

Test Report



INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 95 I

Equipment Under Test: Sensor Battery

Model: Portrait SBT01

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: 95: 2019
KDB: 550599 D01 Medical Body Area Network v01r01
Medical Body Area Network (MBAN) Measurement
Procedures
(December 8, 2017)

Date: 6 September 2021

Issued by: 

Henri Mäki
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Date: 6 September 2021

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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	Operating Frequency Range corrected, Test setup block diagram added	6 September 2021

PRODUCT DESCRIPTION

Equipment Under Test

Trade mark: GE
Model: Portrait SBT01
Type: Sensor Battery
Serial no: Sample 1: SRX21020128SP (EMC4)
Sample 2: SRX21020129SP (EMC5)
Sample 3: X0017480004PZR (RF_SB_RFV_C1)
FCC ID: 2AO8L-SBT01
IC: 25821-SBT01

General Description

Portrait SBT01 (later Sensor Battery) is a part of GE Healthcare's Portrait Mobile Monitoring Solution system. The Sensor Battery enables continuous monitoring of patients by acquiring signals from body-worn sensor and further transmitting data to a Portrait HUB01 through the GE proprietary Medical Body Area Network (MBAN) radio. In addition to the active MBAN radio, the Sensor Battery has passive NFC (ISO/IEC 14443) and RFID (EPCglobal Gen-2) radios. The NFC is used to pair a sensor with a Hub. The RFID is used for asset management. All Sensor Battery antennas are integrated in the mechanics. Besides the wireless interfaces, the Sensor Battery incorporates the GE proprietary DSI (Digital Sensor Interface) connector. The two galvanic pins of the DSI connector are used for two-way power delivery: charging a Sensor Battery (while located in the Portrait BCH01 Bedside Charger) and powering up a connected sensor (during patient monitoring). The optical UART interface of the DSI is used as data interface between a Sensor Battery and a connected sensor. The DSI also enables a SW update for the Sensor Battery.

This test report contains the results for MBAN operating in 2390-2400 MHz frequency band.

Classification

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

Modifications Incorporated in the EUT

No.	Name	Description
1	EMC4	Radiated sample, rev J (mass production equivalent), no modifications
2	EMC5	Radiated sample, rev J (mass production equivalent), no modifications
3	RF_SB_RFV_C1	Conducted sample

In Sample 3 the PWB RF is reworked to be rev J (mass production) equivalent. The RF test cables were plugged into existing production test connectors. The production test connectors locate on the PWB next to antenna inputs.

Ratings and declarations

Operating Frequency Range (OFR): 2392.8 – 2398.0 MHz
Channels: 3
Channel separation: 2.6 MHz
Transmission technique: Digital modulation
Modulation: GFSK
Antenna type: Integrated custom antenna
Integral Antenna gain: 2.0 dBi (highest gain in the frequency range)

Power Supply

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

Mechanical Size of the EUT

Height: 36 mm

Width: 53 mm

Length: 17mm

Peripherals

Peripheral	Description / Usage
SpO2-sensor	GE Portrait SpO2 P-SP01. Companion device during testing.

The peripherals were provided by the customer.

SUMMARY OF TESTING

Test Specification	Description of Test	Result
§95.2565(b)	Frequency Stability	PASS
§95.2567(f)	Radiated Power	PASS
§95.2573(e)	Emission Bandwidth	PASS
§95.2579(a)(5), (b)	Unwanted Emissions	PASS
§95.2579(f)	Band-Edge Measurement	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 C63.26-2015.

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-wearable-puck-swup-1.0.0.4.0.22-1153.1.ecf96a6)

Radiated measurements were performed with the transmit power set to the maximum level the equipment hardware is capable of. During all other tests the transmit power was set to the maximum level at which the final product is able to operate, limited by the software. The test conditions related to the transmit power levels were provided by the customer.

During radiated emissions measurements the peripheral SpO2-sensor was connected to the EUT.

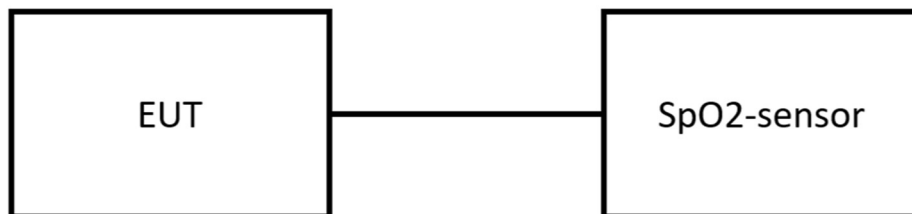


Figure 1: Test setup block diagram

Table 1: Test frequencies

Channel	Frequency (MHz)
12 Low	2392.8
14 High	2398.0

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

Frequency Stability

Standard: ANSI C63.26-2015
Tested by: HEM
Date: 13 January 2021
Temperature: 22.1 °C
Humidity: 21.1 %RH
Barometric pressure: 1005.5 mbar
Measurement Uncertainty: ± 5.380 ppm, level of confidence 95 % (k = 2)

FCC Rule: 95.2565(b)

All MBAN devices must maintain a frequency stability of ± 100 ppm over the applicable temperature range.

The equipment is placed inside a temperature chamber, and the chamber temperature is allowed to stabilize. The equipment is turned on, and the frequency is recorded at startup, and at 2 minutes, 5 minutes, and 10 minutes after the equipment is turned on. Four measurements in total are made at one temperature, and the highest deviation from the nominal frequency is reported.

Results

Table 2: Frequency Stability results, LOW channel

Temperature [°C]	Measured [MHz]	Deviation [ppm]	Result
+0	2392.7836060	-6.851	PASS
+10	2392.7852850	-6.150	PASS
+20	2392.7847300	-6.382	PASS
+30	2392.7834255	-6.927	PASS
+40	2392.7823160	-7.391	PASS

Table 3: Frequency Stability results, HIGH channel

Temperature [°C]	Measured [MHz]	Deviation [ppm]	Result
+0	2397.9834410	-6.905	PASS
+10	2397.9852550	-6.149	PASS
+20	2397.9847450	-6.362	PASS
+30	2397.9833600	-6.939	PASS
+40	2397.9822260	-7.412	PASS

Radiated Power

Standard: ANSI C63.26-2015
Tested by: HEM
Date: 13 January 2021
Temperature: 22.1 °C
Humidity: 21.1 %RH
Barometric pressure: 1005.5 mbar
Measurement Uncertainty: ±0.349 dB, level of confidence 95 % (k = 2)

FCC Rule: 95.2567(f)

MBAN transmissions in the 2390-2400 MHz frequency band are limited to a maximum EIRP that shall not exceed the lesser of 13 dBm or $16 + 10 \log(\text{EBW})$ dBm, where EBW is the emission bandwidth expressed in MHz.

Results

Table 4: Radiated Power results

Channel	EIRP [dBm]	Limit [dBm]	Result
LOW	10.51	13.00	PASS
HIGH	10.52	13.00	PASS

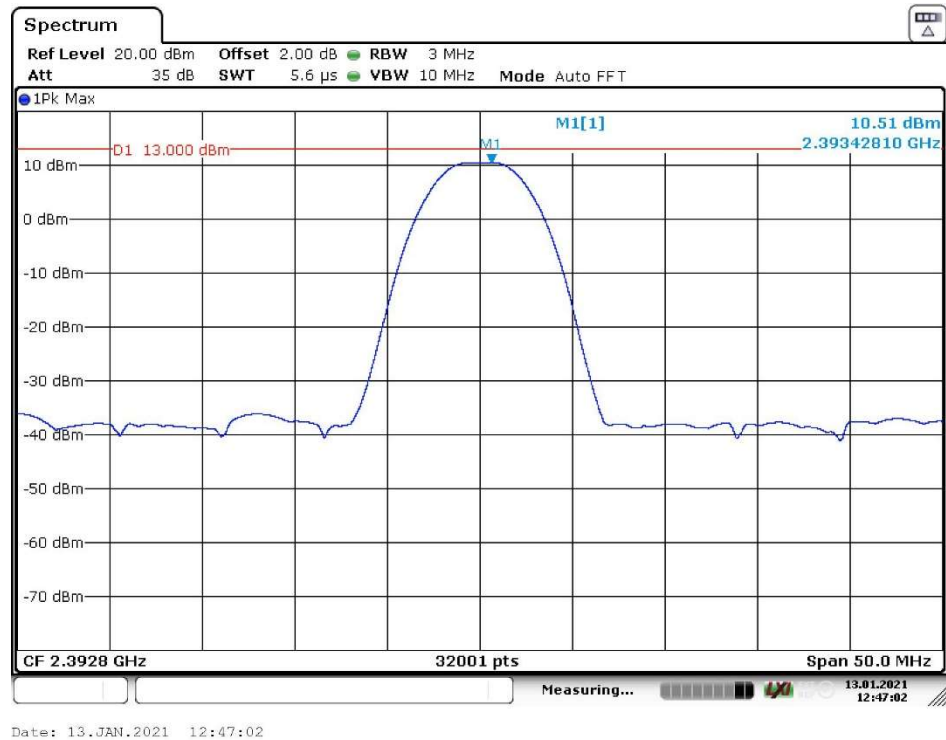


Figure 2: Radiated Power, LOW channel

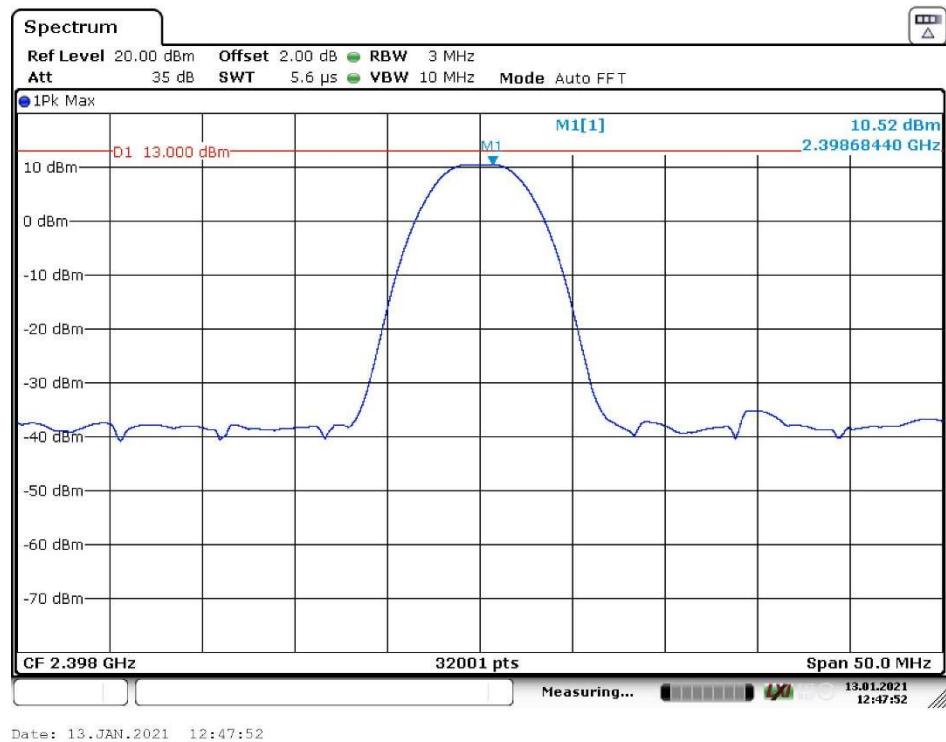


Figure 3: Radiated Power, HIGH channel

Note: The Offset in figures equals the antenna gain 2.0 dBi

Emission Bandwidth

Standard: ANSI C63.26-2015
Tested by: HEM
Date: 13 January 2021
Temperature: 22.1 °C
Humidity: 21.1 %RH
Barometric pressure: 1005.5 mbar
Measurement uncertainty 0.0005 %, level of confidence 95 % (k = 2)

FCC Rule: §95.2573(e)

All transmissions associated with an MBAN are limited to an emission bandwidth (EBW) of less than or equal to 5 MHz, where the EBW is determined by measuring the width of the signal between points, one below the carrier center frequency and one above the carrier center frequency, that are 20 dB down relative to the maximum level of the modulated carrier.

Results

Table 5: Emission Bandwidth results

Channel	EBW [MHz]	Limit [MHz]	Result
LOW	2.39899	5.0	PASS
HIGH	2.39805	5.0	PASS

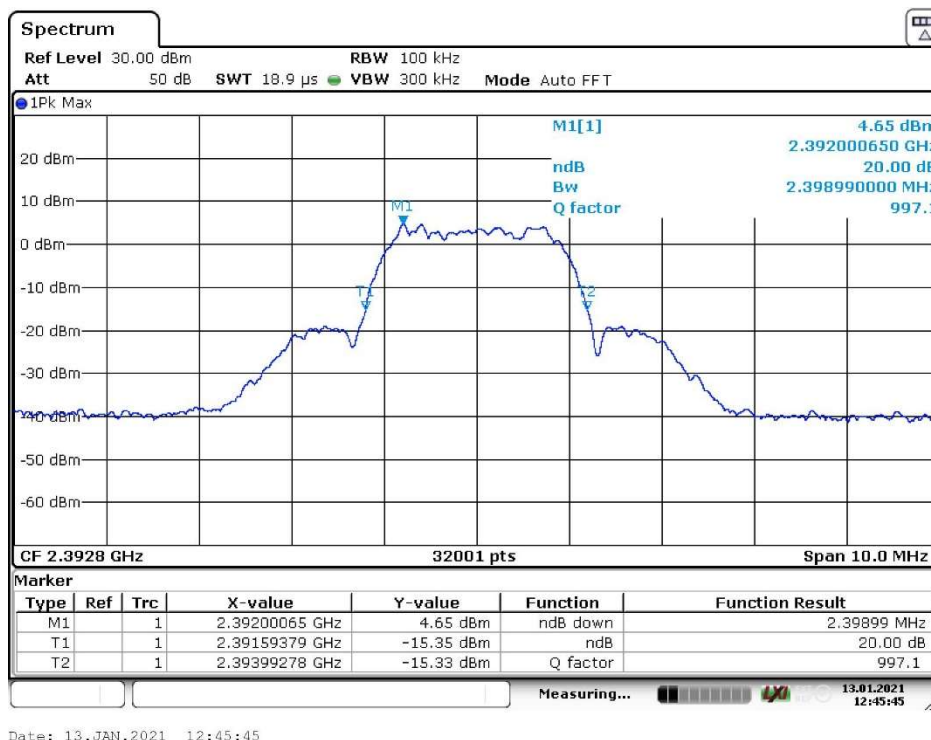


Figure 4: Emission Bandwidth, LOW channel

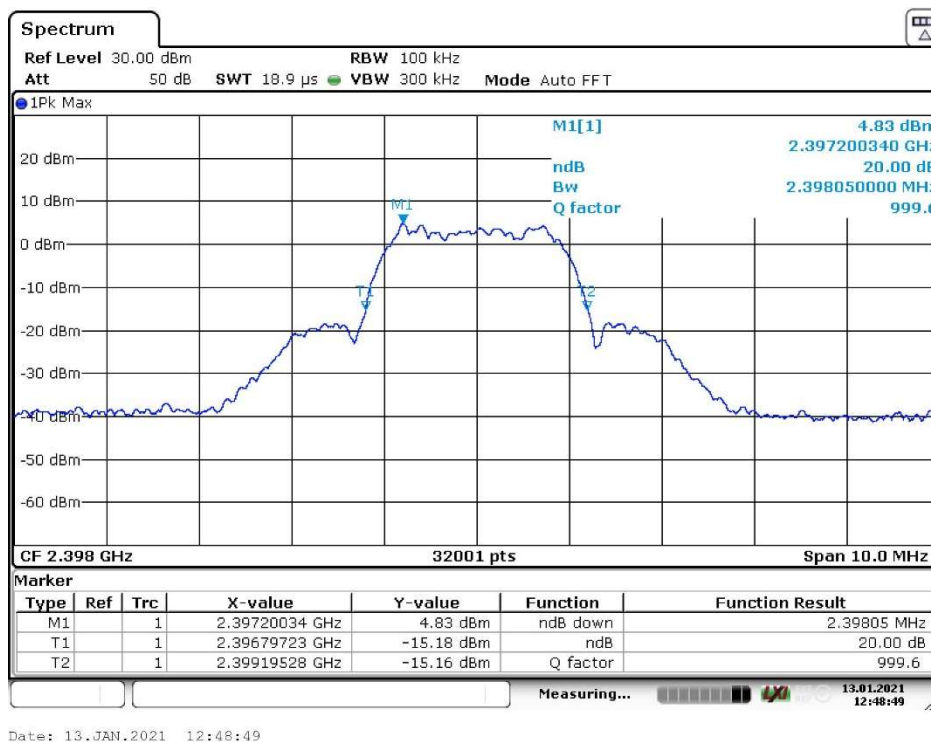


Figure 5: Emission Bandwidth, HIGH channel

Unwanted Emissions

Standard: ANSI C63.26-2015
Tested by: PKA
Date: 28 January 2021
Temperature: 23.4 °C
Humidity: 20.4 %RH
Barometric pressure: 997.4 mbar
Measurement uncertainty: ±4.51 dB, level of confidence 95 % (k = 2)

FCC Rule: §95.2579(a)(5), (b)

The field strength levels associated with all MBAN emissions on frequencies beyond the first 2.5 MHz relative the edges of the 2360-2400 MHz frequency band must be less than or equal to the relevant limits when measured at a distance of 3 meters.

The measurement was performed within a semi anechoic chamber. Additional floor absorbers were placed on the floor between the EUT and receiving antenna in radiated emission test above 1 GHz. The worst interferences were determined during measurements by rotating the turntable and adjusting the antenna height. The measurements were performed with horizontal and vertical antenna polarizations.

Frequency [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector	RBW
30 - 88	100	40.0	Quasi-peak	100 kHz
88 - 216	150	43.5	Quasi-peak	100 kHz
216 - 960	200	46.0	Quasi-peak	100 kHz
960 - 1000	500	54.0	Quasi-peak	1 MHz
Above 1000	500	54.0	Average	1 MHz

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

The Peak values are measured for Band-Edge compliance and informative purposes. No final measurements were made below 1000 MHz with Quasi-Peak detector due to high margin to the relevant Quasi-Peak limit.

Results LOW channel

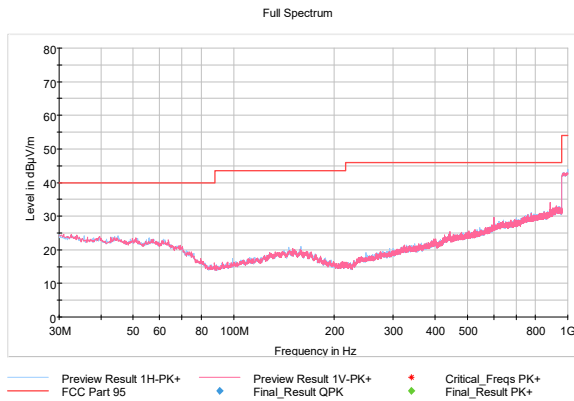


Figure 6: LOW channel (30 – 1000 MHz)

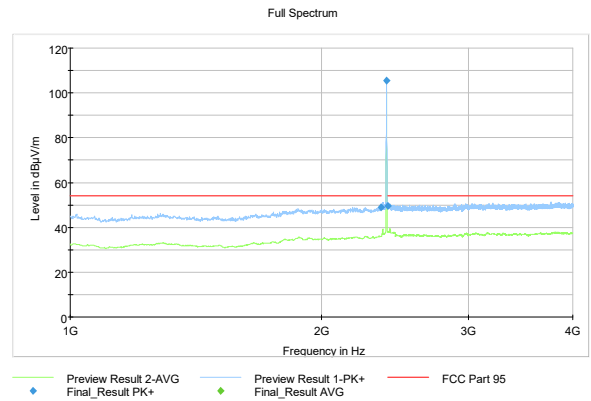


Figure 7: LOW channel (1 – 4 GHz)

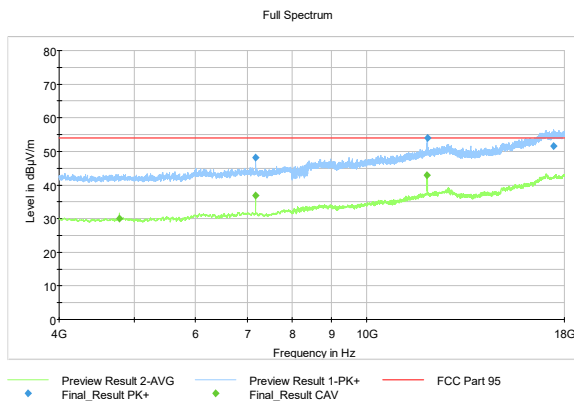


Figure 8: LOW channel (4 – 18 GHz)

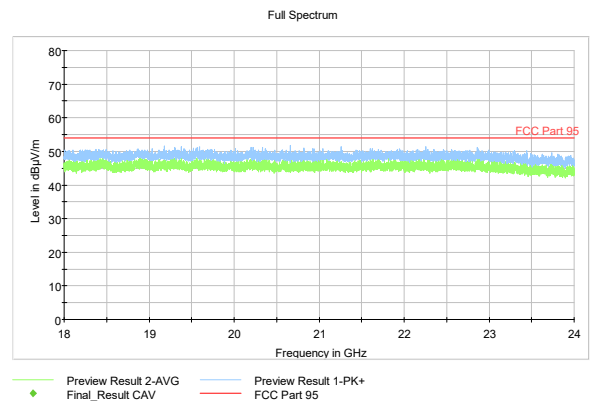


Figure 9: LOW channel (18 – 24 GHz)

Table 6: Peak results LOW channel

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2358.700000	48.85	-20 dBc	36.56	1000.0	1000.000	100.0	H	262.0	13.2
2393.450000	105.41	---	---	1000.0	1000.000	130.0	H	82.0	13.6
2400.000000	49.45	-20 dBc	35.96	1000.0	1000.000	336.0	H	104.0	13.8
7176.425000	48.07	---	---	1000.0	1000.000	126.0	V	142.0	10.4
11967.225000	54.10	---	---	1000.0	1000.000	116.0	V	45.0	17.4
17444.375000	51.61	---	---	1000.0	1000.000	176.0	H	128.0	24.2

Table 7: Average results LOW channel

Frequency (MHz)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4784.425000	30.11	54.00	23.89	1000.0	1000.000	111.0	H	45.0	7.4
7176.375000	36.96	54.00	17.04	1000.0	1000.000	111.0	V	259.0	10.4
11960.625000	42.87	54.00	11.13	1000.0	1000.000	111.0	V	45.0	17.5

Results HIGH channel

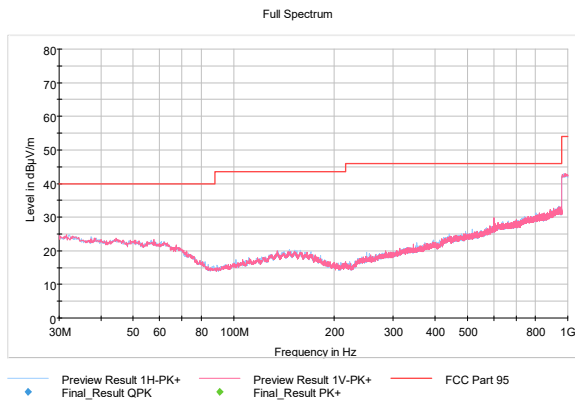


Figure 10: HIGH channel (30 – 1000 MHz)

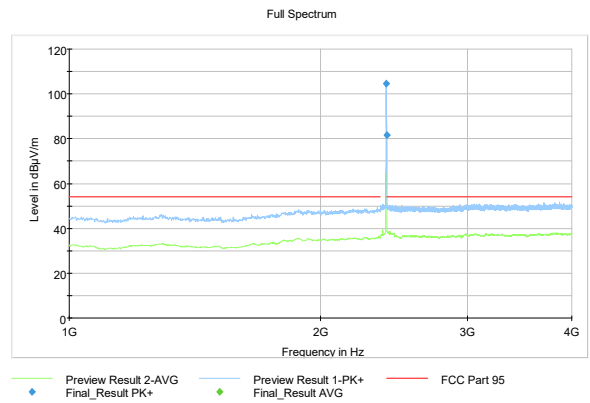


Figure 11: HIGH channel (1 – 4 GHz)

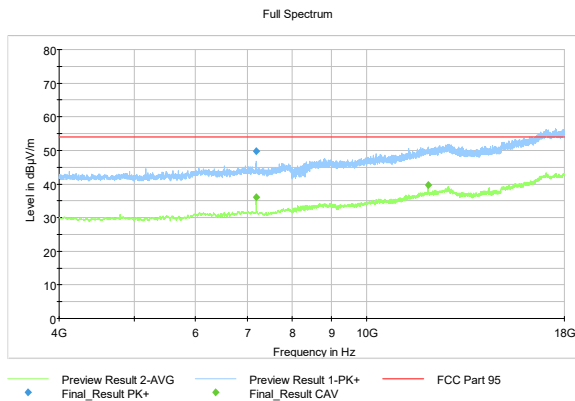


Figure 12: HIGH channel (4 – 18 GHz)

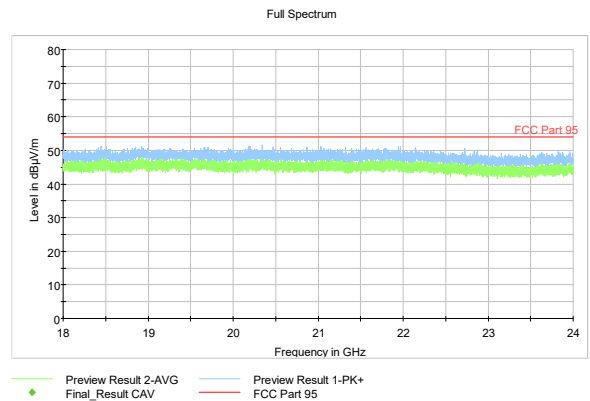


Figure 13: HIGH channel (18 – 24 GHz)

Table 8: Peak results HIGH channel

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2397.200000	104.72	---	---	1000.0	1000.000	152.0	H	98.0	13.7
2400.000000	81.66	-20 dBc	3.06	1000.0	1000.000	152.0	H	98.0	13.8
7191.825000	49.78	---	---	1000.0	1000.000	100.0	H	128.0	10.6

Table 9: Average results HIGH channel

Frequency (MHz)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7195.975000	36.13	54.00	17.87	1000.0	1000.000	137.0	H	317.0	10.7
11993.275000	39.60	54.00	14.40	1000.0	1000.000	105.0	V	52.0	17.5

Band-Edge Measurement

Standard:	ANSI C63.26-2015	
Tested by:	HEM	PKA
Date:	13 January 2021	28 January 2021
Temperature:	22.1 °C	23.4 °C
Humidity:	21.1 %RH	20.4 %RH
Barometric pressure:	1005.5 mbar	997.4 mbar
Measurement uncertainty:	conducted:	±2.90 dB, level of confidence 95 % (k = 2)
	radiated:	±4.51 dB, level of confidence 95 % (k = 2)

FCC Rule: §95.2579 (f)

The EIRP levels (expressed within a 1 MHz bandwidth) associated with all MBAN emissions on frequencies within the first 2.5 MHz relative to the edges of the 2360-2400 MHz frequency band must be attenuated by at least 20 dB relative to the maximum EIRP level (within any 1 MHz) of the fundamental-frequency emission (i.e., 20 dBc).

Both conducted and radiated measurements were performed. During conducted measurements the upper band-edge was measured using a resolution bandwidth narrower than the specified 1 MHz, and the integration was performed over the 1 MHz bandwidth.

Conducted results

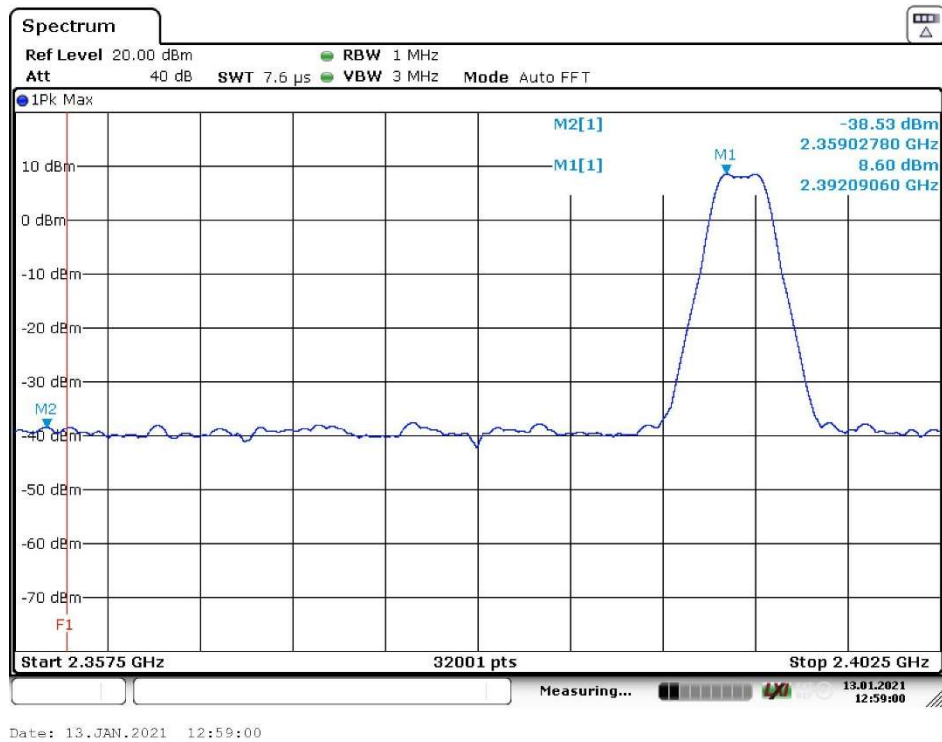


Figure 14: Lower band-edge



Figure 15: Upper band-edge

Table 10: Conducted lower and upper band-edge results

Frequency [MHz]	Measured [dBm]	EIRP *) [dBm]	Limit	Margin [dB]
2359.02780	-38.52	---	-9.40	29.03
2392.09060	8.60	10.60	---	---
2398.69123	8.63	10.63	---	---
2400.50000	-21.31	-19.31	-9.37	9.94

*) Antenna gain 2.0 dBi

Radiated results

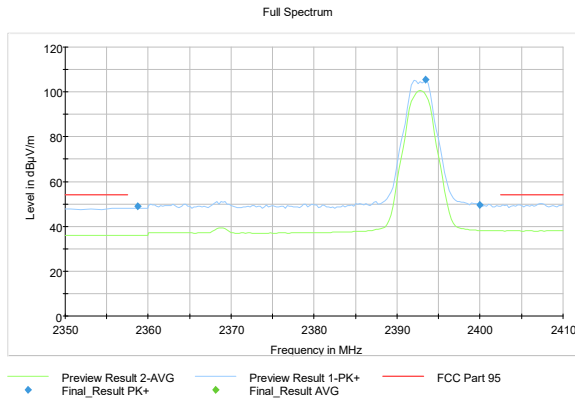


Figure 16: Lower band-edge

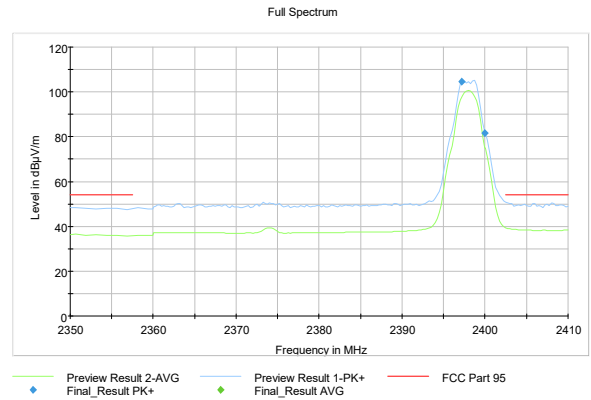


Figure 17: Upper band-edge

Table 11: Radiated lower and upper band-edge results

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2358.700000	48.85	85.41 *)	36.56	1000.0	1000.000	100.0	H	262.0	13.2
2393.450000	105.41	---	---	1000.0	1000.000	130.0	H	82.0	13.6
2400.000000	49.45	85.41 *)	35.96	1000.0	1000.000	336.0	H	104.0	13.8
2397.200000	104.72	---	---	1000.0	1000.000	152.0	H	98.0	13.7
2400.000000	81.66	84.72 *)	3.06	1000.0	1000.000	152.0	H	98.0	13.8

*) -20 dBc

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	SCHWARZBECK	VULB 9168	inv. 8911	2020-11-04	2022-11-04
ANTENNA MAST	MATURO	TAM 4.0E	inv. 10181	NCR	NCR
ATTENUATOR	PASTERNAK	10 dB, DC-40 GHz	sn:A1	2019-04-01	2021-04-01
ATTENUATOR	PASTERNAK	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
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv. 10183	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