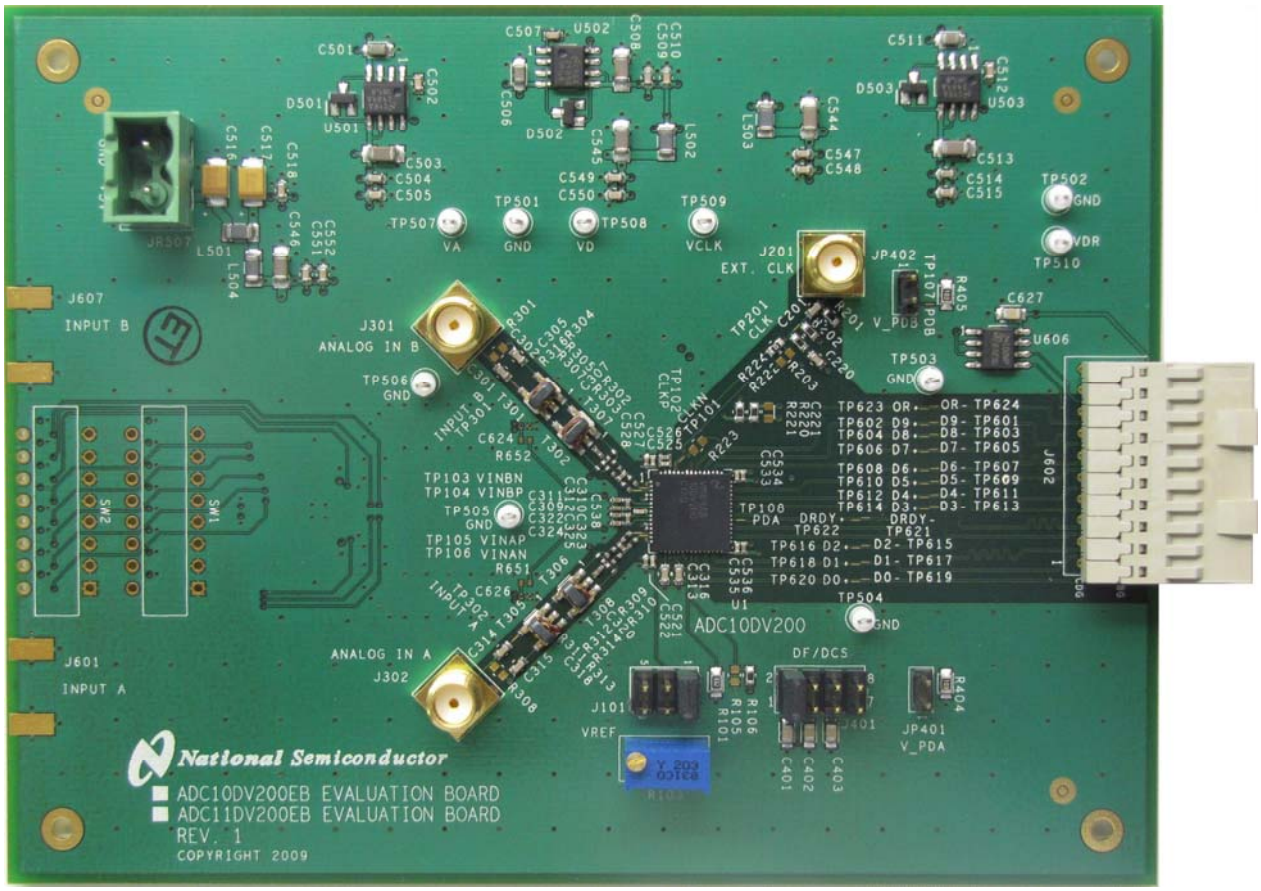
National Semiconductor

June 2009
Rev 0.9

Evaluation Board User's Guide

ADC10DV200, 10-Bit, 200 Msps A/D Converter

ADC11DV200, 11-Bit, 200 Msps A/D Converter



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1.0 Introduction

This Evaluation Board may be used to evaluate the ADC10DV200, or ADC11DV200. The ADC is one of a family of 10 and 11 bit converters that provides data at rates of up to 200MHz. Further reference in this manual to the ADC10DV200 is meant to also include the other listed parts unless otherwise specified

The evaluation board is designed to be used with the WaveVision5™ Data Capture Board which is connected to a personal computer through a USB port and running WaveVision5™ software, operating under Microsoft Windows. The software can perform an FFT on the captured data upon command and, in addition to a frequency domain plot, shows dynamic performance in the form of SNR, SINAD, THD and SFDR. The latest WaveVision hardware and software is available through the National Semiconductor website: http://www.national.com/store/view_item/index.html?nsid=WAVEVSN+BRD+5.1

2.0 Board Assembly

The ADC10DV200 Evaluation Board comes pre-assembled. Refer to the Bill of Materials in *Section 8* for a description of components, to *Figure 1* for major component placement and to *Section 6* for the Evaluation Board schematic.

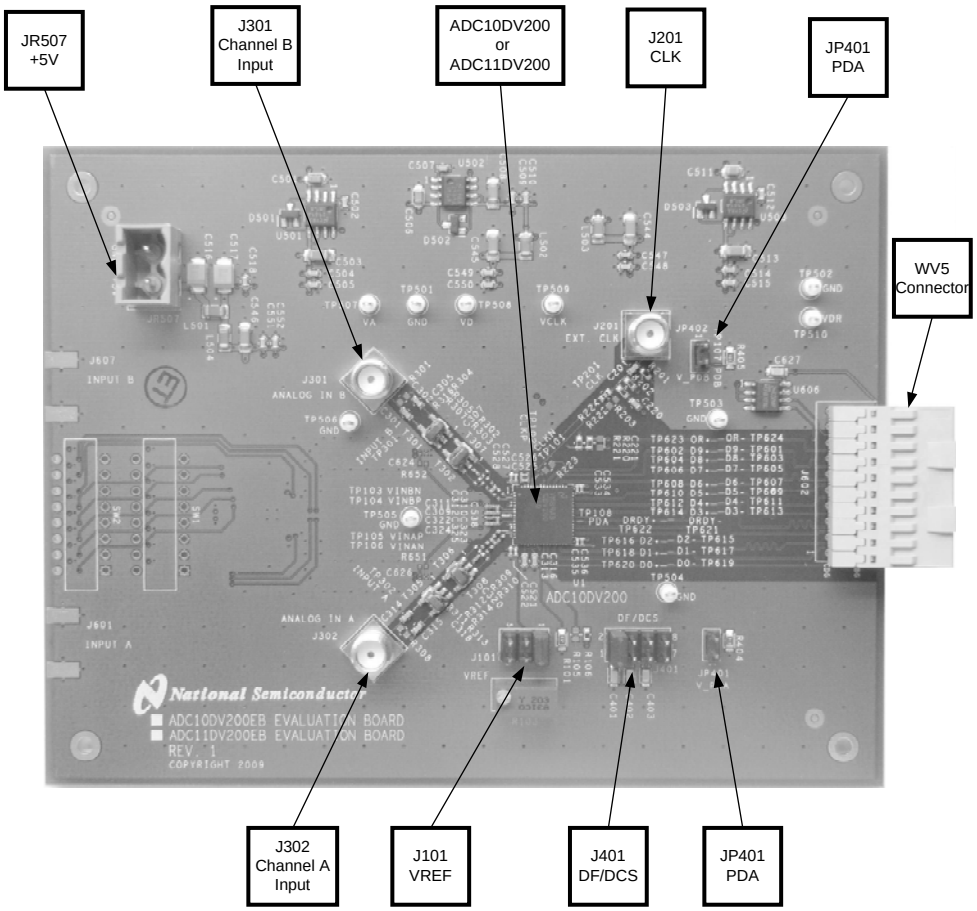


Figure 1. Major Component and Jumper Locations

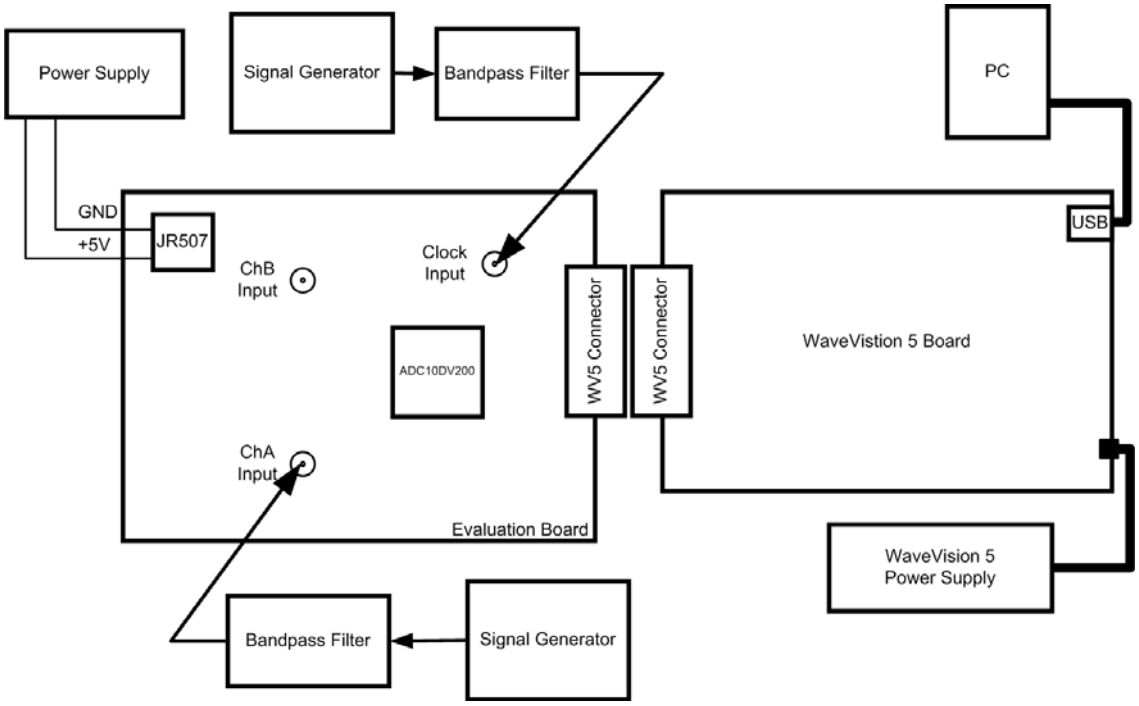


Figure 2. Test Set up

3.0 Quick Start

Refer to *Figure 1* for locations of jumpers, test points and major components. Refer to *Figure 2* for the test set up. The board is configured by default to use a external clock source and internal reference. Refer to Section 4.0 and the Appendix for more information on jumper settings. The input network of this board is configured for input frequencies greater than 70MHz. Refer to Section 4.1 for more information about input networks.

You must have version 5.0 or later of the WaveVision™ software to properly test this board. You can download the latest version from:
http://www.national.com/analog/adc/wavevision5

1. Apply power to the WaveVision5™ board and connect it to the computer using a USB cable. See the WaveVision5™ Board Manual for operation of that board. Connect the evaluation board to the WaveVision™ Digital Interface Board.
2. Connect a clean +5V power supply to pin 2 of Power Connector JR507. Pin 1 is ground.
3. Connect a signal from a 50-Ohm source to connector J301 or J302. Be sure to use a bandpass filter before the Evaluation Board.
4. Adjust the input signal amplitude as needed to ensure that the signal does not over-range by examinining a histogram of the output data with the WaveVision5™ software.

4.0 Functional Description

The ADC10DV200 Evaluation Board schematic is shown in *Section 6.* A list of test points and jumper settings can be found in the Appendix.

4.1 Analog Input

To obtain the best distortion results the analog input network must be optimized for the signal frequency being applied. The ADC10DV200 Evaluation Board comes configured as seen in *Figure 3*.

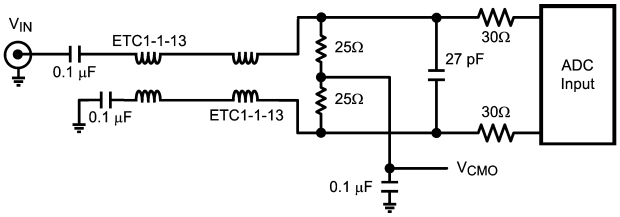


Figure 3. Analog Input Network for F_{IN} > 70MHz

The input network is intended to accept a low-noise sine wave and will perform well over a wide input frequency range. To accurately evaluate the dynamic performance of this converter, the input test signal will have to be passed through a high-quality bandpass filter.

Input signals can also be amplified using an onboard LMH6517 DVGA (U601). To use the DVGA, some components must be installed and some removed. The following components must be installed: R651-R656. The following components must be removed: R302, R303, R309, and R310. Then connect signals from a 50-Ohm source to connectors J601 and J607.

4.2 ADC reference circuitry

The ADC10DV200 can use an internal or external voltage reference. The internal reference is selectable between a 0.75V or 0.5V reference. External references can be set from 0.2V to 1.4V. This Evaluation Board is configured to use the internal 0.75V reference.

4.3 ADC clock circuit

Components can be installed or removed to select the path of the clock to the ADC. While not as convenient as pin-type jumpers, these introduce less distortion into the clock signal.

Care must be taken to provide a high quality low jitter clock source. A single ended input clock can be buffered by U203 (NC7SV125) and applied to the ADC's clock input pin. Or U203 can be bypassed and the input clock pin driven directly.

A differential clock can also be applied to the ADC's clock input pins through U201 (ETC-1-13).

Refer to Appendix A to configure the clock for your application. The Evaluation Board is configured by default to use a single ended clock to drive the input pins directly.

4.4 Digital Data Output

The LVDS digital output data is available for probing at test points TP601 through TP624. The signals are also available at the WaveVision™ (WV5) connector J602.

4.5 Data Format/ Duty Cycle Stabilizer

Output data format and the duty cycle stabilizer (DCS) are controlled by jumper J401.
Shorting pins 1-2 of J401 sets the output format to offset binary with DCS On. This is the default setting.
Shorting pins 3-4 of J401 sets the output format to 2's complement with DCS Off.
Shorting pins 5-6 of J401 sets the output format to offset binary with DCS Off.
Shorting pins 7-8 of J401 sets the output format to 2's complement with DCS On.

4.6 Power Supply Connections

Power to this board is supplied through power connector J507. The only supply needed is +5V at pin 2 plus ground at pin 1.

Voltage and current requirements for the ADC10DV200 Evaluation Board are:

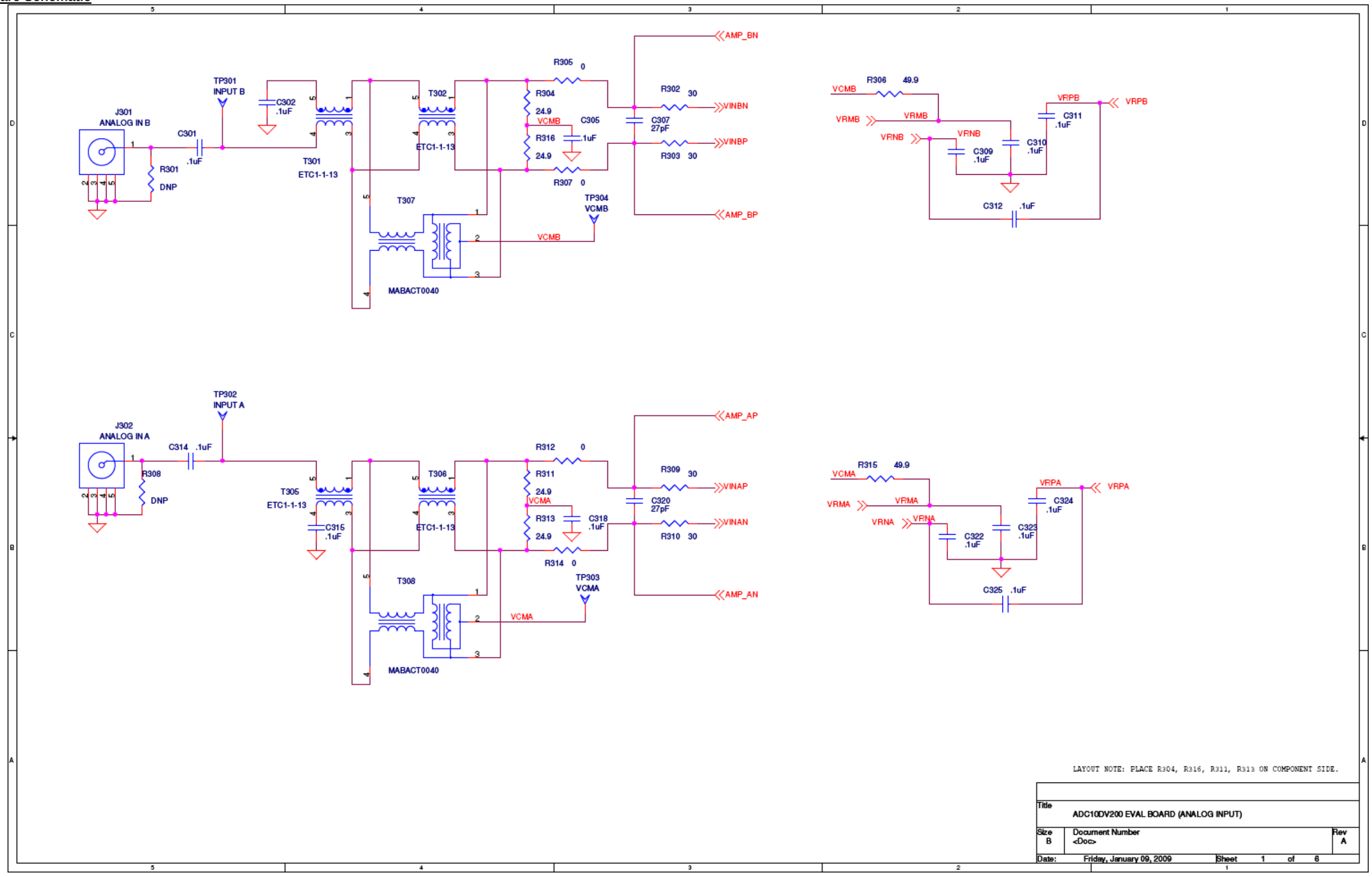
- +5.0V at 500 mA

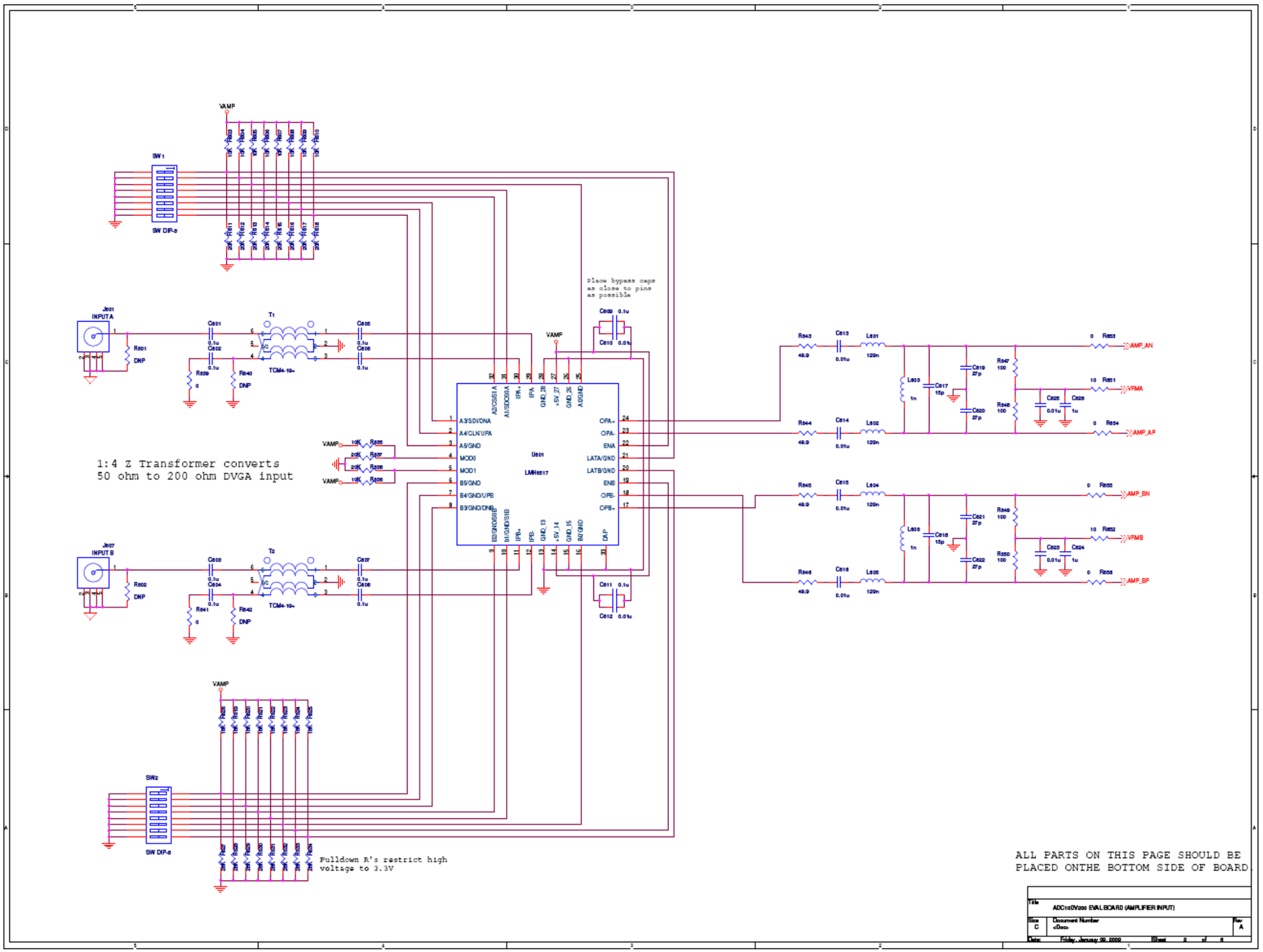
5.0 Installing the ADC10DV200 Evaluation Board

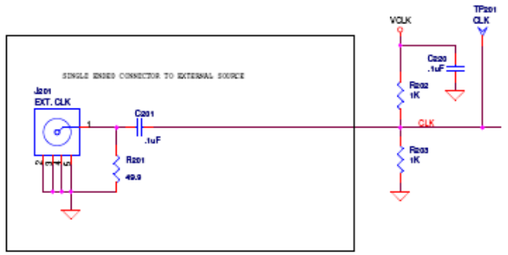
The evaluation board requires power supplies as described in *Section 4.6*. An appropriate signal source should be connected to the Signal Input SMA connectors J301 or J302. When evaluating dynamic performance, an appropriate signal generator (such as the HP8644B or the R&S SME-03) with 50 Ohm source impedance should be connected to the Analog Input connector through an appropriate bandpass filter as even the best signal generator available can not produce a signal pure enough to evaluate the dynamic performance of an ADC.

If this board is used in conjunction with the WaveVision5™ Data Capture Board and WaveVision5™ software, a USB must be connected between the Data Capture Board Board and the host. See the WaveVision5™ Data Capture Board manual for details.

6.0 Hardware Schematic




1:4 Z Transformer converts
50 ohm to 200 ohm DVGA input
Place bypass caps as close to pins as possible
Pulldown R's restrict high voltage to 3.3V
ALL PARTS ON THIS PAGE SHOULD BE PLACED ONTHE BOTTOM SIDE OF BOARD.
ADC10DV200 EVAL BOARD (AMPLIFIER INPUT)
INPUT A
INPUT B
SW DIP-8
SW DIP-8
TCM4-19+
TCM4-19+
LMH6517
VAMP
AMP_AN
AMP_AP
AMP_BN
AMP_BP
VFMA
VFMB



CLOCK TERMINATION/DRIVER TO DUT (SELECT ONLY ONE OF THE THREE, A TO C, NOT MULTIPLES)

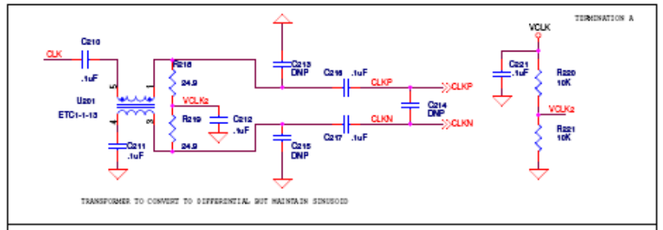
DIFFERENTIAL CLOCK

TO USE BALUN, APPLY C210, C214 AND C217. REMOVE R222, R223, R224, R225 AND JP204

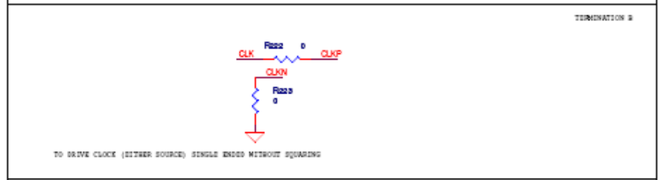
SINGLE ENDED CLOCK (IN BOTH TERMINATIONS B & C, POPULATE R223)

TO SEND THE SINGLE ENDED CLOCK TO THE PART DIRECTLY, POPULATE R222 AND R223.
REMOVE C210, C214, C217, R224, R225 AND JP204

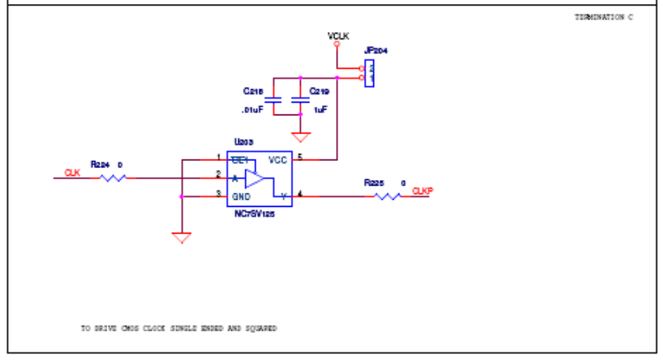
TO SEND A SQUARED SINGLE-ENDED CLOCK, POPULATE R223, R224, R225 AND JP204.
REMOVE C210, C214, C217 AND R222



TRANSFORMER TO CONVERT TO DIFFERENTIAL BUT MAINTAIN SINUSOID

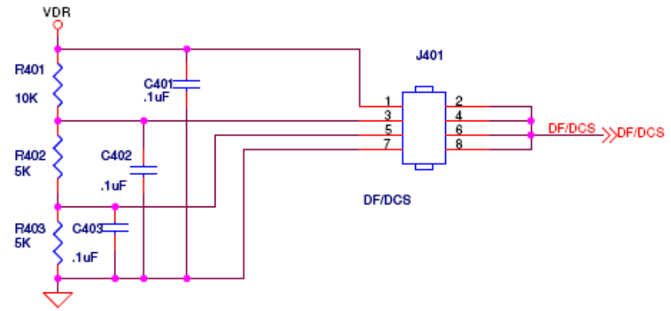


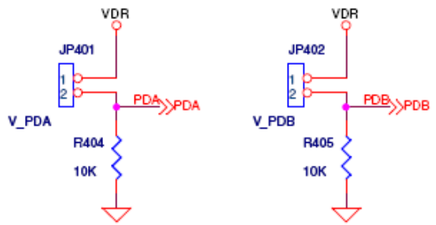
TO DRIVE CLOCK (EITHER SOURCE) SINGLE ENDED WITHOUT SQUARING

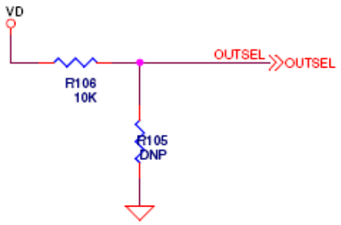


TO DRIVE CMOS CLOCK SINGLE ENDED AND SQUARED

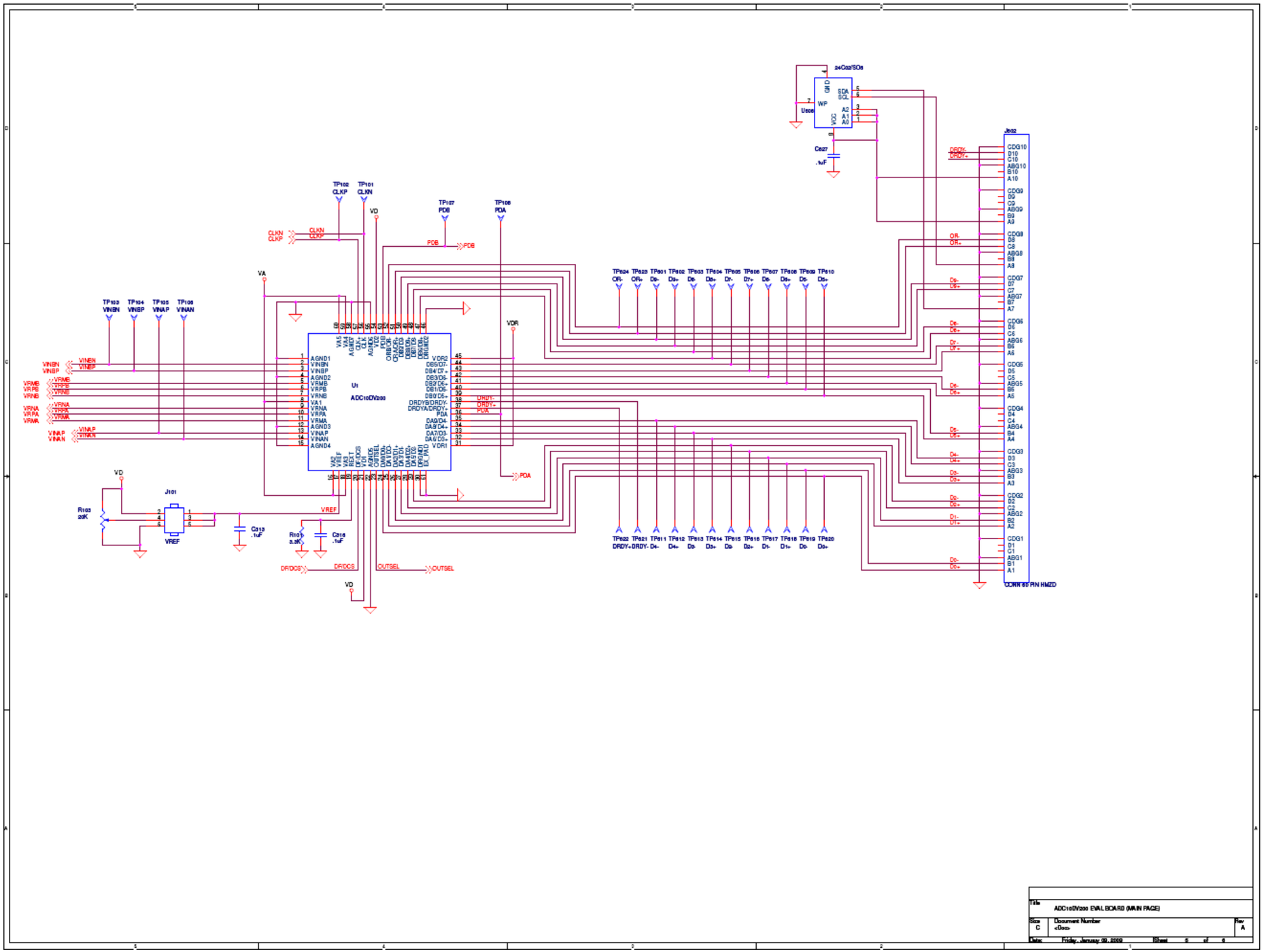
Title	ADC10DV200 EVAL BOARD (CLOCK INPUTS)	
Size C	Document Number <Doc>	Rev A
Date: Friday, January 02, 2009	Sheet 3 of 6	

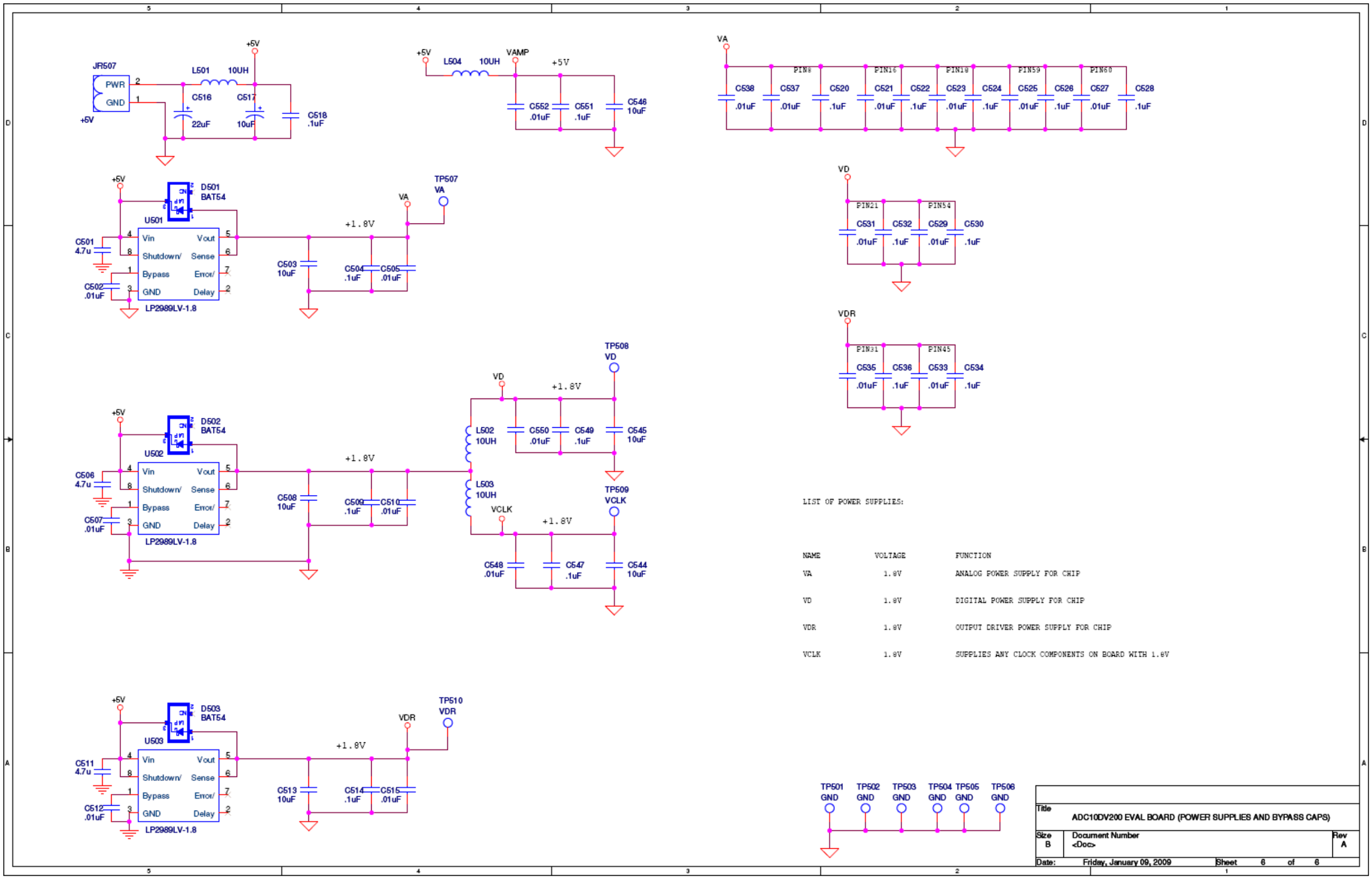




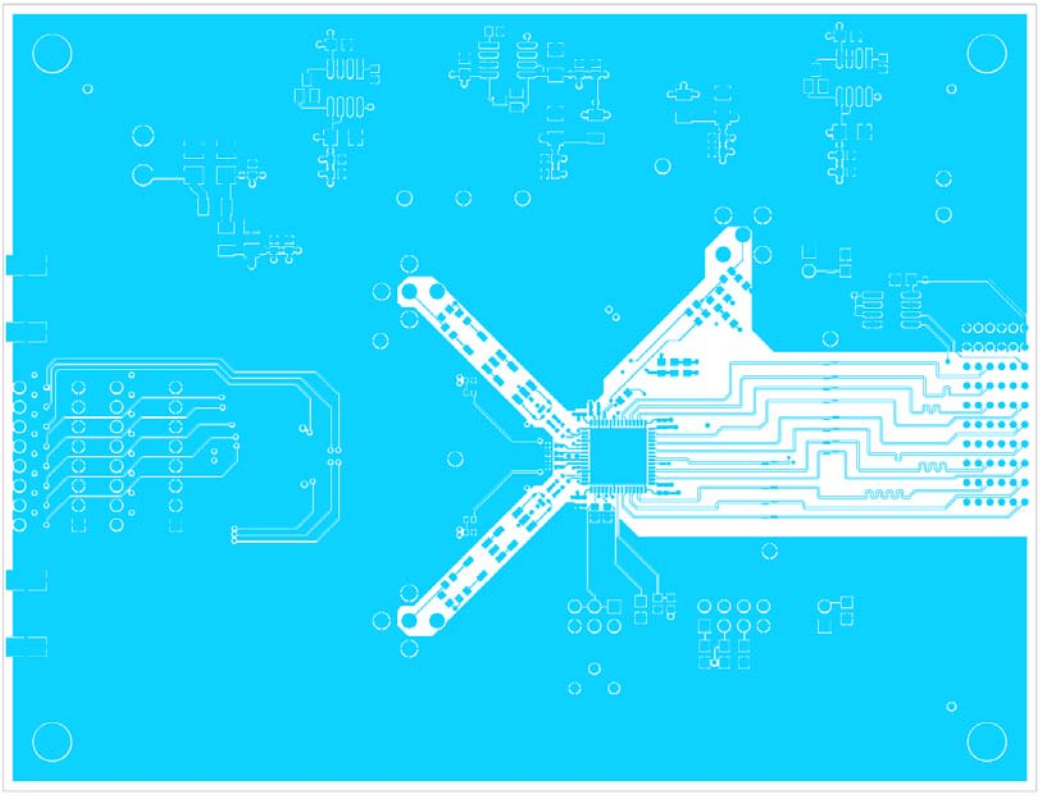


Title	ADC10DV200 (DIGITAL INPUTS)	
Size B	Document Number <Doc>	Rev A
Date: Friday, January 09, 2009	Sheet 4 of 6	

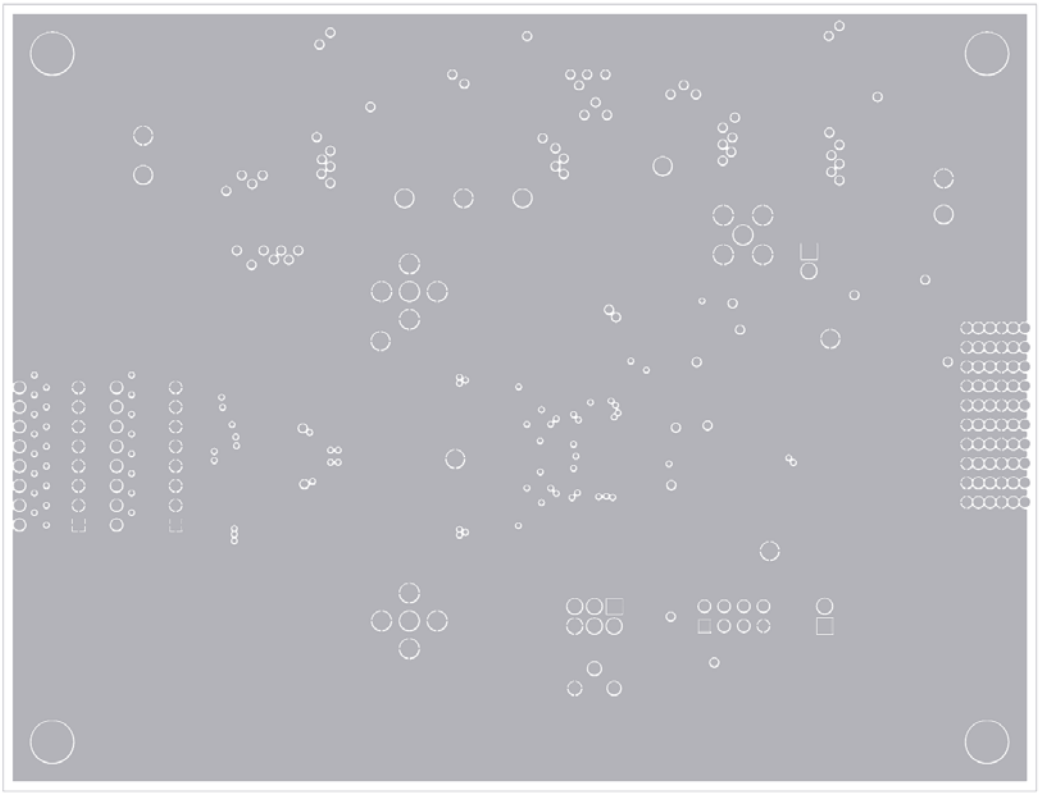

ADC10DV200
U1
J602
J101
VA
VD
VDR
VREF
VINBN
VINBP
VINAP
VINAN
VRMB
VRPB
VRNB
VRNA
VRPA
VRMA
CLKN
CLKP
PDB
PDA
OUTSEL
DRDCS
DRDYB/DRDY-
DRDYA/DRDY+
CONN 60 PIN HMZD
Title
ADC10DV200 EVAL BOARD (MAIN PAGE)
Size
C
Document Number
<Doc>
Rev
A
Date: Friday, January 09, 2009
Sheet 5 of 6


JR507
PWR
GND
+5V
L501 10UH
C516 22uF
C517 10uF
C518 .1uF
L504 10UH
VAMP
C552 .01uF
C551 .1uF
C546 10uF
VA
PIN8
PIN16
PIN19
PIN59
PIN60
C538 .01uF
C537 .01uF
C520 .1uF
C521 .01uF
C522 .1uF
C523 .01uF
C524 .1uF
C525 .01uF
C526 .1uF
C527 .01uF
C528 .1uF
VD
PIN21
PIN54
C531 .01uF
C532 .1uF
C529 .01uF
C530 .1uF
VDR
PIN31
PIN45
C535 .01uF
C536 .1uF
C533 .01uF
C534 .1uF
D501 BAT54
U501
Vin
Vout
Shutdown/
Sense
Bypass
Error/
GND
Delay
LP2989LV-1.8
C501 4.7u
C502 .01uF
C503 10uF
C504 .1uF
C505 .01uF
+1.8V
TP507
VA
D502 BAT54
U502
C506 4.7u
C507 .01uF
C508 10uF
C509 .1uF
C510 .01uF
L502 10UH
C550 .01uF
C549 .1uF
C545 10uF
TP508
VD
L503 10UH
VCLK
C548 .01uF
C547 .1uF
C544 10uF
TP509
VCLK
D503 BAT54
U503
C511 4.7u
C512 .01uF
C513 10uF
C514 .1uF
C515 .01uF
TP510
VDR
TP501 GND
TP502 GND
TP503 GND
TP504 GND
TP505 GND
TP506 GND
LIST OF POWER SUPPLIES:
NAME VOLTAGE FUNCTION
VA 1.8V ANALOG POWER SUPPLY FOR CHIP
VD 1.8V DIGITAL POWER SUPPLY FOR CHIP
VDR 1.8V OUTPUT DRIVER POWER SUPPLY FOR CHIP
VCLK 1.8V SUPPLIES ANY CLOCK COMPONENTS ON BOARD WITH 1.8V
Title
ADC10DV200 EVAL BOARD (POWER SUPPLIES AND BYPASS CAPS)
Size B
Document Number <Doc>
Rev A
Date: Friday, January 09, 2009
Sheet 6 of 6

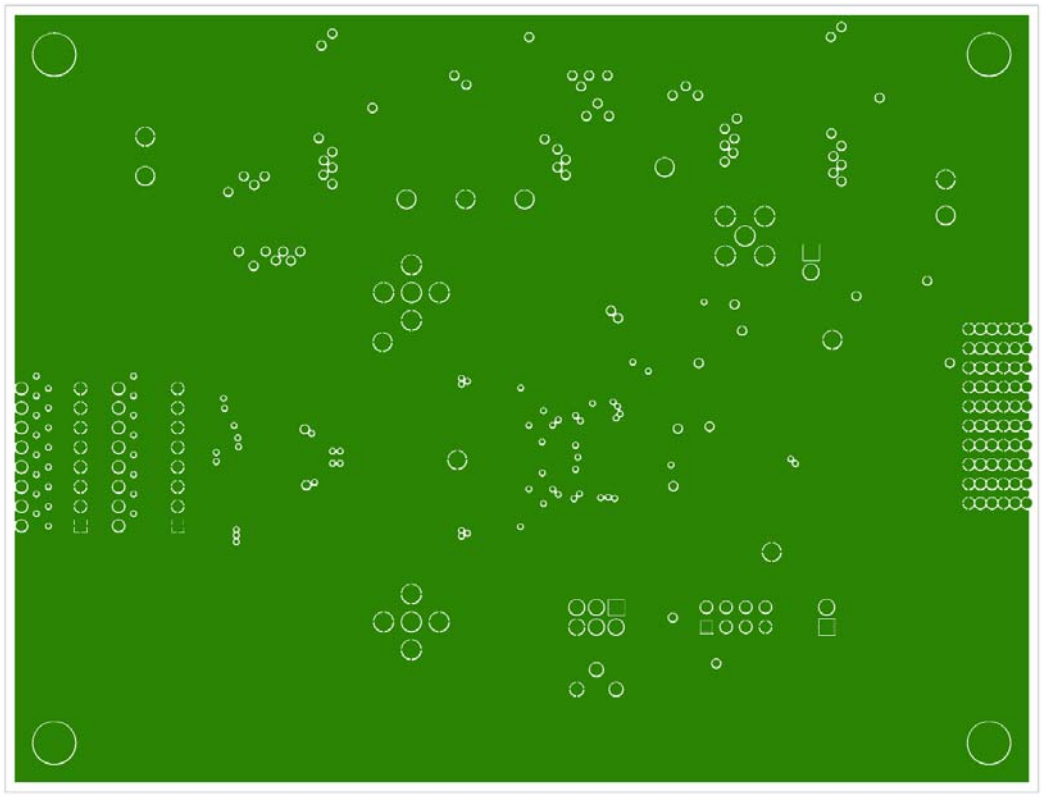
7.0 Evaluation Board Layout



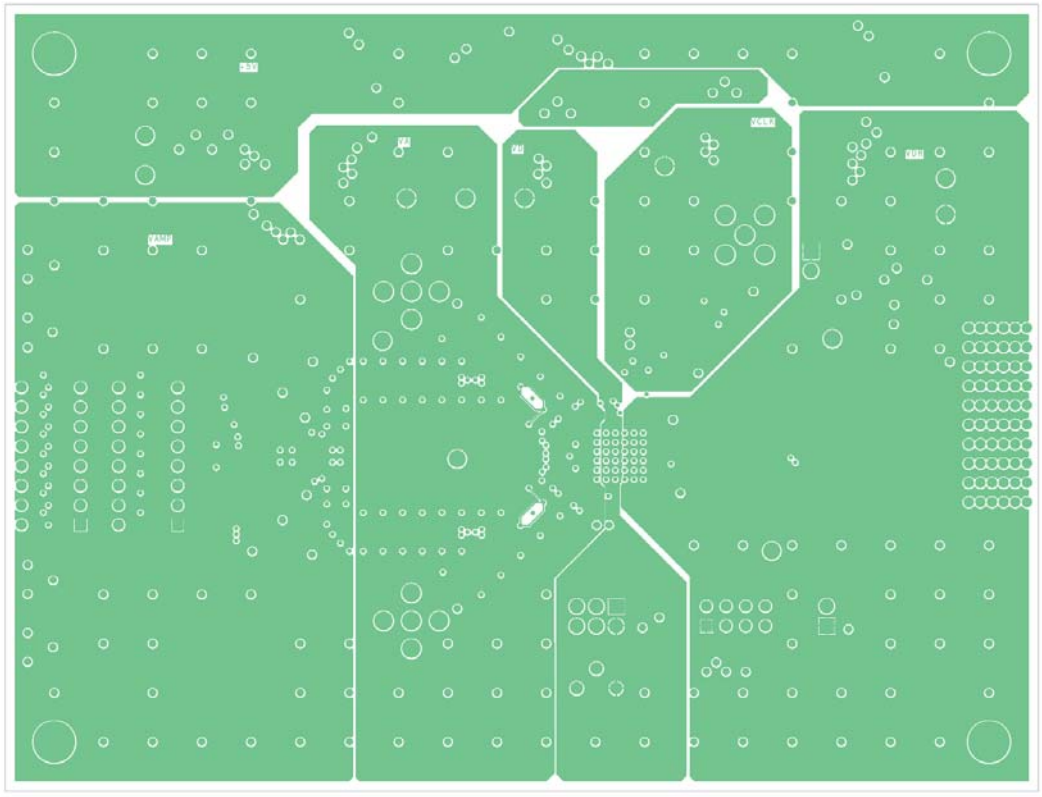
Layer 1 : Component Side



Layer 2 : Ground

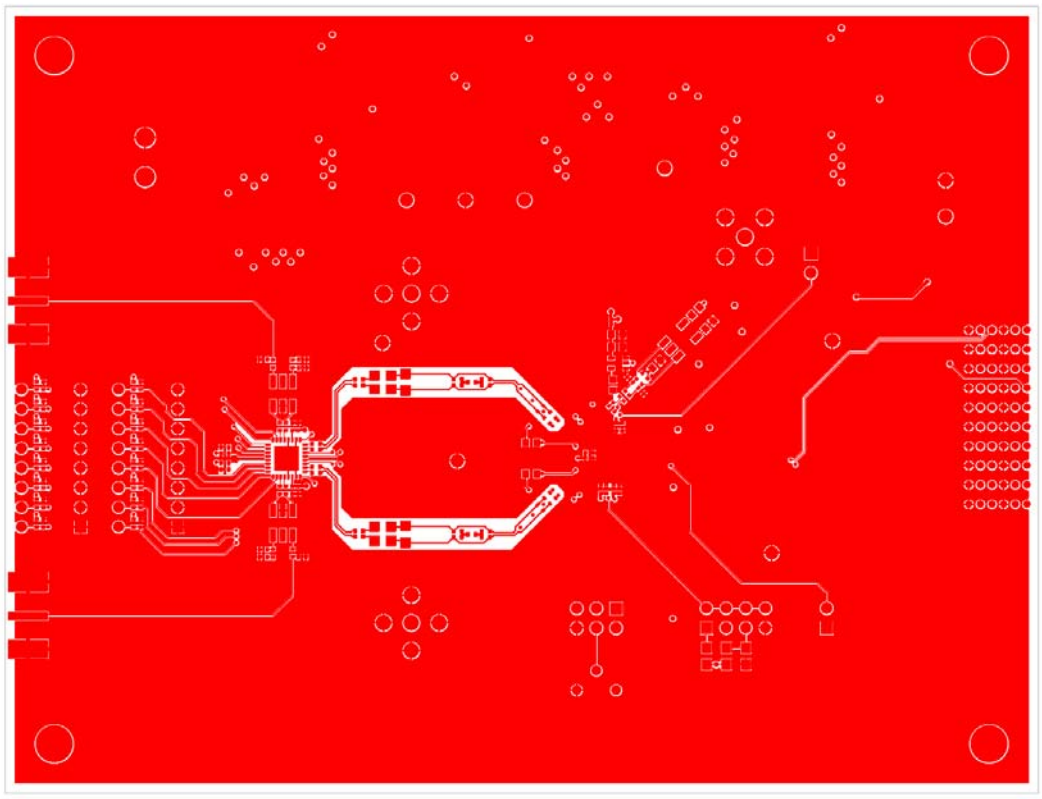


Layer 3 : Ground



Layer 4 : Power

Layer 5 : Ground



Layer 6 : Circuit Side

8.0 Evaluation Board Bill of Materials

Item	Qty	Reference	Part	Part Number	Vendor
1	15	C201,C220, C301,C302,C313,C314, C315,C316,C504,C509,C514, C518,C547,C549,C551	.1uF	PCC1762CT	Digi-Key
3	8	C305,C309,C311, C312,C318,C322,C324,C325,	.1uF	490-1318-1	Digi-Key
4	10	C218,C502,C505,C507,C510, C512,C515,C548,C550,C552	.01uF	PCC1784CT	Digi-Key
5	1	C219	1uF	PCC2224CT	Digi-Key
6	2	C307,C320	27pF	PCC270CQCT	Digi-Key
7	2	C310,C323	.1uF	PCC2336CT	Digi-Key
8	4	C401,C402,C403,C627	.1uF	PCC1828CT	Digi-Key
9	3	C501,C506,C511	4.7uF	PCC1842CT	Digi-Key
10	6	C503,C508,C513,C544,C545, C546	10uF	PCC1894CT	Digi-Key
11	1	C516	22uF	399-3717-1	Digi-Key
12	1	C517	10uF	399-3705-1	Digi-Key
13	9	C520,C522,C524,C526,C528, C530,C532,C534,C536	.1uF	PCC2146CT	Digi-Key
14	10	C521,C523,C525,C527,C529, C531,C533,C535,C537,C538	.01uF	PCC2270CT	Digi-Key
18	3	D501,D502,D503	BAT54	BAT54-FDICT	Digi-Key
19	1	JP204	HEADER 2	N/A	
20	1	JP401	V_PDA	S1011E-2	
21	1	JP402	V_PDB	S1011E-2	
22	1	JR507	+5V	277-1150	Digi-Key
23	1	J101	VREF	S2011E-3	
24	1	J201	EXT. CLK	ARFX1231	Digi-Key
25	1	J301	ANALOG IN B	ARFX1231	
26	1	J302	ANALOG IN A	ARFX1231	
27	1	J401	DF/DCS	S2011E-4	
29	1	J602	CONN 60 PIN HMZD	6469028-1	Digi-Key
31	4	L501,L502,L503,L504	10UH	490-1055-1	Digi-Key
34	1	R101	3.3K	311-3.3KARCT	Digi-Key
35	1	R103	20K	3296y-203LF	Digi-Key
37	1	R106	10K	311-10KGRCT	Digi-Key
38	1	R201	49.9	P49.9HCT	Digi-Key
39	2	R202,R203	1K	P1.00KHCT	Digi-Key
40	6	R218,R219,R304,R311,R313, R316	24.9	P24.9LCT	Digi-Key
41	2	R220,R221	10K	P10.0KHCT	Digi-Key
42	2	R224,R225	0	311-0.0GRCT	Digi-Key
43	4	R302,R303,R309,R310	30	311-30JRCT	Digi-Key
44	4	R305,R307,R312,R314	0	311-0.0JRCT	Digi-Key
45	2	R306,R315	49.9	311-49.9HRCT	Digi-Key

46	3	R401,R404,R405	10K	311-10KARCT	Digi-Key
47	2	R402,R403	5.1K	311-5.1KARCT	Digi-Key
70	6	TP501,TP502,TP503,TP504, TP505,TP506	GND	5002K	Digi-Key
71	1	TP507	VA	5002K	Digi-Key
72	1	TP508	VD	5002K	Digi-Key
73	1	TP509	VCLK	5002K	Digi-Key
74	1	TP510	VDR	5002K	Digi-Key
100	4	T301,T305,T302,T306	ETC1-1-13	ETC1-1-13	Richardson
102	1	U1	ADC10DV200 (or ADC11DV200)	ADC10DV200CISQ or ADC11DV200CISQ	
104	1	U203	NC7SV125	NC7SV125P5X	Mouser
105	3	U501,U502,U503	LP2989LV-1.8	LP2989AIM-1.8	Digi-Keys
107	1	U606	24C02/SO8	511-M24C02-WMN6P	Mouser
		DO NOT POPULATE			
100	1	U201	ETC1-1-13	ETC1-1-13	Richardson
101	2	T307,T308	MABACT0040	MABACT0040	Richardson
36	3	R105,R301,R308	DNP		
42	2	R222,R223	0	311-0.0GRCT	Digi-Key
2	3	C213,C214,C215	DNP		
3	2	C216,C217	.1uF	490-1318-1	Digi-Key
1	4	C210,C211,C212,C221	.1uF	PCC1762CT	Digi-Key
106	1	U601	LMH6517	LMH6517SQ	National
28	1	J601	INPUT A	WM5534	Digi-Key
30	1	J607	INPUT B	WM5534	Digi-Key
48	4	R601,R602,R640,R642	DNP		
56	2	SW1,SW2	SW DIP-8	GH7176	Digi-Key
99	2	T1,T2	TCM4-19+	TCM4-19+	Mini-Circuits
50	18	R611,R612,R613,R614,R615, R616,R617,R618,R627,R628, R629,R630,R631,R632,R633, R634,R637,R638	20K	P20.0KLCT	Digi-Key
49	16	R603,R604,R605,R606,R607, R608,R609,R610,R619,R620, R621,R622,R623,R624,R625, R626	10K	311-10KJRCT	Digi-Key
51	2	R635,R636	10K	311-10.0KLCT	Digi-Key
32	4	L601,L602,L604,L605	129nH	495-3433-1	Digi-Key
33	2	L603,L606	1nH		
44	4	R653,R654,R655,R656	0	311-0.0JRCT	Digi-Key
52	2	R639,R641	0	311-0.0JRCT	Digi-Key
53	4	R643,R644,R645,R646	49.9	311-49.9LCT	Digi-Key
54	4	R647,R648,R649,R650	100	311-100JCT	Digi-Key
55	2	R651,R652	10	311-10JRCT	Digi-Key
3	10	C601,C602,C603,C604,C605, C606,C607,C608,C609,C611	.1uF	490-1318-1	Digi-Key
15	8	C610,C612,C613,C614,C615, C616,C623,C625	0.01uF	PCC103BQCT	Digi-Key
16	2	C617,C618	15pF	PCC150CQCT	Digi-Key
17	2	C624,C626	1uF	PCC2364CT	Digi-Key
6	4	C619,C620,C621,C622	27pF	PCC270CQCT	Digi-Key

APPENDIX

A1.0 Operating in the Computer Mode

The ADC10DV200 Evaluation Board is compatible with the WaveVision5™ Data Capture Board and WaveVision5™ software. You can download the latest version from: http://www.national.com/analog/adc/wavevision5

When connected to the WaveVision5™ Board, data capture is easily controlled from a personal computer operating in the Windows environment. The data samples that are captured can be observed on the PC video monitor in the time and frequency domains. The FFT analysis of the captured data yields insight into system noise and distortion sources and estimates of ADC dynamic performance such as SINAD, SNR and THD.

A2.0 Summary Tables of Test Points, Connectors, and Jumper Settings

A2.1 Test Points

Test Points on the ADC10DV200 Evaluation Board

Voltage Signal Name	Measure at	Nominal Voltage (V)	Voltage Limits (V)
VA	TP507	1.8	1.7 to 1.9
VD	TP508	1.8	1.7 to 1.9
VDR	TP510	1.8	1.7 to 1.9
VCLK	TP509	1.8	1.7 to 1.9

A2.2 Connectors

JR507 Connector - Power Supply Connections

1	GND	Power Supply Ground
2	+5V	+5V Power Supply

A2.3 Jumper settings

Note: Default settings are in **bold**

JP401 : Power Down Channel A

Connect 1-2	Channel A is in power down mode
1-2 OPEN	**Channel A is in normal operation**

JP402 : Power Down Channel B

Connect 1-2	Channel B is in power down mode
1-2 OPEN	**Channel B is in normal operation**

J401 : Output Data Format and Duty Cycle Stabilizer

Connect 1-2	**Output format is offset binary, DCS is On**
Connect 3-4	Output format is 2's complement, DCS is Off
Connect 5-6	Output format is offset binary, DCS is Off
Connect 7-8	Output format is 2's complement, DCS is On

A2.4 Clock Circuit Solder Jumper settings

Components can be installed or removed to select the path of the clock to the ADC. While not as convenient as pin-type jumpers, these introduce less distortion into the clock signal.

Termination A: Differential Sinusoid	Install C210, C216, and C217 Remove R223, R224, R225, and JP204
Termination B: Single Ended Sinusoid	**Install R222 and R223** **Remove C210, C216, C217, R224, R225 and JP204**
Termination C: Single Ended Square	Install R223, R224, R225, and JP204 Remove C210, C216, C217, and R222

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National Semiconductor Corporation Americas
Tel: 1-800-272-9959
Fax: 1-800-737-7018
Email: support@nsc.com

National Semiconductor Europe
Fax: +49 (0) 1 80-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 699508 6208
English Tel: +49 (0) 870 24 0 2171
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National Semiconductor Asia Pacific Customer Response Group
Tel: 65-2544466
Fax: 65-2504466
Email:sea.support@nsc.com

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Tel: 81-3-5639-7560
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