



MAX3806 Evaluation Kit

General Description

The MAX3806 evaluation kit (EV kit) is an assembled and tested demonstration board that simplifies evaluation of the MAX3806 receiver for optical distance measurement. The input can be configured to evaluate the receiver with and without a photodiode. The board is powered by a +5V supply and an optional +12V supply can be used for photodiode reverse bias. Simple 2-pin jumpers set the operational modes. SMA connectors at the input and output provide an easy interface to test equipment.

Features

- ◆ Powered by +5V Supply
- ◆ Input Configurable for Electrical and Optical Evaluation
- ◆ Selectable +5V or +12V Photodiode Reverse Bias
- ◆ 2-Pin Jumpers Set Operational Modes
- ◆ SMA Connectors for Input and Output

Ordering Information

PART	TYPE
MAX3806EVKIT+	EV Kit

+Denotes lead(Pb)-free and RoHS compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	33 μ F \pm 10% tantalum capacitor (C case) Nichicon F931C336MCC
C2, C4, C5	3	0.1 μ F \pm 10% ceramic capacitors (0603)
C3, C6	2	0.01 μ F \pm 10% ceramic capacitors (0603)
C7	1	2pF \pm 0.25pF ceramic capacitor (0603)
C8	1	1 μ F \pm 10% ceramic capacitor (0603)
D1	0	Photodiode (not installed)
J1, J2, J5	3	Test points Keystone 5000
J3, J4	2	SMA connectors, edge-mount, round contact Johnson 142-0701-801
JU1, JU2, JU3	3	1 x 2-pin headers (0.1in centers) Sullins PEC36SAAN

DESIGNATION	QTY	DESCRIPTION
JU4	1	1 x 3-pin headers (0.1in centers) Sullins PEC36SAAN
L1	1	Inductor (1210) Panasonic ELJ-PA470KF
L2	1	Shielded power inductor API Delevan, Inc. SDS680R-225M
R1	1	49.9 Ω \pm 1% resistor (0603)
R2	1	24.9k Ω \pm 1% resistor (0603)
R3	1	499 Ω \pm 1% resistor (0603)
R4	1	2k Ω \pm 1% resistor (0603)
TP1-TP5	5	Test points Keystone 5000
U1	1	Receiver for optical distance measurement (12 TQFN-EP*) Maxim MAX3806GTC+
—	4	Shunts for JU1-JU4 Sullins SSC02SYAN
—	1	PCB: MAX3806 EVKIT+ REV A

+Denotes a lead(Pb)-free/RoHS-compliant package.

*EP = Exposed pad.

MAX3806 Evaluation Kit

Quick Start

Electrical Evaluation

- 1) Remove bias inductor L2. This inductor is used only for optical evaluations.
- 2) Reinstall C7 and R2, if removed previously for optical evaluation.
- 3) Verify jumpers are installed on JU1 (DIS) and JU2 (GAIN). This enables the receiver and sets the gain to 60k Ω .
- 4) Remove jumper from JU3 (ATT). This sets the internal attenuator to 0dB.
- 5) Connect a +5V supply to J1 (+5V_VCC) and J2 (GND). Set the supply current limit to 20mA.
- 6) Connect an electrical pulse generator to the receiver input (SMA J3). Set the pulse amplitude = 258mVp (this converts to 10 μ Ap through on-board series 25k Ω resistor), width = 60ns, and period = 8 μ s.
- 7) Connect the receiver output (SMA J4) to a scope. Verify the scope input is set to high impedance. The output pulse amplitude should be approximately 600mVp.

Optical Evaluation

- 1) Remove C7 and R2.
- 2) Reinstall bias inductor L2, if removed previously for electrical evaluation.
- 3) Install photodiode D1 (not included with EV kit). The board layout accommodates through-hole and surface-mount photodiodes.
- 4) Verify jumpers are installed on JU1 (DIS) and JU2 (GAIN). This enables the receiver and sets the gain to 60k Ω .
- 5) Remove jumper from JU3 (ATT). This sets the internal attenuator to 0dB.
- 6) Connect a +5V supply to J1 (+5V_VCC) and J2 (GND). Set the supply current limit to 20mA.
- 7) Move jumper to left side of JU4 (side labeled +12V).
- 8) Connect a +12V supply to J5 (+12V_PD_BIAS). Set the supply current limit to 5mA.
- 9) Set up an optical pulse generator with peak amplitude = 10 μ W, width = 60ns, and period = 8 μ s. Use an optical-to-electrical (O/E) converter and scope to verify the transmitter pulse shape and amplitude.

- 10) Mount the EV kit in a fixture or place in a clamp and align the laser source to the photodiode.

- 11) Connect the receiver output (SMA J4) to a scope. Verify the scope input is set to high impedance. The pulse should appear on the scope. The pulse shape and amplitude depend on multiple factors including distance and alignment to the laser source, photodiode reverse bias voltage, capacitance and responsivity of the photodiode, and scope bandwidth.

Detailed Description

The MAX3806 EV kit is a simple board for evaluating the functionality and performance of the MAX3806 receiver. The input is configured for electrical evaluation using a passive network that emulates the response of a photodiode. A few components can be removed and a photodiode installed for optical evaluation (see the *Quick Start* section and Figures 1 and 2). Photodiode reverse bias is selected using a 3-pin jumper to be +5V (main board supply) or +12V, which requires a second supply. Two-pin jumpers set the operating modes for gain, attenuation, and output disable (see Table 1). Input and output SMA connectors provide an easy interface to 50 Ω test equipment such as a pulse generator, network analyzer, spectrum analyzer, and scope.

Photodiode Emulation

The input is configured for electrical evaluation after removing bias inductor L2. The input has an on-board 50 Ω termination and is AC-coupled to the receiver. There is a series resistor to transform voltage pulses to current pulses and a shunt capacitor connected directly at the input pin to help emulate the photodiode junction capacitance. This network provides an electrical interface to the IC that is similar, but not exactly the same, as a photodiode.

The input current is calculated as:

$$I_{IN} = V_{IN}/R_{IN}$$

V_{IN} = source voltage terminated into 50 Ω

R_{IN} = series resistor (R2) + MAX3806 input impedance

Note that the MAX3806 input impedance changes with the GAIN setting. See Table 2.

For example, with GAIN = 60k Ω and ATTENUATION = 0dB, a 258mVp input voltage generates a 10 μ Ap input current. The resulting MAX3806 output would be approximately 600mVp (10 μ A \times 60k Ω) when terminated into a high-impedance (2k Ω or greater) load.

MAX3806 Evaluation Kit

Table 1. Jumper Settings

COMPONENT	NAME	FUNCTION
JU1	DIS	Enables/disables output OPEN = output disabled SHORT = output enabled
JU2	GAIN	Selects transimpedance (gain) OPEN = 30k Ω gain SHORT = 60k Ω gain
JU3	ATT	Enables/disables internal attenuator OPEN = 0dB attenuation SHORT = 14dB attenuation
JU4	PHOTO DIODE REVERSE BIAS	Selects photodiode reverse bias voltage. Setting important only when photodiode is connected. Set jumper to right side to connect photodiode cathode to +5V provided from main supply. Set jumper to left side to connect photodiode cathode to +12V provided from +12V_PD_BIAS supply. The +12V_PD_BIAS supply can be set to any voltage less than +16V.

Table 2. MAX3806 Input Impedance

GAIN (k Ω)	JUMPER JU2 SETTING	INPUT IMPEDANCE (Ω)
60	SHORT	800
30	OPEN	300

The 25k Ω series resistor (R2) limits the input current range. Lower value resistors can be used to test larger input currents, but the currents should be limited to 2mA_p to ensure the receiver input is not damaged.

Photodiode Installation

The input can be configured for optical evaluation by installing a photodiode D1 and removing C7 and R2. The connections to the photodiode are through-holes with large plating on the top layer to accommodate both through-hole and surface-mount photodiodes. Note that the ground plane under the input network has been removed to minimize capacitance. The EV kit can be mounted in a fixture or placed in a clamp to align the laser source to the photodiode.

Transient Response

Transient response is most easily measured using a 50 Ω pulse generator and a high-impedance scope. For electrical evaluation, the voltage source is set to obtain the desired input current and the output voltage is measured at SMA J4 or test points TP4 and TP5. Make sure the scope is set for high impedance. If a probe is used, make

the ground loop as short as possible. For optical evaluation, the laser source is set to obtain the desired input current for a given photodiode responsivity. The output is measured the same way as the electrical evaluation.

Bandwidth Measurement

Bandwidth is most easily measured electrically using a network analyzer and the photodiode emulation circuit at the receiver input. The network analyzer should be calibrated at a power level \leq -6dBm to keep the receiver in the linear range. The peak-to-peak input current with GAIN = 60k Ω is calculated as:

$$I_{IN} = \frac{2\sqrt{50 \times \frac{10^{\frac{P_{IN}(dBm)}{10}}}{1000}}}{0.707 \times R_{IN}}$$

where $P_{IN}(dBm)$ is the network analyzer power level in dBm and R_{IN} is the series resistor (R2) + MAX3806 input impedance.

For example, with $P_{IN} = -6dBm$, GAIN = 60k Ω , and $R_{IN} = 25.8k\Omega$, the input current is 12 μ A_{p-p}.

Note that the gain is lower than expected because the MAX3806 output is driving the network analyzer 50 Ω input instead of a high-impedance load. Also note that the MAX3806 output impedance changes with ATT setting. See Table 3. The load does not affect bandwidth, but the gain with a 50 Ω load is needed to calculate input-referred noise.

MAX3806 Evaluation Kit

Table 3. MAX3806 Output Impedance

ATT (dB)	JUMPER JU3 SETTING	OUTPUT IMPEDANCE (Ω)
0	OPEN	51
14	SHORT	114

Bandwidth can also be measured using a photodiode, but it should be noted that the photodiode capacitance limits the bandwidth of the receiver.

Noise Measurement

Noise is most easily measured using a spectrum analyzer, such as the Agilent E4402B, that can measure channel power within a defined frequency band. The measured channel power is converted to voltage and divided by the receiver gain to obtain input-referred noise current. Note that the receiver gain is lower than expected because the MAX3806 output is driving the spectrum analyzer 50Ω input instead of a high-impedance load. Gain for the noise calculation should be obtained using a network analyzer before starting the noise measurement.

The receiver gain using a 50Ω load is calculated as:

$$\text{GAIN}(\text{with } 50\Omega \text{ load}) = R_{IN} \times 10^{\frac{S21(\text{dB})}{20}}$$

where $S21(\text{dB})$ is the receiver gain in dB measured using a network analyzer and R_{IN} is the series resistor ($R2$) + MAX3806 input impedance. Typically the gain is taken at a frequency within the flat portion of the frequency response (i.e., 5MHz).

For noise measurements without a photodiode, the input AC-coupling capacitor C3 must be removed to isolate the receiver input. The trace between C3 and the receiver input creates approximately 0.6pF of capacitance. Capacitor C7 then presents a known capacitance to the input. For noise measurements with a photodiode installed, R2 and C7 must be removed.

The input-referred noise is calculated as:

$$I_{\text{NOISE}} = \frac{\sqrt{50 \times \frac{10^{\frac{P_{\text{OUT}}(\text{dBm})}{10}}}{1000}}}{\text{GAIN}(\text{with } 50\Omega \text{ load})} \times 10^9$$

where $P_{\text{OUT}}(\text{dBm})$ is the measured channel power with no input signal applied and I_{NOISE} has units nARMS.

For example, with settings of $\text{GAIN} = 60\text{k}\Omega$ and $\text{ATT} = 0\text{dB}$, the measured gain at 5MHz using a network analyzer (50Ω load) would be approximately $30\text{k}\Omega$. Using $30\text{k}\Omega$ gain and -54.5dBm of measured channel power ($f < 100\text{MHz}$), results in 14nARMS input-referred noise.

MAX3806 Evaluation Kit

Evaluates: MAX3806

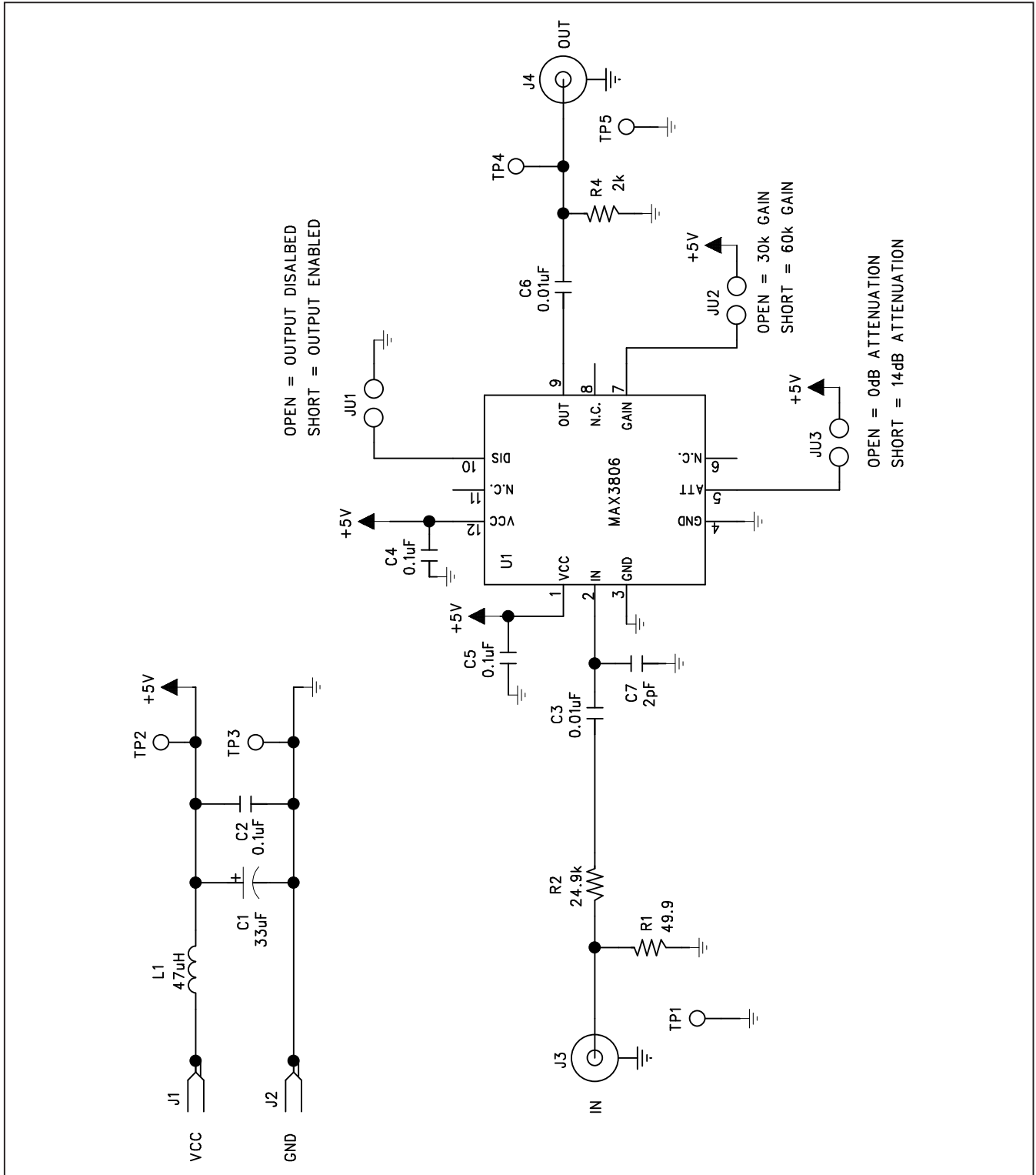


Figure 1. MAX3806 EV Kit Schematic—Electrical Configuration

MAX3806 Evaluation Kit

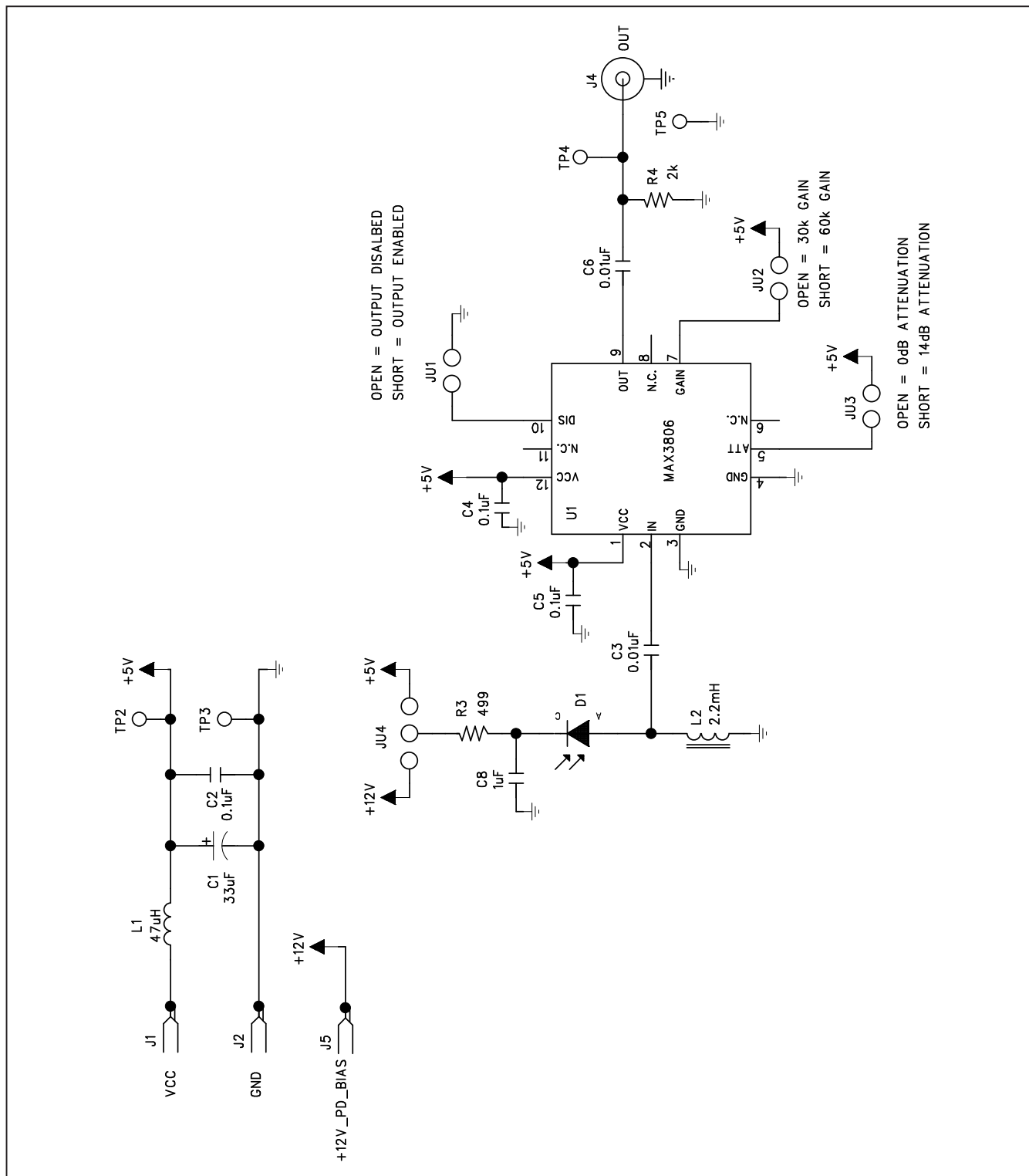


Figure 2. MAX3806 EV Kit Schematic—Optical Configuration

MAX3806 Evaluation Kit

Evaluates: MAX3806

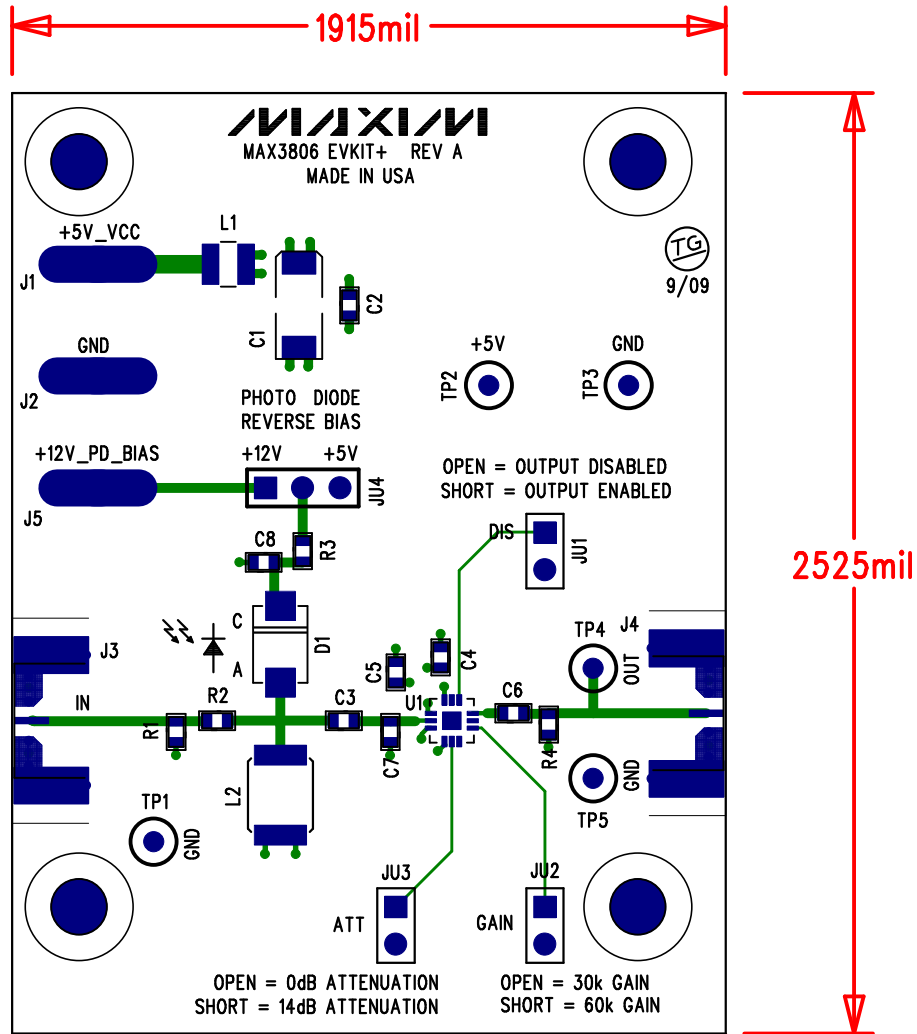


Figure 3. MAX3806 EV Kit Component Placement Guide—Component Side

MAX3806 Evaluation Kit

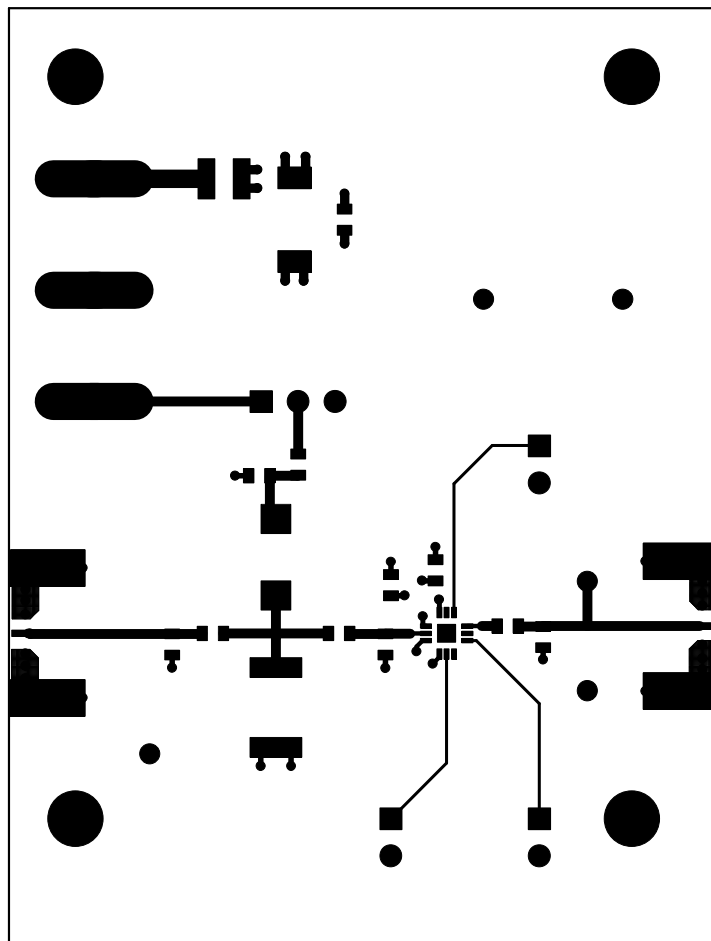


Figure 4. MAX3806 EV Kit PCB Layout—Component Side

MAX3806 Evaluation Kit

Evaluates: MAX3806

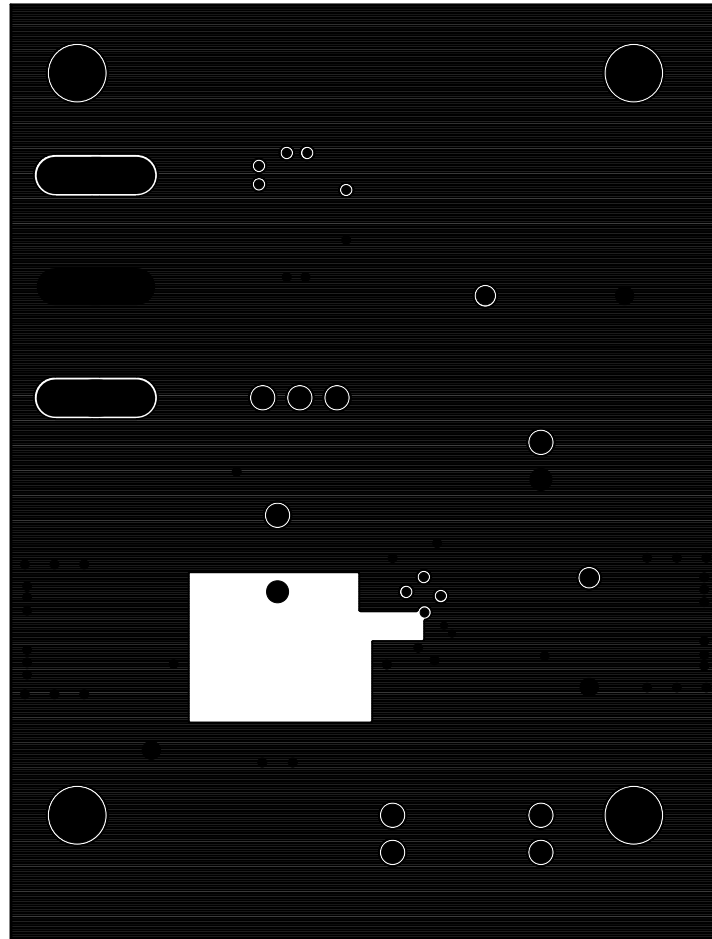


Figure 5. MAX3806 EV Kit PCB Layout—Ground Plane

MAX3806 Evaluation Kit

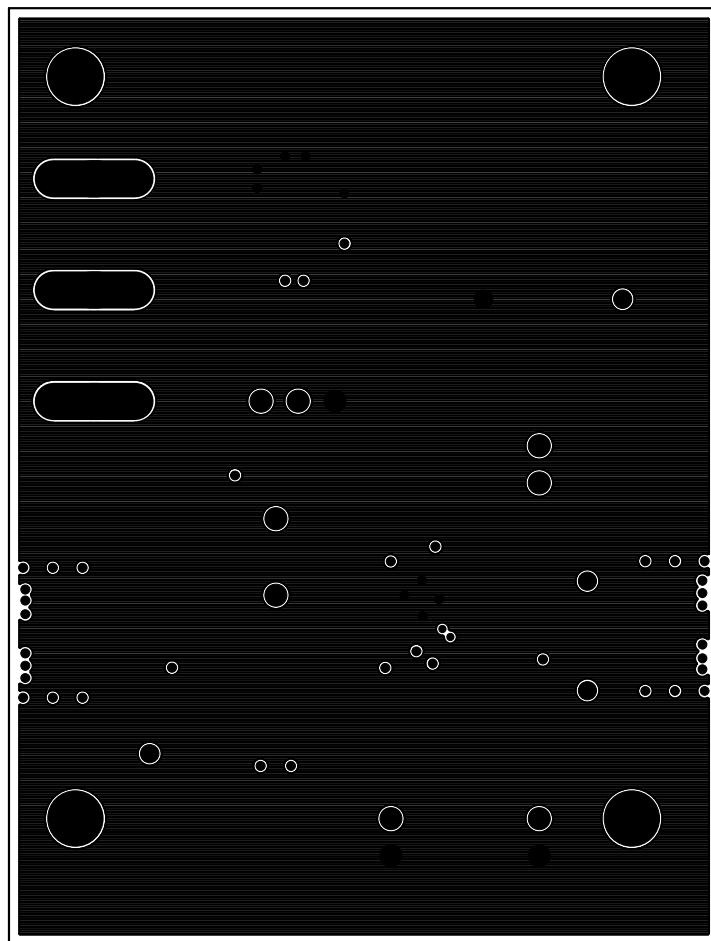


Figure 6. MAX3806 EV Kit PCB Layout—Power Plane

MAX3806 Evaluation Kit

Evaluates: MAX3806

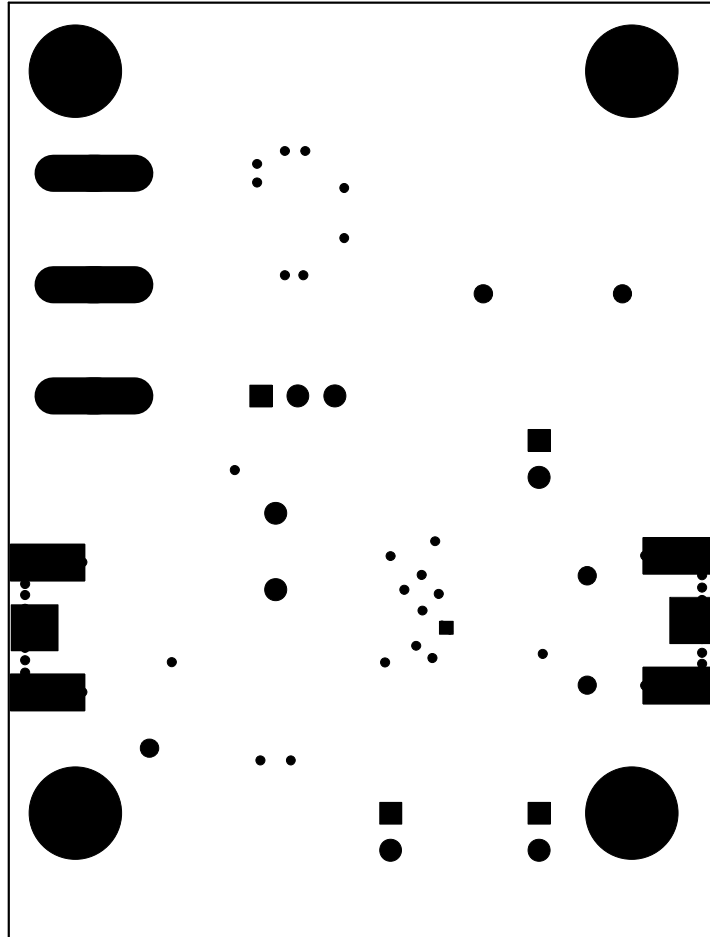


Figure 7. MAX3806 EV Kit PCB Layout—Solder Side

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