MAX22190PMB#

Evaluates: MAX22190

General Description

The MAX22190 peripheral module provides the hardware to evaluate the MAX22190 Octal Industrial Digital Input. Refer to the MAX22190 IC data sheet for detailed information regarding operation of the IC. The module takes advantage of the features in the MAX22190 allowing it to be powered from a single low voltage logic supply (3.0-5.5V) without the need for a 24V field supply. Note that this module provides a subset of the MAX22190 features – for greater flexibility refer to the MAX22190 EV kit.

The module can be used in various ways; the device is configured by SPI interface. Maxim sells low-cost USB2PMB1#, USB2PMB2#, and USB2GPIO# adapter boards that use the Munich GUI software for communication through a USB cable generating SPI communication with the MAX22190. This is not included with this board. Alternatively, any microcontroller or FPGA with a 12-pin Pmod™-compatible connector can be used. Another option for the user is to wire-wrap a temporary connection from their system to the pins on connector X1. For these later two options the user needs to write their own control software.

The Pmod PCB dimension is just 45mm long x 20mm wide, with the width determined by the size of the X1 and X2 connectors.

Features

- Easy Evaluation of the MAX22190
- Powered from Single 3.0-5.5V Logic Supply, Without the Need for 24V Field Supply
- Configured for IEC 61131-2 Type 1 and Type 3 Sensor Inputs
- Proven PCB Layout
- Works with USB2PMB2# or USB2GPIO# Adapter and Munich GUI Software

MAX22190PMB# EV Kit File

FILE	DECRIPTION
Munich_GUISetupV2.21.ZIP	Munich GUI Software for use with the USB2PMB adapter

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

MAX22190PMB# Photo
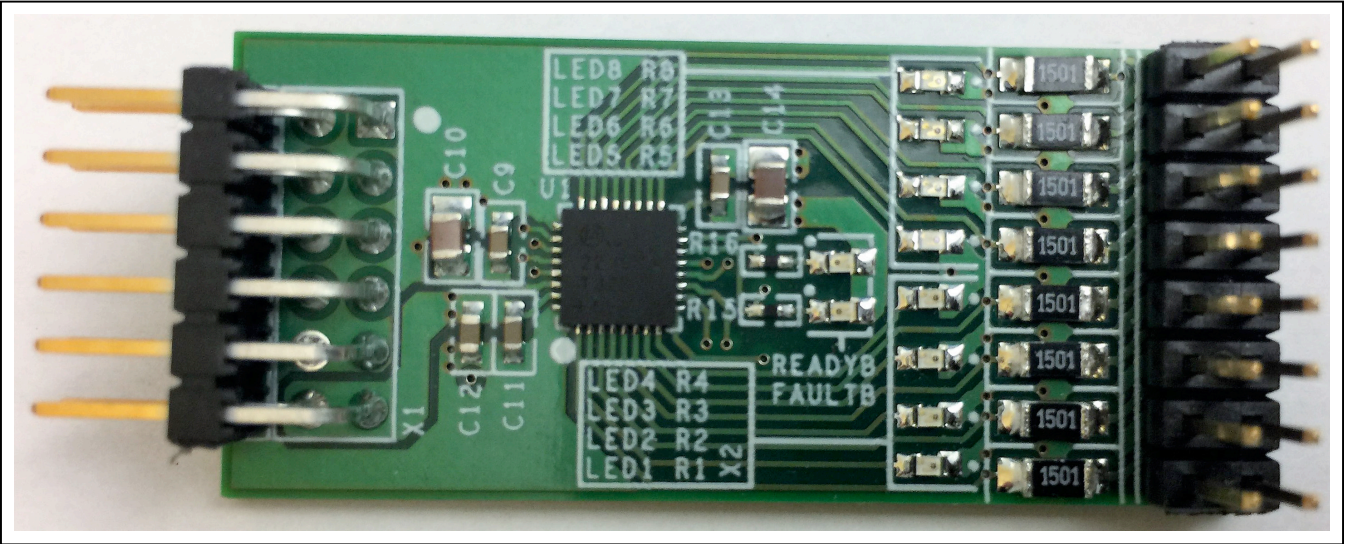
Pmod is a trademark of Digilent Inc.

maxim integrated™

Quick Start

Required Equipment

- MAX22190PMB#
- USB2PMB1# or USM2PMB2#, or USB2GPIO#
- 24V DC power supply or 24V digital signal generator
- PC with Windows XP, Windows 7, Windows 8.1, Windows 10 and a spare USB port
- Micro-USB cable
- Munich GUI v2.21 or higher

*Note: In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the EV kit software. Text in **bold and underline** refers to items from the Windows operating system.*

Procedure

The Pmod board is fully assembled and tested. Follow the steps below to verify board operation: If the USB2PMB1# or USB2PMB2# or USB2GPIO# adapter is used, the user can download software by following the steps below to get started. In this description the USB2PMB2# adapter is used:

1) Visit **www.maximintegrated.com/** to download the latest version of the Munich_GUI software, version 2.21 or later, Munich_GUISetupV2.21.ZIP.

2) Save the software to a temporary folder. Unzip the .ZIP file and double-click the .EXE file to run the installer. A message box asking **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) Connect the MAX22190PMB# Pmod connector X1 to the connector on USB2PMB2#.

5) Connect the USB2PMB2# to the PC with the Micro-USB cable. The MAX22190PMB# is powered by USB. The READYB LED (yellow) and FAULTB LED (red) are on.

6) Once the hardware is ready to use, launch the Munich software. The status bar in the GUI should display **Disconnected** in the bottom right-hand corner. Go to the **Device** tab to select the **MAX22190PMB**. See Figure 3.

7) Click the button **Connect** and observe that after clicking Connect button, the FAULTB LED (red) is off.

8) In the **Sample** box select **Read Continuously**. Munich GUI will constantly monitor digital inputs and show the logic level.

9) Turn on **Wire Break detection on all Pins**. Munich GUI will monitor if the inputs are connected to the sensor input cables. If nothing is connected to the **X2** connector, all inputs are shown as **low**, and all Wire Break boxes are shown in red. See Figure 5. On the MAX22190PMB# board, the READYB and FAULTB LEDs are both on.

10) Connect the negative output of the DC voltage supply to X2 Pin 2. Connect the positive output of the DC voltage supply to X2 Pin 1. Set the DC voltage supply output to 24V, and then enable the output. Observe that LED1 (green) should be turned on, and the Munich GUI should show **high** on IN1, and IN1 Wire Break box should disappear. See Figure 6. *Note: X2 Pin 2, 4, 6, 8, 10, 12, 14, 16 (inside pins) are all connected to GND. X2 Pin 1, 3, 5, 7, 9, 11, 13, 15 (outside pins) are connected to IN1 – IN8 respectively. See MAX22190PMB# Schematics.*

11) Connect the positive output of the DC voltage supply to X2 Pin 3. Observe that LED2 (green) should be turned on, and the Munich GUI should show high on IN2, and IN2 Wire Break box should disappear. See Figure 7. *Note: On connector X2, the GND pins are next to the input pins. When connect 24V to the input pins, care should be taken not to connect to the GND pins, in case a short is created on the board and voltage supply.*

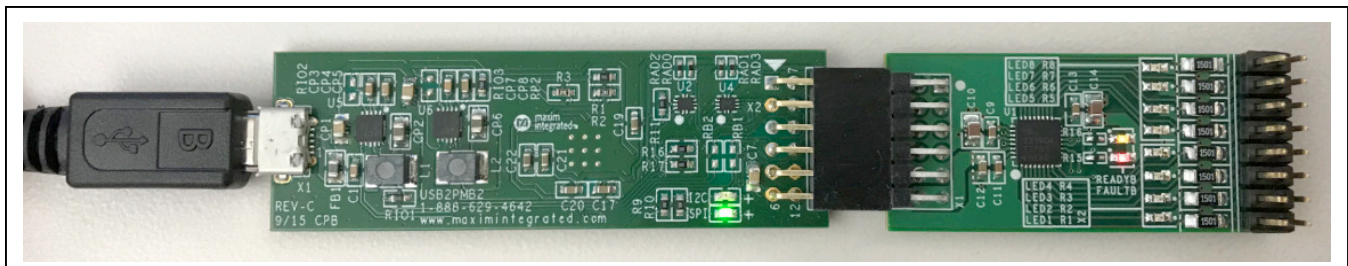12) Repeat the step 11 to X2 Pin 5, 7, 9, 11, 13, 15 to verify the functionality of IN3, IN4, IN5, IN6, IN7 and IN8.

Figure 2. MAX22190PMB# with USB2PMB2# Adapter

Detailed Description of Hardware

The MAX22190 is an IEC 61131-2 compliant, Industrial Digital Input (DI) device that translates eight, 24V digital industrial inputs to a serial bit stream which is read via SPI interface. MAX22190PMB# only supports sensors that source current – refer to MAX22190 datasheet for details. The MAX22190 can be powered with a 24V 'Field Supply' or alternatively using a 3.0 – 5.5V supply connected to the VDD pin. This module takes advantage of this feature to avoid the need for an external 24V supply. The VDD24 pin must be left floating (not connected). For ease of use this module only supports a subset of the MAX22190 features – for greater flexibility refer to the MAX22190 EV kit.

The MAX22190PMB# hardware provides everything needed to quickly evaluate the MAX22190 using the 'PMOD'. An optional USB2PMB2# module can be used with the Munich GUI to provide the USB-to-MAX22190 interface to control the MAX22190. The USB2PMB2# adapter provides a 3.3V output from the USB interface providing VDD to MAX22190.

This module does not feature galvanic isolation. If the user wishes to isolate the module, then select the USB2GPIO# adapter and use it with the USB2GPIOISO# isolation module. Both modules work seamlessly with the Munich GUI.

If the user wishes to perform EMC Standard Compliance tests, such as IEC 61000-4-x, refer to the MAX22190EVKIT#, which is designed to support these tests. The MAX22190PMB# is designed for easy prototyping and software development and does not include the external components such as TVS diodes.

Input Channels

The MAX22190 has eight inputs which are configured to meet IEC 61131-2 Types 1, 3 Digital Inputs. Resistor R10 sets the input current limit and in conjunction with series input resistors R1 – R8 provide the correct voltage and current trip points. Table 1 shows the pinout for connector X2. Each input channel has an associated LED (LED1 – LED8) to provide a visual indication for the state of the digital input. Another feature of MAX22190 is the ability to detect wire-break condition at each input to help diagnose if a sensor wiring is faulty (disconnected). Resistor R9 is used to set the nominal 'break current' at 100µA.

Diagnostic Features

The MAX22190 has many built-in diagnostic features to support fault-tolerant applications. This includes wire-break detection, voltage supply monitors, overtemperature monitors and CRC for the SPI interface communications.

$\overline{FAULT}$ is an open-drain output that is used to notify the host processor of a fault. When enabled, $\overline{FAULT}$ goes low to indicate that one or more of the flags in the FAULT1 and FAULT2 registers have been set. Refer to the MAX22190 data sheet for further details of the fault conditions and flags.

The GUI will show Wire-Break if the button for wire-break detection is on. The FAULTB LED will be on when either a POR or fault condition (wire-break), is detected. The READYB LED should always be on, showing the device is ready to use. The GUI also shows Over Temperature based on the fault ALRMT1 in the FAULT1 register; provided the Temp Fault button is enabled, the GUI will indicate a fault condition when the IC die temperature exceeds 115°C. For details of other over temperature faults, refer to the MAX22190 data sheet and the MAX22190EVKIT#.

SPI Interface

The MAX22190 has an SPI-compatible interface used to read input data, read diagnostic data, and configure all of the registers. The interface can be operated in one of four modes as controlled by the strapping inputs M0 and M1. For this module M0 is tied high and M1 is tied low meaning the frame length is 16-bits, CRC mode is disabled, and Daisy Chain is not enabled. It is possible to change the SPI mode by reconfiguring R11-R14 resistors, see *MAX22190PMB# Schematics*. If the user changes R11-R14 settings, they cannot use Munich GUI anymore and will need to develop their own software to support other SPI modes. Please refer to MAX22190 datasheet for detailed information on all SPI modes of operation.

Note that this SPI interface has no galvanic isolation. If isolation is required for an end application, please refer to a companion product MAX14483 Digital Isolator which is optimized to support MAX22190.

Table 1. MAX22190PMB# X2 Connector Pinout

X2 PIN	CONNECTION
1	IN1
3	IN2
5	IN3
7	IN4
9	IN5
11	IN6
13	IN7
15	IN8
2, 4, 6, 8, 10, 12, 14, 16	GND

PMOD Style Connector

The MAX22190PMB# can plug directly into a Pmod-compatible port through X1. Note that the pin definitions are determined by the USB2PMB2# adapter and, if the user wishes to use this board with their own host, they must configure the microcontroller or FPGA to match MAX22190 signals. For more information on the interface and control, refer to the MAX22190 IC data sheet.

Detailed Description of Software

For easy development and testing, Maxim provide our Munich GUI which supports a number of different PMOD boards using low cost USB adapters also available from Maxim. For MAX22190PMB# use Munich GUI version 2.21 or later.

Connect to Hardware

The Device menu has options to search and connect to the hardware (see Figure 3). Select MAX22190PMB. Use the **Scan Adapters** option to search for the USB2PMB modules connected to the PC. If modules are found, the serial numbers of the modules are listed in the **USB2PMBs** menu item. Select the serial number in the **USB2PMBs** list to connect the software to communicate with that module. The software can only communicate to one module at a time. Select **Connect** and notice how status changes from **Disconnected** to **Connected** in the lower-right area of the GUI (see Figure 4).

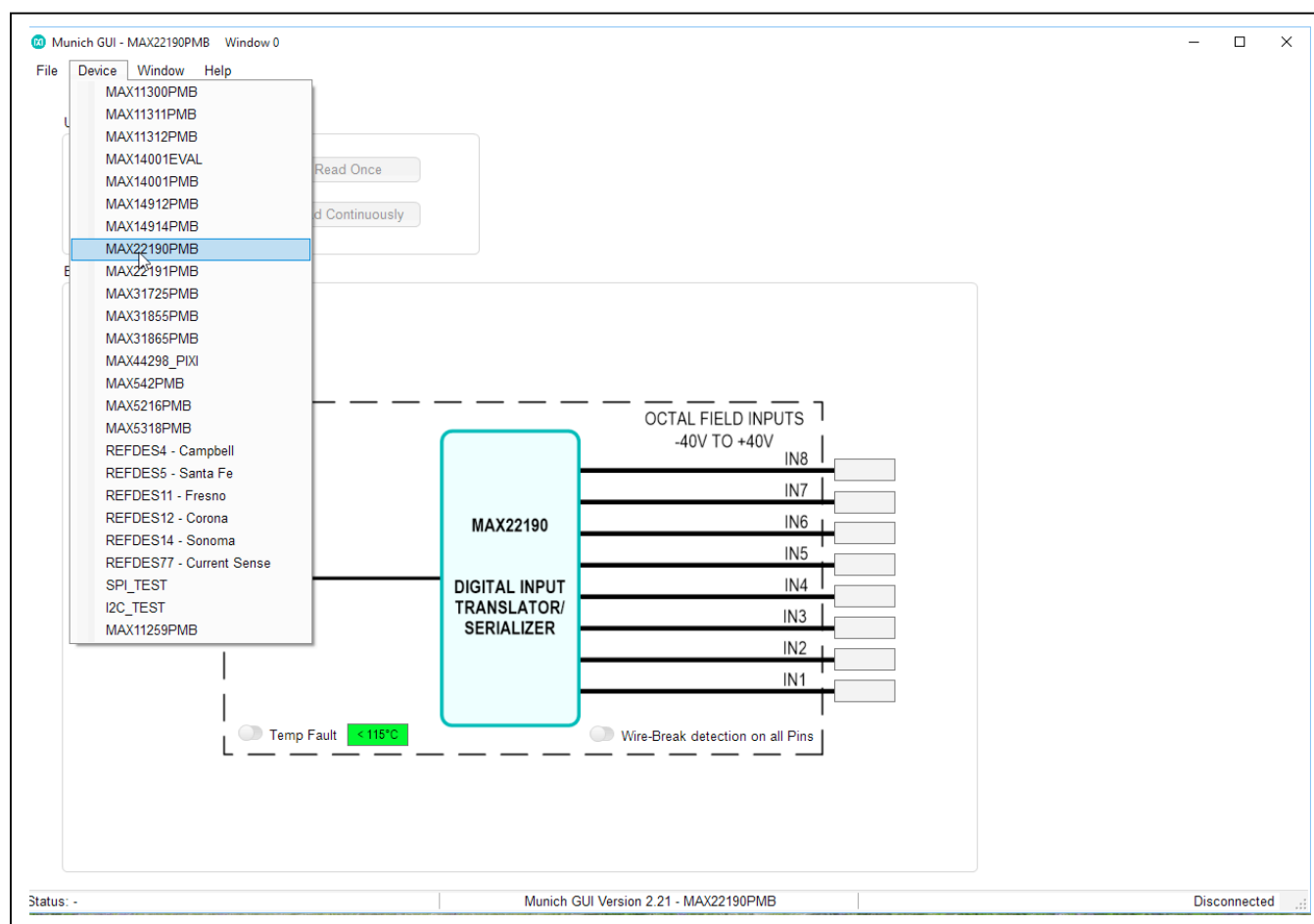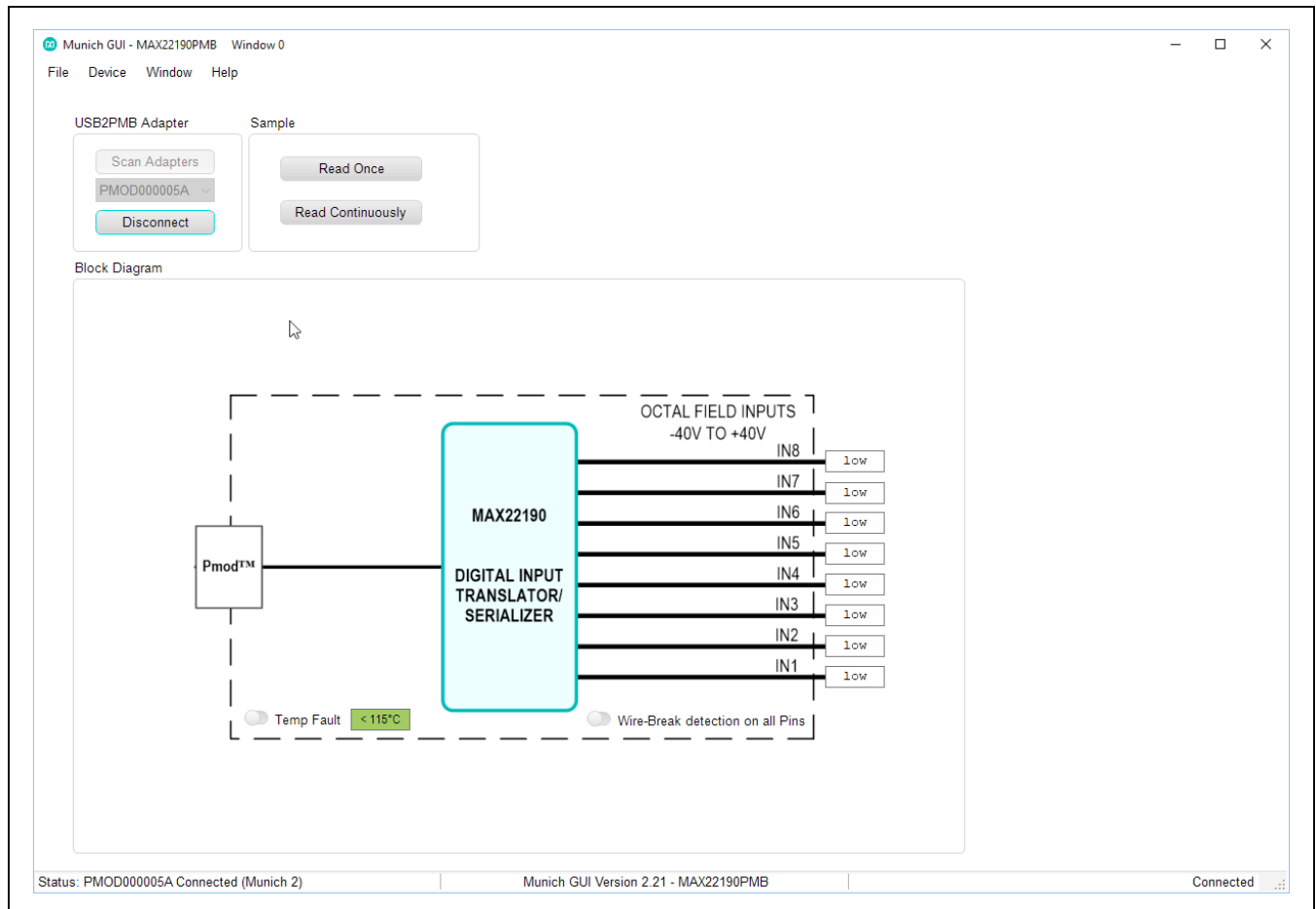Figure 3. MAX22190PMB# Software (Munich GUI Device Menu)

Figure 4. MAX22190PMB# connected in Munich GUI Device Wire Break Disabled

Reading Input Channels

Select **Read Continuously** to make the GUI continuously monitor digital inputs and show the logic level. Turn on **Wire Break detection on all input Pins**. Munich GUI will monitor if the inputs are connected to the sensor input cables. If nothing is connected to the X2 connec-tor, all inputs are shown as **Low**, and all **Wire Break** boxes are shown in red (see Figure 5). At power-up the MAX22190PMB# board, the READYB and FAULTB LEDs are both on. FAULTB shows power-on-reset detected and should turn off after the first read operation.
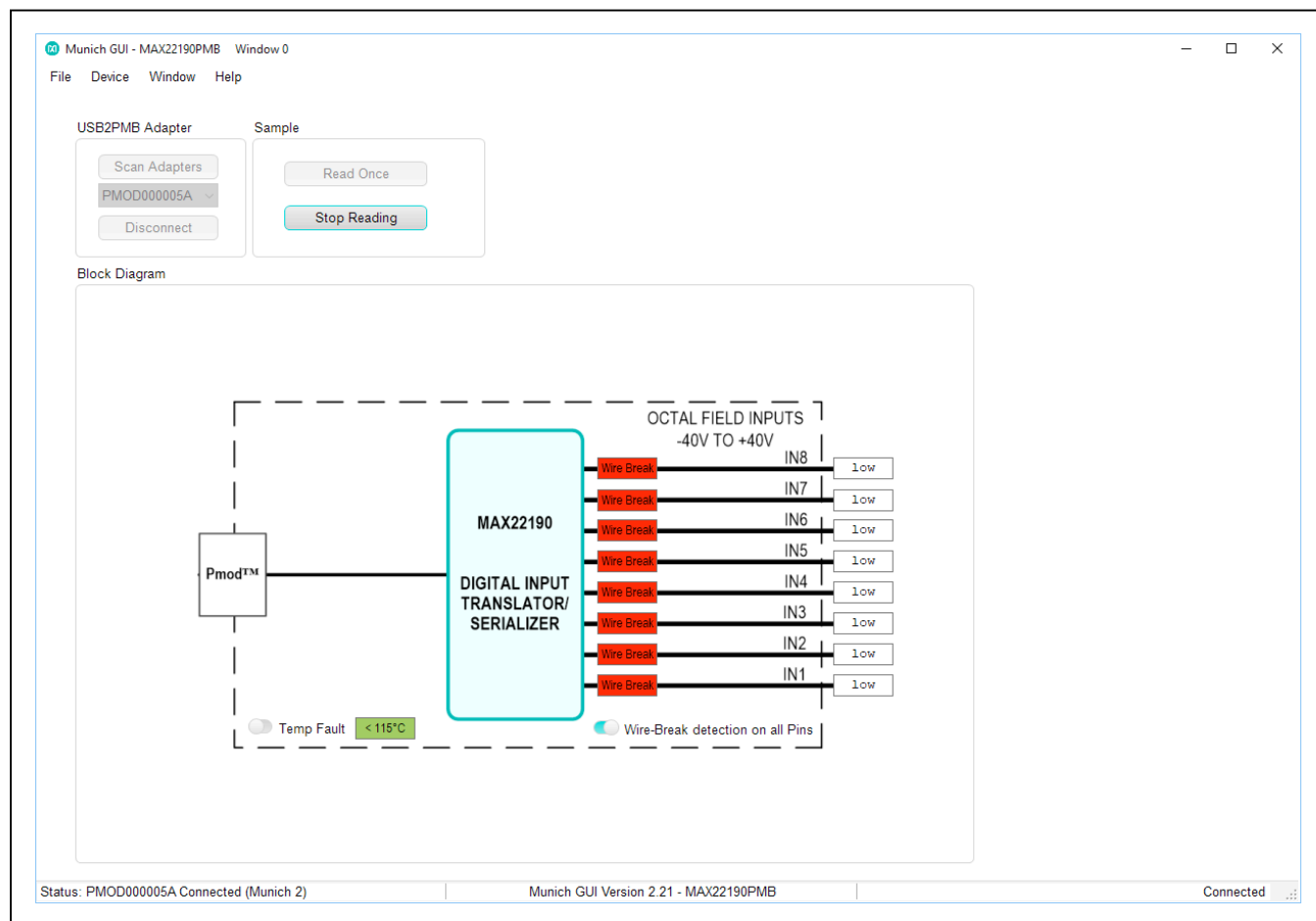
Figure 5. MAX22190PMB# Software All Inputs Floating

Connect the negative output of the DC voltage supply to X2 Pin 2. Connect the positive output of the DC voltage supply to X2 Pin 1. Set the DC voltage supply output to 24V, and then enable the output. Observe that LED1 (green) should be turned on, and the Munich GUI should show **High** on IN1, and IN1 **Wire Break** box should disappear (see Figure 6).
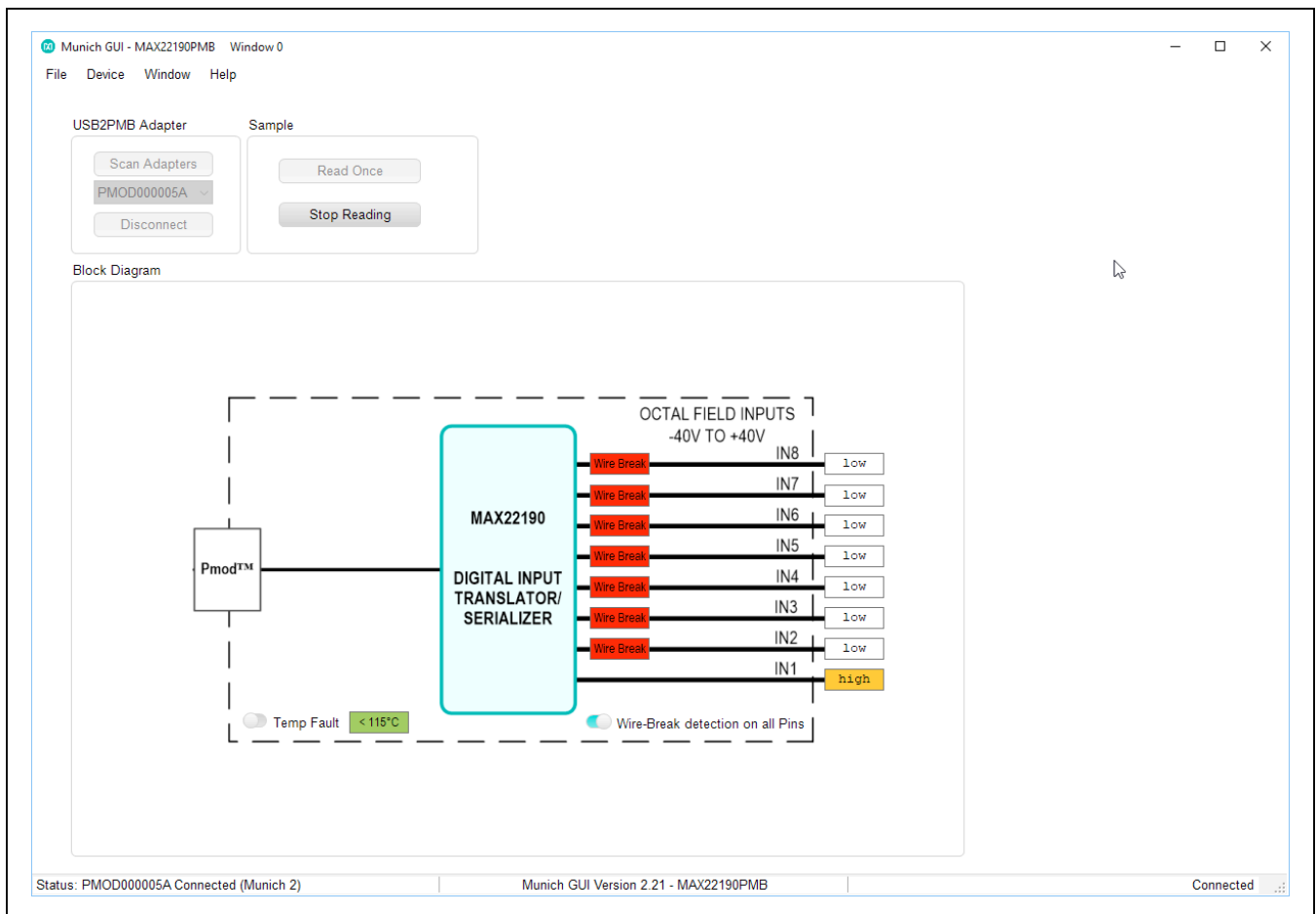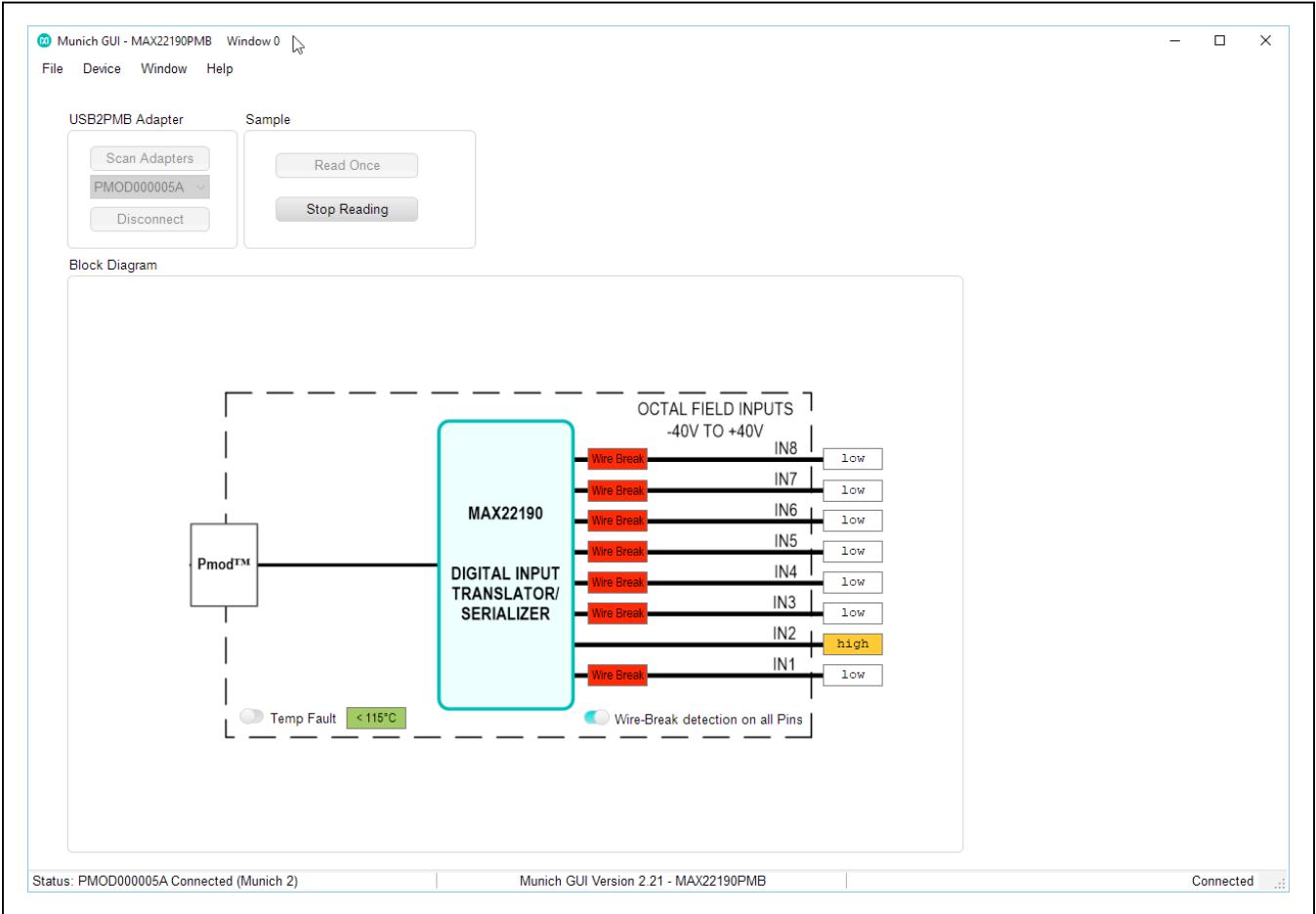

Figure 6. MAX22190PMB# Software IN1 High

Connect the positive output of the DC voltage supply to X2 Pin 3. Observe that LED2 (green) should be turned on, and the Munich GUI should show **High** on IN2, and IN2 **Wire Break** box should disappear (see Figure 7).

Figure 7. MAX22190PMB# Software IN2 High

Ordering Information

PART	TYPE
MAX22190PMB#	Peripheral Module

MAX22190PMB# Bill of Materials

| ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION	COMMENTS
1	C9, C11, C13	-	3	CC0603KRX7R0BB104	YAGEO	0.1UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.1UF; 100V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R	
2	C10, C14	-	2	C2012X7S2A105K125; GRJ21BC72A105KE11	TDK;MURATA	1UF	CAPACITOR; SMT (0805); CERAMIC CHIP; 1UF; 100V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7S	
3	C12	-	1	UMK107AB7105KA	TAIYO YUDEN	1UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 1UF; 50V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R	
4	FAULTB	-	1	LTST-C193KRKT-2A	LITE-ON ELECTRONICS INC.	LTST-C193KRKT-2A	DIODE; LED; EXTRA THIN; EXTRA BRIGHT; RED; SMT (0603); VF=2.2V; IF=0.002A	
5	LED1-LED8	-	8	LTST-C193KGKT-5A	LITE-ON ELECTRONICS INC.	LTST-C193KGKT-5A	DIODE; LED; STANDARD; YELLOW-GREEN; SMT (0603); PIV=1.9V; IF=0.005A; -55 DEGC TO +85 DEGC	
6	R1-R8	-	8	CRCW12061K50FKEAHP	VISHAY DALE	1.5K	RES; SMT (1206); 1.5K; 1%; +/-100PPM/DEGC; 0.75W	
7	R9	-	1	ERJ-2RKF2402X	PANASONIC	24K	RESISTOR; 0402; 24K OHM; 1%; 100PPM; 0.10W; THICK FILM	
8	R10	-	1	ERJ-2RKF7501	PANASONIC	7.5K	RESISTOR; 0402; 7.5K OHM; 1%; 100PPM; 0.1W; THICK FILM	
9	R11, R13	-	2	ERJ-2GE0R00X	PANASONIC	0	RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM	
10	R15, R16	-	2	ERJ-2RKF1002	PANASONIC	10K	RESISTOR; 0402; 10K OHM; 1%; 100PPM; 0.10W; THICK FILM	
11	R17-R23	-	7	ERJ-2GEJ220X	PANASONIC	22	RESISTOR; 0402; 22 OHM; 5%; 200PPM; 0.10W; METAL FILM	
12	READYB	-	1	LTST-C193KSKT-5A	LITE-ON ELECTRONICS INC.	LTST-C193KSKT-5A	DIODE; LED; YELLOW; SMT (0603); VF=2V; IF=0.005A	
13	U1	-	1	MAX22190ATJ+	MAXIM INTEGRATED	MAX22190ATJ+	EVKIT PART-IC; OCTAL INDUSTRIAL DIGITAL INPUT WITH DIAGNOSTICS; PACKAGE OUTLINE: 21-0140; PACKAGE CODE: T3255+6; LAND PATTERN NO.: 90-0603; TQFN32-EP	
14	X1	-	1	TSW-106-08-S-D-RA	SAMTEC	TSW-106-08-S-D-RA	CONNECTOR; THROUGH HOLE; DOUBLE ROW; RIGHT ANGLE; 12PINS;	
15	X2	-	1	PBC08DAAN	SULLINS ELECTRONICS CORP.	PBC08DAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 16PINS; -65 DEGC TO +125 DEGC	
16	PCB	-	1	MAX22190PMB_DEMO_A	MAXIM	PCB	PCB:MAX22190PMB_DEMO_A	-
17	C1-C8	DNP	0	GCM155R72A102KA37	MURATA	1000PF	CAPACITOR; SMT (0402); CERAMIC CHIP; 1000PF; 100V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R; AUTO	
18	R12, R14	DNP	0	ERJ-2GE0R00X	PANASONIC	0	RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM	
TOTAL			41					

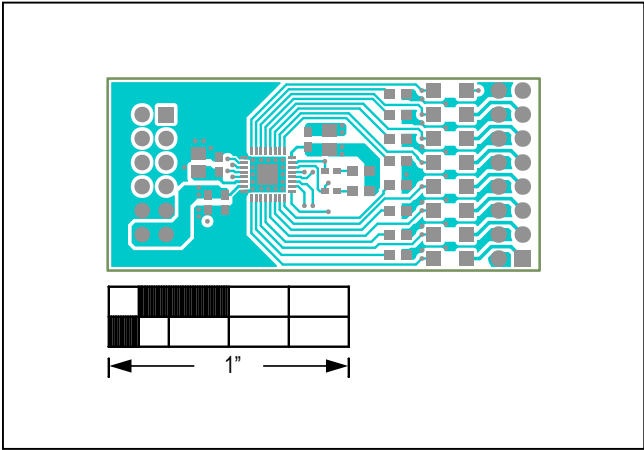## MAX22190PMB# Schematics
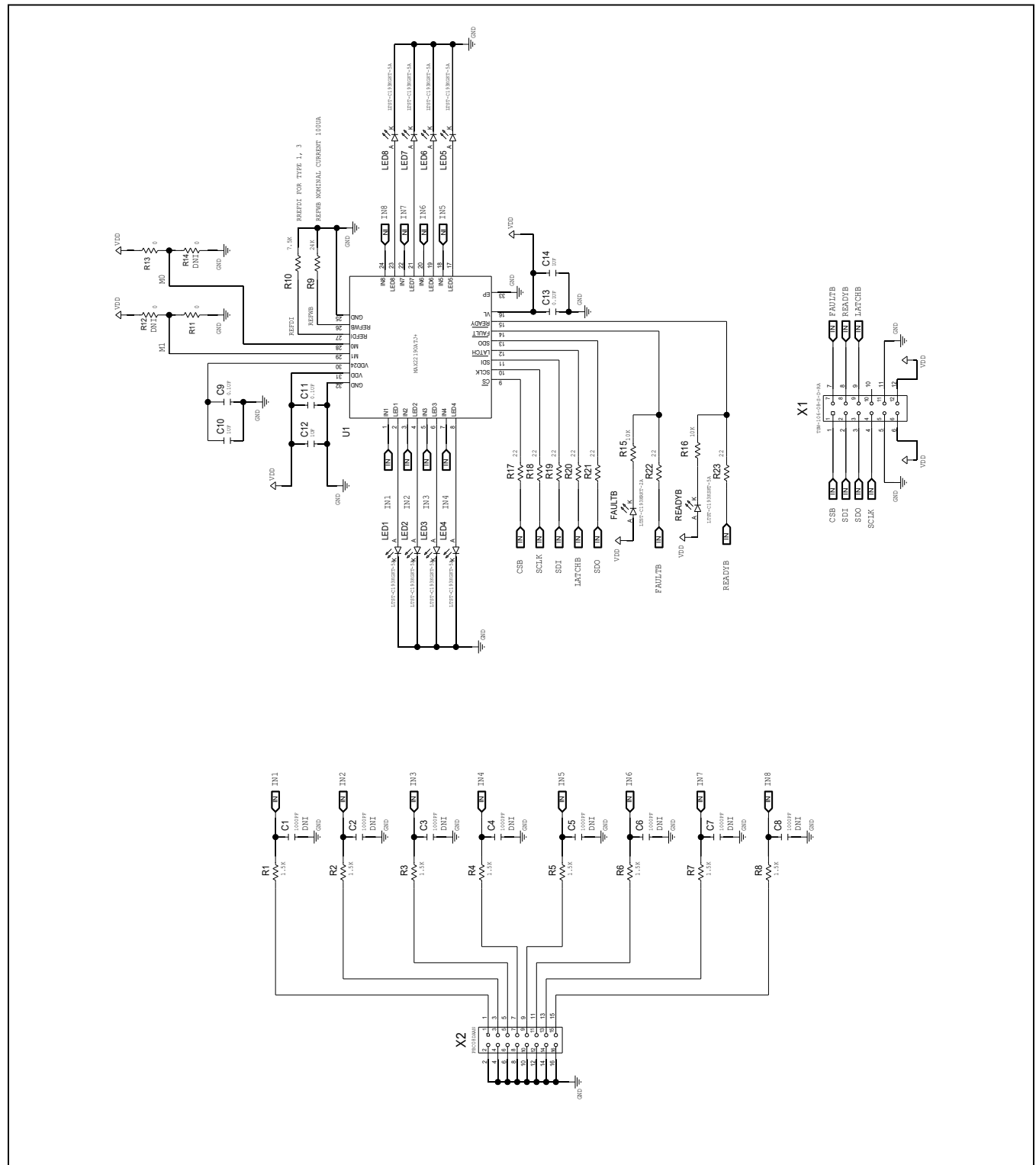
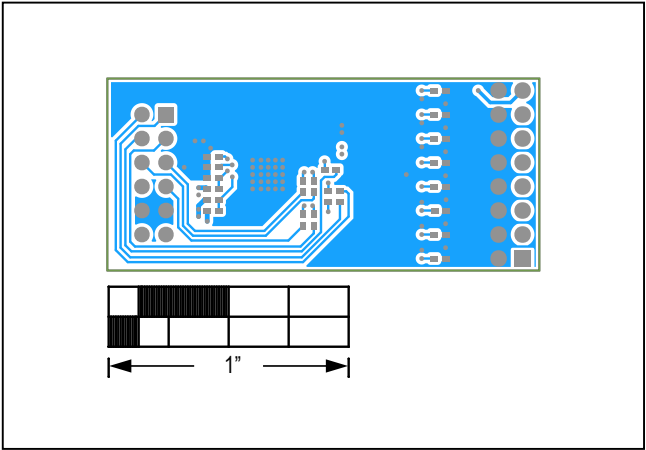## MAX22190PMB# PCB Layout Diagrams
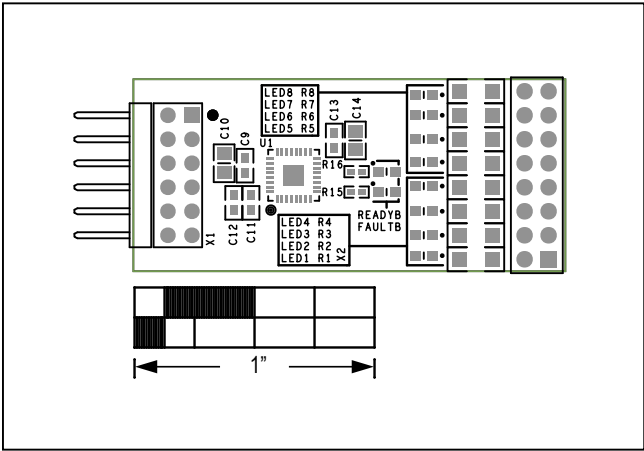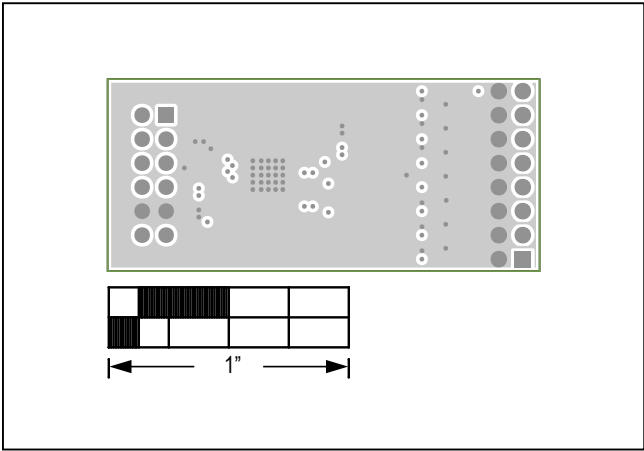
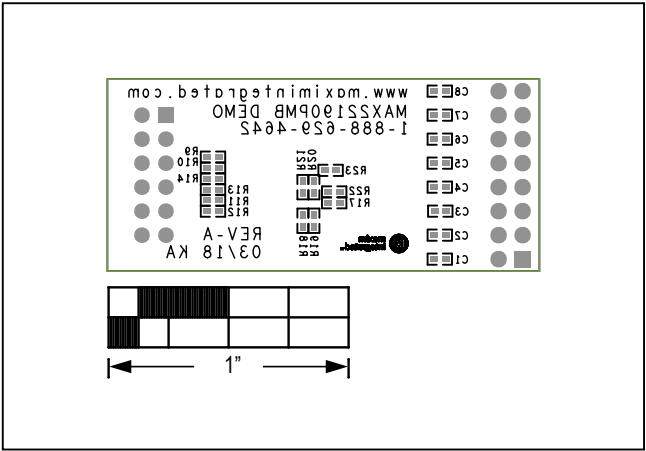

MAX22190PMB#—Top Silkscreen
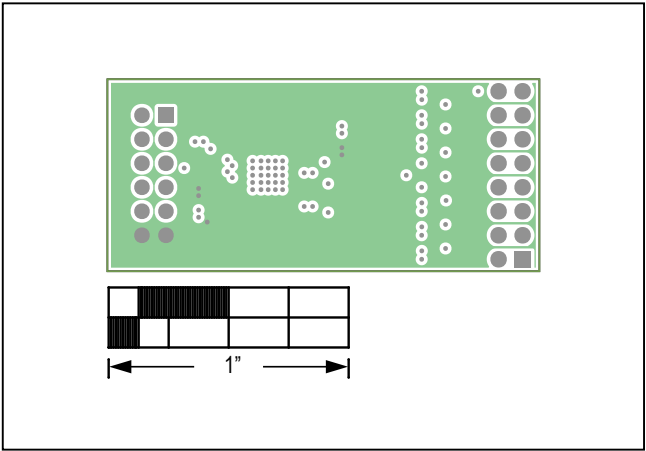
MAX22190PMB#—Internal 3

MAX22190PMB#—Top

MAX22190PMB#—Bottom

MAX22190PMB#—Internal 2

MAX22190PMB#—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	8/18	Initial release	—

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