

Notification of the National Telecommunications Commission

Regarding Safety Standard for the Use of Radiocommunication Equipment on Human Health

The National Telecommunications Commission has realized the widespread popularity of radiocommunication equipment and the importance of the general public health and safety, and hence recognized the necessity to put in place the requirements for the exposure limits to electromagnetic waves from the use of radiocommunication equipment in order to safeguard human health against any hazards, and ensure safety of the use of such equipment and protection of the consumers.

By virtue of Section 51 (6) and Section 78 paragraph one of the Act on Organization to Assign Radio Frequency and to Regulate the Broadcasting and Telecommunication Services B.E. 2543 (2000), Section 32 paragraph one of the Telecommunications Business Act B.E. 2544 (2001), and Section 29 (4) of the Radiocommunication Act B.E. 2498 (1955), and its amendments, the National Telecommunications Commission hereby announces the establishment of the Safety Standard for the Use of Radiocommunication Equipment on Human Health, as detailed in the Standard No. NTC TS 5001 – 2550 appended hereto.

This Notification shall take effect on and from the day following the date of its publication in the Royal Gazette.

Announced on the 29th day of March B.E. 2550 (2007)

General Choochart Promphrasid

Chairman of the National Telecommunications Commission



**Safety Standard for the Use of Radiocommunication
Equipment on Human Health**

NTC TS 5001 – 2550

**Limits and Measurement of Exposure to Electromagnetic Waves
In the Frequency Range of 9 kHz – 300 GHz**

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Safety Standard for the Use of Radiocommunication Equipment on Human Health Limits and Measurement of Exposure to Electromagnetic Waves In the Frequency Range of 9 kHz – 300 GHz

1. Scope

This standard determines the limits of humans' exposure to electromagnetic waves in the frequency range of 9 kHz-300 GHz. This aims at using as the guidelines in monitoring and supervising radiocommunication transmission and installation to safeguard human health against any hazards from the exposure to the magnetic waves from such equipment.

This standard does not cover human exposure to electromagnetic radiation during the medical treatment process.

2. Types of People Exposed to Electromagnetic Waves

People exposed to such magnetic radiation are classified into two groups below:

2.1 Occupational exposure refers to human exposure to electromagnetic waves from radiocommunication equipment as a result of their occupation or human exposure on regular basis. These people are the exposure group with awareness of the exposure degree and having undergone training on the possible risks, with proper preparation during their performance of duty and use of the equipment.

2.2 General public exposure refers to the general public exposed to electromagnetic waves from radiocommunication equipment, excluding those mentioned in 2.1 above. Generally, these people are not aware of the hazards and are not likely to reduce or avoid such exposure. This accordingly demands stricter determination of the limits of exposure than those for the occupational exposure group.

3. Types of Radiocommunication Equipment

Radiocommunication equipment falling in the purview of the safety standard for the use of radiocommunication equipment on human health are divided into three categories as follows:

3.1 Radiocommunication equipment, of which the electromagnetic radiation component is, in normal use, positioned close to the user's head, or less than 20 centimeters from the body of the user

For this category, assessment of the specific absorption rate (SAR) has to be made to ensure that it will not exceed the limits set forth under this standard.

This category also includes portable, handheld and body-worn equipment.

3.2 Radiocommunication equipment, of which the electromagnetic radiation component is, in normal use, positioned at least 20 centimeters from the body of the user

This category does not fall under the requirement for assessment of the SAR but is subject to assessment of magnetic field strength, to ensure that it will not exceed the standard limits.

This category also includes mobile phones installed in vehicles and mobile phones in general.

3.3 Radiocommunication equipment in fixed location and with broad area of electromagnetic radiation

This category does not fall under the requirement for assessment of the SAR but is subject to assessment of magnetic field strength, to ensure that it will not exceed the standard limits.

This category also includes fixed station and base station in the radiocommunication business.

4. Definitions

4.1 Radiocommunication equipment means such device and equipment as defined under the radiocommunication law.

4.2 Exposure limit means maximum numerical value of the electromagnetic exposure in term of electric field strength, magnetic field strength, power density and SAR.

4.3 Electric field strength (E) means electric force exerted on a positive test charge placed at a certain point within the electric field, measured in voltage per meter (V/m).

4.4 Magnetic field strength (H) means the force that a magnetic field exerts on a theoretical unit magnetic pole in free space, measured in ampere per meter (A/m).

4.5 Power density (S) means the amount of power delivered by an energy source, i.e. radio frequency wave, measured in watt per square meter (W/m^2).

4.6 Plane wave means a constant-frequency wave whose wavefronts (surfaces of constant phase) are infinite parallel planes normal to the phase velocity vector.

The correlation between power density and magnetic and electric fields in case of plane wave can be exhibited as below:

$$\mathbf{S} = \mathbf{E} \times \mathbf{H}$$

4.7 Equivalent plane wave power density (S_{eq}) means magnitude of the magnetic flux density of the plane wave with equal electric strength (E) and magnetic strength (H), as below:

$$S_{eq} = \frac{E^2}{377} = H^2 \times 377$$

Notes :

E : Electric field strength, measured in voltage per meter (V/m)

H : Magnetic field strength, measured in ampere per meter (A/m)

377 : Free-space impedance value, measured in ohm (Ω)

4.8 Specific absorption (SA) means energy absorption per mass unit of biological tissue, which is time integral of the specific absorption rate, measured in joules per kilogram (J/kg).

4.9 Specific absorption rate (SAR) means the rate at which energy is absorbed per mass unit of biological tissue, measured in watt per kilogram (W/kg). It is the dosimetric measurement unit generally used for the measurement of electromagnetic exposure over the range of 100 kHz.

4.10 Equivalent isotropically radiated power (e.i.r.p.) means the unit of measurement of the strength of a radiated field, typically from a radio antenna.

5. Limits

The standard limits set for exposure to electromagnetic wave in the frequency range of 9 kHz - 300 GHz based on the limits indicated in the document on ICNIRP Guidelines for Limiting Exposure to Time-varying Electric, Magnetic and Electromagnetic Fields (Up to 300 GHz), 1998 edition, worked out and released by International Commission on Non-Ionizing Radiation Protection (ICNIRP), as below:

5.1 Exposure limits to electromagnetic radiation from radiocommunication equipment, of which the radiation component is, in normal use, positioned close to the user's head, or less than 20 centimeters from the body of the user

The SAR in the frequency range of 100 kHz-10 GHz for occupational exposure group and general public exposure group shall not exceed the following:

1) SAR for occupational exposure group

	SAR (W/kg)
Average SAR for the whole body	0.4
Average SAR for the head and trunk	10
Average SAR for the limbs	20

2) SAR for general public exposure group

	SAR (W/kg)
Average SAR for the whole body	0.08
Average SAR for the head and trunk	2
Average SAR for the limbs	4

Notes:

1. The SAR shown above is the 6-minute average of the SAR assessed.
2. The SAR for the whole body is a division result of the total power of the body absorption and the total body mass.
3. The SAR for the specific parts of the body is an average per 10 gram mass of the tissue of the same parts in cubic shape.

5.2 Exposure limits to electromagnetic radiation from wireless communication transmission equipment, of which the radiation component is, in normal use, positioned at least 20 centimeters from the human body, and that in fixed location and with broad area of electromagnetic radiation

Limits of electromagnetic field strength for occupational exposure group and general public exposure group shall not be over exceed the following:

1) Limits of electromagnetic field strength for occupational exposure group

Frequency range	E-field strength (V/m)	H-field strength (A/m)	Equivalent plane wave power density S_{eq} (W/m ²)
93 kHz-65 kHz	610	24.4	-
65 kHz-1 MHz	610	$1.6/f$	-
1 MHz-10 MHz	$610/f$	$1.6/f$	-
10 MHz-400 MHz	61	0.16	10
400 MHz-2 GHz	$3f^{1/2}$	$0.008f^{1/2}$	$f/40$
2 GHz-300 GHz	137	0.36	50

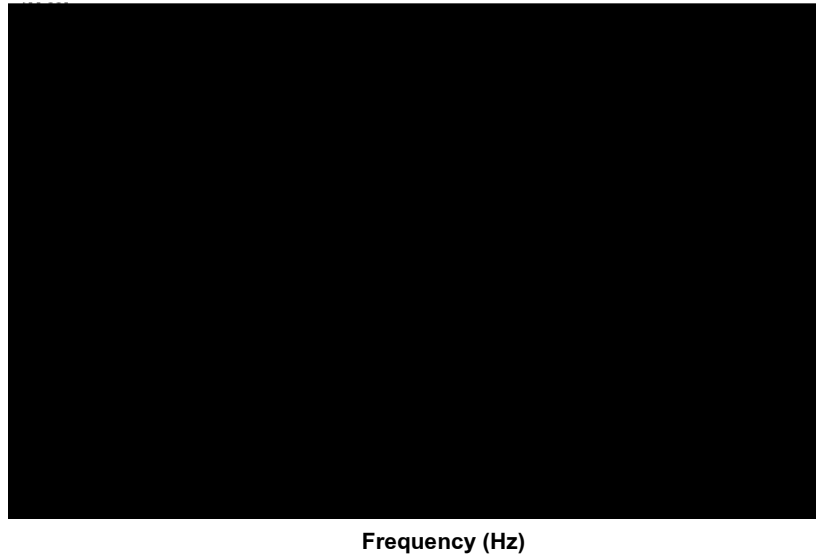
2) Limits of electromagnetic field strength for general public exposure group

Frequency range	E-field strength (V/m)	H-field strength (A/m)	Equivalent plane wave power density S_{eq} (W/m ²)
9 kHz-150 kHz	87	5	-
150 kHz-1 MHz	87	$0.73/f$	-
1 MHz-10 MHz	$87/f^{1/2}$	$0.73/f$	-
10 MHz-400 MHz	28	0.073	2
400 MHz-2 GHz	$1.375f^{1/2}$	$0.0037f^{1/2}$	$f/200$
2 GHz-300 GHz	61	0.16	10

Notes:

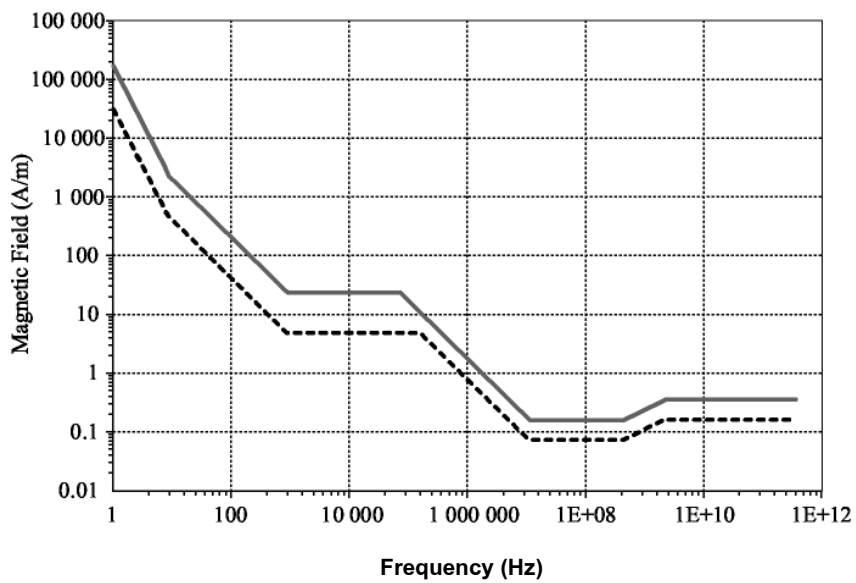
1. E-field strength is electric field strength, measured in voltage per meter (V/m).
2. H-field strength is magnetic field strength, measured in ampere per meter (A/m).
3. f refers to frequency, measured in MHz
4. For frequency range of 100 kHz-10 GHz, the S_{eq} , E^2 and H^2 shown are the average of those in certain 6-minute periods.
5. For frequency over 10 GHz, the S_{eq} , E^2 and H^2 shown are the average of those in certain periods of $68 / f^{1.05}$ minutes, where f refers to frequency measured in GHz.

The charts exhibiting the limits of electric field strength and those of magnetic field strength for occupational exposure group and general public exposure group are shown below in **Figure 1** and **Figure 2** respectively:



----- Limit for general public exposure
 _____ Limit for occupational exposure

Figure 1: Limits of electric field strength



----- Limit for general public exposure
 _____ Limit for occupational exposure

Figure 2: Limits of magnetic field strength

5.3 Assessment of exposure to magnetic wave radiation concurrently from over one source

In case of exposure to electromagnetic wave radiation concurrently from over one source and at diversified frequencies, the measurement of the degree of the exposure in overall to ensure whether it complies with the limits in 5.2 or not is subject to the following calculation formula:

$$\sum_{i=1\text{kHz}}^{1\text{MHz}} \frac{E_i}{E_{l,i}} + \sum_{i>1\text{MHz}} \frac{E_i}{a} \leq 1$$

$$\sum_{j=1\text{kHz}}^{1\text{MHz}} \frac{H_j}{H_{l,j}} + \sum_{j>1\text{MHz}} \frac{H_j}{b} \leq 1$$

Whereas	E_i	=	Electric field strength at frequency i
	$E_{l,i}$	=	Level of limit at frequency i
	H_j	=	Magnetic field strength at frequency j
	$H_{l,j}$	=	Level of limit at frequency j
	a	=	Measured at 610 V/m for occupational exposure group and 87 V/m for general public exposure group
	b	=	Measured at 24.4 A/m for occupational exposure group and 5 A/m for general public exposure group

$$\sum_{i=100\text{kHz}}^{1\text{MHz}} \left(\frac{E_i}{c} \right)^2 + \sum_{i>1\text{MHz}}^{300\text{GHz}} \left(\frac{E_i}{E_{l,i}} \right)^2 \leq 1$$

$$\sum_{j=100\text{kHz}}^{1\text{MHz}} \left(\frac{H_j}{d} \right)^2 + \sum_{j>1\text{MHz}}^{300\text{GHz}} \left(\frac{H_j}{H_{l,j}} \right)^2 \leq 1$$

Whereas	E_i	=	Electric field strength at frequency i
	$E_{l,i}$	=	Level of limit at frequency i
	H_j	=	Magnetic field strength at frequency j
	$H_{l,j}$	=	Level of limit at frequency j
	c	=	Measured at $610/f$ V/m (f in MHz) for occupational exposure group and $87/f^{1/2}$ V/m for general public exposure group
	d	=	Measured at $1.6/f$ A/m (f in MHz) for occupational exposure group and $0.73/f$ for general public exposure group

6. Methods of Measurement

6.1 Measurement of SAR

The measurement of SAR shall follow the applicable international, regional and national standards. Some of them are:

- 1) IEC 62209-1 (20054) : Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 1 : Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)
- 2) EN 50361 (2001) : Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz-3 GHz)
- 3) IEEE Std 1528 (2003) : IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices : Measurement Techniques

6.2 Measurement of electromagnetic field strength

The measurement or calculation of electromagnetic field strength shall follow the international, regional and national standards. Some of them are:

- 1) IEC 61566 (1997) : Measurement of exposure to radio-frequency electromagnetic fields-Field strength in the frequency range of 100 kHz to 1 GHz
- 2) ITU-T Recommendation K.52 (2004) : Guidance on complying with limits for human exposure to electromagnetic fields
- 3) ITU-T Recommendation K.61 (2003) : Guidance to measurement and numerical prediction of electromagnetic fields for compliance with human exposure limits for wireless communication installation.
- 4) ANSI/IEEE C95.3 (2002) : Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave