Prototype Plug-In Module

The TI Prototype Plug-in Module (SIDEGIG-PROTOEVM) allows compatible TI Audio Class-D amplifier EVM's to adapt to any application. The plug-in module makes it easy to add any custom circuitry to the EVM while leaving the original EVM intact. The board features a standard breadboard for more temporary changes which can then be made more permanent through the solderable 0.1" prototype area underneath. Common EVM connections are available nearby as well as convenient power and grounds. This plug-in module can be used to quickly evaluate several prototypes as the main connector to the audio EVM is easy to unplug and swap. This document provides information including setup, operation, schematics, bill of materials (BOM) and printed-circuit board (PCB) layout. For questions and support, visit the E2E forums: www.e2e.ti.com.

The main contents of this document are:

- Hardware description
- Hardware implementations
- Design documents

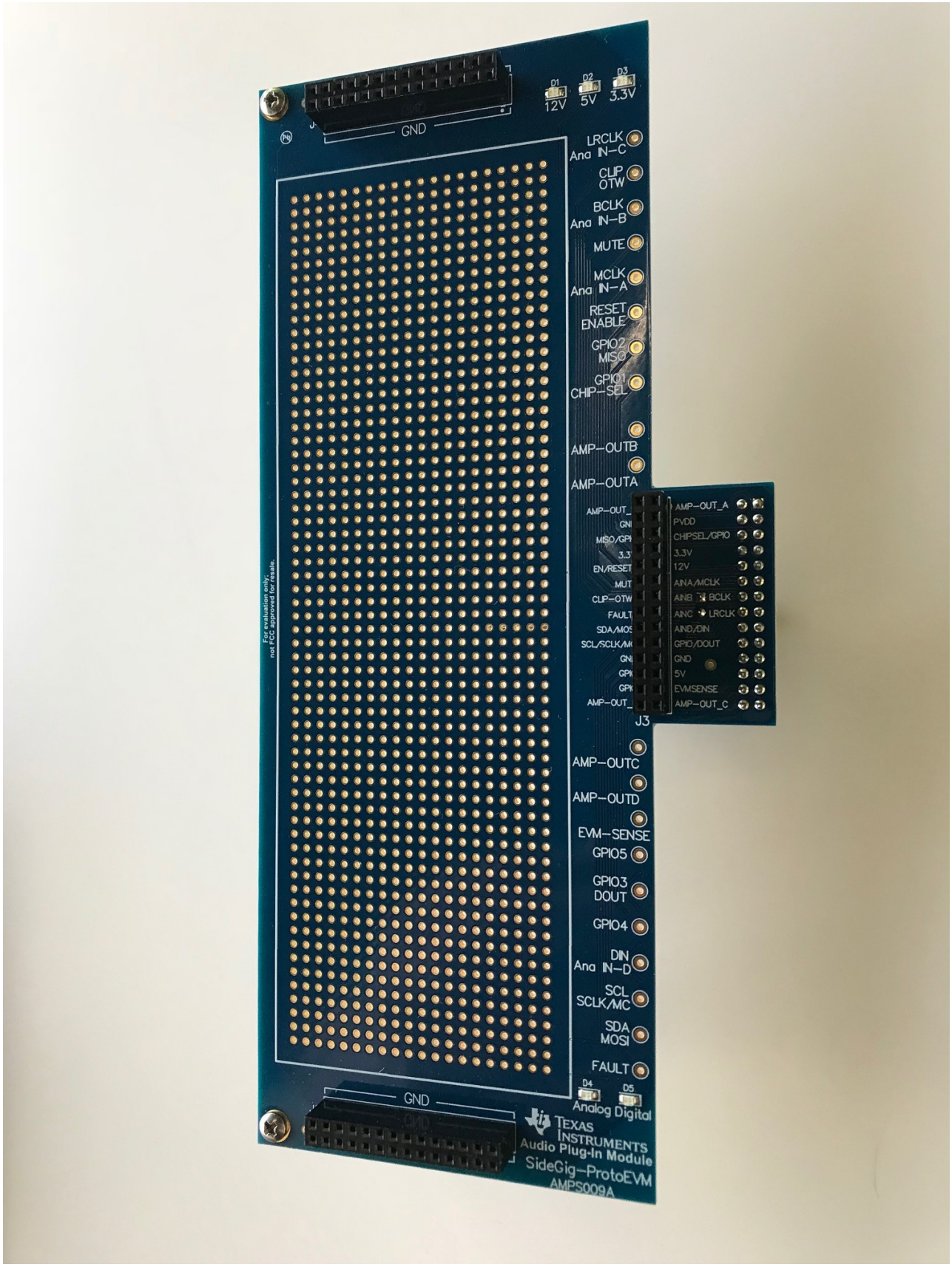

Figure 1. Prototype Plug-In Module

Contents

List of Figures

List of Tables

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1 Hardware Overview

The Prototype Plug-in Module allows an audio Class-D amplifier to be customized with easy to add external circuitry. This Plug-in module can easiliy be removed and swapped for any other so that multiple designs can be evaluated with one unchanged Class-D amplifier EVM.

1.1 Features

The Prototype EVM module includes the following features:

- Compatible with the TI Audio Plug-in Module Ecosystem
- Standard 0.1" breadboard and prototype area.
- Self-powered when connected to an audio Class-D EVM
- Differential outputs for both high and low channels which can directly drive the audio Class-D EVM
- Standard headers allow access to all EVM inputs, outputs, and control signals
- 12V, 5V (on most EVMs), and 3.3V as well as ground are provided alongside the prototyping area.
- All Class-D Audio EVM modes are supported (SE/BTL/PBTL)

1.2 Class-D EVM Compatibility

The Prototype Plug-in Module is compatible with both analog and digital input Class-D EVMs designed with the audio interface board (AIB) connector. See the SIDEGIG-PROTOEVM tools folder on TI.com for a list of compatible Class-D EVMs.

1.2.1 Audio Plug-In Module Output Types

The Prototype Plug-in Module can be used to interface any of the Class-D amp inputs through it's multi-use output connector.

1.3 AIB Pinout

This section shows the AIB connector pinout used by the Prototype Plug-in Module (see Figure 2). Any pin names not listed in Table 1 are unused by this plug-in module.

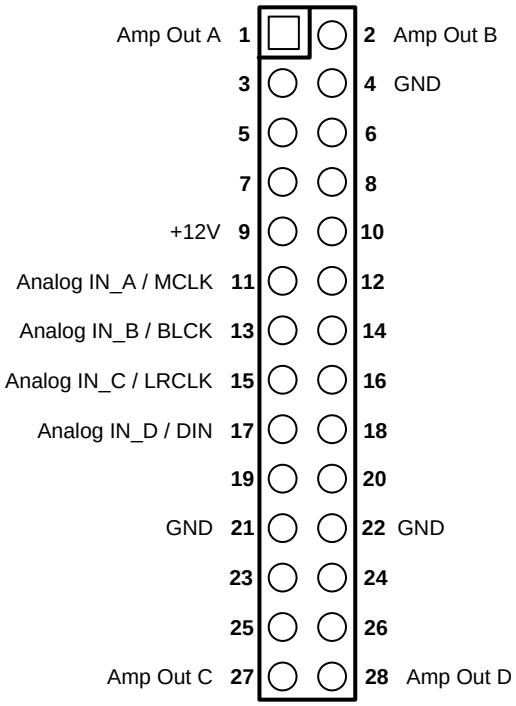

Figure 2. AIB Connector Pinout

Table 1. AIB Connector Pin Descriptions

Pin Number	Function	Description	Audio EVM Input/Output	Audio Plug-in Module Input/Output
1	Amp Out A	Speaker Level output from audio Class-D EVM (SE or one side of BTL)	O	I
2	Amp Out B	Speaker Level output from audio Class-D EVM (SE or one side of BTL)	O	I
3	PVDD	PVDD voltage supply from audio Class-D EVM (variable voltage depending on Class-D EVM use)	O	I
4	GND	Ground Refereance between Audio Plug-in Module and audio Class-D EVM	-	-
5	GPIO / CHIP_SEL	GPIO or Chip Select; used for advanced function	I/O	I/O
6	GPIO / MISO	GPIO for advanced function / MISO for SPI control	I/O	I/O
7	3.3V	3.3V Supply from EVM; used for powering Audio Plug-in Module	O	I
8	3.3V	3.3V Supply from EVM; used for powering Audio Plug-in Module	O	I
9	12V	12V Supply from EVM; used for powering Audio Plug-in Module	O	I
10	EN / RESET	Assert Enable / Reset control for audio Class-D EVM (Active Low)	I	O
11	Analog IN_A / MCLK	Analog audio Input A (analog in EVM) / Master I2S Bus (Digital in EVM)	I	O
12	MUTE	Assert Mute of audio Class-D EVM (Active Low)	I	O
13	Analog IN_B / BCLK	Analog audio Input B (analog in EVM) / Bit Clock I2S Bus (Digital in EVM)	I	O

Table 1. AIB Connector Pin Descriptions (continued)

14	/CLIP_OTW	Clipping detection and/or Over Temprature Warning from audio Class-D EVM (Active Low)	O	I
15	Analog IN_C / LRCLK	Analog audio Input C (analog in EVM) / Frame Clock I2S Bus (Digital in EVM)	I	O
16	/FAULT	Fault detection from audio Class-D EVM (Active Low)	O	I
17	Analog IN_D / DIN	Analog audio Input D (analog in EVM) / Data In I2S Bus (Digital in EVM)	I	O
18	SDA / MOSI	SDA for I2C control / MOSI for SPI control	I/O	I/O
19	GPIO / DOUT	3.3V Supply from EVM; used for powering Audio Plug-in Module	I/O	I/O
20	SCL / SCLK / MC	SCL for I2C control / SCLK for SPI control	I/O	I/O
21	GND	Ground Refereance between Audio Plug-in Module and audio Class-D EVM	-	-
22	GND	Ground Refereance between Audio Plug-in Module and audio Class-D EVM	-	-
23	5V	5V Supply from EVM; Not available on all audio Class-D EVMs	O	I
24	GPIO	GPIO used for advanced function	I/O	I/O
25	EVM Input Sense (A or D)	Audio Plug-in Module sensing for audio Class-D EVM input type, analog or digital. (10K pull-down for digital input; 10K pull-up to 3.3V for analog input)	O	I
26	GPIO	GPIO used for advanced function	I/O	I/O
27	Amp Out C	Speaker Level output from audio Class-D EVM (SE or one side of BTL)	O	I
28	Amp Out D	Speaker Level output from audio Class-D EVM (SE or one side of BTL)	O	I

2 Prototype Plug-In Module Setup

This section describes the setup and use of the Prototype Plug-in Module.

2.1 Preparation and First Steps for Setup

The Prototype Plug-in Module plugs into any audio Class-D EVM using the AIB connector.

To plug the board in, simply align the AIB connector on the Prototype Plug-in Module and the audio EVM and press into place. No additional setup is required. The plug-in module automatically powers up when the Class-D EVM is powered.

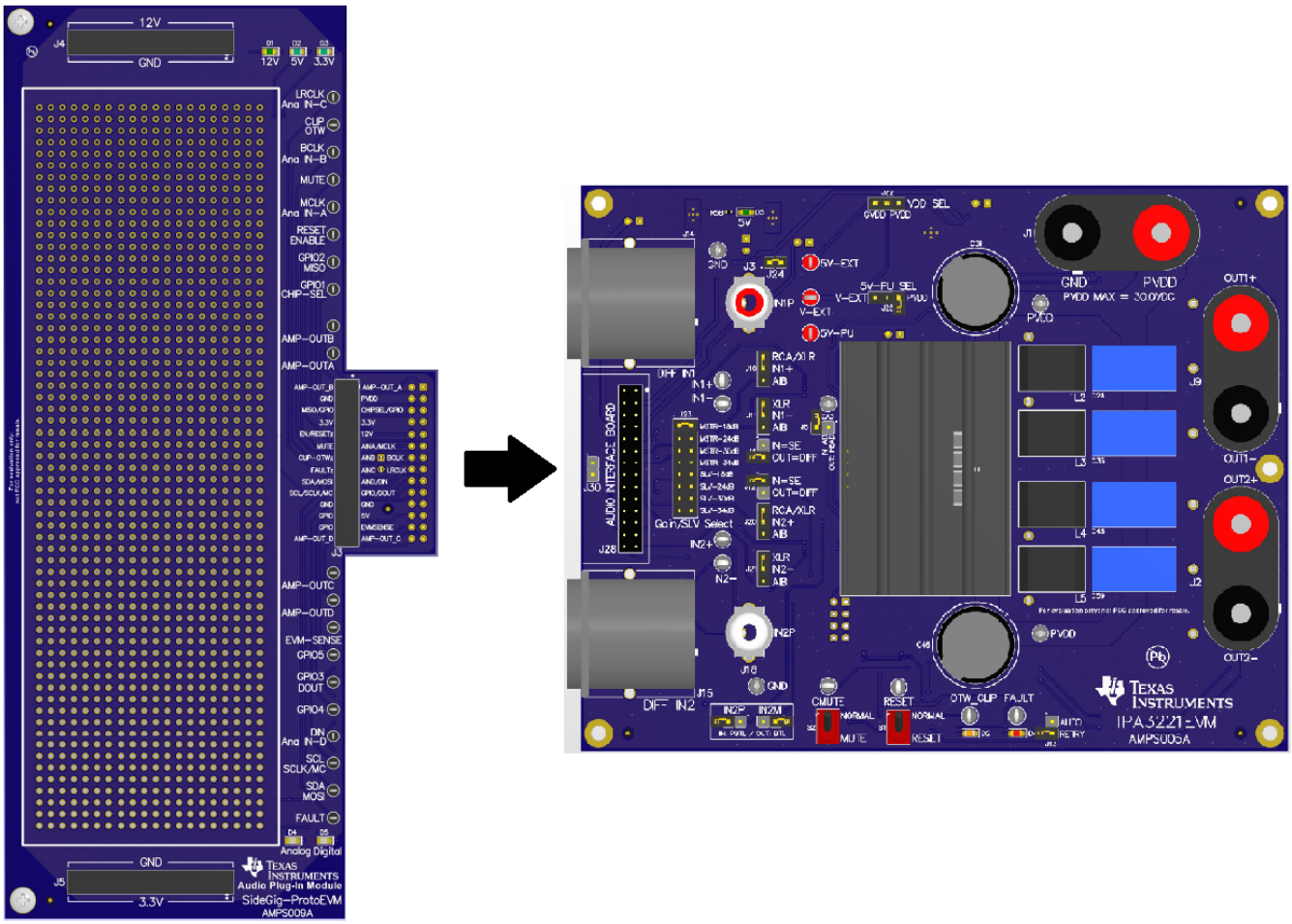

Figure 3. Connecting Prototype Plug-in Module to EVM

2.2 Prototype Plug-In Module Connections

This subsection describes the connections available on the Prototype Plug-in Module. Figure 4 shows the Prototype Plug-in Module.

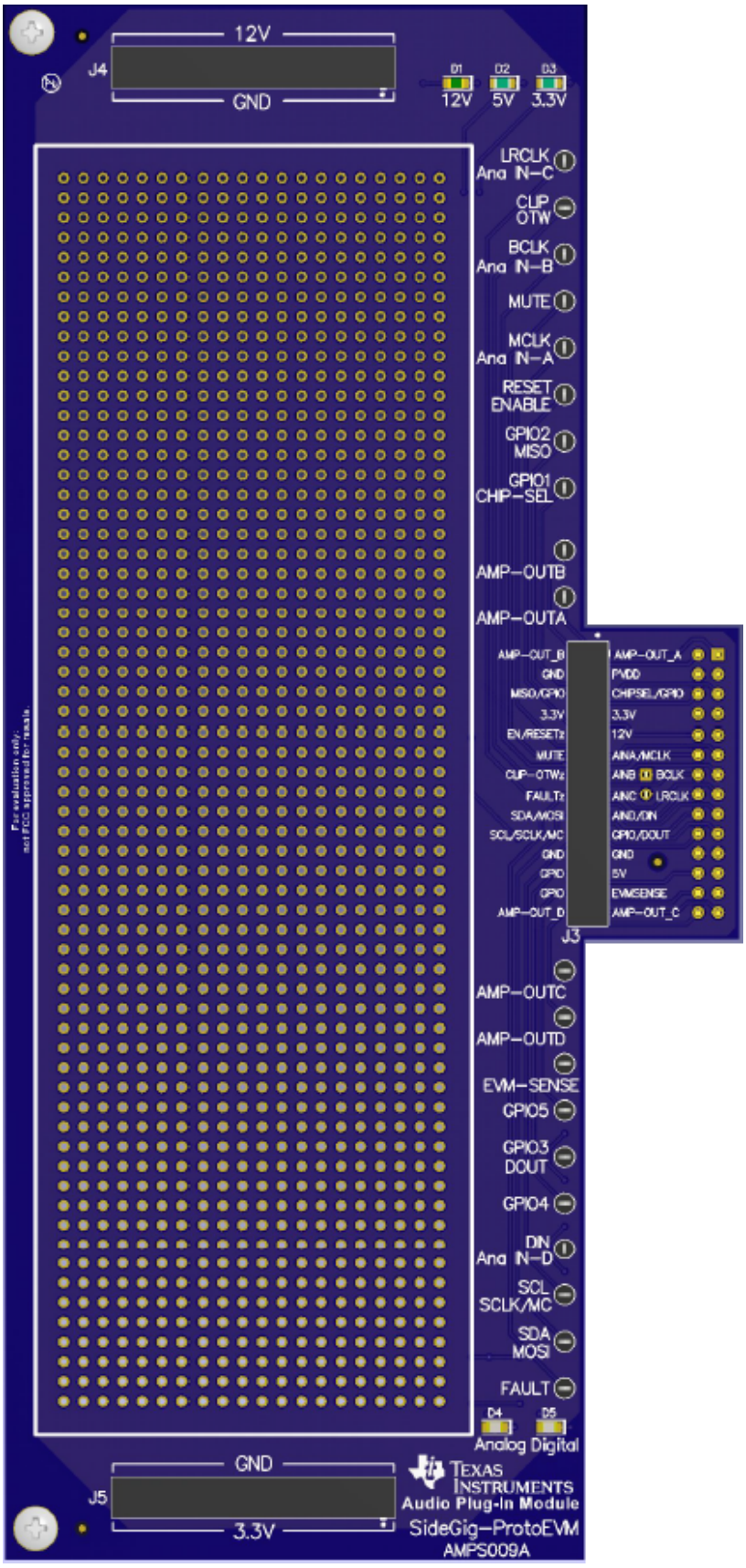

Figure 4. Prototype Plug-in Module

2.2.1 Prototyping Area and Breadboard

The Protoype Plug-in board features a large prototyping area with standard 0.1" spacing for use with DIP style or through-hole components. Any circuit can be constructed in this large space, there is no limitation in this area as all the vias are individual and can be used for any purpose. This area is for soldered components and is the more long term option on the plug-in board.

The kit also comes included with a breadboard which utilizes the same spacing as the prototyping area. This breadboard also accepts DIP style or through-hole components while also allowing circuitry to easily be added or removed. The breadboard is more temporary than the soldered prototype area which makes it a great area for a first attempt at any added circuitry. Once debugged, a circuit can be soldered to the prototyping area beneath the breadboard for a more permanent installation.

2.2.2 EVM Supplies and Grounding

Positioned at the top and bottom edge of the prototyping/breadboard area are two sets of supplies and GND pins. The J4 connector includes 14 positions for +12V along the top row as well as 14 GND positions in the bottom row. This 12V supply should not exceed 500mA which is provided from the attached EVM. The J5 connector includes 14 GND positions along the top row as well as 14 positions for +3.3V in the bottom row. This 3.3V supply should not exceed 100mA which is provided from the attached EVM.

2.2.3 LED Indicators and EVM Connections

The plug-in board offers LED indication of the attached EVM function. Power Supply LEDs for 12V, 5V, and 3.3V indicate whether an attached EVM includes the associated supplies and if they are connected to the plug-in board. These can also be used to ovserve a potential power supply issue on the attached EVM.

The lower edge of the plug-in board includes two Input Sense LEDs. These indicate the type of EVM that has been attached. An analog input style EVM will include a pull-up to 3.3V which will light the plug-in board Analog LED. A digital input EVM will include a pull-down which will light the plug-in board Digital LED. It should be noted that an EVM without a pull-up or pull-down will light the Digital LED so this should be verified.

The plug-in board includes a 28-pin connector (J3) which breaks out all signals coming from the EVM. This connector allows for easy access to all EVM connections mentioned in Table 1. The same signals are also available on the Right edge of the plug-in board via test points.

3 Design Files

3.1 Schematic

Figure 5 shows the SIDEGIG-PROTOEVM schematics.

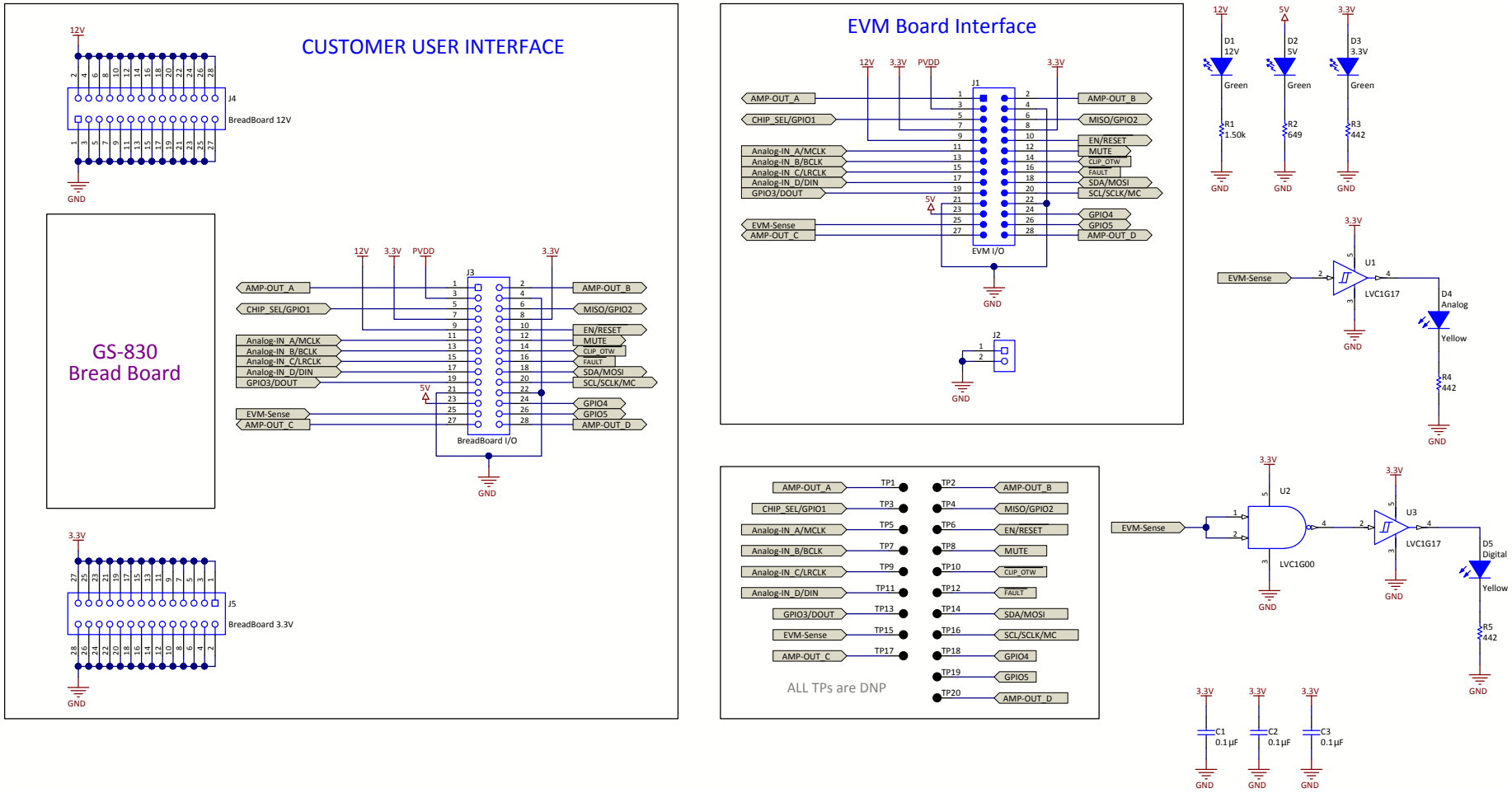

Figure 5. SIDEGIG-PROTOEVM Schematic

3.2 Board Layouts

Figure 6 and Figure 7 show the SIDEGIG-PROTOEVM layout images.

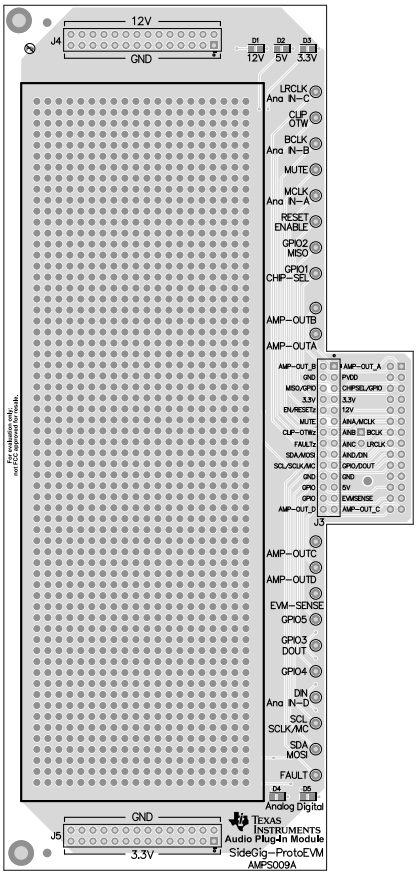

Figure 6. Top Overlay

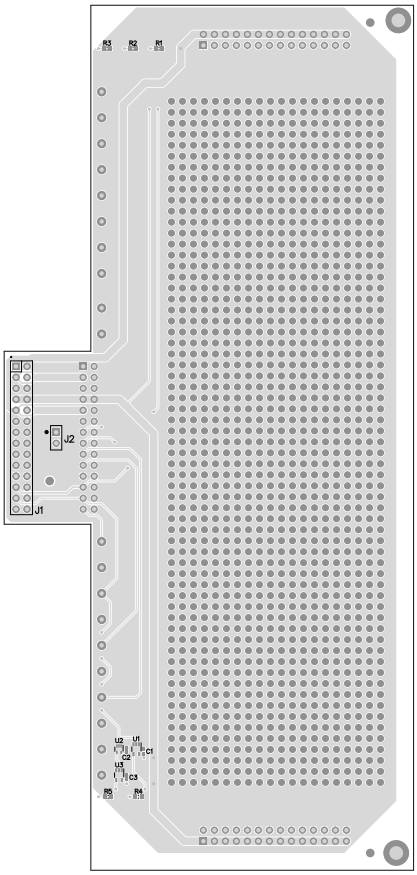

Figure 7. Bottom Overlay

3.3 Board Dimensions

Figure 8 shows the SIDEGIG-PROTOEVM board dimensions.

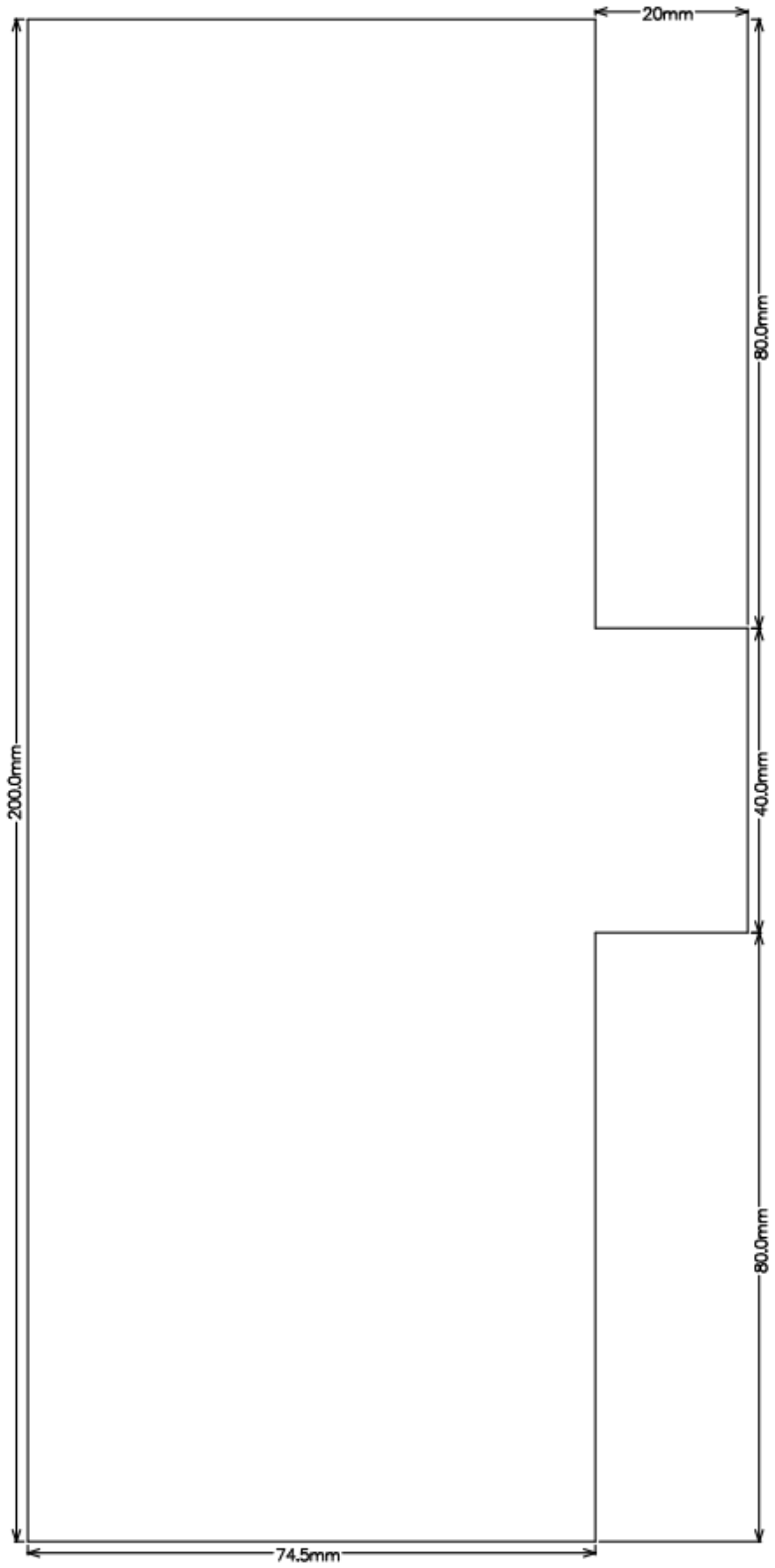

Figure 8. SIDEGIG-PROTOEVM Board Dimensions

3.4 Bill of Materials

Table 2 shows the SIDEGIG-PROTOEVM BOM.

Table 2. Bill of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		AMPS009	Any	-	-
C1, C2, C3	3	0.1uF	CAP, CERM, 0.1 µF, 25 V, +/- 10%, X7R, 0402	0402	GRM155R71E104KE14D	MuRata		
D1	1	Green	LED, Green, SMD	LED_0805	LTST-C171GKT	Lite-On		
D2, D3	2	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On		
D4, D5	2	Yellow	LED, Yellow , SMD	0805 LED	LTST-C170KSKT	Lite-On		
H1, H2	2		MACHINE SCREW PAN PHILLIPS 4-40	Machine Screw, 4-40, 1/4 inch	PMSSS 440 0025 PH	B&F Fastener Supply		
H3, H4	2		1/4 Round Female Standoff, Alum, 1-1/2"	3483, 1/4 Round Female Standoff, 1-1/2"	3483	Keystone		
H5	1		Proto Board Model GS-830	Used in PnP output and some BOM reports	GS-830	Used in BOM report	-	-
J1	1		Header, 100mil, 14x2, Gold, TH	14x2 Header	TSW-114-07-G-D	Samtec		
J2	1		Receptacle, 100mil, 2x1, Tin, TH	Receptacle, 2x1, 100mil, Tin	PPTC021LFBN-RC	Sullins Connector Solutions		
J3, J4, J5	3		Receptacle, 2.54mm, 14x2, Tin, TH	Receptacle, 2.54mm, 14x2, TH	PPTC142LFBN-RC	Sullins Connector Solutions		
R1	1	1.50k	RES, 1.50 k, 1%, 0.1 W, 0603	0603	ERJ-3EKF1501V	Panasonic		
R2	1	649	RES, 649, 1%, 0.1 W, 0603	0603	RC0603FR-07649RL	Yageo America		
R3, R4, R5	3	442	RES, 442, 1%, 0.1 W, 0603	0603	RC0603FR-07442RL	Yageo America		
U1, U3	2		SINGLE SCHMITT-TRIGGER BUFFER, DCK0005A (SOT-SC70-5)	DCK0005A	SN74LVC1G17DCKR	Texas Instruments	SN74LVC1G17DCKT	Texas Instruments

Table 2. Bill of Materials (continued)

U2	1		Single 2 Input Positive NAND Gate, DRL0005A (SOT-OTHER-5)	DRL0005A	SN74LVC1G00DRLR	Texas Instruments		Texas Instruments
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20	0		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone		

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