

EMC EMISSION - TEST REPORT

Test Report File No. : **W301833301** Date of issue: 23 October 1998

Model / Serial No. : 9767 / C2-33

Product Type : Pacemaker Programming Head

Applicant : Medtronic Inc

Manufacturer : Medtronic Inc

License holder : Medtronic Inc

Address : 7000 Central Avenue NE
: Fridley MN 55432

Test Result : ☒ **Positive** ☐ **Negative**

Test Project Number : W8333

Reference(s)

Total pages including Appendices : 30

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DIRECTORY - EMISSIONS

		Page(s)
A) Documentation		
Test report		<u>1 - 10</u>
Directory		<u>2</u>
Test Regulations		<u>3</u>
Deviation from standard / Summary		<u>10</u>
Test-setups (Photos)		<u>11 - 12</u>
Test-setup (drawing)		<u>Appendix A</u>
B) Test data		
Conducted emissions	10/150 kHz - 30 MHz	<u>5, 9</u>
Radiated emissions	10 kHz - 30 MHz	<u>5, 9</u>
Radiated emissions	30 MHz - 1000 MHz	<u>6, 9</u>
Interference power	30 MHz - 300 MHz	<u>6, 9</u>
Equivalent Radiated emissions	1 GHz - 18 GHz	<u>7, 9</u>
C) Appendix A		
Test Data Sheets and Test Setup Drawing(s)		<u>A2 - A12</u>
D) Appendix B		
Constructional Data Form		<u>B2</u>
Product Information Form(s)		<u>B3 - B4</u>
E) Appendix C		
Measurement Protocol		<u>C1 - C2</u>

EMISSIONS TEST REGULATIONS :

The emissions tests were performed according to following regulations:

☐ - EN 50081-1 / 1991

☐ - EN 55011 / 1991

☐ - EN 55013 / 1990

☐ - EN 55014 / 1987

☐ - EN 55014 / A2:1990

☐ - EN 55014 / 1993

☐ - EN 55015 / 1987

☐ - EN 55015 / A1:1990

☐ - EN 55015 / 1993

☐ - EN 55022 / 1987

☐ - EN 55022 / 1994

☐ - BS

☐ - VCCI

☒ - FCC Part 15 Subpart C Section 15.209 - Radiated

☒ - FCC Part 15 Subpart B - Conducted

☐ - CISPR 11 (1990)

☐ - CISPR 22 (1993)

☐ - Group 1

☐ - Class A

☐ - Household appliances and similar

☐ - Portable tools

☐ - Semiconductor devices

☐ - Household appliances and similar

☐ - Portable tools

☐ - Semiconductor devices

☐ - Class A

☐ - Class A

☐ - Class A

☒ - Class A

☐ - Group 1

☐ - Class A

☐ - Class A

☐ - Group 2

☐ - Class B

☐ - Class B

☐ - Class B

☐ - Class B

☐ - Class B

☐ - Group 2

☐ - Class B

☐ - Class B

Environmental conditions in the lab:

	<u>Actual</u>
Temperature	: 23 °C
Relative Humidity	: 47 %
Atmospheric pressure	: 98.8 kPa
Power supply system	: 12 VDC (from programmer)

Sign Explanations:

- ☐ - not applicable
- ☒ - applicable

Emissions Test Conditions: CONDUCTED EMISSIONS (Interference Voltage)

The *CONDUCTED EMISSIONS (INTERFERENCE VOLTAGE)* measurements were performed at the following test location:

☐ - Test not applicable

- ☐ - Wild River Lab Large Test Site (Open Area Test Site)
- ☐ - Wild River Lab Small Test Site (Open Area Test Site)
- ☐ - Oakwood Lab (Open Area Test Site)
- ☒ - Wild River Lab Screen Room
- ☐ - New Brighton Lab Shielded Room

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Date
■ - ESH-3	Rohde & Schwarz	EMI Receiver	892473/004	5-98
■ - 3825/2	EMCO	50 Ω LISN	8812-1437	5-98

Use of the calibrated equipment on this list ensures traceability to national and international standards.

Emissions Test Conditions: RADIATED EMISSIONS (Magnetic Field)

The *RADIATED EMISSIONS (MAGNETIC FIELD)* measurements were performed at the following test location:

- ☒ - Wild River Lab Large Test Site (Open Area Test Site)
- ☐ - Wild River Lab Small Test Site (Open Area Test Site)
- ☐ - Oakwood Lab (Open Area Test Site)

at a test distance of :

- ☒ - 3 meters
- ☐ - 10 meters

☐ - Test not applicable

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Date
■ - ESH-3	Rohde & Schwarz	EMI Receiver	892473/004	5-98
■ - HFH2-Z2	Polarad	Loop Antenna	879285/036	6-97

Use of the calibrated equipment on this list ensures traceability to national and international standards.

Emissions Test Conditions: RADIATED EMISSIONS (Electric Field)

The **RADIATED EMISSIONS (ELECTRIC FIELD)** measurements, in the frequency range of 30 MHz-1000 MHz, were tested in a horizontal and vertical polarization at the following test location :

☒ - Test not applicable

- ☐ - Wild River Lab Large Test Site (Open Area Test Site)
- ☐ - Wild River Lab Small Test Site (Open Area Test Site)
- ☐ - Oakwood Lab (Open Area Test Site)

at a test distance of :

- ☐ - 3 meters
- ☐ - 10 meters
- ☐ - 30 meters

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Date
--------------	--------------	-------------	---------------	----------

Use of the calibrated equipment on this list ensures traceability to national and international standards.

Emissions Test Conditions: INTERFERENCE POWER

The **INTERFERENCE POWER** measurements were performed by using the absorbing clamp on the mains and interface cables in the frequency range 30 MHz - 300 MHz at the following test location :

☒ - Test not applicable

- ☐ - Wild River Lab Large Test Site (Open Area Test Site)
- ☐ - Wild River Lab Small Test Site (Open Area Test Site)
- ☐ - Oakwood Lab (Open Area Test Site)
- ☐ - Wild River Lab Screen Room
- ☐ - New Brighton Lab Shielded Room

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Date
--------------	--------------	-------------	---------------	----------

Emissions Test Conditions: RADIATED EMISSIONS (Electric Field)

The *EQUIVALENT RADIATED EMISSIONS* measurements in the frequency range 1 GHz - 100 GHz were performed in a horizontal and vertical polarization at the following test location :

- ☐ - Wild River Lab Large Test Site (Open Area Test Site)
- ☐ - Wild River Lab Small Test Site (Open Area Test Site)
- ☐ - Oakwood Lab (Open Area Test Site)
- ☐ - Wild River Lab Screen Room

at a test distance of:

- ☐ - 1 meters
- ☐ - 3 meters
- ☐ - 10 meters

☒ - Test not applicable

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Date
--------------	--------------	-------------	---------------	----------

Use of the calibrated equipment on this list ensures traceability to national and international standards.

Equipment Under Test (EUT) Test Operation Mode - Emission tests :

The device under test was operated under the following conditions during emissions testing:

- ☐ - Standby
- ☐ - Test program (H - Pattern)
- ☐ - Test program (color bar)
- ☐ - Test program (customer specific)
- ☐ - Practice operation
- ☐ - Normal Operating Mode
- ☒ - Medtronic proprietary.

Configuration of the device under test:

- ☐ - See Constructional Data Form in Appendix B - Page B2
- ☒ - See Product Information Form in Appendix B - beginning on Page B3

The following peripheral devices and interface cables were connected during the measurement:

- | | |
|---|----------------|
| <input type="checkbox"/> - _____ | Type : _____ |
| <input type="checkbox"/> - _____ | Type : _____ |
| <input type="checkbox"/> - _____ | Type : _____ |
| <input type="checkbox"/> - _____ | Type : _____ |
| <input type="checkbox"/> - _____ | Type : _____ |
| <input type="checkbox"/> - _____ | Type : _____ |
| <input type="checkbox"/> - _____ | Type : _____ |
| <input type="checkbox"/> - _____ | Type : _____ |
| <input type="checkbox"/> - unshielded power cable | |
| <input type="checkbox"/> - unshielded cables | |
| <input checked="" type="checkbox"/> - shielded cables | MPS.No.: _____ |
| <input type="checkbox"/> - customer specific cables | |
| <input type="checkbox"/> - _____ | |
| <input type="checkbox"/> - _____ | |

Emission Test Results:

Conducted emissions 10/150 kHz - 30 MHz

The requirements are ☒ - MET ☐ - NOT MET

Minimum limit margin 18 dB at 1.5 MHz

Maximum limit exceeding dB at MHz

Remarks: Programmer meets Class A requirements.

Radiated emissions (magnetic field) 10 kHz - 30 MHz

The requirements are ☒ - MET ☐ - NOT MET

Minimum limit margin for fundamental 23 dB at 150.0 kHz

Minimum limit margin for spurious/harmonics 16 dB at 600.0 kHz

Remarks: The fundamental was measured to be 81 dBuV/m in average mode at 3 meters, 61 dBuV/m (1122 microvolts/meter) at 10 meters. The 10 meter limit is extrapolated using the square of an inverse linear distance extrapolation factor (40 dB/decade) to be 84 dBuV/m (15848 microvolts/meter). The fourth harmonic was measured to be 50 dBuV/m in quasi-peak mode at 3 meters, 36 dBuV/m (63.1 microvolts/meter) at 10 meters. The 10 meter limit is extrapolated using the square of an inverse linear distance extrapolation factor (40 dB/decade) to be 52 dBuV/m (398.1 microvolts/meter).

Radiated emissions (electric field) 30 MHz - 1000 MHz

The requirements are ☐ - MET ☐ - NOT MET

Minimum limit margin for fundamental dB at MHz

Minimum limit margin for spurious dB at MHz

Remarks:

Interference Power at the mains and interface cables 30 MHz - 300 MHz

The requirements are ☐ - MET ☐ - NOT MET

Minimum limit margin dB at MHz

Maximum limit exceeding dB at MHz

Remarks:

Equivalent Radiated emissions 1 GHz - 4.2 GHz

The requirements are ☐ - MET ☐ - NOT MET

Minimum limit margin dB at MHz

Maximum limit exceeding dB at MHz

Remarks:

DEVIATIONS FROM STANDARD:

None.

GENERAL REMARKS:

The radiated measurements from 10 kHz to 30 MHz are made in quasi-peak detection, except for the levels noted between 110-490 kHz, which are made in average detection. The conducted emission measurements contained in this report are made on the AC input to the Programmer, which supplies DC voltage to the Programming Head (EUT).

The data sheets reflect W8215 & W8392, which reflects the projects under which the testing was performed. The report was requested under the project W8333.

SUMMARY:

The requirements according to the technical regulations are

☒ - met

☐ - not met.

The device under test does

☒ - fulfill the general approval requirements mentioned on page 3.

☐ - not fulfill the general approval requirements mentioned on page 3.

Testing Start Date: 15 May 1998

Testing End Date: 08 September 1998

- TÜV PRODUCT SERVICE INC -

Thomas K. Swanson
T. K. Swanson
Test Technician

Joel T. Schneider
Tested By:
J. T. Schneider

File No. W301833301, Page 10 of 12

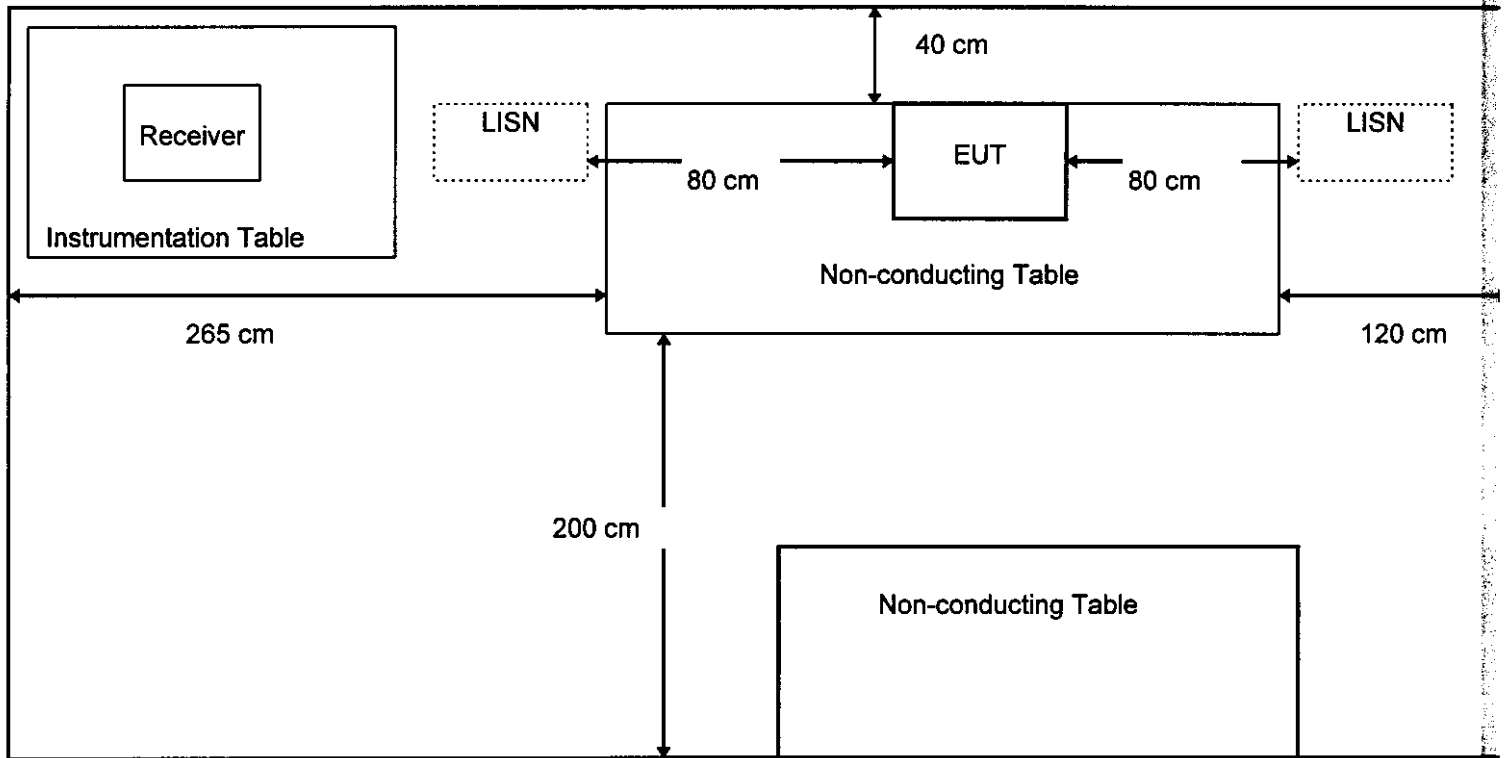
Appendix A

Test Data Sheets
and
Test Setup Drawing(s)

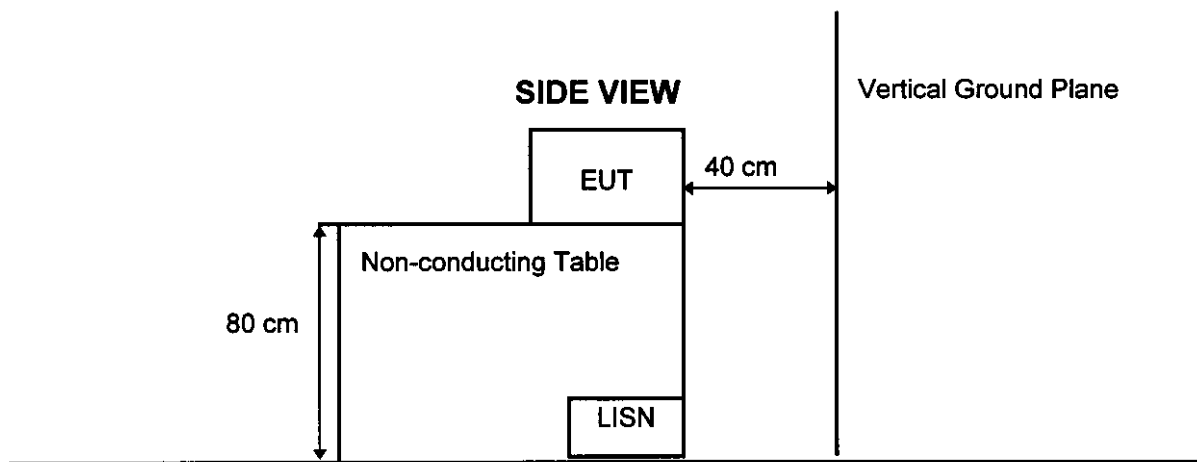
TEST SETUP FOR EMISSIONS TESTING

WILD RIVER LAB
Screen Room

TOP VIEW



SIDE VIEW



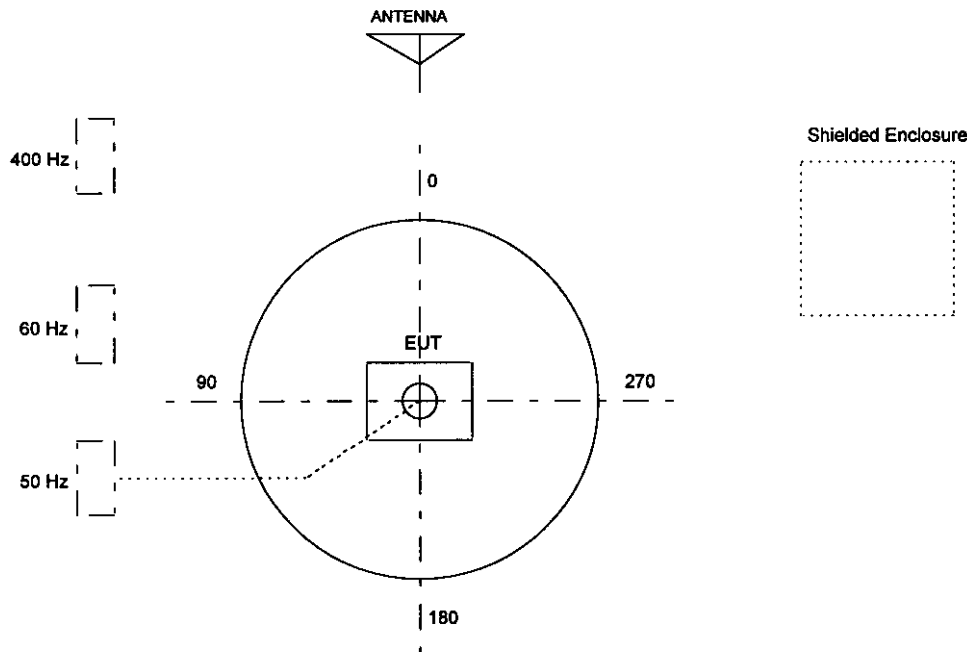
Other Measurements:
2 meters from top of EUT to ceiling
80 cm from closest part of EUT to the LISN

TEST SETUP FOR EMISSIONS TESTING

WILD RIVER LAB
Large Test Site

Notes:

1. Items shown in dotted lines are located on the floor below the test area. It is 5 meters vertically from the ground floor to the test area.
2. 50 Hz, 60 Hz, and 400 Hz are power panels for alternating current.
3. The antenna may be positioned horizontally 3, 10 or 30 meters from the center of the turntable.
4. The circle is a 6.7 meter diameter turntable.
5. A ground plane is in the plane of this sheet.
6. The test sample is shown in the azimuthal position representing zero degrees.

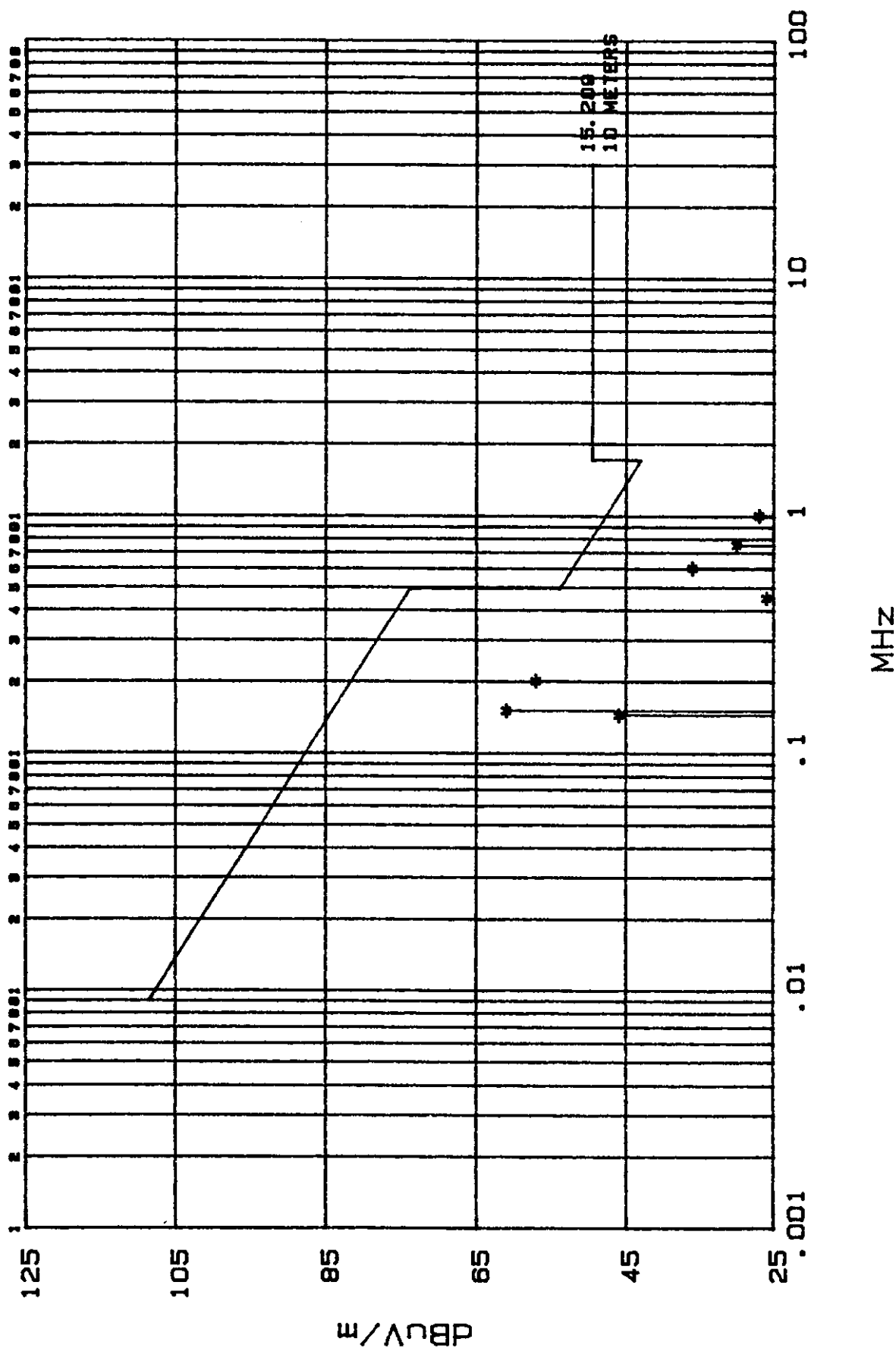


REPORT #W8333
RUN 1

TUV PS

FIGURE _____
DATE 05/15/98

MAGNETIC FIELD RADIATED EMISSION
MEDTRONIC 9767 PROGRAMMING HEAD
POWERED FROM PROGRAMMER - 10 METERS



TUV PS

Figure _____

MAGNETIC FIELD RADIATED EMISSION
MEDTRONIC 9767 PROGRAMMING HEAD
POWERED FROM PROGRAMMER - 10 METERS

Report W8333 Run 1
Date: 05/15/98 Page 1
Engineer _____
Tech _____

Measurement Summary

Frequency (MHz)	Amplitude (dBuV/m)	DELTA 15.209 10 METERS
0.1438	46	-38
0.1500	61	-23
0.2000	57	-24
0.4500	26	-48
0.6000	36	-16
0.7500	30	-20
1.0000	27	-20

Minimum Passing Margin for 15.209 10 METERS is 16 dB at .6 MHz

File W8333 Run 1

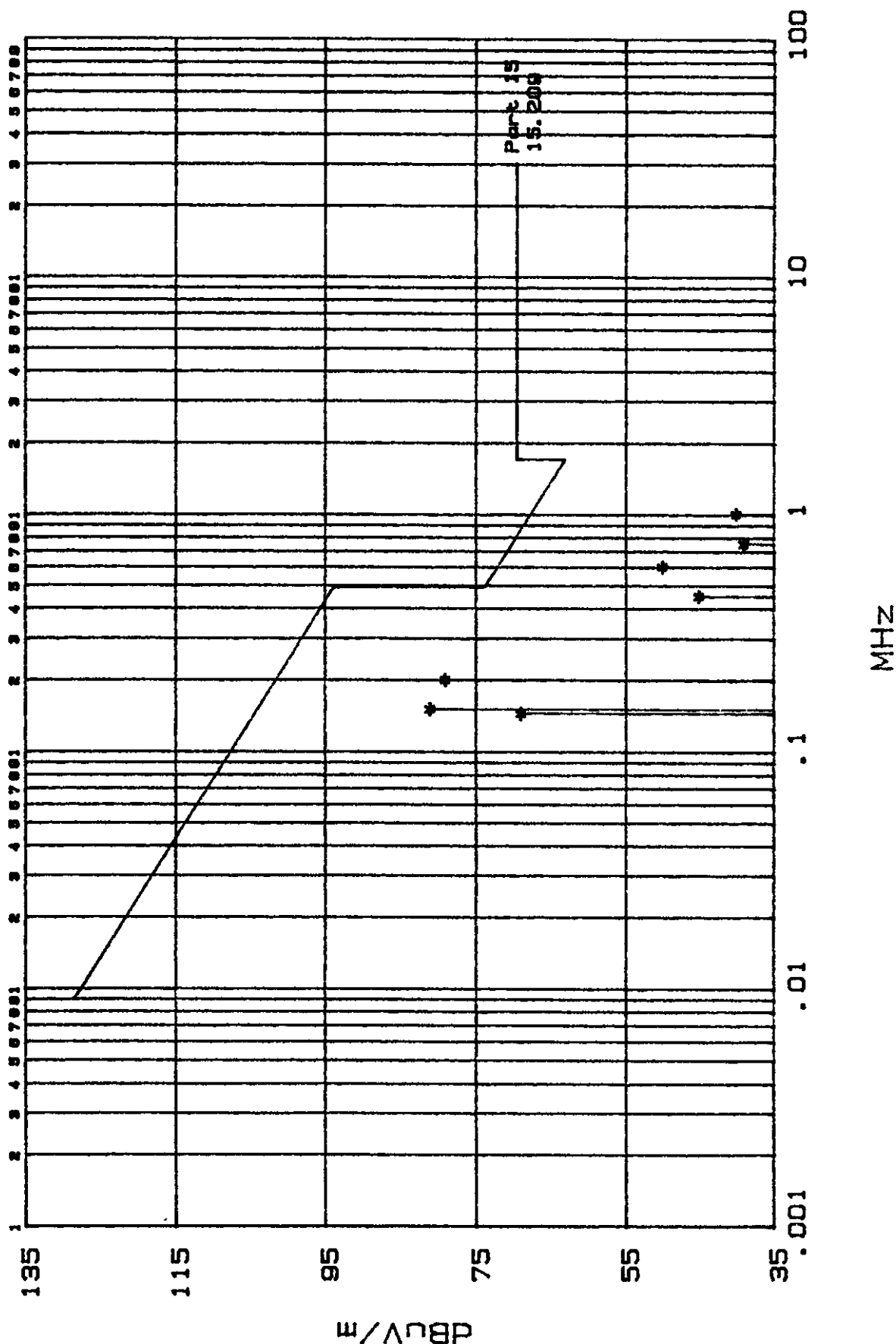
REPORT #W8333
RUN 1

TUV PS

FIGURE

MAGNETIC FIELD RADIATED EMISSION DATE 05/15/98
MEDTRONIC 9767 PROGRAMMING HEAD

POWERED FROM PROGRAMMER - 3 METERS



TUV PS

Figure _____

MAGNETIC FIELD RADIATED EMISSION
MEDTRONIC 9767 PROGRAMMING HEAD
POWERED FROM PROGRAMMER - **3 METERS**

Report W8333 Run 1
Date: 05/15/98 Page 1
Engineer _____
Tech _____

Measurement Summary

Frequency (MHz)	Amplitude (dBuV/m)	DELTA Part 15 15.209
0.1438	69	-35
0.1500	81	-23
0.2000	79	-22
0.4500	45	-49
0.6000	50	-22
0.7500	39	-31
1.0000	40	-27

Minimum Passing Margin for Part 15 15.209 is 22 dB at .6 MHz

File W8333 Run 1

Radiated Emissions

TEST REPORT # W8215REQUIREMENT 15.209ANALYZER ESH-3DATE 5/15/98ANTENNA POLARAD LOOPPRODUCT ID PROGRAMMING HEADSHEET 1 OF 1

TEST FREQ. (MHz)	dBuV	Factor (dB)*	Condition 1 dBuV/m	Condition 2 dBuV/m	Condition 3 dBuV/m	Condition 4 dBuV/m	Cond. 5 Ave. Peak	Cond. 6 Ave. Dist. Amb	REMARKS
.01			60						AMBIENT
.015			47	50					AMB.
.02			42	54					AMB.
.0214			51						AMB.
.024			66						AMB.
.0313			65						AMB.
.06			45						AMB.
.0627			57						AMB.
.1			53						AMB.
.1253			48						AMB.
.1438	Ave		50	62	78	85	69	46	104.4 @ 3M 84.4 @ 10M
.15	"		63	74	91	81	61		104.0 @ 3M 84.0 @ 10M
.197.2"			64	72	90	79	57		101.5 @ 3M 81.5 @ 10M
.2499			60	63					AMB.
.3			46	54					AMB.
.4			37	50					AMB.
.45	"		34	46	54	45	26		94.5 @ 3M 74.5 @ 10M
.4994			42						AMB.
.6			33	38	50			36	72.0 @ 3M 52.0 @ 10M
.625			43						AMB.
.75			31	37	39			30	70.1 @ 3M 50.1 @ 10M
1.			34	38	40			27	67.6 @ 3M 47.6 @ 10M

NO FURTHER SIGNALS.

Condition 1 QUASI-PEAK - AXES X - ANT 1 - 3MCondition 2 QUASI-PEAK - AXES Y - ANT 0 - 3MCondition 3 QUASI-PEAK - AXES Z - ANT 0 - 3MCondition 4 AVERAGE - AXES Z - ANT 0 - 3MCondition 5 AVERAGE - " - " - 10MCondition 6 QUASI-PEAK - " - " - 10MTested By Joel T. Schneider Results (Pass / Fail)
 TÜV Product Service
 1775 Old Hwy 8
 New Brighton, MN 55112
 Telephone: (612)-631-2487

 EMRADIAT.DOC
 Author: D.S. Carlson
 Released:
 Page 1 of 1

REPORT #W8333

TUV PS

FIGURE

RUN 1

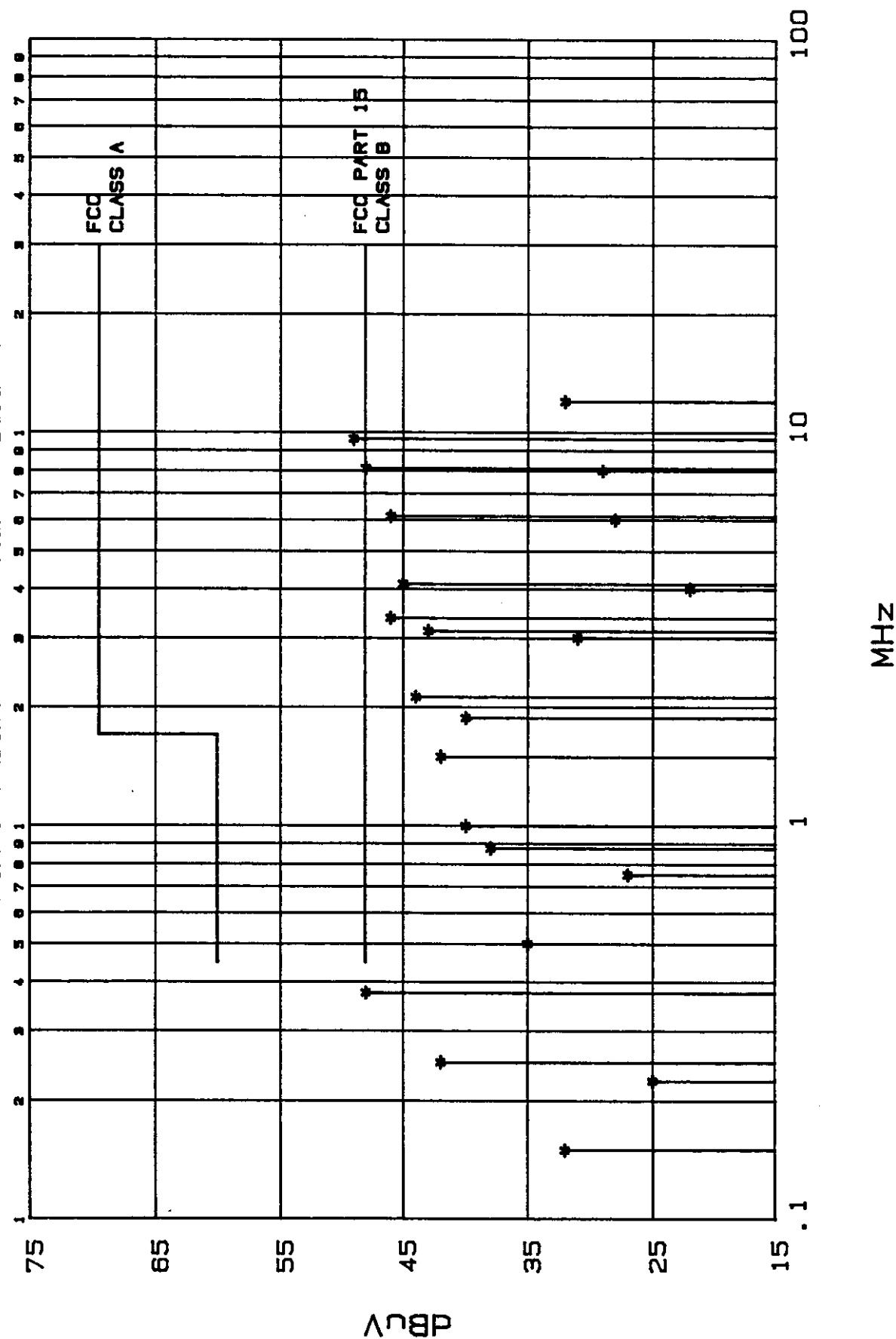
NARROWBAND CONDUCTED EMISSIONS

DATE 09-08-98

Medtronic

9790 with 9767 RF Head

Quasi-Peak - 60 HZ - 120 V



TUV PS

Figure _____

NARROWBAND CONDUCTED EMISSIONS

edtronic 9790 with 9767 RF Head
 uasi-Peak - 60 HZ - 120 V

Report W8333

Run 1

Date: 09-08-98

Page 1

Engineer _____

Tech _____

Measurement Summary

Frequency (MHz)	Amplitude (dBuV)	DELTA FCC CLASS A	DELTA FCC PART 15 CLASS B
0.1500	32	N/A	N/A
0.2250	25	N/A	N/A
0.2510	42	N/A	N/A
0.3760	48	N/A	N/A
0.5020	35	-25	-13
0.7520	27	-33	-21
0.8780	38	-22	-10
1.0000	40	-20	-8
1.5000	42	-18	-6
1.8800	40	-29	-8
2.1300	44	-25	-4
3.0100	31	-38	-17
3.1300	43	-26	-5
3.3800	46	-23	-2
4.0100	22	-47	-26
4.1300	45	-24	-3
6.0100	28	-41	-20
6.1400	46	-23	-2
8.0200	29	-40	-19
8.1400	48	-21	0
9.6400	49	-20	1 *
12.0200	32	-37	-16

Minimum Passing Margin for FCC CLASS A is 18 dB at 1.5 MHz

Maximum Failing Margin for FCC PART 15 CLASS B is 1 dB at 9.6 MHz

File W8333 Run 1

Form



Conducted Emissions

TEST REPORT # W8392

REQUIREMENT _____

DATE 9/8/98LISN 1437PRODUCT ID: MEDTRONIC 9790 w/9767 RF HEADRECEIVER ESH-3SHEET 1 OF 1

TEST FREQ (MHz)	Condition 1 (dBuV)		Condition 2 (dBuV)		Condition 3 (dBuV)		REMARKS
	Neutral	Line Side	Neutral	Line Side	Neutral	Line Side	
.15	32	32			31	32	
.225	25	25			24	25	
.251	42	42			41	42	
.376	39	47		46	38	48	
.502	35	34			35	35	
.752	27	26			27	24	
.878	38	33			38	31	
1.	37	32			30/40	26	
1.5	36	38			42	32	
1.88	38	40			40	32	
2.13	42	42			44	39	
3.01	34	34			25	31	
3.13	47	47	39	41	41	43	
3.38	47	50	40	45	38	46	
4.01	30	33			20	22	
4.13	46	51		45	35	45	
6.01	34	39			23	28	
6.14	46	53		45	38	46	
8.02	34	39			27	29	
8.14	46	51		43/46	42	48	
12.02	24/36	31			32	28	
9.64	51	55	42	48	45	49	

Condition1 50Hz, 230V, Q.P.Condition2 " " AVE. + 60Hz, 120VCondition3 60Hz, 120V, Q. P.Tested By ATX Results (Pass / Fail)

TUV Product Service
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New Brighton, MN 55112
Telephone: (612)-631-2487

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Page 1 of 1

TUV PRODUCT SERVICE CONDUCTED EMISSIONS

08. Sep 98 08:41

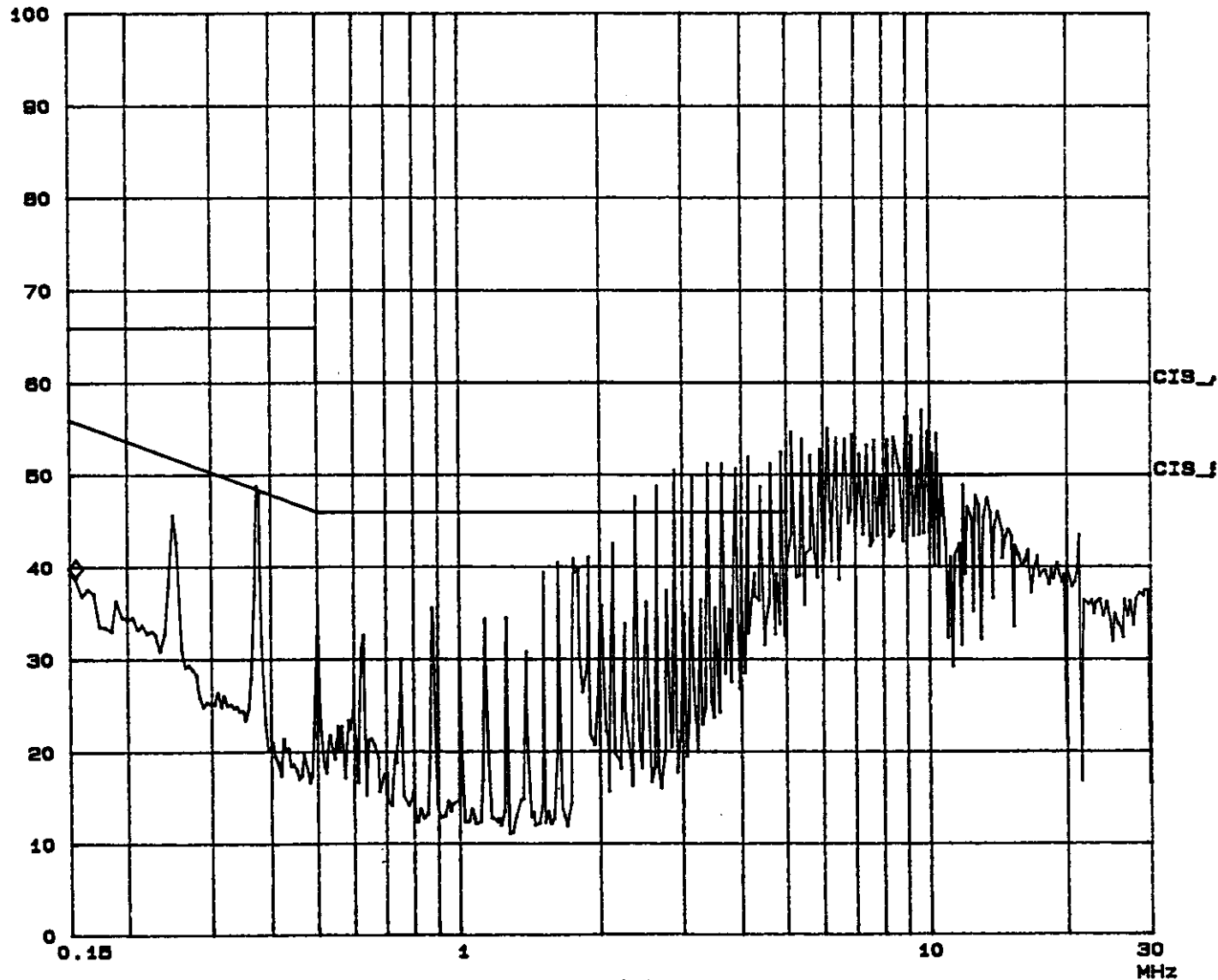
EUT: 9767 RF HEAD W/9790
 Manuf: MEDTRONIC
 Operator: JTS
 Test Spec: CISPR CLASS A
 Comment: 50 Hz 230VAC
 09/08/98

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK	10ms	AUTO	LN OFF	50dB

Transducer No.	Start	Stop	Name
1	150k	30M	Limiter

dBuV \diamond Mkr : 155.00 kHz 38.9 dBuV



Appendix B

**Constructional Data Form
and
Product Information Form(s)**

Constructional Data Form

Not Applicable

PRODUCT INFORMATION FORM

NOTE: It is required to complete both 1) a Product Information Form for each unit under test and 2) a Constructional Data Form for each system tested as outlined in the enclosed instructions. Please be sure to include accurate description and model number information as TÜV will use this, as written, when preparing the After Test Documentation.

Company Name Medtronic, Inc.
 Company Address 7000 Central Ave. N.E.
Fridley, MN 55432

Customer Representatives Curt Sponberg
 Equipment Description Pacemaker Programming Head

Model Number 9767 Programming Head Serial Number C2-33

Type of Test Development
☒ Initial Design Verification
 Design Change (Please describe exact changes below)
 Production Sample (Audit Test)

Changes Made _____

Oscillator Frequencies
 The downlink is frequency shift keyed at 150 KHz and at 200 KHz. It is crystal controlled.

Power Interface		Power Supply	
Frequency	<u>DC</u>	Description	<u>n/a</u>
Voltage	<u>↑ 12 VDC</u>	Manufacturer	_____
# of Phases	_____	Model Number	_____
Current	<u>↑ 150 mA.</u>	Switching Freq	_____

Power Cable
 Hardwired ☒ Flexible
☒ Shielded Unshielded
☒ Attached Removable

Power Line Filter
 Manufacturer _____ Model Number _____
n/a

Cabinet Shielding Provision

~~EMC conductive spray paint~~

Software and/or Operating Modes

Medtronic proprietary

Interfacing Equipment or Simulators

Description	Model Number	Serial Number	FCC ID#
9790 Programmer	9790	IDC400101P	n/a
Telemetry electronics module	9767TEM	C-23	n/a

I/O Cables

Function	Length	Type	Shield Termination
n/a			

Block Diagram

Provided in submission package.

Appendix C

MEASUREMENT PROTOCOL FOR FCC

GENERAL INFORMATION

Measurement Uncertainty

The test system for conducted emissions is defined as the LISN, tuned receiver or spectrum analyzer, and coaxial cable. The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. These test systems have a measurement uncertainty of ± 4.5 dB. The equipment comprising the test systems are calibrated on an annual basis.

Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into it's characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

CONDUCTED EMISSIONS

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

RADIATED EMISSIONS

The final level, expressed in dB μ V/m, is arrived at by taking the reading from the spectrum analyzer (Level dB μ V) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has the FCC limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets in Attachment B. The amplifier gain is automatically accounted for by using an analyzer offset.

Example:

Frequency (MHz)	Level (dB μ V)	+	Factor & Cable (dB)	=	Final (dB μ V/m)	-	FCC B Limit (dB μ V/m)	=	Delta FCC B (dB)
32.21	13.9	+	16.3	=	30.2	-	40.0	=	-9.8

DETAILS OF TEST PROCEDURES

General Standard Information

The test methods used comply with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

Conducted Emissions

Conducted emissions on the 60 Hz power interface of the EUT are measured in the frequency range of 450 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50 Ω /50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. In some cases, a pre-scan using a spectrum analyzer is initially performed on the units comprising the system under test to locate the highest emissions. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver or spectrum analyzer with quasi-peak and average detection and recorded on the data sheets.

Radiated Emissions

Radiated emissions from the EUT are measured in the frequency range of 30 to 1000 MHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 3 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees. Intentional radiators are rotated through three orthogonal axes to determine the attitude that maximizes the emissions.

In the frequency range of 9 kHz to 30 MHz, measurements are made with quasi-peak or average detection with a loop antenna. The antenna is positioned 1 meter above the ground plane and rotated about its vertical axis for maximum response at each azimuth about the EUT.