Micropower Low Noise Boost Converters with Output Disconnect

FEATURES

- **Low Quiescent Current**
  - **65µA in Active Mode**
  - **1µA in Shutdown Mode**
- **Switching Frequency is Non-Audible Over Entire Load Range**
- **Integrated Power NPN:**
  - **350mA Current Limit (LT3494A)**
  - **180mA Current Limit (LT3494)**
- **Integrated Schottky Diode**
- **Integrated Output Disconnect**
- Integrated Output Dimming
- Wide Input Range: 2.3V to 16V
- Wide Output Range: Up to 40V
- Tiny 8-Lead 3mm × 2mm DFN Package

APPLICATIONS

- OLED Power
- Low Noise Power
- MP3 Players

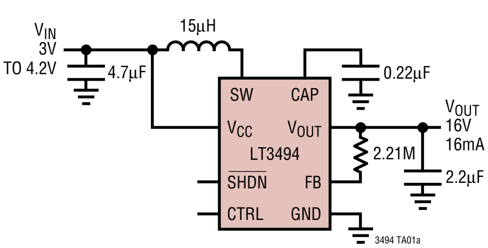
DESCRIPTION

The LT®3494/LT3494A are low noise boost converters with integrated power switch, Schottky diode and output disconnect circuitry. The parts use a novel* control technique resulting in low output voltage ripple as well as high efficiency over a wide load current range. This technique guarantees that the switching frequency stays above the audio band for the entire load range. The parts feature a high performance NPN power switch with a 350mA and 180mA current limit for the LT3494A and LT3494 respectively. The quiescent current is a low 65µA, which is further reduced to less than 1µA in shutdown. The internal disconnect circuitry allows the output voltage to be isolated from the input during shutdown. An auxiliary reference input (CTRL pin) overrides the internal 1.225V feedback reference with any lower value allowing full control of the output voltage during operation. The LT3494/LT3494A are available in a tiny 8-lead 3mm × 2mm DFN package.

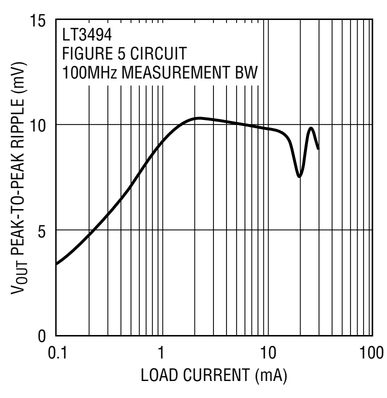
*Patent pending.

TYPICAL APPLICATION

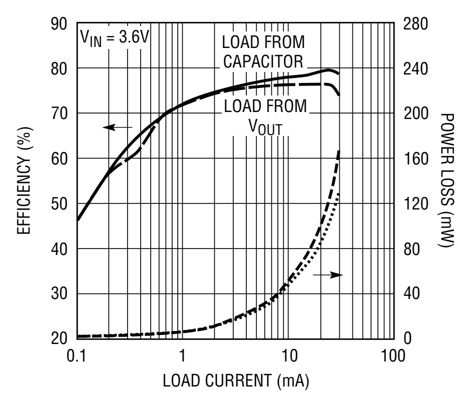
OLED Power Supply from One Li-Ion Cell



Output Voltage Ripple vs Load Current



Efficiency and Power Loss vs Load Current



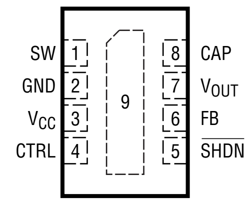
ABSOLUTE MAXIMUM RATINGS

(Note 1)

V_{CC} Voltage 16V
SW Voltage 40V
CAP Voltage 40V
V_{OUT} Voltage 40V
$\overline{SHDN}$ Voltage 16V
CTRL Voltage 16V
FB Voltage 2.5V
Maximum Junction Temperature ....125°C
Operating Temperature Range (Note 2) ... –40°C to 85°C
Storage Temperature Range.................. –65°C to 125°C

PACKAGE/ORDER INFORMATION

TOP VIEW



DDB PACKAGE
8-LEAD (3mm × 2mm) PLASTIC DFN
T_{JMAX} = 125°C, θ_{JA} = 76°C/W
EXPOSED PAD (PIN 9) IS GND, MUST BE SOLDERED TO PCB

ORDER PART NUMBER	DDB PART MARKING
LT3494EDDB LT3494AEDDB	LCCD LCRW

Order Options Tape and Reel: Add #TR
Lead Free: Add #PBF Lead Free Tape and Reel: Add #TRPBF
Lead Free Part Marking: http://www.linear.com/leadfree/

Consult LTC Marketing for parts specified with wider operating temperature ranges.

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V_{CC} = 3V, $V_{\overline{SHDN}}$ = V_{CC}, unless otherwise noted. (Note 2)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Minimum Operating Voltage				2.3	2.5	V
Maximum Operating Voltage					16	V
Feedback Voltage	V_{CTRL} = 3V (Note 3)	●	1.205	1.225	1.245	V
FB Resistor		●	179	182	184	kΩ
Quiescent Current	Not Switching			65	75	µA
Quiescent Current in Shutdown	$V_{\overline{SHDN}}$ = 0V, V_{CC} = 3V			0	1	µA
Minimum Switch Off Time	After Start-Up Mode, V_{FB} = 1V, V_{CTRL} = 3V (Note 4) During Start-Up Mode, V_{FB} = 0.2V, V_{CTRL} = 3V (Note 4)			100 450		ns ns
Maximum Switch Off Time	V_{FB} = 1.5V	●	15	20	30	µs
Switch Current Limit	LT3494A (Note 5) LT3494 (Note 5)		225 115	350 180	450 250	mA mA
Switch V_{CESAT}	LT3494A, I_{SW} = 200mA LT3494, I_{SW} = 100mA			180 110		mV mV
Switch Leakage Current	V_{SW} = 5V, $V_{\overline{SHDN}}$ = 0			0.01	1	µA
Schottky Forward Voltage	I_{DIODE} = 100mA			900	1100	mV
Schottky Reverse Leakage				0.05	1	µA
PMOS Disconnect $V_{CAP} – V_{OUT}$	I_{OUT} = 10mA, V_{CAP} = 5V			250		mV
$\overline{SHDN}$ Input Voltage High			1.5			V
$\overline{SHDN}$ Input Voltage Low					0.3	V
$\overline{SHDN}$ Pin Bias Current	$V_{\overline{SHDN}}$ = 3V $V_{\overline{SHDN}}$ = 0V			5 0	10 0.1	µA µA

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V_{CC} = 3V, $V_{\overline{SHDN}}$ = V_{CC}, unless otherwise noted. (Note 2)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
CTRL Pin Bias Current	V_{CTRL} = 0.5V, Current Flows Out of Pin	●		20	100	nA
CTRL to FB Offset	V_{CTRL} = 0.5V			8	15	mV
Maximum Shunt Current	V_{FB} = 1.3V, V_{CAP} = 5V			230		µA

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: The LT3494/LT3494A are guaranteed to meet performance specifications from 0°C to 85°C. Specifications over the –40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

Note 3: Internal reference voltage is determined by finding V_{FB} voltage level which causes quiescent current to increase 20µA above "Not Switching" level.

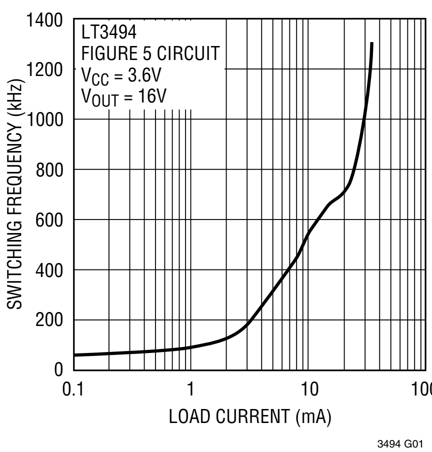
Note 4: If CTRL is overriding the internal reference, Start-Up mode occurs when V_{FB} is less then half the voltage on CTRL. If CTRL is not overriding the internal reference, Start-Up mode occurs when V_{FB} is less then half the voltage of the internal reference.

Note 5: Current limit guaranteed by design and/or correlation to static test.

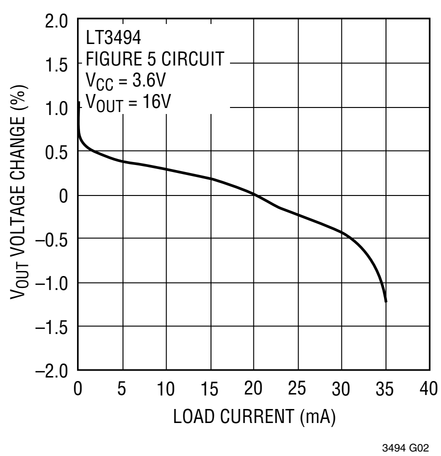
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = 25°C unless otherwise noted.

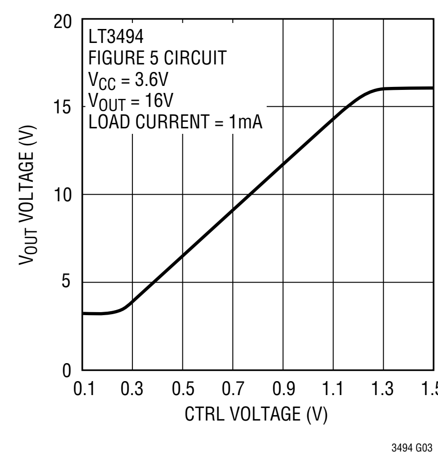
Switching Frequency vs Load Currrent



Load Regulation

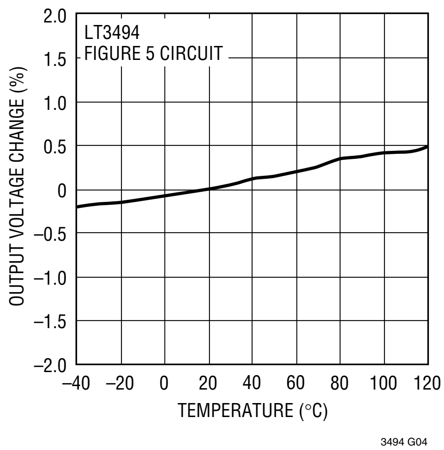


V_{OUT} vs CTRL Voltage

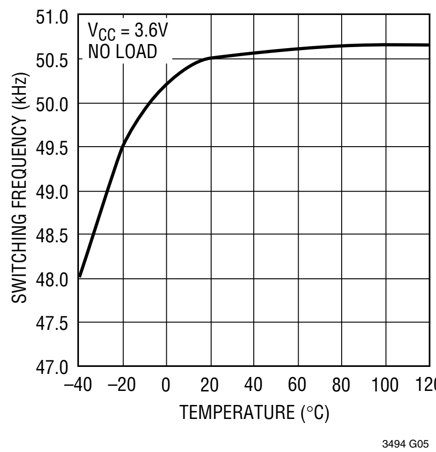


TYPICAL PERFORMANCE CHARACTERISTICS T_A = 25°C unless otherwise noted.

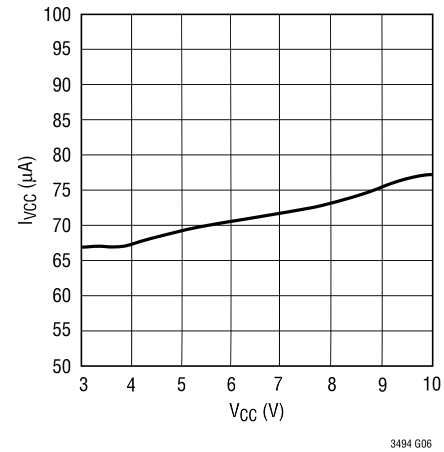
Output Voltage vs Temperature



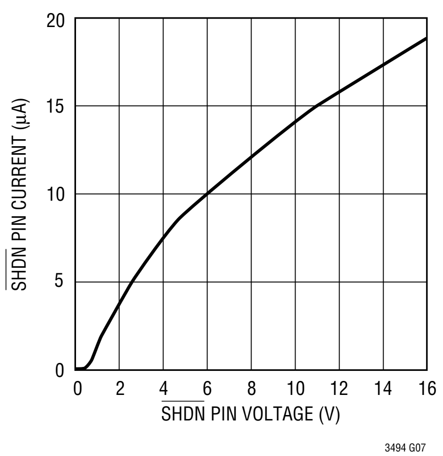
Minimum Switching Frequency



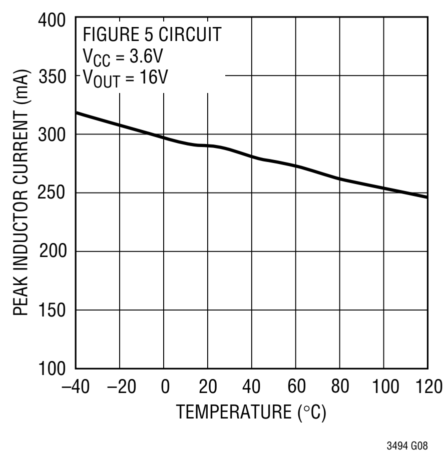
Quiescent Current–Not Switching



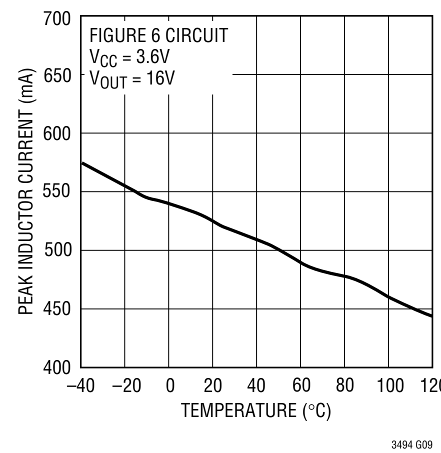
SHDN Current vs SHDN Voltage



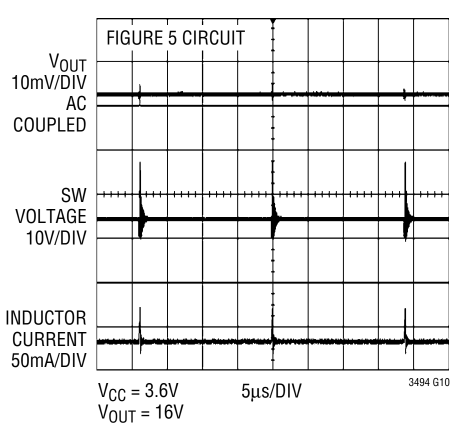
Peak Inductor Current (LT3494)



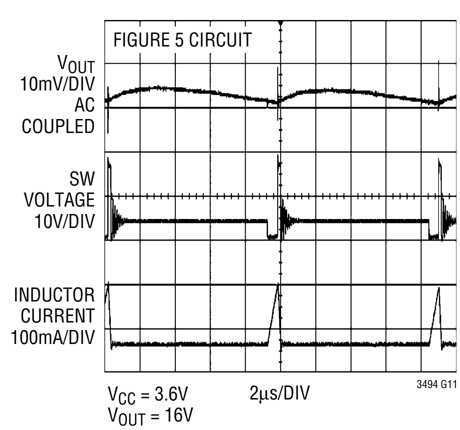
Peak Inductor Current (LT3494A)



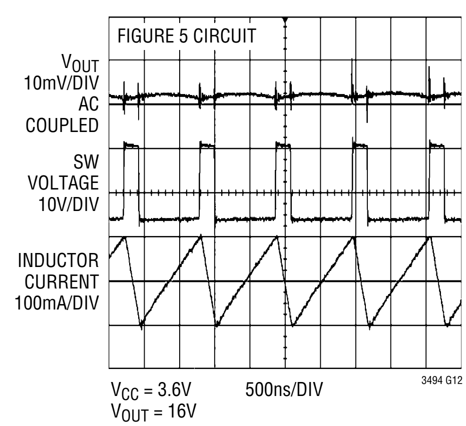
LT3494 Switching Waveforms at No Load



LT3494 Switching Waveforms at 1mA Load

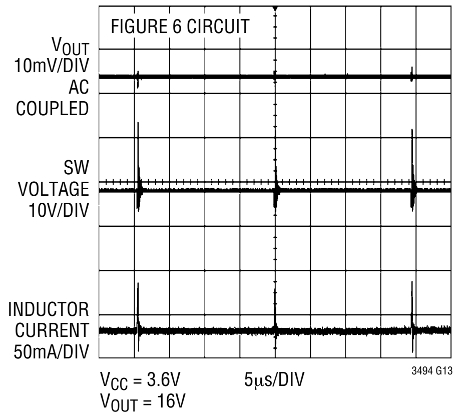


LT3494 Switching Waveforms at 25mA Load

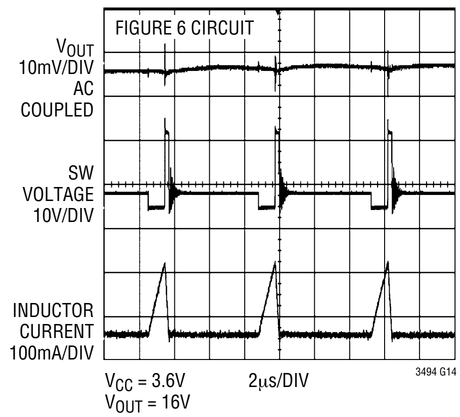


TYPICAL PERFORMANCE CHARACTERISTICS T_A = 25°C unless otherwise noted.

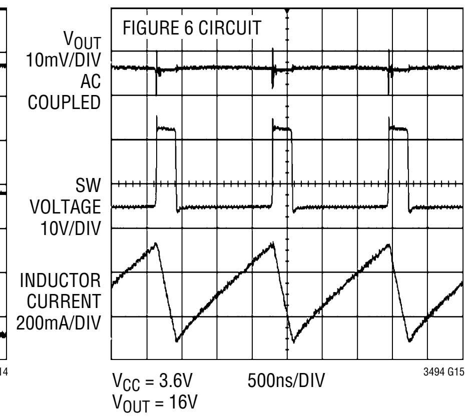
LT3494A Switching Waveforms at No Load



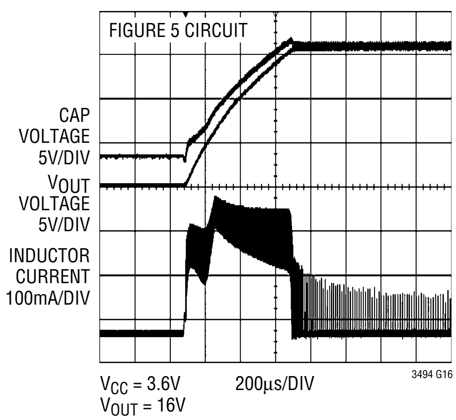
LT3494A Switching Waveforms at 5mA Load



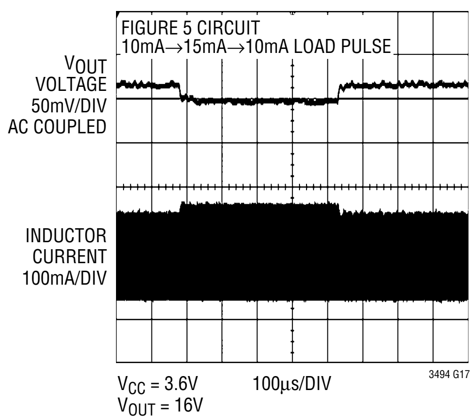
LT3494A Switching Waveforms at 30mA Load



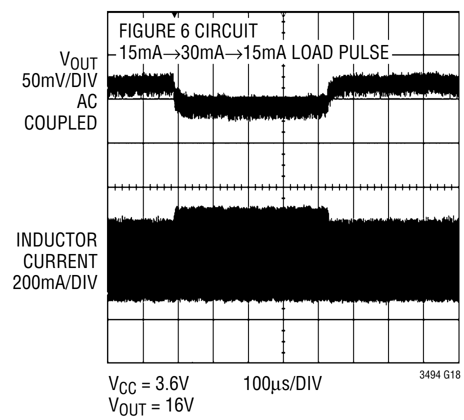
LT3494 Start-Up Waveforms



LT3494 Transient Response



LT3494A Transient Response



PIN FUNCTIONS

SW (Pin 1): Switch Pin. This is the collector of the internal NPN power switch. Minimize the metal trace area connected to this pin to minimize EMI.

GND (Pin 2): Ground. Tie directly to local ground plane.

V_{CC} (Pin 3): Input Supply Pin. Must be locally bypassed.

CTRL (Pin 4): Dimming Pin. If not used, tie CTRL to 1.5V or higher. If in use, drive CTRL below 1.225V to override the internal reference. See Applications Information for more information.

$\overline{\text{SHDN}}$ (Pin 5): Shutdown Pin. Tie to 1.5V or more to enable device. Ground to shut down.

FB (Pin 6): Feedback Pin. Reference voltage is 1.225V. There is an internal 182k resistor from the FB pin to GND. To achieve the desired output voltage, choose R1 according to the following formula:

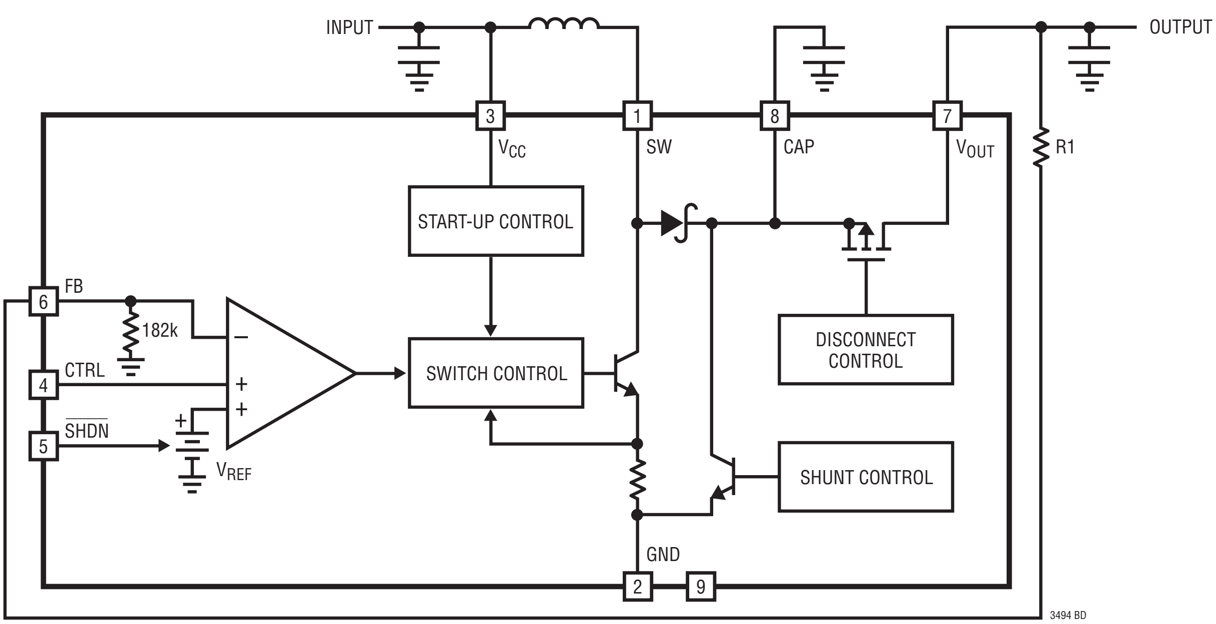
$$R1 = 182 \bullet \left(\frac{V_{OUT(MAX)}}{1.225} - 1 \right) k\Omega$$

V_{OUT} (Pin 7): Drain of Output Disconnect PMOS. Place a bypass capacitor from this pin to GND. See Applications Information.

CAP (Pin 8): This is the cathode of the internal Schottky diode. Place a bypass capacitor from this pin to GND.

Exposed Pad (Pin 9): Ground. This pin must be soldered to PCB.

BLOCK DIAGRAM



OPERATION

The LT3494/LT3494A use a novel control scheme to provide high efficiency over a wide range of output current. In addition, this technique keeps the switching frequency above the audio band over all load conditions.

The operation of the part can be better understood by refering to the Block Diagram. The part senses the output voltage by monitoring the voltage on the FB pin. The user sets the desired output voltage by choosing the value of the external top feedback resistor. The parts incorporate a precision 182k bottom feedback resistor. Assuming that output voltage adjustment is not used (CTRL pin is tied to 1.5V or greater), the internal reference (V_{REF} = 1.225V) sets the voltage at which FB will servo to during regulation.

The Switch Control block senses the output of the amplifier and adjusts the switching frequency as well as other parameters to achieve regulation. During the start-up of the circuit, special precautions are taken to insure that the inductor current remains under control.

Because the switching frequency is never allowed to fall below approximately 50kHz, a minimum load must be present to prevent the output voltage from drifting too high. This minimum load is automatically generated within the part via the Shunt Control block. The level of this current is adaptable, removing itself when not needed to improve efficiency at higher load levels.

The LT3494/LT3494A also have an integrated Schottky diode and PMOS output disconnect switch. The PMOS switch is turned on when the part is enabled via the $\overline{SHDN}$ pin. When the parts are in shutdown, the PMOS switch turns off, allowing the V_{OUT} node to go to ground. This type of disconnect function is often required in power supplies.

The only difference between the LT3494A and LT3494 is the level of the current limit. The LT3494A has a typical peak current limit of 350mA while the LT3494 has a 180mA limit.

APPLICATIONS INFORMATION

Choosing an Inductor

Several recommended inductors that work well with the LT3494/LT3494A are listed in Table 1, although there are many other manufacturers and devices that can be used. Consult each manufacturer for more detailed information and for their entire selection of related parts. Many different sizes and shapes are available. Use the equations and recommendations in the next few sections to find the correct inductance value for your design.

Inductor Selection—Boost Regulator

The formula below calculates the appropriate inductor value to be used for a boost regulator using the LT3494/LT3494A (or at least provides a good starting point). This value provides a good trade off in inductor size and system performance. Pick a standard inductor close to this value. A larger value can be used to slightly increase the available output current, but limit it to around twice the value calculated below, as too large of an inductance will decrease the output voltage ripple without providing much additional output current. A smaller value can be used (especially for systems with output voltages greater than 12V) to give a smaller physical size. Inductance can be calculated as:

$$L = (V_{OUT} - V_{IN(MIN)} + 0.5V) \bullet 0.66\ (\mu H)$$

where V_{OUT} is the desired output voltage and $V_{IN(MIN)}$ is the minimum input voltage. Generally, a 10µH or 15µH inductor is a good choice.

Table 1. Recommended Inductors

PART	FOR USE WITH	VALUE (µH)	MAX DCR (Ω)	MAX DC I (mA)	SIZE (mm × mm × mm)	VENDOR
LQH32CN100K53	LT3494/LT3494A	10	0.3	450	3.5 × 2.7 × 1.7	Murata
LQH32CN150K53	LT3494	15	0.58	300	3.5 × 2.7 × 1.7	www.murata.com
CDRH3D11-100	LT3494	10	0.24	280	4.0 × 4.0 × 1.2	Sumida
CDHED13/S-150	LT3494/LT3494A	15	0.55	550	4.0 × 4.2 × 1.4	www.sumida.com

APPLICATIONS INFORMATION

Capacitor Selection

The small size and low ESR of ceramic capacitors makes them suitable for most LT3494/LT3494A applications. X5R and X7R types are recommended because they retain their capacitance over wider voltage and temperature ranges than other types such as Y5V or Z5U. A 4.7µF input capacitor and a 2.2µF to 10µF output capacitor are sufficient for most LT3494/LT3494A applications. Always use a capacitor with a sufficient voltage rating. Many capacitors rated at 2.2µF to 10µF, particularly 0805 or 0603 case sizes, have greatly reduced capacitance when bias voltages are applied. Be sure to check actual capacitance at the desired output voltage. Generally a 1206 size capacitor will be adequate. A 0.22µF or 0.47µF capacitor placed on the CAP node is recommended to filter the inductor current while the larger 2.2µF to 10µF placed on the V_{OUT} node will give excellent transient response and stability. Table 2 shows a list of several capacitor manufacturers. Consult the manufacturers for more detailed information and for their entire selection of related parts.

Table 2. Recommended Ceramic Capacitor Manufacturers

MANUFACTURER	PHONE	URL
Taiyo Yuden	408-573-4150	www.t-yuden.com
AVX	843-448-9411	www.avxcorp.com
Murata	814-237-1431	www.murata.com
Kemet	408-986-0424	www.kemet.com

Setting Output Voltage and the Auxiliary Reference Input

The LT3494/LT3494A are equipped with both an internal 1.225V reference and an auxiliary reference input. This allows the user to select between using the built-in reference and supplying an external reference voltage. The voltage at the CTRL pin can be adjusted while the chip is operating to alter the output voltage of the LT3494/LT3494A for purposes such as display dimming or contrast adjustment. To use the internal 1.225V reference, the CTRL pin must be held higher than 1.5V. When the CTRL pin is held between 0V and 1.5V, the LT3494 will regulate the output such that the FB pin voltage is nearly equal to the CTRL pin voltage. At CTRL voltages close to 1.225V, a soft transition occurs between the CTRL pin and the internal reference. Figure 1 shows this behavior.

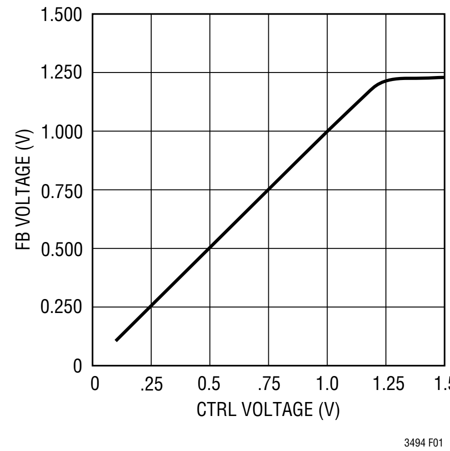


Figure 1. CTRL to FB Transfer Curve

To set the maximum output voltage, select the values of R1 according to the following equation:

$$R1 = 182 \bullet \left(\frac{V_{OUT(MAX)}}{1.225} - 1 \right) k\Omega$$

When CTRL is used to override the internal reference, the output voltage can be lowered from the maximum value down to nearly the input voltage level. If the voltage source driving the CTRL pin is located at a distance to the LT3494/LT3494A, a small 0.1µF capacitor may be needed to bypass the pin locally.

Choosing a Feedback Node

The single feedback resistor may be connected to the V_{OUT} pin or to the CAP pin (see Figure 2). Regulating the V_{OUT} pin eliminates the output offset resulting from the voltage drop across the output disconnect PMOS. Regulating the CAP pin does not compensate for the voltage drop across the output disconnect, resulting in an output voltage V_{OUT} that is slightly lower than the voltage set by the resistor divider. Under most conditions, it is advised that the feedback resistor be tied to the V_{OUT} pin.

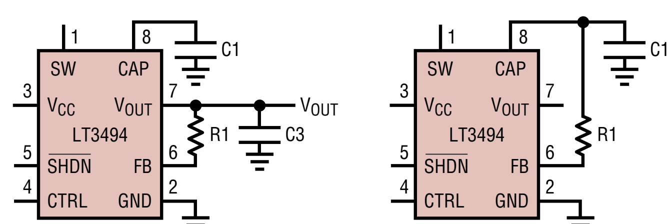


Figure 2. Feedback Connection Using the CAP Pin or the V_{OUT} Pin

3494fb

APPLICATIONS INFORMATION

Connecting the Load to the CAP Node

The efficiency of the converter can be improved by connecting the load to the CAP pin instead of the V_{OUT} pin. The power loss in the PMOS disconnect circuit is then made negligible. By connecting the feedback resistor to the V_{OUT} pin, no quiescent current will be consumed in the feedback resistor string during shutdown since the PMOS transistor will be open (see Figure 3). The disadvantage of this method is that the CAP node cannot go to ground during shutdown, but will be limited to around a diode drop below V_{CC}. Loads connected to the part should only sink current. **Never force external power supplies onto the CAP or V_{OUT} pins.** The larger value output capacitor (2.2µF to 10µF) should be placed on the node to which the load is connected.

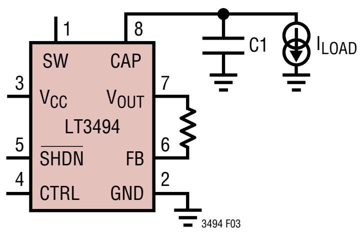


Figure 3. Improved Efficiency

Maximum Output Load Current

The maximum output current of a particular LT3494/LT3494A circuit is a function of several circuit variables. The following method can be helpful in predicting the maximum load current for a given circuit:

Step 1: Calculate the peak inductor current:

$$I_{PK} = I_{LIMIT} + \frac{V_{IN} \bullet 400 \bullet 10^{-9}}{L} \text{ amps}$$

where I_{LIMIT} is 0.180A and 0.350A for the LT3494 and LT3494A respectively. L is the inductance value in Henrys and V_{IN} is the input voltage to the boost circuit.

Step 2: Calculate the inductor ripple current:

$$I_{RIPPLE} = \frac{(V_{OUT} + 1 - V_{IN}) \bullet 150 \bullet 10^{-9}}{L} \text{ amps}$$

where V_{OUT} is the desired output voltage.

If the inductor ripple current is greater than the peak current, then the circuit will only operate in discontinuous conduction mode. The inductor value should be increased so that $I_{RIPPLE} < I_{PK}$. An application circuit can be designed to operate only in discontinuous mode, but the output current capability will be reduced.

Step 3: Calculate the average input current:

$$I_{IN(AVG)} = I_{PK} - \frac{I_{RIPPLE}}{2} \text{ amps}$$

Step 4: Calculate the nominal output current:

$$I_{OUT(NOM)} = \frac{I_{IN(AVG)} \bullet V_{IN} \bullet 0.75}{V_{OUT}} \text{ amps}$$

Step 5: Derate output current:

$$I_{OUT} = I_{OUT(NOM)} \bullet 0.7 \text{ amps}$$

For low output voltages the output current capability will be increased. When using output disconnect (load current taken from V_{OUT}), these higher currents will cause the drop in the PMOS switch to be higher resulting in reduced output current capability than those predicted by the preceding equations.

Inrush Current

When V_{CC} is stepped from ground to the operating voltage while the output capacitor is discharged, a higher level of inrush current may flow through the inductor and integrated Schottky diode into the output capacitor. Conditions that increase inrush current include a larger more abrupt voltage step at V_{IN}, a larger output capacitor tied to the CAP pin and an inductor with a low saturation current. While the internal diode is designed to handle such events, the inrush current should not be allowed to exceed 1A. For circuits that use output capacitor values within the recommended range and have input voltages of less than 5V, inrush current remains low, posing no hazard to the device. In cases where there are large steps at V_{CC} (more than 5V) and/or a large capacitor is used at the CAP pin, inrush current should be measured to ensure safe operation. The LT3494A circuits experience higher levels of current during start-up and steady-state operation. An external diode placed from the SW pin to

APPLICATIONS INFORMATION

the CAP pin will improve efficiency and lower the stress placed on the internal Schottky diode.

Board Layout Considerations

As with all switching regulators, careful attention must be paid to the PCB board layout and component placement. To maximize efficiency, switch rise and fall times are made as short as possible. To prevent electromagnetic interference (EMI) problems, proper layout of the high frequency switching path is essential. The voltage signal of the SW pin has sharp rising and falling edges. Minimize the length and area of all traces connected to the SW pin and always use a ground plane under the switching regulator to minimize interplane coupling. In addition, the FB connection for the feedback resistor R1 should be tied directly from the Vout pin to the FB pin and be kept as short as possible, ensuring a clean, noise-free connection. Recommended component placement is shown in Figure 4.

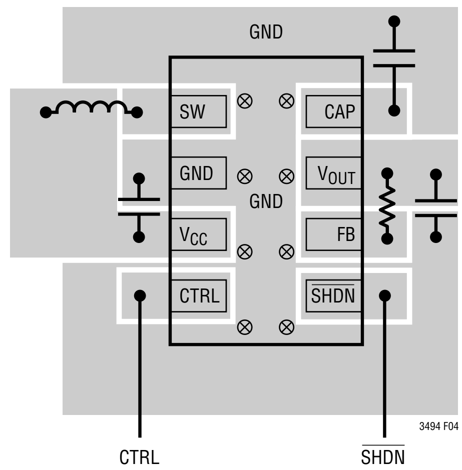
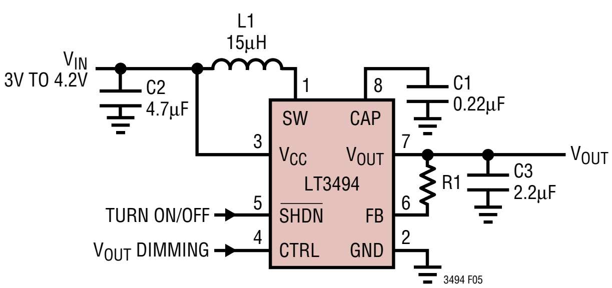


Figure 4. Recommended Layout

TYPICAL APPLICATIONS

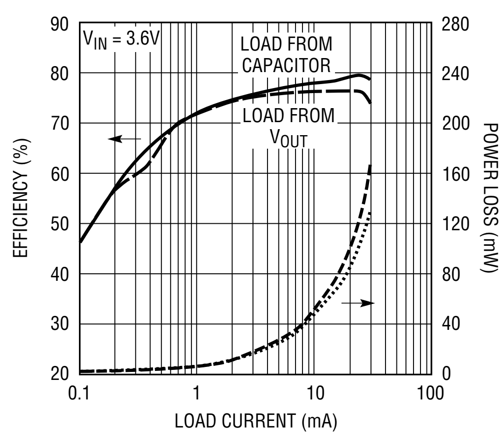


C1, C2: X5R OR X7R WITH SUFFICIENT VOLTAGE RATING
C3: MURATA GRM31MR71E225K
L1: MURATA LQH32CN150K53

Figure 5. One Li-Ion Cell Input Boost Converter with the LT3494

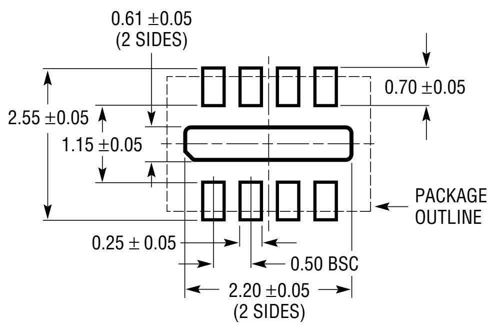
V_{OUT}	R1 VALUE REQUIRED (MΩ)	MAXIMUM OUTPUT CURRENT AT 3V INPUT (mA)
25	3.57	8.6
24	3.40	9.3
23	3.24	10.0
22	3.09	10.6
21	2.94	11.3
20	2.80	12.1
19	2.67	12.9
18	2.49	13.6
17	2.37	14.8
16	2.21	16.0
15	2.05	17.2

3.6V to 16V Efficiency

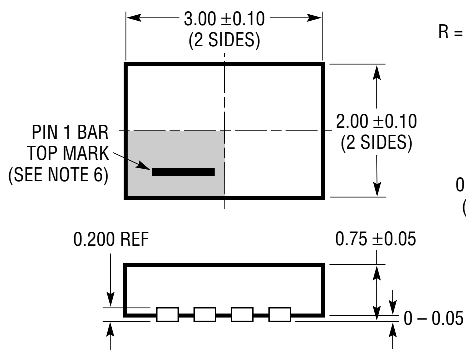


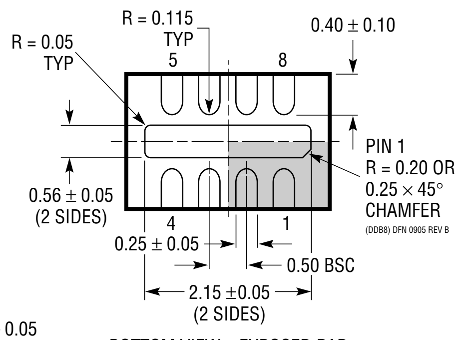
PACKAGE DESCRIPTION

DDB Package
8-Lead Plastic DFN (3mm × 2mm)
(Reference LTC DWG # 05-08-1702 Rev B)



RECOMMENDED SOLDER PAD PITCH AND DIMENSIONS

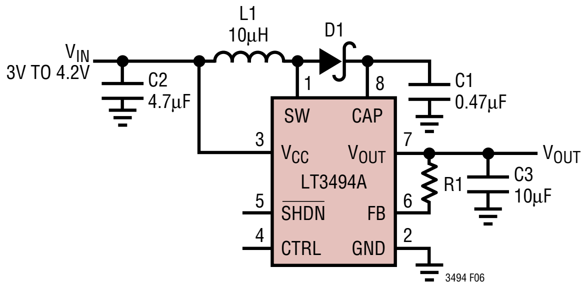




BOTTOM VIEW—EXPOSED PAD

NOTE:
1. DRAWING CONFORMS TO VERSION (WECD-1) IN JEDEC PACKAGE OUTLINE M0-229
2. DRAWING NOT TO SCALE
3. ALL DIMENSIONS ARE IN MILLIMETERS
4. DIMENSIONS OF EXPOSED PAD ON BOTTOM OF PACKAGE DO NOT INCLUDE MOLD FLASH. MOLD FLASH, IF PRESENT, SHALL NOT EXCEED 0.15mm ON ANY SIDE
5. EXPOSED PAD SHALL BE SOLDER PLATED
6. SHADED AREA IS ONLY A REFERENCE FOR PIN 1 LOCATION ON THE TOP AND BOTTOM OF PACKAGE

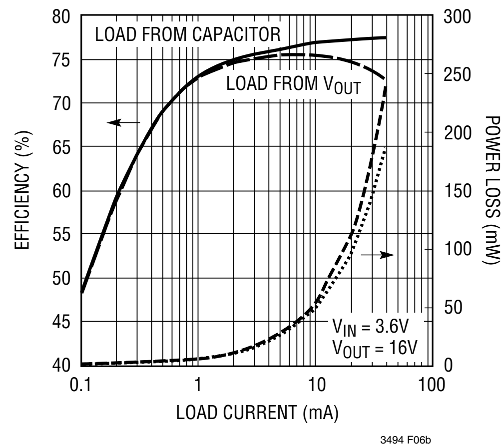
TYPICAL APPLICATION



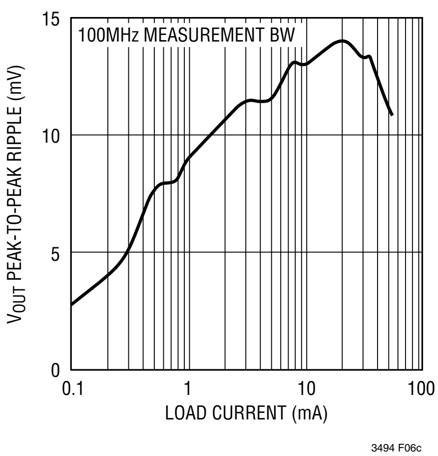
C1, C2: X5R OR X7R WITH SUFFICIENT VOLTAGE RATING
C3: TAIYO YUDEN TMK316BJ106ML
D1: CENTRAL SEMICONDUCTOR CMDSH-3
L1: MURATA LQH32CN100K53

Figure 6. One Li-Ion Cell Input Boost Converter with the LT3494A

Efficiency and Power Loss vs Load Current



Output Voltage Ripple vs Load Current



V_{OUT}	R1 VALUE REQUIRED (MΩ)	MAXIMUM OUTPUT CURRENT AT 3V INPUT (mA)
25	3.57	13.0
24	3.40	14.0
23	3.24	15.0
22	3.09	16.5
21	2.94	17.5
20	2.80	19.0
19	2.67	20.0
18	2.49	21.5
17	2.37	23.0
16	2.21	25.0
15	2.05	27.0

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1613	550mA (I_{SW}), 1.4MHz, High Efficiency Step-Up DC/DC Converter	V_{IN}: 0.9V to 10V, $V_{OUT(MAX)}$ = 34V, I_Q = 3mA, I_{SD} < 1µA, ThinSOT Package
LT1615/LT1615-1	300mA/80mA (I_{SW}), High Efficiency Step-Up DC/DC Converters	V_{IN}: 1V to 15V, $V_{OUT(MAX)}$ = 34V, I_Q = 20µA, I_{SD} < 1µA, ThinSOT Package
LT1930/LT1930A	1A (I_{SW}), 1.2MHz/2.2MHz, High Efficiency Step-Up DC/DC Converters	V_{IN}: 2.6V to 16V, $V_{OUT(MAX)}$ = 34V, I_Q = 4.2A/5.5mA, I_{SD} < 1µA, ThinSOT Package
LT1945 (Dual)	Dual Output, Boost/Inverter, 350mA (I_{SW}), Constant Off-Time, High Efficiency Step-Up DC/DC Converter	V_{IN}: 1.2V to 15V, $V_{OUT(MAX)}$ = ±34V, I_Q = 40µA, I_{SD} < 1µA, 10-Lead MS Package
LT1946/LT1946A	1.5A (I_{SW}), 1.2MHz/2.7MHz, High Efficiency Step-Up DC/DC Converters	V_{IN}: 2.45V to 16V, $V_{OUT(MAX)}$ = 34V, I_Q = 3.2mA, I_{SD} < 1µA, 8-Lead MS Package
LT3467/LT3467A	1.1A (I_{SW}), 1.3MHz/2.1MHz, High Efficiency Step-Up DC/DC Converters with Soft-Start	V_{IN}: 2.4V to 16V, $V_{OUT(MAX)}$ = 40V, I_Q = 1.2mA, I_{SD} < 1µA, ThinSOT Package
LT3463/LT3463A	Dual Output, Boost/Inverter, 250mA (ISW), Constant Off-Time, High Efficiency Step-Up DC/DC Converters with Integrated Schottkys	V_{IN}: 2.3V to 15V, $V_{OUT(MAX)}$ = ±40V, I_Q = 40µA, I_{SD} < 1µA, DFN Package
LT3471	Dual Output, Boost/Inverter, 1.3A (I_{SW}), High Efficiency Boost-Inverting DC/DC Converter	V_{IN}: 2.4V to 16V, $V_{OUT(MAX)}$ = ±40V, I_Q = 2.5mA, I_{SD} < 1µA, DFN Package

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