



HYUNDAI CALIBRATION & CERTIFICATION TECH. CO., LTD.

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CERTIFICATION

Manufacture:
TECHSAN I & C CO., LTD.

436, MOGOK-DONG, PYEONGTAEK-SI,
GYEOUNGGI-DO, KOREA

TECHSAN I & C FRN : 009419888

Date of Issue : May 25, 2004

Test Report No.: HCT-F04-0502

Test Site: HYUNDAI CALIBRATION & CERTIFICATION
TECHNOLOGIES CO., LTD.

HCT FRN : 0005-8664-21

FCC ID :

RJ5LM15

MODEL(S) :

LM1530A, LM1535A, LM1540A, LM1545A

Rule Part(s): Part 15 & 2; ET Docket 95-19
Equipment Class: FCC Class B Peripheral Device (JPB)
Standard(s): FCC Class B: 1998 (CISPR 22)
EUT Type: 15" LCD Monitor
Max. Resolution(s): 1024 X 768 (@60KHz/75Hz)
Model(s): LM1530A, LM1535A, LM1540A, LM1545A
Port/Connector(s) 15-pin D-sub VGA connector, AUDIO IN.
LCD Panel SAMSUNG Electronics (LTM150XH-L01)

This equipment has been shown to be in compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2001 (Grant Notes: #19, #28).

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.

Ki-Soo Kim

Report prepared by : Ki-Soo Kim

Manager of EMC Tech. Part



HYUNDAI CALIBRATION & CERTIFICATION TECH. CO., LTD.



TABLE OF CONTENTS

| | PAGE |
|--|----------|
| REPORT COVER | 1 |
| TABLE OF CONTENTS | 2 |
| 1.1 SCOPE | 3 |
| 2.1 INTRODUCTION (SITE DESCRIPTION) | 4 |
| 3.1 PRODUCTION INFORMATION | 5-6 |
| 4.1 PRELIMINARY TESTS | 7 |
| 5.1 DESCRIPTION OF TESTS | 8-9 |
| 6.1 LIST OF SUPPORT EQUIPMENT | 10-11 |
| 7.1 TEST DATA (CONDUCTED) | 12-15 |
| 8.1 TEST DATA (RADIATED) | 16 |
| 9.1 SAMPLE CALCULATIONS | 17 |
| 10.1 TEST EQUIPMENT | 18 |
| 11.1 TEST SOFTWARE USED | 19 |
| 12.1 CONCLUSION | 20 |

ATTACHMENT A: **FCC ID LABEL & LOCATION**

ATTACHMENT B: **EXTERNAL PHOTOGRAPHS**

ATTACHMENT C: **BLOCK DIAGRAM(S)**

ATTACHMENT D: **TEST SETUP PHOTOGRAPHS**

ATTACHMENT E: **USER'S MANUAL**

ATTACHMENT F-1: **INTERNAL PHOTOGRAPHS**

ATTACHMENT F-2: **INTERNAL PHOTOGRAPHS**

ATTACHMENT F-3: **INTERNAL PHOTOGRAPHS**

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: | TECHSAN I & C |
| Address: | 436, MOGOK-DONG, PYEONGTAEK-SI, GYEOUNGGI-DO, KOREA |

- **FCC ID : RJ5LM15**
- Equipment Class: FCC Class B Peripheral Device (JBP)
- EUT Type: 15" LCD MONITOR
- Model(s): LM1530A, LM1535A, LM1540A, LM1545A
- LCD Panel: SAMSUNG Electronics (LTM150XH-L01)
- Max. Resolution: 1024 X 768 (@60KHz/75Hz)
- Frequency Range : V-Sync: 56.3Hz – 75.0Hz , H-Sync: 31.47kHz – 60.02kHz
- Cable(s): Shielded D-Sub (with ferrite on both ends)
- Power Cord: Unshielded
- Rule Part(s): FCC Part 15 Subpart B
- Test Procedure(s): ANSI C63.4 (2001)
- Dates of Tests: April 26, 2004 ~ May 12, 2004
- Place of Tests: 254-1,MAEKOK-RI,HOBUP-MYUN,ICHON-SI,KYOUNGKI-DO,467-701,KOREA

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 (ANSIC63.4-2001) was used in determining radiated and conducted emissions emanating from **TECHSAN I & C CO.,LTD. 15-inch LCD Monitor FCC ID: RJ5LM15**

The open area test site and conducted measurement facility used to collect the radiated data are located at the 254-1, MAEKOK-RI,HOBUP-MYUN,ICHON-SI,KYOUNGKI-DO, 467-701,KOREA. The site is constructed in conformance with the requirements of ANSI C63.4 and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated July 23,2003 (Confirmation Number: EA90661)

3.1 PRODUCT INFORMATION

3.2 Equipment Description

Equipment Under Test (EUT) is the **TECHSAN I & C CO.,Ltd.** (**Models : LM1530A, LM1535A, LM1540A, LM1545A**) **15-inch LCD Monitor**

FCC ID: : **RJ5LM15**

Maximum Resolution(s): 1024 X 768 (@60KHz/75Hz)

Frequency Range(s): H-Sync: 31.47kHz – 60.02kHz
V-Sync: 56.3Hz – 75.0 Hz

Pixel Pitch: 0.297mm

Power Supply: AC 100-240V, 1.0A

Power Cord: *Unshielded* AC power cord

Port(s)/Input Connector(s): 15-pin D-sub VGA connector, AUDIO IN.

Cable(s): Shielded D-Sub (with ferrite on both ends)

Dimensions (W×H×D): 347.6 X 373 X 170mm

Weight (Net) : 5.5 (4.3)Kg unpacked

EMI Suppression Devices:

1. Apply a ferrite core to the OSD signal interface cable



2. Attach a piece of copper foil by bridging it from the LCD panel frame to the OSD board



3. Attach a conductive gasket at the LCD's rear panel



4.1 PRELIMINARY TESTS

4.1 AC Power line Conducted Emission Tests

During Preliminary Tests, the following models were investigated

| Model name | Conducted emission Level (Margin) | The worst model |
|------------|-----------------------------------|-----------------|
| LM1530A | 1.000MHz ; 40.90dBuV (15.1 dB) | |
| LM1535A | 2.220MHz ; 41.30dBuV (14.7 dB) | |
| LM1540A | 0.925MHz ; 41.80dBuV (14.2 dB) | X |
| LM1545A | 15.460MHz ; 39.70dBuV (16.3 dB) | |

4.2 Radiated Emission Tests

During Preliminary Tests, the following models were investigated

| Model name | Radiated emission Level (Margin) | The worst model |
|------------|----------------------------------|-----------------|
| LM1530A | 220.5MHz ; 24.6dBuV/m (5.4 dB) | |
| LM1535A | 232.4MHz ; 32.2dBuV/m (4.8 dB) | |
| LM1540A | 551.3MHz ; 32.6dBuV/m (4.4 dB) | X |
| LM1545A | 617.4MHz ; 31.8dBuV/m (5.2 dB) | |

5.1 Description of Tests

5.2 Description of Tests(Conducted)

The power line 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. 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 center 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

| RFI CONDUCTED | CISPR 22 CLASS B Limits dB(uV/m) | |
|-----------------|-------------------------------------|---------------------|
| Freq. Range | CISPR 22 Quasi-Peak | CISPR 22 Average |
| 150kHz - 0.5MHz | 66-56** | 56-46** |
| 0.5MHz - 5MHz | 56 | 46 |
| 5MHz - 30MHz | 60 | 50 |

*FCC Class B limits starts from 450kHz
 **Limits decreases linearly with the logarithm of frequency

Table 1. RFI Conducted Limits

5.3 Description of Tests(Radiated)

Radiated Emissions

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 300 MHz using biconical antenna, 300 to 1000 MHz using log- periodic antenna, and above 1 GHz using linearly polarized horn antennas. Final measurements were made outdoors at 10-meter test range using Dipole antennas 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. 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.

| ITE Radiated Limits | |
|-----------------------------------|---|
| Frequency (MHz) | CISPR Limit @ 10m. Quasi-Peak dB [μ V/m] |
| 30-88 | 30.0 |
| 88-216 | 30.0 |
| 216-230 | 30.0 |
| 230-960 | 37.0 |
| 960-1000 | 37.0 |
| > 1000 | No Specified Limit |
| | |
| | |
| | |
| | |
| * Limit extrapolated 20 dB/decade | |

Table 2. Radiated Class B limits @ 10-meters

6.1 Support Equipment Used

| DEVICE TYPE | MANUFACTURER | MODEL NUMBER | FCC ID / DoC | CONNECTED TO |
|---------------|-------------------------|--------------------------------------|--------------|--------------|
| MONITOR (EUT) | TECHSAN I & C CO., LTD. | LM1530A, LM1535A LM1540A, LM1545A | RJ5LM15 | P.C |
| P.C | H/P | HP Pavilion 8921 | DoC | N/A |
| KEY BOARD | H/P | 5181 | DoC | P.C |
| MOUSE | Microsoft | IntelliMouse | DoC | P.C |
| PRINTER | H/P | C4569A | DoC | P.C |
| SERIAL MOUSE | Logitech | M-M28 | DoC | P.C |

6.2 Cable Description

| | Power Cord Shielded (Y/N) | I/O Cable Shielded (Y/N) | Length (M) |
|--------------|------------------------------|-----------------------------|----------------|
| MONITOR(EUT) | N | Y | 1.8(P), 1.5(D) |
| PC(HOST) | N | N/A | 1.8(P) |
| KEY BOARD | N/A | Y | 1.8(D) |
| MOUSE | N/A | Y | 1.8(D) |
| PRINTER | N | Y | 1.8(P),1.8(D) |
| SERIAL MOUSE | N/A | Y | 1.8(D) |
| AUDIO IN | N/A | Y | 1.5(D) |

The marked "(D)" means the Data Cable and "(P)" means the Power Cable.

6.3 Noise Suppression Parts on Cable. (I/O CABLE)

| | Ferrite Bead (Y/N) | Location | Metal Hood (Y/N) | Location |
|--------------|-----------------------|----------|---------------------|----------|
| MONITOR(EUT) | Y | BOTH END | Y | BOTH END |
| KEY BOARD | N | N/A | Y | P.C END |
| MOUSE | Y | N/A | Y | P.C END |
| PRINTER | N | N/A | Y | BOTH END |
| SERIAL MOUSE | N | N/A | Y | EUT END |
| AUDIO IN | Y | BOTH END | N | N/A |

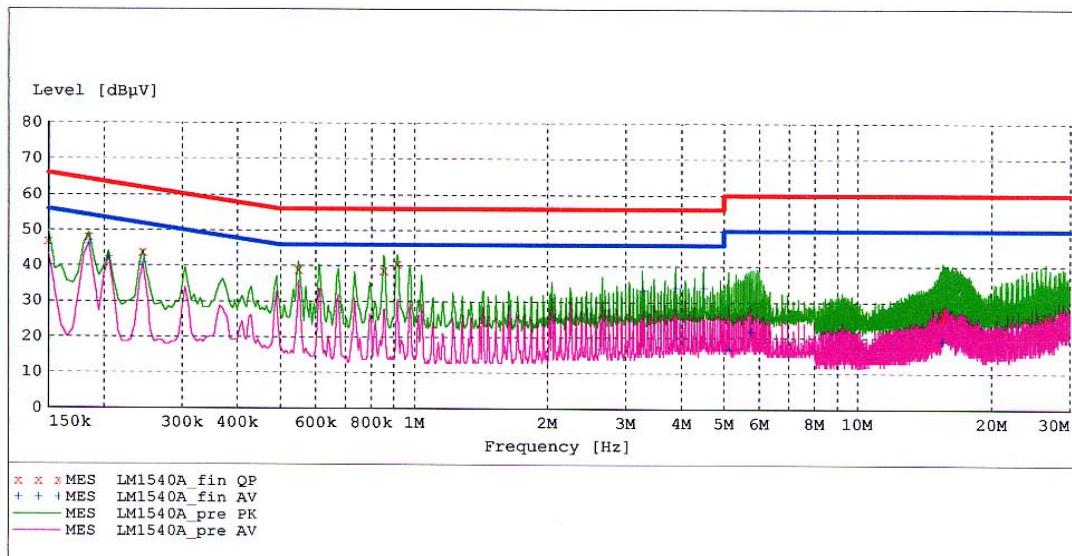
7.1 LINE-CONDUCTED TEST DATA

**HYUNDAI C-TECH
EMC TESTING Laboratory**

EUT: LM1540A
 Manufacturer: TECHSAN I & C CO., LTD.
 Operating Condition: 1024 X768 75Hz
 Test Site: SHIELD ROOM
 Operator: KS-KIM
 Test Specification: CISPR 22 CLASS B
 Comment: N
 Start of Test: 5/12/04 / 9:32:19AM

SCAN TABLE: "CISPR 22 Voltage"

| Short Description: | | CISPR 22 Voltage | | | | | |
|--------------------|----------------|------------------|----------|---------|---------|------------|---------|
| Start Frequency | Stop Frequency | Step Width | Detector | Meas. | IF Time | Transducer | Bandw. |
| 150.0 kHz | 500.0 kHz | 5.0 kHz | MaxPeak | 10.0 ms | 9 kHz | None | Average |
| 500.0 kHz | 5.0 MHz | 5.0 kHz | MaxPeak | 10.0 ms | 9 kHz | None | Average |



MEASUREMENT RESULT: "LM1540A_fin_QP"

5/12/04 9:35AM

| Frequency MHz | Level dB μ V | Transd dB | Limit dB μ V | Margin dB | Line | PE |
|------------------|---------------------|--------------|---------------------|--------------|------|-----|
| 0.150000 | 46.90 | 10.1 | 66 | 19.1 | 1 | --- |
| 0.185000 | 48.10 | 10.1 | 64 | 16.2 | 1 | --- |
| 0.245000 | 43.80 | 10.1 | 62 | 18.1 | 1 | --- |
| 0.550000 | 39.00 | 10.1 | 56 | 17.0 | 1 | --- |
| 0.855000 | 38.70 | 10.1 | 56 | 17.3 | 1 | --- |
| 0.920000 | 40.50 | 10.1 | 56 | 15.5 | 1 | --- |
| 15.525000 | 27.20 | 10.5 | 60 | 32.8 | 1 | --- |
| 15.585000 | 25.80 | 10.5 | 60 | 34.2 | 1 | --- |
| 26.490000 | 25.90 | 10.6 | 60 | 34.1 | 1 | --- |

MEASUREMENT RESULT: "LM1540A_fin AV"

5/12/04 9:35AM

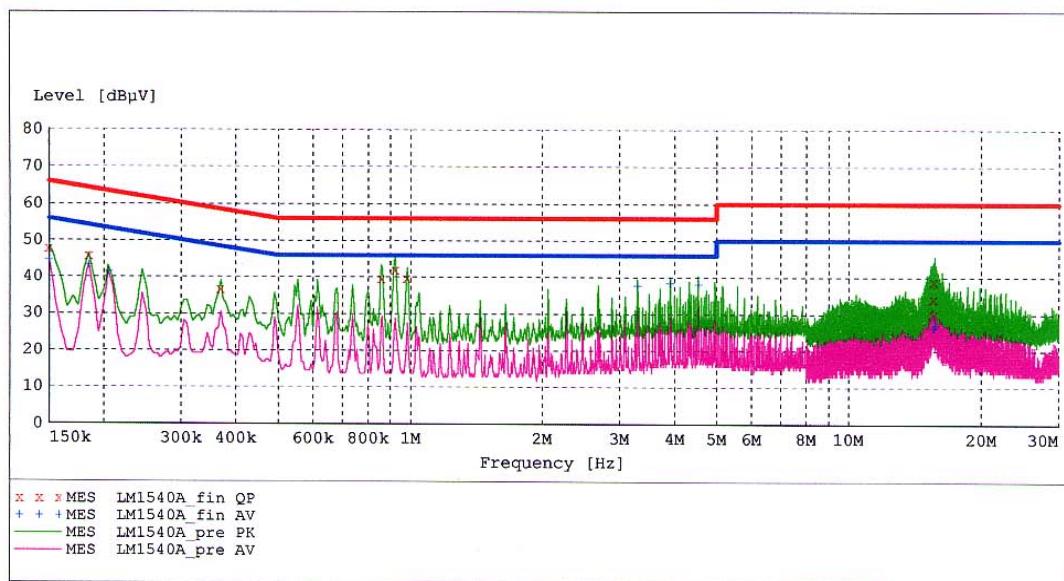
| Frequency MHz | Level dB μ V | Transd dB | Limit dB μ V | Margin dB | Line | PE |
|------------------|---------------------|--------------|---------------------|--------------|------|-----|
| 0.185000 | 46.20 | 10.1 | 54 | 8.0 | 1 | --- |
| 0.205000 | 42.50 | 10.1 | 53 | 10.9 | 1 | --- |
| 0.245000 | 40.70 | 10.1 | 52 | 11.2 | 1 | --- |
| 3.275000 | 33.20 | 10.2 | 46 | 12.8 | 1 | --- |
| 3.890000 | 34.20 | 10.3 | 46 | 11.8 | 1 | --- |
| 4.505000 | 34.00 | 10.3 | 46 | 12.0 | 1 | --- |
| 5.125000 | 16.70 | 10.3 | 50 | 33.3 | 1 | --- |
| 5.765000 | 21.80 | 10.3 | 50 | 28.2 | 1 | --- |
| 15.585000 | 19.30 | 10.5 | 50 | 30.7 | 1 | --- |

**HYUNDAI C-TECH
 EMC TESTING Laboratory**

EUT: LM1540A
 Manufacturer: TECHSAN I & C CO., LTD.
 Operating Condition: 1024 X768 75Hz
 Test Site: SHIELD ROOM
 Operator: KS-KIM
 Test Specification: CISPR 22 CLASS B
 Comment: H
 Start of Test: 5/12/04 / 9:37:20AM

SCAN TABLE: "CISPR 22 Voltage"

| CISPR 22 Voltage | | | | | | |
|------------------|----------------|------------|----------|---------|---------|------------|
| Start Frequency | Stop Frequency | Step Width | Detector | Meas. | IF Time | Transducer |
| 150.0 kHz | 500.0 kHz | 5.0 kHz | MaxPeak | 10.0 ms | 9 kHz | None |
| 500.0 kHz | 5.0 MHz | 5.0 kHz | Average | 10.0 ms | 9 kHz | None |
| | | | MaxPeak | | | |
| | | | Average | | | |


MEASUREMENT RESULT: "LM1540A_fin QP"

5/12/04 9:40AM

| Frequency MHz | Level dB μ V | Transd dB | Limit dB μ V | Margin dB | Line | PE |
|------------------|---------------------|--------------|---------------------|--------------|------|-----|
| 0.150000 | 47.80 | 10.1 | 66 | 18.2 | 1 | --- |
| 0.185000 | 45.70 | 10.1 | 64 | 18.5 | 1 | --- |
| 0.370000 | 36.70 | 10.1 | 59 | 21.8 | 1 | --- |
| 0.860000 | 39.50 | 10.1 | 56 | 16.5 | 1 | --- |
| 0.925000 | 41.80 | 10.1 | 56 | 14.2 | 1 | --- |
| 0.985000 | 39.60 | 10.1 | 56 | 16.4 | 1 | --- |
| 15.595000 | 34.10 | 10.5 | 60 | 25.9 | 1 | --- |
| 15.660000 | 38.90 | 10.5 | 60 | 21.1 | 1 | --- |
| 15.715000 | 30.00 | 10.5 | 60 | 30.0 | 1 | --- |

MEASUREMENT RESULT: "LM1540A_fin AV"

5/12/04 9:40AM

| Frequency MHz | Level dB μ V | Transd dB | Limit dB μ V | Margin dB | Line | PE |
|------------------|---------------------|--------------|---------------------|--------------|------|-----|
| 0.150000 | 44.80 | 10.1 | 56 | 11.2 | 1 | --- |
| 0.185000 | 43.30 | 10.1 | 54 | 11.0 | 1 | --- |
| 0.205000 | 41.40 | 10.1 | 53 | 12.0 | 1 | --- |
| 3.305000 | 37.70 | 10.2 | 46 | 8.3 | 1 | --- |
| 3.925000 | 38.60 | 10.3 | 46 | 7.4 | 1 | --- |
| 4.545000 | 38.30 | 10.3 | 46 | 7.7 | 1 | --- |
| 15.595000 | 26.50 | 10.5 | 50 | 23.5 | 1 | --- |
| 15.720000 | 28.90 | 10.5 | 50 | 21.1 | 1 | --- |
| 15.780000 | 27.10 | 10.5 | 50 | 22.9 | 1 | --- |

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 6).
3. Line H = Hot , N = Neutral

** Measurements using CISPR quasi-peak mode.

8.1 RADIATED TEST DATA

| Frequency MHz | Reading dBuV | Ant. Factor dB | Cable Loss dB | ANT POL (H/V) | Total dBuV/m | Limit dBuV/m | Margin dB |
|------------------|-----------------|-------------------|------------------|------------------|-----------------|-----------------|--------------|
| 143.9 | 6.65 | 14.62 | 2.6 | V | 23.9 | 30 | -6.1 |
| 177.1 | 3.88 | 15.82 | 3.0 | H | 22.7 | 30 | -7.3 |
| 185.4 | 4.48 | 15.98 | 3.1 | V | 23.5 | 30 | -6.5 |
| 199.9 | 4.67 | 16.24 | 3.2 | V | 24.1 | 30 | -5.9 |
| 210.1 | 3.97 | 16.55 | 3.3 | H | 23.8 | 30 | -6.2 |
| 215.4 | 2.48 | 16.70 | 3.3 | V | 22.5 | 30 | -7.5 |
| 430.6 | 9.82 | 17.83 | 4.8 | V | 32.4 | 37 | -4.6 |
| 483.2 | 7.11 | 18.88 | 5.0 | H | 31.0 | 37 | -6.0 |
| 551.3 | 7.00 | 20.25 | 5.4 | V | 32.6 | 37 | -4.4 |
| 617.4 | 4.35 | 21.66 | 5.7 | V | 31.7 | 37 | -5.3 |
| 644.3 | 4.24 | 22.54 | 5.8 | V | 32.6 | 37 | -4.4 |
| 686.7 | 3.64 | 22.53 | 6.0 | H | 32.2 | 37 | -4.8 |

Radiated Measurements at 10-meters.

1024 X 768 (@60KHz/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 8).

** AFCL = Antenna Factor (Roberts dipole) and Cable Loss .

*** 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.

9.1 Sample Calculations

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

8.2 Example 1:

@ 0.925 MHz

| | |
|---------------|--------------------------------------|
| Class B limit | = 56.0 dB μ V |
| Reading | = 41.8 dB μ V (calibrated level) |
| | = 41.8 – 56.0 = - 14.2 |
| Margin | = 14.2 dB below limit |

8.3 Example 2:

@ 551.3 MHz

| | |
|-----------------------------|---------------------------------------|
| Class B limit | = 37 dB μ V/m |
| Reading | = 7.0 dB μ V/m (calibrated level) |
| Antenna Factor + Cable Loss | = 25.6 dB |
| Total | = 32.6 dB μ V/m |
| | = 32.6 – 37.0 = - 4.4 |
| Margin | = 4.4 dB below limit |

10.1 Test Equipment

| <u>Type</u> | <u>Manufacture</u> | <u>Model Number</u> | <u>CAL Date</u> |
|------------------------|--------------------|---------------------|-----------------|
| EMI Test Receiver | Rohde & Schwarz | ESH3 | 2003.07.16 |
| EMI Test Receiver | Rohde & Schwarz | ESVP | 2003.10.01 |
| EMI Test Receiver | Rohde & Schwarz | ESI40 | 2003.11.16 |
| EMI Test Receiver | Rohde & Schwarz | ESVS30 | 2003.07.16 |
| LISN | EMCO | 3816/2 | 2003.11.29 |
| LISN | EMCO | 3816/2 | 2003.08.22 |
| Amplifier | Hewlett-Packard | 8447E | 2003.08.23 |
| Absorbing Clamp | Rohde & Schwarz | MDS-21 | 2004.04.24 |
| Dipole Antennas | Rohde & Schwarz | VHAP | 2003.07.16 |
| Dipole Antennas | Rohde & Schwarz | UHAP | 2003.07.16 |
| Biconical Antenna | Rohde & Schwarz | VHA9103 | 2003.07.12 |
| Log-Periodic Antenna | Rohde & Schwarz | UHALP9107 | 2003.07.12 |
| Antenna Position Tower | EMCO | 1051-12 | N/A |
| Turn Table | EMCO | 1060-06 | N/A |
| Power Analyzer | Voltech | PM 3300 | 2004.2.15 |
| Reference Network | Impedance Voltech | IEC 555 | N/A |
| AC Power Source | PACIFIC | Magnetic Module | N/A |
| AC Power Source | PACIFIC | 360AMX | 2003.11.25 |
| Controller | HD GmbH | HD 100 | N/A |
| EMI in Motion | HD GmbH | KMS 560 | N/A |

11.1 Test Software Used

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The software, contained on a 3-1/2 inch disc, was inserted into drive A and is auto starting on power-up. Once loaded, the program sequentially exercises each system component in turn. The sequence used is :(1) Display test, (2) RS 232 test (3) Key board test,(4) Printer test,(5) FDD test,(6) HDD test. The complete cycle takes about 20 seconds and is repeated continuously. As the keyboard and mouse are strictly input devices, no data is transmitted to them during test. They are however, continuously scanned for data input activity. The video resolution modes setup and change program was used during the radiated and conducted emission testing.

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 (1024x768, 800x600, 640x480, 720x400) were investigated and tested

12.1 Conclusion

The data collected shows that the TECHSAN I & C CO., LTD. 15-inch LCD Monitor **FCC ID:RJ5LM15**

complies with §15.107 and §15.109 of the FCC Rules.