NCP1570DEMO/D

Demonstration Note for NCP1570

5.0 V/12 V Bias to 2.5 V/10 A Synchronous Buck Converter

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DEMONSTRATION NOTE

Description

The NCP1570 demonstration board is a 3.6″ by 1.8″, two–layer printed circuit board, optimized for small solution size and lowest solution cost. This demonstration circuit can be used to evaluate the performance and functionality of NCP1570, Low Voltage Synchronous Buck Controller. From a 5.0 V input with a 12 V bias supply, this board produces a 2.5 V, 10 A output. The NCP1570 controller uses the V^2™ control scheme to achieve the fastest possible transient response and best overall regulation, while using the least number of external components. Another feature of the NCP1570 is a Power Good output to indicate whether the output signal is within regulation limits. The NCP1570 also provides under–voltage lockout, soft start, and built–in adaptive FET non–overlap.

Features

- Synchronous Buck Topology
- 1% Output Voltage Regulation
- Entire 5.0 V to 2.5 V, 10 A Converter Fits in Less Than 2.3 in.^{2}
- Power Good Output with Programmable Delay
- V^2 Control Method
- Fixed–Frequency Internal 200 kHz Oscillator
- 200 ns Transient Response
- 0 or 100% Duty Cycle During Load Transient
- Programmable Soft Start
- Under–Voltage Lockout
- Excellent Line and Load Regulation
- Low Output Voltage Ripple

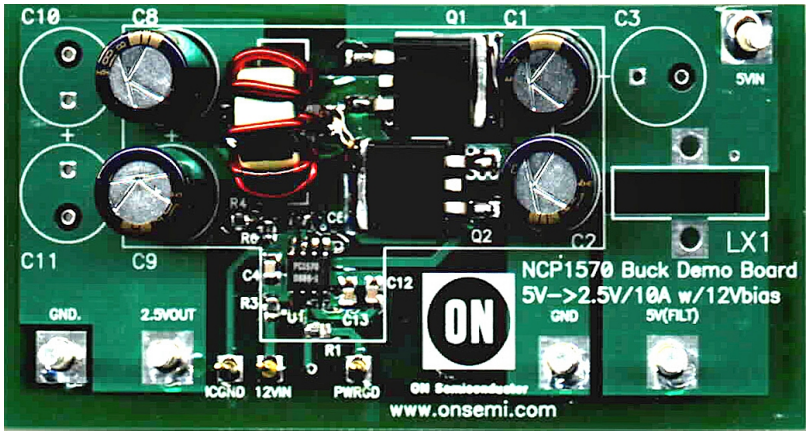

Figure 1. NCP1570 Demonstration Board

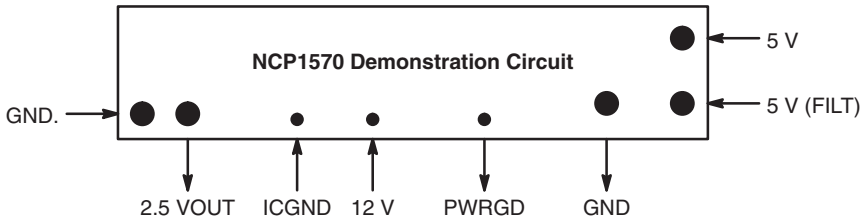

Figure 2. Application Diagram

TERMINAL DESCRIPTION

Terminal Name	Description
5 V	Power stage power supply, 5.0 V recommended.
5 V (FILT)	Power stage power supply, filtered with optional inductor, 5.0 V recommended.
GND	Return for the 5.0 V supply.
2.5 VOUT	2.5 V/10 A output.
GND.	Return for the 2.5 V/10 A output.
PWRGD	Power Good signal indicates output voltage in regulation.
12 VIN	IC and MOSFET bias power supply, 12 V recommended.
ICGND	Return for the 12 V supply.

MAXIMUM RATINGS

Pin Name	V_{MAX}	V_{MIN}	I_{SOURCE}	I_{SINK}
5 V	6.3 V	–0.3 V	N/A	10 A
5 V (FILT)	6.3 V	–0.3 V	N/A	10 A
GND	0.3 V	–0.3 V	15 A	N/A
2.5 VOUT	6.3 V	–0.3 V	17 A	N/A
GND.	0.3 V	–0.3 V	N/A	17 A
PWRGD	6.3 V	–0.3 V	1.0 mA	20 mA
12 VIN	15 V	–0.3 V	N/A	450 mADC
ICGND	0.3 V	–0.3 V	450 mADC	N/A

ELECTRICAL CHARACTERISTICS ($25°C \le T_A \le 50°C$, $11\ V \le V_{IN} \le 13.4\ V$, $f_{SW} = 200$ kHz, unless otherwise noted)

Parameter	Test Conditions	Min	Typ	Max	Unit
V_{OUT}					
Output Voltage	$0.5\ A < I(2.5\ V_{OUT}) < 10\ A$	–	2.50	–	V
Line Regulation	$10\ V \le V_{IN}$ (12 V) ≤ 15 V	–	0.03	–	%
Line Regulation	$4.5\ V \le V_{IN}$ (5.0 V) ≤ 5.5 V	–	0.05	–	%
Load Regulation	$0.5\ A < I(2.5\ V_{OUT}) < 10\ A$	–	0.2	–	%
Ripple and Noise	$0.5\ A < I(2.5\ V_{OUT}) < 10\ A$, 20 MHz Scope Bandwidth	–	25	–	mV_{PP}
Transient Regulation	5.0 A, 10 A/μs Load Step, 20 MHz Scope Bandwidth	–	92	–	mV
Transient Recovery Time	5.0 A Load Step, 20 MHz Scope Bandwidth. Measure the time when output exceeds DC limit.	–	250	–	μs
Efficiency	$I(2.5\ V_{OUT}) = 10\ A$	–	85	–	%
V_{IN}					
Start Threshold	–	8.0	8.5	9.0	V
Stop Threshold	–	7.0	7.5	8.0	V
General					
Switching Frequency	Free Running	150	175	250	kHz

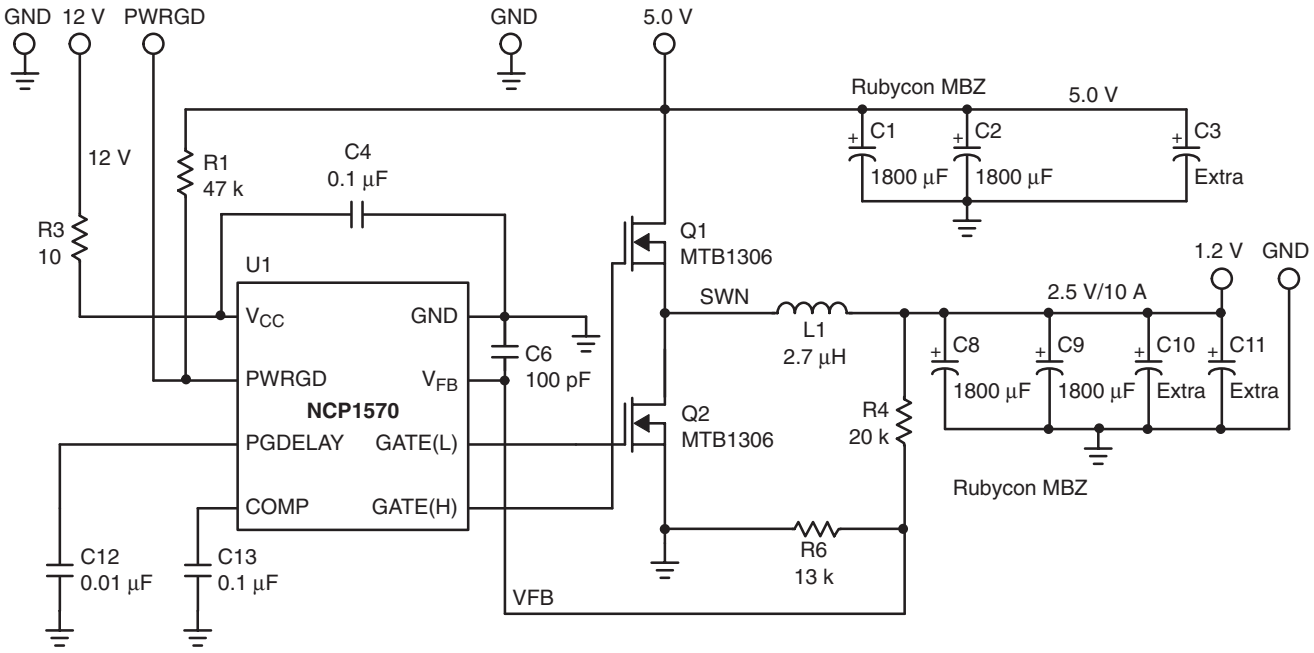

Figure 3. Demonstration Circuit Schematic

OPERATION GUIDELINES

- Two supplies are required to operate this converter. A 5.0 V supply capable of delivering at least 6.0 A is used to derive the output voltage. A 12 V supply capable of 50 mA is used to power the IC. Separate grounds are provided for each input.
- Connect a load directly to the 2.5 V output and its separate return ground. A short connection to the load will ensure the best load regulation and smallest output ripple voltage.
- The Power Good output is high when the output is within 90% of regulation. When the output falls below 70% of design output voltage, Power Good goes low. The Power Good pin is pulled high through a 47 kΩ resistor to the 5.0 V line.
- The IC reference voltage is 0.985 V. A 13 k/20 k resistor divider is used to set the output voltage to 2.5 V. These components can be changed to provide any desired voltage between 0.985 V and 5 V, however, some small jitter may become noticeable below 1.2 V output. Also, the series combination of the two resistors should be large enough (at least 10 k) to avoid pulling too much current.
- If the user requires a lower input current slew rate or less voltage drop at the 5.0 V input, provisions have been made to add an inductor. If an input inductor is used, additional input capacitance will be necessary to prevent damage to the existing input capacitors.

TYPICAL PERFORMANCE CHARACTERISTICS

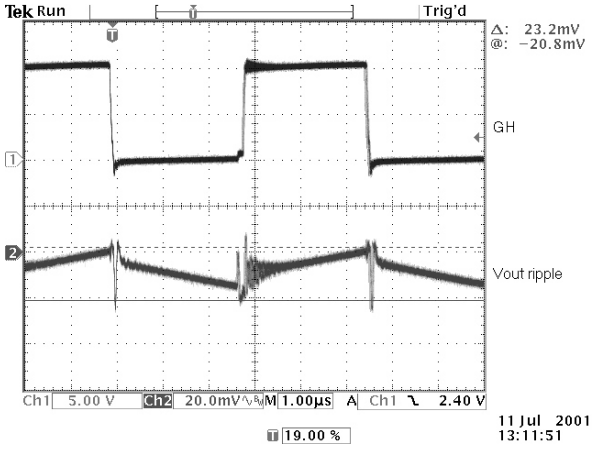

Figure 4. GH and V_{OUT} Ripple at No Load

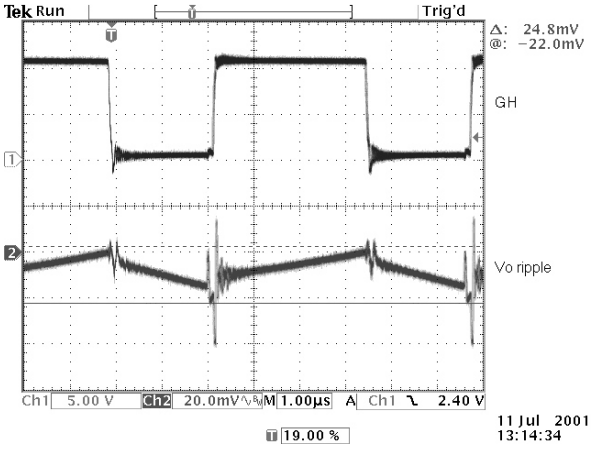

Figure 5. GH and V_{OUT} Ripple at 10 A Load

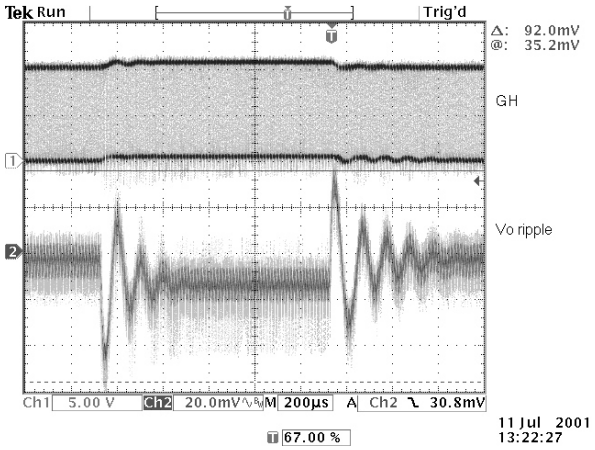

Figure 6. GH and V_{OUT} Ripple in 50 mA–10 A Transient Load

Table 1. Component Temperatures Measured in Still Air, and Ambient Temperature at 23°C

	V_{OUT}	V_{OUT}	
Load	0	10	A
Top FET	31	62	°C
Bottom FET	33	58	°C
Inductor	38	58	°C
Input Cap.	30	48	°C
Output Cap.	30	41	°C
IC	42	55	°C

BILL OF MATERIALS

Item	Qty	Reference	Part	Mfg. & P/N	Distributor
1	4	C1, 2, 8, 9	1800 μF	Rubycon MBZ–Series Low ESR Capacitor	Masline 716–546–5373
2	1	C3, 10, 11	Empty	Provision	–
3	2	C4, 13	Ceramic, 0.1 μF/25 V 0805	Panasonic ECJ–3VB1E104K	Digi–Key 800–344–4539
4	1	C6	Ceramic, 100 pF/25 V 0805	Panasonic TBD	Digi–Key 800–344–4539
5	1	C12	Ceramic, 0.01 μF/25 V 0805	Panasonic TBD	Digi–Key 800–344–4539
6	1	L1	2.7 μH Inductor 8T #16AWG on a T50–52B Micrometals Core	–	–
7	2	Q1, Q2	N–Channel D^2PAK MOSFET 30 V/30 A	ON Semiconductor MTB1306	ON Semiconductor 800–282–9855
8	1	R1	Resistor 47 kΩ 5% 0805	Panasonic TBD	Digi–Key 800–344–4539
9	1	R3	Resistor 10 kΩ 5% 0805	Panasonic TBD	Digi–Key 800–344–4539
10	1	R4	Resistor 20 kΩ 1% 0805	Panasonic TBD	Digi–Key 800–344–4539
11	1	R6	Resistor 13 kΩ 1% 0805	Panasonic TBD	Digi–Key 800–344–4539
12	1	U1	Low–Voltage Synchronous Buck Controller	ON Semiconductor NCP1570	ON Semiconductor 800–282–9855

PCB LAYOUT

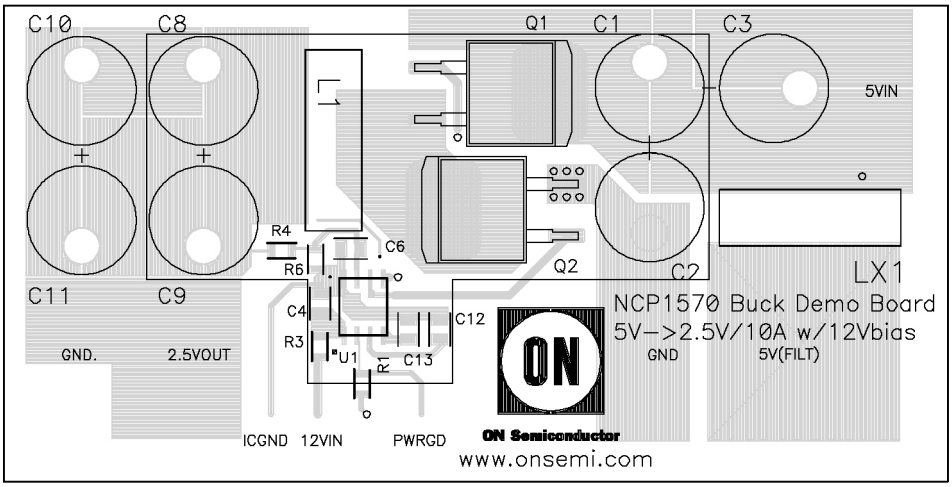

Figure 7. Top Layer and Top Silk

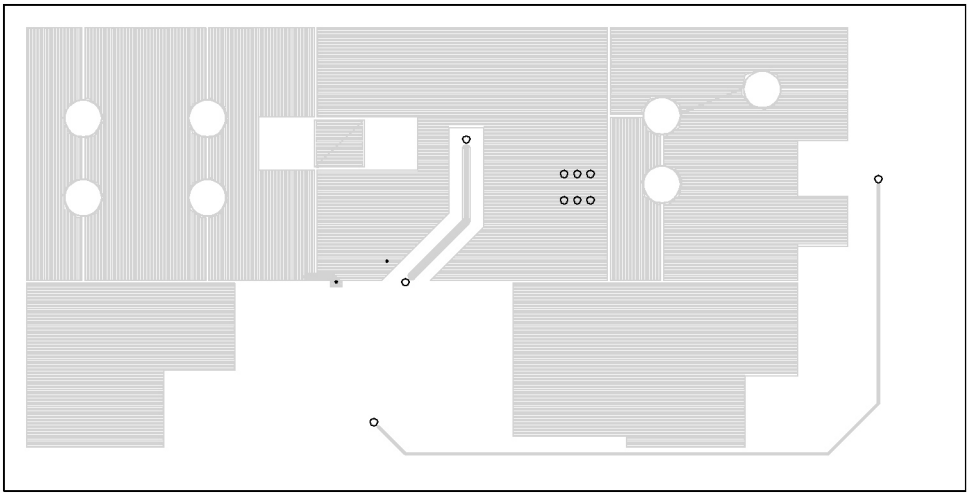

Figure 8. Bottom Layer

Notes

V^2 is a trademark of Switch Power, Inc.

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