

# MAXIM

## MAX668 Evaluation Kit

Evaluates: MAX668/MAX669

### General Description

The MAX668 evaluation kit (EV kit) combines a constant-frequency, pulse-width-modulation (PWM) step-up controller with an external N-channel MOSFET and Schottky diode to provide a regulated output voltage. The EV kit accepts a +3V to  $V_{OUT}$  input and converts it to a +12V output for currents up to 1A, with greater than 90% conversion efficiency. The EV kit operates at 500kHz, allowing the use of small external components.

The MAX668 EV kit is a fully assembled and tested surface-mount circuit board. This EV kit can also be configured for the application circuits listed in the *EV Kit Application Circuit Capabilities* table. For input voltages below 3V and down to 1.8V, replace the MAX668 with a MAX669. The MAX669 must always operate in bootstrapped mode (JU2 shunt across pins 1 and 2).

### Ordering Information

PART	TEMP. RANGE	IC PACKAGE
MAX668EVKIT	0°C to +70°C	10 $\mu$ MAX

**Note:** To evaluate the MAX669, request a MAX669EUB free sample with the MAX668EVKIT.

### EV Kit Application Circuit Capabilities

$V_{IN(MIN)}$ (V)	$V_{OUT}$ (V)	$I_{OUT}$ (A)
1.8	12	0.4
1.8	24	0.1
2.5	12	0.65
3	5	3
3	12	1
3	36	0.02
12	24	0.5

**Note:** Design information for these applications is included. The shaded row shows EV kit configuration as shipped.

### Features

- ◆ +3V to  $V_{OUT}$  Input Range (as shipped)
- ◆ +12V or Adjustable Output Voltage
- ◆ Output Current Up to 1A
- ◆ N-Channel External MOSFET
- ◆ 4 $\mu$ A IC Shutdown Current
- ◆ 500kHz Switching Frequency
- ◆ Surface-Mount Components
- ◆ Fully Assembled and Tested

### Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	68 $\mu$ F, 20V, low-ESR tantalum cap Sprague 593D686X0020E2W or AVX TPSE686M020R0150
C5	1	120 $\mu$ F, 20V, low-ESR tantalum cap Sprague 594D127X0020R2T
C2	1	0.1 $\mu$ F ceramic capacitor
C3	1	0.22 $\mu$ F ceramic capacitor
C4, C8	2	1 $\mu$ F ceramic capacitors
C7	1	220pF ceramic capacitor
C6	0	Not installed
D1	1	3A Schottky diode Hitachi HRF302A or Motorola MBRS340T3
L1	1	4.7 $\mu$ H power inductor Sumida CDRH104-4R7 (shielded), Coiltronics UP2B-4R7, or Coilcraft DO3316P-472
N1	1	N-channel MOSFET Fairchild FDS6680 or International Rectifier IRF7801
R1	1	0.020 $\Omega$ , 1%, 1/2W resistor Dale WSL-2010-R020F or IRC LR2010-01-R020F
R2	1	218k $\Omega$ , 1% resistor
R3	1	24.9k $\Omega$ , 1% resistor
R4	1	100k $\Omega$ , 1% resistor
U1	1	MAX668EUB
JU1, JU2	2	3-pin headers
JU3	1	2-pin header
None	2	Shunts (JU1, JU2)
None	1	MAX668/MAX669 PC board
None	1	MAX668/MAX669 data sheet

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## Component Suppliers

SUPPLIER	PHONE	FAX
AVX	803-946-0690	803-626-3123
CoilCraft	708-639-6400	708-639-1469
Coiltronics	561-241-7876	561-241-9339
Dale-Vishay	402-564-3131	402-563-6418
Fairchild	408-721-2181	408-721-1635
Hitachi	888-777-0384	650-244-7947
International Rectifier	310-322-3331	310-322-3332
IRC	512-992-7900	512-992-3377
Motorola	602-303-5454	602-994-6430
Siliconix	408-988-8000	408-970-3950
Sprague	603-224-1961	603-224-1430
Sumida	708-956-0666	708-956-0702
Vishay/Vitramon	203-268-6261	203-452-5670

**Note:** Please indicate that you are using the MAX668 when contacting these component suppliers.

## Quick Start

The MAX668 EV kit is fully assembled and tested. Follow these steps to verify board operation. **Do not turn on the power supply until all connections are completed.**

- 1) Place the shunt on JU1 across pins 1 and 2. Verify that the shunt is across JU2 pins 2 and 3 ( $V_{CC}$  is tied to  $V_{IN}$ ) and JU3 is open (LDO is open).
- 2) Connect a +5V supply to the  $V_{IN}$  pad. Connect ground to the GND pad.
- 3) Connect a voltmeter to the  $V_{OUT}$  pad.
- 4) Turn on the power supply and verify that the output voltage is 12V.

## Detailed Description

The MAX668 EV kit provides a regulated +12V output voltage from an input source as low as +3V. It drives loads up to 1A with greater than 90% conversion efficiency. This EV kit is shipped configured in the non-bootstrapped mode ( $V_{CC}$  is tied to  $V_{IN}$ ). However, there are several methods of connecting  $V_{CC}$  and LDO depending on the specific design including input and output voltage range, quiescent power dissipation, MOSFET selection, and load.

If the minimum input voltage is below +3.0V, use the MAX669 with  $V_{CC}$  bootstrapped from  $V_{OUT}$  (Table 1). In bootstrapped mode, if  $V_{OUT}$  is always less than +5.5V, then LDO may be shorted to  $V_{CC}$  to eliminate the dropout voltage of the LDO regulator. This increases the gate drive to the MOSFET, which lowers the MOSFET on-resistance but increases the MAX668 supply current due to gate-charge loss.

If  $V_{IN}$  is greater than +3.0V, the MAX668's  $V_{CC}$  can be powered from  $V_{IN}$ . This will decrease quiescent power dissipation, especially when  $V_{OUT}$  is large. If  $V_{IN}$  is always less than +5.5V, LDO may be shorted to  $V_{CC}$  to eliminate the dropout voltage of the LDO regulator. If  $V_{IN}$  is in the range of +3V to +4.5V, then the user may still want to bootstrap from  $V_{OUT}$  to increase gate drive to the MOSFET at the expense of power dissipation. If  $V_{IN}$  is always greater than +4.5V, the  $V_{CC}$  input should always be tied to  $V_{IN}$ , since bootstrapping from  $V_{OUT}$  will not increase the gate drive from LDO, but quiescent power dissipation will rise. Jumpers JU2 and JU3 control the  $V_{CC}$  and LDO inputs (see MAX668/MAX669 data sheet).

## Jumper Selection

The 3-pin header JU1 selects shutdown mode. Table 1 lists the selectable jumper options. The 3-pin header JU2 selects bootstrapped mode. Table 2 lists the selectable jumper options. For  $V_{CC}$  less than 5.5V, use the 2-pin header JU3 to short LDO to  $V_{CC}$ . This eliminates the internal linear regulator (LDO) dropout voltage. For the MAX668, this allows operation with input voltages down to 2.7V. Table 3 lists the selectable jumper options.

## Other Output Voltages

The MAX668 EV kit can also be used to evaluate other output voltages. Refer to the *Output Voltage Selection* section in the MAX668 data sheet for instructions on selecting the feedback resistors R2 and R3. **For output voltages greater than 15V, replace C5 (20V) with a capacitor that has a higher voltage rating.**

In addition to the standard EV kit configuration of  $3V_{IN}$  to  $12V_{OUT}$  at 1A, the *EV Kit Application Circuit Capabilities* table listed several common Input/Output combinations. Table 4 lists the components recommended for these alternative circuits.

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**Table 1. Jumper JU1 Functions**

SHUNT LOCATION	SYNC/ $\overline{\text{SHDN}}$ PIN	MAX668 OUTPUT
1 and 2	Connected to VCC	MAX668 enabled, $V_{\text{OUT}} = 12\text{V}$ . MAX668 operates at internal frequency.
2 and 3	Connected to GND	Shutdown mode, $V_{\text{OUT}} = V_{\text{IN}} - \text{diode}$
Not installed	Floating	MAX668 can be externally synchronized when the SYNC/ $\overline{\text{SHDN}}$ pad is clocked.

**Table 2. Jumper JU2 Functions**

SHUNT LOCATION	VCC PIN	MAX668 MODE
1 and 2	Connected to $V_{\text{OUT}}$	Bootstrapped mode
2 and 3	Connected to $V_{\text{IN}}$	Non-bootstrapped mode

**Table 3. Jumper JU3 Functions**

SHUNT LOCATION	LDO PIN
On	Connected to VCC
Off	Open

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**Table 4. Components for Alternate Application Circuits**

V <sub>IN</sub> (MIN) (V)	V <sub>OUT</sub> (V)	I <sub>OUT</sub> (A)	MAXIM PART NO.	JU2 BOOT-STRAPPED vs. NON-BOOT-STRAPPED	L1 (μH)	R1 (mΩ)	R2 (kΩ)	R3 (kΩ)	R4 (kΩ)	D1	N1	C1	C5	C6
1.8	12	0.4	MAX669	1 & 2 Bootstrapped	4.7 Sumida CDRH10 4-4R7	20 Dale WSL-2010-R020F	218	24.9	100	Hitachi HRF302A	International Rectifier IRF7401	68μF 20V AVX TPSE686M 020R0150	120μF 20V Sprague 594D127X 0020R2T	Open
1.8	24	0.1	MAX669	1 & 2 Bootstrapped	1.0 Coilcraft D03316-102	15 Dale WSL-2010-R015F	454	24.9	200	Hitachi HRF302A	International Rectifier IRF7401	68μF 20V AVX TPSE686M 020R0150	22μF 35V AVX TPSE226M 035R0300	22μF 35V AVX TPSE226M 035R0300
2.5	12	0.65	MAX669	1 & 2 Bootstrapped	4.7 Sumida CDRH10 4-4R7	20 Dale WSL-2010-R020F	218	24.9	100	Hitachi HRF302A	International Rectifier IRF7401	68μF 20V AVX TPSE686M 020R0150	120μF 20V Sprague 594D127X 0020R2T	Open
3	5	3	MAX668	1 & 2 Bootstrapped	4.7 Sumida CDRH12 7-4R7	15 Dale WSL-2512-R015F	75	24.9	100	Hitachi HRF502A	Fairchild FDS6680	330μF 10V Kemet T510X337 M010	330μF 10V Kemet T510X337 M010	330μF 10V Kemet T510X337 M010
3	36	0.020	MAX668	2 & 3 Non-Bootstrapped	4.7 Sumida CD43-4R7	100 Dale WSL-1206-R100F	398	24.9	100	Central Semiconductor CMPD914	Fairchild FDS5610	10μF 6.3V, X7R Taiyo Yuden JMK325BJ1 06MN	2.2μF 50V, X7R Kemet C1825C22 5MR0RAC	Open
12	24	0.5	MAX668	2 & 3 Non-Bootstrapped	22 Sumida CD73-220	50 Dale WSL-2010-R050F	453	24.9	100	Motorola MBR5140T3	Fairchild FDS6680	33μF 20V AVX TPSE336M 020R0200	22μF 35V AVX TPSE226M 035R0300	Open

**Note:** This table lists components recommended for building other application circuits using the MAX668 EV kit.

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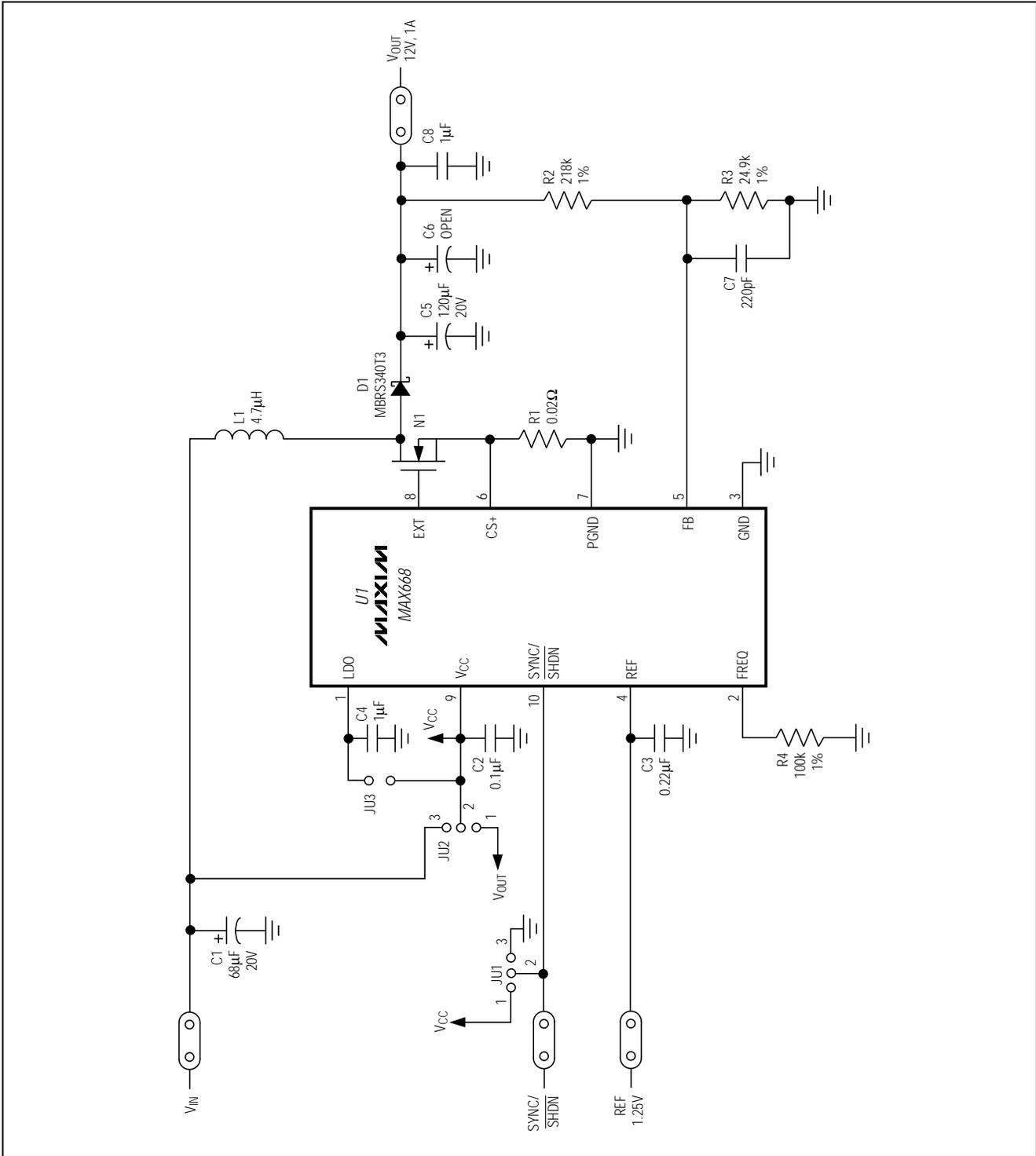


Figure 1. MAX668 EV Kit Schematic

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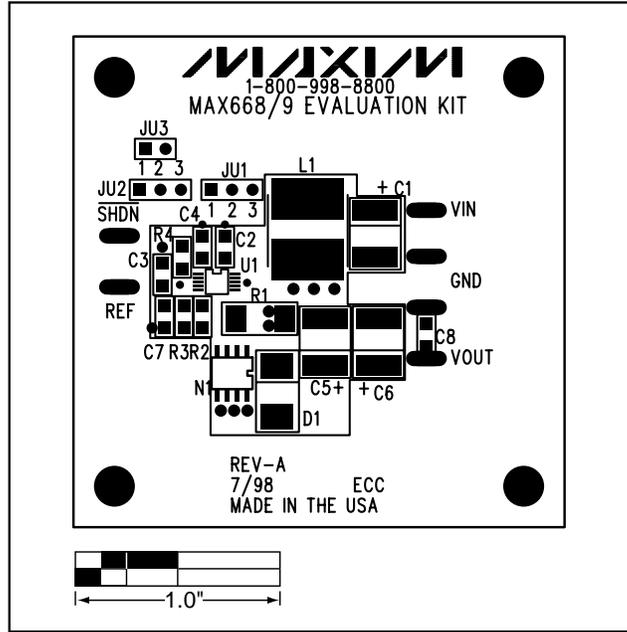


Figure 2. MAX668 EV Kit Component Placement Guide—Component Side

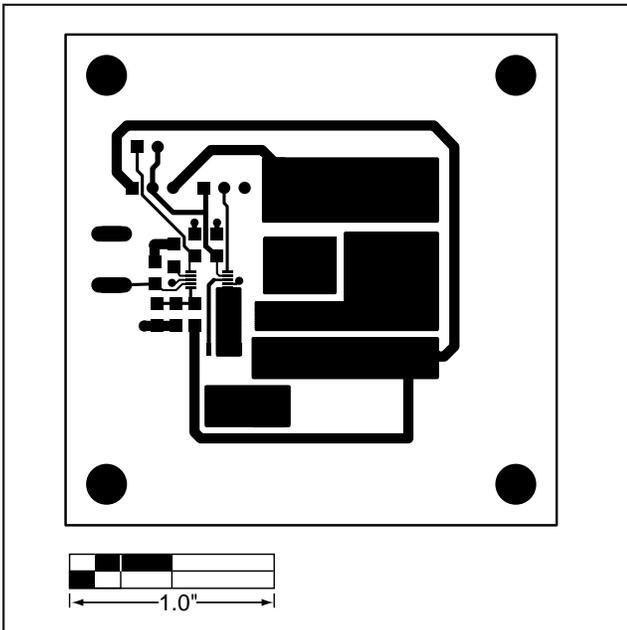


Figure 3. MAX668 EV Kit PC Board Layout—Component Side

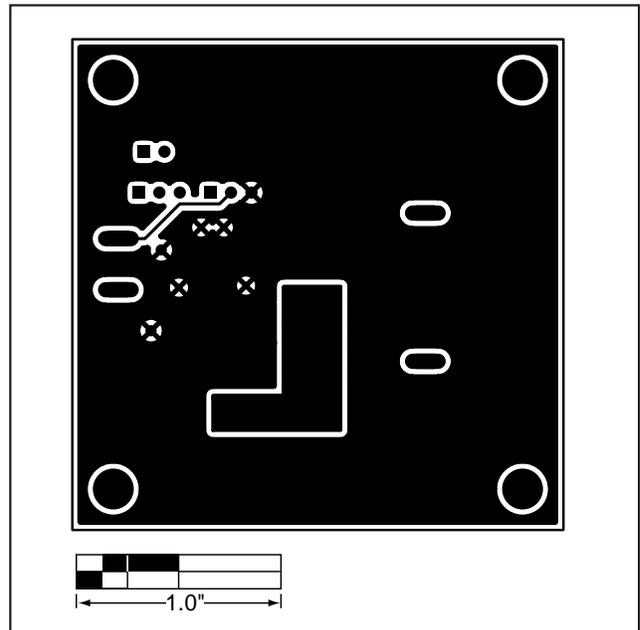


Figure 4. MAX668 EV Kit PC Board Layout—Solder Side

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