

**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 μ A
- Built-in Current Limit Protection and Thermal Shutdown Circuit

Applications

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

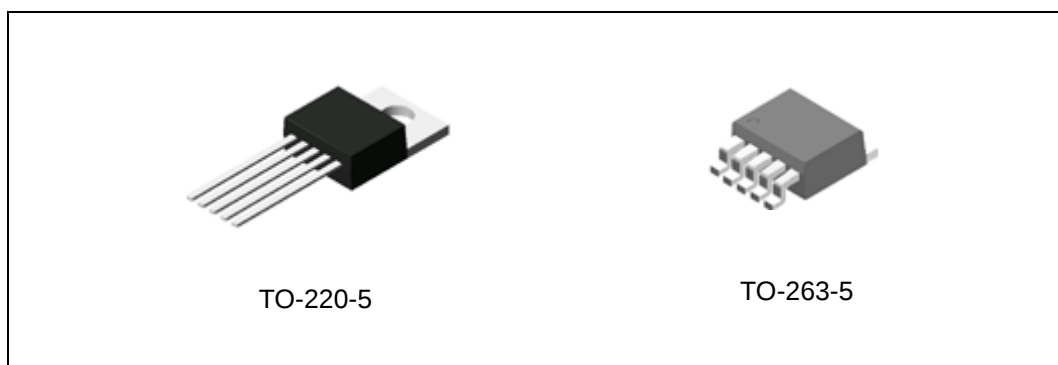


Figure 1. Package Types of AP3003

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Pin Configuration

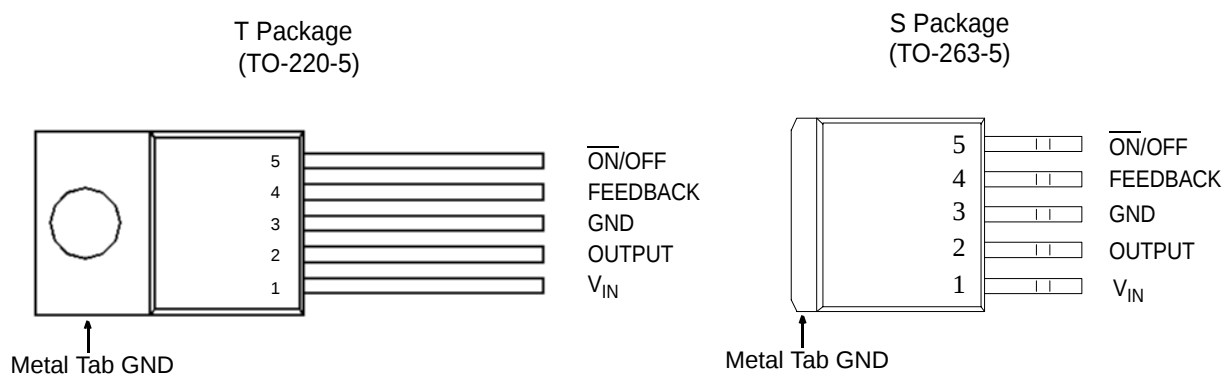


Figure 2. Pin Configuration of AP3003 (Top View)

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	$\overline{ON/OFF}$	The TTL logic compatible input to control the regulator on or off



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Functional Block Diagram

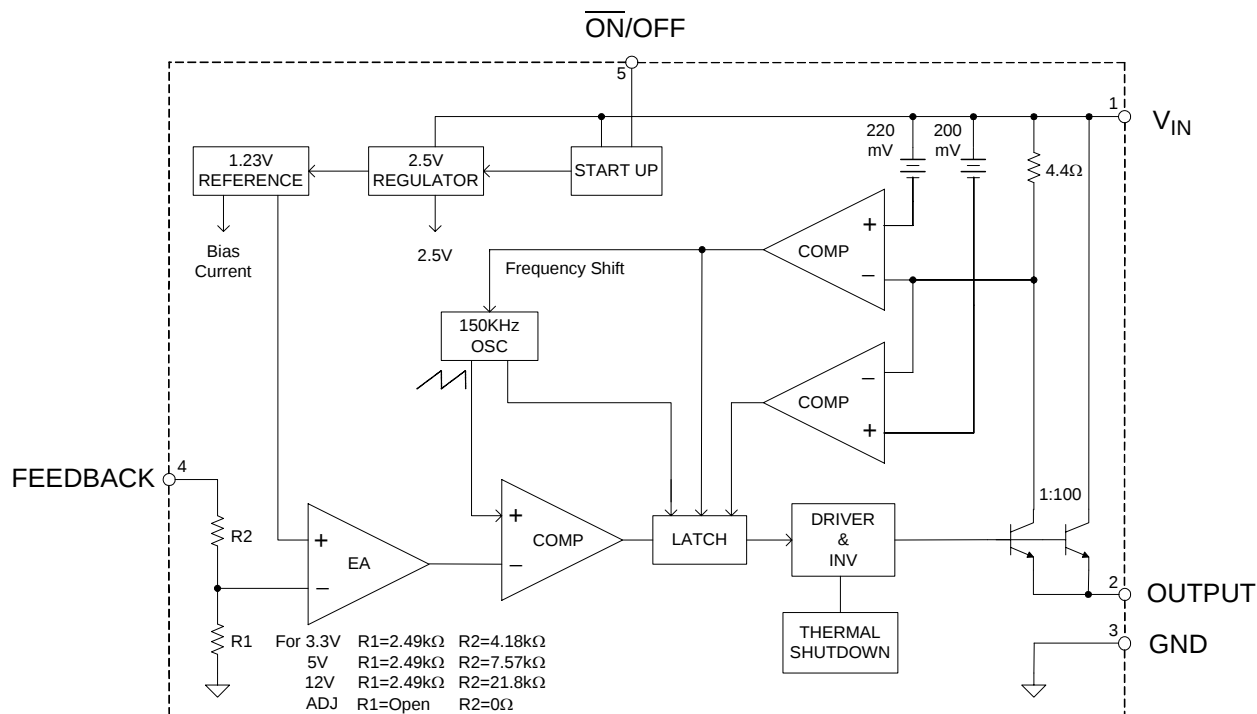
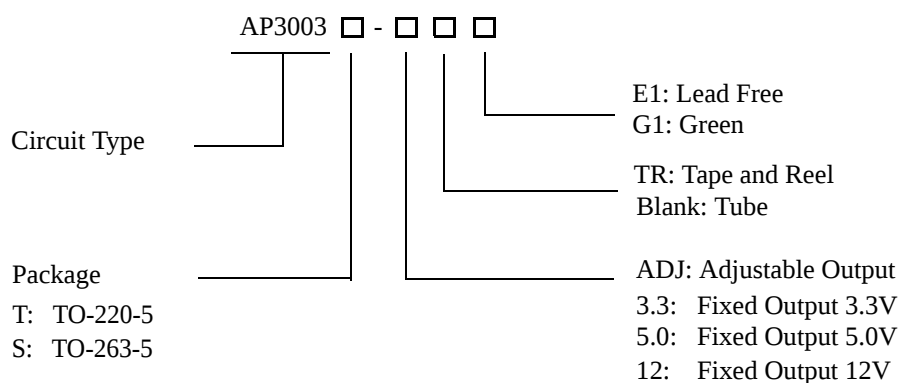


Figure 3. Functional Block Diagram of AP3003

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

Package	Temperature Range	Part Number		Marking ID		Packing Type
		Lead Free	Green	Lead Free	Green	
TO-220-5	-40 to 85°C	AP3003T-ADJE1	AP3003T-ADJG1	AP3003T-ADJE1	AP3003T-ADJG1	Tube
		AP3003T-3.3E1	AP3003T-3.3G1	AP3003T-3.3E1	AP3003T-3.3G1	Tube
		AP3003T-5.0E1	AP3003T-5.0G1	AP3003T-5.0E1	AP3003T-5.0G1	Tube
		AP3003T-12E1	AP3003T-12G1	AP3003T-12E1	AP3003T-12G1	Tube
TO-263-5	-40 to 85°C	AP3003S-ADJE1	AP3003S-ADJG1	AP3003S-ADJE1	AP3003S-ADJG1	Tube
		AP3003S-ADJTRE1	AP3003S-ADJTRG1	AP3003S-ADJE1	AP3003S-ADJG1	Tape & Reel
		AP3003S-3.3E1	AP3003S-3.3G1	AP3003S-3.3E1	AP3003S-3.3G1	Tube
		AP3003S-3.3TRE1	AP3003S-3.3TRG1	AP3003S-3.3E1	AP3003S-3.3G1	Tape & Reel
		AP3003S-5.0E1	AP3003S-5.0G1	AP3003S-5.0E1	AP3003S-5.0G1	Tube
		AP3003S-5.0TRE1	AP3003S-5.0TRG1	AP3003S-5.0E1	AP3003S-5.0G1	Tape & Reel
		AP3003S-12E1	AP3003S-12G1	AP3003S-12E1	AP3003S-12G1	Tube
		AP3003S-12TRE1	AP3003S-12TRG1	AP3003S-12E1	AP3003S-12G1	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with "G1" suffix are available in green packages.

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

Parameter		Symbol	Value	Unit
Input Voltage		V_{IN}	40	V
$\overline{ON/OFF}$ Pin Voltage		$V_{\overline{ON/OFF}}$	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)	3.3V	V_{IN}	32	V
	5.0V		32	
	12V		32	
	ADJ ($V_{OUT}=3.2V$)		32	
	ADJ ($V_{OUT}=2.5V$)		25	
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}	$5.5\text{V} \leq V_{\text{IN}} \leq 32\text{V}$, $0.2\text{A} \leq I_{\text{LOAD}} \leq 3\text{A}$	3.168 3.135	3.3	3.432 3.465	V
Efficiency	η	$V_{\text{IN}}=12\text{V}$, $I_{\text{LOAD}}=3\text{A}$		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}	$7\text{V} \leq V_{\text{IN}} \leq 32\text{V}$, $0.2\text{A} \leq I_{\text{LOAD}} \leq 3\text{A}$	4.800 4.750	5	5.200 5.250	V
Efficiency	η	$V_{\text{IN}}=12\text{V}$, $I_{\text{LOAD}}=3\text{A}$		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}	$15\text{V} \leq V_{\text{IN}} \leq 32\text{V}$, $0.2\text{A} \leq I_{\text{LOAD}} \leq 3\text{A}$	11.52 11.40	12.0	12.48 12.60	V
Efficiency	η	$V_{\text{IN}}=24\text{V}$, $I_{\text{LOAD}}=3\text{A}$		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}	$4.5\text{V} \leq V_{\text{IN}} \leq 25\text{V}$, $0.2\text{A} \leq I_{\text{LOAD}} \leq 3\text{A}$, V_{OUT} programmed for 2.5V	1.193 1.18	1.23	1.267 1.28	V
Efficiency	η	$V_{\text{IN}}=12\text{V}$, $I_{\text{LOAD}}=3\text{A}$, $V_{\text{OUT}}=2.5\text{V}$		73		%


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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	50 100	nA
Oscillator Frequency	f	(Note 3)	127 110	150	173 173	kHz
Saturation Voltage	V_{SAT}	$I_{LOAD}=3A$ (No output devices, $V_{FB}=0V$)		1.2	1.5 1.6	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 3.4	4.5	6.9 7.5	A
Output Leakage Current	I_{SWL}	Output=0V, No output devices, $V_{FB}=1.3V$, $V_{IN}=32V$		50		μA
		Output=-1V, No output devices, $V_{FB}=1.3V$, $V_{IN}=32V$		2	30	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	200 250	μA
$\overline{ON/OFF}$ Pin Logic Input Threshold Voltage	V_{IL}	Regulator ON			0.6	V
	V_{IH}	Regulator OFF	2.0			
$\overline{ON/OFF}$ Pin Input Current	I_H	$V_{PIN5}=2.5V$ (Regulator OFF)		5	15	μA
	I_L	$V_{PIN5}=0.5V$ (Regulator ON)		0.02	5	μA

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).

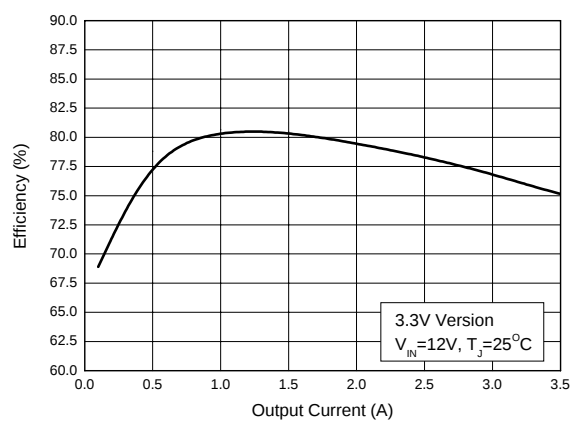
**150kHz 3A BUCK DC-DC CONVERTER****AP3003****Typical Performance Characteristics**

Figure 4. Efficiency vs. Output Current

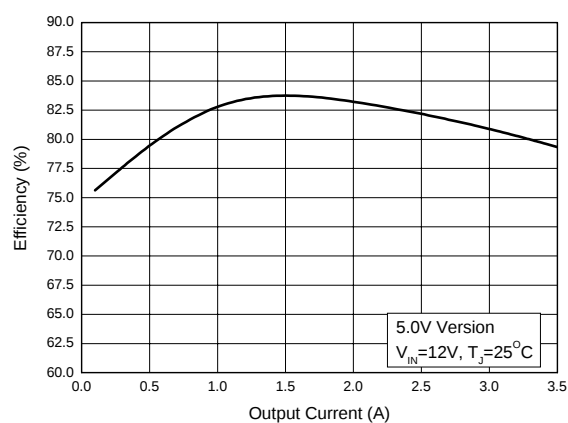


Figure 5. Efficiency vs. Output Current

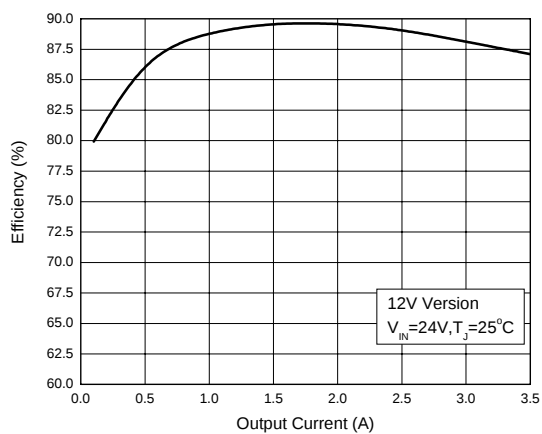


Figure 6. Efficiency vs. Output Current

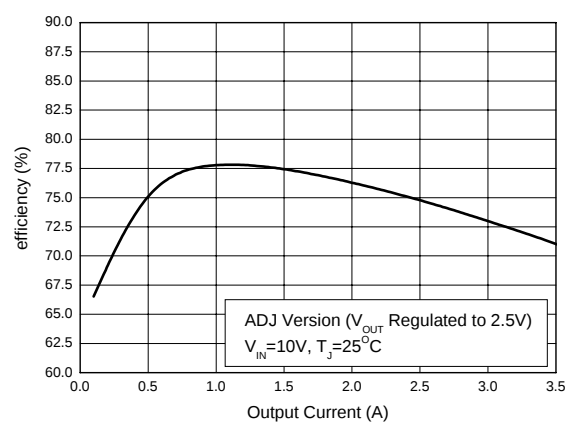


Figure 7. Efficiency vs. Output Current

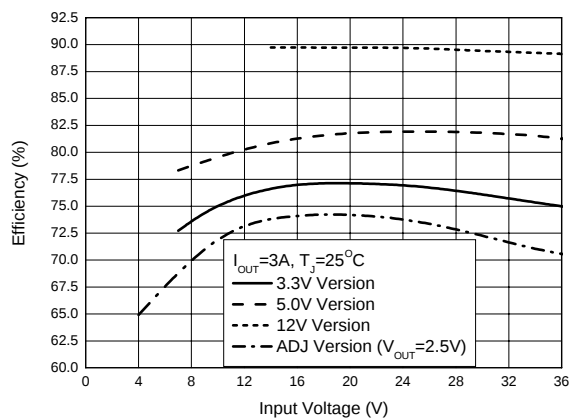
**150kHz 3A BUCK DC-DC CONVERTER****AP3003****Typical Performance Characteristics (Continued)**

Figure 8. Efficiency vs. Input Voltage

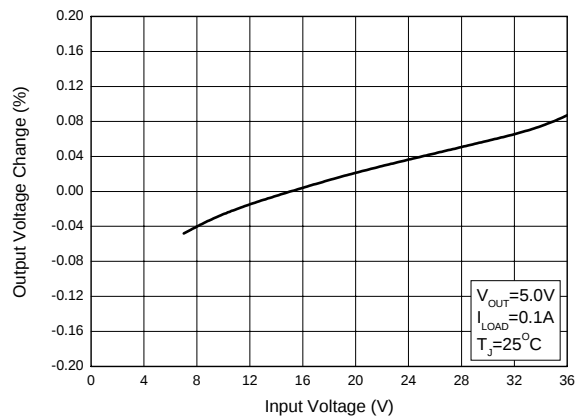


Figure 9. Line Regulation

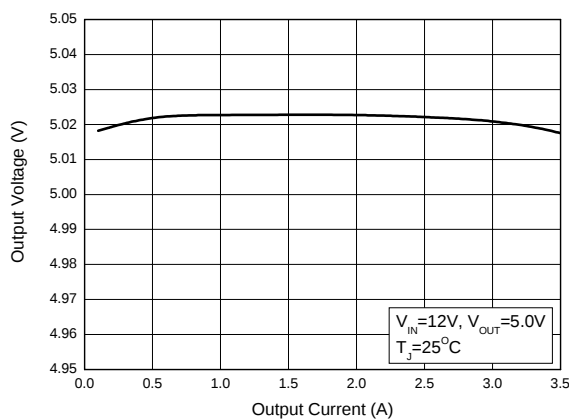


Figure 10. Load Regulation

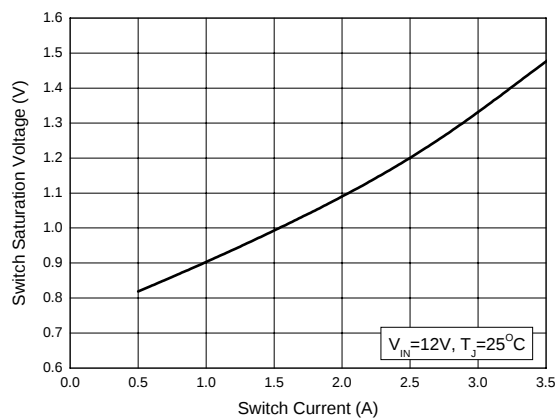


Figure 11. Switch Saturation Voltage vs. Switch Current

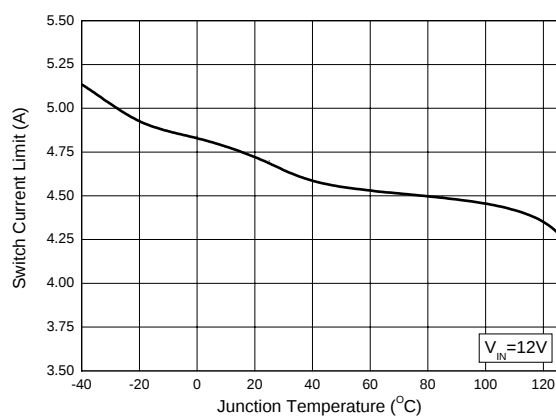
**150kHz 3A BUCK DC-DC CONVERTER****AP3003****Typical Performance Characteristics (Continued)**

Figure 12. Switch Current Limit vs. Junction Temperature

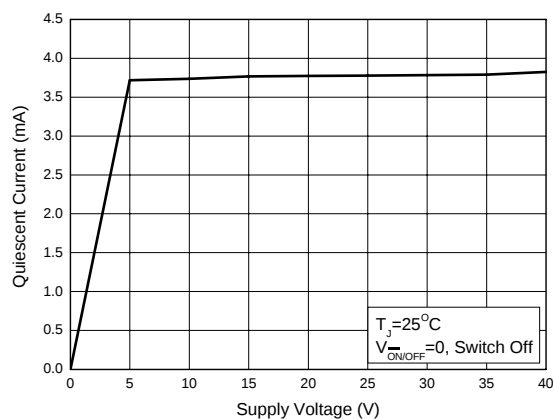


Figure 13. Quiescent Current vs. Supply Voltage

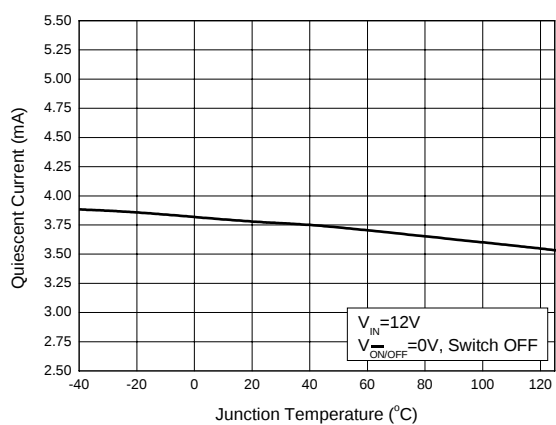


Figure 14. Quiescent Current vs. Junction Temperature

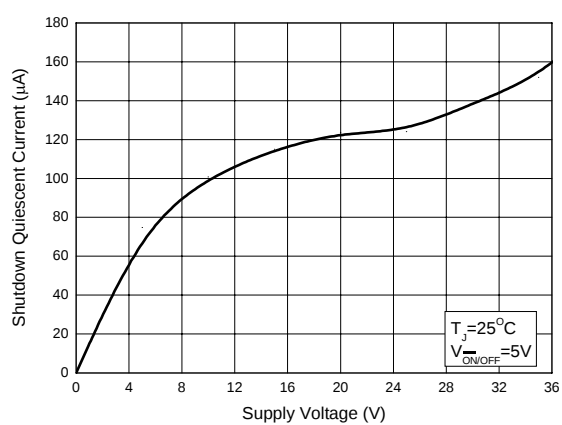


Figure 15. Shutdown Quiescent Current vs. Input Voltage

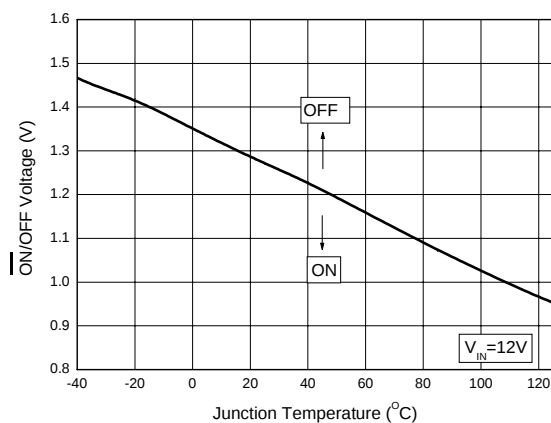
**150kHz 3A BUCK DC-DC CONVERTER****AP3003****Typical Performance Characteristics (Continued)**

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

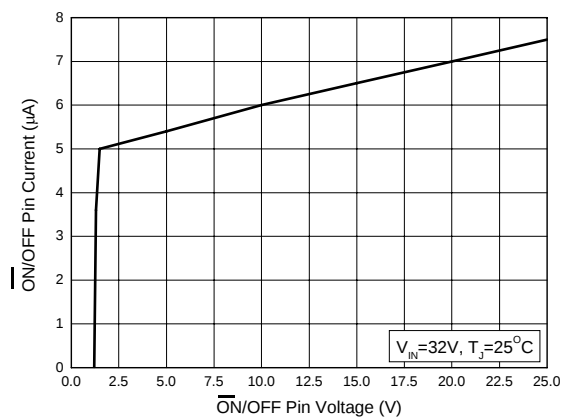


Figure 17. On/Off Pin Current vs. On/Off Pin Voltage

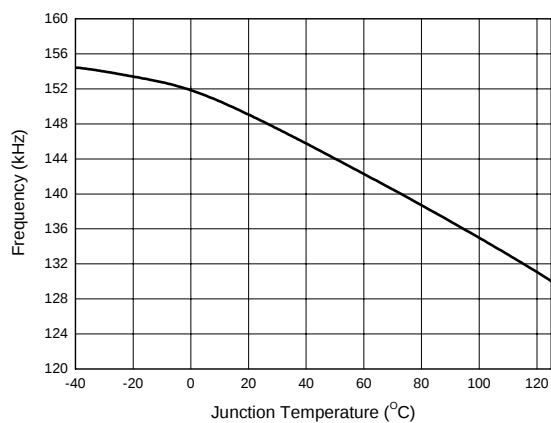
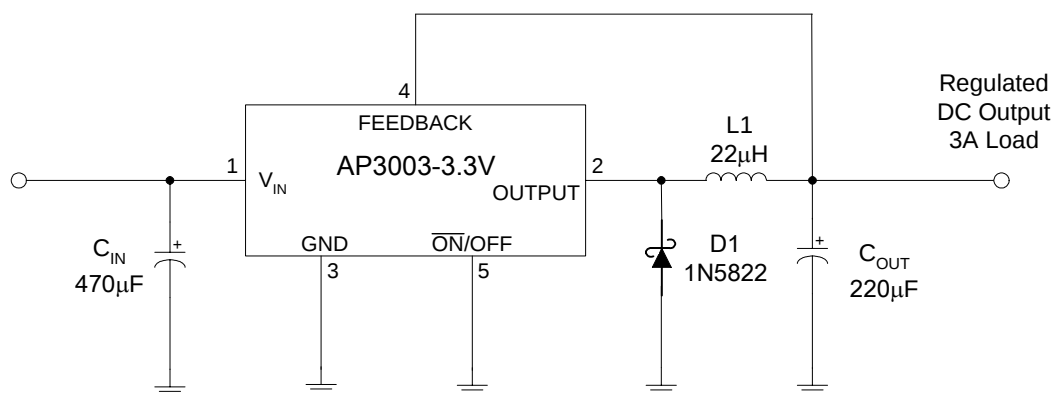


Figure 18. Switching Frequency vs. Junction Temperature

150kHz 3A BUCK DC-DC CONVERTER

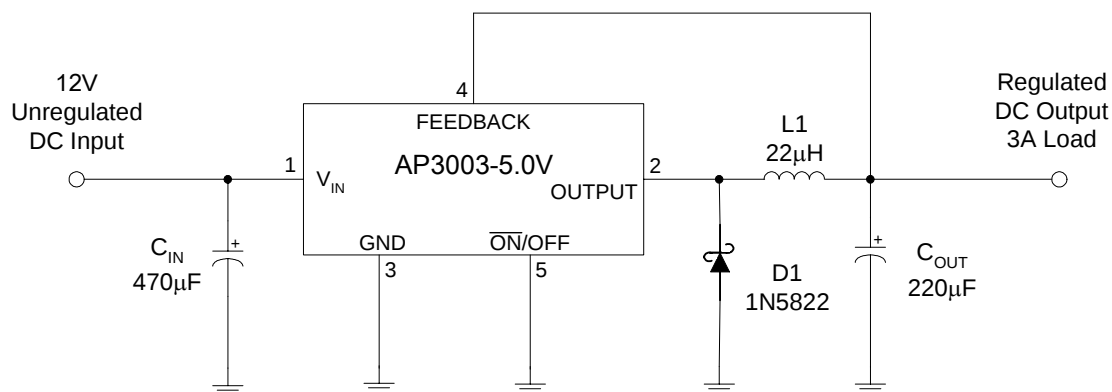
AP3003

Typical Application



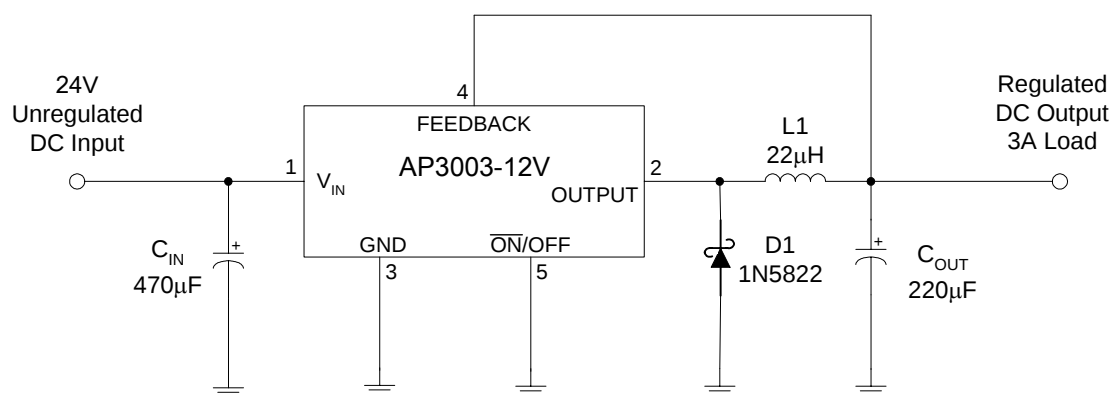
L1: Sumida CDRH127/LDNP-220MC or Equivalent

Figure 19. Typical Application of AP3003-3.3V



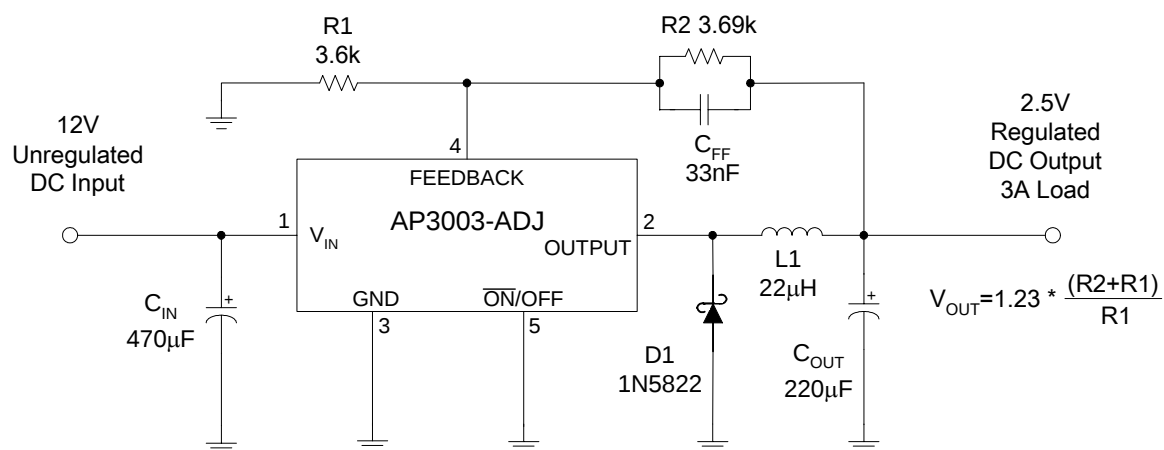
L1: Sumida CDRH127/LDNP-220MC or Equivalent

Figure 20. Typical Application of AP3003-5.0V

**150kHz 3A BUCK DC-DC CONVERTER****AP3003****Typical Application (Continued)**

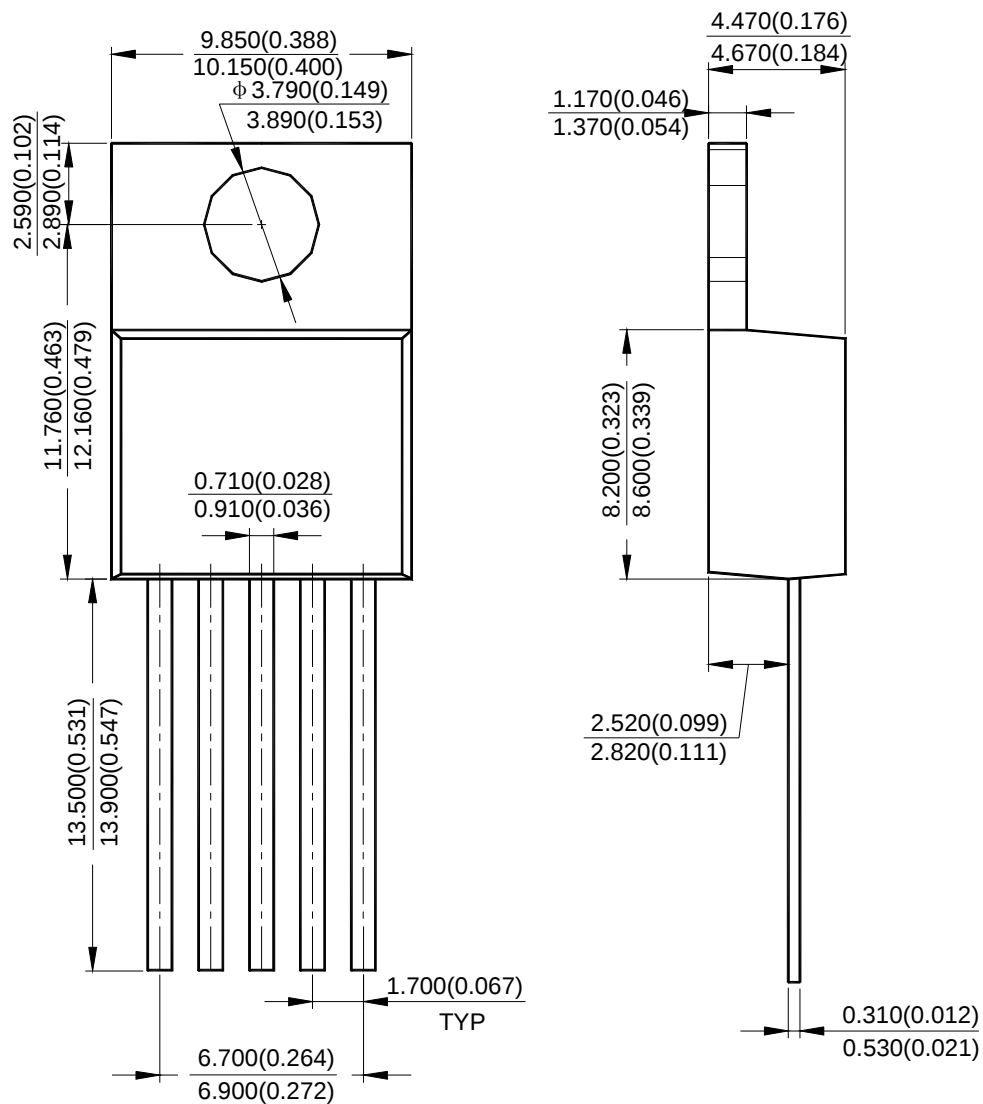
L1: Sumida CDRH127/LDNP-220MC or Equivalent

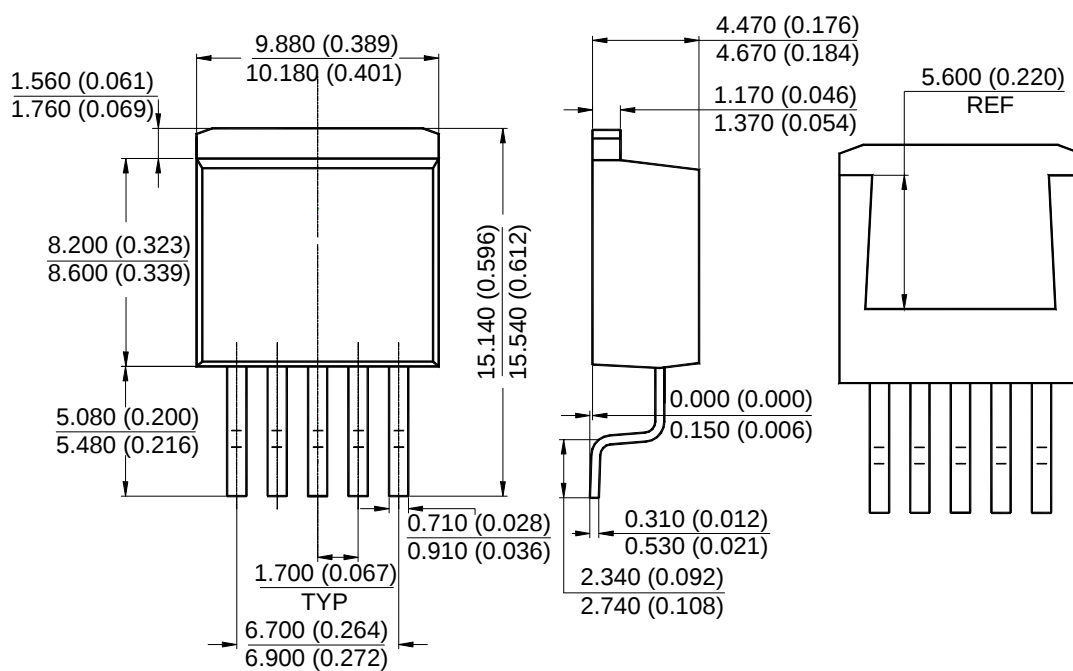
Figure 19. Typical Application of AP3003-12V



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

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