

MAX22201 Evaluation Kit

Evaluates: MAX22201

General Description

The MAX22201 evaluation kit (EV kit) provides a proven design to evaluate the MAX22201 brushed DC motor driver. The MAX22201 IC integrates very low impedance FETs in a full bridge configuration for use in 36V, 3.5A motor driver applications. The typical R_{ON} (high side + low side) of this configuration is 0.3Ω . The EV kit features headers, test points, and terminal blocks to provide an interface to the MAX22201 motor driver PWM inputs, current sense outputs, and power supply inputs and motor driver outputs. An on-board ICM7556 provides an on-board PWM generator with a fixed frequency of 16.5kHz and an adjustable duty cycle from 4% to 95%. The EV kit also allows the user to adjust the integrated current limiting using an on-board potentiometer.

Features

- Easy Evaluation of the MAX22201
- Configurable for External PWM or Adjustable On-Board PWM Input
- Configurable RILIM Resistor to Adjust Integrated Current Limit Threshold
- Configurable ROFF Resistor to Adjust OFF Time
- Fully Assembled and Tested
- Proven PCB Layout

Ordering Information appears at end of data sheet.

MAX22201 EV Kit Board

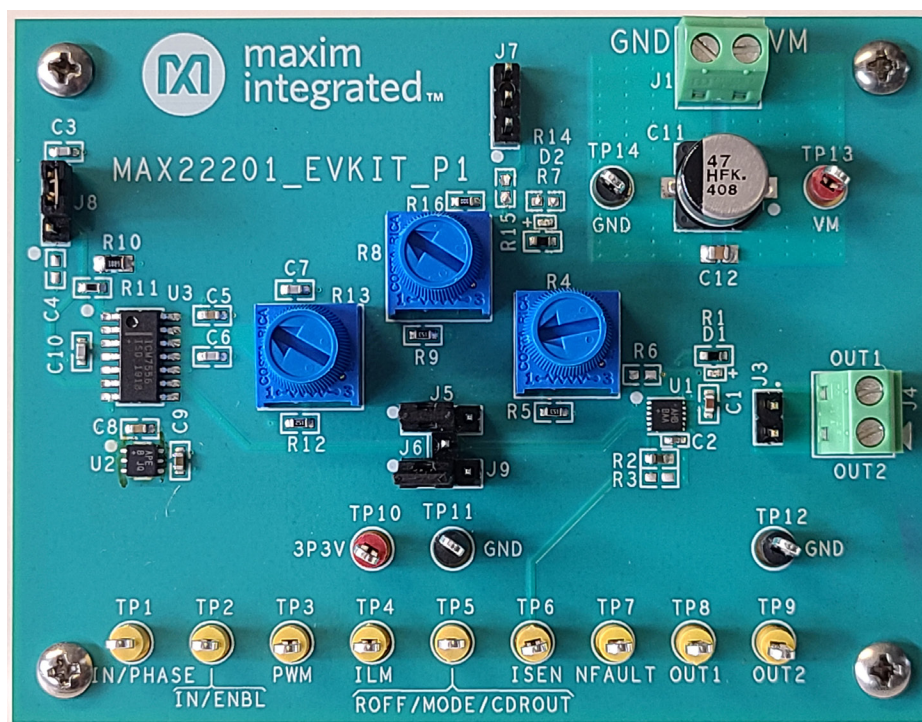


Figure 1. MAX22201 EV Kit Board

Quick Start

Required Equipment

- MAX22201 EV kit
- +36V DC, 5A power supply
- Optional up to 100kHz square wave signal generator
- Brushed DC motor or load

Procedure

It is recommended that the engineer read the MAX22201 IC data sheet prior to using the EV kit. Refer to the Typical Application Circuits and Detailed Description in the MAX22201 IC data sheet for more information. The EV kit is fully assembled and tested. Use the following steps to verify board operation:

- 1) As with all motor drive applications, stopping or braking the motor can cause a back EMF (BEMF) current and voltage spike. At high supply voltages (+36V), this can cause the supply to rise above the absolute maximum allowable voltage to the supply pins of a motor drive IC. It is highly recommended that the power supply be clamped appropriately to avoid damage to the motor driver IC.
- 2) Verify that all shunts are installed in their default position as described in [Table 2](#).
- 3) Adjust the current limit threshold using potentiometer R4 and reading the resistance using test point TP4 and a GND test point.
- 4) If a load or DC motor is being used, connect the load or motor to terminal block J4.
- 5) Connect a +4V to +36V DC power supply to the terminal block J1 or TP13 and TP14 and turn on the supply.
- 6) If the part is started with IN1 and IN2 at a logic-low state, the part enters a low-power sleep mode. To power on the device, both inputs IN1 and IN2 must first be driven to a logic-high state for at least 400μs.
- 7) Pin 2 of headers J5 and J9 or TP1 (IN1) and TP2 (IN2) can be used to drive the MAX22201 PWM inputs. To drive IN1 or IN2 high continuously, use shunts on headers J5 and J9. To Drive IN1 or IN2 with the on-board PWM signal, use pin 2 of either header J5 or J9 and pin 1 of J6. See the [Example Startup Procedure](#) section for an example of a startup sequence and [Table 2](#) for more information.

Example Startup Procedure

The steps below describe the startup procedure using the on-board PWM signal to drive the MAX22201 inputs.

- 1) Verify that all shunts are installed as described in step 2 of the quick start procedure. This brings the part up in low-power sleep mode.
- 2) Move the shunts to position 1-2 on J5 and J9. This exits the low-power sleep mode.
- 3) To drive a motor connected to the output forward in continuous mode, move the shunt on J9 to position 2-3. This drives the DC motor in forward mode with IN1 = logic high and IN2 logic low. Return the shunt on J9 to position 1-2 to enter brake mode.
- 4) To drive a motor connected to the output forward with PWM control, move the shunt on J9 so that it can be installed across pin1 of J6 and pin 2 of J9. This drives the DC motor in forward with the on-board PWM signal. The PWM signal duty cycle can be adjusted using R13. Return the shunt on J9 to position 1-2 to enter brake mode.
- 5) To drive a motor connected to the output reverse in continuous mode, move the shunt on J5 to position 2-3. This drives the DC motor in reverse mode with IN1 = logic low and IN2 logic high. Return the shunt on J5 to position 1-2 to enter brake mode.
- 6) To drive a motor connected to the output reverse with PWM control, move the shunt on J5 so that it can be installed across pin1 of J6 and Pin 2 of J5. This drives the DC motor in reverse with the on-board PWM signal. The PWM signal duty cycle can be adjusted using R13. Return the shunt on J5 to position 1-2 to enter brake mode.

Detailed Description of Hardware (or Software)

The MAX22201 EV kit provides a proven layout and evaluation circuit for the MAX22201 (U1) IC. The EV kit features a MAX15006 (U2) ultra-low quiescent current LDO to provide +3.3V from an input voltage of +4V to +36V from the VM supply to power the on-board PWM switching circuitry. On-board PWM switching is achieved using an ICM7556 (U3) dual timer IC and can be routed to either IN1 or IN2 input of the MAX22201.

Power Supplies

The MAX22201 IC can be powered by either applying a +4V to +36V power supply to terminal block J1 or test points TP13 and TP14. The on-board +3.3V MAX15006 LDO (U3) and ICM7556 (U3) dual timer circuit is sourced from this supply.

MAX22201 Input Configuration

The MAX22201's inputs (IN1 and IN2) can be driven either using an external signal applied to IN1 using TP1 and IN2 using TP2, or the user can choose to drive the MAX22201 inputs using the on-board generated PWM signal.

Headers J5, J6, and J9 can be configured to either drive one or both MAX22201 inputs with a continuous voltage of +3.3V or GND, or can be configured to drive one

MAX22201 input to +3.3V and apply a PWM signal to the other MAX22201 input. The on-board PWM signal is routed to a single pin header J6. Pin 2 of headers J5 and J9 are routed to the MAX22201 inputs IN1 and IN2. Pin 1 on J5 and J9 are connected to +3.3V and pin 3 on J5 and J9 are connected to GND. [Table 1](#) describes the operation of the MAX22201 outputs based on the MAX22201 input pin states.

[Figure 2](#) and [Table 2](#) describe the configuration of headers J5, J6, and J9 to drive the MAX22201 inputs using either the on-board PWM signal or continuously with +3.3V or GND. Potentiometer R13 can be used to adjust the duty cycle of the on-board PWM signal from 4% to 95%. [Figure 3](#) and [Figure 4](#) show the duty cycle range of the on-board PWM generated signal.

Table 1. Full Bridge IN1 and IN2 Truth Table

IN1	IN2	OUT1	OUT2	DESCRIPTION
0	0	High-Z	High-Z	Coast; H-bridge disabled to High-Z (sleep mode is entered after 2.2ms typical)
0	1	L	H	Reverse (current from OUT2 to OUT1)
1	0	H	L	Forward (current from OUT1 to OUT2)
1	1	L	L	Brake; slow decay

Table 2. On-Board PWM Configuration Table (Default Configuration)

HEADER	SHUNT POSITION	DESCRIPTION
J5	1-2	MAX22201 input IN1 connected to +3.3V
	2-3*	MAX22201 input IN1 connected to GND
J6	J6 pin 1 to J5 pin 2	On-board PWM signal connected to the MAX22201 input IN1
	J6 pin 1 to J5 pin 2	On-board PWM signal connected to the MAX22201 input IN2
J9	1-2	MAX22201 input IN2 connected to +3.3V
	2-3*	MAX22201 input IN2 connected to GND
J8	1-2	User customizable PWM frequency with the population of C4
	2-3*	Selects the default PWM frequency of 16.5kHz
J7	Unpopulated*	Not used, leave unpopulated

*Default shunt position.

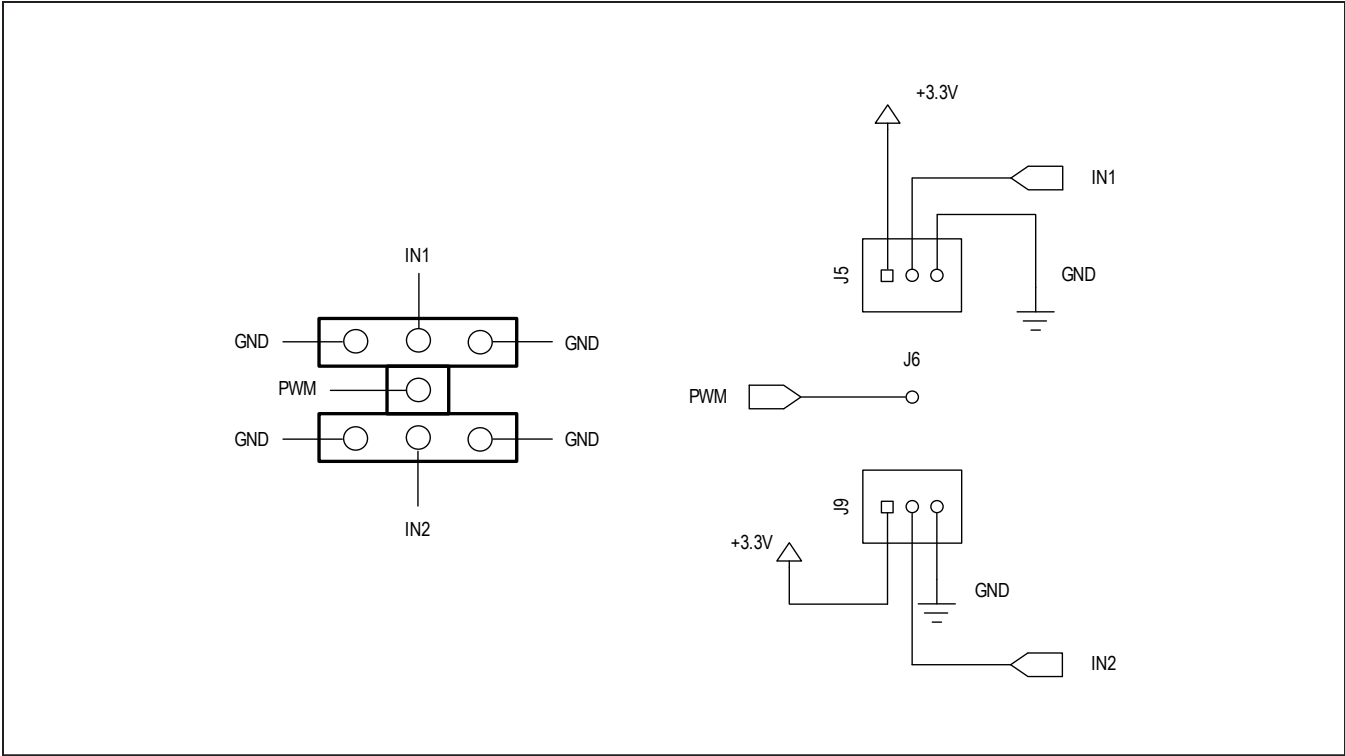


Figure 2. Configuration of the MAX22201 Input Headers J5, J6, and J9

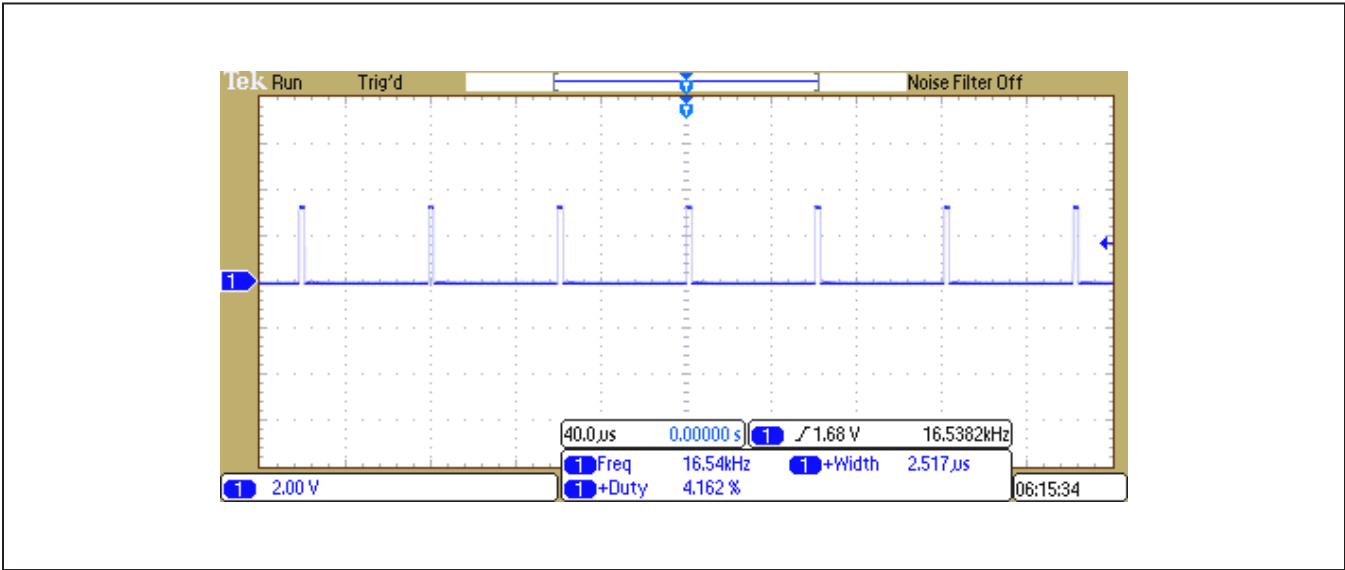


Figure 3. PWM Signal Measured at Test Point TP3 With a 4% Duty Cycle

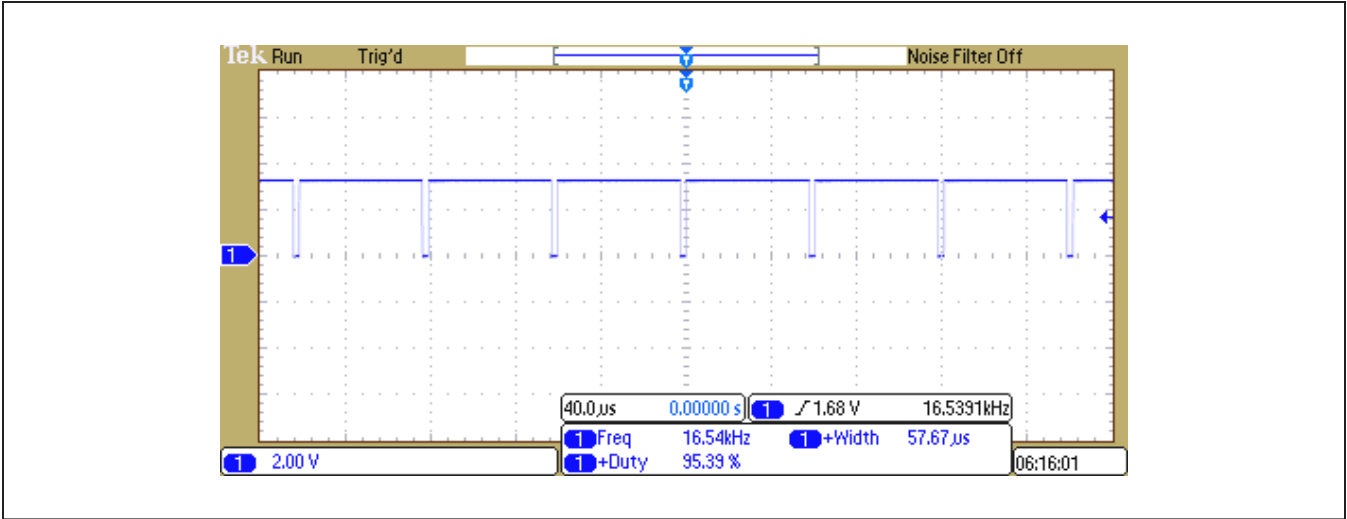


Figure 4. PWM Signal Measured at Test Point TP3 with a 95% Duty Cycle

Current Drive Regulation and Current Limiter

The integrated current limit can be adjusted using potentiometer R4. The resistance connected from the MAX22201 ILIM pin to GND can be adjusted from 18kΩ to 115kΩ for a corresponding current limit of 2.7A to 0.43A. If the current limit threshold is reached, the device enters a slow decay cycle by enabling both low-side FETs for a specified off time (t_{OFF}). The current limit threshold equation is given below where $K_{ILIM} = 50KV$:

$$I_{TRIP}(A) = \frac{K_{ILIM}(KV)}{R_{ILIM}(k\Omega)}$$

Off-Time Configuration

The MAX22201's off time can be adjusted using potentiometer R8 with values from 30kΩ to 230kΩ. The equation for determining the off time is given below where $C_{OFF}(nF) = 0.333nF$.

$$t_{OFF}(\mu s) = R_{OFF}(k\Omega) \times C_{OFF}(nF)$$

Ordering Information

PART	TYPE
MAX22201EVKIT#	EV KIT

#Denotes RoHS compliance.

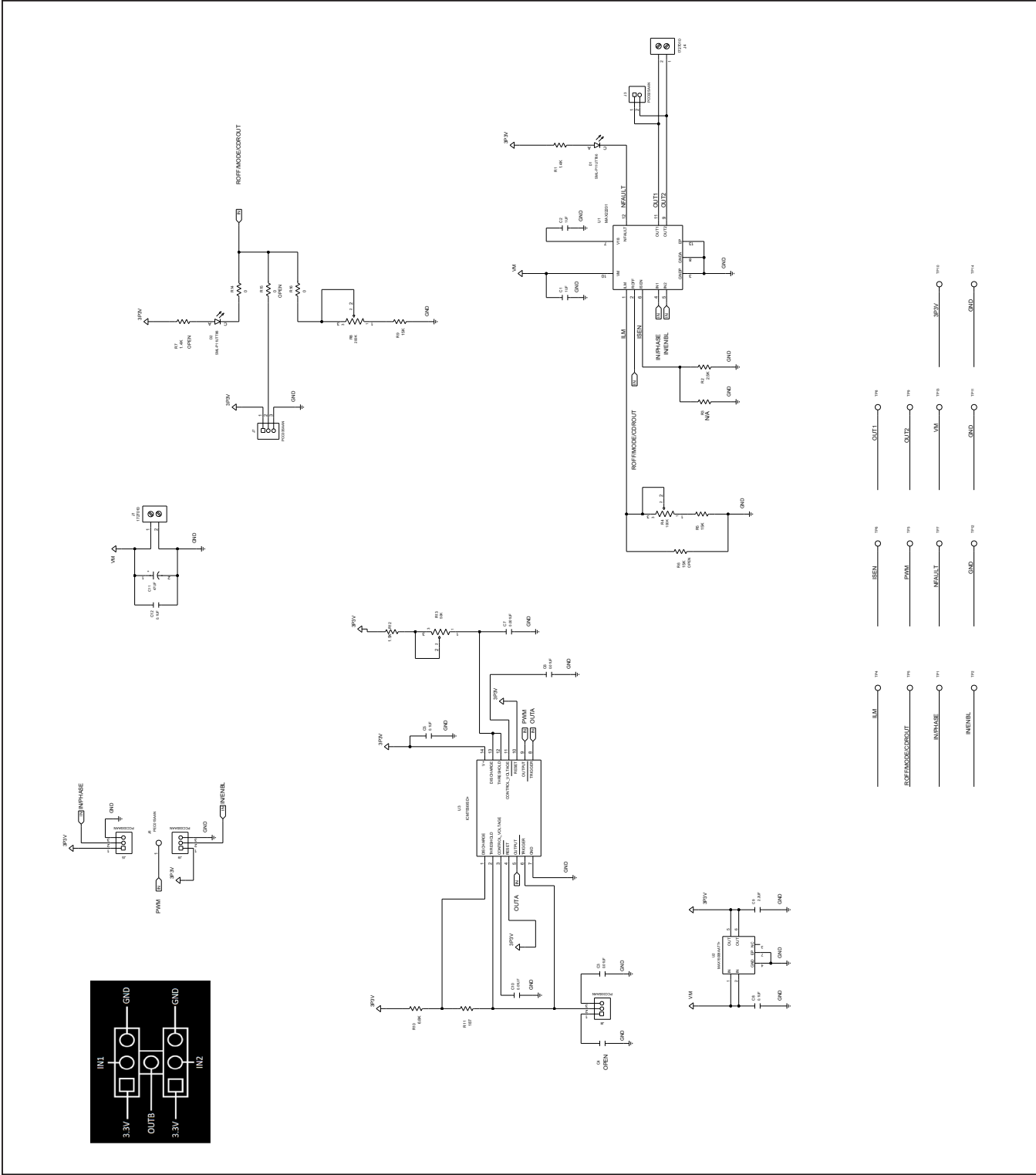
MAX22201 EV Kit Bill of Materials

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	C1	-	1	UMK107BJ105KA; C1608X5R1H105K080AB; CL10A105KB8NNN; GRM188R61H105KAAL	TAIYO YUDEN;TDK; SAMSUNG;MURATA	1UF	CAP; SMT (0603); 1UF; 10%; 50V; X5R; CERAMIC
2	C2	-	1	C0402C105K8PAC; CC0402KRX5R6BB105	KEMET;YAGEO	1UF	CAP; SMT (0402); 1UF; 10%; 10V; X5R; CERAMIC
3	C3, C6, C10	-	3	C1608COG1H103J080AA; CGA3E2COG1H103J080AD; GRM1885C1H103JA01	TDK;TDK;MURATA	0.01UF	CAP; SMT (0603); 0.01UF; 5%; 50V; COG; CERAMIC
4	C5	-	1	C0603C104J4RAC; X7R0603CTTD104J; GRM188R71C104JA01	KEMET;KOA SPEER ELECTRONICS INC; MURATA	0.1UF	CAP; SMT (0603); 0.1UF; 5%; 16V; X7R; CERAMIC;
5	C7	-	1	GRM1885C1E102JA01	MURATA	0.001UF	CAP; SMT (0603); 0.001UF; 5%; 25V; COG; CERAMIC
6	C8	-	1	C1608X5R1H104K080AA	TDK	0.1UF	CAP; SMT (0603); 0.1UF; 10%; 50V; X5R; CERAMIC
7	C9	-	1	C1608X5R1E225K; TMK107ABJ225KA; TMK107BJ225KA; GRM188R61E225KA12	TDK;TAIYO YUDEN; TAIYO YUDEN;MURATA	2.2UF	CAP; SMT (0603); 2.2UF; 10%; 25V; X5R; CERAMIC
8	C11	-	1	EEE-FK1H470P	PANASONIC	47UF	CAP; SMT (CASE_E); 47UF; 20%; 50V; ALUMINUM-ELECTROLYTIC
9	C12	-	1	C0805C104J1RAC; 08051C104JAT2A; GCM21BR72A104JA37	KEMET;AVX;MURATA	0.1UF	CAP; SMT (0805); 0.1UF; 5%; 100V; X7R; CERAMIC
10	D1, D2	-	2	SML-P11UTT86	ROHM	SML-P11UTT86	DIODE; LED; SMT; PIV=1.8V; IF=0.02A
11	J1, J4	-	2	1727010	PHOENIX CONTACT	1727010	CONNECTOR; FEMALE; THROUGH HOLE; GREEN TERMINAL BLOCK; RIGHT ANGLE; 2PINS
12	J3	-	1	PCC02SAAN	SULLINS	PCC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 2PINS; -65 DEGC TO +125 DEGC
13	J5, J7-J9	-	4	PCC03SAAN	SULLINS	PCC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 3PINS; -65 DEGC TO +125 DEGC
14	J6	-	1	PEC01SAAN	SULLINS ELECTRONICS CORP	PEC01SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 1PIN
15	R1	-	1	CRCW06031K40FK	VISHAY DALE	1.4K	RES; SMT (0603); 1.4K; 1%; +/-100PPM/DEGC; 0.1000W
16	R2	-	1	MCT06030E2501B	VISHAY DALE	2.5K	RES; SMT (0603); 2.5K; 0.10%; +/-15PPM/DEGC; 0.1000W
17	R4	-	1	3386P-1-104TLF	BOURNS	100K	RES; THROUGH HOLE-RADIAL LEAD; 100K; 10%; +/-100PPM/DEGC; 0.5W
18	R5, R9	-	2	TNPW060315K0BE; ERA-3AEB153	VISHAY DALE; PANASONIC	15K	RES; SMT (0603); 15K; 0.10%; +/-25PPM/DEGC; 0.1000W
19	R8	-	1	3386P-1-204TLF	BOURNS	200K	RES; THROUGH HOLE-RADIAL LEAD; 200K; 10%; +/-100PPM/DEGC; 0.5W
20	R10	-	1	CRCW08056K80FK	VISHAY DALE	6.8K	RES; SMT (0805); 6.8K; 1%; +/-100PPM/DEGC; 0.1250W

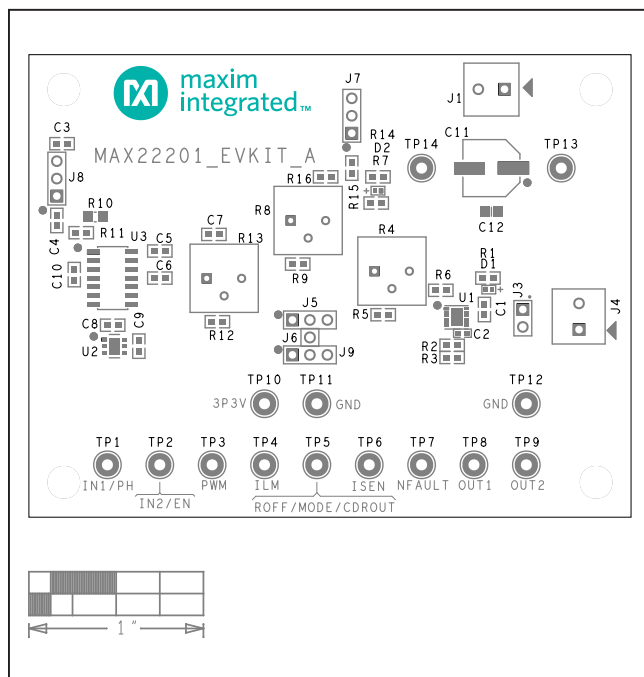
MAX22201 EV Kit Bill of Materials (continued)

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
21	R11	-	1	CRCW0603187RFK; ERJ-3EKF1870	VISHAY DALE; PANASONIC	187	RES; SMT (0603); 187; 1%; +/-100PPM/DEGC; 0.1000W
22	R12	-	1	TNPW06031K50BE; ERA-3YEB152V	VISHAY DALE; PANASONIC	1.5K	RES; SMT (0603); 1.5K; 0.10%; +/-25PPM/DEGC; 0.1000W
23	R13	-	1	3386P-1-503TLF	BOURNS	50K	RES; THROUGH HOLE-RADIAL LEAD; 50K; 10%; +/-100PPM/DEGC; 0.5W
24	R14, R16	-	2	CRCW06030000Z0	VISHAY DALE	0	RES; SMT (0603); 0; JUMPER; JUMPER; 0.1000W
25	TP1-TP9	-	9	5014	KEystone	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; YELLOW; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
26	TP10, TP13	-	2	5010	KEystone	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; RED; PHOSPHOR BRONZE WIRE SIL;
27	TP11, TP12, TP14	-	3	5011	KEystone	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
28	U1	-	1	MAX22201	MAXIM	MAX22201	EVKIT PART - IC; MAX22201; PACKAGE OUTLINE DRAWING: 21-0664; PACKAGE LAND PATTERN: 90-0397
29	U2	-	1	MAX15006AATT+	MAXIM	MAX15006AATT+	IC; VREG; ULTRA-LOW QUIESCENT-CURRENT LINEAR REGULATOR; TDFN6-EP 3X3
30	U3	-	1	ICM7556ISD+	MAXIM	ICM7556ISD+	IC; TIMR; GENERAL PURPOSE TIMER; NSOIC14 150MIL
31	PCB	-	1	MAX22201	MAXIM	PCB	PCB:MAX22201
32	R6	DNP	0	TNPW060315K0BE; ERA-3AEB153	VISHAY DALE; PANASONIC	15K	RES; SMT (0603); 15K; 0.10%; +/-25PPM/DEGC; 0.1000W
33	R7	DNP	0	CRCW06031K40FK	VISHAY DALE	1.4K	RES; SMT (0603); 1.4K; 1%; +/-100PPM/DEGC; 0.1000W
34	R15	DNP	0	CRCW06030000Z0	VISHAY DALE	0	RES; SMT (0603); 0; JUMPER; JUMPER; 0.1000W
35	C4	DNP	0	N/A	N/A	OPEN	PACKAGE OUTLINE 0603 NON-POLAR CAPACITOR
36	R3	DNP	0	N/A	N/A	N/A	RESISTOR; 0603 PACKAGE; GENERIC
TOTAL			51				

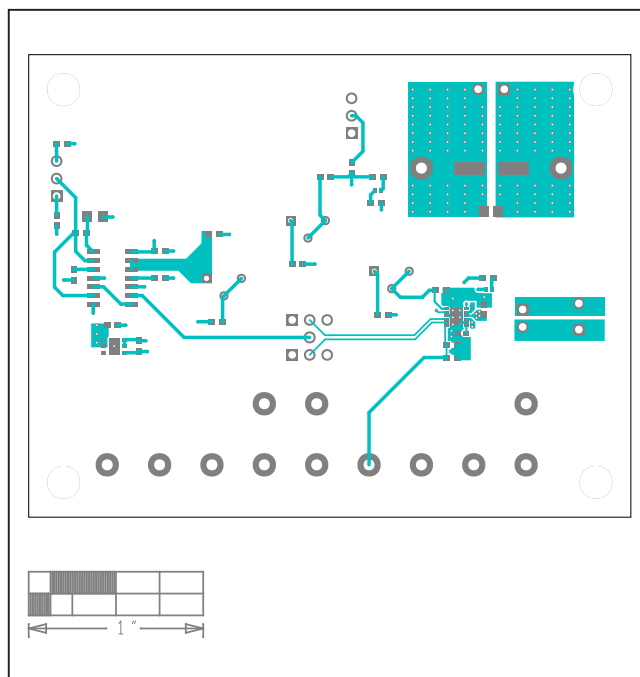
MAX22201 EV Kit Schematic



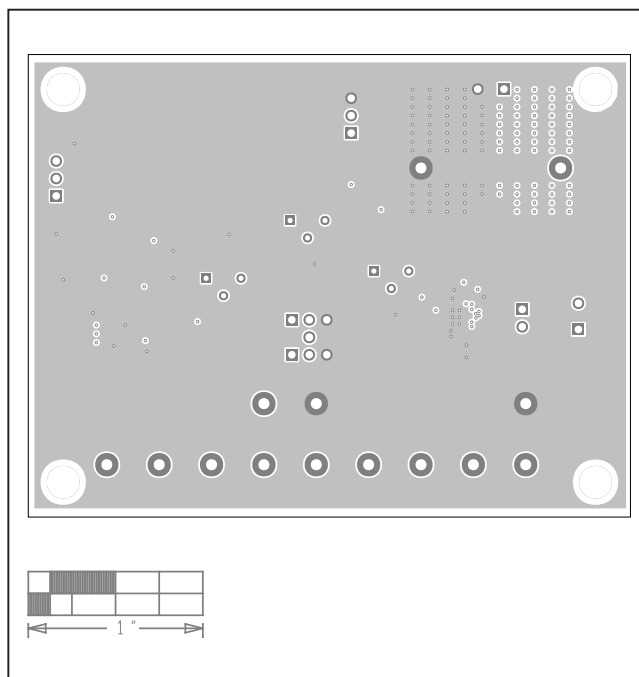
MAX22201 EV Kit PCB Layouts



MAX22201 EV Kit Component Placement Guide—Top Silkscreen

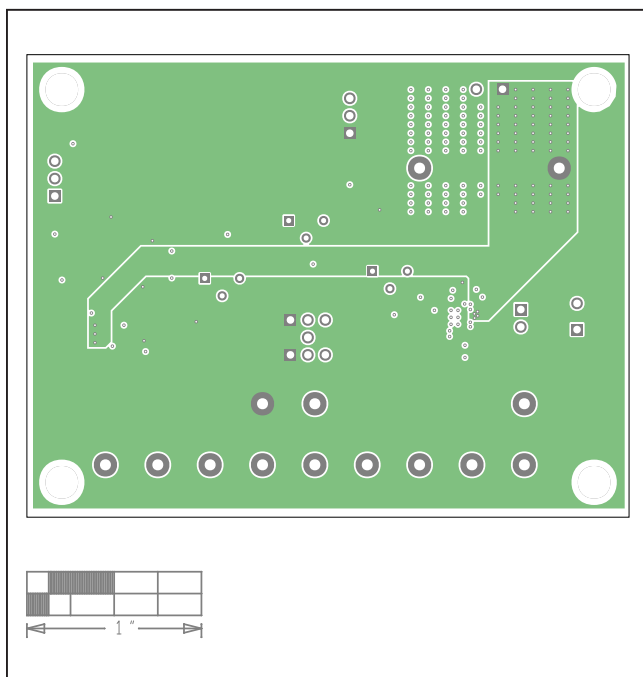


MAX22201 EV Kit PCB Layout—Top

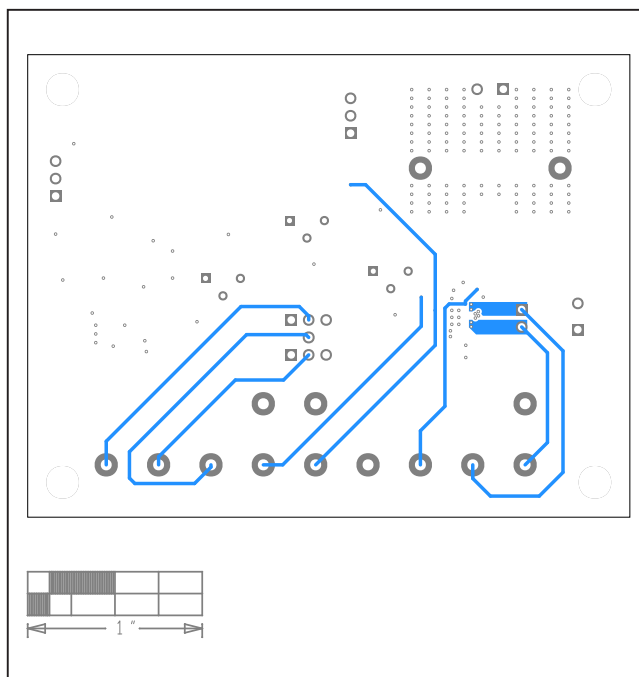


MAX22201 EV Kit PCB Layout—Internal2

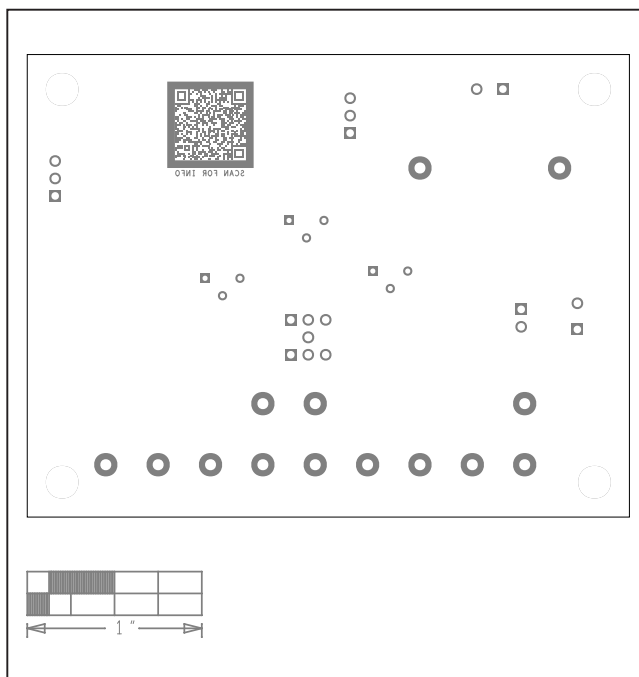
MAX22201 EV Kit PCB Layouts (continued)



MAX22201 EV Kit PCB Layout—Internal3



MAX22201 EV Kit PCB Layout—Bottom

MAX22201 EV Kit Component Placement Guide—Bottom
Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	1/21	Initial release	—

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