# DC-to-DC Boost Converters are changing the Face of Mobile Commerce

**Abstract:**
NXP DC-to-DC Boost Converters allow battery input voltages in the range of 2.3 to 5.25 volts to supply a regulated, fixed output voltage at up to 500mA. They are designed primarily to enhance the performance of Near Field Communication controllers in mobile devices. Other uses include performance improvements for back-lit displays and radio frequency devices.

## Introduction

Mobile devices equipped with Near Field Communication (NFC) are changing the way people shop, research product information, make product selections, and then pay for their purchases. Mobile devices are inherently dependent on a battery power supply that fluctuates throughout the day as different device functions are turned on and off or the battery charge is gradually depleted. The NFC working range is directly affected by the voltage level and as the voltage fluctuates, so does the strength of the field that NFC relies upon.

DC-to-DC boost converters improve the performance of NFC enabled smart phones, tablets, and other mobile devices. Performance improvements enhance user experience by making the NFC enabled devices easier and more reliable to use, which results in wider acceptance and improved privacy and security.

As a Point-Of-Sale purchase method, an NFC enabled mobile device allows payment with a single “tap” on the POS terminal. It is faster, easier, and safer than using a credit card and more convenient than a smart card. The short working range and requirement for the user to activate the mobile device’s payment option prevents information theft and fraudulent purchases.

Used in conjunction with consumer goods, NFC can improve product sales by helping consumers make choices. Faced with a wide array of products to choose from, consumers may delay making an immediate selection while they determine the exact product required.

At home, they can tap the head of their electric toothbrush to record which replacement model is required. The information is saved until they reach the store where another tap shows them which toothbrush head to purchase.

**Figure 1.** *NFC enabled Smartphones are easy to use.*

## Boost Converters Enhance User Experience

Available voltage levels directly affect the working range of NFC enabled mobile devices. Throughout the day, battery charge levels decline and the voltage level gradually drops. As the mobile user makes use of typical features, the available battery voltage rises and falls.

In one instance, a mobile user maintains an internet connection using Wi-Fi and talks on the phone using Bluetooth. Each radio draws additional power and lowers the voltage level which in turn affects the NFC working range. When the call is disconnected, the range increases slightly with the higher voltage. Ending the Wi-Fi connection also lowers battery use and increases range.

The fluctuation in voltage level affects user experience because they perceive the changes in working range as inconsistent operation. DC-to-DC Boost Converters allow manufacturers to provide a consistent working range and a positive user experience.

## Consumer Experience

Perception is nine tenths of reality. If a consumer takes a fully charged NFC enabled cell phone to the mall for a day of shopping, their first few taps are easy and have a high rate of success. The user easily accesses product information and makes purchases with their mobile phone.

With a DC-to-DC Boost Converter, the NFC components operate at a consistent voltage level (5.0 volts or higher) regardless of the battery charge state or which of the mobile device's components are currently in use. Working range does not diminish over time or change with the use of other components and functions, and the user's perception remains consistent throughout the day with a higher rate of successful taps.

Consistent operation also enables the user to adapt to their mobile device and improve their own success rate. The result is greater satisfaction and confidence in the device's ability to provide an easy, trouble-free experience.

## User Experience

Mobile devices including smart phones and tablets are available in a wide range of sizes and DC-to-DC Boost Converters can improve NFC operation in all of them.

Some mobile users prefer larger devices which can accommodate a larger antenna, but require the higher voltage provided by a boost converter. The larger antenna and coil allow an improvement in the working range by up to 50 percent. A greater working range makes it easier to use the device for a better user experience, resulting in wider acceptance of the technology and the manufacturer's products.

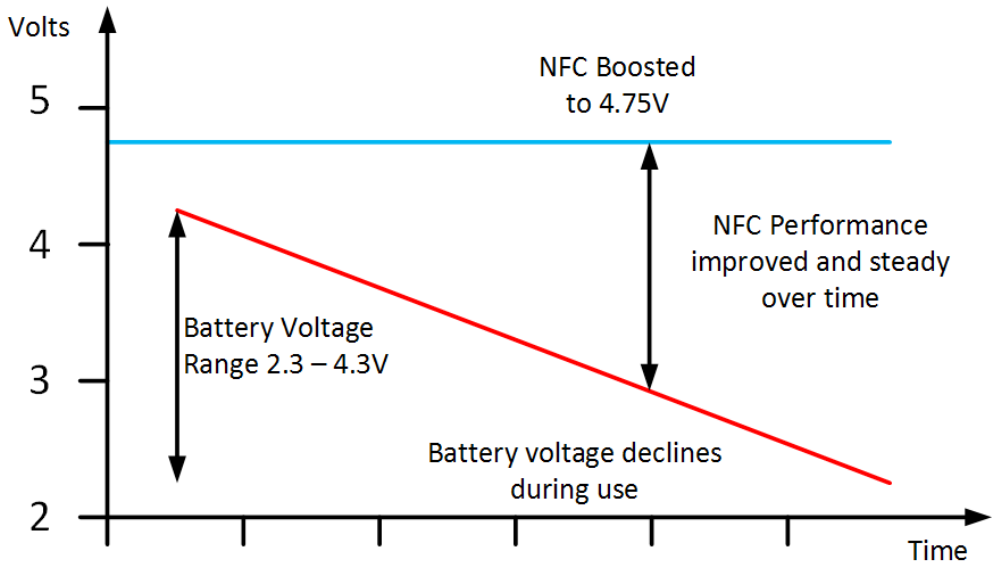
Other users enjoy smaller, lighter devices which in turn require minimum component size. Higher voltage from a DC-to-DC Boost Converter allows the mobile device manufacturer to reduce the antenna and coil size which keeps the mobile device small and lightweight. The NFC working range remains consistent and operation is stable and dependable. The result is an unchanging, quality user experience that lasts throughout the day.

## DC-to-DC Boost Converters Provide Superior Performance

Battery voltage is typically 4.3 volts when fully charged, and as low as 2.3 volts when exhausted. During charging (when the phone is connected to external power) the available voltage may be higher than five volts.

It is the job of the DC-to-DC Boost Converter to provide at least 5 volts to the NFC controller, and remain steady as the battery voltage declines, as shown by figure 2.

**Figure 2.** *DC-DC Boost delivers steady and strong NFC field.*



A further advantage is an improvement in the Power Supply Rejection Ratio (PSRR) of the NFC controller. Using a DC-to-DC Boost Converter with the higher voltage of 5.25 volts results in even greater headroom which in turn results in a better PSRR.

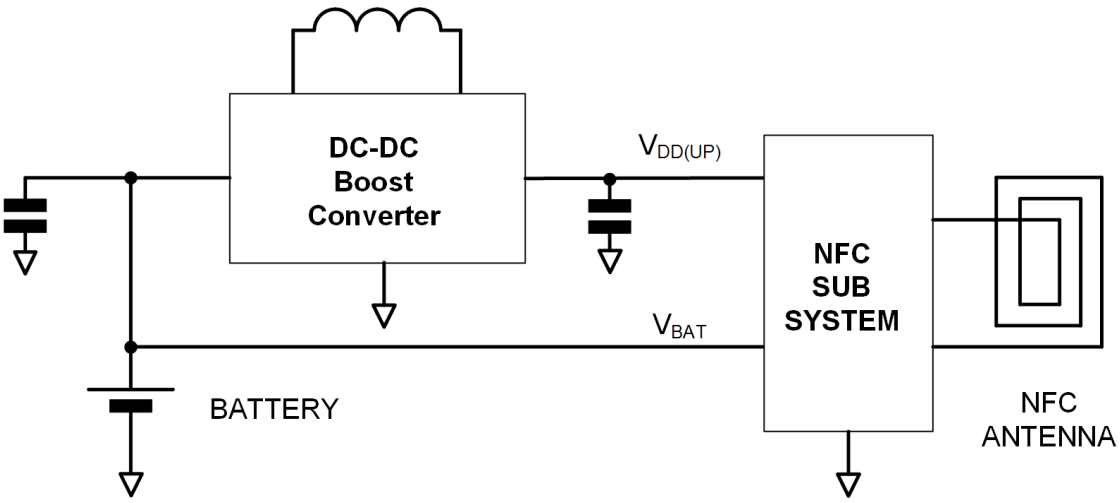
Lower ripple, combined with a higher PSRR, delivers an improved NFC field with minimal noise and variance to provide a more consistent and user friendly experience for mobile device users. The end result is a satisfied consumer that will come to rely on the device and seek future products with a similar implementation.

At a full load current of 500mA and a minimum battery voltage of 2.3volts, ripple voltage is at 20mV. At nominal battery levels of 3.6 volts, this falls to just 13mV, under the same load, and much lower than the competitor parts.

Enhancements to DC-to-DC Boost Converter technology include operating at a switching frequency of 3 MHz, versus 2.5 MHz for competitor devices, which reduces the inductor's footprint for increasingly compact smartphone designs. NXP's boost converters have up to 94 percent efficiency which reduces battery drain.

Only three external components (an inductor, and two capacitors) are required to complete the DC-to-DC Boost Converter design, as shown in figure 3.

**Figure 3.** *NFC enhanced by a DC-DC Boost Converter.*




Electrical noise is the enemy of many radio systems found in a smartphone. By reducing noise in the relevant bands from 10 KHz to 1.5 MHz, these DC-to-DC Boost Converters improve the performance of those other radio receivers within the mobile device.

## DC-to-DC Boost Converter Overview

NXP DC-to-DC Boost Converters allow battery input voltages in the range of 2.3 to 5.25 volts to supply a regulated, fixed output voltage at up to 500mA. They are designed primarily to enhance the performance of Near Field Communication controllers in mobile devices. Other uses include performance improvements for back-lit displays and radio frequency devices.

An example of newly available DC-to-DC Boost Converters are the NXP PCA941x family with output voltages from 5.0V to 5.4V as shown in table 1. These devices are pin for pin compatible to existing products from competition and with improvements on critical parameters. Two component options provide versatility via the enable pin where EN set low provides either a disable or a pass-through mode for VIN < VOUT, denoted by the A version, and the devices require just three external components.

**Table 1.** *NXP DC-DC Boost Converter Family.*

| OUTPUT VOLTAGE | DISCONNECT MODE | PASS-THROUGH MODE |
|---|---|---|
| 5.0V | PCA9410 | PCA9410A |
| 5.25V | PCA9411 | PCA9411A |
| 5.4V | PCA9412 | PCA9412A |

DC-to-DC Boost Converters create superior mobile products. They allow manufacturers to incorporate designs that enhance user experience and increase customer satisfaction. NXP's DC-to-DC Boost Converters provide an improved experience by building a product feature with the stability and sensitivity that result in a higher level of consumer satisfaction.

## Summary: DC-to-DC Boost Converter Advantages

- They supply a higher voltage which results in a higher field strength and more consistent working range.
- A regulated, stabilized voltage that is independent of battery level keeps the user experience consistent.
- Less RF noise in the relevant bands reduces interference with other radios in smart phones and other mobile devices.
- The boosted voltage improves the Power Supply Rejection Ratio.

Near Field Communication products provide users with better security than older technologies and make mobile transactions easier, faster, and more reliable. NXP boost converters integrate seamlessly with NXP's NFC controllers, provide improved power regulation with less noise, and extend the working range of NFC enabled mobile devices.

Visit NXP.COM for more information on including the DC-to-DC Boost Converter in mobile device design.

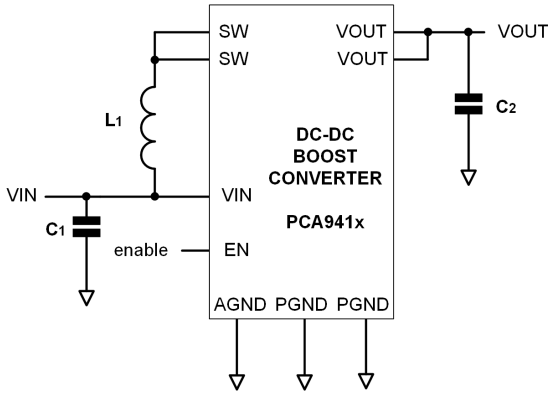



**Figure 4.** *DC-DC Converter requires only three external components.*