

FCC TEST REPORT

FCC ID: SY4-A02028

On Behalf of

Shanghai Huace Navigation Technology Ltd.
Unmanned Surface Vessel

Model No.: Apache 3, Apache 3 Pro, Apache 4

Prepared for : Shanghai Huace Navigation Technology Ltd.

Address : 577 Songying Road, Qingpu District, 201706 Shanghai, China

Prepared By : Shenzhen Alpha Product Testing Co., Ltd.

Building i, No.2, Lixin Road, Fuyong Street, Bao'an District, 518103,

Address : Shenzhen, Guangdong, China

Report Number : A2312264-C01-R01

Date of Receipt : January 22, 2024

Date of Test : January 22, 2024 - June 27, 2024

Date of Report : June 27, 2024

Version Number : V0
Result Pass

TABLE OF CONTENTS

	<u>De</u>	escription	Page
1	TES	ST SUMMARY	5
2	GE	NERAL INFORMATION	6
	2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8	GENERAL DESCRIPTION OF EUT RELATED SUBMITTAL(S) / GRANT (S) TEST METHODOLOGY TEST FACILITY ACCESSORIES OF DEVICE (EUT) TESTED SUPPORTING SYSTEM DETAILS TEST CONDITIONS MEASUREMENT UNCERTAINTY	
3 4		ST INSTRUMENTS LISTSTEM TEST CONFIGURATION	_
	4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 4.11	TEST MODE CONFIGURATION OF TESTED SYSTEM. CONDUCTED AV OUTPUT POWER PEAK-TO-AVERAGE RATIO OCCUPY BANDWIDTH. MODULATION CHARACTERISTIC. OUT OF BAND EMISSION AT ANTENNA TERMINALS ERP, EIRP MEASUREMENT FIELD STRENGTH OF SPURIOUS RADIATION MEASUREMENT FREQUENCY STABILITY V.S. TEMPERATURE MEASUREMENT FREQUENCY STABILITY V.S. VOLTAGE MEASUREMENT	
5	TES	ST SETUP PHOTO	57

Report No.: A2312264-C01-R01

TEST REPORT DECLARATION

Applicant Shanghai Huace Navigation Technology Ltd.

Address 577 Songying Road, Qingpu District, 201706 Shanghai, China

Manufacturer Shanghai Huace Navigation Technology Ltd.

Address 577 Songying Road, Qingpu District, 201706 Shanghai, China

EUT Description Unmanned Surface Vessel

> (A) Model No. : Apache 3, Apache 3 Pro, Apache 4

Trademark (B)

Measurement Standard Used:

FCC CFR Title 47 Part 2 FCC CFR Title 47 Part 22 Subpart H FCC CFR Title 47 Part 24 Subpart E FCC CFR Title 47 Part 27

The device described above is tested by Shenzhen Alpha Product Testing Co., Ltd. to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC Part 15 Subpart C limits both conducted and radiated emissions. The test results are contained in this test report and Shenzhen Alpha Product Testing Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

After the test, our opinion is that EUT compliance with the requirement of the above standards.

This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Shenzhen Alpha Product Testing Co., Ltd.

Tamas Wen Tested by (name + signature)..... Project Engineer Jack Xu Approved by (name + signature).....:

Yannis Wen

Project Manager

Date of issue..... June 27, 2024

Revision History

Revision	Issue Date	Revisions	Revised By
V0	June 27, 2024	Initial released Issue	Yannis Wen

1 Test Summary

Test Item	Section in CFR 47	Result
RF Exposure (SAR)	Part 1.1307 Part 2.1093	Pass* (Please refer to SAR Report)
RF Output Power	Part 2.1046 Part 22.913 (a)(2) Part 24.232 (c)	Pass
Peak-to-Average Ratio	Part 2.1046 Part 24.232 (d)	Pass
Modulation Characteristics	Part 2.1047	Pass
99% & -26 dB Occupied Bandwidth	Part 2.1049 Part 22.917 Part 24.238	Pass
Spurious Emissions at Antenna Terminal	Part 2.1051 Part 22.917 (a) Part 24.238 (a)	Pass
Field Strength of Spurious Radiation	Part 2.1053 Part 22.917 (a) Part 24.238 (a)	Pass
Out of band emission, Band Edge	Part 22.917 (a) Part 24.238 (a)	Pass
Frequency stability vs. temperature	Part 2.1055(a)(1)(b)	Pass
Frequency stability vs. voltage	Part 2.1055(d)(1)(2)	Pass

Note: 1. Pass: The EUT complies with the essential requirements in the standard.

^{2.} The conclusion of this test report is judged by actual test data without considering measurement uncertainty.

2 General Information

2.1 General Description of EUT

Description/PMN : Unmanned Surface Vessel

Model Number/HVIN(s) : Apache 3, Apache 3 Pro, Apache 4

Diff There is no difference except for the appearance and size. All tests are made

with the Apache 3 model.

Test Voltage : DC 32.4V from battery

Support Networks : GPRS, EGPRS, WCDMA

Support Bands : GSM850, PCS1900, WCDMA Band V, WCDMA Band IV, WCDMA Band II

GSM850: 824.20MHz-848.80MHz PCS1900: 1850.20MHz-1909.80MHz

TX Frequency : WCDMA Band V: 826.40MHz -846.60MHz

WCDMA Band II: 1852.40MHz -1907.60MHz WCDMA Band IV: 1710MHz -1755MHz

GPRS Class : 12 EGPRS Class : 12

GPRS: GMSK

Modulation type : EGPRS: GMSK/8PSK

WCDMA Band II/IV/V: QPSK

Antenna type : Rod antenna

Maximum Gain is 3.52dBi for GSM 850 Maximum Gain is 4.36dBi for PCS1900 Maximum Gain is 3.52dBi for WCDMA Band V

Maximum Gain is 4.22dBi for WCDMA Band IV

Antenna gain

Maximum Gain is 4.22dBi for WCDMA Band IV

Maximum Gain is 4.36dBi for WCDMA Band II

(Antenna information is provided by applicant.)

There is WWAN diversity antenna inside the product, which is only for

receiving function.

Software version : V1.0 Hardware version/FVIN : V1.0

Remark: 1.The worst-case simultaneous transmission configuration was evaluated with no non-compliance found. Results in this report are only for 2G and 3G function, and there is no other transmitter involved.

Operation Frequency List:

GSM 850		PCS	1900	000 WCDMA Band V		WCDMA Band II	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
128	824.20	512	1850.20	4132	826.40	9262	1852.40
129	824.40	513	1850.40	4133	826.60	9263	1852.60
• ;	• :	• :	• :	• :	• ::	• ;	• :
189	836.40	660	1879.80	4181	836.20	9399	1879.80
190	836.60	661	1880.00	4182	836.40	9400	1880.00
191	836.80	662	1880.20	4183	836.60	9401	1880.20
• :	• :	• :	• :	• :	• :	• :	• ;
250	848.60	809	1909.60	4232	846.40	9537	1907.40
251	848.80	810	1909.80	4233	846.60	9538	1907.60

Regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Final test channel:

GSM 850		PCS	1900	WCDMA Band V		WCDMA Band II	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
128	824.20	512	1850.20	4132	826.40	9262	1852.40
190	836.60	661	1880.00	4183	836.60	9400	1880.00
251	848.80	810	1909.80	4233	846.60	9538	1907.60

WCDMA Band IV			
Channel	Frequency (MHz)		
1312	1712.4		
1450	1740.0		
1513	1752.6		

Page 8 of 59 Report No.: A2312264-C01-R01

2.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is filing to comply with Section Part 22 subpart H and Part 24 subpart E of the FCC CFR 47 Rules.

2.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures document on TIA/EIA 603 and FCC CFR 47.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055 and 2.1057

2.4 Test Facility

Shenzhen Alpha Product Testing Co., Ltd

Building i, No.2, Lixin Road, Fuyong Street, Bao'an District, 518103, Shenzhen, Guangdong, China

June 21, 2018 File on Federal Communication Commission

Registration Number: 293961

July 25, 2017 Certificated by IC Registration Number: 12135A

2.5 Accessories of Device (EUT)

Accessories : /
Manufacturer : /
Model : /
INPUT : /
OUTPUT : /

2.6 Tested Supporting System Details

No	Description	Manufacturer	Model	Serial Number	Certification or SDoC

2.7 Test Conditions

Items	Required	Actual
Temperature range:	15-35°C	24°C
Humidity range:	25-75%	56%
Pressure range:	86-106kPa	98kPa

2.8 Measurement Uncertainty

Item	Uncertainty
Uncertainty for Power point Conducted Emissions Test	2.74dB
Uncertainty for Radiation Emission test in 3m chamber	2.13 dB(Polarize: V)
(below 30MHz)	2.57dB(Polarize: H)
Uncertainty for Radiation Emission test in 3m chamber	3.77dB(Polarize: V)
(30MHz to 1GHz)	3.80dB(Polarize: H)
Uncertainty for Radiation Emission test in 3m chamber	4.16dB(Polarize: H)
(1GHz to 25GHz)	4.13dB(Polarize: V)
Uncertainty for radio frequency	5.4×10-8
Uncertainty for conducted RF Power	0.37dB
Uncertainty for temperature	0.2°C
Uncertainty for humidity	1%
Uncertainty for DC and low frequency voltages	0.06%

3 Test Instruments list

EquipmentManufactureModel No.Firmware versionSerial No.Last cal.9*6*6 anechoic chamberCHENYU9*6*6/N/A2022.05.1Spectrum analyzerROHDE&SCHWARZFSV40-N2.31021372023.08.1	6 1Year
chamber CHENYU 9*6*6 / N/A 2022.05.1 Spectrum analyzer ROHDE&SCHWARZ FSV40-N 2.3 102137 2023.08.1	6 1Year
analyzer ROHDE&SCHWARZ FSV40-N 2.3 102137 2023.08.1	
	3 1Year
Spectrum analyzer Agilent N9020A A.14.16 MY499100060 2023.08.1	/ 110ai
Receiver ROHDE&SCHWARZ ESR 2.28 SP1 1316.3003K03- 102082-Wa 2023.08.1	6 1Year
Receiver R&S ESCI 4.42 SP1 101165 2023.08.1	3 1Year
Bilog Antenna Schwarzbeck VULB 9168 / VULB 9168#627 2023.08.2	3 1Year
Horn Antenna SCHWARZBECK BBHA 9120 / 2106 2023.08.1	9 1Year
Loop Antenna SCHWARZBECK FMZB 1519B / 00128 2023.08.1	9 1Year
RF Cable Resenberger Cable 1 / RE1 2023.08.1	3 1Year
RF Cable Resenberger Cable 2 / RE2 2023.08.1	3 1Year
RF Cable Resenberger Cable 3 / CE1 2023.08.1	3 1Year
Pre-amplifier HP HP8347A / 2834A00455 2023.08.1	3 1Year
Pre-amplifier Agilent 8449B / 3008A02664 2023.08.1	3 1Year
L.I.S.N.#1 Schwarzbeck NSLK8126 / 8126-466 2023.08.1	3 1Year
L.I.S.N.#2 ROHDE&SCHWARZ ENV216 / 101043 2023.08.1	6 1Year
Horn Antenna SCHWARZBECK BBHA 9170 / 00946 2023.08.1	9 1Year
Preamplifier SKET LNPA_1840- / SK2018101801 2023.08.1	1 Year
Power Meter Agilent E9300A / MY41496628 2023.08.1	
Power Sensor DARE RPR3006W / 15100041SNO91 2023.08.1	3 1 Year
Temp. & Humid. Teelong TL-HW408S / TL-20191205-01 2023.07.25	1 Year
Switching Mode JUNKE JK12010S / 20140927-6 2023.08.1	1 Year
Adjustable attenuator MWRFtest N/A / N/A N/A	N/A
10dB Attenuator Mini-Circuits DC-6G / N/A N/A	N/A

Software Information					
Test Item	Software Name	Manufacturer	Version		
RE	EZ-EMC	EZ	Alpha-3A1		
CE	EZ-EMC	EZ	Alpha-3A1		

4 System test configuration

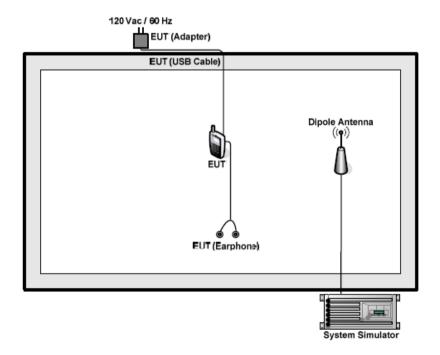
4.1 Test mode

During all testing, EUT is in link mode with base station emulator at maximum power level. The spurious emission measurements were carried out in semi-anechoic chamber with 3-meter test range, and EUT is rotated on three test planes to find out the worst emission.

Test modes					
Band	Radiated	Conducted			
GSM 850	■ GPRS 1 link	■ GPRS 1 link			
	■ EPRS 1 link	■ EGPRS 1 link			
PCS 1900	■ GPRS 1 link	■ GPRS 1 link			
	■ EGPRS 1 link	■ EGPRS 1 link			
WCDMA II	■ RMC 12.2Kbps link	■ RMC 12.2Kbps link			
WCDMA Band IV	■ RMC 12.2Kbps link	■ RMC 12.2Kbps link			
WCDMA Band V	■ RMC 12.2Kbps link	■ RMC 12.2Kbps link			

Note: The maximum power levels are GSM mode for GMSK link, GPRS multi-slot class 8 mode for GMSK link, EGPRS multi-slot class 8 mode for 8PSK link, RMC12.2Kbps mode for WCDMA Band V/II. only these modes were used for all tests.

4.2 Configuration of Tested System



4.3 Conducted AV Output Power

Test Requirement:	FCC part22.913(a) and FCC part24.232(b), FCC part 27.50 (d)(4)		
Test Method:	FCC part2.1046		
Limit:	GSM850, WCDMA Band V: 7W(38.45dbm)		
	PCS1900, WCDMA Band II: 2W(33.01dbm)		
	WCDMA Band IV: 1W(30.00dbm)		
Test setup:	EUT Splitter Communication Tester Signal Analyzer		
	Note: Measurement setup for testing on Antenna connector		
Test Procedure:	The transmitter output port was connected to base station.		
	2. The RF output of EUT was connected to the Signal Analyzer by RF cable and attenuator, the path loss was compensated to the results for each measurement.		
	Set EUT at maximum power through base station.		
	Select lowest, middle, and highest channels for each band and different modulation.		
	5. Measure the maximum burst average power.		
Test Instruments:	Refer to section 5.0 for details		
Test mode:	Refer to section 6.1 for details		
Test results:	Pass		

Measurement Data

Conducted Burst Power (dBm)						
Band		GSM850		PCS1900		
Channel	128	190	251	512	661	810
Frequency	824.20	836.60	848.80	1850.20	1880.00	1909.80
GPRS (GMSK, 1 TX slot)	30.86	29.14	29.78	27.70	27.41	27.39
GPRS (GMSK, 2 TX slot)	29.93	28.51	31.06	28.01	27.47	27.67
GPRS (GMSK, 3 TX slot)	28.09	29.84	30.82	29.60	30.53	29.01
GPRS (GMSK, 4 TX slot)	29.61	28.98	28.29	28.86	28.90	29.28
EGPRS (8PSK, 1 TX slot)	27.18	27.88	29.34	27.97	28.58	27.68
EGPRS (8PSK, 2 TX slot)	27.34	27.35	27.08	28.61	27.78	27.49
EGPRS (8PSK, 3 TX slot)	27.64	27.72	27.81	26.92	27.78	26.50
EGPRS (8PSK, 4 TX slot)	28.46	27.89	27.29	28.11	27.36	27.55

Burst Average Power (dBm)						
Band	WCDMA Band II			WCDMA Band V		
Channel	9262	9400	9538	4132	4183	4233
Frequency	1852.4	1880.0	1907.6	826.4	836.6	846.6
RMC 12.2Kbps	23.92	23.72	23.77	24.02	23.81	23.95
HSDPA Subtest-1	23.24	23.48	22.67	23.39	23.55	23.03
HSDPA Subtest-2	23.15	22.88	22.14	23.41	23.08	22.92
HSDPA Subtest-3	22.40	22.71	22.24	23.68	23.22	22.90
HSDPA Subtest-4	23.24	23.07	22.76	23.07	23.10	22.69
HSUPA Subtest-1	22.40	22.82	22.96	23.32	23.50	23.18
HSUPA Subtest-2	22.79	23.56	22.32	23.68	23.89	22.85
HSUPA Subtest-3	23.02	23.04	22.14	23.05	22.88	23.06
HSUPA Subtest-4	23.05	22.81	22.12	23.83	23.45	23.14
HSUPA Subtest-5	22.54	22.78	22.04	23.66	23.18	23.19

Burst Average Power (dBm)					
Band	WCDMA Band IV				
Channel	1312	1450	1513		
Frequency	1712.4	1740.0	1752.6		
RMC 12.2Kbps	23.89	23.86	23.82		
HSDPA Subtest-1	23.51	23.43	23.08		
HSDPA Subtest-2	23.54	23.11	23.12		
HSDPA Subtest-3	23.71	23.14	23.08		
HSDPA Subtest-4	22.94	23.09	22.75		
HSUPA Subtest-1	23.29	23.48	23.09		
HSUPA Subtest-2	23.61	23.90	22.69		
HSUPA Subtest-3	22.93	22.91	23.21		
HSUPA Subtest-4	23.87	23.61	23.25		
HSUPA Subtest-5	23.62	23.14	23.36		

4.4 Peak-to-Average Ratio

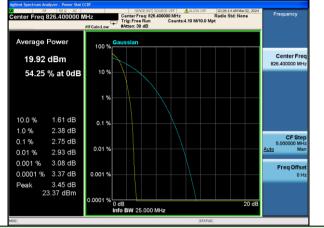
Test Requirement:	FCC part24.232(d)		
Test Method:	FCC part2.1046		
Limit:	13db		
Test setup:	EUT Splitter Communication Tester		
	Signal Analyzer		
	Note: Measurement setup for testing on Antenna connector		
Test Procedure:	The transmitter output port was connected to base station.		
	The RF output of EUT was connected to the Signal Analyzer by RF cable and attenuator, the path loss was compensated to the results for each measurement.		
	Set EUT at maximum power through base station.		
	Select lowest, middle, and highest channels for each band and different modulation.		
	5. Measure the maximum burst average power.		
	6. Record the maximum peak-to-average ratio value.		
Test Instruments:	Refer to section 5.0 for details		
Test mode:	Refer to section 6.1 for details		
Test results:	Pass		

Measurement data

Test mode	Peak	to Average I	Limit	Result	
	Low Ch.	Middle Ch.	High Ch.	(dB)	
WCDMA Band II	3.09	3.04	2.83	13	PASS
WCDMA Band IV	3.18	3.10	3.38	13	PASS
WCDMA Band V	2.75	2.98	2.97	13	PASS



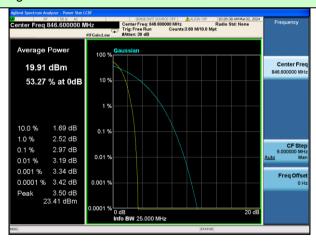




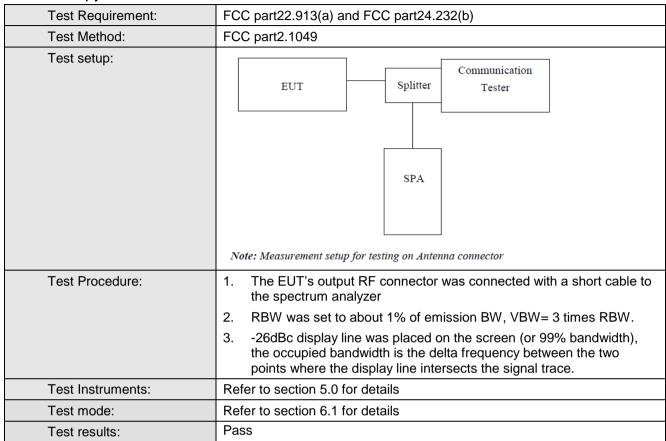
Middle Ch.



High Ch.



4.5 Occupy Bandwidth



Measurement Data

EUT Mode	Channel	Frequency (MHz)	99% Occupy bandwidth (KHz)	-26dB bandwidth (KHz)
	128	824.20	234.73	310.6
GSM 850 (GPRS 1 link)	190	836.60	239.10	318.4
(Or NO 1 mint)	251	848.80	236.97	305.7
	128	824.20	239.67	321.0
GSM 850 (EGPRS 1 link)	190	836.60	241.30	317.5
(LOT NO T mint)	251	848.80	235.64	317.8
500 4000	512	1850.20	238.60	314.1
PCS 1900 (GPRS 1 link)	661	1880.00	240.93	312.2
(Or ito i mint)	810	1909.80	236.98	314.6
PCS 1900 (EGPRS 1 link)	512	1850.20	247.28	319.5
	661	1880.00	240.76	321.0
	810	1909.80	237.04	308.3
	4132	826.40	4160.8	4684.0
WCDMA Band V (RMC 12.2Kbps link)	4183	836.60	4181.0	4702.0
(TOPO IIII)	4233	846.60	4162.0	4707.0
	9262	1852.4	4157.3	4712.0
WCDMA Band II (RMC 12.2Kbps link)	9400	1880.0	4158.4	4707.0
	9538	1907.6	4184.6	4728.0
	1312	1712.4	4164.2	4705.0
WCDMA Band IV (RMC 12.2Kbps link)	1450	1740.0	4175.1	4705.0
(TAMO 12.21Apps IIIIK)	1513	1752.6	4166.3	4697.0

Test plot as follows:

GSM 850 (GPRS 1 link)



Lowest channel



Middle channel



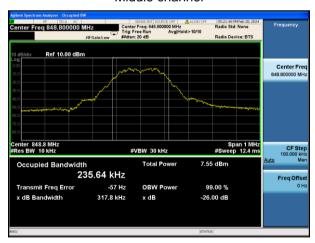
Highest channel

GSM 850 (EGPRS 1 link)



Lowest channel





Highest channel

PCS 1900 (GPRS 1 link)

Lowest channel



Middle channel

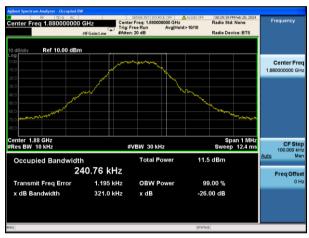


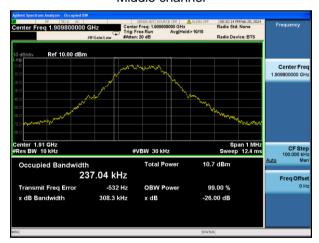
Highest channel

PCS 1900 (EGPRS 1 link)



Lowest channel



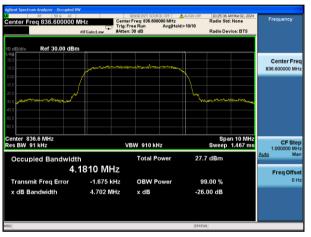


Highest channel

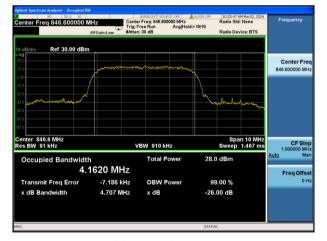
WCDMA Band V (RMC 12.2Kbps link)

SENSE:INT SOURCE OFF A Center Freq: 826.400000 MHz Trig: Free Run Avg|Hold> RF | 50 0 AC | Center Freq 826.400000 MHz Ref 30.00 dBm Center Free 826.400000 MH CF Ste 1.000000 MH Span 10 MHz Sweep 1.467 ms VBW 910 kHz Total Powe 28 3 dBn 4.1608 MHz Freq Offse -507 Hz OBW Power Transmit Freq Error 99.00 % 4.684 MHz -26.00 dB

Lowest channel

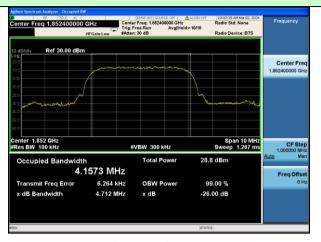


Middle channel

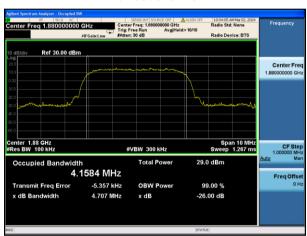


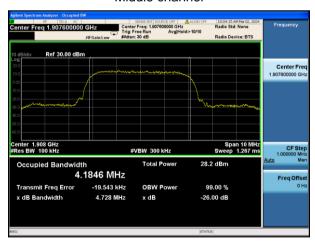
Highest channel

WCDMA Band II (RMC 12.2Kbps link)



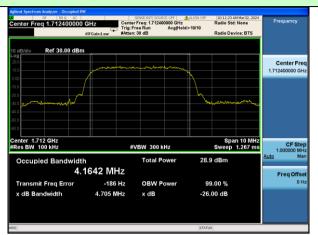
Lowest channel



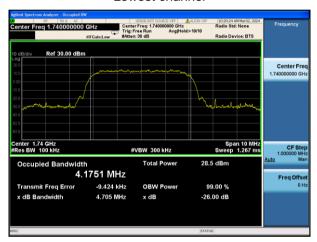


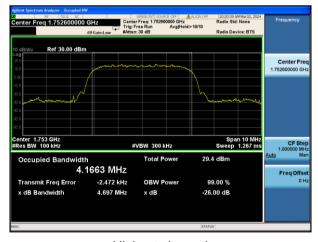
Highest channel

WCDMA Band IV (RMC 12.2Kbps link)



Lowest channel





Highest channel

4.6 MODULATION CHARACTERISTIC

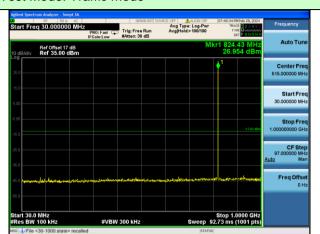
According to FCC § 2.1047(d), Part 22H & 24E there is no specific requirement for digital modulation, therefore modulation characteristic is not presented.

4.7 Out of band emission at antenna terminals

Test Requirement:	FCC part22.917(a) and FCC part24.238(a)		
Test Method:	FCC part2.1051		
Limit:	-13dBm		
Test Procedure:	Note: Measurement setup for testing on Antenna connector 1 The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. 2 The resolution bandwidth of the spectrum analyzer was set at 1MHz,		
	sufficient scans were taken to show the out of band Emissions if an up to 10th harmonic. 3 For the out of band: Set the RBW, VBW = 1MHz, Start=30MHz, Stop= 10th harmonic.		
	4 Band Edge Requirements: In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to measure the out of band Emissions.		
Test Instruments:	Refer to section 5.0 for details		
Test mode:	Refer to section 6.1 for details		
Test results:	Pass		

Test plot as follows:

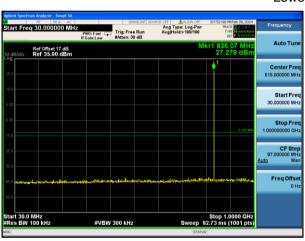
Note: During the conducted spurious emission test, a band filter was used. The information of the filter is reported at section 6.0 (refer to item 24, 25).



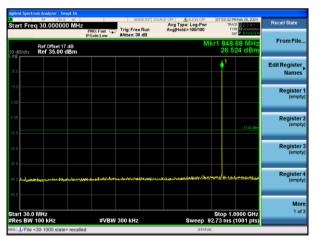
GSM 850 (GPRS 1 link)



Lowest channel



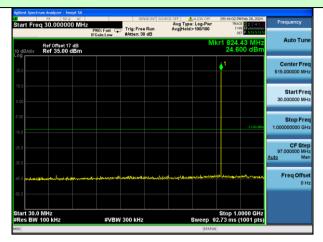






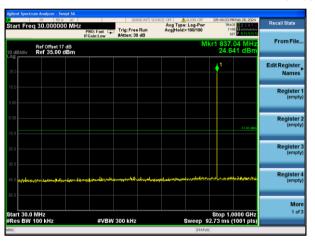
Highest channel

GSM 850 (EGPRS 1 link)

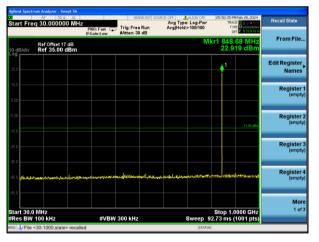




Lowest channel

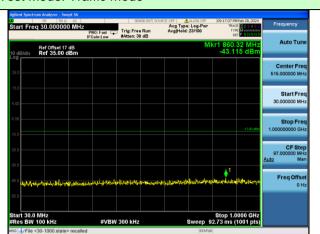








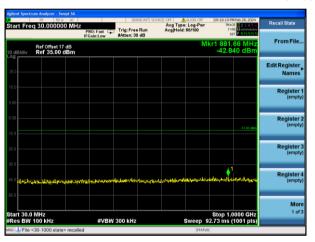
Highest channel



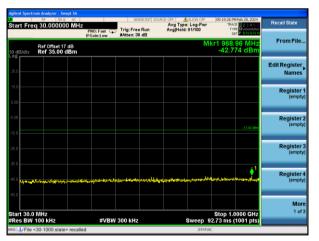
PCS1900 (GPRS 1 link)



Lowest channel



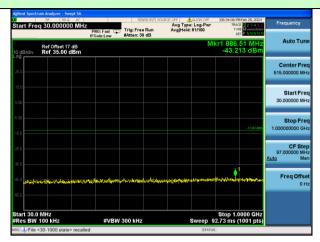






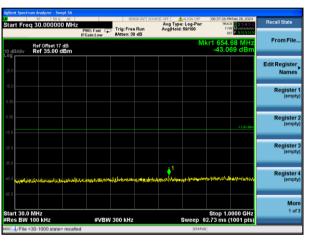
Highest channel

PCS1900 (EGPRS 1 link)

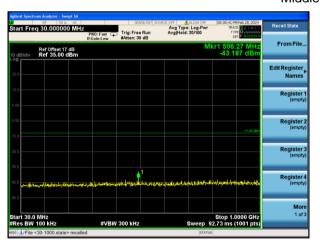




Lowest channel



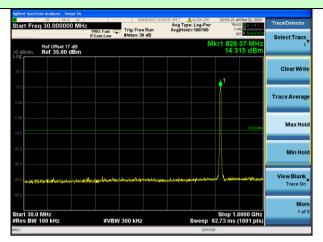






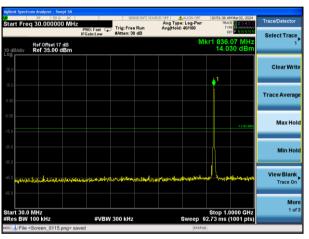
Highest channel

WCDMA Band V (RMC 12.2Kbps link)

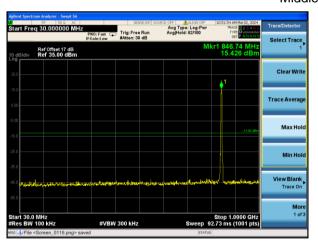




Lowest channel









Highest channel