

FCC TEST REPORT

for

47 CFR, Part 15, Subpart C

Equipment : Industrial Radio Remote Controller (Transmitter)

Model No. : F21-60

FCC ID : LWNF21-60

Filing Type : Certification

Applicant : Lee's Hi-Tech Enterprise Co., Ltd.
8F-1, No. 288-2, Hsin Ya Rd., Chien Chen Zone,
KaoHsiung, Taiwan, R.O.C.

- The test result refers exclusively to the test presented test model / sample.
- Without the written authorization of the test lab., the Test Report may not be copied.
- **Certificate or Test Report must not be used by the applicant to claim the product in this test report endorsement by NVLAP or any agency of U.S. government.**

SPORTON International Inc.

6F, No.106, Sec. 1, Hsin Tai Wu Rd., Hsi Chih, Taipei Hsien, Taiwan, R.O.C.

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CERTIFICATE OF COMPLIANCE

for

FCC Part 15, Subpart C

Equipment : Industrial Radio Remote Controller (Transmitter)

Model No. : F21-60

FCC ID : LWNF21-60

Applicant : **Lee's Hi-Tech Enterprise Co., Ltd.**
8F-1, No. 288-2, Hsin Ya Rd., Chien Chen Zone,
KaoHsiung, Taiwan, R.O.C.

I **HEREBY** CERTIFY THAT :

The measurements shown in this test report were made in accordance with the procedures given in **ANSI C63.4 - 1992** and the energy emitted by this equipment was **passed** both radiated and conducted emission limits. Testing was carried out on May 09, 2001 at **SPORTON International Inc.** LAB. in Lin Kou.


K. J. Lin
Manager

SPORTON International Inc.

6F, No.106, Sec. 1, Hsin Tai Wu Rd., Hsi Chih, Taipei Hsien, Taiwan, R.O.C.

1. General Description of Equipment under Test

1.1. Applicant

Lee's Hi-Tech Enterprise Co., Ltd.
8F-1, No. 288-2, Hsin Ya Rd., Chien Chen Zone,
KaoHsiung, Taiwan, R.O.C.

1.2. Manufacturer

Same as 1.1.

1.3. Basic Description of Equipment under Test

Equipment	: Industrial Radio Remote Controller (Transmitter)
Model No.	: F21-60
FCC ID	: LWNF21-60
Trade Name	: Lee's Hi-Tech
Power Supply Type	: From Battery (AA size x 4)
Power Cord	: N/A

1.4. Feature of Equipment under Test

- **Modulation type is Super Heterodyne.**
- Operation Frequency: 433.05 ~ 434.79MHz (set by software)
 - ◆ **The operation frequency of the EUT may be set from 433.05 to 434.79MHz, but each equipment will be set to only a fixed frequency, such as 433.1MHz, or 434.5MHz, not a frequency range.**
- Power Supply: Four 1.5volts Alkaline or Rechargeable Batteries (AA Size)
- RF Power: <7.85nW (3m)
- Modulation: $\leq \pm 2.5\text{KHz}$; NBFM
- Joystick Type: Proportional Joystick with mechanical feeling
- Dimensions: 220x110x90mm (excluding protrusion)
- Weight: about 3000g (excluding wire cable)

2. Test Configuration of Equipment under Test

2.1. Test Manner

- a. The EUT has been associated with peripherals pursuant to ANSI C63.4-1992 and configuration operated in a manner which tended to maximize its emission characteristics in a typical application.
- b. A receiver, which is designed to be used for EUT when marketed, was used during testing.
- c. The Lee's Receiver was used for EMI test.
- d. Frequency range investigated: conduction 150 KHz to 30 MHz, radiation 30 MHz to 4,330MHz.
- e. The radiated emissions testing was made by rotating three orthogonal axes.(Normal mode, Horizontal mode, Vertical mode).
- f. The operation frequency of the EUT may be set from 433.05 to 434.79MHz. But each equipment will be set to only a fixed frequency, such as 433.1MHz, or 434.5MHz, not a frequency range.
The actual operation frequency of two EUTs are 433.09MHz and 434.78MHz.
- g. The EUT employs a switch that will automatically deactivate the transmitter within no more than 5 seconds of being released.
- h. The EUT has no periodic transmission at regular predetermined interval.
- e. Pursuant to 15.231(c) of Part 15. Subpart C, the bandwidth of the emission at the 20dB point shall be no wider than 0.25% of the center frequency for EUT.

The carrier frequency of EUT is 433.09MHz and 434.78MHz

$433.09\text{MHz} * 0.25\% = 1082.725\text{KHz}$. $434.78\text{MHz} * 0.25\% = 1086.95\text{KHz}$.

For 433.09MHz, the bandwidth is 285KHz (as shown in section 2.4.1 of this test report), which is less than 1082.725KHz.

For 434.78MHz, the bandwidth is 578KHz (as shown in section 2.4.2 of this test report), which is less than 1086.95KHz;

The EUT meet the 20dB point bandwidth requirement.

2.2. Description of Test System

Support Unit 1. -- Receiver (Lee's Hi-Tech)

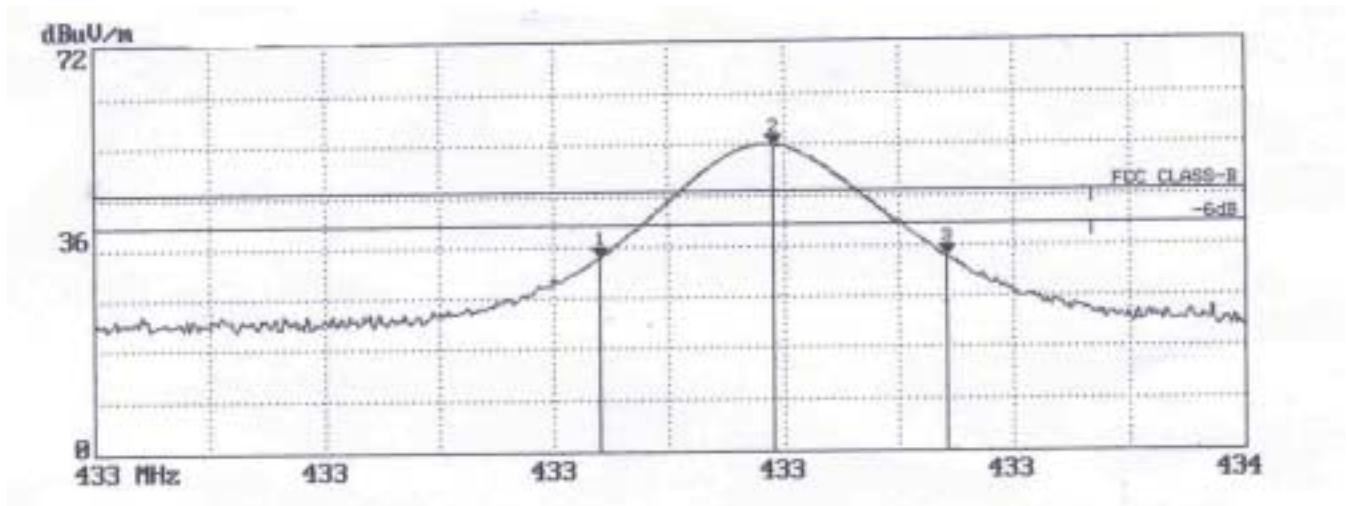
Model No. : F21-60

2.3. Connection Diagram of Test System

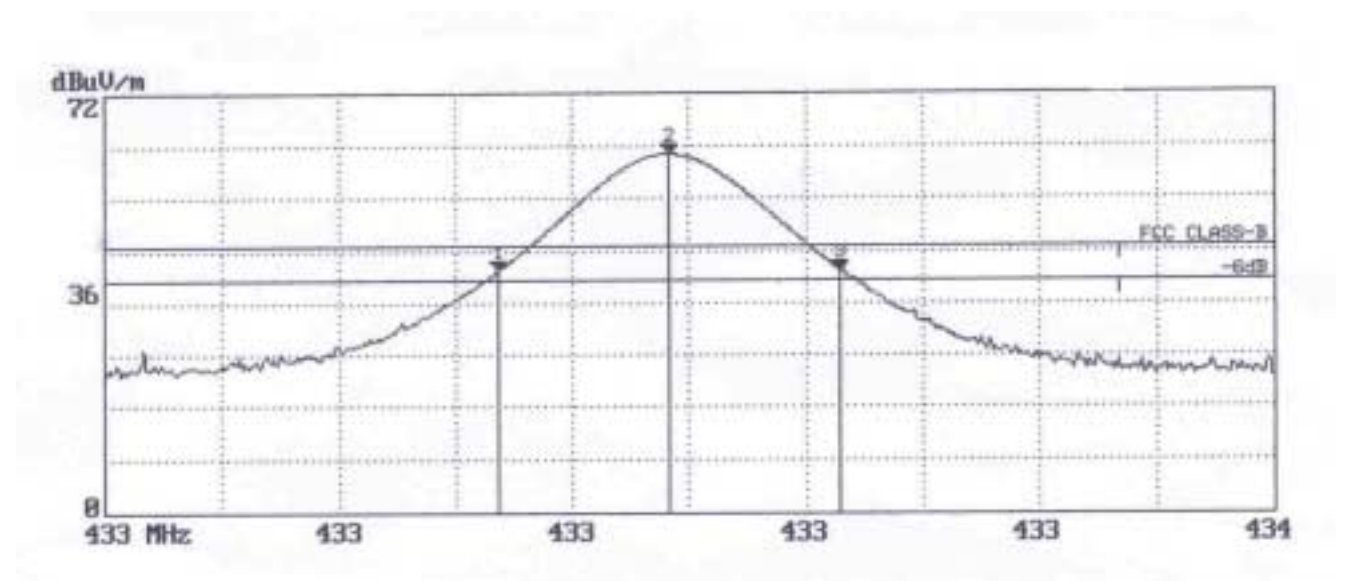


2.4. A plot shows the EUT meet the requirement of 15.231(c)

2.4.1. EUT with 433.09MHz

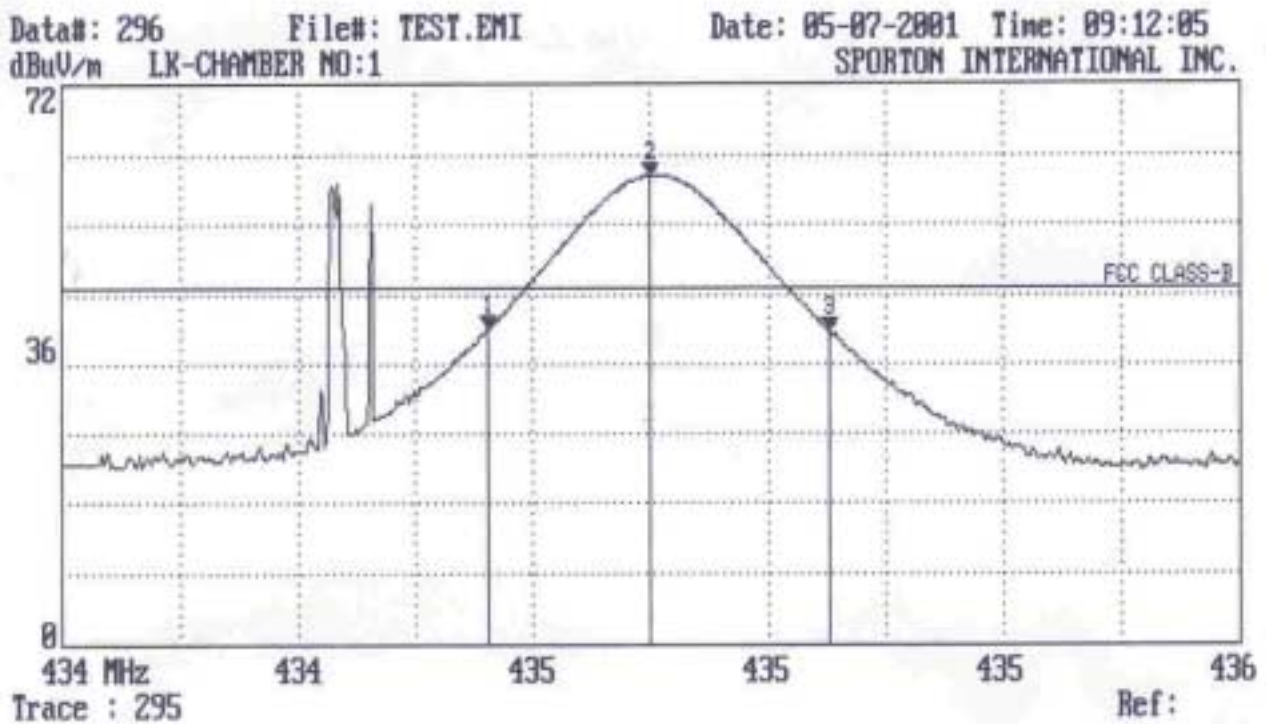


VERTICAL 20dB: 302KHz



HORIZONTAL 20dB: 292KHz

2.4.2. EUT with 434.78MHz



the bandwidth of the emission at the 20dB point is 578KHz

3. Test Software

No test software was used during testing.

4. General Information of Test

4.1. Test Facility

This test was carried out by SPORTON International Inc.

Test Site Location : No. 30-2, Lin 6, Diing-Fwu Tsuen, Lin-Kou-Hsiang,
Taipei Hsien, Taiwan, R.O.C.

TEL : 886-2-2601-1640

FAX : 886-2-2601-1695

4.2. Standard for Methods of Measurement

ANSI C63.4-1992

4.3. Test in Compliance with

FCC Part 15, Subpart C

4.4. Frequency Range Investigated

- a. Conduction: from 450 kHz to 30 MHz
- b. Radiation : from 30 MHz to 4,348 MHz

4.5. Test Distance

The test distance of radiated emission from antenna to EUT is 3 M.

5. Test of Conducted Powerline

The power supply of the EUT is from battery.

So Conducted Powerline test is not applicable to this equipment.

6. Test of Radiated Emission

Radiated emissions from 30 MHz to 4,348 MHz were measured with a bandwidth of 120 kHz according to the methods defines in ANSI C63.4-1992. The EUT was placed on a nonmetallic stand in the open-field site, 0.8 meter above the ground plane, as shown in section 6.3. The interface cables and equipment positions were varied within limits of reasonable applications to determine the positions producing maximum radiated emissions.

6.1. Major Measuring Instruments

6.1.1. from 30MHz to 1GHz

- Amplifier (HP 87405A)
 - Attenuation 0 dB
 - RF Gain 20 dB
 - Signal Input 10 MHz to 3 GHz
- Spectrum Analyzer (ADVANTEST R3261C)
 - Attenuation 0 Db
 - Start Frequency 30 MHz
 - Stop Frequency 1000 MHz
 - Resolution Bandwidth 1 MHz
 - Video Bandwidth 1 MHz
 - Signal Input 9KHz to 2.6 GHz
- Test Receiver (R&S ESEC30)
 - Resolution Bandwidth 120 KHz
 - Frequency Band 9 KHz to 2.75 GHz
 - Quasi-Peak Detector ON for Quasi-Peak Mode
OFF for Peak Mode

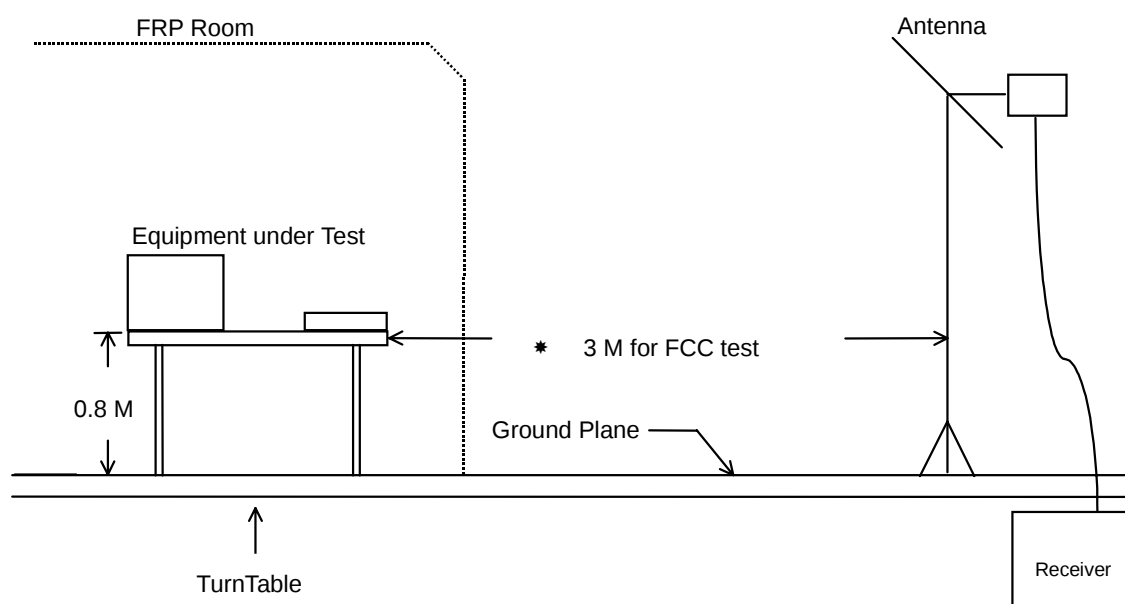
6.1.2. from 1GHz to 4.348GHz

- Receiver (HP 8546A)
 - Attenuation 0 dB
 - Start Frequency 1000 MHz
 - Stop Frequency 4,348 MHz
 - Resolution Bandwidth 1 MHz
 - Video Bandwidth 1 MHz
 - Signal Input 9 KHz to 6.5 GHz

6.2. Test Procedures

- a. The EUT was placed on a rotatable table top 0.8 meter above ground.
- b. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
- c. The table was rotated 360 degrees to determine the position of the highest radiation.
- d. The antenna is a half wave dipole and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
- e. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
- f. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 6 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 6 dB margin will be repeated one by one using the quasi-peak method and reported.

6.3. Typical Test Setup Layout of Radiated Emission



6.4. Test Result of Radiated Emission

6.4.1. EUT with 433.09MHz

6.4.1.1 Test mode : NORMAL MODE

- Frequency range: 30 ~ 1000MHz
- Test Distance : 3 M
- Temperature : 27°C
- Relative Humidity : 60 %
- Test Date : Feb. 13, 2001
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

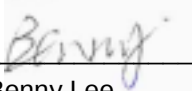
The Radiated Emission test was passed at minimum margin

563.000 MHz / 44.23 dBuV (HORIZONTAL) Antenna Height 1 Meter, Turntable Degree 70 °.

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m) (uV/m)	Emission (dBuV/m) (uV/m)	Level (uV/m)	Margin (dB)	Detect Mode
130.30	V	12.79	1.50	1.44	43.50 150	15.73	6.12	-27.77	Peak
563.00	V	18.72	3.34	16.67	46.00 200	38.73	86.40	-7.27	Peak
996.00	V	20.34	4.82	2.20	54.00 501	27.36	23.33	-26.64	Peak
130.50	H	12.79	1.50	0.94	43.50 150	15.23	5.77	-28.27	Peak
563.00	H	18.72	3.34	22.17	46.00 200	44.23	162.74	-1.77	Q.P.
996.00	H	20.34	4.82	1.81	54.00 501	26.97	22.31	-27.03	Peak

Fundamental Frequency and Spurious Emissions :

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m) (uV/m)	Emission (dBuV/m) (uV/m)	Level (uV/m)	Margin (dB)	Detect Mode
433.09	V	16.78	2.72	39.82	80.89 11079	59.32	924.70		Q.P.
866.00	V	20.43	4.49	1.76	60.79 1095	26.68	21.58	-21.57	Q.P.
433.09	H	16.78	2.72	51.49	80.79 10952	70.99	3544.05	-34.11	Q.P.
866.00	H	20.43	4.49	4.35	60.79 1095	29.27	29.07	-9.80	Q.P.

Test Engineer : 

Benny Lee

6.4.1.2 Test mode : HORIZONTAL MODE

- Frequency range: 30 ~ 1000MHz
- Test Distance : 3 M
- Temperature : 27°C
- Relative Humidity : 60 %
- Test Date : Feb. 13, 2001
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

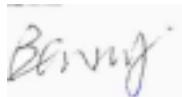
The Radiated Emission test was passed at minimum margin

563.000 MHz / 44.70 dBuV (HORIZONTAL) Antenna Height 1 Meter, Turntable Degree 50 °.

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m) (uV/m)	Emission (dBuV/m) (uV/m)	Level (uV/m)	Margin (dB)	Detect Mode
130.70	V	12.73	1.50	2.69	43.50 150	16.92	7.01	-26.58	Peak
563.00	V	18.72	3.34	16.84	46.00 200	38.90	88.10	-7.10	Q.P.
130.30	H	12.79	1.50	0.77	43.50 150	15.06	5.66	-28.44	Peak
563.00	H	18.72	3.34	22.64	46.00 200	44.70	171.79	-1.30	Peak

Fundamental Frequency and Spurious Emissions :

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m) (uV/m)	Emission (dBuV/m) (uV/m)	Level (uV/m)	Margin (dB)	Detect Mode
433.09	V	16.78	2.72	45.32	80.79 10952	64.82	1741.81	-15.97	Q.P.
866.00	V	20.43	4.49	4.52	60.79 1095	29.44	29.65	-31.35	Q.P.
433.09	H	16.78	2.72	46.82	80.79 10952	66.32	2070.14	-14.47	Q.P.
866.00	H	20.43	4.49	4.02	60.79 1095	28.94	27.99	-31.85	Q.P.

Test Engineer : 

Benny Lee

6.4.1.3 Test mode : VERTICAL MODE

- Frequency range: 30 ~ 1000MHz
- Test Distance : 3 M
- Temperature : 27°C
- Relative Humidity : 60 %
- Test Date : Feb. 13, 2001
- Test mode : VERTICAL Mode
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

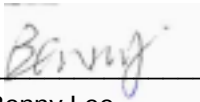
The Radiated Emission test was passed at minimum margin

563.000 MHz / 39.06 dBuV (HORIZONTAL) Antenna Height 1 Meter, Turntable Degree 20 °.

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m) (uV/m)	Emission (dBuV/m) (uV/m)	Level	Margin (dB)	Detect Mode
130.70	V	12.73	1.50	1.11	43.50 150	15.34	5.85	-28.16	Peak
563.00	V	18.72	3.34	16.17	46.00 200	38.23	81.56	-7.77	Q.P.
130.70	H	12.73	1.50	-0.31	43.50 150	13.92	4.97	-29.58	Peak
563.00	H	18.72	3.34	22.07	46.00 200	44.13	160.88	-1.87	Peak

Fundamental Frequency and Spurious Emissions :

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m) (uV/m)	Emission (dBuV/m) (uV/m)	Level	Margin (dB)	Detect Mode
433.09	V	16.78	2.72	45.82	80.79 10952	65.32	1845.02	-15.47	Q.P.
866.00	V	20.43	4.49	2.18	60.79 1095	27.10	22.65	-33.69	Q.P.
433.09	H	16.78	2.72	42.82	80.79 10952	62.32	1306.17	-18.47	Q.P.
866.00	H	20.43	4.49	5.18	60.79 1095	30.10	31.99	-30.69	Q.P.

Test Engineer : 

Benny Lee

6.4.2. Frequency Range of Test : from 1,000 MHz to 4,331 MHz

Remark: Frequency from 1000MHz to 4,331MHz, the emission emitted by the EUT is too low to be measured

6.4.3. EUT with 434.78MHz

6.4.2.1 Test mode : NORMAL MODE

- Frequency range: 30~1000MHz
- Test Distance : 3 M
- Temperature : 24°C
- Relative Humidity : 52 %
- Test Date : May 9, 2001
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

The Radiated Emission test was passed at minimum margin

434.78MHz / 70.43dBuV (VERTICAL) Antenna Height 1 Meter, Turntable Degree 360 °.

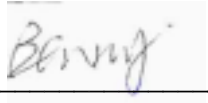
Frequency (MHz)	Antenna Polarity	Cable Factor	Reading Loss	Limits	Emission Level	Margin	Detect
		(dB/m)	(dB)	(dBuV) (dBuV/m) (uV/m)	(dBuV/m) (uV/m)	(dB)	Mode
130.30	V	11.33	1.58	0.78	43.50 150	13.69 4.84	-29.81 Peak
300.00	V	12.95	2.50	5.33	46.00 200	20.78 10.94	-25.22 Peak
132.60	H	11.23	1.61	1.61	43.50 150	14.45 5.28	-29.05 Peak
253.60	H	11.91	2.29	2.27	46.00 200	16.47 6.66	-29.53 Peak

Fundamental Frequency and Spurious Emissions :

Frequency (MHz)	Antenna Polarity	Cable Factor	Reading Loss	Limits	Emission Level	Margin	Detect
		(dB/m)	(dB)	(dBuV) (dBuV/m) (uV/m)	(dBuV/m) (uV/m)	(dB)	Mode
434.78	V	16.08	3.18	36.67	80.85 11028	55.93 625.89	-24.92 Q.P.
869.50	V	20.21	4.86	11.16	60.85 1103	36.23 64.79	-24.62 Q.P.
434.78	H	16.08	3.18	51.17	80.85 11028	70.43 3322.77	-10.42 Q.P.
869.50	H	20.21	4.86	9.50	60.85 1103	34.57 53.52	-26.28 Q.P.

- Frequency Range of Test : from 1,000 MHz to 4348 MHz

Remark: Frequency from 1000MHz to 4348 MHz, the emission emitted by the EUT is too low to be measured

Test Engineer : 

Benny Lee

6.4.1.2 Test mode : VERTICAL MODE

- Frequency range: 30~1000MHz
- Test Distance : 3 M
- Temperature : 24°C
- Relative Humidity : 52 %
- Test Date : May 9, 2001
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

The Radiated Emission test was passed at minimum margin

269.60 MHz / 20.25 dBuV (VERTICAL) Antenna Height 1.1 Meter, Turntable Degree 30 °.

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m) (uV/m)	Emission (dBuV/m) (uV/m)	Level (uV/m)	Margin (dB)	Detect Mode
130.30	V	11.33	1.58	2.45	43.50 150	15.36	5.86	-28.14	Peak
269.60	V	12.26	2.34	5.65	46.00 200	20.25	10.29	-25.75	Peak
131.60	H	11.27	1.60	0.11	43.50 150	12.98	4.46	-30.52	Peak
300.00	H	12.95	2.50	3.00	46.00 200	18.45	8.37	-27.55	Peak

Fundamental Frequency and Spurious Emissions :

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m) (uV/m)	Emission (dBuV/m) (uV/m)	Level (uV/m)	Margin (dB)	Detect Mode
434.78	V	16.08	3.18	43.67	80.85 11028	62.93	1401.20	-17.92	Q.P.
869.50	V	20.21	4.86	7.50	60.85 1103	32.57	42.51	-28.28	Q.P.
434.78	H	16.08	3.18	38.67	80.85 11028	57.93	787.95	-22.92	Q.P.
869.50	H	20.21	4.86	9.50	60.85 1103	34.57	53.52	-26.28	Q.P.

- Frequency Range of Test : from 1,000 MHz to 4348 MHz

Remark: Frequency from 1000MHz to 4348 MHz, the emission emitted by the EUT is too low to be measured

Test Engineer : 
Benny Lee

6.4.1.3 Test mode : HORIZONTAL MODE

- Frequency range: 30~1000MHz
- Test Distance : 3 M
- Temperature : 24°C
- Relative Humidity : 52 %
- Test Date : May 9, 2001
- Emission level (dBuV/m) = 20 log Emission level (uV/m)
- Corrected Reading : Antenna Factor + Cable Loss + Reading = Emission

The Radiated Emission test was passed at minimum margin

269.60 MHz / 19.00 dBuV (VERTICAL) Antenna Height 1 Meter, Turntable Degree 5 °.

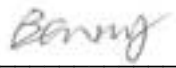
Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m) (uV/m)	Emission (dBuV/m) (uV/m)	Level (uV/m)	Margin (dB)	Detect Mode
130.30	V	11.33	1.58	1.45	43.50 150	14.36	5.22	-29.14	Peak
269.60	V	12.26	2.34	4.40	46.00 200	19.00	8.91	-27.00	Peak
132.10	H	11.27	1.60	0.28	43.50 150	13.15	4.54	-30.35	Peak
300.00	H	12.95	2.50	2.67	46.00 200	18.12	8.05	-27.88	Peak

Fundamental Frequency and Spurious Emissions :

Frequency (MHz)	Polarity	Antenna Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Limits (dBuV/m) (uV/m)	Emission (dBuV/m) (uV/m)	Level (uV/m)	Margin (dB)	Detect Mode
434.78	V	16.08	3.18	41.17	80.85 11028	60.43	1050.75	-20.42	Q.P.
869.50	V	20.21	4.86	7.66	60.85 1103	32.73	43.30	-28.12	Q.P.
434.78	H	16.08	3.18	46.33	80.85 11028	65.59	1903.27	-15.26	Q.P.
869.50	H	20.21	4.86	11.83	60.85 1103	36.90	69.98	-23.95	Q.P.

- Frequency Range of Test : from 1,000 MHz to 4348 MHz

Remark: Frequency from 1000MHz to 4348 MHz, the emission emitted by the EUT is too low to be measured

Test Engineer : 

Benny Lee

7. Antenna Factor & Cable Loss

Frequency (Mhz)	Antenna Factor (dB)	Cable Loss (dB)
30	17.8	0.8
35	16.9	0.8
40	16.2	0.8
45	13.2	0.8
50	10.9	0.8
55	9.0	1.0
60	7.2	1.0
65	6.8	1.0
70	6.5	1.0
75	7.1	1.2
80	7.8	1.2
85	9.1	1.0
90	10.4	1.2
95	10.7	1.2
100	11.0	1.3
110	12.3	1.3
120	13.5	1.3
130	12.9	1.5
140	11.6	1.5
150	10.6	1.7
160	9.5	1.8
170	9.6	1.8
180	9.8	1.7
190	9.8	1.7
200	9.8	1.7
220	11.2	1.8
240	12.6	1.8
260	13.5	2.0
280	13.6	2.0
300	13.8	2.2
320	14.5	2.3
340	15.2	2.4
360	15.8	2.5
380	16.1	2.5
400	16.5	2.5
450	16.9	2.8
500	17.7	3.0
550	18.6	3.3
600	19.1	3.3
650	19.8	3.5
700	18.8	3.7
750	18.6	4.0
800	20.3	4.2
850	20.9	4.3
900	19.4	4.8
950	21.9	4.7
1000	20.2	4.8
1000	24.3	4.1
2000	28.1	5.8
3000	30.3	7.2
4000	32.8	8.6
5000	33.6	10.0

8. EMI Suppression Component List

1. Add a core on internal power cable (as shown on internal photos page 11)

9. List of Measuring Equipments Used

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Spectrum Analyzer (Site 6)	ADVANTEST	R3261C	71720760	9KHz – 2.6GHz	Mar. 08, 2000	Radiation
Receiver (Site 6)	R&S	ESCS30	847793/003	9 K – 2.75 GHz	Dec. 27, 2000	Radiation
Amplifier (Site 6)	HP	87405A	3207A01437	100K - 3GHz	Aug. 03, 2000	Radiation
Bilog Antenna (Site 6)	CHASE	CBL6112A	2442	30MHz -2GHz	Jun. 23, 2000	Radiation
Half-wave dipole antenna (Site 6)	EMCO	3121C	9705-1285	28 M - 1GHz	May 17, 2000	Radiation
Turn Table (site 6)	EMCO	2080	9711-2021	0 ~ 360 degree	N/A	Radiation
Antenna Mast (site 6)	EMCO	2075	9711-2115	1 m- 4 m	N/A	Radiation
Receiver	HP	8546A	3325A00108	9KHz~6.5GHz	Dec.15, 2000	Radiation
Horn Antenna	EMCO	3115	4976	1GHz~18GHz	Jun. 22, 2000	Radiation

10. Uncertainty of Test Site

Uncertainty of Conducted Emission Measurement

Contribution	Probability Distribution	150KHz – 30MHz
Cable and I/P attenuator calibration	normal(k=2)	± 0.3
RCV/SPA specification	rectangular	± 2.5
LISN coupling specification	rectangular	± 1.5
Transducer factor frequency interpolation	rectangular	± 0.2
Mismatch Receiver VSWR $\Gamma_1=0.09$ LISN VSWR $\Gamma_2=0.33$ Uncertainty= $20\log(1-\Gamma_1*\Gamma_2)$	U-shaped	0.2
combined standard uncertainty Ue(y)	normal	± 1.7
Measuring uncertainty for a level of confidence of 95% U=2Ue(y)	normal (k=2)	± 3.4

$$U = \sqrt{\{(0.3/2)^2 + (2.5^2 + 1.5^2 + 0.2^2)/3 + (0.2)^2/2\}} = 1.7$$

Uncertainty of Radiated Emission Measurement

Contribution	Probability Distribution	3m	10m
Antenna factor calibration	normal(k=2)	± 1.6	± 1.6
cable loss calibration	normal(k=2)	± 0.3	± 0.3
RCV/SPA specification	rectangular	± 2.5	± 2.5
Antenna Directivity	rectangular	± 3	± 0.5
Antenna Factor V.S. Height	rectangular	± 2	± 2
Antenna Factor Interpolation for Frequency	rectangular	± 0.25	± 0.25
site imperfection	rectangular	± 2	± 2
Mismatch Receiver VSWR $\Gamma_1=0.09$ Antenna VSWR $\Gamma_2=0.67$ Uncertainty= $20\log(1-\Gamma_1*\Gamma_2)$	U-shaped	± 0.54	± 0.54
combined standard uncertainty Ue(y)	normal	± 2.9	± 2.4
Measuring uncertainty for a level of confidence of 95% U=2Ue(y)	normal (k=2)	± 5.8	± 4.8

$$U = \sqrt{\{(1.6/2)^2 + (0.3/2)^2 + (3^2 + 0.5^2 + 2^2 + 0.25^2 + 2^2)/3 + (0.54)^2/2\}} = 2.4 \text{ for 10m test distance}$$

$$U = \sqrt{\{(1.6/2)^2 + (0.3/2)^2 + (3^2 + 3^2 + 2^2 + 0.25^2 + 2^2)/3 + (0.54)^2/2\}} = 2.9 \text{ for 3m test distance}$$