NATIONAL COMMUNICATIONS AUTHORITY



**GUIDELINES for the establishment and operation of FM broadcasting station in Ghana**

**2016**

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# **Introduction**

The National Communications Authority (NCA) hereinafter referred to as “the Authority”, is mandated under Section 2 of the Electronic Communications Act, 2008, Act 775 to regulate the radio spectrum designated or allocated for broadcasting services in accordance with the standards and requirements of the International Telecommunications Union (ITU) and its Radio Regulations as agreed to or adopted by the Republic. In furtherance of carrying out this function, the law mandates the Authority to determine technical and other standards and issue guidelines for the operation of broadcasting organizations and bodies providing broadcasting services.

The FM sound broadcasting service involves the broadcasting of sound which may be accompanied by associated text/data, using a transmitter and other ancillary equipment in the VHF band II (87.5 to 108 MHz).

It is currently one of the key services regulated by the Authority, with over 439 authorised FM radio stations across Ghana as at the end of the second quarter of 2016. It is therefore important that the Authority sets out guidelines to govern the operation of FM broadcasting stations in Ghana to ensure that quality broadcasting service is delivered to the general public.

# **Scope**

This document sets out the minimum standards for the establishment and operation of FM Sound Radio Broadcasting in the VHF Band II in Ghana.

# **Legal and Administrative**

An authorised FM radio station shall:

1. Commence the construction and installation of facilities for the provision of the broadcast service within two (2) years after the  date of the grant of the frequency authorisation in accordance with Regulation 54(1) of the Electronic Communications Regulations, 2011, L.I. 1991;
2. Upon completion of construction, installation and engineering tests, the authorisation holder shall invite the Authority to inspect the station. In accordance with Regulation 54(2) of L.I. 1991, the Authority may make technical recommendations which the operator shall comply with.
3. The Authority shall issue a test certificate or ‘Test Transmission Letter’ before the station can commence operations.
4. If after inspection, the station’s setup is incomplete, the station shall be notified in writing and the Authority shall carry out a second inspection upon receiving an invitation, which cost shall be borne by the authorisation holder.
5. In the event that the station’s facilities do not meet the standard set by the Authority after the second inspection, the Authority in accordance with Regulation 54(4) of L.I. 1991, shall on written notice of not less  than thirty days from the date of the second inspection to the operator,  cancel the frequency authorisation.
6. Provide a means of contact for the public i.e. telephone number(s), email address, location address and postal address.
7. Have a Security post/desk with security personnel at post during all the hours the station is on air.
8. Install a signage/signboard close to its premises for purposes of identifying the station.
9. Acquire fire certificate from the Ghana National Fire Service (GNFS) for their premises and shall have fire extinguishers installed at the studio premises, transmission site, and other vantage points as directed by the GNFS.
10. Make provisions for alternative source of power as backup to the supply from the National Grid to ensure station is always on-air during the hours of operation.
11. Keep a copy of Specification Sheet of the following installed equipment readily available for the purposes of verification and data collection by the Authority:
* **Antenna**: Make, Model, Gain (dB), Mast Height (meters)
* **Transmitter**: Make, Model, Rated Power (watts), Operational Power (watts)
* **Antenna Cable**: Make, Model, Length (meters), loss (dB/meter)
* **Studio Equipment**: List of equipment installed at the studio and their quantities
1. Ensure that Programs and Visitors Logbook is maintained at the studio premises and made available to the Authority on request.
2. Provide sufficient security for the on-air studio to prevent intruders and other unauthorised persons from entering the studio.

## **Amendment of Authorisation**

An FM radio broadcasting station comprises of a studio, transmission system (which uses the assigned transmission frequency) and a link between the studio and the transmission system (i.e. a cable [if studio and transmitter are collocated] or a wireless link using an assigned Studio-To-Transmitter (STL) link [if the studio and transmitter are at a significant distance apart]). The location and specification of individual components of the radio station constitute a part of the FM radio broadcasting frequency authorization and any change in any of the component parts represents an amendment to the frequency authorization.

Section 14(1) of the Electronic Communications Act, 2008, Act 775 states that “a licence or a frequency authorisation may be amended by a written agreement between the licensee or the holder of the frequency authorisation and the Authority”. Section 14(6) of the Act further states that “A licensee or an authorisation holder may request the Authority to amend its licence or frequency authorisation”.

In accordance with the above, an FM Authorisation holder intending to amend any of the following components of the FM Authorisation, shall communicate in writing to the Authority for approval:

1. Change in coverage radius
2. Change in Transmitting System and studio equipment
3. Change in location i.e.
* Change in location of Transmitting System
* Change in location of Studio
* Change in location of both Studio and Transmitting System.
1. Change in shareholding structure

# **Technical**

## **Studio Setup**

The studio shall be setup such that:

1. On-Air light is installed at its entrance.
2. Security door locking system is installed at its entrance.
3. The on-air studio is acoustically treated to deal with echoes, reverberations and noise.
4. It is well ventilated and/or temperature controlled for health and safety of the users and optimum operation of studio equipment.

## **Transmission System**

The FM radio transmission station;

1. Shall deploy the Stereophonic pilot tone system (System 4) with maximum frequency deviation of ±75kHz.
2. Shall transmit within a bandwidth of 200 kHz.
3. Shall not install external Radio Data System (RDS) Encoder/transmission system without prior approval from the Authority.
4. Shall ensure that Unwanted emissions (Spurious, Out-of-band emissions and cabinet radiations) remain within the limits indicated in Annex 2 of this document, in accordance with the provisions of Appendix 3 (Rev. WRC-12) of the ITU Radio Regulations [1] as well as ITU-R Recommendations SM.328-11 [2], SM.329-12 [3] and SM.1541-6 [4] and European standard EN 302 018-1 [5].
5. Shall install cavity filters at the output of its transmitter with an isolation (attenuation) of not less than 70dBc (decibels relative to the carrier) to ensure compliance with 5 above.
6. Shall install directional antennas if the transmitting station is located at a distance of 45km or less from the border with a neighbouring country.
7. Operating a Studio-to-Transmitter Link (STL) shall be subject to the following conditions:
* The maximum power for STL transmitter shall be 15W;
* The STL shall operate on a frequency assigned by the Authority;
* The STL antenna shall be directional;
* The channel bandwidth for the STL shall be less than or equal to 200 kHz;
1. Shall ensure the antenna mast(s) and other equipment are properly earthed.
2. Shall ensure that the transmitter room/compartment are properly ventilated and/or temperature controlled.

## **Coverage Radius**

An Authorised FM Broadcasting station shall design and operate its transmission system such that the signal strength at the periphery of the coverage circle/contour with the authorised radius shall not exceed 54dB(μV/m). This does not mean the station cannot be heard beyond the circle/contour, because the ITU Recommendation BS.412-9 [6] gives a field strength requirement of 34dBμV/m for ‘acceptable’ service. The Geneva 1984 Agreement governing Sound Broadcasting services in the frequency band 87.5 – 108MHz sets the field strength of 54dB(μV/m) as the threshold for coordination of the FM radio broadcasting service in the frequency band.

## **Radio Data System (RDS)**

Radio Data System **(**RDS) is the technical standard that allows FM transmitters to broadcast additional types of information through encoded digital signals that can be displayed on RDS-compatible FM radio receivers.

The operation of RDS in Ghana must be in accordance with the European Standard EN 50067 [7] and ITU-R Recommendation BS 643-3 [8].

In addition, the RDS must meet the following minimum conditions:

1. The insertion of the RDS signals must not affect the reception quality of the main non-RDS receivers.
2. The operation of the RDS must not interfere with other radio transmissions.
3. The maximum deviation of the main carrier by the total baseband signal shall not exceed ±75kHz.
4. The RDS subcarrier frequency must be between 53KHz and 76KHz
5. The RDS subcarrier frequency, 57KHz must be locked in phase or in quadrature to the third harmonic of the pilot tone frequency 19 KHz with frequency tolerance of ±6Hz.

# **Environment and Safety**

The safety of the working environment on and in the vicinity of radio sites must always remain at a consideration of high importance to site operators and engineers.

## **Electrical Safety**

1. Electrical installations at the transmitter site, the studio and other departments of the FM station shall conform to the requirements of the Energy Commission’s Electrical Wiring Regulations, 2012, L.I. 2008.
2. There shall not be exposed electrical wires and loose electrical sockets in the FM station’s premises.
3. All electrical installations shall be earthed according to the Energy Commission’s Electrical Wiring Regulations, 2012, L.I. 2008.

## **Design and Construction of Mast**

1. The Authorisation holder shall obtain the necessary permits from the Metropolitan, Municipal or District Assembly, Environmental Protection Agency and where applicable the Ghana Civil Aviation Authority for the design and construction of masts.
2. The mast design and construction shall comply with the Guidelines for the deployment of Communications Towers, 2010 [9] and Ghana Civil Aviation Authority Guidance on lighting and Marking of Obstacles [10].
3. The mast should be marked/painted to show alternating equal bands of Aviation Orange/Red and White in accordance with the Ghana Civil Aviation Authority Guidance on lighting and Marking of Obstacles [10].
4. The mast should be fitted with obstruction lights in accordance with Ghana Civil Aviation Authority Guidance on lighting and Marking of Obstacles [10].
5. The Authorisation holder shall install lightning arrestors at the apex of the Mast/Tower(s) which shall be earthed according to the Energy Commission’s Electrical Wiring Regulations, 2012, L.I. 2008.

## **Radio Frequency Radiation**

Radio frequency (RF) radiation is a source of hazard to personnel at a radio site. Exposure to high levels of RF radiation may cause damage to body tissues, as a result of electric shock, RF burns, or heating effects, according to the frequencies in use. Therefore, exposure of personnel to high level RF fields near transmitters or antenna systems must be avoided.

 Careful consideration should be given to the safety of personnel working in radio site environments and in particular, the level of exposure experienced whilst climbing an antenna support structure.

1. FM Operators must ensure that specific exposure limits are in conformity with those of the International Commission on Non-Ionizing Radiation Protection (ICNIRP), which are recommended by the World Health Organization (WHO), to protect workers and the general public against excessive exposure to RF fields [11].
2. The following Technical Standards and Specifications must be complied with to mitigate any harmful effects of human exposure to Radiofrequency Electromagnetic Fields:
3. Basic Restrictions for public and occupational exposures as set out in section A of Annex 4;
4. Where the Basic Restrictions are exceeded, the Reference Levels for public and occupational exposure as set out in section B of Annex 4 shall apply; and
5. Limits on Simultaneous exposures to different radio frequencies as set out in Section C of Annex 4.

# **References**

|  |  |
| --- | --- |
| [1]  | ITU-R, “Radio Regulations (Rev. WRC-12): Appendix 3; Maximum permitted power levels for unwanted emissions in the spurious domain,” 2012. |
| [2]  | ITU-R, “Recommendation SM.328-11: Spectra and bandwidth of emissions,” 2006. |
| [3]  | ITU-R, “Recommendation SM.329-12: Unwanted emissions in the spurious domain,” 2012. |
| [4]  | ITU-R, “Recommendation SM.1541-6: Unwanted emissions in the Out-of-Band Domain,” 2015. |
| [5]  | ETSI, “EN 302 018-1: Electromagnetic compatibility and Radio Spectrum Matters (ERM); Transmitting equipment for the Frequency Modulated (FM) sound broadcasting service; Part 1: Technical characteristics and test methods,” 2006. |
| [6]  | ITU-R, “Recommendation BS.412-9: Planning standards for terrestrial FM sound,” 1998. |
| [7]  | ETSI, “EN 50067: Specification of the radio data system (RDS) for VHF/FM sound broadcasting in the frequency range from 87.5 to 108.0MHz,” 1998. |
| [8]  | ITU-R, “Recommendation BS.643-3: Radio data system for automatic tuning and other applications in FM radio receivers for use with pilot-tone system,” 2011. |
| [9]  | Government of Ghana, “Guidelines for deployment of Telecommunications Towers,” 2010. |
| [10]  | Ghana Civil Aviation Authority, “ASAS TP-02: Guidance on lighting and Marking of Obstacles”. |
| [11]  | ICNIRP, “Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic field (up to 300 GHz),” 1999. |
| [12]  | ITU-T, “Recommendation K.52: Guidance on complying with limits for human exposure to electromagnetic fields,” 2004. |
| [13]  | Industry Canada, “BEST-6: Technical Standards and Requirements for FM Broadcasting Transmitters,” 2005. |
| [14]  | ETSI, “ETR-132 Radio Broadcasting Systems; Code of practice for Site Engineering Very High Frequency (VHF) frequency modulated, sound broadcasting transmitters,” 1994. |
| [15]  | ITU-R, “Recommendation BS 450-3:Transmission Standards for FM Sound Broadcasting at VHF,” 2001. |
| [16]  | Ghana, Electronic Communications Regulations, LI 1991, 2011.  |
| [17]  | Ghana, Electronic Communications Act, Act775, 2008.  |

# **Annexure**

# **Annex 1: FM Broadcasting Station Self-Inspection Checklist**

An FM broadcasting operator, preparing to commence operation shall complete the attached self-inspection checklist before inviting the Authority to conduct an inspection at its premises. This checklist provides an opportunity for the operator to review and correct any anomalies/lapses associated with its installation for the operation of the FM station prior to the visit by the Authority.

The following checks are provided to the list of items to aid the operator in determining the station’s compliance with the conditions of operating an FM broadcasting station in Ghana:

- **COMPLETE =** this item indicates full compliance with the standards set out in this document.

- **INCOMPLETE =** this item indicates partial compliance with the standards set out in this document.

If any of the item(s) is/are checked **“INCOMPLETE”**, it implies noncompliance with the conditions and terms of operating an FM broadcasting station, and the operator should therefore take immediate steps to correct it.

| **FM SELF-INSPECTION CHECKLIST** | **Status (Tick as Applicable)** |
| --- | --- |
| **No.** | **Item** | **COMPLETE** | **INCOMPLETE** |
| 1 | Security post/desk and personnel for duration of station’s daily broadcast operation |    |   |
| 2 | Programs/Visitors logbook |   |   |
| 3 | Signage/Signboard |   |   |
| 4 | Fire extinguishers installed at all vantage points and Fire Certificate |   |   |
| 5 | Electrical Safety |  |  |
| 6 | Availability of backup power source |   |   |
| 7 | Specification Sheet of installed equipment |   |   |
| 8 | Permit from EPA approving mast/tower installation *[not required for towers not owned by station but owned by licensed tower company]* |   |   |
| 9 | Studio and transmitter rooms well ventilated or temperature controlled |   |   |
| 10 | On-Air light installed at entrance of studio |   |   |
| 11 | Studio is acoustically panelled |   |   |
| 12 | Studio door is adequately secured |   |   |
| 13 | Directional antenna pointed in the appropriate direction [*only applicable to FM stations less than 45km from a neighbouring country*] |   |   |
| 14 | Cavity filter with isolation of 70dBc installed |   |   |
| 15 |  Lightning arrestor installed on mast/tower(s) |   |   |
| 16 |  Aviation Obstruction light(s) appropriately installed on mast/tower(s) |   |   |
| 17 | Mast/tower(s) is/are properly earthed |   |   |
| 18 |  Mast/tower(s) is/are painted to the specification described in the guideline |   |   |

# **Annex 2: Measurements to be conducted by the National Communications Authority**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NO.** | **METRIC** | **COMPLIANT / MEASURED VALUE** | **NON-COMPLIANT / MEASURED VALUE** | **REMARK(S) / COMMENT(S)** |
|  | Channel bandwidth (≤200kHz) |  |  |  |
|  | Signal strength at periphery of coverage area (≤54dBμV/m) |  |  |  |
|  | Coordinates of Transmission system |  |  |  |
|  | Altitude of Transmission site (antenna location) |  |  |  |
|  | Height of antenna |  |  |  |
|  | Use of authorized STL frequency (where applicable) |  |  |  |
|  | STL channel bandwidth (≤200kHz) |  |  |  |
|  | ICNIRP values |  |  |  |
|  | RDS induced interference (where applicable) |  |  |  |
|  | Interference caused by station to any radio station or telecom service? (YES/NO) |  |  |  |
|  | Interference suffered by station from any radio station or telecom service (YES/NO) |  |  |  |

# **Annex 3: Unwanted Emission Limits for FM Broadcasting Transmitting Equipment**

1. **Spurious Emissions**

**Definition**

Emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out of band emissions.

**Limit**

Spurious emissions shall not exceed the values set out in table 1 below

***Table 1 Spurious Emission Limits for FM Broadcast Transmitter***

|  |  |
| --- | --- |
| **Mean power****of the transmitter,****P** | **Limits****Mean power absolute levels (dBm) or relative levels (dBc) below the power supplied to the antenna port in the reference bandwidth** |
| *P* < 9 dBW | -36 dBm |
| 9 dBW < *P* < 29 dBW | 75 dBc |
| 29 dBW < *P* < 39 dBW | -16 dBm |
| 39 dBW < *P* < 50 dBW | 85 dBc |
| 50 dBW < *P* | -5 dBm |

1. **Out-of-band emissions**

**Definition**

Emission on a frequency or frequencies immediately outside the necessary bandwidth, which results from the modulation process, but excludes spurious emissions.

**Limit**

Out of band emissions shall not exceed the values set out in table 2 below.

***Table 2 Out-of-band emission limits for FM Broadcast Transmitters***

|  |  |
| --- | --- |
| **Frequency relative to the****centre of the channel (kHz)** | **Relative level****(dBc)** |
| -500 | -85 |
| -300 | -85 |
| -200 | -80 |
| -100 | 0 |
| 100 | 0 |
| 200 | -80 |
| 300 | -85 |
| 500 | -85 |

1. **Cabinet Radiation**

**Definition**

Emissions from the equipment, radiated from the enclosure port, other than those present at the antenna port.

**Limit**

Radiated emissions shall not exceed the values set out in table 3 below.

This test shall be performed at a distance of 10 m, where feasible. When size and/or power requirements necessitate testing in a manufacturing facility, other distances may be used (see notes 1 to 3). Tests shall not be carried out in the exclusion band (see note 2 in table 3).

***Table 3 Limits for radiated unwanted emissions for FM Broadcast Transmitter***

|  |  |
| --- | --- |
| **Quasi-peak limits (dBμV/m) at 10m****(see notes 1 and 2)** | **Frequency range** |
| 30 dBμV/m ≤ 60 + 10 log10 (P0/2 000) ≤ 70 dBμV/m | 30 MHz to 230 MHz |
| NOTE 1: P0 = RF output power in W.NOTE 2: The exclusion band for the transmitter extends from Fc - 300 kHz to Fc + 300 kHz, where Fc is the operating frequency in MHz. |

NOTE 1: The measurements can be carried out at other distances. In that case limits are modified according to the relation:

L(x) = L(10m) + 20 log (10/x) where x = distance in meter (m).

NOTE 2: Care should be taken if measuring at test distances below 10 m as this may be in the near field.

NOTE 3: In cases of dispute the measurement distance of 10 m shall take precedence.

# **Annex 4: Limits on Radiation Emissions for FM Transmitters**

1. **Basic Limits for Public and Occupational Exposure (ICNIRP)/ITU-T K.52**

**Explanations**

The exposure limits for the general public are five (5) times lower than for occupational workers. This is because such workers are normally persons who may have been trained to be aware of RF hazards and have been medically assessed to be fit for work in RF fields.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Type of exposure** | **Frequency range** | **Whole body average SAR (W/kg)** | **Localized SAR (head and trunk (W/kg)** | **Localized SAR (limbs) (W/kg** |
| Occupational Workers | 10 MHz-10 GHz | 0.4 | 10 | 20 |
| General Public | 10 MHz-10 GHz | 0.08 | 2 | 4 |
| NOTE: f is the frequency in Hertz. Whole body average SAR: Specific Absorption Rate averaged over the entire body.Localised SAR: Specific Absorption Rate averaged over a localised mass of tissue.SA: Specific Absorption of RF energy per pulse in a defined mass of tissue.Due to electrical inhomogeneity of the body, current densities should be averaged over a cross-section of 1 cm2 perpendicular to the current direction. All SAR values are to be measured in a period of 6-minutes. For a localized SAR averaging mass in any 10g of contiguous tissue, the maximum SAR obtained should be the value used for the estimation of exposure. |

1. **Reference Levels for Public and Occupational Exposure (ICNIRP)/ITU-T K.52**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Type of exposure** | **Frequency range** | **Electric field Strength (V/m)** | **Magnetic Field Strength (A/m)** | **Equivalent Plane Wave Power Density Seq (W/m2** |
| Occupational Workers | 10-400 MHz | 61 | 0.16 | 10 |
| General Public | 10 MHz-10 GHz | 28 | 0.073 | 2 |
| NOTE f is as indicated in the frequency range column. For frequencies between 100 KHz and 10GHz, the averaging time is 6 minutes. Between 100 KHz and 10MHz, peak values for the field strengths are obtained by interpolation from the 1.5-fold peak at 100MHz to the 32-fold peak at 10MHz. For frequencies exceeding 10MHz, it is suggested that the peak equivalent plane-wave power density, as averaged over the pulse width, does not exceed 1000 times the Seq limit, or that the field strength does not exceed the field strength exposure levels given in the above table. |

1. **Simultaneous Exposures to Different Radio Frequencies**

In situations where simultaneous exposures occur from different RF sources, the possibility that these exposures will be additive in their effects has been assumed to occur by these Guidelines. Thus, a cumulative evaluation of the basic restrictions and reference levels for simultaneous exposure to multiple frequencies has to be performed separately for both electro stimulatory and thermal effects on the body. The equations for performing these calculations are as provided below:

**Simultaneous exposure to multiple sources**

For simultaneous exposure to fields at different frequencies, the compliance with the exposure limits is evaluated using the equations below. All conditions for the appropriate frequency ranges are to be satisfied.

$$\sum\_{i=1kHz}^{1MHz}\frac{E\_{i}}{E\_{l,i}}+\sum\_{i>1Mz}^{10MHz}\frac{E\_{i}}{a}\leq 1$$

$$\sum\_{j=1kHz}^{1MHz}\frac{H\_{j}}{H\_{l,j}}+\sum\_{j>1Mz}^{10MHz}\frac{H\_{j}}{b}\leq 1$$

Where:

$E\_{i}$ is the electric field strength at frequency i

$E\_{l,i}$ is the reference limit at frequency i

$H\_{j}$ is the magnetic field strength at frequency j

$H\_{l,j}$ is the reference limit at frequency j

a = 610 V/m for occupational exposure and 87 V/m for general public exposure.

b = 24.4 A/m for occupational exposure and 5 A/m for general public exposure.

$$\sum\_{i=100kHz}^{1MHz}\left(\frac{E\_{i}}{c}\right)^{2}+\sum\_{i>1Mz}^{300GHz}\left(\frac{E\_{i}}{E\_{l,i}}\right)^{2}\leq 1$$

$$\sum\_{j=100kHz}^{1MHz}\left(\frac{H\_{j}}{d}\right)^{2}+\sum\_{j>1Mz}^{300GHz}\left(\frac{H\_{j}}{H\_{l,j}}\right)^{2}\leq 1$$

Where:

$E\_{i}$ is the electric field strength at frequency i

$E\_{l,i}$ is the reference limit at frequency i

$H\_{j}$ is the magnetic field strength at frequency j

$H\_{l,j}$ is the reference limit at frequency j

c = 610/f V/m (f in MHz) for occupational exposure and 87/f1/2 V/m for general public exposure. d = 1.6/f A/m (f in MHz) for occupational exposure and 0.73/f for general public exposure