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**ISO/IEC 10373-6:2001/FPDAM 8.3**

ISO/IEC JTC 1/SC 17/WG 8

Secretariat: DIN

## **Identification cards — Test methods — Part 6: Proximity cards**

**AMENDMENT 8**  
Additional PICC classes

*Cartes d'identification — Méthodes d'essai — Partie 6: Cartes de proximité*

*AMENDEMENT 8*  
*Classes additionnelles de PICC*

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Amendment 8 to ISO/IEC 10373-6:2001 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and personal identification*.



## Identification cards — Test methods — Part 6: Proximity cards

### AMENDMENT 8: Additional PICC classes

*Page 2 of ISO/IEC FDIS 10373-6:2010, 3.1*

Add the following definition and renumber all subsequent definitions:

#### **3.1.5**

##### **Loading effect**

a change in PCD antenna current caused by the presence of PICC(s) in the field due to the mutual coupling modifying the PCD antenna resonance and quality factor

*Page 3 of ISO/IEC FDIS 10373-6:2010, 3.2*

Add the following symbol:

$V_{load}$  DC voltage measured at connector CON3 of the Reference PICC

*Page 6 of ISO/IEC FDIS 10373-6:2010, Clause 5*

Replace subclause 5.2 by the following:

### **5.2 Calibration coils**

This clause defines the size, thickness and characteristics of the calibration coils 1 and 2.

Calibration coil 1 shall be used only in test PCD assembly 1 and calibration coil 2 shall be used only in test PCD assembly 2.

#### **5.2.1 Size of the calibration coil card**

The calibration coil card shall consist of an area which has the height and width of an ID-1 type defined in ISO/IEC 7810:2003 containing a single turn coil concentric with the card outline (see Figure 1).

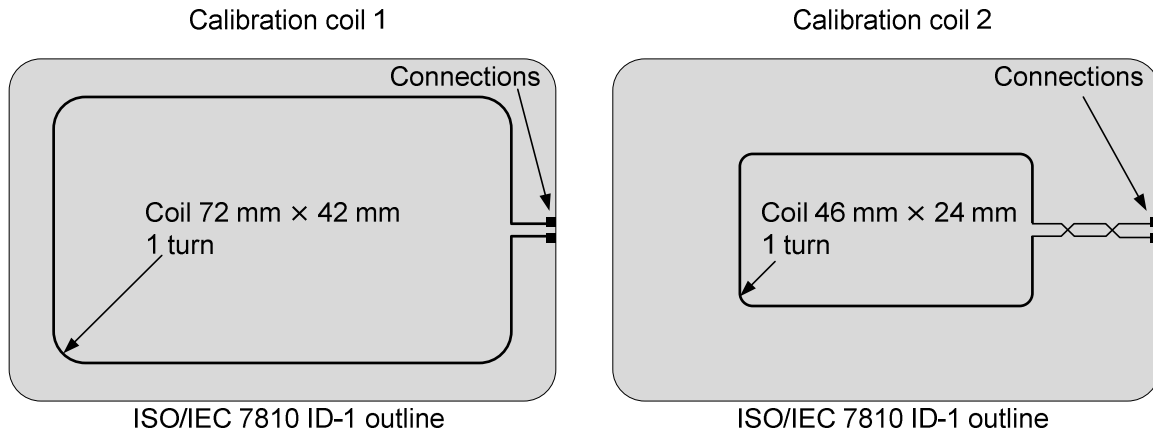


Figure 1 — Calibration coils 1 and 2

**5.2.2 Thickness and material of the calibration coil card**

The thickness of the calibration coil card shall be less than that of an ID-1 card. It shall be constructed of a suitable insulating material.

**5.2.3 Coil characteristics**

The coil on the calibration coil card shall have one turn. Relative dimensional tolerance shall be  $\pm 2\%$ .

The outer size of the calibration coil 1 shall be 72 mm x 42 mm with corner radius 5 mm.

NOTE 1 The area over which the field is integrated is approximately 3000 mm<sup>2</sup>.

NOTE 2 At 13,56 MHz the approximate inductance is 250 nH and the approximate resistance is 0,4  $\Omega$ .

The open circuit calibration factor for the calibration coil 1 is 0,318 V (rms) per A/m (rms) [Equivalent to 900 mV (peak-to-peak) per A/m (rms)].

The outer size of the calibration coil 2 shall be 46 mm x 24 mm with corner radius 2 mm.

NOTE 3 The area over which the field is integrated is approximately 1100 mm<sup>2</sup>.

NOTE 4 At 13,56 MHz the approximate inductance is 140 nH and the approximate resistance is 0,3  $\Omega$ .

The open circuit calibration factor for the calibration coil 2 is 0,118 V (rms) per A/m (rms) [Equivalent to 333 mV (peak-to-peak) per A/m (rms)].

The coil shall be made as a printed coil on printed circuit board (PCB) plated with 35  $\mu\text{m}$  copper. Track width shall be 500  $\mu\text{m}$  with a relative tolerance of  $\pm 20\%$ . The size of the connection pads shall be 1,5 mm x 1,5 mm.

A high impedance oscilloscope probe with an input admittance equivalent to a parallel capacitance  $C_p < 14$  pF and a parallel resistance  $R_p > 9$  k $\Omega$  at 13,56 MHz shall be used to measure the (open circuit) voltage induced in the coil.

NOTE 5 The high impedance oscilloscope probe ground connection should be as short as possible, less than 20 mm or coaxial connection.

Page 7 of ISO/IEC FDIS 10373-6:2010, Clause 5

Replace 5.3 by the following:

### 5.3 Test PCD assembly

Two test PCD assemblies are defined:

- Test PCD assembly 1 for PICCs of classes 1, 2 and 3 and for PICCs which do not claim compliance with a class;
- Test PCD assembly 2 for PICCs of classes 4, 5 and 6.

Each test PCD assembly shall consist of a circular test PCD antenna and two parallel sense coils: sense coil a and sense coil b. The test set-up is shown in Figure 2. The sense coils shall be connected such that the signal from one coil is in opposite phase to the other. The  $10\ \Omega$  potentiometer P1 serves to fine adjust the balance point when the sense coils are not loaded by a PICC or any magnetically coupled circuit. The capacitive load of the probe including its parasitic capacitance shall be less than  $14\ \text{pF}$ .

NOTE 1 The capacitance of the connections and of the oscilloscope probe should be kept to a minimum for reproducibility.

NOTE 2 In order to avoid any unintended misalignment in case of an unsymmetrical set-up the tuning range of the potentiometer P1 is only  $10\ \Omega$ . If the set-up cannot be compensated by the  $10\ \Omega$  potentiometer P1 the overall symmetry of the set-up should be checked.

NOTE 3 The high impedance oscilloscope probe ground connection should be as short as possible, less than  $20\ \text{mm}$  or coaxial connection.

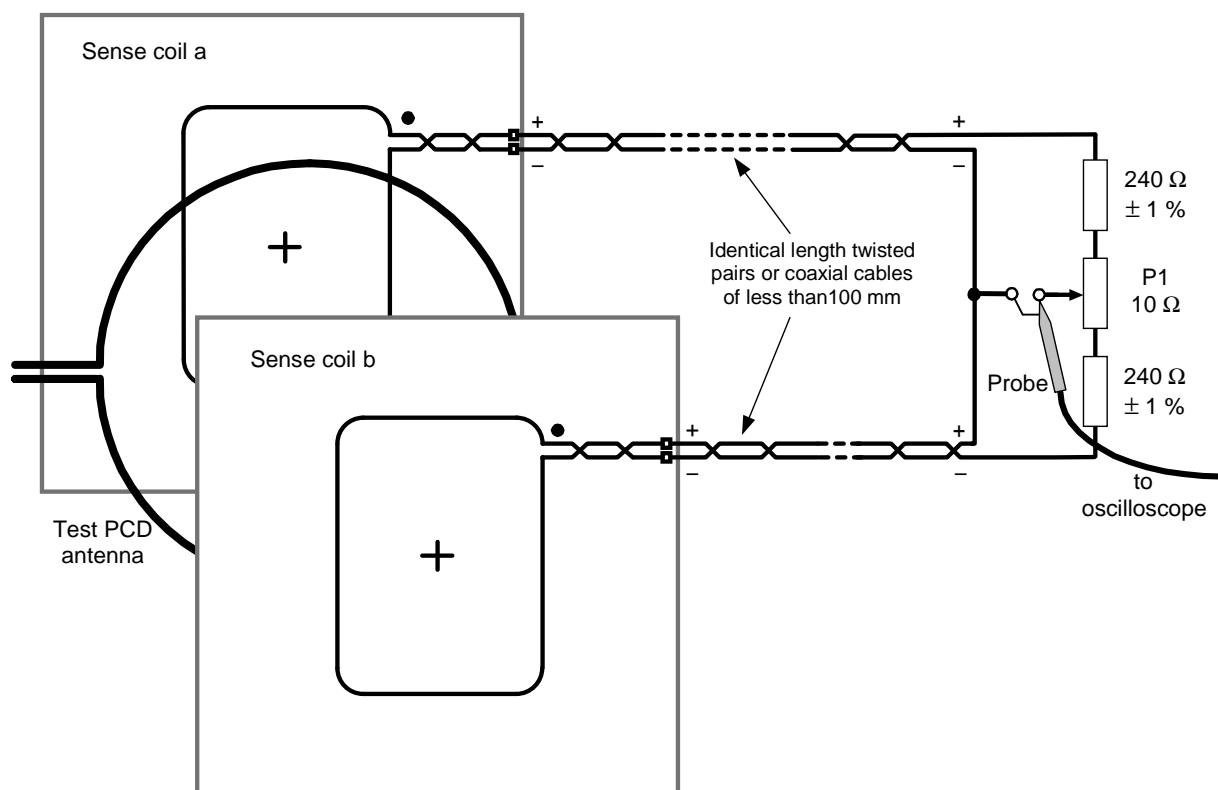


Figure 2 — Test set-up (principle)



### **5.3.1 Test PCD antenna**

In test PCD assembly 1 the test PCD antenna 1 shall have a diameter of 150 mm.

In test PCD assembly 2 the test PCD antenna 2 shall have a diameter of 100 mm.

Each test PCD antenna construction shall conform to the corresponding drawings in Annex A.

The matching of each test PCD antenna should be accomplished by using an impedance analyzer or a network analyzer or an LCR meter. If either an impedance analyzer or a network analyzer or an LCR meter is not available, then the matching may be accomplished with the procedure given in Annex B.

### **5.3.2 Sense coils**

In test PCD assembly 1 the size of the sense coils 1 shall be 100 mm × 70 mm with corner radius 10 mm.

In test PCD assembly 2 the size of the sense coils 2 shall be 60 mm × 47 mm with corner radius 10 mm.

Each sense coil construction shall conform to the corresponding drawings in Annex C.

### **5.3.3 Assembly of Test PCD**

The sense coils 1 and test PCD antenna 1 shall be assembled parallel and with the sense and antenna coils coaxial and such that the distance between the active conductors is 37,5 mm as shown in Figure 3.

The sense coils 2 and test PCD antenna 2 shall be assembled parallel and with the sense and antenna coils coaxial and such that the distance between the active conductors is 23 mm as shown in Figure 3.

The dimensional tolerance shall be better than  $\pm 0,5$  mm. The distance between the coil in the DUT and the calibration coil shall be equal with respect to the coil of the test PCD antenna.

NOTE These distances are chosen to offer a strong and homogenous magnetic field in the DUT position.

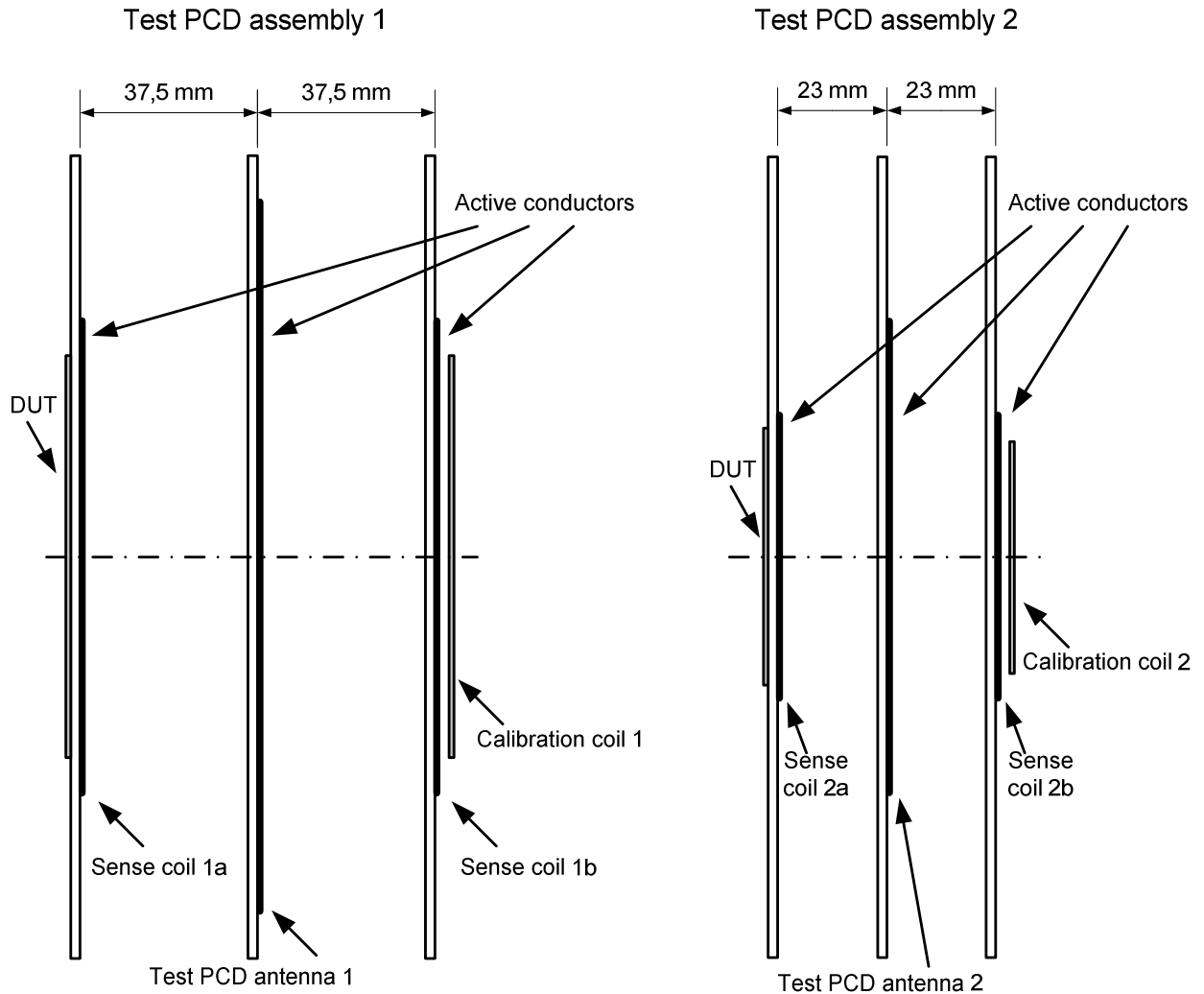


Figure 3 — Test PCD assembly 1 and test PCD assembly 2

Page 10 of ISO/IEC FDIS 10373-6:2010, 5.4.2

Replace 1<sup>st</sup> paragraph with:

"The Reference PICCs coils layouts are defined in Annex D. If connectors are used between the coils and the circuitry those connectors shall have minimal, if any, effect on the RF measurements."

Page 11 of ISO/IEC FDIS 10373-6:2010, 5.4.3

Replace "6 V" by " $V_{load}$ " in steps f), g) and i) and in NOTE.

Page 14 of ISO/IEC FDIS 10373-6:2010, 7.1

Add the following paragraph, table and note:

All PCD tests of ISO/IEC 14443-2 parameters shall be performed using Reference PICCs 1, 2 and 3 and optionally other Reference PICCs corresponding to the optional classes supported by the PCD, with the relevant parameters and test PCD assembly as defined in Table 3.

**Table 3 — Classes parameters**

Class	Reference PICC	$V_{load}$	$R2_{min}$	$R2_{max}$	Test PCD assembly
1	1	6 V	870 $\Omega$	1070 $\Omega$	Test PCD assembly 1
2	2	4,5 V	1030 $\Omega$	1260 $\Omega$	Test PCD assembly 1
3	3	4,5 V	1080 $\Omega$	1320 $\Omega$	Test PCD assembly 1
4	4	4,5 V	990 $\Omega$	1210 $\Omega$	Test PCD assembly 2
5	5	4,5 V	960 $\Omega$	1170 $\Omega$	Test PCD assembly 2
6	6	4,5 V	900 $\Omega$	1100 $\Omega$	Test PCD assembly 2

NOTE  $V_{load}$  may be harmonized to 4,5 V for all classes in future revisions of ISO/IEC 10373-6.

Page 16 of ISO/IEC FDIS 10373-6:2010, 7.1.1

Add the following paragraph:

"The maximum and minimum field strength values to be used with each Reference PICC are given in ISO/IEC 14443-2:2001/AMD4, Table 1."

Page 15 of ISO/IEC FDIS 10373-6:2010, 7.1.1.2

Replace "3 V" with " $V_{load}$  as defined in Table 3" in steps c) and d) of the procedure for  $H_{min}$ .

Replace the Warning in Procedure for  $H_{min}$  test with:

**"WARNING — R2 value should be between  $R2_{min}$  and  $R2_{max}$  as defined in Table 3. Check this range at least once before using the alternative method."**

Page 15 of ISO/IEC FDIS 10373-6:2010, 7.1.1.3

Replace the paragraph with:

"The test report shall confirm the operating volume in which the DC voltage measured at CON3 for R2 or variable load resistor adjusted to  $H_{min}$  and  $H_{max}$  field strength fulfils the requirements defined in steps d) of the two procedures of 7.1.1.2."

Page 15 of ISO/IEC FDIS 10373-6:2010, Clause 7

Delete 7.1.2 and its subclauses.

Page 16 of ISO/IEC FDIS 10373-6:2010, Clause 7

Delete 7.1.3 and its subclauses.

Page 16 of ISO/IEC FDIS 10373-6:2010, 7.1.4.2

Replace step d) by the following:

"d) Apply and adjust a DC voltage at CON2 to obtain a DC voltage at connector CON3 of  $V_{load}$  as defined in Table 3."

Page 17 of ISO/IEC FDIS 10373-6:2010, 7.1.5.2

Replace step c) by the following:

"c) Apply and adjust a DC voltage at CON2 to obtain a DC voltage at connector CON3 of  $V_{load}$  as defined in Table 3."

Page 18 of ISO/IEC FDIS 10373-6:2010, 7.2.1.2

Replace the first paragraph starting with "Step 1" with:

"Step 1: The load modulation test circuit of Figure 2 and the test PCD assembly of Figure 3 defined for the PICC class (see ISO/IEC 14443-2/Amd.4, 8.2.2) are used. If the PICC does not claim to meet the requirements of one particular class as specified in ISO/IEC 14443-1:2008/Amd.1, then select the test PCD assembly 1."

Page 21 of ISO/IEC FDIS 10373-6:2010, 7.2.4

Replace 7.2.4 and its subclauses with the following:

## **7.2.4 PICC maximum loading effect**

### **7.2.4.1 Purpose**

This test is used to measure the PICC loading effect.

### **7.2.4.2 Test procedure**

Depending on the claimed PICC class, select:

- the relevant  $H_{min}$  as defined in ISO/IEC 14443-2:2001/AMD4, Table 2;
- the relevant Reference PICC as defined in Table 3 and its reference voltage  $V_{load}$ ;
- the relevant test PCD assembly as defined in Table 3.

If the PICC does not claim any particular class as specified in ISO/IEC 14443-1:2008/AMD1, then "Class 1" parameters, test apparatus and circuits shall be used for this test.

## ISO/IEC 10373-6:2001/FPDAM 8.3

The PICC loading effect at  $H_{\min}$  shall be measured using the Test PCD assembly. It shall not exceed the loading effect of the selected Reference PICC tuned to 13,56 MHz and calibrated to obtain  $V_{\text{load}}$  at CON3 at  $H_{\min}$ . The procedure of this substitution method is as follows.

- a) Tune the selected Reference PICC to 13,56 MHz as described in 5.4.3.
- b) Calibrate the Test PCD assembly to produce the  $H_{\min}$  operating condition on the calibration coil.
- c) Place the Reference PICC into the DUT position on the Test PCD assembly. Switch the jumper J1 to position 'b' and adjust R2 to obtain a DC voltage of  $V_{\text{load}}$  measured at connector CON3. Alternatively, jumper J1 may be set to position 'c' and the applied voltage on CON2 is adjusted to obtain a DC voltage of  $V_{\text{load}}$  at connector CON3. In both cases, the operating field condition shall be verified by monitoring the voltage on the calibration coil and adjusted if necessary.

**WARNING — R2 value should be between  $R2_{\min}$  and  $R2_{\max}$  as defined in Table 3. Check this range at least once before using the alternative method.**

- d) Remove the Reference PICC.
- e) Place the PICC under test into the DUT position on the Test PCD assembly.
- f) Measure the field strength monitored by the calibration coil.

This field strength shall be greater than  $H_{\min}$ .

### 7.2.4.3 Test report

The test report shall give the value of the measured field strength.

*Page 23 of ISO/IEC FDIS 10373-6:2010, Annex A*

Replace all occurrences of "test PCD antenna" with "test PCD antenna 1".

Add a new subclause at the end of annex A:

## A.3 Test PCD antenna 2

### A.3.1 Test PCD antenna 2 layout including impedance matching network

Figures A.7 and A.8 illustrate the Test PCD antenna 2 layout. Drawings are not to scale.

The antenna coil track width is 1,8 mm (except for through-plated holes).

Starting from the impedance matching network there are crossovers every 45 °.

Printed circuit board (PCB): FR4 material, thickness 1,6 mm, double sided with 35  $\mu\text{m}$  copper.

NOTE 1 The layout and the position of the impedance matching network are informative. The outer PCB dimensions are informative.

NOTE 2 Such printed circuit boards and  $R_{\text{ext}}$  resistors are available from various commercial sources.

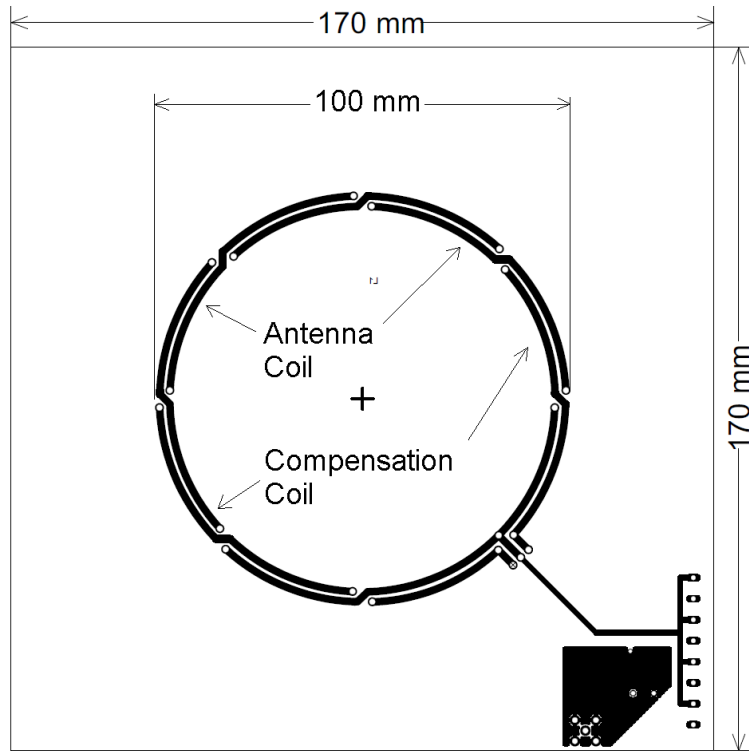


Figure A.7 — Test PCD antenna 2 layout including impedance matching network (view from front)

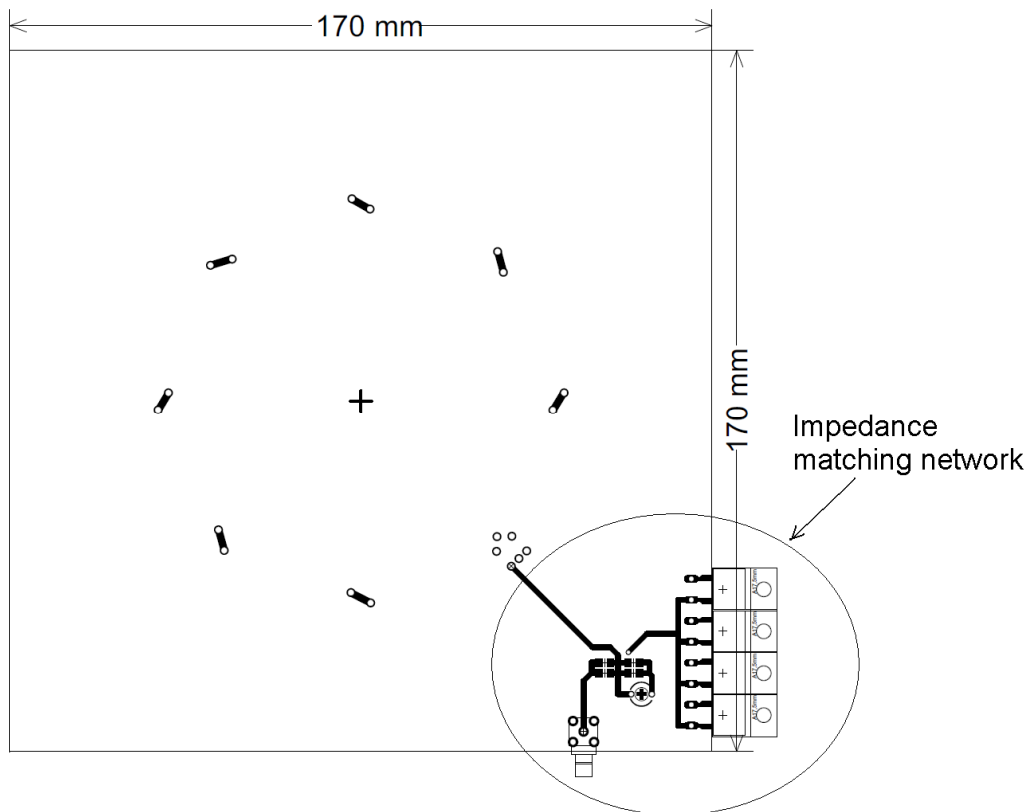
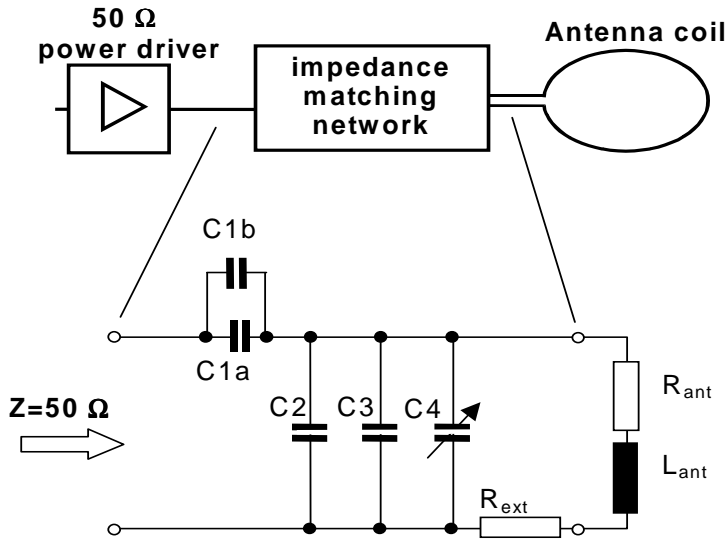


Figure A.8 — Test PCD antenna 2 layout including impedance matching network (view from back)

**A.3.2 Impedance matching network 2**

See A.2.2 with the following values.



**Component Table:**

	Value	Unit	Remarks
C1a	100	pF	Voltage range 200 V
C1b	12	pF	Voltage range 200 V
C2	270	pF	Voltage range 200 V
C3	18	pF	Voltage range 200 V
C4	2-27	pF	Voltage range 200 V
R <sub>ext</sub>	2,7	Ω	Power range 20 W

**Figure A.9 — Impedance matching network 2**

NOTE 1 R<sub>ext</sub> may be built by either a parallel circuit composed of two equal branches having two resistors of 2,7 Ω 5 W in series each or a parallel circuit of 10 Ω, 10 Ω, 10 Ω and 15 Ω, 5 W.

NOTE 2 R<sub>ext</sub> should be placed on the GND side of the antenna as drawn.

NOTE 3 The parasitic capacitance of the antenna is not shown in Figure A.9.

Page 31 of ISO/IEC FDIS 10373-6:2010, Annex C

Add following sub clause headline directly after C.1:

**C.1.1 Sense coil 1 layout**

Replace “Figure C.1 — Layout for sense coils a and b” by “Figure C.1 — Layout for sense coils 1 (a and b)”.

Page 32 of ISO/IEC FDIS 10373-6:2010, Annex C

Add following sub clause before C.2 and renumber figures in Annex C:

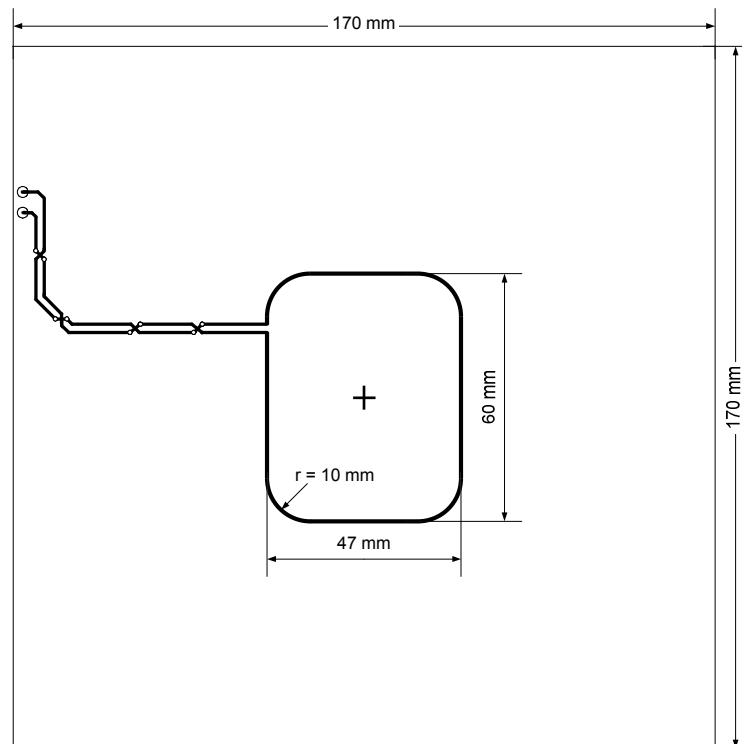
**C.1.2 Sense coil 2 layout**

Figure C.2 illustrates the sense coils 2 layout. Drawings are not to scale.

The sense coil track width is 0,5 mm with relative tolerance ± 20 % (except for through-plated holes). Size of the coils refers to the outer dimensions.

Printed circuit board (PCB): FR4 material, thickness 1,6 mm, double sided with 35 µm copper.

NOTE Such printed circuit boards are available from various commercial sources.



**Figure C.2 — Layout for sense coils 2 (a and b)**

Page 33 of ISO/IEC FDIS 10373-6:2010, Annex D

Change the title to "Reference PICCs".

Page 33 of ISO/IEC FDIS 10373-6:2010, D.1

Add a subclause title:

### **"D.1 Reference PICC 1 coil layouts"**

Change the first sentence with:

"Figure D.1 specifies the Reference PICC 1 Pick up coil and Main coil layouts."

Change title of figure D.1 to:

**"Figure D.1 – Reference PICC 1 Pick up coil and Main coil layouts"**

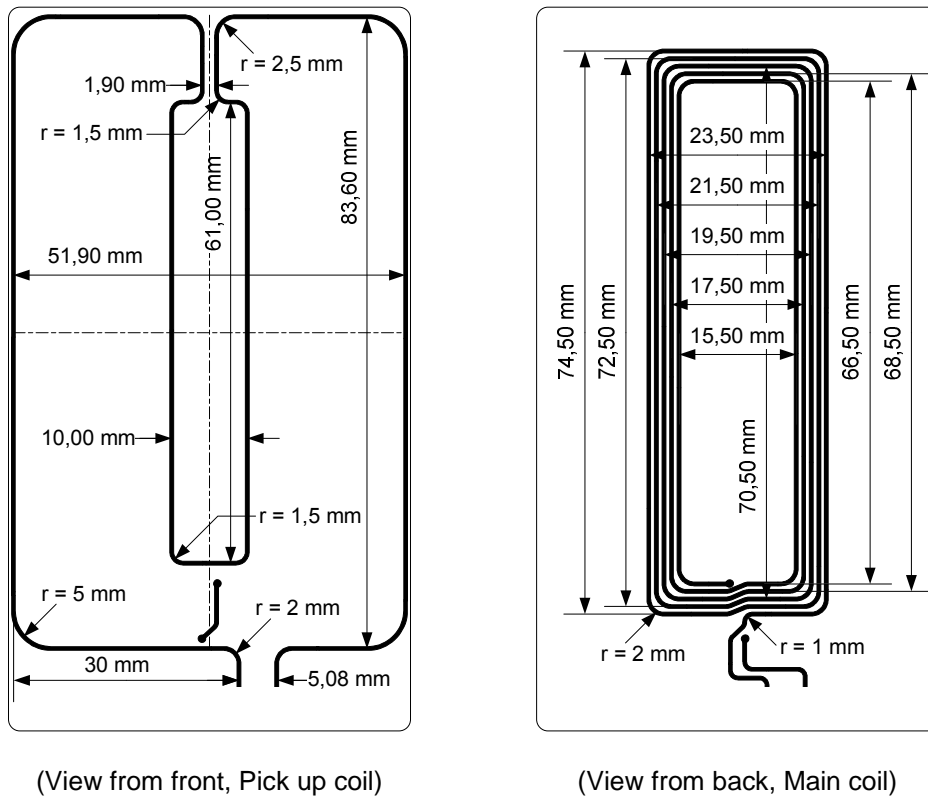
Page 33 of ISO/IEC FDIS 10373-6:2010, Annex D

Add following sub clauses at the end of D.1:



### D.2 Reference PICC 2 coil layouts

Figure D.2 specifies the Reference PICC 2 Pick up coil and Main coil layouts.



**Figure D.2 — Reference PICC 2 Pick up coil and Main coil layouts**

Dimensions to track center (drawings are not to scale).

Main coil dimensions: 75 mm x 24 mm (outer dimensions).

The Pick up coil and the Main coil shall be concentric.

The two coils track width and spacing shall be 0,5 mm with a relative tolerance of  $\pm 20\%$ .

All main coil corners radii shall be 2 mm.

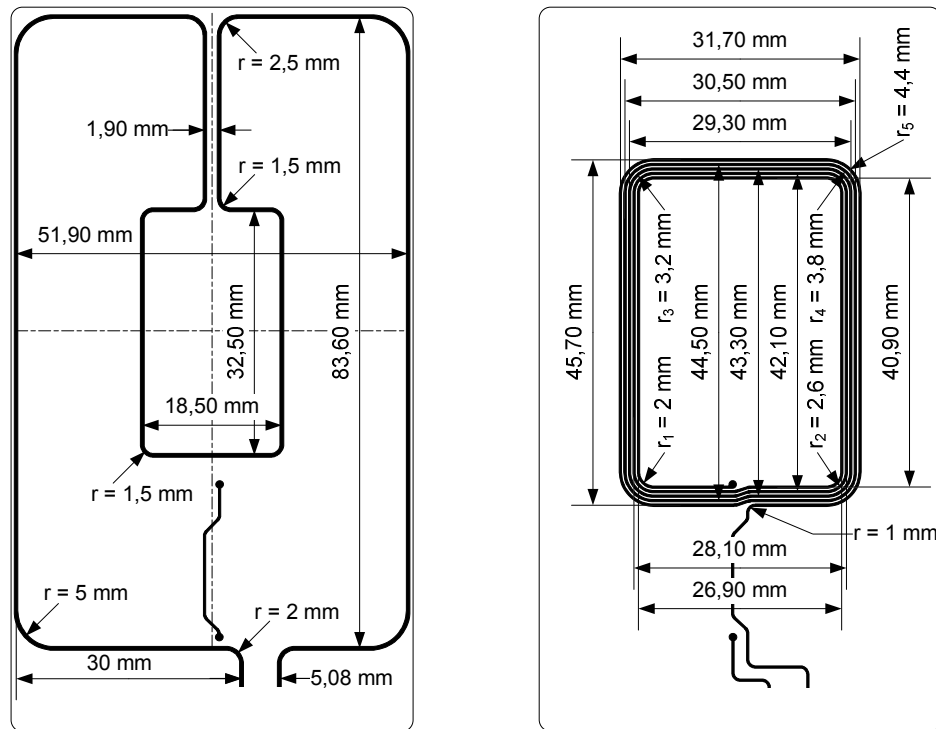
Printed circuit board (PCB): FR4 material, thickness 0,76 mm with a relative tolerance of  $\pm 10\%$ , double sided with 35  $\mu\text{m}$  copper.

NOTE 1 At 13,56 MHz the inductance of the Main coil L1 is 2,4  $\mu\text{H} \pm 10\%$  and the resistance is 1,9  $\Omega \pm 10\%$ .

NOTE 2 At 13,56 MHz the inductance of the Pick up coil L2 is 417 nH  $\pm 10\%$  and the approximate resistance is 0,8  $\Omega \pm 10\%$ .

### D.3 Reference PICC 3 coil layouts

Figure D.3 specifies the Reference PICC 3 Pick up coil and Main coil layouts.



(View from front, Pick up coil)

(View from back, Main coil)

**Figure D.3 — Reference PICC 3 Pick up coil and Main coil layouts**

Dimensions to track center (drawings are not to scale).

Main coil dimensions: 46 mm x 32 mm (outer dimensions).

The Pick up coil and the Main coil shall be concentric.

The Pick up coil track width shall be 0,5 mm with a relative tolerance of  $\pm 20 \%$ .

The Main coil track width and spacing shall be 0,3 mm with a relative tolerance of  $\pm 20 \%$ .

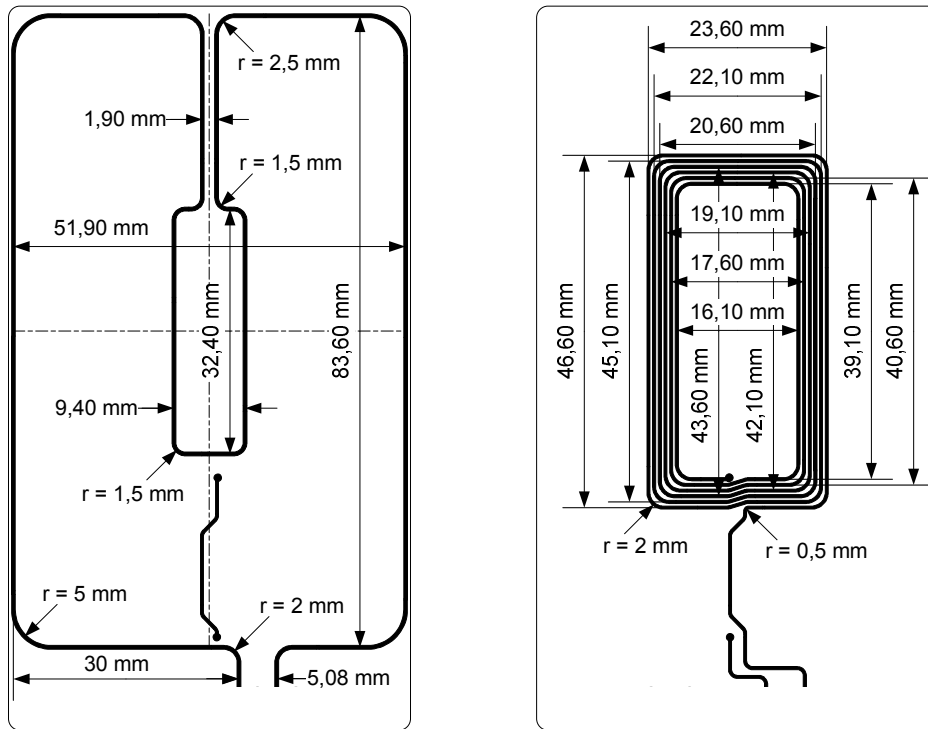
Printed circuit board (PCB): FR4 material, thickness 0,76 mm with a relative tolerance of  $\pm 10 \%$ , double sided with 35  $\mu\text{m}$  copper.

NOTE 1 At 13,56 MHz the inductance of the Main coil L1 is 2,39  $\mu\text{H} \pm 10 \%$  and the resistance is 2,18  $\Omega \pm 10 \%$ .

NOTE 2 At 13,56 MHz the inductance of the Pick up coil L2 is 405 nH  $\pm 10 \%$  and the approximate resistance is 0,76  $\Omega \pm 10 \%$ .

### D.4 Reference PICC 4 coil layouts

Figure D.4 specifies the Reference PICC 4 Pick up coil and Main coil layouts.



(View from front, Pick up coil)

(View from back, Main coil)

**Figure D.4 — Reference PICC 4 Pick up coil and Main coil layouts**

Dimensions to track center (drawings are not to scale).

Main coil dimensions: 47 mm x 24 mm (outer dimensions).

The Pick up coil and the Main coil shall be concentric.

The Pick up coil track width shall be 0,5 mm with a relative tolerance of  $\pm 20\%$ .

All main coil corners radii shall be 2 mm.

The Main coil track width shall be 0,4 mm and the spacing shall be 0,35 mm with a relative tolerance of  $\pm 20\%$ .

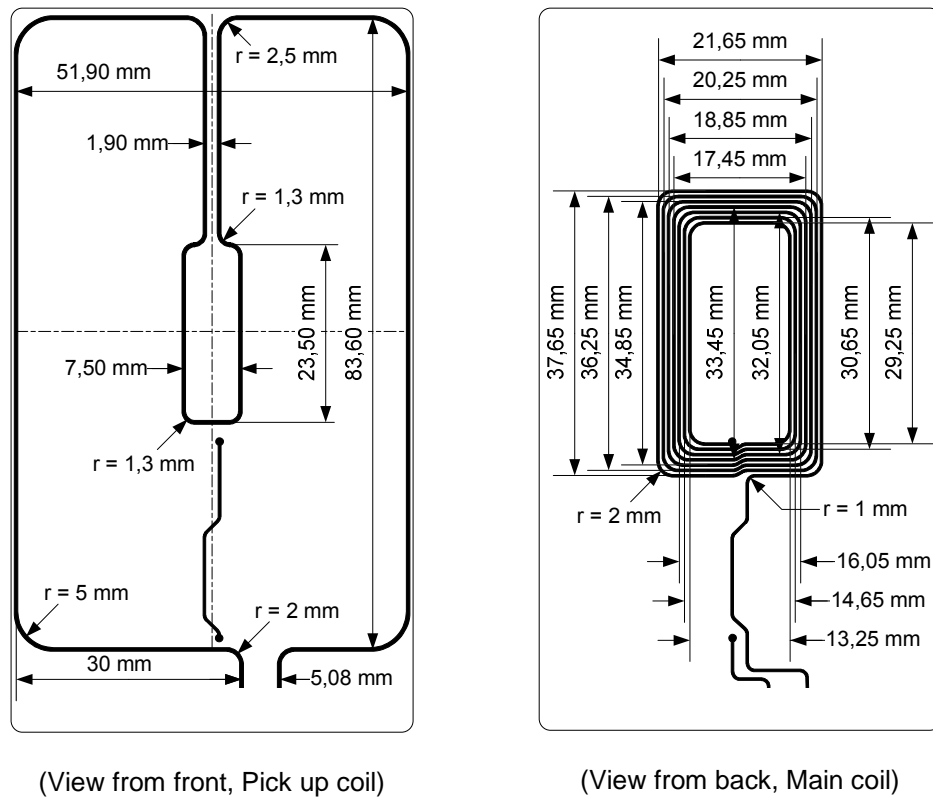
Printed circuit board (PCB): FR4 material, thickness 0,76 mm with a relative tolerance of  $\pm 10\%$ , double sided with 35  $\mu\text{m}$  copper.

NOTE 1 At 13,56 MHz the inductance of the Main coil L1 is 2,3  $\mu\text{H} \pm 10\%$  and the resistance is 1,8  $\Omega \pm 10\%$ .

NOTE 2 At 13,56 MHz the inductance of the Pick up coil L2 is 390 nH  $\pm 10\%$  and the approximate resistance is 0,7  $\Omega \pm 10\%$ .

## D.5 Reference PICC 5 coil layouts

Figure D.5 specifies the Reference PICC 5 Pick up coil and Main coil layouts.



**Figure D.5 — Reference PICC 5 Pick up coil and Main coil layouts**

Dimensions to track center (drawings are not to scale).

Main coil dimensions: 38 mm x 22 mm (outer dimensions).

The Pick up coil and the Main coil shall be concentric.

The Pick up coil track width shall be 0,5 mm with a relative tolerance of  $\pm 20\%$ .

All main coil corners radii shall be 2 mm.

The Main coil track width and spacing shall be 0,35 mm with a relative tolerance of  $\pm 20\%$ .

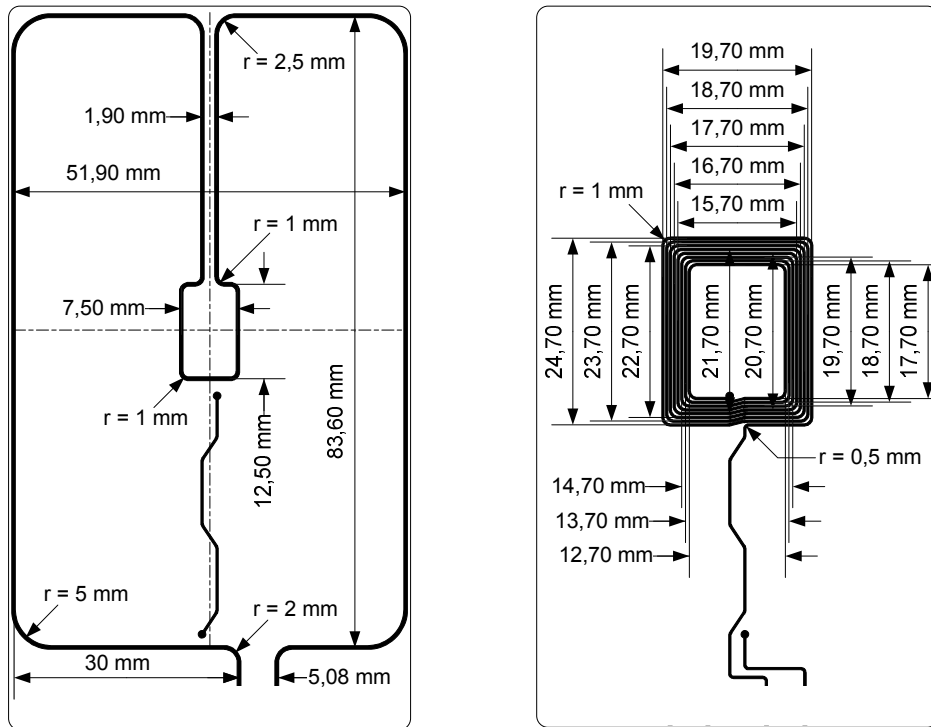
Printed circuit board (PCB): FR4 material, thickness 0,76 mm with a relative tolerance of  $\pm 10\%$ , double sided with 35  $\mu\text{m}$  copper.

NOTE 1 At 13,56 MHz the inductance of the Main coil L1 is 2,4  $\mu\text{H} \pm 10\%$  and the resistance is 1,9  $\Omega \pm 10\%$ .

NOTE 2 At 13,56 MHz the inductance of the Pick up coil L2 is 380 nH  $\pm 10\%$  and the approximate resistance is 0,7  $\Omega \pm 10\%$ .

### D.6 Reference PICC 6 coil layouts

Figure D.6 specifies the Reference PICC 6 Pick up coil and Main coil layouts.



(View from front, Pick up coil)

(View from back, Main coil)

**Figure D.6 — Reference PICC 6 Pick up coil and Main coil layouts**

Dimensions to track center (drawings are not to scale).

Main coil dimensions: 25 mm x 20 mm (outer dimensions).

The Pick up coil and the Main coil shall be concentric.

The Pick up coil track width shall be 0,5 mm with a relative tolerance of  $\pm 20\%$ .

All main coil corners radii shall be 1 mm.

The Main coil track width shall be 0,3 mm and the spacing shall be 0,2 mm with a relative tolerance of  $\pm 20\%$ .

Printed circuit board (PCB): FR4 material, thickness 0,76 mm with a relative tolerance of  $\pm 10\%$ , double sided with 35  $\mu\text{m}$  copper.

NOTE 1 At 13,56 MHz the inductance of the Main coil L1 is 2,3  $\mu\text{H} \pm 10\%$  and the resistance is 2,2  $\Omega \pm 10\%$ .

NOTE 2 At 13,56 MHz the inductance of the Pick up coil L2 is 370 nH  $\pm 10\%$  and the approximate resistance is 0,7  $\Omega \pm 10\%$ .