

EMI TEST REPORT

Test Report No. : 23KE0038-HO-3

Applicant : Matsushita Electric Industrial Co.,Ltd.
Panasonic System Solutions Company

Type of Equipment : Order Taker Unit

Model No. : WX-CT2020

Test standard : FCC Part 90

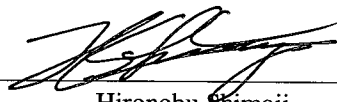
FCC ID : ACJ9TAWX-CT2020

Test Result : Complied

1. This test report shall not be reproduced in full or partial, without the written approval of UL Apex Co., Ltd.
2. The results in this report apply only to the sample tested.
3. This equipment is in compliance with above regulation. We hereby certify that the data contain a true representation of the EMC profile.
4. The test results in this report are traceable to the national or international standards.
5. This test report does not constitute an endorsement by NIST/NVLAP or U.S. Government.

Date of test : June 26, 27, 30, July 1, 10 and 11, 2003

Tested by : 
Hiroka Umeyama
EMC Service

Approved by : 
Hironobu Shimoji
Group Leader of EMC Service

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SECTION 1: Client information

Company name : Matsushita Electric Industrial Co.,Ltd.
Panasonic System Solutions Company

Brand name : Panasonic

Address : 4-3-1, TSUNASHIMA-HIGASHI, YOKOHAMA-
CITY, KANAGAWA, 223-8639 JAPAN

Telephone Number : +81 45 540 5525

Facsimile Number : +81 45 540 5511

Contact Person : Shinichi ohgo

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment : Order Taker Unit

Model No. : WX-CT2020

Serial No. : CF0001

Rating : DC3.6V

Country of Manufacture : Japan

Receipt Date of Sample : June 23, 2003

Condition of EUT : Engineering prototype

2.2 Product Description

Matsushita Electric Industrial Co.,Ltd. Panasonic System Solutions Company.
Model: WX-CT2020 (referred to as the EUT in this report) is the Order Taker Unit.

The clock frequency of this EUT is as follows;

Equipment identification	:	Order Taker Unit
Intended use/Purpose of the equipment	:	Drive Through System for the fast food store
Equipment Type	:	Transceiver
Frequency of Operation	:	from 463.6125MHz to 464.3875MHz
Other Clock Frequency	:	PLL clock 21.85MHz
		Receive VCO 442.2125~442.9875MHz
		RF CPU clock 4.19MHz
		Baseband clock 3.58MHz
Modulation	:	Frequency modulation
Bandwidth / Channel spacing	:	12.5kHz / 25MHz
Transmit power or power range	:	15mW (not including the antenna gain)
Channel access protocol	:	Rotary SW
Mode of operation	:	Duplex
Antenna Gain	:	-3dB
Method of Frequency Generation	:	Synthesizer
Operating temperature range	:	-10 deg. C. to 50 deg. C.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part90

Title : PRIVATE LAND MOBILE RADIO SERVICES

3.2 Procedures and results

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	RF Output Power	Section 2.1046 Section 2.1053	Section 90.217	-	N/A	-	Complied
2	Modulation Characteristics	Section 2.1047(a) and (b)	-	-	N/A	-	Complied
3	Emission Bandwidth	Section 2.1049	-	-	N/A	-	Complied
4	Field Strength of Spurious Emission	Section 2.1053	Section 90.217	-	N/A	4.9dB 927.99MHz, Vertical	Complied
5	Frequency Stability Measurement	Section 2.1055	Section 90.217(c)	-	N/A	-	Complied

Note: UL Apex's EMI Work Test Procedure QPM05.

3.3 Additions to Standards

No addition, deviation or exclusion has been made from standards.

3.4 Confirmation

UL Apex Co, Ltd. hereby confirms that E.U.T., in the configuration tested, complies with the specifications FCC Part 90.

3.5 Uncertainty

Spurious Emission(Radiated)

The measurement uncertainty (with a 95% confidence level) for this test using Loop antenna is $\pm 1.9\text{dB}$.

The measurement uncertainty (with a 95% confidence level) for this test using Biconical antenna is $\pm 4.5\text{dB}$.

The measurement uncertainty (with a 95% confidence level) for this test using Logperiodic antenna is $\pm 5.2\text{dB}$.

The measurement uncertainty (with a 95% confidence level) for this test using Horn antenna is $\pm 6.6\text{dB}$.

☐ The result is within Head Office EMC Lab's uncertainty.

☒ The data listed in this test report has enough margin.

3.6 Test Location

UL Apex Co., Ltd. Head Office EMC Lab. No.2 semi anechoic chamber, 7.5 x 5.8 x 5.2m. No.3 measurement room,
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone: +81 596 24 8116 Facsimile: +81 596 24 8124

This semi anechoic chamber has been fully described in a report submitted to FCC office, and listed on June 05, 2002.
(Registration number: No.2 :846015)

*NVLAP Lab. code: 200572-0

3.7 Test set up, Test instruments and Data of EMI

Refer to APPENDIX 1 to 3.

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SECTION 4: Operation of E.U.T. during testing

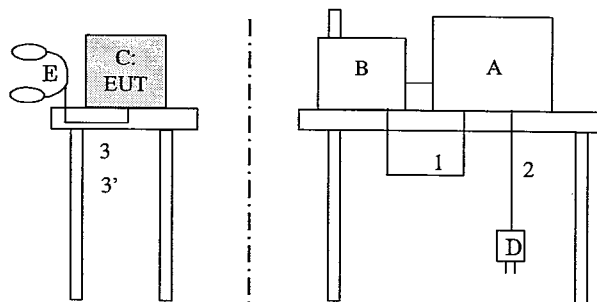
4.1 Operating Modes

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to typical use.

The sequence is used : Continuous Transmitting mode

Justification: The system was configured in typical fashion (as a customer would normally use it) for testing.

4.2 Configuration and peripherals



* Cabling was taken into consideration and test data was taken under worst case conditions.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	FCC ID	Remark
A	Center Module	WX-CC2010	CF0001	Panasonic	ACJ9TAWX-C C2010	-
B	Transceiver	WX-CT2030	CF0001	Panasonic	ACJ9TAWX-C T2030	-
C	Order Taker Unit	WX-CT2020	CF0001	Panasonic	ACJ9TAWX-C T2020	EUT
D	AC Adaptor	WX-C516	AH0099	Panasonic	UL E140898	-
E	All-in-One Headset	WX-C1027	-	Panasonic	-	-*1)

List of cables used

No.	Name	Length (m)	Shield	Backshell Material
1	LAN Cable	3.0	N	Polyvinyl chloride
2	Power Cable	3.0	Y	Polyvinyl chloride
3	Headset Cable	1.0	N	Polyvinyl chloride *1)
3'	Audio Cable	1.8	N	Polyvinyl chloride *2)

*1) These are connected except for the Modulation characteristics and Emission Bandwidth testings.

*2) This is connected for the Modulation characteristics and Emission Bandwidth testings.

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SECTION 5: RF Output power

Test Procedure

- (1) Tune up the transmitter.
- (2) The receiving antenna is adjusted to the correct length for the carrier frequency.
- (3) Raise and lower the receiving antenna to obtain a maximum reading on the Spectrum Analyzer with the antenna at horizontal polarity. Then the turntable is rotated to further increase this maximum reading. Repeat this procedure of raising and lowering the antenna and rotating the turntable until the highest possible signal Obtains. Record this maximum reading.
- (4) Repeat step3 with the antenna polarized vertically.
- (5) Remove the transmitter and replace it with the half-wave dipole antenna. The center of this antenna is approximately at the same location as the center of the transmitter.
- (6) Feed the input of the half-wave dipole antenna with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both transmitting and receiving antennas horizontally polarized and with the signal generator tuned to the carrier frequency, raise and lower the receiver antenna to obtain a maximum reading at the Spectrum Analyzer. Adjust the level of the signal generator output until the maximum reading at the Spectrum Analyzer is obtained.
- (7) Repeat step6 with both transmitting and receiving antennas vertically polarized.

Test data : **APPENDIX 3**
Test result : **Pass**
Test instruments : **MAEC-02, MTR-02, SA-07, MCC-12, MPA-02, MLA-03, MDA-03/04, MSG-03, MAT-07**

SECTION 6: MODULATION CHARACTERISTICS

Test Procedure : FCC part 2.1047

Test instruments : MS616B (Anritsu), UPA3 (Rohde & Schwarz), MST-01, MLA-02

Test data

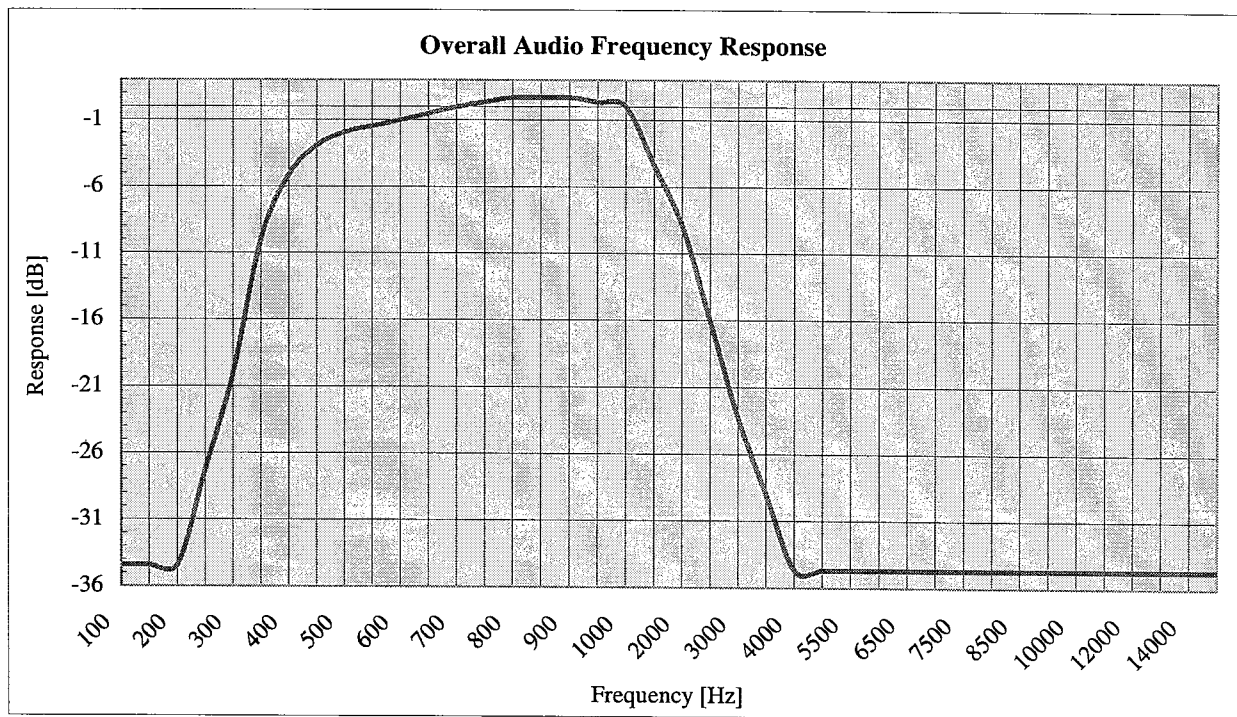
(a) Overall Audio Frequency Response

Temperature : 25 deg.C

Humidity : 58 %

Input level : -30dBm

0 dB = -3.9dBVrms. at 1kHz



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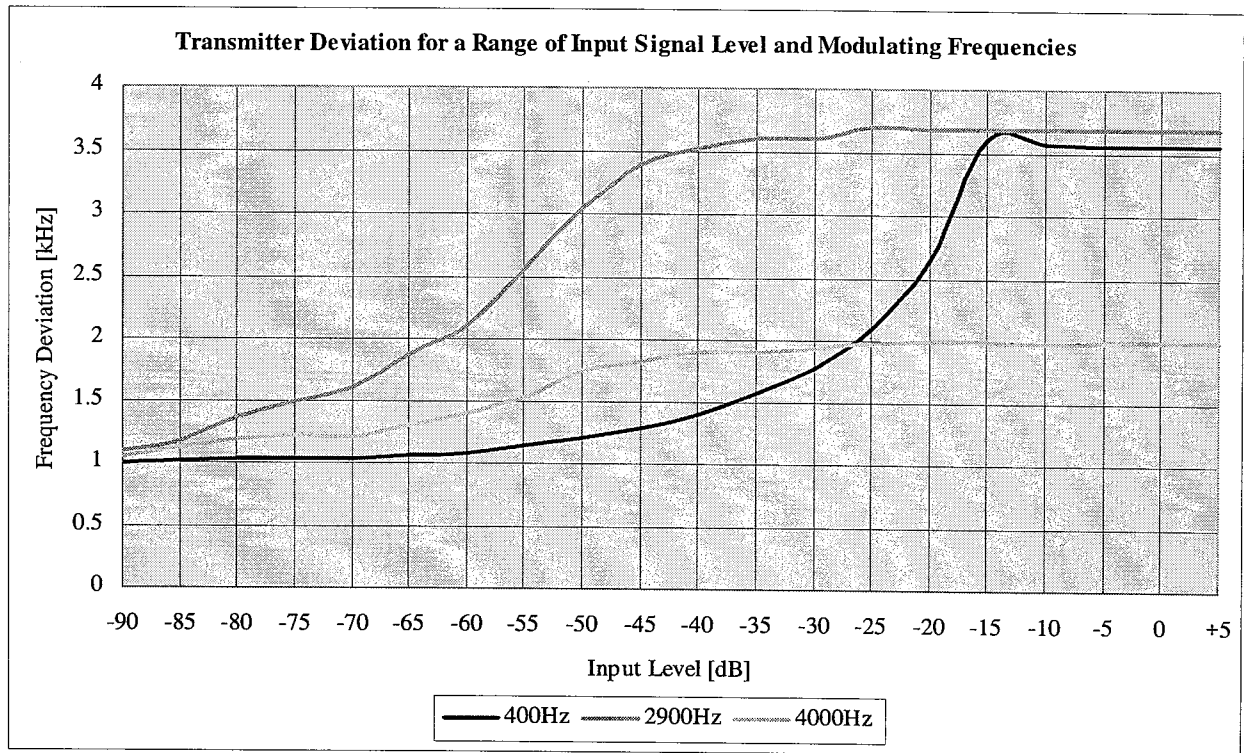
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b) Transmitter Deviation for a Range of Input Signal Level and Modulating Frequencies

Temperature : 24 deg.C

Humidity : 58 %

Input level : -38.9dBm (-40dBV) at 1kHz



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SECTION 7: Emission Bandwidth

Test Procedure

- (1) Set the reference level the spectrum analyzer to the unmodulated carrier level of the EUT.
- (2) Search maximum response of audio frequency and read maximum frequency deviation.
- (3) Then EUT was modulation by 2.5kHz and it's level was increased 16dB.

Test instruments : SA-07, MCC-12, MPA-02, MLA-02, UPA3

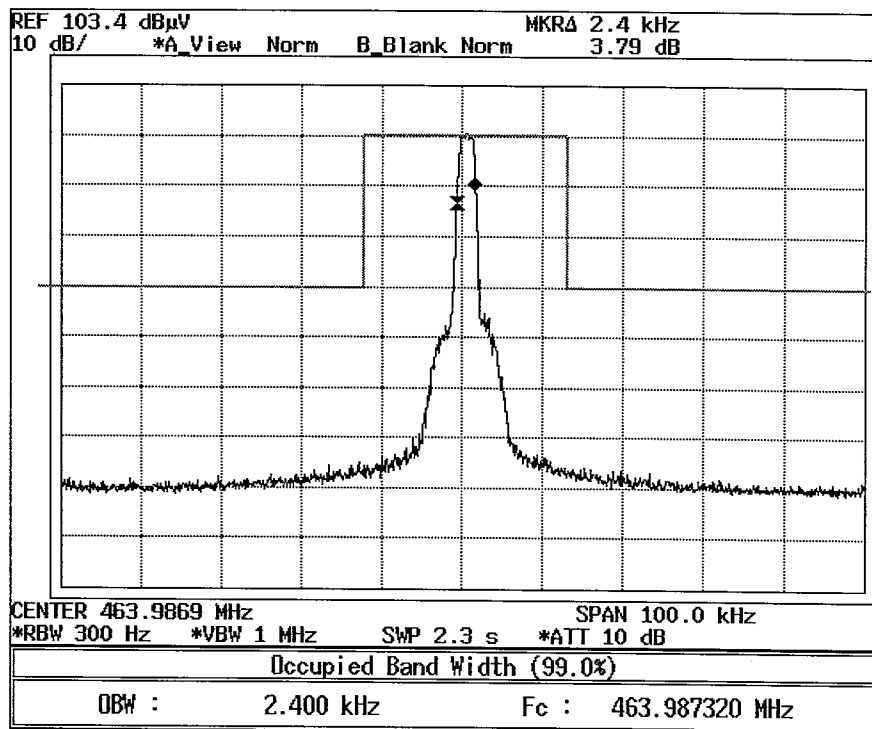
Test result : Pass

(a) No input

Operation mode : No audio input.

Temperature : 25 deg. C

Humidity : 58 %



463.99MHz : 93.23dBuV

-26dB Bandwidth : 3.2kHz , 99% Occupied Bandwidth : 2.4kHz

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(b) 2.5kHz modulation

Operation mode:

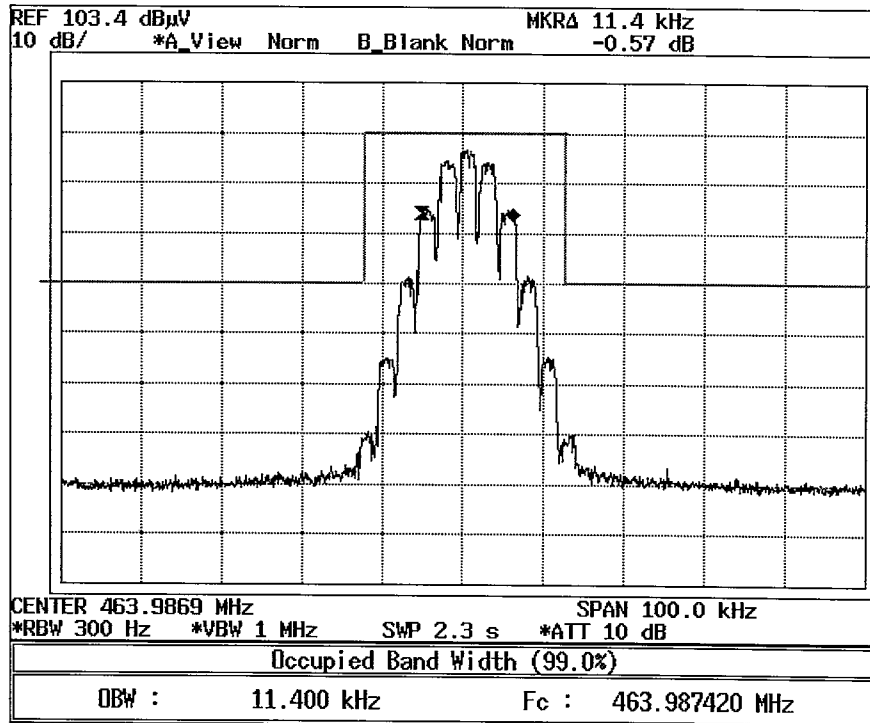
Modulated by 2.5 kHz tone at input level 16 dB greater than that necessary to produce 50% modulation.

Then input level was established at frequency of maximum response of the modulation circuit.

Temperature : 25 deg. C

Humidity : 58 %

Input level : -29dBm



463.99MHz : 93.29dBuV

-26dB Bandwidth : 12.4kHz , 99% Occupied Bandwidth : 11.4kHz

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SECTION 8: Field Strength of Spurious Emission

Test Procedure

- (1) Tune-up the transmitter(EUT).
- (2) Device Vertical: Place the device so that it's longest axis of antenna is vertical.
- (3) For each spurious measurement the receiving antenna is adjusted to the correct length for the frequency involved. These measurements are made from the lowest radio frequency generated in the EUT or 25MHz to the tenth harmonics of the carrier.
- (4) For each spurious frequency, raise and lower the receiving antenna to obtain a maximum reading on the spectrum analyzer with the antenna at horizontal polarity.
Then the turntable is rotated to further increase this maximum reading. Repeat this procedure of raising and lowering the antenna and rotating the turntable until highest possible signal has been obtain.
Record this maximum reading.
- (5) Repeat Step4 for each spurious frequency with the antennae polarized vertically.
- (6) Device Horizontal : Place the device so that it's longest axis of antenna is horizontal.
- (7) Repeat Step3, Step4, and Step5.
- (8) The attenuation of the spurious in dB can be calculated from the following formula:

$$\begin{array}{rcl} \text{Spurious Emission} & & \text{Carrier} \\ \text{Attenuation} & = & \text{Power} \\ [\text{dB}] & & [\text{dBm}] \end{array} \quad - \quad \begin{array}{r} \text{Spurious Emission} \\ \text{Power} \\ [\text{dBm}] \end{array}$$

Test data : APPENDIX 3
Test result : Pass
Test instruments : MAEC-02, MTR-02, SA-07, MCC-12, MCC-05/06, MHA-05/06, MPA-01/02
MAT-07, MBA-03, MLA-03, MDA-03/04, MSG-01/03, MCC-10

SECTION 9: Frequency Stability Measurement

Test data : APPENDIX 3
Test result : Pass
Test instruments : UC-01, MCH-01

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APPENDIX 2: Test instruments

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APPENDIX 3: Data of EMI test

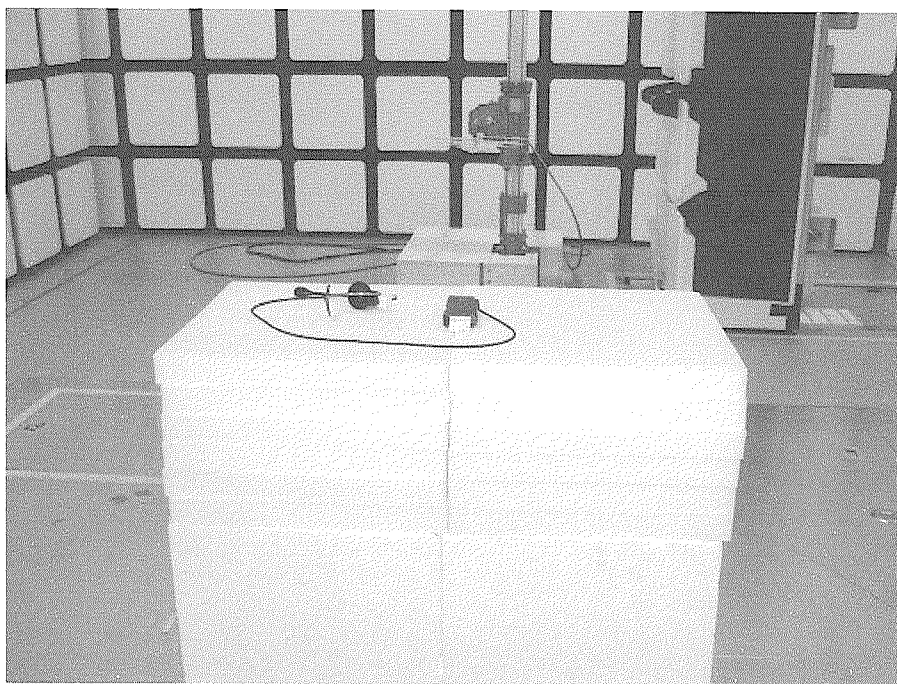
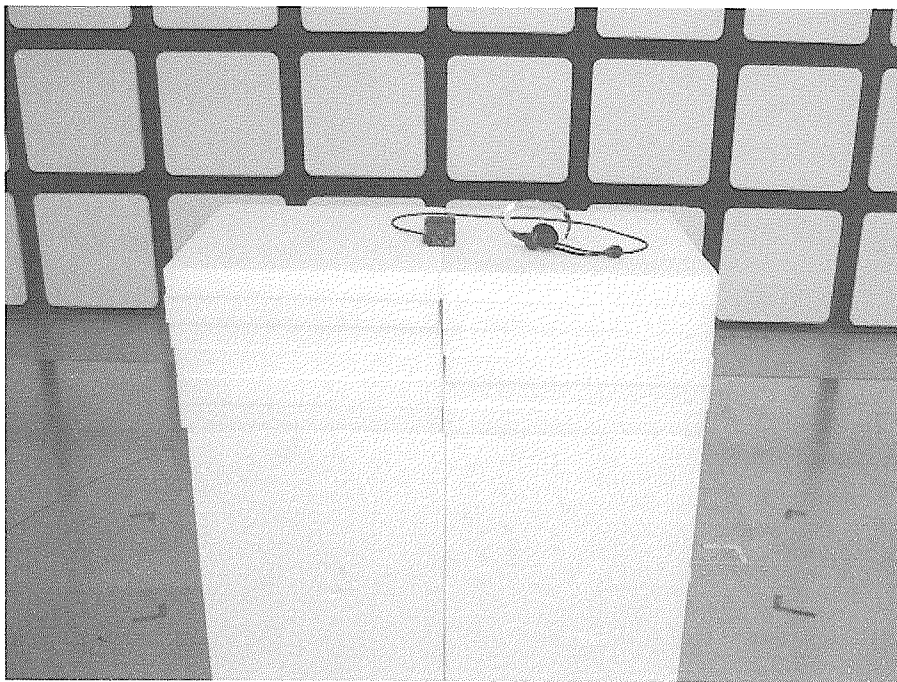
Page 17 : RF Output Power

Page 18 : Spurious Emission

Page 19 : Frequency Stability

APPENDIX 1: Photographs of test setup

Test Setup



APPENDIX 2: Test Instruments

Control No.	Instrument	Manufacturer	Model No	Test Item	Calibration Date * Interval(month)
UC-01	Universal Counter	Agilent	53131A		2002/10/24 * 12
MCH-01	Temp.&Humid. Chamber	Tabai Espec	PL-2KP	RE	2002/12/18 * 12
MAEC-02	Anechoic Chamber	TDK	Semi Anechoic Chamber 3m	RE	2003/04/11 * 12
MTR-02	Test Receiver	Rohde & Schwarz	ESCS30	RE	2003/01/31 * 12
SA-07	Spectrum Analyzer	Advantest	R3273	RE	2002/12/10 * 12
MCC-12	Coaxial Cable	Fujikura/Agilent	MCC-12-01(8D-2W15m),MC C-12-02(5D-2W-0.7),MCC-1 2-03(5D-2W-0.8),MCC-12-0 4(5D-2W-1m),MCC-12-05(R F SW),MCC-12-06(RF SW), ※ MCC-12-07(5D-2W-0.4m)5/8 追加	RE	2003/05/08 * 12
MPA-02	Pre Amplifier	Agilent	87405A	RE	2003/04/17 * 12
MLA-03	Logperiodic Antenna	Schwarzbeck	USLP9143	RE	2003/04/28 * 12
MDA-03	Dipole Antenna	Schwarzbeck	UHAP	RE	2002/12/20 * 12
MDA-04	Dipole Antenna	Schwarzbeck	UHAP	RE	2002/10/16 * 12
MSG-03	Signal Generator	Rohde & Schwarz	SML03	RE	2002/10/08 * 12
MSG-01	Signal Generator	Rohde & Schwarz	SMR40	RE	2002/11/25 * 12
MHA-05	Horn Antenna	Schwarzbeck	BBHA9120D	RE	2003/01/11 * 12
MHA-06	Horn Antenna	Schwarzbeck	BBHA9120D	RE	2003/01/11 * 12
MCC-05	Microwave Cable	Storm	421-011	RE	2003/01/14 * 12
MCC-06	Microwave Cable	Storm	421-011	RE	2003/01/14 * 12
MCC-10	Coaxial cable	Storm	90-195-394	RE	2003/03/26 * 12
MPA-01	Pre Amplifier	Agilent	8449B	RE	2003/02/08 * 12
MAT-07	Attenuator(6dB)	Weinschel Corp	2	RE	2002/12/24 * 12
UPA3	Audio Analyzer	Rohde&Schwarz	UPA3	RE	2002/06/26 * 12
MS616B	Modulation Analyzer	Anritsu	MS616B	RE	2002/06/26 * 12

All equipment is calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

Test Item:

RE: Radiated emission

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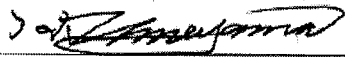
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DATA OF RADIATED EMISSIONS

UL Apex Co., Ltd.
Head Office EMC Lab. No.2 Semi Anechoic Chamber

COMPANY : Matsushita Electric Industrial Co.,Ltd.	REPORT NO : 23KE0038-HO - 3
EQUIPMENT : Order Taker Unit	REGULATION : Fcc Part 90 Section 90.217
MODEL : WX-CT2020	TEST METHOD : Fcc Part 2 Section 2.1046
S/ N : CF0001	TEST DISTANCE : Fcc Part 2 Section 2.1053
FCC ID : ACJ9TAWX-CT2020	TEST DISTANCE : 3m
IC Number : -	DATE : 06/27/2003
POWER : DC3.6V	TEMPERATURE : 26 deg.C
MODE : Transmitting (Mid : 463.9875MHz)	HUMIDITY : 60 %


 ENGINEER : Hiroka Umeyama

No.	FREQ [MHz]	SG READING		CABLE LOSS [dB]	ATTEN [dB]	RESULT		RESULT		LIMITS (ERP) [mW]
		HOR	VER			HOR	VER	HOR	VER	
		[dBm]				[dBm]		[mW]		
1	463.99	11.0	11.0	1.5	9.9	-0.4	-0.4	0.9	0.9	120.0

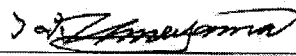
CALCULATION:READING(SG)-LOSS(CABLE)-ATTEN
Tx/Rx ANTENNA:Dipole Antenna

DATA OF SPURIOUS EMISSIONS TEST (30MHz-5GHz)

UL APex Co., Ltd.

EMC HEAD OFFICE DIVISION No.2 SEMI ANECHOIC CHAMBER

COMPANY	: Matsushita Electric Industrial Co.,Ltd.	REPORT NO	: 23KE0038-HO - 3
EQUIPMENT	: Order Taker Unit	REGULATION	: FCC Part 90 Section 90.217
MODEL	: WX-CT2020	TEST METHOD	: FCC Part 2 Section 2.1053
S/N	: CF0001		
FCC ID	: ACJ9TAWX-CT2020	TEST DISTANCE	: 3m
IC No	: 216A-CT2020	DATE	: 07/10/2003 and 07/11/2003
POWER	: DC3.6V	TEMPERATURE	: 25 deg.C and 27deg.C
MODE	: Transmitting (Mid : 463.9875MHz)	HUMIDITY	: 60% and 60%


 Engineer : Hiroka Umeyama

No.	FREQ [MHz]	SG READING		CABLE LOSS [dB]	ANT GAIN [dBi]	ATTEN [dB]	E.R.P		RESULT		LIMIT [dBc]	MARGIN	
		HOR	VER				HOR	VER	HOR	VER		HOR	VER
		[dBm]					[dBm]		[dBc]			[dB]	
1	927.99	-24.4	-23.0	2.1	2.15	10.2	-36.7	-35.3	36.3	34.9	30.0	6.3	4.9
2	1391.96	-41.2	-43.3	2.2	7.5	0.0	-38.1	-40.2	37.7	39.8	30.0	7.7	9.8
3	1855.95	-50.9	-48.4	2.6	10.1	0.0	-45.6	-43.1	45.2	42.7	30.0	15.2	12.7
4	2319.94	-45.7	-47.4	2.7	11.0	0.0	-39.6	-41.3	39.2	40.9	30.0	9.2	10.9
5	2783.93	-52.3	-54.0	3.0	11.1	0.0	-46.4	-48.1	46.0	47.7	30.0	16.0	17.7
6	3247.91	-50.8	-53.6	3.3	11.4	0.0	-44.9	-47.7	44.5	47.3	30.0	14.5	17.3
7	3711.90	-56.2	-57.1	3.6	11.9	0.0	-50.1	-51.0	49.7	50.6	30.0	19.7	20.6
8	4175.89	-49.1	-51.7	3.9	12.3	0.0	-42.9	-45.5	42.5	45.1	30.0	12.5	15.1
9	4639.88	-53.5	-54.6	4.1	12.6	0.0	-47.2	-48.3	46.8	47.9	30.0	16.8	17.9

CALCULATION: E.R.P=READING(SG)-LOSS(CABLE)+ANT.GAIN-ATTEN-2.15

RESULT: DEVIATION FROM CARRIER (-0.4dBm)

RxANTENNA: Biconical Antenna(30-300MHz), Logperiodic Antenna(300-1000MHz), Horn Antenna(1-13GHz)

TxANTENNA: Dipole Antenna(30-1000MHz), Horn Antenna(1-13GHz)

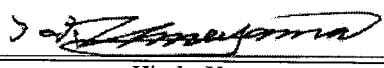
All other emissions were at least 20dB below the specification limit.

DATA OF FREQUENCY STABILITY

UL Apex Co., Ltd.

Head Office EMC Lab. No.3 Measurement Room

COMPANY	: Matsushita Electric Industrial Co.,Ltd.	REPORT NO	: 23KE0038-HO - 3
EQUIPMENT	: Order Taker Unit	REGULATION	: Fcc Part 90 Section 90.217(c)
MODEL	: WX-CT2020	TEST METHOD	: Fcc Part 2 Section 2.1055(a)(1)and(b)
S/ N	: CF0001		: Fcc Part 2 Section 2.1055(d)(1)and(b)
FCC ID	: ACJ9TAWX-CT2020	TEST DISTANCE	: -
IC Number	: 216A-CT2020	DATE	: 06/26/2003
POWER	: DC3.6V	TEMPERATURE	: 20 deg.C
MODE	: Transmitting (Mid : 463.9875MHz)	HUMIDITY	: 60 %

Engineer :  Hiroka Umeyama

Temp.	Volt.	Frequency Reading	Frequency Error	Limit
[deg.C]	[V]	[MHz]	[kHz]	[kHz]
-30.0	3.6	463.986090	1.50	12.5
-20.0	3.6	463.989108	1.52	12.5
-10.0	3.6	463.989163	1.57	12.5
0.0	3.6	463.988768	1.18	12.5
10.0	3.6	463.988162	0.57	12.5
20.0	3.6	463.987593	0.00	12.5
30.0	3.6	463.986110	1.48	12.5
40.0	3.6	463.985632	1.96	12.5
50.0	3.6	463.985944	1.65	12.5

Temp.	Volt.	Frequency Reading	Frequency Error	Limit
[deg.C]	[V]	[MHz]	[kHz]	[kHz]
20.0	3.6	463.987593	0.00	12.5
20.0	3.4	463.988520	0.93	12.5