

Prüfbericht-Nr.: Test report no.:	CN232NV4 003	Auftrags-Nr.: Order no.:	168442419	Seite 1 von 26 Page 1 of 26
Kunden-Referenz-Nr.: Client reference no.:	N/A	Auftragsdatum: Order date:	2023-08-24	
Auftraggeber: Client:	Marquardt GmbH Scholss-Strasse 16, 78604 Rietheim-Weilheim, Germany			
Prüfgegenstand: Test item:	NFC Door Handle			
Bezeichnung / Typ-Nr.: Identification / Type no.:	HH4			
Auftrags-Inhalt: Order content:	Test Report			
Prüfgrundlage: Test specification:	CFR47 FCC Part 15: Subpart C Section 15.225 RSS-210 Issue 10			
Wareneingangsdatum: Date of sample receipt:	2023-08-26	Please refer to Photo Document		
Prüfmuster-Nr.: Test sample no.:	A003542899-001			
Prüfzeitraum: Testing period:	2023-04-07 – 2023-09-12			
Ort der Prüfung: Place of testing:	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by:			genehmigt von: authorized by:	
Datum: Date:	2023-09-25	Signed by: Bell Hu	Ausstellungsdatum: Issue date:	2023-09-25
Stellung / Position:		Sachverständige(r)/Expert	Stellung / Position:	
		Sachverständige(r)/Expert		
Sonstiges / Other:	FCC ID: IYZHH4; IC: 2701A-HH4 PMN: NFC Door Handle; HVIN:HH4 This report is based on CN232NV4 001 for C2PC, the differences between them are detailed in section 3.1.			
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet * Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the above mentioned test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.				

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Anmerkungen
Remarks

1	Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden. <i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i>
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3	Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt. <i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i> <i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i>
4	Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019. <i>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</i>

Test Summary

5.1.1 ANTENNA REQUIREMENT

RESULT: Pass

5.1.2 20dB BANDWIDTH & 99% BANDWIDTH

RESULT: Pass

5.1.3 FREQUENCY STABILITY

RESULT: Pass

5.1.4 RADIATED SPURIOUS EMISSION (IN-BAND & OUT-BAND EMISSIONS)

RESULT: Pass

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1 General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: Photographs of the Test Set-up

Appendix B: Test Results.

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.

No. 362 Huanguan Road Middle, Longhua District, Shenzhen 518110, People's Republic of China

FCC Accreditation Designation No.: CN1260

ISED Wireless Device Testing Laboratory: 25069

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Unwanted Emission Testing (TS9975)				
Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
EMI Test Receiver	R&S	ESR 7	102021	25.07.2024
Signal Analyzer	R&S	FSV 40	101439	25.07.2024
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	25.07.2024
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	25.07.2024
Amplifier	R&S	SCU-18F	180070	25.07.2024
Amplifier	R&S	SCU40A	100475	25.07.2024
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	06.08.2024
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	06.08.2024
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	27.08.2024
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	06.08.2024
Test software	R&S	EMC32 (V10.60.10)	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NV9P2	N/A
3m Semi-Anechoic Chamber	Albatross	SAC-3m	APC17151-SAC	22.06.2024

2.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institute of Metrology) or where calibration is performed in other countries, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-7}$
Conducted Emission, (9kHz to 150kHz)/(150kHz to 30MHz)	$\pm 3.70 \text{ dB} / \pm 3.30 \text{ dB}$
Radiated Emission (3m SAC), 30MHz to 1000MHz	$\pm 4.52 \text{ dB}$
Radiated Emission (3m SAC), above 1000MHz	$\pm 4.37 \text{ dB}$
All emissions, radiated	$\pm 4.17 \text{ dB}$

2.6 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendix A & B of this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Shenzhen) Co., Ltd. file for certification follow-up purposes.

2.7 Status of Facility Used for Testing

The TÜV Rheinland (Shenzhen) Co., Ltd. Test facility located at No. 362 Huanguan Road Middle, Longhua District, Shenzhen 518110, People's Republic of China is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

3 General Product Information

3.1 Product Function and Intended Use

The EUT is NFC Door Handle, which supports card recognition (RFID) function.

For details refer to the User Manual, Technical Description and Circuit Diagram.

This report is based on CN232NV4 001 for C2PC, the frequency determining chip ST25R3920 changed to ST25R3920B:

- 1) The new chip ST25R3920B component is pin-for-pin compatible with the original chip ST25R3920.
- 2) The new chip has the same basic function as the old chip.
- 3) No change in radio parameters has occurred.
- 4) The same conditions apply when a small area (approximately the same area as the chip) of the PCB is replaced with an equivalent chip.

Based on above change, the items RSE and Frequency Stability re-tested.

3.2 Ratings and System Details

Table 2: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment	NFC Door Handle
Type Designation	HH4
FCC ID	IYZHH4
IC	2701A-HH4
PMN	NFC Door Handle
HVIN	HH4
Operating Temperature Range	-40°C~80 °C
Operating Voltage	9-16V DC
Testing Voltage	12V DC
Technical Specification of RFID	
Operating Frequency	13.56 MHz
Type of Modulation	ASK
Channel Number	1 channel
Antenna Type	Integral Antenna
Antenna gain	0dBi

3.3 Independent Operation Modes

The basic operation modes are:

- A. On, RFID transmitting mode
- B. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- Application Form

- User Manual

4 Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

Radio Spectrum: The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All tests were performed according to the procedures in ANSI C63.10: 2013.

According to clause 3.1, all tests were performed on model HH4 in this report.

4.3 Special Accessories and Auxiliary Equipment

Table 3: List of Accessories and Auxiliary Equipment

Description	Manufacturer	Model	S/N
--	--	--	--

4.4 Countermeasures to Achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Technical Construction File (TCF).

No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

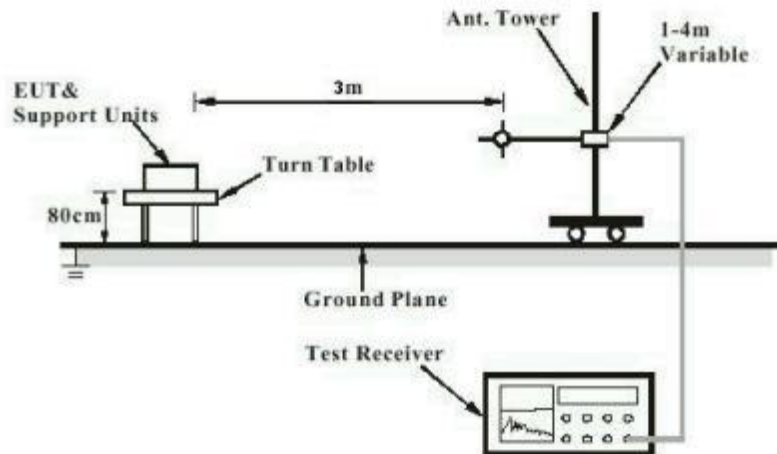


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

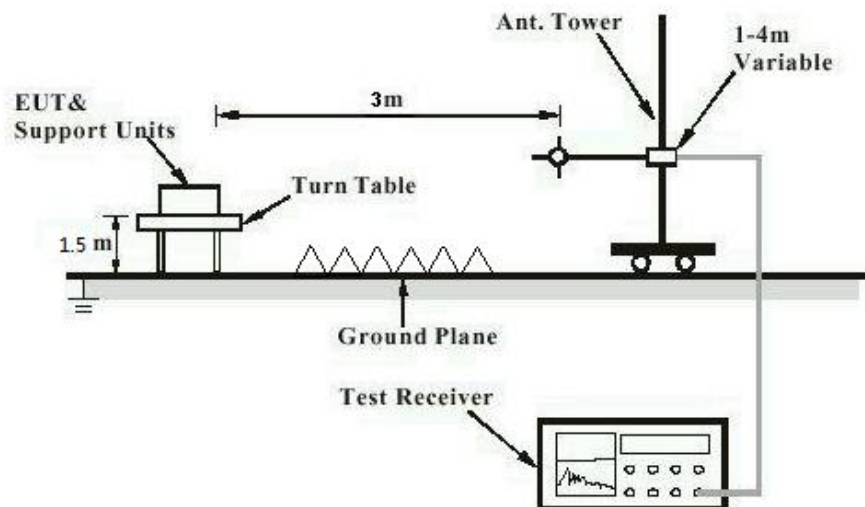


Diagram of Measurement Configuration for Conducted Transmitter Measurement

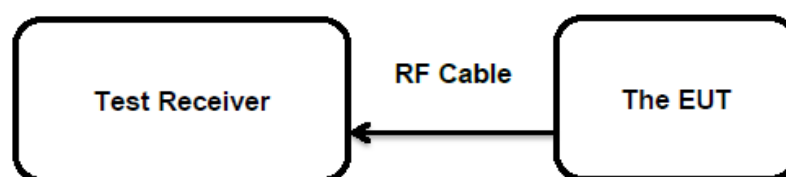
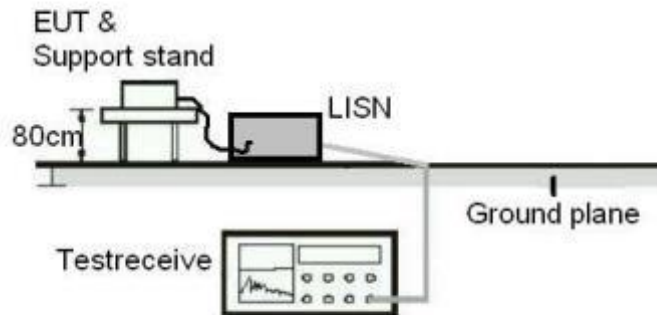


Diagram of Measurement Equipment Configuration for Mains Conduction Measurement



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:

Pass

Test Specification

Test standard : FCC Part 15.203
RSS-Gen Clause 6.8

The EUT has an Integral Antenna, the directional gain of antenna of RFID is 0 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement.

Therefore the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

5.1.2 20dB Bandwidth & 99% Bandwidth

RESULT:
Pass

Test Specification

Test standard : FCC Part 15.215 (c)
 : RSS-Gen Clause 6.7
 Basic standard : ANSI C63.10: 2013
 Limits : N/A
 Kind of test site : Shielded Room

Test Setup

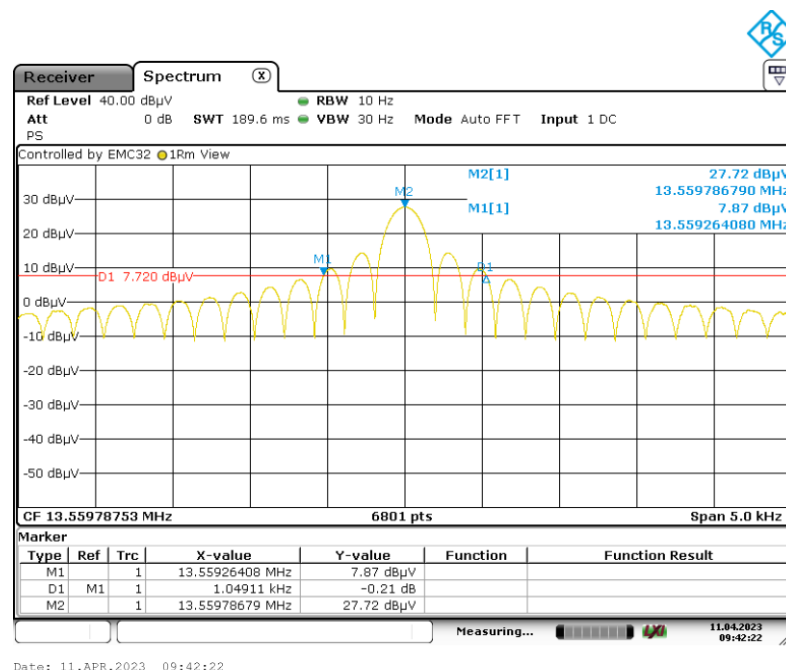
Date of testing : 2023-04-11
 Input voltage : DC 12V
 Operation mode : A
 Ambient temperature : 25 °C
 Relative humidity : 56 %
 Atmospheric pressure : 101 kPa

For details refer to following test result.

Table 4: Test Result of 20dB Bandwidth

Test Frequency (MHz)	20dB Bandwidth (KHz)	F _L (MHz)	F _H (MHz)	Limit (MHz)	Result
13.56	1.049	13.5593	13.5603	13.553-13.567	Pass

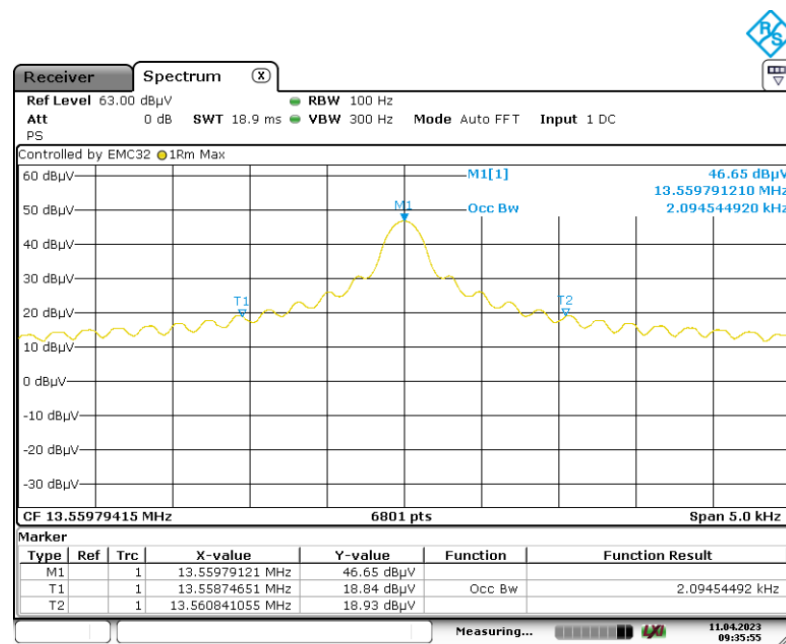
20dB bandwidth



99% bandwidth

Table 5: Test Result of 20dB Bandwidth

Test Frequency (MHz)	99% Bandwidth (KHz)	F _L (MHz)	F _H (MHz)	Limit (MHz)	Result
13.56	2.095	13.5587	13.5608	13.553-13.567	Pass



Date: 11.APR.2023 09:35:55

5.1.3 Frequency Stability

RESULT:

Pass

Test Specification

Test standard : FCC Part 15.225 (e)
 : RSS-210 Issue 10, B(6)(b)
 Basic standard : ANSI C63.10: 2013
 Limits : $\pm 0.01\%$ of Operating Frequency (1.356 KHz)
 Kind of test site : Shielded Room

Test Setup

Date of testing : 2023-09-04 to 2023-09-06
 Input voltage : DC 12V
 Operation mode : A
 Ambient temperature : 25 °C
 Relative humidity : 56 %
 Atmospheric pressure : 101 kPa

For details refer to following test result.

Table 6: Test Result of Frequency Tolerance

Test Frequency (MHz)	Test Conditions		Test Results (KHz)	Deviation (KHz)	Limit (KHz)	Result
	Temp(°C)	Volt(V DC)				
13.56	-20	12	13559.888	0.112	$\pm 0.01\%$ (1.356 KHz)	Pass
	-10	12	13559.725	0.275		Pass
	0	12	13559.732	0.268		Pass
	10	12	13559.758	0.242		Pass
	20	12	13559.848	0.152		Pass
	30	12	13559.836	0.164		Pass
	40	12	13559.793	0.207		Pass
	50	12	13559.740	0.260		Pass
	20	9	13559.703	0.297		Pass
		16	13559.772	0.228		Pass

Note: Deviation (kHz) = (Test Result-13.56MHz)*1000

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5.1.4 Radiated Spurious Emission (In-Band & Out-Band Emissions)

RESULT:

Pass

Test Specification

Test standard : FCC Part 15.225 (a)(b)(c)(d)
FCC Part 15.209 & 15.205
RSS-210 Issue 10, B(6)(a)
Basic standard : ANSI C63.10: 2013
Limits : Refer to FCC Part 15.209(a)
RSS-Gen Section 8.9 & 8.10
Kind of test site : 3m Semi-anechoic Chamber

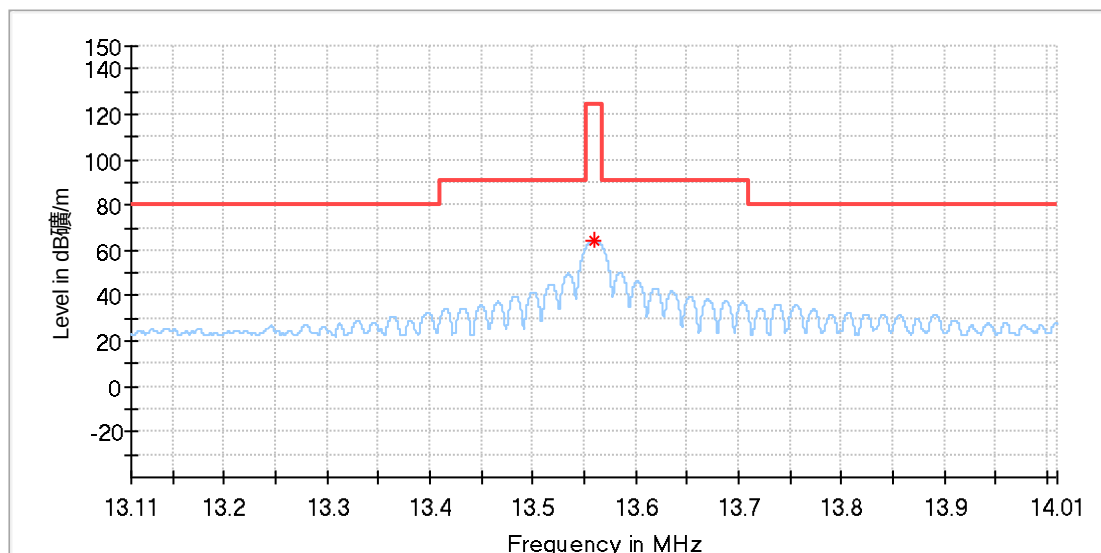
Test Setup

Date of testing : 2023-09-04 to 2023-09-06
Input voltage : DC 12V
Operation mode : A
Ambient temperature : 22 °C
Relative humidity : 52 %
Atmospheric pressure : 101 kPa

Operation within the band 13.110-14.010 MHz

EUT Information

EUT Name:	NFC Door Handle
Model:	HH4
Test Mode:	NFC
Order No/Sample No:	168442419/A003542899-001
Test Voltage::	DC 12V
Remark:	Temp 23 Humi:53%
Test Standard:	FCC 15.225
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical Freqs

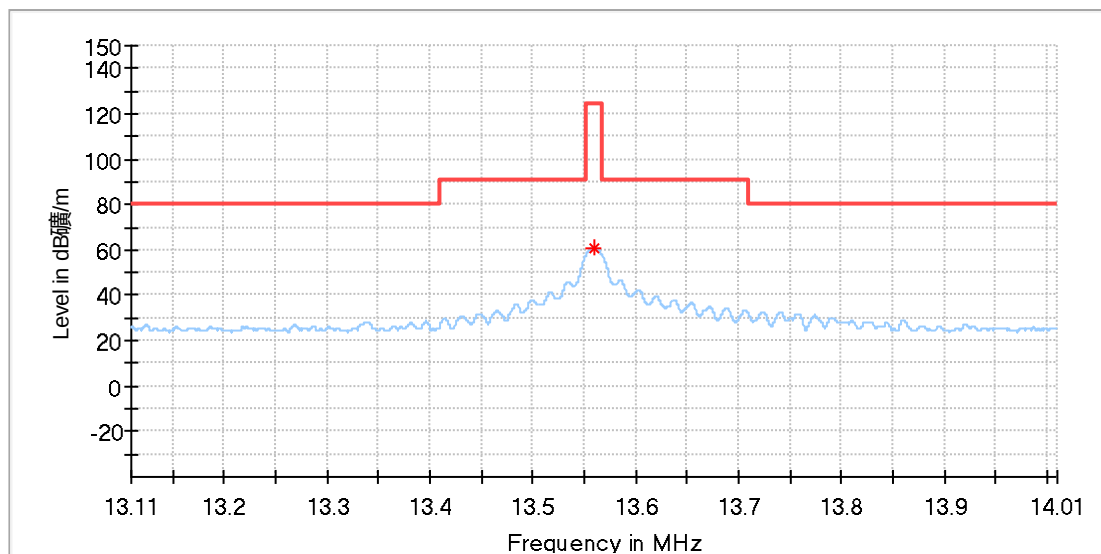
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
13.560000	64.55	124.00	59.45	100.0	X	146.0	20.0

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
---	---	---	---	---		---	---	

EUT Information

EUT Name: NFC Door Handle
Model: HH4
Test Mode: NFC
Order No/Sample No: 168442419/A003542899-001
Test Voltage:: DC 12V
Remark: Temp 23 Humi:53%
Test Standard: FCC 15.225
Tested By: Kei Zhang
Reviewed By: Terry Yin



Critical Freqs

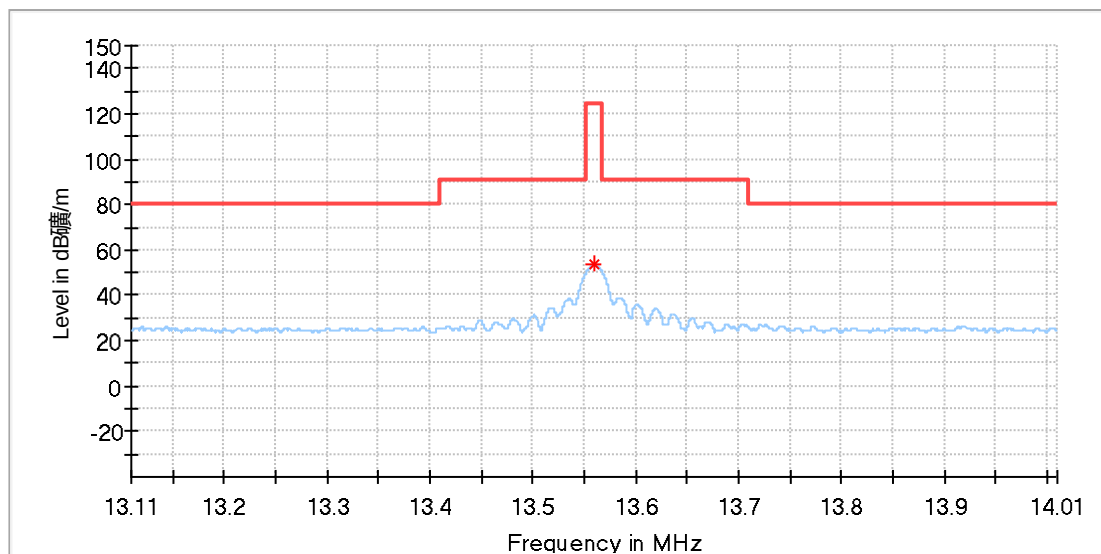
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
13.560000	60.76	124.00	63.24	100.0	Y	296.0	20.0

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
---	---	---	---	---		---	---	

EUT Information

EUT Name: NFC Door Handle
Model: HH4
Test Mode: NFC
Order No/Sample No: 168442419/A003542899-001
Test Voltage:: DC 12V
Remark: Temp 23 Humi:53%
Test Standard: FCC 15.225
Tested By: Kei Zhang
Reviewed By: Terry Yin



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
13.560000	53.41	124.00	70.59	100.0	Z	12.0	20.0

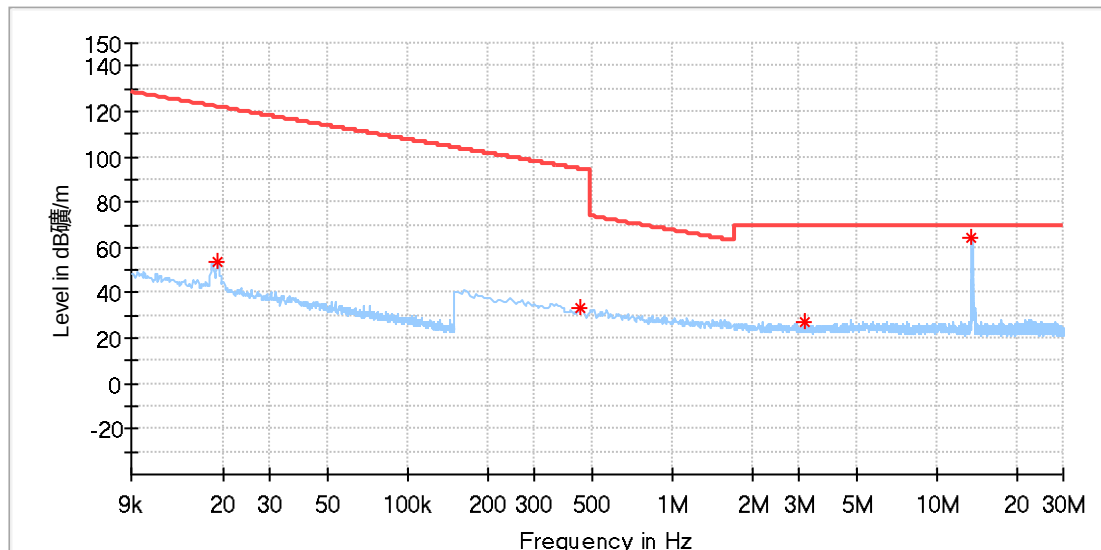
Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
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9KHz-30MHz:

EUT Information

EUT Name:	NFC Door Handle
Model:	HH4
Test Mode:	NFC
Order No/Sample No:	168442419/A003542899-001
Test Voltage::	DC 12V
Remark:	Temp 23 Humi:53%
Test Standard:	FCC 15.225
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical Freqs

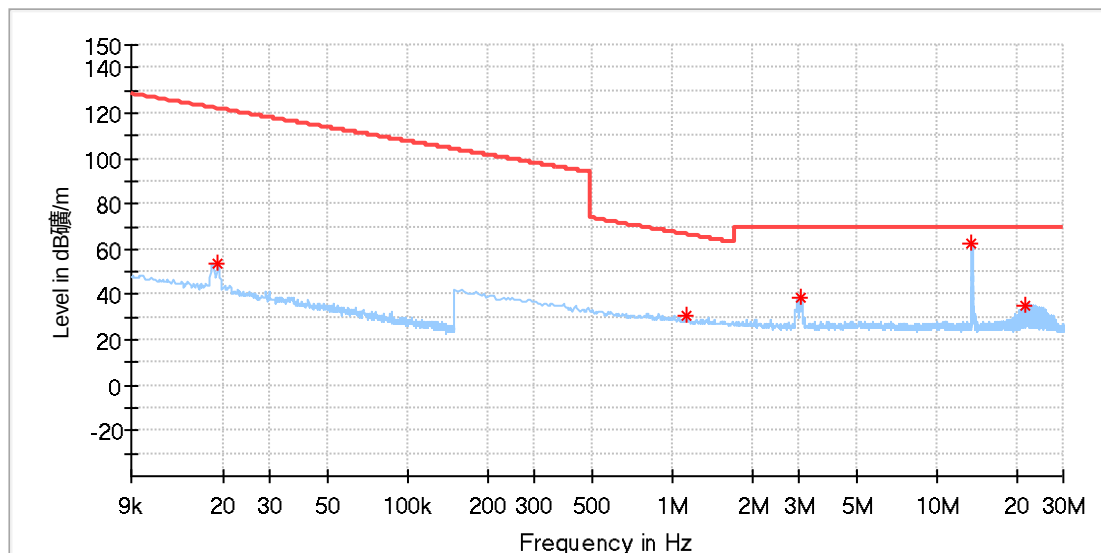
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
0.019172	53.48	121.94	68.46	100.0	X	279.0	20.1
0.448500	33.68	94.57	60.89	100.0	X	235.0	20.1
3.187677	27.05	69.50	42.45	100.0	X	214.0	20.2
13.560552	64.65	69.50	4.85	100.0	X	166.0	20.5

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name: NFC Door Handle
Model: HH4
Test Mode: NFC
Order No/Sample No: 168442419/A003542899-001
Test Voltage:: DC 12V
Remark: Temp 23 Humi:53%
Test Standard: FCC 15.225
Tested By: Kei Zhang
Reviewed By: Terry Yin



Critical Freqs

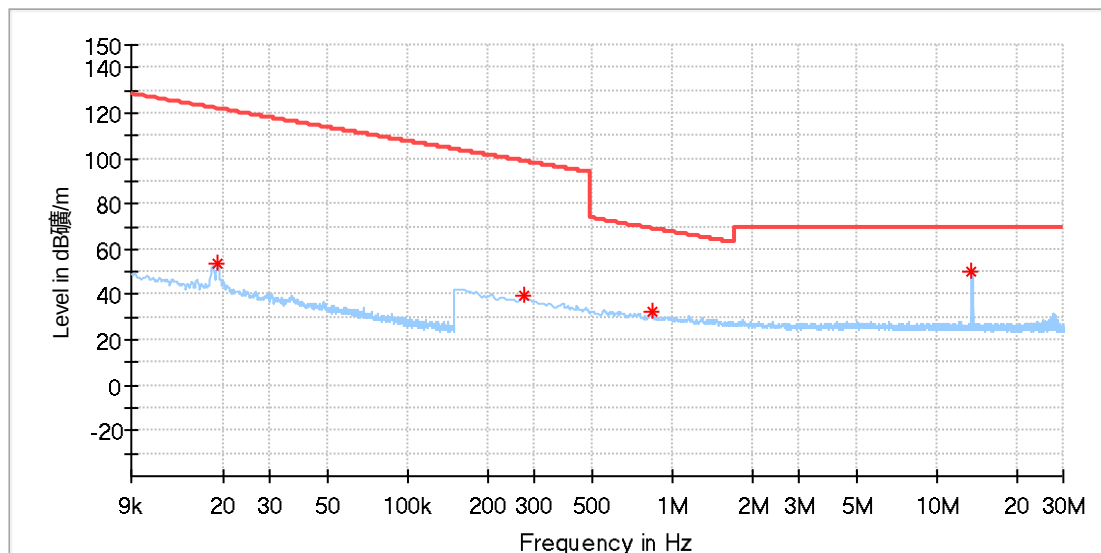
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
0.019172	53.95	121.94	67.98	100.0	Y	222.0	20.1
1.133294	31.02	66.54	35.52	100.0	Y	167.0	20.1
3.077934	38.49	69.50	31.01	100.0	Y	157.0	20.2
13.560552	62.17	69.50	7.33	100.0	Y	283.0	20.5
21.672728	35.49	69.50	34.01	100.0	Y	186.0	20.6

Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name: NFC Door Handle
Model: HH4
Test Mode: NFC
Order No/Sample No: 168442419/A003542899-001
Test Voltage:: DC 12V
Remark: Temp 23 Humi:53%
Test Standard: FCC 15.225
Tested By: Kei Zhang
Reviewed By: Terry Yin



Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
0.019172	53.31	121.94	68.62	100.0	Z	199.0	20.1
0.272912	39.21	98.88	59.67	100.0	Z	244.0	20.1
0.834794	32.23	69.19	36.95	100.0	Z	163.0	20.1
13.560552	50.54	69.50	18.96	100.0	Z	35.0	20.5

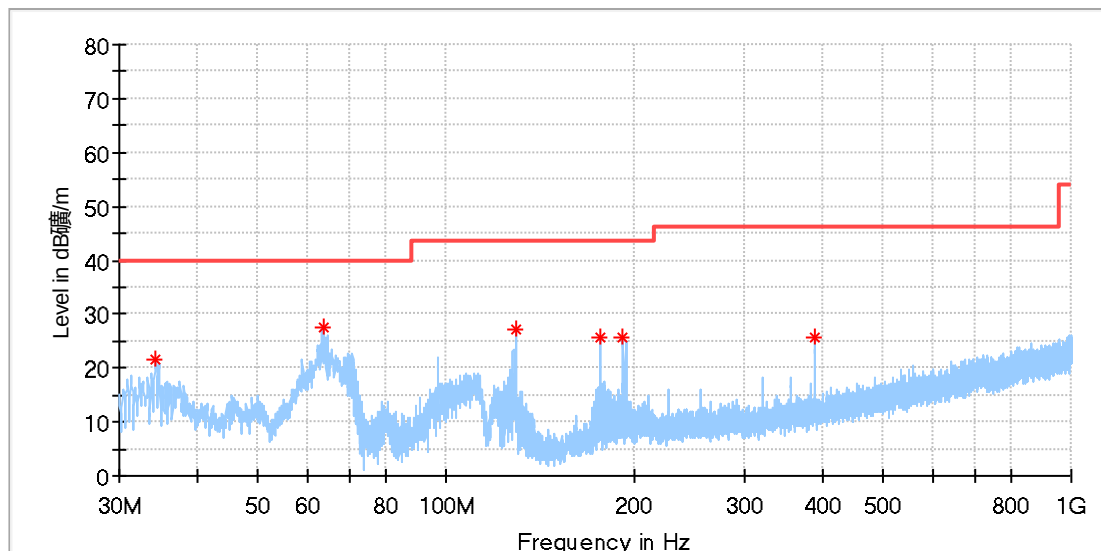
Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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30MHz-1000MHz:

EUT Information

EUT Name: NFC Door Handle
Model: HH4
Test Mode: NFC
Order No/Sample No: 168442419/A003542899-001
Test Voltage:: DC 12V
Remark: Temp 23 Humi:53%
Test Standard: FCC 15.225
Tested By: Kei Zhang
Reviewed By: Terry Yin



Critical Freqs

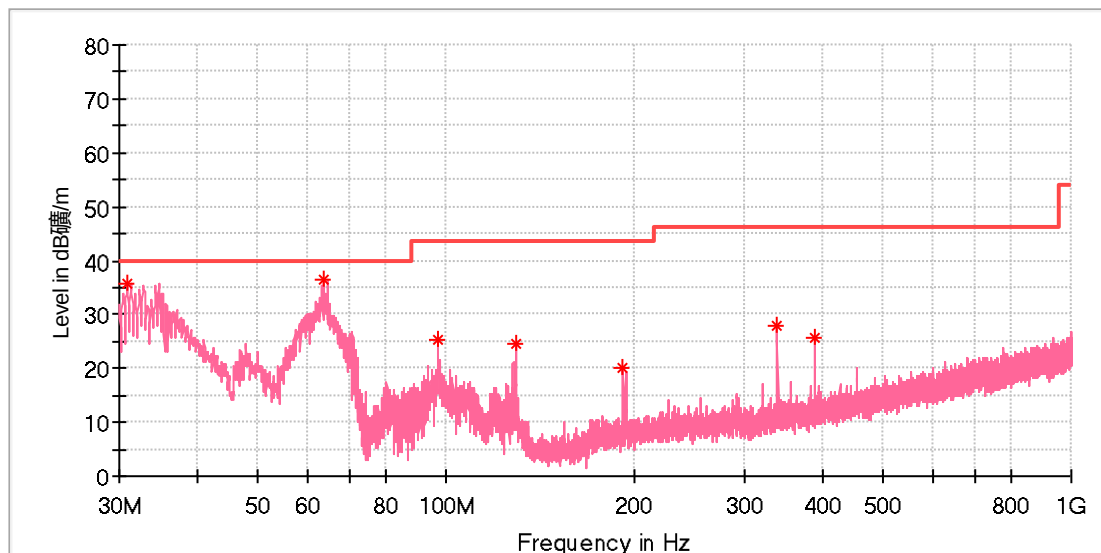
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
34.327692	21.44	40.00	18.56	100.0	H	179.0	-22.5
63.726154	27.65	40.00	12.35	100.0	H	314.0	-20.1
129.536923	27.34	43.50	16.16	100.0	H	179.0	-22.1
176.283462	25.58	43.50	17.92	100.0	H	7.0	-21.1
191.990000	25.58	43.50	17.92	100.0	H	0.0	-19.7
388.526923	25.63	46.00	20.37	100.0	H	230.0	-14.4

Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name: NFC Door Handle
Model: HH4
Test Mode: NFC
Order No/Sample No: 168442419/A003542899-001
Test Voltage:: DC 12V
Remark: Temp 23 Humi:53%
Test Standard: FCC 15.225
Tested By: Kei Zhang
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Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.932692	35.87	40.00	4.13	100.0	V	333.0	-23.2
63.726154	36.48	40.00	3.52	100.0	V	250.0	-20.1
97.153846	25.16	43.50	18.34	100.0	V	218.0	-19.7
129.499615	24.40	43.50	19.10	100.0	V	316.0	-22.1
191.990000	20.02	43.50	23.48	100.0	V	306.0	-19.7
339.019615	28.04	46.00	17.96	100.0	V	142.0	-15.4
388.452308	25.73	46.00	20.27	100.0	V	119.0	-14.4

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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6 Photographs of the Test Set-Up

For photographs of the test set-up, refer to the appendix A.

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