



National Information & Communications Technology Authority

EMF EXPOSURE LIMIT GUIDELINE 2018
(Frequency range 0 to 300 GHz)

made under Section 218 of the NICT Act 2009

Doc Ref#

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1 FOREWORD

The National Information and Communications Technology Authority (NICTA) under the section 218 of the Act, has the mandate to make rules and guidelines relating to ICT industry for the purpose of regulatory compliance and fulfillment of the Act objectives.

This Guideline is developed purposely to establish the EMF human exposure limits in the frequency range from 0 to 300GHz that will provide protection against possible adverse health effects from RF sources that emits EMF radiation.

This Guideline also proposes compliance, enforcement and record keeping measures which all importers, suppliers, and operators shall comply to when dealing with such ICT equipment or sources which emits EMF radiation.

Relevant Regulatory guidelines and standards as outlined in clause 11 are to be read in conjunction with this Instrument, purposely to further the understanding of the objectives and application of this Guideline and the Act.

This guideline aligns with the new legislation and regulations and supersedes the old PANGTEL Instrument "*Code of Practice on the limits of human exposure to radiofrequency electromagnetic fields in the frequency of up to 300 GHz*".

2 INTRODUCTION

The deployment of ICT infrastructures that includes radio antennas, mobile base stations and even the simple usage of cell phones have raised concerns from the public of the potential health risks that may arise from the exposure and the usage of such technology.

The main argument and/or concern that has been raised from time to time is the potential risk to cancer that may arise from exposure to radiation, that is through direct usage of cell phone or for being too close to a base station or any form of EMF sources.

This Guideline has been developed in accordance with **Section 218** of the Act purposely to establish the EMF human exposure limits in the frequency range from 0 to 300GHz from EMF sources.

Various countries have their own EMF Exposure guidelines and standards. The disparities in EMF standards/guidelines is influenced by factors like, countries carrying out independent research, use of different method to assess these studies, varying interpretation of the scientific data or differences in philosophies for public health standards development.

Such disparities in international guidelines/standards can cause confusion amongst regulators and policy makers, increase public anxiety and pose challenge to the operators and dealers of ICT systems who will be forced to customise their products to comply with each market.

To address that, WHO and ITU have endorsed the ICNIRP guidelines and encourages member states who do not have their own guidelines or standards to adopt the document.

Hence for the purpose of this Instrument, NICTA has adopted the ICNIRP guidelines and encourages operators/suppliers to comply with all recommendations as outlined in the ICNIRP document.

3 SCOPE

This Guideline applies to;

- public and worker's exposure to EMF field or radiation in the frequency range 0 to 300 GHz.
- broad range of EMF Sources, hence is not centric to any particular technology or service and is intended to cover all EMF emanating from various sources such as radio and TV transmitters, mobile handsets and base stations, microwave and satellite systems.

The guidelines in this Instrument does not apply to patients undergoing medical diagnosis or treatment under professional supervision or to military personnel.

4 OBJECTIVES

The objectives of the Guideline are;

- to protect the public and workers from possible adverse health effects arising from exposure to EMF fields in their living and working environment;
- to establish limits on EMF Exposure levels that person's dealing or installing sources of EMF should comply with during installation and operation of such devices;
- to promote awareness through the use and distribution of this Guideline with the principle purpose of educating the public of the real dangers of EMF exposures and the allowable exposure limits based on scientifically proven information.

5 INTERPRETATION

In this Instrument the terms and/or phrases will mean as follows;

Act *means* National Information and Communications Technology Act 2009 (NICT Act 2009).

Dealing *means* importing, selling or installing of RF equipment and/or EMF sources that emits EMF field or radiation.

Document *means* ICNIRP Guidelines.

EMF *means* Electronic Magnetic Field.

EMF sources *means* any form of equipment or device that emits EMF field or radiation.

Guideline *means* Instrument.

Instrument *means* Guideline as defined in the Act.

ICNIRP *means* International Commission on Non-Ionizing Radiation Protection.

Public *means* members of the public who are not trained or have not been provided with necessary information or gears to protect themselves from EMF exposure and are covered under the Public Exposure limits in accordance with basic restrictions and reference level respectively.

Worker *means* a trained employee that is exposed to EMF in his/her working environment and is subject to occupational exposure limits in accordance with basic restrictions and reference level respectively.

Basic Restriction *means* maximum allowable EMF limits a person can be exposed to without their health being affected.

Occupational Exposure *means* exposure in a work place and is subjected to the occupational basic restrictions and reference level.

Public Exposure *means* exposure at a public place and is subjected to public basic restrictions and reference level.

Public Places *means* an area or space which is accessible to the public such as Parks, schools, bus stops, stadiums and shops etc.

Reference Level *means* reference level of EMF exposure which is used as a comparison to basic restrictions to ensure compliance. If the reference level is said to have exceeded the respective basic restriction than it is not in compliance.

Site *means* an area or space where a RF equipment or EMF source has been installed (eg. Mobile base station).

6 EMF EXPOSURE LIMITS & COMPLIANCE PROCEDURES

6.1 EMF Exposure Limits

The recommendation by the International Commission on Non-Ionizing Radiation Protection with respect to Basic Restrictions and Reference Levels will be adopted as the applicable Exposure Limits.

All persons *dealing* with any device that emits EMF shall comply with the exposure limits as determined in the ICNIRP guidelines.

NICTA shall designate appropriate measures as given in clause 8.0 to ensure compliance.

There are two (2) types of Exposure Limits

- Basic Restrictions
- Reference Levels

The Exposure limits are further classified into Public and Occupational Exposure as given in the tables below;

Table 1. Basic Restrictions-Public Exposure

Frequency Range	Current density for head and trunk (mA/m ²)(rms)	Whole-body average SAR (W kg ⁻¹)	Localized SAR (head and trunk) (W kg ⁻¹)	Localized SAR (limbs) (W kg ⁻¹)
Up to 1 Hz	8	-	-	-
1-4 Hz	$8/f$	-	-	-
4 Hz-1 kHz	2	-	-	-
1-100 kHz	$f/500$	-	-	-
100 kHz-10 MHz	$f/500$	0.08	2	4
10 MHz-10 GHz	-	0.08	2	4

^aNote:

1. f is the frequency in hertz.
2. Because of electrical inhomogeneity of the body, current densities should be averaged over a cross-section of 1 cm² perpendicular to the current direction.
3. For frequencies up to 100 kHz, peak current density values can be obtained by multiplying the rms value by $\sqrt{2}$ (1.414). For pulses of duration t_p the equivalent frequency to apply in the basic restrictions should be calculated as $f\sqrt{2}/(2t_p)$.
4. For frequencies up to 100 kHz and for pulsed magnetic fields, the maximum current density associated with the pulses can be calculated from the rise/fall times and the maximum rate of change of magnetic flux density. The induced current density can then be compared with the appropriate basic restriction.
5. All SAR values are to be averaged over any 6-min period.
6. Localized SAR averaging mass is any 10 g of contiguous tissue; the maximum SAR so obtained should be the value used for the estimation of exposure.
7. For pulses of duration t_p the equivalent frequency to apply in the basic restrictions should be calculated as $f\sqrt{2}/(2t_p)$. Additionally, for pulsed exposures in the frequency range 0.3 to 10 GHz and for localized exposure of the head, in order to limit or avoid auditory effects caused by thermoelastic expansion, an additional basic restriction is recommended. This is that the SA should not exceed 10 mJ kg⁻¹ for workers and 2mJ kg⁻¹ for the general public, averaged over 10 g tissue.

Table 2. Reference Levels – Public Exposure

Frequency range	E-field strength (V m ⁻¹)	H-field strength (A m ⁻¹)	B-field (uT)	Equivalent plane wave power density S _{eq} (W m ⁻²)
Up to 1 Hz	-	3.2 x 10 ⁴	4 x 10 ⁴	-
1-8 Hz	10,000	3.2 x 10 ⁴ /f ²	4 x 10 ⁴ /f ²	-
8-25 Hz	10,000	4,000/ f	5,000/f	-
0.025-0.8 kHz	250/f	4/ f	5/f	-
0.8-3 kHz	250/f	5	6.25	-
3-150 kHz	87	5	6.25	-
0.15-1 MHz	87	0.73/ f	0.92/f	-
1-10 MHz	87/f ^{1/2}	0.73/ f	0.92/f	-
10-400 MHz	28	0.073	0.092	2
400-2,000 MHz	1.375 f ^{1/2}	0.0037 f ^{1/2}	0.0046 f ^{1/2}	f/200
2-300 GHz	61	0.16	0.20	10

^a Note:

1. f as indicated in the frequency range column.
2. Provided that basic restrictions are met and adverse indirect effects can be excluded, field strength values can be exceeded.
3. For frequencies between 100 kHz and 10 GHz, S_{eq}, E₂, H₂, and B₂ are to be averaged over any 6-min period.
4. For peak values at frequencies up to 100 kHz see Table 1, note 3.
5. For peak values at frequencies exceeding 100 kHz see Figs. 1 and 2. Between 100 kHz and 10 MHz, peak values for the field strengths are obtained by interpolation from the 1.5-fold peak at 100 kHz to the 32-fold peak at 10 MHz. For frequencies exceeding 10 MHz it is suggested that the peak equivalent plane wave power density, as averaged over the pulse width does not exceed 1,000 times the S_{eq} restrictions, or that the field strength does not exceed 32 times the field strength exposure levels given in the table.
6. For frequencies exceeding 10 GHz, S_{eq}, E₂, H₂, and B₂ are to be averaged over any 68/f^{1.05}-min period (f in GHz).
7. No E-field value is provided for frequencies ,1 Hz, which are effectively static electric fields. perception of surface electric charges will not occur at field strengths less than 25 kV/m. Spark discharges causing stress or annoyance should be avoided.

Table 3. Basic Restrictions – Occupational Exposure

Frequency Range	Current density for head and trunk (mA m ⁻²)(rms)	Whole-body average SAR (W kg ⁻¹)	Localized SAR (head and trunk) (W kg ⁻¹)	Localized SAR (limbs) (W kg ⁻¹)
Up to 1 Hz	40	-	-	-
1-4 Hz	40/ f	-	-	-
4 Hz-1 kHz	10	-	-	-
1-100 kHz	f /100	-	-	-
100 kHz-10 MHz	f /100	0.4	10	20
10 MHz-10 GHz	-	0.4	10	20

^a Note:

^a Note:

1. f is the frequency in hertz.
2. Because of electrical inhomogeneity of the body, current densities should be averaged over a cross-section of 1 cm² perpendicular to the current direction.
3. For frequencies up to 100 kHz, peak current density values can be obtained by multiplying the rms value by 1.414. For pulses of duration t_p the equivalent frequency to apply in the basic restrictions should be calculated as f⁵ 1/(2t_p).
4. For frequencies up to 100 kHz and for pulsed magnetic fields, the maximum current density associated with the pulses can be calculated from the rise/fall times and the maximum rate of change of magnetic flux density. The induced current density can then be compared with the appropriate basic restriction.
5. All SAR values are to be averaged over any 6-min period.
6. Localized SAR averaging mass is any 10 g of contiguous tissue; the maximum SAR so obtained should be the value used for the estimation of exposure.
7. For pulses of duration t_p the equivalent frequency to apply in the basic restrictions should be calculated as f⁵ 1/(2t_p). Additionally, for pulsed exposures in the frequency range 0.3 to 10 GHz and for localized exposure of the head, in order to limit or avoid auditory effects caused by thermoelastic expansion, an additional basic restriction is recommended. This is that the SA should not exceed 10 mJ kg⁻¹ for workers and 2mJ kg⁻¹ for the general public, averaged over 10 g tissue.

Table 4. Reference Levels – Occupational Exposure

Frequency range	E-field strength (V m ⁻¹)	H-field strength (A m ⁻¹)	B-field (uT)	Equivalent plane wave power density S _{eq} (W m ⁻²)
Up to 1 Hz	-	1.63 x 10 ⁵	2 x 10 ⁵	-
1-8 Hz	20,000	1.63 x 10 ⁵ /f ²	2 x 10 ⁵ /f ²	-
8-25 Hz	20,000	2x10 ⁴ / f	2.5x10 ⁴ /f	-
0.025-0.82 kHz	500/f	20/f	25/ f	-
0.82-65 kHz	610	24.4	30.7	-
0.065-1 MHz	610	1.6/f	2.0/f	-
1-10 Mhz	610/f	1.6/f	2.0/f	-
10-400 MHz	61	0.16	0.2	10
400-2,000 Mhz	3f ^{1/2}	0.008f ^{1/2}	0.01f ^{1/2}	f/40
2-300 GHz	137	0.36	0.45	50

^aNote:

1. f as indicated in the frequency range column.
2. Provided that basic restrictions are met and adverse indirect effects can be excluded, field strength values can be exceeded.
3. For frequencies between 100 kHz and 10 GHz, S_{eq}, E₂, H₂, and B₂ are to be averaged over any 6-min period.
4. For peak values at frequencies up to 100 kHz see Table 2, note 3.
5. For peak values at frequencies exceeding 100 kHz see Figs. 1 and 2. Between 100 kHz and 10 MHz, peak values for the field strengths are obtained by interpolation from the 1.5-fold peak at 100 kHz to the 32-fold peak at 10 MHz. For frequencies exceeding 10 MHz it is suggested that the peak equivalent plane wave power density, as averaged over the pulse width, does not exceed 1,000 times the S_{eq} restrictions, or that the field strength does not exceed 32 times the field strength exposure levels given in the table.
6. For frequencies exceeding 10 GHz, S_{eq}, E₂, H₂, and B₂ are to be averaged over any 68/f^{1.05}-min period (f in GHz).
7. No E-field value is provided for frequencies >1 Hz, which are effectively static electric fields. Electric shock from low impedance sources is prevented by established electrical safety procedures for such equipment.

Fig. 1. Reference levels for exposure to time varying electric fields (compare to Tables 2 and 4)

Health Physics April 1998, Volume 74, Number 4

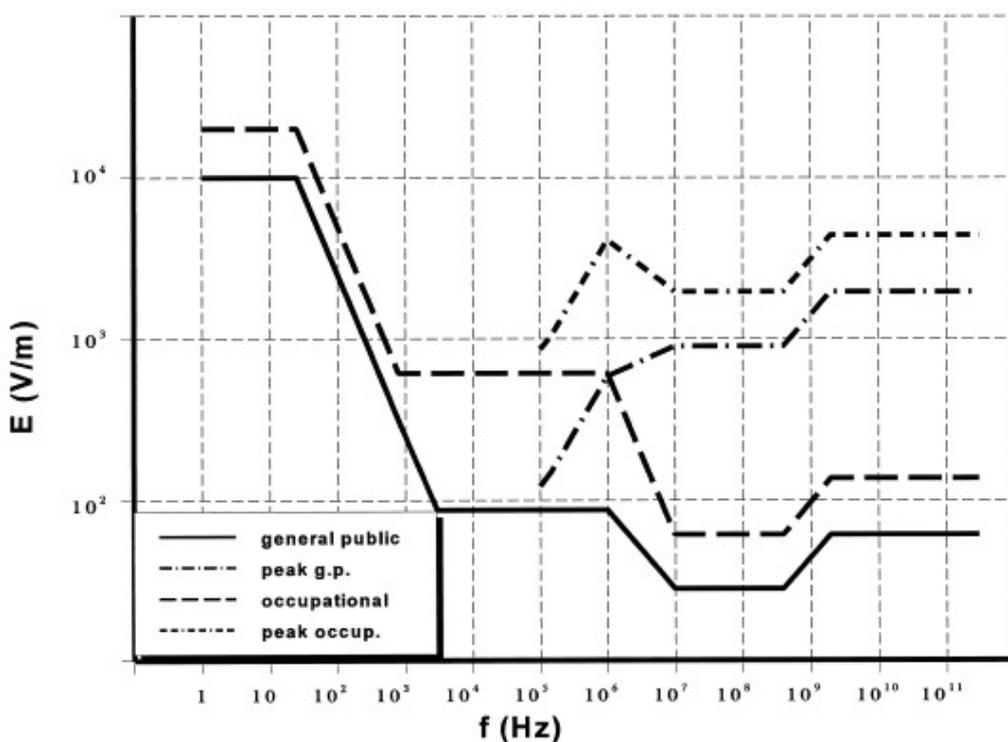
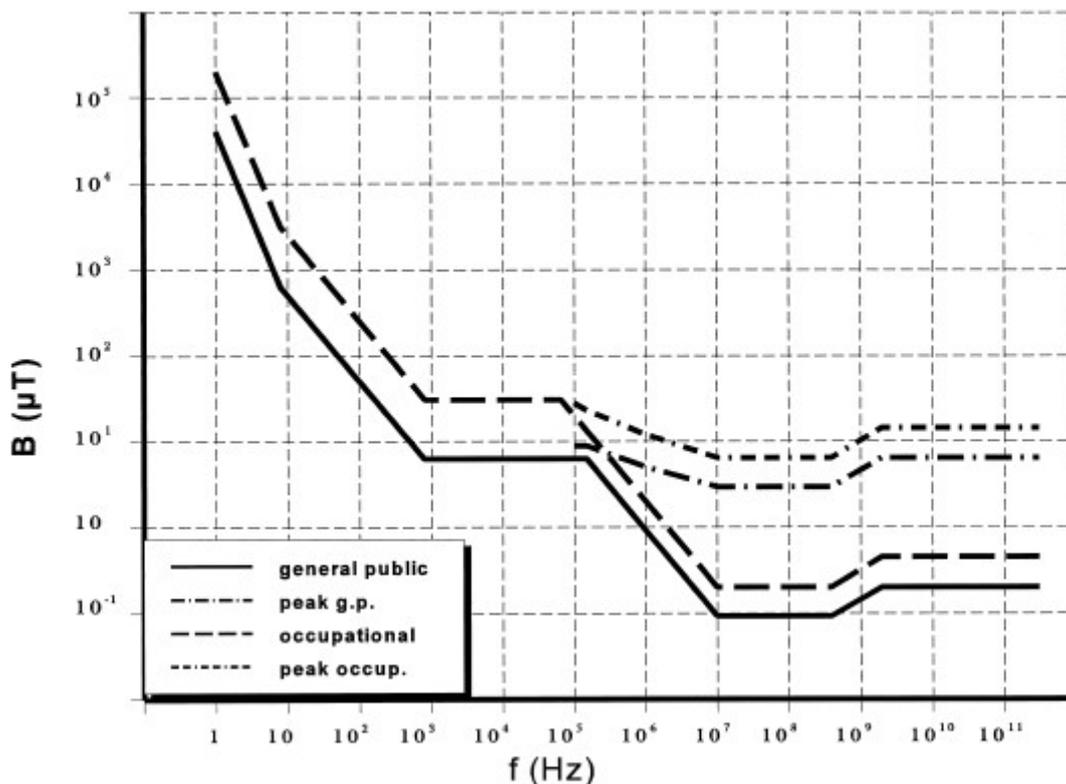


Fig.2. Reference levels for exposure to time varying magnetic fields (compare Tables 2 and 4)



6.2 Compliance

6.2.1 Public Exposure

All operators and/or owners of EMF emitting sources should ensure EMF exposures should not exceed the Reference Levels as set out in Table 2.0 in this Guideline.

In a situation where the Reference level in Table 2.0 is exceeded an evaluation is needed to determine whether or not the Basic Restrictions in Table 1.0 have been exceeded.

If the exposure levels are within the Basic Restrictions Limits than the Site is said to have complied.

However, if the Basic Restriction levels are exceeded, then the site has not complied and subject to measures outlined in clause 8.0.

6.2.2 Occupational Exposure

A certain category of workers are to be given the same protection as members of public as far as their work exposures to EMF is concerned. These workers include;

- Workers working in Public Areas
- Pregnant Women whom their pregnancy has been declared to their employers
- Workers with metallic implants which can suffer adverse interference from exposure levels in their work
- Workers with no appropriate training regarding workplace procedures that can allow them to work in areas where exposures can exceed those permitted by Public

In workplaces where workers, other than those mention, are exposed to EMF at or below the Reference Levels set out in Table 4.0 are in compliance with this Guideline.

In workplaces where workers, other than those mentioned, are exposed to EMF that exceeds the Reference Levels set out in Table 4.0, an evaluation must be conducted to establish if EMF exposures exceed the Basic Restrictions in set out in Table 3.0. EMF exposure should be at or below the Basic Restrictions set out in Table 3.0 to ensure compliance.

If the said EMF exposure exceeds the Basic Restrictions set out in Table 3.0, then it's not in compliance with this Guideline and is subject to measures outlined in Clause 8.0.

NICTA will verify Compliance with this Guideline through performing relevant measurement, type testing, calculation and modelling in accordance to relevant guidelines and recommendations (Clause 11).

7 REPORTING AND MEASUREMENTS

NICTA may from time to time carryout measurements and evaluations on public areas and/or workplaces to ensure the level of EMF exposure limits complies with the limit requirements as set out in this Guideline.

8 ENFORCEMENT

For compliance NICTA shall enforce the following measures;

- Operators or site owners with installations within the vicinity of a Public Area to ensure the EMF emissions comply with the EMF exposure limits by taking necessary steps to restrict public access and/or reduce EMF emissions from the source(s) contributing to the exposure.
- Extending the boundaries of areas where public Reference Levels in Table 2.0 may be exceeded, and restricting public access to these areas.
- Removing of EMF emitting sources from Public Areas where the Reference Levels in Table 2.0 maybe exceeded.

- Requiring Tower and/or EMF emitting device owners to use appropriate signs, warnings and public notices.
- Operators or Site owners must ensure that workers who are exposed to EMF at work, and who are classified as trained workers, received any necessary information and training relating to their exposure and are made aware of any mitigating measures needed to comply with EMF exposure limits.
- Workers who have not received necessary information and training as required for trained workers as provided for under subclause 6.2.2 will received the same protection as a member of Public as set out in this Guideline.

9 RECORD KEEPING & INFORMATION PROVISION

NICTA will record and maintain a database of all EMF exposure measurements made by, or on behalf of NICTA by a recognised third party.

NICTA may publish or disseminate the information, measurements or any other such matter only when it is deemed appropriate.

10 PENALTY

Any operator or site owner who intentionally violate any clause outline in this guideline will be penalised in accordance with NICTA Act and/or other relevant PNG State laws.

11 MANDATORY INSTRUMENT AND REVELANT GUIDELINES

These Mandatory instruments and Standards will be used for reference purposes when reading this Guideline;

- Guideline on Deployment of Communication Towers
- ICNIRP Guidelines
- ITU K52. Guidance on complying with limits for human exposure to electromagnetic fields

12 DOCUMENT ADMINISTRATION

12.1 Document Amendments

NICTA in consultation with relevant stakeholders may, from time to time alter, update or modify the provisions in this Guideline including the EMF exposure level limits and parameters to meet international and/or national requirements as necessary.

12.2 Document Enforcement

This Guideline is in force and effective on the date its Gazettal is announced by the National Gazettal Office.

12.3 Document Publication And Distribution

The copies of this Guideline is available on NICTA website www.nicta.gov.pg as electronic copy, can be collected as hardcopy at NICTA HQ or maybe forwarded by email upon request.

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