1.5A High Efficiency Step-down Converter

Description

The SC15A15 family of devices is high efficiency synchronous step-down dc-dc converters optimized for battery powered portable applications. The devices are ideal for portable applications powered by a single Li-Ion battery cell or by 3-cell NIMH/NICD batteries. With an output voltage range from 5.0 V down to 0.7 V, the devices support low voltage DSPS and processors in PDAS, pocket PCs, as well as notebooks computers. The SC15A15 operates at a fixed switching frequency of 1MHz.The SC15A15 supports up to 1.5A load current.

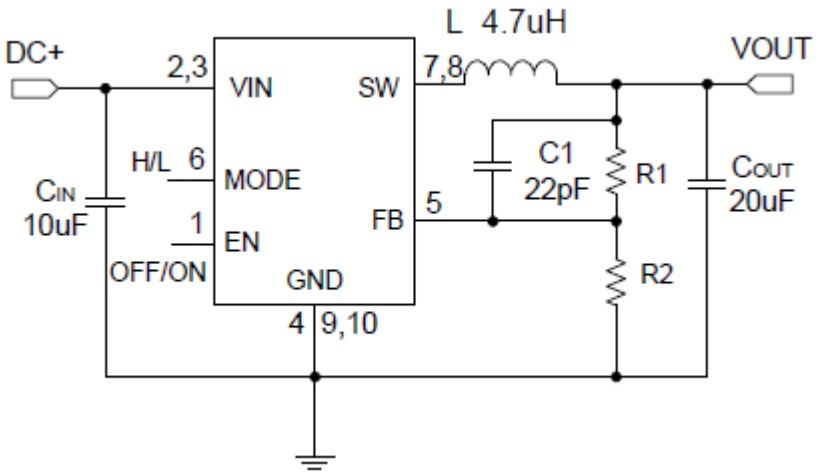
Features

- Input Supply Voltage :2.5V-5.5V
- Standard 5V to 3.3V Conversion
- Up to 90% Conversion Efficiency
- Typical Quiescent Current: 40μA
- Load Current: up to 1.5A
- Thermal Shutdown, Internal Soft Start
- Short-Circuit Protection
- Switching Frequency up to 1MHz
- Adjustable and Fixed Output Voltage
- 100% Duty Cycle for Lowest Dropout
- DFN3Ø3-10L Package

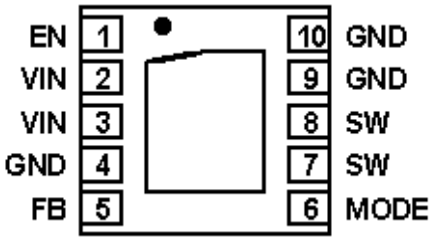
Applications

- Portable MP3 Players, Wireless Headsets
- USB Powered Modems
- MID, PDA,
- Pocket PC and Smart Phones

Typical Application Circuit



Pin Configurations

Package Type	Pin Configurations
SC15A15 DFN3×3-10L	

Pin Description

PIN DFN-10L	NAME	DESCRIPTION
1.	EN	En Control Input. Forcing this pin above 1.5V enables the part. Forcing this pin below 0.4V shuts down the device. In shutdown, all functions are disabled drawing <1uA supply current. Do not leave EN floating.
2、3	VIN	Supply voltage input.
4、9、10	GND	Ground.
5.	FB	Feedback Pin. Receive the feedback voltage from an external resistive divider which is connected to the output. In the adjustable version, the output voltage is set by a resistive divider according to the following formula: V_{OUT}=0.58V×（1+R1/R2）.
6.	MODE	When MODE connects V_{IN}, high power consumption; When MODE connects GND, low power consumption.
7、8	SW	Switch Node Connection to inductor. This pin connects to the drains of the internal main and synchronous power MOSFET switches.

Absolute Maximum Ratings

- V_{IN}、V_{FB} ---------- –0.3V to 6V
- $V_{ON/OFF}$、V_{SW} ---------- –0.3V to （V_{IN}+0.3）V
- I_{SW} ---------- 2A
- Maximum Junction Temperature ---------- 125℃
- Operating Ambient Temperature Range ---------- –40℃ to 85℃
- Storage Temperature Range ---------- –65℃ to 125℃
- Lead Temperature (Soldering, 10 sec) ---------- 300℃

Electrical Characteristics

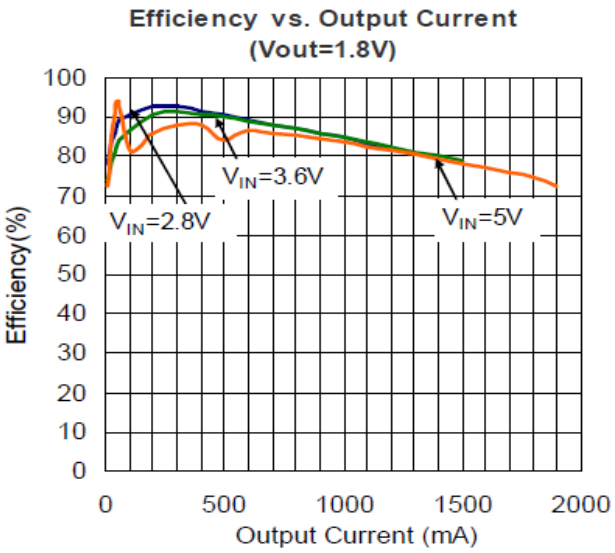
Operating Conditions: T_A=25 ℃,V_{IN}=3.6V unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	SC15A15			UNITS
			MIN	TYP	MAX	
V_{IN}	Operating Voltage Range		2.5		5.5	V
V_{FB}	Regulated Voltage	T_A = 25℃	0.565	0.58	0.598	V
I_{FB}	Feedback Current				±30	nA
ΔV_{FB}	V_{REF}	V_{IN}=2.5V~5.5V		0.03	0.4	%/V
F_{OSC}	Oscillator Frequency	V_{FB}=0.58V or V_{OUT}=100%	0.8	1.0	1.25	MHz
I_Q	Quiescent Current	V_{FB} = 0.5V or V_{OUT} =90%, I_{LOAD} =0A,Mode=0V			40	μA
I_S	Shutdown Current	V_{EN} = 0V, V_{IN} = 4.2V		0.1	1	μA
I_{PK}	Peak Inductor Current	V_{IN} = 3.6V, V_{FB} = 0.5V or V_{OUT} = 90%,		1.5		A
R_{PFET}	$R_{DS(ON)}$ of P-Channel FET	I_{SW} = 500mA		0.1		Ω
R_{NFET}	$R_{DS(ON)}$ of N-Channel FET	I_{SW} = -500mA		0.3		Ω
EFFI	Efficiency	V_{IN}=EN=3.6V,I_{OUT}=100mA		92		%
ΔV_{OUT}	V_{OUT} Line Regulation	V_{IN}=2.5V~5.5V		0.04	0.3	%/V
$V_{LOADREG}$	V_{OUT} Load Regulation			0.33		%

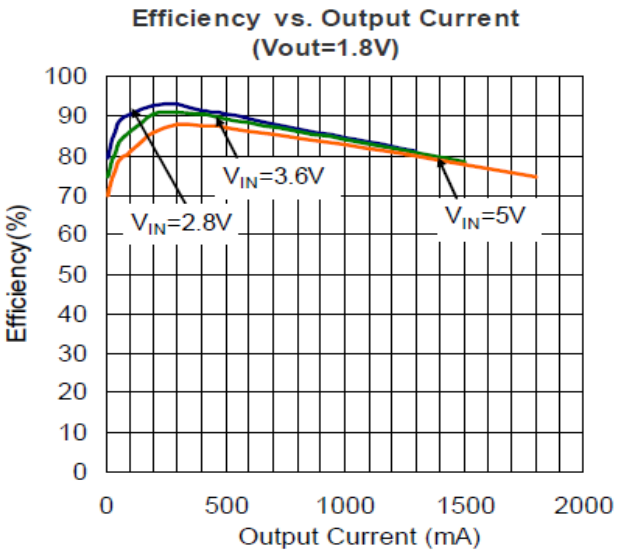
Typical Performance Charateristics

T_A=25℃, C_{IN}=10μF, C_{OUT}=10μF, L=4.7μH, R1=200K, R2=100K, unless otherwise noted.

MODE Connect GND

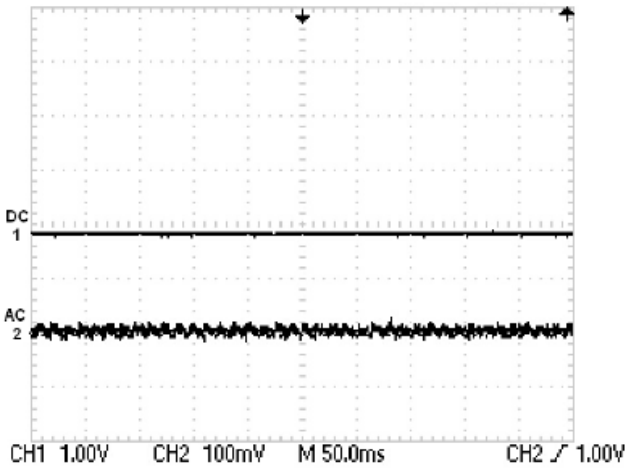


MODE Connect VIN



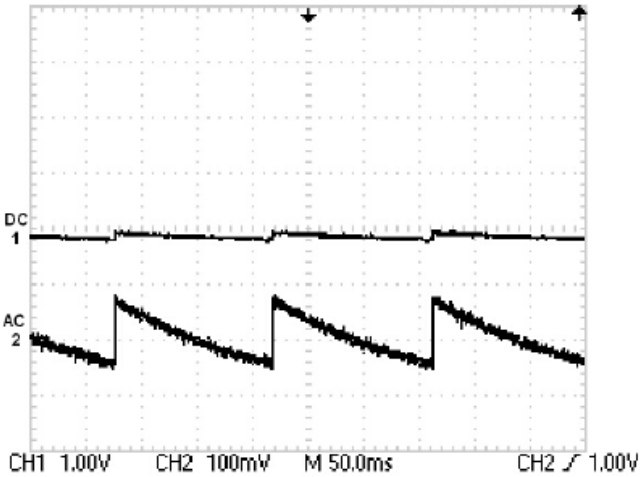
Output Noise

(VIN=5V, I_{LOAD}=0, MODE Connect VIN)



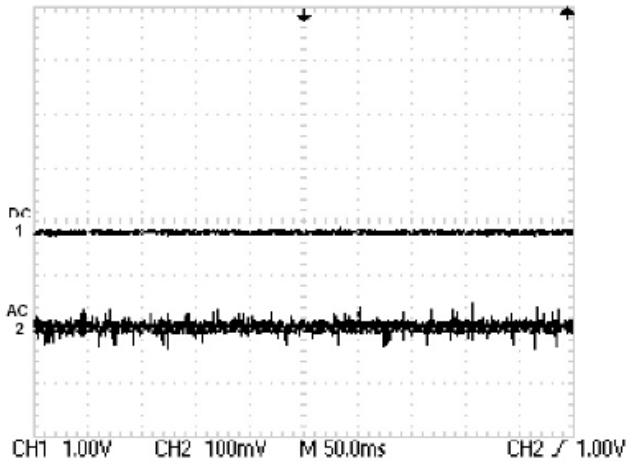
Output Noise

（VIN=5V, I_{LOAD}=0, MODE Connect GND）



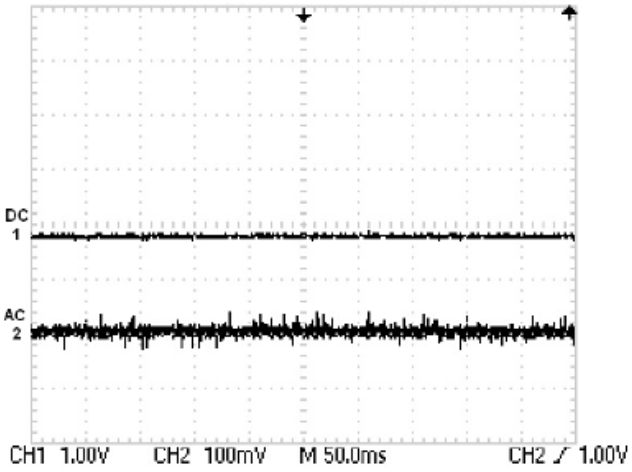
Output Noise

（VIN=5V, I_{LOAD} =1A, MODE Connect VIN）



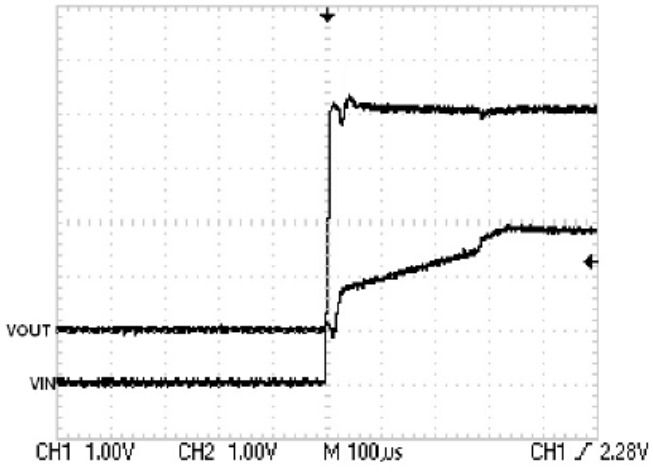
Output Noise

（VIN=5V, I_{LOAD} =1A, MODE Connect GND）



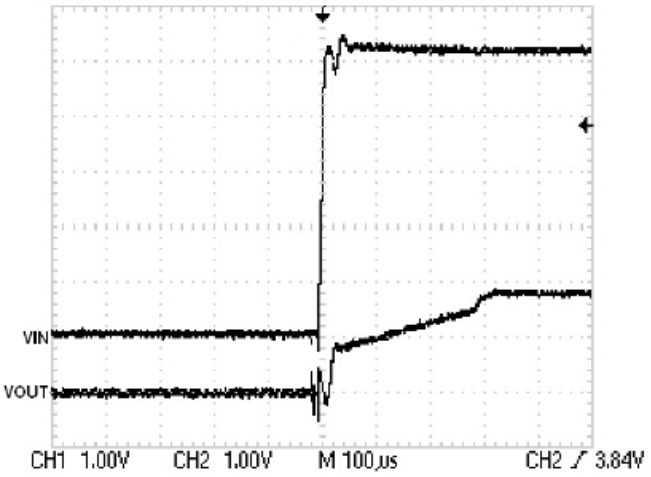
Start –up from power on

(V_{IN}=5V, I_{LOAD}=0A, MODE Connect GND)



Start –up from power on

(V_{IN}=5V, I_{LOAD}=0A, MODE Connect VIN)



Application Information

Inductor Selection

For most applications, the value of the inductor will fall in the range of 1mH to 4.7mH. Its value is chosen ased on the desired ripple current. Large value inductors lower ripple current and small value inductors esult in higher ripple currents. Higher V_{IN} or V_{OUT} also increases the ripple current as shown in quation .A reasonable starting point for setting ripple current is$\triangle I_L$ = 0.6A (40% of 1.5A).

$$\Delta I_L = \frac{1}{(f)(L)} V_{OUT}\left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

The DC current rating of the inductor should be at least equal to the maximum load current plus half the ripple current to prevent core saturation. Thus, a 1.8A rated inductor should be enough for most applications (1.5A + 0.3A). For better efficiency, choose a low DC-resistance inductor.

Different core materials and shapes will change the size/current and price/current relationship of an inductor. Toroid or shielded pot cores in ferrite or perm alloy materials are small and don't radiate much energy, but generally cost more than powdered iron core inductors with similar electrical characteristics. The choice of which style inductor to use often depends more on the price vs. size requirements and any radiated field/EMI requirements than on what SC15A15 requires to operate.

Output and Input Capacitor Selection

In continuous mode, the source current of the top MOSFET is a square wave of duty cycle V_{OUT}/V_{IN}. To prevent large voltage transients, a low ESR input capacitor sized for the maximum RMS current must be used. The maximum RMS capacitor current is given by:

$$C_{IN} \text{ required } I_{RMS} \cong I_{OMAX} \frac{\left[V_{OUT}(V_{IN} - V_{OUT})\right]^{1/2}}{V_{IN}}$$

This formula has a maximum at $V_{IN} = 2V_{OUT}$, where $I_{RMS} = I_{OUT}/2$. This simple worst-case condition is commonly used for design because even significant deviations do not offer much relief. Note that the capacitor manufacturer's ripple current ratings are often based on 2000 hours of life. This makes it advisable to further derate the capacitor, or choose a capacitor rated at a higher temperature than required. Always consult the manufacturer if there is any question.

The selection of C_{OUT} is driven by the required effective series resistance (ESR).Typically, once the ESR requirement for C_{OUT} has been met, the RMS current rating generally far exceeds the $I_{RIPPLE(P-P)}$requirement. The output ripple $\triangle V_{OUT}$ is determined by:

$$\Delta V_{OUT} \cong \Delta I_L\left(ESR + \frac{1}{8fC_{OUT}}\right)$$

Where f = operating frequency, C_{OUT} = output capacitance and $\triangle I_L$ = ripple current in the inductor. For a fixed output voltage, the output ripple is highest at maximum input voltage since $\triangle I_L$ increases with input voltage.

Aluminum electrolytic and dry tantalum capacitors are both available in surface mount configurations. In the case of tantalum, it is critical that the capacitors are surge tested for use in switching power supplies. An excellent choice is the AVX TPS series of surface mount tantalum. These are specially constructed and tested for low ESR so they give the lowest ESR for a given volume. The Table 1 shows the suggested capacitors for C_{IN} and C_{OUT}.

Board Layout Suggestions

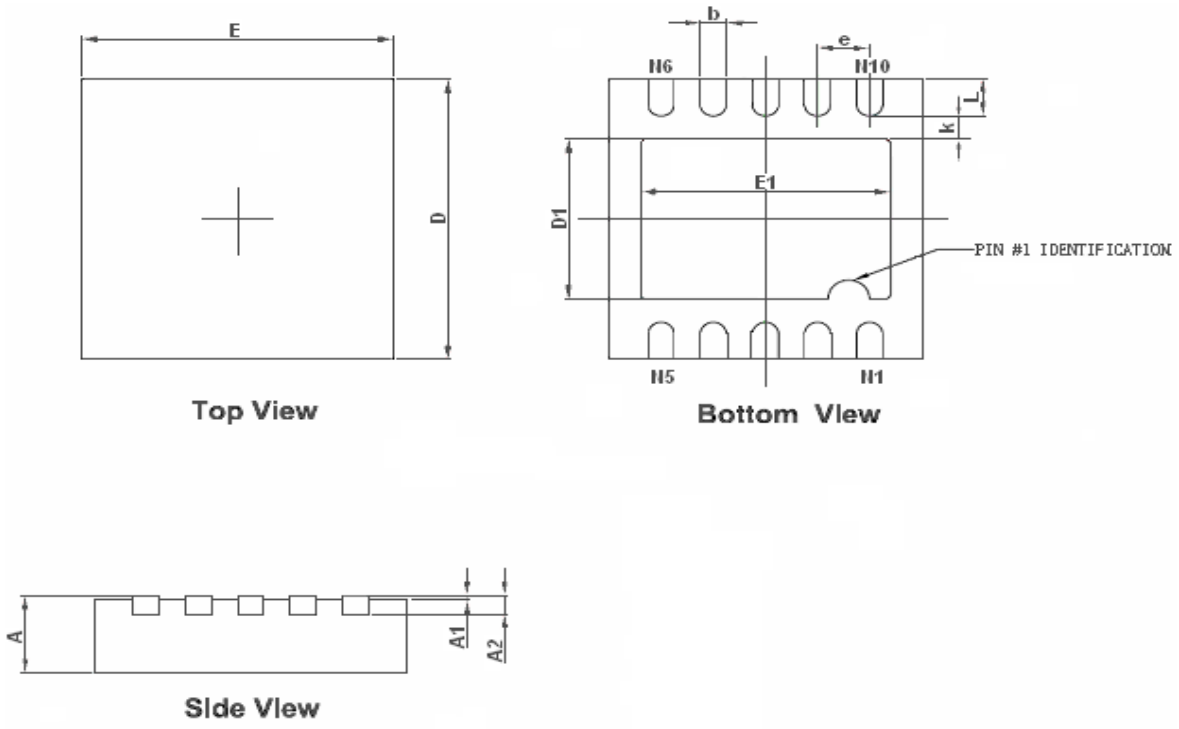
When laying out the printed circuit board, the following checklist should be used to ensure proper operation of the SC15A15. Check the following in your layout:

- **The power traces, consisting of the GND trace, the SW trace and the V_{IN} trace should be kept short, direct and wide.**
- **Put the input capacitor as close as possible to the device pins (V_{IN} and GND).**
- **SW node is with high frequency voltage swing and should be kept small area. Keep analog components away from SW node to prevent stray capacitive noise pick-up.**

- **Connect all analog grounds to a command node and then connect the command node to the power ground behind the output capacitors.**

Packaging Information

DFN3×3-10L Package Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A2	0.153	0.253	0.006	0.010
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E1	2.300	2.500	0.091	0.098
k	0.200MIN		0.008MIN	
b	0.200	0.300	0.008	0.012
e	0.500TYP		0.020TYP	
L	0.300	0.500	0.012	0.020