General Description

The MAX17558 EV kit provides a proven design to evaluate the MAX17558 wide 4.5V to 60V input, dual-output, synchronous step-down DC-DC controller. The EV kit provides 5V/5A and 3.3V/10A at the outputs from a 6V to 60V input supply. The switching frequency of the EV kit is preset to 350kHz for optimal efficiency and component size. The EV kit features adjustable input undervoltage-lockout and soft-start time, selectable PWM/DCM modes, 180° out-of-phase/0° in-phase operation, current-limit threshold, and independent open-drain PGOOD signals.

Features

- 6V to 60V Input Range
- Output Rails: V_{OUT1}: 5V/5A, V_{OUT2}: 3.3V/10A
- 350kHz Switching Frequency
- Independent Enable Inputs
- Independent Adjustable Soft-Start Time
- Configurable Tracking Operation
- Selectable PWM/DCM Modes of Operation
- Selectable 180° Out-of-Phase/0° In-Phase Operation
- Selectable Current-Limit Threshold
- Independent PGOOD Outputs
- Overcurrent, Overvoltage, and Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested

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

Quick Start

Required Equipment

- MAX17558 EV kit
- 4.5V to 60V, 15A DC power supply
- Loads capable of sinking 5A and 10A
- Two digital voltmeters (DVM)

Procedure

The EV kit is 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) Ensure that the DC power supply is disabled. Set the power supply voltage to 24V.
2) Set one of the loads to 5A and the other to 10A. Disable the load in the case of an electronic load. Leave the load unconnected in the case of a resistor load and ensure that the resistor power rating is high enough to dissipate the output power.
3) Connect the positive terminal of the power supply to the VIN connector and the negative terminal of the power supply to PGND connector, which is nearest to VIN connector.
4) Connect one digital voltmeter across VOUT1 connector and the nearest PGND connector with the positive terminal of the DVM connected to VOUT1 connector.
5) Connect the other digital voltmeter across VOUT2 connector and the nearest PGND connector with the positive terminal of the DVM connected to VOUT2 connector.
6) Verify the shunts on jumpers, as described in Table 1, to select default settings of the EV kit.
7) Turn on the DC power supply.
8) Verify that the digital voltmeters display the expected voltages (5V±1% on VOUT1 and 3.3V±1% on VOUT2).
9) Enable the electronic load (connect the load in the case of resistor load).
10) Verify that the voltmeters display the expected voltages (5V±1% on V_{OUT1} and 3.3V±1% on V_{OUT2}).

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Detailed Description of Hardware

The EV kit provides a proven design to evaluate the device. The EV kit provides 5V/5A and 3.3V/10A at the outputs from 6V to 60V input supply. The EV kit can also operate over the 4.5V to 60V range to provide only 3.3V output by connecting a shunt of JU4 at the 2-3 position to disable the 5V output. The EV kit is preset to operate at 350kHz for optimum efficiency and component size.

The EV kit provides set resistors R16, R17 and R18, R19 and jumpers JU4, JU5 to enable/disable the output at a desired input UVLO voltage. The DCM or PWM mode of operation can be selected using JU3. JU1 allows selection of 180°/0° phase-shift operation between the two controllers. JU2 allows the selection of three different current-limit thresholds for both controllers. Refer to Table 2 through Table 4 for additional jumper setting details.

Configuring the Output Voltages (V_{OUT1}, V_{OUT2})

The device's output voltages (V_{OUT1} and V_{OUT2}) can be adjusted between 0.8V to 24V through sets of feedback resistor-dividers (R6, R7 and R26, R27) by the following formula:

$$R7 = \frac{R6}{\left(\frac{V_{OUT1}}{0.8} - 1\right)}$$

Please refer to the MAX17558 IC data sheet to select R6 resistor values and change compensation components, as well as output capacitors, for new output voltage settings.

Soft-Start (SS_)

The device offers an SS_ pin used to adjust the soft-start time to limit inrush current during startup. Soft-start times are controlled by the values of C21 and C30 for V_{OUT1} and V_{OUT2}, respectively. An internal 5μA current source charges the capacitor at the SS_ pin, providing a linear ramping voltage for output voltage reference. The soft-start time of V_{OUT1} and V_{OUT2} are calculated based on the following equation:

$$t_{SS\_OUT1} = C21 \times \frac{0.8V}{5\mu A}$$

The default soft-start time on the EV kit is approximately 2.4ms.

Enable/Undervoltage-Lockout Level (EN_)

The device's two controllers may be independently shut down/enabled using the EN1 and EN2 pins. The EN_ pin can be programmed at 1.25V (typ) to detect the input undervoltage-lockout at a desired input voltage to enable/disable the corresponding controller with 50mV (typ) hysteresis. Connect a resistor-divider to EN_ from V_{IN} to GND to program the input undervoltage-lockout threshold to turn on/off the corresponding controller.

For normal operation, the device is enabled whenever the input voltage is greater than 4.5V and JU4 and JU5 are open. Set the voltage at which each controller turns on by placing a shunt across pins 1-2 on JU4 and JU5, and adjust the resistor-divider formed by R16, R17 for controller 1 and by R18, R19 for controller 2. Table 2 shows the EV kit's jumper settings for configuring the EN_ pin.

Select R17 (R19 for OUT2) below 10K and calculate the R16 (R18) based on the following equation:

$$R16 = \frac{R17 \times (V_{INUVLO} - 1.25)}{1.25}$$

Where V_{INUVLO} is the input voltage at which the controller is required to turn on.

Table 1. Default Setting of MAX17558 EV kit

JUMPER	SHUNT POSITION	FUNCTION
JU1	Unconnected	Configure output 1 and output 2 180° out-of-phase operation
JU2	1-2	Select 75mV current-limit threshold
JU3	1-2	Select the PWM mode of operation
JU4	Unconnected	Enable control 1
JU5	Unconnected	Enable control 2

Mode Selection (SKIP)

The device's SKIP pin is used to select light-load operating mode among the PWM/DCM modes of operation. Table 3 shows the EV kit's jumper settings for configuring the desired light-load operating mode.

Phase Shift Between Controllers

JU1 can be configured to switch between 0° and 180° phase-shift of the device's two controllers. Table 4 shows the jumper configurations to select the phase-shift between the two controllers.

Current-Limit Threshold Selection (JU2)

The current-limit threshold of both of the device's controllers can be selected using the JU2. Table 5 shows the EV kit jumper settings for selecting the current-limit threshold.

Each controller's peak current limit can be adjusted independently by changing the values of R1 and R2. Note that changing R1 and R2 values affect the stability and current-sense signal across the current sense pins. Refer to the "Current Sensing" section of the MAX17558 IC data sheet for calculating the current-sense resistor value.

Table 2. Enable Control (JU4, JU5)

JUMPER	SHUNT POSITION	EN	MAX17558 OUTPUT
JU4	Not installed	Unconnected	Enabled
	1-2	Connected to the midpoint of input UVLO divider	Enabled, UVLO level is set by the resistor-divider from VIN to GND.
	2-3	Connected to GND	Disabled
JU5	Not installed	Unconnected	Enabled
	1-2	Connected to the midpoint of input UVLO divider	Enabled, UVLO level is set by the resistor-divider from VIN to GND.
	2-3	Connected to GND	Disabled

Table 3. Mode Selection (JU3)

SHUNT POSITION	SKIP PIN	LIGHT-LOAD OPERATING MODE
1-2	Connected to VCCINT	PWM mode
2-3	Connected to VCCINT through a 100K resistor	DCM mode

Table 4. Phase-Shift Selection (JU1)

SHUNT POSITION	SEL_PH PIN	PHASE-SHIFT
1-2	Connected to VCCINT	0°
Not installed	Unconnected	180°

Table 5. Peak Current-Limit Threshold Selection (JU2)

SHUT POSITION	ILIM Pin	PEAK CURRENT LIMIT THRESHOLD
1-2	Connected to VCCINT	75mV
Not installed	Unconnected	50mV
2-3	Connected to GND	30mV

Switching Frequency

The device's switching frequency is set to 350kHz by resistor R14. Replace R14 with another value to set the switching frequency between 100kHz to 2200kHz. Use the following equation to calculate R14 when reconfiguring the switching frequency:

$$R_{RT} = \frac{(f_{SW} + 133)}{8.8}$$

Where F_{SW} is in kHz and R14 is in KΩ.

When reconfiguring the EV kit's switching frequency, it may be necessary to change the loop-compensation network's components to new values. Refer to the "Loop Compensation" section in the MAX17558 IC data sheet for computing new compensation component values.

Power-Good Outputs

The EV kit provides power-good output test points (PGOOD1 and PGOOD2) to monitor the PGOOD1 and PGOOD2 signals. The PGOOD signals are pulled-up to VCCINT by R21 and R20. PGOOD1 and PGOOD2 are high when V_{OUT1} and V_{OUT2}, respectively, are within the 90%-110% range of their programmed output voltages. When VOUT1 and VOUT2 are outside of the 90%-110% range of their programmed output voltages, PGOOD1 and PGOOD are pulled low, respectively.

Power Supply Tracking

The EV kit is set up for independent soft-start without tracking. The EV kit outputs are also operated in tracking mode, with either output as a master by the following modifications.

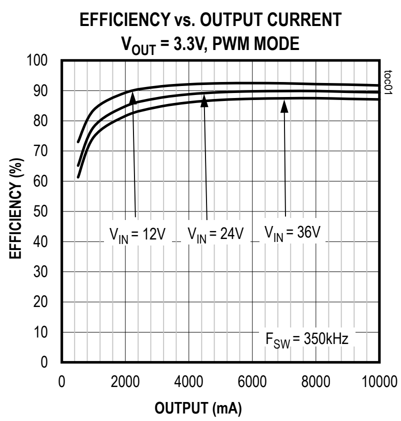
For OUT2 to track OUT1, follow the steps below:

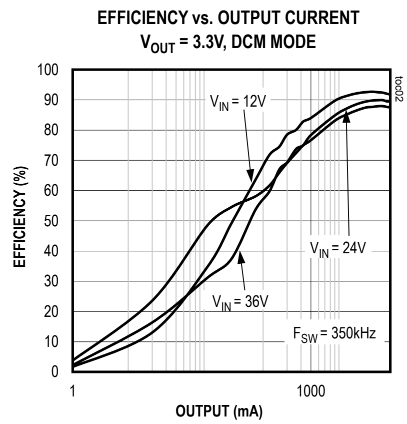
- Replace R23 with a 0Ω resistor
- Replace R22 and C30 with a resistive divider such that the parallel combination of the divider resistors is less than 10kΩ. The ratios of the resistor-dividers should be identical to the ratios of R26, R27, R6, and R7 for the coincident tracking and ratiometric tracking, respectively.

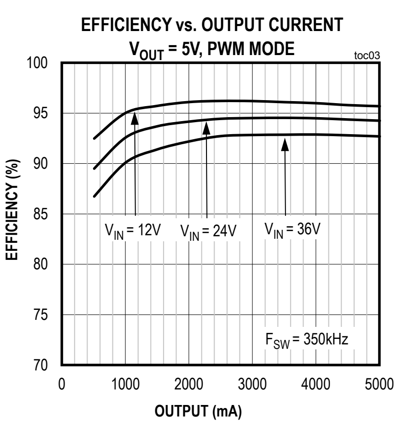
For OUT1 to track OUT2, follow the steps below:

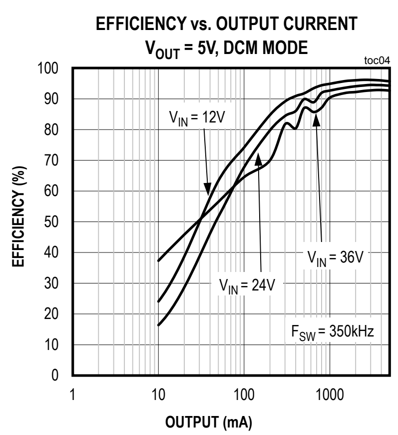
- Replace R30 with a 0Ω resistor
- Replace R29 and C21 with a resistive-divider such that the parallel combination of the divider resistors is less than 10kΩ. The ratios of the divider resistors should be identical to the ratios of R6, R7 and R26, R27 for the coincident tracking and ratiometric tracking, respectively.

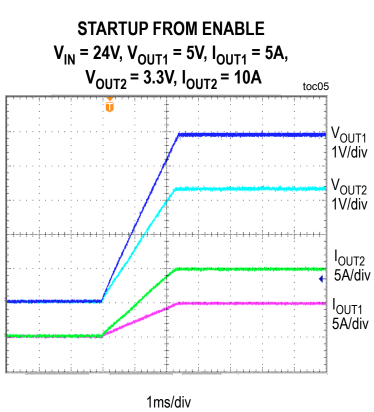
EV Kit Performance Report

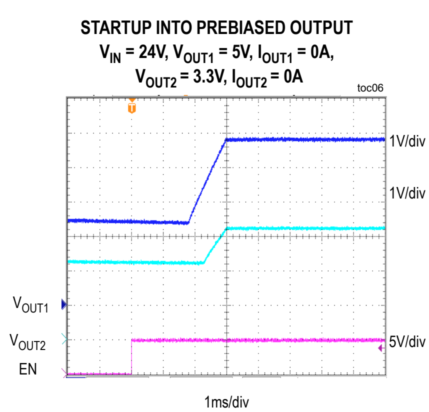




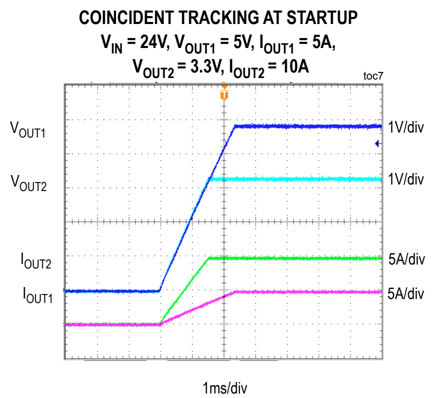


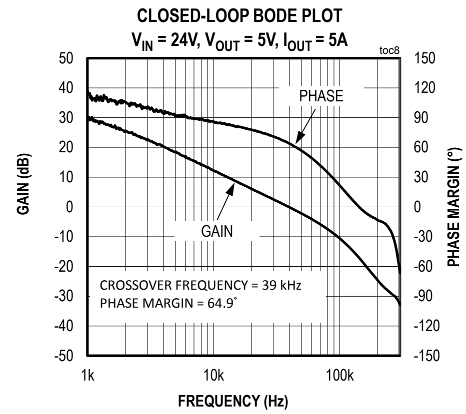


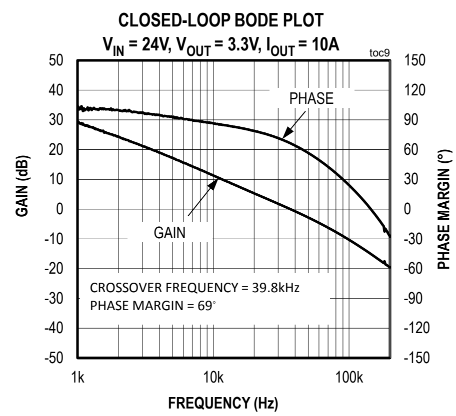




EV Kit Performance Report (continued)







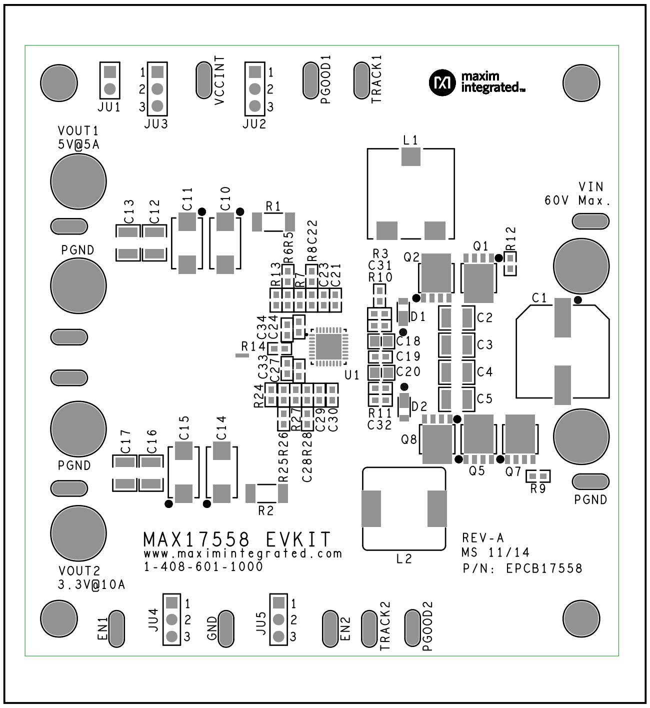


Figure 1. MAX17558 EV Kit Component Placement Guide—Component Top Side

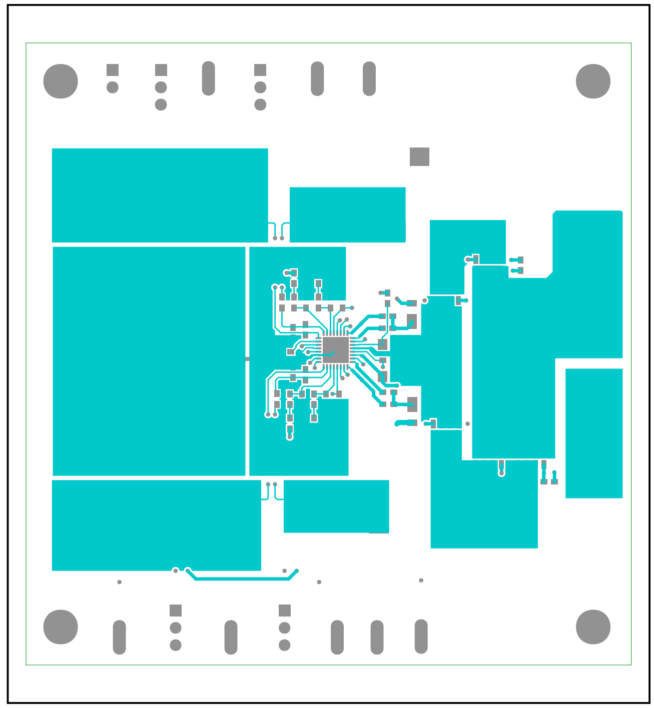


Figure 2. MAX17558 EV Kit PCB Layout—Component Top Side

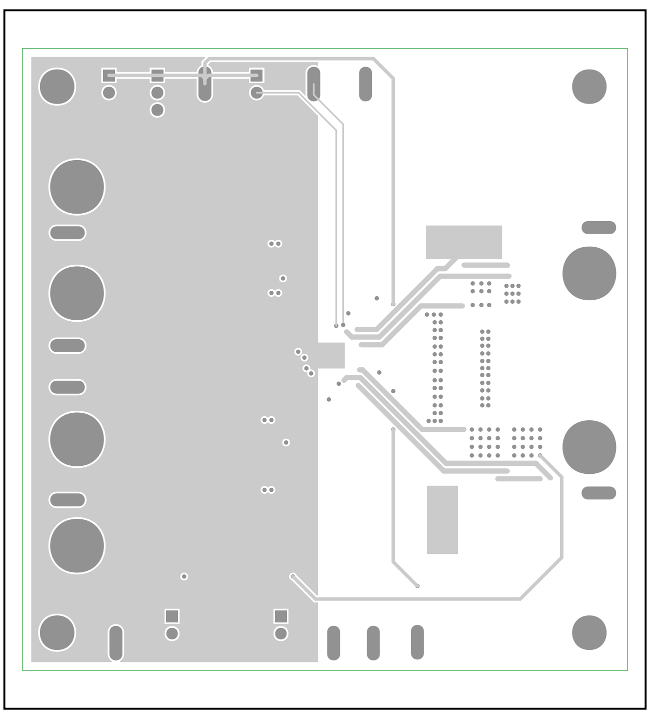


Figure 3. MAX17558 EV Kit PCB Layout—Inner Layer 1

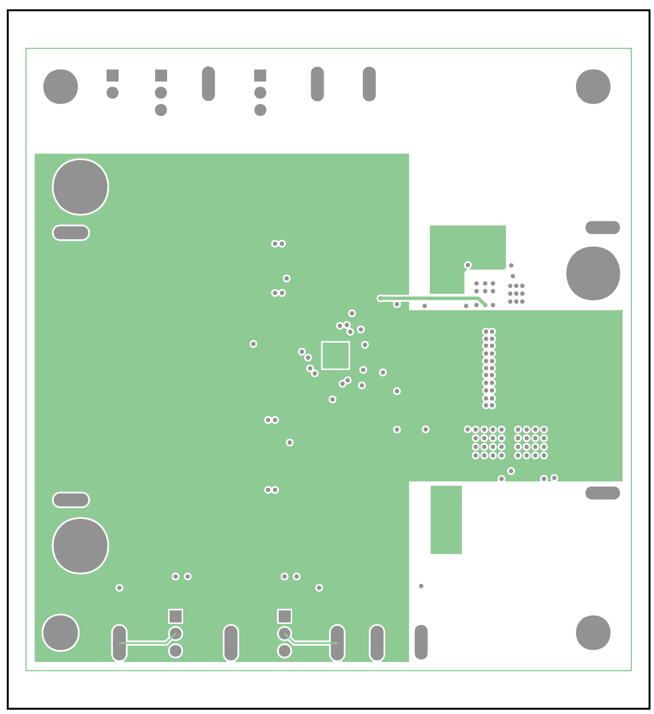


Figure 4. MAX17558 EV Kit PCB Layout—Inner Layer 2

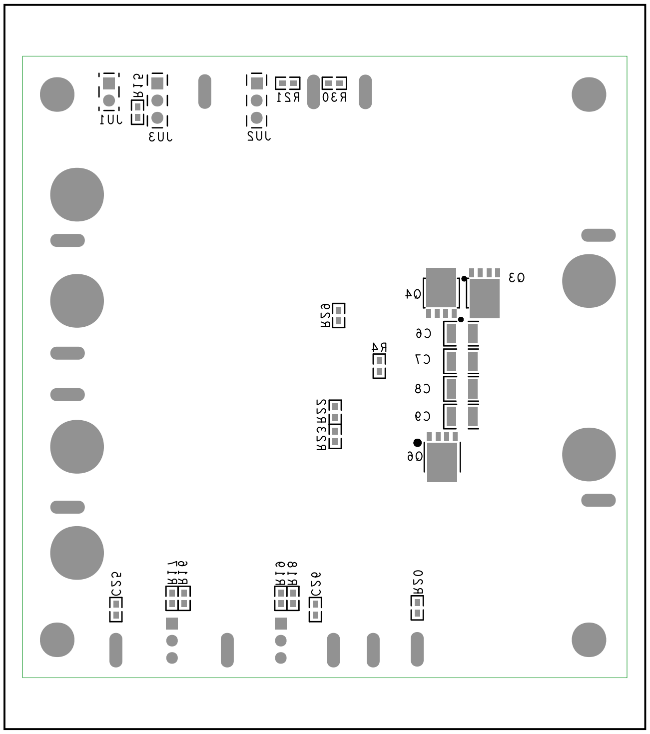


Figure 5. MAX17558 EV Kit Component Placement Guide—Solder Bottom Side

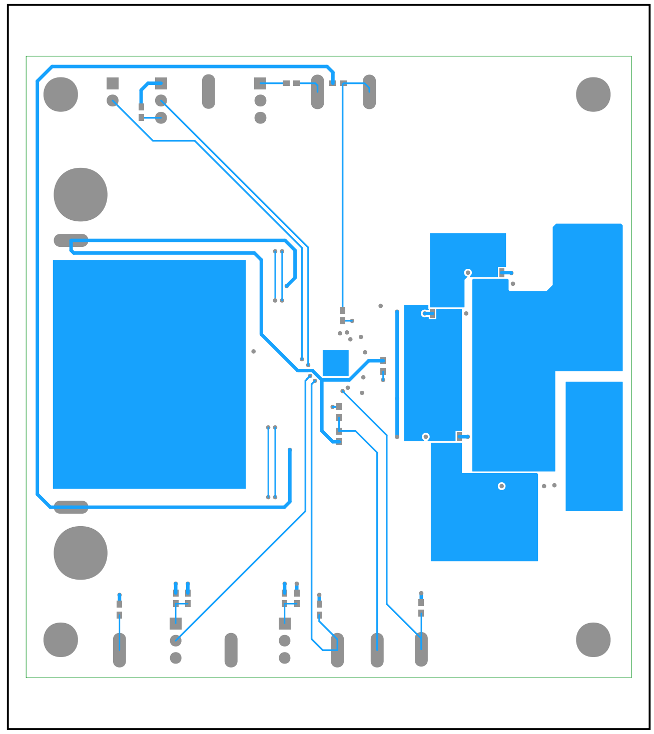


Figure 6. MAX17558 EV Kit PCB Layout—Component Bottom Side

Component Suppliers

SUPPLIER	WEBSITE
Wurth Elektronik	www.we-online.com
Renesas Electronics	am.renesas.com
Murata Americas	www.murata.com
Panasonic Electronic Components	www.panasonic.com/industrial
Vishay Dale	www.vishay.com
TDK Corp.	www.tdk.com
Rubycon Corp.	www.rubycon.com
TT Electronics/Welwyn	www.welwyn-tt.com

***Note:** Indicate that you are using the MAX17558 when contacting these component suppliers.*

Component List and Schematic

See the following links for component information and schematics:

- **MAX17558 EV BOM**
- **MAX17558 EV Schematic**

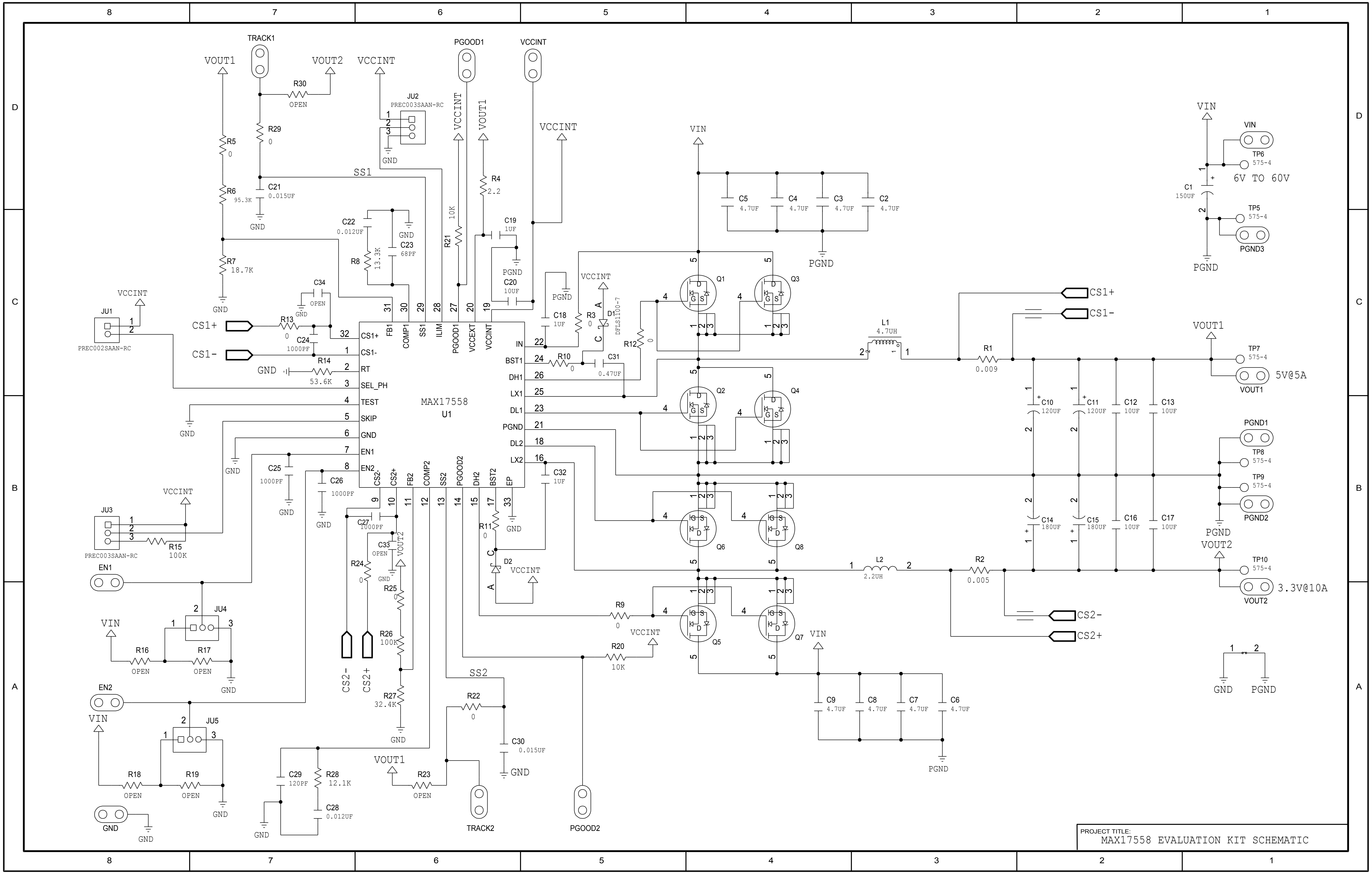
Ordering Information

PART	TYPE
MAX17558EVKIT#	EV kit

#Denotes RoHS compliant.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/15	Initial release	—


MAX17558
U1
VIN
6V TO 60V
5V@5A
3.3V@10A
VOUT1
VOUT2
VCCINT
PGND
GND
CS1+
CS1-
CS2+
CS2-
SS1
SS2
TRACK1
TRACK2
PGOOD1
PGOOD2
EN1
EN2
JU1
JU2
JU3
JU4
JU5
L1
4.7UH
L2
2.2UH
PROJECT TITLE:
MAX17558 EVALUATION KIT SCHEMATIC

BILL OF MATERIALS (BOM)

DESIGNATION	QTY	DESCRIPTION
C1	1	150uF, 80V , Aluminum-Electrolytic Capacitor PANASONIC EEVFK1K151Q
C2-C9	8	4.7uF ±20%, 80V X7R Ceramic Capacitor Murata GRM32ER71K475ME14#
C10, C11	2	120uF, 6.3V , Electrolytic Capacitor PANASONIC EEFSX0J121E7
C12,C13,C16,C17	4	10uF ±10%, 10V X7R Ceramic Capacitor(1210) Murata GRM32DR71A106KA01L
C14, C15	2	180uF, 6.3V , Electrolytic Capacitor RUBYCON 6SW180M
C18	1	1uF ±10%, 100V X7S Ceramic Capacitor(0805) TDK Corporation C2012X7S2A105K
C19,C32	1	1uF ±10%, 16V X7R Ceramic Capacitor(0603) Murata GRM188R71A105KA61J
C20	1	10uF ±10%, 10V X7R Ceramic Capacitor(0805) Murata GRM21BR71A106KE51L
C21,C30	2	15nF ±10%, 16V X7R Ceramic Capacitor(0603) Murata GRM188R71C153KA01D
C22,C28	2	12nF ±10%, 16V X7R Ceramic Capacitor(0603) Murata GRM188R71C123KA01D
C23	1	68pF ±5%, 50V C0G Ceramic Capacitor(0603) Murata GRM1885C1H680J
C24,C25,C26,C27	4	1nF ±10%, 16V X7R Ceramic Capacitor(0603) Murata GRM188R71C102KA01D
C29	1	120pF ±5%, 50V C0G Ceramic Capacitor(0603) Murata GRM1885C1H121JA01D
C31	1	0.47uF ±10%, 16V X7R Ceramic Capacitor(0603) Murata GRM188R71A474KA61D
C33,C34	0	Not Installed.

BILL OF MATERIALS (BOM)

		Ceramic Capacitor (0603)
JU1	1	2-pin header (0.1" pitch)
JU2,JU3, JU4,JU5	4	3-pin header (0.1" pitch)
L1	1	4.7μH, 9.4A Inductor Coilcraft SER1360-472KL
L2	1	2.2μH, 11.5A Inductor Wurth Electronics 7447709002
Q1,Q5,Q7	3	60V, 25A N-Channel MOSFET (LFPAK) Renesas RJK0651DPB
Q2,Q8	2	60V, 45A MOSFET (LFPAK) Renesas RJK0653DPB
Q3	0	Not installed, N-Channel MOSFET (LFPAK) Renasas RJK0651DPB
Q4,Q6	0	Not installed (LFPAK) Renasas RJK0653DPB
D1,D2	2	100V Schottky Diode (POWERDI 123) Diodes Incorporated DFLS 1100-7
R1	1	9mΩ ±1% 1Watt current sense resistor (2010) ROHM Semiconductor PMR50HZPFU9L00
R2	1	5mΩ ±1% 1.5Watt current sense resistor (2010) TT Electronics/Welwyn LRMAT2010-R005FT4
R3,R5,R9,R10,R11,R12,R13, R22,R24, R25,R29	11	0Ω ±1% resistor (0603
R4	1	2.2Ω ±1% resistor (0603)
R6	1	95.3KΩ ±1% resistor (0603)
R7	1	18.7KΩ ±1% resistor (0603
R8	1	13.3KΩ ±1% resistor (0603)
R14	1	53.6KΩ ±1% resistor (0603)
R15,R26	2	100KΩ ±1% resistor (0603)
R20, R21	2	10KΩ ±1% resistor (0603)

BILL OF MATERIALS (BOM)

R16, R17, R18, R19, R23, R30	0	Not installed, resistor (0603)
R27	1	32.4KΩ ±1% resistor (0603
R28	1	12.1KΩ ±1% resistor (0603)
U1	1	Wide 4.5V to 60V Input, Dual Output, Step-Down DC-DC Controller (32 TQFN-EP) Maxim MAX17558ATJ+
VIN,PGND,VOUT1,PGND,VOUT2,PGND,EN1,EN2,GND,PGOOD1,PGOOD2, VCCINT,TRACK1,TRACK2	14	20G tinned copper Bus wire formed into “U” shaped loops (0.25” off the PC board)
VIN,PGND,VOUT1,PGND,VOUT2,PGND	6	Non -Insulate Jack Keystone Electronics 575-4