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Identification cards — Test methods — Part 7: Vicinity cards

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Contents

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

ISO/IEC 10373 consists of the following parts, under the general title *Identification card(s) – Test methods:*

- *Part 1 General characteristics tests*
- *Part 2 Cards with magnetic stripes*
- *Part 3 Integrated circuit(s) cards with contacts and related interface devices*
- *Part 4 Contactless integrated circuit cards*
- *Part 5 Optical memory cards*
- *Part 6 Proximity cards*
- *Part 7 Vicinity cards*
-

Identification cards — Test methods — Part 7: Vicinity cards

1 Scope

This International Standard defines test methods for characteristics of identification cards according to the definition given in ISO/IEC 7810. Each test method is cross-referenced to one or more base standards, which may be ISO/IEC 7810 or one or more of the supplementary standards that define the information storage technologies employed in identification cards applications.

NOTE 1 Criteria for acceptability do not form part of this International Standard but will be found in the International Standards mentioned above.

NOTE 2 Test methods described in this International Standard are intended to be performed separately. A given card is not required to pass through all the tests sequentially.

This part of ISO/IEC 10373 deals with test methods, which are specific to contactless integrated circuit technology (vicinity cards). Part 1 of the standard, General characteristics, deals with test methods which are common to one or more ICC technologies and other parts deal with other technology-specific tests.

Unless otherwise specified, the tests in this part of ISO/IEC 10373 shall be applied exclusively to Vicinity cards defined in ISO/IEC 15693-1 and FDIS 15693-2.

2 Normative reference(s)

The following standards contain provisions, which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 7810	Identification cards - Physical characteristics.
ISO/IEC FCD15693-1:1998	Identification cards - Vicinity integrated circuit(s) cards - Part 1: Physical characteristics.
ISO/IEC CD15693-2:1998	Identification cards - Vicinity integrated circuit(s) cards - Part 2: Radio frequency power and signal interface
ISO/IEC CD15693-3:1998	Identification cards - Vicinity integrated circuit(s) cards - Part 3: Anticollision and transmission protocol
IEC 61000-4-2: 1995	Electromagnetic compatibility (EMC) Part 4: Testing and measurement

	techniques - Clause 2: Electrostatic discharge immunity test
ISBN 92-67-10188-9, 1993	ISO Guide to the Expression of Uncertainty in Measurement,

3 Terms and definitions

For the purpose of this International Standard, the following definitions apply:

3.1
Base standard

The standard which the test method is used to verify conformance to.

3.2
DUT

Device under test.

3.3
ESD

Electrostatic Discharge.

3.4 Normal use

Use as an Identification Card (see clause 4 of ISO/IEC 7810:1995), involving equipment processes appropriate to the card technology and storage as a personal document between equipment processes.

3.5
Testably functional

Surviving the action of some potentially destructive influence to the extent that any integrated circuit(s) present in the card continues to show a response[1] as defined in ISO/IEC 15693-3 which conforms to the base standard.

3.6
Test method

A method for testing characteristics of identification cards for the purpose of confirming their compliance with International Standards.

[1] This International Standard does not define any test to establish the complete functioning of integrated circuit(s) cards. The test methods require only that the minimum functionality (testably functional) be verified. This may, in appropriate circumstances, be supplemented by further, application specific functionality criteria which are not available in the general case.

4 Default items applicable to the test methods

4.1 Test environment

Unless otherwise specified, testing shall take place in an environment of temperature 23°C ± 3°C (73°F ± 5°F) and of relative humidity 40% to 60%.

4.2 Pre-conditioning

Where pre-conditioning is required by the test method, the identification cards to be tested shall be conditioned to the test environment for a period of 24 h before testing.

4.3 Default tolerance

Unless otherwise specified, a default tolerance of ± 5% shall be applied to the quantity values given to specify the characteristics of the test equipment (e.g. linear dimensions) and the test method procedures (e.g. test equipment adjustments).

4.4 Spurious Inductance

Resistors and capacitors should have negligible inductance.

4.5 Total measurement uncertainty

The total measurement uncertainty for each quantity determined by these test methods shall be stated in the test report.

Basic information is given in “ISO Guide to the Expression of Uncertainty in Measurement“, ISBN 92-67-10188-9, 1993.

5 Static electricity test

The purpose of this test is to check the behavior of the card IC in relation to electrostatic discharge (ESD) exposure of the test sample. The card under test is exposed to a simulated electrostatic discharge (ESD, human body model) and its basic operation checked following the exposure.

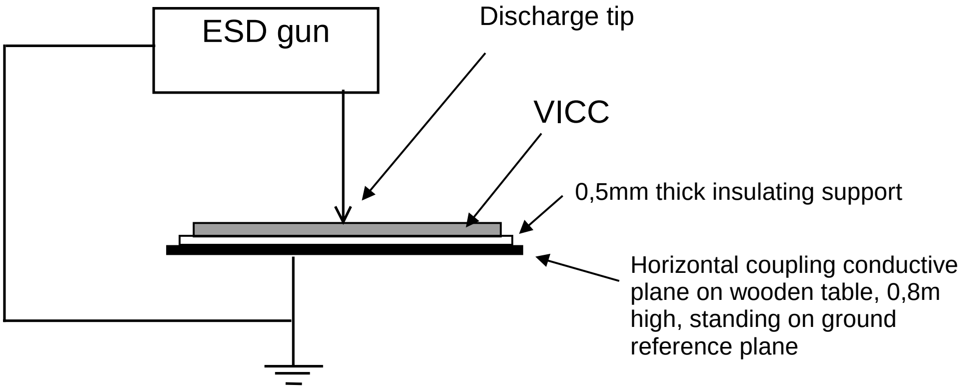


Figure 1 — ESD test circuit

5.1 Apparatus

Refer to IEC 61000-4-2: 1995.

a) Main specifications of the ESD generator

- energy storage capacitance: 150 pF ± 10%
- discharge resistance: 330 Ohm ± 10%
- charging resistance: between 50 MOhm and 100 MOhm
- rise time: 0,7 to 1 ns

b) Selected specifications from the optional items

- type of equipment: table top equipment
- discharge method: direct and contact discharge to the equipment under test
- discharge electrodes of the ESD generator: Round tip probe of 8 mm diameter (to avoid breaking surface label layer of card)

5.2 Procedure

Connect the ground pin of the apparatus to the conductive plate upon which the card is placed.

Apply the discharge successively in normal polarity to each of the 20 test zones shown in Figure 2. Then repeat the same procedure with reversed polarity. Allow a cool-down period between successive pulses of at least 10s.

WARNING - If the card includes contacts, the contacts shall be face up and the zone which includes contacts shall not be exposed to this discharge.

Check that the card remains testably functional (see clause 3) at the end of the test.

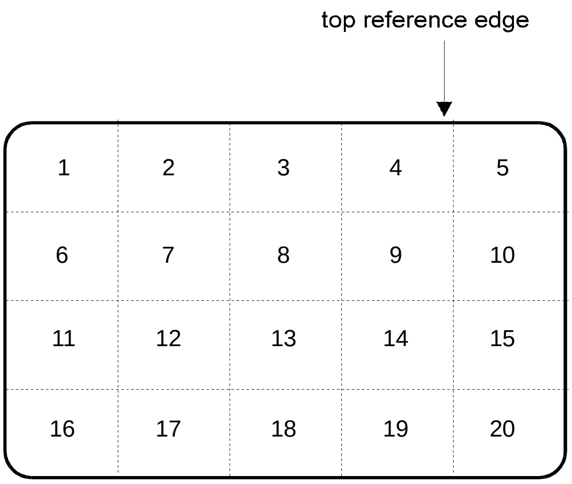


Figure 2 — Test zones on card for ESD test

5.3 Test report

The test report states, whether the card remains testably functional.

6 Test apparatus and test circuits

This clause defines the test apparatus and test circuits for verifying the operation of a VICC or a VCD according to ISO/IEC CD15693-2. The test apparatus includes:

a) Calibration coil
b) Test VCD assembly
c) Reference VICC
d) Digital sampling oscilloscope

These are described in the following clauses.

6.1 Calibration coil

This clause defines the size, thickness and characteristics of the calibration coil.

6.1.1 Size of the Calibration coil card

The Calibration coil card consists of an area, which has the height and width defined in ISO/IEC 7810 for ID1 type containing a single turn coil concentric with the card outline.

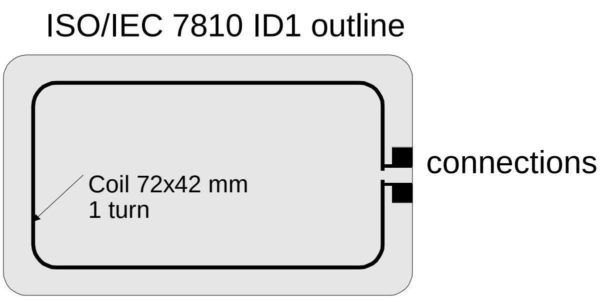


Figure 3 — Calibration coil

6.1.2 Thickness and material of the Calibration coil card

The thickness of the calibration coil card shall be 0,76 mm +/-10%. It shall be constructed of a suitable insulating material.

6.1.3 Coil characteristics

The coil on the Calibration coil card shall have one turn. The outer size of the coil shall be 72 mm (± 2%) x 42 mm (± 2%) with corner radius 5 mm. (The area over which the field is integrated is 3000 mm^2).
The coil is made as a printed coil on PCB plated with 35 µm copper.

Track width shall be 500 µm ± 20%. The size of the connection pads shall be 1,5 mm x 1,5 mm.

NOTE At 13,56 MHz the nominal inductance is 200 nH and the nominal resistance is 0,25 Ohm.

A high impedance oscilloscope probe (e.g. >1MOhm, <14pF) shall be used to measure the (open circuit) voltage in the coil. The resonance frequency of the whole set (calibration coil, connecting leads and probe) shall be above 60 MHz.

NOTE A parasitic capacitance of the probe assembly of less than 35 pF normally ensures a resonant frequency for the whole set of greater than 60 MHz.

The open circuit calibration factor for this coil is 0,32 Volts (rms) per A/m (rms).
[Equivalent to 900 mV (peak-to-peak) per A/m (rms)]

NOTE The signal on the terminals of the calibration coil should be measured with a high impedance probe which does not load the coil significantly.

6.2 Test VCD assembly

The test apparatus for load modulation consists of a 150 mm diameter VCD antenna and two parallel sense coils: sense coil a and sense coil b. The schematic is shown in Figure 4. The sense coils are connected such that the signal from one coil is in opposite phase to the other. The 50 Ohm potentiometer P1 in series with two 220 Ohm resistors serves to fine adjust the balance point when the sense coils are not loaded by a VICC or any magnetically coupled circuit. The capacitive load of the probe including its parasitic capacitance shall be less than 14pF.

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

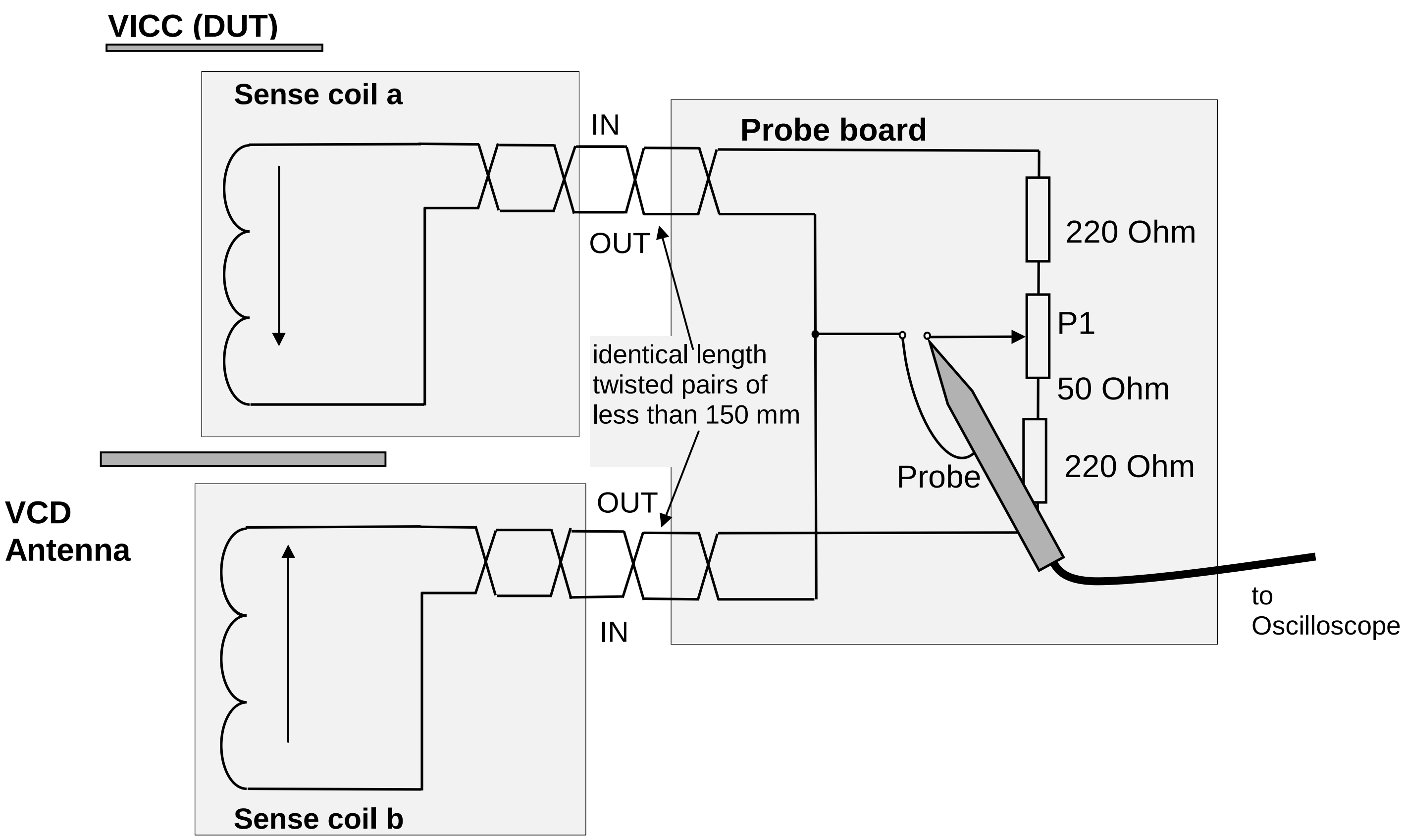


Figure 4 — Load modulation test circuit

6.2.1 Test VCD antenna

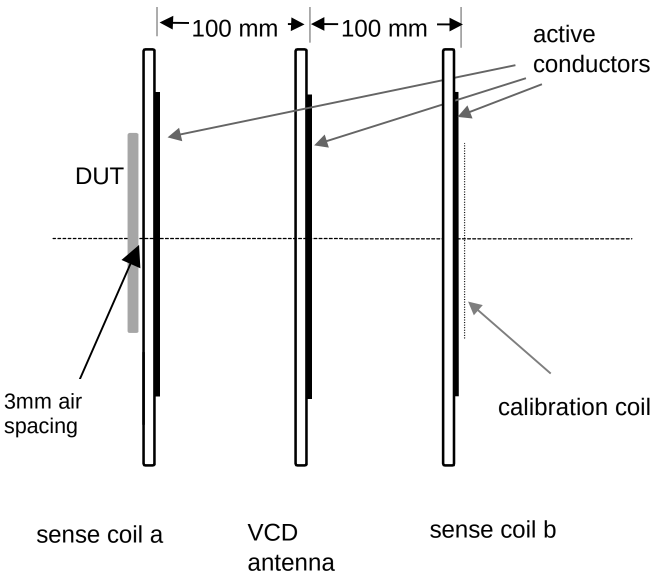
The Test VCD antenna shall have a diameter of 150 mm and its construction shall conform to the drawings in Annex A. The tuning of the antenna may be accomplished with the procedure given in Annex B.

6.2.2 Sense coils

The size of the sense coils is 100 x 70 mm. The sense coil construction shall conform to the drawings in Annex C.

6.2.3 Assembly of test VCD

The sense coils and Test VCD antenna are assembled parallel and with the sense and antenna coils coaxial and such that the distance between the active conductors is 100 mm as in Figure 5.



NOTE : The distance of 100 mm reflects larger read distance and avoids parasitic effects such as detuning by closer spacing or ambiguous results due to noise and other environmental effects.

Figure 5 — Test VCD assembly

6.3 Reference VICC

Reference VICC's are defined to test the ability of a VCD
- to power a VICC
- to detect the minimum load modulation signal from the VICC.

6.3.1 Reference VICC for VCD power

The schematic for the power test is shown in Annex D. Power dissipation can be set by the resistor R_1 or R_2 respectively in order to measure H_{min} and H_{max} as defined in clause 8.1.2. The resonant frequency can be adjusted with C_2.

6.3.2 Reference VICC for load modulation test

The schematic for the load modulation test is shown in Annex E. The load modulation can be chosen to be resistive or reactive.

This Reference VICC is calibrated by using the Test VCD assembly as follows: The Reference VICC is placed in the position of the DUT (Device under test). The load modulation signal amplitude is measured as described in clause 7.2. This amplitude should correspond to the minimum amplitude at all values of field strength required by the base standard.

6.3.3 Dimensions of the Reference VICC

The reference VICC consists of an area containing the coils which has the height and width defined in ISO/IEC 7810 for ID1 type. An area external to this, containing the circuitry which emulates the required VICC functions, is appended in a way as to allow insertion into the test setups described below and so as to cause no interference to the tests. The dimensions shall be as in Figure 6.

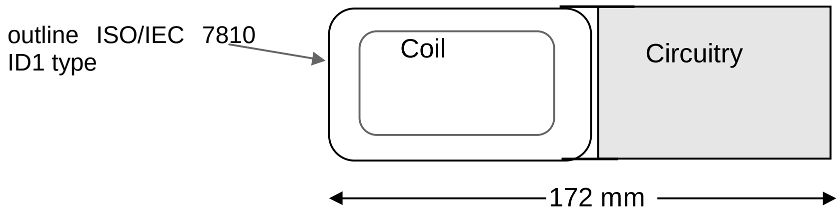


Figure 6 — Reference VICC dimensions

6.3.4 Thickness of the Reference VICC board

The thickness of the reference VICC active area shall be 0,76 mm +/-10%.

6.3.5 Coil characteristics

The coil in the active area of the reference VICC shall have 4 turns and shall be concentric with the area outline.
The outer size of the coils shall be 77 mm ± 2% x 47 mm ± 2%.
The coil is printed on PCB plated with 35 µm copper.
Track width and spacing shall be 500 µm ± 20%.

NOTE At 13,56 MHz the nominal inductance is 3,5 µH and the nominal resistance is 1 Ohm.

6.4 Digital sampling oscilloscope

The Digital sampling oscilloscope shall be capable of sampling at a rate of at least 100 million samples per second with a resolution of at least 8 bits at optimum scaling. The oscilloscope should have the capability to output the sampled data as a text file to facilitate mathematical and other operations such as windowing on the sampled data using external software programmes (Annex F).

7 Functional test - VICC

7.1 Purpose

The purpose of this test is to determine the amplitude of the VICC load modulation signal within the operating field range specified in clause 6.2 of the base standard and the functionality of the VICC with the modulation under emitted fields as defined in Figure 1 and Figure 2 of ISO/IEC 15693-2, clause 7.1, of the base standard.

7.2 Test procedure

Step 1: The load modulation test circuit of Figure 4 and the Test VCD assembly of Figure 5 are used.

The current in the VCD antenna shall be adjusted to the required field strength and modulation waveforms as measured by the calibration coil without any VICC. The output of the load modulation test circuit of Figure 4 is connected to a digitizing sampling oscilloscope. The 50 Ohm potentiometer shall be trimmed to minimise the residual carrier. This signal shall be at least 40 dB lower than the signal obtained by shortening one sense coil.

Step 2: The VICC under test shall be placed in the DUT position, concentric with sense coil **a**. The current of the VCD antenna has to be re-adjusted to the required field strength.

NOTE The waveform of the subcarrier load modulation fc is sampled with at least 100 million samples per second with a resolution of at least 8 bits at optimum scaling of the digitizing oscilloscope.

Exactly two subcarrier cycles of the sampled modulation waveform shall be Fourier transformed. A discrete Fourier transformation with a scaling such that a pure sinusoidal signal results in its peak magnitude shall be used. To minimize transient effects, a subcarrier cycle immediately following a non-modulating period must be avoided. In case of two subcarrier frequencies this procedure shall be repeated for the second subcarrier frequency.

The resulting amplitudes of the two upper sidebands at fc+ fs1 and fc+fs2 and the two lower sidebands at fc- fs1 and fc-fs2 respectively shall be above the value defined in clause 8.1 of the base standard.

An appropriate command sequence as defined in 15693-3 shall be sent by the Reference VCD to obtain a signal or load modulation response from the VICC.

7.3 Test report

The test report shall give the measured amplitudes of the upper sidebands at fc+ fs1 and fc+fs2 and the lower sidebands at fc-fs1 and fc-fs2.

8 Functional test - VCD

8.1 VCD field strength and Power transfer

8.1.1 Purpose

This test measures the field strength produced by a VCD in the operating volume. The test procedure of clause 8.1.2 is also used to determine that the VCD generates a field not higher than the value specified in ISO/IEC 15693-1.
This test uses a reference VICC as defined in Annex D to determine that a specific VCD to be tested is able to supply a certain power to a VICC placed anywhere within the defined operating volume.

8.1.2 Test procedure

Procedure for H_{max} test:

1. Tune the Reference VICC to 13,56 MHz.

NOTE: The resonance frequency of the test VICC is measured by using an impedance analyser or a LCR-meter connected to a calibration coil. The coil of the test VICC should be placed on the calibration coil as close as possible, with the axes of the two coils being congruent. The resonance frequency is that frequency at which the reactive part of the measured complex impedance is at maximum.

2. Set Jumper J1 to position b to activate R_2 .

3. Position the Reference VICC within the defined operating volume of VCD under test.

4. The DC voltage (V_{DC}) across resistor is measured with a high impedance voltmeter and shall not exceed 3 Volts where the load resistor parallel to the coil L set to R_2 and the fieldstrength equals H_{max}.

Procedure for H_{min} test:

1. Tune the Reference VICC to 13,56 MHz.

2. Set Jumper J1 to position a to activate R_1 .

3. Position the Reference VICC within the defined operating volume of the VCD under test.

4. The DC voltage (V_{DC}) across resistor R_3 is measured with a high impedance voltmeter and shall exceed 3 Volts where the load resistor parallel to the coil L set to R_2 and the fieldstrength equals H_{min}.

8.1.3 Test report

The test report shall give the measured values for V_{DC} at H_{min} and H_{max} under the defined conditions.

8.2 Modulation index and waveform

8.2.1 Purpose

This test is used to determine the index of modulation of the VCD field as well as its rise-, fall-, and overshoot values as defined in Figure 1 and Figure 2 of ISO/IEC 15693-2 within the defined operating volume.

8.2.2 Test procedure

The Calibration coil is positioned anywhere in the defined operating volume, and the modulation index and waveform characteristics are determined from the induced voltage on the coil displayed on a suitable oscilloscope.

8.2.3 Test report

The test report shall give the measured modulation index of the VCD field and the rise-, fall-, and overshoot values as defined in Figure 1 and Figure 2 of ISO/IEC 15693-2 within the defined volume.

8.3 Load modulation reception (informative only)

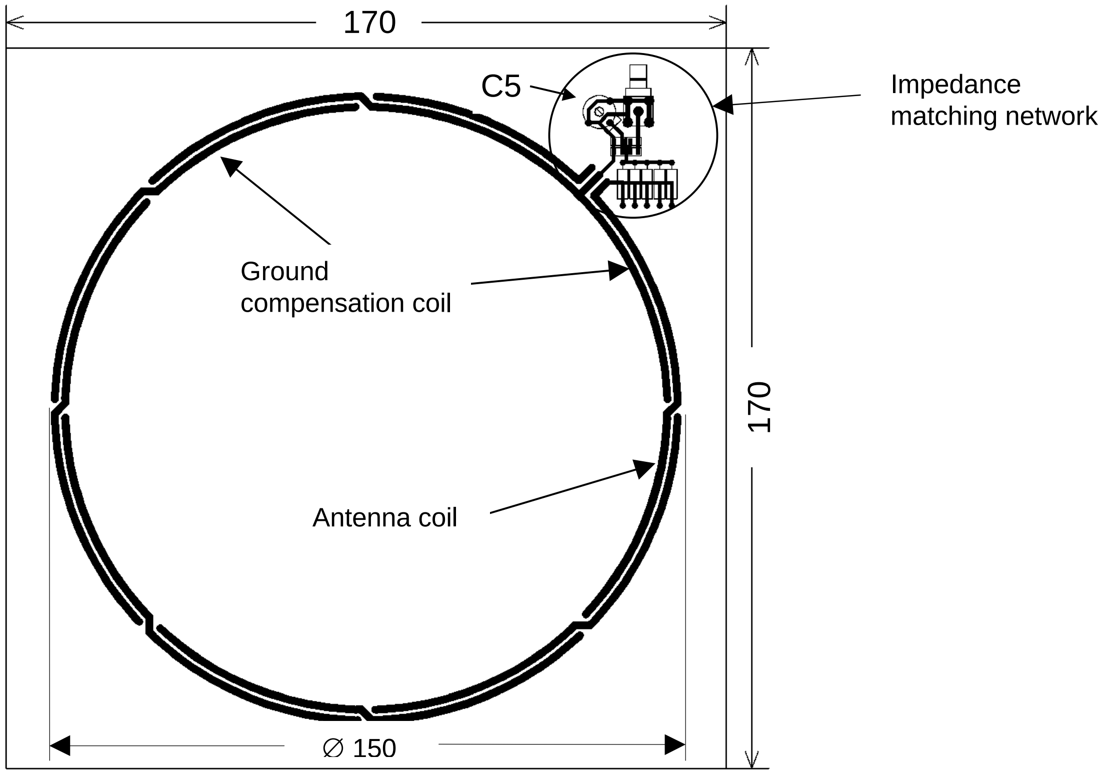
This test may be used to verify that a VCD correctly detects the load modulation of a VICC which conforms to the base standard. It is supposed that the VCD has means to indicate correct reception of the subcarrier(s) produced by a test VICC.

Annex E shows a circuit which can be used in conjunction with the test apparatus to determine the sensitivity of a VCD to load modulation within the defined operating volume.

Annex A
(normative)

Test VCD Antenna

A1 Test VCD Antenna layout including impedance matching network



Dimensions in millimetres (Drawings are not to scale).

Note: The antenna coil track width is 1,8 mm.
Starting from the impedance matching network there are crossovers every 45°.
PCB: FR4 material thickness 1,6 mm, double sided with 35 µm copper.

Figure A.1 — Test VCD antenna layout including impedance matching network (View from front)

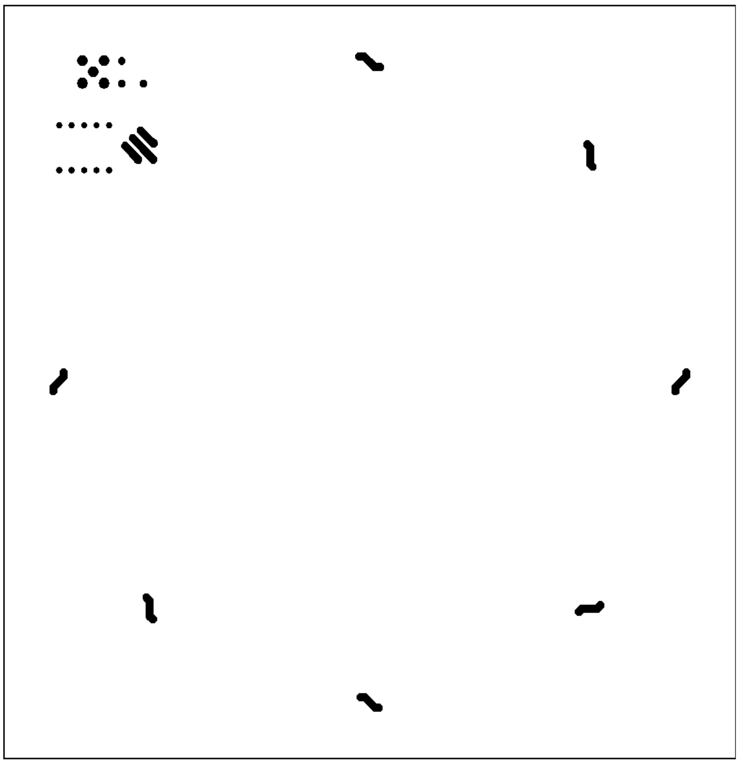
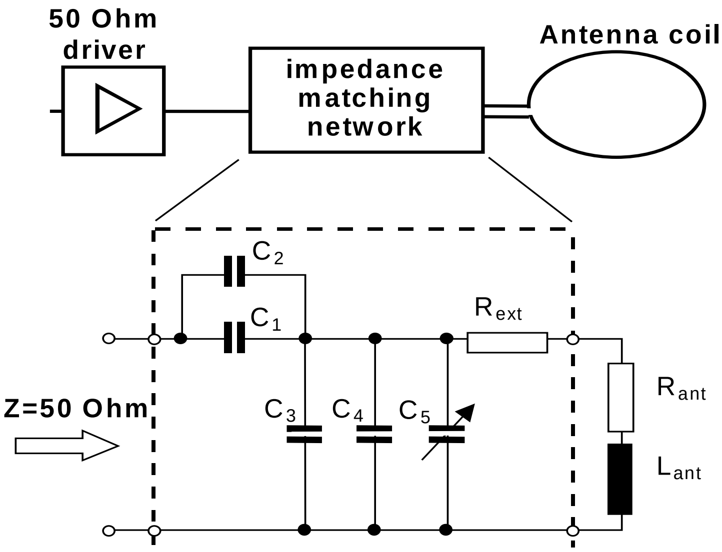


Figure A.2 — VCD Antenna Layout (View from back)

A.2 Impedance matching network

The antenna impedance is adapted to the function generator output impedance (50 Ohm) by a matching circuit (see below). The capacitors C_1, C_2, C_3 and C_4 have fixed values. The input impedance phase can be adjusted with the variable capacitor C_5.

NOTE: Care has to be taken to keep maximum voltages and maximum power dissipation within the specified limits of the individual components.



Component Table:

	Value	Unit
C_1	39	pF
C_2	8,2	pF
C_3	180	pF
C_4	33	pF
C_5	2-27	pF
Rext	5x4.7 (parallel)	Ohm

Figure A3 – Impedance matching network

Annex B
(informative)

Test VCD Antenna tuning

The figures below show the two steps of a simple phase tuning procedure to match the impedance of the antenna to that of the driving generator. After the two steps of the tuning procedure the signal generator should be directly connected to the antenna output for the tests.

Step 1:

A high precision resistor of 50 Ohm (e.g. 50 Ohm BNC terminating resistor) is inserted in the ground line between the signal generator output and an antenna connector. The two probes of the oscilloscope are connected to the function generator output and in parallel to the serial reference resistor. The oscilloscope displays a Lissajous figure when it is set in Y to X presentation. The function generator is set to:

Wave form: Sinusoidal

Frequency : 13,56 MHz

Amplitude: 2V - 5V rms

The probe, which is connected in parallel to the reference resistor has a small parasitic capacitance Cprobe.
A calibration capacitor Ccal in parallel to the output connector compensates this probe capacitor if Ccal = Cprobe. The output is terminated with a second high precision resistor of 50 Ohm (+/-1%) (e.g. 50 Ohm BNC terminating resistor). The probe capacitor is compensated when the Lissajous figure is completely closed.

NOTE: The ground cable has to be run close to the probe to avoid induced voltages caused by the magnetic field.

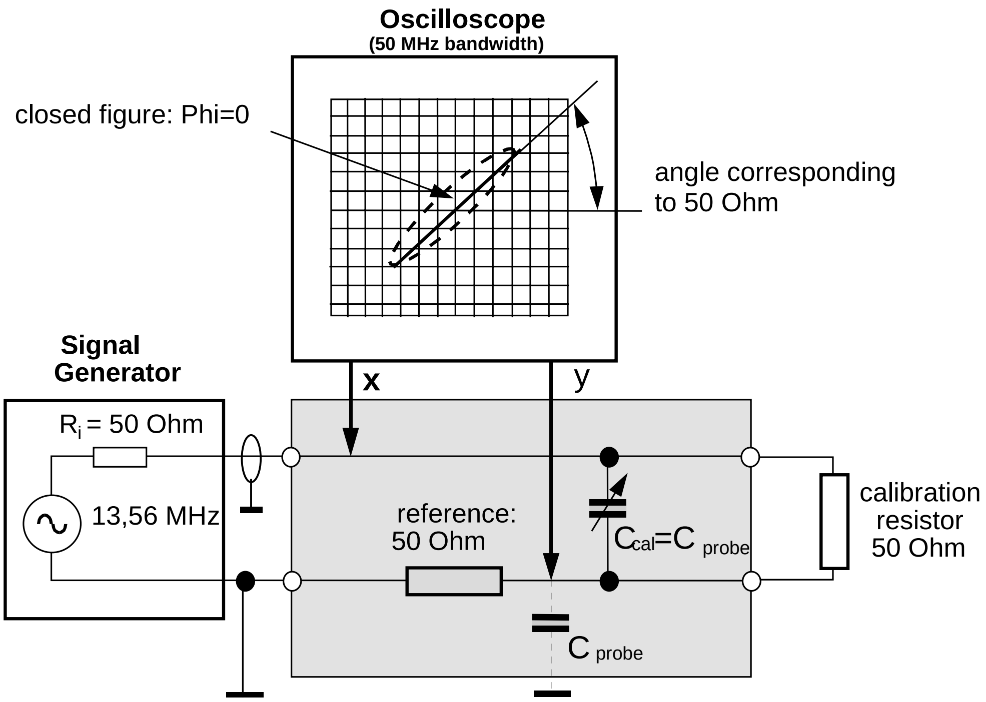


Figure B1 – Calibration set up (Step 1)

Step 2:

Using the same values as set for step 1, in the second step the matching circuitry is connected to the antenna output. The capacitor C_5 on the antenna board is used to tune the phase to zero.

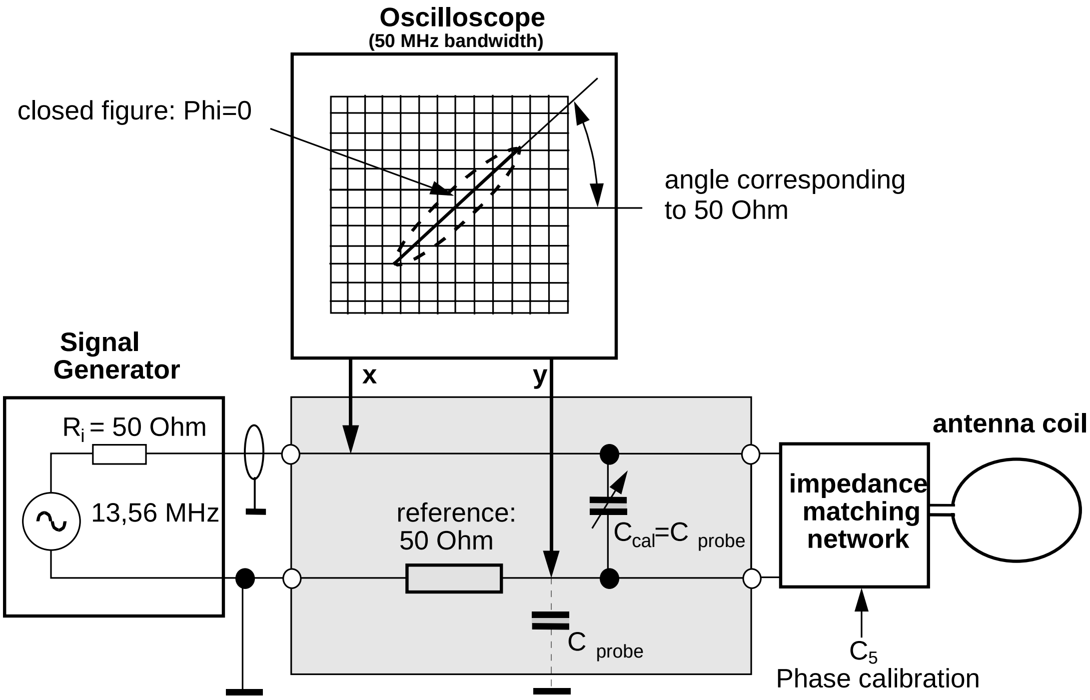
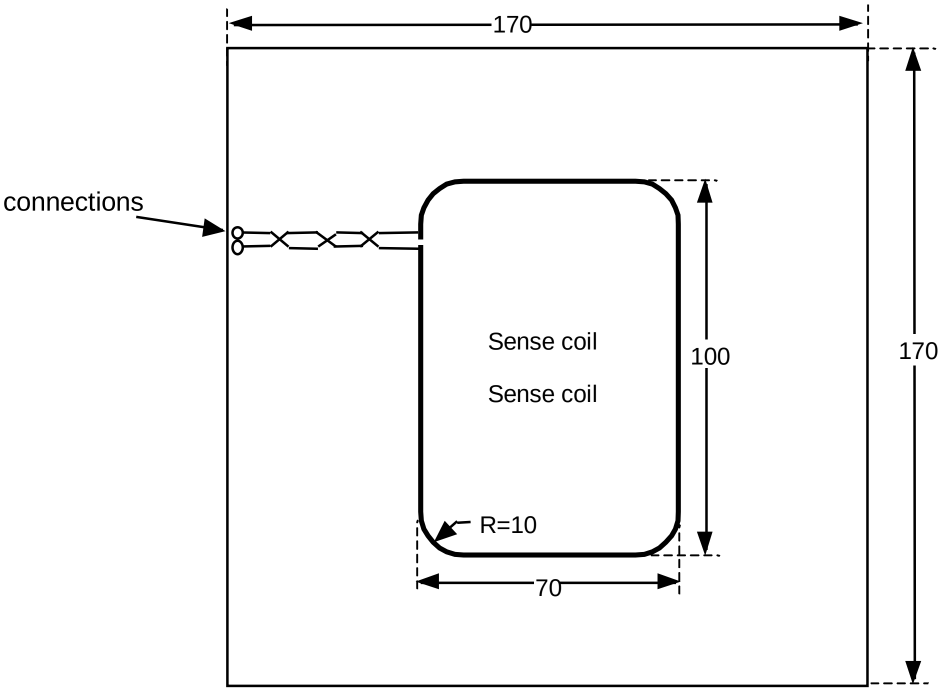


Figure B2 – Calibration Set up (Step 2)

Annex C
(normative)

Sense Coil

C.1 Sense coil layout



Dimensions in millimeters (Drawings are not to scale).

NOTE: PCB: FR4 material thickness 1,6 mm. The coils are made as printed coils plated with 35 µm copper. Sense track width 0,5 mm ±20%. Sizes of the coils refer to the outer dimensions.

Figure C1 – Sense coil layout

C.2 Sense coil assembly

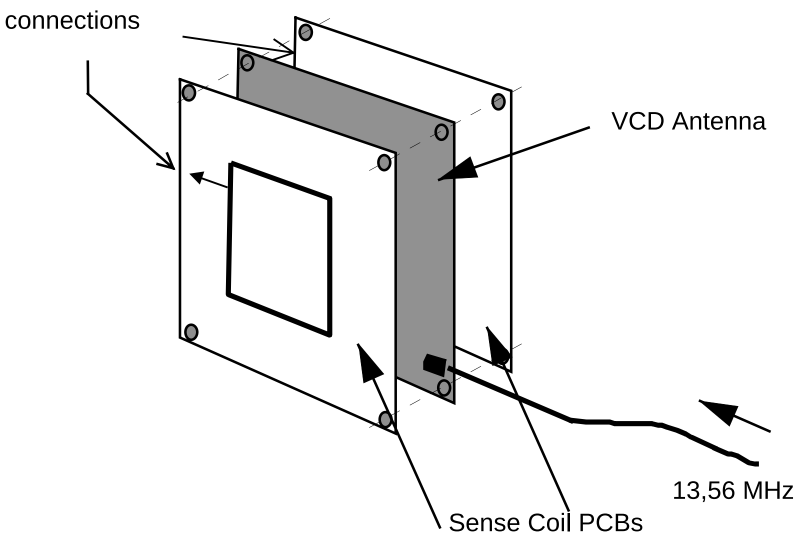
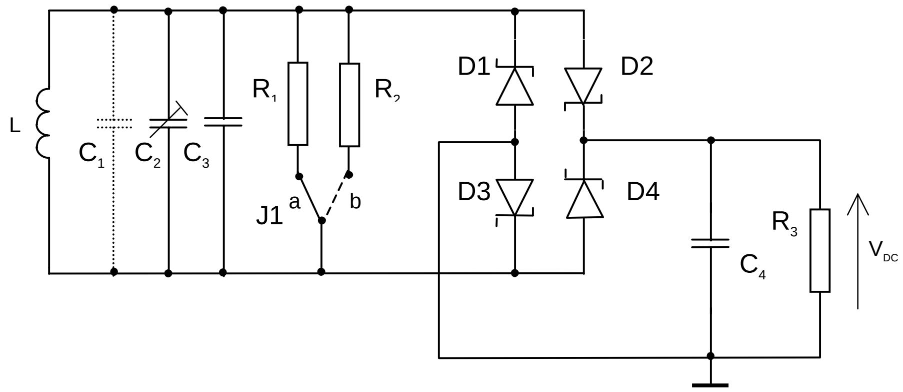


Figure C2 – Sense coil assembly

Annex D
(normative)

Reference VICC for VCD power test



Jumper settings:

J1 a: min. fieldstrength
b: max. fieldstrength

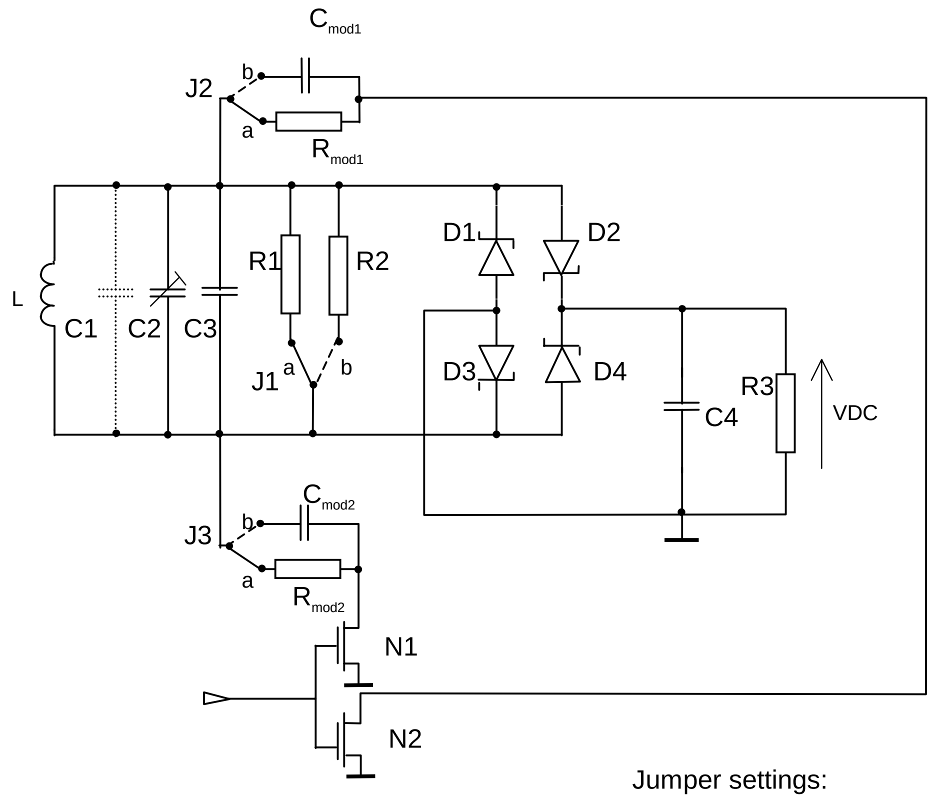
Components list

Component	Value
L (coil)	See clause 6.3.5
C_1	Stray capacitance ~5pF
C_2	2 … 10 pF
C_3	27 pF
C_4	10 nF
D1, D2, D3, D4	BAR43 or equivalent
R_1	11 kOhm
R_2	91 Ohm
R_3	100 kOhm

Figure D1 – Circuit diagram for Reference VICC

Annex E
(informative)

Reference VICC for load modulation test



Jumper settings:

J1 a: min. fieldstrength
b: max. fieldstrength

J2, J3 a: resistive load
b: capacitive load

Components list

Component	Value
R1	11 kOhm
R2	91 Ohm
R3	100 kOhm
D1, D2, D3, D4	BAR43 or equivalent
L	See 6.3.5
C1	Stray capacitance ~ 5 pF
C2	2 … 10 pF
C3	27 pF
C4	10 nF
N1, N2	N-MOS Transistor with low parasitic capacitance
Rmod1, Rmod2	to be defined
Cmod1, Cmod2	to be defined

Figure E1 – Circuit diagram for Reference VICC for load modulation test

Annex F
(informative)

Programme for the evaluation of the spectrum

The following program gives an example for the calculation of the magnitude of the spectrum from the VICC.

TO BE INCLUDED AFTER FCD