18V, 2A, 500KHz
Synchronous Buck Converter

EA8212

Datasheet

General Description

The EA8212 is a 2A buck regulator, designed to operate from 4.5V to 18V input voltage range. Built-in low $R_{DS(ON)}$ high/low side Power-MOSFETS not only reduce external components and has up to 96% efficiency, ideal for 2A output current applications. The EA8212 is designed to take into account the light load mode operation. At output loading 20mA condition, the efficiency up to 80%. The EA8212 has complete protection functions, including cycle-by-cycle current limit, short circuit protection, OVP, OTP and UVLO protection. The internal compensation design not only allows users to more simplified application, and can reduce the cost of external components. The EA8212 is available in the SOT-23-6 package and easy to use.

Features

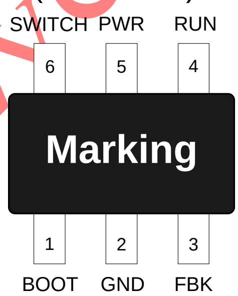
- Built-in Low $R_{DS(ON)}$ Power-MOSFETS
- Efficiency Up to 96%
- Light Load Efficiency Up to 80%
- 4.5V to 18V Input Voltage Range
- Output Adjustable Down to 0.6V
- 2A Continuous Load Current
- Fixed 500KHz Switching Frequency
- Internal Compensation
- Cycle-by-Cycle Current Limit
- Auto Recovery Hiccup Mode Short Circuit Protection
- Output Over Voltage Protection
- Input UVLO Protection
- Auto Recovery OTP Protection
- Available in SOT-23-6 Package

Applications

- Distributed Power Systems
- Netcom Products
- LCD TVs and Flat TVs
- Notebooks

Pin Configurations

(TOP VIEW)



SOT-23-6

Pin Description

Pin Name	Function Description	Pin No.
BOOT	The power input of the internal high side N-MOSFET gate driver. Connect a 33nF ceramic capacitor from BOOT pin to SWITCH pin.	1
GND	Ground pin.	2
FBK	Feedback input. Connect FBK pin and GND pin with voltage dividing resistors to set the output voltage.	3
RUN	The device turns on/turns off control input. The EA8212 on/off state can be controlled by RUN pin voltage level. Connect RUN pin to PWR pin with a 150KΩ pull up resistor for automatic startup.	4
PWR	The EA8212 power input pin. Recommended to use two 10uF MLCC capacitors between PWR pin and GND pin.	5
SWITCH	Internal MOSFET switching output. Connect SWITCH pin with a low pass filter circuit to obtain a stable DC output voltage.	6

Function Block Diagram

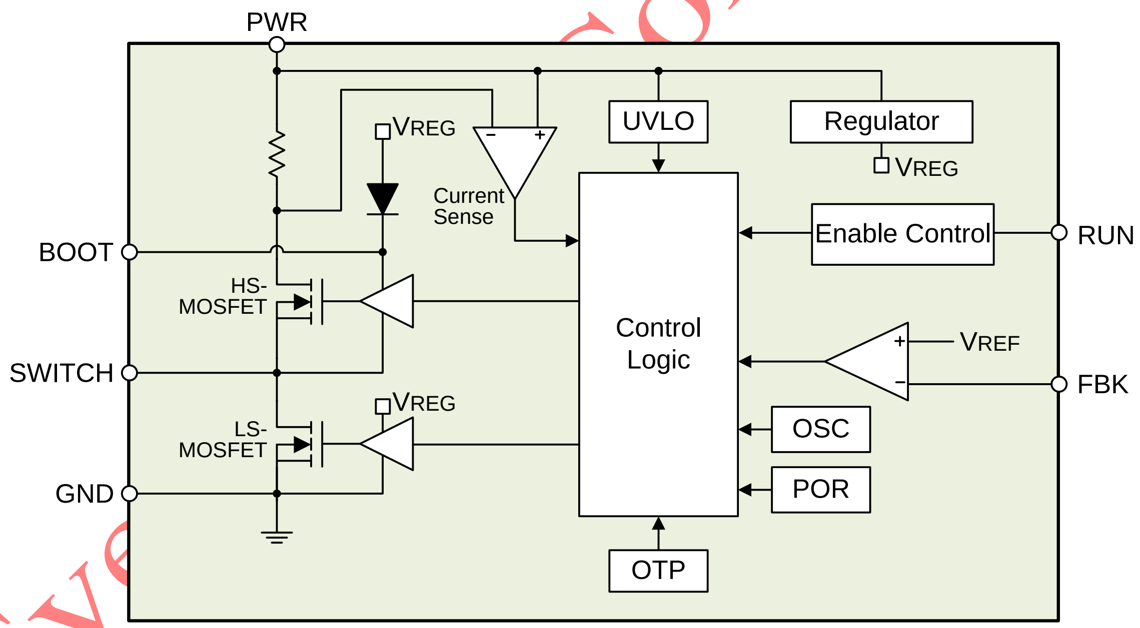


Figure 1. EA8212 internal function block diagram

Absolute Maximum Ratings

Parameter	Value
Input Voltage (V_{PWR})	-0.3V to +21V
RUN Pin Input Voltage (V_{RUN})	-0.3V to +21V
BOOT Pin Voltage (V_{BOOT})	V_{SWITCH}-0.3V to V_{SWITCH}+6.3V
SWITCH Pin Voltage (V_{SWITCH})	-1V to +23V
FBK Pin Voltage (V_{FBK})	-0.3V to +6.3V
Ambient Temperature operating Range (T_A)	-40°C to +85°C
Maximum Junction Temperature (T_{Jmax})	+150°C
Lead Temperature (Soldering, 10 sec)	+260°C
Storage Temperature Range (T_S)	-65°C to +150°C

Note (1):Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Exposure to "Absolute Maximum Ratings" conditions for extended periods may affect device reliability and lifetime.

Package Thermal Characteristics

Parameter	Value
SOT-23-6 Thermal Resistance (θ_{JC})	125°C/W
SOT-23-6 Thermal Resistance (θ_{JA})	250°C/W
SOT-23-6 Power Dissipation at T_A=25°C (P_{Dmax})	0.5W

Note (1): P_{Dmax} is calculated according to the formula: $P_{DMAX}=(T_{JMAX}-T_A)/\theta_{JA}$.

Recommended Operating Conditions

Parameter	Value
Input Voltage (V_{PWR})	+4.5V to +18V
RUN Pin Input Voltage (V_{RUN})	-0.3V to +18V
Output Voltage (V_{OUT})	+0.6V to +12V
Junction Temperature Range (T_J)	-40°C to +125°C

Electrical Characteristics

V_{PWR}=12V, T_A=25°C, unless otherwise noted

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage	V_{PWR}		4.5		18	V
Shutdown Supply Current	I_{SD}	V_{RUN} = 0V		0.1	1	uA
Quiescent Current	I_Q	V_{RUN} = 2V, V_{FBK} = 105% V_{REF}, I_{LOAD} = 0A		400		uA
UVLO Threshold	V_{UVLO}	V_{PWR} Rising		2.8		V
UVLO Hysteresis	$V_{UV-HYST}$			300		mV
Output Load Current	I_{LOAD}				2	A
Reference Voltage	V_{REF}	4. 5V ≤ V_{PWR} ≤ 21V	0.588	0.6	0.612	V
Switching Frequency	F_{SW}		400	500	600	KHz
Short Frequency	F_{SHORT}	V_{OUT} = 0V		100		KHz
High Side MOSFET On-Resistance	$R_{DS(ON)-HM}$			90		mΩ
Low Side MOSFET On-Resistance	$R_{DS(ON)-LM}$			70		mΩ
High Side MOSFET Current Limit	I_{LIM-HM}		3	4		A
High Side MOSFET Leakage Current	$I_{LEAK-HM}$	V_{RUN} = 0V, V_{SWITCH} = 0V		1	10	uA
RUN Pin Input Low Voltage	V_{RUN-L}				0.4	V
RUN Pin Input High Voltage	V_{RUN-H}		2			V
Maximum Duty Cycle	D_{MAX}	V_{FBK} = 0.5V		92		%
High Side MOSFET Minimum On Time	T_{ONMIN}			60		ns
Thermal Shutdown Threshold	T_{OTP}			160		°C
Thermal Shutdown Hysteresis	T_{HYST}			30		°C

Note (1): MOSFET on-resistance specifications are guaranteed by correlation to wafer level measurements.
(2): Thermal shutdown specifications are guaranteed by correlation to the design and characteristics analysis.

Application Circuit Diagram

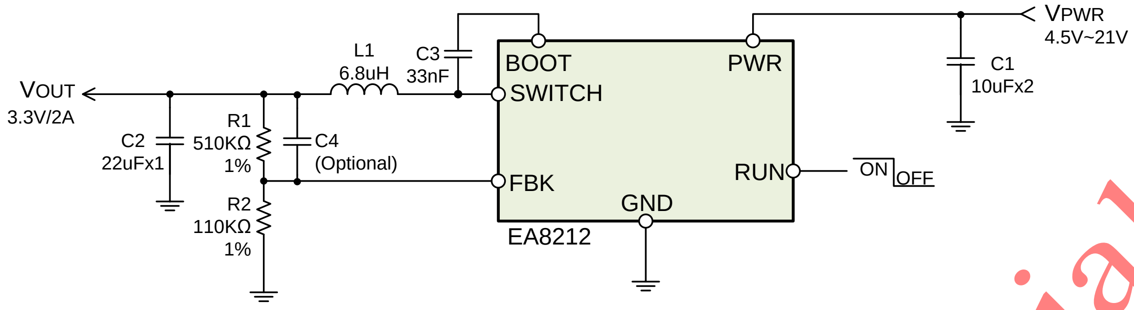


Figure 2. Typical application circuit diagram

Ordering Information

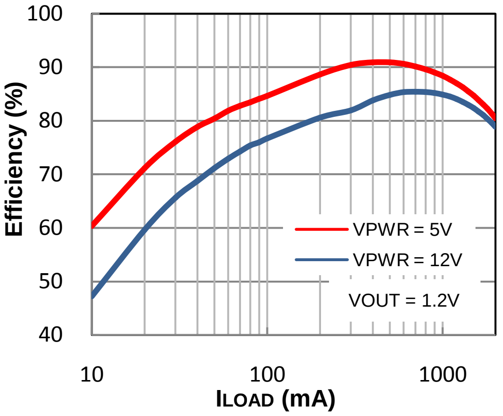
Part Number	Package Type	Packing Information
EA8212T6R	SOT-23-6	Tape & Reel / 3000

Note (1):“T6”: Package type code.
(2):“R”: Tape & Reel.

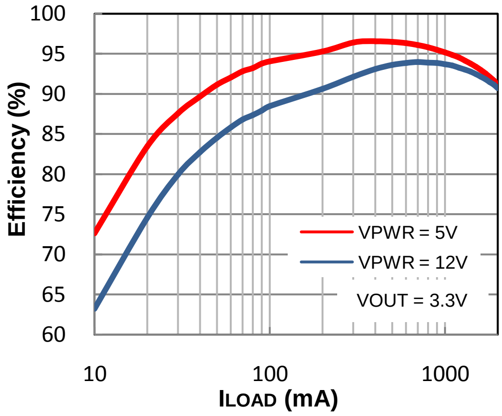
Typical Operating Characteristics

V_{PWR}=12V, V_{OUT}=3.3V, L1=6.8uH, C1=10Fx2, C2=22uF, T_A=25°C, unless otherwise noted

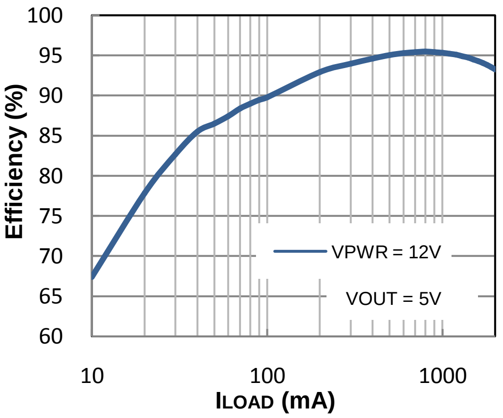
Efficiency vs. Load Current



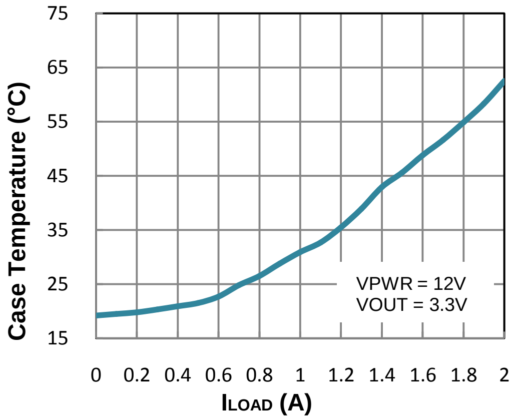
Efficiency vs. Load Current



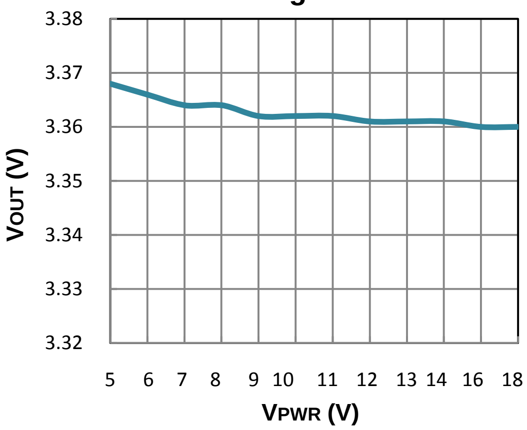
Efficiency vs. Load Current



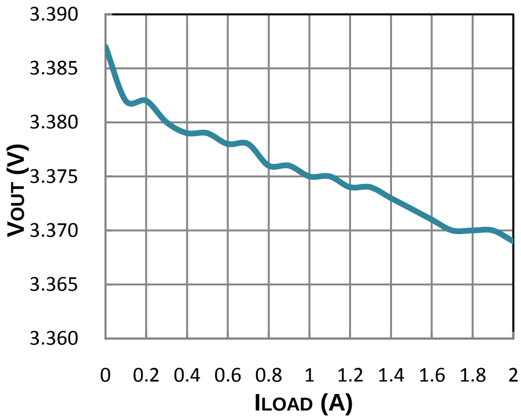
Tc vs. Load Current



Line Regulation

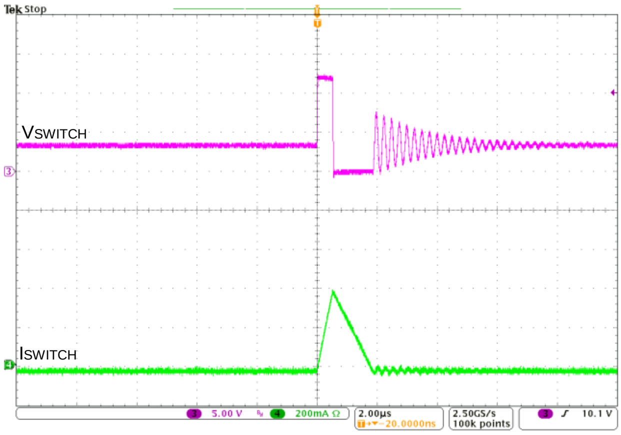


Load Regulation

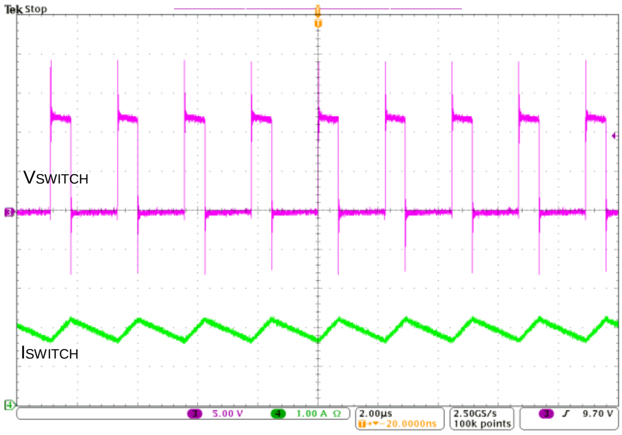


Typical Operating Characteristics

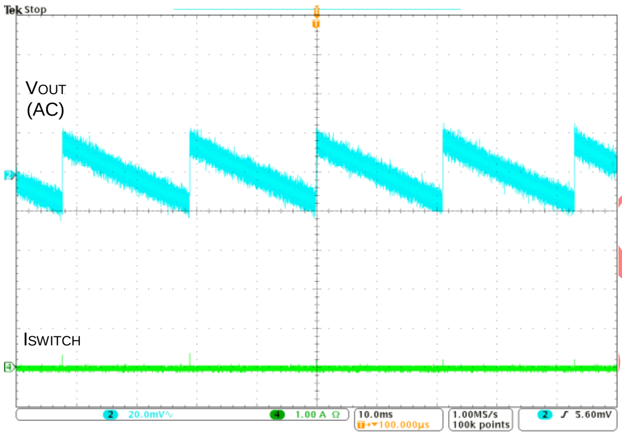
V_{PWR}=12V, V_{OUT}=3.3V, L1=6.8uH, C1=10Fx2, C2=22uF, T_A=25°C, unless otherwise noted



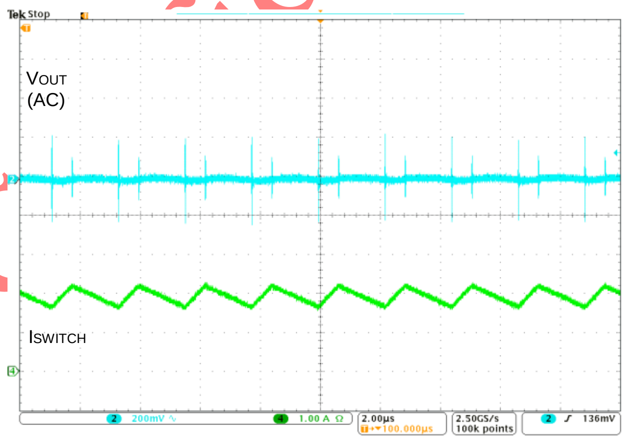
0A Loading Switching Waveform



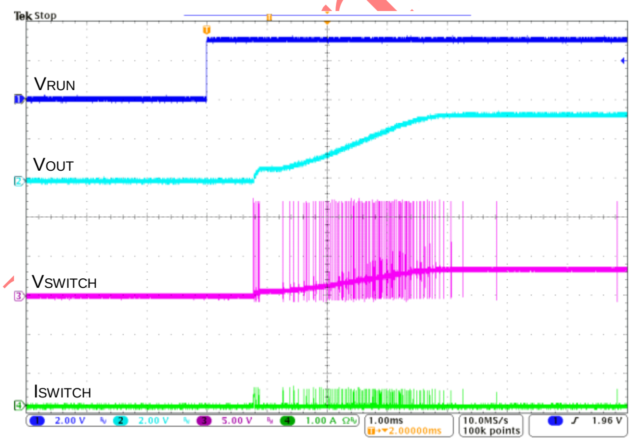
2A Loading Switching Waveform



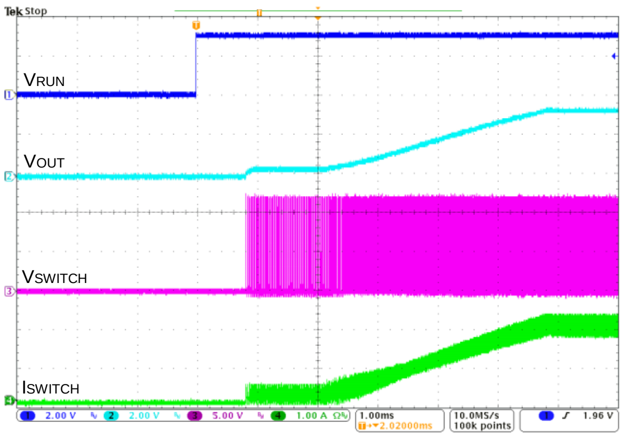
0A Loading Output Ripple Waveform



2A Loading Output Ripple Waveform



0A Loading Power On Waveform



2A Loading Power On Waveform

Application Information

Enable Control

The EA8212 use RUN pin to control the regulator turns on / turns off. When the RUN pin input voltage is higher than 2V, the EA8212 enters the operating mode. Drive the RUN pin input voltage lower than 0.4V to ensure the EA8212 into shutdown mode, as shown in Figure3. When the device works in the shutdown mode, the shutdown supply current is less than 1uA. The EA8212 also provides automatic startup function as shown in Figure 4. Connect RUN pin and PWR pin with a 150KΩ resistor, when the PWR supply input voltage increasing and higher than RUN pin threshold voltage, the EA8212 will enter operating mode automatically.

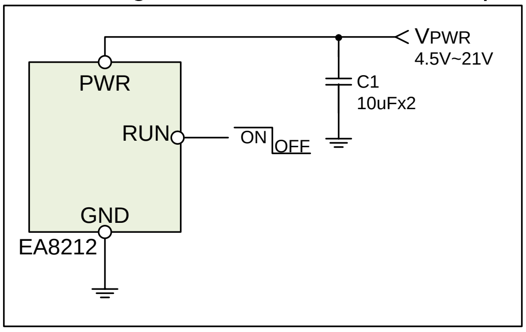


Figure 3. Enable control by RUN pin voltage

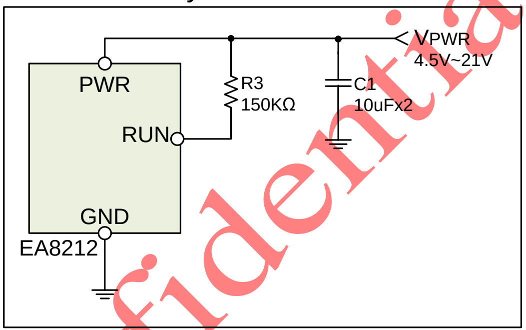


Figure 4. Automatic startup application circuit

Output Voltage Setting

The EA8212 output voltage can be set via a resistor divider (R1, R2). The output voltage is calculated by following equation:

$$V_{OUT} = 0.6 \times \frac{R1}{R2} + 0.6\ \text{V}$$

Taking into account the loop stability, R1 resistance value must be greater than 100KΩ. The following table lists common output voltage and the corresponding R1, R2 resistance value for reference.

Output Voltage	R1 Resistance	R2 Resistance	Tolerance
5V	220KΩ	30KΩ	1%
3.3V	510KΩ	110KΩ	1%
1.8V	200KΩ	100KΩ	1%
1.2V	100KΩ	100KΩ	1%

Input / Output Capacitors Selection

The input capacitors are used to suppress the noise amplitude of the input voltage and provide a stable and clean DC input to the device. Because the ceramic capacitor has low ESR characteristic, so it is suitable for input capacitor use. It is recommended to use X5R or X7R MLCC capacitors in order to have better temperature performance and smaller capacitance tolerance. In order to suppress the output voltage ripple, the MLCC capacitor is also the best choice. The suggested part numbers of input / output capacitors are as follows:

Vendor	Part Number	Capacitance	Edc	Parameter	Size
TDK	C2012X5R1C106K	10uF	16V	X5R	0805
TDK	C3216X5R1E106K	10uF	25V	X5R	1206
TDK	C2012X5R0J226K	22uF	6.3V	X5R	0805
TDK	C3216X5R1A226M	22uF	10V	X5R	1206

Output Inductor Selection

The output inductor selection mainly depends on the amount of ripple current through the inductor ΔI_L. Large ΔI_L will cause larger output voltage ripple and loss, but the user can use a smaller inductor to save cost and space. On the contrary, the larger inductance can get smaller ΔI_L and thus the smaller output voltage ripple and loss. But it will increase the space and the cost. The inductor value can be calculated as:

$$L = \frac{V_{PWR} - V_{OUT}}{\Delta I_L \times F_{SW}} \times \frac{V_{OUT}}{V_{PWR}}$$

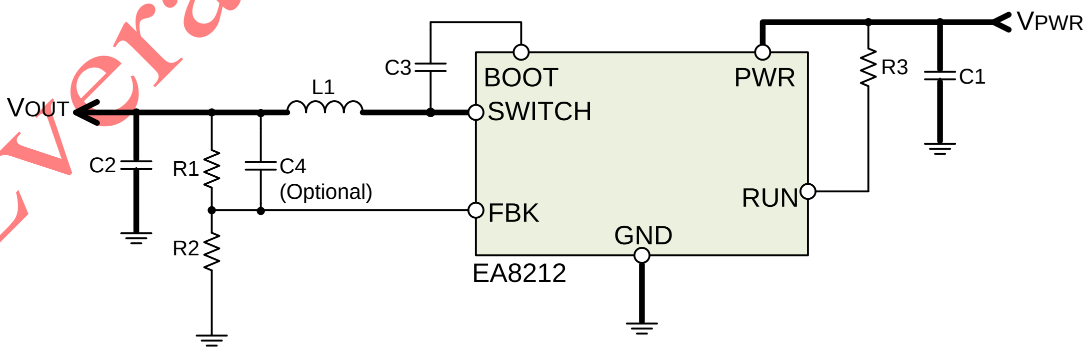
For most applications, 4.7uH to 10uH inductors are suitable for EA8212. The suggested part numbers of output inductors are as follows:

Vendor	Part Number	Inductance	DCR (Max.)	Saturation Current	Dimensions (mm) (WxLxH)
SUMIDA	CDRH8D38-4R7	4.7uH	29mΩ	4A	8x8x3.8
SUMIDA	CDRH8D43R-6R8	6.8uH	29.8mΩ	4.2A	8.3x8.5x4.5

PCB Layout Recommendations

For EA8212 PCB layout considerations, please refer to the following suggestions in order to get good performance.

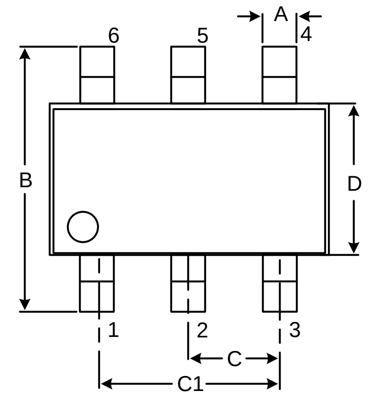
- High current path traces (shown as Figure 5.) need to be widened.
- Place the input capacitors as close as possible to the PWR pin to reduce noise interference.
- Keep the feedback path (from V_{OUT} to FBK) away from the noise node (ex. SWITCH).
- SWITCH is a high current noise node. Complete the layout by using short and wide traces.



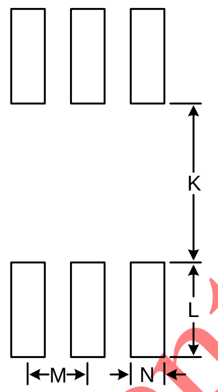
* Bold lines indicate high current paths

Package Information

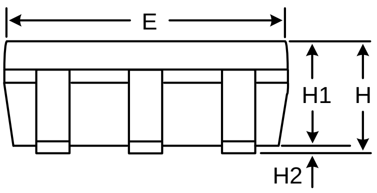
SOT-23-6 Package



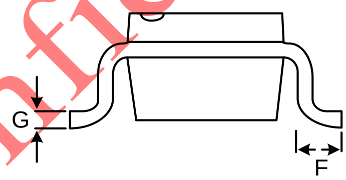
Top View



Recommended Layout Pattern



Side View



Front View

Unit: mm

Symbol	Dimension Min	Dimension Max	Symbol	Dimension Typ
A	0.25	0.52	K	1.40
B	2.59	3.01	L	1.40
C	0.85	1.05	M	0.95
C1	1.70	2.10	N	0.65
D	1.40	1.80		
E	2.70	3.10		
F	0.30	0.62		
G	0.08	0.25		
H	0.89	1.35		
H1	0.89	1.20		
H2	0.00	0.15		