

Produkte Products

Prüfbericht - Nr.:

14034388 001

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Test Report No.:

Auftraggeber:

Client:

Sunflex Europe GmbH

Konrad-Zuse-Str. 13 58239 Schwerte

Germany

Gegenstand der Prüfung: Airmouse

Test Item:

Bezeichnung: Identification:

V908354

Serien-Nr.:

Engineering sample

Serial No .:

Wareneingangs-Nr.:

00131127146-012

Eingangsdatum:

27.11.2013

Receipt No .:

Date of Receipt:

Zustand des Prüfgegenstandes bei Anlieferung:

Condition of test item at delivery:

Test sample(s) is/are not damaged and

suitable for testing.

Prüfort:

TÜV Rheinland Hong Kong Ltd.

8/F., First Group Centre, 14 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong

Global United Technology Services Co., Ltd.

2nd Floor, Block No.2, Laodong Industrial Zone, Xixiang Road Baoan District.

Shenzhen, China

Prüfgrundlage: Test Specification:

Testing Location:

FCC Part 15 Subpart C

ANSI C63.4-2003

CISPR 22:1997

Prüfergebnis:

Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).

Test Results:

The test item passed the test specification(s).

Prüflaboratorium:

TÜV Rheinland Hong Kong Ltd.

Testing Laboratory:

8 - 10/F., Goldin Financial Global Square, 7 Wang Tai Road, Kowloon Bay.

Kowloon, Hong Kong

geprüft/ tested by:

kontrolliert/ reviewed by:

06.02.2014

Mika Chan Project Manager

06.02.2014

Sharon Li

Name/Stellung

Datum

Section Manager Name/Stellung

Datum

Name/Position

Unterschrift

Unterschrift

Date

Signature

Date

Name/Position

Signature

Sonstiges:

FCCID: 2AA95-V908354

Other Aspects

Abkürzungen:

P(ass) entspricht Prüfgrundlage F(ail)

entspricht nicht Prüfgrundlage

Abbreviations:

P(ass) passed

N/A

nicht anwendbar nicht getestet

F(ail) failed

N/A N/T

not applicable

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 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 safety mark on this or similar products. TÜV Rheinland Hong Kong Ltd. · 8-10/F., Goldin Financial Global Square · 7 Wang Tai Road, Kowloon Bay, Hong Kong ·

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Product information

Manufacturers declarations

	Transceiver
Operating frequency range	2402 - 2480 MHz
Type of modulation	GFSK; Pi/4 DQPSK; 8 DPSK
Number of channels	79
Channel separation	1 MHz
Type of antenna	PCB Antenna
Antenna gain (dBi)	0
Power level	fix
Type of equipment	stand alone radio device
Connection to public utility power line	No
Nominal voltage	Internal battery V _{nor} : 3.7V DC
	Charging: 5.0V DC
Independent Operation Modes	Page scan
	Inquiry scan
	Connection state - BT Link

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Product function and intended use

The test item is a Bluetooth Air Mouse based on the Bluetooth technology.

Bluetooth is a short-range radio link intended to be a cable replacement between portable and/or fixed electronic devices.

Bluetooth operates in the unlicensed ISM Band at 2.4 GHz. In the US a band of 83.5 MHz width is available. In this band, 79 RF channels spaced 1MHz apart are defined.

The channel is represented by a pseudo-random hopping sequence through the 79 channels. The channel is divided into time slots, with a nominal slot length of $625\mu s$, where each slot corresponds to different RF hop frequencies. The nominal hop rate is 1600 hops/s. The symbol rate on the channel is 1-3Mbps. The device supports basic rate (BR) and enhanced data rate (EDR).

The USB connector is for charging only, no data exchange supported.

Submitted documents

Circuit Diagram Block Diagram Bill of material User Manual Label Artwork

Remark

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases.

Special accessories and auxiliary equipment

Additional accessory used for testing

The product has been tested together with the following additional accessory:



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List of Test and Measurement Instruments

Global United Technology Services Co., Ltd. (Registration number: 600491)

Radiated Emission

Equipment	Manufacturer	Туре	S/N	Cal Due Date
3m Semi- Anechoic Chamber	ZhongYu Electron	9.0(L)*6.0(W)* 6.0(H)		05 Apr 2015
Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)		N/A
ESU EMI Test Receiver	R&S	ESU26		28 Jun 2014
Loop Antenna	Zhinan	ZN30900A		28 Jun 2014
Bi-log Hybrid Antenna	SCHWARZBECK	VULB9163		17 Mar 2014
Double-ridged horn antenna	SCHWARZBECK	9120D		17 Mar 2014
Horn Antenna	ETS-LINDGREN	3160-09		17 Mar 2014
RF Amplifier	HP	8347A		28 Jun 2014
RF Amplifier	HP	8349B		28 Jun 2014
EMI Test Software	AUDIX	E3		N/A
Coaxial cable	GTS	N/A		28 Jun 2014
Coaxial Cable	GTS	N/A		28 Jun 2014
Thermo meter	N/A	N/A		30 Jun 2014

TÜV Rheinland Hong Kong Ltd.

Radio Frequency Test

Equipment	Manufacturer	Туре	S/N	Cal Due Date
Spectrum Analyzer	Rohde & Schwarz	FSP30	100007	03 Dec 2014

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Results FCC Part 15 - Subpart C

Subclause 15.203 – Antenna Information

Pass

Requirement: No antenna other than that furnished by the responsible party shall be used with the

device

Results: Permanent PCB printed antenna

Verdict: Pass

Subclause 15.204 - Antenna Information

Pass

Requirement: Provide information for every antenna proposed for the use with the EUT

Results: a) Antenna type: PCB printed antenna

b) Manufacturer and model no: N.A. c) Gain with reference to an isotropic radiator: 0 dBi

Verdict: Pass

Subclause 15.207 - Disturbance Voltage on AC Mains

Pass

Test Port: AC mains input port of the AC/DC adapter.

Applied Voltage: 120VAC

Power supply model: Please refer to page 4 Mode of operation: Charging + Transmitting

Live measurement

Frequency range (MHz)	Frequency (MHz)	Quasi-peak (dBμV)	Average (dBμV)	Limit QP (dBµV)	Limit AV (dBµV)	Verdict
0.15 0.5	0.150	59.0	42.2	66 - 56	56 - 46	Pass
0,15 – 0,5	0.228	50.1	32.0	66 - 56	56 - 46	Pass
> 0,5 - 5	0.534	34.6	15.8	56	46	Pass
> 5 - 30	13.428	33.2	28.3	60	50	Pass

Neutral measurement

Frequency range (MHz)	Frequency (MHz)	Quasi-peak (dBμV)	Average (dBμV)	Limit QP (dBµV)	Limit AV (dBµV)	Verdict
0,15 - 0,5	0.150	61.2	43.3	66 - 56	56 - 46	Pass
0,15 - 0,5	0.174	56.9	37.0	66 - 56	56 - 46	Pass
> 0,5 - 5	0.543	35.9	27.1	56	46	Pass
> 5 – 30	12.900	35.3	33.0	60	50	Pass

Results: The radio frequency voltage that is conducted back onto the AC power line on any

frequency or frequencies within the band 150kHz to 30MHz does not exceed the limits.

For test results plots refer to Appendix 1, page 2-3.

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Subclause 15.247 (a)(1) – Carrier Frequency Separation

Pass

Requirement: Frequency hopping systems shall have hopping channel carrier frequencies separated

by a minimum of 25kHz or the two-third of the 20dB bandwidth of the hopping channel,

whichever is greater.

Test Specification: FCC Part 15 Subpart A - Subclause 15.31

Mode of operation: Tx mode (hopping on) at 8 DPSK

Port of testing : Temporary antenna port

Detector : Peak

RBW/VBW : 100 kHz / 300 kHz

Supply voltage : 3.7VDC Temperature : 23°C Humidity : 50%

Results: Pre-scan has been conducted to determine the worst-case mode from all possible

combinations between available modulations and packet types.

The centre frequencies of the hopping channels are separated by more than the two-

third of the 20dB bandwidth. For test Results plots refer to Appendix 1, page 4.

Verdict: Pass

Subclause 15.247 (a)(1)(iii) – Number of Hopping Channels

Pass

Requirement: Frequency hopping systems operating in the 2400MHz-2483.5MHz bands shall use at

least 15 hopping frequencies.

Test Specification: FCC Part 15 Subpart A - Subclause 15.31

Mode of operation: Tx mode (hopping on) at GFSK, Pi/4 DQPSK, 8 DPSK

Port of testing : Temporary antenna port

Detector : Peak

RBW/VBW : 1 MHz / 3 MHz

Supply voltage : 3.7VDC Temperature : 23°C Humidity : 50%

Results: The total number of hopping frequencies is more than 15. For test result plots, please

refer to Appendix 1, page 5.

Verdict: Pass

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Subclause 15.247 (a)(1)(iii) – Time of Occupancy (Dwell Time)

Pass

Requirement: Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15

channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels

employed.

Test Specification: FCC Part 15 Subpart A – Subclause 15.31 Mode of operation: Tx mode (hopping on), DH5 packet at GFSK

Port of testing : Temporary antenna port

Detector : Peak

RBW/VBW : 1 MHz / 3 MHz

Supply voltage : 3.7VDC Temperature : 23°C Humidity : 50%

Results: Time period calculation = $0.4 \times 79 = 31.6s$

Dwell time (GFSK) = $130 \times 2.904 \times 10^{-3} = 377.52 \times 10^{-3} \text{ s}$

 $<= 400 \times 10^{-3} \text{ s}$

For test result plots, please refer to Appendix 1, page 6.

Verdict: Pass

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Subclause 15.247 (a) - 20 dB Bandwidth

Pass

Requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the two-third of the 20dB bandwidth of the hopping channel,

whichever is greater.

Test Specification: FCC Part 15 Subpart A - Subclause 15.31 Mode of operation: Tx mode (hopping off) at GFSK, 8 DPSK

Port of testing : Temporary antenna port

Detector : Peak

RBW/VBW : 30 kHz / 100 kHz

: 3.7VDC Supply voltage Temperature : 23ºC Humidity : 50%

Results: Pre-scan has been conducted to determine the worst-case mode from all possible

combinations between available modulations and packet types.

For test protocols refer to Appendix 1, page 7-10.

GFSK Modulation

Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (MHz)
2402	0.468	0.408	0.876
2441	0.468	0.474	0.942
2480	0.450	0.396	0.846

8 DPSK Modulation

Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (MHz)
2402	0.660	0.660	1.320
2441	0.666	0.654	1.320
2480	0.666	0.648	1.314

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Subclause 15.247 (a)(1) - Hopping Sequence

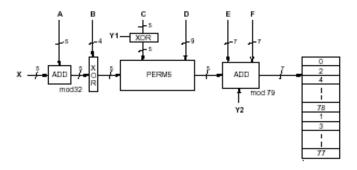
Pass

Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies.

Hopping sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master. The X input determines the phase in the 32-hop segment, whereas Y1 and Y2 selects between master-to-slave and slave-to-master transmission. The inputs A to D determine the ordering within the segment, the inputs E and F determine the mapping onto the hop frequencies.



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```
Example data:
Hop sequence {k} for CONNECTION STATE:
CLK start: 0x0000010
ULAP: 0x00000000
#ticks:
             00 02 | 04 06 | 08 0a | 0c 0e | 10 12 | 14 16 | 18 1a | 1c 1e |
0x0000010: 08 66 | 10 70 | 12 19 | 14 23 | 16 01 | 18 05 | 20 33 | 22 37 |
0x0000030: 24 03 | 26 07 | 28 35 | 30 39 | 32 72 | 34 76 | 36 25 | 38 29 |
0x0000050: 40 74 | 42 78 | 44 27 | 46 31 | 48 09 | 50 13 | 52 41 | 54 45 |
0x0000070: 56 11 | 58 15 | 60 43 | 62 47 | 32 17 | 36 19 | 34 49 | 38 51 |
0x0000090: 40 21 | 44 23 | 42 53 | 46 55 | 48 33 | 52 35 | 50 65 | 54 67
0x00000b0: 56 37 | 60 39 | 58 69 | 62 71 | 64 25 | 68 27 | 66 57 | 70 59 |
0x00000d0: 72 29 | 76 31 | 74 61 | 78 63 | 01 41 | 05 43 | 03 73 | 07 75 |
0x00000f0: 09 45 | 13 47 | 11 77 | 15 00 | 64 49 | 66 53 | 68 02 | 70 06 |
0x0000110: 01 51 | 03 55 | 05 04 | 07 08 | 72 57 | 74 61 | 76 10 | 78 14 |
0x0000130: 09 59 | 11 63 | 13 12 | 15 16 | 17 65 | 19 69 | 21 18 | 23 22
0x0000150: 33 67 | 35 71 | 37 20 | 39 24 | 25 73 | 27 77 | 29 26 | 31 30 |
0x0000170: 41 75 | 43 00 | 45 28 | 47 32 | 17 02 | 21 04 | 19 34 | 23 36 |
0x0000190: 33 06 | 37 08 | 35 38 | 39 40 | 25 10 | 29 12 | 27 42 | 31 44 |
0x00001b0: 41 14 | 45 16 | 43 46 | 47 48 | 49 18 | 53 20 | 51 50 | 55 52
0x00001d0: 65 22 | 69 24 | 67 54 | 71 56 | 57 26 | 61 28 | 59 58 | 63 60 |
0x00001f0: 73 30 | 77 32 | 75 62 | 00 64 | 49 34 | 51 42 | 57 66 | 59 74 |
0x0000210: 53 36 | 55 44 | 61 68 | 63 76 | 65 50 | 67 58 | 73 03 | 75 11 |
0x0000230: 69 52 | 71 60 | 77 05 | 00 13 | 02 38 | 04 46 | 10 70 | 12 78 |
0x0000250: 06 40 | 08 48 | 14 72 | 16 01 | 18 54 | 20 62 | 26 07 | 28 15 |
0x0000270: 22 56 | 24 64 | 30 09 | 32 17 | 02 66 | 06 74 | 10 19 | 14 27
0x0000290: 04 70 | 08 78 | 12 23 | 16 31 | 18 03 | 22 11 | 26 35 | 30 43 |
0x00002b0: 20 07 | 24 15 | 28 39 | 32 47 | 34 68 | 38 76 | 42 21 | 46 29
0x00002d0: 36 72 | 40 01 | 44 25 | 48 33 | 50 05 | 54 13 | 58 37 | 62 45 |
0x00002f0: 52 09 | 56 17 | 60 41 | 64 49 | 34 19 | 36 35 | 50 51 | 52 67
0x0000310: 38 21 | 40 37 | 54 53 | 56 69 | 42 27 | 44 43 | 58 59 | 60 75
0x0000330: 46 29 | 48 45 | 62 61 | 64 77 | 66 23 | 68 39 | 03 55 | 05 71
0x0000350: 70 25 | 72 41 | 07 57 | 09 73 | 74 31 | 76 47 | 11 63 | 13 00 |
0x0000370: 78 33 | 01 49 | 15 65 | 17 02 | 66 51 | 70 67 | 03 04 | 07 20 |
0x0000390: 68 55 | 72 71 | 05 08 | 09 24 | 74 59 | 78 75 | 11 12 | 15 28 |
0x00003b0: 76 63 | 01 00 | 13 16 | 17 32 | 19 53 | 23 69 | 35 06 | 39 22
0x00003d0: 21 57 | 25 73 | 37 10 | 41 26 | 27 61 | 31 77 | 43 14 | 47 30 |
0x00003f0: 29 65 | 33 02 | 45 18 | 49 34 | 19 04 | 21 08 | 23 20 | 25 24 |
```

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Subclause 15.247 (b)(1) - Peak Output Power

Pass

Test Specification: FCC Part 15 Subpart A - Subclause 15.31

Mode of operation: Tx mode (hopping off) at GFSK, Pi/4 DQPSK, 8 DPSK

Port of testing : Temporary antenna port

Detector : Peak

RBW/VBW : 3 MHz / 10 MHz

Supply voltage : 3.7VDC Temperature : 23°C Humidity : 50%

Requirement: For frequency hopping systems operating in the 2400-2483.5 MHz band employing at

least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 Watt. For all other frequency hopping systems in the 2400 – 2483.5 MHz band:

0.125 Watts.

Results: For test result plots, please refer to Appendix 1, page 11-16.

GFSK Modulation

Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	-3.46	0.00	-3.46	1 / 30.0	Pass
2441	-2.39	0.00	-2.39	1 / 30.0	Pass
2480	-1.87	0.00	-1.87	1 / 30.0	Pass

Pi/4 DQPSK Modulation

Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	-2.54	0.00	-2.54	0.125 / 21.0	Pass
2441	-1.38	0.00	-1.38	0.125 / 21.0	Pass
2480	-1.29	0.00	-1.29	0.125 / 21.0	Pass

8 DPSK Modulation

Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power	Limit (W/dBm)	Verdict
2402	-2.51	0.00	-2.51	0.125 / 21.0	Pass
2441	-1.41	0.00	-1.41	0.125 / 21.0	Pass
2480	-1.29	0.00	-1.29	0.125 / 21.0	Pass

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Subclause 15.247 (d) – Band-edge Compliance of Conducted Emissions Pass

Test Specification: FCC Part 15 Subpart A - Subclause 15.31

Mode of operation: Tx mode (hopping off and on modes) at GFSK, Pi/4 DQPSK, 8 DPSK

Port of testing : Temporary antenna port

Detector : Peak

RBW/VBW : 100 kHz / 300 kHz

Supply voltage : 3.7VDC Temperature : 23°C Humidity : 50%

Requirement: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or

digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on

either an RF conducted or a radiated measurement.

Results: Pre-scan has been conducted to determine the worst-case mode from all possible

combinations between available modulations and packet types.

The spurious found outside any 100 kHz bandwidth of the operating frequency band are well below 20dB of the highest desired transmit power. For test result plots, please refer

to Appendix 1, page 17-18.

Subclause 15.205 (a) - Restricted Bands next to Band-Edge Pass

Test Specification: FCC Part 15 Subpart A – Subclause 15.31

Mode of operation: Tx mode (hopping off) at GFSK

Port of testing : Temporary antenna port

Detector : Peak

RBW/VBW : 1 MHz / 1 MHz

Supply voltage : 3.7VDC Temperature : 23°C Humidity : 50%

Requirement: Radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also

comply with the radiated emission limits specified in 15.209(a).

Results: Pre-scan has been conducted to determine the worst-case mode from all possible

combinations between available modulations and packet types.

There is no peak found in the restricted bands. For test result plots, please refer to

Appendix 1, page 19-22.

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Subclause 15.247 (d) - Spurious Conducted Emissions

Pass

Test Specification: FCC Part 15 Subpart A - Subclause 15.31

Mode of operation: Tx mode (hopping off) at 8 DPSK

Port of testing : Temporary antenna port

Detector : Peak

RBW/VBW : 100 kHz / 300 kHz

Supply voltage : 3.7VDC Temperature : 23 °C Humidity : 50 %

Requirement: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or

digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on

either an RF conducted or a radiated measurement.

Results: Pre-scan has been conducted to determine the worst-case mode from all possible

combinations between available modulations and packet types.

The spurious emissions found outside any 100kHz bandwidth of the operating frequency band in the three transmit frequency are well below 20dB of the highest desired transmit power. All three transmit frequency modes comply with the limit stated in subclause

15.247(d). For test protocols refer to Appendix 1, page 23-24.

8 DPSK Modulation

Operating Frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2402	4800	-46.09	-4.19	-41.90	Pass
2441	4850	-45.66	-5.53	-40.13	Pass
2480	4950	-46.41	-5.84	-40.57	Pass

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Subclause 15.247	7 (d) – Spurious	Radiated Emissions	Pass	
Test Specification Mode of operation Port of testing Detector RBW/VBW Supply voltage Temperature Humidity	: Tx mode (hopper : Enclosure: Peak	oing off) at GFSK kHz for f < 1 GHz		
Requirement:	level of the desibands, as defin	pandwidth outside the frequency bar ired power. In addition, radiated emis ed in section15.205(a), must also co in section 15.209(a).	ssions which fall in the restricted	
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. All three transmit frequency modes comply with the field strength within the restricted bands. There is no spurious found below 30MHz.			
Tx frequency 240	2MHz	Vertical Polarization		
Frequency (MHz)		Level (dBμV/m)	Limit/ Detector (dBµV/m)	
4804.000		53.83	74.0 / PK	
4804.000		41.17	54.0 / AV	
Tx frequency 240	2MHz	Horizontal Polarization		
Frequency		Level	Limit/ Detector	
(MHz)		(dBμV/m)	(dBμV/m)	
4804.000		51.36	74.0 / PK	
4804.000		39.07	54.0 / AV	
Tx frequency 244	1MHz	Vertical Polarization		
Frequency		Level	Limit/ Detector	
(MHz)		(dBμV/m)	(dBµV/m)	
4876.000		52.90	74.0 / PK	
4876.000		38.28	54.0 / AV	
Tx frequency 244	1MHz	Horizontal Polarization	1	
Frequency		Level	Limit/ Detector	
(MHz)		(dBµV/m)	(dBμV/m)	
4882.000		49.12	74.0 / PK	
4882.	000	36.77	54.0 / AV	
Tx frequency 248	80MHz	Vertical Polarization		
Frequency		Level	Limit/ Detector	
(MHz)		(dBμV/m)	(dBμV/m)	
4960.000		48.39	74.0 / PK	
4960.000		36.34	54.0 / AV	

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Tx frequency 2480MHz	Horizontal Polarization	
Frequency (MHz)	Level (dBμV/m)	Limit/ Detector (dBμV/m)
4960.000	51.28	74.0 / PK
4960.000	37.88	54.0 / AV

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