EMC – TEST REPORT

Issue Date: June 22, 1999

Ö EMISSIONS

Test Report File No.	:	MC1019
Project No.	:	98NK32893
Model / Type	:	Wirsbo Genius Transmitter Type 98004A
Kind of Product	:	Radiant Floor Heating Control (Transmitter)
Applicant/Grantee	:	PentaCom A/S Brundtland Center Danmark Brundtlandparken 2, P.O.B. 86 DK 6520 Toftlund, Denmark
Listee	:	Wirsbo Company 5925 148th Street W Apple Valley, MN 55124
Manufacturer	:	Same as Applicant (PentaCom A/S)
	:	
Test Result	:	**COMPLIANT**

This report without appendices consists of 10 pages. Appendix A contains test photos, Appendix B contains original test data and Appendix C describes the EUT's transmission scheme. The data contained in this report reflects only the items tested in the configurations and mode of operations described. An attempt has been made to arrange the EUT, with the equipment provided, into a test configuration which maximizes the observed emissions of the EUT while simulating, as close as practical, a typical end-use installation.

REPORT DIRECTORY

SECTION TITLE

1.0 GENERAL PRODUCT DESCRIPTION

Radiant Floor Heating Transmitter. The transmitter is a microprocessor based unit consisting of a transmitter / thermostat.

1.0.1 Equipment Mobility:

Wall-mount

1.0.2 Test Voltage and Frequency:

Voltage (V)	Frequency (Hz)
*3.6V	dc

* Internal AA battery

1.1 MODEL DIFFERENCES

Not applicable.

1.2 ENVIRONMENTAL CONDITIONS IN TEST LAB

Temperature:	**20-25 ℃**
Relative Humidity:	**30-60% RH**
Atmospheric Pressure:	**860-1060 mbar**

1.3 CALIBRATION OF EQUIPMENT USED FOR MEASUREMENT

All test equipment and test accessories are calibrated on a regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less.

1.4 EUT CONFIGURATION(s)

See Appendix A for individual set-up configuration(s). In addition to the EUT, the following peripheral devices and/or cables were connected during the measurement:

Device	Manufacturer	Model	Serial #	FCC ID
EUT	PentaCom A/S	Type 98004A	FCC 0	N/A

Cable	Manuf.	Length	Type	Shield Type	Shield Termination
None	N/A	N/A	N/A	N/A	N/A

1.5 EUT OPERATING MODE(s)

The equipment under test was operated during the measurements under the following conditions:

Transmitting continuous zeros (determined to be the worst case condition).

In real life applications, the device transmits for 17.2mS (total 172 bit @ 10 kbps giving a total RF frame duration t(frame) = 17.20 ms) and then does not transmit for at least 11 seconds. See Appendix C for EUT's transmission scheme.

1.6 DEVICE MODIFICATIONS

The following modifications were necessary for compliance:

None.

2.0 EMISSIONS TEST REGULATIONS

Emissions testing was performed according to the following regulations:

47 CFR, Part 15, Subpart C, April 1999

ANSI C63.4 – 1992

Industry Canada, RSS-210, Issue 2, Rev. 1, February 1996

The device was considered to be a **momentarily operated device with data transmission per Clause 6.1.1(e) of RSS-210 and Section 15.231(e) of CFR 47, Part 15**.

The following conditions were met:

(1) The duration of each transmission is less than one seconds (actual duration is 17.2mS).
(2) The silent period between transmissions is at least 30 times the duration of the transmission (17.2ms x 30 = 0.52 seconds) and at least 10 seconds. The actual minimum silent period is 11 seconds.

See Appendix C for EUT's transmission scheme.

CONDUCTED VOLTAGE EMISSIONS

Standard Reference

RSS-210, Clause 6.6
CFR 47, Part 15, Section 15.207

Remarks

Not applicable.

The EUT is battery operated and employs no provision for operation while connected to the AC power line. Therefore these measurements are not applicable or required.

RADIATED ELECTRIC FIELD EMISSIONS

Standard Reference
RSS-210, Clause 6.1.1(e) and Table 4
CFR 47, Part 15, Section 15.231(e)

Test Location
10 Meter Semi-Anechoic Chamber

Test Instruments
Spectrum Analyzer / Quasi-peak Adapter / Preselector
Hewlett Packard Model 8566B Spectrum Analyzer
Model 85650A Quasi-peak Adapter
Model 85685A RF Preselector No. FCA4002, FCA4003, EMC4001, EMC4002
Last Cal. 5-20-99, Next Cal. 11-20-99
Antennas
Electro-Metrics, Biconical Antenna Model EM-6912A, S/N 114
Last Cal. 1–16-99, Next Cal. 1-16-00
Chase, Log Periodic Antenna Model UPA6108, S/N 1120
Last Cal. 3-13-99, Next Cal. 3-13-00
EMCO, Horn Model 3115, S/N 2638
Last Cal. 5-8-99, Next Cal. 5-8-00

Frequency Range of Measurement

30MHz-5000MHz

Measurement Distance

3 meters

Test Results
The requirements are:
MET

Remarks
See App. B for complete test results.

OCCUPIED (20dB) BANDWIDTH

Standard Reference

RSS-210, Clause 6.1.1(c)
CFR 47, Part 15, Paragraph 15.231(c)

Test Location

Laboratory Open Area

Test Instruments

Spectrum Analyzer / Quasi-peak Adapter / Preselector

Advantest Model 3261A Spectrum Analyzer No. FCA 4001
Model R3551 Preselector No. FCA4005
Last Cal. 12-14-98, Next Cal. 12-14-99

Test Results

The requirements are:
MET

Remarks

See App. B for complete test results.

TEMPERATURE / FREQUENCY STABILITY

Standard Reference

RSS-210, Clause 6.1.1(d)
CFR 47, Part 15, Section 15.231(d)

Test Location

Environmental Chamber

Test Instruments

Frequency Counter
Hewlett Packard, Model 5386A, S/N 2621A00329

Thermometer
Fluke 51, S/N 7226073
Last Cal. 12-1-98, Next Cal. 12-1-99

Temperature Variation

3, 10, 20, 30, 40 and 45 degree C

Test Results

There are no requirements for transmitters operating at 433 MHz. Measurements were made for informational purposes only.

Remarks

See App. B for complete test results.

Though the standards specify testing from –20 to +50 degree C, the **transmitter is programmed to stop transmitting when the temperature detected is outside the range of 3 to 45 degree C**. Therefore testing was done between 3 and 45 degree C.

Measurements were performed on a device employing new batteries.

3.0 GENERAL REMARKS

Sample Receipt Date : May 10, 1999

Test Dates

Start : June 01, 1999
End : June 10, 1999

3.1 SUMMARY

The requirements according to the technical regulations are:

MET

Underwriters Laboratories Inc.
333 Pfingsten Road
Northbrook, IL 60062 USA

FCC Site Number: 31040/SIT 1300F2
NVLAP Lab Code: 100414-0
IC Site Number: IC 2180

Test Engineer:

Jack Steiner (Ext 42307)
EMC Senior Project Engineer
International EMC Services

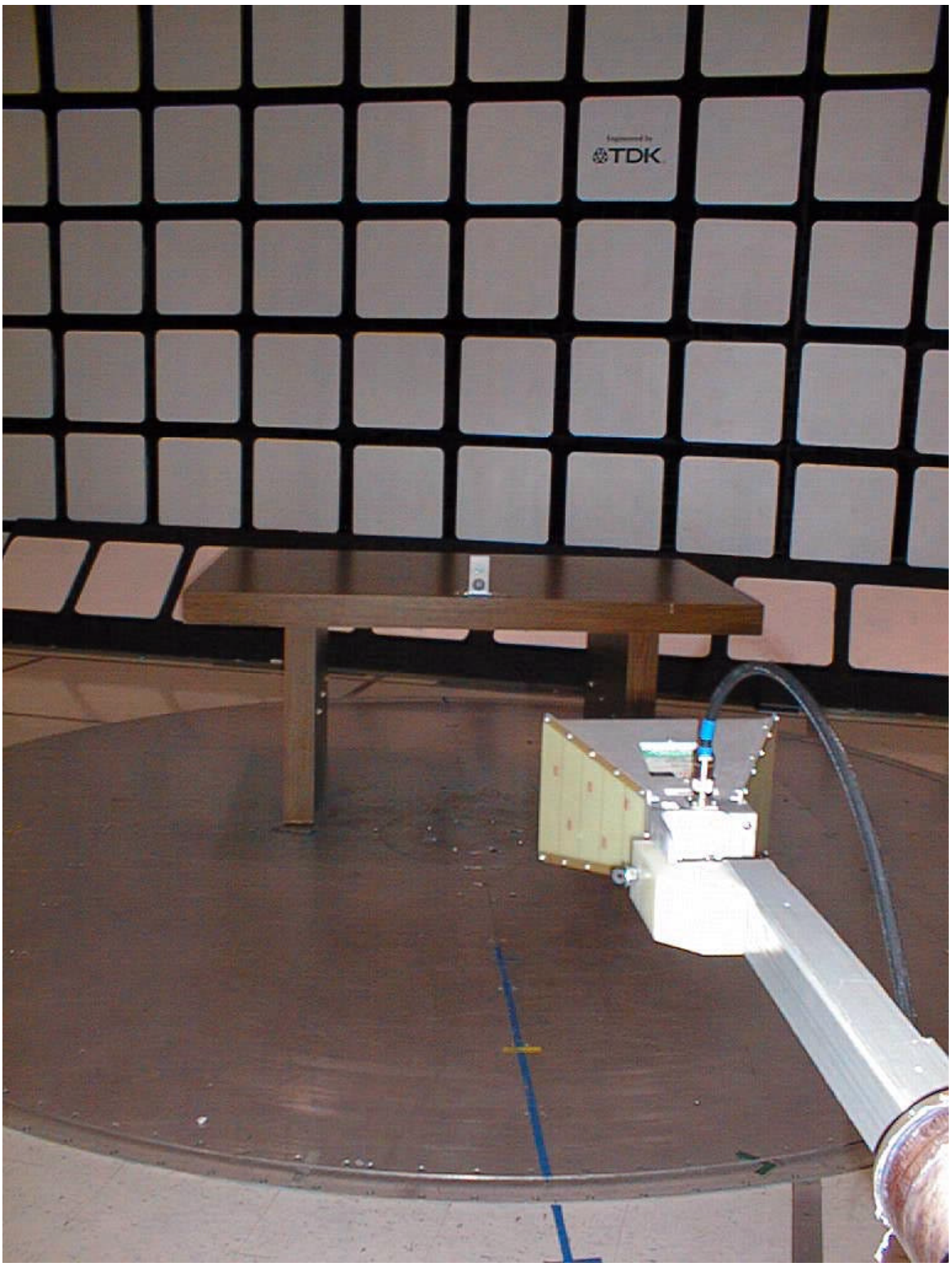
Reviewed by:

Michael J. Windler
Associate Managing Engineer
International EMC Services

APPENDIX A

PHOTOS

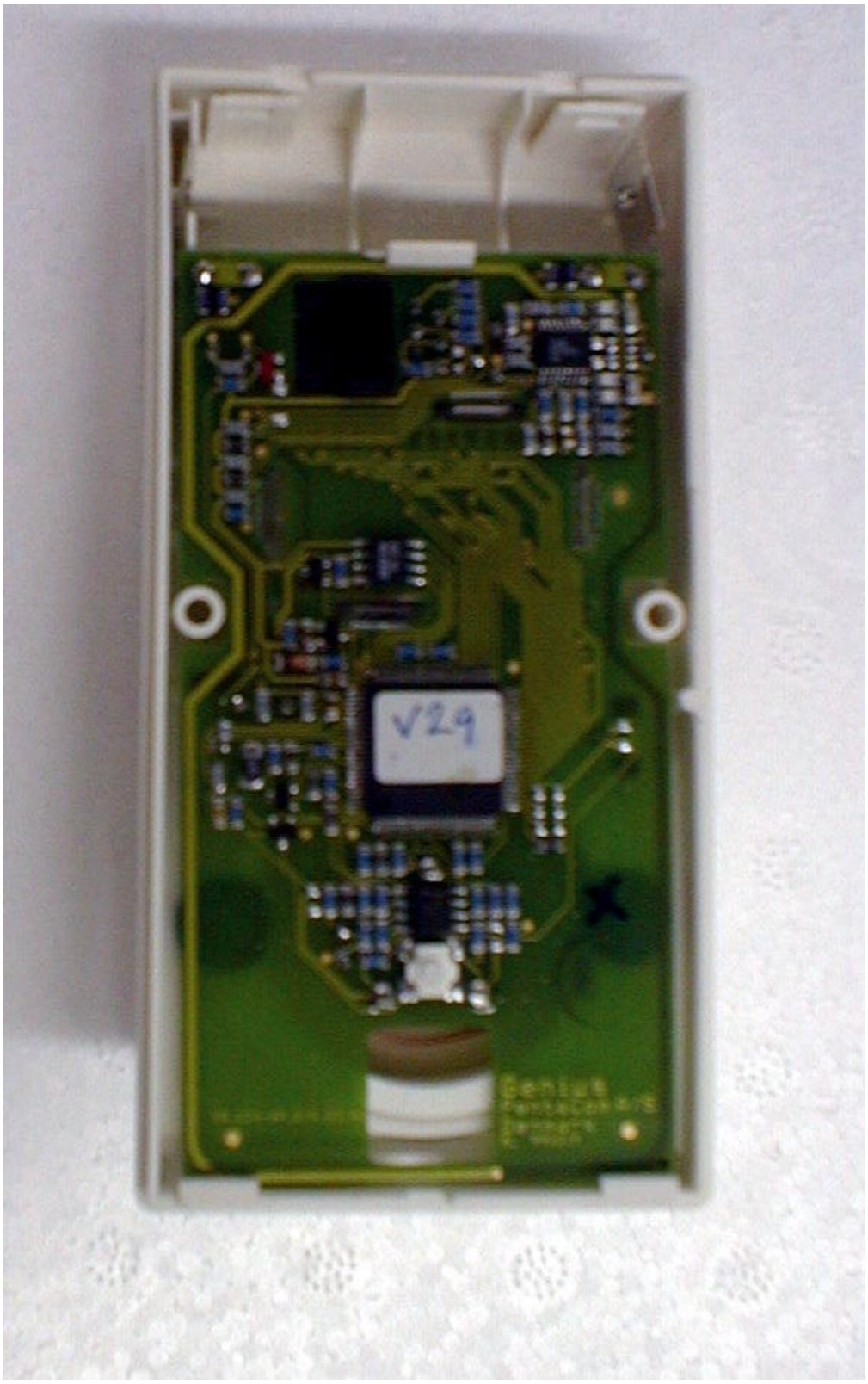
Radiated Emission Measurement



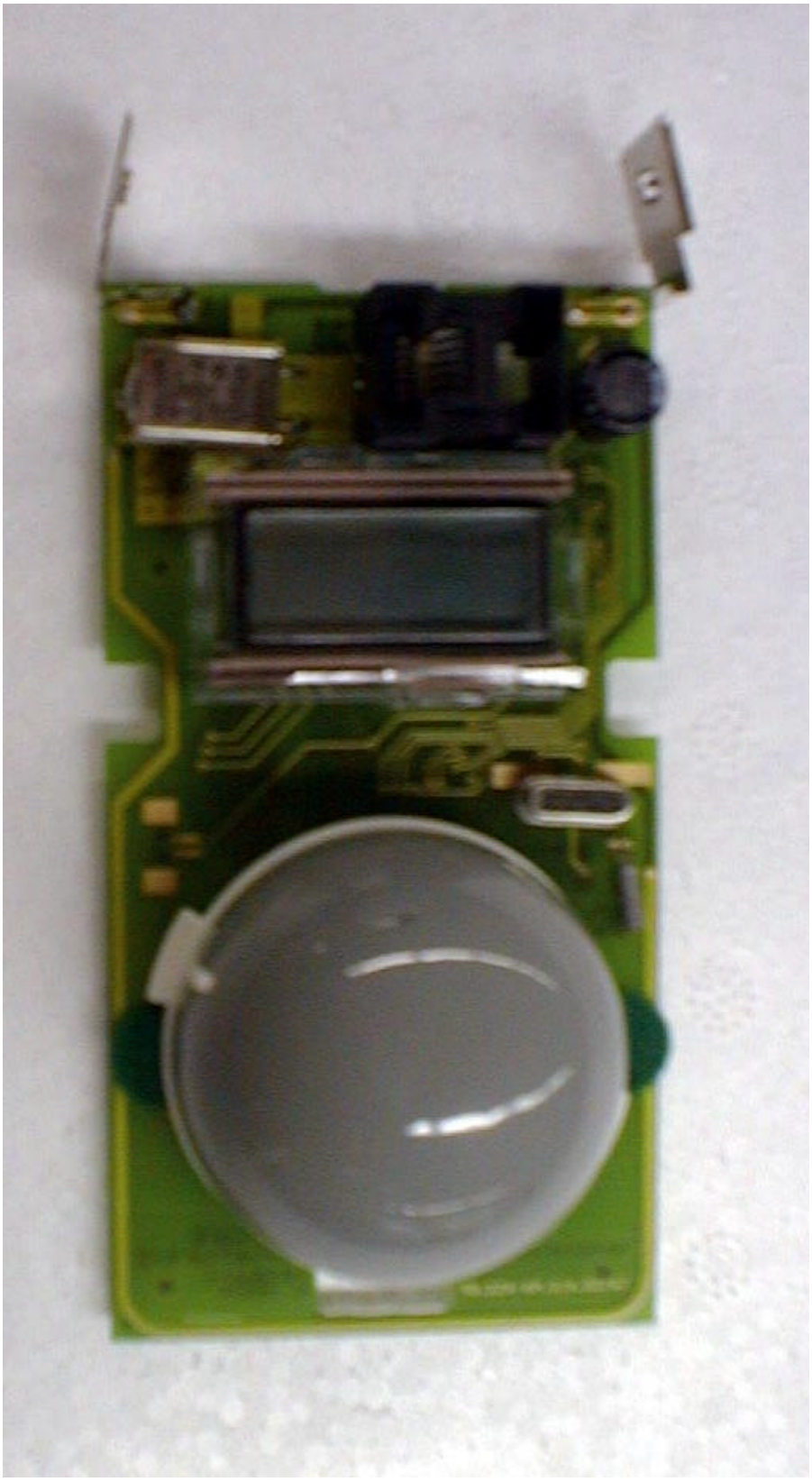
EUT External View – Front

EUT External View – Back

EUT Internal – Back of PWB



EUT Internal – Front of PWB



APPENDIX B

TEST DATA

EMISSIONS

Radiated Electric Field Emissions
Occupied Bandwidth
Temperature Stability

Measurement of Electromagnetic Radiation Disturbance

Preliminary Measurement of Electromagnetic Radiation Disturbance (Plots)

Preliminary measurements of electromagnetic radiation were performed and used as a guide in determining at what frequencies, and the operating mode, final measurements would be made.

During these preliminary measurements, the EUT was placed on a 0.8 meter high wood table, placed on a 4 meter turntable, located in a 10 meter semi-anechoic chamber.

The receiving antenna was positioned 3 meters from the closest face of the EUT. The receiving antenna height was adjusted to 1, 2, 3 and 4 meters.

Measurements were made while the EUT was rotated about its vertical axis through a 360 degree azimuth, the indicated frequency range was continuously swept, the maximum emission level recorded. These measurements were performed for the horizontal and vertical receiving antenna polarities.

Preliminary measurements were performed with a receiver employing peak detection and the appropriate CISPR receiver bandwidth for the frequency ranges covered.

Final Measurement of Electromagnetic Radiation (Tabular Data)

Detected emissions were maximized by rotating the EUT about its vertical axis through a 360 degree azimuth and varying the height of the receiving antenna from 1 to 4 meters in both the horizontal and vertical polarities.

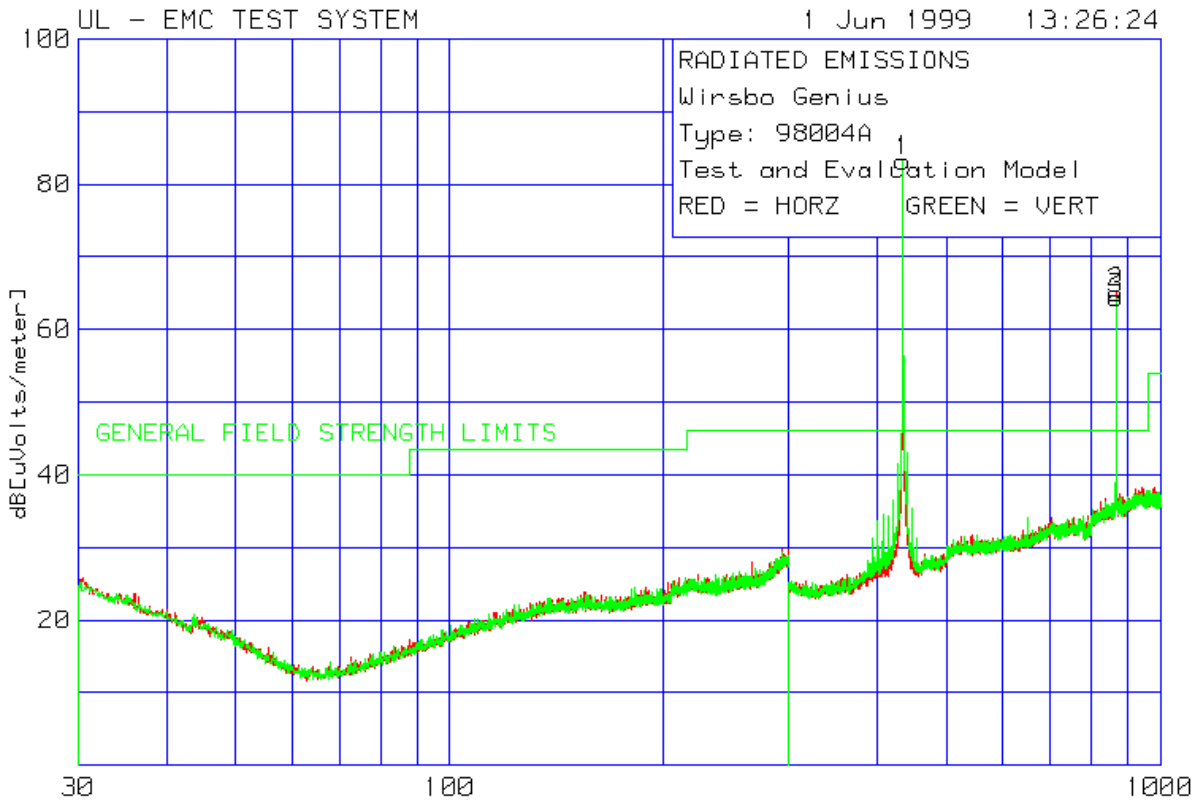
Measurements of radiated electromagnetic disturbance were performed in the operating mode determined to generate the highest emission levels.

Measurements of radiated electromagnetic disturbance were performed with a receiver employing the appropriate bandwidth for the ranges in which measurements were made.

UNDERWRITERS LABORATORIES INC.
Preliminary Radiated Emissions

Date Tested: June 1, 1999

Manufacturer	:	PentaCom A/S
Equipment Under Test	:	Type 98004A Wirsbo Genius Transmitter
Requirement	:	CFR 47, Part 15 and RSS-210
Detection Mode	:	**Peak**
Bandwidth	:	1000 MHz
Measurement Distance	:	3 meter
Antenna Type	:	30 - 300 MHz, Biconical 300 - 1000 MHz, Log-Periodic



UNDERWRITERS LABORATORIES INC.
Final Radiated Emissions

Date Tested: June 1, 1999

Manufacturer	: PentaCom A/S
Equipment Under Test	: Type 98004A Wirsbo Genius Transmitter
Requirement	: CFR 47, Part 15 and RSS-210
Detection Mode	: **Peak**
Bandwidth	: 1000 MHz
Measurement Distance	: 3 meter
Antenna Type	: 30 - 300 MHz, Biconical 300 - 1000 MHz, Log-Periodic

Frequency **MHz**	**Meter Reading** **dBuV/m**	**Cable Loss** **dB**	**Antenna Factor** **dB**	**Measured Intensity** **dBuV/m**	***Average Value of Measured Emissions**	**3 meter Limit** **dBuV/m**	**Antenna Height** **meter**	**Turntable Azimuth** **degrees**
433.8793	65.7	2.4	17.1	85.2	**69.9**	72.8	115 V	266
433.8793	61.2	2.4	17.1	80.7	65.42	72.8	100 H	162
867.8125	36.8	3.7	23.8	64.3	49.02	52.8	101H	189
867.8125	36.6	3.7	23.8	64.1	48.82	52.8	124 V	321

Notes:

H - Horizontal antenna polarity

V - Vertical antenna polarity

* - Per clause 15.35 of CFR 47, Part 15 and clause 6.5 of RSS-210, the measured field strength was determined by averaging the pulse train over a 0.1 second interval. The EUT's total RF frame duration is 17.20 ms, and the device does not transmit more than one frame every 11 seconds (See Appendix C for the EUT's transmission scheme). The average value of measured emissions was calculated as follows:

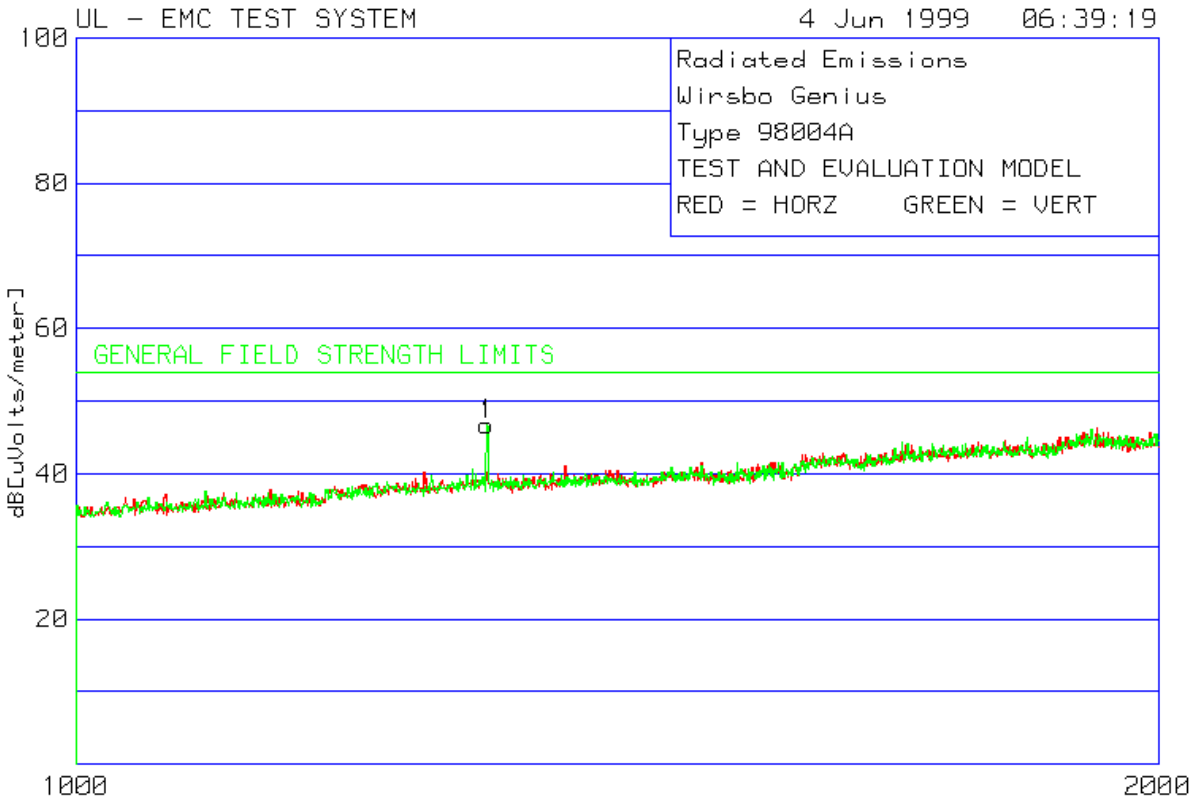
17.20ms / 100ms = 0.172

20log(0.172) = -15.28dB

UNDERWRITERS LABORATORIES INC.
Preliminary Radiated Emissions

Date Tested: June 4, 1999

Manufacturer	:	PentaCom A/S
Equipment Under Test	:	Type 98004A Wirsbo Genius Transmitter
Requirement	:	CFR 47, Part 15 and RSS-210
Detection Mode	:	**Peak**
Measurement Distance	:	3 meter
Antenna Type	:	Horn



UNDERWRITERS LABORATORIES INC.
Final Radiated Emissions

Date Tested: June 4, 1999

Manufacturer : PentaCom A/S
Equipment Under Test : Type 98004A Wirsbo Genius Transmitter
Requirement : CFR 47, Part 15 and RSS-210
Detection Mode : **Average Detection**
Measurement Distance : 3 meter
Antenna Type : Horn

Frequency **MHz**	**Meter Reading dBuV/ m**	**Cable Loss dB**	**Antenna Factor dB**	**Measured Intensity dBuV/m**	**3 meter Limit dBuV/m**	**Antenna Height meter**	**Turntable Azimuth degrees**
*1301.7282	16.6	4.8	25.4	46.8	54	100 V	283
*1301.7282	9.2	4.8	25.4	39.4	54	104 H	102

Notes:

H - Horizontal antenna polarity

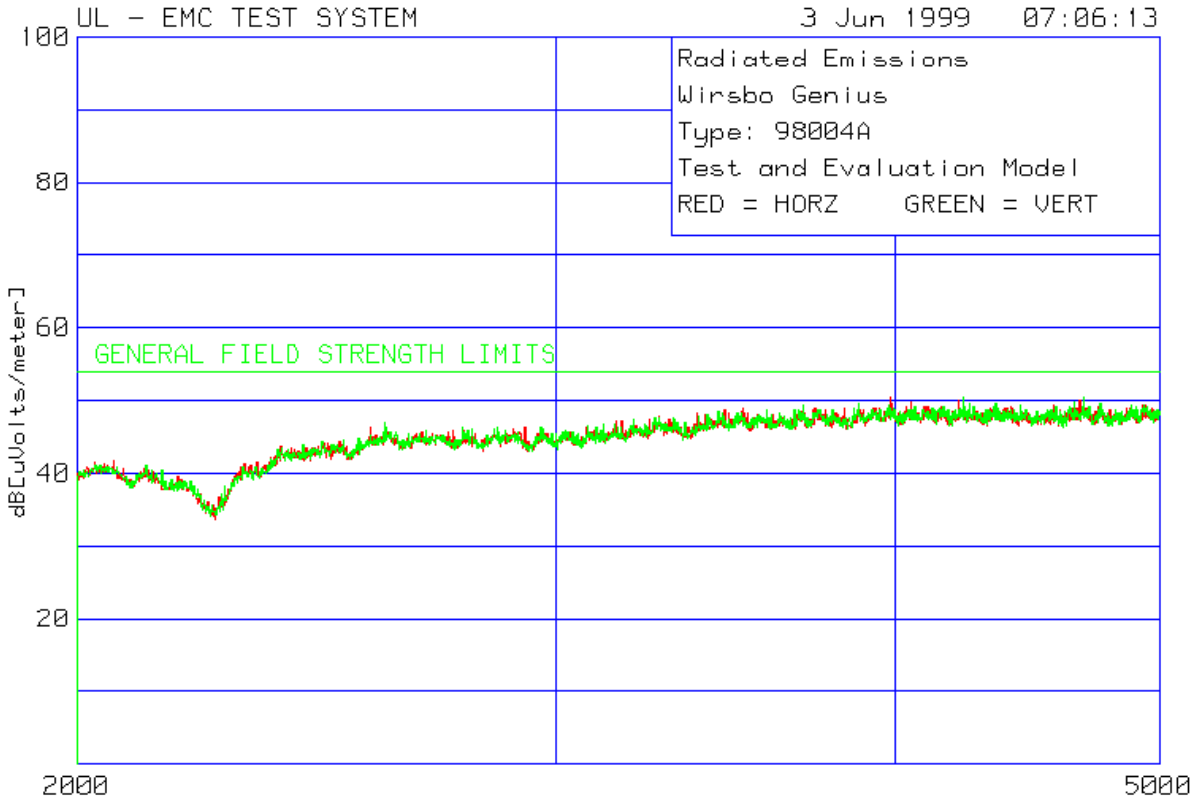
V - Vertical antenna polarity

* - These emissions appear within the restricted band. As such they must comply with the general radiated emission requirements of Table 3 of RSS-210 and clause 15.209 of CFR 47, Part 15.

UNDERWRITERS LABORATORIES INC.
Preliminary Radiated Emissions

Date Tested: June 3, 1999

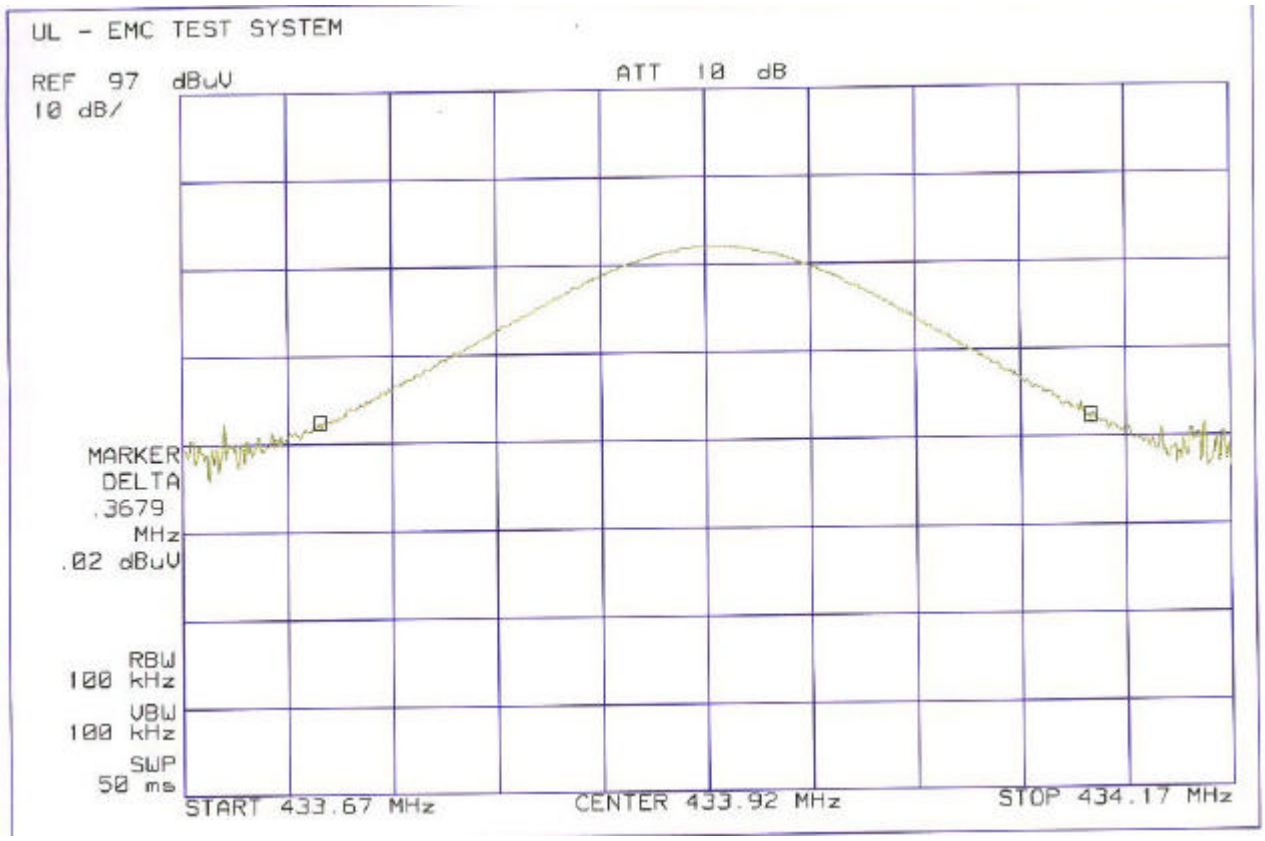
Manufacturer	:	PentaCom A/S
Equipment Under Test	:	Type 98004A Wirsbo Genius Transmitter
Requirement	:	CFR 47, Part 15 and RSS-210
Detection Mode	:	**Peak**
Measurement Distance	:	3 meter
Antenna Type	:	Horn



UNDERWRITERS LABORATORIES INC.
Occupied (20dB) Bandwidth

Date Tested: June 3, 1999

Manufacturer : PentaCom A/S
Equipment Under Test : Type 98004A Wirsbo Genius Transmitter
Requirement : CFR 47, Part 15 and RSS-210



Per RSS-210 clause 6.1.1(c) and CFR 47, Part 15 clause 15.231(c), the 20dB bandwidth shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz.

Center Frequency	Measured 20dB Bandwidth	Limit (0.25% Center)
433.87 MHz	0.3679 MHz	1.08 MHz

UNDERWRITERS LABORATORIES INC.
Temperature / Frequency Stability

Date Tested: June 10, 1999

Manufacturer : PentaCom A/S
Equipment Under Test : Type 98004A Wirsbo Genius Transmitter
Requirement : CFR 47, Part 15 and RSS-210

Temperature	Measured Carrier Frequency	Frequency Tolerance
-20 degree C	N/A	N/A
-10 degree C	N/A	N/A
0 degree C	N/A	N/A
3 degree C	433.93367 MHz	*
10 degree C	433.93452 MHz	*
20 degree C	433.93458 MHz	Reference
30 degree C	433.93475 MHz	*
40 degree C	433.93478 MHz	*
45 degree C	433.93482 MHz	*
50 degree C	N/A	N/A

* - less than 0.001%

Though the standards specify testing from –20 to +50 degree C, the **transmitter is programmed to stop transmitting when the temperature detected is outside the range 3 to 45 degree C**. Therefore testing was done between 3 and 45 degree C.