Test Report

HELEM2306000293-2

FINAS Finnish Accreditation Service T004 (EN ISO/IEC 17025)

INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C AND ISED CANADA REQUIREMENTS

Equipment Under Test:	Battery-Operated Belt Sander
Trademark:	Mirka
Model:	FBS-B 13x457
Type:	-
Manufacturer / Customer:	Mirka Ltd. Pensalavägen 210 FI-66850, Jeppo Finland
FCC Rule Part:	§15.247
IC Rule Part:	RSS-247, Issue 3, 2023 RSS-Gen, Issue 5 Amendment 2, 2021
KDB:	558074 D01 15.247 Meas Guidance v05r02

- *partial testing, see test suite for details*

Date:	19 October 2023	Date:	19 October 2023
Issued by:	Henri Mäki Testing Engineer	Checked by:	Pekka Kälviäinen Testing Engineer

TABLE OF CONTENTS

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	13 September 2023
1.1	Unwanted Emissions section updated to include information about exploratory measurements and EUT orientation.	19 October 2023

PRODUCT DESCRIPTION

Equipment Under Test

Equipment Under Test:	Battery-Operated Belt Sander
Trademark:	Mirka
Model:	FBS-B 13x457
Type:	-
Serial no:	2303296236002
FCC ID:	2AK2S-BCA
IC:	22379-BCA
Radio module or chip:	Nordic Semiconductor nRF8001 (Bluetooth Low Energy v4.0)

General Description

The equipment under test is a battery-operated belt sander.

Classification

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

Modifications Incorporated in the EUT

No modifications.

Ratings and declarations

Operating frequency range:	2402 – 2480 MHz
Nominal channel bandwidth	2 MHz
Number of channels:	40
Channel separation:	2 MHz
Transmission technique:	DSSS
Modulation:	GFSK
Data rate:	1 Mbps
Antenna type:	Integral ceramic chip (Walsin RFANT8010080A3T)
Antenna gain:	+2 dBi
Antenna count:	1
EUT dimensions:	27 x 9 x 13 cm, 0.7 kg
Power requirements:	10.8 VDC (battery voltage rating)
Operating temperature range:	+10…+40 °C

SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.203	Antenna Requirement	**PASS**
§15.207 / RSS-Gen 8.8	AC Power-Line Conducted Emissions	**N/A**
§15.247(a)(2) / RSS-247 5.2 a)	6 dB Bandwidth	**N/T**
RSS-Gen 6.7	Occupied Bandwidth 99 %	**N/T**
§15.247(b)(3) / RSS-247 5.4 d)	Maximum Peak Conducted Output Power	**N/T**
§15.247(d) / RSS-247 5.5	Unwanted Emissions	**PASS**
§15.247(e) / RSS-247 5.2 b)	Power Spectral Density	**N/T**

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

The radio was configured with nRF Connect v4.1.2 software. Normal modulation and maximum transmit power were used during the tests.

Radiated tests were performed in a semi-anechoic chamber with a measurement distance of 3 meters. During measurements above 1 GHz absorbers were placed on the floor. The motor of the EUT was running at maximum speed.

Figure 1: Test setup block diagram

Table 1: Test frequencies and settings

Channel	Frequency (MHz)	Power setting	PHY	Packet length
37	2402	0 dBm	LE 1Mbps	37 bytes
17	2440	0 dBm	LE 1Mbps	37 bytes
39	2480	0 dBm	LE 1Mbps	37 bytes

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

Antenna Requirement

Standard: FCC Rule §15.203
Tested by: HEM
Date: 4 September 2023

FCC Rule: §15.203

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.

Specification	Requirement (at least one of the following shall be applied)	Conclusion
§15.203	1. Permanently attached antenna 2. Unique coupling to the intentional radiator 3. Professionally installed radio. The installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.	**PASS**
Note	Option 1 is used	

Unwanted Emissions

Standard:	ANSI C63.10-2013
Tested by:	HEM, LAS
Date:	4, 6, 7 September 2023
Temperature:	23 °C
Humidity:	48 – 53 %RH
Measurement uncertainty:	± 4.51 dB, level of confidence 95 % (k = 2)
Test result	**PASS**

FCC Rule: §15.247(d)

RSS-247 clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in §15.209(a) and RSS-Gen clause 8.9 is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) and RSS-Gen clause 8.10, must also comply with the radiated emission limits specified in §15.209(a) and RSS-Gen clause 8.9.

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

Exploratory measurements were performed with the EUT in three orthogonal positions (X, Y, Z) in order to find the worst-case orientation. Final measurements were performed in the worst position.

Test results (TX 2402 MHz)

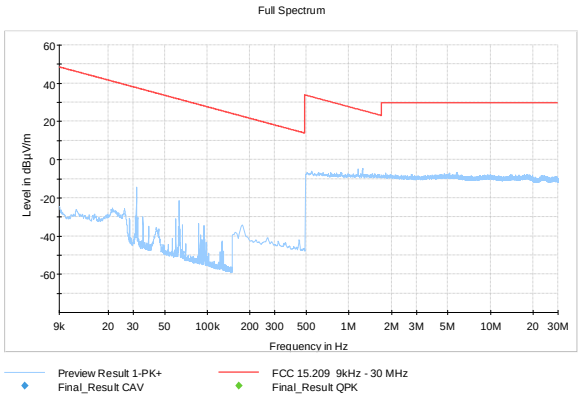

Figure 2: 9 kHz – 30 MHz (TX 2402 MHz)

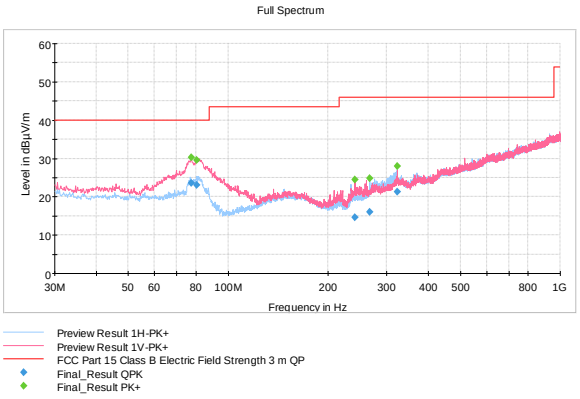

Figure 3: 30 – 1000 MHz (TX 2402 MHz)

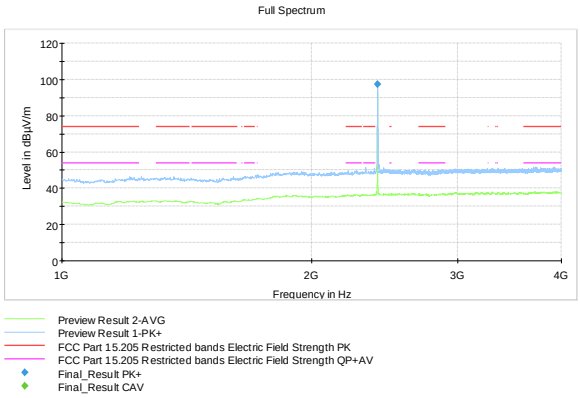

Figure 4: 1 – 4 GHz (TX 2402 MHz)

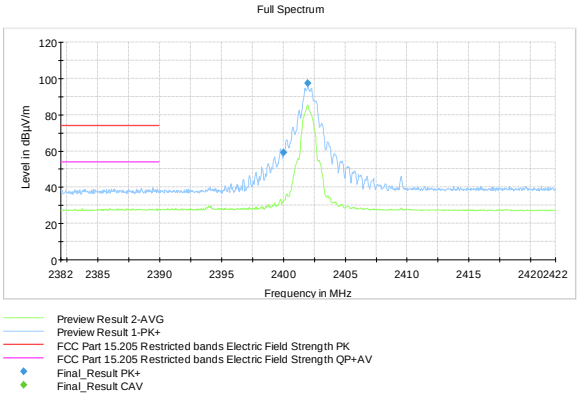

Figure 5: Lower band-edge with 100 kHz RBW

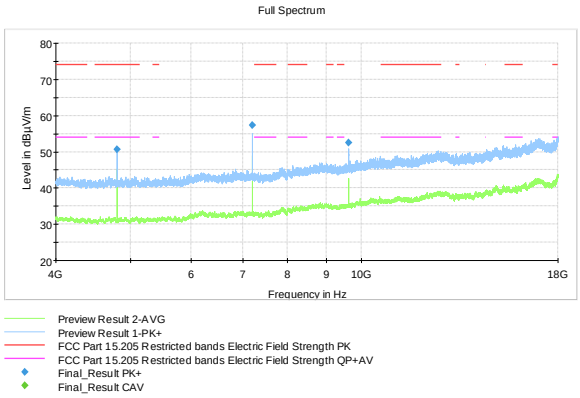

Figure 6: 4 – 18 GHz (TX 2402 MHz)

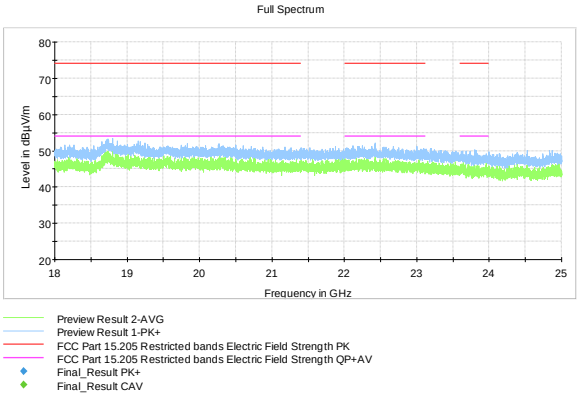

Figure 7: 18 – 25 GHz (TX 2402 MHz)

Table 2: Test results with quasi-peak detector (TX 2402 MHz)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
77.345000	23.60	40.00	16.40	15 x 1000.0	120.000	100.0	V	318.0	14.0
80.285000	23.10	40.00	16.90	15 x 1000.0	120.000	111.0	V	287.0	13.0
241.205000	14.57	46.00	31.43	15 x 1000.0	120.000	257.0	V	255.0	17.3
266.345000	15.95	46.00	30.05	15 x 1000.0	120.000	112.0	H	60.0	18.3
322.825000	21.35	46.00	24.65	15 x 1000.0	120.000	108.0	H	52.0	20.2

Table 3: Test results with peak detector (TX 2402 MHz)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2402.000000	97.51	---	---	15 x 1000.0	1000.000	126.0	H	94.0	13.7
4803.400000	50.64	74.00	23.36	15 x 1000.0	1000.000	107.0	H	23.0	7.4
7205.200000	57.37	77.51	20.14	15 x 1000.0	1000.000	154.0	H	157.0	10.8
9606.900000	52.51	77.51	25.00	15 x 1000.0	1000.000	107.0	H	272.0	14.3

Table 4: Lower band-edge measurement result (TX 2402 MHz)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2400.000000	59.05	77.46	18.41	15 x 1000.0	100.000	222.0	V	143.0	13.7
2402.000000	97.46	---	---	15 x 1000.0	100.000	158.0	H	191.0	13.7

Test results (TX 2440 MHz)

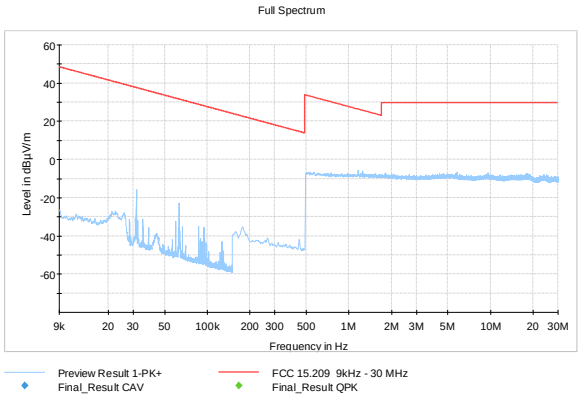

Figure 8: 9 kHz – 30 MHz (TX 2440 MHz)

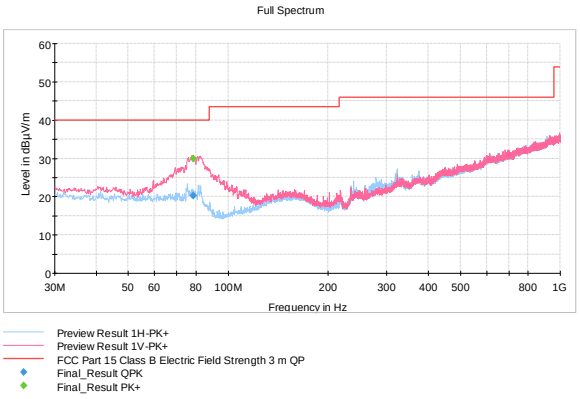

Figure 9: 30 – 1000 MHz (TX 2440 MHz)

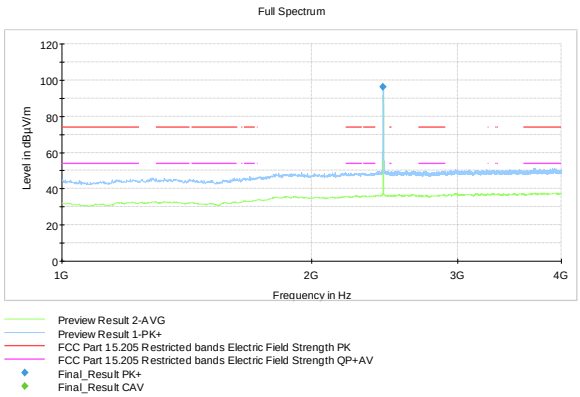

Figure 10: 1 – 4 GHz (TX 2440 MHz)

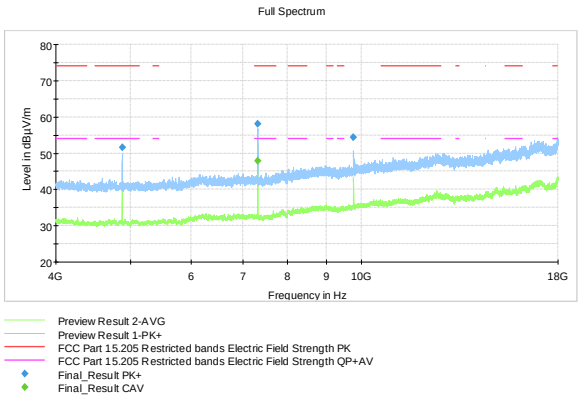

Figure 11: 4 – 18 GHz (TX 2440 MHz)

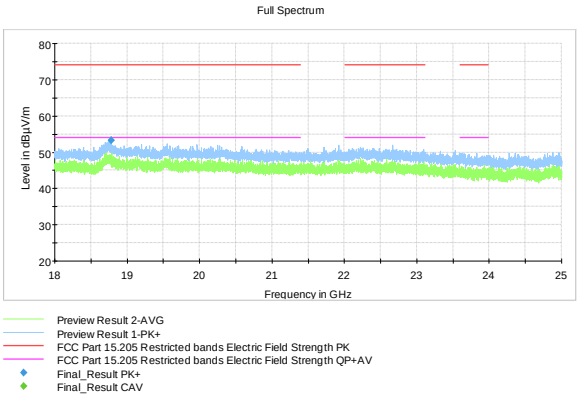

Figure 12: 18 – 25 GHz (TX 2440 MHz)

Table 5: Test results with quasi-peak detector (TX 2440 MHz)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
78.345000	20.31	40.00	19.69	15 x 1000.0	120.000	126.0	V	54.0	13.7

Table 6: Test results with peak detector (TX 2440 MHz)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2439.750000	96.14	---	---	15 x 1000.0	1000.000	175.0	H	179.0	13.6
4879.500000	51.51	74.00	22.49	15 x 1000.0	1000.000	163.0	H	235.0	7.6
7319.200000	58.05	74.00	15.95	15 x 1000.0	1000.000	174.0	H	145.0	10.7
9761.100000	54.28	76.14	21.86	15 x 1000.0	1000.000	209.0	H	115.0	14.7
18779.200000	53.17	74.00	20.83	15 x 1000.0	1000.000	234.0	V	97.0	8.1

Table 7: Test results with average detector (TX 2440 MHz)

Frequency (MHz)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7319.400000	47.94	54.00	6.06	15 x 1000.0	1000.000	166.0	H	143.0	10.7

Test results (TX 2480 MHz)

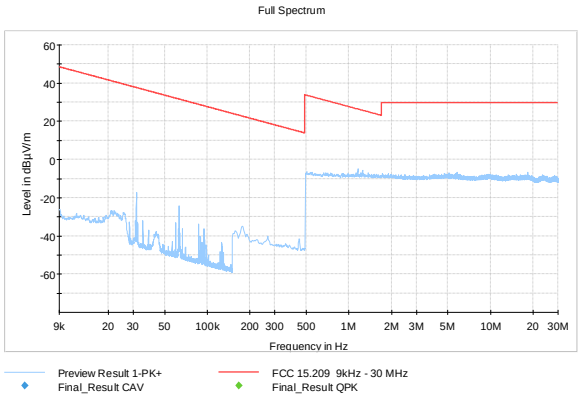

Figure 13: 9 kHz – 30 MHz (TX 2480 MHz)

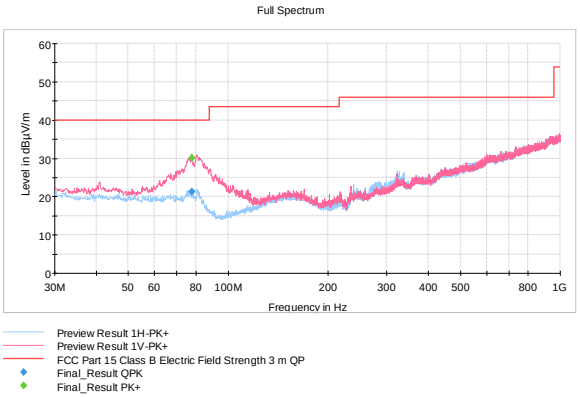

Figure 14: 30 – 1000 MHz (TX 2480 MHz)

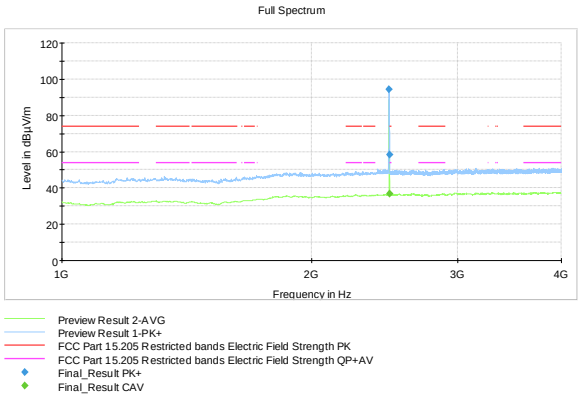

Figure 15: 1 – 4 GHz (TX 2480 MHz)

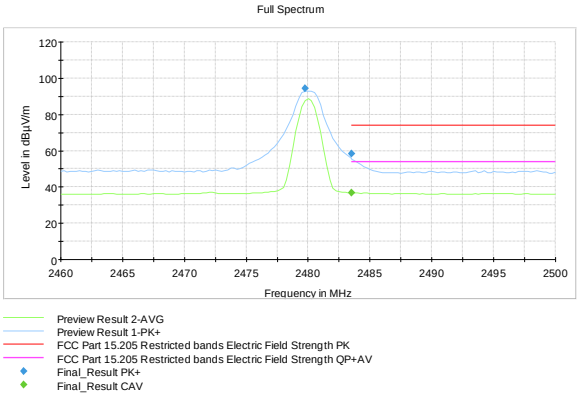

Figure 16: Upper band-edge (TX 2480 MHz)

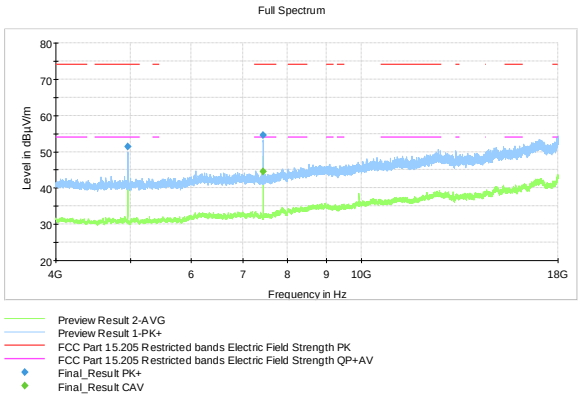

Figure 17: 4 – 18 GHz (TX 2480 MHz)

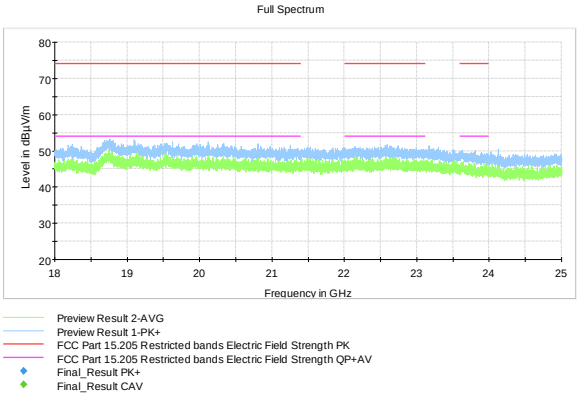

Figure 18: 18 – 25 GHz (TX 2480 MHz)

Table 8: Test results with quasi-peak detector (TX 2480 MHz)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
77.915000	21.25	40.00	18.75	15 x 1000.0	120.000	105.0	V	318.0	13.8

Table 9: Test results with peak detector (TX 2480 MHz)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2479.750000	94.34	---	---	15 x 1000.0	1000.000	189.0	H	184.0	13.7
2483.500000	58.28	74.00	15.72	15 x 1000.0	1000.000	211.0	H	180.0	13.7
4960.600000	51.46	74.00	22.54	15 x 1000.0	1000.000	135.0	V	68.0	7.4
7439.300000	54.53	74.00	19.47	15 x 1000.0	1000.000	138.0	H	159.0	10.4

Table 10: Test results with average detector (TX 2480 MHz)

Frequency (MHz)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.500000	36.71	54.00	17.29	15 x 1000.0	1000.000	210.0	H	186.0	13.7
7439.600000	44.50	54.00	9.50	15 x 1000.0	1000.000	139.0	H	159.0	10.4

TEST EQUIPMENT

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
ANTENNA	EMCO	3160-09, emi 18-26.5GHz	inv. 7294	2023-02-23	2024-02-23
ANTENNA	EMCO	3117, emi 1-18GHz	inv. 7293	2022-06-16	2024-06-16
ANTENNA	ROHDE & SCHWARZ	HFH2-Z2 , 335.4711.52	inv. 8013	2022-10-25	2024-10-25
ANTENNA	SCHWARZBECK	VULB 9168	inv. 8911	2022-11-29	2024-11-29
ANTENNA MAST	MATURO	TAM 4.0E	inv. 10181	NCR	NCR
ATTENUATOR	PASTERNACK	10 dB, DC-40 GHz	sn. A1	2023-03-20	2025-03-20
ATTENUATOR	PASTERNACK	PE 7004-4 (4dB)	inv. 10126	2023-03-13	2024-03-13
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10670	2023-06-19	2024-06-19
FILTER	WAINWRIGHT	WHKX4.0/18G-10SS	inv. 10403	2023-01-09	2025-01-09
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv. 10183	NCR	NCR
RF PREAMPLIFIER	CIAO	CA118-3123	inv. 10278	2022-09-21	2023-09-21
RF PREAMPLIFIER	CIAO	CA1840-5019	inv. 10593	2022-09-21	2023-09-21
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 SAC	inv. 10517	2022-10-27	2023-10-27
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
TURNTABLE	MATURO	DS430 UPGRADED	inv. 10182	NCR	NCR

NCR = No Calibration Required

END OF REPORT