

# TEST RESULT SUMMARY

## FCC PART 15 SUBPART C Section 15.209

MANUFACTURER'S NAME	Medtronic Neurological
NAME OF EQUIPMENT	RX1 ENS
TYPE OF EQUIPMENT	Battery-powered, temporary external neurostimulator
MODEL NUMBER	<b>37021</b>
MANUFACTURER'S ADDRESS	800 53 <sup>rd</sup> Avenue NE Columbia Heights, MN 55421
TEST REPORT NUMBER	WC403136.1 Rev A
TEST DATE	06 July 2004

According to testing performed at TÜV Product Service Inc, the above-mentioned unit is in compliance with the electromagnetic compatibility requirements defined in FCC Part 15 Subpart C, Section 15.209.

It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics. Any modifications necessary for compliance made during testing on the above mentioned date(s) must be implemented in all production units for compliance to be maintained.

TÜV Product Service Inc, as an independent testing laboratory, declares that the equipment tested as specified above conforms to the requirements of FCC Part 15 Subpart C, Section 15.209.

Date: 20 April 2005



Location: Taylors Falls MN  
USA

R. M. Johnson  
Tested By

T. K. Swanson  
Reviewed By

# EMC EMISSION - TEST REPORT

Test Report File No. : **WC403136.1 Rev A** Date of issue: 20 April 2005Model No. : **37021**Product Name : **RX1 ENS**Product Type : **Battery-powered, temporary external neurostimulator**Applicant : **Medtronic Neurological**Manufacturer : **Medtronic Neurological**License holder : **Medtronic Neurological**Address : **800 53<sup>rd</sup> Avenue NE**: **Columbia Heights, MN 55421**Test Result :  **Positive**  **Negative**Test Project Number :  
Reference(s) : **WC403136.1 Rev A**Total pages including  
Appendices : **26**

*TÜV Product Service Inc is a subcontractor to TÜV Product Service, GmbH according to the principles outlined in ISO/IEC Guide 25 and EN 45001.*

*TÜV Product Service Inc reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. TÜV Product Service Inc shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV Product Service Inc issued reports.*

*This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full without our written approval. This report shall not be used by the client to claim product endorsement by NVLAP or any agency of the US government.*

*TÜV Product Service Inc and its professional staff hold government and professional organization certifications and are members of AAMI, ACIL, AEA, ANSI, IEEE, NVLAP, and VCCI*

### REVISION RECORD

REVISION	TOTAL NUMBER OF PAGES	DATE	DESCRIPTION
	25	25 July 2004	Initial Release
A	26	20 April 2005	Revisions include: <ul style="list-style-type: none"> <li>▪ Pg 10, Results for Part 15.209: Corrected dB/decade to 36 dB/decade.</li> </ul>



## D I R E C T O R Y - E M I S S I O N S

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## EMISSIONS TEST REGULATIONS :

The emissions tests were performed according to following regulations:

- |   |   |                                    |
|---|---|------------------------------------|
| <input type="checkbox"/> - EN 50081-1 / 1991  | <input type="checkbox"/> - Group 1                          | <input type="checkbox"/> - Group 2 |
| <input type="checkbox"/> - EN 55011 / 1991  | <input type="checkbox"/> - Class A                          | <input type="checkbox"/> - Class B |
| <input type="checkbox"/> - EN 55013 / 1990  | <input type="checkbox"/> - Household appliances and similar |                                    |
| <input type="checkbox"/> - EN 55014 / 1987  | <input type="checkbox"/> - Portable tools                   |                                    |
|   | <input type="checkbox"/> - Semiconductor devices            |                                    |
| <input type="checkbox"/> - EN 55014 / A2:1990   | <input type="checkbox"/> - Household appliances and similar |                                    |
| <input type="checkbox"/> - EN 55014 / 1993  | <input type="checkbox"/> - Portable tools                   |                                    |
|   | <input type="checkbox"/> - Semiconductor devices            |                                    |
| <input type="checkbox"/> - EN 55015 / 1987  |   |                                    |
| <input type="checkbox"/> - EN 55015 / A1:1990   |   |                                    |
| <input type="checkbox"/> - EN 55015 / 1993  |   |                                    |
| <input type="checkbox"/> - EN 55022 / 1987  | <input type="checkbox"/> - Class A                          | <input type="checkbox"/> - Class B |
| <input type="checkbox"/> - EN 55022 / 1994  | <input type="checkbox"/> - Class A                          | <input type="checkbox"/> - Class B |
| <input type="checkbox"/> - BS   |   |                                    |
| <input type="checkbox"/> - VCCI   | <input type="checkbox"/> - Class A                          | <input type="checkbox"/> - Class B |
| <input checked="" type="checkbox"/> - FCC Part 15 Subpart C Section 15.209                      |   |                                    |
| <input type="checkbox"/> - FCC Part 15 Subpart C Section 15.207 Conducted Emission Requirements |   |                                    |
| <input type="checkbox"/> - FCC Part 15 Subpart B  | <input type="checkbox"/> - Class A                          | <input type="checkbox"/> - Class B |
| <input type="checkbox"/> - CISPR 11 (1990)  | <input type="checkbox"/> - Group 1                          | <input type="checkbox"/> - Group 2 |
|   | <input type="checkbox"/> - Class A                          | <input type="checkbox"/> - Class B |
| <input type="checkbox"/> - CISPR 22 (1993)  | <input type="checkbox"/> - Class A                          | <input type="checkbox"/> - Class B |

**Environmental conditions in the lab:**

	<u>Actual</u>
Temperature	: 16 °C
Relative Humidity	: 81 %
Atmospheric pressure	: 98.0 kPa
Power supply system	: 3 VDC Battery

**Sign Explanations:**

- not applicable
- applicable



**Emissions Test Conditions: CONDUCTED EMISSIONS [FCC 15.207]**

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

**Emissions Test Conditions: RADIATED EMISSIONS (FCC 15.209 10 kHz - 30 MHz)**

The *RADIATED EMISSIONS (MAGNETIC FIELD)* 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)

at a test distance of :

- 0.3 meters
- 1 meter
- 3 meter
- 10 meters
- 30 meters

**Test equipment used :**

	TUV ID	Model Number	Manufacturer	Description	Serial Number	Cal Due
<input checked="" type="checkbox"/>	2534	ESHS-20	Rhode & Schwarz	EMI Receiver	837055/003	1-14-05
<input checked="" type="checkbox"/>	2517	HFH2-Z2	Polorad	Loop Antenna	879285/036	4-27-05

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST) and is calibrated annually.

### Emissions Test Conditions: RADIATED EMISSIONS (FCC 15.209 Electric Field 30 - 1000 MHz)

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) – NSA measurements made 2-03, due 2-05.
- Oakwood Lab (Open Area Test Site)

at a test distance of :

- 3 meters
- 10 meters
- 30 meters

Test equipment used :

TUV ID	Model Number	Manufacturer	Description	Serial Number	Cal Due
<input checked="" type="checkbox"/> - 3203	EM-6917B	Electro-Metrics	Biconicalog Periodic	106	3-30-05
<input checked="" type="checkbox"/> - 2690	8566B	Hewlett-Packard	Spectrum Analyzer (Unit F)	2430A00930	1-28-05
<input checked="" type="checkbox"/> - 2673	85662A	Hewlett-Packard	Analyzer Display (Unit A)	2152A03687	1-28-05
<input checked="" type="checkbox"/> - 2681	85650A	Hewlett-Packard	Quasi-Peak Adapter	2430A00562	2-23-05
<input checked="" type="checkbox"/> - 2671	8447D	Electro-Mechanics (EMCO)	Preamplifier	2648A04942	Code B

Cal Code B = Calibration verification performed internally. Cal Code Y = Calibration not required when used with other calibrated equipment.

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST) and is calibrated annually.

### 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



**Emissions Test Conditions: RADIATED EMISSIONS Electric Field 1 to 100 GHz**

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:

- 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

**at a test distance of:**

- 1 meters
- 3 meters
- 10 meters



**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) – Continuous telemetry uplink per FE04
- Practice operation
- Normal Operating Mode
- \_\_\_\_\_

**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:**

- \_\_\_\_\_ Type : \_\_\_\_\_
- \_\_\_\_\_ Type : \_\_\_\_\_
- \_\_\_\_\_ Type : \_\_\_\_\_
- \_\_\_\_\_ Type : \_\_\_\_\_
- \_\_\_\_\_ Type : \_\_\_\_\_
- unshielded power cable
- unshielded cables
- shielded cables                      MPS.No.: \_\_\_\_\_
- customer specific cables
- \_\_\_\_\_
- \_\_\_\_\_

### Emission Test Results:

#### FCC 15.207 - Conducted emissions 450 kHz - 30 MHz

The requirements are  - MET  - NOT MET  - N/A

Minimum margin of compliance \_\_\_\_\_ dB at \_\_\_\_\_ kHz

Maximum margin of non-compliance \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Remarks: \_\_\_\_\_

#### FCC 15.209 - Radiated emissions (magnetic field) 10 kHz - 30 MHz

The requirements are  - MET  - NOT MET

Minimum limit margin for fundamental \_\_\_\_\_ 54 dB at \_\_\_\_\_ 175.0 kHz

Minimum limit margin for spurious/harmonics \_\_\_\_\_ >10 dB at \_\_\_\_\_ MHz

Remarks: The fundamental was measured to be 76 dBuV/m (6309.5 microvolts/meter) in Average mode at 0.3 meters, 58 dBuV/m (794.3 microvolts/meter) at 1 meter and 40 dBuV/m (100.0 microvolts/meter) at 3 meters. This extrapolates to a level of -32 dBuV/m (0.025 microvolts/meter) at 300 meters using 36 dB/decade as indicated by testing. The limit is 22.7 dBuV/m (13.7 microvolts/meter) at 300 meters. No spurious emissions or other harmonics were detected.

#### FCC 15.209 - Radiated emissions (electric field) 30 MHz - 1000 MHz

The requirements are  - MET  - NOT MET

Minimum margin of compliance \_\_\_\_\_ >10 dB at \_\_\_\_\_ MHz

Minimum limit margin for spurious \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Remarks: No emissions detected within 10 dB of the limit.

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

The requirements are  - MET  - NOT MET  - N/A

Remarks: \_\_\_\_\_

#### Equivalent Radiated emissions 1 GHz - 100 GHz

The requirements are  - MET  - NOT MET  - N/A

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.

**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: 06 July 2004

Testing End Date: 06 July 2004

- TÜV PRODUCT SERVICE INC -

*Thomas K. Swanson*

T. K. Swanson  
Reviewed By

*R. M. Johnson*

Tested By:  
R. M. Johnson

Test-setup photo(s):  
Conducted emission 450 kHz - 30 MHz

**Not Applicable**



Test-setup photo(s):  
Radiated emission 10 kHz - 1000 MHz



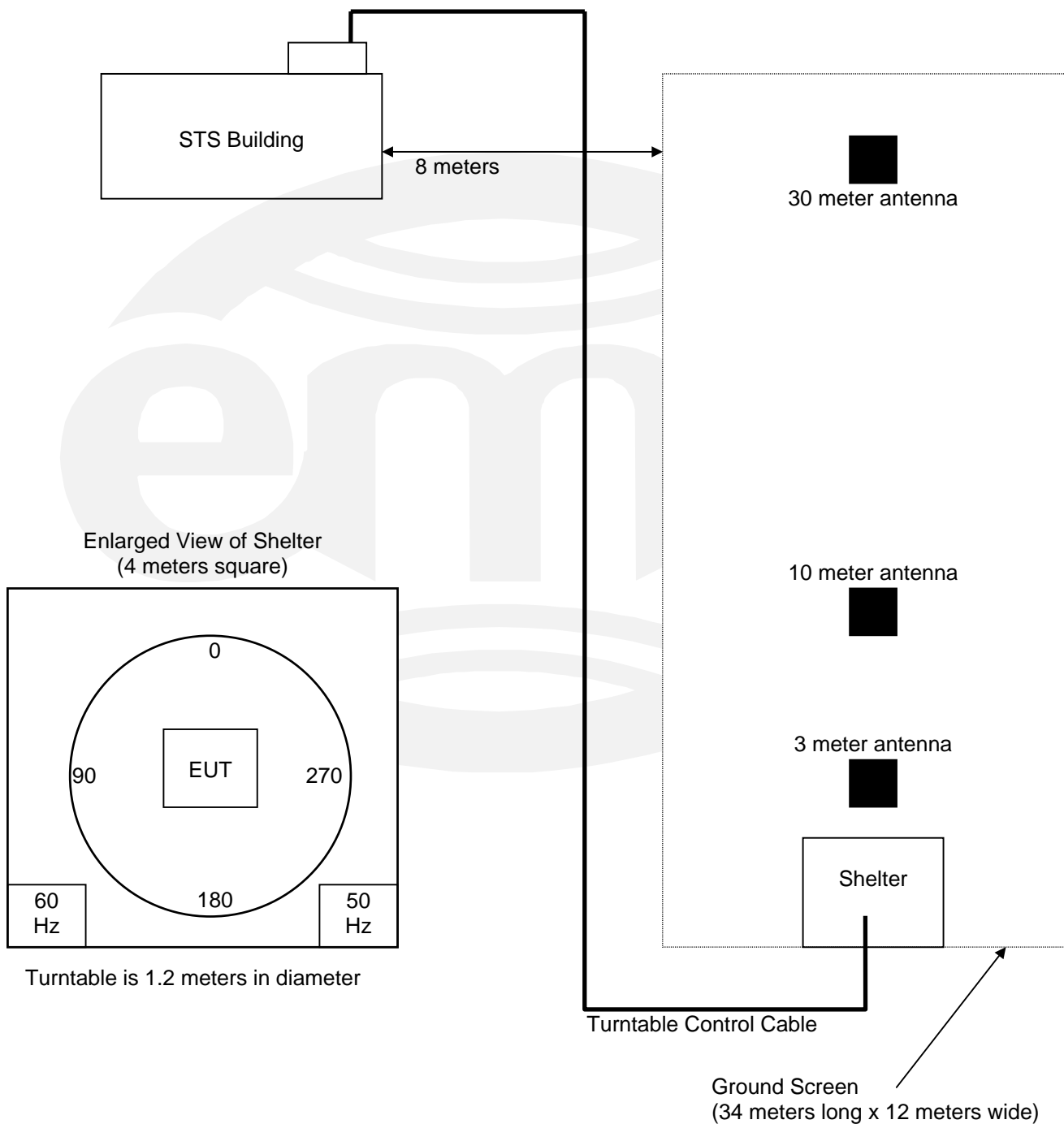
## Appendix A

Test Data Sheets  
and  
Test Setup Drawing(s)



**TEST SETUP FOR EMISSIONS TESTING**

WILD RIVER LAB  
Small Test Site (STS)





FCC Part 15.209 Radiated Emissions									
Test Report # WC403136.1					Test Date: 06 July 04				
Company: Medtronic									
EUT: Model 37021									
	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dBuV/m	margin
MHz	0.3 m	1 m	3 m	10 m	30 m	30 m Limit	300 m	300 m Limit	dB
0.009								48.5193746	48.51937
<b>0.175</b>	<b>76</b>	<b>58</b>	<b>40</b>	<b>22</b>	<b>4</b>	<b>N/A</b>	<b>-32</b>	<b>22.7434639</b>	<b>54.74346</b>
0.49						53.8003			
0.49						33.8003			
1.705						22.96974			
1.705						29.54243			
30						29.54243			
Levels at .3, 1 and 3 meters are measured - other levels are extrapolated.									

# RADIATED EMISSIONS



Test Report #: 3136 Run 1                      Test Area: STS  
 EUT Model #: 37021 (ENS)                      Date: 7/6/04  
 EUT Serial #: NJR000078N                      EUT Power: Internal Battery                      Temperature: 16.0 °C  
 Test Method: EN55011 B Grp 1                      Air Pressure: 98.0 kPa  
 Customer: Medtronic Neurological - Matt Micheals                      Rel. Humidity: 81.0 %

EUT Description: External Neurological Stimulator

Notes: External Device

Data File Name: 3136.dat                      Page: 1 of 1

### List of measurements for run #: 1

FREQ	LEVEL (dBuV)	CABLE / ANT / PREAMP / ATTEN (dB)	FINAL (dBuV / m)	POL / HGT / AZ (m)(DEG)	DELTA1 EN 55011 B Grp 1 10 m	DELTA2
No EUT emissions detected with near field probe in direct contact with ENS.						
30 MHz to 1000 MHz frequency range scanned.						
Continuous telemetry uplink mode per test application FE04						
End of test data.						

Tested by: J. C. Sausen  
 \_\_\_\_\_  
 Printed

  
 \_\_\_\_\_  
 Signature

Reviewed by: TKS  
 \_\_\_\_\_  
 Printed

  
 \_\_\_\_\_  
 Signature

## Appendix B

Constructional Data Form

and/or

Product Information Form(s)



## EMC Test Plan and Constructional Data Form

PLEASE COMPLETE THIS DOCUMENT IN FULL, ENTERING N/A IF THE FIELD IS NOT APPLICABLE.

**Applicant** -- NOTE: This information will be input into your test report as shown below.  
Press the F1 key at any time to get HELP for the current field selected.

Company: Medtronic Neurological

Address: 800 53<sup>rd</sup> Avenue NE  
Columbia Heights, MN 55421

Contact: Debbie Gorski Position: Design Assurance Engineer

Phone: 763-514-7489 Fax: 763-514-5612

E-mail Address: debbie.gorski@medtronic.com

**General Equipment Description** -- NOTE: This information will be input into your test report as shown below.

EUT Description Battery-powered, temporary external neurostimulator

EUT Name RX1 ENS

Model No.: 37021 Serial No.: \_\_\_\_\_

Product Options: N/A

Configurations to be tested: ENS with a screening cable and the longest lead and extension pair

**Test Objective**

- EMC Directive 89/336/EEC (EMC)  FCC: Class  A  B Part 15,C
- Std: \_\_\_\_\_  VCCI: Class  A  B
- Machinery Directive 89/392/EEC (EMC)  BCIQ: Class  A  B
- Std: \_\_\_\_\_  Canada: Class  A  B
- Medical Device Directive 93/42/EEC (EMC)  Australia: Class  A  B
- Std: See attachment  Other: \_\_\_\_\_
- Vehicle Directive 72/245/EEC (EMC)  
Std: \_\_\_\_\_
- FDA Reviewers Guidance for Premarket  
Notification Submissions (EMC)

**TÜV Product Service Certification Requested**

- Attestation of Conformity (AoC)  International EMC Mark (IEM)
- Certificate of Conformity (CoC)  Compliance Document
- Protection Class (N/A for vehicles)  Class I  Class II  Class III

## EMC Test Plan and Constructional Data Form

(Press **F1** when field is selected to show additional information on Protection Class.)

### Attendance

Test will be:  Attended by the customer     Unattended by the customer

### Failure - Complete this section if testing will not be attended by the customer.

If a failure occurs, TUV Product Service should:

- Call contact listed above, if not available then stop testing. (After hrs phone): \_\_\_\_\_
- Continue testing to complete test series.
- Continue testing to define corrective action.
- Stop testing.

### EUT Specifications and Requirements

Length 3.52"                      Width: 2.12"                      Height: 1.10"                      Weight: 3.54 oz  
 : \_\_\_\_\_

### Power Requirements

*Regulations require testing to be performed at typical power ratings in the countries of intended use. (i.e., European power is typically 230 VAC 50 Hz or 400 VAC 50 Hz, single and three phase, respectively)*

Voltage:                      3.0V (2 AA                      (If battery powered, make sure battery life is sufficient to complete testing.)  
    batteries)

# of Phases: \_\_\_\_\_

Current    Current  
 (Amps/phase(max)): \_\_\_\_\_ (Amps/phase(nominal)): \_\_\_\_\_

### Other Special Requirements

### Typical Installation and/or Operating Environment

(ie. Hospital, Small Business, Industrial/Factory, etc.)

*Operating environment can be residential, business and hospital/Doctor's office.*

### EUT Power Cable

- Permanent    OR     Removable                      Length (in meters): \_\_\_\_\_
- Shielded        OR     Unshielded
- Not Applicable

EMC Test Plan and Constructional Data Form



EUT Interface Ports and Cables												
Interface			Shielding									
Type	Analog	Digital	Qty	Yes	No	Type	Termination	Connector Type	Port Termination	Length (in meters)	Removable	Permanent
<b>EXAMPLE:</b> RS232	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Foil over braid	Coaxial	Metallized 9-pin D-Sub	Characteristic Impedance	6	<input checked="" type="checkbox"/>	<input type="checkbox"/>
N/A	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>

## EMC Test Plan and Constructional Data Form

### EUT Software.

Revision Level: app 0101, ver 4.3  
 app FE04, ver 1.0

Description: app 0101 is the released application for design verification.  
 app FE04 is a test application for continuous uplink (emissions testing)

**EUT Operating Modes to be Tested** -- list the operating modes to be used during test. It is recommended the equipment be tested while operating in a typical operation mode. FCC testing of personal computers and/or peripherals requires that a simple program generate a complete line of upper case H's. Provide a general description of all software, firmware, and PLD algorithms used in the equipment. List all code modules as described above, with the revision level used during testing. Consult with your TÜV Product Service Representative if additional assistance is required.

1. Stimulation (pulse-width, rate, amplitude)
  
- 2.
  
- 3.

**EUT System Components** -- List and describe all components which are part of the EUT. For FCC testing a minimum configuration is required. (ie. Mouse, Printer, Monitor, External Disk Drive, Motherboard, etc.)

Description	Model #	Serial #	FCC ID #
Screening Cable	3550-31		
Octad Z Lead (75cm)	3777		
1x8 Extension (60cm)	37081		
Screener	37021	NJR000078N	LF537021

## EMC Test Plan and Constructional Data Form

<b>Support Equipment</b> -- List and describe all support equipment which is not part of the EUT. (i.e. peripherals, simulators, etc)			
<i>Description</i>	<i>Model #</i>	<i>Serial #</i>	<i>FCC ID #</i>
Physician programmer	8840		LF58840

<b>Oscillator Frequencies</b>			
<i>Frequency</i>	<i>Derived Frequency</i>	<i>Component # / Location</i>	<i>Description of Use</i>
100 kHz		Y1	System Clock

<b>Power Supply</b>			
<i>Manufacturer</i>	<i>Model #</i>	<i>Serial #</i>	<i>Type</i>
N/A			<input type="checkbox"/> Switched-mode: (Frequency) _____ <input type="checkbox"/> Linear <input type="checkbox"/> Other: _____
			<input type="checkbox"/> Switched-mode: (Frequency) _____ <input type="checkbox"/> Linear <input type="checkbox"/> Other: _____

<b>Power Line Filters</b>		
<i>Manufacturer</i>	<i>Model #</i>	<i>Location in EUT</i>
N/A		



Form

# EMC Test Plan and Constructional Data Form



<b>Critical EMI Components (Capacitors, ferrites, etc.)</b>				
<i>Description</i>	<i>Manufacturer</i>	<i>Part # or Value</i>	<i>Qty</i>	<i>Component # / Location</i>
N/A				

**EMC Critical Detail --** Describe other EMC Design details used to reduce high frequency noise.

(PLEASE INSERT "ELECTRONIC SIGNATURE" BELOW IF POSSIBLE)

**Authorization Signatures**

\_\_\_\_\_  
Customer authorization to perform tests according to this test plan.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Test Plan/CDF Prepared By (please print)

\_\_\_\_\_  
Date

\_\_\_\_\_  
Reviewed by TÜV Product Service Associate

\_\_\_\_\_  
Date

## 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  $\pm 4.5$  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 its 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  $\text{dB}\mu\text{V}$ , is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit.

To convert between  $\text{dB}\mu\text{V}$  and  $\mu\text{V}$ , 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  $\text{dB}\mu\text{V}/\text{m}$ , is arrived at by taking the reading from the spectrum analyzer (Level  $\text{dB}\mu\text{V}$ ), adding the antenna correction factor and cable loss factor (Factor dB) to it, then subtracting the preamp gain. 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 A.

Example:

FREQ (MHz)	LEVEL ( $\text{dB}\mu\text{V}$ )	CABLE/ANT/PREAMP (dB)	FINAL ( $\text{dB}\mu\text{V}/\text{m}$ )	POL/HGT/AZ (m) (deg)	DELTA1 FCC B
60.80	42.5Qp	+ 1.2 + 10.9 - 25.5 =	29.1	V 1.0 0.0 -	-10.9

## 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  $\Omega$ /50  $\mu$ 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. The antenna is also positioned horizontally at the specified distances.