380kHz, 2A Asynchronous DC-DC Buck Converter AP3201A

General Description

The AP3201A is a 380kHz fixed frequency, current mode, PWM buck (step-down) DC-DC converter, capable of driving a 2A load with high efficiency, excellent line and load regulation. The device integrates N-channel power MOSFET switch with low on-resistance. 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 AP3201A. This feature greatly simplifies the design of switch-mode power supplies.

This IC is available in HMSOP-10 package.

Features

- Input Voltage Range: 4.75V to 18V
- Fixed 380kHz Frequency
- High Efficiency: up to 93%
- Output Current: 2A
- 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

- LCD TV
- Set Top Box
- Portable DVD
- Digital Photo Frame



HMSOP-10

Figure 1. Package Type of AP3201A

Pin Configuration

MH Package
(HMSOP-10)

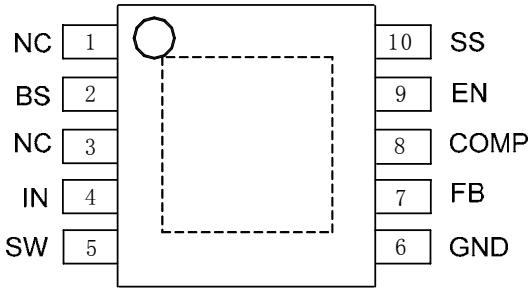


Figure 2. Pin Configuration of AP3201A (Top View)

Pin Description

Pin Number	Pin Name	Function
1, 3	NC	No connection or tied to ground
2	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 power MOSFET
4	IN	Supply input pin. A capacitor should be connected between the IN pin and GND pin to keep the input voltage constant
5	SW	Power switch output pin. This pin is connected to the inductor and bootstrap capacitor
6	GND	Ground pin
7	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 0.920V, 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
8	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
9	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
10	SS	Soft-start control input pin. 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 unconnected

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Functional Block Diagram

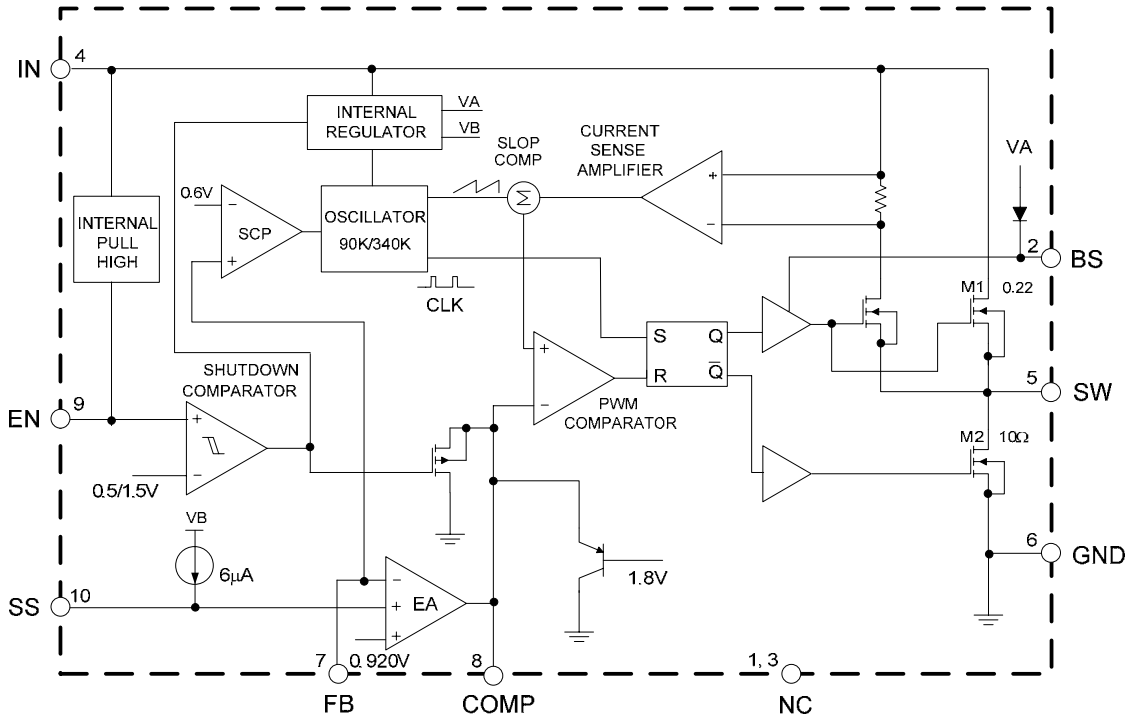
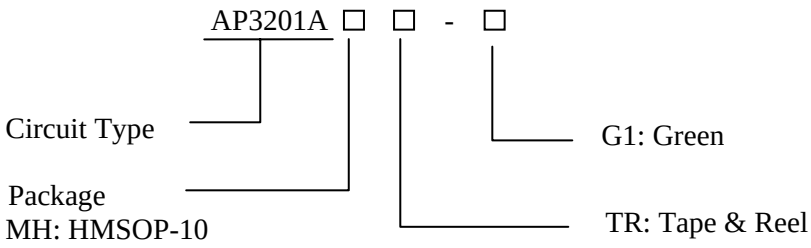


Figure 3. Functional Block Diagram of AP3201A

Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing Type
HMSOP-10	-40 to 85°C	AP3201AMHTR-G1	3201AMH-G1	Tape & Reel

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

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}	20	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	θ_{JA}	60	ºC/W
Operating Junction Temperature	T_J	150	ºC
Storage Temperature	T_{STG}	-65 to 150	ºC
Lead Temperature (Soldering, 10sec)	T_{LEAD}	260	ºC
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	$I_{OUT\ (Max)}$	2		A
Operating Ambient Temperature	T_A	-40	85	ºC

Electrical Characteristics

V_{IN}=V_{EN}=12V, V_{OUT}=3.3V, unless otherwise specified. Specification with standard typeface are for T_A=25 ºC, and those in **boldface type** apply over the full operating temperature range (T_A=-40 ºC to 85 ºC)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Voltage	V_{IN}		4.75		18	V
Quiescent Current	I_Q	V_{FB}=1.0V, V_{EN}=2V		1.0	1.5	mA
Shutdown Supply Current	I_{SHDN}	V_{EN}=0V		1	10	μA
Feedback Voltage	V_{FB}		**0.902**	**0.920**	**0.938**	V
Feedback Over Voltage Threshold	V_{FBOV}			1.1		V
Feedback SCP Voltage Threshold	V_{FBSCP}			0.6		V
Feedback Bias Current	I_{FB}	V_{FB}=1V	-0.1		0.1	μA
High-side Switch On-resistance (Note 2)	R_{DSONH}	I_{SW}=0.5A		0.22		Ω
Low-side Switch On-resistance (Note 2)	R_{DSONL}	I_{SW}=0.05A		10		Ω
High-side Switch Leakage Current	I_{LEAKH}	V_{IN}=18V, V_{EN}=0V V_{SW}=0V		0.1	10	μA
High-side Switch Current Limit	I_{LIMH}		2.8	3.8		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	
EN Pull-up Current	I_{EN-PH}	V_{EN}=0V		1.0		μA
Input UVLO Threshold	V_{UVLO}	V_{IN} Rising	3.5	3.9	4.4	V
Input UVLO Hysteresis	V_{HYS}			0.3		V
Oscillator Frequency	F_{OSC1}			380		kHz
Short Circuit Oscillator Frequency	F_{OSC2}			90		kHz
Maximum Duty Cycle	D_{MAX}	V_{FB}=0.8V		90		%
Minimum Duty Cycle	D_{MIN}	V_{FB}=1.0V			0	%
Error Amplifier Voltage Gain (Note 3)	A_{EA}			400		V/V
Error Amplifier Transconductance	G_{EA}			700		μA/V
COMP to Current Sense Transconductance	G_{CS}			2.4		A/V
Thermal Shutdown (Note 3)	T_{OTSD}			160		ºC
Thermal Shutdown Hysteresis (Note 3)	T_{HYS}			30		ºC
Soft-start Time (Note 3)	t_{SS}	I_{OUT}=500mA C_{SS}=0.1μF		10		ms
Soft-start Current	I_{SS}			6		μA

Note 2: $R_{DSON}=\frac{V_{SW1}-V_{SW2}}{I_{SW1}-I_{SW2}}$

Note 3: Not tested, guaranteed by design.

Typical Performance Characteristics

T_A=25ºC, V_{IN}=12V, V_{OUT}=3.3V, unless otherwise noted.

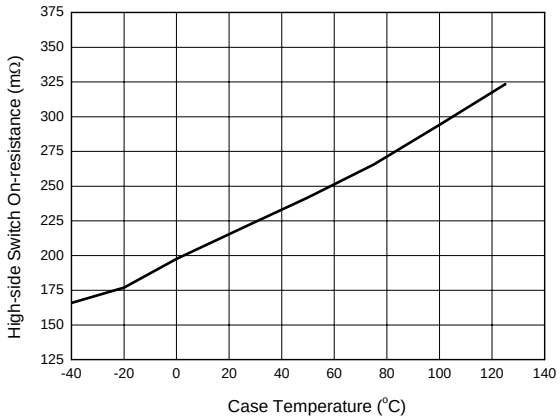


Figure 4. High-side Switch On-resistance vs. Case Temperature

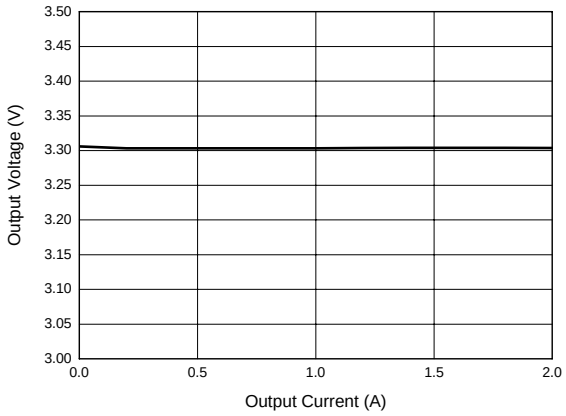


Figure 5. Output Voltage vs. Output Current

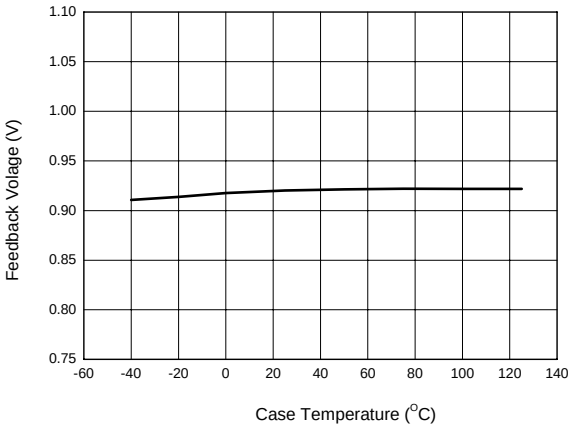


Figure 6. Feedback Voltage vs. Case Temperature

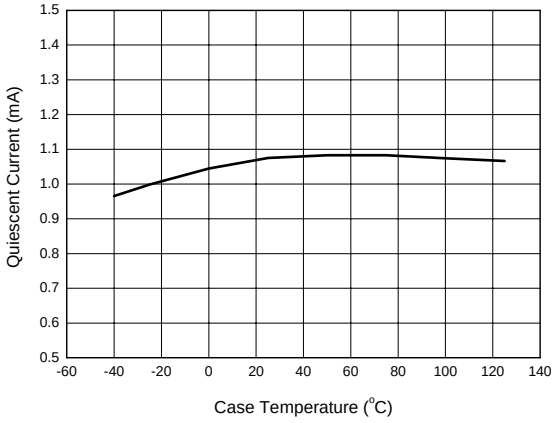


Figure 7. Quiescent Current vs. Case Temperature

Typical Performance Characteristics (Continued)

T_A=25ºC, V_{IN}=12V, V_{OUT}=3.3V, unless otherwise noted.

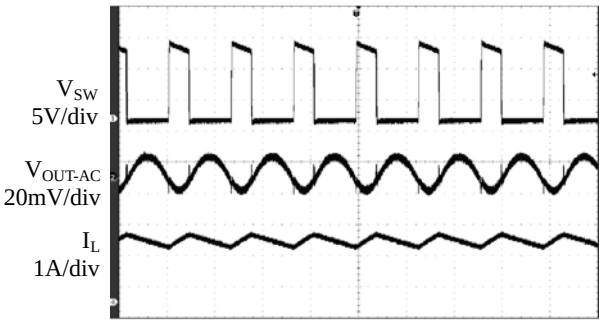


Figure 8. Output Ripple (I_{OUT}=2A)

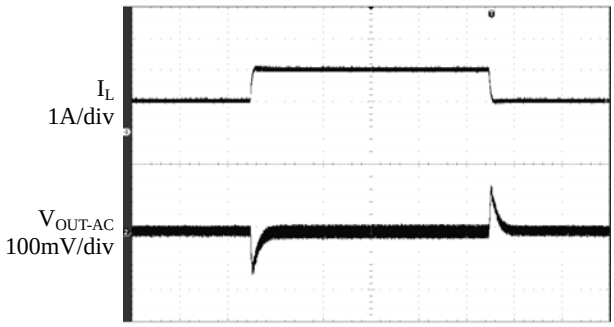


Figure 9. Load Transient (I_{OUT}=1 to 2A)

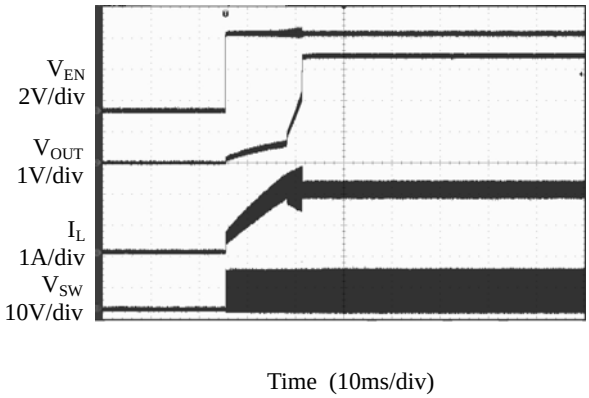


Figure 10. Enable Turn on Characteristic (I_{OUT}=2A, CC Mode)

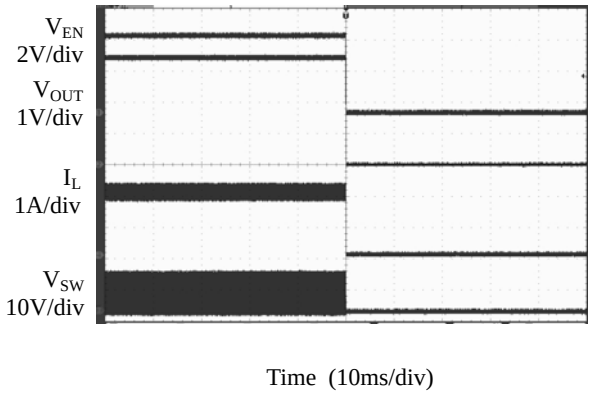


Figure 11. Enable Turn off Characteristic (I_{OUT}=2A, CC Mode)

Typical Performance Characteristics (Continued)

T_A=25 ºC, V_{IN}=12V, V_{OUT}=3.3V, unless otherwise noted.

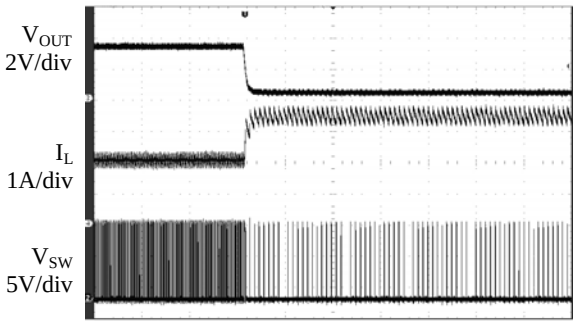


Figure 12. Short Circuit Protection
(I_{OUT}=2A)

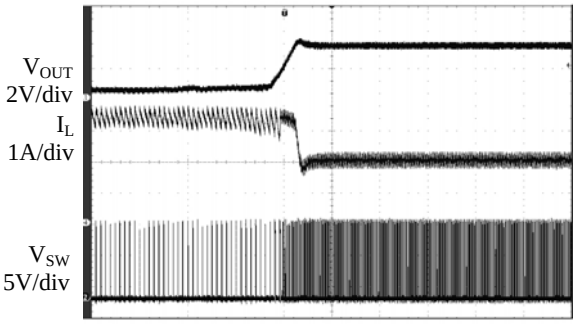


Figure 13. Short Circuit Recovery
(I_{OUT}=2A)

Typical Application

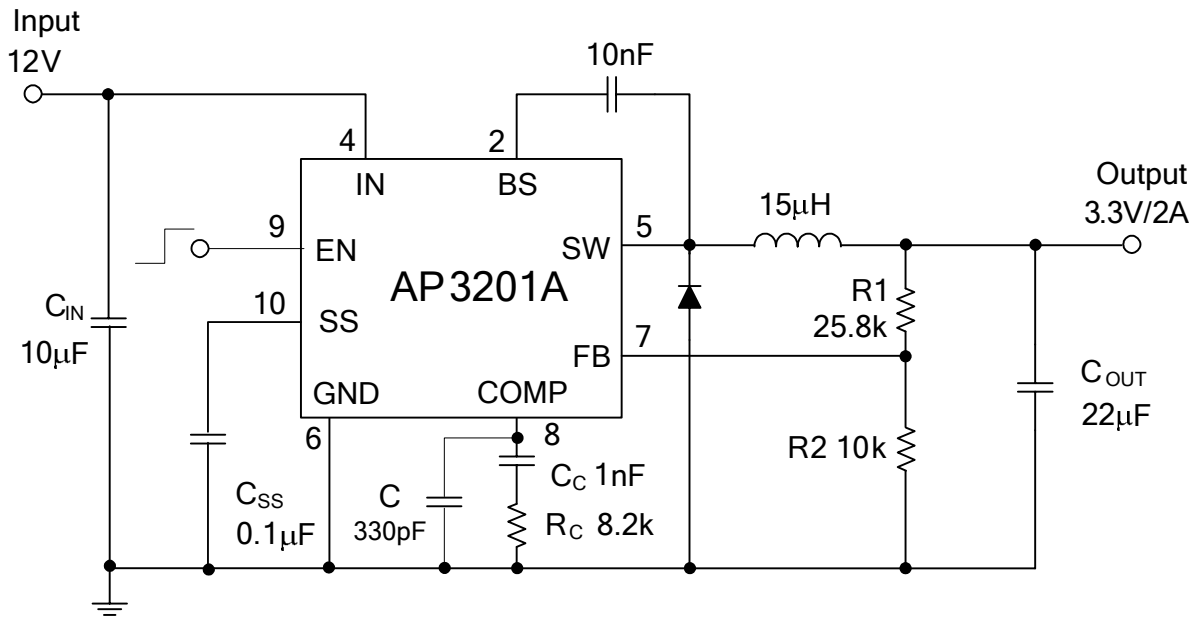
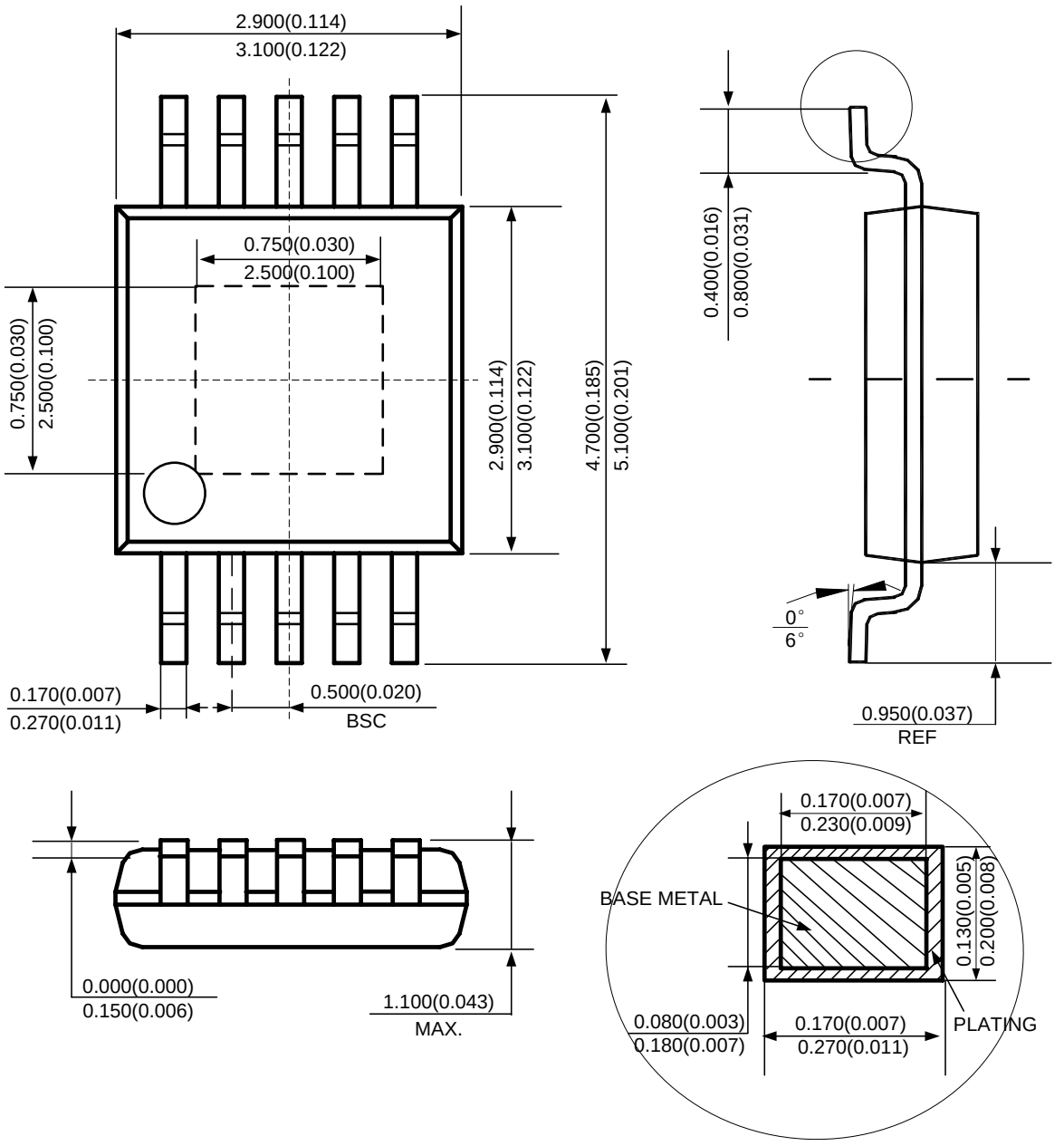


Figure 14. Typical Application of AP3201A

Mechanical Dimensions

HMSOP-10 **Unit: mm(inch)**



Note: 1. Eject hole, oriented hole and mold mark is optional.
2. The figure of exposed pad is not restrained as regular rectangle.



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MAIN SITE

- Headquarters
BCD Semiconductor Manufacturing Limited
No. 1600, Zi Xing Road, Shanghai ZiZhu Science-based Industrial Park, 200241, China
Tel: +86-21-24162266, Fax: +86-21-24162277

- Wafer Fab
Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd.
800 Yi Shan Road, Shanghai 200233, China
Tel: +86-21-6485 1491, Fax: +86-21-5450 0008

REGIONAL SALES OFFICE

Shenzhen Office
Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd., Shenzhen Office
Unit A Room 1203, Skyworth Bldg., Gaoxin Ave.1.S., Nanshan District, Shenzhen, China
Tel: +86-755-8826 7951
Fax: +86-755-8826 7865

Taiwan Office
BCD Semiconductor (Taiwan) Company Limited
4F, 298-1, Rui Guang Road, Nei-Hu District, Taipei, Taiwan
Tel: +886-2-2656 2808
Fax: +886-2-2656 2806

USA Office
BCD Semiconductor Corp.
30920 Huntwood Ave. Hayward, CA 94544, USA
Tel : +1-510-324-2988
Fax: +1-510-324-2788