

## 380kHz, 3A Asynchronous DC - DC Buck Converter

**AP3203**

### General Description

The AP3203 is a 380kHz fixed frequency, current mode, PWM buck (step-down) DC-DC converter, capable of driving a 3A load with high efficiency, excellent line and load regulation. The device integrates N-channel power MOSFET switch with low on-resistance. The current mode control provides fast transient response and cycle-by-cycle current limit.

A standard series of inductors are available from several different manufacturers optimized for use with the AP3203. This feature greatly simplifies the design of switch-mode power supplies.

This IC is available in PSOP-8 package.

### Features

- Input Voltage Range: 4.75V to 18V
- Fixed 380kHz Frequency
- High Efficiency: up to 93%
- Output Current: 3A
- Current Mode Control
- Built-in Over Current Protection
- Built-in Thermal Shutdown Function
- Built-in UVLO Function
- Built-in Over Voltage Protection
- Programmable Soft-start

### Applications

- Portable DVD
- DPF
- LCD-TV
- STB



Figure 1. Package Type of AP3203

# 380kHz, 3A Asynchronous DC - DC Buck Converter

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## Pin Configuration

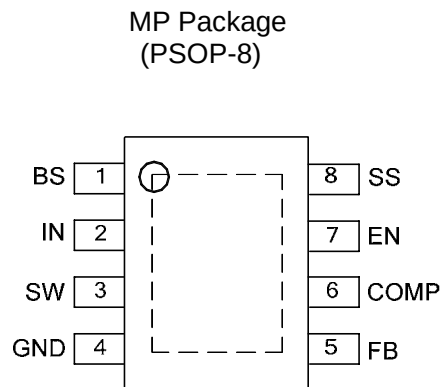


Figure 2. Pin Configuration of AP3203 (Top View)

## Pin Description

| Pin Number | Pin Name | Function                                                                                                                                                                                                                                                                                                                                          |
|------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1          | BS       | Bootstrap pin. A bootstrap capacitor is connected between the BS pin and SW pin. The voltage across the bootstrap capacitor drives the internal high-side NMOS switch                                                                                                                                                                             |
| 2          | IN       | Supply input pin. A capacitor should be connected between the IN pin and GND pin to keep the DC input voltage constant                                                                                                                                                                                                                            |
| 3          | SW       | Power switch output pin. This pin is connected to the inductor and bootstrap capacitor                                                                                                                                                                                                                                                            |
| 4          | GND      | Ground pin                                                                                                                                                                                                                                                                                                                                        |
| 5          | FB       | Feedback pin. This pin is connected to an external resistor divider to program the system output voltage. When the FB pin voltage exceeds 20% of the nominal regulation value of 1.222V, the over voltage protection is triggered. When the FB pin voltage is below 0.6V, the oscillator frequency is lowered to realize short circuit protection |
| 6          | COMP     | Compensation pin. This pin is the output of the transconductance error amplifier and the input to the current comparator. It is used to compensate the control loop. Connect a series RC network from this pin to GND. In some cases, an additional capacitor from this pin to GND pin is required                                                |
| 7          | EN       | Control input pin. Forcing this pin above 1.5V or set this pin floating enables the IC. Forcing this pin below 0.5V shuts down the IC. When the IC is in shutdown mode, all functions are disabled to decrease the supply current below 1μA                                                                                                       |
| 8          | SS       | Soft-start control input. SS controls the soft-start period. Connect a capacitor from SS to GND to set the soft-start period. A 0.1μF capacitor sets the soft-start period to 10ms. To disable the soft-start feature, leave SS disconnected                                                                                                      |

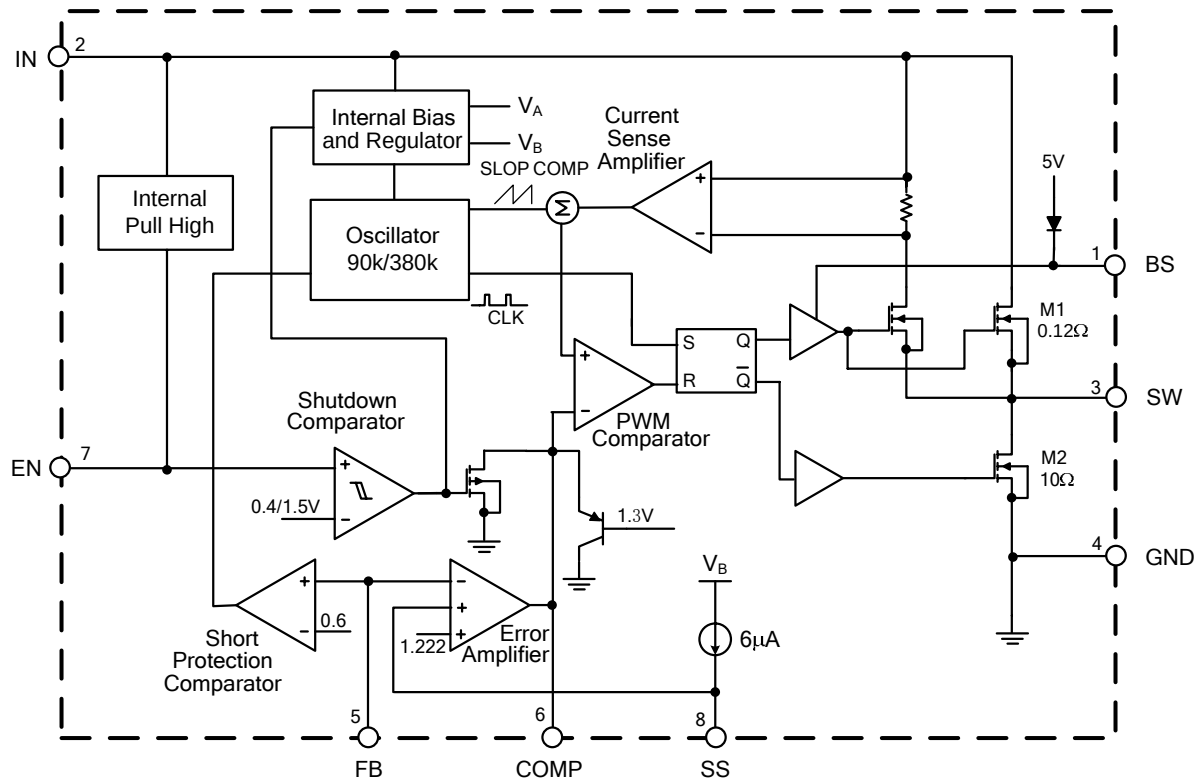
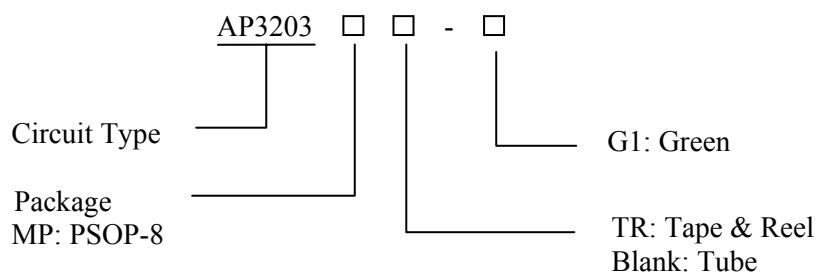
**380kHz, 3A Asynchronous DC - DC Buck Converter****AP3203****Functional Block Diagram**

Figure 3. Functional Block Diagram of AP3203

**Ordering Information**

| Package | Temperature Range | Part Number   | Marking ID | Packing Type |
|---------|-------------------|---------------|------------|--------------|
| PSOP-8  | -40 to 85°C       | AP3203MP-G1   | 3203MP-G1  | Tube         |
|         |                   | AP3203MPTR-G1 | 3203MP-G1  | Tape & Reel  |

BCD Semiconductor's Pb-free products, as designated with "G1" suffix in the part number, are RoHS compliant and green.

**380kHz, 3A Asynchronous DC - DC Buck Converter****AP3203****Absolute Maximum Ratings (Note 1)**

| Parameter                           | Symbol        | Value              | Unit |
|-------------------------------------|---------------|--------------------|------|
| IN Pin Voltage                      | $V_{IN}$      | -0.3 to 20         | V    |
| EN Pin Voltage                      | $V_{EN}$      | -0.3 to $V_{IN}$   | V    |
| SW Pin Voltage                      | $V_{SW}$      | 21                 | V    |
| BS Pin Voltage                      | $V_{BS}$      | -0.3 to $V_{SW}+6$ | V    |
| FB Pin Voltage                      | $V_{FB}$      | -0.3 to 6          | V    |
| COMP Pin Voltage                    | $V_{COMP}$    | -0.3 to 6          | V    |
| SS Pin Voltage                      | $V_{SS}$      | -0.3 to 6          | V    |
| Thermal Resistance                  | $\theta_{JA}$ | 105                | °C/W |
| Operating Junction Temperature      | $T_J$         | 150                | °C   |
| Storage Temperature                 | $T_{STG}$     | -65 to 150         | °C   |
| Lead Temperature (Soldering, 10sec) | $T_{LEAD}$    | 260                | °C   |
| ESD (Machine Model)                 |               | 200                | V    |
| ESD (Human Body Model)              |               | 2000               | V    |

Note 1: Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.

**Recommended Operating Conditions**

| Parameter                     | Symbol          | Min  | Max | Unit |
|-------------------------------|-----------------|------|-----|------|
| Input Voltage                 | $V_{IN}$        | 4.75 | 18  | V    |
| Maximum Output Current        | $I_{OUT} (Max)$ | 3    |     | A    |
| Operating Ambient Temperature | $T_A$           | -40  | 85  | °C   |

**380kHz, 3A Asynchronous DC - DC Buck Converter****AP3203****Electrical Characteristics**

$V_{IN}=V_{EN}=12V$ ,  $V_{OUT}=3.3V$ ,  $T_A=25^{\circ}C$ , unless otherwise specified. And those in **boldface type** apply over the full operating temperature rang ( $T_A=-40^{\circ}C$  to  $+85^{\circ}C$ ).

| Parameter                              | Symbol        | Conditions                                | Min          | Typ          | Max          | Unit        |
|----------------------------------------|---------------|-------------------------------------------|--------------|--------------|--------------|-------------|
| Input Voltage                          | $V_{IN}$      |                                           | 4.75         |              | 18           | V           |
| Quiescent Current                      | $I_Q$         | $V_{EN}=2V$ ,<br>$V_{FB}=1.35V$           |              | 1.0          | 1.5          | mA          |
| Shutdown Supply Current                | $I_{SHDN}$    | $V_{EN}=0V$                               |              | 1            | 10           | $\mu A$     |
| Feedback Voltage                       | $V_{FB}$      |                                           | <b>1.185</b> | <b>1.222</b> | <b>1.258</b> | V           |
| Feedback Over Voltage Threshold        | $V_{FBOV}$    |                                           |              | 1.48         |              | V           |
| Feedback SCP Voltage Threshold         | $V_{FB\_SCP}$ |                                           |              | 0.6          |              | V           |
| Feedback Bias Current                  | $I_{FB}$      | $V_{FB}=1V$                               | -0.1         |              | 0.1          | $\mu A$     |
| Upper Switch On-resistance             | $R_{DSONH}$   | $I_{SW}=0.5A$                             |              | 0.12         |              | $\Omega$    |
| Lower Switch On-resistance             | $R_{DSONL}$   | $I_{SW}=0.05A$                            |              | 10           |              | $\Omega$    |
| High-side Switch Leakage Current       | $I_{LEAKH}$   | $V_{IN}=18V$ , $V_{EN}=0V$<br>$V_{SW}=0V$ |              | 0.1          | 10           | $\mu A$     |
| High-side Switch Current Limit         | $I_{LIMH}$    |                                           | 4            | 5.2          |              | A           |
| Low-side Switch Current Limit          | $I_{LIML}$    | From Drain to Source                      |              | 0.15         |              | A           |
| EN Pin Threshold                       | $V_{ENH}$     |                                           | 1.5          |              |              | V           |
|                                        | $V_{ENL}$     |                                           |              |              | 0.5          | V           |
| EN Pull-up Current                     | $I_{EN\_PH}$  | $V_{EN}=0V$                               |              | 1.0          |              | $\mu A$     |
| Input UVLO Threshold                   | $V_{UVLO}$    | $V_{IN}$ Rising                           | 3.55         | 3.85         | 4.15         | V           |
| Input UVLO Hysteresis                  | $V_{HYS}$     |                                           |              | 0.3          |              | V           |
| Oscillator Frequency                   | $f_{OSC1}$    |                                           |              | 380          |              | kHz         |
| Short Circuit Oscillator Frequency     | $f_{OSC2}$    |                                           |              | 80           |              | kHz         |
| Maximum Duty Cycle                     | $D_{MAX}$     | $V_{FB}=1.0V$                             |              | 90           |              | %           |
| Minimum Duty Cycle                     | $D_{MIN}$     | $V_{FB}=1.35V$                            |              |              | 0            | %           |
| Error Amplifier Voltage Gain (Note 3)  | $A_{EA}$      |                                           |              | 400          |              | V/V         |
| Error Amplifier Transconductance       | $G_{EA}$      |                                           | 700          | 950          | 1200         | $\mu A/V$   |
| COMP to Current Sense Transconductance | $G_{CS}$      |                                           |              | 5.4          |              | A/V         |
| Thermal Shutdown (Note 3)              | $T_{OTSD}$    |                                           |              | 160          |              | $^{\circ}C$ |
| Thermal Shutdown Hysteresis (Note 3)   | $T_{HYS}$     |                                           |              | 30           |              | $^{\circ}C$ |
| Soft-start Time (Note 3)               | $t_{SS}$      | $C4=0.1\mu F$ ,<br>$I_{OUT}=500mA$        |              | 10           |              | ms          |
| Soft-start Current                     | $I_{SS}$      |                                           |              | 6            |              | $\mu A$     |

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Note 2:  $R_{DS(on)} = \frac{V_{SW1} - V_{SW2}}{I_{SW1} - I_{SW2}}$

Note 3: Not tested, guaranteed by design.

**Typical Performance Characteristics**

T<sub>A</sub>=25°C, V<sub>IN</sub>=12V, V<sub>OUT</sub>=3.3V, unless otherwise noted.

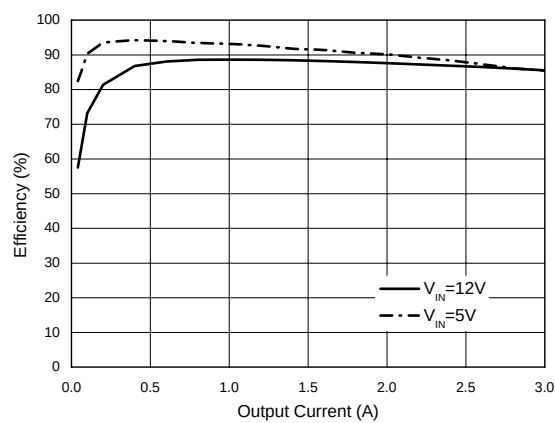


Figure 4. Efficiency vs. Output Current

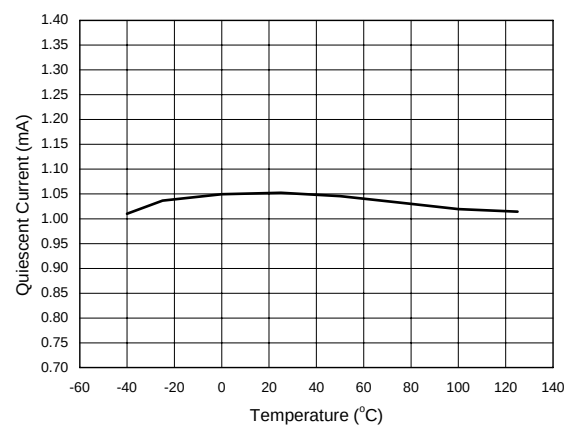


Figure 5. Quiescent Current vs. Temperature

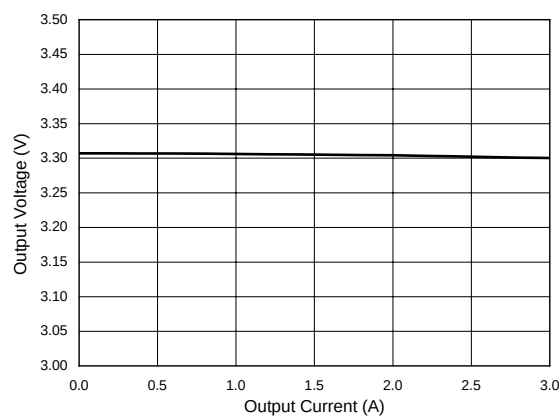


Figure 6. Output Voltage vs. Output Current

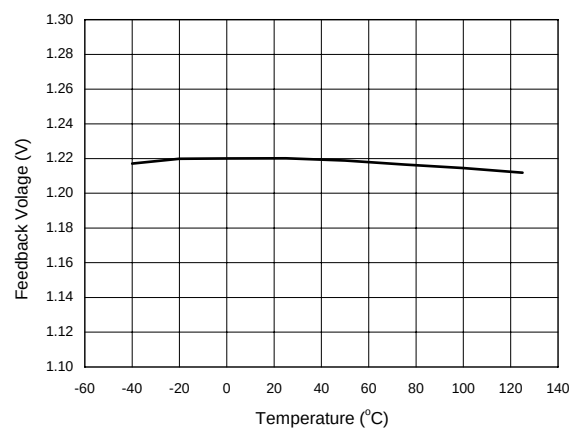
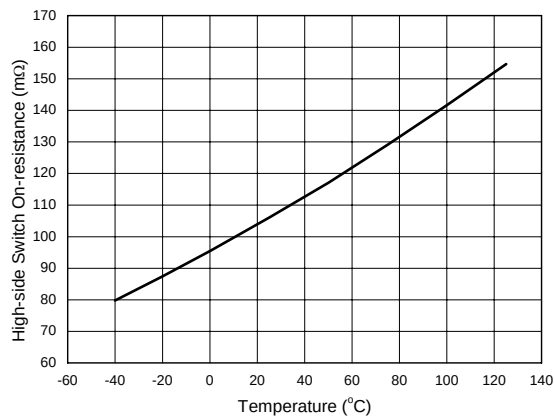
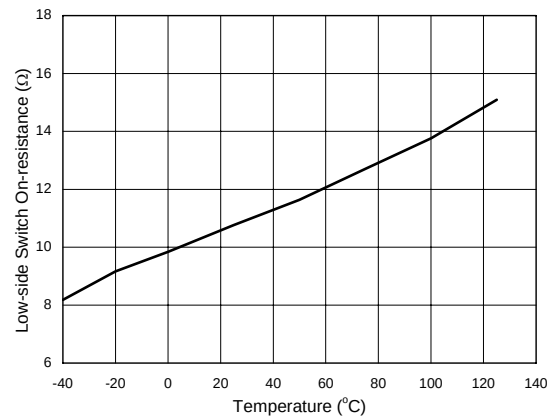
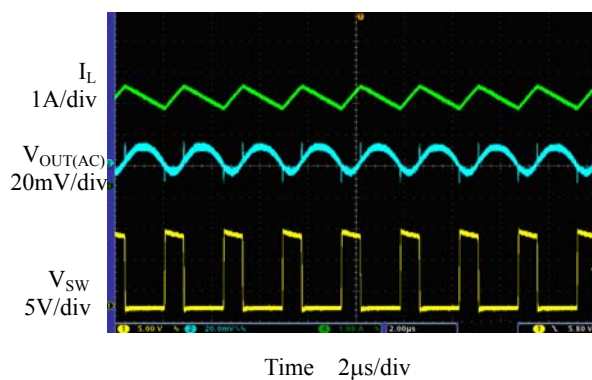
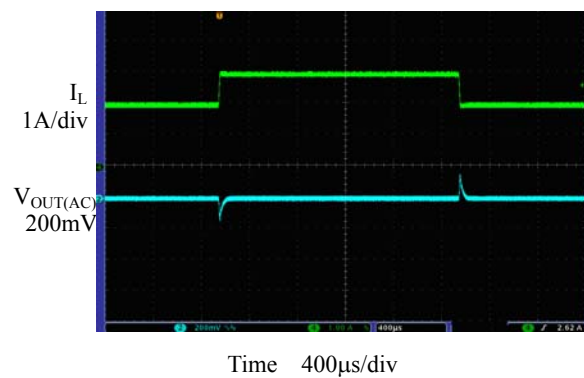


Figure 7. Feedback Voltage vs. Temperature

**380kHz, 3A Asynchronous DC - DC Buck Converter****AP3203****Typical Performance Characteristics (Continued)** $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=12\text{V}$ ,  $V_{OUT}=3.3\text{V}$ , unless otherwise noted.Figure 8.  $R_{DS(on)H}$  vs. TemperatureFigure 9.  $R_{DS(on)L}$  vs. TemperatureFigure 10. Output Ripple  
( $V_{IN}=12\text{V}$ ,  $V_{OUT}=3.3\text{V}$ ,  $I_{OUT}=3\text{A}$ )Figure 11. Load Transient  
( $V_{IN}=12\text{V}$ ,  $V_{OUT}=3.3\text{V}$ ,  $I_{OUT}=2\text{A}$  to  $3\text{A}$ )

# 380kHz, 3A Asynchronous DC - DC Buck Converter

AP3203

## Typical Performance Characteristics (Continued)

$T_A=25^{\circ}\text{C}$ ,  $V_{IN}=12\text{V}$ ,  $V_{OUT}=3.3\text{V}$ , unless otherwise noted.

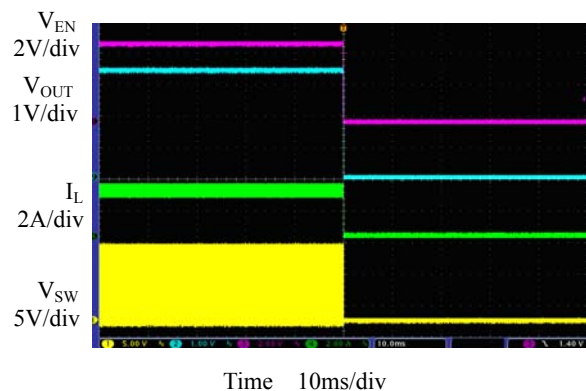


Figure 12. Enable Turn Off  
( $V_{IN}=12\text{V}$ ,  $V_{OUT}=3.3\text{V}$ ,  $I_{OUT}=3\text{A}$ , with Resister load)

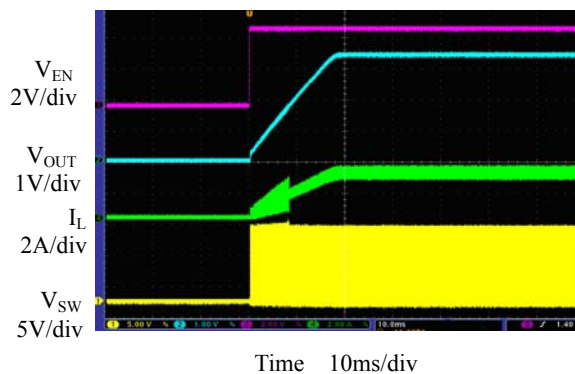


Figure 13. Enable Turn On  
( $V_{IN}=12\text{V}$ ,  $V_{OUT}=3.3\text{V}$ ,  $I_{OUT}=3\text{A}$ , with Resistance Load)

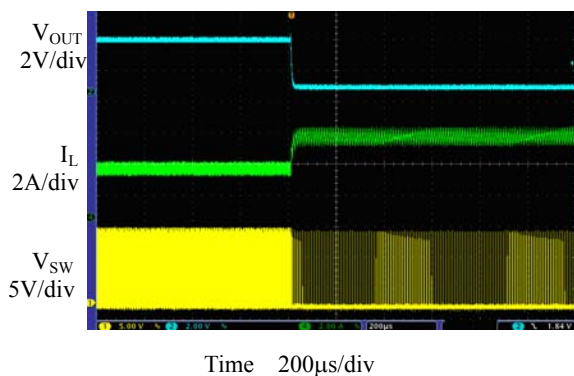


Figure 14. Short Circuit Protection  
( $V_{IN}=12\text{V}$ ,  $V_{OUT}=3.3\text{V}$ ,  $I_{OUT}=3\text{A}$ )

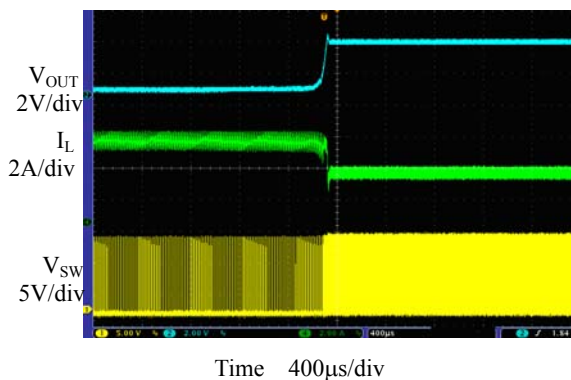


Figure 15. Short Circuit Recovery  
( $V_{IN}=12\text{V}$ ,  $V_{OUT}=3.3\text{V}$ ,  $I_{OUT}=3\text{A}$ )



# 380kHz, 3A Asynchronous DC - DC Buck Converter

## AP3203

### Typical Application

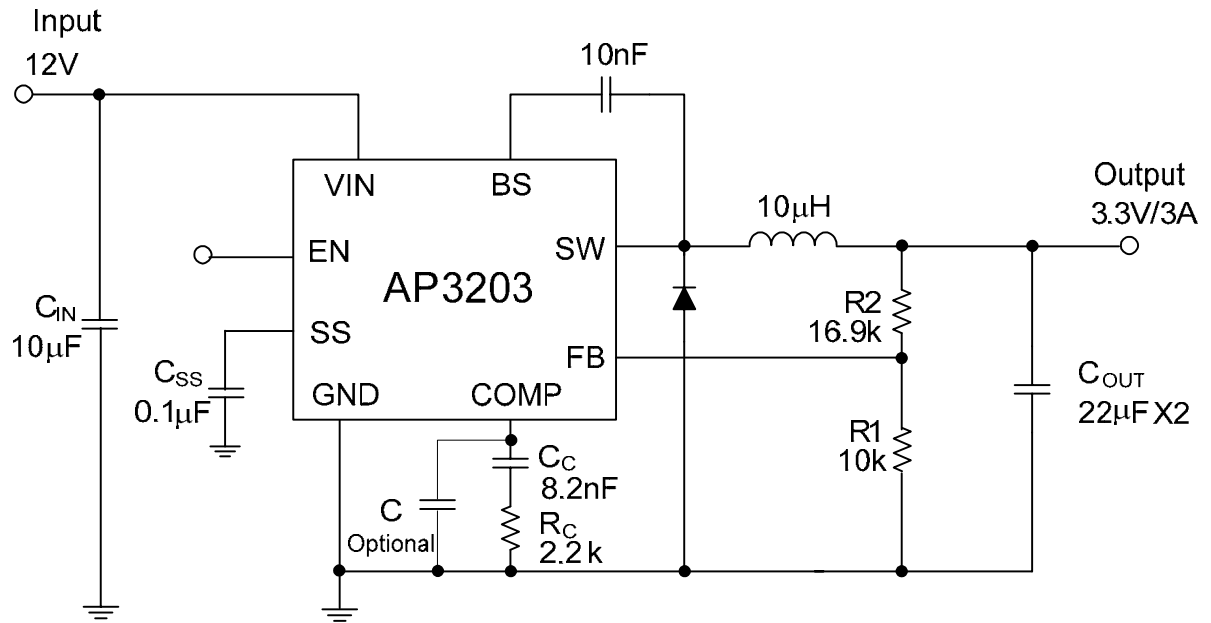


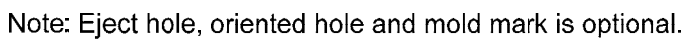
Figure 8. Typical Application of AP3203



**AP3203**

# PSOP-8

Unit: mm(inch)





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