AFEDRI8201EVM

Evaluation Module

User's Guide

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High-Speed Communications

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It is important to operate this EVM within the input voltage range of 0 V to 5 V and the output voltage range of 0 V and 3.3 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 50°C. The EVM is designed to operate properly with certain components above 50°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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Preface

Read This First

About This Manual

This user's guide provides the information needed to set up and operate the AFEDRI8201EVM evaluation module. For a more detailed description of the AFEDRI8201, please refer to the product data sheet available from the Texas Instruments web site at http://www.ti.com. Additional support documents are listed in the sections of this guide entitled *Related Documentation from Texas Instruments*.

How to Use This Manual

Throughout this document, the acronym **EVM** and the phrase **evaluation module** are synonymous with the AFEDRI8201EVM.

Information About Cautions

This book contains cautions.

CAUTION

This is an example of a caution statement.

A caution statement describes a situation that could potentially damage your software or equipment.

The information in a caution or a warning is provided for your protection. Please read each caution carefully.

Related Documentation From Texas Instruments

The following documents provide information regarding Texas Instrument integrated circuits used in the assembly of the AFEDRI8201EVM. These documents are available from the TI web site. The last character of the literature number corresponds to the document revision, which is current at the time of the writing of this user's guide. Newer revisions may be available from the TI web site at http://www.ti.com or by calling the Texas Instruments Literature Response Center at (800) 477−8924 or the Product Information Center at (972) 644−5580. When ordering, identify the document(s) by both title and literature number.

Data Sheets:	**Literature Number:**
AFEDRI8201	SBWS017

If You Need Assistance

If you have questions regarding either the use of this evaluation module or the information contained in the accompanying documentation, please contact the Texas Instruments Product Information Center at (972) 644−5580 or visit the TI Semiconductor Online Technical Support pages at http://www.ti.com.

FCC Warning

This equipment is intended for use in a laboratory test environment only. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to sub-part J of part 15 of the FCC regulations, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

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AFEDRI8201EVM

The AFEDRI8201EVM is designed to assist with evaluating the performance of the AFEDRI8201 analog-to-digital converter (ADC) with digital downconverter.

Topic **Page**

1 Overview

This user’s guide gives a general overview of the AFEDRI8201 evaluation module (EVM), and provides a general description of the feature and functions to be considered while using this module.

1.1 Purpose

The AFEDRI8201EVM is a platform for evaluating the AFEDRI8201 ADC with digital downconverter under various signal, reference, and supply conditions. This document should be used in combination with the EVM schematic diagrams (see Figure 2, Figure 3, and Figure 4) and the supplied USB interface drive software.

1.2 EVM Basic Functions

Analog input to the AFE is provided via external SMA connectors. The single-ended input is converted into a differential signal at the input of the device. The input path is transformer-coupled.

The EVM provides one external SMA connector for converting the single-ended input to a differential AFE clock signal at the input of the device.

Digital outputs from the EVM are via two 40-pin connectors and two DSK peripheral 80-pin connectors.

The AFE internal registers can be programmed using the onboard USB interface module through a PC.

Power connections to the EVM are made through either a 5V DC supply, or 3.3V and 1.8V supplies.

1.3 Power Requirements

The EVM can be powered in one of two ways:

1) The EVM can be powered directly with a +5V supply if using the AC/DC (+90V to +265V AC input/+5V DC output adapter) module; or

2) The EVM can be powered by lab power from +5V analog, 3.3V analog, 3.3V digital, and 1.8V digital supplies.

CAUTION

Voltage Limits

Exceeding the maximum input voltages can damage EVM components. Undervoltage may cause improper operation of some or all of the EVM components.

1.4 Operational Procedure

The AFEDRI8201EVM provides a flexible means of evaluating the AFE-DRI8201 in a number of modes of operation. The following basic setup procedure can be used as a board confidence check.

1) Verify all jumper settings against the jumper lists in Table 1, Table 2, and Table 3.

Table 1. Pin Jumper List Table

Jumper	Function	Installed	Default
JP1	GSET of Test DAC	No	N/A
JP2	Lab 5V DC/DSP Voltage Supply Switch	Yes	Ext
JP3	Digital Input Voltage: Lab 5V DC/3.3V	Yes	Int
JP4	3.3V Digital Supply Operation: Lab 3.3V/Regulator 3.3V	Yes	Int
JP5	1.8V Digital Supply Operation: Lab 1.8V/Regulator 1.8V	Yes	Int
JP6	3.3V Analog Supply Operation: Lab 3.3V/Regulator 3.3V	Yes	Int

Table 2. Jumper and Push Button Switch List Table

Jumper	Function	Default
S1	FGPA Reset	Open
S3	Program Reset	Open
JP7	Aux DAC Output	Open

Table 3. Relay List Table

Jumper	Function
K1A	DSK Connector Option to SCK
K2A	DSK Connector Option to MOSI
K3A	DSK Connector Option: MISO or DOUT1

2) Connect supplies to the EVM in the following manner:

- ❑ +5V Lab Supply to P6 (default setup)
- ❑ +5V AC/DC Supply to JP2 (only for testing external AC/DC supply)
- ❑ +3.3V Analog Supply to P8 (only for testing 1.8V or 3.3V supplies)
- ❑ +3.3V/1.8V Lab Supply to P7 (only for testing 1.8V or 3.3V supplies)

2 Circuit Description

The schematic diagrams for the EVM are located at the end of this document (see Figure 2, Figure 3, and Figure 4).

2.1 Analog Inputs

The EVM can be configured to provide the AFE with transformer-coupled inputs from a single-ended source. The inputs are provided via SMA connectors (J6) for a transformer-coupled input.

2.2 Clock Inputs

The initial configuration of the EVM provides a transformer-coupled clock input (J8) to the AFE differential clock.

2.3 Serial Interface

The EVM has a USB interface input through FPGA to control a serial bus to operate of the registers of the AFE.

2.4 Outputs

The data outputs from the AFE have two possible connection options: two 40-pin connectors (P3 and P4), or two DSK 80-pin connectors (P1 and P5).

- 40-pin connector output pins:
  - I Output: on connector P3 (Digital Interface 1), from pin 4 (LSB) to pin 34 (MSB), even pins only (odd pins are ground).
  - Q output: on connector P4 (Digital Interface 2), from pin 2 (LSB) to pin 32 (MSB), even pins only (odd pins are ground).
  - Strobe: On connector P3, pin 2 (sample I and Q data on falling edge of strobe)
- 80-pin connector output pins:
  - See schematic diagrams shown in Figure 2, Figure 3, and Figure 4.

3 Software Description

3.1 Xilinx FPGA Software

The Xilinx FPGA program has been preinstalled in the Xilinx EPROM.

3.2 Visual Basic Software

The user must install the AFEDRI8201 SPI Control program and a USB driver on a PC. The AFEDRI8201 registers can then be configured through the PC GUI.

3.2.1 Installation of the AFEDRI8201 Software

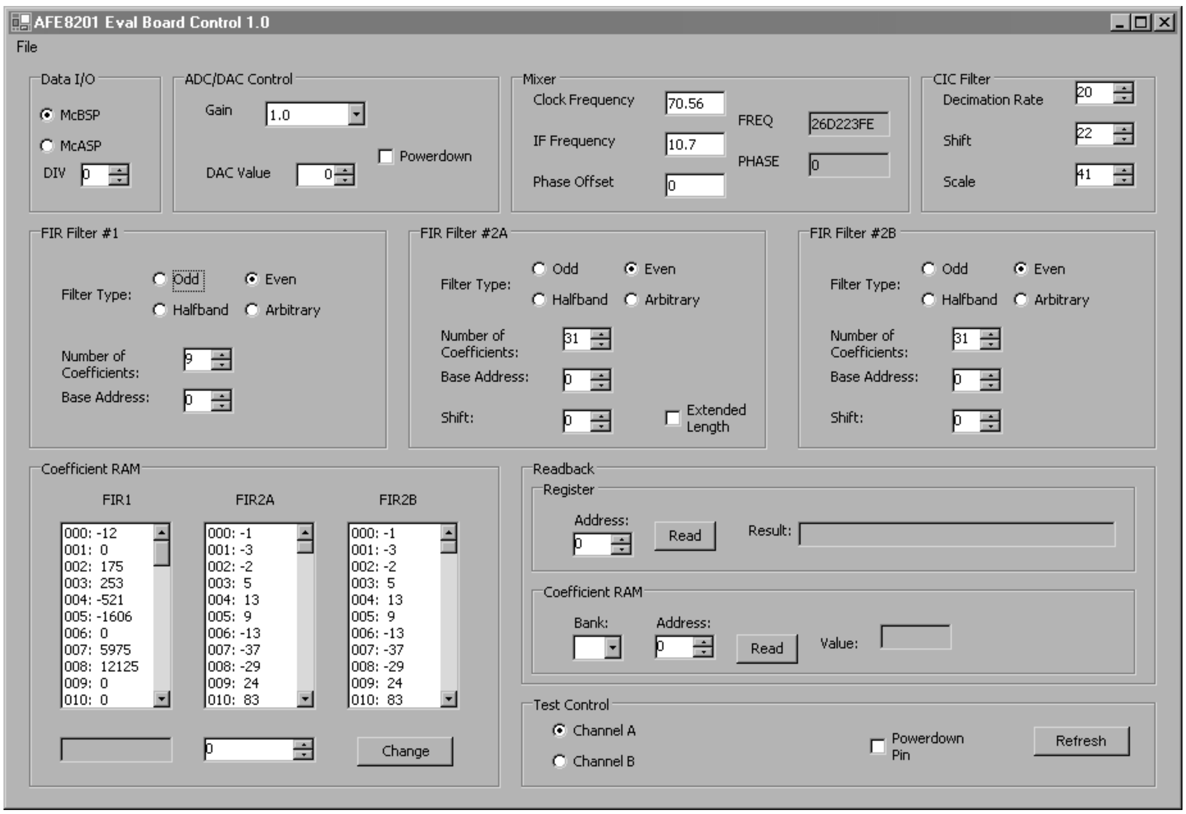
1) Unzip the file *AFEDRI8201eval.zip* provided on the installation CD in the AFEDRI8201EVM package.
   a) If you do not have the CD, download *dotnetfx.exe* (Microsoft .NET Framework Version 1.1 Redistributable Package) from:
      http://www.microsoft.com/downloads/details.aspx?FamilyID=262d25e3-f589-4842-8157-034d1e7cf3a3&displaylang=en
      or from the Microsoft Windows website.
2) Open the unzipped folder and run *dotnetfx.exe*. This program installs the required environment for the Visual Basic .net programs to run.
3) From the same unzipped folder, run *setup.exe.*
4) Power-up the evaluation board.
5) Plug the USB connector from the evaluation board into an available USB port on the PC. The PC should begin the driver installation. When asked for the correct location of the USB drivers (such as ftd2xx.inf), specify the location of the unzipped *AFEDRI8201EVM Hardware Driver* folder.
6) Once the drivers are finished loading, the evaluation board and software are now installed.

3.2.2 Operation of the VB Software

1) After initial installation, the AFEDRI8201 Evaluation software should be running. To start the AFEDRI8201 Evaluation software in the future, go to: *C:\Program Files\Texas Intruments\AFEDRI8201* and double-click *AFEDRI8201 SPI Control.exe* icon. The install program placed shortcuts on your desktop and in your Start menu.

2) Load the default configuration by clicking **File|Open** and select *default.afe* from the dialog box. (This file is located in the same location as the *AFEDRI8201 SPI Control.exe* file.) This loads a typical configuration into the AFEDRI8201EVM, as shown in Figure 1.

Figure 1. AFEDRI8201 Eval Software Screenshot



3) Operation of the EVM depends upon the settings of the following parameters:

   a) The IF frequency and sampling frequencies are entered as floating point values. MHz are used as the units, but the actual units do not matter, as long as the frequency and sampling units are the same. The software calculates the required register values for the mixer.

   b) Phase offset is in degrees and is also a floating point value.

   c) Each time you type data into a field, you must hit *Enter* for the new value to be activated. The AFEDRI8201EVM is updated as soon as the field is updated.

   d) The **Refresh** button will rewrite everything (registers and memories) into the AFEDRI8201EVM. This is useful if you need to change devices or otherwise power down the EVM board.

   e) The memory contents are shown in three lists. To change a value, double-click on the appropriate line in the list. The values relevant to that line appear just below the three lists. Type the new value where indicated and click **Change**.

   f) The **Channel A/Channel B** radio buttons in the test control section determine which filter output is sent to the output pins.

   g) The control DAC is set to produce a full-scale ramp using the DIN interface. The *DAC Value* setting under *ADC/DAC Control* has no effect. A readback of the DAC value register will return a random value between 0 and 4095.

   h) There are two power-down check boxes. The checkbox under *ADC/DAC Control* sets power-down via a register write, whereas the checkbox under *Test Control* sets the PWD pin high.

4) To save a configuration, click **File|Save** and enter the name you want to give the file. The default extension is *.afe*. The configuration files can also be edited in a text editor, but be careful to use only a single space as a delimiter.

4 Physical Description

This section describes the physical characteristics and printed circuit board (PCB) layout of the EVM and lists the components used on the module.

4.1 Schematic, PCB Layout, and Bill of Materials

The schematic diagrams are shown in Figure 2, Figure 3, and Figure 4.

The EVM is constructed on a 4-layer PCB using FR-4 material. The individual layers are shown in Figure 5, Figure 6, Figure 7, and Figure 8.

The Bill of Materials is listed in Table 4.

Figure 2. Schematic: AFEDRI8201

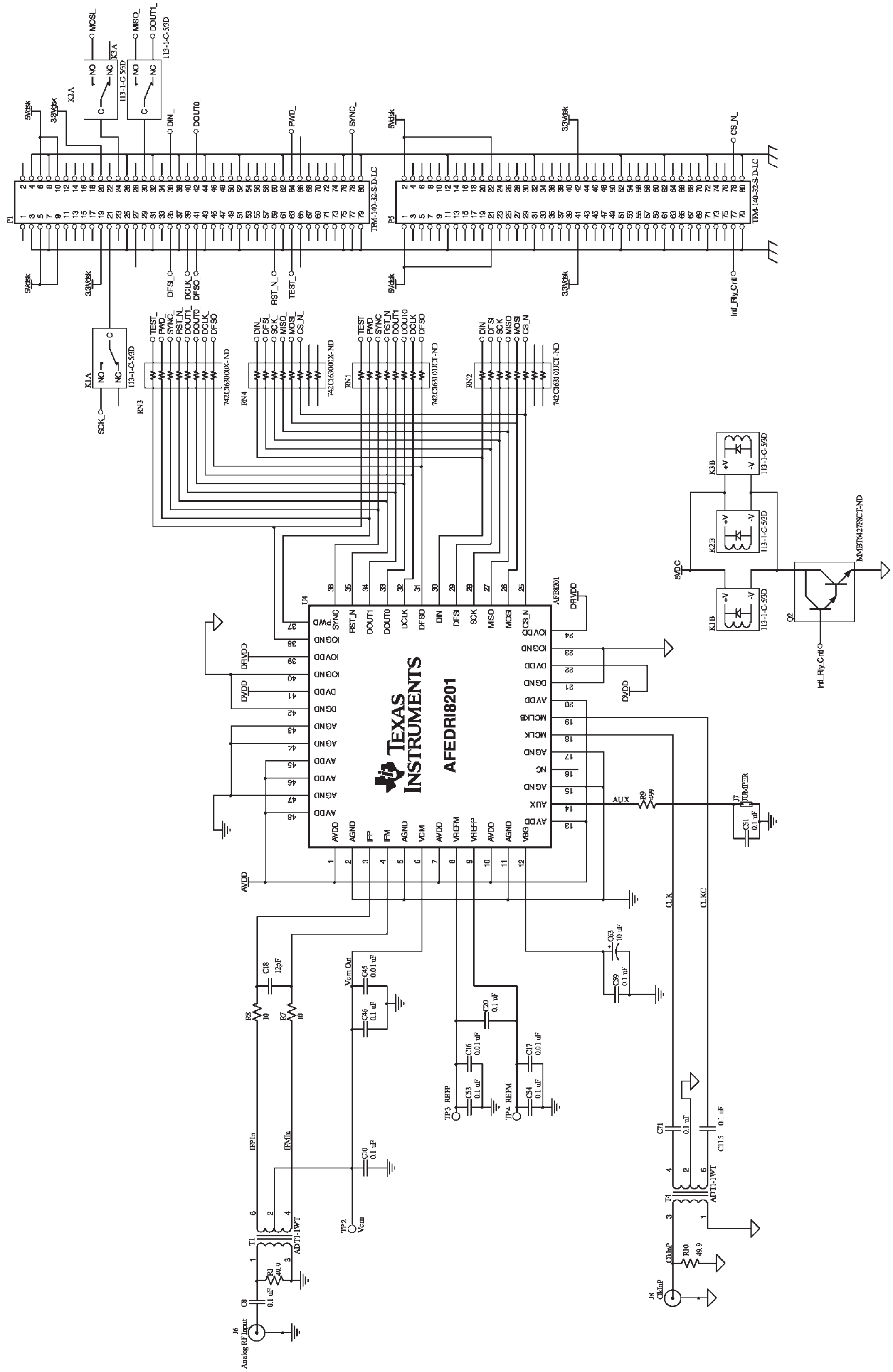


Figure 3. Schematic: Xilinx

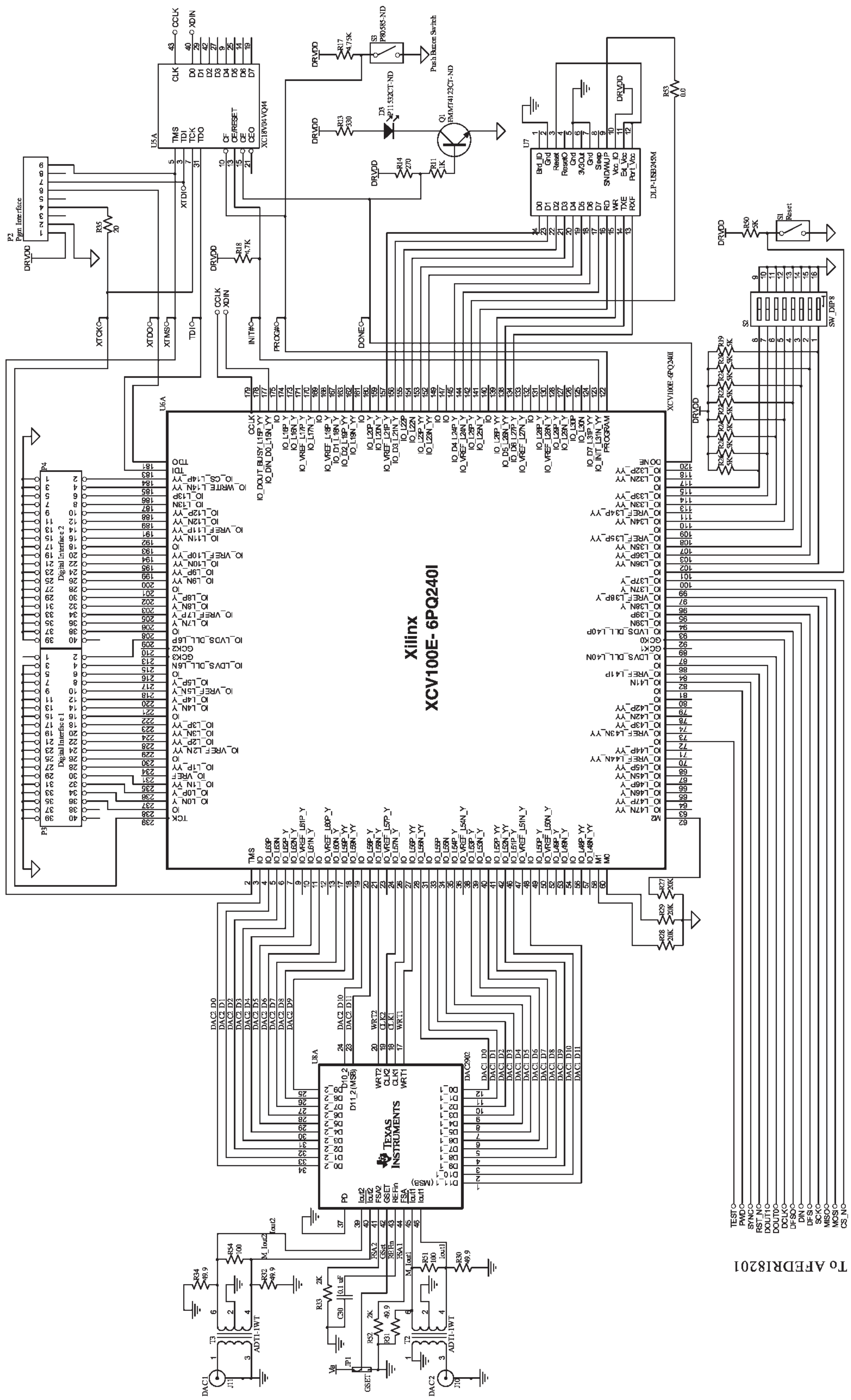


Figure 4. Schematic: Power Supply

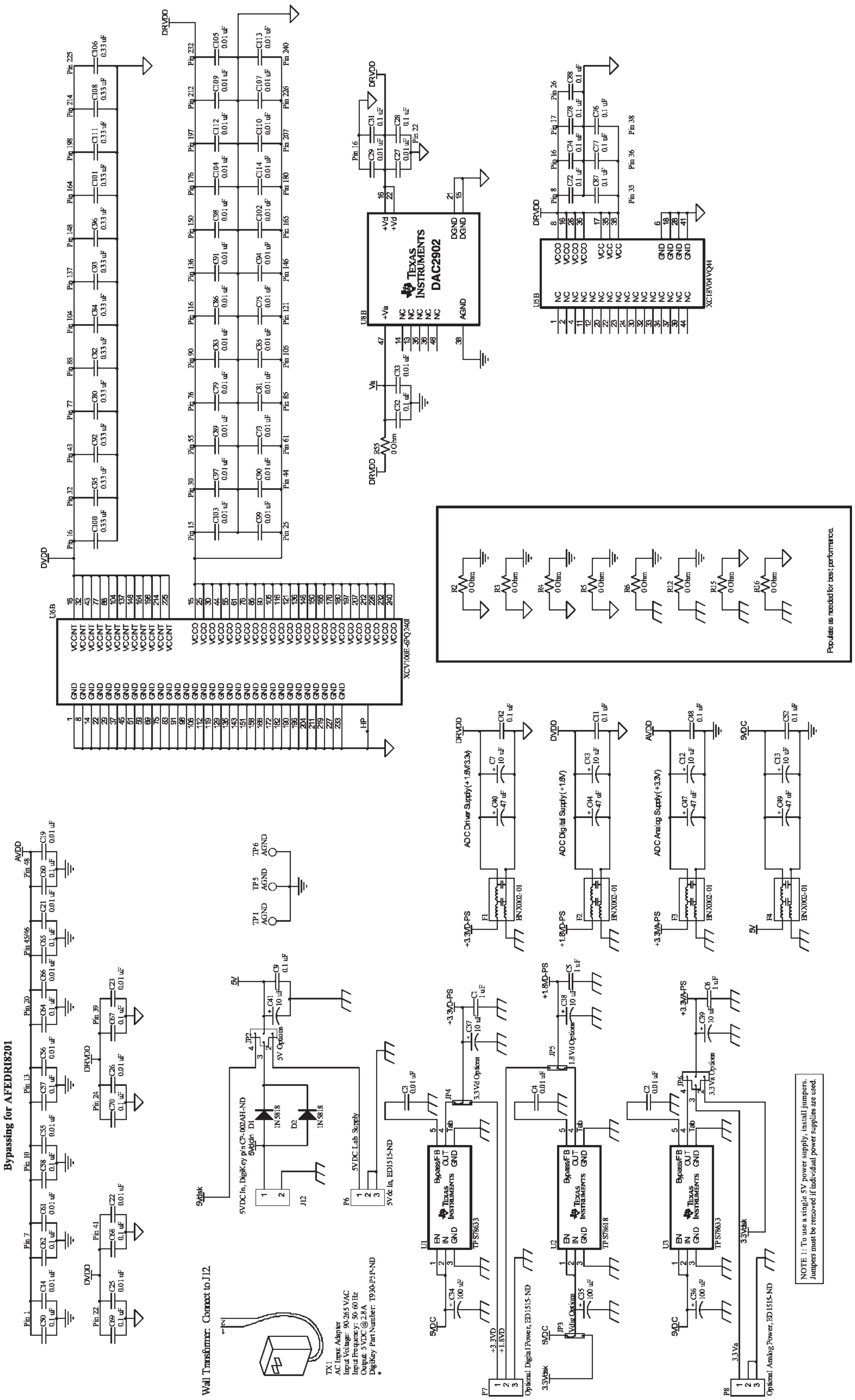


Figure 5. PCB Layout: Top Layer (top view)

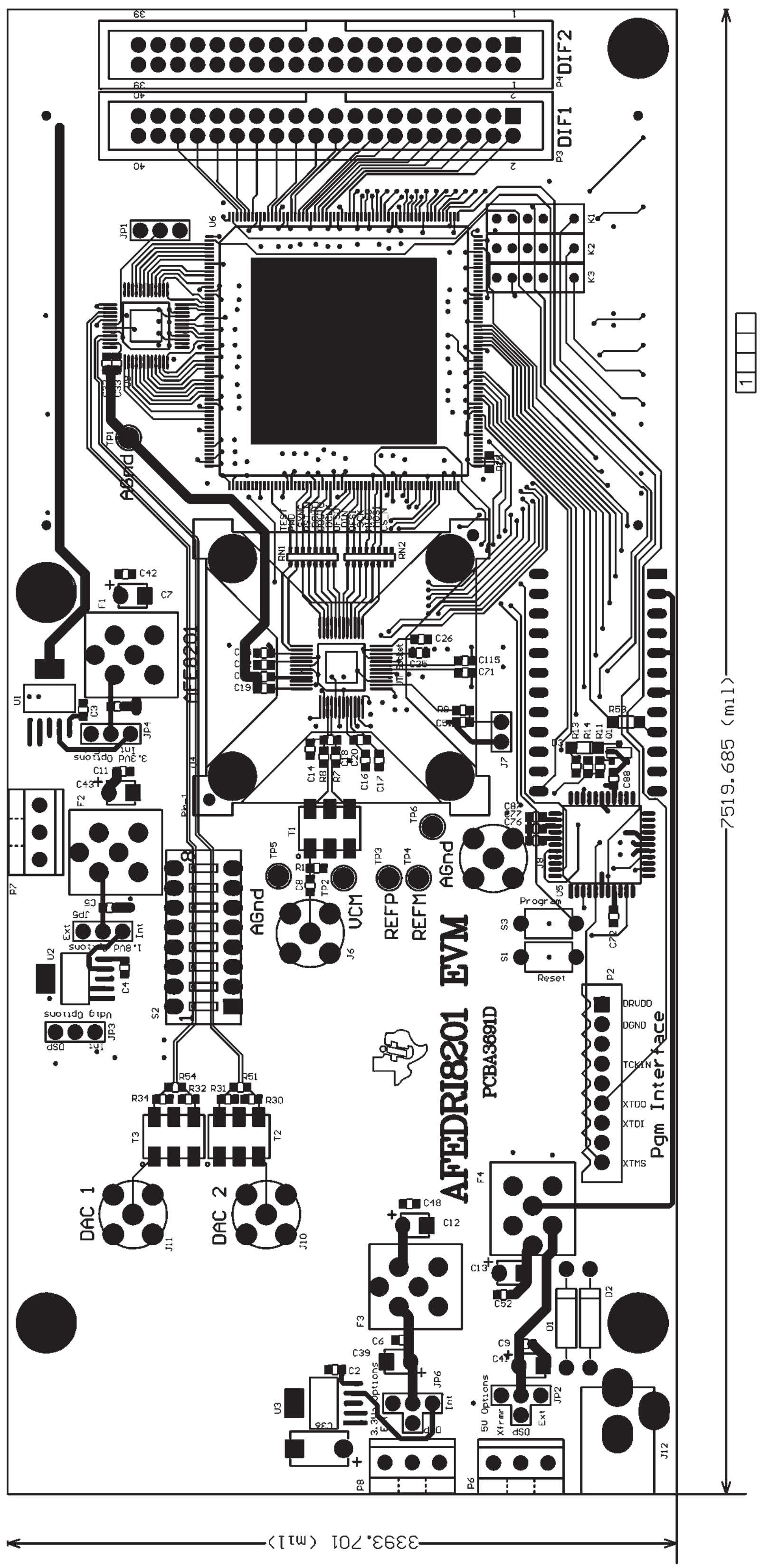


Figure 6. PCB Layout: Ground Plane (top view)

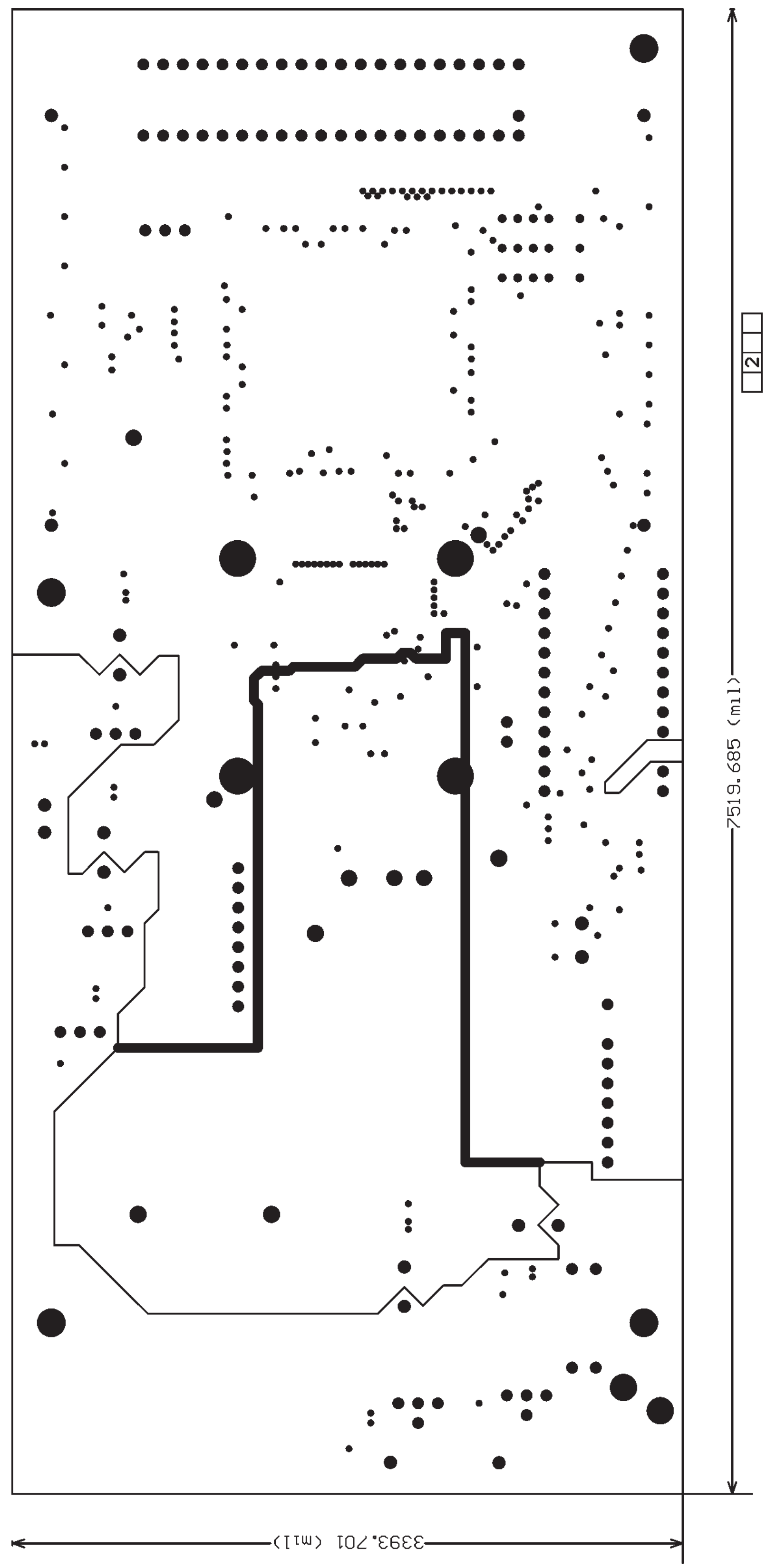


Figure 7.   PCB Layout: Power Plane (top view)

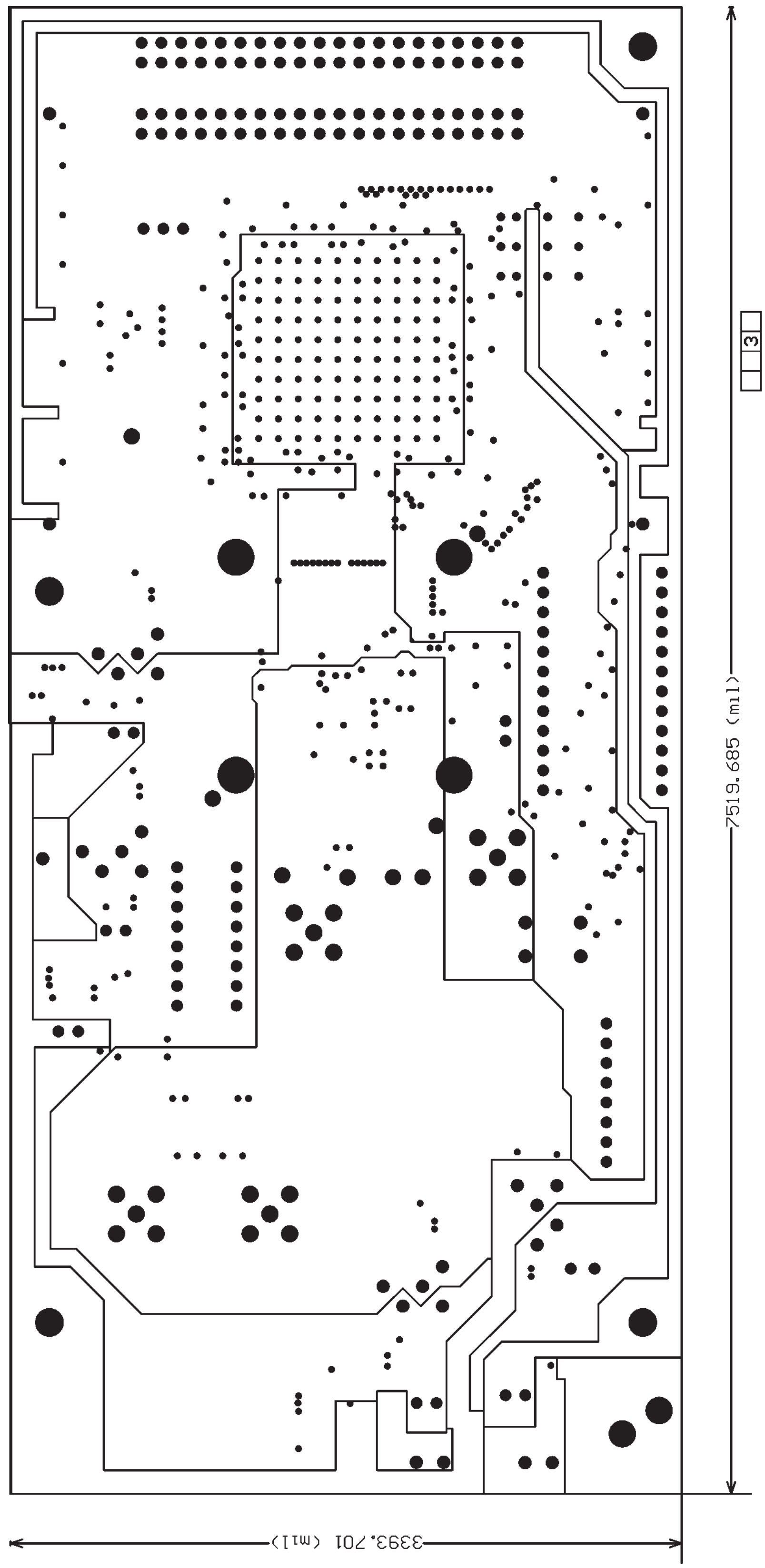


Figure 8. PCB Layout: Bottom Layer (bottom view)

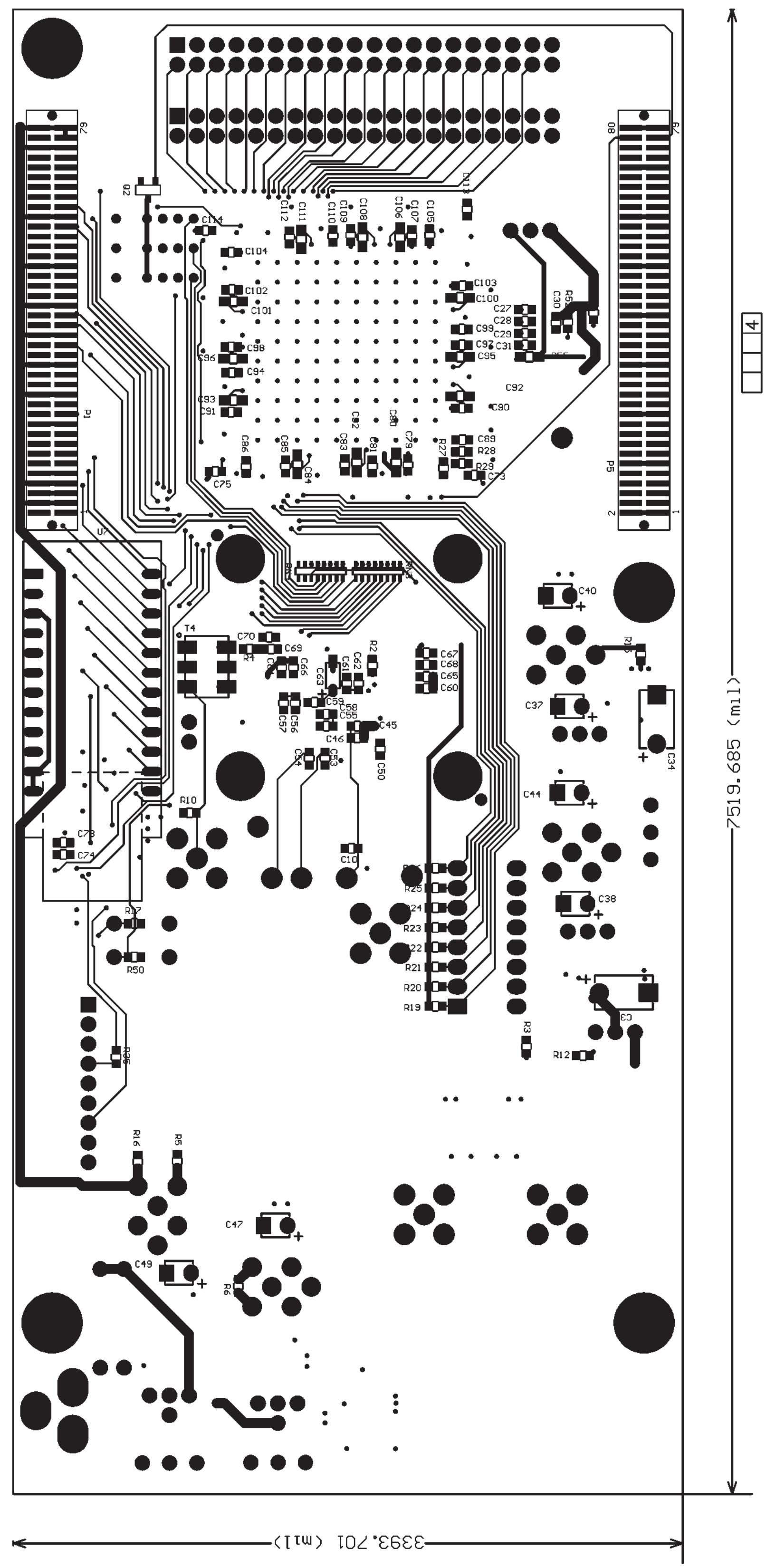


Table 4. Bill of Materials

Qty	Part Number	Components	Description	Vendor
3	PCC2287CT−ND	C1, C5, C6	Capacitor, 1μF, ceramic 0603 package	Digi-Key
1	C1608C0G1H120J	C18	Capacitor, 12pF, ceramic 0603 package	Digi-Key
44	C0603C103J5RACTU	C2, C3, C4, C14, C16, C17, C19, C21, C22, C23, C25, C26, C27, C29, C33, C45, C55, C56, C61, C66, C73, C75, C79, C81, C83, C85, C86, C89, C90, C91, C94, C97, C98, C99, C102, C103, C104, C105, C107, C109, C110, C112, C113, C114	Capacitor, 0.01μF, ceramic 0603 package	Digi-Key
3	ECS−T1AD107R	C34, C35, C36	Capacitor, 100μF, T491D package	Digi-Key
4	399−3003−1−ND	C40, C44, C47, C49	Capacitor, 47μF, T491B package	Digi-Key
1	ECS−T1AY106R	C63	Capacitor, 10μF, T491A package	Digi-Key
8	ECS−T1AX106R	C7, C12, C13, C37, C38, C39, C41, C43,	Capacitor, 10μF, T491B package	Digi-Key
37	C1608Y5V1H104Z	C8, C9, C10, C11, C20, C28, C30, C31, C32, C42, C46, C48, C50, C51, C52, C53, C54, C57, C58, C59, C60, C62, C64, C65, C67, C68, C69, C70, C71, C72, C74, C76, C77, C78, C87, C88, C115	Capacitor, 0.1μF, ceramic 0603 package	Digi-Key
12	445−1356−1−ND	C80, C82, C84, C92, C93, C95, C96, C100, C101, C106, C108, C111	Capacitor, 0.33μF, ceramic 805 package	Digi-Key
2	MBR1100RLOSTR−ND	D1, D2,	Diode, 1N5818, axial	Digi-Key
1	P11532CT−ND	D3,	LED	Digi-Key
4	BNX002−01	F1, F2, F3, F4		
4	142−0701−201	J6, J8, J10, J11	SMA	Johnson Components
1	CP−002AH−ND	J12	DC_POWER_JACK_PJ−002AH	Digi-Key
31		J7	Pin strip for jumpers and JTAG	Digi-Key
3	113−1−C−5/3D	K1, K2, K3	Relay	Pickering
2	TFM−140−32−S−D−LC	P1, P5	Connector, DSP	Samtec

Table 4. Bill of Materials (continued)

Qty	Part Number	Components	Description	Vendor
2	IDC40	P3, P4	Digital interface connector	Digi-Key
3	ED1515−ND	P6, P7, P8	Power connector, 3-position	Digi-Key
1	FMMT4123CT−ND	Q1	Transistor, GP NPN, SOT23	Digi-Key
1	MMBT6427FSCT−ND	Q2	Transistor, Darlington, SOT23	Digi-Key
6	311−49.9HCT−ND	R1, R10, R30, R31, R32, R34	Resistor, thick-film, 49.9Ω, 0603 package	Digi-Key
1	311−1.00KHCT−ND	R11	Resistor, thick-film, 1kΩ, 0603 package	Digi-Key
1	311−330HCT−ND	R13	Resistor, thick-film, 330Ω, 0603 package	Digi-Key
1	311−270HCT−ND	R14	Resistor, thick-film, 270Ω, 0603 package	Digi-Key
1	311−4.75KHCT−ND	R17	Resistor, thick-film, 4.75kΩ, 0603 package	Digi-Key
1	311−4.70KHCT−ND	R18	Resistor, thick-film, 4.7kΩ, 0603 package	Digi-Key
9	311−4.99KHCT−ND	R19, R20, R21, R22, R23, R24, R25, R26, R50	Resistor, thick-film, 5kΩ, 0603 package	Digi-Key
8	311−0.0GCT−ND	R2, R3, R4, R5, R6, R12, R15, R16	Resistor, thick-film, 0Ω, 0603 package	Digi-Key
3	311−20.0KHCT−ND	R27, R28, R29	Resistor, thick-film, 20kΩ, 0603 package	Digi-Key
2	311−2.00KHCT−ND	R33, R52	Resistor, thick-film, 2kΩ, 0603 package	Digi-Key
1	311−20.0HCT−ND	R35	Resistor, thick-film, 20Ω, 0603 package	Digi-Key
2	311−100HCT−ND	R51, R54	Resistor, thick-film, 100Ω, 0603 package	Digi-Key
1	311−0.0ECT−ND	R53	Resistor, thick-film, 0Ω, 1206 package	Digi-Key
1	311−0.0ACT−ND	R55	Resistor, thick-film, 0Ω, 0805 package	Digi-Key
2	311−10.0HCT−ND	R7, R8	Resistor, thick-film, 10Ω, 0603 package	Digi-Key
1	311−499HCT−ND	R9	Resistor, thick-film, 499Ω, 0603 package	Digi-Key
2	742C163101JCT−ND	RN1, RN2	RESNET_CTS_742C163	Digi-Key
2	742C163000X−ND	RN3, RN4	RESNET_CTS_742C163	Digi-Key
1	P80585−ND	S1, S3	Push-Button	Digi-Key
1	CT2068−ND	S2	Switch_DIP8	Digi-Key

Table 4. Bill of Materials (continued)

Qty	Part Number	Components	Description	Vendor
4		SO1, SO2, SO3, SO4	Standoff FF	
4	ADT1−1WT	T1, T2, T3, T4		Mini-Circuits
3	5006K−ND	TP1, TP5, TP6	Test Point, Black	Digi-Key
3	5007K−ND	TP2, TP3, TP4	Test Point, White	Digi-Key
2	TPS78633	U1, U3	SOT223−5	TI
1	TPS78618	U2	SOT223−5	TI
1	XC18V01VQ44	U5	QFP44	Digi-Key
1	XCV100E−6PQ240C	U6	HQFP240	Digi-Key
1	DLP−USB245M	U7		Mouser/DLP Design
1	DAC2902	U8	TQFP−48	TI