ADS7886EVM/ADS7887EVM/ADS7888EVM

This Users guide describes the characteristics, operation, and use of the ADS7886/ADS7887/ADS7888 12/10/8-bit, 1-MSPS, 1.25-MSPS, high-speed, serial-interface analog-to-digital (A/D) converter evaluation (EVM) board. A complete circuit description as well as schematic diagram and bill of materials is included for revision B of the EVMs.

Contents

List of Figures

List of Tables

1 EVM Overview

1.1 Features

- Full-featured evaluation module (EVM) for the ADS7886/ADS7887/ADS7888 12/10/8-bit, 1-MSPS, 1.25-MSPS, single-channel, high-speed serial interface A/D converter.
- On board signal conditioning
- On board reference

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2 Introduction

The ADS7886 is a 12-bit, 1-MSPS serial-interface, analog-to-digital converter (ADC). The ADS7887 is a 10-bit, 1.25-MSPS serial-interface A/D converter. The ADS7888 is a 8-bit, 1.25-MSPS analog to digital converter. The devices include a capacitor based SAR A/D converter with inherent sample and hold. The serial interface for each A/D converter is controlled by the two signals chip select and the serial shift clock. The input signal is sampled with the falling edge of chip select, and serial shift clock is used as conversion and the serial data output clock.

The devices operate from 2.35 V up to 5.25 V, and are available in SOT23 and SC70 packages. This EVM features the larger SOT23 package. Low power consumption and a small size make these devices ideally suitable for battery powered, portable applications. The ADS7886 is available in 6-pin SOT23, and SC70 packages and is specified for operation from -40°C to 125°C.

The high level of the digital input to the device is not limited to device VDD. This means the digital input can go as high as 5.25 V when the device supply is 2.35 V. This feature is useful when digital signals are coming from other circuit with different supply levels.

3 Analog Interface

The ADS7886/ADS7887/ADS7888 A/D converter has one analog input pin. A signal for the input pin can be applied at connector P1, pin 2 (shown in Table 1), or applied to the center pin of SMA connector J1. The input range of the converter set by the power supply voltage applied at pin 1. For example, if VDD = 2.35 V, then V_I can range from 0 V up to 2.35 V or 2.35 V_{PP}.

Table 1. Analog Input Connector

Description	Signal Name	Connector.Pin Number		Signal Name	Description
Reserved	N/C	P1.1	P1.2	(+)	VIN
Reserved	N/C	P1.3	P1.4	N/C	Reserved
Reserved	N/C	P1.5	P1.6	N/C	Reserved
Reserved	N/C	P1.7	P1.8	N/C	Reserved
Pin tied to Ground	AGND	P1.9	P.10	N/C	Reserved
Pin tied to Ground	AGND	P1.11	P1.12	N/C	Reserved
Reserved	N/C	P1.13	P1.14	N/C	Reserved
Pin tied to Ground	AGND	P1.15	P1.16	N/C	Reserved
Pin tied to Ground	AGND	P1.17	P1.18	N/C	Reserved
Reserved	N/C	P1.19	P1.20	EXT_REF	External Reference Input

3.1 Signal Conditioning

The VIN input to the ADS7886, ADS7887, and ADS7888 is driven with a low impedance source. In many cases, an input driver is not necessary, but in those cases where the source impedance exceeds 200 Ω, using a buffer helps achieve the rated performance of the converter.

The amplifier circuit shown in Figure 1 is the buffer circuit used on the ADS7886/ADS7887/ADS788EVM. This circuit consists of the THS4031, a high-speed, low noise, low distortion amplifier configured as an inverting gain of one. The circuit shown Figure 1 is optimized to achieve the ac (i.e., SNR, THD, SFDR, etc) specifications listed in the ADS7886/ADS7887/ADS7888 datasheets. Note the input circuit may require adjustments to achieve best performance for the test system.

The 15-Ω series resistor works with the capacitor, C20, to filter the input signal and isolates the amplifier from the capacitive load. The 680-pF capacitor to ground at the input of the A/D works with the series resistor to filter the input signal, behaves like a charge reservoir, and provides a short to ground for high frequency noise and kickback currents when the device switches from hold to sample mode. This external filter capacitor also works with the amplifier to charge the internal sampling capacitor during sampling mode.

The type of input capacitors used in the signal path can make a few decibels of difference in AC performance. The factory recommends using either polypropylene or C0G type capacitor in the input signal path. The polypropylene capacitor causes the least distortion of the input signal and has excellent long-term stability, but is bulky and expensive. The C0G ceramic is lower cost, comes in smaller packages, and perform well in many applications, but tends to not be as stable over time and temperature as polypropylene capacitors. The 680-pF capacitors installed on the EVM are low cost C0G type manufactured by TDK Corporation.

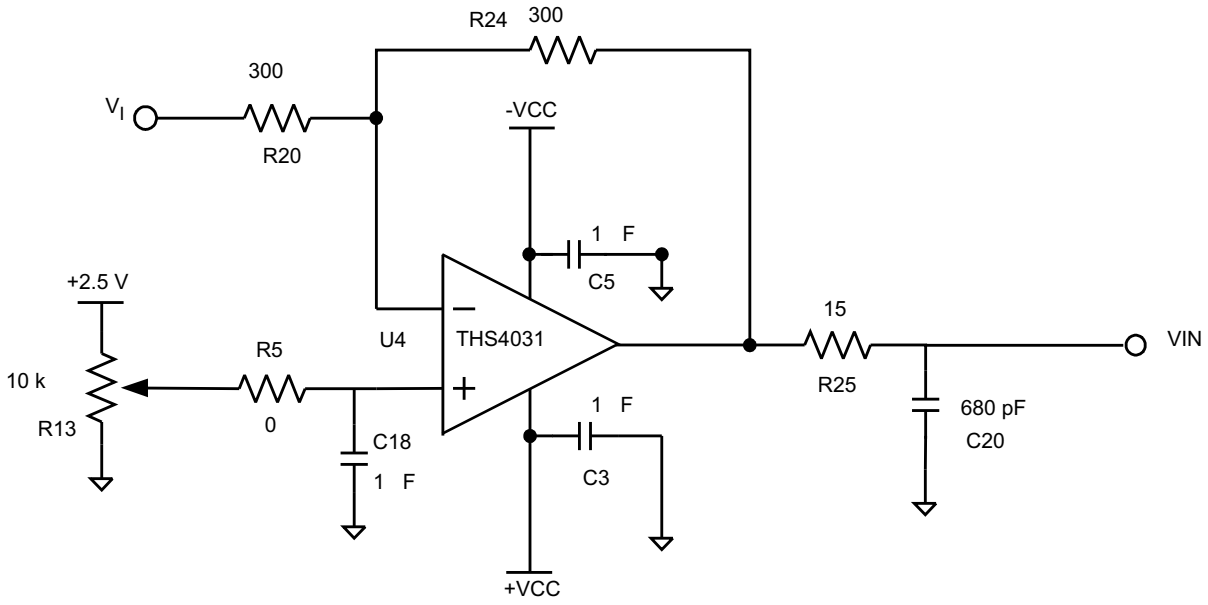


Figure 1. Input Buffer Circuit

3.2 Reference

The ADS7886, ADS7887, and ADS7888 reference voltage is derived from the supply voltage internally. Consequently, the supply voltage to these converters must be driven with a low impedance source and be decoupled to ground at the chip. It is recommended that, at least, a 1-µF and 10-nF decoupling capacitors be placed close to the chip. The traces from these capacitors to the VDD pin should be wide, low impedance traces.

The converters themselves draw very little current from the supply lines. Therefore, the supply voltage pin for the ADS7886, ADS7887, and ADS7888 can be connected directly to the system supply or to a low noise and low drift reference chip. The EVM provides users the option to power the A/D converter from either the analog supply voltage applied at TP4 or from an onboard 2.5-V reference chip.

Table 2. Jumper Setting[1]

Reference Designator	Description	Jumper Setting	
		1-2	2-3
SJP1	Set negative supply of U2 to ground.	Installed[2]	Not installed
	Select negative supply of U2 to -VCC.	Not installed	Installed
SJP2	Set negative supply of U4 to ground.	Installed	Not installed
	Select negative supply of U4 to -VCC.	Not installed	Installed[2]
W1	Apply CS from P2.1 to the ADC Chip select pin	Installed	Not installed
	Apply FS from P2.7 to the ADC Chip select pin	Not installed	Installed[2]
W2	Set BVDD to +5VD	Installed	Not installed
	Set BVDD to +3.3VD	Not installed	Installed[2]
W3	Set 2.5 V to W4 (pin 3)	Installed[2]	Not installed
	Set user applied voltage to W4 (pin 3)	Not installed	Installed
W4	Set DUT power supply pin to 5 V	Installed[2]	Not installed
	Set DUT power supply pin to voltage on W3 (pin 2).	Not installed	Installed

(1) These jumper setting are for PWB revision B of the ADS7886EVM/7887EVM/7888EVM.
(2) Factory Installed

4 Digital Interface

The ADS7886EVM/ADS7887EVM/ADS7888EVM is designed for easy interfacing to multiple platforms. Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient dual row header/socket combination at P1 and P2. Consult Samtec at www.samtec.com or 1-800-SAMTEC-9 for a variety of mating connector options.

The digital input and output signals for the converter is made available via connector P2 on the ADS7886EVM/ADS7887EVM/ADS7888EVM, see Table 3 for connector pin-out.

Table 3. Serial Control Connector P2

Description	Signal Name	Connector.Pin#		Signal Name	Description
Chip Select	$\overline{CS}$	P2.1	P2.2	N/C	Reserved
Serial Clock	SCLK	P2.3	P2.4	DGND	Ground
Reserved	N/C	P2.5	P2.6	N/C	Reserved
Frame Sync	FS	P2.7	P2.8	N/C	Reserved
Reserved	N/A	P2.9	P2.10	DGND	Ground
Reserved	N/C	P2.11	P2.12	N/C	Reserved
Serial Data Out	SDO	P2.13	P2.14	N/C	Reserved
Reserved	N/C	P2.15	P2.16	N/C	Reserved
Reserved	N/C	P2.17	P2.18	DGND	Ground
Reserved	N/C	P2.19	P2.20	N/A	Reserved

I/O buffer and level translation functions may not be required for many applications. These devices have the high-level digital input that is not limited to the device VDD voltage, but to 5.25 V. This means the ADC can be powered up at 2.35 V and interfaced to 5-V logic directly.

The ADS7886/ADS7887/ADS7888 output low-level and high-level voltages are 0.4 V and VDD - 0.2 V, respectively. If the ADS7886/ADS7887/ADS7888 is powered up at 5 V and the host processor is at 1.8 V, then level translation maybe required. The output level translation function (done by U6 on the EVM) may be required depending on the host processor. Check your host processor's data sheet for input logic levels.

5 Power Supplies

The EVM accepts four power supplies.

- A dual $\pm V_S$ dc supply for the dual supply operational-amplifers. Recommended ±6 VDC.
- A single 5-V dc supply for analog section of the board (A/D + reference).
- A single 5-V or 3.3-V dc supply for digital section of the board (output buffers U6).

There are two ways to provide these voltages.

1. Wire in voltages at test points on the EVM. See Table 4.

Table 4. Power Supply Test Points

Test Point	Signal	Description
TP1	+VA	Apply +6 VDC. Positive supply for amplifier.
TP2	–VA	Apply -6 VDC. Negative supply for amplifier.
TP3	+BVDD	Apply 3.3 VDC or 5 VDC. See the ADC data sheet for full range.
TP4	+AVCC	Apply 5 VDC.

2. Use the power connector J2, and derive the voltages elsewhere. The pin out for this connector is shown in Table 5. If using this connector, then set W1 jumper to connect +3.3VD or +5VD from connector to +BVDD. Short between pins 1-2 to select +5VD, or short between pins 2-3 to select +3.3VD as the source for the digital buffer voltage supply (+BVDD).

Table 5. Power Connector Pin Out

Signal	J1 Pin		Signal
+VA (6 V)	1	2	–VA (–6 V)
+5VA	3	4	N/C
DGND	5	6	AGND
N/C	7	8	N/C
+3.3VD	9	10	+5VD

The voltage applied to the VDD pin of the ADC is controlled by W4. If pins 1 and 2 are shorted, then +5VCC is applied to the ADC. If pins 2 and 3 are shorted, then the reference voltage selected by W3 is powering the ADC. See Table 2 or the schematic drawings at the end of this user's guide to determine how power is supplied to the various ICs on the board.

6 Using the EVM

The ADS7886/ADS7887/ADS7888EVM serves three functions:

1. As a reference design
2. As a prototype board and
3. As software test platform

6.1 As a Reference Board

As a reference design, the ADS7886EVM/ADS7887EVM/ADS7888EVM contains the essential circuitry to showcase the A/D converter. This essential circuitry includes the input amplifier, reference circuit, and buffers. The analog input circuit is optimized for 100-kHz input signal; therefore, users may need to adjust the resistor and capacitor values to accommodate higher frequencies and different test systems. In ac-type applications where signal distortion is concern, care should be taken to insure polypropylene or C0G type capacitors are used in the signal path.

The design and layout of this EVM, in conjunction with the ADC data sheet, can be used as the guide when incorporating this ADC into the user system board.

6.2 As a Prototype Board

As a prototype board, the buffer circuit consists of resistor pads for configuring the input as either inverting or noninverting configurations. The input circuit can be modified to accommodate user prototype needs, whether it be evaluating another amplifier or limiting noise for best performance. The analog, power, and digital connectors can be made to plug into a standard 0.1 inch breadboard or ribbon cables to interface directly to FPGAs or processors.

6.3 As a Software Test Platform

As a software test platform, connectors P1 and P2 plug into the serial interface connectors of the 5-6K interface card. The 5-6K interface card plugs into the TMS320C5000™ DSP and TMS320C6000™ DSP starter kits (DSK). See the 5-6K interface card user's guide (SLAU104) for more information.

7 ADS7886EVM BOM

Table 6 contains a complete Bill of Materials for the ADS7886EVM . The schematic diagram is also provided for reference. Contact the Product Information Center or e-mail dataconvapps@list.ti.com for questions regarding this EVM.

Table 6. ADS7886EVM Bill of Materials

Item No.	QTY	Value	Reference Designators	Footprint	Mfg	Mfg Part number	Description
1	5	NI	R1 R2	603	NOT INSTALLED	NOT INSTALLED	
			R3 R4 R26				
2	1	0	R5	805	Panasonic-ECG or Alternate	ERJ-6GEY0R00V	RES 0.0 OHM 1/10W 5% 0805 SMD
3	5	0	R6 R7 R9	603	Panasonic-ECG or Alternate	ERJ-3GEY0R00V	RES ZERO OHM 1/16W 5% 0603 SMD
			R11 R12				
4	2	100	R8 R15	603	Panasonic-ECG or Alternate	ERJ-3EKF1000V	RES 100 OHM 1/16W 1% 0603 SMD
5	1	140	R16	603	Yageo America or Alternate	9T06031A1400DBHFT	RES ZERO OHM 1/16W 5% 0603 SMD
6	4	NI	R10 R21	805	Not Installed	Not Installed	
			R22 R23				
7	1	10k	R13	BOURNS_32X4W	Bourns	3214W-1-103E	TRIMPOT 10K OHM 4MM TOP ADJ SMD
8	1	1k	R14	603	Yageo America or Alternate	9C06031A1001FKHFT	RES 1.00K OHM 1/10W 1% 0603 SMD
9	2	10k	R18 R19	603	Panasonic ECG or Alternate	ERJ-3EKF1002V	RES 10.0K OHM 1/16W 1% 0603 SMD
10	1	15	R25	603	Panasonic-ECG or Alternate	ERJ-3EKF15R0V	RES 15.0 OHM 1/16W 1% 0603 SMD
11	2	300	R20 R24	805	Yageo America or Alternate	9C08052A3000FKHFT	RES 300 OHM 18W 1% 0805 SMD
12	1	0	R28	1206	Panasonic-ECG or Alternate	ERJ-8GEY0R00V	RES ZERO OHM 1/4W 5% 1206 SMD
13	1	NI	C1	1206	Not Installed	Not Installed	
14	4	1uF	C2 C3 C4	603	TDK Corporation or Alternate	C1608X5R1A105KT	CAP CER 1.0UF 10V X5R 10% 0603
			C9				
15	2	1uF	C5 C18	805	TDK Corporation or Alternate	C2012X7R1E105K	CAP CER 1.0UF 25V X7R 0805 T/R
16	1	0.47uF	C8	603	TDK Corporation or Alternate	C1608X5R1A474K	CAP CER .47UF 10V X5R 10% 0603
17	2	NI	C11 C19	805	Not Installed	Not Installed	

Table 6. ADS7886EVM Bill of Materials (continued)

18	1	0.1uF	C15	603	TDK Corporation or Alternate	C1608X7R1E104K	CAP CER .10UF 25V X7R 10% 0603
19	1	2.2uF	C17	603	TDK Corporation or Alternate	C1608X5R1A225MT	CAP CER 2.2UF 6.3V X5R 20% 0603
20	1	10nF	C13	603	TDK Corporation or Alternate	C1608C0G1H100D	CAP CER 10PF 50V C0G 0603
21	4	10uF	C22 C23	805	TDK Corporation or Alternate	C2012X5R0J106M	CAP CER 10UF 6.3V X5R 20% 0805
			C24 C25				
22	4	10uF	C26 C27	1206	TDK Corporation or Alternate	C3216X5R1C106KT	CAP CER 10UF 16V X5R 20% 1206
			C28 C29				
23	1	680pF	C20	603	TDK Corporation or Alternate	C1608C0G1H681J	CAP CER 680PF 50V C0G 5% 0603
24	4	1000pF	C36 C37	603	TDK Corporation or Alternate	C1608C0G1H102J	CAP CER 1000PF 50V C0G 5% 0603
			C38 C39				
25	3	MMZ2012R601A	L1 L3 L4	1206	TDK Corporation	MMZ2012R601A	FERRITE CHIP 600 OHM 500MA 0805
26	12	NI	C6 C7 C10 C12 C14 C21 C30 C31 C32 C33 C34 C35	603	NOT INSTALLED	NOT INSTALLED	Multilayer Ceramic - 0805 Size
27	1	REF3225	U3	SOT23-6	Texas Instruments	REF3225AIDBVT	low drift reference REF 3225, 3230, 3233, 3240
28	2	THS4031	U2 U4	8-SOP(D)	Texas Instruments	THS4031CD	100-MHz LOW-NOISE HIGH SPEED AMPLIFIER
29	1	DUT	U5	6-SOT(DBV)	Texas Instruments	ADS7886SBDBVR	ADS7886 12 Bit 1MSPS serial A/D converter
30	1	SN74LVC1G07	U6	5-SOT(DBV)	Texas Instruments	SN74LVC1G07DBVR	SINGLE BUS BUFFER GATE WITH OUTPUT ENABLE
31	2		W1 W2	3pos_jump	Samtec	TSW-103-07-L-S	3 Position Jumper _ .1" spacing
32	2		W3 W4	3-POS_JUMPER_2MM	Samtec	TMM-103-03-T-S	2mm low profile
33	2	10X2X.1	P1 P2	10X2X.1_SMT_PLUG and SOCKET	Samtec	SSW-110-22-S-D-VS	0.025" SMT SOCKET - BOTTOM SIDE OF PWB
34	2				Samtec	TSM-110-01-T-D-V-P	0.025" SMT PLUG - TOP SIDE of PWB
35	1	SMA_PCB_MT	J1	SMA_JACK	Johnson Components Inc.	142-0701-301	Right Angle SMA Connector
36	1	Power Supply	J2	5X2X.1_SMT_SOCKET	Samtec	SSW-105-22-S-D-VS	0.025" SMT SOCKET - BOTTOM SIDE OF PWB
37	1				Samtec	TSM-105-01-T-D-V-P	0.025" SMT PLUG - TOP SIDE of PWB
38	2		SJP1 SJP2	SJP3			
39	10	TP_.025	TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP9 TP12 TP15	test_point2	Keystone Electronics	5000K-ND	TEST POINT PC MINI .040"D RED
40	5	TP_.025	TP8 TP10	test_point2	Keystone Electronics	5001K-ND	TEST POINT PC MINI .040"D BLACK
			TP11 TP13				
			TP14				

On the ADS7888EVM, item 29 is the ADS7888SDBVT device. On the ADS7887EVM, item 29 is the ADS7887SDBVT device.

8 ADS7886EVM LAYOUT

This chapter contains the layout drawings for revision B of the ADS7886EVM, ADS7887EVM, and ADS7888EVM printed circuit board.

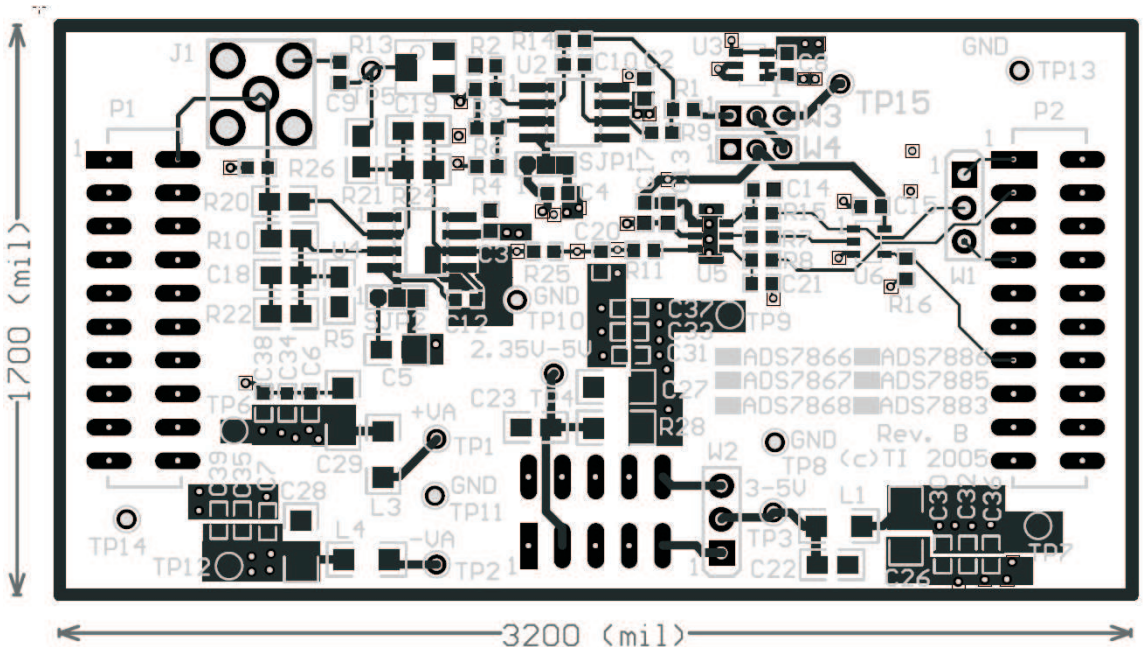


Figure 2. Top - Layer 1

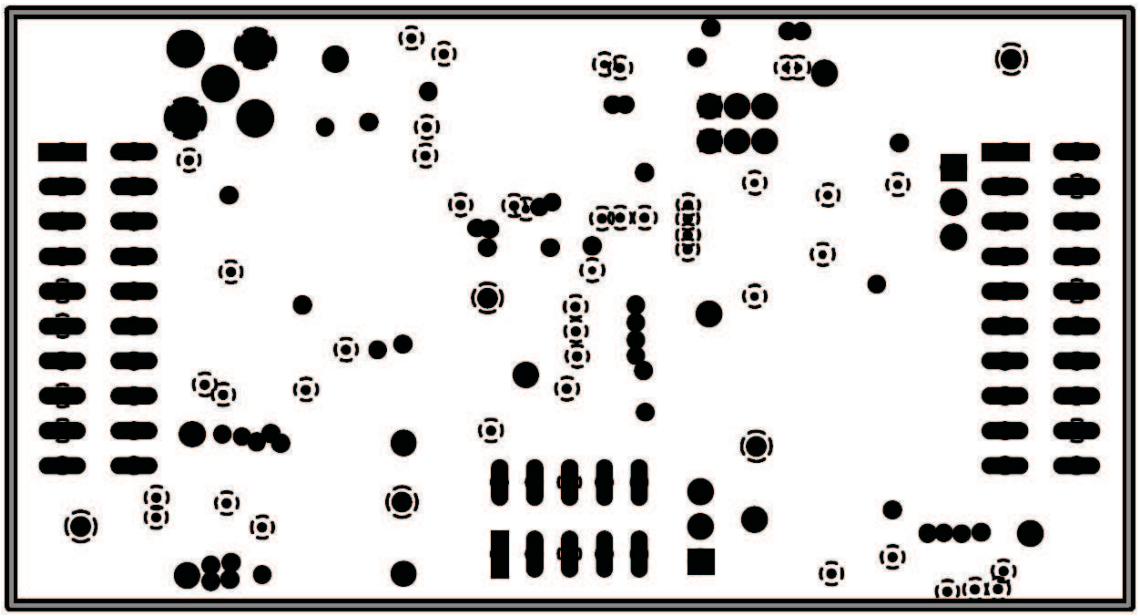


Figure 3. Ground Plane - Layer 2

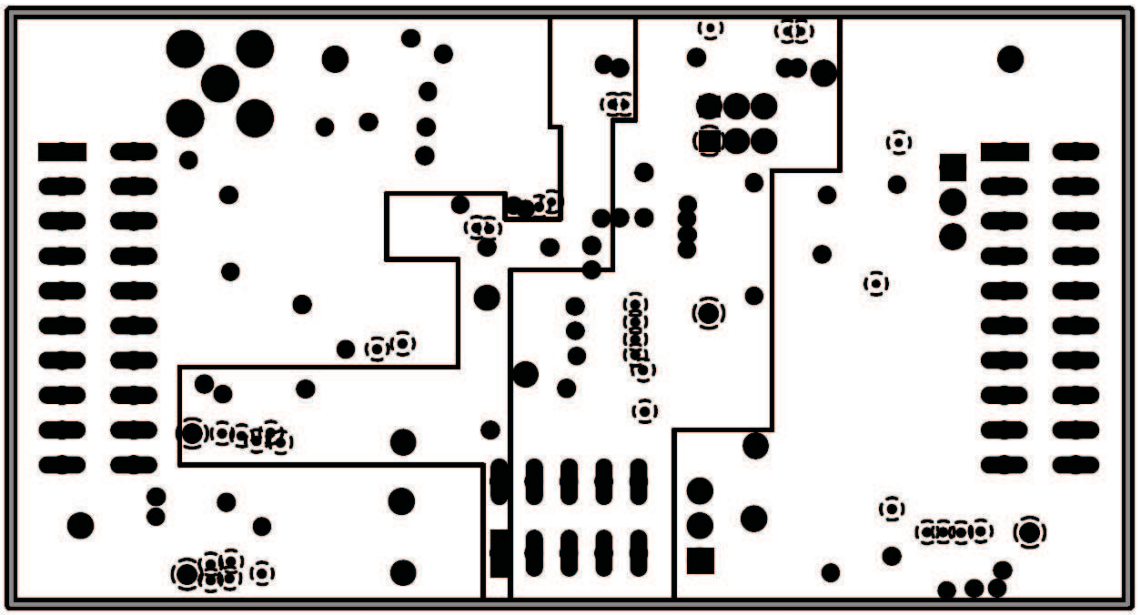


Figure 4. Power Plane - Layer 3

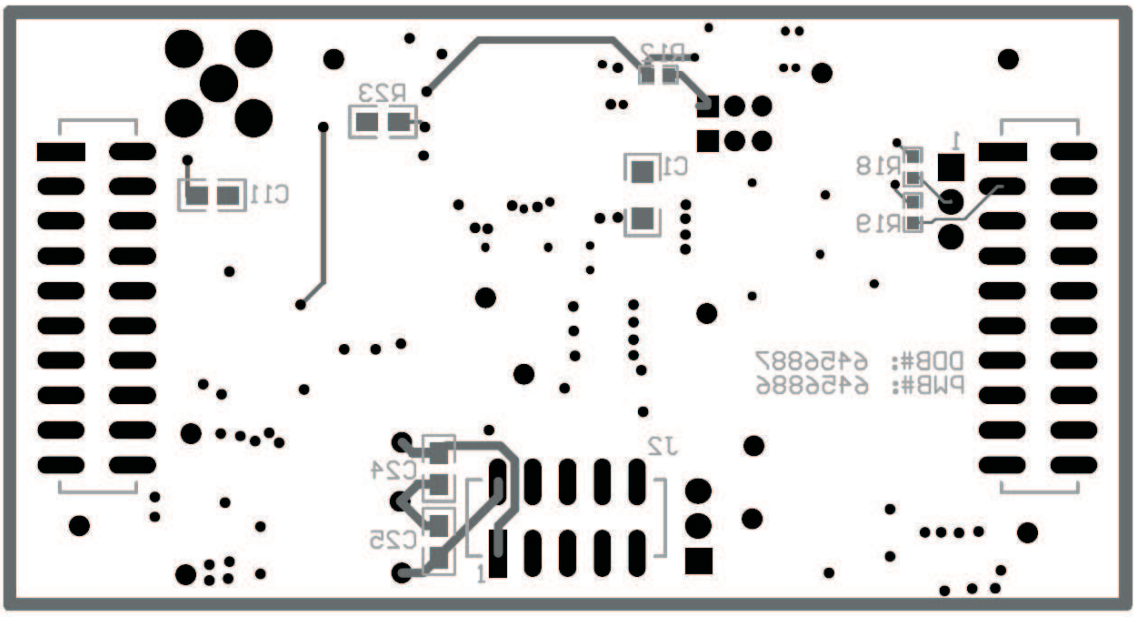
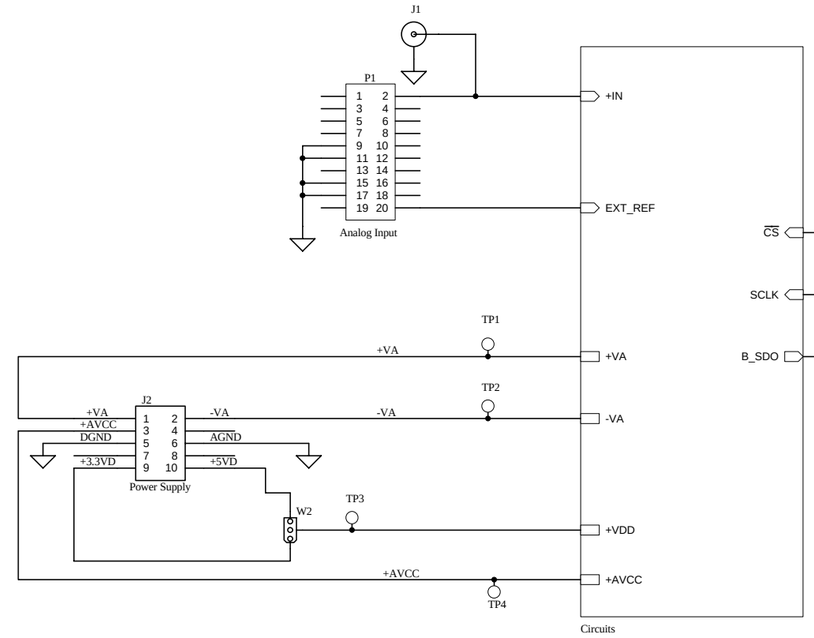


Figure 5. Bottom - Layer 4

9 ADS7886EVM Schematic

Revision History		
REV	ECN Number	Approved



Engineer:	Lijoy Philipose
Drawn By:	Lijoy Philipose
FILE:	BlockDiagram.sch

TEXAS INSTRUMENTS

12500 TI Boulevard. Dallas, Texas 75243

TITLE: ADS7866/67/68/86/87/88EVM Block Diagram

DOCUMENT CONTROL #: 6456887 REV: B

DATE: 7-Feb-2006 SIZE: SHEET: 1 OF: 2

Revision History		
REV	ECN Number	Approved

U3 REF3225: GND_F, GND_S, ENABLE, OUT_F, OUT_S, IN; C8 0.47uF; +5VCC

U2 OPA735: R4 NI, R6 0, R3 NI, R2 NI, C2 1uF, +VA, -VA, SJP1, C4 1uF, C10 NI, R14 1k, R9 0, R12 0, R1 NI

W3, TP15, W4, +5VCC, +VCC, C1 NI, C13 10nF, C17 2.2uF

U5 DUT: VCC, GND, VIN, CS, SDO, SCLK

ADS7866/ADS7867/ADS7868
ADS7883/ADS7884/ADS7885
ADS7886/ADS7887/ADS7888

R15 100, C14 NI, +IOVDD, R18 10k, CS, R7 0, SDO

U6 SN74LVC1G07: OE, A, GND, VCC, Y; +VCC, C15 0.1uF, R16 140, +IOVDD, B_SDO

TP5, R13 10k, R5 0, C9 1uF

U4 THS4031: C3 1uF, +VA, R10 NI, R22 NI, C18 1uF, R25* 15, R11 0, C20* 680pF, C12* NI, SJP2, -VA, C5 1uF, +IN, R26 NI, R21 NI, R20 300, C11 NI, R23 NI, R24 300, C19* NI

R8 100, C21 NI, SCLK, R19 10k

+AVCC, R28 0, TP9, +5VCC, C23 10uF, C27 10uF, C31 NI, C33 NI, C37 1000pF, TP14, TP10

+VDD, L1 MMZ2012R601A, TP7, +IOVDD, C22 10uF, C26 10uF, C30 NI, C32 NI, C36 1000pF, TP8

+VA, L3 MMZ2012R601A, TP6, C24 10uF, C29 10uF, C6 NI, C34 NI, C38 1000pF, TP11, TP13, C25 10uF, C28 10uF, C7 NI, C35 NI, C39 1000pF, TP12, -VA, L4 MMZ2012R601A

TEXAS INSTRUMENTS
12500 TI Boulevard. Dallas, Texas 75243

TITLE: Circuits			
DOCUMENT CONTROL #: 6456887			REV: B
Engineer: Lijoy Philipose			
Drawn By: Lijoy Philipose			
FILE: Circuits	DATE: 7-Feb-2006	SIZE:	SHEET: 2 OF: 2

10 Related Documentation from Texas Instruments

To obtain a copy of any of the following TI documents, call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center (PIC) at (972) 644-5580. When ordering, please identify this booklet by its title and literature number. Updated documents can also be obtained through our website at www.ti.com.

Data Sheets:	Literature Number:
ADS7887/ADS7888	SLAS468
ADS78886	SLAS492
REF1004C-2.5	SBVS002
SN74AHC1G125	SCLS377
THS4031	SLOS224
OPA227	SBOS110

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

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 2.35 V to 5.25 V and the output voltage range of 0.4 V and VDD - 0.2 V.

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 30°C. The EVM is designed to operate properly with certain components above 30°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.

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