Test Report

INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C AND ISED CANADA REQUIREMENTS
RF CO-LOCATION TEST REPORT

Equipment Under Test:	Mobile Patient Monitor
Model:	Portrait HUB01
Manufacturer:	GE Healthcare Finland Oy Kuortaneenkatu 2 FI-00510, Helsinki Finland
Customer:	GE Healthcare Finland Oy Kuortaneenkatu 2 FI-00510, Helsinki Finland
FCC Rule Part:	2.947(f) 15.207 15.209 15.247(d)
IC Rule Part:	RSS-GEN Issue 5 Amendment 2, 2021

Date:	16 April 2021	Date:	16 April 2021
Issued by:	Henri Mäki Testing Engineer	Checked by:	Mikko Halonen Development Engineer

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GENERAL REMARKS

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.

RELEASE HISTORY

Version	Changes	Issued
1.0	Initial release	29 March 2021
1.1	IC requirements added	16 April 2021

PRODUCT DESCRIPTION

Equipment Under Test

Trade mark:	GE
Model:	Portrait HUB01
Type:	Mobile Patient Monitor
Serial no:	Sample 1: SRW20440005SP (RF_HUB_RFV_1) Sample 2: SRW20440017SP (RF_HUB_RFV_2)
FCC ID:	2AO8L-HUB01
IC:	25821-HUB01
Contains FCC ID:	2AO8L-WL18DBMOD (WLAN-module)
Contains IC:	25821-WL18DBMOD (WLAN-module)

General Description

The Portrait HUB01 (later Hub) is a part of GE Healthcare's Portrait Mobile Monitoring Solution system. The Hub enables continuous monitoring of patients by acquiring signals from body-worn sensors through the GE proprietary Medical Body Area Network (MBAN) radio as well as displaying trends and events. The Hub further delivers the patient data to a hospital network through the WLAN (802.11a/b/g/n) radio. Pairing between a Hub and a sensor is made by using an NFC (ISO/IEC 14443) reader in the Hub. In addition to the active MBAN, WLAN and NFC radios, the Hub has a passive RFID tag (EPCglobal Gen-2) that is used for asset management. All Hub antennas are integrated in the mechanics. Besides the wireless interfaces the hub incorporates a 5-pin GE proprietary USB connector in the back of the Hub. The USB connector is used for charging the Hub battery and it enables the SW updates and device configuration.

Classification

Fixed device	☐
Mobile Device (Human body distance > 20cm)	☒
Portable Device (Human body distance < 20cm)	☒

Modifications Incorporated in the EUT

No.	Name	Description
1	RF_HUB_RFV_1	Radiated sample
2	RF_HUB_RFV_2	Radiated sample

In both samples the PWB RF is reworked to be mass production equivalent.

Ratings and declarations

Operating Frequency Range:	MBAN	2402.0-2478.8 MHz
	WLAN	2412-2462 MHz / 5180-5825 MHz
	NFC	13.56 MHz
	RFID	902-928 MHz
Channels:	MBAN	31
	WLAN	11 / 21
	NFC	1
	RFID	50
Channel separation:	MBAN	2.5 / 2.6 / 2.7 MHz
	WLAN	5 MHz / 20 MHz
	NFC	N/A
	RFID	500 kHz
Transmission technique:	Digital modulation	
Modulation:	MBAN	GFSK
	WLAN	according to IEEE802.11a/b/g/n
	NFC	according to ISO/IEC 14443 106 kbps
	RFID	according to EPCglobal Gen-2
Antenna type:	custom integrated antennas	
Integral Antenna gain (max):	MBAN	2.9 dBi (bottom antenna), 5.6 dBi (top antenna)
	WLAN	6.0 dBi (top antenna 2.4 GHz), 4.0 dBi (bottom antenna 5 GHz), 6.8 dBi (top antenna 5 GHz)
	NFC	N/A
	RFID	N/A

Power Supply

Operating voltage range: 3.6 V_{DC} (nominal battery voltage)

Mechanical Size of the EUT

Height: 21 mm Width: 63 mm Length: 141 mm

Peripherals

Peripheral	Description / Usage
4 x Sensor Batteries	GE Portrait SBT01
Charger unit	GE Portrait BCH01, battery charging unit for the EUT and peripheral sensor batteries. Used during conducted emissions on power supply lines test.
AC/DC adapter	XP Power ACM36US12-XZ1110A, power supply for the charger unit.
Laptop	Dell Precision 3541, companion device for conducted emissions on power supply lines test.
AC/DC adapter	Dell HA65NM130, power supply for the laptop.
RFID reader	Nordic ID Sampo S1 813-S1A. Used during radiated emissions to read the RFID tag of the EUT.

The peripherals were provided by the customer.

SUMMARY OF TESTING

Test Specification	Description of Test	Result
ANSI C63.10-2013, clause 7.5	Duty Cycle	-
§15.207(a) / RSS-GEN 8.8	Conducted Emissions on Power Supply Lines	**PASS**
§15.209(a), §15.247(d) / RSS-GEN 8.9, 8.10	Radiated Emissions Within the Restricted Bands	**PASS**

The decision rule applied for the tests results stated in this test report is according to the requirements of section 1.3 of ANSI C63.10-2013.

EUT Test Conditions during Testing

The EUT was in continuous transmit mode during all the tests. The EUT was configured into the wanted channel using software provided by the manufacturer:

- MBAN test mode: 1.0.0.4.0.13-1116.1.20b2780
- TI calibrator scripts from GE GIT repository wearable-wireless-tools rev. 4c3f017

Radiated emissions were measured while all radios were enabled and set to transmit (WLAN on either 2.4 GHz band or 5 GHz band). The RFID tag was continuously read with the peripheral RFID reader. During conducted emissions measurement MBAN and NFC were set to transmit. During all tests MBAN and WLAN were set to transmit through top antennas of the EUT. WLAN b- and a-protocols were used during testing with 1 Mbps and 6 Mbps data rates, respectively.

During Conducted Emissions on Power Supply Lines measurement the EUT and peripheral sensor batteries were placed on a charger unit and the batteries were charging. The charger unit was connected via USB to a peripheral laptop, which was reading the battery charge levels during the test. The AC mains input voltage was 120 V, 60 Hz.

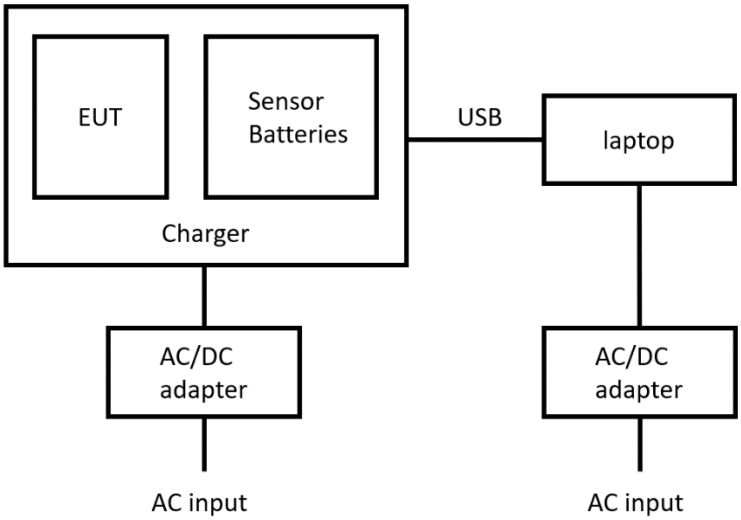

Figure 1: Test setup block diagram for conducted emissions on power supply lines

Table 1: Test frequencies

Radio	Channel	Frequency (MHz)
NFC	1	13.56
RFID	-	902-928
MBAN	15	2402.0
WLAN (2.4 GHz)	6	2437.0
WLAN (5 GHz)	36	5180.0

Test Facility

Testing Laboratory / address: FCC designation number: **FI0002** ISED CAB identifier: **T004**	SGS Fimko Ltd Takomotie 8 FI-00380, HELSINKI FINLAND
Test Site:	☐ K10LAB, ISED Canada registration number: **8708A-1** ☒ K5LAB, ISED Canada registration number: **8708A-2** ☐ T10LAB

TEST RESULTS

Duty Cycle

Standard:	ANSI C63.10-2013
Tested by:	HEM
Date:	11 January 2021
Temperature:	21.9 °C
Humidity:	25.5 %RH
Barometric pressure:	1005.1 mbar
Measurement uncertainty:	±0.1 %, level of confidence 95 % (k = 2)

FCC rule: 15.35(c)

The average field strength may be found by measuring the peak pulse amplitude and subtracting the duty cycle correction factor (DCCF) from the peak pulse amplitude. The correction factor may be applied to all emissions that demonstrate the same pulse timing characteristics as the fundamental emission.

During testing the EUT was set to communicate with peripheral sensors. Both antenna connectors of the EUT were connected to the measurement system. The measured duty cycle is the cumulative result of both antennas in normal operation.

The test was performed with an automated software.

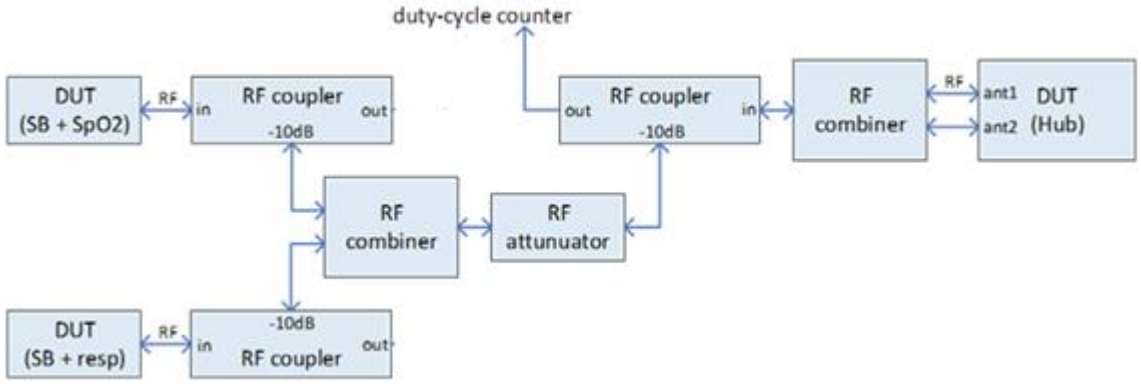

Figure 2: Duty cycle measurement setup

Results

Table 2: Duty cycle results

Duty Cycle (%)	DCCF (dB)
0.967	**-40.29**

At the request of the customer the duty cycle of 10 % is used to determine the duty cycle correction factor:

$$DCCF = 20\log(0.10)\,\mathrm{dB} \approx -20.00\,\mathrm{dB}$$

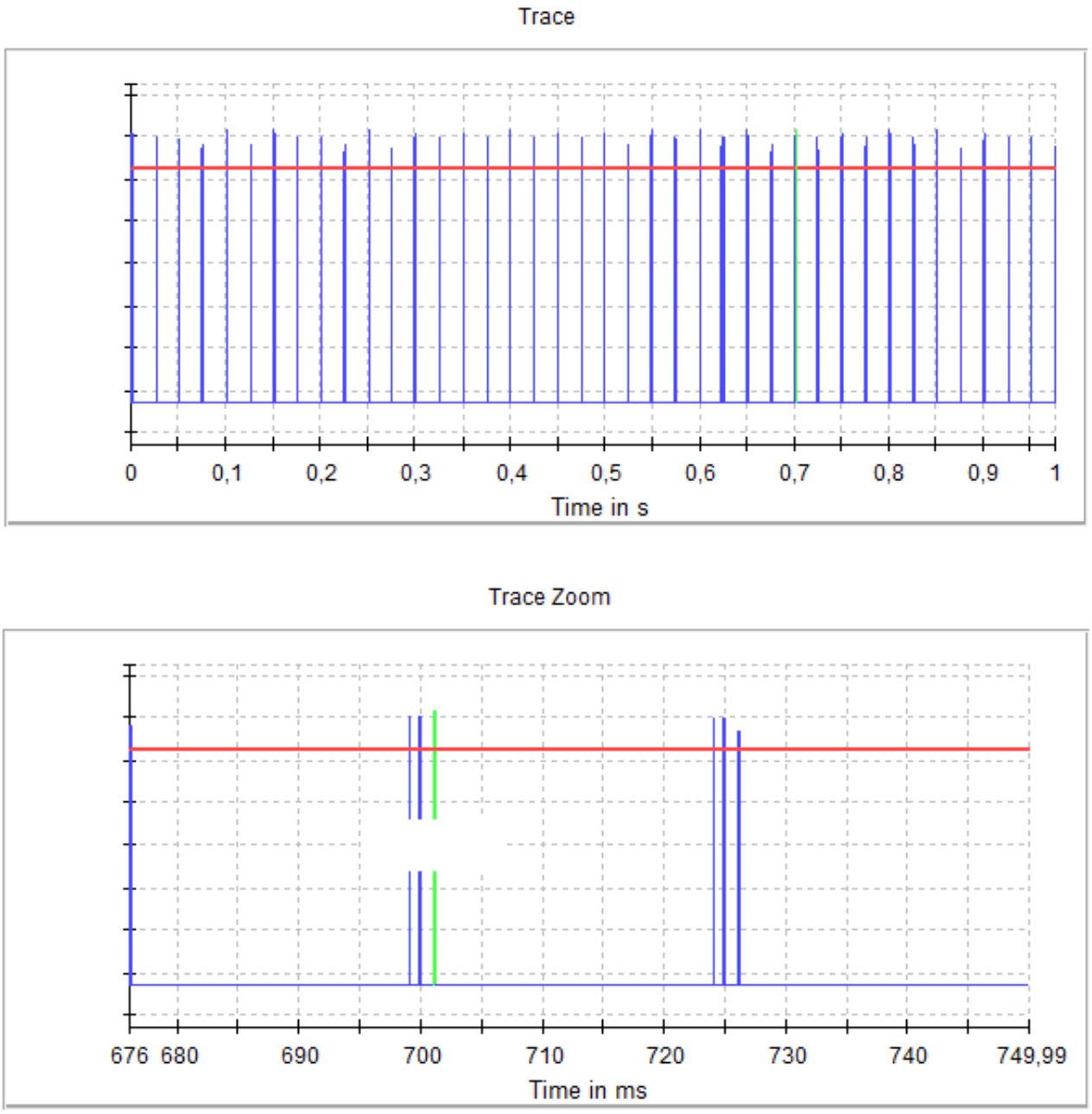

Figure 3: Duty cycle

Conducted Emissions In The Frequency Range 150 kHz – 30 MHz

Standard:	ANSI C63.10-2013
Tested by:	HEM
Date:	1 February 2021
Temperature:	23.1 °C
Humidity:	17.1 %RH
Barometric pressure:	990.6 mbar
Measurement uncertainty:	± 2.9 dB, level of confidence 95 % (k = 2)

FCC Rule: 15.207(a)
RSS-GEN 8.8

Conducted disturbance voltage was measured with an artificial main network from 150 kHz to 30 MHz with 4 kHz steps and a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

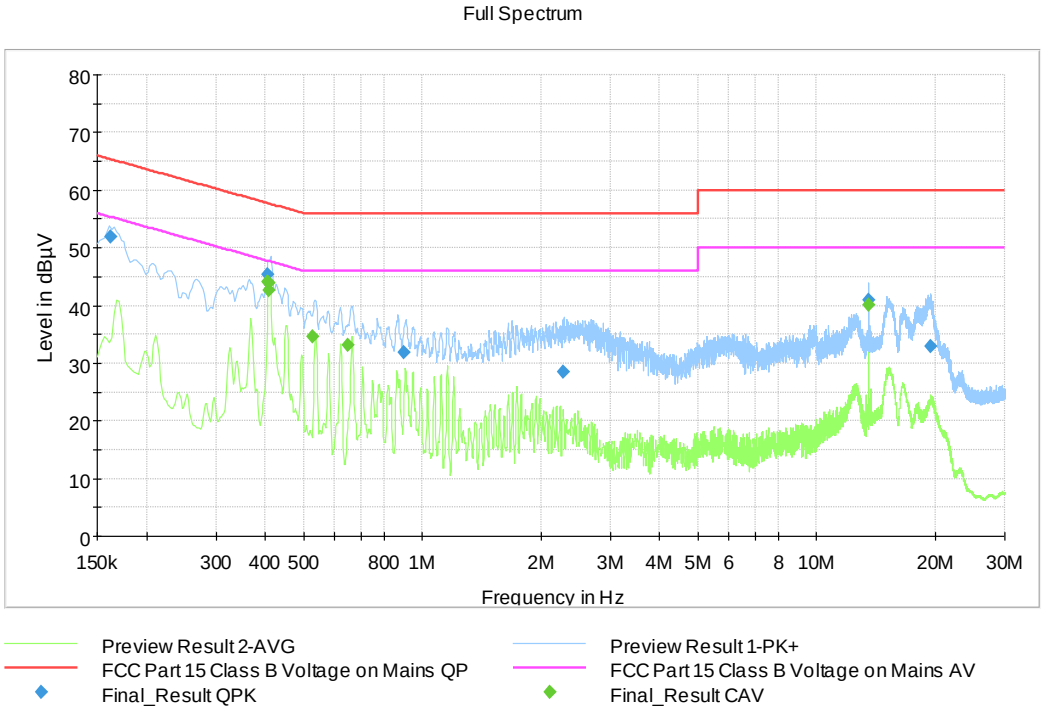

Figure 4: The measured curves with peak- and average detector

Final measurements from the worst frequencies

Table 3: Final QuasiPeak measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.162000	51.96	65.36	13.40	1000.0	9.000	L1	9.6
0.404250	45.29	57.77	12.48	1000.0	9.000	L1	9.7
0.898750	31.85	56.00	24.15	1000.0	9.000	L1	9.8
2.270000	28.49	56.00	27.51	1000.0	9.000	N	9.9
13.562500	40.94	60.00	19.06	1000.0	9.000	N	10.3
19.416000	32.91	60.00	27.09	1000.0	9.000	N	10.5

Table 4: Final Average measurements from the worst frequencies

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.406000	44.13	47.73	3.60	1000.0	9.000	L1	9.7
0.407250	43.92	47.70	3.78	1000.0	9.000	L1	9.7
0.408750	42.62	47.67	5.05	1000.0	9.000	N	9.7
0.528000	34.69	46.00	11.31	1000.0	9.000	L1	9.7
0.648250	33.24	46.00	12.76	1000.0	9.000	L1	9.7
13.558500	40.18	50.00	9.82	1000.0	9.000	N	10.3

The correction factor in the final result table contains the sum of the transducers (cables).
The result value is the measured value corrected with the correction factor.

Transmitter Radiated Spurious Emissions 9 kHz - 40 GHz

Standard:	ANSI C63.10-2013	
Tested by:	HEM, PKA	HEM
Date:	27 January 2021	28 January 2021
Temperature:	23.5 °C	23.4 °C
Humidity:	24.6 %RH	20.4 %RH
Barometric pressure:	992.9 mbar	997.4 mbar
Measurement uncertainty:	± 4.51 dB, level of confidence 95 % (k = 2)	

FCC Rule: 15.247(d), 15.209(a)

RSS-GEN 8.9, 8.10

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables).

Frequency range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector
30 - 80	100	40.0	Quasi-peak
88 - 216	150	43.5	Quasi-peak
216 - 960	200	46.0	Quasi-peak
960 - 1000	500	54.0	Quasi-peak
Above 1000	500	54.0	Average
Above 1000	5000	74.0	Peak

Investigative measurements were made to determine the worst EUT orientation. The presented final results are the results in the worst orientation.

Results (2.4 GHz WLAN transmitting)

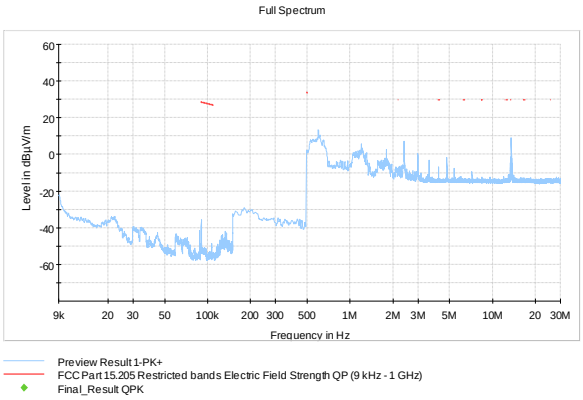

Figure 5: Result 9 kHz – 30 MHz

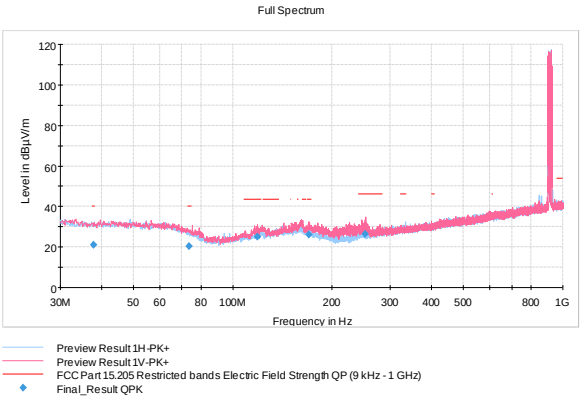

Figure 6: Result 30 – 1000 MHz

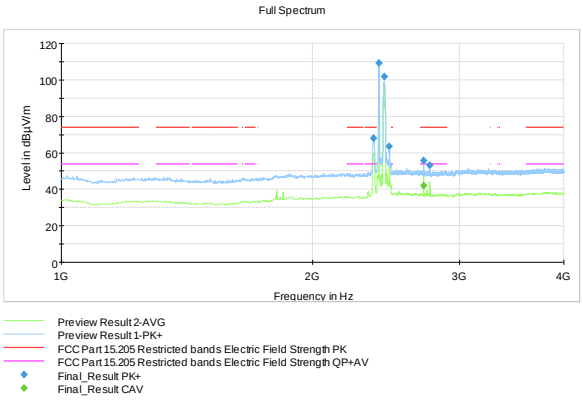

Figure 7: Result 1 – 4 GHz

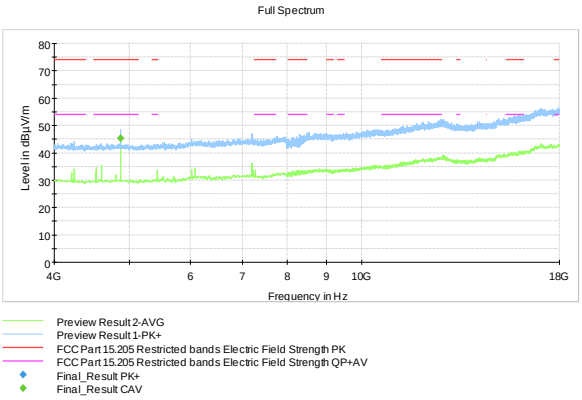

Figure 8: Result 4 – 18 GHz

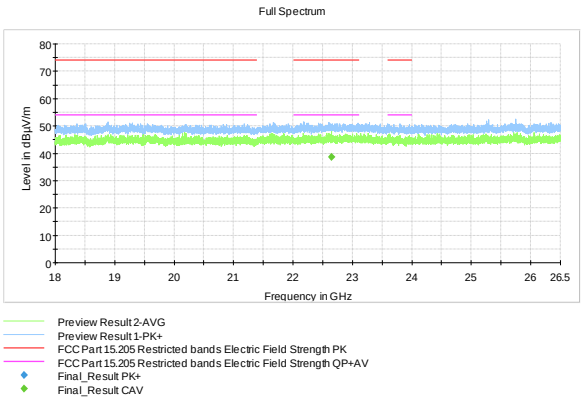

Figure 9: Result 18 – 26.5 GHz

Table 5: Peak results (2.4 GHz WLAN transmitting)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2364.375000	67.88	74.00	6.12	1000.0	1000.000	244.0	H	341.0	13.4
2401.200000	109.09	---	---	1000.0	1000.000	240.0	H	347.0	14.2
2437.850000	101.78	---	---	1000.0	1000.000	188.0	H	8.0	13.9
2471.400000	63.67	---	---	1000.0	1000.000	185.0	H	6.0	14.1
2718.750000	55.83	74.00	18.17	1000.0	1000.000	144.0	H	342.0	13.8
2765.050000	53.13	74.00	20.87	1000.0	1000.000	157.0	H	286.0	13.7

Table 6: Average results (2.4 GHz WLAN transmitting)

Frequency (MHz)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2364.375000	47.88 *)	54.00	6.12	1000.0	1000.000	244.0	H	341.0	13.4
2718.550000	42.04	54.00	11.96	1000.0	1000.000	320.0	H	341.0	13.8
4873.925000	45.28	54.00	8.72	1000.0	1000.000	137.0	H	24.0	7.5
22644.550000	38.53	54.00	15.47	1000.0	1000.000	180.0	H	124.0	8.2

*) calculated from measured peak-value with duty cycle correction factor

Table 7: Quasi-peak results (2.4 GHz WLAN transmitting)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.871000	21.01	40.00	18.99	1000.0	120.000	163.0	H	0.0	22.8
73.704000	20.27	40.00	19.73	1000.0	120.000	100.0	V	349.0	21.3
118.829000	25.11	43.52	18.41	1000.0	120.000	127.0	V	0.0	21.8
169.785000	26.16	43.52	17.36	1000.0	120.000	100.0	V	157.0	24.0
252.041000	26.48	46.02	19.54	1000.0	120.000	109.0	V	240.0	23.7

Results (5 GHz WLAN transmitting)

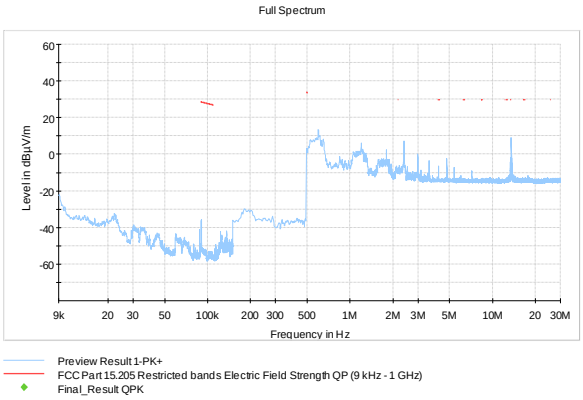

Figure 10: Result 9 kHz – 30 MHz

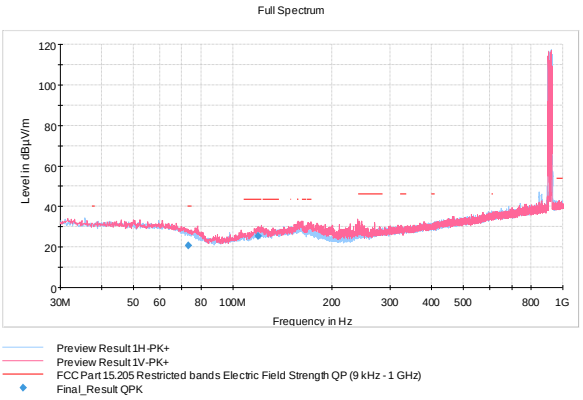

Figure 11: Result 30 – 1000 MHz

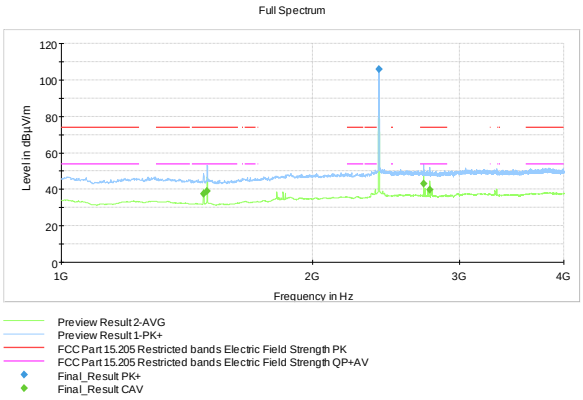

Figure 12: Result 1 – 4 GHz

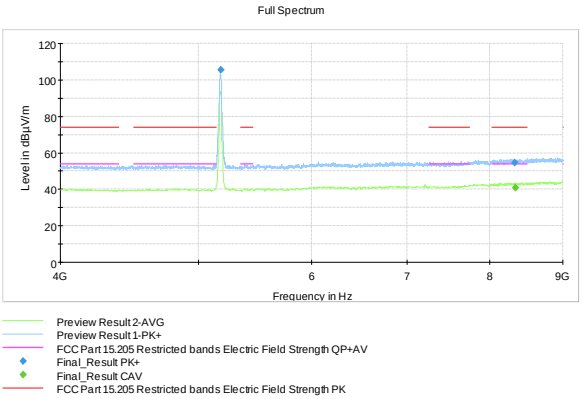

Figure 13: Result 4 – 9 GHz

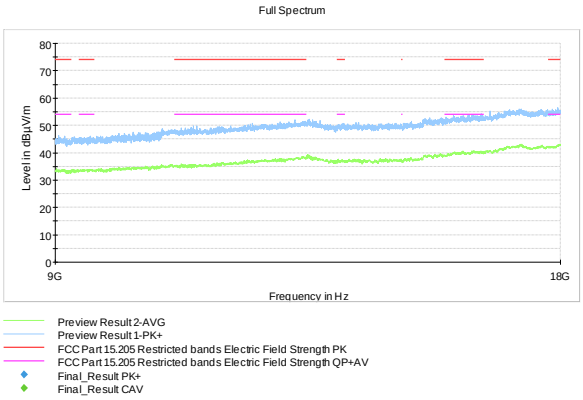

Figure 14: Result 9 – 18 GHz

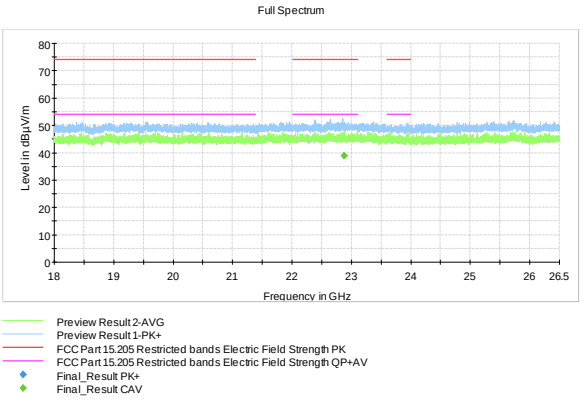

Figure 15: Result 18 – 26.5 GHz

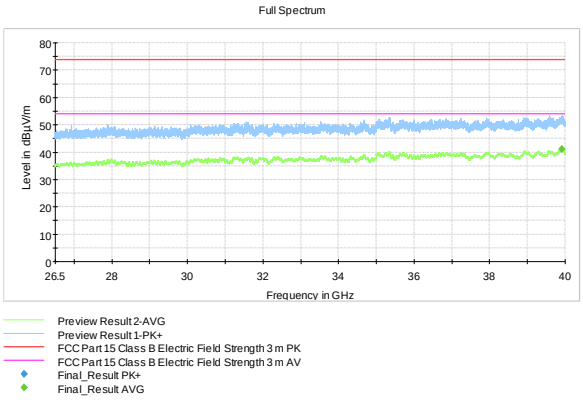

Figure 16: Result 26.5 – 40 GHz (vertical)

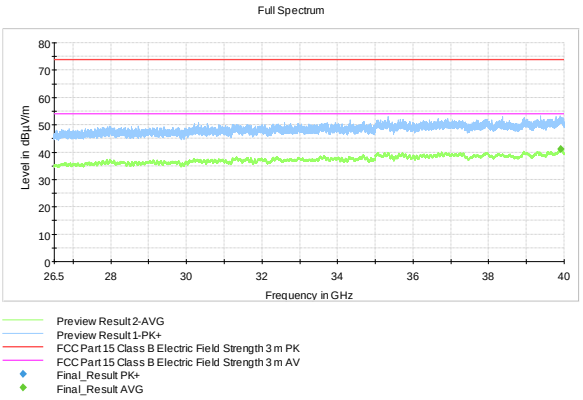

Figure 17: Result 26.5 – 40 GHz (horizontal)

Table 8: Peak results (5 GHz WLAN transmitting)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2401.200000	105.70	---	---	1000.0	1000.000	148.0	H	288.0	14.2
5179.925000	105.33	---	---	1000.0	1000.000	105.0	H	75.0	17.5
8329.875000	54.74	73.90	19.16	1000.0	1000.000	147.0	H	292.0	22.0

Table 9: Average results (5 GHz WLAN transmitting)

Frequency (MHz)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1479.825000	37.42	54.00	16.58	1000.0	1000.000	100.0	H	343.0	9.2
1495.225000	39.15	54.00	14.85	1000.0	1000.000	157.0	H	160.0	9.6
2718.750000	43.13	54.00	10.87	1000.0	1000.000	107.0	H	338.0	13.8
2765.250000	39.93	54.00	14.07	1000.0	1000.000	134.0	H	211.0	13.7
8332.825000	40.98	53.90	12.92	1000.0	1000.000	219.0	H	73.0	22.0
22879.950000	38.80	54.00	15.20	1000.0	1000.000	166.0	V	198.0	7.7
39905.500000	41.21	53.90	12.69	10000.0	1000.000	150.0	V	3.0	-10.7
39910.140625	41.12	53.90	12.78	10000.0	1000.000	150.0	H	265.0	-11.1

Table 10: Quasi-peak results MID channel

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
73.230000	20.59	40.00	19.41	1000.0	120.000	118.0	V	192.0	21.4
119.497000	25.43	43.50	18.07	1000.0	120.000	127.0	V	15.0	21.8

TEST EQUIPMENT

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
ANTENNA	EMCO	3160-09, emi 18-26.5GHz	inv. 7294	2020-02-20	2021-02-20
ANTENNA	EMCO	3117, emi 1-18GHz	inv. 7293	2020-03-11	2022-03-11
ANTENNA	ETS LINDGREN	3160-10, emi 26.5-40GHz	inv:9151	2020-08-15	2021-08-14
ANTENNA	ROHDE & SCHWARZ	HFH2-Z2 , 335.4711.52	inv. 8013	2020-10-28	2022-10-28
ANTENNA	SCHWARZBECK	VULB 9168	inv. 8911	2020-11-04	2022-11-04
ANTENNA MAST	MATURO	TAM 4.0E	inv. 10181	NCR	NCR
ATTENUATOR	PASTERNACK	10 dB, DC-40 GHz	sn:A1	2019-04-01	2021-04-01
ATTENUATOR	PASTERNACK	PE 7004-4 (4dB)	inv. 10126	2019-04-01	2021-04-01
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10679	2020-07-20	2021-07-20
FILTER	WAINWRIGHT	HP, WHKX4.0/18G-10SS	inv:10403	2019-04-01	2021-04-01
LISN	ROHDE & SCHWARZ	ENV216	inv. 9611	2020-03-03	2021-03-03
LISN	ROHDE & SCHWARZ	ESH3-Z5	inv. 8019	2020-05-19	2021-05-19
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv. 10183	NCR	NCR
OSP BASE UNIT	ROHDE & SCHWARZ	OSP120	inv:10882	2019-02-28	2021-02-28
OSP-B157W 8 PORT	ROHDE & SCHWARZ	OSP-B157W8	inv:10883	2019-02-06	2021-02-06
OSP-B157WX	ROHDE & SCHWARZ	OSP-B157WX	inv:10884	2019-02-13	2021-02-13
POWER SUPPLY	CALIFORNIA INSTR.	5001 iX Series II	inv. 7826	NCR	NCR
RF PREAMPLIFIER	CIAO	CA118-3123	inv. 10278	2020-10-09	2021-10-09
RF PREAMPLIFIER	CIAO	CA1840-5019	inv. 10593	2020-10-09	2021-10-09
SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSV40	inv:10881	2020-06-10	2021-09-06
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
TURNTABLE	MATURO	DS430 UPGRADED	inv. 10182	NCR	NCR

NCR = No calibration required

END OF REPORT