PCTEST Engineering Laboratory, Inc.
*6660-B Dobbin Road • Columbia, MD 21045 • U.S.A.*
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*http://www.pctestlab.com*

# CERTIFICATE OF COMPLIANCE

**LG Electronics Inc. - DID Division**
**184, Kongdan-dong, Kumi,**
**Kyoungsangbuk-do, KOREA**
**Attn: Mr. Do-Hyung Kim, Engineer**

**Dates of Tests: October 16-17, 2000**
**Test Report S/N: B.201009504.BEJ**
**Test Site: PCTEST Lab., MD U.S.A.**

| | |
|---|---|
| **FCC ID** | **BEJCB795D** |
| **APPLICANT** | **LG ELECTRONICS INC.** |

| | |
|---|---|
| **Rule Part(s):** | **FCC Part 15 Subpart B** |
| **Equipment Class:** | **Class B Peripheral Device (JBP)** |
| **EUT Type:** | **17" CRT Color Monitor** |
| **Max. Resolution:** | **1600 x 1200 Non-Interlaced @ 75Hz** |
| **Trade Name(s):** | ***LG®*** |
| **Model(s):** | ***CB795D*** |

**This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-1992 (Note Codes: #19, #37).**

**I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.**

*PCTEST certifies that no party to this application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.*

Randy Ortanez
President & Chief Engineer

NVLAP®
Lab Code 100431-0

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# MEASUREMENT REPORT

## 1.1 Scope

*Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission.*

| | |
|---|---|
| **Applicant Name:** | **LG ELECTRONICS INC. - DID Division** |
| **Address:** | **184, Kongdan-dong, Kumi,<br>Kyoungbuk, Korea** |
| **Contact Person:** | **Do-Hyung Kim, Engineer<br>Product Engineering Dept., Safety & EMC Team** |

- FCC ID: **BEJCB795D**
- Equipment Class: B Digital Device / Peripheral (JBP)
- EUT Type: 17" CRT Color Monitor
- Trade Name(s): ***LG®***
- Model(s): ***LB680A-EA***
- Max. Resolution: 1600 x 1200 Non-Interlaced @ 75Hz
- Frequency Range: H-Sync: 30kHz –96kHz<br>V-Sync: 50Hz – 160Hz
- Cable(s): Shielded D-Sub (with ferrite on both ends)
- Power Cord: Unshielded AC
- Rule Part(s): FCC Part 15 Subpart B
- Test Procedure(s): ANSI C63.4 (1992)
- Dates of Tests: October 16-17, 2000
- Place of Tests: PCTEST Lab, Columbia, MD U.S.A.
- Test Report S/N: B.201009504.BEJ

NVLAP Lab Code 100431-0

# 2.1 INTRODUCTION

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C63.4-1992) was used in determining radiated and conducted emissions emanating from **LG Electronics Inc. 17" CRT Color Monitor FCC ID: BEJCB795D.**

These measurement tests were conducted at ***PCTEST Engineering Laboratory, Inc.*** facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39° 11'15" N latitude and 76° 49'38" W longitude. The facility is 1.5 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 on October 19, 1992.

## 2.2 PCTEST Location

The map at right shows the location of the PCTEST Lab, its proximity to the FCC Lab, the Columbia vicinity area, the Baltimore-Washington International (BWI) airport, and the city of Baltimore, and the Washington, D.C. area. (see Figure1).

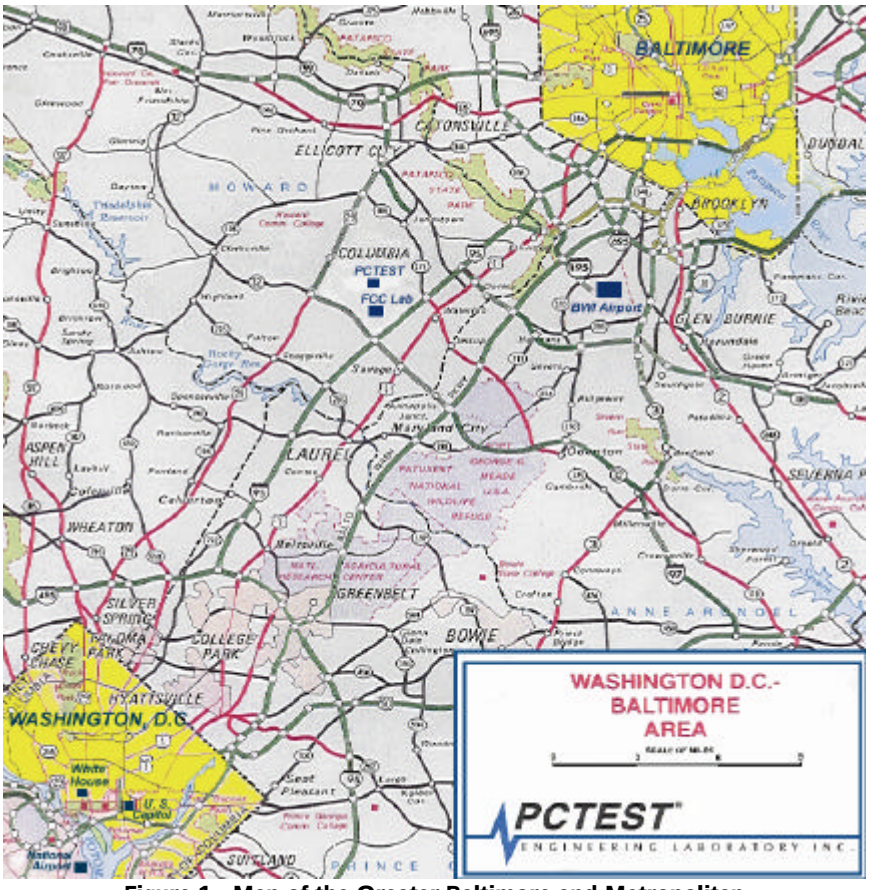


**Figure 1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area.**

# 3.1 Product Information

## 3.2 Equipment Description

The Equipment Under Test (EUT) is the **LG Electronics Inc. (LG Model: *LB680A-EA*) 17" CRT Color Monitor FCC ID: BEJCB795D.**

| | |
|---|---|
| Maximum Resolution(s): | 1600 x 1200 Non-interlaced @ 75Hz |
| Frequency Range(s): | H-Sync: 30kHz – 96kHz<br>V-Sync: 50Hz – 160Hz |
| Display Type: | 17-inch CRT<br>Anti-Reflective Anti-Static coating, U-coating |
| Pixel Pitch: | 0.26mm dot pitch |
| Power Supply: | Output: (Max: 130W)<br>Input: AC 100-240V 50/60Hz 2.0A |
| Power Cord(s): | *Unshielded* AC power cord |
| Port(s)/Input Connector(s): | (1) 15-pin D-Sub Connector |
| Cable(s): | S*hielded* D-Sub (with ferrite on both ends) |
| Dimensions (WxHxD): | 41.6 x 43.2 x 44.0 cm |
| Weight (Net): | 18 kg |

## 4.1 Description of Tests

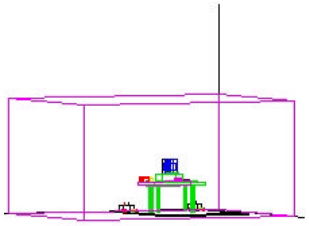

Fig. 2. Shielded Enclosure
Line-Conducted Test Facility

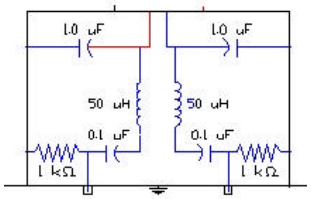


Fig. 3. LISN Schematic Diagram

### 4.2 Powerline Conducted RFI (150kHz- 30MHz)

The powerline conducted RFI measurements were performed according to CISPR 22. The EUT was placed on a non-conducting 1.0 by 1.5 meter table which is 0.8 meters in height and 0.40 meters away from the vertical wall of the shielded enclosure (see Figure 2). Power to the EUT is provided through a Rohde & Schwarz 50 Ω / 50 uH Line Impedance Stabilization Network (LISN) and the support equipment through a separate Solar 50 Ω / 50 uH Line- Conducted Test Facility LISN. Sufficient time for the EUT, support equipment, and test equipment were allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME. The spectrum was scanned from 150kHz to 30 MHz. Each maximum EME was remeasured using an EMI receiver. The detector function of the receiver was set to CISPR quasi- peak and average mode with the bandwidth set to 9 kHz. Each emission was maximized consistent with the typical applications by varying the configuration of the test sample. Interface cables were connected to the available interface ports of the test unit. The effect of varying the position of cables was investigated to find the configuration that produces maximum Diagram emission. Excess cable lengths were bundled at the centre with 30- 40cm. in length. The worst-case configuration is noted in the test report and the photographs are attached. Each EME reported was calibrated using the Rohde & Schwarz SMX signal generator and are listed on Table 1.

| RFI Conducted | FCC Class B | CISPR 22 Class B | |
|---|---|---|---|
| | Limits dB[uV/m] | Limits dB[uV/m] | |
| Freq. Range | FCC Class B | CISPR 22 | CISPR 22 |
| | Quasi-Peak | Quasi-Peak | Average |
| 150 kHz – 0.5 MHz | 48* | 66 – 56** | 56 – 46** |
| 0.5 MHz – 5 MHz | 48 | 56 | 46 |
| 5 MHz – 30 MHz | 48 | 60 | 50 |
| * FCC Class B limits starts from 450 kHz.<br>** Limit decreases linearly with the logarithm of frequency. | | | |

Table 1. CISPR 22 Class B RFI Conducted Limits

# 4.1 Description of Tests (Continued)

## 4.3 Radiated Emissions

Fig. 4. Radiated Test @ 10-meters

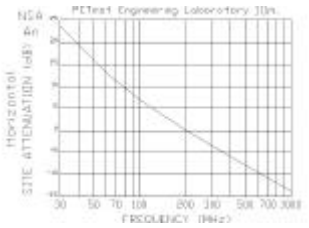

Fig. 5. NSA Theoretical Attenuation Curves (Horiz. Pol.)

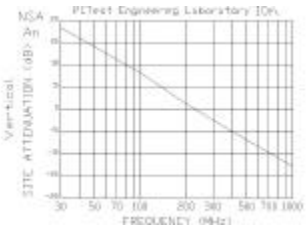

Fig. 6. NSA Theoretical Attenuation Curves (Vert. Pol.)

Preliminary measurements were made indoors at 1 meter using broadband antennas, broadband amplifier, and spectrum analyzer to determine the frequency producing the maximum EME. Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The spectrum was scanned from 30 to 200 MHz using biconical antenna, 200 to 1000 MHz using log- spiral antenna, and above 1 GHz using linearly polarized horn antennas. Final measurements were made outdoors at 10-meter test range using Roberts™ Dipole antennas (see Figure 4) and EMI receiver. For frequencies above 1 GHz, horn antennas were used. Sufficient time for the EUT, support equipment, and test equipment were allowed in order for them to warm up to their normal operating condition. The EMI receiver detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 120 kHz. The EUT, support equipment, and interconnecting cables were arranged to the configuration that produces the maximum EME emission found during preliminary scan. The turntable containing the system was rotated; the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission (see Figure 4). Horizontal and vertical antenna polarizations were checked. Each emission was maximized by: varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and/ or support equipment, and powering the monitor the computer aux AC outlet, if applicable; and changing the polarity of the antenna, whichever determined the worst-case emission. Photographs of the worst-case emission can be seen in Appendix A. Each EME reported was calibrated using the Rohde & Schwarz SMX signal generator.

| ***ITE Radiated Limits*** | | | |
|---|---|---|---|
| Frequency (MHz) | FCC Limit @ 3m. Quasi-Peak dB[µV/m] | FCC Limit @ 10m.* Quasi – Peak dB[µV/m] | CISPR Limit @ 10m. Quasi-Peak dB[µV/m] |
| 30-88 | 40.0 | 29.5 | 30.0 |
| 88-216 | 43.5 | 33.0 | 30.0 |
| 216-230 | 46.0 | 35.6 | 30.0 |
| 230-960 | 46.0 | 35.6 | 37.0 |
| 960-1000 | 54.0 | 43.5 | 37.0 |
| > 1000 | 54.0 | 43.5 | No Specified limit |
| * Limit extrapolated 20 dB/decade | | | |

Table 2. Radiated Class B limits @ 10-meters

## 5.1 Support Equipment Used

| | | | |
|---|---|---|---|
| **1.** | **LG Electronics 17"**<br>StudioWorks Monitor | **FCC ID: BEJCB795D (EUT)**<br>1.8 m. unshielded AC power cord<br>1.5 m. shielded D-sub cable (with ferrite on both ends) | **S/N: 010KG00001** |
| 2. | GATEWAY Mid Tower<br><br>NUMBER NINE PCI Card | Model: P55C-200<br>1.8 m. unshielded AC power cord<br>Model: IMAGINE 128 | S/N: 007078699 |
| 3. | H/P Printer | FCC ID: BS46XU2225C<br>1.8 m. unshielded AC power cord<br>1.0 m. shielded printer cable | S/N: 2633560396 |
| 4. | GATEWAY Mouse | FCC ID: D7J2196003-XX<br>1.6 m. shielded cable | S/N: 03400409 |
| 5. | GATEWAY Keyboard | Model: MOSXK<br>1.6 m. shielded cable | S/N: PCT387 |
| 6. | GOLDSTAR Modem | FCC ID: BEJ3JXGSM2400<br>1.8 m. unshielded DC power cord<br>1.2 m. shielded serial cable | S/N: 164 |

***(See "Attachment H - Test Setup Photographs" for actual system test setup.)***

# 6.1 LINE-CONDUCTED TEST DATA

## 6.2 Conducted Emissions

**(See Data under PLOTS – Attachment D)**

**NOTES:**

1. **All modes of operation were investigated and the worst-case emissions are reported.**
2. **The CISPR RFI conducted limits are listed on Table 1 (Page 4).**
3. **Line A = Phase Line B = Neutral**
4. **Deviations to the Specifications: None**

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* *All readings are calibrated by HP8640B signal generator with accuracy traceable to the National Institute of Standards and Technology (formerly NBS).*

** *Measurements using CISPR quasi-peak mode.*

# 7.1 RADIATED TEST DATA

## 7.2 Radiated Emissions

| **FREQ.** (MHz) | **Level*** (dBµV/m) | **AFCL**** (dB) | **POL** (H/V) | **Height** (m) | **Azimuth** (° angle) | **F/S** (dBµV/m) | **Margin***** (dB) |
|---|---|---|---|---|---|---|---|
| 162.4 | 11.05 | 14.44 | V | 2.6 | 70 | 25.5 | - 4.5 |
| 254.3 | 11.24 | 18.95 | H | 2.1 | 115 | 30.2 | - 6.8 |
| 277.4 | 10.01 | 19.78 | H | 1.9 | 130 | 29.8 | - 7.2 |
| 346.3 | 6.72 | 22.17 | V | 1.6 | 125 | 28.9 | - 8.1 |
| 352.7 | 8.12 | 22.37 | H | 1.2 | 85 | 30.5 | - 6.5 |
| 416.2 | 6.61 | 24.08 | H | 1.2 | 165 | 30.7 | - 6.3 |

Table 3. Radiated Measurements at 10-meters.

**1600 x 1200- Non-interlaced @ 75Hz**

**NOTES:**
1. **All modes of operation were investigated, and the worst-case emissions are reported.**
2. **The radiated limits are listed on Table 2 (Page 5).**

* *All readings are calibrated by HP8640B signal generator with accuracy traceable to the National Institute of Standards and Technology (formerly NBS).*

** *AFCL = Antenna Factor (Roberts dipole) and Cable Loss (30 ft. RG58C/U).*

*** *Measurements using CISPR quasi-peak mode. Above 1GHz, peak detector function mode is used using a resolution bandwidth of 1MHz and a video bandwidth of 1MHz. The peak level complies with the average limit. Peak mode is used with linearly polarized horn antenna and low-loss microwave cable.*

## 8.1 Sample Calculations

**$dB\mu V = 20 \log_{10} (\mu V/m)$**

**$dB\mu V = dBm + 107$**

## 8.2 Example 1:

**@ 20.3 MHz**

| | |
|---|---|
| Class B limit | = 250 μV = 47.96 dBμV |
| Reading | = - 67.8 dBm (calibrated level) |
| Convert to dbμV | = - 67.8 + 107 = 39.2 dBμV |
| $10^{(39.2/20)}$ | = 91.2 μV |
| **Margin** | = 39.2 - 47.96 = - 8.76 |
| | = **8.8 dB below limit** |

## 8.3 Example 2:

**@ 66.7 MHz**

| | |
|---|---|
| Class B limit | = 100 μV/m = 47.96 dBμV/m |
| Reading | = - 76.0 dBm (calibrated level) |
| Convert to dbμV/m | = - 76.0 + 107 = 31.0 dBμV/m |
| Antenna Factor + Cable Loss | = 5.8 dB |
| Total | = 36.8 dBμV/m |
| **Margin** | = 36.8 - 40.0 = - 3.2 |
| | = **3.2 dB below limit** |

# 9.1 Accuracy of Measurement

## 9.2 Measurement Uncertainty Calculations:

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994).

| Contribution (Line Conducted) | Probability Distribution | Uncertainty (± dB) | |
|---|---|---|---|
| | | 9kHz-150MHz | 150-30MHz |
| Receiver specification | Rectangular | 1.5 | 1.5 |
| LISN coupling specification | Rectangular | 1.5 | 1.5 |
| Cable and input attenuator calibration | Normal (k=2) | 0.3 | 0.5 |
| Mismatch: Receiver VRC $\Gamma_1$ = 0.03<br>LISN VRC $\Gamma_R$ = 0.8 (9kHz) 0.2 (30MHz)<br>Uncertainty limits 20Log(1 ± $\Gamma_1$ $\Gamma_R$) | U-Shaped | 0.2 | 0.35 |
| System repeatability | Std. deviation | 0.2 | 0.05 |
| Repeatability of EUT | | - | - |
| Combined standard uncertainty | Normal | 1.26 | 1.30 |
| Expanded uncertainty | Normal (k=2) | 2.5 | 2.6 |

Calculations for 150kHz to 30MHz:

$$u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)} = \pm\sqrt{\frac{1.5^2 + 1.5^2}{3} + (\frac{0.5}{2})^2 + 0.35} = \pm 1.298\text{dB}$$

$$U = 2U_c(y) = \pm 2.6\text{dB}$$

| Contribution (Radiated Emissions) | Probability Distribution | Uncertainties (± dB) | |
|---|---|---|---|
| | | 3 m | 10 m |
| Ambient Signals | | - | - |
| Antenna factor calibration | Normal (k=2) | ± 1.0 | ± 1.0 |
| Cable loss calibration | Normal (k=2) | ± 0.5 | ± 0.5 |
| Receiver specification | Rectangular | ± 1.5 | ±1.5 |
| Antenna directivity | Rectangular | + 0.5 / - 0 | + 0.5 |
| Antenna factor variation with height | Rectangular | ± 2.0 | ± 0.5 |
| Antenna phase centre variation | Rectangular | 0.0 | ± 0.2 |
| Antenna factor frequency interpolation | Rectangular | ±. 0.25 | ± 0.25 |
| Measurement distance variation | Rectangular | ± 0.6 | ± 0.4 |
| Site imperfections | Rectangular | ± 2.0 | ± 2.0 |
| Mismatch: Receiver VRC $\Gamma_1$ = 0.2<br>Antenna VRC $\Gamma_R$ = 0.67 (Bi) 0.3 (Lp)<br>Uncertainty limits 20Log(1 ± $\Gamma_1$ $\Gamma_R$) | U-Shaped | + 1.1<br>- 1.25 | ± 0.5 |
| System repeatability | Std. Deviation | ± 0.5 | ± 0.5 |
| Repeatability of EUT | | - | - |
| Combined standard uncertainty | Normal | + 2.19 / - 2.21 | + 1.74 / - 1.72 |
| Expanded uncertainty U | Normal (k=2) | + 4.38 / - 4.42 | + 3.48 / - 3.44 |

Calculations for 3m biconical antenna. Coverage factor of k=2 will ensure that the level of confidence will be approximately 95%, therefore:

$$U = 2u_c(y) = 2 \times \pm 2.19 = \pm 4.38\text{dB}$$

## 10.1 Test Equipment

| 10.2 Type | Model | Cal. Due Date | S/N |
|---|---|---|---|
| Microwave Spectrum Analyzer | HP 8566B (100Hz-22GHz) | 12/05/00 | 3638A08713 |
| Microwave Spectrum Analyzer | HP 8566B (100Hz-22GHz) | 04/17/01 | 2542A11898 |
| Spectrum Analyzer/Tracking Gen. | HP 8591A (9kHz-1.8GHz) | 06/02/01 | 3144A02458 |
| Spectrum Analyzer | HP 8591A (9kHz-1.8GHz) | 10/15/01 | 3108A02053 |
| Spectrum Analyzer | HP 8594A (9kHz-2.9GHz) | 11/02/00 | 3051A00187 |
| Signal Generator* | HP 8640B (500Hz-1GHz) | 06/02/01 | 2232A19558 |
| Signal Generator* | HP 8640B (500Hz-1GHz) | 06/02/01 | 1851A09816 |
| Signal Generator* | Rohde & Schwarz (0.1-1000MHz) | 09/11/01 | 894215/012 |
| Ailtech/Eaton Receiver | NM 37/57A-SL (30-1000MHz) | 04/12/01 | 0792-03271 |
| Ailtech/Eaton Receiver | NM 37/57A (30-1000MHz) | 03/11/01 | 0805-03334 |
| Ailtech/Eaton Receiver | NM 17/27A (0.1-32MHz) | 09/17/01 | 0608-03241 |
| Quasi-Peak Adapter | HP 85650A | 08/09/01 | 2043A00301 |
| Ailtech/Eaton Adapter | CCA-7 CISPR/ANSI QP Adapter | 03/11/01 | 0194-04082 |
| RG58 Coax Test Cable | No. 167 | | n/a |
| Harmonic/Flicker Test System | HP 6841A (IEC 555-2/3) | | 3531A00115 |
| Broadband Amplifier (2) | HP 8447D | | 1145A00470, 1937A03348 |
| Broadband Amplifier | HP 8447F | | 2443A03784 |
| Transient Limiter | HP 11947A (9kHz-200MHz) | | 2820A00300 |
| Horn Antenna | EMCO Model 3115 (1-18GHz) | | 9704-5182 |
| Horn Antenna | EMCO Model 3115 (1-18GHz) | | 9205-3874 |
| Horn Antenna | EMCO Model 3116 (18-40GHz) | | 9203-2178 |
| Biconical Antenna (4) | Eaton 94455/Eaton 94455-1/Singer 94455-1/Compliance Design 1295, 1332, 0355 | | |
| Log-Spiral Antenna (3) | Ailtech/Eaton 93490-1 | | 0608, 1103, 1104 |
| Roberts Dipoles | Compliance Design (1 set) A100 | | 5118 |
| Ailtech Dipoles | DM-105A (1 set) | | 33448-111 |
| EMCO LISN (2) | 3816/2 | | 1077, 1079 |
| EMCO LISN | 3725/2 | | 2009 |
| Microwave Preamplifier 40dB Gain | HP 83017A (0.5-26.5GHz) | | 3123A00181 |
| Microwave Cables | MicroCoax (1.0-26.5GHz) | | |
| Ailtech/Eaton Receiver | NM37/57A-SL | | 0792-03271 |
| Spectrum Analyzer | HP 8591A | | 3034A01395 |
| Modulation Analyzer | HP 8901A | | 2432A03467 |
| NTSC Pattern Generator | Leader 408 | | 0377433 |
| Noise Figure Meter | HP 8970B | | 3106A02189 |
| Noise Figure Meter | Ailtech 7510 | | TE31700 |
| Noise Generator | Ailtech 7010 | | 1473 |
| Microwave Survey Meter | Holaday Model 1501 (2.450GHz) | | 80931 |
| Digital Thermometer | Extech Instruments 421305 | | 426966 |
| Attenuator | HP 8495A (0-70dB) DC-4GHz | | |
| Bi-Directional Coax Coupler | Narda 3020A (50-1000MHz) | | |
| Shielded Screen Room | RF Lindgren Model 26-2/2-0 | | 6710 (PCT270) |
| Shielded Semi-Anechoic Chamber | Ray Proof Model S81 | | R2437 (PCT278) |
| Environmental Chamber | Associated Systems Model 1025 (Temperature/Humidity) | | PCT285 |

* Calibration traceable to the National Institute of Standards and Technology (NIST).

## 11.1 Test Software Used

```
10    CLS: LCD 7,0
20    FOR I = 1 TO 80
30    PRINT H;
40    NEXT I
50    FOR K= 1 TO 25
60    LPRINT H;
70    NEXT K
80    OPEN COM1:1200,N,8,1,CS0,DS0" FOR OUTPUT AS #1
90    PRINT#1,ATDT,0123456789"
100   CLOSE: GOTO 20
```

NOTE: This is a sample of the basic program used during the test. However, during testing, a different software program may be used; whichever determines the worst-case condition. In addition, the program used also depends on the number and type of devices being tested.

Actual program used is the "H" pattern in Notepad under Windows environment. All resolution modes (1600x1200, 1280x1024, 1024x768, 800x600, 640x480 Non-interlaced) were investigated and tested.

## 12.1 Conclusion

The data collected shows that the **LG Electronics Inc. 17" CRT Color Monitor FCC ID: BEJCB795D** complies with §15.107 and §15.109 of the FCC Rules.

No modifications were made to the device.