



L.S. Compliance, Inc.

W66 N220 Commerce Court
Cedarburg, WI 53012
262-375-4400 Fax: 262-375-4248

Assigned Engineer: Abtin Spantman

COMPLIANCE TESTING OF:

E-Stylus Electric Motor Hand piece

PREPARED FOR:

Dentsply International
Professional Division
Attn.: Mr. Spartak Copaev
901 West Oakton Street
Des Plaines, IL 60018-1884

TEST REPORT NUMBER:

303302 TX

TEST DATE(S):

June 20th and 25th, 2003

All results of this report relate only to the items that were tested. This report is not to be reproduced, except in full, without written approval of L. S. Compliance, Inc.

Table of Contents

Section	Description	Page
Index		2
1	L. S. Compliance in Review	3
2	A2LA Certificate of Accreditation	4
3	A2LA Scope of Accreditation	5
4	Test Certificate	6
5	Product and General Information	7
6	Product Description	7
7	Test Requirements	7
8	Summary of Test Report	8
9	Introduction	8
10	Purpose	8
11	Radiated Emissions Test	9-16
12	Conducted Emissions Test	17-21
Appendix		
A	Test Equipment List	22

1. L. S. Compliance In Review

L. S. Compliance, Inc. is located in Cedarburg, Wisconsin – United States.

We may be contacted by:

Mail: L. S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, Wisconsin 53012

Phone: 262-375-4400
Fax: 262-375-4248
E-mail: eng@lsr.com

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025 : 2005
with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: **1255.01**

U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Conformity Assessment Body operating under the U. S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union EMC Directive 89/336/EEC, Article 10.2.

Date of Validation: **January 16, 2001**

Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on 47CFR 2.948
FCC Registration Number: **90756**

Listing of 3 and 10 meter OATS based on 47CFR 2.948

FCC Registration Number: **90757**

Industry Canada

On-file, 3 Meter Semi-Anechoic Chamber based on 47CFR 2.948
File Number: **IC 3088**

On-file 3 and 10 Meter OATS based on RSS-210

File Number: **IC 3088-A**

2. A2LA Certificate of Accreditation



3. A2LA Scope of Accreditation



American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999

L.S. COMPLIANCE, INC.
W66 N220 Commerce Court
Cedarburg, WI 53012
James Blaha Phone: 262 375 4400

ELECTRICAL (EMC)

Valid to: January 31, 2005

Certificate Number: 1255-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

Test

Test Method(s)

Emissions

Conducted Emissions

Continuous/Discontinuous

Code of Federal Regulations (CFR) 47, FCC Method Parts
15 and 18 using ANSI C63.4;
EN: 55011, 55022, 55081-1, 55081-2;
CISPR: 11, 22; CNS 13438

Radiated Emissions

Code of Federal Regulations (CFR) 47, FCC Method Parts
15 and 18 using ANSI C63.4;
EN: 55011, 55022, 55081-1, 55081-2;
CISPR: 11, 22; CNS 13438

Current Harmonics

EN 61000-3-2

Voltage Fluctuations & Flicker

EN 61000-3-3

Immunity

Conducted Immunity

Fast Transients/Burst

IEC: 1000-4-4, 801-4;

EN: 61000-4-4, 50082-1, 50082-2

Surge

IEC: 1000-4-5, 801-5; ENV 50142;

EN: 61000-4-5, 50082-1, 50082-2

RF Fields

IEC: 1000-4-6, 801-6; ENV 50141;

EN: 61000-4-6, 50082-1, 50082-2

Voltage Dips/Interruptions

IEC 1000-4-11;

EN: 61000-4-11, 50082-1, 50082-2

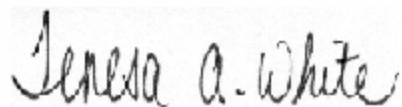
A handwritten signature in black ink that reads "Howard M. Robinson".

(A2LA Cert. No. 1255.01) 03/26/03
5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644 3248 • Fax: 301-662 2974

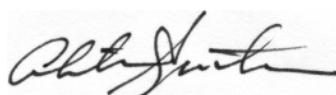


4. TEST CERTIFICATE

Manufacturer:	Dentsply International
Model No.:	761105-Controller
Serial No.:	Engineering Unit
Description:	E-Stylus Electric Motor Hand piece
Frequency Range:	911-916 MHz
Test Voltage:	26 VDC



Prepared By: _____ August 5, 2003
Teresa A. White, Document Coordinator Date



Tested By: _____ August 5, 2003
Abtin Spantman, EMC Engineer Date



Approved By: _____ August 5, 2003
Kenneth L. Boston, EMC Lab Manager Date
PE # 31926 Licensed Professional Engineer
Registered in the State of Wisconsin, United States

5. Product and General Information

Manufacturer:	Dentsply International
Model No.:	761105-Controller
Serial No.:	Engineering Unit
Description:	E-Stylus Electric Motor Hand piece
Frequency Range:	911-916 MHz
Test Voltage:	26 VDC

6. Product Description

The E-Stylus Electric Motor Hand-piece System is designed for cutting, shaping and polishing procedures in general dentistry, as well as for use with rotary endodontic files. The benefit of the system over conventional air driven devices is its ability to maintain constant speed over a wide range of bur load-torques in general dentistry and to limit file torque in endodontic procedures.

The product is comprised of a remote display and control unit (RDCU), an electric motor, an electronic control unit (CU), and a hose connecting the motor to the control unit, a number of different contra-angle and straight attachments, and a 26 VDC power supply.

The RDCU and the control unit each have a wireless RF transceiver for bi-directional communication with each other.

The microprocessor controlled RDCU has a liquid crystal display (LCD) and several buttons for operator interface. The control unit is also microprocessor controlled and contains all the motor control circuitry, as well as the physical interface for the air and water flows to the motor.

7. Test Requirements

The EUT was tested for Radiated Emissions to establish compliance with the limits set forth by Title 47 CFR, Parts 15.107, 15.109 and 15.249, for a low powered transceiver. The EUT was tested on the lowest, and highest channels, in accordance with Part 15.31.

8. Summary of Test Report

DECLARATION OF CONFORMITY

The Dentsply International E-Stylus Electric Motor Hand piece was found to **MEET** the requirements as described within the specification of Title 47 CFR FCC, Parts 15.207, 15.209, 15.249 and I.C. RSS-210.

The enclosed test results pertain to the samples of the test item listed, and only for the tests performed per the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report.

9. Introduction

On June 20th and 25th, 2003 a series of Radiated Emission tests were performed on one sample of the Dentsply International E-Stylus Electric Motor Hand piece, Model Number 761105-Controller, Serial Number "Engineering Unit", here forth referred to as the "*Equipment Under Test*" or "*EUT*". This product operates by means of a wireless RF transceiver for bi-directional communication between the remote display unit and the control unit. These tests were performed using the procedures outlined in ANSI C63.4-2001 for intentional radiators, and in accordance with the limits set forth in FCC Parts 15.207, 15.209 and 15.249 (Industry Canada RSS-210) for a transmitter or digital device. These tests were performed by Abtin Spantman, EMC Engineer of L.S. Compliance, Inc. and witnessed by Spartak Copaev of Dentsply International.

10. Purpose

The above-mentioned tests were performed in order to determine the compliance of the equipment under test (EUT) with limits contained in various provisions of Title 47 CFR, FCC Part 15, including: 15.207, 15.209 and 15.249. All Radiated Emission tests were performed to measure the emissions in the frequency bands described in this report, and to determine whether said emissions are below the limits established by the above sections.

These tests were performed in accordance with the procedure described in the American National Standard for methods of measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2001). Another document used as a reference for the EMI Receiver specification was the Comite International Special Des Perturbations Radioelecrtiques (CISPR) Number 16-1, 2002.

11. Radiated Emissions Test

Test Setup

The test setup was assembled in accordance with Title 47, CRF FCC Part 15 and ANSI C63.4-2001. The EUT was placed on an 80cm high non-conductive pedestal centered on a flush mounted 2-meter diameter turntable inside the 3 Meter Semi-Anechoic, FCC listed Chamber located at L. S. Compliance, Inc., Cedarburg, Wisconsin. The EUT was operated in normal operating mode, with bi-directional communication between the remote unit and the control unit, using 26 volts DC as provided by an external power supply. The emission limits are applicable at a separation distance of 3 meters, and are found in the Calculation of Radiated Emissions Limits page of this report. Measurements above 5 GHz were performed at a 1 meter separation distance. Please refer to Appendix A for a list of the test equipment. The test sample was operated on one of two (2) standard channels: low (911.6 MHz), and high (916.6 MHz) to comply with Part 15.31.

Test Procedure

Preliminary radiation measurements were performed on the EUT in the 3 Meter FCC listed Semi-Anechoic, Chamber, located at L. S. Compliance, Inc. in Cedarburg, Wisconsin. The frequency range from 30 MHz to 6000 MHz was scanned, and levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive wooden table in the 3 Meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the test object. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz and a Double Ridge Waveguide Horn Antenna was used for measuring emissions above 1 GHz. The maximum radiated emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities. For measurements above 5 GHz, an E4407B Spectrum Analyzer was used with the Horn Antenna, at a fixed antenna height of 1 meter and a separation distance of 1 meter.

The EUT was operated in two modes during the test. The unit was operated in standby mode as well as with the motor operating, and the worst case emissions in each case were identified. For those frequencies that had significant emissions, the EUT was scanned for emissions at those particular frequencies from 30 MHz to 10,000 MHz to establish compliance in accordance with FCC Parts 15.35 and 15.209 (RSS-210). The Biconical, Log Periodic and Horn Antennas were used as the sensing antennas. The EUT was positioned on an 80 cm high wooden table in the center of a flush-mounted turntable. The EUT was rotated, and the antenna mast was scanned to obtain a maximum signal level.

Final emission measurements were performed in the 3 Meter Semi-Anechoic Chamber and the results of the highest emissions seen, along with azimuth and height, are recorded in the Radiated Emissions Data Chart in this report.

Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at a N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The HP 8546A EMI Receiver was operated with a bandwidth of 120 kHz for measurements below 1 GHz, and a bandwidth of 1 MHz when measuring above 1 GHz. The Peak, Quasi-Peak and Average Detector functions were utilized. From 5 GHz to 10 GHz, an HP E4407 Spectrum Analyzer and an EMC0 Horn Antenna were used at a 1 meter separation distance.

Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.249 for an intentional radiator (Canada RSS-210). The frequencies with significant signals were recorded and plotted as shown in the Data Charts and Graphs.

CALCULATION OF RADIATED EMISSIONS LIMITS

For FCC Part 15.249 (902-928 MHz)

FIELD STRENGTH OF FUNDAMENTAL FREQUENCIES:

Limit of 50,000 μ V/m; in dB; $20 \log (50,000) = 94$ dB μ V/m

FIELD STRENGTH OF HARMONIC FREQUENCIES:

Limit of 500 μ V/m; in dB; $20 \log (500) = 54$ dB μ V/m

FIELD STRENGTH OF SPURIOUS/FREQUENCIES BY: 15.249(C)

Limit of -50 dBc of the fundamental limit; $94 - 50 + 44$ dB μ V
Except where the 15.209 limits will allow a higher limit to be used. (**)

Frequency (MHz)	Limit (μ V/m)	Limit (dB μ V/m)
902-928	50,000	94
f ₂ , f ₃ , f ₄ ...	500	54
Spurs; 30-88	159	44
Spurs; 88-216	159	44
Spurs; 216-960	500	46 (**)
Spurs; 960-9280	500	54 (**)

Measurement of Electromagnetic Radiated Emissions Upon a 3 meter FCC Listed Site

Frequency Range Inspected: 30 MHz – 10,000 MHz
Test Requirements: Title 47CFR 15.249, and 15.209

Manufacturer:	Dentsply International					
Date(s) of Test:	June 20 th and 25 th , 2003					
Test Engineer:	Abtin Spantman					
Model #:	761105-Controller					
Serial #:	Engineering Unit					
Voltage:	26 VDC					
Distance:	3 Meters (f<6 GHz), 1 meter (f>6GHz)					
Configuration:	Normal operation					
Channels:	Low= 911 MHz and High=916 MHz					
Detectors Used:		Peak	0	Quasi-Peak	0	Average

Test Equipment Utilized:

EMI Measurement Instrument: HP 8546A and Agilent E4407B

Biconical Antenna: EMCO 3110

Log Periodic Antenna: EMCO 43146A

Double Ridged Wave Guide Horn Antenna: EMCO 3115

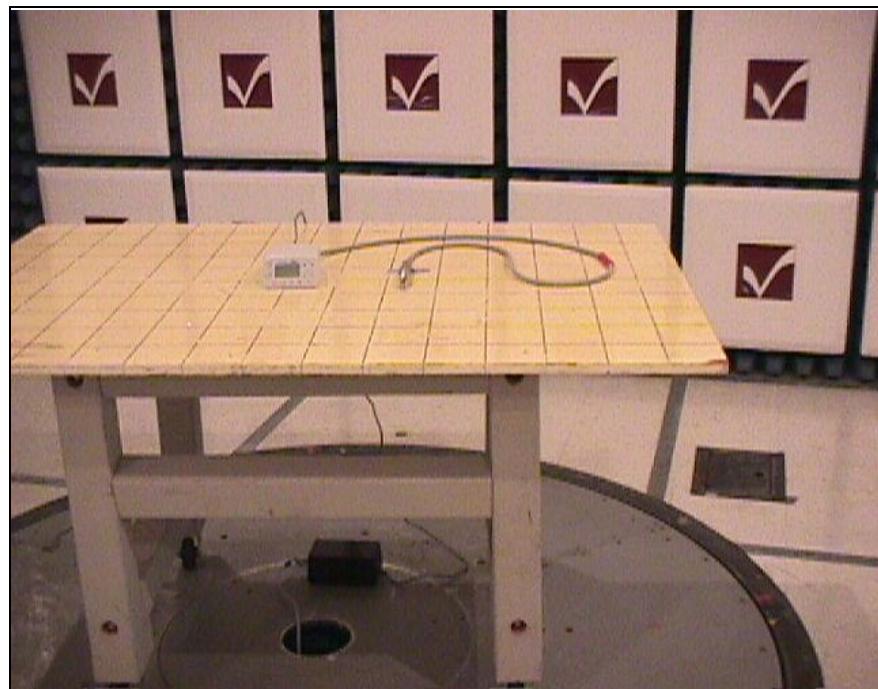
The following table depicts the level of significant radiated emissions found:

Frequency (MHz)	Antenna Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBmV/m)	Limit (dBmV/m)	Margin (dB)
55.3	V	Low	1.00	50	28.5	44.0	15.5
195.0	V	Low	1.00	50	37.2	44.0	6.8
215.0	H	Low	1.00	245	33.1	44.0	10.9
300.5	H	Low	1.00	300	26.6	46.0	19.4
911.6	H	Low	1.00	0	90.5	94.0	3.5
942.9	H	Low	1.00	0	28.7	46.0	17.3
1823.0	H	Low	1.00	15	32.2	54.0	21.8
2733.0	V	Low	1.00	100	42.1	54.0	11.9
55.3	V	High	1.05	50	26.6	44.0	17.4
195.0	V	High	1.00	50	37.0	44.0	7.0
215.0	H	High	1.00	155	33.4	44.0	10.6
305.0	H	High	1.00	50	28.7	46.0	17.3
916.6	H	High	1.00	0	90.4	94.0	3.6
928.7	H	High	1.00	0	25.8	46.0	20.2
1833.0	V	High	1.05	95	31.1	54.0	22.9
2750.0	V	High	1.65	105	40.4	54.0	13.6

Notes:

- 1) A Quasi-Peak Detector was used in measurements below 1 GHz, and an Average Detector was used in measurements above 1 GHz.
- 2) All other emissions were either better than 20 dB below the limits, or at receiver system noise floor.
- 3) Two modes of stand-by and motor-on were investigated. The motor had minimal effects in the readings within these frequency ranges. The effects of the motor are more visible in the conducted RF measurements that follow.

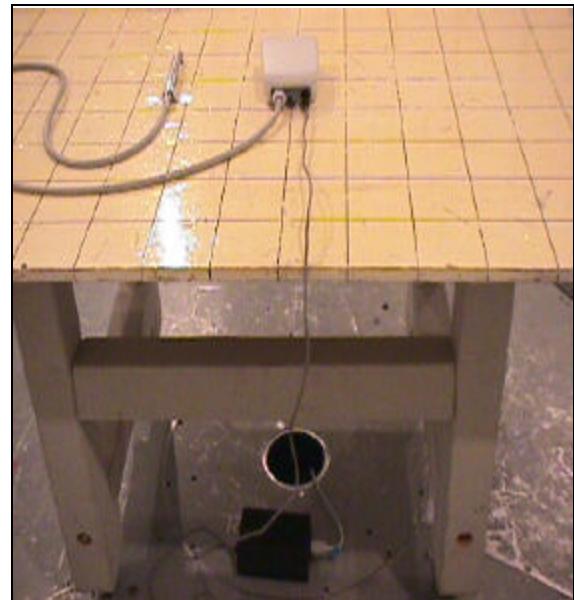
Photos of the Radiated Emissions Tests



View of the EUT during Radiated Emission Testing in the 3 Meter FCC Listed Chamber



Close up view of the stylus

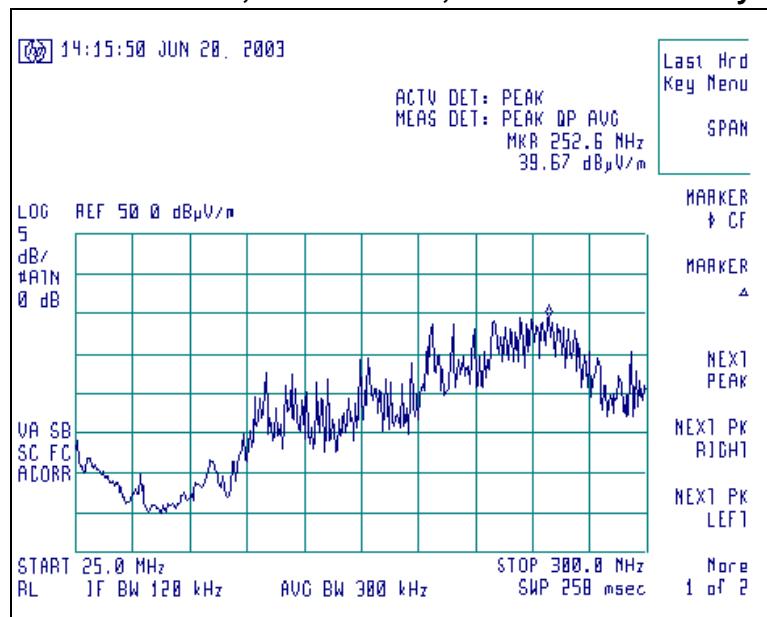


View from the rear of the unit

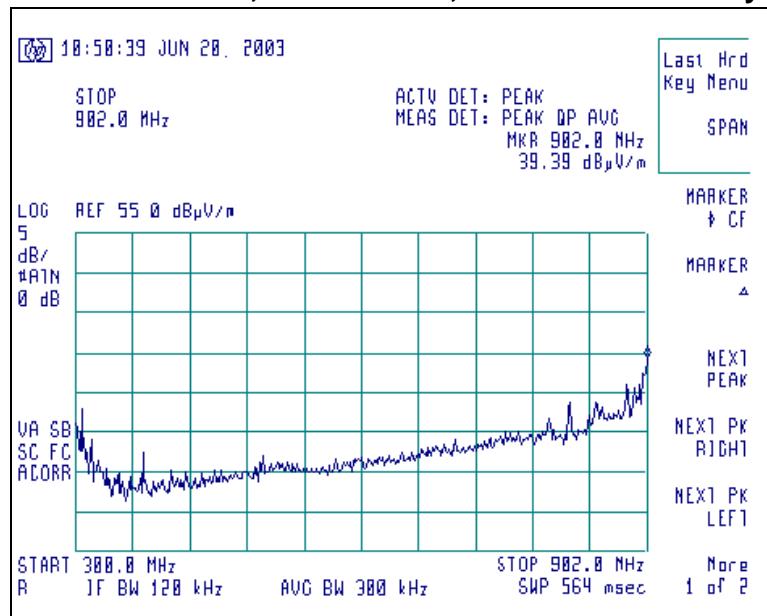
SIGNATURE SCAN OF RADIATED EMISSIONS

Highest emissions were observed with the antenna in the horizontal polarization. The difference in emissions between channels was insignificant, and hence, only emissions from the low channel are shown here.

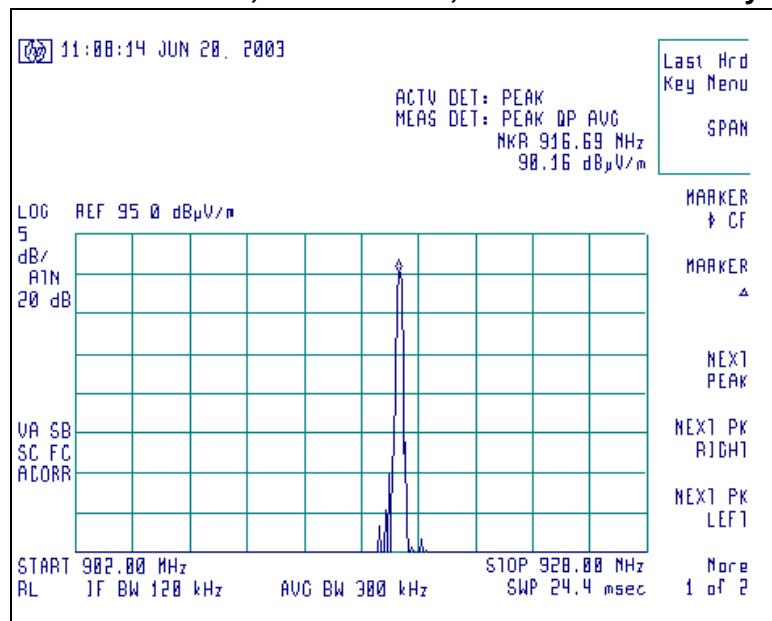
From 30 MHz to 300 MHz, Low Channel, Antenna Horizontally Polarized



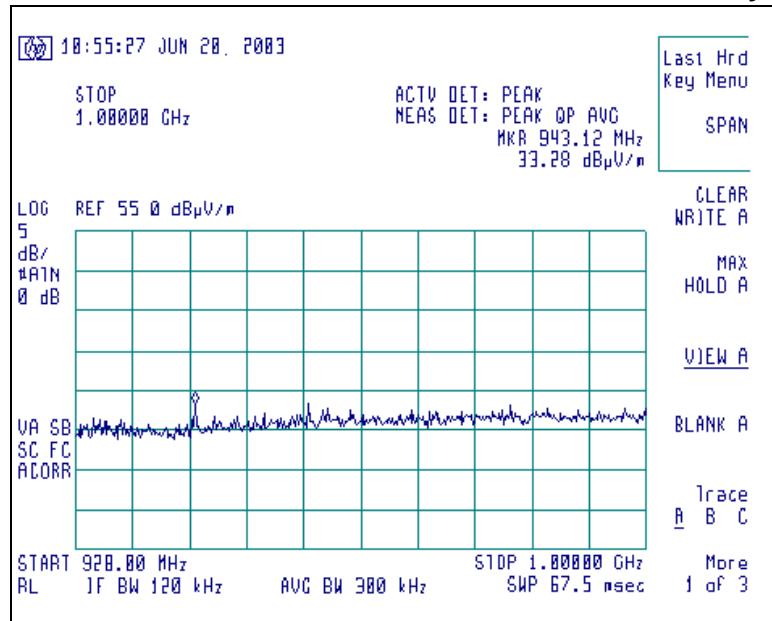
From 300 MHz to 902 MHz, Low Channel, Antenna Horizontally Polarized



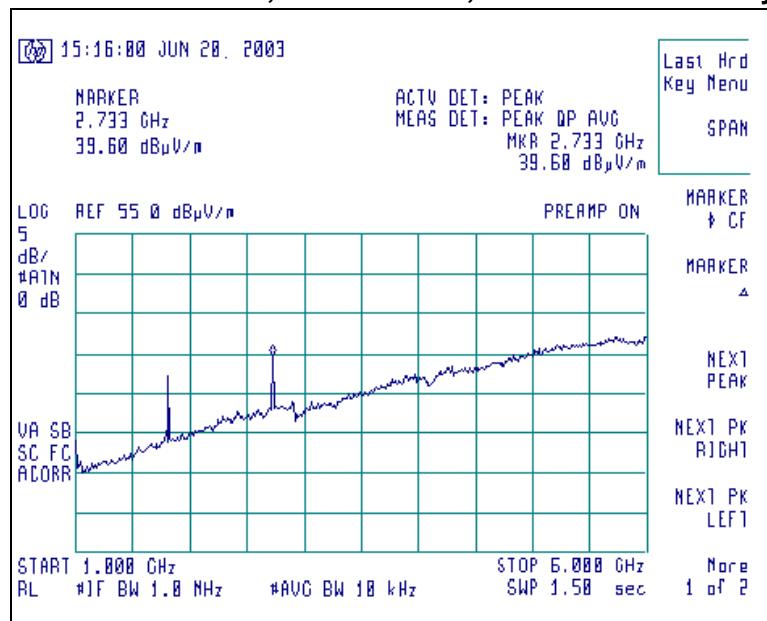
From 902 MHz to 928 MHz, Low Channel, Antenna Horizontally Polarized



From 928 MHz to 1000 MHz, Low Channel, Antenna Horizontally Polarized



From 1000 MHz to 6000 MHz, Low Channel, Antenna Horizontally Polarized



No significant emissions were observed above 3,000 MHz.

12. Conducted Emissions Test

Test Setup

The Conducted Emissions tests were performed within an 8' x 10' Shielded Room located at L.S. Compliance, Inc. in Cedarburg, Wisconsin. The EUT was placed on a non-conductive table, with a height of 80 cm above the reference ground plane. The EUT's power supply was plugged into a 50Ω (ohm), 50/250 μ H Line Impedance Stabilization Network (LISN). The test area and setup are in accordance with ANSI C63.4-2001 and (EN 55011). The AC power source to the LISN was fed into the 8' x 10' Shielded Room via an appropriate broadband EMI Filter. Final readings were then taken and recorded.

Test Procedure

After the EUT was setup in the 8' x 10' Shielded Room and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to the HP 8546A EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral). The appropriate frequency range and bandwidths were entered into the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1 (2001), Section 1, Table 1, for Quasi-Peak and Average Detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded. The limits for Conducted Emissions can be found in Title 47 CFR 15.207.

Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter are traceable to a N.I.S.T. site. All cables are calibrated and checked periodically for conformance. The emissions are measured on the HP 8546A EMI Receiver, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

Test Results

The EUT was found to MEET the Conducted Emissions requirements of Title 47 CFR 15.207. See the Data Charts and Graphs for more details of the test results.

Conducted Emissions Data Chart

Test Standard: Title 47 CFR 15.207

Manufacturer:	Dentsply International					
Date(s) of Test:	June 20 th and 25 th , 2003					
Test Engineer:	Abtin Spantman					
Model #:	761105-Controller					
Serial #:	Engineering Unit					
Voltage:	26 VDC					
Configuration:	Normal operation					
Detectors Used:		Peak	0	Quasi-Peak	0	Average

Environmental Conditions in the Lab:

Temperature: 20 – 25° C

Atmospheric Pressure: 86 kPa – 106 kPa

Relative Humidity: 30 – 60%

Test Equipment Utilized:

EMI Receiver: HP 8546A

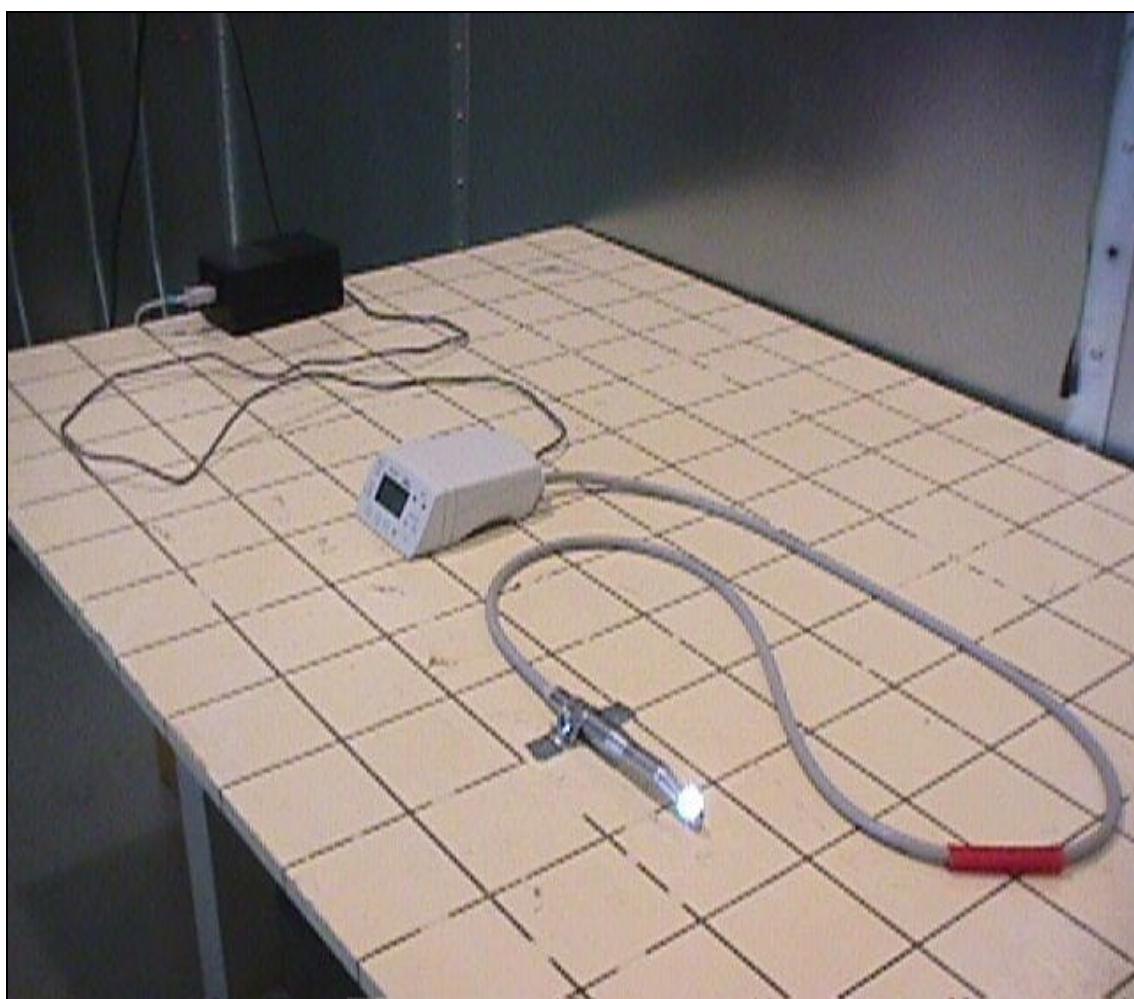
LISN: EMCO 3816/2NM

Transient Limiter: HP 119474A

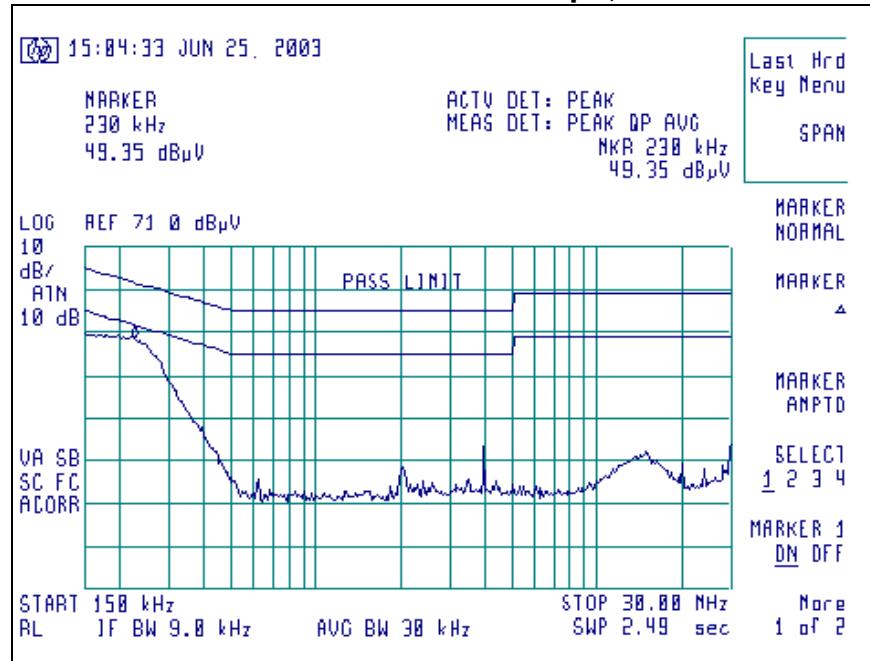
Frequency (MHz)	Line	QUASI-PEAK			AVERAGE		
		Q-Peak Reading (dB μ V/m)	Q-Peak Limit (dB μ V/m)	Quasi-Peak Margin (dB)	Average Reading (dB μ V/m)	Average Limit (dB μ V/m)	Average Margin (dB)
0.174	L1 (Standby)	44.6	64.8	20.2	15.5	54.8	39.3
0.174	L1 (Motor On)	53.4	64.8	11.4	23.4	54.8	31.4
0.228	L1 (Standby)	43.6	62.5	18.9	15.6	52.5	36.9
0.228	L1 (Motor On)	52.5	62.5	10.0	22.2	52.5	30.3
4.0	L1 (Standby)	29.9	56.0	26.1	28.3	46.0	17.7
15.2	L1 (Standby)	21.6	60.0	38.4	18.0	50.0	32.0
13.9	L1 (Motor On)	31.2	60.0	28.8	26.8	50.0	23.2
0.174	L1 (Motor On)	53.3	64.8	11.5	23.2	54.8	31.6
0.228	L1 (Motor On)	52.4	62.5	10.1	22.1	52.5	30.4
4.0	L1 (Motor On)	30.1	56.0	25.9	28.6	46.0	17.4
13.4	L1 (Motor On)	34.0	60.0	26.0	23.1	50.0	26.9

Notes: Emissions on L1, from both Stand-by mode and Motor-On mode have been shown for comparison.

Photo of the Conducted Emissions Test

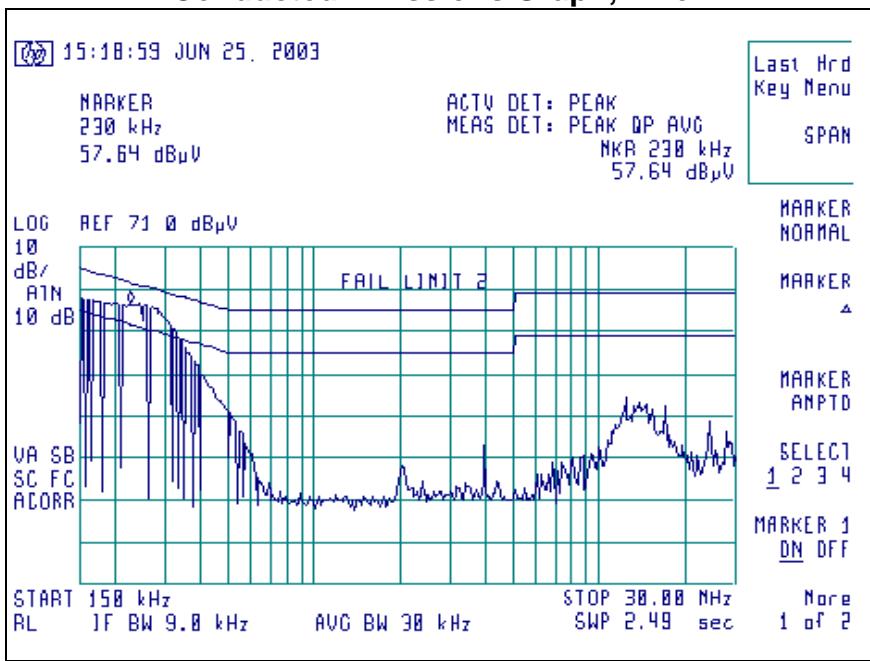


Conducted Emissions Graph, Line 1



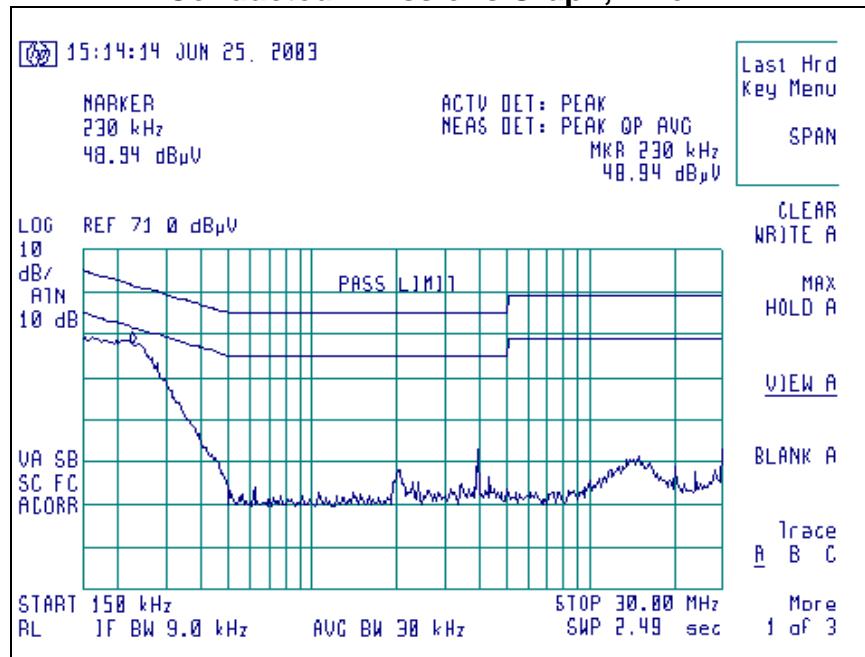
Stand-by Mode

Conducted Emissions Graph, Line 1



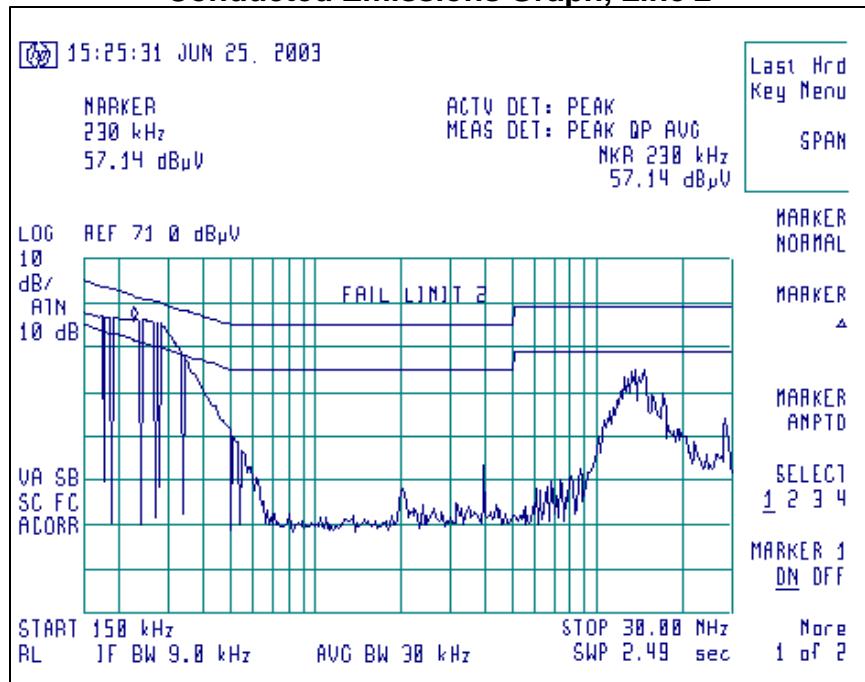
Motor-On Mode

Conducted Emissions Graph, Line 2



Stand-by Mode

Conducted Emissions Graph, Line 2



Motor-On Mode

APPENDIX A

Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Date	Due
AA960008	EMCO	3816/2NM	9701-1057	Line Impedance Stabilization Network	9/19/02	9/19/03
AA960031	HP	119474A	3107A01708	Transient Limiter	6/19/03	6/19/04
AA960077	EMCO	93110B	9702-2918	Biconical Antenna	9/19/02	9/19/03
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	9/19/02	9/19/03
AA960081	EMCO	3115	6907	Double Ridge Horn Antenna	11/12/02	11/12/03
CC00221C	Agilent	E4407B	US39160256	Spectrum Analyzer	10/28/02	10/28/03
EE960004	EMCO	2090	9607-1164	Device Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	9/20/02	9/20/03
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	9/20/02	9/20/03
N/A	LSC	Cable	0011	3 Meter 1/2" Armored Cable	6/19/03	6/19/04
N/A	LSC	Cable	0038	1 Meter RG 214 Cable	6/19/03	6/19/04
N/A	LSC	Cable	0050	10 Meter RG 214 Cable	6/19/03	6/19/04
N/A	Pasternack	Attenuator	N/A	10 dB Attenuator	6/19/03	6/19/04

Note 1 - Equipment calibrated within a traceable system.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3 Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V