

Prüfbericht-Nr.: <i>Test report no.:</i>	CN21KVOZ 001	Auftrags-Nr.: <i>Order no.:</i>	168341166	Seite 1 von 16 <i>Page 1 of 16</i>
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2021-12-05	
Auftraggeber: <i>Client:</i>	WHST CO., LTD. Factory 1, Wanchun High-tech Innovation Park, East District of Economic & Technological Development Zone, Wuhu, Anhui, China			
Prüfgegenstand: <i>Test item:</i>	High Resolution Long Range Radar			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	STA77-5			
Auftrags-Inhalt: <i>Order content:</i>	Test Report			
Prüfgrundlage: <i>Test specification:</i>	FCC CFR Title 47, Part 95, Subpart M KDB 653005 D01 76-81 GHz Radars v01r01 FCC CFR Title 47, Part 2, Subpart J, Section 2.1091			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2021-11-01	Please refer to Photo Document		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003156258-015			
Prüfzeitraum: <i>Testing period:</i>	2021-12-30 – 2022-01-02			
Ort der Prüfung: <i>Place of testing:</i>	TÜV Rheinland Taiwan Ltd.			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>	genehmigt von: <i>authorized by:</i>			
Datum: <i>Date:</i>	2021-01-12		2021-01-12	
Stellung / Position:	Senior Project Manager	Stellung / Position:	Reviewer	
Sonstiges / Other:	FCC ID: 2A3Y9STA775002A			
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	4 = ausreichend N/A = nicht anwendbar
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory F(ail) = failed a.m. test specification(s)	4 = sufficient N/A = not applicable
5 = mangelhaft N/T = nicht getestet				
5 = poor 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. <i>This test report only relates to the a. m. 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.</i>				

Test Summary

5.1.1 OCCUPIED BANDWIDTH

RESULT: Pass

5.1.2 RADIATED E.I.R.P. POWER

RESULT: Pass

5.1.3 UNWANTED EMISSIONS

RESULT: Pass

5.1.4 FREQUENCY STABILITY

RESULT: Pass

6.1.1 ELECTROMAGNETIC FIELDS

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 Taiwan Ltd.

No. 458-19, Sec. 2, Fenliao Rd., Linkou District, New Taipei City, Taiwan

FCC Designation number: TW1135

2.2 List of Test and Measurement Instruments

Table 1 List of Test and Measurement Equipment

Conducted				
Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
Spectrum Analyzer	R&S	FSV40	101512	2022-1-28
Spectrum Analyzer	Agilent	N9010A	MY53470241	2022-3-3
Thermal Chamber	Giant Force	GHT-150-40-CP-SD	MAA1902-010	2022-3-3
Output Power				
Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
Power Meter	Anritsu	ML2495A	1901008	2022-3-23
Power Sensor	Anritsu	MA2411B	1725269	2022-3-23
Radiated Emission				
Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
SA	R&S	FSV40	101507	2022-4-12
Trilog Antenna	SCHWARZBECK	VULB-9162	247	2022-3-31
Horn Antenna	ETS-Lindgren	3117	00218929	2022-11-24
Horn Antenna	SCHWARZBECK	BBHA 9170	00896	2022-3-31
AMP	R&S	SCU08F1	08320042	2022-5-13
AMP	R&S	SCU-18F	180114	2022-5-13
AMP	R&S	SCU40A	100498	2022-5-13
Microwave Cable	Timesmicrowave	HF-290	W11.01	2022-6-16
Microwave Cable	Timesmicrowave	HF-290	W11.02	2022-6-16
Microwave Cable	Timesmicrowave	HF-290	W12.01	2022-6-16
Microwave Cable	Timesmicrowave	HF-290	W12.02	2022-6-16
JUNFLON Cable	JUNFLON	MWX221	1812S527	2022-6-16
Signal Generator	Keysight	PSG E8257D	MY46521798	2024-9-2
Coincal Horn Antenna	VDI	WR15CH	1-15	2024-4-11
Coincal Horn Antenna	VDI	WR12CH	RCH012RL	2024-4-14
Coincal Horn Antenna	VDI	WR10CH	1-10	2024-2-19
Coincal Horn Antenna	VDI	WR8.0CH	1-8.0	2024-4-7
Coincal Horn Antenna	VDI	WR5.1CH	1-5.1	2024-4-7
Coincal Horn Antenna	VDI	WR3.4DH	1-40	2024-2-18
Mixer SG	VDI	E8257DV15	SGX 068	2022-6-30
Mixer SG	VDI	E8257DV10	SGX 070	2022-6-30

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Mixer SA	VDI	N9029AV15	SAX 039	2022-6-30
Mixer SA	VDI	N9029AV12	SAX 243	2022-6-30
Mixer SA	VDI	N9029AV10	SAX 047	2022-6-30
Mixer SA	VDI	N9029AV08	SAX 045	2022-6-30
Mixer SA	VDI	N9029AV05	SAX 044	2022-6-30
Mixer SA	VDI	N9029AV03	SAX 295	2022-6-30
Harmonic Mixer	Keysight	M1971W	MY56390137	2022-6-30
Harmonic Mixer	Keysight	M19HWDX	160118-1	2023-12-8
Signal Analyzer	Agilent	N9010A	MY52221334	2024-3-3

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

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements as below table.

Parameter	Uncertainty
Radio frequency	$\pm 1 \times 10^{-7}$
Radiated RF power (up to 40 GHz)	± 1.38 dB
Radiated RF power (above 40 GHz up to 75 GHz)	± 2.86 dB
Radiated RF power (above 75 GHz up to 110 GHz)	± 1.72 dB
Radiated RF power (above 110 GHz up to 140 GHz)	± 1.84 dB
Radiated RF power (above 140 GHz up to 220 GHz)	± 2.41 dB
Temperature	± 1 °C
Humidity	± 5 %

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.

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2.7 Status of Facility Used for Testing

The TÜV Rheinland Taiwan Ltd. Test facility located at No. 458-19, Sec. 2, Fenliao Rd., Linkou District, New Taipei City, Taiwan 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 a High Resolution Long Range Radar use in the vehicle, which that operation frequency range is 76GHz to 77GHz.

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

3.2 Ratings and System Details

Table 2: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment:	High Resolution Long Range Radar
Type Designation:	STA77-5
FCC ID:	2A3Y9STA775002A
Operating Voltage:	9Vdc to 16Vdc (battery operated)
Testing Voltage:	12Vdc
Technical Specification of EUT	Value
Assigned Band:	76GHz to 77GHz
Operation Frequency Range:	76GHz to 77GHz
Operating Temperature Range:	-40 °C ~ 85 °C
Type of Modulation:	FMCW
Antenna Type:	Array patch antenna
Antenna Gain:	TX: 20.8(Narrow) / 17.8(wide) dBi; RX:17.8dBi

3.3 Independent Operation Modes

The basic operation modes are:

- A. Tx mode
- B. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- Application Form
- Rating Label
- Block Diagram
- Operation Description

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 C63.26: 2015 & ANSI C63.10: 2020.

4.3 Special Accessories and Auxiliary Equipment

Table 3: Auxiliary Equipment Used during Test

Description	Brand	Model	S/N	Remark
DC Power Supply	GWINSTEK	GPS-3303	GEU915613	Provided by Lab
Notebook	Lenovo	20150	CB21920765	Provided by Lab
CAN-bus Professional tools	N/A	CANalyst-II	N/A	Provided by Applicant

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 30MHz)

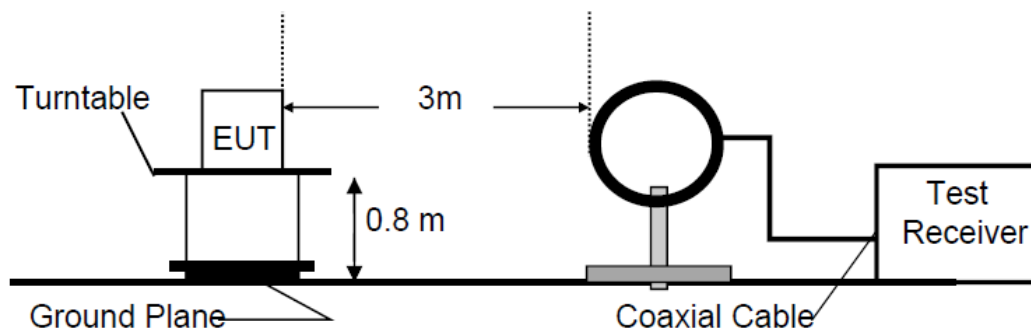


Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

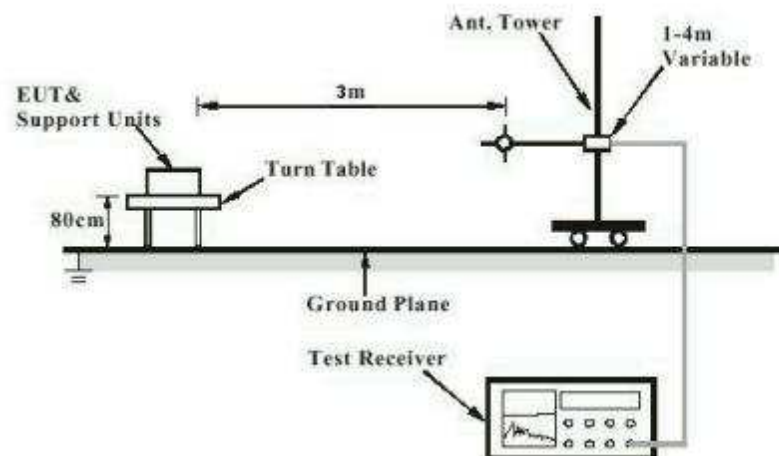
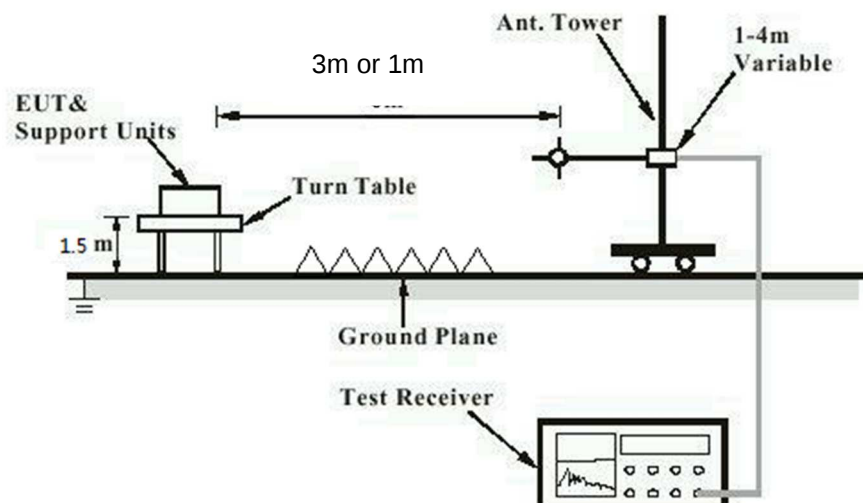


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Occupied Bandwidth

RESULT:

Pass

Test Specification

Test standard	: FCC Part 2.1049
	: FCC Part 95.3379 (b)
Basic standard	: ANSI C63.26: 2015, Clause 5.4
Limits	: Within assigned band (76GHz to 81GHz)
Kind of test site	: 3m Full-anechoic Chamber

Test Setup

Date of testing	: 2021-12-30
Input voltage	: 12Vdc
Operation mode	: A
Ambient temperature	: 24.5~26.5 °C
Relative humidity	: 50~53 %
Atmospheric pressure	: 100~103 kPa

For the measurement records, refer to the appendix B.

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5.1.2 Radiated E.I.R.P. Power**RESULT:****Pass****Test Specification**

Test standard	: FCC Part 95.3367
Basic standard	: ANSI C63.26: 2015, Clause 5.2 : ANSI C63.10: 2020, Clause 9
Limits	: FCC Part 95.3367 (a), Average E.I.R.P. ≤50dBm/MHz : FCC Part 95.3367 (b), Peak E.I.R.P. ≤55dBm/MHz
Kind of test site	: 3m Full-anechoic Chamber

Test Setup

Date of testing	: 2021-12-30
Input voltage	: 12Vdc
Operation mode	: A
Ambient temperature	: 24.5~26.5 °C
Relative humidity	: 50~53 %
Atmospheric pressure	: 100~103 kPa

For the measurement records, refer to the appendix B.

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5.1.3 Unwanted emissions

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 95.3379
Basic standard	: ANSI C63.26: 2015, Clause 5.5 FCC Part 95.3379 (a)(1)
Limits	: FCC Part 95.3379 (a)(2) FCC Part 95.3379 (a)(3)
Kind of test site	: 3m Semi-anechoic Chamber & 3m Full-anechoic Chamber

Test Setup

Date of testing	: 2021-12-30 to 2022-01-02
Input voltage	: 12Vdc
Operation mode	: A
Ambient temperature	: 24.5~26.5 °C
Relative humidity	: 50~53 %
Atmospheric pressure	: 100~103 kPa

For the measurement records, refer to the appendix B.

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5.1.4 Frequency stability

RESULT:

Pass

Test Specification

Test standard	: FCC Part 95.3379 (b)
Basic standard	: ANSI C63.26: 2015, Clause 5.6
Limits	: Within assigned band (76GHz to 81GHz)
Kind of test site	: Temperature and Humidity Chamber

Test Setup

Date of testing	: 2022-01-02
Input voltage	: 12Vdc
Operation mode	: A
Ambient temperature	: 20.1 °C
Relative humidity	: 71 %
Atmospheric pressure	: 100~103 kPa

For the measurement records, refer to the appendix B.

6 Safety Human Exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:
Pass
Test Specification

Test standard : FCC CFR Title 47, Part 2, Subpart J, Section 2.1091
 Test limits : FCC CFR Title 47, Part 1, Subpart I, Section 1.1310

Limits for General Population/Uncontrolled Exposure

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

This device is mobile device, and the applicant declares that the minimum separation distance is greater than 20cm, detail minimum distance refer to below calculation table. Therefore MPE measurement or computational modeling should be used to determine compliance.

MPE Calculation is based on the conducted power, and considering maximum power and antenna gain. The following formula is used to MPE evaluation.

The power density according to far-field model is:

$$S = \frac{P \times G_{(\theta, \phi)}}{4 \times \pi \times R^2}$$

Where:

P = input power of the antenna.
 G = antenna gain relative to an isotropic antenna.
 θ, ϕ = elevation and azimuth angles.
 R = distance from the antenna to the point of investigation.

Test Result:

Operation Frequency (GHz)	Maximum EIRP (dBm)	Maximum EIRP (mW)	Min. Distance (cm)	Calculation (mW/cm ²)	Limit (mW/cm ²)	Result
76.23	31.27	1339.68	20	0.267	1	PASS

7 Photographs of the Test Set-Up

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

8 List of Tables

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