750KHz Asynchronous Boost Converter with CC/CV

❖ GENERAL DESCRIPTION

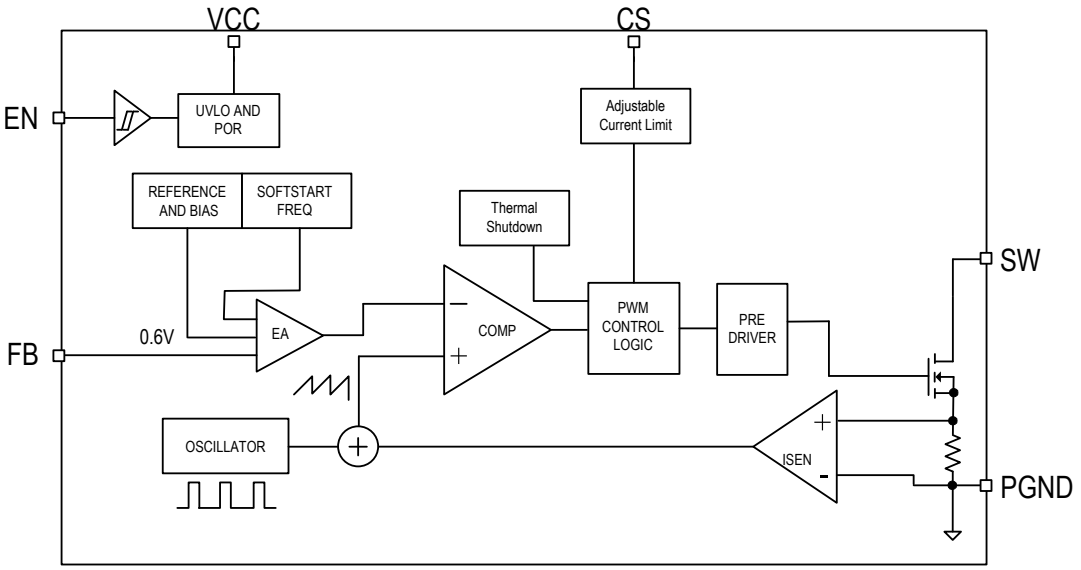
The MA2007 is a current mode step up converter that operates in either CV (Constant Output Voltage) mode or CC (Constant Output Current) mode. It includes an error amplifier, ramp generator, comparator, built-in 70mΩN-Channel power MOSFET make this regulator highly power efficient.

The 750KHz switching frequency allows for smaller external components producing a compact solution for a wide range of load currents. The MA2007 regulates the output voltage up to 5.5V and provides up to 1A output.

❖ FEATURES

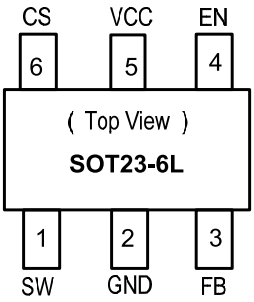
- Over 92% Efficiency
- Adjustable max output voltage to 5.5V
- Internal Switch Current max 3A.
- Programmable Output Current Limit(CC/CV)
- +2.8V to +5.5V Input Range
- 750KHz Fixed Switching Frequency
- 1μA Shutdown Current
- Internal Soft-Start
- Thermal Shutdown
- 70mΩ N-Channel power MOSFET
- SOT-23-6L Pb-free & HF Package

❖ BLOCK DIAGRAM



❖ PIN ASSIGNMENT

The package of MA2007 is SOT23-6L; the pin assignment is given by:



Name	Description
VCC	VCC Input Pin
EN	Chip Enable pin. Active high. Internal pull high for auto start up.
GND	Ground Pin.
FB	Feedback Pin.
SW	Switching Pin
CS	Adjustable Current Sense

❖ ORDER/MARKING INFORMATION

Order Information	Top Marking
MA2007XX X Package Type C: SOT23-6L Packing Blank : Bag A : Taping	A 8 Y W X → ID Code: Internal Week: 01~26(A~Z) 27~52(a~z) Year : 5 = 2015

❖ ABSOLUTE MAXIMUM RATINGS (at T_A=25°C)

Characteristics	Symbol	Rating	Unit
Vin pin voltage	V_{IN}	-0.3 to 6.0	V
EN,CS,FB pin voltage		-0.3 to V_{IN}+0.3	V
SW pin voltage	V_{SW}	Internal limit	V
Continuous Power Dissipation	PD	(T_J-T_A) / θ_{JA}	mW
Operating Junction Temperature	Top	-40 to 125	°C
Storage Temperature Range		-65 to 150	°C
Thermal Resistance from Junction to case	θ_{JC}	180	°C/W
Thermal Resistance from Junction to ambient	θ_{JA}	250	°C/W

Note: θ_{JA} is measured with the PCB copper are (need connect to LX) of approximately 1 in^2 (Multi-layer).

❖ ELECTRICAL CHARACTERISTICS

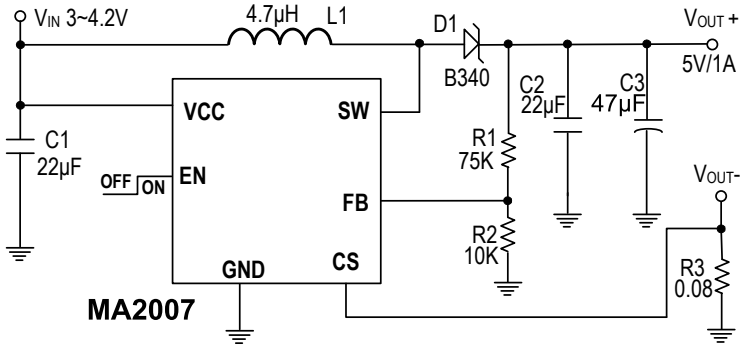
(V_{IN} = 3.6V, V_{EN} =3.6V, V_{OUT} = 5V, T_A = 25°C)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{IN}		2.8	-	5.5	V
Input UVLO	UVLO		2.4	2.6	2.75	V
Quiescent Current	I_{CCQ}	V_{FB} = 1.3V	-	300	-	μA
Shutdown Current	I_{SD}	V_{EN} = 0V	-	1	3	μA
FB Pin Voltage	V_{FB}		0.588	0.6	0.612	V
Load Regulation		0A < I_{OUT}<1A	-	0.5	-	%
Line Regulation		2.8V<V_{IN}<4.5V	-	0.5	-	%/V
EN Pin Voltage High	V_{ENH}		1.4	-	-	V
EN Pin Voltage Low	V_{ENL}		-	-	0.6	V
EN Pin Leakage Current		V_{EN} = 3V	-	0.1	1	μA
Switching Frequency	F_{OSC}		-	750	-	KHz
Current Sense Voltage	V_{CS}		90	100	110	mV
Switching Maximum Duty	Dmax		-	65	-	%
Minimum Duty	Dmin		0	-	-	%
N-Switch $R_{DS(ON)}$ **(Note1)**	$R_{DS(ON)-N}$		-	70	-	mΩ
Thermal Shutdown	T_{SD}		-	150	-	°C
Thermal Shutdown Protection hysteresis	T_{SH}		-	25	-	°C

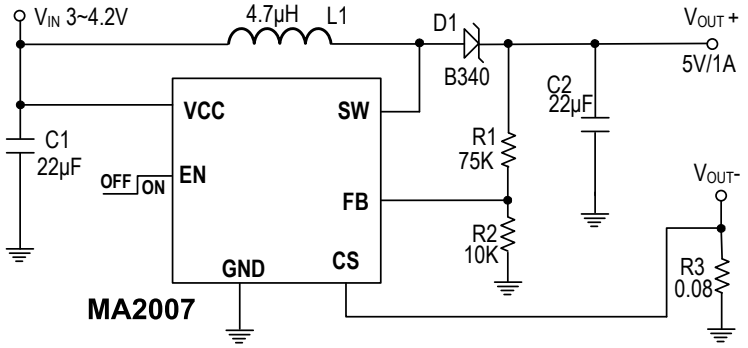
Note1: Guaranteed by design.

❖ APPLICATION CIRCUIT

1. EC (Recommend Circuit)



2. MLCC



$V_{OUT}=V_{FB} \times (1+R1/R2)$, V_{FB} = 0.6V, R2 suggest 5k~30KΩ

$I_{SEN}=V_{CS}/R3 \fallingdotseq$ 1.25A (V_{CS} =0.1V, R3=80mΩ)

Figure 3. Typical Application Circuit

The MA2007 uses a 750KHz fixed-frequency, current-mode regulation architecture to regulate the output voltage. The MA2007 measures the output voltage through an external resistive voltage divider and compares that to the internal 0.6V reference to generate the error voltage. The current-mode regulator compares the error voltage to the inductor current to regulate the output voltage. The use of current-mode regulation improves transient response and control loop stability.

At the beginning of each cycle, the N-Channel MOSFET switch is turned on, forcing the inductor current to rise. The current at the source of the switch is internally measured and converted to a voltage by the current sense amplifier. That voltage is compared to the error voltage. When the inductor current rises sufficiently, the PWM comparator turns off the switch, forcing the inductor current to the output capacitor through the SBD, which forces the inductor current to decrease. The peak inductor current is controlled by the error voltage, which in turn is controlled by the output voltage. Thus the output voltage controls the inductor current to satisfy the load.

Soft-Start

The MA2007 includes a soft-start timer that limits the voltage at the error amplifier output during startup to prevent excessive current at the input. This prevents premature termination of the source voltage at startup due to inrush current. This also limits the inductor current at startup, forcing the input current to rise slowly to the amount required to regulate the output voltage during soft-start.

Current Limit

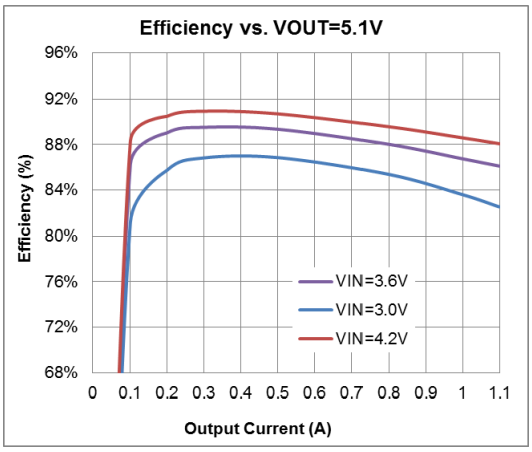
System have two current limit protect function, that Internal Switch Current limit (3A) and a resistor (R3) in between CS and GND pin to program peak output current. Do not put capacitance at CS pin. To set the over current point according to the following equation:

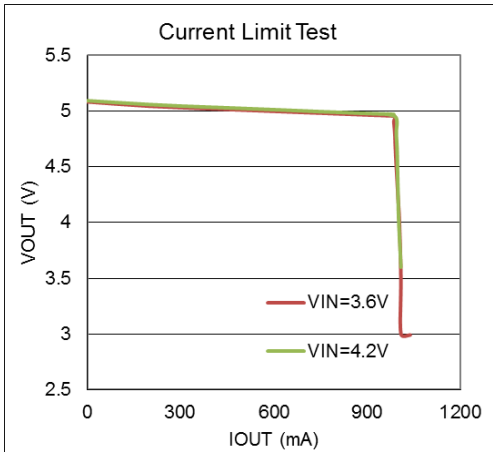
$$I_{SEN} = V_{CS} / R3,\ V_{CS} = 0.1V$$

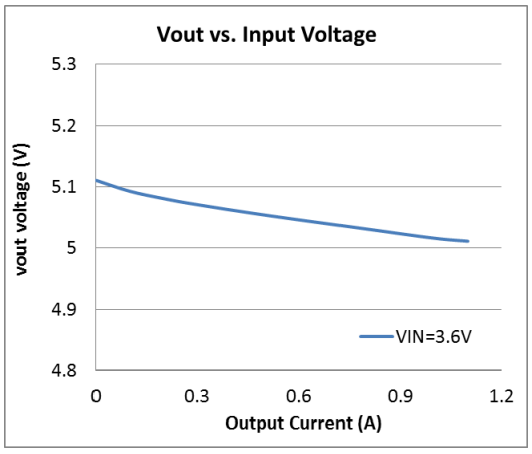
CC Measurement

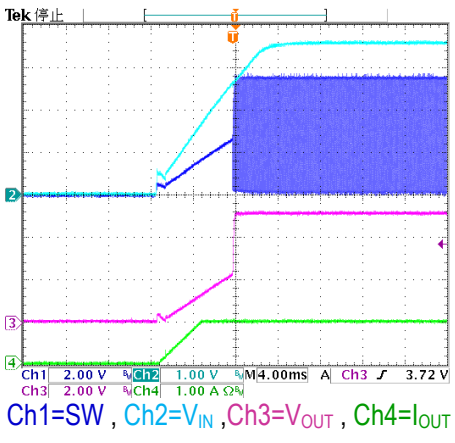
R3	150mΩ	100mΩ	80mΩ	70mΩ
IOUT	667mA	1000mA	1250mA	1430mA

❖ TYPICAL CHARACTERISTICS



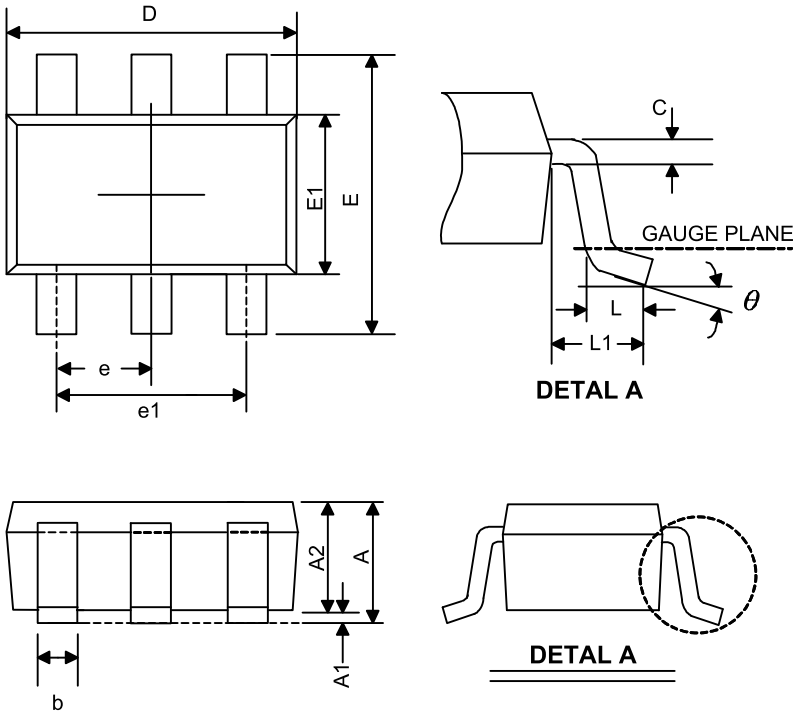






Ch1=SW , Ch2=V_{IN} ,Ch3=V_{OUT} , Ch4=I_{OUT}

❖ PACKAGE OUTLINES



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.05	-	1.45	0.041	-	0.057
A1	0.05	-	2.15	0.002	-	0.085
A2	0.90	1.10	1.30	0.035	0.043	0.051
b	0.30	-	0.50	0.012	-	0.020
C	0.08	-	0.22	0.003	-	0.009
D	2.70	2.90	3.10	0.106	1.114	0.122
E1	1.40	1.60	1.80	0.055	0.063	0.071
E	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	-	0.60	0.012	-	0.024
L1	0.50	0.60	0.70	0.020	0.024	0.028
e1	1.80	1.90	2.00	0.071	0.075	0.079
e	0.85	1.00	1.15	0.033	0.037	0.045
θ	0°	4°	8°	0°	4°	8°