Korea Technology Institute Co., Ltd.

Test Report

Test Report No.:	**KTI05EF07005**		
Registration No.:	**99058**		
Applicant:	**MIRERO TECHNOLOGY CO., LTD.**		
Applicant Address:	**6F Greenhill B/D 538-4, Sang-Dong, Bucheon-Si, Wonmi-Gu, Gyeonggi-Do, Korea**		
Product:	**REMOTE CONTROLLER**		
FCC ID:	**TH4WT-447TM**	**Model No.**	**WT-447TM**
Receipt No.:	**05-0717**	**Date of receipt:**	**July 11, 2005**
Date of Issue:	**July 25, 2005**		
Testing location	**Korea Technology Institute Co., Ltd. 51-19, Sanglim3-Ri, Docheok-Myeun, Gwangju-Shi, Gyeungki-Do, Korea**		
Test Standards:	**FCC/ANSI. C63.4: 2001**		
Rule Parts: FCC	**Part 15, Subpart C**		
Equipment Class:	**Security/Remote Control Transmitter**		
Test Result:	**The above-mentioned product has been tested with compliance.**		

Tested by: Y.M. Lee / Engineer

Young Moon

Signature **Date**

Approved by: G. C. Min /President

G C Min

Signature **Date**

Other Aspects:	
Abbreviations:	*** OK, Pass=passed * Fail=failed * N/A=not applicable**

☞ **- This test report is not permitted to copy partly without our permission.**

- This test result is dependent on only equipment to be used.

- This test result is based on a single evaluation of one sample of the above mentioned.

- This test report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S Government.

- We certify this test report has been based on the measurement standards that is traceable to the national or international standards.

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1. General

This equipment has been shown to be capable of compliance with the applicable technical standards and was tested in accordance with the measurement procedures as indicated in this report.

We attest to the accuracy of data. Korea Technology Institute Co., Ltd. performed all measurements reported herein. And were made under Chief Engineer's supervisor.
We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

2. Test Site

Korea Technology Institute Co., Ltd.

2.1 Location

51-19, Sanglim3-Ri, Docheok-Myeun, Gwangju-Shi, Gyeungki-Do, Korea

The Test Site is in compliance with ANSI C63.4/2001 for measurement of radio Interference.

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

- Conducted Emissions

Kind of Equipment	Type	S/N	Calibrated until
Spectrum Analyzer	R3261C	61720417	01.2006
Field Strength Meter	ESPC	832827/011	06.2006
LISN	KNW407	8-1157-2	01.2006
LISN	EM-7823	115019	04.2006
Conducted Cable	N/A	N/A	11.2005

- Radiated Emissions

Kind of Equipment	Type	S/N	Calibrated until
Field Strength Meter	ESPC	832827/011	06.2006
Spectrum Analyzer	R3261C	61720417	01.2006
Pre Amplifier	8447D	2944A06874	11.2005
Biconical Antenna	VHA9103	1111	01.2006
Logperodic Antenna	UHALP9107	1568	01.2006
Horn Antenna	3115	6443	06.2006
Open Site Cable	N/A	N/A	11.2005
Antenna Mast	DETT-03	N/A	N/A
Antenna & Turntable controller	DETT-04	91X519	N/A

2.3 Test Date

Date of Application: July 11, 2005

Date of Test: July 20, 2005

2.4 Test Environment

24℃/50%/989mbar

3. Description of the tested samples

The EUT is REMOTE CONTROLLER which is sending radio frequency by using 447 MHz

The EUT is compliance with Subpart C is authorized under a certificate procedure.

3.1. Rating and Physical Characteristics

Size(mm) : 48(W)x33(D)x0.8(H)

TX Frequency : 447.36MHz

Power : 3V, CR3020 Button cell

Modulation : FSK

TX Power : under 10mW

3.2. Submitted Documents

- User's Guide
- Block Diagram

4. Measurement Conditions

Testing Input Voltage: DC 3V

4.1 Modes of Operation

The EUT was in the following operation mode during all testing;

1) The EUT is emitting Radio Frequency

4.2 Additional Equipment

DEVICE TYPE	Manufacturer	M/N	S/N	FCC ID
-	-	-	-	-

4.3 Uncertainty

1) Radiated disturbance

Uc (Combined standard Uncertainty) = ± 1.8dB

Expanded uncertainty U=KUc

K = 2

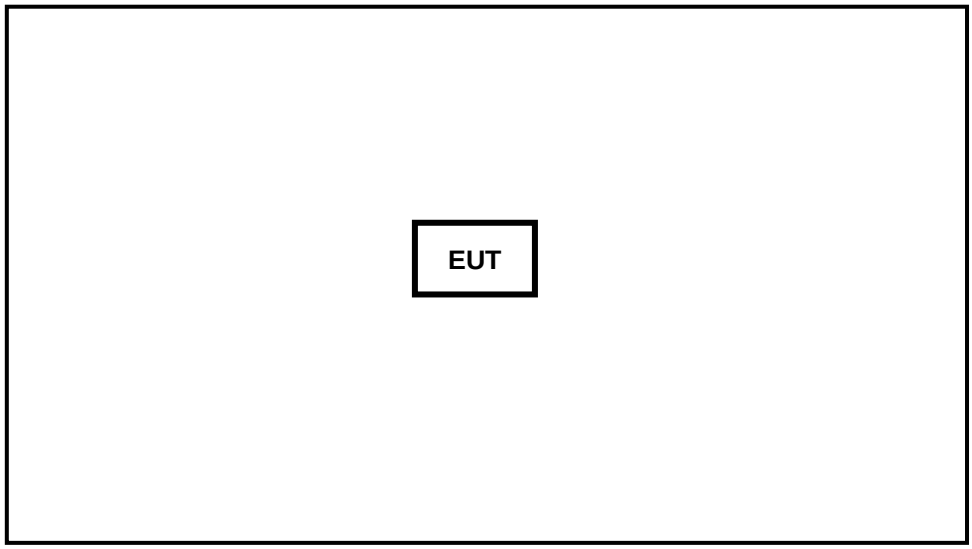
∴ U = ± 3.6dB

2) Conducted disturbance

Uc = ± 0.88dB

U = KUc=2 x Uc = ± 1.8dB

4.4 Test Setup



5. Definition and Limits

5.1 Definition

Intentional radiator:

A device that intentionally generates and emits radio frequency energy by radiation or induction.

5.2 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.25
0.495 – 0.505 **	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 21.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
5.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2655 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3360 - 4400	Abobe 38.6
13.36 – 13.41			

Remark "" : Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz**

5.3 Limitation

(1) Conducted Emission Limits :

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the conducted limit is the following:

Frequency(MHz)	Emission(dBuV)
0.15 – 0.5	66dBuV – 56dBuV
0.5 – 5.0	56 dBuV
5.0 – 30.0	60 dBuV

(2) Radiated Emission Limits :

According to 15.231 the field strength of emissions from intentional radiators operated under these frequency bands shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental	
	uV/meter	dBuV/meter
40.66-40.70	2,250	67.04
70-130	1,250	61.94
130-174	1,250 to 3,750**	61.94 to 71.48**
174-260	3,750	71.48
260-470	3,750 to 12,500**	71.48 to 81.94**
Above	12,500	81.94

** linear interpolations

Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, μV/m at 3meters=56.81818(F)-6136.3636; For the band 260-470 MHz, μV/m at 3meters=41.6667(F)-7083.3333. The maximum permitted unwanted emission level is 20dB below the maximum permitted fundamental level.

(3) Emission Band Limits :

According to 15.231, The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. For devices operating above 900MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20dB down from the modulated carrier.

(4) Limit of trans mission time

According to 15.231(a)(1)

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

5.4 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device :

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

5.5 User Information

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

6. Radiated Emission Measurement

6.1 Applicable Standard

1. According to 15.231 the field strength of emissions from intentional radiators operated under 260-470MHz bands shall not exceed 3,750 to 12,500t uV/meter.
2. According to 15.231, The maximum permitted unwanted emission level is 20dB below the maximum permitted fundamental level.

6.2 Measurement Procedure

A. Preliminary Measurement For Portable Devices

For portable devices, the following procedure was performed to determine the maximum emission axis of EUT:

1. With the receiving antenna is H polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
2. With the receiving antenna is V polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
3. Compare the results derived from above two steps. So, the axis of maximum emission from EUT was determined and the configuration was used to perform the final measurement.

B. Final Measurement

1. Test setup was configured as clause 4.4 this report. Turn on EUT and make sure that it is in normal function.
2. For emission frequencies measured below 1GHz, a pre-scan is performed in a semi-anechoic chamber to determine the accurate frequencies of higher emissions and then each selected frequency is precisely measured. As the same purpose, for emission measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.
3. For emission measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from $0_{\circ}$ to $360_{\circ}$ with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.
5. Repeat step 4 until all frequencies that need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the frequencies of highest emission with varying the placement of cables (if any) associated with EUT to obtain the worse case and record the result.

Table 1: Test Data, Radiated Emissions

A. 447.36MHz

Frequency (MHz)	Height [m]	Angle [°]	(1) Reading Peak (dBμV)		(2) AFCL (dB/m)	(3) Actual (dBμV/m)		(4) Limit (dBμV/m)	(5)Margin (dB)	
			H	V		H	V		H	V
447.36	2.1	7	42.8	35.9	22.72	65.52	58.62	81.26	15.74	22.64
894.72	2.7	25	18.8	22.1	31.07	49.87	53.17	61.26	11.39	8.09
1342.08	-	-	-	-	-	-	-	-	-	-
1789.44	-	-	-	-	-	-	-	-	-	-
2236.80	-	-	-	-	-	-	-	-	-	-
2684.16	-	-	-	-	-	-	-	-	-	-
3131.52	-	-	-	-	-	-	-	-	-	-
3578.88	-	-	-	-	-	-	-	-	-	-
4026.24	-	-	-	-	-	-	-	-	-	-
4473.60	-	-	-	-	-	-	-	-	-	-

***Remark:** "-" means that the emission level is too low to be measured.

f < 1GHz – RBW/VBW : 100KHz, f > 1GHz – RBW/VBW : 1MHz

PK: Peak reading, QP: Quasi Peak reading, AV: Average reading

H: Horizontal, V: Vertical

Note :

1. This manually operated transmitter shall have a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.
2. Limit on the field strength of fundamental

   447.36MHz: 41.6667(447.36)-7083.3333 = 11,556 μV/m (81.26dB μV/m)
3. Limit on the field strength of spurious less than limit value 20dB.
4. If the measured frequencies fall in the restricted frequency band, the limit employed is §15.209 general requirement when frequencies are below or equal to 1 GHz. And the measuring instrument is set to quasi peak detector function, no duty factor applied.

♠ **Margin Calculation**

(5) Margin = (4) Limit – (3) Actual

[(3) Actual = (1) Reading + (2) AFCL]

7. Conducted Emissions (Not Applicable)

This EUT is excused from investigation of conducted emission, for it is powered by DC Battery only. According to §15.207(c),measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

8. Antenna Requirement

8.1 Standard Applicable

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

8.2 Antenna Construction

The antenna is permanently mounted on PCB, no consideration of replacement.

9. Emission Band Measurement

9.1 Standard Applicable

According to 15.231, The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. For devices operating above 900MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20dB down from the modulated carrier.

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 1 and measurement the turn on the EUT. Then set it to any one measured frequency within its operation range and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 10 KHz and 100 KHz respectively with a convenient frequency span including 111 KHz bandwidth of the emission.
4. Mark the bandwidth of emission points and plot the graph on spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

9.3 Measurement Data

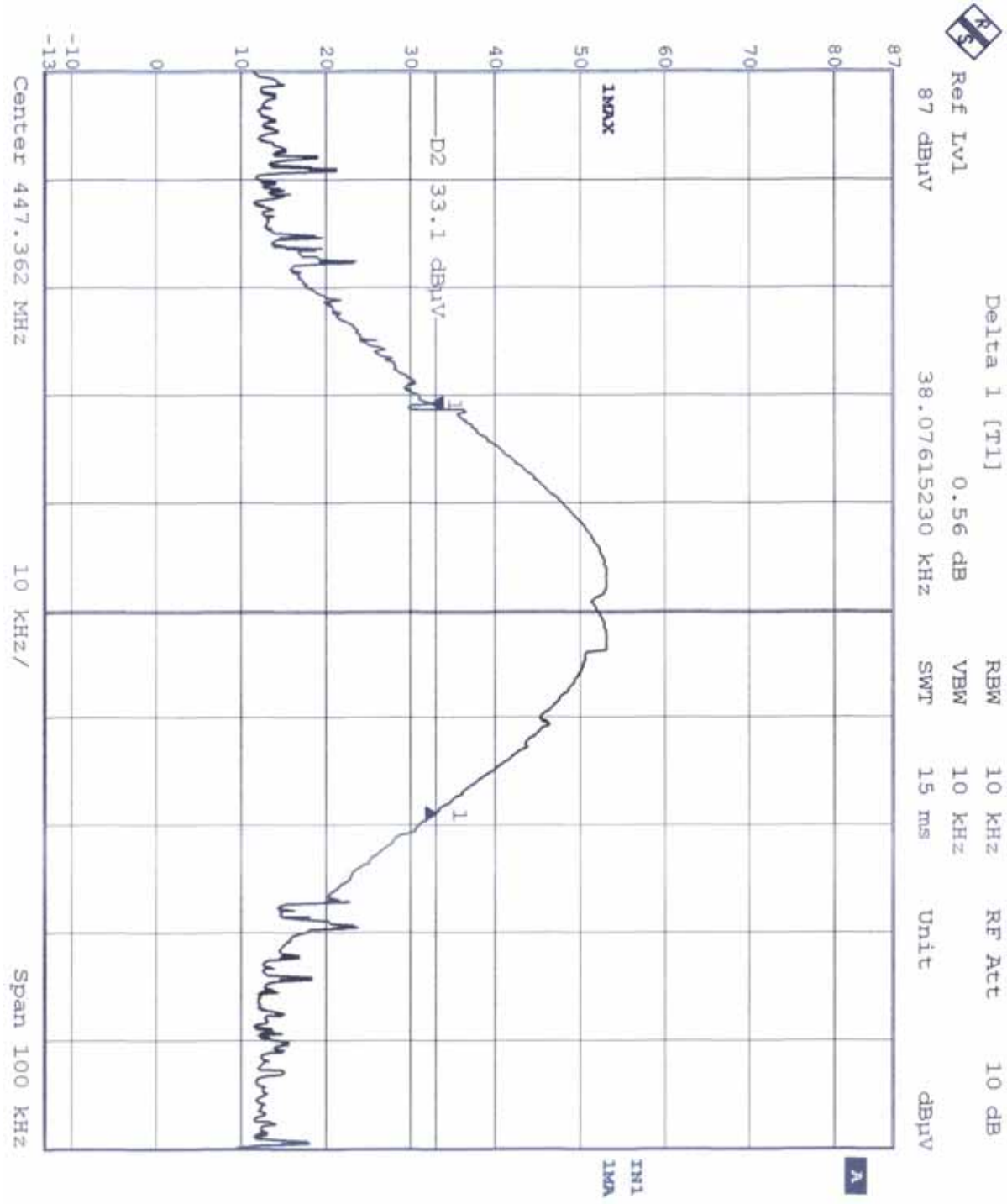
1. Test result:

A. 447.36MHz * 0.25 = 111.84kHz

B. The 20dB bandwidth of 447.36 MHz = 38.076 KHz < 111.84 KHz

Note : Please see appendix 1 for Plotted Data

447.36MHz


Ref Lvl
87 dBµV
Delta 1 [T1]
0.56 dB
38.07615230 kHz
RBW 10 kHz
VBW 10 kHz
SWT 15 ms
RF Att 10 dB
Unit dBµV
1MAX
D2 33.1 dBµV
1
1
IN1
1MA
A
Center 447.362 MHz
10 kHz/
Span 100 kHz