DN0008

Component Selection for 1A, 2A and 3A Synchronous Buck Migration Path

The Future of Analog IC Technology

DESIGN NOTE

Introduction

Increased complexity and compressed product development cycles are driving demand for component flexibility. Customers reward electronics manufacturers who are first to market *and* deliver new products in the most cost efficient manner. Therefore minimizing design cost in both component selection and board layout together with sufficient flexibility to deal with fluctuating market conditions is of utmost importance.

Programmable logic vendors have answered the call by supplying multiple products with varying memory, gate and I/O capacities in a common pin out. Should the system require more or fewer programmable resources, the most cost effective logic device can be selected at the last minute without board redesign. Programmable logic vendors have described this feature as a “migration path”, the ability to move to a higher or lower capacity device without any changes to the board. However, changes in logic device selection often result in changes in current demands on power supplies such as V_{CORE} and $V_{I/O}$. This forces another interesting question on the design engineer, whether to employ potentially costly over-designed power supplies or face the possibility of having to redesign the board for optimized power supplies.

Monolithic Power Systems addresses that concern with the introduction of a migration path for step down DC/DC voltage regulators. The MP2309, MP2305, and MP2307 are pin compatible synchronous regulators able to supply 1A, 2A, and 3A of current respectively at voltages as low as 0.9 volts. System engineers no longer have to face the choice between an over-designed high cost power supply or an expensive lengthy board redesign. Additionally, these DC/DC regulators can also be configured to meet the power sequencing requirements of logic devices.

This design note provides comprehensive component selection and case sizes for the total solution that will enable simple migration from one MPS device to another. The paper is broken into two sections: first where the available input voltage is between 5V – 15V; second where the available input voltage is between 15V – 23V. Tables for both sections are based on the circuit schematic Figure 1 on the following page.

For product datasheets please visit our website at www.monolithicpower.com

Note: Before commencing board design confirm that the external components listed are available. MPS has made every effort to check the availability of components as of the print date, but cannot guarantee availability of such components in the future.

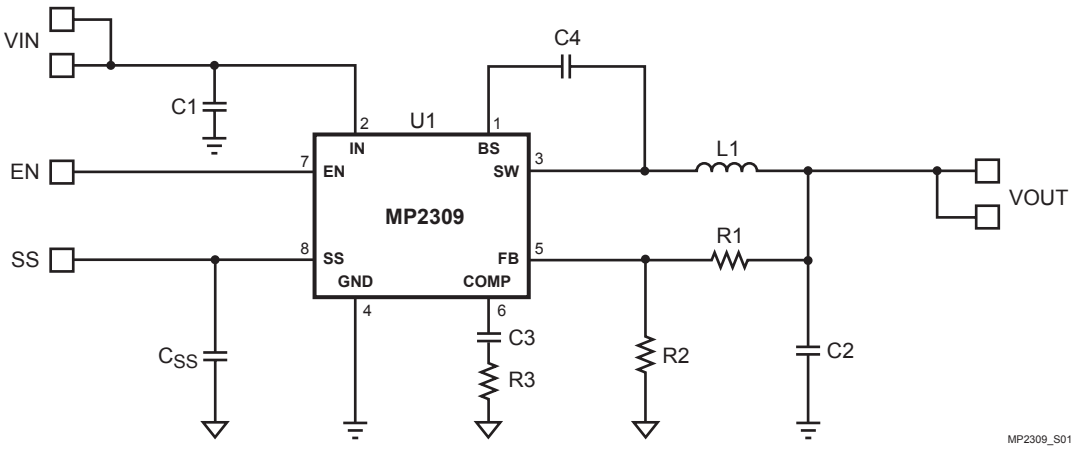

Figure 1—Application Schematic

Input Voltage: 5V – 15V

Component values and common footprint size for external components are listed below for various output voltages. Capacitors C1 and C2 use X5R dielectric material. Capacitors C3 and C4 use X7R dielectric material. Rating refers to the voltage rating for capacitors and the value tolerance for resistors. For Inductors, the "rating" category indicates the appropriate Sumida Inductor type.

The soft-start capacitor (C_{SS}) is user adjustable and not solution dependent. Therefore its values are not included in the following tables. Please see the product datasheet for details on the relationship between soft-start capacitance and power-up ramp.

Table 1—Output Voltage = 12V

V_{IN} = 5V – 15V	C1	C2	C3	C4	L1	R1	R2	R3
MP2309 (1A)	10µF	22µF	2.2nF	10nF	33µH	121kΩ	10kΩ	25.5kΩ
MP2305 (2A)	22µF	47µF	1nF	10nF	22µH	121kΩ	10kΩ	33kΩ
MP2307 (3A)	22µF	47µF	2.2nF	10nF	22µH	121kΩ	10kΩ	10kΩ
Case Size	SM1206	SM1210	SM0603	SM0603	Sumida	SM0402	SM0402	SM0805
Rating	16V	16V	50V	50V	CDRH127	1%	1%	5%

Table 2—Output Voltage = 5V

V_{IN} = 5V – 15V	C1	C2	C3	C4	L1	R1	R2	R3
MP2309 (1A)	10µF	22µF	3.3nF	10nF	15µH	44.2kΩ	10kΩ	10kΩ
MP2305 (2A)	22µF	47µF	2.2nF	10nF	15µH	44.2kΩ	10kΩ	15kΩ
MP2307 (3A)	22µF	47µF	3.9F	10nF	15µH	44.2kΩ	10kΩ	7.5kΩ
Case Size	SM1206	SM1210	SM0603	SM0603	Sumida	SM0402	SM0402	SM0805
Rating	16V	6.3V	50V	50V	CDRH104R	1%	1%	5%

Table 3—Output Voltage = 3.3V

V_{IN} = 5V – 15V	C1	C2	C3	C4	L1	R1	R2	R3
MP2309 (1A)	10µF	22µF	3.3nF	10nF	10µH	26.1kΩ	10kΩ	7.5kΩ
MP2305 (2A)	22µF	47µF	3.3nF	10nF	10µH	26.1kΩ	10kΩ	10kΩ
MP2307 (3A)	22µF	47µF	4.7nF	10nF	10µH	26.1kΩ	10kΩ	5.6kΩ
Case Size	SM1206	SM1210	SM0603	SM0603	Sumida	SM0402	SM0402	SM0805
Rating	16V	6.3V	50V	50V	CDRH8D43	1%	1%	5%

Table 4—Output Voltage = 2.5V

V_{IN} = 5V – 15V	C1	C2	C3	C4	L1	R1	R2	R3
MP2309 (1A)	10µF	22µF	4.7nF	10nF	6.8µH	16.9kΩ	10kΩ	5.6kΩ
MP2305 (2A)	22µF	47µF	4.7nF	10nF	6.8µH	16.9kΩ	10kΩ	7.5kΩ
MP2307 (3A)	22µF	47µF	5.6nF	10nF	6.8µH	16.9kΩ	10kΩ	4.7kΩ
Case Size	SM1206	SM1210	SM0603	SM0603	Sumida	SM0402	SM0402	SM0805
Rating	16V	6.3V	50V	50V	CDRH8D43	1%	1%	5%

Table 5—Output Voltage = 1.8V

V_{IN} = 5V – 15V	C1	C2	C3	C4	L1	R1	R2	R3
MP2309 (1A)	10µF	22µF	5.6nF	10nF	4.7µH	9.53kΩ	10kΩ	3.9kΩ
MP2305 (2A)	22µF	47µF	6.8nF	10nF	4.7µH	9.53kΩ	10kΩ	5.6kΩ
MP2307 (3A)	22µF	47µF	6.8nF	10nF	4.7µH	9.53kΩ	10kΩ	4.3kΩ
Case Size	SM1206	SM1210	SM0603	SM0603	Sumida	SM0402	SM0402	SM0805
Rating	16V	6.3V	50V	50V	CDRH8D38	1%	1%	5%

Table 6—Output Voltage = 1.5V

V_{IN} = 5V – 15V	C1	C2	C3	C4	L1	R1	R2	R3
MP2309 (1A)	10µF	22µF	8.2nF	10nF	4.7µH	6.34kΩ	10kΩ	3.3kΩ
MP2305 (2A)	22µF	47µF	8.2nF	10nF	4.7µH	6.34kΩ	10kΩ	4.7kΩ
MP2307 (3A)	22µF	47µF	8.2nF	10nF	4.7µH	6.34kΩ	10kΩ	3.3kΩ
Case Size	SM1206	SM1210	SM0603	SM0603	Sumida	SM0402	SM0402	SM0805
Rating	16V	6.3V	50V	50V	CDRH8D38	1%	1%	5%

Table 7—Output Voltage = 1.2V

V_{IN} = 5V – 15V	C1	C2	C3	C4	L1	R1	R2	R3
MP2309 (1A)	10µF	22µF	10nF	10nF	4.7µH	3.01kΩ	10kΩ	2.7kΩ
MP2305 (2A)	22µF	47µF	10nF	10nF	4.7µH	3.01kΩ	10kΩ	3.6kΩ
MP2307 (3A)	22µF	47µF	10nF	10nF	4.7µH	3.01kΩ	10kΩ	2.7kΩ
Case Size	SM1206	SM1210	SM0603	SM0603	Sumida	SM0402	SM0402	SM0805
Rating	16V	6.3V	50V	50V	CDRH8D38	1%	1%	5%

Input Voltage: 15V – 23V

External component requirements for the input voltage range of 15V – 23V are similar to that of the 5V – 15V input section with one exception. Input capacitor C1 must be adjusted to have a 25V rating in all cases requiring a shift to case size 1210. Capacitive values and dielectric material for C1 remain the same. All other external components remain the same for the appropriate part number and output voltage.