

IEEE 802.3bt PoE PD Reference Designs with an Isolated DC/DC Converter based on NCP1566



ON Semiconductor®

www.onsemi.com

REFERENCE DESIGN

General

This document describes how to make a Class 8 PD reference design by combining an IEEE 802.3bt PoE-PD EVB and an active clamp forward converter EVB based on NCP1566.

The PoE-PD EVB can be either [NCP1095GEVB](#), based on PD Controller NCP1095 that uses an external pass-switch, or [NCP1096GEVB](#), based on PD Controller NCP1096 with internal pass-switch.

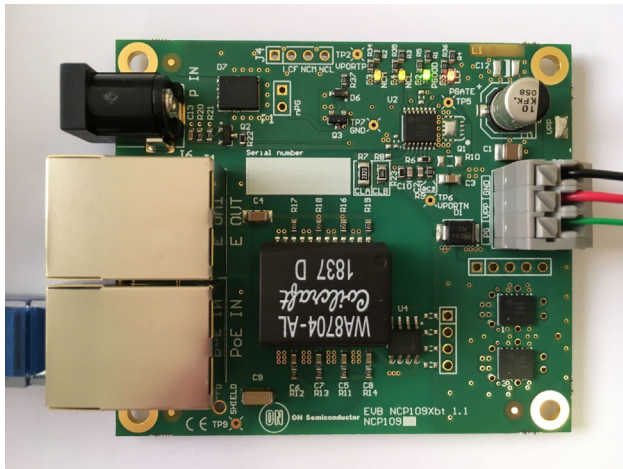


Figure 1. Operational PoE-PD EVB

The NCP1566 based DC/DC converter EVB can be either [NCP1566POE12V6AGEVB](#), [NCP1566TEL5V10AGEVB](#) or [NCP1566TELECGEVB](#) (3.3 V/30 A).

Table 1. DC/DC CONVERTERS

DC/DC Converters	Output Voltage
NCP1566TELECGEVB	3.3 V
NCP1566TEL5V10AGEVB	5 V
NCP1566POE12V6AGEVB	12 V

Interconnection Schematic

The power output of the PoE-PD controller (net “GND” and net “VPORTP”) and the power input of the DC/DC converter (net “GND” and node “22”) need to be interconnected.

Next to these two power connections, there is a third control signal that is used to keep the DC/DC converter off when the PoE-PD controller is charging the input capacitance. Therefore, the control output of the PoE-PD controller (net “PGOOD”) and the control input of the DC/DC converter (node “40”) need to be connected to an additional diode, at the cathode and anode respectively.

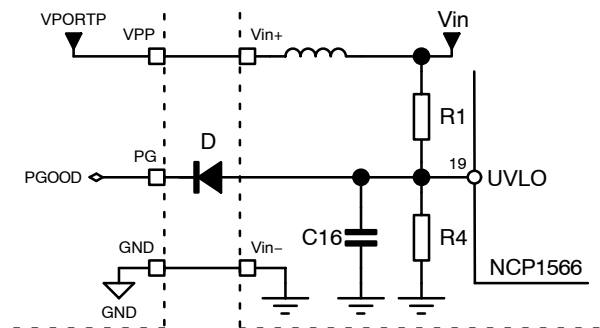


Figure 2. Top Level Schematic

Recommended part numbers for this diode (reference designator D in Figure 2) are BAS70L, NSR02100 or eventually BAS70SL.

Table 2. RECOMMENDED DIODES

Product	V_F Max ($I_F = 1$ mA)	I_R Max ($V_R = 50$ V)	Package Type
BAS70L	0.41 V	0.1 μ A	SOT-23
NSR02100	0.45 V	0.05 μ A	SOD-323
BAS70SL	0.41 V	0.2 μ A	SOD-923

Guidance on how to fine-tune the schematics for the final design can be found in section ‘Maintain Power Signature (MPS)’ and eventually in sections ‘System Startup’ and ‘Auxiliary Supply’ further in this document.

Quick Interconnection and Start Guide

Step 1: Solder a wire on the undervoltage (UVLO) control connection of the NCP1566 DC/DC converter EVB: e.g. on the pad of capacitor C16 (highlighted by a rectangle in Figure 3 and at the end of the yellow wire in the Figure 4).

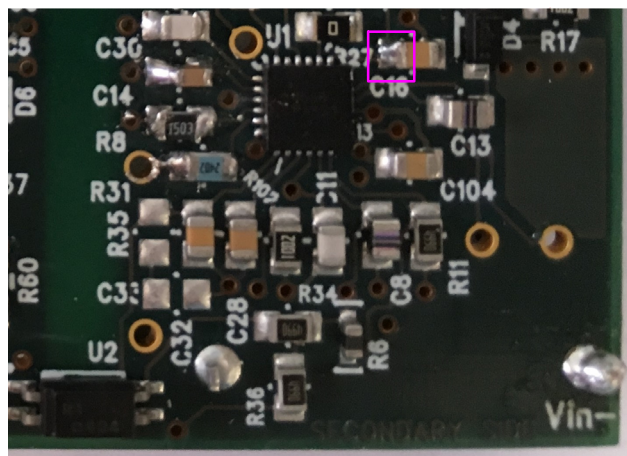


Figure 3. UVLO on NCP1566EVB

Step 2: Solder two wires on the power connections of the NCP1566 DC/DC converter EVB: e.g. on the pins of connector J1b and J1a (labeled “Vin-” and “Vin+”).

See the black and red wires in the picture below.

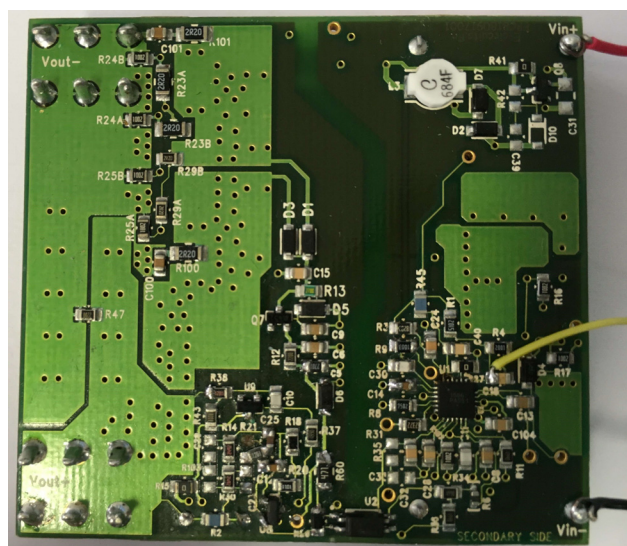


Figure 4. NCP1566EVB with Wire Connections

Step 3: Look for an additional diode. Recommended diode part numbers are listed in table 2, but a diode in Axial Lead (DO-35) package like BAY72, 1N3595, 1N914B or 1N4454 might be easier to work with here.

Solder the anode of this diode on the other end of the control connection wire already fixed to the NCP1566 DC/DC converter EVB before.

Connect the cathode of this diode to the control connection on connector J2 of the PoE-PD EVB (at the location labeled “PG”).

See the yellow wire and the DO-35 diode in the figure(s) below.

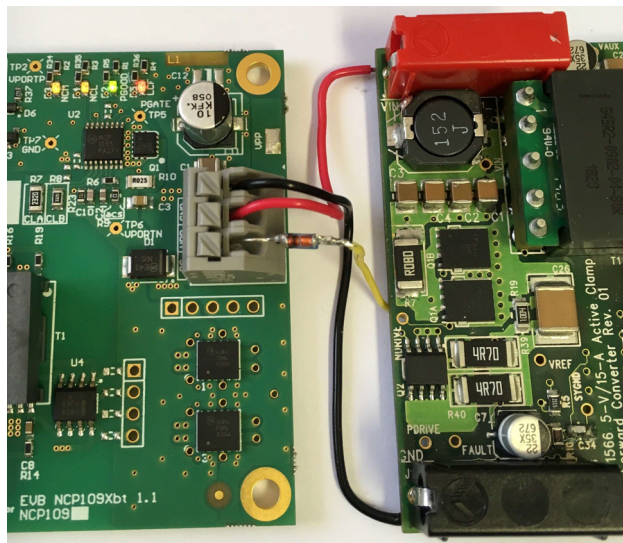


Figure 5. Interconnections between both EVBs

Step 4: Connect the power connections of the NCP1566 DC/DC converter EVB to connector J2 on the PoE-PD EVB (at the locations labeled “GND” and “VPP”).

See the black and red wires in the picture above.

Step 5: Insert the Ethernet cable (cf. blue cable in the picture below) coming from the PSE in the Ethernet connector J3 (labeled “PoE IN”) on the PoE-PD EVB.

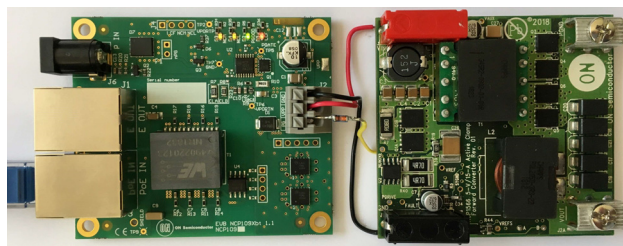


Figure 6. Operational PoE-PD and DC/DC EVBs Showing Basic Interconnections

If the PSE powers up the system the green PGOOD LED (located on the PoE-PD EVB) should be ON.

The status of the remaining LEDs depends on the PSE being used. See the [NCP1095GEVB](#) or [NCP1096GEVB](#) User's Manual to determine the assigned power and the PSE categorization.

System Startup

A PD can be underpowered and assigned to Class 3 only. Therefore, the DC/DC converter behind the PoE-PD EVB should not draw more than 13 W during start-up.

Eventually – depending on the start-up behavior of the remainder of the system – the soft-start setting of the 5 V DC/DC converter (NCP1566TEL5V10AGEVB) might need to be adapted to accomplish this by increasing the capacitance value of C14.

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 PoE-PD eval board to make sure the load current is always sufficient and the PoE-PD EVB remains powered.

In combination with any of the three NCP1566 DC/DC converter EVBs this load resistor is no longer required. So for the final design, this load resistor should not be populated in order not to waste power unnecessarily.

Power Limit

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

PDs assigned to Class 8 may consume up to 71.3 W measured at the PD power interface. Therefore, the output current of the DC/DC converter should be limited to the values listed in Table 3:

Table 3. MAXIMUM ALLOWED DC/DC OUTPUT CURRENT FOR CLASS 8 OPERATION

DC/DC Converter EVB	Output Voltage	Output Current
NCP1566TELECGEBV	3.3 V	20 A
NCP1566TEL5V10AGEVB	5 V	13 Apk
NCP1566POE12V6AGEVB	12 V	5.4 A

Auxiliary Supply

The PoE-PD EVB 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”. However, the customer must take caution when using a high voltage auxiliary supply: the PoE-PD EVB has to be unpowered when this high voltage supply is inserted.

Do not insert the high voltage auxiliary supply when the PoE-PD EVB is already powered by a PSE.

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

The voltage of the auxiliary supply should be in the 48 V range as indicated in Table 4.

Table 4. ELECTRICAL CHARACTERISTICS

	Operating Range
Auxiliary Input Voltage [Warning!]	37.5–57 V
Auxiliary Input Current	0–2.4 A

If the customer needs to implement a system in which a high voltage rear auxiliary supply can be inserted while the PD is already powered by the PSE, the GreenBridge2 rectifiers need a gate drive circuit allowing them to be disabled. See the [NCP1095GEVB](#) or [NCP1096GEVB](#) User’s Manual or contact the GreenBridge2 application team.

ON Semiconductor and  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. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. “Typical” parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including “Typicals” must be validated for each customer application by customer’s technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer 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 part. 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.

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

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

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

For additional information, please contact your local Sales Representative