

Hopping Channel Separation Channel 39



Hopping Channel Separation Channel 78



## 4.6 Number of Hopping Frequency Used

### 4.6.1 Test Procedure

1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable.  
Equipment mode: Spectrum analyzer  
RBW: 300KHz  
VBW: 1MHz
2. Set the spectrum analyzer on Max-Hold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
3. Repeat above procedures until all frequencies measured were complete.

### 4.6.2 Test Setup

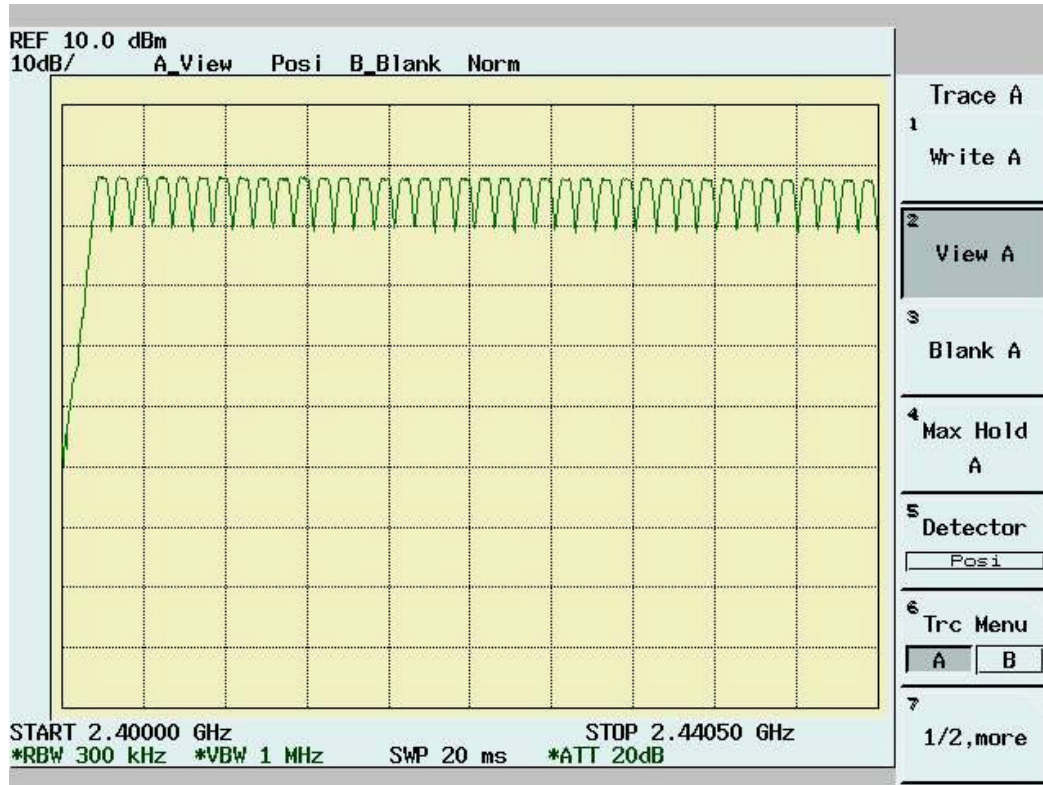


### 4.6.3 Test Data

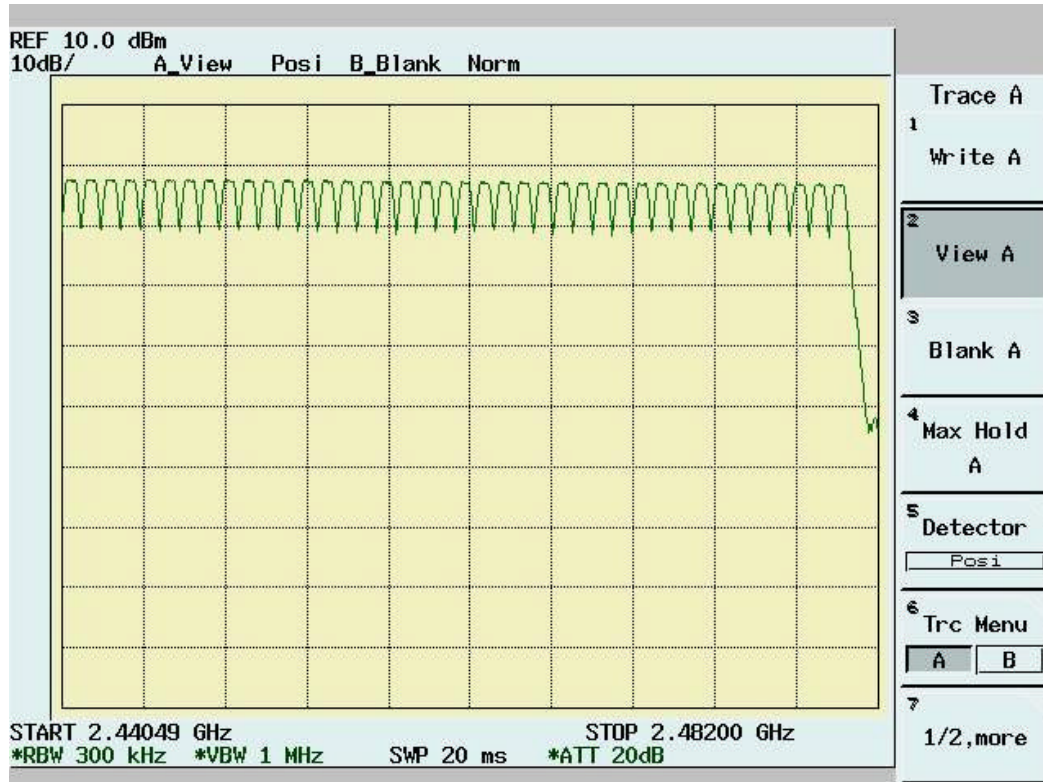
Number of Hopping Frequency Used

| Test result | Limit<br>(KHz) | Pass/Fail |
|-------------|----------------|-----------|
| 79          | >75            | Pass      |

2400~2405MHz



2405~2482MHz



## 4.7 Dwell Time

### 4.7.1 Test Procedure

1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable.  
Equipment mode: Spectrum analyzer  
RBW: 1MHz  
VBW: 1MHz  
SPAN: Zero Span
2. Adjust the center frequency of spectrum analyzer on any frequency be measured.
3. Measure the Dwell Time by spectrum analyzer Marker function.
4. Repeat above procedures until all frequencies measured were complete.

### 4.7.2 Test Setup



#### 4.7.3 Test Data

##### Dwell Time

Temperature ( ):25

Test Engineer:Jerry Chiou

Humidity (%):55

| Mode | Frequency<br>(MHz) | Spectrum<br>Reading<br>(μs) | Test<br>Result<br>(ms) | Limit<br>(ms) | Pass/Fail |
|------|--------------------|-----------------------------|------------------------|---------------|-----------|
| DH1  | 2402               | 396                         | 253.44                 | < 400         | Pass      |
| DH3  | 2402               | 1648                        | 351.57                 | < 400         | Pass      |
| DH5  | 2402               | 2896                        | 370.69                 | < 400         | Pass      |

| Mode | Frequency<br>(MHz) | Spectrum<br>Reading<br>(μs) | Test<br>Result<br>(ms) | Limit<br>(ms) | Pass/Fail |
|------|--------------------|-----------------------------|------------------------|---------------|-----------|
| DH1  | 2441               | 394                         | 252.16                 | < 400         | Pass      |
| DH3  | 2441               | 1648                        | 351.57                 | < 400         | Pass      |
| DH5  | 2441               | 2888                        | 369.66                 | < 400         | Pass      |

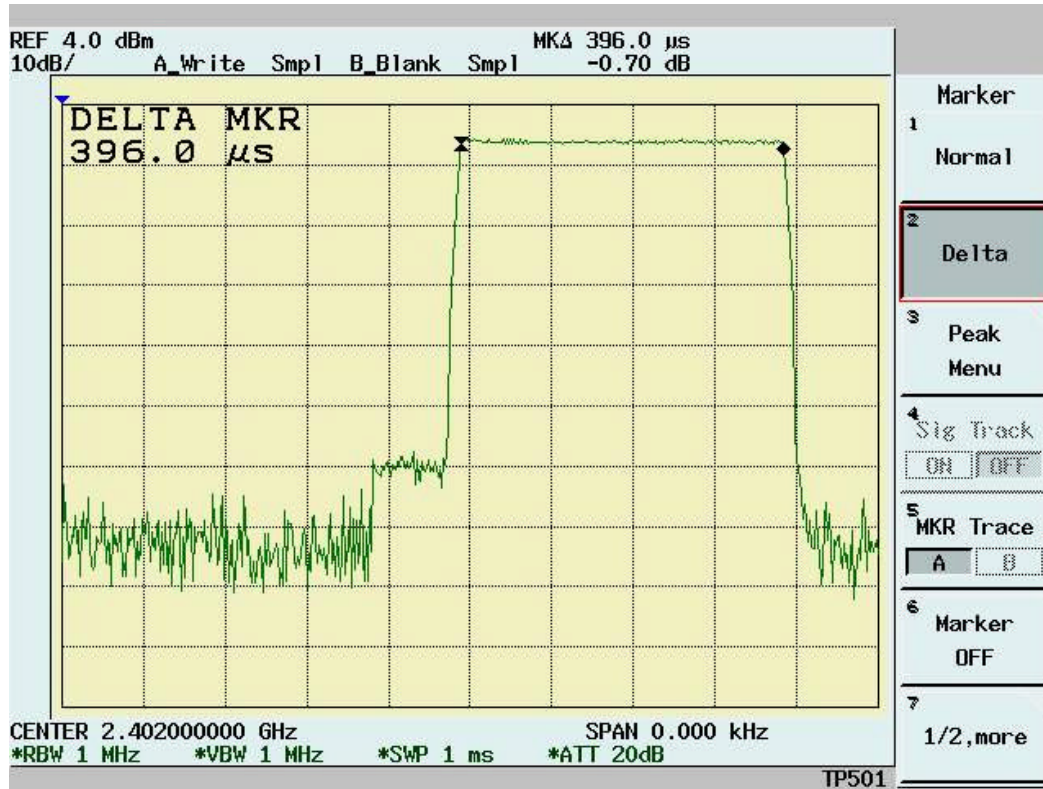
| Mode | Frequency<br>(MHz) | Spectrum<br>Reading<br>(μs) | Test<br>Result<br>(ms) | Limit<br>(ms) | Pass/Fail |
|------|--------------------|-----------------------------|------------------------|---------------|-----------|
| DH1  | 2480               | 394                         | 252.16                 | < 400         | Pass      |
| DH3  | 2480               | 1648                        | 351.57                 | < 400         | Pass      |
| DH5  | 2480               | 2888                        | 369.66                 | < 400         | Pass      |

Note:

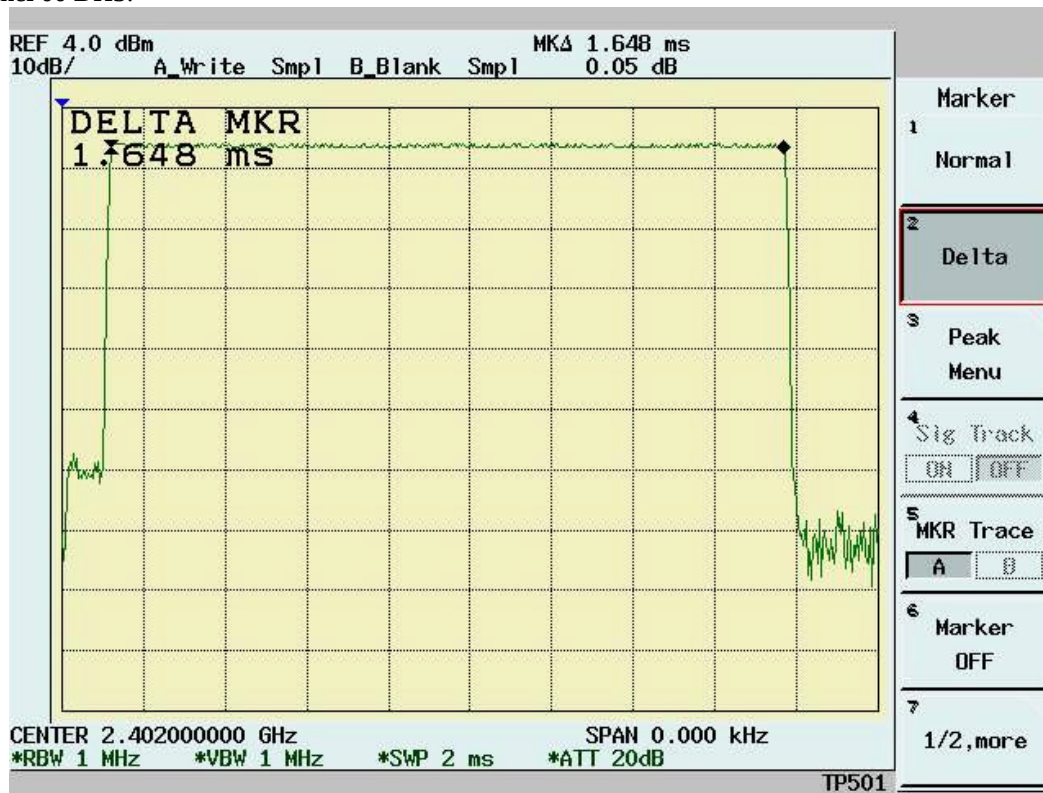
A period time=79x0.4(s)=31.6(s)

|      |                |                               |             |
|------|----------------|-------------------------------|-------------|
| CH00 | DH1 time slot= | 396 (μs)*(1600/(1*79))*31.6=  | 253.44 (ms) |
|      | DH3 time slot= | 1648 (μs)*(1600/(3*79))*31.6= | 351.57 (ms) |
|      | DH5 time slot= | 2896 (μs)*(1600/(5*79))*31.6= | 370.69 (ms) |
| CH39 | DH1 time slot= | 394 (μs)*(1600/(1*79))*31.6=  | 252.16 (ms) |
|      | DH3 time slot= | 1648 (μs)*(1600/(3*79))*31.6= | 351.57 (ms) |
|      | DH5 time slot= | 2888 (μs)*(1600/(5*79))*31.6= | 369.66 (ms) |
| CH78 | DH1 time slot= | 394 (μs)*(1600/(1*79))*31.6=  | 252.16 (ms) |
|      | DH3 time slot= | 1648 (μs)*(1600/(3*79))*31.6= | 351.57 (ms) |
|      | DH5 time slot= | 2888 (μs)*(1600/(5*79))*31.6= | 369.66 (ms) |

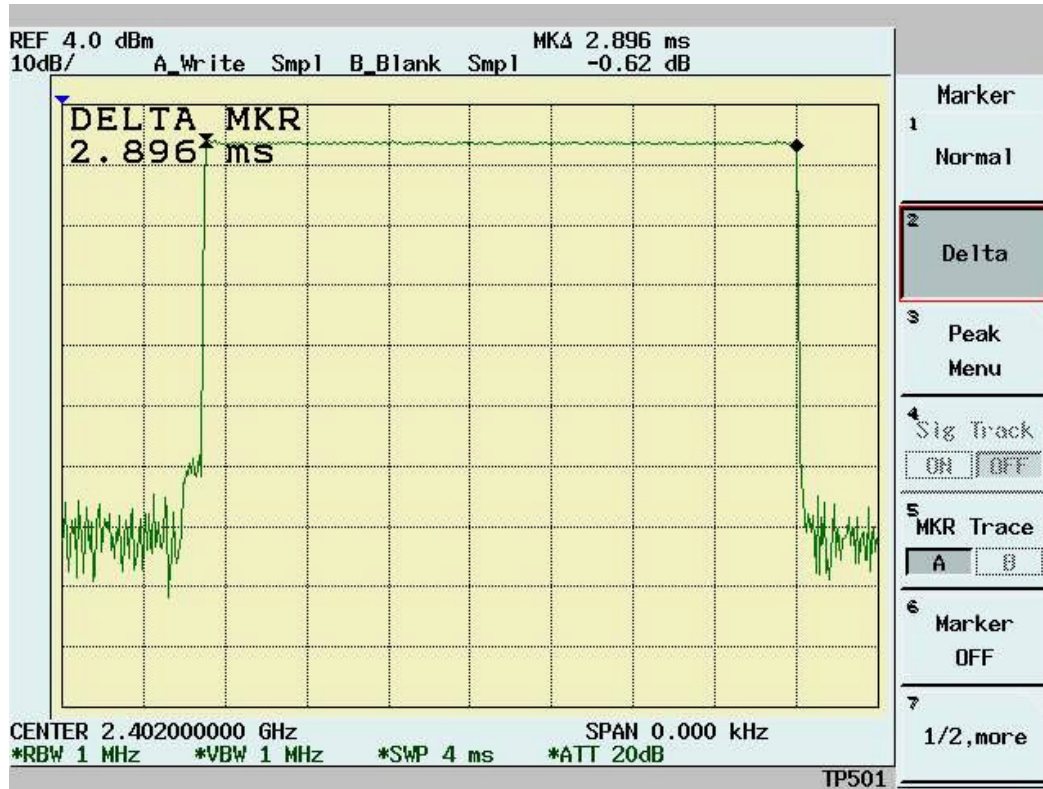
Channel 00 DH1:



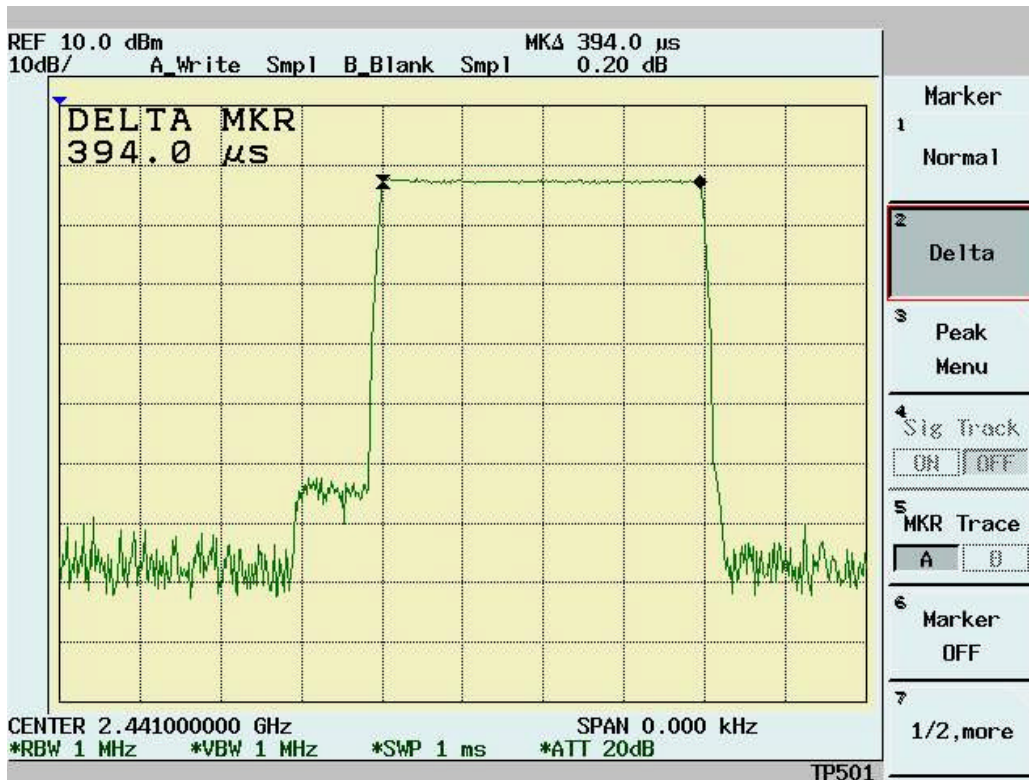
Channel 00 DH3:



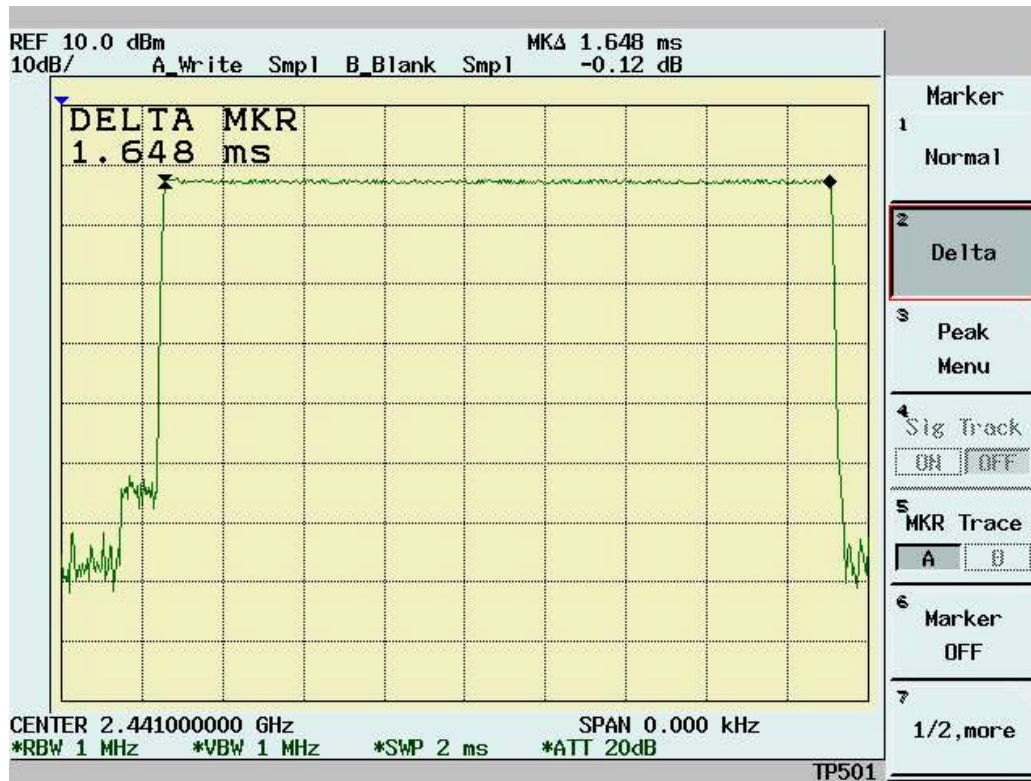
Channel 00 DH5:



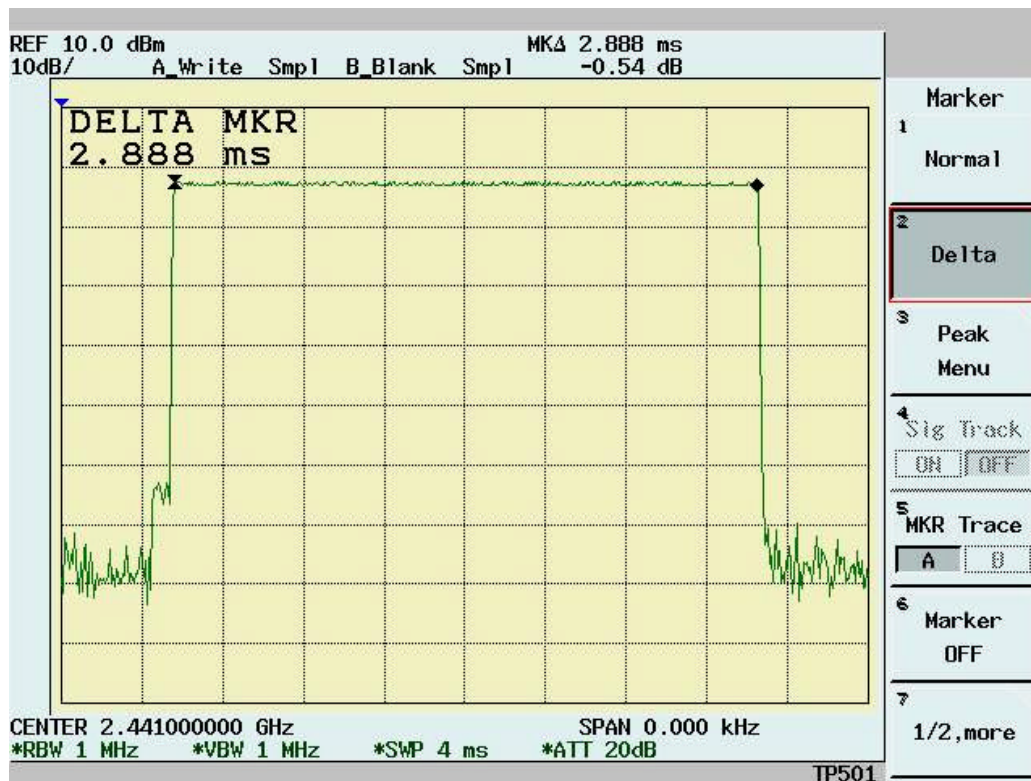
Channel 39 DH1:



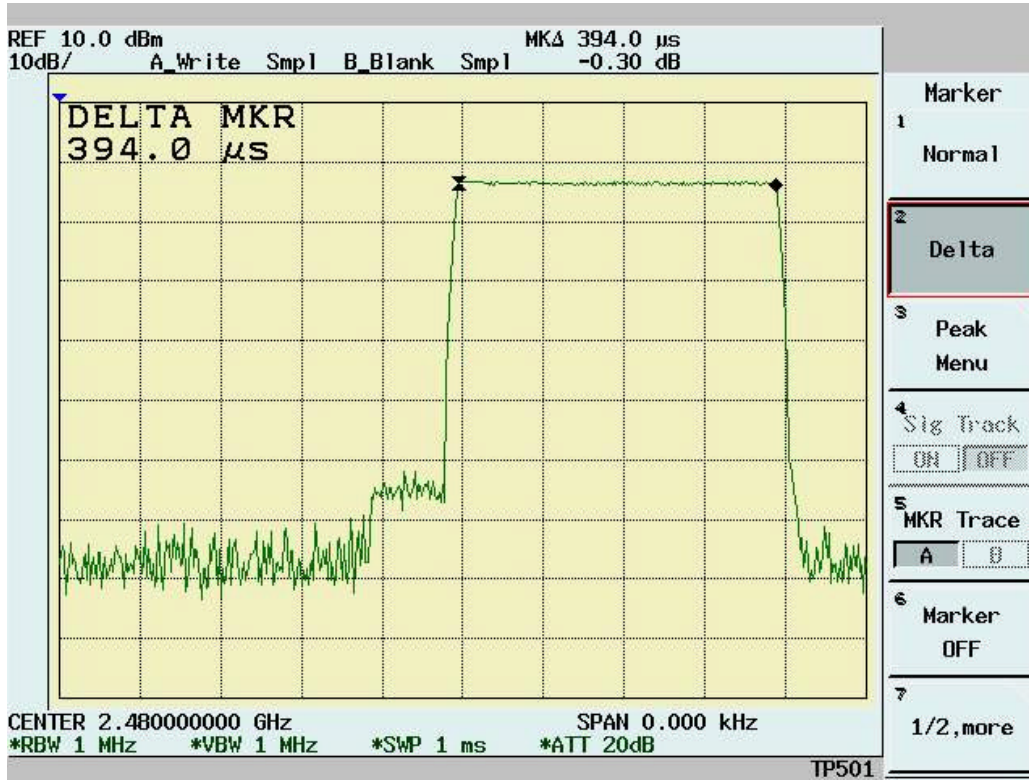
Channel 39 DH3:



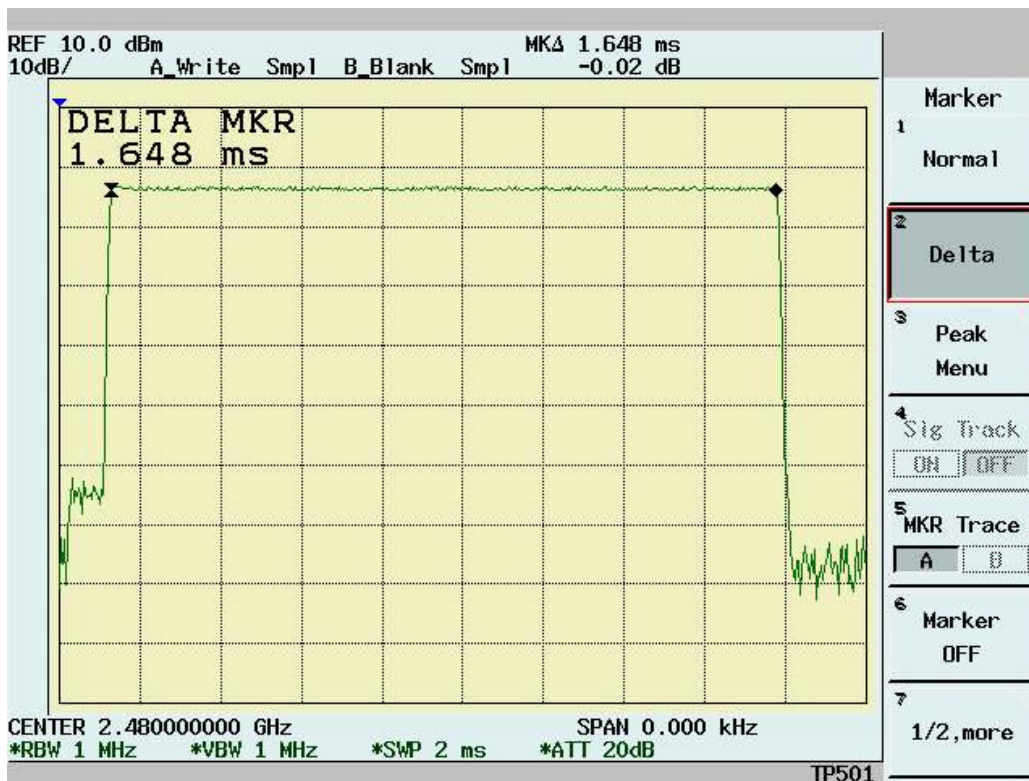
Channel 39 DH5:



Channel 78 DH1:



Channel 78 DH3:



Channel 78 DH5:



## 5. Appendix

### 5.1 Appendix A: Measurement Procedure for Power line Conducted Emissions

The measurements are performed in a 3.5m x 3.4m x 2.5m shielded room, which referred as Conduction 01 test site, or a 3m x 3m x 2.3m test site, which referred as Conduction 02 test site. The EUT was placed on non-conduction 1.0m x 1.5m table, which is 0.8 meters above an earth-grounded.

Power to the EUT was provided through the LISN which has the Impedance (50ohm/50uH) vs. Frequency Characteristic in accordance with the required standard. Power to the LISNs were filtered to eliminate ambient signal interference and these filters were bonded to the ground plane. Peripheral equipment required to provide a functional system (support equipment) for EUT testing was powered from the second LISN through a ganged, metal power outlet box which is bonded to the ground plane at the LISN.

If the EUT is supplied with a flexible power cord, the power cord length in excess of the distance separating the EUT from the LISN shall be folded back and forth at the center of the lead so as to form a bundle not exceeding 40cm in length. If the EUT is provided with a permanently coiled power cord, bundling of the cord is not required. If the EUT is supplied without a power cord, the EUT shall be connected to the LISN by a power cord of the type specified by the manufacturer which shall not be longer than 1 meter. The excess power cord shall be bundled as described above. If a non-flexible power cord is provided with the EUT, it shall be cut to the length necessary to attach the EUT to the LISN and shall not be bundled.

The interconnecting cables were arranged and moved to get the maximum emission. Both the line of power cord, hot and neutral, were measured.

The highest emissions were analyzed in details by operating the spectrum analyzer in fixed tuned mode to determine the nature of the emissions and to provide information which could be useful in reducing their amplitude.

## 5.2 Appendix B: Test Procedure for Radiated Emissions

### Preliminary Measurements in the Anechoic Chamber

The radiated emissions are initially measured in the anechoic chamber at a measurement distance of 3 meters. Desktop EUT are placed on a wooden stand 0.8 meter in height. The measurement antenna is 3 meters from the EUT. The test setup in anechoic chamber is the same as open site. The turntable rotated 360°C. The antenna height is varied from 1-2.5m. The primary objective of the radiated measurements in the anechoic chamber is to identify the frequency spectrum in the absence of the electromagnetic environment existing on the open test site. The frequencies can then be pre-selected on the open test site to obtain the corresponding amplitude. The initial scan is made with the spectrum analyzer in automatic sweep mode. The spectrum peaks are then measured manually to determine the exact frequencies.

### Measurements on the Open Site or 10m EMC Chamber

The radiated emissions test will then be repeated on the open site or 10m EMC chamber to measure the amplitudes accurately and without the multiple reflections existing in the shielded room. The EUT and support equipment are set up on the turntable of one of the 3 or 10 meter open field sites. Desktop EUT are set up on a wooden stand 0.8 meter above the ground.

For the initial measurements, the receiving antenna is varied from 1-4 meter height and is changed in the vertical plane from vertical to horizontal polarization at each frequency. Both reading are recorded with the quasi-peak detector with 120KHz bandwidth. For frequency between 30 MHz and 1000MHz, the reading is recorded with peak detector or quasi-peak detector. For frequency above 1 GHz, the reading is recorded with peak detector or average detector with 1 MHz bandwidth.

At the highest amplitudes observed, the EUT is rotated in the horizontal plane while changing the antenna polarization in the vertical plane to maximize the reading. The interconnecting cables were arranged and moved to get the maximum emission. Once the maximum reading is obtained, the antenna elevation and polarization will be varied between specified limits to maximize the readings.

## 5.3 Appendix C: Test Equipment

### 5.3.1 Test Equipment List

| Location   | Equipment Name                    | Brand                       | Model                    | S/N              | Last Cal. Date | Next Cal. Date |
|------------|-----------------------------------|-----------------------------|--------------------------|------------------|----------------|----------------|
| Conduction | Coaxial Cable 1F-C2               | Harbourindustries           | RG400                    | 1F-C2            | 07/15/2006     | 07/15/2007     |
| Conduction | Digital Hygro-Thermometer Conduct | MicroLife                   | HT-2126G                 | ISL-Conduction02 | 11/30/2006     | 11/30/2007     |
| Conduction | EMI Receiver 07                   | Schwarzbeck Mess-Elektronik | FCKL 1528                | 1528-201         | 09/01/2007     | 09/01/2008     |
| Conduction | LISN 04                           | EMCO                        | 3810/2                   | 9604-1429        | 12/30/2006     | 12/30/2007     |
| Conduction | LISN 06                           | R&S                         | ESH3-Z5                  | 828874/009       | 12/13/2006     | 12/13/2007     |
| Radiation  | BILOG Antenna 08                  | Schaffner                   | CBL6112B                 | 2756             | 06/12/2006     | 06/12/2007     |
| Radiation  | Coaxial Cable Chmb 02-10M         | Belden                      | RG-8/U                   | Chmb 02-10M      | 07/12/2006     | 07/12/2007     |
| Radiation  | Digital Hygro-Thermometer Chmb 02 | MicroLife                   | HT-2126G                 | Chmb 02          | 11/30/2006     | 12/30/2007     |
| Radiation  | EMI Receiver 03                   | HP                          | 85460A                   | 3448A00183       | 04/10/2006     | 04/10/2007     |
| Radiation  | Spectrum Analyzer 13              | Advantest                   | R3132                    | 121200411        | 02/17/2007     | 02/17/2008     |
| Radiation  | Horn Antenna 02                   | Com-Power                   | AH-118                   | 10088            | 12/28/2006     | 12/27/2007     |
| Radiation  | Horn Antenna 04                   | Com-Power                   | AH-826                   | 081-001          | 03/24/2007     | 03/23/2008     |
| Radiation  | Horn Antenna 05                   | Com-Power                   | AH-640                   | 100A             | 11/16/2006     | 11/15/2007     |
| Radiation  | Microwave Cable RF SK-01          | HUBER+SUHNERAG.             | Sucoflex 102             | 22139 /2         | 11/09/2006     | 11/09/2007     |
| Radiation  | Preamplifier 09                   | MITEQ                       | AFS44-00102650-40-10P-44 | 858687           | 04/02/2006     | 04/02/2007     |
| Radiation  | Preamplifier 10                   | MITEQ                       | JS-26004000-27-5A        | 818471           | 12/28/2006     | 12/27/2007     |
| Radiation  | High Pass Filter 01               | HEWLETT-PACKARD             | 84300-80038              | 001              | N/A            | N/A            |
| Radiation  | High Pass Filter 02               | HEWLETT-PACKARD             | 84300-80039              | 005              | N/A            | N/A            |
| Radiation  | Spectrum Analyzer 14              | Advantest                   | R3182                    | 140600028        | 11/21/2006     | 11/21/2007     |

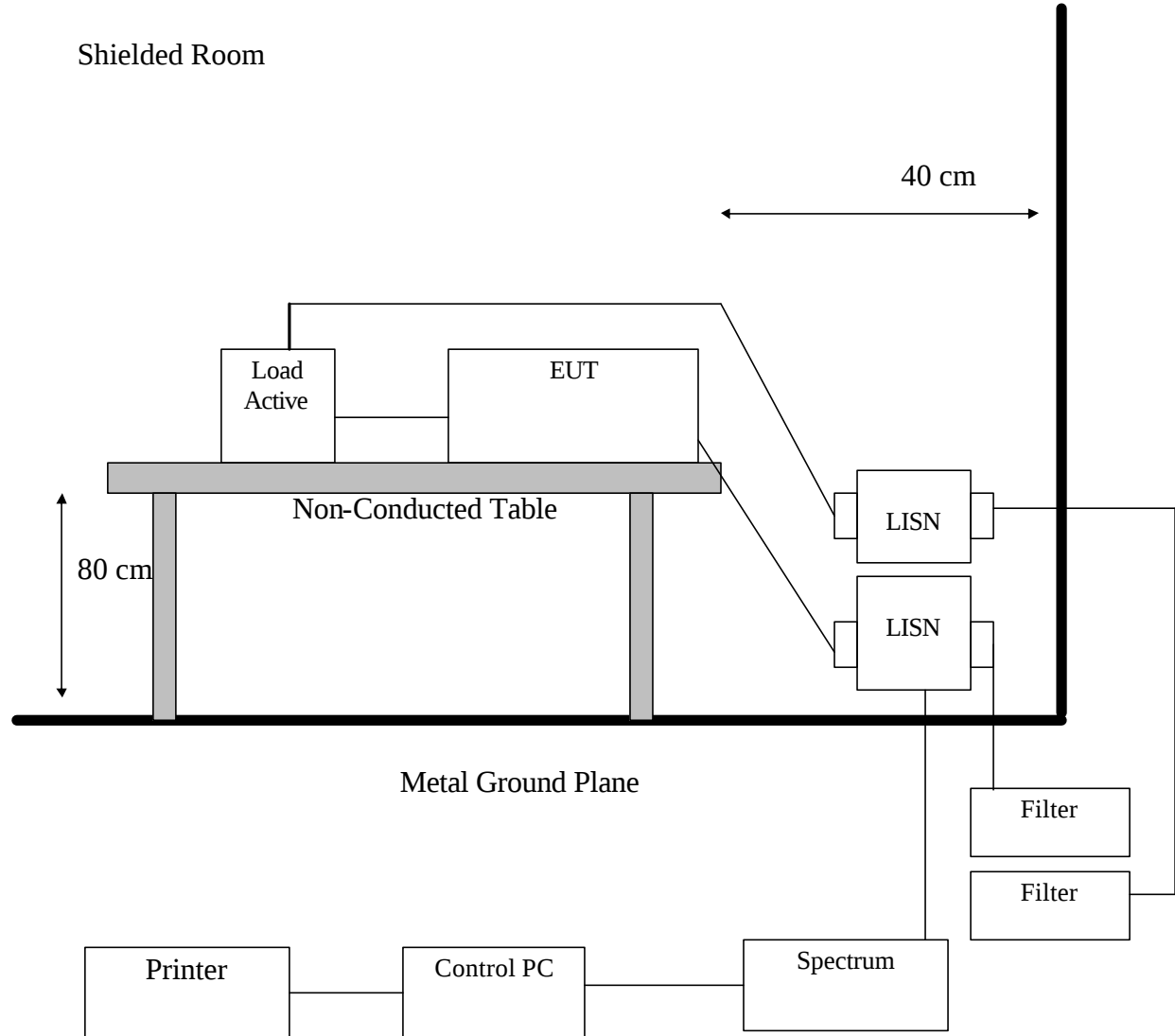
Note: Calibration is traceable to NIST or national or international standards.

### 5.3.2 Software for Controlling Spectrum/Receiver and Calculating Test Data

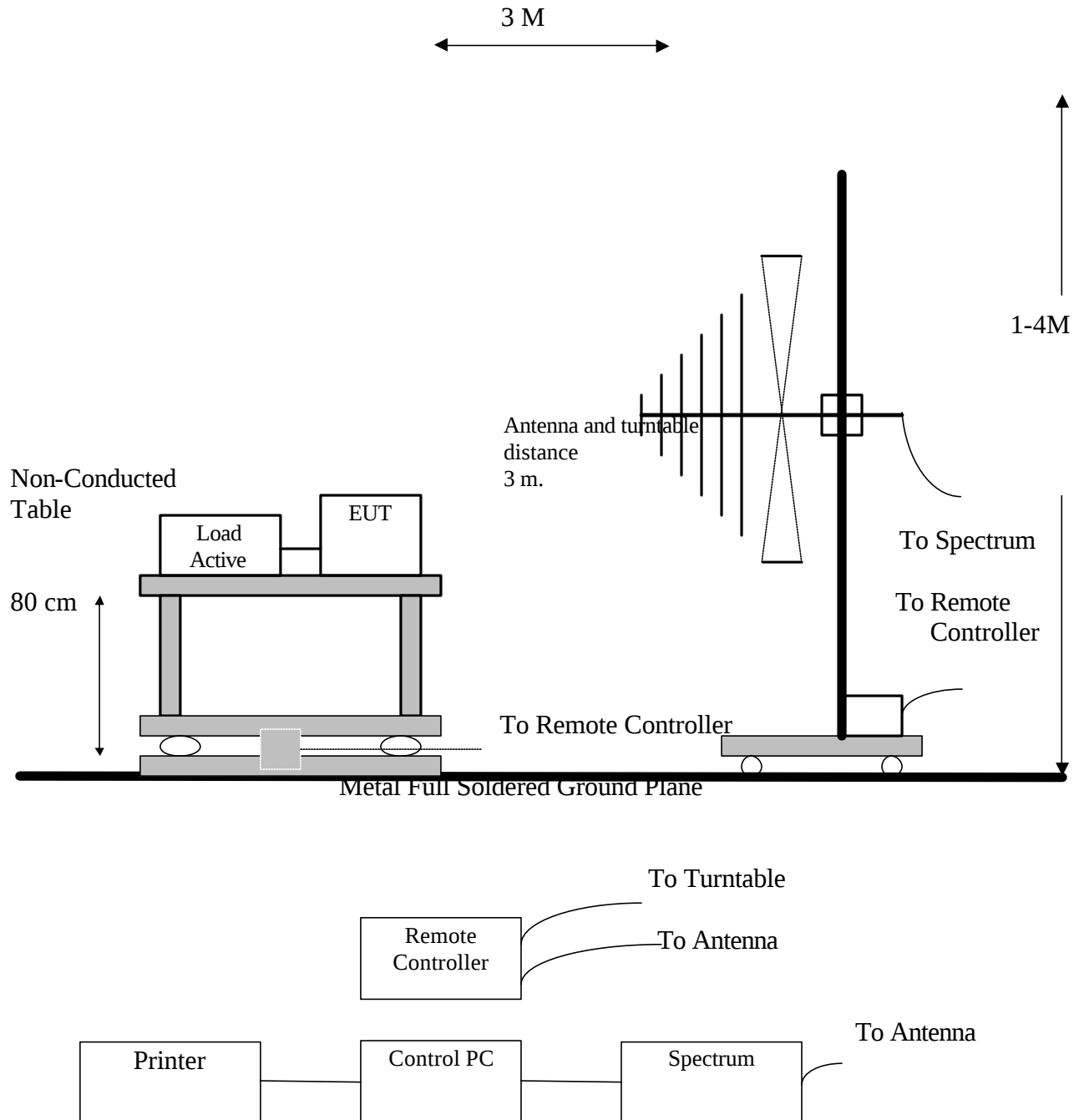
| Radiation/Conduction | Filename | Version | Issued Date |
|----------------------|----------|---------|-------------|
| Conduction           | Tile.exe | 1.12E   | 7/7/2000    |
| Radiation            | Tile.exe | 1.12C   | 6/16/2000   |

## 5.4 Appendix D: Layout of EUT and Support Equipment

### 5.4.1 General Conducted Test Configuration



## 5.4.2 General Radiation Test Configuration



## 5.5 Appendix E: Description of Support Equipment

### 5.5.1 Description of Support Equipment

#### Support unit 1: (for conduction test)

|                         |                                                                                       |
|-------------------------|---------------------------------------------------------------------------------------|
| Description:            | DELL Notebook Personal Computer                                                       |
| Model:                  | Latitude D400                                                                         |
| Serial Number:          | N/A                                                                                   |
| CPU:                    | Pentium M- 1.5GHz( FSB 400 MHz)                                                       |
| A/C Adapter Type:       | LITEON 65W (Model PA-1650-05D) 3 Pins                                                 |
| Hard Disk Driver:       | Toshiba (Model: MK4019GAX) 40 GB                                                      |
| MDC Modem:              | Conexant (Model: RD01-D480)                                                           |
| VGA Connector:          | One 15 Pins                                                                           |
| Serial Connector:       | One 9 Pins                                                                            |
| RJ11 Connector:         | One 2 Pins                                                                            |
| RJ45 Connector:         | One 8 Pins                                                                            |
| USB Connector:          | Two 4 Pins                                                                            |
| 1394 Connector:         | One 4 Pins                                                                            |
| Smart Card Slot:        | One                                                                                   |
| PCMCIA Slot:            | One                                                                                   |
| Earphone Port:          | One                                                                                   |
| Microphone Port:        | One                                                                                   |
| Power In Port:          | One                                                                                   |
| Battery:                | Sanyo 6-cell (Model: 6T087)                                                           |
| RAM:                    | Nanya DDR 256MB x 1                                                                   |
| LCD Panel and Inverter: | Toshiba 12.1" XGA (Model: LTM12C505D) ;<br>RICOH KEIKI Inverter (Model: K3E19T5 0090) |
| Power Cord:             | Non-shielded, Detachable                                                              |

### Support unit 2: (for conduction test)

|                    |                          |
|--------------------|--------------------------|
| Description:       | 24" LCD Monitor          |
| Manufacturer :     | DELL                     |
| Model Number:      | 2405FPW                  |
| Serial Number      | N/A                      |
| Power Supply Type: | AC 100~240V 50~60Hz      |
| DC Output Port:    | one                      |
| VGA Port:          | one                      |
| DVI Port:          | one                      |
| Power In:          | one                      |
| USB Port:          | five                     |
| Video Port:        | one                      |
| S-Video In:        | one                      |
| Y/PB/PR Port:      | one                      |
| CF Port:           | one                      |
| SM Port:           | one                      |
| MS Port:           | one                      |
| SD/MMC Port:       | one                      |
| FCC ID:            | N/A                      |
| Power Cable:       | Non-shielded, Detachable |

### Support unit 3: (for conduction test)

|                |                                           |
|----------------|-------------------------------------------|
| Description:   | External HDD                              |
| Model:         | F12-UF                                    |
| Serial Number: | NA                                        |
| Power Adaptor: | YHI(Model:YS-1015U12)                     |
| 1394 Port:     | one 6-Pins                                |
| USB:           | one 4-Pins                                |
| Power In:      | one                                       |
| Power Cable:   | Non-shielded, Detachable, (Can Dismantle) |

### Support unit 4: (for conduction test)

|                |                                           |
|----------------|-------------------------------------------|
| Description:   | External HDD                              |
| Model:         | F12-UF                                    |
| Serial Number: | NA                                        |
| Power Adaptor: | YHI(Model:YS-1015U12)                     |
| 1394 Port:     | one 6-Pins                                |
| USB:           | one 4-Pins                                |
| Power In:      | one                                       |
| Power Cable:   | Non-shielded, Detachable, (Can Dismantle) |

### Support unit 5: (for conduction test)

|                |                            |
|----------------|----------------------------|
| Description:   | ATA Microphone and HeadSet |
| Model:         | 1221K                      |
| Serial Number: | N/A                        |

### Support unit 6: (for conduction test)

Description: Bluetooth USB Adapter  
Model: BU-2091-J  
Serial Number: N/A

### Support Unit 7: (for radiation test)

Description: IBM Notebook Personal Computer  
Model: 2371  
Serial Number: N/A  
Power Supply Type: Switching AC Adapter 56W  
Lite-On (Model: 02K6809) 3 pins  
CPU Type: Intel Pentium-M 1.2 GHz  
Hard Disk Device: Hitachi 20GB (Model: HTC424020F7AT00)  
DDR: 256MB Infineon (Model: HYB25D256160BT-6)  
BT/MODEM card: Actiontec (Model: BMDC200)  
Wireless card: Phillips (Model: WLAN 802.11ABG 930700811107 WW)  
DC-In: one  
VGA Port: one  
USB2.0 Connector: two  
LAN Connector: one  
Modem Port: one  
PCIMCIA Connector: one  
SD Connector: one  
Docking Connector: one  
Battery: Sanyo 4 cell (Model: 92P0999)  
Power Cord: Shielded 3 PIN, 2 PIN  
LCD: Samsung 12.1" XGA TFT (Model: LTN121XA-L01)  
Maximum display Resolution: 1024X768 Non-interlaced

### Support Unit 2: (for radiation test)

Description: Card Phone Extender Board  
Model: Card Phone USB-E  
Serial Number: N/A  
USB2.0 Connector: one  
Express Card port: one

### 5.5.2 Software for Controlling Support Unit

Test programs exercising various part of EUT were used. The programs were executed as follows:

- A. Read and write to the disk drives.
- B. Send H pattern to the displays.(Monitor)
- C. The RF software makes the transmitter continuously sending RF signals
- D. Repeat the above steps.

|                            | Filename     | Issued Date |
|----------------------------|--------------|-------------|
| CSR Bluesuite<br>V1.20.0.0 | Bluetest.exe | 2004/04/08  |
| LCD Monitor                | RtrX.exe     | 1998/05/12  |

### 5.5.3 I/O Cable Condition of EUT and Support Units

| Description                           | Path                                        | Cable Length | Cable Type                      | Connector Type |
|---------------------------------------|---------------------------------------------|--------------|---------------------------------|----------------|
| AC Power Cord                         | 110V (~240V) to EUT SPS                     | 1.8M         | Nonshielded, Detachable         | Plastic Head   |
| ATA Microphone and HeadSet Data Cable | Microphone to EUT Line in Port and Line out | 1.5M         | Non-shielded, Un-detachable     | Plastic Head   |
| Monitor D-SUB Data Cable              | Monitor D-SUB Port to EUT VGA Port          | 1.8M         | Shielded, Detachable(with core) | Metal Head     |
| USB data cable*2                      | USB external hard disk to EUT USB Port      | 1.8M         | Shielded, Un-detachable         | Metal Head     |
| LAN data cable                        | NB LAN(RJ-45) Port to EUT LAN port          | 33 feet      | Non-shielded, Detachable        | Plastic Head   |
| Phone data cable                      | NB Modem(RJ-11) Port to EUT Modem port      | 33 feet      | Non-shielded, Detachable        | Plastic Head   |

## 5.6 Appendix F: Accuracy of Measurement

Test Site: Conduction 02

| Item | Source of Uncertainty                                                            | Probability Distribution | Total Uncertainties (dB) |              | Standard Uncertainty (dB) |       |
|------|----------------------------------------------------------------------------------|--------------------------|--------------------------|--------------|---------------------------|-------|
| 1    | Systematic Effects:<br>(Assessment from 20 repeat observation; 1 reading on EUT) | Normal                   | k=2                      | 0.104        | k=1                       | 0.052 |
| 2    | Random Effects:<br>(Assessment from 20 random observations; 1 reading on EUT)    | Normal                   | k=2                      | 0.330        | k=1                       | 0.165 |
| 3    | Receiver Calibration                                                             | Rectangular              | k=1.73                   | 1.000        | k=1                       | 0.577 |
| 4    | LISN Factor Calibration                                                          | Normal                   | k=2                      | 1.200        | k=1                       | 0.600 |
| 5    | Cable Loss Calibration                                                           | Normal                   | k=2                      | 1.000        | k=1                       | 0.500 |
| 6    | Combined Standard Uncertainty $U_c(y)$                                           | Normal                   |                          |              | k=1                       | 0.850 |
| 7    | <b>Total Uncertainty @95% mim. Confidence Level</b>                              | <b>Normal</b>            | <b>k=2</b>               | <b>1.701</b> |                           |       |

Measurement Uncertainty Calculations:

$$U_c(y) = \text{square root} (u_1(y)^2 + u_2(y)^2 + \dots + u_n(y)^2)$$

$$U = 2 * U_c(y)$$

Note: The measurement Uncertainties mentioned above also refer to NIS 81-1994 of NAMAS :  
The treatment of Uncertainty in EMC Measurement.

Test Site: Chamber 02-3M

| Item | Source of Uncertainty                                                            | Probability Distribution | Total Uncertainties (dB) |              | Standard Uncertainty (dB) |       |
|------|----------------------------------------------------------------------------------|--------------------------|--------------------------|--------------|---------------------------|-------|
| 1    | Systematic Effects:<br>(Assessment from 20 repeat observation; 1 reading on EUT) | Normal                   | k=2                      | 0.067        | k=1                       | 0.034 |
| 2    | Random Effects:<br>(Assessment from 20 random observations; 1 reading on EUT)    | Normal                   | k=2                      | 0.103        | k=1                       | 0.052 |
| 3    | Receiver Calibration                                                             | Rectangular              | k=1.73                   | 1.000        | k=1                       | 0.577 |
| 4    | Antenna Factor Calibration                                                       | Normal                   | k=2                      | 1.700        | k=1                       | 0.850 |
| 5    | Cable Loss Calibration                                                           | Normal                   | k=2                      | 1.000        | k=1                       | 0.500 |
| 6    | Combined Standard Uncertainty Uc(y)                                              | Normal                   |                          |              | k=1                       | 1.029 |
| 7    | <b>Total Uncertainty @95% mim. Confidence Level</b>                              | <b>Normal</b>            | <b>k=2</b>               | <b>2.059</b> |                           |       |

Measurement Uncertainty Calculations:

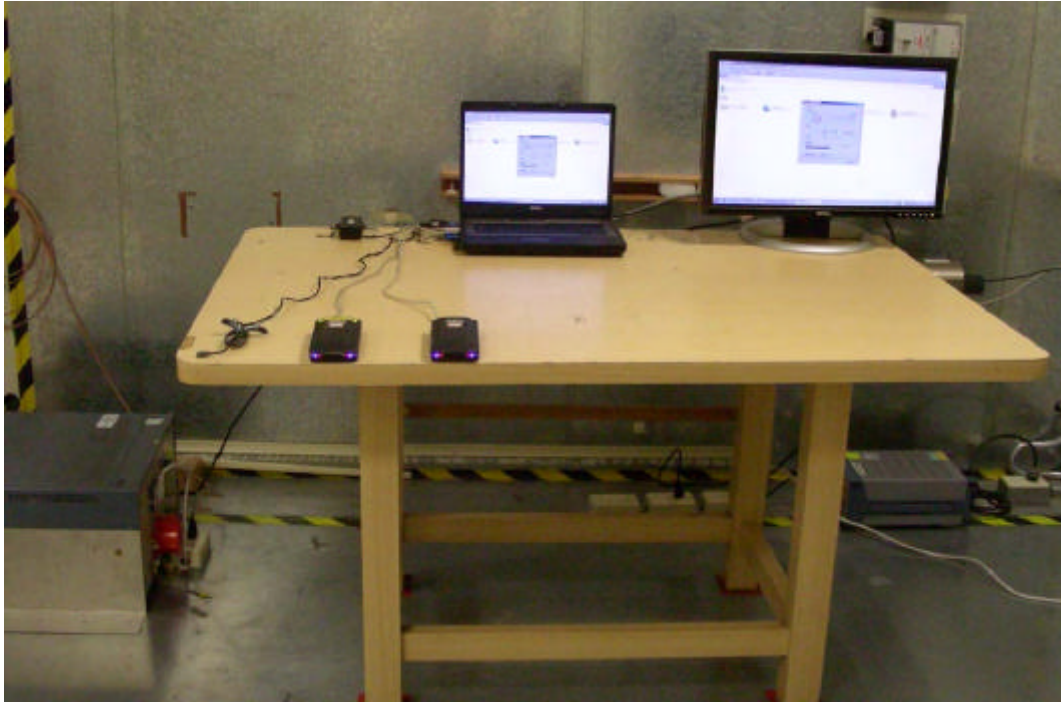
$$U_c(y) = \text{square root} (u_1(y)^2 + u_2(y)^2 + \dots + u_n(y)^2)$$

$$U = 2 * U_c(y)$$

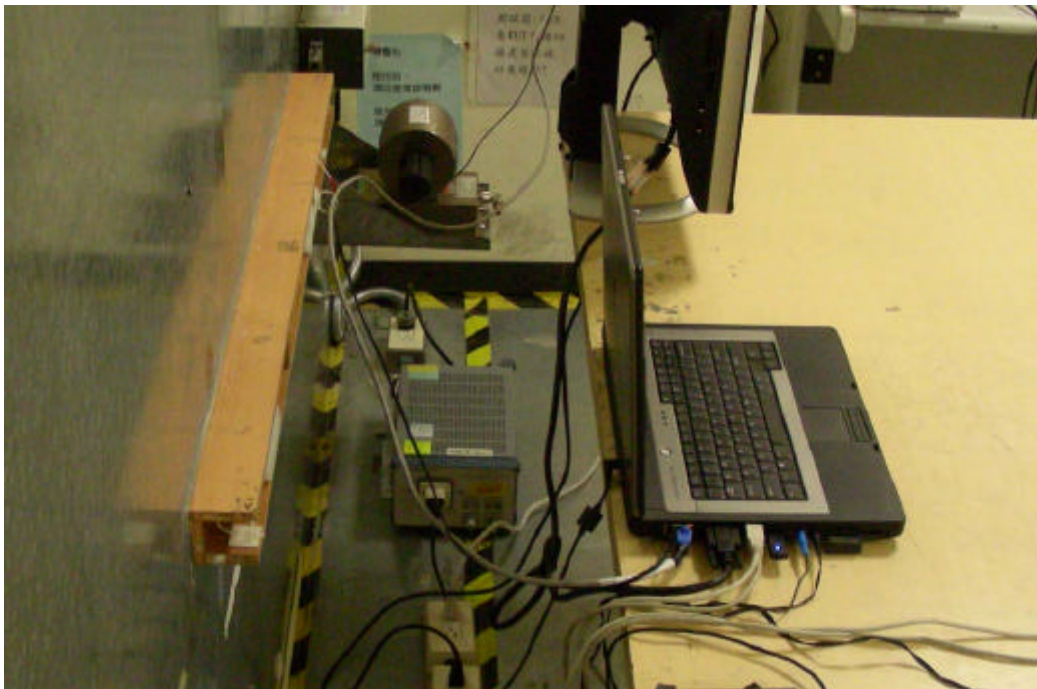
Note: The measurement Uncertainties mentioned above also refer to NIS 81-1994 of NAMAS :  
The treatment of Uncertainty in EMC Measurement.

## 5.7 Appendix G: Photographs of EUT Configuration Test Set Up

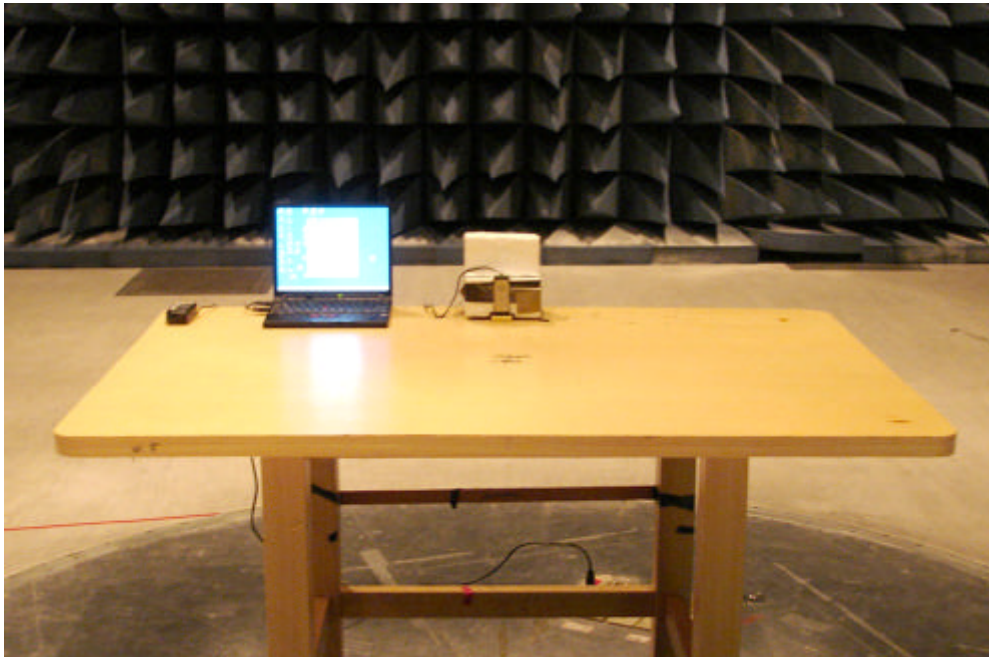
The Front View of Highest Conducted Set-up For EUT



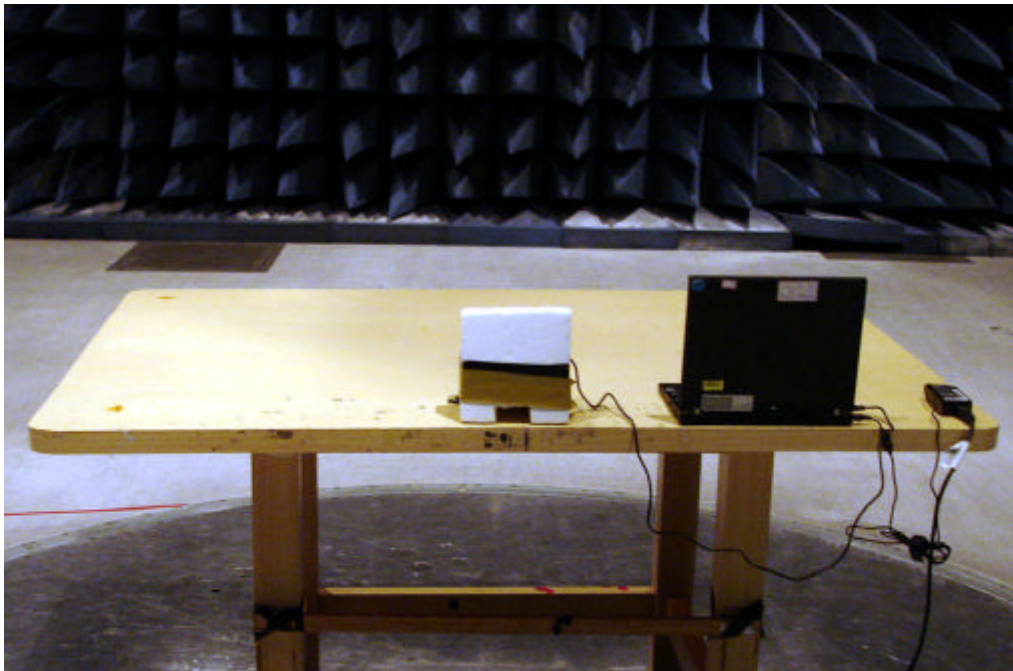
The Back View of Highest Conducted Set-up For EUT



The Front View of Highest Radiated Set-up For EUT



The Back View of Highest Radiated Set-up For EUT



## 5.8 Appendix H: Antenna Spec.

Please refer to the attached file.