

# AN 1902

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

Rev. 1.0 — 16 April 2010

Application note

### Document information

| Info            | Content   |
|-----------------|---|
| <b>Keywords</b> | UCODE EPC G2, G2iL, G2iL+, Reference Design, Antenna Design, EU frequency band, Aluminum, OmniDir4015 |
| <b>Abstract</b> | 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**

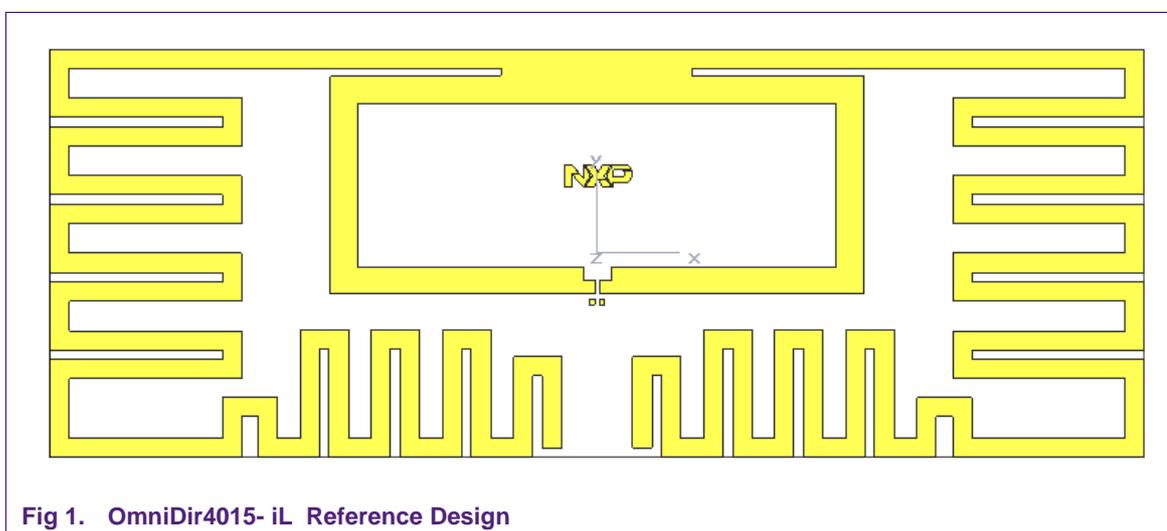
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## 1. OmniDir4015 Reference Antenna Design

### 1.1 Geometry

- Dimensions of the design: 40 mm x 15 mm;
- Antenna material: aluminium; thickness 10  $\mu\text{m}$ ;
- Substrate material: PET; thickness 50 $\mu\text{m}$ ;
- 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)

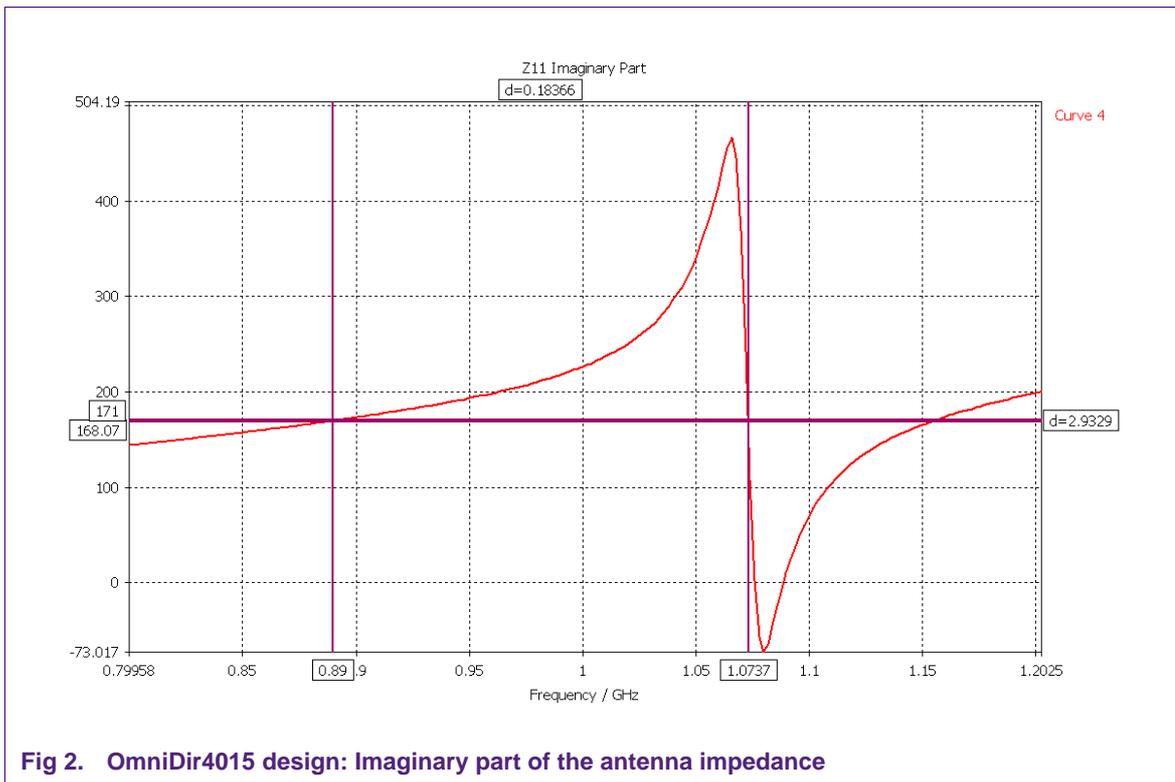
**All measurements and simulation results are based on the converted paper label.**

## 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 ( $j 171 \text{ Ohm}$ ) is at the frequency of 890 MHz. Another matching point is at 1.07 GHz.



## 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):

$$\Gamma = \frac{Z_A - Z_{IC}^*}{Z_A + Z_{IC}} \tag{1}$$

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

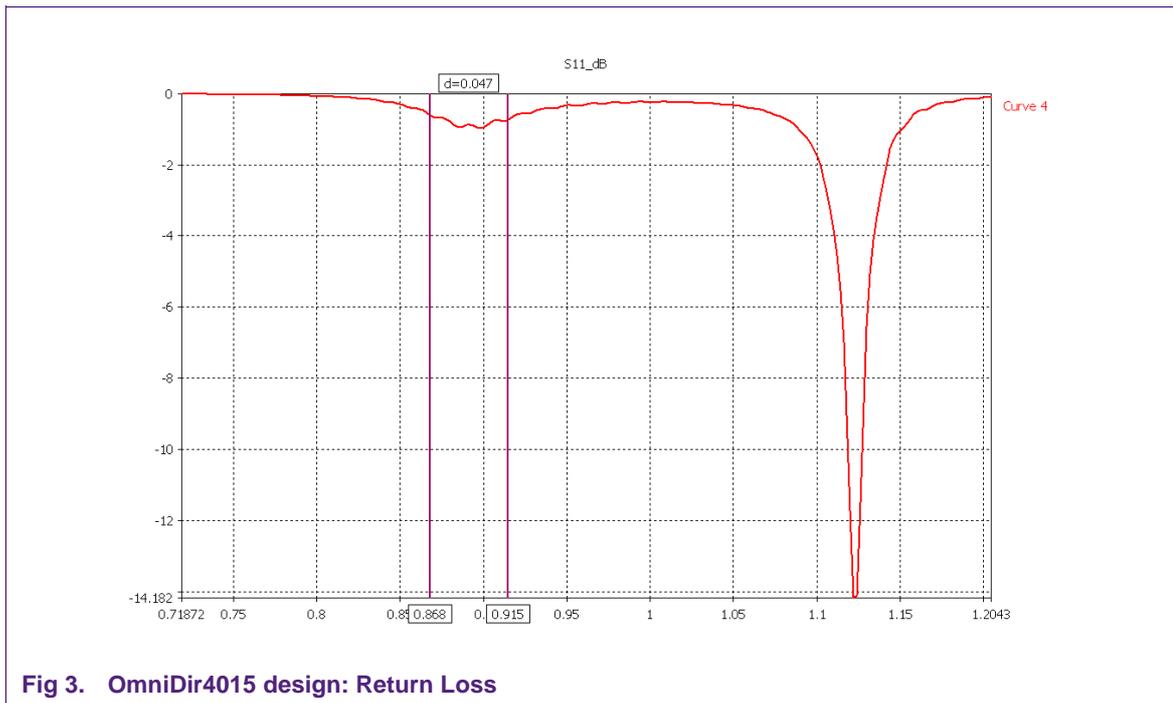


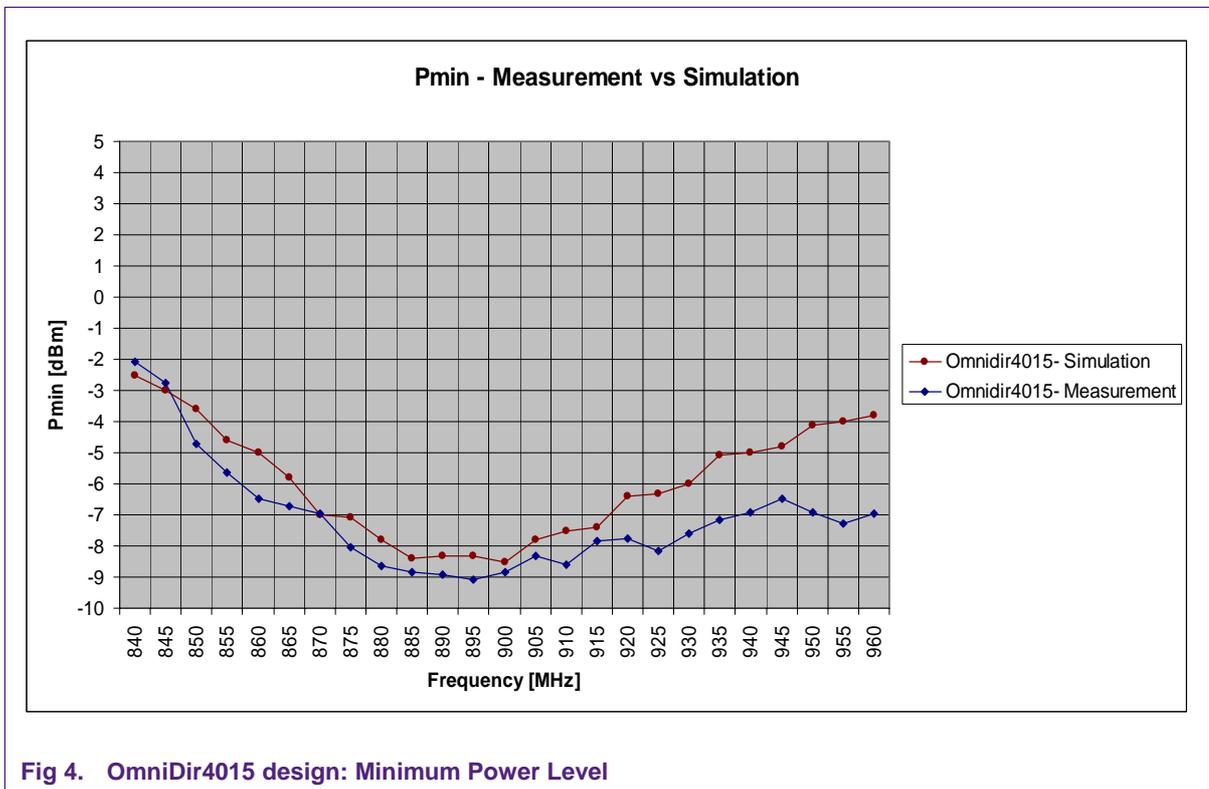
Fig 3. OmniDir4015 design: Return Loss

### 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:

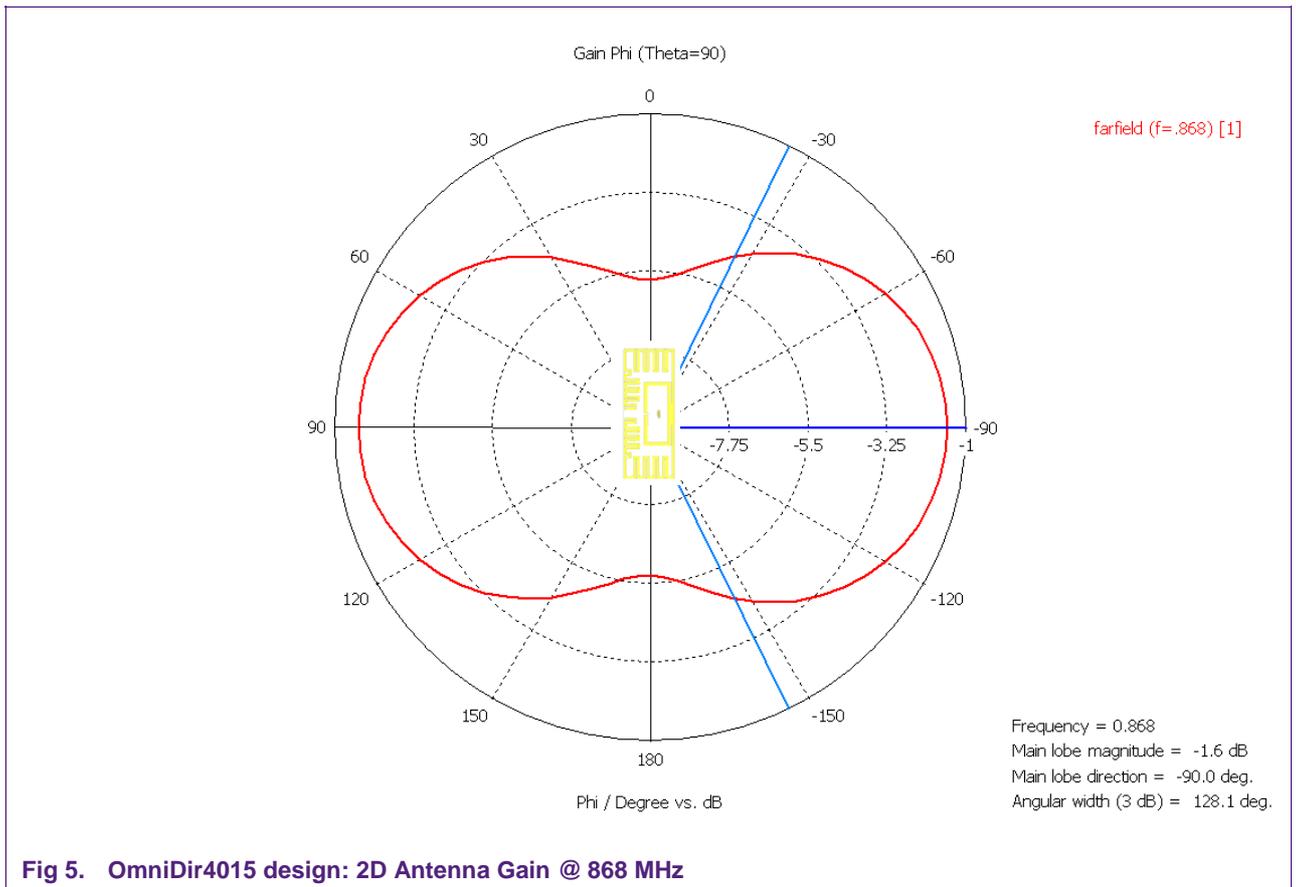
- Measurements are based on hand made samples
- Measured label is covered with 0.2 mm on each side, simulation was done with 0.25 mm paper on each side.

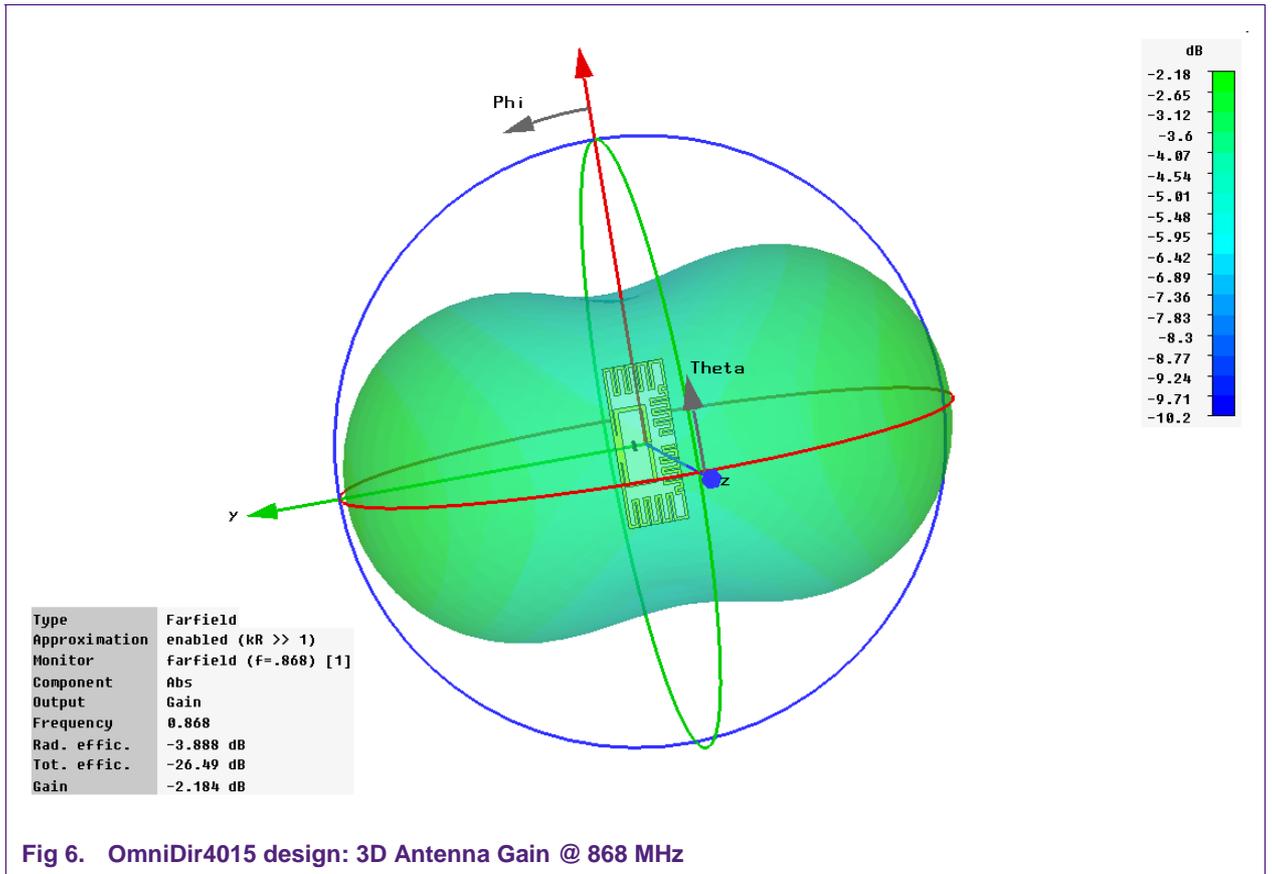


### 2.4 Antenna Gain

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





## Assembly process

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### 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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