

AN 1902

OmniDir 4015 Reference Design for G2iL / G2iL+ (OmniDir4015-iL)

Rev. 1.0 — 16 April 2010

Application note

Document information

Info	Content
Keywords	UCODE EPC G2, G2iL, G2iL+, Reference Design, Antenna Design, EU frequency band, Aluminum, OmniDir4015
Abstract	This application note is a reference antenna design description for the UCODE G2iL / G2iL+ IC.



Revision history

Rev	Date	Description
1.0	16.04.2010	First initial release; Author: BR

Contact information

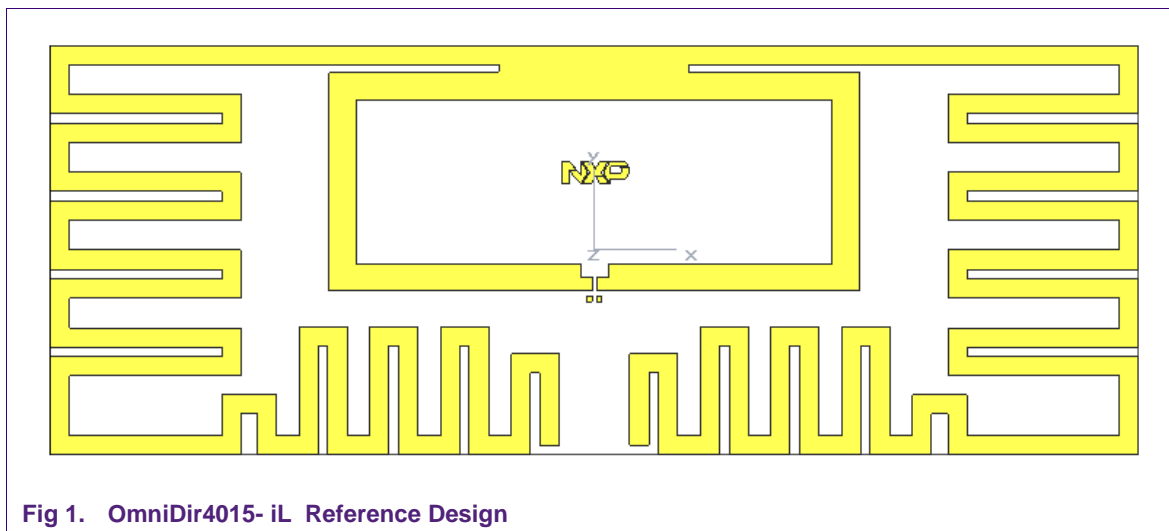
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1. OmniDir4015 Reference Antenna Design

1.1 Geometry

- Dimensions of the design: 40 mm x 15 mm;
- Antenna material: aluminium; thickness 10 µm;
- Substrate material: PET; thickness 50µm;
- Antenna should be matched to following assembled IC impedance:
($Z_{\text{ass. IC}} = 17.3 - j 171.4 \text{ Ohm @ } 915 \text{ MHz @ } P_{\text{IC}} = P_{\text{IC min}} + 0.5\text{dB}$);
 $C_{\text{serial}} = 1.02 \text{ pF}$;



1.2 Label Conversion

This antenna was optimized for fashion applications, assuming following scenario:

- Label is converted into a paper tag
- Paper thickness: 0.2 mm – 0.25 mm, inlay covered from both sides
- Optimum performance in EU frequency band (868 MHz)

All measurements and simulation results are based on the converted paper label.

2. CST Simulation Results

The following simulations are solved using CST with Transient Solver, a commercial 3-D solver for electromagnetic structures used for antenna design and the design of complex RF electronic circuit elements.

2.1 Antenna Impedance

One of the key characteristics of the label antenna is its complex input impedance as a function of frequency. Below curve (**Fig.2**) shows the inductive part of the antenna impedance. The complex matching point ($j\ 171\ \Omega$) is at the frequency of 890 MHz. Another matching point is at 1.07 GHz.

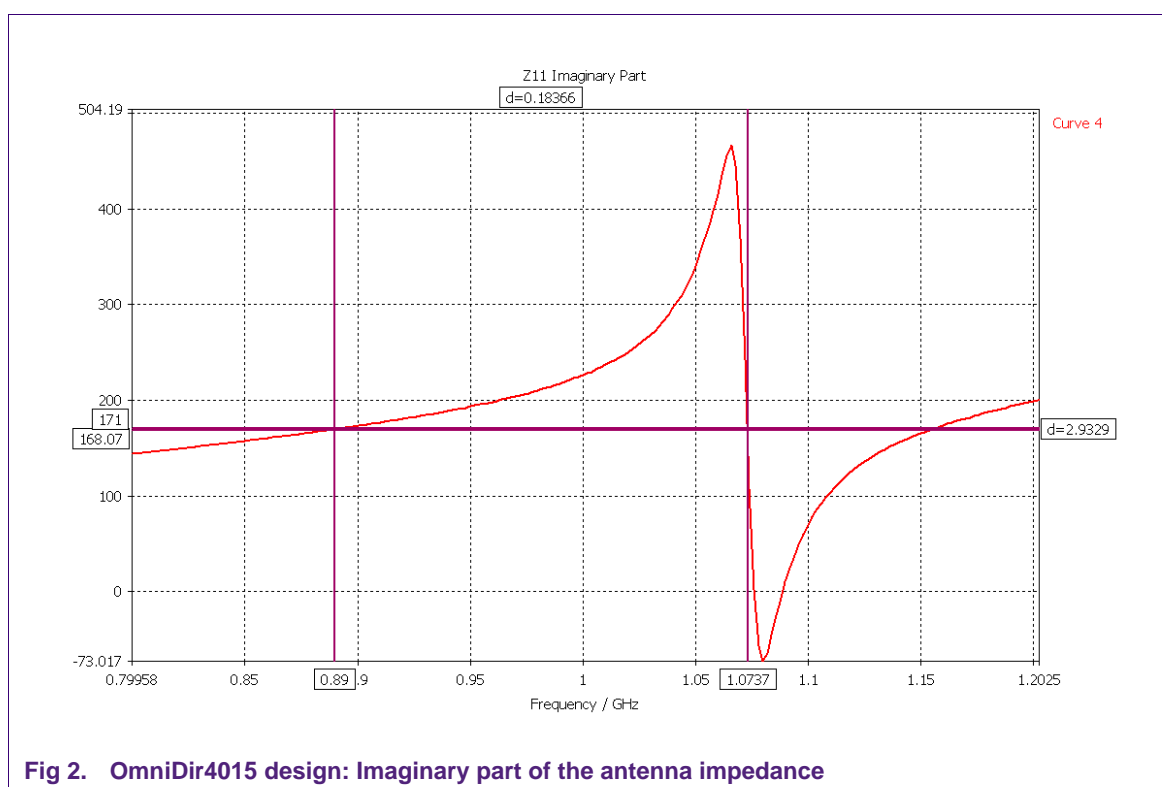


Fig 2. OmniDir4015 design: Imaginary part of the antenna impedance

2.2 Return Loss

The return loss expresses the mismatch between the antenna impedance and the assembled IC impedance over frequency, and is calculated by following formula (Equation 1):

$$\Gamma = \frac{Z_A - Z_{IC}^*}{Z_A + Z_{IC}} \quad (1)$$

The corresponded curve is shown in **Fig 3**. The curve is based on the assumption that the IC impedance remains constant.

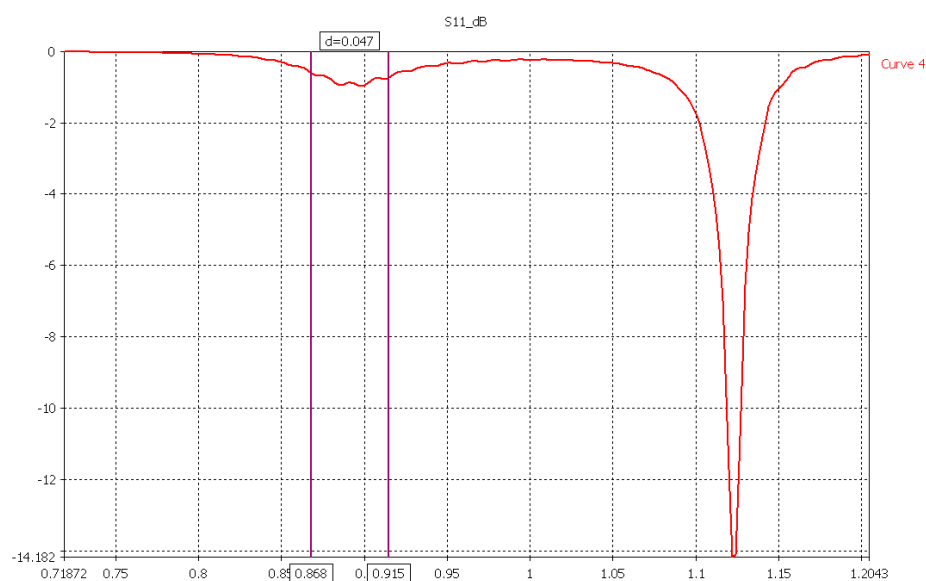


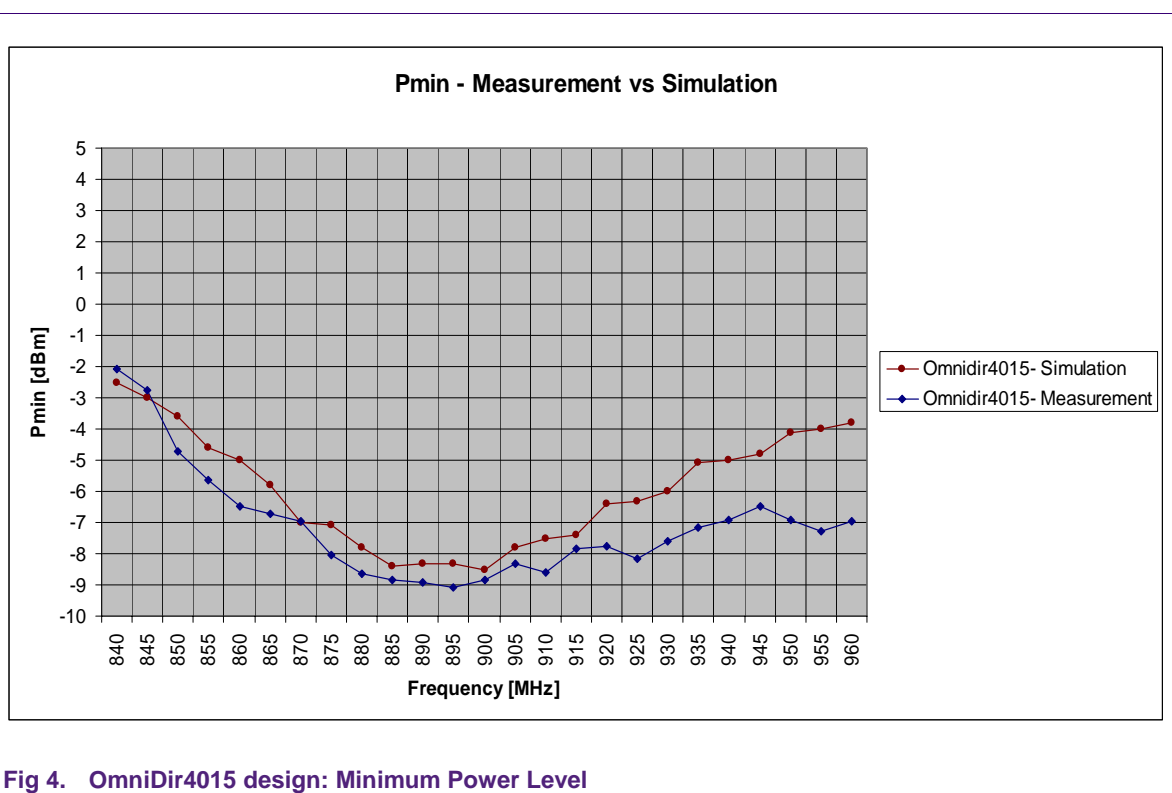
Fig 3. OmniDir4015 design: Return Loss

2.3 Minimum Power

The minimum power level at the label, which is necessary in order to communicate with a reader, is a key parameter of a label. It is directly related to the read range. Below figure shows the simulated minimum power level and the measured minimum power level of the OmniDir4015 inlay, converted into a paper tag.

Interpretation: The resonance frequency of both curves is equal. Differences can have several reasons:

- Measurements are based on hand made samples
- Measured label is covered with 0.2 mm on each side, simulation was done with 0.25 mm paper on each side.



2.4 Antenna Gain

The label radiation properties are shown in Fig 5 and Fig 6. The maximal Gain is -1.6 dBi.

The main target of this design was to get read performance from all orientations

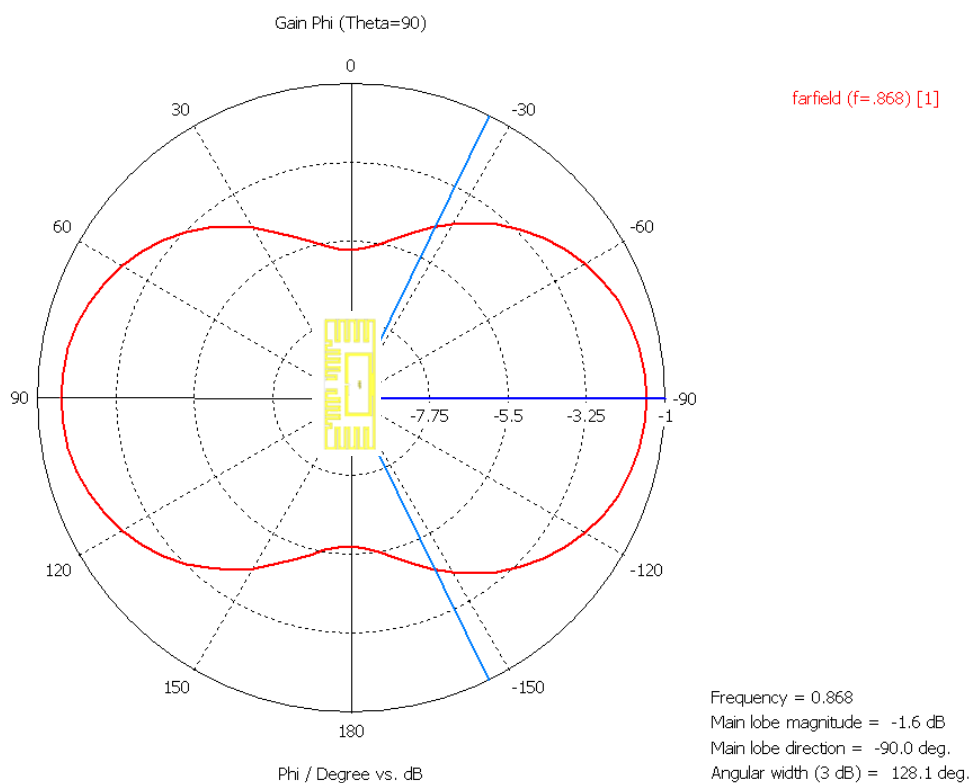
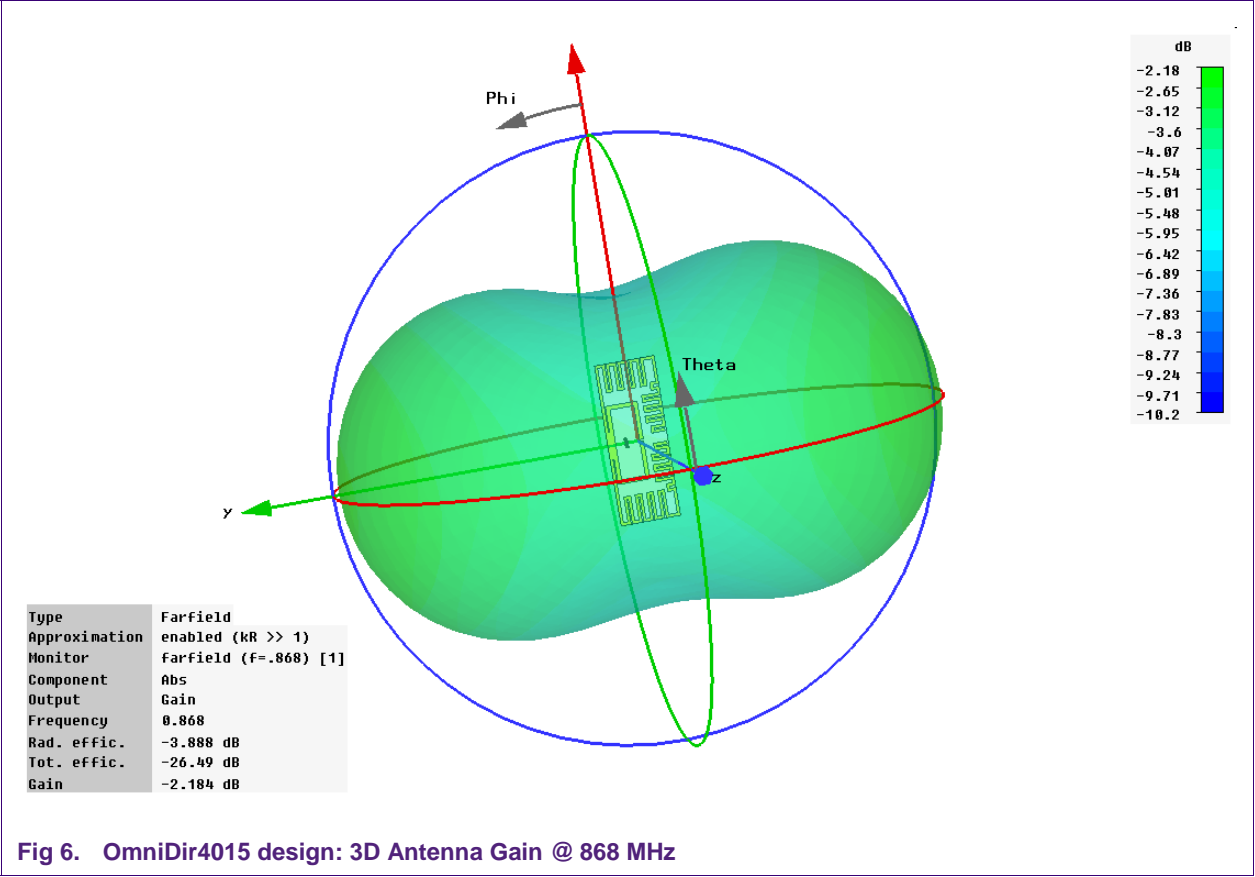


Fig 5. OmniDir4015 design: 2D Antenna Gain @ 868 MHz



Assembly process

2.5 Equipment

- Thermode Test Station TTS 300 from Mühlbauer
- Low force thermode

2.6 Recommended assembly parameters

- Antenna: Alu 10um
- Substrate: PET 50um
- Glue: E&C 13975-11A
- Paper thickness: 0.25 mm on each side
- Temperature
 - Upper thermode: 190°C
 - Lower thermode: 160°C
- Bonding time: 10 sec.
- Bonding pressure: 1,9 N

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Date of release: 16 April 2010
Document identifier: 1902