

# NCP1096GEVB

## NCP1096 Evaluation Board User's Manual

### IEEE 802.3bt PoE-PD Interface Controller Board



ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

## EVAl BOARD USER'S MANUAL

### General

The NCP1096GEVB board allows easy implementation and evaluation of a Power-over-Ethernet powered equipment that is able to operate with an assigned power level up to 90 W. The evaluation board is based on the PoE PD Controller NCP1096 (U2) that uses an internal pass-switch and sense resistor. The board can also facilitate the design of proprietary 100 W+ applications.

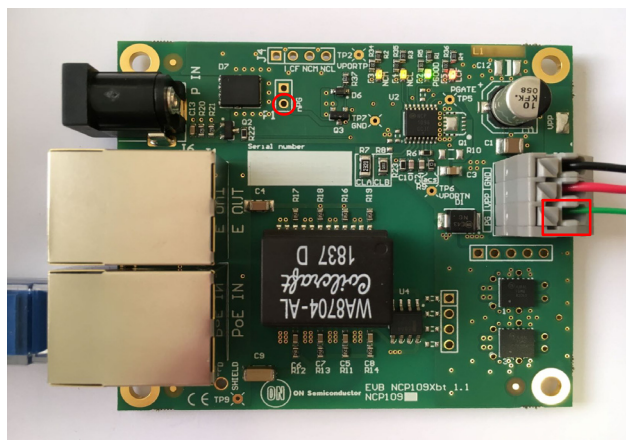


Figure 1. Operational NCP1096GEVB Showing Basic Interconnections

The NCP1096GEVB board is designed as a PoE splitter: having a PoE-enabled Ethernet port (labeled “PoE IN”) as input and offering the power to a separate connector (J2) while passing through the data to another Ethernet port (labeled “E OUT”).

### Quick Start Guide

**Step 1:** Connect the power connections available on connector J2 (labeled “GND” and “VPP”) to the DC/DC converter on the system that needs to be powered (cf. black and red wires in the picture on the left). The DC/DC converter behind the NCP1096 EVB should be operational over a 34 V to 57 V voltage range.

**Step 2:** Connect the **control connection** to the DC/DC converter! **It is important that the DC/DC converter or any significant load is kept off when the pass-switch is charging the input capacitance.**

For a DC–DC converter with an undervoltage (UV or UVLO) or an active high enable (EN or SHND), the “PG” signal on connector J2 could be used (cf. green wire in the picture on the left). The “PG” signal will be clamped to 18 V by a zener when the board is powered up. For some DC–DC converter boards an additional diode in series with the control connection might be required (cathode connected to NCP1096 and anode connected to the DC–DC converter).

For a DC–DC converter with an active low enable ( $\overline{\text{EN}}$  or SHDN or  $\overline{\text{ON/OFF}}$ ), the “nPG” signal on P1 could be used. The “nPG” signal will be pulled up to VPP during the inrush phase. Always check the voltage rating of the enable, shutdown or undervoltage pin of the DC–DC converter.

**Step 3:** Insert the Ethernet cable (cf. blue cable in the picture on the left) coming from the PSE in the Ethernet connector J3 labeled “PoE IN”.

If the PSE powers up the system the green PGOOD LED should be ON.

The status of the remaining LEDs depends on the PSE being used.

# NCP1096GEVB

## Assigned Power

The NCP1096GEVB will request Class 8 during Physical Layer classification. PDs need to take into account that they can be underpowered and eventually be assigned to Class 3, 4 or 6.

The state of the NCM and NCL outputs provides information about the power level that the PSE has assigned to the NCP1096GEVB during classification. See Table 1 to determine the assigned power based on the status of the orange NCM and NCL leds.

**Table 1. CLASSIFICATION RESULT**

NCM Led	NCL Led	Assigned Class	Assigned Power
off	off	3	13 W
off	on	4	25.5 W
on	off	6	51 W
on	on	8	71.3...90 W

PDs assigned to Class 8 may consume greater than 71.3 W as long as they guarantee not to exceed the 90 W power limit at the PSE power interface. Operation beyond 71.3 W is, however, only possible if additional information is available to the PD regarding the actual link section DC resistance between the PSE and the PD.

The application should always operate at or below the assigned power limit. Failure to do so will result in the PSE disconnecting the PD!

## PSE Categorization

The state of the LCF output provides information (retrieved during classification) about the type of PSE the NCP1096GEVB is connected to. See Table 2 to determine the PSE Type based on the status of the red LCF led.

**Table 2. PSE TYPE**

LCF Led	PSE Categorization
off	The PSE is categorized according to 802.3af/at (PSE Type 1 or Type 2)
on	The PSE is categorized according to 802.3bt (PSE Type 3 or Type 4)

The PSE Type determines the MPS timing. It also indicates to a PD requesting Autoclass whether it makes sense to go to the maximum power state according to its assigned Class.

## System Startup

A PD can be underpowered and assigned to Class 3 only.

Therefore the DC/DC converter behind NCP1096GEVB should not draw more than 13 W during start-up. Eventually the soft-start setting of the DC/DC converter might need to be adapted to accomplish this.

## Requested Power

As mentioned before, the NCP1096GEVB will request Class 8 during Physical Layer classification. If a lower Class or power level is preferred, resistor R8 labeled “CLB” and/or resistor R7 labeled “CLA” should be changed. See the [NCP1096 datasheet](#) for the nominal resistance values.

The Class the PD is actually assigned to is always limited to the requested Class.

## Autoclass

The NCP1096GEVB will by default not request Autoclass during Physical Layer classification. If the PD should request Autoclass, remove 0E resistor R9 labeled “acs”.

## Maintain Power Signature (MPS)

A PD should draw a minimum amount of current in order to prevent the PSE from removing power. The load resistor R15 was added on the bottom side of the board to make sure the load current is always sufficient and the NCP1096GEVB remains powered.

Depending on the minimum current the system may draw, the resistance value of R15 should be increased for the final design in order not to waste power unnecessarily.

For some systems, the load resistor can even be omitted.

# NCP1096GEVB

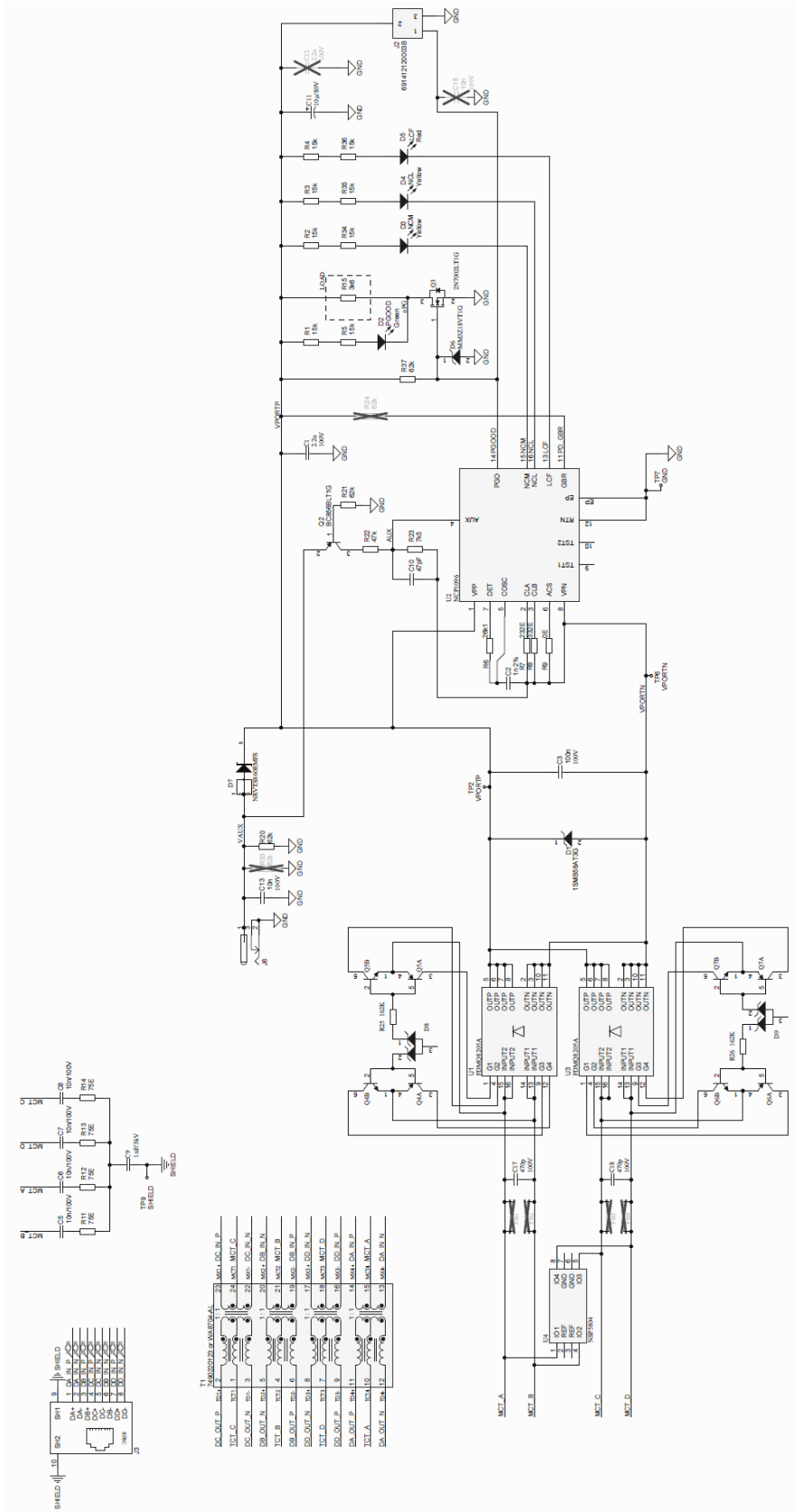


Figure 2. Schematic Diagram NCP1096

# NCP1096GEVB

## Auxiliary Supply

The NCP1096GEVB supports drawing power from an alternate or local power source in applications connected to non-PoE enabled networks. A rear auxiliary supply can be inserted in connector J6 labeled “P IN”.

The recommended voltage of the auxiliary supply is 24 V.

**Table 3. ELECTRICAL CHARACTERISTICS**

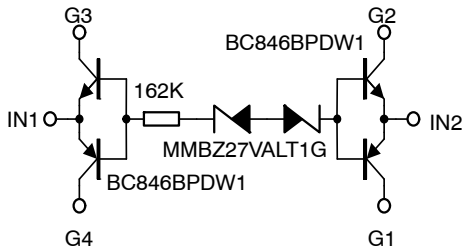
	Operating Range
Auxiliary Input Voltage	20–30 V
Auxiliary Input Current	0–5 A
Auxiliary Input Voltage, Extended [Warning!]	10–57 V

If an auxiliary supply that is too low (10.1 V... 20 V) is inserted before the UVLO threshold was crossed by the PSE, the class driver could become unintentionally activated. Therefore it is recommended to adapt the AUX resistor divider to  $R_{22} = 33\text{ k}\Omega$  and  $R_{23} = 15\text{ k}\Omega$  for operation with a low voltage auxiliary supply voltage.

The NCP1096GEVB is able to operate with an auxiliary supply voltage up to 57 V. However the customer must take caution when using a high voltage (>30 V) auxiliary supply: the NCP1096GEVB has to be unpowered when this high voltage (30 V... 57 V) supply is inserted.

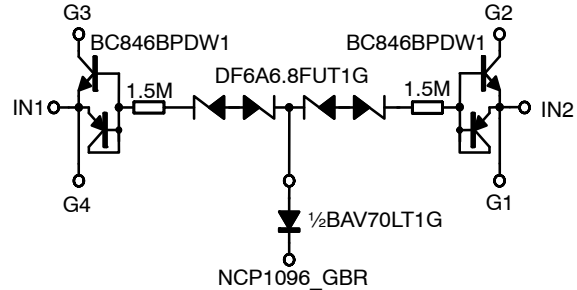
**Do not insert a high voltage (>30 V) auxiliary supply when the NCP1096GEVB is already powered by a PSE.**

Violating the warning above may result in the PD sourcing power on the “PoE IN” Ethernet connector.



**Figure 3. GreenBridge2 GDC on NCP1096GEVB**

If the customer needs to implement a system in which a high voltage (>30 V) rear auxiliary supply can be inserted while the PD is already powered by the PSE, both GreenBridge2 rectifiers (U1 and U3) need a gate drive circuit allowing them to be disabled. Figure 4 shows a gate drive circuit (GDC) able to turn off the GreenBridge2 internal top MOSFETs.



**Figure 4. Basic GreenBridge2 GDC with Disable**

If the AUX input pin of NCP1096 is pulled high, it will immediately drive the GBR pin low. The above gate drive circuit controlled by the GBR pin makes sure the PD does not source power under any circumstance in combination with a high voltage (> 30 V) auxiliary supply.

The gate drive circuit shown in Figure 4 is NOT implemented on NCP1096GEVB. Therefore a high voltage (>30 V) auxiliary supply should not be inserted when NCP1096GEVB is already powered by a PSE.

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 to 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