

Evaluates: MAX22088

MAX22088 Evaluation Kit

General Description

The MAX22088 evaluation kit (EV kit) provides a proven design to evaluate the MAX22088 Home Bus transceiver.

The EV kit includes an evaluation board with two circuits, a master circuit, and a remote/device circuit, that can be used to demonstrate the full functionality of the MAX22088 Home Bus transceiver in a complete Home Bus application.

For easy evaluation, on the remote/device side, the MAX15462 5V step-down DC-DC converter is included to power external system loads at 200mA (max). In addition, the MAX12931 digital isolator is used for convenient and correct measuring of digital Home Bus signals.

Features

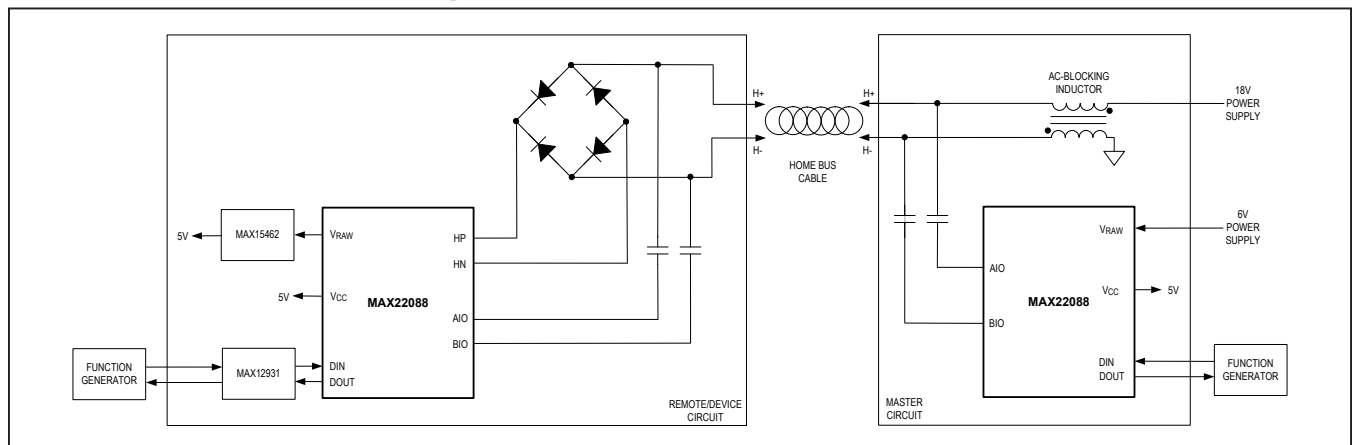
- Easy Evaluation of the MAX22088
- Two On-Board Configurations, Master Circuit and Remote/Device Circuit, for Complete Home Bus Evaluation
- Robust Design with $\pm 1\text{kV}$ Line-to-Line and Line-to-GND Surge Transient Immunity
- On-Board Isolated Digital Interface for Simple Testing and Monitoring
- Fully Assembled and Tested
- Proven PCB Layout

Ordering Information appears at end of data sheet.

MAX22088 EV Kit Board



MAX22088 EV Kit Block Diagram



Quick Start

Recommended Equipment

- MAX22088EVKIT#
- Two 24V, 200mA DC power supplies
- Digital multimeter
- Data generator, or function generator
- Digital oscilloscope
- A pair of twisted wires (22 or 24 AWG) 20cm or longer

Procedure

The MAX22088 EV kit is fully assembled and tested.

Follow the steps below to verify board operation:

Note: Do not short the ground of master circuit (GND1) and remote/device circuit (GND2) of the board. See the [Master and Remote/Device Grounds](#) section for more information. Ensure that the ground terminal of the power supply is not connected to earth ground.

- 1) Connect the H1+ of J10 (pin 1) to the H2+ of J15 (pin 1) with one of the twisted wires.
- 2) Connect the H1- of J10 (pin 2) to the H2- of J15 (pin 2) with the other of the twisted wires.
- 3) Verify that all jumpers are in their default positions as shown in [Table 1](#).

Table 1. MAX22088 EV Kit Shunt Positions

JUMPER	SHUNT POSITION	DEVICE	DESCRIPTION
CIRCUIT 1 (MASTER CIRCUIT)			
J1	Open	U2	Disable the MAX22088 (U2) transmitter output.
	1-2*		Enable the MAX22088 (U2) transmitter output.
J6	Open*		Enable the MAX22088 (U2) internal high-pass filter.
	1-2		Disable the MAX22088 (U2) internal high-pass filter.
J7	Open*	U2	Measure AIO and BIO signals.
	1-2		Short AIO to BIO. NEVER PLACE A SHUNT at J7.
J8	Open	-	Disconnect the transformer from the H+ line.
	1-2*		Connect the transformer to the H+ line.
J9	Open		Disconnect the transformer from the H- line.
	1-2*		Connect the transformer to the H- line.
CIRCUIT 2 (REMOTE/DEVICE CIRCUIT)			
J12	Open	U4	Disable the MAX15462 (U2) DC-DC converter.
	1-2*		Enable the MAX15462 (U2) DC-DC converter.
J11	Open	U3	Disable the MAX22088 (U3) transmitter output.
	1-2*		Enable the MAX22088 (U3) transmitter output.
J13	Open*		Enable the MAX22088 (U3) internal high-pass filter.
	1-2		Disable the MAX22088 (U3) internal high-pass filter.
J14	Open*	U3	Measure AIO and BIO signals.
	1-2		Short AIO to BIO. NEVER PLACE A SHUNT at J14.
DIGITAL ISOLATOR			
J2	Open	U1	Disconnect the MAX12931 (U1) power supply from VCC1 (master circuit).
	1-2*		Connect the MAX12931 (U1) power supply to VCC1 (master circuit).
J3	Open	U1	Disconnect the MAX12931 (U1) power supply from VCC2 (remote/device circuit).
	1-2*		Connect the MAX12931 (U1) power supply to VCC2 (remote/device circuit).
J4	Open	U1	Disable the MAX12931 (U1) ISO_OUT output
	1-2*		Enable the MAX12931 (U1) ISO_OUT output. DOUT2 is connected to ISO_OUT.
J5	Open	U1	Disable the MAX12931 (U1) ISO_IN input.
	1-2*		Enable the MAX12931 (U1) ISO_IN input. ISO_IN is connected to DIN2.

*Default Position.

- 4) Set the first 24V DC power supply to 18V and connect it to the XFMR_IN test point (TP3). Connect the ground terminal to the GND1 test point.
- 5) Set the second 24V DC power supply to 6V and connect it to the VRAW1 test point (TP4). Connect the ground terminal to the GND1 test point.
- 6) Connect the digital multimeter to the VCC1 test point (TP5). Connect the ground terminal to the GND1 test point.
- 7) Turn both DC power supplies on.
- 8) Verify that the digital multimeter reads 5V (typ) on VCC1 (TP4).
- 9) Move the digital multimeter to the VCC2 test point (TP21) and GND2 test point.
- 10) Verify that the VCC2 voltage is 5V (typ).
- 11) Move the digital multimeter to the VOUT2 test point (TP19).
- 12) Verify that the voltage on VOUT2 is 5V (typ).
- 13) Verify that green LEDs DS1 to DS4 are all turned on.
- 14) Connect the oscilloscope probes to the ISO_IN test point (TP1), the H1+ test point (TP16), the H1- test point (TP17), and the DOUT1 test point (TP14).
- 15) Connect the ground terminals for all scope probes to the GND1 test points (TP6–TP10).
- 16) Connect the function generator to the ISO_IN test point (TP1). Connect the ground terminal to the GND1 test point.
- 17) Set the function generator output to a 25kHz 0V–5V square wave with 50% duty cycle.
- 18) Turn on the function generator.
- 19) Verify that all signals are as shown in [Figure 1](#).

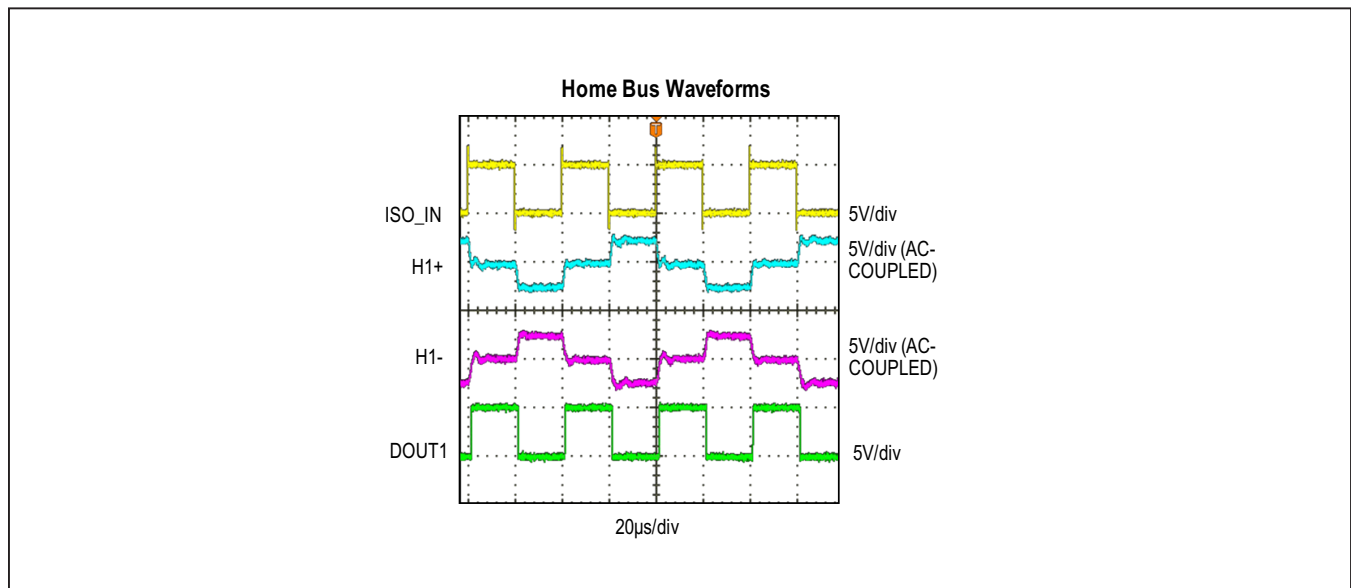


Figure 1. MAX22088 EV Kit Waveforms at 50kbps

Detailed Description of Hardware

The MAX22088 EV kit consists of two MAX22088 circuit configurations for both master and remote/device transceiver evaluation. Connect both circuits together to build a complete Home Bus network.

In the master circuit, the MAX22088 is configured as a Home Bus master. Power is sourced from this circuit to the remote/device circuit when the on-board AC-blocking inductor (T1) is connected to the H+ and H- lines.

In the remote/device circuit, the MAX22088 is configured as a Home Bus remote/device. Power is received from the master circuit through the H+ and H- lines.

The MAX22088 EV kit also includes an on-board 5V step-down DC-DC converter to power external loads up to 200mA(max) on the remote/device side. An on-board digital isolator (MAX12931) is included for easy monitoring and evaluation of digital signals.

Home Bus System

The MAX22088 Home Bus transceiver complies with the Home Bus standard where data and power are passed on a single pair of wires. The MAX22088 EV kit is optimized for 57.6kbps operation. External component modifications are required to operate the EV kit at a lower data rate. Contact Maxim before operating the EV kit at data rates below 20kbps. See [Table 2](#) for recommended values.

Master Circuit

Power is sourced from the master circuit in a Home Bus network. The power for downstream Home Bus devices is supplied to the H+ line through the on-board AC-blocking inductor. Connect an external voltage to the XFMR_IN test point (TP3) to supply power to the Home Bus lines. The MAX22088 EV kit master circuit also requires an external voltage at VRAW. Connect a minimum 5V supply to the VRAW1 test point (TP4). When the MAX22088

is configured as a master transceiver, it receives digital signals from the remote/device circuit through the H+ and H- lines at the J10 terminal block. Monitor the DOUT1 test point (TP14) to verify the received digital signals.

Remote/Device Circuit

The remote/device circuit in a Home Bus application receives power from the H+ and H- lines. On the MAX22088 EV kit, the remote transceiver (U3) is powered from the H+ and H- lines connected to the master circuit. A 5V regulated output is generated at the VCC2 test point (TP21). Signals connected to the digital input (DIN2) are transmitted over the H+ and H- lines to the master circuit when J10 is connected to J15.

On-Board 5V DC-DC Regulator

The MAX22088 EV kit remote/device circuit includes a MAX15462 DC-DC step-down converter to generate a regulated 5V output at VOUT2 (TP19) that can be used to power external loads up to 200mA (max). Place a shunt on J12 to enable the 5V output at VOUT2 (TP19).

RST Input

The MAX22088 uses the RST pin to enable or disable the transmitter and set the initial state of the transmitter output. Set RST high to disable the transmitter on the MAX22088. Set RST low to enable the transmitter. The receiver on the MAX22088 is always enabled.

Leave J1 open to set the MAX22088 in the master circuit (U2) to receive mode only. Place a shunt on J1 to enable the transmitter.

Leave J11 open to set the MAX22088 in the remote/device circuit (U3) to receive mode only. Place a shunt on J11 to enable the transmitter.

When the master and remote/device circuits are connected, set one MAX22088 device to receive mode and enable the transmitter of the other MAX22088.

Table 2. Recommended Component Values for Different Data Rate

COMPONENT	FUNCTION	DATA RATE (kbps)		
		9.6	57.6*	200
C7, C10, C24, C26	AIO, BIO coupling capacitors	22µF	2.2µF	2.2µF
R9	Master-side static termination resistor	Open	1kΩ	1kΩ
R10	Master-Side dynamic termination resistor	82Ω	82Ω	82Ω
R26	Remote-side static termination resistor	240Ω	1kΩ	1kΩ
R28	Remote-side dynamic termination resistor	82Ω	82Ω	82Ω
C15, C18	Capacitor setting the Active Inductor	470nF	100nF	100nF

*Default Data Rate.

High-Pass Filter

The MAX22088 features an integrated high-pass filter to filter out lower frequency voltage fluctuations received on the H+ and H- lines.

Place a shunt on J6 to disable the high-pass filter on the MAX22088 in the master circuit (U2). Leave J6 open to enable the internal filter.

Place a shunt on J13 to disable the high-pass filter on the MAX22088 in the remote/device circuit (U3). Leave J13 open to enable the internal filter.

Transceiver Termination

The MAX22088 EV kit includes an on-board 82Ω dynamic termination resistor between BIO and TERM, and a 1kΩ static termination resistor between AIO and BIO, at both master and remote circuits.

Master and Remote/Device Grounds

In a typical Home Bus application, the remote device ground is isolated from the master ground. Shorting the master and remote device grounds creates a ground loop and can cause signal integrity issues during normal operation.

On the MAX22088 EV kit, ensure that GND1 and GND2 test points are never connected. Do not probe test points on both circuits at the same time to avoid shorting the grounds through the oscilloscope probes. Use the on-board isolation interface to verify signals on both circuits simultaneously, if needed. See the [Isolated Input and Output](#) section for more information.

Isolated Input and Output

The MAX22088 EV kit features an on-board digital isolator, MAX12931, for easy monitoring and evaluation of digital signals. The MAX12931 (U1) ensures the master ground (GND1) and remote/device ground (GND2) are not inadvertently connected during evaluation.

Place shunts on the J2–J5 jumpers to enable the on-board digital isolator.

Connect the digital input signal to the ISO_IN test point (TP1). This signal is passed through the MAX12931 to the DIN input (DIN2) of the remote/device MAX22088 (U3). The signal at the ISO_OUT test point (TP2) is the digital output (DOOUT2) of the MAX22088 (U3) in remote/device circuit. When the master and remote/device circuits are connected, monitor the digital output (DOOUT1) of the master MAX22088 (U1) to verify that the output signal of the Home Bus system is the same as the digital input signals (ISO_IN).

Ensure that all scope grounds are connected to GND1 during operation.

IEC 61000-4-4 Surge Immunity Compliance

The MAX22088 EV kit is designed and tested to withstand ±1kV surge transients, both line-to-ground and line-to-line, in compliance with IEC standard 61000-4-4. The MAX22088 Home Bus pins HP, HN, AIO, BIO, and TERM are protected from surge transients with external components. TVS diodes D3 and D8 protect HP and HN pins from surge transients between H+ and H- lines. TVS diodes D4 and D5 provide protection from surge transients between H+/H- lines and ground. TVS diodes D1, D2, D6, and D7, and current-limiting resistors R14, R15, R32, and R33 further protect AIO, BIO, and TERM pins. See the [MAX22088 EV Kit Schematics](#) and *Surge Protection* section in *Application Information* in the MAX22088 data sheet for more information.

Ordering Information

PART	TYPE
MAX22088EVKIT#	EV KIT

#Denotes RoHS compliant.

MAX22088 EV Kit Bill of Materials

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	C1, C2	—	2	C0402C104J4RAC; GCM155R71C104JA55	KEMET; MURATA	0.1UF	CAP; SMT (0402); 0.1UF; 5%; 16V; X7R; CERAMIC
2	C3, C13, C16, C19	—	4	CC0805JKX7R9BB105	YAGEO	1UF	CAP; SMT (0805); 1UF; 5%; 50V; X7R; CERAMIC
3	C4, C22	—	2	C0603C105K4RAC; C1608X7R1C105K080AC; EMK107B7105KA; CGA3E1X7R1C105K080AC; 0603YC105KAT2A	KEMET; MURATA; TDK; TAIYO YUDEN; TDK;AVX	1UF	CAP; SMT (0603); 1UF; 10%; 16V; X7R; CERAMIC
4	C5, C23	—	2	C1608X5R1A106K080AC	TDK	10UF	CAP; SMT (0603); 10UF; 10%; 10V; X5R; CERAMIC
5	C6	—	1	TAP106K050SCS	AVX	10UF	CAP; THROUGH HOLE-RADIAL LEAD; 10UF; 10%; 50V; TANTALUM
6	C7, C10, C24, C26	—	4	C2012X7R1H225K125AC	TDK	2.2UF	CAP; SMT (0805); 2.2UF; 10%; 50V; X7R; CERAMIC
7	C8, C12	—	2	EEE-1EA101XP	PANASONIC	100UF	CAP; SMT (CASE_D8); 100UF; 20%; 25V; ALUMINUM-ELECTROLYTIC
8	C15, C18	—	2	GCJ188R71H104KA12; GCM188R71H104K; CGA3E2X7R1H104K080AA; CGA3E2X7R1H104K080AD; CL10B104KB8WPN	MURATA; MURATA; TDK;TDK; SAMSUNG	0.1UF	CAP; SMT (0603); 0.1UF; 10%; 50V; X7R; CERAMIC
9	C20	—	1	UMK107BJ105KA; C1608X5R1H105K080AB; CL10A105KB8NNN; GRM188R61H105KAAL	TAIYO YUDEN; TDK; SAMSUNG; MURATA	1UF	CAP; SMT (0603); 1UF; 10%; 50V; X5R; CERAMIC
10	C21	—	1	GRM21BR61A106KE19; ECJ-2FB1A106; CL21A106KPLQNC; GRM219R61A106KE44	MURATA; PANASONIC; SAMSUNG ELECTRONICS; MURATA	10UF	CAP; SMT (0805); 10UF; 10%; 10V; X5R; CERAMIC
11	D1, D2, D6, D7	—	4	P6SMB6.8A	LITTELFUSE	5.8V	DIODE; TVS; SMB (DO-214AA); VRM=5.8V; IPP=58.1A
12	D3-D5	—	3	SMAJ28CA	BOURNS	28V	DIODE; TVS; SMA (DO-214AC); VRM=28V; IPP=8.8A
13	D8	—	1	SMBJ24A	LITTELFUSE	24V	DIODE; TVS; SMB (DO-214AA); PIV=24V; IPP=15.5A
14	DS1-DS4	—	4	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
15	J1-J9, J11-J14	—	13	TSW-102-23-G-S	SAMTEC	TSW-102-23-G-S	CONNECTOR; THROUGH HOLE; SINGLE ROW; STRAIGHT; 2PINS; -55 DEGC TO +125 DEGC

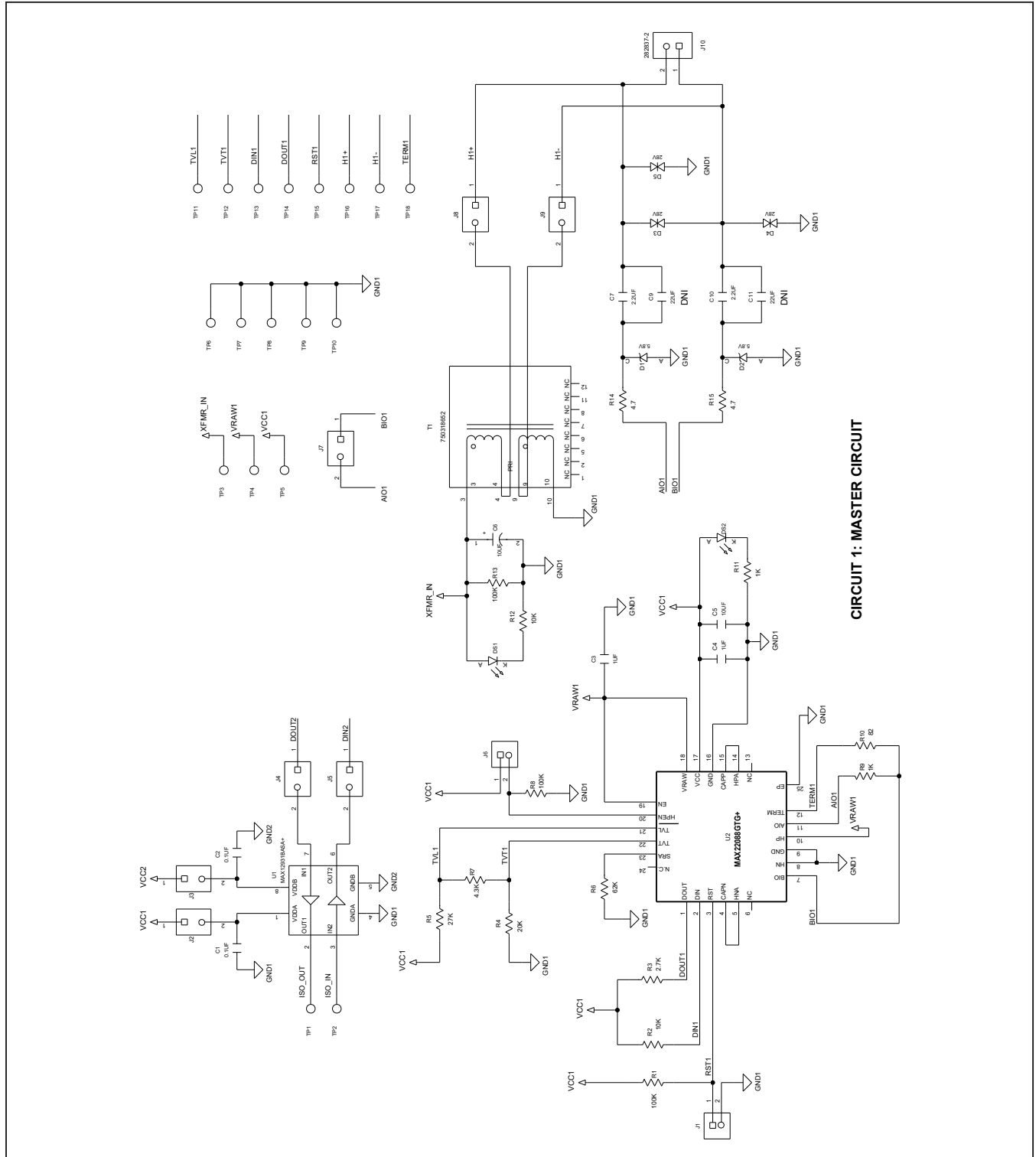
MAX22088 EV Kit Bill of Materials (continued)

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
16	J10, J15	—	2	282837-2	TE CONNECTIVITY	282837-2	CONNECTOR; FEMALE; THROUGH HOLE; PC TERMINAL BLOCK; RIGHT ANGLE; 2PINS;
17	L1	—	1	LPS4018-473MLB	COILCRAFT	47UH	INDUCTOR; MAGNETICALLY SHIELDED FERRITE BOBBIN CORE; SMT; 47UH; TOL=+/-20%; 0.68A; -40 DEGC TO +85 DEGC
18	MH1-MH4	—	4	9032	KEYSTONE	9032	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON
19	R1, R8, R16, R22, R27	—	5	CRCW0603100KFK; RC0603FR-07100KL; RC0603FR-13100KL; ERJ-3EKF1003; AC0603FR-07100KL	VISHAY DALE; YAGEO; YAGEO; PANASONIC	100K	RES; SMT (0603); 100K; 1%; +/-100PPM/DEGC; 0.1000W
20	R2, R12, R17	—	3	CRCW060310K0FK; ERJ-3EKF1002; AC0603FR-0710KL; RMCF0603FT10K0	VISHAY DALE; PANASONIC; YAGEO	10K	RES; SMT (0603); 10K; 1%; +/-100PPM/DEGC; 0.1000W
21	R3, R18	—	2	CRCW06032K70FK; ERJ-3EKF2701	VISHAY DALE; PANASONIC	2.7K	RES; SMT (0603); 2.7K; 1%; +/-100PPM/DEGC; 0.1000W
22	R4, R20	—	2	MCR03EZPF2002; ERJ-3EKF2002; CR0603-FX-2002ELF; CRCW060320K0FK	ROHM; PANASONIC; BOURNS; VISHAY DALE	20K	RES; SMT (0603); 20K; 1%; +/-100PPM/DEGC; 0.1000W
23	R5, R19	—	2	CRCW060327K0FK	VISHAY DALE	27K	RES; SMT (0603); 27K; 1%; +/-100PPM/DEGC; 0.1000W
24	R6, R24	—	2	CRCW060362K0FK	VISHAY DALE	62K	RES; SMT (0603); 62K; 1%; +/-100PPM/DEGC; 0.1000W
25	R7, R23	—	2	CRCW06034K30FK	VISHAY DALE	4.3K	RES; SMT (0603); 4.3K; 1%; +/-100PPM/DEGC; 0.1000W
26	R9, R26	—	2	CRCW08051K00FK; ERJ-6ENF1001; MCR10EZHF1001; RC0805FR-071KL	VISHAY DALE; PANASONIC; ROHM;YAGEO	1K	RES; SMT (0805); 1K; 1%; +/-100PPM/DEGC; 0.1250W
27	R10, R28	—	2	RL1220S-820-F	SUSUMU CO LTD.	82	RES; SMT (0805); 82; 1%; +/-200PPM/DEGC; 0.3300W
28	R11, R30, R31	—	3	CRCW06031K00FK; ERJ-3EKF1001; CR0603AFX-1001ELF	VISHAY; PANASONIC; BOURNS	1K	RES; SMT (0603); 1K; 1%; +/-100PPM/DEGC; 0.1000W
29	R13	—	1	TNPW0805100KBE; ERA-6YEB104V	VISHAY DALE; PANASONIC	100K	RES; SMT (0805); 100K; 0.10%; +/-25PPM/DEGC; 0.1250W
30	R14, R15, R32, R33	—	4	ERJ-3RQF4R7	PANASONIC	4.7	RES; SMT (0603); 4.7; 1%; +/-100PPM/DEGC; 0.1000W
31	R21	—	1	RCW06033K30FK; RC0603FR-073K3L; RK73H1J3301F	VISHAY; YAGEO; VISHAY	3.3K	RES; SMT (0603); 3.3K; 1%; +/-100PPM/DEGC; 0.1000W
32	R25	—	1	RC0402JR-070RL; CR0402-16W-000RJT	YAGEO PHYCOMP; VENKEL LTD.	0	RES; SMT (0402); 0; 5%; JUMPER; 0.0630W
33	R29	—	1	CRCW0603180KFK	VISHAY DALE	180K	RES; SMT (0603); 180K; 1%; +/-100PPM/DEGC; 0.1000W

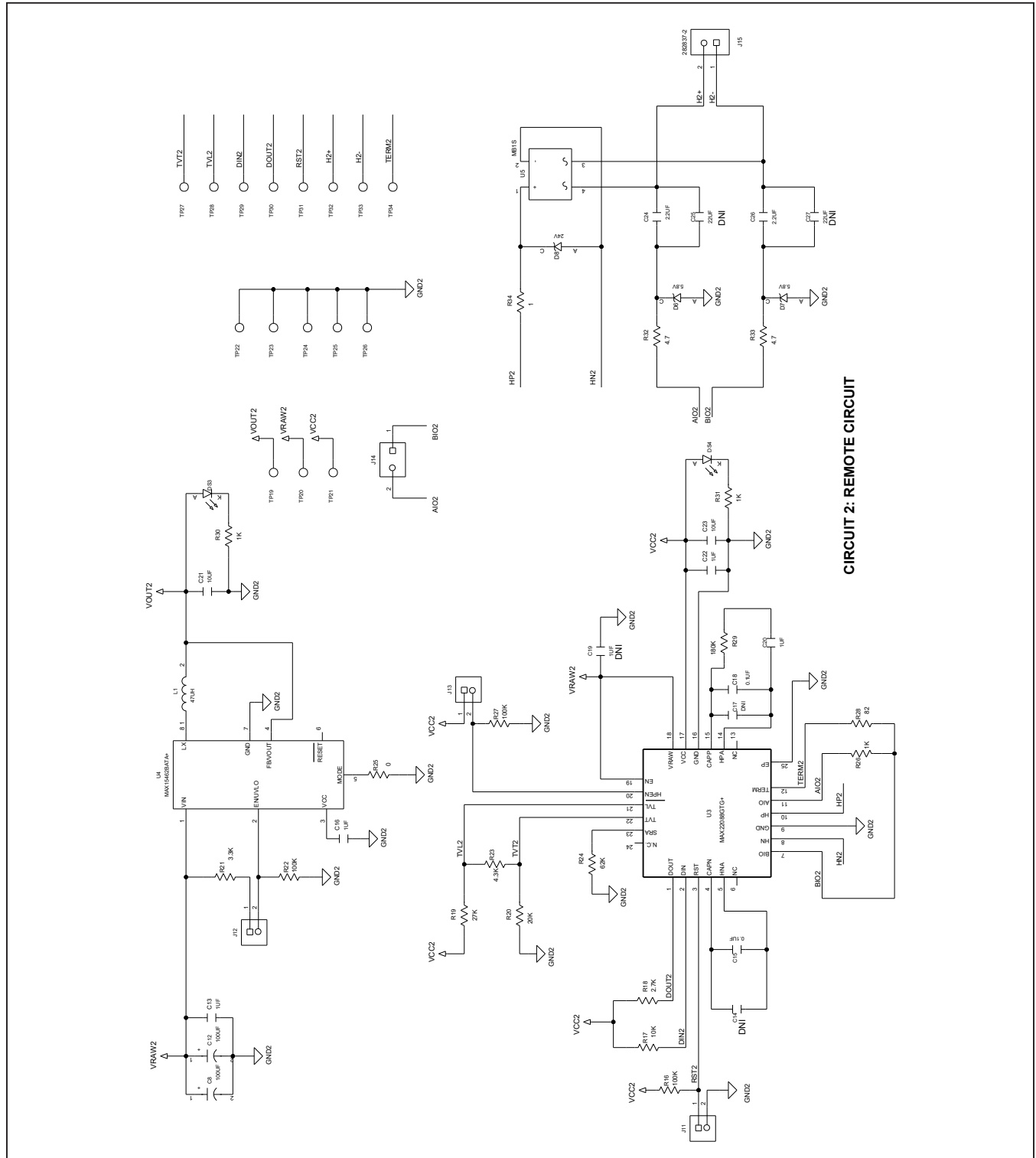
MAX22088 EV Kit Bill of Materials (continued)

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
34	R34	—	1	ERJ-3RQF1R0; CRCW06031R00FK	PANASONIC;VISHAY	1	RES; SMT (0603); 1; 1%; +/-100PPM/DEGC; 0.1000W
35	T1	—	1	750318652	WURTH ELECTRONICS INC	750318652	EVKIT PART - TRANSFORMER; 750318652; TURN RATIO=1:1; 12 PINS; TH
36	TP1, TP2, TP11-TP18, TP27-TP34	—	18	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;
37	TP3-TP5, TP19-TP21	—	6	5010	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; RED; PHOSPHOR BRONZE WIRE SIL;
38	TP6-TP10, TP22-TP26	—	10	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;
39	U1	—	1	MAX12931BASA+	MAXIM	MAX12931BASA+	IC; DISO; TWO-CHANNEL; LOW-POWER; 3KVRMS AND 5KVRMS DIGITAL ISOLATORS; NSOIC8
40	U2, U3	—	2	MAX22088GTG+	MAXIM	MAX22088GTG+	EVKIT PART - IC; MAX22088GTG+; HOMEBUS TRANSCEIVER; PACKAGE CODE: T2444+4C; PACKAGE OUTLINE NUMBER: 21-0139; LAND PATTERN NUMBER: 90-0022
41	U4	—	1	MAX15462BATA+	MAXIM	MAX15462BATA+	IC; VCON; 42V; 300MILLIAMPERE; ULTRA-SMALL; HIGH EFFICIENCY; SYNCHRONOUS STEP-DOWN DC-DC CONVERTER; TDFN8-EP
42	U5	—	1	MB1S	ON SEMICONDUCTOR	MB1S	DIODE; RECT; SMT (SOIC-4); PIV=100V; IF=0.5A
43	PCB	—	1	MAX22088	MAXIM	PCB	PCB:MAX22088
44	C9, C11, C25, C27	DNP	0	ECE-A1HN220U	PANASONIC	22UF	CAP; THROUGH HOLE-RADIAL LEAD; 22UF; 20%; 50V; ALUMINUM-ELECTROLYTIC
45	C14, C17	DNP	0	GCM188R71H104KA12; GCM188R71H104K; CGA3E2X7R1H104K080AA; CGA3E2X7R1H104K080AD; CL10B104KB8WPN	MURATA;MURATA; TDK;TDK;SAMSUNG	0.1UF	CAP; SMT (0603); 0.1UF; 10%; 50V; X7R; CERAMIC
TOTAL			128				

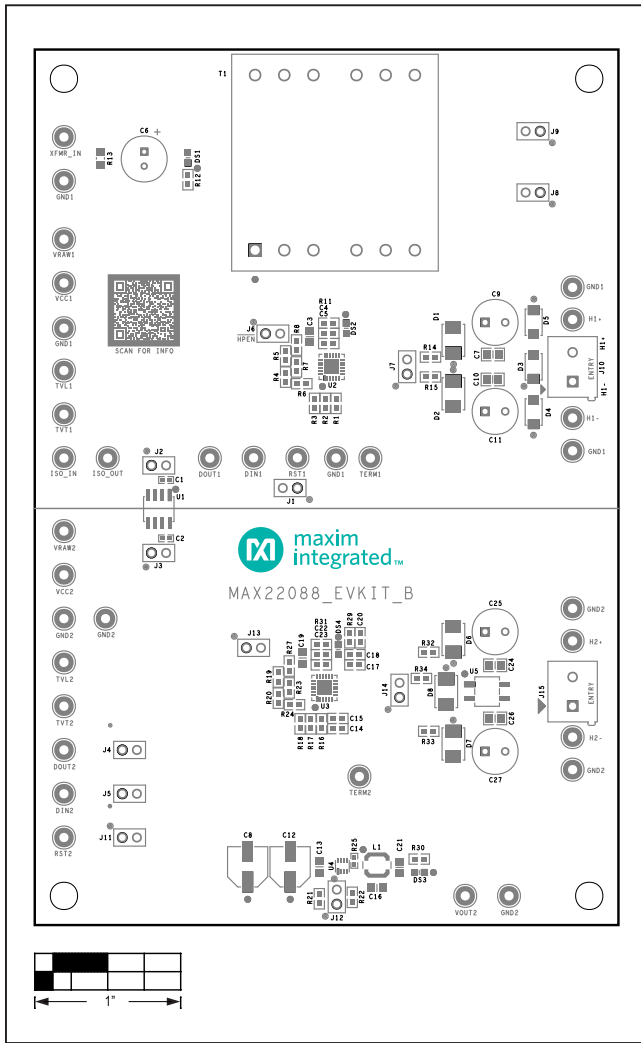
MAX22088 EV Kit Schematics



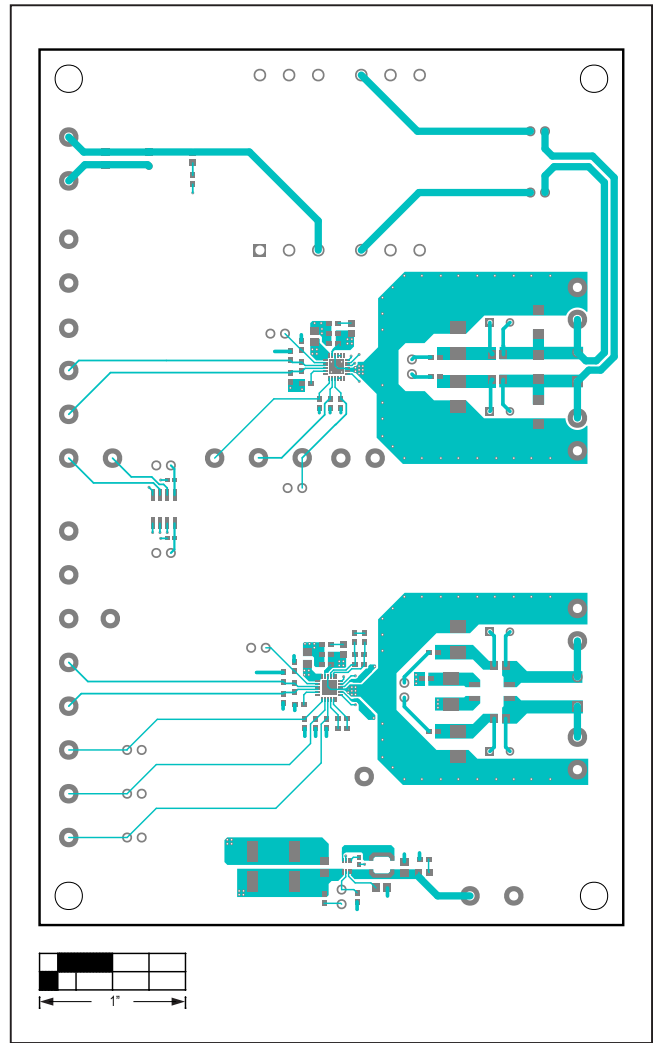
MAX22088 EV Kit Schematics (continued)



MAX22088 EV Kit PCB Layout

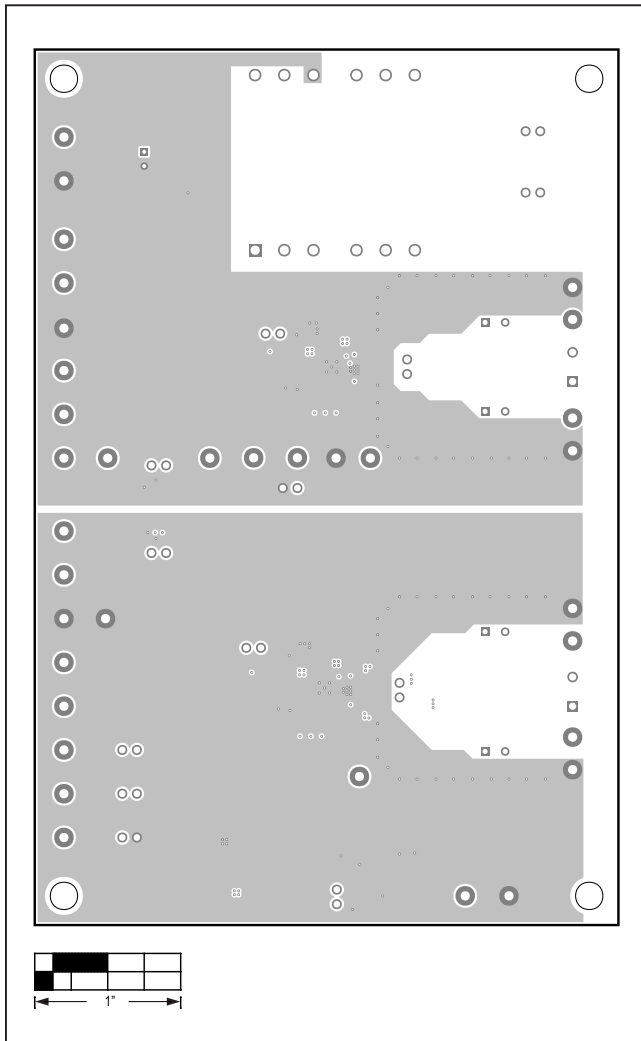


MAX22088 EV Kit—Top Silkscreen

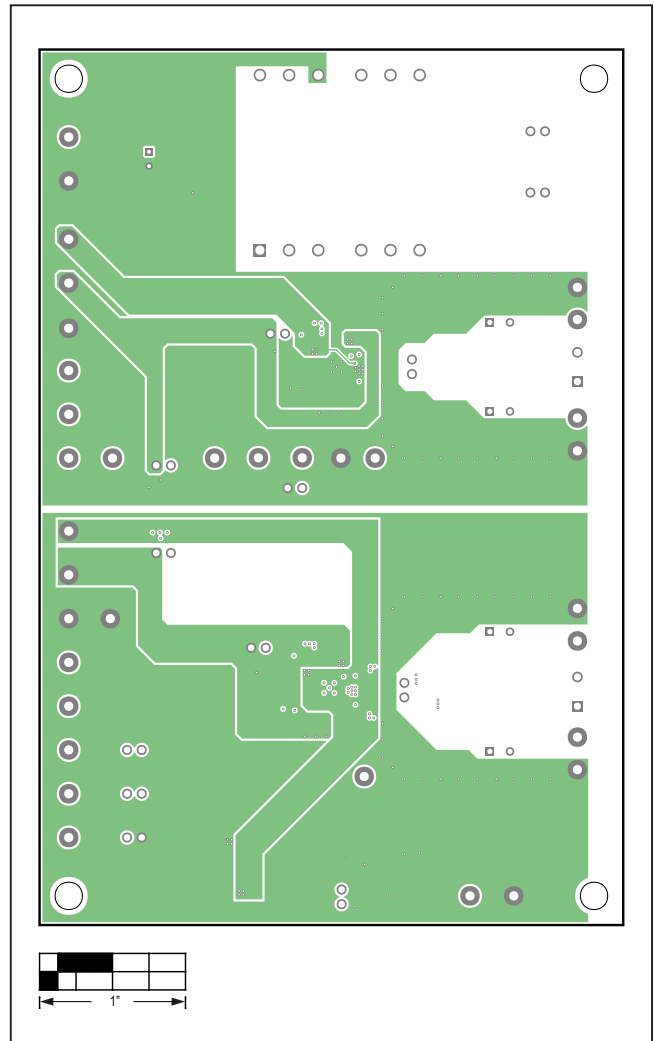


MAX22088 EV Kit—Top Layer

MAX22088 EV Kit PCB Layout (continued)

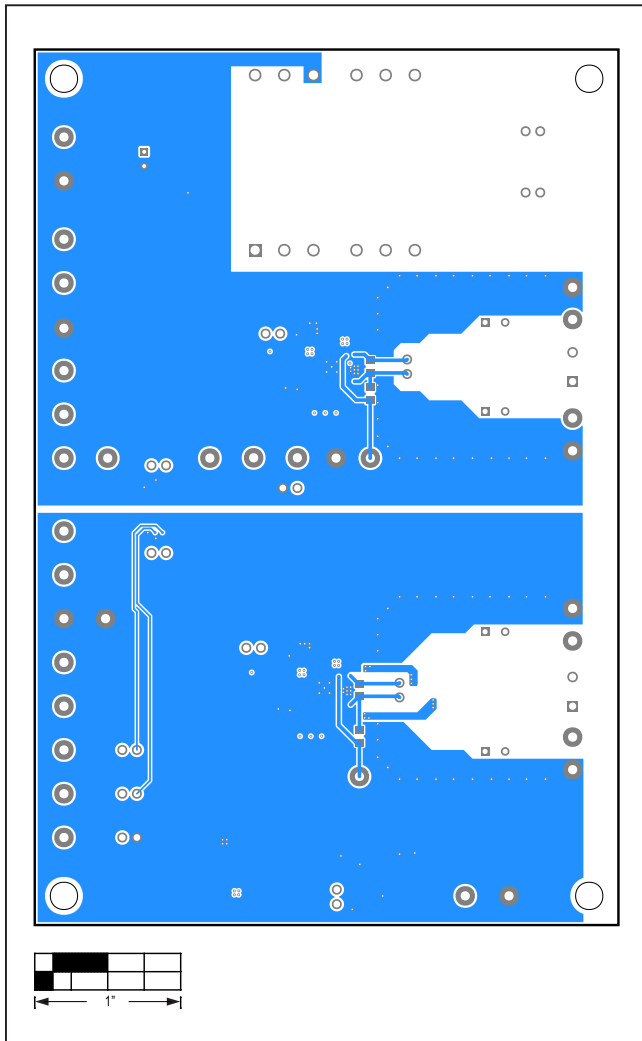


MAX22088 EV Kit—Internal Layer 2

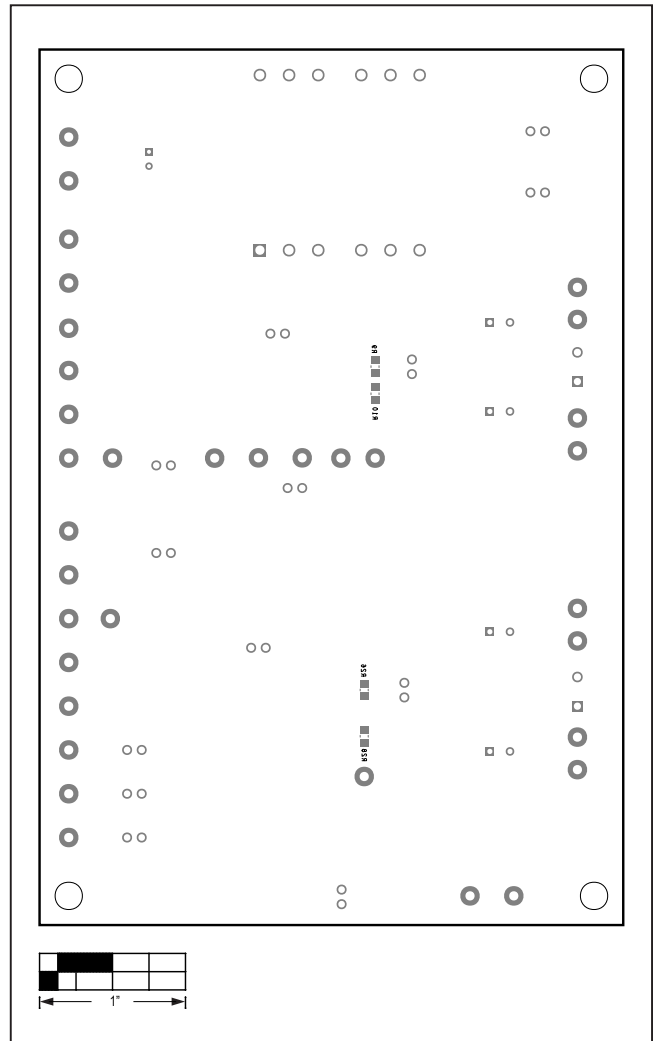


MAX22088 EV Kit—Internal Layer 3

MAX22088 EV Kit PCB Layout (continued)



MAX22088 EV Kit—Bottom Layer



MAX22088 EV Kit—Bottom Silkscreen