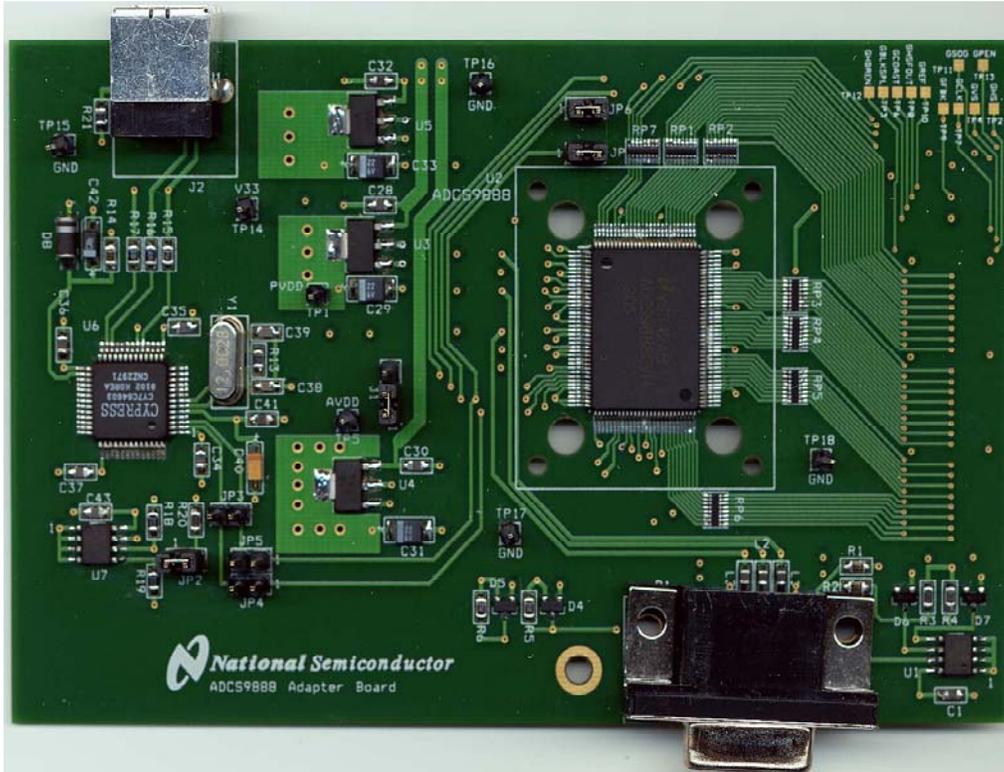


# ADCS9888 Evaluation Board Users Guide

National Semiconductor  
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ADCS9888 Evaluation Board User's Guide



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## ADCS9888 Evaluation Board User's Guide

### References

- 1) Product datasheet is found at: <http://www.national.com/ds/AD/ADCS9888.pdf>
- 2) Product information is found at: <http://www.national.com/pf/AD/ADCS9888.html>
- 3) Product information regarding the Pixelworks evaluation tools can be found at: <http://www.pixelworks.com/>
- 4) Pixelworks demo system part numbers:

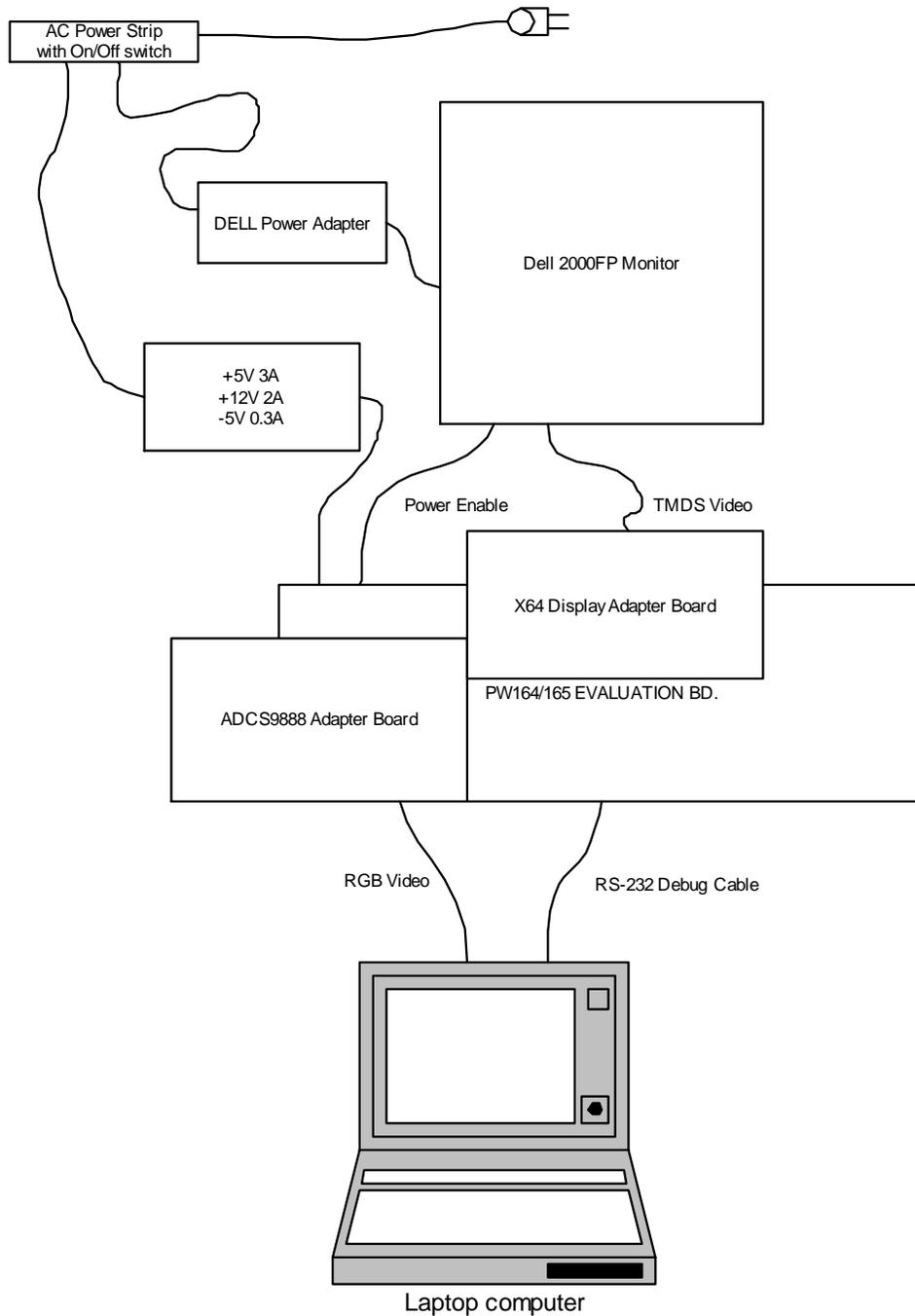
950-0042-01	PW166 Evaluation Kit
900-0021-11	TMDS data output adapter
421-0007-00	20" UXGA monitor

## 1.0 Introduction

The ADCS9888 Adapter Board, as shown in Figure 1, is a complete PCBA (printed circuit board assembly) which has been designed to be compatible with the graphics input device header on the PW164/165/166 Evaluation Board. This card is compatible with the

Pixelworks AD9888 Adapter card and can be used in place of that card with the Pixelworks scaler evaluation tool. An additional USB interface circuit has been provided on this board for future applications, but is not used with the Pixelworks software tools.

## 1.1 Block Diagram



## 2.0 Quick Start

1. Ensure that JP2, JP6 and JP7 have shorting jacks installed.
2. Ensure that J1 has a shorting jack installed between pins 1 and 2 (the two pins closer to the National Semiconductor logo on the board).
3. Connect the ADCS9888 adapter board to the PW164/165/166 evaluation board. Locate connector JP1 on the evaluation board and connect JP1 on the adapter board to it. Pin 1 of both connectors should be connected together. Note that both boards have 74 pin connector footprints, but only 72 pin connectors are installed.
4. The Pixelworks evaluation system will have two AC adapters. Both of these should be plugged into a switchable power strip that has no other devices plugged in. Switch the power strip on, and observe that the evaluation system initializes normally. The display should show the Pixelworks splash screen “Pixelworks – see the future”
5. Connect an appropriate video source to connector P1 on the ADCS9888 Adapter Board.
6. Observe that the Pixelworks Evaluation System performs an auto-detect on the video signal, and the image is displayed.

## 3.0 Functional Description

### 3.1 Connectors, Headers and Test Points

The input video signal is applied at the high density 15 pin D-SUB connector P1. The pinout of the connector follows the standard VGA convention as follows:

- 1- Red Video Signal
- 2- Green Video Signal
- 3- Blue Video Signal
- 4- Ground
- 5- Ground
- 6- Red Video Return
- 7- Green Video Return
- 8- Blue Video Return
- 9- NC
- 10- Ground
- 11- NC
- 12- SDA
- 13- HSYNC
- 14- VSYNC
- 15- SCL

Connection to the Pixelworks evaluation board is made at JP1 which is a 72 pin connector mounted on the bottom of the circuit board. Note that this is a 72 pin connector mounted on a 74 pin footprint. Pin 1 is connected at pin 1, so pins 73 and 74 are not connected to the Pixelworks board. The pinout of this connector is shown in the schematics. In normal use, the +5V power supply is provided through this connector from the Pixelworks board. Control signals from the Pixelworks scaler and data and timing signals output by the ADCS9888 are also transferred through JP1.

The USB connector, J2 is provided for communications with the ADCS9888 when the adapter board is used standalone, without the Pixelworks evaluation system. Pinout is standard for a USB device connector.

A number of shorting jacks are present on the board as follows:

- J1 – Pin 1 is 3.3V from U4, Pin 2 is AVDD bus to U2, Pin 3 is Ground.
- JP2 – Connects SDA bus to U7 EEPROM for Cypress USB.
- JP3 – Test points for SDA and SCL from U6.
- JP4 – Connects U6 SCL to U2.
- JP5 – Connects U6 SDA to U2.
- JP6 – Connects JP1 SCL to U2.
- JP7 – Connects JP1 SDA to U2.

Two types of test points are present on the board, several larger ground points are present at the following points:

- TP15 – Ground Plane
- TP16 – Ground Plane
- TP17 – Ground Plane
- TP18 – Ground Plane

PVDD is available at TP1, AVDD is available at TP5, and V33 is available at TP14.

A number of small test pads are available as follows:

- TP2 – GHS (SOGOUT)
- TP3 – GBLKSPL (CLAMP)
- TP4 – GVS (VSOUT)
- TP6 – GCOAST (COAST)
- TP7 – GCLK (DATAACK)
- TP8 – GHSFOUT (CKINV)
- TP9 – GFBK (HSOUT)
- TP10 – GREF (NC)
- TP11 – GSOG (NC)
- TP12 – GHDREN (NC)
- TP13 – GPEN (NC)

### 3.2 Circuit Description

The primary signal interfaces to the adapter board are the connector mating it to the Pixelworks evaluation board, and the signal input connector. JP1 provides the +5V power supply source. This voltage is regulated by three separate LM1117 devices to provide the V33, AVDD and PVDD power supplies for the ADCS9888 and other circuitry. Three separate regulators are used to provide the best isolation between the supplies for the analog circuitry, digital outputs, and the PLL/VCO. Jumper J1 allows the user to connect the supply for the digital outputs to either the built in 3.3V regulator, or an external source at a lower voltage. This could be used if you wish to connect the adapter board to a different scaler board that requires a lower output voltage swing from the ADCS9888. JP1 also provides the serial configuration

The video input signal is connected at the VGA connector P1. Connections are provided for all typical input signals, Red Green and Blue video, as well as the digital synchronizing signals HSYNC and VSYNC. When using a component video signal with analog composite synchronizing signals, the HSYNC and VSYNC inputs can either be floated or connected to Ground. This connector also provides serial data and serial clock connections to an EEPROM for plug and play monitor connectivity. A USB interface is included on this board, but is not used in conjunction with the Pixelworks evaluation system.

### 3.3 Connection Table

<b>Connector Label</b>	<b>Pin Number</b>	<b>Description</b>
P1	n/a	Connect to video signal
JP1	n/a	Connect to Pixelworks evaluation board or other power/interface board
J2	n/a	USB connector to host PC for stand-alone operation

## 4.0 Setup / Installation and Operation

### Installing the ADCS9888 Evaluation Adapter Board

(For use without a Pixelworks demo platform, please refer to Section 5.0 Stand-Alone Operation.)

The adapter board receives power and control signals from header JP1 that is connected to the corresponding connector JP1 on the Pixelworks evaluation board. Input video signals are applied at connector P1. Video signal generators, or computer video sources can be used. Standard VGA video cables can be used with computer video sources but one should make sure that the cable has the required bandwidth and quality for the signals being used. Adapter cables with BNC connectors on one end, and 15 pin D-sub connectors on the other are available for use with signal generators or other component video sources.

A mounting hole is provided on the adapter board that will allow fastening the board to the Pixelworks adapter system for more permanent and robust usage.

The adapter board should be carefully connected to the Pixelworks evaluation board. Caution and proper ESD control procedures should be used when handling and connecting the board. Then the input signal cable can be connected. After ensuring that all connections are correct, the Pixelworks evaluation system can be turned on. (Please refer to the Pixelworks documentation for details regarding operation of the evaluation system.) Different video formats can be input to the system. As the video mode is changed, the system should auto-detect that the mode has been changed and configure for the new mode. The IR remote control can be used to adjust system parameters through the Pixelworks On Screen Display (OSD). The most important adjustments can be located in the “picture” menu. Under this menu, the following adjustments are available:

- brightness
- contrast
- h position
- v position
- phase
- frequency
- scaling

The most frequently adjusted settings are “frequency” and “phase”. Frequency adjusts the ADCS9888 PLL

clock divider setting, while the “phase” adjusts the sample phase adjust setting. These are both key parameters to accurate sampling of the incoming video waveform.

The PLL clock divider must be set correctly so that the number of ADC samples is equal to the number of pixel periods output by the video source. If these are not equal, the sampled video will display an interference pattern as the sampling phase varies across the screen. The sample phase adjust should be set to the optimum value that results in the ADC sample point occurring during the most stable (lowest slope) portion of the video signal.

The next most frequently adjusted setting is the h position. If the auto-detect done by the Pixelworks scaler is not perfect, the frequency, sample phase or horizontal position may not be set to the correct setting. After the frequency and phase settings are optimized, the “h position” should be adjusted until the image is centered on the screen. Adjustment of the “v position” is rarely required, but if needed, it can be varied until the image is vertically centered on the screen.

Other settings that may need to be adjusted are the brightness and contrast. The “brightness” adjustment changes the ADCS9888 Offset register values. The “contrast” adjustment changes the ADCS9888 Gain register values.

Lastly, the “scaling” setting can be changed to select different modes of image scaling from the Pixelworks scaler device. For most usage this should be set to “one to one”, this forces the scaler to not do any scaling. In this mode, the displayed image is always an accurate representation of the output data of the ADC. If other settings are used, the displayed image may contain scaling artifacts that are not present in the raw data, especially when input signals are at a different image resolution than the output display device.

The Pixelworks debug software PWDebugEval.exe can be used to inspect the ADCS9888 register values, and to make some changes to register values. Unfortunately, if changes are made that effect the system too much, the Pixelworks scaler may redo the auto-detect and will wipe out any register changes.

Please refer to the Pixelworks evaluation system documentation for details regarding the operation of PWDebugEval.

## 5.0 Stand-alone Operation

The board can be used in stand-alone mode using a logic analyzer or other device to capture the output data. In this mode, register settings are configured using the on-board USB micro-controller and “SensorEval” software installed on a Windows host computer.

### 5.1 Interface Connector

The main 72 pin connector (first 72 pins of the 74 pin connector on the schematic) should be used to input power (+5V DC) and output all timing and data signals. It can also be used for serial communication signals to configure the ADCS9888 register settings if a suitable master device is connected.

An adapter header (SAMTEC p/n:HTMS-136-02-S-D, see <http://www.samtec.com>) is provided with the evaluation board. A circuit board can be designed using this connector to adapt the signals to the target scaler or ASIC used. Refer to the schematics later in this document for the pinout of the connector and other details of the evaluation board. Schematics in Orcad electronic format are available upon request.

### 5.2 Software Installation and Operation

Please refer to the “National Sensor Evaluation (SensorEval) 1.01 (or later) Software Users Guide”.

Once +5V power is applied to the board through the 72 pin connector, the USB cable can be connected and the SensorEval software can be launched.

When selecting the device, choose the “adcs9888”. The I2C address of the evaluation board is 4d. Ensure that this address is set correctly in the software for proper operation.

Refer to the ADCS9888 datasheet for register definitions and recommended settings for different video modes.

Several example register files are included in the adcs9888 folder. These give settings for a number of common video modes. The naming convention is as follows:

adcs9888\_XXYY\_OPT.dat

- XX is the horizontal resolution abbreviation (eg. 06 is 640x480, 08 is 800x600, etc.)
- YY is the refresh rate in Hz
- OPT provides additional details regarding the source of the standard.

These register files can be loaded using the File>Open Reg menu item.

Video signals should be applied through the D-Subminiature connector P1. If the registers have been set correctly for the video signal input, the ADCS9888 PLL will lock and output timing/data will be stable. The output data can be captured using a logic analyzer. The DATAACK outputs can be used to clock the DATA outputs in to the analyzer. HSOUT and VSOUT can be used as triggers to align the data captured to the video source line and frame.

## 6.0 Electrical Specifications

### 6.1 Electrical Specifications

#### Power Requirements

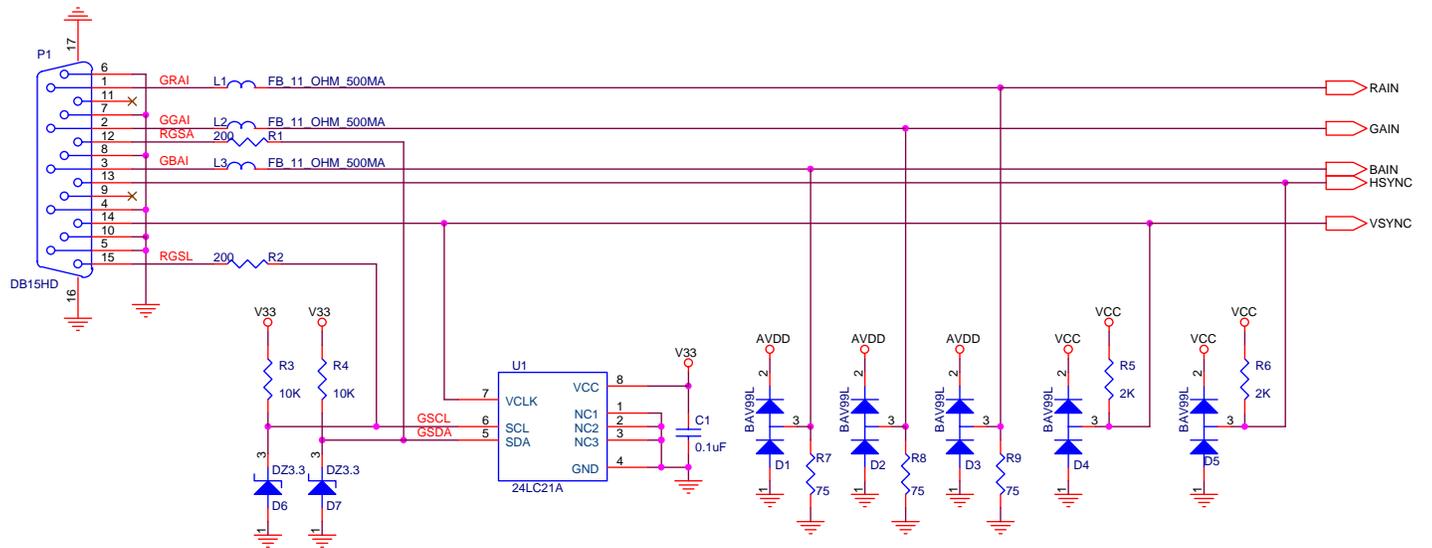
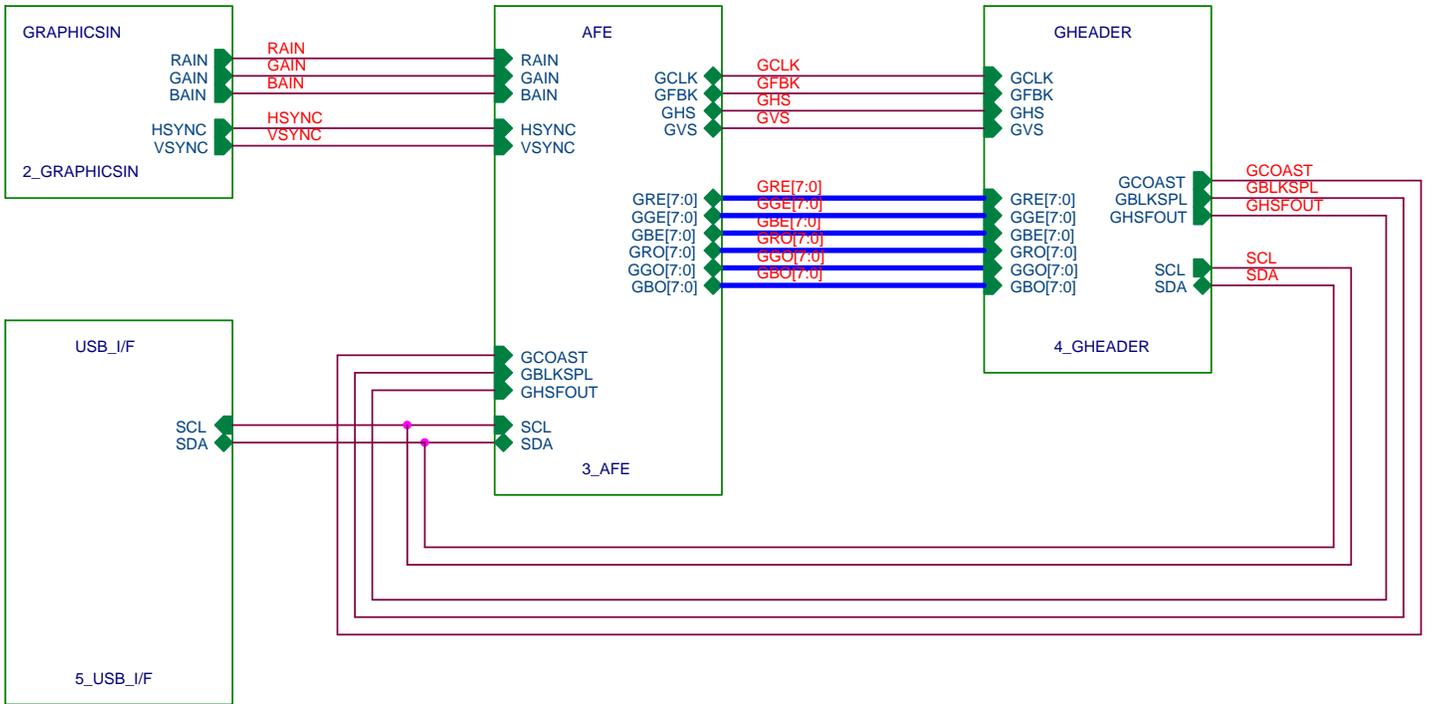
VCC	+5.0 ± 0.1 V, 350 mA max.
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#### Analog Input

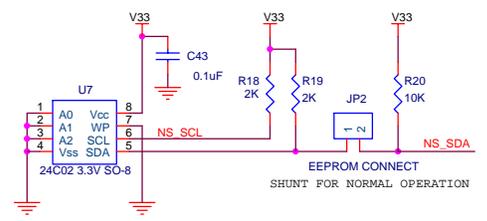
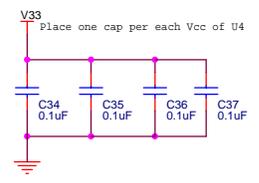
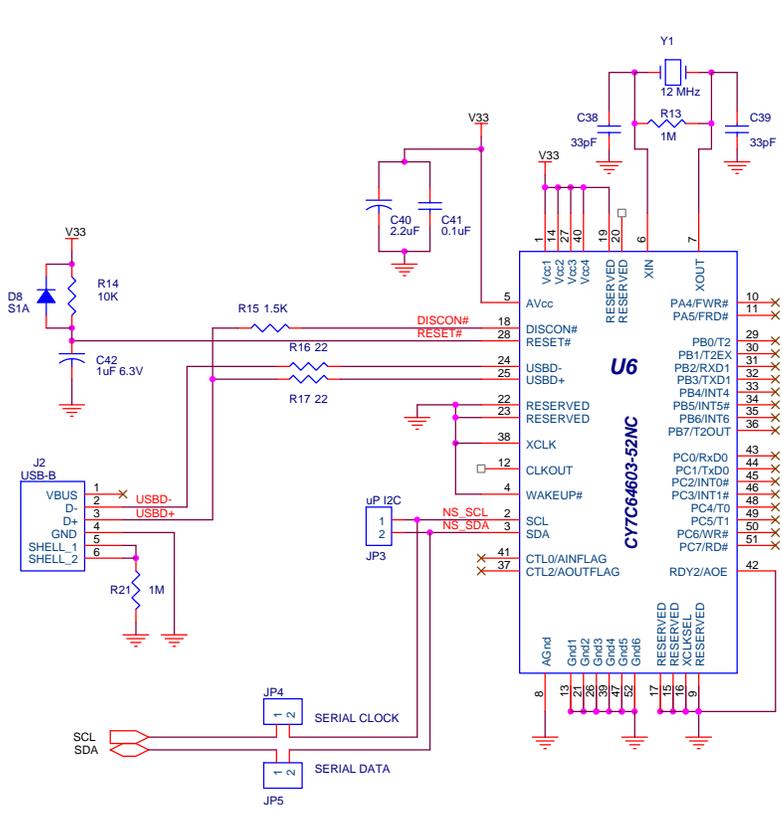
Nominal Voltage:	0.7 V <sub>p-p</sub> RGB or YPbPr (1.0 V <sub>p-p</sub> including sync.)
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Impedance:	75 Ohms
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## 6.2 Electrical Schematic

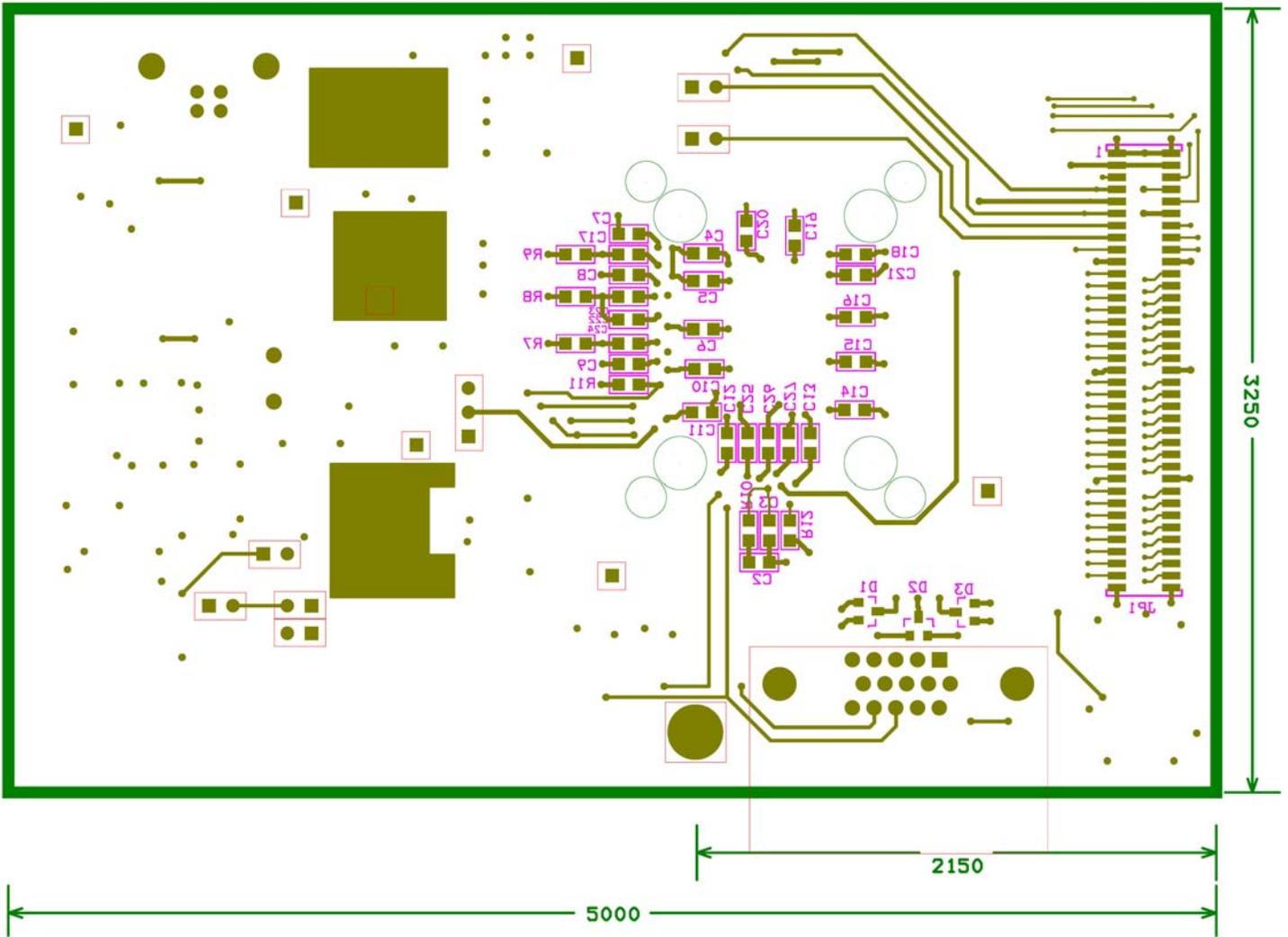




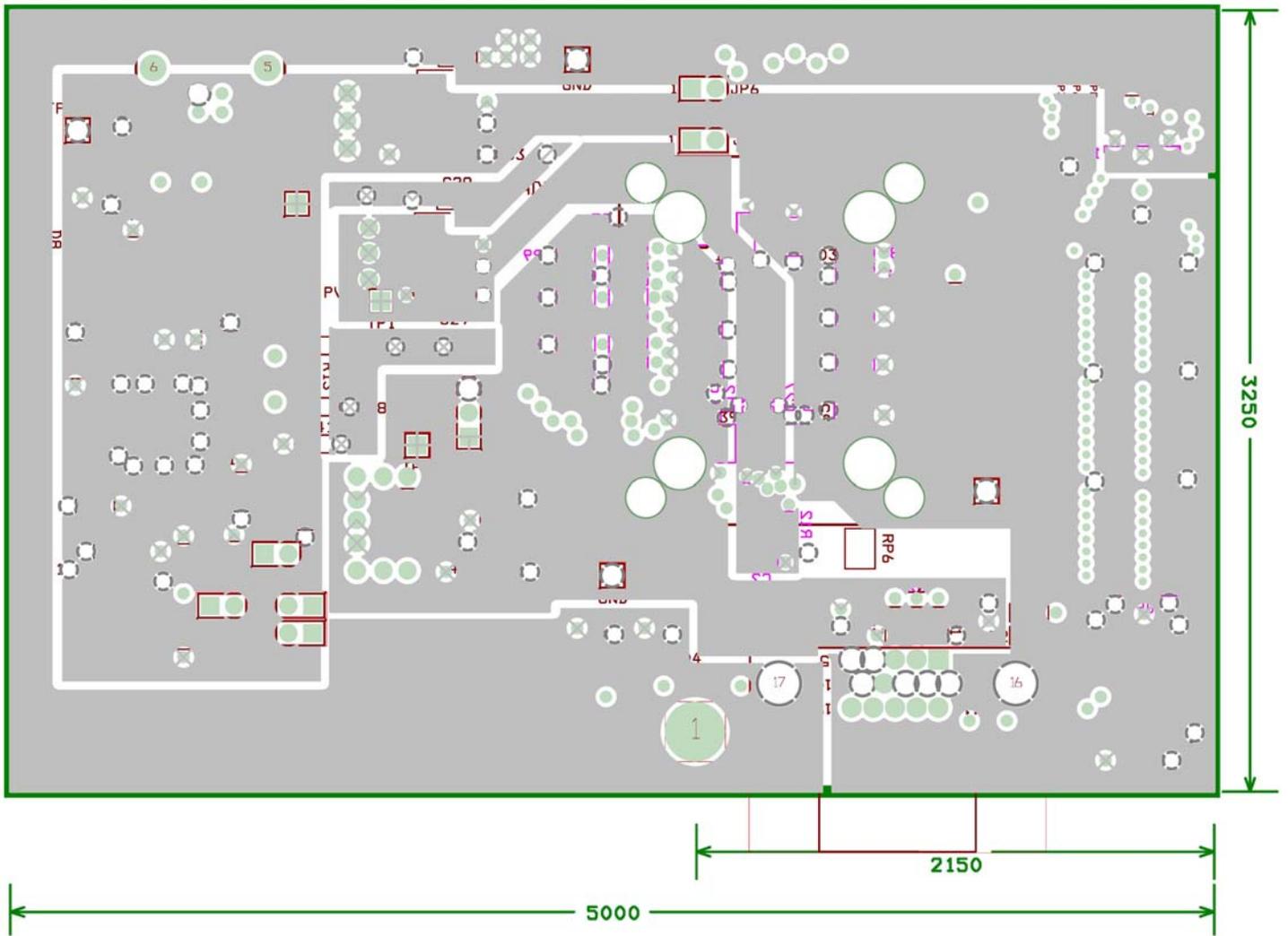




Bottom View



# Power Planes



## 6.4 Bill of Materials

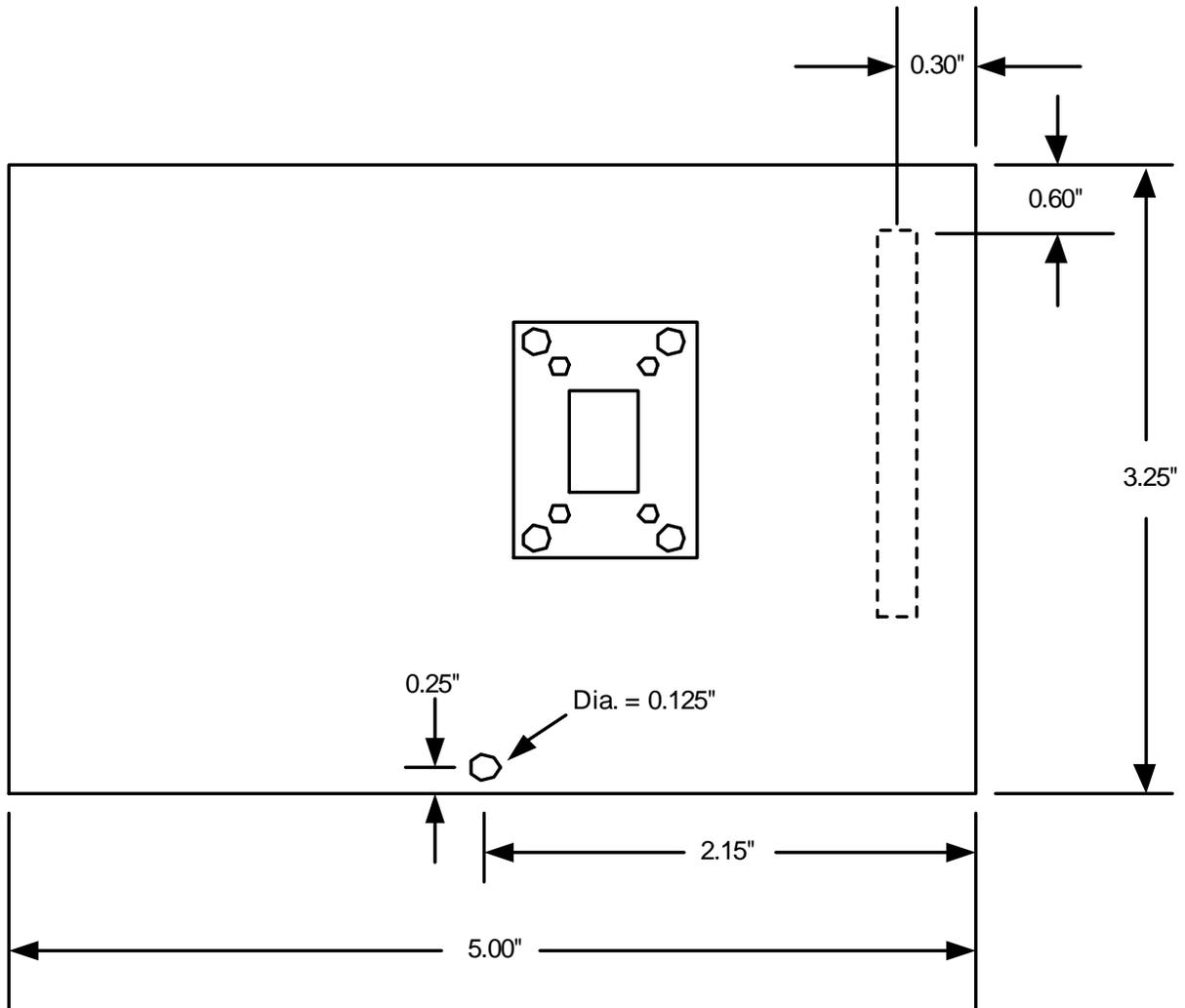
Part	Description	Manufacturer/Supplier	Part_Number
0.1uF			
	0.1uF,10%,16V,0805,X7R_Ceramic_Capacitor	DIGIKEY	PCC1812CT-ND
39nF	39000pF,10%,50V,0805,X7R_Ceramic_Capacitor	DIGIKEY	PCC1835CT-ND
3.9nF	3900pF,10%,50V,0805,X7R_Ceramic_Capacitor	DIGIKEY	PCC392BNCT-ND
47nF	0.047uF, 10%, 16V, 0805, X7R Ceramic Capacitor	DIGIKEY	PCC1836CT-ND
1nF	1000pF, 10%, 50V, 0805, X7R Ceramic Capacitor	DIGIKEY	PCC102BNCT-ND
22uF	22uF,20%,6V,B-size_Tantalum_Capacitor	DIGIKEY	PCS1226CT-ND
33pF	33pF, 5%, NPO, 0805, 50V	DIGIKEY	PCC330CGCT-ND
2.2uF	2.2uF,10V TANTALUM SMT	DIGIKEY	PCS2225CT-ND
1uF 6.3V	1uF 16V TANTALUM SMT	DIGIKEY	PCS3105CT-ND
BAV99L	Dual switching diode	Philips	BAV99 T/R
DZ3.3	3.3V Zener Diode, SOT-23	Motorola	MMBZ5226BLT
S1A	Surface Mount Rectifier Diode 50V, 1A	Fairchild	S1A
RECEPT_36X2	72-pin 0.05 by 0.1-inch SMT pitch recept	Samtec	RSM-136-02-L-D
2 PIN JUMPER	2 pin, 0.1" spacing jumper header	Any	Any
3 PIN JUMPER	3 pin, 0.1" spacing jumper header	Any	Any
USB-B	USB, PCB Mount B Type right angle connector		
FB_11_OHM_500MA	Ferrite Bead,0805,11_Ohm,500mA	Steward	LI0805E110R
DB15HD	15-pin, Right Angle, VESA DSUB Connector	DIGIKEY	815RF-ND
101R	R-PACK, 16 PIN, 8 IND 100 OHM	DIGIKEY	742C163101JCT-ND
200	200-Ohm,5%,0805,ThickFilmResistor	DIGIKEY	P200ACT-ND
10K	10-kOhm,5%,0805,ThickFilmResistor	DIGIKEY	P10KACT-ND
2K	2.0-kOhm,5%,0805,ThickFilmResistor	DIGIKEY	P2.0KACT-ND
75	75-Ohm,5%,0805,ThickFilmResistor	DIGIKEY	P75ACT-ND
3.3K	3.3-kOhm,1%,0805,ThickFilmResistor	DIGIKEY	P3.32KCCT-ND
4K7	4.7-kOhm,5%,0805,ThickFilmResistor	DIGIKEY	P4.7KACT-ND
1M	1.0-MOhm,5%,0805,ThickFilmResistor	DIGIKEY	P1.0MACT-ND
1.5K	1.5-kOhm,5%,0805,ThickFilmResistor	DIGIKEY	P1.5KACT-ND
22	22-Ohm,5%,0805,ThickFilmResistor	DIGIKEY	P22.0ACT-ND
TP	N/A	N/A	N/A
24LC21A	VESA DDC EEPROM, 8-pin SOIC	Microchip	24LC21A/SN
ADCS9888	VIDEO AFE, 8 Bit, 205 MSPS	National Semiconductor	ADCS9888CCVH
LM1117-3.3 SOT-223	LM1117 3.3V SOT-223	National Semiconductor	
CY7C64603-52NC	CY7C64603-52NC	Cypress Semiconductor	
24C02 3.3V SO-8	AT24C02-10PC-2.7	Microchip	
12 MHz	12 MHz HC-49US (SHORT CAN)	Citizen	HC49US12.000MABJ

## 7.0 Mechanical Specifications

### 7.1 Operating Mechanical and Environmental Specifications

	Minimum	Typical	Maximum
Temperature	5 degrees C	25 degrees C	45 degrees C
Humidity	5 % RH	45 % RH	85 % RH
Pressure		101 kPa	

### 7.2 Evaluation Board Basic Dimensions



### 6.4.3 Electrostatic Discharge (ESD) Precautions

The user shall use ESD precautions as specified in National Semiconductor ESD control document (SC)CSI-3-038 available through [www.national.com](http://www.national.com).

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