Description

The A7207 is a high-efficiency step-up DC-DC converter designed to generate a fixed voltage of +3.3V.

The A7207 achieves an efficiency of up to 90%. The minimum input voltage is 1.5V, the output voltage is fixed at 3.3V, and output current is up to 200mA (@2V).

The A7207 features a shutdown mode in order to save power, where it draws less than 1uA. In shutdown mode the battery is connected directly to the output enabling the supply of real-time-clocks.

The A7207 provides a power-on reset output that goes high-impedance when the output reaches 90% of its regulation point.

The SHDNN trip threshold of the A7207 can be used as an input voltage detector that disables the A7207 when the battery voltage falls to a predetermined lever.

An internal synchronous rectifier is included, thus an external transistor or Schottky diode is not required.

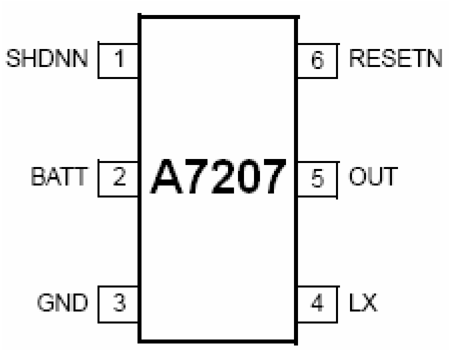
The A7207 is available in SOT-26 package.

Features

- Output Current: up to 200mA (@2V)
- Fixed Output Voltage: 3.3V
- Efficiency: up to 90%
- Internal Synchronous Rectifier
- Requires No External Schottky Diode or FETs
- Shutdown Mode Supply Current: Less Than 1uA
- Minimum Input Voltage: +1.5V
- Accurate Shutdown Low-Battery Cutoff Threshold
- Battery Input Connected to Pin Out In Shutdown Mode for Backup Power
- SOT-26 package is available.

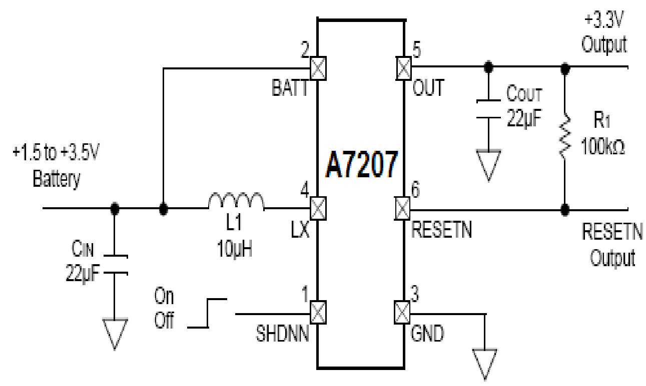
- Cordless Phones
- Remote Wireless Transmitters
- Digital Still Cameras
- Handheld Instruments
- Pagers
- PC Cards
- Battery Backup

Ordering Information



SOT-26	A7207E6

Typical Application



Pin Description

Pin Name	Pin Number	Description
SHDNN	1	Active-Low Logic Shutdown Input 0 = The A7207 is off and the current into BATT is ≦1uA (typ) 1 = The A7207 is on
BATT	2	Battery Voltage Input
GND	3	Ground
LX	4	External Inductor Connection
OUT	5	Output Voltage
PRESETN	6	Active-Low reset output

Absolute Maximum Ratings

Parameter	Min	Max	Unit
All Pins to GND	-0.3	7	V
LX Current		1	A
Latch-Up	-100	100	mA
Package Power Dissipation Θ_{JA} = 9.1mW/℃ above +70℃ (T_{AMB} = +70℃)		500	mW
Operating Temperature Range	-40	+85	℃
Electrostatic Discharge	-500	+500	V
Humidity (Non-Condensing)	5	85	%
Storage Temperature Range	-55	125	℃
Junction Temperature		150	℃
Package Body Temperature		260	℃

Stresses beyond 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 Electrical Characteristics is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

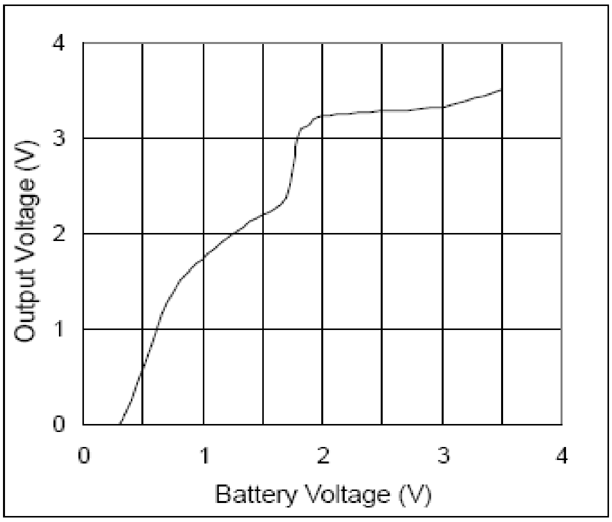
Electrical Characteristics (V_{BATT}= +2V, V_{OUT}= +3.3, V_{SHDNN}= +1.5V,T_{AMB}=25℃, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Battery Input Range	V_{BATT}		1.5		3.5	V
Startup Battery Input Voltage (Note1)	V_{SU}	R_{LOAD} = 47Ω, T_{AMB} = 25℃		1.22	1.5	V
		R_{LOAD} = 47Ω, T_{AMB} = -40 to +85℃		1.24		
Output Voltage (Note2)	V_{OUT}	T_{AMB} = 25℃	3.267	3.30	3.333	V
		T_{AMB} = -40 to 85℃	3.217		3.373	
N-Channel On-Resistance	R_{NCH}	I_{LX} = 100mA, T_{AMB} = 25℃		0.3	1.2	Ω
		I_{LX} = 100mA, T_{AMB} = -40 to 85℃			1.5	
P-Channel On-Resistance	R_{PCH}	I_{LX} = 100mA, T_{AMB} = 25℃		0.4	1.3	Ω
		I_{LX} = 100mA, T_{AMB} = -40 to 85℃			1.6	
N-Channel Switch Current Limit (Note1)	I_{MAX}	T_{AMB} = 25℃	550	700	850	mA
		T_{AMB} = -40 to 85℃	450		950	
Switch Maximum On-Time	ton	T_{AMB} = 25℃	5	7	9	us
		T_{AMB} = -40 to 85℃	4		10	
Synchronous Rectifier Zero-Crossing Current		T_{AMB} = 25℃	8	30	60	mA
		T_{AMB} = -40 to 85℃	0		65	
Quiescent Current into OUT		V_{OUT} = +3.5V, T_{AMB} = +25℃		35	55	uA
		V_{OUT} = +3.5V, T_{AMB} = -40 to +85℃			60	
Shutdown Current into OUT		V_{SHDNN} = +0V, T_{AMB} = +25℃		0.01	1	uA
		V_{SHDNN} = 0V, T_{AMB} = -40 to +85℃			2	
Quiescent Current into BATT		V_{OUT} = +3.5V, T_{AMB} = +25℃		0.01	1	uA
		V_{OUT} = +3.5V, T_{AMB} = -40 to +85℃			2	
Shutdown Current into BATT		V_{SHDNN} = +0V, T_{AMB} = +25℃		0.01	1	uA
		V_{SHDNN} = 0V, T_{AMB} = -40 to +85℃			2	
SHDNN Logic Low (Note1)		V_{BATT} = +1.5 to +3.5V			0.3	V
SHDNN Threshold		Rising Edge, T_{AMB} = +25℃	1.185	1.228	1.271	V
		Rising Edge, T_{AMB} = -40 to +85℃	1.17		1.286	
SHDNN Threshold Hysteresis				0.02		V
RESETN Threshold		Falling Edge, T_{AMB} = +25℃	2.830	3.000	3.110	V
		Falling Edge, T_{AMB} = -40 to +85℃	2.800		3.140	
RESETN Voltage Low		I_{RESETN} = 1mA, V_{OUT} = +2.5V, T_{AMB} = +25℃			0.15	V
		I_{RESETN} = 1mA, V_{OUT} = +2.5V, T_{AMB} = -40 to +85℃			0.2	
RESETN Leakage Current		V_{RESETN} = +5.5V, T_{AMB} = +25℃		0.1	100	nA
		V_{RESETN} = +5.5V, T_{AMB} = +85℃		1		
LX Leakage Current		T_{AMB} = +25℃		0.1	1000	nA
		T_{AMB} = +85℃		10		
Maximum Load Current	I_{LOAD}	V_{BATT} = +2V		200		mA
Efficiency		V_{BATT} = +3V, I_{LOAD} = 100mA		90		%

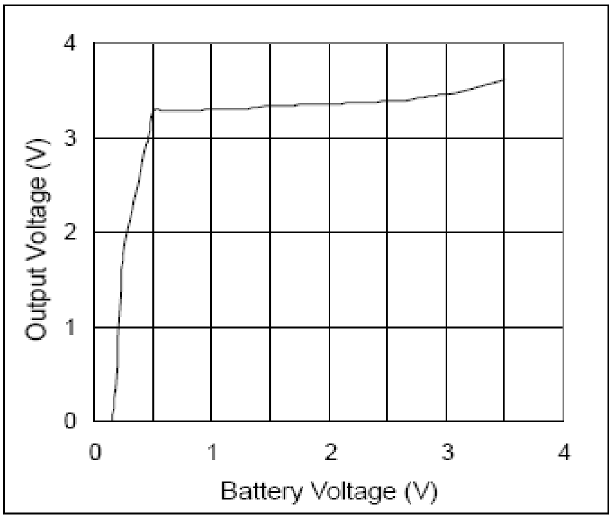
Note1: Guaranteed by design and Verified by lab evaluation. Note2: Startup is performed if any EN pin goes high.

Typical Application (V_{OUT} = 3.3V, V_{BATT} = +2V, T_{AMB} = +25℃, unless otherwise specified.)

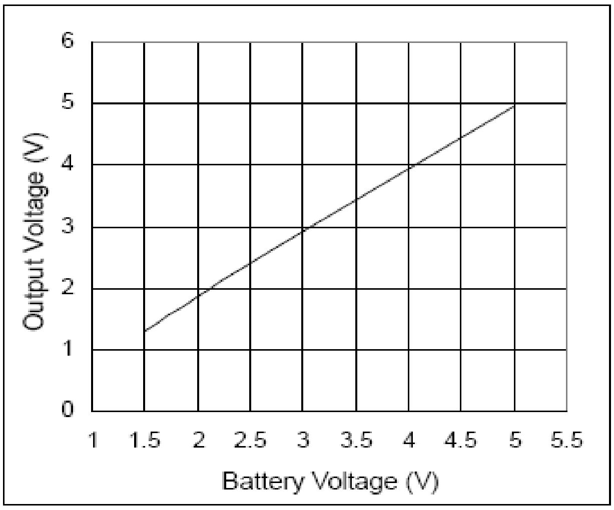
1. V_{OUT} vs. V_{BATT}; On, 16Ω



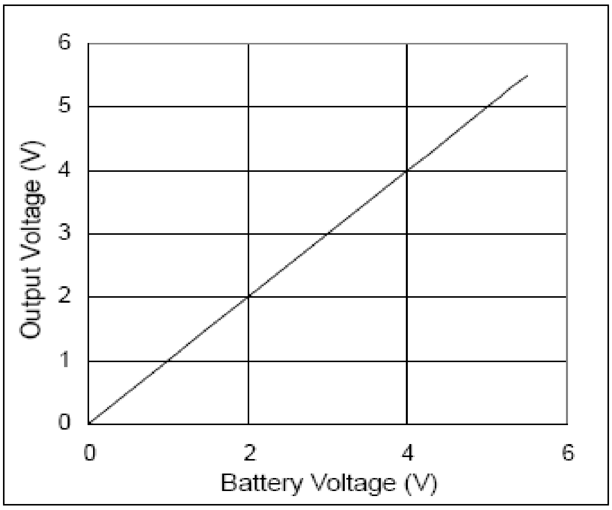
2. V_{OUT} vs. V_{BATT}; On, 33Ω



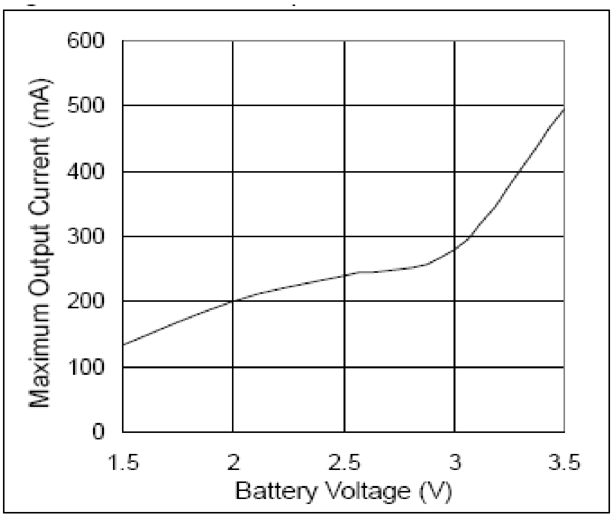
3. V_{OUT} vs. V_{BATT}; Shutdown, 200mA Load



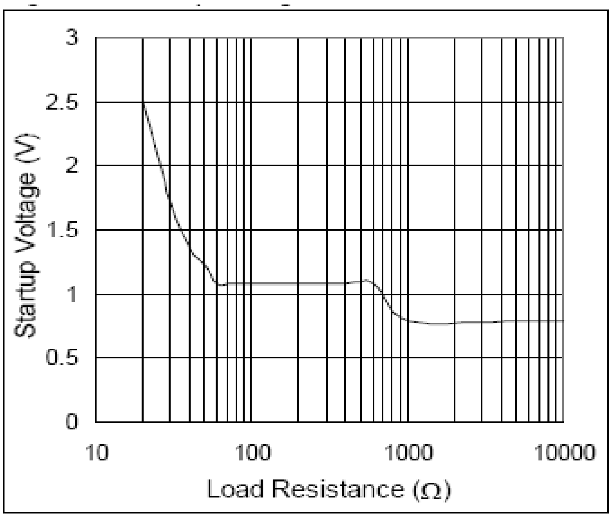
4. V_{OUT} vs. V_{BATT}; Shutdown, No Load



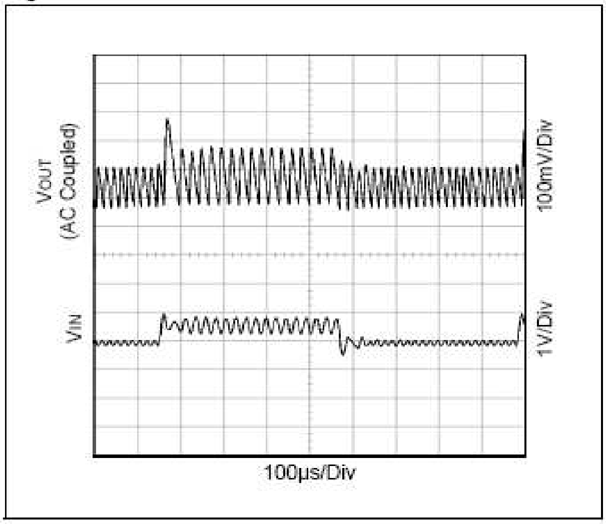
5. Maximum Output Current vs. V_{BATT}



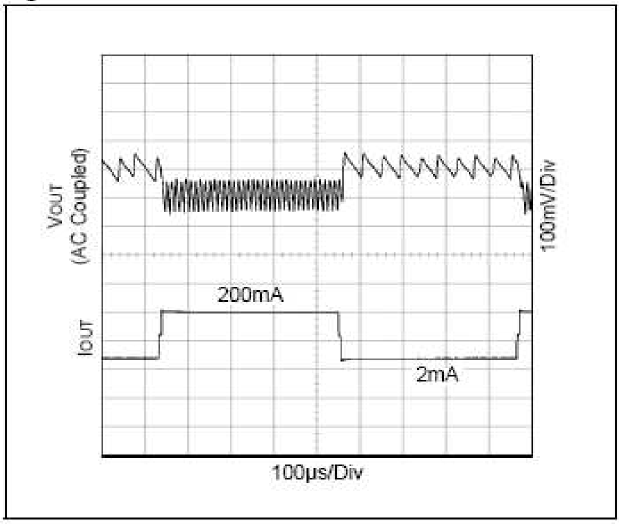
6. Startup Voltage vs. Load Resistance



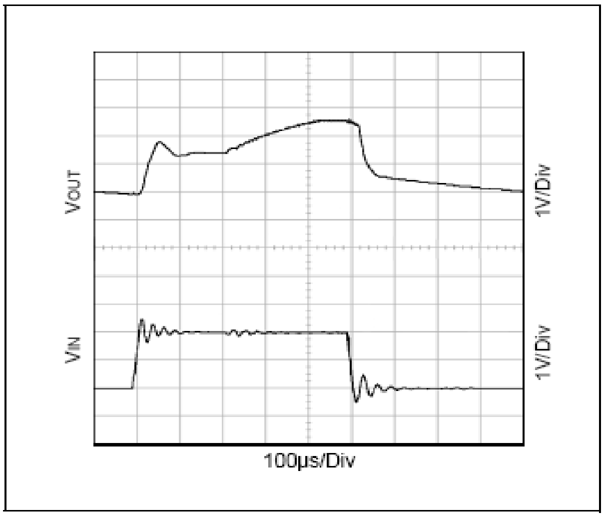
7. Line Transient



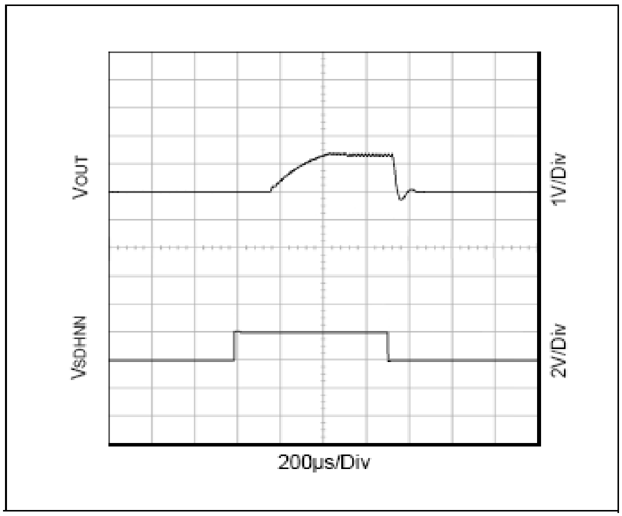
8. Load Transient



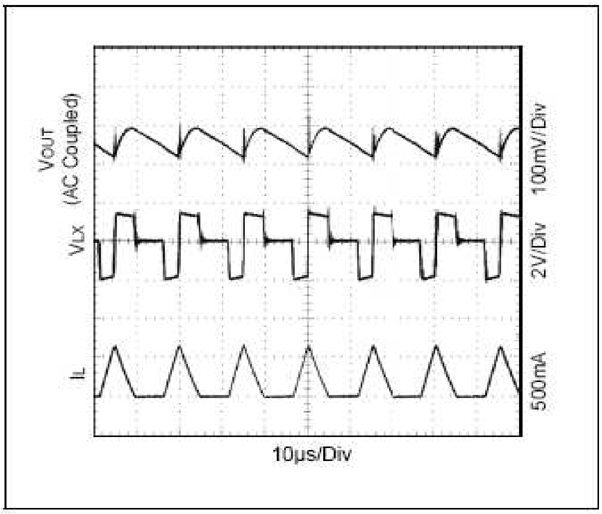
9. On/Off Response; R_{LOAD} = 33Ω



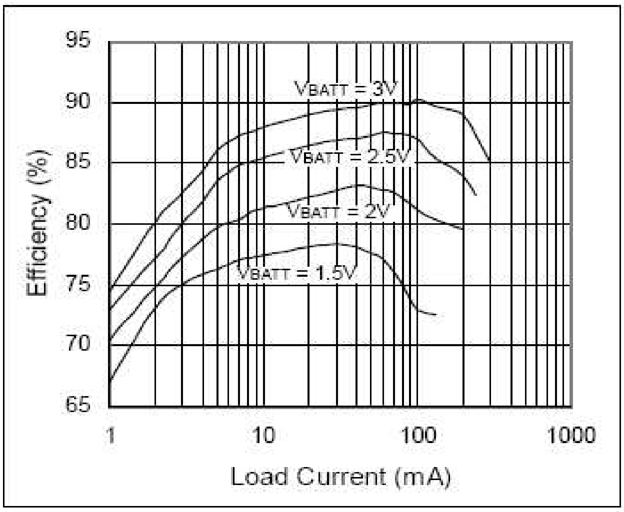
10. Shutdown Response; R_{LOAD} = 33Ω



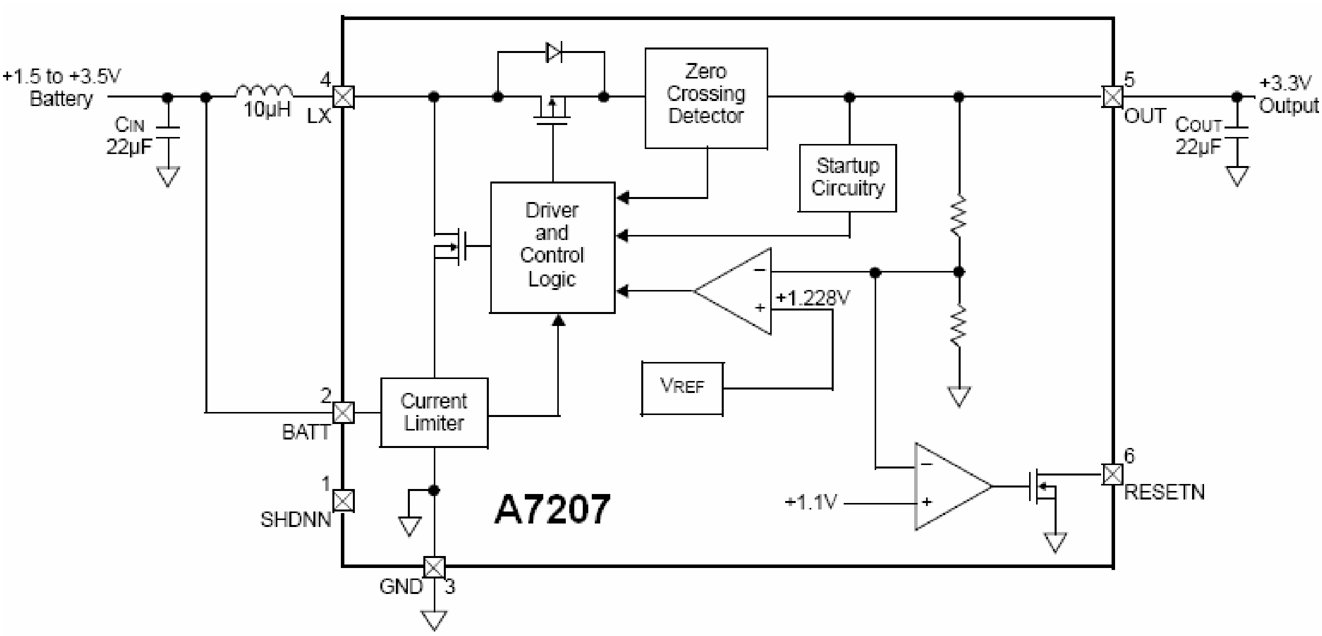
11. Switching Waveforms; R_{LOAD} = 33Ω



12. Efficiency vs. Load Current



Block Diagram



The A7207 is a high-efficiency, compact step-up converter with 35uA quiescent supply current which ensures the highest efficiency over a wide load range. With a minimum of +1.5V input voltage, the device is well suited for applications with one- or two-cells, such as lithium ion (Li+), nickel-metal-hydride (NiMH), or alkaline.

The input battery is connected to the device through an inductor and an internal P-FET when pin SHDNN is low. In this state, the step-up converter is off and the voltage drop across the P-FET body diode is eliminated, and the input battery can be used as a battery-backup or real-time-clock supply.
The built-in synchronous rectifier significantly improves efficiency and reduces PCB circuit size and costs by eliminating the need for an external Schottky diode.

Detailed Information

Control Circuitry

The A7207 integrated current-limited key circuitry provides low quiescent current and extremely-high efficiency over a wide V_{OUT} range without the need for an oscillator. Inductor current is limited by the 7us switch maximum on-time or by the 0.7A N-channel current limit. At each cycle, the inductor current must ramp down to zero after the on-time before the next cycle may start. When the error comparator senses that the output has fallen below the regulation threshold, another cycle begins.

An internal synchronous rectifier eliminates the need for an external Schottky diode, thereby reducing costs and PCB surface area. As the inductor discharges, the P-channel MOSFET turns on and shunts the MOSFET body diode, resulting in a significant reduction of the rectifier voltage drop, improving efficiency without external components.

Shutdown

When pin SHDNN is low, the A7207 is switched off and no current is drawn from battery; when pin SHDNN is high the device is switched on. If SHDNN is driven from a logic-level output, the logic high-level (on) should be referenced to V_{OUT} to avoid intermittently switching the device on.

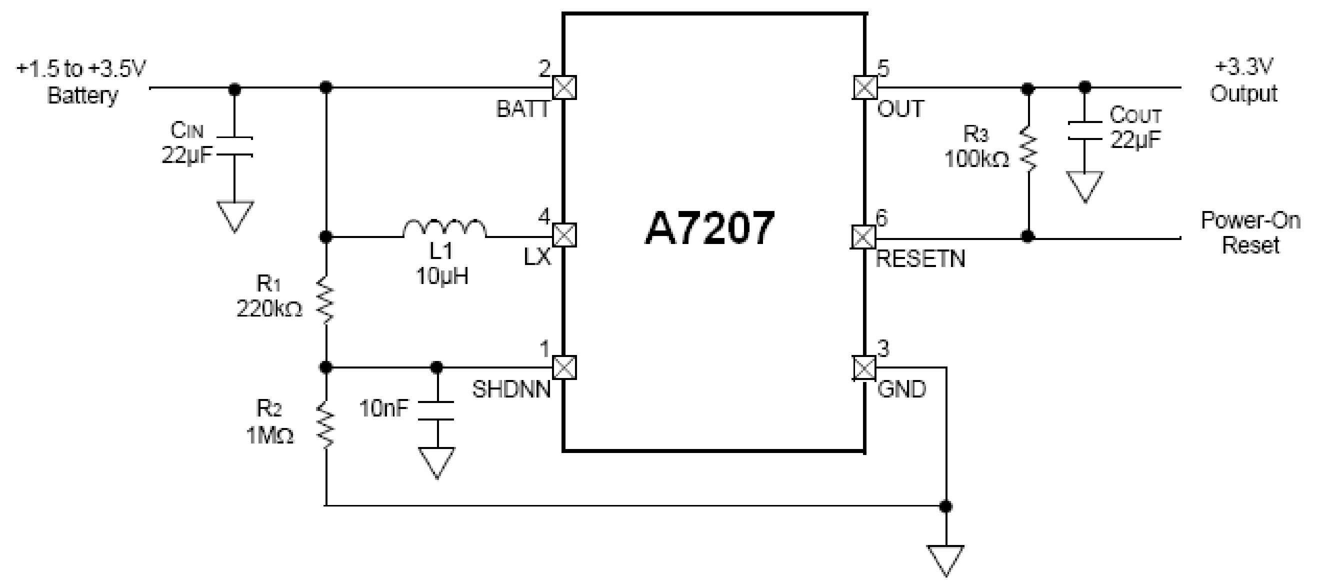
Note: If pin SHDNN is not used, it should be connected directly to pin out.

In shutdown the battery input is connected to the output through the inductor and the internal synchronous rectifier P-FET. This allows the input battery to provide backup power for devices such as an idle microcontroller, memory, or real-time-clock, without the usual diode forward drop. In this way a separate backup battery is not needed.

In cases where there is residual voltage during shutdown, some small amount of energy will be transferred from pin OUT to pin BATT immediately after shutdown, resulting in a momentary spike of the voltage at pin BATT. The ratio of C_{IN} and C_{OUT} partly determine the size and duration of this spike, as does the current-sink ability of the input device.

Low-Battery Cutoff

The A7207 SHDNN trip threshold (1.228V) can be used as an input voltage detector that disables the device when the battery input voltage falls to a pre-set level. An external resistor-divider network can be used to set the battery-detection voltage.



Calculate the value for R1 by:

$$R1 = R2 \times ((V_{OFF}/V_{SHDNN}) - 1)$$

Where:

V_{OFF} is the battery voltage at which the A7207 shuts down.

V_{SHDNN} = 1.228V

The value of R2 should be between 100kΩ and 1MΩ to minimize battery drain.

Note: Input ripple can cause false shutdowns, therefore to minimize the effect of ripple, a low value capacitor from SHDNN to GND should be used to filter out input noise. The value of the capacitor should be such that the R/C time constant is > 2ms.

Power-On Reset

The A7207 provides a power-on reset output (RESETN) that goes high-impedance when the output reaches 90% of its regulation point. RESETN goes low when the output is below 90% of the regulation point. A 100kΩ to 1MΩ pull resistor between pin RESETN and pin OUT can provide a microprocessor logic control signal.

Note: Connect pin RESETN to GND when the power-on reset feature is not used.

Inductor Selection

The control circuitry of the A7207 permits a wide range of inductor values to be selected – from 4.7 to 47uH; 10uH is ideal for most applications.

The intended application should dictate the value of L. The trade-off between required PCB surface area and desired output ripple are the determining factors: smaller values for L require less PCB space, larger values of reduce output ripple. If the value of L is large enough to prevent I_{MAX} from being reached before ton expires, the A7207 output power will be reduced.

For maximum output current calculate the value for L as:

$$(V_{BATT(MAX)}(1us))/0.7A < L < (V_{BATT(MIN)}(7us))/0.7A$$

$$I_{OUT(MAX)} = (0.7A/2)(V_{BATT(MIN)} – (0.7A/2)(R_{NCH} + R_{IND}))V_{OUT}$$

Where:

R_{IND} is the inductor series resistance.

R_{NCH} is the $R_{DS(ON)}$ of the N-channel MOSFET (0.3Ω typ).

Note: Coils should be able to handle $500mA_{RMS}$ and have a $I_{SAT} \geqq 1A$ and should have a $R_{IND} \leqq 100m\Omega$

Capacitor Selection

C_{OUT} Selection

Choose a C_{OUT} value to achieve the desired output ripple percentage. A 22uF ceramic capacitor is a good initial value.

The value for C_{OUT} can be determined by:

$$C_{OUT} > (L + 2.5uH) \times V_{BATT(MAX)}^2 / r\%$$

Where:

R is the desired output ripple in %.

C_{IN} Selection

C_{IN} reduces the peak current drawn from the battery and can be the same value as C_{OUT}. A larger value for C_{IN} can be used to further reduce ripple and improve A7207 efficiency.

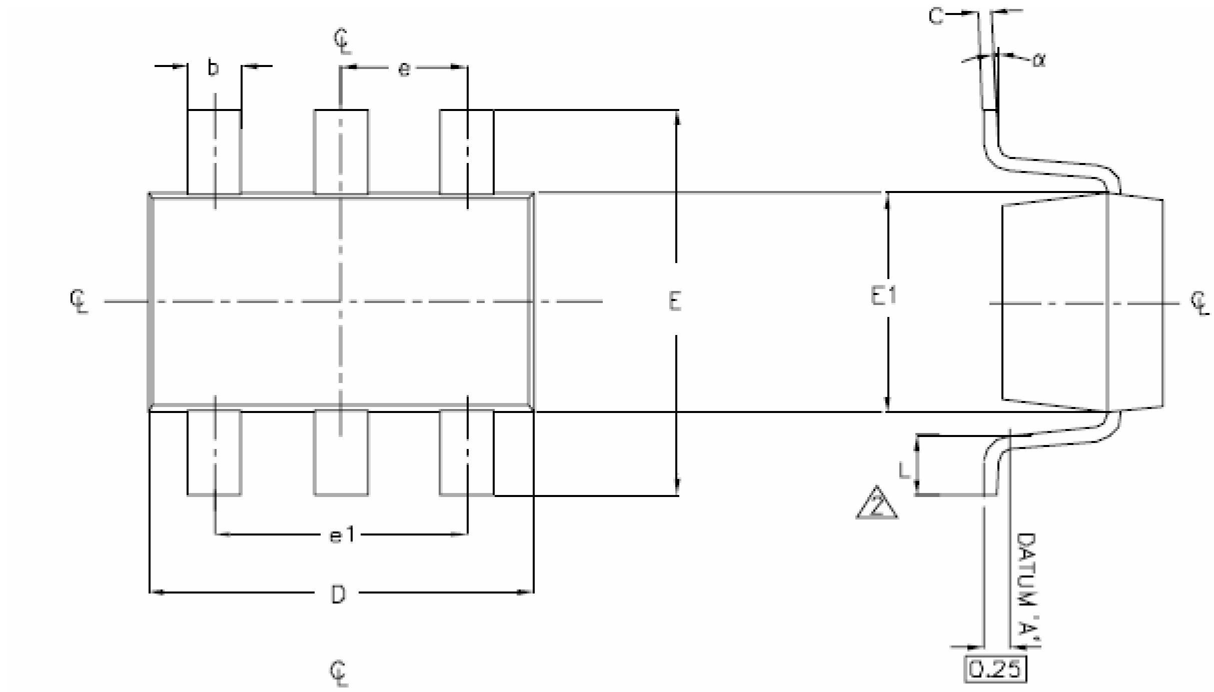
PC Board Layout and Grounding

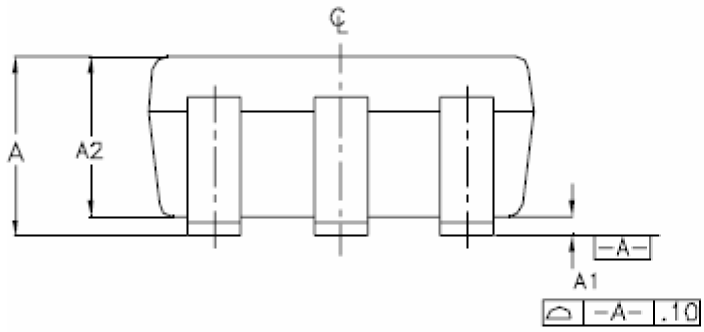
Well-designed printed circuit-board layout is important for minimizing ground bounce and noise.

- Place pin GND lead and the ground leads of C_{IN} and C_{OUT} as close to the device as possible.
- Keep the lead to pin LX as short as possible.
- To maximize output power and efficiency and minimize output ripple voltage, use a ground plane and solder the GND pin directly to the ground plane.

Packaging Information

Dimension in SOT-26 (Unit: mm)





Symbol	Min	Max
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.35	0.50
C	0.08	0.20
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.75
L	0.35	0.55
E	0.95 REF	
α	0°	10°

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