TELECOMMUNICATIONS & TELEMATICS FOR TRANSPORTS LABORATORY

IMQ CSQ

Telecommunications & Telematics for Transports Lab.

TEST REPORT

Ref. No. ARSK00125/2

Date: 2011-02-10

Measurements performed in accordance with:

FCC Rules : Code of Federal Regulations (CFR) no. 47

PART 15 – RADIO FREQUENCY DEVICES

PRODUCT	:	WIRELESS HANDWEEL SYSTEM
TESTED MODEL	:	HRA 550 FS / HRA 551 FS (HEIDENHAIN brand) SelBOX-ADAPTER (SELCA brand)
FCC ID	:	YJKHRA550FS
APPLICANT	:	DR. JOHANNES HEIDENHAIN GmbH Dr. Johannes Heidenhain Straße 5 – 83301 Traunreut, Germany
MANUFACTURER	:	DR. JOHANNES HEIDENHAIN GmbH Dr. Johannes Heidenhain Straße 5 – 83301 Traunreut, Germany
TRADEMARK	:	HEIDENHAIN - SELCA
SERIAL NUMBER	:	ID 633 108-02 SN X 27 466 991 (HRA 550 FS)
OTHER INFORMATION	Testing dates	: 2010-05-26 - 2010-12-23 - IMQ BEM: 54677
	Tested samples No.	: 1
	Testing Laboratory	: IMQ S.p.A. Via Quintiliano, 43 I-20138 MILANO

Tested by :	R. Torri	Signature:	Roberto Torri	Date :	2011-02-10
Checked by:	M. De Angelis	Signature:	Mario De Angelis	Date :	2011-02-10

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2010-12-23	Test Results and Evaluation Report
Rev. 1	2011-02-10	Adjournments in accord to certification request of 01-18-2011

CONTENTS

1 GENERAL DESCRIPTION OF EQUIPMENT UNDER TEST

1.1 APPLICANT

NAME	DR. JOHANNES HEIDENHAIN GmbH
ADDRESS	Dr. Johannes Heidenhain Straße 5
COUNTRY	GERMANY

1.2 MANUFACTURER

NAME	DR. JOHANNES HEIDENHAIN GmbH
ADDRESS	Dr. Johannes Heidenhain Straße 5
COUNTRY	GERMANY

1.3 EQUIPMENT CLASSIFICATION

According to the definition 15.3 (o) EUT is a **Intentional Radiator operating within the bands 2400-2483,5 MHz** so it shall fulfil provisions of 47CFR Part 15 Subpart C – Intentional radiators – and Section 15.247.

1.4 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Parameters	Value
Type of equipment :	WIRELESS HANDWEEL SYSTEM
Model:	HRA 550 FS
FCC ID. :	YJKHRA550FS
Trade Name:	HEIDENHAIN
Data cable :	/
Telecom cable :	/
Power supply type :	HR550FS – dedicated NiMh battery pack HRA 550 FS – DC supply power by dedicated controller system
AC power input cable :	/
DC power input cable :	/

Model tested	Brand	Description
HRA 550 FS	HEIDENHAIN	Accesspoint - Interface between controllers and CNC machine for recharging and wireless communication with the portable controller
HRA 551 FS	HEIDENHAIN	Identical to HRA 550 FS (Accessorised for different mounting method. See also manufacturer declaration)
Derivate model	**Brand**	**Description**
SelBOX-ADAPTER	SELCA	Accesspoint - Interface between controllers and CNC machine for recharging and wireless communication with the portable controller

1.5 FEATURE OF EQUIPMENT UNDER TEST

Power specification	
Operating frequency:	2405 ÷ 2480 MHz
Maximum RF radiated power:	16.95 dBm
Modulation:	DTS
Channel Spacing:	5 MHz
Antenna:	Integral antenna “F” reverse strip on PCB (-3 dBi gain)
RX sensitivity:	/
Main SW identification	/
Main HW Board identification	/
Peripherals included (for system application)	None
Interfaces :	None
Integrated interfaces :	None
AC adapter:	None

CHANNEL CONFIGURATION

Channel (No.)	Frequency (MHz)
00	2405
01	2410
02	2415
03	2420
04	2425
05	2430
06	2435
07	2440
08	2445
09	2450
10	2455
11	2460
12	2465
13	2470
14	2475
15	2480

2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST

2.1 ENVIRONMENTAL CONDITIONS

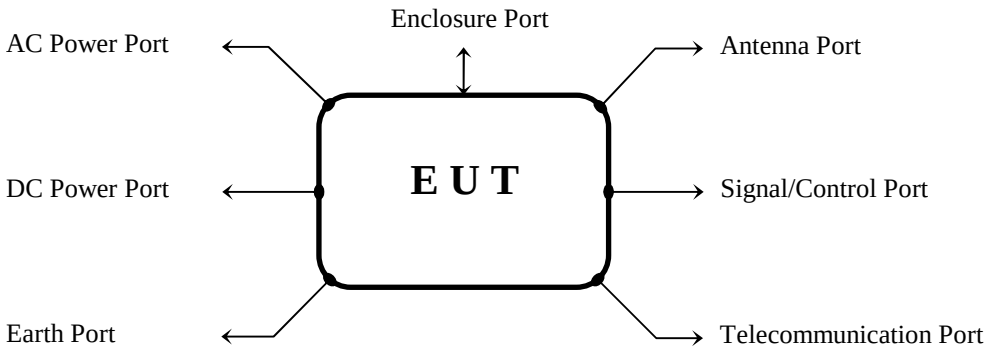
TEST CONDITIONS	MEASURED
Ambient Temperature	20 ÷ 25 °C
Relative Humidity	50 ÷ 60 %
Atmospheric Pressure	900 ÷ 1000 mbar

2.2 DESCRIPTION OF SUPPORT EQUIPMENT

Here following the details concerning equipment needed for correct operation or loading of the EUT:

EQUIPMENT	MANUFACTURER	MODEL
/	/	/

2.3 INTERFACE IDENTIFICATION AND CONNECTION DIAGRAM OF TEST SYSTEM



#	Port	Description	Max length	Ref. Document
1	Enclosure	Plastic case	/	/
2	AC power input	Non present	/	/
2	AC power output	Non present	/	/
3	DC power input	Power by dedicated controller system (only for fixed interface)	/	/
4	Earth	Non present	/	/
5	Telecommunication	Non present	/	/
6	Signal	Serial line (only for fixed interface)	/	/
6	Control	Non present	/	/
7	Antenna	Integrated antenna (“F reverse” on PCB)	/	/

3 OPERATION OF EQUIPMENT UNDER TEST

3.1 OPERATING TEST CONDITIONS

Ref.	Description
#1	Continuous transmission (single channel transmission)

4 TESTS IDENTIFICATION AND RESULTS

TABLE 1 : SUMMARY OF TESTS

CFR47 Part 15 Section	Title	Operating condition	Result	Test No.
15.203 / 204 15.247 (b)(4)(i)	**Antenna Requirements**	/	PASS	**1**
15.207 (a)	**Conducted Emission**	#1	PASS	**2**
15.209 (a) (f)	**Radiated Emission**	#1	PASS	**3**
15.247 (a)	**Frequency hopping and Digitally Modulated intentional radiators**			
15.247(a)	20 dB Bandwidth	Not applicable		
15.247(a)(1)	Carrier frequency (Hopping Channel) Separation	Not applicable		
15.247(a)(1)(iii)	Number of Hopping Channels Used	Not applicable		
15.247(a)(1)(iii)	Time occupancy (Dwell Time) of Each Channel (ch) within a 0,4 x N_{ch} (sec) Period	Not applicable		
15.247(a)(2)	**6dB Bandwidth**	#1	PASS	**4**
15.247(b)	**Maximum Peak Output Power**			
15.247(b) (1)	Peak Output Power	Not applicable		
15.247(b) (3)	**RF power output, radiated (EIRP)**	#1	PASS	**5**
15.247(b) (4)	Antenna gain	Not applicable		
15.247(c)	Operation with directional antenna gains greater than 6 dBi	Not applicable		
15.247 (d)	**Band-edge Compliance of RF Radiated Emissions**	#1	PASS	**6**
15.247 (d)	**Spurious Emission in restricted band near 2400-2483.5 MHz**	#1	PASS	**7**
15.247 (d)	Conducted Emissions outside the band 2,400-2,483.5 MHz	Not applicable		
15.247 (e)	**Transmitter Power Spectral Density**	#1	PASS	**8**
15.247 (f)	Hybrid systems	Not applicable		
15.247 (g)	FHSS Transmission characteristics	Not applicable		
15.247 (h)	Recognition of occupied channel and multiple transmission system	Not applicable		
15.247(i) (§ 47CFR1.1307(b)(1))	**RF Exposure Evaluation**	#1	PASS	**9**

The uncertainties for the tests and measurements are those listed in IMQ Operational Instruction IO-80-U01.

4.1 METHODS OF MEASUREMENT

All compliance measurements have been carried out using the procedures described in the standard ANSI C63.4-2009, ANSI C63.10-2009 and Section 15.31 of CFR47 Part 15 – Subpart A (General).

Additional test requirements have been adopted according to the reference Section indicated in the Test Table 1.

4.2 FREQUENCY RANGE INVESTIGATED

a. Radiated emission tests: from 9 kHz to tenth harmonic of fundamental

5 MEASUREMENTS AND TESTS DATA

TEST No. 1	Title "Antenna Requirements"	47CFR Part 15 Ref. Section 15.203 / 204 15.247 (b)(4)(i)
TEST REQUIREMENTS	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.	

Antenna specifications	
N° of authorized antenna types	Not Applicable
Antenna type	Integral antenna "F" reverse strip on PCB
Maximum total gain	-3dB
External power amplifiers	Not present

Test Result:

The transmitter meets the requirements of section 15.203 and 15.247 (b)(4)(i)

TEST No. 2	Title "Conducted emission"	47CFR Part 15 Ref. Section
		15.207
TEST REQUIREMENTS	Test setup	ANSI C63.4
	Limits of mains terminal disturbance voltage	15.207 (a)
	Frequency range	150 kHz – 30 MHz
	IF bandwidth	9 kHz
	EMC class	B

TEST DATA	PORT UNDER TEST	OPERATING CONDITION	RESULT
	AC mains power input port	#1	Complies
	Note: In search of max noise (phase(s) and neutral) the EUT is connected to AC mains by AC/DC adapter		

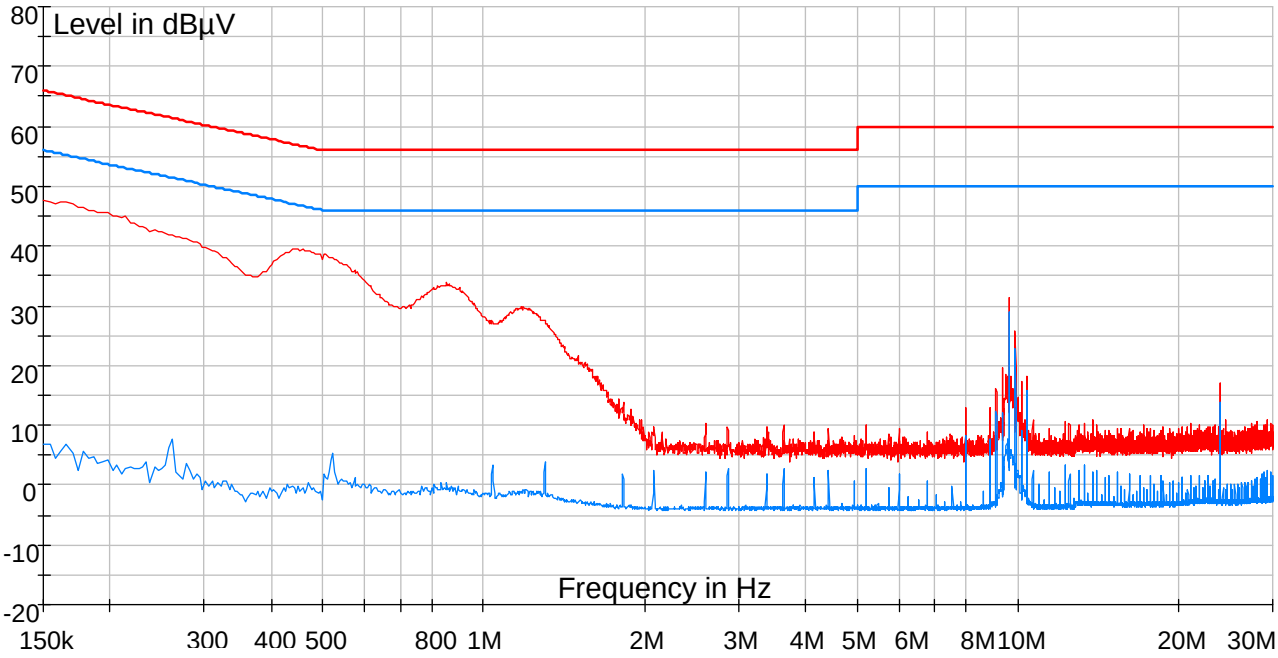
1) The EUT was placed on a wooden table of size, 80 cm by 80 cm, raised 80 cm in which is located 40 cm away from the vertical wall the shielded room.
2) Each EUT power cord input cord was individually connected through a 50Ω/50μH LISN to the input power source.
3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 10 kHz during the measurements.
6) The measurements with Quasi-Peak detector are performed only for frequencies for which the Peak values are ≥ (Q.P. limit - 6 dB).

Test Result:

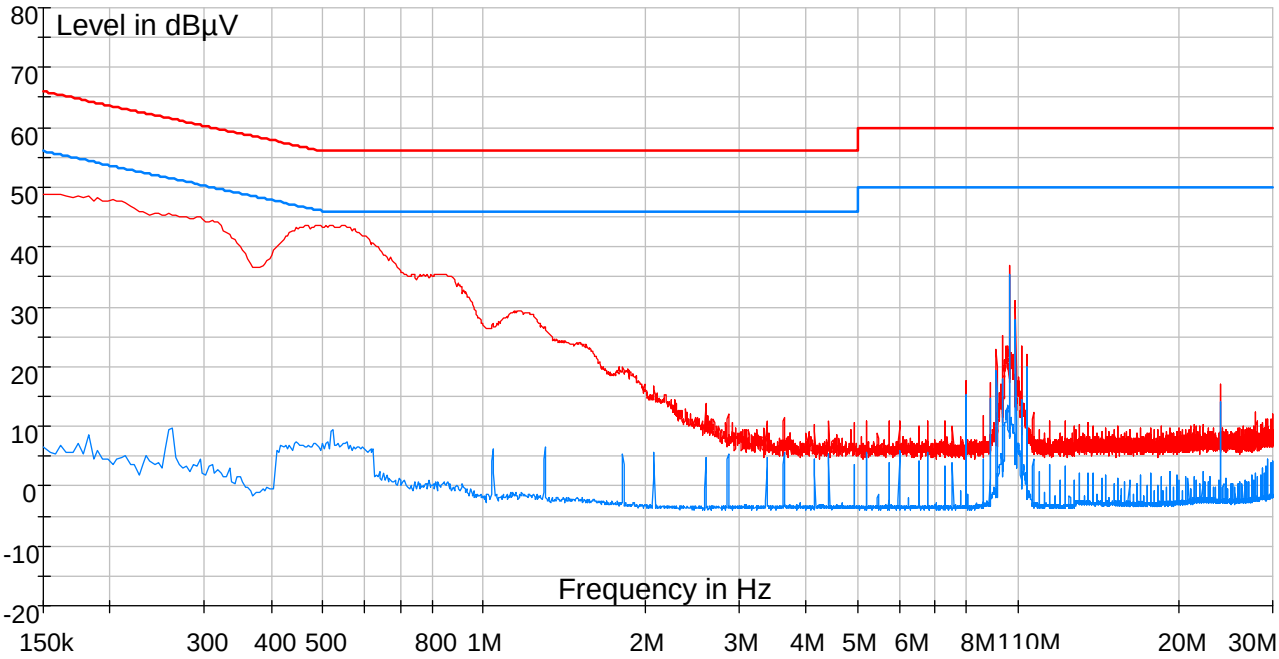
Within the specifications

MEASUREMENTS RESULTS

MEASURE LINE: PHASE



MEASURE LINE: NEUTRAL



TEST No. 3	Title "Radiated disturbances"	47CFR Part 15 Ref. Section 15.209
TEST REQUIREMENTS	Test setup	ANSI C63.4
	Test facility	Semi-anechoic chamber
	Test distance	3 m
	Limits for radiated disturbances	15.209 (a)
	Frequency range	9 kHz to tenth harmonic of fundamental
	IF bandwidth (below 30 MHz)	9 kHz
	IF bandwidth (below 1,000 MHz)	120 kHz
	IF bandwidth (above 1,000 MHz)	1 MHz
	EMC class	B
	(*) In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is: Extrapolation (dB) = 40log (300meter / 3meter) = +80db Extrapolation (dB) = 40log (30meter / 3meter) = +40db	

1) The EUT was placed on turntable which is 0.8 m above the ground plane
2) The turntable shall rotate from 0° to 360° degrees to determine the position of maximum emission level.
3) The EUT is positioned 3 m away from the receiving antenna which varied from 1 to 4 m to find the highest emission.
4) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 100 kHz below 1000 MHz and 1 MHz above 1000 MHz.
5) The receiving antenna was positioned in both horizontal and vertical polarization.
6) The measurements with Quasi-Peak detector, below 1000 MHz are performed only for frequencies for which the Peak values are ≥ (Q.P. limit - 6 dB).

LIMITS FOR SPURIOUS

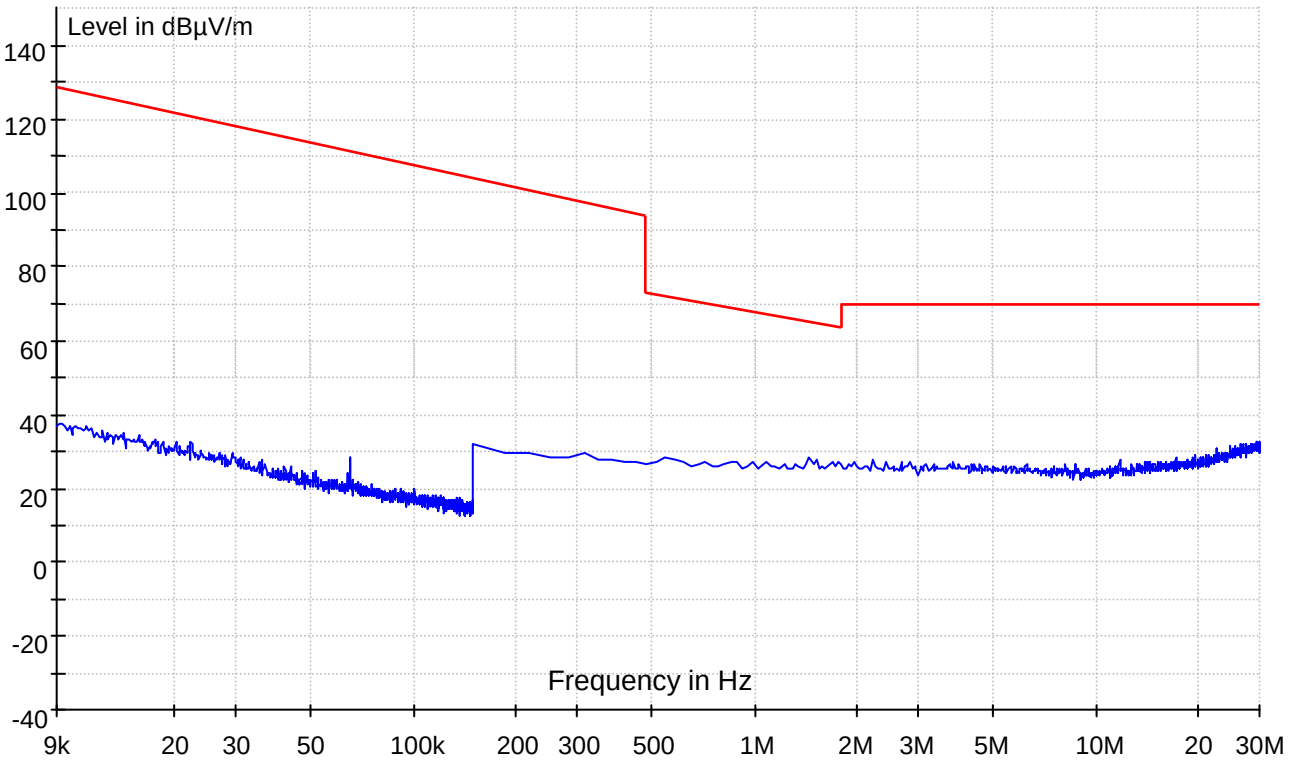
Band of operations	Peak (dBµV/m)	Average Limit (dBµV/m)
Restricted bands (par. 15.205)	74	54
Other bands	According to 15.209 or fundamental –20dB (which is greater)	According to 15.209 or fundamental –20dB (which is greater)

Tested samples

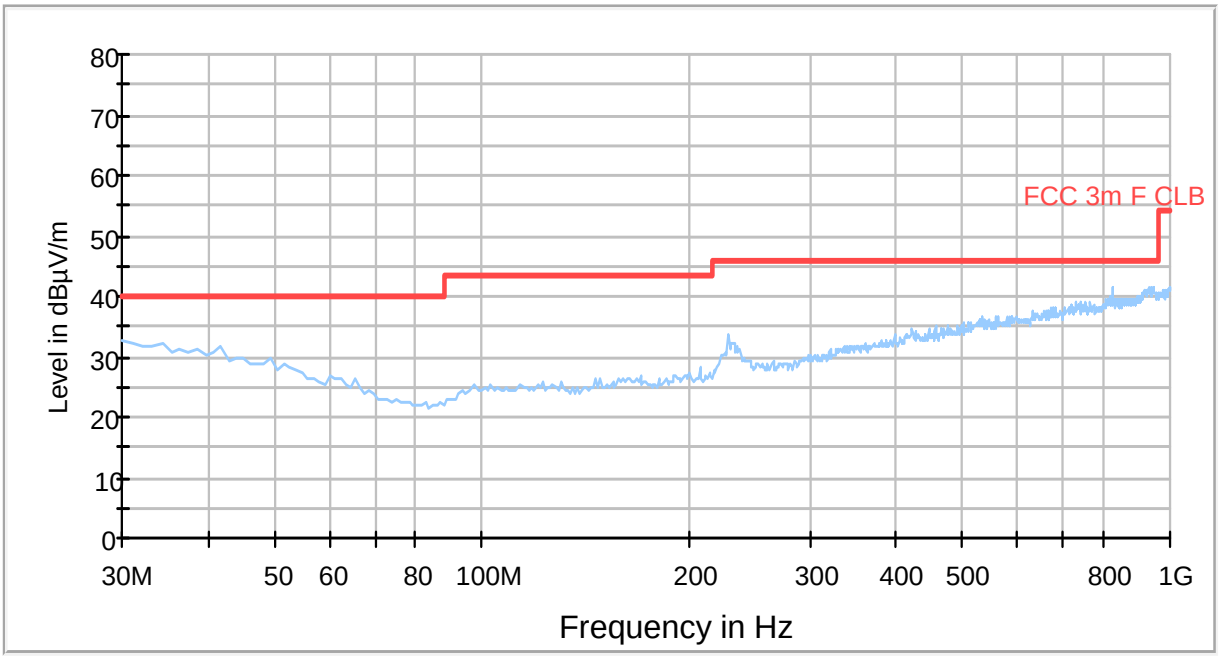
SAMPLE
HRA 550 FS

The sample has been tested together the HR 550 FS.

MEASUREMENTS RESULTS (9kHz÷30 MHz)



MEASUREMENTS RESULTS (30÷1,000 MHz)



MEASUREMENTS RESULTS (1000 MHz to 24800 MHz)

Channel n°00 : 2,405 MHz

PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measured Level (dBµV)	Pre-amplifier Gain (dB)	Cables Loss (dB)	Antenna Factor (dBm^{-1})	Calculated Level (dBµV/m)	Limit (µV/m)	Limit (dBµV/m)	Margin (dB)
2,405	100,80	33,00	3,55	27,40	98,75	-	-	-
4,809	61,57	32,80	5,44	31,54	65,75	5.000	74	8,3
7,213	46,51	32,76	6,90	36,06	56,71	5.000	74	17,3
9,618	49,88	32,15	9,36	38,08	65,17	5.000	74	8,8
12,027	45,14	31,66	11,55	39,10	64,13	5.000	74	9,9
f>12,027	not significant	-	-	-	-	5.000	74	-

Formula:

Calculated Level(dBµV/m) = Measured Level(dBµV) - Pre-amplifier Gain(dB) + Cable Loss(dB) + Antenna Factor (dBm^{-1})

Sample:

100,8 - 33,00 + 3,55 + 27,40 = 98,75

AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dBµV)	Pre-amplifier Gain (dB)	Cables Loss (dB)	Antenna Factor (dBm^{-1})	Calculated Level (dBµV/m)	Limit (µV/m)	Limit (dBµV/m)	Margin (dB)
2,405	73,75	33,00	3,55	27,40	71,70	-	-	-
4,809	34,52	32,80	5,44	31,54	38,70	500	54	15,3
7,213	21,30	32,76	6,90	36,06	31,50	500	54	22,5
9,618	22,61	32,15	9,36	38,08	37,90	500	54	16,1
12,027	12,81	31,66	11,55	39,10	31,80	500	54	22,2
f>12,027	not significant	-	-	-	-	500	54	-

Formula:

Calculated Level(dBµV/m) = Measured Level(dBµV) - Pre-amplifier Gain(dB) + Cable Loss(dB) + Antenna Factor (dBm^{-1})

Sample:

73,75 - 33,00 + 3,55 + 27,40 = 71,7

Channel n°08 : 2,445 MHz

PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measured Level (dBµV)	Pre-amplifier Gain (dB)	Cables Loss (dB)	Antenna Factor (dBm^{-1})	Calculated Level (dBµV/m)	Limit (µV/m)	Limit (dBµV/m)	Margin (dB)
2,445	109,87	33,00	3,55	27,40	107,82	-	-	-
4,881	66,71	32,80	5,44	31,54	70,89	5.000	74	3,1
7,319	45,76	32,76	6,90	36,06	55,96	5.000	74	18,0
9,752	49,63	32,15	9,36	38,08	64,92	5.000	74	9,1
12,203	46,88	31,66	11,55	39,10	65,87	5.000	74	8,1
f>12,203	not significant	-	-	-	-	5.000	74	-

Formula:

Calculated Level(dBµV/m) = Measured Level(dBµV) - Pre-amplifier Gain(dB) + Cable Loss(dB) + Antenna Factor (dBm^{-1})

Sample:

109,87 - 33,00 + 3,55 + 27,40 = 107,82

AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dBµV)	Pre-amplifier Gain (dB)	Cables Loss (dB)	Antenna Factor (dBm^{-1})	Calculated Level (dBµV/m)	Limit (µV/m)	Limit (dBµV/m)	Margin (dB)
2,445	83,35	33,00	3,55	27,40	81,30	-	-	-
4,881	38,12	32,80	5,44	31,54	42,30	500	54	11,7
7,319	21,00	32,76	6,90	36,06	31,20	500	54	22,8
9,752	23,81	32,15	9,36	38,08	39,10	500	54	14,9
12,203	19,61	31,66	11,55	39,10	38,60	500	54	15,4
f>12,203	not significant	-	-	-	-	500	54	-

Formula:

Calculated Level(dBµV/m) = Measured Level(dBµV) - Pre-amplifier Gain(dB) + Cable Loss(dB) + Antenna Factor (dBm^{-1})

Sample:

83,35 - 33,00 + 3,55 + 27,40 = 81,3

Channel n°15 : 2,480 MHz

PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measured Level (dBµV)	Pre-amplifier Gain (dB)	Cables Loss (dB)	Antenna Factor (dBm^{-1})	Calculated Level (dBµV/m)	Limit (µV/m)	Limit (dBµV/m)	Margin (dB)
2,48	112,97	33,00	3,55	27,40	110,92	-	-	-
4,959	67,73	32,80	5,44	31,54	71,91	5.000	74	2,1
7,44	46,67	32,76	6,90	36,06	56,87	5.000	74	17,1
9,918	53,65	32,15	9,36	38,08	68,94	5.000	74	5,1
12,4	49,09	31,66	11,55	39,10	68,08	5.000	74	5,9
f>12,400	not significant	-	-	-	-	5.000	74	-

Formula:

Calculated Level(dBµV/m) = Measured Level(dBµV) - Pre-amplifier Gain(dB) + Cable Loss(dB) + Antenna Factor (dBm^{-1})

Sample:

112,97 - 33,00 + 3,55 + 27,40 = 110,92

AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dBµV)	Pre-amplifier Gain (dB)	Cables Loss (dB)	Antenna Factor (dBm^{-1})	Calculated Level (dBµV/m)	Limit (µV/m)	Limit (dBµV/m)	Margin (dB)
2,48	87,25	33,00	3,55	27,40	85,20	-	-	-
4,959	40,59	32,80	5,44	31,54	44,77	500	54	9,2
7,44	20,91	32,76	6,90	36,06	31,11	500	54	22,9
9,918	28,40	32,15	9,36	38,08	43,69	500	54	10,3
12,4	20,83	31,66	11,55	39,10	39,82	500	54	14,2
f>12,400	not significant	-	-	-	-	500	54	-

Formula:

Calculated Level(dBµV/m) = Measured Level(dBµV) - Pre-amplifier Gain(dB) + Cable Loss(dB) + Antenna Factor (dBm^{-1})

Sample:

87,25 - 33,00 + 3,55 + 27,40 = 85,2

TEST No.4	Title "6 dB Bandwidth"	47CFR Part 15 Ref. Section 15.247 (a) (2)
TEST SET-UP & REQUIREMENTS	**Spectrum analyzer settings**	
	Span	2 MHz
	Resolution (or IF) Bandwidth (RBW)	100 kHz
	Video (or Average) Bandwidth (VBW)	300 kHz
	Sweep time	2,5 ms
	Detector function	Peak
	Trace	max hold
	Attenuator	/
	LIMIT	**≥ 500 kHz**

The EUT is set to transmit has its maximum data rate.
The transmitter output was connected to the spectrum analyzer through a test coupler (radio frequency coupling device associated with the integral antenna of the equipment under test).
The Channel bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6 dB.

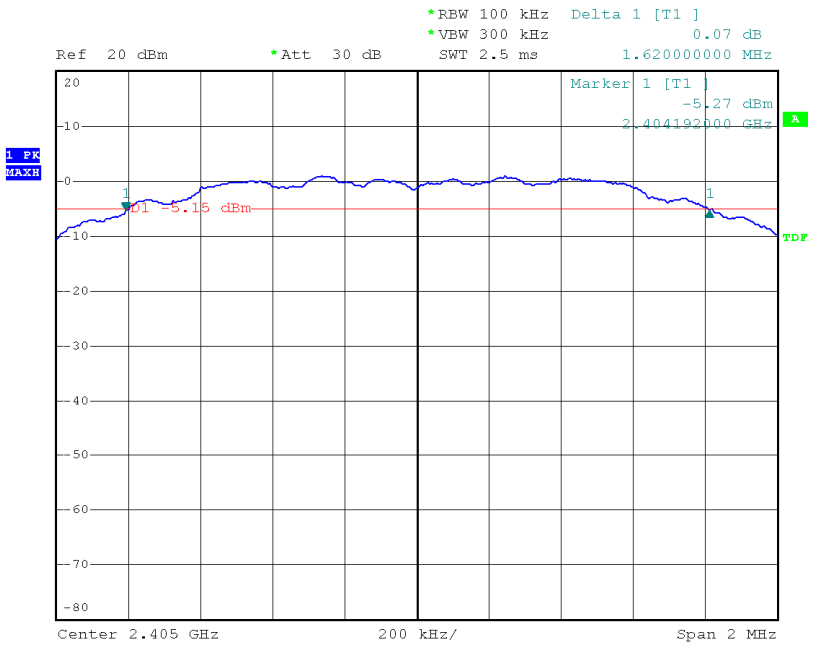
Test Result:

Channel (No.)	Frequency (MHz)	Channel Bandwidth (MHz)	Plot (No.)
00	2,405	1.620	1
08	2,445	1.608	2
15	2,480	1.596	3

Tested samples

SAMPLE
HRA 550 FS

Plot No. 1



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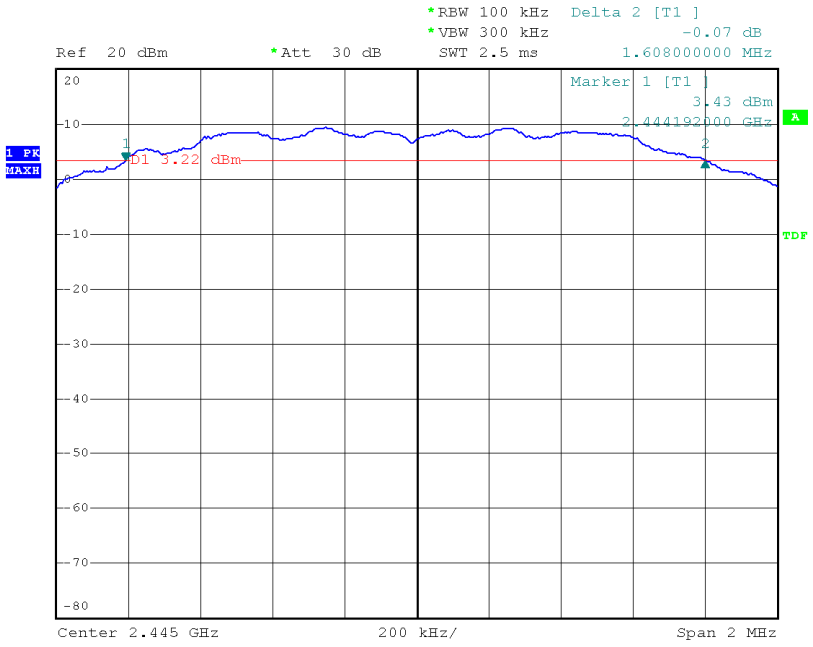
Plot No. 2



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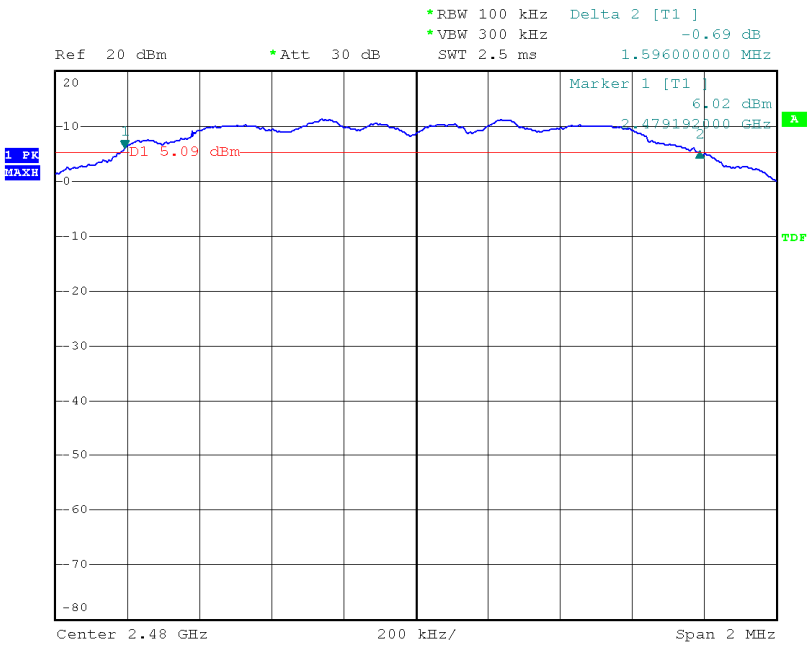
Plot No. 3



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TEST No.5	Title " Maximum Peak Output Power with External Antenna (De Facto EIRP)"	47CFR Part 15 Ref. Section 15.247 (b) (3)
TEST SET-UP & REQUIREMENTS	**Spectrum analyzer settings**	
	Span	/
	Resolution (or IF) Bandwidth (RBW)	10 MHz
	Video (or Average) Bandwidth (VBW)	10 MHz
	Sweep time	2,5 ms
	Detector function	Peak
	Trace	max hold
	Attenuator	/
	LIMIT	**1 Watt (30dBm)**

Radiated measurements:

As the EUT is supplied with a dedicated antenna, the effective radiated power is measured in a 3m anechoic chamber with the substitution antenna method.

Tested samples

SAMPLE
HRA 550 FS

Test Result

Radiated measure (Peak detector)

Channel	Measured Receiver Signal (dBm)	Frequency (MHz)	Signal Generator (dBm)	Antenna Gain (dB)	Cables Loss (dB)	Calculated Radiated Output Power (eirp) (dBm)
00	13,22	2,405	-1,94	10,42	0,76	7,72
08	20,83	2,445	5,68	10,45	0,76	15,37
15	22,48	2,480	7,23	10,48	0,76	16,95

Channel	Calculated Radiated Output Power (eirp) (dBm)	Limit (W)	Limit (dBm)	Margin (dB)
00	7,72	1	30	22,28
08	15,37	1	30	14,63
15	16,95	1	30	13,05

Formula:

Calculated Radiated Output Power (dBm) = Transmitted Signal (dBm) - Cable Loss (dB) + Antenna Gain (dB)

Sample:

-1,94 - 0,76 + 10,42 = 7,72

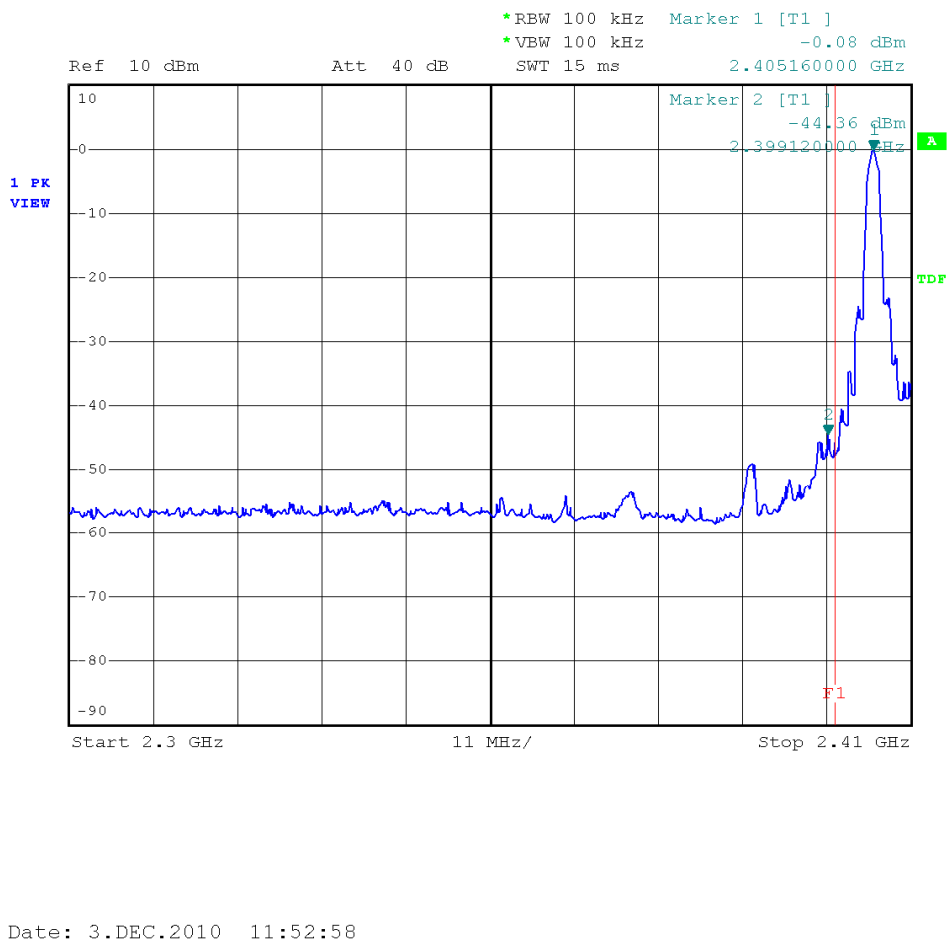
TEST No. 6	Title "Band-edge Compliance of RF Radiated Emissions"	47CFR Part 15 Ref. Section 15.247 (d)
TEST SET-UP & REQUIREMENTS	**Spectrum analyzer settings**	
	Span	Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
	Resolution (or IF) Bandwidth (RBW)	1 MHz (100 kHz band-edge)
	Video (or Average) Bandwidth (VBW)	1 MHz (100 kHz band-edge)
	Sweep time	Auto
	Detector function	Peak and Average
	Trace	Max hold
	Attenuator	/
	LIMIT	**> 20 dB below that in the 100kHz bandwidth within the assigned band**

Tested samples

SAMPLE
HRA 550 FS

Test Result:

Band-edge compliance, lower band edge, (Peak)



All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Frequency (MHz)	Measured Power (dBm)	Measured Power at band edge (dBm)	Difference to the signal peak (dB)	Limit (dB)	Margin (dB)
2,405	-0,08	-44,36	-44,28	-20,08	24,28

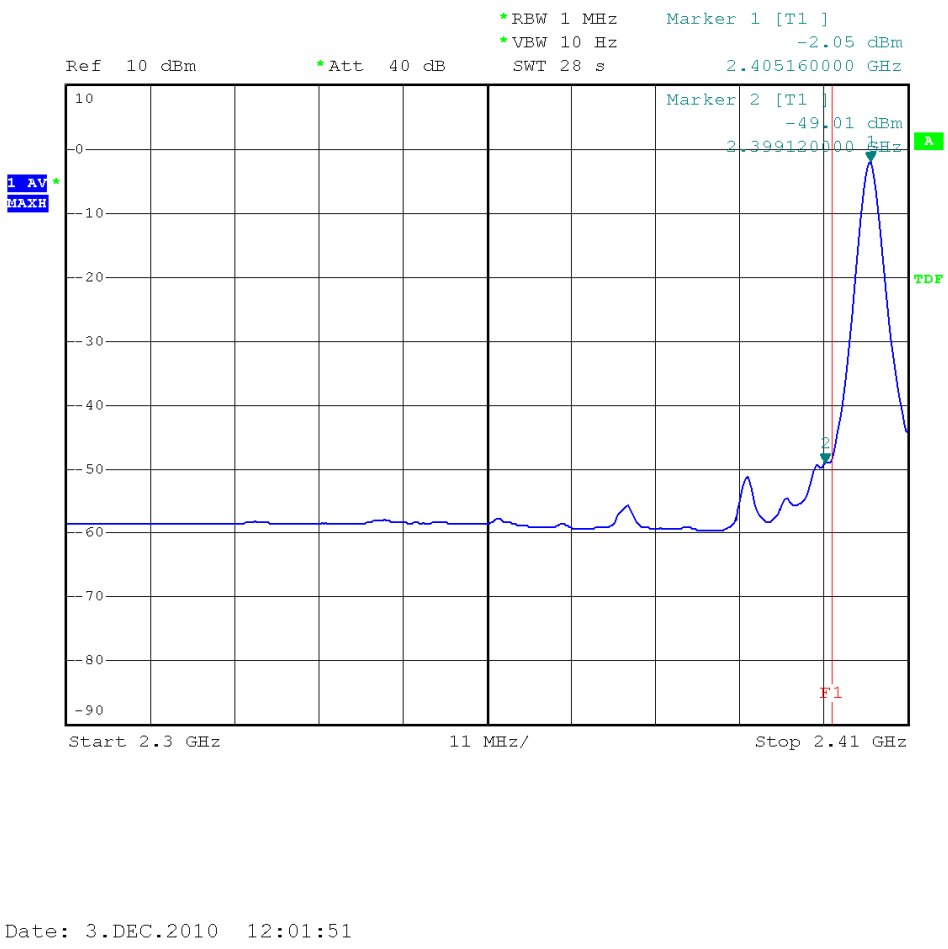
Formula:

Difference to signal peak (dB) = Measured Power at band edge (dBm) - Measured Power (dBm)

Sample:

-44,36 - (-0,08) = -44,28

Band-edge compliance, lower band edge, (Average)



All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Frequency (MHz)	Measured Power (dBm)	Measured Power at band edge (dBm)	Difference to the signal peak (dB)	Limit (dB)	Margin (dB)
2,405	-2,05	-49,01	-46,96	-22,05	26,96

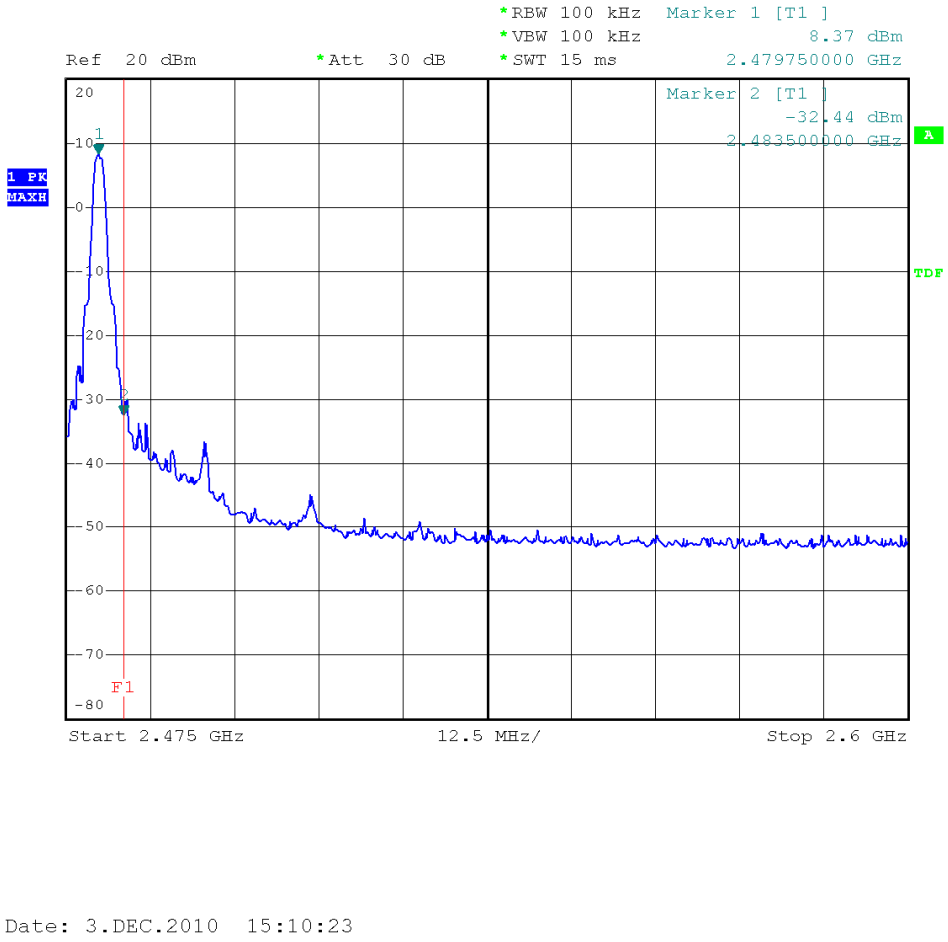
Formula:

Difference to signal peak (dB) = Measured Power at band edge (dBm) - Measured Power (dBm)

Sample:

-49,01 - (-2,05) = -46,96

Band-edge compliance, upper band edge, (Peak)



All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Frequency (MHz)	Measured Power (dBm)	Measured Power at band edge (dBm)	Difference to the signal peak (dB)	Limit (dB)	Margin (dB)
2,480.5	8,37	-32,44	-40,81	-11,63	20,81

Formula:

Difference to signal peak (dB) = Measured Power at band edge (dBm) - Measured Power (dBm)

Sample:

-32,44 - (8,37) = -40,81

Band-edge compliance, upper band edge, (Average)

All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Frequency (MHz)	Measured Power (dBm)	Measured Power at band edge (dBm)	Difference to the signal peak (dB)	Limit (dB)	Margin (dB)
2,480.5	8,83	-25,80	-34,63	-11,17	14,63

Formula:

Difference to signal peak (dB) = Measured Power at band edge (dBm) - Measured Power (dBm)

Sample:

-25,8 - (8,83) = -34,63

TEST No. 7	Title "Spurious Emission in restricted band near 2400-2483.5 MHz"	47CFR Part 15 Ref. Section 15.247 (d)
TEST SET-UP & REQUIREMENTS	**Spectrum analyzer settings**	
	Span	Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
	Resolution (or IF) Bandwidth (RBW)	1 MHz with peak detector
	Video (or Average) Bandwidth (VBW)	1 MHz with peak detector
	Resolution (or IF) Bandwidth (RBW)	1 MHz with average detector
	Video (or Average) Bandwidth (VBW)	10 Hz with average detector
	Sweep time	Auto
	Detector function	Peak and Average
	Trace	Max hold
	Attenuator	/
	LIMIT	**Peak = 5000 µV / m** **Average = 500 µV / m**

Tested samples

SAMPLE
HRA 550 FS

Spurious Emission in restricted band near 2400-2483.5 MHz

PEAK DETECTOR

Frequency (MHz)	Measured Level (dBµV)	Pre-amplifier Gain (dB)	Cables Loss (dB)	Antenna Factor (dBm^{-1})	Calculated Level (dBµV/m)	Limit (µV/m)	Limit (dBµV/m)	Margin (dB)
2,398	50,30	33,00	3,55	27,40	48,25	5000	74,00	25,75

Formula:

Calculated Level (dBµV/m) = Measured Level (dBµV) - Pre-amplifier Gain (dB) + Cable Loss (dB) + Antenna Factor (dBm^{-1})

Sample:

50,3 - 33,00 + 3,55 + 27,40 = 48,25

AVERAGE DETECTOR

Frequency (MHz)	Measured Level (dBµV)	Pre-amplifier Gain (dB)	Cables Loss (dB)	Antenna Factor (dBm^{-1})	Calculated Level (dBµV/m)	Limit (µV/m)	Limit (dBµV/m)	Margin (dB)
2,398	27,76	33,00	3,55	27,40	25,71	500	54,00	28,29

Formula:

Calculated Level (dBµV/m) = Measured Level (dBµV) - Pre-amplifier Gain (dB) + Cable Loss (dB) + Antenna Factor (dBm^{-1})

Sample:

27,76 - 33,00 + 3,55 + 27,40 = 25,71

Spurious Emission in restricted band near 2400-2483.5 MHz

PEAK DETECTOR

Frequency (MHz)	Measured Level (dBµV)	Pre-amplifier Gain (dB)	Cables Loss (dB)	Antenna Factor (dBm^{-1})	Calculated Level (dBµV/m)	Limit (µV/m)	Limit (dBµV/m)	Margin (dB)
2,484	66,58	33,00	3,95	27,65	65,18	5000	74,00	8,82

Formula:

Calculated Level (dBµV/m) = Measured Level (dBµV) - Pre-amplifier Gain (dB) + Cable Loss (dB) + Antenna Factor (dBm^{-1})

Sample:

66,58 - 33,00 + 3,55 + 27,40 = 65,18

AVERAGE DETECTOR

Frequency (MHz)	Measured Level (dBµV)	Pre-amplifier Gain (dB)	Cables Loss (dB)	Antenna Factor (dBm^{-1})	Calculated Level (dBµV/m)	Limit (µV/m)	Limit (dBµV/m)	Margin (dB)
2,484	42,63	33,00	3,95	27,65	41,23	500	54,00	12,77

Formula:

Calculated Level (dBµV/m) = Measured Level (dBµV) - Pre-amplifier Gain (dB) + Cable Loss (dB) + Antenna Factor (dBm^{-1})

Sample:

42,63 - 33,00 + 3,55 + 27,40 = 41,23

TEST No.8	Title "Transmitter Power Spectral Density"	47CFR Part 15 Ref. Section 15.247 (e)
TEST SET-UP & REQUIREMENTS	**Spectrum analyzer settings**	
	Span	1.5 MHz
	Resolution (or IF) Bandwidth (RBW)	3 kHz
	Video (or Average) Bandwidth (VBW)	10 kHz
	Sweep time	500 s
	Detector function	Peak
	Trace	max hold
	Attenuator	/
	LIMIT	8 dBm

The transmitter output was connected to the spectrum analyzer through a test coupler (radio frequency coupling device associated with the integral antenna of the equipment under test).

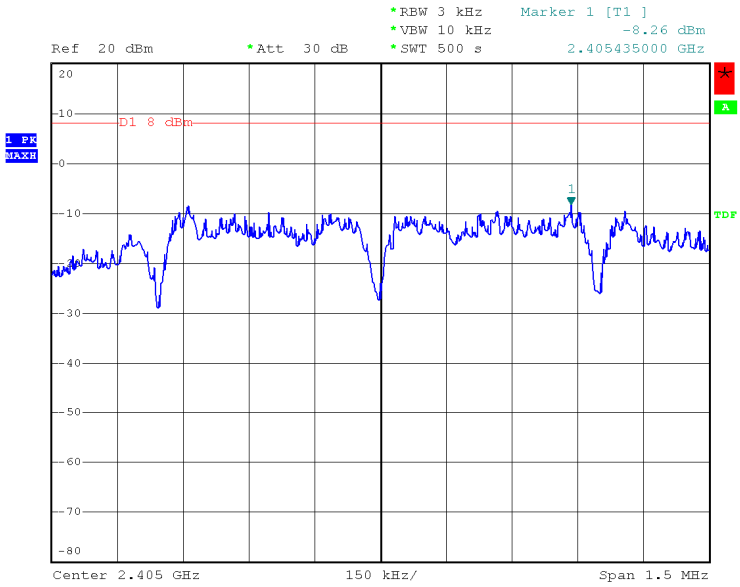
After trace stabilisation the marker shall be set on the signal peak. The indicated level is the power spectral density.

Test Result:

Channel (No.)	Transmitter power on 3 kHz band (dBm)	Plot (No.)
00	-8.26	1
08	-0.55	2
15	+1.83	3

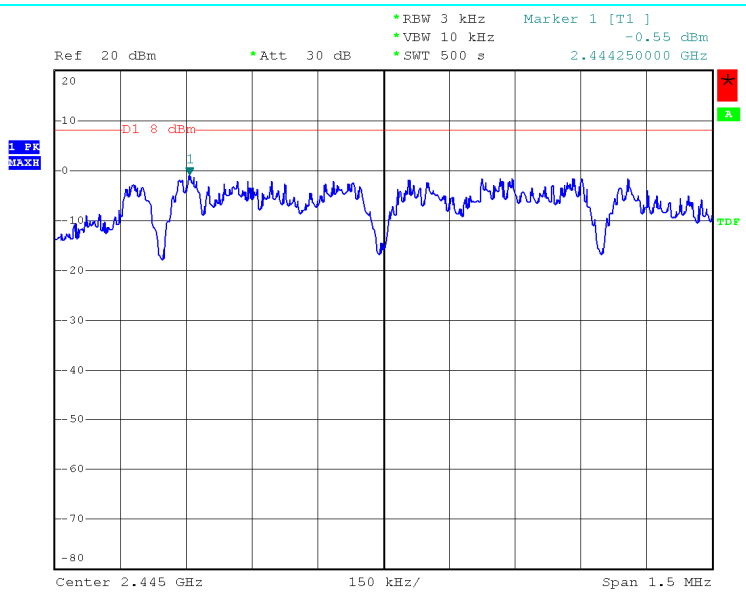
Within the specifications

Plot No. 1:



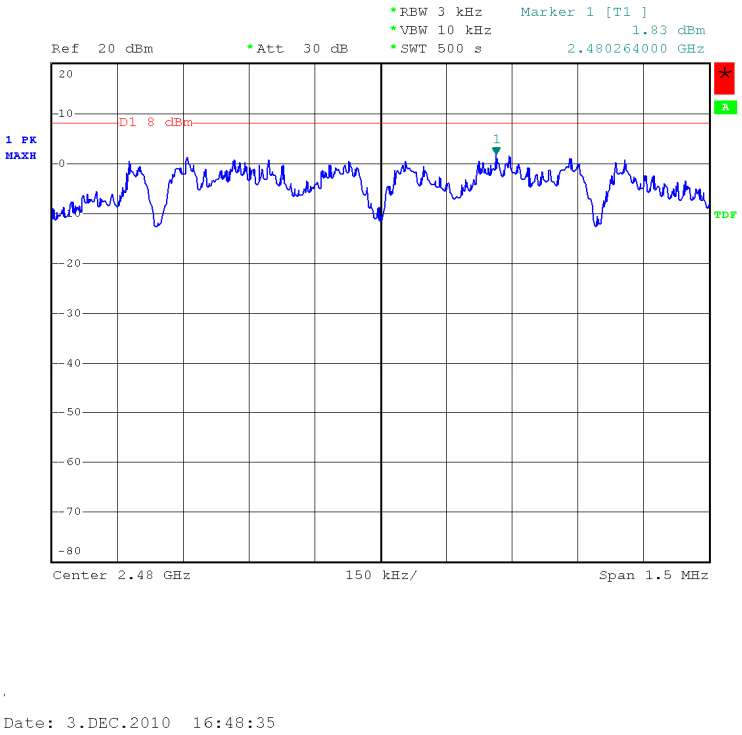
Date: 3.DEC.2010 17:02:55

Plot No. 2:



Date: 3.DEC.2010 17:06:56

Plot No. 3:



TEST No.9	Title "RF Exposure Evaluation"	47CFR Part 15 Ref. Section 15.247 (i)
TEST SET-UP & REQUIREMENTS	Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.	
	EUT classification	Unlicensed equipment associated with a mobile application (installed in a fixed position in uncontrolled locations)
	LIMITS	Table 1 in Section 1.1310

Limit for maximum permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Avarage Time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3÷3.0	614	1.63	(100)*	6
3.0÷30	1842/f	4.89/f	($900/f^2$)*	6
30÷300	61.4	0.163	1.0	6
300÷1500	--	--	f/300	6
1500÷100,000	--	--	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3÷3.0	614	1.63	(100)*	30
3.0÷30	824/f	2.19/f	($180/f^2$)*	30
30÷300	27.5	0.073	0.2	30
300÷1500	--	--	f/1500	30
1500÷100,000	--	--	1.0	30
F = Frequency in MHz *Plane-wave equivalent power density				

The distance from the device's transmitting antenna where the exposure level reaches the maximum permitted limit is calculated using the general equation:

$S = P*G/ 4\pi R^2$

Where:
S = Power Density (mW/cm^2)
P = Conducted power (mW)
G = Linear power gain relative to isotropic radiator (numeric gain)
R = Distance (cm)

RF Exposure evaluation Distance:

Channel	Frequency	Output power to antenna	Power density @ 20 cm	Distance where the exposure level reaches the limit	Limits
(No.)	(MHz)	(dBm)	(mW/cm^2)	(cm)	(mW/cm^2)
00	2,405	+7.72	0.0012	0.307	5
08	2,445	+15.37	0.0069	0.740	5
15	2,480	+16.95	0.0099	0.888	5

Test Result:

The EUT does not exceed the Commission's RF exposure guidelines limits; furthermore, Spread spectrum transmitters operate according to the Section 15.247 are categorically excluded from routine environmental evaluation. RF exposure limit warning or SAR test are not required.

6 ADDITIONAL TECHNICAL INFORMATION

6.1 ELECTROMAGNETICALLY RELEVANT COMPONENTS:

Components	N°	Manufacturer	Type – Technical data
Radio Module			
HR 550 FS (handwheel) and HRA 550 FS (access point)			
Host Equipment			
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6.2 RFI SUPPRESSION DEVICES:

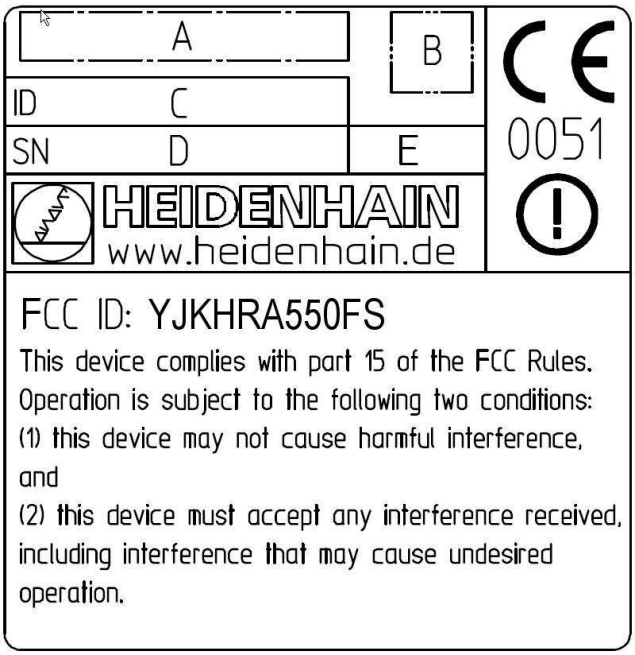
Components	N°	Manufacturer	Type – Technical data
None			

6.3 EMI PROTECTION DEVICES:

Components	N°	Manufacturer	Type – Technical data
None			

7 TECHNICAL DOCUMENTATION

DOCUMENT. Marking label



Beschriftungstabelle / Labeling table

Feld Field	Beschriftung Labeling	Klischee Printing block
A	Merkmal **NAMEA1_TYPA2** aus SML Characteristic **NAMEA1_TYPA2** from SML	743422-01
B	Seriennummer 2D-Barcode Data Matrix ECC 200 Serial number 2D-bar code Data Matrix ECC 200	
C	Teilenummer (Klartext) / Part number (plain language)	
D	Prototypenkenner (wenn vergeben)_Seriennummer_Kundenindex (wenn vergeben) im Klartext Prototype code (if assigned)_Serial number_customer index (if assigned) in the plain language	
E	Herstellungsdatum **DATECODE01** / Date of manufacture **DATECODE01**	

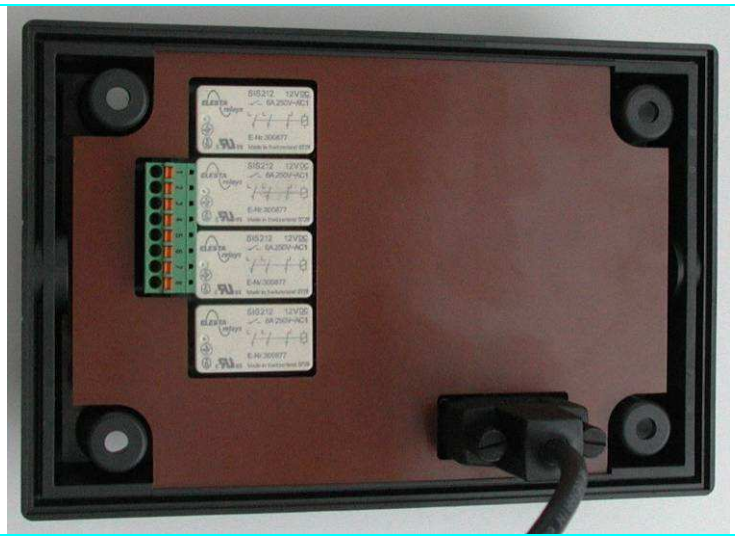
Das Zeichen "_" in der Tabelle bedeutet eine Leerstelle im Text.
The "_" character in the table indicates a space in the text.

SML = classification list

8 PHOTOGRAPHIC DOCUMENTATION

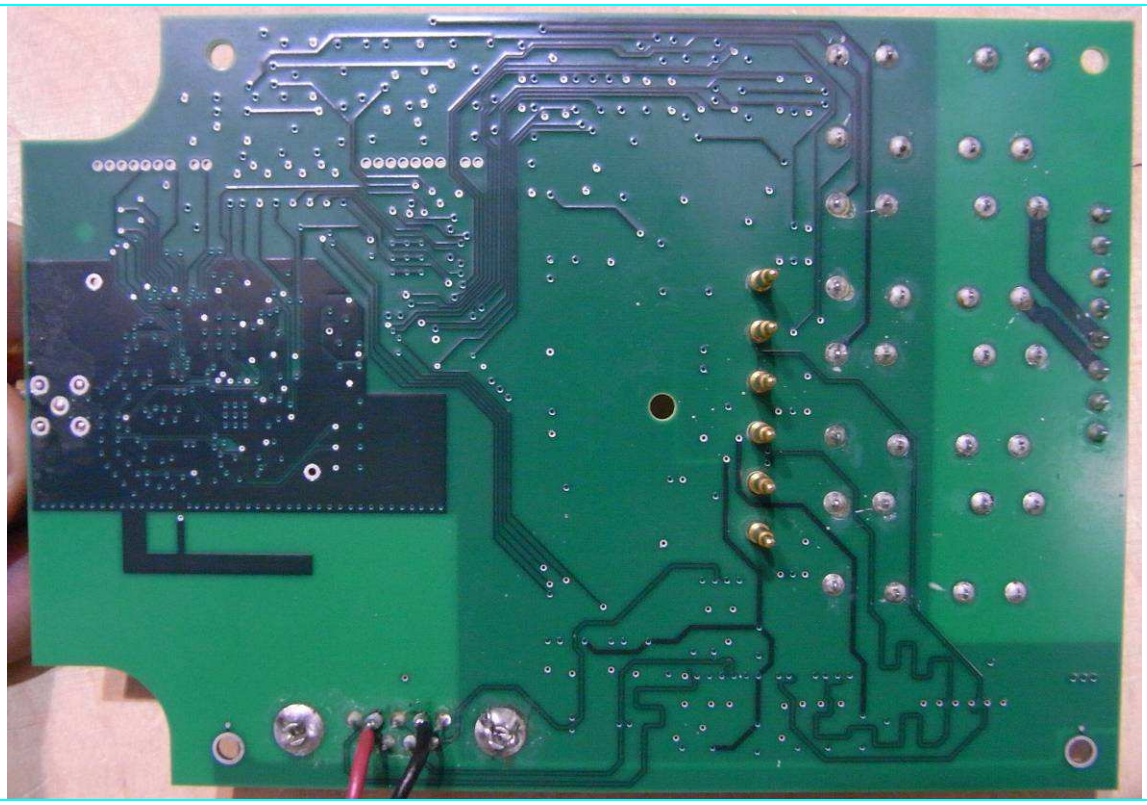
8.1 EUT IDENTIFICATION

External view of interface between controllers and CNC machine for recharging and wireless communication with the portable controller



Back view

Internal View



Internal – Back PCB view

8.2 TEST SET-UP

Set up of Radiated emission test

9 MEASUREMENT AND TEST EQUIPMENT INSTRUMENTATION

Instruments	Manufacturer	Model	IMQ serial number	Calibration data	Calibration interval (Month)
Emi Receiver	Rohde & Schwarz	ESCI	S-04355	12/2009	12
Emi Receiver	Rohde & Schwarz	ESVS	S-04197	12/2008	18
Spectrum Analyzer	Rohde & Schwarz	FSP40	S-03629	11/2009	24
Loop Antenna	Rohde & Schwarz	HFH2-Z2	S-02508	12/2008	24
Antenna Bilog	ARA	LPD-2513	S-02385	07/2009	24
Antenna ridged horn 1÷18 GHz	Schwarzbeck	BBHA9120D	S-03464	02/2009	24
Antenna ridged horn 15÷40 GHz	Schwarzbeck	BBHA9170	S-03668	05/2010	24
Pre-amplifier 1-26.5 GHz	HP	HP 8449 B	S-03542	07/2008	24
Pre-amplifier 30-1000 MHz	BONN ELEKTRONIK	BLNA	S-04193	12/2008	24
Digital Oscilloscope	Yokogawa	DL7200	S-03745	05/2010	12
Band Reject Filter 2400÷2483 MHz	Wainwright	WRCG2400 / 2483	S-04308	/	/
Highpass Filter 3.4÷18 GHz	Wainwright	WHK3.4/18	S-04309	/	/
Crystal Detector	Agilent	8472B	S-04467	/	/
Software for test automation	Rohde & Schwarz	ES-K1 V.1.60	/	/	/