47A/827A/DTR

DRAFT TECHNICAL REPORT

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Title

Integrated circuits - Measurement of electromagnetic emissions - Part 1-1: General conditions and definitions - Near-field scan data exchange format.

This document is a proposal of the French National Committee concerning an exchange format for near-field scan data. It is intended to facilitate the exchange of data and comparison of results, which today is extremely difficult owing to the large number of data formats used.

During a meeting of IEC SC47A WG9 in Nantes, France, in April 2008, it was agreed that the proposal should become a Draft Technical Report.

The Project Leader, John Shepherd, prepared a document, which was presented at the IEC SC47A WG9 meeting in Tokyo in October 2008. It was decided that the document should first be circulated as a "Document for Comments", in order to collect the technical requirements and points of view of all potential users of the exchange format.

47A/806/DC was circulated on 2008-12-26 and comments were collected in CC_47A_806. After reviewing them during the WG9 meeting in Krakow, Poland, in April 2009, it was decided according to 47A/818/INF that this document would be circulated as DTR.

NOTE: This document cancels and replaces 47A/827/DTR due to the earlier document was circulated showing the markup changes which were not intended.

Near-Field Scan Data Exchange Format

CONTENTS

FOREWORD

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IEC61967-1-1, which is a technical report, has been prepared by subcommittee 47A: Integrated circuits, of IEC technical committee 47: Semiconductor devices.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

[1)] The National Committees are requested to note that for this publication the maintenance result date is 2013

Near-Field Scan Data Exchange Format

INTRODUCTION

Near-field scan measurements, as described for example in IEC 61967-3 or IEC 62132-9, and simulations generate a large amount of data. Many different formats are used for storing the data, thereby rendering its exchange extremely difficult.

The proposed format is intended to facilitate exchange of near-field scan data between industrials, academics, EDA tool vendors and end customers. It is based on the well-known XML format, which is both machine and human readable. Its structure allows the files to be generated and processed on any operating system. In order to limit file size, it is possible to store the information and data in a single file or multiple files. Moreover, the ASCII-based XML format allows the files to be compressed to a very high level with readily available compression software.

The three conventional coordinate systems (Cartesian, cylindrical and spherical) are supported by the proposed exchange format. Information on the device under test, the test set-up, the probe, etc., is also included in the files. Notes and links to external documents allow complex test environments to be well described.

The version of the exchange format described in this document is 1.0. Future revisions will add items, such as new keywords and rules, considered to be "enhancements" to Version 1.0. Consequently, all future revisions will be considered supersets of Version 1.0, allowing backward compatibility.

Near-Field Scan Data Exchange Format

1 Scope

This document provides guidance for exchanging data generated by near-field scan measurements.

The described exchange format could also be used for near-field scan data generated by simulation software.

It should be noted that, although it has been developed for near-field scan, its use is not restricted to this application.

The exchange format can be applied to emission, immunity and impulse immunity near-field scan data in the frequency and time domains.

The scope of the document includes neither the methods used for the measurements or simulations, nor the software and algorithms used for generating the exchange file or for processing or viewing the data contained therein.

2 Terms and definitions

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

2.1
NFS

Near-field scan

2.2
XML
eXtensible Markup Language

2.3
Section
A section is an XML element placed one level below the root element or within another section. It contains one or more XML elements, but no value.

2.4
Parent
A parent refers to a keyword which is one level above another keyword (child).

2.5
Child
A child refers to a keyword which is one level below another keyword (parent).

3 General syntax rules and guidelines

3.1 General

The following rules and guidelines ensure that files intended for exchange will be correctly recognised and processed by viewers and processors. Examples of XML files conforming to the present exchange format are given in Annex A

3.2 XML requirements

3.2.1 General

This exchange format uses eXtensible Markup Language (XML) 1.0 (Fourth Edition) to structure the information. XML is derived from the Standard Generalized Markup Language (SGML) (ISO 8879).

The rules below ensure that the NFS files can be parsed correctly by an XML parser.

3.2.2 XML declaration

Although the XML declaration is optional in an XML file, the near-field scan file should include an XML declaration, dedicated to basic XML parsers. An NFS file parser does not interpret this header.

A file header example is given below:

```
<?xml version="1.0" encoding="UTF-8"?>
```

The XML declaration shall be the first line of the file.

3.2.3 XML elements

All information is saved in the form of XML elements. Each element starts with a start-tag and ends with an end-tag. The start-tag consists of a keyword enclosed in triangular brackets, “<Keyword>”. The end-tag consists of the same keyword prefixed by the character "/" and enclosed in brackets, “</Keyword>”. Content in the form of text is enclosed by a start-tag and an end-tag.

An example of an element is given below:

```
<Keyword>        <!—- start-tag -->
      text       <!-- content -->
</Keyword>       <!—- end-tag -->
```

It is also allowed to write an element on the same line, for example, to include short content:

```
<Keyword>text</Keyword>
```

The contents of an element may consist of one or more other elements or a value (numerical, or alphanumerical). For clarity, tab characters may be used for indenting. Except when used for surrounding keywords, triangular brackets "<" and ">" shall not be part of content.

An empty element may be included to indicate that a particular keyword exists, but has no content:

```
<empty_element/>
```

3.2.4 Root element

The XML file shall contain one, and only one, root element. It encloses all the other elements and is therefore the sole parent element to all the other elements. The start-tag of the root element is placed at the beginning of the file or after the XML declaration when present. The end-tag of the root element is at the last entry of the file.

3.2.5 Comments

Comments may be inserted into the file between “<!--” and “-->”. An example is given below:

```
<!-- this line is a comment -->
```

Comments can be inserted anywhere in the file, except inside start- and end-tags, and written on a single line or on several lines. All text enclosed by comment brackets is considered as a comment and may be ignored.

3.2.6 Line terminations

In order to facilitate readability, it is usual to organise the file into lines. The line termination sequence shall be either a linefeed character or a carriage return character followed by a linefeed character.

3.2.7 Element hierarchy

The order of the elements is not important, but their hierarchy must be respected.

Example layout:

```
<Keyword1> ... </Keyword1>
<Keyword2>
      <Keyword21> ... </Keyword21>
      <Keyword22> ... </Keyword22>
</Keyword2>
<Keyword3> ... </Keyword3>
```

An acceptable equivalent layout of the example:

```
<Keyword3> ... </Keyword3>
<Keyword1> ... </Keyword1>
<Keyword2>
      <Keyword22> ... </Keyword22>
      <Keyword21> ... </Keyword21>
</Keyword2>
```

In this layout the order is changed, but the hierarchy is respected.

An unacceptable layout of the example:

```
<Keyword2> ... </Keyword2>
<Keyword22> ... </Keyword22>
<Keyword21> ... </Keyword21>
<Keyword3>
      <Keyword1> ... </Keyword1>
</Keyword3>
```

In this layout the hierarchy is not respected.

3.3 Keyword requirements

3.3.1 General

Keywords, placed in start- and end-tags, are used to introduce descriptions, values and sections that are specific to NFS measurements and simulations. A list of keywords is given in Annex B and a more detailed description of each keyword is given in Annex C. Some keywords, such as Frequencies, Unit, List, etc, may be present in several sections. A parent

keyword is required when a child keyword is present. The rules below ensure that the file can be correctly parsed by an NFS parser.

3.3.2 Keyword characters

Only ASCII characters, as defined in ANSI Standard X3.4-1986, may be used in the files. The use of characters with codes greater than hexadecimal 07E is not allowed. Also, ASCII control characters (those numerically less than hexadecimal 20) are not allowed, except for tabs or in a line termination sequence. For example, the "°" character (ASCII 176) is not permitted. Only alphabetical or numerical characters can be used to write keywords. Spaces are not permitted. If needed, the underscore "_" character can separate the parts of a multi-word keyword.

3.3.3 Keyword syntax

The content of the files is case sensitive. All keywords shall be written in lower case starting with an upper case letter.

3.3.4 Root element keywords

As described in 3.2.4, all elements of the file shall be enclosed within the root element. The following keywords are reserved for root elements and must not be used for any other purposes in the file:

EmissionScan

ImmunityScan

If the proposed XML file format is used for other applications, other keywords may be used in the root element, but NFS parsers may not be able to parse the file.

3.4 File structure

3.4.1 General

The information to be exchanged may be stored in a single XML file or in several XML and data files. The following rules and guidelines ensure that the files can be correctly located by an NFS parser.

3.4.2 File names

To facilitate portability between operating systems, file names should have a base name of no more than forty characters followed by a period ".", followed by a filename extension of no more than three characters. The file name and extension must use characters from the set (space, " ", 0x20 is not included):

```
a b c d e f g h i j k l m n o p q r s t u v w x y z
0 1 2 3 4 5 6 7 8 9 _ ^ $ ~ ! # % & - { } ) ( @ ' `
```

3.4.3 File paths

In order to ensure portability and compressibility, only relative paths can be used to define a path name. An absolute path is not exportable and is not permitted. The relative path must start with "./" to indicate that the path name of the picture file will be appended to the path of the current XML file. It is not permitted to browse to a higher level from the current XML path (e.g. by using "../"). A file name without "./" is assumed to be located in the same directory as the current XML file.

3.4.4 Single XML file

When the information is contained in a single XML file, it shall conform to the rules and guidelines applicable to XML files as described in 3.2.

Data is included in the Data section of the file within the XML element using the keyword: List.

3.4.5 Multiple XML files

The XML document is divided into several sections having the root element as parent. Such a section contains information on a particular part of the NFS environment and is defined by keywords such as Component, Setup, Probe, Data, etc. Each XML file may contain one or more sections and shall conform to the rules and guidelines applicable to XML files as described in 3.2.

In order to ensure portability and compressibility, all the XML files shall be placed in the same directory, as shown in Figure 1. The NFS parser shall parse all the XML files that are in the main directory.

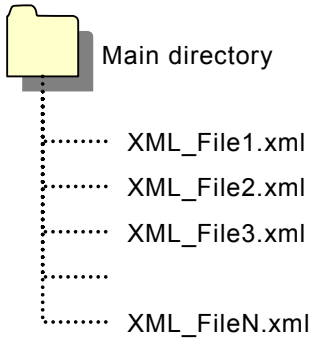

Figure 1 — Multiple XML files

3.4.6 Separate data files

The information may be contained a single or multiple XML files and the data contained in one or more additional data files. The XML files shall conform to the rules and guidelines applicable to XML files as described above and in 3.2. The data files shall contain only lines of data as described in 3.8. The names and paths of the data files are defined by the keyword: Data_files and shall conform to 3.4.2 and 3.4.3.

In order to ensure portability and compressibility, the data files shall be placed either in the same directory as the XML files or in a sub-directory located at the same level or a lower level as the XML files, as shown in Figure 2. It is not permitted to locate the additional files at a higher level than the XML files.

3.4.7 Additional files

An XML file may contain references to other files such as image files (Keyword: Image) and document files (Keyword: Documentation). In order to ensure portability and compressibility, these additional files shall be placed either in the same directory as the single XML file or in a sub-directory located at the same level or a lower level as the XML files, as shown in Figure 3. It is not permitted to locate the additional files at a higher level than the XML files.

3.4.8 File compression

When compressing the file system, care must be taken to include the paths of the various XML and data files in the compressed file. This ensures that, when decompressed, the file

structure is conserved. The paths are not required when all files are stored in the same directory.

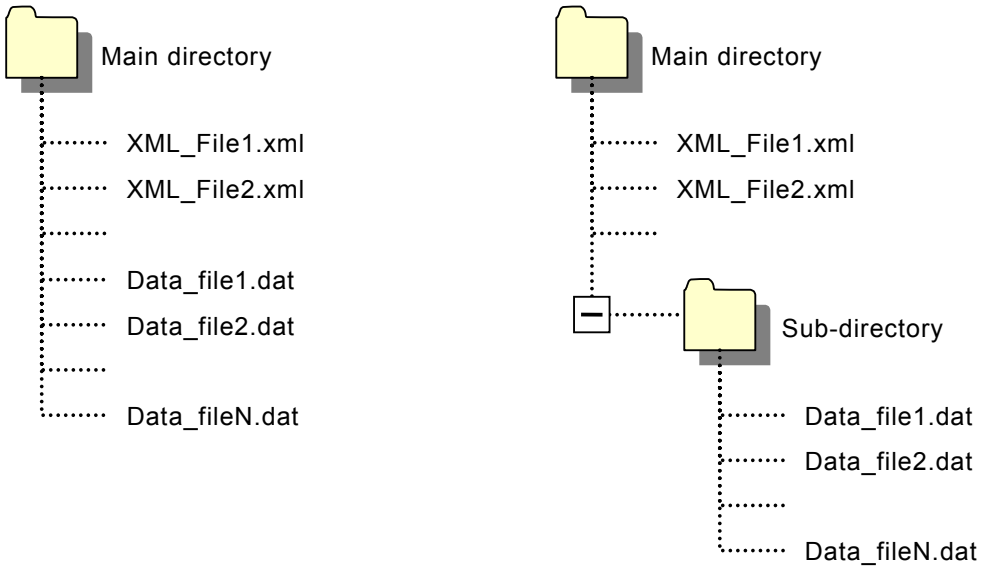

Figure 2 — XML files with data files

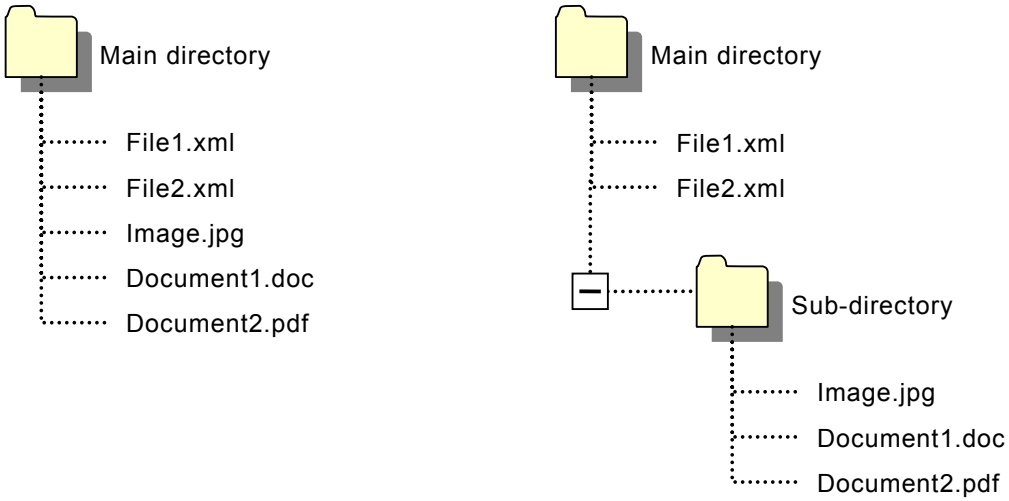

Figure 3 — Additional files

3.5 Values

3.5.1 General

When an element contains a value, this may be a numerical value (e.g. 123.45), a numerical value with units (e.g. 123.45MHz) or a text string (e.g. This is text string number 2).

3.5.2 Numerical syntax

Numerical values may be expressed in decimal form with the period as the decimal separator (e.g. 123.45) or in scientific form (e.g. 1.2345e2). Spaces " " and commas ",", which are often used as thousand separators, and other characters are not allowed.

In cases where several numerical values are required, they shall be separated by spaces " " or tab characters.

3.5.3 Numerical with units syntax

The numerical value (see 3.5.2) is followed by valid units, as described in 1.1.1 (e.g. 123.45MHz). Spaces are not allowed between the numerical value and the units.

3.5.4 Text string

A text string may represent a word recognised by the NFS parser or it may be a file name, a description, etc. A text string may contain any of the alphanumerical characters given in 3.3.2.

3.5.5 Valid units

Units may be expressed as simple linear units or as logarithmic units (dB).

Although not strictly a near-field parameter, power flux density has also been included in the list of valid units for completeness.

Valid units are:

V = volt	A = Ampere	W = Watt	Ohm
Hz = Hertz	m = metre	s = second	

Inverse units are also valid:

S = Siemens =1/Ohm

Combined units are permitted, such as:

V/m = Volt per metre

A.m = Ampere metre

/V.m = per Volt metre

Valid scaling factors are:

T = tera:	1e12	k = kilo:	1e3	n = nano:	1e-9
G = giga:	1e9	m = milli:	1e-3	p = pico:	1e-12
M = mega:	1e6	u = micro:	1e-6	f = femto:	1e-15

When no scaling factors are specified, the appropriate base units are assumed. These are volts, Amperes, Watts, Ohms, Siemens, Hertz, metres and seconds. Abbreviations for the units (e.g., pV, nA, ms, MHz) shall be used, except Ohm, which shall be written in full.

All temperatures shall be represented in degrees Celsius. The symbol "°C" is not required.

Angles shall be expressed in degrees. The symbol "°" is not required.

Units are case sensitive.

Table 1 shows a list of valid logarithmic units. The logarithmic units for performance factor contain brackets in order to avoid confusion with other units (e.g. dBm for dB milliwatt and dB(m) for dB metre).

Table 1 — Valid logarithmic units

Usage	Symbol	Unit	Reference
Ratio	dB	Decibel	1
Power	dBW	dB Watt	1W
Power	dBm	dB milliWatt	1mW
Voltage	dBV	dB volt	1V
Voltage	dBuV	dB microvolt	1uV
Current	dBA	dB Ampere	1A
Current	dBuA	dB microAmpere	1uA
Electric field strength	dBV/m	dB volt per metre	1V/m
Electric field strength	dBuV/m	dB microvolt per metre	1uV/m
Magnetic field strength	dBA/m	dB Ampere per metre	1A/m
Magnetic field strength	dBuA/m	dB microAmpere per metre	1uA/m
Power flux density	dBW/m2	dB Watt per square metre	$1W/m^2$
Power flux density	dBm/m2	dB milli Watt per square metre	$1mW/m^2$
Performance factor[a]	dB(V.m)	dB Volt metre	1V.m
Performance factor[a]	dB(A.m)	dB Ampere metre	1A.m
Performance factor[a]	dB(Ohm.m)	dB Ohm metre	1Ω.m
Performance factor[a]	dB(Ohm/m)	dB Ohm per metre	1Ω/m
Performance factor[a]	dB(S.m)	dB Siemen metre	1S.m
Performance factor[a]	dB(S/m)	dB Siemen per metre	1S/m
Performance factor[a]	dB(m)	dB metre	1m
Performance factor[a]	dB(/m)	dB per metre	1/m
Performance factor[a]	dB(/V.m)	dB per Volt metre	1/(V.m)
Performance factor[a]	dB(/A.m)	dB per Ampere metre	1/(V.m)
Performance factor[a]	dB(V/m2)	dB Volt per square metre	$1V/m^2$
Performance factor[a]	dB(A/m2)	dB Ampere per square metre	$1V/m^2$
Performance factor[a]	dB(/m2)	dB per square metre	$1/m^2$
Performance factor[a]	dB(m2/V)	dB square metre per Volt	$1m^2/V$
Performance factor[a]	dB(m2/A)	dB square metre per Ampere	$1m^2/A$
Performance factor[a]	dB(m2)	dB square metre	$1m^2$
The corresponding linear units are also permitted.			
[a] Details of performance factor are given in 3.9			

3.6 Coordinate systems

3.6.1 General

The near-field scan data may be based on Cartesian, cylindrical or spherical coordinate systems. The keyword: Coordinates defines the coordinate system used in the document. The right-hand Cartesian coordinate system is used by default.

3.6.2 Cartesian coordinate system

In order to accommodate different scan table coordinate systems and existing documents, Cartesian coordinates may be either right-hand (see Figure 4) or left-hand (see Figure 5). However, the right-hand Cartesian coordinate system is preferred and shall be used whenever possible.

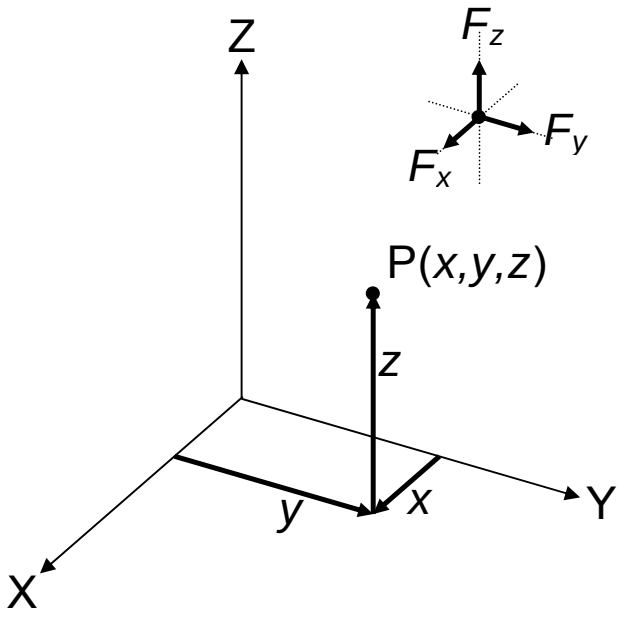

Figure 4 — Right-hand Cartesian coordinate system

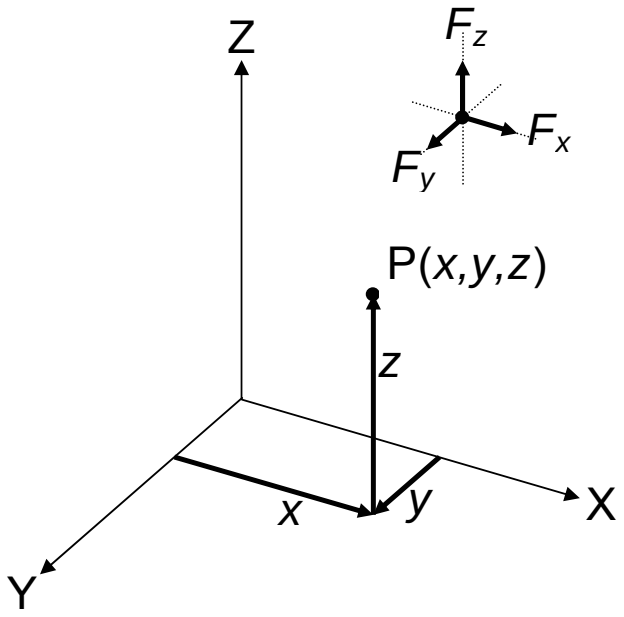

Figure 5 — Left-hand Cartesian coordinate system

3.6.3 Cylindrical coordinate system

Although the scan equipment may be orientated differently, the cylindrical coordinate system assumes that the polar plane (r, A) lies in the XY plane of a Cartesian coordinate system and that the linear axis (h) lies in the z-direction of a Cartesian coordinate system, as shown in Figure 6.

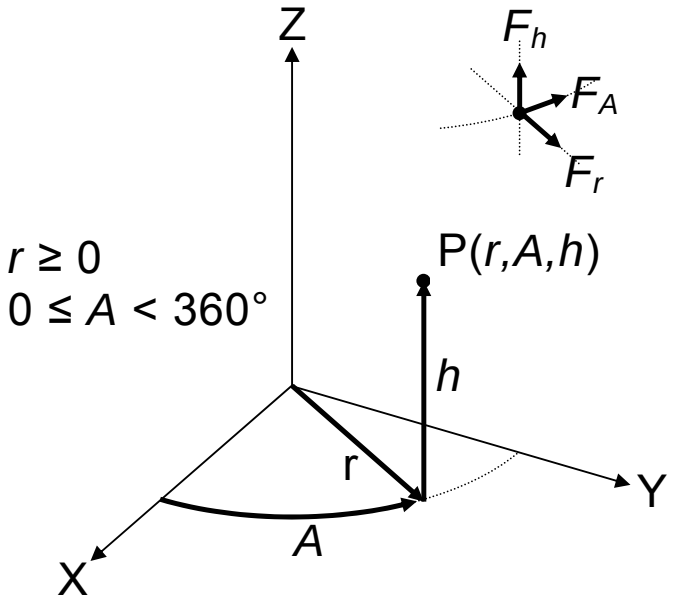

Figure 6 — Cylindrical coordinate system

3.6.4 Spherical coordinate system

Similarly, the spherical coordinate system assumes that the azimuth angle (A) lies in the XY plane of a Cartesian coordinate system and that the zenith angle (B) lies between the Z-axis of a Cartesian coordinate system and the vector r, as shown in Figure 7. In order to avoid the use of negative angle values, the zenith angle shall be used in preference to the elevation angle (angle between the XY-plane and the vector r), which is used for antenna radiation diagrams, for example.

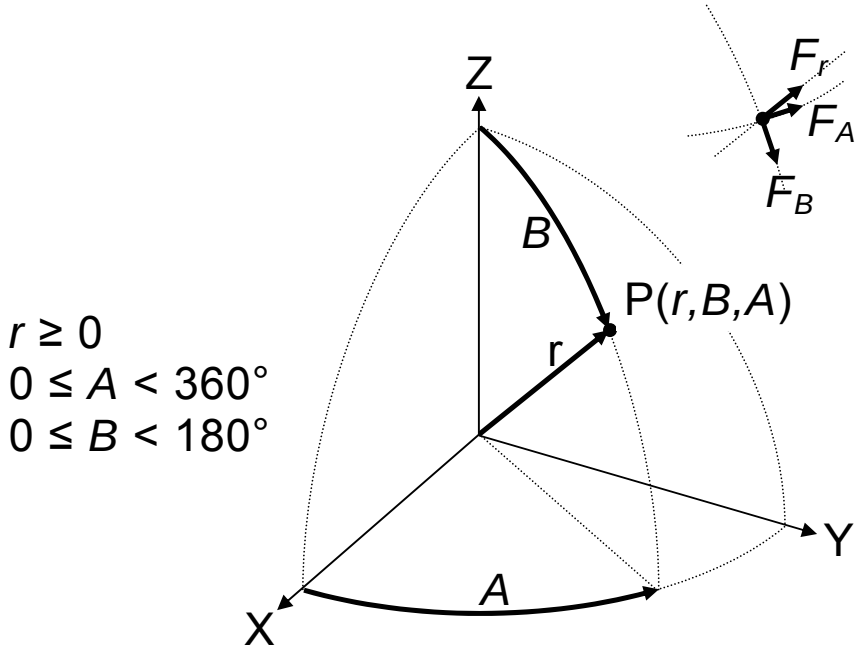

Figure 7 — Spherical coordinate system

3.6.5 Coordinate offsets

Provision is provided for the origin of the scan area to be offset from the origin of the scan table, for example. The offset is specified using the keywords: X0, Y0, Z0, R0, H0, A0 and B0. Figure 8 and Figure 9 show the offsets for right-hand and left-hand Cartesian coordinates respectively. Offsets in the cylindrical and spherical coordinate systems are used in a similar way.

3.6.6 Image coordinates

The scan information can be overlaid with a picture of the component. The image dimensions are specified with the keywords: Xsize, Ysize, Zsize, Rsize, Hsize, Asize and Bsize. The origin of the image may be offset from the origin of the scan table this offset is specified using the keywords: Xoffset, Yoffset, Zoffset, Roffset, Hoffset, Aoffset and Boffset. Figure 8 and Figure 9 show the offsets and dimensions of the image for right-hand and left-hand Cartesian coordinates respectively.

In the Cartesian coordinate system the overlay of an image is usually in the XY plane, but it is also possible to overlay it in the XZ or YZ planes. This is specified by the pairs of keywords used for the size (e.g. Xsize and Ysize) and offset (e.g. Xoffset and Yoffset), etc) of the image. When using spherical or cylindrical coordinates, the flat picture has no meaning. Nevertheless a picture of the component, measurement setup, etc may be included, even though it cannot be overlaid on the scan. In this case no size and offset keywords shall be included in the document.

More details of how images should be included in the project are given in 3.10

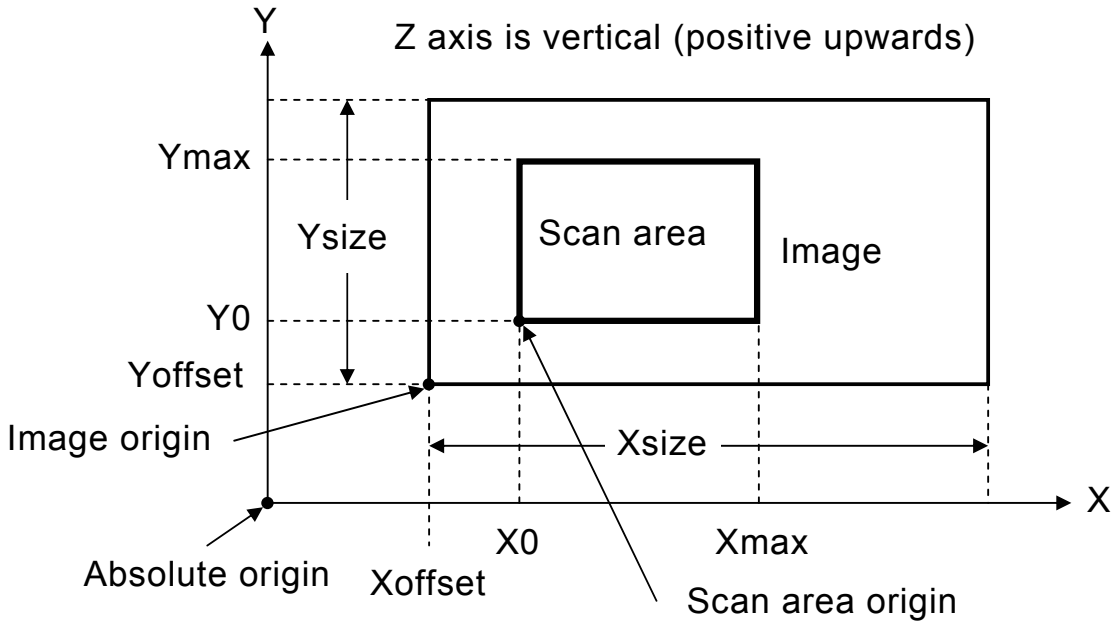

Figure 8 — Offsets and image positioning (right-hand Cartesian)

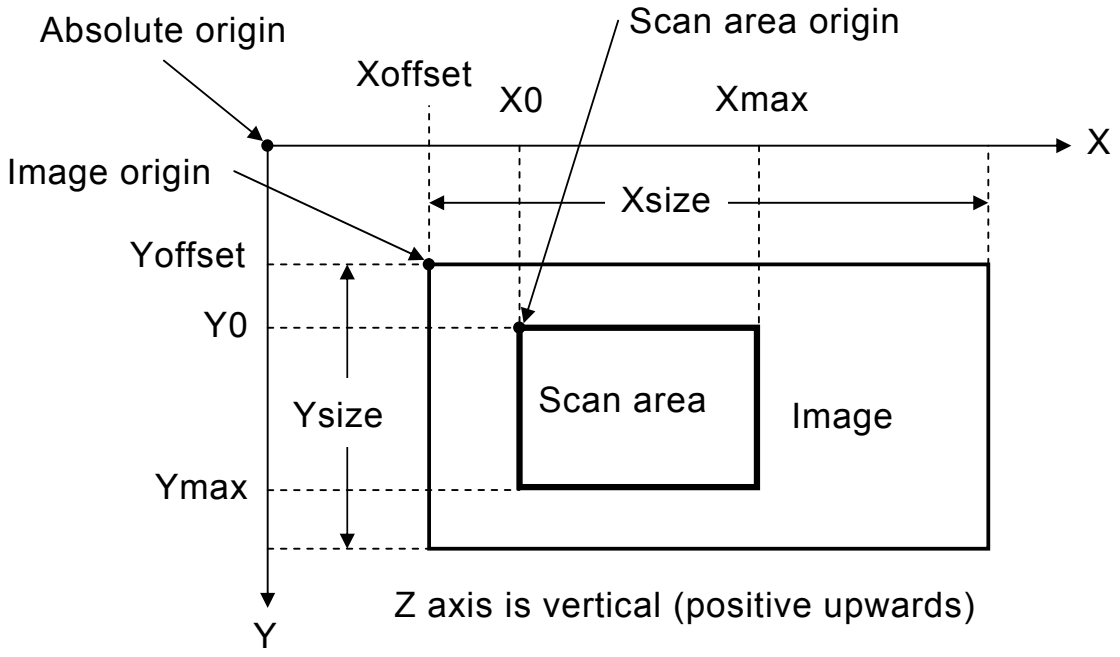

Figure 9 — Offsets and image positioning (left-hand Cartesian)

3.7 Field type and orientation

The field type is specified using the keyword: Field. Typically, the value will be "E" for the electrical field and "H" for the magnetic field. If the orientation of the field is not included in the data, the value can be enhanced by adding the field component, e.g.: "Ex", "Hz", Eh, Hr, etc.

The figures in 3.6 also show the field (F) directions corresponding to each coordinate system. The field may be magnetic (H) or electric (E). In all cases the directions are parallel or tangential to the axes or angles of the coordinate system.

It is also possible to include the orientation of the field in the data (see 3.8). It is specified by the keyword: Coordinates, using an azimuth angle C and, optionally, a zenith angle D. If the zenith angle is omitted, its default value is 90°, which sets the two-dimensional orientation in the XY, AH or BA plane, depending on the coordinate system. Figure 10, Figure 11, Figure 12 and Figure 13 show the field orientations corresponding to each coordinate system.

The radiation diagram of a probe is generally symmetrical. The azimuth and zenith angles can therefore be limited to 180° and 90°.

Table 2 shows the relationship between the azimuth and zenith angles and the field component for each coordinate system.

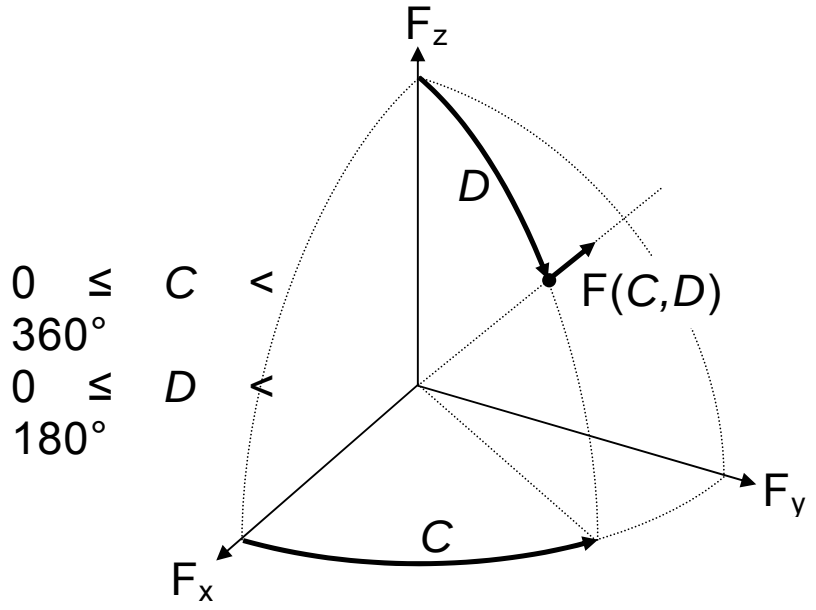

Figure 10 — Field orientation – Right-hand Cartesian coordinate system

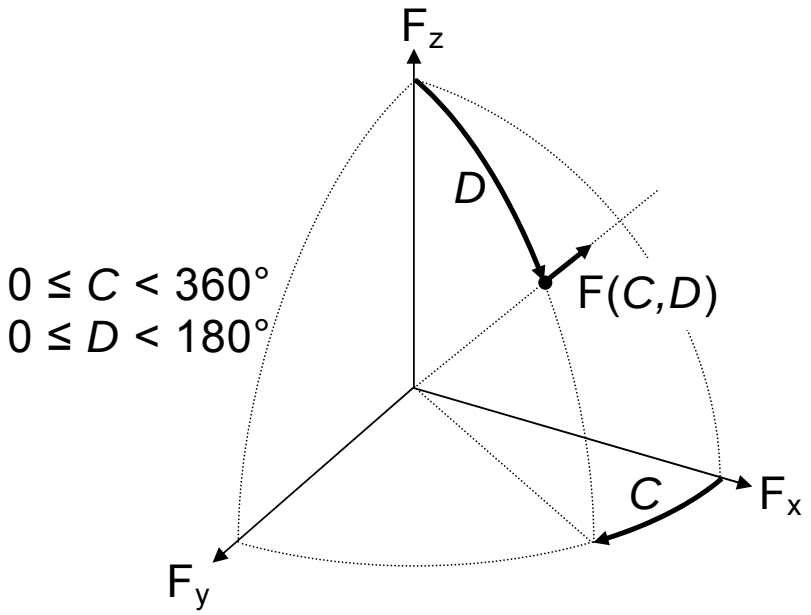

Figure 11 — Field orientation – Left-hand Cartesian coordinate system

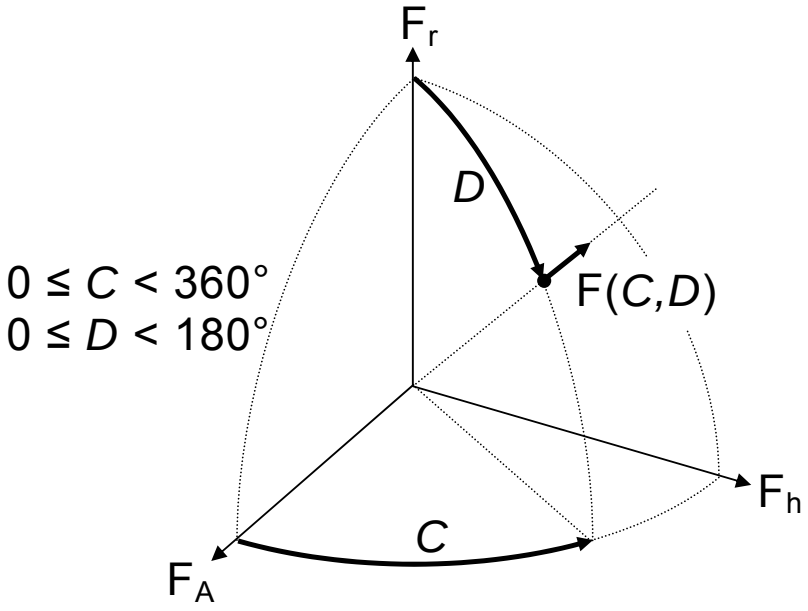

Figure 12 — Field orientation – Cylindrical coordinate system

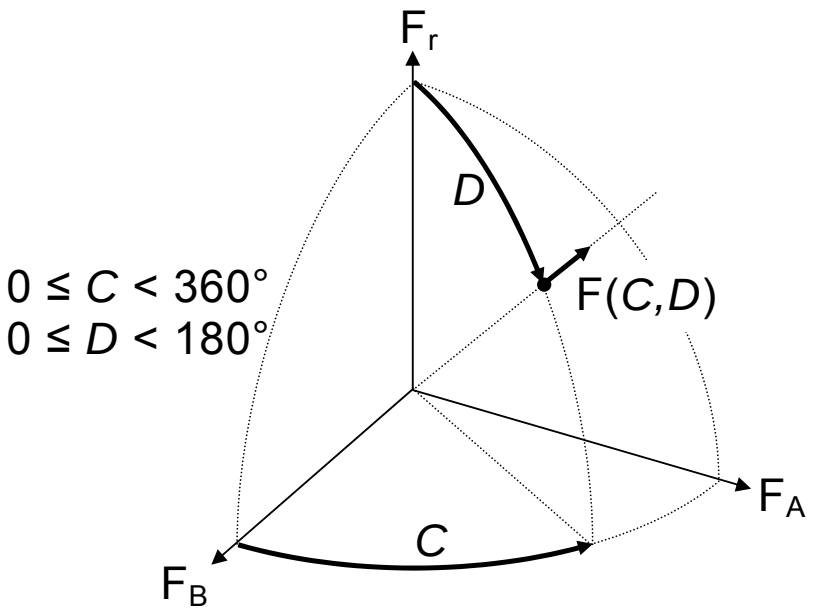

Figure 13 — Field orientation – Spherical coordinate system

Table 2 — Relationship between azimuth, zenith angles and field component

Coordinates	C (°)	D (°)	Field
Cartesian	-	0	z
	0	90	x
	90	90	y
Cylindrical	-	0	r
	0	90	a
	90	90	h
Spherical	-	0	r
	0	90	b
	90	90	a

3.8 Data syntax

3.8.1 General

The data may be organised with coordinate information (preferred and default) or without coordinate information.

3.8.2 Data with coordinate information

When coordinate information is included, data is organised with one line for each point. Each line contains the coordinates of the point (e.g. x y z) followed by data values for each frequency separated by a space " ". The keyword: Frequencies specifies the frequencies at which data is included and its order. The order in which the lines are inserted in the document is not important.

Axis1 Axis2 Axis3 data_f1 data_f2 ……..data_fn

The coordinate information contains at a least the three coordinates of the coordinate system used, as described in 3.6, and may also include field orientation angles C and D, as described in 3.7.

Axis1 Axis2 Axis3 C D data_f1 data_f2 ……..data_fn

The coordinate system used and the type of field orientation are specified using the keyword: Coordinates. In order to simplify the reading of the data, the order of the coordinates is fixed and only the values shown in Table 3 shall be used. The values are not case sensitive.

Table 3 — Permitted values for the keyword Coordinates

Coordinate system	Order of axes	Field orientation		
		None	Azimuth	Azimuth and zenith
Right-handed Cartesian	x, y, z	xyz	xyzc or xyzcf	xyzcd or xyzcdf
Left-handed Cartesian	x, y, z	-xyz	-xyzc or -xyzcf	-xyzcd or -xyzcdf
Cylindrical	R, A, h	rah	rahc or rahcf	rahcd or rahcdf
Spherical	r, B, A	rba	rbac or rbacf	rbacd or rbacdf

When the field orientation is frequency dependent (e.g. when the orientation of the field is optimised for the maximum field strength) "f" is added at the end of the value. In this case the field orientation data (C or C D) precedes the data for each frequency.

Axis1 Axis2 Axis3 C1 D1 data_f1 C2 D2 data_f2 …….. Cn Dn data_fn

3.8.3 Data without coordinate information

When the coordinates are not included, the step between measurements in each direction shall be uniform. The keyword: Coordinates takes the value "none" (not case sensitive).

The minimum (or offset), maximum and step values for each axis shall be specified using the keywords: X0, Xmax, Xstep, etc, which also define the coordinate system used (see Figure 8 and Figure 9). The maximum value shall be greater than the minimum value and the step value shall be positive, except in the case of the left-hand Cartesian coordinate system, which is indicated by a negative Ystep value.

If an axis contains only one value (i.e. the scan is not three-dimensional), only the minimum value is required and the corresponding maximum and step values need not be included.

Field orientation data is not permitted.

The measurement data values are separated by a space or a line termination sequence (see 3.2.6). This allows the data to be organised in lines when it is given at several frequencies. The data shall be ordered as shown in

Table 4.

An example of a simple XML file without coordinate information is given in A.5.

3.8.4 Data format

The data may include magnitude, magnitude and angle or real and imaginary data, as specified by the keyword: Format, which may take the following values:

- omitted: Magnitude data only (default)
- "ma": Magnitude and phase angle data
- "ri" Real and imaginary data

The frequencies at which the data is measured are specified in the frequencies section. An example XML file with magnitude and angle data is given in A.2

In the case of immunity scans, the default criterion can be included in the file. The keyword Criterion allows the default criterion to be described. The data values then correspond to the level at which the default criterion is attained. If a single default criterion is required then the description shall be included within Criterion tags as shown in A.8. The single data criterion is then valid for all data values.

In many cases, particularly when scanning complex devices, it is desirable to specify several default criteria and be able to associate each data value with a specific criterion. This can be achieved by inserting an Index keyword followed by a Description keyword for each criterion, as shown in A.6. In order to associate a specific criterion with a data value, the index of the specific criterion is inserted in the data after the corresponding value for each point and each frequency.

3.8.5 Data notation

Data and coordinates may be expressed in decimal notation (e.g. 123.45) or scientific notation (e.g. 1.2345e2). Units may also be defined for the coordinates and data. As the values are stored in ASCII form, the number of digits and the type of notation has a direct and significant effect on the file size, especially when the file contains data for many points.

It can be seen from the above example that, for the same number, the decimal notation requires fewer characters than the scientific notation. However, 0.0000012345 requires more characters than 1.2345e-6. If this value concerns for example a voltage, defining the units as uV allows the data to be written as 1.2345, which requires even fewer characters than the scientific notation.

Many instruments and simulators generate data with a large number of digits, all of which are not significant. For example, a spectrum analyser may output a value of power as 12.3456789 dBm (9 significant digits). Considering the accuracy of the instrument, a value of 12.34 dBm (4 significant digits) may be largely sufficient.

Data values should be expressed in the best suited units and with a number of characters compatible with the accuracy required.

Table 4 — Order of measurement points when coordinates are not included

Cartesian coordinates			Cylindrical coordinates			Spherical coordinates		
x0	y0	z0	r0	A0	h0	r0	B0	A0
x1	y0	z0	r1	A0	h0	r1	B0	A0
:	:	:	:	:	:	:	:	:
xmax	y0	z0	rmax	A0	h0	rmax	B0	A0
x0	y1	z0	r0	A1	h0	r0	B1	A0
x1	y1	z0	r1	A1	h0	r1	B1	A0
:	:	:	:	:	:	:	:	:
xmax	y1	z0	rmax	A1	h0	rmax	B1	A0
:	:	:	:	:	:	:	:	:
x0	ymax	z0	r0	Amax	h0	r0	Bmax	A0
x1	ymax	z0	r1	Amax	h0	r1	Bmax	A0
:	:	:	:	:	:	:	:	:
xmax	ymax	z0	rmax	Amax	h0	rmax	Bmax	A0
x0	y0	z1	r0	A0	h1	r0	B0	A1
x1	y0	z1	r1	A0	h1	r1	B0	A1
:	:	:	:	:	:	:	:	:
xmax	y0	z1	rmax	A0	h1	rmax	B0	A1
x0	y1	z1	r0	A1	h1	r0	B1	A1
x1	y1	z1	r1	A1	h1	r1	B1	A1
:	:	:	:	:	:	:	:	:
xmax	y1	z1	rmax	A1	h1	rmax	B1	A1
:	:	:	:	:	:	:	:	:
x0	ymax	z1	r0	Amax	h1	r0	Bmax	A1
x1	ymax	z1	r1	Amax	h1	r1	Bmax	A1
:	:	:	:	:	:	:	:	:
xmax	ymax	z1	rmax	Amax	h1	rmax	Bmax	A1
:	:	:	:	:	:	:	:	:
x0	y0	zmax	r0	A0	hmax	r0	B0	Amax
x1	y0	zmax	r1	A0	hmax	r1	B0	Amax
:	:	:	:	:	:	:	:	:
xmax	y0	zmax	rmax	A0	hmax	rmax	B0	Amax
x0	y1	zmax	r0	A1	hmax	r0	B1	Amax
x1	y1	zmax	r1	A1	hmax	r1	B1	Amax
:	:	:	:	:	:	:	:	:
xmax	y1	zmax	rmax	A1	hmax	rmax	B1	Amax
:	:	:	:	:	:	:	:	:
x0	ymax	zmax	r0	Amax	hmax	r0	Bmax	Amax
x1	ymax	zmax	r1	Amax	hmax	r1	Bmax	Amax
:	:	:	:	:	:	:	:	:
xmax	ymax	zmax	rmax	Amax	hmax	rmax	Bmax	Amax

3.9 Performance factor

The performance factor of the probe may be included in the Perf_factor section of the probe section.

The performance factor PF of a probe relates the measured or applied value (e.g. power in dBm, or voltage) to the field strength (e.g. H-field in V/m) and may be defined in one of two ways:

$$PF1 = \frac{M_F}{F}$$

$$\text{or} \quad PF2 = \frac{F}{M_F}$$

Where: M_F is the measured or applied value

F is the measured or generated field strength

The same expressions may also be expressed in dB:

$$dB(PF1) = dB(M_F) - dB(F)$$

$$\text{or} \quad dB(PF2) = dB(F) - dB(M_F)$$

The relationship can be readily recognised by the units in which the performance factor is expressed. Table 5 and Table 6 show permitted combinations of units.

In order to avoid multiplying the number of units for performance factor, scaling factors (k, m, u, etc.) shall not be used. The use of parentheses in the units avoids confusion with other units (e.g. dBm for dB milliwatt and dB(m) for dB metre). By default the units are assumed to be dB(V.m).

If the units of the values in the Measurement section are field strength values (e.g. A/m, V/m, etc.), the performance factor is assumed to have been taken into account. In this case a Perf_factor section is not required.

Table 5 — Performance factor linear units

Performance factor equation		**PF1 = M_F/F**			**PF2 = F/M_F**		
Field strength units (F)		**A/m**	**V/m**	**W/m2**	**A/m**	**V/m**	**W/m2**
Measured or applied signal units (M_F)	**V**	Ohm.m	m	A/m2	S/m	/m	m2/A
	A	m	S.m	V/m2	/m	Ohm/m	m2/V
	W	V.m	A.m	/m2	/V.m	/A.m	m2

Table 6 — Performance factor logarithmic units

Performance factor equation		**dB(PF1) = dB(M_F)-dB(F)**			**dB(PF2) = dB(F)-dB(M_F)**		
Field strength units (F)		**dBA/m**	**dBV/m**	**dBW/m2**	**dBA/m**	**dBV/m**	**dBW/m2**
Measured or applied signal units (M_F)	**dBV**	dB(Ohm.m)	dB(m)	dB(A/m2)	dB(S/m)	dB(/m)	dB(m2/A)
	dBA	dB(m)	dB(S.m)	dB(V/m2)	dB(/m)	dB(Ohm/m)	dB(m2/V)
	dBW	dB(V.m)	dB(A.m)	dB(/m2)	dB(/V.m)	dB(/A.m)	dB(m2)

For an emission scan the probe measures the field (electrical or magnetic) surrounding it. The distance from the source is of no significance. The performance factor is therefore defined as a function of frequency. The Frequencies section defines the frequencies at which the probe performance factor is specified and the performance factor values are given in the List section. Only one value shall be specified for each frequency. Care should be taken to include sufficient frequencies to describe the characteristic accurately. An example file for an emission scan is shown in A.7

For an immunity scan, the probe generates a field (electrical or magnetic) which decreases with increasing distance. It is therefore necessary to define the performance factor as a function of both distance (altitude) above the device being scanned and frequency. The Frequencies section defines the frequencies at which the probe performance factor is specified and the performance factor values are given in the List section. In this case the List section shall contain lines consisting of an altitude followed by the performance factor values for each frequency. One line is required for each value of altitude. The units of the altitude value are specified by the keyword: Unit_a. Care should be taken to include sufficient frequencies to describe the characteristic accurately. An example file for an immunity scan is shown in A.8

3.10 Images

In order to facilitate interpretation of scan results, the scan information can be overlaid with a picture of the component. Keywords in the Component section allow an image file to be referenced and the image size and position to be specified. Details of the size and offset keywords are given in 3.6.6

3.10.1 Image file types

Image files, typically containing a picture (photo) of the component should be in JPEG format and use the extension .jpg or .jpeg. Other file types may be used, but viewers and processors may not be able to display the image correctly.

When using spherical or cylindrical coordinates, a flat picture has no meaning. Nevertheless a picture of the component, measurement setup, etc may be included, even though it cannot be overlaid on the scan. In this case no size and offset keywords are included in the file (see 3.6.6). Other image file types allowing a three-dimensional representation may be used in this case, but viewers and processors may not be able to display the image correctly.

3.10.2 Image file name and path

The path and filename of the image file is specified with the keyword: Path. The path shall conform to 3.4.2 and 3.4.3.

Annex A
(Informative)
Example files

A.1 Minimum default file

```
<?xml version="1.0" encoding="UTF-8"?>
<EmissionScan>
      <Nfs_ver>1.0</Nfs_ver>
      <Filename>Minimum_NFS_file.xml</Filename>
      <File_ver>1</File_ver>
      <Data>
            <Measurement>
                  <List>
26e-3 29e-3 2e-3 -58
                  </List>
            </Measurement>
      </Data>
</EmissionScan>
```

This example represents the minimum file required by the near-field scan XML file format. It contains the information for a near-field emission scan with one data point and at an unspecified frequency.

All values are default:

- The coordinate system is right-handed Cartesian.
- Coordinate information is present (x=26e-3, y=29e-3, z=2e-3)
- All offsets are zero.
- Measurements are in the frequency domain and the value is magnitude only expressed in dBm.
- No probe information is given
- Default values for units, etc are assumed: dBm, m, etc.

For such a minimum file, it is strongly recommended to choose a file name describing clearly the measurement conditions (e.g. Devicename_xxxMHz.xml). Additional information can be added by including the appropriate keywords or a notes section.

A.2 File with magnitude and angle data

```
<?xml version="1.0" encoding="UTF-8"?>
<EmissionScan>
      <Nfs_ver>1.0</Nfs_ver>
      <Filename> magnitude_angle_data.xml</Filename>
      <File_ver>1</File_ver>
      <Data>
            <Frequencies>
                  <Unit>MHz</Unit>
                  <List>100 200 300 400</List>
            </Frequencies>
            <Measurement>
                  <Format>ma</Format>
                  <List>
26e-3 29e-3 2e-3 -58 22 -60 35 -59 42 -55 51
                  </List>
            </Measurement>
      </Data>
</EmissionScan>
```

This example shows a file with data for one point at four frequencies with magnitude and angle data:

- The coordinate system is right-handed Cartesian (default).
- Data is in the frequency domain and the value is magnitude expressed in dBm and angle.
- All other values are default.

A.3 File with field azimuth and zenith orientation

```
<?xml version="1.0" encoding="UTF-8"?>
<EmissionScan>
      <Nfs_ver>1.0</Nfs_ver>
      <Filename>Azimuth_zenith_field_orientation.xml</Filename>
      <File_ver>1</File_ver>
      <Probe>
            <Field>H</Field>
      </Probe>
      <Data>
            <Coordinates>xyzcd</Coordinates>
            <Frequencies>
                  <Unit>MHz</Unit>
                  <List>100 200 300 400</List>
            </Frequencies>
            <Measurement>
                  <List>
26e-3 29e-3 2e-3 0 0 -58 -60 -59 -55
26e-3 29e-3 2e-3 0 90 -58 -60 -59 -55
26e-3 29e-3 2e-3 90 90 -58 -60 -59 -55
                  </List>
            </Measurement>
      </Data>
</EmissionScan>
```

This example shows a file with data for one point at four frequencies with three field orientation angles:

- The coordinate system is right-handed Cartesian.
- The probe measures the H-field and both azimuth and zenith angles are included in the coordinate information (Coordinates = xyzcd)
- The three lines of measurement data correspond to Hz (C=0, D=0), Hx (C=0°, D=90°) and Hy (C=90°, D=90°).
- Data is in the frequency domain and the value is magnitude only expressed in dBm.
- All other values are default.

A.4 File with optimised field azimuth orientation

```
<?xml version="1.0" encoding="UTF-8"?>
<EmissionScan>
      <Nfs_ver>1.0</Nfs_ver>
      <Filename>Azimuth_optimised_field_orientation.xml</Filename>
      <File_ver>1</File_ver>
      <Probe>
            <Field>H</Field>
      </Probe>
      <Data>
            <Coordinates>xyzcf</Coordinates>
            <Frequencies>
                  <Unit>MHz</Unit>
                  <List>100 200 300 400</List>
            </Frequencies>
            <Measurement>
                  <List>
26e-3 29e-3 2e-3 5 -58 8 -60 4 -59 10 -55
                  </List>
            </Measurement>
      </Data>
</EmissionScan>
```

This example shows a file with measurement data for one point at four frequencies with field azimuth orientation optimised for a maximum reading at each frequency:

- The coordinate system is right-handed Cartesian (default).
- The probe measures the H-field and the optimised azimuth angles are included in front of the magnitude data at each frequency:

  100 MHz: 5° -58 dBm

  200 MHz: 8° -60 dBm

  300 MHz: 4° -59 dBm

  400 MHz: 10° -55 dBm
- All other values are default.

A.5 File without coordinate information

```
<?xml version="1.0" encoding="UTF-8"?>
<EmissionScan>
      <Nfs_ver>0.5</Nfs_ver>
      <Filename>No_coordinates.xml</Filename>
      <File_ver>1</File_ver>
      <Data>
            <Coordinates>none</Coordinates>
            <X0>10mm</X0>
            <Xstep>1mm</Xstep>
            <Xmax>13mm</Xmax>
            <Y0>20mm</Y0>
            <Ystep>2mm</Ystep>
            <Ymax>24mm</Ymax>
            <Z0>2mm</Z0>
            <Measurement>
                  <List>
-58 -60 -61 -60
-59 -57 -58 -57
-60 -55 -57 -56
                  </List>
            </Measurement>
      </Data>
</EmissionScan>
```

This example shows a file containing the information for a near-field scan with twelve measurement points and at an unspecified frequency:

- Coordinate information is not included in the measurement data, indicated by the value of Coordinates "none"
- The coordinate system is right-handed Cartesian, indicated by the presence of X0, Y0, Z0, etc.
- The measurements are scanned in the X-direction from 10mm to 13mm in 1mm steps, in the Y direction from 20mm to 24mm in 2mm steps and at a Z value of 2mm (see 3.8.3)
- The measurement data is organised with one line for each Y value (see 3.8.3)
- Measurements are in the frequency domain and the value is magnitude only expressed in dBm.
- No probe information is given.
- All other values are default.

Table A.1 — Data matrix

Y	X			
	10 mm	**11 mm**	**12 mm**	**13 mm**
20 mm	-58 dBm	-60 dBm	-61 dBm	-60 dBm
22 mm	-59 dBm	-57 dBm	-58 dBm	-57 dBm
24 mm	-60 dBm	-55 dBm	-57 dBm	-56 dBm

A.6 File for immunity scan with multiple criteria

```
<?xml version="1.0" encoding="UTF-8"?>
<ImmunityScan>
      <Nfs_ver>1.0</Nfs_ver>
      <Filename>Immunityscan_with_multiple_criteria.xml</Filename>
      <File_ver>1</File_ver>
      <Data>
            <Frequencies>
                  <Unit>MHz</Unit>
                  <List>100 200 300 400</List>
            </Frequencies>
            <Criterion>
                  <Index>1</Index>
                  <Description>
                        PLL Frequency shift of 10kHz
                  </Description>
                  <Index>2</Index>
                  <Description>uP reset</Description>
                  <Index>3</Index>
                  <Description>VDC shifted by+/-0.2V</Description>
            </Criterion>
            <Measurement>
                  <Format>ma</Format>
                  <List>
26e-3 29e-3 2e-3 -58 22 2 -60 35 1 -59 42 3 -55 51 1
                  </List>
            </Measurement>
      </Data>
</ImmunityScan>
```

This example shows a file with data for one point at four frequencies with magnitude and angle data and associated default criteria:

- The coordinate system is right-handed Cartesian (default).
- Data is in the frequency domain and the value is magnitude expressed in dBm and angle.
- The default criteria are:

  1 PLL Frequency shift of 10kHz

  2 uP reset

  3 VDC shifted by+/-0.2V

- The default criteria are 2, 1, 3 and 1 at 100MHz, 200MHz, 300MHz and 400MHz respectively.
- All other values are default.

A.7 File for emission scan with performance factor

```
<?xml version="1.0" encoding="UTF-8"?>
<EmissionScan>
      <Nfs_ver>1.0</Nfs_ver>
      <Filename>Emissionscan_with_PF.xml</Filename>
      <File_ver>1</File_ver>
      <Probe>
            <Field>Hy</Field>
            <Frequencies>
                  <Unit>MHz</Unit>
                  <List>100 1000</List>
            </Frequencies>
            <Perf_factor>
                  <List>
                        -80 -60
                  </List>
            </ Perf_factor >
      </Probe>
      <Data>
            <Frequencies>
                  <Unit>MHz</Unit>
                  <List>100 200 300 400</List>
            </Frequencies>
            <Measurement>
                  <List>
26e-3 29e-3 2e-3 -78 -60 -59 -65
                  </List>
            </Measurement>
      </Data>
</EmissionScan>
```

This example shows a file with emission data for one point at four frequencies:

- The coordinate system is right-handed Cartesian (default).
- Performance factor data is given in dB(V.m) (default) at 100MHz and 1000MHz
- All other values are default.
- Table A.2 shows the data in dBm converted to magnetic field strength (H) assuming a linear interpolation of the performance factor in dB with logarithmic frequency.

Table A.2 — Magnetic field strength

Frequency (MHz)	100	200	300	400
Measured power (dBm)	-78	-60	-59	-65
Performance factor (dB(V.m))	-80	-74	-70.5	-68
Magnetic field strength (dBA/m)	-28	-16	-18.5	-27

A.8 File for immunity scan with performance factor

```
<?xml version="1.0" encoding="UTF-8"?>
<ImmunityScan>
      <Nfs_ver>1.0</Nfs_ver>
      <Filename>Immunityscan_with_PF.xml</Filename>
      <File_ver>1</File_ver>
      <Probe>
            <Field>Hz</Field>
            <Frequencies>
                  <Unit>MHz</Unit>
                  <List>100 1000</List>
            </Frequencies>
            <Perf_factor>
                  <Unit_a>mm</Unit_a>
                  <List>
                        1 -34.0 -33.1
                        2 -22.0 -21.1
                  </List>
            </ Perf_factor >
      </Probe>
      <Data>
            <Frequencies>
                  <Unit>MHz</Unit>
                  <List>100 200 300 400</List>
            </Frequencies>
            Criterion>Pin 5 goes high</Criterion>
            <Measurement>
                  <List>
26e-3 29e-3 1e-3 31 29 25 31
26e-3 29e-3 2e-3 43 41 37 43
                  </List>
            </Measurement>
      </Data>
</ImmunityScan>
```

This example shows a file with immunity data for two points (same X and Y, but different Z) at four frequencies:

- The coordinate system is right-handed Cartesian (default).
- Performance factor data is given in dB(V.m) (default) at 100 MHz and 1000 MHz for two altitudes (1 mm and 2 mm)
- Only one default criterion is specified.
- All other values are default.
- Table A.3 shows the data in dBm converted to magnetic field strength (H) assuming a linear interpolation of the performance factor in dB with frequency.

Table A.3 — Magnetic field strength

Altitude (mm)	100 MHz	200 MHz	300 MHz	400 MHz
1	35 dBA/m	32.7 dBA/m	28.6 dBA/m	34.5 dBA/m
2	35 dBA/m	32.7 dBA/m	28.6 dBA/m	34.5 dBA/m

Annex B
(Normative)
Valid keywords

B.1 General

In the present annex valid keywords are listed with a brief description and an indication of whether the keyword is required, required in particular conditions or optional. More details concerning the usage of the keywords are given in Annex C.

B.2 File header keywords

The following keywords are placed at the beginning of the file after the root element start-tag:

Nfs_ver	Version of file format (1.0)	Required
Filename	Name of file	Required
File_ver	Version of file	Required
Date	Creation or modification date	Optional
Source	Originator of the file	Optional
Disclaimer	Disclaimer information	Optional
Copyright	Copyright	Optional

B.3 Global keywords

The following keywords may be placed anywhere in the file, except within an XML element containing a value:

Notes	Notes to clarify the file	Optional
Documentation	Documentation to clarify the file	Optional

B.4 Component section keywords

The following keywords may be used in the Component section:

Component	Component section	Required if children
Name	Name of component	Optional
Manufacturer	Component Manufacturer	Optional
Status	Status of component	Optional
Image	Contains elements concerning an image	Required if children
Path	Image file name and path	Optional
Unit	Units used for image size and offset	Optional
Xsize	Image size in the X direction	Optional
Ysize	Image size in the Y direction	Optional
Zsize	Image size in the Z direction	Optional
Rsize	Image size in the R direction	Optional
Hsize	Image size in the H direction	Optional
Asize	Image size in the A direction	Optional

Bsize	Image size in the B direction	Optional
Xoffset	Image offset in the X direction	Optional
Yoffset	Image offset in the Y direction	Optional
Zoffset	Image offset in the Z direction	Optional
Roffset	Image offset in the R direction	Optional
Hoffset	Image offset in the H direction	Optional
Aoffset	Image offset in the A direction	Optional
Boffset	Image offset in the B direction	Optional

B.5 Setup section keywords

The following keywords may be used in the Component section:

Setup	Setup section	Required if children
Config	Contains elements concerning the configuration	Required if children
Probe_signal	Describes the probe signal for an immunity scan	Optional
Att	Equipment attenuation setting	Optional
Average	Equipment averaging on of off	Optional
Ref_level	Equipment reference level setting	Optional
Rbw	Equipment resolution bandwidth setting	Optional
Vbw	Equipment video bandwidth setting	Optional
Swp	Equipment sweep time setting	Optional
Tps	Equipment time per frequency step setting	Optional
Detector	Equipment detector type	Optional
Preamp	Equipment preamplifier setting	Optional
Preselector	Equipment preselector setting	Optional
Xdiv	Equipment horizontal scale per division	Optional
Ydiv	Equipment vertical scale per division	Optional
Bw	Equipment bandwidth setting	Optional
Coupling	Equipment coupling setting	Optional
Transducer	Transducer section	Required if children
Frequencies	Frequencies section	Required if List
Unit	Units used for the frequencies	Optional
List	List of frequencies at which the transducer gain is specified	Optional
Gain	Transducer gain values	Optional

B.6 Probe section keywords

The following keywords may be used in the Probe section:

Probe	Probe section	Required if children
Name	Name of probe	Optional

Field	Describes the field(s) of the probe	Optional
Frequencies	Frequencies section	Required if List
Unit	Units used for the frequencies	Optional
List	List of frequencies at which the probe performance factor is specified	Optional
Perf_factor	Performance factor section	Required if children
Unit_a	Units used for the probe altitude	Optional
Unit	Units used for the performance factor of the probe	Required if List
List	List of probe performance factor values	Optional

B.7 Data section keywords

The following keywords may be used in the Data section:

Coordinates	Defines the coordinate system and probe orientation of the scan	Optional
X0	Start of scan (offset) in the X direction	Required if no coordinates with data
Y0	Start of scan (offset) in the Y direction	Required if no coordinates with data
Z0	Start of scan (offset) in the Z direction	Required if no coordinates with data
R0	Start of scan (offset) in the R direction	Required if no coordinates with data
H0	Start of scan (offset) in the H direction	Required if no coordinates with data
A0	Start of scan (offset) in the A direction	Required if no coordinates with data
B0	Start of scan (offset) in the B direction	Required if no coordinates with data
Xmax	Maximum scan value in the X direction	Required if no coordinates with data
Ymax	Maximum scan value in the Y direction	Required if no coordinates with data
Zmax	Maximum scan value in the Z direction	Required if no coordinates with data
Rmax	Maximum scan value in the R direction	Required if no coordinates with data
Hmax	Maximum scan value in the H direction	Required if no coordinates with data
Amax	Maximum scan value in the A direction	Required if no coordinates with data
Bmax	Maximum scan value of in the B direction	Required if no coordinates with data
Xstep	Step size of the scan in the X direction	Required if no coordinates with data
Ystep	Step size of the scan in the Y direction	Required if no coordinates with data

Zstep	Step size of the scan in the Z direction	Required if no coordinates with data
Rstep	Step size of the scan in the R direction	Required if no coordinates with data
Hstep	Step size of the scan in the H direction	Required if no coordinates with data
Astep	Step size of the scan in the A direction	Required if no coordinates with data
Bstep	Step size of the scan in the B direction	Required if no coordinates with data
Frequencies	Frequencies section	Required if List
Unit	Units used for the frequencies	Optional
List	List of frequencies at which the measurement or simulation data is listed	Optional
Times	Times section	Required if List
Unit	Units used for the times	Optional
List	List of times at which the measurement or simulation data is listed	Optional
Criterion	Criterion section	Optional
Index	Criterion index for an immunity scan	Required if Description
Description	Criterion description for an immunity scan	Optional
Measurement	Measurement section	Required
Unit	Units used for the measurement or simulation data	Optional
Unit_x	Units of the scan position in the X direction	Optional
Unit_y	Units of the scan position in the Y direction	Optional
Unit_z	Units of the scan position in the Z direction	Optional
Unit_r	Units of the scan position in the R direction	Optional
Unit_h	Units of the scan position in the H direction	Optional
Format	Format of the measurement or simulation data	Optional
Data_files	List of data files containing measurement or simulation data	Required if not List
List	List of measurement or simulation data	Required if not Data_files

Annex C
(Normative)
Keyword usage rules

The following tables give usage rules for keywords showing also the parent keyword and examples of values

Table C.1 — File header keywords

Keyword	Parent	Usage rules	Default units or value	Examples
Nfs_ver	Root element	Specifies the version of file format (1.0). Should follow the root element. Informs parsers of the version of XML exchange format used and allows them to know what keywords to expect.		<Nfs_ver>1.0</Nfs_ver>
Filename	Root element	Specifies the file name. Normally follows the keyword: Nfs_ver. The file name shall conform to 3.4.2. In addition, the file name shall use the extension ".xml". The file name shall include only the name of the file. Path information is not permitted.		<Filename> My_file.xml </Filename>
File_ver	Root element	Tracks the revision level of a particular .xml file. Revision level is set at the discretion of the originator of the file.		<File_ver>2.0</File_ver>
Date	Root element	The value can contain blanks, be of any format, but should be limited to a maximum of 20 characters. The month should be spelled out for clarity. The parser considers this information as a data string and does not interpret it.		<Date>March 12, 2008</Date>
Source	Root element	The value can contain blanks and be of any format. The parser considers this information as a data string and does not interpret it.		<Source> Prepared by A.B. Smith </Source>
Disclaimer	Root element	The value can contain blanks and be of any format. The parser considers this information as a data string and does not interpret it.		<Disclaimer> This file contains results of near-field scan. Other use is not guaranteed </Disclaimer>
Copyright	Root element	The value can contain blanks and be of any format. The parser considers this information as a data string and does not interpret it.		<Copyright> Copyright 2008, XYZ Corp., All Rights Reserved </Copyright>

Table C.2 — Global keywords

Keyword	Parent	Usage rules	Default units or value	Examples
Note	Any element except those containing a value.	Optionally adds information about the component, setup, probe, data, etc. The value can contain blanks, and be of any format. A notes section can be inserted anywhere in the file and the number of note sections in the file is not limited. The parser considers this information as a data string and it does not interpret it.		<Notes> Use this section for any special notes </Notes>
Document	Any element except those containing a value.	Optionally adds the paths to files containing documentation on the project. The path shall conform to 3.4.2 and 3.4.3.		<Documentation> Project doc.pdf Measurement_descr.doc </Documentation>

Table C.3 — Component section keywords

Keyword	Parent	Usage rules	Default units or value	Examples
Component	Root element	Contains information on the component being scanned. This section contains only elements relative to the component.		<Component> Component elements </Component>
Name	Component	Specifies the component Name. The parser considers this information as a data string and does not interpret it.		<Name>Board_1</Name>
Manufacturer	Component	Specifies the manufacturer of the component. The value can contain blanks and be of any format. The parser considers this information as a data string and does not interpret it.		<Manufacturer> XYZ Corp </Manufacturer>
Status	Component	Describes the present status of the equipment under test. Information such as operating conditions, hardware and software configuration may be included. The parser considers this information as a data string and does not interpret it.		<Status> Software version 4.1 Device maskset A04A Supply voltage 5.3V </Status>
Image	Component	Contains information on the image associated to the component being scanned. More details are given in 3.10. This section contains only elements relative to the image.		<Image> Image elements </Image>
Path	Image	Specifies the path name of the picture of the component under test. The file name, extension and path shall conform to 3.10.		<Path> ./images/mpcxxxx.jpg </Path> <Path>mpcxxxx.jpg</Path>
Unit	Image	Specifies the units of the size and offset of the image. The value must conform to 1.1.1. If this keyword is omitted, the units are assumed to be "m". Angles are in degrees.	m	<Unit>mm</Unit>

Keyword	Parent	Usage rules	Default units or value	Examples
Xsize Ysize Zsize Rsize Hsize Asize Bsize	Image	Specifies the size of the image in a direction in the specified units. The keywords shall conform to the coordinate system specified by the keyword: Coordinates. Data must conform to 3.6.6. The value shall be numerical (see 3.5.2).	m	<Xsize>50</Xsize>
Xoffset Yoffset Zoffset Roffset Hoffset Aoffset Boffset	Image	Specifies the offset of the image in a direction in the specified units. The keywords shall conform to the coordinate system specified by the keyword: Coordinates. Data must conform to 3.6.6. The value shall be numerical (see 3.5.2).	m	<Xoffset>2</Xoffset>

Table C.4 — Setup section keywords

Keyword	Parent	Usage rules	Default units or value	Examples
Setup	Root element	Contains information on the setup of the scan. This section contains only elements relative to the setup.		<Setup> Setup elements </Setup>
Config	Setup	Contains information on the configuration of the scan setup. This section contains only elements relative to the configuration.		<Config> Configuration elements </Config>
Probe_signal	Config	Describes the signal applied to the probe during immunity testing. If this keyword is omitted, it is assumed that the signal input to the probe is a continuous wave at the frequencies specified in the measurement section and having a level contained in the measurement data. The parser considers this information as a data string and does not interpret it.		<Probe_signal> Pulse: Width=50ns Period=10us </Probe_signal>
Att	Config	Specifies the input attenuation of the equipment used during near-field scan. The value shall be numerical (see 3.5.2). The attenuation unit is "dB".	dB	<Att>10</Att>
Average	Config	Specifies whether averaging is used for measuring the signal level during near-field scan. The value shall be "on" or "off". The parser considers this information as a data string and does not interpret it.		<Average>on</Average>
Ref_level	Config	Specifies the reference level of the equipment used during near-field scan. If the units are omitted, "dBm" are assumed. Values must conform to 3.5.3 and 1.1.1.	dBm	<Ref_level>-40</Ref_level> <Ref_level>60dBuV</Ref_level>

Keyword	Parent	Usage rules	Default units or value	Examples
Rbw	Config	Specifies the resolution bandwidth of the equipment used during near-field scan. If the units are omitted, "Hz" are assumed. Values must conform to 3.5.3 and 1.1.1.	Hz	<Rbw>3kHz</Rbw>
Vbw	Config	Specifies the video bandwidth of the equipment used during near-field scan. If the units are omitted, "Hz" are assumed. Values must conform to 5.4.2 and 5.4.4.	Hz	<Vbw>3kHz</Vbw>
Swp	Config	Specifies the time of a complete sweep of the equipment used during near-field scan. If the units are omitted, "s" are assumed. Values must conform to 5.4.2 and 5.4.4.	s	<Swp>20ms</Swp>
Tps	Config	Specifies the time per frequency step of the equipment used during near-field scan. If the units are omitted, "s" are assumed. Values must conform to 5.4.2 and 5.4.4.	s	<Tps>1ms</Tps>
Detector	Config	Specifies the detector type used during measurement. Values could include: MaxPeak, CISPR Average, QuasiPeak, RMS, Sample, etc. The parser considers this information as a data string and does not interpret it.		<Detector> Quasipeak </Detector>
Preamp	Config	Specifies the whether the internal preamplifier is activated. The value shall be "on", "off" or a value in dB.	dB	<Preamp>on</Preamp> <Preamp>30</Preamp>
Preselector	Config	Specifies the whether the internal preselector is activated. The value shall be "on" or "off". The parser considers this information as a data string and does not interpret it.		< Preselector > on </ Preselector >
Xdiv	Config	Specifies the horizontal scale per division of the equipment used during near-field scan. If the units are omitted, "s" are assumed. Values must conform to 5.4.2 and 5.4.4.	s	<Xdiv>20ms</Xdiv>
Ydiv	Config	Specifies the vertical scale per division of the equipment used during near-field scan. If the units are omitted, "V" are assumed. Values must conform to 5.4.2 and 5.4.4.	V	<Ydiv>200mV</Ydiv>
Bw	Config	Specifies the bandwidth of the equipment used during near-field scan. If the units are omitted, Hz" are assumed. Values must conform to 5.4.2 and 5.4.4.	Hz	<Bw>20MHz</Bw>

Keyword	Parent	Usage rules	Default units or value	Examples
Coupling	Config	Specifies the coupling of the equipment used during measurement. Values could include: DC, AC, 50ohm, etc. The parser considers this information as a data string and does not interpret it.		<Coupling>DC</Coupling>
Transducer	Setup	Contains information on the transducer (pre-amplifier, power amplifier, cables, attenuator, directional coupler, etc.) used in the scan setup. This contains only elements relative to the transducer.		<Transducer> Transducer elements </Transducer>
Frequencies	Transducer	Contains information on the frequencies at which the transducer gain is specified. This section contains only elements relative to the frequencies.		<Frequencies> Frequency elements </Frequencies>
Unit	Frequencies	Specifies the units of the frequencies used for specifying the transducer gain. The value must conform to 5.4.4. If this keyword is omitted, the units are assumed to be "Hz".	Hz	<Unit>MHz</Unit>
List	Frequencies	Specifies a list of frequencies at which the transducer gain is listed. The values shall be numerical (see 3.5.2).		<List>10 50 100 200 500</List>
Gain	Transducer	Specifies a list of transducer gain values corresponding to the frequencies listed in the Frequencies section of the Transducer section. The values shall be numerical (see 5.4.1). If no Frequencies section is included and a single gain value specified, the gain is assumed to be constant over the scan frequency range. If a single gain value of zero is specified, a transducer is present, but its gain and cable losses are assumed to be included in the Performance Factor of the probe. If no gain keyword is present, the measured signal level is assumed to be measured at the output of the probe. The gain unit is "dB".	dB	<Gain>30 29 27 28 29.5</Gain>

Table C.5 — Probe section keywords

Keyword	Parent	Usage rules	Default units or value	Examples
Probe	Root element	Contains information on the probe used for the scan. This section contains only elements relative to the probe.		<Probe> Probe elements </Probe>

Keyword	Parent	Usage rules	Default units or value	Examples
Name	Probe	Specifies the probe Name. The parser considers this information as a data string and does not interpret it.		<Name>MyProbeHz</Name>
Field	Probe	Describes the field component measured by the probe used during the test. The value can contain blanks and be of any format. The parser considers this information as a data string and does not interpret it. Values could include: E, Ez, Ey, Ez, Er, Eh, EA, EB, H, Hz, Hy, Hz, Hr, HA, HB, Hh, Hxy, etc.		<Field>H</Field> <Field>Hx</Field> <Field>Exyz</Field>
Frequencies	Probe	Contains information on the frequencies at which the probe performance factor is specified. This section contains only elements relative to the frequencies.		<Frequencies> Frequency elements </Frequencies>
Unit	Frequencies	Specifies the units of the frequencies used for specifying the performance factor of the probe. The value must conform to 5.4.4. If this keyword is omitted, the units are assumed to be "Hz".	Hz	<Unit>MHz</Unit>
List	Frequencies	Specifies a list of frequencies at which the performance factor of the probe is listed. The values shall be numerical (see 3.5.2).		<List>10 50 100 200 500</List>
Perf_factor	Probe	Contains information on performance factor of the probe used for the scan. This section contains only elements relative to the performance factor of the probe.		<Perf_factor> Performance factor elements </Perf_factor>
Unit_a	Perf_factor	Specifies the units of the distance (altitude) of the probe from the device being scanned. The value must conform to 5.4.4. If this keyword is omitted, the units are assumed to be "m".	m	<Unit_a>mm</Unit_a> <Unit_a>um</Unit_a>
Unit	Perf_factor	Specifies the units of the probe performance factor data. The value must conform to 5.4.4. If this keyword is omitted, the units are assumed to be "dB(V.m)".	dB(V.M)	<Unit>dB(A.m)</Unit>
List	Perf_factor	Specifies a list of probe performance factor data corresponding to the frequencies listed in the Frequencies section of the Probe section. The values shall be numerical (see 5.4.1). In the case of an immunity scan the first value is the altitude above the measured device, as described in 3.9.		<List>-10.024 -0.002 10.85</List> <List> 1 -10.024 -0.002 10.85 2 -11.230 -1.426 9.698 3 -12.364 -2.297 8.832 </List>

Table C.6 — Data section keywords

Keyword	Parent	Usage rules	Default units or value	Examples
Data	Root element	Contains information on the measurement or simulation data of the scan. This section contains only elements relative to the data.		<Data> Data elements </Data>
Coordinates	Data	Specifies the coordinate system used for the scan. If this keyword is omitted, the coordinate system is right-handed Cartesian with coordinates and no field orientation by default ("xyz"). The value must conform to 3.8.2 or 3.8.3.	xyz	<Coordinates> xyz </Coordinates> <Coordinates> rahcdf </Coordinates> <Coordinates> none </Coordinates>
X0 Y0 Z0 R0 H0 A0 B0	Data	Specifies the start position or offset of the near-field scan with respect to the absolute origin. The keywords shall conform to the coordinate system specified by the keyword: Coordinates. Values must conform to 3.6.5. The value shall be numerical with units (see 3.5.3). If units are not included, the units are assumed to be "m". Angles are in degrees.	m	<X0>0.01</X0> <Y0>2.1e1mm</Y0> <Z0>600um</Z0> <A0>5</A0>
Xmax Ymax Zmax Rmax Hmax Amax Bmax	Data	Specifies the stop position of the near-field scan with respect to the absolute origin when coordinates are not included in the measurement or simulation data. Values must conform to 3.6.5 and 3.8.3. The value shall be numerical with units (see 3.5.3). If units are not included, the units are assumed to be "m". Angles are in degrees.	m	<Xmax>0.001</Xmax> <Amax>20</Amax> <Ymax>10um</Ymax>
Xstep Ystep Zstep Rstep Hstep Astep Bstep	Data	Specifies the step size of the near-field scan when coordinates are not included in the measurement or simulation data. Values must conform to 3.6.5 and 3.8.3. The value shall be numerical with units (see 3.5.3). If units are not included, the units are assumed to be "m". Angles are in degrees.	m	<Xmax>0.001</Xmax> <Amax>20</Amax> <Ymax>10um</Ymax>
Frequencies	Data	Contains information on the frequencies at which the measurement or simulation data is specified. Only one Frequencies section or one Times section shall be included.		<Frequencies> Frequency elements </Frequencies>
Unit	Frequencies	Specifies the units of the frequencies at which the measurement or simulation data is specified. The value must conform to 1.1.1. If this keyword is omitted the units are assumed to be "Hz".	Hz	<Unit>MHz</Unit>

Keyword	Parent	Usage rules	Default units or value	Examples
List	Frequencies	Specifies a list of frequencies at which the the measurement or simulation data is listed. The values shall be numerical (see 3.5.2).	Hz	<List>10 50 100 200 500</List>
Times	Data	Contains information on the times at which the measurement or simulation data is specified. Only one Frequencies section or one Times section shall be included.		<Times> Time elements </Times>
Unit	Times	Specifies the units of the times at which the measurement or simulation data is specified. The value must conform to 1.1.1. If this keyword is omitted the units are assumed to be "s".	s	<Unit>us</Unit>
List	Times	Specifies a list of times at which the the measurement or simulation data is listed. The values shall be numerical (see 3.5.2).		<List>10 20 30 40 50</List>
Criterion	Data	Describes the default criterion in an immunity scan of the equipment under test. When only one criterion is present, the description can be included directly in the criterion keyword and the parser considers this information as a data string and does not interpret it. When several criteria are required, the Index and Description keywords shall be used. (see 3.8.4).		<Criterion> Output 4 changes state </Criterion> <Criterion> Criterion elements </Criterion>
Index	Criterion	Attributes an integer numerical index to an immunity default criterion. This keyword shall be omitted when only one criterion is present. (see 3.8.4).		<Index>1</Index>
Description	Criterion	Describes a default criterion in an immunity scan of the equipment under test. The keyword must be preceded by and Index keyword. The parser considers this information as a data string and does not interpret it. (see 3.8.4).		<Description> Output 4 changes state </Description>
Measurement	Data	Contains information on the NFS measurement or simulation data of the scan. This section contains only elements relative to the NFS measurement or simulation data.		<Measurement> Measurement elements </ Measurement >
Unit	Measurement	Specifies the units of the NFS measurement or simulation data. The value must conform to 1.1.1. If this keyword is omitted the units are assumed to be "dBm", if a Frequencies section is present, or "V", if a Times section is present in the Data section.	dBm or V	<Unit>dBuV</Unit> <Unit>mV</Unit>

Keyword	Parent	Usage rules	Default units or value	Examples
Unit_x Unit_y Unit_z Unit_r Unit_h	Measurement	Specifies the units of the scan position in the X, Y and Z directions (Cartesian coordinates) and h direction (Cylindrical coordinates). The value must conform to 1.1.1. If this keyword is omitted in the Measurement section the units are assumed to be "m". Angles A and B (Cylindrical coordinates and spherical coordinates) are in degrees.	m	<Unit_x>um</Unit_x> <Unit_z>mm</Unit_z>
Format	Measurement	Specifies the format of the NFS measurement or simulation data. The value shall be "ma", meaning "magnitude and angle", or "ri", meaning real and imaginary" (see 3.8.4). If this keyword is omitted in the Measurement section, the format of the data is assumed to contain only magnitude information. The units of the magnitude, real and imaginary information are specified by the keyword: Unit in the measurement section. The units of the angle information are degrees.		<Format>ma</Format>
Data_files	Measurement	Specifies the path names of the files containing a list of NFS measurement or simulation data corresponding to the frequencies or times listed in the Frequencies or Times section of the Data section. The path names are separated by a space character " " or a line termination. The file names and paths shall conform to 3.4.2 and 3.4.3. The files shall conform to 3.4.6. Only one Data_files keyword or one List keyword shall be included in the Measurement section.		<Data_files> ./Data/mpcxxxx_1.dat mpcxxxx_2.dat mpcxxxx.txt </Data_files>
List	Measurement	Specifies a list of NFS measurement or simulation data corresponding to the frequencies or times listed in the Frequencies or Times section of the Data section (see 3.8). The values shall be numerical (see 5.4.1). Only one Data_files keyword or one List keyword shall be included in the Measurement section.	dBm or V	<List> 26.0 29.0 2.0 -93.691 -93.726 27.0 29.0 2.0 -92.753 -90.772 </List>