

# 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

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**Table 1. DEMONSTRATION BOARD TERMINALS**

Terminal	Function
VIN	Positive dc input voltage
GND	Common dc return
VOUT	Regulated dc output voltage
EN	Enable input
SYNCl	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 (SYNCl)	-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**

( $T_A = 25^\circ\text{C}$ ,  $4.5\text{ V} \leq V_{IN} \leq 40\text{ V}$ ,  $V_{EN} = 2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $0 \leq I_{OUT} \leq 1.2\text{ A}$ , unless otherwise specified)

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

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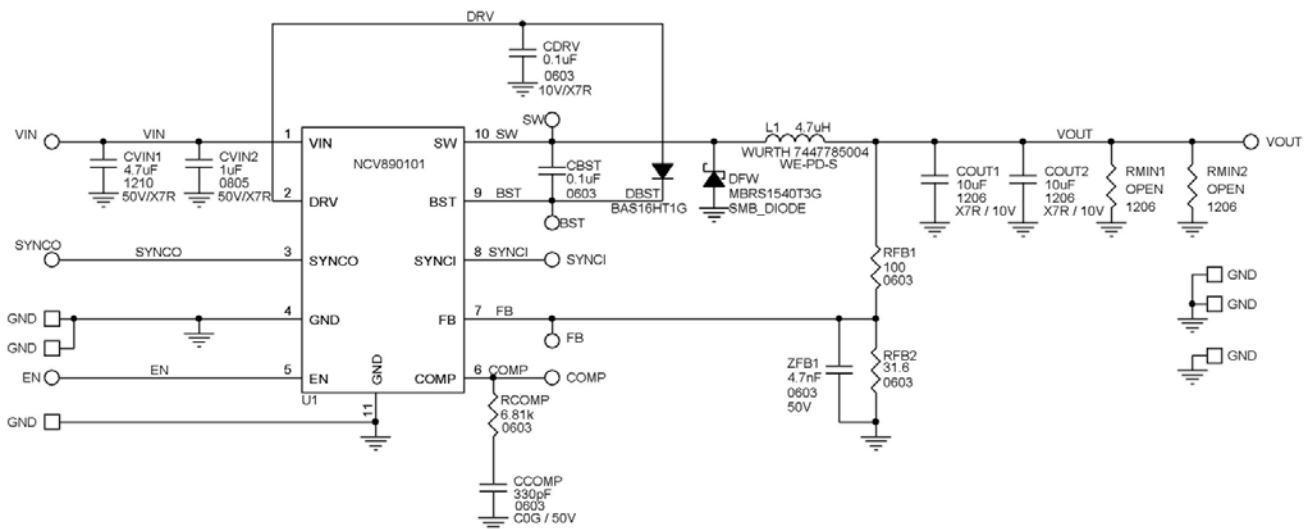


Figure 2. NCV890101GEVB Board Schematic

## 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.

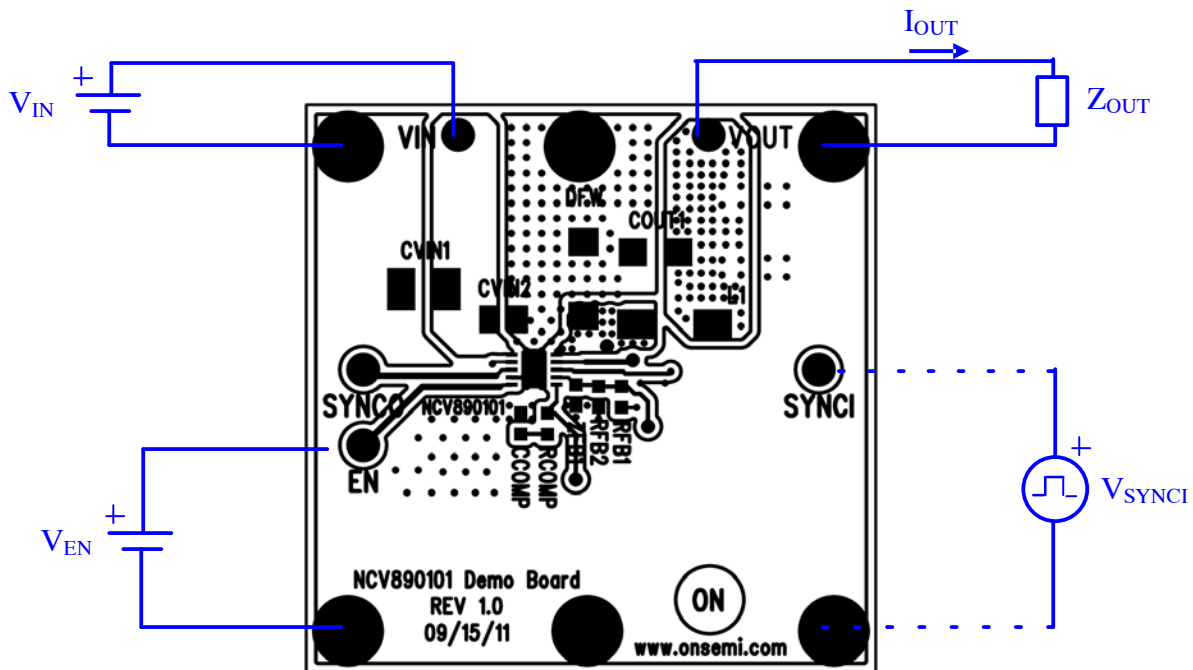


Figure 3. NCV890101GEVB Board Connections

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## TYPICAL PERFORMANCE

### Efficiency

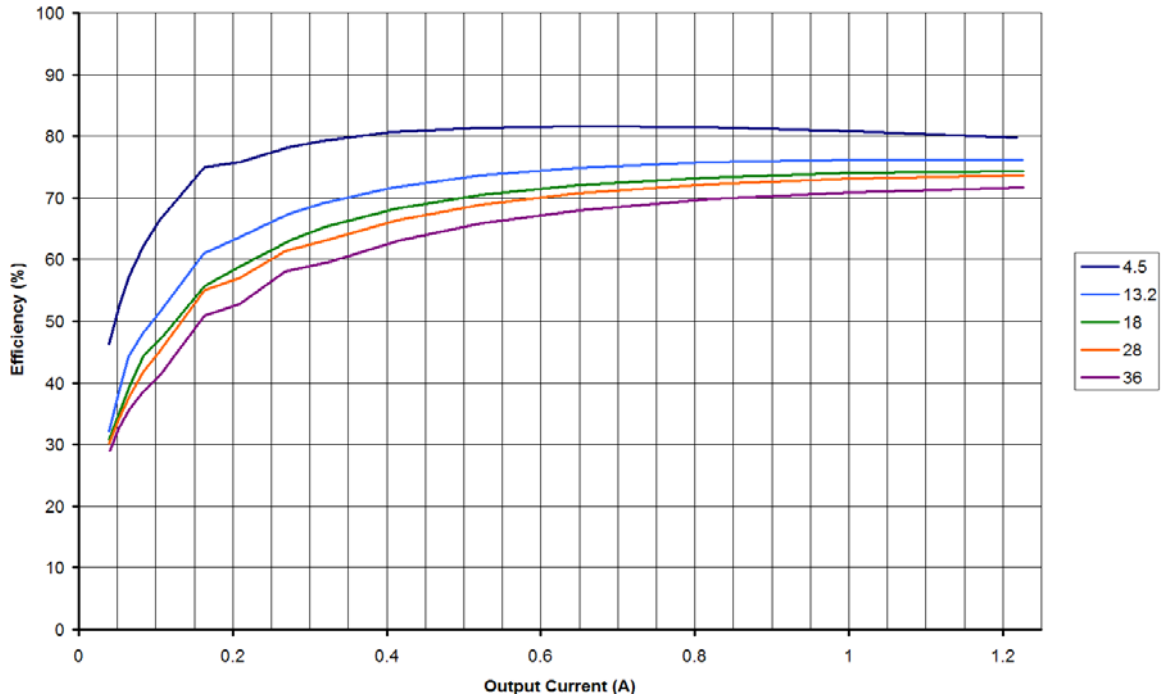


Figure 4. Efficiency at 2 MHz for a 3.3 V output

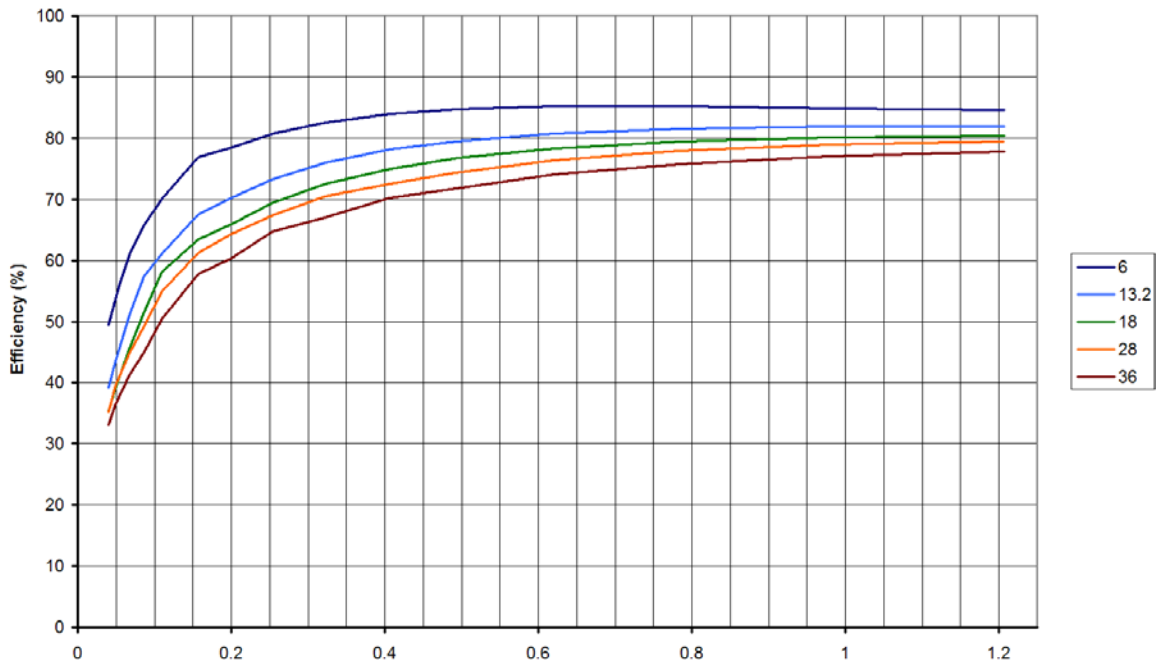


Figure 5. Efficiency at 2 MHz for a 5 V output

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## Regulation

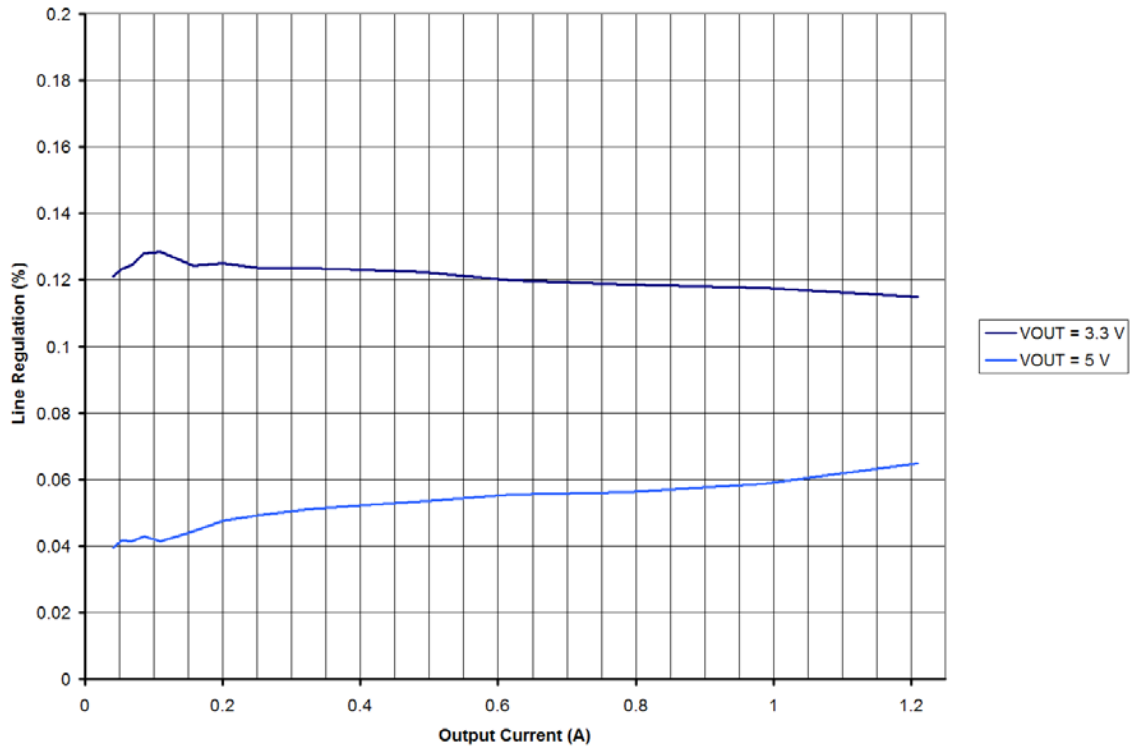


Figure 6. Load Regulation at 2 MHz for a 3.3 V and a 5 V output

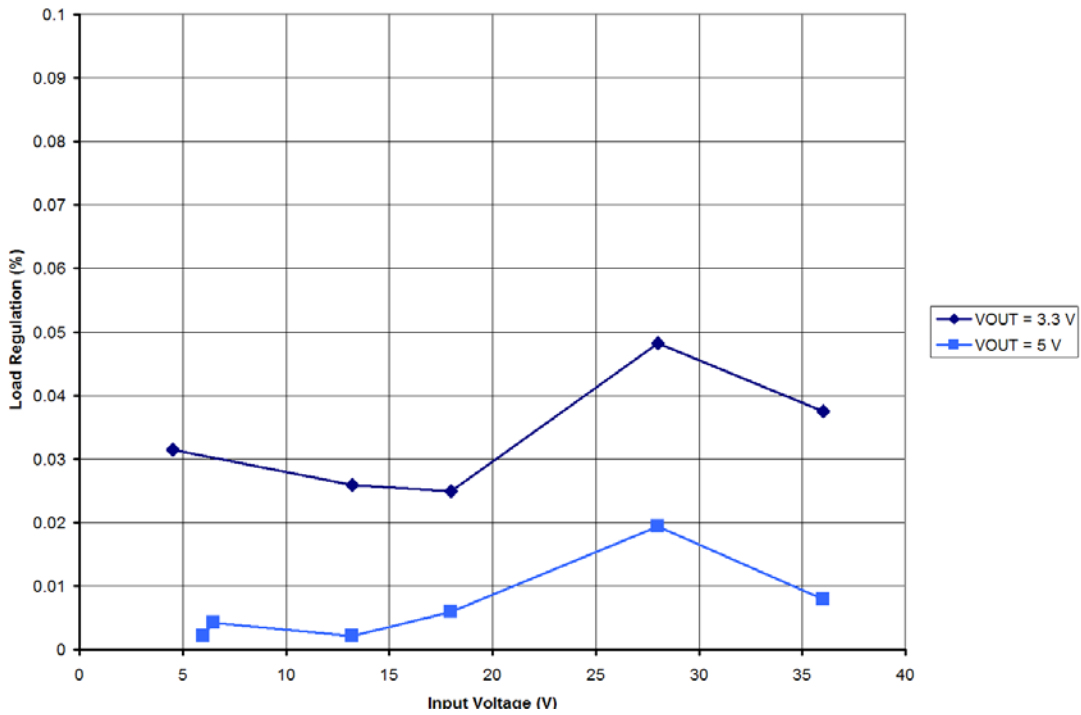


Figure 7. Line Regulation at 2 MHz for a 3.3 V and a 5 V output

Start-up

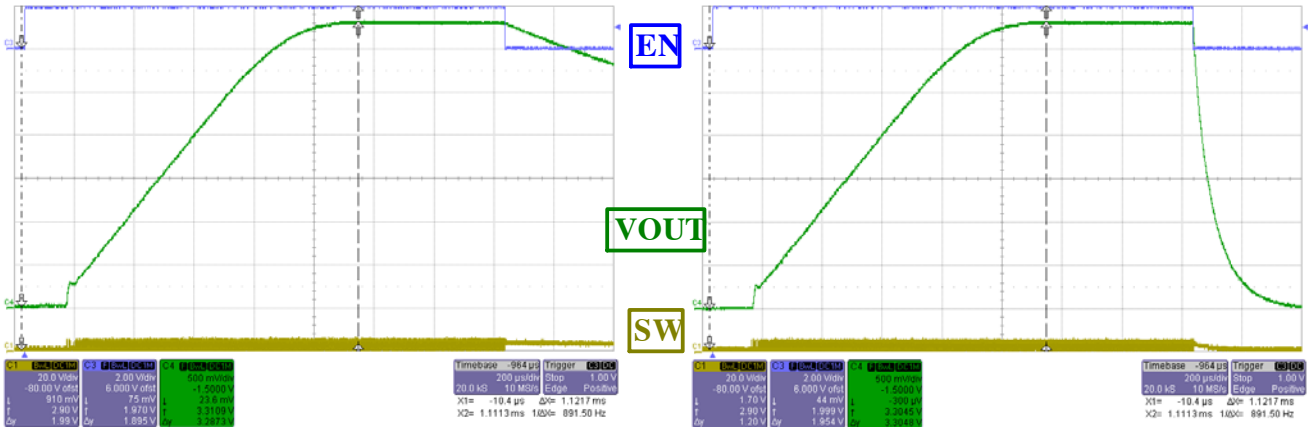


Figure 8. Typical start-up with  $V_{IN} = 4.5\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$  and  $I_{OUT} = 0\text{ A}$

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

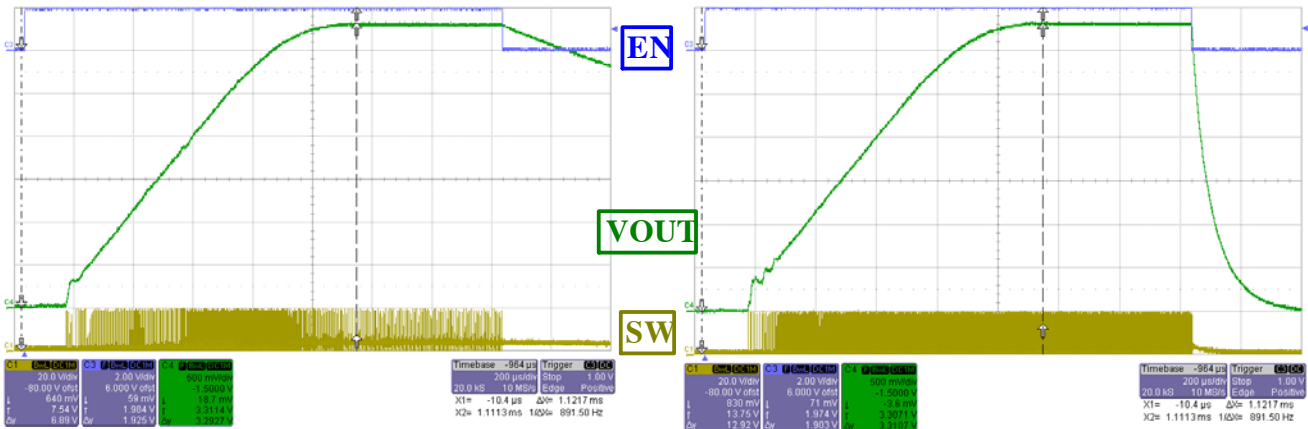


Figure 10. Typical start-up with  $V_{IN} = 19\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$  and  $I_{OUT} = 0\text{ A}$

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

Load Transients

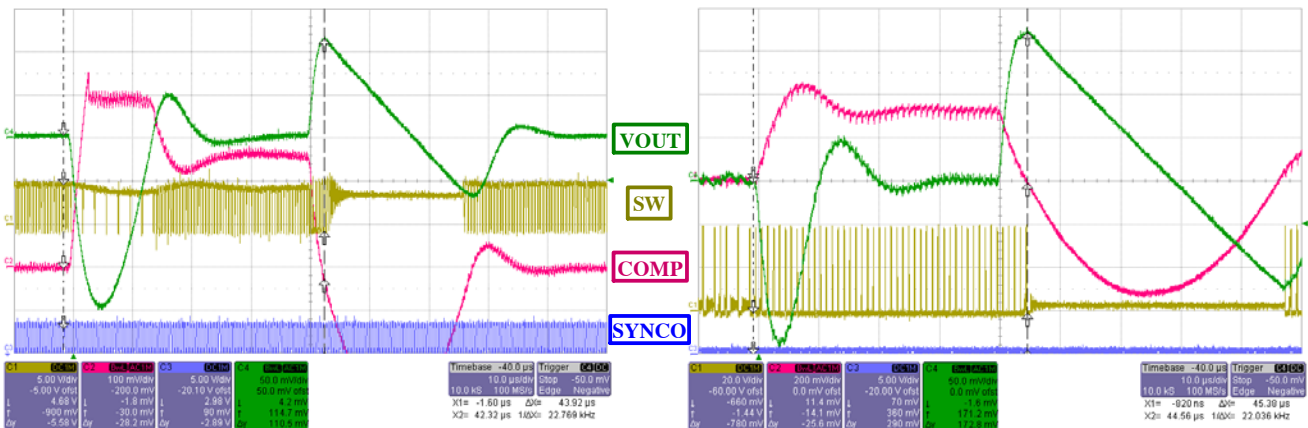


Figure 12. Load transient 0.1 A to 1.2 A, with  $V_{OUT} = 3.3\text{ V}$  and  $V_{IN} = 4.6\text{ V}$

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

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## Synchronization

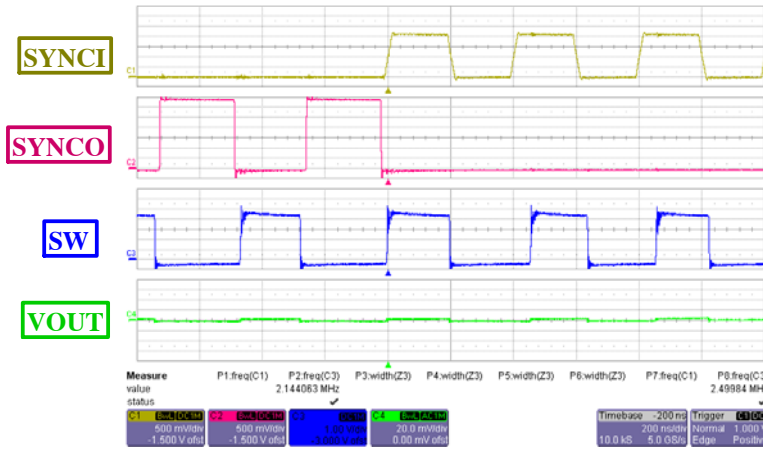


Figure 14. Starting synchronization at 2.5 MHz (from free-running)

## Minimum on time

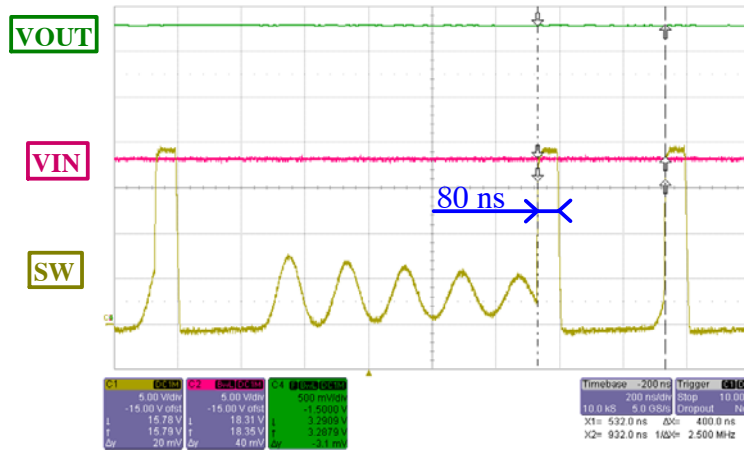
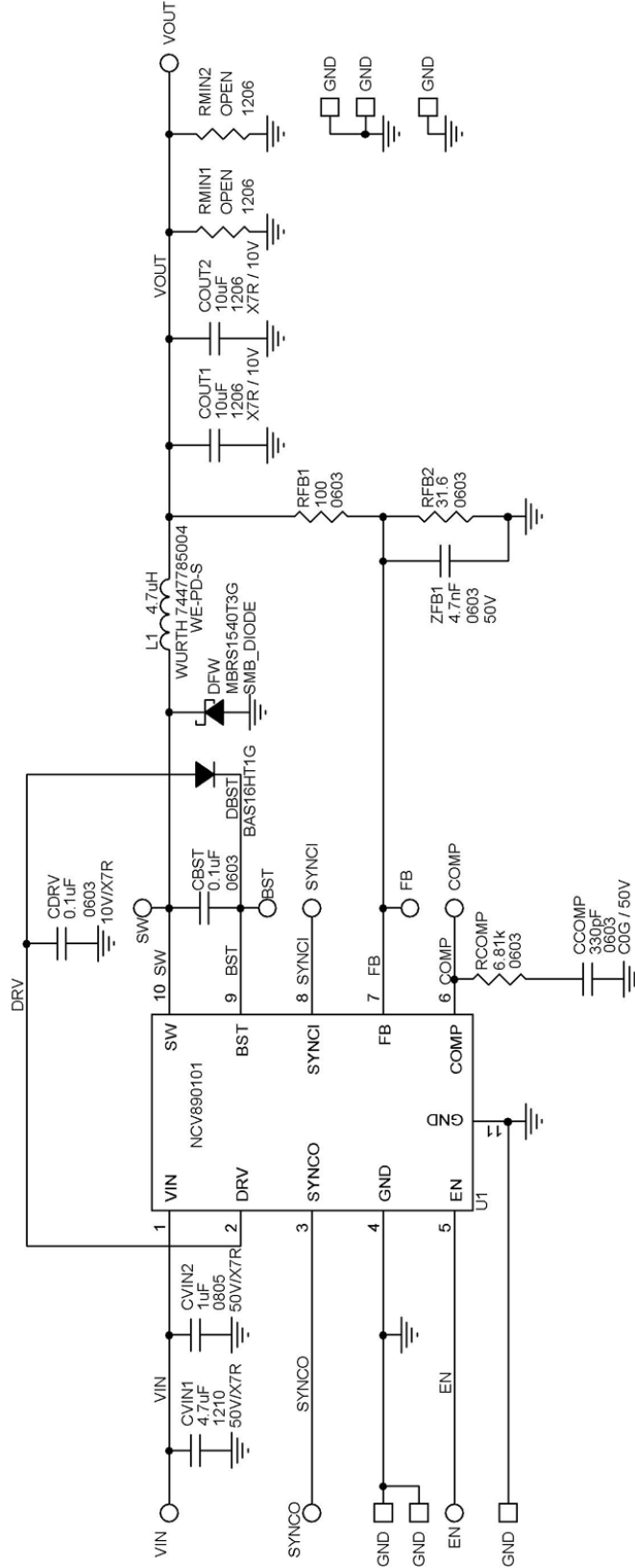


Figure 15. Minimum on time seen during a load transient

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## Schematic





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## PCB LAYOUT

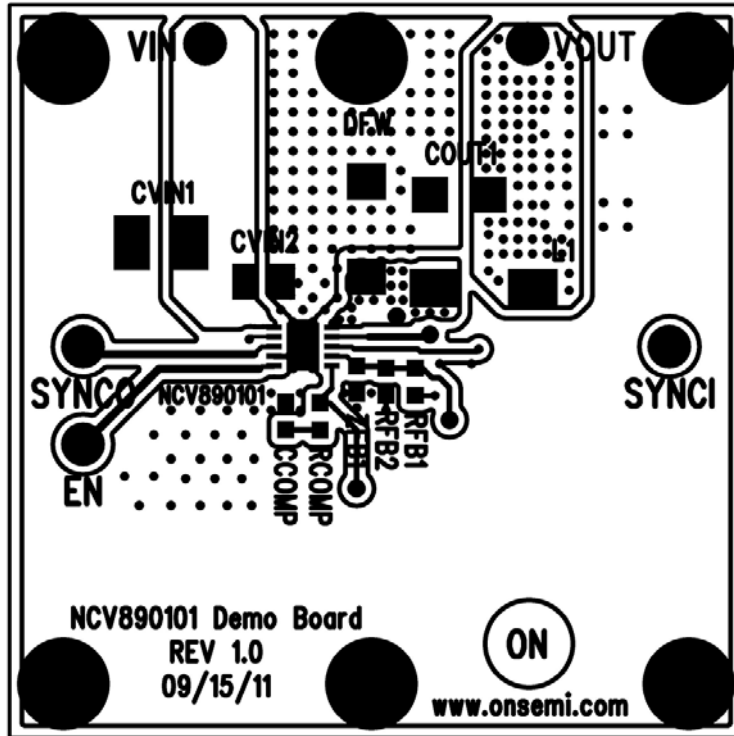


Figure 16. Top View

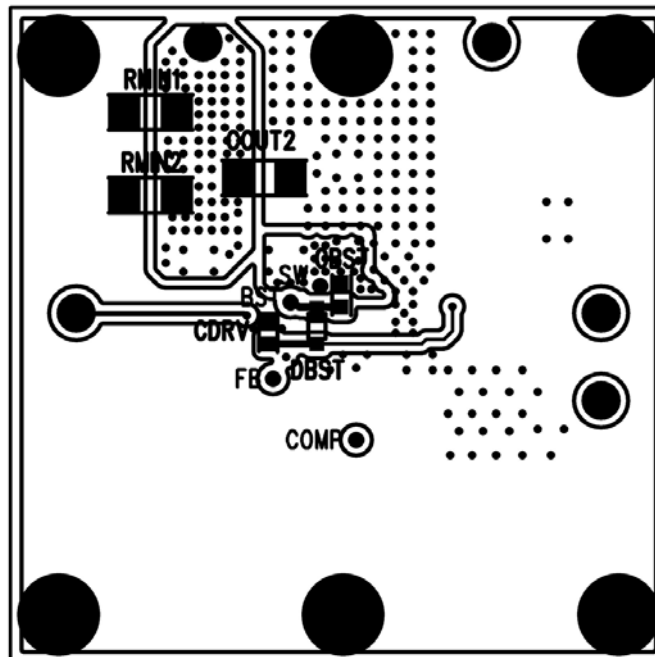


Figure 17. Bottom View

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**Table 4. BILL OF MATERIALS**

Reference	Value	Part #	Manufacturer	Description	Package
U1		NCV890101	ON Semiconductor	Integrated circuit	3x3 DFN10
L1	4.7 $\mu$ H	7447785004	Würth	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 $\mu$ F		Murata	Capacitor, Ceramic, 50V, X7R	1210
CVIN2	1 $\mu$ F		Murata	Capacitor, Ceramic, 50V, X5R	0805
CDRV, CBST	0.1 $\mu$ F		Kemet	Capacitor, Ceramic, 10V, X7R	0603
ZFB1	4.7 nF		Murata	Capacitor, Ceramic, 50V, X7R	0603
COUT1, COUT2	10 $\mu$ F		Murata	Capacitor, Ceramic, 10V, X7R	1206
CCOMP	330 pF		Murata	Capacitor, Ceramic, 50V, C0G	0603
RCOMP	6.81 K $\Omega$		Vishay	Resistor, 1%	0603
RFB1	100 $\Omega$		Vishay	Resistor, 1%	0603
RFB2	31.6 $\Omega$		Vishay	Resistor, 1%	0603

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