UNISYS

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Product Compliance Test Center
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ELECTROMAGNETIC INTERFERENCE TEST REPORT

Doc. 20050112R / Project No. 1161

TEST STANDARD: USA 47 CFR PART 15

MelodyWave Baton
FCC ID: RXR0362022000

SCHULMERICH CARILLONS, INC.
SELLERSVILLE, PA

TEST DATE: January 3 – February 4, 2004
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PREFACE

This report documents product testing conducted to verify compliance of the specified EUT with applicable standards and requirements as identified herein. EUT, test instrument configurations, test procedures and recorded data are generally described in this report. The reader is referred to the applicable test standards for detailed procedures. The following table summarizes the test results obtained during this evaluation.

SUMMARY

The Schulmerich Carillons, MelodyWave Baton (FCC ID: RXR0362022000) was tested to the standards listed below, and found to have the following characteristics:

TEST	STANDARD	REQUIREMENT	RESULT
Radiated Emissions - Intentional Radiation	FCC Part 15C, Section 15.249 (Operating Band: 902 –928 MHz)	902 MHz – 10 GHz	Below Max. Permissible limit
Radiated Emissions - Spurious and Unintentional Radiation	FCC Part 15C, Section 15.209 FCC Part 15B, Class B	30 MHz – 10 GHz	Below Max. Permissible limit

EUT Modifications

The following modifications were made on the MelodyWave Baton to meet the EMI requirements:

The Baton Transmit power was lowered to -10 dBm.

MEASUREMENT UNCERTAINTY				
Measurement Type	Measurement Dist	Frequency Range	Measurement Limit	Expanded Combined Uncertainty
Radio Disturbance	10 meters	30 MHz to 1 GHz	Class A	4.3 dB
Radio Disturbance	10 meters	30 MHz to 1 GHz	Class B	5.0 dB
Radio Disturbance	3 meters	30 MHz to 1 GHz	Class B	4.3 dB
Conducted Disturbance	N/A	150 kHz to 30 MHz	Class A or B	3.6 dB

As all values of uncertainty are less than the CISPR 16-4:2002 recommendations, no adjustments to measured data presented in this report are required.

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1.0 Description of The Equipment Under Test (EUT)

Equipment Identification	MelodyWave Baton
Part Number	036-2022-000
ID Number	42
Manufacturer	Schulmerich Carillons, Inc. PO Box 903 1 Carillon Hill Sellersville, PA 18960-0903
Technical Contact	Chris Nadovich (JTA) Mark Hofmeister Gregory L. Schwartz
Condition Received	Acceptable for Test
Date Received	1/3/2005
Sample Type	Production Unit
Equipment Classification	Intentional Radiator, Unlicensed Low power Transmitter
Unisys Test Personnel	Itamar Gonen Dipak Patel

Unless otherwise noted in the individual test results sections, testing was performed on the EUT configured as follows.

1.1 General Description

1.1 General Description

The MelodyWave Baton Assembly is comprised of a 915 MHz RF transceiver mounted on a control PCB contained in a 1¼”x1¼”x15” black or white ABS housing. Combined with the 36-2024 MelodyWave Base Station Assembly and some form of tone generation, it forms a musical instrument. In simple terms, when the baton is actuated, it sends a message to the base station; the base station in turn processes this message and causes the tone generator to play a note.

The instrument uses a TDM scheme to allow unfettered communication between up to 49 batons and the base station. Communication is performed on one pair of frequencies separated by 500 kHz. Base tick transmission occurs on the lower frequency and baton data occurs on the upper. Four possible frequency pairs are listed below:

Baton Transmit Freq:	908.90 MHz or 909.90 MHz or 910.90 MHz or 911.90 MHz
Baton Receive Freq:	908.40 MHz or 909.40 MHz or 910.40 MHz or 911.40 MHz

The base station emits a tick message every 53.25 msec from which all batons base their transmission times. An address, set via a DIP switch on the control PCB, defines both the time slot the baton uses and the musical note it plays. When a valid action is performed on the baton, sensed either by accelerometer or photo-transistor signals, the baton waits for reception of a base station tick and then transmits, in its time slot, data appropriate to the sensed action. The data packet contains 72 bits: 32 preamble, 16 synch word, and 24 data payload. It is modulated with FSK at 76.8 kbits/sec with a deviation of 39.6 kHz around its center frequency. The baton is capable of transmitting successfully up to 8 packets per second. Each packet is 937.5 µsec in duration.

The baton is powered by a fused 7.2V NiMH rechargeable battery. This is regulated down to 3.0 VDC for the RF module and 5.0 VDC for all remaining control circuitry. Power is applied to the baton via a tilt switch and control circuitry when the baton is picked up from a horizontal position. It is removed only via the control circuitry when the baton is inactive.

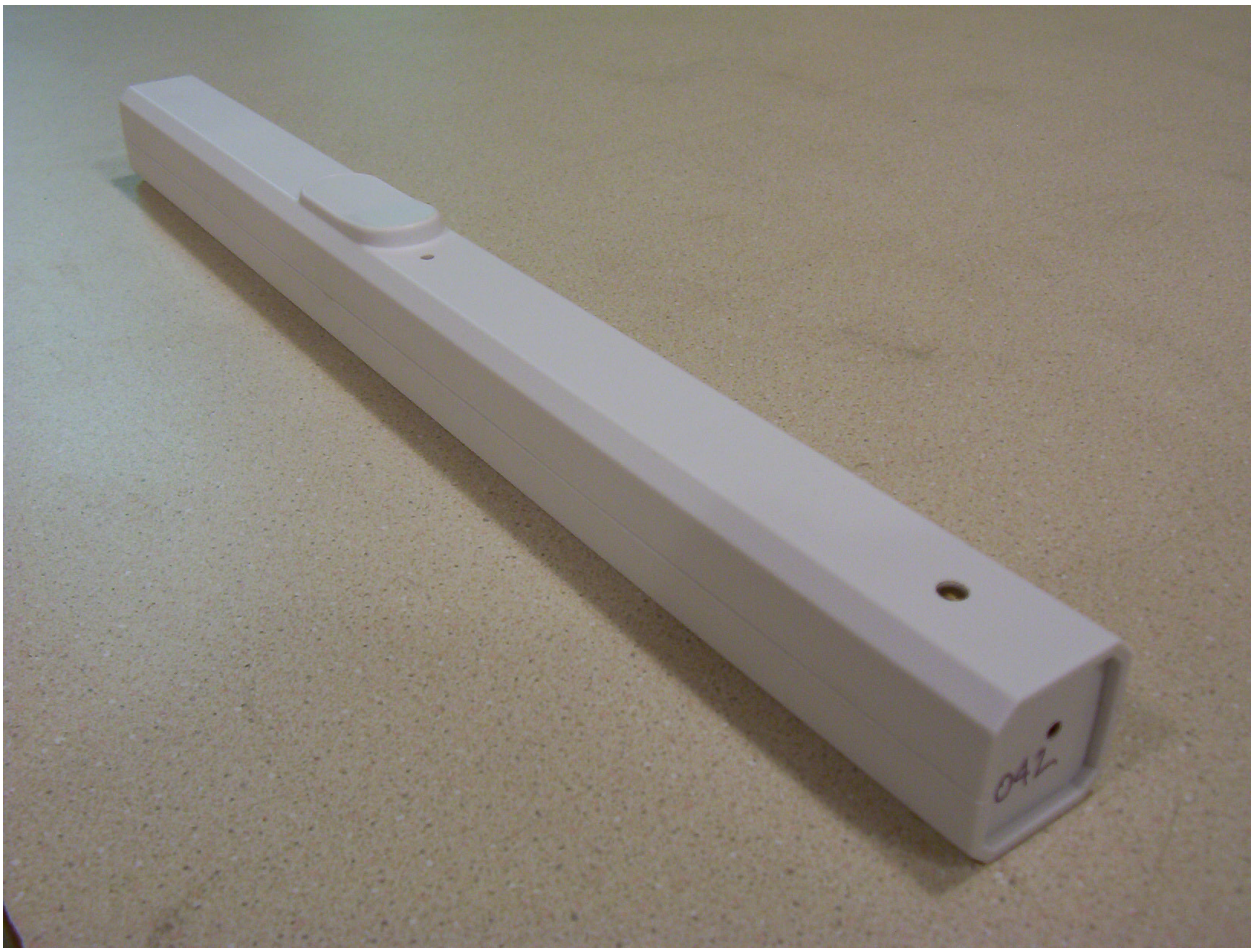


Photo 1 – MelodyWave Baton – Top of Baton in the near part of photo

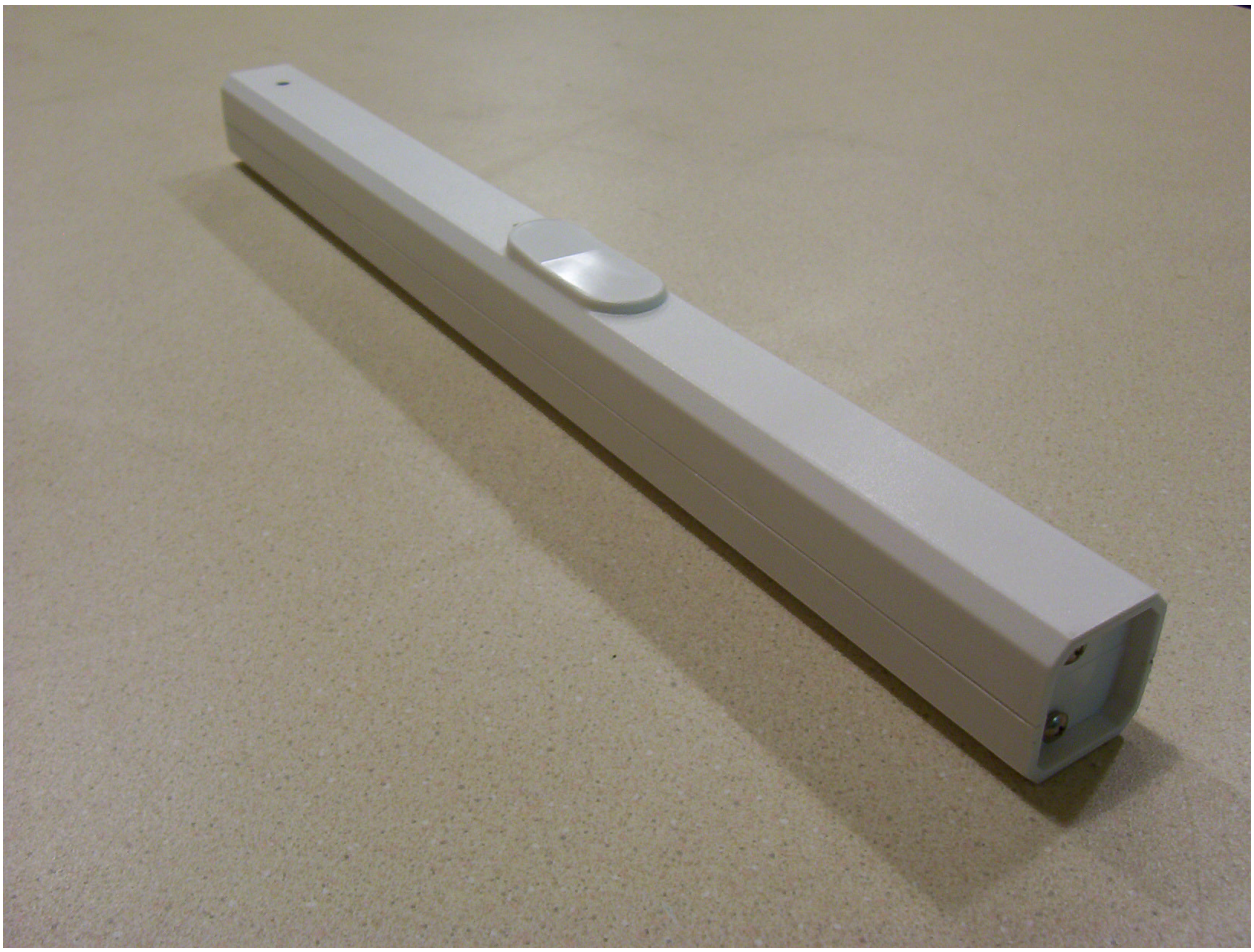


Photo 2 –MelodyWave Baton – Bottom of Baton in the near part of photo

1.2 Test Configurations

The Baton EUT was tested by incorporating test software which caused the baton to transmit a repetitive play message signal 8 times a second. The Baton EUT was tested by observing reception of a valid transmitted signal at the base station. Proper reception is verified by observing that the correct LED relating to the Baton EUT illuminated.

Testing was carried out on a single EUT configuration. The EUT was placed on a cardboard boxes, and on a couple pieces of wood to reach an 80 cm height. The testing was performed with mounting the EUT in the three different positions as identified below:

1. Vertical Straight Up
2. On Side with the Transmitting (Tx) Light facing up
3. On Side with the Transmitting (Tx) Light facing horizontally (to the side)

Detailed EUT Hardware Listing

The MelodyWave Baton has a permanent, non-detachable antenna. It incorporates the following printed circuit board assembly:

Description	Manufacturer	Manufacturer's Model Number/ Part Number
MelodyWave 915MHz, RF Module	Schulmerich Carillons, Inc.	036-1736-000

Test Support Items

The following device was used to verify the EUT operation.

Description	Manufacturer	Model Number	Serial Number
MelodyWave Base Station	Schulmerich Carillons	036-2024-000	93

1.3 Rationale for The Chosen Configuration

The tested configuration represents deliverable hardware.

1.4 EUT Modifications

The Baton Transmit power was lowered to -10dBm in ordered to meet FCC requirements.

2.0 Operation of The EUT During Testing

Unless otherwise noted in the individual test results sections, testing was performed on the EUT as follows.

2.1 General

Climatic Environment

The following were the ambient conditions in the laboratory during testing:
Temperature: 22^{o} C ± 5^{o} C
Relative Humidity 50% ± 10% RH

Input Power

The MelodyWave Baton is a battery-operated device. Testing was performed using a fully charged 7.2 V rechargeable Nimh battery.

2.2 Operating Mode

During the emissions testing the MelodyWave Baton was operated for continuous transmit/receive mode of operation. The communication was established with the MelodyWave Base Station (used as support item). The MelodyWave Baton was transmitting 8 packets per second simulating the maximum speed at which a person can play the device. During the nontransmit time, the EUT remains in receive mode of operation. Thus the emission recorded and presented were taken for both the transmit as well as receive operation of the EUT.

Since the MelodyWave Baton can be operated in four transmitting frequencies (908.9 MHz - 911.9 MHz), during intentional radiated emissions testing the MelodyWave Baton was operated for continuous transmission at the following three selected transmitting frequencies:

908.9 MHz (Low)

909.9 MHz (Medium)

911.9 MHz (High)

2.3 Rationale for The Chosen Mode of Operation

The selected mode of operation simulated the actual application of the EUT, simulating the maximum speed at which a person can play the device, therefore it was considered as an appropriate operating mode for the EMI evaluation.

3.0 Applicable Requirements, Methods and Procedures

3.1 Applicable Requirements

The results of the measurement of the radio disturbance characteristics of the EUT described herein may be applied and, where appropriate, provide a presumption of compliance to one or more of the following requirements or to other requirement at the discretion of the client, regulatory agencies, or other entities.

USA

47 CFR, Part 15, Radio Frequency Devices,
- Subpart B, "Unintentional Radiators".
- Subpart C, "Intentional Radiators".

Canada

Industry Canada (IC) Spectrum Management and Telecommunication Policy, Radio Standards Specification RSS-210, "Low Power License – Exempt Radiocommunication Devices (All Frequency Bands)". Issue 5, November 2001.

3.2 Basic Test Methods and Procedures

The applicable regulatory product family or generic standards require that radio disturbance/interference tests be performed in accordance with the following:

- C63.4, 2003 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in The Range of 9 kHz to 40 GHz".

3.3 Deviations Or Exclusions From The Requirements And Standards

There were no deviations or exclusions from the requirements and standards.

4.0 Test Results

4.1 Radiated Emissions

4.1.1 Test Facility

The test site is an all weather, open field measurement facility defined by an elliptical area of 3258 square meters, which is free of reflective metallic objects and extraneous electromagnetic signals. A non-metallic A-Frame enclosure covers 172 square meters of the ellipse. This enclosure contains a ground level 5-meter diameter turntable, capable of rotating equipment through a complete 360 degrees, and a 3-meter and 10-meter test range with a remotely controlled antenna mast. The floor of the A-Frame and surface of the turntable are covered with a flat metal continuous ground plane. The ground plane extends outside the A-Frame to a distance of 35.6 meters from the center of the turntable. The width of the extension is 2.4 meters.

The ground plane, under the A-Frame enclosure, is covered with protective insulating material. A cellar located beneath the ground level of the A-Frame structure houses personnel and instrumentation for remote control of the antenna mast, the turntable, and other equipment above ground level. The test site complies with the Attenuation Measurements specified in ANSI C63.4 - 2001, and is registered with FCC, VCCI, BSMI, NEMKO and EZU.

For electric field radiated emissions, the EUT and support peripherals or devices required to facilitate EUT operation were positioned either directly on the turntable surface (floor standing equipment) or on a wooden table 80 cm. in height (tabletop equipment), depending on the size and status of the sample. Hardware not needed in the test field such as remote terminals or non-standard exercisers were placed in the basement below the turntable.

4.1.2 Radiated Emissions Test Procedure

Radiated Emissions 30 MHz – 1000 MHz

Initial measurements, for the purpose of identifying suspect emissions from the equipment under test, were performed by dividing the test frequency range into the following twenty bands:

Band	Frequency Range	Band	Frequency Range	Band	Frequency Range
1)	30 - 40 MHz	8)	108 - 148 MHz	15)	570 - 670 MHz
2)	40 - 50 MHz	9)	148 - 165 MHz	16)	670 - 770 MHz
3)	50 - 88 MHz	10)	165 - 200 MHz	17)	770 - 855 MHz
4)	88 - 93 MHz	11)	200 - 300 MHz	18)	855 - 875 MHz
5)	93 - 98 MHz	12)	300 - 450 MHz	19)	875 - 892 MHz
6)	98 - 103 MHz	13)	450 - 470 MHz	20)	892 - 1000 MHz
7)	103 - 108 MHz	14)	470 - 570 MHz		

Each of these bands was monitored on a spectrum analyzer display while the turntable was initially positioned at the reference 0 degree point. A mast mounted broadband antenna was located at a distance of 3/10 meters (as applicable) from the periphery of the EUT(s). The antenna was set to a height of 1 meter, for the vertical polarity and a height of 2.5 meters, for horizontal polarity for these suspect emission scans. All emissions with amplitudes 8 dB or less below the appropriate regulatory limit were identified and saved for later source identification and investigation. This initial suspect identification procedure was repeated for turntable positions of 90, 180 and 270 degrees.

The source of questionable emissions was verified by powering off the EUT(s). Those emissions remaining were removed from the suspect list. Valid suspect emissions were then maximized through cable manipulation. The highest six signals or all within 4 dB of the limit, identified during this initial investigation, were then maximized by rotating the turntable through a complete 360 degrees of azimuth and then raising the antenna from 1 to 4 meters of elevation with the turntable positioned at the angle of maximum signal level. When the EUT(s) azimuth, antenna height and polarization that produced the maximum indication were found, the emission amplitude and frequency were remeasured to obtain maximum peak and quasi-peak field strength. The frequencies and amplitudes of RFI emissions are recorded in this report in units derived as follows:

Field Strength (dBuV/m) = meter reading (dBuV) + antenna factor (dB/m)+ Cable Loss (dB)

Radiated Emissions above 1 GHz

The required test frequency range above 1 GHz, was scanned manually by placing a Double Ridged Guide antenna at a distance of 3 meters from the perimeter of the equipment under test. Emissions were monitored using EMI Test Receiver ESIB 40 set for a 1 MHz bandwidth with rotating the turntable through a complete 360 degrees of azimuth. Both horizontal and vertical antenna polarities were investigated for suspect emissions. The support equipment and test item(s) were powered off in turn to determine the source of the emissions. The test procedure described above for 30 –1000 MHz was observed to maximize the emissions. The measurements were made with both peak and average detectors. The field strengths were recorded as follows:

Field Strength (dBuV/m) = Meter reading (dBuV) + Correction Factor*

* Correction Factor includes Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)

4.1.3 Radiated Emissions Test Results (1/3/2005 -2/4/2005)

4.1.3.1 Radiated Emissions - Intentional Radiator

Fundamental Frequency Emissions

Fundamental transmission frequency emissions were measured at a test distance of 3 meter for all the three EUT orientations. The quasi-peak detector levels measured by the RF measurement receiver were corrected as the PRF of the transmission was found less than 20 Hz. It is understood that because of the emission PRF was less then the 20 Hz, the RF receiver indicated quasi-peak detector levels may have lower amplitude value than the actual amplitude. The required correction to the receiver indicated reading was determined by finding the difference between the amplitudes of EUT emission and the emission that has a same pulse width but a PRF of 20 Hz.

The pulse width and PRF of the emission at the fundamental frequency were measured as below:

Pulse width: 947 us PRF: 7.92 Hz

Using a Agilent model E8254A (250 KHz- 40 GHz) signal generator, a simulated signals having above measured pulse width and PRF of 7.92 Hz and 20 Hz were generated. The amplitudes of these two simulated signals were measured using quasi-peak detector. The measured amplitudes showed a difference of 0.89 dB. This difference was added to the RF receiver indicated quasi-peak detector level to find accurate amplitude.

The following tables on the next page show the corrected (taking in to account effect of the emission PRF) quasi-peak data compared to the FCC Part 15 Section 15.249 limit for fundamental emissions at 3 meter test distance.

Low Transmitting Frequency, EUT Position: Straight Up Vertical

Freq	Q-Pk	Pol	Angle	Ht	CF	Limit	Delta
[MHz]	[dBuV/m]		[deg]	[cm]	[dB]	[dBuV/m]	[dB]
908.88	88.74	V	359.8	199	27.86	94	-5.26
908.88	81.84	H	104	135	27.86	94	-12.96

Low Transmitting Frequency, EUT Position, Horizontal, Tx Light Facing Up

Freq	Q-Pk	Pol	Angle	Ht	CF	Limit	Delta
[MHz]	[dBuV/m]		[deg]	[cm]	[dB]	[dBuV/m]	[dB]
908.88	84.64	V	143	137	27.86	94	-9.36
908.88	92.72	H	142	153	27.86	94	-1.28

Low Transmitting Frequency, EUT Position: Horizontal, Tx Light the side

Freq	Q-Pk	Pol	Angle	Ht	CF	Limit	Delta
[MHz]	[dBuV/m]		[deg]	[cm]	[dB]	[dBuV/m]	[dB]
908.88	84.24	V	336	248	27.86	94	-9.76
908.88	93.40	H	143	153	27.86	94	-0.60

Medium Transmitting Frequency, EUT Position: Straight Up Vertical

Freq	Q-Pk	Pol	Angle	Ht	CF	Limit	Delta
[MHz]	[dBuV/m]		[deg]	[cm]	[dB]	[dBuV/m]	[dB]
909.886	88.29	V	359	196	27.89	94	-5.71
909.886	81.04	H	85	133	27.89	94	-12.96

Medium Transmitting Frequency, EUT Position, Horizontal, Tx Light Facing Up

Freq	Q-Pk	Pol	Angle	Ht	CF	Limit	Delta
[MHz]	[dBuV/m]		[deg]	[cm]	[dB]	[dBuV/m]	[dB]
909.886	80.75	V	0	100	27.89	94	-13.25
909.886	90.83	H	324	145	27.89	94	-3.17

Medium Transmitting Frequency, EUT Position: Horizontal, Tx Light the side

Freq	Q-Pk	Pol	Angle	Ht	CF	Limit	Delta
[MHz]	[dBuV/m]		[deg]	[cm]	[dB]	[dBuV/m]	[dB]
909.886	85.20	V	105	141	27.89	94	-8.80
909.886	92.04	H	206	145	27.89	94	-1.96

High Transmitting Frequency, EUT Position: Straight Up Vertical

Freq	Q-Pk	Pol	Angle	Ht	CF	Limit	Delta
[MHz]	[dBuV/m]		[deg]	[cm]	[dB]	[dBuV/m]	[dB]
911.87	87.09	V	17	203	27.95	94	-6.91
911.87	81.58	H	87	138	27.95	94	-12.42

High Transmitting Frequency, EUT Position, Horizontal, Tx Light Facing Up

Freq	Q-Pk	Pol	Angle	Ht	CF	Limit	Delta
[MHz]	[dBuV/m]		[deg]	[cm]	[dB]	[dBuV/m]	[dB]
911.87	82.01	V	159	100	27.95	94	-11.99
911.87	89.81	H	327	140	27.95	94	-4.19

High Transmitting Frequency, EUT Position: Horizontal, Tx Light the side

Freq	Q-Pk	Pol	Angle	Ht	CF	Limit	Delta
[MHz]	[dBuV/m]		[deg]	[cm]	[dB]	[dBuV/m]	[dB]
911.87	84.00	V	331	259	27.95	94	-10.00
911.87	91.11	H	203	147	27.95	94	-2.89

Harmonics of Fundamental Frequency Emissions (Upto 10 GHz)

Emission scan for harmonics of the fundamental frequency was performed up to 10 GHz at a test distance of 3 meter for all the three EUT orientations. Harmonics emissions detected with peak detector were significantly below the applicable average limit specified in FCC Part 15, Section 15.249, therefore no peak or average measurements performed/recorded.

Overall Results: All fundamental radiated emissions and harmonics of the fundamental frequency, at a distance of 3 meters from the MelodyWave Baton, are below the 3 meter limit specified by FCC Part 15, Section 15.249.

4.1.3.2 Radiated Emissions – Spurious and Unintentional Radiation (30 MHz-10 GHz)

Emission scan for detection of spurious and unintentional radiation was performed for all the three EUT orientations. No EUT signals found, so noise floor measurements were made as shown below. The recorded levels are compared with the applicable limit specified in FCC Part 15, Section 15.209 which is the same limit as FCC Part 15 specified for Class B digital devices for the test measurement frequency spectrum. Measurement scan was performed for the frequency range of 30 MHz to 10 GHz, at the test distance of 3 meters.

30-10000MHz Measurements

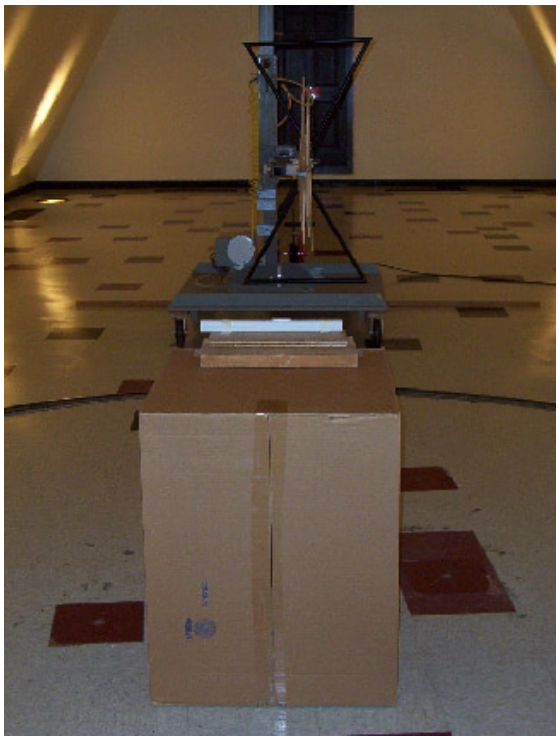
Freq [MHz]	Q-Pk [dBuV/m]	Pol	Angle [deg]	Ht [cm]	CF [dB]	Limit [dBuV/m]	Delta [dB]	Comment
50	20.7	V	1	100	15.36	40	-19.3	Noise Floor
230	13.32	V	1	100	14.02	46	-32.68	Noise Floor
430	18.92	V	1	100	19.79	46	-27.08	Noise Floor
630	24.14	V	1	100	23.46	46	-21.86	Noise Floor
830	27.45	V	1	100	26.76	46	-18.55	Noise Floor
980	29.56	V	1	100	28.36	54	-24.44	Noise Floor

Overall Results: All the EUT signals, other then fundamental and its harmonics, are under the 3 meter limit specified by FCC Part 15, Class B digital devices and FCC Part 15, Section 15.209.

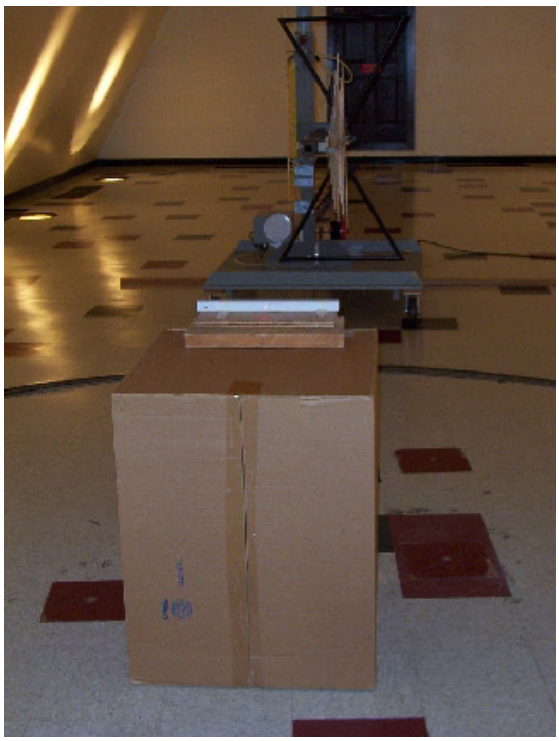
Test Setup Photos

Radiated Emission Test Setup – Vertical Orientation, Front View

Radiated Emission Test Setup – Vertical Orientation, Rear View



Radiated Emission Test Setup – EUT on Side, Tx Light Facing Up



Radiated Emission Test Setup – EUT on Side, Tx Light Facing towards front

Appendix A – Test Equipment

Description	Freq Range (Hz)	Model Number	Manufacturer	ID / SN	Last Cal Date
EMI Test Receiver	20 Hz – 40 GHz	ESIB 40	Rohde & Schwarz	C-062	12/7/04
Antenna	25M - 2G	LPB-2520/A	ARA	B962	4/7/04
Controller, Tower and Turntable	NA	2090	EMCO	B812	NA
Amplifier	1G – 40G	NSP4000-44	Miteq	B827	8/3/04
Antenna	1G – 18G	96001	EATON	U926	2/11/04
High Pass Filter	1.5G-18G	6HC1500/18000-3-KK	Trilithic Inc.	A088	11/1/04