Evaluation Board User Guide

MAX20815EVKIT#

Evaluates: MAX20815

General Description

The MAX20815 evaluation kit (EV kit) is a reference design platform designed for evaluation of the MAX20815, a single-output, fully integrated, highly efficient, step-down DC-DC switching regulator with PMBus™ interface. The MAX20815 has an internal 1.8V LDO output to power the gate drives (V_{CC}) and internal circuitry (AVDD). The device also has an optional LDO input pin (LDOIN), allowing connection from a 2.5V to 5.5V bias input supply for optimized efficiency. The EV kit is capable to deliver up to 15A to the load. The EV kit package is a fully assembled and tested multilayer PCB implementation of high efficiency and high-power density.

The selection of key converter configuration parameters, acting on two external resistors, allows design flexibility to match several application scenario requirements.

Refer to the MAX20815 IC data sheet for detailed information regarding the description, features, benefits, and parameters.

Features and Benefits

- Wide 2.7V to 16V Input Voltage Range
- 0.4V to 5.8V Output Voltage Range
- Selectable: Switching Frequency, OCP Threshold, DEM Feature, DCM Mode, Voltage Loop Gain, and PMBus Address
- High Efficiency and Power Density
- Low Component Count
- Proven PCB Layout
- Fully Assembled and Tested for Basic Functionality

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

PMBus is a trademark of SMIF, Inc.

Quick Start

Required Equipment

- MAX20815 EV Kit
- MAX20815 EV Kit Data Sheet (This Document)
- 2.7V to 16V Power Supply with Optional 3.3V External Power Supply
- 0 to 15A Load
- Digital Multimeters
- Oscilloscope and Probes
- Windows PC with a Spare USB Port
- MAXPOWERTOOL002 USB-to-SMBus Interface (Order Separately)
- Maxim Digital PowerTool GUI Software

Procedure

The EV kit is fully assembled and tested. Follow the steps to install the EV kit software, make the required hardware connections, and start operation of the kit.

Note: Do not supply V_{IN} (VDDH) until the board has been correctly configured with input and output cables connected. Follow the steps to verify basic board operations and to run the EV kit.

1. Visit the Analog Devices website to download and install the latest version of the *Digital PowerTool Software*.
2. Connect the USB cable from the PC to the MAXPOWERTOOL002 interface adapter.
3. Connect the adapter ribbon cable to the matching header J1 on the EV kit, ensuring that J1-Pin1 is adjacent to the red wire on the ribbon cable.
4. Connect a powered-off 2.7V to 16V input supply to J5 (positive terminal) and J8 (negative terminal). Optionally, connect the supply sense leads to TP4 (positive sense) and TP7 (negative sense) for best accuracy. If external bias is preferred, connect a powered-off 3.3V power supply to TP3 (positive terminal) and TP6 (negative terminal).
5. Connect the electronic load to the outputs at screw terminals ST1 and ST2, being careful to observe the VOUT and GND polarity indicated by the silkscreen labels.
6. Verify that the position of each jumper on the board is correct according to the configuration that needs to be tested (see *Table 1* for the jumpers).

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7. Connect the V_{OUT} scope probe/multimeter to TP8 (positive) and TP11 (negative).
8. Turn on the power supply.
9. Start the GUI software. The **Dashboard** window should appear as shown in *Figure 1*.
10. Enable the IC by positioning the SW1 toggle switch or by setting the OPERATION and ON_OFF_CONFIG commands in the PowerTool GUI.
11. Enable the electronic load, if applicable.
12. Observe that V_{OUT} = 1V.
13. For efficiency measurement, J4 is used to measure V_{IN}, and J6 is used to measure V_{OUT}.

    Note: VLDOIN on the PCB is the same as AUX3P3_EXT on the schematic; VIN on the PCB is the same as VDDH on the schematic; VCC on the PCB is the same as 1.8V_VCC on the schematic.

MAX20815 EV Kit Photo

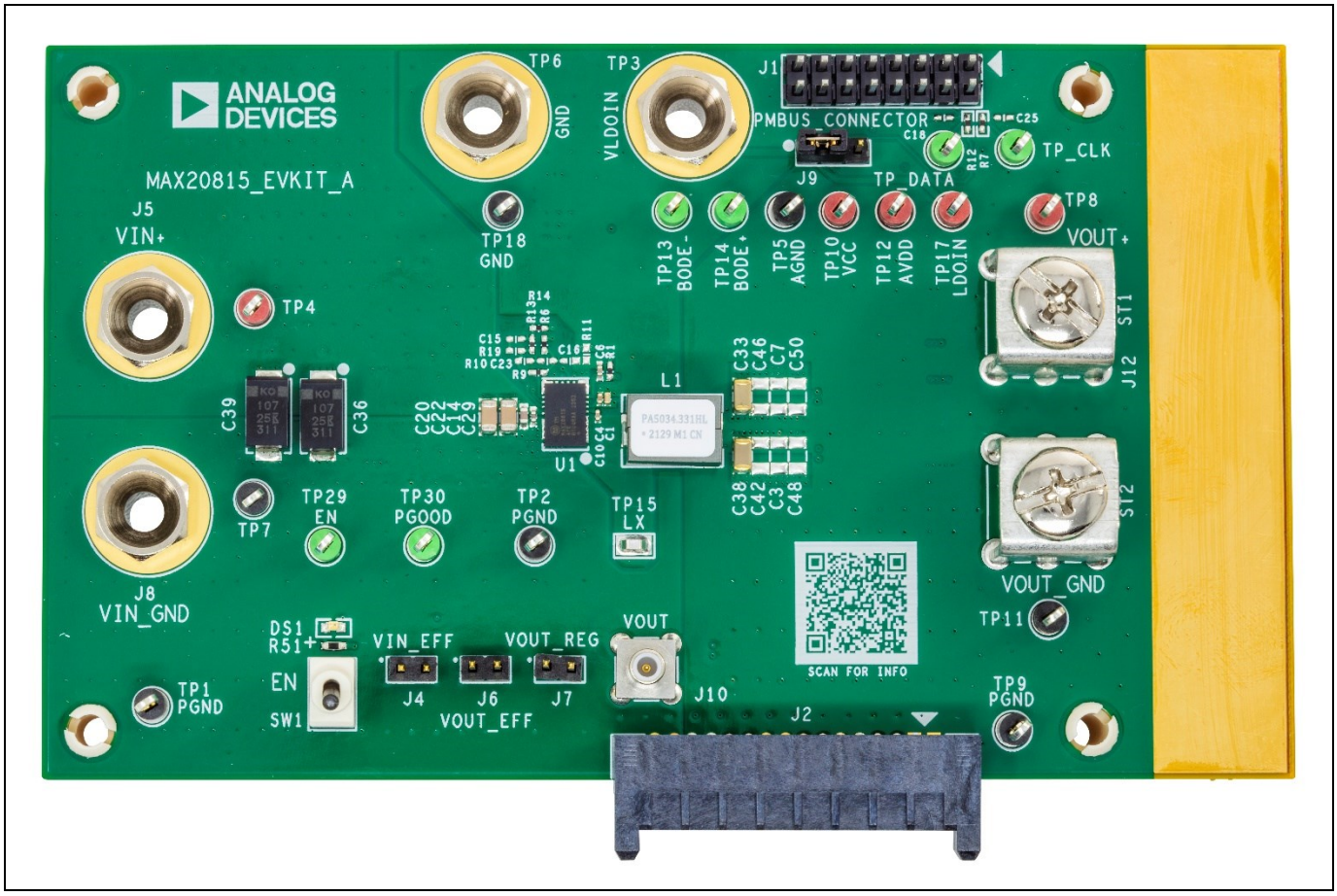


Table 1. Jumper Connection Guide

JUMPER	DEFAULT CONNECTION	FEATURE
J9	SHORT 2-3	Use internal 1.8V V_{CC} for PMBus communication
J4	OPEN	V_{IN} efficiency sensor point
J6	OPEN	V_{OUT} efficiency sensor point
J7	OPEN	V_{OUT} regulation test point

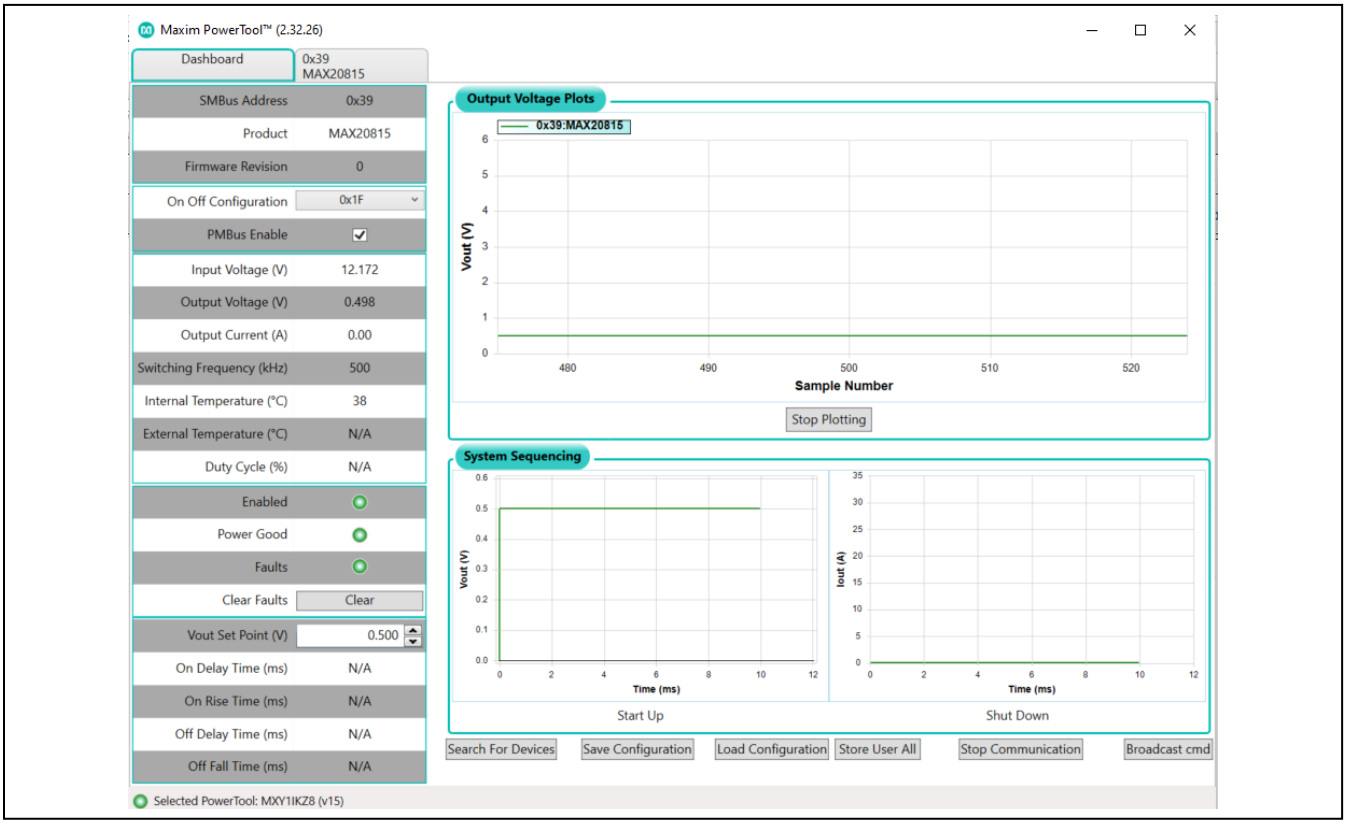


Figure 1. Maxim PowerTool GUI Software Dashboard Window

Detailed Description of Software

The PowerTool software presents system-level information on the **Dashboard** tab. This view collects basic information for all Analog Devices PMBus devices found on the bus. This tab configures sequencing and output voltage levels, and presents an overview of the system status. Clicking the **Stop Communication** button stops all PMBus transactions from the PowerTool GUI. To force detection of all active devices on the bus, click the **Search for Devices** button.

For detailed information on a particular device, click on the sub-tab for that device's peripheral address. This opens a view with a set of further sub-tabs specific to that device as shown in *Figure 2*. The sub-tabs available vary depending on the GUI version and the connected device's capability, but typically include **Configuration**, **Monitor**, **Faults Set**, and **PMBus Command**.

The **Configure** tab presents the most commonly used PMBus command data in human-readable form. The device status is updated by continuous polling of these commands. Configuration settings for an individual device can be saved to or restored from an external file. PMBus command settings can be saved to or restored from the device's internal nonvolatile memory as well.

The **Monitor** tab shows continuously updated telemetry data from the device. Rolling plots of output voltage, input voltage, output current, and temperature data are shown, including indication of fault limits relative to the operating point.

The **Faults Set** tab allows the user to configure and monitor the status of most protection and warning functions. The fault levels and fault response commands are configured from this tab. The full contents of the STATUS_ register commands are available by clicking the **View Fault/Warning bit by bit** button. Fault and warning flags are cleared by clicking the **Clear Fault/Warning** button, which sends the CLEAR_FAULTS PMBus command to the device.

The **PMBus Command** tab shows all supported PMBus commands in a series of sub-tabs, allowing detailed configuration and analysis of the command values. The user can view the command values in hexadecimal or decimal format by checking or clearing the **Force Hex** checkbox. The **Use PEC** checkbox enables or disables Packet Error Checking for all GUI communications. Note that the command data is continuously updated by polling; typing a new value into the text boxes causes the new value to be sent to the device.

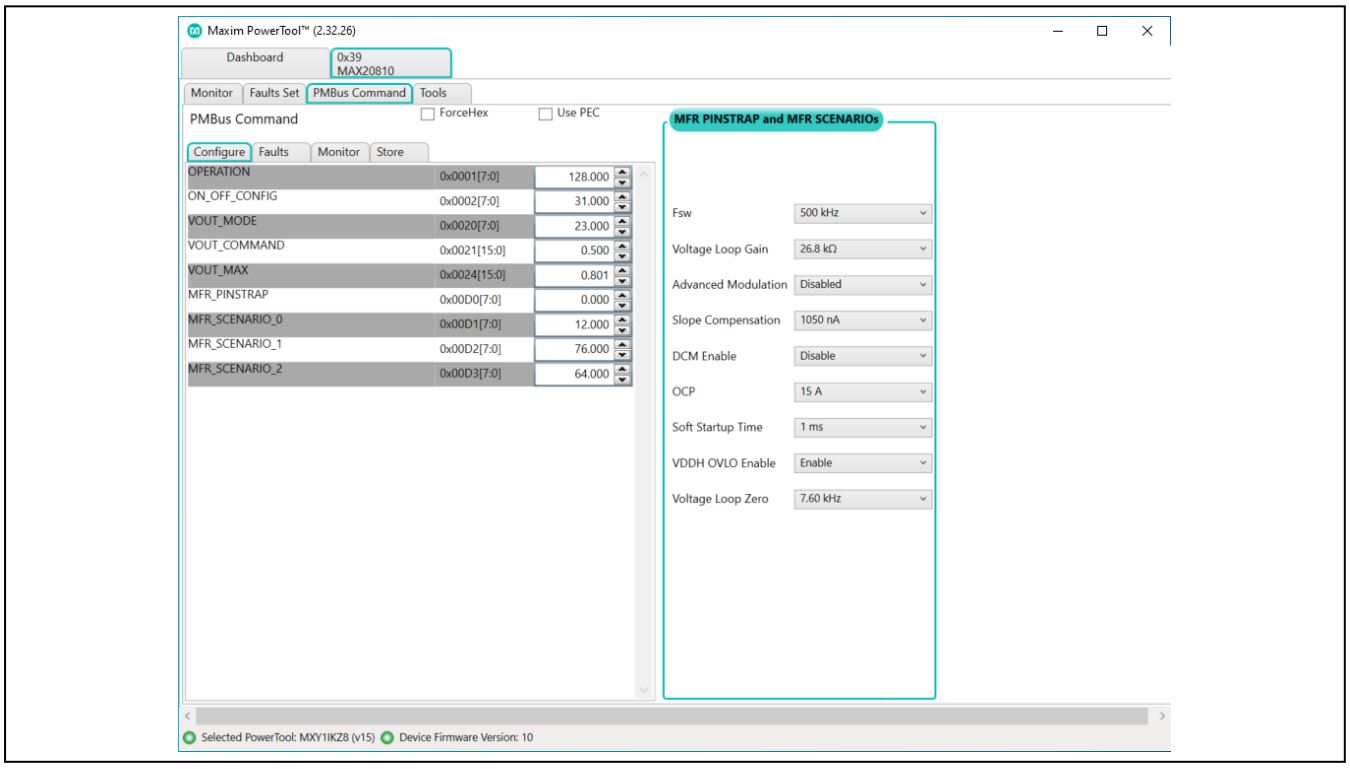


Figure 2. Detailed View for One Device; ***Configure*** *Sub-Tab*

Detailed Description of Hardware

This evaluation kit should be used with the following documents:

MAX20815 IC data sheet
MAX20830/MAX20815/MAX20810 PMBus Command Set User Guide
MAX20815 EV kit data sheet (this document)

For the latest versions of the documents listed above, refer to the *MAX20815 product page*.

Bode Plot

A 10Ω resistor is installed between the VOUT sense point and SNSP pin in series with the top divider resistor to measure the Bode plot. TP13 and TP14 test points are provided on the board on either side of the 10Ω resistor for small signal injection and the ability to measure the Bode plot for V_{OUT}.

Operation

The MAX20815 IC is a monolithic, single-output, high-frequency, step-down converter with PMBus interface and optional external bias LDO that is optimized for applications requiring high-power density and high efficiency. Detailed product and application information is provided in the MAX20815 IC data sheet.

Output Enable (EN)

The EN pin is used to enable/disable the operation and therefore the output voltage. On the EV kit board, the selection switch SW1 is present to allow enabling and disabling the regulator.

Output Voltage Selection

The MAX20815 EV kit is set up to initially boot up to an output voltage of 1V. The device has a default 0.5V reference voltage. The reference voltage can be adjusted by the PMBus VOUT_COMMAND from 0.4V to 0.8V with 1.95mV resolution. When the output voltage is higher than V_{REF}, it 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} = Reference voltage

R_{FB1} = Top divider resistor

R_{FB2} = Bottom divider resistor

Soft-Start

When VDDH (VIN) and EN are above their rising thresholds, soft-start begins, and switching is enabled. The output voltage of the enabled output starts to ramp up. The default soft-start ramp time is 1ms. The 3ms soft-startup time option can be selected by using the PMBus MFR_SCENARIO_1 command. The device supports smooth startup with the output prebiased.

Switching Frequency

Switching frequency is a programmable parameter, and PGM1 is used to select the switching frequency. For the EV kit, the switching frequency is set to 500kHz by default. Refer to the *PGM1 Switching Frequency and Scenario Selection* table (Table 2) in the IC data sheet. Switching frequency can also be changed by using the PMBus MFR_PINSTRAP command.

Pin-Strap Programmability

The MAX20815 EV kit provides an option to configure the part for desired application using PGMx resistor values. Refer to Table 1 and Table 2 in the IC data sheet. Appropriate values of resistors R2 and R5 can be used for the desired application.

Transient

The MAX20815 EV kit provides an option to connect to an Analog Devices internal fast-transient load generator to perform fast-transient load testing through the J2 connector.

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. The detailed fault can be viewed in the GUI. Refer to the MAX20815 IC data sheet for more details.

Input-Voltage Monitoring

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

Switching-Voltage Monitoring

The switching waveform can be monitored on TP15 for LX and TP2 for PGND.

Output-Voltage Monitoring

TP8 and TP11 monitor the output voltage. These test points should not be used for loading.

Efficiency Testing

J4 is provided to measure V_{IN} (VDDH) during efficiency measurement. Additionally, J6 is provided to measure V_{OUT} during efficiency measurement.

Ordering Information

PART	TYPE
MAX20815EVKIT#	EV Kit

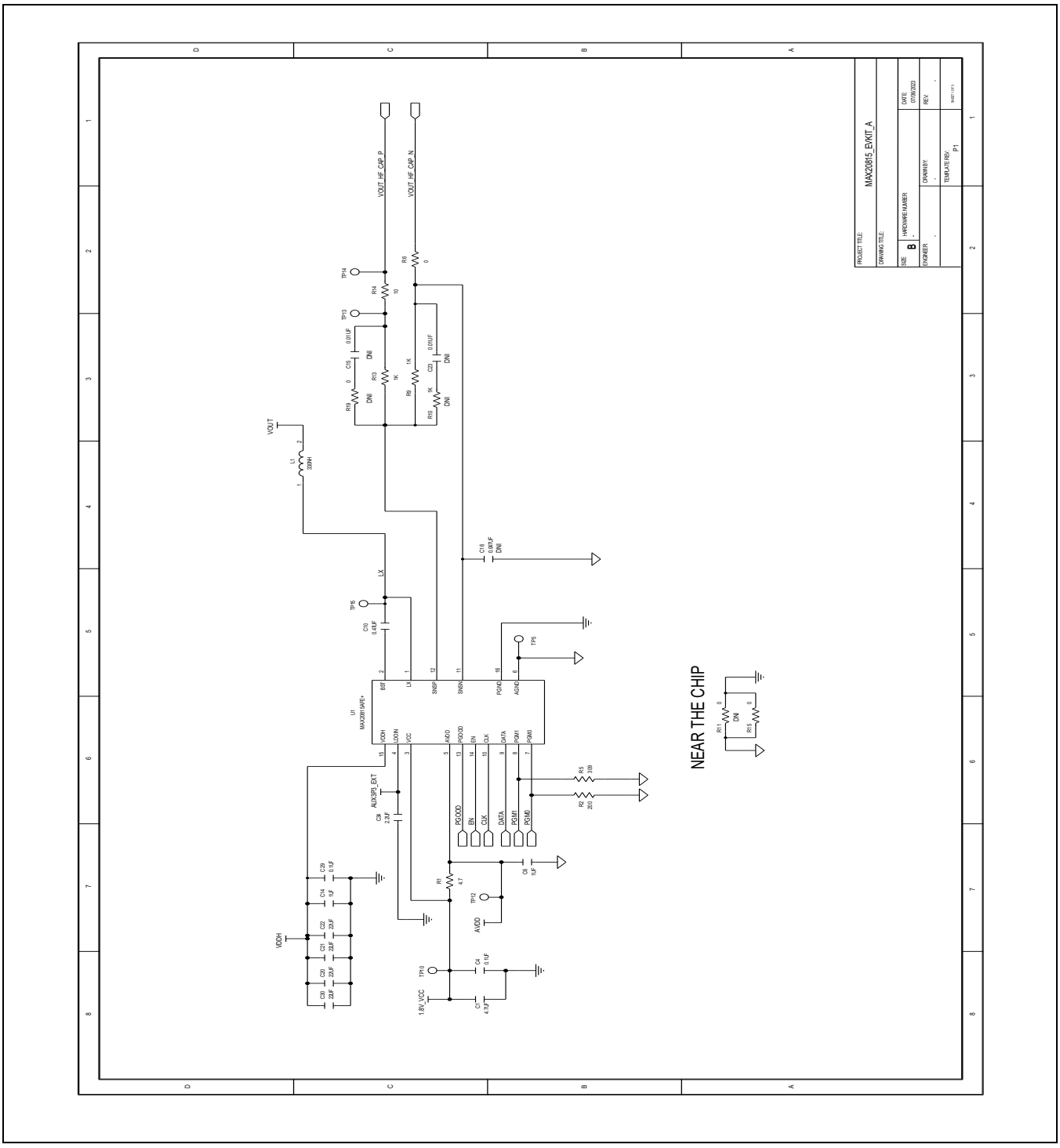
#Denotes RoHS-compliant.

MAX20815 EV Kit Bill of Materials

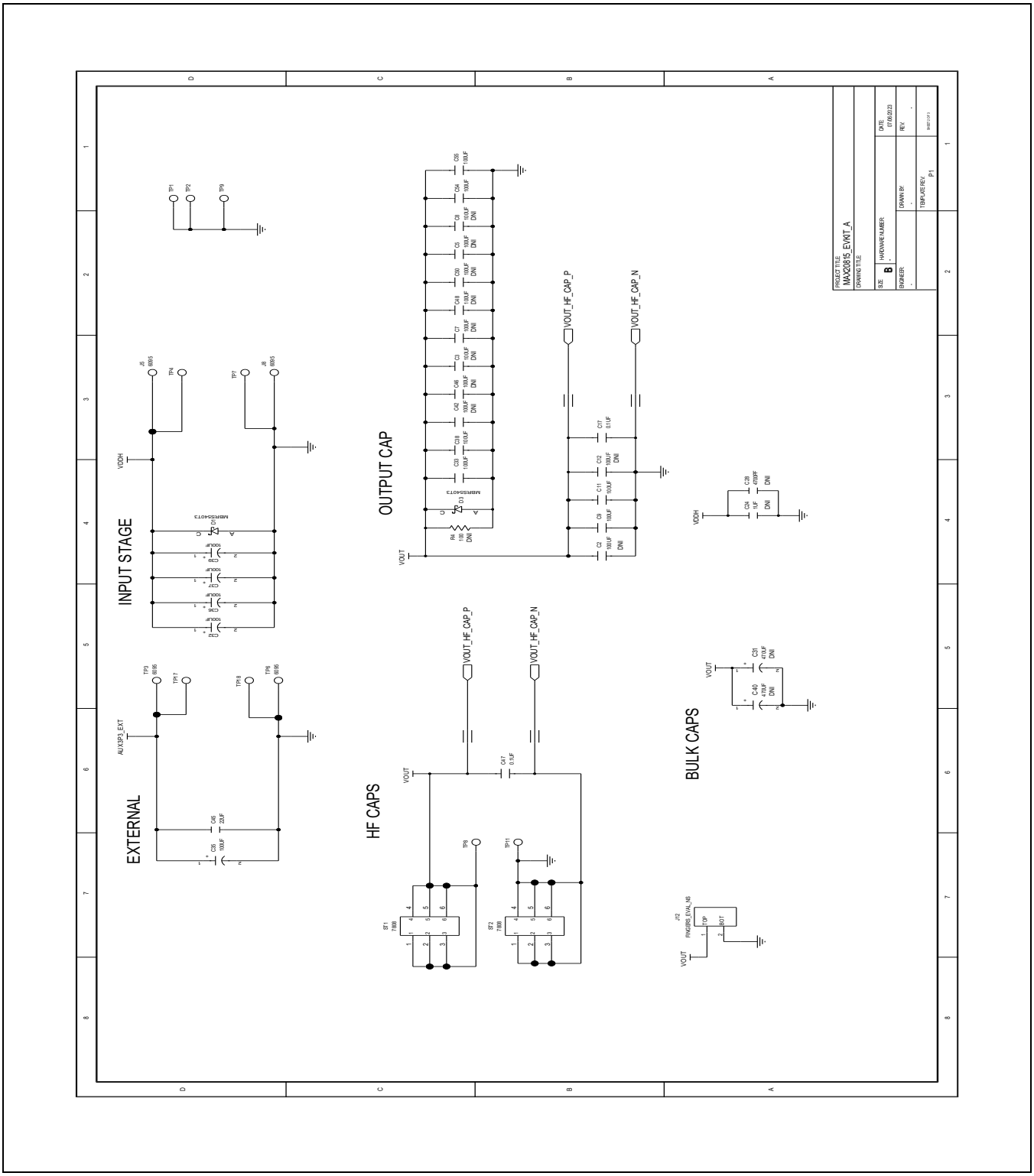
ITEM	REF_DES	DNI/ DNP	QTY	MFG_PART#	MFG	VALUE	DESCRIPTION
1	C1	-	1	GRM155R60J475ME87; GRM153R60J475ME15; GRM155R60J475ME47	MURATA; MURATA; MURATA	4.7UF	CAP; SMT (0402); 4.7UF; 20%; 6.3V; X5R; CERAMIC
2	C4	-	1	GRM155R60J104KA01; C0402C104K9PAC	MURATA; KEMET	0.1UF	CAP; SMT (0402); 0.1UF; 10%; 6.3V; X5R; CERAMIC
3	C6	-	1	CL05B105KQ5NQNC; GRM155R70J105KA12	SAMSUNG ELECTRONICS; MURATA	1UF	CAP; SMT (0402); 1UF; 10%; 6.3V; X7R; CERAMIC
4	C9, C11, C33, C38, C54, C55	-	6	GRM31CD80J107ME39	MURATA	100UF	CAP; SMT (1206); 100UF; 20%; 6.3V; X6T; CERAMIC
5	C10	-	1	GRM155R60J474KE19	MURATA	0.47UF	CAP; SMT (0402); 0.47UF; 10%; 6.3V; X5R; CERAMIC
6	C13	-	1	C0402C101J5GAC; NMC0402NPO101J; CC0402JRNPO9BN101; GRM1555C1H101JA01; C1005C0G1H101J050BA	KEMET; NIC COMPONENTS CORP.; YAGEO PHICOMP; MURATA; TDK	100PF	CAP; SMT (0402); 100PF; 5%; 50V; C0G; CERAMIC
7	C14	-	1	C1608X5R1E105M080AC	TDK	1UF	CAP; SMT (0603); 1UF; 20%; 25V; X5R; CERAMIC
8	C17, C47	-	2	GRM155R71E104KE14; C1005X7R1E104K050BB; TMK105B7104KVH; CGJ2B3X7R1E104K050BB	MURATA; TDK; TAIYO YUDEN; TDK	0.1UF	CAP; SMT (0402); 0.1UF; 10%; 25V; X7R; CERAMIC
9	C20-C22, C30, C45	-	5	CL31X226KAHN3N; GRM31CC81E226KE11	SAMSUNG; MURATA	22UF	CAP; SMT (1206); 22UF; 10%; 25V; X6S; CERAMIC
10	C26	-	1	C0402C102K5GAC	KEMET	1000PF	CAP; SMT (0402); 1000PF; 10%; 50V; C0G; CERAMIC
11	C29	-	1	TMK105BJ104KV; GRM155R61E104KA87	TAIYO YUDEN; MURATA	0.1UF	CAP; SMT (0402); 0.1UF; 10%; 25V; X5R; CERAMIC
12	C32, C36, C37, C39	-	4	T521X107M025ATE060	KEMET	100UF	CAP; SMT (7343); 100UF; 20%; 25V; TANTALUM
13	C34	-	1	C1005X7S0J225K050BC; GRM155C70J225KE11	TDK;MURATA	2.2UF	CAP; SMT (0402); 2.2UF; 10%; 6.3V; X7S; CERAMIC
14	C35	-	1	T491X107K025A	KEMET	100UF	CAP; SMT (7343-43); 100UF; 10%; 25V; TANTALUM
15	D1, D3	-	2	MBRS540T3G	ON SEMICONDUCTOR	MBRS540T3	DIODE; SCH; SURFACE MOUNT SCHOTTKY POWER RECTIFIER; SMC; PIV=40V; IF=5A
16	DS1	-	1	LGL29K-G2J1-24-Z	OSRAM	LGL29K-G2J1-24-Z	DIODE; LED; SMARTLED; GREEN; SMT; PIV=1.7V; IF=0.02A
17	J1	-	1	TSW-108-07-T-D	SAMTEC	TSW-108-07-T-D	CONNECTOR; MALE; THROUGH HOLE; TSW SERIES; 0.0125INCH SQUARE POST HEADER; STRAIGHT; 16PINS
18	J2	-	1	UPS-08-01-01-L-RA	SAMTEC	UPS-08-01-01-L-RA	CONNECTOR; FEMALE; THROUGH HOLE; DUAL LEAF POWER HEADER; RIGHT ANGLE; 8PINS
19	J4, J6, J7	-	3	PCC02SAAN	SULLINS	PCC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 2PINS; -65 DEGC TO +125 DEGC
20	J5, J8, TP3, TP6	-	4	6095	KEYSTONE	6095	CONNECTOR; FEMALE; PANELMOUNT; NON-INSULATED RECESSED HEAD BANANA JACK; STRAIGHT THROUGH; 1PIN
21	J9	-	1	PCC03SAAN	SULLINS	PCC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 3PINS; -65 DEGC TO +125 DEGC
22	J10	-	1	131-3701-266	JOHNSON COMPONENTS	131-3701-266	CONNECTOR; MALE; THROUGH HOLE; SMB JACK VERTICAL PCB MOUNT; STRAIGHT; 5PINS
23	L1	-	1	PA5034.331HLT	PULSE ELECTRONICS	330NH	INDUCTOR; SMT; SHIELDED; 330NH; 15%; 40A
24	MH1-MH4	-	4	9032	KEYSTONE	9032	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON
25	Q1	-	1	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
26	R1	-	1	CRCW04024R70FK	VISHAY DALE	4.7	RES; SMT (0402); 4.7; 1%; +/-100PPM/DEGC; 0.0630W
27	R2	-	1	ERJ-2RKF2000	PANASONIC	200	RES; SMT (0402); 200; 1%; +/-100PPM/DEGC; 0.1000W
28	R3	-	1	TNPW040249R9BE; RG1005P-49R9-B-T; ERA-2AEB49R9	VISHAY; SUSUMU CO LTD.; PANASONIC	49.9	RES; SMT (0402); 49.9; 0.10%; +/-25PPM/DEGC; 0.0630W
29	R5	-	1	ERJ-2RKF3090	PANASONIC	309	RES; SMT (0402); 309; 1%; +/-100PPM/DEGC; 0.1000W
30	R6	-	1	RC0402FR-070RL	YAGEO	0	RES; SMT (0402); 0; 1%; JUMPER; 0.0630W
31	R7, R12	-	2	ERJ-2RKF3301	PANASONIC	3.3K	RES; SMT (0402); 3.3K; 1%; +/-100PPM/DEGC; 0.1000W
32	R9, R13	-	2	CRG0402F1K0	TE CONNECTIVITY	1K	RES; SMT (0402); 1K; 1%; +/-100PPM/DEGC; 0.0630W
33	R14	-	1	ERJ-2RKF10R0	PANASONIC	10	RES; SMT (0402); 10; 1%; +/-100PPM/DEGC; 0.1000W
34	R15	-	1	RC0402JR-070RL; CR0402-16W-000RJT	YAGEO PHYCOMP; VENKEL LTD.	0	RES; SMT (0402); 0; 5%; JUMPER; 0.0630W
35	R16, R41	-	2	CRCW040220K0FK	VISHAY DALE	20K	RES; SMT (0402); 20K; 1%; +/-100PPM/DEGC; 0.0630W
36	R42	-	1	RC0603FR-07100RL; CR0603-FX-1000ELF	YAGEO;BOURNS	100	RES; SMT (0603); 100; 1%; +/-100PPM/DEGC; 0.1000W
37	R51	-	1	ERJ-3EKF2100	PANASONIC	210	RES; SMT (0603); 210; 1%; +/-100PPM/DEGK; 0.1000W
38	ST1, ST2	-	2	7808	KEYSTONE	7808	TERMINAL; BODY LENGTH=0.67IN; BODY WIDTH=0.47IN; HEIGHT=0.45IN; SCRW; BRASS
39	SU1	-	1	S1100-B; SX1100-B; STC02SYAN	KYCON; KYCON; SULLINS ELECTRONICS CORP.	SX1100-B	TEST POINT; JUMPER; STR; TOTAL LENGTH=0.24IN; BLACK; INSULATION=PBT;PHOSPHOR BRONZE CONTACT=GOLD PLATED
40	SW1	-	1	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

41	TP1, TP2, TP5, TP7, TP9, TP11, TP18	-	7	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;
42	TP4, TP8, TP10, TP12, TP17	-	5	5010	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; RED; PHOSPHOR BRONZE WIRE SIL;
43	TP13, TP14, TP29, TP30, TP_CLK, TP_DATA	-	6	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;
44	TP15	-	1	USE FOR COLD TEST: 5015	KEYSTONE	N/A	TEST POINT; SMT; PIN LENGTH=0.135IN; PIN WIDTH=0.07IN; PIN HEIGHT=0.06IN; SILVER; PHOSPHOR BRONZE WITH SILVER PLATE CONTACT; USE FOR COLD TEST
45	U1	-	1	MAX20815AFE+	ANALOG DEVICES	MAX20815AFE+	EVKIT PART - IC; MAX20815; 15A; 2MHZ; 2.7V TO 16V INTEGRATED STEP-DOWN SWITCHING REGULATOR WITH PMBUS; PACKAGE OUTLINE DRAWING: 21-100528; LAND PATTERN NUMBER: 90-100191; PACKAGE CODE: F164A6F+2; FC2QFN16
46	PCB	-	1	MAX20815	ANALOG DEVICES	PCB	PCB:MAX20815
47	C2, C3, C5, C7-C8, C12, C42, C46, C48, C50	DNP	10	GRM31CD80J107ME39	MURATA	100UF	CAP; SMT (1206); 100UF; 20%; 6.3V; X6T; CERAMIC
48	C15, C23	DNP	2	C0402C103J3RAC	KEMET	0.01UF	CAP; SMT (0402); 0.01UF; 5%; 25V; X7R; CERAMIC
49	C16	DNP	1	C0402C473J8RAC	KEMET	0.047UF	CAP; SMT (0402); 0.047UF; 5%; 10V; X7R; CERAMIC
50	C18, C25	DNP	2	C0402C479D8GAC	KEMET	4.7PF	CAP; SMT (0402); 4.7PF; +/-0.5PF; 10V; C0G; CERAMIC
51	C24	DNP	1	C1608X5R1E105M080AC	TDK	1UF	CAP; SMT (0603); 1UF; 20%; 25V; X5R; CERAMIC
52	C28	DNP	1	GRM155R71E472KA01	MURATA	4700PF	CAP; SMT (0402); 4700PF; 10%; 25V; X7R; CERAMIC
53	C31, C40	DNP	2	T491X477K010AT	KEMET	470UF	CAP; SMT (7343); 470UF; 10%; 10V; TANTALUM
54	R4	DNP	1	ERJ-P08J101	PANASONIC	100	RES; SMT (1206); 100; 5%; +/-200PPM/DEGC; 0.6600W
55	R10	DNP	1	CRG0402F1K0	TE CONNECTIVITY	1K	RES; SMT (0402); 1K; 1%; +/-100PPM/DEGC; 0.0630W
56	R11, R19	DNP	2	RC0402JR-070RL; CR0402-16W-000RJT	YAGEO PHYCOMP; VENKEL LTD.	0	RES; SMT (0402); 0; 5%; JUMPER; 0.0630W

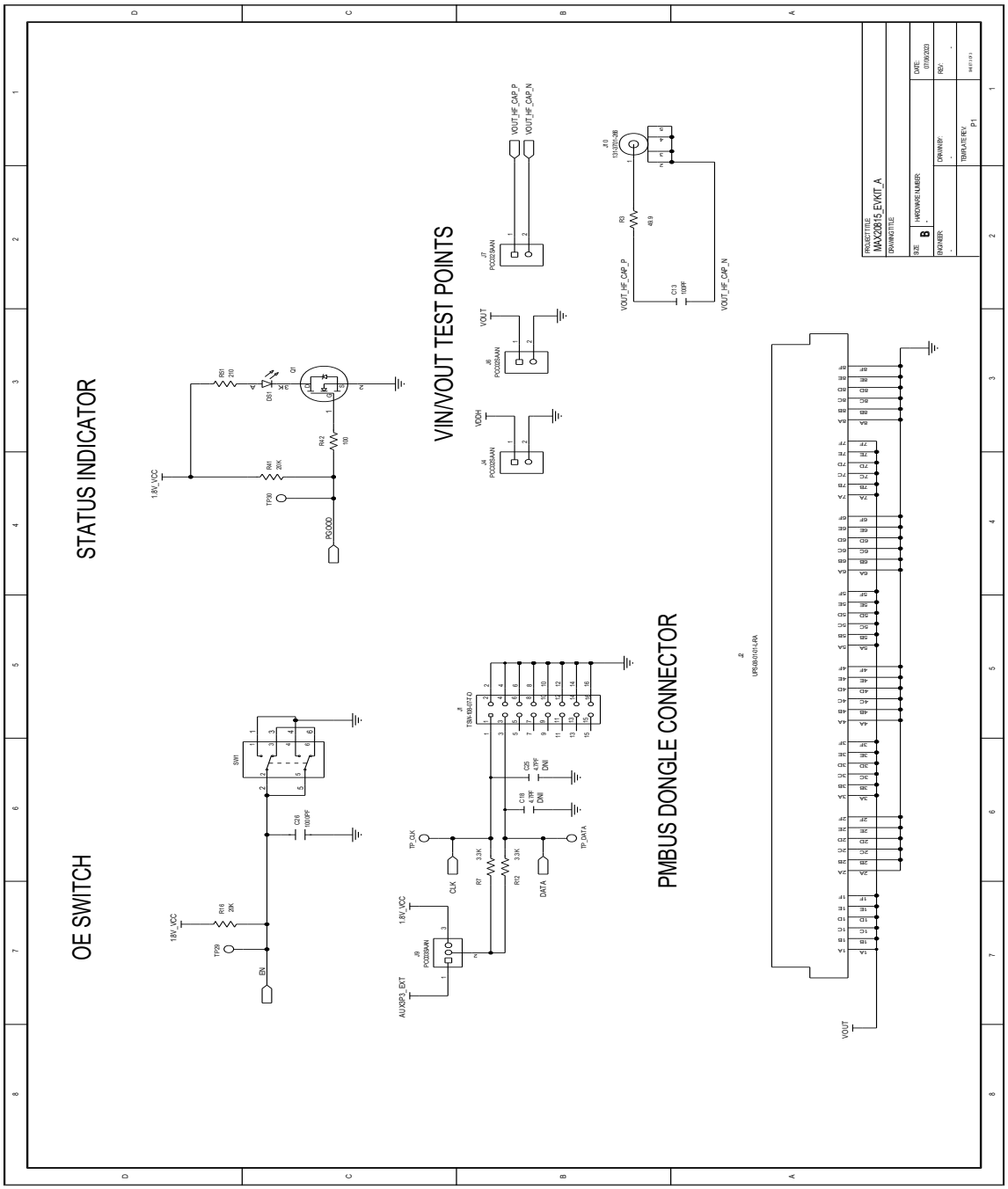
MAX20815 EV Kit Schematic



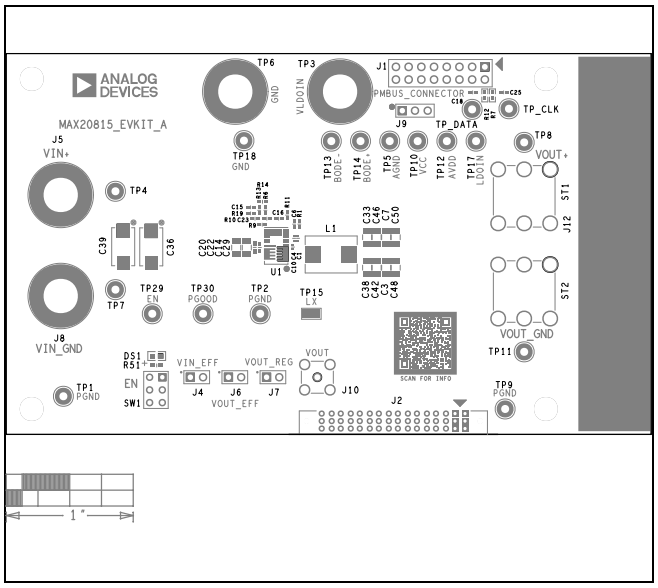
MAX20815 EV Kit Schematics (continued)



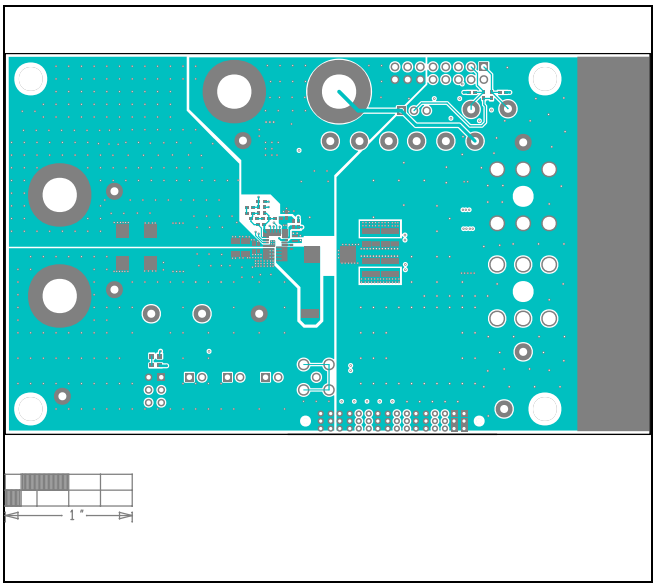
MAX20815 EV Kit Schematics (continued)



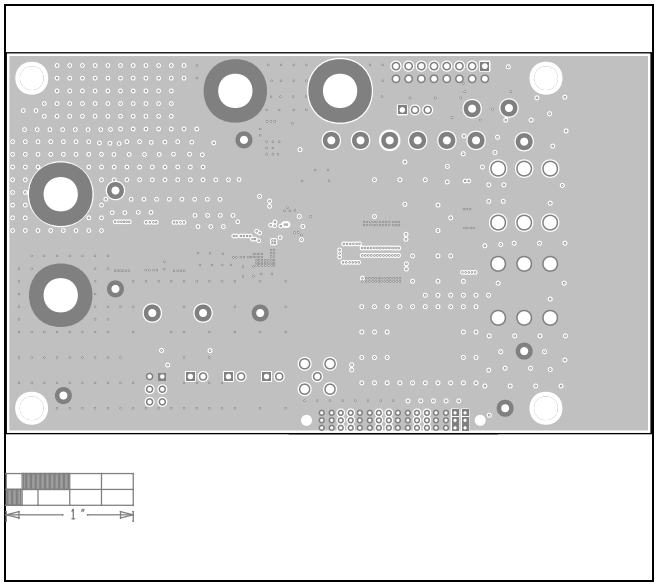
MAX20815 EV Kit PCB Layouts



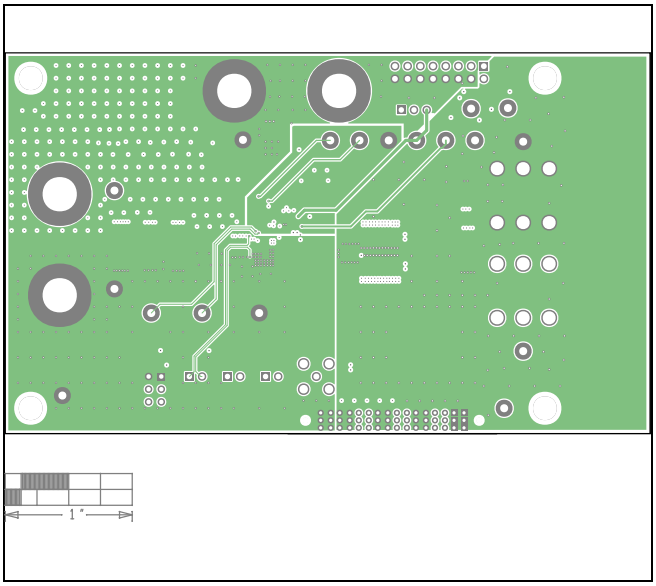
MAX20815 EV Kit Component Placement Guide—Top Silkscreen



MAX20815 EV Kit PCB Layout—Top

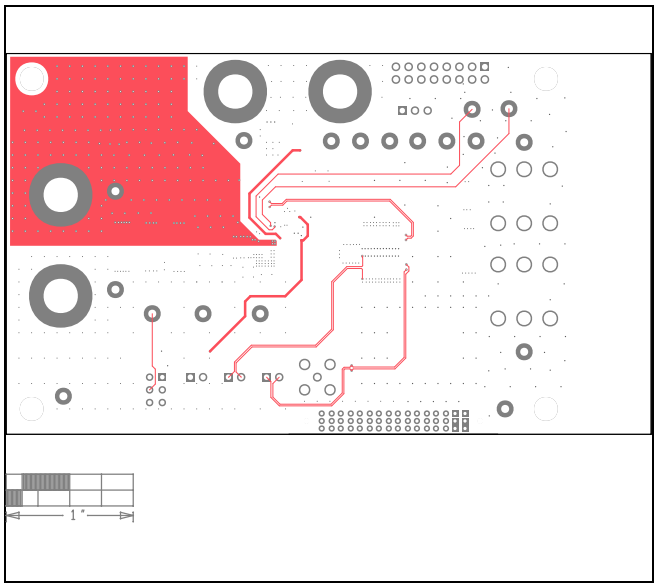


MAX20815 EV Kit PCB Layout—Layer 2

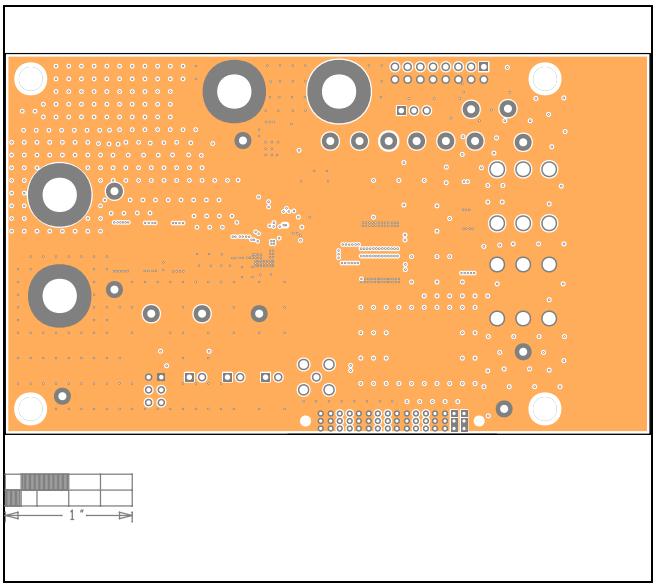


MAX20815 EV Kit PCB Layout—Layer 3

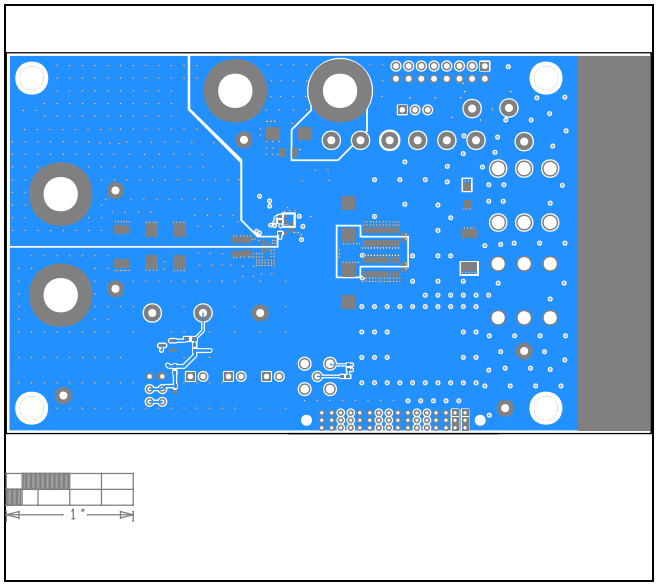
MAX20815 EV Kit PCB Layouts (continued)



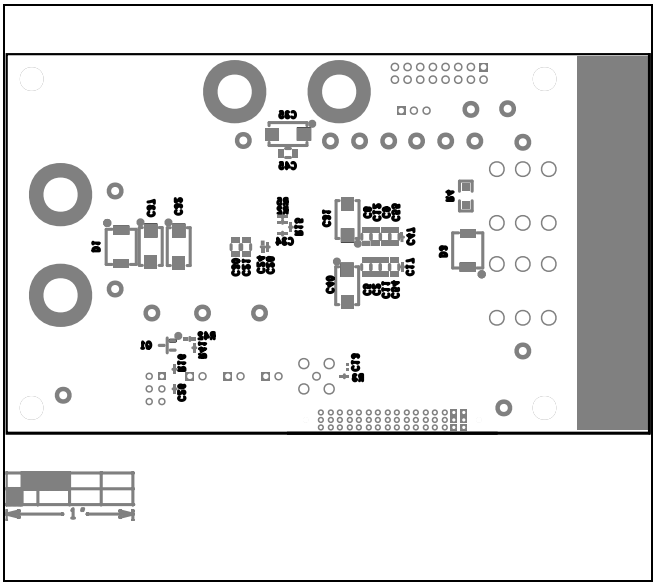
MAX20815 EV Kit PCB Layout—Layer 4



MAX20815 EV Kit PCB Layout—Layer 5



MAX20815 EV Kit PCB Layout—Bottom



MAX20815 EV Kit Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	9/23	Initial release	—