1.2A/24V/1.4MHz Asynchronous Buck Converter

❖ GENERAL DESCRIPTION

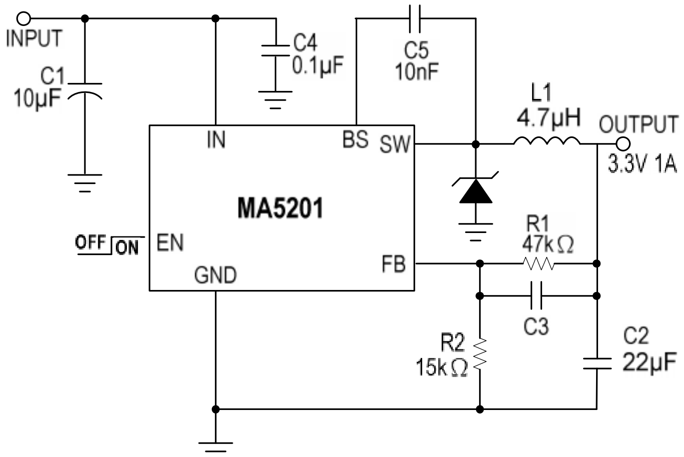
The MA5201 is a monolithic asynchronous buck regulator. The device integrates power MOSFET, and provides 1.2A of continuous load current over a wide input voltage of 4.75V to 24V. Current mode control provides fast transient response and cycle-bicycle current limit.

An adjustable soft-start prevents inrush current at turn-on, and in shutdown mode the supply current drops to 1μA. This device, available in SOT23-6 package, provides a very compact solution with minimal external components.

❖ FEATURES

- Wide 4.75V to 24V Operating Input Range
- Integrated 300mΩ Power MOSFET Switches
- Output Adjustable from VFB(0.81V) to 12V
- Internal Soft-Start
- Stable with Low ESR Ceramic Output Capacitors
- Fixed 1.4MHz Frequency
- Cycle-by-Cycle Over Current Protection
- Input Under Voltage Lockout

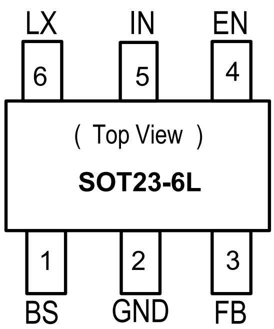
❖ APPLICATION CIRCUIT



$V_{OUT}=V_{FB} \times (1+R1/R2)$, $V_{FB} = 0.81V$, R2 suggest 10k~30kΩ

❖ PIN ASSIGNMENT

The package of MA5201 is SOT23-6L; the pin assignment is given by:

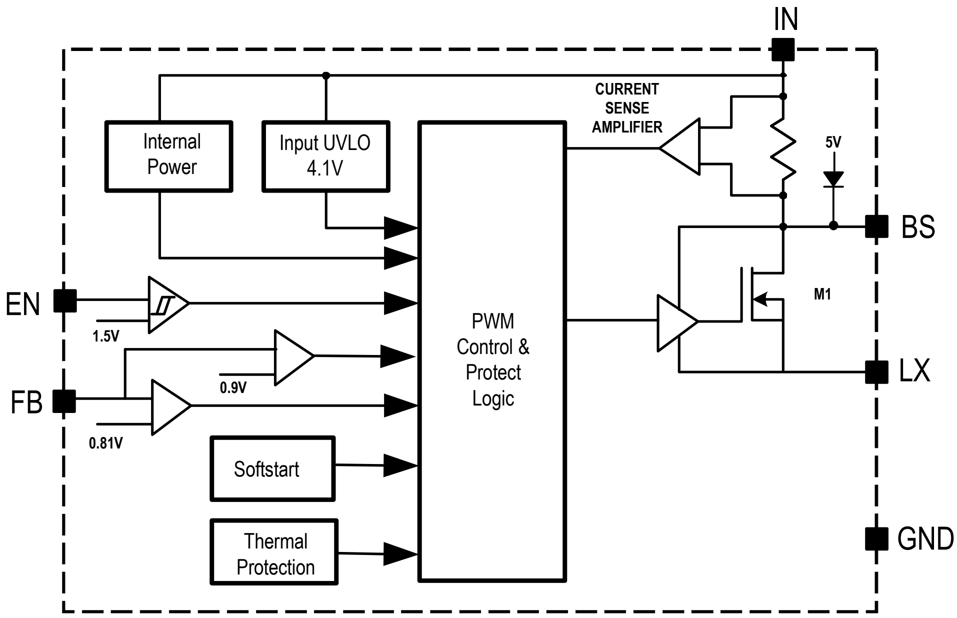


Name	Description
BS	Boot-Strap Pin. Supply high side gate driver. Decouple this pin to LX pin with 0.1uF ceramic cap.
GND	Ground Pin.
FB	Output Feedback Pin. Connect this pin to the center point of the output resistor divider to program the output voltage: Vout=0.81*(1+R1/R2)
EN	Enable control. Pull high to turn on. Do not float.
IN	Input pin. Decouple this pin to GND pin with at least 1uF ceramic cap
LX	Inductor pin. Connect this pin to the switching node of inductor

❖ RDER/MARKING INFORMATION

Order Information	Top Marking
MA5201 XX X Package Type C: SOT23-6L Packing Blank : Bag A : Taping	D1 Y W X X → ID Code: Internal W → Week: 01~26(A~Z) 27~52(a~z) Y → Year : 3 = 2013

❖ BLOCK DIAGRAM



❖ A BSOLUTE MAXIMUM RATINGS (at T_A=25°C)

Characteristics	Symbol	Rating	Unit
Supply Voltage	V_{IN}	26	V
Switch Node Voltage	V_{SW}	–0.3 to V_{IN} +0.3	V
Boost Voltage	V_{BS}	V_{SW} + 6	V
All Other Pins		–0.3 to +6	V
Lead Temperature		260	°C
Storage Temperature		–65 to +150	°C
Junction Temperature	T_J	150	°C
Input Voltage	V_{IN}	4.75 to 24	V
Output Voltage	V_{OUT}	VFB to 12	V
Ambient Operating Temperature		–40 to +85	°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 area of approximately 0.5 in^2(Multi-layer). That need connect to GND pin.

ELECTRICAL CHARACTERISTICS

(V_{IN} = 12V, T_A = +25°C, unless otherwise noted.)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Shutdown Supply Current	I_{SD}	V_{EN} = 0V	-	1	3.0	μA
Quiescent Current	I_{CCQ}	V_{EN} = 2.5V; V_{FB} = 0.63V	-	750	-	uA
Feedback Voltage	V_{FB}	4.75V ≤ V_{IN} ≤ 16V	0.794	0.810	0.826	V
Feedback Overvoltage Threshold	$OVP_{(FB)}$		-	1.1X	-	V_{FB}
High-Side Switch On Resistance (Note)	$R_{DS(ON)1}$		-	300	-	mΩ
High-Side Switch Leakage Current		V_{EN} = 0V, V_{SW} = 0V	-	-	10	μA
Switch Current Limit		Minimum Duty Cycle	-	1.5	-	A
Oscillation Frequency	F_{OSC1}		-	1400	-	KHz
Short Circuit Oscillation Frequency	F_{OSC2}	V_{FB} = 0V	-	200	-	KHz
Maximum Duty Cycle	D_{MAX}		-	90	-	%
Minimum On Time (Note)	$T_{ON(min)}$		-	100	-	ns
EN Shutdown Threshold Voltage	ENH	V_{EN} Rising	1.1	1.5	2.0	V
EN Shutdown Threshold Voltage Hysteresis			-	210	-	mV
Input Under Voltage Lockout Threshold	UVLO	V_{IN} Rising	3.80	4.10	4.40	V
Input Under Voltage Lockout Threshold Hysteresis	UVLO-Hys		-	210	-	mV
Soft-Start Period		C_{SS} = 0.1μF	-	4	-	ms
Thermal Shutdown	T_{SD}		-	150	-	°C
Thermal Shutdown Hysterisis	T_{SH}		-	30	-	°C

Note: Guaranteed by design.

❖ FUNCTION DESCRIPTIONS

The MA5201 is a synchronous rectified, current-mode, step-down regulator. It regulates input voltages from 4.75V to 24V down to an output voltage as low as V_{FB}, and supplies up to 1.2A of load current.

The MA5201 uses current-mode control to regulate the output voltage. The output voltage is measured at FB through a resistive voltage divider and amplified through the internal Tran conductance error amplifier. The voltage at the COMP pin is compared to the switch current measured internally to control the output voltage.

The converter uses internal N-Channel MOSFET switches to step-down the input voltage to the regulated output voltage. Since the high side MOSFET requires a gate voltage greater than the input voltage, a boost capacitor connected between SW and BS is needed to drive the high side gate. The boost capacitor is charged from the internal 5V rail when SW is low.

When the MA5201 FB pin exceeds 10% of the nominal regulation voltage of V_{FB}, the over voltage comparator is tripped and the COMP pin is discharged to GND, forcing the high-side switch off.

External Bootstrap Diode

An external bootstrap diode may enhance the efficiency of the regulator, the applicable conditions of external BST diode are:

- V_{OUT}=5V or 3.3V; and
- Duty cycle is high: $D = \dfrac{V_{OUT}}{V_{IN}} > 65\%$

In these cases, an external BST diode is recommended from the output of the voltage regulator to BST pin, as shown in Fig.1

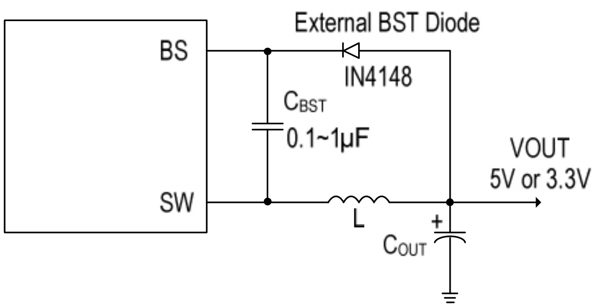
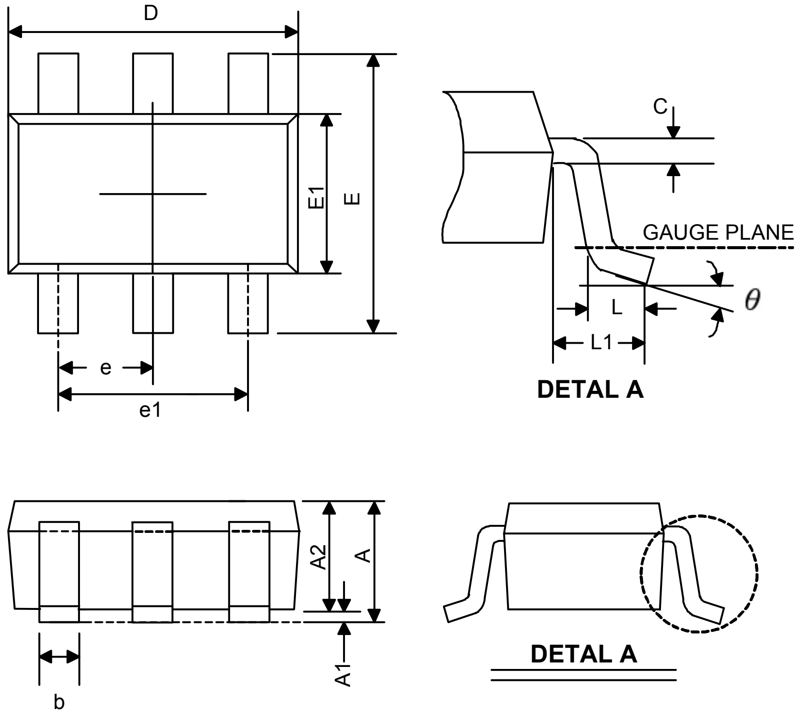


Figure 1 Add Optional External Bootstrap Diode to Enhance Efficiency

The recommended external BST diode is IN4148, and the BST cap is 0.1~1μF.

❖ 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°