Notification of the MIC Radio Research Laboratory No. 2004-66

According to the provisions of Article 47-2 paragraph 1 of the Radio Waves Act and Article 62 paragraph 1 item 2 (2) of Enforcement Regulation of the same statute, the standard of measuring radio wave strength is determined and notified as follows.

September 22, 2004

Director of the MIC Radio Research Lab.

Requirements for Measurement of Electromagnetic Field Strength

(Unofficial Translation)

Article 1 (Purpose) The purpose of this notification is to stipulate the Standard of Measuring Electromagnetic Wave Strength (hereinafter referred to as "MEASUREMENT STANDARD") in accordance with Article 42-2 Paragraph 1 of the Radio Waves Act.

Article 2 (Definitions) The definitions of terms used under this regulation are as follows:

1. The term "measurement standard" means the measurement method and its related procedural standard.

2. The term "electric field strength" means an intensity of a unit positive charge at a

particular point within an electric field.

3. The term “magnetic field strength” means the magnetic flux intensity of a linear, isotropic medium divided by the magnetic permeability of the medium at a given frequency.

4. The term “magnetic flux intensity” means a vector quantity generating force proportional to the movement speed of a moving charge.

5. The term “power density” means the power passing a unit area perpendicular to the direction of movement of a radio wave.

6. The term “low frequency wave bandwidth” means a frequency band below 10kHz starting from 0Hz.

7. The term “high frequency wave bandwidth” means a frequency band ranging from 10kHz to 300GHz.

8. The term “long distance field area” means an area where magnetic field strength is approximately inversely proportional to the distance from the electromagnetic field center due to the long distance from the center.

9. The term “short distance field area” means an area where the conditions of the long distance field are not constituted due to the close proximity of the electromagnetic field center.

10. The term “free space condition” means a condition in which a location of measurement is situated far away from the electromagnetic field center, and there are no obstacles around the location.

11. The term “polarized wave” means the path of an electric field, magnetic field or electromagnetic vector with respect to time. If the path forms part of a straight line, it is called “a linearly polarized wave”; if it forms a circle, “a circularly polarized wave; and

if it forms an ellipse, “an elliptically polarized wave.”

12. The term “multiple radiation sources” means multiple electromagnetic field sources with different frequencies, situated at different locations.

13. The term “probe” means a sensor that can measure the intensity of an electric field or a magnetic field.

14. The term “effective value (rms)” means the square root of the average of squared sine wave signals over time.

15. The term “peak rate” means a maximum value over time.

16. The term “combined electromagnetic field” means the square root of the sum of the squared value of the electromagnetic field measured from three straight lines perpendicular to each other at a measuring location; or in the case of elliptically polarized waves (or circularly polarized waves), it means the square root of the sum of the squared value of the electromagnetic field, measured in the direction of major and minor axes (or, in the case of a circle, two arbitrary axes perpendicular to each other), on a plane including an electromagnetic ellipse (or a circle).

17. The term “measurement uncertainty” means a percentage indicating a distribution of measurement values resulting from several factors of a measurement process, including calibration errors of a measuring device, an auxiliary measuring device and connecting cables, and environmental conditions.

Article 3 (Application Range) This standard shall be applied to an evaluation of the acceptability of the electromagnetic wave strength defined by the Standard for the Protection of the Human Body Against Radio Waves, which has been determined and notified by the Minister of Information and Communication. However, magnetic flux

intensity, according to the standard of electromagnetic wave strength, can be calculated from a measure of the strength of a magnetic field, and electric intensity from a measure of the strength of an electric field.

Article 4 (General Conditions for Measuring Devices)

 (Measuring Devices) Measuring devices should satisfy each of the following conditions.

1. Measuring devices should have wide enough operation ranges and frequency bandwidths.

2. Measuring devices as well as power lines and connecting cables should be shielded properly and not be influenced by an external electromagnetic field.

3. Measuring devices with a low frequency wave bandwidth should be operated by the installed power supply and should be able to be operated continuously over eight hours without recharging or exchanging the power supply.

4. Measuring devices should be able to measure effective values and peak rates of an electric field and of the components of a magnetic field.

 (Probe) Measuring probes should meet each of the following conditions.

1. In the case of a low frequency wave band, the cross-sectional area of a single-axis probe should be smaller than 0.01m2, and the maximum size of three-axis probe should be shorter than 0.2m.

2. In general, the size of a probe for a high frequency wave band should be smaller than 1/4 of a wave or smaller than 0.1m. In the case of a high frequency wave band of below 1MHz, the maximum size of a probe under a free space condition should be less than 0.2m.

 A measurement result should not be influenced by external factors such as environmental conditions of temperature or humidity, equipment configurations for measurement, interference by measurers, and frequency wave induction by power lines and connecting cables.

Article 5 (Measurement Conditions)

 Measurements of an electromagnetic field should be conducted at a work place or residential area of people who are exposed to it. If there are several conditions, the worst condition should be selected.

 To minimize an influence of direct frequency wave induction and to obtain reliable measurements, a probe and electromagnetic field source should be fully separated depending on a frequency.

 At the time of measurement, the power of portable apparatus causing an electromagnetic field should be turned off.

Article 6 (Calibration errors/Uncertainty of Measuring Devices)

 Measurement devices with an effective calibration date should be used; after maintenance, they should be calibrated immediately.

 The uncertainties of measuring devices calibrated at a low frequency wave band should be within ± (10% of readout + 2V/m) for the electric field and within ±(10% of readout + 16mA/m) for the magnetic field.

 The measurement uncertainty of devices calibrated at a high frequency wave band should be within ±1dB.

Article 7 (Selection of Measuring Devices)

 Measuring devices should be selected properly by considering a frequency of an electromagnetic field source, maximum strength and time varying rate of an electromagnetic field, and polarized waves of an electromagnetic field.

 Measuring devices should have a wide enough bandwidth to measure all harmonic radiation components that cannot be ignored, including basic frequency components from an electromagnetic field source.

Article 8 (Method of Measuring a Low Frequency Wave Electromagnetic Field)

 A measurement of the strength of an electromagnetic field with a three-axis isotropic probe should be a maximum value of the combined electric field at a measuring location. However, when measuring an electric field with linearly polarized waves or when finding out about the shape of an ellipse forming an electric field, a single-axis probe can be used.

 If an electric field is emitted from stationary facilities, a measurement of the field should be conducted at the work place of workers or a residential area of citizens. If an electric field is emitted from electric and electronic apparatus, the measurement should be performed at a regular distance.

 If the strength of an electric field is measured, a distance between a probe and a measurer should be over 2.5m. However, if the strength of a magnetic field is measured, there is no limit for the distance.

 (Measurement of an Electromagnetic Field under Power Lines) Measurements of an electromagnetic field under power lines shall be based on each of the following methods.

1. The strength of an electromagnetic field should be measured 1m above the ground surface. However, if measured at other heights, an accurate location of measurement should be indicated.

2. A probe should be placed at a location where a perpendicular component of an electric field can be read.

3. A distance between a measuring device and a movable object should be three times the height of the object. A distance between a measuring device and a stationary object should be over 1m.

Article 9 (A Measuring Method for a high frequency wave electric field)

 For the measurement of an electromagnetic field, a combined electromagnetic field should be measured by a three-axis isotropic probe. To measure a linearly polarized electric field or to find out about the shape of an ellipse at an elliptically polarized electric field, a single-axis probe can be used.

 If there is a single radiation source at a long distance field area, measurements are made by each of the following methods.

1. A linearly polarized plane wave is measured by a measurement device for the strength of an electric field. In this case, the intensity of a magnetic field can be calculated from the strength of an electric field.

2. If a measurement is made near a metal object, a distance from the object should be over three times the length of a probe.

3. The metal part of a measuring device or a support should be covered with an absorber. Also, by maintaining a wave for an organic structure to be below 1/4, the measurement uncertainty should be within ±2dB.

 If there are multiple radiation sources at a long distance area, measurements are made by each of the following methods.

1. If the frequency of a radiation source is known and if a standard value defined by the Standard for the Protection of Human Body Against Radio Wave, which has been determined and notified by the Minister of Information and Communication, is constant within a measurement frequency range, a wide-band measuring device should used for measurement.

2. If the frequency of a radiation source is known and if the standard value of No.1 mentioned above is not constant within a measurement frequency range, the strength of an electromagnetic field for each frequency component should be measured by a narrow-band measuring device.

 The strength of an electromagnetic field at a short-distance field area should be measured by each of the following items.

1. The strength of an electromagnetic field at a short-distance field area should measured by a probe that is smaller that the wave of a measuring frequency to measure drastic spatial changes.

2. If the strength of an electromagnetic field at a frequency area is over 300MHz, an isotropic probe with a three-axis dipole should be used to measure an electric field. The

strength of an electromagnetic field is calculated from the measured strength of the electromagnetic field.

3. If the strength of an electromagnetic field at a frequency area is below 300MHz, the probe and isotropic probe with a three-axis loop in No.2 mentioned above should all be used to measure the electric field and the magnetic field.

4. If a frequency and polarized wave are all known in Nos. 2 and 3, a narrow-band single-axis probe can be used.

⑤ A minimum required distance between a probe and a radiation source of an electromagnetic field, as well as between a probe and a scatterer, should take the bigger value of the two: (a) three times the size of a probe, (b) 20cm.

Article 10 (Writing a Measurement Report)

After measurements of the strength of an electromagnetic field are completed, reports on the results of low-frequency measurement and high-frequency measurement should be constructed according to Table 1 and Table 2, respectively.

Addenda

This notification shall be enforced from September 22, 2004.

[Table 1]

Results of the Measurement of Electromagnetic Field (Low Frequency)	
Measurement of Physical Quantity	□ Strength of electric field (V/m) □ Strength of magnetic field (A/m)
Measurement of Polarized Field	□ Linearly polarized □ Circularly polarized □ Elliptically polarized □ Not known
Measuring Probe	□ Single-axis □ Three-axis
Measuring Place	Longitude: Latitude: Altitude: do/si si/gun/gu ro/gu/up/myun dong bunji (Detailed description of place; drawings or photos attached)
Measuring Environment	Description of temperature, humidity, the condition of earth's surface, wind speed, and temperature
Source of Electromagnetic Field	Description of line voltage, line current, structure of conductor, or other electromagnetic field center.
Range of Frequency	3 dB high-low frequency
Measuring Device	(Maker, Model name, Probe size and shape, Date of recent revision)
Measuring Period	Year Month Date Hour Min. Sec. - Year Month Date Hour Min. Sec.
Measurement Time	Minutes Seconds
Measurement distance 1	(Distance between the electromagnetic field center and a probe)
Measurement distance 2	(Distance between a measuring device and a measurer)
Reference 1	(Description of metal object, size, and distance between measuring spots)
Reference 2	Activity condition of people exposed to the measuring environment
Measurement Data □Effective value □Peak value	Maximum time_____, Minimum time_____, Average time_____ If elliptical wave: Strength major field _____ Strength of minor field _____
Measurement Uncertainty	

In accordance with the provisions stipulated by the notice of the MIC Radio Research Laboratory No. 2004-66, the above measurement results are notified.

Date: _____/_____/_____
MM DD YYYY

Department:
Name of Reporter: (Signature or Seal)

Name of Measuring Institution

Note: Separate forms can be used to report more measurement results.

[Table 2]

Results of the Measurement of Electromagnetic Field (High Frequency)

Measuring Physical Quantity	□ Strength of electric field (V/m) □ Strength of magnetic field (A/m)
Measuring Condition	□ Long-distance field, Single radiation source □ Long-distance field, Multiple radiation sources □ Short-distance field
Measuring Place	Latitude: Longitude: Altitude: Do/si si/gun/gu ro/gu/up/myun dong bunji (Detailed description of place, Drawings or photos attached)
Measuring Environment	Description of temperature, humidity, and the condition of earth's surface
Source of Electromagnetic Field	Description of electromagnetic field center, changed contents
Range of Measuring Frequency	3 dB high-low frequency
Measuring Device	Maker, Model name, Size of probe, Date of recent revision
Measuring Period	Year Month Date Hour Min. Sec. - Year Month Date Hour Min Sec
Measuring Time	Minutes Seconds
Measuring Distance 1	(Distance between radiation source and probe)
Measuring Distance 2	(Distance between measuring device and measurer)
Reference 1	(Description of metal objects, size and distance from a measuring spot)
Reference 2	Activity condition of people exposed to the measuring environment
Measuring Data	□ Effective value □ Peak value Maximum time_____, Minimum time_____, Average time_____
Measurement Uncertainty	

According to the provisions stipulated by the notice of the MIC Radio Research Laboratory No. 2004-66, the above measurement results are notified.

Date: _____/_____/_____
MM DD YYYY

Department:
Name of Reporter: (Signature or Seal)

Name of Measuring Institution

Note: Separate forms can be used to report more measurement results.

Standard for Measuring Electromagnetic Field Strength