NCP1082

Integrated PoE-PD & DC-DC Converter Controller with 9 V Auxiliary Supply Support

ON Semiconductor®

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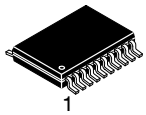

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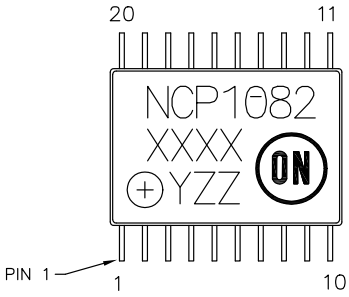


NCP1082 = Specific Device Code
XXXX = Date Code
Y = Assembly Location
ZZ = Traceability Code

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

Introduction

The NCP1082 is a member of ON Semiconductor's Power over Ethernet Powered Device (PoE−PD) product family and represents a robust, flexible and highly integrated solution targeting demanding Ethernet applications. It combines in a single unit an enhanced PoE−PD interface fully supporting the IEEE 802.3af specification and a flexible and configurable DC−DC converter controller.

The NCP1082's exceptional capabilities enable applications to smoothly transition from non−PoE to PoE enabled networks by also supporting power from auxiliary sources such as AC power adapters and battery supplies, eliminating the need for a second switching power supply.

ON Semiconductor's unique manufacturing process and design enhancements allow the NCP1082 to deliver up to 13 W of regulated power to support PoE applications according to the IEEE 802.3af standard. This device leverages the significant cost advantages of PoE−enabled systems to a broad spectrum of products in markets such as VoIP phones, wireless LAN access points, security cameras, point of sales terminals, RFID readers, industrial ethernet devices, etc.

The integrated current mode DC−DC controller facilitates isolated and non−isolated fly−back, forward and buck converter topologies. It has all the features necessary for a flexible, robust and highly efficient design including programmable switching frequency, duty cycle up to 80 percent, slope compensation, and soft start−up.

The NCP1082 is fabricated in a robust high voltage process and integrates a rugged vertical N−channel DMOS with a low loss current sense technique suitable for the most demanding environments and capable of withstanding harsh environments such as hot swap and cable ESD events.

The NCP1082 complements ON Semiconductor's ASSP portfolio in communications and industrial devices and can be combined with other high−voltage interfacing devices to offer complete solutions to the communication, industrial and security markets.

Features

- This is a Pb−Free Device

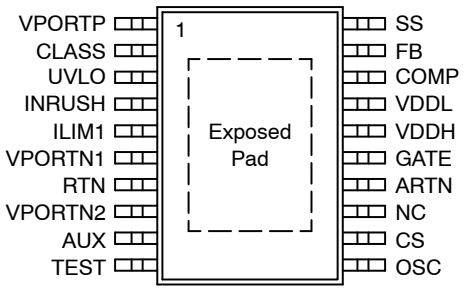
Powered Device Interface

- Flexible Auxiliary Power Supply Support
- 9 V Front, Rear and Direct Auxiliary Supply Connections
- Fully Supports IEEE 802.3af Standard
- Regulated Power Output up to 13 W
- Programmable Classification Current
- Adjustable Under Voltage Lock Out
- Programmable Inrush Current Limit
- Programmable Operational Current Limit up to 500 mA
- Over−temperature Protection
- Industrial Temperature Range −40°C to 85°C with Full Operation up to 150°C Junction Temperature
- 0.6 Ohm Hot−swap Pass−switch with Low Loss Current Sense Technique
- Vertical N−channel DMOS Pass−switch Offers the Robustness of Discrete MOSFETs with Integrated Temperature Control

DC−DC Converter Controller

- Current Mode Control
- Supports Isolated and Non−isolated DC−DC Converter Applications
- Internal Voltage Regulators
- Wide Duty Cycle Range with Internal Slope Compensation Circuitry
- Programmable Oscillator Frequency
- Programmable Soft−start Time

PIN DIAGRAM



(Top View)

ORDERING INFORMATION

Part Number	Temperature Range	Package	Shipping Configuration†
NCP1082DEG	−40°C to 85°C	TSSOP−20 EP (Pb−Free)	74 units / Tube
NCP1082DER2G	−40°C to 85°C	TSSOP−20 EP (Pb−Free)	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

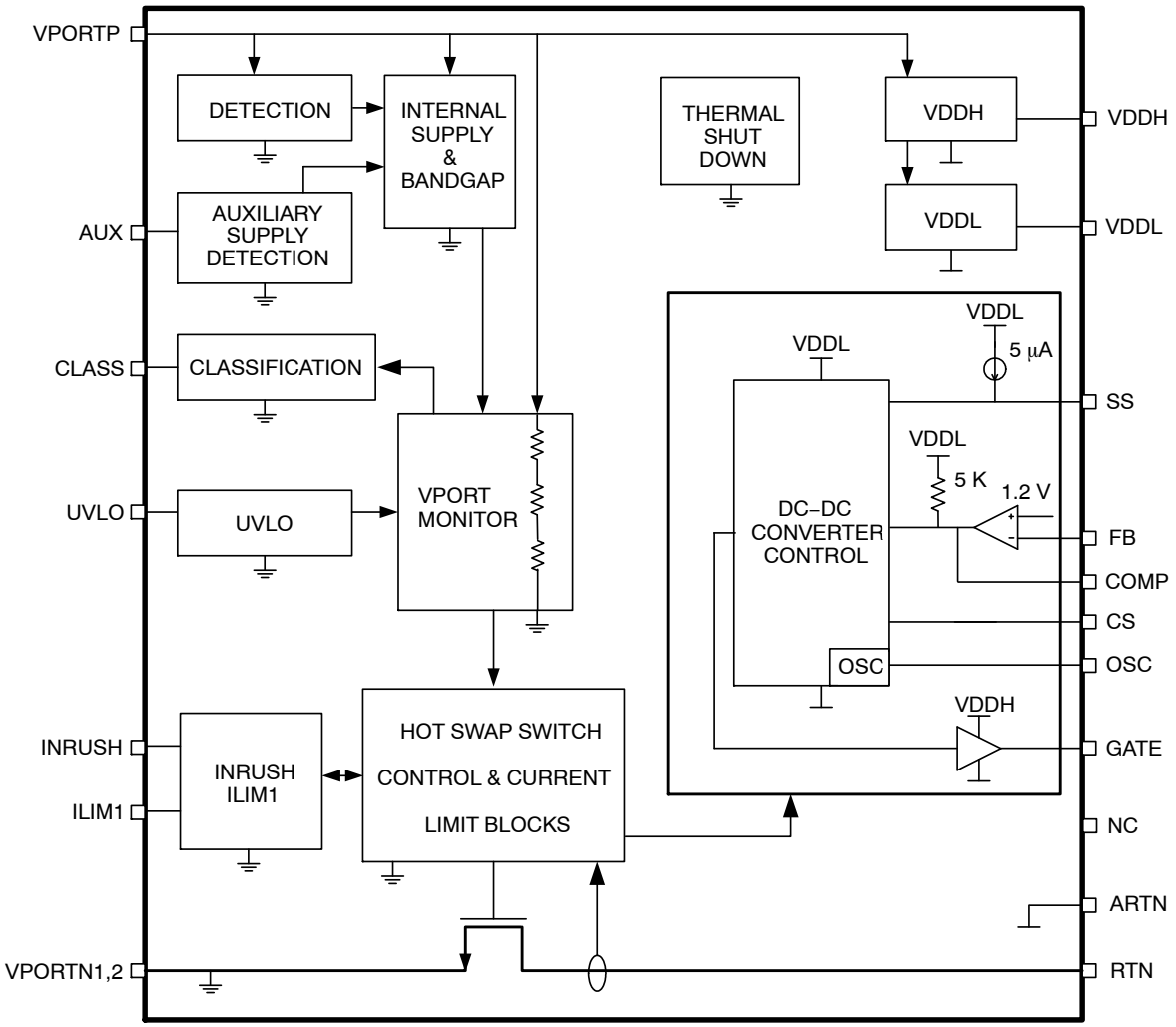


Figure 1. NCP1082 Block Diagram

SIMPLIFIED APPLICATION DIAGRAMS

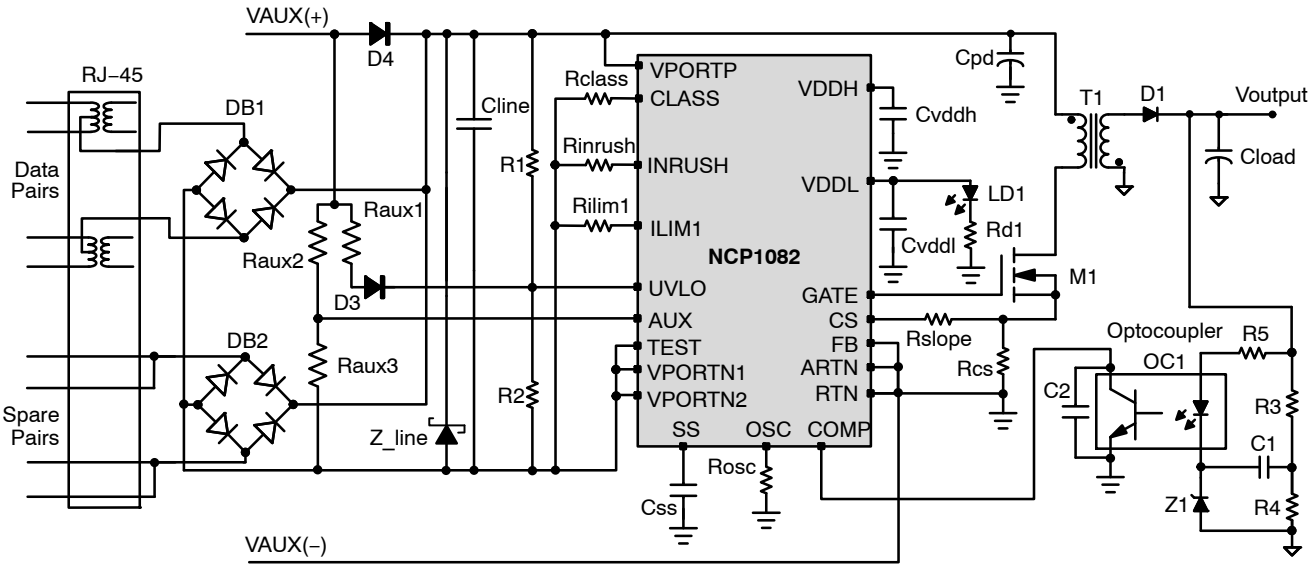


Figure 2. Isolated Fly−back Converter with Rear Auxiliary Support

Figure 2 shows the integrated PoE−PD switch and DC−DC controller configured to work in a fully isolated application. The output voltage regulation is accomplished with an external opto−coupler and a shunt regulator (Z1).

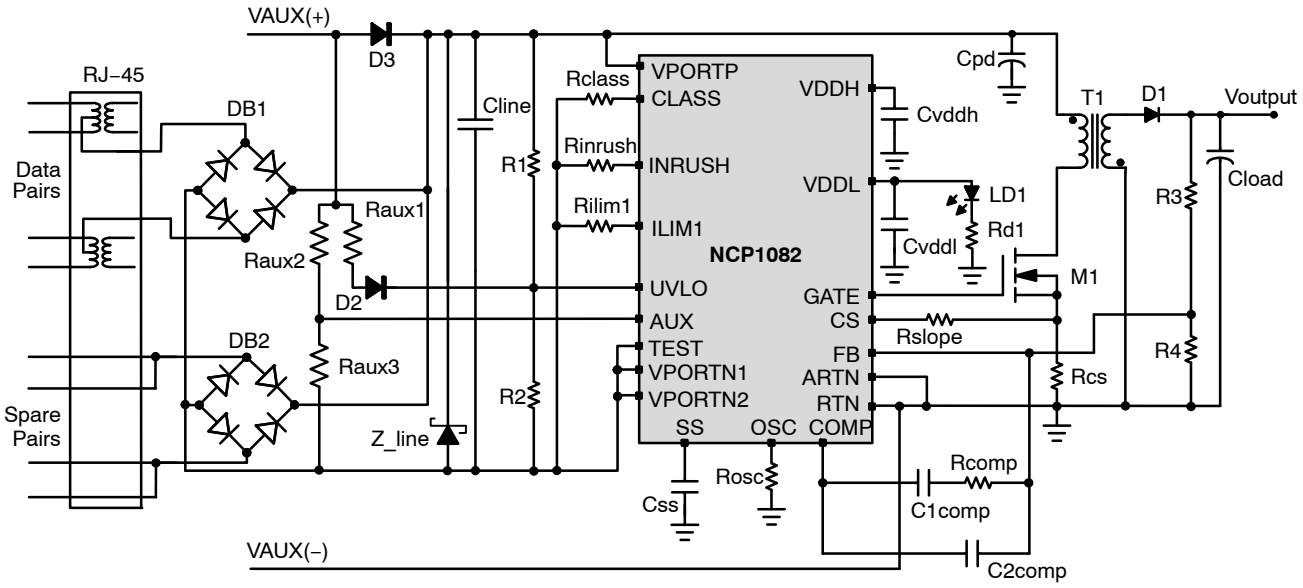


Figure 3. Non−Isolated Fly−back Converter with Rear Auxiliary Support

Figure 3 shows the integrated PoE−PD and DC−DC controller configured in a non−isolated fly−back configuration. A compensation network is inserted between the FB and the COMP pin for overall stability of the feedback loop.

SIMPLIFIED APPLICATION DIAGRAMS

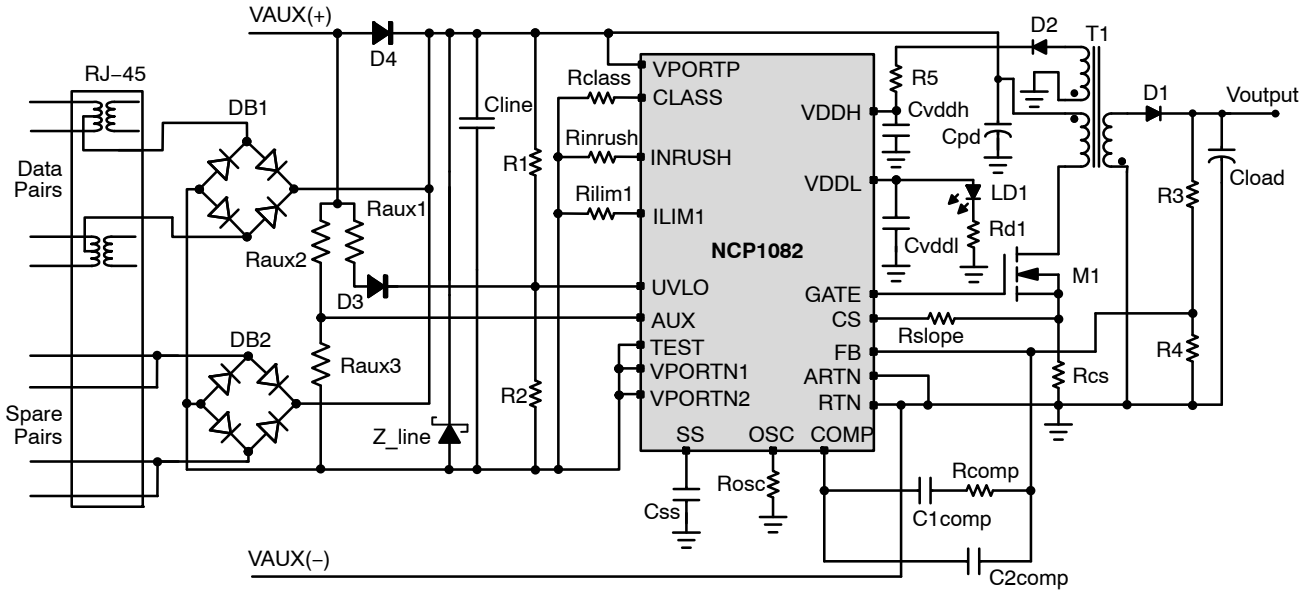


Figure 4. Non−Isolated Fly−back with Extra Winding and Rear Auxiliary Support

Figure 4 shows the same non−isolated fly−back configuration as Figure 3, but adds a 12 V auxiliary bias winding on the transformer to provide power to the NCP1082 DC−DC controller via its VDDH pin. This topology shuts off the current flowing from VPORTP to VDDH and therefore reduces the internal power dissipation of the PD, resulting in higher overall power efficiency.

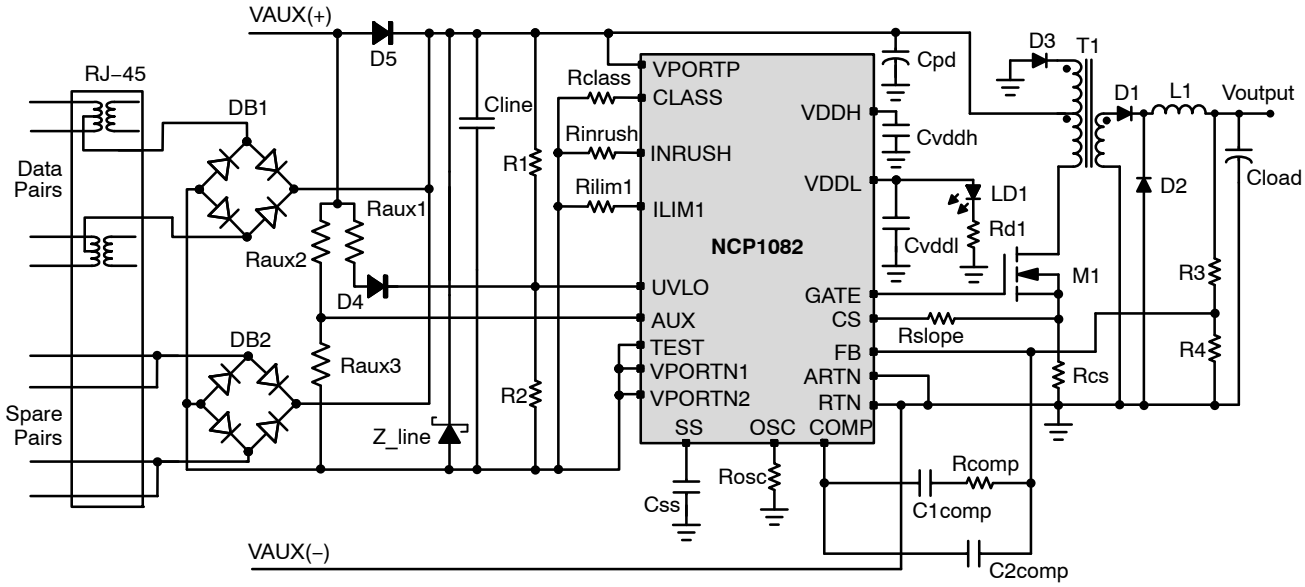


Figure 5. Non−Isolated Forward Converter with Rear Auxiliary Support

Figure 5 shows the NCP1082 used in a non−isolated forward topology.

Table 1. PIN DESCRIPTIONS

Name	Pin No.	Type	Description
VPORTP	1	Supply	Positive input power. Voltage with respect to $VPORTN_{1,2}$
VPORTN1 VPORTN2	6,8	Ground	Negative input power. Connected to the source of the internal pass−switch.
RTN	7	Ground	DC−DC controller power return. Connected to the drain of the internal pass−switch. It must be connected to ARTN. This pin is also the drain of the internal pass−switch.
ARTN	14	Ground	DC−DC controller ground pin. Must be connected to RTN as a single point ground connection for improved noise immunity.
VDDH	16	Supply	Output of the 9 V LDO internal regulator. Voltage with respect to ARTN. Supplies the internal gate driver. VDDH must be bypassed to ARTN with a 1 μF or 2.2 μF ceramic capacitor with low ESR.
VDDL	17	Supply	Output of the 3.3 V LDO internal regulator. Voltage with respect to ARTN. This pin can be used to bias an external low−power LED (1 mA max.) connected to ARTN, and can also be used to add extra biasing current in the external opto−coupler. VDDL must be bypassed to ARTN with a 330 nF or 470 nF ceramic capacitor with low ESR.
CLASS	2	Input	Classification current programming pin. Connect a resistor between CLASS and $VPORTN_{1,2}$.
INRUSH	4	Input	Inrush current limit programming pin. Connect a resistor between INRUSH and $VPORTN_{1,2}$.
ILIM1	5	Input	Operational current limit programming pin. Connect a resistor between ILIM1 and $VPORTN_{1,2}$.
UVLO	3	Input	DC−DC controller under−voltage lockout input. Voltage with respect to $VPORTN_{1,2}$. Connect a resistor−divider from VPORTP to UVLO to $VPORTN_{1,2}$ to set an external UVLO threshold.
GATE	15	Output	DC−DC controller gate driver output pin.
OSC	11	Input	Internal oscillator frequency programming pin. Connect a resistor between OSC and ARTN.
NC	13		No connect pin, must not be connected.
COMP	18	I/O	Output of the internal error amplifier of the DC−DC controller. COMP is pulled−up internally to VDDL with a 5 kΩ resistor. In isolated applications, COMP is connected to the collector of the opto−coupler. Voltage with respect to ARTN.
FB	19	Input	DC−DC controller inverting input of the internal error amplifier. In isolated applications, the pin should be strapped to ARTN to disable the internal error amplifier.
CS	12	Input	Current−sense input for the DC−DC controller. Voltage with respect to ARTN.
SS	20	Input	Soft−start input for the DC−DC controller. A capacitor between SS and ARTN determines the soft−start timing.
AUX	9	Input	When the pin is pulled up, the IEEE detection mode is disabled and the device can be supplied by an auxiliary supply. Voltage with respect to $VPORTN_{1,2}$. Connect the pin to the auxiliary supply through a resistor divider.
TEST	10	Input	Digital test pin must always be connected to $VPORTN_{1,2}$.
EP			Exposed pad. Connected to $VPORTN_{1,2}$ ground.

Table 2. ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Min	Max	Unit
VPORTP	Input power supply	Voltage with respect to $VPORTN_{1,2}$	−0.3	72	V
RTN ARTN	Analog ground supply 2	Pass−switch in off−state (Voltage with respect to $VPORTN_{1,2}$)	−0.3	72	V
VDDH	Internal regulator output	Voltage with respect to ARTN	−0.3	17	V
VDDL	Internal regulator output	Voltage with respect to ARTN	−0.3	3.6	V
CLASS	Analog output	Voltage with respect to $VPORTN_{1,2}$	−0.3	3.6	V
INRUSH	Analog output	Voltage with respect to $VPORTN_{1,2}$	−0.3	3.6	V
ILIM1	Analog output	Voltage with respect to $VPORTN_{1,2}$	−0.3	3.6	V
UVLO	Analog input	Voltage with respect to $VPORTN_{1,2}$	−0.3	3.6	V
OSC	Analog output	Voltage with respect to ARTN	−0.3	3.6	V
COMP	Analog input / output	Voltage with respect to ARTN	−0.3	3.6	V
FB	Analog input	Voltage with respect to ARTN	−0.3	3.6	V
CS	Analog input	Voltage with respect to ARTN	−0.3	3.6	V
SS	Analog input	Voltage with respect to ARTN	−0.3	3.6	V
NC	Open pin				
AUX	Analog input	Voltage with respect to $VPORTN_{1,2}$	−0.3	3.6	V
TEST	Digital input	Voltage with respect to $VPORTN_{1,2}$	−0.3	3.6	V
T_A	Ambient temperature		−40	85	°C
T_J	Junction temperature		−	150	°C
T_J−TSD	Junction temperature (Note 1)	Thermal shutdown condition	−	175	°C
T_{stg}	Storage Temperature		−55	150	°C
$T_{\theta JA}$	Thermal Resistance, Junction to Air (Note 2)	Exposed pad connected to $VPORTN_{1,2}$ ground		37.6	°C/W
ESD−HBM	Human Body Model	per JEDEC Standard JESD22	4	−	kV
ESD−CDM	Charged Device Model		750	−	V
ESD−MM	Machine Model		300	−	V
LU	Latch−up	per JEDEC Standard JESD78	±200	−	mA
ESD−SYS	System ESD (contact/air) (Note 3)		8/15	−	kV

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.

1. T_J−TSD allowed during error conditions only. It is assumed that this maximum temperature condition does not occur more than 1 hour cumulative during the useful life for reliability reasons.
2. Mounted on a 1S2P (3 layer) test board with copper coverage of 25 percent for the signal layers and 90 percent copper coverage for the inner planes at an ambient temperature of 85°C in still air. Refer to JEDEC JESD51−7 for details.
3. Surges per EN61000−4−2, 1999 applied between RJ−45 and output ground and between adapter input and output ground of the demo board. The specified values are the test levels and not the failure levels.

Recommended Operating Conditions

Operating conditions define the limits for functional operation and parametric characteristics of the device. Note that the functionality of the device outside the operating conditions described in this section is not warranted. Operating outside the recommended operating conditions for extended periods of time may affect device reliability.

All values concerning the DC−DC controller, VDDH and VDDL blocks are with respect to ARTN. All others are with respect to $VPORTN_{1,2}$ (unless otherwise noted).

Table 3. OPERATING CONDITIONS

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
INPUT SUPPLY						
VPORT	Input supply voltage	VPORT = VPORTP − $VPORTN_{1,2}$	0		57	V
SIGNATURE DETECTION						
Vsignature	Input supply voltage signature detection range		1.4		9.5	V
Rsignature	Signature resistance (Note 4)		23.75		26.25	kΩ
Offset_current	I_VportP + I_Rtn	VPORTP = RTN = 1.4 V	−	1.8	5	μA
Sleep_current	I_VportP + I_Rtn	VPORTP = RTN = 9.5 V	−	15	25	μA
CLASSIFICATION						
Vcl	Input supply voltage classification range		13		20.5	V
Iclass0	Class 0: Rclass 10 kΩ (Note 5)	Iclass0 = I_VportP + I_Rdet	0	−	4	mA
Iclass1	Class 1: Rclass 130 Ω (Note 5)	Iclass1 = I_VportP + I_Rdet	9	−	12	mA
Iclass2	Class 2: Rclass 69.8 Ω (Note 5)	Iclass2 = I_VportP + I_Rdet	17	−	20	mA
Iclass3	Class 3: Rclass 44.2 Ω (Note 5)	Iclass3 = I_VportP + I_Rdet	26	−	30	mA
Iclass4	Class 4: Rclass 30.9 Ω (Note 5)	Iclass4 = I_VportP + I_Rdet	36	−	44	mA
IDC_{class}	Internal current consumption during classification (Note 6)	For information only	−	600	−	μA
UVLO						
Vuvlo_on	Default turn on voltage (VportP rising)	UVLO pin tied to $VPORTN_{1,2}$		38	40	V
Vuvlo_off	Default turn off voltage (VportP falling)	UVLO pin tied to $VPORTN_{1,2}$	29.5	32	−	V
Vhyst_int	UVLO internal hysteresis	UVLO pin tied to $VPORTN_{1,2}$	−	6	−	V
Vuvlo_pr	UVLO external programming range	UVLO pin connected to the resistor divider (R1 & R2) AUX pin tied to $VPORTN_{1,2}$ For information only	13	−	50	V
Vuvlo_pr_aux	UVLO external programming VPORT range with low auxiliary supply support	UVLO & AUX pins configured for auxiliary supply support	8.5	−	18	V
Vhyst_ext	UVLO external hysteresis	UVLO pin connected to the resistor divider (R1 & R2)	−	15	−	%
Uvlo_Filter	UVLO on/off filter time	For information only	−	90	−	μS
AUXILIARY SUPPLY OPERATION – INPUT SUPPLY						
Vaux_min1	VPORTP−ARTN voltage at startup (required for VDDH > VDDH_Por_R)	VAUX rising − No external load on VDDL & VDDH	8.7	−	−	V
Vaux_min2	VPORTP−ARTN voltage during PWM operation (required for VDDH > VDDH_Por_F)	Voltage with respect to Ivddl_load1 & Ivddh_load1 for the load current conditions	8.5	−	−	V

4. Test done according to the IEEE 802.3af 2 Point Measurement. The minimum probe voltages measured at the PoE−PD are 1.4 V and 2.4 V, and the maximum probe voltages are 8.5 V and 9.5 V.
5. Measured with an external Rdet of 25.5 kΩ between VPORTP and $VPORTN_{1,2}$, and for 13 V < VPORT < 20.5 V (with VPORT = VPORTP − $VPORTN_{1,2}$). Resistors are assumed to have 1% accuracy.
6. This typical current excludes the current in the Rclass and Rdet external resistors.

Table 3. OPERATING CONDITIONS

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
AUXILIARY SUPPLY OPERATION – AUX PIN						
Vaux_off	Voltage range of the AUX pin where the auxiliary supply circuit is guaranteed not operational.	Voltage with respect to $VPORTN_{1,2.}$	–	–	0.2	V
Vaux_on	Voltage range of the AUX pin where the auxiliary supply circuit is guaranteed operational.	Voltage with respect to $VPORTN_{1,2}$	1.5	–	3.3	V
Raux	Total resistance value of the resistor divider connected to the AUX pin (sum of R_{aux1} and R_{aux3})	Between VAUX supply & $VPORTN_{1,2}$	–	–	25	kΩ
AUXILIARY SUPPLY OPERATION – VDDL REGULATOR						
Ivddl_load1	Current load on the VDDL pin with VPORTP − ARTN = 8.5 V (Notes 7 and 8)	Ivddh_load + Ivddl_load < 4.5 mA	–	–	1	mA
Ivddl_load2	Current load on the VDDL pin with VPORTP − ARTN > 12.5 V (Notes 7 and 8)	Ivddh_load + Ivddl_load < 10 mA	–	–	2.25	mA
AUXILIARY SUPPLY OPERATION – VDDH REGULATOR						
Ivddh_load1	Current load on the VDDH regulator with VPORTP − ARTN = 8.5 V (Notes 7 and 8)	Ivddh_load + Ivddl_load < 4.5 mA	–	–	4.5	mA
Ivddh_load2	Current load on the VDDH regulator with VPORTP − ARTN > 12.5 V (Notes 7 and 8)	Ivddh_load + Ivddl_load < 10 mA	–	–	10	mA
PASS−SWITCH AND CURRENT LIMITS						
Ron	Pass−switch Rds−on	Max Ron specified at T_J = 130°C	–	0.6	1.2	Ω
I_Rinrush1	Rinrush = 150 kΩ (Note 9)	Measured at RTN− $VPORTN_{1,2}$ = 3 V	95	125	155	mA
I_Rinrush2	Rinrush = 57.6 kΩ (Note 9)	Measured at RTN− $VPORTN_{1,2}$ = 3 V	260	310	360	mA
I_Rilim1	Rilim1 = 84.5 kΩ (Note 9)	Current limit threshold	450	510	570	mA
INRUSH AND ILIM1 CURRENT LIMIT TRANSITION						
Vds_pgood	VDS required for power good status	RTN−VPORTNx falling; voltage with respect to $VPORTN_{1,2}$	0.8	1	1.2	V
Vds_pgood_hyst	VDS hysteresis required for power good status	Voltage with respect to $VPORTN_{1,2}$	–	8.2	–	V

7. Ivddl_load = current flowing out of the VDDL pin.
   Ivddh_load = current flowing out of the VDDH pin + current delivered to the Gate Driver (function of the frequency, VDDH voltage & MOSFET gate capacitance).
8. See Figures 6 and 7 for specifications on the load current at lower or higher VPORTP-ARTN voltages. In case the application requires more current capability on VDDL and VDDH, it is recommended to externally supply the VDDH pin with a bias winding from the transformer or to add a diode between VAUX(+) and VDDH pin (verify the VAUX voltage does not exceed the VDDH voltage range).
9. The current value corresponds to the PoE−PD input current (the current flowing in the external Rdet and the quiescent current of the device are included). Resistors are assumed to have 1% accuracy.

Table 3. OPERATING CONDITIONS

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VDDH REGULATOR						
VDDH_reg	Regulator output voltage (Notes 10 and 11)	Ivddh_load + Ivddl_load < 10 mA with Ivddl_load < 2.25 mA and 12.5 V < VPORTP − ARTN < 57 V	8.4	9	9.6	V
VDDH_Off	Regulator turn−off voltage	For information only	−	VDDH_reg + 0.5 V	−	V
VDDH_lim	VDDH regulator current limit (Notes 10 and 11)		13	−	26	mA
VDDH_Por_R	VDDH POR level (rising)		7.3	−	8.3	V
VDDH_Por_F	VDDH POR level (falling)		6	−	7	V
VDDH_ovlo	VDDH over−voltage level (rising)		16	−	18.5	V
VDDL REGULATOR						
VDDL_reg	Regulator output voltage (Notes 10 and 11)	Ivddl_load < 2.25 mA with Ivddh_load + Ivddl_load < 10 mA and 12.5 V < VPORTP − ARTN < 57 V	3.05	3.3	3.55	V
VDDL_Por_R	VDDL POR level (rising)		VDDL − 0.2	−	VDDL − 0.02	V
VDDL_Por_F	VDDL POR level (falling)		2.5	−	2.9	V
GATE DRIVER						
Gate_Tr	GATE rise time (10−90%)	Cload = 2 nF, VDDHreg = 9 V	−	−	50	ns
Gate_Tf	GATE fall time (90−10%)	Cload = 2 nF, VDDHreg = 9 V	−	−	50	ns
PWM COMPARATOR						
VCOMP	COMP control voltage range	For information only	1.3	−	3	V
ERROR AMPLIFIER						
Vbg_fb	Reference voltage	Voltage with respect to ARTN	1.15	1.2	1.25	V
Av_ol	DC open loop gain	For information only	−	80	−	dB
GBW	Error amplifier GBW	For information only	1	−	−	MHz
SOFT−START						
Vss	Soft−start voltage range		−	1.15	−	V
Vss_r	Soft−start low threshold (rising edge)		0.35	0.45	0.55	V
Iss	Soft−start source current		3	5	7	μA
CURRENT LIMIT COMPARATOR						
CSth	CS threshold voltage		324	360	396	mV
Tblank	Blanking time	For information only	−	100	−	ns

10. Power dissipation must be considered. Load on VDDH and VDDL must be limited especially if VDDH is not powered by an auxiliary winding.
11. Ivddl_load = current flowing out of the VDDL pin.
    Ivddh_load = current flowing out of the VDDH pin + current delivered to the Gate Driver (function of the frequency, VDDH voltage & MOSFET gate capacitance).

Table 3. OPERATING CONDITIONS

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
OSCILLATOR						
DutyC	Maximum duty cycle	Fixed internally	–	80%	–	
Frange	Oscillator frequency range		100	–	500	kHz
F_acc	Oscillator frequency accuracy			±25		%
CURRENT CONSUMPTION						
$Ivport P_1$	VPORTP internal current consumption (Note 12)	DC−DC controller off	–	2.5	3.5	mA
$Ivport P_2$	VPORTP internal current consumption (Note 13)	DC−DC controller on	–	4.7	6.5	mA
THERMAL SHUTDOWN						
TSD	Thermal shutdown threshold	T_J = junction temperature	150	–	–	°C T_J
Thyst	Thermal hysteresis	T_J = junction temperature	–	15	–	°C T_J
THERMAL RATINGS						
Ta	Ambient temperature		−40	–	85	°C
Tj	Junction temperature	Parametric values guaranteed Max 1000 hours	–	–	125 150	°C °C

12. Conditions
    a. No current through the pass−switch
    b. DC−DC controller inactive (SS shorted to RTN)
    c. No external load on VDDH and VDDL
    d. VPORTP = 57 V
13. Conditions
    a. No current through the pass−switch
    b. Oscillator frequency = 100 kHz
    c. No external load on VDDH and VDDL
    d. Aux winding not used
    e. 2 nF on GATE, DC−DC controller enabled
    f. VPORTP = 57 V

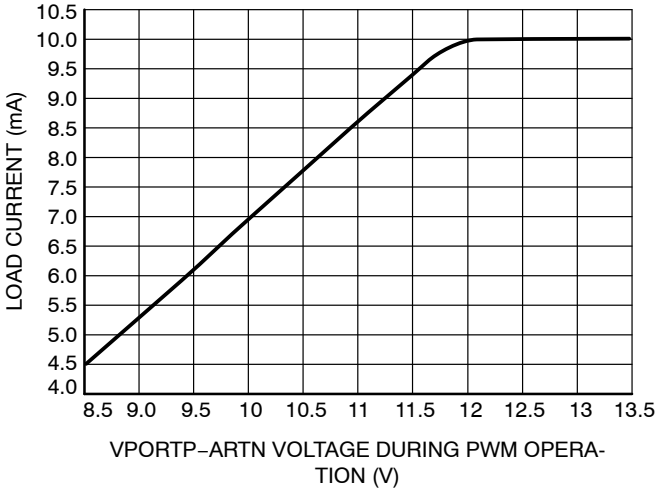


Figure 6. (Ivddl_load)max with Auxiliary Supply Operation

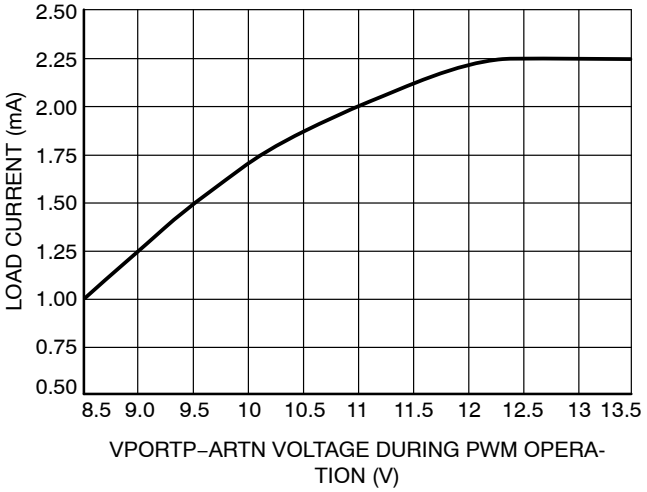


Figure 7. (Ivddh_load+Ivddl_load)max with Auxiliary Supply Operation

DESCRIPTION OF OPERATION

Powered Device Interface

The PD interface portion of the NCP1082 supports the IEEE 802.3af defined operating modes: detection signature, current source classification, inrush and operating current limits. In order to give more flexibility to the user and also to keep control of the power dissipation in the NCP1082, both current limits are configurable. The device enters operation once its programmable Vuvlo_on threshold is reached, and operation ceases when the supplied voltage falls below the Vuvlo_off threshold. Sufficient hysteresis and Uvlo filter time are provided to avoid false power on/off cycles due to transient voltage drops on the cable.

Detection

During the detection phase, the incremental equivalent resistance seen by the PSE through the cable must be in the IEEE 802.3af standard specification range (23.75 kΩ to 26.25 kΩ) for a PSE voltage from 2.7 V to 10.1 V. In order to compensate for the non−linear effect of the diode bridge and satisfy the specification at low PSE voltage, the NCP1082 presents a suitable impedance in parallel with the 25.5 kΩ R_{det} external resistor connected between VPORTP and VPORTN. For some types of diodes (especially Schottky diodes), it may be necessary to adjust this external resistor.

When the Detection_Off level is detected (typically 11.5 V) on VPORTP, the NCP1082 turns on its internal 3.3 V regulator and biasing circuitry in anticipation of the classification phase as the next step.

Classification

Once the PSE device has detected the PD device, the classification process begins. In classification, the PD regulates a constant current source that is set by the external resistor RCLASS value on the CLASS pin. Figure 8 shows the schematic overview of the classification block. The current source is defined as:

$$I_{class} = \frac{V_{bg}}{R_{class}}, \text{ (where } V_{bg} \text{ is 1.2 V)}$$

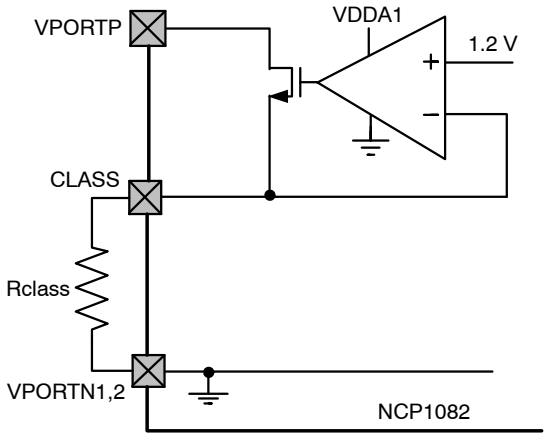


Figure 8. Classification Block Diagram

Power Mode

When the classification hand−shake is completed, the PSE and PD devices move into the operating mode.

Under Voltage Lock Out (UVLO)

The NCP1082 incorporates an under voltage lock out (UVLO) circuit which monitors the input voltage and determines when to apply power to the DC−DC controller.

To use the default settings for UVLO (see Table 3), the pin UVLO must be connected to $VPORTN_{1,2}$. In this case the signature resistor has to be placed directly between VPORTP and $VPORTN_{1,2}$, as shown in Figure 9.

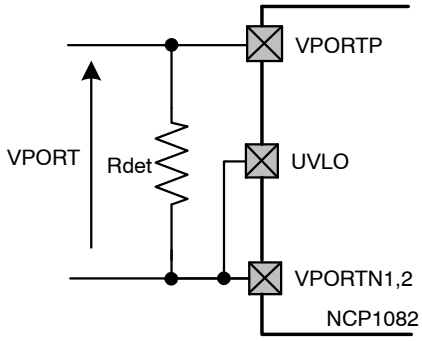


Figure 9. Default UVLO Settings

To define the UVLO threshold externally, the UVLO pin must be connected to the center of an external resistor divider between VPORTP and $VPORTN_{1,2}$ as shown in Figure 10. The series resistance value of the external resistors must add to 25.5 kΩ and replaces the internal signature resistor.

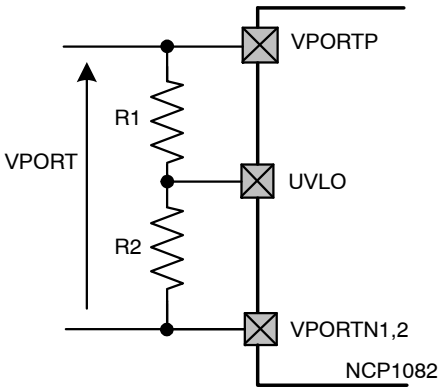


Figure 10. External UVLO Configuration

For a Vuvlo_on desired turn−on voltage threshold, R1 and R2 can be calculated using the following equations:

$$R1 + R2 = R_{det}$$

$$R2 = \frac{1.2}{V_{ulvo\_on}} \times R_{det}$$

When using the external resistor divider, the NCP1082 has an external reference voltage hysteresis of 15 percent typical.

Auxiliary Supply Support

To support applications connected to non PoE enabled networks and minimize the bill of materials, the NCP1082 supports drawing power from an external supply. The NCP1082 supports the IEEE 802.3af standard when the PoE capability is available and acts as a regular DC-DC converter when there is no power source on the Ethernet cable as shown in Figure 11.

Auxiliary supply support can be implemented in three ways depending on where the auxiliary supply is injected. The front, rear and direct auxiliary supply configurations are explained in more detail in the application note AND9080.

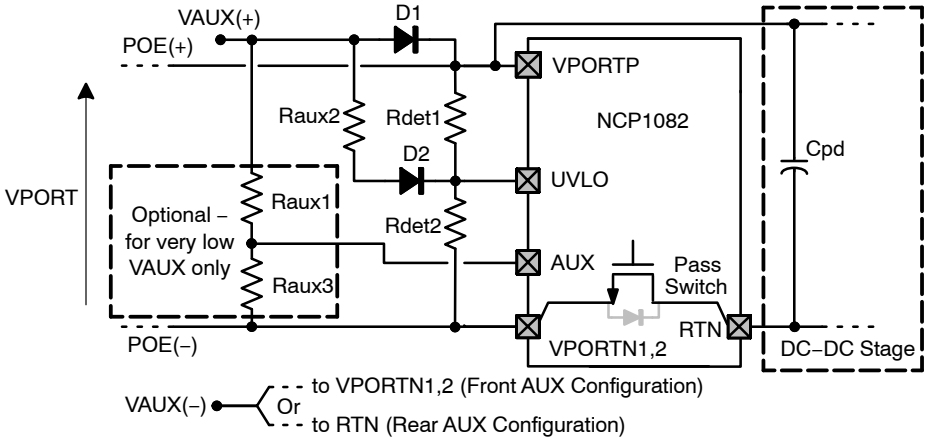


Figure 11. Front and Rear Auxiliary Supply Input with Support for Very Low Input Voltages

When the auxiliary input supply is above 13.5 V, connect the AUX pin to $VPORTN_{1,2}$. When the auxiliary supply is below 13.5 V (but above 9 V), calculate the voltage dividers Raux1, Raux3 and Raux2, Rdet1, Rdet2 to divide the input voltage using the below formulas together with the formulas from the previous section. This will ensure that for valid input voltages, the voltage at the UVLO and AUX pins are above their threshold voltages. Note that the maximum voltage is 3.3 V.

$$R_{aux3} = \frac{R_{aux1} \times V_t}{V_{aux} - V_{dp} - V_t}$$

$$R_{aux2} = \frac{V_{aux} - V_{dp} - V_d - V_t}{\frac{V_t}{845} - \frac{V_{aux} - V_{dp} - V_d - V_t}{24\ K}}$$

$$R_{aux1} = 20\ k\Omega$$

Where V_d is the voltage drop over the rectifiers and masking diodes (typical 0.6 V), V_{dp} is the forward drop of the NCP1082 internal diode (typical 0.5 V), and V_t is the threshold voltage on the AUX pin (typical 1.5 V).

Note that as soon the auxiliary supply is connected the PoE interface (detection and classification) is disabled and does not allow the PD device to be powered from the Ethernet until the auxiliary supply is removed.

If the PoE PD device was drawing the current from the Ethernet cable before the auxiliary supply is connected, the power will continue to be supplied from the Ethernet cable unless the voltage of the auxiliary supply is higher than the Ethernet supply voltage.

Inrush and Operational Current Limitations

The inrush current limit and the operational current limit are programmed individually by an external Rinrush and Rilim1 resistors respectively connected between INRUSH and $VPORTN_{1,2}$, and between ILIM1 and $VPORTN_{1,2}$ as shown in Figure 12.

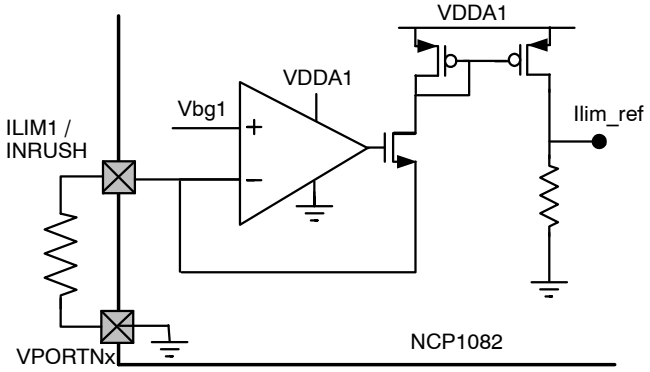


Figure 12. Current Limitation Configuration (Inrush & Ilim1 Pins)

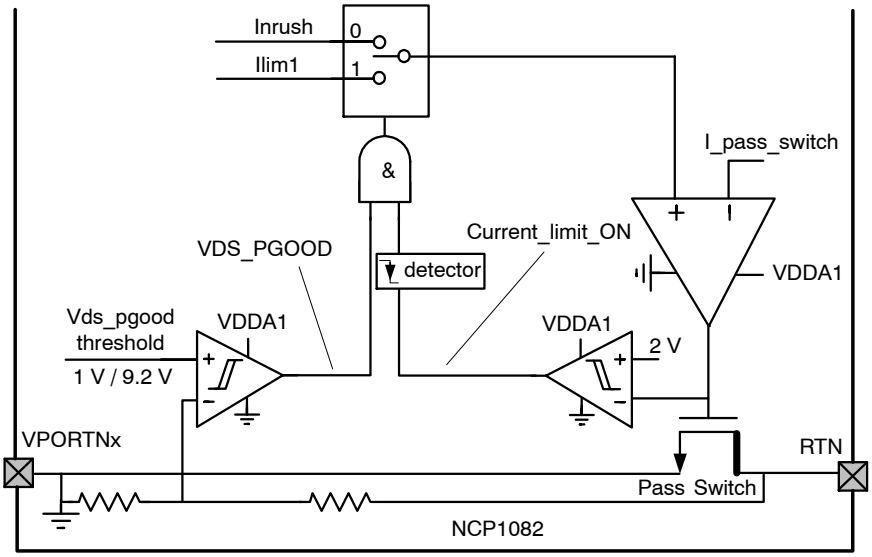


Figure 13. Inrush and Ilim1 Selection Mechanism

When VPORT reaches the UVLO_on level, the Cpd capacitor is charged with the INRUSH current (in order to limit the internal power dissipation of the pass−switch). Once the Cpd capacitor is fully charged, the current limit switches from the inrush current to the operational current level (ilim1) as shown in Figure 13. This transition occurs when both following conditions are satisfied:

1. The VDS of the pass−switch is below the Vds_pgood low level (1 V typical).
2. The pass−switch is no longer in current limit mode, meaning the gate of the pass−switch is "high" (above 2 V typical).

The operational current limit will stay selected as long as Vds_pgood is true (meaning that RTN−VPORTN$_{1,2}$ is below the high level of Vds_pgood). This mechanism allows a current level transition without any current spike in the pass−switch because the operational current limit (ilim1) is enabled once the pass−switch is not limiting the current anymore, meaning that the Cpd capacitor is fully charged.

Thermal Shutdown

The NCP1082 includes thermal protection which shuts down the device in case of high power dissipation. Once the thermal shutdown (TSD) threshold is exceeded, following blocks are turned off:

- DC−DC controller
- Pass−switch
- VDDH and VDDL regulators
- CLASS regulator

When the TSD error disappears and if the input line voltage is still above the UVLO level, the NCP1082 automatically restarts with the current limit set in the inrush state, the DC−DC controller is disabled and the Css (soft−start capacitor) discharged. The DC−DC controller becomes operational as soon as RTN−VPORTN$_{1,2}$ is below the Vds_pgood threshold.

DC−DC Converter Controller

The NCP1082 implements a current mode DC−DC converter controller which is illustrated in Figure 14.

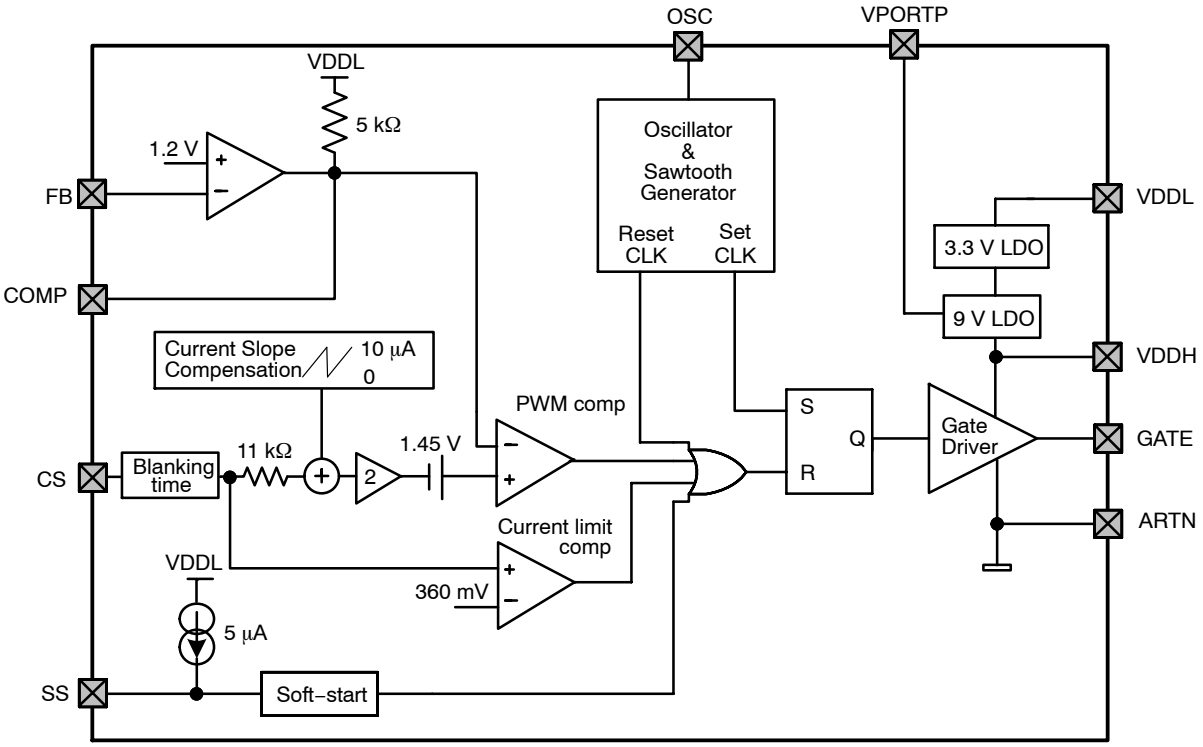


Figure 14. DC−DC Controller Block Diagram

Internal VDDH and VDDL Regulators and Gate Driver

An internal linear regulator steps down the VPORTP voltage to a 9 V output on the VDDH pin. VDDH supplies the internal gate driver circuit which drives the GATE pin and the gate of the external power MOSFET. The NCP1082 gate driver supports an external MOSFET with high Vth and high input gate capacitance. A second LDO regulator steps down the VDDH voltage to a 3.3 V output on VDDL. VDDL powers the analog circuitry of the DC−DC controller.

In order to prevent uncontrolled operations, both regulators include power−on−reset (POR) detectors which prevent the DC−DC controller from operating when either VDDH or VDDL is too low. In addition, an over−voltage lockout (OVLO) on the VDDH supply disables the gate driver in case of an open−loop converter with a configuration using the bias winding of the transformer (see Figure 4).

Both VDDH and VDDL regulators turn on as soon as VPORT reaches the Vuvlo_on threshold.

Error Amplifier

In non−isolated converter topologies, the high gain internal error amplifier of the NCP1082 and the internal 1.2 V reference voltage regulate the DC−DC output voltage. In this configuration, the feedback loop compensation network should be inserted between the FB and COMP pins as shown in Figures 3, 4 and 5.

In isolated topologies the error amplifier is not used because it is already implemented externally with the shunt regulator on the secondary side of the DC−DC controller (see Figure 2). Therefore the FB pin must be strapped to ARTN and the output transistor of the opto−coupler has to be connected on the COMP pin where an internal 5 kΩ pull−up resistor is tied to the VDDL supply (see Figure 14).

Soft−Start

The soft−start function provided by the NCP1082 allows the output voltage to ramp up in a controlled fashion, eliminating output voltage overshoot. This function is programmed by connecting a capacitor C_{SS} between the SS and ARTN pins.

While the DC−DC controller is in POR, the capacitor C_{SS} is fully discharged. After coming out of POR, an internal current source of 5 μA typically starts charging the capacitor C_{SS} to initiate soft−start. When the voltage on SS pin has reached 0.45 V (typical), the gate driver is enabled and DC−DC operation starts with a duty cycle limit which increases with the SS pin voltage. The soft−start function is finished when the SS pin voltage goes above 1.6 V for which the duty cycle limit reaches its maximum value of 80 percent.

Soft−start can be programmed by using the following equation:

$$t_{SS}(ms) = 0.23 \times C_{SS}(nF)$$

Current Limit Comparator

The NCP1082 current limit block behind the CS pin senses the current flowing in the external MOSFET for current mode control and cycle−by−cycle current limit. This is performed by the current limit comparator which, on the CS pin, senses the voltage across the external Rcs resistor located between the source of the MOSFET and the ARTN pin.

The NCP1082 also provides a blanking time function on CS pin which ensures that the current limit and PWM comparators are not prematurely trigged by the current spike that occurs when the switching MOSFET turns on.

Slope Compensation Circuitry

To overcome sub−harmonic oscillations and instability problems that exist with converters running in continuous conduction mode (CCM) and when the duty cycle is close or above 50 percent, the NCP1082 integrates a current slope compensation circuit. The amplitude of the added slope compensation is typically 110 mV over one cycle.

As an example, for an operating switching frequency of 250 kHz, the internal slope provided by the NCP1082 is 27.5 mV/ μA typically.

DC−DC Controller Oscillator

The frequency is configured with the Rosc resistor inserted between OSC and ARTN, and is defined by the following equation:

$$R_{OSC}(k\Omega) = \frac{38600}{F_{OSC}(kHz)}$$

The duty cycle limit is fixed internally at 80 percent.

PACKAGE DIMENSIONS

TSSOP−20 EP
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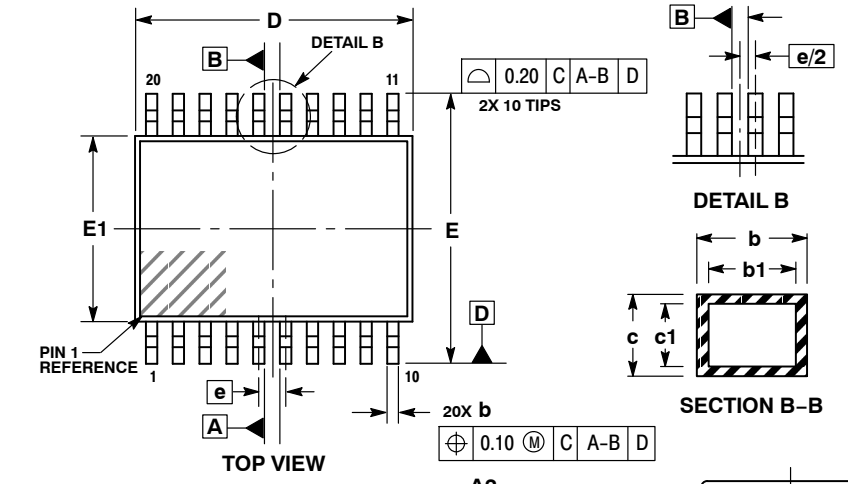
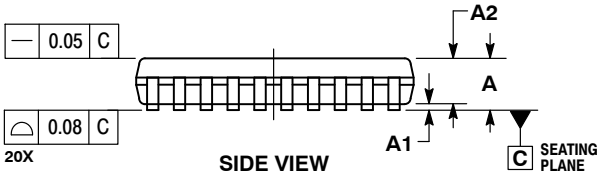
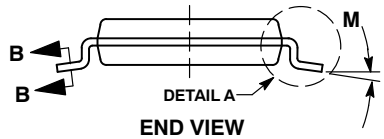
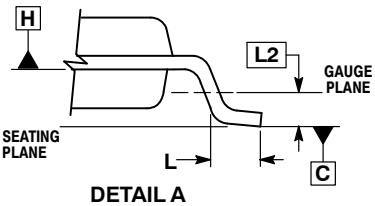
ISSUE O



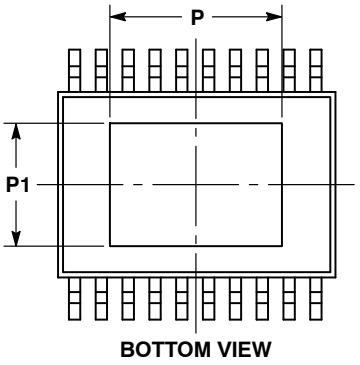
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.07 IN EXCESS OF THE LEAD WIDTH AT MMC. DAMBAR CANNOT BE LOACTED ON THE LOWER RADIUS OR THE FOOT OF THE LEAD.
4. DIMENSIONS b, b1, c, c1 TO BE MEASURED BETWEEN 0.10 AND 0.25 FROM LEAD TIP.
5. DATUMS A AND B ARE ARE DETERMINED AT DATUM H. DATUM H IS LOACTED AT THE MOLD PARTING LINE AND COINCIDENT WITH LEAD WHERE THE LEAD EXITS THE PLASTIC BODY.
6. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.15 PER SIDE. D AND E1 ARE DETERMINED AT DATUM H.







	MILLIMETERS	
DIM	MIN	MAX
A	---	1.10
A1	0.05	0.15
A2	0.85	0.95
b	0.19	0.30
b1	0.19	0.25
c	0.09	0.20
c1	0.09	0.16
D	6.40	6.60
E	6.40 BSC	
E1	4.30	4.50
e	0.65 BSC	
L	0.50	0.70
L2	0.25 BSC	
M	0°	8°
P	---	4.20
P1	---	3.00



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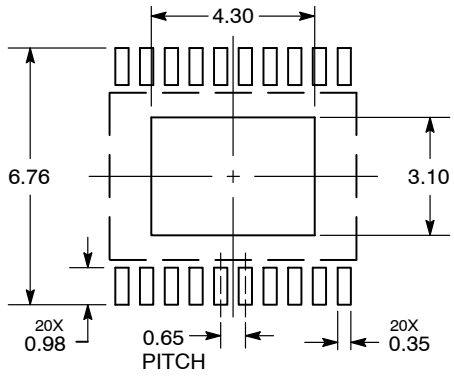

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*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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