

# TABLE OF CONTENTS

|   | Page       |
|---|------------|
| <b>TELEVISION SYSTEM .....</b>                                      | <b>2</b>   |
| <b>Characteristics of the PAL System .....</b>                      | <b>2,3</b> |
| <b>Video Path Performance Requirements.....</b>                     | <b>3</b>   |
| <b>Audio Path Performance Requirements .....</b>                    | <b>5</b>   |
| <b>General Code of Practice on Transmitters .....</b>               | <b>6</b>   |
| <b>Mast Height .....</b>  | <b>6</b>   |
| <b>Commissioning of Station.....</b>                                | <b>7</b>   |
| <b>Logging of Transmitted Programmes.....</b>                       | <b>8</b>   |
| <b>Monitoring Equipment for TV Stations.....</b>                    | <b>10</b>  |
| <b>Translators and Transposers.....</b>                             | <b>12</b>  |
| <b>Categories of Cameras.....</b>                                   | <b>12</b>  |
| <b>Cable Connections.....</b>                                       | <b>14</b>  |
| <b>Environmental Condition.....</b>                                 | <b>15</b>  |
| <b>Camera Control Unit Requirements.....</b>                        | <b>18</b>  |
| <b>Electrical Performance Requirements.....</b>                     | <b>19</b>  |
| <b>High Frequency Electromagnetic Interference.....</b>             | <b>26</b>  |
| <b>Performance Tolerance Limits for Video Tape Recorders.....</b>   |            |
| <b>Cable Television.....</b>  | <b>32</b>  |
| <b>SOUND BROADCASTING.....</b>                                      | <b>33</b>  |
| <b>Monitoring Equipment Requirements for Sound Broadcasting....</b> | <b>34</b>  |
| <b>Logging of Transmitted Programmes.....</b>                       | <b>36</b>  |
| <b>Full Sound Transmitter.....</b>                                  | <b>36</b>  |
| <b>Studio Transmitter Links.....</b>                                | <b>43</b>  |

**NATIONAL COMMUNICATIONS AUTHORITY**  
**TECHNICAL PLANNING GUIDELINES FOR**  
**RADIO AND TELEVISION**

**TELEVISION SYSTEM**

This section establishes the technical standards for television broadcasting in Ghana. The video signals must be one volt peak to peak and zero dBm for audio. The approved colour television system is the **PHASE ALTERNATING BY LINE – (P.A.L.) System**. Operation shall be on PAL system B for V.H.F. transmission and PAL system G for U.H.F. transmission. The basic characteristics of this system are as follows:-

| <b>CHARACTERISTICS OF THE PAL SYSTEM</b>                 |                |                |
|--|----------------|----------------|
| <b>PARAMETER</b>   | <b>SYSTEM</b>  |                |
|  | <b>PAL - B</b> | <b>PAL – G</b> |
| LINES PER PICTURE  | 625            | 625            |
| FIELD FREQUENCY (Hz)                                     | 50             | 50             |
| LINE DURATION H  | 64 micro sec.  | 64 micro sec.  |
| LINE FREQUENCY (Hz)                                      | 15,625         | 15,625         |
| FIELD DURATION   | 20ms           | 20ms           |
| VIDEO BANDWIDTH (MHz)                                    | 5              | 5              |
| CHANNEL BANDWIDTH  | 7              | 7              |
| NEAREST EDGE OF CHANNEL RELATIVE TO VISION CARRIER (MHz) | -1.25          | -1.25          |
| SOUND CARRIER FREQUENCY RELATIVE TO VISION CARRIER (MHz) | 5.5            | 5.5            |
| WIDTH OF VESTIGIAL SIDEBAND (MHz)                        | 0.75           | 0.75           |

| <b>CHARACTERISTICS OF THE PAL SYSTEM</b> |                 |                 |
|--|-----------------|-----------------|
| <b>PARAMETER</b>                         | <b>SYSTEM</b>   |                 |
|  | <b>PAL - B</b>  | <b>PAL - G</b>  |
| VISION MODULATION POLARITY               | NEGATIVE        | NEGATIVE        |
| SOUND MODULATION                         | FM              | FM              |
| FM DEVIATION (KHz)                       | 50              | 50              |
| VISION I.F. (MHz)                        | 38 <sup>0</sup> | 38 <sup>0</sup> |
| VISION/SOUND RATIO                       | 10:1            | 10:1            |

## **TECHNICAL**

| <b>VIDEO PATH PERFORMANCE REQUIREMENTS</b> |                    |                   |                    |                   |                      |
|--|--------------------|-------------------|--------------------|-------------------|----------------------|
| <b>SIGNAL LEVELS:</b>                      | <b>DIRECT PATH</b> | <b>WORST PATH</b> | <b>STUDIO PATH</b> | <b>O. B. PATH</b> | <b>O.B.LINK PATH</b> |
| a) VIDEO SYGNAL                            | IVP-P              | IVP-P             | IVP-P              | IVP-P             | IVP-P                |
| b) PICTURE LEVEL                           | 0.7v               | 0.7v              | 0.7v               | 0.7v              | 0.7v                 |
| c) ADJUSTMENT ERROR                        | ±0.2dB             | ±0.2dB            | ±0.2dB             | ±0.2dB            | ±0.2dB               |
| d) SYNC                                    | 0.3v               | 0.3v              | 0.3v               | 0.3v              | 0.3v                 |
| e) SIGNAL LEVEL                            |                    |                   |                    |                   |                      |
| f) GAIN STABILITY                          | ±0.2dB             | ±0.2dB            | ±0.2dB             | ±0.2dB            | ±0.2dB               |

| <b>LINEAR WAVE FORM DISTORTION</b>       |       |       |       |         |       |
|--|-------|-------|-------|---------|-------|
| a) 2T PULSE-TO-BAR                       | 1/2%K | 1/2%K | 1/2%K | 1/2/5%K | 2%K   |
| b) 2T PULSE RESPONSE                     | 1/2%K | 1/2%K | 1/2%K | 1/2/5%K | 2%K   |
| c) 2T BAR RESPONSE                       | 1/2%K | 1/2%K | 1/2%K | 1/2/5%K | 2%K   |
| d) 50Hz SQUAREWAVE RESPONSE              | 1/2%K | 1/2%K | 1/2%K | 1/2/5%K | 2%K   |
| e) CHROMINANCE/LUMINANCE GAIN INEQUALITY | ±3%   | ±4%   | ±8%   | ±3%     | ±4%   |
| f) CHROMINANCE/LUMINANCE DELAY           | ±20ns | ±40ns | ±20ns | ±20ns   | ±20ns |

| <b>NON LINEARITY DISTORTION</b>          |           |           |           |           |           |
|--|-----------|-----------|-----------|-----------|-----------|
| a) LUMINANCE LINE TIME NON-LINEARITY     | 3%        | 5%        | 3%        | 3%        | 5%        |
| b) DIFFERENTIAL PHASE                    | $\pm 2^0$ | $\pm 5^0$ | $\pm 2^0$ | $\pm 2^0$ | $\pm 5^0$ |
| c) DIFFERENTIAL GAIN                     | $\pm 3\%$ | $\pm 4\%$ | $\pm 8\%$ | $\pm 3\%$ | $\pm 4\%$ |
| d) TRANSIENT GAIN<br>CHANGE LUMINANCE    | 2%        | 5%        | 2%        | 2%        | 5%        |
| e) TRANSIENT GAIN<br>CHANGE CHROMINANCE  | 2%        | 5%        | 2%        | 2%        | 5%        |
| f) TRANSIENT GAIN<br>CHANGE CROSSTALK    | 2%        | 5%        | 2%        | 2%        | 5%        |
| g) TRANSIENT GAIN<br>LUMINANCE CROSSTALK | -         | -         | -         | -         | $\pm 3\%$ |

| <b>INPUT/OUTPUT IMPEDANCE RETURN LOSS</b> |                    |                    |                    |                    |                    |
|---|--------------------|--------------------|--------------------|--------------------|--------------------|
| LUMINANCE                                 | -30dB              | -30dB              | -30dB              | -30dB              | -30dB              |
| CHROMINANCE                               | $\pm 0.2\text{dB}$ | $\pm 0.2\text{dB}$ | $\pm 0.2\text{dB}$ | $\pm 0.2\text{dB}$ | $\pm 0.2\text{dB}$ |
| LOW FREQUENCY                             | 0.3v               | 0.3v               | 0.3v               | 0.3v               | 0.3v               |
| <b>VLF RESPONSE</b>                       |                    |                    |                    |                    |                    |
| a) FIRST OVERSHOOT                        | 20%                | 20%                | -                  | 20%                | 20%                |
| b) SECOND OVERSHOOT                       | 8%                 | 8%                 | -                  | 8%                 | 8%                 |

| <b>NOISE</b>  |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|
| a) WEIGHTED LUMINANCE (RMS)                         | -58dB | -58dB | -64dB | -64dB | -55dB |
| b) WEIGHTED CHROMINANCE (RMS)                       | -58dB | -52dB | -58dB | -55dB | -52dB |
| c) TOTAL LOW FREQUENCY<br>RANDOM AND PERIODIC (P-P) | -45dB | -45dB | -45dB | -45dB | -40dB |
| d) LOW FREQUENCY RANDOM (P-P)                       | -52dB | -52dB | -52dB | -52dB | -52dB |
| e) INTERCHANNEL CROSSTALK                           | -52dB | -45dB | -52dB | -55dB | -     |

| <b>MODULATION DERIVED DISTORTION</b>  |   |   |   |    |       |
|---|---|---|---|----|-------|
| (SOUND TO VISION CROSSWALK)   |   |   |   |    |       |
| a) SOUND SUBCARRIER MODULATED   | - | - | - | -- | -52dB |
| b) SOUND SUBCARRIER UNMODULATED OF INTERMODULATED (LEVEL OF INTERMODULATION PRODUCTS BETWEEN SOUND AND CHROMINANCE SUBCARRIERS) | - | - | - | -  | -57dB |

| <b>AUDIO PATH PERFORMANCE REQUIREMENTS</b>               |                    |                   |                    |                   |                      |
|--|--------------------|-------------------|--------------------|-------------------|----------------------|
| <b>SIGNAL LEVEL:</b>                                     | <b>DIRECT PATH</b> | <b>WORST PATH</b> | <b>STUDIO PATH</b> | <b>O. B. PATH</b> | <b>O.B.LINK PATH</b> |
| a) OUTPUT SIGNAL LEVEL AT Agreed interface after line-up | OdBm<br>±0.25dB    | OdBm<br>±0.5dB    | OdBm<br>±0.25dB    | OdBm<br>±0.25dB   | OdBm<br>±0.25dB      |
| b) GAIN STABILITY VARIATION ONE HOUR                     | ±0.25dB            | ±0.5dB            | ±0.25dB            | ±0.25dB           | ±0.25dB              |

| <b>AMPLITUDE/FREQUENCY RESPONSE</b> |      |      |      |      |        |      |
|-------------------------------------|------|------|------|------|--------|------|
| a) 40 KHz– 15 KHz                   | ±1dB | ±1dB | ±1dB | ±1dB | ±1dB   | ±1dB |
| W.R.T.1KHz                          | -2   | -3   | -2   | -2   | -3.0   |      |
| b) 125Hz – 10KHz                    | ±1dB | ±1dB | ±1dB | ±1dB | ±0.5dB |      |
| W.R.T.1KHz                          | -1   | -2   | -1   | -1   | -2.0   |      |

| <b>TOTAL HARMONIC DISTORTION</b> |      |      |      |      |      |
|----------------------------------|------|------|------|------|------|
| a) 1KHz AT – 10dBu               | 0.5% | 0.5% | 0.5% | 0.5% | 1.0% |
| b) 1KHz AT + 8dBu                | 0.5% | 1.0% | 0.5% | 0.5% | 1.0% |
| c) 80KHz AT – 10dBu              | 0.5% | 0.5% | 0.5% | 0.5% | 1.0% |
| d) 1KHz AT + 8dBu                | 5.5% | 2.0% | 1.0% | 1.0% | 1.0% |
| e) INPUT OVERLOAD                | -    | -    | 17dB | 17dB | -    |

| <b>SIGNAL/NOISE RATIO</b>                 |      |      |      |      |      |
|---|------|------|------|------|------|
| a) OdBu Input                             |      |      |      |      |      |
| i) Weighted, Random, Peak                 | 60dB | 56dB | 60dB | 60dB | 42dB |
| ii) Unweighted, Random, Peak              | -    | -    | 63dB | 63dB | 47dB |
| b) 50dBu Input                            |      |      |      |      |      |
| i) Weighted, Random, Peak                 | -    | 53dB | 56dB | 56dB | 56dB |
| ii) Unweighted, Random, Peak              | -    | -    | 60dB | 60dB | -    |
| c) Interchannel Crosstalk, Weighted, Peak | 53dB | 53dB | 53dB | 53dB | 53dB |

| <b>MODULATION DERIVED DISTORTION</b> |   |   |   |   |      |
|--------------------------------------|---|---|---|---|------|
| Vision to sound Crosstalk Weighted   | - | - | - | - | 45dB |

**GENERAL CODE OF PRATICE ON TRANSMITTERS**  
**EFFECTIVE RADIATED POWER (ERP)**

Not more than 100kw for private broadcasting based on the usable field strength. This value equals 48dB for Band 1, 55dB for Band III, 65dB for Band IV and 70dB for Band V.

**MAST HEIGHT**

The height of the mast shall be such as to meet the maximum ERP of 100kw. Evidence of clearance for mast erection from the Civil Aviation Authority must be submitted to the Board before the commencement of mast erection.

**MAINTENANCE OF MAST/TOWER**

There must be periodic inspection and maintenance of mast/tower. See Appendix A attached for details.

## **TELEVISION RECEIVERS**

All television sets imported into or manufactured in Ghana shall incorporate both VHF/UHF facilities.

## **COMMISSIONING OF STATION**

Before any station can commence operation, the Board will ascertain compliance with the specifications in this Code.

## **OPERATIONS**

Engineering log book must be kept and made available to the Authority on demand. Such log books among other information shall contain the following:

- a) Input level for video and audio signals
- b) Frequency Deviation
- c) Depth of Modulation
- d) Output Frequency
- e) Output Power
- f) Reflected Power

## **CALL SIGN**

- a) The station identification/call sign must be registered with the Board
- b) Such call sign/station identification must be displayed at least once every 30 minutes.

## **DECODER**

For all scrambled transmissions, decoders must be made available to the Authority for the purpose of monitoring such transmissions.

## **MODIFICATION**

Modification/changes of equipment and Antenna system shall be made only after prior notification and approval by the National Communications Authority.

## **LOGGING OF TRANSMITTED PROGRAMMES**

All transmitted programmes (total outputs) shall be recorded and retained by the station for at least three (3) months from date of airing. These must be submitted to the Authority on demand.

## **INSTALLATION AND SAFETY**

- a) Earth resistance shall not exceed one ohm.
- b) Lightning arrestor system shall be installed on the Mast/Tower
- c) Surge arrestor shall be provided to protect equipment
- d) Mast/Tower markings shall be orange/white in colour
- e) Aviation warning lights must be installed at appropriate intervals on the Tower/Mast
- f) Structural/Civil Engineers shall be involved in the construction of mast/tower bases in accordance with the designed specifications
- g) Adequate fire fighting equipment must be provided and maintained regularly. Monthly fire drill shall be encouraged.
- h) Rubber mats shall be provided in operational areas.

## **TECHNICAL STAFF**

There shall be evidence of availability of trained and trainable manpower to operate and maintain the station equipment. To this end, training shall be

organized for the technical personnel in factories, stations and broadcast training institutions.

## **TOOLS AND TEST GEARS**

Adequate test gear and tool kits (Electrical/Mechanical) shall be provided in the station.

## **MAINS POWER SUPPLY**

The recommended power supply voltages are as follows:

- a) Single Phase      220V  $\pm 10\%$  50Hz
- b) Three Phase      415V  $\pm 10\%$  50Hz

The power supply installations shall conform with the prevailing wiring regulations in Ghana.

## **TRANSMITTERS**

|                                   |                                |
|-----------------------------------|--------------------------------|
| <b>TRANSMITTER SPECIFICATIONS</b> | <b>MAIN STATION TRANSPOSER</b> |
| <b>VIDEO PERFORMANCE</b>          |                                |
| <b>TRANSMITTER MODULATION</b>     |                                |

### a) **DEPTH LEVEL**

|                    |          |          |
|--------------------|----------|----------|
| i) White level     | 20% + 2% | 20% + 2% |
| ii) Blanking level | 76% + 2% | 76% + 2% |

### **GAIN STABILITY**

Variation of modulation depth on White level and at Blanking level during 24 hours

|     |     |
|-----|-----|
| +1% | +1% |
|-----|-----|

## **NON LINEARITY DISTORTION**

### **a) LUMINANCE SIGNAL**

|                              |       |       |
|------------------------------|-------|-------|
| i) Line time non-linearity   | 5%    | 5%    |
| ii) Chrominance to Luminance | ±1.5% | ±1.5% |

### **b) CHROMINANCE SIGNAL**

|                       |     |     |
|-----------------------|-----|-----|
| i) Differential Phase | +5% | +7% |
| ii) Differential gain | +9% | +8% |

### **c) DYNAMIC GAIN**

|                 |     |      |
|-----------------|-----|------|
| i) Luminance    | ±2% | ±20% |
| ii) Chrominance | ±2% | ±2%  |
| iii) Sync       | ±2% | ±2%  |

### **d) TRANSIENT CRUSHING**

|                 |     |     |
|-----------------|-----|-----|
| i) Luminance    | ±5% | ±5% |
| ii) Chrominance | ±5% | ±5% |
| iii) Sync       | ±3% | ±3% |

## **LINEAR DISTORTION**

### **WAVE FORM DISTORTION**

#### **a) 2T PULSE AND BAR**

|                       |      |     |
|-----------------------|------|-----|
| i) Pulse to Bar Ratio | 1.5% | 2%  |
| ii) 2T Pulse response | 2%k  | 3%k |
| iii) 2T Bar Pulse     | 1.5% | 2%  |

#### **a) SYNC**

|              |     |     |
|--------------|-----|-----|
| i) Overshoot | 6%  | 6%  |
| ii) Tilt     | 3%k | 4%k |

## **LUMINANCE/CHROMINANCE INEQUALITY**

|          |         |         |
|----------|---------|---------|
| a) Gain  | ±4%     | ±8%     |
| b) Delay | ±20 ons | ±30 ons |

## **INPUT AND OUT IMPEDANCE**

|             |       |       |
|-------------|-------|-------|
| Return Loss | -30dB | -30dB |
|-------------|-------|-------|

## **NOISE**

|                            |       |       |
|----------------------------|-------|-------|
| a) Continuous Random Noise |       |       |
| i) Weighted Luminance      | -57dB | -51dB |
| ii) Weighted Chrominance   | -52dB | -48dB |
| b) Periodic Noise          | -49dB | -45dB |
| c) LF Noise                | -49dB | -45dB |

## **MODULATION DERIVED DISTORTION**

|                                |       |       |
|--------------------------------|-------|-------|
| a) Intermodulation Products    | -     | -35dB |
| b) Incidental Phase Modulation | -48dB | -46dB |

## **SIGNAL PARAMETERS**

|                             |   |
|-----------------------------|---|
| Carrier Frequency Stability | ±1 (parts in 10 <sup>6</sup> ) ±4(part in 10 <sup>6</sup> ) |
|-----------------------------|---|

## **PROGRAMME**

The Programme Input Equipment shall incorporate such equipment for processing and measuring the signal levels at specific points.

## **MONITORING EQUIPMENT**

Each station shall have full run of equipment to ensure compliance with the standards.

- a) Frequency Counts

- b) Power Meter
- c) Sideband/Spectrum Analyser
- d) 100MHz Oscilloscor (Double Beam)
- e) Multimeter
- f) Field strength meter
- g) Impedance Bridge
- h) Earth resistance meter

### **TRANSLATORS AND TRANSPOSERS**

It might be necessary to use translators or transposers to effectively cover an allocated coverage area. For this purpose, approval must be obtained from the Authority for the allocation of frequency and specifications for the translator/transposer.

### **VISION/AURAL RATIO**

10:1 ratio shall be maintained in the TV transmitter system.

### **STUDIO EQUIPMENT**

#### **TELEVISION CAMERA**

##### **GENERAL**

Cameras are grouped into three categories.

##### **GROUP 1**

Studio Camera System with highest picture quality. These are either used on a tripod or as a hand-held cameras.

##### **GROUP 2**

Electronic News Gathering/Electronic Field Production Cameras (ENG/EFP) with high picture quality for field production and News coverage.

### **GROUP 3**

ENG Cameras with a reduction of picture quality and ease of operation, for news coverage.

### **CAMERA HEAD REQUIREMENTS**

Depending on the intended use of the camera, i.e. whether in the studio, field production or on-the-spot news gathering, consideration shall be made with regards to mechanical and environmental stress during transport and operation. Carrying handles for transport and arrangements of operating controls shall be ergonomically designed and implemented. Coverings for mechanically and optically sensitive elements shall be made available for transport purposes. All inaccessible surfaces of optical systems shall be protected against dust and moisture condensation. Circuit boards and modules whose removal during operations will cause damage shall be clearly marked.

All necessary adaptors, cables and tools, including test charts or test slides needed for alignment and repairs, shall be available as accessories.

Group 1 Cameras shall incorporate a script holder with an adjustable and switchable light.

### **TRIPOD MOUNTING**

The term "Tripod" shall refer to both tripods and pedestals. Cameras of Group 1 shall be equipped with Vinten Debieve wedge plates. Provision for mechanical balancing of the cameras shall be made through appropriate adjustment controls on the tripod head. For hand-held cameras of Group 1, an appropriate adaptor for the wedge plate must be available, especially if large objective lenses are used. Hand-held cameras of Groups 2 and 3 intended for use on small tripods are to be equipped with quick-change wedge plates (SATCHLER/VINTEN).

The positioning of the centre of gravity of camera and lens must be able to properly accommodate both tripod and shoulder mount operations by adjusting the wedge plate.

### **CABLE CONNECTION**

The following connections shall be available for the different groups:

| ITEM | CABLE TYPE                                       | CAMERA GROUP |         |     |
|------|--|--------------|---------|-----|
|      |  | STUDIO       | ENG/EFP | ENG |
| a    | Camera Cable                                     | 1            | 1       | 1   |
| b    | Inter-Communication                              | 2            | 1       | 1   |
| c    | Programme (CUE) Sound                            | 1            | 1       | 1   |
| d    | Monochrome Video (for Dolly/<br>Reporter Monitor | 2            | 1       | 1   |
| e    | Tally Connection (for Dolly)                     | 2            | -       | -   |
| f    | V.T.R. Connection                                | -            | 1       | 1   |
| g    | Composite Video Out                              | 1            | 1       | 1   |
| h    | Sync (Black & Burst) Input                       | 1            | 1       | 1   |
| i    | Power Output (for Spotlight/Dolly<br>Monitor*    | 1            | -       | -   |
| J    | Audio Playback to Camera                         | 1            | 1       | -   |

*\*Note: Power outputs must be fed into the camera cable over isolation transformers, fused and separately switchable at the camera control unit. The cable connections must be non-reversible and secure against damage and loosening due to movement.*

### **ENVIRONMENTAL STABILITY**

Cameras and accessories shall maintain the conditions of standard specifications under continuous operations in the following ambient temperature range and relative humidity:

## ENVIRONMENTAL CONDITION

## CAMERA GROUP

|                      | 1 & 2         | 3             |
|----------------------|---------------|---------------|
| a) Temperature Range | -5°C to +40°C | -5°C to +55°C |
| b) Relative Humidity | 90%           | 95%           |

Turn on and operation of cameras in an ambient temperature range of -10°C to +60°C shall not lead to any camera failure. Cameras shall be made splash-proof by means of rain covers. A rain-proof version is especially desirable for cameras in Groups 2 and 3. The camera, in a turned-off-condition, must be able to withstand an ambient temperature range of -20°C to +70°C and a relative humidity of 95% without sustaining any damages.

### a) **OPTICAL SYSTEM**

For cameras of Groups 1 and 2, zoom lenses with a focal length of about 10:1 and a horizontal angular field range of about 5° to 50° are standard: the lenses must be capable of operating with an open aperture over the 10:1 zoom range. An ON/OFF switchable zoom range-stop, independent of the iris, is required. Zoom lenses with focal length range of up to 45:1 are to be provided for tripod-mounted cameras. The lenses shall be capable of achieving sharp focus at distances of at least 0.8m to infinite. (A minimum focal distance of 2 meters is acceptable for special telephoto zoom lenses). "MICRO" features are desirable in camera zoom lenses.

In place of the above lenses, Groups 1 and 2 cameras must be capable of accepting special (zoom or fixed focal length) lenses in order to obtain very narrow (about 2°) or wide (about 65°) angles of view or extremely large aperture as long as this is compatible with the optical colour splitter.

b) **LENSE QUALITY**

The quality of lenses to be used with respect to contrast, vignetting, flare, light transmittance and geometric distortion must be such that, no discernible deterioration of the given characteristics of the total camera system occur when an operationally optimum iris setting (1 or 2 f-stops down from open aperture) is used. In extreme settings – open aperture and extreme focal length – certain reductions in quality are allowed. 2% geometric distortion is allowable for wide-angle lenses. However, the lenses must not cause polarization effects.

c) **LENS MOUNTING, FOCUS & FOCAL LENGTH CONTROLS**

Lens mount flanges must ensure that the focal plane and optical axis do not shift when lenses are changed. There should be no sharp vignetting in the corners of the image over the full focus and zoom range. The mounting must allow for quick lens change. Extremely large lenses with a lens support bridge are to be mountable on cameras of Group 1. It is therefore required that the camera wedge plate be fastened in a definite position in relation to the optical axis, so that a shifting of the optical image centre, measured at the shortest focal length in relation to the longest focal length, must not be more than 5% of the image height over the full focal length and shall not shift erratically.

Lenses of cameras of Group 1 must allow the setting of focus and focal length by means of servo-control and provide a high degree of operational comfort: choice of setting speed, separate pre-settings, jolt-free transfer from pre-set to manual control: easy replacement of the servo control's electrical and mechanical assemblies and simple

adjustments. Lenses for hand-held cameras of Group 2 shall also be servo-controllable, particularly, for tripod mount operations.

A direct manual control of the lens setting ring after turning off the servo-control, shall be possible without any damage to the servo gears. The macro setting shall be attained manually over a separate setting ring or in combination with focal length control, by transversing past an end mark. The macro-setting of a lens shall be made inoperative by means of locking device or pin. For Group 3 cameras automatic focus must allow for manual intervention by the camera person as needed and must be disconnectable.

d. **COLOUR AND NEUTRAL DENSITY FILTERS**

Cameras of all groups must be capable of continuously covering a colour temperature range of 2500°K to 10,000°K by means of conversion filters in conjunction with electronic colour balance. The electronic colour balance shall be capable of covering a range of 2500°K to 6000° K without optical filters. Provision shall be made for placing a colour conversion filter together with either a neutral density filter or a “STAR BURST” filter or a simple combined filter in the optical path. An indication of the selected filter setting must be available.

e. **ELECTRONIC VIEWFINDER**

For tripod mount operation, viewfinders shall be located at the camera head and have adjustable tilt and rotation. Viewfinders for hand-held cameras must have enough position adjustment capability in order to optically adapt to the right eye of the camera person.

The only connections to the viewfinder shall be the composite (colour) video, the tally and power source.

The picture diagonal shall be 17cm for cameras of Group 1; 13cm for hand-held cameras operated on tripod and at least 3.8cm for cameras with a monocular (eye-piece).

The 2.5x magnifier in front of the 3.8cm screen for monocular operation shall provide a large field of view and must be adjustable for people wearing glasses (assuming the eye is corrected to >1m). Controls for contrast and brightness must be provided in addition to a switchable aperture correction (peaker) with maximum emphasis between 3 and 4MH. The amount of video peaking shall be internally adjustable. The picture area must have an Aspect Ratio of 4:3.

## **CAMERA CONTROL UNIT REQUIREMENTS**

### a) **GENERAL**

Various control units, appropriately co-ordinated, and with possibility of transferring controls, shall be provided for cameras of Groups 1 and 2 such as set-up and control consoles, unicontrol-knob and matching unit. The set up controls, as far as possible, shall have detent positions and/or scales that allow the nominal settings to be located quickly. Hand-held cameras of Groups 2 shall be equipped such that, in operating, functions can be remote-controlled by an appropriate control unit.

### b) **BASIC SET-UP CONTROLS**

For studio cameras of Group 1, all remote controllable functions for adjustment of the camera system shall be contained in the main

control unit and arranged in an ergonomically suitable manner. The controls shall include:-

- i) Registration (for 3-Tube cameras)
- ii) Beam current (for Tube cameras if not automatically regulated)
- iii) Flare correction
- iv) Contour correction
- v) Shading correction
- vi) Gamma correction of individual channels
- vii) Black Level pre-set
- viii) A selector switch for Test positions
- ix) Colour Bars ON/OFF
- x) Picture size
- xi) Colour ON/OFF

In addition, controls intended for the operational control unit, shall also be included at the main Camera Control Unit. Hand-held cameras of Groups 2 and 3 should be adjustable directly without remote control. Registration controls, for tube-type cameras, shall be available without opening the cameras but should be kept covered.

### **OPERATIONAL CONTROLS (REMOTE UNITS)**

- a) The operational controls for studio cameras of Groups 1 and 2, in addition to the controls for focal length and focus (and, if necessary, for filter wheel) at the camera head, shall comprise the following elements:-
  - i) Iris
  - ii) Common Black Level
  - iii) White Level (Gain Switch)

- iv) Black and White levels for the individual chroma channels (Green optional)
  - v) Common Gamma
  - vi) Colour saturation
  - vii) Black Stretch
  - viii) Lens Cap/Beam switch
  - ix) Colour temperature (electrical)
  - x) Colour filter wheel
  - xi) Selection switch for picture monitor and waveform monitor
  - xii) Additional Controls for the following: Contours, Level settings, Flare, Colour ON/OFF and Colour Bars ON/OFF.
- b) For hand-held cameras of Group 2, a remote control unit with the following functions shall also be provided:
- i) Power ON/OFF
  - ii) Intercommunications
  - iii) On-Air Tally
  - iv) Common Black Level/Iris
  - v) Separate Black/White Level Controls for Red and Blue Channels
  - vi) Colour Bars
  - vii) Horizontal Phase
  - viii) Subcarrier Phase
  - ix) Selector Switch for Monitoring

A transfer of the control functions to the operational control unit shall not affect other settings on the main control unit. The controls for the IRIS and COMMON BLACK LEVEL shall be incorporated into the unicontrol knob.

- c. Hand-held cameras of Groups 2 and 3 are to be operatable with the following functions at the camera-head:
- i) Focal length
  - ii) Focus
  - iii) Iris (Automatic or manual)
  - iv) Filter Wheel
  - v) Colour Bars
  - vi) Gain Switch
  - vii) Auto Black/White balance
  - viii) Auto Registration (tube cameras)
  - ix) Black Stretch
  - x) Registration & Signal Selection Switch – for alignment purposes for tube cameras (concealed under a covering)
  - xi) PowerOff/Stand-By/Camera-On-Switch
  - xii) VTR Start/Stop
  - xiii) Viewfinder signal selector switch

d. **AUTO FUNCTIONS**

For studio cameras of Group 1, automatic functions that will encompass a full camera system alignment under microprocessor control, are desirable. The adjustment settings stored in the memory shall be maintained without change for at least 8 days, even when the camera has been powered down.

The electronic memory circuit shall be located in the camera head. The accompanying control unit shall be capable of being connected, in turn, to a number of cameras and the adjustment procedures for routine operation shall be appreciably delayed. Operational displays of automatic functions are desirable and it should be possible to store

pre-determined camera settings (different “moods”). Microprocessor-supported diagnostics are to be provided.

e. **CABLE COMPENSATION**

Provisions shall be made for compensation – preferably, automatic self-compensation of transmission errors up to 800 meters of camera cable. The compensation shall not affect, in any way, the internal level adjustments of the camera head via amplifiers.

**BASIC SET-UP CONTROLS**

The cameras shall be set up for the following tests according to the normal procedures of the programme contractor. Controls should be re-adjusted subsequently only as required to perform the test.

- a) Iris:- same as needed to produce 100% output from a 60% reflectance neutral surface under normal studio lighting.
- b) Zoom angle:- the test shall be carried out at a non-extreme setting.
- c) Aperture correction and contours:- adjusted as for normal studio use.
- d) Gamma correction:- 0.45 (nominal)

**WARM-UP TIME, STABILITY AND POWER SUPPLY DEPENDENCY**

The camera shall be capable of producing acceptable pictures after a one minute warm-up.

After a warm-up time of 10 minutes for cameras of Groups 2 and 3; and 30 minutes for Group 1, the operational settings of the video signal levels must be stable enough such that subsequent adjustments for continuous operation will not be necessary. After a one-hour period, the specified conditions must be maintained. This stability is maintained when the camera system is repeatedly turned off and on during successive days.

The ambient temperature may vary by 0° to 15° around nominal 20°C. In addition ..... line voltages may vary + 10% from the nominal value ..... operational value of a battery-powered camera shall not change within a range of 10 to 14 volts.

Variations in powerline frequencies should not cause any noticeable ripple or hum effects (in picture geometry or signal levels).

## **SCANNING SYSTEM**

2.1 INTERLACED

625 LINES

## **SYNC SYSTEM**

INTERNAL SYNC OPERATION WITH BUILT-IN SYNC GENERATOR  
AND EXTERNAL SYNCHRONISATION  
(GENLOCK) AUTO OR MANUAL LOCKING

## **GENLOCK SIGNAL**

VBS 1.0V P-P/75 Ohms

OR

CBS 0.45V P-P Ohms

## **ASPECT RATIO**

H 4:V 3

## **HORIZONTAL RESOLUTION**

600 LINES MINIMUM AT CENTRE

## **REGISTRATION**

0.05% ALL ZONES EXCLUDING LENS DISTORTION

INTERCOM

4 – WIRE FOR GROUPS 1 & 2

SIMPLIFIED FOR GROUP 3

## **OUTPUTS**

- a) COMPOSITE VIDEO 1.0v p-p
- b) SYNC LEVEL 0.3V
- c) TERMINATION 75 ohms
- d) RETURN LOSS 30 dB

| OUTPUTS           | CAMERA GROUP |   |          |
|-------------------|--------------|---|----------|
|                   | 1<br>STUDIO  | 2<br>E.N.G./E.F.P.                        | 3<br>ENG |
| COMPOSITE         | 4            | 2<br>1 X BNC<br>1 X IN<br>CAMERA<br>CABLE | 1        |
| RGB LINEAR        | 1            | 1   |          |
| RGBFOR CHROMA KEY | 1            | 1   |          |

For composite colour and RGB video output, changing the termination of one of the outputs from open-circuit to short-circuit shall not cause the luminance signal voltage of the other (75 OHMS TERMINATED) outputs to change by more than 2%.

| SETTING RANGE: COMMON WHITE LEVEL |      |       |       |       |     |       |
|-----------------------------------|------|-------|-------|-------|-----|-------|
| GROUP 1                           | -3.0 | 0 + 3 | +6    | 18    | -12 | dB    |
| GROUPS 2 & 3                      | 0    | +6    | +12dB | or 0, | +9  | +18dB |

(Internal -6dB switch for beam setting).

## **LINEAR DISTORTION**

For total signal amplification path K-factor-measures with a 50Hz square wave, 2T/2OT and stair-step signal, must be smaller than 1%. The following shall not be exceeded:-

- i) **50Hz SQUARE WAVE**  
Maximum Tilt 2% of the White level
- ii) **15Hz SQUARE WAVE**  
Maximum Tilt 1% of the White level
- iii) **2T-PULSE**  
Amplitude +4%  
Baseline-distortion <-1%
- iv) **2OT-PULSE**  
Subcarrier amplitude: +4%  
Baseline – Distortion: <-4%  
Frequency Response +4% to 5MHz  
Referenced to 15KHz -10% to 7MHz

### **CROSS-TALK ATTENUATION**

Cross-talk attenuation between individual channels and from added external signals (video and audio) must be greater than 50dB within the transmitted frequency range. This shall be valid for camera cables up to 400 meters; at 800m, no appreciable interference shall occur in the picture.

### **PERIODIC NOISE**

At optimal gamma correction, periodically occurring noise in the blanking interval shall not be larger than 1%.

In the active video interval, this shall not be larger than 0.3% of white level.

### **BLACK SHADING**

- a) Inner zone – Luminance 2%
- b) Inner zone colour – separation difference 1%
- c) Overall (whole field) – Luminance 4%

- d) Overall colour-separation difference 2%

### **WHITE SHADING**

- a) Inner – Luminance 5%  
b) Overall (whole field) – Luminance 10%  
c) Overall colour – separation signals Green 5%  
Red 7%

Not more than half of these tolerances shall occur in any 10% of picture width or height.

### **GEOMETRICAL ERRORS: REGISTRATION**

Deviation from the ideal geometry shall not be more than 0.5% of image height for Group 1 cameras and not more than 1% for Groups 2 and 3. The difference in geometric errors of neighbouring circles shall not be more than 0.3% of the image height. Focal length of lens shall be set minimal distortion (in accordance with the lens manufacturers' instructions). Geometric errors caused by the earth's magnetic field shall not exceed 0.5% of the image height. Time variable deviations of the geometry (Hum and Ripple) shall not exceed 0.1% of the image height. 25Hz intensity modulation caused by line pairing shall not cause any noticeable interference.

### **HIGH FREQUENCY ELECTROMAGNETIC INTERFERENCE**

R.F. Radiation of any frequency and with a maximum field strength of 500mv/m shall not cause disturbances longer than 0.3% of the white level or any interference with synchronization. Camera systems with camera cables utilizing frequency multiplexing (e.g. Triax cable) shall not exceed a mutual interference of 0.3% when camera head and camera control unit

are adjacent and connected by at least 800 meters of parallel – laid camera cable. (Less than 0.6% for 1600 meters cable).

### **MAGNETIC INTERFERENCE**

For a field strength of 20A/m at 50Hz, the additional geometric errors must be less than 0.2% of image height. Registration errors must be less than 50ns for zone 1 and 70ns for zone 2. The depth of modulation in the luminance signal at 5MHz may not diminish by more than 5%.

### **SHOCK, ACOUSTICAL AND MICROPHONIC INTERERERENCE**

As far as possible, microphonic effects in the imaging devices, excited by inherent acoustical noise, vibrations from normal use and external noise up to 110 dB should not occur.

### **CAMERA CABLE**

Approved Multicore, Triax and Optical Fibre cables and cable fittings shall be used. The cables shall be impact-resistant and flexible, with an allowable curvature radius of less than 20cm. The cable shall be cold-resistant down to -20°C. Cable fittings shall be equipped with appropriate strain reliefs (bending & pulling). The cable connectors shall be splash-proof.

In addition, the cable fittings shall have undetachable protective covers.

### **CAMERA TALLY**

For studio cameras of Groups 1 and 2, several red tally lights shall be attached to the camera head. The red tally lights on the camera head must be clearly visible – even when using extremely large objective lenses

– and if possible, should be attached to the lens housing (either as ring light at the front of the lens or as two lights symmetrical to the optical axis). A separate ON/OFF switch for the front tally light must be coupled with the VTR record mode.

## **INTERCOMMUNICATIONS**

A four-wire intercommunication system shall be incorporated for for cameras of Groups 1 and 2. The camera head shall have two separate connections for plugging in headsets; the main camera control and operational control units each requiring only one head set connector. A volume control shall be provided. Light weight, noise-compensated head sets with dynamic microphones shall be used. For Group 1 cameras, a separate communications links between camera person and dolly grip is desirable. It should be possible to switch off the microphone at the camera head. A Signal-to-Noise Ratio greater than 40dB shall be attainable at normal levels of speech. The volume setting range must be large enough that an understandable conversation is possible even when several headset stations are connected in the system and with an external noise of 90dB(A) (100 dB 'A' with a 20dB sound insulated head-set). For cameras of Groups 2 and 3 used for ENG work, the head-sets shall allow monitoring of playback audio from the VTR, in addition to being used for intercommunications.

## **VIDEO TAPE RECORDING**

Video Tape Recorders (V.T.R.s) are categorized into two groups:

## **GROUP 1**

Professional Studio Video Tape Recorders: These must be of the highest quality picture recording and reproduction capacity. These are for use in recording full-length programmes and programmes involving multiple generation editing. These must permit the processing of the Vertical Blanking Interval so that Vertical Insertion Test Signals are not lost.

## **GROUP 2**

Professional Video Tape Recorders: These must be of high quality and shall be for use in News coverage; and programme inserts of not more than five minutes continuous duration in a full length programme.

Tolerance listed for the video recorders refer to a single recording and replay; not necessarily on the same machine. For purpose of playback alignment, it is recommended that the first sixty seconds of the tape should carry an appropriate test signal (video and audio tone) which shall be the station's standard on all tapes.

## **AUDIO RECORDERS**

### **SPECIFICATIONS ON AUDIO RECORDERS**

#### **a) OUTPUT SIGNAL LEVEL**

- |                                    |        |
|------------------------------------|--------|
| i) Insertion Gain Adjustment Error | +1.0dB |
| ii) Gain Stability                 | +0.5dB |

#### **b) AMPLITUDE/FREQUENCY RESPONSES**

- |                    |        |
|--------------------|--------|
| i) 40Hz to 15 KHz  | +1.5dB |
| w.r.t 1KHz         | -2.5dB |
| ii) 125Hz to 10KHz |        |
| w.r.t. 1KHz        | 1.0dB  |



|       |   |                |        |
|-------|---|----------------|--------|
| iv)   | SIGNAL TO NOISE RATIO<br>(WEIGHTED)               | 68dB           | 52Db   |
| v)    | TOTAL HARMONIC DISTORTION<br>(AT 1KHz REF. LEVEL) | 1%             | 3%     |
| vi)   | CROSS-TALK (1KHz)                                 | <-71dB         | <-50dB |
| vii)  | PHASE DIFFERENTIAL (AT 15KHz)                     | $\pm 20^\circ$ | -      |
| viii) | DEPTH OF ERASURE (AT 1KHz)                        | >-65dB         | -60dB  |
| ix)   | WOW AND FLUTTER WEIGHTED<br>(PEAK)                | 0.15%          | 0.20%  |

## AUDIO RECORDERS

### SPECIFICATIONS ON AUDIO RECORDERS

#### a) OUTPUT SIGNAL

|     |                                 |        |
|-----|---------------------------------|--------|
| i)  | Insertion Gain Adjustment Error | +1.0dB |
| ii) | Gain Stability                  | +0.5dB |

#### b) AMPLITUDE/FREQUENCY RESPONSES

|     |                               |                  |
|-----|-------------------------------|------------------|
| i)  | 40Hz to 15 KHz<br>w.r.t 1KHz  | +1.5dB<br>-2.5dB |
| ii) | 125Hz to 10KHz<br>w.r.t. 1KHz | 1.0dB            |

#### c) SIGNAL/NOISE RATIO

|     |                          |      |
|-----|--------------------------|------|
| i)  | Weighted, Random, Peak   | 40dB |
| ii) | Unweighted, Random, Peak | 45dB |

#### d) INTERCHANNEL CROSSTALK

|     |   |      |
|-----|---|------|
| i)  | Related tracks, unweighted, peak<br>40Hz to 15KHz | 40dB |
| ii) | Unrelated tracks, unweighted, peak                | 50dB |

e) **TOTAL HARMONIC DISTORTION**

- |                     |    |
|---------------------|----|
| i) 1KHz at 8dBu     | 2% |
| ii) 80Hz at 8dBu    | 2% |
| iii) 1KHz at -10dBu | 2% |
| iv) 1KHz at -10dBu  | 2% |

f) **WOW AND FLUTTER**

|                |       |
|----------------|-------|
| Weighted, peak | 0.12% |
|----------------|-------|

## **CABLE TELEVISION**

### **GENERAL**

There should be no direct transmission to the subscribers. However, the modern concept allows the use of Multipoint Microwave Distribution System (MMDS). Once the MMDS channels are used up, the distribution by cable becomes an option. The licenses shall restrict their transmission to the channels and mode specified in their licences only. The maximum power per channel shall not be more than 20 watts at each approved location/site. The entirety of the technical tolerances enumerated for Television operation **shall apply to Cable Television** service.

### **MICROWAVE MULTIPOINT DISTRIBUTION (MMDS) SYSTEM**

The MMDS transmitter shall be an all solid state system. Included among other features are the following specifications:

### **VISUAL**

- |                        |                          |
|------------------------|--------------------------|
| a) Output Power        | maximum of 20 watts peak |
| b) Colour Transmission | PAL                      |
| c) Output Frequency    | 2500MHz – 2700MHz        |
| d) Frequency Stability | 0005%                    |

|    |                         |        |
|----|-------------------------|--------|
| e) | Spurious Products       | 60dB   |
| f) | Harmonics               | 63dB   |
| g) | Differential Phase      | ±30    |
| h) | Differential Gain       | 5%     |
| i) | Low Frequency linearity | 5%     |
| j) | Output power stability  | ±0.3dB |
| k) | K-Factor (2T)           | 2%     |
| l) | Signal to Noise         | 50dB   |

### **AURAL**

|    |                  |                  |
|----|------------------|------------------|
| a) | Output power     | 2 watts          |
| b) | Emission         | F3               |
| c) | Audio Distortion | Less than 0.5%   |
| d) | FM Noise         | 60dB             |
| e) | AM Noise         | 60dB             |
| f) | Pre-emphasis     | 75 micro seconds |
| g) | Deviation        | 25 KHz           |

## **SOUND BROADCASTING**

### **GENERAL**

This section establishes the technical standards for Radio Sound Broadcasting in Ghana.

### **MODES OF TRANSMISSION**

Sound broadcasting may operate on Short Wave (SW), Medium Wave (MW) and Frequency Modulated (FM) Systems. The National Communications Authority allows the Ghana Broadcasting Corporation station to operate on all these modes.

## **LOCATION OF STATION**

The Location of Transmitting Stations shall be such that the Primary Service Area is covered without causing co-channel interference.

## **HEIGHT OF MAST**

The Radiator for Medium wave transmitter, Short Wave and FM Masts shall not exceed the requirement of the Civil Aviation Authority.

## **MONITORING EQUIPMENT**

Each station must have a full range of test and monitoring equipment to ensure compliance with the standards. There should include:

- a) Frequency Counter
- b) Power Meter
- c) Modulation Meter
- d) Spectrum Analyser
- e) Oscilloscope
- f) Multimeter
- g) Distortion and noise meter
- h) Audio Signal generator
- i) Vu meter
- j) Earth Resistance meter

## **INSTALLATION AND SAFETY**

- a) Structural/Civil Engineers shall be involved in the construction of the Mast/Tower bases in accordance with design specifications
- b) Earth resistance shall not exceed one ohm
- c) Lightning arrestor system shall be installed on the Mast/Tower
- d) Surge arrestors shall be provided to protect equipment
- e) Mast/Tower marking shall be in orange and white colours.

- f) Aviation warning lights must be installed at appropriate intervals of Mast Tower
- g) Adequate fire fighting equipment must be provided and maintained regularly. Monthly fire drill should be encouraged.
- h) Rubber mats must be provided in the operational areas.

### **TOOLS AND TEST GEAR**

Adequate test gear and tool-kits (Electrical/Mechanical) shall be provided at the station.

### **MODIFICATIONS**

Modifications/Changes of equipment and Antenna systems shall be made only after prior notification of and approval by the Authority.

### **OPERATIONS**

Engineering Log must be kept and made available to the Authority on demand. Such Log books shall, among other information, contain the following:

- a) Input level for Audio Signals
- b) Frequency Deviation
- c) Depth of Modulation
- d) Output Frequency
- e) Output power
- f) Reflected Power

### **CALL SIGNS**

- a) The Station Identification/Call Sign must be registered with the Authority.
- b) Such Call Sign/Station Identification must be aired at least once every 30 minutes.

## **LOGGING OF TRANSMITTED PROGRAMME**

All transmitted programmes (total outputs) shall be recorded and retained by the station for at least 3 months from the day of airing. They must be submitted to the Authority on demand.

## **TRANSLATOR AND TRANSPOSER**

It might be necessary to use more than one Transmitter to effectively cover an allocated area. For the purpose, a prior application shall be made to the Authority for allocation of other frequencies. In this case, the operator shall take all necessary precautions to keep within approved coverage areas.

## **MAINS POWER SUPPLY**

The recommended power supply voltages are as follows:

- a) Single Phase 220V  $\pm 10\%$  50Hz
- b) Three Phase 415V  $\pm 10\%$  50Hz

The power supply installations shall conform with the prevailing wiring regulations in Ghana.

## **SOUND TRANSMITTER SYSTEM**

### **MEDIUM WAVE TRANSMITTER**

The medium wave transmitter shall be solid-state transmitter and shall, among other features have the following:

\*Parallel modular configuration which provides true active reserve without need for Engineering intervention.

\*On-air serviceability which allows module removal without interruption in broadcasting.

\*Built-in duplicate exciter to offer complete back-up of critical low level control circuitry.

The specification must include:

- |    |                           |   |  |
|----|---------------------------|---|--|
| a) | RF Frequency Range        | - | 531 to 1710 KHz  |
| b) | RF Terminating            | - |  |
| c) | Impedance                 | - | 50ohms   |
| d) | Audio Frequency Response  | - | $\pm 0.5\text{dB}$ (30 – 10KHz)  |
| e) | Square Wave Overshoot     | - | 2% at 400Hz  |
| f) | Square Wave Tilt          | - | 3% or less at 40Hz   |
| g) | Audio Harmonic Distortion | - | Better than 1% at 95% modulation (30Hz -10KHz)                         |
| h) | Audio Intermodulation     | - | Less than 1% at 85% Mod.   |
| i) | Modulation Capability     | - | 125% positive peak modulation capability                               |
| j) | Carrier Shift             | - | Not exceeding 1%   |
| k) | RF Harmonics              | - | -80dB  |
| l) | Spurious Outputs          | - | -80dB  |
| m) | Frequency Stability       | - | $\pm 5\text{HZ}$ or $\pm 5\text{pm}$ (10°C to $\pm 50^\circ\text{C}$ ) |
| n) | Overall efficiency        | - | Better than 75%  |
| o) | Ambient Temperature       | - | 10°C to 50°C   |
| p) | Humidity Range            | - | 0 – 95%  |

### **FM SOUND TRANSMITTER**

The National Communications Authority recommends that the frequency modulation sound broadcasting in band 87.5 to 108 MHz must comply with the following:-

- The maximum frequency deviation should be  $\pm 75\text{KHz}$
- The pre-emphasis should be 50 or 75 micro seconds

- c) In the absence of interference from industrial and domestic equipment a field strength at the border of the allocated coverage area shall not exceed 50 micro volt/meter for monophonic service and 250 micro volt/meter for stereophonic service.

## **STUDIO EQUIPMENT**

### **CASSETTE RECORDER/REPRODUCERS**

The cassette Recorder/Reproducers must be fully professional in the design of its transport, control and memory systems. The quality features should include:

- a) 3 Heads (Erase, Record, Play)
- b) Dual Input/Output with +4dBm balanced
- c) Adjustable Bias and Equalizer select
- d) Dolby extension circuits and Dolby B/C
- e) Adjustable Bias and Equalizer select
- f) Front panel Line Inputs
- g) Memory Rewind and Replay
- h) Speed: 17/8 and 3 ¾ ips
- i) Total Harmonic Distortion 1% at O.V.U
- j) Signal To Noise Ratio 59dB at 1ips

### **COMPACT DISC PLAYER**

It must be broadcast quality with adjustable headphone output and two audio outputs.

The specifications are:

- a) **FREQUENCY RESPONSE**  
10Hz to 20KHz +0/-0.1dB linear

- b) **HARMONIC DISTORTION**
- c) **CHANNEL SEPARATION**  
Greater than 90dB (20Hz to 20KHz)
- d) **VOW AND FLUTTER**  
Quartz crystal precision
- e) **SEARCH TIME FOR ANY LOCATION**  
Less than 4 seconds (over 15,000 tracks per second)
- f) Signal to Noise from pause: >100dB (20Hz -20KHz)
- g) Start Delay from pause: 0.6secs.

### **REEL TO REEL REPRODUCERS**

It must be of broadcast standard and specifications include:

- a) Closed loop drive offering substantially .....
- b) Linear actuated pressure rollers for a fast smooth start
- c) Solid state logic control circuitry
- d) Cue mode for easy loading and service
- e) Fault detecting for early signaling of a potential malfunction

### **SPECIFICATIONS**

- i) **FREQUENCY RESPONSE:** +2dB(50Hz to 75KHz) at 3.75 ips  
+2dB(50Hz to 75KHz) at 3.75 ips
- ii) **FLUTTER AND VOW:** 3.75ips: less than 0.12% RMS  
NAB 17 DIN  
71/1ips: less than 0.087% RMS  
NAB 17 DIN
- iii) **REEL BIAS** Up to 14 inches

- iv) **SIGNAL TO NOISE RATIO** 68dB
- v) **TOTAL HARMONIC DISTORTION** 0.2%

### **TAPE CARTRIDGE EQUIPMENT**

It must have capacity for mono or stereo Record/Playbacks. The special features should include the following specifications

- a) **WOW AND FLUTTER**  
 Playback maximum 0.15% at 7.5ips  
 Record/Playback maximum 0.15% at 7.5ips.
- b) **AUDIO OUTPUT CONFIGURATION**  
 Transformer coupled, selectable: 600 ohms impedance
- c) **FREQUENCY RESPONSE** +2dB 50Hz to 15KHz
- d) **STANDARD TAPE SPEED** Record/Play 7.5ips
- e) **SYSTEM DISTORTION** <2% (Ref.1KHz at 185n wbm)

### **DECK TURNTABLE**

The console must be capable of instantaneous start, and complete with built-in cue amplifier, additional cartridge illumination and simplified transport loop.

The features should include the following specifications:-

- a) **WOW AND FLUTTER**  
 Maximum +0.075% at 33 1/3 rpm
- b) **TURN-TABLE SPEED**  
 78 rpm  
 45rpm  
 33 1/3 rpm  
 45rpm  
 33 1/3 rpm

c) **FREQUENCY RESPONSE**

|                      |                          |
|----------------------|--------------------------|
| 40Hz to 15KHz:       | 05dB                     |
| 30 Hz approx.:       | -3dB                     |
| below 30Hz approx.   | 20dB per Octave roll-off |
| above 25 KHz approx: | 12dB/Octave roll-off     |

d) **ACCURACY OF TURN-TABLE SPEED**

Quartz controlled at maximum of  $\pm 0.1\%$

e) **OUTPUT VOLTAGE**

Adjustable between 700 mv and 10v (0 to +22dB) into 200 ohms

f) **HARMONIC DISTORTION**

30Hz – 12KHz less than 0.1% at dB (4.4v) into 200 ohms

g) **INPUT VOLTAGE**

|                           |              |
|---------------------------|--------------|
| For dynamic cartridges    | 0.3 to 1.4mv |
| For magnetic Hi-fi system | 2 to 10mv    |

h) **CROSSTALK SUPPRESSION**

30Hz – 25KHz >55dB

i) **RMS S/N RADIO**

75dB minimum

j) **HEADPHONE OUTPUT**

Mono/Stereo – unbalanced, adjustable

On a load of 200K ohms approx. 200 to 600 mv

On a load of 2K ohms approx.500 to 150 mv

## **SWITCHER**

The switcher must be accessible internally to terminal boards and to attenuators, switches, modules and all components for easy maintenance. The amplifiers shall be plug-in models.

Additional features shall include the following specifications:-

### **a) PROGRAMME CHANNELS**

#### **i) INPUT/IMPEDANCE/LEVELS**

##### **LOW MODE 150 ohms, BALANCED**

- 65dBv nominal
- 38dBv maximum

#### **HIGH MODE 54K ohms BALANCE BRIDGING**

- 20dBv nominal
- 20dBv maximum

#### **ii) FREQUENCY RESPONSE**

+0, -1dB, 30Hz to 20KHz

#### **iii) OUTPUT POWER LOAD**

- a) 600 ohms balanced      +8dBm to 0 vu deflection  
   +18dBm capability

#### **b) MONITOR CHANNELS**

- i) **INPUT**  
Push button select programme output channels and an external source.
  
- ii) **FREQUENCY RESPONSE**  
+0, -1dB, 50Hz to 20kHz
- iii) **OUTPUT POWER LOAD**  
8 watts RMS per channel, 8ohm load
  
- c) **CUE/INTERCOM AMPLIFIER**  
one watt RMS mono output to built-in-speaker-input mono (or L & R)
  
- d) **MUTING**  
The relays standards.  
Relays 1 mute monitor/cue speakers with mixer 1 operation. Mixer 2 controls Relay 2. Other combinations assignable.

## **STUDIO TRANSMITTER LINKS**

No studio transmitter link should operate on a Broadcasting frequency.

## **SPECIFICATIONS FOR RADIO STUDIO TRANSMITTER LINKS SYSTEM**

|                       |   |
|-----------------------|---|
| Audio Response        | +1.5dB, 50Hz – 15KHz  |
| Audio Distortion      | Less than 1%, 50Hz to 15KHz<br>(Less than 2% with optional I.F. crystal filter) |
| Signal-to-Noise Ratio | Better than 60dB below 100% modulation  |

## **TRANSMITTER**

Type : Direct FM of voltage-control crystal oscillator (VCXO)

RF Output : 15 watts maximum, 10 watts nominal into 50 ohms load  
Type N Female connector.

RF Frequency Range: 148 – 174 MHz, 215 – 240 MHz; other frequencies  
In the 148 – 470 Hz spectrum on special order.

Emission : 45F3 (+7.5KHz for 100% modulation, 148 – 240 MHz)  
54F3 (+12KHz for 100% modulation,  
300 – 330 MHz and 450 – 470 MHz).

Frequency Stability:  $\pm 0.0005\%$  (-20°C to 50°C)

Harmonic Suppression : 60dB below carrier reference

Spurious Emissions: More than 60dB below carrier

AM Noise: Better than 70dB below carrier reference

Temperature Range: -20°C to 50°C

Audio Input: +10dBm, 600 ohms, balanced

Multiplex Input: 1.5 volts p-p nominal, recommended subcarrier  
Frequency 26 KHz.

Power Requirements: 240V/AC,  $\pm 10\%$ . 50Hz, single phase  
Optional 12 to 15V DC 2.5A maximum

## **RECEIVER**

Type: Superheterodyne

RF Frequency Range: 148 – 174 MHz, 215 – 240 MHz;  
300 – 330 MHz or 450 – 470 MHz).  
spectrum on special order

RF Input:: 50 ohms Type N Female connector.

Sensitivity: Less than 1.5 micro volt for 20dB quieting.

Temperature Range: -2°C to 50°C

Audio Output: 10dBm, 600p, balanced

Power requirements: 240V/AC, ±10%. 50Hz, single phase.