

## Evaluating the AD9262, 16-Bit, Dual Continuous Time Sigma Delta ADC and Demonstrating Direct Conversion

### EVALUATION BOARD DESCRIPTION

The AD9262 evaluation board serves two purposes: as an evaluation platform for the 16-bit dual continuous time sigma delta ADC and as a direct conversion demonstration platform. Table 1 lists the product features of all the Analog Devices, Inc., components in the demonstrator.

The AD9262 is a dual, 16-bit analog-to-digital converter (ADC) based on a continuous time sigma-delta ( $\Sigma$ - $\Delta$ ) architecture that achieves 86 dB of dynamic range over a 10 MHz real or 20 MHz complex bandwidth. The integrated features and characteristics unique to the continuous time  $\Sigma$ - $\Delta$  architecture significantly simplify its use and minimize the need for external components. This evaluation board supports the AD9262 family of products, including the AD9262BCPZ-10, AD9262BCPZ-5, and AD9262BCPZ.

Direct conversion architectures, as shown in Figure 1, use a single frequency translation step to convert the RF channel directly to baseband without any intermediate frequency stages. The frequency translation in this direct conversion demonstrator is accomplished by the ADL5382, which is a quadrature demodulator. The ADL5382 covers the frequency range between 700 MHz and 2.7 GHz.

The AD9262 has passive inputs, therefore allowing the ADL5382 to directly drive the ADC. The AD9262 does not require a filter preceding the converter because the continuous time sigma-delta architecture possesses inherent antialiasing capabilities.

Therefore, minimal or no filtering is required between the demodulator and the ADC. A prototype area for a fourth order filter is provided in which additional filtering can be tested.

To achieve optimal performance from the AD9262, a low jitter differential clock is necessary, and the AD9516 family of parts offers superior clock performance. The AD9516 and a crystal oscillator footprint are included on the evaluation board. In addition to providing a clock option to the ADC, outputs from the AD9516 can be used to drive other external capture devices.

The ADR130B offers the option of using an external 0.5 V band gap reference voltage for the AD9262. The ADP3339 provides a quiet and reliable voltage source to each of the ADI components.

In addition to offering system-level evaluation of the direct conversion architecture, the evaluation board offers the flexibility of isolating the AD9262 from the surrounding components, enabling a detailed evaluation of only the AD9262. The ADC inputs can be disconnected from the ADL5382 and be driven with an external source. The analog inputs of the AD9262 can be driven from either a differential transformer or the ADA4937, which is a very low noise, high linearity differential amplifier.

Complementing the AD9262 evaluation board are additional hardware and software to capture and process the digital data from the output of the ADC. The AD9262 can only be evaluated using the HSC-ADC-EVALCZ high speed ADC data capture card in conjunction with the VisualAnalog™ data capture and analysis software. The SPIController™ software is used to read and write to the AD9262.

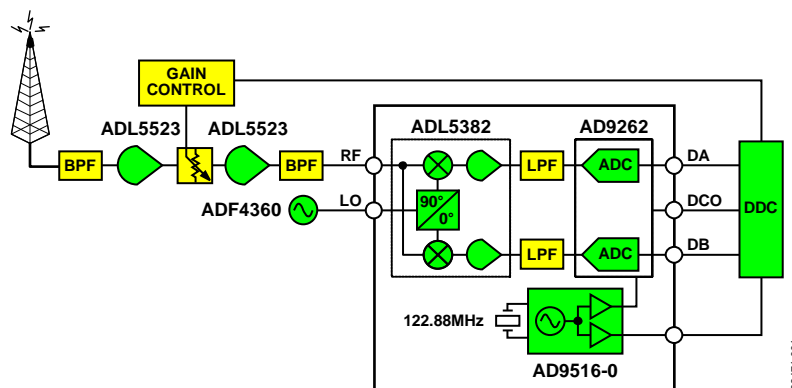


Figure 1. Direct Conversion Receiver Block Diagram

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**REVISION HISTORY**

**1/10—Revision 0: Initial Version**

**PRODUCT FEATURES**

Table 1.

<b>AD9262</b>	<b>ADL5382</b>	<b>AD9516-0</b>
<p>SNR: 82.5 dB (84.5 dBFS) to 10 MHz input                      SFDR: 87 dBc to 10 MHz input                      Noise figure: 15 dB                      Input impedance: 1 k<math>\Omega</math>                      Power: 675 mW                      1.8 V analog supply operation                      1.8 V to 3.3 V output supply                      Selectable bandwidth                          2.5 MHz/5 MHz/10 MHz real                          5 MHz/10 MHz/20 MHz complex                      Output data rate: 30 MSPS to 160 MSPS                      Integrated decimation filters                      Integrated sample rate converter                      On-chip PLL clock multiplier                      On-chip voltage reference                      Offset binary, gray code, or twos complement data format                      Serial control interface (SPI)</p>	<p>I/Q demodulator                      Operating RF frequency: 700 MHz to 2700 MHz                      IIP3 + 30 dBm                      IIP2 + 60 dBm                      Input P1dB + 13dBm                      NF 14 dB @ 900 MHz                      Voltage conversion gain: 5 dB                      Quadrature demodulation accuracy                          Phase accuracy &lt;0.5°                          Amplitude balance &lt;0.25 dB                      LO input: -10 dBm to +5 dBm                      Demodulation bandwidth: ~500 MHz                      I/Q drive 2 V<sub>PEAK</sub> into 200 <math>\Omega</math>                      Programmable power consumption</p>	<p>Low phase noise, phase-locked loop                      On-chip VCO tunes from 2.55 GHz to 2.95 GHz                      External VCO/VCXO to 2.4 GHz (optional)                      One differential or two single-ended reference inputs                      Reference monitoring capability                      Auto and manual reference switchover/holdover modes                      Autorecover from holdover                      Accepts references to 250 MHz                      Programmable delays in path to PFD                      Digital or analog lock detect, selectable                      Three pairs of 1.6 GHz LVPECL outputs                          Each pair shares one to 32 dividers with coarse phase delay                          Additive output jitter: 225 fs rms                          Channel-to-channel skew paired outputs: &lt;10 ps                      Two pairs of 800 MHz LVDS clock outputs                          Each pair shares two cascaded one-to-32 dividers with coarse phase delay                          Additive output jitter: 275 fs rms                          Fine delay adjust (<math>\Delta T</math>) on each LVDS output                      Eight 250 MHz CMOS outputs (two per LVDS output)                      Automatic synchronization of all outputs on power-up                      Manual synchronization of outputs as needed                      Serial control port                      64-lead LFCSP</p>
<b>ADR130B</b>	<b>ADP3339</b>	<b>ADA4937</b>
<p>Initial accuracy                          A grade: <math>\pm 0.70\%</math> (maximum)                          B grade: <math>\pm 0.35\%</math> (maximum)                      Maximum temperature coefficient                          A grade: 50 ppm/<math>^{\circ}\text{C}</math>                          B grade: 25 ppm/<math>^{\circ}\text{C}</math>                      C<sub>LOAD</sub>: 50 nF to 10 <math>\mu\text{F}</math>                      Output current: +4 mA/-2 mA                      Low operating current: 80 <math>\mu\text{A}</math> (typical)                      Output noise: 6 <math>\mu\text{V}</math> p-p @ 1.0 V output                      Input range: 2.0 V to 18 V                      Temperature range: -40<math>^{\circ}\text{C}</math> to +125<math>^{\circ}\text{C}</math>                      Tiny Pb-free TSOT package</p>	<p>High accuracy over line and load: <math>\pm 0.9\%</math> @ 25<math>^{\circ}\text{C}</math>, <math>\pm 1.5\%</math> over temperature                      Ultralow dropout voltage: 230 mV (typical) @ 1.5 A                      Requires only C<sub>O</sub> = 1.0 <math>\mu\text{F}</math> for stability                      anyCAP<sup>®</sup> regulators: stable with any type of capacitor (including MLCC)                      Current and thermal limiting                      Low noise                      2.8. V to 6 V supply range                      -40<math>^{\circ}\text{C}</math> to +85<math>^{\circ}\text{C}</math> ambient temperature range                      SOT-223 package</p>	<p>Extremely low harmonic distortion                          -112 dBc HD2 @ 10 MHz                          -79 dBc HD2 @ 70 MHz                          -70 dBc HD2 @ 10 MHz                          -102 dBc HD3 @ 10 MHz                          -91 dBc HD3 @ 70 MHz                          -84 dBc HD3 @ 100 MHz                      Low input voltage noise: 2.2 nV/<math>\sqrt{\text{Hz}}</math>                      High speed                          -3 dB bandwidth of 1.0 GHz, G = 1                          Slew rate: 6000 V/<math>\mu\text{s}</math>, 25% to 75%                          dB gain flatness to 200 MHz                          Fast overdrive recovery of 1 ns                      1 mV typical offset voltage                      Externally adjustable gain                      Differential-to-differential or single-ended-to-differential operation                      Adjustable output common-mode voltage                      Single-supply operation: 3.3 V to 5 V                      Pb-free, 3 mm <math>\times</math> 3 mm 16-lead LFCSP</p>

GETTING STARTED

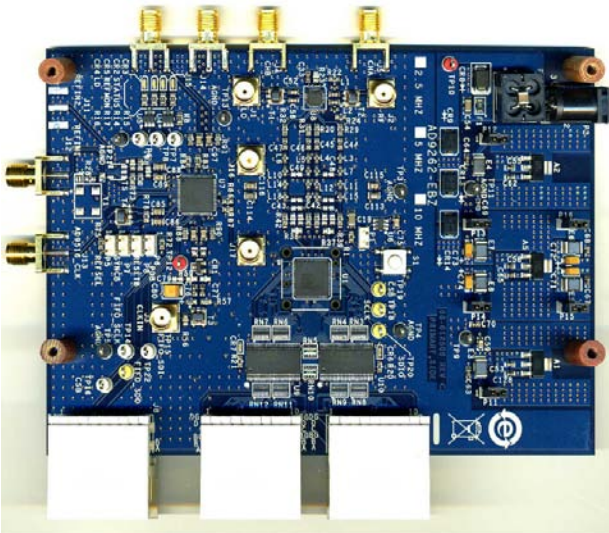


Figure 2. Evaluation Board Front

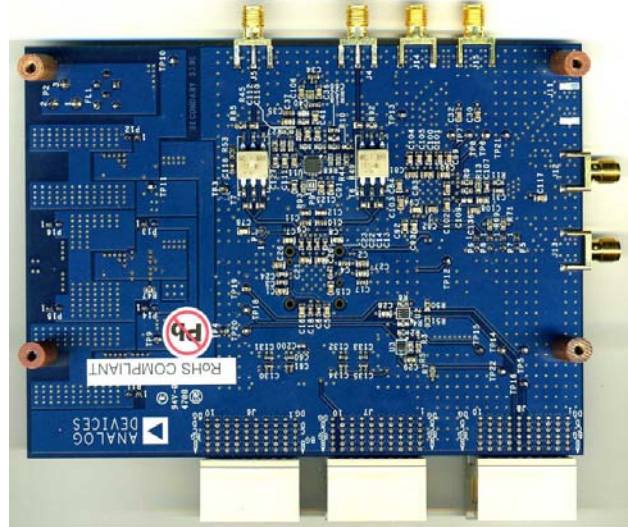


Figure 3. Evaluation Board Back

The default configuration of the AD9262 evaluation board allows a quick and easy start to evaluating the direct conversion receiver subsystem. The default configuration interfaces the ADL5382 directly with the AD9262. Table 2 and Figure 4 show the hardware required to start the evaluation.

Table 2. Quick Start Hardware Requirements

Name	Board	Value	Reference Designator
Power	AD9262EBZ	+6 V	P2
	HSC-ADC-EVALCZ	+5 V	
Clock	AD9262EBZ	640 MHz	J3
RF Input	AD9262EBZ	700 MHz to 2.7 GHz	J2
LO Input	AD9262EBZ	-10 dBm to +5 dBm	J1
USB	HSC-ADC-EVALCZ		

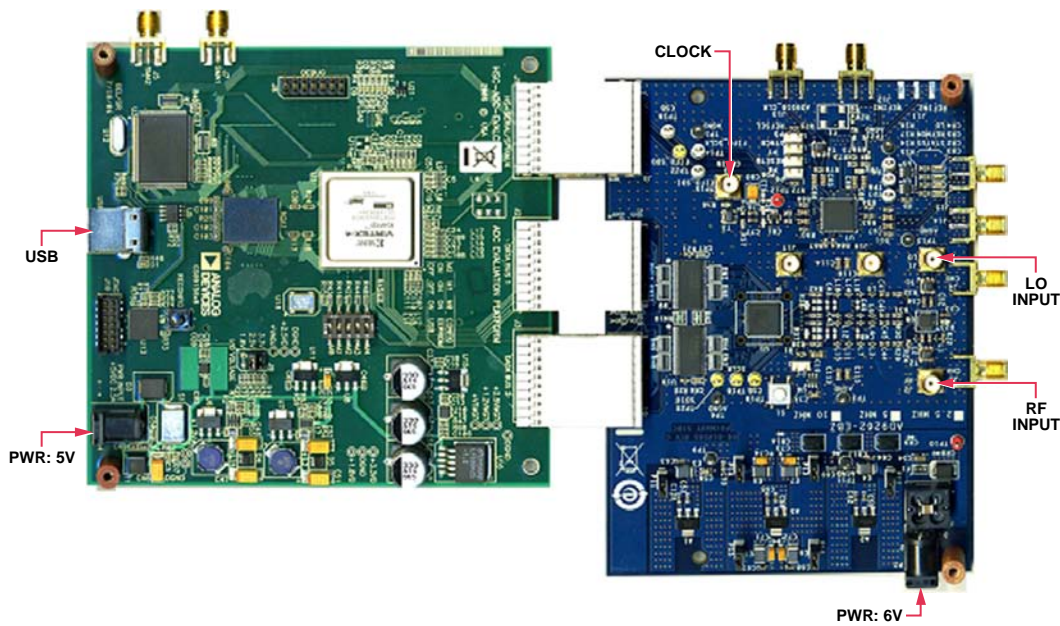


Figure 4. Quick Start Configuration

# CONFIGURING THE EVALUATION BOARD

## POWER SUPPLY

Power is provided to the evaluation board by a single +6.0 V source applied to P2. The power source is regulated down to the appropriate levels by the ADP3339 voltage regulators. Table 3 shows the necessary voltage levels for each component.

**Table 3. Component Power Supplies**

Component	Power Supply
AD9262	1.8 V
ADL5382	5.0 V
AD9516-0	3.3 V

## CLOCK

The AD9262 evaluation board offers many clocking options: a high frequency external clock can be applied directly to the ADC; the AD9516-0 LVPECL or CMOS clock can be used; and a low frequency clock, in conjunction with the integrated PLL from either the AD9516-0 or AD9262, can provide the necessary input clock frequency. The default clock option is configured for an external clock rate of 640 MHz.

The AD9262 evaluation board includes the footprint for a Valpey Fisher VFAC3 crystal oscillator. The crystal oscillator can serve as the reference clock to the AD9516-0, and the chip's internal PLL can be used to generate a clock closest to the desired frequency for the ADC. For example, a 122.88 MHz reference produces a VCO frequency of 2.580 GHz. The AD9516-0 possesses an integrated VCO. The VCO frequency is further divided down by 4 to generate an output clock of 645 MHz, which serves as the input clock to the ADC. To optimize the AD9516-0 for this particular frequency, the loop filter must be configured as shown in Figure 5.

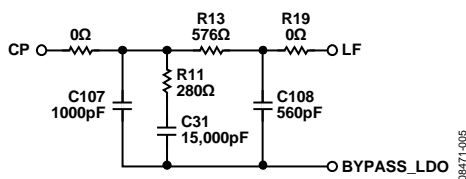


Figure 5. AD9516-0 Loop Filter

If the user chooses an alternative crystal oscillator frequency, the loop filter components must be configured appropriately. Some common crystal oscillators and the corresponding loop filter components are shown in Table 4. Refer to the ADIsimCLK software for design guidance.

**Table 4. AD9516-0 CLK Configuration**

Crystal (MHz)	Loop Filter					AD9262 CLK
	C107	R11	C31	R13	C108	
134.4	1000 pF	232 Ω	18,000 pF	486 Ω	680 pF	672 MHz
122.88	1000 pF	280 Ω	15,000 pF	576 Ω	560 pF	645.12 MHz
39.3216	1500 pF	221 Ω	22,000 pF	453 Ω	680 pF	648.8 MHz

To configure the evaluation board for either the external clock source or the AD9516-0 requires modifying the JP5 and JP6 solder jumpers. The AD9262 sets the common-mode level of the input clock to 450 mV; therefore, the clock source should be ac-coupled to the ADC input clock pins. Use the AD9516-0 software to configure the chip to the appropriate divide ratios.

## RECEIVER INPUT CONFIGURATION

The default configuration uses the complex output signals of the I/Q demodulator as the input signals to the AD9262. In this configuration, the RF input signal should be applied to J2 and the LO signal to J1. The RF input range of the ADL5382 is limited to between 700 MHz and 2.7 GHz. The single-ended RF and LO signals are converted to differential signals using the RF transformers, T2 and T1. The resulting output signals of the demodulator are differential I and Q signals that can be directly applied to the resistive inputs of the AD9262, and no driver amplifiers are required.

Between the output of the ADL5382 and the input to the AD9262 are space holders for a fourth order filter (see Figure 6). This filter may or may not be necessary depending on the application.

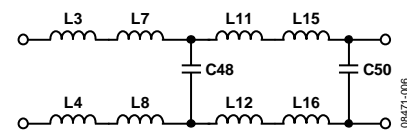


Figure 6. Fourth Order Filter

## ADC ONLY INPUT CONFIGURATION

In addition to using the ADL5382 as an input source to the ADC, the AD9262 can be driven with an external source through either the ADA4937 or a differential transformer.

To configure the evaluation board for an external source, follow the hardware configuration shown in Table 5. The SMA connectors, labeled J5 and J4, correspond to the input signals to Channel A and Channel B, respectively, of the AD9262.

Additionally, short TP17, TP23, TP2, and TP24 to the appropriate pads to route the external signals to the input pins of the AD9262 (see Figure 7). This configuration requires careful attention to ensure that the output signals of the ADL5382 are disconnected and only the signals from the transformer or ADA4937 are routed to the ADC.

Table 5. External ADC Input Configuration

Connector	Setting	Notes
J4, J5		J4: Channel B J5: Channel A
R33 to 42	DNP	Disconnect ADL5382 outputs from the AD9262
TP17	Short to the closest pad on R40	Connect A+ path
TP23	Short to the closest pad on R39	Connect A- path
TP2	Short to the closest pad on R42	Connect B+ path
TP24	Short to the closest pad on R41	Connect B- path

**DIFFERENTIAL TRANSFORMER PATH**

To activate the differential transformer path, configure the jumpers as shown in Table 6.

Table 6. Differential Transformer Configuration

Jumper	Setting	Notes
JP1, JP2	Short Position 1 and Position 2	Configure SMA connectors for transformer inputs
JP3 to JP6	Short Position 2 and Position 3	Configure differential transformer outputs to ADC inputs

**ADC DRIVER PATH**

Set the jumpers as shown in Table 7.

Table 7. ADA4937 Configuration

Jumper	Setting	Notes
JP1, JP2	Short Position 2 and Position 3	Configure SMA connectors for ADA4937 inputs
JP3 to JP6	Short Position 1 and Position 2	Configure outputs from the ADA4937 to ADC inputs

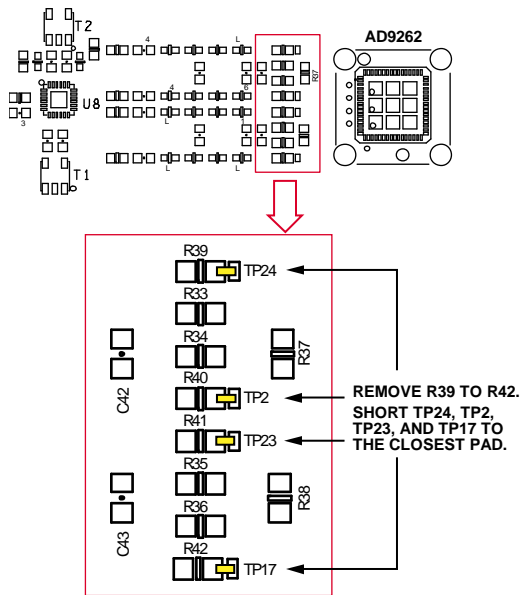


Figure 7. External ADC Jumper Settings

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## SUPPORTING HARDWARE AND SOFTWARE

The AD9262 can only be evaluated using the HSC-ADC-EVALCZ high speed ADC data capture card in conjunction with the VisualAnalog data capture and analysis software. The SPIController software is used to configure the AD9262 and the AD9516 to the appropriate register settings.

### SOFTWARE

Manuals for VisualAnalog, the SPIController software, and the HSC-ADC-EVALCZ data capture hardware are included on the CD in the evaluation board package. It is recommended that the software be installed before connecting the hardware. VisualAnalog relies on the Microsoft .NET framework version 2, which is also included on the package CD. The .NET framework should be installed before installing VisualAnalog. The SPIController software should also be installed.

### HARDWARE

The AD9262 evaluation board and the HSC-ADC-EVALCZ data capture card are powered from a wall-connected switching power supply. The switching power supplies have different output voltages. Connect the 6 V power supply to the AD9262 evaluation board and the 5 V power supply to the HSC-ADC-EVALCZ data capture board. With the HSC-ADC-EVALCZ data capture board powered on and the VisualAnalog software installed, connect the USB cable to the PC and follow all the **Found new hardware** prompts, using the default driver each time.

### AD9262 SPI CONTROLLER

Upon successful software installation and hardware setup, start the AD9262 SPIController software. By default, the software recognizes the AD9262 evaluation board and loads the correct SPIController profile. If it does not, point the software to the following file: **AD9262\_16Bit\_10MSpiR03.cfg**.

The AD9262 SPIController has four tabs. When correctly configured, a message appears on the **CHIP ID** subpane reporting that the AD9262 is interfaced (see Figure 8).

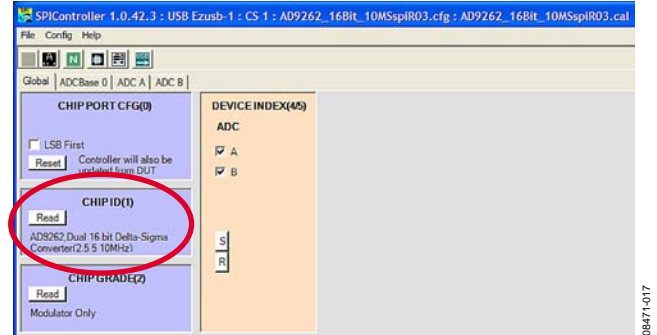


Figure 8. AD9262 SPIController

### AD9516 SPI CONTROLLER

Open another instance of the SPIController for control of the AD9516. If a box titled **Read Test Failure** appears, click **Ignore** to open the SPIController. This error occurs because the software has not been configured correctly to read from the chip. Use the following procedure to appropriately configure the SPIController to read and write to the AD9516:

1. From the **File** menu, select **CfgOpen**; then select **AD9516spiengR03.cfg**.
2. When a **Calibration File Error!** message appears as shown in Figure 9, click **OK**.

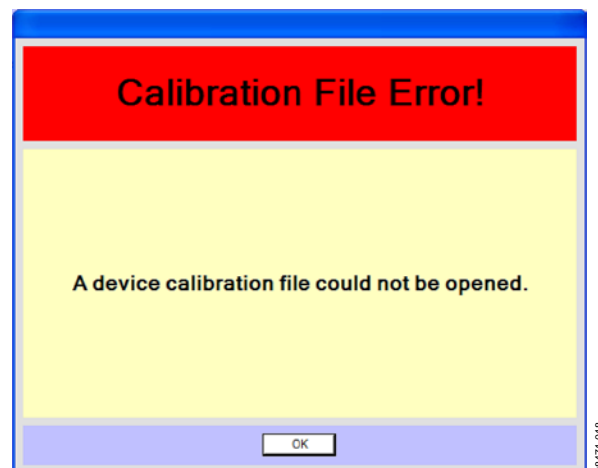


Figure 9.

3. Select **Config** and then **Controller Dialog** and make sure that **FIFO Chip Sel** is set to **2** and that **USB Chan #** is set to the same value as the AD9262 SPIController Cfg dialog (see Figure 10).

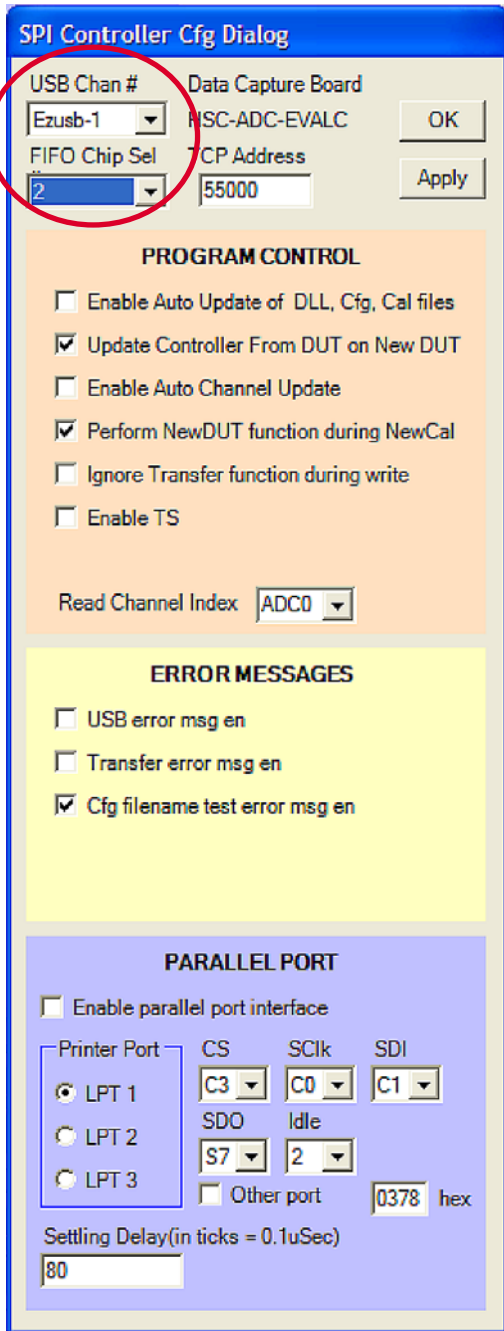


Figure 10.

**AD9516 REGISTER SETTINGS**

The SPIController uses a 4-wire interface; therefore, the AD9516 must be configured for this interface before any further writes can take effect. To configure the AD9516, check the **SDO Enable** bit, as shown in Figure 11.

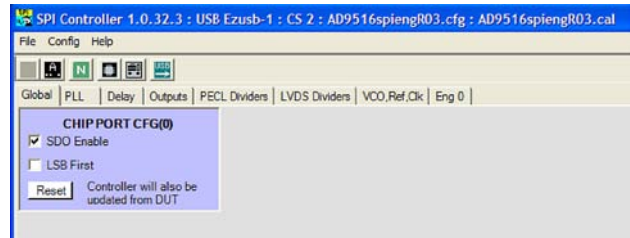


Figure 11. AD9516 Configuration

The AD9516 register settings depend on the particular clock option chosen. Table 8 provides a list of register settings for some common crystal oscillators. The configuration shown in Figure 12 and Figure 13 is for the 122.88 MHz crystal oscillator.

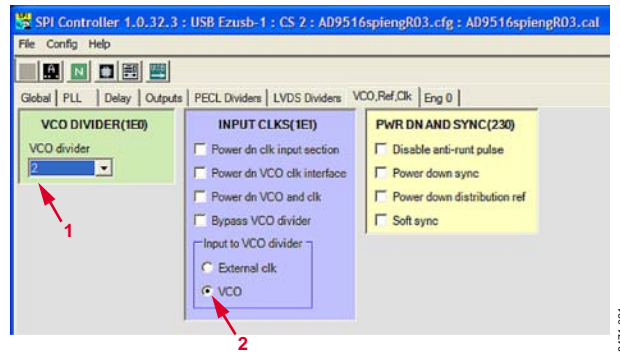


Figure 12. VCO and Clock Configuration for the 122.88 MHz Crystal Oscillator

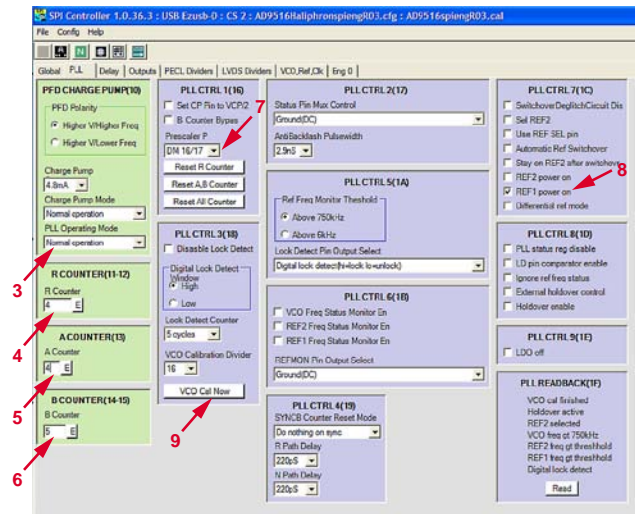


Figure 13. PLL Configuration for the 122.88 MHz Crystal Oscillator



**Table 8. AD9516 Register Settings**

Register	134.4 MHz	122.88 MHz	39.3216 MHz
VCO	2.688 GHz	2.580 GHz	2.595 GHz
R Divider	4	4	1
A/B Counter	0/5	4/5	2/4
Prescaler	16/17	16/17	16/17
Output CLK	672 MHz	645.12 MHz	648.81 MHz

**VisualAnalog OVERVIEW**

Open VisualAnalog and choose a canvas from the AD9262 folder (see Figure 14).

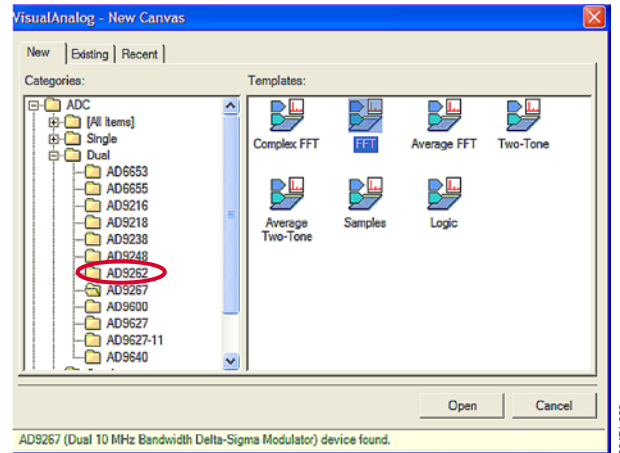
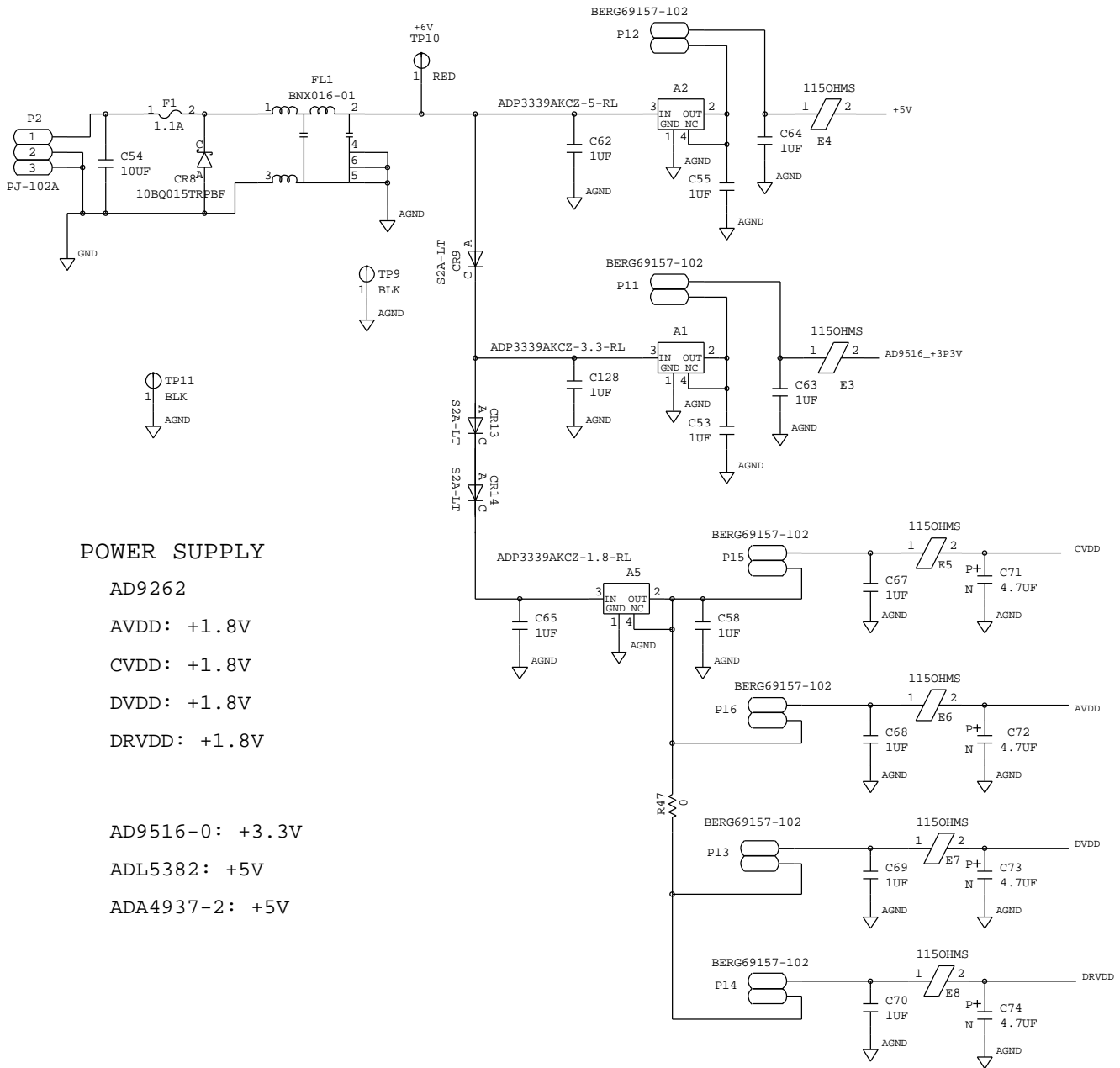


Figure 14. VisualAnalog Canvas

**SCHEMATICS**



**POWER SUPPLY**

AD9262

AVDD: +1.8V

CVDD: +1.8V

DVDD: +1.8V

DRVDD: +1.8V

AD9516-0: +3.3V

ADL5382: +5V

ADA4937-2: +5V

Figure 15. Power Supply Distribution

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09471-009

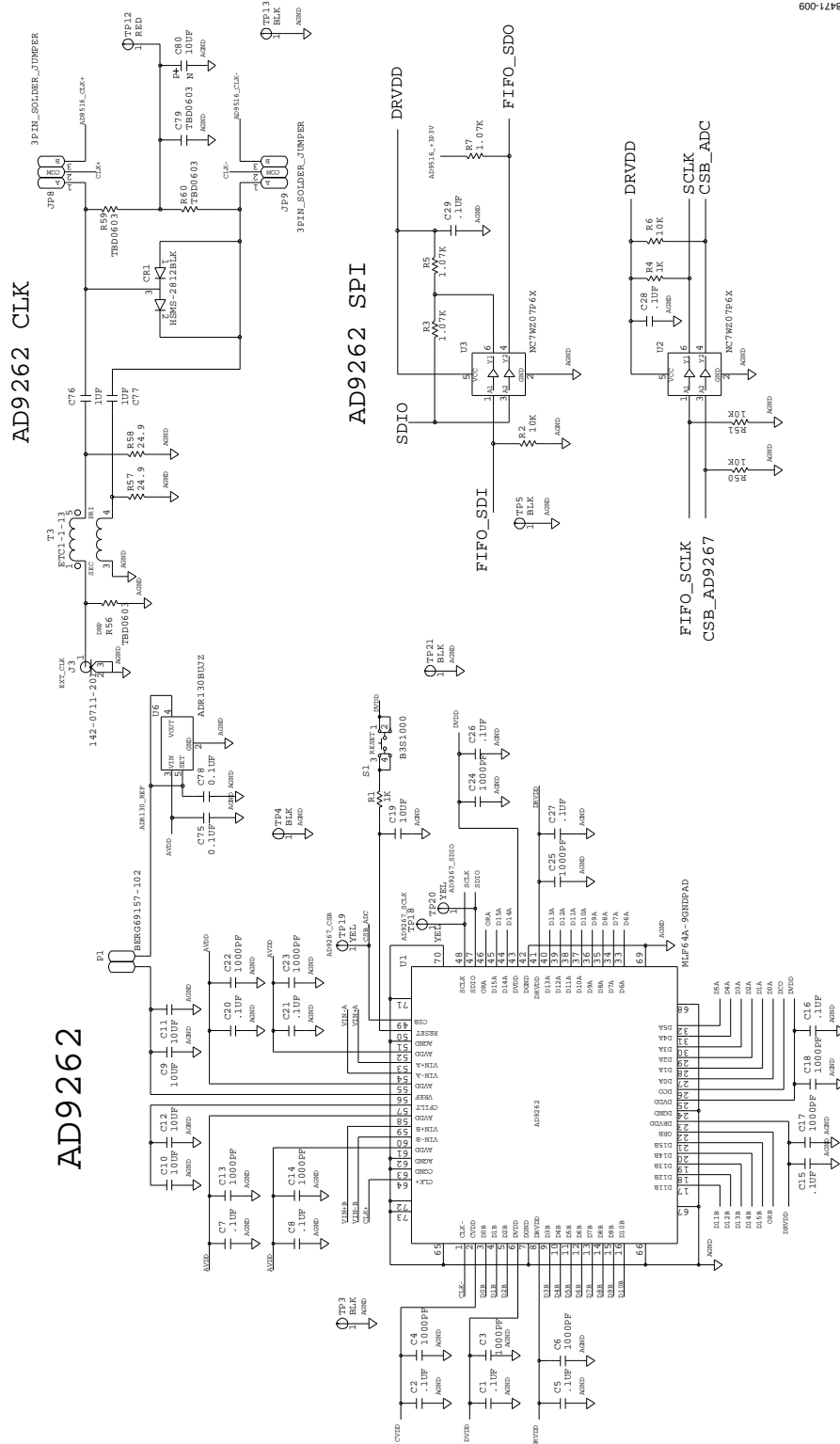


Figure 16. AD9262 Pinout

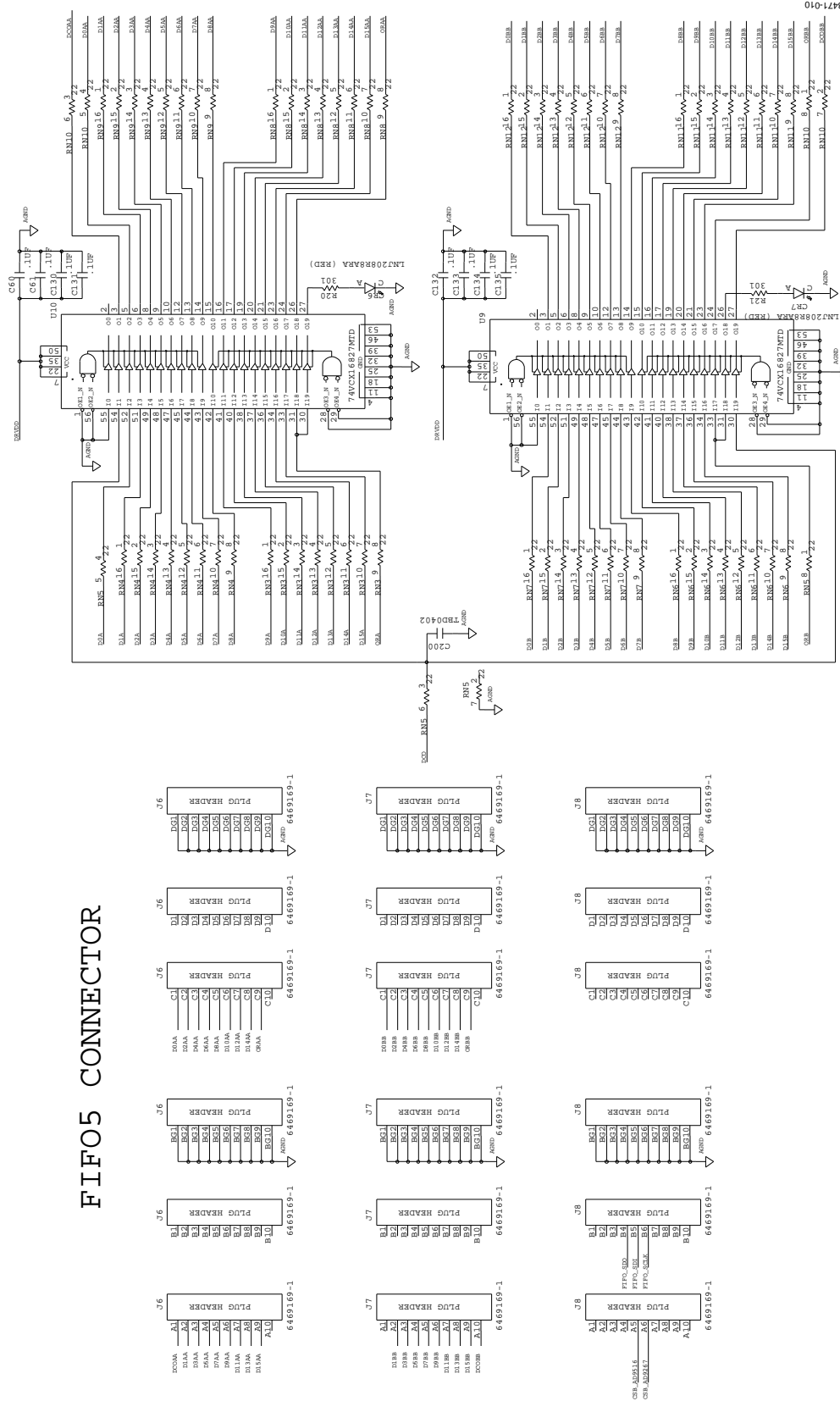


Figure 17. Data Interface to the HSC-ADC-EVALCZ High Speed ADC Data Capture Card

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ADA4937 & XFORMER

AD9262 INPUT

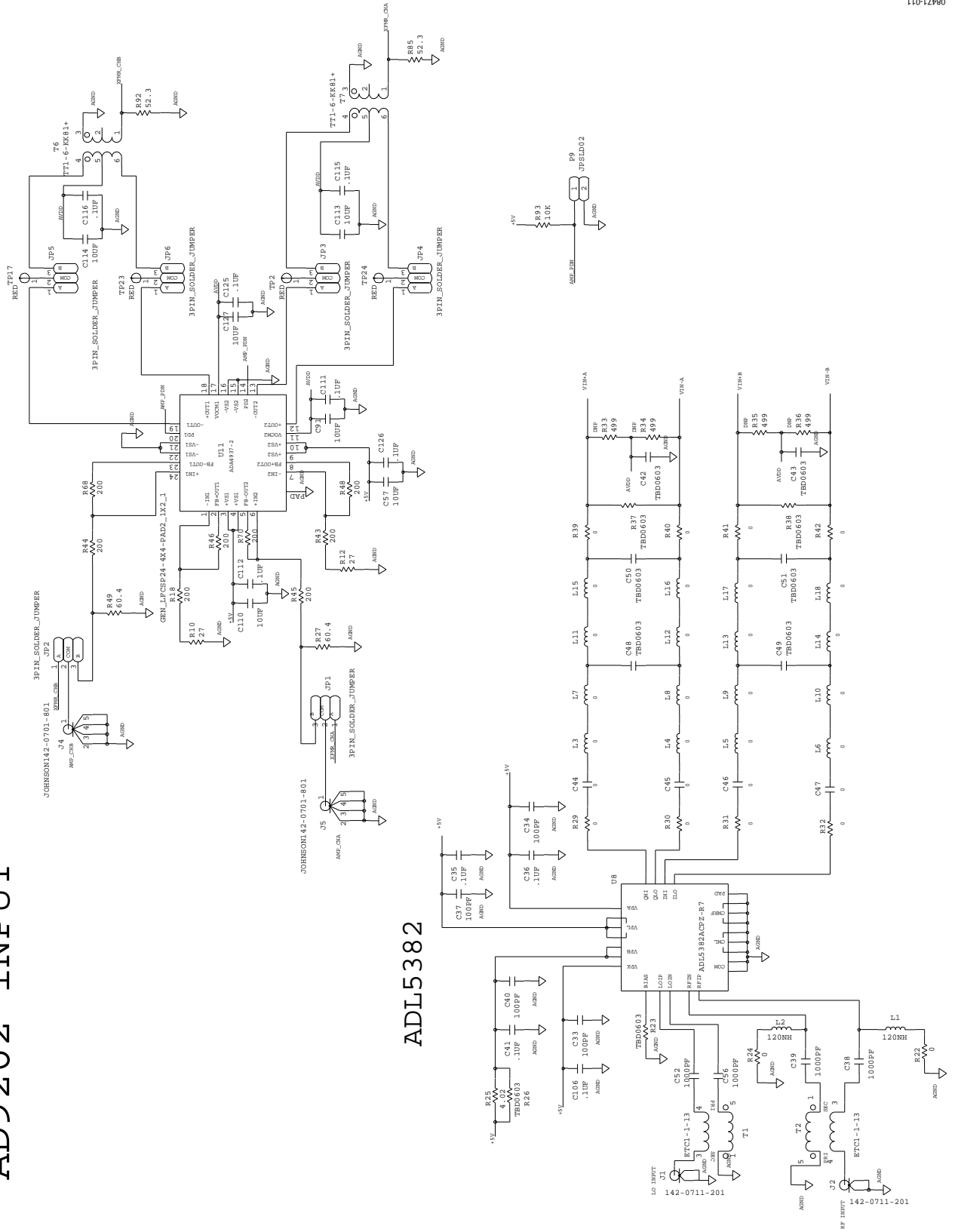


Figure 18. AD9262 Input Configuration

# AD9516

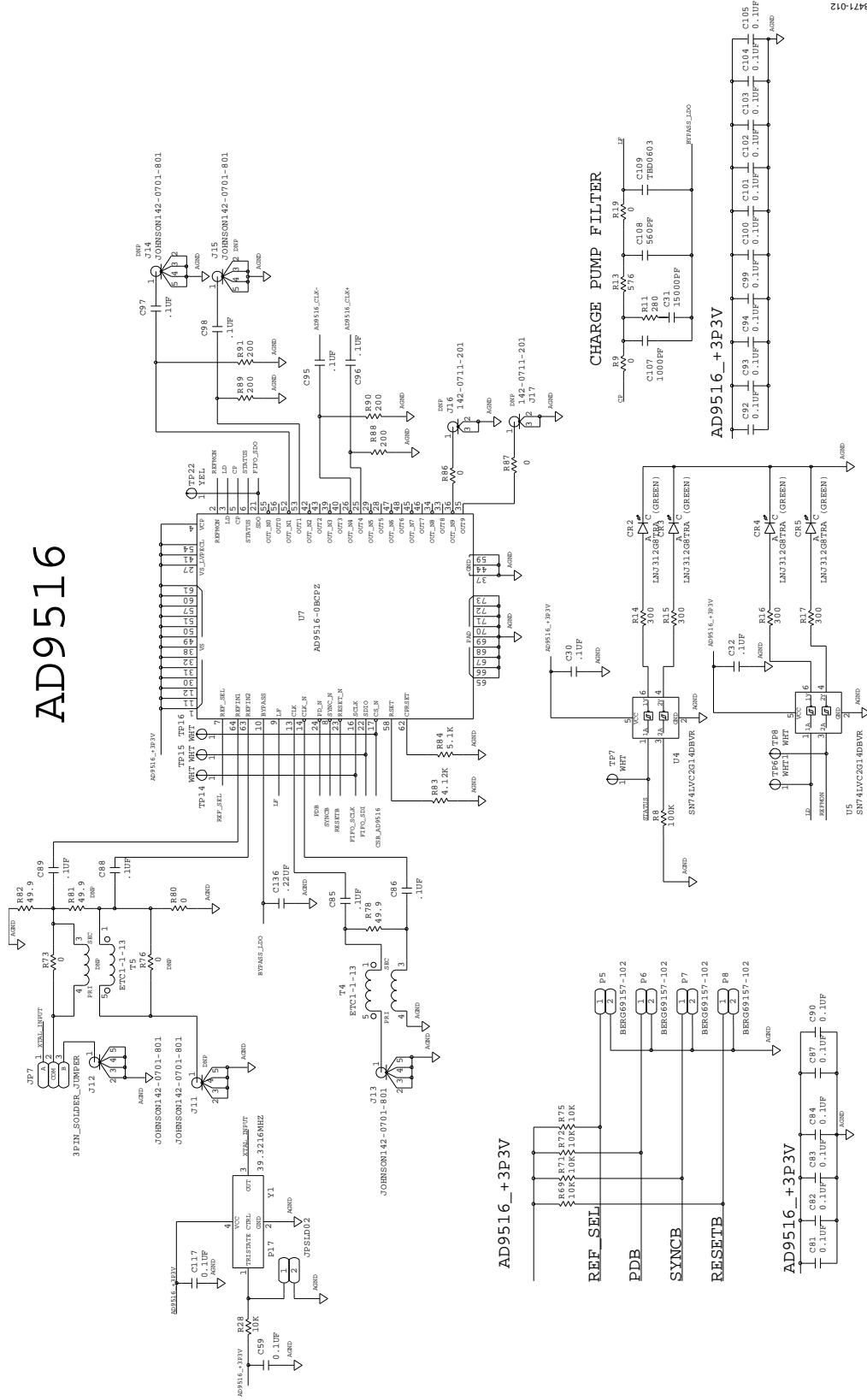


Figure 19. AD9516-0 Configuration

LAYOUT

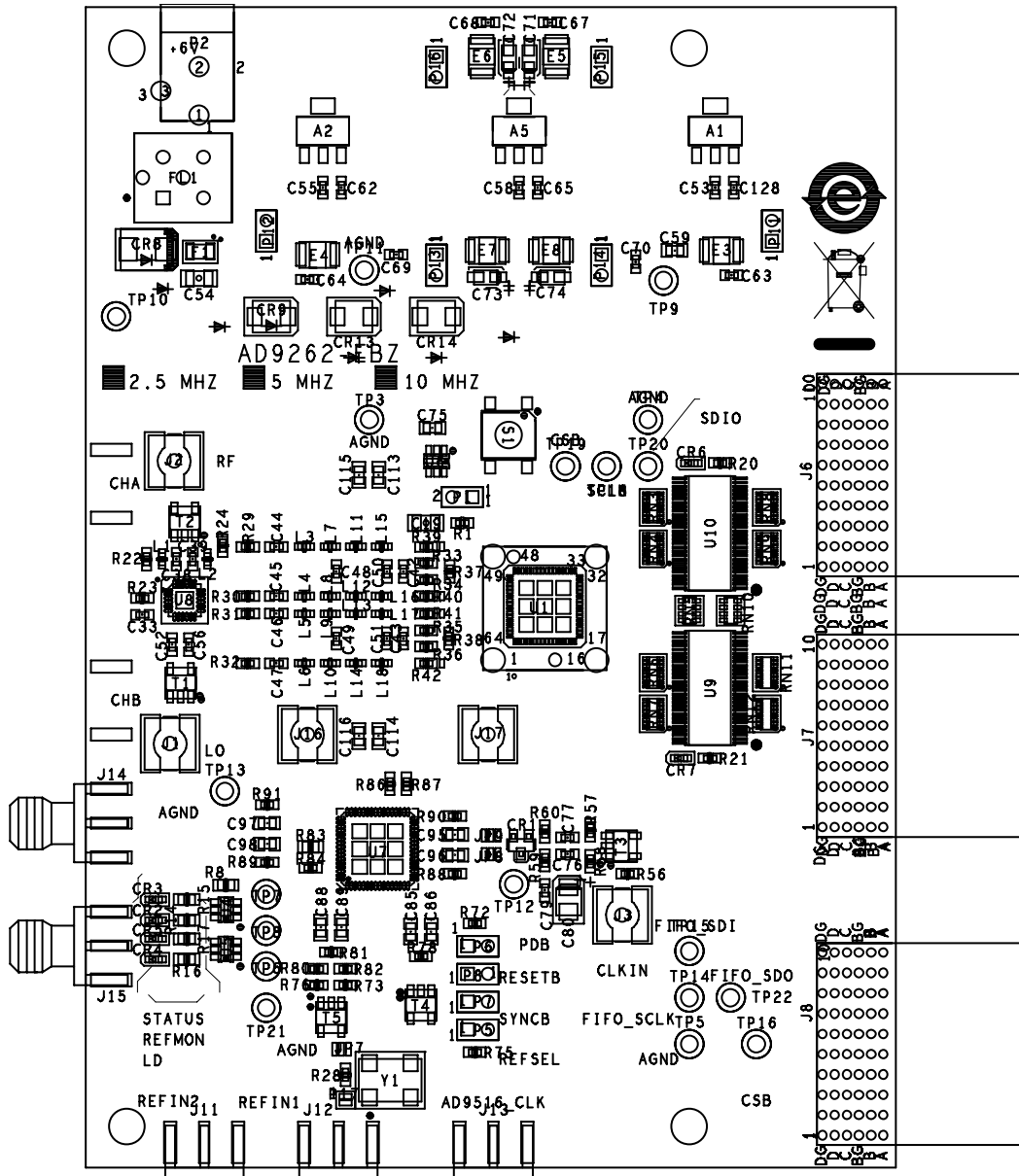


Figure 20. Top Silk

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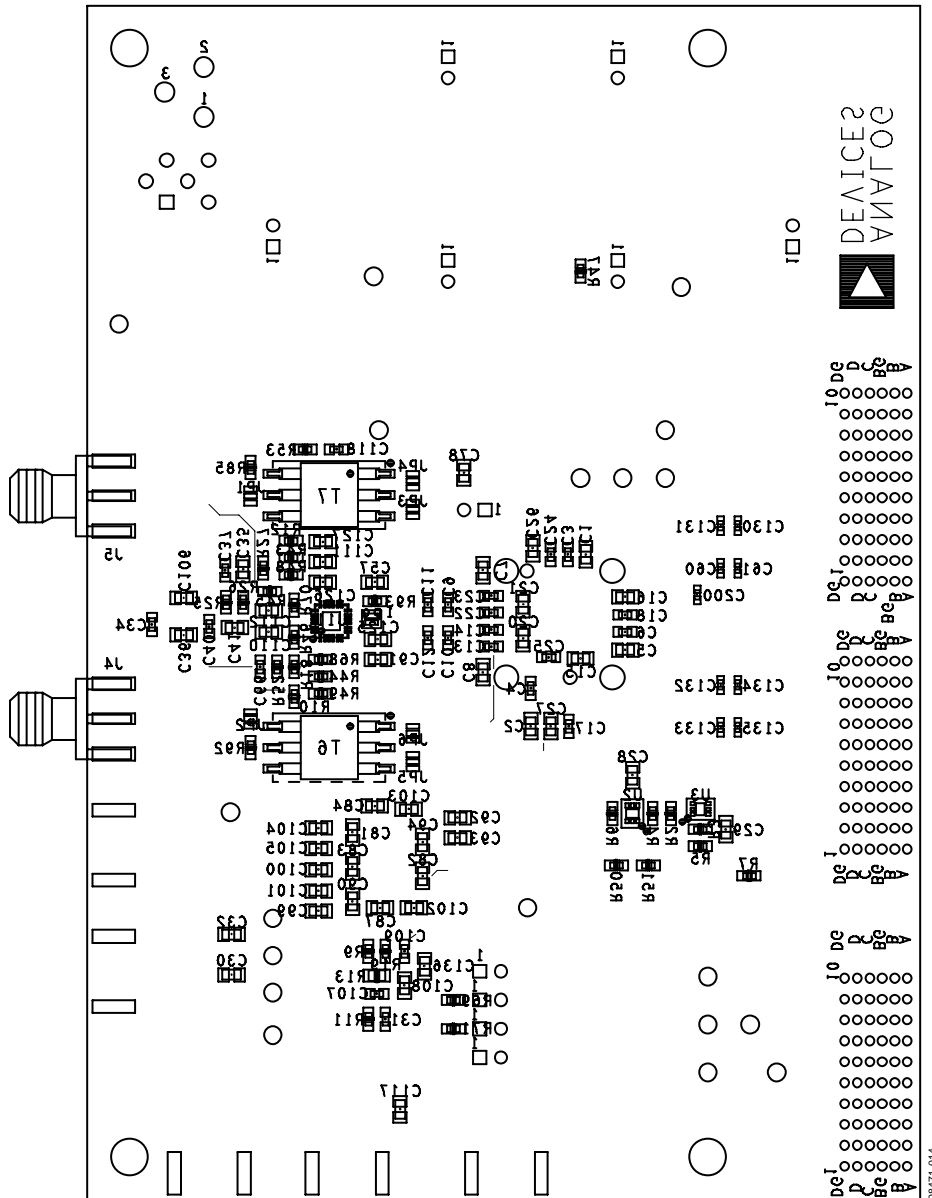


Figure 21. Bottom Silk



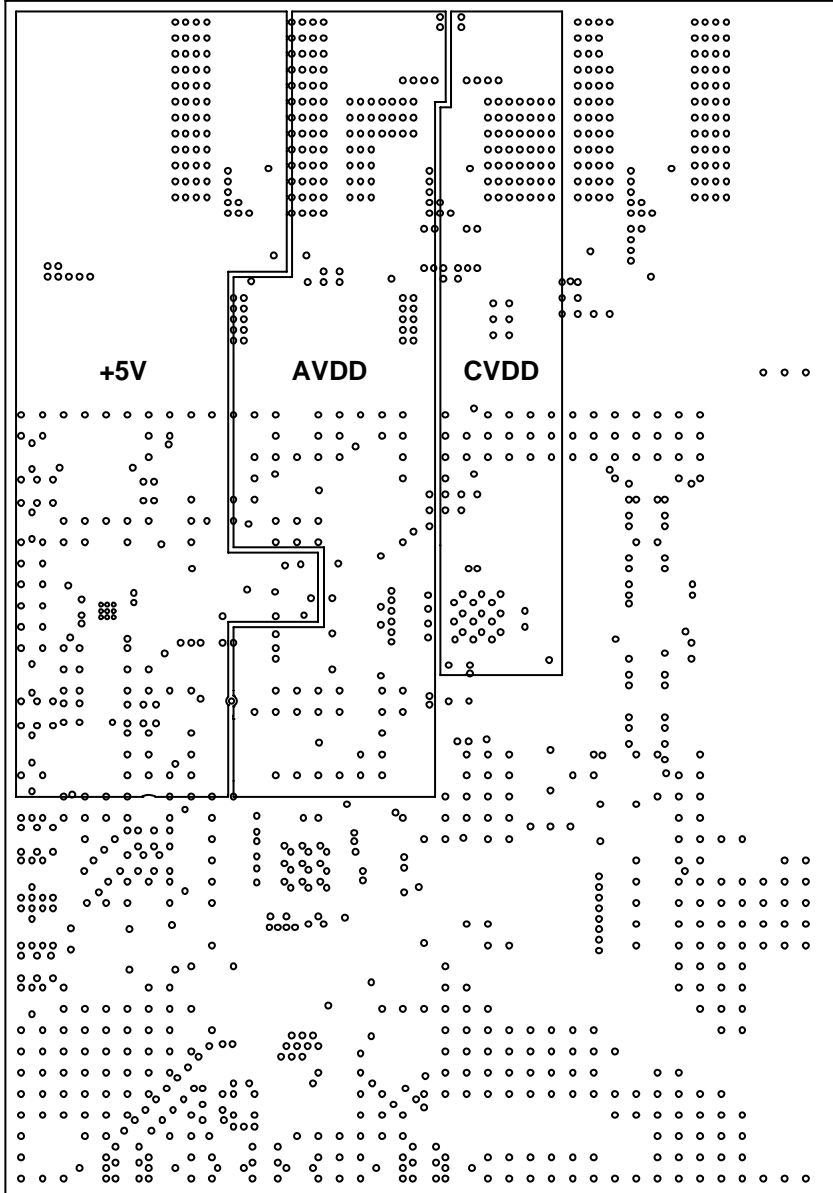
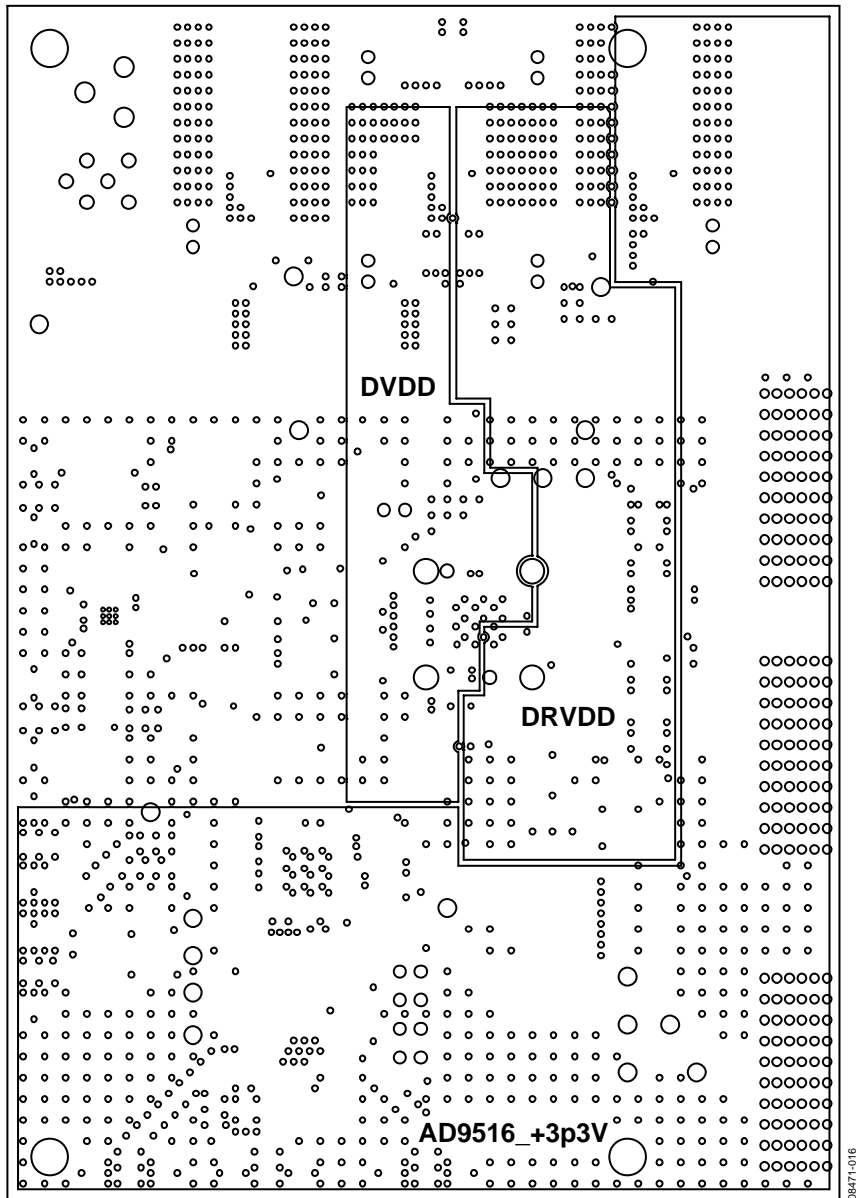


Figure 22. Power 1: Layer 3

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08471-016

Figure 23. Power 2: Layer 4

**ORDERING INFORMATION****BILL OF MATERIALS**

Table 9.

Qty	Reference Designators	Description	Manufacturer	Manufacturer Part Number	Distributor and Part Number
1	A1	IC-ADI high ACC, ADP3339A	Analog Devices	ADP3339AKCZ-3.3	
1	A2	IC-ADI high ACC, ADP3339A	Analog Devices	ADP3339AKCZ-5	
1	A5	IC-ADI high ACC, ADP3339A	Analog Devices	ADP3339AKCZ-1.8	
33	C1, C2, C5, C7, C8, C15, C16, C20, C21, C26, C27, C28, C29, C30, C32, C35, C36, C41, C85, C86, C88, C89, C95, C96, C97, C98, C106, C111, C112, C115, C116, C125, C126	CAP CER 0.10 $\mu$ F 16 V 10% X7R 0805	Murata Electronics, North America	GRM219R71C104 KA01D	Digi-Key 490-1683-1-ND
4	C9, C10, C11, C12	CAP ceramic 10 $\mu$ F 6.3V X5R 0603	Panasonic-ECG	ECJ-1VB0J106M	Digi-Key PCC2395CT-ND
20	C59, C75, C78, C81, C82, C83, C84, C87, C90, C92, C93, C94, C99, C100, C101, C102, C103, C104, C105, C117	CAP 0.10 $\mu$ F 50 V ceramic X7R 0805	Panasonic-ECG	ECJ-2YB1H104K	Digi-Key PCC1840CT-ND
16	C3, C4, C6, C13, C14, C17, C18, C22, C23, C24, C25, C38, C39, C52, C56, C107	CAP 1000 pF 50 V ceramic X7R 0603  CAP 1000 pF 50 V ceramic 0603 SMD	Panasonic-ECG	ECJ-1VB1H102K  ECU-V1H102KBV	Digi-Key PCC1772CT-ND  Digi-Key PCC102BVCT-ND
1	C108	CAP 560 pF 50 V CERM chip 0805 SMD	Panasonic-ECG	ECU-V1H561JCX	Digi-Key PCC561CGCT-ND
4	C44, C45, C46, C47	RES 0.0 $\Omega$ 1/10 W 5% 0603 SMD	ROHM Semiconductor	MCR03EZPJ000	Digi-Key RHM0.0GDKR-ND
0	C42, C43, C48, C49, C50, C51, C79, C109	0603, not populated			
6	C57, C91, C110, C113, C114, C127	CAP CER 10 $\mu$ F 10 V 10% X5R 0805	Murata Electronics, North America	GRM21BR61A106KE	Digi-Key 490-1709-1-ND
14	C53, C55, C58, C62, C63, C64, C65, C67, C68, C69, C70, C76, C77, C128	CAP 1 $\mu$ F 6.3 V ceramic X5R 0603	Panasonic-ECG	ECJ-1VB0J105K	Digi-Key PCC1915CT-ND
8	C60, C61, C130, C131, C132, C133, C134, C135	CAP 0.10 $\mu$ F 16 V ceramic Y5V 0402	Yageo	CC0402ZRY5V7BB104	Digi-Key 311-1047-1-ND
1	C136	CAP 0.22 $\mu$ F 25 V ceramic X7R 0805	Panasonic-ECG	ECJ-2YB1E224K	Digi-Key PCC1832CT-ND
2	C19, C54	CAP 10 $\mu$ F 16 V ceramic X5R 1206	Panasonic-ECG	ECJ-3YB1C106M	Digi-Key PCC2227CT-ND
0	C200	0402, not populated			
1	C31	CAP 15,000 pF 50 V CERM X7R 0603	Panasonic-ECG	ECJ-1VB1H153K	Digi-Key PCC1786CT-ND
4	C33, C34, C37, C40	CAP ceramic 100 pF 50 V 0603 SMD	Panasonic-ECG	ECU-V1H101JCV	Digi-Key PCC101ACVCT-ND

Qty	Reference Designators	Description	Manufacturer	Manufacturer Part Number	Distributor and Part Number
4	C71, C72, C73, C74	CAP tantalum 4.7 $\mu$ F 16 V 20% SMD, A-case CAP 4.7 $\mu$ F 16 V TANT TE series, 3216-18	AVX Corporation Panasonic-ECG	TAJA475M016R ECS-T1CY475R	Digi-Key 478-3032-1-ND Digi-Key PCS3475CT-ND
1	C80	CAP tantalum 10 $\mu$ F 16 V 10% SMD, B-case 3528	AVX Corporation	TAJB106K016R	Digi-Key 478-1673-1-ND
1	CR1	Schottky diode 20 VBR, 1.2 pF	Avago Technologies	HSMS-2812-BLKG	Mouser 630-HSMS-2812- BLKG
3	CR9, CR13, CR14	Rectifier SIL 2 A 50 V DO- 214AA	Micro Commercial Company	S2A-TP	Digi-Key S2A-TPMSCT-ND
4	CR2, CR3, CR4, CR5	LED green TSS type SMD, 0603	Panasonic-SSG	LNJ312G8TRA	Digi-Key P11134CT-ND
2	CR6, CR7	LED red HI BRT SS type LO CUR SM, 0603	Panasonic-SSG	LNJ208R8ARA	Digi-Key P524CT-ND
1	CR8	Diode SCHOTTKY 15 V 1 A SMB, DO-214AA	Vishay IR	VS-10BQ015TRPBF	Digi-Key 10BQ015PBFCT-ND
6	E3, E4, E5, E6, E7, E8	Bead core 4.5 $\times$ 3.2 $\times$ 1.8 SMD	Panasonic-ECG	EXC-CL4532U1	Digi-Key P9812CT-ND
1	F1	Polyswitch 1.10 A reset fuse SMD	Tyco Electronics Raychem Circuit Protection	NANOSMDC110F-2	Digi-Key NANOSMDC110FCT -ND
1	FL1	FLTR EMI 50 M $\Omega$ 15 A 0.10 MHz-1 GHz SMD	Murata Electronics, North America	BNX016-01	Mouser 81-BNX016-01
5	J1, J2, J3, J16, J17	CONN SMA jack RCPT VERT gold SMD, SMAUPSMD	Emerson Network Power Connectivity Solutions	142-0711-201	Mouser 530-142-0711-201 Digi-Key J819-ND
7	J4, J5, J12, J13, J14, J15	CONN jack end launch PCB 0.187" G	Emerson Network Power Connect- ivity Solutions	142-0701-801	Digi-Key 530-142-0701-801 Digi-Key J502-ND
0	J11	CONN jack end launch PCB 0.187" G, not populated	Emerson Network Power Connect- ivity Solutions	142-0701-801	Digi-Key 530-142-0701-801 Digi-Key J502-ND
3	J6, J7, J8	Z-pack connector HDR 4X010P R/A B-plane HMZD	Tyco Electronics	6469169-1	Mouser 571-6469169-1
2	L1, L2	Inductor 120 NH 5% fixed 0603 SMD	Panasonic-ECG	ELJ-RER12JFA	Digi-Key PCD1986CT-ND
16	L3, L4, L5, L6, L7, L8, L9, L10, L11, L12, L13, L14, L15, L16, L17, L18	RES 0.0 $\Omega$ 1/10 W 5% 0603 SMD	ROHM Semiconductor	MCR03EZPJ000	Digi-Key RHM0.0GDKR-ND
11	P1, P5, P6, P7, P8	CONN header 2 POS 0.100 VERT gold	Molex/Waldom Electronics Corporation BERG	22-10-2021 39157-102	Digi-Key WM2722-ND
6	P11, P12, P13, P14, P15, P16	Shunt, ECON, PHBR 15 AU, black	Tyco Electronics	382811-6	Digi-Key A26227-ND
1	P2	CONN jack power 2.1 mm PCB	CUI, Inc.	PJ-102A	Digi-Key CP-102A-ND
2	R1, R4	RES 1.00 k $\Omega$ 1/10 W 1% 0603 SMD	ROHM Semiconductor Panasonic-ECG	MCR03EZPFX1001 ERJ-3EKF1001V	Digi-Key RHM1.00KHCT-ND Digi-Key P1.00KHCT-ND

Qty	Reference Designators	Description	Manufacturer	Manufacturer Part Number	Distributor and Part Number
4	R10, R12, R27, R49	RES 60.4 kΩ 1/10 W 1% 0603 SMD	Panasonic-ECG	ERJ-3EKF6042V	Digi-Key P60.4HCT-ND
1	R11	RES 280 Ω 1/10 W 1% 0603 SMD	Panasonic-ECG	ERJ-3EKF2800V	Digi-Key P280HCT-ND
1	R13	RES 576 Ω 1/8 W 1% 0805 SMD	Panasonic-ECG	ERJ-6ENF5760V	Digi-Key P576CCT-ND
4	R14, R15, R16, R17	RES 300 Ω 1/8 W 5% 0805 SMD	Panasonic-ECG	ERJ-6GEYJ301	Digi-Key P300ACT-ND
12	R18, R43, R44, R45, R46, R48, R68, R70, R88, R89, R90, R91	RES 200 Ω 1/10 W 1% 0603 SMD	Yageo	RC0603FR-07200RL	Digi-Key 311-200HRCT-ND
9	R9, R19, R22, R24, R47, R73, R80, R86, R87	RES 0 Ω 1/10 W 5% 0603 SMD	Panasonic-ECG	ERJ-3GEY0R00V	Digi-Key P0.0GCT-ND
0	R76	RES 0 Ω 1/10 W 5% 0603 SMD, not populated	Panasonic-ECG	ERJ-3GEY0R00V	Digi-Key P0.0GCT-ND
9	R2, R6, R28, R50, R51, R69, R71, R72, R75	RES 10.0 kΩ 1/10 W 1% 0603 SMD	ROHM Semiconductor Panasonic-ECG	MCR03EZPFX1002 ERJ-3EKF1002V	Digi-Key RHM10.0KHCT-ND Digi-Key P10.0KHCT-ND
2	R20, R21	RES 301 Ω 1/10 W 1% 0603 SMD	Panasonic-ECG	ERJ-3EKF3010V	Digi-Key P301HCT-ND
8	R29, R30, R31, R32, R39, R40, R41, R42	RES 0.0 Ω 1/10 W 5% 0603 SMD	ROHM Semiconductor	MCR03EZPJ000	Digi-Key RHM0.0GKR-ND
0	R23, R26, R37, R38, R56, R59, R60	0603, not populated			
1	R25	RES 4.02 Ω 1/10 W 1% 0603 SMD	Yageo	RC0603FR-074R02L	Digi-Key 311-4.02HRCT-ND
3	R3, R5, R7	RES 1.07 kΩ 1/16 W 0.10% 0603 SMD	Susumu Company, Ltd.	RR0816P-1071-B-T5-04H	Digi-Key RR08P1.07KBCT-ND
0	R33, R34, R35, R36	RES 499 Ω 1/10 W 1% 0603 SMD, not populated	Panasonic-ECG	ERJ-3EKF4990V	Digi-Key P499HCT-ND
4	R52, R53, R78, R82	RES 49.9 Ω 1/10 W 1% 0603 SMD	Yageo Panasonic-ECG	RC0603FR-0749R9L ERJ-3EKF49R9V	Digi-Key 311-49.9HRCT-ND Digi-Key P49.9HCT-ND
0	R81	RES 49.9 Ω 1/10 W 1% 0603 SMD, not populated	Yageo Panasonic-ECG	RC0603FR-0749R9L ERJ-3EKF49R9V	Digi-Key 311-49.9HRCT-ND Digi-Key P49.9HCT-ND
2	R57, R58	RES 24.9 Ω 1/10 W 1% 0603 SMD	Yageo Panasonic-ECG	RC0603FR-0724R9L ERJ-3EKF24R9V	Digi-Key 311-24.9HRCT-ND Digi-Key P24.9HCT-ND
1	R8	RES 100 kΩ 1/10 W 0.10% 0805 SMD	Panasonic-ECG	ERA-6YEB104V	Digi-Key P100KZCT-ND
1	R83	RES 4.12 kΩ 1/8 W 1% 0805 SMD	Panasonic-ECG	ERJ-6ENF4121V	Digi-Key P4.12KCCT-ND
1	R84	RES 5.1 kΩ 1/16 W 0.10% 0603 SMD	Panasonic-ECG	ERA-3YEB512V	Digi-Key P5.1KYCT-ND

Qty	Reference Designators	Description	Manufacturer	Manufacturer Part Number	Distributor and Part Number
2	R85, R92	RES 52.3 $\Omega$ 1/10 W 1% 0603 SMD	Panasonic-ECG	ERJ-3EKF52R3V	Digi-Key P52.3HCT-ND
1	R93	RES 10 k $\Omega$ 1/16 W 0.10% 0603 SMD	Panasonic-ECG	ERA-3YEB103V	Digi-Key P10KYCT-ND
2	RN5, RN10	RES array 22 $\Omega$ 8TERM 4RES SMD	CTS	742C083220JPTR	Digi-Key 742C083220JPCT-ND
8	RN3, RN4, RN6, RN7, RN8, RN9, RN11, RN12	RES array 22 $\Omega$ 5% 8 RES SMD	Panasonic-ECG	EXB-2HV220JV	Digi-Key Y1220CT-ND
1	S1	Switch TACT 6 mm SMD MOM 160GF	Omron Electronics, Inc., ECB Division	B3S-1000	Digi-Key SW415-ND
4	T1, T2, T3, T4	TC XFMR/SURF mount	Mini-Circuits	TC1-1-13M+	
0	T5	TC XFMR/SURF mount, not populated	Mini-Circuits	TC1-1-13M+	
2	T6, T7	RF XFMR/SURF MT	Mini-Circuits	TT1-6-KK81+	
2	TP10, TP12	Test point PC compact 0.063"D red	Keystone Electronics	5005 TP-104-01-02	Digi-Key 5005K-ND
7	TP3, TP4, TP5, TP9, TP11, TP13, TP21	Test point PC compact 0.063" D BLK	Keystone Electronics	5006 TP-104-01-00	Digi-Key 5006K-ND
6	TP6, TP7, TP8, TP14, TP15, TP16	Test point PC compact 0.063 D WHT	Keystone Electronics	5007 TP-104-01-09	Digi-Key 5007K-ND
4	TP2, TP17, TP23, TP24	PC test point miniature SMT	Keystone Electronics	5015 TP-108-01	Digi-Key 5015KCT-ND
4	TP18, TP19, TP20, TP22	Test point PC compact 0.063" D YLW	Keystone Electronics	5009 TP-104-01-04	Digi-Key 5009K-ND
1	U1	DUT	Analog Devices	AD9262	
2	U9, U10	IC buffer/line driver 20-bit 56TSSOP	Fairchild Semiconductor	74VCX16827MTD	Mouser 512-74VCX16827 MTD
1	U11	LFCSP24	Analog Devices	ADA4937-2	
2	U2, U3	IC buffer UHS dual OD out SC70-6	Fairchild Semiconductor	NC7WZ07P6X	Mouser 512-NC7WZ 07P6X Digi-Key NC7WZ07P6XCT-ND
2	U4, U5	IC inverter dual SHMT-T SOT-23-6	Texas Instruments	SN74LVC2G14 DBVR	Mouser 595-SN74LVC 2G14 DBVR Digi-Key 296-13010-1-ND
1	U6	Precision series, ADR130BU	Analog Devices	ADR130BUJZ	
1	U7	IC-ADI 14-output AD9516-0	Analog Devices	AD9516-0BCPZ	
1	U8	IC ADI 700 MHz to 2700 MHz quadrature	Analog Devices	ADL5382ACPZ	
0	Y1	IC clock OSC, 39.3216M, not populated	Valpey Fisher	VFAC3	

**NOTES**

## NOTES

**ESD CAUTION**

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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