DS90UB928QEVM User Guide

Literature Number: SNLU131
February 2013

Introduction

1.1 DS90UB928QEVM

The Texas Instruments DS90UB928QEVM evaluation module (EVM) helps system designers evaluate the operation and performance of the DS90UB928Q 5MHz-85MHz FPD-Link III Deserializer (DES). The device translates a high-speed serialized FPD-Link III interface transported over a single shielded twisted pair (STP) into four FPD-Link compatible LVDS data output pairs and one LVDS clock.

The DS90UB928QEVM board features a 20-position IDC connector for connecting to the FPD-Link outputs, and a HSD Automotive Connector for connecting an automotive-grade STP cable to the FPD-Link III input. The included SMA connectors may also be configured as the FPD-Link III data input, enabling evaluation of other connectors and cable configurations.

The EVM contains one deserializer device.

1-1. Device and Package Configurations

Reference	IC	Package
U1	DS90UB928QSQ	WQFN48

1.2 DS90UB928QEVM Kit Contents

The DS90UB928QEVM Kit contains the following items:

- DS90UB928QEVM Evaluation Board
- USB Cable

1.3 System Requirements

The ALP software installation requires a PC with a USB interface running the Windows XP operating system.

1.4 DS90UB928QEVM Overview

The DS90UB928Q deserializer supports rich audiovisual applications in automotive navigation and rear seat entertainment systems. It receives video data, I2S audio, GPIO, and I2C control over a single shielded twisted pair cable. The evaluation board and included software enables easy evaluation of the deserializer features, including:

- Support of 720p video applications with a pixel clock frequency up to 85MHz
- Surround sound I2S Digital Audio Applications with up to 4 I2S data outputs
- Low EMI FPD-Link video output interface
- Bidirectional control channel including GPIO (with 2 dedicated pins), interrupt, and I2C interface
- Up to 10 configurable I2C addresses
- Flexible 3.3V or 1.8V LVCMOS I/O interface
- Adaptive cable equalization
- @SPEED Link BIST Mode and LOCK status indicator LED
- Image Enhancement (White Balancing & Hi-FRC Dithering)
- Backwards compatibility mode allowing pairing with DS90UR905Q and DS90UR907Q serializers

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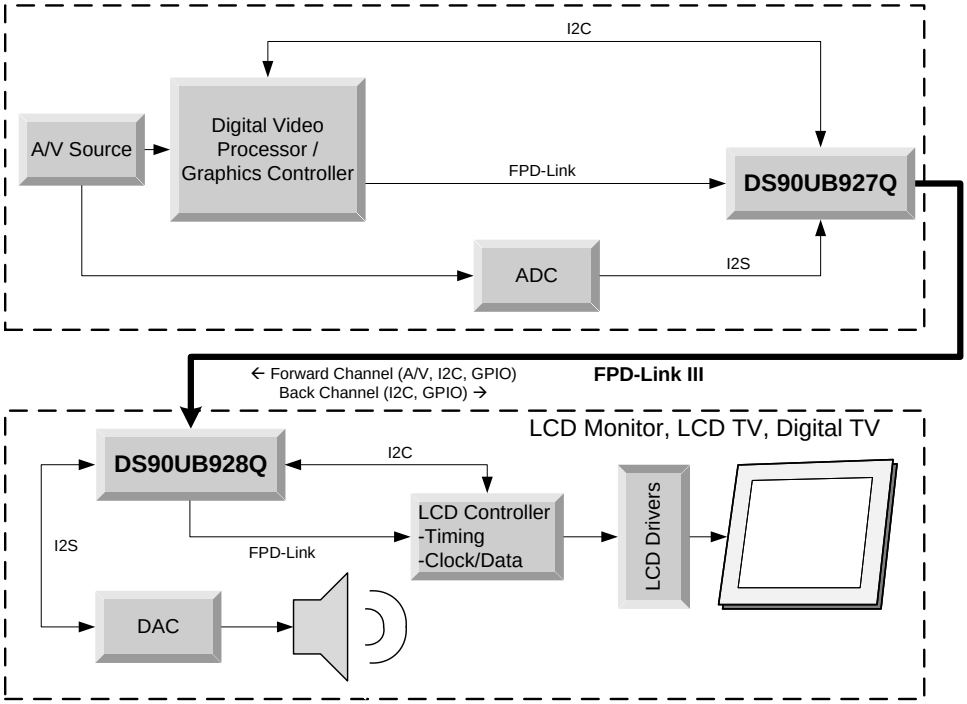
- Internal Pattern Generation
- Loop-through monitor outputs for observing link integrity

1.5 Typical Application

The following diagram illustrates a typical rear seat entertainment application that utilizes the DS90UB928Q deserializer and a compatible serializer (DS90UB925Q or DS90UB927Q). The DS90UB928Q accepts FPD-Link III data transported over an automotive-grade STP cable and deserializes the data stream into video, audio, and control information intended for a display and other local peripherals.



1-1. Typical Application/Evaluation Configuration

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2.1 Board Setup

This section describes how to quickly set up the DS90UB928QEVM with an appropriate serializer for evaluation of the chipset in display applications. The default switches and jumper positions have been set at the factory. This setup guide assumes the user has already installed and configured the included ALP software. See Installation for details.

1. Connect 3.3V DC power and ground from a power supply to J8 (VDD33C) and J9 (VSS). If 1.8V VDDIO operation is desired, set the 1.8V position at JP7 and apply 1.8V DC at pin 1 of JP6. Alternatively, onboard 1.8V DC and 3.3V DC voltage regulators may be utilized by connecting 5V DC at the J7 barrel power jack (center positive).
2. Connect an applicable cable (not provided, HSD automotive connector configured by default) from the DS90UB928QEVM (RX) board FPD-Link III input (J4) to the FPD-Link III output of a compatible FPD-Link III (TX) board (DS90UB925QSEVB or DS90UB927QEVM).
3. From the Video source, connect a flat cable to the TX board and connect the appropriate cable from the RX board to the panel.
4. Connect the included USB cable from a host computer running the included TI ALP software to the USB port (J6) on the RX board. See Usage for further information on using the TI ALP tool.
5. (Optional) Connect audio from an I2S audio source to TX board pins DA (data), CLK (clock), and WC (word clock) and from RX board pins DA, CLK, and WC to an I2S DAC.
6. (Optional) Connect and configure any required GPIO interfaces. GPIO0 and GPIO1 are dedicated pins.

Jumpers and switches have been configured by TI; they should not require any changes for immediate operation of the board. See Evaluation Hardware Overview and the DS90UB928Q device datasheet for further details.

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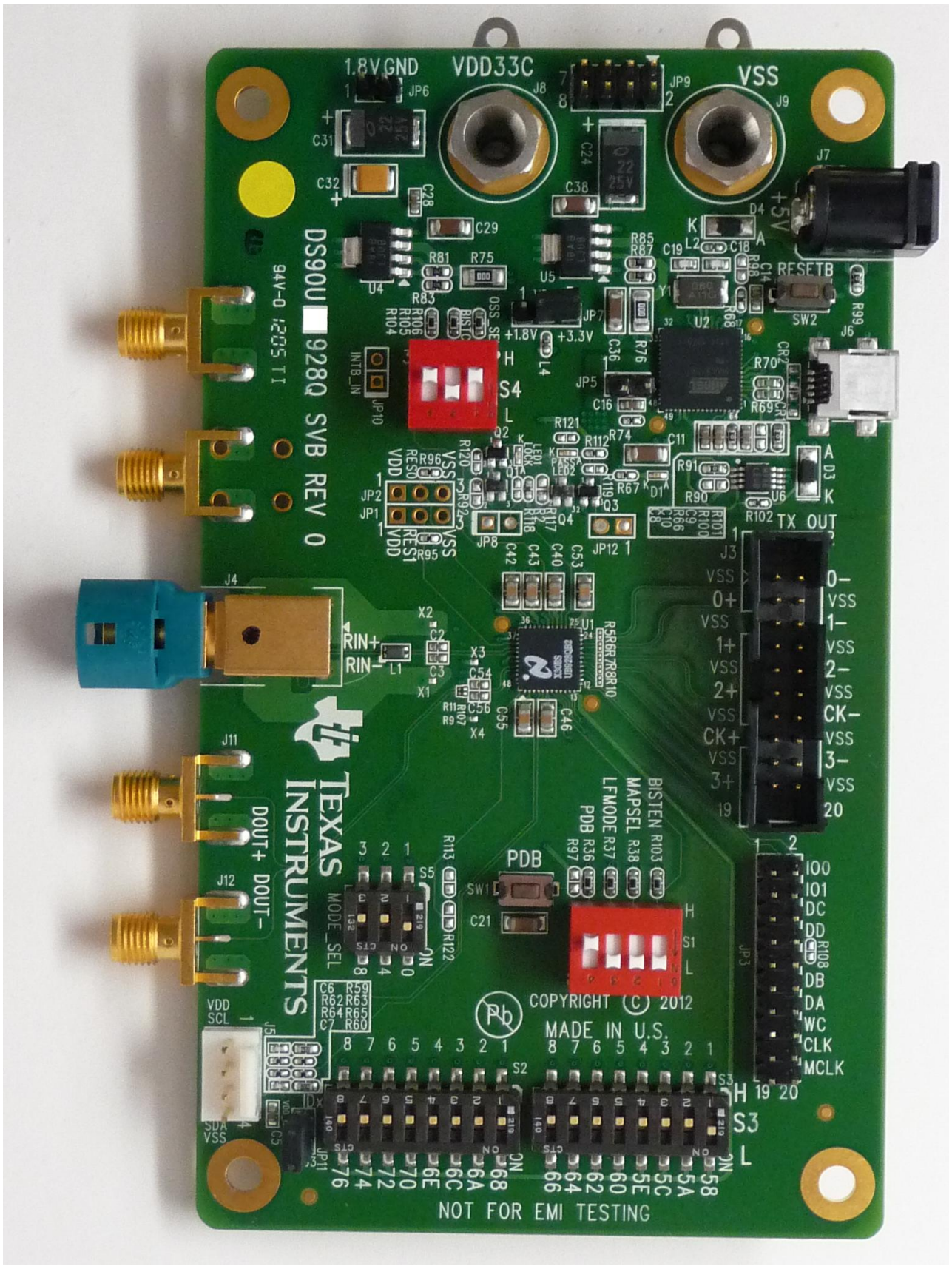

2-1. DS90UB928QEVM

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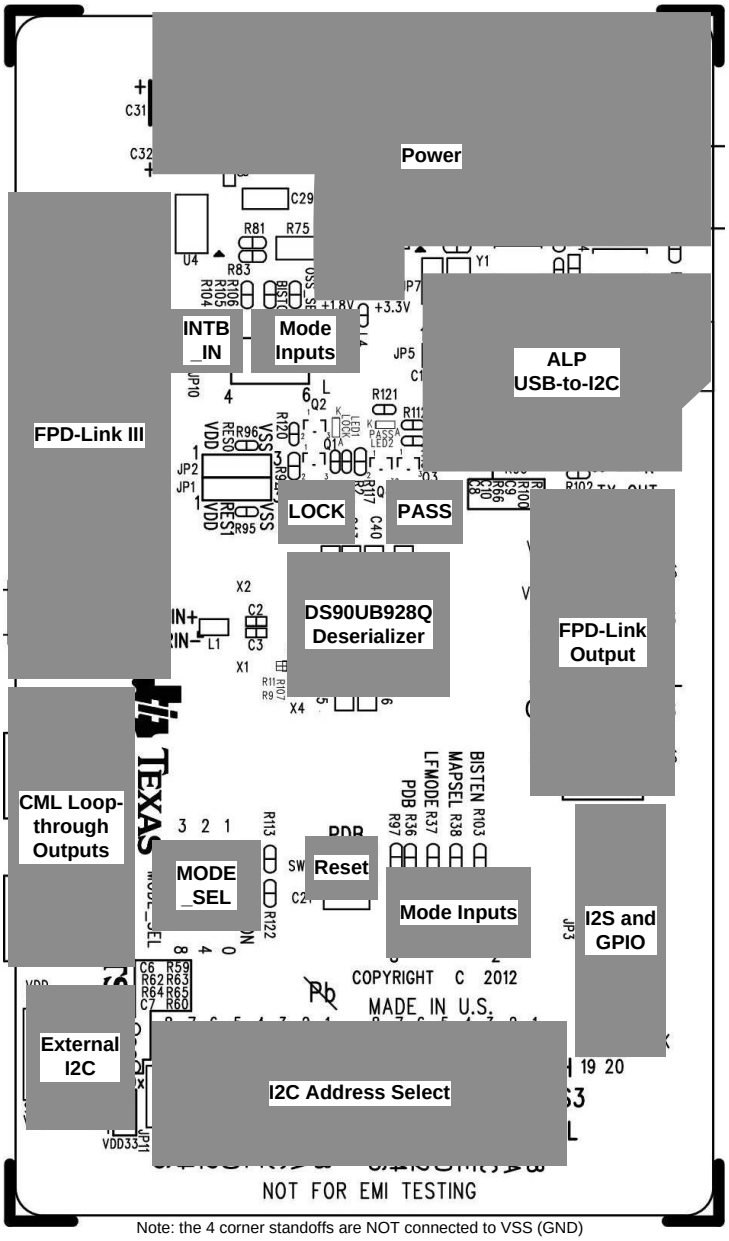
Evaluation Hardware Overview

3.1 Board Overview

The evaluation board includes circuits and interfaces facilitating the different device features of the DS90UB928Q deserializer, including power, video data, FPD-Link III interface, I2S audio, I2C control, connectors, and configuration switches.



Note: the 4 corner standoffs are NOT connected to VSS (GND)

3-1. DS90UB928QEVM Layout

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3.2 Power

Two options are provided for powering the board. +5V DC power may be supplied at the provided barrel connector (J7, center positive), or +3.3V DC through J8 and J9. If 1.8V VDDIO power supply operation is desired, connect +1.8V DC at JP6 and select 1.8V VDDIO power from JP7.

3.3 FPD-Link Video Data Output

The FPD-Link video data output accepts a 20-pin IDC cable or similar 0.1” spaced connector. Connect the clock and 4 FPD-Link (LVDS) data pairs here. Video data mapping is determined from the MAPSEL switch, located on the mode select switch block (S1).

The required standard 100Ω differential termination is not populated on-board by default, but may be populated at R5, R6, R7, R8, and R10, located near the deserializer device (U1). Many sink devices (such as displays) will have termination closer to the connector, or integrated into the module or board. Check the specific target device or module to ensure that proper LVDS termination is used.

3.4 FPD-Link III Interface

The FPD-Link III interface is the receive point for the high-speed (up to 2.975Gbps) forward data channel, as well as the transmit point for the low speed back channel. The default configuration features a Rosenberger HSD-style automotive cable connector (J4). The board also provides two SMA connectors (J1 and J2) to which other cable connectors may be attached. To use the SMA connectors, remove J4 and populate 0Ω resistors at R3 and R4. See Deserializer for details.

The FPD-Link III signal may be probed from the output capacitors and two provided ground pads (X1 and X2). Use a high-bandwidth differential probe to observe the channel. The CML loop-thru interface may also be used for easier observation of the forward-channel link. See the device datasheet for additional details.

3.5 CML Loop-thru Monitor Interface

The evaluation board provides two SMA connectors (J11 and J12) for monitoring the CML Loop-thru driver (CMLOUTP/CMLOUTN pins). If this feature is enabled (see device datasheet for details), the recovered and equalized link eye diagram may be monitored from these outputs, allowing easier observation of link signal integrity.

3.6 Controller

The onboard USB-to-I2C controller allows for easy evaluation of the DS90UB928Q I2C interface without the need for a dedicated external tool. It interfaces with a host PC using the provided TI Analog LaunchPAD (ALP) software. Connect the provided cable to the USB connector at J6. The I2C bus may also be accessed by an external controller via the external I2C interface at J5. If desired, the onboard USB-to-I2C connector may be disconnected from the I2C bus by removing resistors R63 and R65 (see the board schematic for details). See USB-to-I2C Controller for details.

3.7 I2C and Device Addressing

A row of switches provided at S2 and S3 sets the IDx I2C address select. Only one I2C address may be selected at a time. Note that addresses 0x58 and 0x66 through 0x76 are available. All others are reserved.

3.8 I2S and GPIO Interface

JP3 provides connections to the I2S and GPIO interfaces. All GPIOs may be configured as inputs or outputs, with GPIO[3:0] available for bidirectional transport. IO voltage levels should scale with VDDIO.

3.9 Device Address, Reset and Mode Selection Inputs

The Mode Selection Inputs determine the specific mode or state of device operation.

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3.9.1 Mode Selection Inputs (S1)

The Mode Input Switches (S1) configure the following DS90UB928Q device pins:

- **PDB** When set LOW, the device enters a low-power mode and all registers are reset. Set HIGH for normal operation.
- **LFMODE** Set HIGH for 5MHz ≤ PCLK < 15MHz. Set LOW for 15MHZ ≤ PCLK ≤ 85MHz
- **MAPSEL** Set LOW to assign LSBs to TxOUT3±, set HIGH to assign MSBs to TxOUT3±. See device datasheet for details.
- **BISTEN** Set HIGH to enable the Built-In Self-test (BIST) Mode. Set LOW for normal operation.

3.9.2 I2C Address Select (IDx)

10 address switches (S2 and S3) set the deserializer I2C address select voltage input to the IDx pin. Each switch selects a different I2C address, up to 10 unique addresses total. Only one switch may be selected at a time (0x58 default). Note that address 0x58 and 0x66 through 0x76 are available for normal device operation. All others are reserved.

3.9.3 Output State Select (S4)

The output state select switches (S4) set the operating conditions for both normal operation and BIST. See the device datasheet for detailed usage of these pins.

- **OEN**
- **BISTC/INTB_IN**
- **OSS_SEL**

3.9.4 MODE_SEL (S5)

The MODE_SEL switches (S5) configure the analog input value to the device mode selection (MODE_SEL) pin. The provided switches and resistor pads allow for configuration of the MODE_SEL voltage. To use other modes or resistor combinations, replace resistors R111 and R116 and use switch position 1 (see board schematic for details).

- **1 -** Sets Mode 1 (LONG_CABLE=L, REPEAT=L, BKWD=L, I2S_B=L).
- **2 -** Sets Mode 7 (LONG_CABLE=H, REPEAT=H, BKWD=L, I2S_B=L).
- **3 -** Sets Mode 9 (LONG_CABLE=L, REPEAT=L, BKWD=H, I2S_B=L).

3.10 Indicators

The board includes 3 LEDs to indicate deserializer and board status.

- **D1** Indicates that the on-board USB-to-I2C ALP hardware is powered on.
- **PASS** Indicates PASS status, including link error results during and after BIST. See the device datasheet for additional details on BIST mode operation.
- **LOCK** Indicates LOCK status. The LED will remain on if the link is active and the device is locked to the remote serializer.

3.11 Input/Output Connectors

The following jumpers and connectors are provided on the board:

- **J1/J2 FPD-Link III SMA Inputs (optional)** – These optional inputs may be used to evaluate the FPD-Link III serial link with different cable configurations. To use, remove J4 and populate R3 and R4 with 0Ω resistors.
- **J3 20-pin FPD-Link (I) Output** – Connect to LVDS data and clock here. The board does not provide the required 100Ω terminations as these are normally located closer to, or integrated into, the sink device (display). If desired, termination resistors may be populated at R5, R6, R7, R8, and R10. See the device datasheet for output electrical characteristics and requirements.
- **J4 FPD-Link III HSD Automotive Input** – Connect an automotive-grade STP cable with HSD connector here. Remove the connector (J4) if the SMA outputs (J1/J2) are used (see description

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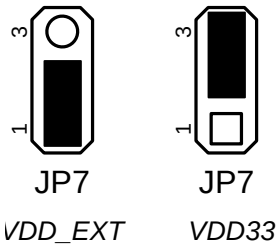
above).

- **J5 4-pin I2C Input/Output** – Connect SDA, SCL, VSS, and VDD33 to external I2C peripherals or controllers here. The EVM board provides the recommended 4.7kΩ pull-up resistors.
- **J6 USB Connector for USB-to-I2C Controller** – Connect USB cable to host PC to use the ALP evaluation software with the EVM board.
- **J7 5V External Power Input (optional)** – Connect a +5V center-positive 2.1mm barrel connector here to supply power to the board. Onboard regulators supply the devices with 3.3V VDDIO and 3.3V/1.8V VDDIO supplies. Do not connect J8/J9 if this connector is used.
- **J8 +3.3V VDD33 Power Input** – Connect to 3.3V power supply.
- **J9 VSS Power** – Connect to system ground (GND).
- **JP1/JP2 Reserved** – Do not populate or connect to external inputs/outputs
- **JP3 I2S/GPIO Input/output Header** – Connect to I2S input pins or bidirectional GPIO pins. See the device datasheet for detailed I2S and GPIO usage.
- **JP5 Reserved** – Do not short or connect to external inputs/outputs
- **JP6 VDDIO_EXT Power Input** – Connect to independent external VDDIO supply if VDDIO ≠ VDD33
- **JP7 VDDIO Select** – Connect jumper to select VDDIO=VDD33 [2-3] or VDDIO=VDDIO_EXT [1-2]



3-2. VDDIO Select (JP7) Jumper Settings

- **JP8 LOCK Monitor** – Probe LOCK status here.
- **JP9 AUX Power** – Alternative power connection header. See board schematics for details.
- **JP10 INTB_IN** – General-purpose interrupt. See device datasheet for control register and usage descriptions.
- **JP11 I2C Power Enable** – Place jumper (default) to provide 3.3V power to on-board I2C pull-up resistors.
- **JP12 PASS Monitor** – Probe PASS status here.
- **SW1 PDB Reset** – Press to set PDB LOW (device resets and all registers are cleared to default values).
- **SW2 ALP Reset** – Resets onboard USB-to-I2C hardware.

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ALP Software

4.1 Overview

The Analog Launch PAD (ALP) software allows evaluation of the I2C control interface of the DS90UB928Q deserializer. The tool provides a graphical interface for reading/writing the device registers. It also features several useful tools for manipulating advanced device-specific features, including internal pattern generation and image enhancement features.

System Requirements:

Operating System: Windows XP or Vista

USB version: 2.0

4.2 Installation

Download the TI Analog Launch PAD (ALP) software from the TI website. Make sure the EVM USB port is not connected to the host PC.

The following installation instructions are for the Windows XP Operating System:

Install the ALP Software

Execute the ALP Setup Wizard program called “Setup.exe”.

1. Click “Next”
2. Select “I accept the agreement”
3. Click “Next”
4. Select the location to install the ALP software and click “Next”
5. Select the location for the Start Menu shortcut and click “Next”
6. Create a desktop shortcut icon and Quick Launch button (optional). Click “Next”
7. Click “Install.” The software will be extracted and installed to the system.
8. Uncheck “Launch Analog LaunchPAD” and click “Finish.” The ALP software should not be launched until the USB driver is installed.

Install the USB Driver

To install the ALP hardware USB driver, connect the USB cable from the host PC to the DS90UB928QEVM USB port (J6):

1. Select “No, not at this time” then click “Next”
2. Click “Install from a list or specific location” then click “Next”
3. Click “Search for the best driver in these locations”. Uncheck “Search removable media” and check “Include this location in the search.”
4. Browse to the Install Directory which is typically located at “C:\Program Files\National Semiconductor Corp\Analog LaunchPAD\vx.x.x\Drivers” and select the “Next” button. Windows should find the driver.
5. Click “Continue Anyway”.
6. Click “Finish”

The software installation is now complete. The ALP software may now be launched.

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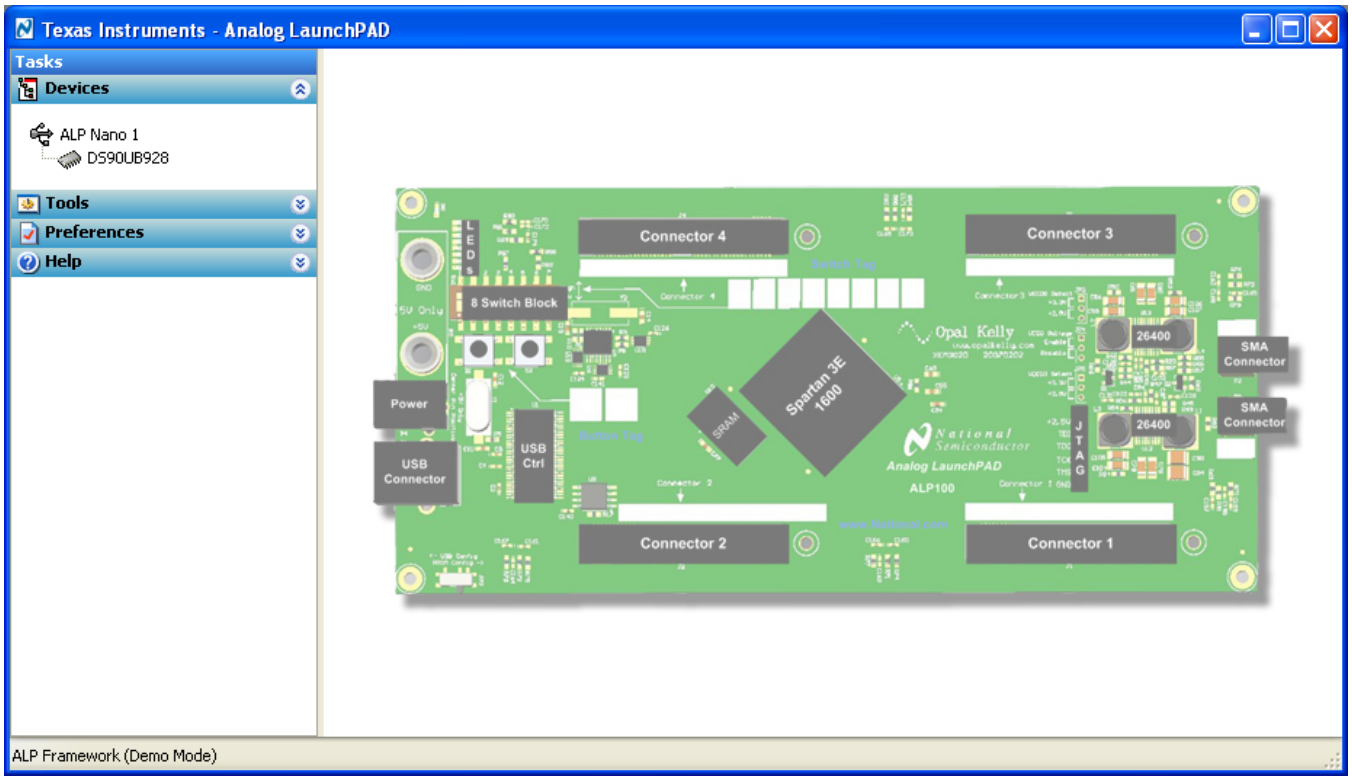
4.3 Usage

Startup

Make sure all the software has been installed and the hardware is powered on and connected to the PC. Execute “Analog LaunchPAD” from the start menu. The default start menu location is “Programs\National Semiconductor Corp\Analog LaunchPAD vx.x.x\Analog LaunchPAD”.

The application should come up in the state shown below. If it does not, see 4.4. Under the Devices tab click on “DS90UB928Q” to select the device and open up the device profile and its associated tabs.



4-1. ALP Startup Screen

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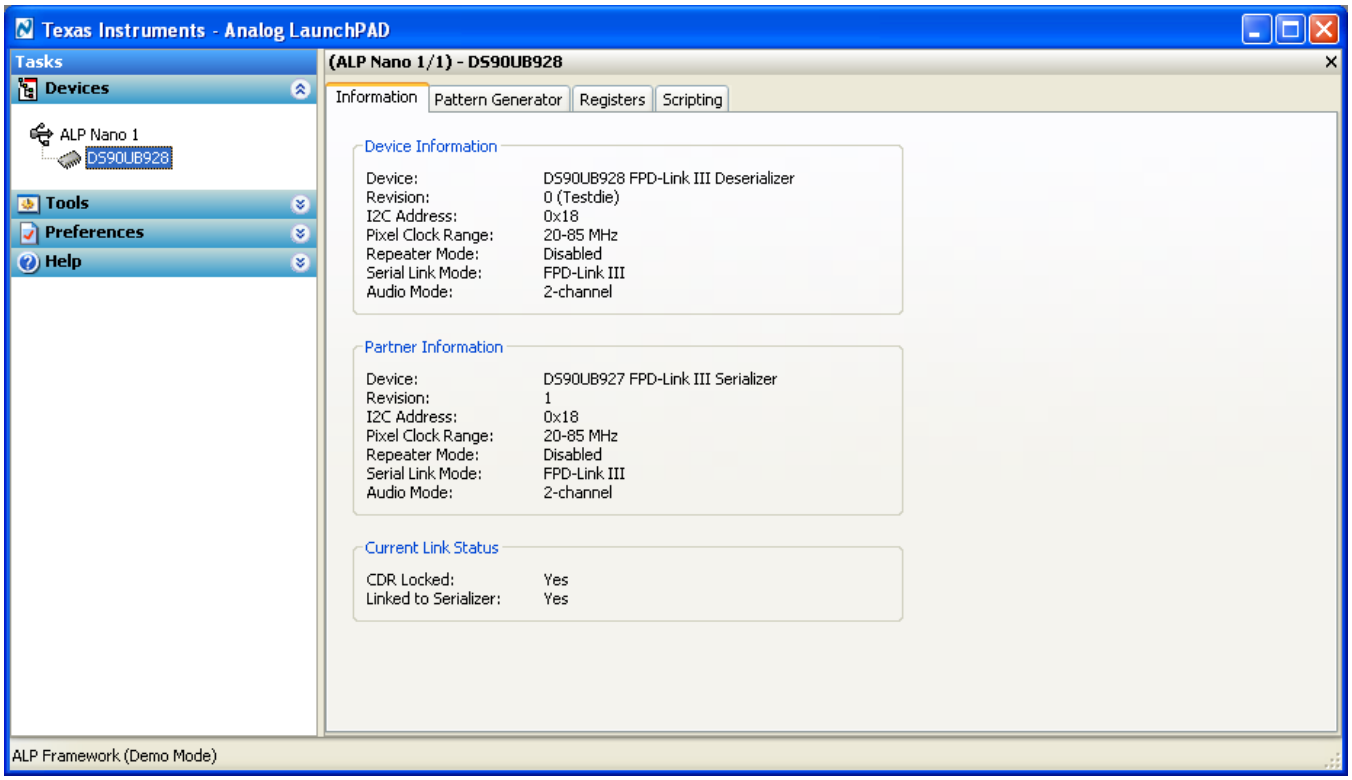
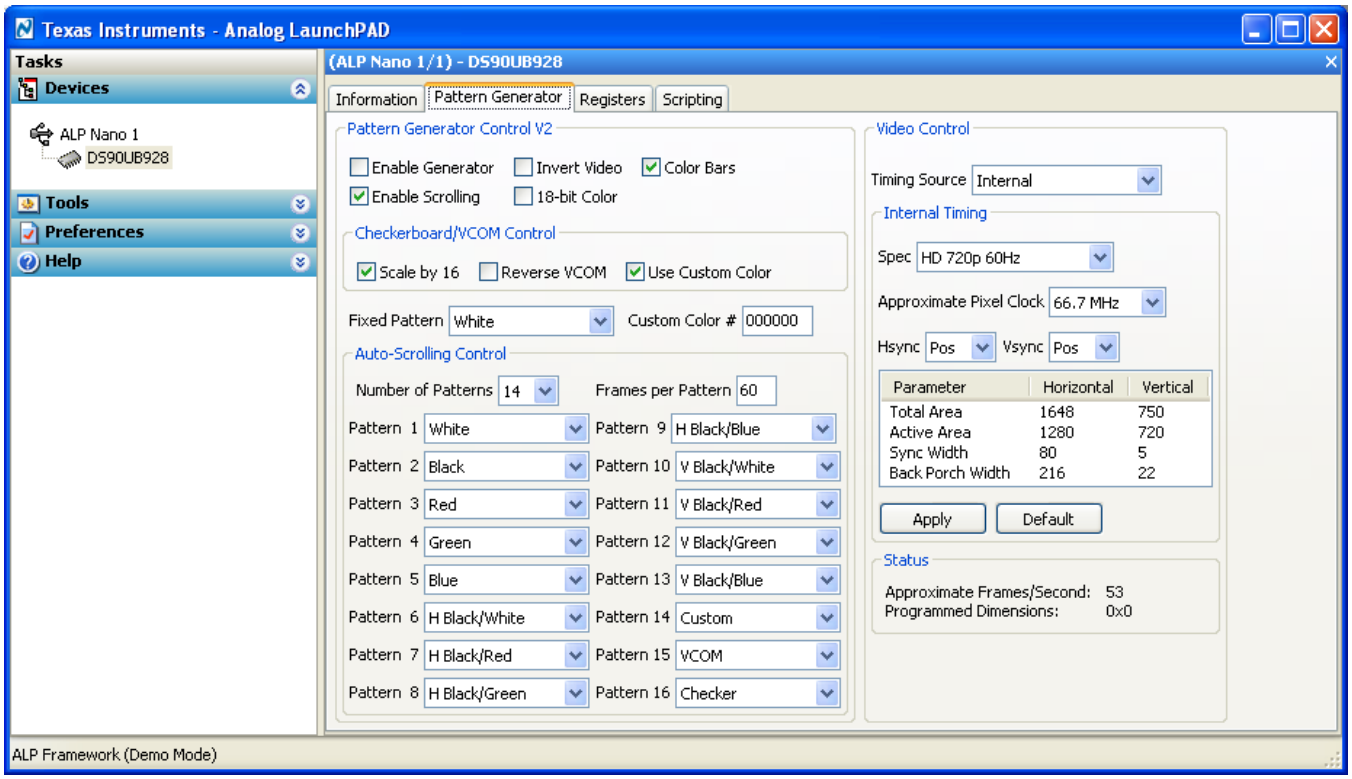


4-2. Information Tab



4-3. Pattern Generator Tab

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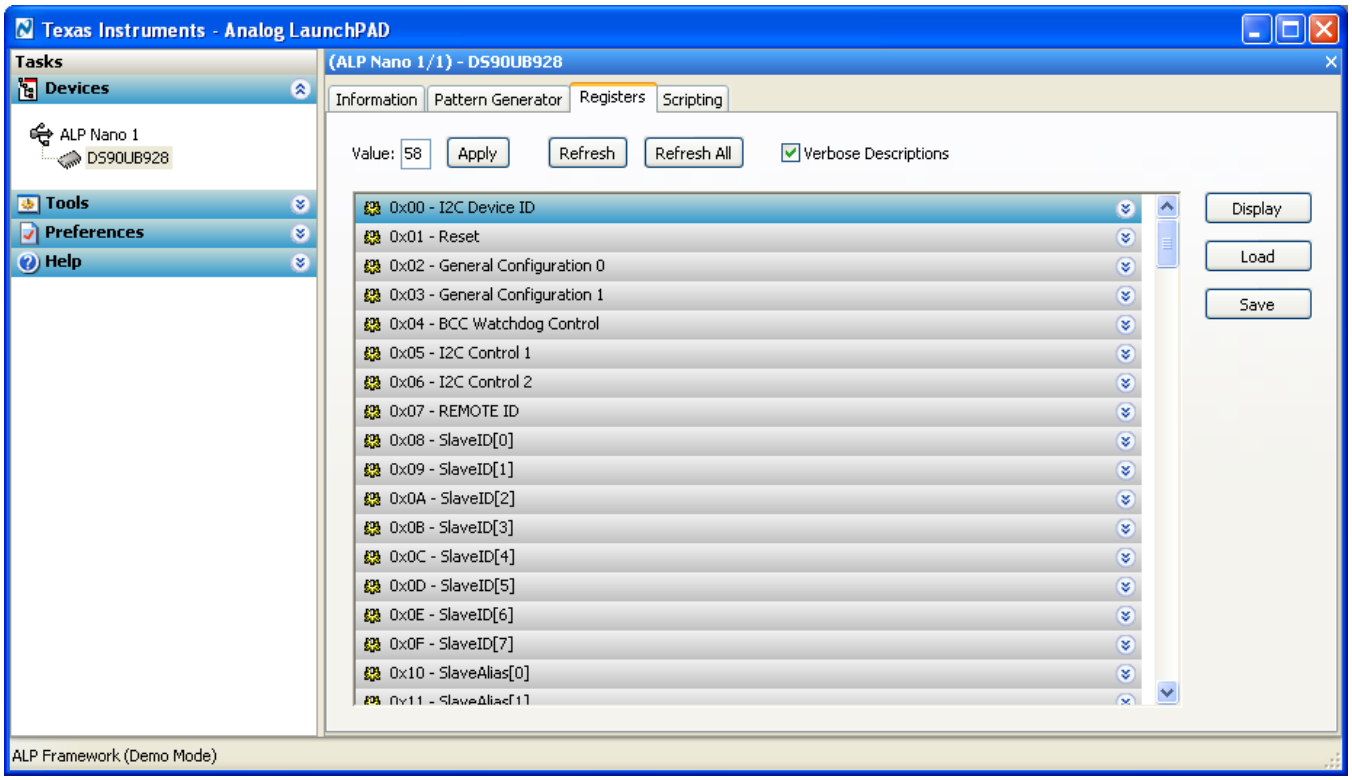
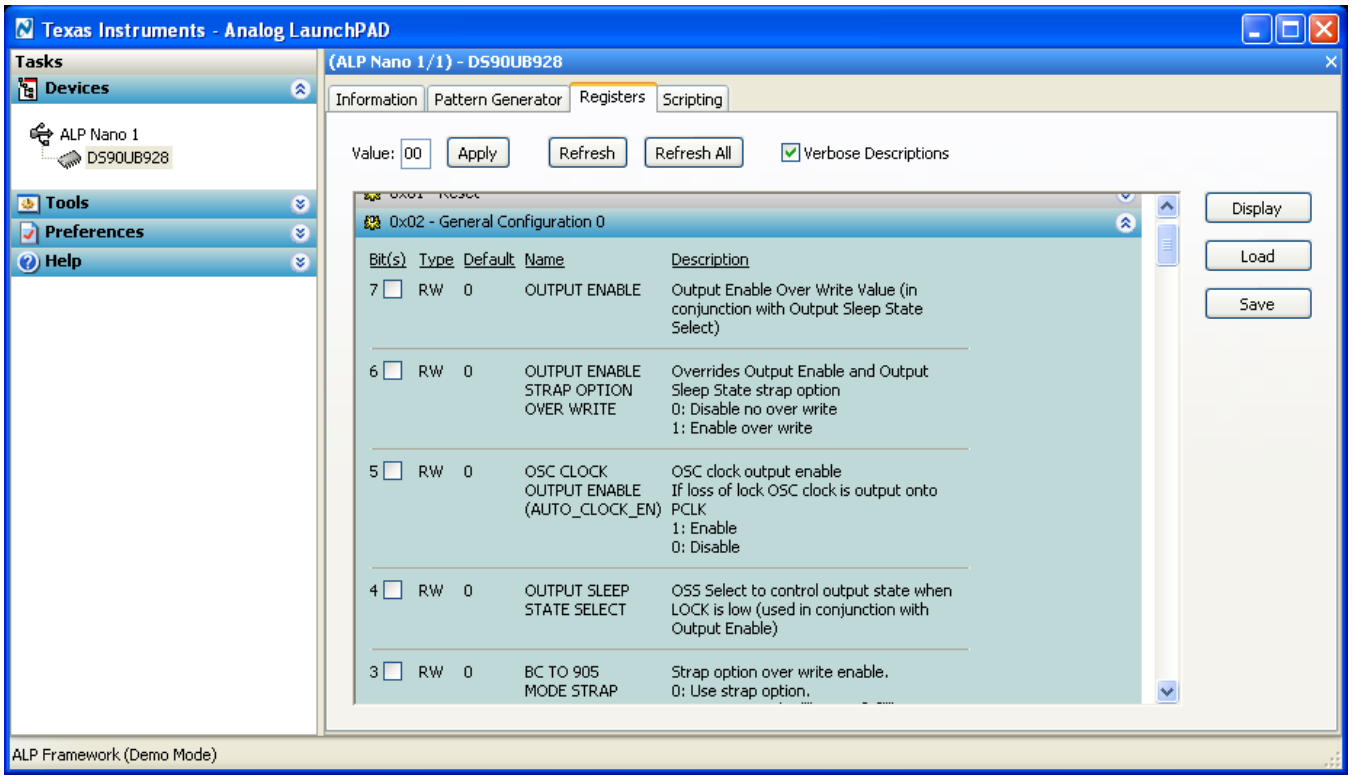


4-4. Register Tab



4-5. Register Tab with expanded register description

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4.3.1 Information Tab

The information tab gives basic device state information, including local device information, partner device information, and current link status. For both the local device and partner device, the tab gives the following information:

- Device Name
- Device Revision
- I2C address
- Pixel clock range (set by LFMODE)
- Repeater Status (set by MODE_SEL)
- Serial Link Mode (set by MODE_SEL)
- Audio mode (set by configuration registers)

4.3.2 Pattern Generator Tab

The Pattern Generator Tab enables interactive control of the internal pattern generator features. The pane controls timing information and different pattern settings, including a scrolling function. Timing information is configured from the Video Control panel, and supports the following timing/clocking sources:

- External
- Internal
- Internal w/ Ext. Clock

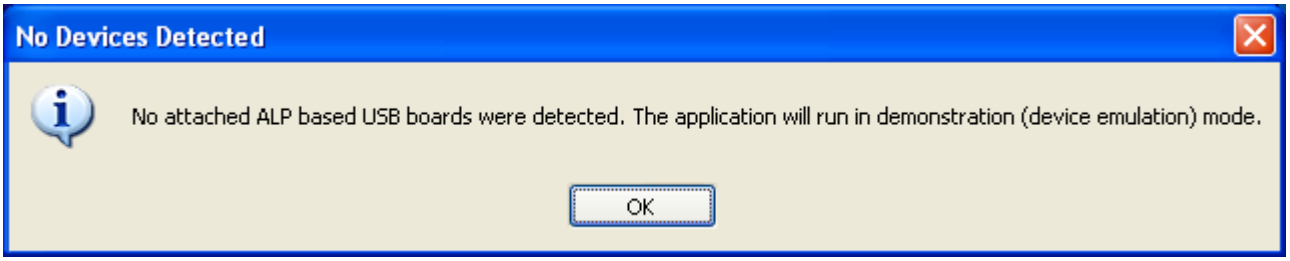
The Internal timing option allows evaluation of the link performance without the need for an external source. The Video Control panel also provides several timing and pixel clock options, including several presets covering common video resolutions. See TI application note AN-2198 for more details.

4.3.3 Registers Tab

The Registers Tab allows for direct reading/writing of individual registers or register bits located on the local device. Each register drop-down shows the name and description of individual bits or groupings of bits. Use the check boxes to set individual bits, and commit the register write by clicking the “Apply” button. Click the “Refresh” or “Refresh All” buttons to read an update of the selected register or all registers respectively.

4.4 Troubleshooting

If the following window opens after starting the ALP software, double check the hardware setup and that the board USB port is connected to the host PC.



4-6. No Devices error message

The USB driver may not be installed. Check the device manager. There should be a device named ”NSC ALP Nano Atmel” device under the “Universal Serial Bus Controllers” as shown below.

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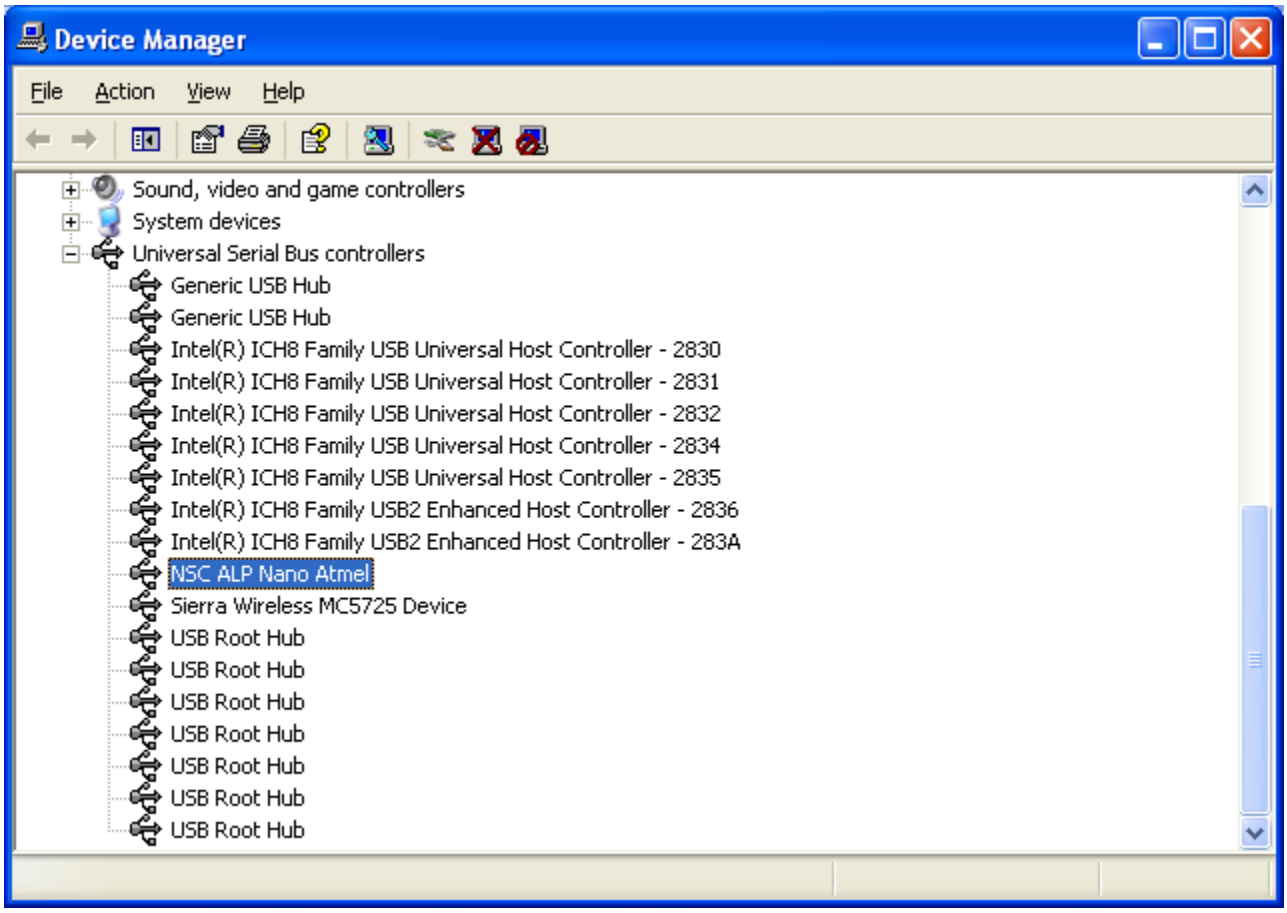

4-7. Windows XP Analog LaunchPAD USB Driver

The software should start with only “DS90UB928Q” 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 in 4-8.

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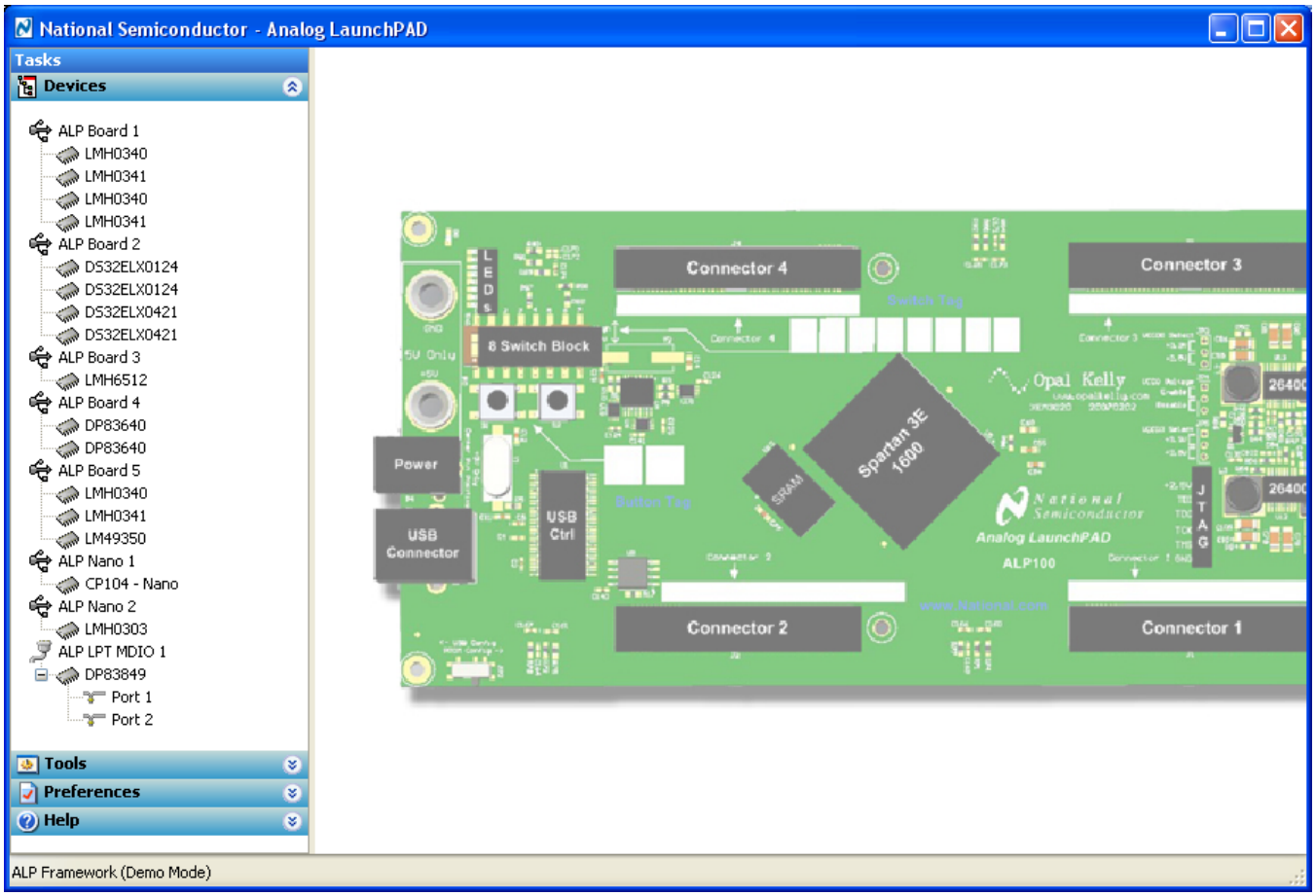
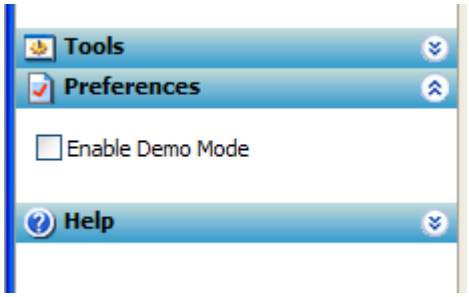


4-8. Analog LaunchPAD in Demo Mode

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



4-9. Analog LaunchPAD Preferences Menu

After demo mode is disabled, the ALP software will poll the ALP hardware. The ALP software will update and display only “DS90UB928Q” under the “Devices” pull down menu.

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Additional Information

5.1 Related Documents

Additional information may be found in the device product folder at www.ti.com

- DS90UB928Q device datasheet
- DS90UB927Q device datasheet
- DS90UB925Q device datasheet
- TI Application Note AN-2173
- TI Application Note AN-2198

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Board Schematic

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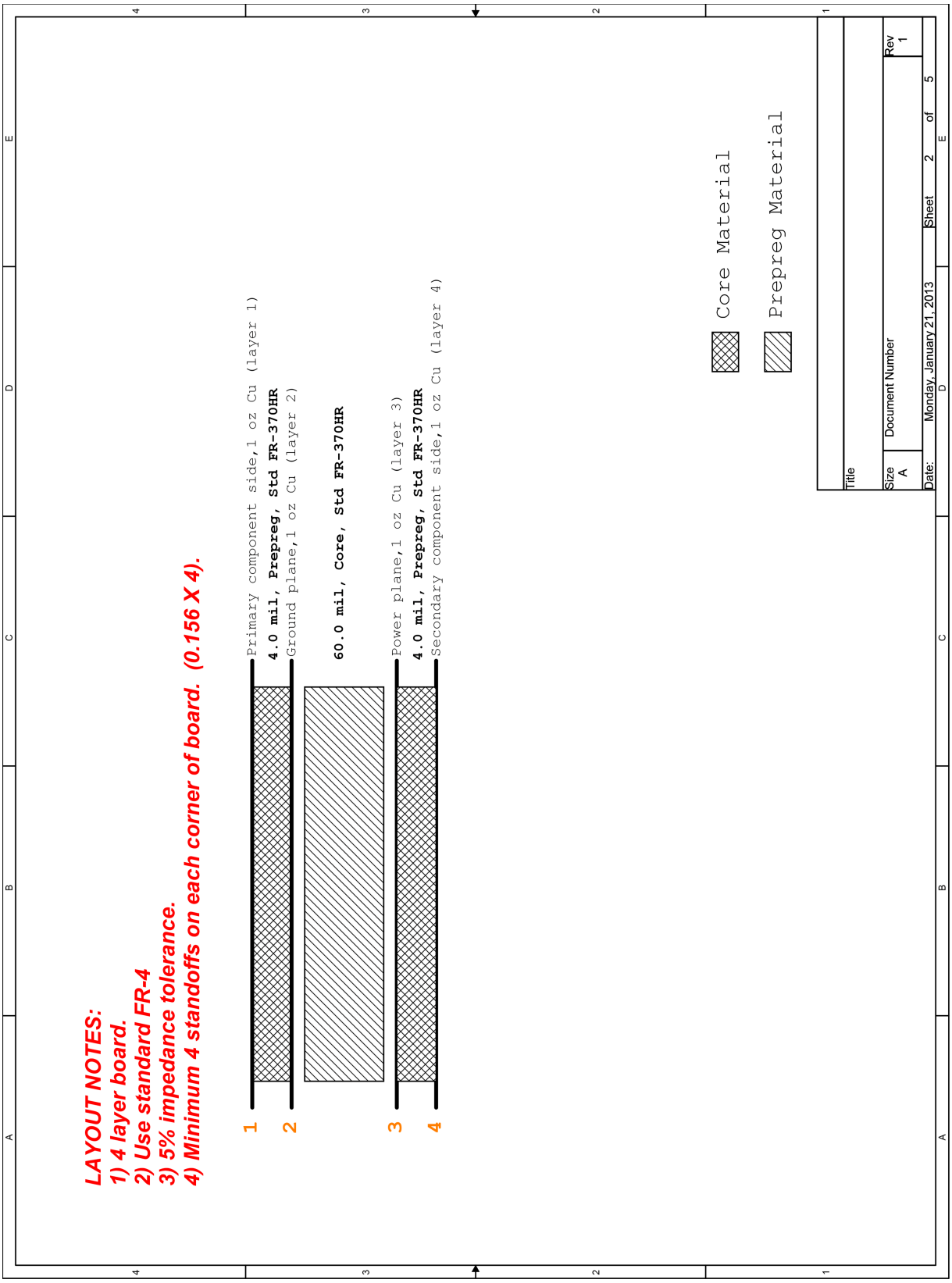
A.1 Board Stackup



A-1. Board Stackup

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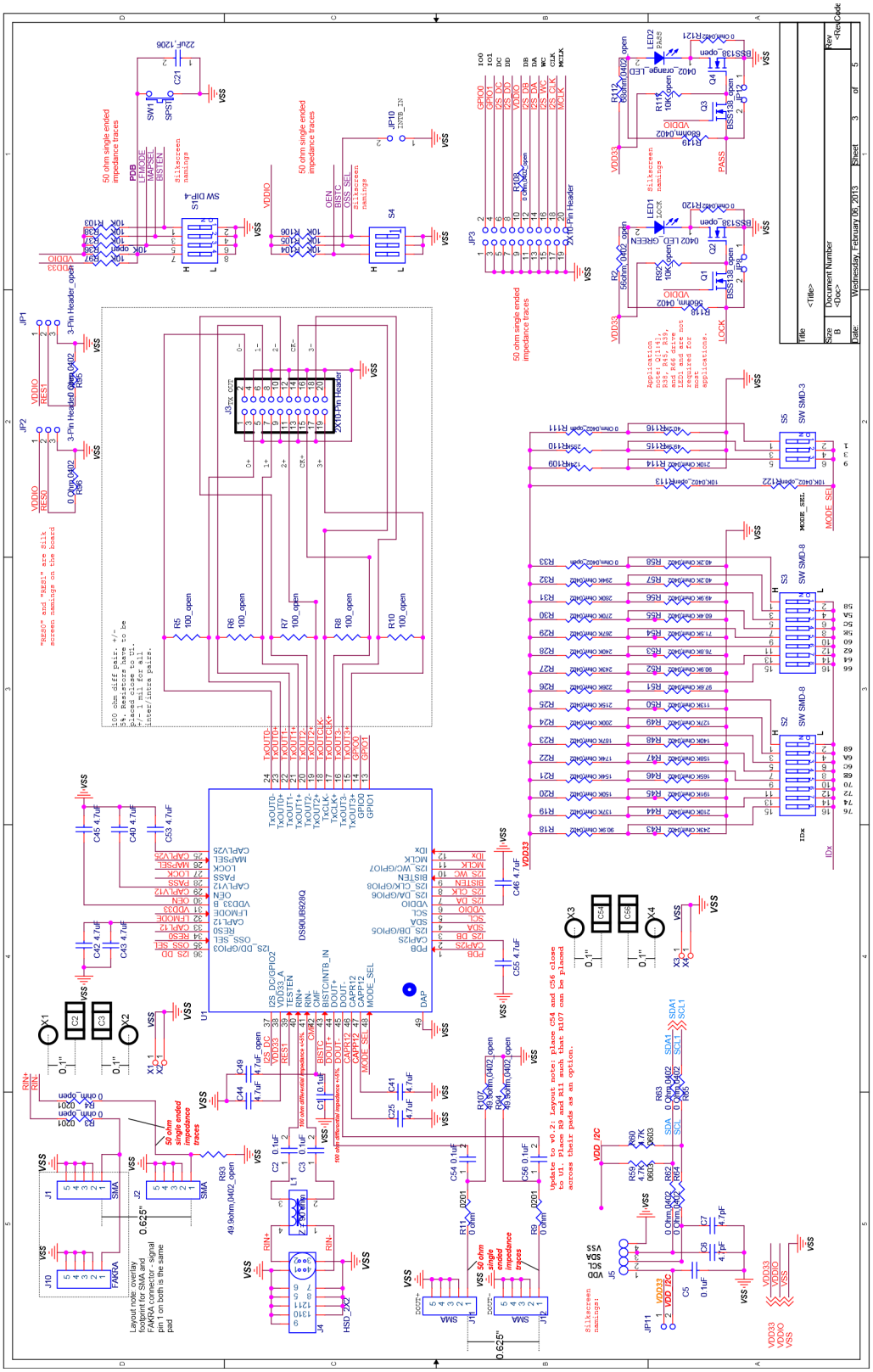
A.2 DS90UB928Q Deserializer



A-2. DS90UB928Q Deserializer

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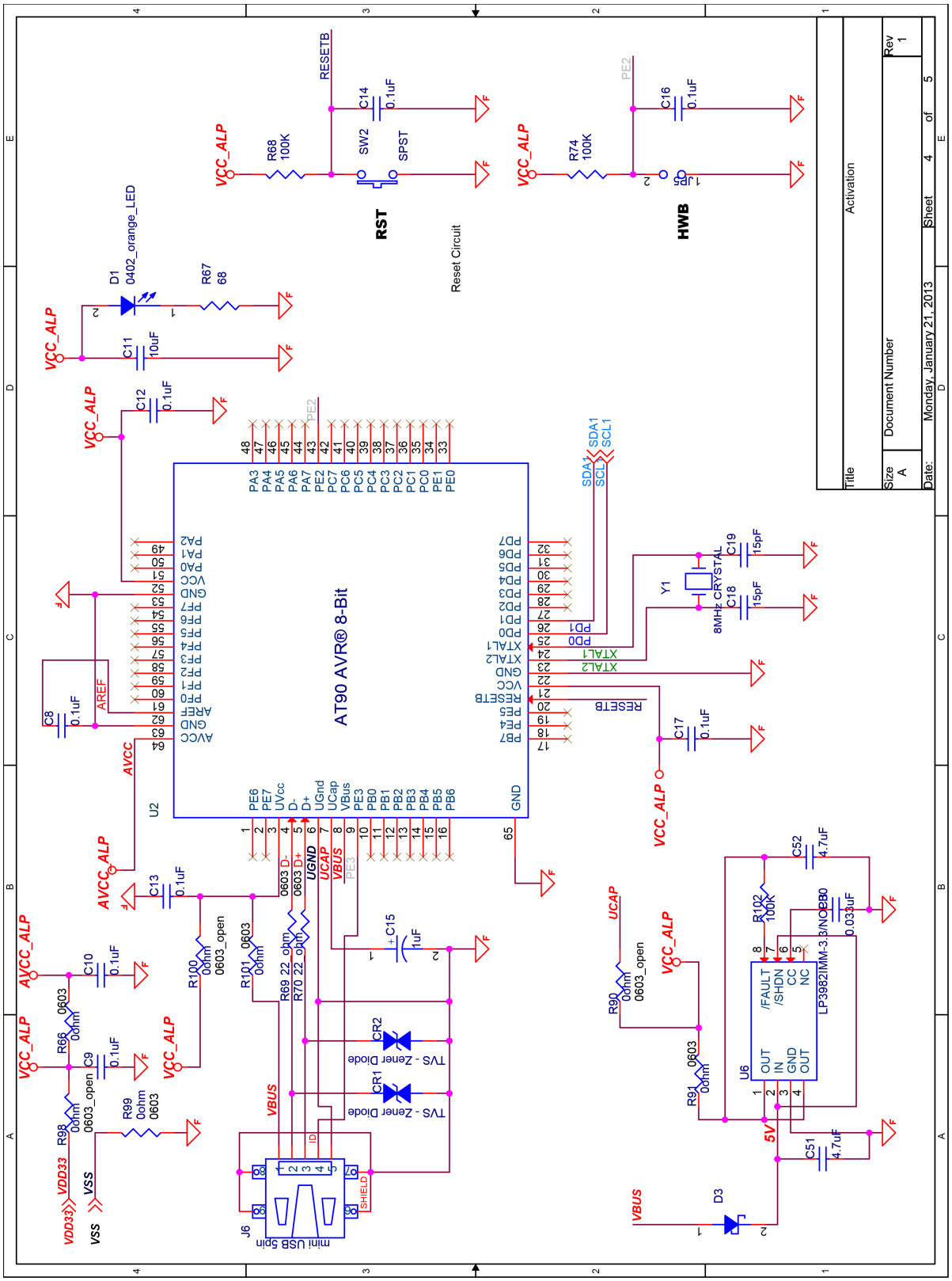
A.3 USB-to-I2C Controller



A-3. USB-to-I2C Controller

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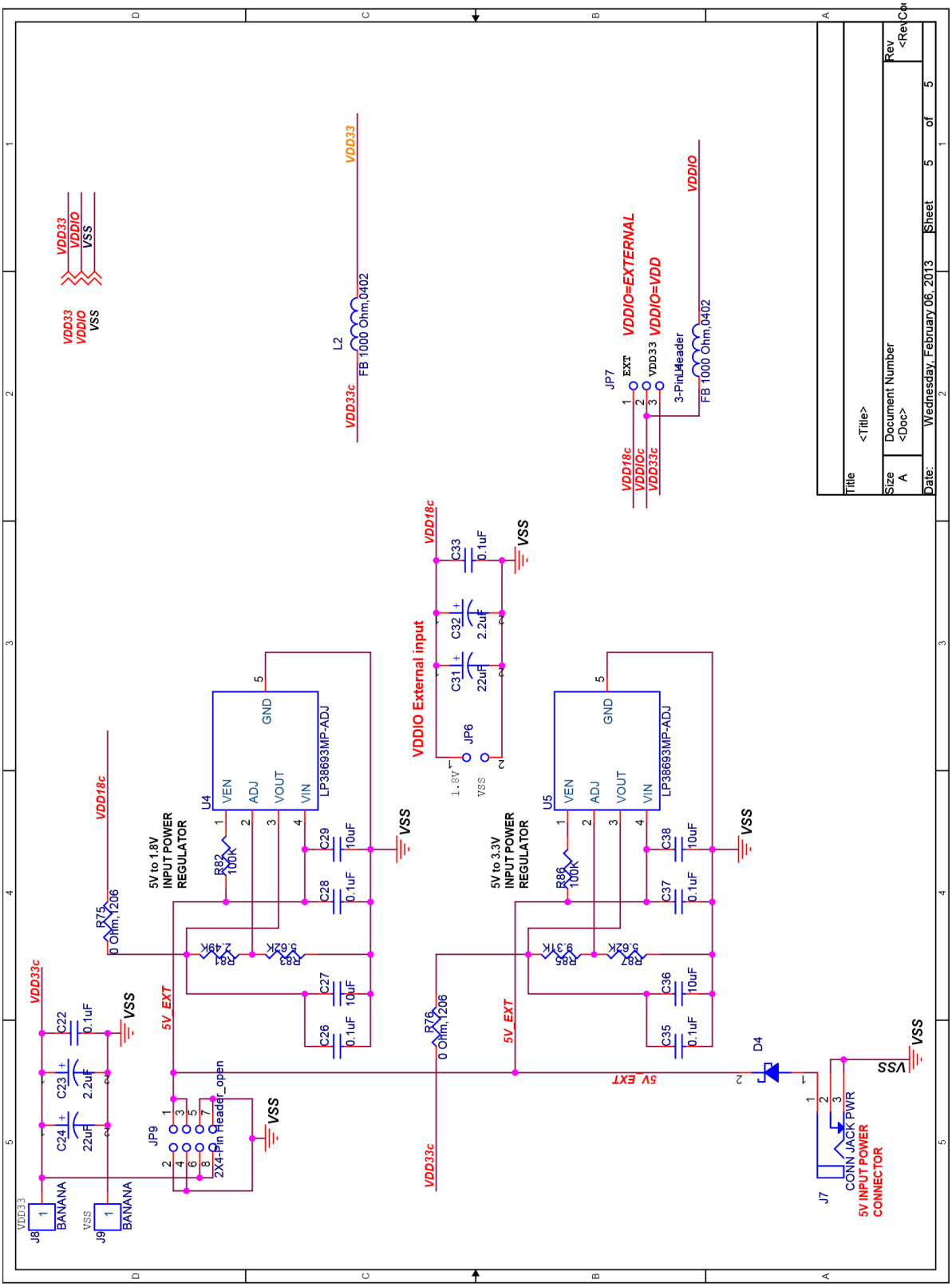
A.4 Power



A-4. Power

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B.1 DS90UB928QEVM BOM

B-1. DS90UB928QEVM BOM

Item	Qty	Reference	Description	Manufacturer	Part Number
1	2	CR1,CR2	SUPPRESSOR ESD 24VDC 0603 SMD	Littelfuse Inc	PGB1010603MR
2	16	C1,C5,C8, C9,C10,C12,C13,C14, C16,C17,C22,C26,C28,C33,C35, C37	CAP CER .1UF 50V 10% X7R 0603	Murata Electronics North America	GRM188R71H104KA93D
3	4	C2,C3,C54, C56	CAP CER .1UF 16V X7R 0402	Murata	GCM155R71C104KA55D
4	2	C6,C7	CAP CERAMIC 4.7PF 25V C0G 0402	Panasonic	ECD-G0E4R7C
5	5	C11,C27,C29,C36,C38	CAP CER 10UF 16V X7R 10% 1206.	TDK	C3216X7R1C106K
6	1	C15	CAPACITOR TANT 1.0UF 16V 10% SMD	Kemet	T491A105K016AT
7	2	C18,C19	CAP CERAMIC 15PF 50V NP0 0603	Kemet	C0603C150J5GACTU
8	1	C21	CAP CER 22UF 6.3V 10% X7R 1206	Murata	GCM31CR70J226KE23L
9	2	C23,C32	CAPACITOR TANT 2.2UF 20V 10% SMD	KEMET	T491B225K020AT
10	2	C24,C31	CAP TANTALUM 22UF 25V 20% SMD	nichicon	F931E226MNC
11	12	C25,C40,C41,C42,C43,C44,C45, C46,C51,C52,C53,C55	CAP CER 4.7UF 16V X7R 0805	Murata	490-5332-1-ND
12	1	C30	CAP CERM 33000PF 5% 50V X7R 0603	AVX Corporation	06035C333JAT2A
13	2	D1,LED2	LED ORN/CLEAR 610NM 0402 SMD	Lumex Opto/Components Inc	SML-LX0402SOC-TR
14	2	D3,D4	DIODE SCHOTTKY 400MW 20V SOD123	Diodes Inc.	SD103CW-13-F
15	1	JP3	CONN HEADER 20POS .100 STR 15AU	FCI	67997-220HLF
16	3	JP5,JP6,JP11	CONN HEADER VERT .100 2POS 30AU	AMP/Tyco	87220-2
17	1	JP7	CONN HEADER VERT .100 3POS 15AU	AMP/Tyco	87224-3

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B-1. DS90UB928QEVM BOM (continued)

Item	Qty	Reference	Description	Manufacturer	Part Number
18	4	J1,J2,J11,J12	End Launch Jack Receptacle - Tab Contact	Johnson Components	142-0701-851
19	1	J3	CONN HEADER 20 POS STRGHT GOLD.	3M	N2520-6002RB
20	1	J4	Automotive HSD Connector - Right Angle Plug	Rosenberger	D4S20B-40ML5-Y
21	1	J5	CONN HEADER 4POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-11-2042
22	1	J6	CONN RECEPT MINI USB2.0 5POS	Hirose	UX60-MB-5ST
23	1	J7	CONN POWER JACK 2.1MM.	CPU Inc	PJ-002A
24	2	J8,J9	BANANA-female (non-insulated)	Johnson	108-0740-001
25	1	LED1	LED GREEN 0.2MM 13MCD 0402 SMD	Rohm	SML-P12PTT86
26	1	L1	CHOKE COIL COMMON MODE 280MA SMD	Murata	DLW21SN900HQ2L
27	2	L2,L4	FERRITE CHIP 1000 OHM 0402	Murata	BLM15AX102SN1D
28	2	R9,R11	RES 0.0 OHM 1/20W 5% 0201 SMD	Panasonic	ERJ-1GE0R00C
29	2	R18,R52	RES 90.9K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF9092X
30	1	R19	RES 137K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1373X
31	1	R20	RES 150K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1503X
32	1	R21	RES 154K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1543X
33	1	R22	RES 174K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1743X
34	1	R23	RES 187K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1873X
35	1	R24	RES 200K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2003X
36	1	R25	RES 215K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2153X
37	1	R26	RES 226K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2263X
38	2	R27,R43	RES 243K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2433X
39	1	R28	RES 240K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2403X
40	1	R29	RES 267K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2673X
41	1	R30	RES 270K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2703X
42	1	R31	RES 280K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2803X
43	1	R32	RES 294K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2943X

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B-1. DS90UB928QEVM BOM (continued)

Item	Qty	Reference	Description	Manufacturer	Part Number
44	7	R37,R38,R97,R103,R104,R105,R106	RES 10.0K OHM 1/10W 1% 0603 SMD	Panasonic	ERJ-3EKF1002V
45	2	R44,R114	RES 210K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2103X
46	1	R45	RES 191K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1913X
47	1	R46	RES 165K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1653X
48	1	R47	RES 158K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1583X
49	1	R48	RES 140K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1403X
50	1	R49	RES 127K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1273X
51	1	R50	RES 113K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1133X
52	1	R51	RES 97.6K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF9762X
53	1	R53	RES 76.8K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF7682X
54	1	R54	RES 71.5K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF7152X
55	1	R55	RES 60.4K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF6042X
56	1	R56	RES 49.9K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF4992X
57	2	R57,R58	RES 40.2K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF4022X
58	2	R59,R60	RES 4.7K OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ472V
59	8	R62,R63,R64,R65,R95,R96,R120,R121	RES ZERO OHM 1/16W 5% 0402 SMD	Panasonic	ERJ-2GEJ0R00X
60	4	R66,R91,R99,R101	RES ZERO OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEY0R00V
61	2	R67,R119	RES 68 OHM 1/10W 5% 0402 SMD	Panasonic	ERJ-2GEJ680X
62	5	R68,R74,R82,R86,R102	RES 100K OHM 1/10W 5% 0402 SMD	Panasonic	ERJ-2GEJ104X
63	2	R69,R70	RES 22 OHM 1/16W 3300PPM 5% 0603	Panasonic	ERA-V33J220V
64	2	R75,R76	RES ZERO OHM 1/4W 5% 1206 SMD	Panasonic	ERJ-8GEY0R00V
65	1	R81	RES 2.49K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06032K49FKEA
66	2	R83,R87	RES 5.62K OHM 1/10W 1% 0603 SMD.	Vishay	CRCW06035K62FKEA
67	1	R85	RES 9.31K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06039K31FKEA
68	1	R109	RES 124K OHM 1/10W 1% 0603 SMD	Panasonic	ERJ-3EKF1243V
69	1	R119	RES 255K OHM 1/10W 1% 0603 SMD	Panasonic	ERJ-3EKF2553V

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B-1. DS90UB928QEVM BOM (continued)

Item	Qty	Reference	Description	Manufacturer	Part Number
70	1	R115	RES 49.9K OHM 1/10W 1% 0603 SMD	Panasonic	ERJ-3EKF4992V
71	1	R116	RES 40.2K OHM 1/10W 1% 0603 SMD	Panasonic	ERJ-3EKF4022V
72	1	R118	RES 56 OHM 1/10W 5% 0402 SMD	Panasonic	ERJ-2GEJ560X
73	2	SW1,SW2	SWITCH TACT	APEM Components	ADTSM31NV
74	1	S1	SWITCH DIP EXTENDED SEALED 4POS	Grayhill	78B04ST
75	2	S2,S3	SWITCH TAPE SEAL 8 POS SMD	CTS Electrocomponents	219-8MST
76	1	S4	SWITCH DIP EXTENDED UNSEAL 3POS	Grayhill	78B03T
77	1	S5	SWITCH TAPE SEAL 3 POS SMD	CTS Electrocomponents	219-3MST
78	1	U1	FPD-Link III Deserializer LVDS	TI	DS90UB928QSQ
79	1	U2	IC AVR MCU 128K 64QFN	Atmel	AT90USB1287-16MU
80	2	U4,U5	IC REG LDO 500MA ADJ SOT223-4	TI	LP38693MP-ADJ/NOPB
81	1	U6	IC REG LDO 300MA 3.3V 8MSOP	TI	LP3982IMM-3.3/NOPB
82	1	Y1	CRYSTAL 8.000 MHZ 18PF SMD	Abracon Corporation	ABM3-8.000MHZ-D2Y-T

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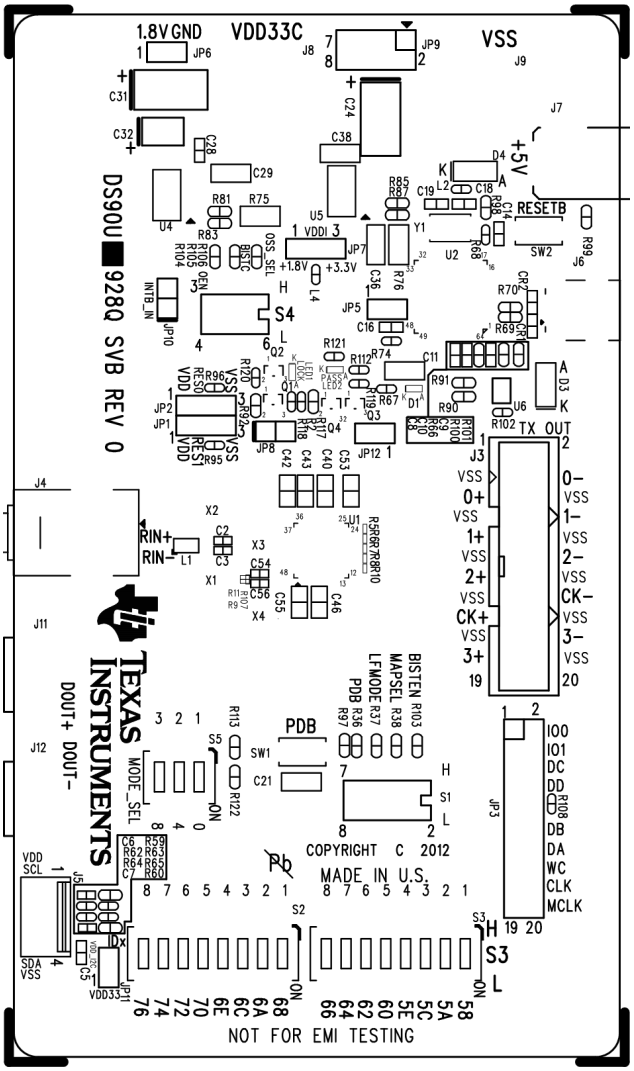
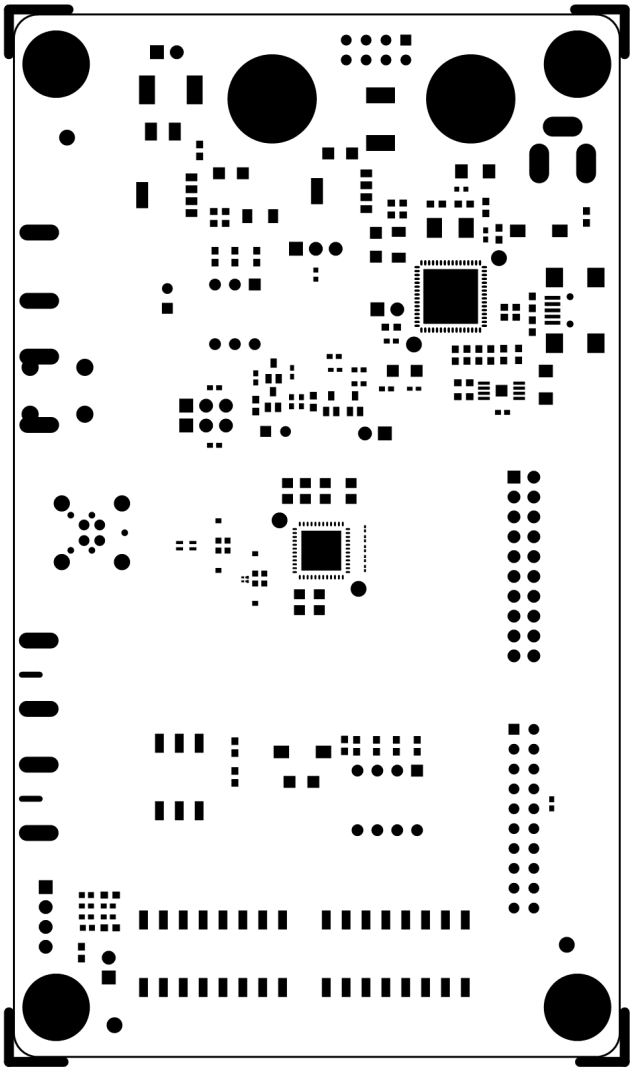
Board Layout

C.1 Board Layers

The following mechanical drawings (not to scale) illustrate the physical layout and stack-up of the 4-layer DS90UB928QEVM evaluation board:



C-1. Top Silkscreen



C-2. Top Solder Mask

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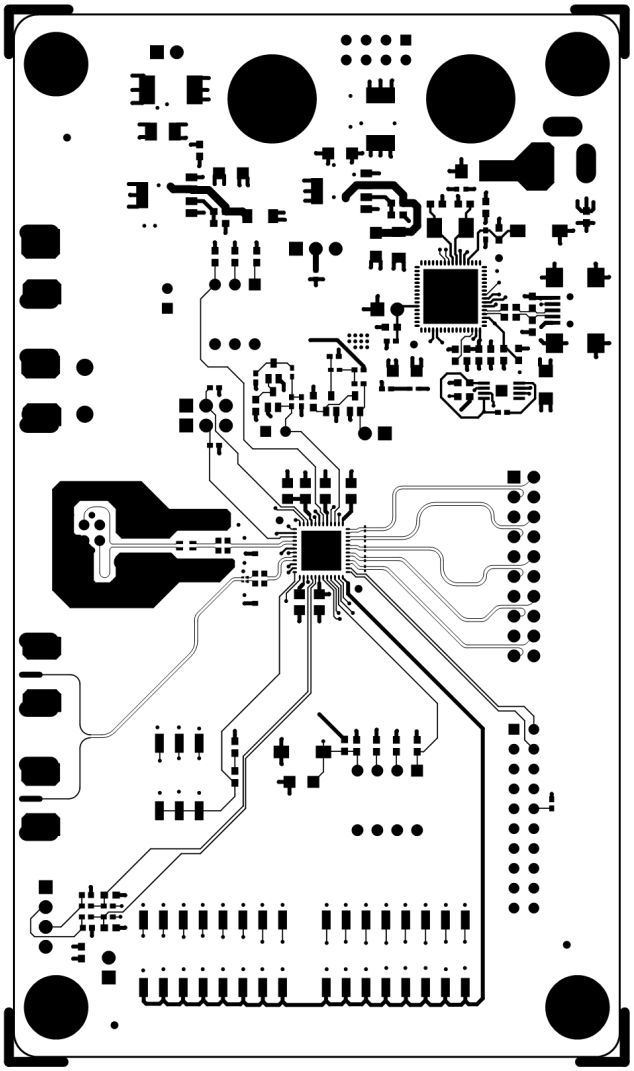
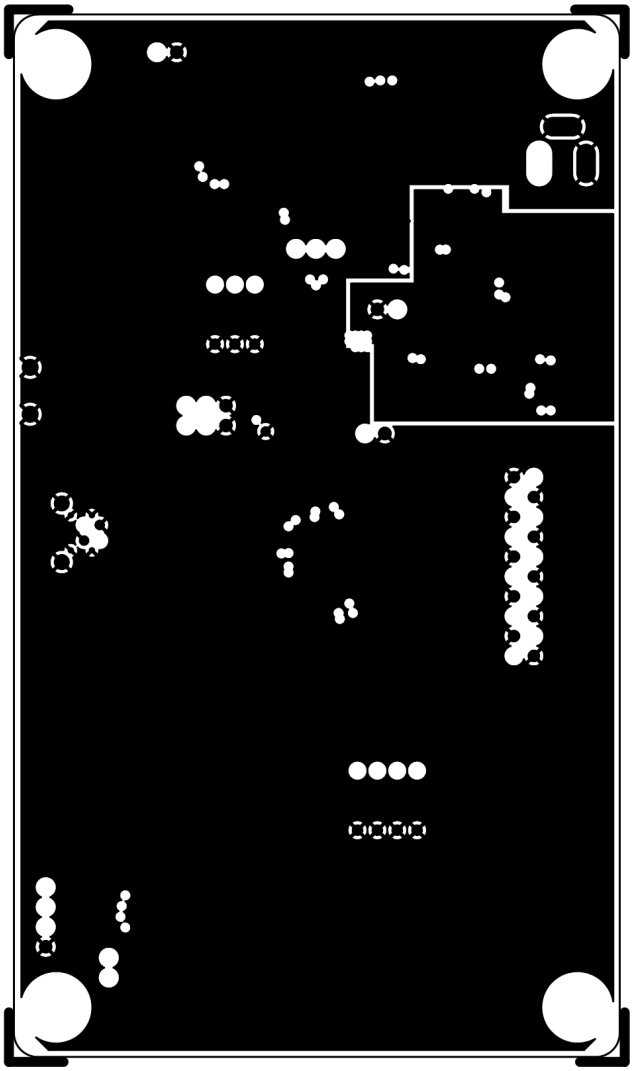


C-3. Top Copper



C-4. Internal Layer 1: Ground

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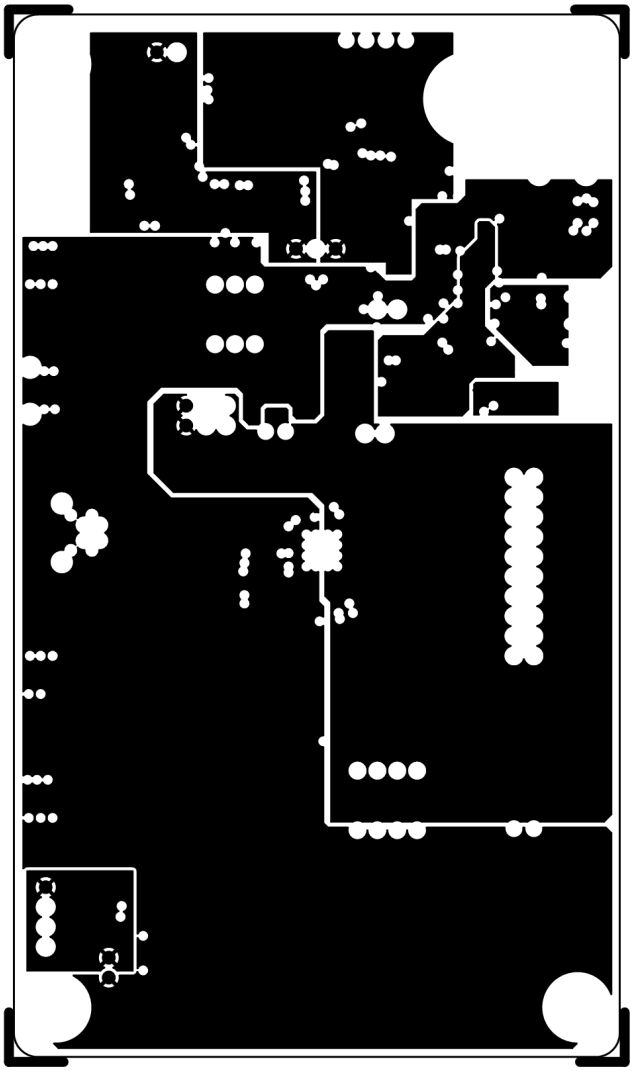
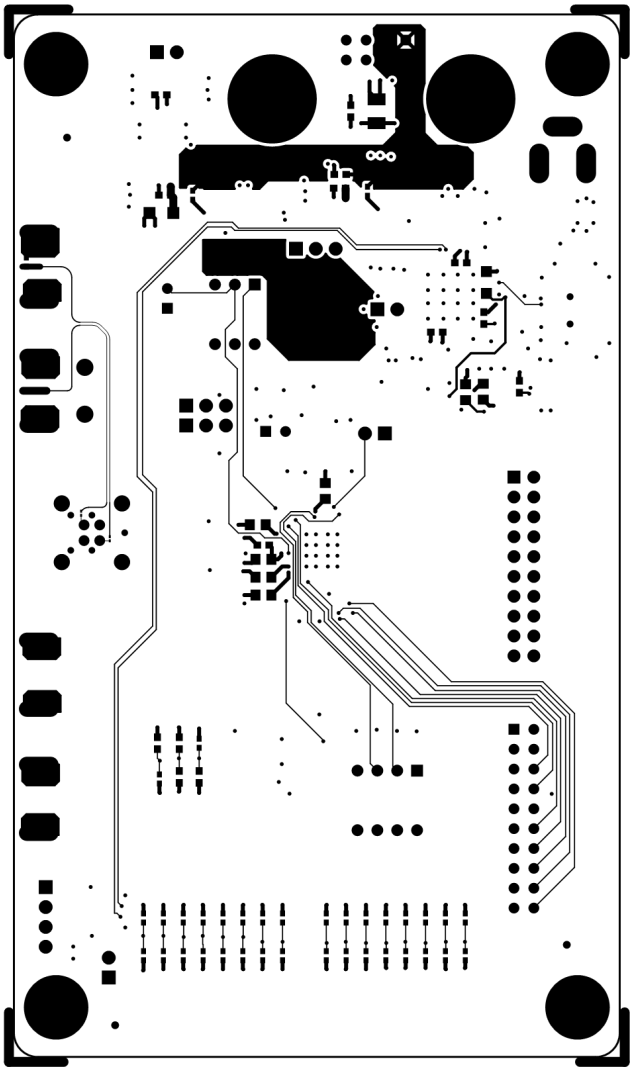


C-5. Internal Layer 2: Power



C-6. Bottom Copper

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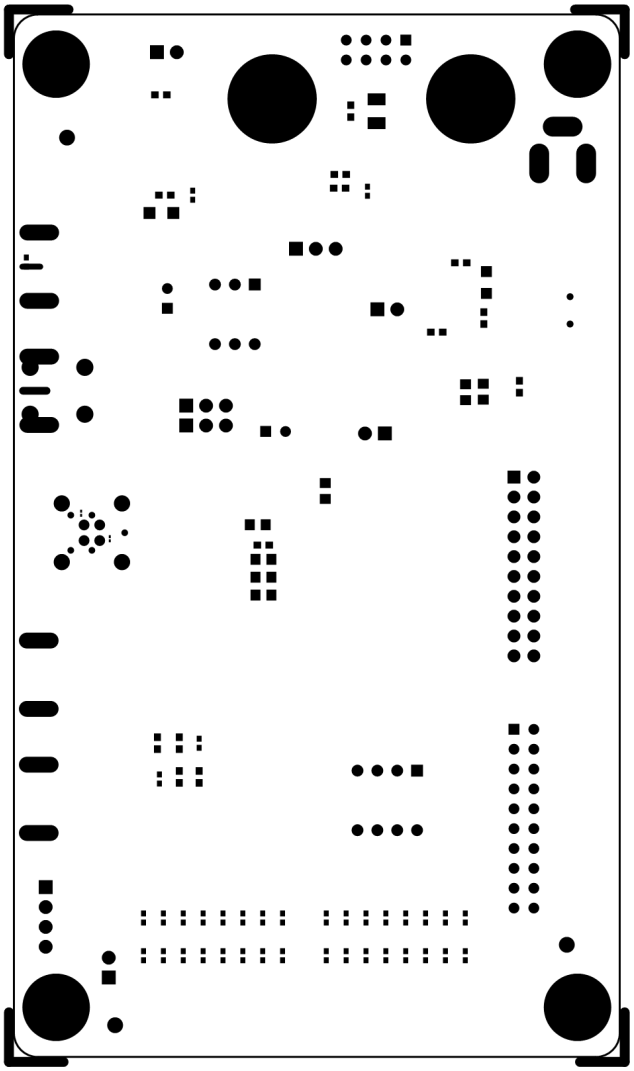
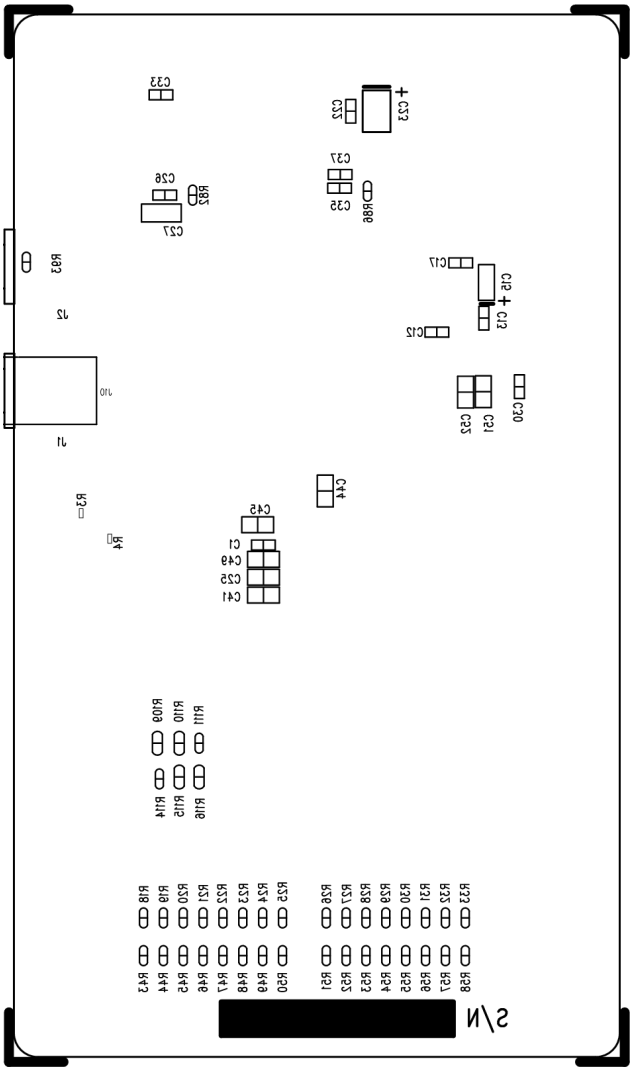


C-7. Bottom Solder Mask



C-8. Bottom Silkscreen

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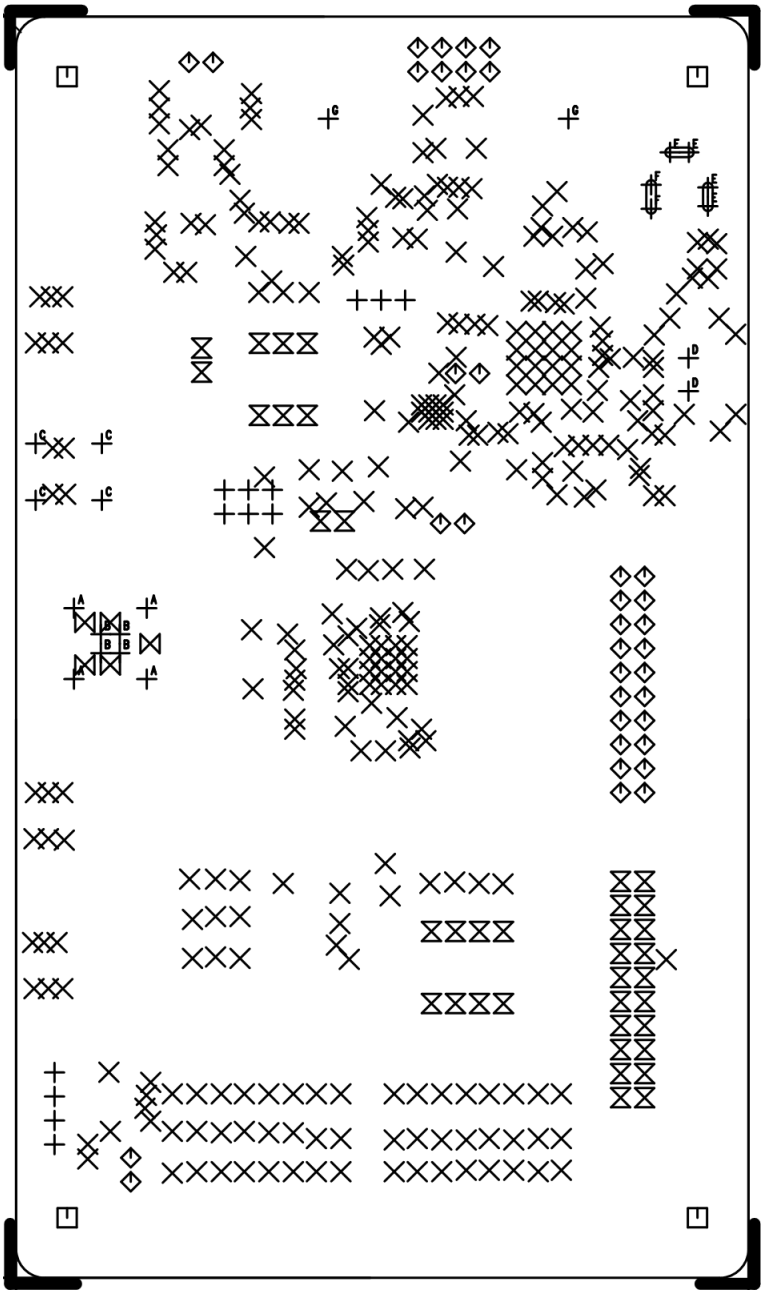

C-9. Drill

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Revision History

DS90UB928QEVMUser Guide Revision History

Revision	Date	Comments
1.0	02/18/2013	Initial Revision.

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

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EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

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.

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 LIMITED 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. 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.

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 visit www.ti.com/esh or contact TI.

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. 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.

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module 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 or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment 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.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

http://www.tij.co.jp

【ご使用にあたっての注】

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

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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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なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル
http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. 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 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

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