

Low-Noise Step-Up DC-DC Converter

General Description

The MAX17067 boost converter incorporates high-performance (at 1.2MHz), current-mode, fixed-frequency, pulse-width modulation (PWM) circuitry with a built-in 0.15Ω n-channel MOSFET to provide a highly efficient regulator with fast response.

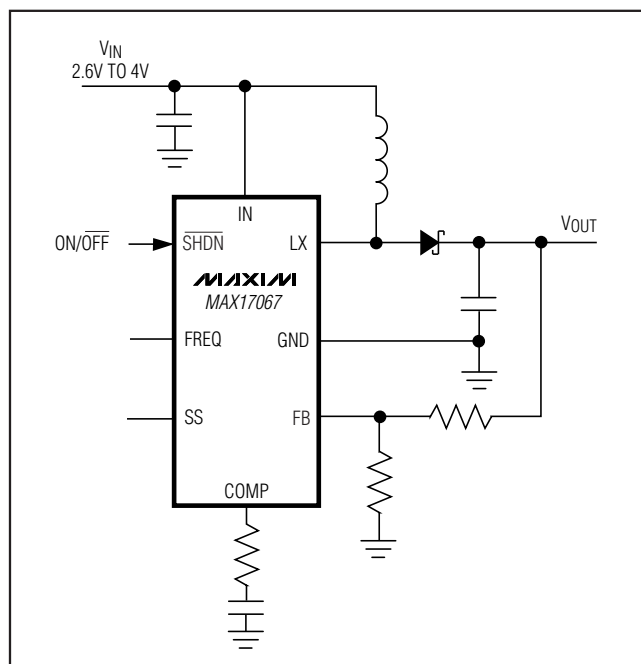
High switching frequency (640kHz or 1.2MHz selectable) allows for easy filtering and faster loop performance. An external compensation pin provides the user flexibility in determining loop dynamics, allowing the use of small, low equivalent-series-resistance (ESR) ceramic output capacitors. The device can produce an output voltage as high as 18V.

Soft-start is programmed with an external capacitor, which sets the input-current ramp rate. The MAX17067 is available in a space-saving 8-pin μ MAX[®] package. The ultra-small package and high switching frequency allow the total solution to be less than 1.1mm high.

Application

LCD Displays

Typical Operating Circuit



μ MAX is a registered trademark of Maxim Integrated Products, Inc.

Features

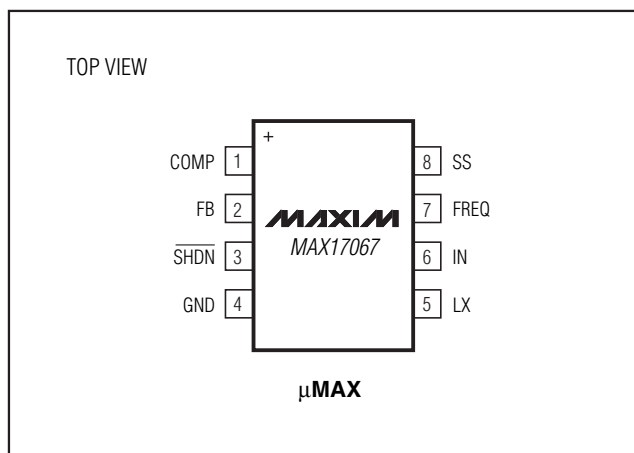
- ◆ 90% Efficiency
- ◆ Adjustable Output from V_{IN} to 18V
- ◆ 2.4A, 0.15Ω, 22V Power MOSFET
- ◆ +2.6V to +4.0V Input Range
- ◆ Pin-Selectable 640kHz or 1.2MHz Switching Frequency
- ◆ Programmable Soft-Start
- ◆ Small 8-Pin μ MAX Package
- ◆ Integrated Input Voltage Clamp Circuit

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	PKG CODE
MAX17067EUA+	-40°C to +85°C	8 μ MAX	U8+1

+ Denotes a lead-free package.

Pin Configuration



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ABSOLUTE MAXIMUM RATINGS

LX to GND	-0.3V to +22V
SHDN, FREQ to GND	-0.3V to +7.5V
IN to GND (Note 1)	-0.3V to +6V
SS, COMP, FB to GND	-0.3V to ($V_{IN} + 0.3V$)
RMS LX Pin Current	1.2A

Continuous Power Dissipation ($T_A = +70^\circ\text{C}$)	
8-Pin μMAX (derate 4.1mW/ $^\circ\text{C}$ above $+70^\circ\text{C}$)	330mW
Operating Temperature Range	-40°C to $+85^\circ\text{C}$
Junction Temperature	$+150^\circ\text{C}$
Storage Temperature Range	-65°C to $+150^\circ\text{C}$
Lead Temperature (soldering, 10s)	$+300^\circ\text{C}$

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

($V_{IN} = \overline{\text{SHDN}} = 3V$, $\text{FREQ} = 3V$, $T_A = 0^\circ\text{C}$ to $+85^\circ\text{C}$, unless otherwise noted. Typical values are at $T_A = +25^\circ\text{C}$.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Supply Range	V_{IN}	$V_{OUT} < 18V$	2.6		4.0	V
Output Voltage					18	V
Input Supply Clamp Voltage		Use external limiting resistor; $R_{IN} = 100\Omega$, $V_{IN} = 10V$ (Note 3)	6.05	6.40	6.60	V
V_{IN} Undervoltage Lockout	UVLO	V_{IN} rising, typical hysteresis is 50mV, LX remains off below this level	2.30	2.45	2.57	V
Quiescent Current	I_{IN}	$V_{FB} = 1.3V$, not switching		0.3	0.6	mA
		$V_{FB} = 1.0V$, switching		1.5	2.5	
Shutdown Supply Current	I_{IN}	$\overline{\text{SHDN}} = \text{GND}$, $T_A = +25^\circ\text{C}$		30	60	μA
		$\overline{\text{SHDN}} = \text{GND}$, $T_A = +85^\circ\text{C}$		30		
ERROR AMPLIFIER						
Feedback Voltage	V_{FB}	Level to produce $V_{COMP} = 1.24V$	1.23	1.24	1.25	V
FB Input Bias Current	I_{FB}	$V_{FB} = 1.24V$	50	125	200	nA
Feedback-Voltage Line Regulation		Level to produce $V_{COMP} = 1.24V$, $2.6V < V_{IN} < 5.5V$		0.05	0.15	%/V
Transconductance	g_m	$\Delta I = 5\mu\text{A}$	100	240	440	μS
Voltage Gain	A_V			3800		V/V
OSCILLATOR						
Frequency	f_{OSC}	FREQ = GND	500	640	780	kHz
		FREQ = IN	1000	1200	1400	
Maximum Duty Cycle	DC	FREQ = GND, FREQ = IN	89	92	95	%
n-CHANNEL SWITCH						
Current Limit	I_{LIM}	$V_{FB} = 1V$, duty cycle = 68% (Note 4)	1.8	2.4	3.4	A
On-Resistance	R_{ON}			150	275	$\text{m}\Omega$
Leakage Current	I_{LXOFF}	$V_{LX} = 20V$		10	20	μA
Current-Sense Transresistance	R_{CS}		0.2	0.3	0.4	V/A
SOFT-START						
Reset Switch Resistance					100	Ω
Charge Current		$V_{SS} = 1.2V$	2.5	4.5	6.5	μA

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ELECTRICAL CHARACTERISTICS (continued)

($V_{IN} = \overline{SHDN} = 3V$, $FREQ = 3V$, $T_A = 0^{\circ}C$ to $+85^{\circ}C$, unless otherwise noted. Typical values are at $T_A = +25^{\circ}C$.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
CONTROL INPUTS						
Input Low Voltage	V_{IL}	\overline{SHDN} , $FREQ$, $V_{IN} = 2.6V$ to $4.0V$			$0.3 \times V_{IN}$	V
Input High Voltage	V_{IH}	\overline{SHDN} , $FREQ$, $V_{IN} = 2.6V$ to $4.0V$	$0.7 \times V_{IN}$			V
Hysteresis		\overline{SHDN} , $FREQ$		$0.1 \times V_{IN}$		V
FREQ Pulldown Current	I_{FREQ}		3	6	9	μA
\overline{SHDN} Input Current	$I_{\overline{SHDN}}$	$\overline{SHDN} = GND$, $T_A = +25^{\circ}C$	-1		+1	μA
		$\overline{SHDN} = GND$, $T_A = +85^{\circ}C$		0		
Thermal Shutdown		Temperature rising		160		$^{\circ}C$
		Hysteresis		20		

ELECTRICAL CHARACTERISTICS

($V_{IN} = \overline{SHDN} = 3V$, $FREQ = 3V$, $T_A = -40^{\circ}C$ to $+85^{\circ}C$, unless otherwise noted.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Supply Range	V_{IN}	$V_{OUT} < 18V$	2.6		4.0	V
Output Voltage Range					18	V
Input Supply Clamp Voltage		Use external limiting resistor; $R_{IN} = 100\Omega$, $V_{IN} = 10V$ (Note 3)	6.03		6.60	V
V_{IN} Undervoltage Lockout	UVLO	V_{IN} rising, typical hysteresis is 80mV, LX remains off below this level	2.30		2.57	V
Quiescent Current	I_{IN}	$V_{FB} = 1.3V$, not switching			0.6	mA
		$V_{FB} = 1.0V$, switching			2.5	
ERROR AMPLIFIER						
Feedback Voltage	V_{FB}	Level to produce $V_{COMP} = 1.24V$	1.227		1.253	V
FB Input Bias Current	I_{FB}	$V_{FB} = 1.24V$			200	nA
Feedback-Voltage Line Regulation		Level to produce $V_{COMP} = 1.24V$, $2.6V < V_{IN} < 4.0V$			0.15	%/V
Transconductance	g_m	$\Delta I = 5\mu A$	100		440	μS
OSCILLATOR						
Frequency	f_{OSC}	$FREQ = GND$	450		830	kHz
		$FREQ = IN$	950		1500	
Maximum Duty Cycle	DC	$FREQ = GND$, $FREQ = V_{IN}$	89		95	%

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ELECTRICAL CHARACTERISTICS (continued)

($V_{IN} = \overline{\text{SHDN}} = 3\text{V}$, $\text{FREQ} = 3\text{V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
n-CHANNEL SWITCH						
Current Limit	I_{LIM}	$V_{\text{FB}} = 1\text{V}$, duty cycle = 68% (Note 4)	1.8		3.4	A
On-Resistance	R_{ON}	$V_{\text{IN}} = 3\text{V}$			275	Ω
Current-Sense Transresistance	R_{CS}		0.19		0.40	V/A
SOFT-START						
Reset Switch Resistance					100	Ω
Charge Current		$V_{\text{SS}} = 1.2\text{V}$	2.5		6.5	μA
CONTROL INPUTS						
Input Low Voltage	V_{IL}	$\overline{\text{SHDN}}$, FREQ , $V_{\text{IN}} = 2.6\text{V}$ to 4.0V			$0.3 \times V_{\text{IN}}$	V
Input High Voltage	V_{IH}	$\overline{\text{SHDN}}$, FREQ , $V_{\text{IN}} = 2.6\text{V}$ to 4.0V	$0.7 \times V_{\text{IN}}$			V

Note 1: Limit on I_{IN} absolute maximum ratings is for operation without the use of an external resistor for the internal clamp circuit. See the *IN Supply Clamp Circuit* section for I_{IN} voltage limits during clamping circuit operation.

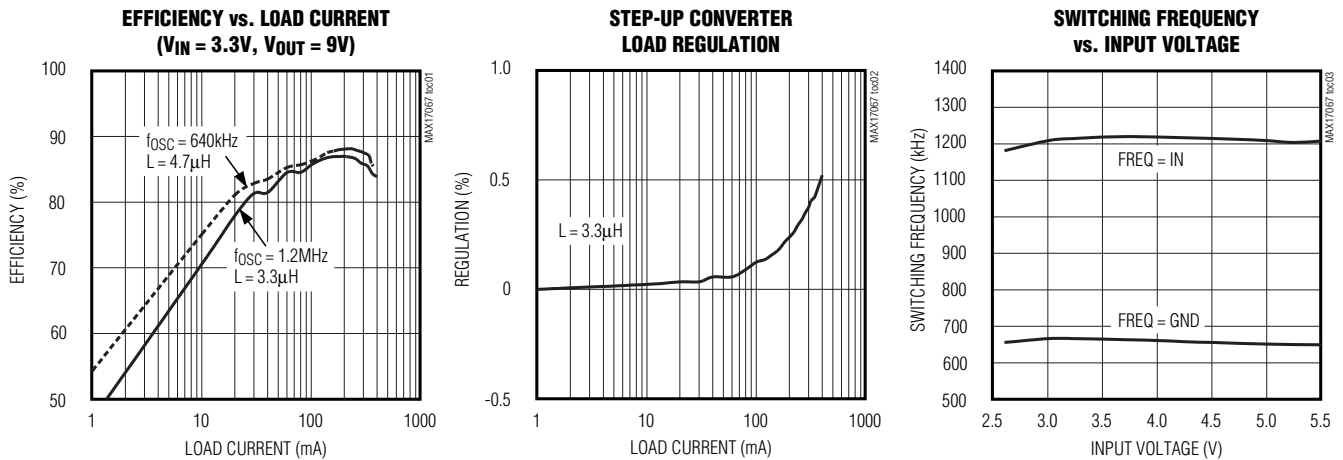
Note 2: Limits are 100% production tested at $T_A = +25^\circ\text{C}$. Maximum and minimum limits over temperature are guaranteed by design and characterization.

Note 3: See the *IN Supply Clamp Circuit* section to properly size the external resistor.

Note 4: Current limit varies with duty-cycle slope compensation. See the *Output-Current Capability* section.

Typical Operating Characteristics

(Circuit of Figure 1, $V_{\text{IN}} = 3.3\text{V}$, $f_{\text{OSC}} = 640\text{kHz}$, $T_A = +25^\circ\text{C}$, unless otherwise noted.)

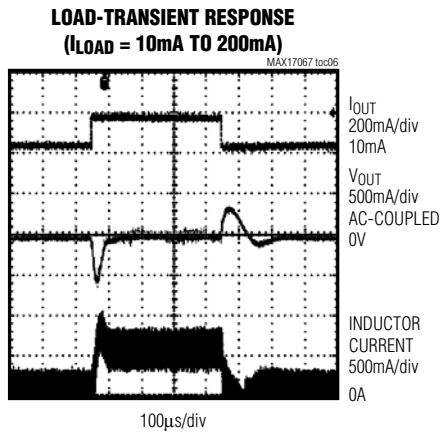
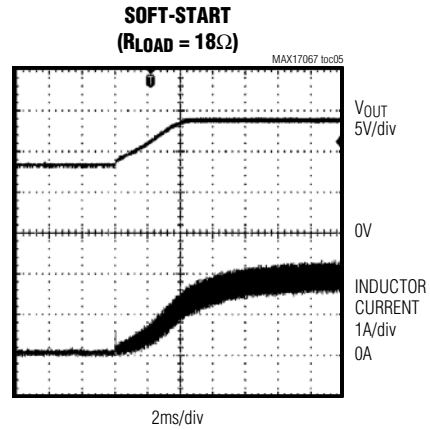
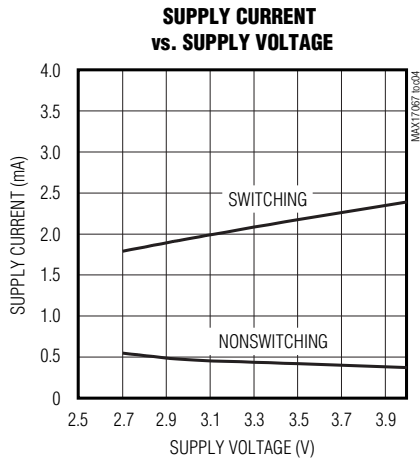


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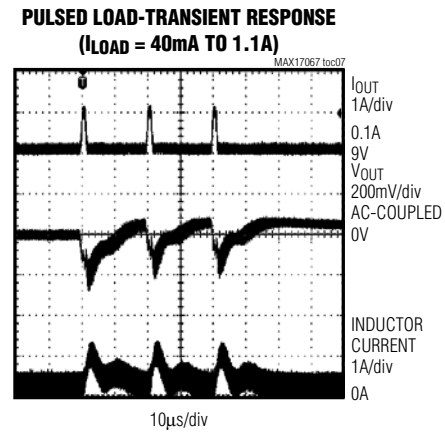
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Typical Operating Characteristics (continued)

(Circuit of Figure 1, $V_{IN} = 3.3V$, $f_{OSC} = 640kHz$, $T_A = +25^\circ C$, unless otherwise noted.)

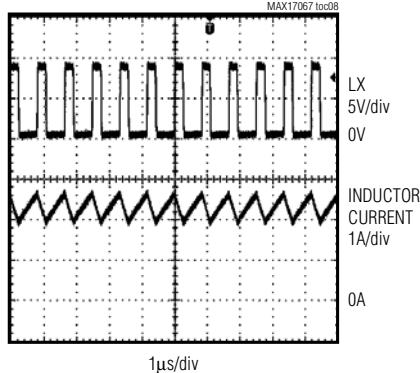


$L = 3.3\mu H$
 $R_{COMP} = 39k\Omega$
 $C_{COMP1} = 620pF$



$L = 3.3\mu H$
 $R_{COMP} = 39k\Omega$
 $C_{COMP1} = 620pF$

SWITCHING WAVEFORMS ($I_{LOAD} = 500mA$)



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Pin Description

PIN	NAME	FUNCTION
1	COMP	Compensation Pin for Error Amplifier. Connect a series RC from COMP to ground. See the <i>Loop Compensation</i> section for component selection guidelines.
2	FB	Feedback Pin. Reference voltage is 1.24V nominal. Connect an external resistor-divider tap to FB and minimize the trace area. Set V_{OUT} according to: $V_{OUT} = 1.24V (1 + R1 / R2)$. See Figure 1.
3	$\overline{\text{SHDN}}$	Active-Low Shutdown Control Input. Drive $\overline{\text{SHDN}}$ low to turn off the MAX17067.
4	GND	Ground
5	LX	Switch Pin. Connect the inductor/catch diode to LX and minimize the trace area for lowest EMI.
6	IN	Supply Pin. Bypass IN with at least a 1 μ F ceramic capacitor directly to GND.
7	FREQ	Frequency Select Input. When FREQ is low, the oscillator frequency is set to 640kHz. When FREQ is high, the frequency is 1.2MHz. This input has a 5 μ A pulldown current.
8	SS	Soft-Start Control Pin. Connect a soft-start capacitor (C_{SS}) to this pin. Leave open for no soft-start. The soft-start capacitor is charged with a constant current of 4 μ A. Full current limit is reached after $t = 2.5 \times 10^5 C_{SS}$. The soft-start capacitor is discharged to ground when $\overline{\text{SHDN}}$ is low. When $\overline{\text{SHDN}}$ goes high, the soft-start capacitor is charged to 0.5V, after which soft-start begins.

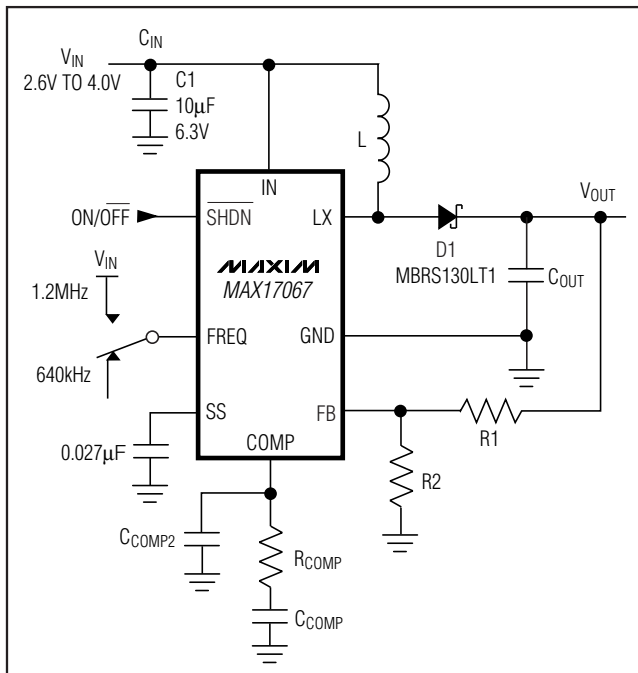


Figure 1. Typical Application Circuit

Detailed Description

The MAX17067 is a highly efficient power supply that employs a current-mode, fixed-frequency PWM architecture for fast-transient response and low-noise operation. The device regulates the output voltage through a combination of an error amplifier, two comparators, and several signal generators (Figure 2). The error amplifier compares the signal at FB to 1.24V and varies the COMP output. The voltage at COMP determines the current trip point each time the internal MOSFET turns on. As the load varies, the error amplifier sources or sinks current to the COMP output accordingly to produce the inductor peak current necessary to service the load. To maintain stability at high duty cycle, a slope-compensation signal is summed with the current-sense signal.

At light loads, this architecture allows the ICs to “skip” cycles to prevent overcharging the output voltage. In this region of operation, the inductor ramps up to a fixed peak value, discharges to the output, and waits until another pulse is needed again.

