

Prüfbericht-Nr.: <i>Test report no.:</i>	CN21MGFY 005	Auftrags-Nr.: <i>Order no.:</i>	168384804	Seite 1 von 21 <i>Page 1 of 21</i>
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2022-07-01	
Auftraggeber: <i>Client:</i>	Mavenir Systems, Inc. 1700 International Pkwy #200, Richardson, TX 75081, USA			
Prüfgegenstand: <i>Test item:</i>	Active Antenna Unit			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	MA64WA			
Auftrags-Inhalt: <i>Order content:</i>	Type test			
Prüfgrundlage: <i>Test specification:</i>	FCC 47 CFR Part 27			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2022-07-03	N/A		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003168776-004 A003172245-001			
Prüfzeitraum: <i>Testing period:</i>	2021-11-26 – 2021-12-17 2022-07-05 – 2022-08-05			
Ort der Prüfung: <i>Place of testing:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>	 Andy Yan	genehmigt von: <i>authorized by:</i>	 Hardy Suo	
Datum: <i>Date:</i>	2022-09-02	Ausstellungsdatum: <i>Issue date:</i>	2022-09-02	
Stellung / Position	Project Manager	Stellung / Position	Reviewer	
Sonstiges / Other: This report is based on original test report CN21MGFY 002 to add SCS 60KHz through software and minor changes of non-radio portion. Please refer to clause 3.1 for detail information.				
FCC ID: 2AWAS-901-00002				
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 N/A = nicht anwendbar	4 = ausreichend N/T = nicht getestet
Legend:	1 = very good P(ass) = passed a.m. test specifications(s)	2 = good F(ail) = failed a.m. test specifications(s)	3 = satisfactory N/A = not applicable	4 = sufficient 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. RF POWER OUTPUT (POWER DENSITY)

RESULT: Pass

5.1.2. PEAK TO AVERAGE RATIO

RESULT: Pass

5.1.3. MODULATION CHARACTERISTICS

RESULT: Pass

5.1.4. OCCUPIED BANDWIDTH AND 26DB BANDWIDTH

RESULT: Pass

5.1.5. SPURIOUS EMISSIONS AT ANTENNA TERMINALS

RESULT: Pass

5.1.6. SPURIOUS EMISSIONS AT ANTENNA TERMINALS – BAND EDGE

RESULT: Pass

5.1.7. FIELD STRENGTH OF SPURIOUS RADIATION

RESULT: Pass

5.1.8. FREQUENCY STABILITY

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: Test Results of Antenna Conducted Items.

Appendix B: Test Results of Field Strength of Spurious Radiation

Appendix C: Photographs of the Test Set-Up

1.2.TEST STANDARD(S)

Applied Rules:	FCC 47 CFR Part 2 FCC 47 CFR Part 27
Test Method:	KDB 971168 D01 ANSI C63.26-2015 KDB Publication No. 971168 D01 KDB Publication No. 662911 D01

2. TEST SITES

2.1. TEST FACILITIES

TÜV Rheinland (Shenzhen) Co., Ltd.

(FCC Registration No.: 694916 & IC Registration Number: 25069)

Address: No. 362 Huanguan Road Middle, Longhua District, Shenzhen 518110, P.R. China

2.2. TEST DATE

Date of test: 2021-12-06 to 2021-12-13 and 2022-07-05 to 2022-08-05

2.3. LIST OF TEST AND MEASUREMENT INSTRUMENTS

Table 1: List of Test and Measurement Equipment

Description	Manufacturer	Model	Serial No.	Calibrated until (DD.MM.YYYY)
Radio Spectrum Testing				
Spectrum Analyzer	Keysight	N9020B	MY60112195	14.11.2022
Spectrum Analyzer	Keysight	N9020B	MY60240665	24.05.2023
Power Supply (DC)	ITECH	IT6742	8007600117675 10051	12.10.2022
Temperature/ Humidity Clock	--	HTC-2	GC-SZ-007197	07.12.2022
Temp.&Humidity Chamber	TEMAK	CDM-E-S042	T2368	05.08.2022
Field Strength of Spurious Radiation				
Signal Generator	R&S	SMB100A	180840	09.08.2022
Wideband Radio Communication Tester	R&S	CMW500	165339	09.08.2022
Signal Analyzer	R&S	FSV 40	101440	09.08.2022
System Controller Interface	R&S	SCI-100	S10010036	N/A
Filterbank	R&S	GSM	100811	09.08.2022
OSP	R&S	OSP 120	102041	N/A
OSP	R&S	OSP 150	101385	02.12.2022
Pre-amplifier	R&S	SCU08F1	08320030	09.08.2022
Amplifier	R&S	SCU-18F	180079	09.08.2022
Amplifier	R&S	SCU40A	100450	09.08.2022

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Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	192	08.08.2022
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218719	08.08.2022
Wideband Ridged Horn Antenna (12-18 GHz)	Steatite	QMS-00208	18312	08.08.2022
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19066	08.08.2022
Biconical Broadband Antenna (30 MHz - 1 GHz)	Schwarzbeck	VUBA 9117	357	02.08.2024
Double Ridged Broadband Horn Antenna (1 – 18 GHz)	Schwarzbeck	BBHA 9120 D	01760	30.07.2024
Broadband Horn Antenna (15 – 40 GHz)	Schwarzbeck	BBHA 9170	00862	02.08.2024
Test software	R&S	EMC32 (V10.50.40)	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NW9P2	N/A
3m Fully Anechoic Chamber	Albatross	FAC-3m	APC17151-FAC	22.06.2024

2.4.Traceability

All measurement equipment calibrations are traceable to NIST or where calibration is performed outside the United States, to equivalent nationally recognized standards organizations.

2.5.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.

2.6.Location of Original Data

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

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2.7. Status of Facility Used for Testing

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

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3. GENERAL PRODUCT INFORMATION

3.1. GENERAL DESCRIPTION

The EUT is a 5G New Radio Active Antenna Unit operating in 3700-3980.

The difference between model MA64WA and registration is show in the below table:

Model	MA64WA (Original)	MA64WA (Variant)
Frequency	Only support SCS 30KHz	Support SCS 30KHz and 60KHz by software update
Hardware	SFP Port: 4 LED: 5 FPGA voltage change Others are same	SFP Port: 3 LED: 3 FPGA voltage change Others are same
Hardware version	R1C	R1F
Software version	6.2.1	6.6.7
Declaration Operating Voltage:	-44 ~ -58.5Vdc	-38.5 ~ -57.5Vdc

Note1: With the consideration of identities and differences listed above, all items were full retested for SCS 60KHz and partial items were retested for SCS 30KHz such as Power, field strength of radiation etc., refer to Appendix A and Appendix B for retest data.

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

3.2. SYSTEM DETAILS

Table 2: General Information of EUT

General Information of EUT	Description
Kind of Equipment:	Active Antenna Unit
Type Designation:	MA64WA
FCC ID:	2AWAS-901-00002
Operating Voltage:	-38.5 ~ -57.5Vdc

Table 3: Technical Specification of EUT

Characteristic	Description			
Operated Modes:	New Radio			
Operational Frequency Band(s):	3700-3980MHz			
RF Output Power (Conducted):	No. of Carriers	BW[MHz]	Power Level Per CH Per Carrier [dBm]	Total output power [W]
	1CC	20	27.96	40
		40	30.97	80
		60	32.73	120
		80	33.98	160
		100	34.95	200

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	2CC	20+20	27.96	80
		40+40	30.97	160
		60+60	32.73	240
		80+80	33.16	265
		100+100	33.16	265
Modulation Type:	QPSK, 16QAM, 64QAM, 256QAM			
Antenna Gain:	24.8 dBi			
Extreme Voltage:	DC -44V ~ -58.5V			
Extreme Temperature:	-40 ~ +55 °C			

Table 4: Operating Frequency Range and Channel Bandwidth of EUT

Frequency Band(s)	Frequency Range	
	Transmitting f _{UL} (MHz)	Receiving f _{DL} (MHz)
N77	3700 ~ 3980	3700 ~ 3980

3.3.INDEPENDENT OPERATION MODES

The basic operation modes are:

- A. EUT transmits a modulated signal with the highest power and the highest duty cycle.

QPSK (NR-FR1-TM1.1)
16QAM (NR-FR1-TM3.2)
64QAM (NR-FR1-TM3.1)
256QAM (NR-FR1-TM3.1a)

3.4.NOISE GENERATING AND NOISE SUPPRESSING PARTS

Refer to the Circuit Diagram.

3.5.SUBMITTED DOCUMENTS

- | | |
|---|--|
| ☒ User Manual | ☒ Rating Label |
| ☒ Circuit Diagram | ☒ PCB Layout |
| ☒ Block Diagram | ☒ Photo Document |
| ☒ Schematics | ☒ Parts List |

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.

4.2.Test Operation and Test Software

Test operation refers to test setup in chapter 5. All testing were performed according to the procedure in KDB 971168 D01 and ANSI C63.26.

Table 5: List of Frequencies under Test

Conf. No.	Total output power [W]	Power Level Per CH Per Carrier [dBm]	No. of Carriers	Carrier. BW [MHz]	SCS [KHz]	Carrier Center Freq. [MHz]		
						Bottom	Middle	Top
1	40	27.96	1	20	30/60	3710	3840	3970
2	80	30.97	1	40	30/60	3720	3840	3960
3	120	32.73	1	60	30/60	3730	3840	3950
4	160	33.98	1	80	30/60	3740	3840	3940
5	200	34.95	1	100	30/60	3750	3840	3930
6	80	27.96	2	20	30/60	3710 + 3730	3710 + 3970 (No-continuous)	3950 + 3970
7	160	30.97	2	40	30/60	3720 + 3760	3720 + 3960 (No-continuous)	3920 + 3960
8	240	32.73	2	60	30/60	3730 + 3790	3730 + 3950 (No-continuous)	3890 + 3950
9	265	33.16	2	80	30/60	3740 + 3820	3740 + 3940 (No-continuous)	3860 + 3940
10	265	33.16	2	100	30/60	3750 + 3850	3750 + 3930 (No-continuous)	3830 + 3930
11	80	27.96	2	20	30/60	3710 + 3730	3830 + 3850	3950 + 3970
12	160	30.97	2	40	30/60	3720 + 3760	3820 + 3860	3920 + 3960

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13	240	32.73	2	60	30/60	3730 + 3790	3810 + 3870	3890 + 3950
14	265	33.16	2	80	30/60	3740 + 3820	3800 + 3880	3860 + 3940
15	265	33.16	2	100	30/60	3750 + 3850	3790 + 3890	3830 + 3930

Table 6: Test Environments

Environment Parameter	Selected Values During Tests		
	Temperature (°C)	Voltage (V) dc	Relative Humidity (%)
Normal (NTNV)	24	-48	51%
HTHV	55 °C	-57.5	---
LTHV	-40 °C	-57.5	---
HTLV	55 °C	-38.5	---
LTLV	-40 °C	-38.5	---

Variant: Voltage range update to -38.5 ~ -57.5Vdc from -44 ~ -58.5Vdc

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4.3.Special Accessories and Auxiliary Equipment

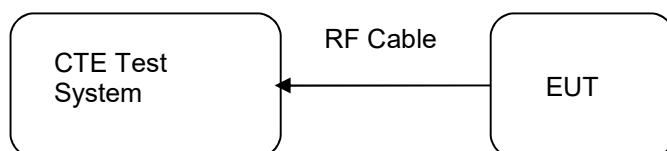
Refer to Appendix Part 1

4.4.Countermeasures to achieve EMC Compliance

The test sample, which has been tested, contained the noise suppression parts as described in the Constructional Data Form or the Technical Construction File. No additional measures were employed to achieve compliance.

4.5.Test Setup Diagram

Diagram of Measurement Equipment Configuration for Transmitter Conducted Measurement



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5. TEST RESULTS

5.1. ESSENTIAL REQUIREMENTS

5.1.1. RF POWER OUTPUT (POWER DENSITY)

RESULT:

Pass

Test standard	:	FCC CFR 47 Part 27.50 (j)
Limits	:	Operating band FCC Limit 3700-3980MHz EIRP 1640 Watts/MHz
Test procedure	:	Clause 5.2.4 of ANSI C63.26
Kind of test site	:	Shielding Room

TEST SETUP

Date of testing	:	2021-12-06 – 2021.12-08 2022-07-05 – 2022-08-05
Input voltage	:	DC -48V
Test environment	:	☒ Normal test conditions ☐ Extreme test conditions
Operation mode	:	A
Ambient temperature	:	24 °C
Relative humidity	:	51%
Atmospheric pressure	:	101.0 kPa

$$\text{EIRP} = P_{\text{Meas}} + G_T$$

where

EIRP: equivalent isotropically radiated power, respectively (expressed in the same units as P_{Meas} , e.g. dBm)

P_{Meas} : measured transmitter output power, in dBm

G_T : gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

Refer to attached Appendix A for details of test results.

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5.1.2. PEAK TO AVERAGE RATIO

RESULT:

Pass

Test standard	:	FCC CFR 47 Part 27.50 (j), Part 2.1046 The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB
Test procedure	:	Clause 5.2.6 of ANSI C63.26
Kind of test site	:	Shielding Room

TEST SETUP

Date of testing	:	2021-11-24 – 2021.11-28 2022-07-05 – 2022-08-05
Input voltage	:	DC -48V
Test environment	:	☒ Normal test conditions ☐ Extreme test conditions
Operation mode	:	A
Ambient temperature	:	24 °C
Relative humidity	:	51%
Atmospheric pressure	:	101.0 kPa

Refer to attached Appendix A for details of test results.

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5.1.3. MODULATION CHARACTERISTICS

RESULT:

Pass

Test standard	:	FCC CFR 47 FCC 2.1047(d)
Test Requirement	:	A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.
Test procedure	:	Clause 5.3 of ANSI C63.26
Kind of test site	:	Shielding Room

TEST SETUP

Date of testing	:	2021-12-08 – 2021.12-09
Input voltage	:	DC -48V
Test environment	:	☒ Normal test conditions ☐ Extreme test conditions
Operation mode	:	A
Ambient temperature	:	24 °C
Relative humidity	:	51%
Atmospheric pressure	:	101.0 kPa

Refer to attached Appendix A for details of test results.

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5.1.4.OCCUPIED BANDWIDTH AND 26DB BANDWIDTH

RESULT:

Pass

Test standard	:	FCC CFR 47 Part 27.53, Part 2.1049
Test requirement	:	The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable: Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.
Test procedure	:	Section 5.4.4 of ANSI C63.26 ☒ Conducted measurements ☐ Radiated measurements
Kind of test site	:	Shielding Room

TEST SETUP

Date of testing	:	2021-12-09 – 2021.12-10 2022-07-05 – 2022-08-05
Input voltage	:	DC -48V
Test environment	:	☒ Normal test conditions ☐ Extreme test conditions
Operation mode	:	A
Ambient temperature	:	25 °C
Relative humidity	:	50%
Atmospheric pressure	:	101.0 kPa

Refer to attached Appendix A for details of test results.

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5.1.5.SPURIOUS EMISSIONS AT ANTENNA TERMINALS

RESULT:

Pass

Test standard	:	FCC CFR 47 Part 27.53(l), Part 2.1051 -13 dBm/MHz
Test procedure	:	Clause 5.7.4 of ANSI C63.26
Kind of test site	:	Shielding Room

TEST SETUP

Date of testing	:	2021-12-10 – 2021.12-11 2022-07-05 – 2022-08-05
Input voltage	:	DC -48V
Test environment	:	☒ Normal test conditions ☐ Extreme test conditions
Operation mode	:	A
Ambient temperature	:	25 °C
Relative humidity	:	51%
Atmospheric pressure	:	101.0 kPa

The limit calculation:

Limit = $P_{\text{Meas}} \text{ (dBm)} - [43 + 10\log(P_{\text{Meas}})] = -13 \text{ dBm}$

Note:

Since the EUT has 64 TX ports, the emission limit for one TX port is -31dBm/MHz (-13dBm/MHz divided by 64).

The test is done on TX port 24, which with the highest output power density.

The EUT has 16 identical PCB boards.

Refer to attached Appendix A for details of test results.

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5.1.6.SPURIOUS EMISSIONS AT ANTENNA TERMINALS – BAND EDGE

RESULT:

Pass

Test standard	:	FCC CFR 47 Part 27.53(l), Part 2.1051
Limits	:	< - 13 dBm / 1% Emission BWs
Test procedure	:	Clause 5.7.3 of ANSI C63.26
Kind of test site	:	Shielding Room

TEST SETUP

Date of testing	:	2021-12-11 – 2021.12-12 2022-07-05 – 2022-08-05
Input voltage	:	DC -48 V
Test environment	:	☒ Normal test conditions ☐ Extreme test conditions
Operation mode	:	A.1
Ambient temperature	:	25 °C
Relative humidity	:	51%
Atmospheric pressure	:	101.0 kPa

The limit calculation:

Limit = P_{Meas} (dBm) – [43+10log(P_{Meas})] = -13 dBm

Refer to attached Appendix A for details of test results.

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5.1.7.FIELD STRENGTH OF SPURIOUS RADIATION

RESULT:

Pass

Test standard	:	FCC CFR 47 Part 27.53, Part 2.1053
Limits	:	< - 13 dBm /1MHz
Test procedure	:	Clause 5.5 of ANSI C63.26
Kind of test site	:	3m Semi Anechoic Room

TEST SETUP

Date of testing	:	2021-11-26 – 2021.11-27 2022-07-05 – 2022-08-05
Input voltage	:	DC -48 V
Test environment	:	☒ Normal test conditions ☐ Extreme test conditions
Operation mode	:	A.1, B
Ambient temperature	:	25 °C
Relative humidity	:	48%
Atmospheric pressure	:	101.0 kPa

The limit calculation:

Limit = P_{Meas} (dBm) – [43+10log(P_{Meas})] = -13 dBm

Sweep the whole frequency band through the range from 9 kHz to the 10th harmonic of the carrier, the emissions below the noise floor will not be recorded in this report. The measurement is performed for all operational modes, only the data of the worst mode is recorded in this report.

Refer to attached Appendix B for details of test results.

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5.1.8.FREQUENCY STABILITY

RESULT:

Pass

Test standard	:	FCC CFR 47 Part 27.54, Part 2.1055
	:	The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.
Test procedure	:	Clause 5.6.3 of ANSI C63.26
Kind of test site	:	Shielding Room

TEST SETUP

Date of testing	:	2021-12-12 – 2021.12-13 2022-07-05 – 2022-08-05
Input voltage	:	See Appendix A
Test environment	:	☒ Normal test conditions ☒ Extreme test conditions
Operation mode	:	A.1
Ambient temperature	:	See Appendix A
Relative humidity	:	See Appendix A
Atmospheric pressure	:	See Appendix A

Refer to attached Appendix A for details of test results.

6. SYSTEM MEASUREMENT UNCERTAINTY

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

Table 7: System Measurement Uncertainty

Measurement Type	Frequency	Expanded uncertainty (U_{lab})
Antenna Port Conducted Emission	9KHz-40GHz	± 1.5 dB
Radiated Emission (3m SAC)	Level accuracy (30MHz to 1000MHz)	± 4.52 dB
	Level accuracy (above 1000MHz)	± 4.37 dB

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