



Suruhanjaya Komunikasi dan Multimedia Malaysia
Malaysian Communications and Multimedia Commission

COMMUNICATIONS AND MULTIMEDIA ACT 1998
COMMISSION DETERMINATION ON THE MANDATORY STANDARD FOR
ELECTROMAGNETIC FIELD EMISSION FROM RADIOCOMMUNICATIONS
INFRASTRUCTURE

DETERMINATION NO. 1 OF 2010

Pursuant to the Ministerial Direction on the Standard for Electromagnetic Field Emission from Radiocommunications Infrastructure, Direction No. 7 of 2010 and in exercise of the powers conferred by sections 55 and 104(2) of the Communications and Multimedia Act 1998 [Act 588], the Commission hereby determines as follows:

Citation and commencement

1. This Determination may be cited as the **Commission Determination on the Mandatory Standard for Electromagnetic Field Emission from Radiocommunications Infrastructure, Determination No. 1 of 2010.**
2. This Determination shall come into operation on 1 January 2011.

Interpretation

3. Any terms used in this Determination shall, unless the context otherwise requires, have the same meaning as in the Act or the regulations made under it.
4. Unless the context otherwise requires, words in the singular include the plural and vice versa.

Licensees subject to this mandatory standard

5. All Network Facility Providers and Network Service Providers operating radiocommunications infrastructures which emit Electromagnetic Fields ("EMF") for the purpose of communications shall be subject to these mandatory standards. These communications infrastructures shall include base stations transmitters, repeaters and broadcast transmitters.

Standards for Electromagnetic Field Emission from Radiocommunications Infrastructure

Exposure Limits

6. The limit of EMF emission from a radiocommunications infrastructure site at public accessible areas shall not exceed any one of the parameters below:

Table 1: Exposure Limits for General Public

Frequency range	E-field strength (Vm^{-1})	H-field strength (Am^{-1})	B-field (μT)	Equivalent plane wave power density S_{eq} (Wm^{-2})
1 MHz - 10 MHz	$87/\sqrt{f}$	$0.073/f$	$0.092/f$	-
10 MHz - 400 MHz	28	0.073	0.092	2
400 MHz - 2GHz	$1.375\sqrt{f}$	$0.0037\sqrt{f}$	$0.0046\sqrt{f}$	$f/200$
2 GHz - 300 GHz	61	0.16	0.20	10

Notes:

1. f is the frequency in MHz
2. A power density of $10 W/m^2$ is equivalent to $1mW/cm^2$
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla or 12.57 milligauss

[Source: ICNIRP]

7. The limit for EMF emission for occupational workers shall not be more than the parameters below:

Table 2: Exposure Limits for Occupational Workers

Frequency range	E-field strength (V/m)	H-field strength (A/m)	B-field (μT)	Equivalent plane wave power density S_{eq} (W/m^2)
1 MHz - 10 MHz	$610/f$	$1.6/f$	$2.0/f$	-
10 MHz - 400 MHz	61	0.16	0.2	10
400 MHz - 2 GHz	$3\sqrt{f}$	$0.008\sqrt{f}$	$0.01\sqrt{f}$	$f/40$
2 GHz - 300 GHz	137	0.36	0.45	50

Notes:

1. f is the frequency in MHz
2. A power density of $10 W/m^2$ is equivalent to $1mW/cm^2$
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla or 12.57 milligauss

[Source: ICNIRP]

Prediction Methods for Compliance Achievement

8. The procedure for compliance with the exposure limit as stipulated above shall be in accordance with the methods below.

9. Transmitters with maximum EIRP of 2W or less are classified as inherently compliant and no further action is deemed necessary.

A. Compliance by EIRP calculation

10. In the case of single transmitter sites, assessment of the value of $(EIRP/EIRP_{th})$ is to be made at various publicly accessible points in the environment surrounding the Base Transceiver Station ("BTS") site under study (for example on rooftop, on ground or at adjacent buildings). For avoidance of doubt, three (3) sectors/panels for coverage in all directions may be considered as one (1) transmitter. The assessment is based on the formula:

$$\sum \frac{EIRP_i}{EIRP_{th,i}} \leq 1$$

where $EIRP_i$ is the temporal averaged radiated power of the antenna at a particular frequency i , and $EIRP_{th,i}$ is the EIRP threshold relevant to the particular antenna parameters and accessibility conditions.

11. The criteria for listing various accessibility conditions depending on accessibility of various areas in the proximity of the transmitter to person and directivity categories for a set of reference antenna parameter or types are as set out in ITU-T Recommendation K.52 Annex B.

12. The method of calculation is detailed in ITU-T Recommendation K.52 Annex B Appendix II and III.

13. If the value of $(EIRP/EIRP_{th})$ is found to be less than one at all points in the environment, the site is declared compliant.

B. Compliance by software simulation

14. For complex sites (where there are two (2) or more transmitters/antennas) as envisaged in a shared BTS site like rooftop pole or rooftop having multiple towers or multiple antennas mounted on a single tower in urban area that involve reflections from building or fluctuations in earth elevations, hence requires complicated multi-ray algorithms. These more sophisticated methods to predict EMF exposure are needed to refine the zone boundaries obtained using ITU-T Recommendation K.52 or for complex situation where the EIRP methods of ITU-T Recommendation K.52 may be insufficient.

15. For such complex scattering environments, it would require detailed electromagnetic mapping of the area around the BTS using appropriate software as proposed in ITU-T Recommendation K.52 and ITU-T Recommendation K.61.

16. The test results of software simulation are to be presented in the form of the power density, calculated in a plane of interest, expressed as a percentage of the exposure limit with logarithmic legend. Various positions two (2) meters above the roof top level of the BTS site, ground level and roof top or floors of adjacent buildings in the vicinity of 30 meters radius from the BTS should be considered.

17. Based on these simulated results, it is required that EMF measurements are performed if the electromagnetic exposure is found to exceed the stipulated exposure limit.

C. Compliance of Shared sites

18. Sites categorised as 'shared sites' are as follows:

- (a) A ground base tower site with transmitters from multiple service providers;
- (b) A roof top, with cluster of transmitters from multiple service providers; and
- (c) Other infrastructures with transmitters from multiple service providers (examples include advertisement boards, minarets, lamp post etc.).

19. For the purpose of compliance with the mandatory standard, every shared site shall be assigned a Radio Frequency ("RF") owner. The responsibilities of the RF owner shall be as follows:

- (a) to conduct simulation to ensure compliance of the site to the exposure limits;
- (b) To implement remedial measures in the event of non compliance, if required; and
- (c) To ensure future compliance assessment in the event there is a change or addition to the particular site.

The "RF owner" for each site shall be decided by the service providers themselves. However, the assignment as "RF Owner" for all the shared sites shall be fairly distributed among the service providers.

20. In cases of non compliance where public access cannot be restricted to exclusion zones (like adjacent building with over exposure), the rectification of non compliance shall be the joint responsibility of the 'RF owner' as well as all the service providers operating antennas at the said site. The cause of non compliance can be due to single service provider or combined effect. Where exposure limits are exceeded, the following rules shall apply to rectify the breach:

- (a) All service providers have to individually prove their compliance for the non compliance point or area. The single or multiple service providers who fail to prove their individual compliance will be requested to use mitigation techniques either by reducing transmitted power, increasing antenna height, changing antenna direction (azimuth), or if required, relocating antenna; and
- (b) In case of all service providers individually proving compliance but where the combined effect of many antennas have caused non compliance, the problem can be rectified with simulation or frequency selective measurements with the following rules being applicable:

- (i) Simulate individual exclusion zones for every antenna and rectify or move the antenna whose exclusion zone is crossing non compliant area(s) or point(s). If no individual antenna's exclusion zone is crossing non compliant area, then remove the antenna whose exclusion zone is nearest to the non compliant area or point. Repeat the process until the site is compliant; or
- (ii) Do frequency selective measurement with worst case extrapolation and if any individual service provider found to exceed exposure limit, rectify or move the offending antenna(s). If no individual antenna or service provider exceed the threshold independently in frequency selective measurement, rectify or move the antenna or service provider with maximum value of power density. Repeat the process till the site is compliant.

21. At a given point or location, marginal contribution of EMF radiation from BTS located farther than 100 meters can be excluded for the purpose of the estimation of the overall EMF exposure.

22. All service providers have to individually and jointly comply with the restriction prescribed for EMF exposure limits for general public. Hence, responsibility of EMF compliance of shared sites lies with all service providers on site. In the case of overall non-compliance of shared site, penalty shall be imposed on all service providers on site.

Exclusion Zones Calculation

A. Single Antennas or Sectoral Antennas at Single Pole

23. The exclusion zone distance for general public and occupational exposure can be calculated using the formulas in below table (Refer to ITU-T Recommendation K.70, Annex C):

Table 3: Calculation for exclusion zone for the general public

Radio Frequency Range	General Public Exposure	
1 to 10 MHz	$r = 0.10 \sqrt{(eirp \times f)}$	$r = 0.129 \sqrt{(erp \times f)}$
10 to 400 MHz	$r = 0.319 \sqrt{eirp}$	$r = 0.409 \sqrt{erp}$
400 to 2000 MHz	$r = 6.38 \sqrt{(eirp / f)}$	$r = 8.16 \sqrt{(erp / f)}$
2000 to 300000 MHz	$r = 0.143 \sqrt{eirp}$	$r = 0.184 \sqrt{erp}$

where:

r is the minimum antenna distance, in meters.

f is the frequency in MHz

erp is the effective radiated power in the direction of the largest antenna gain, in Watts.

eirp is the equivalent isotropic radiated power in the direction of the largest antenna gain, in Watts.

Table 4: Calculation for exclusion zone for the occupational worker

Radio Frequency Range	Occupational Exposure	
1 to 10 MHz	$r = 0.0144 \times f \times \sqrt{\text{eirp}}$	$r = 0.0184 \times f \times \sqrt{\text{erp}}$
10 to 400 MHz	$r = 0.143 \sqrt{\text{eirp}}$	$r = 0.184 \sqrt{\text{erp}}$
400 to 2000 MHz	$r = 2.92 \sqrt{(\text{eirp} / f)}$	$r = 3.74 \sqrt{(\text{erp} / f)}$
2000 to 300000 MHz	$r = 0.0638 \sqrt{\text{eirp}}$	$r = 0.0819 \sqrt{\text{erp}}$

where:

r is the minimum antenna distance, in meters.

f is the frequency in MHz

erp is the effective radiated power in the direction of the largest antenna gain, in Watts.

eirp is the equivalent isotropic radiated power in the direction of the largest antenna gain, in Watts.

B. Multiple antennas site

24. Analytical formulas are sufficient for calculations of exclusion zone parameters for single antennas or multiple antennas at single location. However, on many sites numerous antennas are installed in close proximity to each other and the calculation of exclusion zones through analytical formulas become impractically conservative or difficult to interpret due to the complexity of the environment. For complex scattering environments, exclusion zones/compliance distances for multiple antennas in close proximity are drawn by software simulation based on methodologies as prescribed in ITU-T Recommendation K.52 and ITU-T Recommendation K.61 documents.

25. The 3D exclusion zones results after electromagnetic mapping is used for prediction of exact exclusion zones distances.

Signages

A. Exclusion Zones and implementation of Signage

26. EMF exposure assessment is made if the transmitters are present and conducted for all locations where people might be exposed to EMF in their normal activities. All such exposures to EMF relates to one of these three zones (See Figure below) :

(a) **Compliance zone**

In the compliance zone, potential exposure to EMF is below the applicable limits for both controlled/occupational exposure and uncontrolled/general public exposure.

(b) **Occupational zone**

In the occupational zone, potential exposure to EMF is below the applicable limits for controlled/occupational exposure but exceeds the applicable limits for uncontrolled/general public exposure.

(c) **Exceedance zone**

In the exceedance zone, potential exposure to EMF exceeds the applicable limits for both controlled/occupational exposure and uncontrolled/general public exposure.

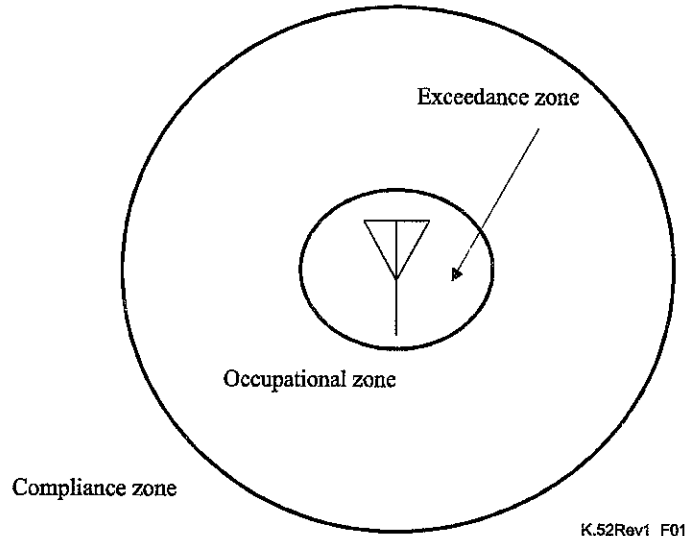
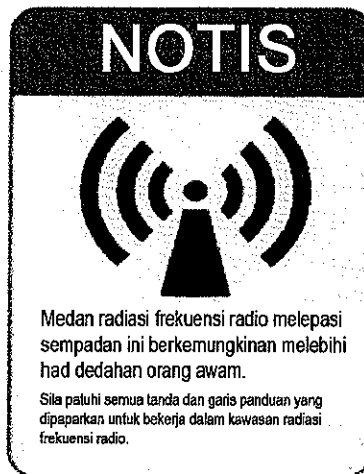


Figure 1: Illustration of exposure zones

B. Safety Signage

27. Notice signage: The service provider will ensure provision of proper signage at the entrance of site (roof top or tower). The following notice sign board shall be placed by the service provider.



MS2232-2 (Annex C)
Typical size is 20 cm X 14 cm

28. Warning signage for public: The service provider will ensure provision of proper signage on the boundary of occupational exclusion zones by way of fencing/ yellow coloured lines and the following sign board.



MS2232-2 (Annex C)
Typical size is 20 cm X 14 cm

29. Warning signage for occupational workers: The service provider will ensure provision of proper signage on the boundary of exceeds exclusion zones or on the radiating structure (tower/pole) by way of fencing/red coloured lines and the following sign board.



MS2232-2 (Annex C)
Typical size is 20 cm X 14 cm

References

1. Basic standard for the calculation and measurement of electromagnetic field strength and Specific Absorption Rate related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz): CENELEC EN 50383;

2. Draft IEC Determination of Radio Frequency field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure : IEC 62232 Ed. 1.0
3. Evaluation of human exposure to electromagnetic fields from a stand-alone broadcast transmitter (30 MHz - 40 GHz): IEC 62577 Ed. 1.0;
4. Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz), 1998 published by International Commission on Non-Ionizing Radiation Protection (ICNIRP);
5. Guidance on complying with limits for human exposure to electromagnetic fields: ITU-T Recommendation K.52(12/2004);
6. Guidance to measurement and numerical prediction of electromagnetic fields for compliance with human exposure limits for telecommunication installations: ITU-T Recommendation K.61 (06/2003);
7. Malaysian Communications and Multimedia Act 1998 [*Act 588*];
8. Malaysian Standard Guidelines for Limiting Exposure to Time-varying Electric, Magnetic and electromagnetic Fields – Part 2: For Frequency from 3 KHz to 300 GHz (MS2232-2);
9. Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations: ITU-T Recommendation K.70(06/2007);
10. Regulatory Framework on the Sharing of Telecommunications Infrastructure (ISSN 15511 – 2829) – Reg-R002 published by Jabatan Telekom Malaysia (JTM); and
11. Technical Standard on Radio Frequency Emission Control of Cellular Radio Sites (MTSFB 004: 2005 Revision 1) published by Malaysian Technical Standards Forum Berhad.

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Chairman

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