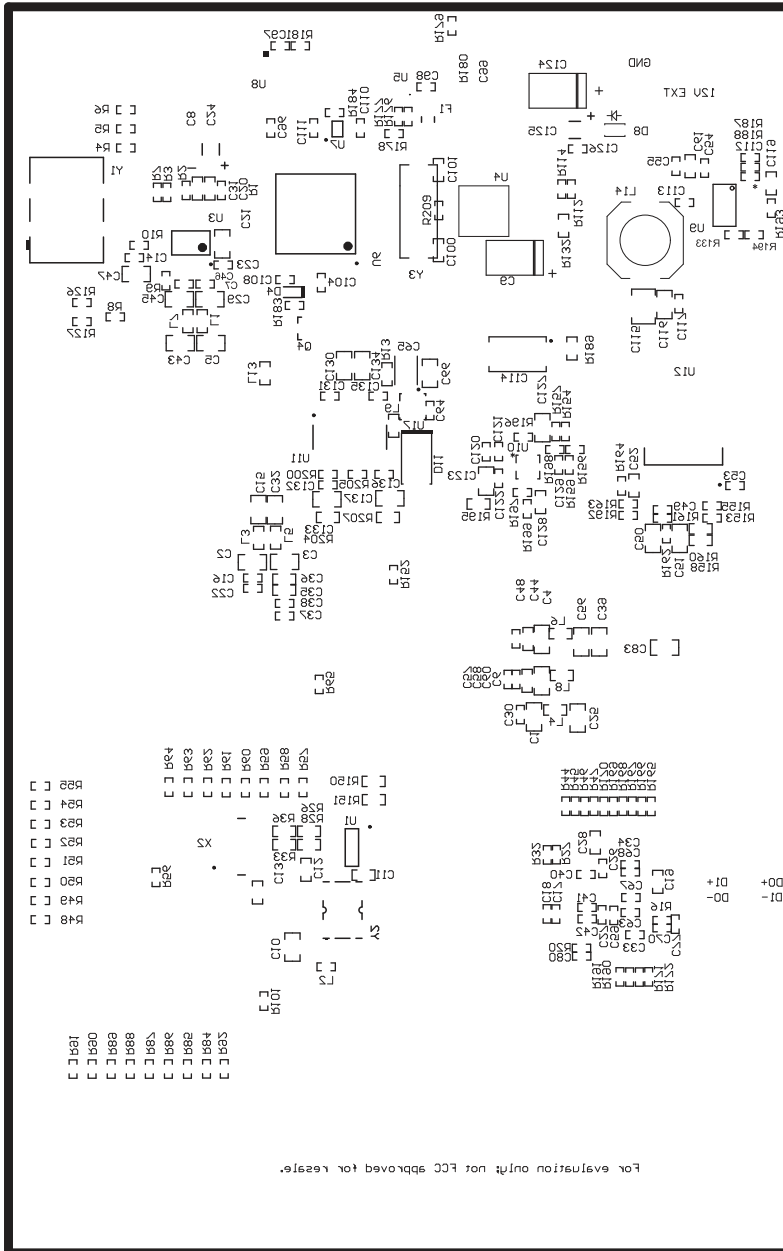
ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #:	REV: A	SUN REV: Not In VersionControl
PLOT NAME = LAYER 1 (PRIMARY SIDE )			
Top Layer	GENERATED : 11/26/2014 3:36:14 PM	TEXAS INSTRUMENTS	



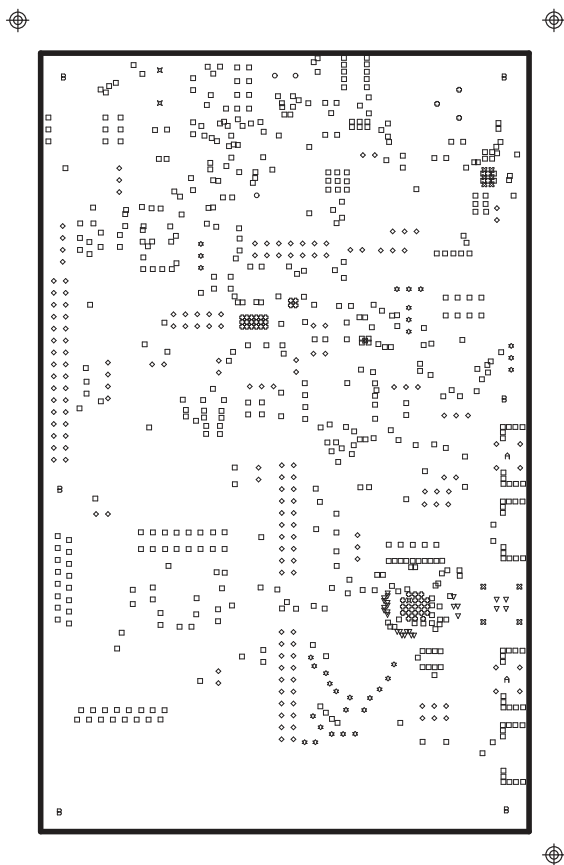
ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #:	REV: A	SUN REV: Not In VersionControl
PLOT NAME = LAYER 4 (SECONDARY SIDE)			
Bottom Layer	GENERATED : 11/26/2014 3:36:14 PM	TEXAS INSTRUMENTS	



ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #:	REV: A	SUN REV: Not In VersionControl
PLOT NAME = SOLDERMASK (SECONDARY SIDE)			
Bottom Solder Mask	GENERATED	: 11/26/2014 3:36:15 PM	TEXAS INSTRUMENTS



ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #:	REV: A	SUN REV: Not In VersionControl
PLOT NAME = SILKSCREEN <SECONDARY SIDE>			
Bottom Overlay	GENERATED	: 11/26/2014 3:36:16 PM	TEXAS INSTRUMENTS



Symbol	Hit Count	Finished Hole Size	Plated	Hole Type	Tolerance	SLOT DETAIL
o	1	7.87mil (0.200mm)	PTH	Round	+/-3.0	
⊗	2	35.43mil (0.900mm)	NPTH	Round	+/-2.0	
*	2	59.06mil (1.500mm)	PTH	Round	+/-3.0	
⊕	2	66.93mil (1.700mm)	NPTH	Round	+/-2.0	
B	3	40.00mil (1.016mm)	PTH	Slot	+/-3.0	70.00mil X 150mil
x	4	63.00mil (1.600mm)	PTH	Round	+/-3.0	
A	6	125.98mil (3.200mm)	PTH	Round	+/-3.0	
o	7	13.00mil (0.330mm)	PTH	Round	+/-3.0	
⊗	8	74.80mil (1.900mm)	PTH	Round	+/-3.0	
⊕	12	39.37mil (1.000mm)	PTH	Round	+/-3.0	
o	18	38.00mil (0.965mm)	PTH	Round	+/-3.0	
*	19	11.00mil (0.279mm)	PTH	Round	+/-3.0	
□	22	6.00mil (0.152mm)	PTH	Round	+/-3.0	
∇	42	7.87mil (0.200mm)	PTH	Round	+/-3.0	
∇	46	40.16mil (1.020mm)	PTH	Round	+/-3.0	
⊕	147	40.00mil (1.016mm)	PTH	Round	+/-3.0	
x	521	12.00mil (0.305mm)	PTH	Round	+/-3.0	
	862 Total					

ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #:	REV: A	SUN REV: Not In VersionControl
PLOT NAME =			
Drill Drawing	GENERATED	: 11/26/2014 3:36:16 PM	TEXAS INSTRUMENTS

1
2
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A
6
A

B
B
B

C
C
C

D
D
D

1
2
3
4
5
6

Symbol	Hit Count	Finished Hole Size	Plated	Hole Type	Tolerance	SLOT DETAIL
O	1	7.87mil (0.200mm)	PTH	Round	+/-0.0	
#	2	35.43mil (0.900mm)	NPTH	Round	+/-0.0	
*	2	59.06mil (1.500mm)	PTH	Round	+/-0.0	
●	2	66.93mil (1.700mm)	NPTH	Round	+/-0.0	
B	3	40.00mil (1.016mm)	PTH	Slot	+/-0.0	70.00mil X 150mil
X	4	63.00mil (1.600mm)	PTH	Round	+/-0.0	
A	6	125.99mil (3.200mm)	PTH	Round	+/-0.0	
O	7	13.00mil (0.330mm)	PTH	Round	+/-0.0	
#	8	74.80mil (1.900mm)	PTH	Round	+/-0.0	
#	12	39.37mil (1.000mm)	PTH	Round	+/-0.0	
o	18	36.00mil (0.914mm)	PTH	Round	+/-0.0	
o	19	11.00mil (0.279mm)	PTH	Round	+/-0.0	
o	22	6.00mil (0.152mm)	PTH	Round	+/-0.0	
V	42	7.87mil (0.200mm)	PTH	Round	+/-0.0	
V	46	40.16mil (1.020mm)	PTH	Round	+/-0.0	
o	147	40.00mil (1.016mm)	PTH	Round	+/-0.0	
X	521	12.00mil (0.305mm)	PTH	Round	+/-0.0	
862 Total						

**FAB NOTES:**

BOARD SHOULD BE PANELIZED WITH .500 RAILSON BOTH SIDES.

ALL 6.0 MIL DRILL NEEDS TO BE CONDUCTIVE FILLED AND PLATED OVER TOP.

ALL VIAS SHOULD BE TENTED (TOP AND BOTTOM)

**IMPEDANCE DETAILS:**

10 MIL TRACE WIDTH REQUIRES 45 OHM CONTROLLED IMPEDANCE ON TOP AND BOTTOM.

8 MIL TRACE WIDTH REQUIRES 50 OHM CONTROLLED IMPEDANCE ON TOP, SIG1, AND BOTTOM.

4 MIL TRACE WIDTH REQUIRES 50 OHM CONTROLLED IMPEDANCE ON GND1.

8 MIL TRACE WIDTH AND 11 MIL AIRGAP REQUIRES 90 OHM CONTROLLED IMPEDANCE ON TOP AND BOTTOM.

7 MIL TRACE WIDTH AND 14 MIL AIRGAP REQUIRES 100 OHM CONTROLLED IMPEDANCE ON TOP.

4 MIL TRACE WIDTH AND 16 MIL AIRGAP REQUIRES 100 OHM CONTROLLED IMPEDANCE ON GND1.

6 MIL TRACE WIDTH AND 14 MIL AIRGAP REQUIRES 100 OHM CONTROLLED IMPEDANCE ON SIG1.

**DESIGN INFORMATION**

BOARD SIZE (REFER ALSO ARRAY/PANEL PROFILING INFORMATION)

3100MIL X 7200MIL

Number of Layers: 6

MIN. TRACK WIDTH: 4 MIL

MIN. CLEARANCE: 5 MIL

MIN. VIA PAD SIZE: 72 MIL

MINIMUM ANNUAL RING 0.05mm (0.001) EXTERNAL

PER IPC-D-275 CLASS 2 LEVEL C

REGISTRATION TOLERANCES: METAL +/- .0 MIL, HOLES +/- .3 MIL

**MATERIAL:**

FR-4  FR-4 High Tg  OTHER

THICKNESS:  62 MIL (1.5mm) +/-10%  OTHER

TOLERANCE:  ANSI IPC-6012 TYPE 3 CLASS 2

OTHER +/-

BOW & TWIST:  ANSI IPC-6012 TYPE 3 CLASS 2

OTHER +/-

**COPPER THICKNESS (FINISH):**

OUTER:  1.4MIL (1oz)  2MIL (1.4oz)  2.8MIL (2oz)

INNER SIGNAL:  1.4MIL (1oz)  2.8MIL (2oz)  N/A

**DRILLING:**

REFERENCE:  AS SHOWN  NC\_DRILL FILES

PTH MIN COPPER THICKNESS:  1MIL  OTHER

**BOARD FINISH:**

SLACKSCREEN:  TOP  BOTTOM

SLACKSCREEN COLOR:  WHITE  OTHER

SOLDER RESIST COLOR:  GREEN  BLUE  OTHER

**SURFACE FINISH:**

IMMERSION GOLD (ENIG)

MAL. TIN/SILVER OR EQUIV  OTHER

**ARRAY/PANEL:**

CUT AND TRIM PER MECH LAYER 1

NC. ROUTE  V. SCORE

**CERTIFICATION:**

MATERIALS AND WORKMANSHIP FOR ALL POBS TO MEET OR EXCEED THE REQUIREMENTS OF:

ANSI IPC-A-600F CLASS ->  1  2  3

UL 94V-0  RoHS  OTHER PER ORDER

**ADDITIONAL REQUIREMENTS:**

MICROSECTION:  YES

BARE BOARD ELEC. TEST:  NONE  REQUIRED  PER ORDER

MANUFACTURER'S DIALOG:  RAL  METAL  SLK

**Layer Stack Up Detail for: DS90U947-SUG00XX-00X\_PcbDoc**

Layer	Material	Color	Thickness	Minimum	Maximum	Notes
Top Solder Mask	C-67B	0.78mil	0.78mil	Solder Resist		
O1_Top	C-67L	1.78mil	1.78mil	FR-4	Core	
O2_SAME	C-65	1.3mil	4.00mil	FR-4	Prepreg	
O3_SAME	C-52	1.3mil	26.00mil	FR-4	Core	
O4_SAME	C-59	1.3mil	4.00mil	FR-4	Prepreg	
O5_SAME	C-94	1.3mil	16.00mil	FR-4	Core	
O6_Bottom	C-68L	1.78mil	1.78mil	FR-4	Core	
Bottom Solder Mask	C-67B	0.78mil	0.78mil	Solder Resist		

**DESIGNER:** TRAN, DATE: A

**SCALE:** 1:109

**FILE NAME:** SUG01153A\_PcbDoc

**DESIGNED FOR:** Public Release

**DATE:** 11/26/2014 3:35:12 PM

**TEXAS INSTRUMENTS**

These instruments (TI) and/or its licensors do not warrant the accuracy or completeness of this specification or any information contained therein. TI and/or its licensors do not warrant that this design will meet the specifications, will be suitable for your application or fit for any particular purpose, or will operate in an implementation. TI and/or its licensors do not warrant that the design is production worthy. You should completely validate and test your design implementation to confirm the system functionality for your application.

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## Revision History

Changes from Original (November 2014) to A Revision	Page
• Changed Title to DS90Ux947-Q1EVM User's Guide.....	5
• Changed DS90UB or DS90UH to DS90ux throughout document. ....	5
• Changed rows in <a href="#">Table 2-1</a> .....	29

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

## STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.
  - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software
  - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
  - 2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
  - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
  - 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.
3. *Regulatory Notices:*
  - 3.1 *United States*
    - 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
    - 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

### CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### FCC Interference Statement for Class A EVM devices

*NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*



## FCC Interference Statement for Class B EVM devices

*NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### 3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

#### Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

#### Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

#### Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

#### Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

### 3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。  
[http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page)

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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2. 実験局の免許を取得後ご使用いただく。
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西新宿三井ビル

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#### 4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

#### 4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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