





RADIO TEST REPORT

(FCC Part 15 Subpart C)

Applicant:	Marquardt GmbH				
Address:	Schloss-str.16,78604 Rietheim-Weilheim,Germany				
Manufacturer:	Marquardt GmbH				
Address:	Schloss-str.16,78604 Rietheim-We	eilheim,Germany			
Product:	P417 NFC Reader				
Brand Name:	Marquardt				
Model Name:	GR3				
FCC ID:	IYZGR3				
Date of tests:	Jun. 06, 2023 ~ Aug. 11, 2023				
The tests have bee	en carried out according to the requi	rements of the following standard:			
□ Part 15 Subpa	rt C §15. 225				
	2013				
CONCLUSION: Th	CONCLUSION: The submitted sample was found to COMPLY with the test requirement				
Prepared by Simon Wang Approved by Luke Lu					
Engineer / Mobile Department Manager / Mobile Department					
	Simon Wang	luke lu			

This report is governed by, and incorporates by reference, the Conditions of Testing as posted at the date of issuance of this report at http://www.bureauveritas.com/home/about-us/our-business/cps/about-us/terms-conditions/ and is intended for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. Measurements of conformity are based on simple acceptance criteria without taking measurement uncertainty into account, unless otherwise requested in writing. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence or if you require measurement uncertainty; provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents.

Date: Aug. 11, 2023

Date: Aug. 11, 2023

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REPORT REVISE RECORD

SSUE NO. REASON FOR CHANGE		DATE ISSUED	
W7L-230608W004RF01	Original release	Aug. 11, 2023	

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SUMMARY OF TEST RESULT

FCC Rule	Description	Limit	Result	Remark
-	99% Bandwidth	-	Pass	-
15.225(a)(b)(c)	Field Strength of Fundamental Emissions	15.225(a)(b)(c)	Pass	-
15.215	20dB Spectrum Bandwidth	15.215	Pass	-
15.225(d) 15.209	Radiated Emission	15.225(d) & 15.209	Pass	-
15.207	AC Conducted Emission	15.207(a)	Note	See note 1
15.225(e)	Frequency Stability	< ±100 ppm	Pass	-
15.203	Antenna Requirement	N/A	Pass	-

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.



1 GENERAL DESCRIPTION

1.1 GENERAL DESCRIPTION OF EUT

Items	Description
Tx/Rx Frequency Range	13.553MHz ~ 13.567MHz
Channel Number	1
20dBW	2.722 kHz
99%OBW	2.488 kHz
Antenna Type	PCB Antenna
Type of Modulation	ASK

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.2 MODIFICATION OF EUT

No modifications are made to the EUT during all test items.

1.3 APPLICABLE STANDARDS

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.225
- ANSI C63.10-2013



2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST

2.1 DESCRIPTIONS OF TEST MODE

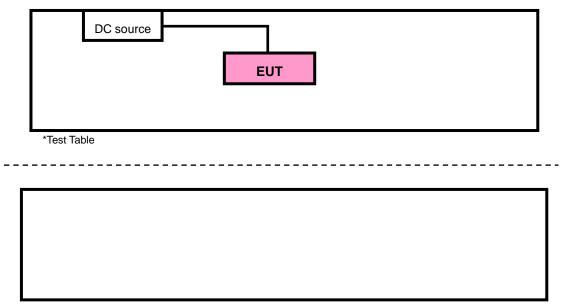
Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

	Test Items				
Α	C Power Line Conducted Emissions	Field Strength of Fundamental Emissions			
20	0dB Spectrum Bandwidth	Frequency Stability			
R	adiated Emissions 9kHz~30MHz	Radiated Emissions 30MHz~1GHz			
No	te:				
1.	The EUT was programmed to be in continuous	ly transmitting mode.			
2.	The ancillary equipment, NFC card, is used	to make the EUT (NFC) continuously transmit at			
	13.56MHz and is placed around 3 cm gap to the EUT.				
3.	3. Pre-Scan has been conducted to determine the worst-case mode from all possible combination				
	between available modulations, work in modes and data rates. Selected for the final test as listed				
	below.				

Frequency	Work in Modes	Туре	Data Rate (Kbps)			
13.56 MHz	Card Emulation Reader/Writer Peer-to-Peer	□A □B ☑F □V	□ 106 □ 212 □ 424 □ 848			
Remark: The mark" means is chosen for testing; The mark" means is not chosen for testing.						

2.2 TEST CONFIGURATIONS

< For Fundamental Emissions and Mask and Radiated Emissions Measurement >



^{*} Kept in a remote area

2.3 SUPPORT EQUIPMENT

FOR All TESTS

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	DC source	Kikusui/JP	PMX18-5A	0000001	N/A

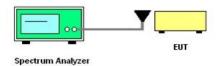
NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	DC Line: Unshielded, Detachable 0.6m

2.4 TEST SETUP

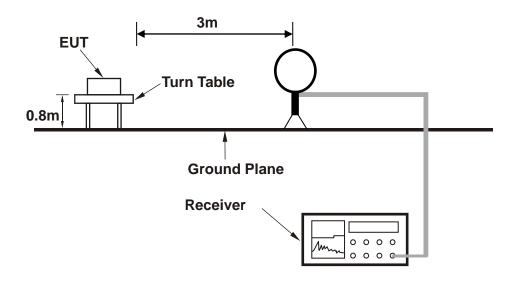
The EUT is continuously communicating during the tests.

EUT was set in the Hidden menu mode to enable NFC communications.

Setup diagram for Conducted Test



Setup diagram for Radiation(9KHz~30MHz) Test

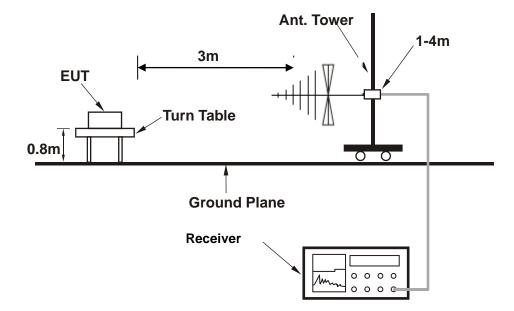


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Setup diagram for Radiation (Below 1G) Test



2.5 MEASUREMENT RESULTS EXPLANATION EXAMPLE

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 5 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
=
$$5 + 10 = 15$$
 (dB)



3 TEST RESULT

3.1 20DB AND 99% BANDWIDTH MEASUREMENT

3.1.1 LIMIT OF 20DB AND 99% BANDWIDTH

Intentional radiators must be designed to ensure that the 20dB and 99% emission bandwidth in the specific band 13.553~13.567MHz.

3.1.2 TEST PROCEDURES

- The spectrum analyzer connected via a receive antenna placed near the EUT in peak Max hold mode.
- The resolution bandwidth of 1 kHz and the video bandwidth of 3 kHz were used. (Since the signal being measured is CW or CW-like, it is impractical to adjust RBW according to C63.10 because the bandwidth measured will always follow RBW and the result will be approximately twice as large as RBW.)
- 3. Measured the spectrum width with power higher than 20dB below carrier.
- 4. Measured the 99% OBW.

3.1.3 TEST RESULT OF 20DB AND 99% BANDWIDTH

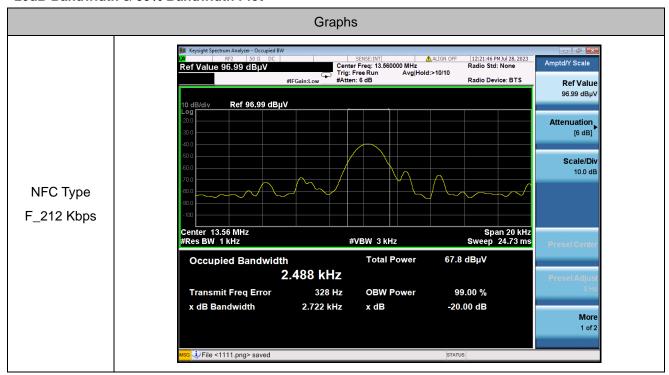
Test Mode :	NFC		Temperature :		23℃	
Test Engineer :	Jace hu		Relative Humidity :		50%	
Mode	Frequency	20dB Ban	dwidth [kHz]	99	% OBW[kHz]	Verdict
NFC Type F_212 Kbps	13.56MHz	2.	.722		2.488	PASS

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20dB Bandwidth & 99% Bandwidth Plot



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3.2 FREQUENCY STABILITY MEASUREMENT

3.2.1 LIMIT OF FREQUENCY STABILITY

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% (100ppm) of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

3.2.2 TEST PROCEDURES

- 1. The spectrum analyzer connected via a receive antenna placed near the EUT.
- 2. EUT have transmitted signal and fixed channelize.
- 3. Set the spectrum analyzer span to view the entire emissions bandwidth.
- 4. Set RBW = 1 kHz, VBW = 3 kHz with peak detector and maxhold settings.
- 5. The fc is declaring of channel frequency. Then the frequency error formula is $(fc-f)/fc \times 10^6$ ppm and the limit is less than ± 100 ppm.
- 6. Extreme temperature rule is -20°C~50°C.

3.2.3 TEST RESULT OF FREQUENCY STABILITY

The NFC Type F_212 Kbps is the worst case, Only report worst mode data

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NFC Type F_212 Kbps

Voltage (Vdc)	Temperature	Measurement	Frequency	Limit(ppm)	Result
voitage (vuc)	(°C)	Frequency (MHz)	Tolerance(ppm)	Lillit(ppili)	Nesuit
10.2	20	13.56006	4.42		Pass
13.8	20	13.56015	11.06		Pass
	-20	13.56028	20.65		Pass
	-10	13.56022	16.22	±100	Pass
	0	13.55982	-13.27		Pass
12	10	13.55991	-6.64	±100	Pass
12	20	13.55984	-11.80		Pass
	30	13.55989	-8.11		Pass
	40	13.55983	-12.54		Pass
	50	13.56014	10.32		Pass



3.3 FIELD STRENGTH OF FUNDAMENTAL EMISSIONS AND MASK MEASUREMENT

3.3.1 LIMIT OF FIELD STRENGTH OF FUNDAMENTAL EMISSIONS AND MASK

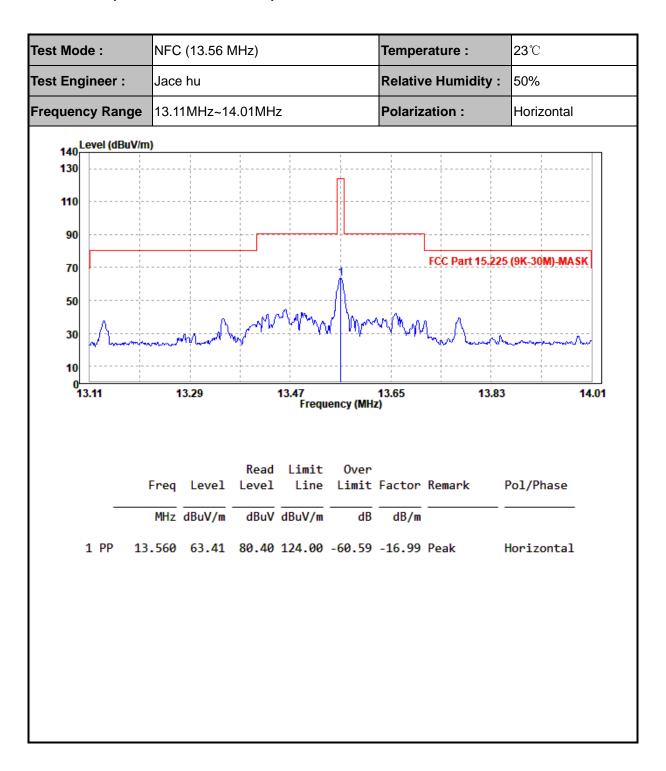
Rules and specifications	FCC CFR 47 Part 15 section 15.225					
Description	Compliance with th	Compliance with the spectrum mask is tested with RBW set to 9kHz.				
From of Emission (MUT)	Field Strength	Field Strength	Field Strength	Field Strength		
Freq. of Emission (MHz)	(µV/m) at 30m	(dBµV/m) at 30m	(dBµV/m) at 10m	(dBµV/m) at 3m		
1.705~13.110	30	29.5	48.58	69.5		
13.110~13.410	106	40.5	59.58	80.5		
13.410~13.553	334	50.5	69.58	90.5		
13.553~13.567	15848	84.0	103.08	124.0		
13.567~13.710	334	50.5	69.58	90.5		
13.710~14.010	106	40.5	59.58	80.5		
14.010~30.000	30	29.5	48.58	69.5		

3.3.2 TEST PROCEDURES

- Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the loop receiving antenna mounted antenna tower was placed 3 meters far away from the turntable.
- 2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
- 3. The height of the receiving antenna was fixed at one meter above ground to find the maximum emissions field strength.
- 4. For Fundamental emissions, use the receiver to measure QP reading.
- 5. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
- 6. Compliance with the spectrum mask is tested with RBW set to 9kHz.

Note: Emission level ($dB\mu V/m$) = 20 log Emission level ($\mu V/m$).

3.3.3 TEST RESULTS OF FIELD STRENGTH OF FUNDAMENTAL EMISSIONS AND MASK (1.705 MHZ ~ 30 MHZ)



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NFC (13	NFC (13.56 MHz)			Temper	ature :	23 ℃	
Jace hu			Relative Humidity :			50%	
13.11MF	lz~14.01MHz	MHz		Polarization :		Vertical	
n)							
	<u>-</u>						
			-				
			<u>.</u>		FCC Part 15.22	5 (9K-30M)-MA	K
		N.	·A				
	Jan Mary) Julian	My Jim			
13.29		13.47	nov (Mila	13.65	13.83	3	14.01
					Remark	Pol/Phase	
3.560 63	3.31 80.30	124.00	-60.69	-16.99	Peak	Vertical	
	Jace hu 13.11MH n) 13.29 Freq Le	Jace hu 13.11MHz~14.01MHz n) 13.29 Read Freq Level Level MHz dBuV/m dBuV	Jace hu 13.11MHz~14.01MHz n) 13.29 13.47 Freque Read Limit Freq Level Level Line MHz dBuV/m dBuV dBuV/m	Jace hu 13.11MHz~14.01MHz n) 13.29 13.47 Frequency (MHz Read Limit Over Freq Level Level Line Limit MHz dBuV/m dBuV dBuV/m dB	Jace hu 13.11MHz~14.01MHz Polariza 13.29 13.47 Frequency (MHz) Read Limit Over Level Level Line Limit Factor MHz dBuV/m dBuV dBuV/m dB dB/m	Jace hu 13.11MHz~14.01MHz Polarization: The state of t	Jace hu 13.11MHz~14.01MHz Polarization: FCC Part 15.225 (9K-30M)-MAS FCC Part 15.225 (9K-30M)-MAS 13.29 13.47 Frequency (MHz) Freq Level Line Limit Factor Remark Pol/Phase MHz dBuV/m dBuV dBuV/m dB dB/m

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3.4 RADIATED EMISSIONS MEASUREMENT

3.4.1 LIMIT

The field strength of any emissions which appear outside of 13.110 ~14.010MHz band shall not exceed the general radiated emissions limits.

Frequencies	Field Strength	Measurement Distance
(MHz)	(μV/m)	(meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

3.4.2 MEASURING INSTRUMENT SETTING

The following table is the setting of receiver.

Receiver Parameter	Setting
Attenuation	Auto
Frequency Range: 9kHz~150kHz	RBW 200Hz for QP
Frequency Range: 150kHz~30MHz	RBW 9kHz for QP
Frequency Range: 30MHz~1000MHz	RBW 120kHz for Peak

Note: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

3.4.3 TEST PROCEDURES

- Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
- 2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
- The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
- 4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the

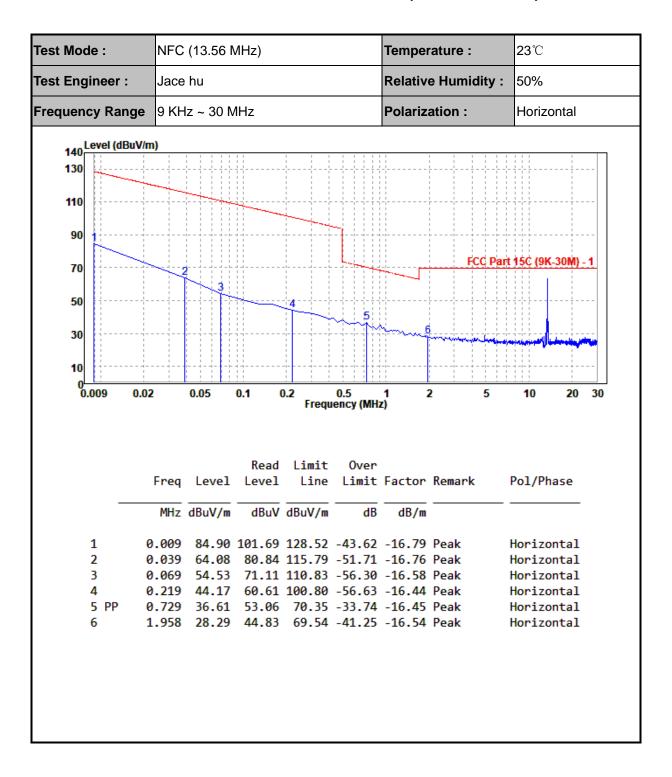


turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.

- 5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
- 6. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
- 7. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver.



3.4.4 TEST RESULTS OF RADIATED EMISSIONS (9 KHZ ~ 30 MHZ)



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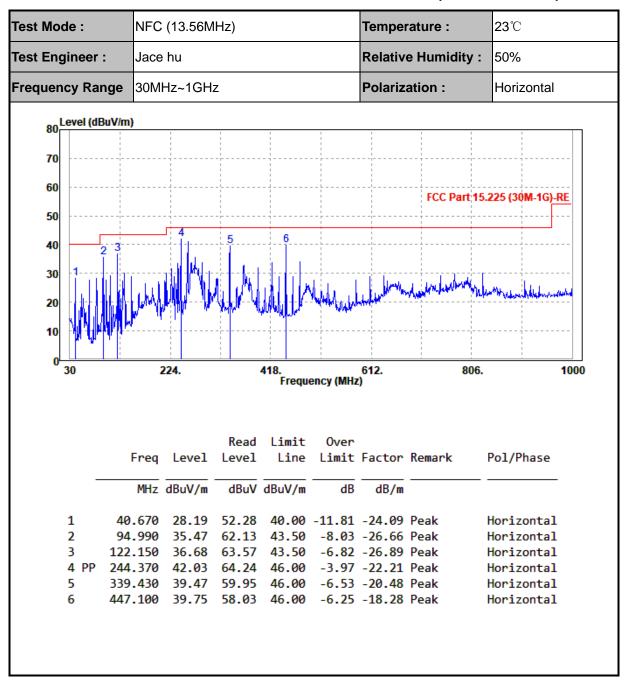
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est Mode :	NFC	NFC (13.56 MHz) Jace hu 9 KHz ~ 30 MHz			Temperature : Relative Humidity : Polarization :		23℃ 50% Vertical		
est Engineer :	Jace								
requency Range	9 KH								
140 Level (dBuV/	m)								
130							 		
	-								
110			4				} 		
				-	-				
90 1									
70	<u>.</u>		11	<u> </u>			FCC Par	t 15C (9K-30M)	1
	7								
50			3						
					4	5			
30						سماسي	Committee of the same	-	
							Commence of the company of the compa	Maria Maria	•
10							Marine Day		
	12	0.05		0.2 Frequ	0.5	1	2 5	10 20	30
10	12				0.5 ency (MHz	1		10 20	30
10)2			Frequ		1		10 20	30
10		0.05	0.1 (Frequ Limit	ency (MHz Over	1 2)	2 5		30
10		0.05	0.1	Frequ Limit	ency (MHz Over	1 2)		10 20 Pol/Phase	30
10	Freq	0.05	Read	Frequ Limit Line	Over	factor	2 5		30
10	Freq	0.05	Read	Frequ Limit	ency (MHz Over	1 2)	2 5		30
10 0.009 0.0	Freq MHz 0.009	Level dBuV/m 83.74	Read Level dBuV	Limit Line dBuV/m	Over Limit ———————————————————————————————————	1 ; Factor dB/m -16.79	2 5 Remark Peak	Pol/Phase ———— Vertical	30
10 0.009 0.0	Freq MHz 0.009 0.039	0.05 Level dBuV/m 83.74 61.55	Read Level dBuV 100.53 78.31	Limit Line dBuV/m 128.52 115.79	Over Limit ———————————————————————————————————	Factor dB/m -16.79 -16.76	Remark Peak Peak	Pol/Phase ———— Vertical Vertical	30
10 0.009 0.0	Freq MHz 0.009 0.039 0.129	0.05 Level dBuV/m 83.74 61.55 48.65	Read Level dBuV 100.53 78.31 65.11	Limit Line dBuV/m 128.52 115.79 105.39	Over Limit ———————————————————————————————————	Factor dB/m -16.79 -16.76 -16.46	Remark Peak Peak Peak	Pol/Phase Vertical Vertical Vertical	30
10 0.009 0.0	Freq MHz 0.009 0.039 0.129 0.429	0.05 Level dBuV/m 83.74 61.55 48.65 37.66	Read Level dBuV 100.53 78.31 65.11 54.18	Limit Line dBuV/m 128.52 115.79 105.39 94.96	Over Limit ———————————————————————————————————	Factor dB/m -16.79 -16.76 -16.46 -16.52	Remark Peak Peak Peak Peak	Pol/Phase Vertical Vertical Vertical Vertical	30
10 0.009 0.0 1 2 3 4 5 PP	Freq MHz 0.009 0.039 0.129	0.05 Level dBuV/m 83.74 61.55 48.65 37.66	Read Level dBuV 100.53 78.31 65.11 54.18 46.18	Limit Line dBuV/m 128.52 115.79 105.39	Over Limit ———————————————————————————————————	Factor dB/m -16.79 -16.76 -16.46 -16.52 -16.43	Remark Peak Peak Peak Peak Peak	Pol/Phase Vertical Vertical Vertical	30

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3.4.5 TEST RESULT OF RADIATED SPURIOUS EMISSION (30MHZ ~ 1GHZ)





Test Mode :	NFC	NFC (13.56MHz) Jace hu 30MHz~1GHz			Tempe	rature :	23℃	23℃		
Test Engineer	: Jace					Relativ	e Humidity	: 50%	50%	
Frequency Rar	nge 30M				Polariz	ation :	Vertic	Vertical		
80 Level (dE	BuV/m)									
70										
60										
50							FCC Part	15.225 (30)	M-1G)-RE	
		4								
40	2 3			5						
30			1		 u :	6				
20		1:HA	115		March	l kilipita in ma	that were by many annual or the	ماركانو أوالاس بسلام طالبته	definition	
							1 1			
10										
0 30		224.		418. Frequ	ency (MHz	612. z)	80	6.	1000	
		224.			ency (MHz		80	6.	1000	
		224.	Road	Frequ			80	6.	1000	
		224.	Read Level		0ver	z)	80 Remark	6. Pol/Ph		
	Freq	Level	Level	Frequ Limit Line	Over Limit	Factor	Remark			
0 30	Freq MHz	Level dBuV/m	Level dBuV	Limit Line dBuV/m	Over Limit	Factor dB/m	Remark —	Pol/Ph	ase	
0 30	Freq MHz 40.670	Level dBuV/m 36.55	dBuV 61.28	Limit Line dBuV/m	Over Limit dB	Factor dB/m -24.73	Remark 	Pol/Ph	ase ——	
0 30	Freq MHz 40.670 94.990	Level dBuV/m 36.55 33.09	dBuV 61.28 60.60	Limit Line dBuV/m 40.00 43.50	Over Limit dB -3.45 -10.41	Factor dB/m -24.73 -27.51	Remark 	Pol/Ph 	ase —— al al	
0 30	Freq MHz 40.670	Level dBuV/m 36.55 33.09	dBuV 61.28	Limit Line dBuV/m 40.00 43.50 43.50	Over Limit dB -3.45 -10.41	Factor dB/m -24.73 -27.51 -27.68	Remark Peak Peak Peak Peak	Pol/Ph	ase ——— al al al	
1 PP 2 3	Freq MHz 40.670 94.990 122.150	Level dBuV/m 36.55 33.09 33.71	dBuV 61.28 60.60 61.39	Limit Line dBuV/m 40.00 43.50 43.50 46.00	Over Limit dB -3.45 -10.41 -9.79	Factor dB/m -24.73 -27.51 -27.68 -20.44	Remark Peak Peak Peak Peak Peak	Pol/Ph Vertic Vertic Vertic	ase al al al	



3.5 ANTENNA REQUIREMENTS

3.5.1 STANDARD APPLICABLE

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. 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 the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

3.5.2 ANTENNA CONNECTED CONSTRUCTION

An PCB Antenna design is used.

3.5.3 ANTENNA GAIN

The antenna peak gain of EUT is less than 6 dBi.

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LIST OF MEASURING EQUIPMENT

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.	
3m Semi-anechoic	ETS-LINDGREN	9m*6m*6m	Euroshieldpn-	May 19 22	Mov. 17.06	
Chamber	E 13-LINDGREN	9111 0111 0111	CT0001143-1216	May. 18,23	May. 17,26	
Bilog Antenna	ETS-LINDGREN	3143B	00161965	Feb. 18,23	Feb. 17,24	
MXE EMI Receiver	KEYSIGHT	N9038A-544	MY54450026	Mar. 28,23	Mar. 27,24	
Signal Pre-Amplifier	EMSI	EMC 9135	980249	May. 06,23	May. 05,24	
E3 Test Software	E3	V 9.160323	N/A	N/A	N/A	
		FMZB	00470	0 00 00	Sep.02,23	
Loop Antenna	Schwarzbeck	1519B	00173	Sep.03,22		

- NOTE: 1. The calibration interval of the above test instruments is 12 months or 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 525120; The Designation No. is CN1171.



UNCERTAINTY OF EVALUATION

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

MEASUREMENT	UNCERTAINTY
AC Power Conducted emissions	±2.70dB
Radiated emissions (9KHz~30MHz)	±2.68dB
Radiated emissions (30MHz~1GHz)	±4.98dB
Occupied Channel Bandwidth	±43.58KHz
Frequency Stability	±76.97Hz

