ADS131A04 Evaluation Module User's Guide

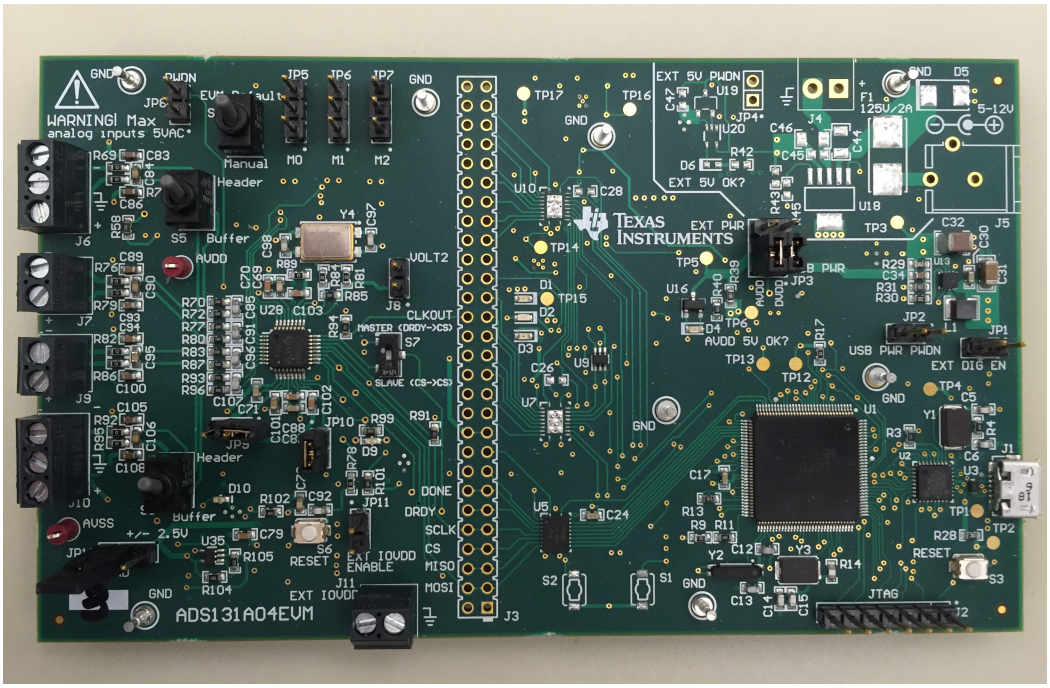


Figure 1. ADS131A04 Evaluation Module

The ADS131A04EVM is an evaluation module kit that provides hardware and software support for evaluation of the ADS131A04 delta-sigma analog-to-digital converter (ADC). The kit utilizes the TM4C1294NCPDT processor to communicate with the ADC via SPI and provide communication with a PC over USB interface. The kit also includes a software application that runs on a PC allowing for register manipulation and data collection from the ADC.

Table 1. Related Documentation

Device	Literature Number
ADS131A04	SBAS590

WARNING

This EVM is not intended for high voltage connections. Do not connect inputs of this EVM to voltages higher than 5 VAC to minimize shock hazard.

Microsoft, Windows are registered trademarks of Microsoft Corporation.

Copyright © 2016, Texas Instruments Incorporated

Contents

1 EVM Overview 3
1.1 Software Requirements 3
1.2 Hardware Requirements 3
1.3 Software Reference 3
1.4 Supported Functionality 3
2 Quick Start 4
2.1 Default Jumper and Switch Configuration 4
2.2 Power Connection 5
2.3 Startup 5
3 Hardware Reference 5
3.1 Jumper and Switch Configuration Reference 5
3.2 Header and Connector Reference 7
4 Software Details 10
4.1 Installing the Software 10
4.2 Connecting to the EVM Hardware 12
4.3 Using the Software With the ADS131A04EVM 12
5 EVM Hardware Details 14
5.1 Analog Inputs 14
5.2 Digital Inputs 14
5.3 Clock 14
5.4 Mode Pins 14
5.5 ADC Reference 15
5.6 Reset 15
6 Power Supply Connections – EVM and ADC 16
6.1 Powering the EVM 16
6.2 Powering the ADS131A04 16
7 ADS131A04 Bill of Materials, PCB Layouts, and Schematics 17
7.1 Bill of Materials 17
7.2 PCB Layouts 22
7.3 Schematic 23

List of Figures

1 ADS131A04 Evaluation Module 1
2 ADS131A04 EVM 4
3 Delta-Sigma Evaluation Engine Installation Instructions 10
4 ADS131A04 Device Package Installation Instructions 11
5 ADS131A04 Main Tab 12
6 Top Soldermask 22
7 Bottom Soldermask 22
8 ADS131A04EVM Schematic 23
9 ADS131A04EVM Power Schematic 24
10 ADS131A04EVM Digital Header Schematic 25
11 ADS131A04EVM Power USB Schematic 26
12 ADS131A04EVM Power External Schematic 27
13 ADS131A04EVM ADC Schematic 28
14 ADS131A04EVM ADC Power Schematic 29

Copyright © 2016, Texas Instruments Incorporated

1 EVM Overview

The ADS131A04EVM is an evaluation module kit that provides hardware and software support for evaluation of the ADS131A04 delta-sigma analog-to-digital converter (ADC). The kit utilizes the TM4C1294NCPDT processor to communicate with the ADC via SPI and provide communication with a PC over USB interface. The kit also includes a software application that runs on a PC allowing for register manipulation and data collection from the ADC.

1.1 Software Requirements

PC with Microsoft® Windows® 7 or higher operating system.

1.2 Hardware Requirements

PC with available USB connection.

1.2.1 Power Supply

- USB powered
- (Optional) Lab supply for AVDD and IOVDD

1.3 Software Reference

Refer to the *PA Delta-Sigma Evaluation Software User's Guide* (SBAU260) for the core software documentation or use the *Menu* option on the software tab.

1.4 Supported Functionality

1.4.1 Supported Hardware Functionality

- Bipolar (±2.5 V) and Unipolar (3.3 V and GND) AVDD and AVSS supply operation
- Header for external IOVDD
- Fully-differential or single-ended buffers on two channels
- Digital header for external processor or controller configuration
- Configurable to all interface mode options
- On-board or external ADC clock operation
- On-board or external ADC voltage reference

1.4.2 Supported Software Functionality

- Bipolar (±2.5 V) and unipolar (3.3 V and GND) AVDD and AVSS supply operation
- 24-bit asynchronous slave mode operation
- CRC error detection ON/OFF

Copyright © 2016, Texas Instruments Incorporated

2 Quick Start

This section provides a guide to quickly begin using the EVM.

2.1 Default Jumper and Switch Configuration

The EVM should come configured with the settings listed in Table 2 and illustrated in Figure 2.

Table 2. Default Settings

Jumper	Position	Function
JP1	Not Installed	Use on-board processor
JP2	Not Installed	USB derived supplies ON
JP3 - DVDD	1-3	DVDD from USB supply
JP3 - AVDD	2-4	AVDD from USB supply
JP5	1-2	Sets M0 pin (valid with S4 set to *Manual*)
JP6	2-3	Sets M1 pin (valid with S4 set to *Manual*)
JP7	2-3	Sets M2 pin (valid with S4 set to *Manual*)
JP8	Installed	Charge pump connected to AVSS
JP9	Installed	Use on-board external voltage reference
JP10	Not Installed	Use on-board IOVDD supply
JP11	1-2	Select single-supply operation (3.3 V/GND)
Switch		
S4	Up	Set Mx pin for operation with software
S5	Up	Channel 1 connected to J1 header
S7	Down	Device interface connected for *SLAVE* mode operation
S8	Up	Channel 4 connected to J7 header

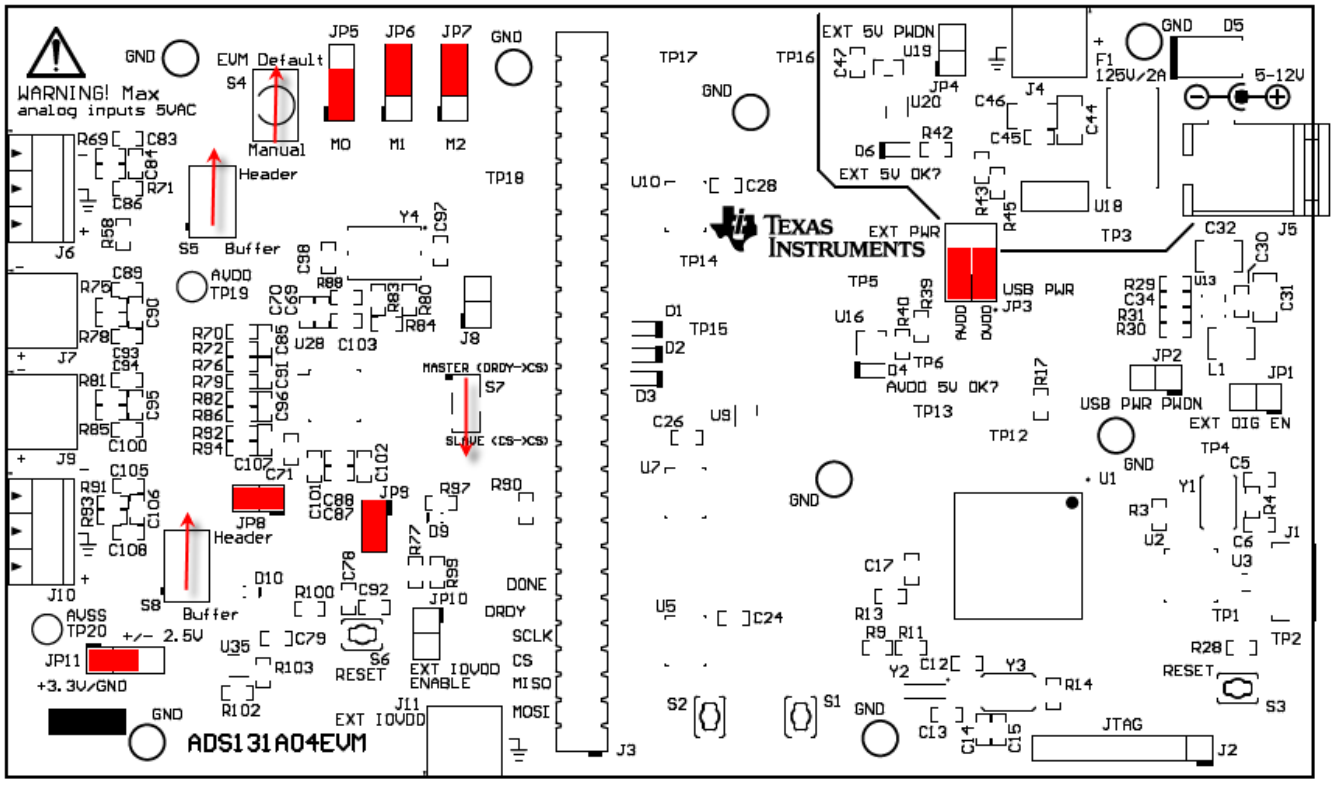


Figure 2. ADS131A04 EVM

Copyright © 2016, Texas Instruments Incorporated

2.2 Power Connection

The EVM is powered via the USB interface with the PC. Connect the EVM to a USB connector on your PC to power the board.

2.3 Startup

Use the following steps at startup:

1. Install the core application software onto your PC.
2. Install the correct device package onto your PC.
3. Ensure all jumpers and switches are configured in the default configuration per Table 2 and Figure 2.
4. Connect the EVM to your PC using a USB cable.
5. Install drivers (if necessary).
6. Start the software on your PC.

NOTE: The device has powered correctly if D1 and D2 are both lit green.

3 Hardware Reference

3.1 Jumper and Switch Configuration Reference

Table 3 provides all jumper and switch configuration settings for the EVM.

Table 3. Jumper and Switch Options

Jumper	Position	Description
JP1	Operation of EVM with external digital stimulus	
	Installed (ON)	Hold processor in reset and disables level shifter to allow external digital signals
	Uninstalled (OFF)	Normal operation with on-board processor
JP2	Power down USB power supplies	
	Installed (ON)	USB-derived power supplies powered down
	Uninstalled (OFF)	USB-derived power supplies ON
JP3	AVDD and DVDD supply connections: ● Pins 1, 3, and 5 control the DVDD connection ● Pins 2, 4, and 6 control AVDD connection	
	1-3 shorted (DVDD)	Connect DVDD to USB power
	3-5 shorted (DVDD)	Connect DVDD to external power
	2-4 shorted (AVDD)	Connect AVDD to USB power
	4-6 shorted (AVDD)	Connect AVDD to external power
JP5	M0 control	
	1-2	M0 pin connected to IOVDD
	2-3	M0 pin connected to DGND
	Open	M0 pin floating
JP6	M1 control	
	1-2	M1 pin connected to IOVDD
	2-3	M1 pin connected to DGND
	Open	M1 pin floating
JP7	M2 control	
	1-2	M2 pin connected to IOVDD
	2-3	M2 pin connected to DGND
	Open	M2 pin floating

Copyright © 2016, Texas Instruments Incorporated

Table 3. Jumper and Switch Options (continued)

Jumper	Position	Description
JP8	Negative charge-pump connection to AVSS	
	Installed (ON)	Charge pump is OFF (software)
	Uninstalled (OFF)	Charge pump up is ON (software)
J8	N/A	External clock input
JP9	ADC reference connection	
	Installed (ON)	Use EVM reference and buffer
	Uninstalled (OFF)	Use external reference
JP10	IOVDD power selection	
	Installed (ON)	J11 supply voltage
	Uninstalled (OFF)	On-board generated IOVDD
JP11	ADC supply selector (AVDD and AVSS)	
	1-2	Use 3.3-V/GND supplies
	2-3	Use ±2.5-V supplies
Switch		
S3	Processor *RESET* button (press to reset processor)	
S4	ADC Mx pin configuration	
	Down	Mx manually controlled via JP5-7
	Up	3 Mx pin configured for compatibility with EVM software
S5	ADC IN1 connection	
	Up	Inputs connected to terminal blocks
	Down	Inputs connected to buffers
S6	ADS131A04 *RESET* button (press to reset ADC)	
S7	Master/Slave interface connection	
	Down	Interface configured for device is master (DRDY → CS)
	Up	Interface configured for device is slave (CS → CS)
S8	ADC IN4 connection	
	Up	Inputs connected to terminal blocks
	Down	Inputs connected to buffers

Copyright © 2016, Texas Instruments Incorporated

3.2 Header and Connector Reference

This section provides the connection information and detail for all of the headers and connectors on the EVM hardware.

3.2.1 JTAG Header

The J2 header is provided for programming the on-board processor with firmware updates or user firmware. Exercise care when using the JTAG since it is possible to erase the EVM firmware and not be able to communicate with the EVM software application. Table 4 shows the J2 header functions.

Table 4. JTAG Header, J2

Function	Signal Name	Pin
Processor *RESET* Signal	RESET	1
JTAG test data out signal	TDO	2
JTAG test data in signal	TDI	3
JTAG test mode select signal	TMS	4
JTAG test clock signal	TCK	5
Debug UART receive signal	RX	6
Debug UART transmit signal	TX	7

Copyright © 2016, Texas Instruments Incorporated

3.2.2 Analog Input Headers

J6, J7, J9, and J10 provide headers to connect external analog signals to the EVM for evaluation purposes. The functions for these headers are listed in Table 5 through Table 8 .

WARNING

This EVM is not intended for connection to high voltage. Do not connect inputs of this EVM to voltages higher than 5 VAC to minimize shock hazard.

Table 5. Analog Input Header, J6

Function	Signal Name	Pin
Analog input – to ADC/op amp	IN1–	1
Ground	GND	2
Analog input + to ADC/op amp	IN1+	3

Table 6. Analog Input Header, J7

Function	Signal Name	Pin
Analog input – to ADC/op amp	IN2–	1
Analog input + to ADC/op amp	IN2+	2

Table 7. Analog Input Header, J9

Function	Signal Name	Pin
Analog input – to ADC/op amp	IN3–	1
Analog input + to ADC/op amp	IN3+	2

Table 8. Analog Input Header, J10

Function	Signal Name	Pin
Analog input – to ADC/op amp	IN4–	1
Ground	GND	2
Analog input + to ADC/op amp	IN4+	3

3.2.3 External IOVDD Connection

The EVM provides the capability to connect an external supply for IOVDD (see Table 9).

Table 9. External IOVDD Header, J11

Function	Signal Name	Pin
External IOVDD	IOVDD	1
Ground	GND	2

Copyright © 2016, Texas Instruments Incorporated

3.2.4 Digital Interface Header

Table 10 lists the functions and signals for the digital interface.

Table 10. Digital Interface, J3

Function	Signal Name	Pin Number	
		Processor Side(1)	ADC Side(2)
No Connnect	NA	1	2
SPI 0	MISO	3	4
	MOSI	5	6
	$\overline{CS}$	7	8
	SCLK	9	10
	$\overline{DRDY}$	11	12
	$\overline{DONE}$	13	14
Bank1 level shifter voltage	IOVDD	19	20
Bank2 level shifter voltage	IOVDD	37	38
Bank3 level shifter voltage	IOVDD	55	56

(1) Odd numbered pins not included are connected to microprocessor inputs whose functionality is not used for this EVM. SeeFigure 10 for connection details.
(2) Even numbered pins not included are not connected.

Copyright © 2016, Texas Instruments Incorporated

4 Software Details

4.1 Installing the Software

4.1.1 Delta-Sigma Evaluation Engine

Download the *Delta-Sigma ADC EvaluaTIon Software* installer from the EVM tool page and save to a known folder. Run the installer and follow the on-screen prompts. Note that future software versions may show slightly different screens.

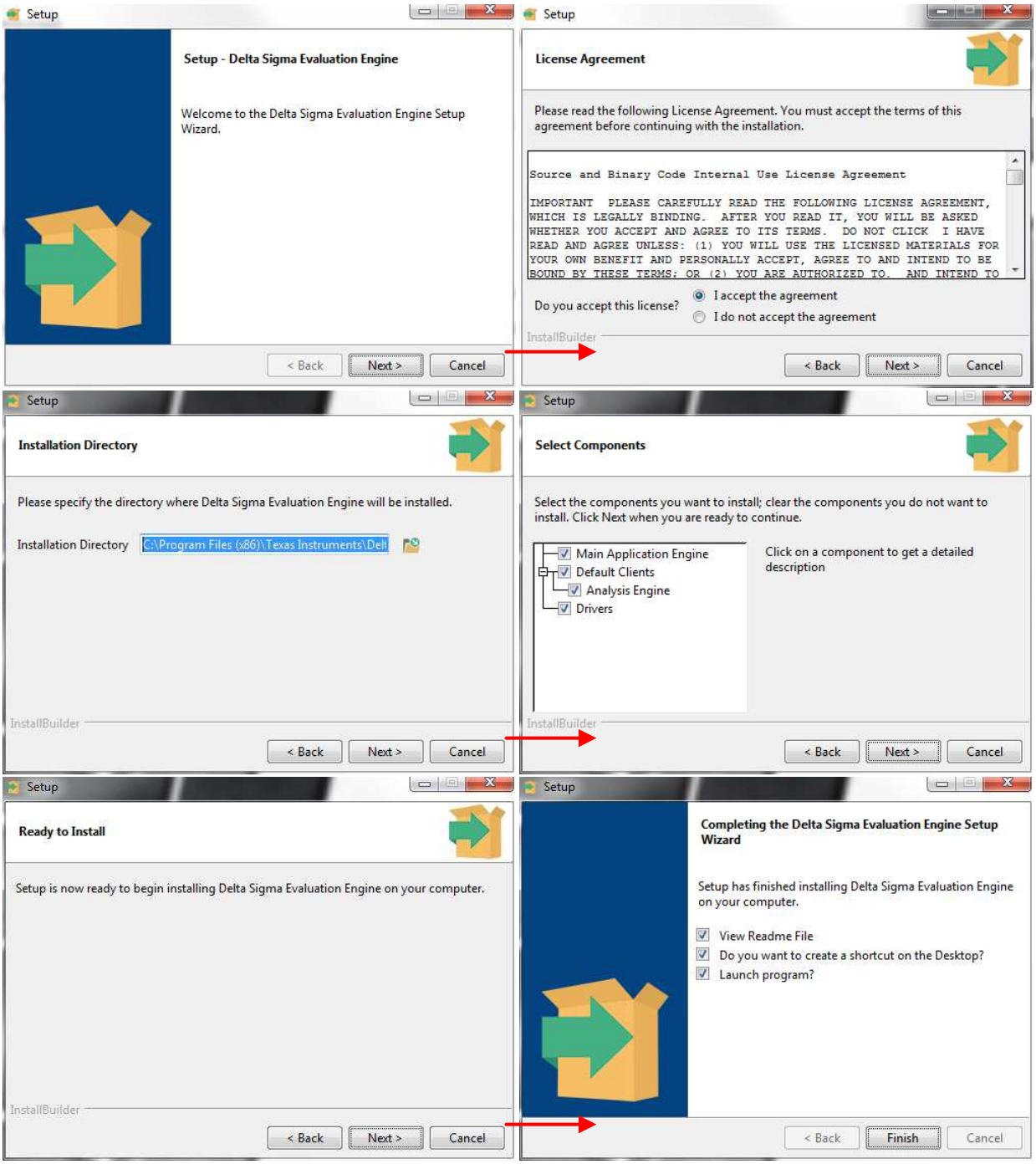


Figure 3. Delta-Sigma Evaluation Engine Installation Instructions

Copyright © 2016, Texas Instruments Incorporated

4.1.2 ADS131A04 Device Package

Download the *ADS131A04 device package* installer from the EVM tool page and save to a known folder. Run the *ADS131A04 device package* installer and follow the on-screen prompts. Note that future software versions may show slightly different screens.

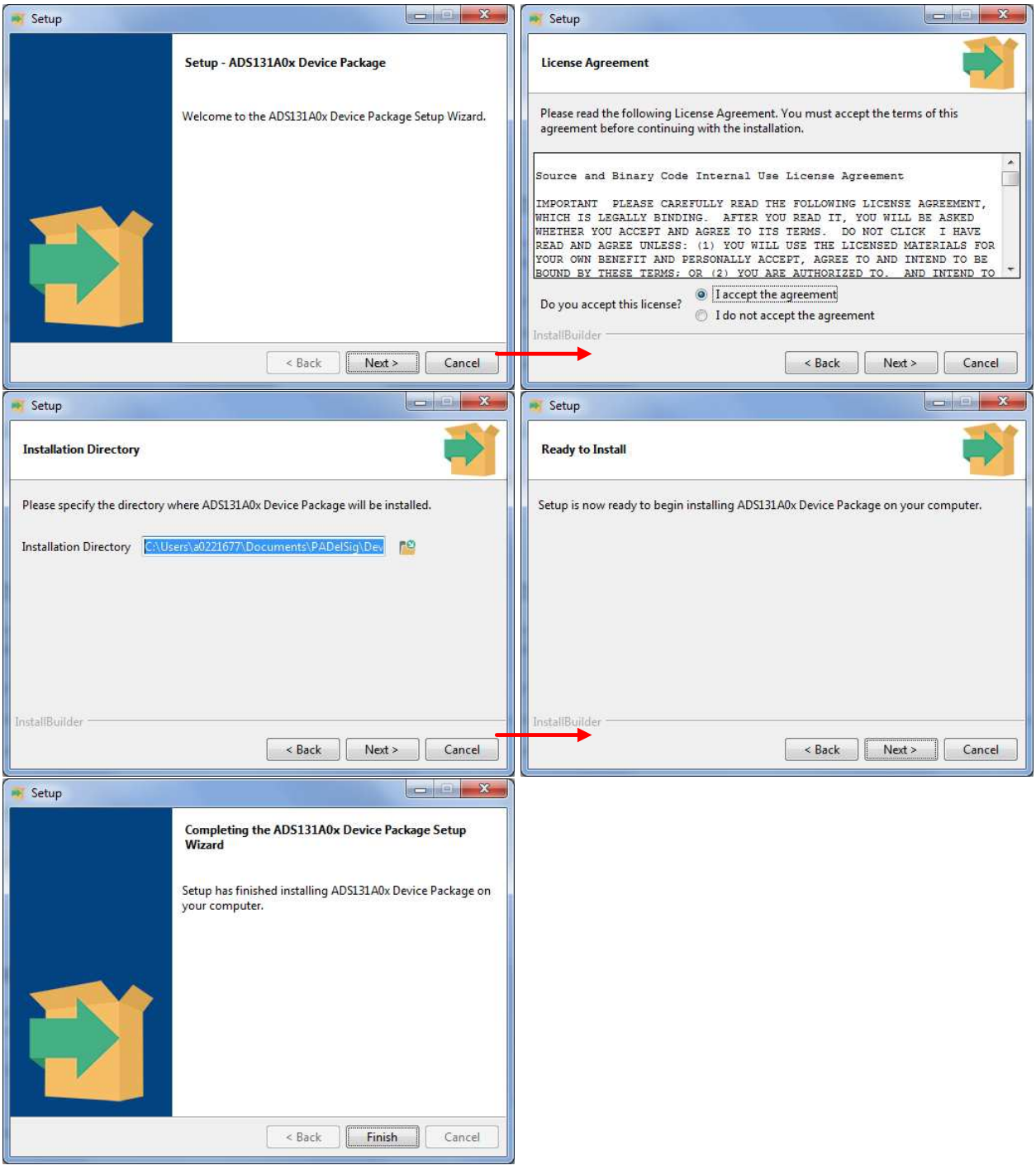


Figure 4. ADS131A04 Device Package Installation Instructions

Copyright © 2016, Texas Instruments Incorporated

4.2 Connecting to the EVM Hardware

After the *Delta-Sigma ADC EvaluaTIon Software* and the ADS131A04 device package are installed, ensure that all jumpers and switches are in their default positions per Table 2, and then connect the hardware with the provided USB mini cable. Start the *Delta-Sigma Evaluation Engine*. The GUI automatically detects the connected hardware and displays the device register map under the *Main* tab as shown in Figure 5.

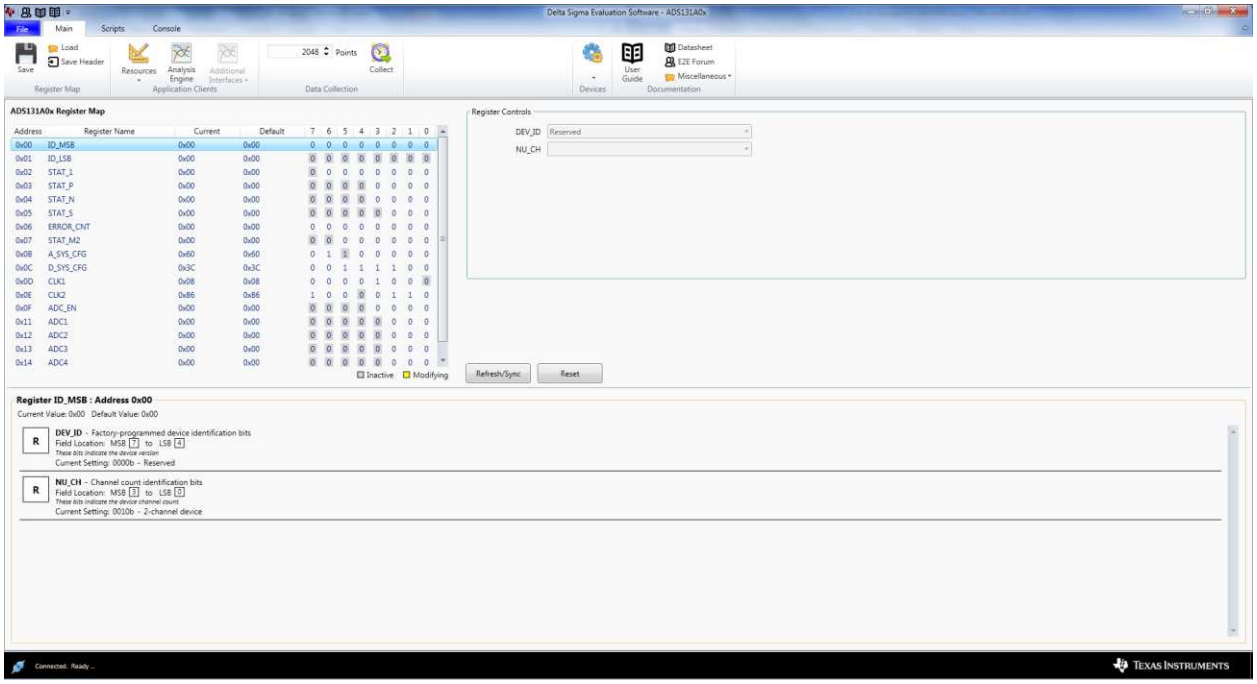


Figure 5. ADS131A04 Main Tab

4.3 Using the Software With the ADS131A04EVM

This section covers the functionality of the ADS127L01 device package only. For more information about the *Delta-Sigma Evaluation Engine*, refer to the *PA Delta-Sigma Evaluation Software User's Guide* (SBAU260).

Upon startup, the GUI scans for the connected hardware. Once the ADS131A04EVM is plugged in, the *Main* tab refreshes to display the ADS131A04 *Register Map* as shown in Figure 5. The *Main* tab also grants user control over register settings and provides a detailed description for the current values in each register.

4.3.1 Data Collection

Data is collected through the analysis engine client which is accessed by clicking the corresponding icon in the upper left area in the *Main* tab. Details about data collection and saving collected data to a file are given in the *PA Delta-Sigma Software User's Guide*.

Copyright © 2016, Texas Instruments Incorporated

4.3.2 ADS131A04-Specific Commands

Table 11 shows the ADS131A04-specific commands that can be used in the *Scripts* tab. For more information about scripts, refer to the *PA Delta-Sigma Evaluation Software User's Guide* (SBAU260).

Table 11. ADS131A04 EVM Device-Specific Software Commands

Command	Description	Format
NULL	Null command	NULL
RESET	Software reset - forces device in a POR state	RESET
STANDBY	Enter a low power state	STANDBY
WAKEUP	Wakeup from reset or standby mode	WAKEUP
LOCK	Ignore all communication except UNLOCk	LOCK
UNLOCK	Bring device out of LOCK	UNLOCK
RREGS	Read <number> registers beginning at <address>	RREG <address> <number>
WREG	Write register <address> with <data>	WREG <address> <data>
WREGS	Write registers beginning with <address> with all data listed beginning with <data0>	WREG <address> <data0> <data1>…

Copyright © 2016, Texas Instruments Incorporated

5 EVM Hardware Details

5.1 Analog Inputs

The analog inputs to the EVM can be connected at the terminal blocks located on the left side of the board (J6, J7, J9, and J10).

J6 (ADC IN1 channel) provides an optional fully-differential buffer that can be installed to evaluate the effects of a buffered input channel. J10 (ADC IN4 channel) provides an optional buffer that can be installed to evaluate the effects of a single-ended buffered input channel.

WARNING



This EVM is not intended for connection to high voltage. Do not connect inputs of this EVM to voltages higher than 5 VAC to minimize shock hazard.

5.2 Digital Inputs

Access the digital signals of the device via J3. This header allows for the connection to a logic analyzer or when the EVM is used in a stand-alone configuration for connections to the microprocessor or microcontroller.

If controlling the ADS131A04 with an external processor is desired, power down the onboard TM4C1294NCPDT by placing a jumper on JP1.

5.3 Clock

By default, a clock is supplied to the ADC via an external 16.384-MHz crystal.

To connect an external clock to the device, do the following:

1. Remove R80 and R83, if they are populated.
2. Connect the external clock to JP5 pin 1.

5.4 Mode Pins

The ADC Mx (mode) pins are controlled via S4 and JP5-7.

For operation with the EVM software, S4 should be switched to the up position (EVM Default), which connects the mode pins to default values that work with the EVM software.

NOTE: For the software to communicate with the hardware, S4 should be used in the EVM Default position. The EVM may be removed and used separately with other modes of operation.

Switch S4 to the down position (Manual) for manual control of the mode pins and now JP5-7 controls the mode pins. The mode pins are tri-state pins so JP5-7 have valid configuration in 1-2 (connected to IOVDD), 2-3 (connect to DGND), and open connection (floating).

Copyright © 2016, Texas Instruments Incorporated

5.4.1 Master and Slave Configuration

S7 must be configured to agree with the Mx pin settings for the master or slave configuration of the hardware. By default, S7 is placed in the down position for slave mode operation. Switching S7 to up configures the hardware for master mode.

5.5 ADC Reference

The reference of the ADC can be provided via the reference and buffer on the EVM or from an external source.

To use the reference and buffer on the EVM, ensure that JP9 is installed. This is the default configuration of the hardware.

To use an external reference, remove JP9 and connect the external reference to JP9, pin 1.

5.6 Reset

Reset the ADC by pressing S6.

Copyright © 2016, Texas Instruments Incorporated

6 Power Supply Connections – EVM and ADC

6.1 Powering the EVM

The EVM is only powered by the USB connection at J1.

6.2 Powering the ADS131A04

The ADS131A04 analog supply is provided by AVDD and AVSS connections. The ADC is designed to be operated by either via single or bipolar supply.

6.2.1 Single-Supply Configuration

To connect the ADC in a single-supply configuration, install a jumper on JP11, pins 1-2. This connects 3.3 V to AVDD and AGND to AVSS.

6.2.2 Bipolar Supply Configuration

To connect the ADC in a bipolar supply configuration, install a jumper on JP11, pin 2-3. This connects 2.5 V to AVDD and –2.5 V to AVSS.

6.2.3 Charge Pump Operation

To use the charge pump on the ADS131A04, the device must be configured in single-supply operation by shorting pins 1-2 on JP11. Next, remove the jumper on JP8, if it is installed. Finally, correctly set the registers in the ADS131A04 using the EVM software.

If the charge pump is unused, JP8 must be installed.

CAUTION

Do not operate the ADC in bipolar mode with the charge pump enabled. Ensure JP8 is removed before changing the JP11 connection to bipolar operation.

6.2.4 IOVDD Supply

Installing JP10 allows the use of an external IOVDD voltage for the ADS131A04 which can be connected at J11.

Copyright © 2016, Texas Instruments Incorporated

7 ADS131A04 Bill of Materials, PCB Layouts, and Schematics

7.1 Bill of Materials

NOTE: All components should be compliant with the European Union Restriction on Use of Hazardous Substances (RoHS) Directive. Some part numbers may be either leaded or RoHS. Verify that purchased components are RoHS-compliant. (For more information about TI's position on RoHS compliance, see http://www.ti.com.)

Table 12. ADS131A04 Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		PA015	Any		
C1, C20	2	2.2uF	CAP, CERM, 2.2 µF, 35 V, +/- 10%, X5R, 0603	0603	GRM188R6YA225KA12D	Murata		
C2, C3, C4, C7, C9, C10, C11, C16, C17, C18, C19, C22, C23, C24, C25, C30, C35, C71, C82, C99, C104	21	0.1uF	CAP, CERM, 0.1 µF, 25 V, +/- 5%, X7R, 0603	0603	06033C104JAT2A	AVX		
C5, C6	2	27pF	CAP, CERM, 27 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A270JAT2A	AVX		
C8	1	10uF	CAP, CERM, 10 µF, 25 V, +/- 20%, X5R, 0603	0603	GRM188R61E106MA73	Murata		
C12, C13	2	6.8pF	CAP, CERM, 6.8 pF, 50 V, +/- 4%, C0G/NP0, 0603	0603	06035A6R8CAT2A	AVX		
C14, C15	2	12pF	CAP, CERM, 12 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	C0603C120J5GACTU	Kemet		
C21, C38, C39, C41, C42, C70, C79, C81, C87, C102, C103, C109, C110, C114, C115, C116, C118, C119, C121, C122, C124, C126	22	1uF	CAP, CERM, 1 µF, 25 V, +/- 10%, X7R, 0603	0603	GRM188R71E105KA12D	Murata		
C31, C33, C36	3	10uF	CAP, CERM, 10 µF, 35 V, +/- 10%, X7R, 1206	1206	GMK316AB7106KL	Taiyo Yuden		
C32	1	22uF	CAP, CERM, 22 µF, 16 V, +/- 20%, X7R, 1210	1210	C3225X7R1C226M	TDK		
C34, C83, C86, C89, C93, C94, C100, C105, C108	9	100pF	CAP, CERM, 100 pF, 25 V, +/- 10%, X7R, 0603	0603	06033C101KAT2A	AVX		
C37, C40, C43, C84, C90, C95, C106, C113, C117, C120, C128	11	1000pF	CAP, CERM, 1000 pF, 100 V, +/- 5%, X7R, 0603	0603	06031C102JAT2A	AVX		
C68, C77	2	1500pF	CAP, CERM, 1500 pF, 100 V, +/- 5%, X7R, 0603	0603	06031C152JAT2A	AVX		
C69, C78, C80, C123, C125, C127	6	0.01uF	CAP, CERM, 0.01 µF, 100 V, +/- 10%, X7R, 0603	0603	06031C103KAT2A	AVX		
C72	1	10uF	CAP, CERM, 10 µF, 10 V, +/- 10%, X7R, 0805	0805	GRM21BR71A106KE51L	Murata		
C73	1	0.22uF	CAP, CERM, 0.22 µF, 16 V, +/- 10%, X7R, 0603	0603	C0603C224K4RACTU	Kemet		
C74, C75, C76, C92	4	10pF	CAP, CERM, 10 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A100JAT2A	AVX		
C85, C91, C96, C107	4	2700pF	CAP, CERM, 2700 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H272JA01D	Murata		
C97, C98	2	8.2pF	CAP, CERM, 8.2 pF, 50 V, +/- 3%, C0G/NP0, 0603	0603	06035A8R2CAT2A	AVX		
C101	1	0.22uF	CAP, CERM, 0.22 µF, 25 V, +/- 10%, X7R, 0603	0603	GRM188R71E224KA88D	Murata		
C111, C112	2	100uF	CAP, CERM, 100 µF, 10 V, +/- 20%, X5R, 1206_190	1206_190	C3216X5R1A107M160AC	TDK		
D1, D2, D4	3	Green	LED, Green, SMD	LED_0603	LTST-C191TGKT	Lite-On		
D3	1	Red	LED, Red, SMD	LED_0603	LTST-C191KRKT	Lite-On		

Copyright © 2016, Texas Instruments Incorporated

Table 12. ADS131A04 Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
D9, D10	2	Yellow	LED, Yellow, SMD	LED, 1.3x0.65x0.8mm	LY L29K-J1K2-26-Z	OSRAM		
H1, H2, H3, H4	4		Bumpon, Cylindrical, 0.312 X 0.200, Black	Black Bumpon	SJ61A1	3M		
J1	1		Connector, Receptacle, Micro-USB Type B, R/A, Bottom Mount SMT	7.5x2.45x5mm	0473460001	Molex		
J2	1		Header, 100mil, 7x1, Gold, TH	7x1 Header	TSW-107-07-G-S	Samtec		
J6, J10	2		Terminal Block, 6A, 3.5mm Pitch, 3-Pos, TH	10.5x8.2x6.5mm	ED555/3DS	On-Shore Technology		
J7, J9, J11	3		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology		
J8, JP1, JP2, JP8, JP9, JP10	6		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07-G-S	Samtec		
JP3	1		Header, 100mil, 3x2, Gold, TH	3x2 Header	TSW-103-07-G-D	Samtec		
JP5, JP6, JP7, JP11	4		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec		
L1	1	1uH	Inductor, Wirewound, Ferrite, 1 µH, 2.05 A, 0.045 ohm, SMD	1210	LQH32PN1R0NN0	Murata		
Q1	1	-20V	MOSFET, P-CH, -20 V, -0.39 A, SOT-323	SOT-323	BSS223PWH6327	Infineon Technologies		None
R1, R40, R57, R63, R67, R68, R90	7	1.00k	RES, 1.00 k, 1%, 0.1 W, 0603	0603	CRCW06031K00FKEA	Vishay-Dale		
R2	1	8.06k	RES, 8.06 k, 1%, 0.1 W, 0603	0603	CRCW06038K06FKEA	Vishay-Dale		
R3, R5, R7, R10, R15, R16, R19, R65, R74, R104	10	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale		
R4, R11, R84	3	1.00Meg	RES, 1.00 M, 1%, 0.1 W, 0603	0603	CRCW06031M00FKEA	Vishay-Dale		
R6, R8, R12, R70, R72, R76, R79, R82, R86, R92, R94, R95, R96, R100	14	100	RES, 100, 1%, 0.1 W, 0603	0603	CRCW0603100RFKEA	Vishay-Dale		
R9, R17, R33, R36	4	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale		
R13	1	4.87k	RES, 4.87 k, 1%, 0.1 W, 0603	0603	CRCW06034K87FKEA	Vishay-Dale		
R14	1	2.00k	RES, 2.00 k, 1%, 0.1 W, 0603	0603	CRCW06032K00FKEA	Vishay-Dale		
R18	1	51	RES, 51, 5%, 0.1 W, 0603	0603	CRCW060351R0JNEA	Vishay-Dale		
R20, R24, R27, R32, R58, R73, R99, R102	8	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW0603100KFKEA	Vishay-Dale		
R22, R23, R25, R97, R101	5	681	RES, 681, 1%, 0.1 W, 0603	0603	CRCW0603681RFKEA	Vishay-Dale		
R28, R39, R41	3	0.1	RES, 0.1, 1%, 0.1 W, 0603	0603	ERJ-L03KF10CV	Panasonic		
R29	1	768k	RES, 768 k, 1%, 0.1 W, 0603	0603	RC0603FR-07768KL	Yageo America		
R30	1	20.0k	RES, 20.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0720KL	Yageo America		
R31	1	215k	RES, 215 k, 1%, 0.1 W, 0603	0603	RC0603FR-07215KL	Yageo America		
R59, R60, R61, R62	4	499	RES, 499, 1%, 0.1 W, 0603	0603	CRCW0603499RFKEA	Vishay-Dale		
R64, R66	2	49.9	RES, 49.9, 1%, 0.1 W, 0603	0603	CRCW060349R9FKEA	Vishay-Dale		
R69, R71, R75, R77, R78, R80, R81, R83, R85, R87, R88, R89, R91, R93	14	0	RES, 0, 5%, 0.1 W, 0603	0603	ERJ-3GEY0R00V	Panasonic		
R98	1	1.00	RES, 1.00, 1%, 0.1 W, 0603	0603	CRCW06031R00FKEA	Vishay-Dale		
R103	1	66.5k	RES, 66.5 k, 1%, 0.1 W, 0603	0603	CRCW060366K5FKEA	Vishay-Dale		
S3, S6	2		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	Switch, 4.4x2x2.9 mm	TL1015AF160QG	E-Switch		
S4	1		Switch, Toggle, SPDT 1Pos, TH	7 X 11 X4.5 mm	G12AP	NKK Switches		
S5, S8	2		Switch, DPDT, On-On, 0.4 VA, 28 V, TH	DPDT Switch, 4.5x7mm	G22AP	NKK Switches		

Copyright © 2016, Texas Instruments Incorporated

Table 12. ADS131A04 Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
S7	1		Switch, Slide, SPDT 100mA, SMT	Switch, 5.4x2.5x2.5mm	CAS-120TA	Copal Electronics		
SH-J1, SH-J2, SH-J3, SH-J4, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11, SH-J12	11	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
TP7, TP8, TP9, TP10, TP11, TP21, TP22, TP23	8	Double	Terminal, Turret, TH, Double	Keystone1573-2	1573-2	Keystone		
TP19, TP20	2	Red	Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone		
U1	1		Tiva C Series Microcontroller, PDT0128A	PDT0128A	TM4C1294NCPDTI3R	Texas Instruments	TM4C1294NCPDTI3	Texas Instruments
U2	1		Highly Integrated Full Featured Hi-Speed USB 2.0 ULPI Transceiver, QFN-32	5x5 QFN-32	USB3320C-EZK	Microchip		
U3	1		USB ESD Solution with Power Clamp, 4 Channels, -40 to +85 degC, 6-pin SON (DRY), Green (RoHS & no Sb/Br)	DRY0006A	TPD4S012DRYR	Texas Instruments	Equivalent	Texas Instruments
U4	1		256K I2C™ CMOS Serial EEPROM, TSSOP-8	TSSOP-8	24AA256-I/ST	Microchip		
U5	1		8-BIT BIDIRECTIONAL VOLTAGE-LEVEL TRANSLATOR FOR OPEN-DRAIN AND PUSH-PULL APPLICATIONS, RGY0020A	RGY0020A	TXS0108ERGYR	Texas Instruments		Texas Instruments
U6	1		SINGLE BUFFER/DRIVER WITH OPEN-DRAIN OUTPUT, DCK0005A	DCK0005A	SN74LVC1G07DCKR	Texas Instruments	SN74LVC1G07DCKT	Texas Instruments
U9	1		Dual Inverter Buffer/Driver With Open-Drain Outputs, DCK0006A	DCK0006A	SN74LVC2G06DCKR	Texas Instruments		Texas Instruments
U11	1		Single Inverter Buffer/Driver With Open-Drain Output, DCK0005A	DCK0005A	SN74LVC1G06DCKR	Texas Instruments	SN74LVC1G06DCKT	Texas Instruments
U13	1		TINY 1.5-A BOOST CONVERTER WITH ADJUSTABLE INPUT CURRENT LIMIT, DSG0008A	DSG0008A	TPS61252DSGR	Texas Instruments	TPS61252DSGT	Texas Instruments
U14	1		36-V, 1-A, 4.17-uVRMS, RF LDO Voltage Regulator, RGW0020A	RGW0020A	TPS7A4700RGWR	Texas Instruments	TPS7A4700RGWT	Texas Instruments
U15	1		Single Output High PSRR LDO, 150 mA, Fixed 1.8 V Output, 2.5 to 6.5 V Input, with Low IQ, 5-pin SC70 (DCK), -40 to 85 degC, Green (RoHS & no Sb/Br)	DCK0005A	TPS71718DCKR	Texas Instruments	Equivalent	Texas Instruments
U16	1		3-Pin Voltage Supervisors with Active-Low, Open-Drain Reset, DBZ0003A	DBZ0003A	TLV803MDBZR	Texas Instruments	TLV803MDBZT	Texas Instruments
U17	1		1-A Low-Dropout Regulator With Reverse Current Protection, DRV0006A	DRV0006A	TPS73733DRVR	Texas Instruments	TPS73733DRVT	Texas Instruments
U25	1		Ultra Low Power, Rail-to-Rail Output, Fully-Differential Amplifier, DGK0008A	DGK0008A	THS4531AIDGK	Texas Instruments		Texas Instruments
U26, U27	2		1-Ohm DUAL SPDT ANALOG SWITCH 5-V/3.3-V 2-CHANNEL 2:1 MULTIPLEXER/DEMULTIPLEXER, DGS0010A	DGS0010A	TS5A23159DGSR	Texas Instruments	TS5A23159DGST	Texas Instruments
U28	1		Four Channel Analog Front-End for Power Monitoring, Control, and Protection, PBS0032A	PBS0032A	ADS131A04IPBS	Texas Instruments		Texas Instruments
U29	1		50 MHz, Low-Noise, Single-Supply Rail-to-Rail Operational Amplifier, 2.2 to 5.5 V, -40 to 125 degC, 5-pin SOT23 (DBV0005A), Green (RoHS & no Sb/Br)	DBV0005A	OPA365AIDBVR	Texas Instruments	Equivalent	Texas Instruments
U30, U33	2		AUTOSWITCHING POWER MUX, DRB0008B	DRB0008B	TPS2115ADRBR	Texas Instruments	TPS2115ADRBT	Texas Instruments
U31	1		Low-Noise, Very Low Drift, Precision VOLTAGE REFERENCE, DGK0008A	DGK0008A	REF5025IDGKR	Texas Instruments	REF5025IDGKT	Texas Instruments

Copyright © 2016, Texas Instruments Incorporated

Table 12. ADS131A04 Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
U32	1		Single Output High PSRR LDO, 150 mA, Fixed 3.3 V Output, 2.5 to 6.5 V Input, with Low IQ, 5-pin SC70 (DCK), -40 to 85 degC, Green (RoHS & no Sb/Br)	DCK0005A	TPS71733DCKR	Texas Instruments	Equivalent	Texas Instruments
U34	1		Single Output High PSRR LDO, 150 mA, Fixed 2.5 V Output, 2.5 to 6.5 V Input, with Low IQ, 5-pin SC70 (DCK), -40 to 85 degC, Green (RoHS & no Sb/Br)	DCK0005A	TPS71725DCKR	Texas Instruments	Equivalent	Texas Instruments
U35	1		0.9-V to 6.5-V, Nanopower Comparator, DCK0005A	DCK0005A	TLV3691IDCKR	Texas Instruments	TLV3691IDCKT	Texas Instruments
U36	1		UNREGULATED 60-mA CHARGE PUMP VOLTAGE INVERTER, DBV0005A	DBV0005A	TPS60403DBVR	Texas Instruments	TPS60403DBVT	Texas Instruments
U37	1		Single Output High PSRR LDO, 200 mA, Fixed -2.5 V Output, -10 to -2.7 V Input, 5-pin SOT-23 (DBV), -40 to 125 degC, Green (RoHS & no Sb/Br)	DBV0005A	TPS72325DBVT	Texas Instruments	Equivalent	Texas Instruments
Y1	1		Crystal, 24 MHz, 18 pF, SMD	ABM3	ABM3-24.000MHZ-D2Y-T	Abracon Corporation		
Y2	1		CRYSTAL, 32.768KHZ, 7PF, SMD	1.5x1.4x6.7mm	SSPT7F-7PF20-R	Seiko Instruments		
Y3	1		Crystal, 25 MHz, 18 pF, SMD	ABM3	ABM3-25.000MHZ-D2Y-T	Abracon Corporation		
Y4	1		Crystal, 16.384 MHz, 20 pF, SMD	SMD, 4-Leads, Body 7.2x5.2mm	407F35E016M3840	CTS Electrocomponents		
C26, C27, C28, C29, C45, C54, C56, C60, C65, C88	0	0.1uF	CAP, CERM, 0.1 µF, 25 V, +/- 5%, X7R, 0603	0603	06033C104JAT2A	AVX		
C44, C46, C48, C51, C52, C53, C62, C63, C64	0	10uF	CAP, CERM, 10 µF, 35 V, +/- 10%, X7R, 1206	1206	GMK316AB7106KL	Taiyo Yuden		
C47, C50, C55, C61, C66	0	0.01uF	CAP, CERM, 0.01 µF, 25 V, +/- 10%, X7R, 0603	0603	GRM188R71E103KA01D	Murata		
C49	0	1uF	CAP, CERM, 1 µF, 25 V, +/- 10%, X7R, 0603	0603	GRM188R71E105KA12D	Murata		
C57	0	1100pF	CAP, CERM, 1100 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H112JA01D	Murata		
C58	0	0.22uF	CAP, CERM, 0.22 µF, 25 V, +/- 10%, X5R, 0603	0603	06033D224KAT2A	AVX		
C59	0	10pF	CAP, CERM, 10 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A100JAT2A	AVX		
C67	0	4700pF	CAP, CERM, 4700 pF, 100 V, +/- 10%, X7R, 0603	0603	06031C472KAT2A	AVX		
D5	0	12V	Diode, TVS, Uni, 12 V, 600 W, SMB	SMB	SMBJ12A-13-F	Diodes Inc.		
D6	0	Green	LED, Green, SMD	LED_0603	LTST-C191TGKT	Lite-On		
D7	0	20V	Diode, Schottky, 20 V, 1 A, SOD-123F	SOD-123F	PMEG2010AEH,115	NXP Semiconductor		
D8	0	20V	Diode, Schottky, 20 V, 1.1 A, DO-219AB	DO-219AB	SL02-GS08	Vishay-Semiconductor		
F1	0		Fuse, 2 A, 125 V, SMD	SMD, 2-Leads, Body 9.73x5.03mm	0154002.DRT	Littelfuse		
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
H5	0		CABLE USB-A TO MICRO USB-B 0.5M		102-1092-BL-00100	CNC Tech	-	-
J3	0		Header, 2.54 mm, 28x2, Gold, TH	Header, 2.54 mm, 28x2, TH	TSW-128-07-S-D	Samtec		
J4	0		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology		
J5	0		Connector, DC Jack 2.1X5.5 mm, TH	POWER JACK, 14.4x11x9mm	PJ-102A	CUI Inc.		
JP4	0		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07-G-S	Samtec		
L2	0	3.3uH	Inductor, Shielded Drum Core, Ferrite, 3.3 µH, 1.5 A, 0.033 ohm, SMD	CDPH4D19F	CDPH4D19FNP-3R3MC	Sumida		
L3	0	10uH	Inductor, Shielded Drum Core, Ferrite, 10 µH, 1.2 A, 0.124 ohm, SMD	CDRH5D18	CDRH5D18NP-100NC	Sumida		

Copyright © 2016, Texas Instruments Incorporated

Table 12. ADS131A04 Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
R21, R26, R44, R56	0	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale		
R34, R35, R37, R38	0	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale		
R42	0	681	RES, 681, 1%, 0.1 W, 0603	0603	CRCW0603681RFKEA	Vishay-Dale		
R43	0	9.31k	RES, 9.31 k, 1%, 0.1 W, 0603	0603	CRCW06039K31FKEA	Vishay-Dale		
R45	0	3.01k	RES, 3.01 k, 1%, 0.1 W, 0603	0603	CRCW06033K01FKEA	Vishay-Dale		
R46	0	158k	RES, 158 k, 1%, 0.1 W, 0603	0603	CRCW0603158KFKEA	Vishay-Dale		
R47	0	453k	RES, 453 k, 1%, 0.1 W, 0603	0603	CRCW0603453KFKEA	Vishay-Dale		
R48	0	51.1k	RES, 51.1 k, 1%, 0.1 W, 0603	0603	CRCW060351K1FKEA	Vishay-Dale		
R49	0	49.9k	RES, 49.9 k, 1%, 0.1 W, 0603	0603	CRCW060349K9FKEA	Vishay-Dale		
R50	0	15.0k	RES, 15.0 k, 1%, 0.1 W, 0603	0603	CRCW060315K0FKEA	Vishay-Dale		
R51	0	121k	RES, 121 k, 1%, 0.1 W, 0603	0603	CRCW0603121KFKEA	Vishay-Dale		
R52	0	10.0	RES, 10.0, 1%, 0.1 W, 0603	0603	CRCW060310R0FKEA	Vishay-Dale		
R53	0	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW0603100KFKEA	Vishay-Dale		
R54	0	1.30Meg	RES, 1.30 M, 1%, 0.1 W, 0603	0603	CRCW06031M30FKEA	Vishay-Dale		
R55	0	93.1k	RES, 93.1 k, 1%, 0.1 W, 0603	0603	CRCW060393K1FKEA	Vishay-Dale		
S1, S2	0		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	Switch, 4.4x2x2.9 mm	TL1015AF160QG	E-Switch		
SH-J5	0	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
U7, U10	0		8-BIT BIDIRECTIONAL VOLTAGE-LEVEL TRANSLATOR FOR OPEN-DRAIN AND PUSH-PULL APPLICATIONS, RGY0020A	RGY0020A	TXS0108ERGYR	Texas Instruments		Texas Instruments
U8, U12	0		SINGLE BUFFER/DRIVER WITH OPEN-DRAIN OUTPUT, DCK0005A	DCK0005A	SN74LVC1G07DCKR	Texas Instruments	SN74LVC1G07DCKT	Texas Instruments
U18	0		1.5-A LOW-NOISE FAST-TRANSIENT-RESPONSE LOW-DROPOUT REGULATOR, DCQ0006A	DCQ0006A	TL1963ADCQR	Texas Instruments	TL1963ADCQT	Texas Instruments
U19	0		3-PIN VOLTAGE SUPERVISORS, DBV0003A	DBV0003A	TPS3809I50QDBVRQ1	Texas Instruments		Texas Instruments
U20	0		Single Inverter Buffer/Driver With Open-Drain Output, DCK0005A	DCK0005A	SN74LVC1G06DCKR	Texas Instruments	SN74LVC1G06DCKT	Texas Instruments
U21	0		Step-Up DC-DC Converter with Forced PWM Mode, 2.3 to 6 V, -40 to 105 degC, 8-pin SOP (PW8), Green (RoHS & no Sb/Br)	PW0008A	TPS61085TPWR	Texas Instruments	Equivalent	Texas Instruments
U22	0		Single Output High PSRR LDO, 150 mA, Adjustable 1.2 to 33 V Output, 3 to 36 V Input, with Ultra-Low Noise, 8-pin MSOP (DGN), -40 to 125 degC, Green (RoHS & no Sb/Br)	DGN0008D	TPS7A4901DGNR	Texas Instruments	Equivalent	Texas Instruments
U23	0		DC-DC INVERTER, DRC0010J	DRC0010J	TPS63700DRCR	Texas Instruments	TPS63700DRCT	Texas Instruments
U24	0		Single Output High PSRR LDO, 200 mA, Adjustable -1.18 to -33 V Output, -3 to -36 V Input, with Ultra-Low Noise, 8-pin MSOP (DGN), -40 to 125 degC, Green (RoHS & no Sb/Br)	DGN0008D	TPS7A3001DGNR	Texas Instruments	Equivalent	Texas Instruments

Notes: Unless otherwise noted in the Alternate Part Number or Alternate Manufacturer columns, all parts may be substituted with equivalents.

Copyright © 2016, Texas Instruments Incorporated

7.2 PCB Layouts

Figure 6 and Figure 7 illustrate the PCB layouts.

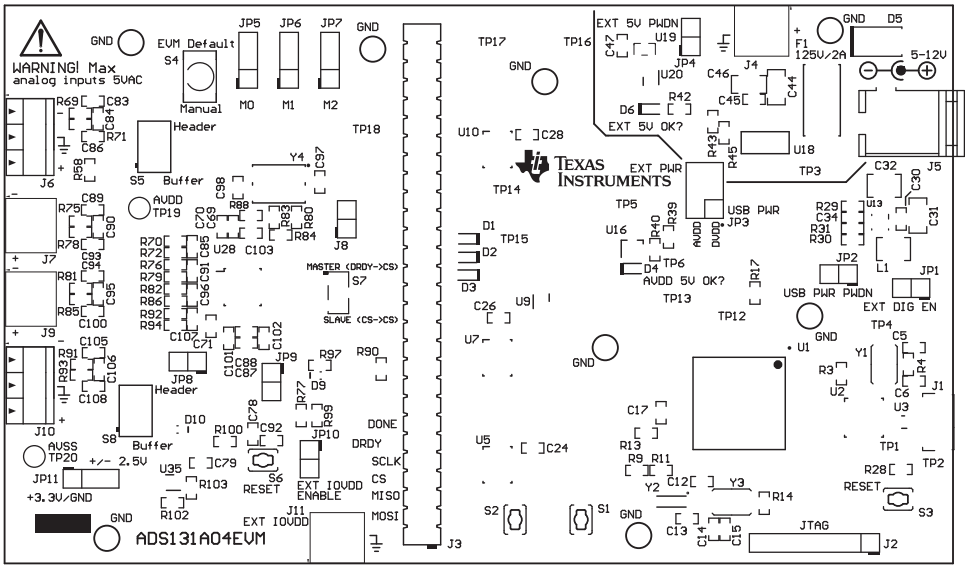


Figure 6. Top Soldermask

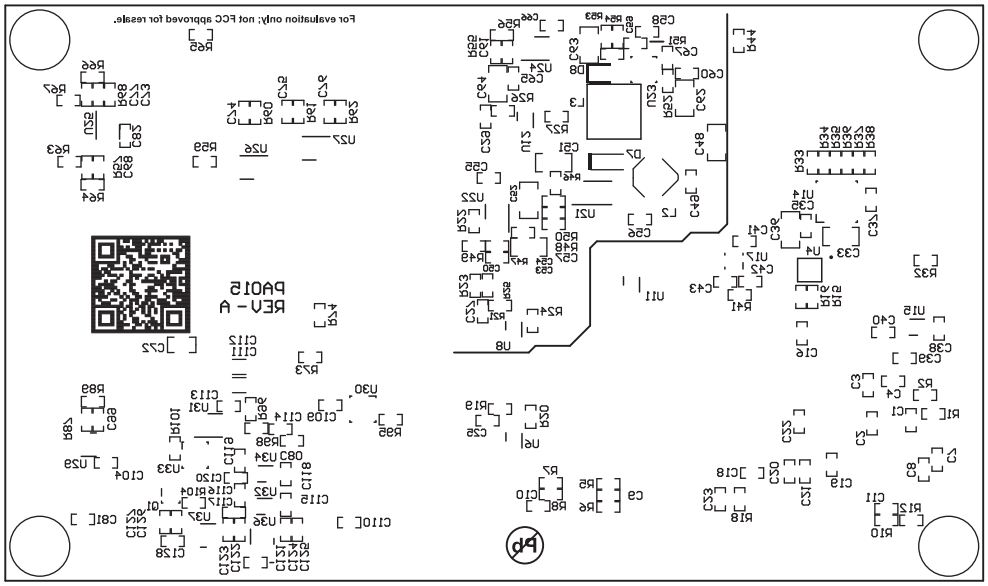


Figure 7. Bottom Soldermask

Copyright © 2016, Texas Instruments Incorporated

7.3 Schematic

Figure 8 through Figure 14 illustrate the EVM schematics.

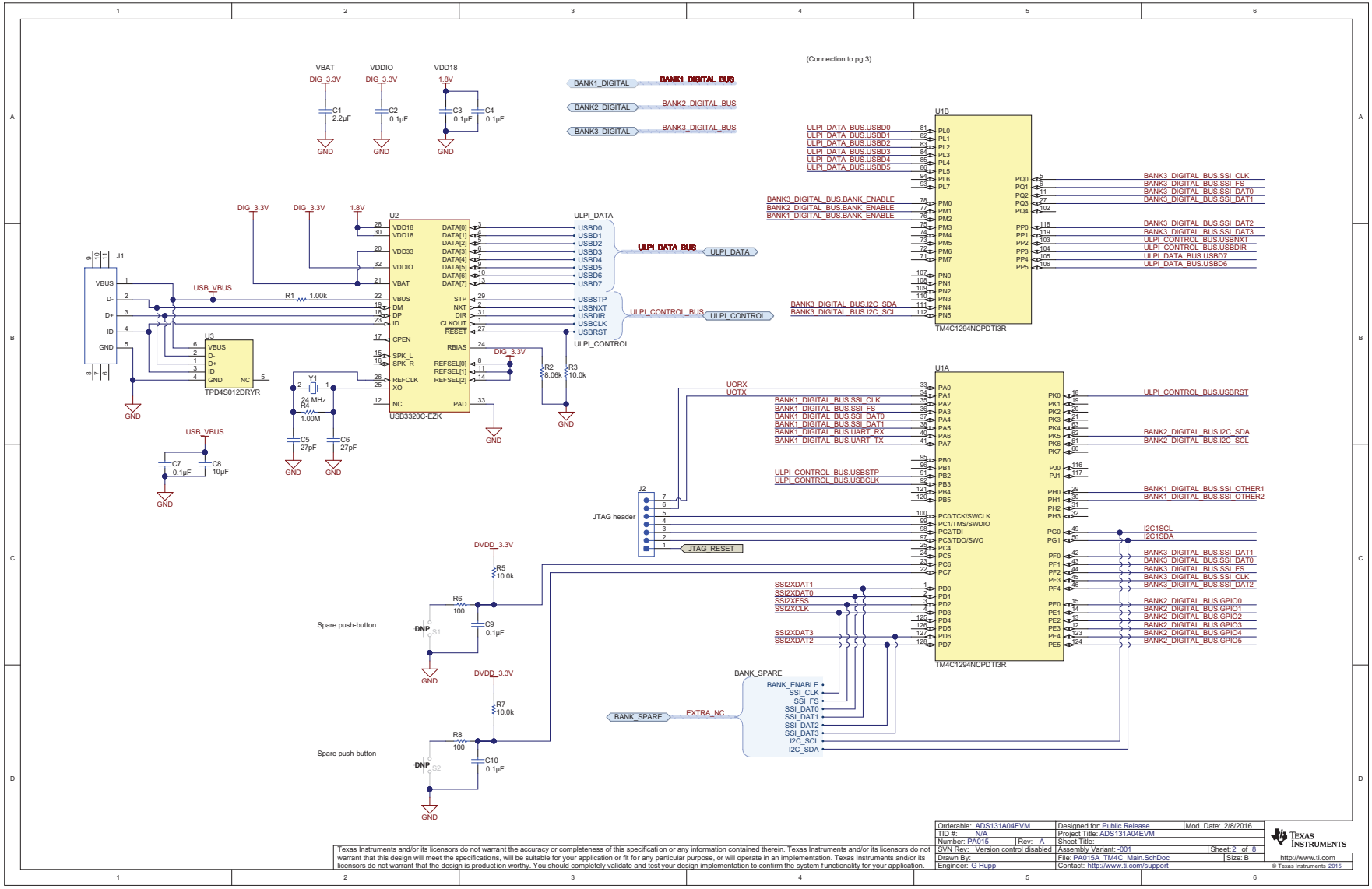


Figure 8. ADS131A04EVM Schematic

Copyright © 2016, Texas Instruments Incorporated

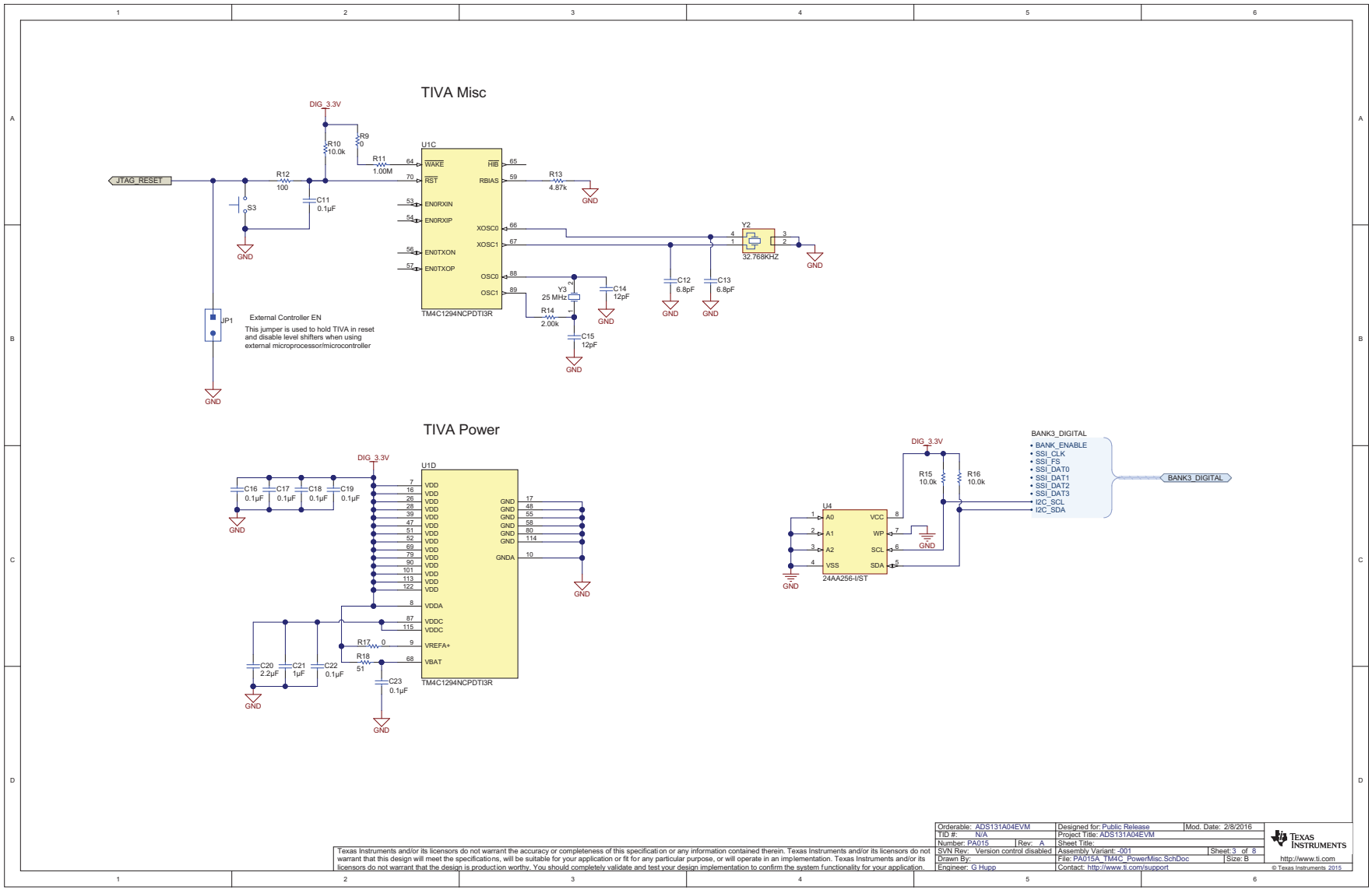


Figure 9. ADS131A04EVM Power Schematic

Copyright © 2016, Texas Instruments Incorporated

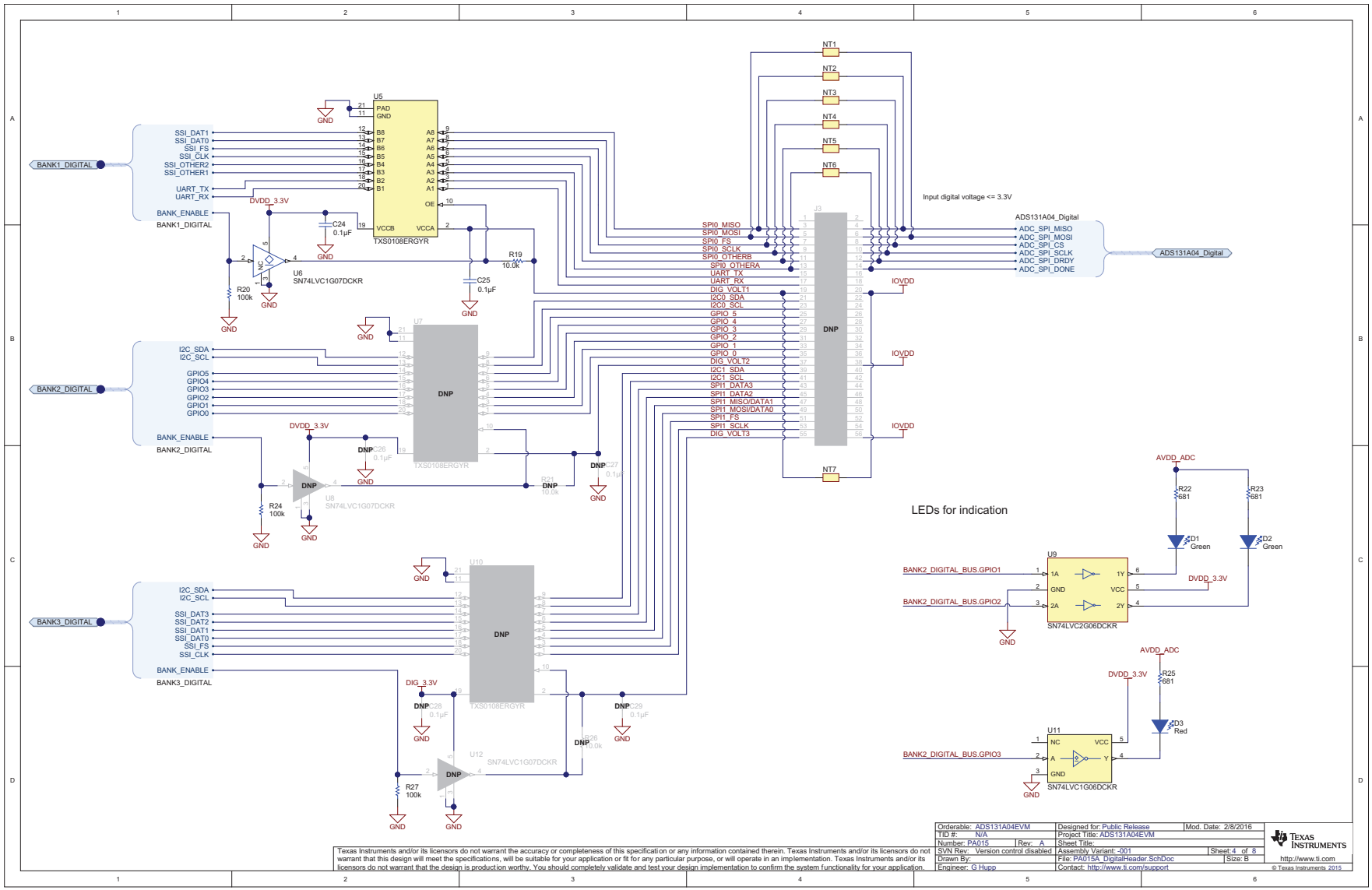
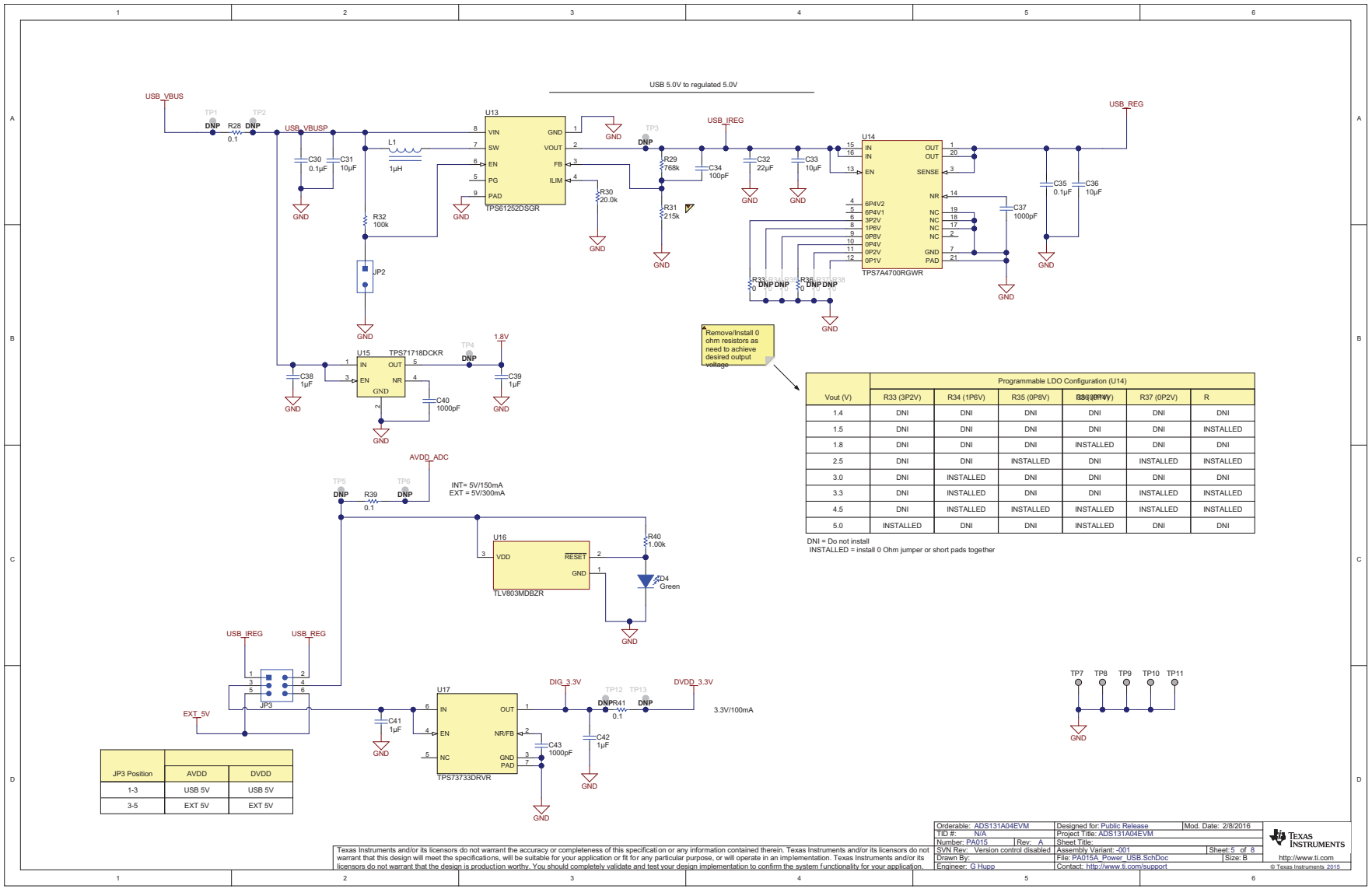


Figure 10. ADS131A04EVM Digital Header Schematic

Copyright © 2016, Texas Instruments Incorporated



Vout (V)	Programmable LDO Configuration (U14)					
	R33 (3P2V)	R34 (1P6V)	R35 (0P8V)	R36 (0P4V)	R37 (0P2V)	R
1.4	DNI	DNI	DNI	DNI	DNI	DNI
1.5	DNI	DNI	DNI	DNI	DNI	INSTALLED
1.8	DNI	DNI	DNI	INSTALLED	DNI	DNI
2.5	DNI	DNI	INSTALLED	DNI	INSTALLED	INSTALLED
3.0	DNI	INSTALLED	DNI	DNI	DNI	DNI
3.3	DNI	INSTALLED	DNI	DNI	INSTALLED	INSTALLED
4.5	DNI	INSTALLED	INSTALLED	INSTALLED	INSTALLED	INSTALLED
5.0	INSTALLED	DNI	DNI	INSTALLED	DNI	DNI

JP3 Position		
	AVDD	DVDD
1-3	USB 5V	USB 5V
3-5	EXT 5V	EXT 5V

Figure 11. ADS131A04EVM Power USB Schematic

Copyright © 2016, Texas Instruments Incorporated

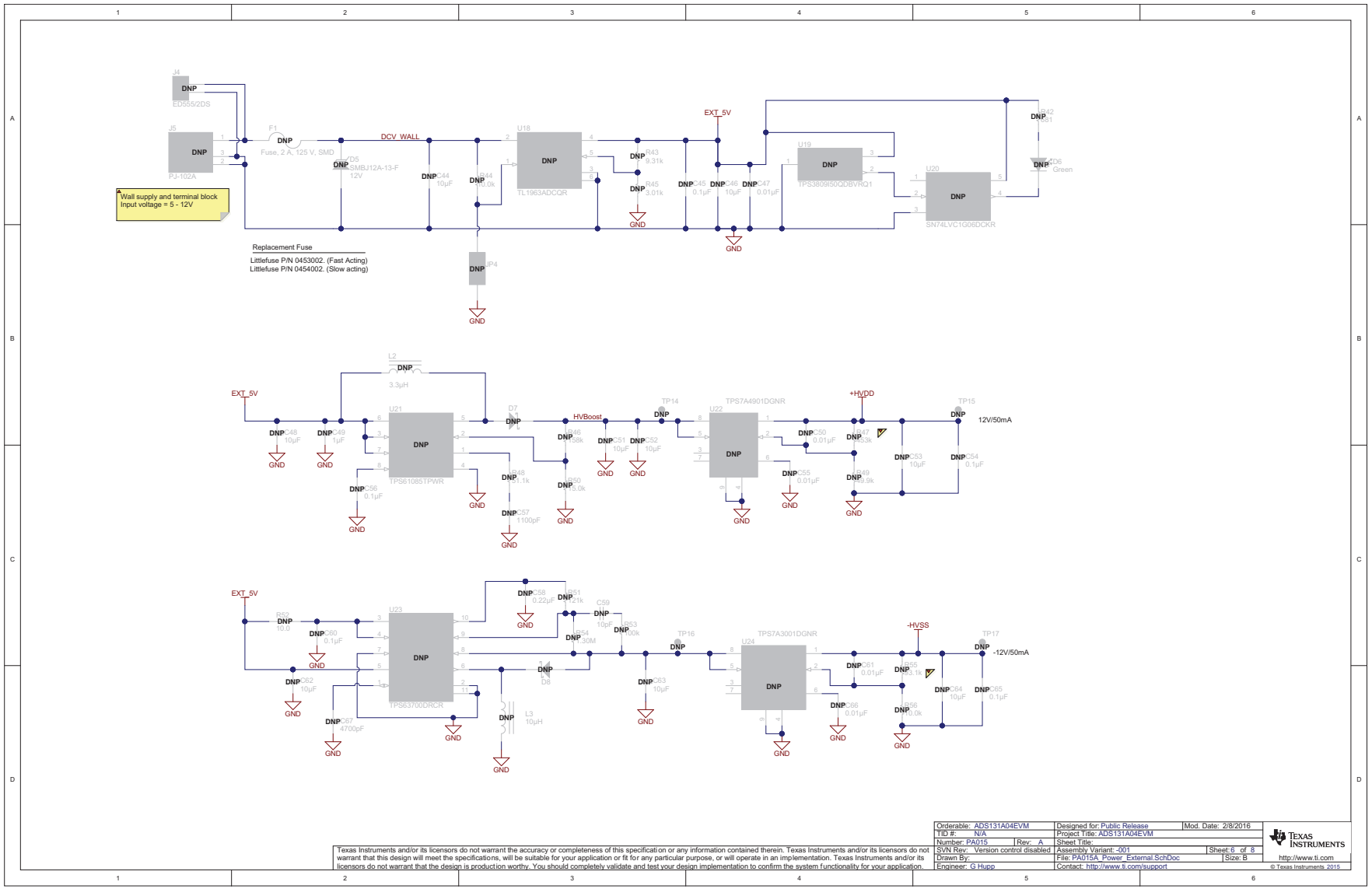


Figure 12. ADS131A04EVM Power External Schematic

Copyright © 2016, Texas Instruments Incorporated

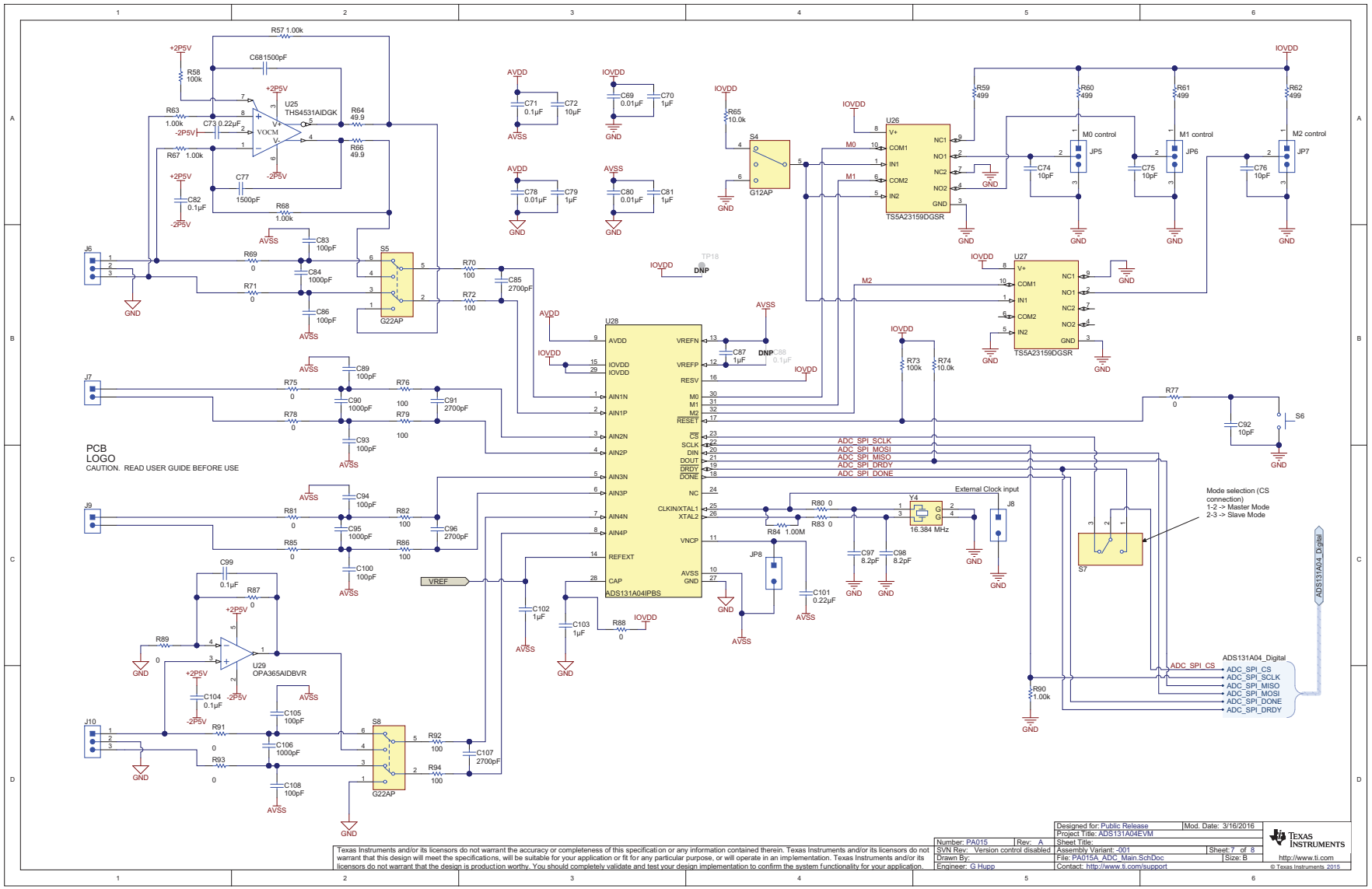


Figure 13. ADS131A04EVM ADC Schematic

Copyright © 2016, Texas Instruments Incorporated

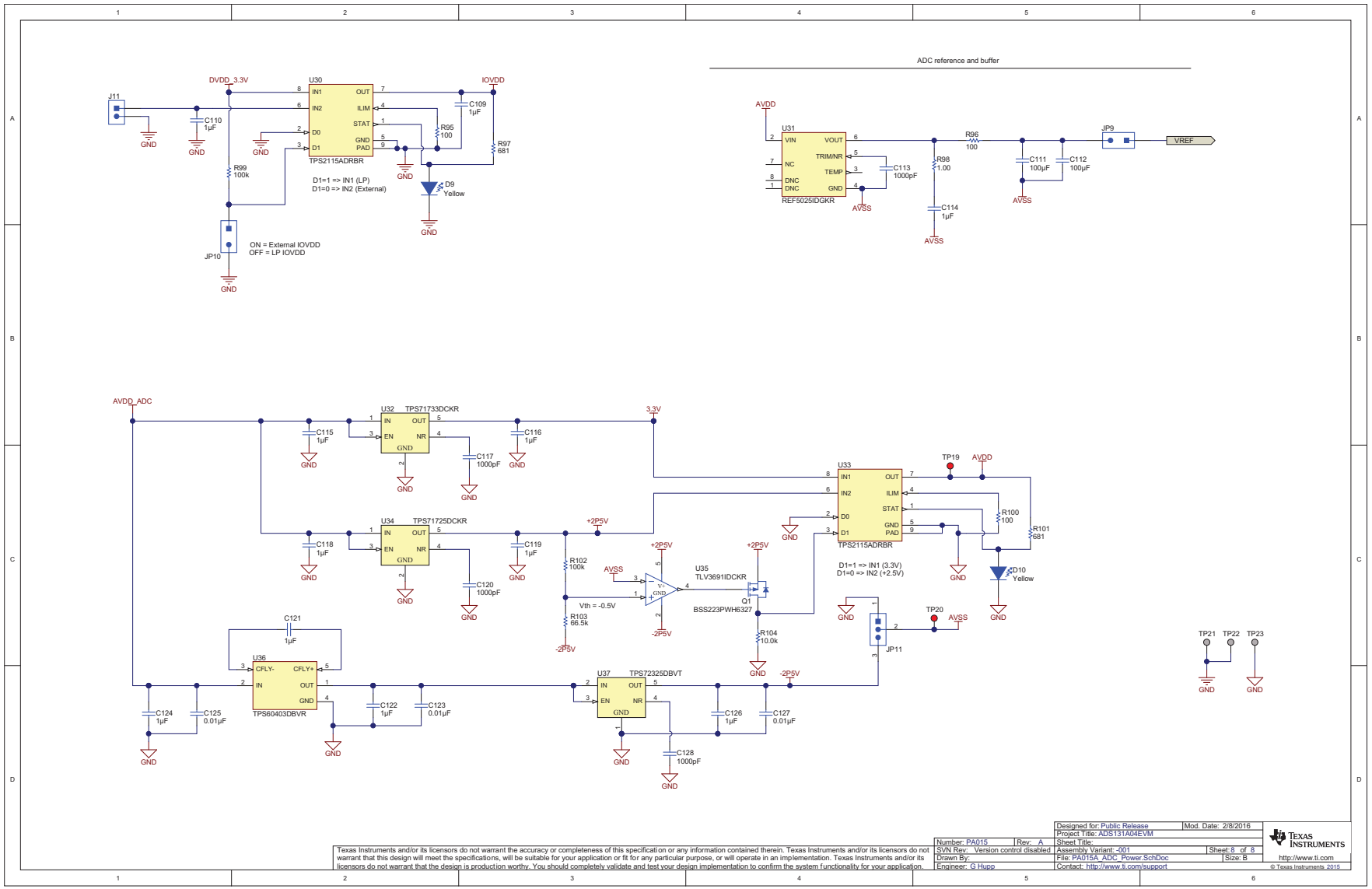


Figure 14. ADS131A04EVM ADC Power Schematic

Copyright © 2016, Texas Instruments Incorporated

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (Month Year) to A Revision	Page
• Updated *ADS131A04 EVM* image to match Table 2 and reflect correct positions, changed caption.	4
• Removed incorrect statement regarding digital signal header in the *Digital Inputs* section.	14
• Changed S4 switch statement from *left position* to *down position* in the *Mode Pins* section.	14

Copyright © 2016, Texas Instruments Incorporated

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.

   2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

      Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。
上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page
電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

   6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

   6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS ANDCONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2016, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2016, Texas Instruments Incorporated