NCV890101GEVB

NCV890101 Automotive Grade High-Frequency Buck Regulator Evaluation Board User's Manual

ON Semiconductor®

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EVAL BOARD USER'S MANUAL

Description

The NCV890101 demonstration board provides a convenient way to evaluate a high-frequency buck converter design. No additional components are required, other than dc supplies for the input and enable voltages. An external clock can be used to synchronize the switching frequency; and the board also provides a synchronization output, enabling it to be used as a master. It is configured for a 3.3 V output with a 2 MHz switching frequency and a 1.2 A maximum output current, over the typical 4.5 V to 18 V automotive input voltage range. In addition, the board regulates up to 36 V thanks to switching frequency foldback.

Key Features

- 3.3 V Output Voltage
- 2 MHz Switching Frequency
- 1.2 A Current Limit
- Wide Input Voltage of 4.5 V to 36 V
- Regulates through Load Dump Conditions
- External Clock Synchronization up to 2.5 MHz
- Synchronization Output
- Automotive Grade

Figure 1. NCV890101GEVB Board Picture

Table 1. DEMONSTRATION BOARD TERMINALS

Terminal	Function
VIN	Positive dc input voltage
GND	Common dc return
VOUT	Regulated dc output voltage
EN	Enable input
SYNCI	Input for external clock synchronization
SYNCO	Output for synchronizing other boards

Table 2. ABSOLUTE MAXIMUM RATINGS
(Voltages are with respect to GND)

Rating	Value	Units
Dc supply voltage (VIN, EN)	-0.3 to 36 V	V
Dc supply voltage (SYNCI)	-0.3 to 6 V	V
Junction Temperature (NCV890101)	-40 to 150	°C
Ambient temperature (Demo Board)	-40 to 85	°C

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.

Table 3. ELECTRICAL CHARACTERISTICS
(T_A = 25°C, 4.5 V ≤ V_{IN} ≤ 40 V, V_{EN} = 2 V, V_{OUT} = 3.3 V, 0 ≤ I_{OUT} ≤ 1.2 A, unless otherwise specified)

Characteristics	Conditions	Typical Value	Units
Regulation			
Output Voltage		3.30	V
Voltage Accuracy		4	%
Line Regulation	I_{OUT} = 1.0 A	0.12	%
Load Regulation	V_{IN} = 13.2 V	0.03	%
Switching			
Switching Frequency		2.0	MHz
Soft-start Time		1.4	ms
SYNCI Frequency range		1.8 to 2.5	MHz
Current Limit			
Average Current Limit	V_{IN} = 6 to 18 V	1.2	A
Cycle-by-cycle Current Limit		1.55	A
Protections			
Input Undervoltage Lockout (UVLO)	V_{IN} decreasing	4.2	V
Thermal Shutdown	T_A increasing	170	°C

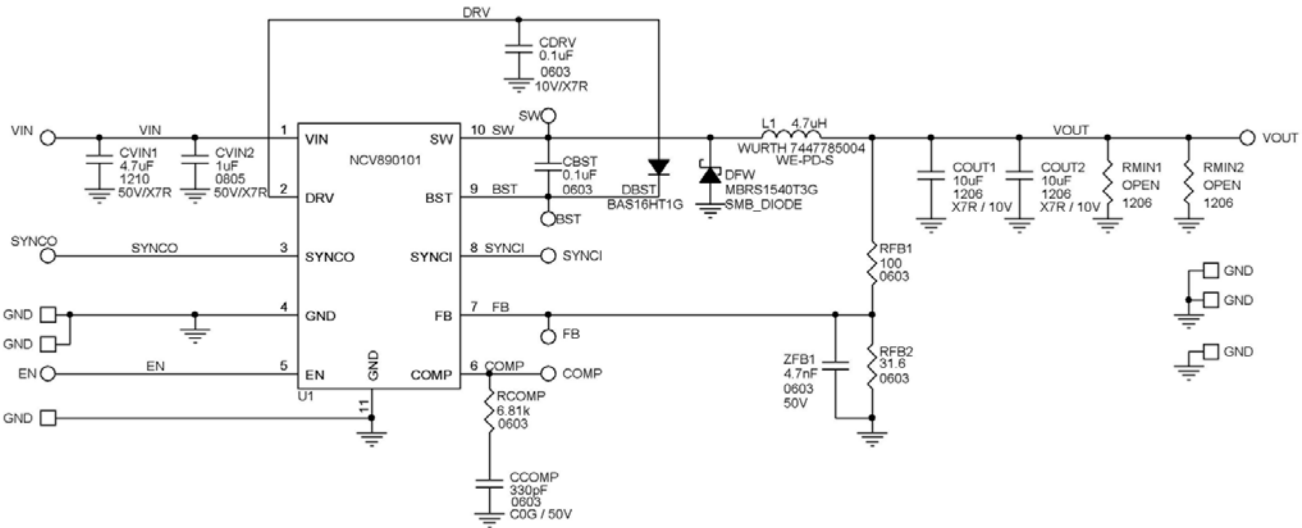


Figure 2. NCV890101GEVB Board Schematic

Operational Guidelines

1. Connect a dc input voltage, within the 4.5 V to 36 V range, between VIN and GND
2. Connect a load between VOUT and GND
3. Connect a dc enable voltage, within the 4.5 V to 36 V range, between EN and GND
4. Optionally, for external clock synchronization, connect a pulse source between SYNCI and GND. The high state level should be within the 2 to 6 V range, and the low state level within the -0.3 V to 0.8 V range, with a minimum pulse width of 40 ns and a frequency within the 1.8 to 2.5 MHz range.

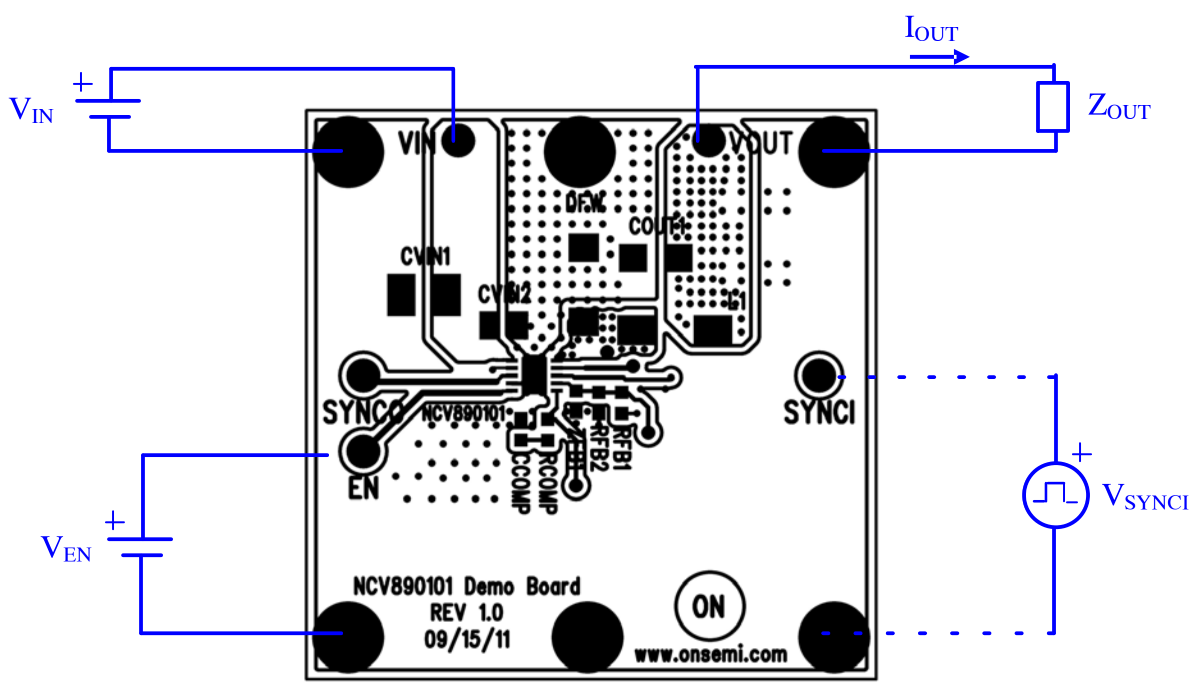


Figure 3. NCV890101GEVB Board Connections

TYPICAL PERFORMANCE

Efficiency

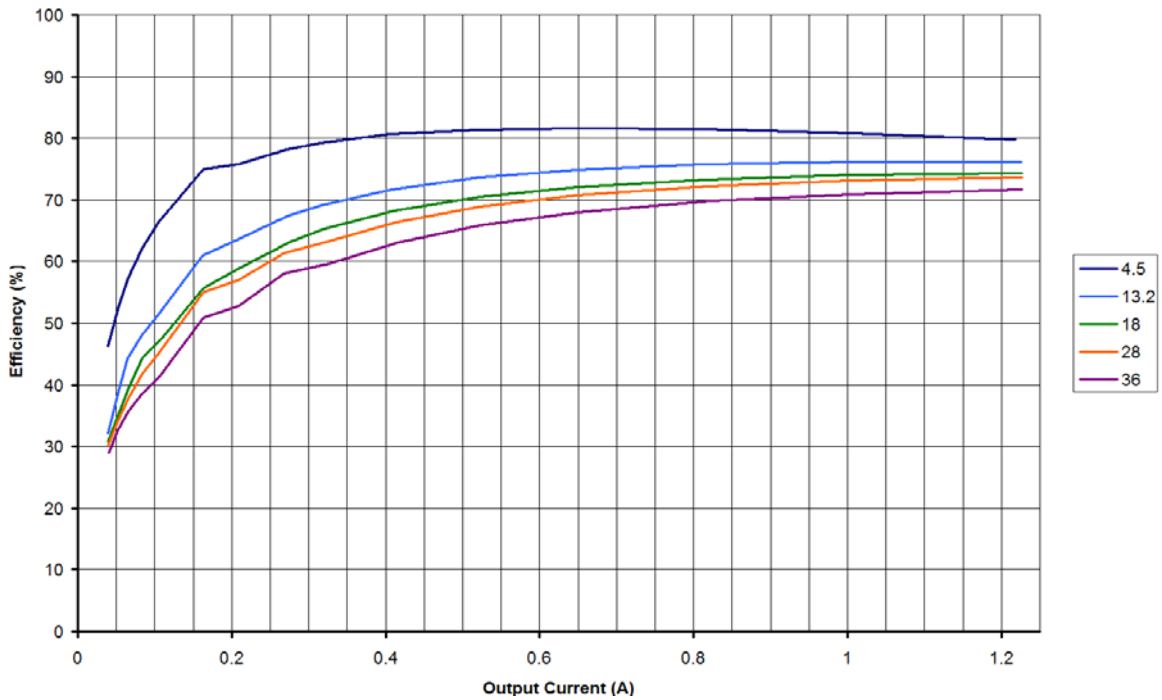


Figure 4. Efficiency at 2 MHz for a 3.3 V output

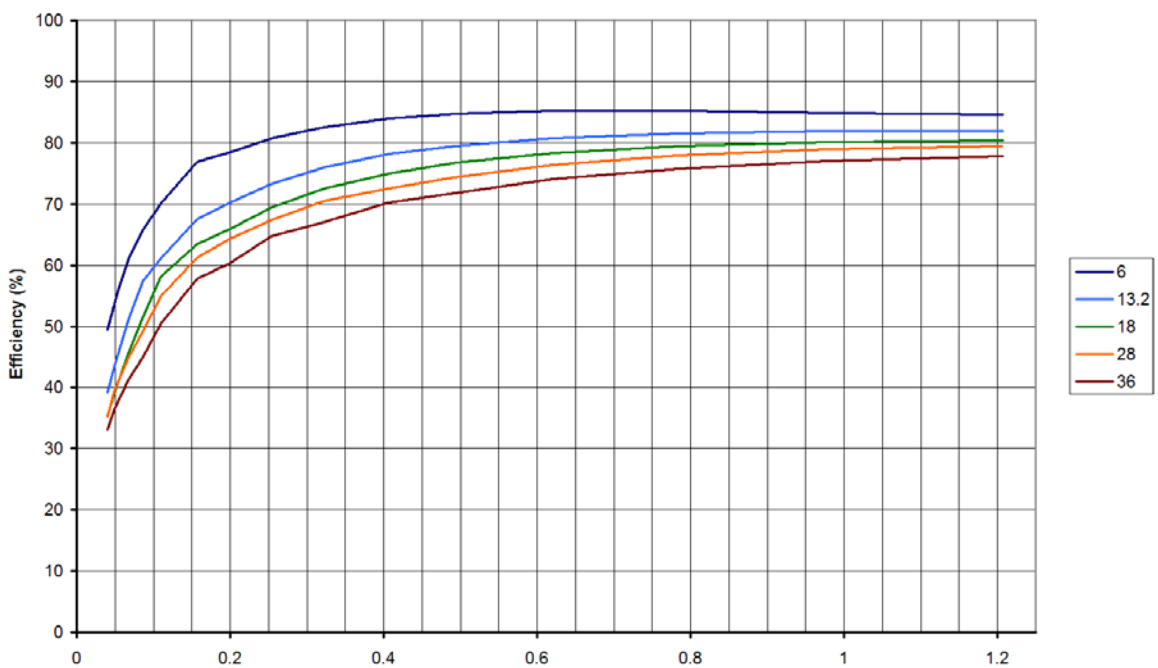


Figure 5. Efficiency at 2 MHz for a 5 V output

Regulation

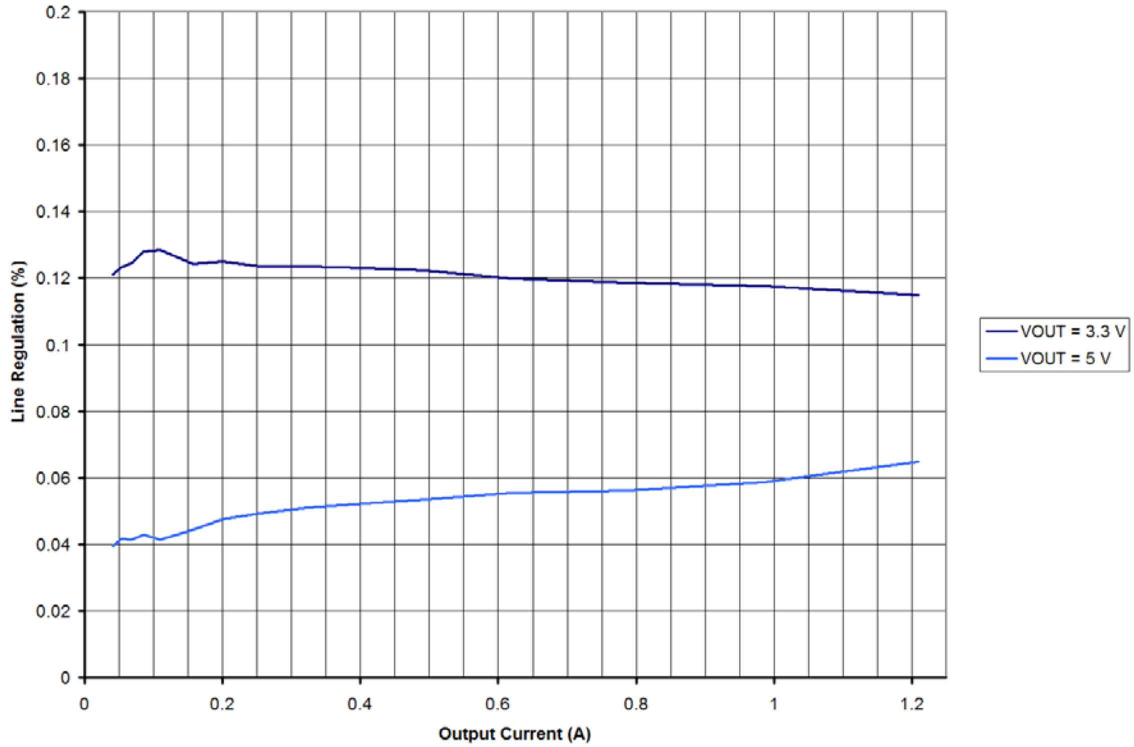


Figure 6. Load Regulation at 2 MHz for a 3.3 V and a 5 V output

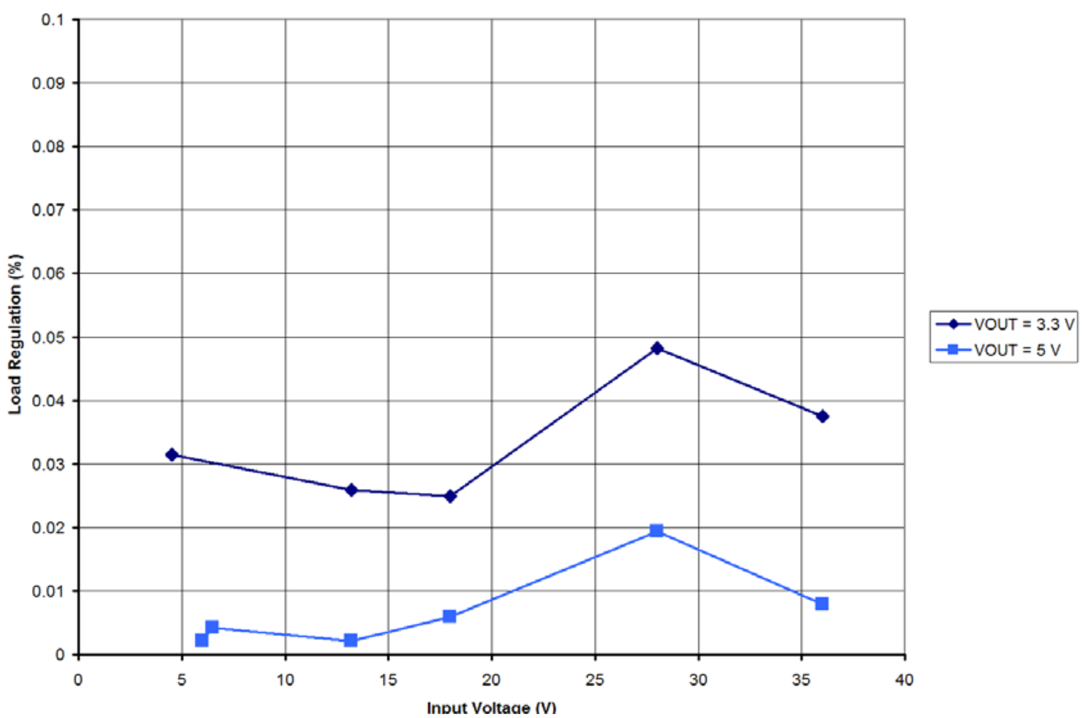


Figure 7. Line Regulation at 2 MHz for a 3.3 V and a 5 V output

Start−up

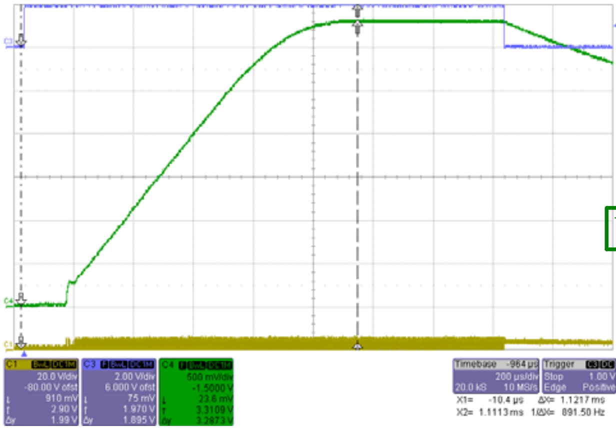


Figure 8. Typical start−up with V_{IN} = 4.5 V, V_{OUT} = 3.3 V and I_{OUT} = 0 A

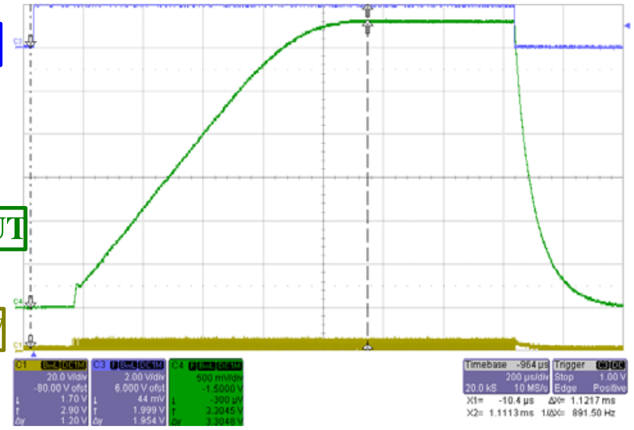


Figure 9. Typical start−up with V_{IN} = 4.5 V, V_{OUT} = 3.3 V and I_{OUT} = 1 A

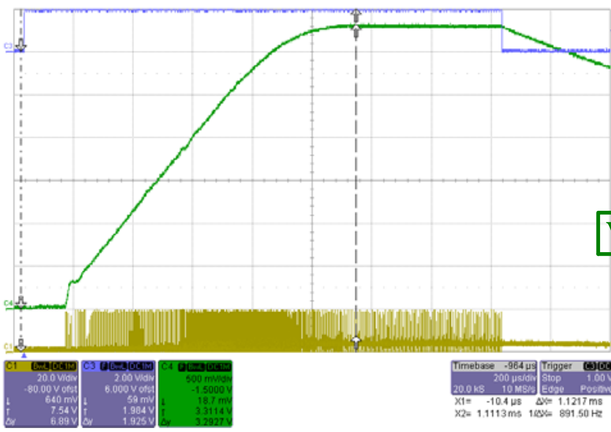


Figure 10. Typical start−up with V_{IN} = 19 V, V_{OUT} = 3.3 V and I_{OUT} = 0 A

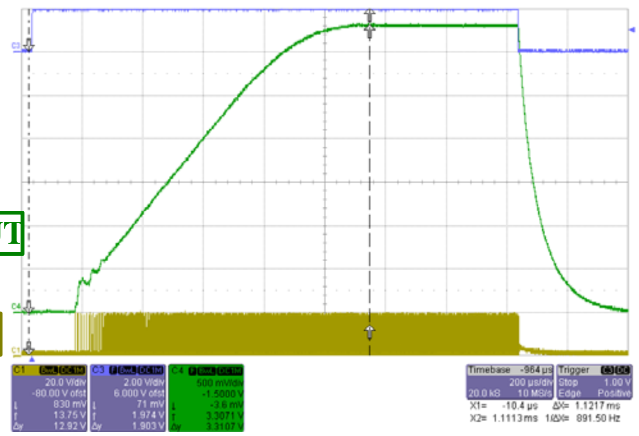


Figure 11. Typical start−up with V_{IN} = 19 V, V_{OUT} = 3.3 V and I_{OUT} = 1 A

Load Transients

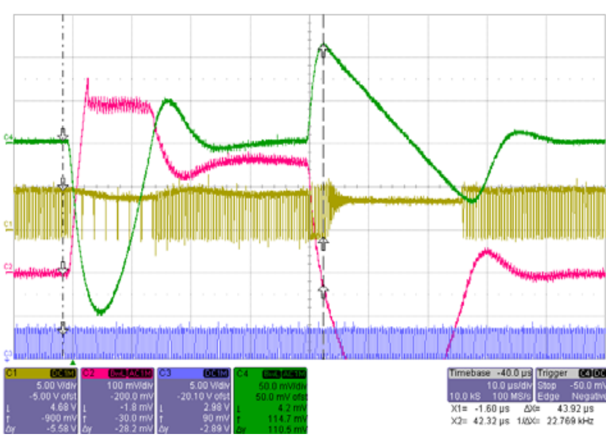


Figure 12. Load transient 0.1 A to 1.2 A, with V_{OUT} = 3.3 V and V_{IN} = 4.6 V

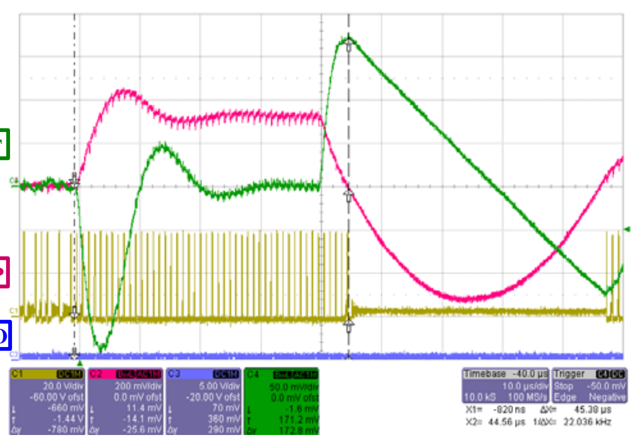


Figure 13. Load transient 0.1 A to 1.2 A, with V_{OUT} = 3.3 V and V_{IN} = 36 V

Synchronization

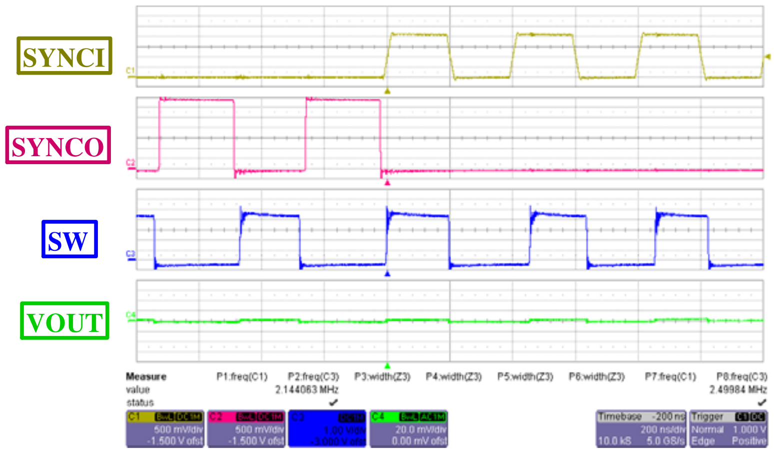


Figure 14. Starting synchronization at 2.5 MHz (from free−running)

Minimum on time

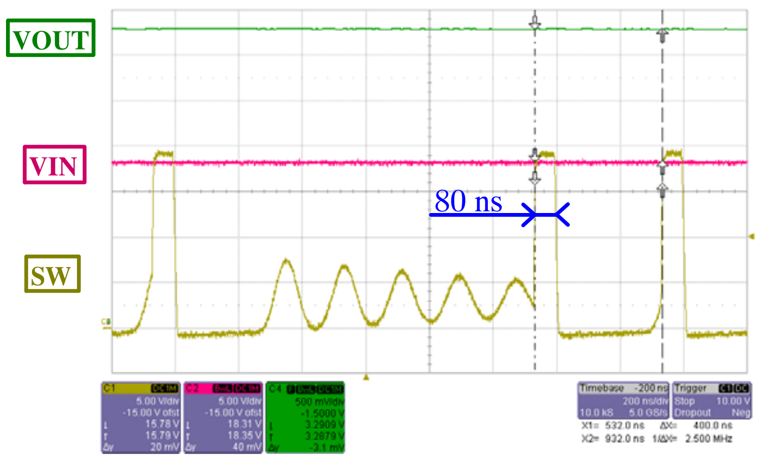
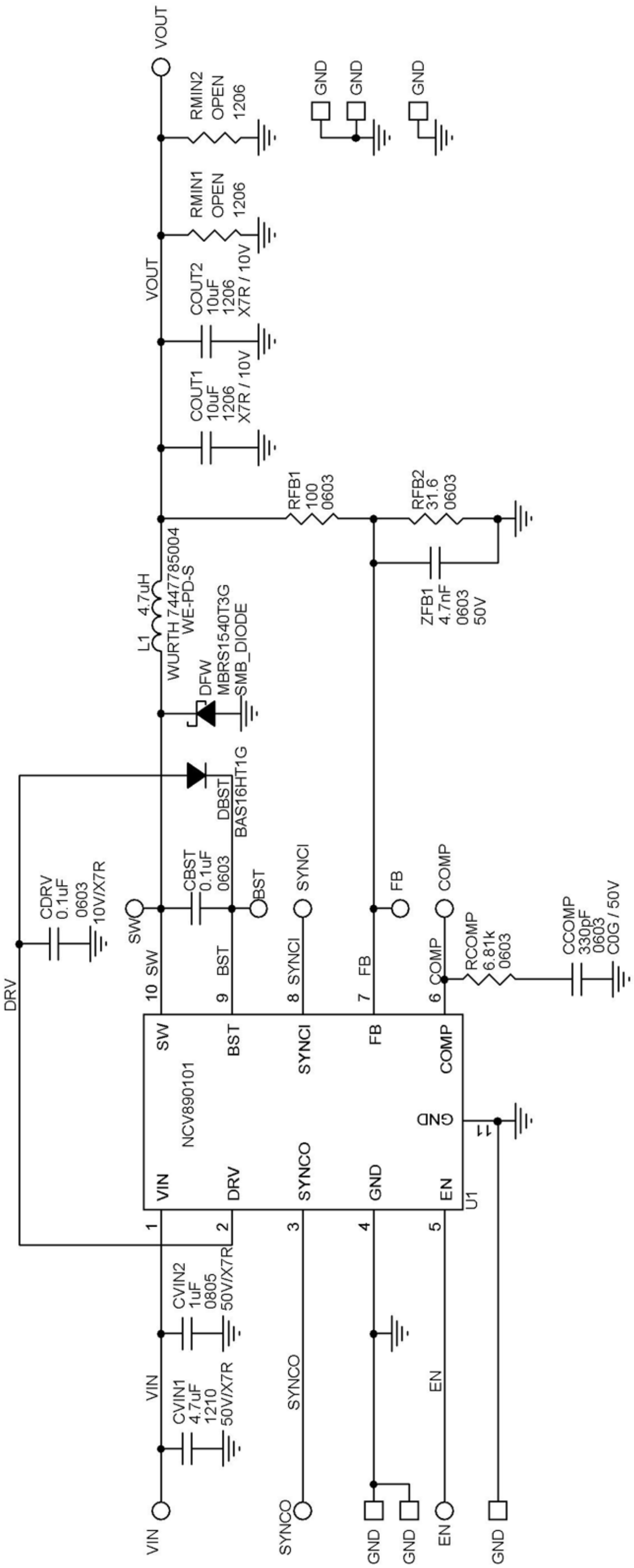


Figure 15. Minimum on time seen during a load transient

Schematic


VOUT
RMIN2
OPEN
1206
RMIN1
OPEN
1206
VOUT
COUT2
10uF
1206
X7R / 10V
COUT1
10uF
1206
X7R / 10V
GND
GND
GND
RFB1
100
0603
RFB2
31.6
0603
ZFB1
4.7nF
0603
50V
L1 4.7uH
WURTH 7447785004
WE-PD-S
DFW
MBRS1540T3G
SMB_DIODE
DBST
BAS16HT1G
CDRV
0.1uF
0603
10V/X7R
CBST
0.1uF
0603
SW
BST
SYNCI
FB
COMP
RCOMP
6.81k
0603
CCOMP
330pF
0603
C0G / 50V
DRV
10 SW
9 BST
8 SYNCI
7 FB
6 COMP
NCV890101
VIN
DRV
SYNCO
GND
EN
GND
11
U1
1
2
3
4
5
CVIN2
1uF
0805
50V/X7R
CVIN1
4.7uF
1210
50V/X7R
VIN
SYNCO
EN
VIN
SYNCO
GND
GND
EN
GND

PCB LAYOUT

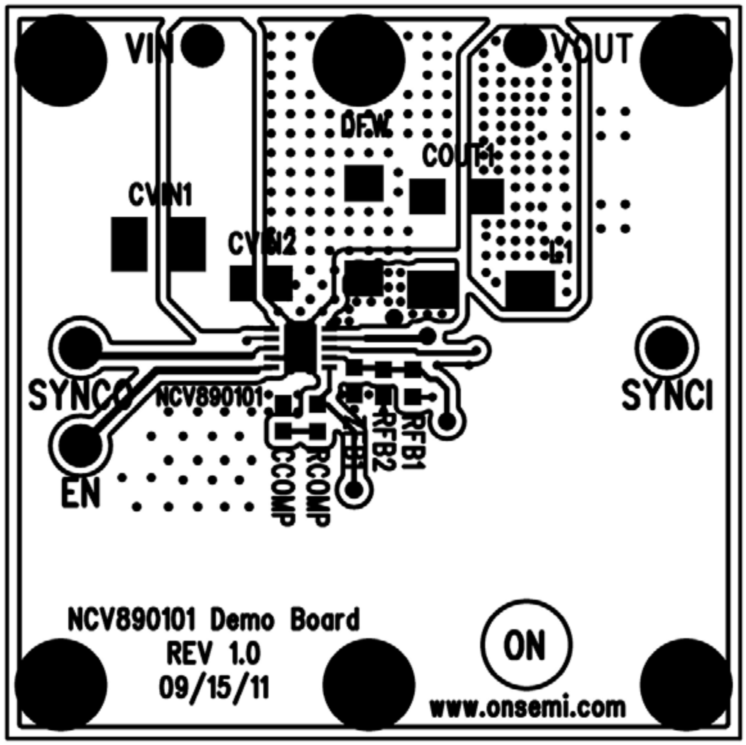


Figure 16. Top View

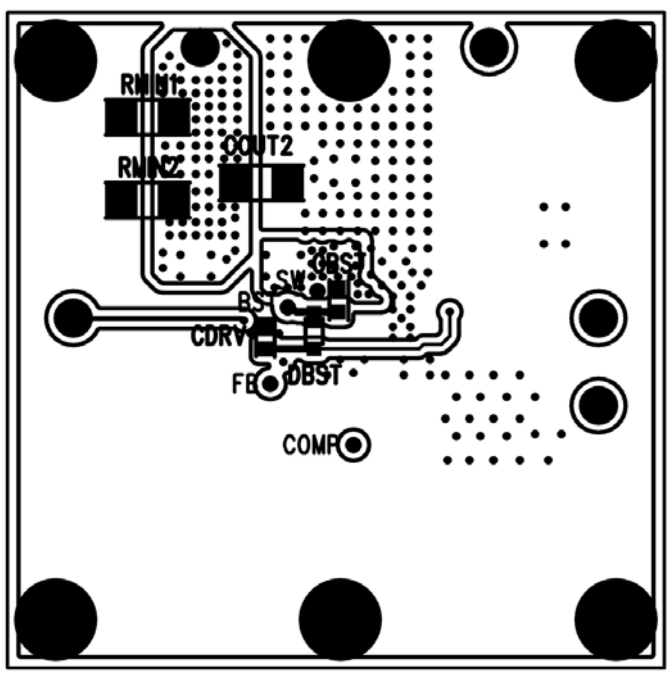


Figure 17. Bottom View

Table 4. BILL OF MATERIALS

Reference	Value	Part #	Manufacturer	Description	Package
U1		NCV890101	ON Semiconductor	Integrated circuit	3x3 DFN10
L1	4.7 μH	7447785004	Wurth	Inductor	WE-PD-XS
DFW		MBRS1540	ON Semiconductor	Diode, Schottky, 1.5A, 40V	SMB
DBST		BAS16HT1	ON Semiconductor	Diode, Switching, 200mA, 75V	SOD-323
CVIN1	4.7 μF		Murata	Capacitor, Ceramic, 50V, X7R	1210
CVIN2	1 μF		Murata	Capacitor, Ceramic, 50V, X5R	0805
CDRV, CBST	0.1 μF		Kemet	Capacitor, Ceramic, 10V, X7R	0603
ZFB1	4.7 nF		Murata	Capacitor, Ceramic, 50V, X7R	0603
COUT1, COUT2	10 μF		Murata	Capacitor, Ceramic, 10V, X7R	1206
CCOMP	330 pF		Murata	Capacitor, Ceramic, 50V, C0G	0603
RCOMP	6.81 KΩ		Vishay	Resistor, 1%	0603
RFB1	100 Ω		Vishay	Resistor, 1%	0603
RFB2	31.6 Ω		Vishay	Resistor, 1%	0603

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