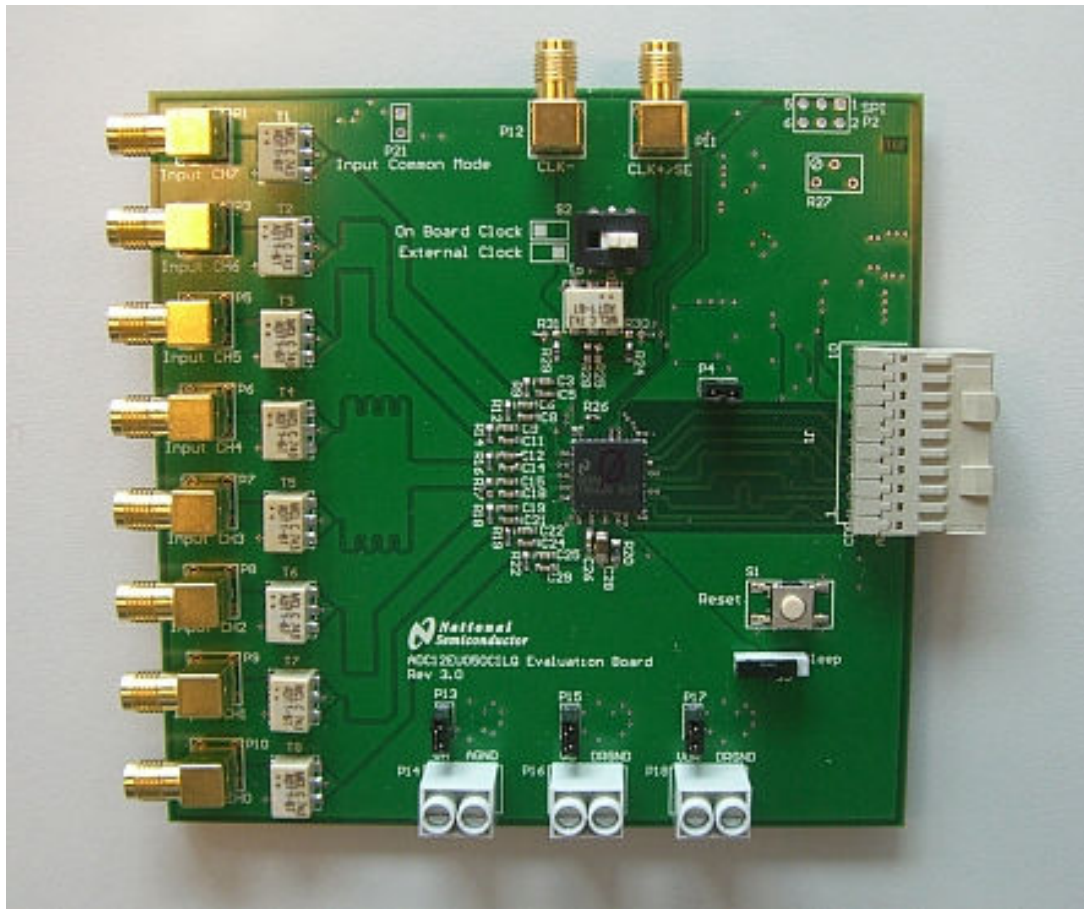


# Evaluation Board User's Guide

## ADC12EU050: Ultra-low Power, Octal, 12-bit, 40-50MSPS Sigma-Delta Analog-to-Digital Converter



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## 1.0 Introduction

This Evaluation Board is used to evaluate one of the A/D Converter ADC12EU050. The ADC is a 12 bit converter that provides data at a rate of 40 – 50 MHz.

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 SFDR and ENOB.

## 2.0 Board Assembly

The ADC12EU050 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.

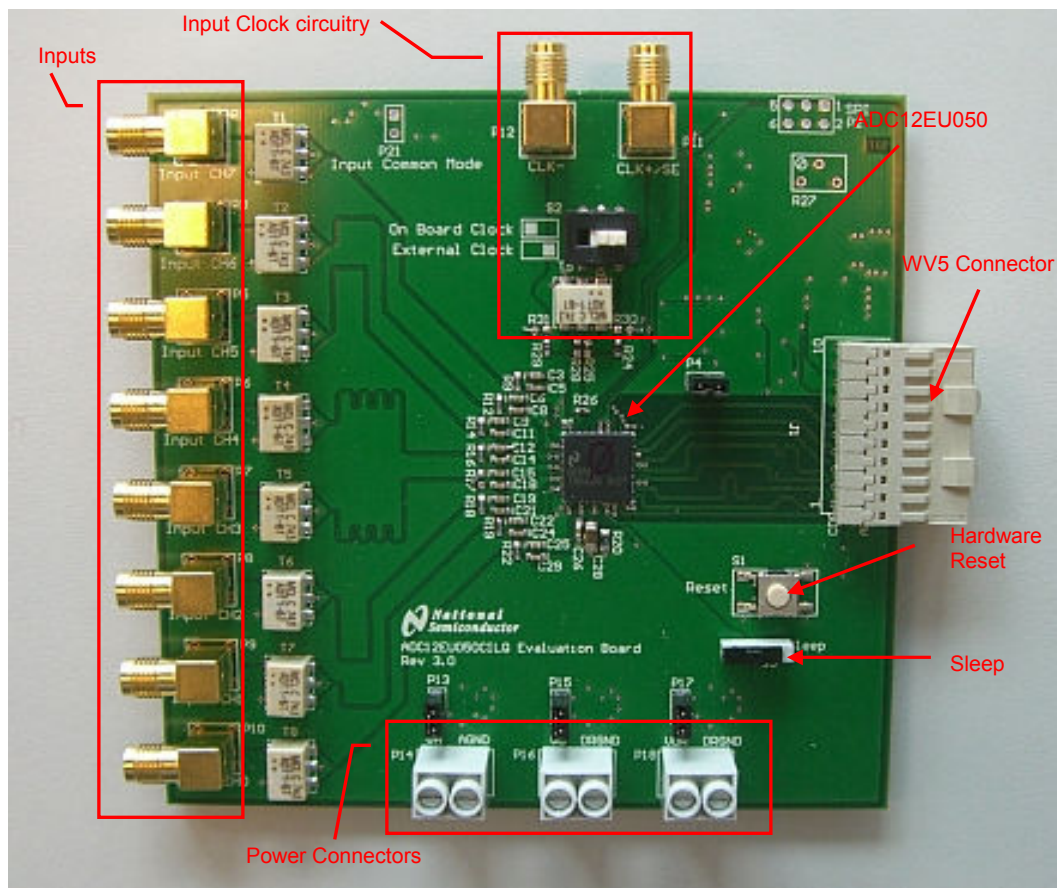


Figure 1: Major Component Locations

## 3.0 Quick Start

Refer to Figure 1 for locations of jumpers, test points and major components. The board is configured by default to use an on board crystal clock source and internal reference. Refer to Section 4.0 for detailed information on jumper settings.

You must have the WaveVision5™ software to test this board. You can download the latest version from the National Semiconductor website.

1. Connect the ADC12EU050 evaluation board to the WaveVision5™ Data Capture Board.
2. Apply power to the WaveVision5™ Data Capture Board.
3. Connect power to the ADC12EU050 board as described in section 4.4, and power it up.
4. Connect the WaveVision5™ board to the computer using a USB cable.
5. Start the WaveVision5™ software.
6. Connect a signal from a 50-Ohm source to connector a channel input. Be sure to use a bandpass filter before the Evaluation Board.
7. Adjust the input signal amplitude as needed to ensure that the signal does not over-range by examining an FFT of the output data with the WaveVision™ software.

## 4.0 Functional Description

The ADC12EU050 Evaluation Board schematic is shown in Section 6. A list of default switch and jumper settings can be found in section 4.10.

### 4.1 Analog Input

The analog input is supplied through standard SMA connectors. The evaluation board is designed for single ended inputs, which are converted to differential by the transformers.

It must be ensured that a high quality signal source is used so that the ADC dynamic performance can be properly evaluated. A bandpass filter on the input signal is highly recommended.

### 4.2 ADC reference

The ADC12EU050 can use an internal or external reference. This evaluation board is configured to use the internal reference.

### 4.3 ADC input clock

The ADC12EU050 can be clocked at 40-50MHz. The input clock circuit is shown in Figure 2 below.

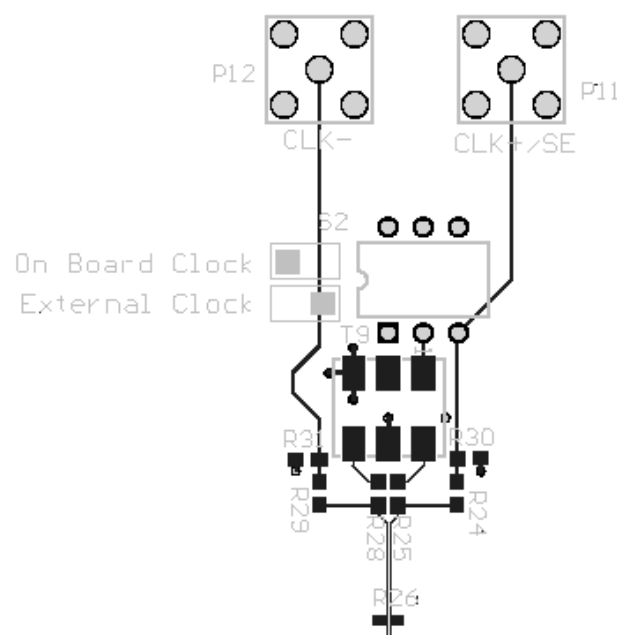


Figure 2: Input clock circuit.

A combination of 0 ohm resistors and a switch are used to select the path of the clock to the ADC. While not as convenient as pin-type jumpers, these introduce less noise into the clock signal.

Selecting “On Board Clock” with switch S2 enables an on board 50MHz crystal oscillator. The output of this oscillator is converted to differential by transformer T9 and routed to the CLK+ and CLK- input of the ADC.

Selecting “External Clock” with switch S2 disables the on-board crystal oscillator. It enables the user to connect a single ended clock to P11. This clock is converted to a differential signal by the transformer T9.

The external clock amplitude and waveform are fairly flexible, but a 600mVpp differential square wave at the chip inputs is recommended.

By changing the 0 ohm resistors R24, R25, R28 and R29 other clock input configurations can be realized. For example, a fully differential clock could be supplied, bypassing the on-board transformer.

If a single ended clock is supplied to the ADC, then the LVDS termination resistor, R26, must be removed.

### 4.4 Power Supply Connections

Power to the board is supplied through the power connectors P14, P16 and P18. The required voltages are shown in Figure 3 below, and described underneath.

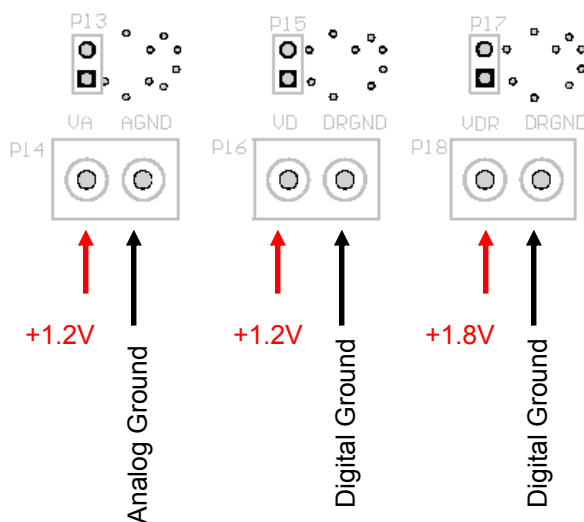


Figure 3: Power Supply Connectoins

P14: Analog power and ground

- ADC12EU050 analog supply, VA.
- Connect VA to 1.2V, AGND to ground
- Current can be measured across P13

P16: Digital power and ground

- ADC12EU050 digital supply, VD.
- Connect VD to 1.2V, DRGND to ground
- Current can be measured across P15

P18: Output driver power and ground

- ADC12EU050 output driver supply, VDR.
- Connect VDR to 1.8V, DRGND to ground (same as DRGND of P16)
- Current can be measured across P17

Generally, all grounds can be tied together, as can analog and digital supplies (VA and VD).

The datasheet for the ADC12EU050 specifies that the output driver supply voltage (VDR) can be 1.2V or 1.8V.

Due to the design of the evaluation system, specifically the distance from the ADC12EU050 to the Xilinx Virtex4 FPGA on the WaveVision5™ board and the connector through which the LVDS outputs are routed, VDR should be kept at 1.8V.

A VDR of 1.2V can be used, but in this case the LVDS current drive (I\_drive, SPI register 0x18, bits 3:2) must be increased to 5mA.

#### 4.5 Reset

The reset button pulls the RSTb pin of the ADC12EU050 low, resetting the ADC. The reset button only affects the ADC, not any other component on the board, or on the WaveVision5™ board.

#### 4.6 Sleep

The sleep switch puts the ADC input sleep mode, by connecting the SLEEP pin to VDR.

#### 4.7 Input Common Mode

Jumper P21 can be used to force a common mode on the ADC inputs. In its default configuration, the evaluation board has capacitively coupled ADC inputs, and using the Input Common Mode jumper will not have any effect.

#### 4.8 Default Jumper and Switch Settings

On delivery, the board's jumpers and switches should be set as defined in the table below. Any directions are defined when the board is positioned as in Figure 1.

| Jumper or Switch | Default Position             |
|------------------|------------------------------|
| P2               | Open                         |
| P4               | Closed                       |
| P13              | Closed                       |
| P15              | Closed                       |
| P17              | Closed                       |
| P21              | Open                         |
| S2               | Left (On Board Clock)        |
| S3               | Left (Sleep mode not active) |

## **5.0 Software and SPI Registers**

The ADC12EU050 evaluation board is designed to be used with the WaveVision5™ data capture board and software. The latest version of the WaveVision5™ software must be used.

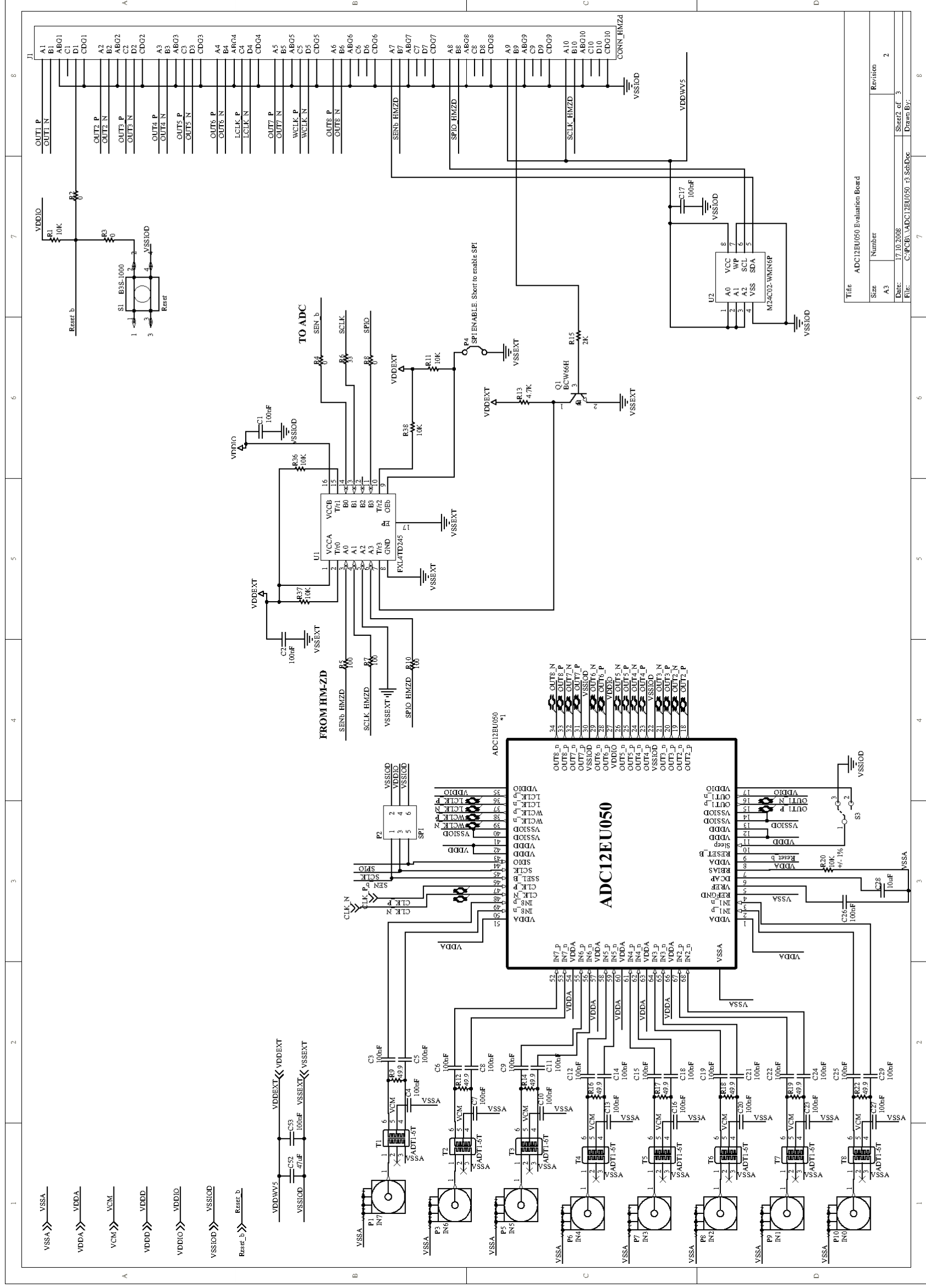
### **5.1 SPI Registers**

As described in the ADC12EU050 datasheet, there are many user registers accessible via the SPI interface.

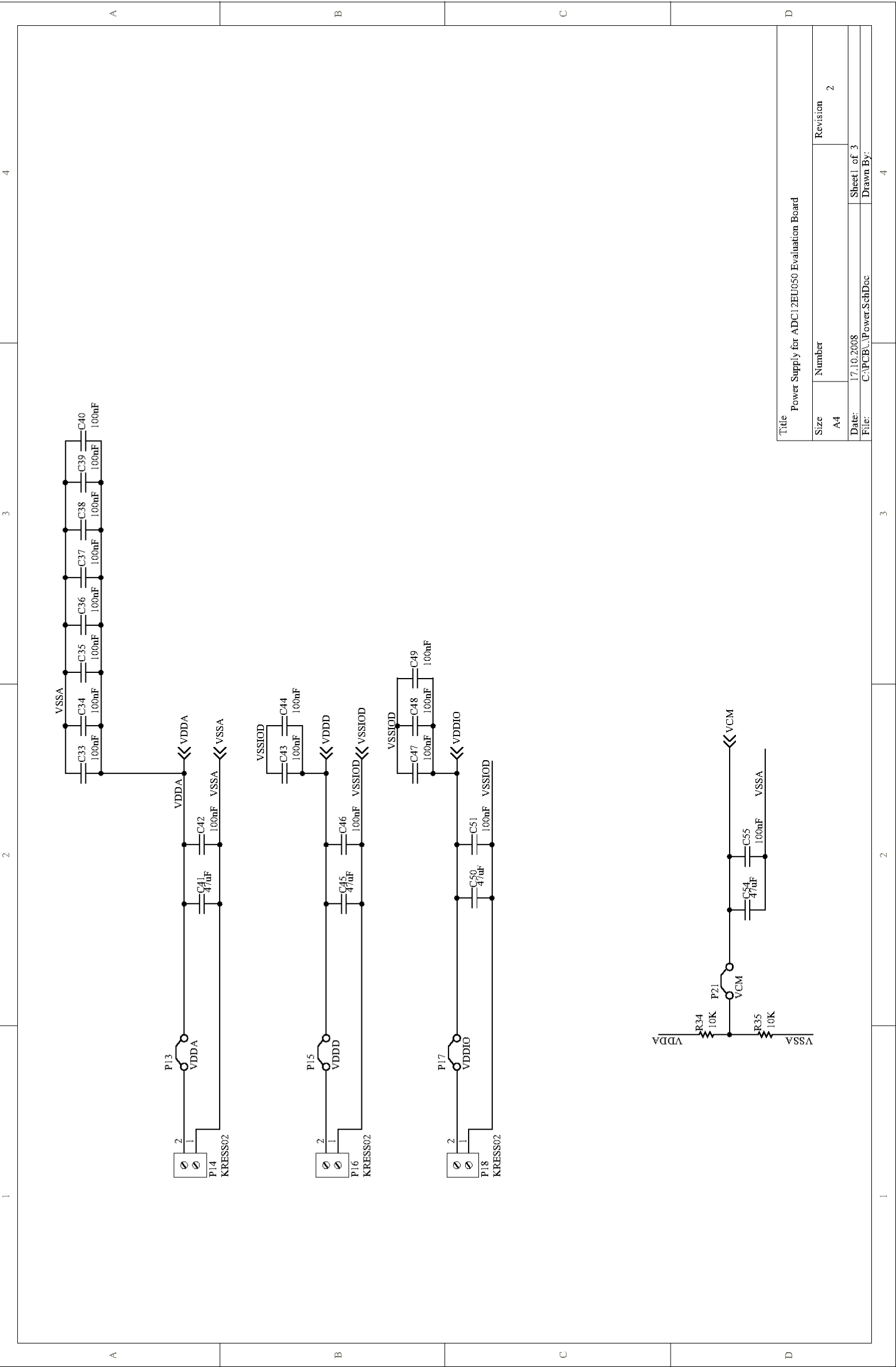
These registers can all be programmed via the “Registers” tab in the WaveVision5™ software.

All registers and values are described in the ADC12EU050 datasheet, which is available from the National Semiconductor website.

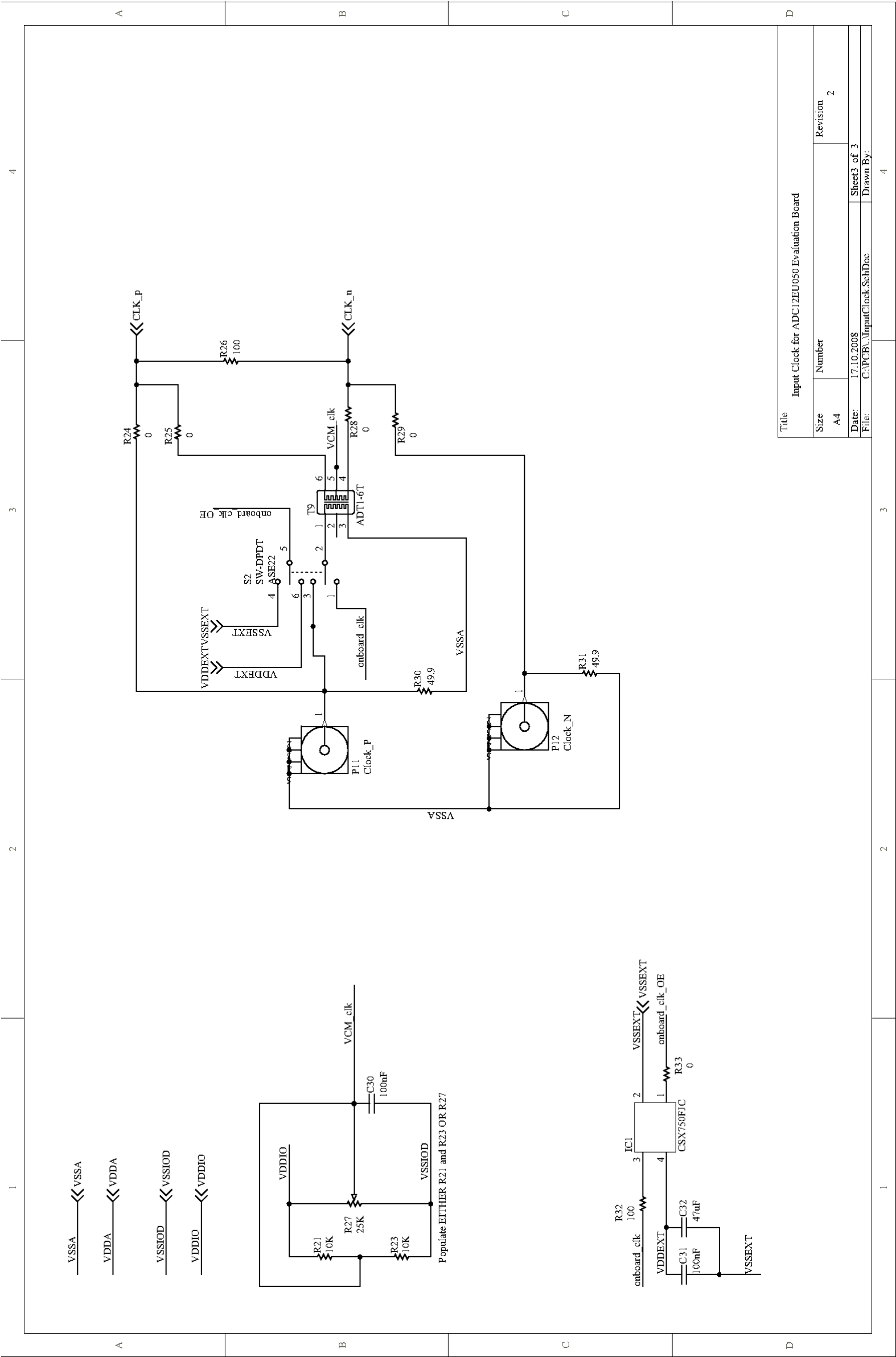
# 7.0 Hardware Schematic



|       |                             |                             |            |
|-------|-----------------------------|-----------------------------|------------|
| Title |                             | ADC12EU050 Evaluation Board |            |
| Size  | Number                      | Revision                    | 2          |
| A3    |                             | Date:                       | 17.10.2008 |
| FILE: | C:\PCB\ADC12EU050_r3.SchDoc | Sheet of                    | 3          |
|       |                             | Drawn By:                   |            |

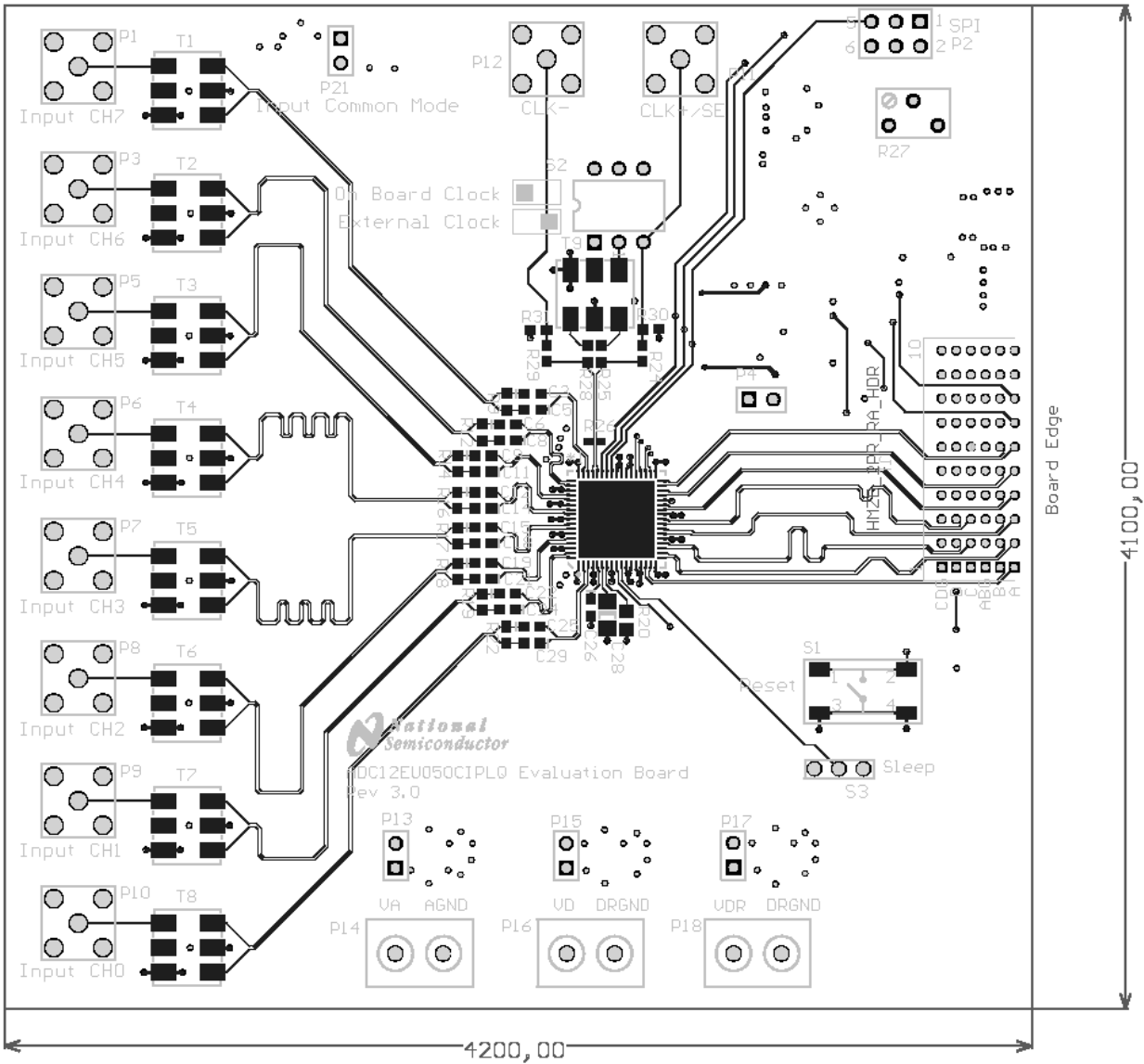


|                                              |                    |          |              |
|----------------------------------------------|--------------------|----------|--------------|
| Title                                        |                    |          |              |
| Power Supply for ADC12EU050 Evaluation Board |                    |          |              |
| Size                                         | Number             | Revision |              |
| A4                                           |                    | 2        |              |
| Date:                                        | 17.10.2008         |          | Sheet 1 of 3 |
| File:                                        | C:\PCB\PowerSchDoc |          | Drawn By:    |

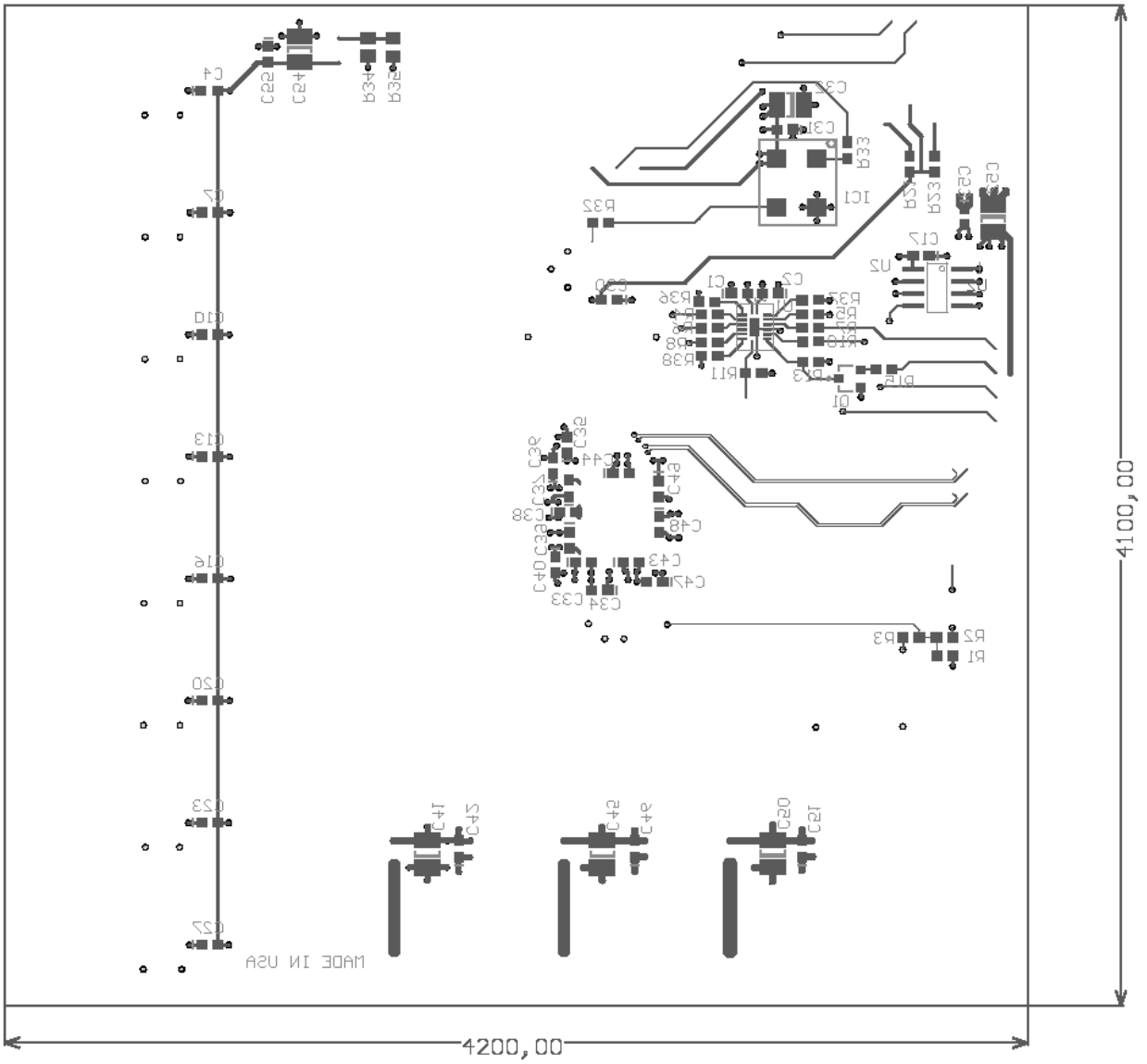


## 8.0 Evaluation Board Layout

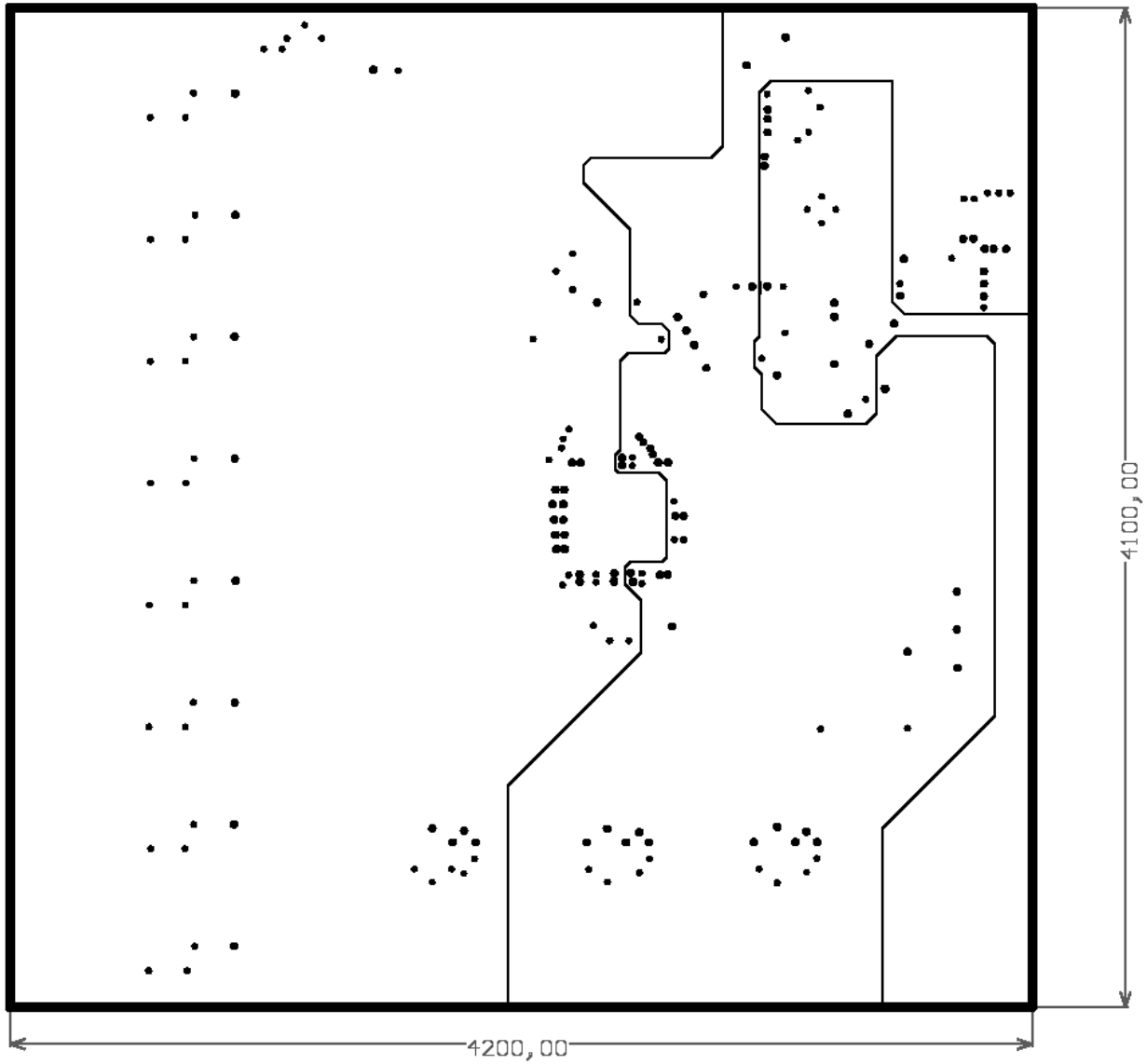
Layer 1 : Top



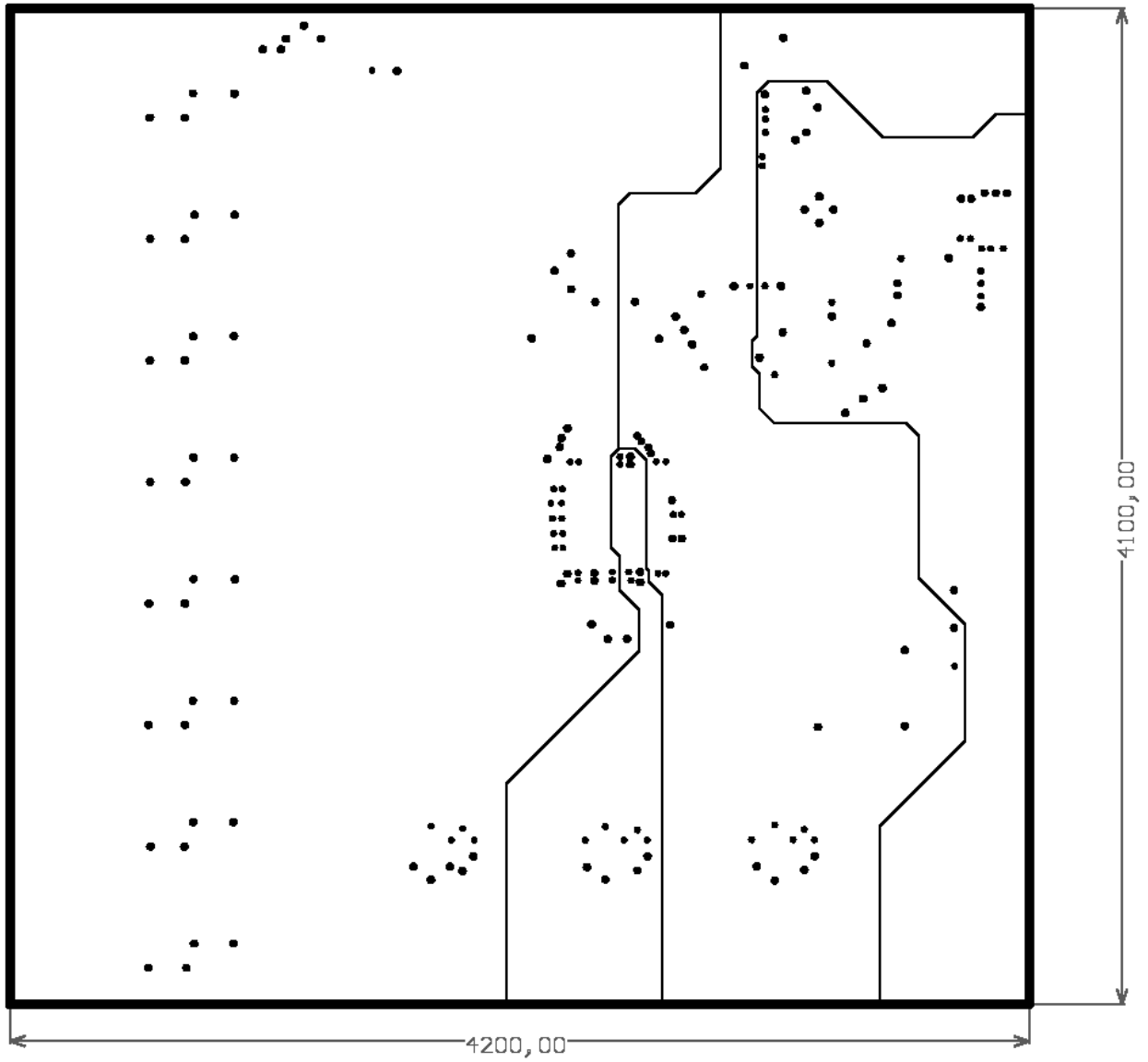
## Layer 2 : Internal Ground Plane



Layer 3 : Internal Power Plane



Layer 4 : Bottom



## 9.0 Evaluation Board Bill of Materials

| Designator                                                                                                                                                                                                                            | Footprint           | Value                                     | Description                                                                      | Quantity |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------|----------------------------------------------------------------------------------|----------|
| *1                                                                                                                                                                                                                                    | QFN10X10-68         | ADC12EU050                                | ADC                                                                              | 1        |
| C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C29, C30, C31, C33, C34, C35, C36, C37, C38, C39, C40, C42, C43, C44, C46, C47, C48, C49, C51, C53, C55 | CC1608-0603         | 100nF                                     | Capacitor (Semiconductor SIM Model)                                              | 48       |
| C28                                                                                                                                                                                                                                   | CC3216-1206         | 10uF                                      | Capacitor (Semiconductor SIM Model)                                              | 1        |
| C32, C41, C45, C50, C52, C54                                                                                                                                                                                                          | CC3225-1210         | 47uF                                      | Capacitor (Semiconductor SIM Model)                                              | 6        |
| IC1                                                                                                                                                                                                                                   | CSX750FJC           | Citizen CSX750FJC50.000M-UT               | Crystal Oscillator                                                               | 1        |
| J1                                                                                                                                                                                                                                    | HMZD_2PR_RA_HDR     | HMZd – Tyco Electronics part no 6469028-1 | HMZd Connector 60 pin                                                            | 1        |
| P1, P3, P5, P6, P7, P8, P9, P10, P11, P12                                                                                                                                                                                             | SMA                 |                                           | RF Coaxial PCB Connector, MMCX; Thru-Hole, Vertical Mount Plug, 50 Ohm Impedance | 10       |
| P2                                                                                                                                                                                                                                    | HDR2X3              | Header 2x3                                | Header, 3-Pin, Dual row                                                          | 1        |
| P14, P16, P18                                                                                                                                                                                                                         | LP2                 | Lumberg KRESS02 Terminal Block            | Terminal Block                                                                   | 4        |
| P4, P13, P15, P17, P21                                                                                                                                                                                                                | HDR1X2              | Header2x1                                 | Jumper Wire                                                                      | 4        |
| Q1                                                                                                                                                                                                                                    | SOT23               | BCW66H                                    | NPN General Purpose Transistor                                                   | 1        |
| R33, R24, R25, R28, R29, R4, R8, R2, R3                                                                                                                                                                                               | CR1608-0603         | 0                                         | Semiconductor Resistor                                                           | 9        |
| R15                                                                                                                                                                                                                                   | CR1608-0603         | 2K                                        | Semiconductor Resistor                                                           | 1        |
| R13                                                                                                                                                                                                                                   | CR1608-0603         | 4.7K                                      | Semiconductor Resistor                                                           | 1        |
| R11, R36, R37, R38, R1, R21, R23                                                                                                                                                                                                      | CR1608-0603         | 10K                                       | Semiconductor Resistor                                                           | 7        |
| R6                                                                                                                                                                                                                                    | CR1608-0603         | 33                                        | Semiconductor Resistor                                                           | 1        |
| R9, R12, R14, R16, R17, R18, R19, R22, R30, R31                                                                                                                                                                                       | CR1608-0603         | 49.9                                      | Semiconductor Resistor                                                           | 10       |
| R32, R5, R7, R10                                                                                                                                                                                                                      | CR1608-0603         | 100                                       | Semiconductor Resistor                                                           | 4        |
| R20, R34, R35                                                                                                                                                                                                                         | CR2012-0805         | 10K +/- 1%                                | Semiconductor Resistor                                                           | 3        |
| R26                                                                                                                                                                                                                                   | CR1005-0402         | 100                                       | Semiconductor Resistor                                                           | 1        |
| R27                                                                                                                                                                                                                                   | 3296Y               | 25K                                       | Potentiometer                                                                    | 1        |
| S1                                                                                                                                                                                                                                    | PushButton          | OMRON B3S-1000                            | Push Button                                                                      | 1        |
| S2                                                                                                                                                                                                                                    | DIP-6               | Tyco ASE22                                | Double-Pole, Double-Throw Switch                                                 | 1        |
| S3                                                                                                                                                                                                                                    | SW-DIP1             | EAO part no 09-03290-01                   | Single Switch                                                                    | 1        |
| T1, T2, T3, T4, T5, T6, T7, T8, T9                                                                                                                                                                                                    | ADT1-6T             | Mini Circuits ADT1-6T                     | Transformer                                                                      | 9        |
| U1                                                                                                                                                                                                                                    | DQFN_50M_16_2P5X3P5 | FXL4TD245                                 | 4-bit level shifter                                                              | 1        |
| U2                                                                                                                                                                                                                                    | SOIC8_05_WG244_L200 | M24C02-WMN6P                              | EEPROM, STMicroelectronics, M24C02-WMN6P                                         | 1        |

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