

EMC TEST REPORT



Applicant:	Marquardt GmbH
Address:	Schloss-str.16,78604 Rietheim-Weilheim,Germany

Manufacturer or Supplier:	Marquardt GmbH
Address:	Schloss-str.16,78604 Rietheim-Weilheim,Germany
Product:	Lotus NFC Reader
Brand Name:	Marquardt
Model Name:	GR5
FCC ID:	IYZGR5
Date of tests:	Nov. 09, 2023 ~ Nov. 24, 2023

The submitted sample of the above equipment has been tested for according to the requirements of the following standards:

- ☐ FCC Part 15, Subpart B, Class A
☒ FCC Part 15, Subpart B, Class B
☒ ANSI C63.4:2014

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Prepared by Chao Wu Engineer / Mobile Department	Approved by Peibo Sun Manager / Mobile Department
 Date: Nov. 24, 2023	 Date: Nov. 24, 2023

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Test Report No.: W7L-P231108W002EM02

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
W7L-P231108W002EM02	Original release	Nov. 24, 2023

1 GENERAL INFORMATION

1.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Lotus NFC Reader	
BRAND NAME	Marquardt	
MODEL NAME	GR5	
NOMINAL VOLTAGE	EUT DC12V	
MODULATION TYPE	NFC	ASK
OPERATING FREQUENCY	NFC	13.56 MHz
HW VERSION	234201	
SW VERSION	232800	
I/O PORTS	Refer to user's manual	
CABLE SUPPLIED	N/A	
ACCESSORY DEVICES	N/A	

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

1.2 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15, Subpart B		
Standard Section	Test Item	Result
FCC Part 15, Subpart B, Class B ANSI C63.4:2014	Conducted Test	Note 1
	Radiated Emission Test (30MHz ~ 1GHz)	Compliance
	Radiated Emission Test (Above 1GHz)	Note 2

Note:

1. Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.
2. The highest frequency generated or used in the device is 13.56MHz, so the test needn't to be executed.

*Test Lab Information Reference

Lab A:

Huarui 7Layers High Technology (Suzhou) Co., Ltd.

Lab Address:

Tower N, Innovation Center, 88 Zhuyi Road, High-tech District, Suzhou City, Anhui Province

Accredited Test Lab Cert 6613.01

The FCC Site Registration No. is 434559; The Designation No. is CN1325.

1.3 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	150kHz ~ 30MHz	±2.70dB
Radiated emissions	30MHz~1GHz	±4.98dB
	1GHz ~6GHz	±4.70dB
	6GHz ~18GHz	±4.60dB
	18GHz ~40GHz	±4.12dB

1.4 DESCRIPTION OF TEST MODES

Test Mode	Test Condition
Radiated emission test	
1	NFC + DC 12V + DC Cable

NOTE: For radiated emission test, Pre-scan all mode, test mode 1 was the worst case and only this mode was presented in this report.

1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

FOR ALL TESTS

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	DC source	HYELEC	HY3010B	551016	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	DC Line: Shielded, Detachable 1.0m;

2 EMISSION TEST

2.1 RADIATED EMISSION MEASUREMENT

2.1.1 LIMITS OF RADIATED EMISSION MEASUREMENT

TEST STANDARD: FCC PART 15, SUBPART B (SECTION: 15.109)

Emissions radiated outside of the specified bands, shall be according to the general radiated limits as following:

Radiated Emissions Limits at 3 meters (dB μ V/m)		
Frequencies (MHz)	FCC 15B, Class A	FCC 15B, Class B
30-88	49	40
88-216	53.5	43.5
216-960	56	46
960-1000	59.5	54
Above 1000	Avg: 59.5 Peak: 79.5	Avg: 54 Peak: 74

Frequency Range (For unintentional radiators)

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
Above 1000	5 th harmonic of the highest frequency or 40GHz, whichever is lower

- NOTE:**
1. The lower limit shall apply at the transition frequencies.
 2. Emission level (dB μ V/m) = 20 log Emission level (uV/m).
 3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.
 4. QP detector shall be applied if not specified.

2.1.2 TEST INSTRUMENTS

Frequency range below 1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
WIDEBANDRADIO COMMUNICATION TESTER	Rohde&Schwarz	CMW500	169399	Jun.27,22	Jun.26,24
3m Semi-anechoic Chamber	TDK	9m*6m*6m	HRSW-SZ-EMC-02Chamber	Nov.24,22	Nov.23,25
Bilog Antenna	SCHWARZBECK	VULB 9163	1264	Feb.28,22	Feb.27,24
EMI Test Receiver	R&S	ESW44	101973	Feb.25,22	Feb.24,24
Measurement Software	R&S	ELEKTRA	N/A	N/A	N/A
6DB attenuator	Tonscend Technology Co., Ltd	N/A	23062787	N/A	N/A
Pre-Amplifier	R&S	SCU08F1	101028	Sep.16,22	Sep.15,24
CABLE	R&S	W13.01	N/A	Oct.27,23	Apr.26,24
CABLE	R&S	W13.02	N/A	Oct.27,23	Apr.26,24
CABLE	R&S	W12.14	N/A	Oct.27,23	Apr.26,24

Frequency range above 1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
WIDEBANDRADIO COMMUNICATION TESTER	Rohde&Schwarz	CMW500	169399	Jun.27,22	Jun.26,24
3m Fully-anechoic Chamber	TDK	9m*6m*6m	HRSW-SZ-EMC-01Chamber	Nov.24,22	Nov.23,25
Horn Antenna	ETS-LINDGREN	3117	227836	Aug.22,22	Aug.21,24
EMI Test Receiver	R&S	ESW44	101973	Feb.25,22	Feb.24,24
Pre-Amplifier	R&S	SCU08F1	101028	Sep.16,22	Sep.15,24
Measurement Software	R&S	ELEKTRA	N/A	N/A	N/A
CABLE	R&S	W13.01	N/A	Oct.27,23	Apr.26,24
CABLE	R&S	W13.02	N/A	Oct.27,23	Apr.26,24
CABLE	R&S	W12.14	N/A	Oct.27,23	Apr.26,24

NOTE:

1. The calibration interval of the above test instruments is 6/24/36 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
2. The test was performed in 3m Chamber.
3. The FCC Site Registration No. is 434559; The Designation No. is CN1325.

2.1.3 TEST PROCEDURE

<Frequency Range below 1GHz>

The basic test procedure was in accordance with ANSI C63.4:2014 (section 12).

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from 1 meter to 4 meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1GHz.

NOTE:

1. The resolution bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. $\text{Emission level(dBuV/m)} = \text{Raw Value(dBuV)} + \text{Correction Factor(dB/m)}$
3. $\text{Correction Factor(dB/m)} = \text{Antenna Factor (dB/m)} + \text{Cable Factor (dB)}$ (if the raw value not contains the amplifier);
4. $\text{Correction Factor(dB/m)} = \text{Antenna Factor (dB/m)} + \text{Cable Factor (dB)} - \text{Amplifier Gain(dB)}$ (if the raw value contains the amplifier).
5. $\text{Margin value} = \text{Emission level} - \text{Limit value}$.

<Frequency Range above 1GHz>

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter fully-anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. The bore sight should be used during the test above 1GHz.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz

NOTE:

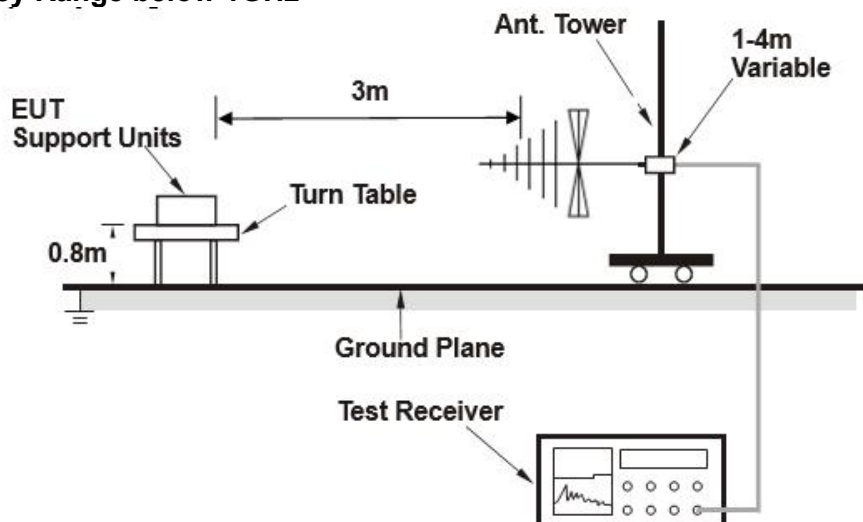
- .The resolution bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- .The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Peak detection at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth of test receiver/spectrum analyzer is 1Hz for Average detection (AV) at frequency above 1GHz.
- .For measurement of frequency above 1000 MHz, the EUT was set 3 meters away from the receiver antenna.
- .Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB/m)
- .Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) (if the raw value not contains the amplifier);
- .Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Amplifier Gain(dB) (if the raw value contains the amplifier)
- .Margin value = Emission level – Limit value.

2.1.4 DEVIATION FROM TEST STANDARD

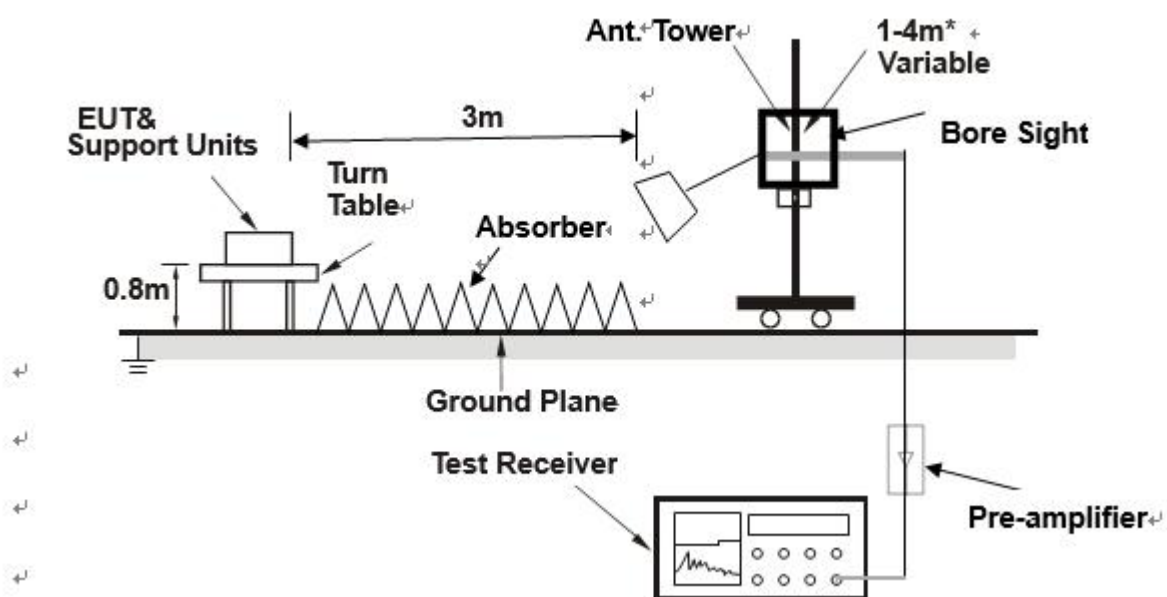
No deviation.

2.1.5 TEST SETUP

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



Note: Above 1G is a directional antenna

depends on the EUT height and the antenna 3dB bandwidth both, refer to section 7.3 of CISPR 16-2-3.

2.1.6 EUT OPERATING CONDITIONS

- Turned on the power and connected of all equipment.
- EUT was operated according to the use type described in the manufacturer's specifications or the user's manual.

2.1.7 TEST RESULTS

Acceleromete alternative worst case:

TEST VOLTAGE	DC 12V	FREQUENCY RANGE	30-1000 MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70 %RH	DETECTOR FUNCTION & RESOLUTION BANDWIDTH	Quasi-Peak, 120 kHz
TESTED BY	Chao Wu		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

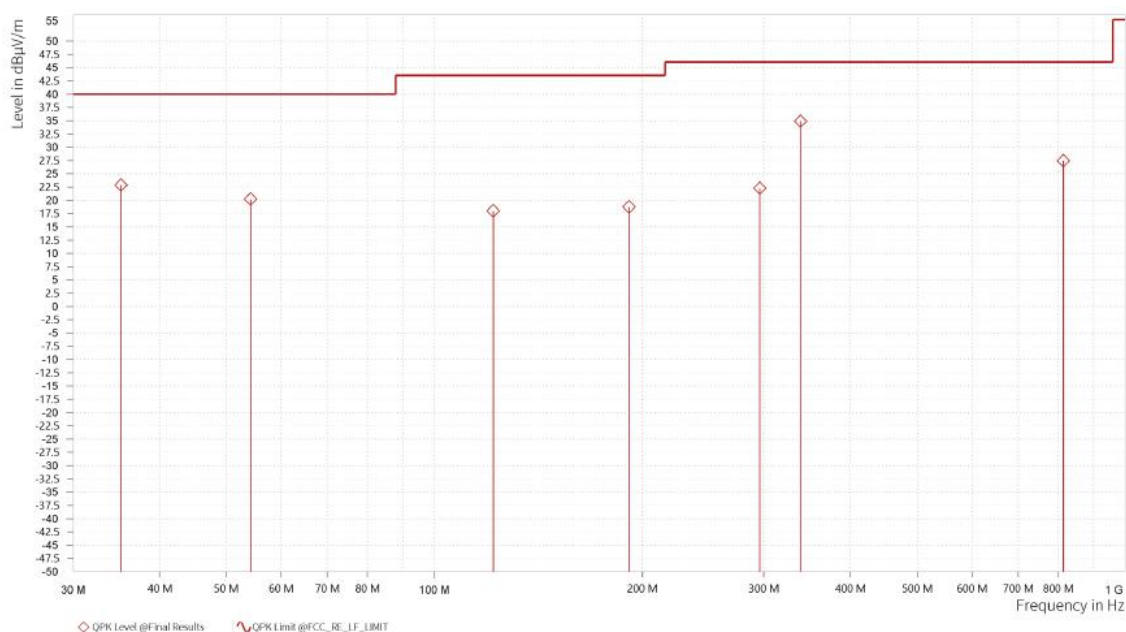
Rg	Frequency [MHz]	QPK Level [dBμV/m]	QPK Limit [dBμV/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]
1	35.203	22.88	40.00	17.12	-12.72	H	224.4	2	120.000
1	54.206	20.19	40.00	19.81	-10.53	H	355.1	2	120.000
1	121.621	17.97	43.50	25.53	-14.27	H	359	2	120.000
1	191.285	18.72	43.50	24.78	-11.85	H	224.4	2	120.000
1	295.780	22.25	46.00	23.75	-7.23	H	135.5	1	120.000
1	338.989	34.90	46.00	11.10	-5.88	H	1	1	120.000
1	813.628	27.43	46.00	18.57	-0.22	H	135.5	1	120.000

REMARKS: 1. Emission level(dBuV/m)=Read Value(dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)- Amplifier Gain

3. The other emission levels were very low against the limit.

4. Margin value = Limit value – Emission level

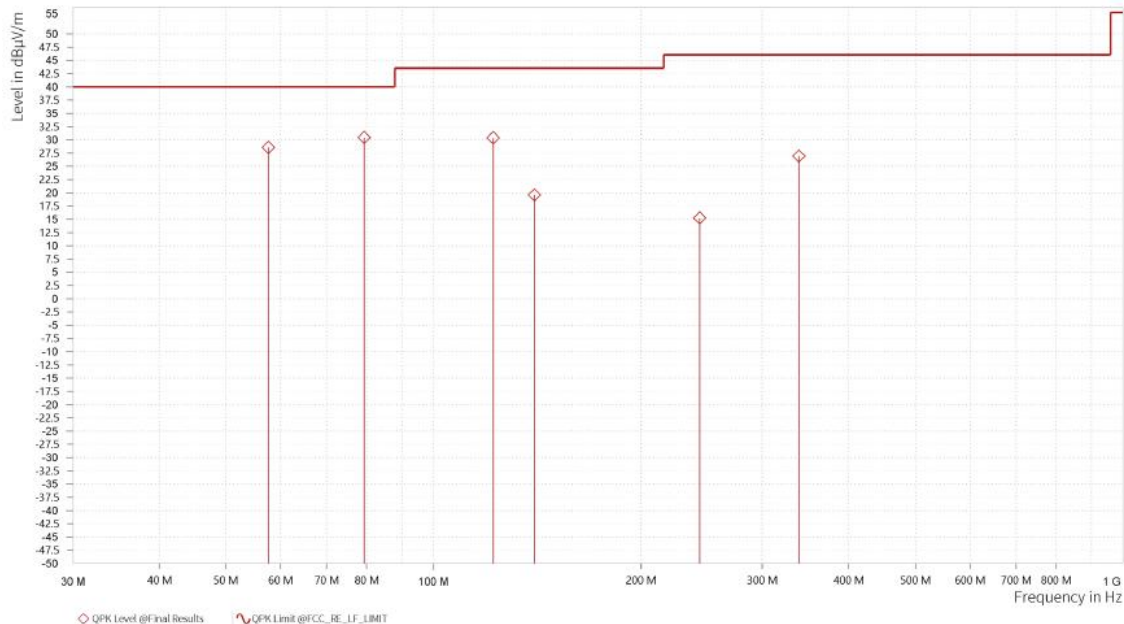


TEST VOLTAGE	DC 12V	FREQUENCY RANGE	30-1000 MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70% RH	DETECTOR FUNCTION & RESOLUTION BANDWIDTH	Quasi-Peak , 120 kHz
TESTED BY	Chao Wu		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

Rg	Frequency [MHz]	QPK Level [dBμV/m]	QPK Limit [dBμV/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]
1	57.601	28.55	40.00	11.45	-11.47	V	4.9	1	120.000
1	79.294	30.42	40.00	9.58	-16.58	V	223.2	2	120.000
1	122.018	30.35	43.50	13.15	-14.36	V	84.6	2	120.000
1	140.095	19.58	43.50	23.92	-15.69	V	136.7	1	120.000
1	243.180	15.22	46.00	30.78	-9.20	V	4.9	1	120.000
1	338.989	26.93	46.00	19.07	-5.88	V	275.4	1	120.000

- REMARKS:**
1. Emission level(dBuV/m)=Read Value(dBuV) + Correction Factor(dB/m)
 2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) -Amplifier Gain
 3. The other emission levels were very low against the limit.
 4. Margin value = Limit value – Emission level



Above 1GHz worst case data:

TEST VOLTAGE	DC 12V	FREQUENCY RANGE	1-6 GHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70% RH	DETECTOR FUNCTION & RESOLUTION BANDWIDTH	Peak/Average, 1 MHz
TESTED BY	Chao Wu		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

Rg	Frequency [MHz]	PK+ Level [dBμV/m]	PK+ Limit [dBμV/m]	PK+ Margin [dB]	AVG Level [dBμV/m]	AVG Limit [dBμV/m]	AVG Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]
1	1,812.500	43.29	74.00	30.71	29.93	54.00	24.07	4.35	H	165.4	1
1	3,097.000	45.90	74.00	28.10	32.79	54.00	21.21	9.04	H	359.1	1
1	5,548.500	49.08	74.00	24.92	35.27	54.00	18.73	13.35	H	299.4	1

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

Rg	Frequency [MHz]	PK+ Level [dBμV/m]	PK+ Limit [dBμV/m]	PK+ Margin [dB]	AVG Level [dBμV/m]	AVG Limit [dBμV/m]	AVG Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]
1	1,787.000	41.44	74.00	32.56	29.19	54.00	24.81	4.08	V	298.2	1
1	4,240.000	46.77	74.00	27.23	33.55	54.00	20.45	10.35	V	1	1
1	7,464.500	52.60	74.00	21.40	40.89	54.00	13.11	16.91	V	1	1

- REMARKS:**
1. Emission level(dBuV/m)=Read Value(dBuV) + Correction Factor(dB/m)
 2. The other emission levels were very low against the limit.
 3. Margin value = Limit value – Emission level

3 APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications were made to the EUT by the lab during the test.

--END--