SERDESUB-913 User's Guide

Table of Contents

TABLE OF CONTENTS 1
INTRODUCTION: 2
DS90UB913Q/914Q SERDES TYPICAL APPLICATION 3
HOW TO SET UP THE DEMO EVALUATION KIT: 3
BI-DIRECTIONAL CONTROL BUS AND I2C MODES: 4
DEMO BOARD POWER CONNECTIONS: 4
DS9UB913Q SERIALIZER BOARD DESCRIPTION: 5
CONFIGURING THE MODE PIN ON THE SERIALIZER BOARD 5
SERIALIZER LVCMOS PINOUT BY CONNECTOR 5
DS9UB914Q DESERIALIZER BOARD DESCRIPTION: 7
DIP SWITCH S2 CONFIGURATION ON THE DESERIALIZER BOARD 7
DIP SWITCH S1 CONFIGURATION ON THE DESERIALIZER BOARD 7
DESERIALIZER LVCMOS PINOUT BY CONNECTOR 8
TYPICAL CONNECTION AND TEST EQUIPMENT 10
TROUBLESHOOTING DEMO SETUP 10
CABLE REFERENCES 11
APPENDIX 12
DS90UB913Q EVK SCHEMATIC 12
DS90UB914Q EVK SCHEMATIC 15
DS90UB913Q PCB LAYOUT 18
DS90UB914Q EVK LAYOUT 20

Introduction:

National Semiconductor's Automotive SERDES DS90UB913/914Q FPD-Link III evaluation kit contains one (1) DS90UB913Q Serializer board and one (1) DS90UB914Q Deserializer board. The boards are mounted with the Rosenberger connectors for connectivity using the Leoni-Dacar cables (not sent along with the kits). The boards also have the option of being populated with single ended coaxial cables. This mode is for evaluation purposes only.

The DS90UB913Q/914Q chipset supports a variety of automotive mega-pixel camera systems over a two (2) wire serial stream. The single differential pair (FPD-Link III) is well-suited for direct connections between an imager and Host Controller/Electronic Control Unit (ECU)/FPGA. The bidirectional control channel of the DS90UB913Q/914Q provides seamless communication between the ECU/FPGA and the display module.
This kit will demonstrate the functionality and operation of the DS90UB913Q and DS90UB914Q chipset. The chipset enables transmission of a high-speed video data along with a low latency bi-directional control bus over a single twisted pair cable. The integrated control channel transfers data bi-directionally over the same serial video link. The transport delivers 10/12 bits of parallel data, two SYNC bits and PCLK together with a bidirectional control channel that supports an I^2C bus. Additionally, there are four unidirectional general purpose (GPI and GPO) signal lines for sending control data. This interface allows transparent full-duplex communication over a single high-speed differential pair, carrying asymmetrical bi-directional control information without the dependency of video blanking intervals. The Serializer and Deserializer chipset is designed to transmit data at PCLK clocks speeds ranging from 10 to 100 MHz and I^2C bus rates up to 400 kbps at up to 10 meters cable length over -40 to +105 Deg C.

The user needs to supply only a single 5V supply to the Deserializer boards as these kits have power transfer over coax/ power transfer over differential pair capabilities.
The demo boards can be used for EMI testing.

System Requirements:

In order to demonstrate, the following are required:

1) Mega-pixel imager modules such as the Omnivision OV10630 or Aptina MT9M023/24.
2) Microcontroller (MCU) or FPGA with I^2C interface bus (I^2C master)
    a. slave clock stretching must be supported by the I2C master controller/MCU.
3) External peripheral device that supports I^2C (slave mode)
4) 5V power supply.

Contents of the Demo Evaluation Kit:

1) One Serializer board with the DS90UB913Q
2) One Deserializer board with the DS90UB914Q

DS90UB913Q/914Q SerDes Typical Application

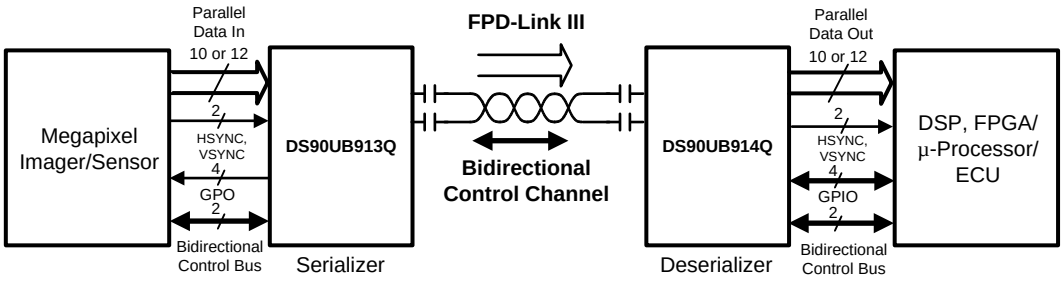


Figure 1. Typical Application of DS90UB913/914Q Chipset

The diagram above illustrates a typical application of DS90UB913Q/914Q chipset. The ECU/FPGA can program device registers on the DS90UB913Q, DS90UB914Q, and remote peripheral device, such as a display module.

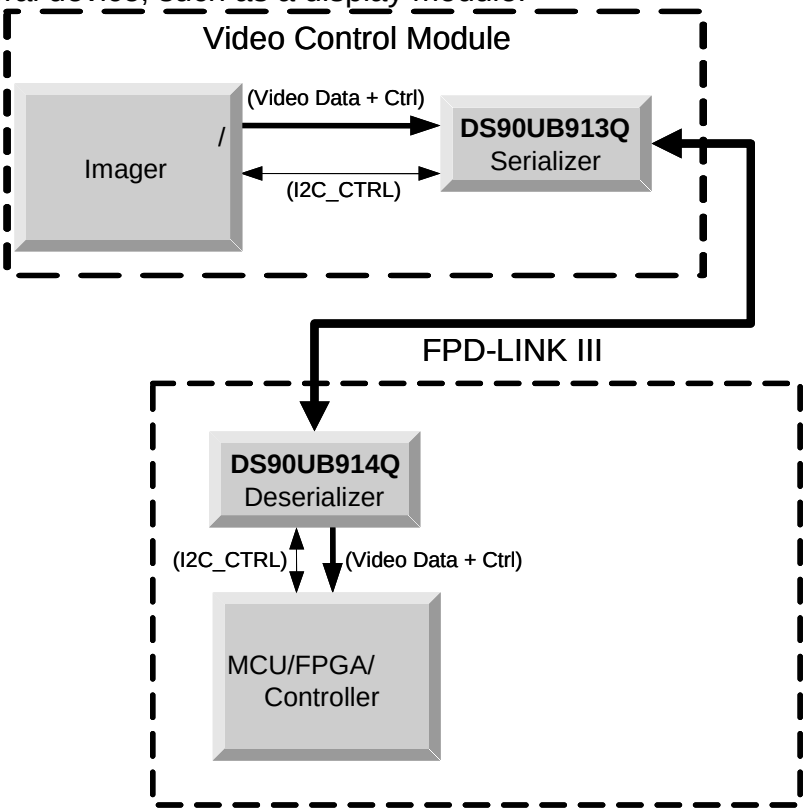


Figure 2. Typical DS90UB913/914Q Imager System Diagram

Refer to the proper datasheet information on Chipsets (Serializer/Deserializer) for more detailed information.

How to set up the Demo Evaluation Kit:

The DS90UB913Q/914Q evaluation boards consist of two sections. The first part of the board provides the point-to-point interface for transmitting parallel video data. The second part of the board allows bi-directional control communication of an I^2C bus control of using a MCU/FPGA to programming a remote peripheral device via the Serializer.

The PCB routing for the Serializer input pins (DIN) accept incoming parallel video data at 1.8V/3.3V LVCMOS signals from J1 IDC connector. The FPD-Link III interface can use a single twisted pair cable or a single coax cable. The output pins (ROUT) are accessed through a JP1 IDC connector. Please follow these steps to set up the evaluation kit for bench testing and performance measurements:

1) Connect the DS90UB913/914Q demo boards using a Leoni/Dacar cable or a coaxial cable(not provided)
2) Jumpers and switches have been configured at the factory; they should not require any changes for immediate operation of the chipset. See text on Configuration settings and datasheet for more details. The jumpers and connectors are configured in external oscillator mode with the VDDIOs toggling at 3.3V.
3) From the imager, connect a flat cable (not supplied) to the Serializer board and connect another flat cable (not supplied) from the Deserializer board to the ECU/FPGA module. *Note: For 50 ohm signal sources, provide 1.8V/3.3V LVCMOS input signal levels into DIN[12:0], HS, VS and PCLK*
4) Connect the Deserializer I2C ports to the I2C of the MCU/FPGA (I2C master). Connect the Serializer I2C ports to the I2C bus of the peripheral slave device.
5) Power for the Serializer and Deserializer boards must be supplied externally through JP5 on the Deserializer board and JP4 on the Serializer board.

Bi-Directional Control Bus And I2C Modes:

In order to communicate and synchronize with remote devices on the I2C bus through the bi-directional control channel, slave clock stretching must be supported by the I2C master controller/ECU. The chipset utilizes bus clock stretching (holding the SCL line low) during data transmission; where the I2C slave pulls the SCL line low prior to the 9th clock of every I2C data transfer (before the ACK signal).

The bidirectional control bus supports an I2C compatible interface that allows programming of the DS90UB913Q, DS90UB914Q, or an external remote device (such as an imager). Register programming transactions to/from the DS90UB913Q/914Q chipset are employed through the clock (SCL) and data (SDA) lines. These two signals have open drain I/Os and must be pulled-up to VDDIO by external resistors. The boards have an option to use the on-board 10KΩ pull-up resistors tied to VDDIO or connected through external pull-ups at the target Host. The appropriate pull-up resistor values will depend upon the total bus capacitance and operating speed. The DS90UB913Q/914Q I2C bus data rate supports up to 400 kbps according to I2C specification.

Demo Board Power Connections:

Power should be only applied to the DS90UB914Q Deserializer boards. Power is transferred over the link using either the Differential pair.

DS9UB913Q Serializer Board Description:

The 2x15-pin IDC connector JP1 accepts 10/12 bits of 1.8V or 3.3V data, HS, VS and PCLK. VDDIO must be set externally for 1.8V or 3.3V LVCMOS inputs using jumper JP8 and JP6 on the Serializer and Deserializer boards respectively.
The Serializer board can be powered from the Deserializer board. For the Serializer to be operational, the S1-PDB switch on 1 must be set HIGH. S1-RES0 must be set LOW.
The boards can be connected to the Deserializer boards using either Rosenberger connectors.

Configuring the Mode Pin on the Serializer Board

To configure the device in the external oscillator mode, PCLK mode or the AON clock mode, switch S8 has to be configured as shown in Table. 1.

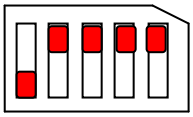
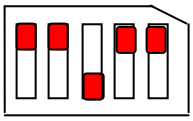
Mode Configuration	Switch S8 Settings
PCLK from imager	
External Oscillator Mode	

Table 1. Mode switch configuration on the Serializer Board

Serializer LVCMOS Pinout by Connector

The following three tables illustrate how the Deserializer connections are mapped to the IDC connector J1 on the Serializer board.

JP1 LVCMOS I/O			
pin no.	**name**	**name**	**pin no.**
1	GND	**DIN0**	2
3	GND	**DIN1**	4
5	GND	**DIN2**	6
7	GND	**DIN3**	8
9	GND	**DIN4**	10
11	GND	**DIN5**	12
13	GND	**DIN6**	14
15	GND	**DIN7**	16
17	GND	**DIN8**	18
19	GND	**DIN9**	20
21	GND	**DIN10**	22
23	GND	**DIN11**	24
25	GND	**HS**	26
27	GND	**VS**	28
29	GND	**PCLK**	30

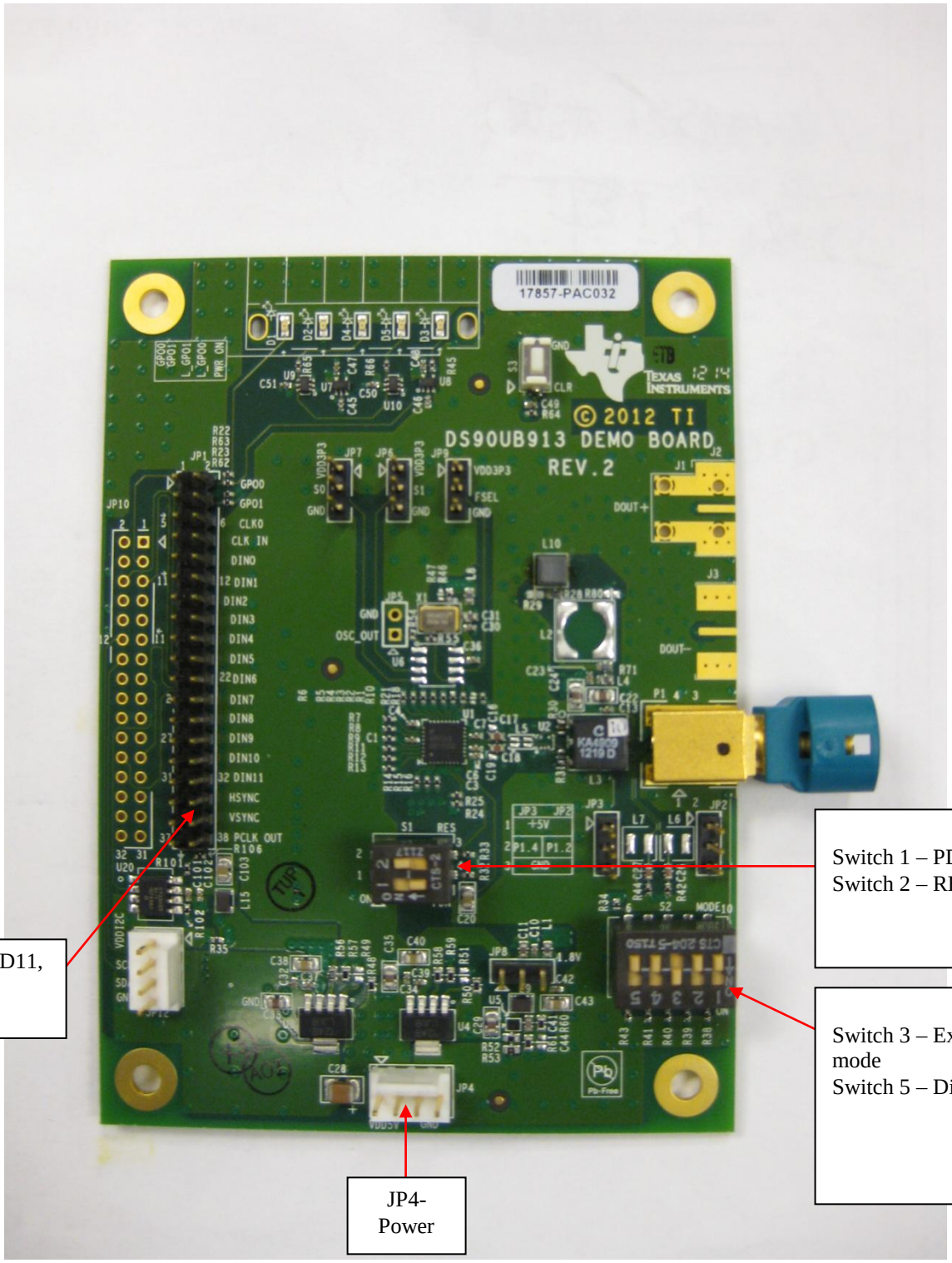


Figure 3. DS90UB913Q Boards with HSD Connector

DS9UB914Q Deserializer Board Description:

The Deserializer board can be powered using header JP5. For the Deserializer to be operational, follow the dip switch configuration for S1 and S2 shown in Table 2 and Table 3. The 2x15 pin IDC Connector JP1 provides access to the 1.8V or 3.3V LVCMOS data, HS, VS and PCLK outputs.
The Deserializer board is by default configured to operate in the 100MHz mode with 3.3V I/O. The default device address of the DS90UB914Q on the Board is C0.

Dip Switch S2 Configuration on the Deserializer Board

To configure the DS90UB914Q device on the Deserializer board, please follow Table.2.

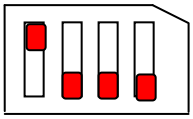
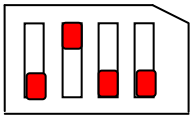
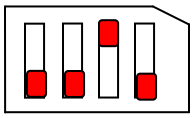
Mode Configuration	Switch S6 Settings
12-bit Low Frequency Mode	
12-bit High Frequency Mode	
10-bit Mode	

Table 2. Mode Switch Configuration on the Deserializer Board

Dip Switch S1 Configuration on the Deserializer Board

To configure the DS90UB914Q device on the Deserializer board, please follow Table.2.

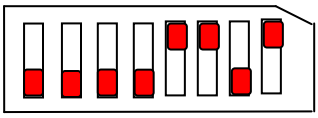
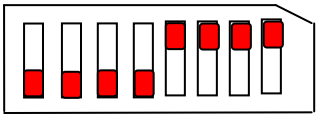
Mode Configuration	Switch S6 Settings
Normal Mode configuration	
BIST Mode configuration	

Table 3. Mode Switch Configuration on the Deserializer Board

Deserializer LVCMOS Pinout by Connector

The following table illustrates how the Deserializer connections are mapped to the IDC connector J1 on the Serializer board.

J1 LVCMOS I/O			
pin no.	**name**	**name**	**pin no.**
1	**ROUT0**	**GND**	2
3	**ROUT1**	GND	4
5	**ROUT2**	GND	6
7	**ROUT3**	GND	8
9	**ROUT4**	GND	10
11	**ROUT5**	GND	12
13	**ROUT6**	GND	14
15	**ROUT7**	GND	16
17	**ROUT8**	GND	18
19	**ROUT9**	GND	20
21	**ROUT10**	GND	22
23	**ROUT11**	GND	24
25	**HS**	GND	26
27	**VS**	GND	28
29	**PCLK**	GND	30

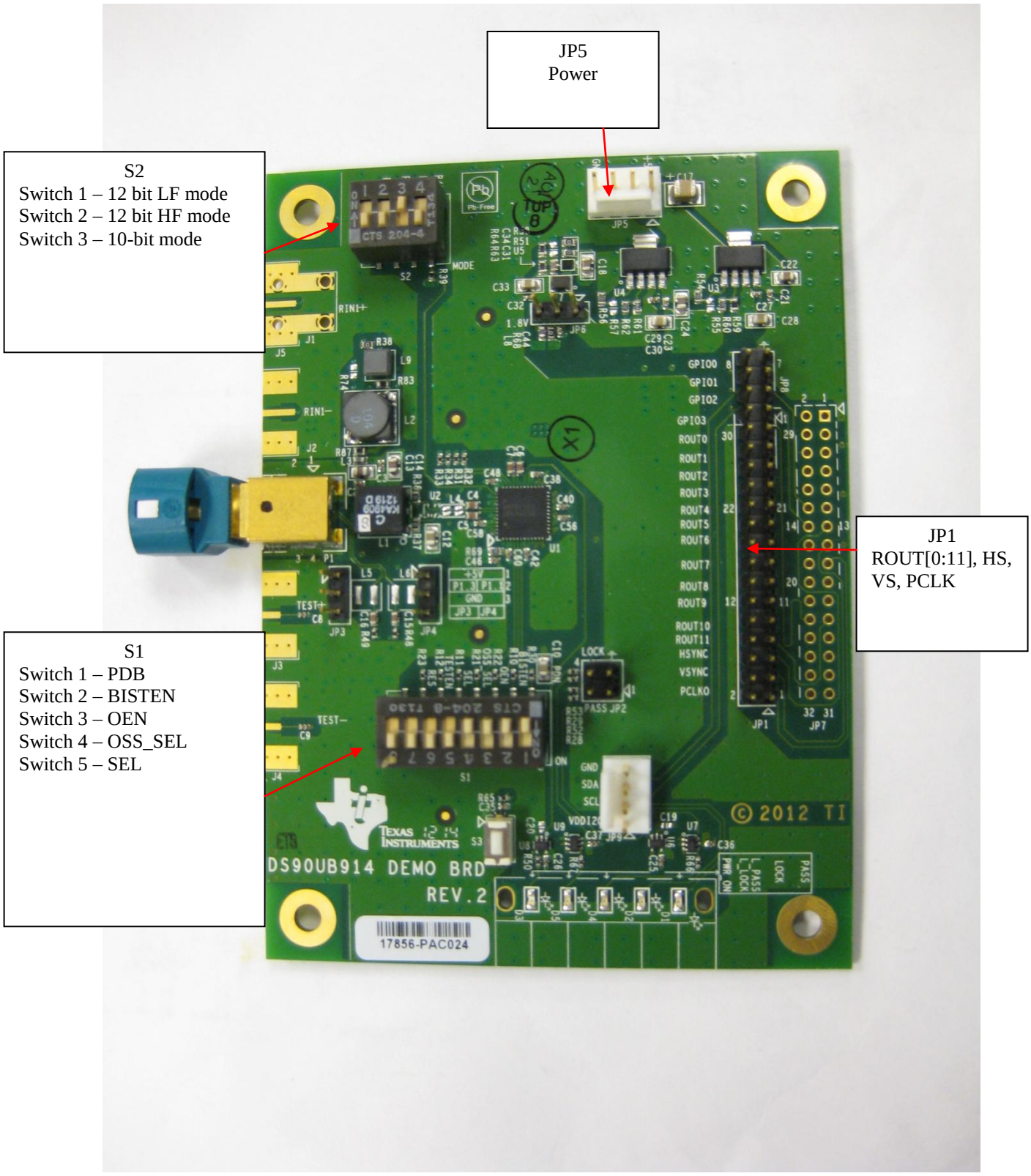


Figure 4. DS90UB914Q Deserializer boards with HSD Connectors

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) Image Sensor such as the OV10630 or MT9M024
2) Any other signal generator / video source that generates the correct input levels.

The following is a list of typical test equipment that may be used to monitor the output signals from the Deserializer:

1) Microcontroller or FPGA with an I2C interface
2) Optional – Logic Analyzer or Oscilloscope
3) Any SCOPE with a bandwidth of at least 50MHz for 1.8V/3.3V LVCMOS and/or 1.5GHz for observing differential signals.

Troubleshooting Demo Setup

If the demo boards are not performing properly, use the following as a guide for quick solutions to potential problems. If the problem persists, please contact the local Sales Representative for assistance.

QUICK CHECKS:

1. Check that Powers and Grounds are connected to both Serializer and Deserializer boards.
2. Verify input clock and input data signals meet requirements (VIL, VIH, tset, thold), Also verify that data is strobed on the selected rising/falling (RFB register) edge of the clock.
3. Check that the Jumpers and Switches are set correctly.
4. Check that the cable is properly connected.

TROUBLESHOOTING CHART

Problem…		**Solution…**
There is only the output clock.		Make sure the data is applied to the correct input pin.
There is no output data.		Make sure data is valid at the input.
No output data and clock.		Make sure Power is on. Input data and clock are active and connected correctly.
Power, ground, input data and input clock are connected correctly, but no outputs.		Check the Power Down pins of both Serializer and Deserializer boards to make sure that the devices are enabled (PDB=Vdd) for operation.
The devices are pulling more than 1A of current.		Check for shorts in the cables connecting the Serializer and Deserializer boards.
After powering up the demo boards, the power supply reads less than 1.8V when it is set to 1.8V.		Use a larger power supply that will provide enough current for the demo boards, a 500mA minimum power supply is recommended.

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.

Cable References

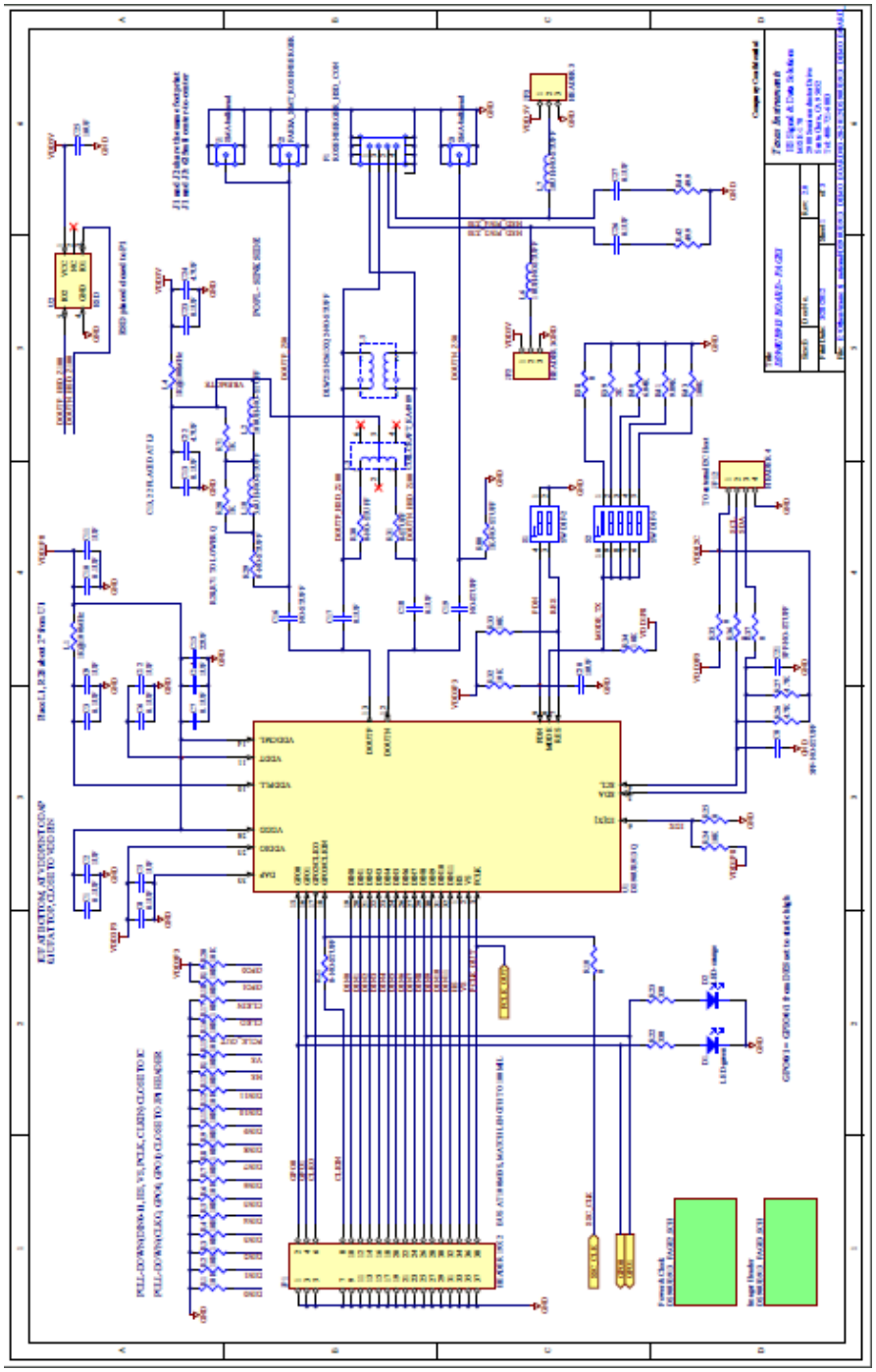
For optimal performance, we recommend Shielded Twisted Pair (STP) 100ohm differential impedance and 24 AWG (or larger diameter) cable for high-speed data applications.
Leoni Dacar 535 series cable:
www.leoni-automotive-cables.com
Rosenberger HSD connector:
www.rosenberger.de/en/Products/35_Automotive_HSD.php

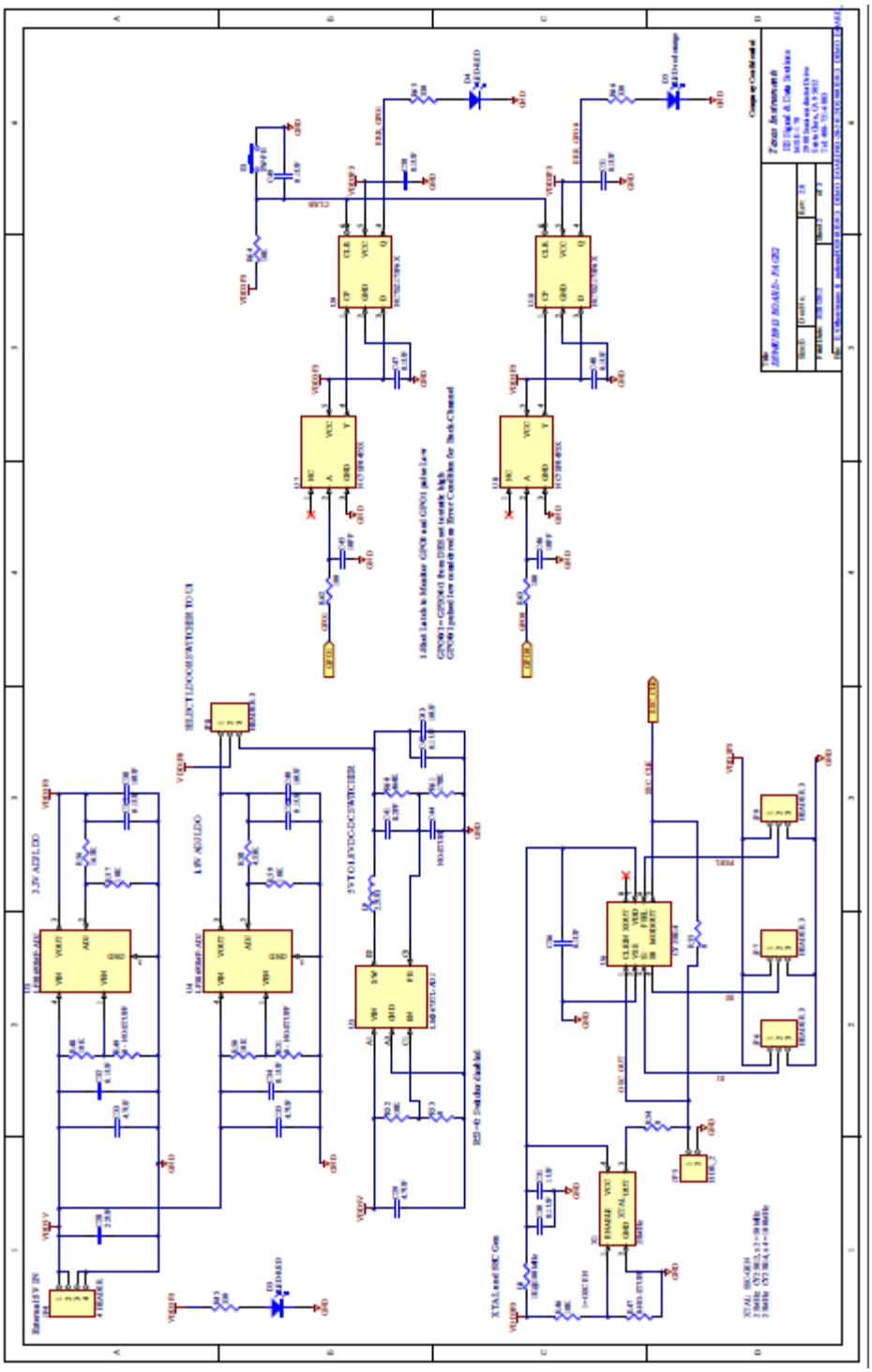
Equipment References

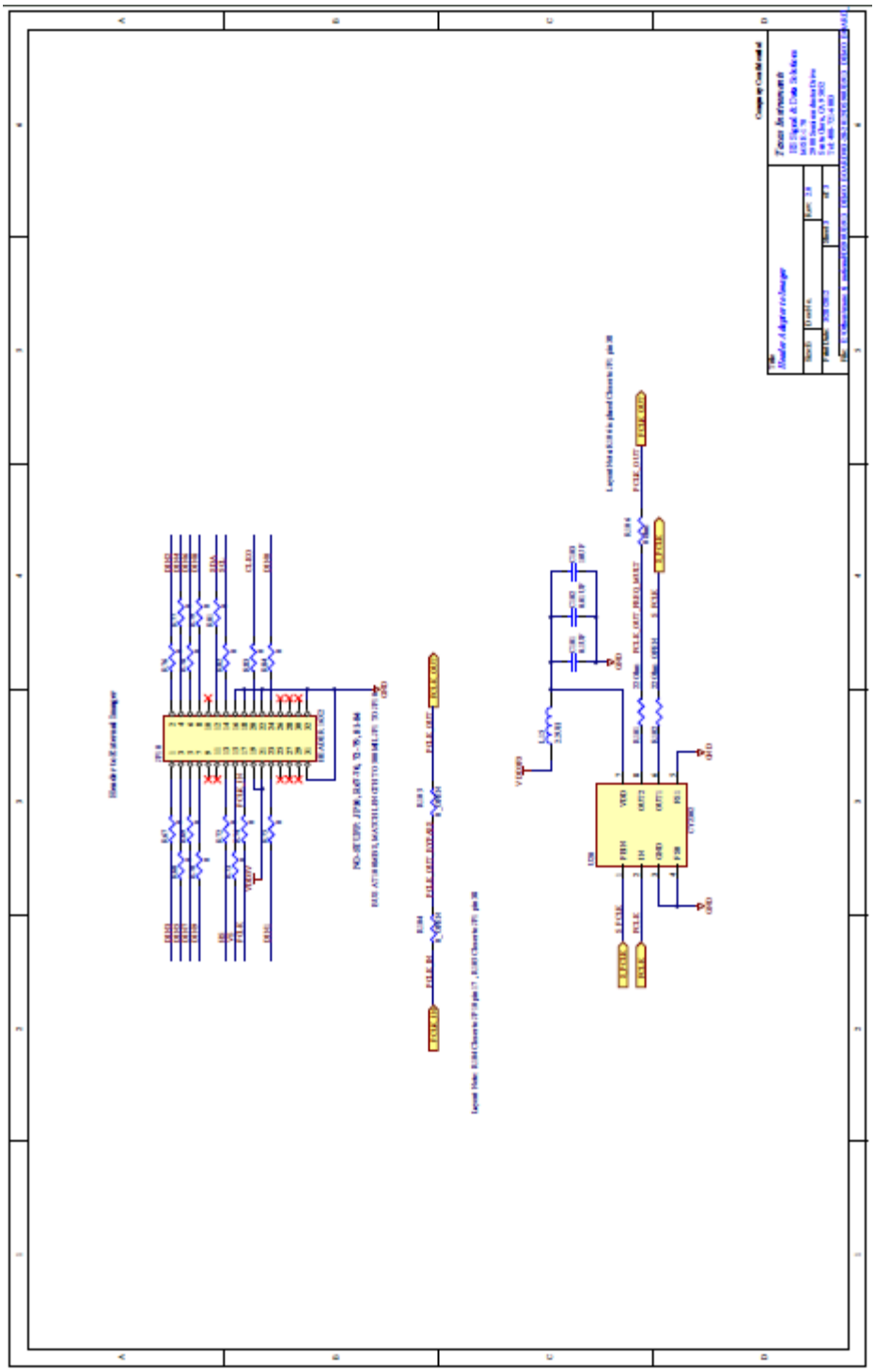
Corelis CAS-1000-I2C/E I2C Bus Analyzer and Exerciser Products:
www.corelis.com/products/I2C-Analyzer.htm

Appendix

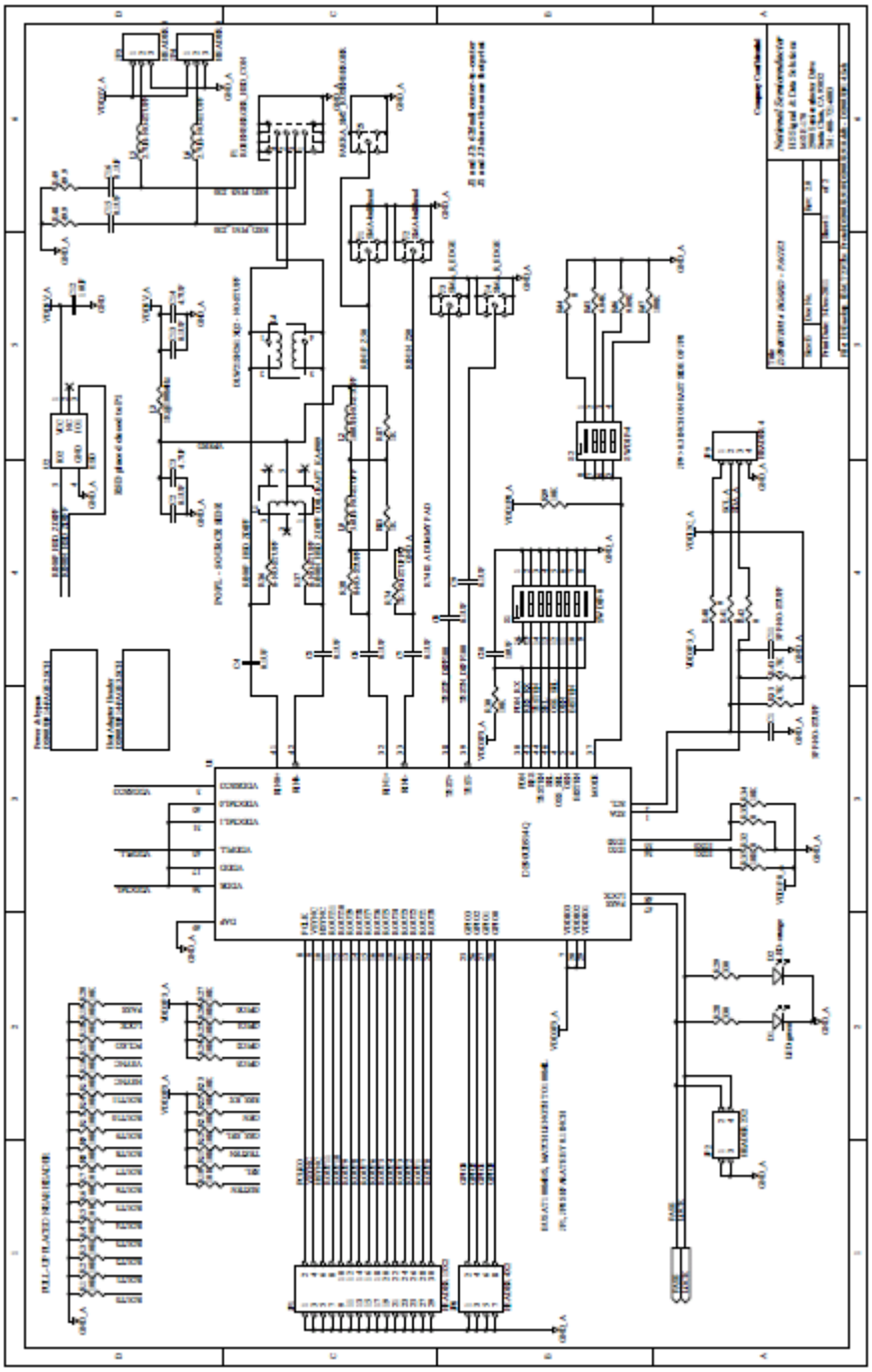
DS90UB913Q EVK Schematic

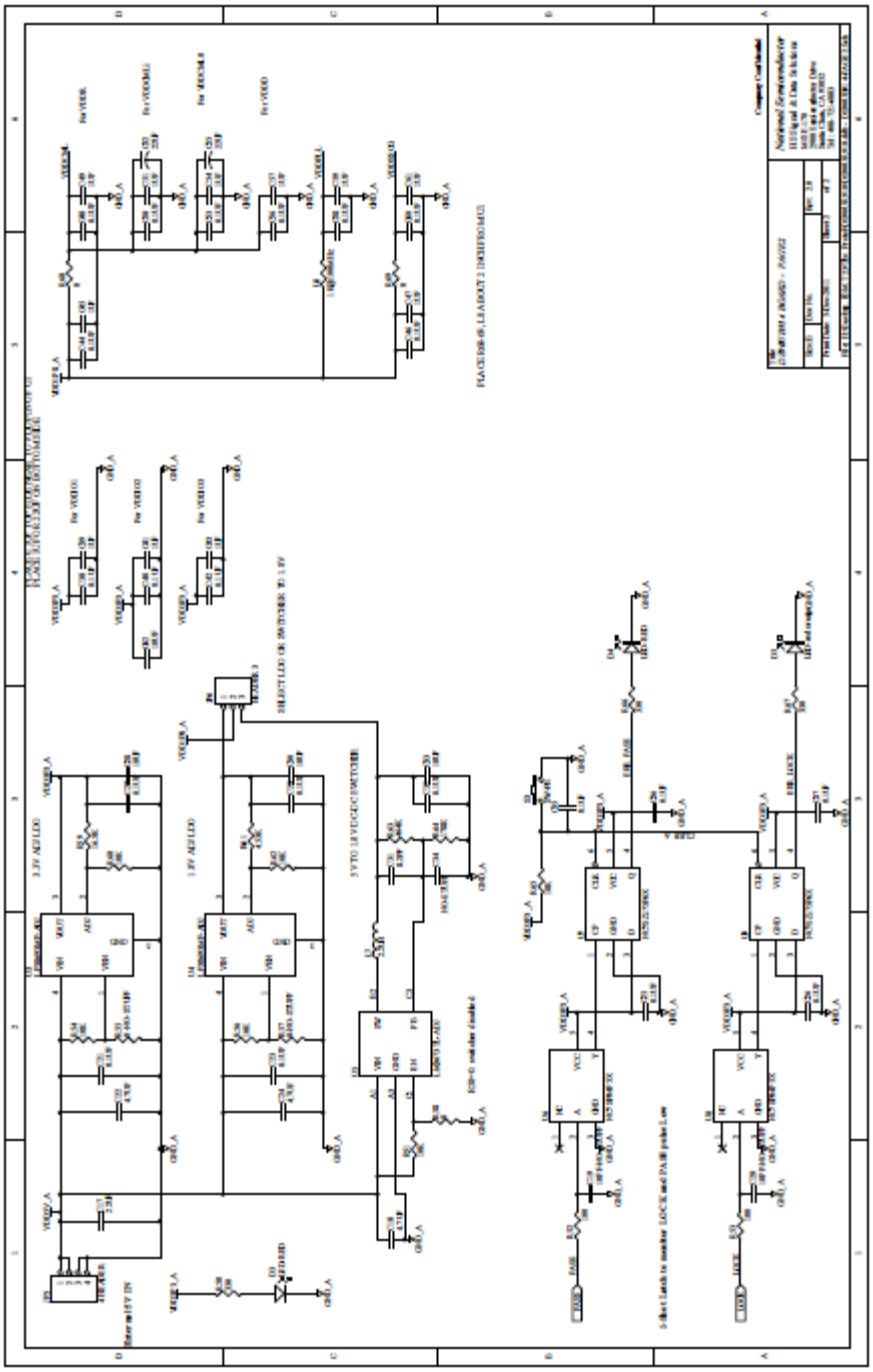


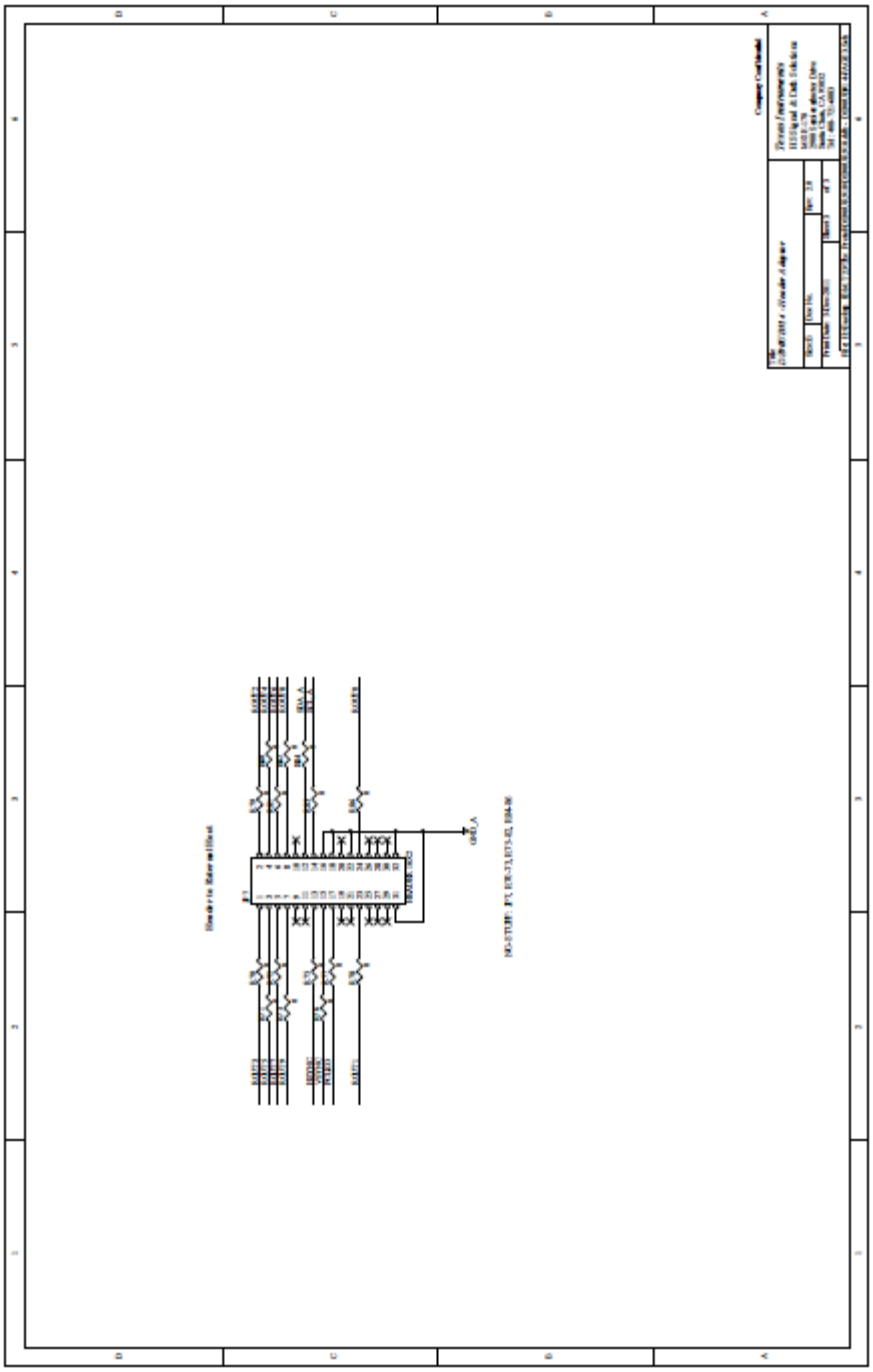




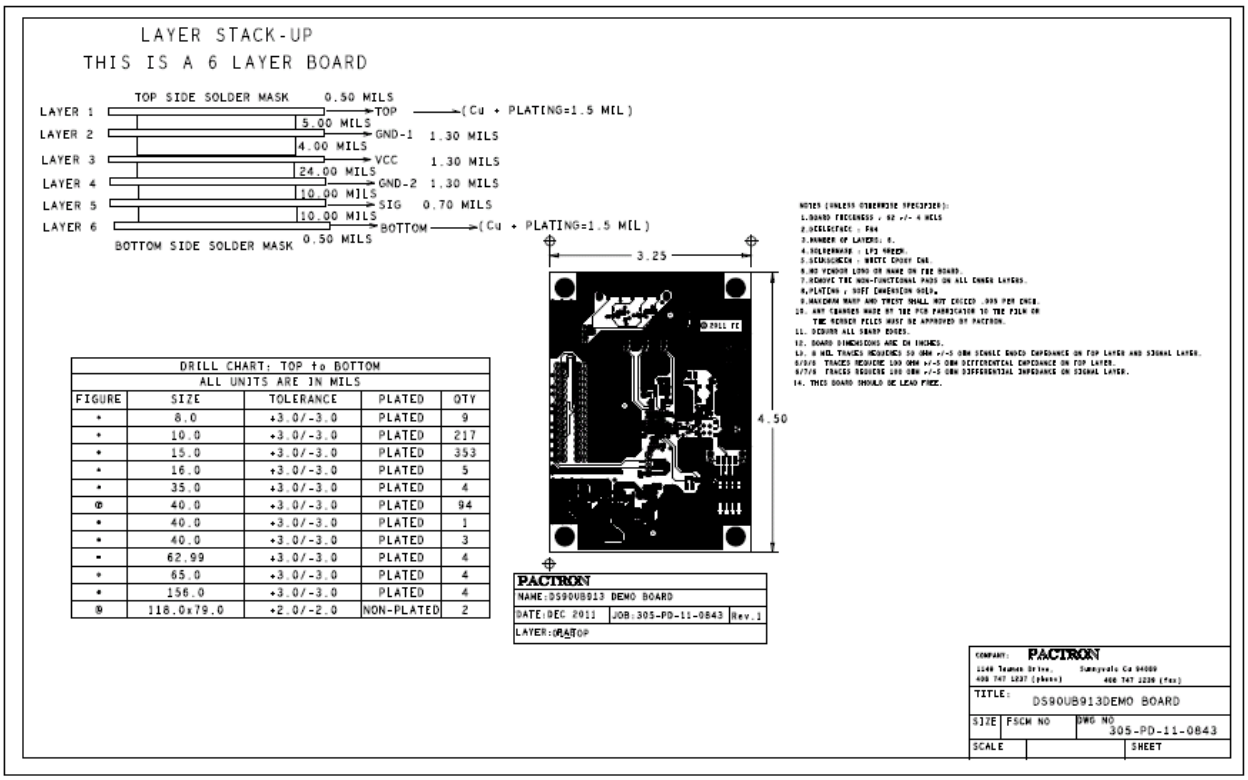
DS90UB914Q EVK Schematic

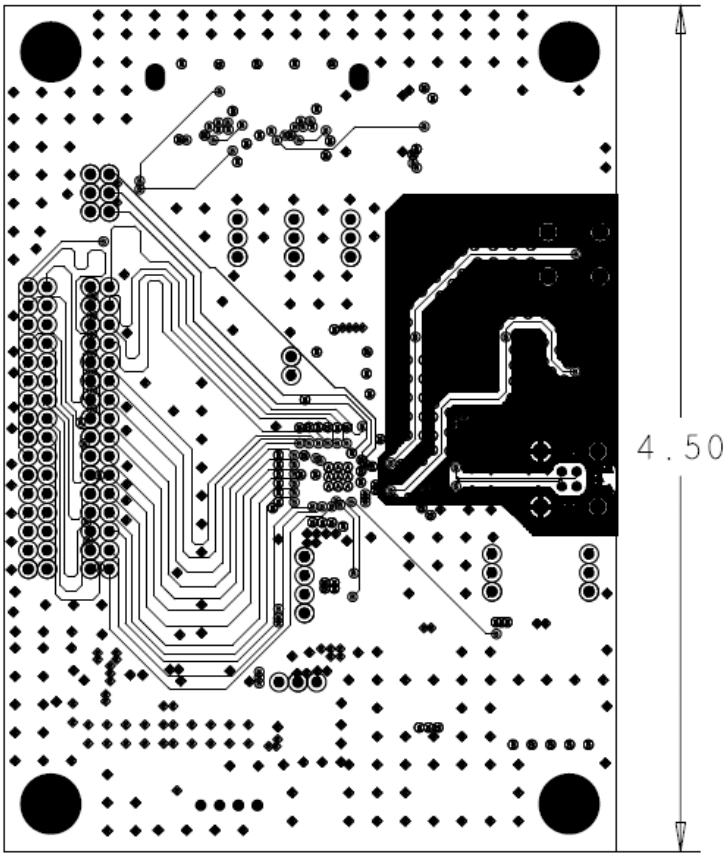


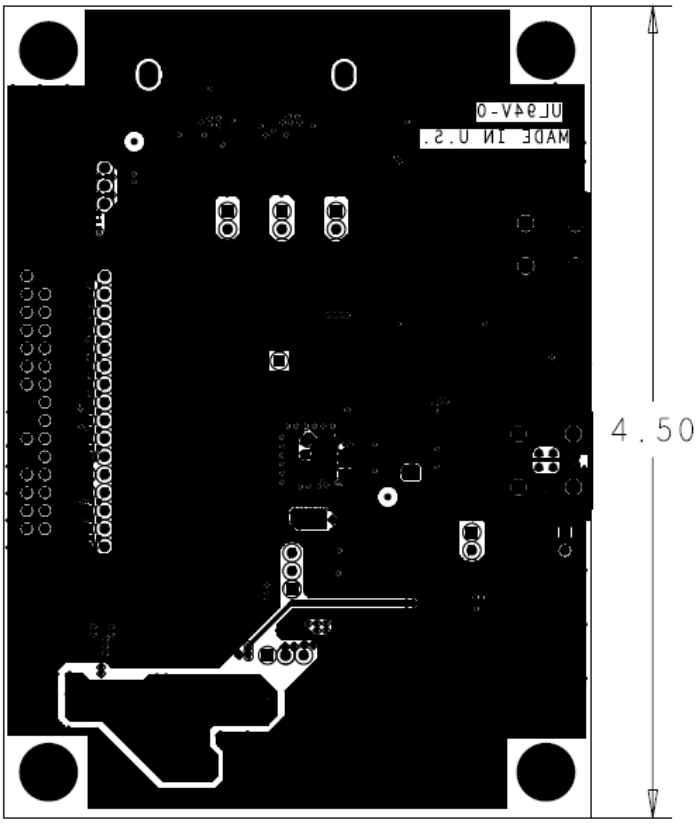




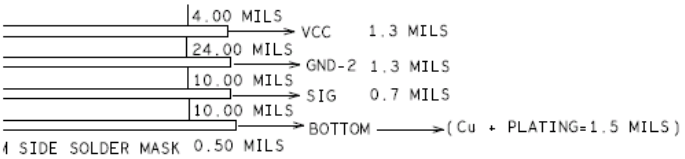
DS90UB913Q PCB Layout

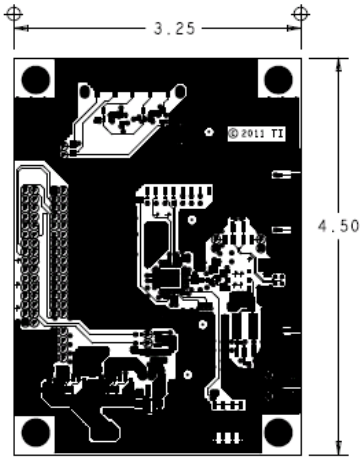



4.50


4.50

DS90UB914Q EVK Layout





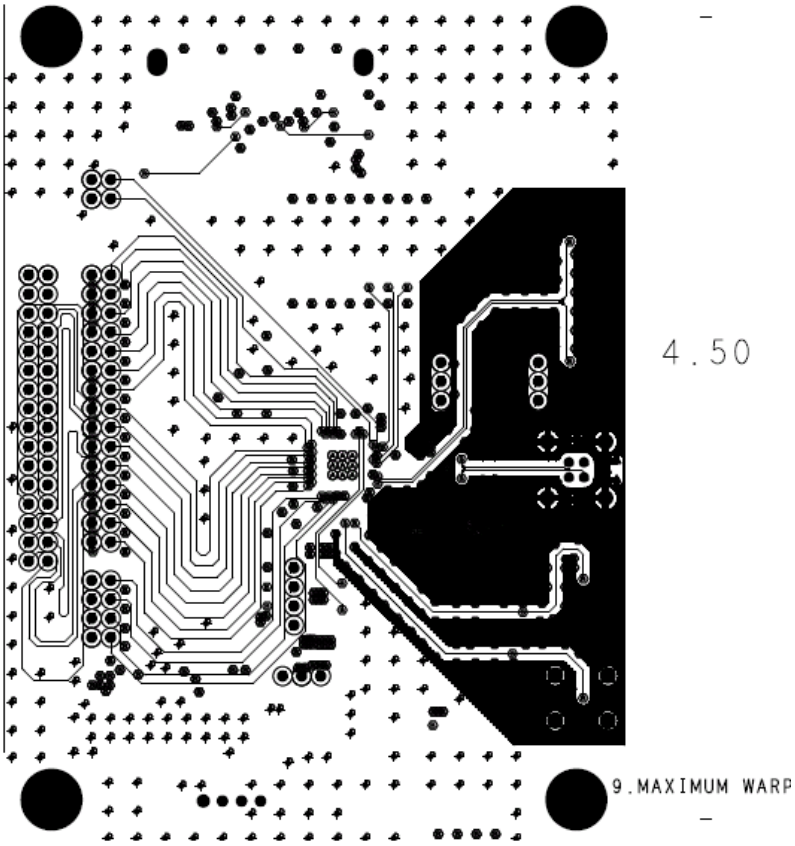
NOTES (UNLESS OTHERWISE SPECIFIED):
1. BOARD THICKNESS : 62 +/- 4 MILS
2. DIELECTRIC : FR4
3. NUMBER OF LAYERS: 6.
4. SOLDERMASK : LPI GREEN.
5. SILKSCREEN : WHITE EPOXY INK.
6. NO VENDOR LOGO OR NAME ON THE BOARD.
7. REMOVE THE NON-FUNCTIONAL PADS ON ALL INNER LAYERS.
8. PLATING : SOFT IMMERSION GOLD.
9. MAXIMUN WARP AND TWIST SHALL NOT EXCEED .005 PER INCH
10. ANY CHANGES MADE BY THE PCB FABRICATOR TO THE FILM THE GERBER FILES MUST BE APPROVED BY PACTRON.
11. DEBURR ALL SHARP EDGES.
12. BOARD DIMENSIONS ARE IN INCHES.
13. 8 MIL TRACES REQUIRES 50 OHM +/-5 OHM SINGLE ENDED
6/9/6 TRACES REQUIRE 100 OHM +/-5 OHM DIFFERENTIAL IMP
6/7/6 TRACES REQUIRE 100 OHM +/-5 OHM DIFFERENTIAL IMP
14. THIS BOARD SHOULD BE LEAD FREE.

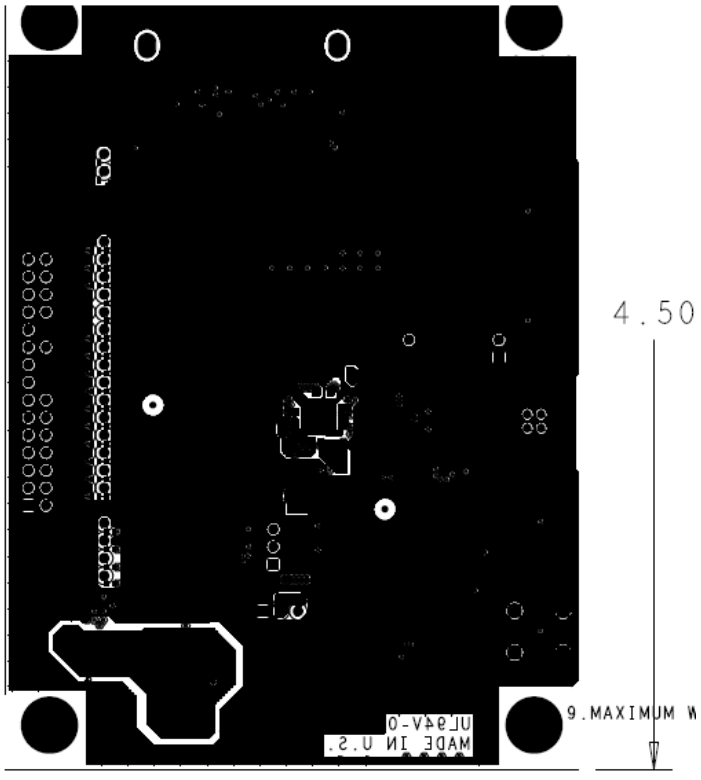
ILL CHART: TOP to BOTTOM
ALL UNITS ARE IN MILS

E	TOLERANCE	PLATED	QTY
0	+3.0/-3.0	PLATED	9
0	+3.0/-3.0	PLATED	335
0	+3.0/-3.0	PLATED	312
0	+3.0/-3.0	PLATED	5
0	+3.0/-3.0	PLATED	4
0	+3.0/-3.0	PLATED	87
0	+3.0/-3.0	PLATED	3
0	+3.0/-3.0	PLATED	1
99	+3.0/-3.0	PLATED	4
0	+3.0/-3.0	PLATED	4
.0	+2.0/-2.0	NON-PLATED	4
79.0	+2.0/-2.0	NON-PLATED	2

PACTRON		
NAME: DS90UB914 DEMO BRD		
DATE: DEC 2011	JOB: 305-PD-11-0844	Rev.1
LAYER: 01 TOP		

COMPANY:


4.50
9.MAXIMUM WARP


4.50
9.MAXIMUM W

FCC Warning

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

EVALUATION BOARD/KIT IMPORTANT NOTICE

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

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

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

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

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

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

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

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

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.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range specified in datasheet.

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

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

During normal operation, some circuit components may have case temperatures greater than 85° C. The EVM is designed to operate properly with certain components above 60° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

NOTES

IMPORTANT NOTICE

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

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI. Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices.

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

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

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

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

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

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
Low Power Wireless	www.ti.com/lpw	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265