

AN11578

Energy Harvesting with the NTAG I²C and NTAG I²C *plus*

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Application note
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Document information

Info	Content
Keywords	NTAG I ² C, NTAG I ² C <i>plus</i> , Energy Harvesting
Abstract	Show influencing factors and optimization for energy harvesting of the NTAG I ² C and NTAG I ² C <i>plus</i>



Revision history

Rev	Date	Description
1.0	20160201	Initial version

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1. Introduction

This application note is valid for both, NTAG I²C and NTAG I²C *plus*. To reduce complexity, in this document NTAG I²C is used to address both connected tags.

The NTAG I²C provides the capability to harvest energy from the RF field. This feature can be used to supply external circuits like microcontrollers with enough energy to operate.

This documents focuses on showing how much energy the NTAG I²C can delivery under which conditions and show the influencing factors for energy harvesting

1.1 Influencing Factors on Energy Harvesting

The factors which influence the power the NTAG I²C is able to harvest are mainly the following:

- **Antenna Size**
Larger antennas usually provide more energy to the tag. To show a typical energy harvesting case, Class 5 antenna was chosen in this application note. With larger antennas it is possible to get more power out of the field.
- **Antenna Turn Count**
An antenna with less turns but with added capacitance to provide the same resonance frequency changes the interaction of the tag with the reader and provides usually more energy.
- **Field Strength**
More field gives more energy
- **Reader detuning**
especially with highly coupled reader systems (reader and tag antenna size the same, small or zero distance) the reader can be detuned from the tag

In general, under load the V_{out} voltage will drop. If too much current is taken out of the NTAG I²C the IC will not be able to communicate over RF. For stable I²C communication the V_{CC} should not drop below recommended minimum V_{CC} (see Electrical characteristics in [1]).

2. Recommendations

To optimize energy harvesting systems, these points should be considered:

- Minimize the current needed to be harvested. Any energy supplied via energy harvesting needs to be supplied by the reader and thus reduces the read range of the tag
- On MCU systems it is advisable to clock down the MCU and also use the deep sleep modes to minimize the current consumption
- The capacity connected to the energy harvesting pin should only be as large as needed by the external system – as larger the capacity is, as harder it is for the reader to wake up and supply the NTAG I²C

3. Example Energy Harvesting Data

For measuring the data a standard ISO-Setup according to ISO/IEC 10373-6 was used as field source. For measuring the energy harvesting current a Class 5 antenna was used and the small ISO tower (Test PCD assembly 2) was used.

The ISO-setup which is built according to ISO/IEC 10373-6 can be used to provide reliable test conditions and field strengths. With this setup exact field strengths can be produced.

3.1 Influence of Field strength variation

The influence of the field strength on the harvested energy is shown in the figure below. A 220 nF cap was used between GND and V_{out}, V_{out} and V_{CC} is connected. Class 5 antenna was used for this measurements. The graphs shows the minimum voltage measured on V_{out} during modulation. A current source is used as load to sink constant current.

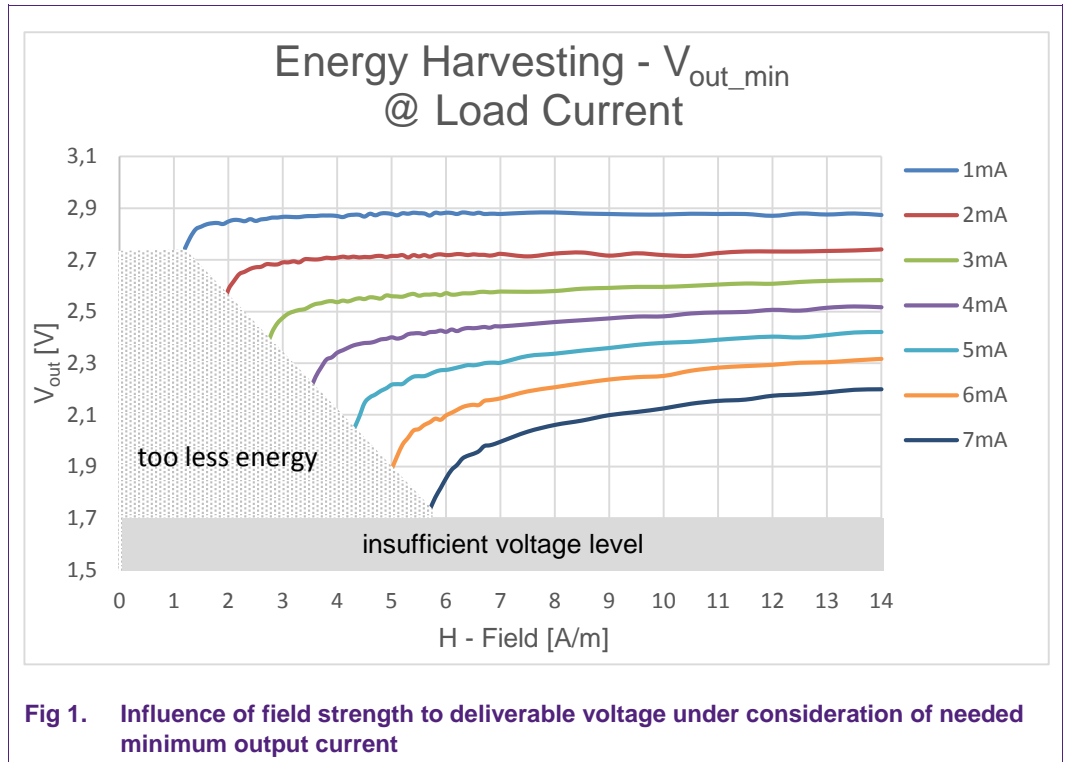


Fig 1. Influence of field strength to deliverable voltage under consideration of needed minimum output current

For a given current load, minimum field strength required for stable operation with least voltage drop on V_{OUT} during RF communication is shown in the below given table:

Table 1. H_{min} and $V_{out\ min}$ on V_{out} for given load current

Current Load [mA]	H_{min} [A/m]	V_{out_min} [V]
1	1.2	2.7
2	1.9	2.5
3	2.7	2.4
4	3.5	2.2
5	4.3	2.0
6	5	1.9
7	5.7	1.7

4. References

- [1] NT3H2111/NT3H2211, NTAG I²C *plus*, NFC Forum Type 2 Tag compliant IC with I²C interface

http://www.nxp.com/documents/data_sheet/NT3H2111_2211.pdf

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