

General Description

The EA8210 is a 2A buck regulator, designed to operate from 4.5V to 21V 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 EA8210 is designed to take into account the light load mode operation. At output loading 20mA condition, the efficiency up to 80%. The EA8210 has complete protection functions, including cycle-by-cycle current limit, short circuit protection, 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 EA8210 is available in the SOT23-6 package and easy to use.

Features

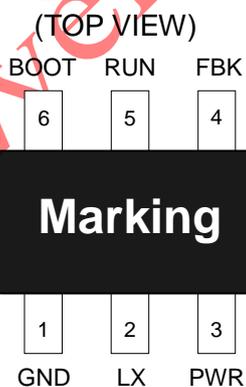
- ▶ Built-in Low $R_{DS(ON)}$ Power-MOSFETS
- ▶ Efficiency Up to 96%
- ▶ Light Load Efficiency Up to 80%
- ▶ 4.5V to 21V Input Voltage Range
- ▶ Output Adjustable Down to 0.8V
- ▶ 2A Continuous Load Current
- ▶ Fixed 500KHz Switching Frequency
- ▶ Internal Compensation
- ▶ Cycle-by-Cycle Current Limit
- ▶ Auto Recovery Hiccup Mode Short Circuit Protection
- ▶ Stable with Low ESR Ceramic Output Capacitors
- ▶ Input UVLO Protection
- ▶ Auto Recovery OTP Protection
- ▶ Available in SOT23-6 Package

Applications

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



Pin Configurations



SOT23-6

Pin Description

| Pin Name | Function Description | Pin No. |
|----------|--|---------|
| GND | Ground pin. | 1 |
| LX | Internal MOSFET switching output. Connect LX pin with a low pass filter circuit to obtain a stable DC output voltage. | 2 |
| PWR | The EA8210 power input pin. Recommended to use two 10uF MLCC capacitors between PWR pin and GND pin. | 3 |
| FBK | Feedback input. Connect FBK pin and GND pin with voltage dividing resistors to set the output voltage. | 4 |
| RUN | The device turns on/turns off control input. The EA8210 on/off state can be controlled by RUN pin voltage level. Connect RUN pin to PWR pin with a 100KΩ pull up resistor for automatic startup. | 5 |
| BOOT | The power input of the internal high side N-MOSFET gate driver. Connect a 100nF ceramic capacitor from BOOT pin to LX pin. | 6 |

Function Block Diagram

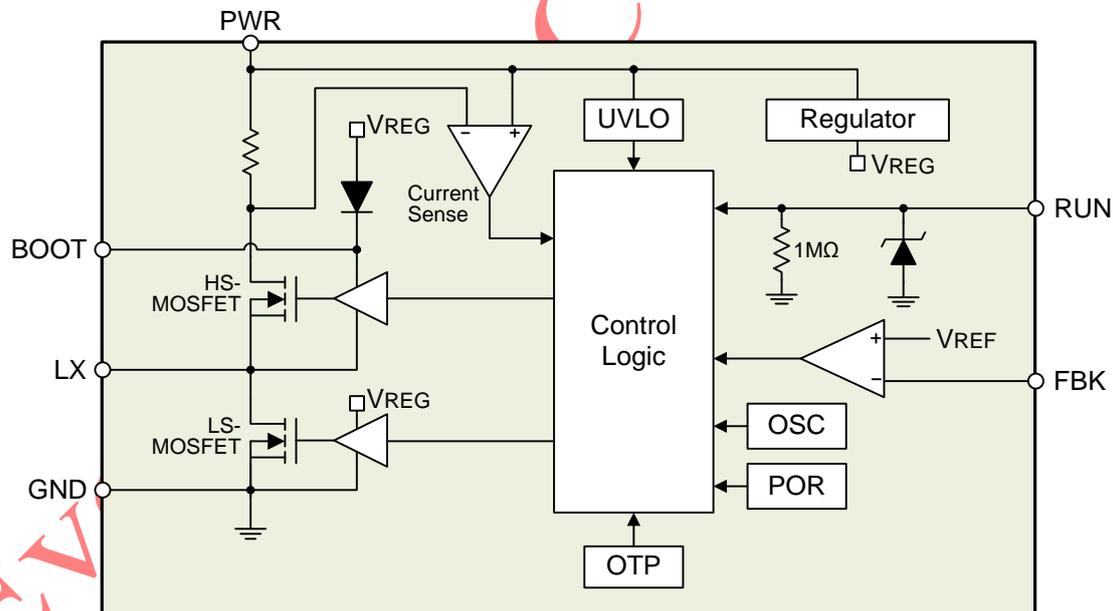


Figure 1. EA8210 internal function block diagram

Absolute Maximum Ratings

| Parameter | Value |
|---|------------------------------|
| Input Voltage (V_{PWR}) | -0.3V to +22V |
| RUN Pin Input Voltage (V_{RUN}) | -0.3V to +6V |
| BOOT Pin Voltage (V_{BOOT}) | $V_{LX}-0.3V$ to $V_{LX}+5V$ |
| LX Pin Voltage (V_{LX}) | -0.3V to $+(V_{PWR}+0.5)V$ |
| FBK Pin Voltage (V_{FBK}) | -0.3V to +6V |
| 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 |
|--|---------|
| SOT23-6 Thermal Resistance (θ_{JC}) | 125°C/W |
| SOT23-6 Thermal Resistance (θ_{JA}) | 250°C/W |
| SOT23-6 Power Dissipation at $T_A=25^\circ\text{C}$ (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 +21V |
| Output Voltage (V_{OUT}) | +0.6V to +17V |
| Junction Temperature Range (T_J) | -40°C to +125°C |

EA8210

21V, 2A, 500KHz Synchronous Buck Converter

Datasheet

Electrical Characteristics

$V_{PWR}=12V$, $T_A=25^{\circ}C$, unless otherwise noted

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|----------------------------------|-----------------|--|-------|------|-------|-------------|
| Input Voltage | V_{PWR} | | 4.5 | | 21 | V |
| Shutdown Supply Current | I_{SD} | $V_{RUN} = 0V$ | | 1 | | μA |
| Quiescent Current | I_Q | $V_{RUN} = 2V$, $V_{FBK} = 105\% V_{REF}$ | | 600 | 800 | μA |
| Output Load Current | I_{LOAD} | | | | 2 | A |
| Reference Voltage | V_{REF} | $4.5V \leq V_{PWR} \leq 21V$ | 0.776 | 0.8 | 0.824 | V |
| Switching Frequency | F_{SW} | | 400 | 500 | 600 | KHz |
| High Side MOSFET On-Resistance | $R_{DS(ON)-HM}$ | | | 90 | | $m\Omega$ |
| Low Side MOSFET On-Resistance | $R_{DS(ON)-LM}$ | | | 70 | | $m\Omega$ |
| High Side MOSFET Current Limit | I_{LIM-HM} | | 3 | 4.5 | | A |
| High Side MOSFET Leakage Current | $I_{LEAK-HM}$ | $V_{RUN} = 0V$, $V_{LX} = 0V$ | | 1 | 10 | μA |
| 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} | $V_{FBK} = 0.7V$ | | 92 | | % |
| High Side MOSFET Minimum On Time | T_{ONMIN} | | | 60 | | ns |
| Input OVP Threshold | V_{OVP} | | | 21.5 | | V |
| Input OVP Hysteresis | $V_{OVP-HYST}$ | | | 100 | | mV |
| Thermal Shutdown Threshold | T_{OTP} | | | 170 | | $^{\circ}C$ |

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

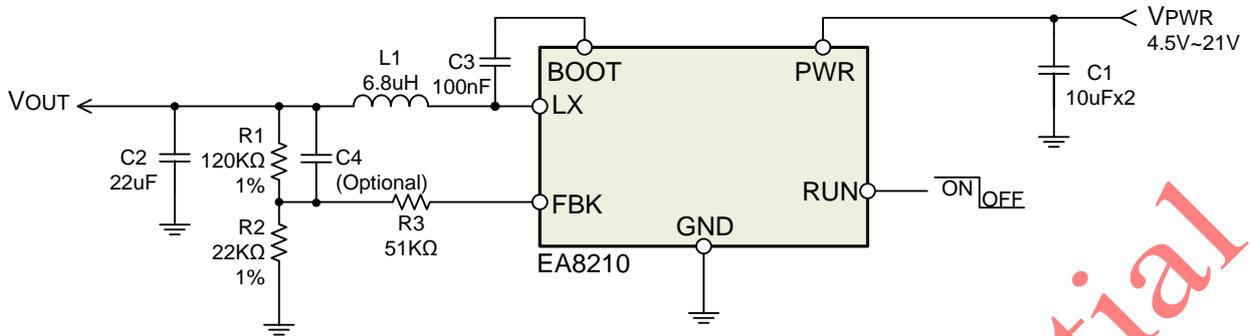


Figure 2. Typical application circuit diagram

Ordering Information

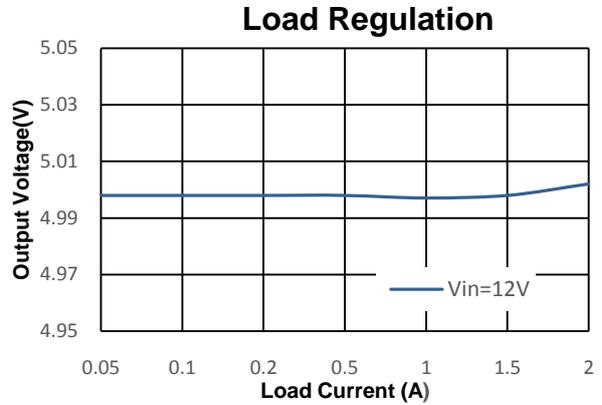
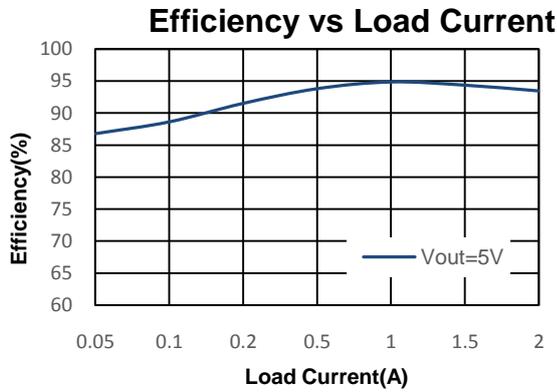
| Part Number | Package Type | Packing Information |
|-------------|--------------|---------------------|
| EA8210T6R | SOT23-6 | Tape & Reel / 3000 |

Note (1): "T6": Package type code.

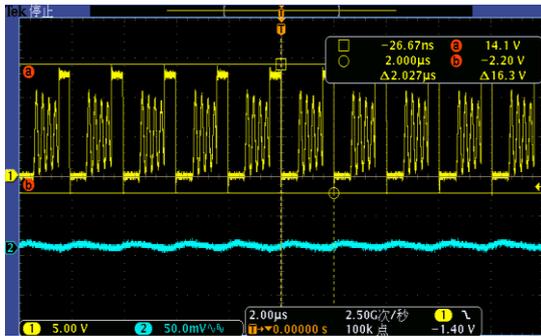
(2): "R": Tape & Reel.

Typical Operating Characteristics

V_{PWR}=12V, L1=6.8uH, C1=10F_{X2}, C2=22uF, T_A=25°C, unless otherwise noted

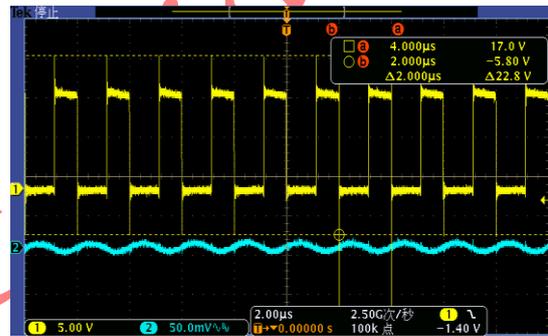


CH1: V_{LX} CH2: V_{OUT(AC)}



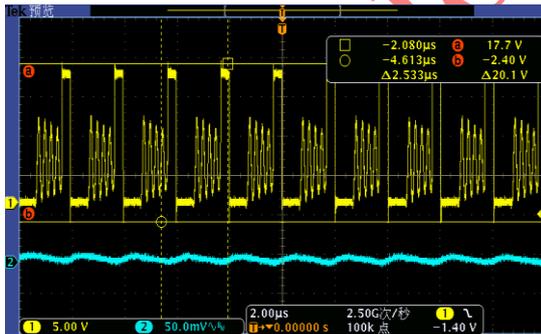
V_{PWR}=12V, I_{LOAD}=0.1A switching waveform

CH1: V_{LX} CH2: V_{OUT(AC)}



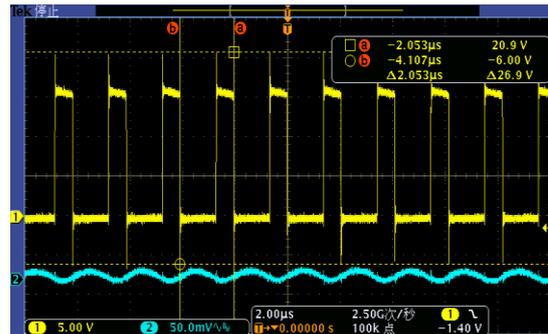
V_{PWR}=12V, I_{LOAD}=2A switching waveform

CH1: V_{LX} CH2: V_{OUT(AC)}



V_{PWR}=16V, I_{LOAD}=0.1A switching waveform

CH1: V_{LX} CH2: V_{OUT(AC)}



V_{PWR}=16V, I_{LOAD}=2A switching waveform

Application Information

Enable Control

The EA8210 use RUN pin to control the regulator turns on / turns off. When the RUN pin input voltage is higher than 2V, the EA8210 enters the operating mode. Drive the RUN pin input voltage lower than 0.4V to ensure the EA8210 into shutdown mode, as shown in Figure3. When the device works in the shutdown mode, the shutdown supply current is about 1uA. The EA8210 also provides automatic startup function as shown in Figure 4. Connect RUN pin and PWR pin with a 100KΩ resistor, when the PWR supply input voltage increasing and higher than RUN pin threshold voltage, the EA8210 will enter operating mode automatically.

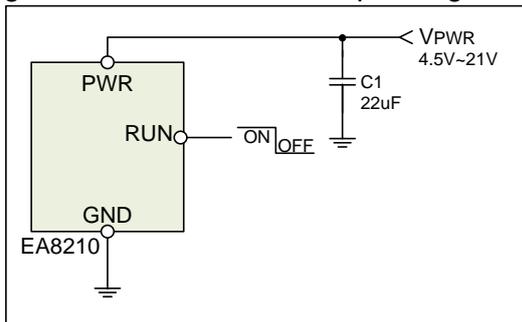


Figure 3. Enable control by RUN pin voltage

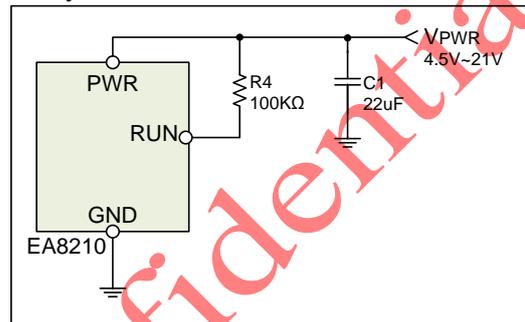


Figure 4. Automatic startup application circuit

Output Voltage Setting

The EA8210 output voltage can be set via a resistor divider (R1, R2). The output voltage is calculated by following equation:

$$V_{OUT} = 0.8 \times \frac{R1}{R2} + 0.8 \text{ V}$$

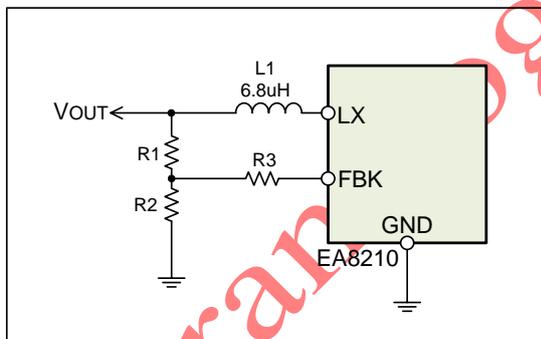


Figure 5. Feedback Network

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, R3 resistance value for reference.

| Output Voltage | R1 Resistance | R2 Resistance | R3 Resistance | Tolerance |
|----------------|---------------|---------------|---------------|-----------|
| 5V | 120KΩ | 22KΩ | 51KΩ | 1% |
| 3.3V | 150KΩ | 47KΩ | 51KΩ | 1% |
| 1.8V | 150KΩ | 120KΩ | 75KΩ | 1% |
| 1.2V | 100KΩ | 200KΩ | 120KΩ | 1% |

EA8210

21V, 2A, 500KHz Synchronous Buck Converter

Datasheet

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 | 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:

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

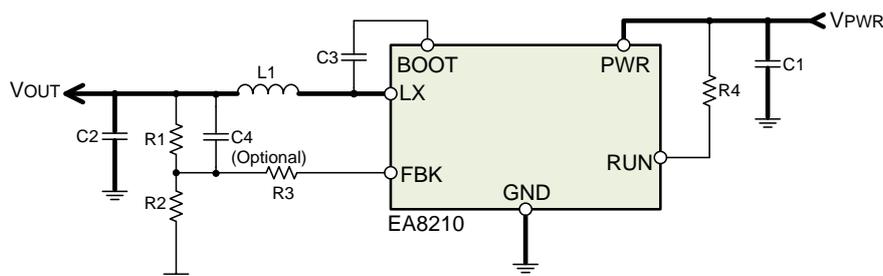
For most applications, 4.7uH to 10uH inductors are suitable for EA8210. The suggested part numbers of output inductors are as follows:

| 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 EA8210 PCB layout considerations, please refer to the following suggestions in order to get good performance.

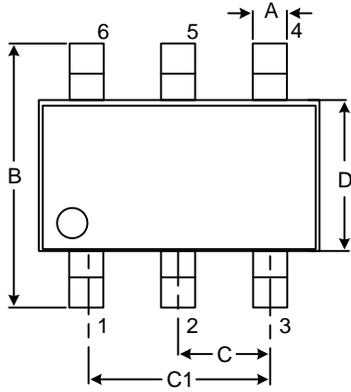
- ▶ High current path traces (shown as below) need to be widened.
- ▶ Place the input capacitors as close as possible to the PWR pin to reduce noise interference.
- ▶ Keep the feedback path (from V_{OUT} to FBK) away from the noise node (ex. LX).
- ▶ LX is a high current noise node. Complete the layout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



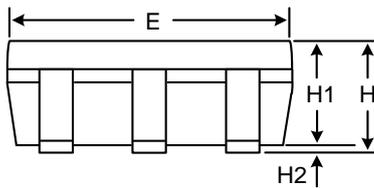
* Bold lines indicate high current paths

Package Information

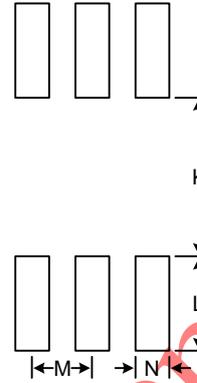
SOT23-6 Package



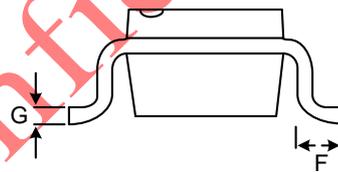
Top View



Side View



Recommended Layout Pattern



Front View

Unit: mm

| Symbol | Dimension | | Symbol | Dimension |
|--------|-----------|------|--------|-----------|
| | Min | Max | | 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 | | |