

EMC TEST REPORT

for

Futaba Corporation

629 Oshiba Mobara, Chiba-Prefecture 297-8588, Japan

Equipment Under Test: Communication System
Model Name: FDK02TU

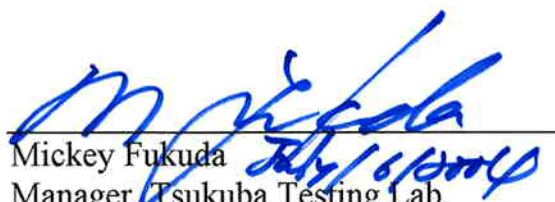
FCC ID: AZP-FDK02TU

Category: FCC Part 15 Sub.part C Low Power Communications Device Transmitter

Tokin Report No.: TXV045244

Date of Issue: July 5, 2004

Approved by


Mickey Fukuda
Manager, Tsukuba Testing Lab.
Tokin EMC Engineering Co., Ltd.

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NVLAP Lab. Code: 200221-0

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1 DESCRIPTION OF DEVICE

A) Kind of Equipment: Communication System

B) FCC ID: AZP-FDK02TU

C) Model Name: FDK02TU

D) Serial No.: None

E) Type of Sample Tested: Pre-production

F) High Frequency Used: 153.5MHz (Transmission)
16.8MHz, 21.7MHz (System)
24MHz (CPU)

G) Rating Power Supply: DC24V

H) Tested Power Supply: DC24V

I) Date of Manufacture: February 2004

J) Manufacturer: Futaba Corporation
1080 Yabutsuka, Chosei-mura, Chosei-gun, Chiba,
299-4395 Japan

K) Description of Operating: Modulation Continuous Transmission Mode

L) Date of Sample Received: March 2, 2004

M) Test Engineer: Yutaka Takeuchi

Report processed by


Hiroko Nakamura
05/Jul./2004

Tested by


Yutaka Takeuchi, Engineer

2 TEST FACILITY

The semi anechoic chamber and open field test site are used for testing, where are located following address. This chamber was fully described in a report dated Nov.13,2003, that was submitted to the FCC. And we had accepted in a letter dated Nov.14,2003 (31040/SIT).

This site was fully described in a report dated Mar 20,2001, that was submitted to the FCC. And we had accepted in a letter dated Mar.26,2001 (31040/SIT).

This laboratory is accredited by NVLAP for NVLAP Lab. Code: 200221-0.

Tokin EMC Engineering Co., Ltd.

Tsukuba Testing Laboratory, Semi Anechoic Chamber, Open Field Test Site No.1 and No.6

Address ; 28-1, Kitahara-aza, Hanashimashinden-ohaza, Tsukuba-city, Ibaraki 305-0875, Japan

3 SUMMARY OF RESULTS

3.1 Electromagnetic Emission

RFI Voltage Measurement **Not Applicable**
(Because this EUT is DC main power supply.)

RFI Field Strength Measurement **PASS**

Although the measured emissions indicate that the EUT complies with the required limits, some measurements are close to these limits. When the uncertainty of measurement is considered, there is some possibility that the EUT may not be compliant.

Test results are traceable to JQA and NML/CSIRO.

3.2 Modifications to The EUT

This EUT was taken countermeasures.

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Yutaka Takeuchi, Engineer

4 TESTED SYSTEM DETAILS

4.1 Peripherals and Others : None

4.2 Type of Used Cables :

Description	Length	Type of shield	Model name	Manufacturer
DC Cable (EUT ~ Battery)	1.0m	Non-shielded	---	---
Coaxial Cable (EUT ~ EUT)	0.5m × 4	Non-shielded	---	---
Feeder Cable (EUT ~ EUT)	2.0m	Non-shielded	---	---

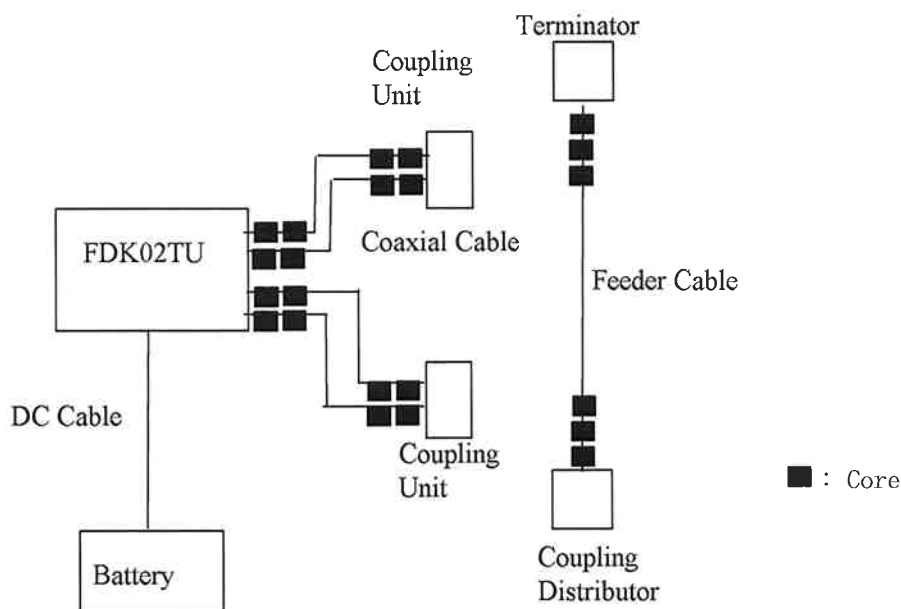


Figure 4-1 System Configuration Diagram

5 TECHNICAL COUNTERMEASURE

5-1 8 cores (Model SR-100, Manufacturer: NT) were added to Coaxial cables.

5-2 6 cores (Model SFT72SN, Manufacturer: TKK) were added to Feeder cable.

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Yutaka Takeuchi, Engineer

6 TEST RESULTS

6.1 RFI Field Strength Measurement

6.1.1 Measurement Instrumentation Used

Semi anechoic Chamber:

(model/serial no./manufacturer/Tokin control no./last calibration/next calibration)

<30MHz to 1000MHz>

Field strength meter.....(FCVU 1534/1534118/Schwarzbeck/RE040/07 Jul.'03/Jul.'04)
 Bi-Log Antenna.....(CBL6111/1154/Chase/TB018/13 Jul.'03/Jul.'04)
 Pre-amplifier.....(8447D/2648A04832/Hewlett Packard/AM007/29 Jan.'04/Jan.'05)
 Spectrum analyzer(8566B/2139A01073/Hewlett Packard/SP00A/04 Jun.'04/Sep.'04)
 Coaxial switch unit(MP59B/6100175602/Anritsu/ME265/08 May'04/May'05)
 Site establishment cable(---/---/---/DKT11/17 May'04/Aug.'04)
 Software(Software Data Calculation Software TEPTO 1.06/---/AES/---/---/---)
 Semi anechoic chamber(Tsukuba AC/---/Tokin/SA012/08 May '04/Aug.'04)

<1000MHz to 2000MHz>

Pre-amplifier(8449B/3008A00681/Hewlett Packard/AM034/15 Jul.'03/Jul.'04)
 Double ridge
 guide horn antenna(3115/6236/EMCO/rental/13 Apr.'04/Apr.'05)
 Spectrum analyzer(8566B/2139A01073/Hewlett Packard/SP00A/04 Jun.'04/Sep.'04)
 Coaxial cable.....(SUCOFLEX 104/144326-4/SUCOFLEX/DK176/04 Jul.'03/Jul.'04)
 Coaxial cable.....(SUCOFLEX 104/147075-4/SUCOFLEX/DK177/04 Jul.'03/Jul.'04)
 Coaxial cable.....(SUCOFLEX 104/149621-4/SUCOFLEX/DK178/04 Jul.'03/Jul.'04)
 Software(Software Data Calculation Software TEPTO 1.06/---/AES/---/---/---)
 Semi anechoic chamber(Tsukuba AC/---/Tokin/SA012/08 May '04/Aug.'04)

The measurement instrumentation used, are calibrated according to Quality Manual.

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 Yutaka Takeuchi, Engineer

Open Field Test Site No.1:

(model/serial no./manufacturer/Tokin control no./last calibration/next calibration)

<30MHz to 1000MHz>

Field strength meter(FCVU1534/130/Schwarzbeck/RE047/13 May.'04/Aug.'04)
 Biconical antenna(BBA9106/2168/Schwarzbeck/TB025/19 Jun.'04/Sep.'04)
 Logperiodic antenna(UHALP9108-A/0268/Schwarzbeck/TL023/19 Jun.'04/Sep.'04)
 Pre-amplifier(8447D/2727A05897/Hewlett Packard/AM001/22 Jan.'04/Jan.'05)
 Spectrum analyzer(E4401B/MY41000004/Agilent/SP047/08 Jun.'04/Sep.'04)
 Attenuator(8495B/3308A17793/Hewlett Packard/ME271/13 May.'04/Aug.'04)
 Coaxial switch unit.....(MP59B/6100226495/Anritsu/ME266/22 Jan.'04/Jan.'05)
 Site establishment cable.....(---/---/---/DKT01/22 Jan.'04/Jan.'05)
 Software.....(Software Data Calculation Software TEPTO 1.06/---/AES/---/---/---)
 Open field test site(Tsukuba No.1/---/Tokin/SA001/22 Jan.'04/Jan.'05)

<1000MHz to 2000MHz>

Pre-amplifier(8449B/3008A00681/Hewlett Packard/AM034/15 Jul.'03/Jul.'04)
 Double ridge
 guide horn antenna(3115/6236/EMCO/rental/13 Apr.'04/Apr.'05)
 Spectrum analyzer(8563E/3450A02894 /Hewlett Packard/SP036/04 Jun.'04/Sep.'04)
 Coaxial cable.....(SUCOFLEX 104/144326-4/SUCOFLEX/DK176/04 Jul.'03/Jul.'04)
 Coaxial cable.....(SUCOFLEX 104/147075-4/SUCOFLEX/DK177/04 Jul.'03/Jul.'04)
 Coaxial cable.....(SUCOFLEX 104/149621-4/SUCOFLEX/DK178/04 Jul.'03/Jul.'04)
 Software(Software Data Calculation Software TEPTO 1.06/---/AES/---/---/---)
 Open field test site(Tsukuba No.1/---/Tokin/SA001/22 Jan.'04/Jan.'05)

The measurement instrumentation used, are calibrated according to Quality Manual.

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Open Field Test Site No.6:

(model/serial no./manufacturer/Tokin control no./last calibration/next calibration)

<30MHz to 1000MHz>

Field strength meter (FCVU1534/131/Schwarzbeck/RE046/28 May.'04/Aug.'04)
 Biconical antenna (BBA9106/2099/Schwarzbeck/TB024/19 Jun.'03/Sep.'04)
 Logperiodic antenna (UHALP9108-A/0115/Schwarzbeck/TL021/19 Jun.'03/Sep.'04)
 Pre-amplifier (8447D/2727A05431/Hewlett Packard/AM006/28 Jan.'04/Jan.'05)
 Spectrum analyzer (R3261A/81720103/Advantest/SP006/07 Jun.'04/Sep.'04)
 Attenuator (8495B/3308A21823/Hewlett Packard/ME273/13 May.'03/Aug.'04)
 Coaxial switch unit..... (MP59B/6100226498/Anritsu/ME267/28 Jan.'04/Jan.'05)
 Site establishment cable..... (---/---/---/DKT07/26 Jan.'04/Jan.'05)
 Software..... (Software Data Calculation Software TEPTO 1.06/---/AES/---/---/---)
 Open field test site (Tsukuba No.6/---/Tokin/SA006/28 Jan.'04/Jan.'05)

<1000MHz to 2000MHz>

Pre-amplifier (8449B/3008A00681/Hewlett Packard/AM034/15 Jul.'03/Jul.'04)
 Double ridge
 guide horn antenna (3115/6236/EMCO/rental/13 Apr.'04/Apr.'05)
 Spectrum analyzer (8563E/3450A02894 /Hewlett Packard/SP036/04 Jun.'04/Sep.'04)
 Coaxial cable..... (SUCOFLEX 104/144326-4/SUCOFLEX/DK176/04 Jul.'03/Jul.'04)
 Coaxial cable..... (SUCOFLEX 104/147075-4/SUCOFLEX/DK177/04 Jul.'03/Jul.'04)
 Coaxial cable..... (SUCOFLEX 104/149621-4/SUCOFLEX/DK178/04 Jul.'03/Jul.'04)
 Software (Software Data Calculation Software TEPTO 1.06/---/AES/---/---/---)
 Open field test site (Tsukuba No.6/---/Tokin/SA006/28 Jan.'04/Jan.'05)

The measurement instrumentation used, are calibrated according to Quality Manual.

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 Yutaka Takeuchi, Engineer

6.1.2 Measurement Procedure

Final test was performed according to ANSI C63.4-2001 at the semi anechoic chamber, open field test site No.1 and No.6. There are no deviations from the standard.

The EUT was placed in a 0.8m high table along with the peripherals. The turn table was separated from the antenna distance 3meters. Cables were placed in a position to produce maximum emissions as determined by experimentation, and operation mode was selected for maximum.

The frequencies and amplitudes of maximum emission were measured at varying azimuths, antenna heights and antenna polarities. Reported are maximized emission levels.

These tests were performed at 120kHz of 6dB bandwidth.

The measurement above 1GHz was tested at RBW 1MHz, at VBW 10Hz.

Test results had obtained from following equation.

$$\text{Result (dB}\mu\text{V/m)} = \text{Level (dB}\mu\text{V)} + \text{Ant. Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Amp. Gain (dB)}$$

<Decision to Pass or Fail>

To judge pass or fail of the test result, it was added "Uncertainty" to the obtained data and then subtracted it from the limit value. If all the values are +(plus), it will be passed and if there is -(minus), it will be failed.

6.1.3 Deviation from the specification: None

6.1.4 Measurement Uncertainty

The data was tested are including uncertainty.

Measurement uncertainty of 30MHz to 300MHz is $\pm 3.58\text{dB}(k=2)$, 300MHz to 1000MHz is $\pm 3.56\text{B}(k=2)$ and it had estimated for decision to PASS or FAIL.

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6.1.5 Test Data

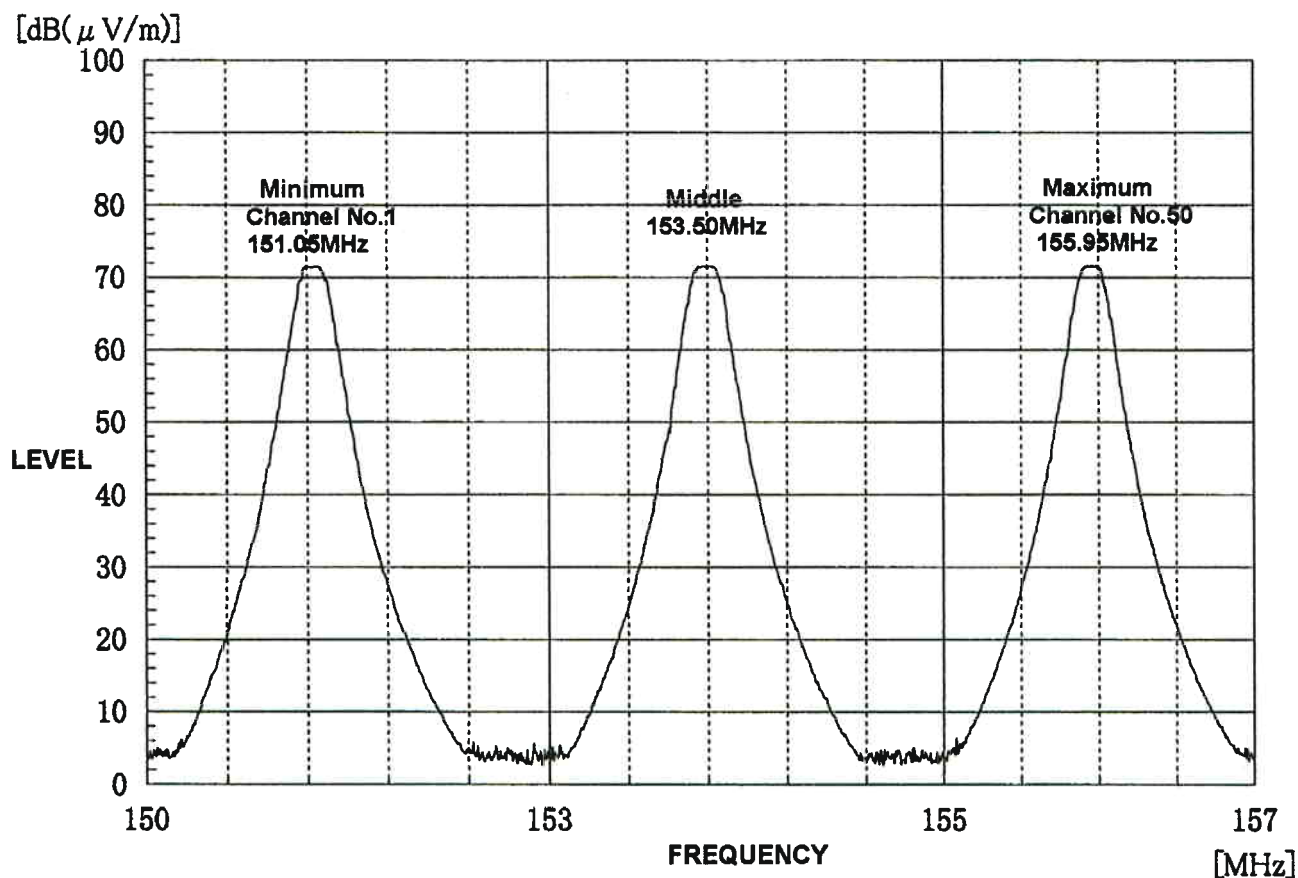


Figure 6.1 Fundamental Frequency Direct Input Waveform

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Yutaka Takeuchi, Engineer

Table 6.1-1 RFI Field Strength Measurement Results (Q-Peak Measurement)

Operating mode: Modulation Continuous Transmission Mode Date of measurement: June 14, 2004
 Test procedure: ANSI C63.4-2001 Temperature: 21 degree C
 Semi anechoic chamber <30MHz to 1000MHz> Humidity: 58 %

Frequency (MHz)	Level		Cable Loss (dB)	Amp. Gain (dB)	Ant. Factor (dB/m)	Result		Result		3 Meter Limit (μV/m)	Margin	
	Ver.	Hor.				Ver.	Hor.	Ver.	Hor.		Ver.	Hor.
48.00	23.0	22.0	1.6	-29.3	8.1	3.4	2.4	1.48	1.32	100	36.6	37.6
153.50	55.5	54.0	3.2	-28.9	11.0	40.8	39.3	109.65	92.26	150	2.7	4.2
243.20	30.0	29.0	4.5	-28.3	12.3	18.5	17.5	8.41	7.50	200	27.5	28.5
307.00	21.0	20.5	5.0	-28.3	12.7	10.4	9.9	3.31	3.13	200	35.6	36.1
460.50	21.0	21.0	6.8	-29.2	16.7	15.3	15.3	5.82	5.82	200	30.8	30.8
614.00	21.0	21.0	8.0	-29.5	19.7	19.2	19.2	9.12	9.12	200	26.8	26.8
767.50	20.5	21.0	8.9	-29.0	21.3	21.7	22.2	12.16	12.88	200	24.3	23.8
921.00	20.5	20.5	9.9	-28.8	24.1	25.7	25.7	19.28	19.28	200	20.3	20.3
972.80	32.0	30.5	10.2	-28.5	24.2	37.9	36.4	78.52	66.07	500	16.1	17.6

Sub.part C limit

Radiated Emission – 3 meter distance

Frequency (MHz)	dBμV/m	μV/m
30 - 88	40.0	100
88 - 216	43.5	150
216 - 960	46.0	200
> 960	54.0	500

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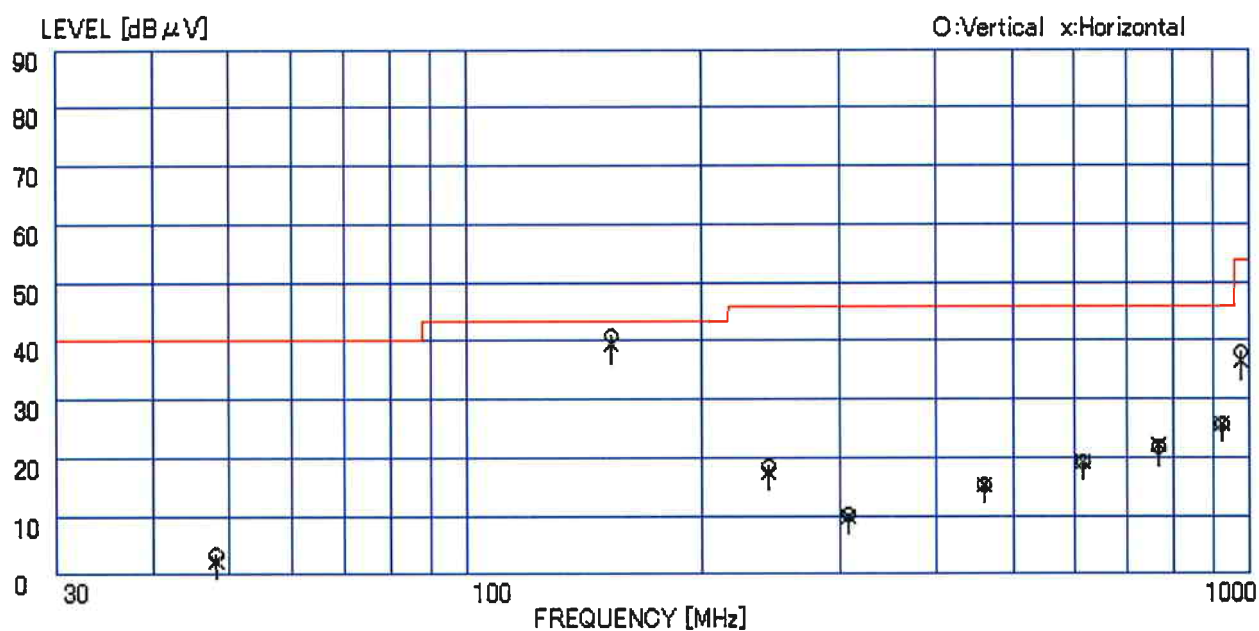


Figure 6.1-1 RFI Field Strength Measurement Results

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Yutaka Takeuchi, Engineer

Table 6.1-2 RFI Field Strength Measurement Results

Operating mode: Modulation Continuous Transmission Mode Date of measurement: June 14, 2004
 Test procedure: ANSI C63.4-2001 Temperature: 21 degree C
 Semi anechoic chamber <1000MHz to 2000MHz> Humidity: 58 %

Frequency (MHz)	Level Ver. Hor. (dBμV)	Cable Loss (dB)	Amp. Gain (dB)	Ant. Factor (dB/m)	Result Ver. Hor. (dBμV/m)	Result Ver. Hor. (μV/m)	3 Meter Limit (μV/m)	Margin Ver. Hor. (dB)
1459.14	41.0 39.5	7.9	-35.3	25.3	38.9 37.4	88.10 74.13	500	15.1 16.6
1702.40	36.0 36.5	8.7	-35.1	26.3	35.9 36.4	62.37 66.07	500	18.1 17.6

Sub.part C limit

Radiated Emission – 3 meter distance

Frequency (MHz)	dBμV/m	μV/m
30 - 88	40.0	100
88 - 216	43.5	150
216 - 960	46.0	200
> 960	54.0	500

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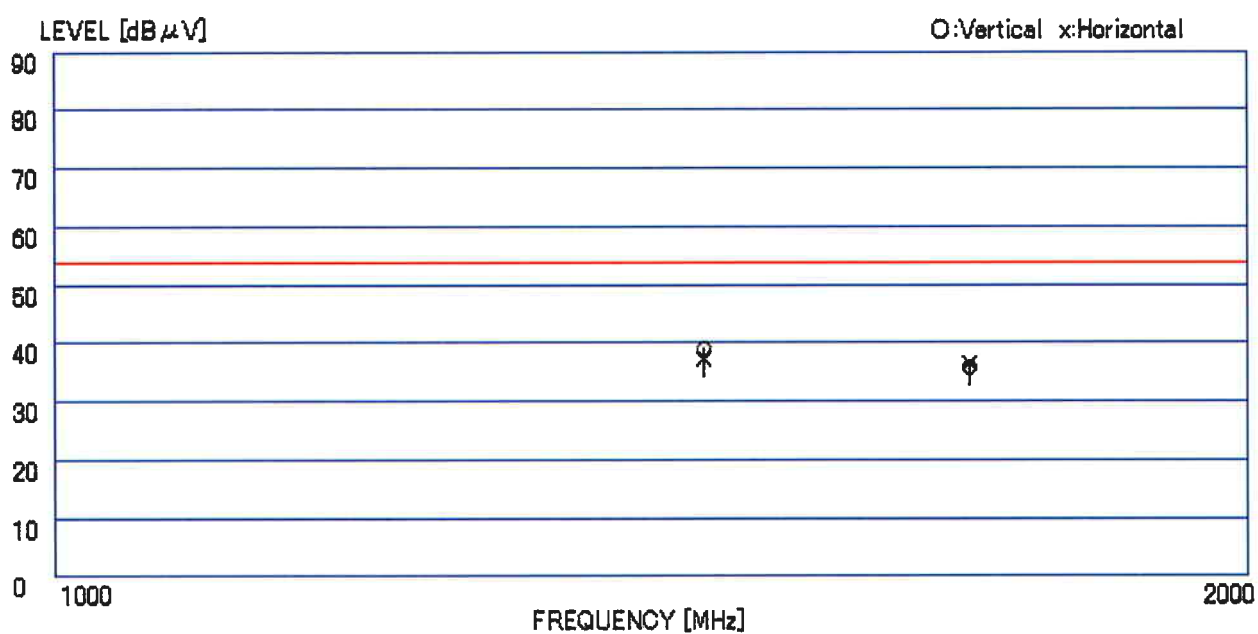


Figure 6.1-2 RFI Field Strength Measurement Results

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Yutaka Takeuchi, Engineer

Table 6.1-3 RFI Field Strength Measurement Results (Q-Peak Measurement)

Operating mode: Modulation Continuous Transmission Mode Date of measurement: July 3, 2004
 Test procedure: ANSI C63.4-2001 Temperature: 26 degree C
 Open Field Test Site No.1 <30MHz to 1000MHz> Humidity: 42 %

Frequency (MHz)	Level		Cable Loss (dB)	Amp. Gain (dB)	Ant. Factor (dB/m)	Result		Result		3 Meter Limit (μV/m)	Margin	
	Ver.	Hor.				Ver.	Hor.	Ver.	Hor.		Ver.	Hor.
	(dBμV)					(dBμV/m)		(μV/m)			(dB)	
151.05	48.0	49.0	2.6	-25.4	15.4	40.6	41.6	107.15	120.23	150	2.9	1.9
302.10	17.0	16.0	3.8	-24.8	14.1	10.1	9.1	3.20	2.85	200	35.9	36.9
453.15	19.0	19.0	4.9	-26.0	17.1	15.0	15.0	5.62	5.62	200	31.0	31.0
604.20	19.5	19.0	5.8	-26.5	19.8	18.6	18.1	8.51	8.04	200	27.4	27.9
755.25	19.5	20.0	6.5	-26.4	22.0	21.6	22.1	12.02	12.74	200	24.4	23.9
906.30	20.0	20.0	7.3	-26.0	24.0	25.3	25.3	18.41	18.41	200	20.7	20.7

Sub.part C limit

Radiated Emission – 3 meter distance

Frequency (MHz)	dBμV/m	μV/m
30 - 88	40.0	100
88 - 216	43.5	150
216 - 960	46.0	200
> 960	54.0	500

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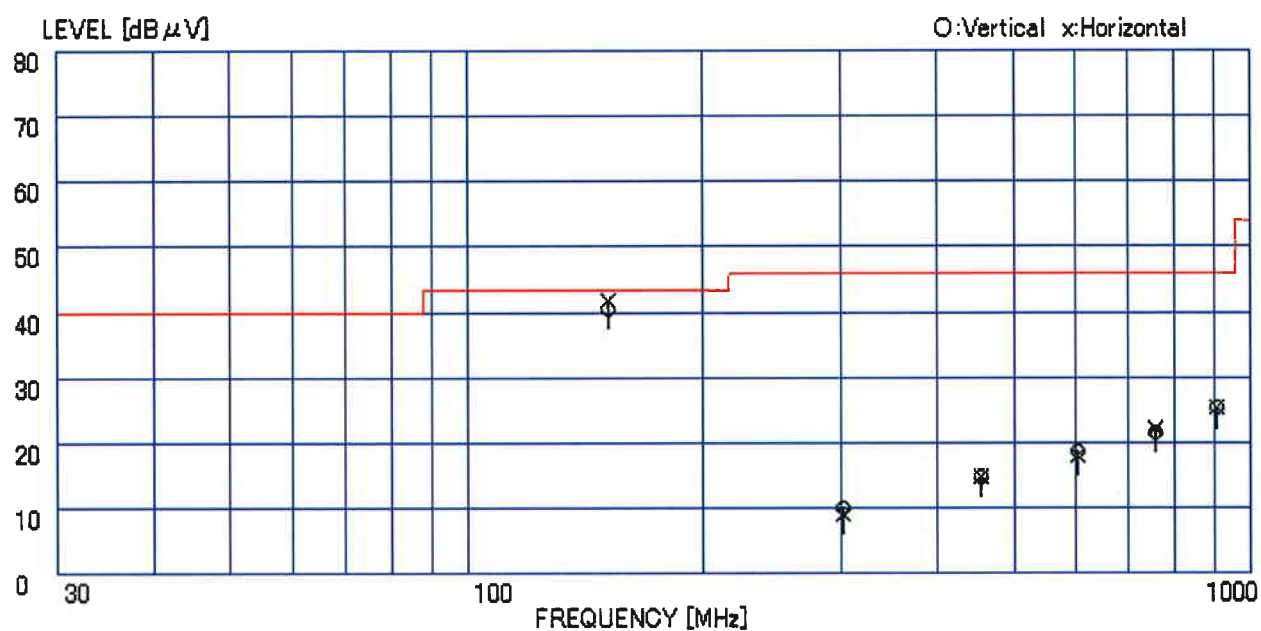


Figure 6.1-3 RFI Field Strength Measurement Results

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Yutaka Takeuchi, Engineer

Table 6.1-4 RFI Field Strength Measurement Results

Operating mode: Modulation Continuous Transmission Mode						Date of measurement: July 3, 2004						
Test procedure: ANSI C63.4-2001						Temperature: 26 degree C						
Open Field Test Site No.1 <1000MHz to 2000MHz>						Humidity: 42 %						
Frequency (MHz)	Level		Cable Loss (dB)	Amp. Gain (dB)	Ant. Factor (dB/m)	Result		Result (μV/m)	3 Meter Limit (μV/m)	Margin		
	Ver.	Hor.				Ver.	Hor.			Ver.	Hor.	
(dBμV)	(dBμV)	(dB)	(dB)	(dB)	(dB/m)	(dBμV/m)	(μV/m)	(μV/m)	(μV/m)	(dB)	(dB)	
1444.50	38.5	38.5	7.9	-35.3	26.8	37.9	37.9	78.52	78.52	500	16.1	16.1
1685.36	34.0	34.0	8.6	-35.1	27.7	35.2	35.2	57.54	57.54	500	18.8	18.8

Sub.part C limit

Radiated Emission – 3 meter distance

Frequency (MHz)	dBμV/m	μV/m
30 - 88	40.0	100
88 - 216	43.5	150
216 - 960	46.0	200
> 960	54.0	500

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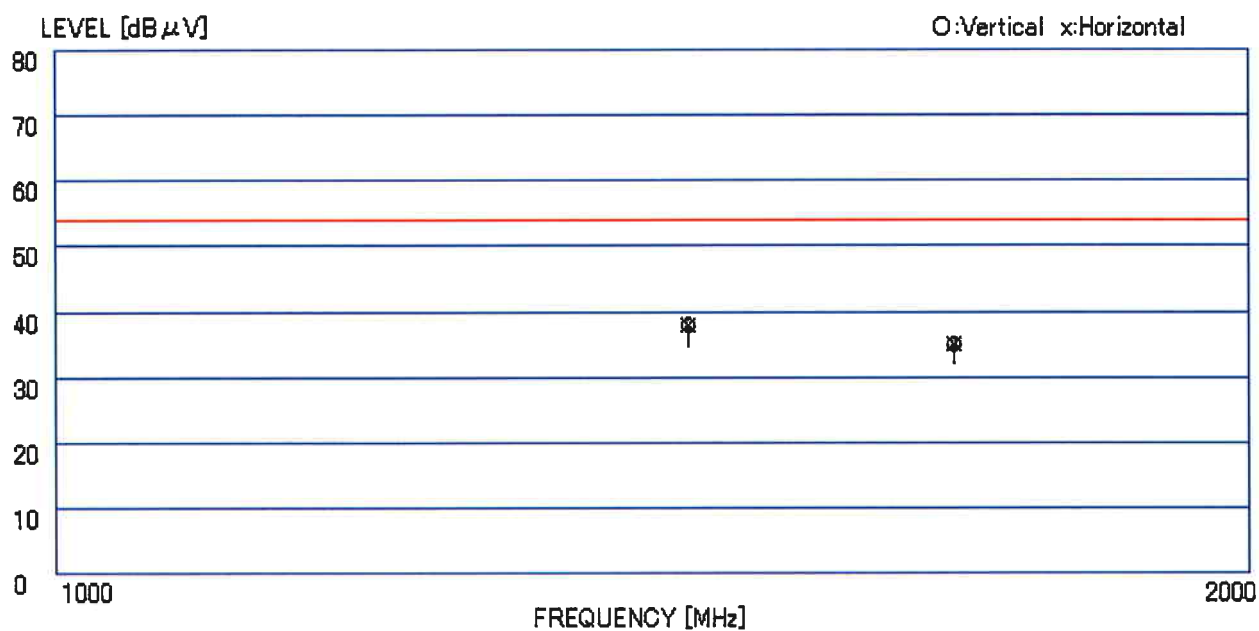


Figure 6.1-4 RFI Field Strength Measurement Results

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Tested by

Yutaka Takeuchi, Engineer

Table 6.1-5 RFI Field Strength Measurement Results (Q-Peak Measurement)

Operating mode: Modulation Continuous Transmission Mode Date of measurement: July 3, 2004
Test procedure: ANSI C63.4-2001 Temperature: 25 degree C
Open Field Test Site No.6 <30MHz to 1000MHz> Humidity: 54 %

Frequency (MHz)	Level		Cable Loss (dB)	Amp. Gain (dB)	Ant. Factor (dB/m)	Result		Result		3 Meter Limit (μV/m)	Margin	
	Ver.	Hor.				Ver.	Hor.	Ver.	Hor.		Ver.	Hor.
	(dBμV)					(dBμV/m)		(μV/m)			(dB)	
155.95	48.5	49.5	2.7	-27.1	15.4	39.5	40.5	94.41	105.93	150	4.0	3.0
311.90	18.0	19.0	4.4	-26.7	14.7	10.4	11.4	3.31	3.72	200	35.6	34.6
467.85	20.0	20.0	5.5	-27.9	17.9	15.5	15.5	5.96	5.96	200	30.5	30.5
623.80	19.5	20.0	6.5	-28.4	19.3	16.9	17.4	7.00	7.41	200	29.1	28.6
779.75	19.5	19.5	7.4	-28.0	21.3	20.2	20.2	10.23	10.23	200	25.8	25.8
935.70	20.5	20.0	8.1	-27.5	24.1	25.2	25.2	18.20	18.20	200	20.8	20.8

Sub.part C limit

Radiated Emission – 3 meter distance

Frequency (MHz)	dBμV/m	μV/m
30 - 88	40.0	100
88 - 216	43.5	150
216 - 960	46.0	200
> 960	54.0	500

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Yutaka Takeuchi, Engineer

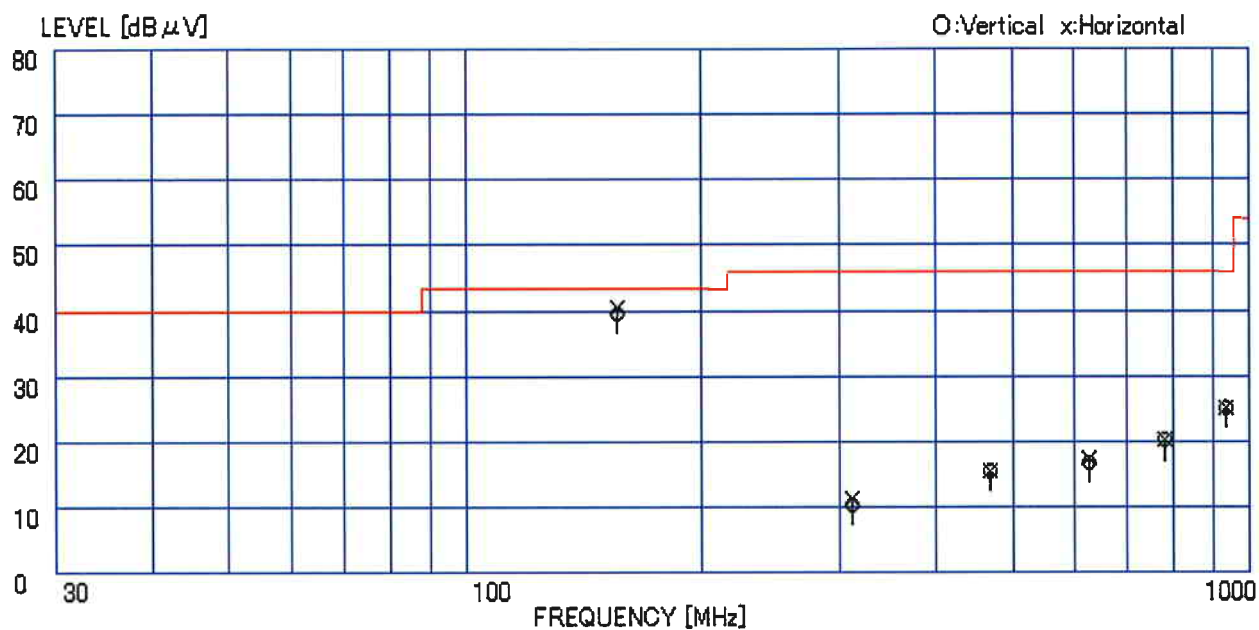


Figure 6.1-5 RFI Field Strength Measurement Results

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Hiroko Nakamura
05/Jul./2004

Tested by


Yutaka Takeuchi, Engineer

Table 6.1-6 RFI Field Strength Measurement Results

Operating mode: Modulation Continuous Transmission Mode						Date of measurement: July 3, 2004						
Test procedure: ANSI C63.4-2001						Temperature: 25 degree C						
Open Field Test Site No.6 <1000MHz to 2000MHz>						Humidity: 54 %						
Frequency (MHz)	Level		Cable Loss (dB)	Amp. Gain (dB)	Ant. Factor (dB/m)	Result		Result Ver. (μV/m)	Hor. (μV/m)	3 Meter Limit (μV/m)	Margin	
	Ver.	Hor.				Ver.	Hor.				Ver.	Hor.
1473.98	38.0	38.5	8.0	-35.4	27.0	37.6	38.1	75.86	80.35	500	16.4	15.9
1720.00	34.5	35.5	8.8	-35.3	28.4	36.4	37.4	66.07	74.13	500	17.6	16.6

Sub.part C limit

Radiated Emission – 3 meter distance

Frequency (MHz)	dBμV/m	μV/m
30 - 88	40.0	100
88 - 216	43.5	150
216 - 960	46.0	200
> 960	54.0	500

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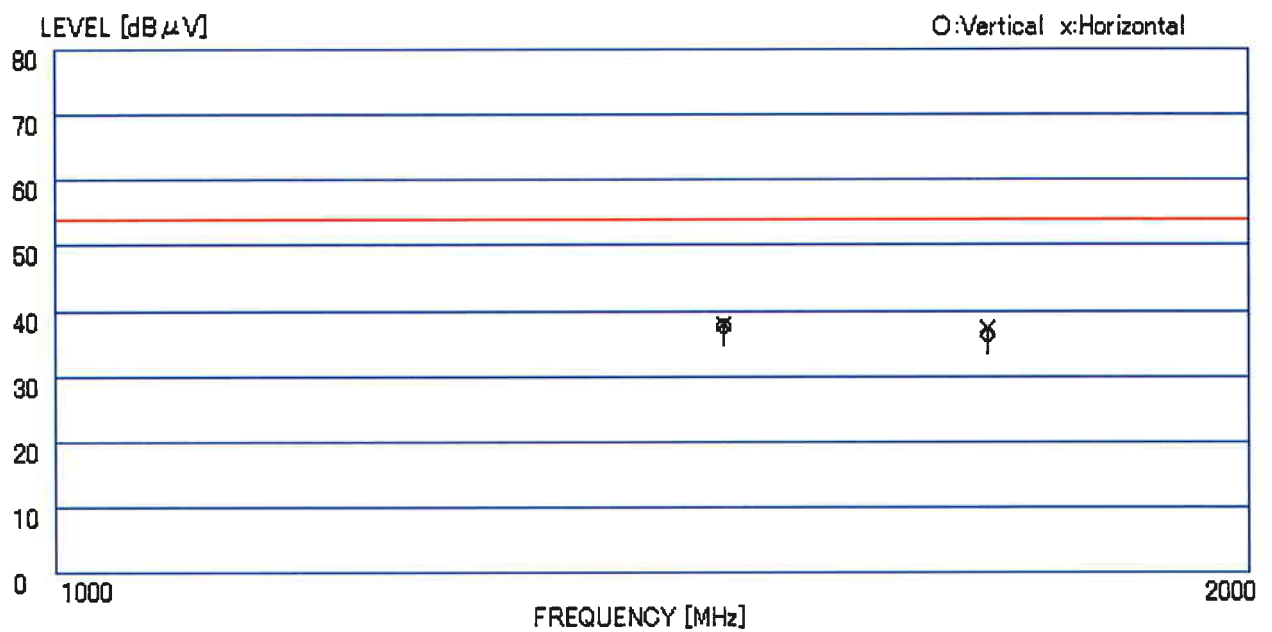


Figure 6.1-6 RFI Field Strength Measurement Results

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Yutaka Takeuchi, Engineer

6.3 Minimum Margin

Table 6.3-1 Minimum Margin

<u>Radiated emission</u>	
<i>Modulation Continuous Transmission</i>	operation mode <i>151.05</i> MHz, <i>1.9</i> dB

6.4 Sample Calculation

Table 6.4-1 Sample Calculation

The maximum radiating emission can be obtained at the frequency of *151.05* MHz,
Horizontal polarization on *Modulation Continuous Transmission* operation mode.

Height of Antenna: *1.9* m, Angle of Turn table: *120°*

Each value at frequency is as follows;

R :	Field strength meter reading	=	<i>49.0</i>	(dBμV)
A :	Antenna factor	=	<i>15.4</i>	(dB/m)
C :	Cable loss	=	<i>2.6</i>	(dB)
G :	Amplifier gain	=	<i>25.4</i>	(dB)

Then radiated emission E(dBμV/m) is ;

$$E = R + A + C - G$$

Therefore, the maximum radiated emission is ;

41.6 (dBμV/m)

Report processed by

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05/Jul./2004

Tested by

Yutaka Takeuchi
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7 MEASUREMENT PHOTOS

Photo 7.1a Setup with the Maximized RFI Field Strength Emission Level
(Semi Anechoic Chamber)



Photo 7.1b Setup with the Maximized RFI Field Strength Emission Level
(Semi Anechoic Chamber)

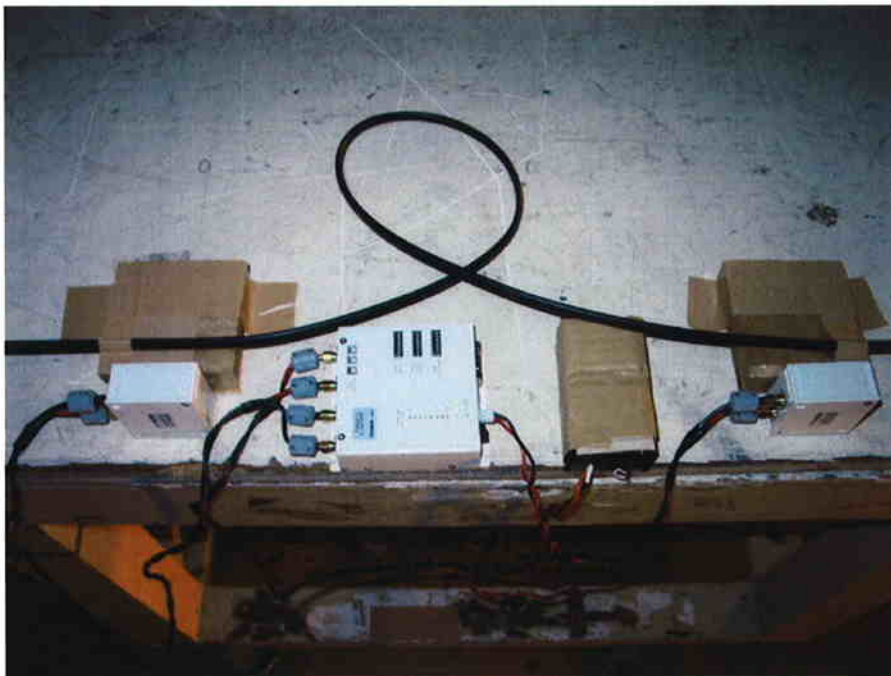


Photo 7.1c Setup with the Maximized RFI Field Strength Emission Level
(Open Field Test Site No.1)



Photo 7.1d Setup with the Maximized RFI Field Strength Emission Level
(Open Field Test Site No.1)

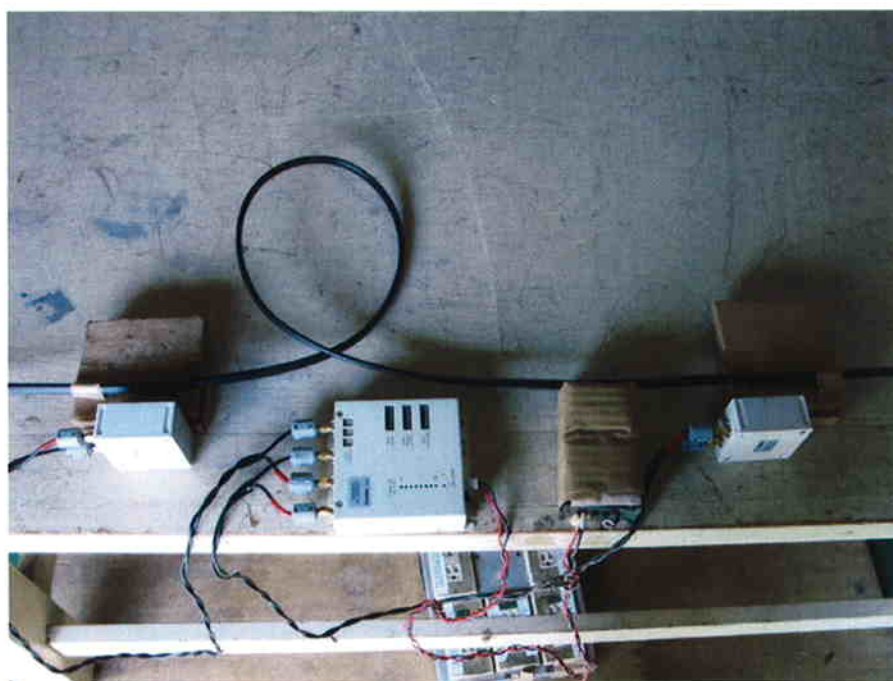


Photo 7.1e Setup with the Maximized RFI Field Strength Emission Level (Open Field Test Site No.6)

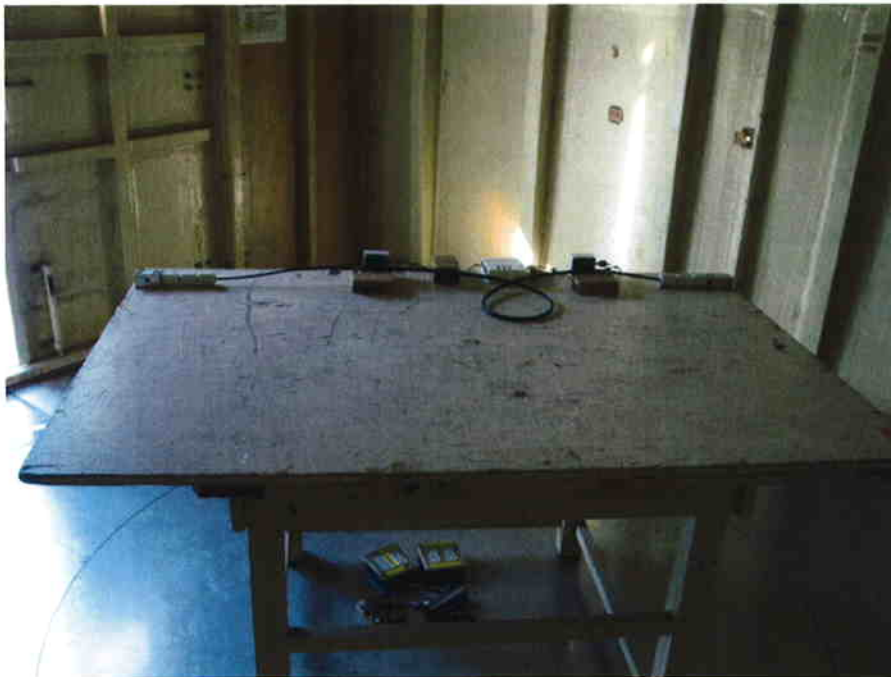


Photo 7.1f Setup with the Maximized RFI Field Strength Emission Level
(Open Field Test Site No.6)

