Click here for production status of specific part numbers.

MAX17577EVKIT#, MAX17578EVKIT# Evaluation Kits

Evaluate: MAX17577 and MAX17578 in -12V and -5V Output-Voltage Applications

General Description

The MAX17577EVKIT# and MAX17578EVKIT# evaluation kits (EV kits) provide a proven design to evaluate the MAX17577 and MAX17578 high-efficiency, high-voltage, inverting, Himalaya synchronous DC-DC converters. The devices generate output voltages (V_{OUT}) from -0.9V to -36V and can deliver up to 1A of load current from a wide 4.5V to 60V-$|V_{OUT}|$ input voltage range.

The MAX17577EVKIT# EV kit generates -12V output (V_{OUT1}) at load currents up to 0.8A from a 16V to 48V input supply and operates at 600kHz switching frequency. This EV kit configuration features MAX17577 that operates in continuous conduction mode (CCM) at all loads, thus, providing a constant frequency operation.

The MAX17578EVKIT# EV kit generates -5V output (V_{OUT2}) at load currents up to 1A from a 16V to 55V input supply and operates at 600kHz switching frequency. This EV kit configuration features MAX17578 that operates in discontinuous conduction mode (DCM) for superior efficiency at light loads.

The EV kits are configured for optimum efficiency and component size. The EV kits feature programmable enable and input undervoltage-lockout (UVLO), soft-start, open-drain $\overline{RESET}$ signal and external clock synchronization. The EV kits also provide a good layout example, which are optimized for conducted, radiated EMI, and thermal performance. For more details about the device *Benefits and Features*, refer to the MAX17577, MAX17578 IC data sheet.

Features

- Operates Over a Wide Input Range
  - MAX17577EVKIT#: V_{OUT1} = -12V, I_{OUT1} = 0.8A, V_{IN1} Range = 16V to 48V
  - MAX17578EVKIT#: V_{OUT2} = -5V, I_{OUT2} = 1A, V_{IN2} Range = 16V to 55V
- Enable/UVLO Input, Resistor Programmable UVLO Threshold
- Adjustable Soft-Start Time
- $\overline{RESET}$ Output with a Pull-Up Resistor to an External Supply
- System Ground Interfaced EN/UVLO and $\overline{RESET}$ Pins
- Overcurrent and Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested
- Complies with CISPR32 (EN55032) Class B Conducted and Radiated Emissions

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

319-100646; Rev 0; 12/20

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Quick Start

Recommended Equipment

- MAX17577EVKIT#, MAX17578EVKIT#
- 60V, 1.5A DC input power supply
- 5V, 10mA DC input power supply
- Loads capable of sinking 1A at -5V and 0.8A at -12V
- 2 Digital Multimeters (DMM)

Equipment Setup and Test Procedure

The EV kits are fully assembled and tested.

Use the following steps to verify and test individual device operation.

Caution: Do not turn on the power supply until all connections are completed.

1) Set the 60V input power supply at a voltage between 16V and 48V for MAX17577EVKIT# or between 16V and 55V for MAX17578EVKIT#. Disable the power supply.
2) Connect the positive terminal of the 60V power supply to the VIN PCB pad and the negative terminal to the nearest GND PCB pad.
3) Connect the positive terminal of the 5V power supply to the VEXT PCB pad and the negative terminal to the nearest GND PCB pad. Set the voltage at 5V.
4) Connect the positive terminal of the corresponding load to the GND PCB pad and the negative terminal to the nearest VOUT PCB pad.
5) Connect one DVM across the VOUT PCB pad and the nearest GND PCB pad, and the another DVM across the $\overline{\text{RESET}}$ pad and GND pad.
6) Verify that no shunts are installed on jumpers. (JU101, JU201) (see Table 1 for details)
7) Turn on the DC power supply.
8) Enable the load.
9) Ensure the input voltage to be above 15.5V which is the EN/UVLO rising threshold.
10) Verify that the DVM across the output terminal displays -12V for MAX17577EVKIT# or -5V for MAX17578EVKIT#.
11) Verify that the DVM across the $\overline{\text{RESET}}$ pad and GND displays 5V.
12) Reduce the input voltage to 12V which is below the EN/UVLO falling threshold.
13) Verify that both the DVMs displays 0V.
14) Disable the input power supply.

Detailed Description of Hardware

The MAX17577EVKIT# and MAX17578EVKIT# EV kits are designed to demonstrate the salient features of MAX17577 and MAX17578 devices. The EV kits consist of typical application circuits of the two devices. Each of these circuits are electrically isolated from each other and hosted on the same PCB. Each of the devices can be evaluated by powering them from their respective input pins. Individual device settings can be adjusted to evaluate their performance under different operating conditions.

Soft-Start Input (SS)

The EV kits offer an adjustable soft-start function to limit inrush current during startup. The soft-start time is adjusted by the value of external soft-start capacitor connected between SS and SOUT pins. The selected output capacitance (C_{OUT}) and the output voltage (V_{OUT}) determine the minimum required soft-start capacitor C_{SS} (C115, C215) as follows:

$$C_{SS} \geq 28 \times 10^{-6} \times C_{OUT} \times V_{OUT}$$

The soft-start time (t_{SS}) is related to the capacitor connected at SS (C_{SS}) by the following equation:

$$t_{SS} = \frac{C_{SS}}{5.55 \times 10^{-6}}$$

For example, to program a 1ms soft-start time, a 5600pF capacitor should be connected from the SS pin to SOUT.

Enable/Undervoltage-Lockout (EN/UVLO) Programming

The MAX17577 and MAX17578 offer an Enable and adjustable input undervoltage-lockout feature. In these EV kits, for normal operation, leave the EN/UVLO jumpers (JU101, JU201) open. When jumpers are left open, the MAX17577 and MAX17578 are enabled when the input voltage rises above 15.5V. To disable the devices, install shunts across pins 2–3 on the jumpers (JU101, JU201). See Table 1 for jumper (JU101, JU201) settings. The EN/UVLO PCB pad on the EV kits support external Enable/Disable control of the device. Leave the jumpers open when external Enable/Disable control is desired. A potential divider formed by the resistors R_{UVL_TOP} (R101, R201) and R_{UVL_BOT} (R102, R202) at the EN/UVLO pin sets the input voltage (V_{INU}) above which the converter is enabled when the jumpers are left open.

Choose R_{UVL_TOP} to be 3.32MΩ (max), and then calculate R_{UVL_BOT} as follows:

$$R_{UVL\_BOT} = \frac{1.229 \times R_{UVL\_TOP}}{(V_{INU} - 1.229)}$$

where, R_{UVL_BOT} is in MΩ. For more details about *Setting the Input Undervoltage-Lockout Level*, refer to the MAX17577, MAX17578 IC data sheet.

External Clock Synchronization (RT/SYNC)

The EV kits provide RT/SYNC PCB pads to synchronize the MAX17577 and MAX17578 to an optional external clock. The external synchronization clock frequency must be between 1.1 x f_{SW} and 1.4 x f_{SW}, where f_{SW} is the switching frequency programmed by the resistors (R105 and R205) connected to the RT/SYNC pin. For more details about the *External Clock Synchronization*, refer to the MAX17577, MAX17578 IC data sheet.

Active-Low, Open-Drain Reset Output ($\overline{RESET}$)

The EV kits provide two PCB pads $\overline{RESET1}$ and $\overline{RESET2}$ to monitor the status of the respective converters. The open drain outputs are connected to 5V external power supply (VEXT1, VEXT2) via pull up resistors (R106, R206). $\overline{RESET}$ goes high 1024 switching cycles after the output voltage rises above 95% (typ) of its set value and it is driven low to respective GND when the output voltage drops below 92% (typ) of its set value.

Input Voltage Range

The MAX17577EVKIT# and MAX17578EVKIT# has a default input voltage range starting from 16V. The operating input voltage range can be modified by changing the values of the resistors connected at the FB and EN/UVLO pins for the same inductor and output capacitor. The deliverable output current also changes with input voltage range. For more details about the *Load Current Capability*, refer to the MAX17577, MAX17578 IC data sheet. Table 2 and Table 3 show the settings for different input voltage ranges for MAX17577EVKIT# and MAX17578EVKIT#, respectively.

Hot Plug-In and Long Input Cables

The MAX17577EVKIT# and MAX17578EVKIT# PCB layouts provide optional electrolytic capacitors (C108 = C208 = 33µF/80V). These capacitors limit the peak voltage at the input of the corresponding device when the DC input source is Hot-Plugged to the EV kit input terminals with input cables. The equivalent series resistance (ESR) of the electrolytic capacitors dampen the oscillations caused by interaction of the inductance of the input cables, and the ceramic capacitors at the converters input.

Table 1. Converter EN/UVLO Jumper (JU101, JU201) Settings

SHUNT POSITION	EN/UVLO PIN	OUTPUT
1-2	Connected to IN	Enabled
Not installed*	Connected to the center node of respective resistor-dividers (R101 and R102; R201 and R202)	Enabled, UVLO level is set by the resistor-divider between IN and GND
2-3	Connected to GND	Disabled

**Default position*

Table 2. MAX17577EVKIT# EN/UVLO and FB Resistor Divider Settings

INPUT VOLTAGE RANGE	R101 (MΩ)	R102	R103 (kΩ)	R104 (kΩ)	LOAD CURRENT
16V to 48V*	3.32	294kΩ	340	27.4	0.8A
8V to 48V	3.32	665kΩ	432	34.8	0.5A
4.5V to 48V	3.32	1.33MΩ	487	39.2	0.3A

**Default Setting*

Table 3. MAX17578EVKIT# EN/UVLO and FB Resistor Divider Settings

INPUT VOLTAGE RANGE	R201 (MΩ)	R202	R203 (kΩ)	R204 (kΩ)	LOAD CURRENT
16V to 55V*	3.32	294kΩ	121	26.7	1A
8V to 55V	3.32	665kΩ	182	40.2	0.75A
4.5V to 55V	3.32	1.33MΩ	226	49.9	0.5A

**Default Setting*

Inductive Output Short-Circuit Protection

The MAX17577EVKIT# and MAX17578EVKIT# PCB layouts provide footprints for optional R-D circuits (R107 and D101, R207 and D201) that are used for *Inductive Output Short-Circuit Protection*. For more details, refer to the MAX17577, MAX17578 IC data sheet.

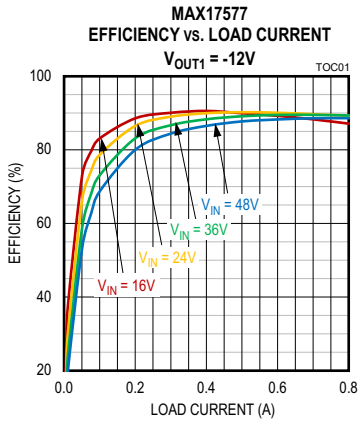
Electromagnetic Interference (EMI)

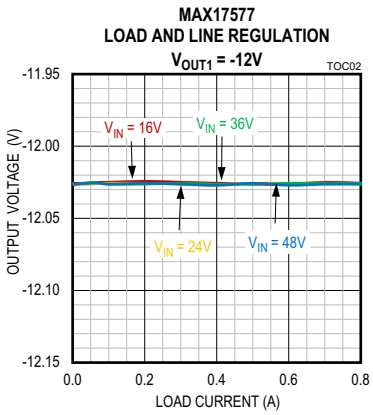
Compliance to conducted emissions (CE) standards requires an EMI filter at the input of a switching power converter. The EMI filter attenuates high-frequency currents drawn by the switching power converter, and limits the noise injected back into the input power source.

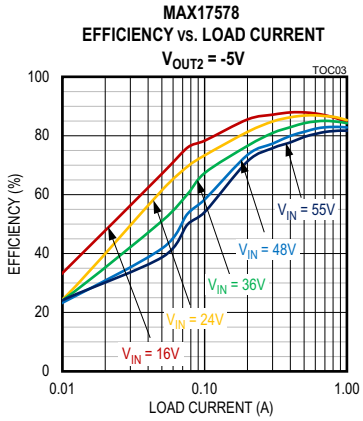
The MAX17577EVKIT# and MAX17578EVKIT# PCBs have designated footprints for the placement of conducted EMI filter components as per the optional Bill of Material (BoM). Use of these filter components results in lower conducted EMI, below CISPR32 Class B limits. Cut open the trace at L102 and L202 before installing EMI filter components. The PCB layouts are also designed to limit radiated emissions from switching nodes of the power converter, resulting in radiated emissions below CISPR32 Class B limits.

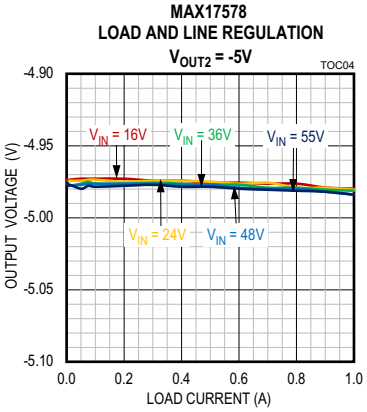
MAX17577EVKIT# and MAX17578EVKIT# EV Kit Performance Reports

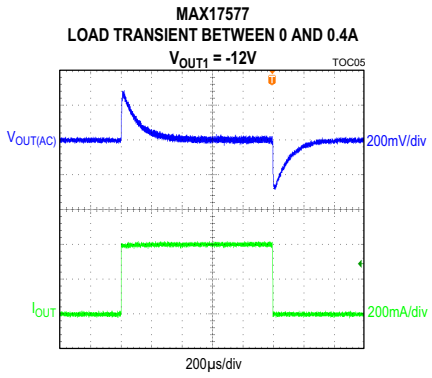
(V_{IN1} = V_{IN2} = 24V, f_{SW1} = f_{SW2} = 600kHz, unless otherwise noted.)

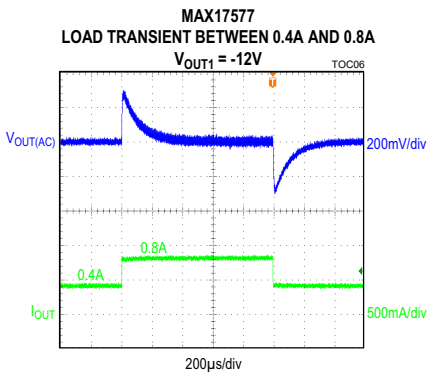








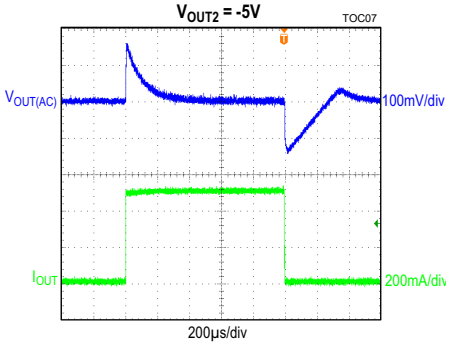




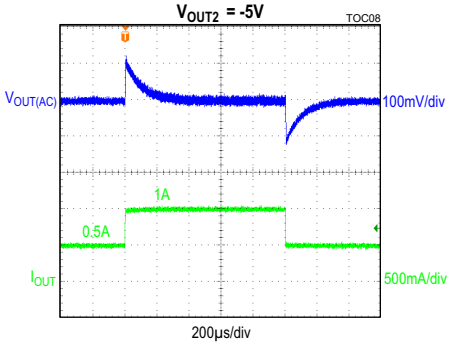
MAX17577EVKIT# and MAX17578EVKIT# EV Kit Performance Reports (continued)

(V_{IN1} = V_{IN2} = 24V, f_{SW1} = f_{SW2} = 600kHz, unless otherwise noted.)

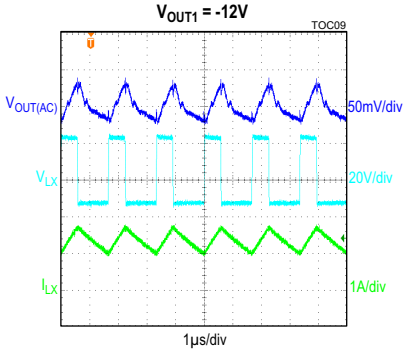
MAX17578
LOAD TRANSIENT BETWEEN 10mA AND 0.5A
V_{OUT2} = -5V



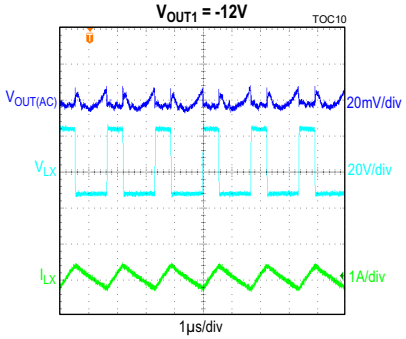
MAX17578
LOAD TRANSIENT BETWEEN 0.5A AND 1A
V_{OUT2} = -5V



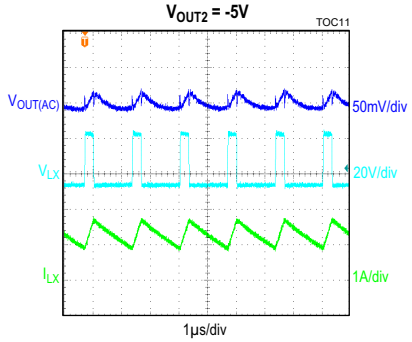
MAX17577
STEADY STATE AT 0.8A LOAD
V_{OUT1} = -12V



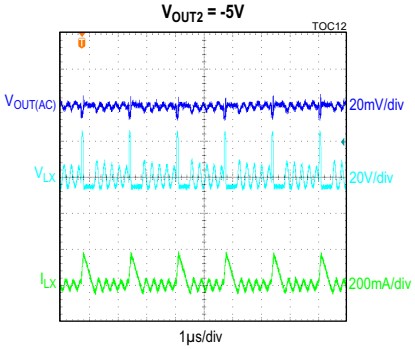
MAX17577
STEADY STATE AT NO LOAD
V_{OUT1} = -12V



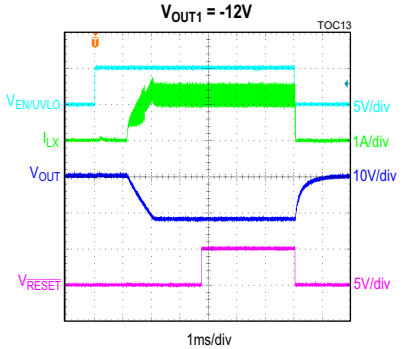
MAX17578
STEADY STATE AT 1A LOAD
V_{OUT2} = -5V



MAX17578
STEADY STATE AT 10mA LOAD
V_{OUT2} = -5V

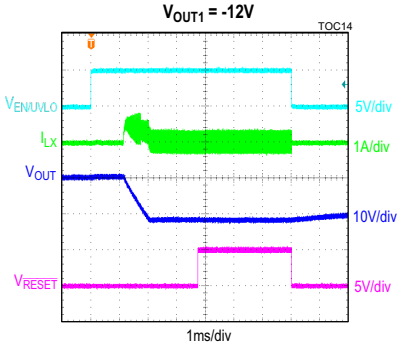


MAX17577
START UP & SHUT DOWN THROUGH EN/UVLO
V_{OUT1} = -12V



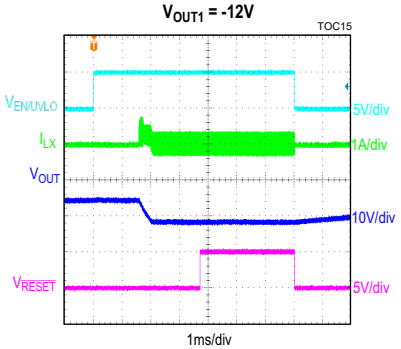
CONDITIONS: 15Ω RESISTIVE LOAD, $\overline{RESET}$ IS PULLED UP TO 5V CONNECTED AT VEXT1

MAX17577
START UP & SHUT DOWN THROUGH EN/UVLO
V_{OUT1} = -12V



CONDITIONS: 1.5kΩ RESISTIVE LOAD, $\overline{RESET}$ IS PULLED UP TO 5V CONNECTED AT VEXT1

MAX17577
START UP WITH PREBIAS VOLTAGE OF -6V
V_{OUT1} = -12V

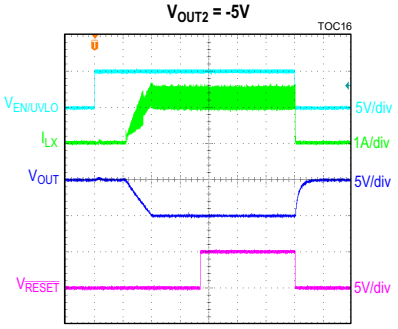


CONDITIONS: 1.5kΩ RESISTIVE LOAD, $\overline{RESET}$ IS PULLED UP TO 5V CONNECTED AT VEXT1

MAX17577EVKIT# and MAX17578EVKIT# EV Kit Performance Reports (continued)

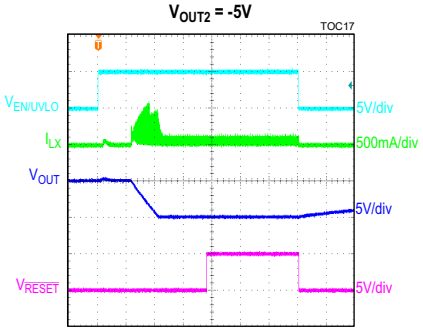
(V_{IN1} = V_{IN2} = 24V, f_{SW1} = f_{SW2} = 600kHz, unless otherwise noted.)

MAX17578
START UP & SHUT DOWN THROUGH EN/UVLO
V_{OUT2} = -5V



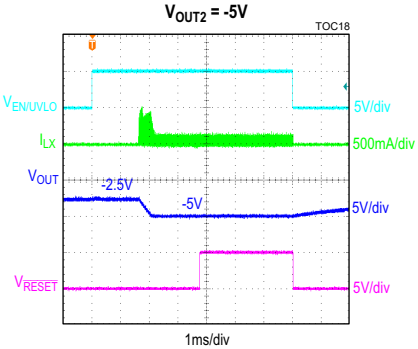
CONDITIONS: 5Ω RESISTIVE LOAD,
$\overline{RESET}$ IS PULLED UP TO 5V CONNECTED AT VEXT2

MAX17578
START UP & SHUT DOWN THROUGH EN/UVLO
V_{OUT2} = -5V



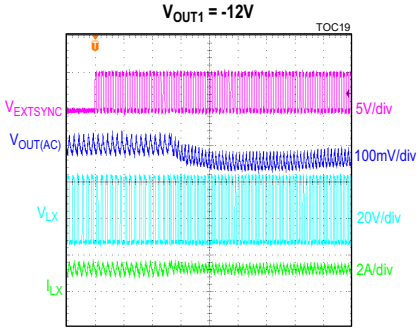
CONDITIONS: 500Ω RESISTIVE LOAD,
$\overline{RESET}$ IS PULLED UP TO 5V CONNECTED AT VEXT2

MAX17578
START UP WITH PREBIAS VOLTAGE OF -2.5V
V_{OUT2} = -5V



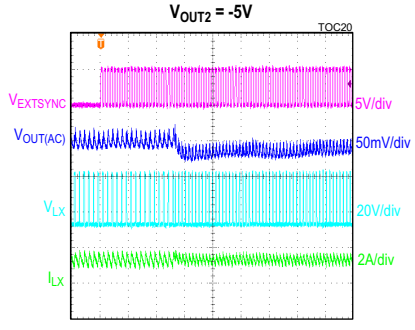
CONDITIONS: 500Ω RESISTIVE LOAD,
$\overline{RESET}$ IS PULLED UP TO 5V CONNECTED AT VEXT2

MAX17577
EXTERNAL CLOCK SYNCHRONIZATION WITH 840kHz
V_{OUT1} = -12V



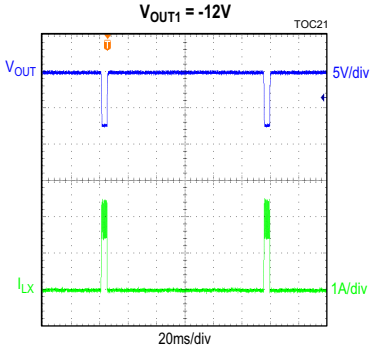
CONDITIONS: 15Ω LOAD

MAX17578
EXTERNAL CLOCK SYNCHRONIZATION WITH 840kHz
V_{OUT2} = -5V



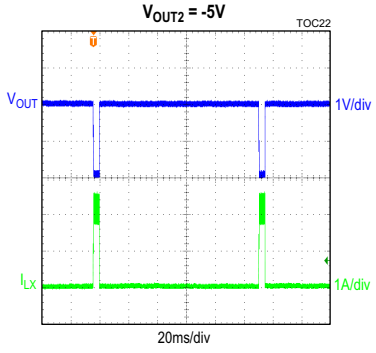
CONDITIONS: 5Ω LOAD

MAX17577
OVERLOAD PROTECTION
V_{OUT1} = -12V



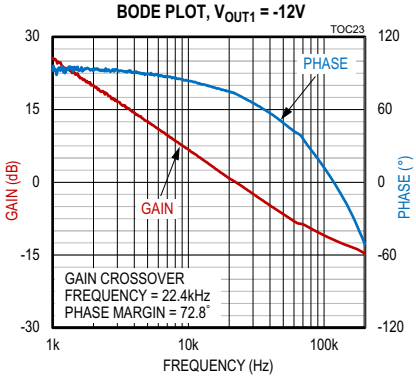
CONDITIONS: 5Ω LOAD

MAX17578
OVERLOAD PROTECTION
V_{OUT2} = -5V



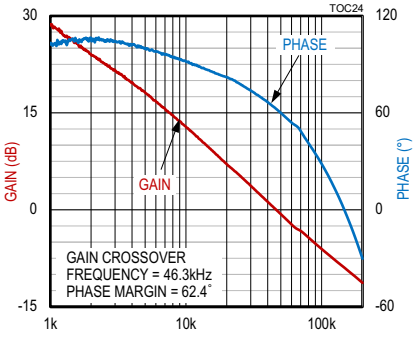
CONDITIONS: 1Ω LOAD

MAX17577
BODE PLOT, V_{OUT1} = -12V



CONDITIONS: 15Ω LOAD

MAX17578
BODE PLOT, V_{OUT2} = -5V

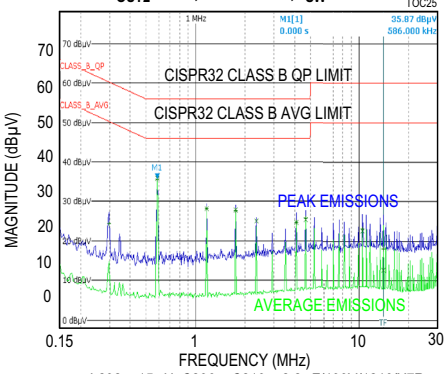


CONDITIONS: 5Ω LOAD

MAX17577EVKIT# and MAX17578EVKIT# EV Kit Performance Reports (continued)

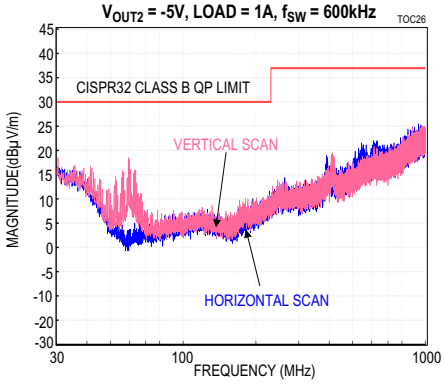
(V_{IN1} = V_{IN2} = 24V, f_{SW1} = f_{SW2} = 600kHz, unless otherwise noted.)

MAX17578 CONDUCTED EMISSIONS PLOT, V_{OUT2} = -5V, LOAD = 1A, f_{SW} = 600kHz



L202 = 15µH, C206 = C210 = 2.2µF/100V/1210/X7R

MAX17578 RADIATED EMISSIONS PLOT, V_{OUT2} = -5V, LOAD = 1A, f_{SW} = 600kHz



Component Suppliers

SUPPLIER	WEBSITE
Coilcraft, Inc.	www.coilcraft.com
Murata Americas	www.murataamericas.com
Panasonic Corp.	www.panasonic.com
SullinsCorp	www.sullinscorp.com
TDK	www.tdk.com

Note: *Indicate that you are using the MAX17577/MAX17578 when contacting these component suppliers.*

Ordering Information

PART	TYPE
MAX17577EVKIT#	EV Kit
MAX17578EVKIT#	EV Kit

#Denotes RoHs compliance.

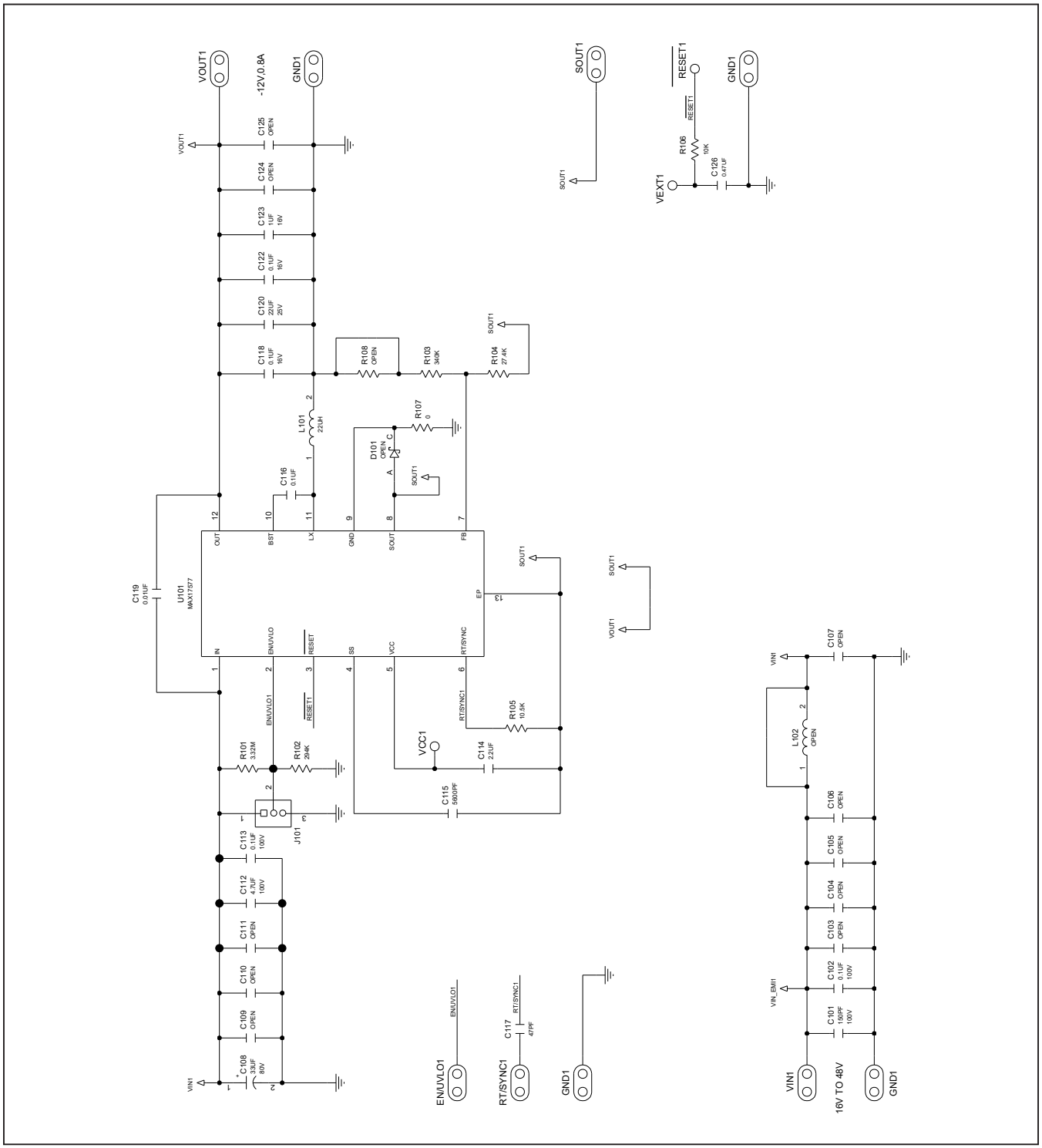
MAX17577EVKIT# and MAX17578EVKIT# EV Kit Bill of Materials

S.No	DESIGNATOR	DESCRIPTION	QUANTITY	MANUFACTURER PART NUMBER
1	C101, C201	150pF±5%; 100V; C0G; Ceramic Capacitor (0402)	2	TDK C1005C0G2A151J050BA
2	C102, C113, C202, C213	0.1µF±10%; 100V; X7R; Ceramic Capacitor (0603)	4	MURATA GRM188R72A104KA35
3	C108, C208	33uF±20%, 80V, Electrolytic capacitor	2	PANASONIC EEE-FK1K330P
4	C112	4.7µF± 10%; 100V; X7R; Ceramic Capacitor (1206)	1	MURATA GRM31CZ72A475KE11
5	C114, C214	2.2µF± 10%; 10V; X7R; Ceramic Capacitor (0603)	2	MURATA GRM188R71A225KE15
6	C115, C215	5600pF± 10%; 25V; X7R; Ceramic Capacitor (0402)	2	MURATA GRM155R71E562KA01
7	C116, C118, C122, C216, C218, C222	0.1µF±10%; 16V; X7R; Ceramic Capacitor (0402)	6	MURATA GRM155R71C104KA88
8	C117, C217	47pF±5%; 50V; C0G; Ceramic Capacitor (0402)	2	MURATA GRM1555C1H470JA01
9	C119, C219	10nF±10%; 100V; X7R; Ceramic Capacitor (0603)	2	TDK C1608X7R2A103K080AA
10	C120, C220	22µF± 20%; 25V; X7R; Ceramic Capacitor (1210)	2	MURATA GRM32ER71E226ME15
11	C123, C223	1µF± 10%; 16V; X7R; Ceramic Capacitor (0603)	2	TDK C1608X7R1C105K080AC
12	C126, C226	0.47µF± 10%; 10V; X7R; Ceramic Capacitor (0402)	2	MURATA GRM155R71A474KE01
13	C212	2.2µF± 10%; 100V; X7R; Ceramic Capacitor (1210)	1	TDK C3225X7R2A225K230AB
14	J101, J201	3-pin header (36-pin header 0.1” centers)	2	SULLINS PEC03SAAN
15	L101	Inductor, 22µH, 3.4A (5.3mm x 5.5mm)	1	COILCRAFT XEL5050-223ME
16	L201	Inductor, 10µH, 4.9A (5.3mm x 5.5mm)	1	COILCRAFT XEL5050-103ME
17	R101, R201	3.32MΩ, ±1%, 1/10W, Resistor (0603)	2	
18	R102, R202	294kΩ, ±1%, 1/10W, Resistor (0603)	2	
19	R103	340kΩ, ±1%, 1/16W, Resistor (0402)	1	
20	R104	27.4kΩ, ±1%, 1/16W, Resistor (0402)	1	
21	R105, R205	10.5kΩ, ±1%, 1/16W, Resistor (0402)	2	
22	R106, R206	10kΩ, ±1%, 1/16W, Resistor (0402)	2	
23	R107, R207	0Ω, ±1%, 1/16W, Resistor (0805)	2	
24	R203	121kΩ, ±1%, 1/16W, Resistor (0402)	1	
25	R204	26.7kΩ, ±1%, 1/16W, Resistor (0402)	1	
26	U101	High-Efficiency, Synchronous, Inverting Output DC-DC Converter (12 TDFN 3mm x 3mm)	1	MAXIM INTEGRATED MAX17577ATC+
27	U201	High-Efficiency, Synchronous, Inverting Output DC-DC Converter (12 TDFN 3mm x 3mm)	1	MAXIM INTEGRATED MAX17578ATC+
28	SU101, SU201	Jumper Socket (2.54mm)	2	SULLINS STC02SYAN
29	C206, C210	OPTIONAL: 2.2µF± 10%; 100V; X7R; Ceramic Capacitor (1210)	2	TDK C3225X7R2A225K230AB
30	L202	OPTIONAL: INDUCTOR, 15µH, 2.2A (4mm x 4mm)	1	COILCRAFT XAL4040-153ME
31	C103, C109, C111, C125, C203, C209, C211, C225	OPEN: Capacitor (0402)	0	
32	C104, C124, C204, C224	OPEN: Capacitor (0603)	0	
33	C105-C107, C110, C205, C207	OPEN: Capacitor (1210)	0	
34	D101, D201	OPEN: Diode (POWERDI-323)	0	
35	L102	OPEN: Inductor (4mm x 4mm)	0	
36	R108, R208	OPEN: Resistor (0603)	0	

DEFAULT JUMPER TABLE	
JUMPER	**SHUNT POSITION**
JU101	Open
JU201	Open

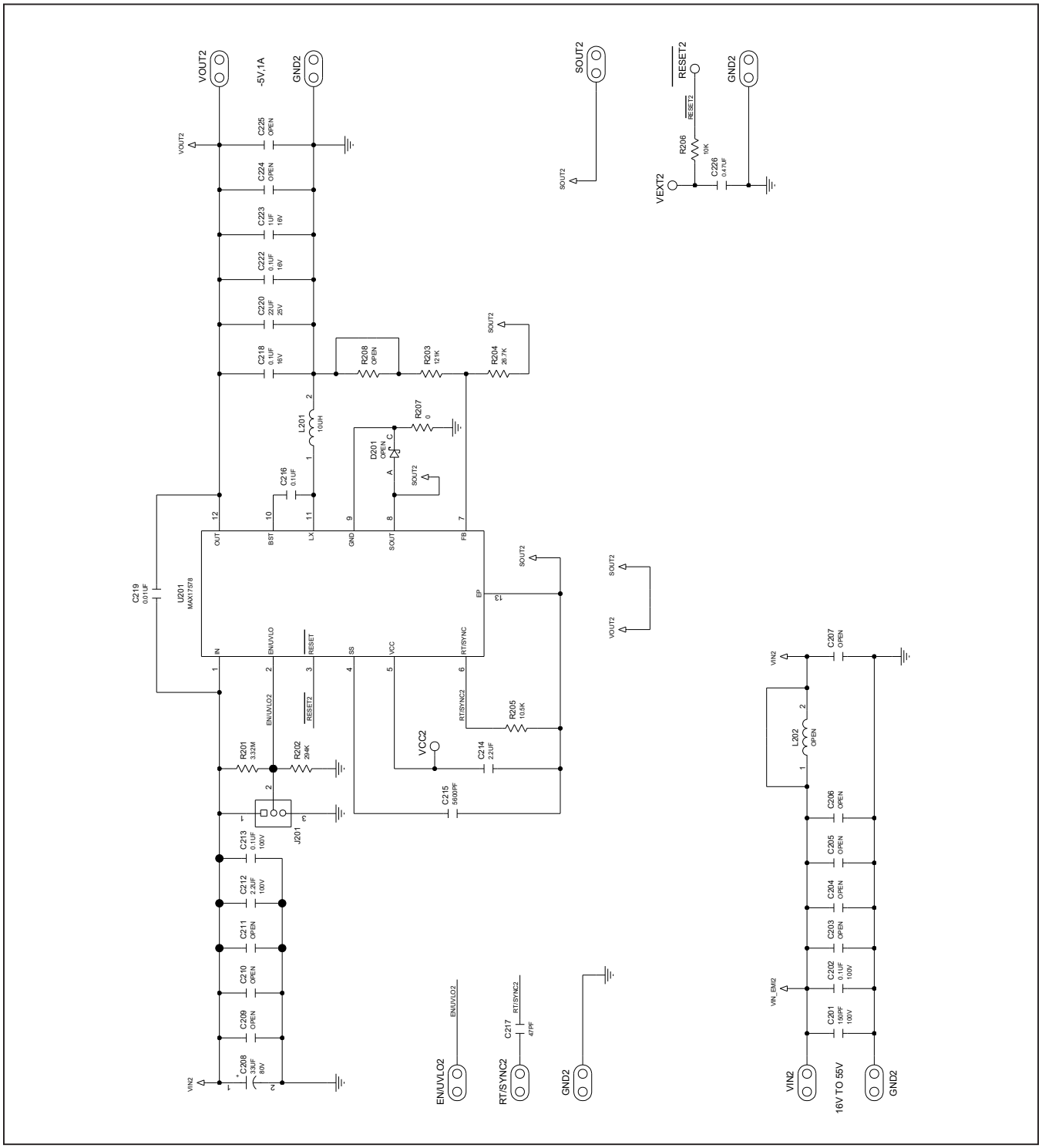
MAX17577EVKIT# and MAX17578EVKIT# EV Kit Schematics

MAX17577EVKIT# Schematic Diagram

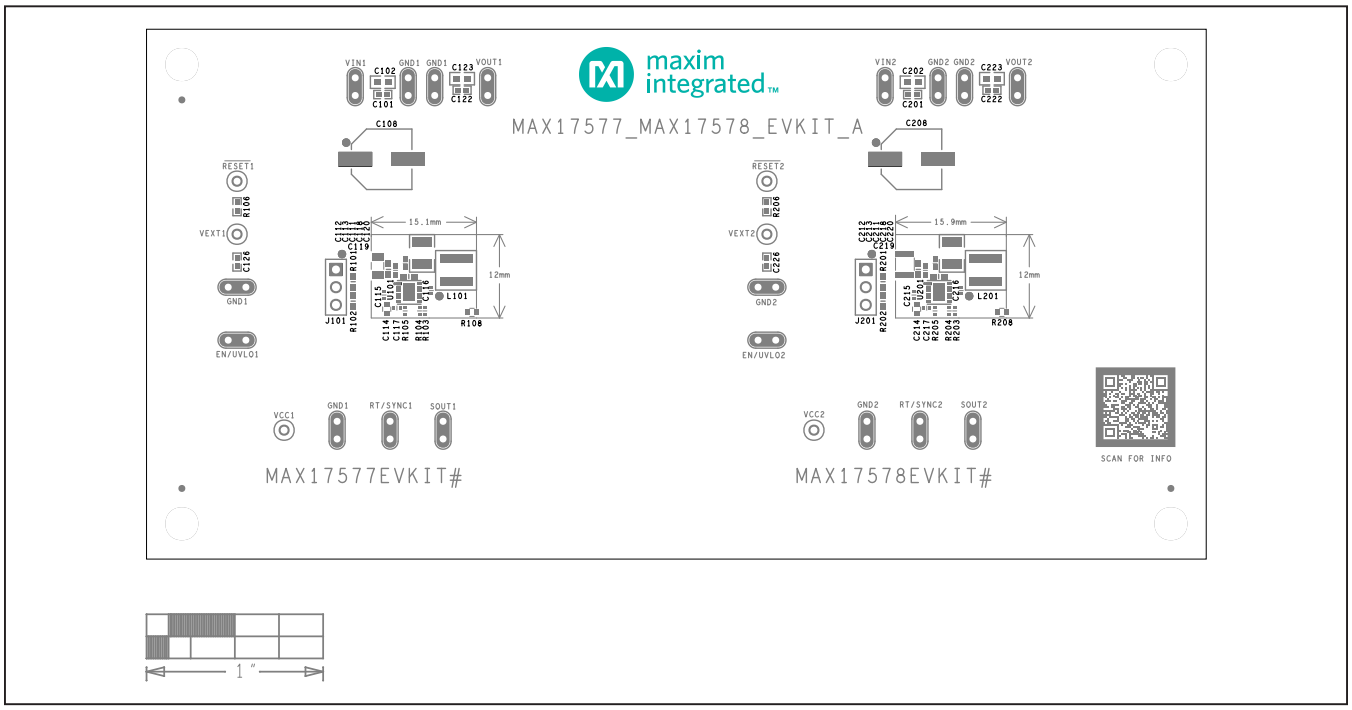


MAX17577EVKIT# and MAX17578EVKIT# EV Kit Schematics (continued)

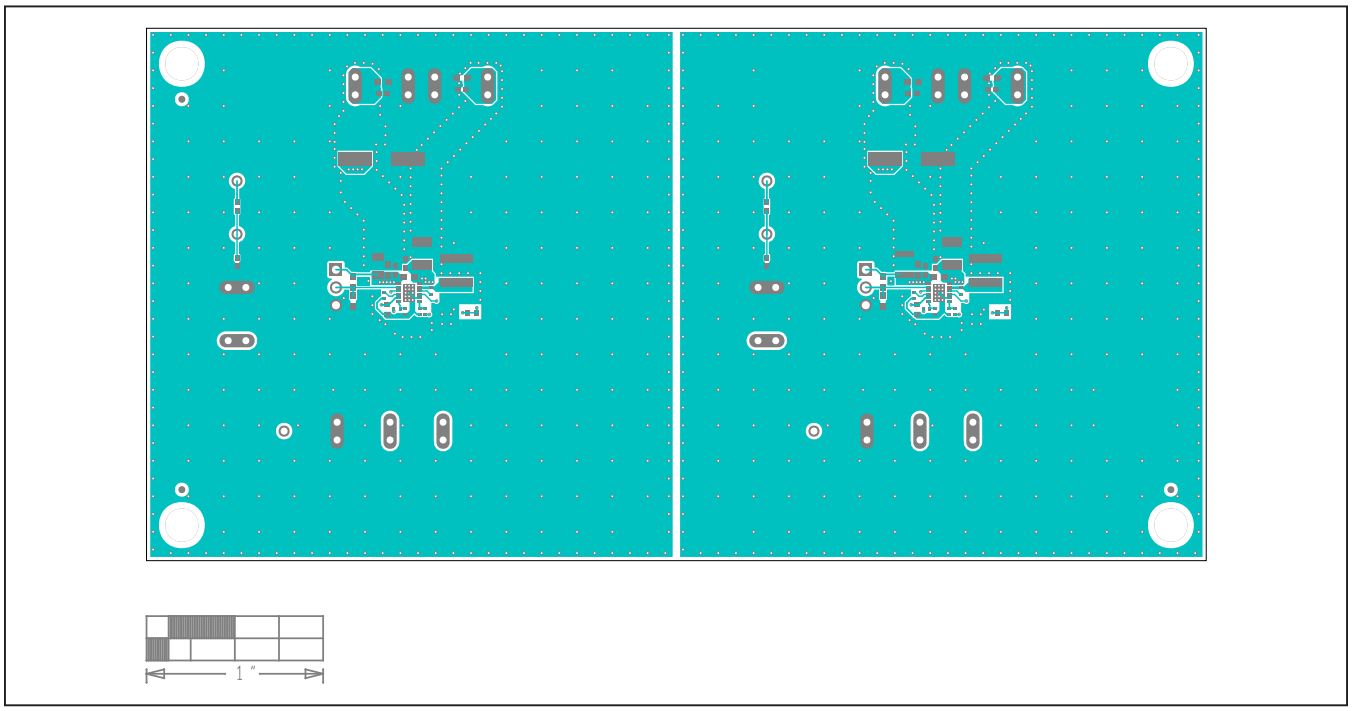
MAX17578EVKIT# Schematic Diagram



MAX17577EVKIT# and MAX17578EVKIT# EV Kits PCB Layouts

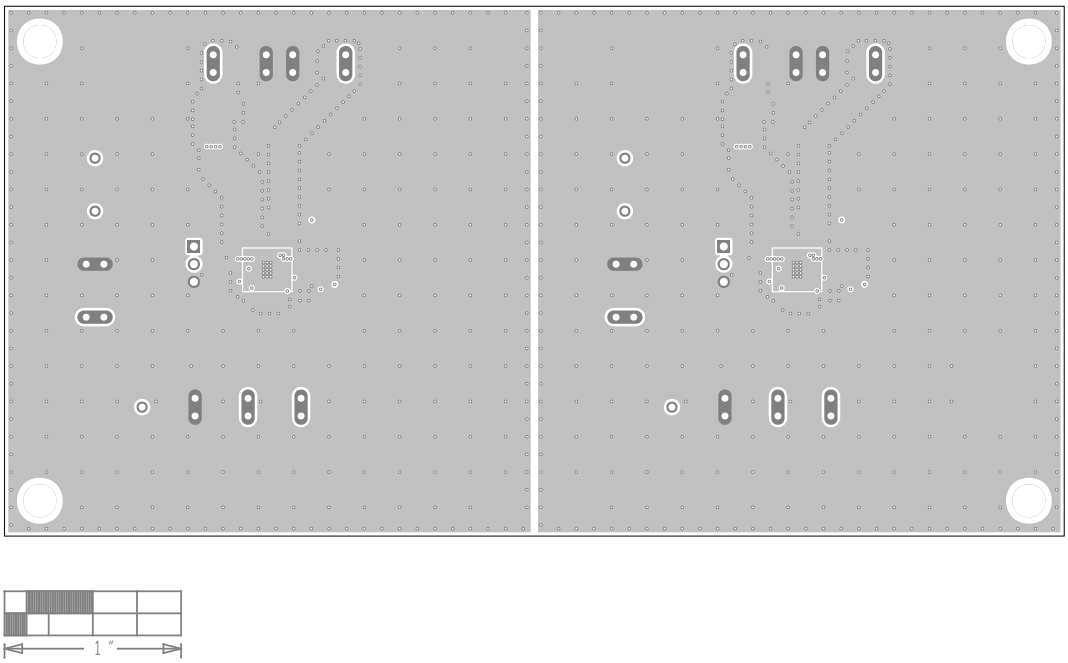


MAX17577EVKIT# and MAX17578EVKIT# EV Kits Component Placement Guide—Top Silkscreen

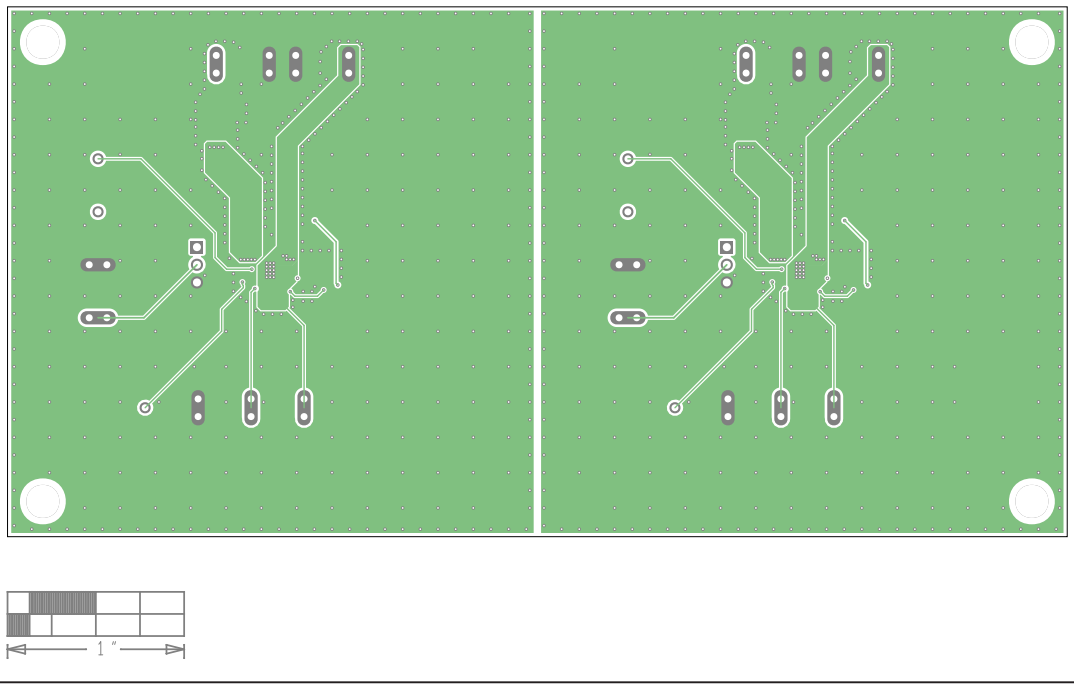


MAX17577EVKIT# and MAX17578EVKIT# EV Kits PCB Layout—Top Layer

MAX17577EVKIT# and MAX17578EVKIT# EV Kits PCB Layouts (continued)

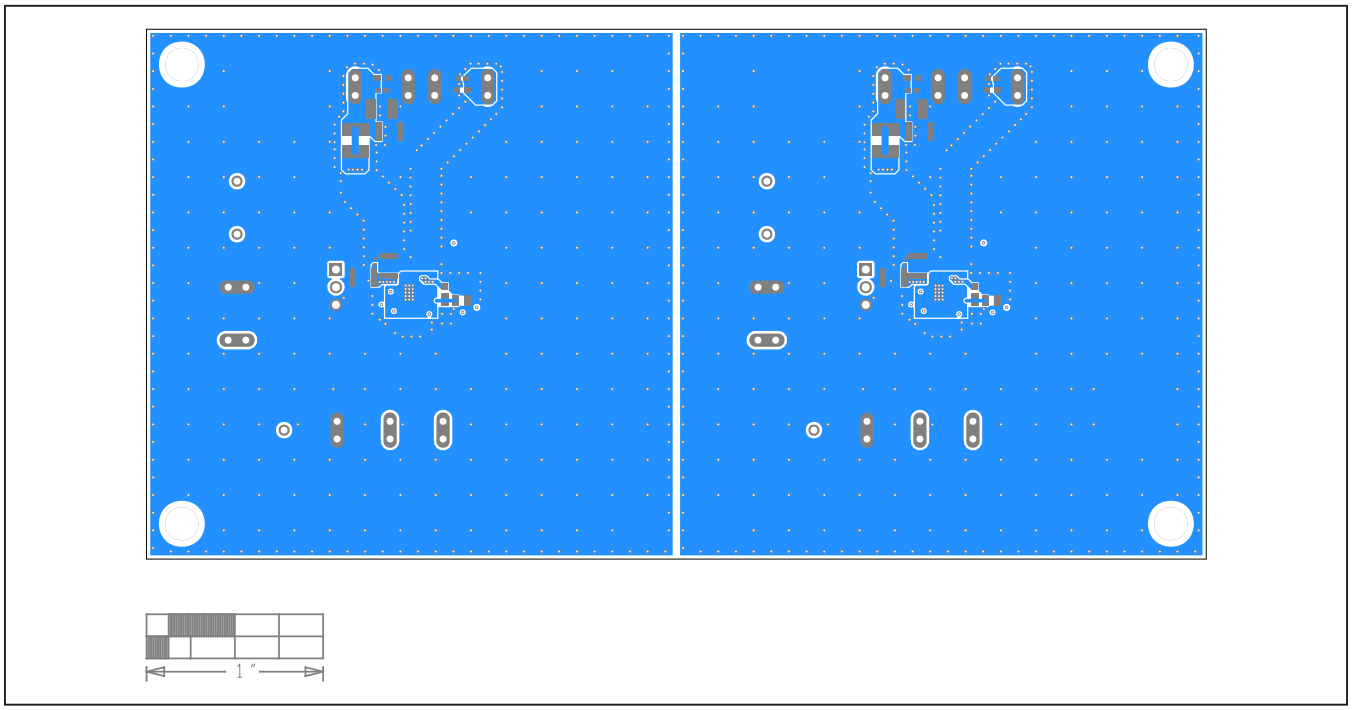


MAX17577EVKIT# and MAX17578EVKIT# EV Kits PCB Layout—Layer 2

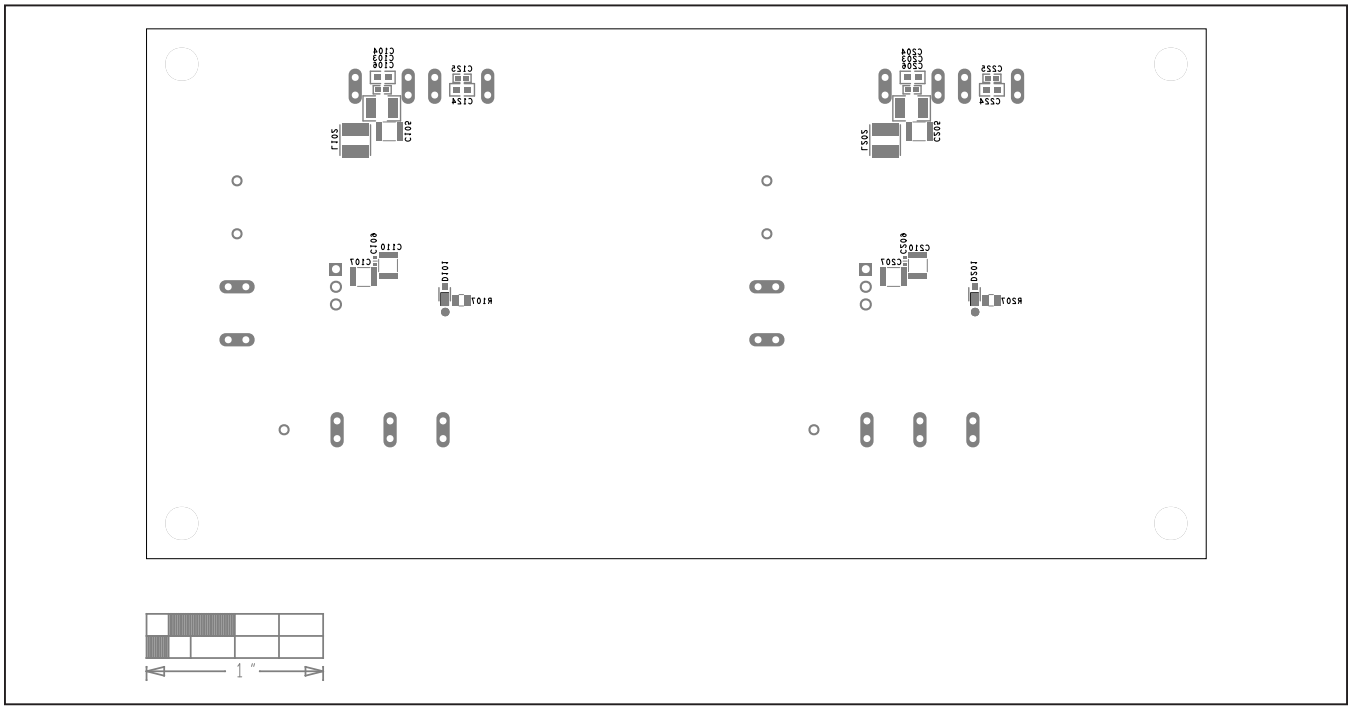


MAX17577EVKIT# and MAX17578EVKIT# EV Kits PCB Layout—Layer 3

MAX17577EVKIT# and MAX17578EVKIT# EV Kits PCB Layouts (continued)



MAX17577EVKIT# and MAX17578EVKIT# EV Kits PCB Layout—Bottom Layer



MAX17577EVKIT# and MAX17578EVKIT# EV Kits Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	12/20	Initial release	—

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