ACE712E

5V/2A Output, 1MHz Synchronous Step-Up Converter with DCP emulator

Description

ACE712E is an ACE Solutions' high efficiency, high frequency synchronous Step-Up converter, capable of delivering output current up to 2A at a 5V output from input as low as 3.3V. With a low Rdson Power MOS and a built-in synchronous rectifier, its efficiency can be as high as 90% at a 5V/2A load. This greatly minimizes power dissipation and reduces heat on the IC, making it ideal for applications that require small board space and have stringent temperature constraints, such as power banks and mobile devices. ACE712E also integrates an USB emulator that provides correct electrical signature on the D+/D- for charging compliant devices. ACE712E also incorporates ACE Solutions True-Shutoff® technology that protects against overload and short-circuit conditions. All of these features are integrated in a tiny DFN3x3-12 package. With 1MHz switching frequency, small external input and output capacitors and inductor can be used.

Features

- Up to 97% Energy Converting Efficiency
- Up to 2A output current at 5V output, 3.3V input
- Dedicated Charging Port (DCP) emulator with BC1.2 compliant
- True Shut off during shutdown and output short- circuit protection
- Thermal Shutdown
- DFN3x3-12

Applications

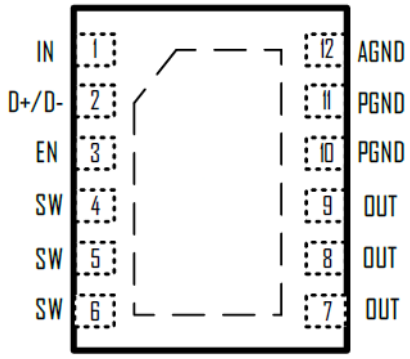
- Power Bank
- Mobile 3G/4G WLAN
- Mobile Bluetooth music player and speaker

Absolute Maximum Ratings

(Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

All Pins Voltage..…..……………–0.3V to 5.5V
Operating Temperature Range ……………………........…………………–40°C to 85°
Storage Temperature Range …………………………………………–55°C to 150°C
Thermal Resistance θ_{JC} θ_{JA}
DFN3X3-12…………………………………………3……………….48 ....°C/W
Lead Temperature (Soldering, 10ssec) ……………………………………260°C
ESD HBM (Human Body Mode) ………………………….……..……………2KV
ESD MM (Machine Mode) ……………………..………………….……………..200V

Packaging Type



DFN3X3-12

PIN DESCRIPTION

PIN #	NAME	DESCRIPTION
1	IN	Input pin. Bypass IN to GND with a 10uF or greater ceramic capacitor.
2	D+/D-	Connected to the D+ and D- line of USB connect, provide the correct voltage with attached portable equipment for USB Dedicated Charging Port (DCP) Emulator.
3	EN	Enable pin for the IC. Drive this pin high to enable the IC, low or floating to disable.
4,5,6	SW	Switching node of the Switching Regulator. Connect a 1uH to 2.2uH inductor between IN and SW pin.
7,8,9	OUT	Output pin. Bypass with a 22uFx2 or larger ceramic capacitor closely between this pin and ground.
10,11	PGND	Power ground pin.
12	AGND	Analog ground pin

Ordering information

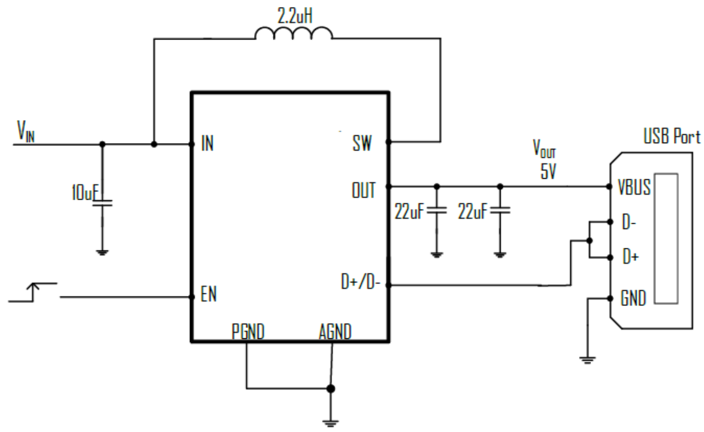
ACE712E XX + H

Halogen - free

Pb - free

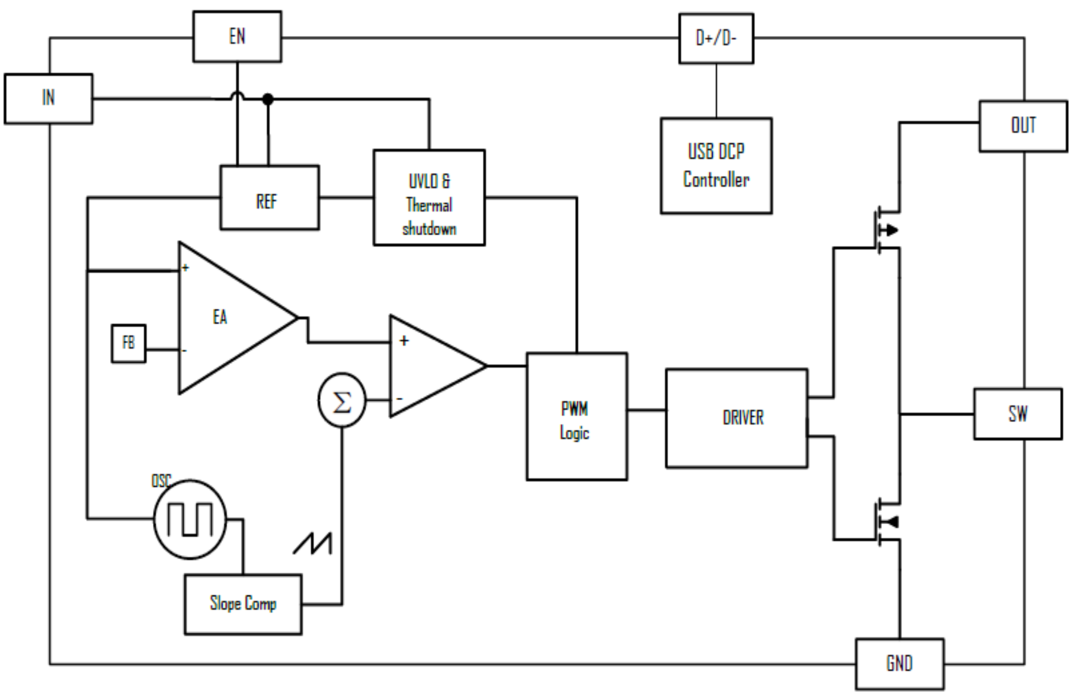
NC12 : DFN3X3-12

Typical Application



2.5A Output Synchronous Boost with USB DCP Emulator

Block Diagram



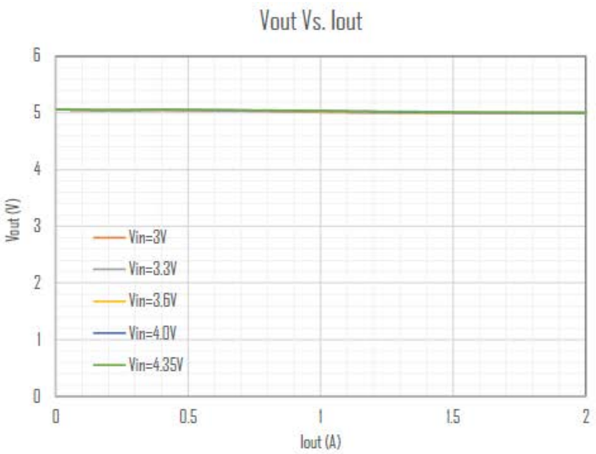
Electrical Characteristics

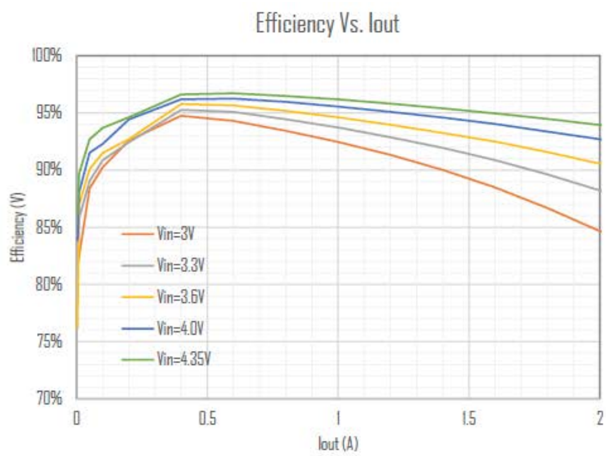
(V_{IN} = 5V, unless otherwise specified. Typical values are at TA = 25oC.)

Parameter		Conditions	Min	Typ	Max	Units
I_Q	Quiescent current at V_{IN}	V_{IN} =3.6V, V_{OUT} =5.5V, Device not switching		6	10	uA
	Quiescent current at V_{OUT}	V_{IN} =3.6V, V_{OUT} =5.5V, Device not switching		120	150	uA
Shutdown Supply Current at V_{IN}		V_{IN} =3.6V, V_{EN} =GND		6	10	uA
V_{IN} UVLO at Rising				3.1		V
V_{IN} UVLO at Falling				2.6		V
V_{OUT}		Output Voltage	4.90	5.03	5.15	V
Low Side Main FET R_{DSON}		V_{OUT} =5V		70		mΩ
Synchronous FET R_{DSON}		V_{OUT} =5V		40		mΩ
Switch Frequency				1		MHZ
Main FET Current Limit				5		A
SW Leakage Current		Vout=5V, Vsw=0 or 5V, V_{EN}=GND	-1	0	1	uA
EN Input Current		V_{EN}=3V		1.5		uA
EN logic high voltage		V_{IN}=3.6V, Rising	1.6			V
EN logic low voltage		Falling			0.6	V
$R_{D\_PAD}1$		D+/D- output impedance at Divider Mode	28	39	50	kΩ
$R_{D\_PAD}2$		D+/D- output impedance at Samsung Mode	9	13	17	kΩ
Thermal Shutdown		Rising, Hysteresis=20°C		150		℃

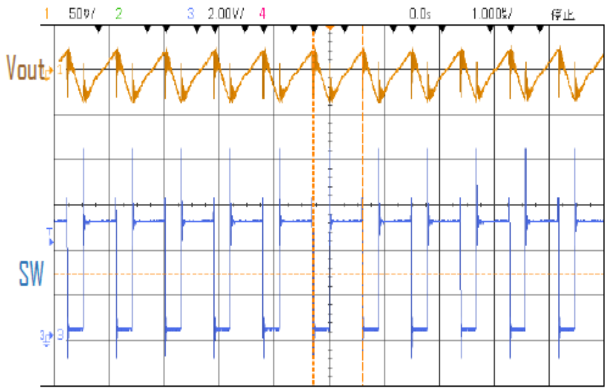
Typical Characteristics

(Typical values are at T_A = 25°C unless otherwise specified.)

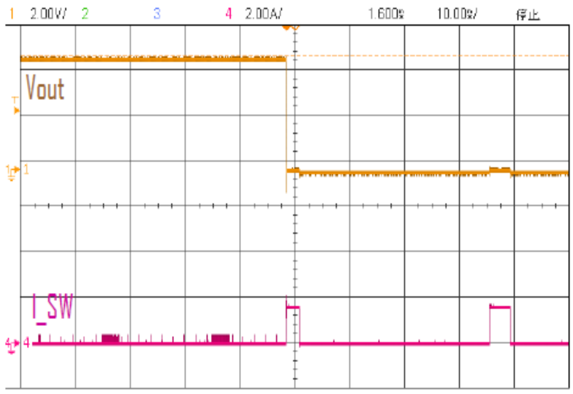




Switching Waveforms: Vin=3.6V, Iout=2A



Output Short Circuit Protection: Vin=4.2V



APPLICATION INFORMATION

Loop Operation

The ACE712E is a wide input range, high-efficiency, DC/DC step up switching regulator, integrated with a 70mΩ Low Side Main MOSFET and 40mΩ synchronous MOSFET. It uses a PWM current-mode control scheme. An error amplifier integrates error between the FB signal and the internal reference voltage. The output of the integrator is then compared to the sum of a current-sense signal and the slope compensation ramp. This operation generates a PWM signal that modulates the duty cycle of the power MOSFETs to achieve regulation for output voltage.

The output voltage is fixed to be 5V by internal resistor as an available USB host ports power source. The peak current of the NMOS switch is also sensed to limit the maximum current flowing through the switch and the inductor. The typical peak current limit is set to 5A. An internal temperature sensor prevents the device from getting overheated in case of excessive power dissipation.

Light Load Operation

Traditionally, a fixed constant frequency PWM DC/DC regulator always switches even when the output load is small. When energy is shuffling back and forth through the power MOSFETs, power is lost due to the finite RDSONs of the MOSFETs and parasitic capacitances. At light load, this loss is prominent and efficiency is therefore very low. ACE712E employs a proprietary control scheme that improves efficiency in this situation by enabling the device into a power saving mode during light load, thereby extending the range of high efficiency operation.

Short-Circuit Protection

Unlike most step-up converters, the ACE712E allows for short circuits on the output. In the event of a short circuit, the device first turns off the NMOS when the sensed current reaches the current limit. After VOUT drops below VIN the device then enters a linear charge period with the current limited same as with the start-up period. In addition, the thermal shutdown circuits disable switching if the die temperature rises above 150°C.

Down Mode (V_{IN}>V_{OUT}) Operation

The ACE712E will continue to supply the output voltage even when the input voltage exceeds the output voltage. Since the PMOS no longer acts as a low-impedance switch in this mode, power dissipation increases within the IC to cause a sharp drop in efficiency. Limit the maximum output current to maintain an acceptable junction temperature.

USB Dedicated Charging Port (DCP) Emulator

The D+/D- is a dedicated charging port emulator, used for the charging of most popular mobile phones and tablet PCs. An auto-detect feature monitors USB data line voltage, and automatically provides the correct electrical signatures on the data lines (D+ and D-) to charge compliant devices. A DCP only provides power and does not provide data connection to an upstream port. A DCP is identified by the electrical characteristics of its data line. It integrate an auto-detect feature to support divider mode and Samsung mode.

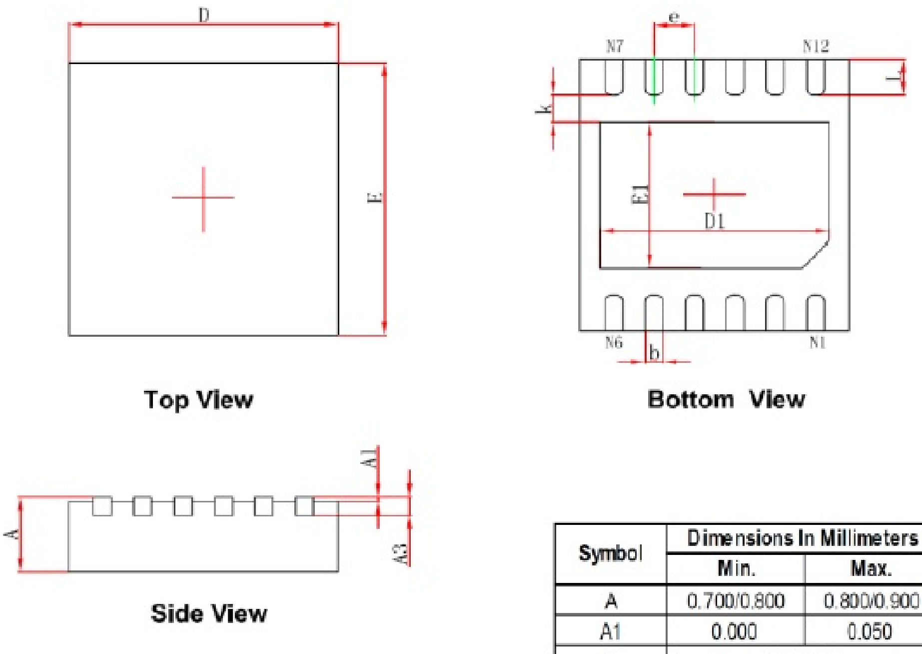
THERMAL CONSIDERATIONS

As the ACE712E has a power MOSFET with internal current limit up to 5A, heat dissipation is always needed to be considered when designing the PCB for such high-power step-up converter. ACE712E employs a package of DFN3x3-12 with only 3^{O}C/W thermal resistance from chip to its thermal pad. So it is crucial for one to lay a large area of copper (in most case, it is the large ground plane), directly contacting the thermal pad of the chip through more than 2 large vias from bottom, to spread the heat away to the ambient environment as fast as possible.

A thicker copper foil is always recommended to help the heat dissipation, so a PCB with 2oz copper thickness is a much better choice than that of 1oz copper.

PACKAGE OUTLINE

DFN3x3-12

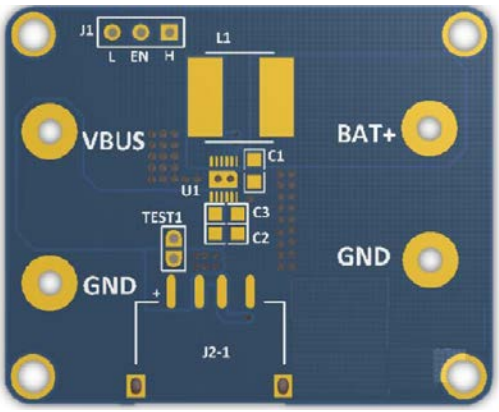


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	2.924	3.076	0.115	0.121
E	2.924	3.076	0.115	0.121
D1	2.450	2.650	0.096	0.104
E1	1.500	1.700	0.059	0.067
k	0.200MIN.		0.008MIN.	
b	0.150	0.250	0.006	0.010
e	0.450TYP.		0.018TYP.	
L	0.324	0.476	0.013	0.019

PCB GUIDELINES

A typical ACE712E demo board is shown below, where you may find only 3-4 peripheral devices are needed.

Please place the 2 output capacitors (C2, and C3) as close to the chip (U1) as possible. The input capacitor C1 is also recommended to be placed close to chip.



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