

# MAX15093/MAX15093A Evaluation Kits

## Evaluate: MAX15093/MAX15093A

### General Description

The MAX15093/MAX15093A evaluation kits (EV kits) provide a proven design to evaluate the MAX15093/MAX15093A hot-swap controllers with an integrated 15A MOSFET. The EV kits are configured to pass 15A in a 2.7V to 18V hot-swap application, thus providing a fully integrated solution. The EV kits use the MAX15093GWL+/MAX15093AGWL+T in a 2.57mm x 4.03mm, 40-bump, 0.5mm pitch wafer-level package (WLP) with a proven four-layer PCB design. As configured, the EV kits are optimized to operate at 12V.

The two EV kit versions (MAX15093AEVKIT# and MAX15093EVKIT#) are built on the same PCB fabrication and can be used interchangeably to evaluate either the MAX15093 or MAX15093A by replacing U1 with the desired device.

### Features

- 2.7V to 18V Operating-Voltage Range
- Up to 15A Configurable Load-Current Capability
- Banana Jacks for Input and Output Voltage
- Programmable Slew-Rate Control
- Selectable/Configurable Circuit-Breaker Threshold
- Configurable Overvoltage/Undervoltage Lockout
- Programmable Timeout Delay
- FAULT and PG Outputs
- Defined Safe Operation Area
- Proven PCB Layout
- Fully Assembled and Tested

### Quick Start

#### Required Equipment

- MAX15093 or MAX15093A EV kit
- 12V, 15A DC power supply
- Voltmeter

#### Procedure

The EV kits are fully assembled and tested. Follow the steps below to verify board operation. **Caution: Do not turn on the power supply until all connections are completed.**

- 1) Verify that a shunt is installed across pins 1-2 on the following jumpers: J1, J3, J4, J5, UV\_IN, and CB.
- 2) Turn on the power supply and set the supply to 12V, then disable the power supply.
- 3) Connect the positive terminal of the power supply to the IN banana jack on the EV kits. Connect the negative terminal of the power supply to the GND banana jack.
- 4) Enable the power supply.
- 5) Verify that the voltage between the OUT and GND banana jacks is 12V.
- 6) Verify that the internal regulator voltage (REG) is 3.3V.
- 7) The EV kits are now ready for additional evaluation.

Ordering Information appears at end of data sheet.

## Detailed Description of Hardware

The MAX15093 EV kit provides a proven design to evaluate the MAX15093. The MAX15093 EV kit can be conveniently connected between the system power and the load using the banana jacks provided for the input and output. PCB pads are provided to monitor and control the device signals. The MAX15093 EV kit operates between 2.7V and 18V up to 15A load current capability.

### Evaluating the MAX15093 or MAX15093A

The MAX15093 EV kit can be used to evaluate the MAX15093A with the MAX15093AGWL+T installed, while the MAX15093A EV kit can be used to evaluate the MAX15093 with the MAX15093GWL+ installed. The MAX15093A is pin-to-pin compatible with the MAX15093. Refer to the MAX15093/MAX15093A IC data sheet for details on the MAX15093A.

### Circuit Breaker (CB)

Jumper CB sets the current limit for the internal circuit breaker (CB) of the device. The CB pin can be connected to a fixed resistor (R5) or a potentiometer (R11) to set the current limit. See [Table 1](#) for shunt positions.

The circuit-breaker threshold can be set according to the following formula:

$$I_{CB} = R_{CB}/2227 - 1.05$$

where  $I_{CB}$  is in A and  $R_{CB}$  (the resistor between CB and ground) is in  $\Omega$ .

### Setting Timeout Delay for $\overline{\text{TIMEOUT}}$ (CDLY)

Capacitor C4 is used to set the timeout delay for  $\overline{\text{TIMEOUT}}$  to go low to prevent internal MOSFET shut-down after power-up. This is set at a rate of 1s/ $\mu\text{F}$ . The EV kit is configured for a 47ms timeout delay.

### Delayed $\overline{\text{TIMEOUT}}$

The IC's  $\overline{\text{TIMEOUT}}$  pin must be pulled low before the timeout delay set by capacitor C4 elapses. The EV kit provides a simple timer circuit comprised of U2, R7, and C5 to pull the  $\overline{\text{TIMEOUT}}$  pin low before the timeout delay. Once PG asserts as open-drain, R7 begins to charge C5 to the output voltage (OUT). When C5 charges to 2/3 x

OUT, U2 pulls the  $\overline{\text{TIMEOUT}}$  pin low. The EV kit is configured to have  $\overline{\text{TIMEOUT}}$  pulled low after ~22ms.

Jumper  $\overline{\text{TIMEOUT}}$  is also provided to bypass the timeout delay and force  $\overline{\text{TIMEOUT}}$  low, if installed. See [Table 2](#) for  $\overline{\text{TIMEOUT}}$  settings.

### Setting the Output Slew Rate

An external capacitor (C3) is connected from GATE to GND on the IC to reduce the output slew rate during startup. During startup, a 5.7 $\mu\text{A}$  (typ) current is sourced to enhance the internal MOSFET with 28V/ms (typ). C3 can be calculated according to the following formula:

$$C3 = I_{GATE} \times (t_{ON}/V_{OUT})$$

where  $I_{GATE}$  is 5.7 $\mu\text{A}$  (typ),  $t_{ON}$  is the desired output ramp-up time, and  $V_{OUT}$  is assumed to start from zero.

### Undervoltage Lockout

The EV kit provides an option to configure the undervoltage-lockout threshold. The undervoltage-lockout threshold for the device is configured by the IN voltage level divided by R1 and (R2 + R3) at the UV pin. By default, the undervoltage-lockout threshold is set to 10.8V. The EV kit also provides an option to externally provide a UV threshold. Remove the jumper for UV\_IN, then connect a power supply with the desired voltage to the UV pin. Remove R2 to make UV independent from OV.

### Overvoltage Lockout

The EV kits provide an option to configure the overvoltage-lockout threshold. The overvoltage-lockout threshold for the device is configured by the IN voltage level divided by (R1 + R2) and R3 at the OV pin. By default, the overvoltage-lockout threshold is set to 14V. The EV kit also provides an option to externally provide an OV threshold. Remove the jumper for UV\_IN, then connect a power supply with the desired voltage to the OV pin. Remove R2 to make OV independent from UV.

### Current-Sense Output (ISENSE)

The IC's ISENSE pin is the output of an accurate current-sense amplifier and provides a source current proportional to the load current flowing into the main switch. The factory-trimmed current ratio is set to 157 $\mu\text{A}/\text{A}$ . On the EV kit, this allows producing a scaled voltage by routing resistor R6 from ISENSE to GND.

**Table 1. CB Jumper Selection**

SHUNT POSITION	CB PIN CONNECTED TO	CURRENT LIMIT
1-2*	R5	16.5A
2-3	R11	Adjustable

\*Default position.

**Table 2.  $\overline{\text{EN}}$  Jumper Selection**

SHUNT POSITION	$\overline{\text{EN}}$ PIN	TIMEOUT DELAY
Installed	Forced to GND	Bypassed
Not installed*	Set low when C5 is charged to 2/3 x OUT; timing is set by R7/C5	47ms (set by C4)

\*Default position.

## Component Suppliers

SUPPLIER	PHONE	WEBSITE
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Murata Americas	770-436-1300	www.murataamericas.com
TDK Corp.	847-803-6100	www.component.tdk.com

**Note:** Indicate that you are using the MAX15093/MAX15093A when contacting these component suppliers.

## Ordering Information

PART	TYPE	DESCRIPTION
MAX15093EVKIT#	EV Kit	Latched-off fault management
MAX15093AEVKIT#	EV Kit	Auto-retry fault management

#Denotes RoHS compliant.

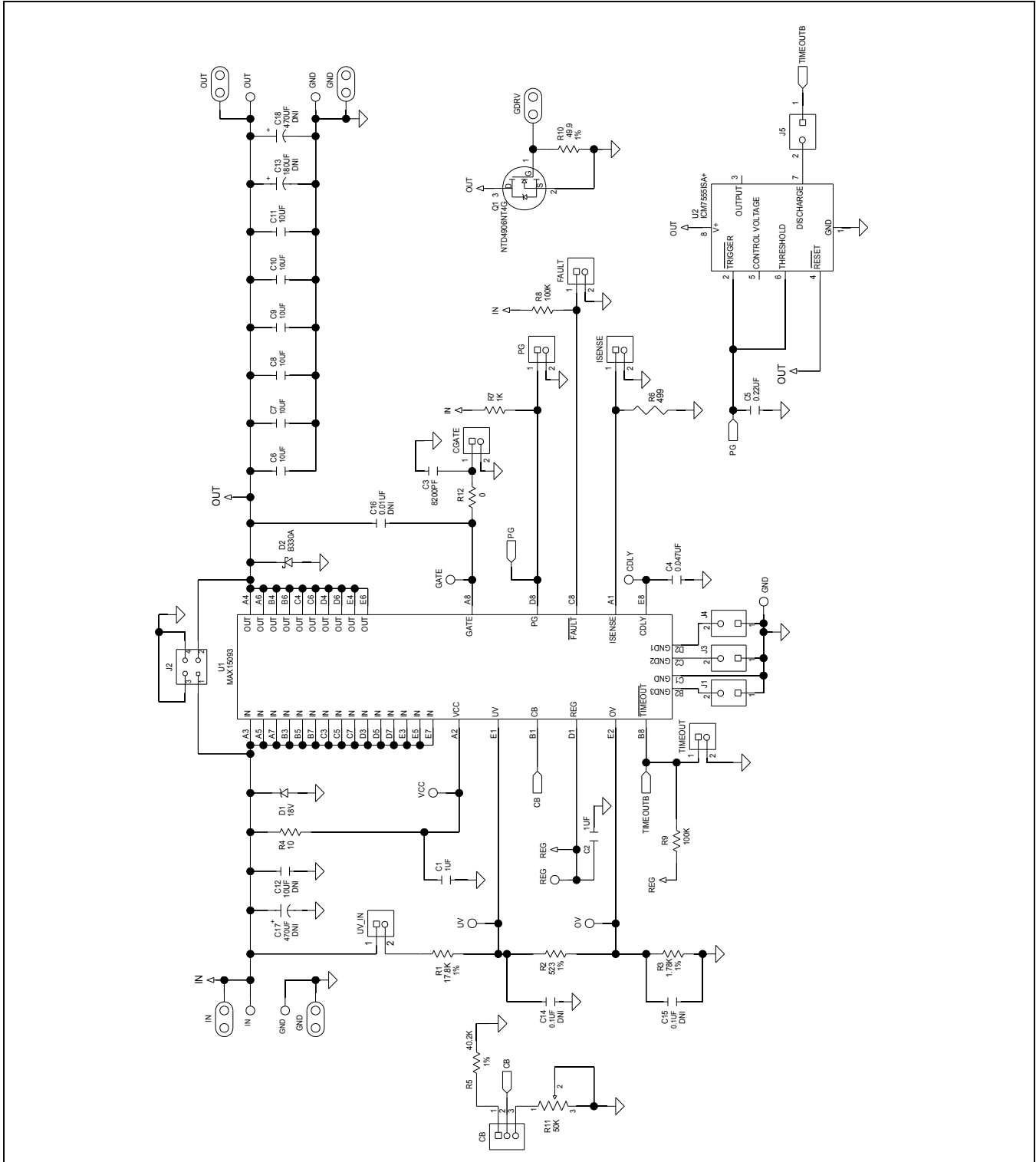
# MAX15093/MAX15093A Evaluation Kits

# Evaluate: MAX15093/MAX15093A

## MAX15093/93A EV Component List

TITLE: Bill of Materials DESIGN: max15093_evkit_a								
ITEM	QTY	REF DES	Var Status	MAXINV	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	2	C1, C2	Pref	20-0001U-251	C1005X5R1E105K050	TDK	1UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 1UF; 25V; TOL=10%; TG=-55 DEGC TO +85 DEGC; TC=X5R
2	1	C3	Pref	20-8200P-14	C0402X7R500822KNP	VENKEL LTD.	8200PF	CAPACITOR; SMT; 0402; CERAMIC; 8200pF; 50V; 10%; X7R; -55degC to +125degC; 0 +/-15% degC MAX.
3	1	C4	Pref	20-0U047-03	C1005X7R1E473K; GRM155R71E473K	TDK/MURATA	0.047UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.047UF; 25V; TOL=10%; TG=-55 DEGC TO +125 DEGC
4	1	C5	Pref	20-00U22-12	C0603C224K3RAC; GCM10X7R224K25; GRM188R71E224KA88; C1608X7R1E224K08	KEMET; MURATA; TDK	0.22UF	CAPACITOR; SMT (1206); CERAMIC CHIP; 10UF; 25V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
5	6	C6-C11	Pref	20-0010U-A4	GRM31CR71E106KA12L; CL318106KAHNNN	MURATA; SAMSUNG ELECTRONICS	10UF	CAPACITOR; SMT (1206); CERAMIC CHIP; 10UF; 25V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
6	1	CB	Pref	01-PEC03SAAN3P-21	PEC03SAAN	SULLINS	PEC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 3PINS
7	6	GATE	Pref	02-TPMINI5000-00		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; RECOMMENDED FOR BOARD THICKNESS=0.062IN; NOT FOR COLD TEST
8	10	TIMEOUT	Pref	01-PEC02SAAN2P-21	PEC02SAAN	SULLINS	PEC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 2PINS
9	1	D1	Pref	30-SMBJ18A-00	SMBJ18A	LITTLE FUSE	18V	DIODE; TVS; SMB (DO-214AA); PIV=18V; IF=20.6A
10	1	D2	Pref	30-B330A-00	B330A	DIODES INCORPORATED	B330A	DIODE; SCH; SMT; PIV=30V; IF=3A
11	5	GNDX2	Pref	01-9020BUSS20AWG-00	9020 BUSS	WEICO WIRE	MAXIMPAD	EVK KIT PARTS; MAXIM PAD; WIRE; NATURAL; SOLID; WEICO WIRE; SOFT DRAWN BUS TYPE-5; 20AWG
12	2	GND, GND1	Pref	01-70071P-80		7007 KEYSTONE	7007 BLACK	CONNECTOR; PANELMOUNT; BINDING POST; STRAIGHT THROUGH; 1PIN;
13	2	IN, OUT	Pref	01-70061P-80		7006 KEYSTONE	7006 RED	CONNECTOR; PANELMOUNT; BINDING POST; STRAIGHT THROUGH; 1PIN;
14	1	J2	Pref	01-PEC02DAAN4P-21	PEC02DAAN	SULLINS ELECTRONIC CORP.	PEC02DAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 4PINS
15	1	Q1	Pref	90-NTD4906NT4G-21	NTD4906NT4G	ON SEMICONDUCTOR	NTD4906NT4G	TRANSISTOR; MOSFET; SINGLE N-CHANNEL; NCH; TO-252; PD-(1.38W); I(54A); V-(30V)
16	1	R1	Pref	80-017K8-23	CRCW040217K8FK	VISHAY DALE	17.8K	RESISTOR; 0402; 17.8K OHM; 1%; 100PPM; 0.063W; THICK FILM
17	1	R2	Pref	80-0523R-23	ERJ-2RKFS230X	VISHAY DALE/PANASONIC		523 ELECTRODE
18	1	R3	Pref	80-01K78-23	ERJ-2RKF1781X	PANASONIC		RESISTOR; 0402; 1.78K OHM; 1%; 100PPM; 0.10W; THICK FILM
19	1	R4	Pref	80-0010R-49	CRCW040210R0JN	VISHAY DALE	10	RESISTOR; 0402; 10 OHM; 5%; 200PPM; 0.063W; THICK FILM
20	1	R5	Pref	80-040K2-24	CRCW060340K2FK; RC0603FR-0740K2L; ERJ-3KF4022V	VISHAY DALE/YAGEO/PANASONIC	40.2K	RESISTOR; 0603; 40.2K; 1%; 100PPM; 0.10W; THICK FILM
21	1	R6	Pref	80-0499R-23	CRCW0402499RFK / ERJ-2RKFA990X	VISHAY DALE / Panasonic	499	RESISTOR; 0402; 1K; 1%; 100PPM; 0.0625W; THICK FILM
22	1	R7	Pref	80-0001K-53	ERJ-3GEY1102V	PANASONIC	1K	RESISTOR; 0603; 1K OHM; 5%; 200PPM; 0.10W; THICK FILM
23	1	R8	Pref	80-0100K-53	ERJ-3GEY1104V	PANASONIC	100K	RESISTOR; 0603; 100K OHM; 5%; 200PPM; 0.10W; THICK FILM
24	1	R9	Pref	80-0100K-Q6	ERJ-2GEJ104X	PANASONIC	100K	RESISTOR; 0402; 100K OHM; 5%; 200PPM; 0.10W; THICK FILM
25	1	R10	Pref	80-049R9-24	CRCW060349R9FK	VISHAY DALE	49.9	RESISTOR; 0603; 49.9 OHM; 1%; 100PPM; 0.10W; THICK FILM
26	1	R11	Pref	80-0050K-AA19	3296Y-1-503LF	BOURNS	50K	RESISTOR; THROUGH HOLE-RADIAL LEAD; 3296 SERIES; 50K OHM; 10%; 100PPM; 0.5W
27	1	R12	Pref	80-0000R-26A	ERJ-2GEOR00X	PANASONIC	0	RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM
28	6	SU1-SU6	Pref	02-JMPFS1100B-00	SX1100-B	KYCON	SX1100-B	TEST POINT; JUMPER; STR; TOTAL LENGTH=0.24IN; BLACK;
29	1	U1	Pref	MAX15093	MAX15093	MAXIM	MAX15093	INSULATION=PBT;PHOSPHOR BRONZE CONTACT-GOLD PLATED
30	1	U2	Pref	ICM7555ISA+	ICM7555ISA+	MAXIM	ICM7555ISA+	EVKIT PART - IC; MAX15093; WLP20; PKG CODE W402B3+1
31	1		Pref	EPCB15093	MAX15093	MAXIM	PCB	IC; TIMER; GENERAL PURPOSE TIMER; NSOIC8 150MIL PCB: MAX15093
TOTAL 62								
DO NOT PURCHASE(DNP)								
ITEM	QTY	REF DES	Var Status	MAXINV	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	1	C12	DNP	20-0010U-P7	C1608X5R1E106M080AC; CL10A106MA8RNNC	TDK/SAMSUNG ELECTRONICS	10UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 10UF; 25V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
2	1	C13	DNP	20-0180U-57	25SEPF180M	PANASONIC	180UF	CAPACITOR; THROUGH HOLE-RADIAL LEAD; ALUMINUM-ELECTROLYTIC; 180UF; 25V; TOL=20%
3	2	C14, C15	DNP	20-000U1-868	GRM155R71E104KE14	MURATA	0.1UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.1UF; 25V; TOL=10%; MODEL=GRM SERIES; TG=-55 DEGC TO +125 DEGC; TC=X7R
4	1	C16	DNP	20-00U01-860	C0402C103K5RAC; GRM155R71H103KA88	KEMET/MURATA	0.01UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.01UF; 50V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
5	2	C17, C18	DNP	20-0470U-39	ECA-1EM471	PANASONIC	470UF	CAPACITOR; THROUGH HOLE-RADIAL LEAD; ALUMINUM-ELECTROLYTIC; 470UF; 25V; TOL=20%
TOTAL 7								
PACKOUT (These are purchased parts but not assembled on PCB and will be shipped with PCB)								
ITEM	QTY	REF DES	MAXINV	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION	COMMENTS
1	1	PACKOUT	88-00711-SML	88-00711-SML	N/A	?	BOX; SMALL BROWN 9 3/16X7X1 1/4 - PACKOUT	ESD BAG; BAG; STATIC SHIELD ZIP
2	1	PACKOUT	87-02162-00	87-02162-00	N/A	?	4inX6in; W/ESD LOGO - PACKOUT	
3	1	PACKOUT	85-MAXKIT-PNK	85-MAXKIT-PNK	N/A	?	PINK FOAM; FOAM; ANTI-STATIC PE	12inX12inX5MM - PACKOUT
4	1	PACKOUT	EVINSERT	EVINSERT	N/A	?	WEB INSTRUCTIONS FOR MAXIM DATA SHEET LABEL(EV KIT BOX) -	PACKOUT
5	1	PACKOUT	85-84003-006	85-84003-006	N/A	?		
TOTAL 5								

MAX15093/93A EV Schematic





MAX15093/93A EV PCB Layout (continued)

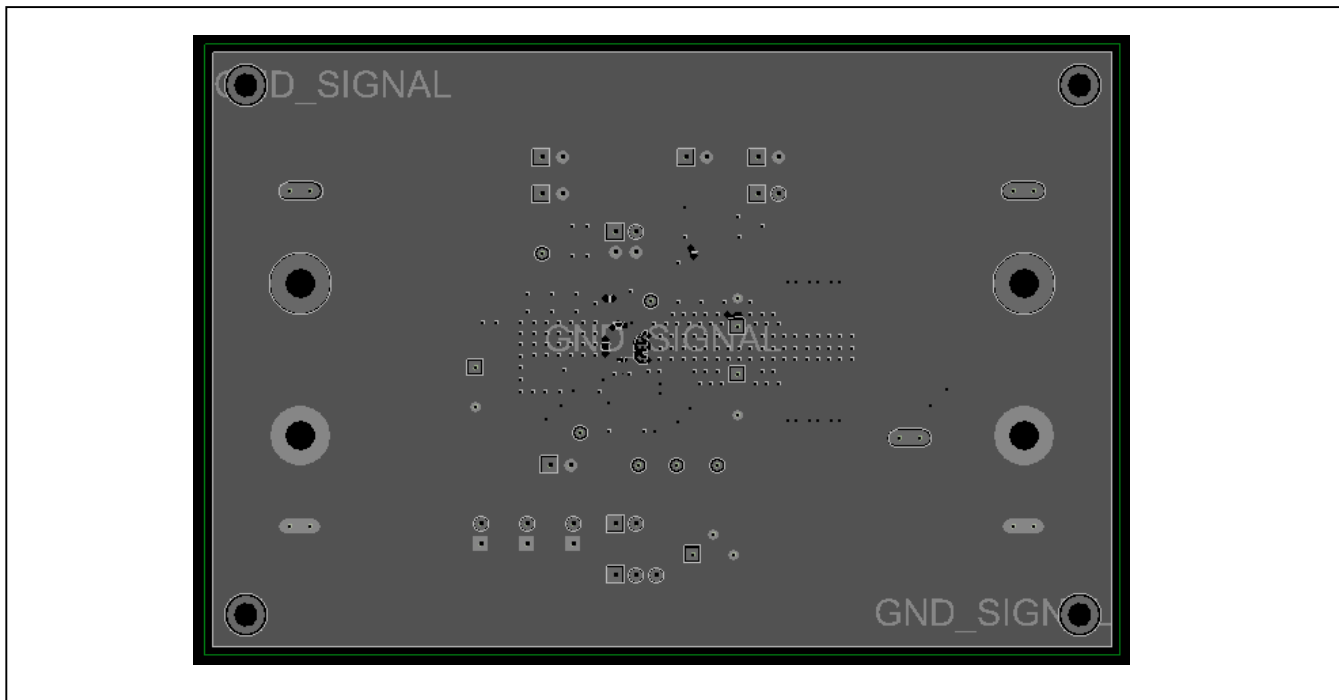


Figure 3. PCB Layout (Layer 2 (GND))

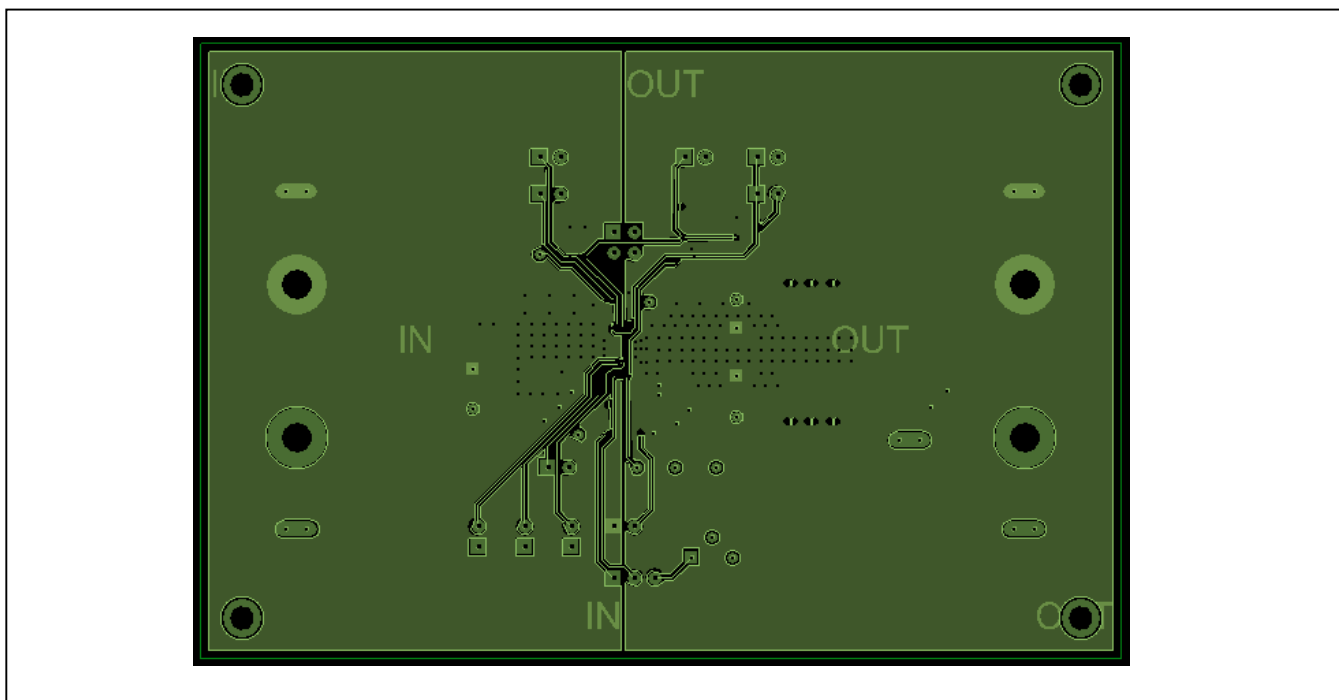


Figure 4. PCB Layout (Layer 3 (PWR))

MAX15093/93A EV PCB Layout (continued)

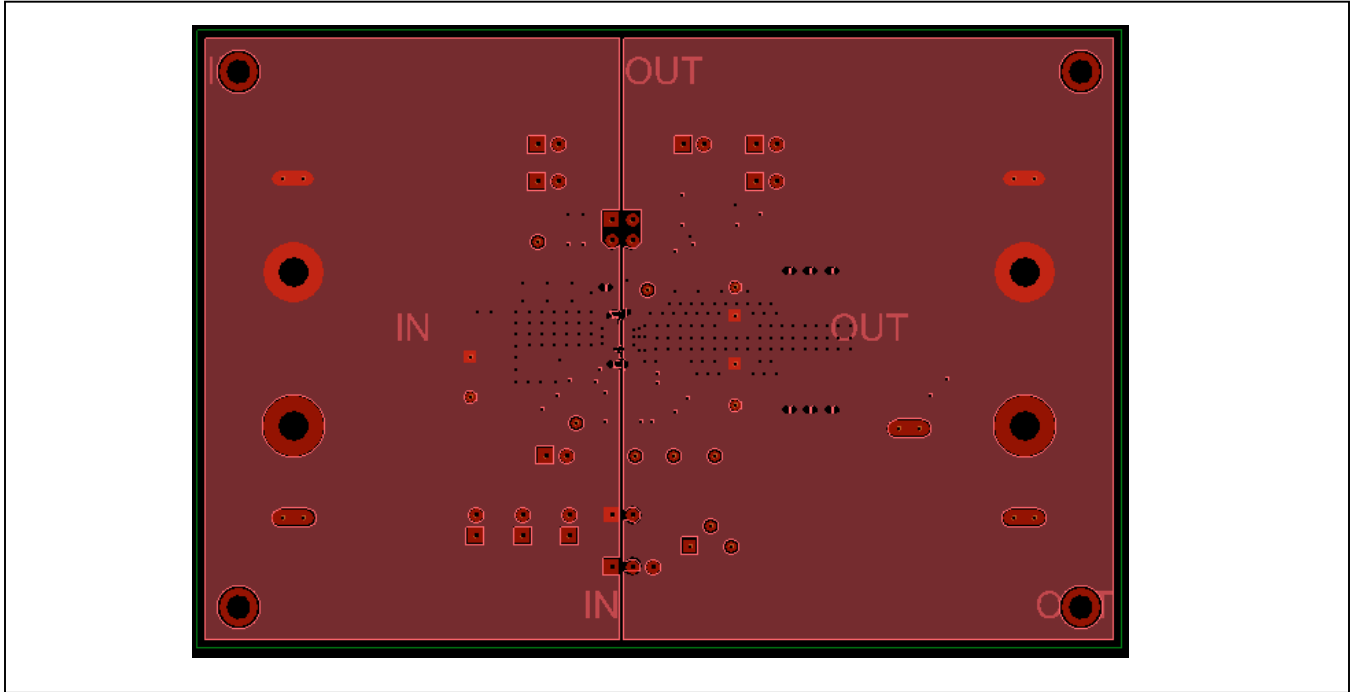


Figure 5. PCB Layout (Solder Side)