



## NCP6334B/C Evaluation Board User's Manual

### 3 MHz, 2 A, High Efficiency, Low Ripple, Adjustable Output Voltage, Synchronous Buck Converter

ON Semiconductor®

<http://onsemi.com>

## EVAL BOARD USER'S MANUAL

### Overview

This document is a manual file for a demo board of the NCP6334B/C, which includes demo board schematics, bill of materials, PCB layout, jumper setup, and test procedure.

### About NCP6334B/C

The NCP6334B/C, a family of synchronous buck converters, which is optimized to supply different sub systems of portable applications powered by one cell Li-ion or three cell Alkaline/NiCd/NiMH batteries. The devices are able to deliver up to 2 A on an external adjustable voltage range from 0.6 V to 3.3 V. Operation with 3 MHz switching frequency allows employing small size inductor and capacitors. Input supply voltage feed-forward control is employed to deal with wide input voltage range. Synchronous rectification and automatic PWM/PFM power save mode offer improved system efficiency. The NCP6334B is in a space saving, low profile 2.0 × 2.0 × 0.75 mm WDFN-8 package.

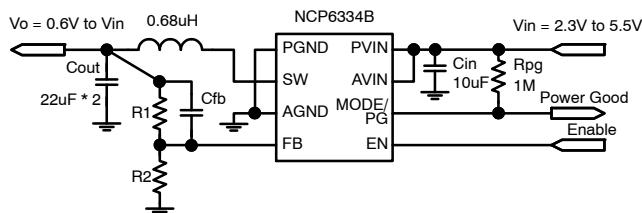
### Features

- 2.3 V to 5.5 V Input Voltage Range
- External Adjustable Voltage
- Up to 2 A Output Current

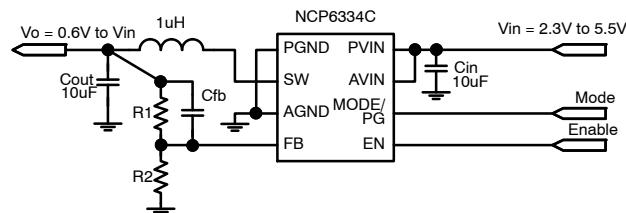
- 3 MHz Switching Frequency
- Synchronous Rectification
- Automatic Power Save or External Mode Selection
- Enable Input
- Power Good Output
- Soft Start
- Over Current Protection
- Active Discharge When Disabled. Hi-Z Version Available upon Request
- Thermal Shutdown Protection
- WDFN-8, 2 × 2 mm, 0.5 mm Pitch Package
- Maximum 0.8 mm Height for Super Thin Applications

### Typical Applications

- Cellular Phones, Smart Phones, and PDAs
- Portable Media Players
- Digital Still Cameras
- Wireless and DSL Modems
- USB Powered Devices
- Point of Load
- Game and Entertainment System



(a) Power Good Output (NCP6334B)



(b) External Mode Selection  
(NCP6334C Available upon Request)

Figure 1. Typical Application Circuits

# NCP6334GEVB

**Table 1. PIN DESCRIPTION**

Pin	Name	Type	Description
1	PGND	Power Ground	Power Ground for power, analog blocks. Must be connected to the system ground.
2	SW	Power Output	Switch Power pin connects power transistors to one end of the inductor.
3	AGND	Analog Ground	Analog Ground analog and digital blocks. Must be connected to the system ground.
4	FB	Analog Input	Feedback Voltage from the buck converter output. This is the input to the error amplifier. For fixed output devices, this pin is directly connected to the output capacitor; For external adjustable output devices, this pin is connected to the resistor divider network between the output and AGND.
5	EN	Digital Input	Enable of the IC. High level at this pin enables the device. Low level at this pin disables the device.
6	PG	Digital Output	PG pin is for NCP6334B with Power Good option. It is open drain output. Low level at this pin indicates the device is not in power good, while high impedance at this pin indicates the device is in power good.
7	AVIN	Analog Input	Analog Supply. This pin is the analog and the digital supply of the device. An optional 1 $\mu$ F or larger ceramic capacitor bypasses this input to the ground. This capacitor should be placed as close as possible to this input.
8	PVIN	Power Input	Power Supply Input. This pin is the power supply of the device. A 10 $\mu$ F or larger ceramic capacitor must bypass this input to the ground. This capacitor should be placed as close as possible to this input.
9	PAD	Exposed Pad	Exposed Pad. Must be soldered to system ground to achieve power dissipation performances. This pin is internally unconnected

**Table 2. MAXIMUM RATINGS**

Rating	Symbol	Value		Unit
		Min	Max	
Input Supply Voltage to GND	$V_{PVIN}, V_{AVIN}$	-0.3	7.0	V
Switch Node to GND	$V_{SW}$	-0.3	7.0	V
EN, PG to GND	$V_{EN}, V_{PG}$	-0.3	7.0	V
FB to GND	$V_{FB}$	-0.3	2.5	V
Human Body Model (HBM) ESD Rating are (Note 1)	ESD HBM	-	2,000	V
Machine Model (MM) ESD Rating are (Note 1)	ESD MM	-	200	V
Latch up Current: (Note 2) All pins, except digital pins Digital pins	$I_{LU}$	-100 -10	100 10	mA
Operating Junction Temperature Range	$T_J$	-40	125	°C
Operating Ambient Temperature Range	$T_A$	-40	85	°C
Storage Temperature Range	$T_{STG}$	-55	150	°C
Thermal Resistance Junction-to-Top Case (Note 4)	$R_{\theta JC}$		12	°C/W
Thermal Resistance Junction-to-Board (Note 4)	$R_{\theta JB}$		30	°C/W
Thermal Resistance Junction-to-Ambient (Note 4)	$R_{\theta JA}$		62	°C/W
Power Dissipation (Note 5)	$P_D$		1.6	W
Moisture Sensitivity Level (Note 6)	MSL		1	-

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

- This device series contains ESD protection and passes the following tests:  
Human Body Model (HBM)  $\pm 2.0$  kV per JEDEC standard: JESD22-A114.  
Machine Model (MM)  $\pm 200$  V per JEDEC standard: JESD22-A115.
- Latch up Current per JEDEC standard: JESD78 class II.
- The thermal shutdown set to 150°C (typical) avoids potential irreversible damage on the device due to power dissipation.
- The thermal resistance values are dependent of the PCB heat dissipation. Board used to drive these data was an 80 x 50 mm NCP6334EVB board. It is a multilayer board with 1 once internal power and ground planes and 2- once copper traces on top and bottom of the board. If the copper trances of top and bottom are 1 once too,  $R_{\theta JC} = 11$  °C/W,  $R_{\theta JB} = 30$  °C/W, and  $R_{\theta JA} = 72$  °C/W.
- The maximum power dissipation (PD) is dependent on input voltage, maximum output current and external components selected.
- Moisture Sensitivity Level (MSL): 1 per IPC/JEDEC standard: J-STD-020A.

# NCP6334GEVB

## Electrical Characteristics

For electrical characteristics, please refer to NCP6334B/C datasheet available on website: <http://www.onsemi.com>.

## Schematic of Demo Board

A schematic of NCP6334B/C demo board is shown in Figure 2, which is for a typical application with 1.8 V output voltage. It is flexible to configure the board for both PG devices (NCP6334B) and Mode devices (NCP6334C). Please refer to Jumper Configuration for details.

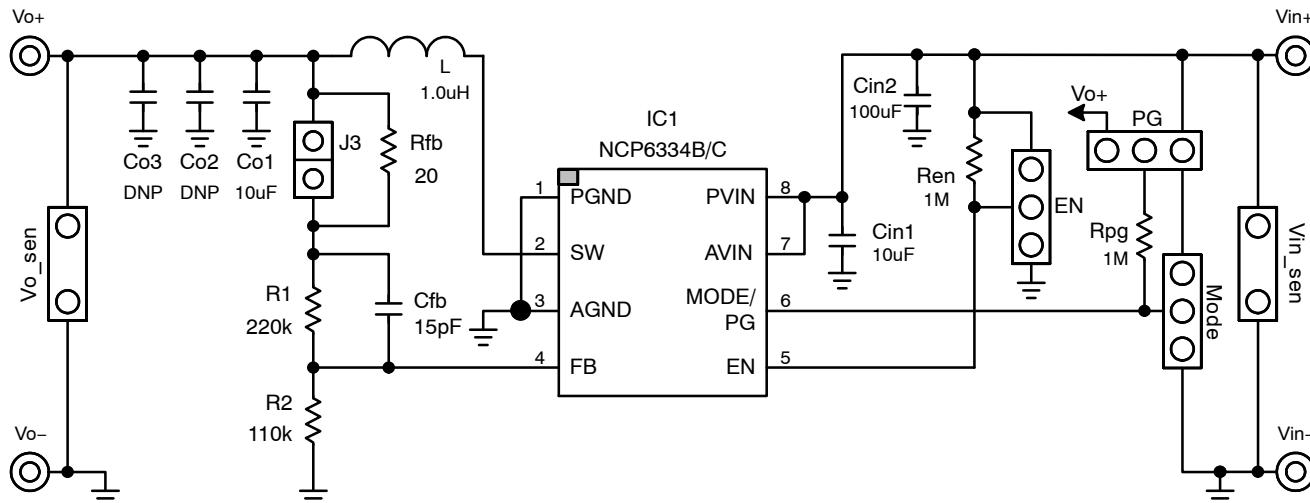


Figure 2. Schematic of NCP6334B/C Demo Board.

Table 3. BILL OF MATERIALS OF DEMO BOARD

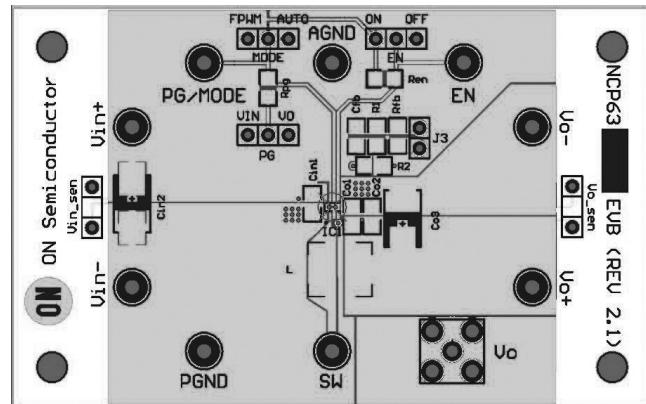
Item	Part Reference	Description	Package	Part Number	Manufacturer	Qty
1	IC1	3 MHz, 2 A, Synchronous Buck Converter	WDFN-8 2.0 x 2.0 x 0.75 mm	NCP63xyB/C	ON Semiconductor	1
2	Cin1	MLCC Cap 10 V, 10 $\mu$ F, X5R, $\pm 20\%$	0805	GRM21BR61A106KE19	muRata	1
3	Cin2	MLCC Cap 6.3 V, 100 $\mu$ F, X5R, $\pm 20\%$	1210	GRM32ER60J107ME20	muRata	1
4	Co1	MLCC Cap 6.3 V, 10 $\mu$ F, X5R, $\pm 20\%$	0603	GRM188R60J106ME47	muRata	1
5	L	Power Choke 1.0 $\mu$ H, $\pm 30\%$ , 2450 mA, 30 m $\Omega$	4.0 x 3.5 x 1.65 mm	LQH44PN1R0NP0	muRata	1
6	Ren, Rpg	Thick Film Chip Resistors, 1 M $\Omega$ , $\pm 5\%$ , 0.1 W	0603	ERJ3GEYJ105V	Panasonic	2
7	R1	Thick Film Chip Resistors, 220k $\Omega$ , $\pm 1\%$ , 0.1 W	0603	ERA3AEB224V	Panasonic	1
8	R2	Thick Film Chip Resistors, 110k $\Omega$ , $\pm 1\%$ , 0.1 W	0603	ERA3AEB114V	Panasonic	1
9	Cfb	MLCC, 15 pF, 50 V, 0603	0603	ECJ1VC1H150J	Panasonic	1
10	Rfb	Thick Film Chip Resistors, 20 $\Omega$ , $\pm 1\%$ , 0.1 W	0603	ERA3AEB200V	Panasonic	1

# NCP6334GEVB

## PCB Layout of Demo Board

A 80 × 50 mm PCB is designed for NCP6334B/C demo board. It is a 4-layer board with 1-once internal ground

planes (middle1 layer and middle2 layer) and 2-once copper traces on top layer and bottom layer of the board. Figure 3 shows layout information of the board.



# NCP6334GEVB

## Connections and Jumper Setup

There are two main configurations of the demo board for two different devices, which are NCP6334B (PG device) and NCP6334C (Mode device). External connections and

jumper setup for both configurations are shown in Figure 4. The default configuration of NCP6334B/C demo board is for NCP6334B devices.

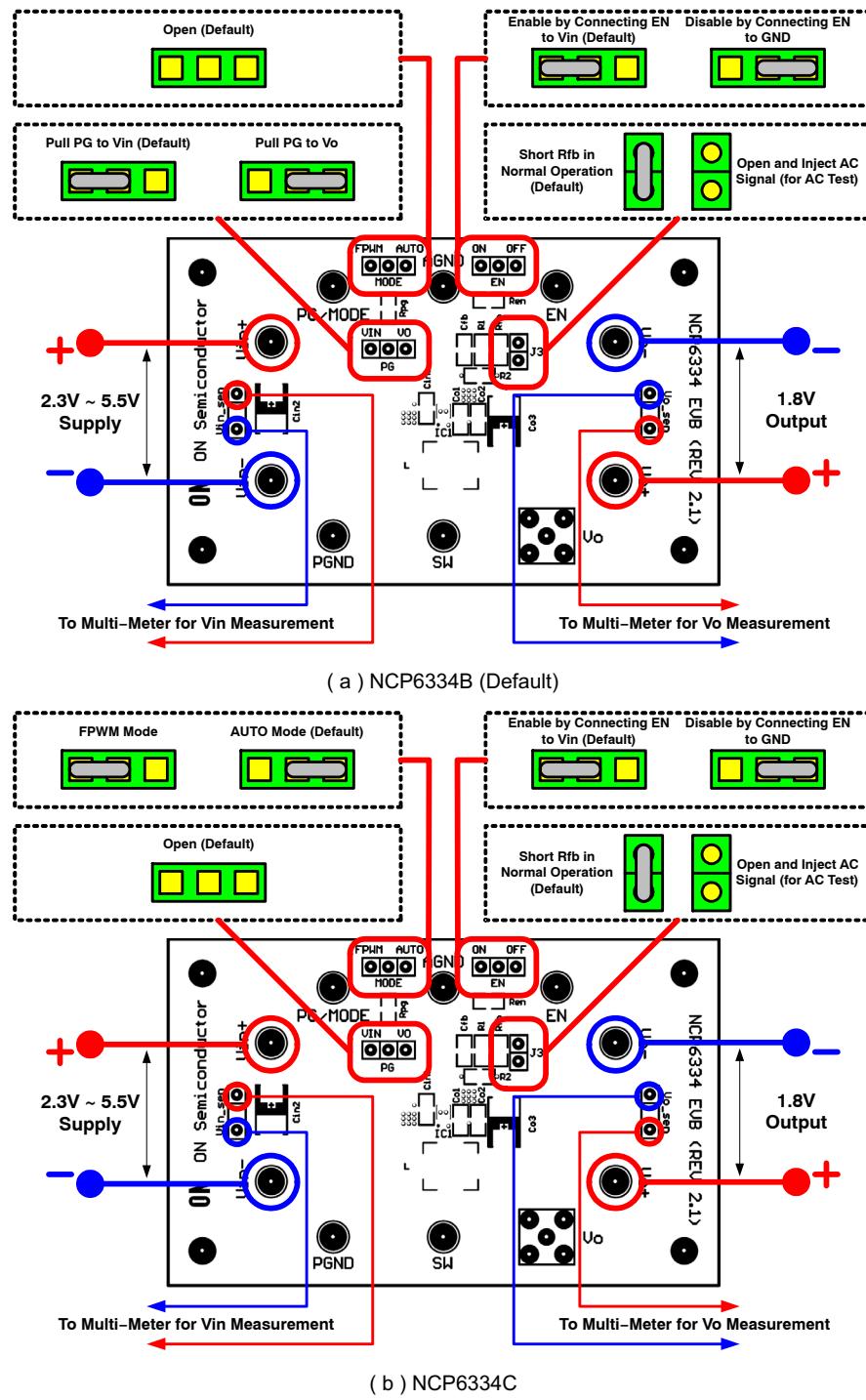


Figure 4. Connections and Jumper Setup of NCP6334B/C Demo Board

# NCP6334GEVB

## Test Procedure of Demo Board

1. Prepare equipments as below list.
  - a. DC power supply
  - b. Electronic load
  - c. Multimeters
  - d. Oscilloscope
2. Check jumper setup to make sure it is a right default configuration for the device under test.
3. Set the power supply to 3.6 V with a current limit higher than 1 A, and then disable the output of the power supply.
4. Connect the power supply to the demo board's connectors Vin+ and Vin-.
5. Disable output of the electronic load and connect it to the demo board's connectors Vo+ and Vo-.
6. Enable the output of the power supply and check the 1.8 V output voltage of the demo board.
7. Set the electronic load to 10 mA and enable its output. Typical input supply current is about 6mA.
8. Monitor the output voltage and SW node signal using an oscilloscope. The converter should operate in DCM with similar waveforms as shown in Figure 5(a).
9. Increase the electronic load to 1.0 A. Typical input supply current is about 565 mA.
10. Monitor the output voltage and SW node signal using the oscilloscope. The converter should operate in CCM with similar waveforms as shown in Figure 5(b). The switching frequency is about 3 MHz.
11. After the test is done, make sure to disable the output of power supply before remove power connectors to protect the device from damage caused by possible high voltage spike in input.



(a)  $Io = 10 \text{ mA}$



(b)  $Io = 1000 \text{ mA}$

**Figure 5. Typical Operation Waveforms of NCP6334B/C Demo Board**

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

The evaluation board/kit (research and development board/kit) (hereinafter the "board") is not a finished product and is as such not available for sale to consumers. The board is only intended for research, development, demonstration and evaluation purposes and should as such only be used in laboratory/development areas by persons with an engineering/technical training and familiar with the risks associated with handling electrical/mechanical components, systems and subsystems. This person assumes full responsibility/liability for proper and safe handling. Any other use, resale or redistribution for any other purpose is strictly prohibited.

The board is delivered "AS IS" and without warranty of any kind including, but not limited to, that the board is production-worthy, that the functions contained in the board will meet your requirements, or that the operation of the board will be uninterrupted or error free. ON Semiconductor expressly disclaims all warranties, express, implied or otherwise, including without limitation, warranties of fitness for a particular purpose and non-infringement of intellectual property rights.

ON Semiconductor reserves the right to make changes without further notice or any board.

You are responsible for determining whether the board will be suitable for your intended use or application or will achieve your intended results. Prior to using or distributing any systems that have been evaluated, designed or tested using the board, you agree to test and validate your design to confirm the functionality for your application. Any technical, applications or design information or advice, quality characterization, reliability data or other services provided by ON Semiconductor shall not constitute any representation or warranty by ON Semiconductor, and no additional obligations or liabilities shall arise from ON Semiconductor having provided such information or services.

The boards are not designed, intended, or authorized for use in life support systems, or any FDA Class 3 medical devices or medical devices with a similar or equivalent classification in a foreign jurisdiction, or any devices intended for implantation in the human body. Should you purchase or use the board for any such unintended or unauthorized application, you shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the board.

This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and may not meet the technical requirements of these or other related directives.

FCC WARNING – This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by ON Semiconductor to be a finished end product fit for general consumer use. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment may cause interference with radio communications, in which case the user shall be responsible, at its expense, to take whatever measures may be required to correct this interference.

ON Semiconductor does not convey any license under its patent rights nor the rights of others.

**LIMITATIONS OF LIABILITY:** ON Semiconductor shall not be liable for any special, consequential, incidental, indirect or punitive damages, including, but not limited to the costs of requalification, delay, loss of profits or goodwill, arising out of or in connection with the board, even if ON Semiconductor is advised of the possibility of such damages. In no event shall ON Semiconductor's aggregate liability from any obligation arising out of or in connection with the board, under any theory of liability, exceed the purchase price paid for the board, if any.

For more information and documentation, please visit [www.onsemi.com](http://www.onsemi.com).

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada

**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)

**Order Literature:** <http://www.onsemi.com/orderlit>

For additional information, please contact your local  
Sales Representative

