

ADS8380EVM

This user's guide describes the characteristics, operation, and use of the ADS8380 18-bit, 600-kHz, high-speed, serial interface analog-to-digital converter evaluation board (EVM). A complete circuit description, schematic diagram, and bill of materials are included.

The following related documents are available on the TI Web site at www.ti.com.

| Data Sheets: | Literature Numbers: |
|---------------------|----------------------------|
| ADS8380 | SLAS387 |
| REF1004C-2.5 | SBVS002 |
| SN74AHC1G125 | SCLS377 |
| THS4031 | SLOS224 |
| OPA132 | SBOS054 |

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1 EVM Overview

1.1 Features

- Full-featured evaluation board for the ADS8380 18-bit, 600-kHz, single-channel, high-speed serial-interface analog-to-digital converter (ADC)
- Onboard signal conditioning
- Onboard reference
- Input and output digital buffer

2 Analog Interface

The ADS8380 analog-to-digital converter has both a positive and negative analog input pin. A signal for the positive 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 EVM ships with the negative input pin shorted to ground close to the converter using via SJP7. The negative and positive input pins have a range of -200 mV to +200 mV and -200 mV to VREF+200 mV, respectively.

Table 1. Analog Input Connector

| Description | Signal Name | Connector Pin No. | | Signal Name | Description |
|-----------------|-------------|-------------------|-------|-------------|--------------------------|
| Inverting Input | -IN | P1.1 | P1.2 | +IN | Noninverting Input |
| Reserved | N/A | P1.3 | P1.4 | N/A | Reserved |
| Reserved | N/A | P1.5 | P1.6 | N/A | Reserved |
| Reserved | N/A | P1.7 | P1.8 | N/A | Reserved |
| Ground | AGND | P1.9 | P1.10 | N/A | Reserved |
| Ground | AGND | P1.11 | P1.12 | N/A | Reserved |
| Reserved | N/A | P1.13 | P1.14 | N/A | Reserved |
| Ground | AGND | P1.15 | P1.16 | N/A | Reserved |
| Ground | AGND | P1.17 | P1.18 | N/A | Reserved |
| Reserved | N/A | P1.19 | P1.20 | REF+ | External Reference Input |

2.1 Signal Conditioning

It is a recommended practice to buffer the analog input to any SAR-type converter with a high-speed, fast-settling, low-noise amplifier. The amplifier circuit shown in [Figure 1](#) is the buffer circuit used on the ADS8380EVM. This circuit consists of the THS4031, a high-speed, low-noise, low-distortion amplifier configured as an inverting gain of one. The circuit shown in [Figure 1](#) was optimized to achieve the ac specifications (i.e., SNR, THD, SFDR, etc.) listed in the ADS8380 data sheet. The 12- Ω series resistor works with the capacitor to filter the input signal, but also isolates the amplifier from the capacitive load. The 6800-pF capacitor to ground at the input of the ADC 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. Polypropylene or C0G-type capacitors are recommended for the input signal path. Polypropylene capacitors cause the least distortion of the input signal and have excellent long-term stability, but are expensive and bulky. C0G ceramic capacitors cost less, come in smaller packages, and perform as well as polypropylene capacitors in many applications, but are not as stable over time and temperature. The 68-pF and 6800-pF capacitors installed on the EVM are low-cost C0G type, manufactured by TDK Corporation.

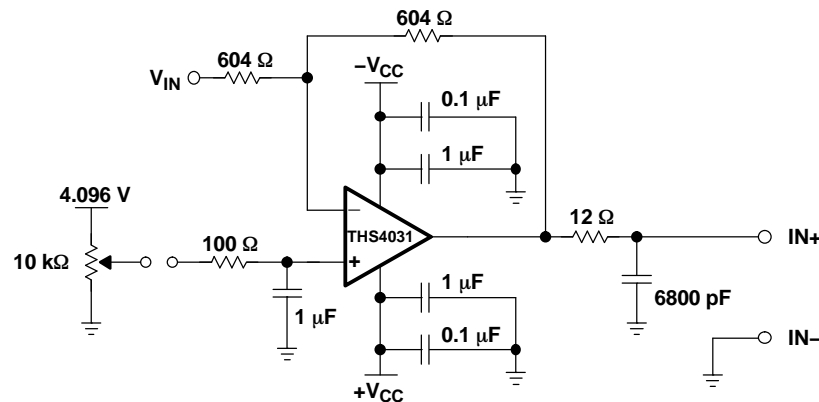


Figure 1. Input Buffer Circuit

2.2 Reference Voltage

The ADS8380EVM allows the designer to select internal, onboard, or user-supplied reference-voltage sources. The internal reference is a 4.096-V reference voltage generated by the ADS8380 on pin 9. The onboard reference can be either a REF3040 (U1) or REF1004-2.5 (U13). The EVM ships with the REF1004-2.5 installed. The reference amplifier, U3, is set for a gain of 1.6, enabling it to take a 2.5-V input and output 4.1 V for use with the converter, or as part of the dc offset voltage circuit for the input buffer (U4). The user-supplied reference voltage is applied to connector P1, pin 20 and can be routed through the reference buffer and filtered, if desired. The EVM allows a number of configurations. See [Table 1](#) for jumper settings or the full schematic in [Section 9](#) for more information. The common SOIC footprint of U13 allows users to evaluate this converter with various reference ICs.

The ADS8380EVM ships with the internal reference tied directly to the reference pin of the converter.

Table 2. Jumper Setting

| Reference Designator | Description | Pins/Pads | |
|----------------------|--|------------------------|------------------------|
| | | 1-2 | 2-3 |
| SJP1 | Buffer onboard reference (REF1004-2.5) | Shorted ⁽¹⁾ | Open |
| | Buffer user-supplied reference voltage applied at P1 pin 20 | Open | Shorted |
| SJP2 | Connect external reference directly to SJP4 | Shorted ⁽¹⁾ | Open |
| | Connect buffered external reference to SJP4 | Open | Shorted |
| SJP3 | Connect U2 negative supply to ground | Shorted | Open |
| | Connect U2 negative supply to -VCC | Open | Shorted ⁽¹⁾ |
| SJP4 | Connect internal reference to REFIN | Shorted ⁽¹⁾ | Open |
| | Connect external reference to REFIN | Open | Shorted |
| SJP5 | Connect U4 negative supply to ground | Shorted | Open |
| | Connect U4 negative supply to -VCC | Open | Shorted ⁽¹⁾ |
| SJP6 | Connect DC offset voltage to U4 | Shorted ⁽¹⁾ | N/A |
| SJP7 | Connect -IN pin to analog ground | Shorted ⁽¹⁾ | N/A |
| W1 | Connect +5VD to BVDD | Shorted ⁽¹⁾ | Open |
| | Connect +3.3VD to BVDD | Open | Shorted |
| W2 | Set signal straight binary/2s complement ($\overline{SB}/2C$) high | Shorted | N/A |
| W3 | Set power down signal (PD) high | Shorted | N/A |
| W4 | Set frame sync signal (FS) high | Shorted | N/A |
| W5 | Set chip select signal (\overline{CS}) low | Shorted | N/A |

⁽¹⁾ Factory Installed

3 Digital Interface

The ADS8380EVM is designed for easy interfacing to multiple platforms. Samtec plug and socket connectors provide a convenient dual row header/socket combination at P1 and P2 to plug into prototype boards or through ribbon cable to user system boards.

The digital input and output signals for the converter is available at connector P2 on the ADS8380EVM; see [Table 3](#) for the connector pinout.

Table 3. Pinout for Serial Control Connector P2

| Description | Signal Name | Connector Pin | | Signal Name | Description |
|-----------------|---------------------|---------------|-------|-------------|---|
| Chip Select | \overline{CS} | P2.1 | P2.2 | SB/2C | Straight binary or 2s complement output |
| Serial Clock | SCLK | P2.3 | P2.4 | DGND | Ground |
| Reserved | N/A | P2.5 | P2.6 | N/A | Reserved |
| Frame Sync | FS | P2.7 | P2.8 | N/A | Reserved |
| Reserved | N/A | P2.9 | P2.10 | N/A | Reserved |
| Reserved | N/A | P2.11 | P2.12 | N/A | Reserved |
| Serial Data Out | SDO | P2.13 | P2.14 | N/A | Reserved |
| BUSY | BUSY | P2.15 | P2.16 | N/A | Reserved |
| Convert Start | \overline{CONVST} | P2.17 | P2.18 | DGND | Ground |
| Power down | PD | P2.19 | P2.20 | N/A | Reserved |

4 Power Supplies

The EVM accepts four power supplies:

- A dual $\pm V_s$ dc supply for the dual-supply operational amplifiers. The maximum recommended voltage is ± 12 Vdc.
- A single +5-Vdc supply for the analog section of the board (A/D + Reference).
- A single +5-Vdc or +3.3-Vdc supply for the digital section of the board (A/D + buffers).

There are two ways to provide these voltages. The first way is to connect the voltages to the test points listed in [Table 4](#).

Table 4. Power Supply Test Points

| Test Point | Signal | Description |
|------------|--------|--|
| TP1 | +VA | Connect +12-Vdc supply for amplifier |
| TP2 | -VA | Connect -12-Vdc supply for amplifier |
| TP3 | +BVDD | Apply +3.3 Vdc or +5 Vdc. See ADC data sheet for full range. |
| TP4 | +AVCC | Apply +5 Vdc |

The second way is to use the power connector J2 and derive the voltages elsewhere. [Table 5](#) gives the pinout for J2. If using this connector, set W1 jumper to connect +3.3VD or +5VD from J2 to +BVDD. Shunt pins 1-2 to select +5VD, or pins 2-3 to select +3.3VD as the source for the digital buffer voltage supply (+BVDD).

Table 5. Power Connector J2 Pinout

| Signal | J2 Pin | | Signal |
|-----------|--------|----|------------|
| +VA(+12V) | 1 | 2 | -VA(-12 V) |
| +5VA | 3 | 4 | N/C |
| DGND | 5 | 6 | AGND |
| N/C | 7 | 8 | N/C |
| +3.3VD | 9 | 10 | +5VD |

5 Using the EVM

The ADS8380EVM serves three functions:

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

5.1 Reference Design

As a reference design, the ADS8380EVM contains the essential circuitry to showcase the analog-to-digital converter. This essential circuitry includes the input amplifier, reference circuit, and buffers. The EVM analog-input circuit is optimized for a 100-kHz input signal; therefore, users may need to adjust the resistor and capacitor values to accommodate higher frequencies. In ac-type applications where signal distortion is a concern, polypropylene or C0G-type capacitors are recommended for use in the signal path.

5.2 Prototype Board

As a prototype board, the buffer circuit has resistor pads for configuring the input as either single-ended or fully differential input. The input circuit can be modified to accommodate user prototype needs, whether it be evaluating another differential amplifier or limiting noise for best performance. The analog, power, and digital connectors can be made to plug into a standard 0.1-in. breadboard or ribbon cables to interface directly to FPGAs or processors.

5.3 Software Test Platform

As a software test platform, connectors P1 and P2 plug into the serial interface connectors of the 5-6K Interface Board. The 5-6K Interface Board plugs into the TMS320C5000 and TMS320C6000 Digital Signal Processor starter kits (DSK). See the *5-6K Interface Board User's Guide* ([SLAU104](#)) for more information.

6 ADS8380EVM Bill Of Materials

The following table contains a complete bill of materials for the ADS8380EVM. The schematic diagram is also provided for reference. Contact the Product Information Center or email dataconvapps@list.ti.com for questions regarding this EVM.

Table 7. ADS8380EVM Bill of Materials

| Item No. | QTY | Value | Reference Designator | Footprint | Manufacturer | Manufacturer's Part Number | Description |
|----------|-----|---------|--|--------------|------------------------------|----------------------------|------------------------------------|
| 1 | 1 | 49.9 Ω | R1 | 805 | Panasonic - ECG or Alternate | ERJ-6ENF49R9V | RES 49.9 Ω 1/10W 1% 0805 SMD |
| 2 | 1 | 1.2 kΩ | R2 | 603 | Yageo America or Alternate | 9C06031A1201FKHFT | RES 1.20 kΩ 1/10 W 1% 0603 SMD |
| 3 | 2 | NI | R4, R5 | 805 | Not Installed | Not Installed | |
| 4 | 3 | 0 Ω | R6, R15, R30 | 603 | Panasonic - ECG or Alternate | ERJ-3GEY0R00V | RES 0 Ω 1/16 W 5% 0603 SMD |
| 5 | 7 | 10 kΩ | R7, R8, R9, R10, R11, R12, R32 | 603 | Panasonic - ECG or Alternate | ERJ-3EKF1002V | RES 10 KΩ 1/16 W 1% 0603 SMD |
| 6 | 1 | 10 kΩ | R13 | BOURNS_32X4W | Bourns | 3214W-1-103E | TRIMPOT 10 KΩ 4MM TOP ADJ SMD |
| 7 | 1 | 768 Ω | R14 | 603 | Panasonic - ECG or Alternate | ERJ-3EKF7680V | RES 768 Ω 1/16 W 1% 0603 SMD |
| 8 | 2 | 0 Ω | R16, R17 | 805 | Panasonic - ECG or Alternate | ERJ-6GEY0R00V | RES 0 Ω 1/10 W 5% 0805 SMD |
| 9 | 2 | 604 Ω | R18, R19 | 805 | Panasonic - ECG or Alternate | ERJ-6ENF6040V | RES 604 Ω 1/10 W 1% 0805 SMD |
| 10 | 1 | 100 Ω | R20 | 805 | Panasonic - ECG or Alternate | ERJ-6ENF1000V | RES 100 Ω 1/10 W 1% 0805 SMD |
| 11 | 1 | 12 Ω | R21 | 805 | Panasonic - ECG or Alternate | ERJ-6GEYJ120V | RES 12 Ω 1/8 W 5% 0805 SMD |
| 12 | 8 | 100 | R22, R23, R24, R25, R26, R27, R28, R29 | 603 | Panasonic - ECG or Alternate | ERJ-3EKF1000V | RES 100 Ω 1/16 W 1% 0603 SMD |
| 13 | 1 | 1 kΩ | R31 | 603 | Panasonic - ECG or Alternate | ERJ-3EKF1001V | RES 1 kΩ 1/16 W 1% 0603 SMD |
| 14 | 1 | 49.9 kΩ | R33 | 805 | Panasonic - ECG or Alternate | ERJ-6ENF4992V | RES 49.9 kΩ 1/10 W 1% 0805 SMD |
| 15 | 1 | 47 μF | C1 | 1206 | TDK Corporation or Alternate | C3216X5R0J476M | CAP CER 47 μF 6.3 V X5R 20% 1206 |
| 16 | 5 | 1 μF | C2, C3, C4, C5, C31 | 805 | TDK Corporation or Alternate | C2012X7R1E105K | CAP CER 1 μF 25 V X7R 0805 T/R |
| 17 | 8 | NI | C6, C7, C21, C23, C44, C45, C59, C60 | 603 | Not Installed | Not Installed | Multilayer Ceramic |
| 18 | 4 | 0.1 μF | C8, C9, C10, C11 | 805 | TDK Corporation or Alternate | C2012X7R1E104K | CAP CER 0.1 μF 25 V X7R 10% 0805 |
| 19 | 12 | 0.1 μF | C12, C13, C16, C17, C18, C52, C53, C54, C55, C56, C57, C58 | 603 | TDK Corporation or Alternate | C1608X7R1E104K | CAP CER 0.1 μF 25 V X7R 10% 0603 |
| 20 | 6 | 2.2 μF | C14, C15, C19, C20, C28, C50 | 603 | TDK Corporation or Alternate | C1608X5R1A225MT | CAP CER 2.2 μF 6.3 V X5R 20% 0603 |
| 21 | 3 | NI | C22, C32, R3 | 805 | Not Installed | Not Installed | Multilayer Ceramic |
| 22 | 1 | 10 μF | C24 | 3528 | Kemet or Alternate | T491B106K016AS | CAPACITOR TANT 10 μF 16 V 10% SMD |
| 23 | 8 | 0.01 μF | C25, C26, C27, C29, C30, C42, C43, C51 | 603 | TDK Corporation or Alternate | C1608X7R1H103KT | CAP CER 10000 pF 50 V X7R 10% 0603 |
| 24 | 1 | 6800 μF | C33 | 805 | TDK Corporation or Alternate | C2012C0G1H682J | CAP CER 6800 pF 50 V C0G 5% 0805 |
| 25 | 4 | 10 μF | C34, C35, C36, C37 | 1206 | TDK Corporation or Alternate | C3216X5R1C106KT | CAP CER 10 μF 16 V X5R 20% 1206 |
| 26 | 4 | 10 μF | C38, C39, C40, C41 | 6032 | Panasonic - ECG or Alternate | ECS-T1EC106R | CAP 10 μF 25 V Tantalum TE SMD |
| 27 | 5 | 1000 pF | C46, C47, C48, C49, C62 | 603 | TDK Corporation or Alternate | C1608C0G1H102KT | CAP CER 1000 pF 50 V C0G 0603 T/R |

Table 7. ADS8380EVM Bill of Materials (continued)

| Item No. | QTY | Value | Reference Designator | Footprint | Manufacturer | Manufacturer's Part Number | Description |
|----------|-----|--------------|---|----------------------------|------------------------------|----------------------------|--|
| 28 | 1 | 1 μ F | C61 | 603 | TDK Corporation or Alternate | C1608X5R1A105KT | CAP CER 1 μ F 10 V X5R 10% 0603 |
| 29 | 4 | MMZ2012R601A | L1, L2, L3, L4 | 805 | TDK Corporation or | MMZ2012R601A | FERRITE CHIP 600 Ω 500 mA 0805 |
| 30 | 1 | NI | U1 | 3-SOT-23 | Not Installed | Not Installed | REF3040 SOT23-3 CMOS Voltage Reference |
| 31 | 1 | OPA132 | U2 | 8-SOP(D) | Texas Instruments | OPA132U | High-Speed FET-Input Operational Amplifier |
| 32 | 8 | SN74X1G125 | U3, U6, U7, U8, U9, U10, U11, U12 | 5-SOT(DBV) | Texas Instruments | SN74AHC1G125DBVR | Single Bus Buffer Gate/Line Driver with 3-State Output |
| 33 | 1 | THS4031 | U4 | 8-SOT(D) | Texas Instruments | THS4031CD | 100-MHz Low-Noise High-Speed Amplifier |
| 34 | 1 | ADS8380 | U5 | 28-PQFP (QFN) | Texas Instruments | ADS8380IBRHPT | 18-Bit 600 kSPS Serial Analog-to-Digital Converter |
| 35 | 1 | REF1004-2.5 | U13 | 8-SOP(D) | Texas Instruments | REF1004C-2.5 | 2.5-V Micropower Voltage Reference |
| 36 | 1 | SMA_PCB_MT | J1 | SMA_JACK | Johnson Components Inc. | 142-0701-301 | Right Angle SMA Connector |
| 37 | 1 | Power Supply | J2 | 5X2X.1_SMT_Socket | Samtec | SSW-105-22-S-D-VS | 0.025-In. SMT Socket - Bottom Side of PWB |
| 38 | 1 | | | | Samtec | TSM-105-01-T-D-V-P | 0.025-In. SMT Plug - Top Side of PWB |
| 39 | 2 | 10X2X.1 | P1, P2 | 10X2X.1_SMT_P LUG_& SOCKET | Samtec | SSW-110-22-S-D-VS | 0.025-In. SMT Socket - Bottom Side of PWB |
| 40 | 2 | | | | Samtec | TSM-110-01-T-D-V-P | 0.025-In. SMT Plug - Top Side of PWB |
| 41 | 1 | 3POS_JUMPER | W1 | 3pos_jump | Samtec | TSW-103-07-L-S | 3-Position Jumper_0.1-In. Spacing |
| 42 | 4 | 2POS_JUMPER | W2, W3, W4, W5 | 2pos_jump | Samtec | TSW-102-07-L-S | 2-Position Jumper_0.1-In. Spacing |
| 43 | 2 | SJP2 | SJP6, SJP7 | SJP2 | Not Installed | Not Installed | Pad 2 Position Jumper |
| 44 | 5 | SJP3 | SJP1, SJP2, SJP3, SJP4, SJP5 | SJP3 | Not Installed | Not Installed | Pad 3 Position Jumper |
| 45 | 10 | TP_.025 | TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP10, TP13, | test_point2 | Keystone Electronics | 5000K-ND | Test Point PC Mini 0.040-In. D Red |
| 46 | 4 | TP_0.25 | TP9, TP11, TP12, TP14 | test_point2 | Keystone Electronics | 5001K-ND | Test Point PC Mini 0.040-In D Black |

8 Board Layers

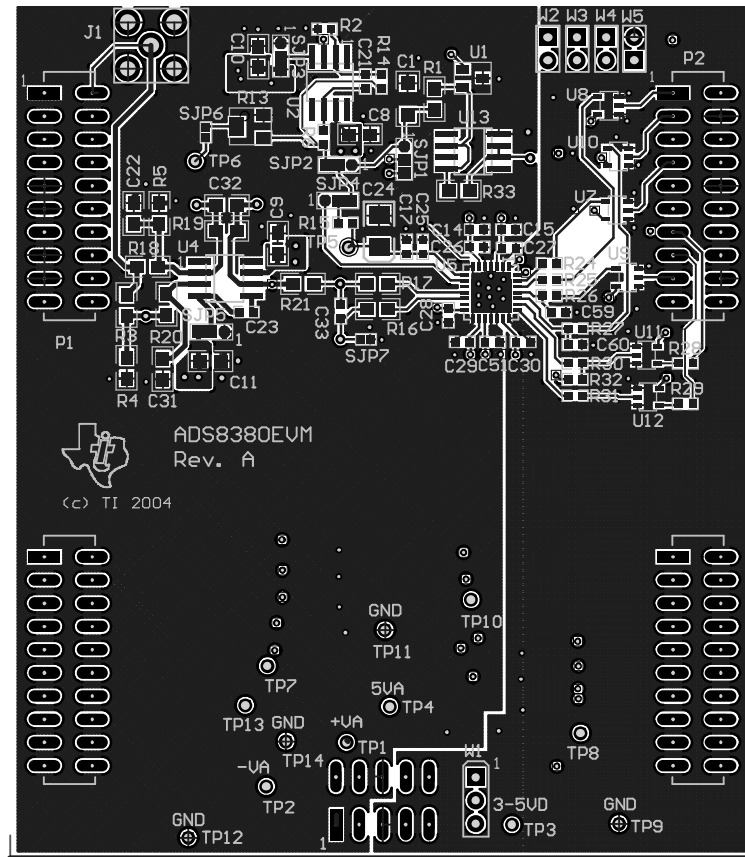


Figure 2. Top Layer

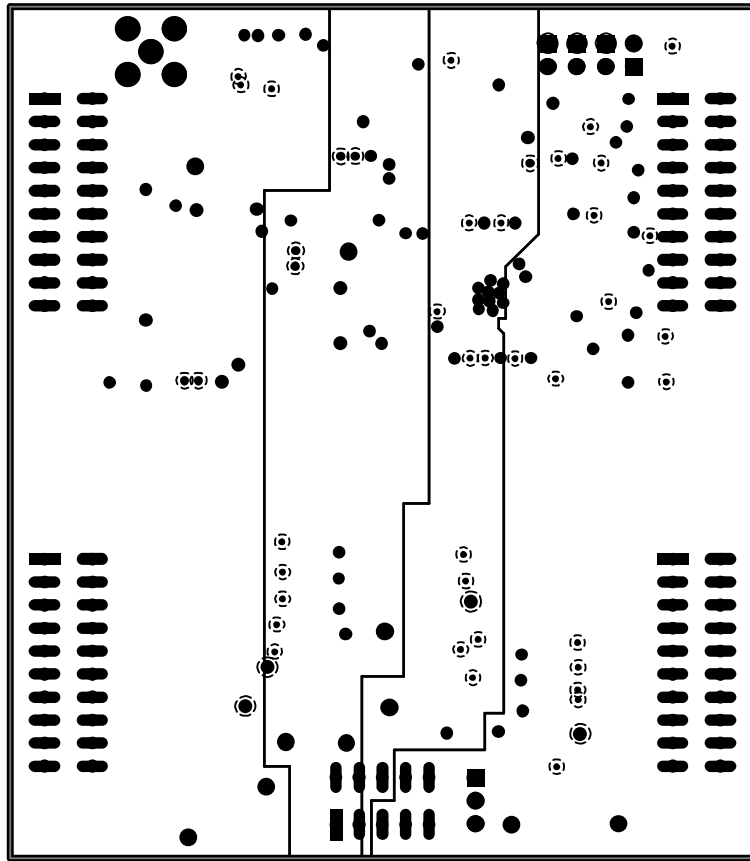


Figure 3. Power Plane

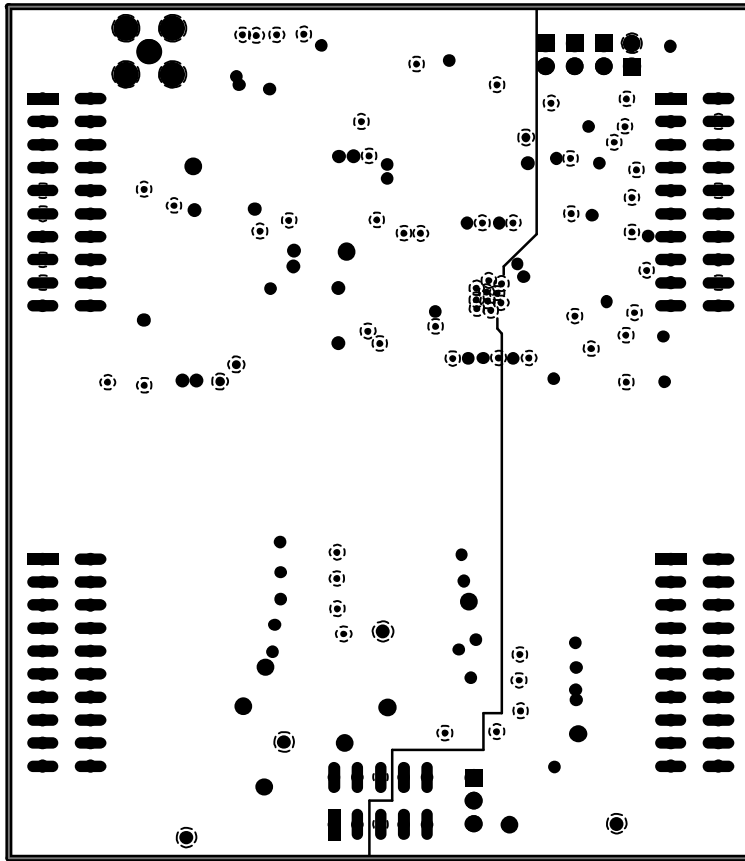


Figure 4. Ground Plane

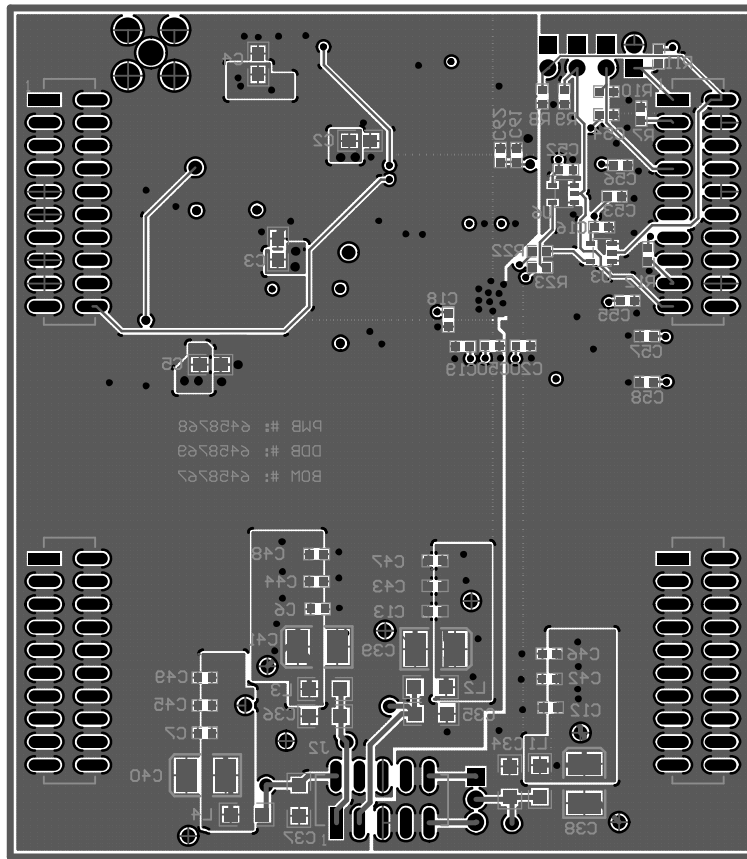
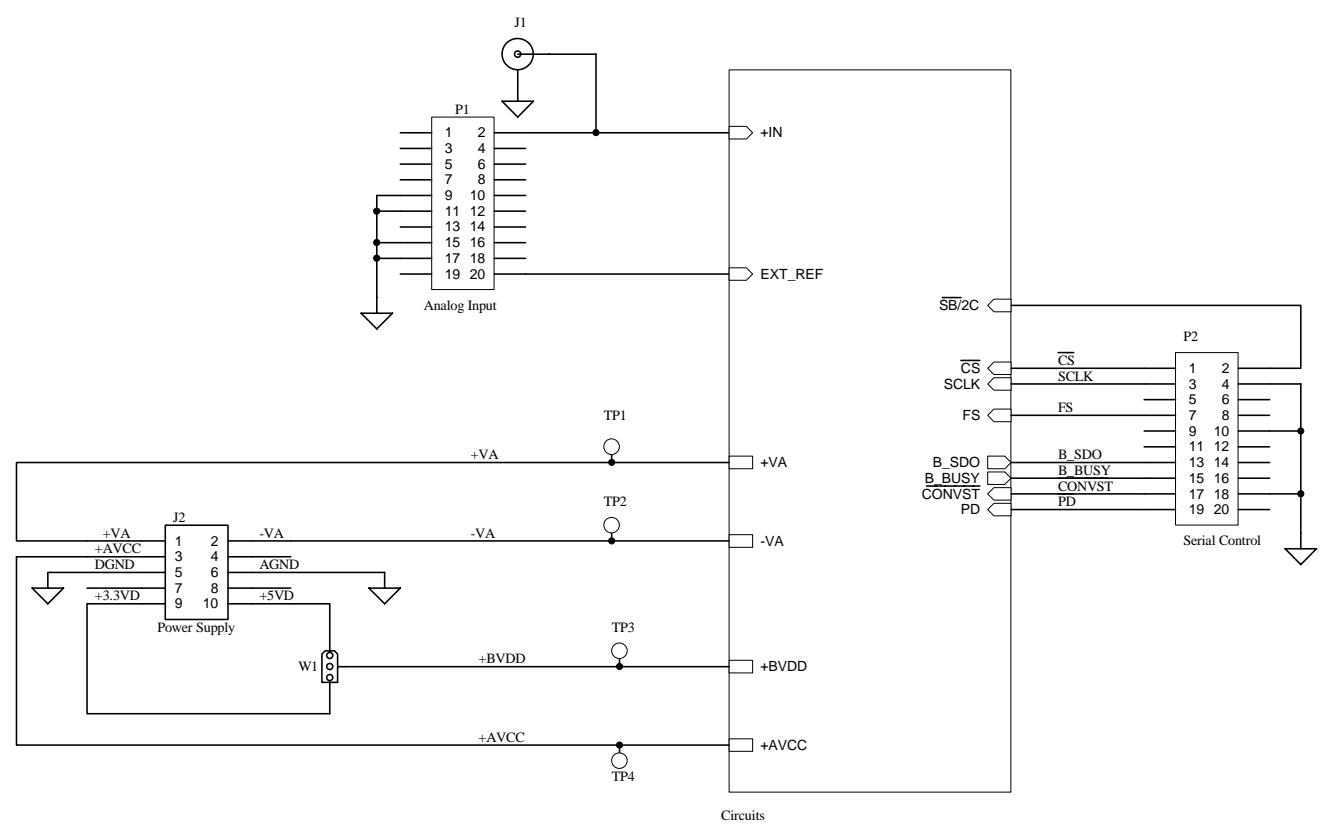


Figure 5. Bottom Layer

9 Schematics

Schematic diagrams are appended following this page.

| Revision History | | |
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| REV | ECN Number | Approved |
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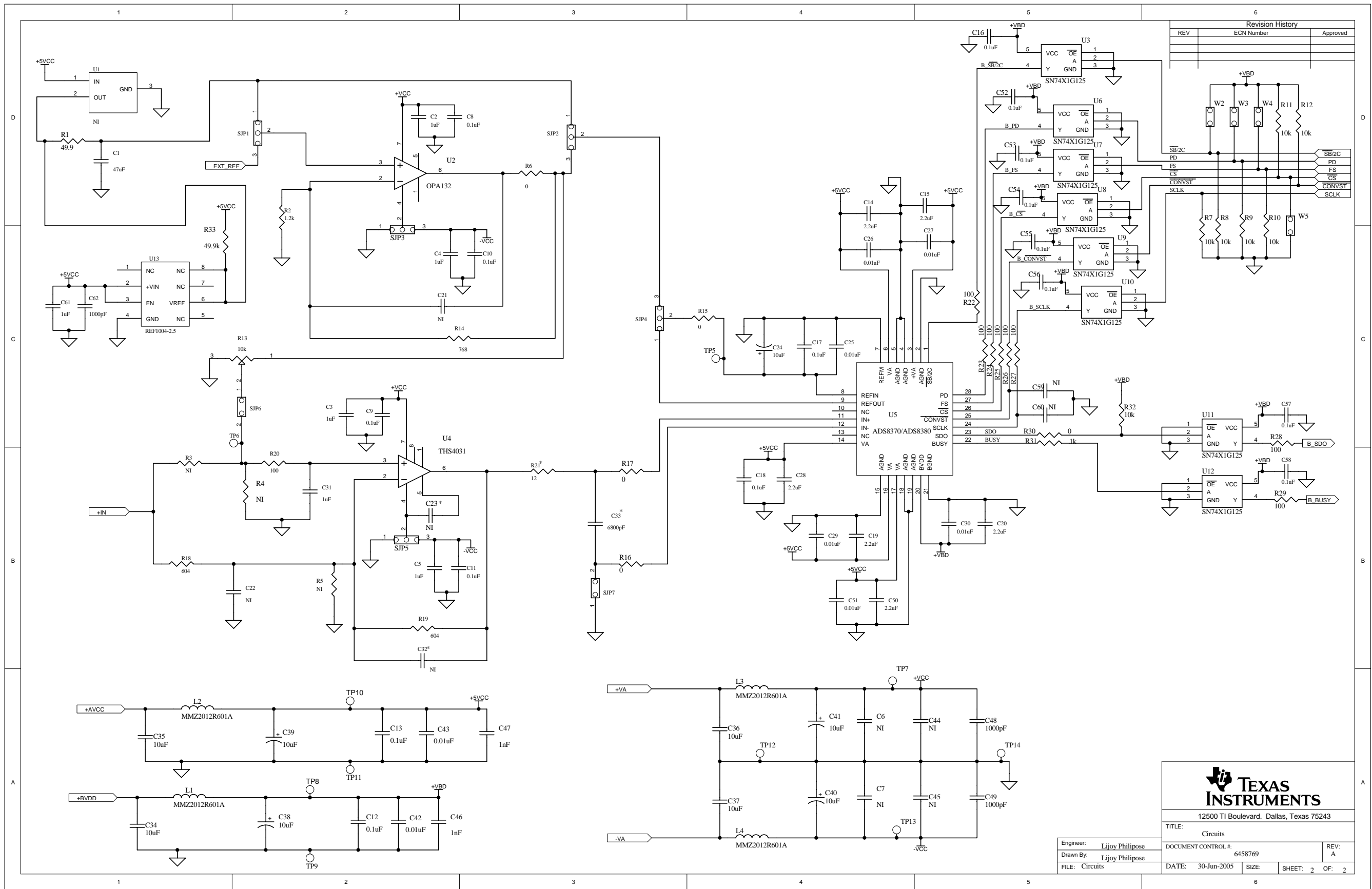


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TITLE: ADS8370EVM/ADS8380EVM

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| Engineer: Lijoy Philipose | DOCUMENT CONTROL #: 6458769 | REV: A |
| Drawn By: Lijoy Philipose | DATE: 30-Jun-2005 | SIZE: SHEET: 1 OF: 2 |

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| Engineer: Lijoy Philipose | DOCUMENT CONTROL #: 6458769 | REV: A |
| Drawn By: Lijoy Philipose | DATE: 30-Jun-2005 | SIZE: SHEET: 1 OF: 2 |



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Engineer: Lijoy Philipose
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