

## MAX22193 Evaluation Kit

Evaluates: MAX22193

### General Description

The MAX22193 evaluation kit (EV kit) provides a proven design to evaluate the MAX22193, a high-speed, quad, industrial digital input with parallel output device.

The MAX22193 EV kit provides a terminal block for all four inputs and a header for all four outputs for easy monitoring and evaluation. Four field-side LEDs are provided to indicate the input status, as well as a READY LED to indicate the MAX22193 is operating normally.

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

### Features

- Easy Evaluation of the MAX22193
  - Configured for IEC 61131-2 Type 1/3
  - Support IEC 61131-2 Type 2 on Signal Channel
  - Parallel Output for Simultaneous Signal Delivery
  - Configurable External  $V_{DD24}$  Voltage Monitoring
- Robust Design with  $\pm 2\text{kV}$  Input Surge Protection
- Withstands  $\pm 8\text{kV}$  Contact Electrostatic Discharge (ESD) and  $\pm 15\text{kV}$  Airgap ESD
- Fully Assembled and Tested
- Proven PCB Layout

### EV Kit Photo



### MAX22193 EV Kit Block Diagram

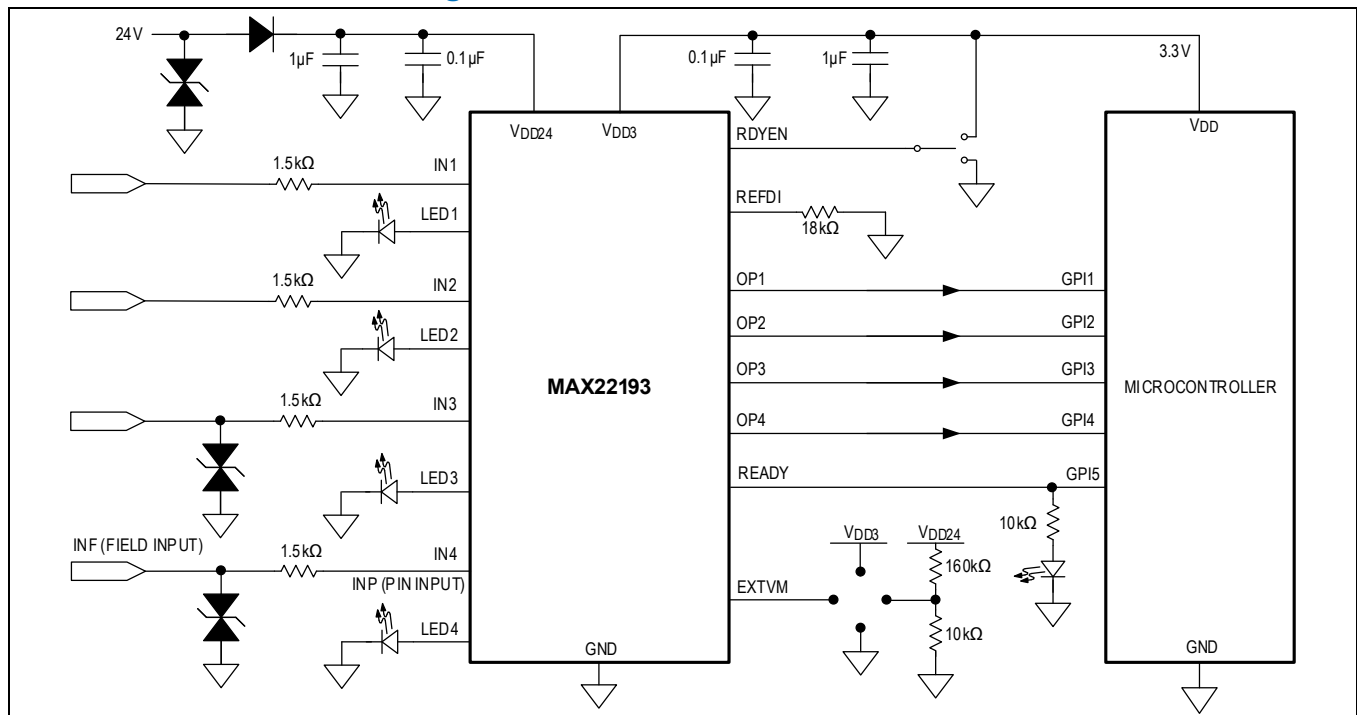


Figure 1. MAX22193 EV Kit Block Diagram

## Quick Start

### Required Equipment

- MAX22193EVKIT#
- Two 24V DC voltage supplies
- Digital multimeter and oscilloscope

### Procedure

The MAX22193 EV kit is fully assembled and tested. The EV kit is configured for four Type 1 or Type 3 inputs. Follow the steps to verify operation of the MAX22193.

1. Verify that all jumper settings are in their default positions as shown in [Table 1](#) and [Figure 2](#).
2. Connect the DC power supply between the EV kit's VDD24 and GND test points. Set the DC power supply output to 24V and then enable the output. Observe that the READY LED (DS5, yellow) on the EV kit is turned on, indicating that the EV kit is powered up normally.
3. Connect another 24V DC voltage supply to input channel 1 between the TP1 and GND test points. Connect the oscilloscope probe to header J2 between OP1 (pin 2) and GND (pin 1 or 6).
4. Set the voltage supply to 24V and then enable the output. Observe that LED1 (green) is on and OP1 logic output transitions to high (3.3V, typ) on the oscilloscope.
5. Repeat steps 4 and 5 for input channels 2, 3, and 4.

**NOTE:** On the MAX22193 EV kit, the sequence of the input test points from top to bottom is as follows: IN3, IN4, IN1, and IN2. See the MAX22193 EV Kit [Schematic](#) and [Layout](#) for details.

**Table 1. MAX22193 EV Kit Jumper Settings**

JUMPER	SHUNT POSITION	DESCRIPTION
J4	1-2*	Connect RDYEN to V <sub>DD3</sub> to enable the READY output.
	2-3	Connect RDYEN to GND to disable the READY output.
J5	1-2*	Connect EXTVM to GND to use internal threshold (14V, typical) for V <sub>DD24</sub> voltage monitoring.
	1-3	Connect EXTVM to external resistor divider to set external threshold for V <sub>DD24</sub> voltage monitoring.
	1-4	Connect EXTVM to V <sub>DD3</sub> to disable V <sub>DD24</sub> voltage monitoring at the READY pin when the device is powered by V <sub>DD3</sub> .

\*Default position.

## Detailed Description of Hardware

The MAX22193 EV kit provides a proven layout for a 4-channel digital input solution with parallel output using the MAX22193. The EV kit supports IEC 61131-2 Type 1, 3 operation and can be configured to support Type 2. This flexibility makes it easier to evaluate the system performance of the MAX22193.

### Power Supply

The EV kit is powered by the 24V external DC supply, connected to VDD24 and GND test points. The MAX22193 has an integrated voltage regulator to provide a 3.3V output at VDD3, which can be used to power the digital isolators or other field-side circuits. Alternatively, if an external 24V DC supply is not available, the device can be powered using an external 3.0V to 5.5V DC supply connected to VDD3 and GND test points while leaving the VDD24 test point unconnected.

### READY and RDYEN

READY is an open-drain PMOS output to indicate that the MAX22193 is working normally. A READY LED (DS5) is provided on the EV kit as a visual indicator of the signal status. When READY is low, the READY LED is off indicating that the device is not ready for operation. The READY output can also be monitored on the READY\_TP test point.

RDYEN is used to enable or disable the READY output. Jumper J4 on the EV kit is used to set the RDYEN; set J1 to the 1-2 position to enable the READY signal and set to the 2-3 position to disable it (see [Table 1](#) for jumper settings).

### External VDD24 Voltage Monitor

The EXTVM pin can be connected in three ways on the EV kit using jumper J5:

- Connect J5 to the 1-2 position to use internal threshold (14V (typ)) for VDD24 voltage monitoring.
- Connect J5 to the 1-4 position to disable VDD24 voltage monitoring at the READY pin if the EV kit is powered by VDD3 using an external DC supply.
- Connect J5 to the 1-3 position to use an external resistive divider (R12 and R13) to set the external threshold for VDD24 voltage monitoring. The default R12 and R13 values set the VDD24 threshold to about 14V (typ). If another VDD24 threshold is desired, resistors R12 and R13 can be changed accordingly.

See [Table 1](#) for jumper settings. Refer to the MAX22193 IC data sheet for more information on the EXTVM pin.

### Type 1/3 Inputs

The MAX22193 EV kit is configured to support the trip points (voltage and current) to satisfy the requirements of IEC 61131-2 Type 1 and Type 3 inputs. Resistor R10 sets the current limiter at a nominal 2.40mA and input resistors R5 to R8 set the voltage thresholds to ensure compliance. The input resistors R5 and R6 are 1.5k $\Omega$ , 1.5W pulse withstanding resistors to support IEC 61000-4-5 surge tolerance up to  $\pm 2$ kV line-to-ground and line-to-line. The input resistors R7 and R8 are paired with TVS diodes D1 and D2 to protect the MAX22193 from surge transients. A separate LED for each input port indicates the status of each input.

### Type 2 Inputs

The MAX22193 EV kit can be configured to support Type 2 inputs. Type 2 inputs require a higher current limit (6mA, minimum). The current limiter for each channel is set to a nominal 7mA by reducing resistor R10 to 6k $\Omega$ . To set the input voltage thresholds correctly, input resistors R5 to R8 need to be reduced to 470 $\Omega$ .

### REFDI Layout

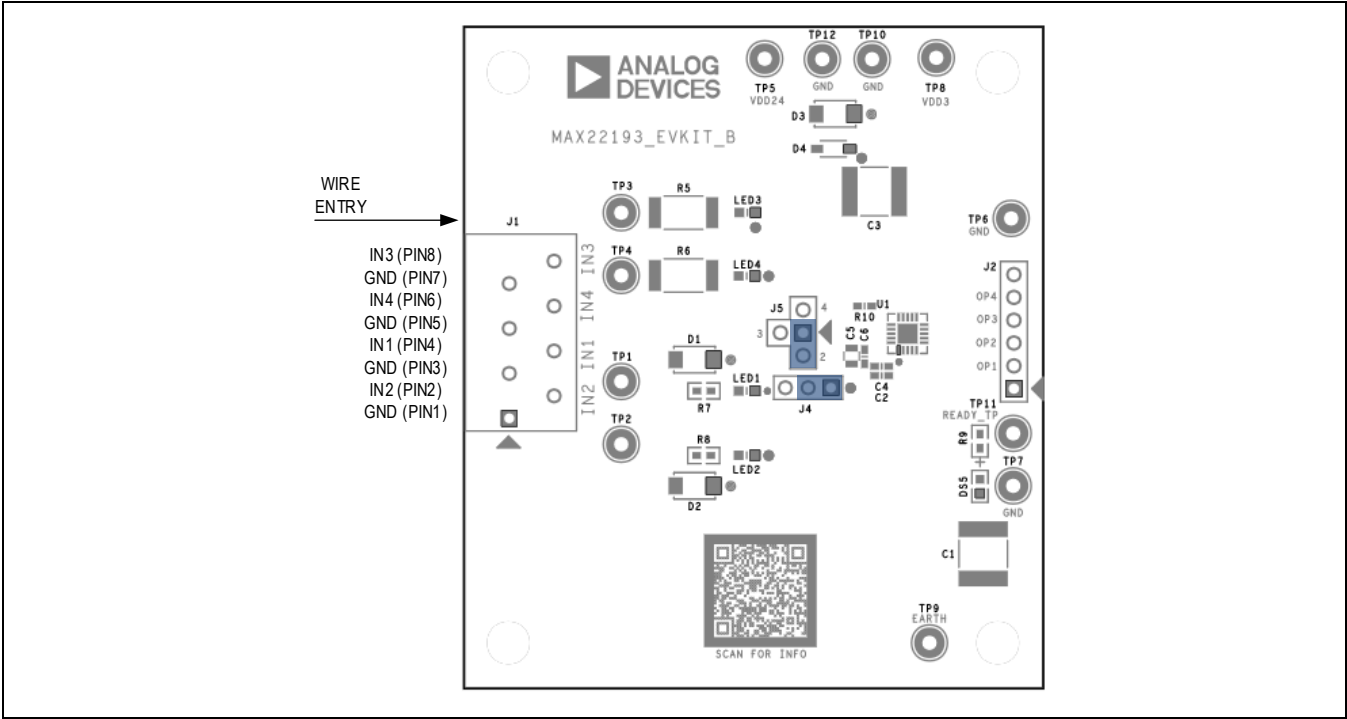
The REFDI resistor is used to set the required input current limit of all input channels. Care must be taken during the layout that the REFDI resistor and REFDI trace are routed far away from all field input traces, especially IN4, to limit the high voltage transients such as electrical fast transients or surge pulses to be coupled into REFDI circuitry. A ground plane is recommended to be placed between the REFDI trace and input traces to better shield the noise. On the MAX22193 EV kit, the REFDI trace is surrounded by a solid ground plane to isolate it from input traces. See the MAX22193 EV kit [PCB Layout](#) for more information.

IEC 61000-4-X Immunity Compliance

The typical application for the MAX22193 requires it to pass basic transient immunity standards as defined by IEC 61000-4-X, covering -2 for electrostatic discharge (ESD) and -5 for surge immunity. The MAX22193 EV kit includes circuitry to support testing these standards up to  $\pm 2\text{kV}$  line-to-ground and line-to-line surge,  $\pm 8\text{kV}$  contact ESD, and  $\pm 15\text{kV}$  air gap ESD. TVS diode D3 (SMAJ33CA) provides protection from surge and ESD voltages applied at  $V_{DD24}$ . A Schottky diode D4 (PMEG4005EH) provides reverse current protection at  $V_{DD24}$ . C1 is a 3300pF safety rated Y capacitor placed between protective earth (PE) and field ground (GND) to improve transient immunity. See [Table 2](#) for the MAX22193 EV kit transient immunity test results.

Table 2. MAX22193 EV Kit Transient Immunity Test Results

TEST		CONDITION	RESULT
Surge	Line-to-line	IEC 61000-4-5, 1.2/50 $\mu\text{s}$ , 40 $\Omega$ + 0.5 $\mu\text{F}$ CDN, minimum 470 $\Omega$ , 1.5W pulse-withstanding resistors in series with IN1-IN4, or SMAJ33CA between IN_ and ground.	$\pm 2\text{kV}$
	Line-to-ground		$\pm 2\text{kV}$
	$V_{DD24}$ -to-ground	IEC 61000-4-5, 1.2/50 $\mu\text{s}$ , 40 $\Omega$ + 0.5 $\mu\text{F}$ CDN, SMAJ33CA between $V_{DD24}$ and ground.	$\pm 1\text{kV}$
ESD	IN_, Contact	IEC 61000-4-2, minimum 470 $\Omega$ , 1.5W pulse-withstanding resistors in series with IN1-IN4, or SMAJ33CA between IN_ and ground.	$\pm 8\text{kV}$
	IN_, Airgap		$\pm 15\text{kV}$
	$V_{DD24}$ , Contact	IEC 61000-4-2, SMAJ33CA between IN_ and ground.	$\pm 8\text{kV}$
	$V_{DD24}$ , Airgap		$\pm 15\text{kV}$



## MAX22193 EV Kit Bill of Materials

ITEM	REF_DES	DNP	QTY	MFG PART #	MFG	VALUE	DESCRIPTION
1	C1	-	1	VJ2220Y332KXUSTX 1;GA355QR7GF332K W01	VISHAY VITRAMON;M URATA	3300PF	CAP; SMT (2220); 3300PF; 10%; 250V; X7R; CERAMIC
2	C2	-	1	C1608X7R1V105K08 0AC	TDK	1UF	CAP; SMT (0603); 1UF; 10%; 35V; X7R; CERAMIC
3	C3	-	1	CGA9N3X7S2A106K 230KB	TDK	10UF	CAP; SMT (2220); 10UF; 10%; 100V; X7S; CERAMIC
4	C4, C6	-	2	CC0603KRX7R0BB1 04;GRM188R72A104 KA35;HMK107B7104 KA;06031C104KAT2 A;GRM188R72A104K	YAGEO;MUR ATA;TAIYO YUDEN;AVX; MURATA	0.1UF	CAP; SMT (0603); 0.1UF; 10%; 100V; X7R; CERAMIC
5	C5	-	1	C2012X7S2A105K12 5AB;GRJ21BC72A10 5KE11;GRM21BC72A 105KE01	TDK;MURATA ;MURATA	1UF	CAP; SMT (0805); 1UF; 10%; 100V; X7S; CERAMIC
6	D1-D3	-	3	SMAJ33CA	VISHAY GENERAL SEMICONDU CTOR	33V	DIODE; TVS; SMA (DO-214AC); VRM=33V; IPP=7.5A
7	D4	-	1	PMEG4005EH	NXP	PMEG4 005EH	DIODE; SCH; SMT (SOD-123F); PIV=40V; IF=0.5A
8	DS5	-	1	LY L29K-H1K2-26-Z	OSRAM	LY L29K- H1K2- 26-Z	DIODE; LED; LY L29K SERIES; SMARTLED; YELLOW; SMT (1608); VF=1.8V; IF=0.02A
9	J1	-	1	250-408	WAGO	250-408	CONNECTOR; FEMALE; THROUGH HOLE; COMPACT TERMINAL STRIP WITH PUSH BUTTON; STRAIGHT; 8PINS
10	J2	-	1	PEC06SAAN	SULLINS ELECTRONIC S CORP.	PEC06 SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 6PINS
11	J4	-	1	PCC03SAAN	SULLINS	PCC03 SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 3PINS; -65 DEGC TO +125 DEGC
12	J5	-	1	TSW-104-07-L-S	SAMTEC	TSW- 104-07- L-S	EVKIT PART-CONNECTOR; MALE; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 4PINS
13	LED1-LED4	-	4	LTST-C193KGKT-5A	LITE-ON ELECTRONIC S INC.	LTST- C193K GKT-5A	DIODE; LED; STANDARD; YELLOW- GREEN; SMT (0603); PIV=1.9V; IF=0.005A; -55 DEGC TO +85 DEGC
14	R5, R6	-	2	RPC2512JT1K50	STACKPOLE ELECTRONIC S INC.	1.5K	RES; SMT (2512); 1.5K; 5%; +/- 100PPM/DEGC; 1.5000W;
15	R7, R8	-	2	CRCW06031K50JN	VISHAY DALE	1.5K	RES; SMT (0603); 1.5K; 5%; +/- 200PPM/DEGC; 0.1000W
16	R9	-	1	CRG0603F10K	TE CONNECTIVI TY	10K	RES; SMT (0603); 10K; 1%; +/- 100PPM/DEGC; 0.1000W
17	R10	-	1	CRCW060318K0FK	VISHAY DALE	18K	RES; SMT (0603); 18K; 1%; +/- 100PPM/DEGC; 0.1000W

18	R12	-	1	ERJ-3EKF1603	PANASONIC	160K	RES; SMT (0603); 160K; 1%; +/- 100PPM/DEGC; 0.1000W
19	R13	-	1	CRCW060310K0FK; ERJ-3EKF1002; AC0603FR-0710KL; RMC0603FT10K0	VISHAY;PAN ASONIC;YAG EO;STACKPO LE	10K	RES; SMT (0603); 10K; 1%; +/- 100PPM/DEGC; 0.1000W
20	SPACER1- SPACER4	-	4	9032	KEystone	9032	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON
21	SU2, SU3	-	2	S1100-B;SX1100- B;STC02SYAN	KYCON;KYC ON;SULLINS ELECTRONIC S CORP.	SX1100 -B	TEST POINT; JUMPER; STR; TOTAL LENGTH=0.24IN; BLACK; INSULATION=PBT;PHOSPHOR BRONZE CONTACT=GOLD PLATED
22	TP1-TP4	-	4	5125	KEystone	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; BROWN; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
23	TP5, TP8	-	2	5010	KEystone	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; RED; PHOSPHOR BRONZE WIRE SIL;
24	TP6, TP7, TP10, TP12	-	4	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;
25	TP9	-	1	5012	KEystone	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; WHITE; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
26	TP11	-	1	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;
27	U1	-	1	MAX22193	MAXIM	MAX22 193	EVKIT PART - IC; PACKAGE OUTLINE DRAWING: 21-0139; LAND PATTERN: 90-0037; TQFN20-EP
28	PCB	-	1	MAX22193	MAXIM	PCB	PCB:MAX22193
29	R1-R4	DNP	0	N/A	N/A	OPEN	PACKAGE OUTLINE 0603 RESISTOR

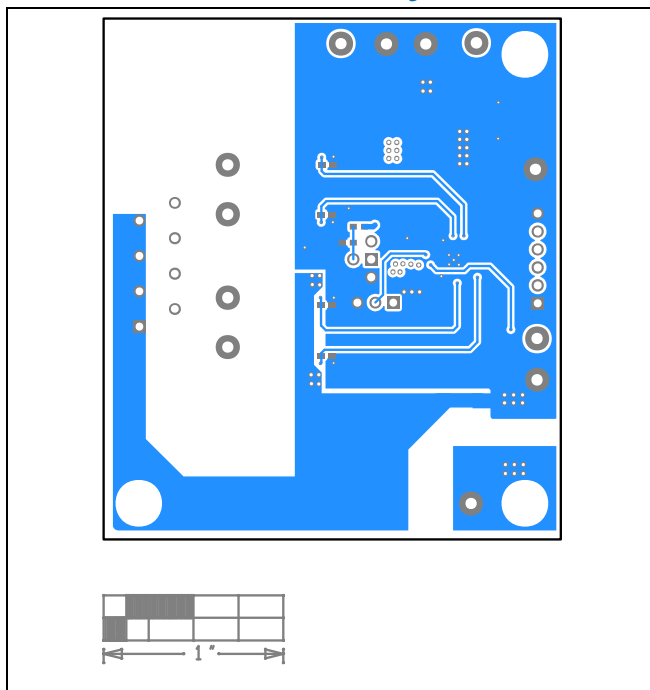
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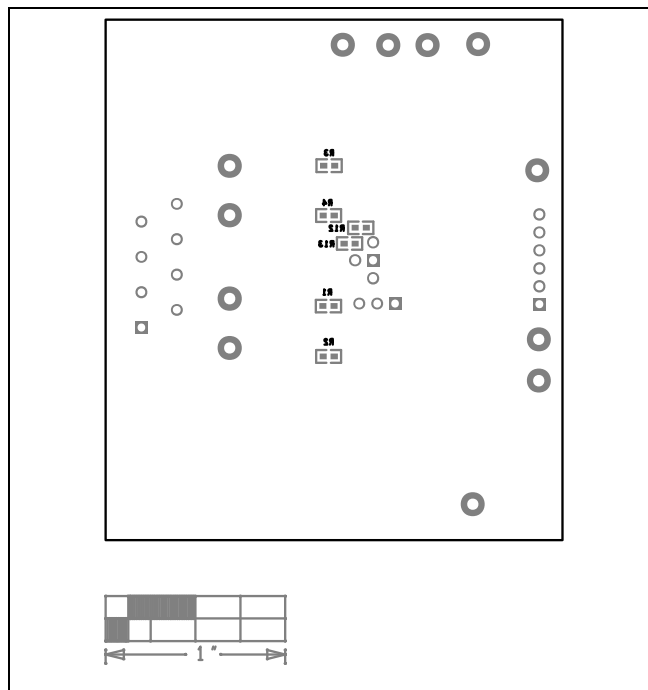
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## MAX22193 EV Kit PCB Layout



MAX22193 EV Kit PCB Layout—Bottom Layer



MAX22193 EV Kit PCB Layout—Bottom Silkscreen

## Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	7/22	Initial release	—



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