Radiocommunication Study Groups

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North American Broadcasters Association (NABA)

WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT NEW REPORT

On measurement techniques for power line high data rate telecommunication systems

The North American Broadcasters Association (NABA, www.nabanet.com) is an association of broadcasters in Canada, Mexico, and the United States, and the NABA Technical Committee is its standing technical body. NABA is thus in a position to present the technical viewpoints of the most authoritative association of professional North American Broadcasters in television and sound programme production, post-production, and distribution for terrestrial, satellite, and cable broadcasting.

NABA is a Sector Member of ITU-R and a long-time participant in ITU-R Study Groups, Working Parties, Task Groups, Rapporteur Groups, etc. NABA numbers among its members Chairmen, Vice-Chairmen and members of the above groups. NABA also participates widely in the ITU work on radio, television and multimedia services and has a strong interest in spectrum management studies including spectrum engineering techniques, spectrum management fundamentals, spectrum monitoring, and inter-service sharing, interference and compatibility.

NABA notes in Annex 5 to Document 1C/35 that Working Party 1C has developed a "Working document towards a preliminary draft new Report" entitled "On measurement techniques for power line high data rate telecommunication systems." The document contains a brief introduction followed by annexes from various administrations as well as an excerpt from ITU-T Recommendation K.60.

NABA draws attention to the fact that the ITU-T Recommendation K.60 has now been amended. In its liaison statement to Study Group 6 (Document 6/164), ITU-T Study Group 5 states:

Quote:

> The following text is to be inserted as the first line of Clause 1 (Scope) of ITU-T Recommendation K.60 – Emission levels and test methods for wireline telecommunication networks to minimize electromagnetic disturbance of radio services (2008-02):
>
> > *"The purpose of this Recommendation is to guide administrations when considering complaints of interference between telecommunication systems and is not intended to set compliance requirements or recommendations for protecting the radio spectrum."*

Unquote:

> It is clear that ITU-T Recommendation K.60 should not be referenced as emission and/or interference limits. NABA proposes that the above “purpose” for ITU-T Recommendation K.60 be added as a footnote to the title of Annex 2 of the working document (Annex 5 of Document 1C/35).

NABA notes further that Annex 1 of the working document contains measurement methods proposed in the United States. The methods contain an assumed extrapolation factor of 40 dB/decade for measurements at frequencies below 30 MHz. However, a recent field study of PLT emissions by the Canadian Communications Research Centre (CRC)[1] contradicts the 40 dB/decade assumption. The CRC Report (attached in Annex 1 of this document) demonstrates that if careful consideration is taken to avoid interference sources beyond the devices under test, the propagation factor is actually 18.2 dB/decade.

The ratio of the RF field strength between three meters and ten meters was studied to understand propagation loss in the operating frequencies of PLT devices. The theoretical field strength ratio between measurements at three meters over ten meters can be derived from the free space loss propagation equation. Since it is a ratio, the equation can be simplified to:

$$Field\ Strength\ Ratio_{(dB)} = 20 * Log\left(\frac{10\,meters}{3\,meters}\right) \approx 10.5\ dB$$

The equation above assumes an extrapolation factor of 20 dB per decades of distance for free space propagation. Thus, there should theoretically be 10.5 dB more field strength at three meters than at ten meters from the houses.

Figure 1 below shows the field strength ratio of three meters over ten meters for each of three PLT devices at each of 17 test sites. To reduce the effect of the ambient noise, the calculations were done from 16 to 28 MHz only. The average field strength ratio over all the devices and test sites is 9.56 dB, 1 dB lower than the theoretical value. Based on these test results, the extrapolation factor was actually 18.2 dB per decade of distance.

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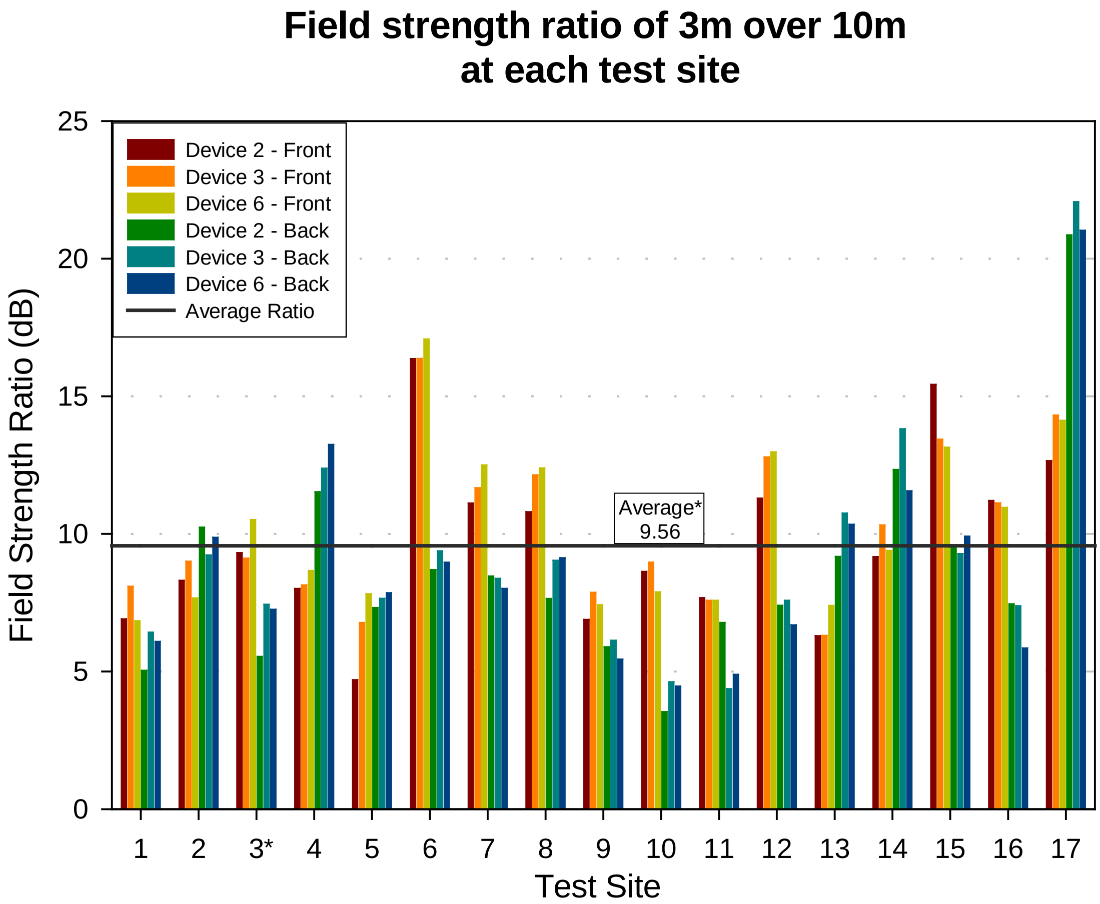
[1] The CRC is the Canadian Government's primary laboratory for research and development (R&D) in advanced telecommunications, with a critical mass and expertise in four major platforms that form the basic transport mechanism for information delivery around the world: wireless, broadcasting, satellite and fibre optics. The CRC has been committed to applied and basic research in communications and related technologies since the late 1940s.

Over the last 50 years many scientific and engineering milestones have been achieved at the CRC, contributing advancements in wireless and satellite communications and broadcast technologies. An institute of Industry Canada since 1993, the CRC has maintained its tradition of excellence in managing technical issues concerning the radio spectrum, the deployment of wireless communications and broadcast services, and the development of new technologies and knowledge for exploitation by Canadian industry. CRC is Canada's main research centre for radiocommunications technology R&D. The CRC mission is to be the centre of excellence for communications R&D, ensuring an independent source of advice for public policy purposes.

FIGURE 1



***Test Site 3 is shown on the graph but not taken into consideration for the calculation of the average.**

The 40 dB/decade value has been under contention by the ARRL in the United States (Document 1C/65. The Federal Communication Commission (FCC) in the United States has initiated a process to reconsider the value[2]. Until such time that the issue is resolved, NABA proposes that each 40 dB/decade number be placed in square brackets and the following footnote been included in the text:

"The 40 dB/decade value is currently under reconsideration in the United States."

An edited version with the "track changes" of the Working Document is presented in Annex 2 below.

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2 Request for further comment and further notice of proposed rule making, "In the Matter of Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems," Federal Communication Commission (FCC), ET Docket No. 04 37, 16 July 2009.

Annex 1

"Measurements of EM radiation from in-house Power Line Telecommunication (PLT) devices operating in a residential environment – Field Test Report", Communications Research Centre (Canada), 24 March 2009

CRC PLT Test Report

Annex 2

WORKING DOCUMENT TOWARD A PRELIMINARY DRAFT NEW REPORT

On measurement methods for power line high data rate telecommunications systems

(Question ITU-R 218/1)

There is an increasing demand for and use of broadband access to the Internet throughout the world. Power line telecommunications systems may provide one means of such access. Such systems are unintentional emitters of RF radiation, and such unintentional emission may cause interference to radiocommunication receivers. The interference coupling path to victim receivers may be by means of radiated emissions, or may be by means of conducted emissions.

Some administrations have already adopted or are developing methods or procedures for measuring either the radiated emissions or the conducted emissions from power line telecommunications systems, or both. This report is a compilation of those methods and procedures. See Annexes 1-5.

Other administrations are in the process of evaluating such measurement methods. Those administrations may wish to consider the methods described in the Annexes to this Report.

In addition, the International Special Committee on Radio Interference (CISPR), which develops limits and methods of measurement for radio frequency disturbances originating from various types of sources, also has work underway on measurement methods for conducted emissions from power line telecommunications systems.

1 Unintentional emissions from PLT systems

PLT modems are designed to communicate with each other by transmitting and receiving signals through power lines. Therefore, in general, the signal power is concentrated in the vicinity of two wires of the power line. However, if the two wires are not well-balanced, the signal power may leak from the power line in the form of radiated emission. Imbalance of the power lines is caused by various loads connected to the lines, such as electrical or electronic devices, and many branch lines connected in parallel with backbone power lines, such as circuits of lamps with their switches.
In addition, branch lines may cause resonance at certain frequencies, resulting in unbalanced signal currents in the lines. Thus, radiated emission from power lines may be caused by imbalance of the signal currents flowing in the PLT system, including factors such as the PLT modems, layout of the

power lines, and varying loads. The imbalance currents in a PLT system may vary with time and frequency. Accordingly, radiated emission levels from a PLT system depend primarily on the signal power of PLT modems, but may change extensively with time, frequency and location (and possibly other factors such as reflective objects that are nearby to the power lines).

2 Measurements on the PLT emissions

There are two different categories of measurements of PLT emissions: radiated emission measurement and conducted emission measurement.

1) Radiated emission measurement

Electromagnetic fields radiated from a PLT system are usually measured along the power lines or outside the house equipped with PLT systems. In general, field-strength measurement results strongly depend on the measurement distance and direction from radiating sources, and the polarization and height of an antenna being used. In the HF band, either a loop antenna or a monopole antenna is used for measuring the magnetic field or electric field, respectively. However, it is difficult to mutually convert the measurement data between the magnetic field strength and the electric field strength, especially at a distance less than about $\lambda/2\pi$, because a conversion factor of 377 ohms may not be applicable.

Radiated emission measurements are usually conducted *in situ* where interference to radio services may occur. However, as described in the previous section, it should be noted that the results may vary with time, frequency, and location.

To minimize the likelihood that PLT systems will cause interference, radiated emission measurements are required by regulations and standards as shown in Annexes 1 (USA), 2 (ITU-T), and 3 (Germany). Annex 4 describes work underway (in Brazil) to correlate radiated measurements that are made with different antenna types. Key factors for the radiated emission measurement are the characteristics of a measuring receiver and the antenna being used (as discussed in Annexes 3 and 4). In addition, the measurement distance, antenna height, and influence of reflecting objects that may be nearby to measurement positions are also important.

2) Conducted emission measurement

In contrast to the radiated emission measurement, the conducted emission measurement may be employed in the equipment authorization test.

As described in the previous section, unintentional radiation from a PLT system originates from the imbalance (common mode) currents that are transformed from the balanced (differential mode) signal currents due to imbalance and resonance of the PLT system. Therefore, measurements are made on the balance and imbalance components of the signal voltage or current conducted on the power line. In actual situations, however, measurement data may be spread in an extremely wide range, because imbalance in PLT modems, power lines, and connected equipment greatly varies with time and frequency as well as layouts and nearby objects to the power lines. Accordingly, in compliance tests of the PLT modem, a network called an “impedance stabilization network (ISN),” is usually used to simulate representative characteristics of actual power line conditions.

To control interference potential of other kinds of electrical/electronic equipment, such as personal computers and household appliances, conducted emission measurements are always requested to show compliance with relevant limits by various standards such as CISPR standards, especially in the frequency range below 30 MHz. In the same way, conducted emission measurements can be applied to PLT modems for equipment authorization tests. Annex 5 (Japan) requests measurements of the common mode signal currents flowing out of a modem under test when it is connected to an ISN. Since the ISN characteristics are strictly specified as a fixed load to the modem, the differential mode signal currents are also restricted by the limits for the common mode currents. Key factors to the conducted emission measurement are the characteristics of a measuring receiver and an ISN being used.

Annex 1 [to Annex 2]

Measurement methods applicable to radiated emissions from power line telecommunications systems in the United States

1 Definitions

Carrier current system: A system, or part of a system, that transmits radio frequency energy by conduction over the electric power lines. A carrier current system can be designed such that the signals are received by conduction directly from connection to the electric power lines (unintentional radiator) or the signals are received over-the-air due to radiation of the radio frequency signals from the electric power lines (intentional radiator).

Access PLT: A carrier current system operating as an unintentional radiator using frequencies between 1.705 MHz and 80 MHz on Medium Voltage (MV) or Low Voltage (LV) lines to provide broadband communications and located on the supply side of the utility service's points of interconnection with customer premises.

MV wires carry between 1,000 and 40,000 volts from a substation and may be overhead or underground; LV wires carry "low voltage," e.g., 240/120 volts from a distribution transformer to a customer premise.

In Home PLT: A carrier current system operating as an unintentional radiator using frequencies between 1.705 MHz and 80 MHz on Low Voltage lines that are not owned, operated or controlled by an electric service provider. This includes closed networks within a customer premise and includes customer premise networks forming connections with access BPL systems.

2 General measurement principles for access PLT and in-house PLT

1) Testing shall be performed with the power settings of the equipment under test (EUT) set at the maximum level.

2) Testing shall be performed using the maximum RF injection duty factor (burst rate). Test modes or test software may be used for uplink and downlink transmissions.

3) Measurements should be made at a test site where the ambient signal level is 6 dB below the applicable limit. (See CISPR 16-1-4, *Specification for radio disturbance and immunity measuring apparatus and methods*, Edition 1.1, 2004-05, Sections 5&8.)

4) If the data communications burst rate is at least 20 burst per second, quasi-peak measurements shall be employed. If the data communications burst rate is 20 bursts per second or less, measurements shall be made using a peak detector.

5) For frequencies above 30 MHz, an electric field sensing antenna, such as a biconical antenna is used. The signal shall be maximized for antenna heights from 1 to 4 metres, for both horizontal and vertical polarizations, in accordance to CISPR 16-1-4, *Specification for radio disturbance and immunity measuring apparatus and methods*, Edition 1.1, 2004-05, Section 4 procedures. For access PLT measurements only, as an alternative to varying antenna height from 1 to 4 metres, these measurements may be made at a height of 1 metre provided that the measured field-strength values are increased by a factor of 5 dB to account for height effects.

6) For frequencies below 30 MHz, an active or passive magnetic loop is used. The magnetic loop antenna should be at 1 metre height with its plane oriented vertically and the emission maximized by rotating the antenna 180 degrees about its vertical axis. When using active magnetic loops, care should be taken to prevent ambient signals from overloading the spectrum analyzer or antenna pre-amplifier.

7) The six highest radiated emissions relative to the limit and independent of antenna polarization shall be reported as stated in CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement,* Edition 5, 2004-05, Section 8.

8) All operational modes should be tested including all frequency bands of operation.

3 Access PLT measurement principles

a) Test environment

1) The equipment under test (EUT) includes all PLT electronic devices *e.g.*, couplers, injectors, extractors, repeaters, boosters, concentrators, and electric utility overhead or underground medium voltage lines.

2) *In-situ* testing shall be performed on three typical installations for overhead line(s) and three typical installations for underground line(s).

b) Radiated emissions measurement principles for overhead line installations

1) Measurements should normally be performed at a horizontal separation distance of 10 metres from the overhead line. If necessary, due to ambient emissions, measurements may be performed a distance of 3 metres. Distance corrections are to be made using an extrapolation factor of 20 dB/decade for frequencies at or above 30 MHz to the specified distance; and an extrapolation factor of [40] dB/decade for frequencies below 30 MHz to the specified distance[3].

2) Testing shall be performed at distances of 0, ¼, ½, ¾, and 1 wavelength down the line from the PLT injection point on the power line. Wavelength spacing is based on the mid-band frequency used by the EUT. In addition, if the mid-band frequency exceeds the lowest frequency injected onto the power line by more than a factor of two, testing shall be extended in steps of ½ wavelength of the mid-band frequency until the distance equals or exceeds ½ wavelength of the lowest frequency injected. (For example, if the device injects frequencies from 3 to 27 MHz, the wavelength corresponding to the mid-band frequency of 15 MHz is 20 metres, and wavelength corresponding to the lowest injected frequency is 100 metres. Measurements are to be performed at 0, 5, 10, 15, and 20 metres down line – corresponding to zero to one wavelength at the mid-band frequency. Because the mid-band frequency exceeds the minimum frequency by more than a factor of two, additional measurements are required at 10-metre intervals until the distance down-line from the injection point equals or exceeds ½ of 100 metres. Thus, additional measurement points are required at 30, 40, and 50 metres down line from the injection point.)

3) Testing shall be repeated for each access PLT component (injector, extractor, repeater, booster, concentrator, etc.)

[3] The 40 dB/decade value is currently under reconsideration in the United States.

4) The distance correction for the overhead-line measurements shall be based on the slant range distance, which is the line-of-sight distance from the measurement antenna to the overhead line. Slant range distance corrections are to be made using an extrapolation factor of 20 dB/decade for frequencies at or above 30 MHz to the specified distance; and an extrapolation factor of [40] dB/decade for frequencies below 30 MHz to the specified distance[4]. (For example, if the measurement is made at a horizontal distance of 10 metres with an antenna height of 1 metre and the height of the PLT-driven power line is 11 metres, the slant range distance is 14.1 metres [10 metres vertical distance and 10 metres horizontal distance]. At frequencies below 30 MHz, the measurements are extrapolated to the required 30-metre reference distance by subtracting [40] log(30/14.1)[5], or 13.1 dB from the measured values. For frequencies above 30 MHz, the correction uses a 20 log factor.

NOTE – In cases where Access PLT devices are coupled to low-voltage power lines (i.e., Home-Plug or modem boosters), apply the overhead-line procedures as stated above along the low-voltage lines.

c) Radiated emissions measurement principles for underground line installations

Underground line installations are those in which the PLT device is mounted in, or attached to, a pad-mounted transformer housing or a ground-mounted junction box and couples directly only to underground cables.

1) Measurements should normally be performed at a separation distance of 10 metres from the in-ground power transformer that contains the PLT device(s). If necessary, due to ambient emissions, measurements may be performed a distance of 3 metres. Distance corrections are to be made using an extrapolation factor of 20 dB/decade for frequencies at or above 30 MHz to the specified distance; and an extrapolation factor of [40] dB/decade[6] for frequencies below 30 MHz to the specified distance.

2) Measurements shall be made at positions around the perimeter of the in-ground power transformer where the maximum emissions occur. Measurements shall be made at a minimum of 16 radial angles surrounding the EUT (or In-ground transformer that contains the PLT device(s)). If directional radiation patterns are suspected, additional azimuth angles shall be examined.

4 In-House PLT measurement principles

1) *In-situ* testing is required for testing of the In-House PLT device.

2) If applicable, the device shall also be tested in a laboratory environment, as a computer. peripheral, for both radiated and conducted emissions tests per the measurement procedures in CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement,* Edition 5, 2004-05, Section 8.

a) Test environment and radiated emissions measurement principles for *in-situ* testing

1) The equipment under test (EUT) includes In-House PLT modems used to transmit and receive PLT signals on low-voltage lines, associated computer interface devices, building wiring, and overhead or underground lines that connect to the electric utilities.

[4] The 40 dB/decade value is currently under reconsideration in the United States.

[5] The 40 dB value is currently under reconsideration in the United States.

[6] The 40 dB/decade value is currently under reconsideration in the United States.

2) *In-situ* testing shall be performed with the EUT installed in a building on an outside wall on the ground floor or first floor. Testing shall be performed on three typical installations. The three installations shall include a combination of buildings with overhead-line(s) and underground line(s). The buildings shall not have aluminium or other metal siding, or shielded wiring (e.g.: wiring installed through conduit, or BX electric cable).

3) Measurements shall be made at positions around the building perimeter where the maximum emissions occur.

4) Measurements should normally be performed at a separation distance of 10 metres from the building perimeter. If necessary, due to ambient emissions, measurements may be performed a distance of 3 metres. Distance corrections are to be made using an extrapolation factor of 20 dB/decade for frequencies at or above 30 MHz to the specified distance; and an extrapolation factor of [40] dB/decade[7] for frequencies below 30 MHz to the specified distance.

b) Additional measurement principles for *in-situ* testing with overhead lines

1) In addition to testing radials around the building, testing shall be performed at three positions along the overhead line connecting to the building (i.e. the service wire). It is recommended that these measurements be performed starting at a distance 10 metres down the line from the connection to the building. If this test cannot be performed due to insufficient length of the service wire, a statement explaining the situation and test configuration shall be included in the technical report.

2) Measurements should normally be performed at a horizontal separation distance of 10 metres from the overhead line connecting to the building. If necessary, due to ambient emissions, measurements may be performed a distance of 3 metres. Distance corrections are to be made using an extrapolation factor of 20 dB/decade for frequencies at or above 30 MHz to the specified distance; and an extrapolation factor of [40] dB/decade[8] for frequencies below 30 MHz to the specified distance.

3) The distance correction for the overhead-line measurements shall be based on the slant range distance, which is the line-of-sight distance from the measurement antenna to the overhead line. Slant range distance corrections are to be made using an extrapolation factor of 20 dB/decade for frequencies at or above 30 MHz to the specified distance; and an extrapolation factor of [40] dB/decade[9] for frequencies below 30 MHz to the specified distance.

c) Measurement principles for testing as a computer peripheral

1) The data rate shall be set at the maximum rate used by the EUT. Test modes or test software may be used to simulate data traffic.

2) Conducted emissions measurements shall be performed in accordance with CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*, Edition 5, 2004-05, Section 5.

3) For In-House PLT devices operating as unintentional radiators either below 30 MHz or above 30 MHz, the radiated emissions from the computer peripheral shall be measured at an Open Area Test Site (OATS) in accordance with the measurement procedures in CISPR 16-1-4, *Specification for radio disturbance and immunity measuring apparatus and methods,* Edition 1.1, 2004-05, Section 5.

[7] The 40 dB/decade value is currently under reconsideration in the United States.

[8] The 40 dB/decade value is currently under reconsideration in the United States.

[9] The 40 dB/decade value is currently under reconsideration in the United States.

Annex 2 [to Annex 2]

Disturbance emission measurements from ITU-T Recommendation K.60[10]

1 General

In order to get the highest readings of disturbance emissions, it should be ensured that the part of the telecommunication network being assessed operates at the maximum signal levels for this site and in the mode previously identified as resulting in maximum RF disturbance field strength. If the system is interactive, it will be important to check for the presence of the reverse path (upstream) signals if these are in the same frequency range as reported in the complaint(s).

Indoor measurements are particularly subjected to uncertainties due to reflections or unknown cable routes for example. It is important to carefully search for the maximum emission and take into account possible influence factors.

Although the measurement of the radiated field has the drawbacks of a relatively high measurement uncertainty and positioning difficulties, this method is applicable both indoor and outdoor.
In addition, when performing indoor measurement, a particular attention to reflections has to be drawn. In certain cases, the field intensity may be double that of the calculated value.

2 Normalization of measurement results to the standard measurement distance

Local restrictions in space (appearing e.g., during indoor measurements) can require a reduction of the measuring distance to less than the standard measurement distance. The measurement distance chosen will be as large as possible, but not closer than 1 m. In case of outdoor measurements, it may also be necessary to use a measurement distance which is larger than the standard distance.

If a measurement distance greater or smaller than the standard measurement distance needs to be used, then three different and accessible measuring points located along the measuring axis will be chosen. The distance between these points should be as large as possible. At each point, the level of the disturbing field strength has to be measured. The local conditions and measurability of the disturbance field strength will be the determining factors.

The measurement results will then be plotted in a diagram showing the field-strength level in dB(µV/m) versus the logarithm of the measurement distance. The line interconnecting the measurement results represents the slope in field strength along the measuring axis. If this slope cannot be determined, then additional measuring points have to be chosen. The field-strength level at the standard measurement distance can be read from the diagram using the straight prolongation of the interconnecting line.

Normalization of measurement results is not permitted if, at the measurement location, the true distance to the telecommunication network cable is not known.

[10] The purpose of this Recommendation is to guide administrations when considering complaints of interference between telecommunication systems and is not intended to set compliance requirements or recommendations for protecting the radio spectrum.

3 Disturbance emission measurements in the frequency range 9 kHz to 30 MHz

3.1 Introduction

In the frequency range 9 kHz to 30 MHz, the magnetic component of the radiated disturbance emission has to be measured and assessed.

A calibrated measuring system, in accordance with CISPR 16-1-1, consisting of a radio disturbance measuring receiver (or a suitable spectrum analyser), in conjunction with an associated loop antenna for the measurement of magnetic field components, and a tripod are required.

Other specialized equipment such as resonant loop antennas can also be used, if necessary.

In order to speed up the measurement, a peak detector has first to be used. If the background noise makes this simple measurement unusable, a quasi-peak detector will be used and the quasi-peak level applied.

It is recommended that both the measuring receiver and the loop antenna have an independent power source with no ground connection (e.g., battery power), particularly in case of indoor measurements, in order to minimize the possibility of current loops via earth that could affect the measurement.

3.2 Measurement procedure

The loop antenna will be mounted on a tripod at a height of 1 metre (at the lower edge of the loop) and allocated at the measurement location previously identified as having the maximum disturbance field strength so that it is at the standard measurement distance.

Set the measuring receiver to the frequency carrying the disturbance and type of detector required, and position the loop antenna so that the maximum reading is obtained.

The measurement of magnetic fields radiated from telecommunication networks in the frequency range up to 30 MHz may become complicated due to the presence of a variety of high-level wanted RF emissions from radio services. In view of this, it may be necessary to identify some frequencies (hereafter described as "quiet frequencies") allocated close to the frequency of the radio service being affected, with low field strengths such that the background noise and any ambient signals are below the applicable limit. Where possible, this margin should be greater than 6 dB. This should be done without altering the antenna position, and ideally with the telecommunication network switched off.

If the network cannot be switched off, then the following alternative may be used:

– Orientate the loop antenna for minimum coupling to the network emission and check that the background noise and any ambient signals are below the applicable limit: where possible, this margin should be greater than 6 dB.

– Orientate the loop antenna for maximum coupling and then increase the measurement distance and check that there is a reduction in the measured field strength in accordance with 7.2.

The quiet frequencies, or frequency ranges, identified will be used to measure the disturbance emission. The operator of the measuring receiver should assess the background noise levels subjectively, on each of these frequencies. Using the measuring bandwidth and detector specified, the highest disturbance field-strength level (in dB(μV/m)) observed over a period of 15 seconds has to be recorded. Any short duration isolated peaks should be ignored.

4 Disturbance emission measurements in the frequency range 30 MHz to 3 000 MHz

4.1 Introduction

The electric component of the radiated disturbance emission has to be measured and assessed.

Usually the electric component will be measured as electric field strength (in dB(µV/m)) at the standard measurement distance.

4.2 Measuring equipment

A calibrated measuring system in accordance with CISPR 16-1-1, consisting of a radio disturbance measuring receiver (or a suitable spectrum analyser) in conjunction with an associated broadband dipole, a biconical, a logarithmic-periodical antenna, or a horn antenna, or similar linearly polarized antenna, each suitable for measurement of electric components of the electromagnetic field, and an antenna mast are required.

In order to speed up the measurement, a peak detector has first to be used. If the background noise makes this simple measurement unusable, a quasi-peak detector will be used and the quasi-peak level applied. Above 1 GHz, no quasi-peak detector exists and only the peak detector has to be used.

4.3 Measurement of the electric disturbance field strength

The measuring antenna will be mounted at the mast and position of the measurement location previously identified as having the maximum disturbance field strength, so that it is at the standard measurement distance.

Local restrictions in space (appearing e.g., during indoor measurements) can require a reduction of the measuring distance. In this case, the measurement distance chosen has to be greater or equal to 1 m. For the measurement, the antenna will be oriented such that maximum coupling is obtained to the disturbing source, without any height scan.

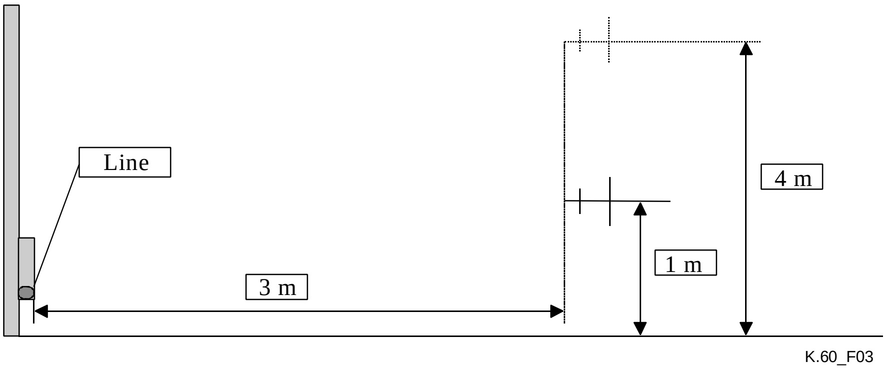
Set the measuring receiver or spectrum analyser to the frequency carrying the disturbance and type of detector required, and perform the measurements. At the specified measurement location and measuring point(s), the direction, height, and polarization (horizontal and vertical) of the measuring antenna will be varied in order to determine the maximum RF disturbance field strength.
The electrical component of the disturbance field strength is to be determined by observing the indication of the measuring receiver over a period of approximately 15 s, and subsequently recording its maximum indication. Isolated peaks occurring casually should be disregarded.

If the antenna and the telecommunication network are located at the same level, then the antenna height will vary between 1 m and 4 m (or the maximum determined by the ceiling) in order to determine the maximum field strength. In varying the antenna height, the antenna should not be positioned closer than 0.5 m to reflecting objects (e.g., walls, ceilings, metallic structures, etc.). The antenna height variation may be restricted owing to local conditions. (See Fig. 3.)

In the case of an outdoor measurement, the antenna height will be varied from 1 m to 4 m.

FIGURE

Antenna height variation



Annex 3 [to Annex 2]

Specification for the measurement of disturbance fields from telecommunications systems and networks in the frequency range 9 kHz to 3 GHz in Germany

Annex 3 is unchanged.

Annex 4 [to Annex 2]

Correlation of mobile monitoring station monopole antenna with loop antenna in Brazil

Annex 4 is unchanged.

Annex 5 [to Annex 2]

Measurement methods for the compliance test in Japan

Annex 5 is unchanged.

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