MAX77859 Evaluation Kit

Evaluates: MAX77859 (WLP)

General Description

The MAX77859 evaluation kit (EV kit) is a fully assembled and tested printed circuit board (PCB) that demonstrates the MAX77859, a high-efficiency, high-performance buck-boost regulator with a peak switching current of 7.8A. It supports USB Type-C PPS requirements with programmable output voltage (20mV/step) and programmable output current limit (50mA/step). The IC is capable of 2.5V to 22V input and dynamically adjustable output (through I²C serial interface) between 3.2V to 16V (internal feedback) or between 3V to 20V (external feedback). The EV kit is factory-configured as internal feedback with a default startup output voltage of 5V. Other startup voltages can be achieved with external feedback resistors.

I/O pins are available to support the I²C serial interface, enable function, forced-PWM mode, and interrupt/power-OK indicator. The I²C target address, switching current limit, and feedback configuration can be adjusted by changing the R_{SEL} resistor (R9). MAXUSB_INTERFACE# allows the use of Windows®-based software with a friendly graphical user interface (GUI) as well as a detailed register-based interface to exercise all features of the IC. The EV kit is compatible with any version of the MAX77859 WLP IC (MAX77859AEWO+T is the default one installed).

Features

- Proven PCB Reference Design and Layout Benefit
- Fully Assembled and Tested
- Sense Points for High-Accuracy Measurements
- Accessible Test Point Pins for EN, FPWM, POKB/INTB, V_{IO}, and I²C Serial Interface SCL, SDA
- MAXUSB_INTERFACE# Allows Easy Communication with a Windows PC
- GUI Software that Drives I²C Serial Interface for Optional Software Control
- Startup Output Voltage Adjustable Through External Feedback Resistors
- Output Voltage and Output Current Limit Dynamically Adjustable Through I²C Serial Interface
- I²C Target Address, Switching Current Limit, and Feedback Configuration Adjustable Using R_{SEL} (R9)

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

Check List

- MAX77859 IC Evaluation Board
- MAXUSB_INTERFACE# (USB-to-I²C Serial Interface)
- USB Type-A to Micro-USB Cable
- Windows-based Graphical User Interface (GUI) Software
  - Can be downloaded from the Analog Devices website at *https://www.analog.com/MAX77859WEVKIT* (under the *Tools & Simulation* tab). Windows 7 or newer is required to use the EV kit GUI software.

EV Kit Specifications

SPECIFICATION	TEST CONDITION	MIN	TYP	MAX	UNIT
Input voltage		2.5		22	V
Output voltage	Internal feedback	3.2		16	V
	External feedback	3		20	
Default output voltage	Internal feedback		5		V
Switching current limit			7.8		A
Peak efficiency	V_{IN} = 7.6V, V_{OUT} = 9V, 1500mA load		96.0		%

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Windows is a registered trademark and registered service mark of Microsoft Corporation.

319-100993; Rev 0; 4/23

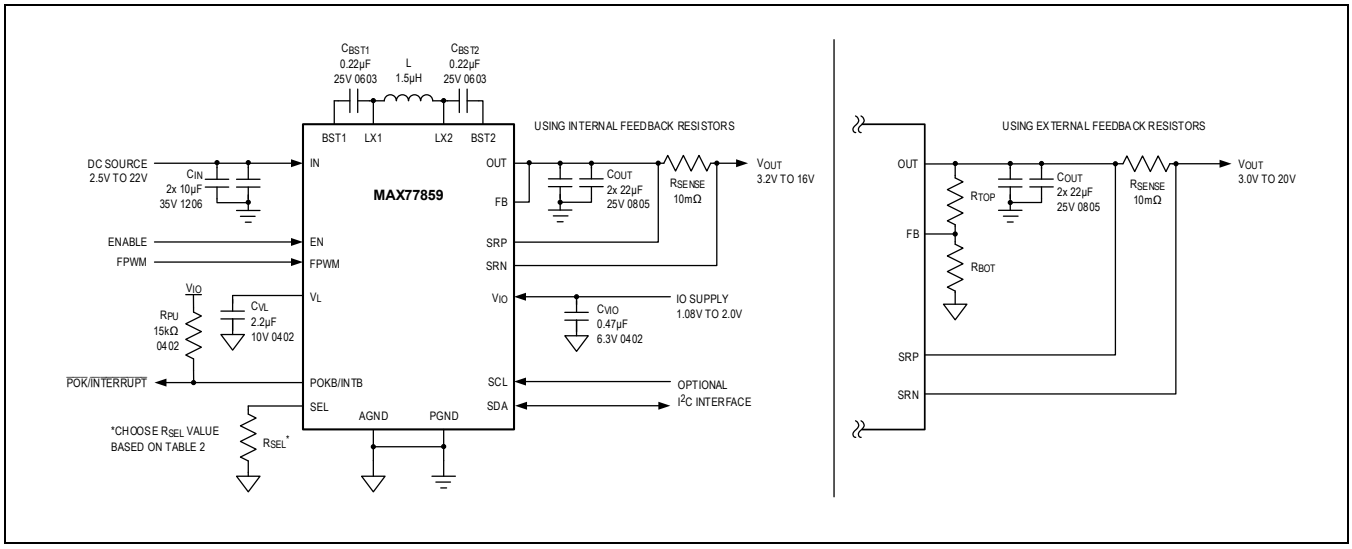


Figure 1. MAX77859 Typical Application Circuit

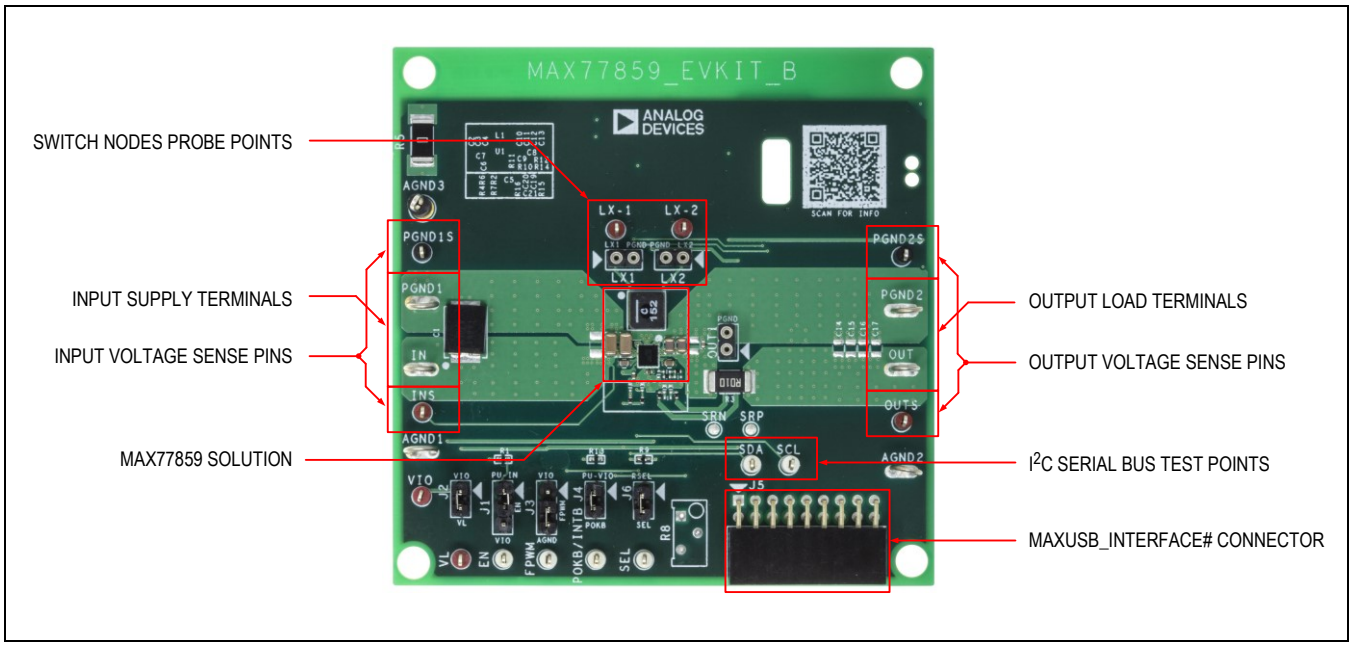


Figure 2. MAX77859 Evaluation Board

EV Kit Default Configuration

With the default jumper settings listed in *Table 1* and the EV kit component values of R_{SEL} (R9) = 0Ω, R_{TOP} (R10) = 0Ω, and R_{BOT} (R11) = OPEN, the MAX77859 EV kit is configured with the following settings:

- Internal Feedback
- Switching Current Limit = 7.8A
- I^2C Target Address (7-Bit) = 0x66
- Switching Frequency = 1.5MHz (adjustable only through I^2C)
- Auto-SKIP Mode
- V_{IO} Disconnected from V_L
- EN Controlled from V_{IO} (as opposed to controlled from V_{IN})

See the *EV Kit Hardware* section to change the EV kit configuration.

Table 1. Default Shunt Positions and Jumper Descriptions

JUMPER	NODE	SHUNT POSITION	FUNCTION
J1	EN	1-2*	Connects EN to V_{IN} through a 510kΩ pullup resistor for standalone operation. See the *Standalone Operation* section for more information.
		2-3	Connects EN to V_{IO}. The converter is enabled when both V_{IN} and V_{IO} are valid.
		Not installed	Floats EN. Use for controlling EN from an external logic signal. The converter is disabled if no external logic signal is connected to EN.
J2	V_{IO}	1-2*	Connects V_{IO} to V_L. Allows V_{IO} to be powered from V_L without the need for a separate V_{IO} supply. See the *Standalone Operation* section for more information.
		Not installed	Disconnects V_{IO} from V_L. V_{IO} needs to be powered from either MAXUSB_INTERFACE# or an external V_{IO} supply.
J3	FPWM	1-2	Connects FPWM to V_{IO}. The converter operates in forced-PWM mode.
		2-3*	Connects FPWM to AGND. The converter operates in auto-SKIP mode. Forced-PWM mode can be enabled through I^2C.
J4	POKB/INTB	1-2*	Connects POKB/INTB to V_{IO} through a 15kΩ pullup resistor.
		Not installed	Floats POKB/INTB.
J6	SEL	1-2*	Connects SEL to R9 pulldown resistor.
		Not installed	Floats SEL.

**Default position*

Quick Start

Required Equipment

- MAX77859 EV kit
- Adjustable DC power supply
- Digital multi-meters
- Electronic load
- MAXUSB_INTERFACE# for I^2C serial interface (optional)
- USB Type-A to Micro-USB cable (optional)
- Windows-based PC with MAX77859 EV kit GUI (optional)

Setup Overview

Typical bench setups for the MAX77859 EV kit with different configurations are shown in *Figure 3*, *Figure 4*, and *Figure 5*.

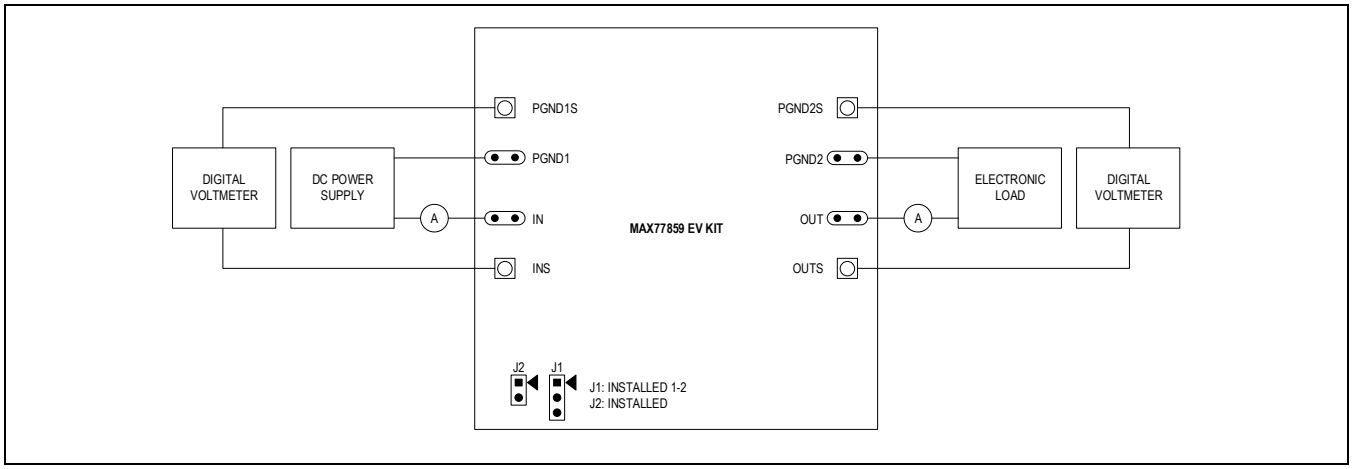


Figure 3. EV Kit Connection Block Diagram—Standalone Operation

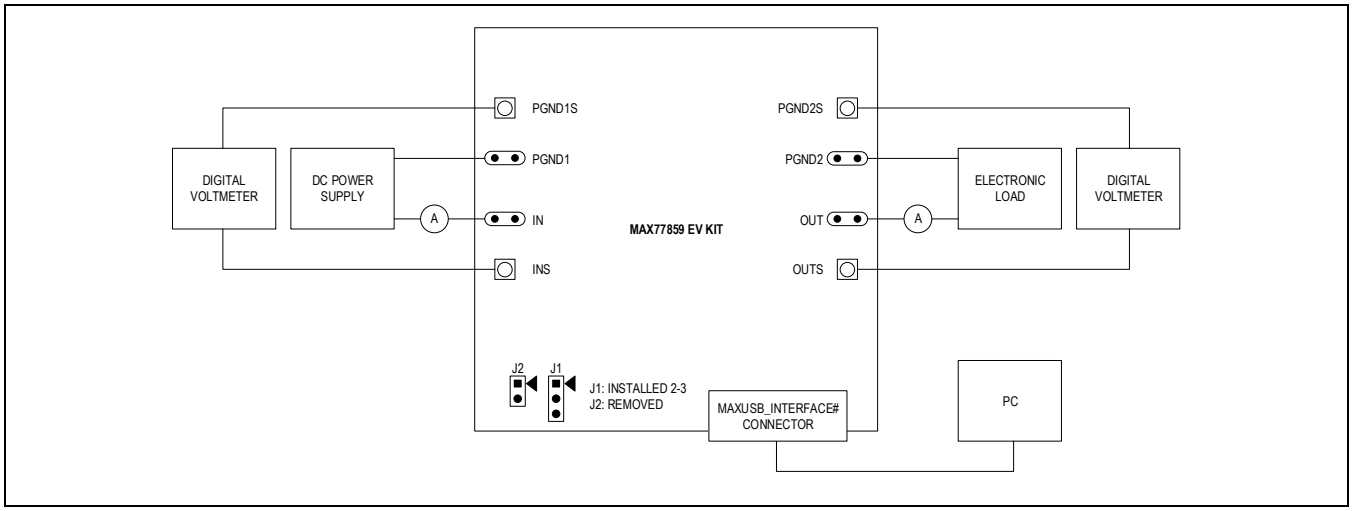


Figure 4. EV Kit Connection Block Diagram—with MAXUSB_INTERFACE#

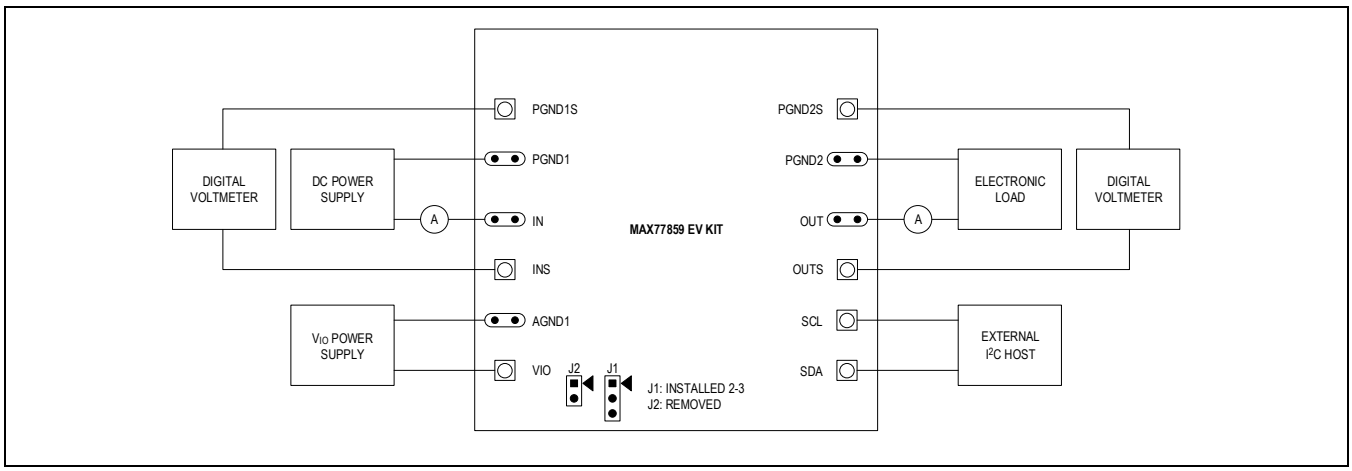


Figure 5. EV Kit Connection Block Diagram—with External I^2C Bus

Procedure

The EV kit is fully assembled and tested. Perform the following steps to verify board operation. Use twisted wires of appropriate gauge (20 AWG) that are as short as possible to connect the load and power sources.

Note: In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the evaluation software. Text in **bold and underlined** refers to items from the Windows operating system.

1. Ensure the EV kit has the correct jumper settings, as shown in *Table 1*.
2. Connect a voltmeter (DVM1) to INS and PGND1S sense pins to measure input voltage.
3. Connect a voltmeter (DVM2) to OUTS and PGND2S sense pins to measure the output voltage.
4. Apply a power supply set to 0V (1.5A current limit) through an ammeter across the IN and PGND1 terminals of the EV kit. Turn the power supply on and increase the voltage to 7.6V.
5. Confirm the DVM2 reads the default output voltage of the EV kit (5V). Confirm the ammeter reads the expected input supply current (about 360µA).
6. Now that the EV kit is confirmed working, short out the series ammeter and increase the power supply's current limit. Connect an electronic load across the OUT and PGND2 terminals to evaluate the performance of the MAX77859 buck-boost regulator.

The next steps in the procedure use the EV kit GUI and MAXUSB_INTERFACE# to evaluate the MAX77859's I²C serial interface. If such evaluation is not required, you can skip the following steps. The EV kit includes onboard 2.2kΩ pullup resistors (R4 and R7) to V_{IO} for I²C serial interface signals SDA and SCL.

7. Install GUI software. Visit the product webpage at *https://www.analog.com/MAX77859WEVKIT* and navigate to *Tools & Simulation* to download the latest version of the EV kit software. Save the EV kit software installation file to a temporary folder and decompress the ZIP file. Run the .EXE installer and follow the on-screen instructions to complete the installation.
8. Turn off the input power supply connected in Step 4.
9. Remove jumper J2. V_{IO} is later powered from the MAXUSB_INTERFACE#'s onboard LDO. Move jumper J1 to position 2-3.
10. Ensure SW1 and SW2 switches on the MAXUSB_INTERFACE# are set to the ON position. This enables the I²C mode on the MAXUSB_INTERFACE#.
11. **Important:** Ensure the V_L jumper on the MAXUSB_INTERFACE# (J5) is set to 1.8V. This sets the MAXUSB_INTERFACE#'s V_{IO} voltage. Setting this incorrectly to 3.3V could potentially damage the MAX77859 IC.
12. Connect the MAXUSB_INTERFACE# to the EV kit. Connect the MAXUSB_INTERFACE# to your PC's USB port using a USB Type-A to Micro-USB cable.
13. Turn on the input power supply.
14. On the PC, open the GUI and click the **Device** button in the menu bar. Click the **Connect** button in the **Device** button's drop-down list. Wait for the device to respond, and in the **Synchronize** window, press the **Connect and Read** button.
15. Drag the slider bar in the **Output Voltage Configuration** section to change the output voltage and click **Write**.
16. Confirm on DVM2 that the software command to change output voltage was successful. If so, the I²C serial interface is confirmed working.

This concludes the Quick Start procedure. Users are now encouraged to further explore the device and its register settings with the GUI software. For more information about the GUI, see the *EV Kit Software* section.

EV Kit Hardware

The MAX77859 EV kit demonstrates the MAX77859 buck-boost regulator. It regulates output from input voltage ranges from 2.5V to 22V. The programmable output range is from 3.2V to 16V with internal feedback resistors, or from 3V to 20V with external feedback resistors. The EV kit is equipped with a general DC input. *Table 1* lists jumpers and associated functions that are available on the EV kit.

Standalone Operation

The MAX77859 is capable of standalone operation, in which the IC starts up whenever V_{IN} and EN are valid, and it does not require a separate supply for the V_{IO} pin. This is useful for systems without a host controller or if the MAX77859 is the only power supply in the system. To configure the MAX77859 EV kit for standalone operation, install header jumper

J1 to position 1-2. This connects EN to V_{IN} through a 510kΩ pullup resistor so that EN is controlled by V_{IN}. Also, install header jumper J2. This connects V_{IO} to V_L so that V_{IO} is powered from V_L, eliminating the need for an external V_{IO} power supply.

MAXUSB_INTERFACE#

The MAXUSB_INTERFACE# along with the companion EV kit GUI software allows users to easily change the MAX77859's register settings with a Windows PC. Before connecting the MAXUSB_INTERFACE# to the EV kit's MAXUSB_INTERFACE# connector (J5), make sure the MAXUSB_INTERFACE# is configured with the following settings:

- SW1, SW2 to ON Position (This enables I²C mode on the MAXUSB_INTERFACE#.)
- V_L Jumper (J5) to 1.8V (This sets the MAXUSB_INTERFACE#'s V_{IO} voltage.)
  - **Warning:** Setting this incorrectly to 3.3V could potentially damage the MAX77859 IC.

The MAXUSB_INTERFACE# also includes an onboard LDO that can supply the necessary voltage to V_{IO}. If you are using the MAXUS_INTERFACE#, disconnect any external V_{IO} supply from the EV kit, and make sure header jumper J2 is removed from the EV kit.

External I²C Bus

If you wish to connect to the external I²C serial bus and not use the MAXUSB_INTERFACE#, unplug the MAXUSB_INTERFACE# from the EV kit's MAXUSB_INTERFACE# connector (J5). Apply an external I/O supply to the V_{IO} pin or power the V_{IO} pin from the V_L pin by connecting the header jumper J2.

Warning: Make sure the external I²C serial bus's logic voltage level is compatible with the MAX77859's I/O logic voltage level (2.0V max). Refer to the *MAX77859* IC data sheet for more information regarding the I/O logic voltage level.

R_{SEL} Configuration Resistor

The MAX77859 includes an SEL pin to set the I²C target address, switching current limit, and feedback configuration. A resistor with 1% tolerance (or better) should be chosen for R_{SEL} (R9). The default R_{SEL} value installed on the EV kit is 0Ω. See *Table 2* for nominal R_{SEL} values and their corresponding settings. The switching current limit is also adjustable dynamically through the I²C serial interface when the IC is enabled. See the *EV Kit Software* section for more information.

Table 2. MAX77859 R_{SEL} Selection Table

R_{SEL} (Ω)	FEEDBACK RESISTOR SELECTION	TYPICAL I_{LIM} (A)	I²C TARGET ADDRESS (7-BIT)	R_{SEL} (Ω)	FEEDBACK RESISTOR SELECTION	TYPICAL I_{LIM} (A)	I²C TARGET ADDRESS (7-BIT)
0*	Internal feedback resistors	7.8	110 0110 (0x66)	3740	External feedback resistors	7.8	110 0110 (0x66)
200			110 0111 (0x67)	8060			110 0111 (0x67)
309			110 1110 (0x6E)	12400			110 1110 (0x6E)
422			110 1111 (0x6F)	16900			110 1111 (0x6F)
536		5.8	110 0110 (0x66)	21500		5.8	110 0110 (0x66)
649			110 0111 (0x67)	26100			110 0111 (0x67)
768			110 1110 (0x6E)	30900			110 1110 (0x6E)
909			110 1111 (0x6F)	36500			110 1111 (0x6F)
1050		3.8	110 0110 (0x66)	42200		3.8	110 0110 (0x66)
1210			110 0111 (0x67)	48700			110 0111 (0x67)
1400			110 1110 (0x6E)	56200			110 1110 (0x6E)
1620			110 1111 (0x6F)	64900			110 1111 (0x6F)
1870		2.0	110 0110 (0x66)	75000		2.0	110 0110 (0x66)
2150			110 0111 (0x67)	86600			110 0111 (0x67)
2490			110 1110 (0x6E)	100000			110 1110 (0x6E)
2870			110 1111 (0x6F)	OPEN			110 1111 (0x6F)

**Default value installed on the EV kit*

Output Voltage Configuration

By default, the EV kit is configured to use internal feedback resistors with a 5V default startup output voltage and an output voltage range from 3.2V to 16V. To achieve a different default startup output voltage other than 5V, or to achieve a lower minimum output voltage range down to 3V or a higher maximum output voltage range up to 20V, external feedback resistors are required. To change the EV kit to an external feedback configuration, replace the feedback resistor R_{TOP} (R10) and R_{BOT} (R11) with appropriate value resistors (use resistors with 1% tolerance or better) and adjust R_{SEL} (R9) accordingly to select the external feedback option. If V_{OUT} is 6V or below, it is also recommended to install a 10pF feed-forward capacitor on C9 when using external feedback.

To select appropriate external feedback resistor values, first chose R_{TOP} (R10) to be between 150kΩ and 330kΩ. Then calculate the value of R_{BOT} (R11) for a desired startup output voltage with the following equation:

$$R_{BOT} = \frac{R_{TOP} \times V_{REF}}{V_{OUT} - V_{REF}}$$

Where V_{REF} is 0.30518V and V_{OUT} is the desired startup output voltage. Note that the output voltage cannot exceed the maximum output voltage of 20V. The recommended external feedback resistor values for common output voltages are listed in *Table 3*.

After startup, the output voltage can be adjusted dynamically using the I^2C serial interface. See the *EV Kit Software* section for more information. When using internal feedback, output voltage ranges are between 3.2V and 16V in 20mV steps. When using external feedback, output voltage range and step size vary based on the external feedback resistor values. To calculate the output voltage range, use the following equation and plug in the minimum V_{REF} of 0.19531V and maximum V_{REF} of 0.97656V:

$$V_{OUT} = \frac{V_{REF}}{R_{BOT}} \times (R_{BOT} + R_{TOP})$$

Output voltage step size can be calculated with the following equation:

$$V_{OUT\_STEP} = \frac{1.22mV}{R_{BOT}} \times (R_{BOT} + R_{TOP})$$

Programmable output voltage ranges and output voltage step sizes for each recommended feedback resistor pair are listed in *Table 3*.

Table 3. Feedback Resistor Value Recommendations

DEFAULT V_{REF} (V)	R_{TOP} R10 (kΩ)	R_{BOT} R11 (kΩ)	STARTUP V_{OUT} (V)	PROGRAMMABLE V_{OUT} RANGE (V)	V_{OUT} STEP SIZE (mV)
0.30518	205	23.2	3	3.0 to 9.61	12
	162	16.5	3.3	3.0 to 10.56	13.2
	Internal feedback resistors*		5	3.2 to 16	20
	160	5.62	9	5.76 to 20	36
	182	4.75	12	7.68 to 20	48
	180	3.74	15	9.6 to 20	60
	330	5.11	20	12.81 to 20	80

**Default EV kit configuration*

High-Temperature Testing

The MAX77859 is rated for operation under junction temperatures up to +125°C. Note that not all components on the EV kit are rated for temperatures this high. Some ceramic capacitors experience extra leakage when put under temperatures higher than they are rated for and supply current readings for the IC might be larger than expected. The MAXUSB_INTERFACE# is also not rated for +125°C. Double-check the components on the EV kit if testing at +125°C

ambient or junction temperatures. Consider replacing these components if IC operation at +125°C ambient or junction temperature is an important use case.

List of capacitors not rated for +125°C: C1 (IN bulk capacitor), C10, C11 (OUT capacitors)

Critical Node Measurement (OUT and LX)

The EV kit comes with probe points for measuring critical nodes OUT1, LX1, and LX2. See *Figure 2* for their locations on the EV kit. Use these probe points to eliminate as much noise as possible when measuring the critical nodes. To ensure the best results, use a very short ground wire from the ground sleeve of the scope probe to the GND side of the probe point, and use the bare tip of the probe directly to the signal side of the probe point (*Figure 6*). Following these guidelines gives the most accurate results when measuring parameters such as output voltage ripple, switching waveforms, and load transient response.

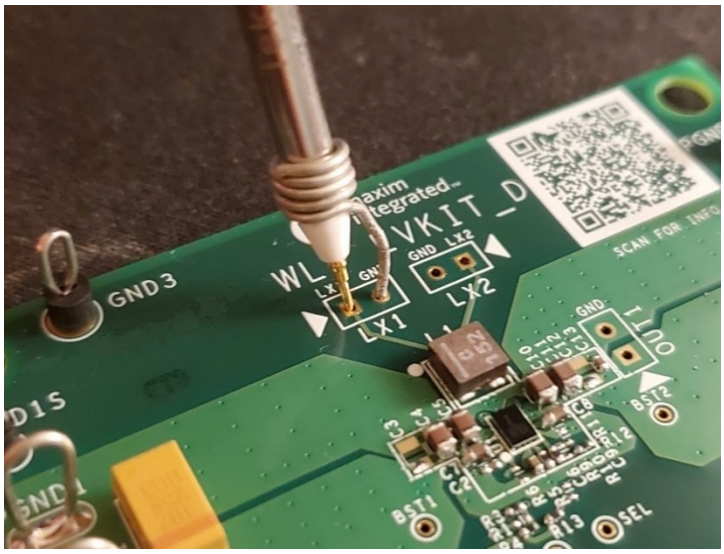


Figure 6. Probing Critical Nodes

Efficiency Measurement (INS and OUTS)

The EV kit also comes with sense pins for accurately measuring input voltage (INS, PGND1S) and output voltage (OUTS, PGND2S). See *Figure 2* for their locations on the EV kit. For the most accurate efficiency, load regulation, and line regulation measurements, use these sense pins to measure input and output voltages.

Warning: These sense pins are only for measuring voltages. Do not connect the input supply to input sense pins and do not connect an electronic load to output sense pins, as these sense pins are not designed to have current running through them. Doing so damages the EV kit. Use input supply terminals for connecting to the input supply and use output terminals for connecting to the electronic load, as shown in *Figure 2*.

Table 4. Usage of Critical Test Points

LOAD TRANSIENT, OUTPUT RIPPLE	LOAD REGULATION, LINE REGULATION, V_{OUT} ACCURACY	EFFICIENCY		SWITCHING NODE	
		OUTPUT VOLTAGE	INPUT VOLTAGE	LX1	LX2
V_{OUT} (OUT1)	V_{OUT} (OUTS, PGND2S)	V_{OUT} (OUTS, PGND2S)	V_{IN} (INS, PGND1S)	LX1 (LX1)	LX2 (LX2)

EV Kit Software

The graphical user interface (GUI) software allows for a quick, easy, and thorough evaluation of the MAX77859. The GUI along with the MAXUSB_INTERFACE# drives I2C communication with the EV kit. Every control in the GUI corresponds directly to a register within the MAX77859. Refer to the *Register Map* section of the MAX77859 IC data sheet for a complete description of the registers. See *Figure 7* for a screenshot of the GUI upon first opening.

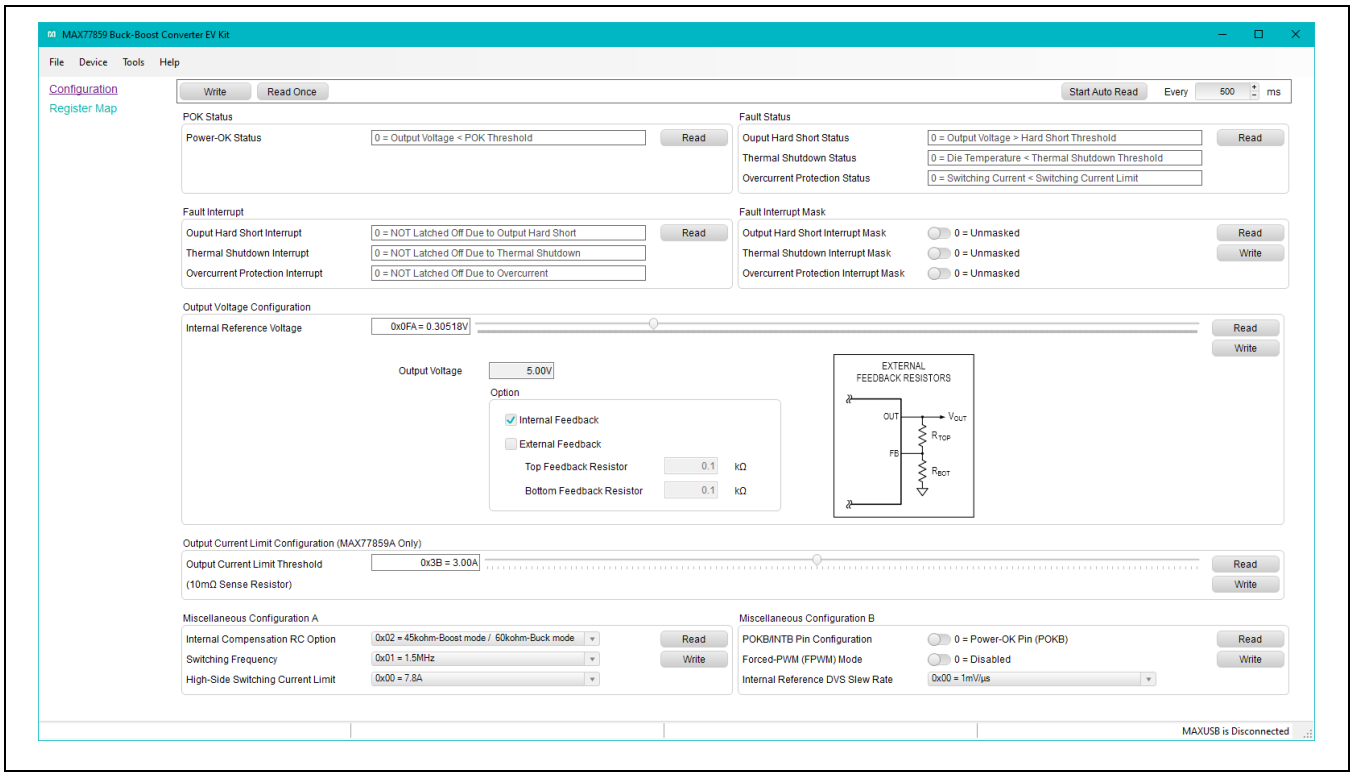


Figure 7. MAX77859 EV Kit GUI Software Configuration Tab

Installation

Visit the product webpage at *https://www.analog.com/MAX77859WEVKIT* and navigate to *Tools & Simulation* to download the latest version of the EV kit software. Save the EV kit software installation file to a temporary folder and decompress the ZIP file. Run the .EXE installer and follow the on-screen instructions to complete the installation.

Windows Driver

After plugging in the MAXUSB_INTERFACE# to the PC with a Micro-USB cable for the first time, wait about 30 seconds for Windows to automatically install the necessary drivers.

Connecting the GUI to MAXUSB_INTERFACE#

After opening the GUI, click **Device** in the upper left corner of the GUI window. Click **Connect** in the drop-down menu. If you have multiple MAXUSB_INTERFACE# adapters or FTDI devices connected to your PC, the **Port Synchronization** menu appears (*Figure 8*). Select the port corresponding to the MAXUSB_INTERFACE# attached to the MAX77859 EV kit and click **Connect**.

The **Device Synchronization** menu opens (*Figure 9*) once the MAX77859 IC responds (voltages on the IN and V_{IO} pins must be valid on the MAX77859 IC for it to respond). The I2C address shown is the MAX77859 ICs 7-bit target address. The address shown changes depending on the EV kit's R_{SEL} configuration. See the EV Kit Hardware *R_{SEL} Configuration Resistor* section to change the address. Click **Connect and Read**. The text at the bottom right of the GUI window changes from "MAXUSB is Disconnected" to "MAXUSB is Connected."

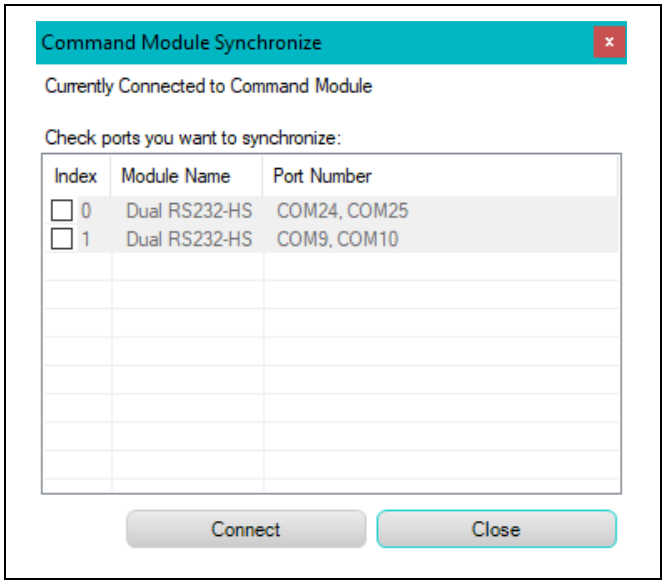


Figure 8. Port Synchronization Menu

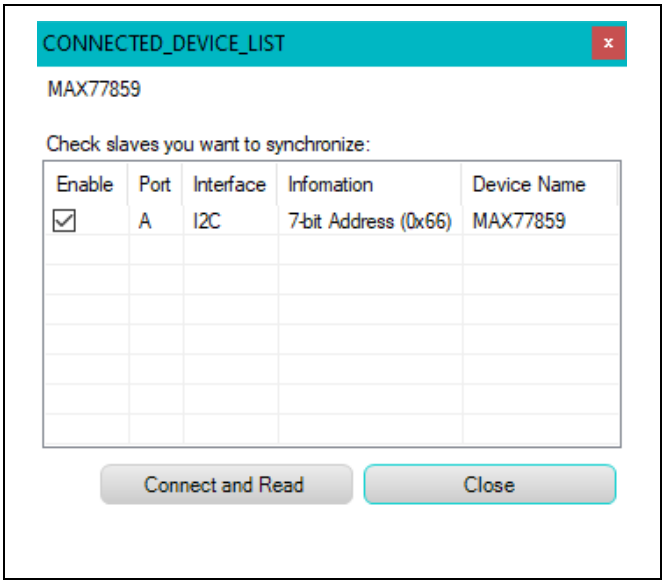


Figure 9. Device Synchronization Menu

Configuration

The **Configuration** tab (*Figure 7*) displays information and the status of the IC on the EV kit as well as all available register settings. It is divided into different sections: POK and Fault Status/Interrupts, Output Voltage Configuration, Output Current Limit Configuration (MAX77859A Only), and Miscellaneous Configurations.

Click **Read Once** located on the top of the GUI window to obtain all setting values currently stored on all the MAX77859's registers. After changing the setting values in the GUI software, click **Write** on the top of the GUI window to apply all settings to the MAX77859's registers. Alternatively, click **Read** on each setting section to obtain the setting values of that particular section currently stored on the MAX77859's registers. After changing the setting values in the GUI software, click **Write** in the corresponding setting section to apply the new settings for that particular section to the MAX77859's registers.

The **POK Status** and **Fault Status** sections (*Figure 10*) display the real-time Power-OK status and fault conditions detected on the MAX77859 IC, which are stored in the STATS register. Periodically check these sections during evaluation to monitor the status of Power-OK (POK), output hard-short, thermal shutdown (THS), and overcurrent protection (OCP). Click **Read** to obtain the latest status from the IC.

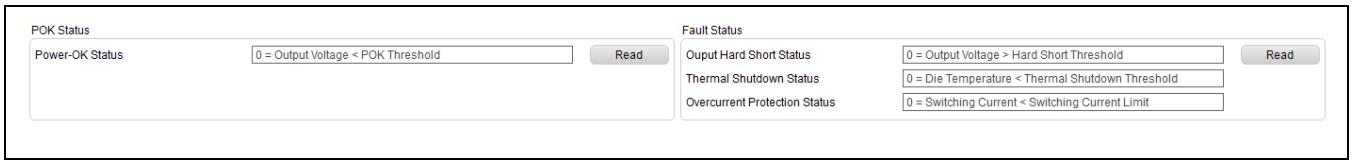


Figure 10. Configuration Tab—POK Status and Fault Status Sections

The **Fault Interrupt** section (*Figure 11*) displays any fault-caused interrupts detected on the MAX77859 IC, which are stored in the INT register. Check this section to identify the cause of fault-induced IC latch-off. Click **Read** to obtain the interrupt information from the IC (reading it also clears the interrupt).

The **Fault Interrupt Mask** section (*Figure 11*) provides settings to mask off any fault-caused interrupts. If a bit is masked, the corresponding fault event does not trigger an interrupt. Refer to the *Power-OK (POK) and Fault Status/Interrupts* section in the IC data sheet for more information. Click **Read** to obtain the setting stored on the IC and click **Write** to apply new settings to the IC.

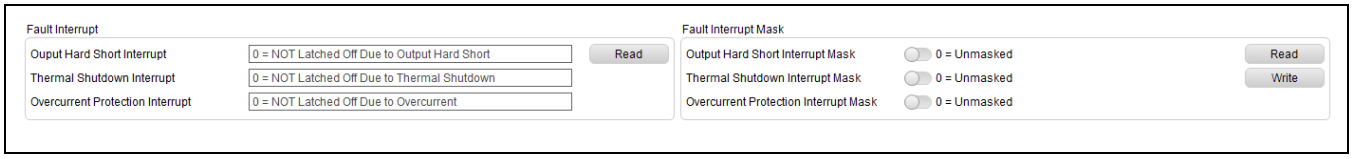


Figure 11. Configuration Tab—Fault Interrupt and Mask Section

The **Output Voltage Configuration** section (*Figure 12*) configures the EV kit IC's output voltage. The output voltage is changed by adjusting the internal reference voltage. Drag the slider to the desired internal reference voltage (or output voltage) and click **Write** to change the output voltage. Clicking **Read** returns the programmed internal reference voltage (or output voltage) to the GUI.

To make evaluation easier, the GUI software displays the corresponding output voltage value in the **Output Voltage** textbox based on the value in the **Internal Reference Voltage** slider. To obtain the correct value, check the **Internal Feedback** or **External Feedback** checkbox corresponding to the EV kit configuration. For external feedback configuration, enter the chosen feedback resistor values in the **Top Feedback Resistor** and **Bottom Feedback Resistor** text boxes to allow the correct calculation of the corresponding output voltage to be displayed on the GUI software.

Note: Changing the **Internal Feedback** or **External Feedback** checkboxes (*Figure 12*) does NOT change the feedback configuration on the EV kit. It is only for calculating and displaying the correct output voltage value on the GUI software. If you wish to change the EV kit's feedback configuration, see the EV Kit Hardware *Output Voltage Configuration* section for details.

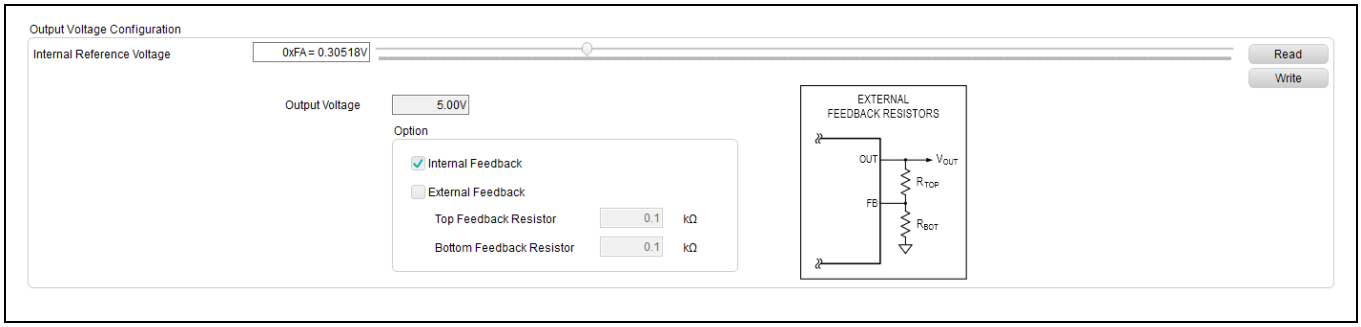


Figure 12. Configuration Tab—Output Voltage Configuration Section

The **Output Current Limit Configuration** section (*Figure 13*) configures the EV kit IC's output current limit (available only on MAX77859A). Drag the slider to the desired output current limit threshold and click **Write** to apply the change. Clicking **Read** returns the programmed output current limit threshold to the GUI.

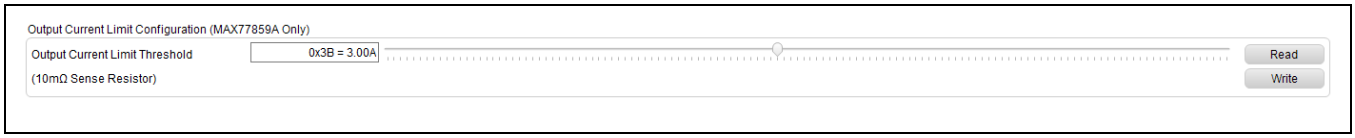


Figure 13. Configuration Tab—Miscellaneous Configuration Sections

The **Miscellaneous Configuration** sections (*Figure 14*) show the remaining register settings of the MAX77859. Use these sections to control internal compensation resistance, switching frequency, switching current limit, POKB/INTB pin function selection, forced-PWM mode, and output voltage change slew rate (using the internal reference voltage DVS slew rate). Refer to the *MAX77859* IC data sheet for more information on each available setting. Click **Read** to obtain the setting stored on the IC and click **Write** to apply new settings to the IC.

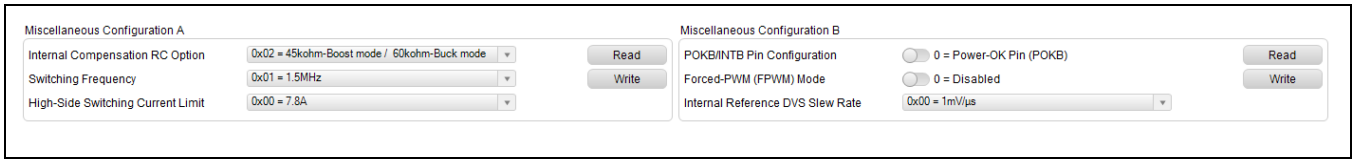


Figure 14. Configuration Tab—Miscellaneous Configuration Sections

Layout Guideline

Careful circuit board layout is critical to achieving low switching power losses and clean, stable operation. The EV kit serves as a recommended layout for the MAX77859. A high-density interconnect (HDI) PCB is required to route to the EN, FPWM, SEL, and SRP pins. *Figure 15* shows an example layout for the MAX77859 WLP package. Use the provided layout files for guidance when designing with the IC. The IC data sheet contains a list of useful tips and guidelines for achieving the best possible layout. They are repeated here for convenience:

- Place the input capacitors (C_{IN}) and output capacitors (C_{OUT}) immediately next to the IN pin and OUT pin of the IC, respectively. Since the IC operates at a high switching frequency, this placement is critical for minimizing parasitic inductance within the input and output current loops, which can cause high voltage spikes and can damage the internal switching MOSFETs.
- Place the inductor next to the LX bumps (as close as possible) and make the traces between the LX bumps and the inductor short and wide to minimize PCB trace impedance. Excessive PCB impedance reduces converter efficiency. When routing LX traces on a separate layer (as in the example), make sure to include enough vias to minimize trace impedance. Routing LX traces on multiple layers is recommended to further reduce trace impedance. Furthermore, do not let LX traces take up an excessive amount of area. The voltage on this node switches very quickly and an additional area creates more radiated emissions.
- Route LX nodes to their corresponding bootstrap capacitor (C_{BST}) as short as possible. Prioritize C_{BST} placement to reduce trace length to the IC.
- Connect the inner PGND bumps to the low-impedance ground plane on the PCB with vias placed next to the bumps. Do not create PGND islands, as PGND islands risk interrupting the hot loops. Connect AGND and AGND island to the low-impedance ground plane on the PCB (the same net as PGND).
- Keep the power traces and load connections short and wide. This is essential for high converter efficiency.
- When utilizing the output current sense feature (MAX77859A only), route SRP and SRN to the sense resistor in parallel, and make sure the traces are as short as possible to limit the amount of noise couple in the signal.
- Do not neglect ceramic capacitor DC voltage derating. Choose capacitor values and case sizes carefully. Refer to the *Output Capacitor Selection* section in the MAX77859 IC data sheet and *Tutorial 5527* for more information.

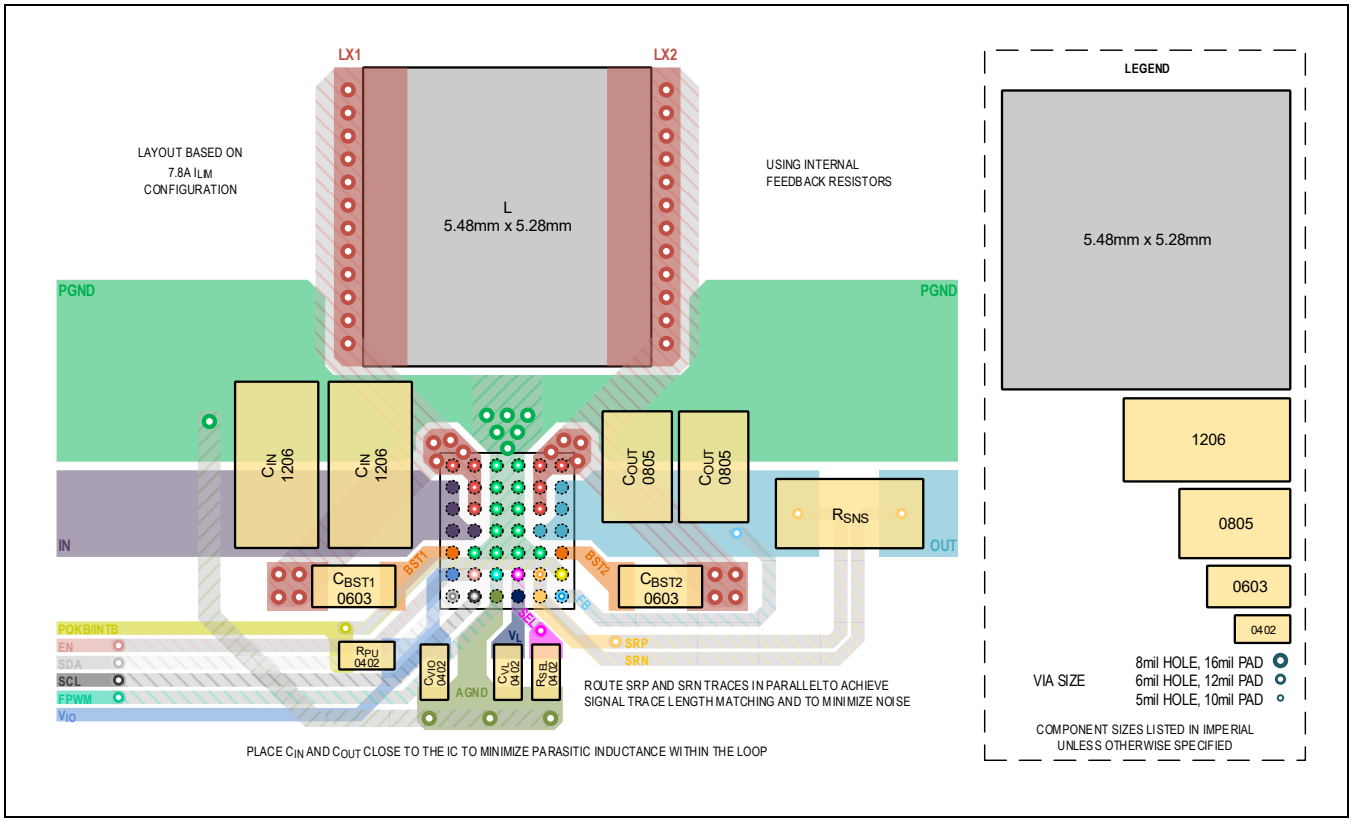


Figure 15. PCB Layout Recommendation for 42 WLP Package with 5.48mm x 5.28mm Inductor

Ordering Information

PART	U1 IC	DEFAULT OUTPUT VOLTAGE	TYPE
MAX77859WEVKIT#	MAX77859AEWO+T	5V	EV Kit

#Denotes RoHS-compliant device that may include lead that is exempt under the RoHS requirements.
+Denotes a lead(Pb)-free/RoHS-compliant package.

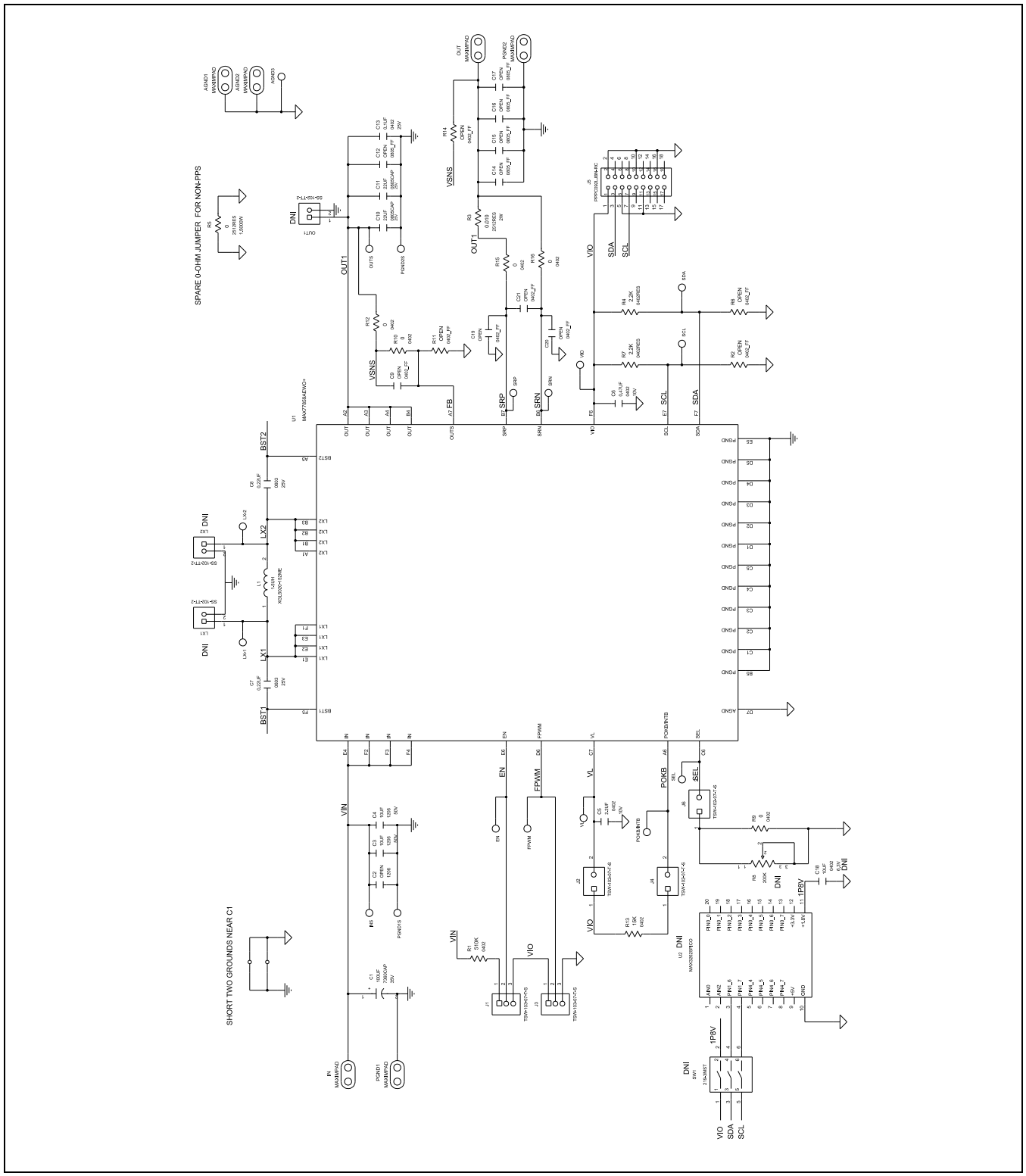
MAX77859 EV Kit Bill of Materials

PART	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
C3, C4	2	CGA5L1X7R1H106K160AE	TDK	10UF	CAP; SMT (1206); 10UF; 10%; 50V; X7R; CERAMIC
C5	1	C1005X7S1A225K050BC	TDK	2.2UF	CAP; SMT (0402); 2.2UF; 10%; 10V; X7S; CERAMIC
C6	1	LMK105B7474KV;GRM155R71A474KE01	PANASONIC;MURATA	0.47UF	CAP; SMT (0402); 0.47UF; 10%; 10V; X7R; CERAMIC
C7, C8	2	C0603C224K3RAC;GMC10X7R224K25;GRM188R71E224KA88;C1608X7R1E224K080AC	KEMET;MURATA;MURATA;TDK	0.22UF	CAP; SMT (0603); 0.22UF; 10%; 25V; X7R; CERAMIC
C10, C11	2	C2012X5R1E226M125AC; CL21A226MAQNNN	TDK;SAMSUNG ELECTRO-MECHANICS	22UF	CAP; SMT (0805); 22UF; 20%; 25V; X5R; CERAMIC
L1	1	XGL5020-152ME	COILCRAFT	1.5UH	INDUCTOR; SMT; COMPOSITE; 1.5UH; 20%; 12.8A
R10, R12	2	ERJ-2GE0R00	PANASONIC	0	RES; SMT (0402); 0; JUMPER; JUMPER; 0.1000W
U1	1	MAX77859AEWO+	ANALOG DEVICES	MAX77859AEWO+	EVKIT PART - IC; CONV; MAX77859AEWO+; PACKAGE OUTLINE DRAWING: 21-100632; PACKAGE CODE: W422C3+1; WLP42
C9	DNP	N/A	N/A	OPEN	CAPACITOR; SMT (0402); OPEN; FORMFACTOR
R11, R14	DNP	N/A	N/A	OPEN	RESISTOR; 0402; OPEN; FORMFACTOR
Components below this line are outside of the immediate MAX77859 evaluation circuit and solution silkscreen.					
AGND1, AGND2, IN, OUT, PGND1, PGND2	6	9020 BUSS	WEICO WIRE	MAXIM PAD	EVK KIT PARTS; MAXIM PAD; WIRE; NATURAL; SOLID; WEICO WIRE; SOFT DRAWN BUS TYPE-S; 20AWG
AGND3	1	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;
ASSY1	1	MAXUSB_INTERFACE#	MAXIM	MAXUSB_INTERFACE#	EVKIT PART-MODULE; KIT; MAXUSB INTERFACE; DUAL-PORT USB-TO-SERIAL INTERFACE BOARD
C1	1	T52M1107M035C0055	VISHAY	100UF	CAP; SMT (7360); 100UF; 20%; 35V; TANTALUM
C13	1	GRM155R71E104KE14; C1005X7R1E104K050BB; TMK105B7104KVH; CGJ2B3X7R1E104K050BB	MURATA;TDK; TAIYO YUDEN;TDK	0.1UF	CAP; SMT (0402); 0.1UF; 10%; 25V; X7R; CERAMIC
EN, FPWM, POKB/INTB, SCL, SDA, SEL	6	5002	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; WHITE; PHOSPHOR BRONZE WIRE SILVER;

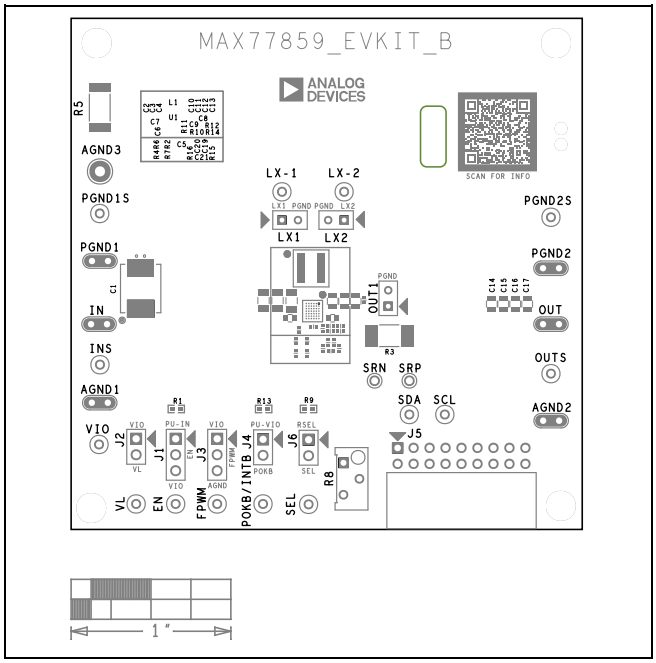
EV_KIT_BOX 1	5	NPC02SXON-RC	SULLINS ELECTRONICS CORP.		CONNECTOR; FEMALE; MINI SHUNT; 0.100IN CC; OPEN TOP; JUMPER; STRAIGHT; 2PINS
INS, LX-1, LX-2, OUTS, VIO, VL	6	5000	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; RED; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
J1, J3	2	TSW-103-07-T-S	SAMTEC	TSW-103-07-T-S	CONNECTOR; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 3PINS
J2, J4, J6	3	TSW-102-07-T-S	SAMTEC	TSW-102-07-T-S	CONNECTOR; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 2PINS; -55 DEGC TO +105 DEGC
J5	1	PPPC092LJBN-RC	SULLINS ELECTRONICS CORP	PPPC092LJBN-RC	CONNECTOR; FEMALE; THROUGH HOLE; PPP SERIES; RIGHT ANGLE; 18PINS
MH1-MH4	4	9032	KEYSTONE	9032	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON
PCB	1	MAX77859	ANALOG DEVICES	PCB	PCB:MAX77859
PGND1S, PGND2S	2	5001	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
R1	1	CRCW0402510KFK	VISHAY DALE	510K	RES; SMT (0402); 510K; 1%; +/-100PPM/DEGK; 0.0630W
R3	1	PCS2512DR0100E	OHMITE	0.01	RES; SMT (2512); 0.010; 0.50%; +/-50PPM/DEGC; 2W
R4, R7	2	RC0402FR-072K2L	YAGEO	2.2K	RES; SMT (0402); 2.2K; 1%; +/-100PPM/DEGC; 0.0630W
R5	1	CRCW25120000Z0EGHP	VISHAY DRALORIC	0	RES; SMT (2512); 0; JUMPER; JUMPER; 1.5000W
R9, R15, R16	3	ERJ-2GE0R00	PANASONIC	0	RES; SMT (0402); 0; JUMPER; JUMPER; 0.1000W
R13	1	ERJ-2RKF1502	PANASONIC	15K	RES; SMT (0402); 15K; 1%; +/-100PPM/DEGC; 0.1000W
C2	DNP	N/A	N/A	OPEN	CAPACITOR; SMT (1206); OPEN; IPC MAXIMUM LAND PATTERN
C12, C14-C17	DNP	N/A	N/A	OPEN	CAPACITOR; SMT (0805); OPEN; FORMFACTOR
C18	DNP	GRM155C80J106ME18	MURATA	10UF	CAP; SMT (0402); 10UF; 10%; 6.3V; X6S; CERAMIC;
C19-C21	DNP	N/A	N/A	OPEN	CAPACITOR; SMT (0402); OPEN; FORMFACTOR
LX1, LX2, OUT1	DNP	SS-102-TT-2	SAMTEC	SS-102-TT-2	IC-SOCKET; SIP; STRAIGHT; PRECISION MACHINED SOCKET STRIP; OPEN FRAME; 2PINS; 100MIL
R2, R6	DNP	N/A	N/A	OPEN	RESISTOR; 0402; OPEN; FORMFACTOR
R8	DNP	3296Y-1-204LF	BOURNS	200K	RESISTOR; THROUGH HOLE-RADIAL LEAD; 3296 SERIES; 200K OHM; 10%; 100PPM; 0.5W

SW1	DNP	219-3MST	CTS	219-3MST	SWITCH; SPST; SMT; STRAIGHT; 20V; 0.1A; SURFACE MOUNT DIP SWITCH-AUTO PLACEABLE; RINSULATION=1000M OHM
U2	DNP	MAX32625PICO	MAXIM	MAX32625PICO	MODULE; BOARD; MAX32625PICO BOARD DESIGN FOR MAX32625 ARM CORTEX-M4F; BOARD; LAMINATED PLASTIC WITH COPPER CLAD;
	61				

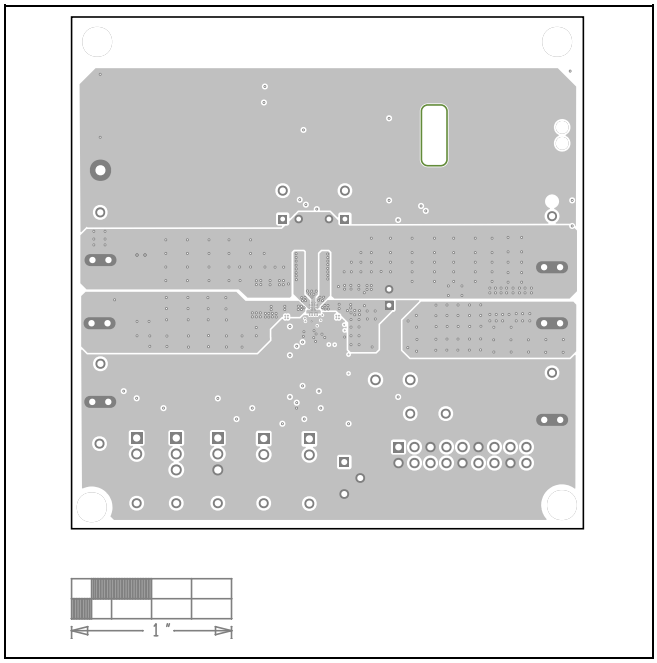
MAX77859 EV Kit Schematic



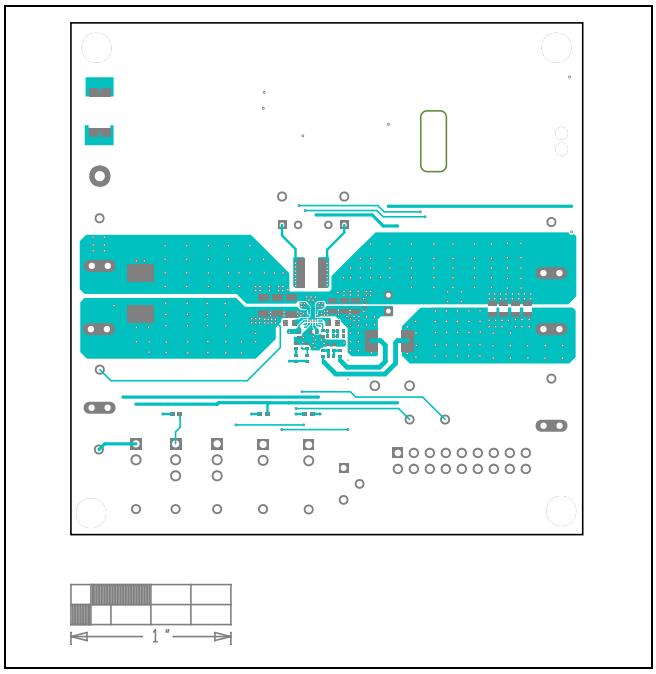
MAX77859 EV Kit PCB Layout



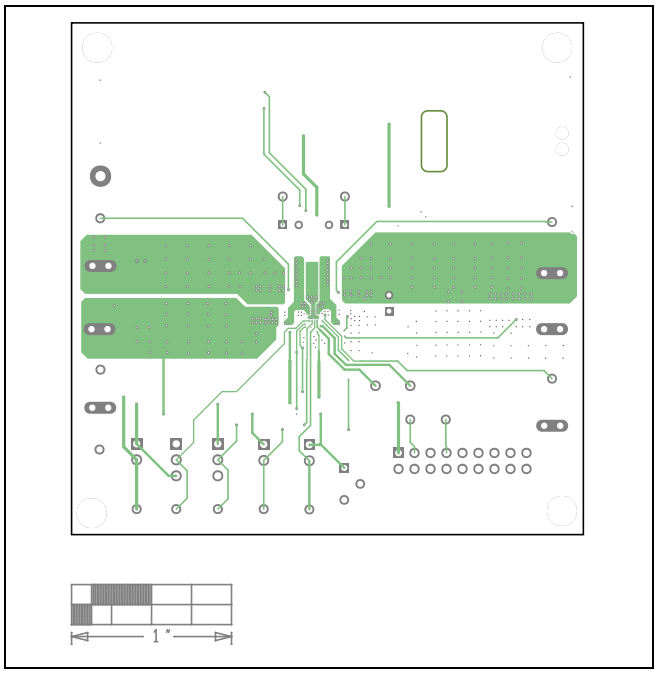
MAX77859 EV Kit Component Placement Guide—Top Silkscreen



MAX77859 EV Kit PCB Layout—Internal 2

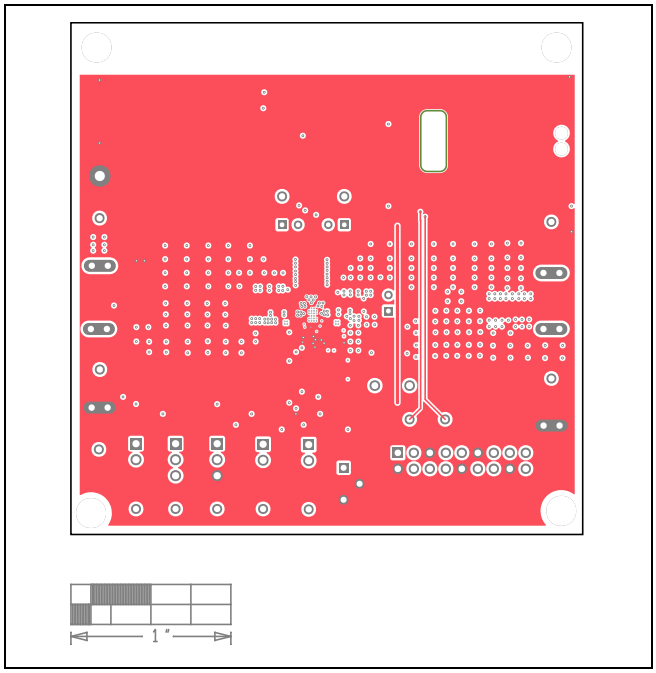


MAX77859 EV Kit PCB Layout—Top View

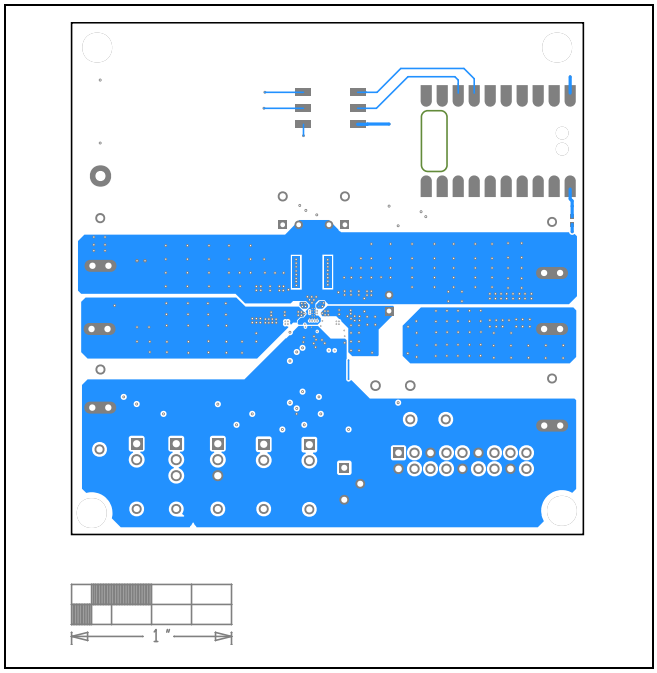


MAX77859 EV Kit PCB Layout—Internal 3

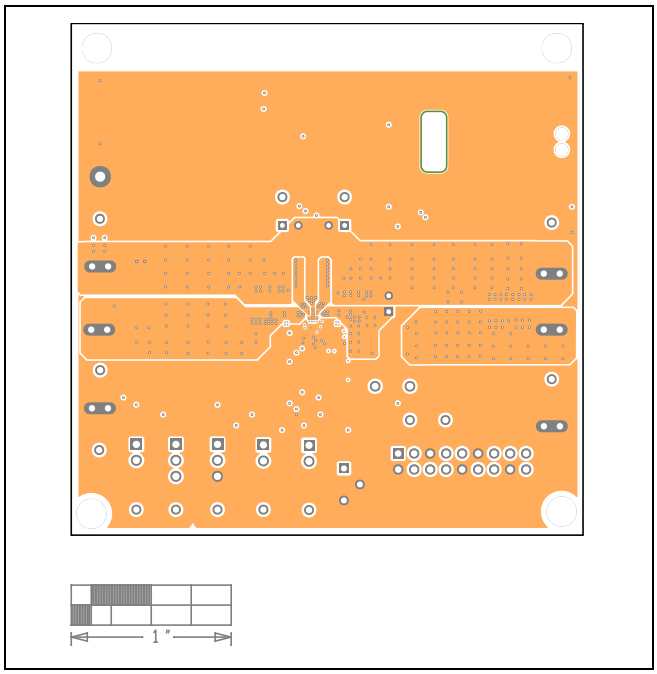
MAX77859 EV Kit PCB Layout (continued)



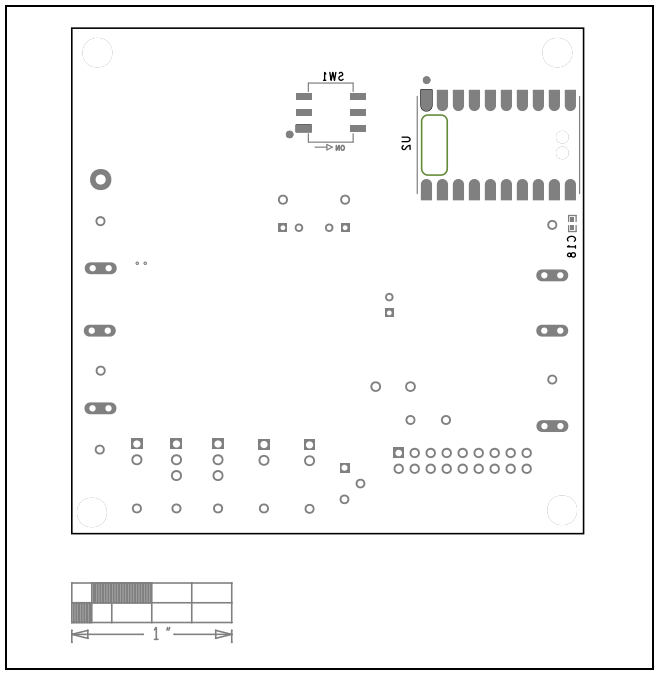
MAX77859 EV Kit PCB Layout—Internal 4



MAX77859 EV Kit PCB Layout—Bottom View



MAX77859 EV Kit PCB Layout—Internal 5



MAX77859 EV Kit PCB Layout—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	4/23	Initial release	—