FCC/IC - TEST REPORT

Report Number	:	**68.950.22.0078.01**	Date of Issue:	2022-02-24
Model	:	**805522**		
Product Type	:	Proximity Sensor		
Applicant	:	Diehl Controls (Nanjing) Co., Ltd.		
Address	:	Jiangjun Avenue 139, Jiangning Development Zone, Nanjing, 211100, PEOPLE'S REPUBLIC OF CHINA		
Manufacturer	:	Diehl Controls (Nanjing) Co., Ltd.		
Address	:	Jiangjun Avenue 139, Jiangning Development Zone, Nanjing, 211100, PEOPLE'S REPUBLIC OF CHINA		
Test Result	:	■ **Positive** ☐ **Negative**		
Total pages including Appendices	:	**23**		

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1 Table of Contents

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2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Building 12&13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District, Shenzhen City, 518052, P. R. China
FCC Registration Number:	514049
FCC Designation Number:	CN5009
ISED#:	10320A
CAB identifier:	CN0077
Telephone:	86 755 8828 6998
Fax:	86 755 8828 5299

3 Description of the Equipment Under Test

Description of the Equipment Under Test

Product/PMN:	Proximity Sensor
Model no:	805522
HVIN:	805522-02
FCC ID:	2A32Z-MDUF0001
IC:	28079-MDUI0001
Options and accessories:	NIL
Ratings:	5VDC, 60mA
RF Transmission Frequency:	24.15GHz
Occupied bandwidth	180MHz
Antenna Type:	PCB Antenna
Antenna Gain:	2dBi
Description of the EUT:	The product is a Proximity Sensor that operated at 24.15GHz, The TX and RX range is 24.15GHz

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	RATINGS	MODEL NO.
Notebook	Lenovo	---	---

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2019 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-Gen Issue 5, February 2021 Amendment 2	General Requirements and Information for the Certification of Radio Apparatus
RSS-210 Issue 10 December 2019	RSS-210 — Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

All the test methods were according to ANSI C63.10-2013.

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5 Summary of Test Results

Technical Requirements					
FCC Part 15 Subpart C 15.249, RSS-Gen, RSS-210					
Test Condition	Pages	Test Site	Test Result		
			Pass	Fail	N/A
15.207 & RSS-Gen A8.8 Conducted emission AC power port	9	Site 1	☒	☐	☐
§15.205(a), §15.209(a), §15.249(a), §15.249(c) & RSS-210 B.10, RSS-GEN 6.13/8.9/8.10 Field strength of emissions and Restricted bands	12	Site 1	☒	☐	☐
§15.249(d), RSS-210 B.10 Out of band emissions	17	Site 1	☒	☐	☐
FCC §15.215(c) 20dB bandwidth & RSS-Gen 6.7 99% Occupied Bandwidth	22	Site 1	☒	☐	☐
§15.203, RSS-GEN 6.8 Antenna requirement	See note 1		☒	☐	☐

Remark 1: N/A- Not Applicable;
Note 1: The EUT used an integral PCB antenna, which gain is 2.0dBi. According to §15.203, it is considered sufficiently to comply with the provisions of this section.

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6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2A32Z-MDUF0001 and IC: 28079-MDUI0001 complies with Section 15.207, 15.205, 15.209, 15.249 of the FCC Part 15, Subpart C Rules; RSS-Gen Issue 5 and RSS-210 issue 10.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment Under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date: 2021-07-19

Testing Start Date: 2021-07-19

Testing End Date: 2022-02-23

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch -

Reviewed by:	Prepared by:	Tested by:
John Zhi	Warlen Song	Carry Cai
EMC Project Manager	EMC Project Engineer	EMC Test Engineer

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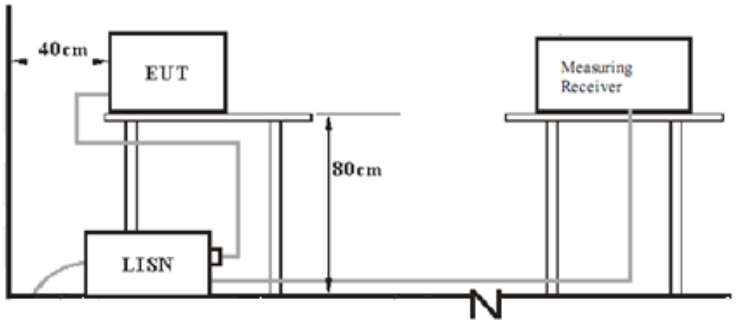
7 Test setups

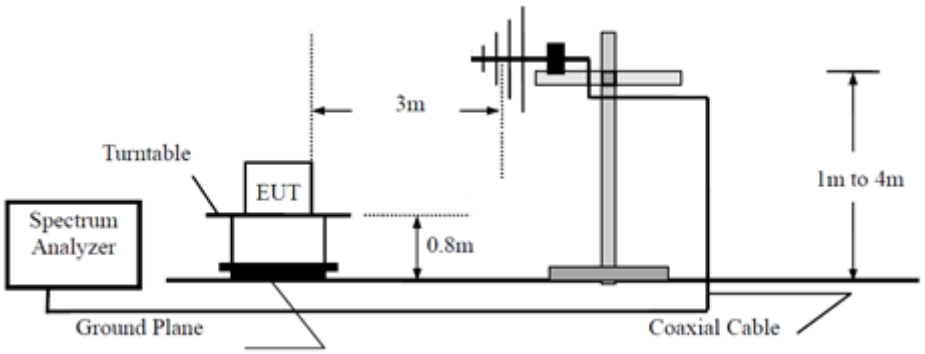
7.1 AC Power Line Conducted Emission test setups

AC Power Line Conducted Emission test setups

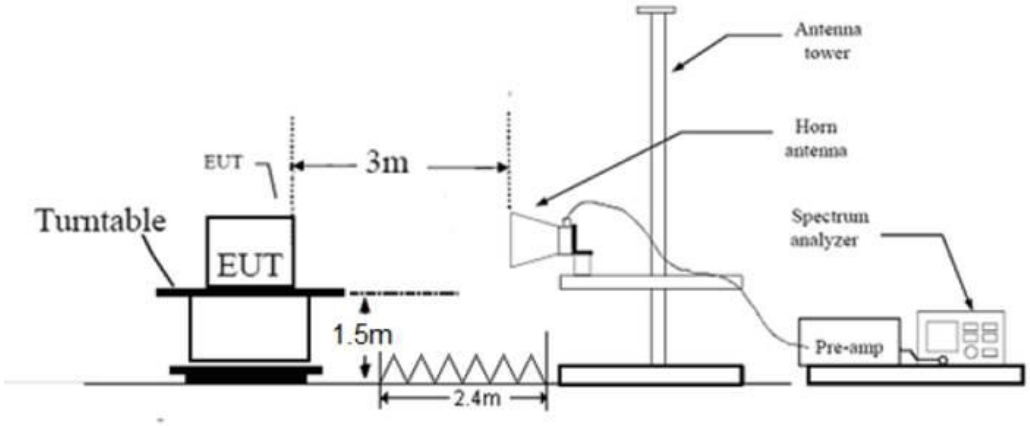


7.2 Radiated test setups

Below 1GHz



Above 1GHz



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8 Technical Requirement

8.1 Conducted Emission

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

*Decreasing linearly with logarithm of the frequency.

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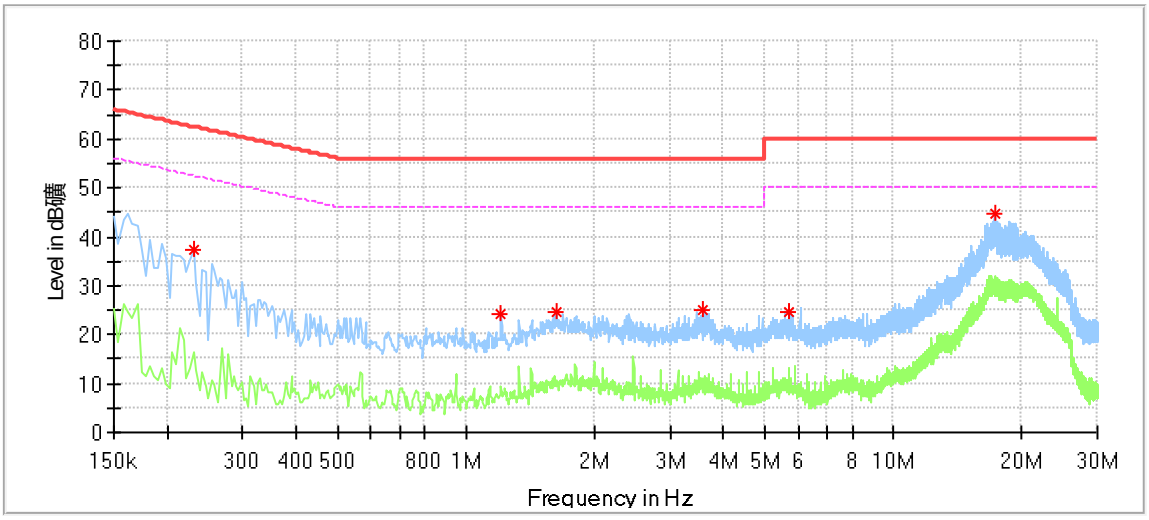
Conducted Emission

Product Type	:	Proximity Sensor
M/N	:	805522
Operating Condition	:	Normal working with transmitting
Test specification	:	Live
Comment	:	AC 120V/60Hz (Powered by an adapter)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.230000	37.21	---	62.45	25.24	L1	9.23
1.210000	24.18	---	56.00	31.82	L1	9.20
1.626000	24.60	---	56.00	31.40	L1	9.22
3.598000	25.02	---	56.00	30.98	L1	9.27
5.686000	24.41	---	60.00	35.59	L1	9.33
17.210000	44.65	---	60.00	15.35	L1	9.41

Remark：
Level=Reading Level + Correction Factor
Correction Factor=Cable Loss + LISN Factor
(The Reading Level is recorded by software which is not shown in the sheet)

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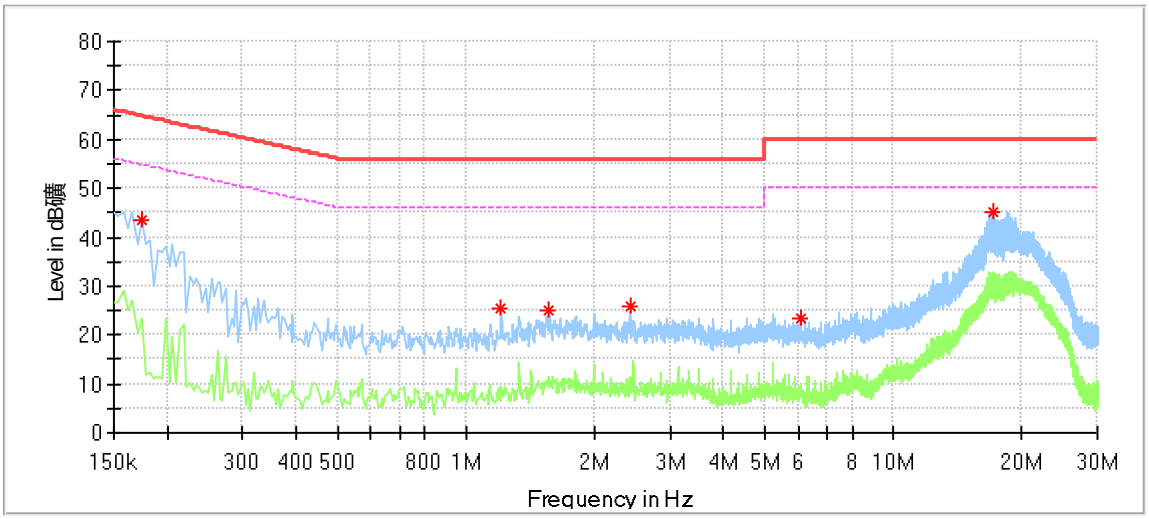
Conducted Emission

Product Type	:	Proximity Sensor
M/N	:	805522
Operating Condition	:	Normal working with transmitting
Test specification	:	Neutral
Comment	:	AC 120V/60Hz (Powered by an adapter)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.174000	43.47	---	64.77	21.29	N	9.40
1.210000	25.43	---	56.00	30.57	N	9.40
1.566000	25.03	---	56.00	30.97	N	9.41
2.418000	26.03	---	56.00	29.97	N	9.43
6.046000	23.31	---	60.00	36.69	N	9.53
17.094000	44.98	---	60.00	15.02	N	9.67

Remark：
Level=Reading Level + Correction Factor
Correction Factor=Cable Loss + LISN Factor
(The Reading Level is recorded by software which is not shown in the sheet)

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8.2 Field strength of emissions and Restricted bands

Test Method

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3-meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3: 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.
4: 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.
5: Use the following spectrum analyzer settings According to C63.10:

For Above 1GHz
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW≥3RBW, Sweep = auto, Detector function = peak and average,
Trace = max hold.

For Below 1GHz
Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 120KHz, VBW≥3RBW, Sweep = auto, Detector function = QP,
Trace = max hold.

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Field strength of emissions and Restricted bands

Limits

According to §15.249 (a) & RSS-210 A2.9(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

According to §15.249 (c)& RSS-210 B.10, Field strength limits are specified at a distance of 3 meters.

According to §15.249 (d)& RSS-210 B.10, Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209& RSS-Gen, whichever is the lesser attenuation.

According to §15.205 and RSS-GEN 8.10 Unwanted emissions falling into restricted bands in §15.205 (a) and RSS-GEN 8.10 Table 7 shall comply with the limits specified in §15.209 and RSS-Gen.

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

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Field strength of emissions and Restricted bands

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

EUT: Proximity Sensor
M/N: 805522
Operating Condition: Tx; 24.15GHz

For Peak Value

Value	Emissions Frequency **MHz**	E-Field Polarity	Correction Factor **dB/m**	PK Emission **dBµV/m**	Limit **dBµV/m**	Margin **dBm**	Emission Type
PK	**833.099375**	H	31.77	39.07	46.00	6.93	Spurious
PK	190.292500	V	18.35	32.50	43.50	11.00	Spurious
PK	5187.000000	H	5.53	49.57	74.00	24.43	Spurious
PK	4315.500000*	V	3.02	48.76	74.00	25.24	Spurious
PK	24091.250000	H	0.58	72.42	128.00	55.58	Fundamental
PK	24058.937500	V	0.61	77.71	128.00	50.29	Fundamental

For AV Value

Value	Emissions Frequency **MHz**	E-Field Polarity	Correction Factor **dB/m**	AV Emission **dBµV/m**	Limit **dBµV/m**	Margin **dBm**	Emission Type
AV	24091.250000	H	0.58	61.47	108.00	46.53	Fundamental
AV	24058.937500	V	0.61	64.32	108.00	43.68	Fundamental
AV	/	H	/	/	54.00	/	Spurious
AV	/	V	/	/	54.00	/	Spurious

Remark:
1: Data of measurement within this frequency range shown "/" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
2: "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
3: PK Emission = Reading Level + Correction Factor
Correction Factor=Antenna Factor + Cable Loss (For Below 1GHz)
Correction Factor = Antenna Factor + Cable Loss- Amplifier Gain (For Above 1GHz)
(The Reading Level is recorded by software which is not shown in the sheet)

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8.3 Out of Band Emissions

Test Method

1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold.
2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
3 The level displayed must comply with the limit specified in this Section.

Limits

According to §15.249(d) & RSS-210 B.10 Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209 and RSS-Gen, whichever is the lesser attenuation.

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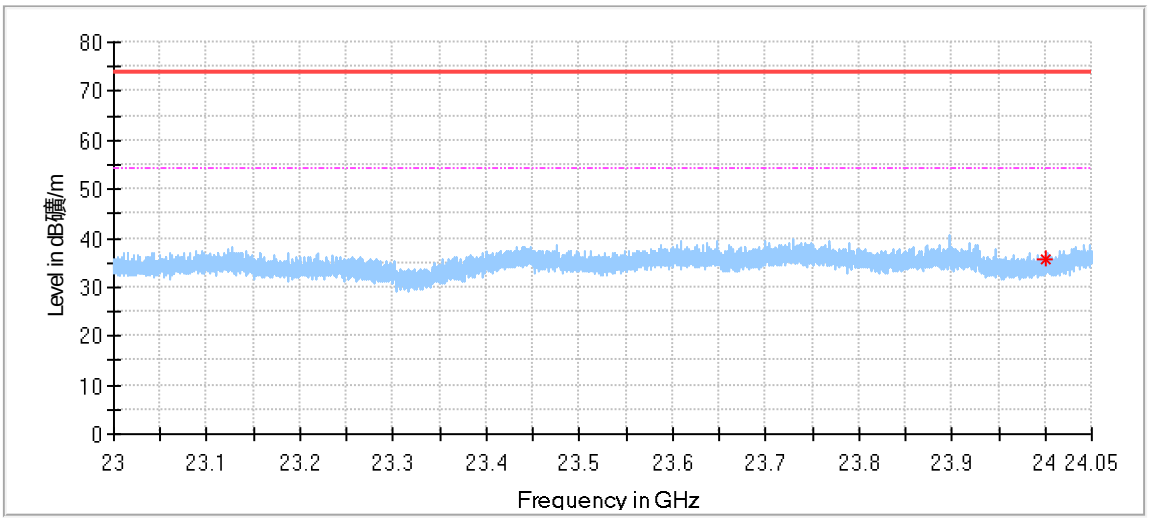
Out of Band Emissions

EUT: Proximity Sensor
M/N: 805522
Operating Condition: Tx; 24.15GHz
Polarization: Horizontal



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
24000.250000	35.83	74.00	38.17	150.0	H	254.0	0.63

Remark：
Level=Reading Level + Correction Factor
Correction Factor=Antenna Factor + Cable Loss – Pre-amplifier
(The Reading Level is recorded by software which is not shown in the sheet)

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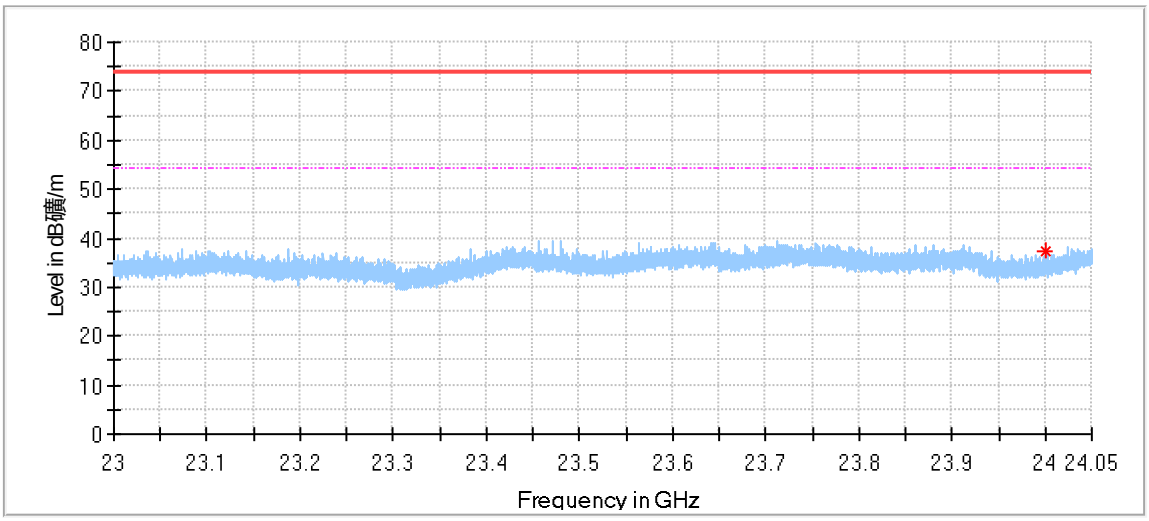
Out of Band Emissions

EUT: Proximity Sensor
M/N: 805522
Operating Condition: Tx; 24.15GHz
Polarization: Vertical



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
24001.062500	37.40	74.00	36.60	150.0	V	295.0	0.63

Remark：
Level=Reading Level + Correction Factor
Correction Factor=Antenna Factor + Cable Loss – Pre-amplifier
(The Reading Level is recorded by software which is not shown in the sheet)

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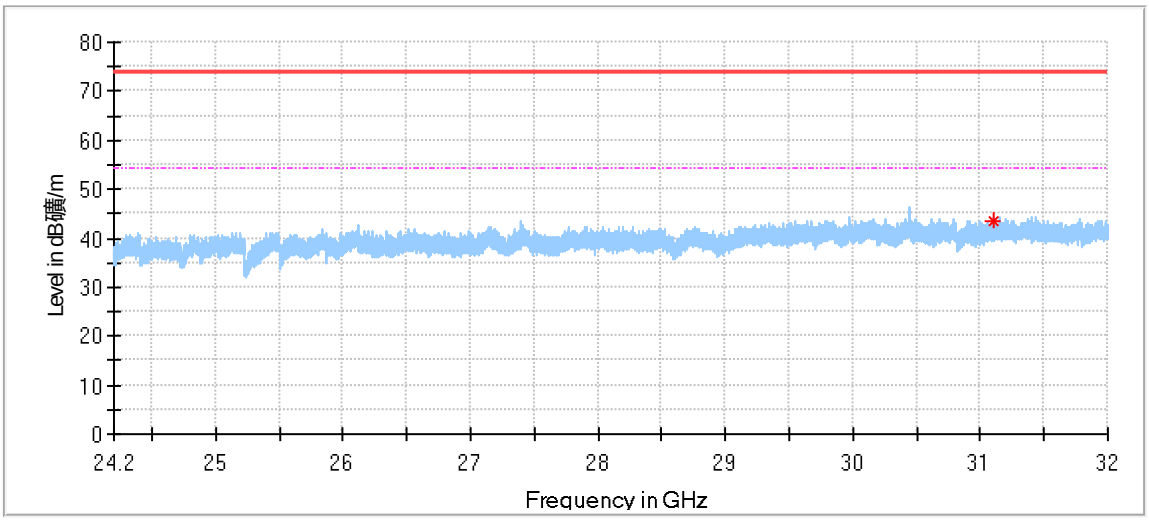
Out of Band Emissions

EUT: Proximity Sensor
M/N: 805522
Operating Condition: Tx; 24.15GHz
Polarization: Horizontal



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
31102.750000	43.38	74.00	30.62	150.0	V	12.0	1.46

Remark：
Level=Reading Level + Correction Factor
Correction Factor=Antenna Factor + Cable Loss – Pre-amplifier
(The Reading Level is recorded by software which is not shown in the sheet)

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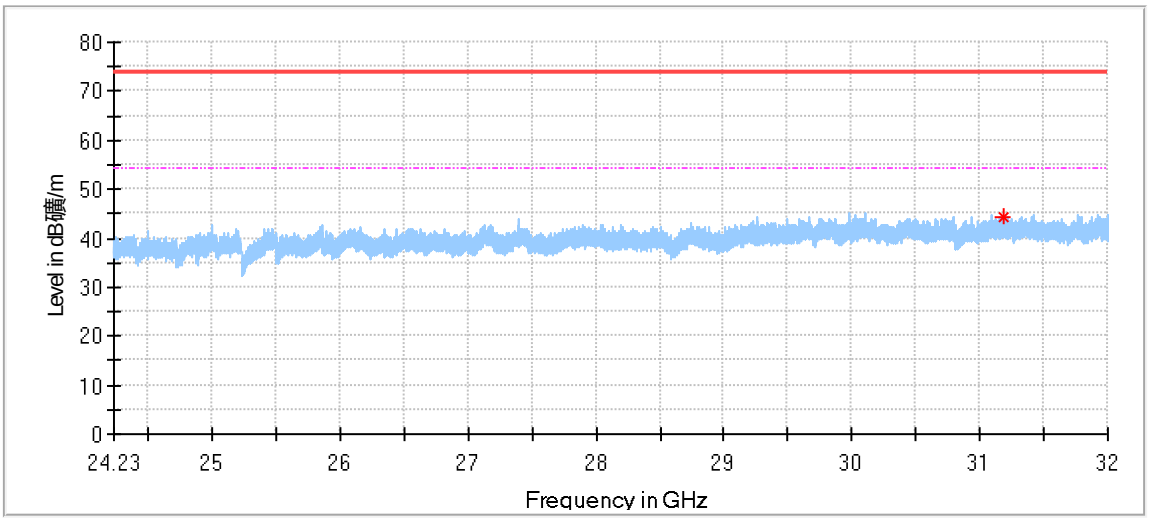
EUT: Proximity Sensor
M/N: 805522
Operating Condition: Tx; 24.15GHz
Polarization: Vertical



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
31186.000000	44.28	74.00	29.72	150.0	H	246.0	1.48

Remark：
Level=Reading Level + Correction Factor
Correction Factor=Antenna Factor + Cable Loss – Pre-amplifier
(The Reading Level is recorded by software which is not shown in the sheet)

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8.4 20dB Bandwidth & 99% Occupied Bandwidth

Test Method

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to spectrum analyser. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.

Limits:

According to 15.215 (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

According to RSS-Gen 6.7 when an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

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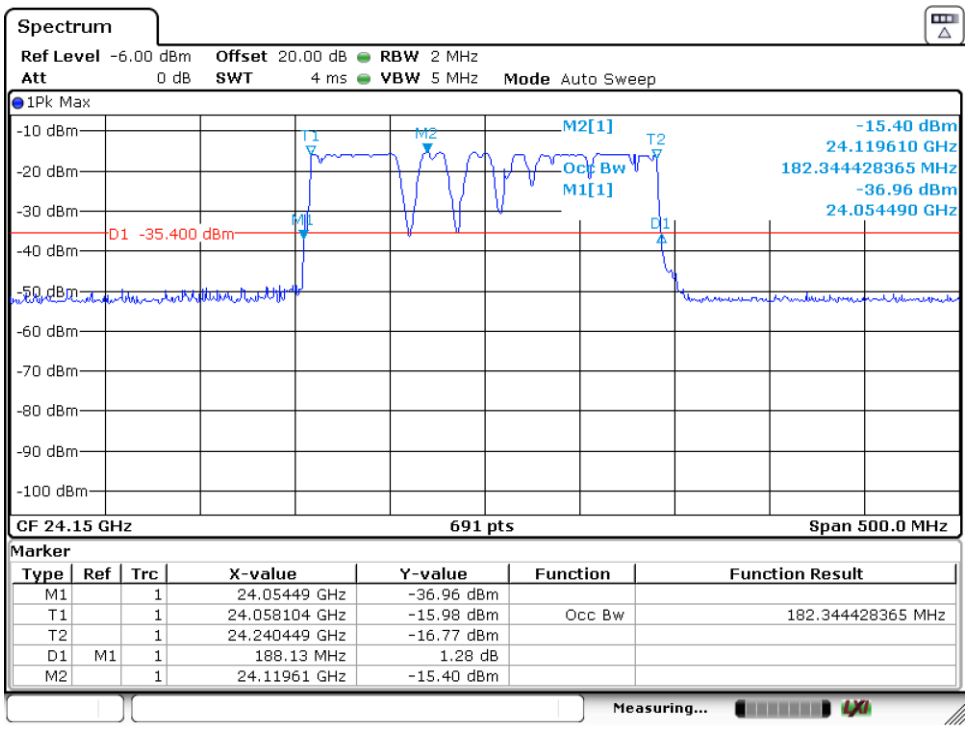
20dB Bandwidth & 99% Occupied Bandwidth

Frequency	20dB Bandwidth	99% Bandwidth	Limit
MHz	MHz	MHz	MHz
2415	188.13	182.34	--



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9 Test equipment lists

Conducted Emission 2# Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde&Schwarz	ESR 3	68-4-74-19-002	102590	1	2022-6-4
LISN	Rohde&Schwarz	ENV216	68-4-87-19-001	102472	1	2022-6-5
Attenuator	Shanghai Huaxiang	TS2-26-3	68-4-81-16-003	080928189	1	2022-6-3
Test software	Rohde&Schwarz	EMC32	68-4-90-19-005-A01	Version10.35.02	N/A	N/A
Shielding Room	TDK	CSR #2	68-4-90-19-005	----	3	2022-11-07

Radiated Emission Test 1# Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde&Schwarz	ESR 7	68-4-74-19-001	102176	1	2022-6-4
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	68-4-80-14-002	707	1	2022-7-23
Pre-amplifier	Rohde&Schwarz	SCU 18	68-4-29-14-001	102230	1	2022-6-6
Attenuator	Mini-circuits	UNAT-6+	68-4-81-21-001	15542	1	2022-8-23
3m Semi-anechoic chamber	TDK	SAC-3 #1	68-4-90-14-001	----	2	2023-5-28
Test software	Rohde&Schwarz	EMC32	68-4-90-14-001-A10	Version10.35.02	N/A	N/A

Radiated Emission 2# Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde&Schwarz	ESR 26	68-4-74-14-002	101269	1	2022-6-4
Wave Guide Antenna	ETS	3117	68-4-80-19-001	00218954	1	2022-5-24
Pre-amplifier	Rohde&Schwarz	SCU 18F	68-4-29-19-001	100745	1	2022-10-10
Pre-amplifier	Rohde&Schwarz	SCU 18F	68-4-29-19-002	100746	1	2022-10-10
Sideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	12827	1	2022-7-21
Pre-amplifier	Rohde&Schwarz	SCU 40A	68-4-29-14-002	100432	1	2022-7-27
Attenuator	Mini-circuits	UNAT-6+	68-4-81-21-002	15542	1	2022-8-23
3m Semi-anechoic chamber	TDK	SAC-3 #2	68-4-90-19-006	----	2	2023-5-28
Test software	Rohde&Schwarz	EMC32	68-4-90-19-006-A01	Version10.35.02	N/A	N/A

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10 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Conducted Emission 150kHz-30MHz (for test using AMN ENV432 or ENV4200)	3.64dB
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 4.63dB; Vertical: 4.61dB;
Uncertainty for Radiated Spurious Emission 1000MHz-3000MHz	Horizontal: 4.81dB; Vertical: 4.89dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.65dB; Vertical: 4.63dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 4.51dB; Vertical: 4.50dB;

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