Testing Tomorrow's Technology

Application for

US Code Title 47, Part 2, Subpart J, Section 2.947, Certification
Per
Part 15, Subpart C, for Intentional Radiators, Section 15.249, Intentional Radiator Operating within the Band 2400 2483.5 MHz

And

US Code Title 47, Part 2, Subpart J, Section 2.902, Verification
Per
Part 15, Subpart B, for Unintentional Radiators, section 15.101, 15.107 and 15.109

For the

HHV200

Manufactured by

Hagenhoff LLC

UST Project: 10-0310
Issue Date: January 26, 2011

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

I certify that I am authorized to sign for the test facility and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: **Alan Ghasiani**

Name: 

Title: **Consulting Engineer - President**

Date: **January 26, 2011**

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: Hagenhoff LLC

MODEL: HHV200

FCC ID: Y6N-HHV200

DATE: January 26, 2011

This report concerns (check one): Original grant_X
Class II change_____

Equipment type: **Intentional Radiator Operating within the bands 2400-2483.5 MHz**

Deferred grant requested per 47 CFR 0.457(d) (1) (ii)? yes_____ No_X

If yes, defer until:_____
date

__N.A.__ agrees to notify the Commission by__N.A.__
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

SUMMARY OF TEST REQUIREMENTS

FCC Requirement	Title	Disposition
15.203	Antenna Requirement	Pass
15.207	Intentional Radiator Power Line Conducted Emissions	NA
15.209	Intentional Radiator Radiated Emissions	Pass
15.249(a)	Fundamental Field Strength	Pass
15.107	Unintentional Radiator Power Line Conducted Emissions	Pass
15.109	Unintentional Radiator Radiated Emissions	Pass

N/A = Not applicable for this unit.

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1 General Information

1.1 Purpose of this Report

This report is prepared as a means of presenting test data to be used by a Telecom Certification Body in determination of whether this product is permitted for unlicensed dissemination to the general public according to the FCC Rules and Regulations for RF Devices, Intentional Radiators.

1.2 Product Description

The Equipment Under Test (EUT) is the Hagenhoff “Vyndicator.” The EUT is a wireless test indicator used for remote measuring and is designed to help toolmakers and lab technicians make accurate remote measurements. The EUT consists of two parts: a receiver and a transmitter.

The EUT receiver only receives signals. The signal enters the Freescale processor, MC13212, and is processed under IEEE 802.15.4 rules.

The EUT transmitter only sends signals at ANT1. There is no reception. The signal leaves the Freescale processor, MC13212, and is processed under IEEE 802.15.4 rules.

1.3 Related Submittal(s)/Grant(s)

1.3.1 The EUT is subject to the following FCC authorizations:

a) Certification under section 15.249 as a transmitter.
b) Verification under 15.101 as a digital device and receiver.

1.3.2 Certification of the Transmitter

The transmitter uses low power direct Sequence Spread Spectrum based on IEEE 802.15 Zigbee transmission protocol, and is tested per Part 15.249 requirements for Certification.

1.3.3 Verification of the Digital apparatus

The Verification requirement shares many common report elements with the Certification report. Therefore, though this report is mostly intended to provide data for the Certification process, the Verification authorization report (part 15.107 and 109) for the Product(s) under test is included herewith.

2 Tests and Measurements

2.1 Configuration of Tested System

The sample was set up and tested per ANSI C63.4, *Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Frequency Range of 9 kHz to 40 GHz (2003).* Conducted and radiated emissions data were taken with the EMC test receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. A Block diagram of the tested system is shown in Figure 3. A listing of the EUT and its test peripherals is found in Table 1 below. Test configuration photographs are found in the attached appendices.

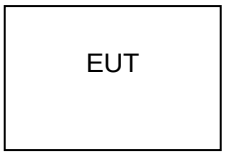


Figure 1- Test Configuration

Table 1 - EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Hagenhoff	HHV200	None	Y6N-HH200	--

2.2 EUT Characterization

The sample used for testing was received by US Tech on December 29, 2010 in good operating condition.

2.3 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and registered with the FCC under designation number US5117. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 2982A-1.

2.4 Test Equipment

Table 2 describes test equipment used to evaluate this product.

Table 2 - Test Instruments used for Evaluation

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/18/2010
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2410A00109	10/29/10
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	2944A06291	9/7/10
BICONICAL ANTENNA 25 MHz to 200 MHz	3110B	EMCO	9307-1431	2/2/10
LOG PERIODIC 100 MHz to 1000 MHz	3146	EMCO	3110-3236	1/22/10 2 Year
HORN ANTENNA 1 GHz to 18 GHz	SAS-571	A. H. Systems	605	2/9/2010 2 Year
PREAMP 1 GHz to 26.5 GHz	8449B	HEWLETT-PACKARD	3008A00480	9/21/10
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

Note: The calibration interval of the above test instruments is 12 months unless stated otherwise, and all calibrations are traceable to NIST/USA.

2.5 Modifications to EUT

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15, Subpart B, class B Limits for the receiver and digital portion of the EUT or the Subpart C, transmitter requirements.

2.6 Measurement Standards (CFR 15.31)

Intentional and unintentional radiators are to use the methods of ANSI C63.4 – 2003. Measurements were made on an Open Area Test Site (OATS) wherever possible. For battery powered equipment, new (or fully charged) batteries are used.

Section 15.31(m) indicates that because the EUT System operates over the 902 MHz to 928 MHz ISM band, measurements must be made near the bottom of the band (around 902 MHz for example) and in the middle of the band (915 MHz) as well as near the top of the band (928 MHz).

2.7 Frequency Range of Radiated Measurements (CFR 15.33)

The frequency range is detailed in Tables 4 through 6 for intentional and unintentional radiators.

2.8 Frequency Range for Intentional Radiators

The spectrum was investigated from the lowest RF signal generated, without going below 9 kHz, to the 10^{th} harmonic of the highest fundamental transmitter frequency (24 GHz maximum).

2.8.1 Frequency Range for Unintentional Radiators

The spectrum was investigated from the lowest RF signal generated, without going below the lowest frequency for which an emissions limit is specified (30 MHz), to the 5^{th} harmonic of the highest fundamental frequency of the digital device (12.0 GHz maximum). See Table 6.

2.9 Measurement Detector Function and Bandwidth (CFR 15.35)

On any frequency below 1000 MHz, the limits shown are based upon measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths. On frequencies above 1000 MHz, the radiation limits are based upon the use of measuring instrumentation employing an average detector function.

When average detector measurements are specified for use, including emission measurements below 1000 MHz, there is also a corresponding limit for Peak detector measurements having a limit of 20 dB above the corresponding average limit unless a different peak emission limit is specified. Measurements above 1000 MHz utilize a minimum resolution bandwidth of 1 MHz.

When radiated emissions limits are expressed in terms of the average value of the emission and pulsed operation is employed, the measurement field strength is determined by averaging over one complete pulse train (Duty Cycle) including blanking intervals for pulse trains up to 0.1 second in duration. The exact method of calculating the average field strength is included below. Refer to Figures 2 and 3 for duty cycle measurement data.

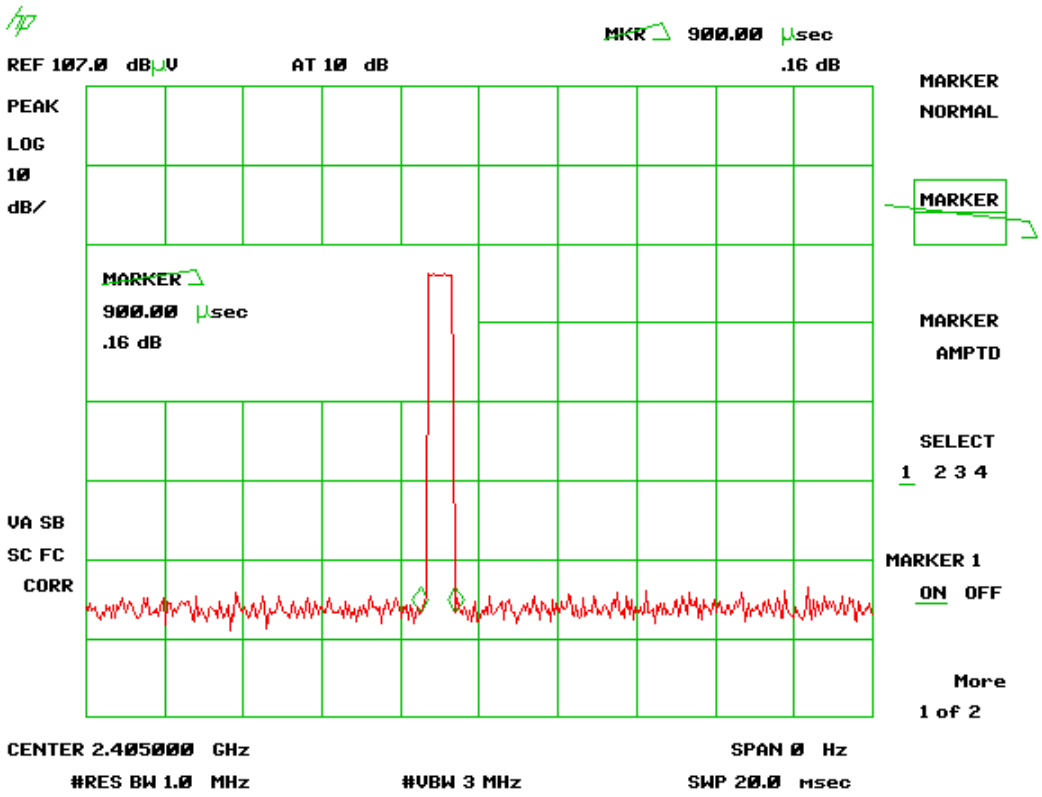
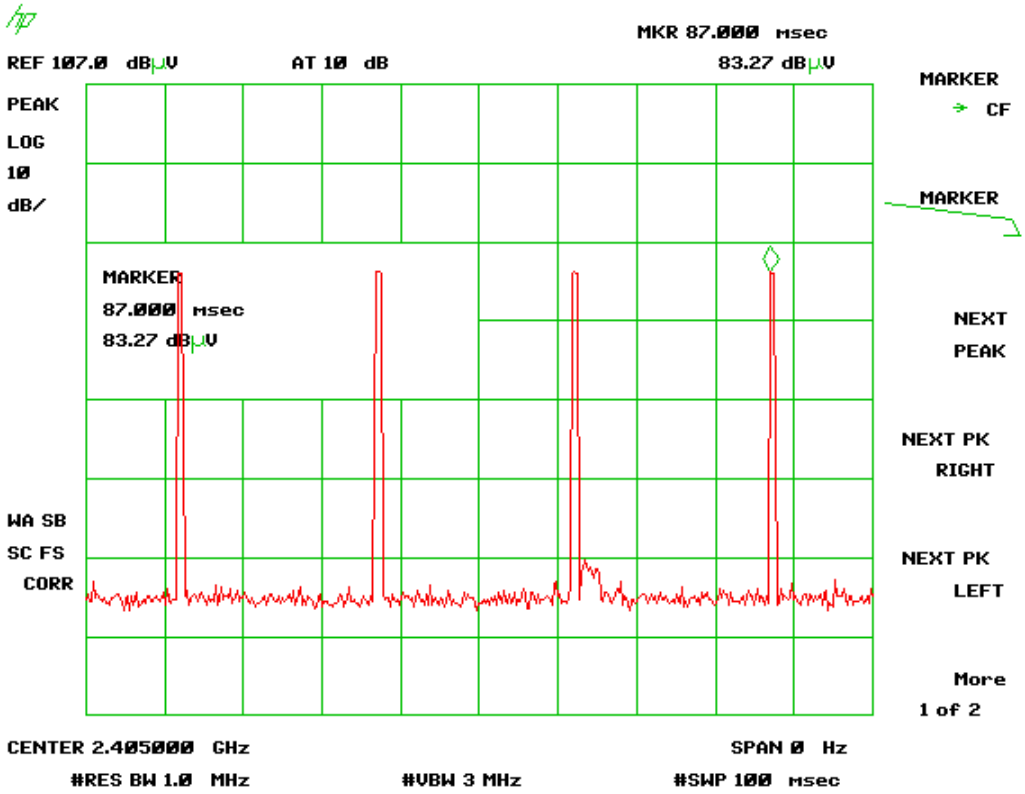


Figure 2 - Transmitter Pulse Width



0.900 mS x 4 = 2.80 mS = 2.80 percent

DC = 20 Log 0.0280 = -31.05 dB

Figure 3– Pulses in a 100 mSec Period

2.10 Antenna Requirement (CFR 15.203)

The intentional radiator is designed to assure that no antenna other than that furnished by the manufacturer is used with the device. The use of a permanently attached antenna is considered sufficient to comply with this requirement. The table below lists details for this permanently attached antenna. If, in the future, additional antennas are contemplated for use, they must be formally evaluated and approved for suitability to these requirements.

Table 3 - Transmitter Antenna

Manufacturer	Model Number	Antenna Type	Frequency	Peak Gain dBi	Impedance Ohms
Fractus	FR05-S1-N-0-104	permanent Mount	2.40	0.30	50

2.11 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207)

Not Applicable - The EUT (both the receiver and transmitter) is battery operated.

2.12 Intentional Radiator, Radiated Emissions (CFR 15.249 (a), (e))

The EUT frequency hopping was stopped and it was placed into a continuous transmit mode of operation. A preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the product and to obtain the worse case result the EUT tested in all X, Y and Z axis. Radiated measurements below 1 GHz were tested with a RBW = 120 kHz. Radiated measurements above 1 GHz were measured using a RBW = VBW = 1 MHz. Test data are found in Tables 4 and 5.

The average values are determined by adding a duty cycle correction factor onto the peak values. The duty cycle correction factor calculation was explained in 2.9.

Table 4 - Peak Fundamental and Harmonics, PK and AVG limits

Radiated Fundamental and Harmonics Emissions								
Test By: K.M.	**Test:** Fundamental and Harmonics CFR 15.249 (a)				**Client:** Hagenhoff, LLC			
	Project: 10-0310		**Class: N/A**		**Model:** HHV200			
Frequency (MHz)	**Test Data (dBuV)**	***DC+FL Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Peak Limits (dBuV/m)**	**Distance / Polarity (Meters)**	**Margin (dB)**	**Det PK / QP**
2405.00	83.93		-2.22	81.71	94.0	3.0m./	12.3	**PK**
1438.25	40.90		-8.63	32.27	54.0	3.0m./	21.7	**AVG**
4805.93	50.56		4.94	55.50	74.0	3.0m./	18.5	**PK**
4806.93	50.56	-20.00	4.95	35.51	54.0	3.0m./	18.5	**AVG**

All other emissions were at least 20 db below the limit.

DC = Duty Cycle = -31 dB (maximum 20 dB allowed)
FL = High Pass Filter
AF = Antenna Factor

Data is corrected by 1.0 dB for loss of high pass filter (FL), except for fundamental

SAMPLE CALCULATION: at 2405 MHz, = 83.93 dBuV+ (-2.22) dB/m = 81.71 dBuV/m @ 3m

Tester

Signature:  **Name: Keyvan Muvahhid**

2.13 Band Edge Measurements (CFR15.249(d))

Band Edge measurements were made at a Low Channel and High Channel peak at highest EUT related emission outside the upper and lower occupied bandwidth. A measurement was made of the fundamental and the emission was measured using a quasi peak setting. A Resolution Bandwidth of > 1% of the emission bandwidth was used. This procedure was repeated for the high channel. The limits were derived as follows:

2.13.1 High Band Edge

Above 2483.5 MHz the limit per section 15.249(d) is 50 db below the fundamental or the value expressed by CFR 15.209 (54 dBuV/m) whichever is the lesser attenuation.

The fundamental recorded in Table 4 is 83.93 dBuV/m.
83.93 dBuV/m -35.58 dBuV/m = 48.35 dB <50
But, 35.58 dBuV/m + (-2.22) correction factor = 33.36 < 54 dBuv/m
Passing Margin= 54 dBuV/m – 33.36 dBuV/m = 20.64 dB

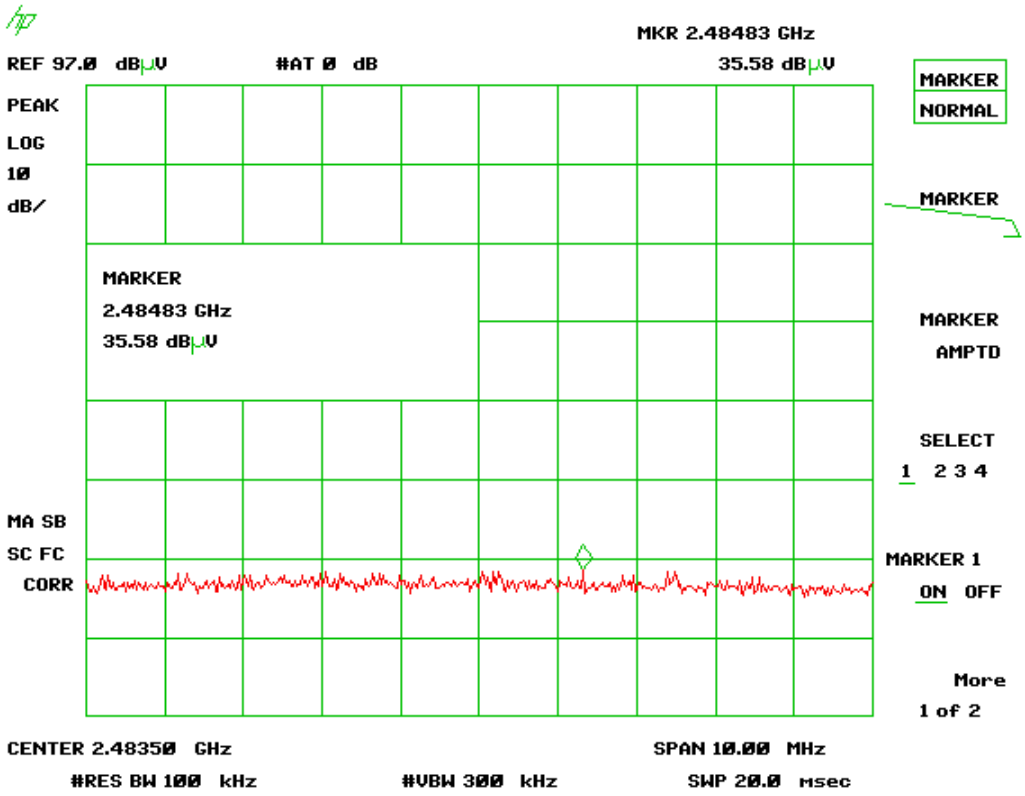


Figure 4 - Radiated Band Edge Compliance – High Channel Delta - QP

2.13.2 Low Band Edge

The fundamental recorded in Table 4 is 83.93 dBuV/m.
Maximum at Low Band Edge @ 2398 MHz: 44.87 dBuV/m < 54 dBuV/m
Passing Margin= 54 dBuV/m – 44.87 dBuV/m = 9.13 dB

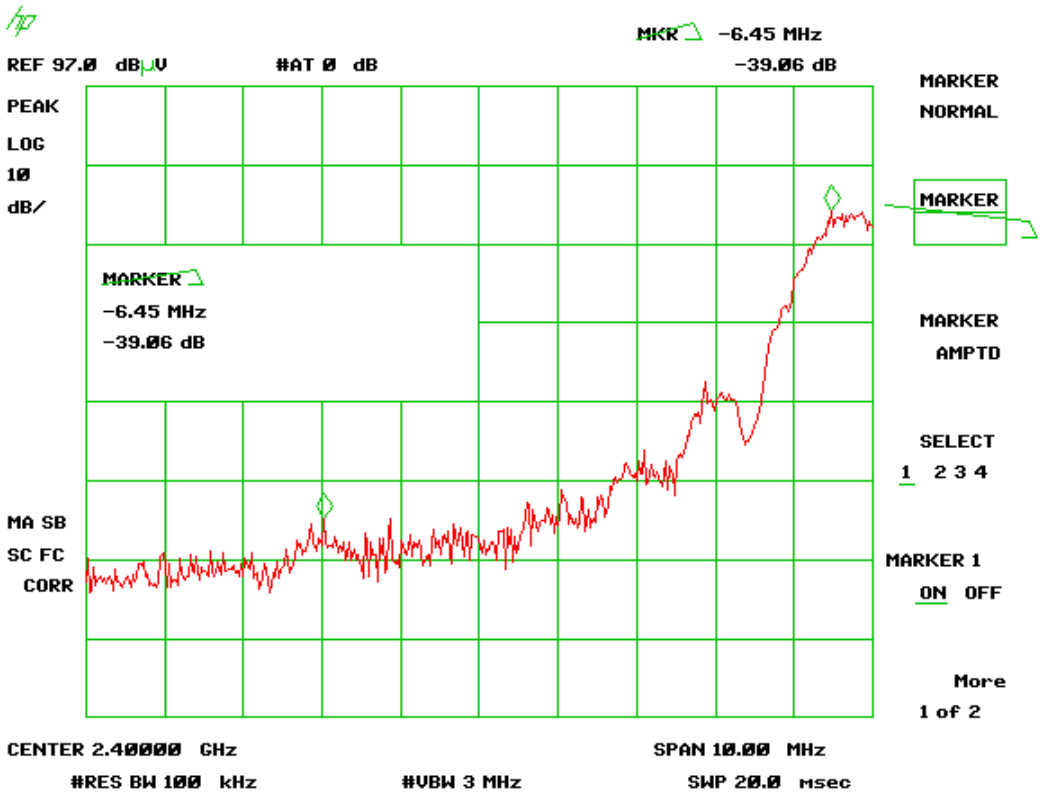


Figure 5 - Radiated Band Edge Compliance – Low Channel Delta - QP

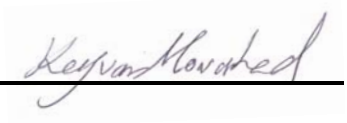
2.14 Unintentional Radiator, Power Conducted Emissions (CFR 15.107)

The unit is battery operated.

Table 5 – Power line Conducted Emissions Data, Class B.

Power Line Conducted Emissions							
Test By: K.M.	**Test:** FCC Power Line Conducted Emissions 150 KHz – 30 MHz , Hot Phase			**Client:** Hagenhoff			
	Project: 10-0310	Sect. 15.107 Class: B		**Model:** HHV200			
Frequency (MHz)	**Test Data (dBuV)**	**IL+CL -PA (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Phase /Neutral**	**Margin (dB)**	**PK / QP**
Battery Powered- Not applicable							

Tested from 150 kHz to 30 MHz.
SAMPLE CALCULATIONS@ 0.1541 MHz: 50.90 dBuV + 0.46 dB = 51.36 dBuV

Tester Signature:  **Name: George Yang**

2.15 Unintentional Radiator, Radiated Emissions (CFR 15.109)

Radiated emissions within the band 30 MHz to 25 GHz were measured with a spectrum analyzer via a pre-amplifier by connecting the spectrum analyzer to a receiving antenna spaced three (3) meters from the EUT. The spectrum analyzer was set for a 50 Ω input impedance with the VBW set to ≥ the RBW bandwidth. The antenna was raised and lowered over a span of 4 meters in order to maximize the signal coming from the EUT. Similarly, the turntable was rotated through 360 degrees in the same maximizing effort. Also the EUT was scanned for a maxima when placed in each of the three mutually exclusive orthogonal planes. The results of the measurements are given in Table 9.

Table 6 - Unintentional Radiator, Peak Radiated Emissions (CFR 15.109).

Peak Radiated Emissions, Digital Device and Receiver							
Test By: K.M	**Test:** Radiated Emissions- 30 MHz to 10 GHz			**Client:** Hagenhoff			
	Project: 10-0310	**Requirement** 15.109, Class: B		**Model:** HHV200			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Peak Limits (dBuV/m)**	**Distance / Polarity (meters)**	**Margin (dB)**	**Detector PK / QP**
All emissions were at least 20 dB below of the FCC part 15.109 limits.							

Test was performed from 30 MHz to 10 GHz.

SAMPLE CALCULATION: NA

Tester Signature: Keyvan Muvahhid **Name: Keyvan muvahhid**

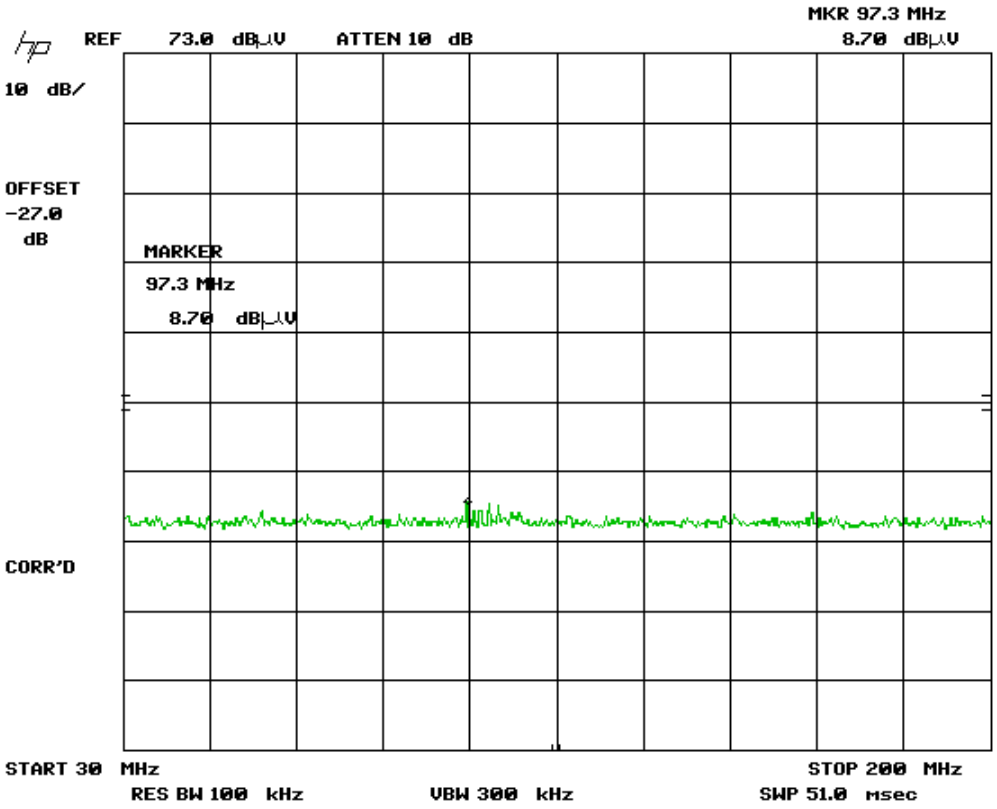


Figure 6 - Radiated emission 30 MHz to 200 MHz Horizontal polarity

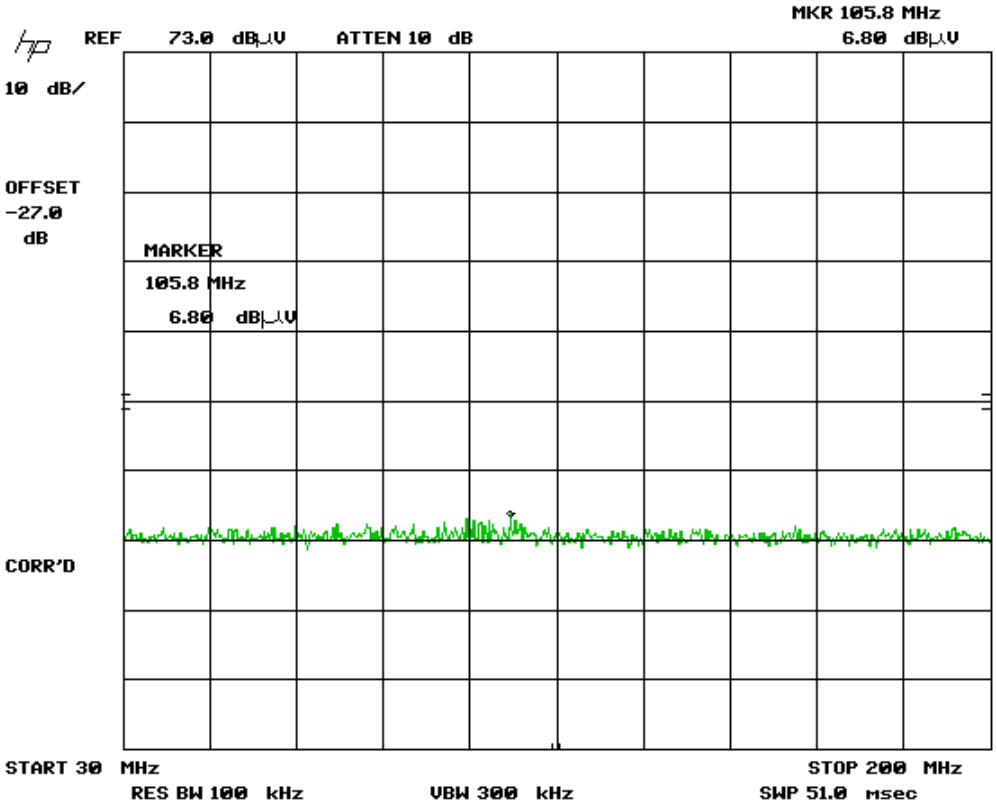


Figure 7 - Radiated emission 30 MHz to 200 MHz Vertical polarity

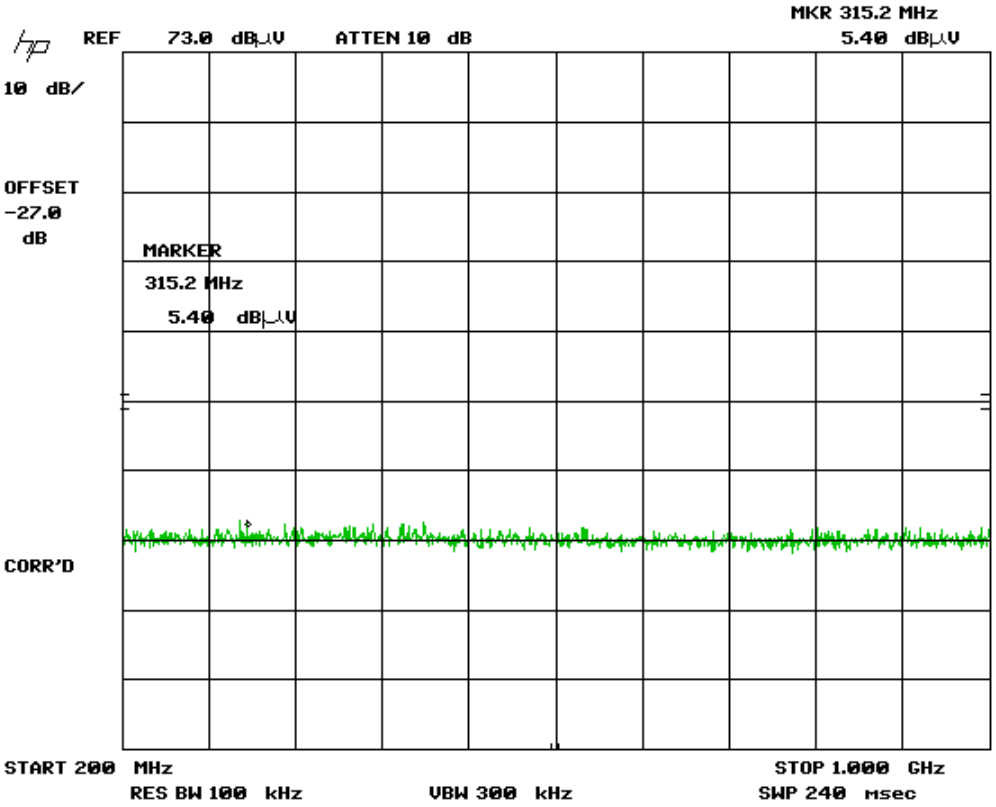


Figure 8 - Radiated emission 200 MHz to 1000 MHz Horizontal polarity

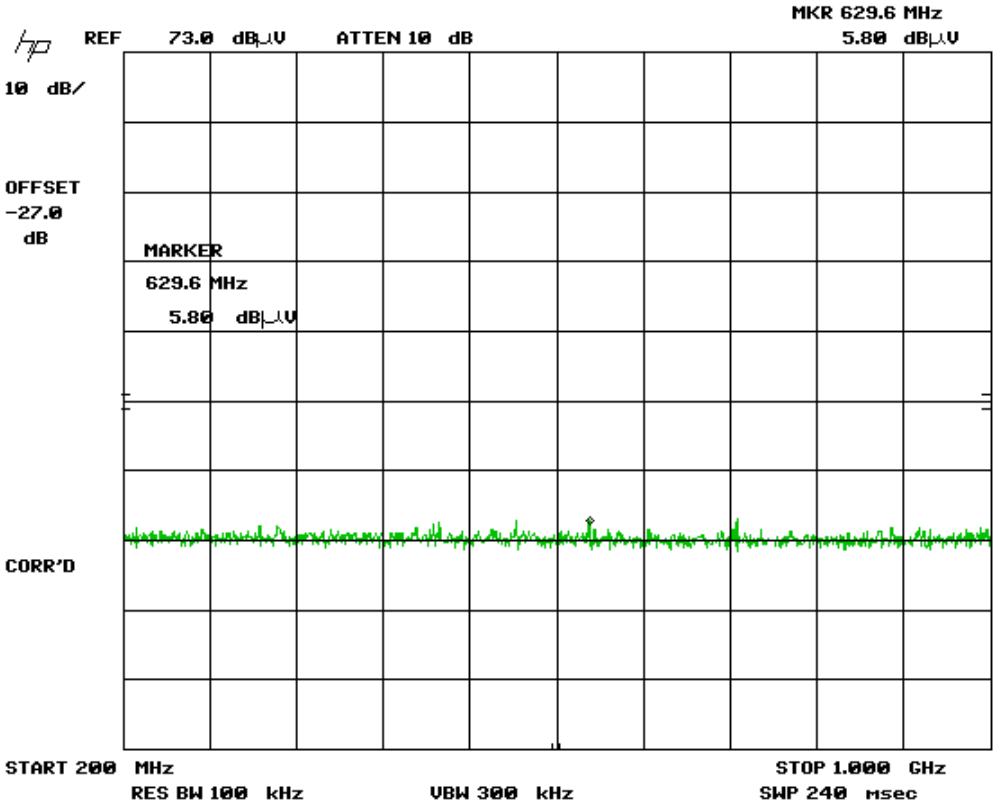


Figure 9 - Radiated emission 200 MHz to 1000 MHz Vertical polarity

2.16 Measurement Uncertainty

2.16.1 Conducted Emissions Measurement Uncertainty:

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.8 dB.

The data listed in this test report has sufficient margin to negate the effects of uncertainty. This measurement unconditionally passes.

2.16.2 Radiated Emissions Measurement Uncertainty:

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.3 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±5.1 dB.

The data listed in this test report has sufficient margin to negate the effects of uncertainty.