MAX20828T Evaluation Kit

Evaluates: MAX20828T

General Description

The MAX20828T evaluation kit (EV kit) is a reference platform designed for the evaluation of the MAX20828T, a dual-output, compact, low-cost, fully integrated, highly efficient, step-down DC-DC switching regulator IC. The IC is in a 21-pin, 3.5mm x 4.6mm, 0.5mm pitch, FC2QFN package. This EV kit can deliver up to 8A load per output. The two outputs can be connected as a single-output, dual-phase regulator that supports up to 16A load current. For more information, refer to the MAX20828T IC data sheet.

The EV kit comprises a fully assembled and tested PCB implementation of the MAX20828T. The jumper pins, test points, and the input/output connectors are included to provide a flexible and convenient use in a wide range of applications.

Benefits and Features

- 2.7V to 16V Input Voltage Range
- 0.5V to 5.8V Output Voltage Range
- High Efficiency and Power Density
- Low Component Count
- Dual-Output or Single-Output Dual-Phase Operation
- Optimized Performance
- Proven PCB Layout
- Fully Assembled and Tested

Quick Start

Required Equipment

- MAX20828T EV kit
- 2.7V to 16V power supply with optional 3.3V external power supply
- 0 to 16A load
- Digital voltmeters
- Oscilloscope and probes

Procedure

The EV kit is fully assembled and tested. The EV kit is preset with the MAX20828T dual-output operation with 1V on rail 1 and 1.8V on rail 2. Follow the steps below to verify board operation.

For dual-output operation:

1. Connect a powered-off 2.7V to 16V input supply to J5 (positive terminal) and J8 (negative terminal). Optionally, connect supply sense leads to TP5 (positive sense) and TP6 (negative sense) for best accuracy. If external bias is preferred, connect a powered-off 3.3V power supply to J32 (positive terminal) and J33 (negative terminal) with jumper J34 installed.
2. Connect the load to the edge connector J12 for rail 1 or J13 for rail 2 (positive on top and negative on bottom).
3. Connect the V_{OUT} scope probe/voltmeter to J2 for rail 1 or J3 for rail 2.
4. Turn on the power supply.
5. Position the SW1 or SW2 toggle switch to enable the IC.
6. Observe that V_{OUT1} = 1V and V_{OUT2} = 1.8V.
7. For efficiency measurements, TP5 and TP6 are used to measure V_{IN}; J2 and J3 are used to measure V_{OUT1} and V_{OUT2}.

For dual-phase operation:

1. When configured to dual-phase operation, only the control loop for rail 1 works and the control loop for rail 2 is bypassed. The EN1 and PGOOD1 are used in dual-phase operation mode to enable the device and indicate the power good status. The EN2 and PGOOD2 can be disconnected.
2. Install a zero-ohm resistor for R2, R44, R45, and R48 to short two rail outputs.
3. Remove R13 for rail 2 to disconnect the sense line and install a zero-ohm resistor in R34 to pull SNSP2 to AVDD.
4. Use the same inductors for L1 and L2.
5. Connect a powered-off 2.7V to 16V input supply to J5 (positive terminal) and J8 (negative terminal). Optionally, connect supply sense leads to TP5 (positive sense) and TP6 (negative sense) for best accuracy. If external bias is preferred, connect a powered-off 3.3V power supply to J32 (positive terminal) and J33 (negative terminal) with jumper J34 installed.
6. Connect the load to the edge connector J12 (positive on top and negative on bottom).
7. Connect the V_{OUT} scope probe/voltmeter to J2 or J3.
8. Turn on the power supply.
9. Position the SW1 toggle switch to enable the IC.
10. Observe that V_{OUT} = 1V.

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11. For efficiency measurements, TP5 and TP6 are used to measure V_{IN}; J2 or J3 is used to measure V_{OUT}.

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

EV Kit Photo

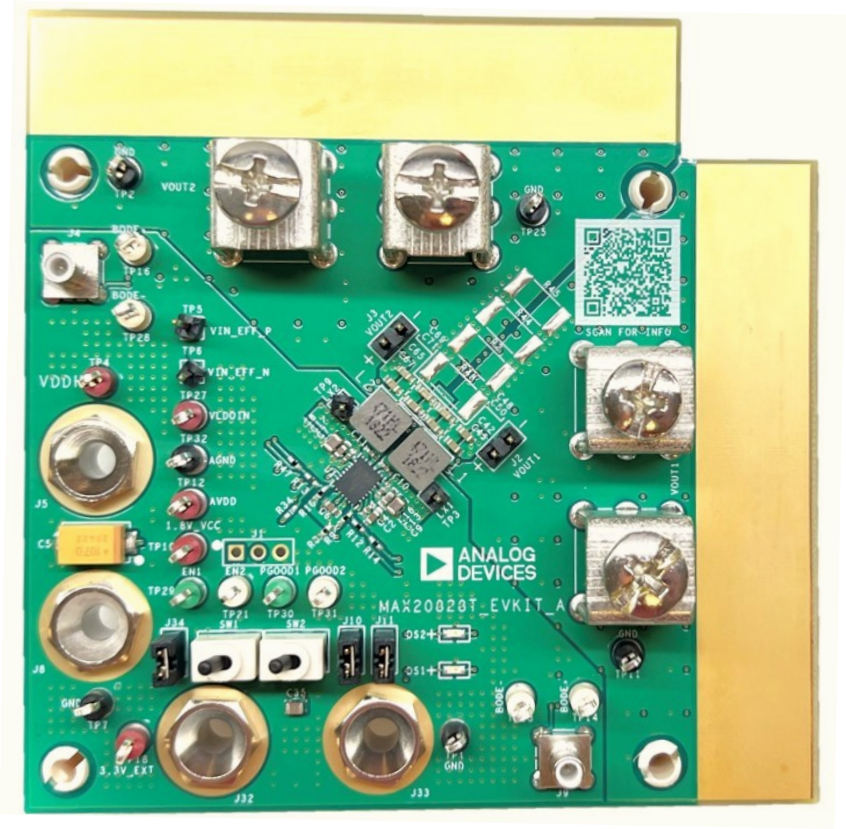


Table 1. Jumper Connection Guide

JUMPER	DEFAULT CONNECTION	FEATURE
J10	INSTALLED	Installed for EN2.
J11	INSTALLED	Installed for PGOOD2.
J34	INSTALLED	Installed for external 3.3V input.

Default options are bold.

Operation

The MAX20828T IC is a monolithic, dual-output high-frequency step-down switching regulator optimized for applications that require a small size and high efficiency. For detailed product and application information, refer to the MAX20828T IC data sheet.

Output Enable (OE)

The OE is used to enable/disable the output voltage. For dual-output operation, rail 1 output voltage is enabled/disabled by SW1, and rail 2 output voltage is enabled/disabled by SW2. For single-output dual-phase operation, EN1 is used and EN2 can be disconnected.

Output-Voltage Selection

The MAX20828T EV kit is set up to initially boot up to an output voltage of 1V of rail 1 and 1.8V of rail 2. The device has a fixed 0.5V reference voltage, and the output voltage is accomplished by placing a voltage divider in the feedback path.

$$V_{OUT} = V_{REF} \times (1 + R_{FB1}/R_{FB2})$$

where:

V_{OUT} = Output voltage

V_{REF} = 0.5V fixed reference voltage

R_{FB1} = Top divider resistor

R_{FB2} = Bottom divider resistor

Soft-Start

When VDDH and EN are above their rising thresholds, the soft-start begins, and switching is enabled. The soft-start ramp time is 3ms. The device supports smooth startup with output pre-biased.

Switching Frequency

The switching frequency is programmable parameters and PGM0 is used to select the switching frequency. For the EV kit, the switching frequency is set to 1000kHz for rail 1 and 2000kHz for rail 2. For more information, refer to *Table 1. PGM0 Switching Frequency, AMS, and DCM Selections* in the MAX20828T IC data sheet.

Pin-Strap Programmability

The EV kit provides an option to configure the part for the desired application using PGMx resistor values. For more information, refer to *Table 1. PGM0 Switching Frequency, AMS, and DCM Selections, Table 2. PGM1 Configurations for OUTPUT1 or Dual-Phase Operation, and Table 3. PGM2 Configurations for OUTPUT2* in the MAX20828T IC data sheet. The appropriate values of the resistors R11, R21, and R35 can be used for the desired application.

Status Monitoring

Whenever the part is actively regulating, and the output voltage is within the power-good window, the PGOOD pin is high. In all other conditions, including enabled but in a fault state, the PGOOD pin is pulled low. For more information, refer to the MAX20828T IC data sheet.

Input-Voltage Monitoring

The input supply can be monitored on TP4 for VDDH and TP7 for GND.

Switching-Voltage Monitoring

The switching waveform can be monitored on TP3 for LX1 and TP9 for LX2.

Output-Voltage Monitoring

The jumpers J2 and J3 monitor the output voltage of rail 1 and rail 2, respectively.

Note: These test points should not be used for loading.

Efficiency Testing

The TP5 (V_{IN}_EFF_P) and TP6 (V_{IN}_EFF_N) test points are provided to measure V_{IN} during efficiency measurement. Additionally, J2 and J3 are provided to measure V_{OUT1} and V_{OUT2} during efficiency measurement.

Bode Plot

A 10Ω resistor is installed between the V_{OUTx} sense point and SNSPx pin to measure the bode plot. The TP13 and TP14 test points are provided on the board on either side of the 10Ω resistor for small signal injection and ability to measure bode plot for V_{OUT1}. The TP28 and TP16 test points are provided on the board on either side of the 10Ω resistor for small signal injection and ability to measure bode plot for V_{OUT2}.

Ordering Information

PART	TYPE
MAX20828TEVKIT#	EV Kit

#Denotes RoHS compliant.

MAX20828T EV Kit Bill of Materials

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	C2	-	1	C1608X5R1E475K080AC; GRM188R61E475KE11	TDK; MURATA	4.7UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 4.7UF; 25V; TOL=10%; TG=-55 DEGC TO +85 DEGC; TC=X5R
2	C3, C5, C34	-	3	TPSD107K020R0085	AVX	100UF	CAPACITOR; SMT; 7343; TANTALUM; 100uF; 20V; 10%; TPS; -55degC to +125degC
3	C4, C7, C16, C31	-	4	GRM155R71E104ME14	MURATA	0.1UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.1UF; 25V; TOL=20%; TG=-55 DEGC TO +125 DEGC; TC=X7R
4	C6, C12, C13	-	3	GRM188R71E105KA12; CGA3E1X7R1E105K; TMK107B7105KA; 06033C105KAT2A; GCM188R71E105KA64; C1608X7R1E105K080AE; CGA3E1X7R1E105K080AC	MURATA;TDK; TAIYO YUDEN;AVX; MURATA;TAIYO YUDEN;TDK	1UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 1UF; 25V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
5	C8, C9	-	2	GRM21BC71E106KE11	MURATA	10UF	CAPACITOR; SMT (0805); CERAMIC CHIP; 10UF; 25V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7S
6	C10, C11	-	2	CL05B224KP5NNN	SAMSUNG ELECTRONICS	0.22UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.22UF; 10V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
7	C26, C30	-	2	C0402C102K5GAC	KEMET	1000PF	CAPACITOR; SMT (0402); CERAMIC CHIP; 1000PF; 50V; TOL=10%; MODEL=; TG=-55 DEGC TO +125 DEGC; TC=C0G
8	C27	-	1	GRM188Z71C225KE43	MURATA	2.2UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 2.2UF; 16V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
9	C29, C45	-	2	C0402C101J5GAC; NMC0402NPO101J; CC0402JRNPO9BN101; GRM1555C1H101JA01; C1005C0G1H101J050BA;	KEMET; NIC COMPONENTS CORP.; YAGEO PHICOMP; MURATA;TDK;TDK	100PF	CAPACITOR; SMT (0402); CERAMIC CHIP; 100PF; 50V; TOL=5%; TG=-55 DEGC TO +125 DEGC; TC=C0G

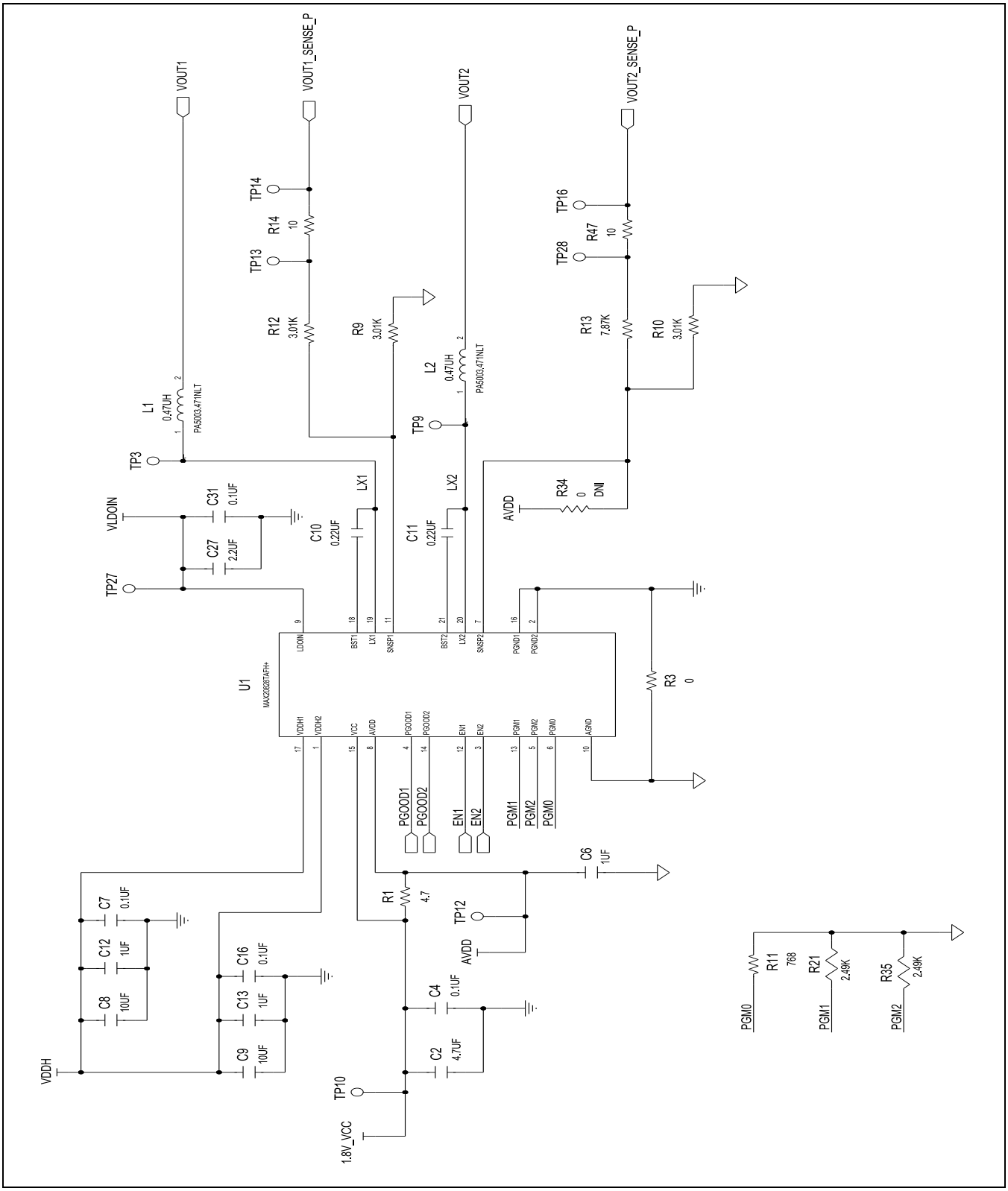
ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
				CGA2B2C0G1H101J050BA			
10	C35	-	1	GRM21BZ70J226ME44	MURATA	22UF	CAP;SMT (0805);22UF;20%;6.3V;X7R;CERAMIC CHIP; NOTE: PURCHASE DIRECT FROM THE MANUFACTURER
11	C32, C36, C37, C39, C42, C46, C48, C50, C60, C63, C65, C67, C69, C71	-	14	GRM188C80J226ME15	MURATA	22UF	CAP; SMT (0603); 22UF; 20%; 6.3V; X6S; CERAMIC CHIP
12	C41, C43 C59, C62	-	4	C0805C476M9PAC; GRM21BR60J476ME15	KEMET;MURATA	47UF	CAPACITOR; SMT (0805); CERAMIC CHIP; ; 6.3V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
13	C47, C61	-	2	GRM155R71E104KE14; C1005X7R1E104K050BB; TMK105B7104KVH; CGJ2B3X7R1E104K050BB	MURATA;TDK;TAIYO YUDEN;TDK	0.1UF	MURATA;TDK;TAIYO YUDEN;TDK
14	D1, D3, D4	-	3	MBRS540T3G	ON SEMICONDUCTOR	MBRS540T3	DIODE; SCH; SURFACE MOUNT SCHOTTKY POWER RECTIFIER; SMC; PIV=40V; IF=5A
15	DS1, DS2	-	2	LGL29K-G2J1-24-Z	OSRAM	LGL29K-G2J1-24-Z	DIODE; LED; SMARTLED; GREEN; SMT; PIV=1.7V; IF=0.02A
16	J2, J3, J10, J11, J34	-	5	TSW-101-22-L-D	SAMTEC	TSW-101-22-L-D	CONNECTOR; MALE; THROUGH HOLE; .025IN SQ POST HEADER; STRAIGHT; 2PINS
17	J4, J9	-	2	131-3701-266	JOHNSON COMPONENTS	131-3701-266	CONNECTOR; MALE; THROUGH HOLE; SMB JACK VERTICAL PCB MOUNT; STRAIGHT; 5PINS
18	J5, J8, J32, J33	-	4	6095	KEYSTONE	6095	CONNECTOR; FEMALE; PANELMOUNT; NON-INSULATED RECESSED HEAD BANANA JACK; STRAIGHT THROUGH; 1PIN
19	L1, L2	-	2	PA5003.471NLT	PULSE	0.47UH	INDUCTOR; SMT; COMPOSITE; 0.47UH; 20%; 18.4A
20	MH1-MH4	-	4	9032	KEYSTONE	9032	MACHINE FABRICATED; ROUND-THRU HOLE

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
							SPACER; NO THREAD; M3.5; 5/8IN; NYLON
21	Q1, Q2	-	2	BSS138	ON SEMICONDUCTOR	BSS138	TRAN; LOGIC LEVEL ENHANCEMENT MODE FIELD EFFECT TRANSISTOR; NCH; SOT-23; PD-(0.36W); I-(0.22A); V-(50V); -55 DEGC TO +150 DEGC
22	R1	-	1	CRCW04024R70FK	VISHAY DALE	4.7	RESISTOR, 0402, 4.7 OHM, 1%, 100PPM, 0.0625W, THICK FILM
23	R3	-	1	RC0402JR-070RL; CR0402-16W-000RJT	YAGEO PHYCOMP; VENKEL LTD	0	RESISTOR; 0402; 0 OHM; 5%; JUMPER; 0.063W; THICK FILM
24	R9, R10, R12	-	3	CRCW04023K01FK	VISHAY DALE	3.01K	RESISTOR; 0402; 3.01 K OHM; 1%; 100PPM; 0.063W; THICK FILM
25	R11	-	1	ERJ-2RKF7680	PANASONIC	768	RES; SMT (0402); 768; 1%; +/-100PPM/DEGC; 0.1W
26	R13	-	1	ERJ-2RKF7871	PANASONIC	7.87K	RES;SMT (0402);7.87K;1%;+/-100PPM/DEGK;0.1W
27	R14, R47	-	2	CRCW040210R0FK; 9C04021A10R0FL	VISHAY DALE;YAGEO	10	RESISTOR; 0402; 10 OHM; 1%; 100PPM; 0.0625W; THICK FILM
28	R25, R26	-	2	CRCW040249R9FKEDHP	VISHAY DRALORIC	49.9	RESISTOR; 0402; 49.9 OHM; 1%; 100PPM; 0.2W; THICK FILM
29	R21, R35	-	2	ERJ-2RKF2491	PANASONIC	2.49K	RESISTOR; 0402; 2.49K OHM; 1%; 100PPM; 0.10W; THICK FILM
30	R39, R40	-	2	ERJ-2RKF1002	PANASONIC	10K	RESISTOR; 0402; 10K OHM; 1%; 100PPM; 0.10W; THICK FILM
31	R41, R52	-	2	CRCW040220K0FK	VISHAY DALE	20K	RESISTOR; 0402; 20K OHM; 1%; 100PPM; 0.063W; THICK FILM
32	R42, R53	-	2	CRCW0603100RFK; ERJ-3EKF1000; RC0603FR-07100RL	VISHAY DALE; PANASONIC	100	RESISTOR; 0603; 100 OHM; 1%; 100PPM; 0.10W; THICK FILM
33	R51, R54	-	2	ERJ-3EKF2100	PANASONIC	210	RESISTOR; 0603; 210 OHM; 1%; 100PPM; 0.10W; THICK FILM
34	ST1-ST4	-	4	7808	KEYSTONE	7808	TERMINAL; BODY LENGTH=0.67IN; BODY WIDTH=0.47IN; HEIGHT=0.45IN; SCRW; BRASS
35	SU1-SU3	-	3	S1100-B; SX1100-B; STC02SYAN	KYCON; KYCON;	SX1100-B	TEST POINT; JUMPER; STR; TOTAL LENGTH=0.24IN; BLACK;

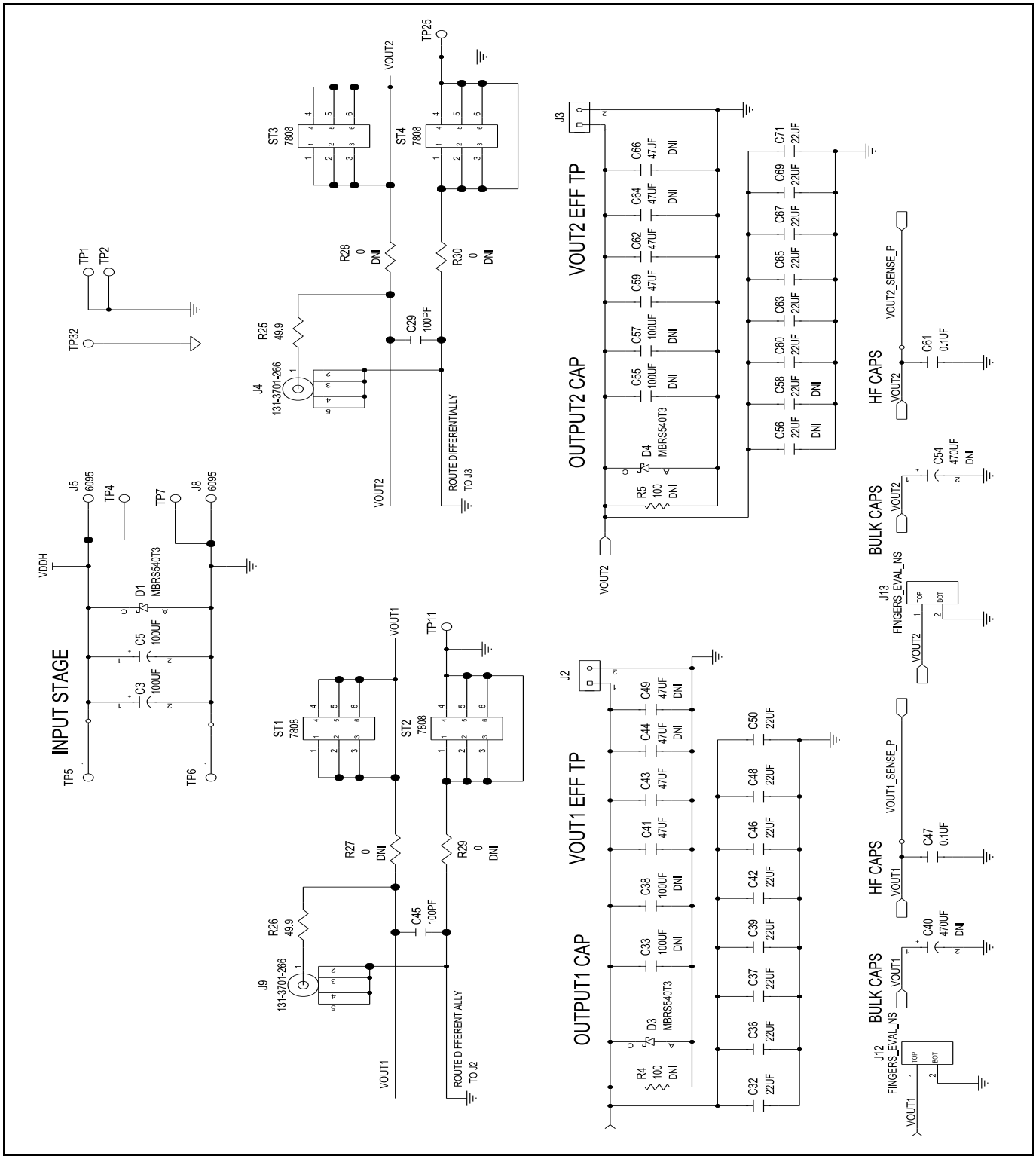
ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
					SULLINS ELECTRONICS CORP		INSULATION=PBT;PHOSPHOR BRONZE CONTACT=GOLD PLATED
36	SW1, SW2	-	2	GT21MCBE	C&K COMPONENTS	GT21MCBE	SWITCH; DPDT; THROUGH HOLE; 20V; 0.4VA; GT SERIES; SEALED ULTRAMINIATURE TOGGLE SWITCH; RCOIL= 0.05 OHM; RINSULATION=10G OHM; C&K COMPONENTS
37	TP1, TP2, TP7, TP11, TP25, TP32	-	6	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; RECOMMENDED FOR BOARD THICKNESS=0.062IN; NOT FOR COLD TEST
38	TP3, TP5, TP6, TP9	-	4	PBC01SAAN	SULLINS ELECTRONICS CORP	PBC01SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 1PIN
39	TP4, TP10, TP12, TP18, TP27	-	5	5010	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; RED; PHOSPHOR BRONZE WIRE SIL; NOT FOR COLD TEST
40	TP13, TP14, TP16, TP21, TP28, TP31	-	6	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; RECOMMENDED FOR BOARD THICKNESS=0.062IN; NOT FOR COLD TEST
41	TP29, TP30	-	2	5126	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; GREEN; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH; RECOMMENDED FOR

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
							BOARD THICKNESS=0.062IN; NOT FOR COLD TEST
42	U1	-	1	MAX20828TAFH+	MAXIM	MAX20828T	EVKIT PART - IC; MAX20828TAFH+; DUAL-OUTPUT 8A; 3MHZ; 2.7V - 16V STEP-DOWN SWITCHING REGULATOR; PACKAGE OUTLINE DRAWING NUMBER: 21-100513; LAND PATTERN: 90-100184; PACKAGE CODE: F213A4F+2; FC2QFN21
43	PCB	-	1	MAX20828T	MAXIM	PCB	PCB:MAX20828T
44	C56, C58	DNP	2	GRM188C80J226ME15	MURATA	22UF	CAP; SMT (0603); 22UF; 20%; 6.3V; X6S; CERAMIC CHIP
45	C33, C38, C55, C57	DNP	4	GRM31CD80J107ME39	MURATA	100UF	CAP; SMT (1206); 100UF; 20%; 6.3V; X6T; CERAMIC CHIP
46	C40, C54	DNP	2	T491X477K010AT	KEMET	470UF	CAPACITOR; SMT (7343); TANTALUM CHIP; 470UF; 10V; TOL=10%; MODEL=T491 SERIES
47	C44, C49, C64, C66	DNP	4	C0805C476M9PAC; GRM21BR60J476ME15	KEMET;MURATA	47UF	CAPACITOR; SMT (0805); CERAMIC CHIP; ; 6.3V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
48	R27-R30	DNP	4	CRCW04020000Z0EDHP; RCS04020000Z0	VISHAY DRALORIC; VISHAY DALE	0	RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.2W; THICK FILM
49	R4, R5	DNP	2	ERJ-P08J101	PANASONIC	100	RESISTOR; 1206; 100 OHM; 5%; 200PPM; 0.66W; THICK FILM
50	R34	DNP	1	RC0402JR-070RL; CR0402-16W-000RJT	YAGEO PHYCOMP; VENKEL LTD	0	RESISTOR; 0402; 0 OHM; 5%; JUMPER; 0.063W; THICK FILM
51	R2, R44, R45, R48	DNP	4	CRCW25120000ZS	VISHAY DALE	0	RESISTOR; 2512; 0 OHM; 1%; JUMPER; 1.0W; METAL FILM
52	J1	DNP	1	PEC03SAAN	SULLINS	PEC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 3PINS

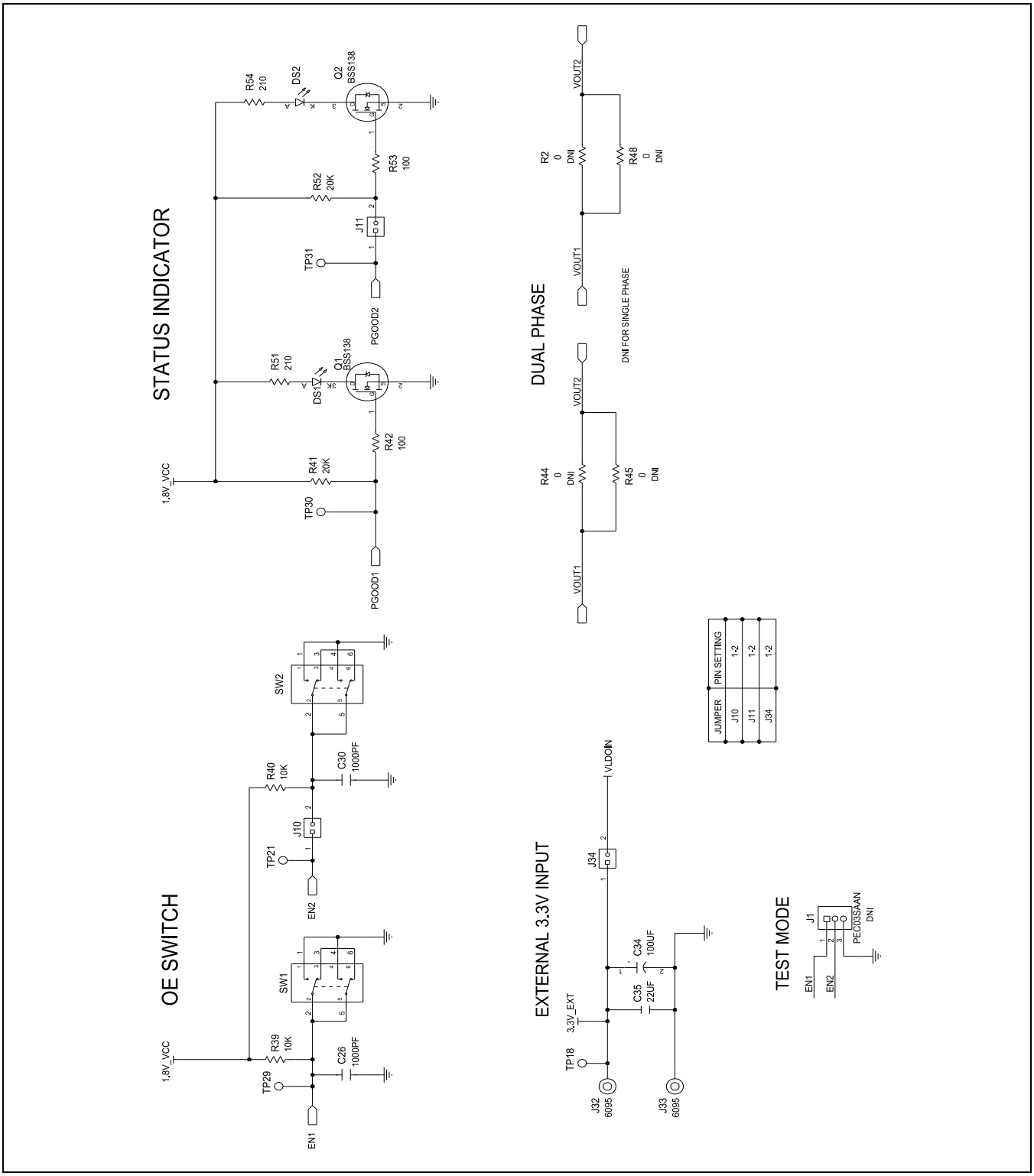
MAX20828T EV Kit Schematic



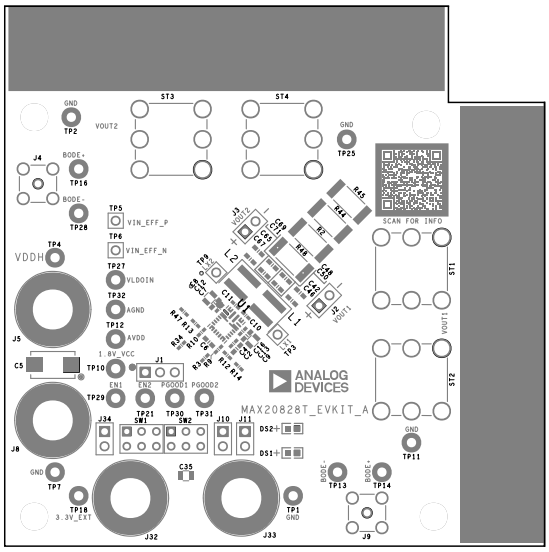
MAX20828T EV Kit Schematic (continued)



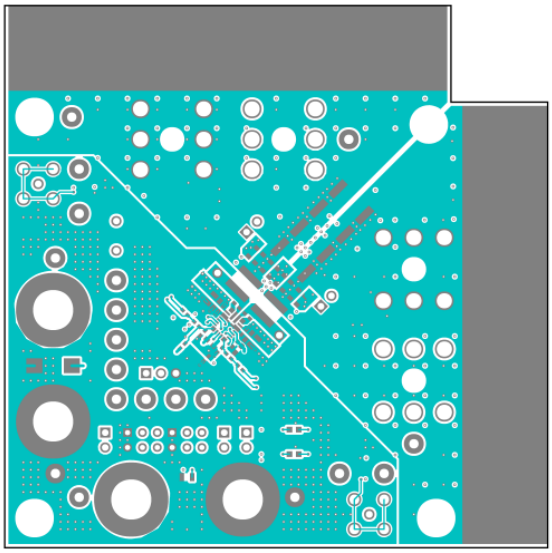
MAX20828T EV Kit Schematic (continued)



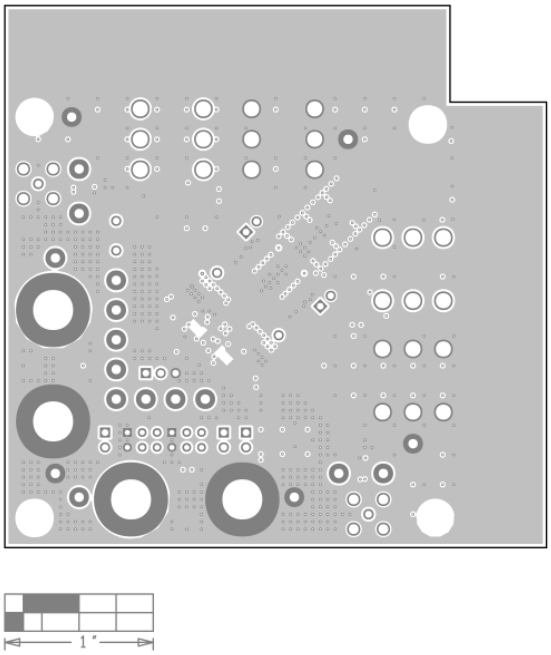
MAX20828T EV Kit PCB Layout



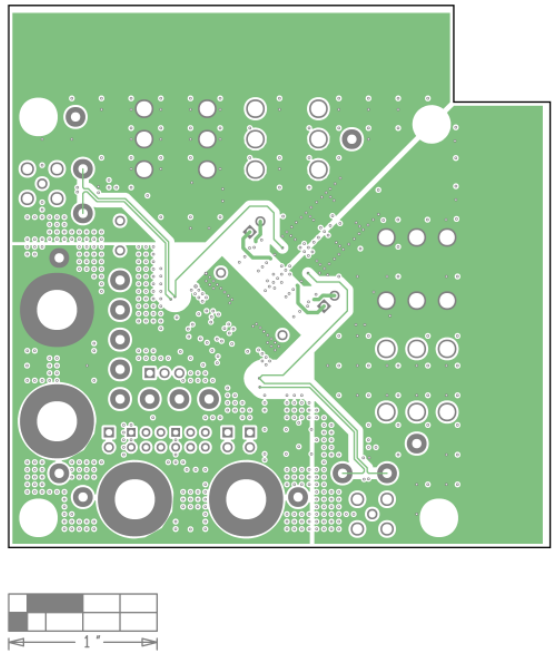
MAX20828T EV Kit Component Placement Guide—Top Silkscreen



MAX20828T EV Kit PCB Layout—Top

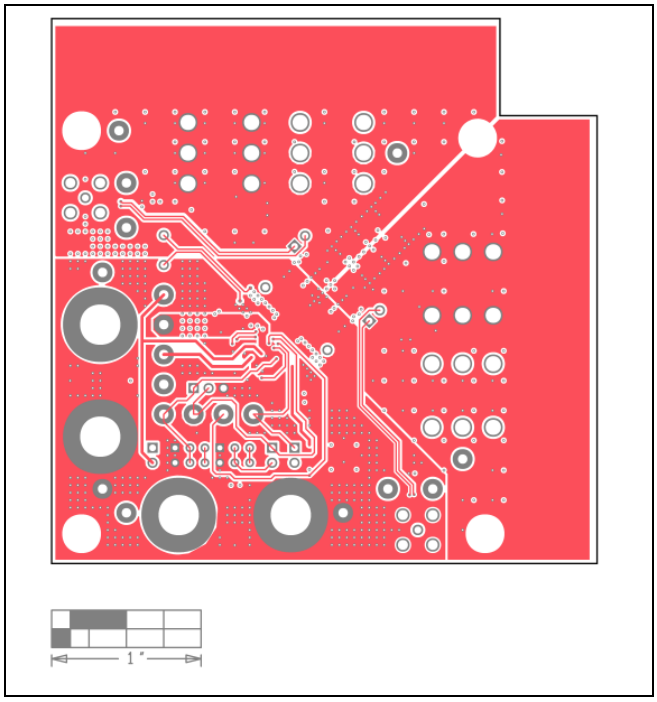


MAX20828T EV Kit PCB Layout—Layer 2

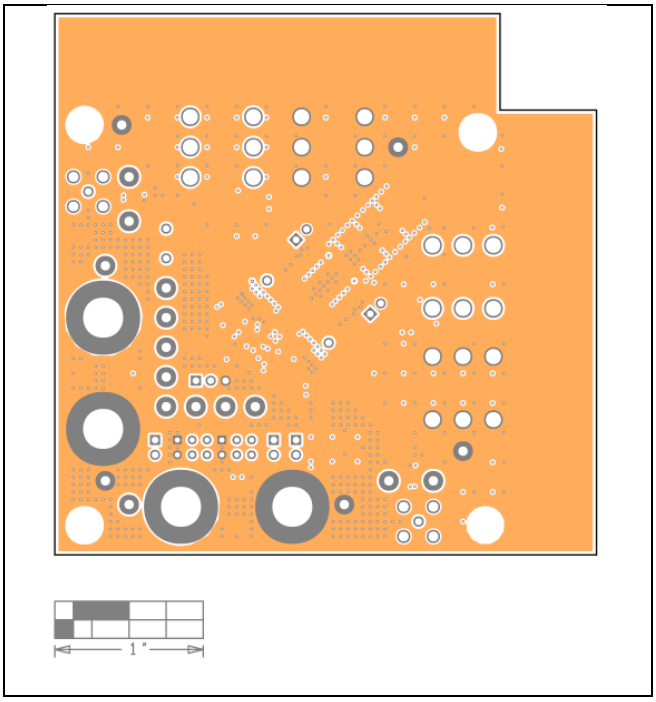


MAX20828T EV Kit PCB Layout—Layer 3

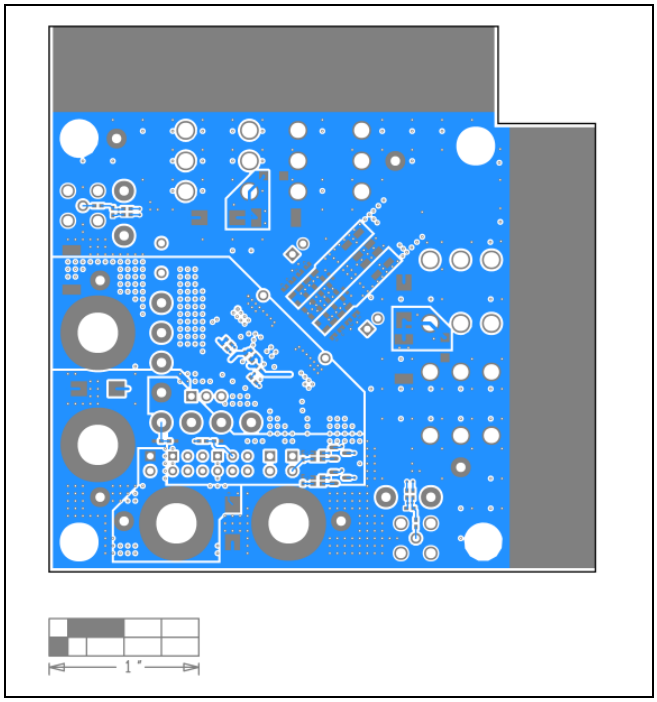
MAX20828T EV Kit PCB Layout (continued)



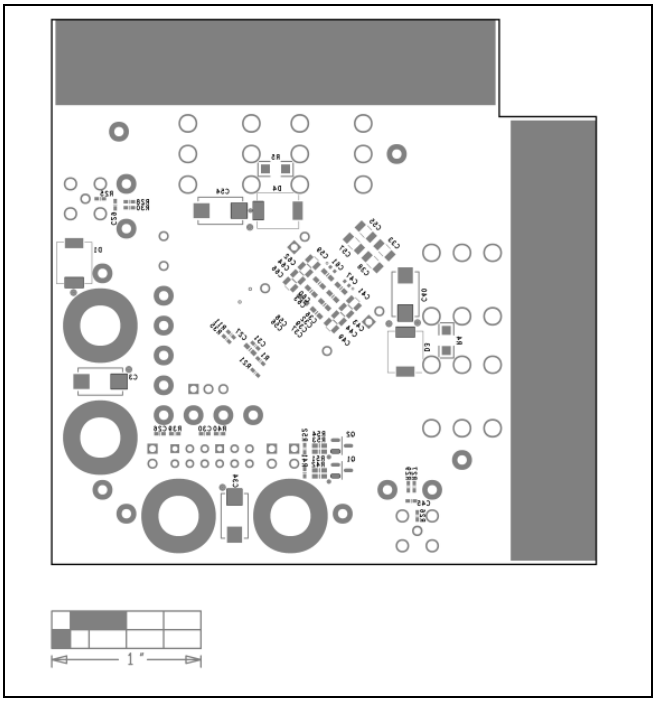
MAX20828T EV Kit PCB Layout—Layer 4



MAX20828T EV Kit PCB Layout—Layer 5



MAX20828T EV Kit PCB Layout—Bottom



MAX20828T EV Kit Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	07/22	Initial release	—