

nPM1304 EK Hardware

v0.9.0

User Guide

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Revision history

Date	Description
December 2025	Updated LDO bypass capacitors on page 23
August 2025	First release

Environmental and safety notices

Environmental and safety notices for the nPM1304 EK and power supply requirements.

Skilled persons

The nPM1304 EK is intended for use only by skilled persons.

A skilled person is someone with relevant education or experience that enables them to identify potential hazards and takes appropriate action to reduce the risk of injury to themselves and others.



Electrostatic discharge

The nPM1304 EK is susceptible to *Electrostatic Discharge (ESD)*.

To avoid damage to your device, it should be used in an electrostatic free environment, such as a laboratory.



Battery replacement

Warning: Due to the following safety concerns the battery in this product shall only be removed or replaced by qualified professionals:

- Replacing the battery with an incorrect battery type can cause a fire or explosion.
- Disposing the battery into a fire or hot oven, crushing it mechanically, or cutting it can cause an explosion.
- Leaving the battery in an environment with an extremely high temperature can cause an explosion or the leakage of flammable liquid or gas.
- Subjecting the battery to extremely low air pressure can cause an explosion or the leakage of flammable liquid or gas.

Pay attention to the polarity of the battery connectors. Connecting the polarity the wrong way causes the device to become very hot.





Environmental Protection

Waste electrical products should not be disposed of with household waste.

Please recycle where facilities exist. Check with your local authority or retailer for recycling advice.



1 Introduction

The nPM1304 *Evaluation Kit (EK)* is a hardware platform used to evaluate the nPM1304 *Power Management Integrated Circuit (PMIC)*.

Key features

- Dedicated *Universal Serial Bus (USB)* Type-C connection powers the nPM1304 PMIC
- Battery connectors support *Negative Temperature Coefficient (NTC)* thermistor connection for monitoring battery temperature
- Male pin headers and probe loops provide easy access to PMIC voltage outputs
- No hardware changes are needed to measure key parameters
- Exposed jumper pins to do the following:
 - Select VSET configuration (resistor, external, or off)
 - Connect to *General-Purpose Input/Output (GPIO)*s
 - Configure load switches or *Low-Dropout Regulator (LDO)*s
 - Connect LEDs
 - Configure the onboard active load
- Onboard nPM Controller circuit for PMIC configuration when connected to a computer
- Plug-and-play connection to nPM PowerUP, which is a computer app that enables quick evaluation and implementation of Nordic PMICs
- Evaluation possible without writing code or programming the device when using nPM PowerUP
- Use with a Nordic *Development Kit (DK)* or develop your own nPM1304 application
- Use with your own custom hardware or develop your own nPM1304 application

nPM1304 PMIC

- 100 mA battery charger
- Two 200 mA buck regulators
- Two dual-purpose 100 mA load switches/50 mA LDOs
- Two-button hard reset
- Fuel gauge
- System-level watchdog and failed-boot recovery
- Intelligent power-loss warning
- Five GPIOs
- Three LED drivers
- Controlled using *Inter-integrated Circuit (I²C)* compatible TWI
- USB-C compatible

nPM PowerUP

- Computer application to simplify evaluation and implementation of Nordic PMIC applications
- Ability to configure, evaluate, and export all PMIC features
- Intuitive user experience for a seamless hardware-firmware-software solution
- Battery profiling to generate a battery model for fuel gauging using the controllable active load on the nPM1304 EK
- Available for download from [nRF Connect for Desktop](#)

Kit content

The nPM1304 EK includes hardware and access to software components, hardware design files, and documentation.

The kit contains the nPM1304 Evaluation Board with pre-mounted jumpers and a 20 mAh lithium-polymer battery.

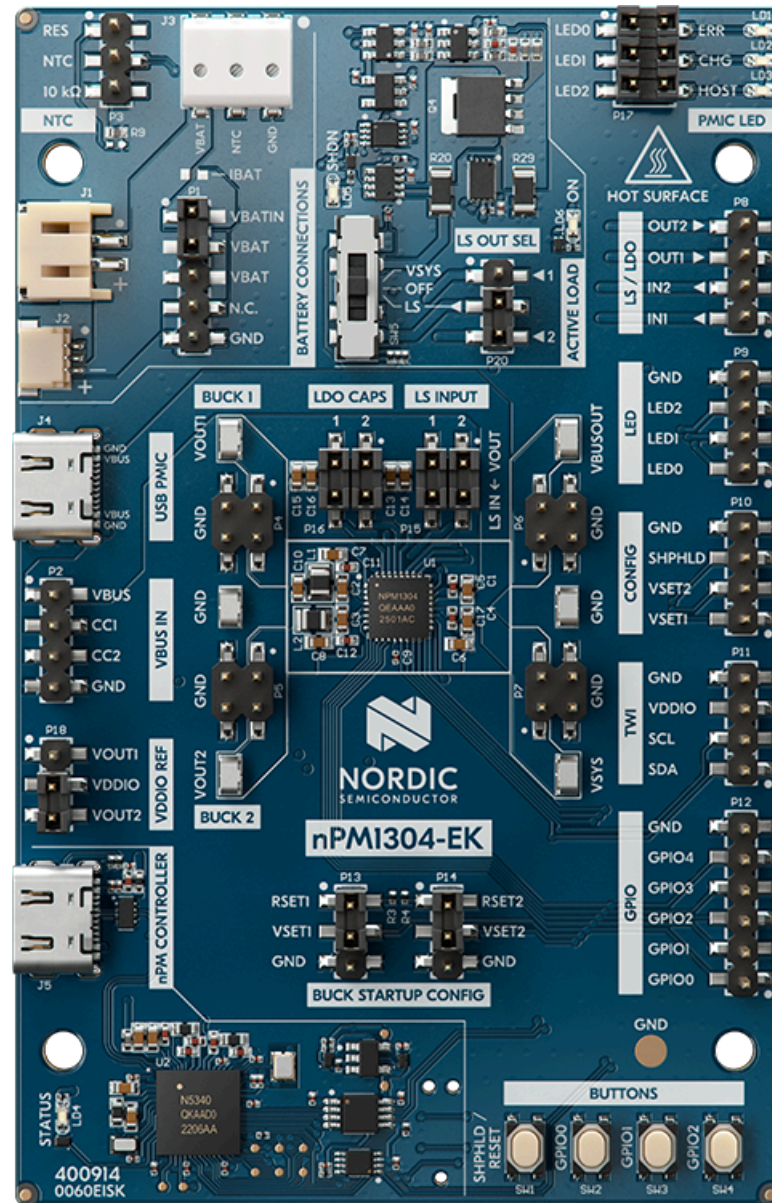


Figure 1: nPM1304 EK

The hardware design files for the nPM1304 EK are available on the [nPM1304 EK product page](#). They include the following resources:

- Schematics
- *Printed Circuit Board (PCB)* layout files
- Bill of materials
- Gerber files

2 Minimum requirements

Before you start, check that you have the required hardware and software.

Hardware requirements

- USB Type-C cable with 1.5 A current capability to power the *PMIC*
- USB Type-C cable with USB 2.0 High Speed compatibility to power the nPM Controller
- Wires with a 2.54 mm (0.1") pitch for connecting the EK with a Nordic *DK* or your own device
- Batteries

The EK supports the following types of batteries:

- Lithium-ion (Li-ion)
- Lithium-polymer (Li-poly)
- Lithium iron phosphate (LiFePO₄)

Software requirements

- nPM PowerUP available from [nRF Connect for Desktop](#)

3 Hardware description

The nPM1304 EK enables the evaluation of different functions and features of the nPM1304 PMIC without extra programming. It allows full configuration flexibility without requiring any hardware modifications.

Jumpers allow for quick configuration. You can use the jumpers to control the output state of the PMIC and operation mode of the BUCK regulators and disable parts of the EK. You can change the output voltages of the regulators and open the full potential of the PMIC using the provided library and sample code.

The following figures show the front and back of the nPM1304 EK.

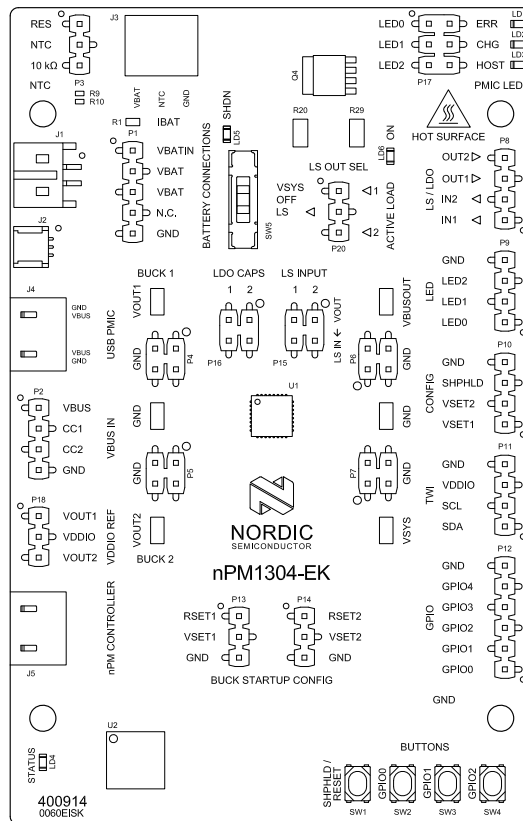


Figure 2: nPM1304 EK front view

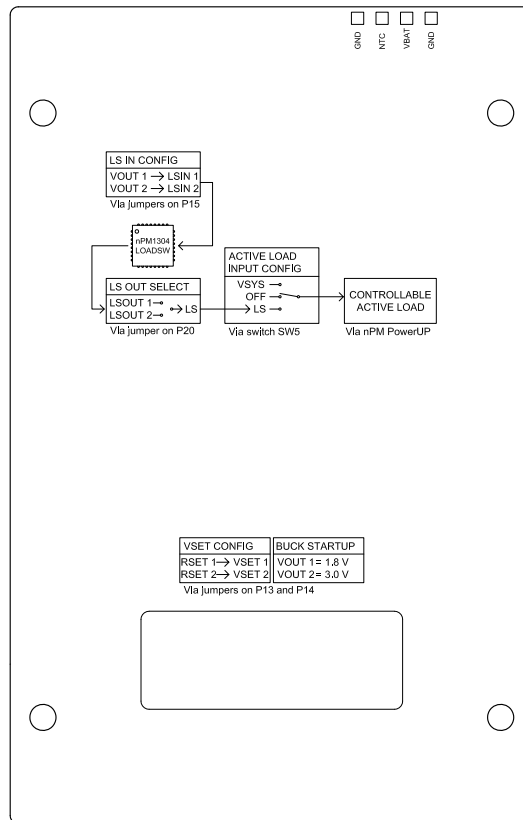


Figure 3: nPM1304 EK back view

3.1 Block diagram

The block diagram illustrates the nPM1304 EK's functional architecture.

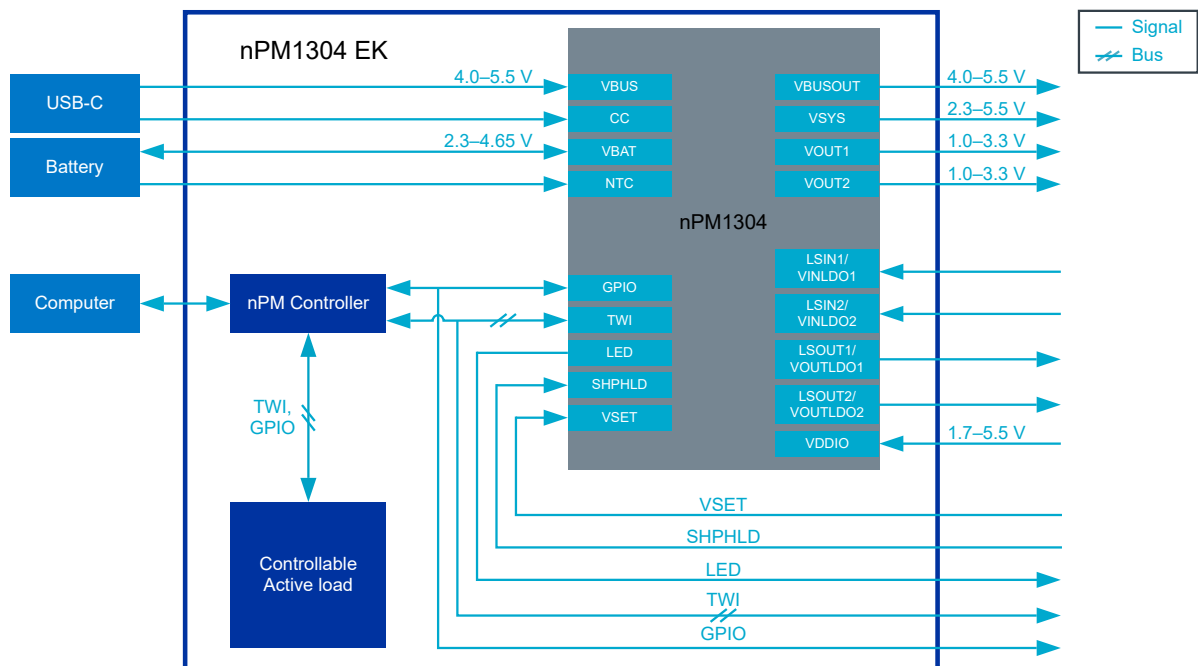


Figure 4: nPM1304 EK block diagram

3.2 Power supply

The nPM1304 EK has a flexible and configurable power supply system to allow testing with different power sources and to facilitate accurate power measurements.

The power supply to the nPM1304 PMIC is from **USB (VBUS)** or battery (**VBAT**). The input voltage ranges from 2.3 V to 5.5 V depending on the source.

USB power is the main input source and the source for battery charging. A compatible battery connected to the EK acts as a complementary power source. The battery powers the EK if no external power source is connected to **USB PMIC** on **J4** or **VBUS** on **P2**. You can also connect the battery through the PCB pads on the back of the EK.

The USB-C connector **nPM CONTROLLER** on **J5** powers the nPM Controller and its circuitry when evaluating the PMIC in the nPM PowerUP computer app.

The following figures show the power supply connections on the nPM1304 EK.

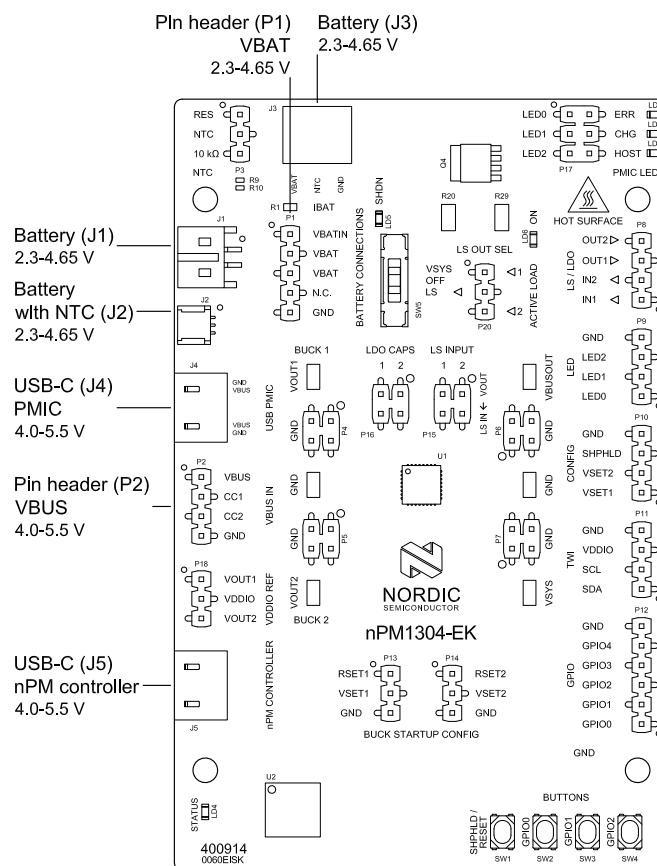


Figure 5: Power supply connections

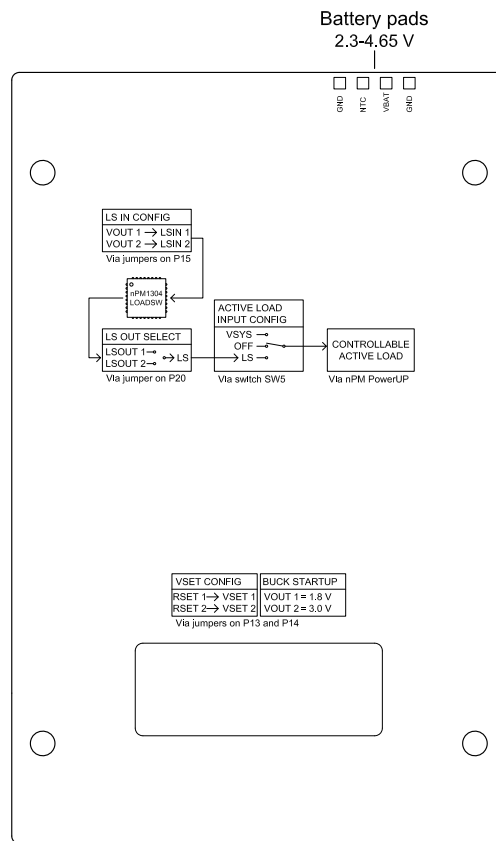


Figure 6: Battery pads

The following table shows the connections for the main and complementary power input sources on the EK.

Input source		Part	Connector type	Comment
Main	VBUS 4.0 V to 5.5 V	J4	USB-C	Use only USB power on this connector.
		P2	Pin header	VBUS on pin 1.
Complementary	VBAT 2.3 V to 4.65 V	J1	JST S2B-PH-SM4 header (2 pins)	Use for batteries without an NTC thermistor. Ground on pin 1.
		J2	JST SM03B header (3 pins)	Use for batteries with an NTC thermistor. Ground on pin 1.
		J3	WAGO terminal block (3 pins)	Solid conductor wires from 0.14–0.34 mm ² .
		P1	Pin header	VBAT on pin 3.
		Pads	PCB pad	Use the pads located at the back of the PCB to solder the battery directly to the EK. The NTC pad is for batteries with an NTC thermistor.

Table 1: Options for connecting power input sources

Note:

- To keep the operating temperature of the EK within safe limits, the recommended input current on VBUS is 1 A.
- The maximum allowed input current on VBUS is determined by the power delivery negotiation between host and PMIC.
- Pay attention to the polarity of the battery connectors (**J1/J2**). Connecting the polarity the wrong way causes the device to become very hot. The nPM1304 EK uses JST configuration B, where pin 1 is **GND**.
- A battery without an NTC thermistor requires an external resistor to be terminated to **GND** on the **NTC** pin on pin header **P3**.

**Battery**

The nPM1304 EK comes with a 20 mAh lithium-polymer battery with the following specifications.

Parameter	Value
Manufacturer part number	LP181917
Nominal voltage	3.70 V
Maximum charge voltage (V_{TERM})	4.20 V
Maximum charge current (I_{CHG})	10 mA
Maximum continuous discharge current	60 mA
Discharge cut-off voltage	2.75 V

Table 2: Battery specifications

3.3 Battery temperature monitoring

The nPM1304 PMIC monitors battery temperature using NTC thermistors, available on different connectors on the EK.

When using a battery pack with an integrated NTC thermistor, use battery connector **J2**. Leave the **NTC** pin on **P3** unconnected.

When using a battery pack without an integrated NTC thermistor on **J1**, **J3**, or header **P1**, use the integrated 10 k Ω resistor on the EK or a custom resistor. See [NTC jumper](#) on page 21 for more information.

If there is no NTC thermistor in the battery pack and a resistor is not connected between **NTC** and **GND** on **P3**, charging will not occur, and the charging LED (**CHG**) does not light up.

3.4 Output connections

The regulated outputs, **VOUT1** and **VOUT2**, and the unregulated outputs, **VBUSOUT** and **VSYS**, are accessible on the nPM1304 EK through pin headers and probe loops.

The connection options are the following:

- Pin headers—use to power other devices like the nRF54L15 DK, nRF5340 Audio DK, or custom hardware.
- Probe loops—use to test the performance of the nPM1304 PMIC using lab equipment like electronic load, a *Source Measure Unit (SMU)*, oscilloscope, or the Power Profiler Kit II (PPK2).

In addition, load switches or *LDO* outputs are available on pin headers. For more information, see [Load switches and LDOs](#) on page 19.

The following figure shows the pin headers and probe loops for the power outputs on the nPM1304 EK.

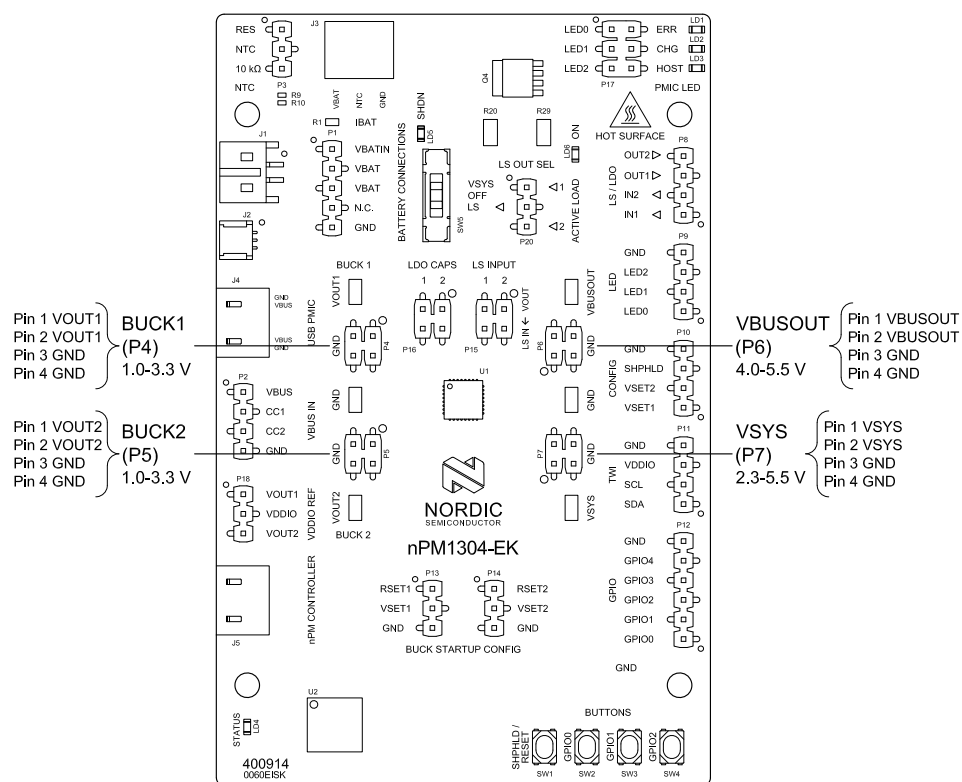


Figure 7: Pin headers and probe loops for power outputs

3.5 I/O pins

The nPM1304 EK provides connections to status and control pins of the nPM1304 PMIC, including five *GPIOs* available for custom workflows.

All status and control pins on the PMIC are accessible on pin headers. For default I/O pin configuration of the EK see [Jumpers and switches](#) on page 19.

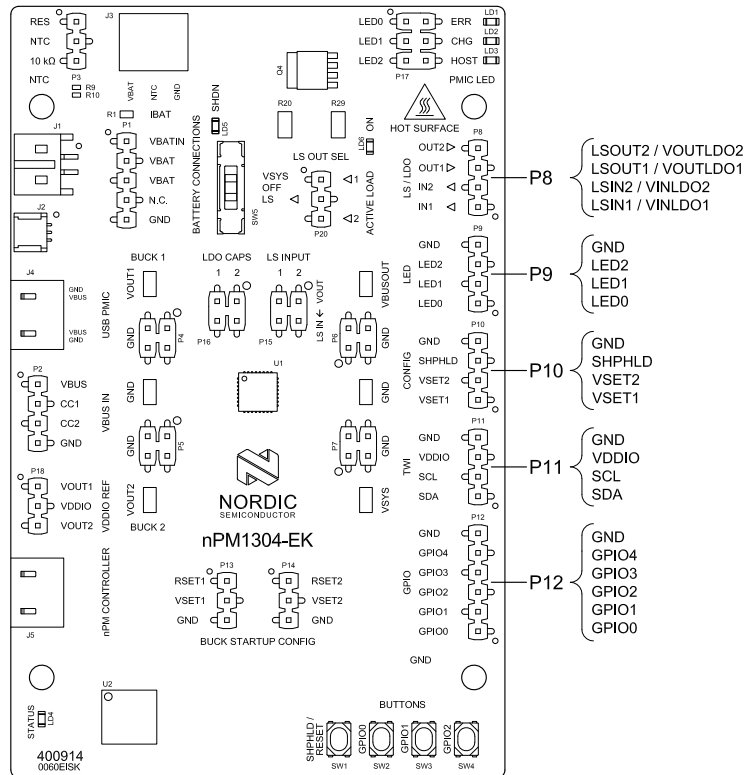


Figure 8: nPM1304 EK I/O pin headers

3.5.1 LEDs

The nPM1304 PMIC has three programmable LED pins, located on pin header **P9**.

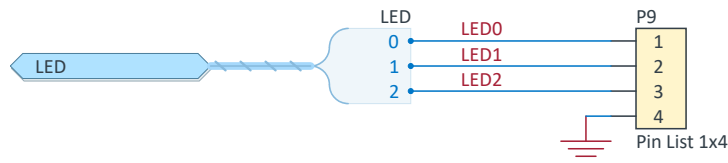


Figure 9: LED configuration

The LED pins can sink constant current up to 5 mA. In addition, the pins can be configured in software to be open-drain connections. The table shows the default settings of the LEDs.

Pin	Pin name	Default indication mode
1	LED0	ERR (error)
2	LED1	CHG (charging)
3	LED2	HOST (host activity)
4	GND	N/A (ground)

Table 3: Default function of LED pins

3.5.2 GPIOs

Five *GPIOs* are available on pin header **P12**. The *GPIOs* can be configured using the nPM Controller or an external host.

All *GPIOs* are inputs with weak pull-down by default.

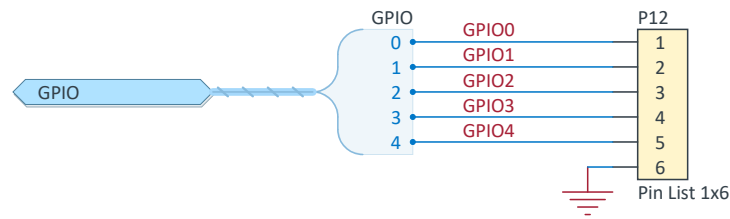


Figure 10: GPIOs

Pin	Pin name	Function
1	GPIO0	PMIC GPIO0
2	GPIO1	PMIC GPIO1
3	GPIO2	PMIC GPIO2
4	GPIO3	PMIC GPIO3
5	GPIO4	PMIC GPIO4
6	GND	Ground

Table 4: GPIO pin functionality

3.5.3 TWI

The I2C compatible TWI is used by the host device to control and monitor the nPM1304 PMIC.

The TWI pins are directly accessible on pin header **P11**.

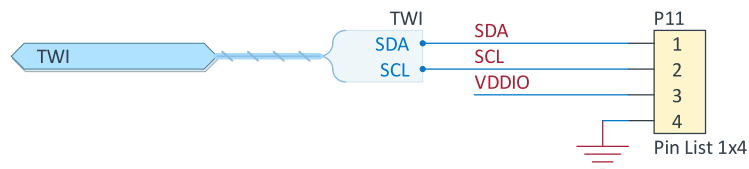


Figure 11: TWI configuration

Pin	Pin name	Function
1	SDA	TWI data line
2	SCL	TWI clock signal
3	VDDIO	TWI voltage reference
4	GND	Ground

Table 5: TWI pin functionality

3.5.4 VSET

The BUCK regulator configuration pins **VSET1** and **VSET2** are available on pin header **P10** for custom BUCK startup configuration through compatible resistors values.

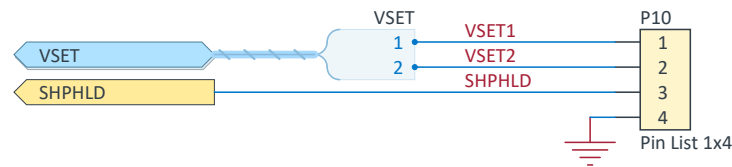


Figure 12: VSET configuration

The **VSET1** and **VSET2** pins are only effective at power up. The external resistor (maximum 5% tolerance) defines the default output voltage setting as found in the following table.

Resistor value	Output voltage	
	VOUT1	VOUT2
< 100 Ω (grounded)	0 V (OFF)	0 V (OFF)
4.7 k Ω	1.0 V	1.8 V
10 k Ω	1.2 V	2.0 V
22 k Ω	1.5 V	2.2 V
47 k Ω	1.8 V (RSET1)	2.4 V
68 k Ω	2.0 V	2.5 V
100 k Ω	2.2 V	2.7 V
150 k Ω	2.5 V	3.0 V (RSET2)
250 k Ω to 500 k Ω	2.7 V	3.3 V

Table 6: Output voltage of VOUT1 and VOUT2

Note: When using external VSET resistors, remove the default VSET jumpers on pin headers **P13** and **P14**.

3.5.5 SHPHLD

The **SHPHLD** input pin is available on pin header **P10**.

Use the **SHPHLD** pin to exit Ship mode and Hibernation mode. It can also be used to reset and power cycle nPM1304.

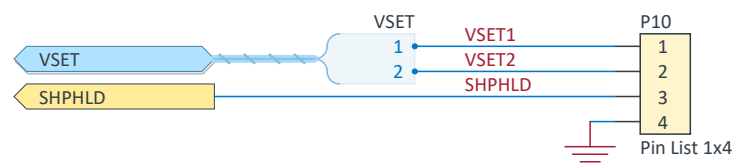


Figure 13: SHPHLD

3.5.6 VDDIO

The **VDDIO** external reference voltage pin is available on pin header **P11**. This is for external voltage input and sets the reference voltage level for the *GPIOs* and the *TWI*.

If using external **VDDIO** supply on **P11**, disconnect the VDDIO input jumper on **P18**. See further details in [VDDIO reference voltage](#) on page 22.

VDDIO is shown in [Figure 11: TWI configuration](#) on page 17.

Note: The minimum **VDDIO** voltage is 1.7 V. Any lower voltage can result in lost TWI communication between host and the nPM1304 PMIC.

3.5.7 Load switches and LDOs

The pins for the dual-purpose load switches and LDOs are available on pin header **P8**. By default, these pins are configured as load switches. To use the pins as LDOs, add bypass capacitors by placing a jumper on pin header **P16**.

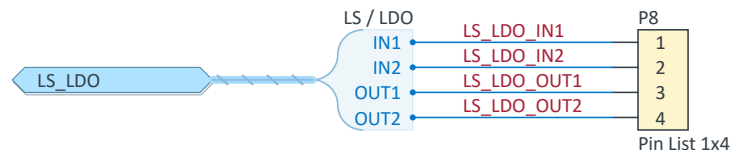


Figure 14: Load switches and LDOs

Pin	Pin name	Load switch	LDO
1	IN1	LSIN1	VINLDO1
2	IN2	LSIN2	VINLDO2
3	OUT1	LSOUT1	VOUPLDO1
4	OUT2	LSOUT2	VOUPLDO2

Table 7: Load switches and LDOs

For more information on load switches and LDOs, see [Load switch configuration](#) on page 22 and [LDO bypass capacitors](#) on page 23.

3.6 Jumpers and switches

The nPM1304 EK has jumpers and switches for easy configuration and control options.

The following figure shows the default jumper configuration of the EK.

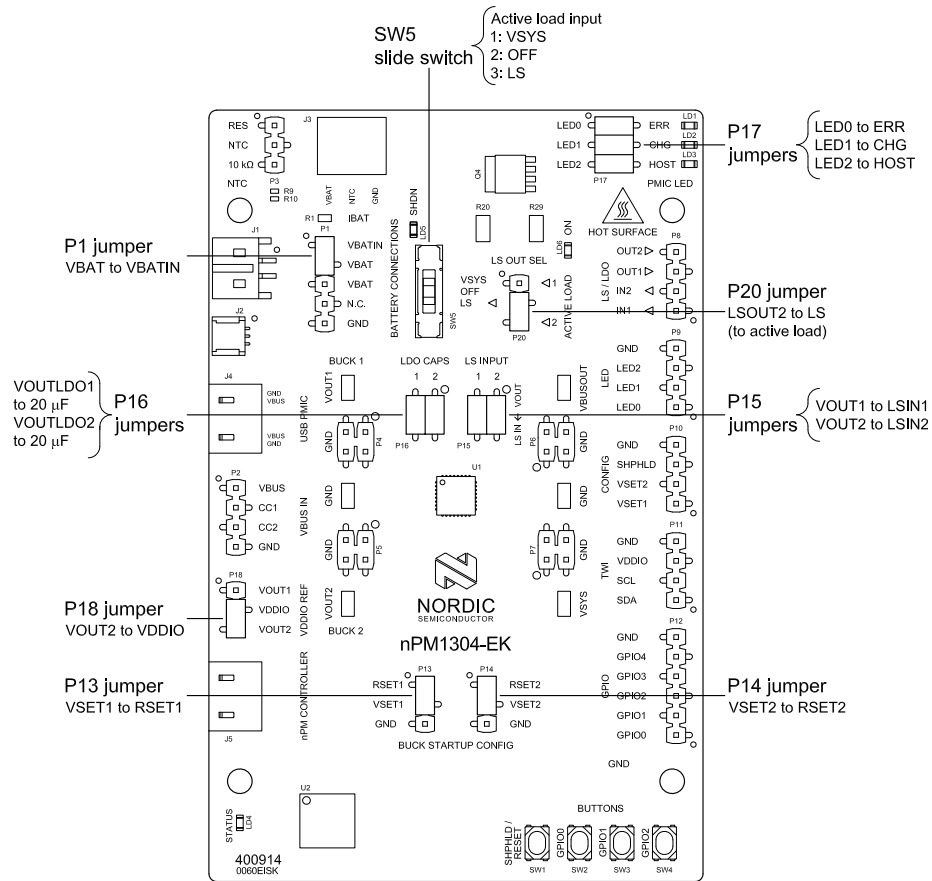


Figure 15: nPM1304 EK default jumper configuration

3.6.1 VBAT jumper

For the battery to be connected to the nPM1304 PMIC, a jumper must be connected between pin 1 and pin 2 on pin header **P1**. This connects **VBAT** to **VBATIN**.

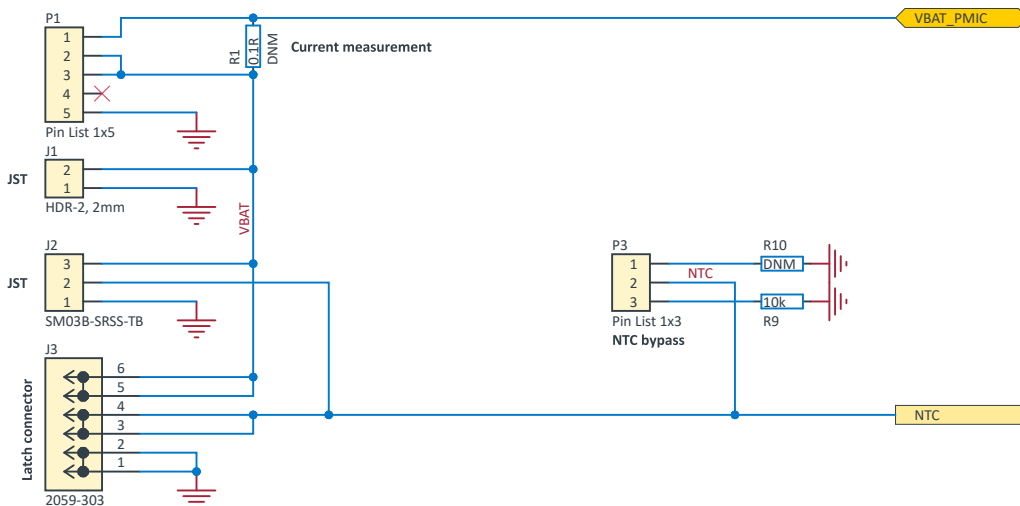


Figure 16: VBAT and NTC jumper configuration

Note: During current measurements with a resistor mounted on **R1**, make sure the **VBAT** jumper on **P1** is not connected. For more information, see [Measure current](#) on page 31.

3.6.2 NTC jumper

If using a battery without an *NTC* thermistor, connect a jumper between **NTC** (pin 2) and **10 k Ω** (pin 3) on pin header **P3** to use the integrated 10 k Ω resistor **R9**.

For a custom resistor there is an empty resistor footprint **R10** available on **P3** (pin 1). To use **R10** connect a jumper between **RES** (pin 1) and **NTC** (pin 2) on pin header **P3**.

The NTC is shown in [Figure 16: VBAT and NTC jumper configuration](#) on page 20.

Pin	Pin name	Function
1	RES	Resistor R10 to GND (unmounted)
2	NTC	PMIC NTC input
3	10 kΩ	Resistor R9 to GND

Table 8: NTC jumper header

3.6.3 Buck startup configuration

The nPM1304 *PMIC* requires a startup **VSET** condition for the BUCK regulators.

Use jumpers on **P13** and **P14** to connect **VSET1** and **VSET2** to the fixed resistors **RSET1** and **RSET2**, or to **GND**.

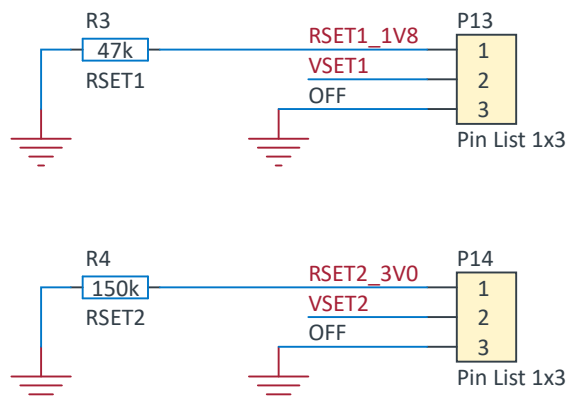


Figure 17: VSET configuration

Configuration	Pin header	Jumper connection		Buck output voltage (VOUT)
BUCK1	P13	VSET1	RSET1	1.8 V
			GND	0 V (OFF)
BUCK2	P14	VSET2	RSET2	3.0 V
			GND	0 V (OFF)

Table 9: Buck startup configuration

An external **VSET** pulldown resistor can also be connected to **VSET1** and **VSET2** on pin header **P10**. In this case, disconnect the jumpers on **P13** and **P14**. Resistor values are given in [Table 6: Output voltage of VOUT1 and VOUT2](#) on page 18.

RSET1 is 47 k Ω and sets **BUCK1** to 1.8 V. **RSET2** is 100 k Ω and sets **BUCK2** to 3.0 V.

The VSET configuration is printed on the back side of the EK.

Note: To avoid issues with floating pins, ensure that the VSET pins have the correct configuration.

3.6.4 VDDIO reference voltage

To set the reference voltage level for the *GPIOs* and the *TWI*, use a jumper to connect either **VOUT1** or **VOUT2** to **VDDIO** on **P18**.

When using the default jumper configuration on the EK, VDDIO is supplied locally by **VOUT2** on **P18**.

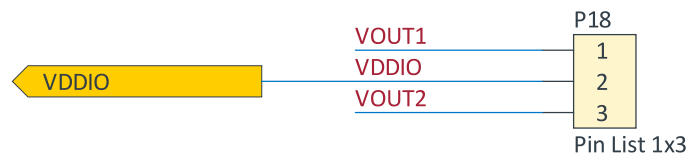


Figure 18: VDDIO

Note: The minimum **VDDIO** voltage is 1.7 V. Any lower voltage can result in lost *TWI* communication between host and nPM1304 *PMIC*.

Note: If **VDDIO** is supplied externally, leave the jumper on **P18** unconnected.

See [VDDIO](#) on page 18 for more information on external supply.

3.6.5 Load switch configuration

The load switches can be connected to the *BUCK* regulators and to the controllable active load circuit on the EK.

Load switch input configuration

The following figure shows how the load switch inputs are connected to **VOUT1** and **VOUT2** with jumpers on **P15**.

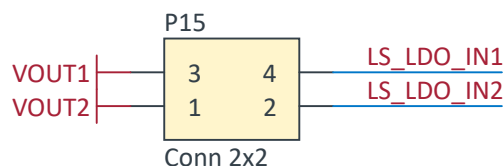


Figure 19: Load switch input configuration

The following table shows the configuration for the load switch inputs.

PMIC pin	Connected net	Connecting jumper pins	Comment
LSIN1/VINLDO1	VOUT1	P15 pin 3 to pin 4	Denoted as 1 on the EK
LSIN2/VINLDO2	VOUT2	P15 pin 1 to pin 2	Denoted as 2 on the EK

Table 10: Configurations for connecting load switch input

Load switch output configuration

The load switch outputs can be connected to the [controllable active load](#) on the EK. Use a jumper on **P20** to select **LSOUT1** or **LSOUT2** as a source for the controllable active load.

The following figure and table show the nPM1304 load switch output configuration.

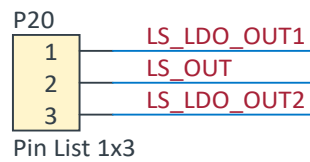


Figure 20: Load switch output configuration

Jumper connection		Comment
LS_OUT	LS_LDO_OUT1	Load switch output LSOUT1 on PMIC. Denoted as 1 on the EK.
	LS_LDO_OUT2	Load switch output LSOUT2 on PMIC. Denoted as 2 on the EK.

Table 11: Configurations for connecting load switch output

Note: When configuring nPM1304 for load switch operation, disconnect the *LDO* bypass capacitor by removing the jumper on **P16**.

3.6.6 LDO bypass capacitors

The bypass capacitors on the *LDO* outputs are available when the load switches are in *LDO* mode.

For *LDO* mode, connect jumpers between pin 1 and 2 on pin header **P16** for **LDO1** and pin 3 and 4 for **LDO2**. The following figure describes the jumper configuration for *LDO* bypass capacitors.

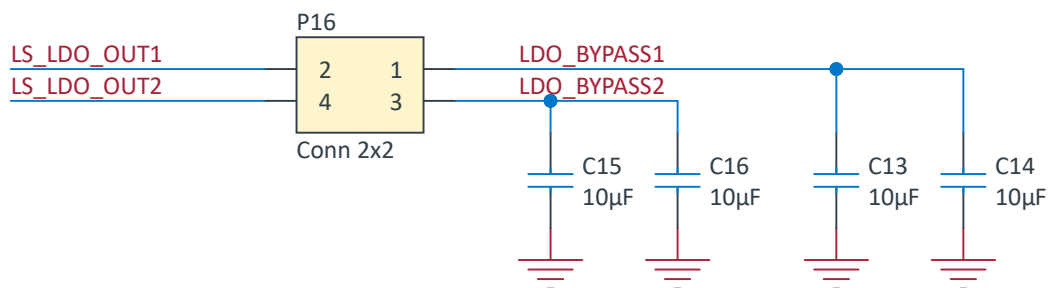


Figure 21: Bypass capacitors on the *LDO* output

PMIC pin	Connected configuration	Connected jumper pins	Comment
VOUTLDO1	LDO_BYPASS1 (20 µF)	P16 pin 1 to pin 2	Denoted as 2 on the EK
VOUTLDO2	LDO_BYPASS2 (20 µF)	P16 pin 3 to pin 4	Denoted as 1 on the EK

Table 12: Jumper configuration for *LDO* bypass capacitors

Note: Ensure the *LDO* bypass capacitors are disconnected when the load switches are not in *LDO* mode.

3.6.7 LED jumper connections

The nPM1304 EK has three LEDs for visualizing the status of the nPM1304 *PMIC*.

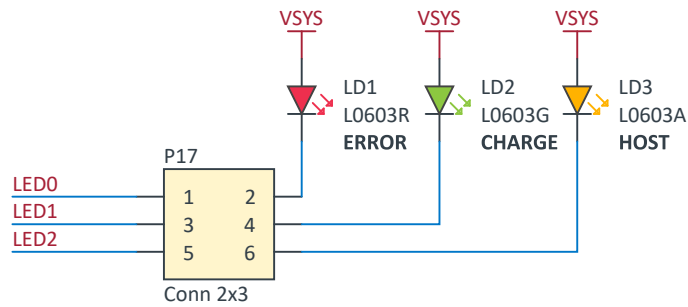


Figure 22: LED indicators for nPM1304 PMIC status

The PCB overlay shows the default states for the LEDs. The LEDs can be configured in software for custom use.

Jumpers on pin header **P17** connects the LEDs on the EK to the PMIC LED pins. During current measurements, or if using external LEDs, the LEDs can be disconnected from the PMIC by removing the jumpers.

PMIC pin	Part	Function	Color	Connecting jumper pins
LED0	LD1	ERR (error)	Red	P17 pin 1 to pin 2
LED1	LD2	CHG (charging)	Green	P17 pin 3 to pin 4
LED2	LD3	HOST (host activity)	Amber	P17 pin 5 to pin 6

Table 13: Default PMIC LED pin configuration and corresponding LEDs on EK

3.7 Buttons

The nPM1304 EK has four push buttons.

The buttons short the following connected *PMIC* pins to ground.

Part	Parameter controlled (PMIC)	Function
SW1	SHPHLD/RESET	PMIC RESET / Exit Ship mode / Exit Hibernation mode
SW2	GPIO0	PMIC GPIO0
SW3	GPIO1	PMIC GPIO1
SW4	GPIO2	PMIC GPIO2

Table 14: nPM1304 EK buttons

3.8 nPM Controller

The nPM Controller circuit on the nPM1304 EK enables easy interaction with the *PMIC* through the nPM PowerUP app or a terminal.

To enable software control, connect **nPM CONTROLLER** on **J5** to a computer using a compatible USB-C cable (see [Minimum requirements](#) on page 9). To establish a successful connection with the PMIC, make sure to power the PMIC first or perform a power cycle on the nPM Controller. See [Connect and use the nPM1304 EK](#) on page 27 to connect the EK and get started with the nPM PowerUP app.

A green LED (**LD4**) next to the nPM Controller shows the status of the nPM Controller connection with the PMIC. LED light patterns and nPM Controller status are shown in the following table.

LED light pattern (LD4)	nPM Controller status	Actions
Fading on/off	Successful connection with nPM1304 PMIC	Correctly powered PMIC and nPM Controller. No action needed.
Toggling on/off	No connection with nPM1304 PMIC	Incorrectly powered. Check if PMIC has power, ensure jumpers are at default settings, or power cycle the nPM Controller.

Table 15: LED pattern and corresponding nPM Controller status

3.9 Controllable active load

The nPM1304 EK has a controllable active load that can be configured with the nPM PowerUP app. It supports dynamic evaluation of the PMIC with a load current up to 99 mA depending on the power supply configuration. The active load supports also battery profiling for fuel gauging in the nPM PowerUP app.

Use slide switch **SW5** to select the input to the controllable active load as shown in the following table.

Slide switch position (SW5)	Description
VSYS	Controllable system load or battery profiling mode.
OFF	Active load is disconnected from PMIC.
LS	Controllable BUCK load through PMIC load switch output LSOUT1 or LSOUT2 .

Table 16: Slide switch settings to configure the controllable active load

To connect the nPM1304 **VSYS** voltage pin to the active load input, move switch **SW5** to the **VSYS** position. This mode supports a load up to 99 mA and is also used for battery profiling and fuel gauging in nPM PowerUP.

To connect the nPM1304 load switch output **LSOUT1** or **LSOUT2** to the active load input, move switch **SW5** to the **LS** position. Use the jumpers on **P20** to select **LSOUT1** or **LSOUT2** and the jumpers on **P15** to select the load switch input **LSIN1** or **LSIN2**. Detailed connection instructions are printed on the back side of the EK. For more information, see [Load switch configuration](#) on page 22.

If the position of **SW5** is changed during operation, the active load automatically turns off.

To disconnect the active load from nPM1304 and minimize current leakage, move switch **SW5** to the **OFF** position.

The EK has two LEDs that show the status of the active load. A green LED (**LD6**) indicates that the active load is on. The brightness of the LED changes with the current level. A red LED (**LD5**) indicates an overheated load circuit. The load circuit powers down to ensure safe operation. Once it cools down, **LD5** turns off and the active load can be re-enabled.

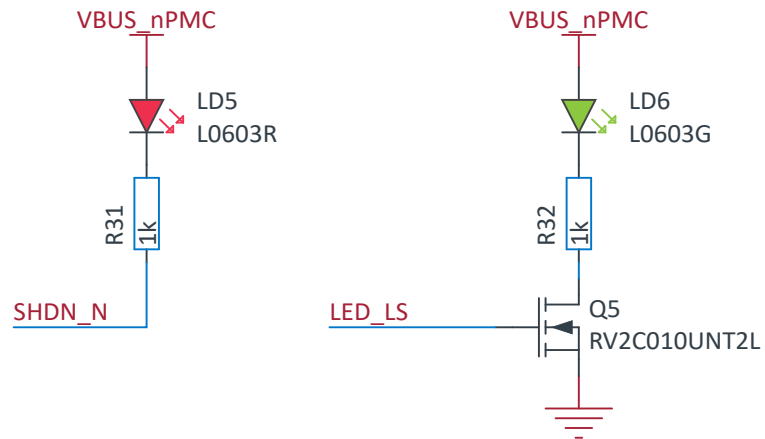


Figure 23: LED indicators for active load status

4 Connect and use the nPM1304 EK

The nPM1304 EK provides three distinct development levels that range from simple evaluation to complete implementation.

The following development alternatives are available:

- Evaluating the nPM1304 *PMIC* without writing any code or performing any device programming
- Using the EK together with a Nordic *DK* to evaluate the *PMIC* or develop your own nPM1304 application
- Using the EK together with your own custom hardware to evaluate the *PMIC* or develop your own *System on Chip (SoC)* application

4.1 Evaluate nPM1304 using nPM PowerUP

The nPM1304 EK provides connections for easy configuration and evaluation of the nPM1304 *PMIC* through the nPM PowerUP computer app available in [nRF Connect for Desktop](#).

With the nPM PowerUP app, you can use the built-in battery models or you can generate your own battery model by using the EK. The generated battery model can be integrated with a host *SoC* for fuel gauging.

4.1.1 Connect the nPM1304 EK with nPM PowerUP

Set up the nPM1304 EK to start using the nPM PowerUP app.

1. To power the nPM1304 *PMIC*, connect a USB-C cable with 1.5 A current capability to **USB PMIC** on **J4**.
2. Insert the battery ensuring the correct polarity as shown on the EK. Depending on your battery, use one of the following alternatives:
 - a) For a battery with an integrated *NTC* thermistor, use the battery connector on **J2**.
 - b) For a battery without an integrated *NTC* thermistor, use the battery connector on **J1** or **J3**. Connect a jumper between **NTC** pin 2 and **10 kΩ** pin 3 on pin header **P3** to use the integrated 10 kΩ resistor.
3. Use a USB-C cable with USB 2.0 High Speed compatibility to connect from your computer to **nPM CONTROLLER** on **J5**.

Use a ferrite bead around the USB cable to reduce electromagnetic interference.

A fading green LED (**LD4**) indicates a successful connection with the [nPM Controller](#).

Function	nPM1304 EK		nRF54L15 DK		Comment
	Pin name	Location	Pin name	Location	
Power	VOUT2	P5 pin 1	VDD	P6 pin 2	3.0 V. Use default VSET2 on EK.
	GND	P5 pin 3	GND	P6 pin 1	Ground.
TWI	SCL	P11 pin 1	P1 . 12	P1 pin 12 (15)	Connect to a TWI compliant <i>GPIO</i> on DK.
	SDA	P11 pin 2	P1 . 11	P1 pin 11 (14)	Connect to a TWI compliant <i>GPIO</i> on DK.
GPIO	GPIO0	P12 pin 1	P0 . 04	P0 pin 4 (7)	Connect to an interrupt compliant <i>GPIO</i> on the DK.
	GPIO1	P12 pin 2	P0 . 03	P0 pin 3 (6)	Connect to an interrupt compliant <i>GPIO</i> on the DK.
	GPIO2	P12 pin 3	P0 . 02	P0 pin 2 (5)	Connect to an interrupt compliant <i>GPIO</i> on the DK.
	GPIO3	P12 pin 4	P1 . 10	P1 pin 11 (13)	Connect to an interrupt compliant <i>GPIO</i> on the DK.
	GPIO4	P12 pin 5	P0 . 00	P0 pin 0 (3)	Connect to an interrupt compliant <i>GPIO</i> on the DK.

Table 17: Connections between nPM1304 EK and nRF54L15 DK

Note: Only *GPIO* ports **P0** and **P1** on the nRF54L15 SoC can be used for interrupt events.

Note: *GPIO* port **P0** on the nRF54L15 SoC is also used for *UART0*.

4.3 Use the nPM1304 EK with custom hardware

When the nPM1304 EK is used with custom hardware make sure they are compatible in terms of voltage and current specifications.

The configuration process is similar to the nRF54L15 *DK*, though some board-specific steps might differ.

Note: If the host device on the custom hardware and the nPM1304 *PMIC* have different I/O reference levels, **VDDIO** on the EK must be supplied by the custom hardware.

5 Measure current

The nPM1304 EK can be set up to monitor current flowing into the nPM1304 PMIC, to and from the battery, and into the external application.

Note: The battery charger includes automatic trickle charge control. This introduces restrictions on the type of instruments that can measure **VBAT**.

Current can be measured using any of the following test instruments.

- Power analyzer, uni/bidirectional capability
- Oscilloscope, bidirectional capability
- Ampere meter, bidirectional capability
- [Power Profiler Kit II \(PPK2\)](#), unidirectional capability
- *SMU*

For higher precision results we recommend the use of an SMU on both input and output parameters. The PPK2 is an affordable alternative to an SMU because it captures traces of both voltage and current changes. When using a PPK2 there is no need to connect an external resistor on the EK. Some attention to the EK is needed to measure current on an output using a series resistor.

For measurement instructions, see sections [Use an oscilloscope for current measurements](#) on page 32, [Use an ampere meter for current measurements](#) on page 33, and [Use a Power Profiler Kit II for current measurements](#) on page 35.

The main power supply for the nPM1304 PMIC is **VBUS**. The complementary power supply, as well as charger output, is **VBAT**. The PMIC regulated outputs are **VOUT1** and **VOUT2**. The unregulated outputs are **VBUSOUT** and **VSYS**.

Component	VBUS	VBAT	VOUT1	VOUT2
Measurement connector	P2, pin 1	P1, pin 1 and pin 2	P4, pin 1 and pin 2 or VOUT1 probe loop	P5, pin 1 and pin 2 or VOUT2 probe loop
Series resistor	External	R1 (IBAT)	External	External
Series resistor range	<100 mΩ	<100 mΩ	<100 mΩ	<100 mΩ
Directionality	Unidirectional	Bidirectional	Unidirectional	Unidirectional

Table 18: Components for current measurement

The nPM1304 EK has a default jumper configuration, see [Jumpers and switches](#) on page 19. To allow the EK to work directly without changes make sure the jumpers are correct before powering up the EK. Prior to measurements, connect the EK to a DC power source (**VBUS**), see [Power supply](#) on page 12 for details.

For more information on current measurement, see the tutorial [Current measurement guide: Introduction](#).

5.1 Use an oscilloscope for current measurements

An oscilloscope measures the voltage drop across a current-measurement resistor. Set up the nPM1304 EK and oscilloscope according to the supply or output that you want to measure.

5.1.1 Prepare for VBAT current measurements

Mount a current-measurement resistor on the EK to measure the current on **VBAT** with an oscilloscope.

For **VBAT** current measurements:

- Mount an **IBAT** current-measurement resistor on **R1**. The recommended value is 100 mΩ or lower, to avoid issues with the *PMIC*'s automatic trickle charge feature and to reduce voltage error.
- Disconnect the jumper between **VBAT** and **VBATIN**.
- Use **P1** pin 1 (**VBATIN**) and pin 2 (**VBAT**) as probe points for performing **VBAT** current measurements.
- Make sure the oscilloscope supports bidirectional measurements.

To restore the EK to default jumper settings after measurements, connect the jumper between **VBAT** and **VBATIN** across pin 1 and pin 2 on **P1** and demount the **IBAT** series resistor.

5.1.2 Prepare for VBUS and VOUT current measurements

To measure the current on **VBUS**, **VOUT1**, or **VOUT2** with an oscilloscope, measure the voltage across an external current-measurement resistor (not mounted).

For **VBUS** current measurement:

- Connect a suitable current-measurement resistor between the source and **VBUS** pin 1 on **P2**.
- Connect **GND** pin 4 on **P2** to the source ground to ensure proper system grounding.

For **VOUT1** current measurement:

- Connect a suitable current-measurement resistor between the load and **VOUT1** pin 1 (or pin 2) on **P4**.
- Connect **GND** pin 3 (or pin 4) on **P4** to the load ground to ensure proper system grounding.

For **VOUT2** current measurement:

- Connect a suitable current-measurement resistor between the load and **VOUT2** pin 1 (or pin 2) on **P5**.
- Connect **GND** pin 3 (or pin 4) on **P5** to the load ground to ensure proper system grounding.

Note: It is recommended to use standard jumper wires compatible with 2.54 mm (0.1") headers. Make sure the jumper wires are rated for the current.

5.1.3 Measure VBAT, VBUS, and VOUT using an oscilloscope

Measure the current with an oscilloscope by probing the voltage drop across a current-measurement resistor.

Make sure you have prepared the EK for the given measurement case as described in [Prepare for VBAT current measurements](#) on page 32 and [Prepare for VBUS and VOUT current measurements](#) on page 32.

Perform the following steps to measure the current using an oscilloscope.

1. Set the oscilloscope to differential mode or a mode that is similar.
2. Connect the oscilloscope using two probes across the probe points of interest depending on the measurement case.

[Figure 25: Current measurements with an oscilloscope](#) on page 33 shows the **VBAT** current-measurement case with probe points across the **IBAT** resistor between pins 1 and 2 on **P1**.

3. Plot the voltage drop measured across the probe points and calculate the current.

The measured voltage drop across the resistor is proportional to the current. For instance, a 100 mΩ resistor causes a 0.1 mV drop for each 1 mA drawn by the current being measured.

The current can be averaged or integrated to analyze current and energy consumption over a period. A minimum of one sample every 5 μs is needed to accurately measure the average current.

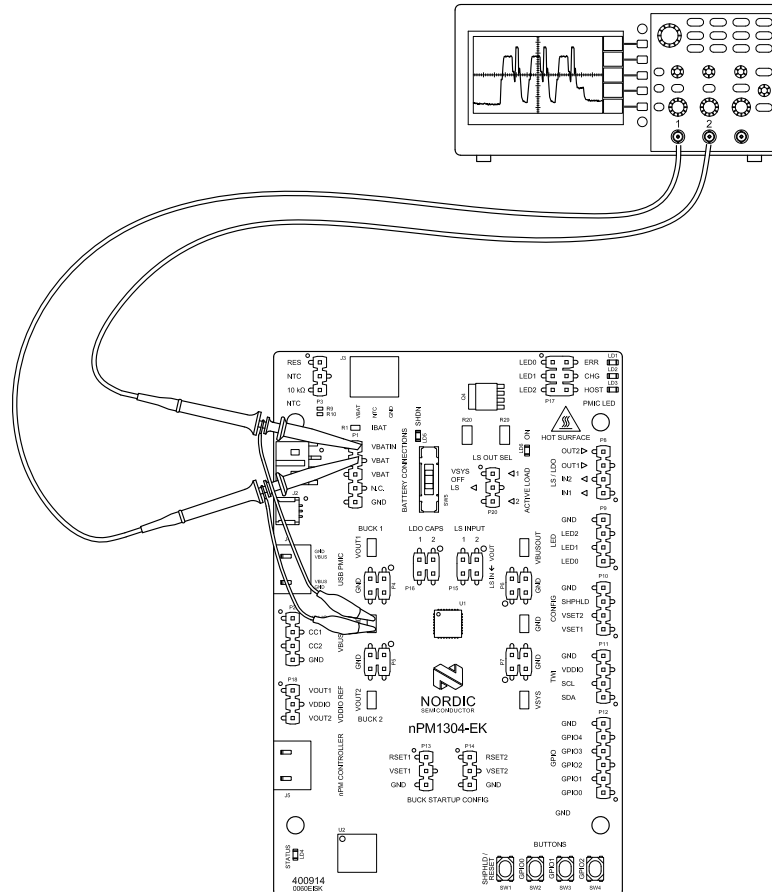


Figure 25: Current measurements with an oscilloscope

To reduce noise, do the following.

- Use X1 passive probes (no attenuation).
- Enable averaging mode to reduce random noise.
- Enable high-resolution function if available.
- Use an active differential probe across the resistor.

5.2 Use an ampere meter for current measurements

An ampere meter can measure the average current flow. This method monitors the current flow by placing the ampere meter in series with the source (or load) and the probe-point. For an ampere meter the current-measurement resistor is integrated in the meter.

5.2.1 Prepare for VBAT, VBUS, and VOUT current measurements

Set up the EK and ampere meter according to the supply or output that you want to measure.

For **VBAT** current measurements:

- Ensure there is no **IBAT** current-measurement resistor mounted on **R1**.
- Disconnect the jumper between **VBAT** and **VBATIN**.

- Use bidirectional capable current measurement equipment as current flow on **VBAT** is bidirectional.
- The automatic trickle charge feature requires the impedance of the measurement circuit to be constant and less than 100 mΩ. Auto ranging multimeters can automatically change resistance depending on their range, this can trigger the error state of the charger.
- Use **P1** pin 1 (**VBATIN**) and pin 2 (**VBAT**) as probe points for performing **VBAT** current measurements.

For **VBUS** current measurements:

- Connect the ampere meter between the source and **VBUS** pin 1 on **P2**.
- Connect **GND** pin 4 on **P2** to the source ground to ensure proper system grounding.

For **VOU1** current measurements:

- Connect the ampere meter between the load and **VOU1** pin 1 (or pin 2) on **P4**.
- Connect **GND** pin 3 (or pin 4) on **P4** to the load ground to ensure proper system grounding.

For **VOU2** current measurements:

- Connect the ampere meter between the load and **VOU2** pin 1 (or pin 2) on **P5**.
- Connect **GND** pin 3 (or pin 4) on **P5** to the load ground to ensure proper system grounding.

Note: It is recommended to use standard jumper wires compatible with 2.54 mm (0.1") headers. Make sure the jumper wires are rated for the high currents.

5.2.2 Measure VBAT, VBUS, and VOUT using an ampere meter

Measure the current with an ampere meter by placing the ampere meter in series with the source or load and the probe point.

Make sure you have prepared the *EK* as described in [Prepare for VBAT, VBUS, and VOUT current measurements](#) on page 33.

Perform the following steps to measure the current using an ampere meter.

1. Connect an ampere meter to the probe-point of interest depending on the measurement case.
[Figure 26: Current measurements with an ampere meter](#) on page 35 shows the **VBAT** current-measurement case with the ampere meter connected between **P1** pins 1 and 2.
2. Read the current value on the ampere meter.

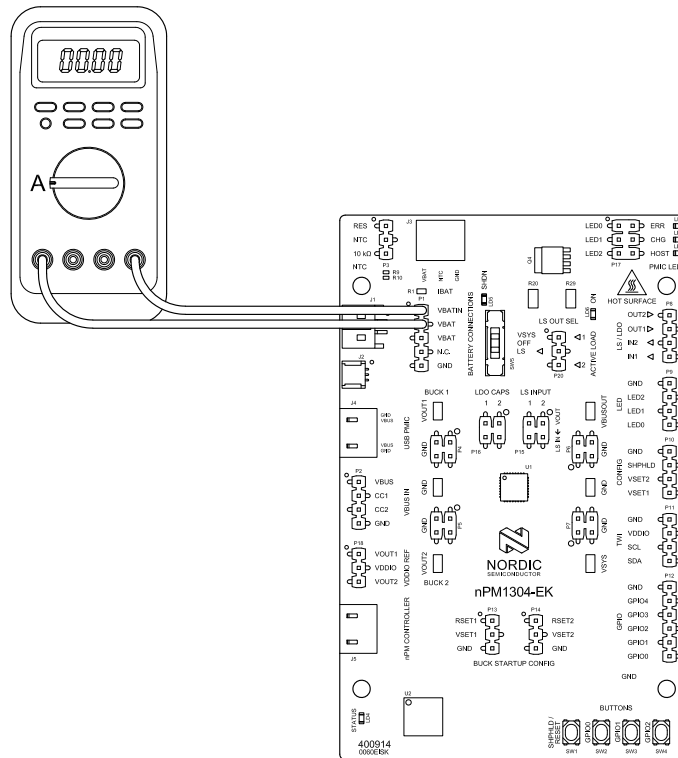


Figure 26: Current measurements with an ampere meter

5.3 Use a Power Profiler Kit II for current measurements

The average and instantaneous current flow can be measured using the Power Profiler Kit II (PPK2). No attention to series resistors is needed.

Set PPK2 in Ampere Meter mode to measure the power outputs (**VOUT1** and **VOUT2**) and in Source Meter mode to measure power inputs (**VBAT** and **VBUS**).

In Source Meter mode the power supply for the nPM1304 EK is from PPK2. In Ampere Meter mode the power for the EK is from an external source, with PPK2 placed in series between the EK and the load.

PPK2 measurement mode	Parameters	Description
Ampere Meter	VOUT1	Power outputs (BUCK outputs) measured with the PPK2 in series between the output and the load.
	VOUT2	
Source Meter (supply)	VBAT	Power inputs (supplies) measured with the PPK2 as the power source into the EK.
	VBUS	

Table 19: Measurement modes for PPK2

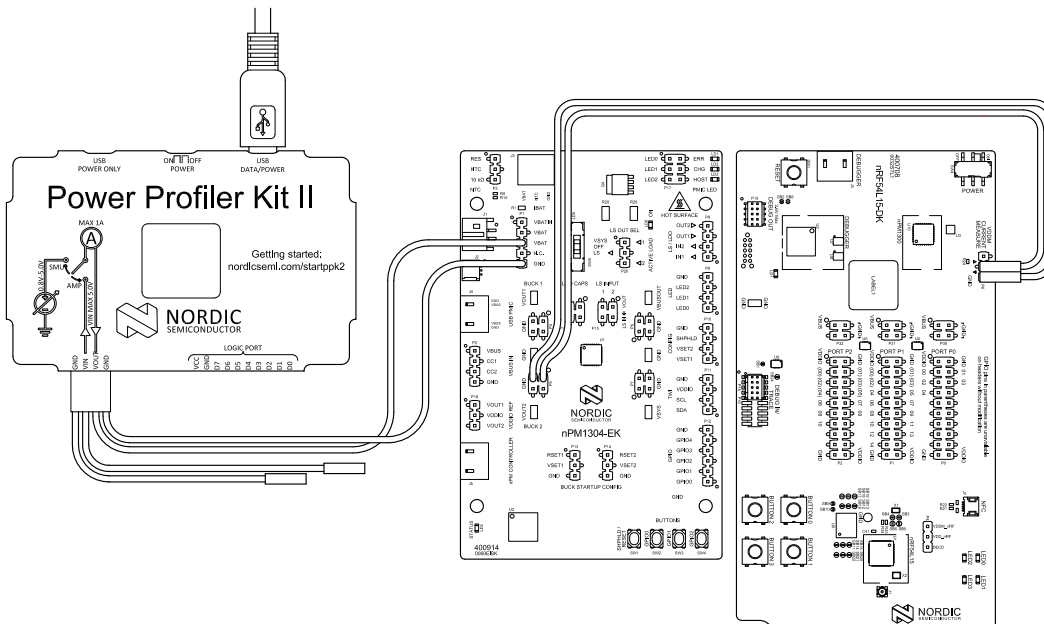
For more information on the PPK2, see the [Power Profiler Kit II](#).

5.3.1 Measure VBAT current

The Power Profiler Kit II (PPK2) is operated in Source Meter mode for this configuration.

1. Connect the PPK2 to the nPM1304 EK with the 4-pin measurement cable using the following pins:
 - PPK2 **GND** to nPM1304 EK **GND** pin 5 on **P1**

- PPK2 **VOUT** to nPM1304 EK **VBAT** pin 3 on **P1**
2. Make sure a jumper is connected between **VBATIN** and **VBAT** pins 1 and 2 on **P1**.
 3. Connect the load (nRF54L15 *DK* in this example) to nPM1304 EK. Depending on what you want to measure, use the following alternatives on the EK:
 - a) **VOUT1**: use pin 1 or 2 and **GND** pin 3 or 4 on **P4**
 - b) **VOUT2**: use pin 1 or 2 and **GND** pin 3 or 4 on **P5**

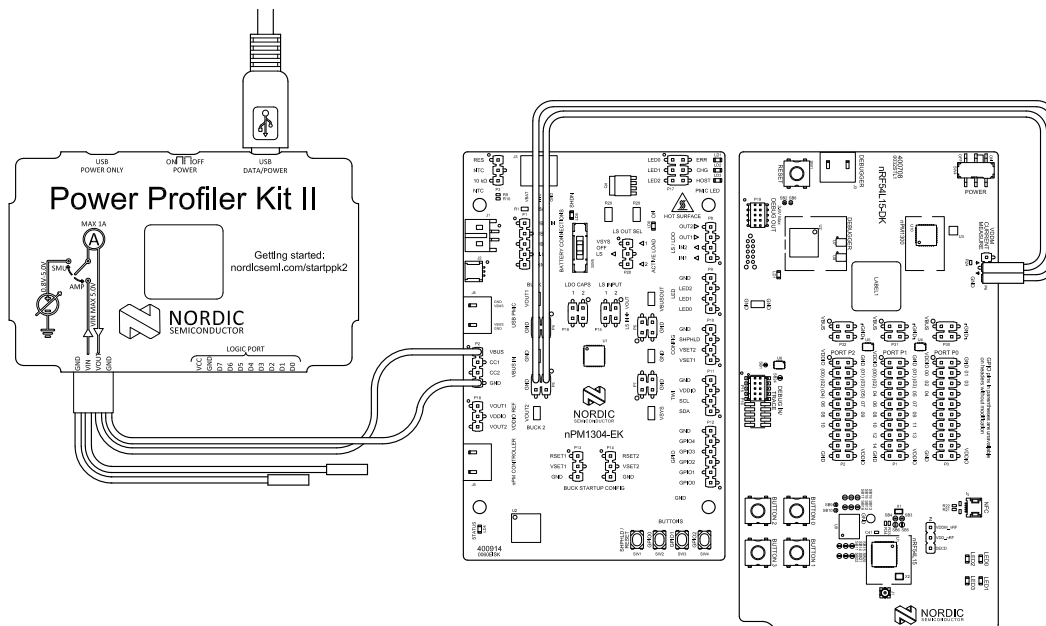


4. Connect the PPK2 to a computer using a USB cable.
5. Start the Power Profiler app.
6. Select your PPK2.
7. Select **Source Meter** as the mode.
8. Set the supply voltage to value between 2.3 V and 4.65 V.
9. Toggle **Enable power output** to power the nPM1304 EK.
10. Click **Start**.

5.3.2 Measure VBUS current

The Power Profiler Kit II (PPK2) is operated in Source Meter mode for this configuration.

1. Connect the PPK2 to the nPM1304 EK with the 4-pin measurement cable using the following pins:
 - PPK2 **GND** to nPM1304 EK **GND** pin 4 on **P2**
 - PPK2 **VOUT** to nPM1304 EK **VBUS** pin 1 on **P2**
2. Connect the load (nRF54L15 *DK* in this example) to nPM1304 EK. Depending on what you want to measure, use the following alternatives on the EK:
 - a) **VOUT1**: use pin 1 or 2 and **GND** pin 3 or 4 on **P4**
 - b) **VOUT2**: use pin 1 or 2 and **GND** pin 3 or 4 on **P5**



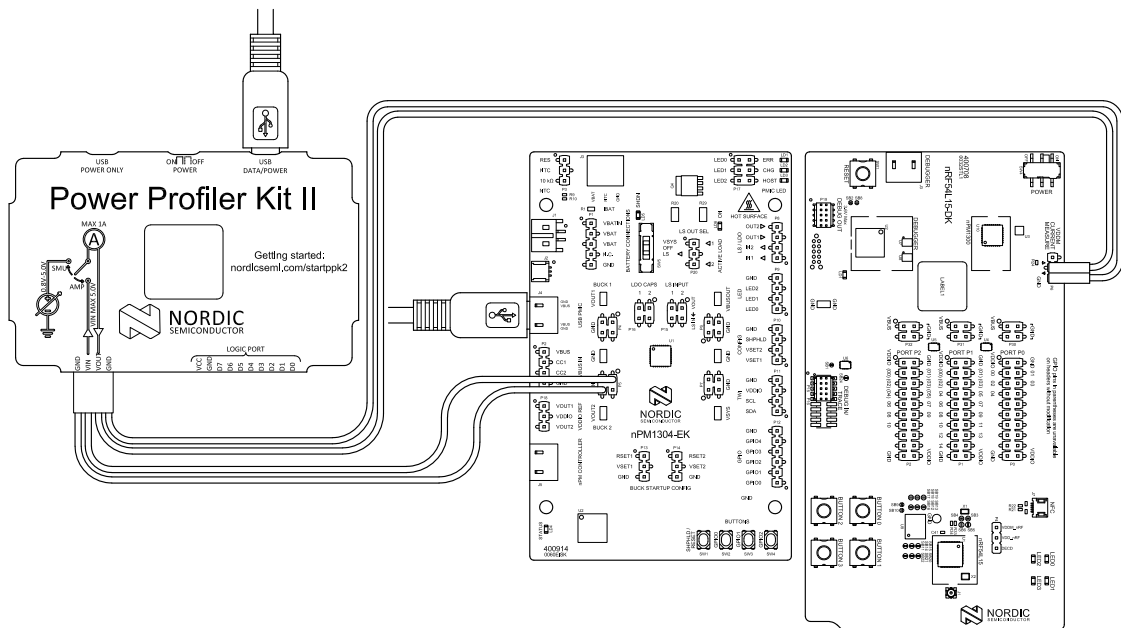
3. Connect the PPK2 to a computer using a USB cable.
4. Start the Power Profiler app.
5. Select your PPK2.
6. Select **Source Meter** as the mode.
7. Set the supply voltage to a value between 4.0 V and 5.5 V.
8. Toggle **Enable power output** to power the nPM1304 EK.
9. Click **Start**.

5.3.3 Measure VOUT1 or VOUT2 current

The Power Profiler Kit II (PPK2) is operated in Ampere Meter mode for this configuration.

Use a 4-pin cable for the pin connection between PPK2, nPM1304 EK, and the target device (nRF54L15 DK in this example).

1. Connect the PPK2 **GND** to nPM1304 EK **GND**. Depending on what you want to measure, use the following alternatives on the EK:
 - a) **VOUT1**: use pin 3 or 4 on **P4**
 - b) **VOUT2**: use pin 3 or 4 on **P5**
2. Connect the PPK2 **VIN** to nPM1304 EK using the following alternatives:
 - a) **VOUT1**: use pin 1 or 2 on **P4**
 - b) **VOUT2**: use pin 1 or 2 on **P5**
3. Connect the PPK2 to the target device (nRF54L15 DK in this example) on the following pins:
 - PPK2 **VOUT** to DK External supply
 - PPK2 **GND** to DK External supply



4. Connect the PPK2 to a computer using a USB cable.
5. Connect the nPM1304 EK to a computer using a USB cable.
6. Start the Power Profiler app.
7. Select your PPK2.
8. Select **Ampere Meter** as the mode.
9. Toggle **Enable power output** to power the target device (nRF54L15 DK in this example).
10. Click **Start**.

6 Regulatory notices

The following regulatory notices apply to the nPM1304 EK.

6.1 REACH SVHC statement

To the present and best of our knowledge, and based upon information available to us from our suppliers, the following components used in the nPM1304 EK contain substances of very high concern (SVHC), as identified in the ECHA Candidate list, above a limit of 0.1% w/w.

Designator	Manufacturer part number	Substance	CAS no.	Safe use instruction
Q4	PSMN9R5-30YLC,115	Lead	7439-92-1	The substance is bound inside the article and is not released during regular use. Specific precautions in handling are not required. The article can be disposed of as electronic waste according to the relevant regulations.

Table 20: Components in nPM1304 EK BOM containing REACH SVHC on ECHA Candidate list

6.2 Halogen statement

The following components used in the nPM1304 EK do not include documentation about substances as defined by the International Electrotechnical Commission (IEC) standard 61249-2-21.

Designator	Manufacturer part number	Safe use instruction
J1	S2B-PH-SM4-TB(LF)(SN)	Halogens are contained within the article and pose a risk only if the component is exposed to fire, which is beyond the intended use of the components in the kit. Specific precautions in handling are not required. The article can be disposed of as electronic waste according to the relevant regulations.

Table 21: Components in nPM1304 EK BOM without documentation according to IEC standard 61249-2-21

Glossary

Application Programming Interface (API)

A language and message format used by an application program to communicate with an operating system, application, or other service.

DC

Direct Current

Development Kit (DK)

A hardware development platform used for application development.

Electrostatic Discharge (ESD)

A sudden discharge of electric current between two electrically charged objects.

Evaluation Kit (EK)

A platform used to evaluate different development platforms.

General-Purpose Input/Output (GPIO)

A digital signal pin that can be used as input, output, or both. It is uncommitted and can be controlled by the user at runtime.

Inter-integrated Circuit (I²C)

A multi-master, multi-slave, packet-switched, single-ended, serial computer bus.

Low-Dropout Regulator (LDO)

A linear voltage regulator that can operate even when the supply voltage is very close to the desired output voltage.

Negative Temperature Coefficient (NTC)

A negative temperature coefficient refers to materials where there is a decrease in electrical resistance when their temperature is raised.

Power Management Integrated Circuit (PMIC)

A chip used for various functions related to power management.

Printed Circuit Board (PCB)

A board that connects electronic components.

Pulse Width Modulation (PWM)

A form of modulation used to represent an analog signal with a binary signal where the switching frequency is fixed, and all the pulses corresponding to one sample are contiguous in the digital signal.

Software Development Kit (SDK)

A set of tools used for developing applications for a specific device or operating system.

Source Measure Unit (SMU)

An electronic instrument that is capable of both sourcing and measuring at the same time.

System on Chip (SoC)

A microchip that integrates all the necessary electronic circuits and components of a computer or other electronic systems on a single integrated circuit.

Universal Serial Bus (USB)

An industry standard that establishes specifications for cables and connectors and protocols for connection, communication, and power supply between computers, peripheral devices, and other computers.

Recommended reading

In addition to the information in this document, you may need to consult other documents.

Nordic documentation

- [nPM1304 Datasheet](#)
- [nPM1304 EK product page](#)
- [nPM PowerUP app](#)

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