



150kHz 3A BUCK DC-DC CONVERTER

AP3003

General Description

The AP3003 series of regulators are fixed frequency PWM buck (step-down) DC/DC converter, capable of driving a 3A load with excellent line and load regulation. These regulators include internal frequency compensation and a fixed frequency oscillator so that they are easy to use. A system adopting AP3003 requires a minimum number of external components to work.

A standard series of inductors, optimized for use with the AP3003 series, are available from several manufacturers. This feature greatly simplifies the design of switch-mode power supplies.

These ICs are available in TO-220-5 and TO-263-5 packages.

Features

- 3.3V, 5V, 12V Fixed ( $\pm 4\%$  Tolerance) and Adjustable ( $\pm 3\%$  Tolerance) Output Versions
- Guaranteed 3A Output Load Current
- 150kHz Fixed Frequency Internal Oscillator
- Input Voltage Range up to 32V
- Requires only 4 external components
- High Efficiency up to 90%
- Excellent Line and Load Regulation
- TTL Shutdown Capability
- Low Power Standby Mode,  $I_Q$  Typically 80 $\mu$ A
- Built-in Current Limit Protection and Thermal Shutdown Circuit

Applications

- LCD Monitor and LCD TV
- On-Card DC-DC Converter
- DVD Recorder
- PDP



Figure 1. Package Types of AP3003





**150kHz 3A BUCK DC-DC CONVERTER** **AP3003**

**Pin Configuration**

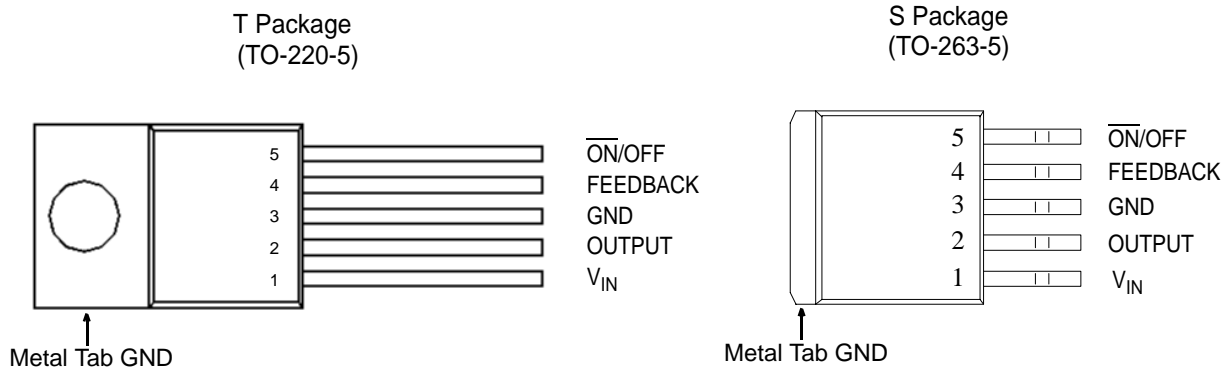


Figure 2. Pin Configuration of AP3003 (Top View)

**Pin Description**

Pin Number	Pin Name	Function
1	$V_{IN}$	Unregulated input voltage
2	OUTPUT	Switch driver output
3	GND	Ground
4	FEEDBACK	Feedback Pin. For fixed version, connect it to system output. For adjustable version, connect it with an external resistor and capacitor feedback network to program the system output voltage
5	ON/OFF	The TTL logic compatible input to control the regulator on or off



**150kHz 3A BUCK DC-DC CONVERTER**

**AP3003**

**Functional Block Diagram**

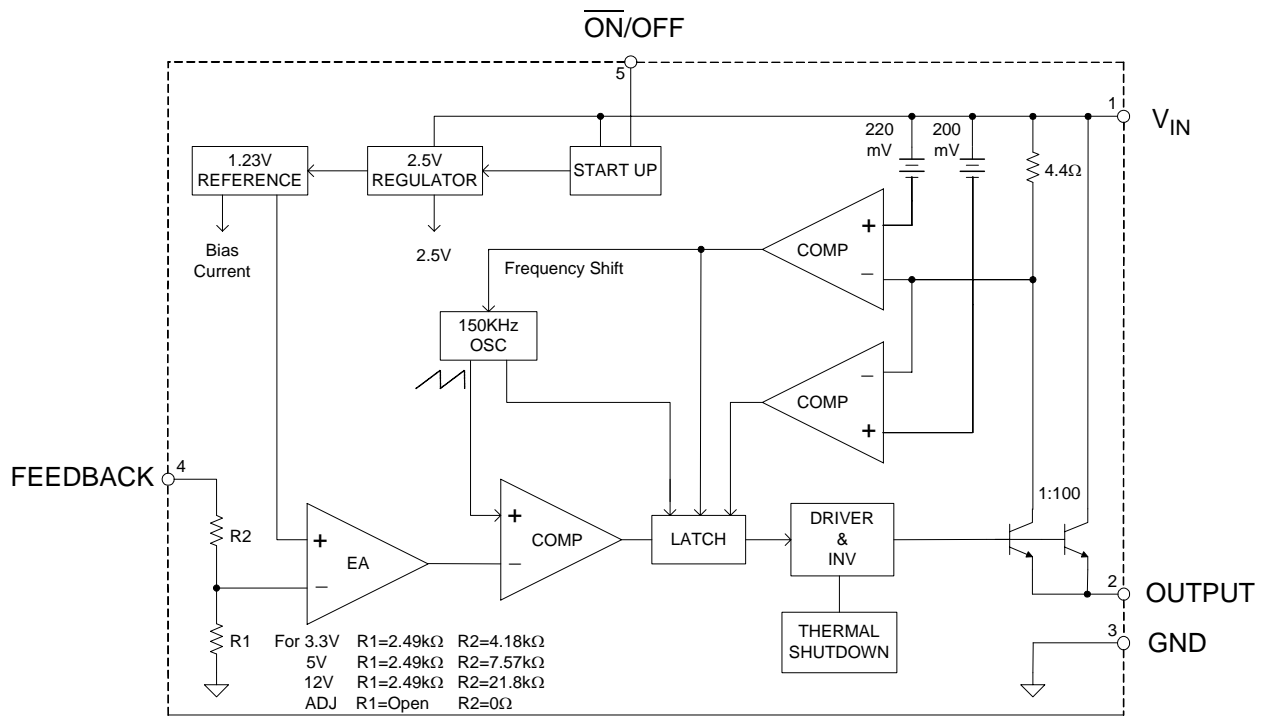


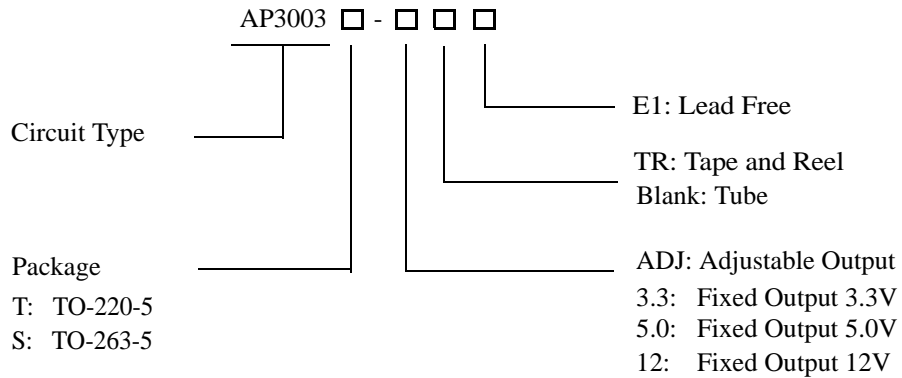
Figure 3. Functional Block Diagram of AP3003



**150kHz 3A BUCK DC-DC CONVERTER**

**AP3003**

**Ordering Information**



Package	Temperature Range	Part Number	Marking ID	Packing Type
		Lead Free	Lead Free	
TO-220-5	-40 to 85°C	AP3003T-ADJE1	AP3003T-ADJE1	Tube
		AP3003T-3.3E1	AP3003T-3.3E1	Tube
		AP3003T-5.0E1	AP3003T-5.0E1	Tube
		AP3003T-12E1	AP3003T-12E1	Tube
TO-263-5	-40 to 85°C	AP3003S-ADJE1	AP3003S-ADJE1	Tube
		AP3003S-ADJTRE1	AP3003S-ADJE1	Tape & Reel
		AP3003S-3.3E1	AP3003S-3.3E1	Tube
		AP3003S-3.3TRE1	AP3003S-3.3E1	Tape & Reel
		AP3003S-5.0E1	AP3003S-5.0E1	Tube
		AP3003S-5.0TRE1	AP3003S-5.0E1	Tape & Reel
		AP3003S-12E1	AP3003S-12E1	Tube
		AP3003S-12TRE1	AP3003S-12E1	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant.

**150kHz 3A BUCK DC-DC CONVERTER****AP3003****Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Value	Unit	
Input Voltage	$V_{IN}$	40	V	
ON/OFF Pin Voltage	$V_{ON/OFF}$	40	V	
Feedback Pin Voltage	$V_{FB}$	40	V	
Operating Junction Temperature	$T_J$	150	°C	
Thermal Resistance (Junction to Ambient, No Heatsink)	TO-220-5	$R_{\theta JA}$	60	°C/W
	TO-263-5			
Lead Temperature (Soldering, 10sec)	$T_{LEAD}$	260	°C	
Storage Temperature Range	$T_{STG}$	-65 to 150	°C	

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	Value	Unit
Maximum Input Voltage (Note 2)	$V_{IN}$	3.3V	V
		5.0V	
		12V	
		ADJ ( $V_{OUT}=3.2V$ )	
		ADJ ( $V_{OUT}=2.5V$ )	
Operating Junction Temperature	$T_J$	-40 to 125	°C

Note 2: For ADJ version, the recommended supply voltage depends on the needed output voltage.



**150kHz 3A BUCK DC-DC CONVERTER** **AP3003**

**Electrical Characteristics**

**For 3.3V Output Voltage Version**

Unless otherwise specified,  $T_J=25^{\circ}\text{C}$ . The specifications with **boldface type** apply over Full Operating Junction Temperature Range.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	$V_{OUT}$	$5.5\text{V} \leq V_{IN} \leq 32\text{V}$ , $0.2\text{A} \leq I_{LOAD} \leq 3\text{A}$	3.168 <b>3.135</b>	3.3	3.432 <b>3.465</b>	V
Efficiency	$\eta$	$V_{IN}=12\text{V}$ , $I_{LOAD}=3\text{A}$		75		%

**For 5V Output Voltage Version**

Unless otherwise specified,  $T_J=25^{\circ}\text{C}$ . The specifications with **boldface type** apply over Full Operating Junction Temperature Range.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	$V_{OUT}$	$7\text{V} \leq V_{IN} \leq 32\text{V}$ , $0.2\text{A} \leq I_{LOAD} \leq 3\text{A}$	4.800 <b>4.750</b>	5	5.200 <b>5.250</b>	V
Efficiency	$\eta$	$V_{IN}=12\text{V}$ , $I_{LOAD}=3\text{A}$		80		%

**For 12V Output Voltage Version**

Unless otherwise specified,  $T_J=25^{\circ}\text{C}$ . The specifications with **boldface type** apply over Full Operating Junction Temperature Range.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	$V_{OUT}$	$15\text{V} \leq V_{IN} \leq 32\text{V}$ , $0.2\text{A} \leq I_{LOAD} \leq 3\text{A}$	11.52 <b>11.40</b>	12.0	12.48 <b>12.60</b>	V
Efficiency	$\eta$	$V_{IN}=24\text{V}$ , $I_{LOAD}=3\text{A}$		88		%

**For ADJ Output Voltage Version**

Unless otherwise specified,  $T_J=25^{\circ}\text{C}$ . The specifications with **boldface type** apply over Full Operating Junction Temperature Range.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Feedback Voltage	$V_{FB}$	$4.5\text{V} \leq V_{IN} \leq 25\text{V}$ , $0.2\text{A} \leq I_{LOAD} \leq 3\text{A}$ , $V_{OUT}$ programmed for 2.5V	1.193 <b>1.18</b>	1.23	1.267 <b>1.28</b>	V
Efficiency	$\eta$	$V_{IN}=12\text{V}$ , $I_{LOAD}=3\text{A}$ , $V_{OUT}=2.5\text{V}$		73		%



**150kHz 3A BUCK DC-DC CONVERTER** **AP3003**

**Electrical Characteristics (Continued)**  
**For All Output Voltage Versions**

Unless otherwise specified ,  $V_{IN}=12V$  for 3.3V, 5V and adjustable version,  $V_{IN}=24V$  for 12V version,  $I_{LOAD}=500mA$ ,  $T_J=25^{\circ}C$ . Specifications with **boldface type** apply over Full Operating Junction Temperature Range.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Feedback Bias Current	$I_{FB}$	Adjustable Version Only, $V_{FB}=1.3V$		10	50 <b>100</b>	nA
Oscillator Frequency	f	(Note 3)	127 <b>110</b>	150	173 <b>173</b>	kHz
Saturation Voltage	$V_{SAT}$	$I_{LOAD}=3A$ ( No output devices, $V_{FB}=0V$ )		1.2	1.5 <b>1.6</b>	V
Maximum Duty Cycle	$D_{MAX}$	$V_{FB}=0V$		100		%
Minimum Duty Cycle	$D_{MIN}$	$V_{FB}=1.3V$		0		%
Current Limit	$I_{CL}$	Peak Current , No output devices, $V_{FB}=0V$	3.6 <b>3.4</b>	4.5	6.9 <b>7.5</b>	A
Output Leakage Current	$I_{SWL}$	Output=0V, No output devices, $V_{FB}=1.3V$ , $V_{IN}=32V$		50		$\mu A$
		Output=-1V, No output devices, $V_{FB}=1.3V$ , $V_{IN}=32V$		2	<b>30</b>	mA
Quiescent Current	$I_Q$	$V_{FB}=1.3V$		5	10	mA
Standby Quiescent Current	$I_{STBY}$	$\overline{ON}/OFF$ Pin=5V, $V_{IN}=18V$		80	200 <b>250</b>	$\mu A$
$\overline{ON}/OFF$ Pin Logic Input Threshold Voltage	$V_{IL}$	Regulator ON			<b>0.6</b>	V
	$V_{IH}$	Regulator OFF	<b>2.0</b>			
$\overline{ON}/OFF$ Pin Input Current	$I_H$	$V_{PIN5}=2.5V$ (Regulator OFF)		5	15	$\mu A$
	$I_L$	$V_{PIN5}=0.5V$ (Regulator ON)		0.02	5	$\mu A$

Note 3: The switching frequency is reduced when the second stage current limit is activated.

Note 4: The specifications with boldface are GBD (Guaranteed By Design ).



**150kHz 3A BUCK DC-DC CONVERTER**

**AP3003**

**Typical Performance Characteristics**

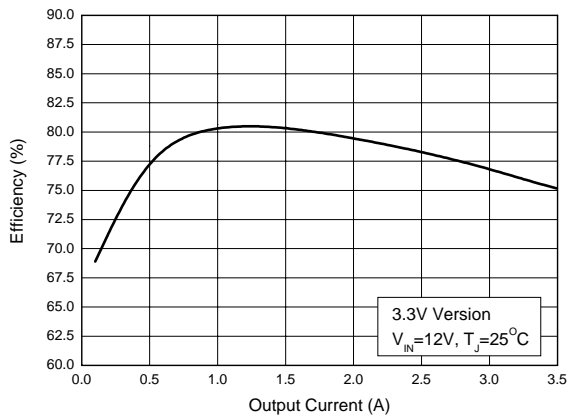


Figure 4. Efficiency vs. Output Current

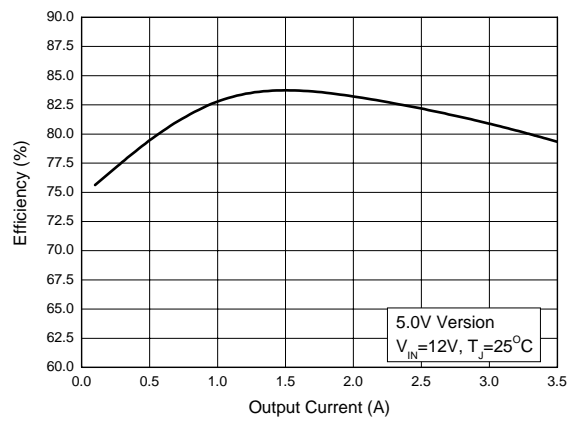


Figure 5. Efficiency vs. Output Current

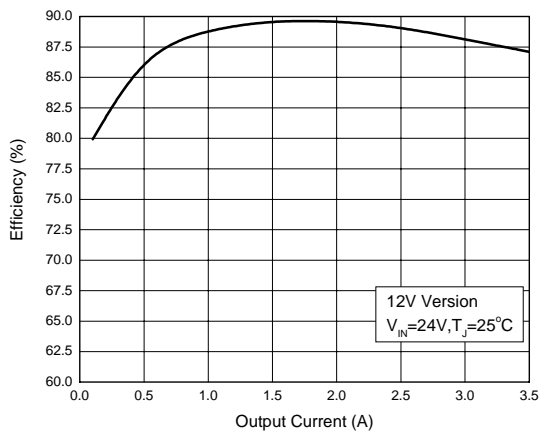


Figure 6. Efficiency vs. Output Current

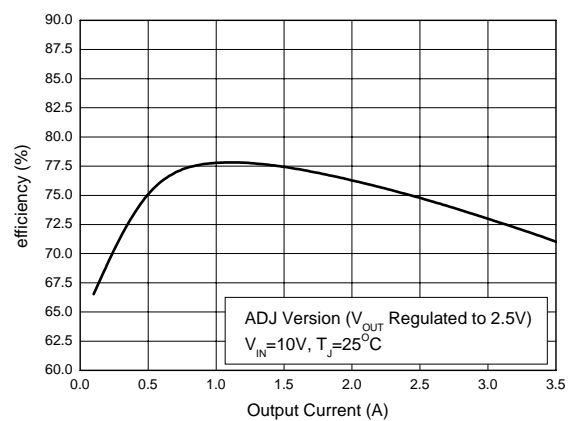


Figure 7. Efficiency vs. Output Current





**150kHz 3A BUCK DC-DC CONVERTER**

**AP3003**

**Typical Performance Characteristics (Continued)**

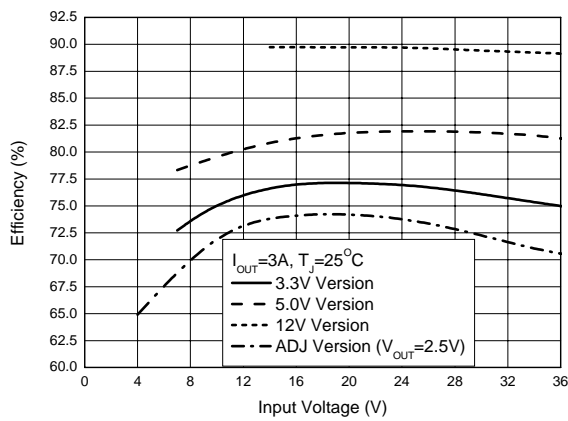


Figure 8. Efficiency vs. Input Voltage

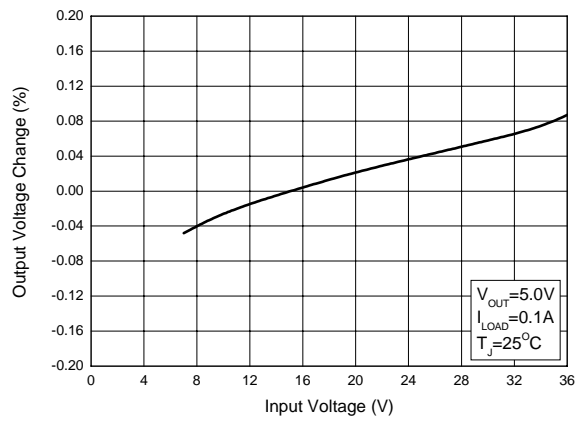


Figure 9. Line Regulation

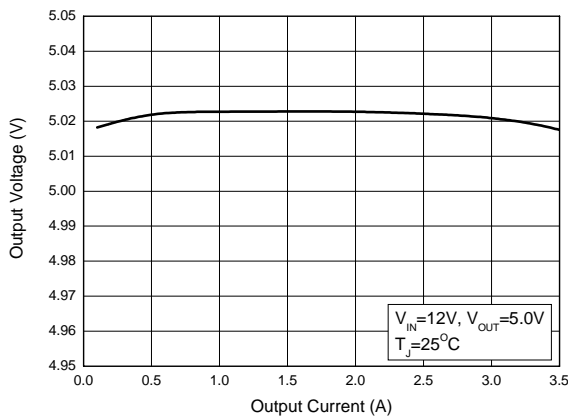


Figure 10. Load Regulation

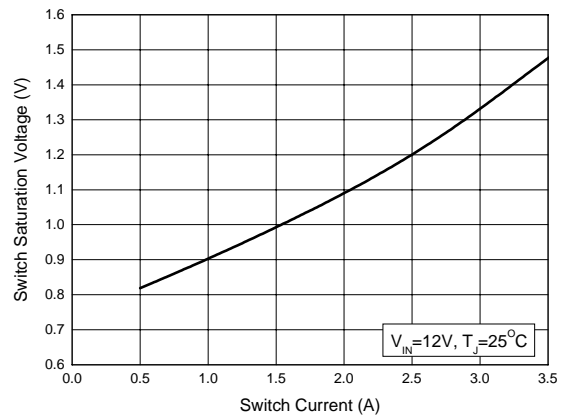


Figure 11. Switch Saturation Voltage vs. Switch Current



150kHz 3A BUCK DC-DC CONVERTER

AP3003

Typical Performance Characteristics (Continued)

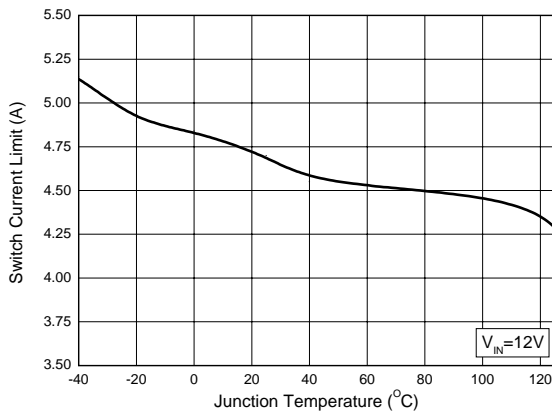


Figure 12. Switch Current Limit vs. Junction Temperature

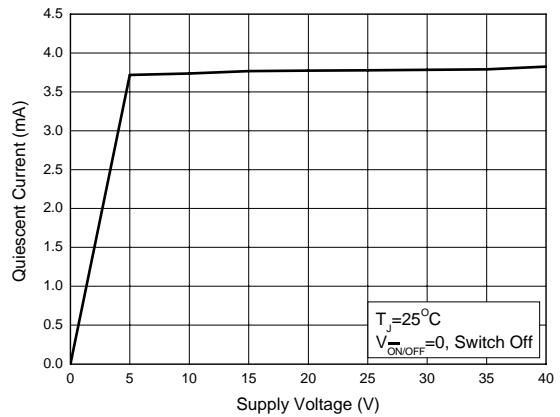


Figure 13. Quiescent Current vs. Supply Voltage

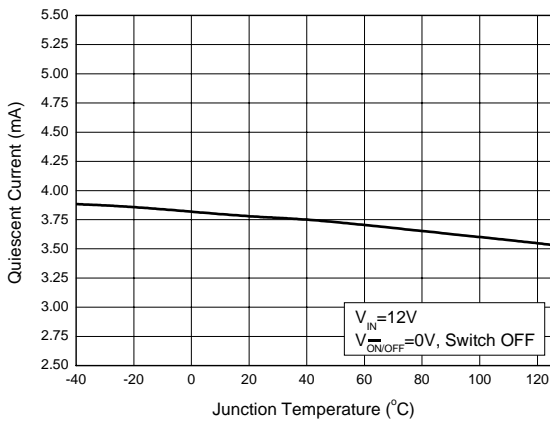


Figure 14. Quiescent Current vs. Junction Temperature

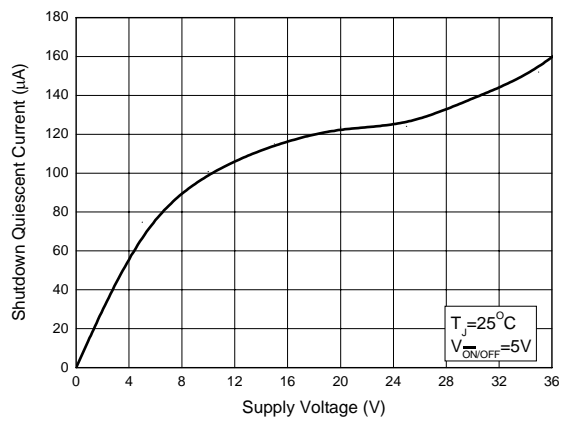


Figure 15. Shutdown Quiescent Current vs. Input Voltage



**150kHz 3A BUCK DC-DC CONVERTER**

**AP3003**

**Typical Performance Characteristics (Continued)**

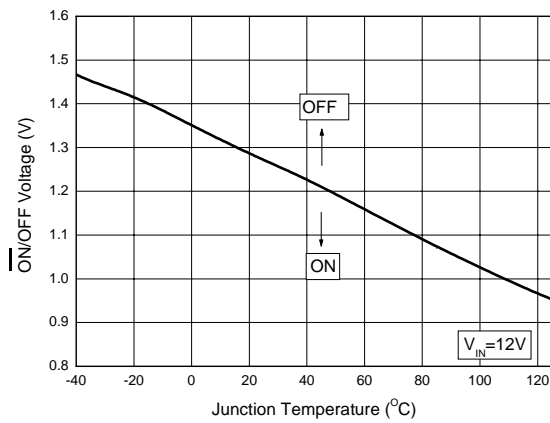


Figure 16. On/Off Threshold Voltage vs. Junction Temperature

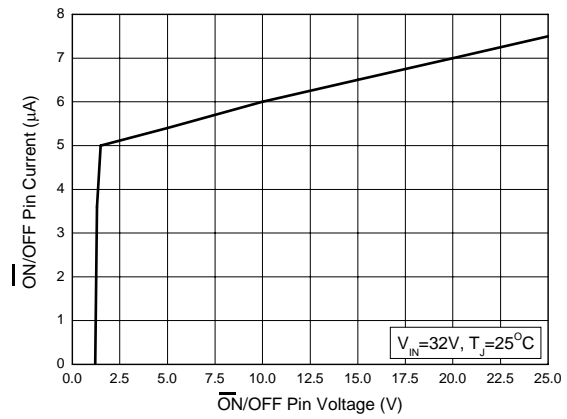


Figure 17. On/Off Pin Current vs. On/Off Pin Voltage

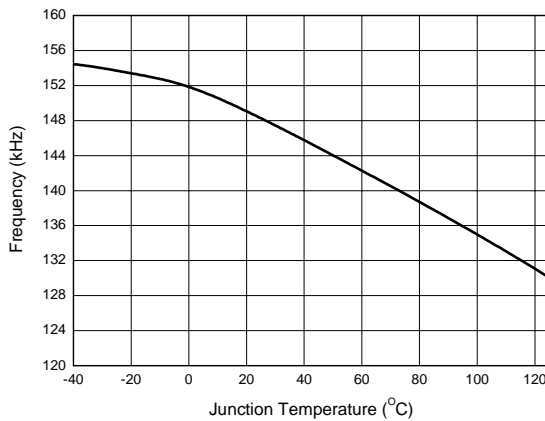


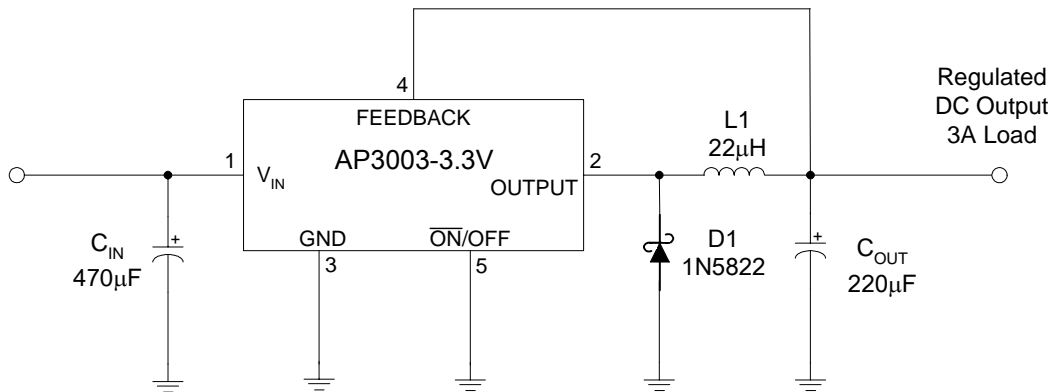
Figure 18. Switching Frequency vs. Junction Temperature



**150kHz 3A BUCK DC-DC CONVERTER**

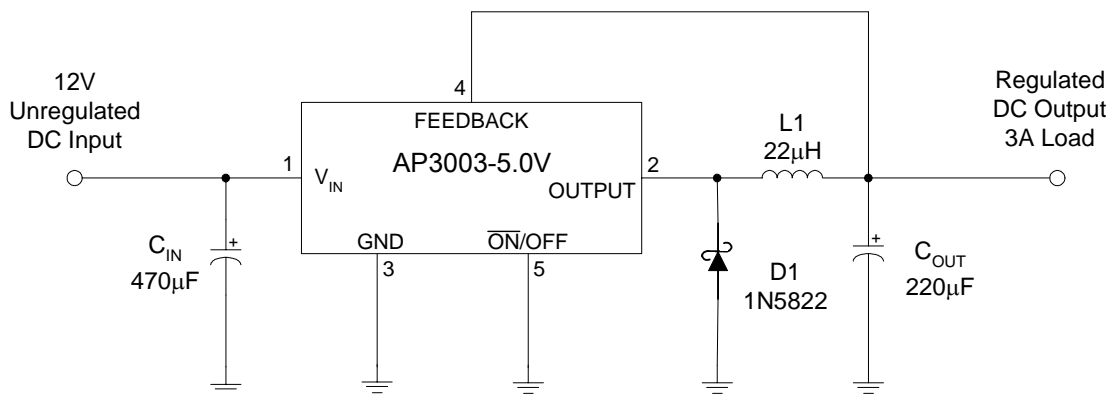
**AP3003**

**Typical Application**



L1: Sumida CDRH127/LDNP-220MC or Equivalent

Figure 19. Typical Application of AP3003-3.3V



L1: Sumida CDRH127/LDNP-220MC or Equivalent

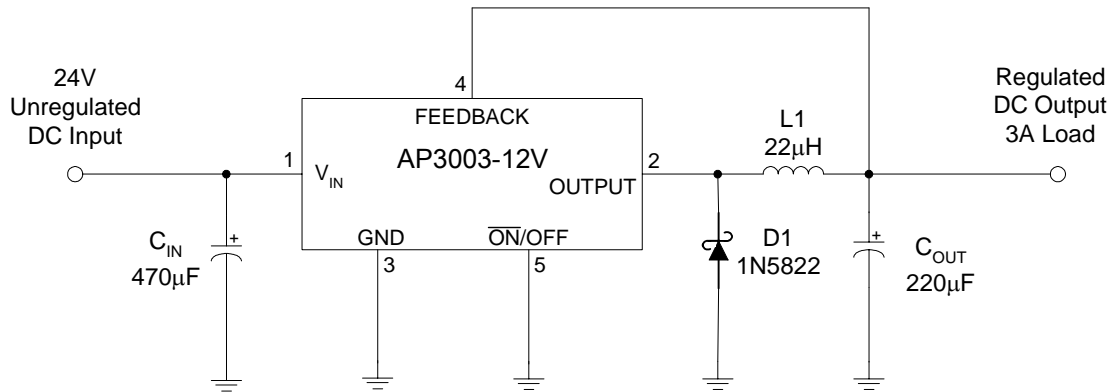
Figure 20. Typical Application of AP3003-5.0V



**150kHz 3A BUCK DC-DC CONVERTER**

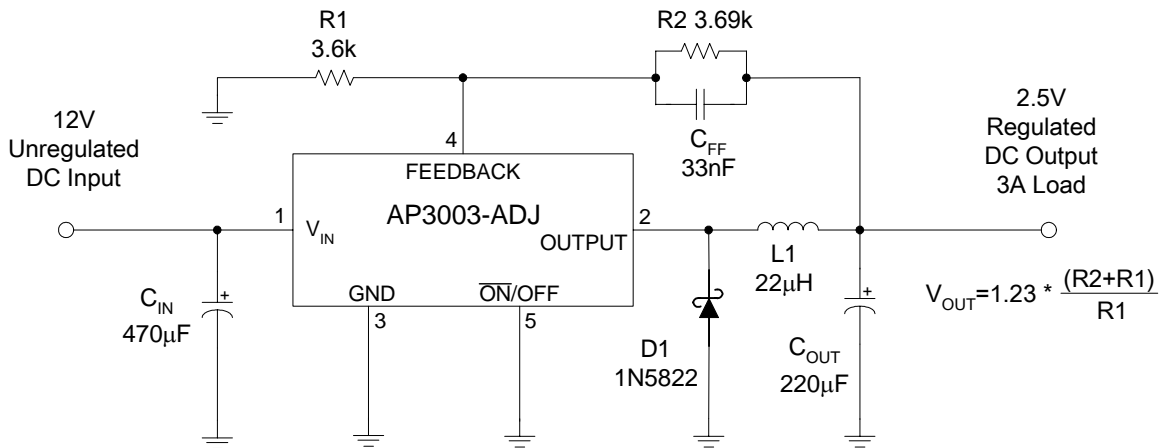
**AP3003**

**Typical Application (Continued)**



L1: Sumida CDRH127/LDNP-220MC or Equivalent

Figure 19. Typical Application of AP3003-12V



L1: Sumida CDRH127/LDNP-220MC or Equivalent

Figure 20. Typical Application of AP3003-ADJ



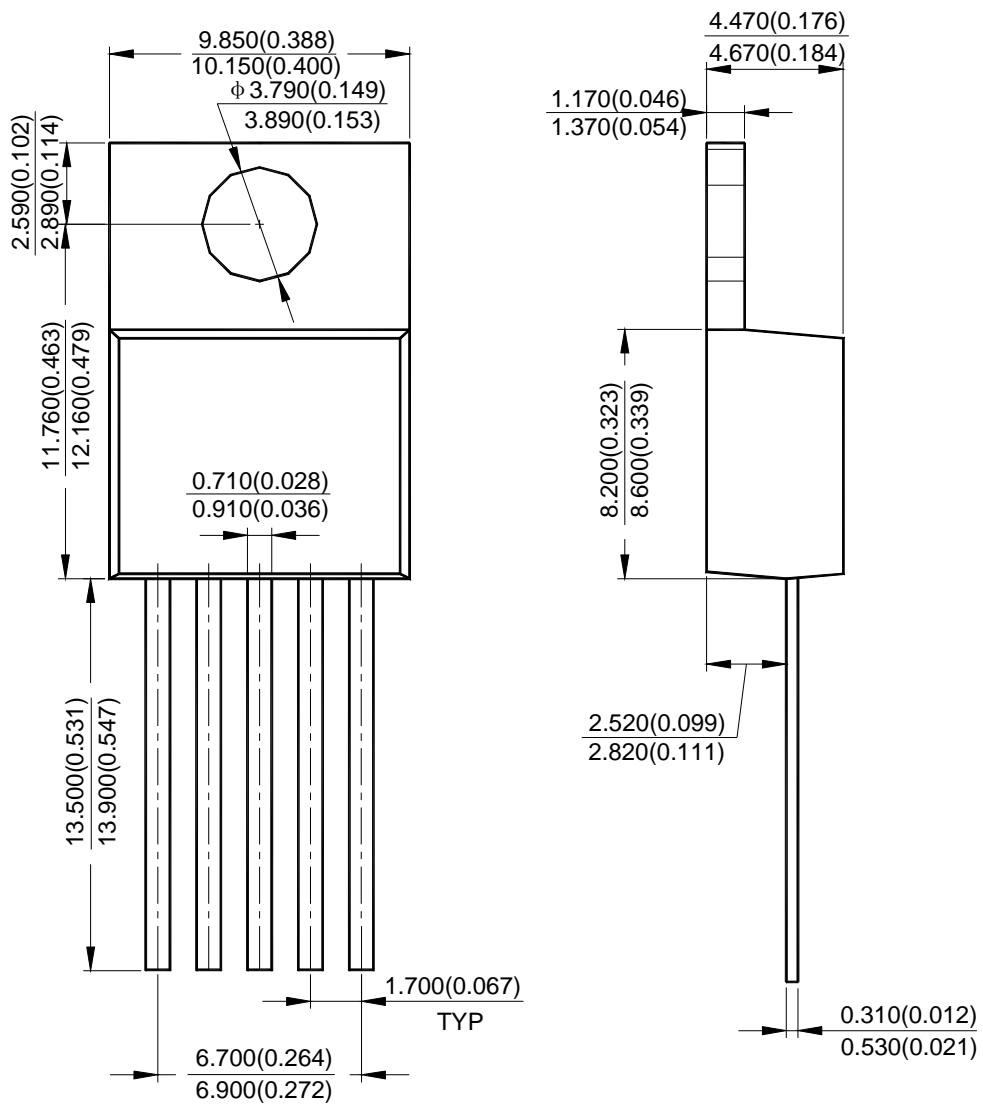
150kHz 3A BUCK DC-DC CONVERTER

AP3003

Mechanical Dimensions

TO-220-5

Unit: mm(inch)



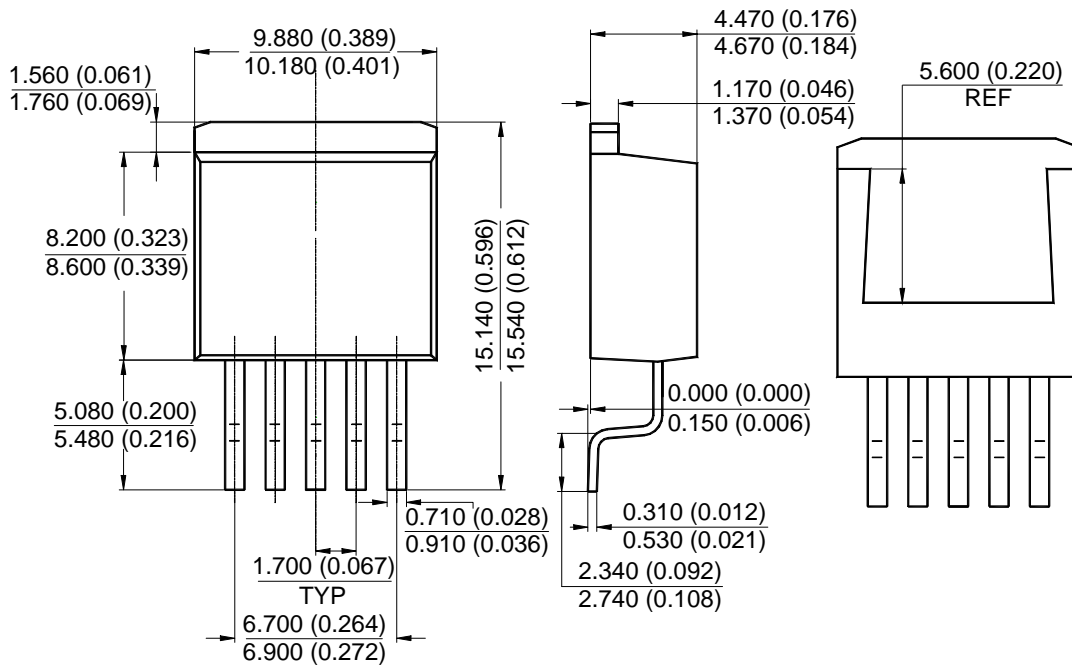


**150kHz 3A BUCK DC-DC CONVERTER** **AP3003**

**Mechanical Dimensions (Continued)**

**TO-263-5**

**Unit: mm(inch)**





BCD Semiconductor Manufacturing Limited

<http://www.bcdsemi.com>

#### IMPORTANT NOTICE

BCD Semiconductor Manufacturing Limited reserves the right to make changes without further notice to any products or specifications herein. BCD Semiconductor Manufacturing Limited does not assume any responsibility for use of any its products for any particular purpose, nor does BCD Semiconductor Manufacturing Limited assume any liability arising out of the application or use of any its products or circuits. BCD Semiconductor Manufacturing Limited does not convey any license under its patent rights or other rights nor the rights of others.

---

#### MAIN SITE

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

**BCD Semiconductor Manufacturing Limited**  
- IC Design Group  
**Advanced Analog Circuits (Shanghai) Corporation**  
8F, Zone B, 900, Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6495 9539, Fax: +86-21-6485 9673

#### REGIONAL SALES OFFICE

**Shenzhen Office**  
**Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd. Shenzhen Office**  
**Advanced Analog Circuits (Shanghai) Corporation Shenzhen Office**  
Room E, 5F, Noble Center, No.1006, 3rd Fuzhong Road, Futian District, Shenzhen 518026, 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 Corporation**  
30920 Huntwood Ave. Hayward,  
CA 94544, U.S.A  
Tel : +1-510-324-2988  
Fax: +1-510-324-2788