[Original Japanese]

Normative Annex 1-2

V-12 / 2008. 04

Procedure for Measuring the Normalized Site Attenuation by Use of a Dipole Antenna and General Guidance on It

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1. Purpose

This document describes a procedure for judgment whether or not a place (open site or semi-anechoic chamber) is appropriate for measuring the field intensity of disturbance.

If a dipole antenna cannot be used for lower frequencies measurement because the size of the facility such as semi-anechoic chamber is not large enough, Appendix II, “Evaluation of measuring site by use of a shortened dipole antenna” applies

2. Instruments to use

(1) Transmitting and receiving antennas

Transmitting and receiving antennas shall be the same type.

Antennas used for the measurement procedure in this Normative Annex are as follows.

1) Tuned Dipole Antenna

This is an antenna whose elements have been tuned shorter than a half wavelength so that the antenna impedance is only in real numbers. The output end of the antenna shall be provided with a coaxial connector through a balanced-unbalanced transformer (balun) (1:1). When the elements are of a commercially available thickness and when tuned to the normal shortening ratio length <note 1>, the antenna impedance will be roughly 60 Ω (only in real numbers with 0 imaginary numbers) <note 2>.

<note 1> The elements are to be adjusted to the length specified by the manufacturer.

<note 2> The ratio of thickness to length of the antenna element determines the shortening ratio and antenna impedance. This ratio of commercially available tuned dipole antennas is normally in the range of 1/50 to 1/1000. The antenna impedance will then be about 56 to 66 Ω.

Table 1.1 below gives example of tuned dipole antennas which are commercially available

Manufacturer	Type name (Type number)	Note
EMCO/EMC Test Systems	3121C, 3120	
Anritsu	MP534A/B, MP651A/B, MP663A,	
Advantest	TR1722	
Compliance Design	Roberts	
Schwarzbeck	VHA9103, UHA9105	
CKC	CKC Dipole antenna	
Kyoritsu	KBA511, KBA611	
Com Power Co.	AD100	
Electrometrics	EM6924, TDA30	
Antenna Research	TDS－3010/Ａ	
Hewlett Packard	HP11966H	

Table 1.1 Example of tuned dipole antenna which are commercially available

If you plan to use an antenna other than listed here and are not sure if it is usable Please send an inquiry to VCCI by attaching a catalogue of the antenna.

Table 1.2 below gives examples of antennas which are not recommendable for measuring site attenuation for the reason given in the note column.

Manufacturer	Type name (Type number)	Note
Anritsu	MP652B	It has a balun to reduce the effect of the ground plain on measurement of the field intensity at frequencies below 250 MHz.
Empire device	NF105/T-1 /T-2 /T-3	For the same reason as above.
StoddartZ	(not known)	For the same reason as above.

Table 1.2 Examples of antennas which are not recommendable for measuring site attenuation

2) Half-wave Dipole Antenna

This is a dipole antenna that is tuned so that the length of the antenna element is the half-wave of the measuring frequency. The entire length of some of commercially available half-wave dipole antennas is known not to be exactly of half-wave length. In this case it is necessary to adjust the length to the one specified by the manufacturer in accordance with operation manuals

The impedance (Z) of a dipole antenna is Z 73Ω＋j42Ω regardless of slight differences in the thickness of the elements.

There are such dipole antenna as those with a 73 – 50 Ω.impedance circuit inserted for impedance matching in addition to a 1 : 1 balun inserted between antenna output and coaxial connector

Table 2 below gives examples of half-wave dipole antennas which are commercially available

Manufacturer	Type name (Type number)	Note
Schwarzbeck	VHAP, UHAP	A 73 – 50 Ω.impedance circuit is inserted between the output terminal of the antenna and balun (1:1)
Rohde＆Schwarz	HZ-12, HZ-13	The same as above.

Table 2 Examples of half-wave dipole antennas which are commercially available

3) Caution for the way to extend telescopic elements

In the case of a dipole antenna made of multistage extendable elements (telescopic elements), extend elements from the thickest first so the variation in impedance due to the differences in stages is kept minimal. .

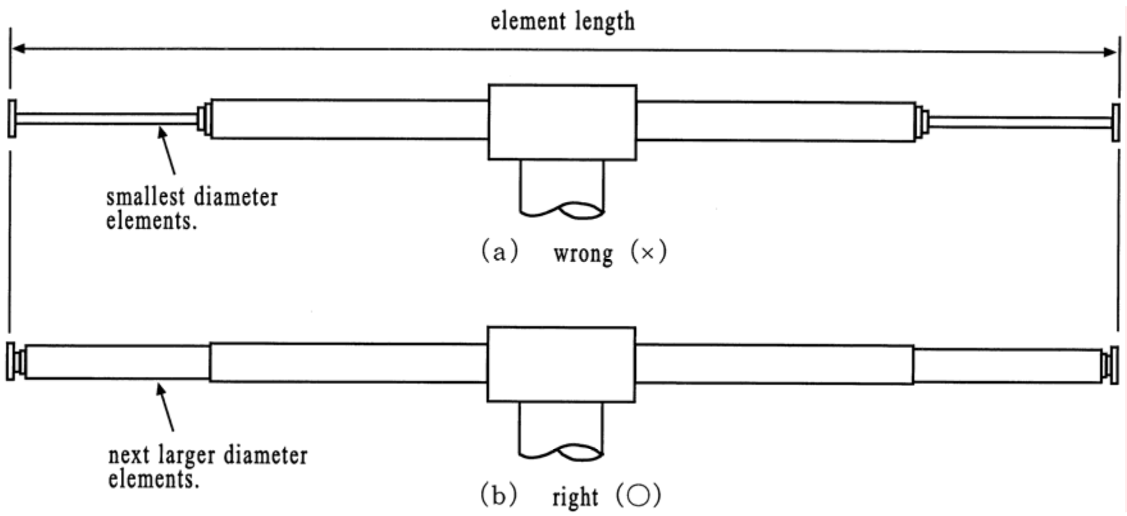

Figure 1 the way to extend telescopic elements

If you extend the element the thinnest first as Figure 1 (a) above you may not be able to carry out correct measurement because the difference in the thickness of the element will change the impedance of the element.

4) Antenna factor

Antenna factor is defined as the ratio of field intensity of the arriving wave to the input voltage at the measuring receiver terminals. If the antenna is equipped with a balun or impedance matching attenuator or other auxiliary circuits, then the losses in these circuits are included. Antenna factor is expressed in dB (1/m).

The antenna factor is influenced by the surrounding conditions. Thus it must be verified whether it was evaluated in free space, at a height of 2 m above a metal ground plane, or at a height of 3 m above a metal ground plane. The appropriate numerical value should be selected for △NSA .from among values corresponding to these conditions. Detailed calculation process is given in Chapter 4 Calculation Method for Evaluation.

(2) Antenna Mast

For a receiving antenna mast, the antenna mast used for the measurement of disturbance field intensity must be used.

For a transmitting antenna mast, it is necessary to use one that can change the mounted antenna height in the range of 2m to 2.75m. The mast should be made of material with wave absorbing nature.

(3) Signal Generator

An oscillator with variable output levels to feed a transmitting antenna with high frequency signal of 30 – 1000 MHz.

(4) Receiver

A receiver capable of receiving a signal of 30 – 1000 MHz frequency with reading resolution higher than 0.1 dB of input. A spectrum analyzer can be used instead.

(5) Network Analyzer

A network analyzer or spectrum analyzer with tracking generator can be used instead of (4) Signal Generator and (5) Receiver.

(6) Cable

A cable connecting a signal generator and transmitting antenna and the one connecting receiving antenna and a receiver shall be of characteristic impedance 50 Ω. Usually an N-type connector is used at the both ends of a cable.

Coaxial cables should be routed so that they do not affect the directivity of the antennas.

(7) Measurements at unspecified frequencies

If exogenous radio wave makes it difficult to measure normalized site attenuation at the exact frequencies specified in Tables 5 and 6, then measurements may be made in the vicinity of frequencies given in the table. In this case interpolation is used to obtain the normalized site attenuation values from Tables 1 and 2, and △NSA from Tables 3, 4, 5, 6, 7, 8,9,10 and 11 of Appendix I (V-3).

3. Measurement procedure

i. Setup of measurement system

Normalized site attenuation measurement shall be carried out with the setup illustrated in Figure 2 below.

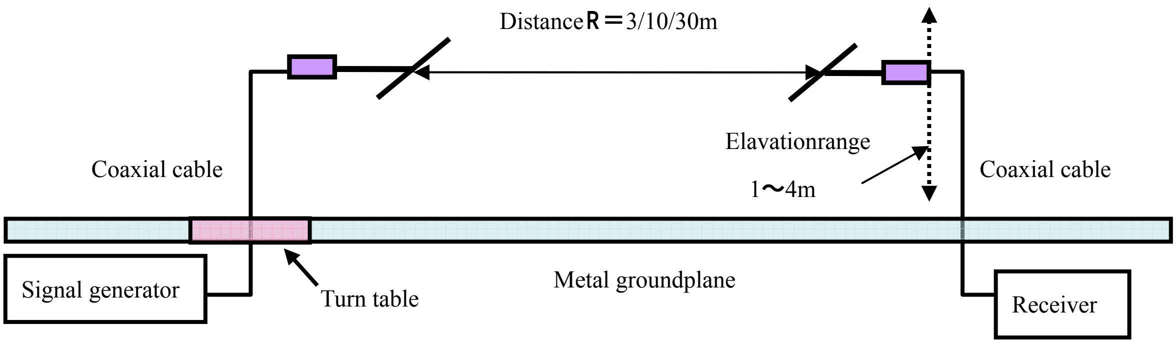

Figure 2 Setup of System for Normalized Site Attenuation Measurement

a) Place a transmitting antenna at the center of the turn table
b) Place a receiving antenna at the measurement distance of 3m, 10m or 30m from the transmitting antenna (position to measure the disturbance field intensity)

ii. Measurement of V_{site}

a) Connect the transmitting antenna set at a specified height to a signal generator
b) Connect the receiving antenna to receiver
c) Feed the output of the signal generator to the transmitting antenna. Set the signal generator frequency to 30 MHz. Set the output level of the signal generator to a level high enough to secure S/N ratio for the site attenuation measurement.
d) Slide up and down the receiving antenna to determine the height making maximum signal readout.
e) Record this value in the column (2) "Receiving level (V_{site})" in table 3 Work sheet

iii. Measurement of V_{direct}

a) Disconnect the transmitting antenna and receiving antenna respectively from cables and couple the cables with coaxial connectors (N-female to N-female) as illustrated in Figure 3.

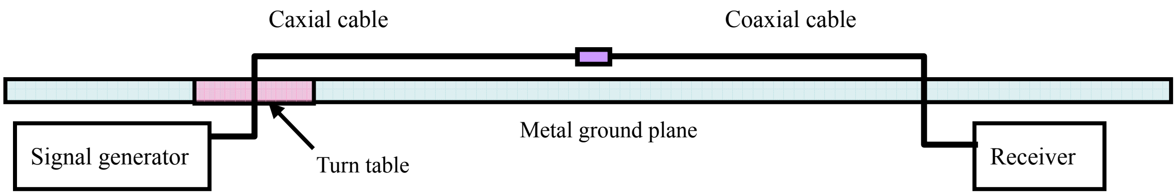

Figure 3 Wiring for measurement

b) Set frequency of the signal generator to 30 MHz and read out the level of receiver

c) Record this value in the column (1) Direct coupling level (“V_{direct}) “ of work sheet in table 3

Repeat steps ii and iii above at all frequencies indicated in standard values of normalized site attenuations (30 MHz – 1000 MH z).

FRQ [MHz]	(1) Direct coupling levels [dB]	(2) Receiving levels [dB]	(3) (1) – (2) [dB]	(4) Antenna factors AF_T[dB]	(5) Antenna factors AF_R[dB]	(6) Corrected value △NSA [dB]	(7) NSA measured values [dB]	(8) NSA Theoretical values [dB]	(9) Difference [dB]
30									
35									
40									
45									
50									
600									
700									
800									
900									
1000									

Table 3 Work sheet (Form 109 for the facility registration can serve as this work sheet)

4. Method of calculation for the site evaluation

Upon completion of the three measurements above, calculate the values of normalized site attenuation for evaluation with the following method.

a) Subtract V_{site} from V_{direct} and record the result in column (3) of Table 3. If V_{site} and V_{direct} cannot be displayed due to automatic measurement then just fill in the result of the subtraction.

b) Fill out columns (4) and (5) of Table 3 with antenna factors used in the measurements.

c) For corrected value △NSA, pick one of the values from Table 4 below which corresponds to the type of antenna used for the measurement and conditions for antenna factors calibration.

Type of antenna used	Conditions for antenna factors calibration	Corrected values to apply
Tuned dipole antenna	Free space	Table 3, Appendix I (V-3)
	At 2m above the ground	Table 4, Appendix I (V-3)
	At 3m above the ground	Table 5, Appendix I (V-3)
Tuned dipole antenna (Equivalent Load impedance 100Ω)	Free space	Table 9, Appendix I (V-3)
	At 2m above the ground	Table 10, Appendix I (V-3)
	At 3m above the ground	Table 11, Appendix I (V-3)
Half-wave dipole antenna	Free space	Table 6, Appendix I (V-3)
	At 2m above the ground	Table 7, Appendix I (V-3)
	At 3m above the ground	Table 8, Appendix I (V-3)

Table 4 Selection of corrected value to apply

d) The result of subtraction “the value in columns (3) – (4) – (5) – (6)” goes into column (7), Table 3

e) Values of normalized site attenuation in Tables 1 and 2 of Appendix I (V-3) go into column (8), Table 3.

f) The result of subtraction of column (8) from column (7) goes into Column (9), Table 3

g) The above calculation is done with the following formula.

NSA = (3) [V_{direct} - V_{site}] – (4) [Transmitting antenna factor] – (5) [Receiving antenna factor] – (6) [Corrected value]

h) If value in column (9) is contained in ±4dB, the electrical characteristics of the measuring place is judged appropriate.