



FCC Part 15, Subpart C, Section 15.247
Test Report

On

IoT Sensor Hub
FCC ID: Z5IHB1

Customer Name: KCF Technologies, Inc.

Customer P.O.: 04232020A

Date of Report: September 17, 2020

Test Report No.: R-3248P-1

Test Start Date: July 28, 2020

Test Finish Date: September 3, 2020

Test Technician: M. Nowak

Approved By: D. Rybicki

Report Prepared By: B. Bolton

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Technical Information

Report Number:	R-3248P-1
Customer:	KCF Technologies, Inc.
Address:	336 S. Fraser Street State College, PA 16801
Manufacturer:	KCF Technologies, Inc.
Manufacturer Address:	336 S. Fraser Street State College, PA 16801
Test Sample:	IoT Sensor Hub
Model Number:	SD-HUB-1-MB SD-HUB-1-MA SD-HUB-1-XB SD-HUB-1-XA
FCC ID:	ZSIHB1
Type:	2.405 to 2.480 GHz Digital Spread Spectrum Transceiver
Power Requirements:	120 VAC, 60 Hz (SD-HUB-1-MA and SD-HUB-1-XA)
Power Requirements:	3.6 VDC internal battery derived from Li-SOCl ₂ (SD-HUB-1-MB and SD-HUB-1-XB)
Frequency of Operation:	2400 – 2483.5 MHz
Equipment Class:	DSS
Equipment Use:	Fixed

Test Specification:

FCC Rules and Regulations Part 15, Subpart C, Section 15.247

Test Procedure:

ANSI C63.4:2014
ANSI C63.10:2013

Test Facility:

Retlif Testing Laboratories
3131 Detwiler Road
Harleysville, PA 19438

FCC Accreditation Designation Number: US2321



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Tests Performed

The test methods performed on the IoT Sensor Hub are shown in Table 1 below:

Table 1 – Test Methods

FCC Part 15, Subpart C	Test Method
15.247(a)(2)	Occupied Bandwidth
15.247(b)(3)	Power Output
15.247(d)	Antenna Port, Conducted Emissions
15.247(d)	Out of Band / Band Edge Radiated Emissions, 9kHz to 25 GHz
15.247(e)	Antenna Port, Power Density
15.207(a)	Conducted Limits, 150 kHz to 30 MHz

The equipment utilized to operate the EUT are shown in Table 2 below:

Table 2 – Support Equipment

Description	Manufacturer	Model Number	Serial Number
Test PC	Dell	Latitude 5490	GG1V7S2
Transceiver	KCF Technologies	SD-PRN-2	C00010D4
Vibration Sensor	KCF Technologies	SD-WVS-1	1000004E
Vibration Sensor	KCF Technologies	SD-WVS-1	1000003C
Vibration Sensor	KCF Technologies	SD-WVS-1	1000002D
Vibration Sensor	KCF Technologies	SD-WVS-1	1000001F
Vibration Sensor	KCF Technologies	SD-WVS-1	1000004B
Vibration Sensor	KCF Technologies	SD-WVS-1	10000034
Vibration Sensor	KCF Technologies	SD-WVS-1	1000003A

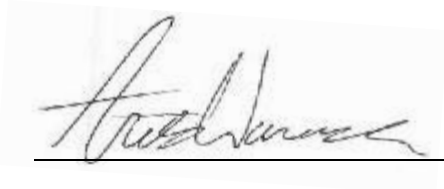


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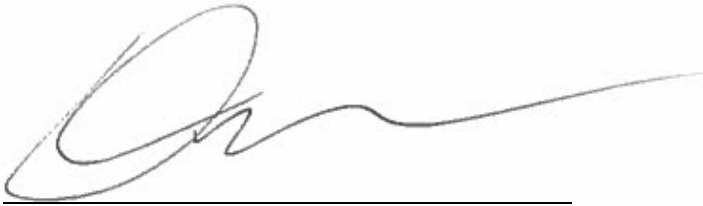
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Certification and Signatures

We certify that this report is a true representation of the results obtained from the tests of the equipment stated. We further certify that the measurements shown in this report were made in accordance with the procedures indicated and vouch for the qualifications of all Retlif Testing Laboratories personnel taking them.



Arik L. Warwick
EMI Test Engineer



David M. Rybicki
Laboratory Supervisor

Non-Warranty Provision

The testing services have been performed, findings obtained and reports prepared in accordance with generally accepted laboratory principles and practices. This warranty is in lieu of all others, either expressed or implied.

Non-Endorsement

This test report contains only findings and results arrived at after employing the specific test procedures and standards listed herein. It is not intended to constitute a recommendation, endorsement or certification of the product or material tested. This test report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.



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Requirements and Test Results

FCC Section 15.247(a)(2), Occupied Bandwidth

Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz bands. The minimum 6 dB bandwidths shall be at least 500 kHz.

- Results:
The EUT complies with the 6 dB bandwidth requirement. The minimum measured 6 dB bandwidth was 625.25 kHz.

FCC Sections 15.247(b)(3), Power Output

Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

For systems using digital modulation in the 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antenna and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antenna and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

- Results:
The EUT complies with the Power Output requirement. The device operates in the 2400 – 2483.5 MHz band. The maximum peak output power was measured and was found to be 34.20 mW.



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Requirements and Test Results (con't)

FCC Section 15.247(d), Antenna Port Conducted Emissions

Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) must also comply with the radiated emissions limits specified in Section 15.209(a) (see Section 15.205(c)).

- **Results:**
In any 100 kHz bandwidth outside the frequency band in which the Spread spectrum intentional radiator was operating, the radio frequency power that was produced by the intentional radiator was at least 20 dB below that in the 100 kHz bandwidth within the band that contained the highest level of the desired power. All emissions, which fell within the restricted bands specified in 15.205(a), were measured and found to be in compliance with the limits specified in 15.209(a).

FCC Section 15.247(e), Antenna Port, Power Density

Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

- **Results:**
The power spectral density conducted from the intentional radiator to the antenna was not greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density was determined in accordance with Section 15.247(b)(3).



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Requirements and Test Results (con't)

FCC Section 15.209(a), Radiated Emission Limits, General Requirements

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 3.

Table 3 - Radiated Emission Limits

Frequency of Emission (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 to 88	100	3
88 to 216	150	3
216 to 960	200	3
Above 960	500	3

- Results:
The field strength of spurious radiated emissions did not exceed the limits specified in Table 3.

FCC Section 15.207(a), Conducted Limits

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits shown in Table 4, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of the paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Table 4 - Conducted Emission Limits

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50
*Decreases due to logarithm of the frequency		

- Results:
The conducted emissions observed did not exceed the limits specified in Table 4.



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Requirements and Test Results (con't)

Field Strength Calculation/Conversion:

The maximized field strength of the emission was obtained as follows:

$$C_R = M_R + C_F$$

Where:

C_R = Corrected Reading in dB μ V/m

M_R = Uncorrected Meter Reading in dB μ V

C_F = Correction Factor in dB (Antenna Factor, Pre-amp + Cable Loss)

Example:

$$M_R = 15.35 \text{ dB}\mu\text{V}$$

$$C_F = 16.85 \text{ dB}$$

$$C_R = 15.35 \text{ dB}\mu\text{V} + 16.85 = 32.2 \text{ dB}\mu\text{V/m}$$

dB μ V/m is converted to uV/M for comparison to the specified limit using the formula:

$$\text{invLog dB}\mu\text{V/M}/20$$

$$32.2 \text{ dB}\mu\text{V/m} = 40.74 \text{ uV/m}$$

RF Power Conversion:

Power readings in dBm may be converted to mW using the formula:

$$\text{InvLog dBm}/10$$

$$\text{Example: } 20\text{dBm} = 100\text{mW}$$



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Requirements and Test Results (con't)

FCC Section 15.247 (i), RF Exposure Limits

Spread Spectrum Transmitters operating under 15.247 must be operated in a manner that ensures the public is not exposed to RF energy levels in excess of the commission's guidelines. Based on the transmitter power and maximum antenna gain (see calculation below) the minimum separation distance was calculated to determine the distance for acceptable MPE power density levels to meet both the Occupational/Controlled Exposure and the General Population/Uncontrolled Exposure requirements of FCC Part 1.1310. The calculation below uses the more stringent General Population MPE Limits.

$$S = \frac{PG}{4\pi D^2}$$

D = Minimum Separation Distance in cm

S = Max allowed Power Density in mW/cm²

Per 1.1310 For the frequency range of 2400 – 2483.5 MHz S = 1mW/cm²

Power (P) = Max power Input to Antenna = 34.20 mW

Gain (G) = Max Power Gain of Antenna = 1.75dBi = 1.5 numeric

$$1\text{mW/cm}^2 = \frac{34.20 \times 1.5}{4\pi \times D^2} = \frac{51.30}{12.57 \times D^2}$$

$$D^2 = 4.08$$

$$D = 2.02 \text{ cm}$$



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Spectrum Analyzer Desensitization Considerations

Due to the nature of the emissions being measured, care was taken to ensure that the resolution bandwidth of the spectrum analyzer was adequate to provide accurate measurements. FCC specified bandwidths of 100 kHz and 1 MHz were utilized below and above 1 GHz, respectively.

General Notes

1. All radiated readings were taken utilizing a detector function specified on each data sheet at a test distance of 3 meters.
2. All measurements for models SD-HUB-1-MA or SD-HUB-1-XA were made with the device powered by 120 VAC, 60 Hz.
3. All measurements for models SD-HUB-1-MB or SD-HUB-1-XB were made with the device powered by a fully charged 3.6VDC internal battery.
4. Each test method was performed on 2 representative models. The model tested will be noted on each data sheet.
5. The frequency range was scanned as specified in each method. For radiated measurements all emissions not reported were more than 20 dB below the specified limit.



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Equipment List

FCC Section 15.247(a)(2), Occupied Bandwidth FCC Section 15.247(b)(3), Power Output FCC Section 15.247(d), Antenna Port, Conducted Emissions FCC Section 15.247(e), Antenna Port, Power Density

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
713	ROHDE & SCHWARZ	RECEIVER, EMI	20 Hz - 26.5 GHz	ESIB26	3/19/2020	3/31/2021
713E	MICRO-COAX	CABLE, COAXIAL	6 FEET 50U50U	UFB311A1-0720-	10/14/2019	10/31/2020
8557	NARDA MICROWAVE	ATTENUATOR, COAXIAL	11 dB, DC - 11 GHz, 20 W	768-10	6/2/2020	6/30/2021
8619	OMEGA	HYGROMETER	-20 to 70 deg. C, 0-99% RH	OM-73	3/16/2020	3/31/2021

FCC Section 15.247(d), Spurious Radiated Emissions

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
127A	ETS / EMCO	ANTENNA, BICONICAL	20 - 200 MHz	3104	5/6/2019	11/30/2020
8016	ETS / EMCO	ANTENNA, LOG PERIODIC	200 MHz - 1 GHz	3146	9/9/2019	3/31/2021
8080	ROHDE & SCHWARZ	RECEIVER, EMI	20 - 1300 MHz	354-3000.56ESVP	11/5/2019	11/30/2020
8300	RETLIF	OPEN AREA TEST SITE, ATTENUATION	3/10 Meter OATS	RPA	5/7/2020	5/31/2022
8300C	UNKNOWN	CABLE, COAXIAL	3/10 METER	3 METER CABLE	8/21/2020	2/28/2021
8644	AGILENT / HP	ANALYZER, SPECTRUM	100 Hz - 22 GHz	85662A	9/23/2019	9/30/2020
8644A	AGILENT / HP	ANALYZER, SPECTRUM	100 Hz - 22.5 GHz	8566B	9/23/2019	9/30/2020
8644B	AGILENT / HP	ANALYZER, RF PRESELECTOR	20 Hz - 2 GHz	85685A	9/23/2019	9/30/2020
8668	DIGI-SENSE	HYGROMETER RH	0 - 50 deg. c, 10 - 90 %	20250-31	3/16/2020	9/30/2020

FCC Section 15.207(a), Conducted Limits

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
8079	ROHDE & SCHWARZ	RECEIVER, EMI	9 kHz - 30 MHz	ESH3	6/24/2020	6/30/2021
8366A	RETLIF	CABLE, COAXIAL	10 KHz - 1 GHz	20' BNC	5/14/2020	5/31/2021
8496	NARDA MICROWAVE	ATTENUATOR, COAXIAL	10 dB, DC - 11 GHz, 20 W	768-10	6/2/2020	6/30/2021
8619	OMEGA	HYGROMETER	-20 to 70 deg. C, 0-99% RH	OM-73	3/16/2020	3/31/2021
8633	SOLAR ELECTRONICS	LISN	50 uH, 150 kHz - 30 MHz	21106-50-BP-25-BNC	6/22/2020	6/30/2021
8634	SOLAR ELECTRONICS	LISN	50 uH, 150 kHz - 30 MHz	21106-50-BP-25-BNC	6/22/2020	6/30/2021
8749	RIGOL	ANALYZER, SPECTRUM	9 kHz - 3.2 GHz	DSA832E	5/19/2020	5/31/2021



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FCC 15.247(a)(2)
Test Data, Occupied Bandwidth, SD-HUB-1-MA

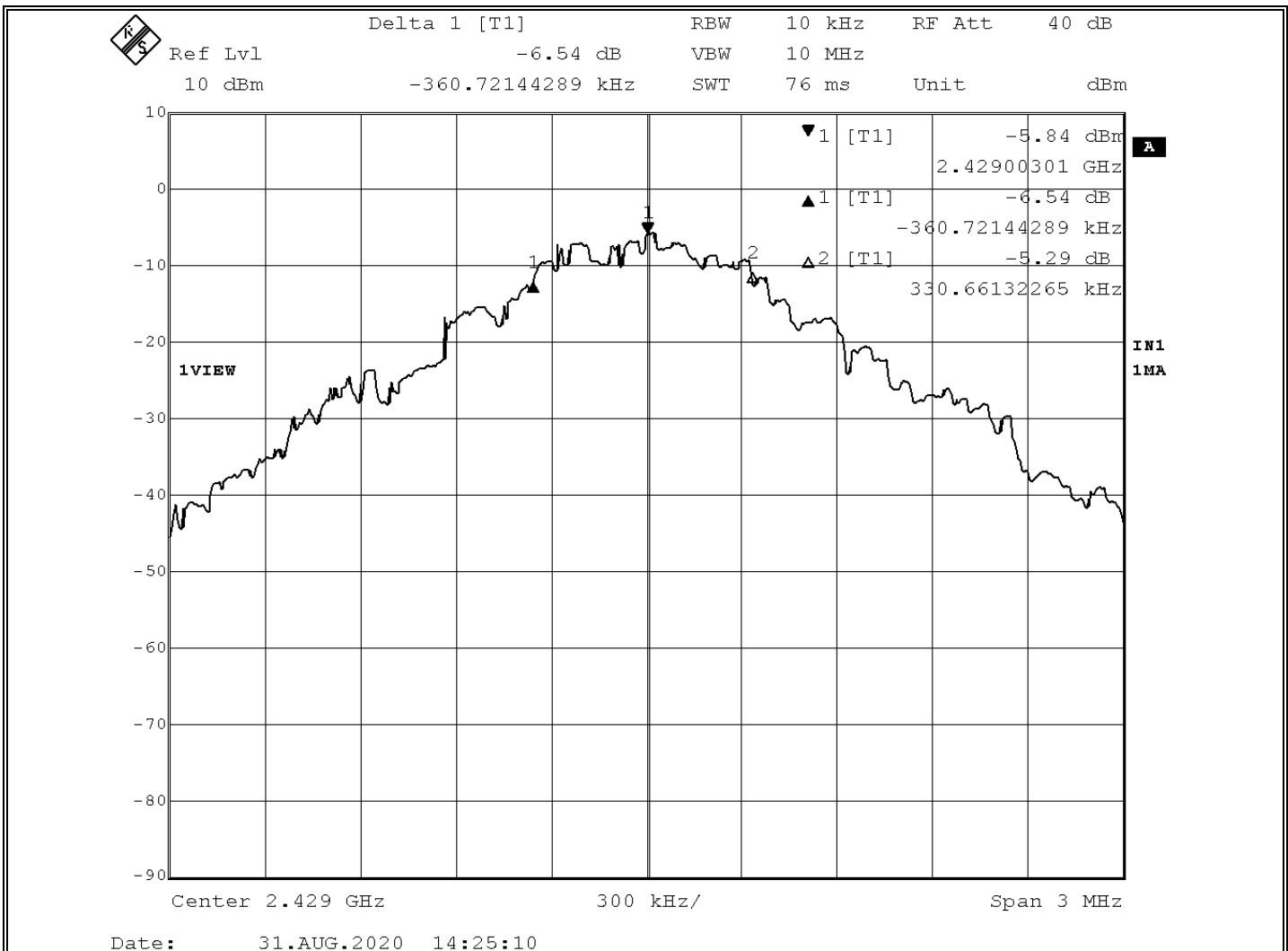


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.247(a)(2), Occupied Bandwidth
Method:	ANSI C63.10, Section 6.9, Occupied Bandwidth Tests
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C00002D
Operating Mode:	Continuously transmitting a modulated signal at 2429 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	2429 MHz 6 dB Bandwidth = 691.38 kHz

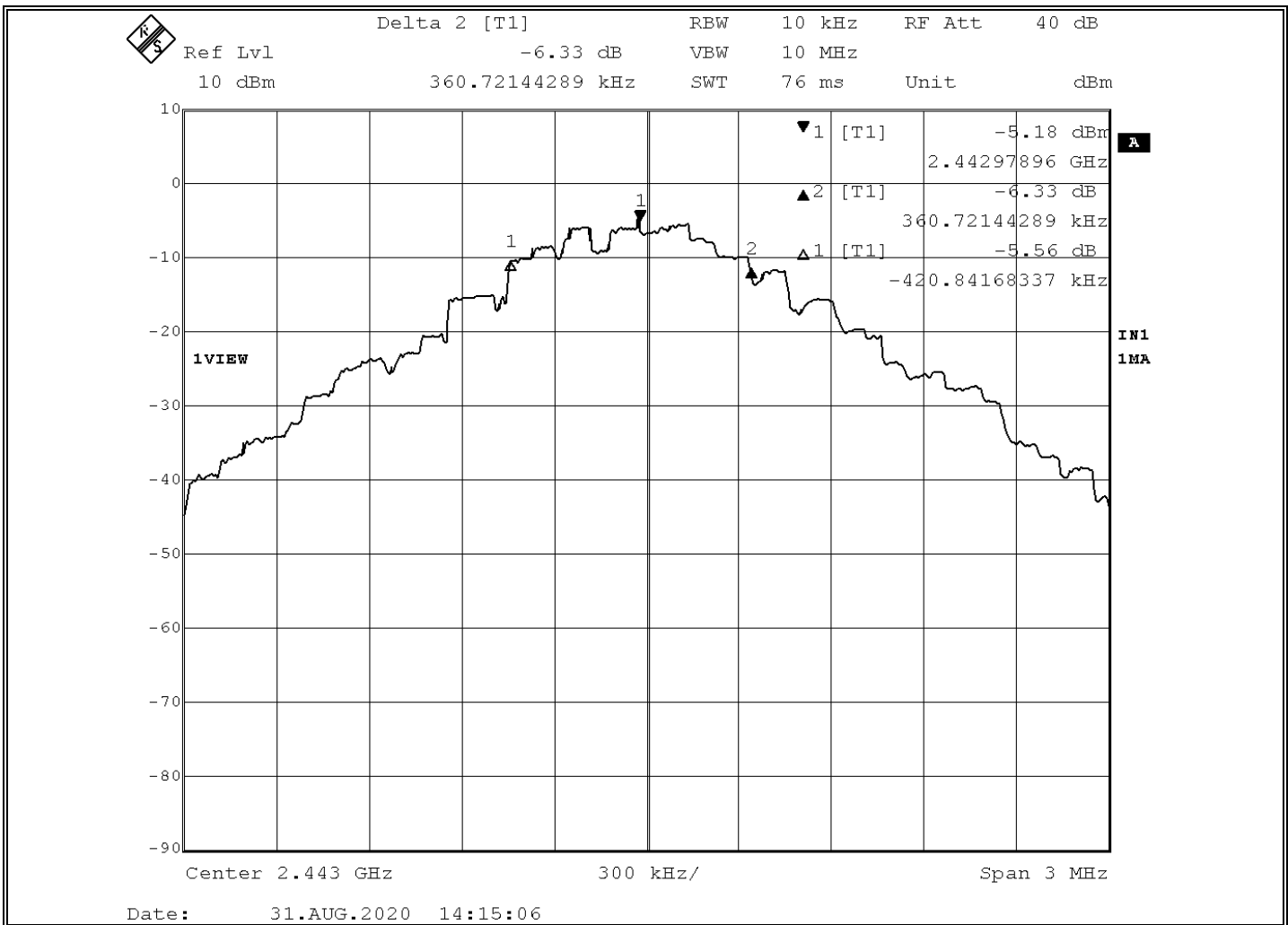


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Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.247(a)(2), Occupied Bandwidth
Method:	ANSI C63.10, Section 6.9, Occupied Bandwidth Tests
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C00002D
Operating Mode:	Continuously transmitting a modulated signal at 2443 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	2443 MHz 6 dB Bandwidth = 781.56 kHz

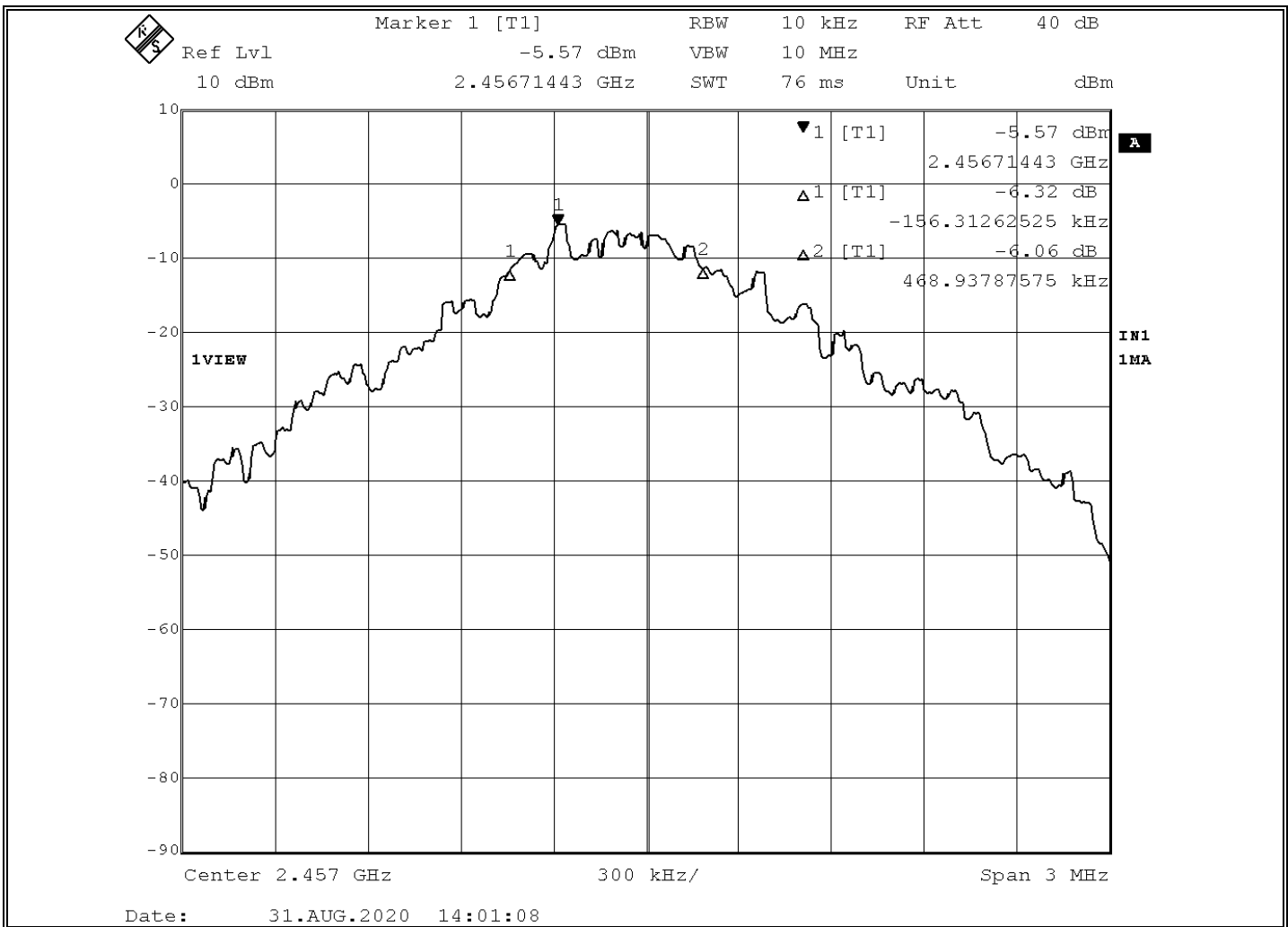


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Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.247(a)(2), Occupied Bandwidth
Method:	ANSI C63.10, Section 6.9, Occupied Bandwidth Tests
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C00002D
Operating Mode:	Continuously transmitting a modulated signal at 2457 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	2457 MHz 6 dB Bandwidth = 625.25 kHz



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FCC 15.247(a)(2)
Test Data, Occupied Bandwidth, SD-HUB-1-XA

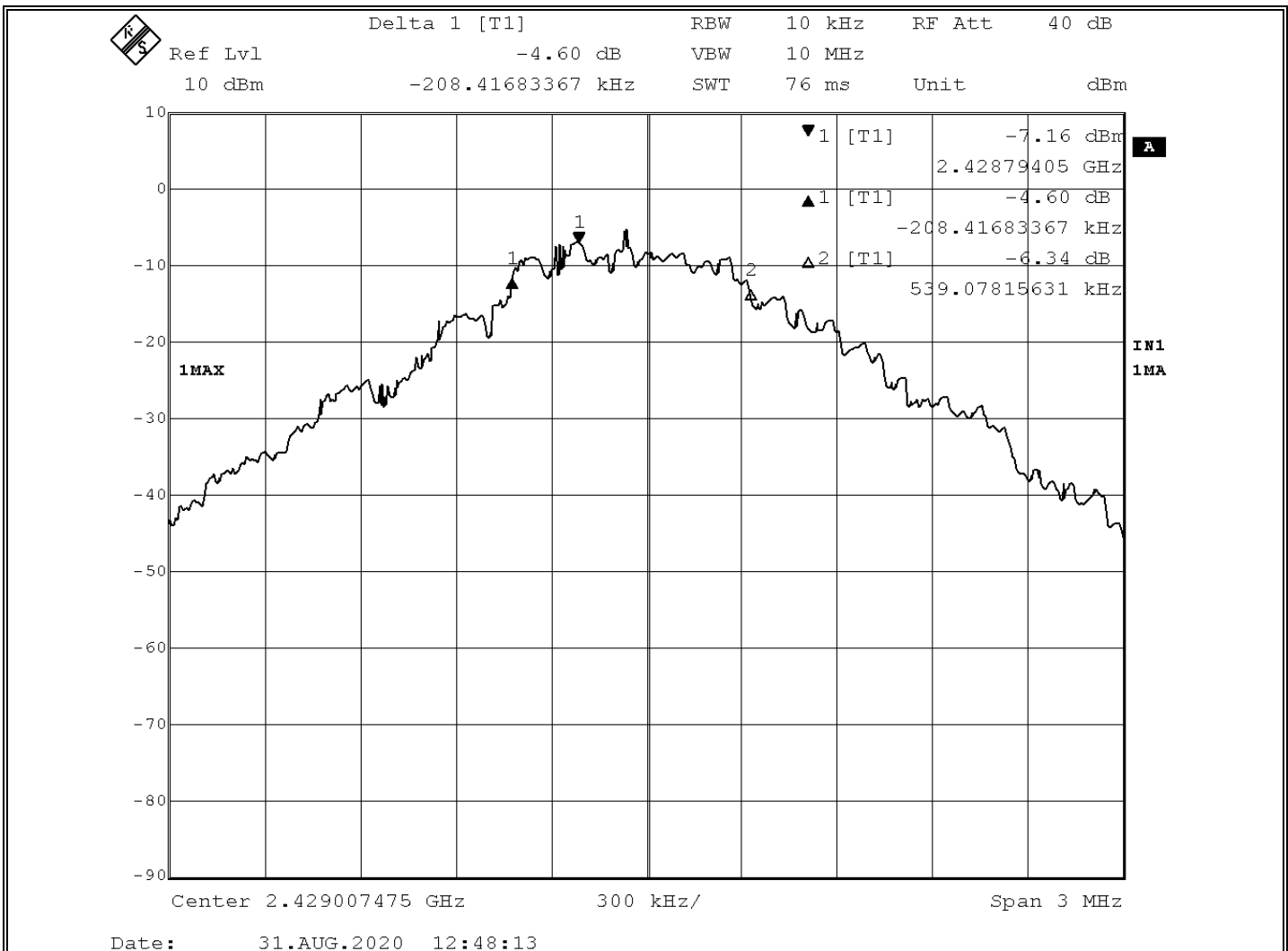


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.247(a)(2), Occupied Bandwidth
Method:	ANSI C63.10, Section 6.9, Occupied Bandwidth Tests
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-XA
Serial Number:	1C000007
Operating Mode:	Continuously transmitting a modulated signal at 2429 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	2429 MHz 6 dB Bandwidth = 747.58 kHz

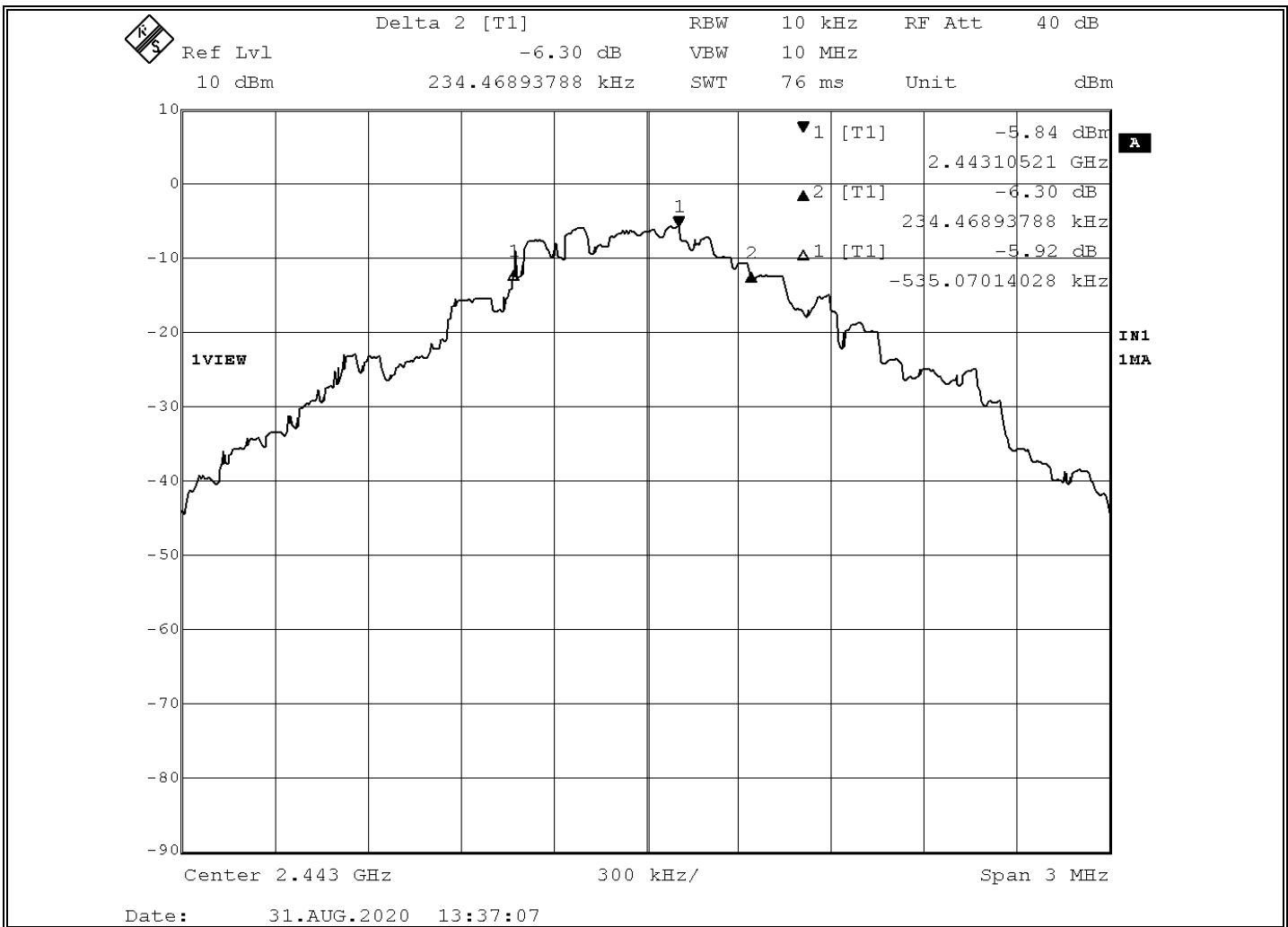


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.247(a)(2), Occupied Bandwidth
Method:	ANSI C63.10, Section 6.9, Occupied Bandwidth Tests
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-XA
Serial Number:	1C000007
Operating Mode:	Continuously transmitting a modulated signal at 2443 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	2443 MHz 6 dB Bandwidth = 769.54 kHz

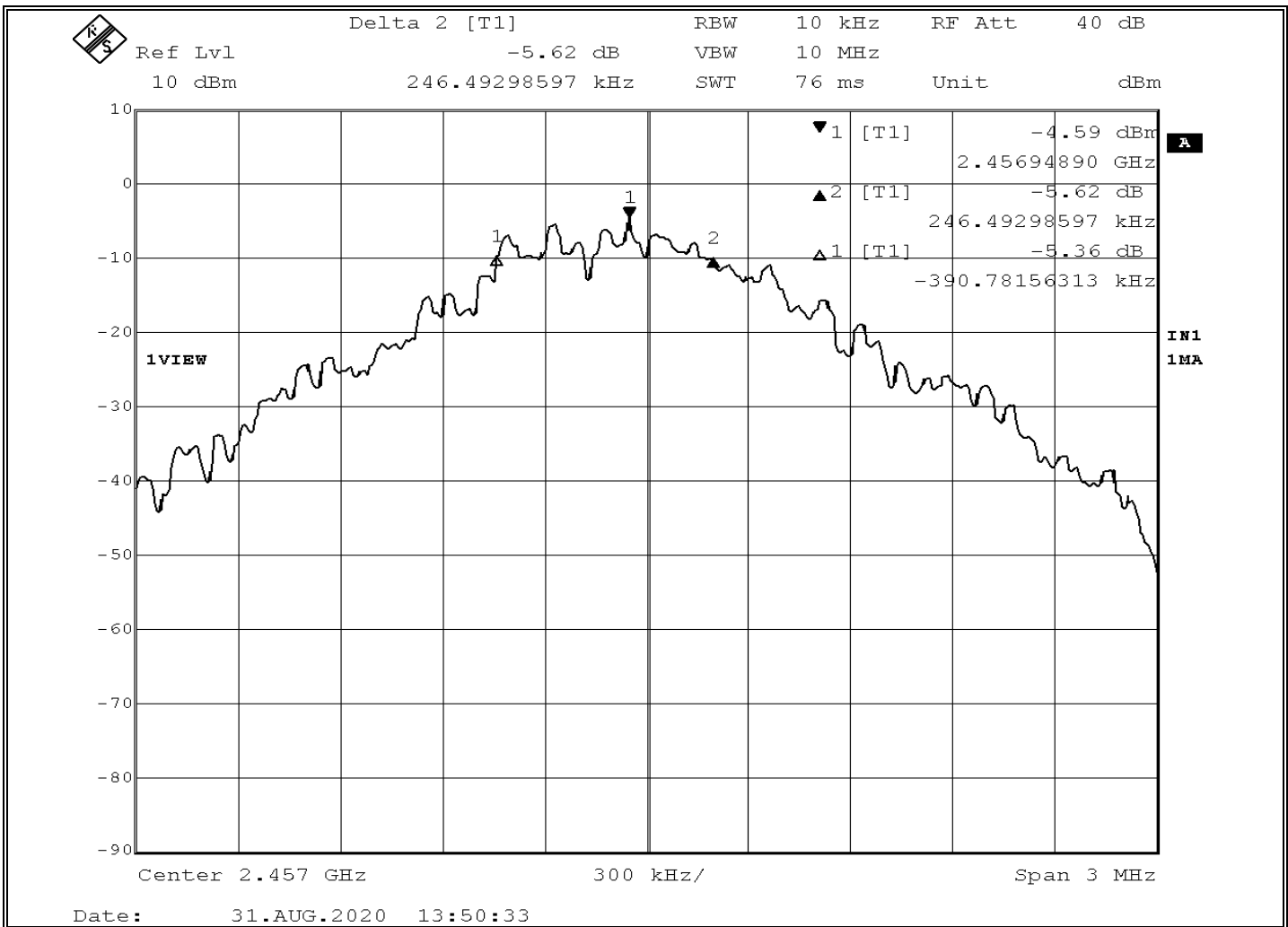


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.247(a)(2), Occupied Bandwidth
Method:	ANSI C63.10, Section 6.9, Occupied Bandwidth Tests
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-XA
Serial Number:	1C000007
Operating Mode:	Continuously transmitting a modulated signal at 2457 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	2457 MHz 6 dB Bandwidth = 637.24 kHz



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FCC 15.247(b)(3)
Test Data, Power Output, SD-HUB-1-MA

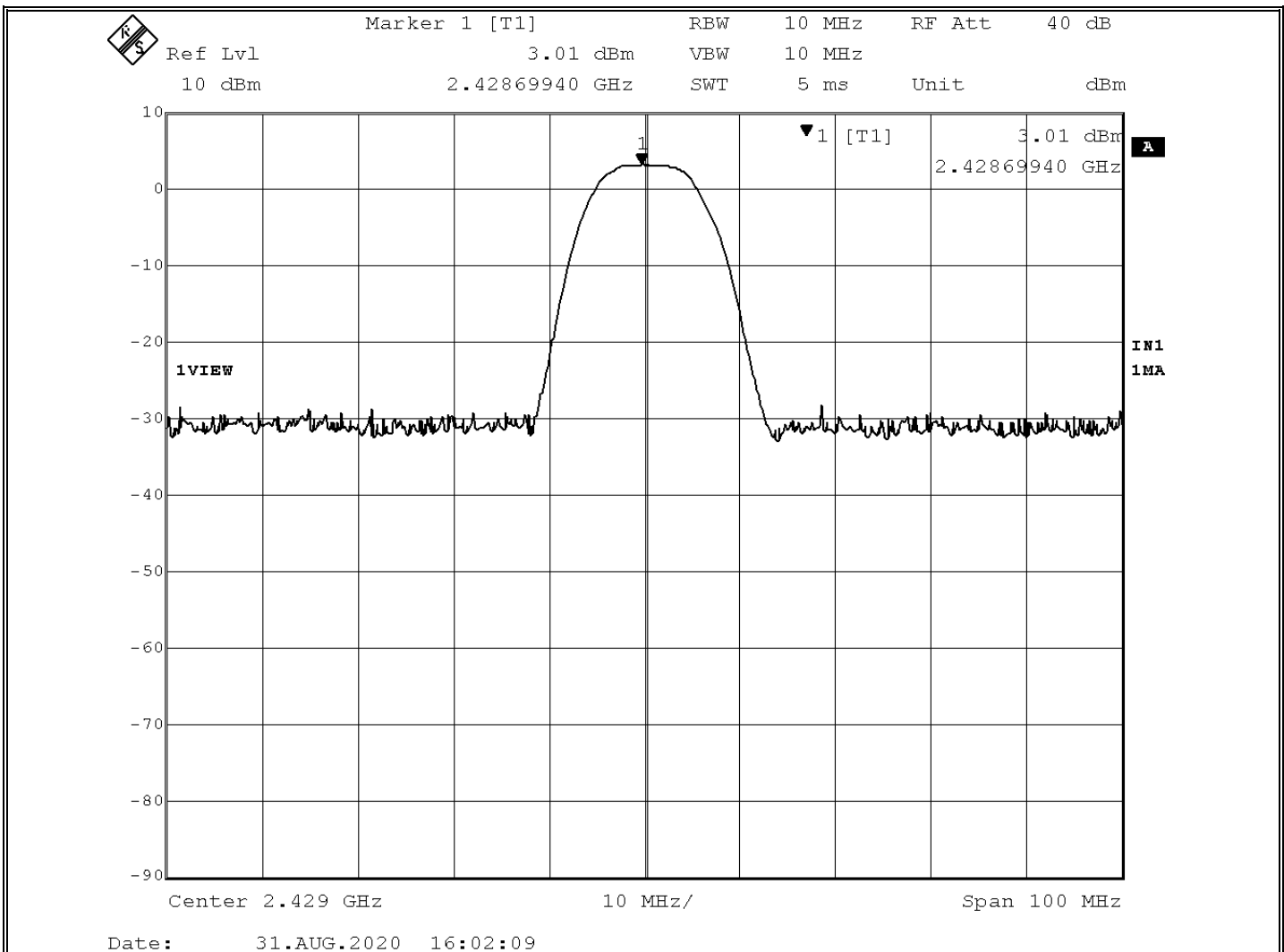


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (b)(3)
Method:	ANSI C63.10, Section 11.9.1 Maximum peak conducted output power
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C00002D
Operating Mode:	Continuously transmitting a modulated signal at 2429 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Peak Power Output = 3.01 dBm + 10.79 dB (attenuator) = 13.8 dBm = 23.99 mW

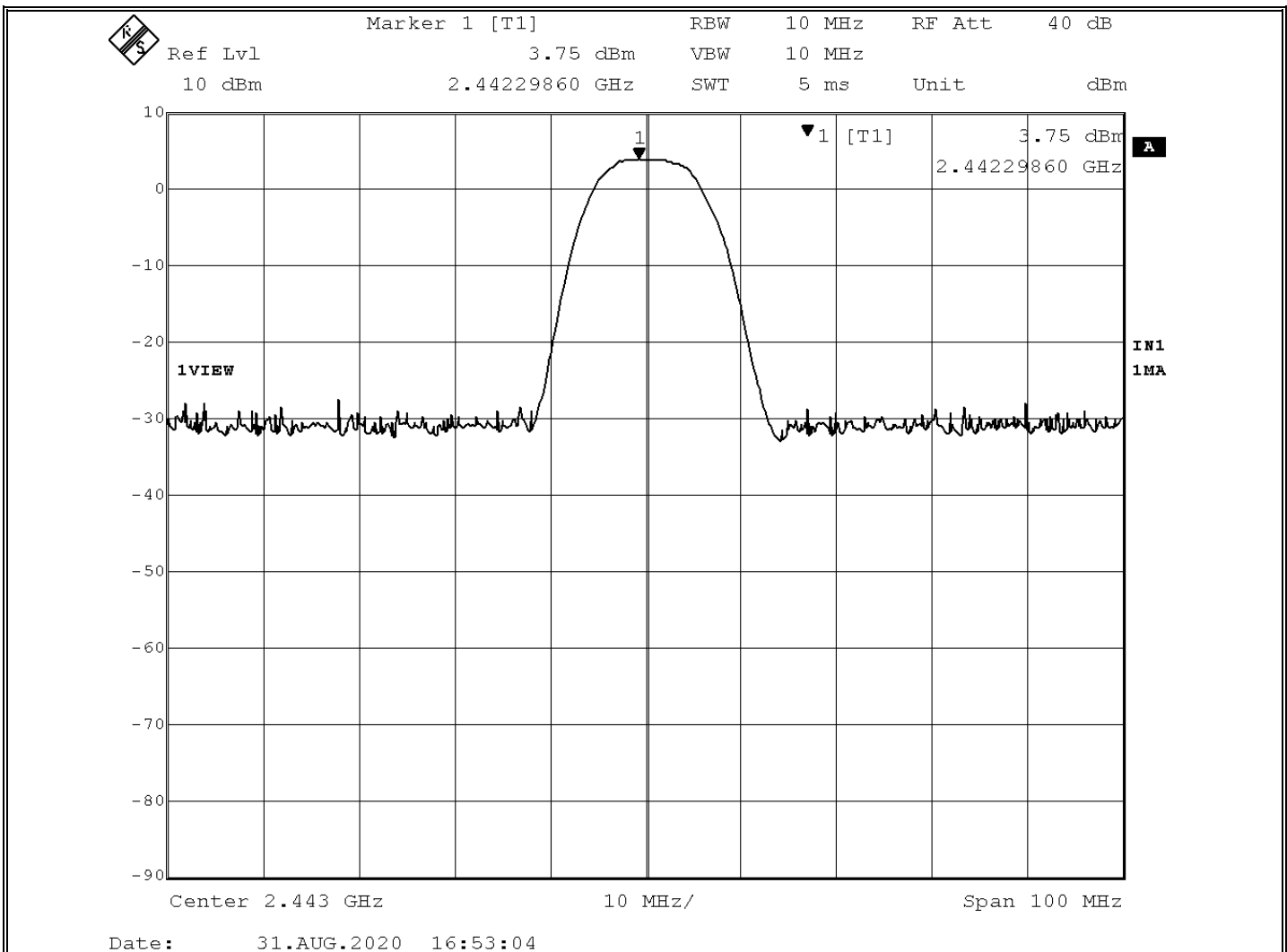


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Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (b)(3)
Method:	ANSI C63.10, Section 11.9.1 Maximum peak conducted output power
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C00002D
Operating Mode:	Continuously transmitting a modulated signal at 2443 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Peak Power Output = 3.75 dBm + 10.79 dB (attenuator) = 14.54 dBm = 28.44 mW

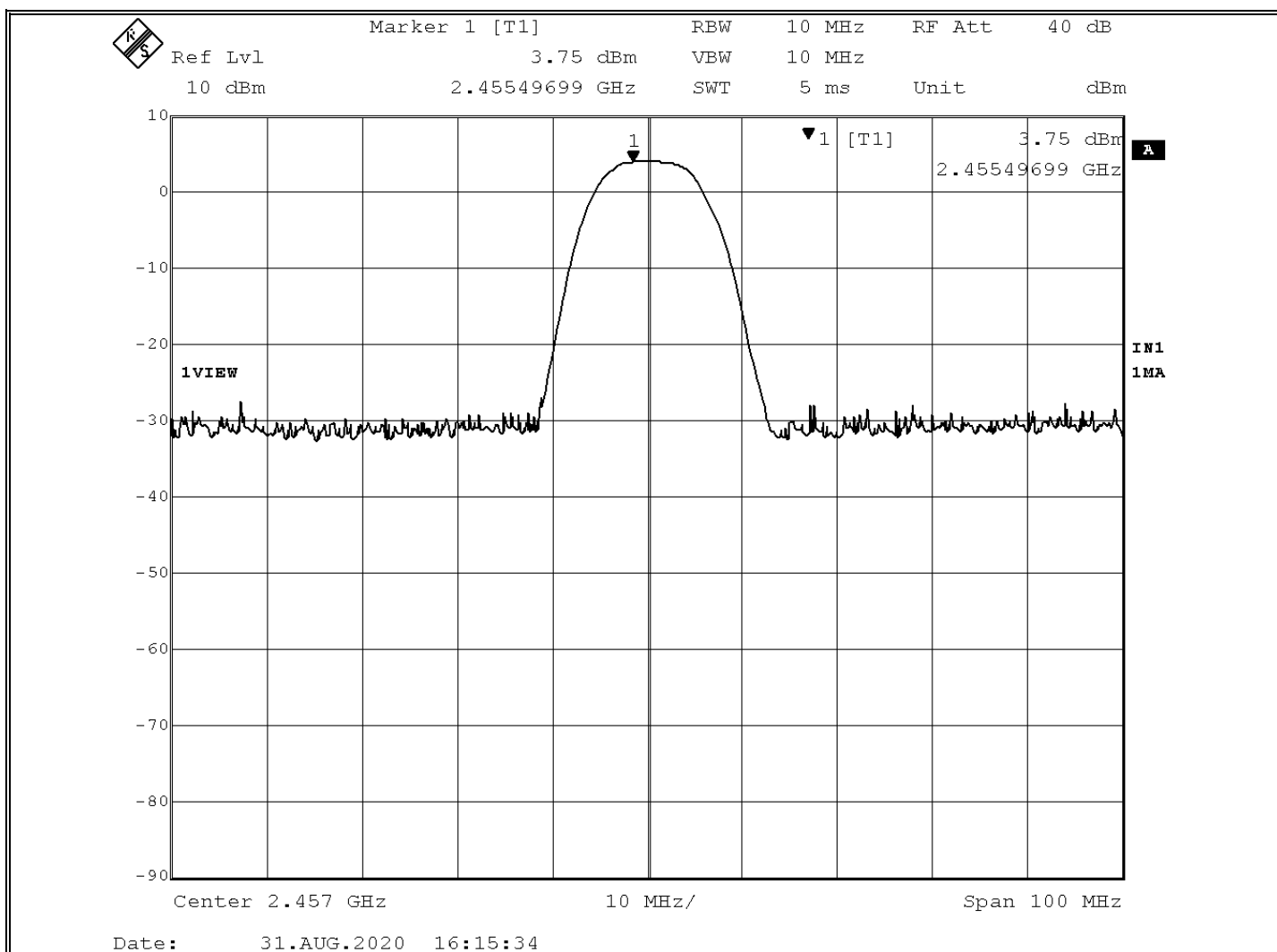


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Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (b)(3)
Method:	ANSI C63.10, Section 11.9.1 Maximum peak conducted output power
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C00002D
Operating Mode:	Continuously transmitting a modulated signal at 2457 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Peak Power Output = 3.75 dBm + 10.79 dB (attenuator) = 14.54 dBm = 28.44 mW



Retlif Testing Laboratories

Report No. R-3248P-1

FCC 15.247(b)(3)
Test Data, Power Output, SD-HUB-1-MB

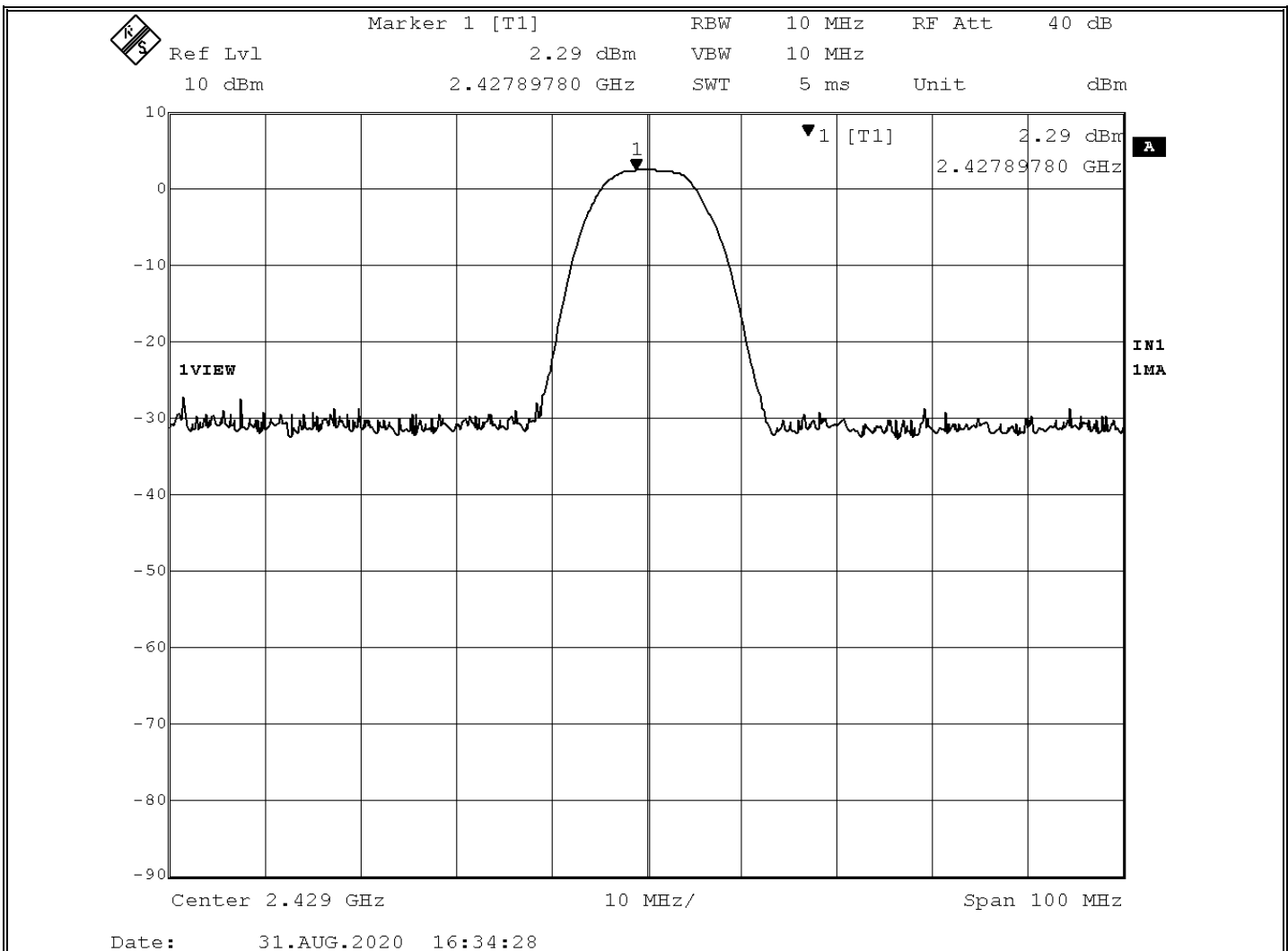


Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (b)(3)
Method:	ANSI C63.10, Section 11.9.1 Maximum peak conducted output power
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MB
Serial Number:	1C00002C
Operating Mode:	Continuously transmitting a modulated signal at 2429 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Peak Power Output = 2.29 dBm + 10.79 dB (attenuator) = 13.08 dBm = 20.32 mW

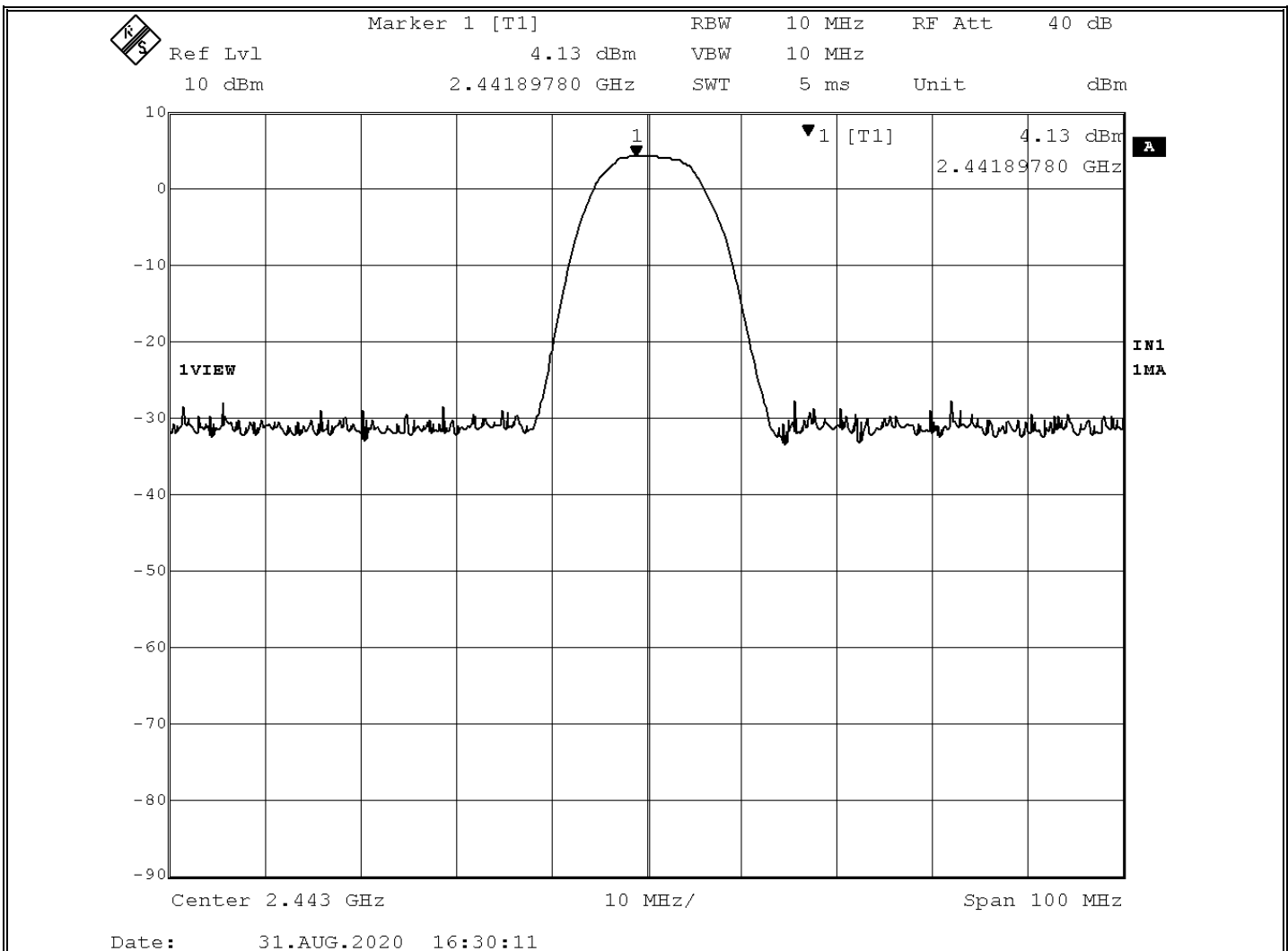


Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (b)(3)
Method:	ANSI C63.10, Section 11.9.1 Maximum peak conducted output power
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MB
Serial Number:	1C00002C
Operating Mode:	Continuously transmitting a modulated signal at 2443 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Peak Power Output = 4.13 dBm + 10.79 dB (attenuator) = 14.92 dBm = 31.06 mW

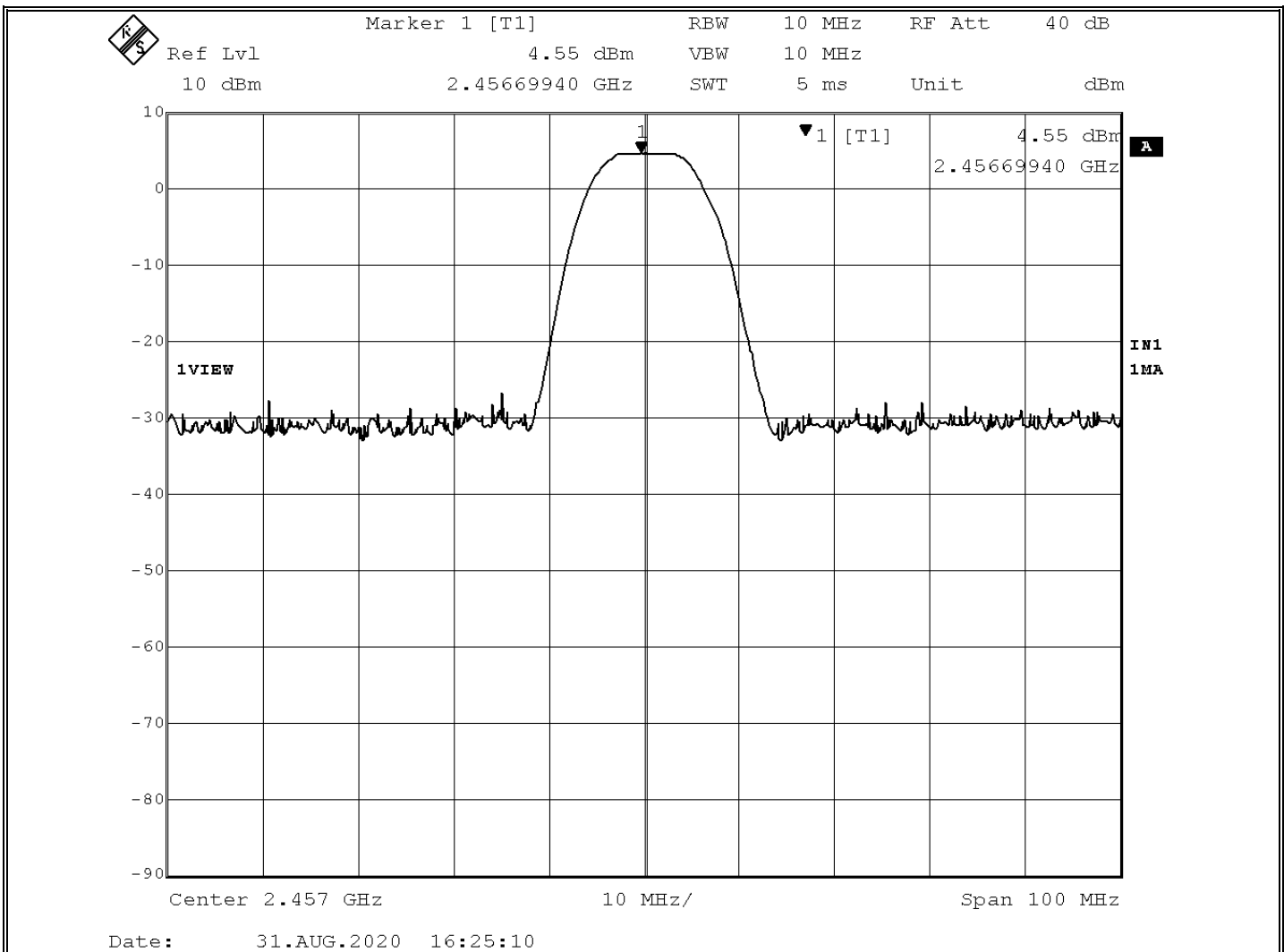


Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (b)(3)
Method:	ANSI C63.10, Section 11.9.1 Maximum peak conducted output power
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MB
Serial Number:	1C00002C
Operating Mode:	Continuously transmitting a modulated signal at 2457 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Peak Power Output = 4.55 dBm + 10.79 dB (attenuator) = 15.34 dBm = 34.20 mW



Retlif Testing Laboratories

Report No. R-3248P-1

FCC Part 15.247, Paragraph (d)
Test Data, Out of Band Emissions, SD-HUB-1-MA

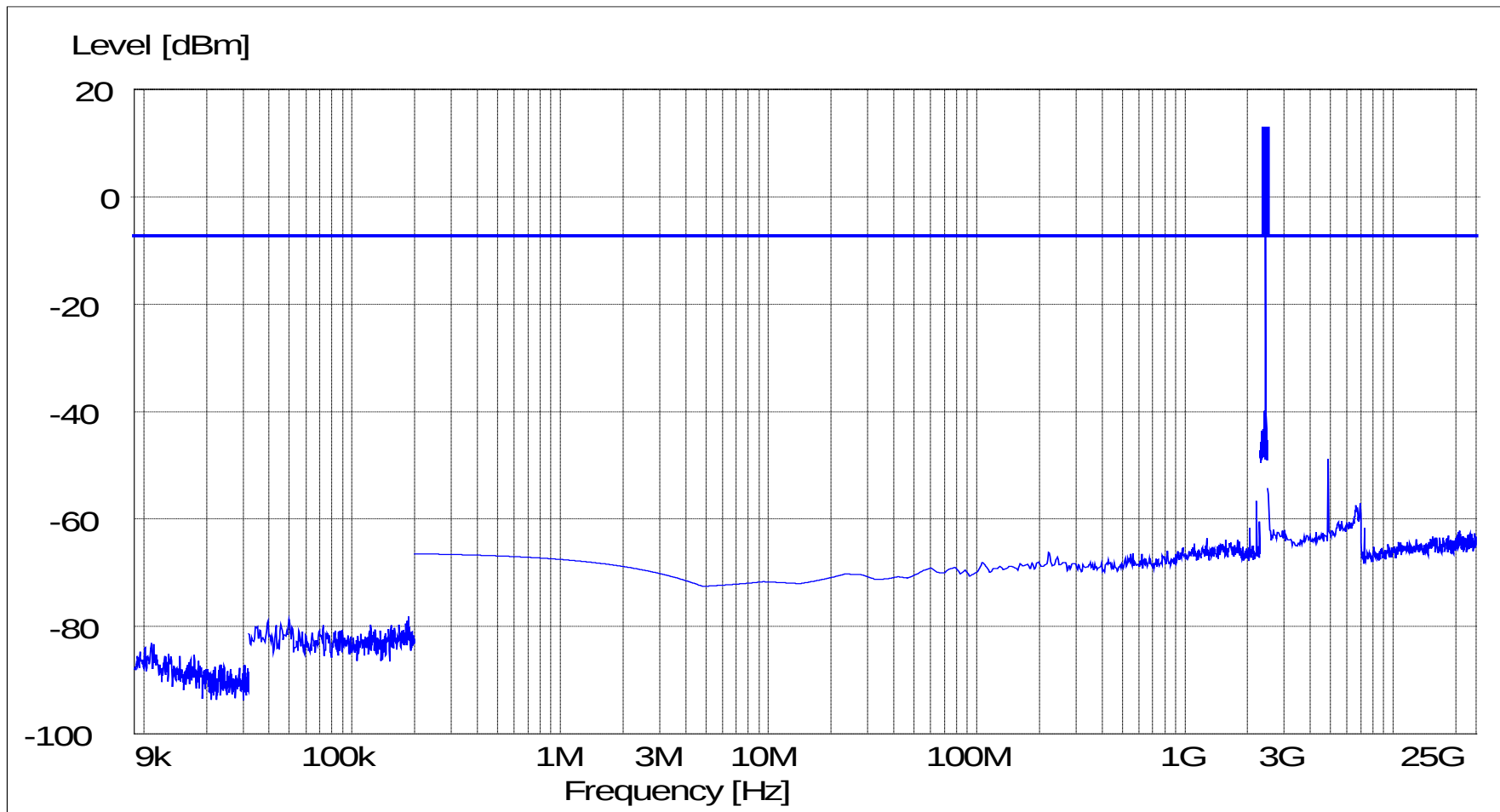


Retlif Testing Laboratories

Report No. R-3248P-1

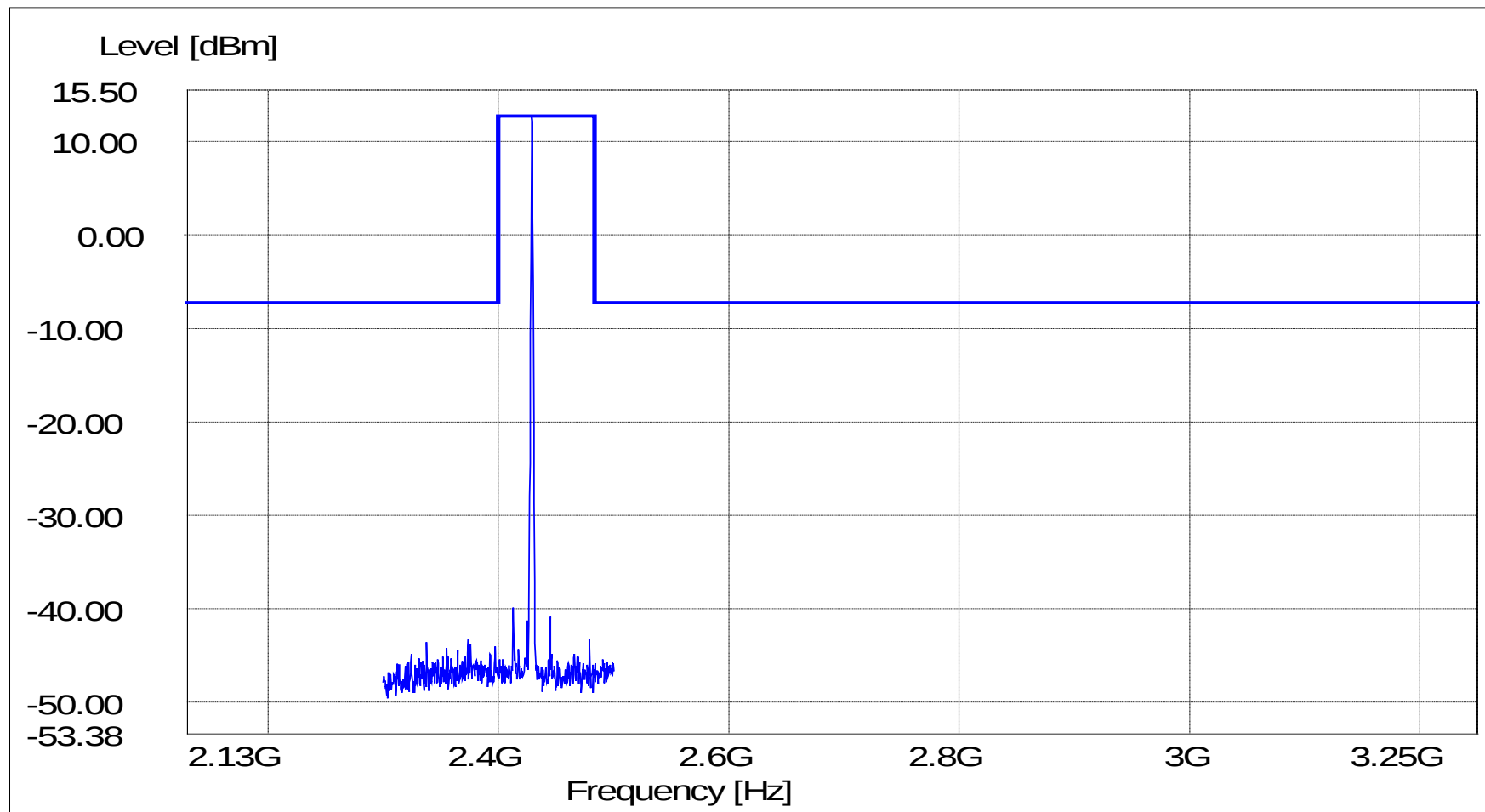
FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.429 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes:



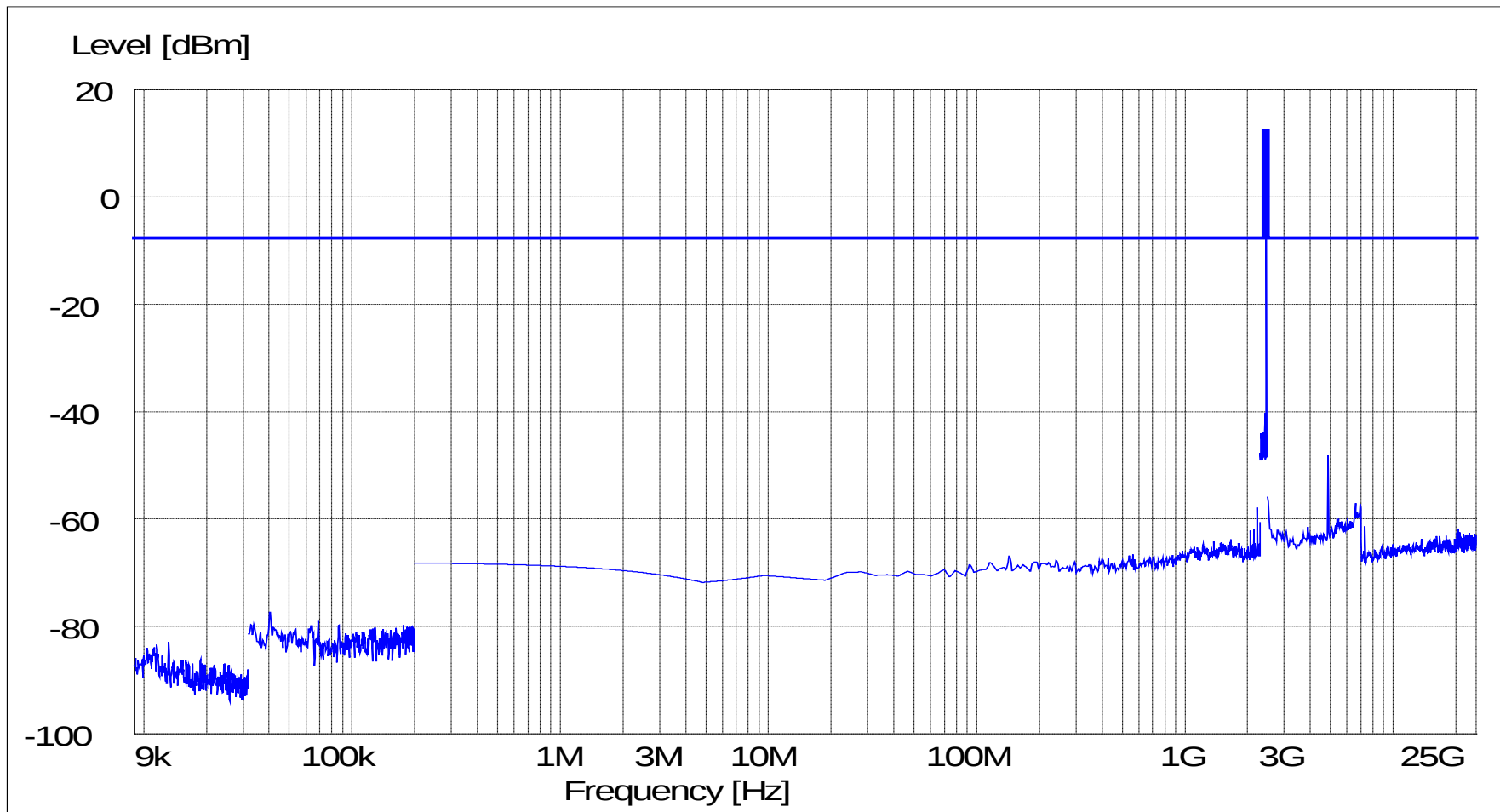
FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.429 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes:: Zoomed in to show peak power and band edge



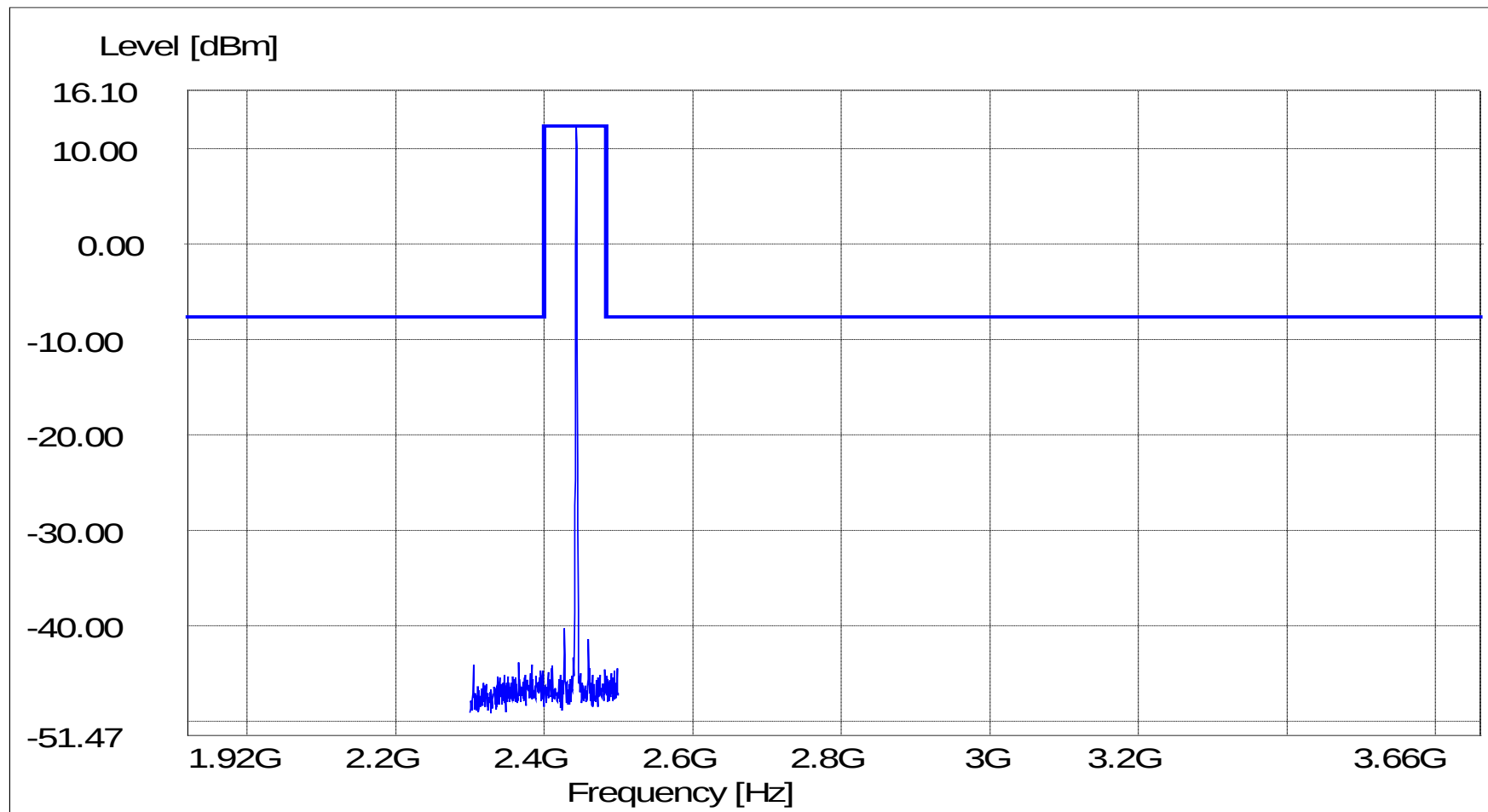
FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.443 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes:



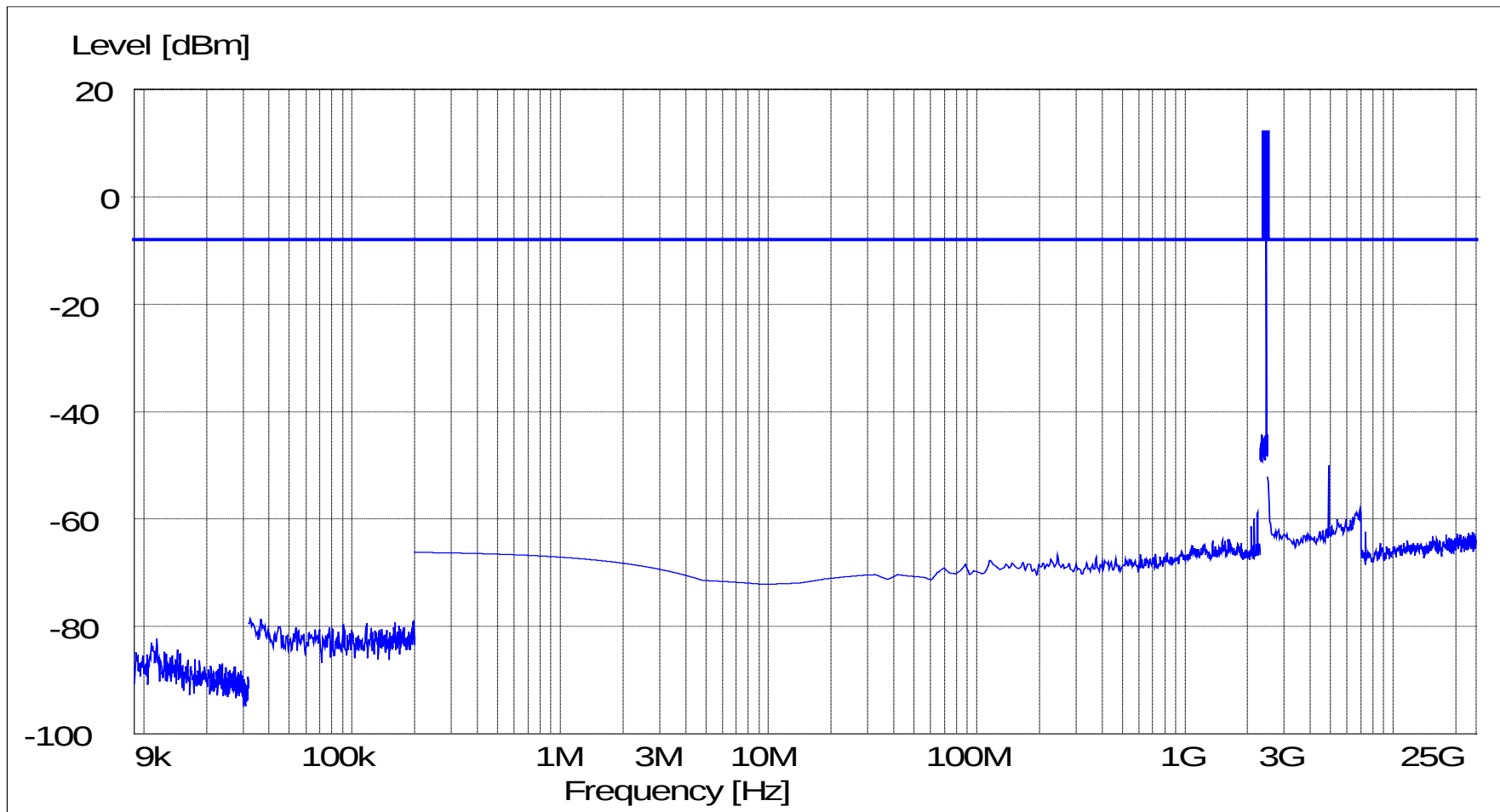
FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.443 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Zoomed in to show peak power and band edge



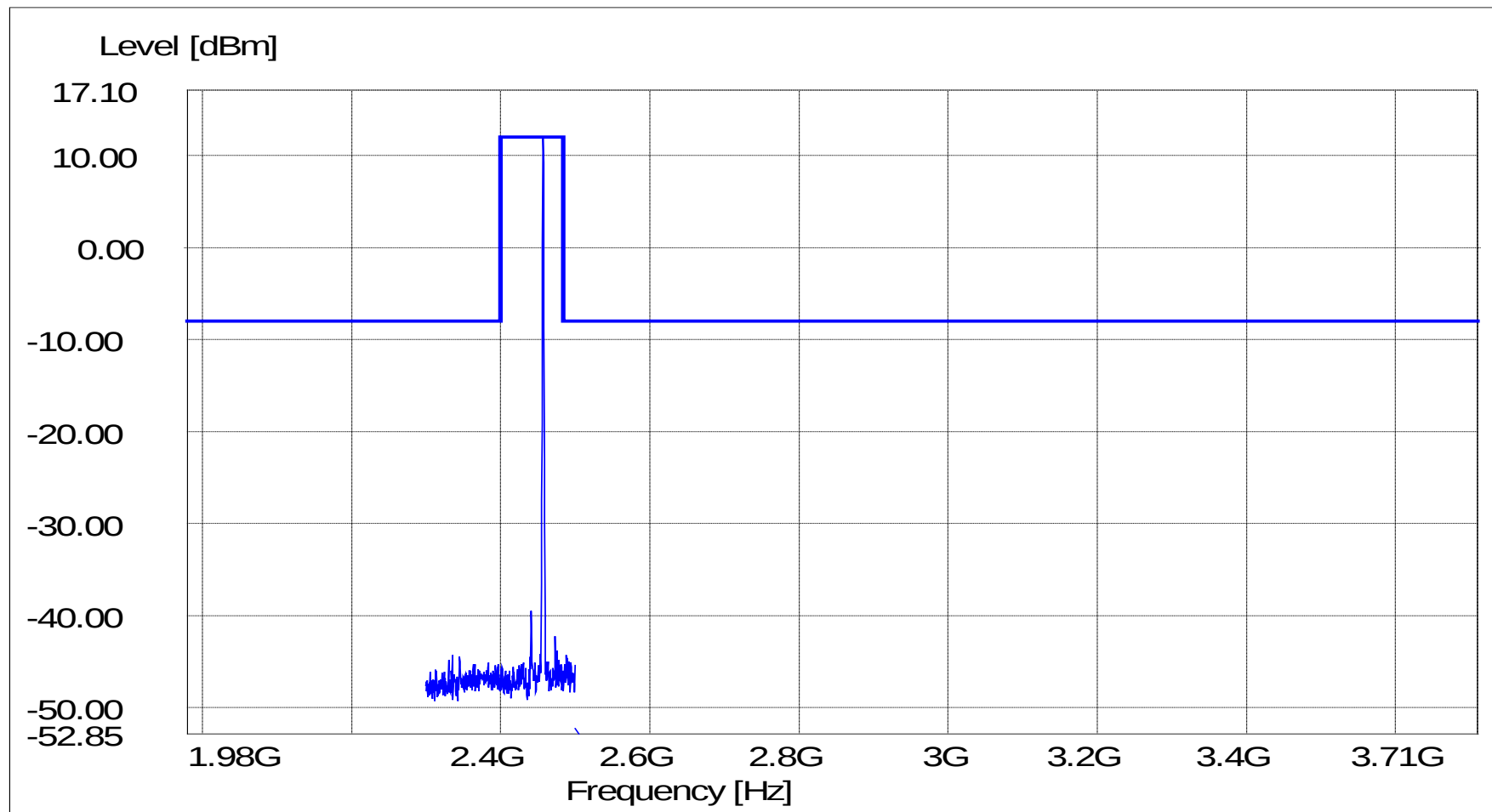
FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.457 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes:



FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.457 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Zoomed in to show peak power and band edge



FCC Part 15.247, Paragraph (d)
Sweep Table, Out of Band Emissions, SD-HUB-1-MA



Retlif Testing Laboratories

Report No. R-3248P-1

SWEEP TABLE: "R-3248P-1 0oB CE"

Unit: dBm

Detector: Mode:

Curve 1: MaxPeak MaxHold

Subrange 1:

Start Frequency: 9.0 kHz
Stop Frequency: 32.0 kHz
Measure Time: Coupled
IF Bandwidth: 1 kHz

Receiver: ESIX Transducer: dBuV to dBm
Signal Path: None System Transducer: None
Meas. Mode: Lin Add. Transd. 1: EN713E 10/20
Tracking Gen.: -- Add. Transd. 2: None
Input: 1 Add. Transd. 3: None

Preamplifier: Off Op. Range: --
RF Att.: 20 dB Preselection: Off
Ref. Level: -10.0 dBm Rep. by Device: --
Min. RF Att.: -- Option: --
IF Att.: -- Video Bandwidth: 5 kHz

Curve 1: On Repetition: 10
Curve 2: Off Stop Mark: Off
Curve 3: Off Stop Message: Off
Curve 4: Off Stop Message:

Subrange 2:

Start Frequency: 32.0 kHz
Stop Frequency: 200.0 kHz
Measure Time: Coupled
IF Bandwidth: 10 kHz

Receiver: ESIX Transducer: dBuV to dBm
Signal Path: None System Transducer: None
Meas. Mode: Lin Add. Transd. 1: EN713E 10/20
Tracking Gen.: -- Add. Transd. 2: None
Input: 1 Add. Transd. 3: None

Preamplifier: Off Op. Range: --
RF Att.: 20 dB Preselection: Off
Ref. Level: -10.0 dBm Rep. by Device: --
Min. RF Att.: -- Option: --
IF Att.: -- Video Bandwidth: 10 MHz

Curve 1: On Repetition: 10
Curve 2: Off Stop Mark: Off
Curve 3: Off Stop Message: Off
Curve 4: Off Stop Message:

Subrange 3:

Start Frequency: 200.0 kHz



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Report No. R-3248P-1

Stop Frequency:	2.3 GHz		
Measure Time:	Coupled		
IF Bandwidth:	100 kHz		
Receiver:	ESIX	Transducer:	dBuV to dBm
Signal Path:	None	System Transducer:	None
Meas. Mode:	Lin	Add. Transd. 1:	EN713E 10/20
Tracking Gen.:	--	Add. Transd. 2:	None
Input:	1	Add. Transd. 3:	None
Preamplifier:	Off	Op. Range:	--
RF Att.:	20 dB	Preselection:	Off
Ref. Level:	-10.0 dBm	Rep. by Device:	--
Min. RF Att.:	--	Option:	--
IF Att.:	--	Video Bandwidth:	10 MHz
Curve 1:	On	Repetition:	10
Curve 2:	Off	Stop Mark:	Off
Curve 3:	Off	Stop Message:	Off
Curve 4:	Off	Stop Message:	

Subrange 4:

Start Frequency:	2.3 GHz		
Stop Frequency:	2.5 GHz		
Measure Time:	Coupled		
IF Bandwidth:	100 kHz		
Receiver:	ESIX	Transducer:	dBuV to dBm
Signal Path:	None	System Transducer:	None
Meas. Mode:	Lin	Add. Transd. 1:	EN713D 10/20
Tracking Gen.:	--	Add. Transd. 2:	None
Input:	1	Add. Transd. 3:	None
Preamplifier:	Off	Op. Range:	--
RF Att.:	Normal	Preselection:	Off
Ref. Level:	10.0 dBm	Rep. by Device:	--
Min. RF Att.:	--	Option:	--
IF Att.:	--	Video Bandwidth:	10 MHz
Curve 1:	On	Repetition:	10
Curve 2:	Off	Stop Mark:	Off
Curve 3:	Off	Stop Message:	Off
Curve 4:	Off	Stop Message:	

Subrange 5:

Start Frequency:	2.5 GHz		
Stop Frequency:	18.0 GHz		
Measure Time:	Coupled		
IF Bandwidth:	100 kHz		
Receiver:	ESIX	Transducer:	dBuV to dBm
Signal Path:	None	System Transducer:	None
Meas. Mode:	Lin	Add. Transd. 1:	EN713E 10/20
Tracking Gen.:	--	Add. Transd. 2:	None
Input:	1	Add. Transd. 3:	None
Preamplifier:	Off	Op. Range:	--



Retlif Testing Laboratories

Report No. R-3248P-1

RF Att.:	20 dB	Preselection:	Off
Ref. Level:	-10.0 dBm	Rep. by Device:	--
Min. RF Att.:	--	Option:	--
IF Att.:	--	Video Bandwidth:	10 MHz

Curve 1:	On	Repetition:	10
Curve 2:	Off	Stop Mark:	Off
Curve 3:	Off	Stop Message:	Off
Curve 4:	Off	Stop Message:	

Subrange 6:

Start Frequency:	18.0 GHz
Stop Frequency:	25.0 GHz
Measure Time:	Coupled
IF Bandwidth:	100 kHz

Receiver:	ESIX	Transducer:	dBuV to dBm
Signal Path:	None	System Transducer:	None
Meas. Mode:	Lin	Add. Transd. 1:	40G EN713E 3/21
Tracking Gen.:	--	Add. Transd. 2:	None
Input:	1	Add. Transd. 3:	None

Preamplifier:	Off	Op. Range:	--
RF Att.:	20 dB	Preselection:	Off
Ref. Level:	-10.0 dBm	Rep. by Device:	--
Min. RF Att.:	--	Option:	--
IF Att.:	--	Video Bandwidth:	10 MHz

Curve 1:	On	Repetition:	10
Curve 2:	Off	Stop Mark:	Off
Curve 3:	Off	Stop Message:	Off
Curve 4:	Off	Stop Message:	



Retlif Testing Laboratories

Report No. R-3248P-1

FCC Part 15.247, Paragraph (d)
Test Data, Out of Band Emissions in Restricted Band, SD-HUB-1-MA

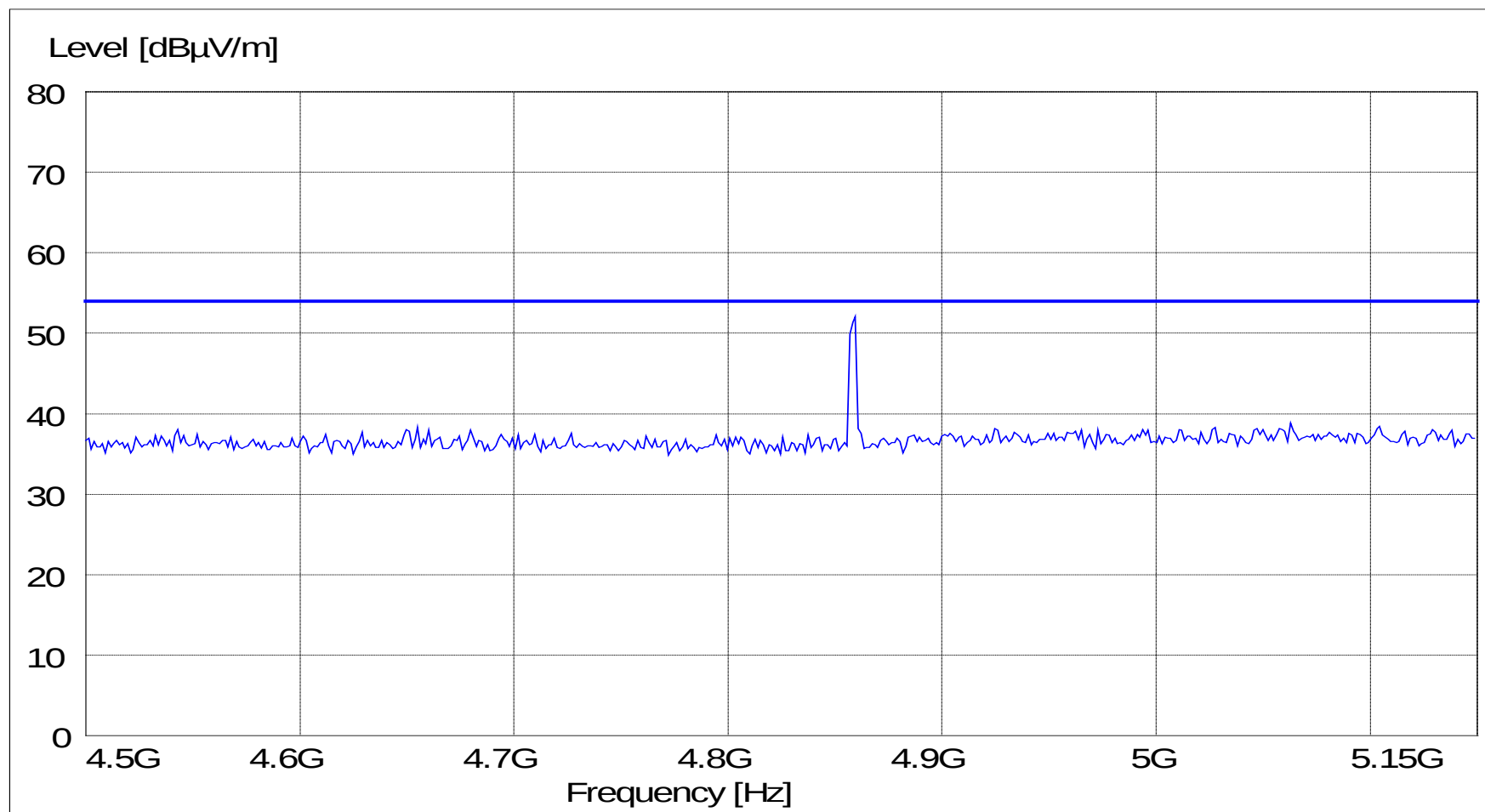


Retlif Testing Laboratories

Report No. R-3248P-1

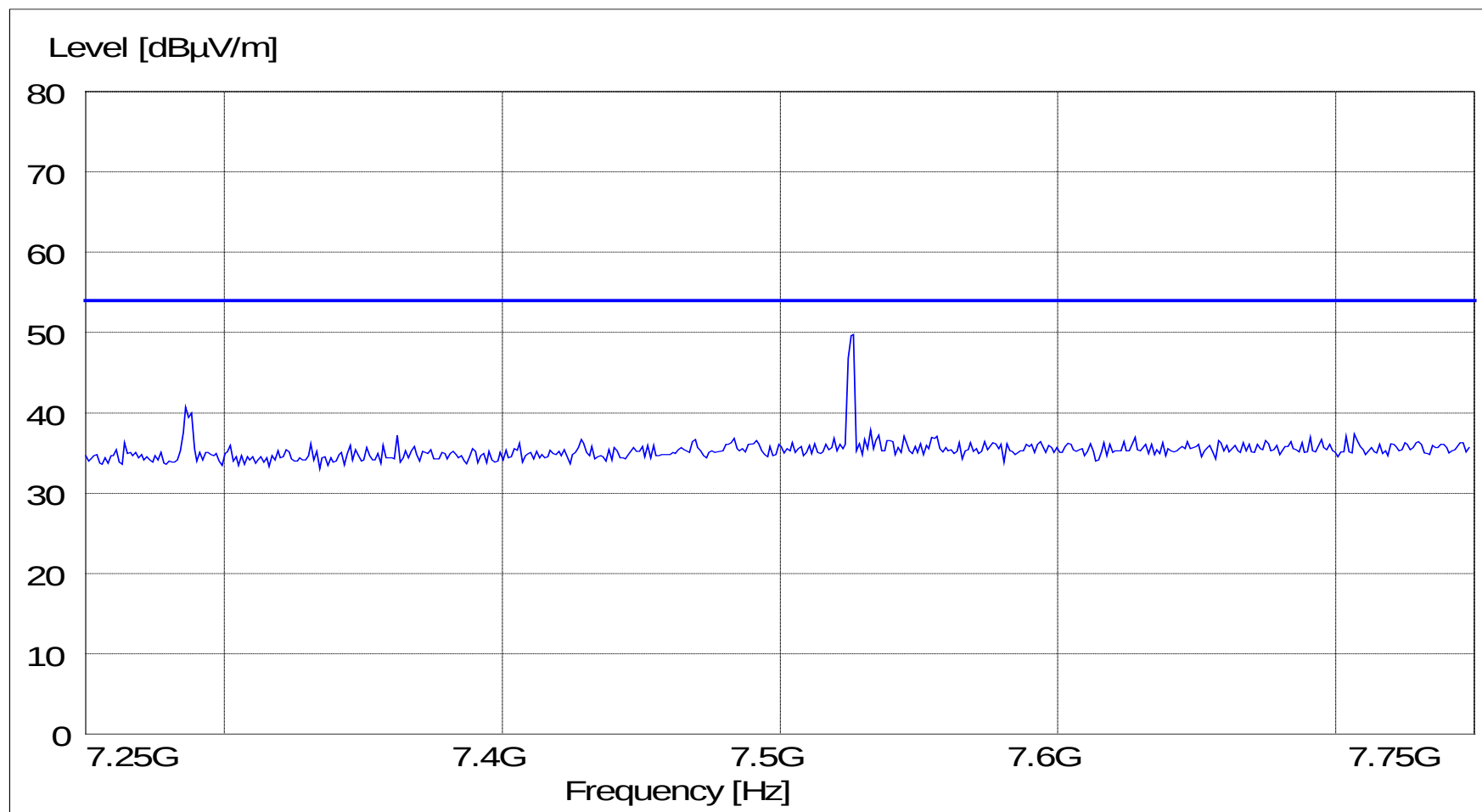
FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.429 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



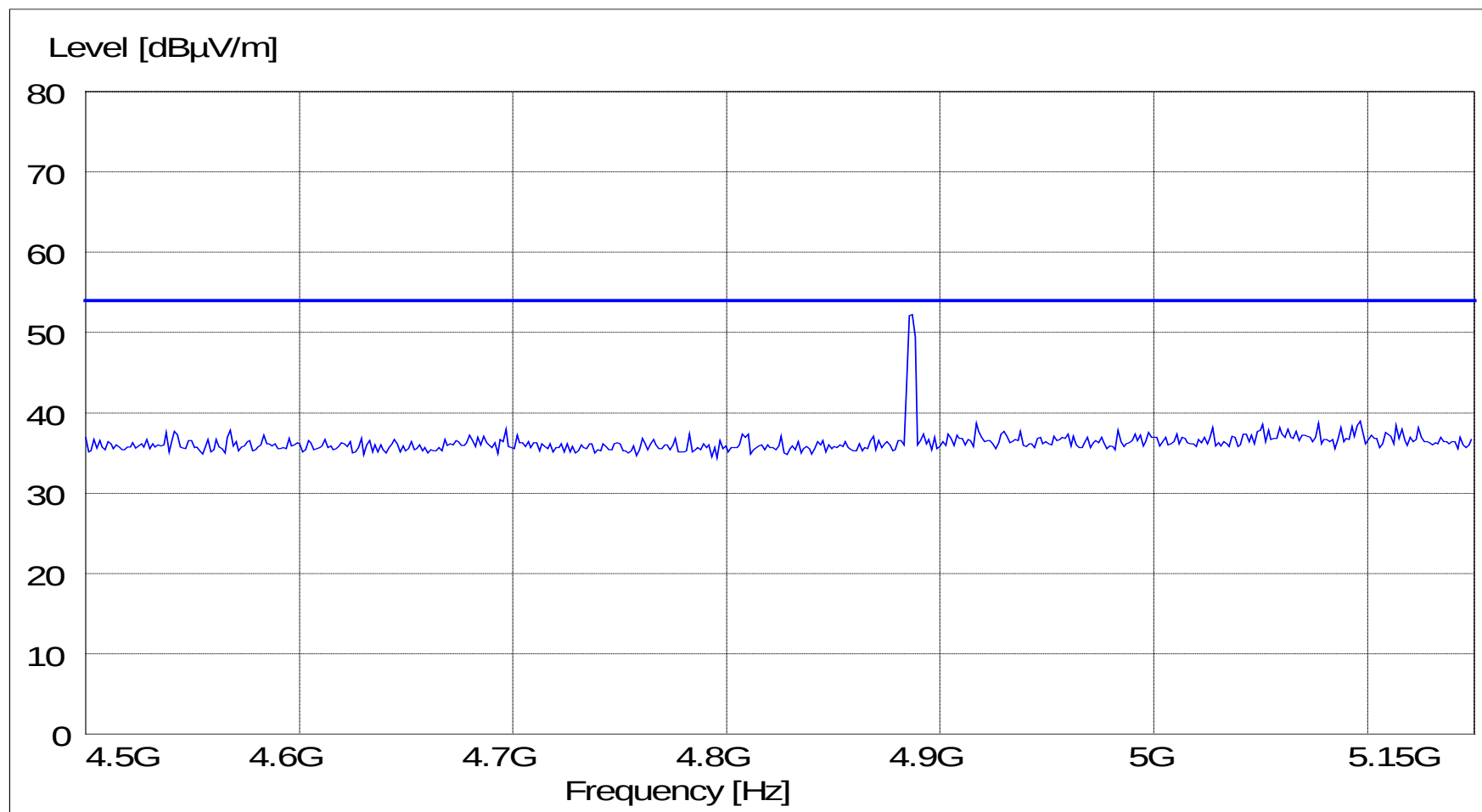
FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.429 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



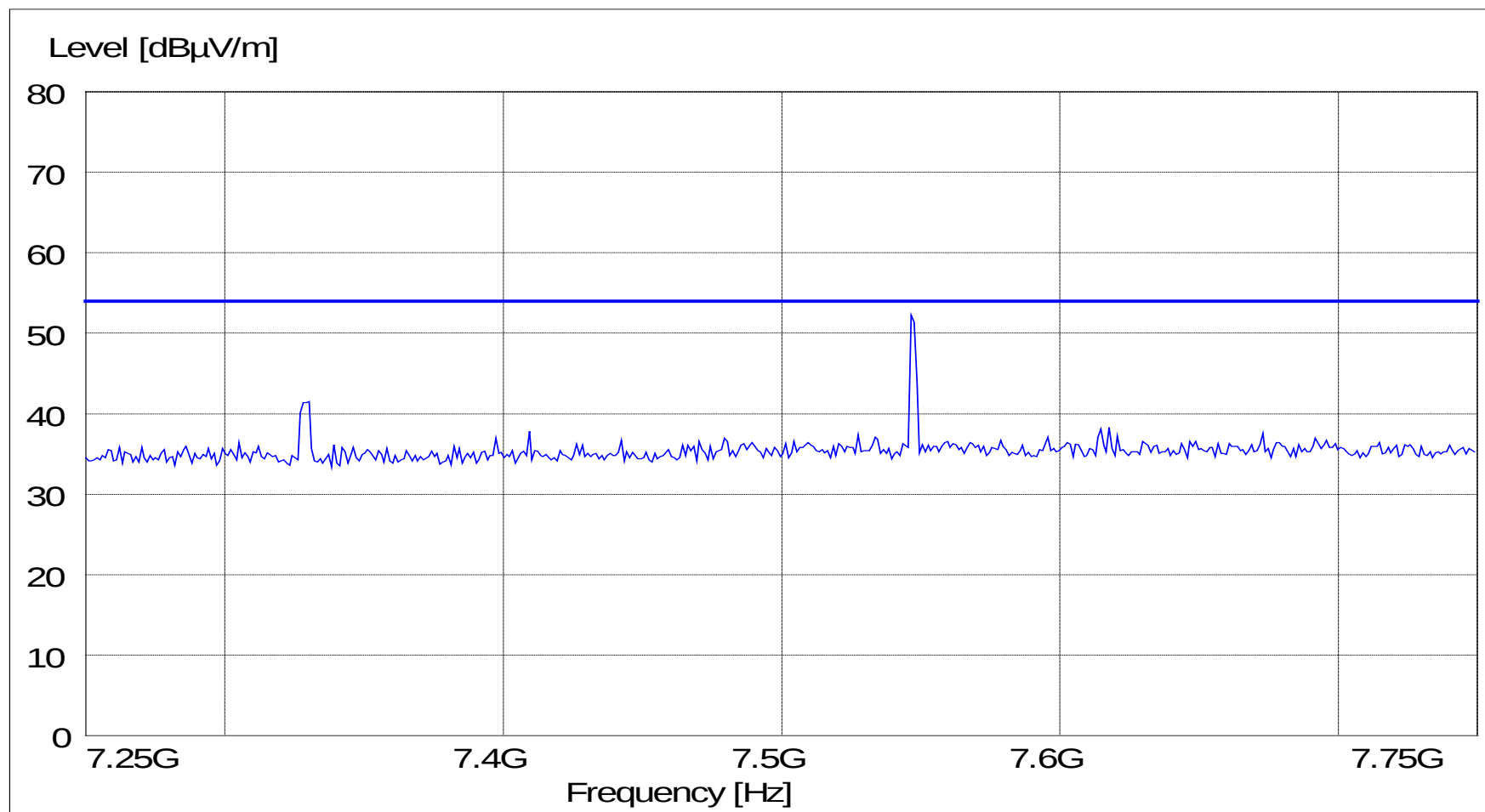
FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.443 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



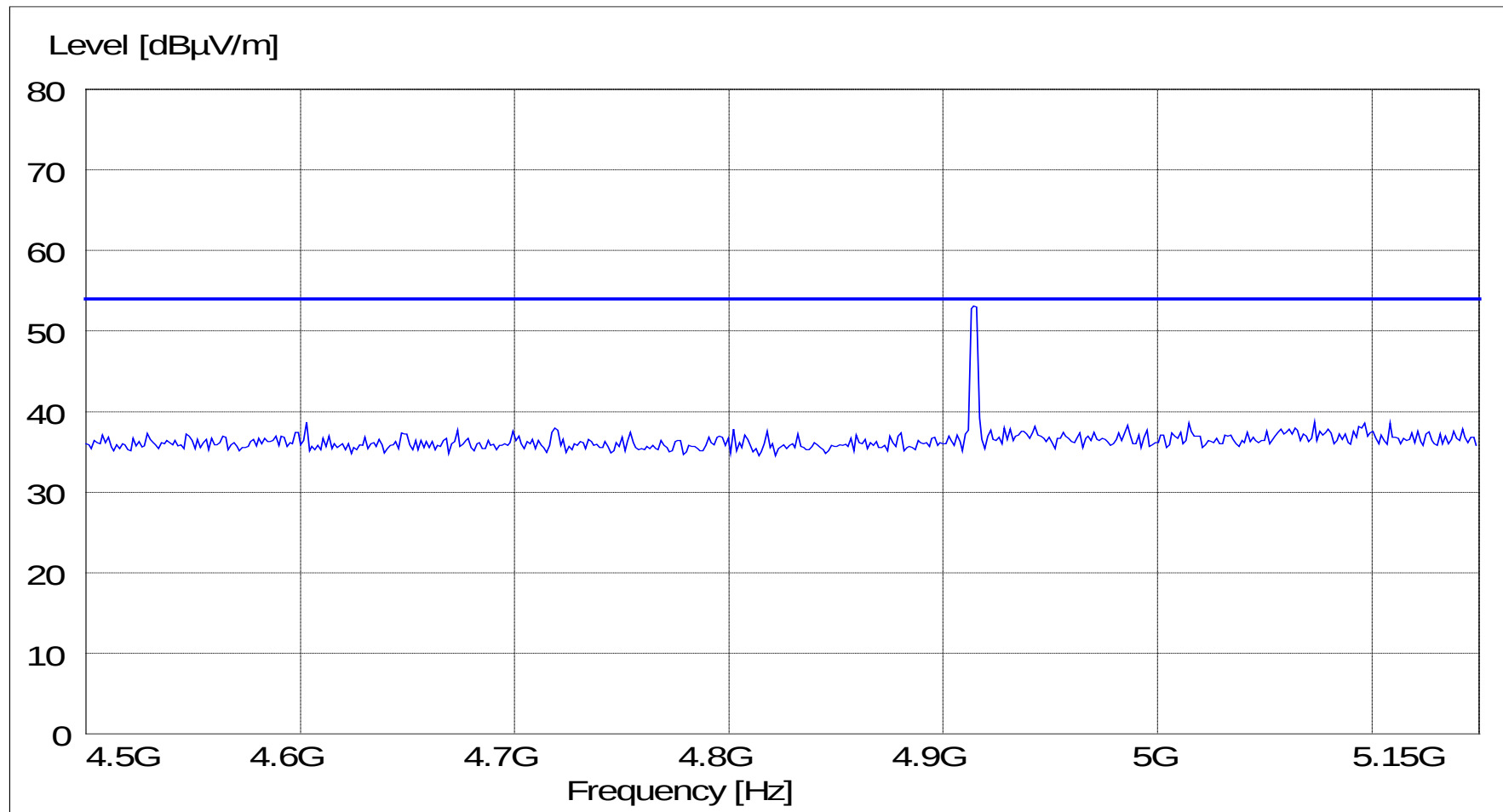
FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.443 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



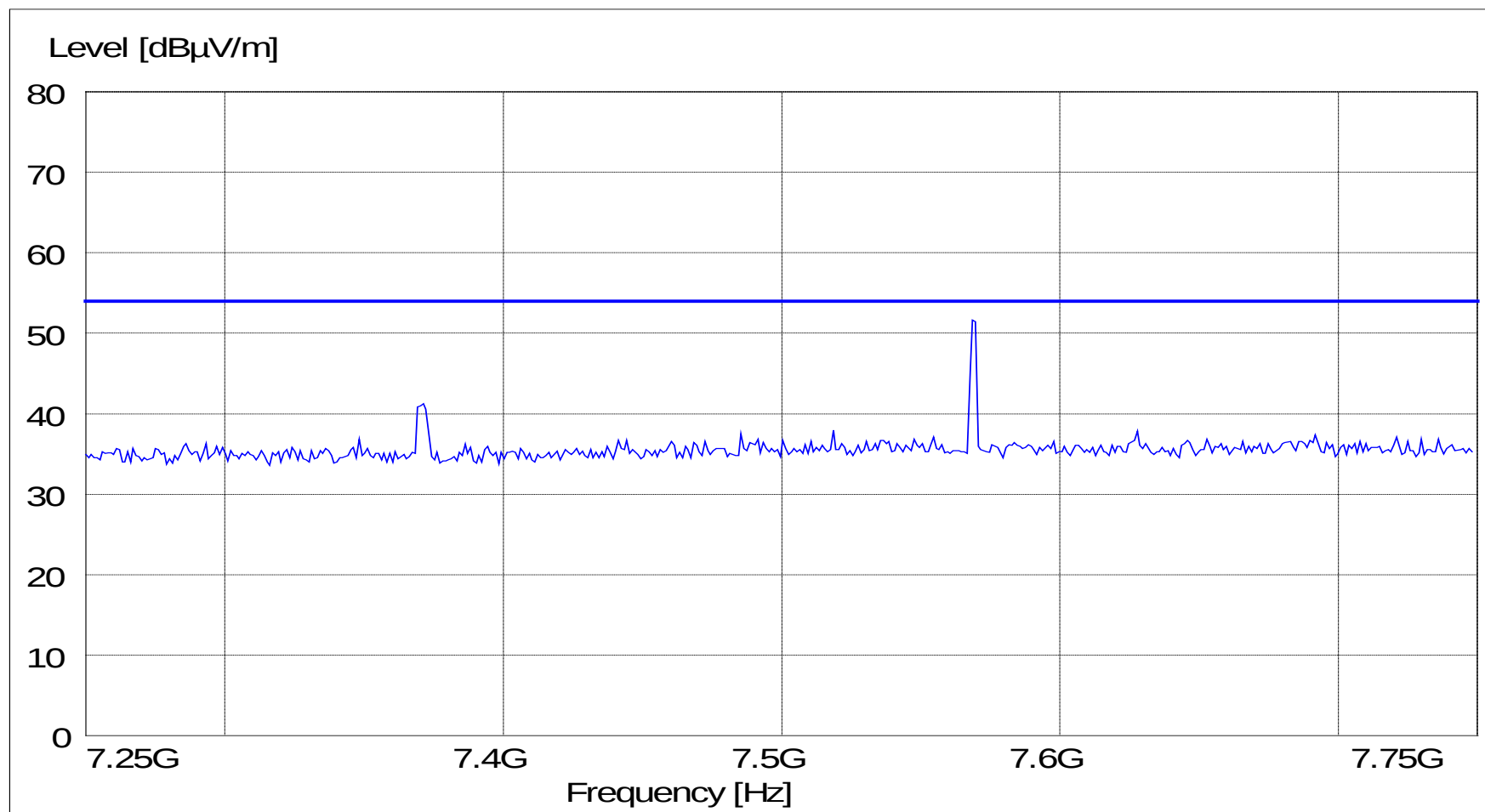
FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.457 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.457 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



FCC Part 15.247, Paragraph (d)
Out of Band Emissions
Sweep Table, Out of Band Emissions in Restricted Band, SD-HUB-1-MA



Retlif Testing Laboratories

Report No. R-3248P-1

SWEEP TABLE: "R-3248P-1 CE restric"

Unit: dBμV/m

Detector: Mode:

Curve 1: MaxPeak MaxHold

Subrange 1:

Start Frequency: 4.5 GHz
Stop Frequency: 5.2 GHz
Measure Time: Coupled
IF Bandwidth: 1 MHz

Receiver:	ESIX	Transducer:	FCC Rest Band 3m2dBi
Signal Path:	None	System Transducer:	None
Meas. Mode:	Lin	Add. Transd. 1:	EN713E 10/20
Tracking Gen.:	--	Add. Transd. 2:	None
Input:	1	Add. Transd. 3:	None

Preamplifier:	Off	Op. Range:	--
RF Att.:	20 dB	Preselection:	Off
Ref. Level:	-10.0 dBm	Rep. by Device:	--
Min. RF Att.:	--	Option:	--
IF Att.:	--	Video Bandwidth:	10 MHz

Curve 1:	On	Repetition:	Continuous
		Stop Mark:	Off
Curve 3:	Off	Stop Message:	Off
Curve 4:	Off	Stop Message:	

Subrange 2:

Start Frequency: 7.3 GHz
Stop Frequency: 7.8 GHz
Measure Time: Coupled
IF Bandwidth: 1 MHz

Receiver:	ESIX	Transducer:	FCC Rest Band 3m2dBi
Signal Path:	None	System Transducer:	None
Meas. Mode:	Lin	Add. Transd. 1:	EN713E 10/20
Tracking Gen.:	--	Add. Transd. 2:	None
Input:	1	Add. Transd. 3:	None

Preamplifier:	Off	Op. Range:	--
RF Att.:	20 dB	Preselection:	Off
Ref. Level:	-10.0 dBm	Rep. by Device:	--
Min. RF Att.:	--	Option:	--
IF Att.:	--	Video Bandwidth:	10 MHz

Curve 1:	On	Repetition:	Continuous
		Stop Mark:	Off
Curve 3:	Off	Stop Message:	Off
Curve 4:	Off	Stop Message:	



Retlif Testing Laboratories

Report No. R-3248P-1

FCC Part 15.247, Paragraph (d)
Test Data, Out of Band Emissions, SD-HUB-1-XA

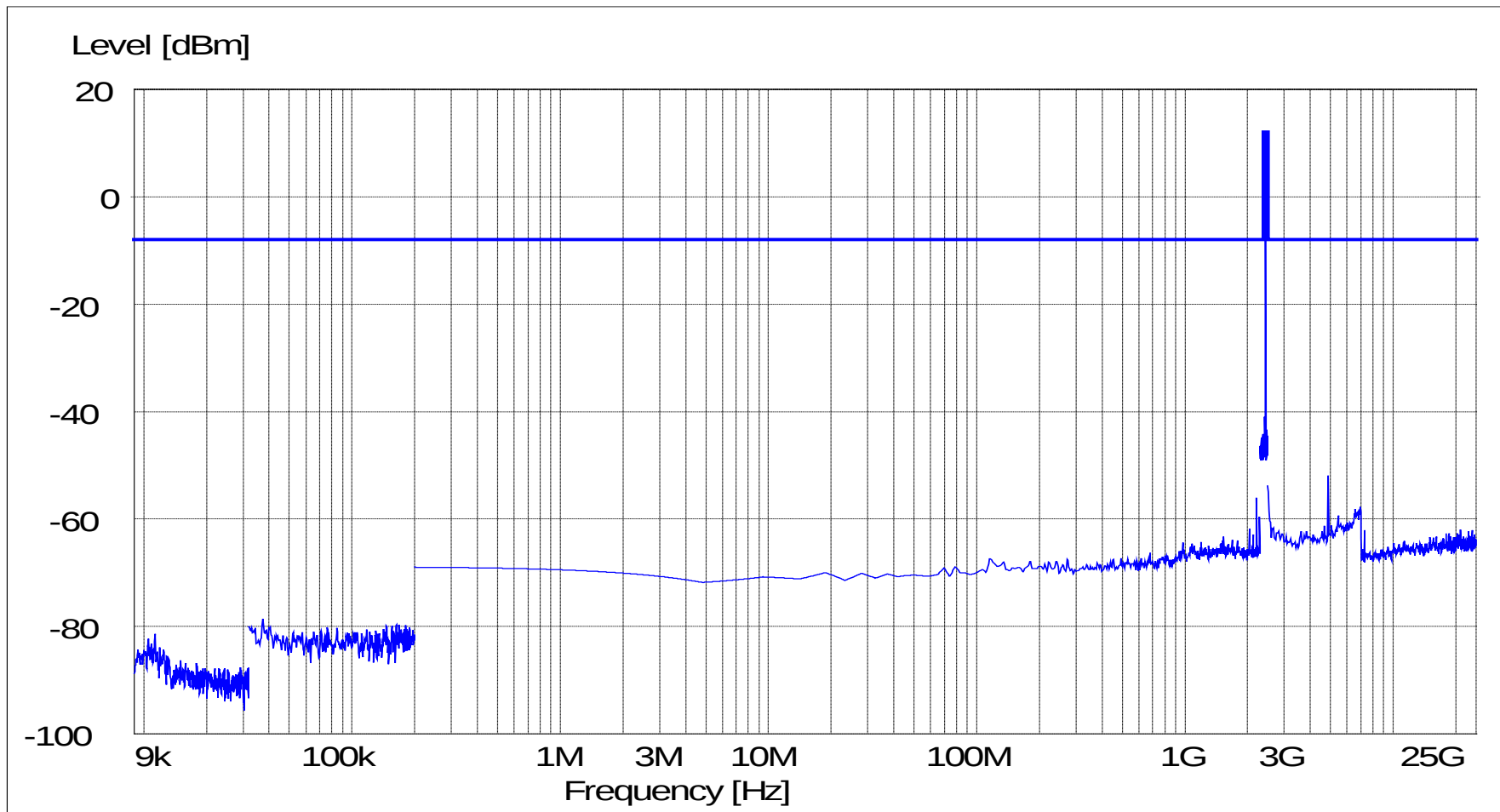


Retlif Testing Laboratories

Report No. R-3248P-1

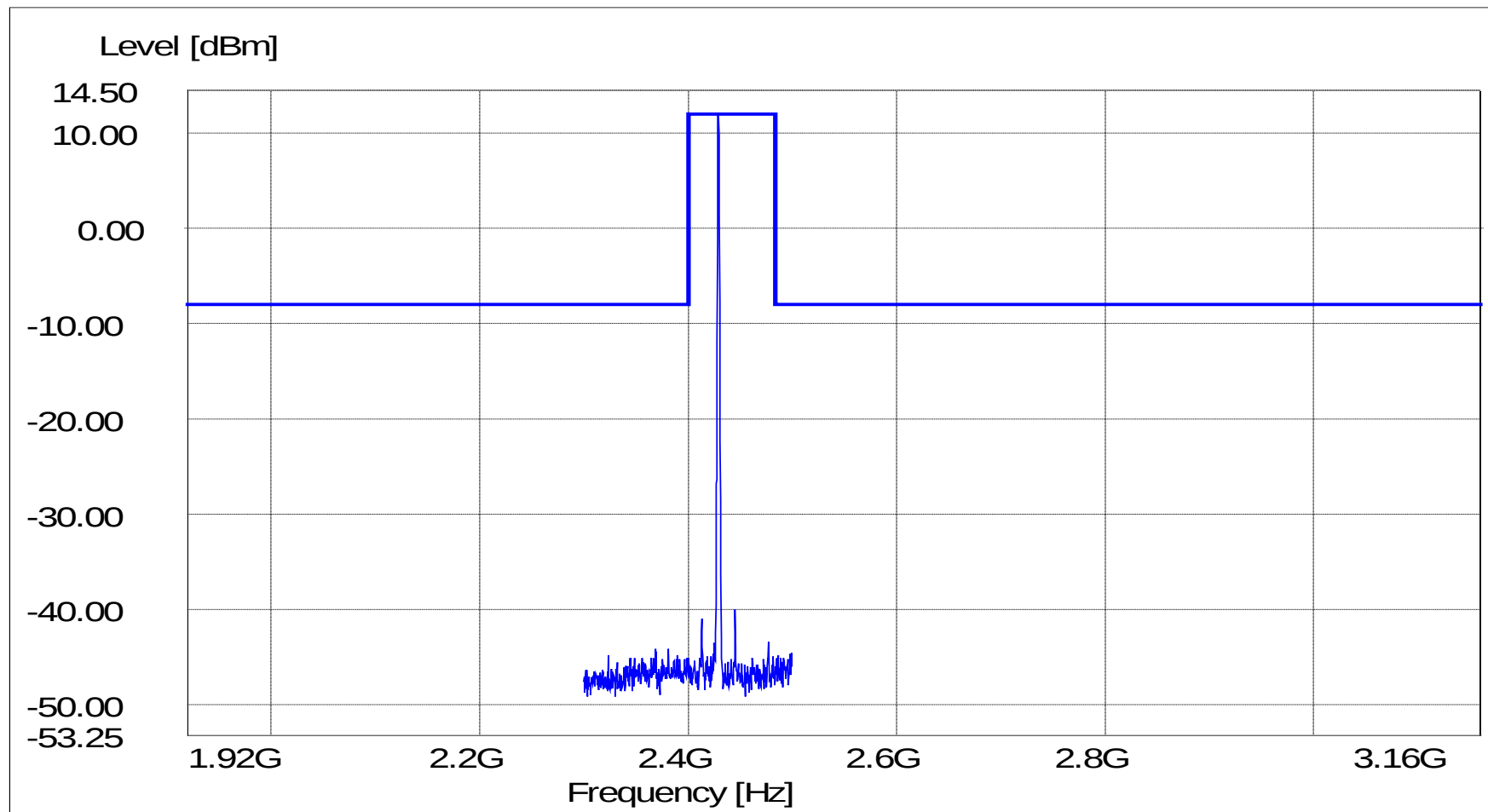
FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-1-XA / 1C000007
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.429 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes:



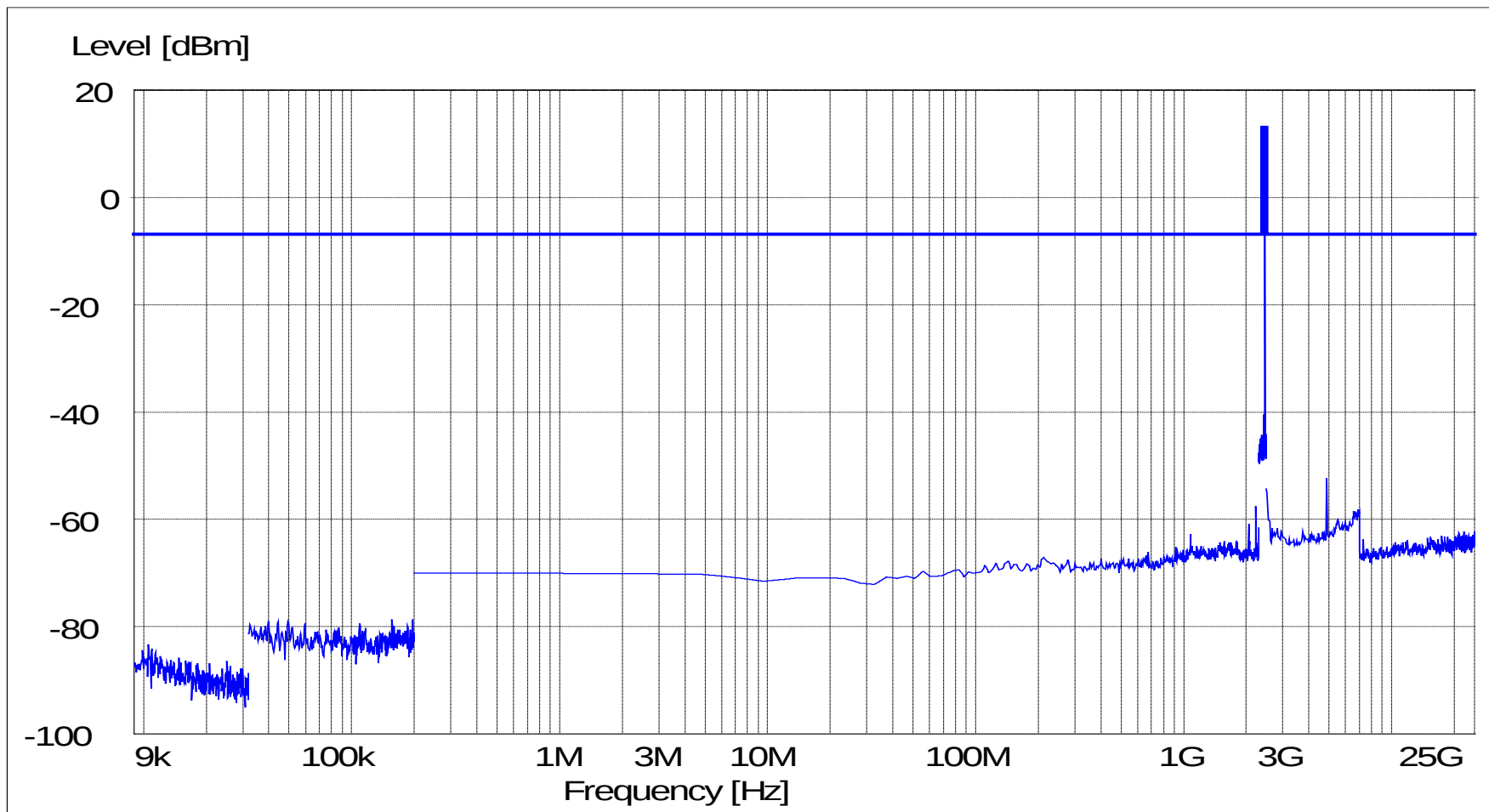
FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-XA / 1C000007
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.429 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Zoomed in to show peak power and band edge



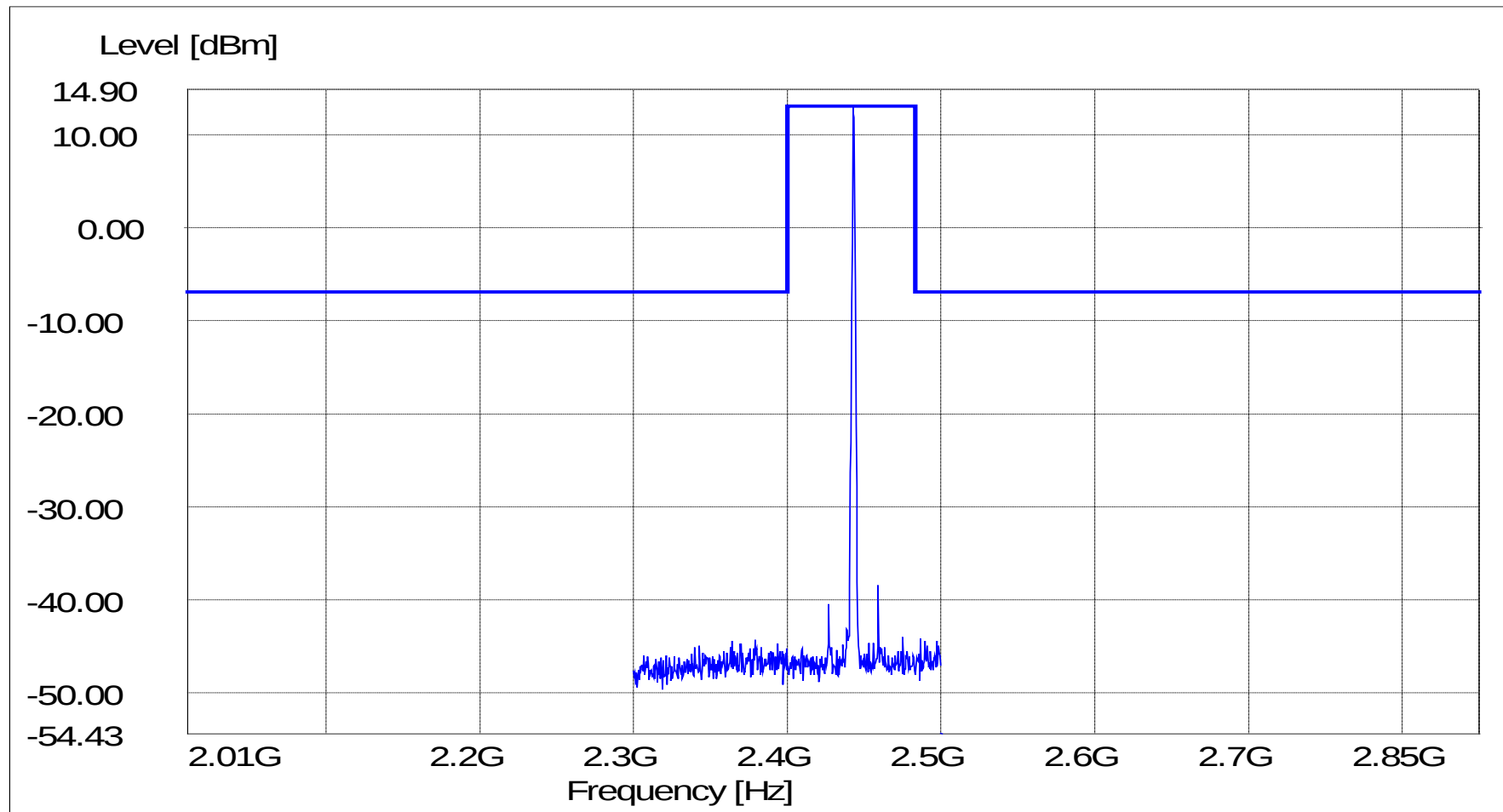
FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.443 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes:



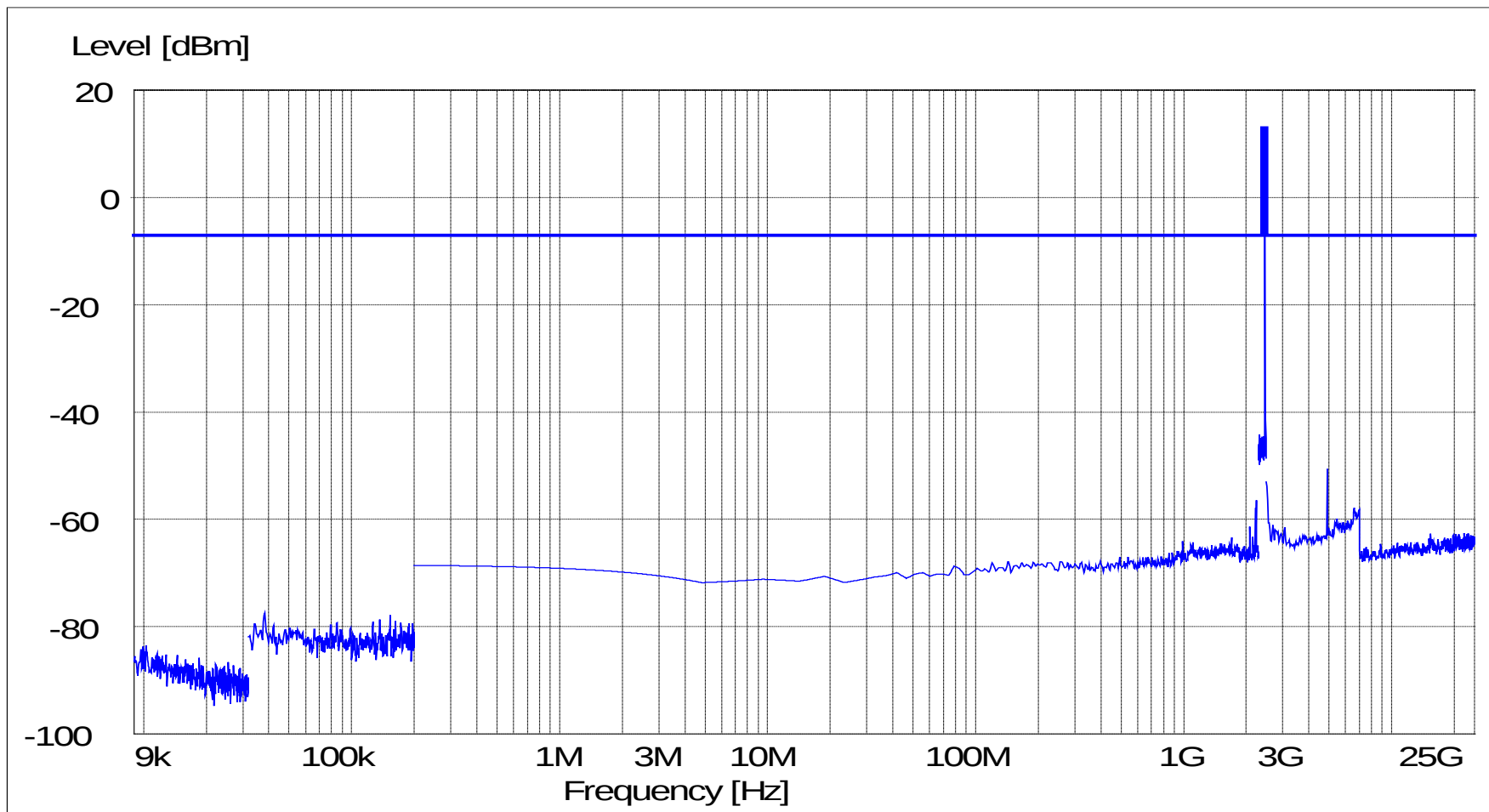
FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.443 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Zoomed in to show peak power and band edge



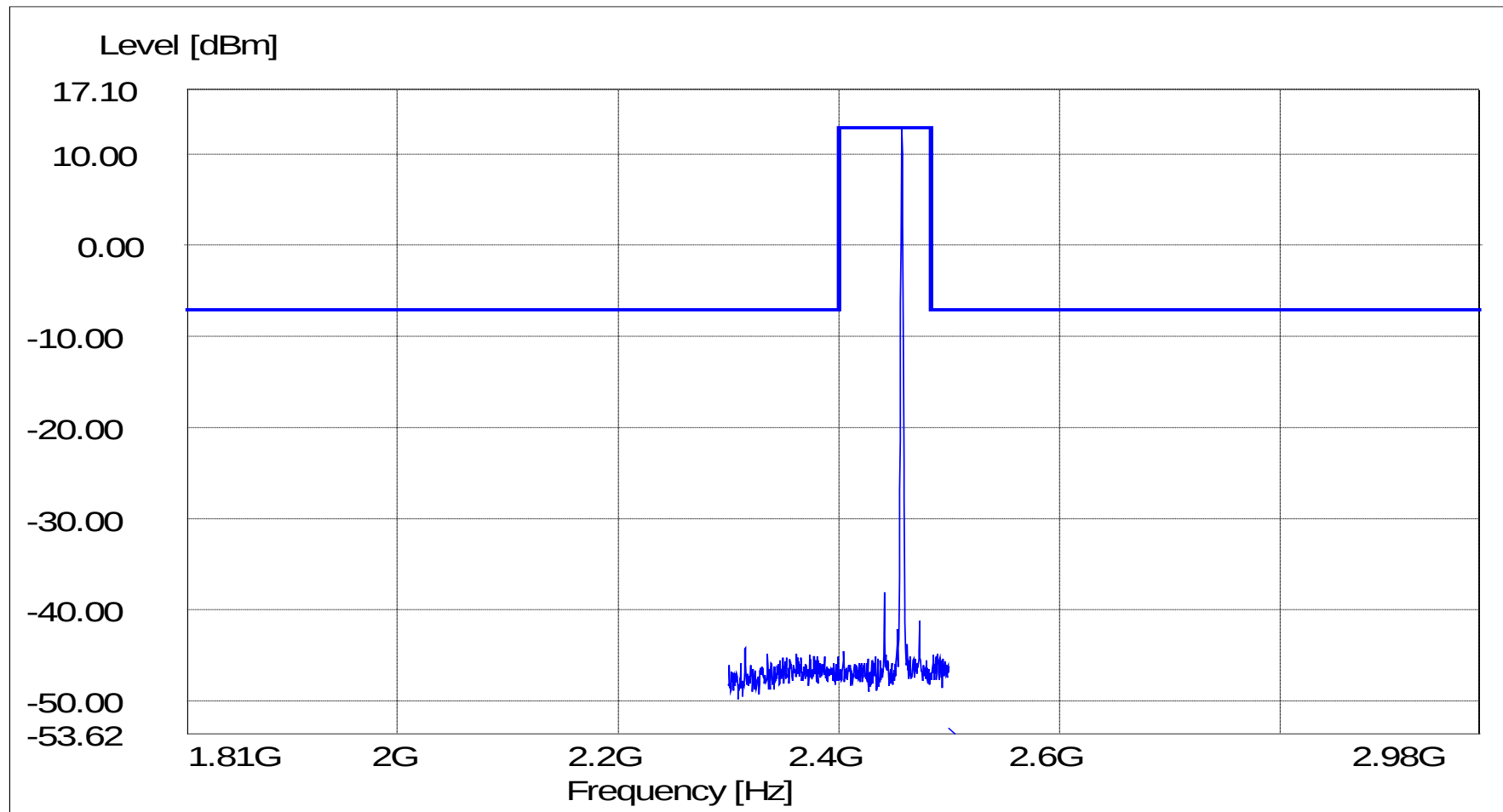
FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.457 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes:



FCC Part 15.247 (d) Out of Band Emissions

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-MA / 1C00002D
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.457 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Zoomed in to show peak power and band edge



**FCC Part 15.247, Paragraph (d)
Sweep Table, Out of Band Emissions, SD-HUB-1-XA**



Retlif Testing Laboratories

Report No. R-3248P-1

SWEEP TABLE: "R-3248P-1 0oB CE"

Unit: dBm

Detector: Mode:

Curve 1: MaxPeak MaxHold

Subrange 1:

Start Frequency: 9.0 kHz
Stop Frequency: 32.0 kHz
Measure Time: Coupled
IF Bandwidth: 1 kHz

Receiver: ESIX Transducer: dBuV to dBm
Signal Path: None System Transducer: None
Meas. Mode: Lin Add. Transd. 1: EN713E 10/20
Tracking Gen.: -- Add. Transd. 2: None
Input: 1 Add. Transd. 3: None

Preamplifier: Off Op. Range: --
RF Att.: 20 dB Preselection: Off
Ref. Level: -10.0 dBm Rep. by Device: --
Min. RF Att.: -- Option: --
IF Att.: -- Video Bandwidth: 5 kHz

Curve 1: On Repetition: 10
Curve 2: Off Stop Mark: Off
Curve 3: Off Stop Message: Off
Curve 4: Off Stop Message:

Subrange 2:

Start Frequency: 32.0 kHz
Stop Frequency: 200.0 kHz
Measure Time: Coupled
IF Bandwidth: 10 kHz

Receiver: ESIX Transducer: dBuV to dBm
Signal Path: None System Transducer: None
Meas. Mode: Lin Add. Transd. 1: EN713E 10/20
Tracking Gen.: -- Add. Transd. 2: None
Input: 1 Add. Transd. 3: None

Preamplifier: Off Op. Range: --
RF Att.: 20 dB Preselection: Off
Ref. Level: -10.0 dBm Rep. by Device: --
Min. RF Att.: -- Option: --
IF Att.: -- Video Bandwidth: 10 MHz

Curve 1: On Repetition: 10
Curve 2: Off Stop Mark: Off
Curve 3: Off Stop Message: Off
Curve 4: Off Stop Message:

Subrange 3:

Start Frequency: 200.0 kHz



Retlif Testing Laboratories

Report No. R-3248P-1

Stop Frequency:	2.3 GHz		
Measure Time:	Coupled		
IF Bandwidth:	100 kHz		
Receiver:	ESIX	Transducer:	dBuV to dBm
Signal Path:	None	System Transducer:	None
Meas. Mode:	Lin	Add. Transd. 1:	EN713E 10/20
Tracking Gen.:	--	Add. Transd. 2:	None
Input:	1	Add. Transd. 3:	None
Preamplifier:	Off	Op. Range:	--
RF Att.:	20 dB	Preselection:	Off
Ref. Level:	-10.0 dBm	Rep. by Device:	--
Min. RF Att.:	--	Option:	--
IF Att.:	--	Video Bandwidth:	10 MHz
Curve 1:	On	Repetition:	10
Curve 2:	Off	Stop Mark:	Off
Curve 3:	Off	Stop Message:	Off
Curve 4:	Off	Stop Message:	

Subrange 4:

Start Frequency:	2.3 GHz		
Stop Frequency:	2.5 GHz		
Measure Time:	Coupled		
IF Bandwidth:	100 kHz		
Receiver:	ESIX	Transducer:	dBuV to dBm
Signal Path:	None	System Transducer:	None
Meas. Mode:	Lin	Add. Transd. 1:	EN713D 10/20
Tracking Gen.:	--	Add. Transd. 2:	None
Input:	1	Add. Transd. 3:	None
Preamplifier:	Off	Op. Range:	--
RF Att.:	Normal	Preselection:	Off
Ref. Level:	10.0 dBm	Rep. by Device:	--
Min. RF Att.:	--	Option:	--
IF Att.:	--	Video Bandwidth:	10 MHz
Curve 1:	On	Repetition:	10
Curve 2:	Off	Stop Mark:	Off
Curve 3:	Off	Stop Message:	Off
Curve 4:	Off	Stop Message:	

Subrange 5:

Start Frequency:	2.5 GHz		
Stop Frequency:	18.0 GHz		
Measure Time:	Coupled		
IF Bandwidth:	100 kHz		
Receiver:	ESIX	Transducer:	dBuV to dBm
Signal Path:	None	System Transducer:	None
Meas. Mode:	Lin	Add. Transd. 1:	EN713E 10/20
Tracking Gen.:	--	Add. Transd. 2:	None
Input:	1	Add. Transd. 3:	None
Preamplifier:	Off	Op. Range:	--



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RF Att.:	20 dB	Preselection:	Off
Ref. Level:	-10.0 dBm	Rep. by Device:	--
Min. RF Att.:	--	Option:	--
IF Att.:	--	Video Bandwidth:	10 MHz

Curve 1:	On	Repetition:	10
Curve 2:	Off	Stop Mark:	Off
Curve 3:	Off	Stop Message:	Off
Curve 4:	Off	Stop Message:	

Subrange 6:

Start Frequency:	18.0 GHz
Stop Frequency:	25.0 GHz
Measure Time:	Coupled
IF Bandwidth:	100 kHz

Receiver:	ESIX	Transducer:	dBuV to dBm
Signal Path:	None	System Transducer:	None
Meas. Mode:	Lin	Add. Transd. 1:	40G EN713E 3/21
Tracking Gen.:	--	Add. Transd. 2:	None
Input:	1	Add. Transd. 3:	None

Preamplifier:	Off	Op. Range:	--
RF Att.:	20 dB	Preselection:	Off
Ref. Level:	-10.0 dBm	Rep. by Device:	--
Min. RF Att.:	--	Option:	--
IF Att.:	--	Video Bandwidth:	10 MHz

Curve 1:	On	Repetition:	10
Curve 2:	Off	Stop Mark:	Off
Curve 3:	Off	Stop Message:	Off
Curve 4:	Off	Stop Message:	



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Report No. R-3248P-1

FCC Part 15.247, Paragraph (d)
Test Data, Out of Band Emissions in Restricted Band, SD-HUB-1-XA

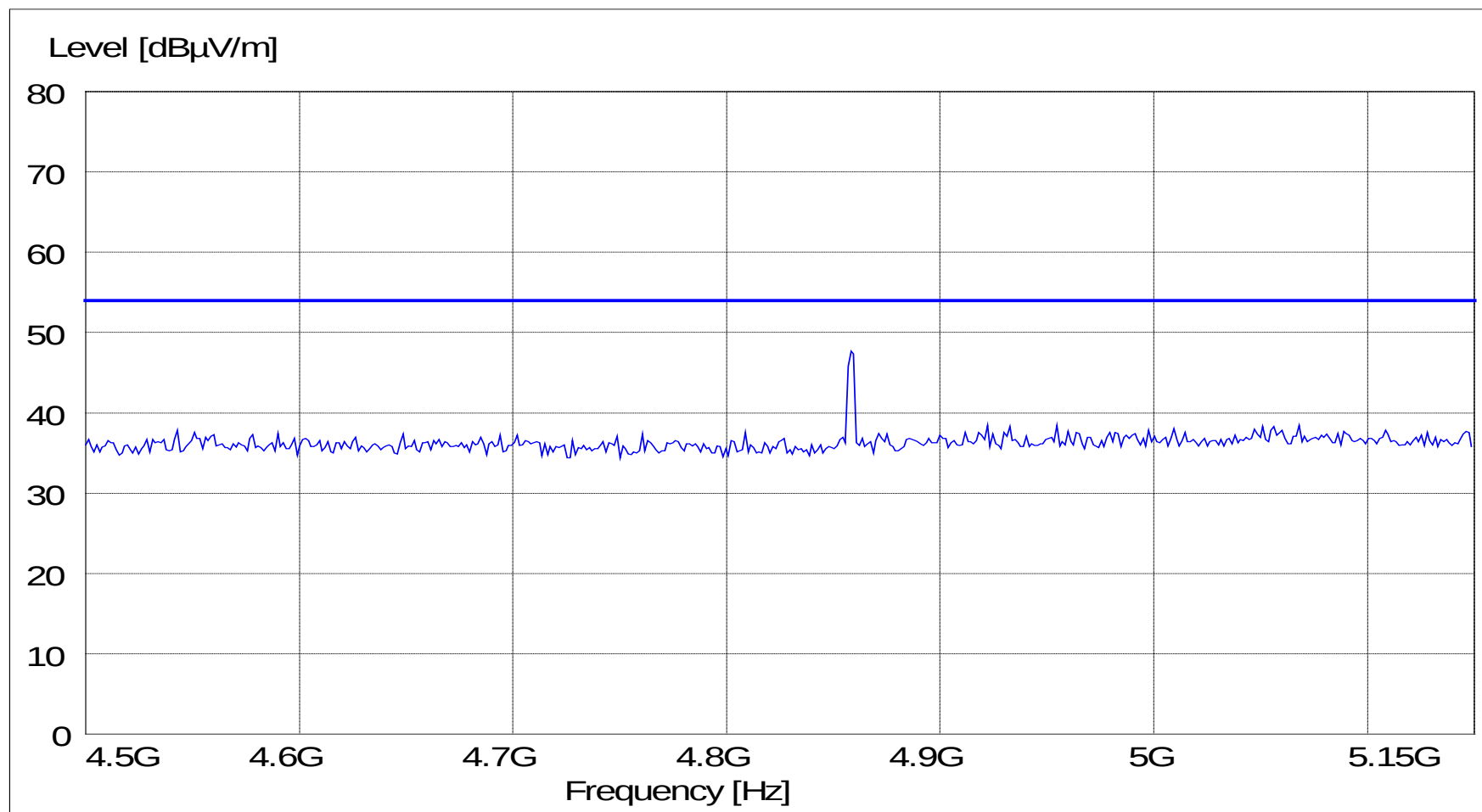


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Report No. R-3248P-1

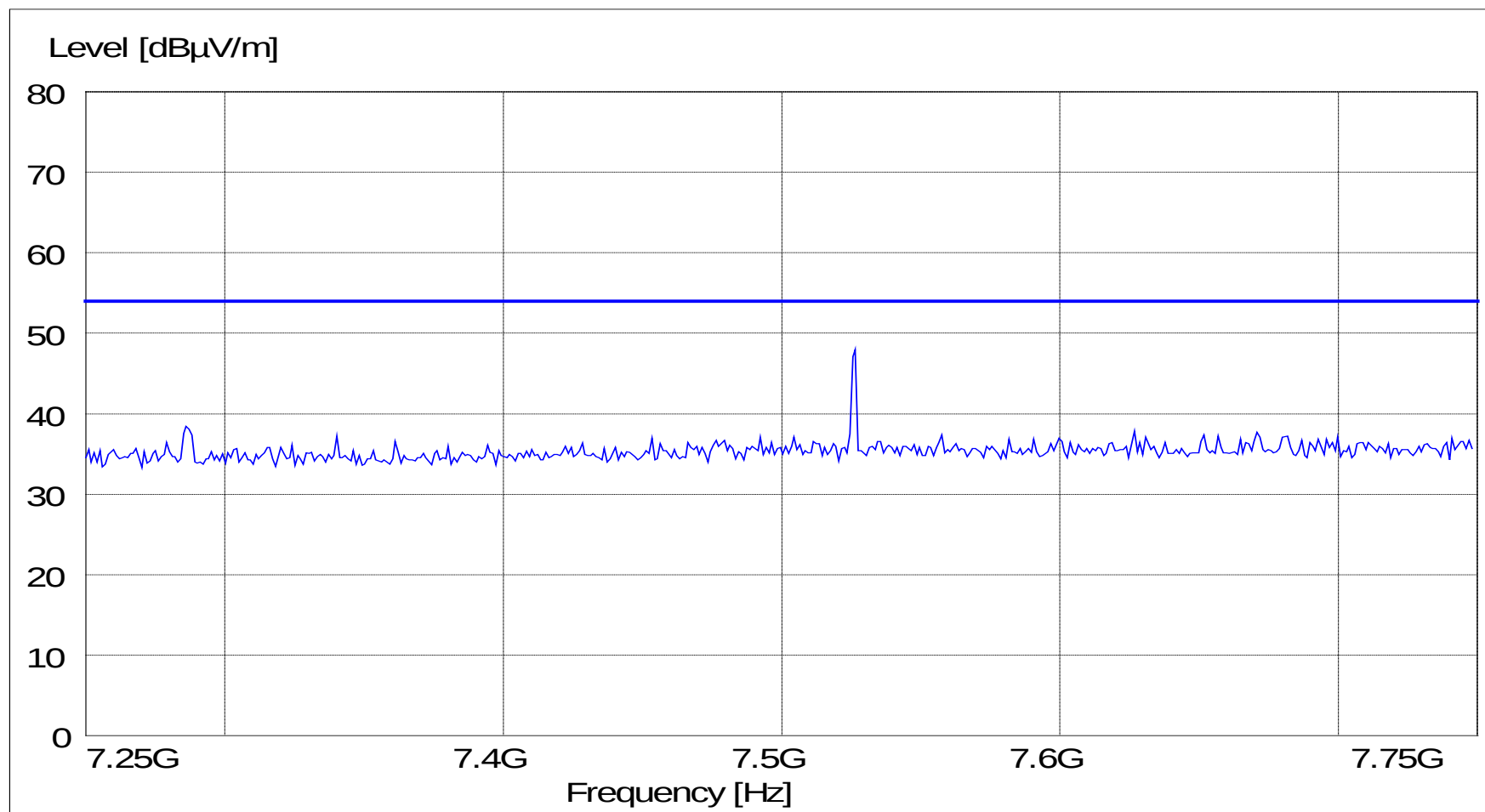
FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-XA / 1C000007
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.429 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



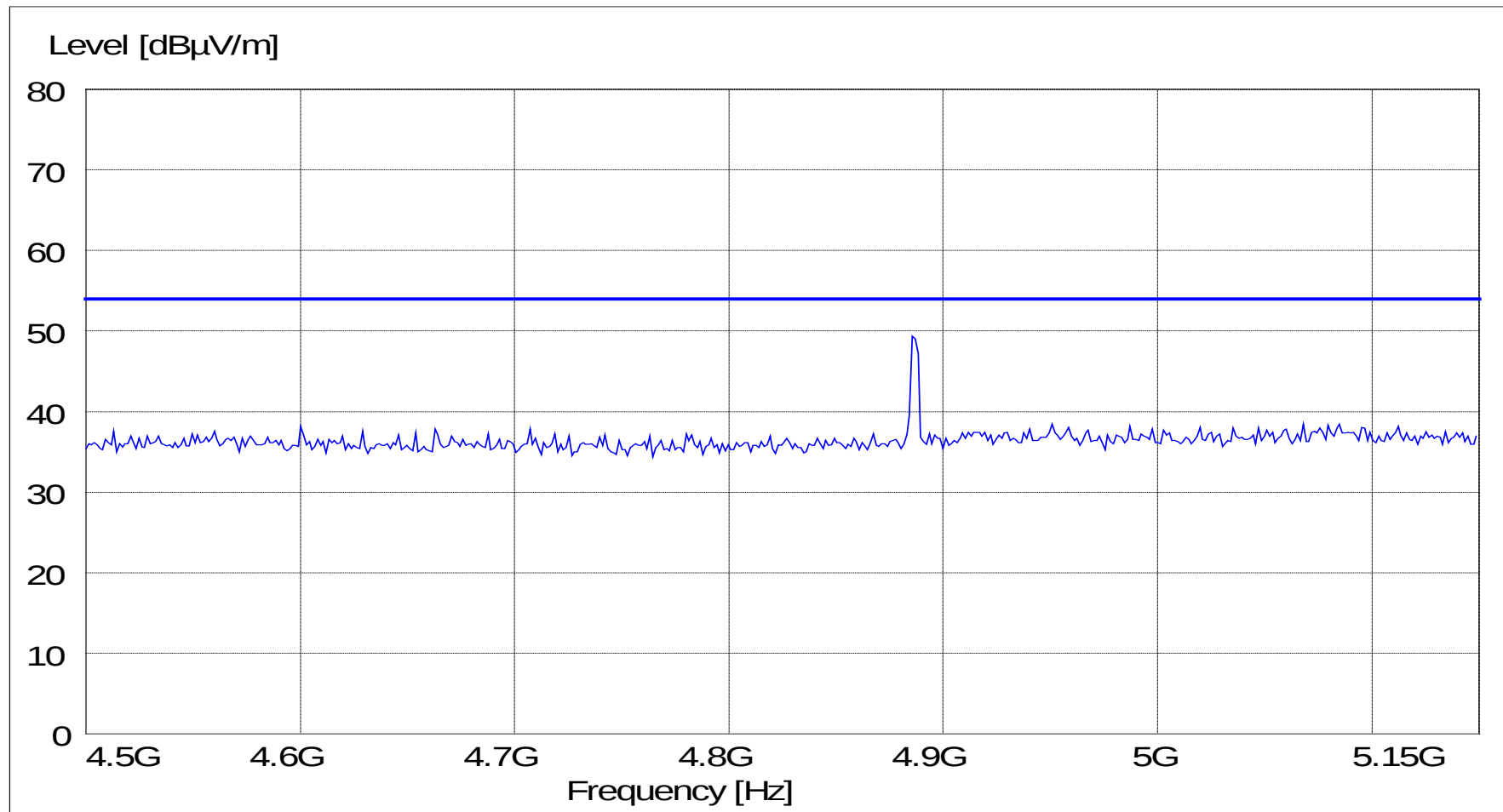
FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-XA / 1C000007
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.429 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



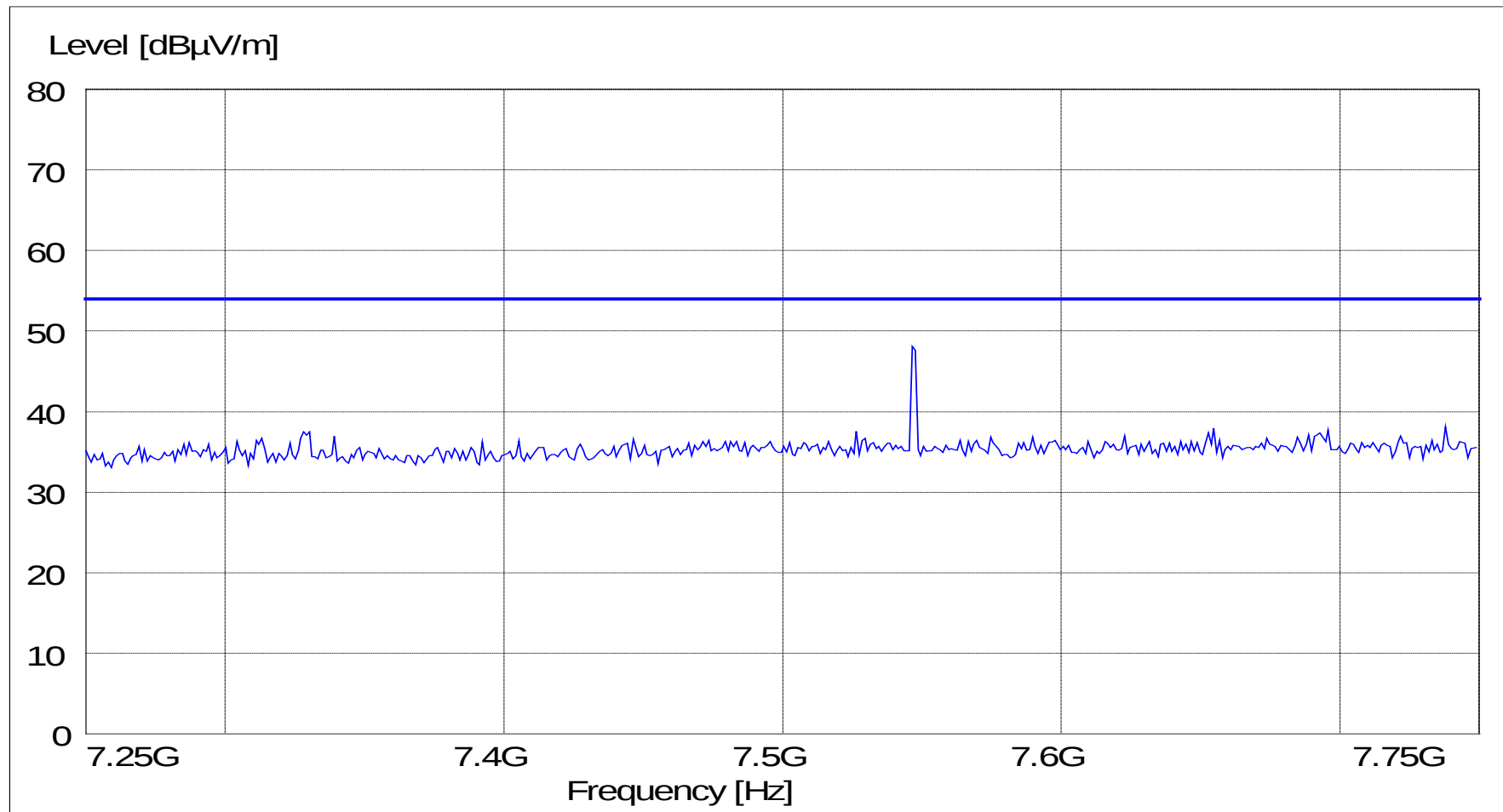
FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-XA / 1C000007
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.443 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



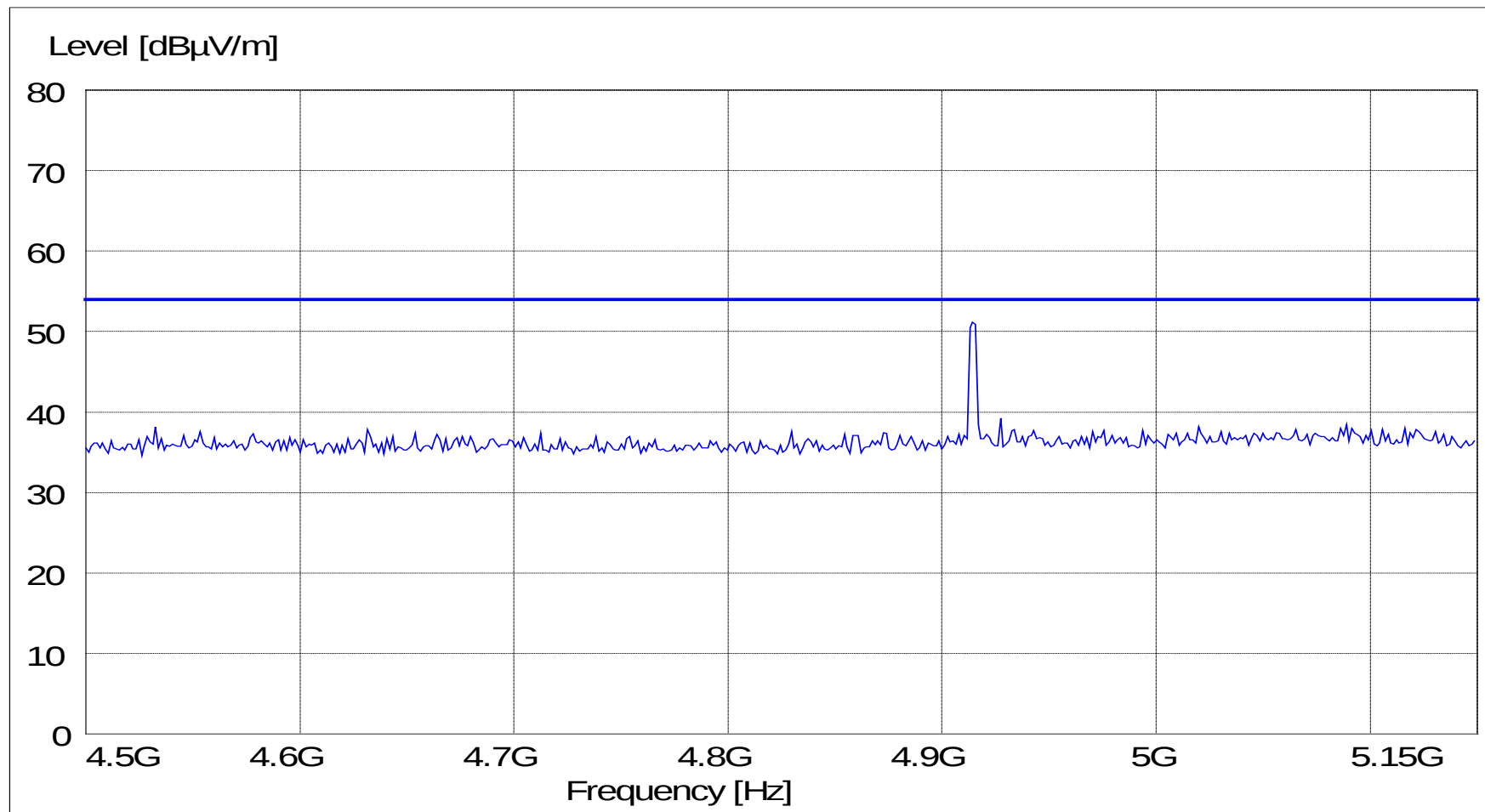
FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-XA / 1C000007
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.443 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



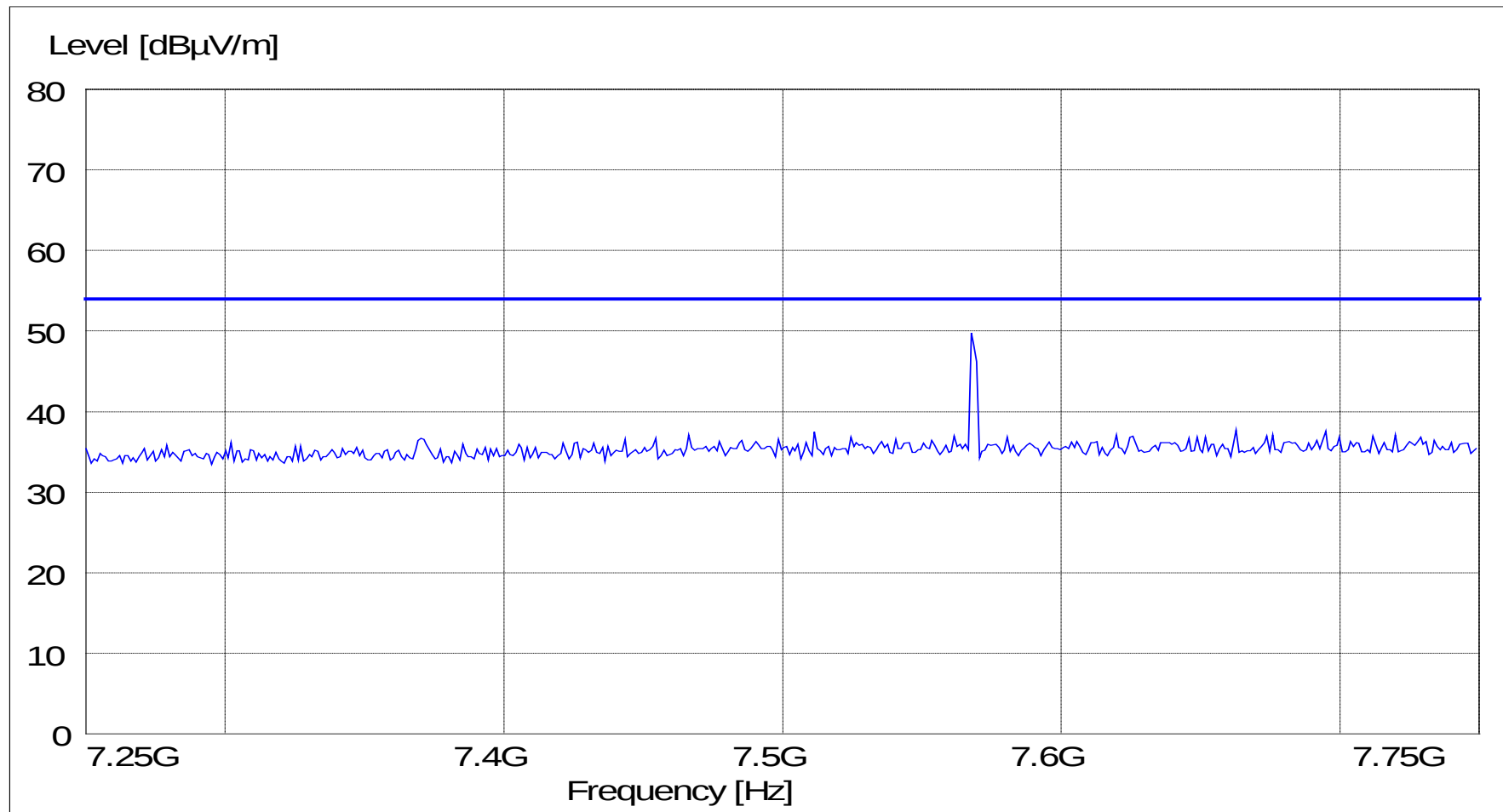
FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-XA / 1C000007
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.457 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



FCC Part 15.247 (d) Out of Band Emissions in Restricted Band

Customer: KCF Technologies, Inc
Test Sample: IoT Sensor Hub
Part/Serial Number: SD-HUB-XA / 1C000007
Test Specification: FCC Part 15, Subpart C
Mode of Operation: Continuously transmitting a modulated 2.457 GHz signal
Technician/Date: S. Macdonald / 9/02/20
Port Tested: Antenna
Notes: Peak Detector



FCC Part 15.247, Paragraph (d)
Sweep Table, Out of Band Emissions in Restricted Band, SD-HUB-1-XA



Retlif Testing Laboratories

Report No. R-3248P-1

SWEEP TABLE: "R-3248P-1 CE restric"

Unit: dBμV/m

Detector: Mode:

Curve 1: MaxPeak MaxHold

Subrange 1:

Start Frequency: 4.5 GHz
Stop Frequency: 5.2 GHz
Measure Time: Coupled
IF Bandwidth: 1 MHz

Receiver: ESIX Transducer: FCC Rest Band 3m2dBi
Signal Path: None System Transducer: None
Meas. Mode: Lin Add. Transd. 1: EN713E 10/20
Tracking Gen.: -- Add. Transd. 2: None
Input: 1 Add. Transd. 3: None

Preamplifier: Off Op. Range: --
RF Att.: 20 dB Preselection: Off
Ref. Level: -10.0 dBm Rep. by Device: --
Min. RF Att.: -- Option: --
IF Att.: -- Video Bandwidth: 10 MHz

Curve 1: On Repetition: Continuous
Stop Mark: Off
Curve 3: Off Stop Message: Off
Curve 4: Off Stop Message: Off

Subrange 2:

Start Frequency: 7.3 GHz
Stop Frequency: 7.8 GHz
Measure Time: Coupled
IF Bandwidth: 1 MHz

Receiver: ESIX Transducer: FCC Rest Band 3m2dBi
Signal Path: None System Transducer: None
Meas. Mode: Lin Add. Transd. 1: EN713E 10/20
Tracking Gen.: -- Add. Transd. 2: None
Input: 1 Add. Transd. 3: None

Preamplifier: Off Op. Range: --
RF Att.: 20 dB Preselection: Off
Ref. Level: -10.0 dBm Rep. by Device: --
Min. RF Att.: -- Option: --
IF Att.: -- Video Bandwidth: 10 MHz

Curve 1: On Repetition: Continuous
Stop Mark: Off
Curve 3: Off Stop Message: Off
Curve 4: Off Stop Message: Off



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Report No. R-3248P-1

FCC 15.247(e)
Test Data, Power Spectral Density, SD-HUB-1-MA

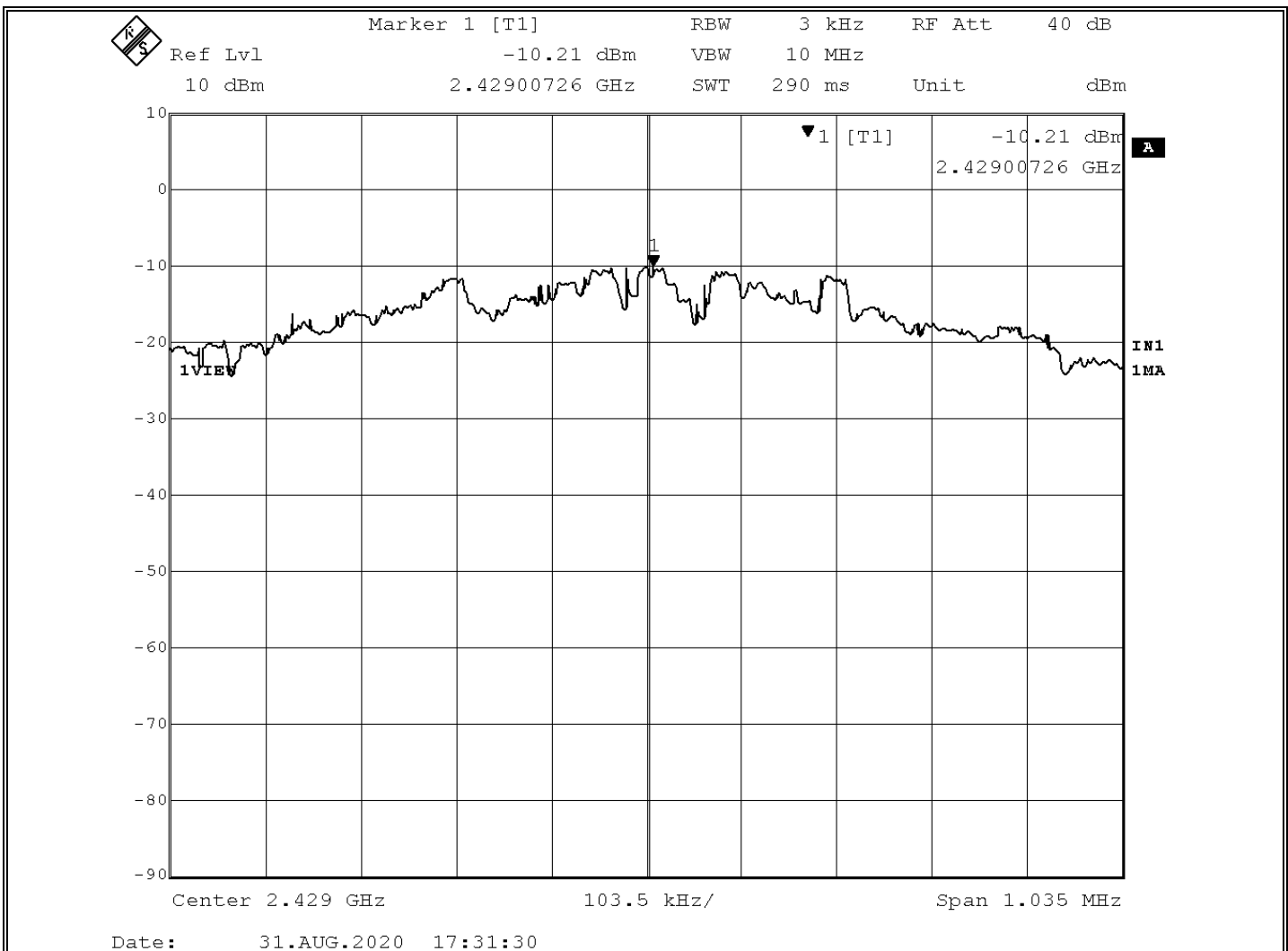


Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (e)
Method:	ANSI C63.10, Section 11.10.2 Maximum power spectral density level in the fundamental emission
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C00002D
Operating Mode:	Continuously transmitting a modulated signal at 2429 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Power Density = -10.21 dBm + 10.79 dB (attenuator) = 0.58 dBm

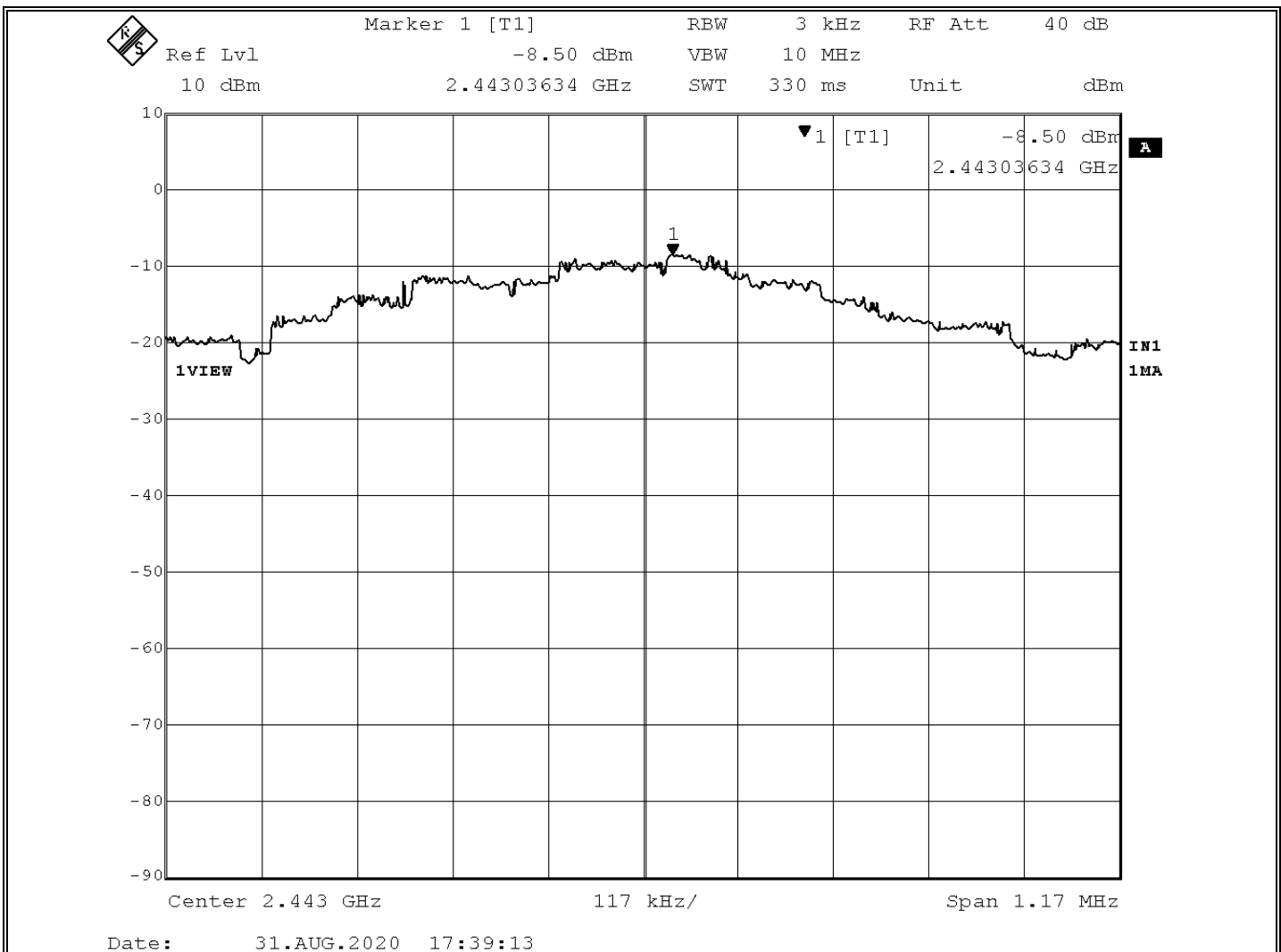


Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (e)
Method:	ANSI C63.10, Section 11.10.2 Maximum power spectral density level in the fundamental emission
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C00002D
Operating Mode:	Continuously transmitting a modulated signal at 2443 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Power Density = -8.50 dBm + 10.79 dB (attenuator) = 2.29 dBm

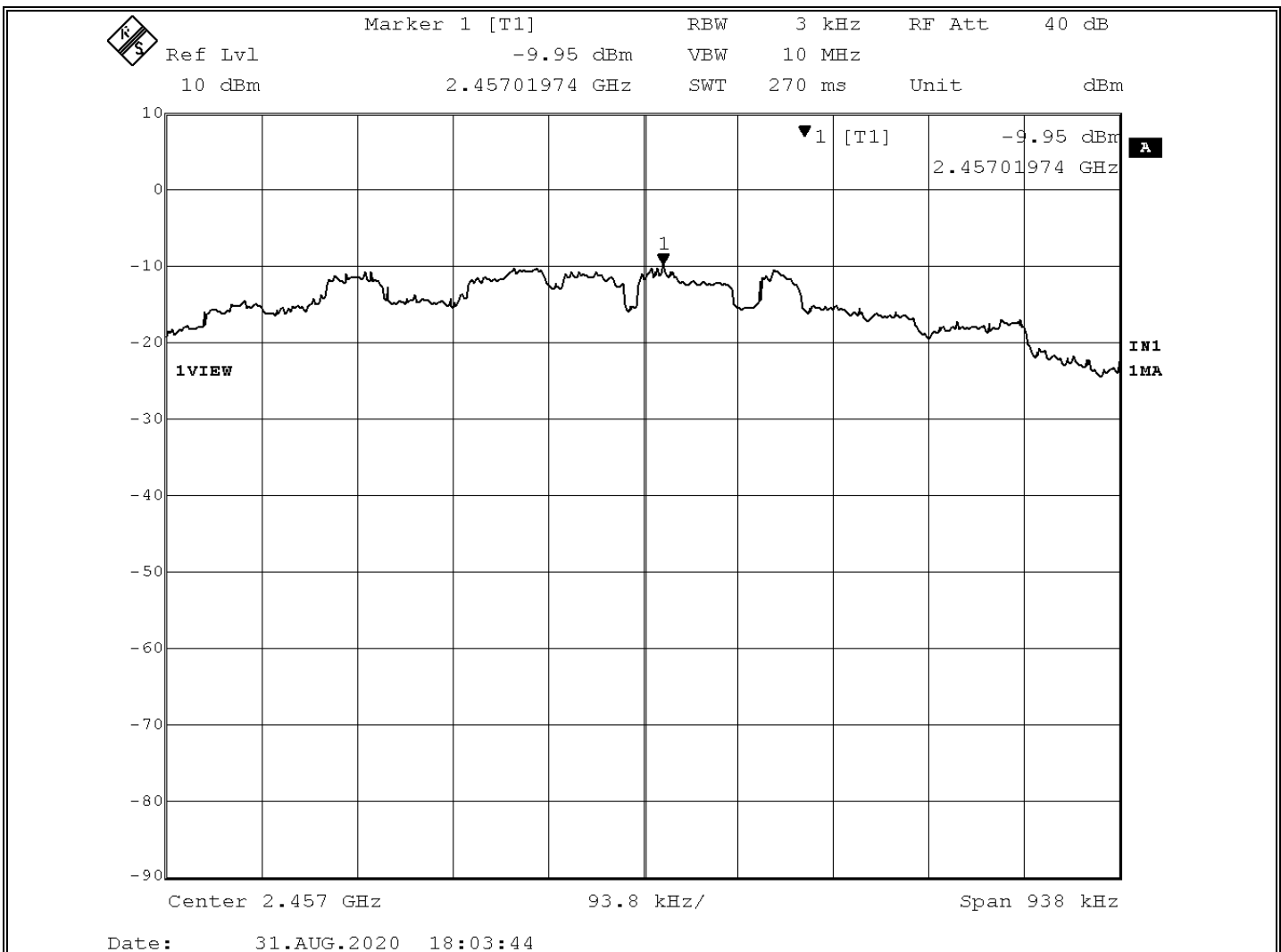


Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (e)
Method:	ANSI C63.10, Section 11.10.2 Maximum power spectral density level in the fundamental emission
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C00002D
Operating Mode:	Continuously transmitting a modulated signal at 2457 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Power Density = $-9.95 \text{ dBm} + 10.79 \text{ dB (attenuator)} = 0.84 \text{ dBm}$



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Report No. R-3248P-1

FCC 15.247(e)
Test Data, Power Spectral Density, SD-HUB-1-XA

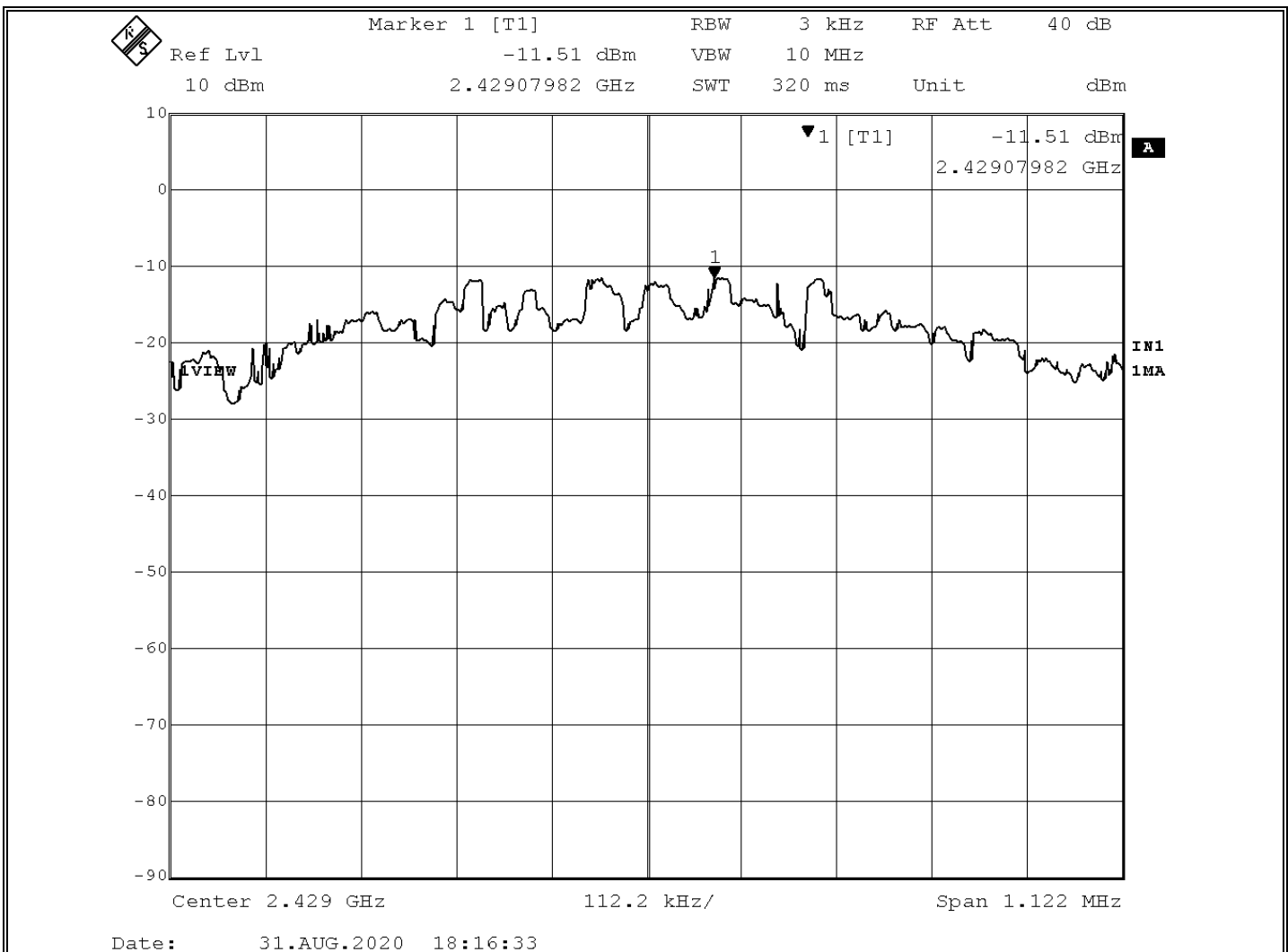


Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (e)
Method:	ANSI C63.10, Section 11.10.2 Maximum power spectral density level in the fundamental emission
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-XA
Serial Number:	1C000007
Operating Mode:	Continuously transmitting a modulated signal at 2429 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Power Density = $-11.51 \text{ dBm} + 10.79 \text{ dB (attenuator)} = -0.72 \text{ dBm}$

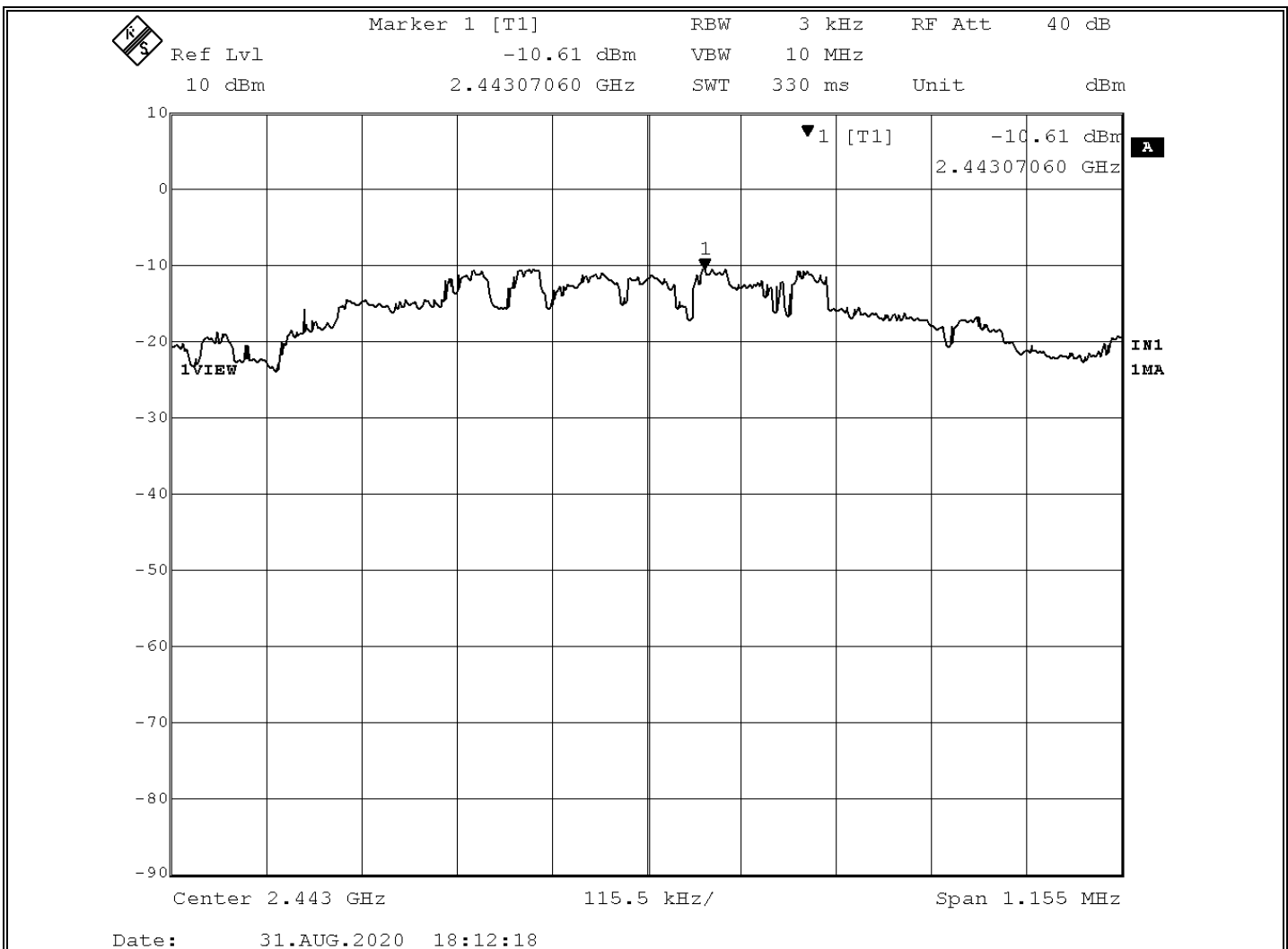


Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (e)
Method:	ANSI C63.10, Section 11.10.2 Maximum power spectral density level in the fundamental emission
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-XA
Serial Number:	1C000007
Operating Mode:	Continuously transmitting a modulated signal at 2443 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Power Density = $-10.61 \text{ dBm} + 10.79 \text{ dB (attenuator)} = 0.18 \text{ dBm}$

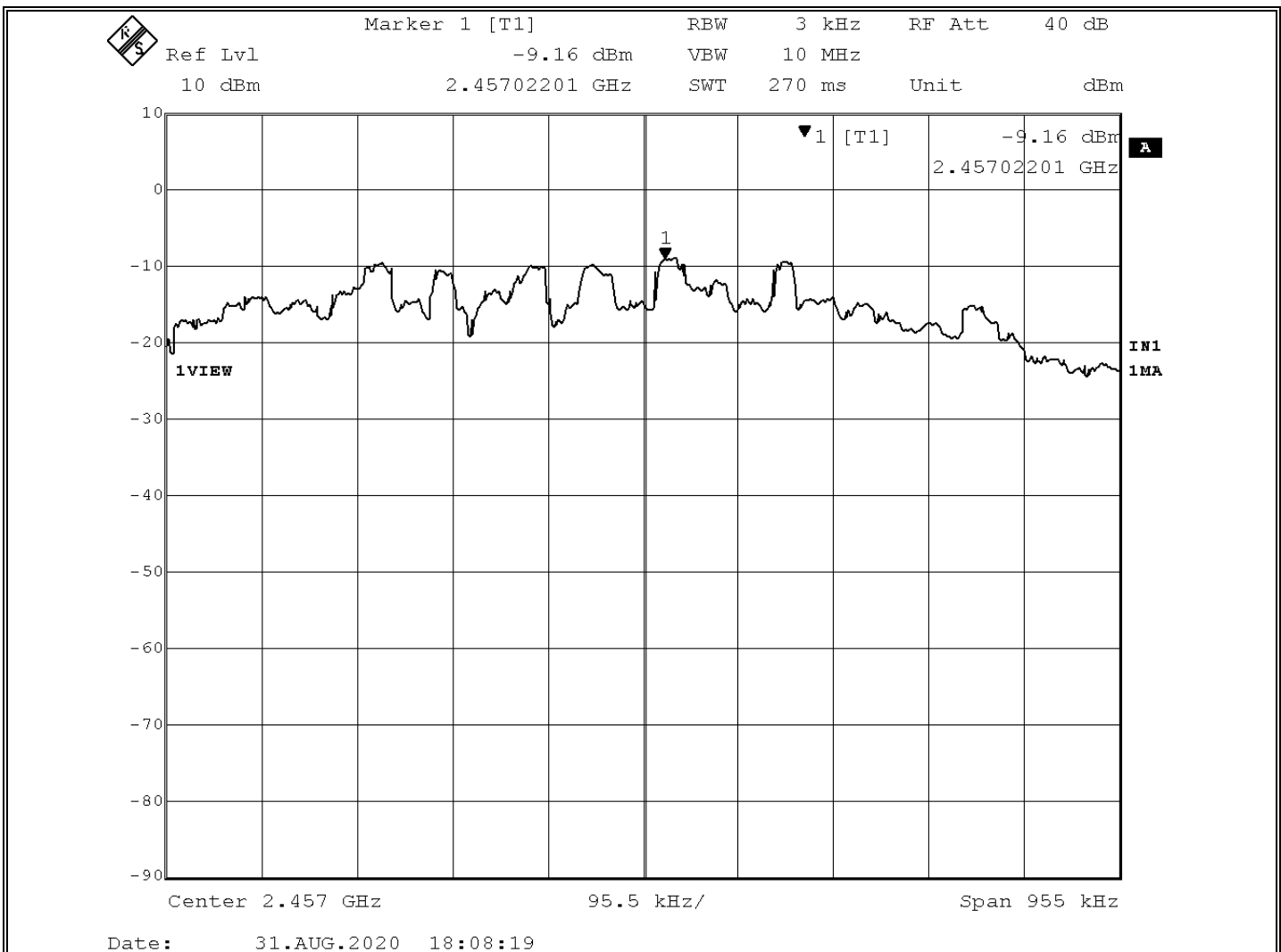


Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (e)
Method:	ANSI C63.10, Section 11.10.2 Maximum power spectral density level in the fundamental emission
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-XA
Serial Number:	1C000007
Operating Mode:	Continuously transmitting a modulated signal at 2457 MHz
Technician:	S. Macdonald
Date(s):	8/31/20
Temperature:	21.6 °C
Relative Humidity:	49.5 %
Notes:	Power Density = $-9.16 \text{ dBm} + 10.79 \text{ dB (attenuator)} = 1.63 \text{ dBm}$



Retlif Testing Laboratories

Report No. R-3248P-1

**FCC Part 15, Subpart C, Section 15.207,
Test Data, Conducted Limits, SD-HUB-1-MA**



Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.207, Conducted Emissions
Method:	ANSI C63.4, Section 7., AC power-line conducted emission measurements
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc.
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C000006
Operating Mode:	Broadcasting Data at 60 Second Intervals
Technician:	M. Nowak
Date(s):	8/25/20
Temperature:	22.5 °C
Relative Humidity:	49.9 %
Lead Tested:	120 VAC, 60 Hz, Hot

The frequency range was scanned from 0.15 MHz to 30 MHz.

The six highest emissions relative to the limit are presented.

The emissions observed from the EUT do not exceed the specified limits.

Frequency	Detector	Meter Reading	Total Correction Factor	Corrected Reading	Limit	Margin
MHz	–	dBµV	dB	dBµV	dBµV	dB
0.4290	Peak	41.1	10.1	51.2*	–	–
0.4290	Quasi-Peak	31.9	10.1	42.0	57.3	15.3
0.4290	Average	21.0	10.1	31.1	47.3	16.2
0.6497	Peak	42.5	10.1	52.6*	–	–
0.6497	Quasi-Peak	32.9	10.1	43.0	56.0	13.0
0.6497	Average	30.0	10.1	40.1	46.0	5.9
0.9667	Peak	48.1	10.1	58.2*	–	–
0.9667	Quasi-Peak	38.7	10.1	48.8	56.0	7.2
0.9667	Average	26.4	10.1	36.5	46.0	9.5
1.9593	Peak	39.4	10.2	49.6*	–	–
1.9593	Quasi-Peak	29.1	10.2	39.3	56.0	16.7
1.9593	Average	15.4	10.2	25.6	46.0	20.4
18.4584	Peak	38.1	10.5	48.6*	–	–
18.4584	Quasi-Peak	25.8	10.5	36.3	60.0	23.7
18.4584	Average	10.4	10.5	20.9	50.0	29.1
25.2400	Peak	41.9	10.6	52.5*	–	–
25.2400	Quasi-Peak	30.1	10.6	40.7	60.0	19.3
25.2400	Average	15.0	10.6	25.6	50.0	24.4

* Peak measurements are recorded for informational purposes only.



Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.207, Conducted Emissions
Method:	ANSI C63.4, Section 7., AC power-line conducted emission measurements
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc.
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C000006
Operating Mode:	Broadcasting Data at 60 Second Intervals
Technician:	M. Nowak
Date(s):	8/25/20
Temperature:	22.5 °C
Relative Humidity:	49.9 %
Lead Tested:	120 VAC, 60 Hz, Neutral

The frequency range was scanned from 0.15 MHz to 30 MHz.

The six highest emissions relative to the limit are presented.

The emissions observed from the EUT do not exceed the specified limits.

Frequency	Detector	Meter Reading	Total Correction Factor	Corrected Reading	Limit	Margin
MHz	–	dBµV	dB	dBµV	dBµV	dB
0.2808	Peak	41.0	10.1	51.1*	–	–
0.2808	Quasi-Peak	31.7	10.1	41.8	60.8	19.0
0.2808	Average	23.1	10.1	33.2	50.8	17.6
0.4215	Peak	43.5	10.1	53.6*	–	–
0.4215	Quasi-Peak	33.8	10.1	43.9	57.4	13.5
0.4215	Average	23.5	10.1	33.6	47.4	13.8
0.5896	Peak	35.8	10.1	45.9*	–	–
0.5896	Quasi-Peak	27.0	10.1	37.1	56.0	18.9
0.5896	Average	24.2	10.1	34.3	46.0	11.7
0.9753	Peak	49.9	10.1	60.0*	–	–
0.9753	Quasi-Peak	39.3	10.1	49.4	56.0	6.6
0.9753	Average	27.4	10.1	37.5	46.0	8.5
18.2961	Peak	46.5	10.5	57.0*	–	–
18.2961	Quasi-Peak	34.4	10.5	44.9	60.0	15.1
18.2961	Average	15.1	10.5	25.6	50.0	24.4
24.7030	Peak	40.0	10.6	50.6*	–	–
24.7030	Quasi-Peak	27.4	10.6	38.0	60.0	22.0
24.7030	Average	13.7	10.6	24.3	50.0	25.7

* Peak measurements are recorded for informational purposes only.



Retlif Testing Laboratories

Report No. R-3248P-1

**FCC Part 15, Subpart C, Section 15.207,
Test Data, Conducted Limits, SD-HUB-1-XA**



Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.207, Conducted Emissions
Method:	ANSI C63.4, Section 7., AC power-line conducted emission measurements
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc.
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-XA
Serial Number:	1C000008
Operating Mode:	Broadcasting Data at 60 Second Intervals
Technician:	M. Nowak
Date(s):	8/25/20
Temperature:	22.5 °C
Relative Humidity:	49.9 %
Lead Tested:	120 VAC, 60 Hz, Hot

The frequency range was scanned from 0.15 MHz to 30 MHz.
The six highest emissions relative to the limit are presented.
The emissions observed from the EUT do not exceed the specified limits.

Frequency	Detector	Meter Reading	Total Correction Factor	Corrected Reading	Limit	Margin
MHz	–	dBµV	dB	dBµV	dBµV	dB
0.2833	Peak	38.6	10.1	48.7*	–	–
0.2833	Quasi-Peak	27.7	10.1	37.8	60.7	22.9
0.2833	Average	18.9	10.1	29.0	50.7	21.7
0.4328	Peak	36.8	10.1	46.9*	–	–
0.4328	Quasi-Peak	28.8	10.1	38.9	57.2	18.3
0.4328	Average	19.7	10.1	29.8	47.2	17.4
1.0193	Peak	46.3	10.1	56.4*	–	–
1.0193	Quasi-Peak	35.7	10.1	45.8	56.0	10.2
1.0193	Average	23.5	10.1	33.6	46.0	12.4
1.9942	Peak	32.7	10.2	42.9*	–	–
1.9942	Quasi-Peak	22.6	10.2	32.8	56.0	23.2
1.9942	Average	10.2	10.2	20.4	46.0	25.6
18.4584	Peak	49.6	10.5	60.1*	–	–
18.4584	Quasi-Peak	34.3	10.5	44.8	60.0	15.2
18.4584	Average	14.8	10.5	25.3	50.0	24.7
19.9852	Peak	41.9	10.5	52.4*	–	–
19.9852	Quasi-Peak	30.9	10.5	41.4	60.0	18.6
19.9852	Average	14.8	10.5	25.3	50.0	24.7

* Peak measurements are recorded for informational purposes only.



Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.207, Conducted Emissions
Method:	ANSI C63.4, Section 7., AC power-line conducted emission measurements
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc.
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-XA
Serial Number:	1C000008
Operating Mode:	Broadcasting Data at 60 Second Intervals
Technician:	M. Nowak
Date(s):	8/25/20
Temperature:	22.5 °C
Relative Humidity:	49.9 %
Lead Tested:	120 VAC, 60 Hz, Neutral

The frequency range was scanned from 0.15 MHz to 30 MHz.
The six highest emissions relative to the limit are presented.
The emissions observed from the EUT do not exceed the specified limits.

Frequency	Detector	Meter Reading	Total Correction Factor	Corrected Reading	Limit	Margin
MHz	–	dBµV	dB	dBµV	dBµV	dB
0.2987	Peak	34.4	10.1	44.5*	–	–
0.2987	Quasi-Peak	25.2	10.1	35.3	60.3	25.0
0.2987	Average	13.4	10.1	23.5	50.3	26.8
0.4405	Peak	36.3	10.1	46.4*	–	–
0.4405	Quasi-Peak	27.5	10.1	37.6	57.1	19.5
0.4405	Average	16.1	10.1	26.2	47.1	20.9
1.0375	Peak	42.3	10.1	52.4*	–	–
1.0375	Quasi-Peak	32.0	10.1	42.1	56.0	13.9
1.0375	Average	21.2	10.1	31.3	46.0	14.7
18.6221	Peak	46.0	10.5	56.5*	–	–
18.6221	Quasi-Peak	32.1	10.5	42.6	60.0	17.4
18.6221	Average	14.9	10.5	25.4	50.0	24.6
20.1625	Peak	39.8	10.5	50.3*	–	–
20.1625	Quasi-Peak	29.1	10.5	39.6	60.0	20.4
20.1625	Average	13.6	10.5	24.1	50.0	25.9
25.1432	Peak	42.6	10.6	53.2*	–	–
25.1432	Quasi-Peak	31.1	10.6	41.7	60.0	18.3
25.1432	Average	16.3	10.6	26.9	50.0	23.1

* Peak measurements are recorded for informational purposes only.



Retlif Testing Laboratories

Report No. R-3248P-1

FCC Part 15, Subpart B, Section 15.109 (a)
Test Data, Digital and Receiver Spurious Emissions, SD-HUB-1-MA



Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart B, Section 15.109(a), Radiated Emissions, Class B
Method:	ANSI C63.4, Section 8, Radiated Emission Measurements, 30MHz to 1GHz
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc.
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-MA
Serial Number:	1C000006
Operating Mode:	Broadcasting Data at 60 Second Intervals
Technician:	M. Nowak
Date(s):	9/3/20
Temperature:	23.2 °C
Relative Humidity:	83 %
Detector:	Quasi-Peak
Test Distance:	3m

Notes: The frequency range was scanned from 30 MHz to 1 GHz

The emissions observed from the EUT do not exceed the specified limits. The six highest readings relative to the limit are presented.

*Noise floor measurement, minimum sensitivity of measurement system.

Frequency	Antenna Pol /Height	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
MHz	(V/H) / (m)	Degrees	dBuV	dB	dBuV/m	uV/m	uV/m
30.00							100
*35.00	H / 1.00	180.0	2.0	12.6	14.6	5.38	
88.00							100
88.00							150
*110.00	H / 1.00	180.0	11.4	13.3	24.7	17.18	
*195.00	H / 1.00	180.0	4.1	18.9	23.0	14.13	
216.00							150
216.00							200
*218.00	H / 1.00	180.0	7.2	13.3	20.5	10.60	
*605.00	H / 1.00	180.0	6.8	23.1	29.9	31.27	
960.00							200
960.00							500
*995.00	H / 1.00	180.0	5.1	30.2	35.3	58.22	
1000.00							500



Retlif Testing Laboratories

Report No. R-3248P-1

FCC Part 15, Subpart B, Section 15.109 (a)
Test Data, Digital and Receiver Spurious Emissions, SD-HUB-1-XA



Retlif Testing Laboratories

Report No. R-3248P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart B, Section 15.109(a), Radiated Emissions, Class B
Method:	ANSI C63.4, Section 8, Radiated Emission Measurements, 30MHz to 1GHz
Job Number/Customer:	R-3248P-1 / KCF Technologies, Inc.
Test Sample:	IoT Sensor Hub
Part Number:	SD-HUB-1-XA
Serial Number:	1C000008
Operating Mode:	Broadcasting Data at 60 Second Intervals
Technician:	M. Nowak
Date(s):	9/3/20
Temperature:	23.2 °C
Relative Humidity:	83 %
Detector:	Quasi-Peak
Test Distance:	3m

Notes: The frequency range was scanned from 30 MHz to 1 GHz

The emissions observed from the EUT do not exceed the specified limits. The six highest readings relative to the limit are presented.

*Noise floor measurement, minimum sensitivity of measurement system.

Frequency	Antenna Pol /Height	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
MHz	(V/H) / (m)	Degrees	dBuV	dB	dBuV/m	uV/m	uV/m
30.00							100
*35.00	H / 1.00	180.0	2.0	12.6	14.6	5.38	
88.00							100
88.00							150
*110.00	H / 1.00	180.0	11.4	13.3	24.7	17.18	
*195.00	H / 1.00	180.0	4.1	18.9	23.0	14.13	
216.00							150
216.00							200
*218.00	H / 1.00	180.0	7.2	13.3	20.5	10.60	
*605.00	H / 1.00	180.0	6.8	23.1	29.9	31.27	
960.00							200
960.00							500
*995.00	H / 1.00	180.0	5.1	30.2	35.3	58.22	
1000.00							500



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