Click here to ask an associate for production status of specific part numbers.

Evaluates: MAX22005

MAX22005PMB#

General Description

The MAX22005PMB# (peripheral module board) provides a Pmod™-compatible hardware solution to evaluate the MAX22005 Twelve-Channel Configurable Industrial Analog Input. Refer to the MAX22005 IC data sheet for more details on the operation of the IC and its register map.

The MAX22005PMB# is most easily evaluated by configuring four universal analog inputs with the Munich GUI software through the USB2PMB2# adapter board. Alternatively, any SPI-compatible microcontroller, adapter board, or FPGA can be used along with a custom driver to evaluate the board.

The PCB dimension is just 99mm long x 23mm wide, with the width determined by the size of the terminal block.

Note the module provides a subset of the MAX22005 features. For greater flexibility, refer to the MAX22005 Evaluation Kit.

***Ordering Information* appears at end of data sheet.**

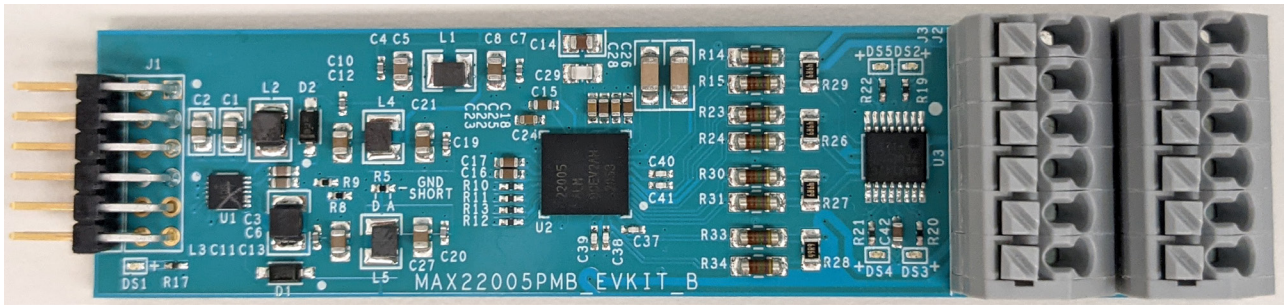
Features

- Easy Evaluation of the MAX22005
- Configurable as 8 Single-Ended Analog Voltage Inputs, 4 Single-Ended Analog Current Inputs, 4 Differential Analog Voltage Inputs, 4 Multifunctional (Universal) Analog Inputs, or Combinations Thereof
- Analog Input Voltage Range: ±12.5V
- Analog Input Current Range: ±25mA
- ±1.5kV Input Surge Protection
- Works with the USB2PMB2# Adapter and Munich GUI Software
- Fully Assembled and Tested
- Proven PCB Layout
- RoHS Compliant

EV Kit Contents

- MAX22005PMB#

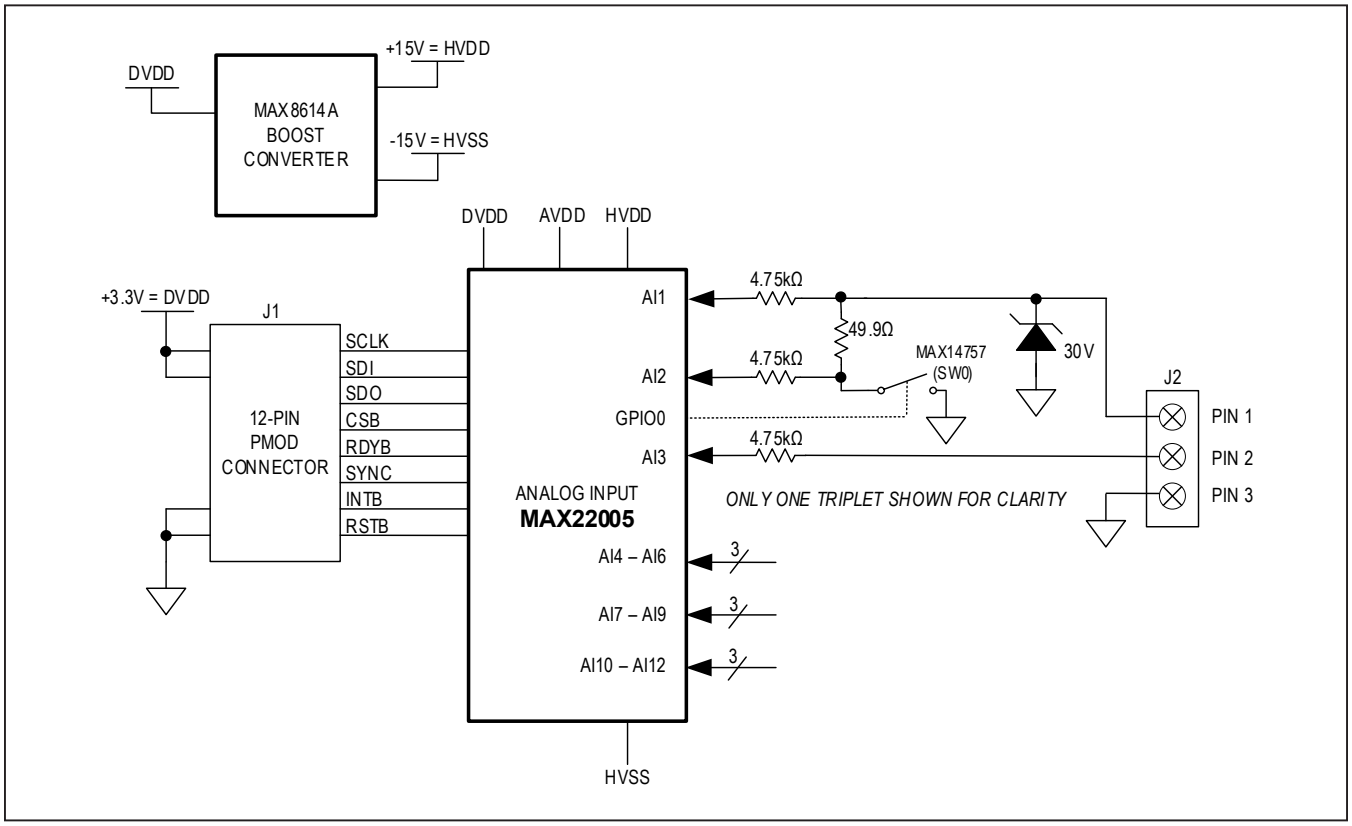
MAX22005PMB# Photo



Pmod is a registered trademark of Digilent Inc.

319-100889; Rev 0; 3/22

Block Diagram



MAX22005PMB# EV Kit Files

FILE	DESCRIPTION
Munich GUISetupV2.25.exe	Munich GUI software for use with the USB2PMB2# adapter

Quick Start

Required Equipment

- MAX22005PMB#
- USB2PMB2# adapter board
- Micro-USB cable
- Windows 10 PC with a spare USB port
- Munich GUI v2.25 or higher
- Voltage and/or Current Source

Note: In the following section(s), software-related items are identified by bolding. Text in **bold** refers to items directly from the Munich GUI software. Text in **bold and underlined** refers to items from the Windows operating system.

Procedure

This quick start procedure assumes the use of the USB2PMB2# adapter and Munich GUI software. For use with other Pmod or SPI-compatible devices, refer to the MAX22005 IC data sheet for register settings and instructions.

1) Visit **www.maximintegrated.com** to download the latest version of the Munich GUI software, version 2.25 or later.
2) Save the software to a temporary folder. Double-click the .exe file to run the installer. A message box **Do you want to allow the following program to make changes to this computer?** might appear. If so, click **Yes**.
3) The installer includes the drivers for the hardware and software. Follow the instructions on the installer, and once complete, click **Finish**. The default location of the software is in the program files directory.
4) The GUI requires voltages and currents to be measured at the J2 and J3 input connector Pins 1, 4, 7, and 10. (See Figure 1 and Table 2 for the J2 and J3 connector pin naming convention in this document.) In the GUI, these are called **Channel 1 (CH1)**, **Channel 2 (CH2)**, **Channel 3 (CH3)**, and **Channel 4 (CH4)**, respectively. These are the multifunctional "universal" analog inputs. The other pins on the J2 and J3 connectors should be grounded for accurate results—ground Pins 2, 5, 8, and 11 to their adjacent GND Pins 3, 6, 9, and 12 as shown in Figure 1. For example:

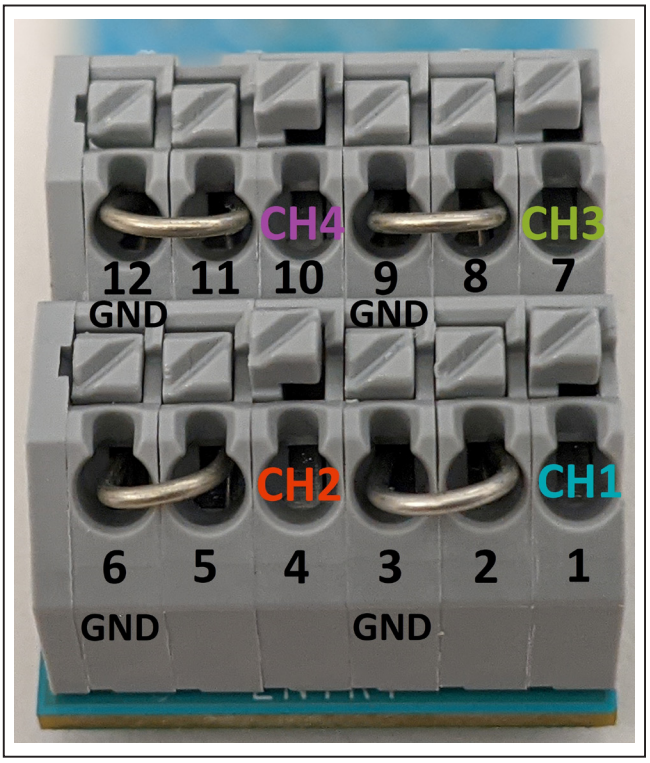


Figure 1. Input Connectors J2 and J3—Input Pin Labels and Grounding

5) Connect USB2PMB2# connector X2 to MAX22005PMB# connector J1 as shown in Figure 2.
6) Connect the Micro-USB cable to the USB2PMB2# USB connector X1. Connect the USB cable to the PC USB port.
7) The MAX22005PMB# is powered by USB through the USB2PMB2#. Confirm that the green DS1 LED (power indicator) is on. The USB2PMB2# green SPI LED should also be on. These are visible in Figure 2.
8) It may take Windows several minutes to install the driver. Wait until Windows successfully installs the driver and shows "**Your device is ready to use**" at the lower right corner near **System Icons**.
9) In the **Device** menu, select **Industrial Analog** → **MAX22005PMB# – 4 Channel Universal Analog In**.
10) Click the **Scan Adapters** button in the **USB2PMB Adapter** box. A USB2PMB2# serial name such as PMOD000003A should appear in the list (or automatically get selected). Click **Connect**.

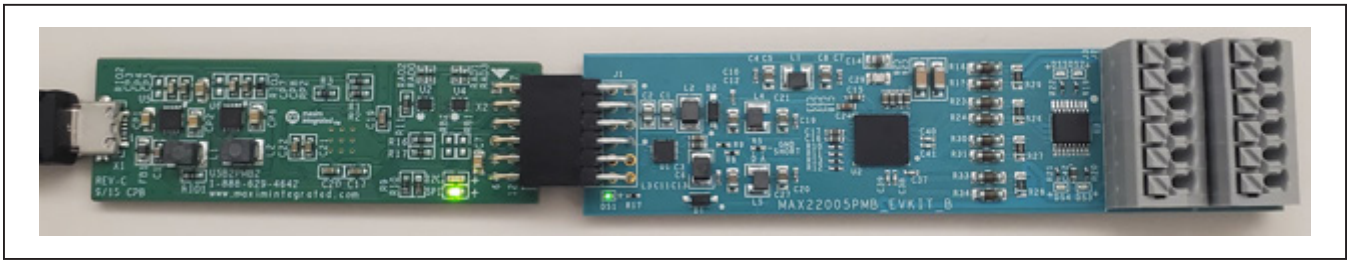


Figure 2. USB2PMB2# and MAX22005PMB# Connection

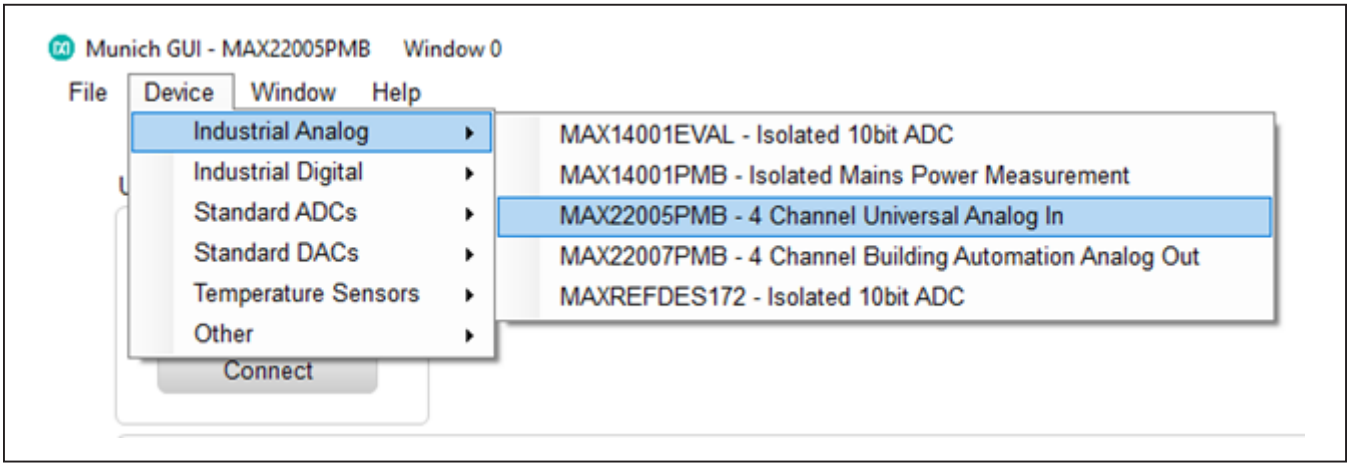


Figure 3. Choosing the MAX22005PMB# GUI in the Device Menu

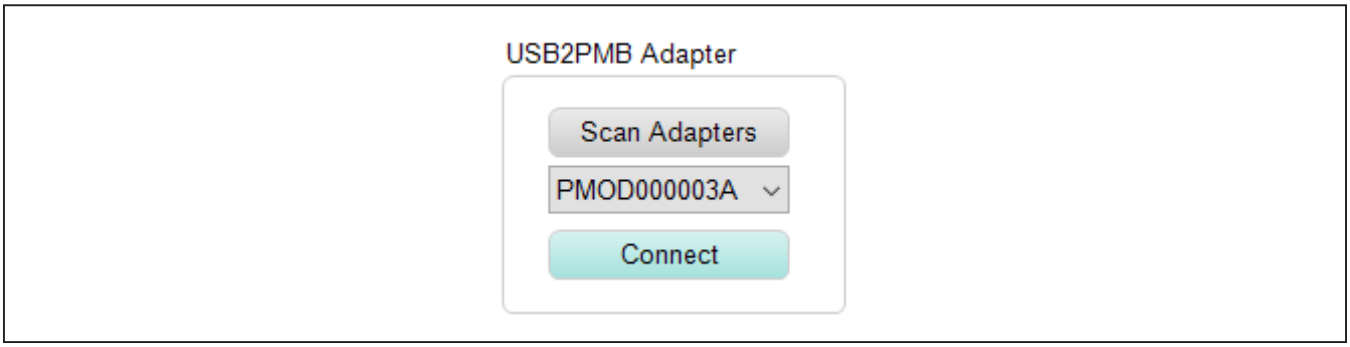


Figure 4. Scanning for USB2PMB Adapters and Connecting

11) Voltages can be measured on the four input channels independently. This example measures all four at once with the same voltage. Select all four Channels in **Measurement Configuration** by checking each box. In the same section, select the **Physical Values** button. In the **Results** box on the right side, **Voltage** should be selected (the button switch is on the left side). See Figure 5.

12) Connect a voltage source from the CH1 (Pin 1), CH2 (Pin 4), CH3 (Pin 7), and CH4 (Pin 10) pins to GND. Remember to connect Pin 2 to Pin 3 (GND), Pin 5 to Pin 6 (GND), Pin 8 to Pin 9 (GND), and Pin 11 to Pin 12 (GND) for proper operation with the Munich GUI. Set the voltage source to +10V and activate it.

13) In the **Sample** box, set the **Sample Rate** and **Sample Count**. Example values are shown in Figure 6.

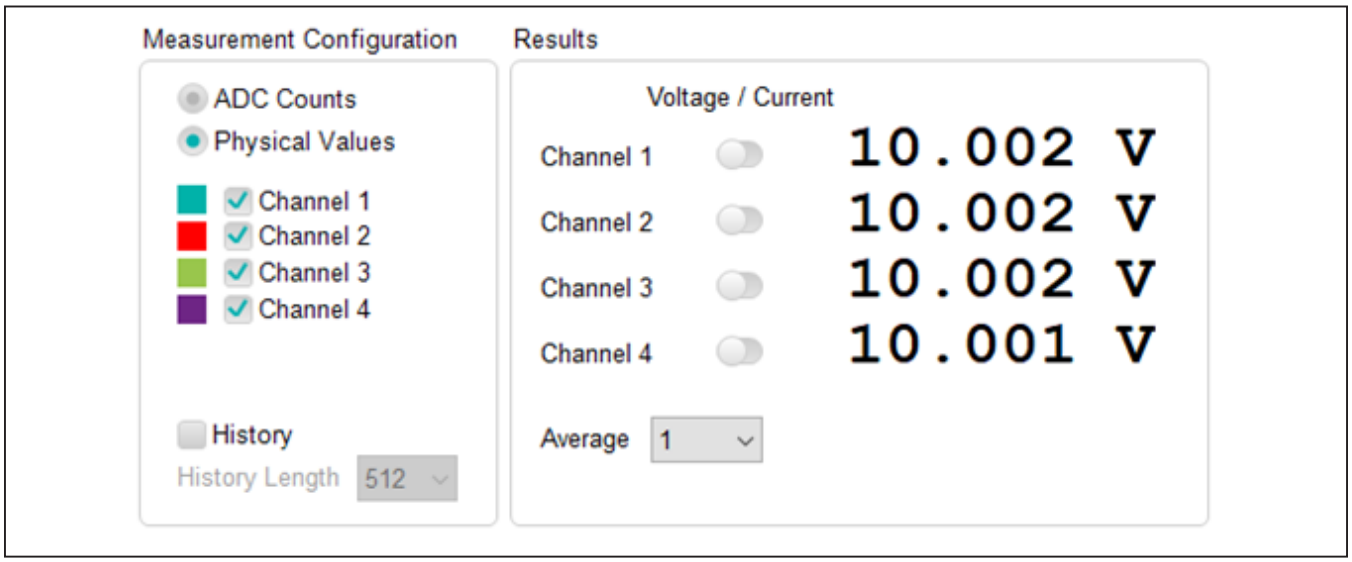


Figure 5. Example Voltage Measurement Settings and Expected Results

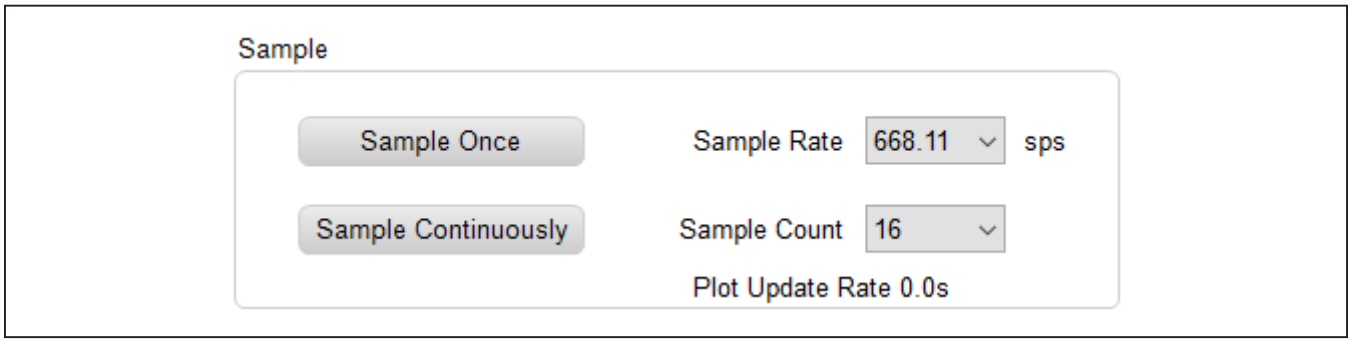


Figure 6. Example Sample Settings

14) Press **Sample Continuously**. You should see voltage values in the **Results** box close to what is in Figure 5. Press **Stop Sampling**.
15) The current measurements are performed one channel at a time. Disable and/or remove the voltage source. Select only the **Channel 1** box in the **Measurement Configuration**. In **Results**, click the **Voltage/Current** button for **Channel 1** so that it slides to the right (colored blue). See Figure 7. Note that it is possible to measure all four channels at once with four different current sources.
16) Connect a current source between CH1 (Pin 1) and the adjacent GND pin (Pin 3). Set the current source to +20mA and activate it. Press **Sample Continuously** in the **Sample** box. You should see a **Channel 1** current measurement result similar to that shown in Figure 7. Press **Stop Sampling**.
17) Then, apply -20mA from the current source and confirm that the current value in **Results** matches. (Note: For higher accuracy in current mode, all channels must be calibrated to accommodate the real sense resistor values. The initial accuracy of the sense resistors is 0.1%, which is much higher than the target of 0.02% Total Unadjusted Error. Refer to the MAX22005 data sheet for a description of the calibration procedure.)
18) Repeat steps 15 through 17 for Channels 2, 3, and 4, if desired.

Detailed Description of Hardware

The MAX22005 is a twelve-channel industrial-grade analog input voltage mode device that can also be configured as an analog input current mode device using an external precision resistor per channel. It can also operate as a multifunctional “universal” analog input using an external precision resistor and a low-cost switch per channel. The MAX22005 features an integrated 24-bit delta-sigma ADC that is shared between all analog inputs. The MAX22005 measurements have a Total Unadjusted Error (TUE) of 0.02% Full Scale Range (FSR) at 25°C factory calibration and a TUE of 0.05% FSR over ±50°C from 25°C factory calibration.

The MAX22005PMB# hardware provides everything needed to evaluate the MAX22005 using the Pmod interface. An optional USB2PMB2# or USB2GPIO# adapter can be used with the Munich GUI to provide the USB-to-SPI interface to communicate with the MAX22005. The MAX22005PMB# is configurable as 8 single-ended analog voltage inputs, 4 single-ended analog current inputs, 4 differential analog voltage inputs, 4 multifunctional (universal) analog inputs, or combinations thereof. Note that these configurations are a subset of the total configurations possible with the MAX22005 IC. For greater flexibility and access to all of the MAX22005 features, refer to the MAX22005 Evaluation Kit.

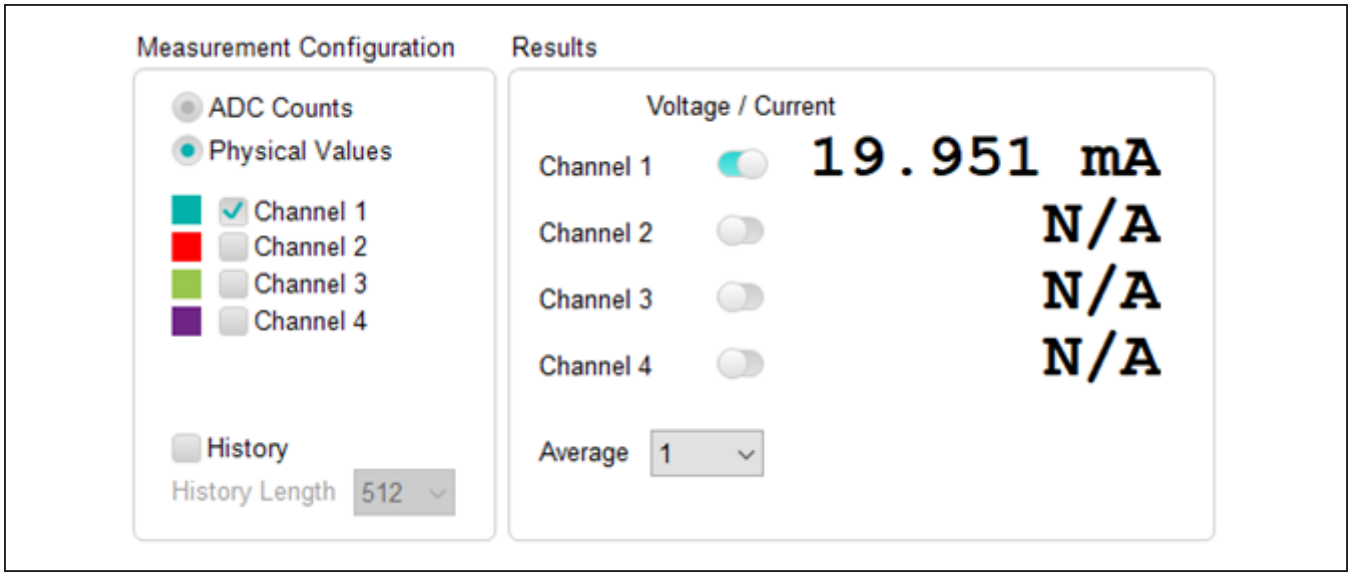


Figure 7. Example Current Measurement Settings and Expected Results

Pmod Connector

The 12-pin Pmod connector (J1) meets the Pmod Interface Type 2A (expanded SPI) standard. Figure 8 details the J1 Pmod connections on the MAX22005PMB#.

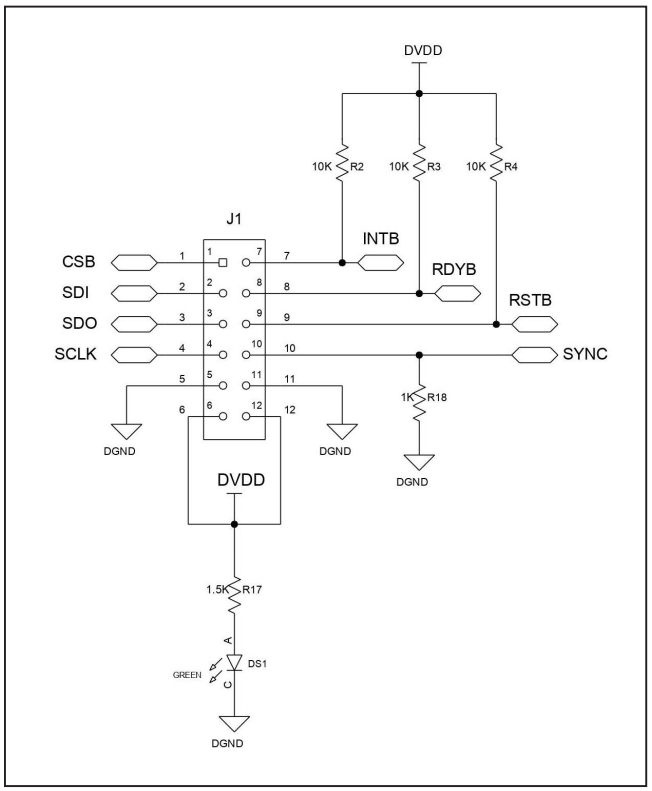


Figure 8. MAX22005PMB# Pmod Connector Schematic

Power Supplies

Power is supplied to the MAX22005PMB# through the J1 Pmod connector's DVDD pins 6 and 12. DVDD from the USB2PMB2# is 3.3V. The MAX22005 IC DVDD pins are supplied directly from the J1 DVDD pins. AVDD is supplied by DVDD through a Pi filter. HVDD and HVSS are supplied by DVDD through a dual boost converter, the MAX8614A. DGND and AGND are connected at one point, the 0Ω R5 short. See Table 1 for the expected values of each supply rail. The expected max current consumption of the MAX22005PMB# is less than 40mA.

Analog Input Configuration

The MAX22005PMB# groups the MAX22005's 12 analog inputs into four sets of three consecutive inputs, called triplets. Each triplet is connected as in Figure 9, which is the first triplet consisting of AI1, AI2, and AI3. The MAX14757 analog switch is used to insert the 49.9Ω precision resistor for current mode measurements. Also, refer to the full MAX22005PMB# schematic diagram to see the J2 and J3 connector to IC input pin connections in their entirety.

Table 1. Supply Voltages

SUPPLY	VOLTAGE
DVDD	3.3V ±0.1V
AVDD	3.3V ±0.1V
HVDD	+15V ±0.5V
HVSS	-15V ±0.5V

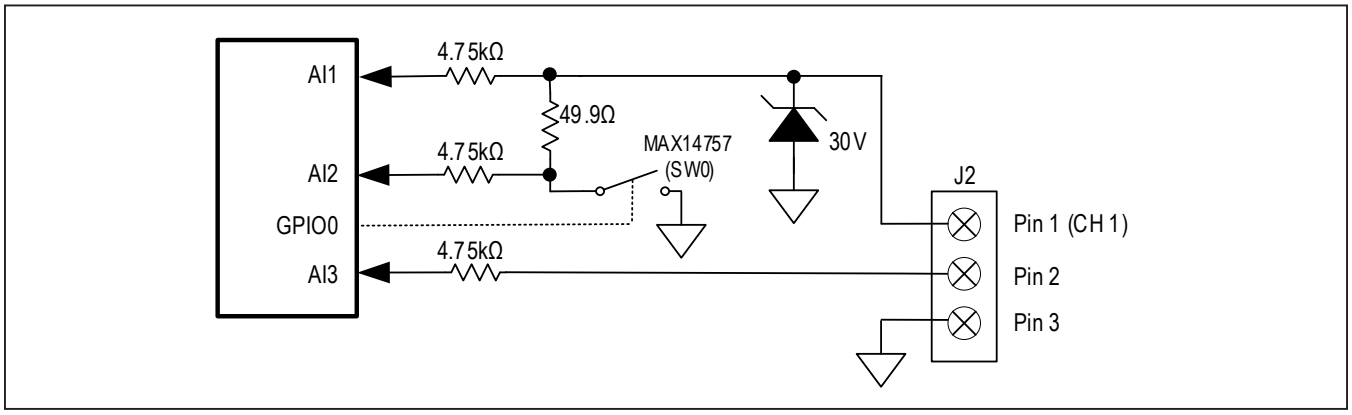


Figure 9. Multifunctional Universal Triplet Input

The analog input pin numbering in this document and their corresponding J2 and J3 analog input connector and IC pin names are summarized in Table 2.

The Munich GUI provides an intuitive way to easily analyze four single-ended "universal" analog inputs, i.e., an input that can measure Voltage or Current. These four universal inputs are Pin 1 (CH1), Pin 4 (CH2), Pin 7 (CH3), and Pin 10 (CH4). The additional inputs Pin 2 (AI3), Pin 5 (AI6), Pin 8 (AI9), and Pin 11 (AI12) should be grounded when using the GUI to ensure accurate measurements of the universal Channel inputs. This can be achieved by connecting a wire between these pins and their adjacent GND pins (Pin 3, Pin 6, Pin 9, and Pin 12). The GUI measures the single-ended channel inputs using the MAX22005's multifunctional differential measurement modes. Using Triplet 1 (AI1, AI2, AI3) as an example, the voltage is measured differentially from AI1 to AI3. Grounding AI3 is recommended to avoid floating connections and ensure a more accurate measurement. After closing SW0, the current is measured by the voltage across the sense resistor from AI1 to AI2. Since the GUI measures differentially, a differential voltage source from AI1 to AI3 can also be measured. In all cases, inaccuracies due to (potentially long) input wire voltage drops should be taken into consideration.

When using the MAX22005PMB# with your own software, Pins 2, 5, 8, and 11 (AI3, AI6, AI9, and AI12) can be used to accommodate other input configurations, for example to measure a single-ended voltage like the voltage drop across a wire to ground. Refer to Application Note 7413-MAX22005 Universal Analog Input Enables Flexible Industrial Control Systems for possible example configurations, in particular the Multifunction Configuration section.

Table 2. Input Pin Names

J2 AND J3 CONNECTOR - PIN	PIN NAME	IC PIN	TRIPLET
J2 - 1	1 (CH1)	AI1	1
J2 - 2	2	AI3	
J2 - 3	3	GND	
J2 - 4	4 (CH2)	AI4	2
J2 - 5	5	AI6	
J2 - 6	6	GND	
J3 - 1	7 (CH3)	AI7	3
J3 - 2	8	AI9	
J3 - 3	9	GND	
J3 - 4	10 (CH4)	AI10	4
J3 - 5	11	AI12	
J3 - 6	12	GND	

LEDs

The DS1 LED is used to confirm that the Pmod DVDD is being supplied to the MAX22005PMB# through the J1 connector (pins 6 and 12). The USB2PMB2# DVDD is 3.3V. The DS2 through DS5 are used to indicate if GPIO0 through GPIO3, respectively, are high (LED on) or low (LED off). The GPIO0 through GPIO3 control switches SW0 through SW3 which switch in the 49.9Ω precision sense resistors for the current measurements. Refer to Table 3 for a summary of the LED states.

Surge Protection

No external surge suppression is needed as all the MAX22005 IC analog inputs are protected against up to ±1.5kV surge pulses as per IEC61000-4-5 using series 4.75kΩ 0.4000W resistors.

Table 3. LED Description

LED	ON	OFF
DS1	DVDD Connected	DVDD Disconnected
DS2	SW0 Closed (CH 1 Current Mode)	SW0 Open (CH1 Voltage Mode)
DS3	SW1 Closed (CH 2 Current Mode)	SW1 Open (CH2 Voltage Mode)
DS4	SW2 Closed (CH 3 Current Mode)	SW2 Open (CH3 Voltage Mode)
DS5	SW3 Closed (CH 4 Current Mode)	SW3 Open (CH4 Voltage Mode)

Detailed Description of Software

The MAX22005PMB# GUI is a part of the Munich GUI for use with USB2PMB2#. A list of all the GUIs and supported devices can be found in the **Device** tab. This is where the MAX22005PMB# GUI is found. A screenshot of the MAX22005PMB# GUI is provided in Figure 10. In the **Window** tab, one can switch between multiple open GUIs, however the user must disconnect from one GUI in order to use another (only one GUI/device can be used at a time). The **Status Log** lists the status and error messages which can be cleared using the **Clear Log** button on the right. The **Scope** box represents the measured **Channel** voltages or currents over time. It is color-coded to match the **Channel** colors in the **Measurement Configuration** box. Near the **Autoscale** checkbox is a collection of graph tool features including (from top left to right): play or pause, "grab and drag" or "zoom in on selection," print, save, graph settings, zoom in, zoom out, default zoom (includes all samples), zoom undo, and zoom redo. The **Scope** graph can be enlarged by clicking the arrow button on the top left and shrunk back by pressing it again.

The **Measurement Configuration** box is where **Channel** measurements can be enabled or disabled by checking the appropriate channel box. The measurements can be displayed in **Physical Values** (volts or amperes) or the raw **ADC Counts** (in decimal) by choosing the corresponding button in the **Measurement Configuration** box. The **History** button enables the graph to display up to the number of samples chosen in the **History Length** drop-down menu. In the **Results** box, one can switch between **Voltage** (left) and **Current** (right and blue) modes using the appropriate channel's button. The displayed measurement results are an average of the number of samples chosen in the **Average** drop-down menu. At the very bottom of the GUI, one can quickly see the connection status and Munich GUI version number.

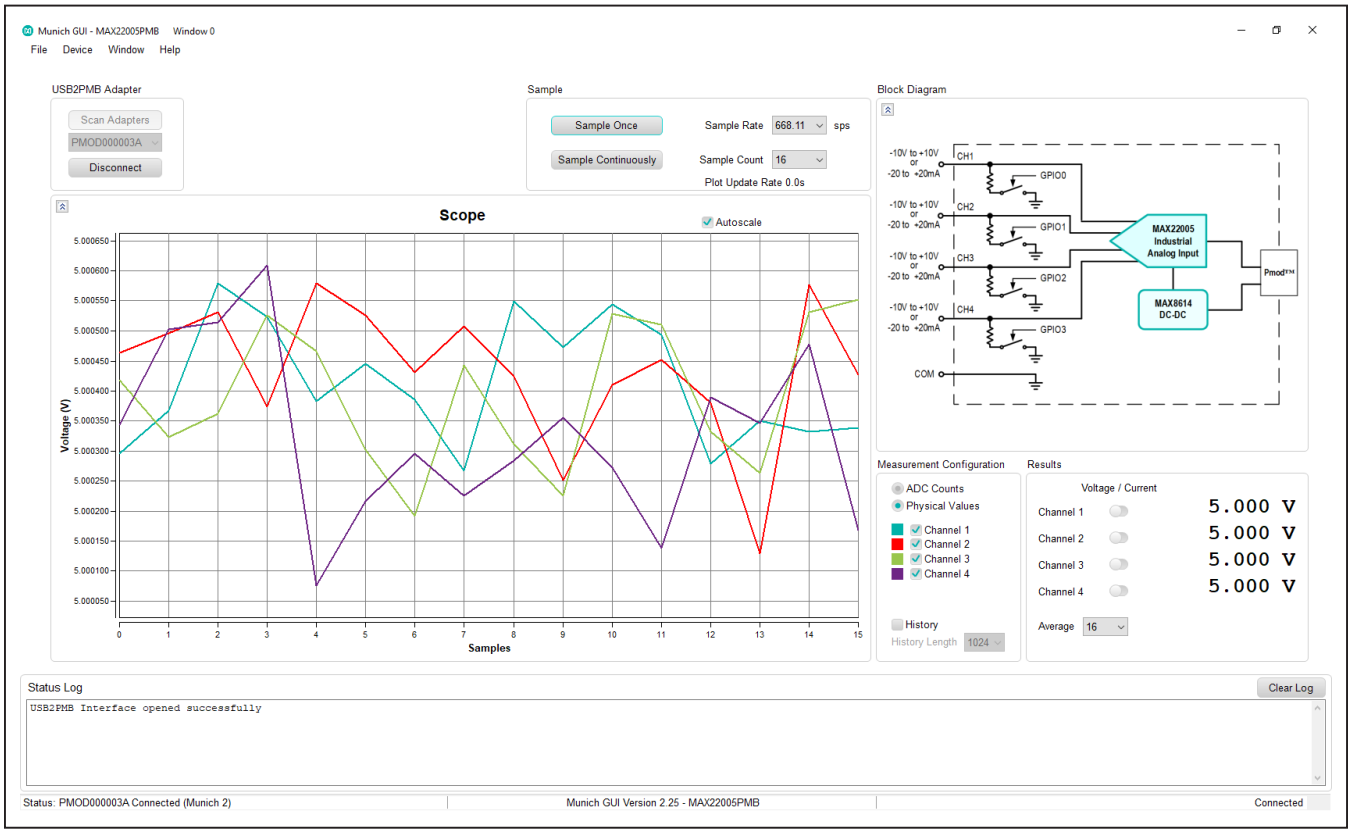


Figure 10. MAX22005PMB# GUI Software

Ordering Information

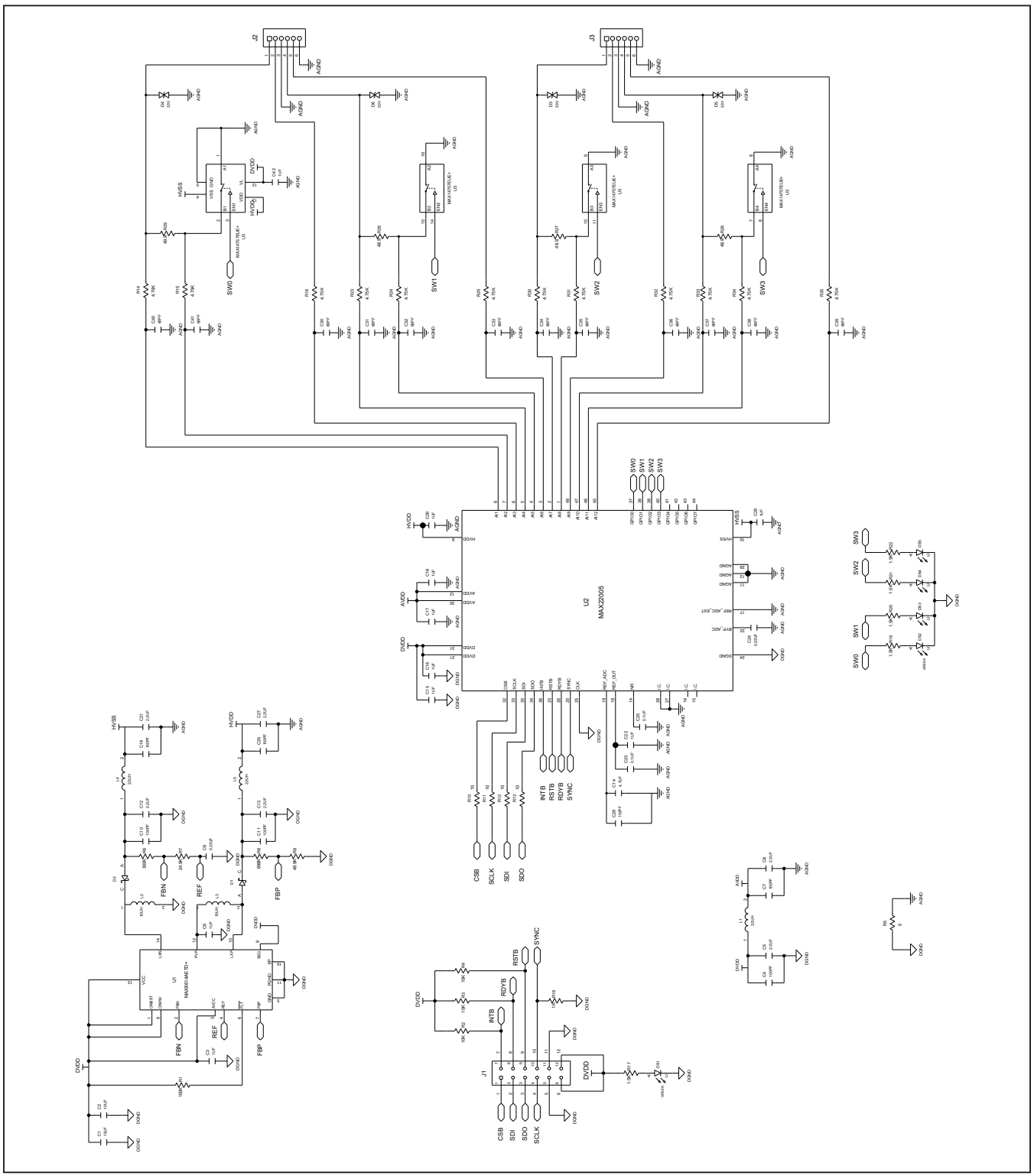
PART	TYPE
MAX22005PMB##	Peripheral Module

#Denotes RoHS compliance.

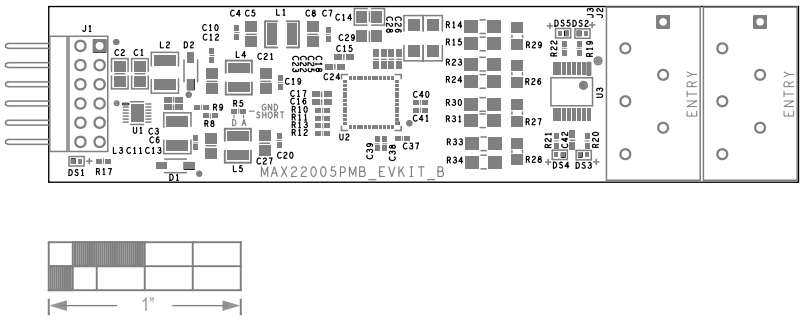
MAX22005PMB# Bill of Materials

ITEM	REF_DES	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION	COMMENTS
1	C1, C2	2	C0805X5R6R3-106MNE; C2012X5R0J106M125AB; JMK212BJ106MG	VENKEL LTD;TDK;TAIYO YUDEN	10UF	CAP; SMT (0805); 10UF; 20%; 6.3V; X5R; CERAMIC	
2	C3, C6, C15-C18, C22, C42	8	C0603C105K4RAC;C1608X7R1C105K080AC; EMK107B7105KA;CGA3E1X7R1C105K080AC; 0603YC105KAT2A	KEMET;MURATA;TDK;TAIYO YUDEN;TDK;AVX	1UF	CAP; SMT (0603); 1UF; 10%; 16V; X7R; CERAMIC	
3	C4, C7, C10, C11, C19, C20	6	C0402C101J5GAC;NMC0402NPO101J; CC0402JRNPO9BN101;GRM1555C1H101JA01; C1005C0G1H101J050BA	KEMET;NIC COMPONENTS CORP.;YAGEO PHICOMP;MURATA;TDK	100PF	CAP; SMT (0402); 100PF; 5%; 50V; C0G; CERAMIC	
4	C5, C8, C12, C13, C21, C27	6	08053C225KAT2A;TMK212B7225KG; GRM21BR71E225KA73;GRT21BR71E225KE13	AVX;TAIYO YUDEN;MURATA;MURATA	2.2UF	CAP; SMT (0805); 2.2UF; 10%; 25V; X7R; CERAMIC	
5	C9	1	CGA2B3X7R0J224M050BB	TDK	0.22UF	CAP; SMT (0402); 0.22UF; 20%; 6.3V; X7R; CERAMIC	
6	C14	1	GRM21BR71A475KA73; LMK212B7475KG-T; C2012X7R1A475K125AC	MURATA;TAIYO YUDEN;TDK	4.7UF	CAP; SMT (0805); 4.7UF; 10%; 10V; X7R; CERAMIC	
7	C23, C25	2	CC0603KRX7R0BB104;GRM188R72A104KA35; HMK107B7104KA;06031C104KAT2A; GRM188R72A104K	YAGEO;MURATA;TAIYO YUDEN;AVX;MURATA	0.1UF	CAP; SMT (0603); 0.1UF; 10%; 100V; X7R; CERAMIC	
8	C24	1	C0603C224K3RAC;GMC10X7R224K25; GRM188R71E224KA88;C1608X7R1E224K080AC	KEMET;MURATA;MURATA;TDK	0.22UF	CAP; SMT (0603); 0.22UF; 10%; 25V; X7R; CERAMIC	
9	C26, C28	2	C1206C105K5RAC;GRM31CR71H105KA61; GRM31MR71H105KA88;GCM31MR71H105KA55; CGA5L3X7R1H105K160AB;C3216X7R1H105K160AE	KEMET;MURATA;MURATA; MURATA;TDK;TDK	1UF	CAP; SMT (1206); 1UF; 10%; 50V; X7R; CERAMIC	
10	C29	1	C0805C151J5GAC	KEMET	150PF	CAP; SMT (0805); 150PF; 5%; 50V; C0G; CERAMIC	
11	C30-C41	12	C0402C680K5RAC	KEMET	68PF	CAP; SMT (0402); 68PF; 10%; 50V; X7R; CERAMIC	
12	D1, D2	2	MBR0520L	FAIRCHILD SEMICONDUCTOR	MBR0520L	DIODE, SCHOTTKY, SOD-123, PIV=20V, Vf=0.385V@If=0.5A, If(ave)=0.5A	
13	D3-D6	4	SMBJ33CA	LITTLEFUSE	33V	DIODE; TVS; SMB (DO-214AA); VRM=33V; IPP=11.3A	
14	DS1-DS5	5	SML-P12PT	ROHM	SML-P12PT	DIODE; LED; SML-P1 SERIES; ULTRA COMPACT HIGH BRIGHTNESS LED; GREEN; SMT (0402); VF=2.2V; IF=0.02A	
15	J1	1	TSW-106-08-S-D-RA	SAMTEC	TSW-106-08-S-D-RA	CONNECTOR; THROUGH HOLE; DOUBLE ROW; RIGHT ANGLE; 12PINS;	
16	J2, J3	2	250-206	WAGO	250-206	CONNECTOR; FEMALE; THROUGH HOLE; PCB TERMINAL BLOCK; PUSH-BUTTON; RIGHT ANGLE; 6PIN ;	
17	L1, L4, L5	3	LQH2HPZ220MJR	MURATA	22UH	INDUCTOR; SMT (1008); MAGNETICALLY SHIELDED; 22UH; TOL=+/-20%; 0.54A	
18	L2, L3	2	LQH32CN100K33	MURATA	10UH	INDUCTOR; SMT (1210); FERRITE; 10UH; 10%; 0.45A	
19	R1	1	ERJ-2GEJ104	PANASONIC	100K	RES; SMT (0402); 100K; 5%; +/-200PPM/DEGC; 0.1000W	
20	R2-R4	3	CRCW020110K0FK	VISHAY DALE	10K	RES; SMT (0201); 10K; 1%; +/-100PPM/DEGC; 0.0500W	
21	R5	1	HCJ0402ZT0R00	STACKPOLE ELECTRONICS INC.	0	RES; SMT (0402); 0; JUMPER; JUMPER; 0.1250W	
22	R6	1	CRCW0402300KFK	VISHAY DALE	300K	RES; SMT (0402); 300K; 1%; +/-100PPM/DEGK; 0.0630W	
23	R7	1	ERJ-2RKF2492	PANASONIC	24.9K	RES; SMT (0402); 24.9K; 1%; +/-100PPM/DEGC; 0.1000W	
24	R8	1	ERJ-2RKF6983	PANASONIC	698K	RES; SMT (0402); 698K; 1%; +/-100PPM/DEGC; 0.1000W	
25	R9	1	ERJ-2RKF4992	PANASONIC	49.9K	RES; SMT (0402); 49.9K; 1%; +/-100PPM/DEGC; 0.1000W	
26	R10-R13	4	ERJ-2RKF10R0	PANASONIC	10	RES; SMT (0402); 10; 1%; +/-100PPM/DEGC; 0.1000W	
27	R14-R16, R23-R25, R30-R35	12	MMA02040C4751F	VISHAY BEYSCHLAG	4.75K	RES; SMT; 4.75K; 1%; +/-50PPM/DEGK; 0.4000W	
28	R17, R19-R22	5	ERJ-2GEJ152	PANASONIC	1.5K	RES; SMT (0402); 1.5K; 5%; +/-200PPM/DEGC; 0.1000W	
29	R18	1	CRCW02011K00FK	VISHAY DALE	1K	RES; SMT (0201); 1K; 1%; +/-100PPM/DEGC; 0.0500W	
30	R26-R29	4	RN73C2A49R9BTDF; 1676703-2	TE CONNECTIVITY;TE CONNECTIVITY	49.9	RES; SMT (0805); 49.9; 0.10%; +/-10PPM/DEGC; 0.1000W	
31	U1	1	MAX8614AETD+	MAXIM	MAX8614AETD+	IC; CONV; DUAL-OUTPUT (+ AND -) DC-DC CONVERTER FOR CCD; TDFN14	
32	U2	1	MAX22005	MAXIM	MAX22005	EVKIT PART - IC; RX16; TWELVE-CHANNEL FACTORY-CALIBRATED CONFIGURABLE INDUSTRIAL ANALOG INPUT; QFN48	
33	U3	1	MAX14757EUE+	MAXIM	MAX14757EUE+	IC; ASW; QUAD NO SPST; +70V ANALOG SWITCH; TSSOP16	
34	PCB	1	MAX22005PMB	MAXIM	PCB	PCB:MAX22005PMB	-
TOTAL		100					

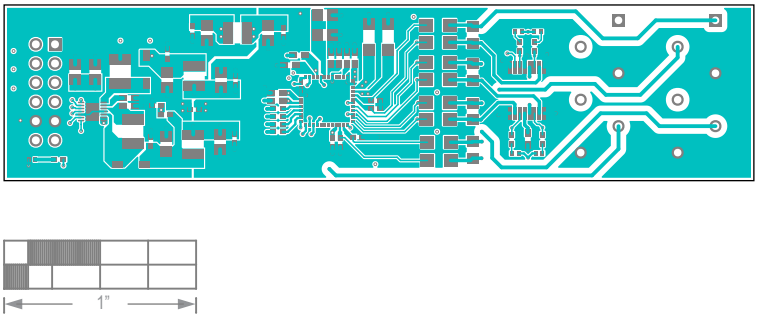
MAX22005PMB# Schematic



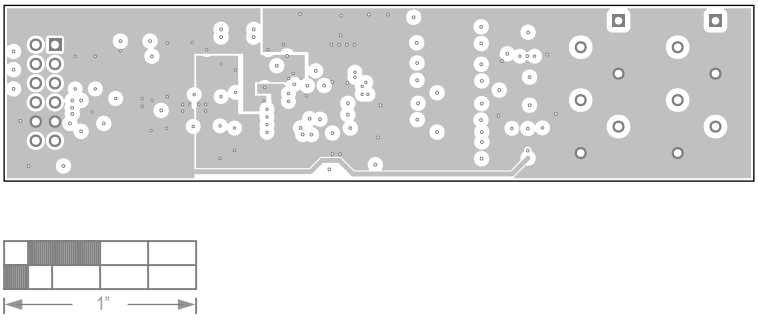
MAX22005PMB# PCB Layout Diagrams



MAX22005PMB# PCB Layout—SILK_TOP

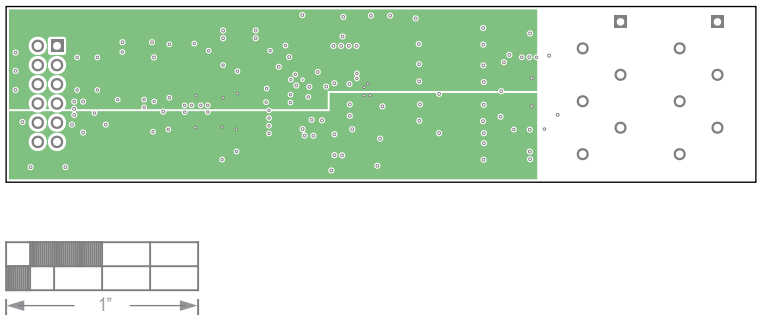


MAX22005PMB# PCB Layout—TOP

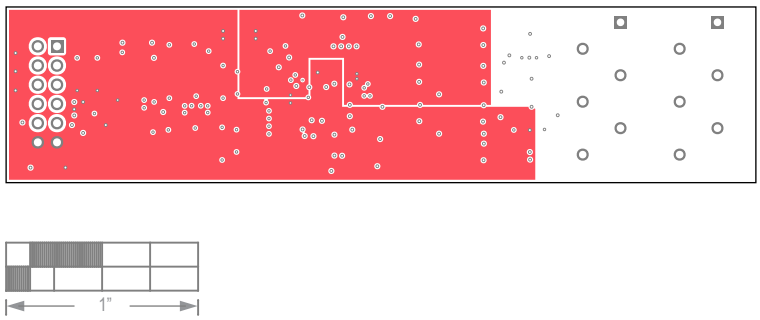


MAX22005PMB# PCB Layout—DGND_AGND1

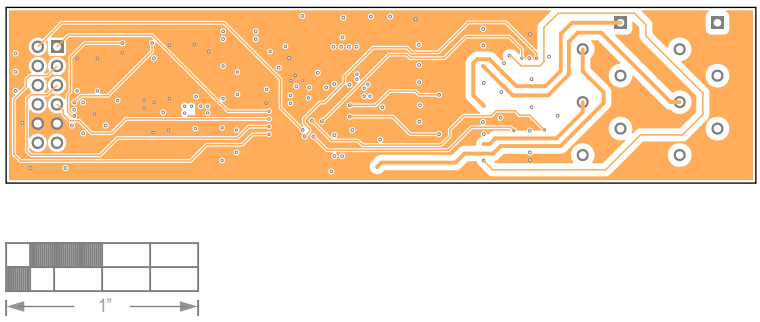
MAX22005PMB# PCB Layout Diagrams (continued)



MAX22005PMB# PCB Layout—HVDD_HVSS

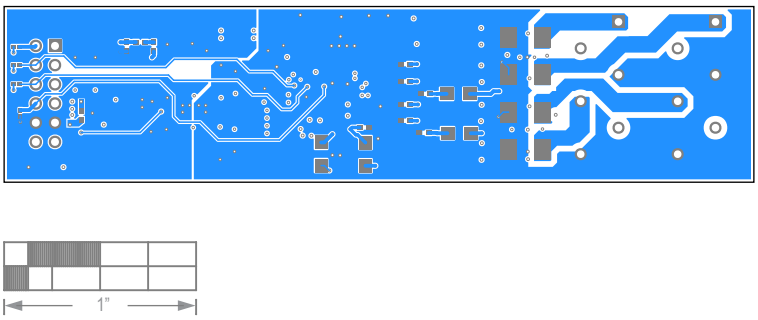


MAX22005PMB# PCB Layout—DVDD_AVDD

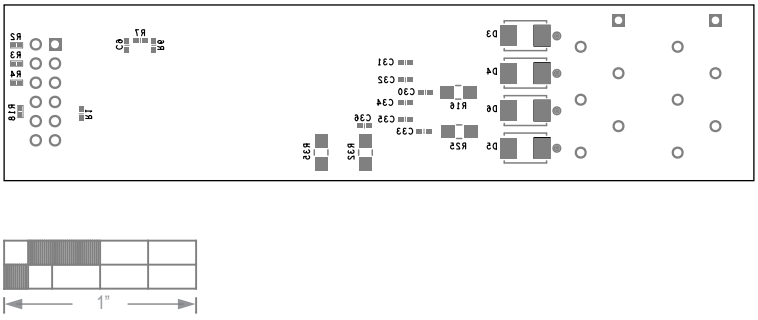


MAX22005PMB# PCB Layout—DGND_AGND2

MAX22005PMB# PCB Layout Diagrams (continued)



MAX22005PMB# PCB Layout—BOTTOM



MAX22005PMB# PCB Layout—SILK_BOT

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	3/22	Initial release	—