

Amber Helm Development L.C.

92723 Michigan Hwy-152

Sister Lakes, Michigan 49047 USA

Tel: 888-847-8027

AKTV8A-2020TX

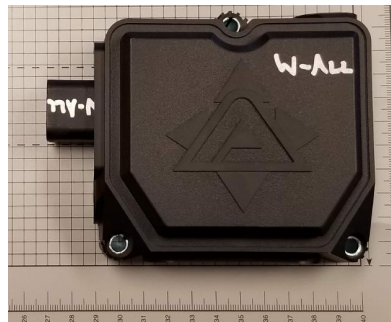
Issued: October 1, 2020

EMC Test Report

regarding

USA: CFR Title 47, Part 15.249 (Emissions)
Canada: ISSED RSS-210v10 (Emissions)

for



iAir3

Category: 2.4GHz Transceiver

Judgments:

15.249/RSS-210v10 Compliant Device

Testing Completed: September 28, 2020



Prepared for:

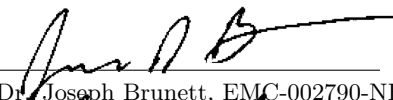
Aktv8, LLC

50660 Century Ct., Wixom Michigan 48393 USA

Phone: (245) 345 9801, Fax: (245) 345 9801

Contact: Paul White, paul@aktv8.com

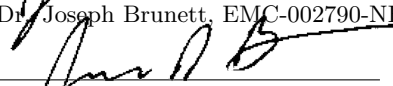
Data Recorded by:


Dr. Joseph Brunett, EMC-002790-NE

Reviewed by:


Gordon Helm, EMC-002401-NE

Prepared by:


Dr. Joseph Brunett, EMC-002790-NE

Date of Issue: October 1, 2020

Revision History

Rev. No.	Date	Details	Revised By
r0	October 1, 2020	Initial Release.	J. Brunett

Contents

Revision History	2
Table of Contents	2
1 Test Report Scope and Limitations	4
1.1 Laboratory Authorization	4
1.2 Report Retention	4
1.3 Subcontracted Testing	4
1.4 Test Data	4
1.5 Limitation of Results	4
1.6 Copyright	4
1.7 Endorsements	4
1.8 Test Location	5
1.9 Traceability and Equipment Used	5
2 Test Specifications and Procedures	6
2.1 Test Specification and General Procedures	6
3 Configuration and Identification of the Equipment Under Test	7
3.1 Description and Declarations	7
3.1.1 EUT Configuration	8
3.1.2 Modes of Operation	8
3.1.3 Variants	8
3.1.4 Test Samples	8
3.1.5 Functional Exerciser	8
3.1.6 Modifications Made	8
3.1.7 Production Intent	9
3.1.8 Declared Exemptions and Additional Product Notes	9
4 Emissions	10
4.1 General Test Procedures	10
4.1.1 Radiated Test Setup and Procedures	10
4.1.2 Conducted Emissions Test Setup and Procedures	12
4.1.3 Power Supply Variation	12
4.2 Intentional Emissions	13
4.2.1 Fundamental Emission Pulsed Operation	13
4.2.2 Fundamental Emission Bandwidth	14
4.2.3 Fundamental Emission Field Strength	16
4.3 Unintentional Emissions	17
4.3.1 Transmit Chain Spurious Emissions	17
5 Measurement Uncertainty and Accreditation Documents	18

List of Tables

1	Test Site List.	5
2	Equipment List.	5
3	EUT Declarations.	7
4	Fundamental Emission Pulsed Operation.	13
5	Fundamental Emission Bandwidth.	14
6	Fundamental Emission Field Strength.	16
7	Transmit Chain Spurious Emissions.	17
8	Measurement Uncertainty.	18

List of Figures

1	Photos of EUT.	7
2	EUT Test Configuration Diagram.	8
3	Radiated Emissions Diagram of the EUT.	10
4	Radiated Emissions Test Setup Photograph(s).	11
5	Fundamental Emission Pulsed Operation.	13
6	Fundamental Emission Bandwidth.	15
7	Accreditation Documents	18

1 Test Report Scope and Limitations

1.1 Laboratory Authorization

Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: US5348 and US5356) and with ISED Canada, Ottawa, ON (File Ref. No: 3161A and 24249). Amber Helm Development L.C. holds accreditation under NVLAP Lab Code 200129-0.

1.2 Report Retention

For equipment verified to comply with the regulations herein, the manufacturer is obliged to retain this report with the product records for the life of the product, and no less than ten years. A copy of this Report will remain on file with this laboratory until November 2030.

1.3 Subcontracted Testing

This report does not contain data produced under subcontract.

1.4 Test Data

This test report contains data included within the laboratories scope of accreditation.

1.5 Limitation of Results

The test results contained in this report relate only to the item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require reevaluation.

1.6 Copyright

This report shall not be reproduced, except in full, without the written approval of Amber Helm Development L.C.

1.7 Endorsements

This report shall not be used to claim product endorsement by any accrediting, regulatory, or governmental agency.

1.8 Test Location

The EUT was fully tested by **Amber Helm Development L.C.**, headquartered at 92723 Michigan Hwy-152, Sister Lakes, Michigan 49047 USA. Table 1 lists all sites employed herein. Specific test sites utilized are also listed in the test results sections of this report where needed.

Table 1: Test Site List.

Description	Location	Quality Num.
OATS (3 meter)	3615 E Grand River Rd., Williamston, Michigan 48895	OATSC

1.9 Traceability and Equipment Used

Pertinent test equipment used for measurements at this facility is listed in Table 2. The quality system employed at Amber Helm Development L.C. has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Table 2: Equipment List.

Description	Manufacturer/Model	SN	Quality Num.	Cal/Ver By / Date Due
Spectrum Analyzer	R & S / FSV30	101660	RSFSV30001	RS / Apr-2021
Biconical	EMCO / 93110B	9802-3039	BICEMCO01	Keysight / Aug-2021
Log Periodic Antenna	EMCO / 3146	9305-3614	LOGEMCO01	Keysight / Aug-2021
BNC-BNC Coax	WRTL / RG58/U	001	CAB001-BLACK	AHD / Apr-2021
3.5-3.5MM Coax	PhaseFlex / PhaseFlex	001	CAB015-PURP	AHD / Jan-2021
Quad Ridge Horn	Singer / A6100	C35200	HQR1TO18S01	Keysight / Aug-2021
K-Band Horn	JEF / NRL Std.	001	HRNK01	AHD / Jul-2021

2 Test Specifications and Procedures

2.1 Test Specification and General Procedures

The goal of Aktiv8, LLC is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the Aktiv8, LLC iAir3 for compliance to:

Country/Region	Rules or Directive	Referenced Section(s)
United States	Code of Federal Regulations	CFR Title 47, Part 15.249
Canada	ISED Canada	ISED RSS-210v10

It has been determined that the equipment under test is subject to the rules and directives above at the date of this testing. In conjunction with these rules and directives, the following specifications and procedures are followed herein to demonstrate compliance (in whole or in part) with these regulations.

ANSI C63.4:2014	"Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
ANSI C63.10:2013	"American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"
TP0102RA	"AHD Internal Document TP0102 - Radiated Emissions Test Procedure"
TP0106RC	"AHD Internal Document TP0106 - Emissions Measurement Procedures (above 40 GHz)"
ISED Canada	"The Measurement of Occupied Bandwidth"

3 Configuration and Identification of the Equipment Under Test

3.1 Description and Declarations

The EUT is a remote controlled electronic suspension control module. The EUT is approximately 11 x 11 x 4 cm in dimension, and is depicted in Figure 1. It is powered by 12 VDC vehicular power system. The EUT is used to control vehicle suspension. Table 3 outlines provider declared EUT specifications.



Figure 1: Photos of EUT.

Table 3: EUT Declarations.

General Declarations	
Equipment Type:	2.4GHz Transceiver
Country of Origin:	USA
Nominal Supply:	12 VDC
Oper. Temp Range:	Not Declared
Frequency Range:	2402 – 2480 MHz
Antenna Dimension:	Not Declared
Antenna Type:	PCB Trace
Antenna Gain:	Not Declared
Number of Channels:	40
Channel Spacing:	Not Declared
Alignment Range:	Not Declared
Type of Modulation:	GFSK
United States	
FCC ID Number:	2AOSC-IAIR3
Classification:	DXT
Canada	
IC Number:	23531-IAIR3
Classification:	Remote Control Device

3.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 2.

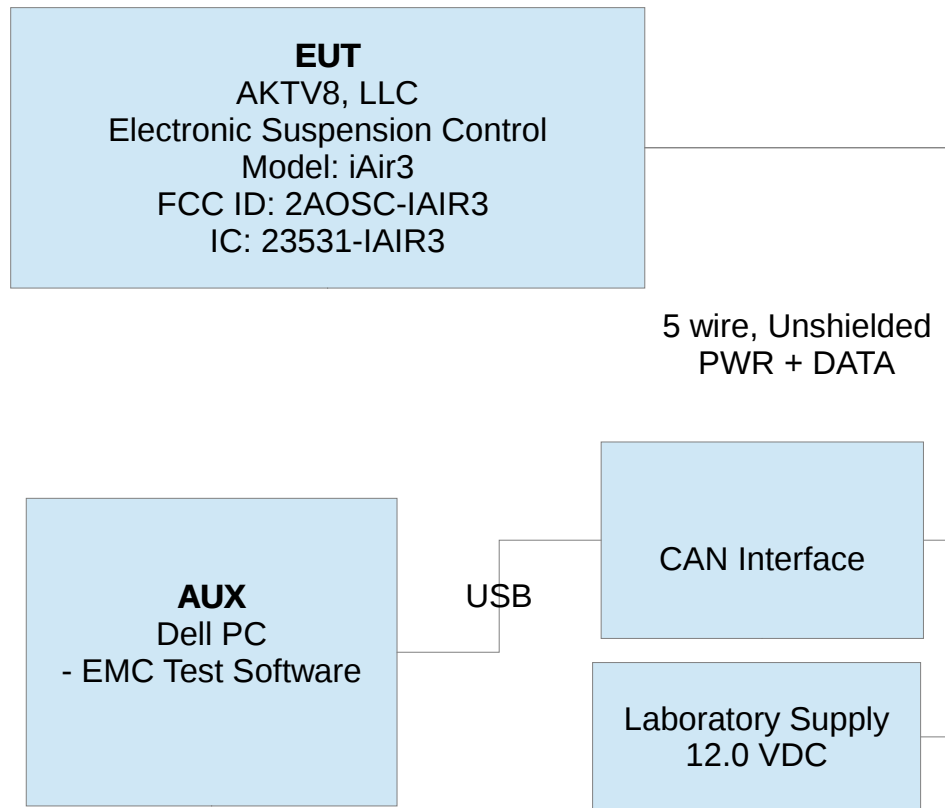


Figure 2: EUT Test Configuration Diagram.

3.1.2 Modes of Operation

The EUT is capable of GFSK modulation as tested herein.

3.1.3 Variants

There is only a single variant of the EUT, as tested.

3.1.4 Test Samples

Two samples in total were provided, each could be controlled by PC software over the EUT CAN bus to be placed into continuous transmission on the Low, Middle, and High channels.

3.1.5 Functional Exerciser

Normal operating EUT functionality was verified by observation of transmitted signal.

3.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory.

3.1.7 Production Intent

The EUT appears to be a production ready sample.

3.1.8 Declared Exemptions and Additional Product Notes

The EUT is permanently installed in a transportation vehicle. As such, digital emissions are exempt from US and Canadian digital emissions regulations (per FCC 15.103(a) and IC correspondence on ICES-003).

4 Emissions

4.1 General Test Procedures

4.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first pre-scanned in our screen room. Spectrum and modulation characteristics of all emissions are recorded. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.8 are employed. After pre-scan, emission measurements are made on the test site of record. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in relevant test standards are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 3. All intentionally radiating elements that are not fixed-mounted in use are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. If the EUT is fixed-mounted in use, measurements are made with the device oriented in the manner consistent with installation and then emissions are recorded. If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied.

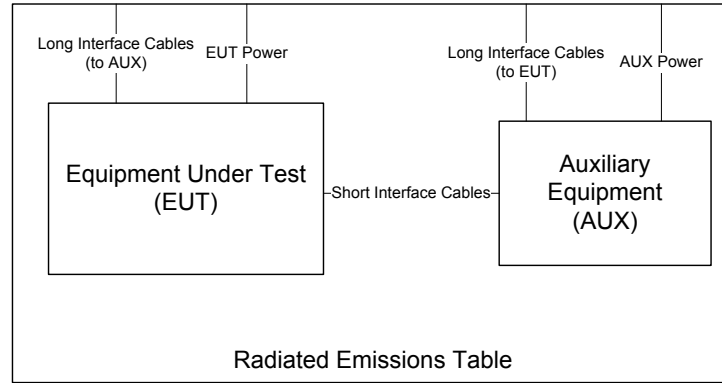


Figure 3: Radiated Emissions Diagram of the EUT.

For devices with intentional emissions below 30 MHz, a shielded loop antenna and/or E-field and H-Field broadband probes are used depending on the regulations. Shielded loops are placed at a 1 meter receive height at the desired measurement distance. For exposure in this band, the broadband probes employed are 10cm diameter single-axis shielded transducers and measurements are repeated and summed over three axes.

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through 360° in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Emissions above 1 GHz are characterized using standard gain or broadband ridge-horn antennas on our OATS with a 4×5 m rectangle of ECCOSORB absorber covering the OATS ground screen and a 1.5m table height. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced. Photographs of the test setup employed are depicted in Figure 4.

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to $\text{dB}\mu\text{V}/\text{m}$ at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where P_R is the power recorded on spectrum analyzer, in dBm, K_A is the test antenna factor in dB/m, K_G is the combined pre-amplifier gain and cable loss in dB, K_E is duty correction factor (when applicable) in dB, and C_F is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is computed, it is computed as

$$\text{EIRP}(\text{dBm}) = E_{3m}(\text{dB}\mu\text{V}/\text{m}) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

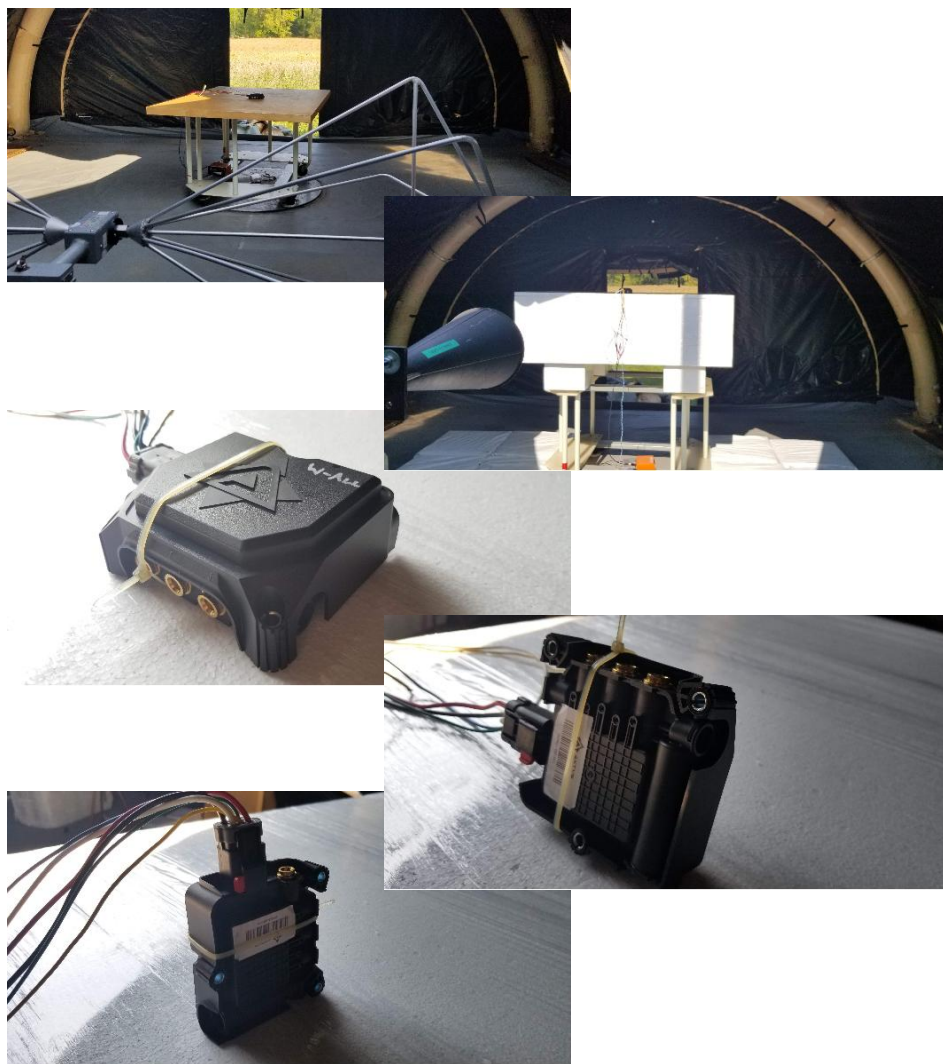


Figure 4: Radiated Emissions Test Setup Photograph(s).

4.1.2 Conducted Emissions Test Setup and Procedures

4.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

4.2 Intentional Emissions

4.2.1 Fundamental Emission Pulsed Operation

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Duty cycle is reported for all relevant modes of operation. The test equipment employed includes RSFSV30001, HQR1TO18S01.

Measurement Results The details and results of testing the EUT are summarized in Table 4. Plots showing the measurements made to obtain these values are provided in Figure 5.

Table 4: Fundamental Emission Pulsed Operation.

Frequency Range f > 1 000 MHz	Det Pk	IFBW 3 MHz	VBW 10 MHz	Test Date: 10-Oct-20
				Test Engineer: Joseph Brunett
				EUT AKTV8 iAir3
				Meas. Distance: Conducted

Pulsed Operation / Duty Cycle								
Transmit Mode	Symbol Rate (Msym/s)	Data Rate (Mbps)	Voltage (V)	Oper. Freq (MHz)	Tx Cycle Time* (ms)	On-Time* (ms)	Duty Cycle (%)	Power Duty Correction (dB)
Cont. Tx.	-	GFSK	12.0	2440.0	-	-	100.0	-

* No duty cycle is applied, EUT setup for continuous GFSK modulation.

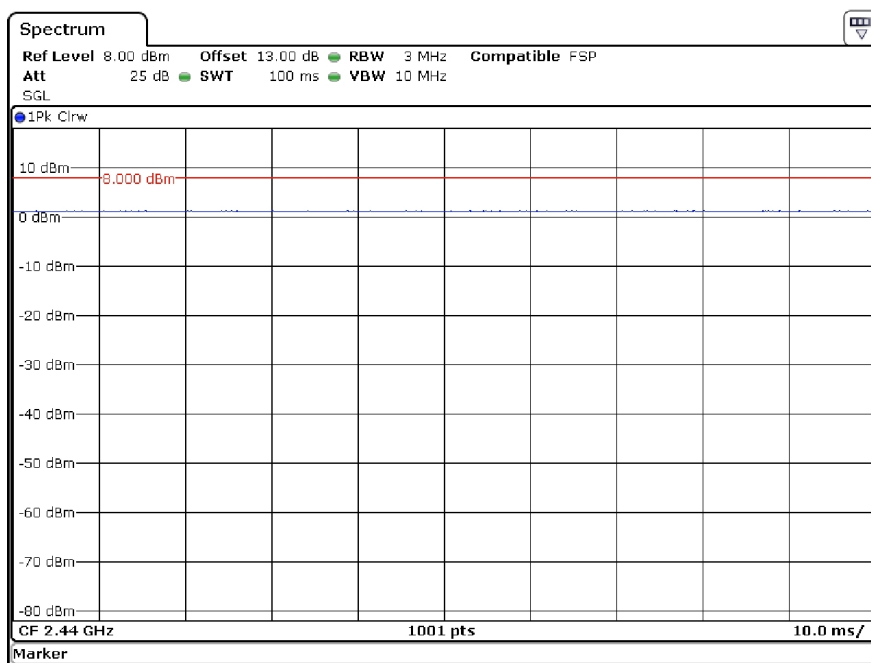


Figure 5: Fundamental Emission Pulsed Operation.

4.2.2 Fundamental Emission Bandwidth

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Emission bandwidth (EBW) of the EUT is measured with the device placed in the test mode(s) with the shortest available frame length and minimum frame spacing. The 20 dB EBW is measured as the max-held peak-detected signal when the IF bandwidth is greater than or equal to 1% of the receiver span. For complex modulations other than ASK and FSK, the 99% emission bandwidth per IC test procedures has a different result, and is also reported. The test equipment employed includes RSFSV30001, HQR1TO18S01.

Measurement Results The details and results of testing the EUT are summarized in Table 5. Plots showing the measurements made to obtain these values are provided in Figure 6.

Table 5: Fundamental Emission Bandwidth.

Frequency Range		Det	IFBW	VBW	Test Date:		10/10/20
f > 1 000 MHz		Pk	30 kHz	100 kHz	Test Engineer:		Joseph Brunett
f > 1 000 MHz		Pk	30 kHz	100 kHz	EUT		AKTV8 iAir3
					Meas. Distance:		Conducted

Occupied Bandwidth								
Transmit Mode	Symbol Rate (Msym/s)	Data Rate* (Mbps)	Voltage (V)	Oper. Freq (MHz)	6 dB BW (MHz)	6 dB BW Limit (MHz)	99% OBW (MHz)	Pass/Fail
Cont. Tx. GFSK	-	-	12.0	2402.0	-	-	1.071	Pass
				2440.0	-	-	1.071	Pass
				2480.0	-	-	1.071	Pass

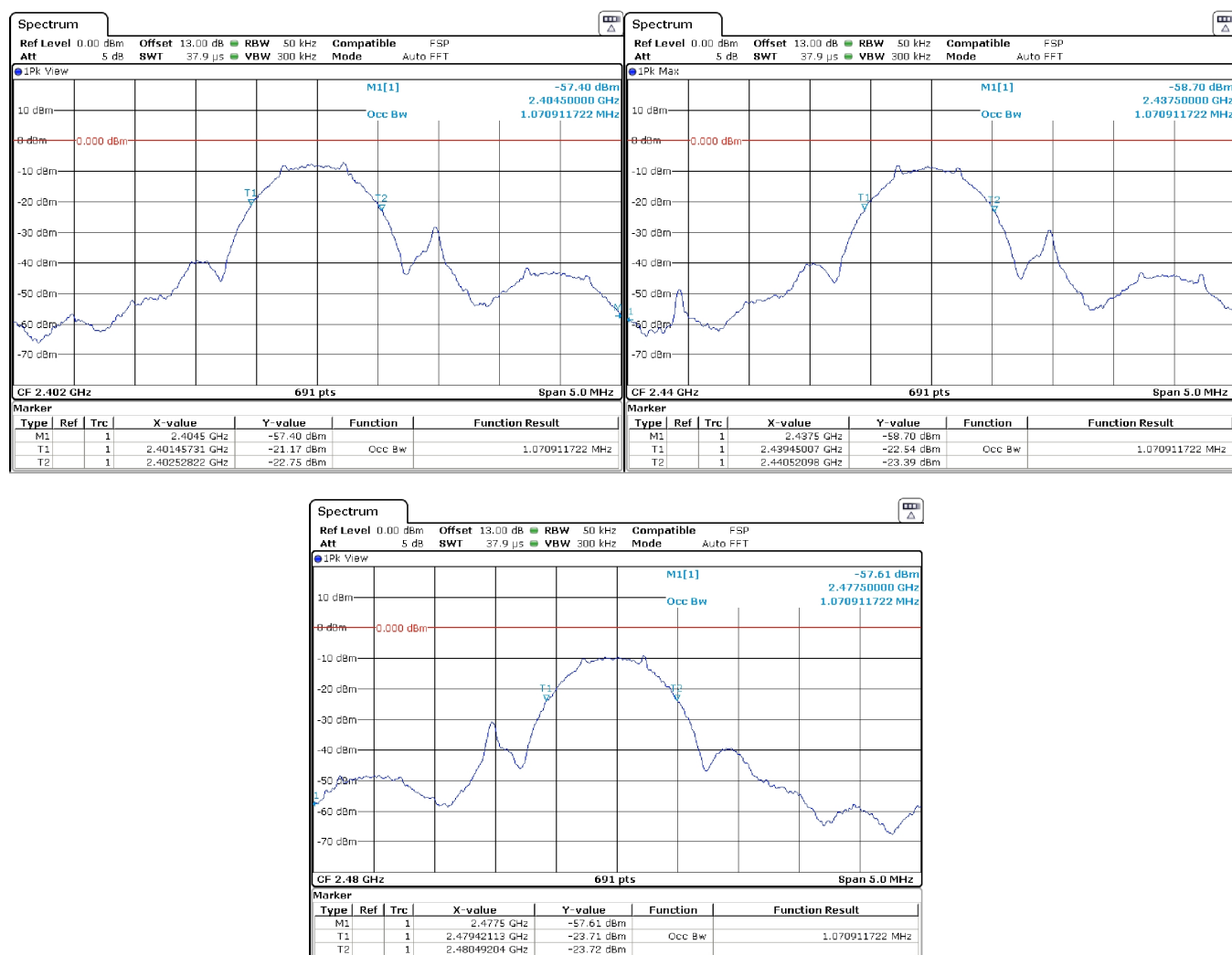


Figure 6: Fundamental Emission Bandwidth.

4.2.3 Fundamental Emission Field Strength

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Fundamental emissions are measured at the regulatory distance on our OATS. The test equipment employed includes RSFSV30001, HQR1TO18S01.

Measurement Results The details and results of testing the EUT are summarized in Table 6.

Table 6: Fundamental Emission Field Strength.

Frequency Range	Det	IF Bandwidth	Video Bandwidth	Test Date:	24-Sep-20
25 MHz $\leq f \leq$ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	Test Engineer:	G. Helm / J. Brunett
f > 1 000 MHz	Pk/Avg	3 MHz	3 MHz	EUT:	AKTV8 iAir3
				Meas. Distance:	3m

FCC/IC

#	Mode	Channel	Freq. MHz	Ant. Used	Ant. Pol.	Table Azim. deg	Ant Height m	Ka dB/m	Kg dB	E3(Pk) dB μ V/m	EIRP (Pk) dBm	E3 (Avg) Limit dB μ V/m	Pass dB
1	CM	L	2402.0	HQR1TO18S01	H/V	.0	1.5	30.5	-0.3	93.5	-1.7	94.0	0.5
2		M	2440.0	HQR1TO18S01	H/V	.0	1.5	30.7	-0.3	91.1	-4.1	94.0	2.9
3		H	2480.0	HQR1TO18S01	H/V	.0	1.5	30.8	-0.3	89.5	-5.7	94.0	4.5
4													
#	Mode	Channel	Freq. MHz	Supply Voltage	Ant. Pol.	Table Azim. deg	Ant Height m	Ka dB/m	Kg dB	E3(Pk) dB μ V/m			
5	CM	L	2402.0	15.0	H/V	rel	1.5	30.5	-0.3	93.5			
6			2402.0	13.8	H/V	rel	1.5	30.5	-0.3	93.5			
7			2402.0	12.0	H/V	.0	1.5	30.5	-0.3	93.5			
8			2402.0	10.2	H/V	rel	1.5	30.5	-0.3	93.5			
9													

* Measured conducted from the radio using conducted test sample.

** Measured radiated at 3 meter distance. Peak power measured with IFBW > OBW per DTS Procedures 9.1.1 RBW > DTS bandwidth

4.3 Unintentional Emissions

4.3.1 Transmit Chain Spurious Emissions

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Spurious radiated emissions measurements are performed to 10 times the highest fundamental operating frequency. The test equipment employed includes RSFSV30001, HQR1TO18S01, HRNK01.

Measurement Results The details and results of testing the EUT are summarized in Table 7.

Table 7: Transmit Chain Spurious Emissions.

Frequency Range	Det	IF Bandwidth	Video Bandwidth	Test Date:	24-Sep-20
25 MHz $\leq f \leq$ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	Test Engineer:	G. Helm / J. Brunett
$f >$ 1 000 MHz	Pk/Avg	1 MHz	3 MHz	EUT:	AKTV8 iAir3
				Mode:	Cont. Modulated
				Meas. Distance:	3m

FCC/IC														
#	Freq. Start MHz	Freq. Stop MHz	Ant. Used	Ant. Pol.	Table Azim. deg	Ant Height m	Ka dB/m	Kg dB	E3(Pk) dBμV/m	E3 Pk Lim dBμV/m	E3(Avg) dBμV/m	E3 Avg Lim dBμV/m	Pass dB	Comments
1	Fundamental Restricted Band Edge (Low Side)													
2	2390.0	2390.0	HQR1TO18S01	H/V	0	1.5	30.5	-0.3	51.2	74.0	40.2	54.0	13.8	all channels; max all orientations; noise
3	2400.0	2400.0	HQR1TO18S01	H/V	0	1.5	30.5	-0.3	56.3	74.0	44.0	54.0	10.0	all channels; max all orientations
4	Fundamental Restricted Band Edge (High Side)													
5	2483.5	2483.5	HQR1TO18S01	H/V	0	1.5	30.8	-0.3	50.2	74.0	40.0	54.0	14.0	all channels; max all orientations
6	Harmonic / Spurious Emissions													
7	4804.0	4804.0	HQR1TO18S01	H/V	0	1.8	32.3	-0.5	55.2	74.0	48.6	54.0	5.4	max all
8	4882.0	4805.0	HQR1TO18S01	H/V	0	1.8	32.3	-0.5	55.7	74.0	49.0	54.0	5.0	max all
9	4960.0	4806.0	HQR1TO18S01	H/V	0	1.8	32.3	-0.5	56.9	74.0	49.9	54.0	4.1	max all
10	4000.0	6000.0	HQR1TO18S01	H/V	0	1.8	32.6	-0.6	56.9	74.0	49.9	54.0	4.1	all channels; max all orientations
11	7206.0	7206.0	HQR1TO18S01	H/V	0	1.8	33.2	-0.7	54.2	74.0	49.5	54.0	4.5	all channels; max all orientations; noise
12	7323.0	7323.0	HQR1TO18S01	H/V	0	1.8	33.3	-0.7	55.2	74.0	50.1	54.0	3.9	all channels; max all orientations; noise
13	7440.0	7440.0	HQR1TO18S01	H/V	0	1.8	33.4	-0.7	52.1	74.0	48.5	54.0	5.5	all channels; max all orientations; noise
14	6000.0	8400.0	HQR1TO18S01	H/V	all	1.5	34.3	-0.8	55.2	74.0	50.1	54.0	3.9	all channels; max all orientations; noise
15	8400.0	12500.0	HQR1TO18S01	H/V	all	1.5	35.6	-1.1	40.9	74.0		54.0	13.1	all channels; max all orientations; noise
16	12500.0	18000.0	HQR1TO18S01	H/V	all	1.5	34.2	-1.6	36.5	74.0		54.0	17.5	all channels; max all orientations; noise
17	18000.0	26000.0	HRNK01	H/V	all	1.5	32.0	0.0	34.9	74.0		54.0	19.1	all channels; max all orientations; noise
18														
19														

*Avg measurements made employing average detector.

5 Measurement Uncertainty and Accreditation Documents

The maximum values of measurement uncertainty for the laboratory test equipment and facilities associated with each test are given in the table below. This uncertainty is computed for a 95.45% confidence level based on a coverage factor of $k = 2$.

Table 8: Measurement Uncertainty.

Measured Parameter	Measurement Uncertainty [†]
Radio Frequency	$\pm(f_{Mkr}/10^7 + RBW/10 + (SPN/(PTS - 1))/2 + 1 \text{ Hz})$
Conducted Emm. Amplitude	$\pm 1.9 \text{ dB}$
Radiated Emm. Amplitude ($f < 30 \text{ MHz}$)	$\pm 3.1 \text{ dB}$
Radiated Emm. Amplitude (30 – 200 MHz)	$\pm 4.0 \text{ dB}$
Radiated Emm. Amplitude (200 – 1000 MHz)	$\pm 5.2 \text{ dB}$
Radiated Emm. Amplitude ($f > 1000 \text{ MHz}$)	$\pm 3.7 \text{ dB}$

[†]Ref: CISPR 16-4-2:2011+A1:2014



Figure 7: Accreditation Documents