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.

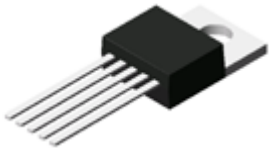
These ICs are available in TO-220-5 and TO-263-5 packages.

Features

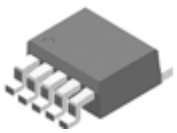
- 3.3V, 5V, 12V Fixed (±4% Tolerance) and Adjustable (±3% Tolerance) Output Versions
- Guaranteed 3A Output Load Current
- 150kHz Fixed Frequency Internal Oscillator
- Input Voltage Range up to 32V
- Requires only 4 external components
- High Efficiency up to 90%
- Excellent Line and Load Regulation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

Applications

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



TO-220-5



TO-263-5

Figure 1. Package Types of AP3003

Pin Configuration

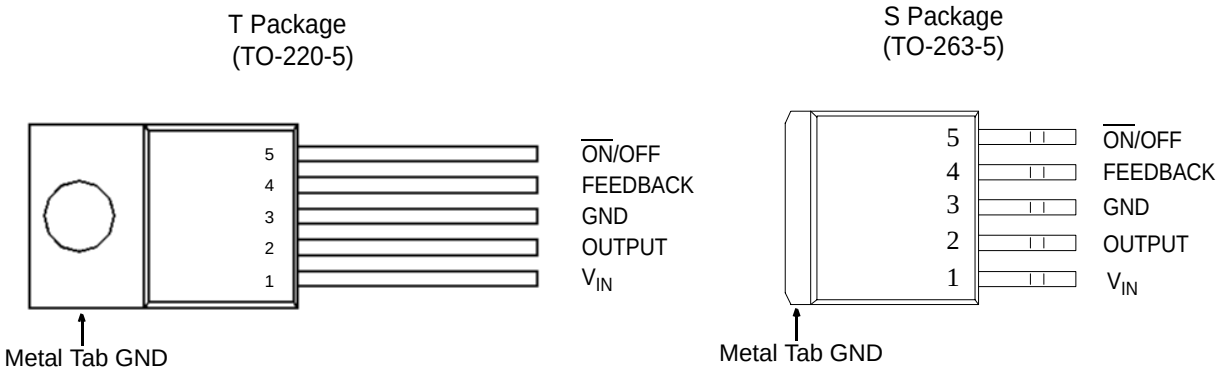


Figure 2. Pin Configuration of AP3003 (Top View)

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

Functional Block Diagram

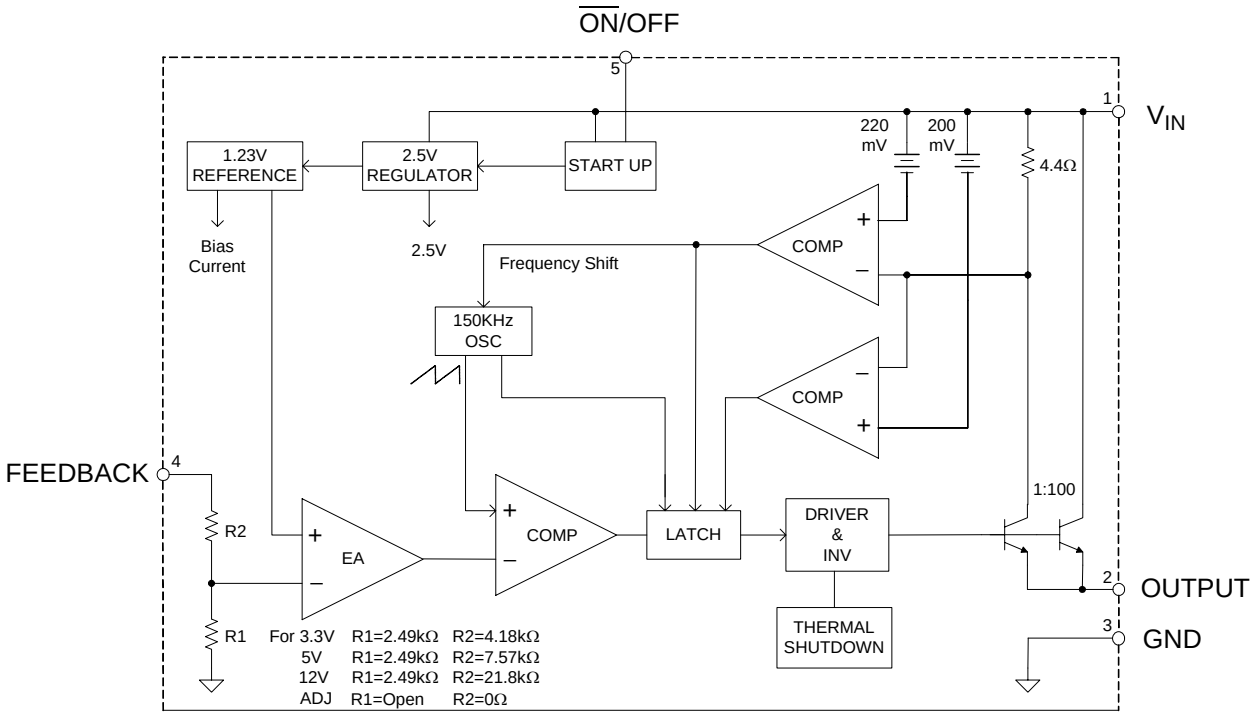
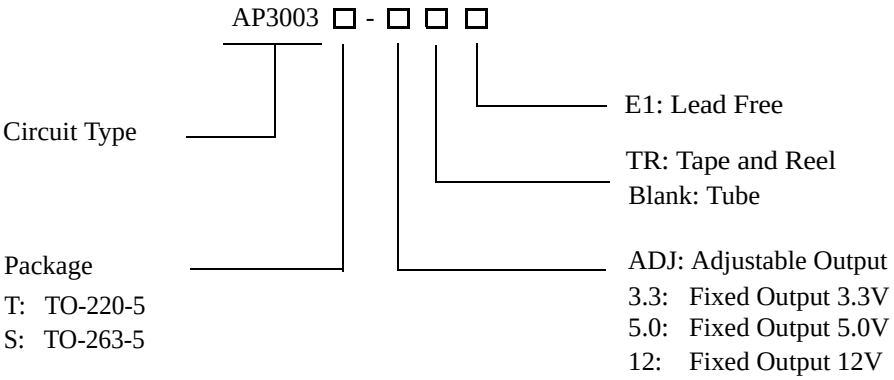


Figure 3. Functional Block Diagram of AP3003

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.

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.

Electrical Characteristics

For 3.3V Output Voltage Version

Unless otherwise specified, T_J=25°C. The specifications with **boldface type** apply over Full Operating Junction Temperature Range.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	5.5V≤V_{IN}≤32V, 0.2A≤I_{LOAD}≤3A	3.168 **3.135**	3.3	3.432 **3.465**	V
Efficiency	η	V_{IN}=12V, I_{LOAD}=3A		75		%

For 5V Output Voltage Version

Unless otherwise specified, T_J=25°C. The specifications with **boldface type** apply over Full Operating Junction Temperature Range.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	7V≤V_{IN}≤32V, 0.2A≤I_{LOAD}≤3A	4.800 **4.750**	5	5.200 **5.250**	V
Efficiency	η	V_{IN}=12V, I_{LOAD}=3A		80		%

For 12V Output Voltage Version

Unless otherwise specified, T_J=25°C. The specifications with **boldface type** apply over Full Operating Junction Temperature Range.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	15V≤V_{IN}≤32V, 0.2A≤I_{LOAD}≤3A	11.52 **11.40**	12.0	12.48 **12.60**	V
Efficiency	η	V_{IN}=24V, I_{LOAD}=3A		88		%

For ADJ Output Voltage Version

Unless otherwise specified, T_J=25°C. The specifications with **boldface type** apply over Full Operating Junction Temperature Range.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Feedback Voltage	V_{FB}	4.5V≤V_{IN}≤25V, 0.2A≤I_{LOAD}≤3A, V_{OUT} programmed for 2.5V	1.193 **1.18**	1.23	1.267 **1.28**	V
Efficiency	η	V_{IN}=12V, I_{LOAD}=3A, V_{OUT}=2.5V		73		%

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°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).

Typical Performance Characteristics

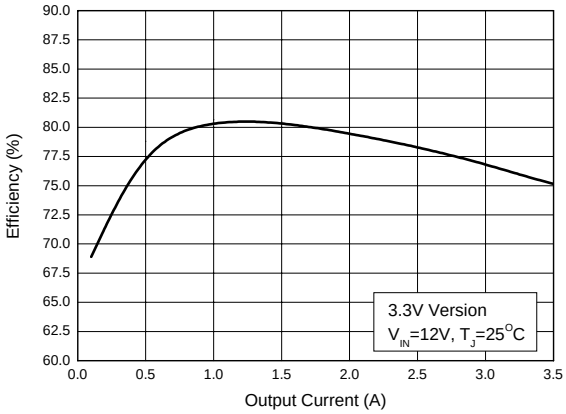


Figure 4. Efficiency vs. Output Current

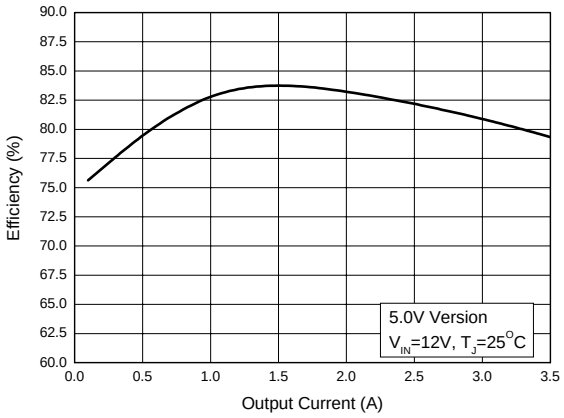


Figure 5. Efficiency vs. Output Current

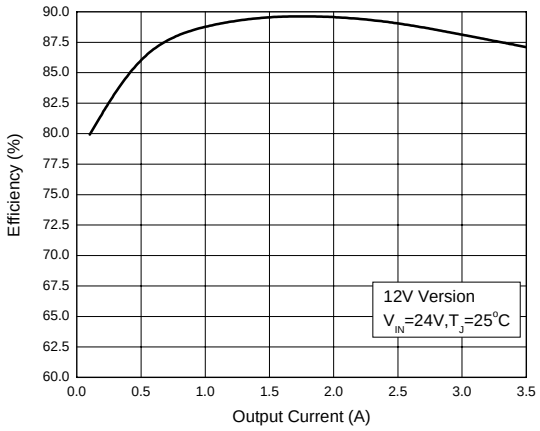


Figure 6. Efficiency vs. Output Current

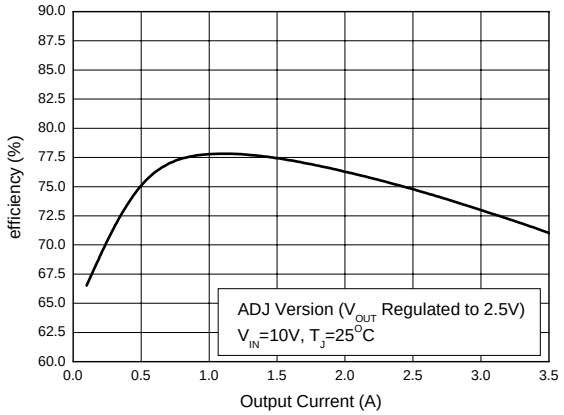


Figure 7. Efficiency vs. Output Current

Typical Performance Characteristics (Continued)

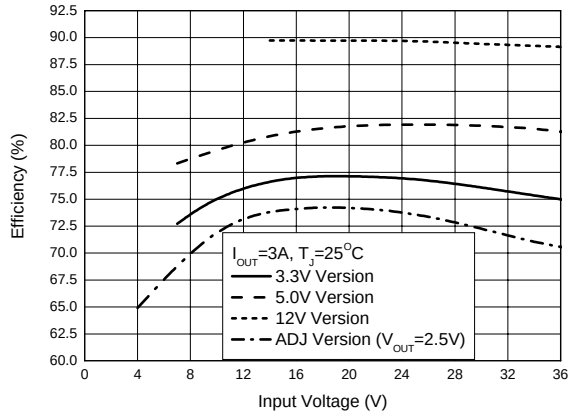


Figure 8. Efficiency vs. Input Voltage

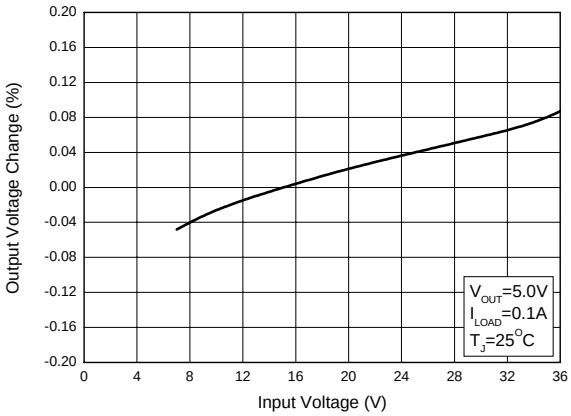


Figure 9. Line Regulation

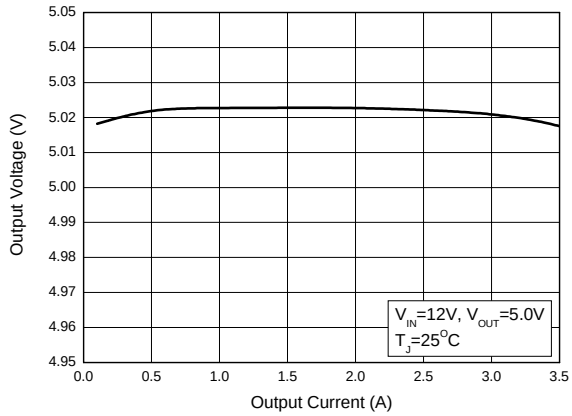


Figure 10. Load Regulation

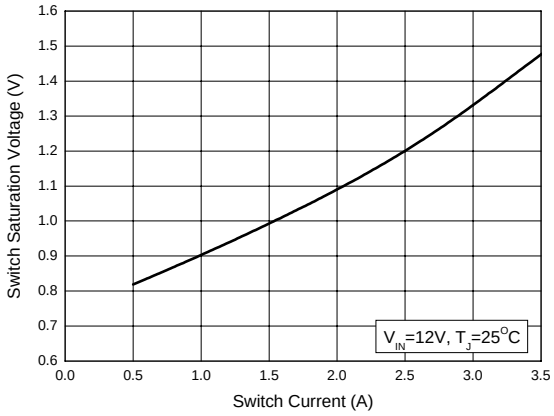


Figure 11. Switch Saturation Voltage vs. Switch Current

Typical Performance Characteristics (Continued)

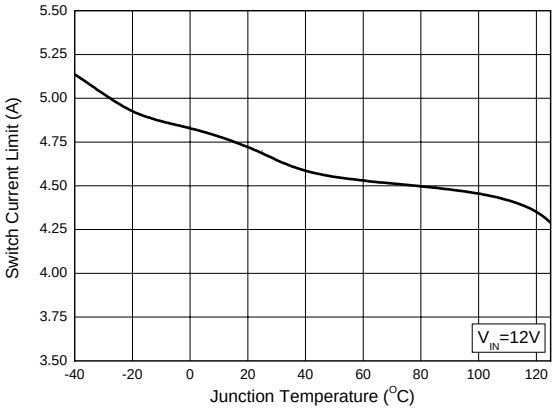


Figure 12. Switch Current Limit vs. Junction Temperature

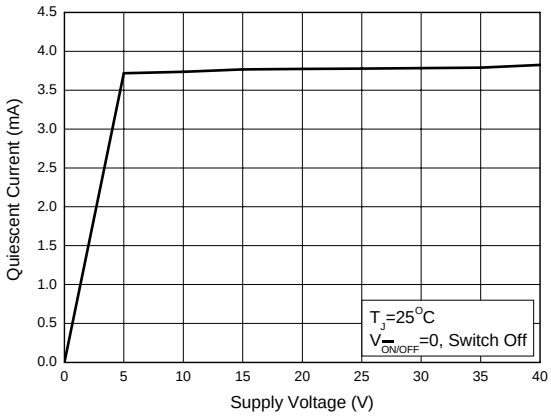


Figure 13. Quiescent Current vs. Supply Voltage

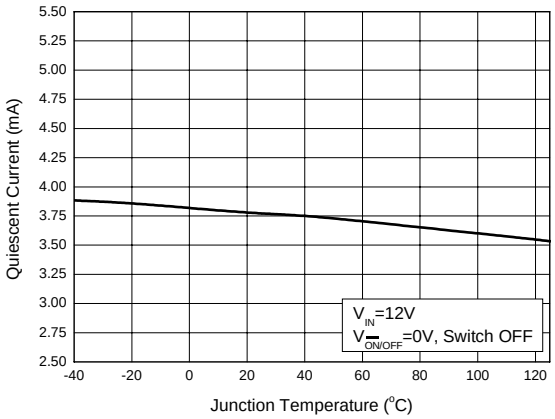


Figure 14. Quiescent Current vs. Junction Temperature

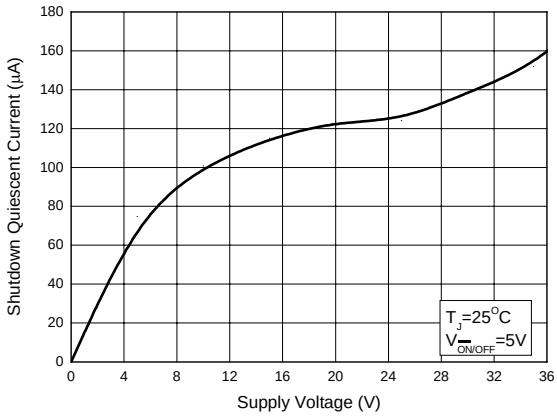


Figure 15. Shutdown Quiescent Current vs. Input Voltage

Typical Performance Characteristics (Continued)

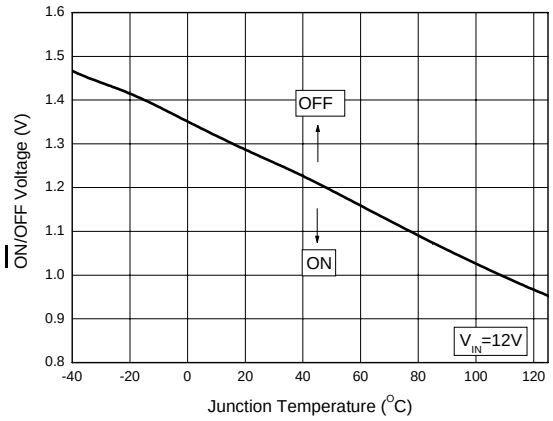


Figure 16. $\overline{On}$/Off Threshold Voltage vs. Junction Temperature

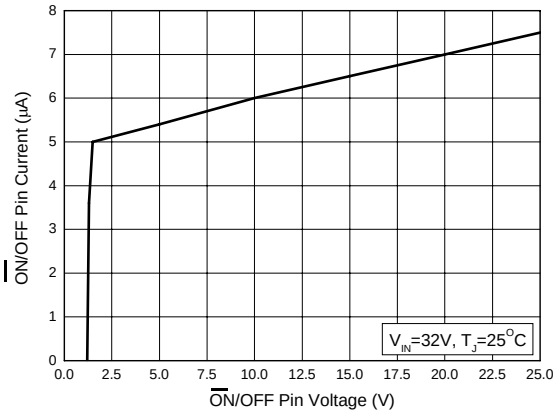


Figure 17. $\overline{On}$/Off Pin Current vs. $\overline{On}$/Off Pin Voltage

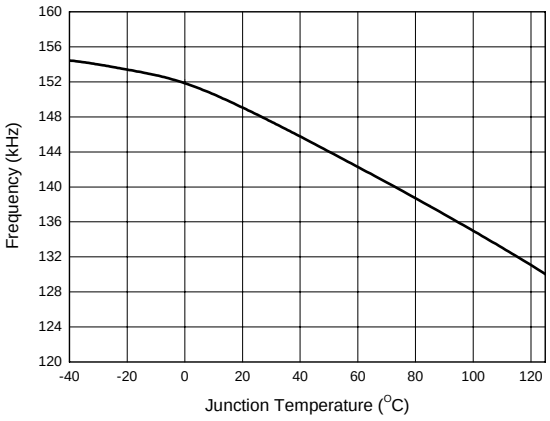
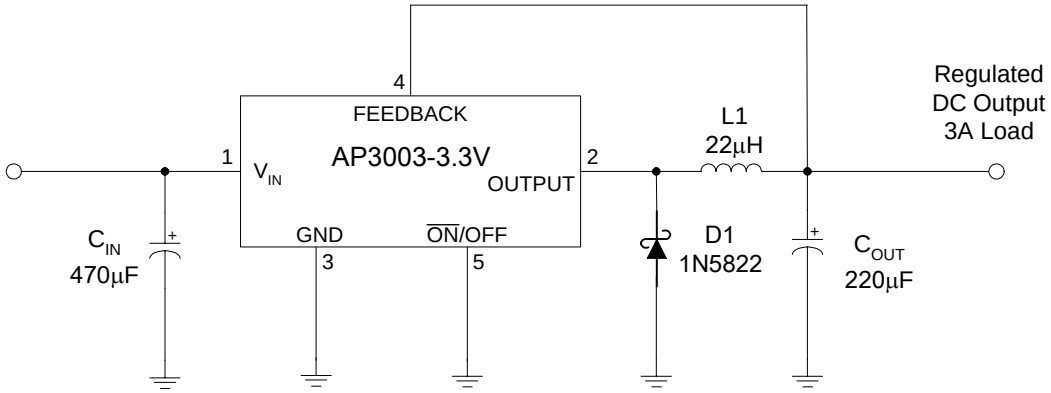


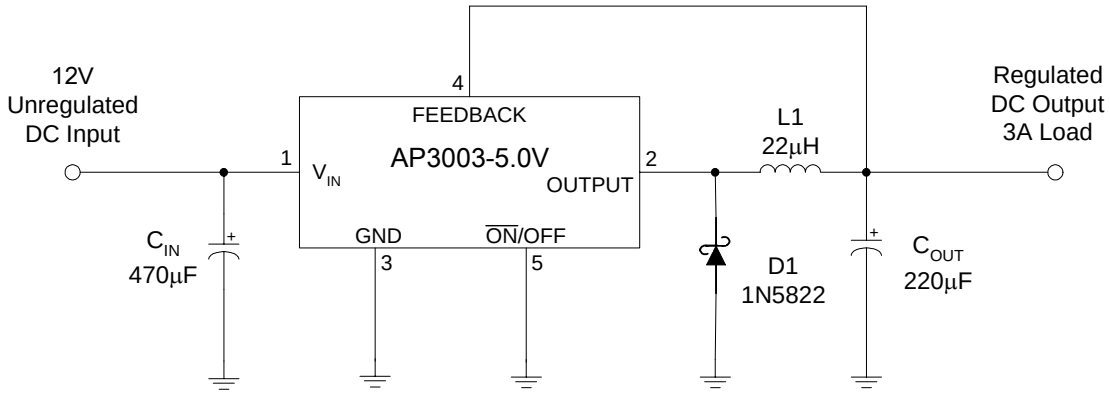
Figure 18. Switching Frequency vs. Junction Temperature

Typical Application



L1: Sumida CDRH127/LDNP-220MC or Equivalent

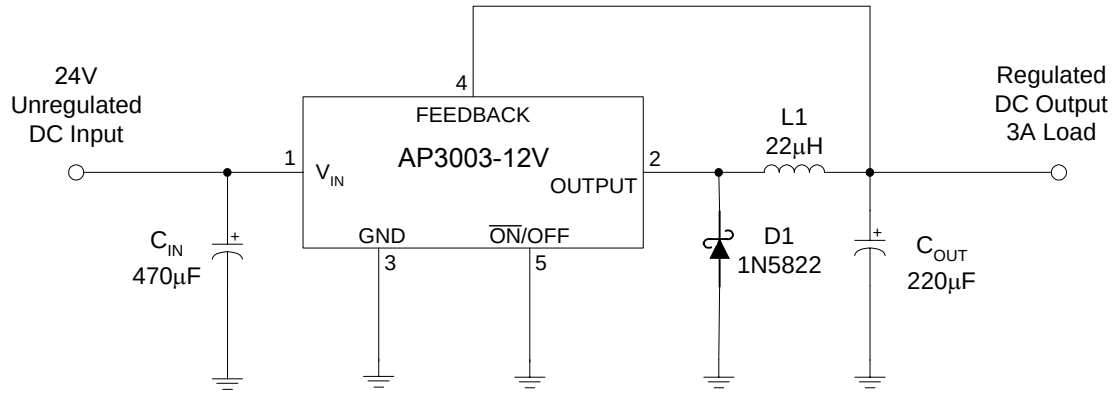
Figure 19. Typical Application of AP3003-3.3V



L1: Sumida CDRH127/LDNP-220MC or Equivalent

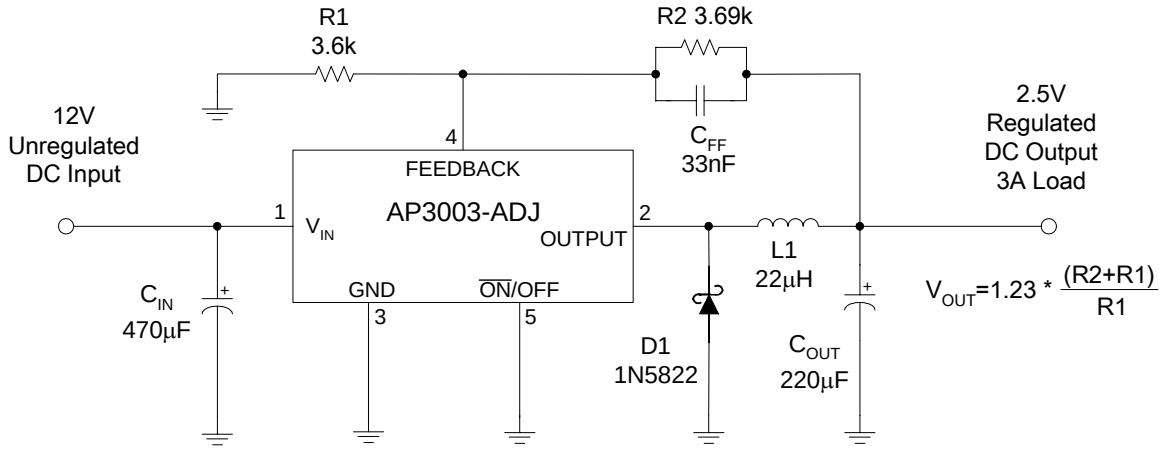
Figure 20. Typical Application of AP3003-5.0V

Typical Application (Continued)



L1: Sumida CDRH127/LDNP-220MC or Equivalent

Figure 19. Typical Application of AP3003-12V

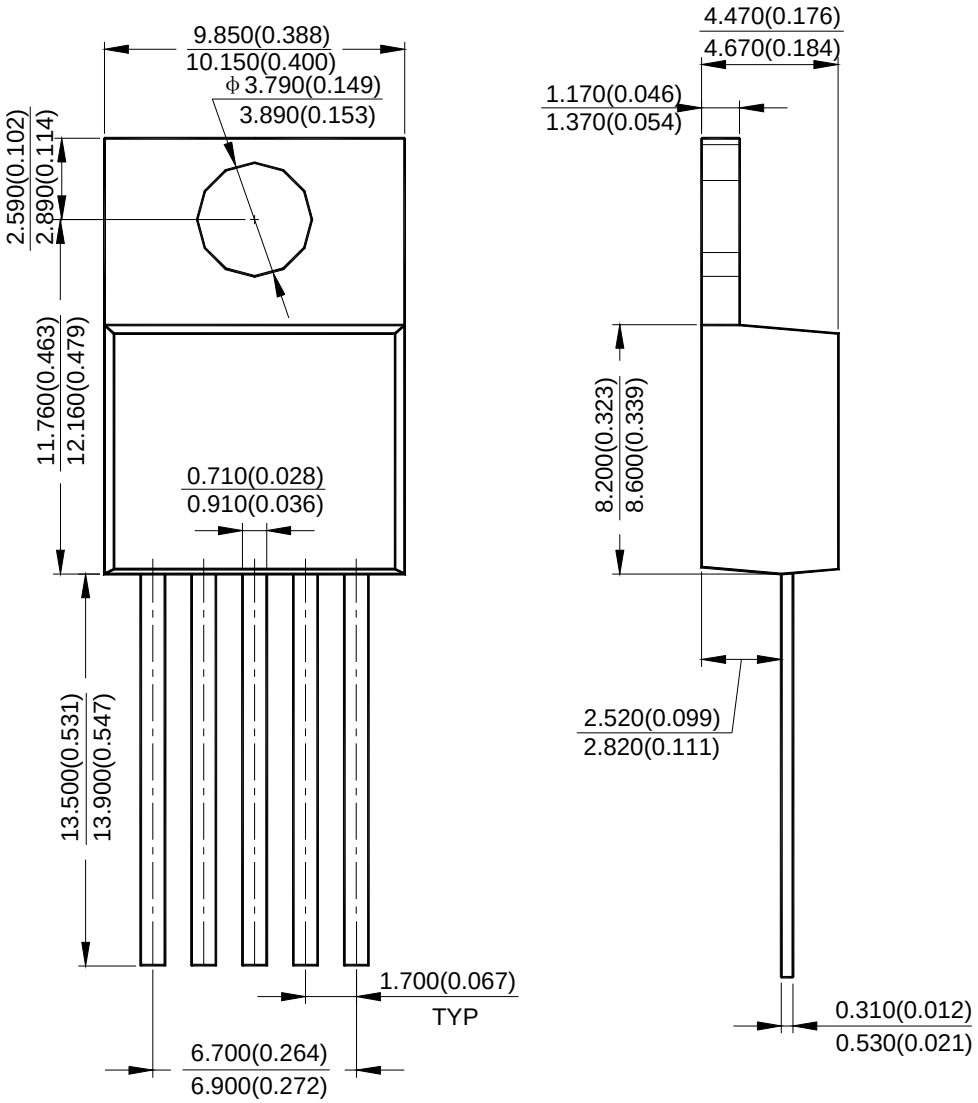


L1: Sumida CDRH127/LDNP-220MC or Equivalent

Figure 20. Typical Application of AP3003-ADJ

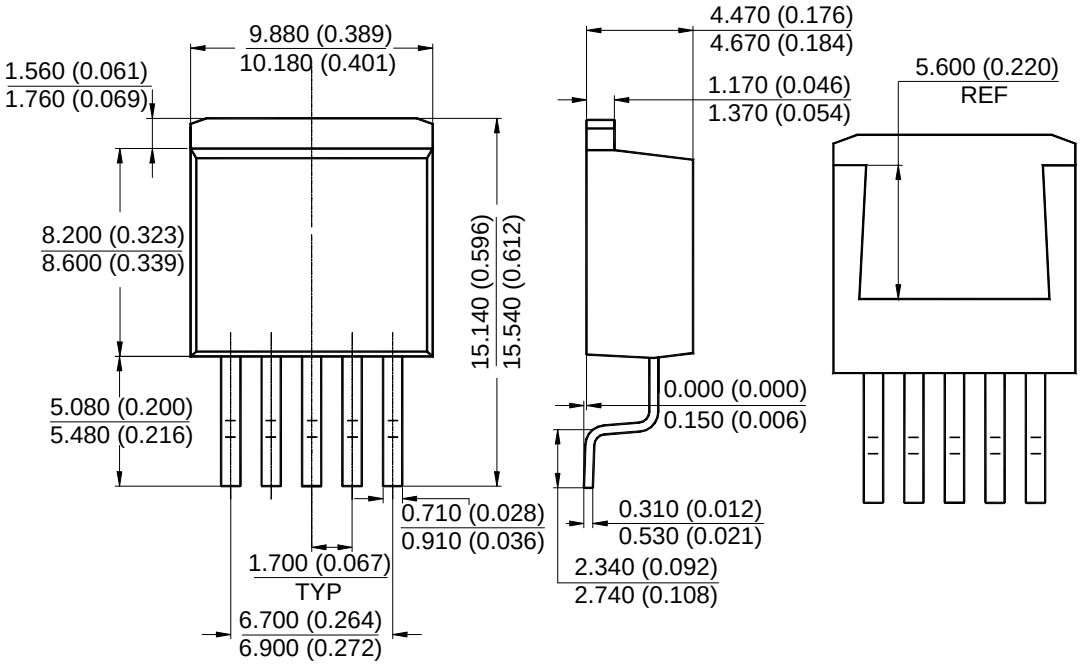
Mechanical Dimensions

TO-220-5 **Unit: mm(inch)**



Mechanical Dimensions (Continued)

TO-263-5 **Unit: mm(inch)**





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