

nPM1100 Hardware Design Guidelines

nWP-040

White Paper

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Revision history

Date	Description
2022-10-10	<ul style="list-style-type: none">• Added nPM1100 reference schematic on page 7• Removed Ship mode and GPIO input with a single button• Editorial changes
2021-05-27	First release

1 Introduction

This document provides guidelines for the hardware design and integration of nPM1100. It is intended for system integrators and hardware engineers.

nPM1100 is an integrated *Power Management Integrated Circuit (PMIC)* with a linear-mode lithium-ion/lithium-polymer battery charger in a compact 2.1x2.1 mm WLCSP package. It has a highly efficient, dual-mode configurable output DC/DC buck regulator.

2 Block diagram

The block diagram shows an overview of nPM1100.

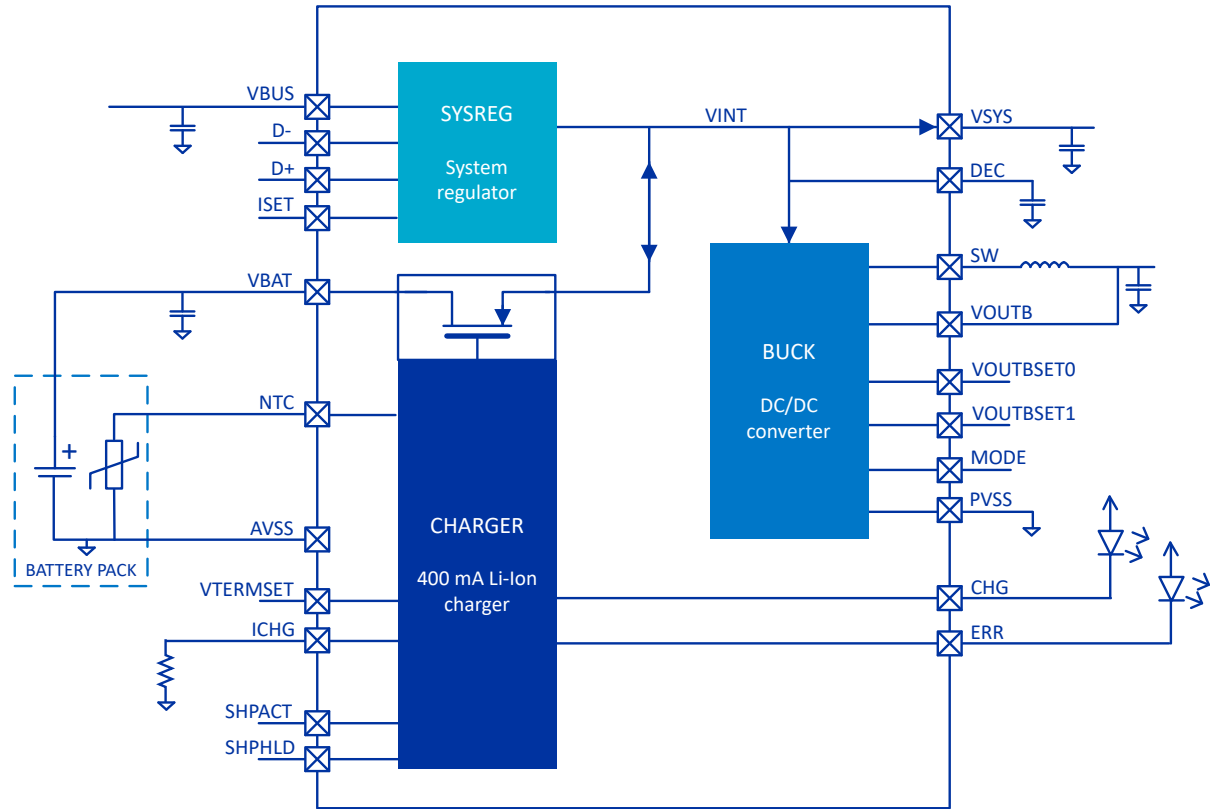


Figure 1: nPM1100 block diagram

3 Hardware integration

This section provides hardware design instructions and tips for successful nPM1100 integration.

3.1 BUCK DC/DC regulator (VOUTB) inductor selection

The buck converter of nPM1100 is designed to operate with an inductor with 2.2 μH nominal inductance, with up to $\pm 20\%$ tolerance.

To ensure loop stability, do not use inductors with other nominal inductances. Additionally, the saturation current of the inductor should be greater than 300 mA. Even if the load current range required in the application under design is lower than the maximum load current of the buck converter, the saturation current requirement of the inductor should be respected. This is because the inductor peak current level is higher than the load current, especially when the buck converter operates in hysteretic mode.

The choice of inductor has a significant effect on the performance of the buck converter, especially on efficiency. The choice is typically a trade-off between size, performance, and cost. The Direct Current Resistance (DCR) given by the manufacturer is one key indicator of the performance, but as the losses in the inductor also include various frequency-dependent effects like magnetic hysteresis losses, eddy currents, and skin effect, the DCR is not a definitive performance metric.

See the following tables for examples of inductor models selected for area, performance, and cost-optimized applications.

Manufacturer	Model	Size (inch/metric)	Height (mm)	DCR (m Ω)	Comment
Taiyo Yuden	MBKK1608T2R2M	0603/1608	1	300	Small footprint
Murata	DFE201210U-2R2M	0805/2012	1	228	Good performance
Samsung Electro-Mechanics	CIGT201610EH2R2MNE	0806/2016	1	73	Good performance
Samsung Electro-Mechanics	CIGT252008LM2R2MNE	1008/2520	0.8	73	Good performance, inexpensive

Table 1: nPM1100 coil examples

Manufacturer	Model	Size (metric)	PWM efficiency at 150 mA	Hysteretic efficiency at 1 mA
Murata	DFE201210U-2R2M	2012	91.017	91.358
Samsung	CIGT201610EH2R2MNE	2016	91.29	91.218
Samsung	CIGT252008LM2R2MNE	2520	91.158	90.663
TDK	VLS201610HBX-2R2M-1	2016	91.068	90.646
Taiyo Yuden	MDKK1616T2R2MM	1616	90.677	90.583
TDK	TFM201610ALMA2R2MTAA	2016	90.924	90.513
TDK	MLP2016H2R2MT	2016	91.139	90.392
Würth	74479275222	2012	90.793	90.336
TDK	MLP2012V2R2MT0S1	2012	90.613	90.096
TDK	MLZ2012M2R2HT000	2012	91.137	90.053
TDK	MLP2012H2R2MT0S1	2012	90.916	89.848
TDK	MLP2012S2R2MT0S1	2012	90.339	89.726
Taiyo Yuden	MBKK1608T2R2M	1608	89.615	88.775
Murata	LQM21PN2R2MCAD	2012	90.384	88.719
Murata	LQM21PN2R2MEHD	2012	90.311	88.561
Murata	LQM18PN2R2MGHD	1608	90.096	87.98
TDK	MLZ2012A2R2WT000	2012	89.903	87.725
Würth	74479763222	1608	89.369	87.531
Murata	LQM18PN2R2MDHD	1608	88.9	86.43
TDK	MLZ1608A2R2WT000	1608	87.797	86.132
Murata	LQM18PN2R2NC0L	1608	87.17	86.011
Murata	LQM21PN2R2MC0D	2012	88.092	85.46
Taiyo Yuden	BRL1608T2R2M	1608	87.135	84.584

Table 2: nPM1100 coil performance comparison

3.2 nPM1100 reference schematic

The reference schematic shows the nPM1100 together with an nRF5x wireless *System on Chip* (SoC).

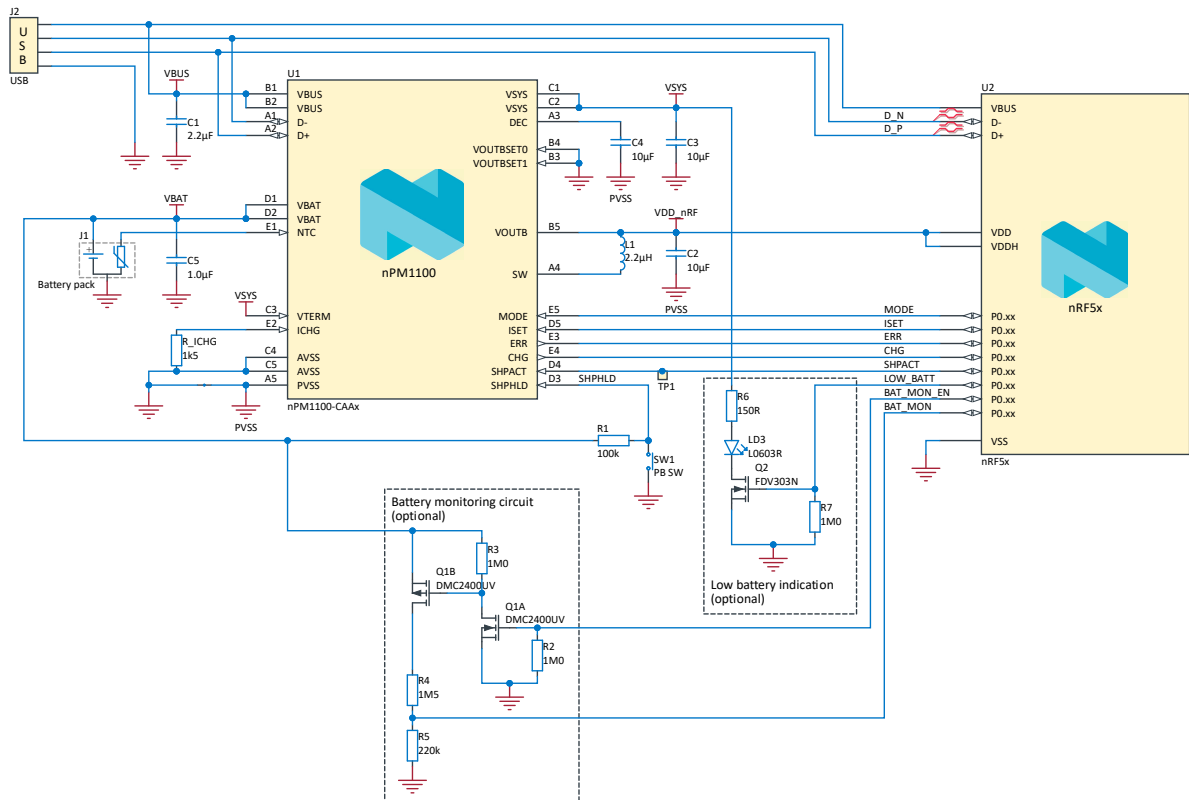


Figure 2: nPM1100 reference schematic

4 End product hardware design recommendations

An end product design often aims to achieve a small device form factor and an attractive appearance.

However, to achieve a good product, other design factors must also be considered. Some design factors conflict with the small device form factor target. This means there is a compromise in design that affects the end product performance and appearance.

4.1 Layout and PCB work

nPM1100 is designed to work on a 2-layer board.

Pads D3 and D4 need to be routed to use ship mode. Access to these pads will most likely require a 4-layer board with μ via in the pad. A 2-layer board is possible, but the hole size might set limitations to board thickness. For boards with via in small pads for nPM1100, Nordic recommends the use of via capping to ensure good solderability.

4.1.1 PCB layout guidelines

The following guidelines can help you create good *Printed Circuit Board (PCB)* layouts.

- Use the **PVSS** ground connection for **DEC** and **VOUT** capacitors to avoid any ground loops.
- Keep the routing to the inductor as short as possible.
- Connect the **PVSS** domain to the main ground in a single point.
- Avoid routing on layers underneath the device that could cut the main ground plane, causing long ground loops.

4.1.2 PCB stack-up

nPM1100 does not have requirements for the *PCB* stack-up.

Other components on the board might have requirements for the stack-up, like 50 Ω impedance on RF lines and USB routing differential impedance. Using micro vias and a 4-layer *PCB* might also set restrictions on the stack-up as an aspect ratio of 1:1 is common for laser vias.

Glossary

Printed Circuit Board (PCB)

A board that connects electronic components.

Power Management Integrated Circuit (PMIC)

A chip used for various functions related to power management.

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.

Recommended reading

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

Nordic documentation

- [nPM1100 Product Specification](#)
- [nPM1100 EK product page](#)
- [nPM1100 EK Hardware User Guide](#)
- [nPM1100 PMIC reference design](#)

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