AN11524

NXQ1TXA6 Evaluation Board

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Document information

Info	Content
Keywords	NXQ1TXA6, NWP2081, Wireless Charging, Qi, mobile devices, base station, magnetic coupled power transfer
Abstract	This document illustrates how to create a Qi A6 wireless power base station. It uses the NXQ1TXA6 charging controller and its evaluation board that can deliver up to 5 W effective output at the wireless mobile device side

Revision history

Rev	Date	Description
v. 1.0	20150217	Initial version

Contact information

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For sales office addresses, please send an email to: **salesaddresses@nxp.com**

1. Introduction

The ubiquity of mobile phones, increases the requirement of a convenient way to charge these devices while on the move. Especially the fast rising number of smart phones widely used and relied upon in daily life. Wireless charging is introduced into smart phones and tablets.

Wireless charging represents the future of public and private charging.

Qi (pronounced as "Chee") is a wireless charging standard developed by Wireless Power Consortium (www.wirelesspowerconsortium.com) for inductive power.

The Qi system (see Figure 1) comprises a base station or a transmitter (TX) pad and a mobile device or a compatible receiver (RX), such as a mobile phone. To use the system, the mobile device is placed on top of the base station pad which charges the device via electromagnetic induction.

The market demand for the convenience and safety of standard-compliant wireless power systems continues to grow rapidly.

NXP offers Qi-compliant base station reference designs to set you immediately on your way to a successful project. NXP supports several types of Qi base stations. This document describes the application of an A6 type base station using NXQ1TXA6 charging controller.

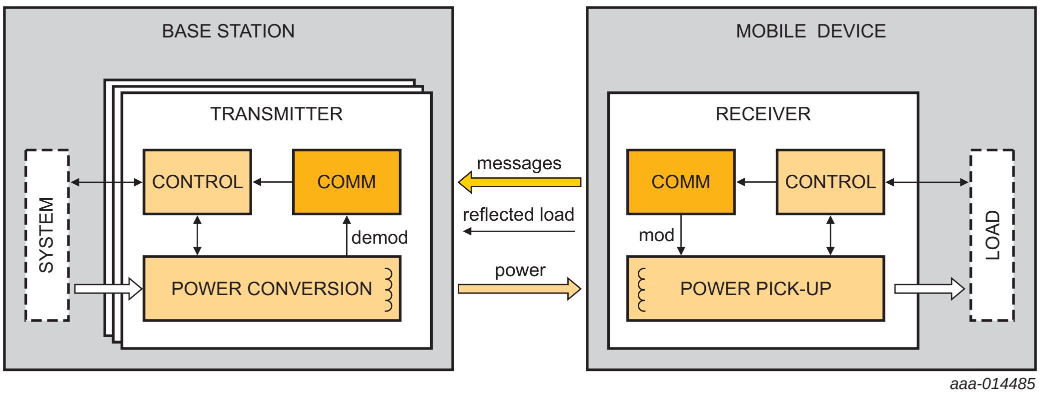


Fig 1. Wireless charging system as defined by Wireless Power Consortium

2. Scope

This document discusses the design of a WPC Qi A6 type base station based on the NXP NXQ1TXA6 Evaluation Board. The NXQ1TXA6 Evaluation Board is Qi certified and it complies with EMI regulation - EN55022 and FCC part 18.

The document is intended to provide engineers with real life practical design applications and get them started on the right note immediately.

For all topics covered, hints are provided to ensure system-level best performance, excellent EMC and lowest application cost.

Near Field Communication (NFC) option for tap to power on to enable zero power standby and Bluetooth pairing is included. There are many other use cases and possibilities with NFC technology but they are not within the scope of this application note.

3. Getting started

3.1 Package contents

The evaluation kit contains the following items:

- NXP NXQ1TXA6 wireless charger evaluation board containing, see Figure 2:
  - NXQ1TXA6 charger controller IC
  - NWP2081 half-bridge level shift controller IC
  - NX2020 MOSFETs
  - NT3H1201 NTAG-I^{2}C NFC forum tag
- AC 110 V/220 V – DC 12 V power supply containing:
  - TEA1720B3T HV start-up fly-back controller for ultra-low no-load charger applications up to 12 W

aaa-015876

Fig 2. Overview of the charging pad

A mobile device to receive the power is not included in the evaluation package. Refer to the WPC website for a list of certified Qi receivers to be used with the evaluation board. To demonstrate NFC tap to power on, ensure that the receivers support both Qi wireless charging and NFC technology.

3.2 Main features

The NXQ1TXA6 Evaluation Board demonstrates:

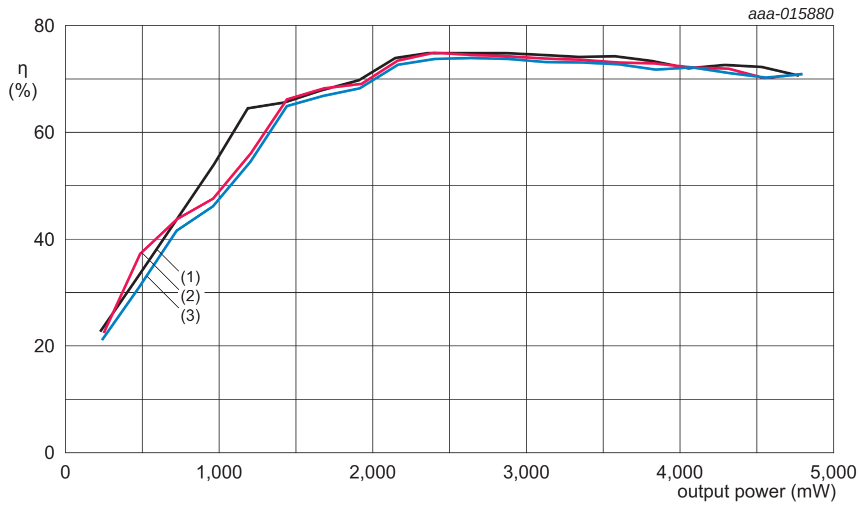
- A reference design with key components from NXP for wireless charging applications based on inductive power transfer standard Qi.
- Shows additional benefits resulting from integration of NFC with wireless charging. Enabling for example zero power standby with the “tap to power on” feature.

3.3 System efficiency

In Figure 3, the system efficiency of the evaluation board is shown using a standard off the shelf receiver.

System efficiency is measured as the ratio of output power of the receiver to the input power of the transmitter. Input power is averaged to take into account variation due to communication between receiver and transmitter.

The quality of the components used in both the transmitter and the receiver, determine the efficiency of the system.



(1) outer coil 1

(2) center coil

(3) outer coil 2

Fig 3. System efficiency

3.4 Board overview

The evaluation board is shown in Figure 4. The left-hand side contains the charging area where the mobile device should be placed. The top right side has the electronics to drive the charging coil and communicate with the mobile device.

Fig 4. Switch, buttons and status LED location overview

The function of the switch and push buttons as well as the meaning of the status LED is explained in the next subsections.

3.5 Stand-by power mode switch

The switch on the top of the board is not a power on/off switch. The switch is for alternating between the "Normal" and the NFC "tap to power on" position as illustrated in Figure 5.

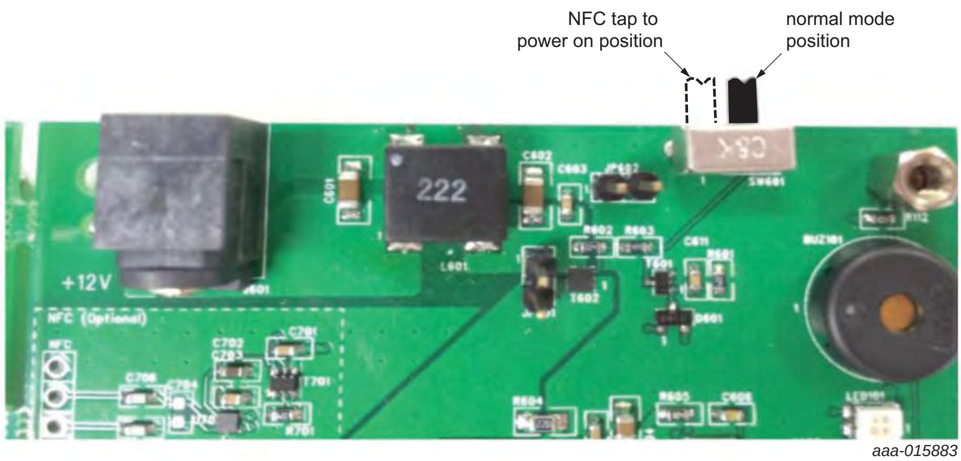


Fig 5. Standby-by power mode switch

In the *Normal* mode, the charging pad periodically monitors the coil for the presence of a Qi receiver. It starts power transfer, once a Qi power receiver is detected.

In the *NFC tap to power on* mode, the charging pad electronics are disconnected from the 12 V supply. The presence of an NFC enabled phone, switches on the 12 V system supply, enabling zero power in standby mode.

Important:

The present generation of NFC phones only performs periodic NFC operations when the display of the phone is on and unlocked. It is only under this condition that the charging pad is woken-up to start power transfer.

3.6 Reset button

Pressing the reset button marked SW101 on the board performs a reset of the charging pad.

3.7 Foreign object detection button

By pressing the left-most button marked SW102 on the board, the charging pad enables or disables Foreign Object Detection (FOD). This feature should be removed for final products.

While charging, the green status LED indicates whether FOD is activated. When FOD is active, the green LED blinks with a rate of 1 Hz. When FOD is disabled, the green LED blinks with a rate of 3 Hz.

3.8 Status LED

An overview of the status signaled by the LEDs is given in the following table:

Table 1. LED status indicator

LED status	Description
Off	If a 12 V DC supply is present, the pad is in the operation mode as defined by the mode switch
Green blinking 1 Hz	Ongoing power transfer - charging mobile device, FOD enabled
Green blinking 3 Hz	Ongoing power transfer - charging mobile device, FOD disabled
Green permanently On	Mobile device charged
Red blinking	No power transfer Error detected: Foreign object, temperature or Receiver indicated error

3.9 NFC functionality

The evaluation board provides a passive tag functionality with NT3H1201 NTAG-I^{2}C. The NTAG-I^{2}C is preprogrammed with a URL link to the NXP website. When most NFC phones are put on the charger pad while the screen is active, an automatic link to the NXP website is made.

Other content can be programmed into NTAG IC by using, for example, NXPs TagWriter.

4. NXP product offering

The NXQ1TXA6 evaluation board was designed based on the NXP products listed in Table 2. The part numbers are hyperlinked to the NXP website to provide quick access to product information and data sheets.

Table 2. NXP components for wireless charger application

Type number	Function	Package		Ordering information
		Version	Description	12NC
NXQ1TXA6/001	Wireless charger controller	SOT865	HVQFN: plastic thermal enhanced very thin quad flat package; no leads; 33 terminals; body 7 × 7 × 0.85 mm	9353 039 36551
NWP2081T	Half-bridge level-shift controller IC	SOT96	plastic small outline package; 8 leads; body width 3.9 mm	9353 021 87518
NX3008NBKW	30 V, single N-channel Trench MOSFET	SOT323	plastic surface-mounted package; 3 leads	9340 656 35115
NX2020N2	30 V, single N-channel Trench MOSFET	SOT1220	plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals	9340 682 45115
BAS21	High-voltage switching diodes	SOT23	plastic surface-mounted package; 3 leads	9335 020 40215
BAT54S	Schottky barrier diodes	SOT23	plastic surface-mounted package; 3 leads	9339 763 80215
TL431	Adjustable precision shunt regulator	SOT23	plastic surface-mounted package; 3 leads	9352 932 76215
Optional				
NT3H1201	NTAG-I2C NFC forum type 2 Tag compliant IC with I^2C interface	SOT902	plastic extremely thin quad flat package; no leads; 8 terminals	9353 028 43125
NX3008CBKS	30 V complementary N/P channel Trench MOSFET	SOT363	plastic surface-mounted package with increased, 6 leads	9340 682 44115
NX2020P1	30 V, single P-channel Trench MOSFET	SOT1220	plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals	9340 656 39115
BAT54C	Schottky barrier (double) diodes	SOT23	plastic surface-mounted package; 3 leads	9339 763 70215
TDA3663	LDO (or use DC-to-DC RT8295A)	SOT223	plastic surface-mounted package with increased heatsink; 4 leads	9352 629 68135
TEA1720B3T	12 W HV start-up fly back controller (SMPS)	SOT96	plastic surface-mounted package; 8 leads	9353 026 97118

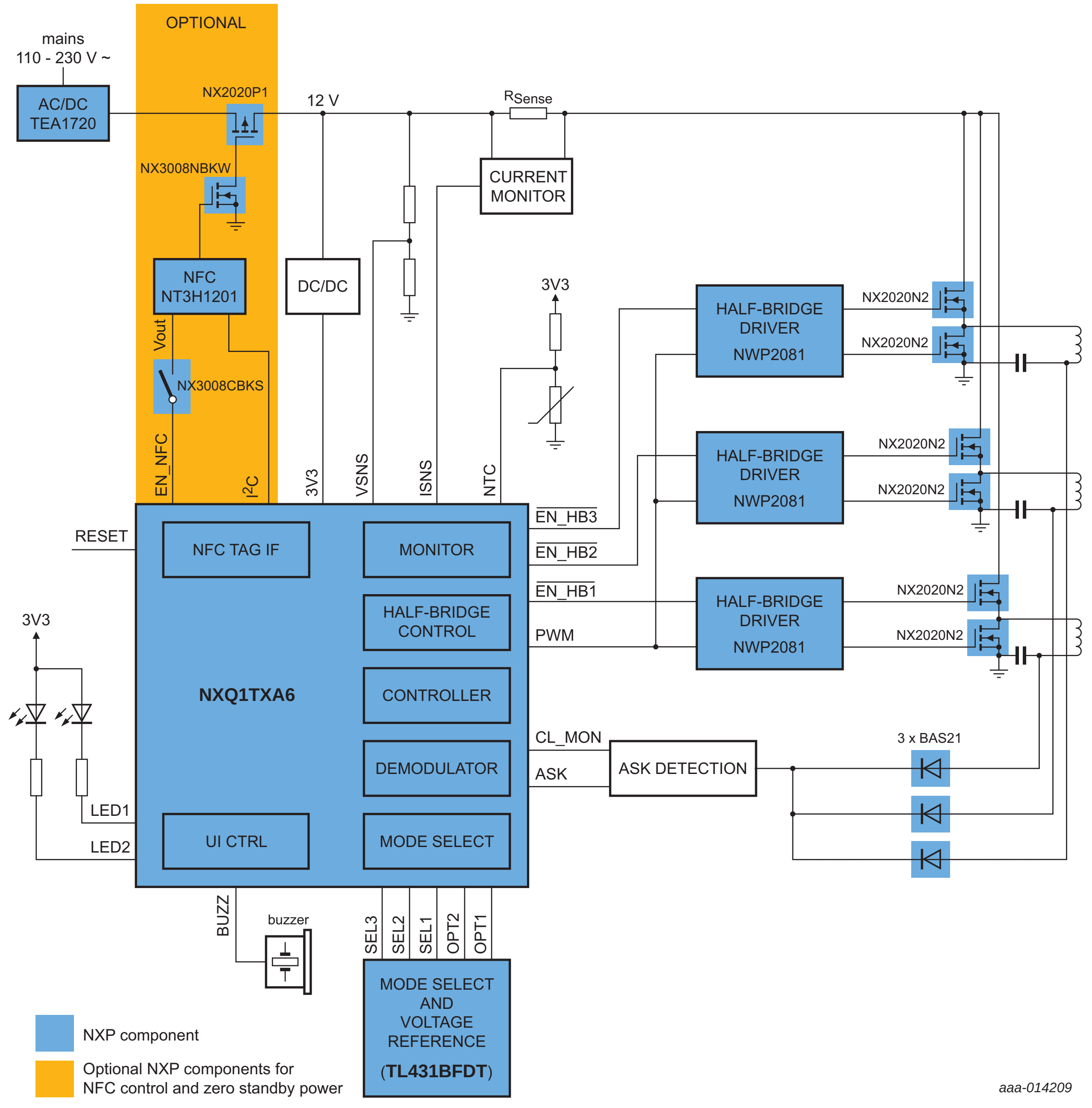
5. System overview

The NXQ1TXA6 Evaluation Board is a WPC Qi A6 type base station, powered by a +12 V AC-to-DC adapter.

It works on the basic principle of inductively coupled power transfer. An alternating current generated from the half-bridge driver is passed through the base station coil. It creates a magnetic field which induces a voltage in the mobile device coil. The mobile device communicates information related to power management and control to the base station.

When the NFC tap to power on feature is enabled, the evaluation board consumes zero power in standby mode.

A block diagram of the NXQ1TXA6 evaluation board is depicted in Figure 6. Each subblock is described in Section 5.1 to Section 5.8.



The block diagram does not depict all semiconductor components used to build up the system. See the related application note for details.

The NXQ1TXA6/001 supports the A6 single-coil and 3-coil configurations.

Fig 6. NXQ1TXA6 evaluation board block diagram

5.1 NXQ1TXA6 charging controller

The NXQ1TXA6 is a wireless charger controller for A6 type base stations. It offers WPC 1.1 Qi-compliant communication and safety functions including Foreign Object Detection (FOD), over-temperature protection and more. The controller supports ping mode during standby to detect potential mobile devices. It also works with the NXP NT3H1201 to enable tap to power on with an NFC enabled phone.

Settings are available via resistor networks for Foreign Object Detection (FOD) level, LED blinking and other options. Refer to NXQ1TXA6 data sheet for further information.

5.2 Half Bridge driver

There are 3 half-bridge driver stages in the NXQ1TXA6 Evaluation Board. Control signals $\overline{\text{EN\_HB1}}$, $\overline{\text{EN\_HB2}}$ and $\overline{\text{EN\_HB3}}$ enable the driver stages independently. At any one time, only one driver stage is enabled for either pinging to detect the presence of a mobile device or active charging. The half-bridge driver stage is designed to output about ~7 W power to ensure minimum 5 W output is received at the mobile device.

NXP NWP2081T half-bridge controller IC and NX2020N2 N-channel Trench MOSFETs are the two key semiconductor components. They drive the A6 type primary coil and series capacitance (LC tank circuit) at operating frequency between 115 kHz to 205 kHz.

Frequency and duty cycle is varied via Pulse-Width Modulated (PWM) signal from the NXQ1TXA6 charging controller

The NXQ1TXA6 Evaluation Board can be configured to support A6 type single coil base station by shorting R117 and R118 in Figure 7 to ground. In this configuration, only half-bridge driver for coil 1 is active. Resistors R117 and R118 are not populated for an A6 type 3-coil base station configuration.

5.3 Amplitude-Shift Keying (ASK) envelope demodulator

One-directional communication from the mobile device to the base station is achieved via back-scattered Amplitude-Shift Keying modulation as illustrated in Figure 1.

The mobile device modulates the magnetic field of the base station using either capacitive or resistive load, at a rate of 2 kbits/sec.

An envelope detector is used to demodulate the communication data. The demodulated output is sent to the NXQ1TXA6 charging controller for further processing.

High voltages up to 100 V_{p-p} can be observed at the input of the envelope detector.

5.4 +12 V universal mains adapter

The power supply design is based on NXP TEA1720 low cost Switched Mode Power Supply (SMPS) controller IC. It is optimized for fly back converter topology to provide high-efficiency over the entire load range with ultra-low power consumption in the no-load condition.

5.5 Current measurement

The current flowing into the power stage is determined by measuring the voltage across a 22 mΩ current sense resistor. The current measurement is needed for Foreign Object Detection (FOD). If FOD is not required, it can be disabled by configuring the resistor networks (refer to NXQ1TXA6 data sheet). The current measurement circuits can be removed. Connect the unused ISNS pin to ground, i.e. not left open. Note that FOD is required to pass Qi certification.

5.6 Bandgap reference voltage

NXQ1TXA6 wireless charging controller needs a band gap reference voltage (±0.5 % tolerance) for critical processing. The TL431 shunt regulator is used in the NXQ1TXA6 Evaluation Board to provide this reference voltage.

5.7 DC-to-DC converter

A DC-to-DC buck converter steps the +12 V input down to +3.3 V, to supply the NXQ1TXA6 charging controller and other +3.3 V circuits.

A Richtek RT8295A DC-to-DC converter is used in the NXQ1TXA6 evaluation board. An option for a linear regulator TDA3663 is available on board. Take note however, that at operating currents of the NXQ1TXA6 evaluation board, the efficiency of the applied DC-to-DC converter is better than a linear regulator.

5.8 Near Field Communication (NFC) zero power in Standby mode

When using the optional feature "NFC tap to power on", the base station is designed for zero power consumption in standby mode. It uses an NT3H1201 NTAG-I2C NFC forum passive tag.

When this feature is enabled, there is no pinging to detect the presence of a mobile device on the charger pad. Instead, an NFC enabled mobile device, for example a phone, wakes up the base station via the NT3H1201. Power transfer takes place with a certified Qi mobile device.

To enable more functions such as Bluetooth pairing, smart advertisements, and connection handovers, the passive tag can be programmed with the NXP TagWriter application (see Section 3.9 “NFC functionality”).

6. Schematics and Bill Of Materials

Customers should start directly from NXQ1TXA6 Evaluation Board as this board is optimized in terms of functional performance and EMI.

Deviations are possible, but they should be kept minimal, carefully weighed and associated potential risks considered. Where possible, customers are encouraged to send their schematics to NXP for review. Contact the nearest NXP application support team in your area for support in designing your wireless charging base station.

During schematic capture, indicate critical components clearly in the schematics so that they are not forgotten during procurement and production. For example, 68 nF C0G/NP0 capacitor, 100 kΩ 1 % tolerance resistor and 100 V rated components.

Certain critical components and PCB layout details are crucial to the success of the project and deserve special attention. In the later part of the document, these details are elaborated. Refer to Section 7 “Critical components”and Section 8 “PCB layout guidelines” in the subsequent pages.

For development of prototype boards, it is best practice to include test points on key signal nodes. For production runs, these test points can be removed from the final PCB.

At the very minimum, create test point for the following signal nodes:

- Power supplies - +3.3 V and +12 V supply nodes
- Output of ASK demodulator - AM signal node
- Output of current sense amplifier - ISOUT signal node
- Pulse Width Modulation - PWM signal node
- The half-bridge driver stage enable - nEN_HB1, 2 and 3 signal node
- System and power grounds - GND, GNDI

6.1 Schematics

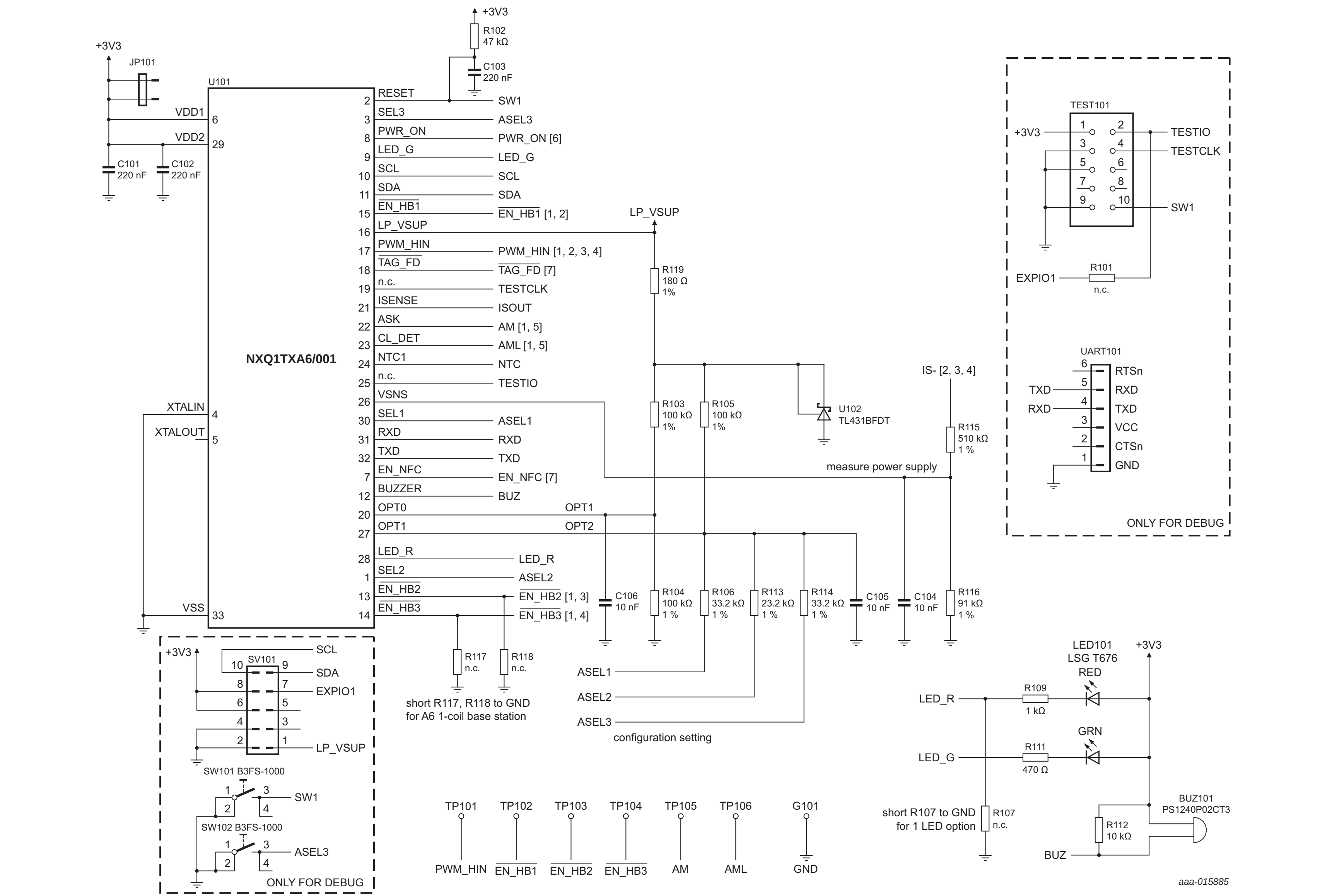


Fig 7. NXQ1TXA6 charging controller schematic

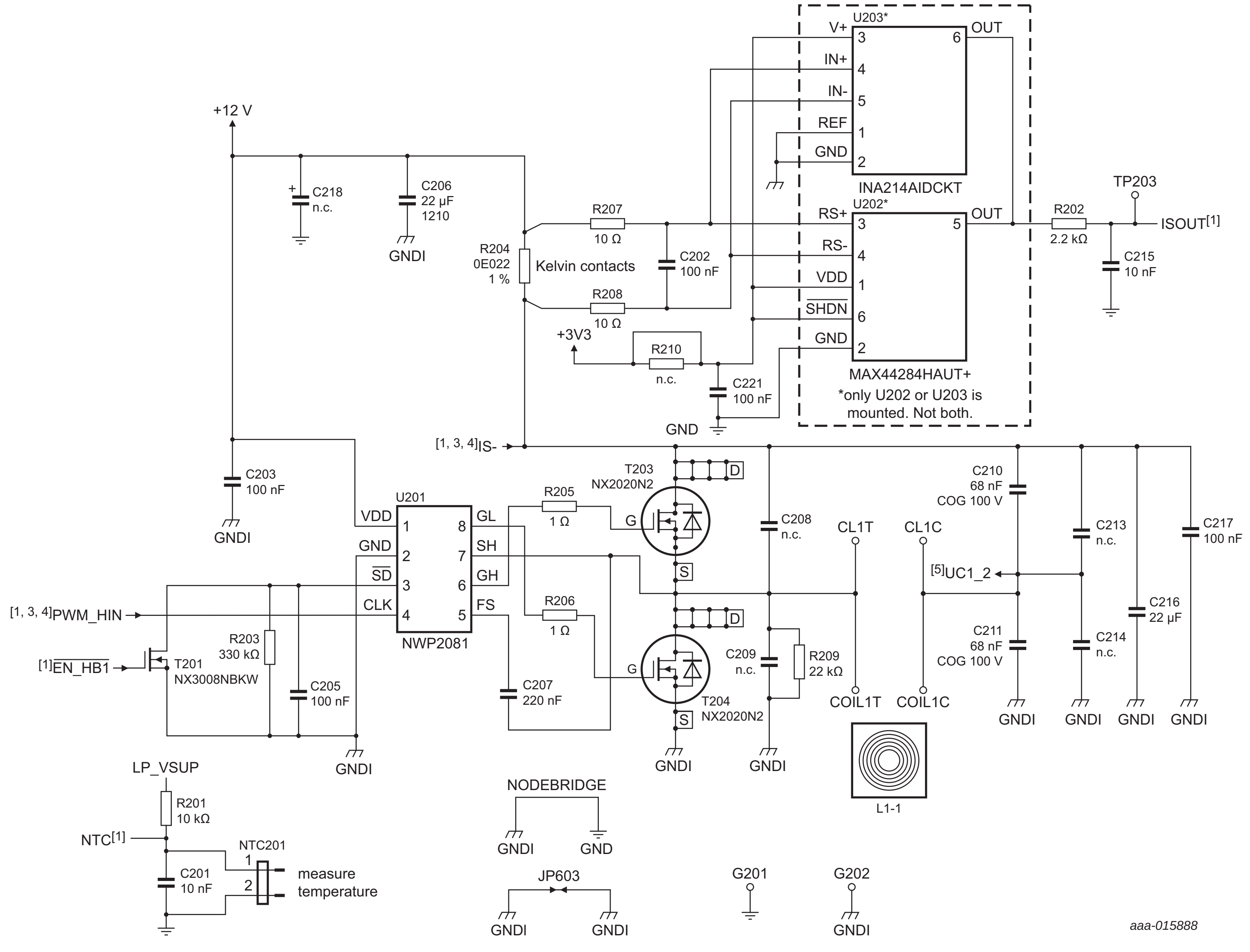


Fig 8. Half bridge driver stage of coil 1 and current sense schematic

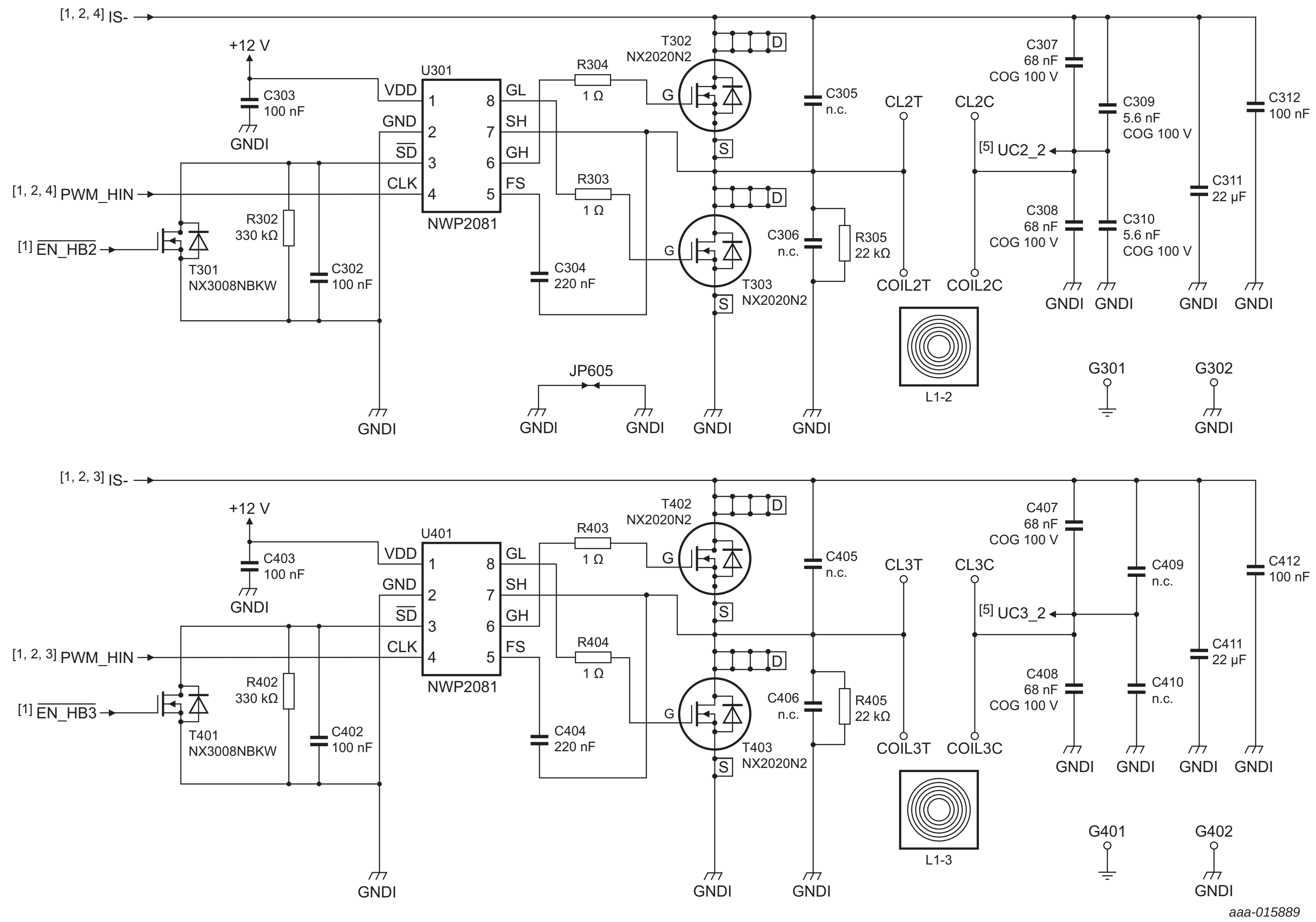


Fig 9. Half bridge driver stage of coil 2 and 3

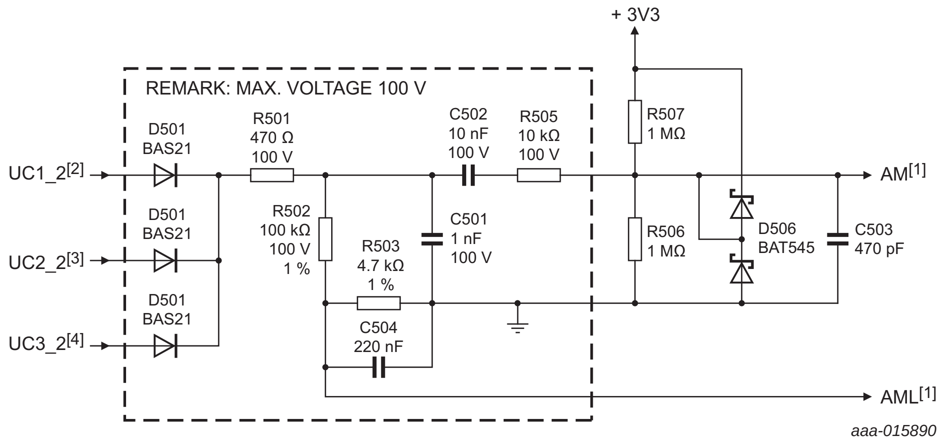


Fig 10. Amplitude Shift Keying (ASK) envelope detector schematic

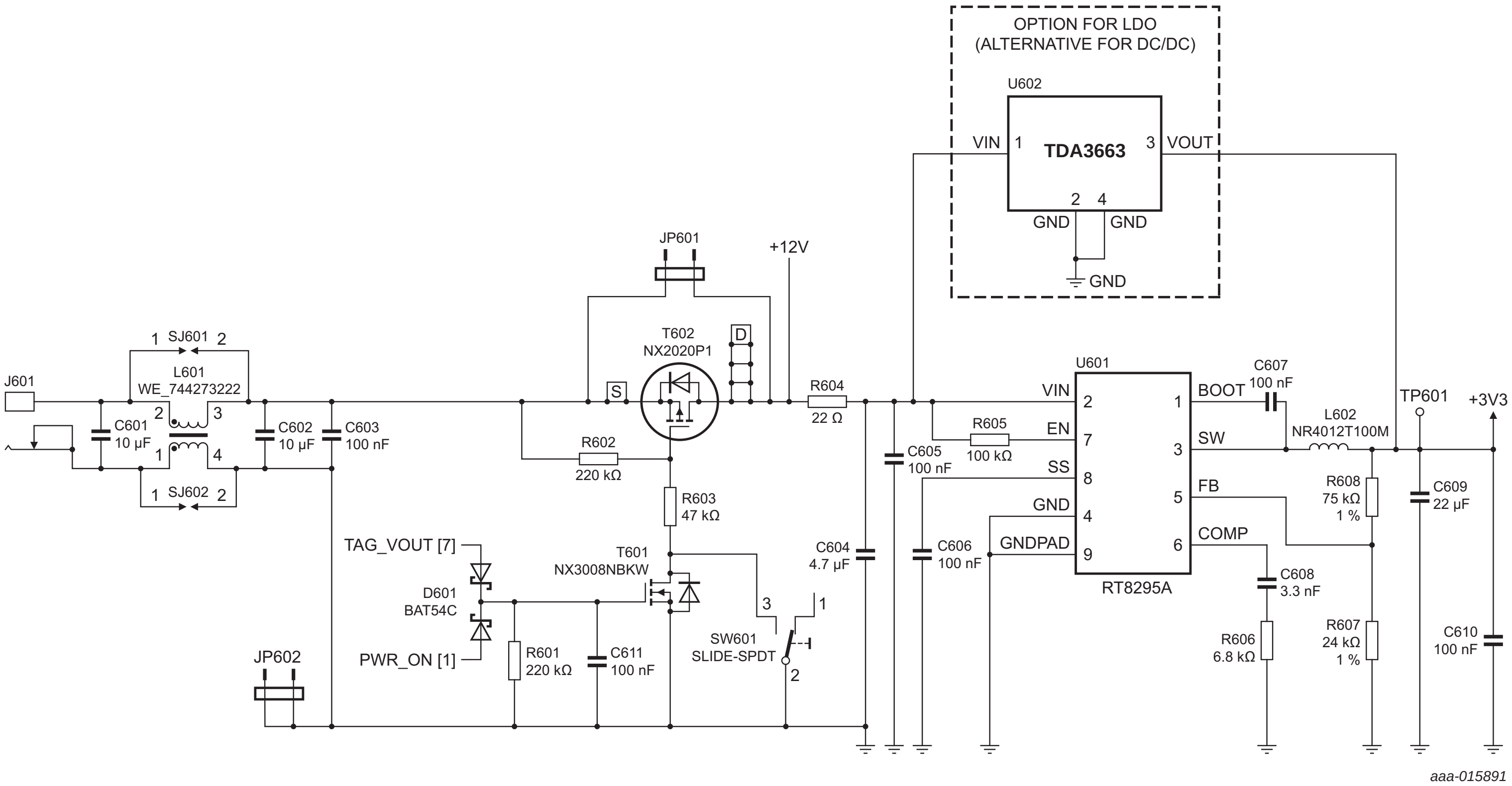


Fig 11. DC supply schematic

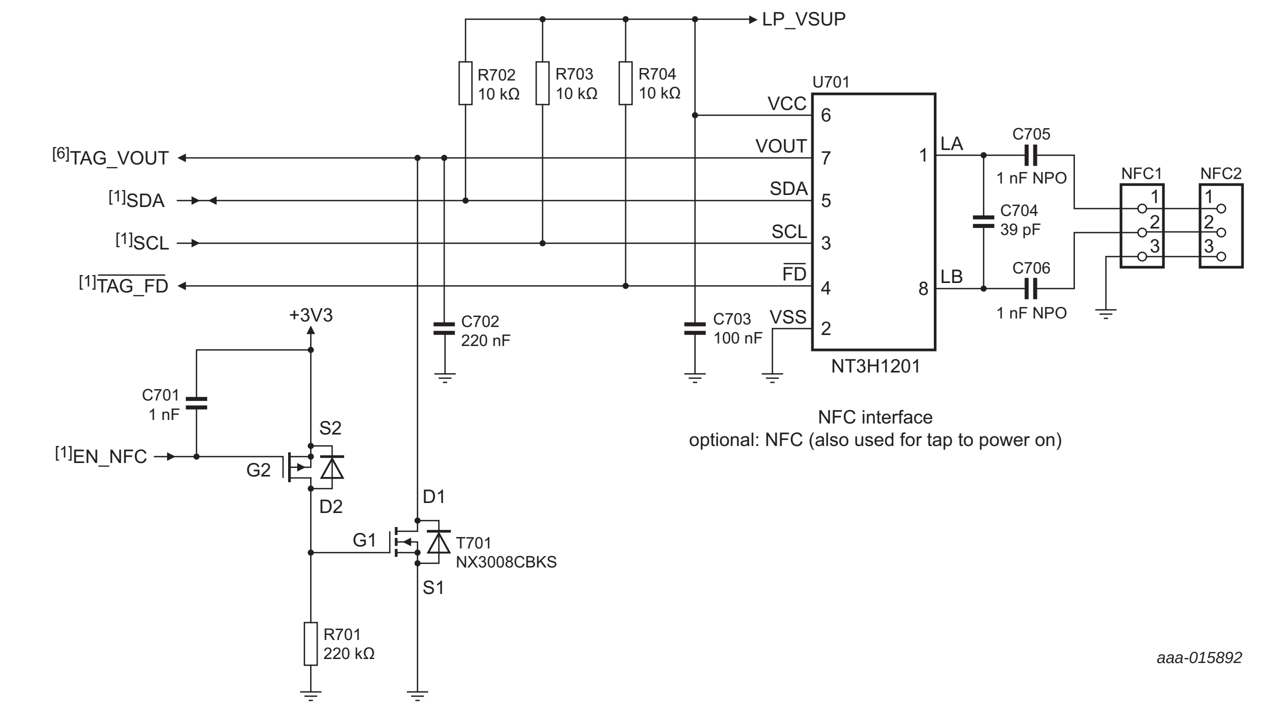


Fig 12. NFC schematic

6.2 Bill Of Materials

The NXQ1TXA6 Evaluation Board is assembled with maximum options for evaluation purposes. For final design, certain components can be removed depending on the required features. The available options and corresponding components are presented below.

Options:

- Buzzer - only when buzzer is needed
- DCDC - when a DC-to-DC converter for 3.3 V is preferred
- LDO - when LDO regulator for 3.3 V is preferred
- NFC - when NFC is needed
- ZERO - when zero power standby is needed (also requires NFC)
- FOD - when FOD is required
- Debug - only for debugging, not for production
- NTC - only when NTC is needed
- NC - not connected, do not place

Table 3. Bill Of Materials (BOM)

Part	Value	Part number	Manufacturer	Package	Optional	Description
BUZ101	PS1240P02CT3	PS1240P02CT3	TDK	PS12	Buzzer	audio indicator; round 12.2 mm × 3.5 mm 4 kHz V_{in} = 3 V
C101	220 nF	Standard	-	C0603	-	capacitor, ceramic, 25 V, X7R, 20 %
C102	220 nF	Standard	-	C0603	-	capacitor, ceramic, 25 V, X7R, 20 %
C103	220 nF	Standard	-	C0603	-	capacitor, ceramic, 25 V, X7R, 20 %
C104	10 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C105	10 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C106	10 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C201	10 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C202	100 nF	Standard	-	C0603	FOD	capacitor, ceramic, 50 V, X7R, 10 %
C203	100 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C205	100 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C206	22 µF/1210	GRM32ER71E226KE15L	MURATA	C1210	-	capacitor, ceramic, 25 V, X7R, 10 %
C207	200 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C208	n.c.	Standard	-	C0603	n.c.	capacitor, ceramic, 50 V, X7R, 10 %
C209	n.c.	Standard	-	C0603	n.c.	capacitor, ceramic, 50 V, X7R, 10 %
C210	68 nF/C0G/1812	C4532C0G2A683J250KA	TDK	C1812	-	capacitor, ceramic, 100 V, C0G, 5 %
C211	68 nF/C0G/1812	C4532C0G2A683J250KA	TDK	C1812	-	capacitor, ceramic, 100 V, C0G, 5 %
C212	100 nF	Standard	-	C0603	FOD	capacitor, ceramic, 50 V, X7R, 10 %
C213	NC/100 V/C0G	Standard	-	C1206	n.c.	capacitor, ceramic, 100 V, C0G, 5 %
C214	NC/100 V/C0G	Standard	-	C1206	n.c.	capacitor, ceramic, 100 V, C0G, 5 %
C215	10 nF	Standard	-	C0603	FOD	capacitor, ceramic, 50 V, X7R, 10 %
C216	22 µF/1210	GRM32ER71E226KE15L	MURATA	C1210	-	capacitor, ceramic, 25 V, X7R, 10 %
C217	100 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C218	NC/25V/Case_D	Standard	-	SMC_D	n.c.	capacitor, Polarized, Case_D, 25 V
C302	100 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C303	100 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C304	220 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C305	n.c.	Standard	-	C0603	n.c.	capacitor, ceramic, 50 V, X7R, 10 %
C306	n.c.	Standard	-	C0603	n.c.	capacitor, ceramic, 50 V, X7R, 10 %
C307	68 nF/C0G/1812	C4532C0G2A683J250KA	TDK	C1812	-	capacitor, ceramic, 100 V, C0G, 5 %

Table 3. Bill Of Materials (BOM) *…continued*

Part	Value	Part number	Manufacturer	Package	Optional	Description
C308	68 nF/C0G/1812	C4532C0G2A683J250KA	TDK	C1812	-	capacitor, ceramic, 100 V, C0G, 5 %
C309	5.6 nF/C0G/1206	GCM3195C2A562JA16D	MURATA	C1206	-	capacitor, ceramic, 100 V, C0G, 5 %
C310	5.6 nF/C0G/1206	GCM3195C2A562JA16D	MURATA	C1206	-	capacitor, ceramic, 100 V, C0G, 5 %
C311	22 μF/1210	GRM32ER71E226KE15L	MURATA	C1210	-	capacitor, ceramic, 25 V, X7R, 10 %
C312	100 nF	Standard	-	C0603	-	capacitor, ceramic, 25 V, X7R, 10 %
C402	100 nF	Standard	-	C0603	-	capacitor, ceramic, 25 V, X7R, 10 %
C403	100 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C404	220 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C405	n.c.	Standard	-	C0603	n.c.	capacitor, ceramic, 50 V, X7R, 10 %
C406	n.c.	Standard	-	C0603	n.c.	capacitor, ceramic, 50 V, X7R, 10 %
C407	68 nF/C0G/1812	C4532C0G2A683J250KA	TDK	C1812	-	capacitor, ceramic, 100 V, C0G, 5 %
C408	68 nF/C0G/1812	C4532C0G2A683J250KA	TDK	C1812	-	capacitor, ceramic, 100 V, C0G, 5 %
C409	NC/100V/C0G	Standard	-	C1206	n.c.	capacitor, ceramic, 100 V, C0G, 5 %
C410	NC/100V/C0G	Standard	-	C1206	n.c.	capacitor, ceramic, 100 V, C0G, 5 %
C411	22 μF/1210	GRM32ER71E226KE15L	MURATA	C1210	-	capacitor, ceramic, 25 V, X7R, 10 %
C412	100 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C501	1 nF/1206	Standard	-	C1206	-	capacitor, ceramic, 100 V, X7R, 10 %
C502	10 nF/1206	Standard	-	C1206	-	capacitor, ceramic, 100 V, X7R, 10 %
C503	470 pF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C504	220 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C601	10 μF/1206	Standard	-	C1206	-	capacitor, ceramic, 25 V, X7R, 10 %
C602	10 μF/1206	Standard	-	C1206	-	capacitor, ceramic, 25 V, X7R, 10 %
C603	100 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C604	4.7 μF/0805	GRM21BR71E475KA73L	MURATA	C0805	-	capacitor, ceramic, 25 V, X7R, 10 %
C605	100 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C606	100 nF	Standard	-	C0603	DCDC	capacitor, ceramic, 50 V, X7R, 10 %
C607	100 nF	Standard	-	C0603	DCDC	capacitor, ceramic, 50 V, X7R, 10 %
C608	3.3 nF	Standard	-	C0603	DCDC	capacitor, ceramic, 50 V, X7R, 10 %
C609	22 μF/0805	GRM21BR60J226ME39L	MURATA	C0805	-	capacitor, ceramic, 6.3 V, X5R, 20 %
C610	100 nF	Standard	-	C0603	-	capacitor, ceramic, 50 V, X7R, 10 %
C611	100 nF	Standard	-	C0603	ZERO	capacitor, ceramic, 50 V, X7R, 10 %

Table 3. Bill Of Materials (BOM) *…continued*

Part	Value	Part number	Manufacturer	Package	Optional	Description
C701	1 nF	Standard	-	C0603	NFC	capacitor, ceramic, 50 V, X7R, 10 %
C702	220 nF	Standard	-	C0603	NFC	capacitor, ceramic, 50 V, X7R, 10 %
C703	100 nF	Standard	-	C0603	NFC	capacitor, ceramic, 50 V, X7R, 10 %
C704	39 pF/NP0	Standard	-	C0603	NFC	capacitor, ceramic, 50 V, NP0, 5 %
C705	1nF/NP0	Standard	-	C0603	NFC	capacitor, ceramic, 50 V, NP0, 5 %
C706	1nF/NP0	Standard	-	C0603	NFC	capacitor, ceramic, 50 V, NP0, 5 %
D501	BAS21	BAS21	NXP Semiconductors	SOT23	-	High-voltage switching diode
D502	BAS21	BAS21	NXP Semiconductors	SOT23	-	High-voltage switching diode
D503	BAS21	BAS21	NXP Semiconductors	SOT23	-	High-voltage switching diode
D506	BAT54S	BAT54S	NXP Semiconductors	SOT23	-	Schottky barrier double diodes
D601	BAT54C	BAT54C	NXP Semiconductors	SOT23	ZERO	Schottky barrier double diodes
J601	DC10A	DC10A	CLIFF Electronic	DC10	-	DC10A - Socket PCB, DC Power, 2.49 mm
Components						
JP101	JP1E	Standard	-	JP1	Debug	header, pin, 2.54 mm, 2 way 1 row
JP601	JP1E	Standard	-	JP1	Debug	header, pin, 2.54 mm, 2 way 1 row
JP602	JP1E	Standard	-	JP1	Debug	header, pin, 2.54 mm, 2 way 1 row
L601	30 µH, 2.2 kΩ	744273222	Würth Elektronik	WE-SL5_HC	-	Line filter, CMODE, 30 µH, 2.2 kΩ 25 %
L602	NR4012T100M	NR4012T100M	TAIYO YUDEN	NR4012	DCDC	Inductor, shielded 10 µH, 740 mA, SMD
L1	Y31-60037F	Y31-60037F	Elec & Eltek Magnetic	Y31-60037F	-	Coil Module - TX (A6) 12.5 µH/11.5 µH
LED101	LSG T676	LSG T676-P7Q7-1+N7P7-24	OSRAM	PLCC-4	-	Standard LEDs - SMD Red/Green
NFC1	NFC-Antenna	NFC-Antenna	-	NFC	NFC	NFC-Antenna
NTC201	B57551G1103F005	B57551G1103F005	EPCOS	-	NTC	thermistor, NTC, Radial leaded
R101	n.c.	Standard	-	R0603	n.c.	chip resistor, 0.1 W, 5 %
R102	47 kΩ	Standard	-	R0603	-	chip resistor, 0.1 W, 5 %
R103	100 kΩ /1 %	Standard	-	R0603	-	chip resistor, 0.1 W, 1 %
R104	100 kΩ /1 %	Standard	-	R0603	-	chip resistor, 0.1 W, 1 %
R105	100 kΩ /1 %	Standard	-	R0603	-	chip resistor, 0.1 W, 1 %
R106	33.2 kΩ /1 %	Standard	-	R0603	-	chip resistor, 0.1 W, 1 %
R107	n.c.	Standard	-	R0603	n.c.	chip resistor, 0.1 W, 5 %

Table 3. Bill Of Materials (BOM) *…continued*

Part	Value	Part number	Manufacturer	Package	Optional	Description
R109	1 kΩ	Standard	-	R0603	-	chip resistor, 0.1 W, 5 %
R111	470 R	Standard	-	R0603	-	chip resistor, 0.1 W, 5 %
R112	10 kΩ	Standard	-	R0603	Buzzer	chip resistor, 0.1 W, 5 %
R113	23.2 kΩ /1 %	Standard	-	R0603	-	chip resistor, 0.1 W, 1 %
R114	33.2 kΩ /1 %	Standard	-	R0603	-	chip resistor, 0.1 W, 1 %
R115	510 kΩ /1 %	Standard	-	R0603	-	chip resistor, 0.1 W, 1 %
R116	91 kΩ /1 %	Standard	-	R0603	-	chip resistor, 0.1 W, 1 %
R117	n.c.	Standard	-	R0603	n.c.	chip resistor, 0.1 W, 5 %
R118	n.c.	Standard	-	R0603	n.c.	chip resistor, 0.1 W, 5 %
R119	180 R / 1 %	Standard	-	R0603	-	chip resistor, 0.1 W, 1 %
R201	10 kΩ	Standard	-	R0603	-	chip resistor, 0.1 W, 5 %
R202	2.2 kΩ	Standard	-	R0603	FOD	chip resistor, 0.1 W, 5 %
R203	330 kΩ	Standard	-	R0603	-	chip resistor, 0.1 W, 5 %
R204	0E022/1 %	WSLP0805R0220FEA	VISHAY	R0805	FOD	chip resistor, 0.1 W, 1 %
R205	1 R	Standard	-	R0603	-	chip resistor, 0.1 W, 5 %
R206	1 R	Standard	-	R0603	-	chip resistor, 0.1 W, 5 %
R207	10 R	Standard	-	R0603	FOD	chip resistor, 0.1 W, 5 %
R208	10 R	Standard	-	R0603	FOD	chip resistor, 0.1 W, 5 %
R209	22 kΩ	RES0603	-	R0603	-	chip resistor, 0.1 W, 5 %
R210	n.c.	Standard	-	R0603	n.c.	chip resistor, 0.1 W, 5 %
R302	330 kΩ	Standard		R0603	-	chip resistor, 0.1 W, 5 %
R303	1 R	Standard		R0603	-	chip resistor, 0.1 W, 5 %
R304	1 R	Standard		R0603	-	chip resistor, 0.1 W, 5 %
R305	22 kΩ	Standard		R0603	-	chip resistor, 0.1 W, 5 %
R402	330 kΩ	Standard		R0603	-	chip resistor, 0.1 W, 5 %
R403	1 R	Standard		R0603	-	chip resistor, 0.1 W, 5 %
R404	1 R	Standard		R0603	-	chip resistor, 0.1 W, 5 %
R405	22 kΩ	Standard		R0603	-	chip resistor, 0.1 W, 5 %
R501	470R/100 V	Standard		R1206	-	chip resistor, 0.25 W, 5 %
R502	100 kΩ/100 V/1 %	Standard		R1206	-	chip resistor, 0.25 W, 1 %
R503	4.7 kΩ/1 %	Standard		R0603	-	chip resistor, 0.1 W, 1 %

Table 3. Bill Of Materials (BOM) *…continued*

Part	Value	Part number	Manufacturer	Package	Optional	Description
R505	10 kΩ/100 V	Standard		R1206	-	chip resistor, 0.25 W, 5 %
R506	1M0	Standard		R0603	-	chip resistor, 0.1 W, 5 %
R507	1M0	Standard		R0603	-	chip resistor, 0.1 W, 5 %
R601	220 kΩ	Standard		R0603	ZERO	chip resistor, 0.1 W, 5 %
R602	220 kΩ	Standard		R0603	ZERO	chip resistor, 0.1 W, 5 %
R603	47 kΩ	Standard		R0603	ZERO	chip resistor, 0.1 W, 5 %
R604	22 R	Standard		R0805	-	chip resistor, 0.125 W, 5 %
R605	100 kΩ	Standard		R0603	DCDC	chip resistor, 0.1 W, 5 %
R606	6.8 kΩ	Standard		R0603	DCDC	chip resistor, 0.1 W, 5 %
R607	24 kΩ /1 %	Standard	-	R0603	DCDC	chip resistor, 0.1 W, 1 %
R608	75 kΩ /1 %	Standard	-	R0603	DCDC	chip resistor, 0.1 W, 1 %
R701	220 kΩ	Standard	-	R0603	NFC	chip resistor, 0.1 W, 5 %
R702	10 kΩ	Standard	-	R0603	NFC	chip resistor, 0.1 W, 5 %
R703	10 kΩ	Standard	-	R0603	NFC	chip resistor, 0.1 W, 5 %
R704	10 kΩ	Standard	-	R0603	NFC	chip resistor, 0.1 W, 5 %
SV101	MA05-2	Standard	-	MA05-2	Debug	header, pin, 2.54 mm, 10 way, 2 row
SW101	B3FS-1000	B3FS-1000	Omron Electronic Components	SWITCHTACT_ DTSM-6	Debug	B3FS-1000 - switch, flat, SPNO
SW102	B3FS-1000	B3FS-1000	Omron Electronic Components	SWITCHTACT_ DTSM-6	Debug	B3FS-1000 - switch, flat, SPNO
SW601	SLIDE-SPDT	SLIDE-SPDT	C&K Components	SLIDE-SPDT	ZERO	OS102011MA1QN1 - switch, SPDT, 0.1 A, 12 V, PCB, R/A
T201	NX3008NBKW	NX3008NBKW	NXP Semiconductors	SOT323	-	30 V, 350 mA N-channel Trench MOSFET
T203	NX2020N2	NX2020N2	NXP Semiconductors	SOT1220	-	30 V N-channel Trench MOSFET
T204	NX2020N2	NX2020N2	NXP Semiconductors	SOT1220	-	30 V N-channel Trench MOSFET
T301	NX3008NBKW	NX3008NBKW	NXP Semiconductors	SOT323	-	30 V, 350 mA N-channel Trench MOSFET
T302	NX2020N2	NX2020N2	NXP Semiconductors	SOT1220	-	30 V N-channel Trench MOSFET
T303	NX2020N2	NX2020N2	NXP Semiconductors	SOT1220	-	30 V N-channel Trench MOSFET
T401	NX3008NBKW	NX3008NBKW	NXP Semiconductors	SOT323	-	30 V, 350 mA N-channel Trench MOSFET

Table 3. Bill Of Materials (BOM) *…continued*

Part	Value	Part number	Manufacturer	Package	Optional	Description
T402	NX2020N2	NX2020N2	NXP Semiconductors	SOT1220	-	30 V N-channel Trench MOSFET
T403	NX2020N2	NX2020N2	NXP Semiconductors	SOT1220	-	30 V N-channel Trench MOSFET
T601	NX3008NBKW	NX3008NBKW	NXP Semiconductors	SOT323	ZERO	30 V, 350 mA N-channel Trench MOSFET
T602	NX2020P1	NX2020P1	NXP Semiconductors	SOT1220	ZERO	30 V, single P-channel Trench MOSFET
T701	NX3008CBKS	NX3008CBKS	NXP Semiconductors	SOT363	NFC	30/30 V, 350/250 mA N/P-channel Trench MOSFET
TEST101	M50-3600542	M50-3600542	Samtec	127_2R10_SMT	Debug	connector header, SMT, R/A, 1.27 mm, 10P
U101	NXQ1TXA6	NXQ1TXA6/001	NXP Semiconductors	SOT865	-	Qi-compliant charging controller
U102	TL431BFDT	TL431BFDT	NXP Semiconductors	SOT23	-	V_{REG}, 0.5 %, 2.495 V, 36 V
U201	NWP2081T	NWP2081T	NXP Semiconductors	SOT96	-	Half bridge driver IC
U202	MAX44284HAUT+	MAX44284HAUT+	Maxim Integrated	SOT457	FOD	High precision, low-power current-sense amplifier
U203	n.c.	INA214AIDCKT	Texas Instruments	SC70	n.c.	voltage output, current-shunt monitor
U301	NWP2081T	NWP2081T	NXP Semiconductors	SOT96	-	Half bridge driver IC
U401	NWP2081T	NWP2081T	NXP Semiconductors	SOT96	-	Half bridge driver IC
U601	RT8295A	RT8295A	Richtek	SOP-8	DCDC	2 A, 23 V, 340 kHz synchronous step-down converter
U602	TDA3663	TDA3663	NXP Semiconductors	SOT223	LDO	3.3 V voltage regulator
U701	NT3H1201	NT3H1201W0FHK	NXP Semiconductors	SOT902	NFC	NFC Forum type 2 Tag compliant IC with I^2C interface
UART101	MA06-1	Standard	-	MA06-1	Debug	header, pin, 2.54 mm, 6 way, 1 row

7. Critical components

As mentioned in Section 6, certain components are critical in the design. In this section, we discuss these components, associated design considerations and potential pitfalls.

7.1 Power stage

7.1.1 Capacitor in LC tank circuit

The capacitor value in the tank circuit must be correct or the system does not function properly. The Wireless Power Consortium (WPC) specify the capacitor values. To verify that the correct value is used in the base station design, refer to WPC specifications.

For a 3-coil A6 type base station design, WPC specifies a value of 147 nF to be used with charging coil closer to the charging pad. It specifies using 136 nF for a charging coil further away from the charging pad.

As an example, Figure 13 depicts the LC tank circuit of coil 1, which is the furthest from the interface surface. The capacitance of C210 and C211 is 68 nF each. Total capacitance combined is 136 nF. Beside capacitor value, the dielectric must be C0G/NP0 type, else efficiency is lower and Qi compliance can be problematic.

The voltages in the tank circuits can swing as much as 100 $V_{p\text{-}p}$ in the NXQ1TXA6 Evaluation Board. It is therefore important to choose the correct voltage rated capacitors. The capacitors C210 and C211 in Figure 13, are 100 V rated.

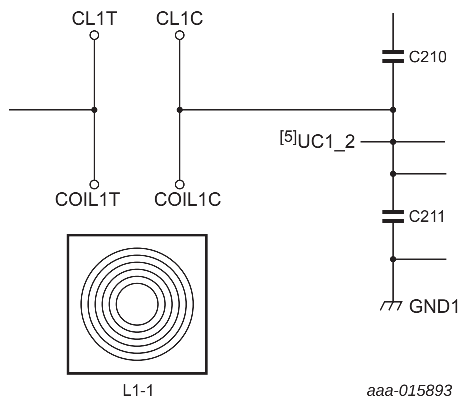


Fig 13. LC tank circuit of coil 1

7.1.2 Half-bridge driver and MOSFETs

For +12 V system such as the A6 type base station, the maximum base station operating conditions lead to MOSFET requirements of a maximum 30 V, minimum 4 A and a maximum Rds_{on} 40 mΩ. In NXQ1TXA6 Evaluation Board, an N-Channel Trench MOSFET NX2020N2 (T203 and T204) is used in combination with NWP2081 (U201) half-bridge controller IC.

If a different MOSFET other than NX2020N2 is designed in, the gate resistor must be adjusted depending on the gate capacitance of the MOSFET. The applied gate resistance and gate capacitance forms an RC time constant which influences the on/off switching times. In particular, the upper FET drive resistor R205 in Figure 14 serves to slow down the Trench MOSFET fast switching action, thus reducing noise.

The gate drive resistors themselves also serve as test points to observe the actual drive waveforms. Do not add any extra test points to the line from half-bridge driver NWP2081 to NX2020N2 MOSFET gates. It may introduce unwanted parasitic inductance or stray capacitance.

7.1.3 Capacitor snubber circuits

The option for a capacitor snubber circuits C208 and C209, in Figure 14, are included but not populated in NXQ1TXA6 Evaluation Board. They are located across the switching MOSFETs to allow tuning to reduce Electro-Magnetic (EM) emission. Capacitor snubber circuits must be placed close to the switching MOSFETs. If snubber circuits are not required, they can be removed from the Bill of Materials.

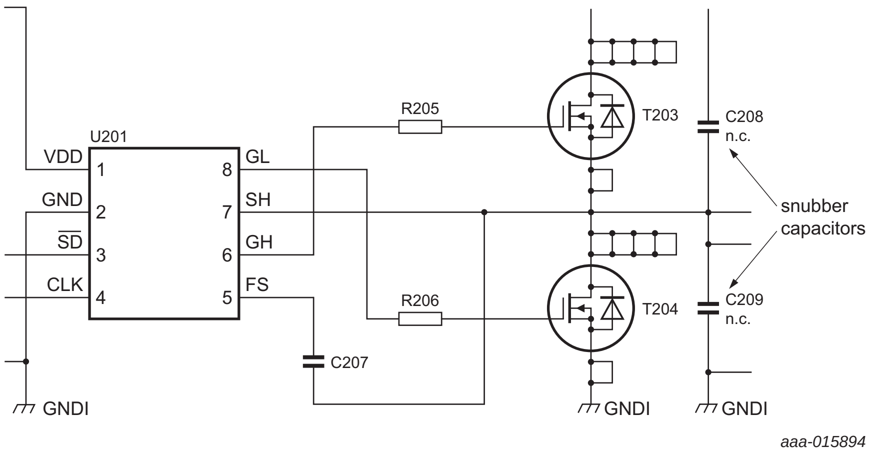


Fig 14. Half bridge driver, MOSFET and capacitor snubber circuits of coil 1

7.2 Current sense resistor

To measure the DC current into the power stage, a current measurement circuit is used. This circuit is shown in Figure 15. A current sense amplifier is used in combination with a current sense resistor in the DC supply to the half-bridge stage.

The current sense resistor R204 in Figure 15 should be 22 mΩ and the tolerance must be 1 % or better. It is used in combination with the current sense amplifier MX44284HAUT on the NXQ1TXA6 Evaluation Board.

The above combination must be followed for all NXQ1TXA6 based system. Deviation could lead to lower efficiency, higher noise and wrong detection of foreign object (FOD). Refer to Bill Of Materials in Section 6 for more information.

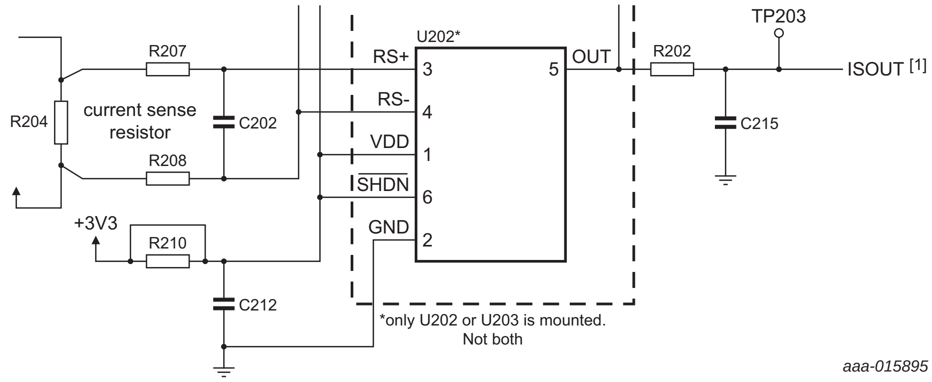


Fig 15. Current sense resistor

7.3 Amplitude-Shift Keying envelope detector

As mentioned earlier, voltage as high as 100 V_{p-p} can be present at the input of the envelope detector show in Figure 16. Use only high-voltage capable devices in the detector circuits. BAS21 diode D501, D502 and D503 diodes capable of withstanding 200 V reverse voltage are used in NXQ1TXA6 Evaluation Board. A larger 1206 SMD footprint is selected for the passive components - resistors R501, R502, R505 and capacitors C501 and C502 to withstand the higher voltage.

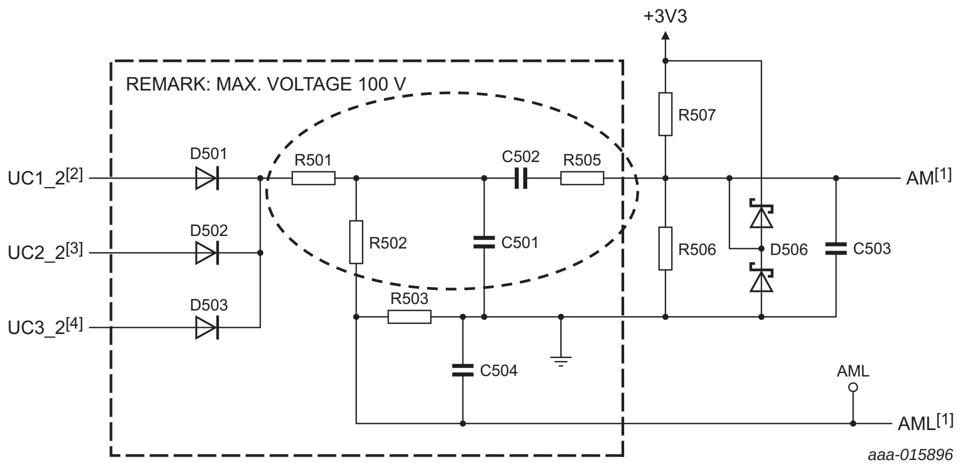


Fig 16. Amplitude Shift Keying (ASK) envelope detector

7.4 Configuration and voltage measurement circuits

The inputs OPT1 and OPT2 are used for configuring the NXQ1TXA6 controller.

Input OPT1 is used to select the user interface (LED and Buzzer) configurations. Multiple configurations for the LED blinking patterns are described in the NXQ1TXA6 data sheet.

The voltage divider on the OPT2 input, when ASEL1 is enabled, sets the FOD threshold. The ASEL2 and ASEL3 signals are used for influencing the FOD detection method. Contact NXP for details on specific design configurations.

When the ASEL1, ASEL2 and ASEL3 lines are not driven the OPT2 input expects a stable 2.495 reference voltage present at its input. The shunt regulator U102 TL431BFDT, with an accuracy of 0.5 %, is used.

The power stage DC voltage is measured in input of VSNS using R115 and R116.

Use only 1 % tolerance resistors in Configuration (OPT0 and OPT1) and Voltage Sensing (VSNS) circuits.

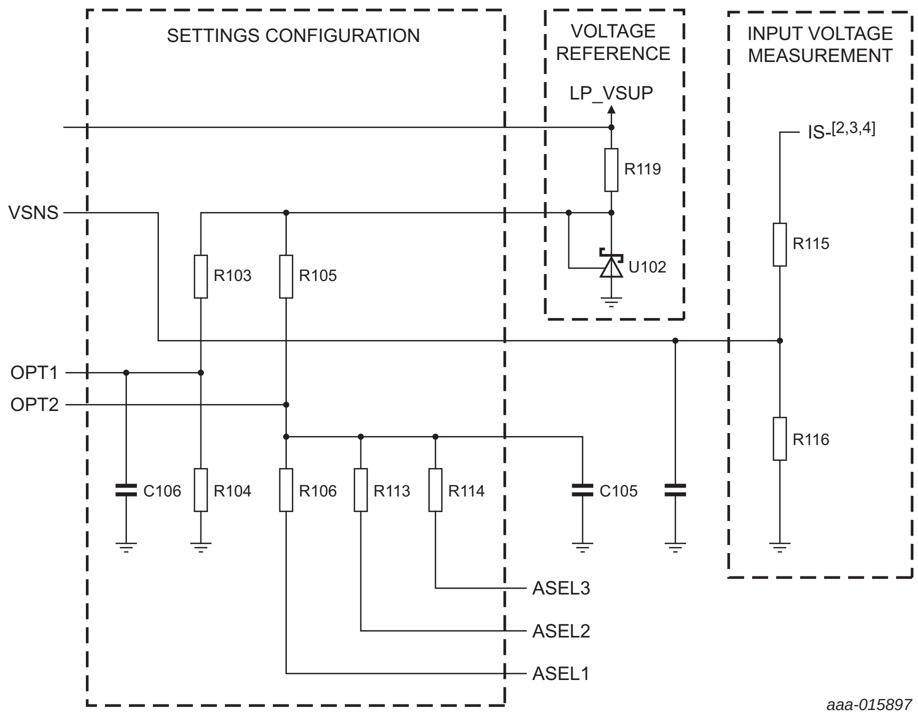


Fig 17. Configuration and voltage measurement

7.5 Thermal protection

NTC201 provides temperature sensing which allows the controller (option) to sense the temperature for safety purposes. When using a thermistor of type b57551G1103F005, the transmitter stops power transfer at temperatures of 70 °C and higher. When the temperature measured by the NTC is below 60 °C, the transmitter commences power transfer. If not used, the NTC input must be connected to VDD.

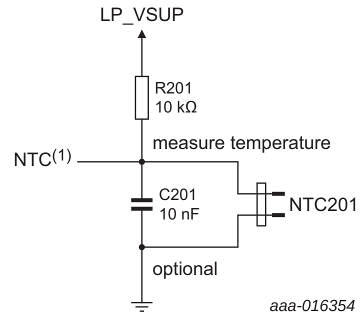


Fig 18. Temperature sensing circuit

7.6 NFC antenna tuning capacitor

Due to the variation in shapes and dimensions of different NFC antennas, it is inevitable that the NFC antenna should be tuned for a new design. Tune the resonance frequency of the intended antenna to match close to 13.56 MHz. It can be done with the parallel capacitor C704. Capacitor dielectric must be C0G/NP0 type. If the resonance frequency is too low after removing parallel capacitor C704, the 1 nF value of the series capacitors C705 and C706, can be lowered.

The internal capacitance of the NFC IC NT3H1201 (U701) is 50 pF typical (refer to NT3H1201 data sheet).

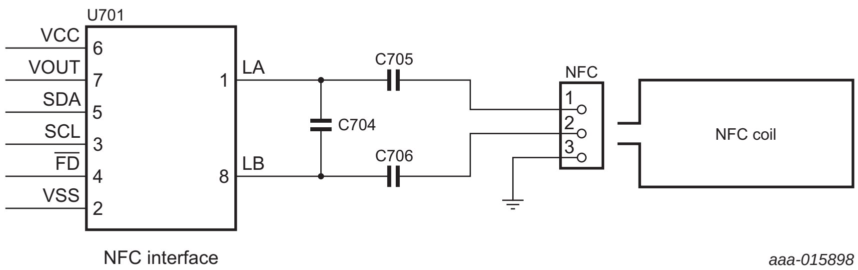


Fig 19. Tuning capacitor NFC antenna

The NFC functionality is optional and not needed for creating a wireless charging base station with NXQ1TXA6 controller.

8. PCB layout guidelines

Having a proper printed circuit board (PCB) layout is critical to the success of the application. A poor constructed PCB layout can cause the whole application not to function properly. Beyond basic circuit operation, it can also directly influence the ElectroMagnetic Compatibility (EMC) profile. Therefore, it is imperative that care should be exercised during the PCB layout stage.

Several good PCB design tips are explained here.

8.1 Ground planes

Design with a 4-layer PCB. The layer stack-up applied in NXQ1TXA6 Evaluation Board is as follows:

1. Layer 1: Component placement and signal trace
2. Layer 2: Clean uninterrupted ground
3. Layer 3: Signal trace
4. Layer 4: Ground and minimal routing trace if required

Notice that with this stacking technique, the signal traces are sandwiched between grounds. It provides a solid ground reference plane and helps to minimize ElectroMagnetic Interference (EMI) noise emissions.

As a rule, use ground planes: use copper-pour in unused areas of the PCB and stitch these areas with vias to inner ground planes.

8.2 NXQ1TXA6 charging controller

The center pad (pin 33) under NXQ1TXA6 charging controller is a ground pin. It is important to stitch with vias to inner ground planes to provide a solid ground reference. Make sure the decoupling capacitors C101and C102 on VDD1 supply pin 6 and VDD2 pin 26, are close by and connected with a wide trace. It ensures effective decoupling action to ground.

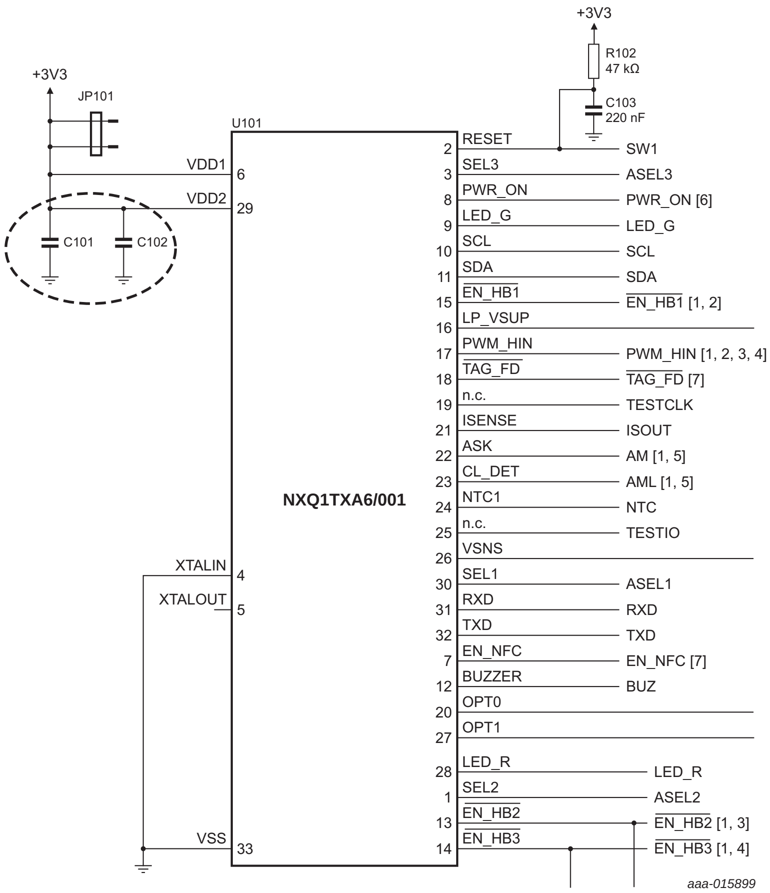


Fig 20. NXQ1TXA6 charging controller supply decoupling capacitors

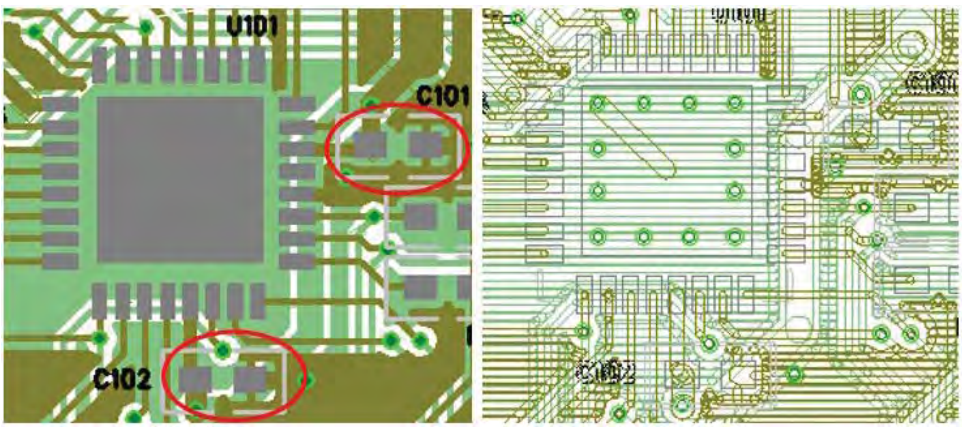


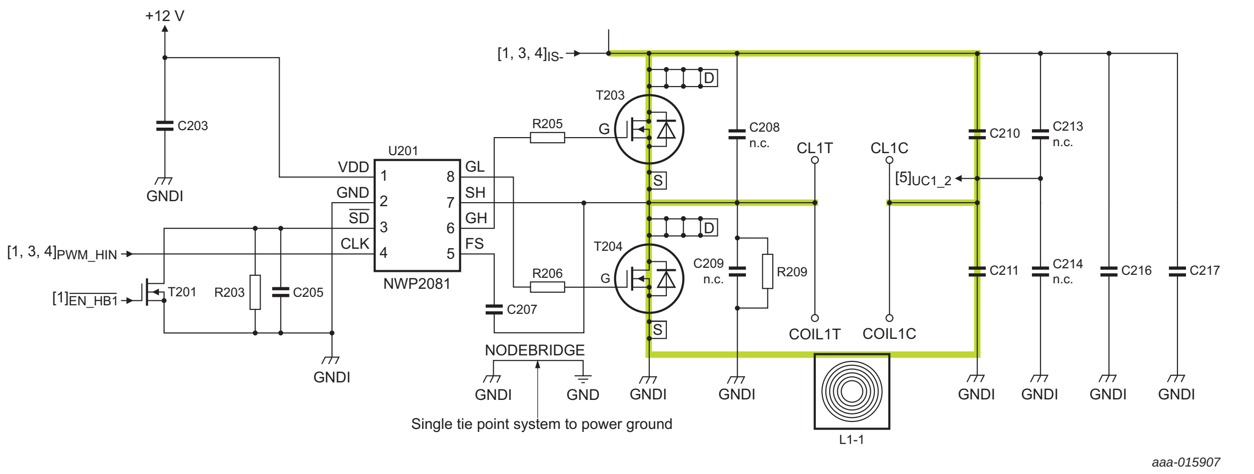
Fig 21. Decoupling capacitors (left) & GND stitching vias underneath NXQ1TXA6 (right)

8.3 Power stage

Separate ground planes are used for the system ground (GND) and the power stage ground (GNDI). It avoids crosstalk on sensitive signals which could otherwise result in erratic system behavior.

It is important to tie the two ground planes together at only ONE point. Having several tie points makes the purpose of separating the grounds useless. Do not have any other non-related signals in the area of the power ground plane.

Keep the current loops, shown in green in Figure 22, compact to minimize radiation. Place the decoupling capacitor (C203), at the VDD supply pin of the NWP2081 (U201), close to the IC.



Single the point system - power grounds

Fig 22. Half bridge driver stage of coil 1

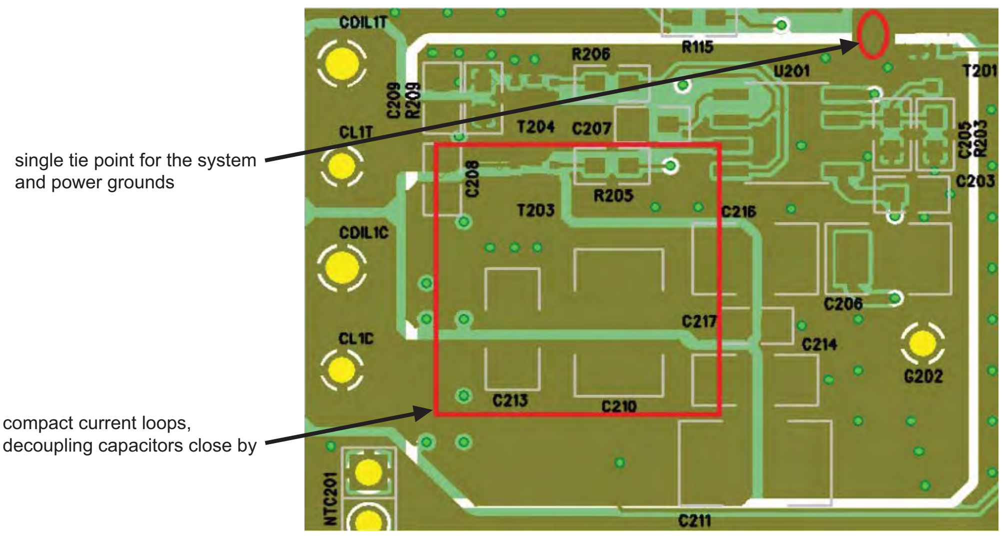


Fig 23. PCB layout of half-bridge driver of coil 1 in NXQ1TXA6 evaluation board

8.4 DC-to-DC converter

The same layout techniques implemented in the power stage can be applied to the DC-to-DC converter as shown in Figure 24 and Figure 25. Keep the current loop through L602 and C609 compact and make sure the decoupling capacitors, inductor and feedback components are close. Use X7R capacitors of good quality for C605 and C609.

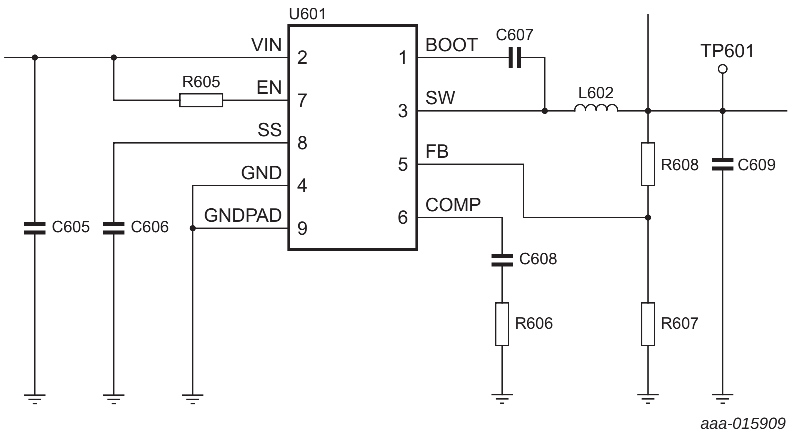


Fig 24. DC-to-DC converter

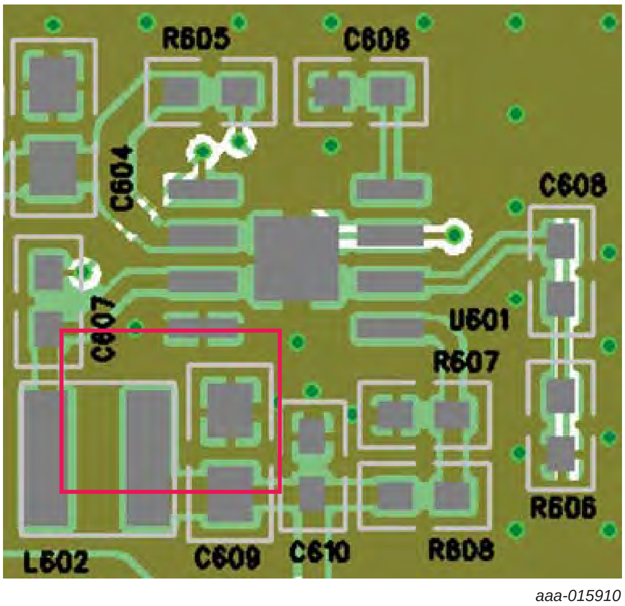


Fig 25. PCB layout of DC-to-DC converter in NXQ1TXA6 evaluation board

8.5 Current sensing layout technique

When dealing with very low voltages generated across a current sense resistor, use the “Four-wire” or “Kelvin-connection” technique. It is important to avoid introducing false voltage drops from adjacent pads and other copper routes.

In the screenshot of NXP NXQ1TXA6 Evaluation Board schematics (see Figure 26), the current sense resistor R204 and input current is flowing from right to left.

Notice in Figure 27 how the R207 and R208 resistors are connected to the pad of R204 to eliminate measurement error. Copper conduction losses and copper resistance temperature dependency are the cause of these errors. It is referred to as the “Four-wire” or “Kelvin-connection” technique.

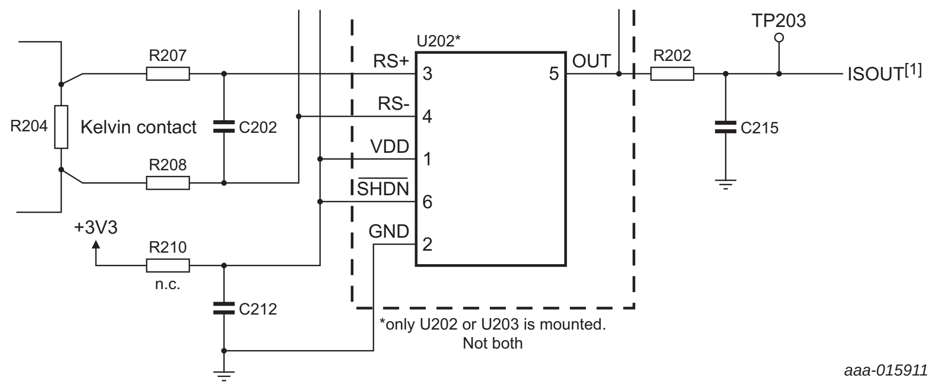


Fig 26. Current sensing

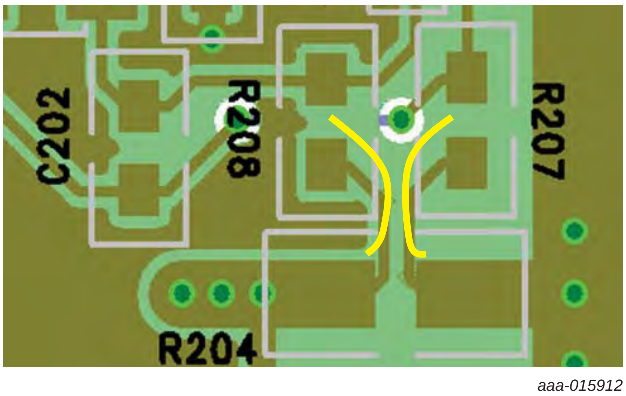


Fig 27. PCB layout of current sense resistor in NXQ1TXA6 evaluation board

Proper and accurate current sensing technique is critical to the correct performance of the Foreign Object Detection (FOD). The sense resistor R204 should have an accuracy of 1 % or better tolerance and have a temperature stability of at least 200 PPM.

8.6 EMC common mode filter

The common mode filter L601 in Figure 28 functions to prevent high frequency disturbance signals from traveling back to the DC input power connector J601. No ground planes or other traces underneath the input power, otherwise it defeats the purpose of having a common mode filter in the first place.

As seen in Figure 29, sufficient gap is created between the input power and the closest copper area to prevent coupling of high frequency noise. It also shows that no copper fill or traces in the inner layers underneath component L601 should be used.

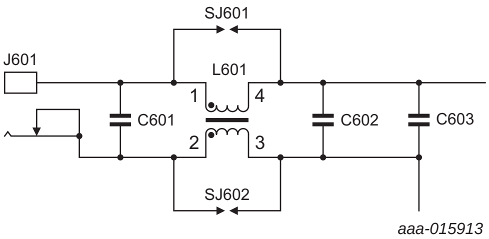


Fig 28. EMC common mode choke L601

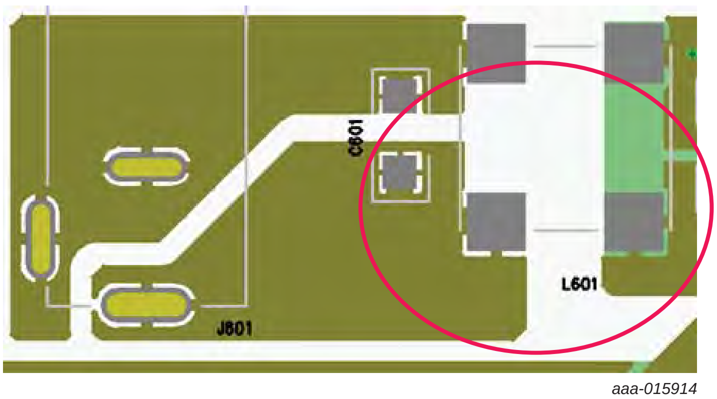


Fig 29. PCB layout of common mode choke L601 in NXQ1TXA6 evaluation board

8.7 Summary

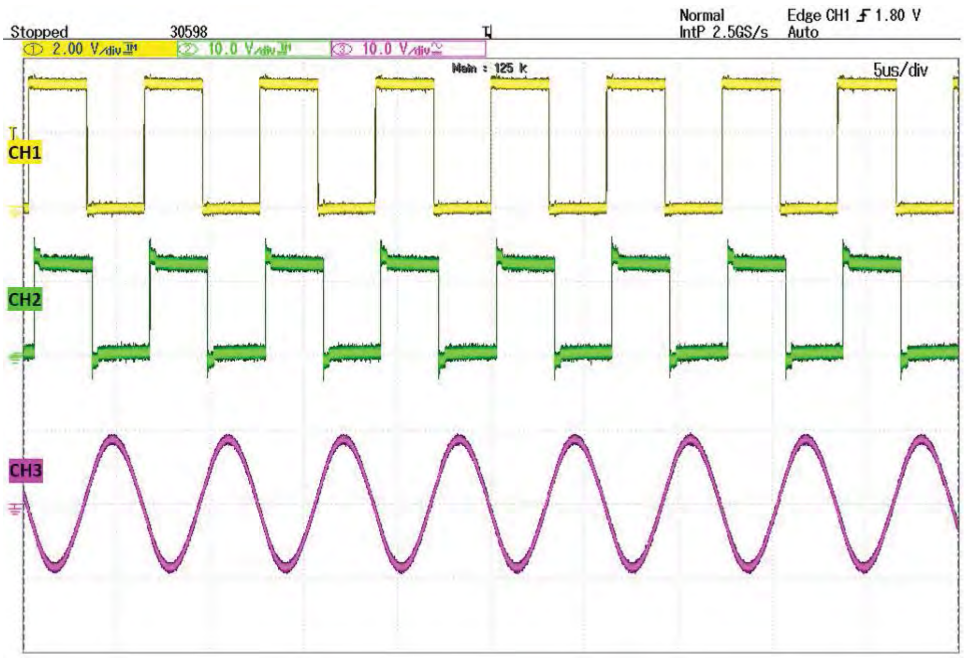
To recap the key notes for a successful design:

1. Use 4-layer PCB
   - Layer 1 Component placement and signal trace
   - Layer 2 Clean uninterrupted ground
   - Layer 3 Signal trace
   - Layer 4 Ground and minimal routing trace if required
2. Separate system ground plane from power ground plane and tie them at only one point
3. Use only components with correct characteristics and ratings
4. Tight current loops in the half-bridge drive stage and DC-to-DC converter
5. Keep decoupling capacitors close by
6. Tune component for performance. Minimal effort if NXQ1TXA6 Evaluation Board is followed closely
7. Test points for key signal nodes

9. Waveforms

This chapter shows several examples of typical waveform as can be observed on the test points in the design. For trace in the figures, the names of the corresponding schematic signal names are mentioned.

9.1 Power stage



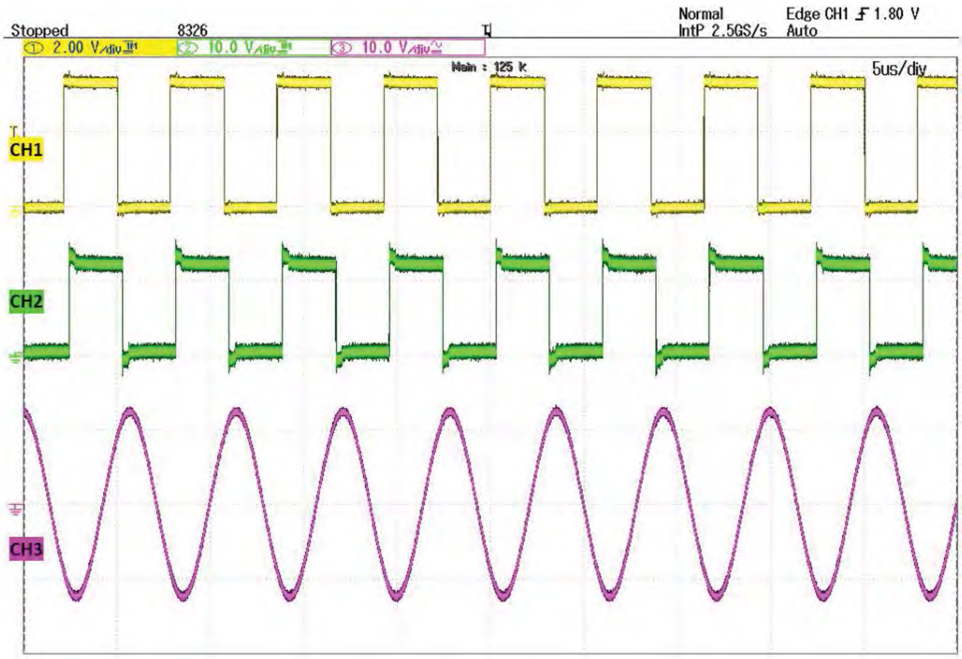
CH1: PWM_HIN - PWM input to half-bridge

CH2: COIL2T - Driver stage, connection of MOSFETs to LC tank

CH3: COIL 2C - Connection of charging coil to resonant capacitor

Fig 30. Power stage 1.25 W load

Figure 30 shows the power stage behavior under a load condition of 1.25 W. Depending on receiver characteristics, the waveform on the connection between charging coil and capacitor can have different shape.



CH1: PWM_HIN - PWM input to half-bridge

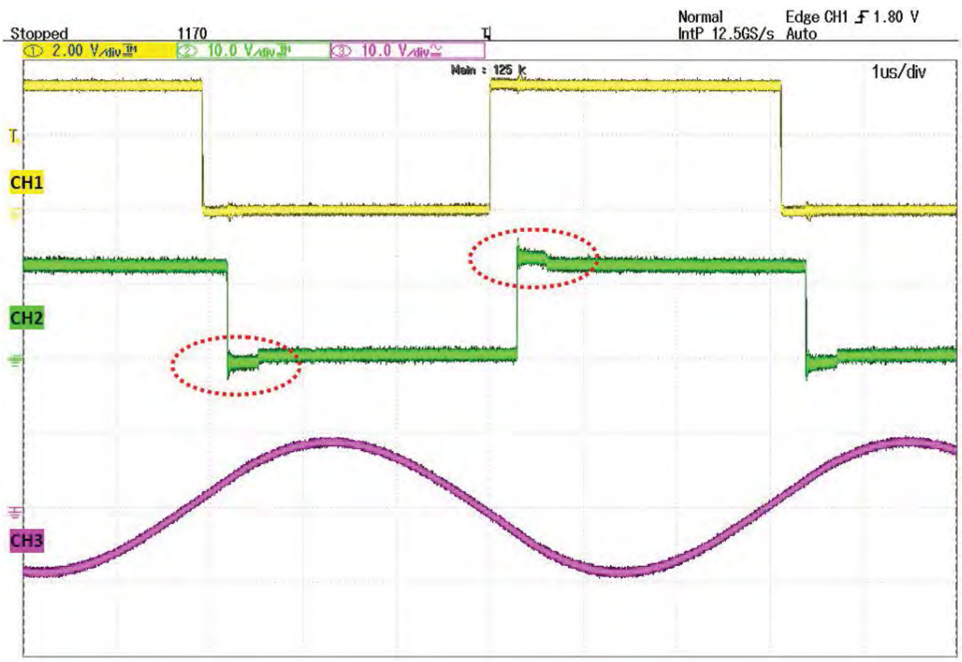
CH2: COIL2T - Driver stage, connection of MOSFETs to LC tank

CH3: COIL2C - Connection of charging coil to resonant capacitor

Fig 31. Power stage 5 W load

Figure 31 shows the power stage behavior under a load of 5 W. Notice that the frequency is lower for the 5 W power transfer compare to the 1.25 W power transfer in Figure 30.

Depending on receiver characteristics, the waveform on the connection between charging coil and capacitor might have different shape.



aaa-015917

CH1: PWM_HIN - PWM input to half-bridge

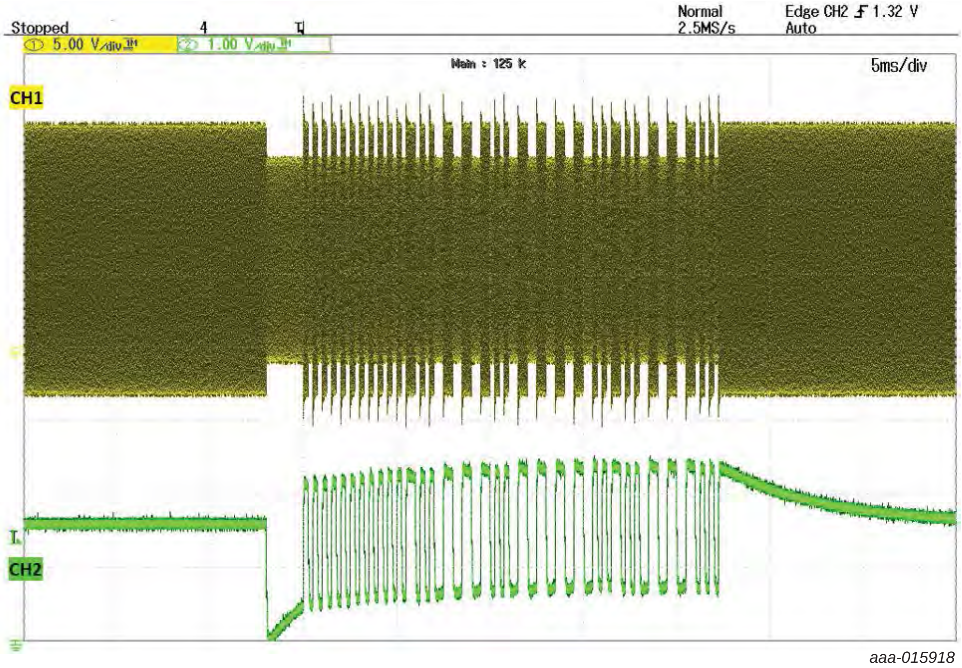
CH2: COIL2T - Driver stage, connection of MOSFETs to LC tank

CH3: COIL2C - Connection of charging coil to resonant capacitor

Fig 32. Power stage, fixed dead-time of 330 ns (load = 1.25 W)

In Figure 32, the dead time behavior of the half-bridge driver is visible in the waveform measured at the output of the driver stage.

9.2 ASK waveforms



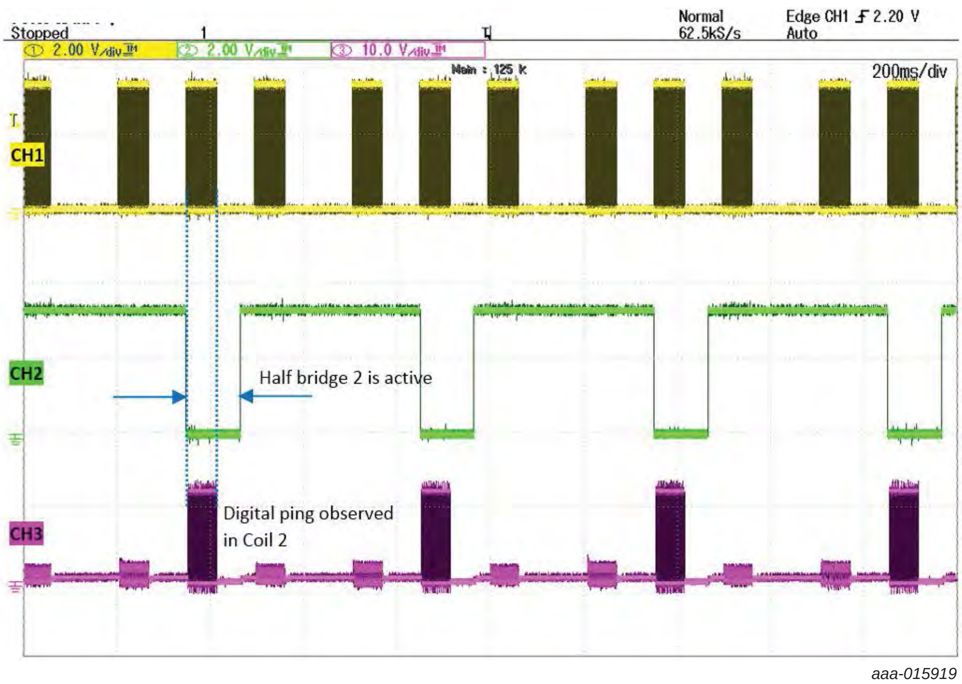
CH1: Coil2C - Connection of charging coil to resonant capacitor

CH2: AM - Output of envelope detector

Fig 33. Typical ASK waveform

Figure 33 shows the ASK waveform visible on the charging coil voltage at spot Coil2C and the resulting output AM of the envelope detector.

9.3 Digital ping



CH1: PWM_HIN - PWM input to the half-bridge

CH2: EN_HB2 - Driver stage enable

CH3: Coil2T - Driver stage, connection of MOSFETs to LC tank

Fig 34. Repeated digital ping

Figure 34 shows that a digital ping is performed on each coil at interval of 500 ms to detect the presence of a Qi receiver device. The waveforms show the digital ping when no receiver is present.

9.4 NFC tap to power on

CH1: +12 V - Switched 12 V supply

CH2: TAG_VOUT - Power harvesting output from NFC NTAG IC

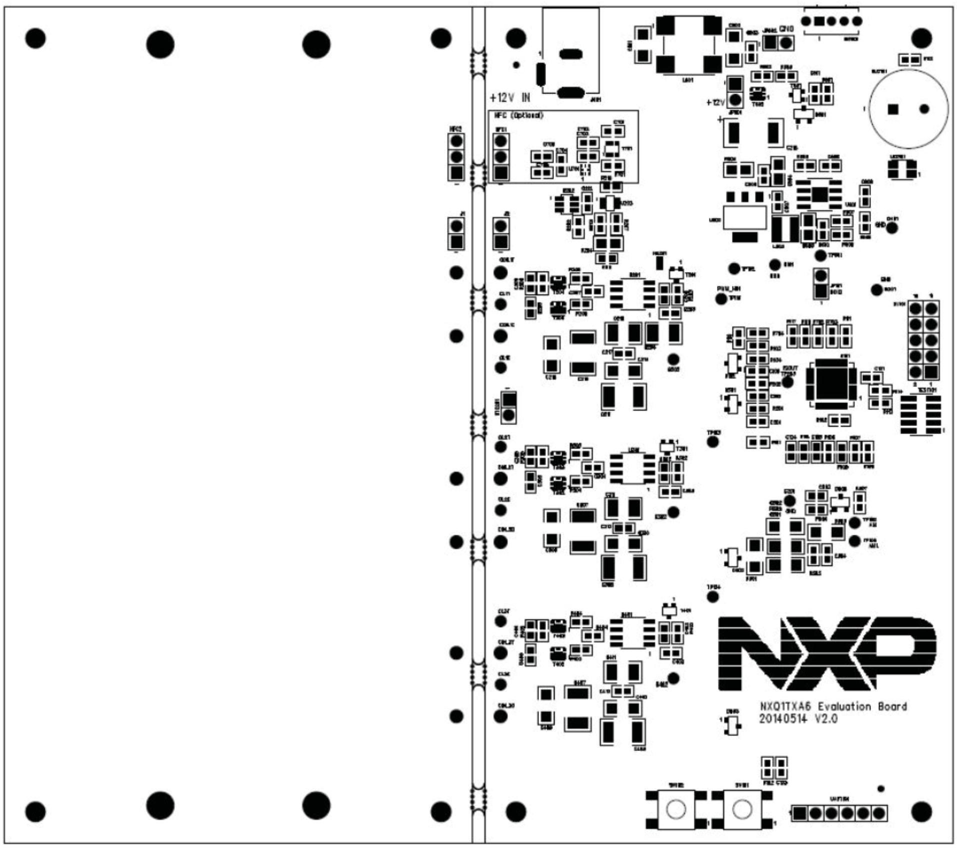
CH3: PWR_ON - PWR_ON take over signal to maintain power

CH4: +3V3 - Charging controller power supply

Fig 35. NFC tap to power on

In NFC tap to power on mode, the charger is completed powered down when not charging resulting in zero standby current. It can be seen with the CH 1 being 0 Volta in Figure 35. When an NFC field is applied to the charging pad by an NFC enabled phone, the NFC TAG chip TAG_VOUT, seen in CH 2, switches on the +12 V supply. After the DC-to-DC converter has created a 3V3 supply and the NXQ1TXA6 charging controller has started, the charging controller keeps the power switch active by enabling the PWR_ON signal as observed in CH4.

10. PCB layout



aaa-015921

Fig 36. PCB component placement

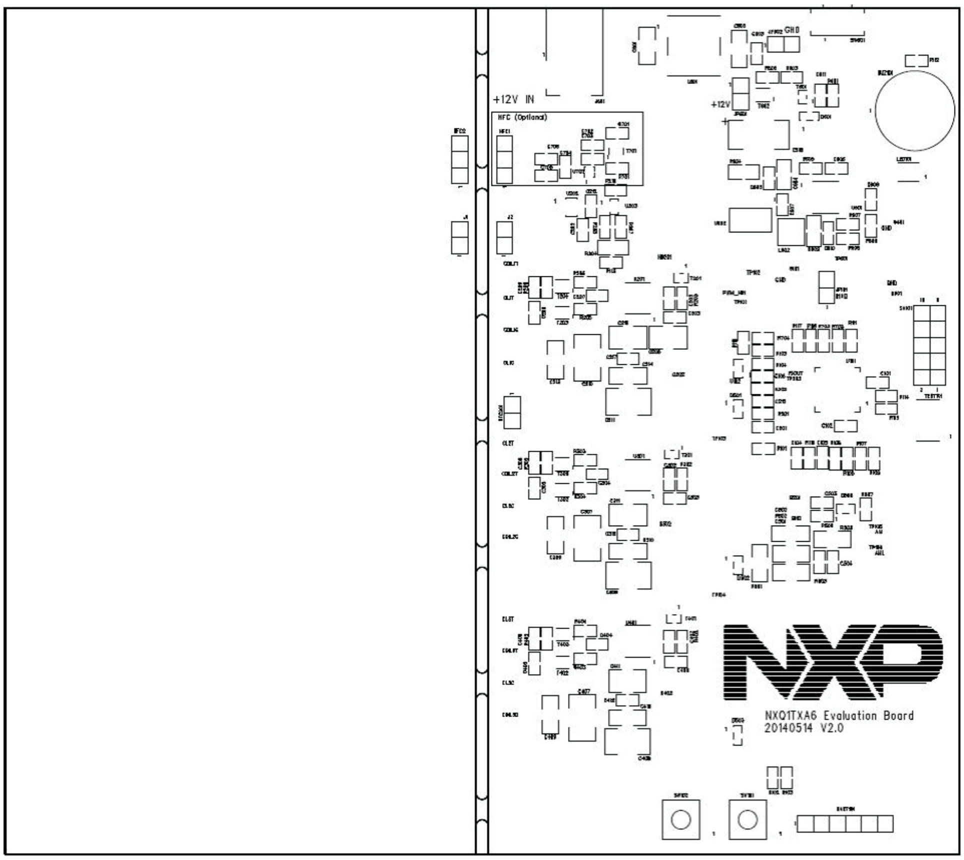
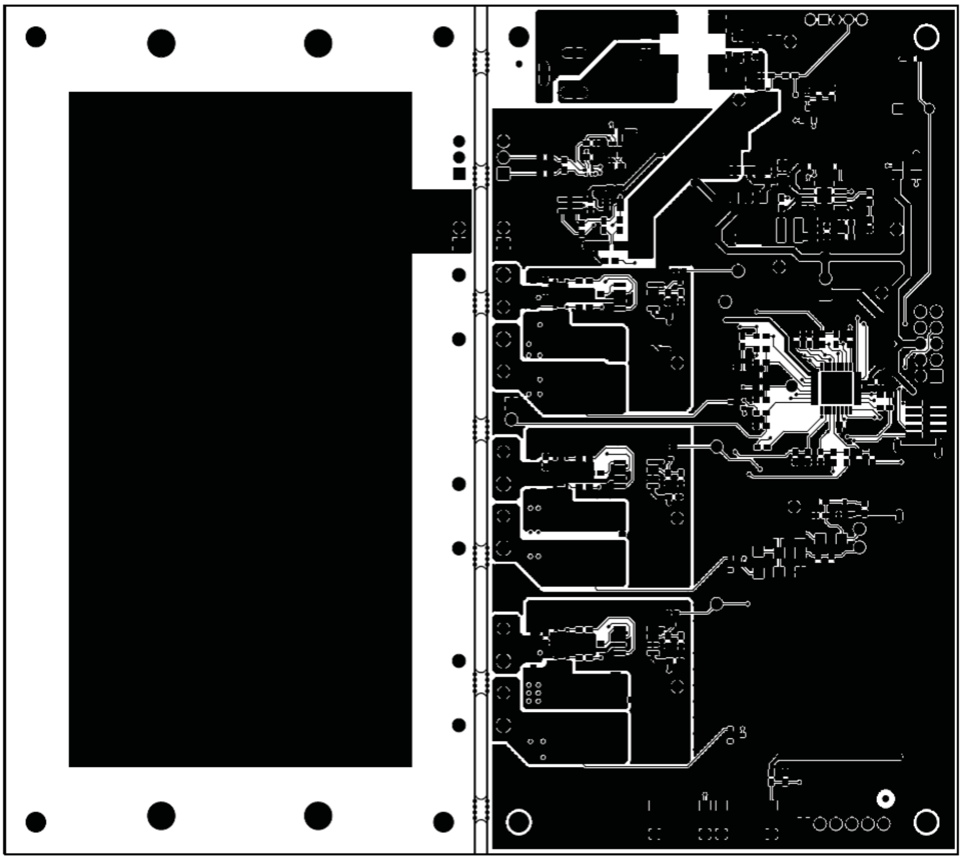


Fig 37. PCB top silkscreen



aaa-015923

Fig 38. PCB top layer

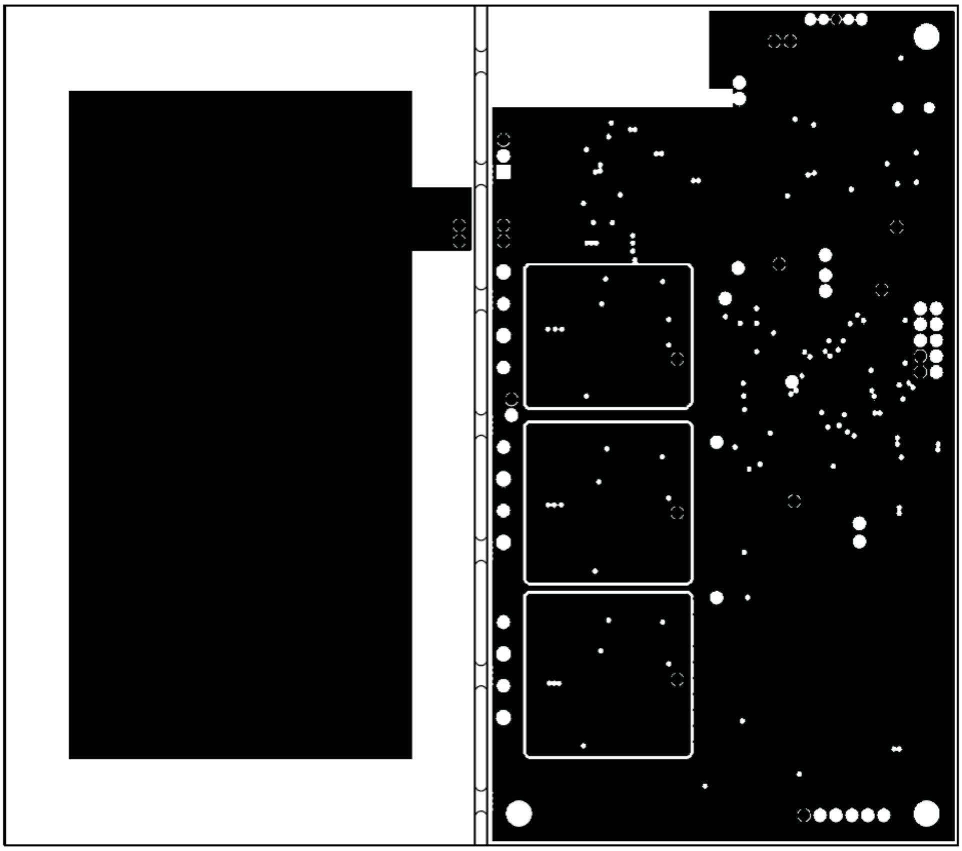


Fig 39. PCB layer 2

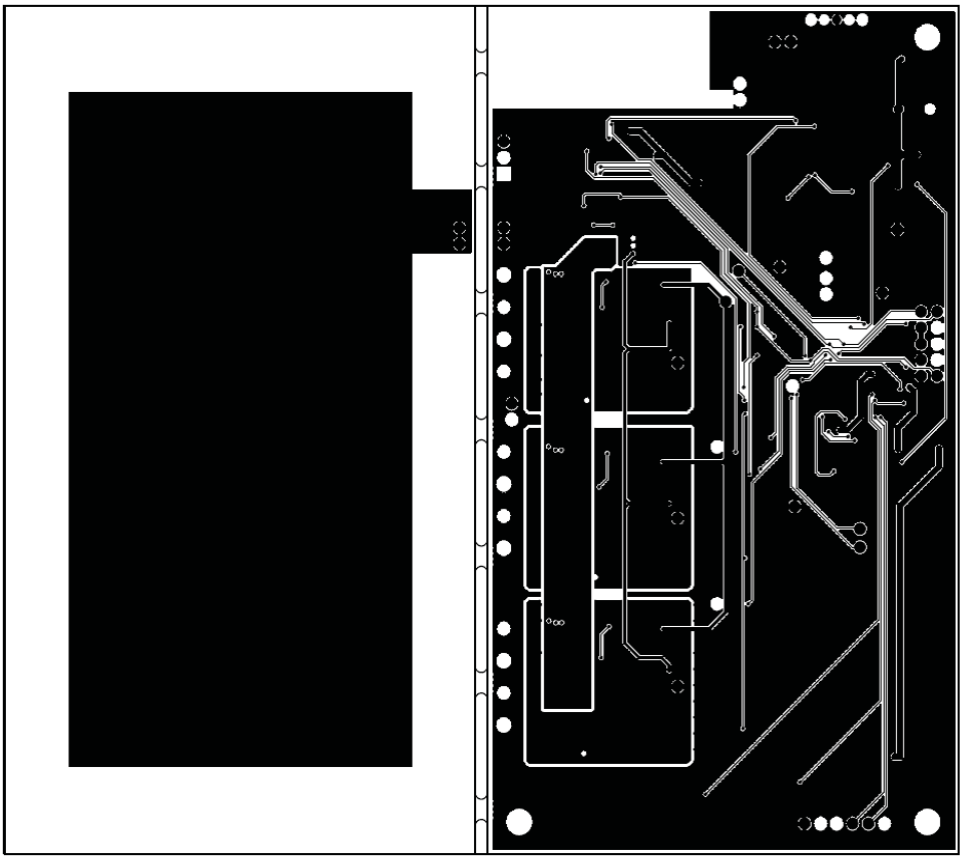


Fig 40. PCB layer 3

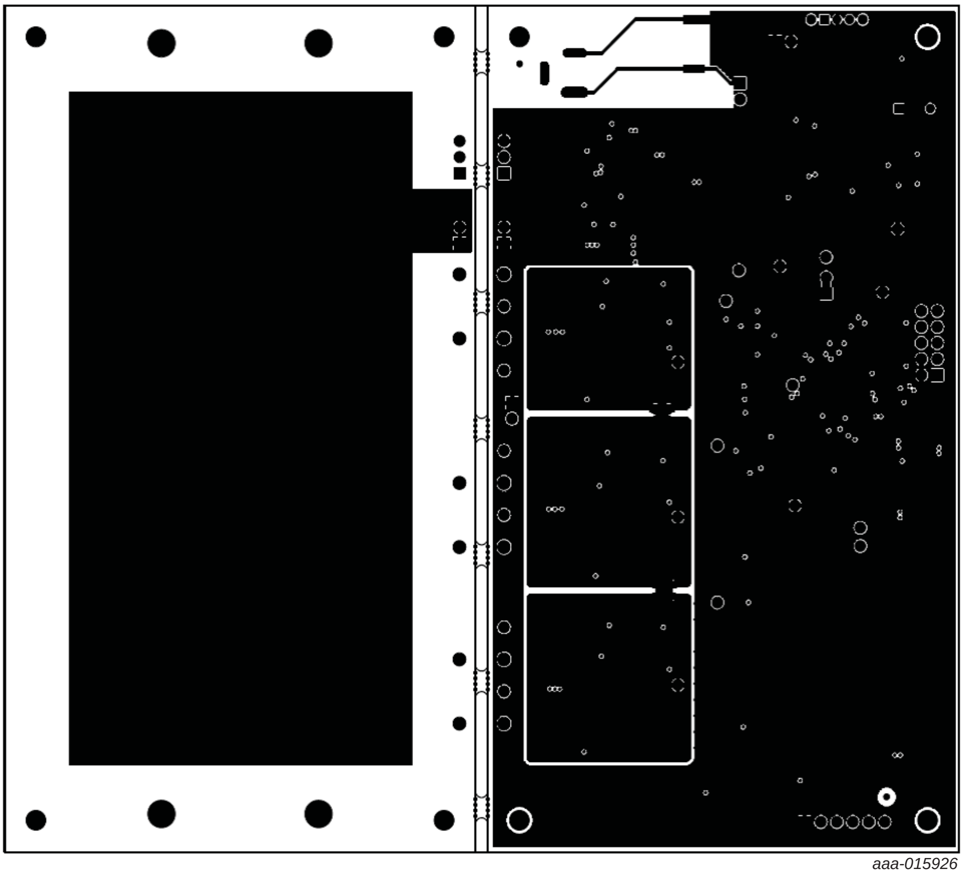


Fig 41. PCB bottom layer

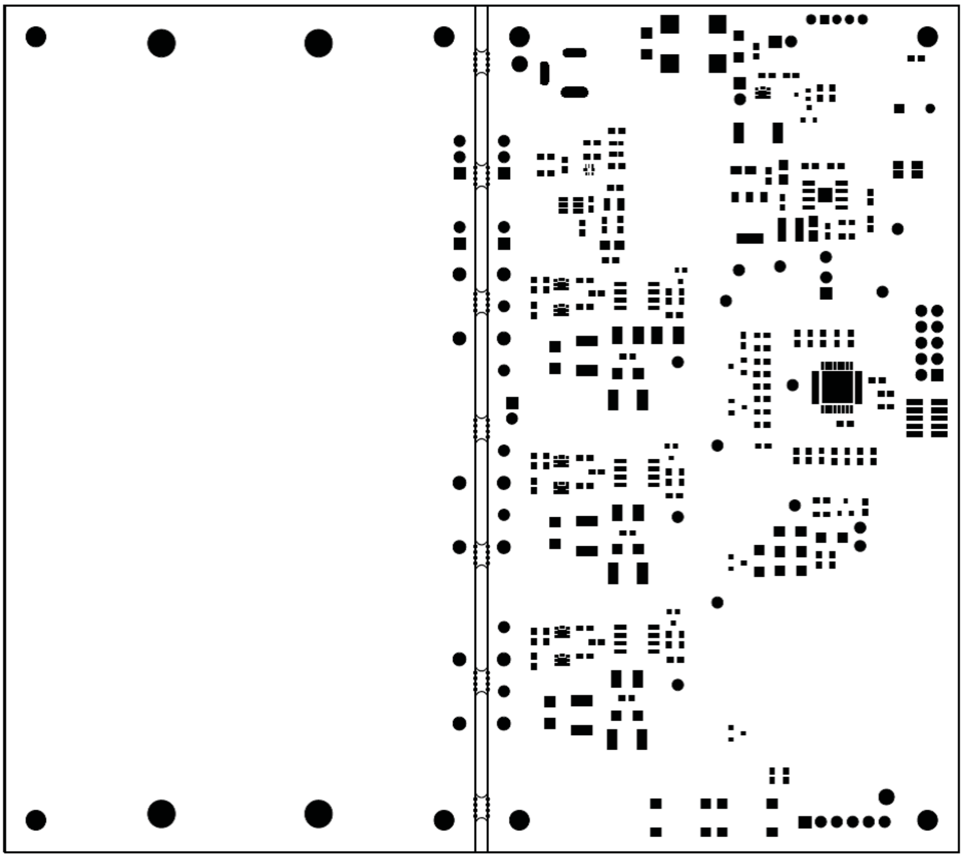


Fig 42. PCB solder mask

11. Conclusion

This document shows how to create a Qi A6 type wireless power base station with NXP NXQ1TXA6 charging controller and NWP2081 half-bridge driver. It is optimized in terms of cost, functional performance and EMI.

It also demonstrates how to achieve zero power in standby mode base station using NFC technology.

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13. Tables

14. Figures

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