

58V Asynchronous Buck Controller With CC/CV

❖ GENERAL DESCRIPTION

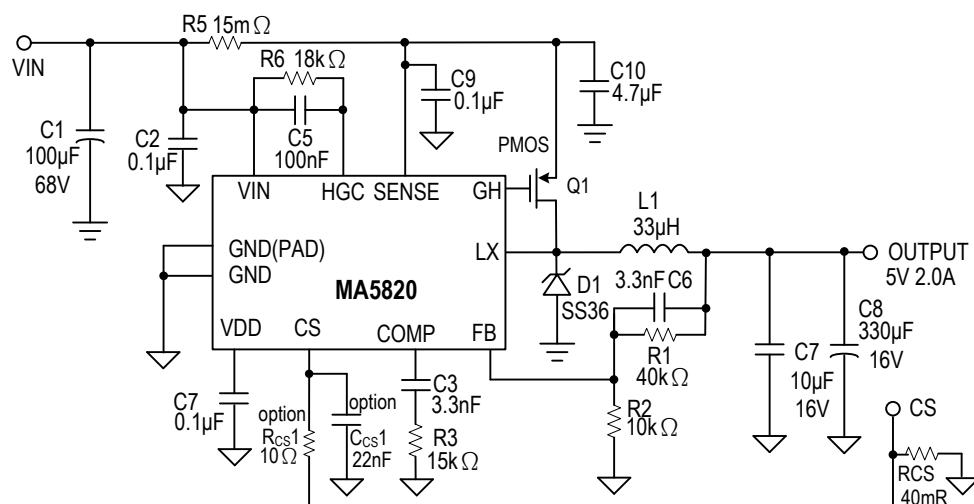
The MA5820 is an asynchronous buck controller. The device need externals high side and external high side power MOSFETs, and provide 3A of continuous load current over a wide input voltage of 10V to 58V. Current mode control provides fast transient response and cycle-bicycle current limit.

An internal soft-start prevents inrush current at turn-on, this device available in small MSOP-10L-EP packages, provides a very compact solution with minimal external components.

❖ FEATURES

- Wide 10V~ 58V Operating Input Range
- Externals high-side P-channel MOSFET Switches
- Output Adjustable : $V_{FB}(1.00V \pm 2\%)$
- Up to 93% Efficiency
- Internal Soft-Start / Thermal Shutdown Protection
- Fixed 240KHz Frequency
- Cycle-by-Cycle Over Current Protection
- Input Under/Over Voltage Lockout

❖ APPLICATION CIRCUIT

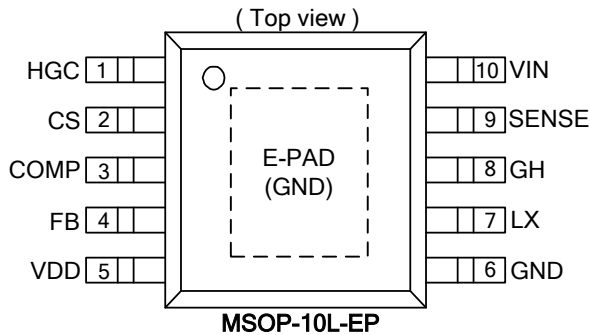


$$V_{OUT} = V_{FB} \times (1 + R1/R2), \quad V_{FB} = 1.0V, \quad R2 \text{ suggest } 1K \sim 30K\Omega.$$

$$I_{CS} = V_{CS} / R_{CS} = 0.095V / 40m\Omega = 2.375A$$

❖ PIN ASSIGNMENT

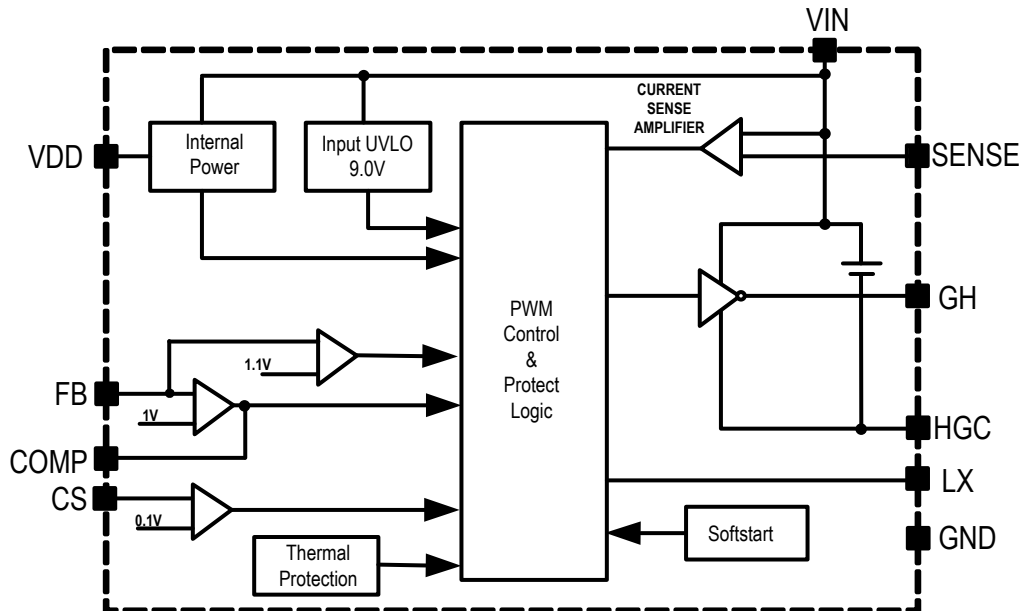
The package of MA5820 is MSOP10L-EP(Exposed pad); the pin assignment is given by:



Name	Description
HGC	Supply high-side gate driver. Decouple this pin to VIN pin with 0.1uf ceramic CAP (e.g. X5R) and 18kR
CS	The Current Sense pin.
COMP	Compensation Node. Connect a series RC network from COMP to GND.
FB	Feedback Input. FB senses the output voltage to regulate that voltage. Drive FB with a resistive voltage divider from the output voltage.
VDD	Internal regulator pin
GND	Ground.
LX	Switching node and Switching sense pin.
GH	Gate driver for external high-side PMOS.
SENSE	Power Input and Current Limit SENSE pin. Bypass SENSE (of High-side PMOS) to Ground with high capacitance 4.7uF ceramic MLCC (e.g. X5R) to eliminate noise, and bypass MA5820 SENSE-pin to pin6-GND with a 1uf~ 10uf ceramic MLCC. (e.g. X5R.). Ensure a very large SENSE area for High-side PMOS cooling.
VIN	Power Input. Bypass VIN to Ground with a suitably high capacitance E-CAP to eliminate noise, and bypass IC PIN10-VIN to pin6-GND with a 0.1uf ceramic MLCC (e.g. X5R.)
E-PAD	Exposed pad. Connect to GND.

❖ RDER/MARKING INFORMATION

Order Information	Top Marking
<p>MA5820XXX → Packing Blank: Tube A : Taping</p> <p>Package Type EM: MSOP10L-EP</p>	<p>MA5820 → Part number XXXXXX → ID code:internal → WW:01~52 → Year:18=2018</p>

❖ BLOCK DIAGRAM

❖ ABSOLUTE MAXIMUM RATINGS (at $T_A=25^\circ\text{C}$)

Characteristics	Symbol	Rating	Unit
Supply Voltage	V_{IN}	-0.3 to +60	V
Switch Node Voltage	V_{SW}	-0.3 to $V_{IN} + 0.3$	V
HGC Node Voltage	V_{SW}	-0.3 to $V_{IN} + 0.3$	V
All Other Pins		-0.3 to +6	V
Lead Temperature		260	$^\circ\text{C}$
Storage Temperature		-65 to +150	$^\circ\text{C}$
Junction Temperature	T_J	150	$^\circ\text{C}$
Input Voltage	V_{IN}	10 to 58	V
Ambient Operating Temperature		-40 to +85	$^\circ\text{C}$
Thermal Resistance from Junction to case	θ_{JC}	15	$^\circ\text{C}/\text{W}$
Thermal Resistance from Junction to ambient	θ_{JA}	40	$^\circ\text{C}/\text{W}$

Note: θ_{JA} is measured with the PCB copper area of approximately 1 in²(Multi-layer). That need connect to exposed pad.

❖ ELECTRICAL CHARACTERISTICS

 ($V_{IN} = 24V$, $T_A = +25^{\circ}C$, unless otherwise noted.)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Quiescent Current	I_{CCQ}	$V_{EN} = 5.0V$; $V_{FB} = 1.1V$	-	4	7	mA
Feedback Voltage	V_{FB}		0.98	1.00	1.02	V
Feedback Overvoltage Threshold	$OVP_{(FB)}$		-	1.1X	-	V_{FB}
GH Rise Time	T_{GHR}	$C_{ISS} \leq 1000pF$	-	40	-	ns
GH Fall Time	T_{GHF}	$C_{ISS} \leq 1000pF$	-	40	-	ns
High-Side Switch Leakage Current		$V_{EN} = 0V$, $V_{SW} = 0V$	-	-	10	μA
HGC voltage	V_{HGC}		-	5	-	V
Oscillation Frequency	F_{OSC1}		-	240	-	KHz
Short Circuit Oscillation Frequency	F_{OSC2}	$V_{FB} = 0V$	-	80	-	KHz
Maximum Duty Cycle	D_{MAX}		-	100	-	%
Minimum On Time (Note)	$T_{ON(min)}$		-	220	-	ns
Current Sense Voltage	V_{CS}		90	100	110	mV
Input Under Voltage Lockout Threshold	UVLO	V_{IN} Rising	8.0	9.0	9.7	V
Input Under Voltage Lockout Threshold Hysteresis	UVLO-Hys		-	210	-	mV
Input Over Voltage Lockout Threshold	OVLO	V_{IN} Rising	-	60	-	V
Input Over Voltage Lockout Threshold Hysteresis	OVLO-Hys		-	4	-	V
Soft-Start Period			-	2	-	ms
Thermal Shutdown	T_{SD}		-	150	-	$^{\circ}C$
Thermal Shutdown Hysteresis	T_{SH}		-	35	-	$^{\circ}C$

Note: Guaranteed by design.

❖ FUNCTION DESCRIPTIONS

The MA5820 is an asynchronous rectified, current-mode, step-down regulator. It regulates input voltages from 10V to 58V down to an output voltage as low as V_{FB} , and supplies up to 3A of load current.

The MA5820 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 Transconductance error amplifier. The voltage at the COMP pin is compared to the switch current measured internally to control the output voltage.

The converter uses external P-Channel MOSFET switches to step-down the input voltage to the regulated output voltage. Since the high side MOSFET requires a gate voltage low than the input voltage, a clamping capacitor connected between HGC and VIN is needed to drive the high side gate.

When the MA5820 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.

❖ APPLICATION INFORMATION

Setting the Output Voltage

The output voltage is set using a resistive voltage divider from the output voltage to FB pin. The voltage divider divides the output voltage down to the feedback voltage by the ratio. Thus the output voltage is:

$$V_{OUT} = V_{FB} \times \frac{R1 + R2}{R2}$$

For example, $V_{FB} = 1.00V$ for a 5.0V output voltage, R2 is 10k Ω , and R1 is 40k Ω .

Inductor Selection

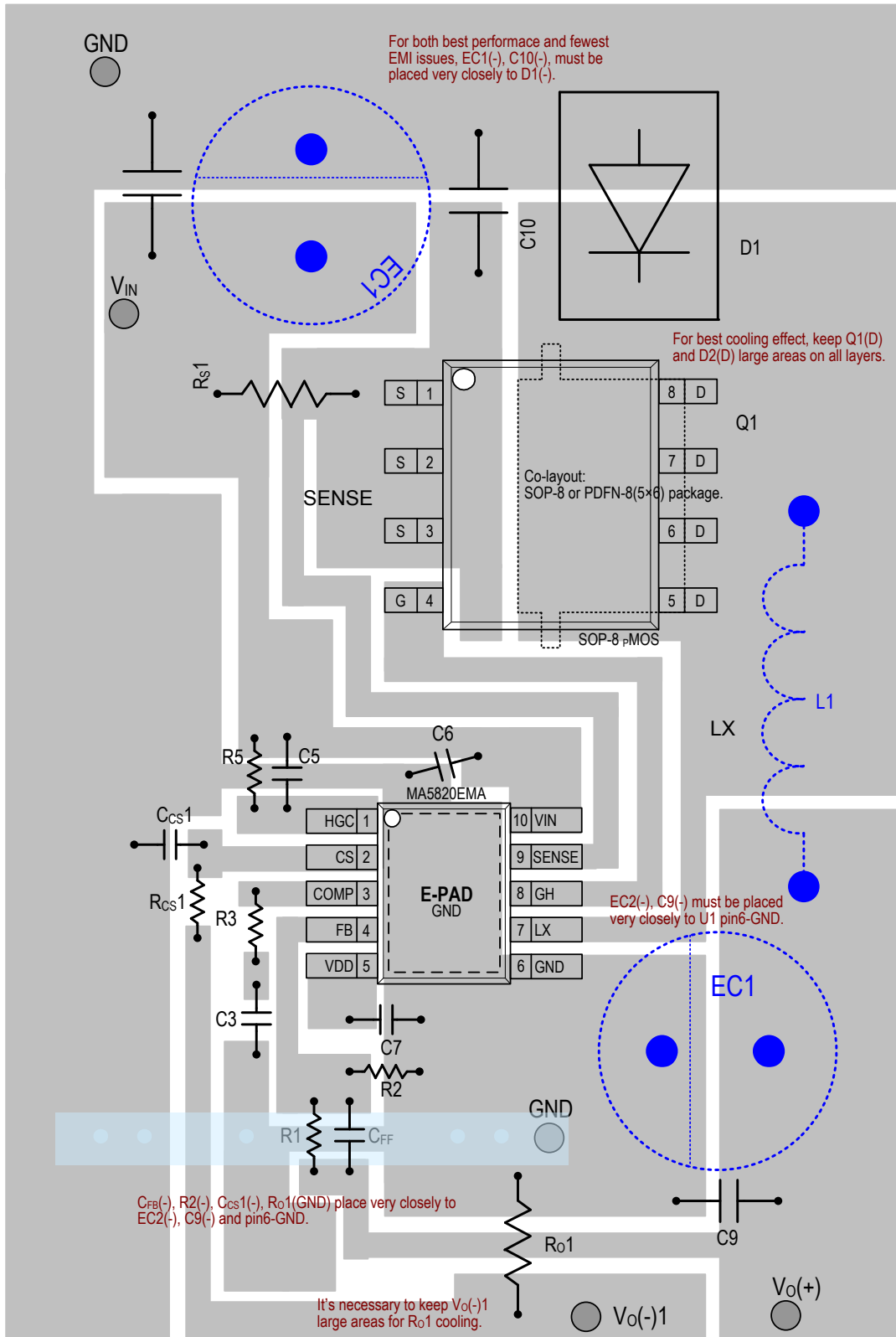
The inductor is required to supply constant current to the output load while being driven by the switched input voltage. A larger value inductor will result in less ripple current that will result in lower output ripple voltage. However, the larger value inductor will have a larger physical size, higher series resistance, and/or lower saturation current. A good rule for determining the inductance to use is to allow the peak-to-peak ripple current in the inductor to be approximately 30% of the maximum switch current limit.

VOUT	<8V	<15V
Inductor	33uH	47uH

The choice of which style inductor to use mainly depends on the price vs. size requirements and any EMI requirements.

Output Short-Circuit protection

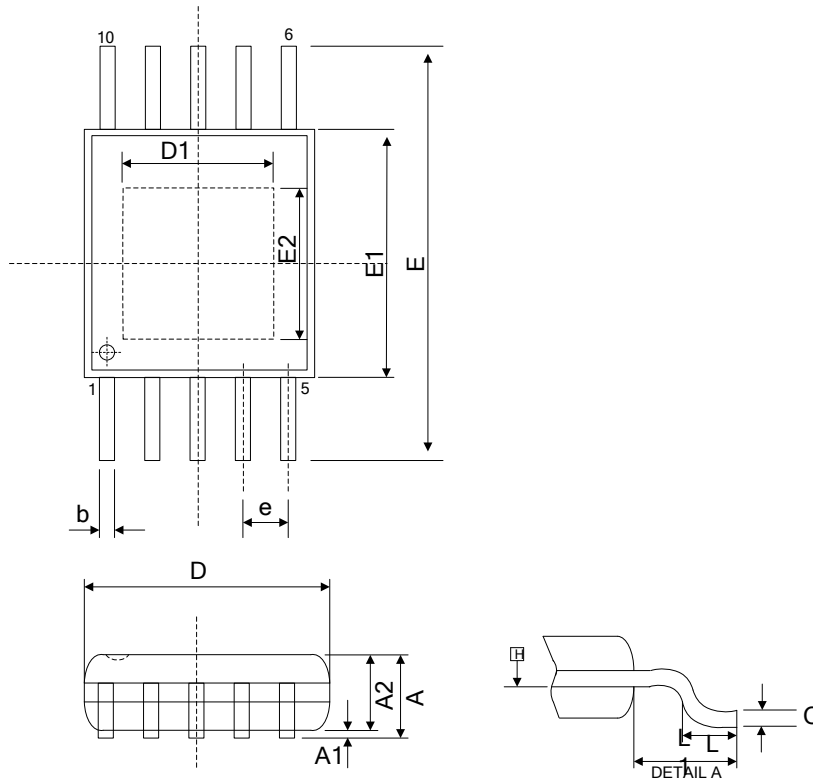
The MA5820 provides output short-circuit protection retry function. When VOUT is short ($V_{FB} < 0.4V$), the auto restart function can be started that restart the regulator cycle by cycle. (Retry time 2mS, Shutdown regulator time 2S).



PCB Layout Recommendation

When laying-out the PCB, the following rules should be used to ensure proper operation of the MA5820. Check the following in your PCB layout:

1. The power traces (V_{IN} , GND, $V_{O(+)}$, LX) should be kept short, direct, wide and.
2. The area of Q1(D) cooling PAD should be given 2cm^2 per layer at least, and 1.5cm^2 per layer for D1 if output 2A. Give at least 12 VIAs ($12\sim 16\text{mils}$) to each of them.
3. Keep LX away from all sensitive traces, like VOUT, FB, COMP and CS rode.
4. The EC1(-), C10(-) must be placed very closely to D1(-) GND.
5. For better cooling effect, it's strongly recommended the E-PAD area of Top-layer $\geq 1\text{cm}^2$, and E-PAD area of bottom- layer $\geq 1.5\text{cm}^2$ if the output current is higher than 4A(rms).

❖ PACKAGE OUTLINES
MSOP-10L-EP


Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.1	-	-	0.043
A1	0	0.08	0.15	0	0.003	0.006
A2	0.75	0.85	0.95	0.03	0.034	0.038
C	0.08	0.15	0.23	0.003	0.006	0.009
D	2.9	3	3.1	0.114	0.118	0.122
D1	0.75	1.63	2.5	0.03	0.064	0.098
E	4.8	4.9	5	0.189	0.193	0.197
E1	2.9	3	3.1	0.114	0.118	0.122
E2	0.75	1.63	2.5	0.03	0.064	0.098
L	0.4	0.6	0.8	0.016	0.024	0.031
b	0.22	0.3	0.38	0.009	0.012	0.015
e	0.50 BSC			0.020 BSC		

JEDEC outline: MO-187 BA-T