

INTERNATIONAL STANDARD



BASIC EMC PUBLICATION

**Electromagnetic compatibility (EMC) –
Part 4-6: Testing and measurement techniques – Immunity to conducted
disturbances, induced by radio-frequency fields**

[IEC 61000-4-6:2023](https://standards.iteh.ai/catalog/standards/sist/ec740baa-1ef8-45f1-9591-318e73359c7b/iec-61000-4-6-2023)

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CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	10
3 Terms and definitions	10
4 General	12
5 Test levels.....	15
6 Test equipment and level adjustment procedure	17
6.1 Test generator	17
6.2 Coupling and decoupling devices.....	19
6.2.1 General	19
6.2.2 Coupling/decoupling networks (CDNs).....	24
6.2.3 Clamp injection devices	26
6.2.4 Direct injection devices.....	30
6.2.5 Decoupling networks	30
6.3 Verification of the common-mode impedance at the EUT port of coupling and decoupling devices	30
6.3.1 General	30
6.3.2 Insertion loss of the 150 Ω to 50 Ω adapters	31
6.4 Setting of the test generator.....	34
6.4.1 General	34
6.4.2 Setting of the output level at the EUT port of the coupling device	35
7 Test setup and injection methods	38
7.1 Test setup.....	38
7.2 EUT comprising a single unit.....	39
7.3 EUT comprising several units.....	42
7.4 Rules for selecting injection methods and test points	44
7.4.1 General	44
7.4.2 Injection method	44
7.4.3 Ports to be tested	46
7.5 CDN injection application	47
7.6 Clamp injection application when the common mode impedance requirements can be met.....	48
7.7 Clamp injection application when the common mode impedance requirements cannot be met.....	48
7.6 Clamp injection application	52
7.7 Direct injection application	53
8 Test procedure	54
9 Evaluation of the test results	55
10 Test report.....	56
Annex A (normative) EM and decoupling clamps.....	57
A.1 EM clamps	57
A.1.1 General	57
A.1.2 Typical Specification of EM clamps.....	57
A.2 EM clamp characterization.....	60
A.2.1 Specification of the clamp test jig	60

A.2.2	Clamp characterization	61
A.3	Decoupling clamp characterization	66
A.3.1	General	66
A.3.2	Specification of decoupling clamps	66
A.3.3	Impedance	66
A.3.4	Decoupling factor	67
Annex B (informative)	Selection criteria for the frequency range of application	69
Annex C (informative)	Guidelines for selecting test levels	71
Annex D (informative)	Information on coupling and decoupling networks	72
D.1	Basic features of the coupling and decoupling networks	72
D.2	Examples of coupling and decoupling networks	72
Annex E (informative)	Information for the test generator specification	77
Annex F (informative)	Test setup for large EUTs	78
F.1	General	78
F.2	Test setup for large EUTs	78
Annex G (informative)	Measurement uncertainty of the voltage test level	81
G.1	General	81
G.2	General symbols	81
G.3	Uncertainty budgets for test methods	81
G.3.1	Definition of the measurand	81
G.3.2	MU contributors of the measurand	82
G.3.3	Input quantities and calculation examples for expanded uncertainty	83
G.4	Expression of the calculated measurement uncertainty and its application	91
G.5	Bibliography	91
Annex H (informative)	Measurement of AE impedance	96
Annex H (informative)	Testing with multiple signals	96
H.1	General	96
H.2	Intermodulation	96
H.3	Power requirements	97
H.4	Level-setting requirements	98
H.5	Linearity check and harmonics checks of the test generator	98
H.6	EUT performance criteria with multiple signals	98
Annex I (informative)	Port-to-port injection	99
I.1	General	99
I.2	Test setup for injection on identical ports	99
I.2.1	Selection of ports	99
I.2.2	Procedure for port-to-port injection	99
Annex J (informative)	Amplifier compression and non-linearity	101
J.1	Objective of limiting amplifier distortion	101
J.2	Possible problems caused by harmonics and saturation	101
J.3	Limiting the harmonic content in the disturbance signal	101
J.4	Effect of linearity characteristic on the immunity test	102
J.4.1	General	102
J.4.2	Evaluation of the amplifier linearity characteristic	102
Bibliography	106

Figure 1 – Diagram showing EM fields near the EUT due to common-mode currents on its cables 13

Figure 2 – Schematic setup for immunity test to RF conducted disturbances.....	15
Figure 2 – Open circuit waveforms at the EUT port of a coupling device for test level 1.....	15
Figure 3 – Example of unmodulated and modulated RF signal	17
Figure 4 – Test generator setup	18
Figure 5 – Principle of coupling and decoupling – Symbols used for the indicated setup principles.....	21
Figure 6 – Principle of coupling and decoupling – Principle of direct injection to screened cables.....	22
Figure 7 – Principle of coupling and decoupling – Principle of coupling to unscreened cables according to the CDN method	23
Figure 8 – Principle of coupling and decoupling – Principle of decoupling	24
Figure 5 – Principle of coupling and decoupling according to the clamp injection method	24
Figure 9 – Example of circuit for level-setting setup in a 150 Ω test jig.....	28
Figure 7 – Example circuit for evaluating the performance of the current clamp	28
Figure 10 – Example of circuit for evaluating the performance transmission loss of the current clamp level-setting	29
Figure 11 – Example of the setup geometry to verify the impedance characteristics of the coupling and decoupling devices.....	32
Figure 12 – Setup principle to verify Z_{ce} of the coupling and decoupling device.....	33
Figure 13 – Setup principle for measuring the insertion loss of two 150 Ω to 50 Ω adapters	33
Figure 8 – Details of setups and components to verify the essential characteristics of coupling and decoupling devices and the 150 Ω to 50 Ω adapters.....	33
Figure 14 – Circuit and construction of the 150 Ω to 50 Ω adapter	34
Figure 15 – Definition of a common-mode point for unscreened and screened cables.....	37
Figure 16 – Setup for level-setting at the EUT port of the coupling/decoupling devices	38
Figure 17 – Example of test setup with a single unit EUT with only one CDN for injection (top view).....	39
Figure 18 – Example of test setup with a single unit EUT (top view) using multiple CDNs.....	42
Figure 11 – Example of a test setup with a multi-unit EUT (top view)	42
Figure 19 – Example of a test setup with a multi-unit EUT (top view)	44
Figure 20 – Rules for selecting the injection method	46
Figure 21 – Immunity test for two-port EUT (when only one CDN can be used).....	49
Figure 22 – General principle of a test setup using clamp injection devices	53
Figure 23 – Example of the test unit locations on the ground plane when using injection clamps (top view).....	53
Figure A.1 – Example: Construction details of the EM clamp.....	59
Figure A.2 – Example: Concept of the EM clamp	60
Figure A.3 – Dimension of a reference plane	61
Figure A.4 – Test jig	61
Figure A.5 – Test jig with inserted clamp.....	61
Figure A.6 – Impedance / decoupling factor measurement setup	62
Figure A.7 – Typical examples for clamp impedance, three typical clamps.....	64
Figure A.8 – Typical examples for decoupling factors, three typical clamps.....	65

Figure A.9 – Normalization setup for coupling factor measurement	65
Figure A.10 – S_{21} coupling factor measurement setup	65
Figure A.11 – Typical examples for coupling factor, three typical clamps	66
Figure A.12 – Decoupling clamp characterization measurement setup.....	67
Figure A.13 – Typical examples for the decoupling clamp impedance	67
Figure A.14 – Typical examples for decoupling factors.....	68
Figure B.1 – Start frequency as function of cable length and equipment size	70
Figure D.1 – Example of a simplified diagram for the circuit of CDN-S1 used with screened cables (see 6.2.2.5).....	73
Figure D.2 – Example of simplified diagram for the circuit of CDN-M1, CDN-M2 and CDN-M3 used with unscreened supply (mains) lines (see 6.2.2.2)	73
Figure D.3 – Example of a simplified diagram for the circuit of CDN-AF2 used with unscreened unbalanced lines (see 6.2.2.4)	74
Figure D.4 – Example of a simplified diagram for the circuit of CDN-T2, used with an unscreened balanced pair (see 6.2.2.3)	74
Figure D.5 – Example of a simplified diagram of the circuit of CDN-T4 used with unscreened balanced pairs (see 6.2.2.3)	75
Figure D.6 – Example of a simplified diagram of the circuit of CDN AF8 used with unscreened unbalanced lines (see 6.2.2.4)	75
Figure D.7 – Example of a simplified diagram of the circuit of CDN-T8 used with unscreened balanced pairs (see 6.2.2.3)	76
Figure F.1 – Example of large EUT test setup with elevated horizontal reference ground plane.....	79
Figure F.2 – Example of large EUT test setup with vertical reference ground plane	80
Figure G.1 – Example of influences upon voltage test level using CDN	82
Figure G.2 – Example of influences upon voltage test level using EM clamp	82
Figure G.3 – Example of influences upon voltage test level using current clamp	82
Figure G.4 – Example of influences upon voltage test level using direct injection.....	83
Figure G.5 – Circuit for level-setting setup of CDN.....	84
Figure H.1 – Impedance measurement using a voltmeter	84
Figure H.2 – Impedance measurement using a current probe.....	84
Figure H.1 – Test frequencies f_1 and f_2 and intermodulation frequencies of the second and third order	96
Figure I.1 – Example of setup, port-to-port injection	100
Figure J.1 – Amplifier linearity measurement setup	103
Figure J.2 – Linearity characteristic	104
Figure J.3 – Measurement setup for modulation depth	104
Figure J.4 – Spectrum of AM modulated signal	105
Table 1 – Test levels.....	16
Table 2 – Characteristics of the test generator.....	18
Table 3 – Main parameter of the combination of the coupling and decoupling device	19
Table 4 – Usage of CDNs	25
Table B.1 – Main parameter of the combination of the coupling and decoupling device when the frequency range of the test is extended above 80 MHz	69
Table E.1 – Required power amplifier output power to obtain a test level of 10 V	77

Table G.1 – CDN level-setting process	84
Table G.2 – CDN test process	84
Table G.3 – EM clamp level-setting process	87
Table G.4 – EM clamp test process.....	87
Table G.5 – Current clamp level-setting process	88
Table G.6 – Current clamp test process	89
Table G.7 – Direct injection level-setting process.....	90
Table G.8 – Direct injection test process.....	90
Table H.1 – Impedance requirements for the AE.....	
Table H.2 – Derived voltage division ratios for AE impedance measurements.....	
Table H.3 – Derived voltage ratios for AE impedance measurements.....	

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –**Part 4-6: Testing and measurement techniques –
Immunity to conducted disturbances, induced by radio-frequency fields****FOREWORD**

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IEC 61000-4-6 has been prepared by subcommittee 77B: High frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility. It is an International Standard.

It forms Part 4-6 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

This fifth edition cancels and replaces the fourth edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) selection of injection devices revised;
- b) need of AE impedance check for clamp injection removed and Annex H deleted;
- c) saturation check revised;
- d) new Annex H on testing with multiple signals;
- e) level-setting only with feedback loop.

The text of this International Standard is based on the following documents:

Draft	Report on voting
77B/863/FDIS	77B/865/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

<https://standards.iteh.ai/catalog/standards/sist/ec740baa-1ef8-45f1-9591-318e73359c7b/iec-61000-4-6:2023>
This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61000 series, published under the general title *Electromagnetic compatibility (EMC)*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

IEC 61000 is published in separate parts according to the following structure:

Part 1: General

General considerations (introduction, fundamental principles)

Definitions, terminology

Part 2: Environment

Description of the environment

Classification of the environment

Compatibility levels

Part 3: Limits

Emission limits

Immunity limits (in so far as they do not fall under the responsibility of the product committees)

Part 4: Testing and measurement techniques

Measurement techniques

Testing techniques

Part 5: Installation and mitigation guidelines

Installation guidelines

Mitigation methods and devices

Part 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into several parts, published either as international standards or as technical specifications or technical reports, some of which have already been published as sections. Others will be published with the part number followed by a dash and a second number identifying the subdivision (example: IEC 61000-6-1).

This part is an international standard which gives immunity requirements and test procedures related to conducted disturbances induced by radio-frequency fields.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields

1 Scope

This part of IEC 61000 relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 150 kHz up to 80 MHz.

NOTE 1 Product committees might decide to use the methods described in this document also for frequencies up to 230 MHz (see Annex B) although the methods and test instrumentation are intended to be used in the frequency range up to 80 MHz.

Equipment not having at least one conducting wire ~~and/or~~ cable (such as mains supply, signal line or earth connection) which can couple the equipment to the disturbing RF fields is excluded from the scope of this document.

NOTE 2 Test methods are ~~defined~~ specified in this part of IEC 61000 to assess the effect that conducted disturbing signals, induced by electromagnetic radiation, have on the equipment concerned. The simulation and measurement of these conducted disturbances are not adequately exact for the quantitative determination of effects. The test methods ~~defined~~ specified are structured for the primary objective of establishing adequate repeatability of results at various facilities for quantitative analysis of effects.

The object of this document is to establish a common reference for evaluating the functional immunity of electrical and electronic equipment when subjected to conducted disturbances induced by RF fields. The test method in this document describes a consistent method to assess the immunity of an equipment or system against a ~~defined~~ specified phenomenon.

NOTE 3 As described in IEC Guide 107, this document is a basic EMC publication for use by product committees of the IEC. As also stated in Guide 107, the IEC product committees are responsible for determining whether this immunity test standard should be applied or not, and if applied, they are responsible for determining the appropriate test levels and performance criteria.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 60050 (all parts), International Electrotechnical Vocabulary (IEV) (available at <<http://www.electropedia.org>>)~~

CISPR 16-1-2, Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements

3 Terms and definitions

~~For the purposes of this document, the terms and definitions given in IEC 60050-161 as well as the following apply.~~

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 artificial hand

AH

electrical network simulating the impedance of the human body under average operational conditions between a hand-held electrical appliance and earth

Note 1 to entry: The construction should be in accordance with CISPR 16-1-2.

[SOURCE: IEC 60050-161:1990, 161-04-27, modified – the note has been added.]

3.2 auxiliary equipment

AE

equipment necessary to provide the equipment under test (EUT) with the signals required for normal operation ~~and equipment to verify the performance of the EUT~~

Note 1 to entry: Auxiliary equipment can be useful for monitoring the EUT.

3.3 clamp injection

~~clamp injection is obtained by means of a clamp-on “current” injecting device on the cable~~

method of injecting signals onto cables using a clamp injection device

3.4 clamp injection device

clamp-on ~~“current” injecting device on a cable being~~ signal injecting device that is either a current clamp or an electromagnetic clamp

3.4.1 current clamp

transformer, the secondary winding of which consists of the cable into which the injection is made

3.4.2 electromagnetic clamp

EM clamp

injection device with combined capacitive and inductive coupling

3.5 common-mode impedance

ratio of the common-mode voltage and the common-mode current at a certain port

Note 1 to entry: This common-mode impedance can be determined by applying a unity common-mode voltage between the terminal(s) or screen of that port and a reference plane (point). The resulting common-mode current is then measured as the ~~vectorial~~ vectorial sum of all currents flowing through these terminal(s) or screen (see also Figure 15a) and Figure 15b)).

3.6 coupling factor

ratio ~~given~~ determined by the open-circuit voltage (e.m.f.) obtained at the EUT port of the coupling (and decoupling) device divided by the open-circuit voltage obtained at the output of the test generator

3.7 coupling network coupling device

electrical circuit or device for transferring energy from one circuit to another with a ~~defined~~ specified impedance

Note 1 to entry: Coupling and decoupling devices can be integrated into one box (coupling and decoupling network (CDN)) or they can be in separate networks.

3.8 coupling/decoupling network CDN

electrical circuit incorporating the functions of both the coupling and decoupling networks

3.9 decoupling network decoupling device

electrical circuit or device for preventing test signals applied to the EUT from affecting other devices, equipment or systems that are not under test

3.10 test generator

generator (RF generator, modulation source, attenuators, broadband power amplifier and filters) capable of generating the required test signal

SEE: Figure 4. standards.iteh.ai/catalog/standards/sist/ec740baa-1ef8-45f1-9591-318e73359c7b/iec-61000-4-6-2023

3.11 electromotive force e.m.f.

voltage at the terminals of the ideal voltage source in the representation of an active element

3.12 measurement result

U_{mr}
voltage reading of the measurement equipment

3.13 voltage standing wave ratio VSWR

ratio of a maximum to an adjacent minimum voltage magnitude along the line

4 General

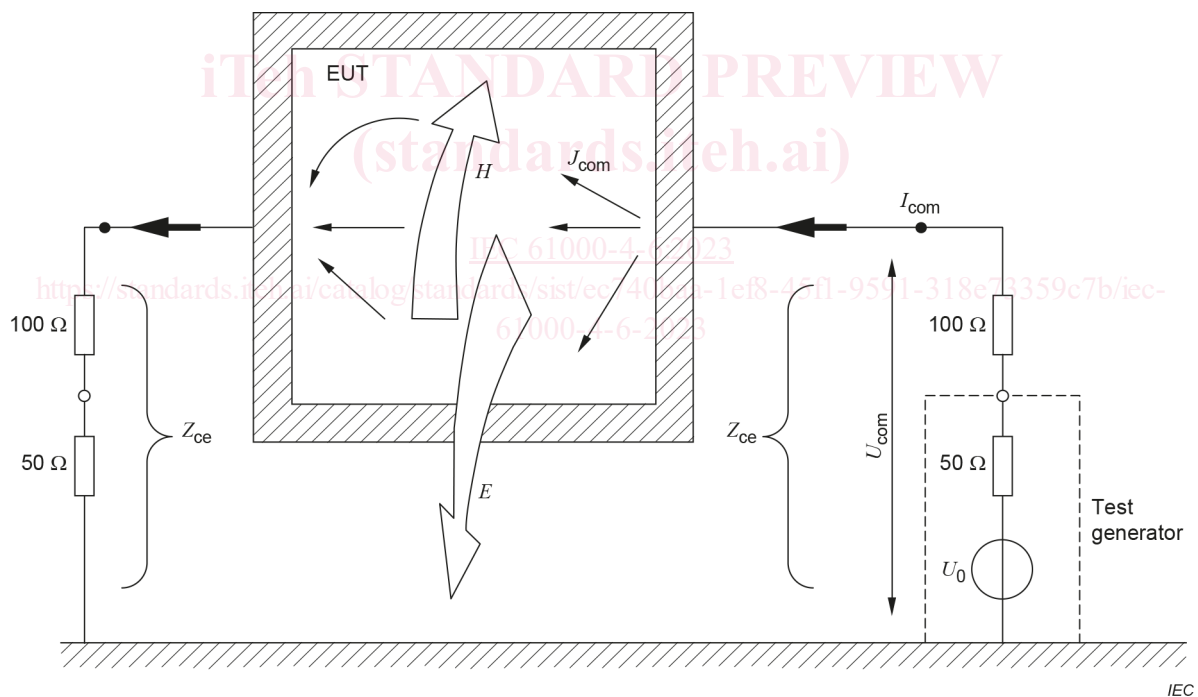
The source of disturbance covered by this document is basically an electromagnetic field, coming from intended RF transmitters, that ~~may~~ can act on the whole length of cables connected to installed equipment. The dimensions of the disturbed equipment, mostly a sub-part of a larger system, are assumed to be small compared with the wavelengths of the interfering signals. The leads entering and exiting the EUT (e.g. mains, communication lines, interface cables) behave as passive receiving antenna networks and signal conduction paths for both intentional and unintentional signals.

Between those cable networks, the susceptible equipment is exposed to currents flowing "through" the equipment. Cable systems connected to an equipment are assumed to be in resonant mode ($\lambda/4$, $\lambda/2$ open or folded dipoles) and as such are represented by coupling and decoupling devices having a common-mode impedance of $150\ \Omega$ with respect to a reference ground plane. ~~Where possible the EUT is tested by connecting it~~ For the method described herein, the EUT is connected between two $150\ \Omega$ common-mode impedance connections: one providing an RF source and the other providing a return path for the current.

This test method subjects the EUT to a source of disturbance comprising electric and magnetic fields, simulating those coming from intentional RF transmitters. These disturbing fields (E and H) are approximated by the electric and magnetic near-fields resulting from the voltages and currents caused by the test setup as shown in Figure 1.

The use of coupling and decoupling devices to apply the disturbing signal to one cable at a time, while keeping all other cables nonexcited (see Figure 2), can only approximate the real situation where disturbing sources act on all cables simultaneously, with a range of different amplitudes and phases.

Coupling and decoupling devices are ~~defined by their characteristics given~~ specified in 6.2. Any coupling and decoupling device fulfilling these characteristics can be used. The CDNs in ~~Annex D~~ Annex C are only examples of commercially available networks.



Z_{ce} Common-mode impedance of the CDN, $Z_{ce} = 150\ \Omega$

U_0 Test generator source voltage (e.m.f.)

U_{com} Common-mode voltage between EUT and reference plane

I_{com} Common-mode current through the EUT

J_{com} Current density on conducting surface or current on other conductors of the EUT

E, H Electric and magnetic fields

NOTE The $100\ \Omega$ resistors are included in the CDNs. The left input is loaded by a (passive) $50\ \Omega$ load and the right input is loaded by the source impedance of the test generator.

Figure a) 1 – Diagram showing EM fields near the EUT due to common-mode currents on its cables