Testing Tomorrow's Technology

Application
For

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and 15.247

And

Innovation, Science, and Economic Development Canada
Certification Per
IC RSS-Gen General Requirements for Radio Apparatus
And
RSS-247 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices

For the

Control Data Systems

Model Number: VN210
(2400 to 2483.5 MHz Transceiver)

FCC ID: 2AKZ5-CDSVN210ISA

UST Project: 19-0203
Issue Date: June 3, 2019

Total Pages: 27

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I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date: June 3, 2019

TESTING

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Control Data Systems
MODEL: VN210
FCC ID: 2AKZ5-CDSVN210ISA
DATE: June 3, 2019

This report concerns (check one): Original [ ]Class II Change [X]

Equipment type: 2400 to 2483.5 MHz Transceiver

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until:_____N/A_____
date
agrees to notify the Commission by N/A
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

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1 General Information

1.1 Purpose of this Report

The purpose of this report is to file for a Class II permissive change for the following reasons:

1. A flex type antenna is being added.

No other hardware changes have been made to the original product. No changes to the transmitter circuitry of the radio, the changes described in this filing result in the same RF characteristics as in the original filing and the other original test results continue to be representative of and applicable to the equipment.

Based on the changes outline above the following tests were performed to show that the radio will continue to meet the requirements:

1. Intentional Spurious emissions CFR 15.247
2. Unintentional Spurious emissions CFR 15.209

Test results are presented herein.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on May 13, 2019 in good operating condition.

1.3 Product Description

The module provides general purpose analog and digital I/O for use by the applications board (see module schematic). The module firmware implements the Nivis Mesh protocol. This module is a direct sequence spread spectrum transceiver operating in the 2400 MHz to 2483.5 MHz ISM band. The system is based on the IEEE 802.15.4 Wireless Personal Area Network (WPAN) standard, with channels spaced at 5 MHz intervals in the ISM band. The system operates at a chip rate of 2 Mcps, a symbol rate of 62.5 kbps, and a bit rate of 250 kbps. O-QPSK modulation is used with 16-ary orthogonal symbols. An input supply of 3.3 VDC is supplied to the RF module using buck-boost power supply. The module transmits with a maximum power of +10 dBm into the onboard MMCX connector. This module does not transmit for more than 42.35 ms over any 100 ms time period.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for the intentional radiator aspect of the device and *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)* for the unintentional radiator aspect of the device as well as FCC subpart B and C of Part 15 and per FCC KDB Publication number 558074 v03r05 for Digital Transmission Systems Operating Under section 15.247.

Digital RF conducted and radiated emissions data below 1 GHz were taken with the measuring receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1.0 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was set to 3 times the RBW or as required per the standard throughout the evaluation process.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC, with designation number is US5301. Additionally this site has been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittal(s)/Grant(s)

The EUT is currently approved as an intentionally transmitting device under FCC ID: 2AKZ5-CDSVN210ISA.

No other related submittals apply.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID	CABLES P/D
Radio module Control Data Systems	VN210	Engineering Sample	FCC ID: 2AKZ5-CDSVN210ISA	N/A
Hewlett-Packard (Laptop)	EliteBook 8530p	2CE010000TG	Unknown	-
Hewlett-Packard (Power Supply Adapter)	384020-001	PA-1900-08H2	Not Applicable	3.0 m UP
Antenna See antenna details	--	--	--	--

S= Shielded, U= Unshielded, P= Power, D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are included herein.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	8/17/2020
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	5/7/2020
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	4/8/2020
LOOP ANTENNA	SAS-200/562	A. H. Systems	142	1/22/2020 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9307-1431	10/23/2019 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	2/1/2021 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	11/28/2020 2 yr
HIGH PASS FILTER	H3R020G2	MICROWAVE CHIRCUITS	001DC9528	4/2/2020

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15.247 or IC RSS-210 requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated, with the device operating at the number of frequencies in each band specified in Table 3 as follows:

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates over 2.4 GHz to 2.4835 GHz, 3 test frequencies will be used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10th harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the following:

Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPRQuasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.6 EUT Antenna Requirements (CFR 15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.Only the antenna(s) listed in Table 4 will be used with this module.

Table 4. Details of Antenna to be Added

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Antenna	Taoglas	PCB/Flex	FXP73	+2.5	MMCX

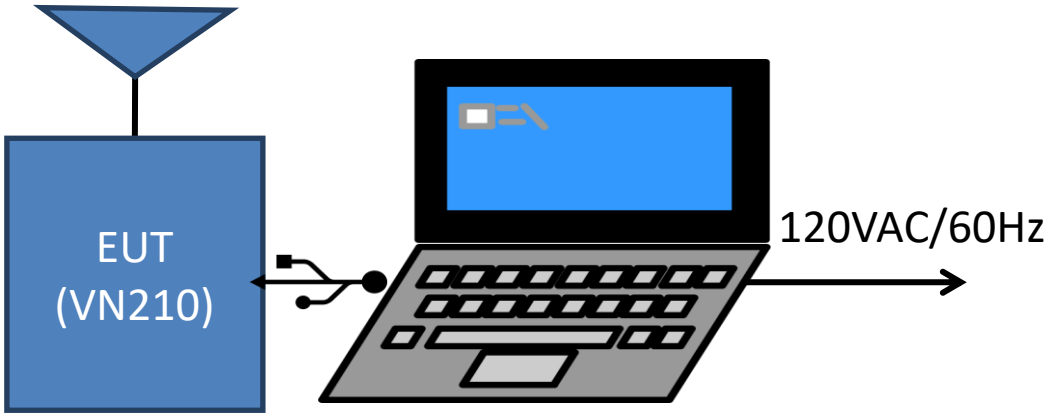


Figure 1. Block Diagram of Test Configuration

Note: The laptop is used for programming the radio module only.

2.7 Restricted Bands of Operation (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious cannot exceed the limits of 15.209. Radiated harmonics and other Spurious are examined for this requirement see paragraph 2.10.

2.8 Transmitter Duty Cycle (Part15.35 (c))

The EUT employs pulse transmission however for testing purpose the EUT was programmed to transmit at a rate >98%. The pulse transmission requirements of this subpart were acknowledge and considered during testing.

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may also be expressed logarithmically in dB.

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d))

On the test site, the EUT was placed on top of a non-conductive table, 80 cm above the floor for measurements below 1 GHz and 150 cm above the floor for measurements > 1 GHz. The EUT was also evaluated in three orthogonal positions to determine the worst case position. The front of the EUT faced the measurement antenna located 3 meters away. Each signal measured was maximized by raising and lowering the receive antenna between 1 and 4 meters in height while monitoring the ever changing spectrum analyzer display (with channel A in the Clear-Write mode and channel B in the Max-Hold mode) for the largest signal visible. That exact antenna height where the signal was maximized was recorded for reproducibility purposes. Also, the EUT was rotated about its Y-axis while monitoring the Spectrum Analyzer display for maximum. The EUT azimuth was recorded for reproducibility purposes. The EUT was measured when both maxima were simultaneously satisfied.

For radiated measurements, the EUT was set into a continuous transmission mode. Below 1 GHz, the RBW of the measuring instrument was set equal to 120 kHz. Peak measurements above 1 GHz were measured using a RBW = 1 MHz, with a VBW ≥ RBW. The results of peak radiated spurious emissions falling within restricted bands are given in the Table following.

For Average measurements above 1 GHz, the emissions were measured using RBW = 1 MHz and VBW = 10 Hz or the duty cycle correction factor was applied to the Peak recorded value.

Table 5. Spurious Radiated Emissions below 30 MHz

9 kHz to 30 MHz, 15.209 limits							
Test: Radiated Emissions				**Client:** Control Data Systems			
Project: 19-0203				**Model:** VN210			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
No emissions found greater than 20 dB below the applicable limit from the lowest clock frequency (9 kHz to 30 MHz).							

Test Date: May17, 2019

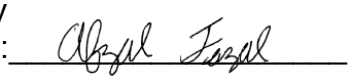
Tested By
Signature:  Name: Afzal Fazal

Table 6. Intentional Radiator, Radiated Emissions (CFR 15.209), 30 MHz to 25 GHz

30 MHz to 1000 MHz with Class B Limits							
Test: Radiated Emissions				**Client:** Control Data Systems			
Project: 19-0203				**Model:** VN210			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK or QP**
No emissions found greater than 20 dB below the applicable limit besides fundamental and harmonic emissions							

Test Date: May 17, 2019

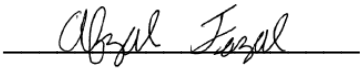
Tested By
Signature:  Name: Afzal Fazal

Table 7. Peak Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15, Para 15.209, 15.247(a)					**Client:** Control Data Systems			
Project: 19-0203					**Model:** VN210			
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
Low - Channel								
2405.00	75.44	--	30.35	105.79	--	3.0m./VERT	--	**PK**
4810.00	59.99	--	2.35	62.34	74.0	3.0m./VERT	11.7	**PK**
7215.00	54.19	-9.50	8.96	53.65	74.0	1.0m./VERT	20.3	**PK**
Mid - Channel								
2440.00	74.63	--	30.37	105.00	--	3.0m./VERT	--	**PK**
4880.00	56.85	--	1.29	58.14	74.0	3.0m./VERT	15.9	**PK**
7320.00	52.41	-9.50	9.17	52.08	74.0	1.0m./VERT	21.9	**PK**
High – Channel								
2475.00	71.46	--	30.37	101.83	--	3.0m./VERT	--	**PK**
4950.00	51.02	--	2.33	53.35	74.0	3.0m./VERT	20.7	**PK**
7425.00	52.09	-9.50	9.36	51.95	74.0	1.0m./VERT	22.0	**PK**

Notes:
1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~) Measurements taken at 1 meter were extrapolated to 3 meters using a factor of (-9.5 dB).
4. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 2405.00 MHz:

Magnitude of Measured Frequency	75.44	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	30.35	dB/m
Corrected Result	105.79	dBuV/m

Test Date: May 15, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

Table 8. Average Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15, Para 15.209, 15.247(a)					**Client:** Control Data Systems			
Project: 19-0203					**Model:** VN210			
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
Low - Channel								
2405.00	72.25	--	30.35	102.60	--	3.0m./VERT	--	**AVG**
4810.00	49.15	--	2.35	51.50	54.0	3.0m./VERT	2.5	**AVG**
7215.00	40.68	-9.50	8.96	40.14	54.0	1.0m./VERT	13.9	**AVG**
Mid - Channel								
2440.00	72.44	--	30.54	102.81	--	3.0m./VERT	--	**AVG**
4880.00	47.52	--	1.29	48.81	54.0	3.0m./VERT	5.2	**AVG**
7320.00	38.82	-9.50	10.11	38.49	54.0	1.0m./VERT	15.5	**AVG**
High – Channel								
2475.00	68.96	--	30.37	99.33	--	3.0m./VERT	--	**AVG**
4950.00	39.72	--	2.33	42.05	54.0	3.0m./VERT	12.0	**AVG**
7425.00	38.74	-9.50	9.36	38.60	54.0	1.0m./VERT	15.4	**AVG**

Notes:
1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peakmeasurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~) Measurements taken at 1 meter were extrapolated to 3 meters using a factor of (-9.5 dB).
4. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
5. Duty Cycle factor of -20 dB is added to the additional factor column.

Sample Calculation at 2405.0 MHz:

Magnitude of Measured Frequency	72.25	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	30.35	dB/m
Corrected Result	102.60	dBuV/m

Test Date: May 15, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

2.10 Band Edge Measurements – (CFR 15.247 (d))

Band Edge measurements are made following the guidelines in ANSI C63.10-2013 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Antenna port radiated measurements are performed to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB when compared to its highest in-band value (contained in a 100 kHz band). Because these frequencies occur above 1000 MHz they have both a peak and average requirement.

To capture the band edge set the Spectrum Analyzer frequency span large enough (usually around 10 MHz) to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. Conducted measurements are performed with RBW ≥1% of the frequency span. In all cases, the VBW is set ≥ RBW. See figures and calculations below for more detail.

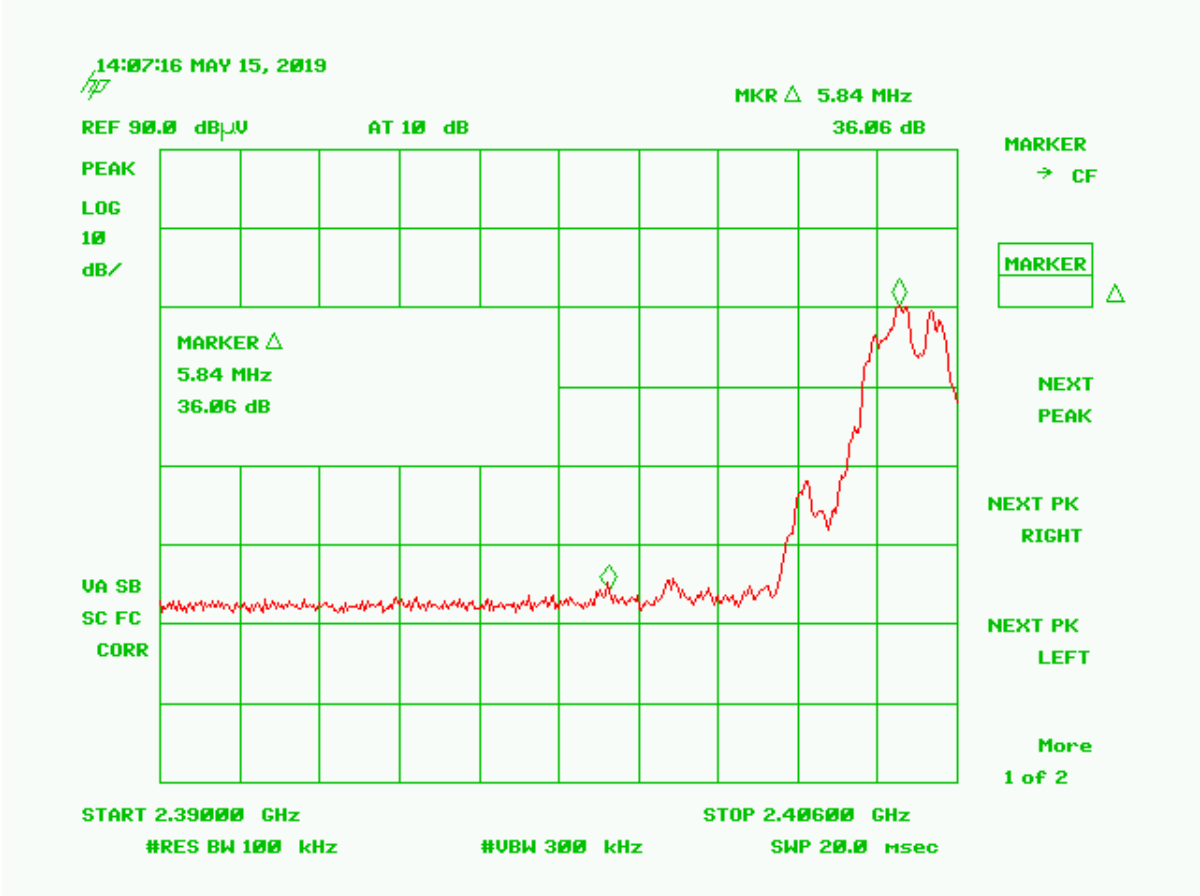


Figure 2. Band Edge Compliance, Low Channel Delta – Peak

Lower band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	36.06	dB
Band Edge Limit	20.00	dB
Band Edge Margin	16.06	dB

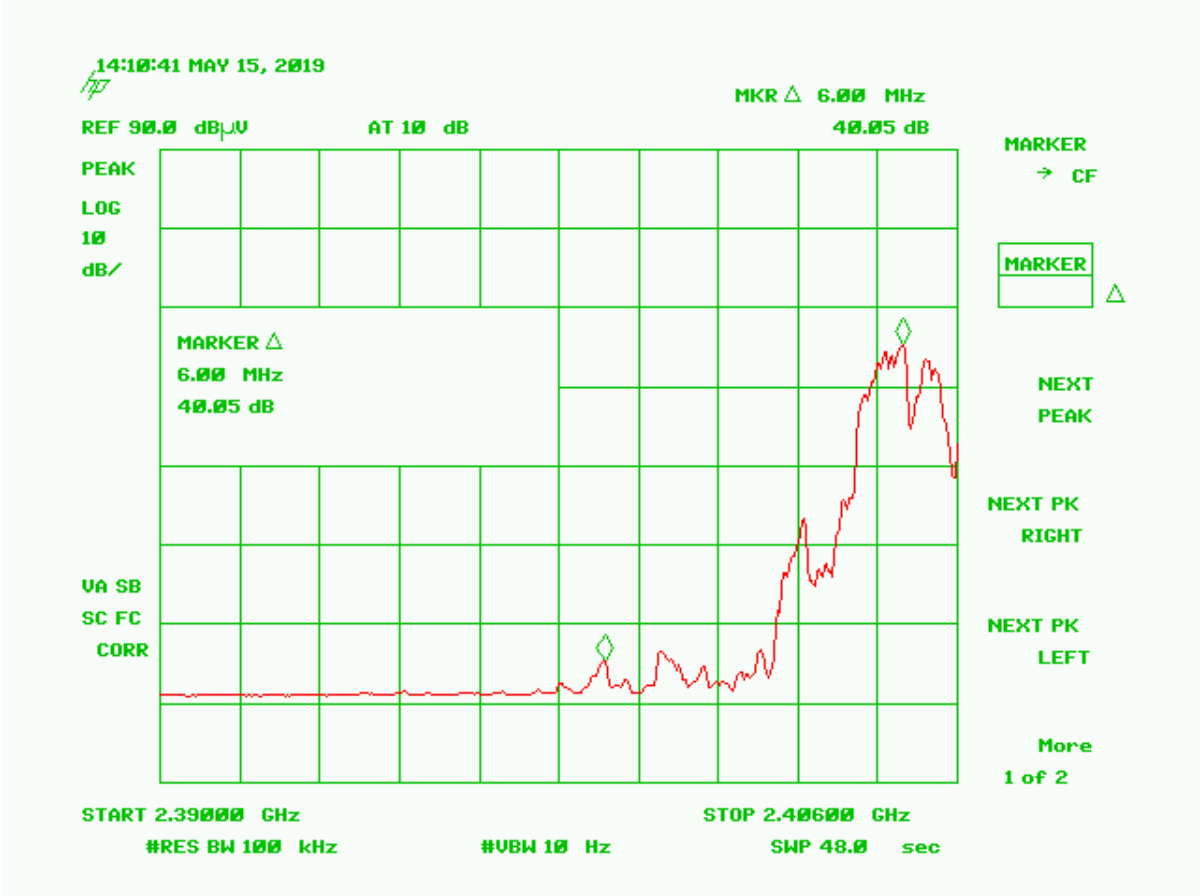


Figure 3. Band Edge Compliance, Low Channel Delta – Average

Lower band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	40.05	dB
Band Edge Limit	20.00	dB
Band Edge Margin	20.05	dB

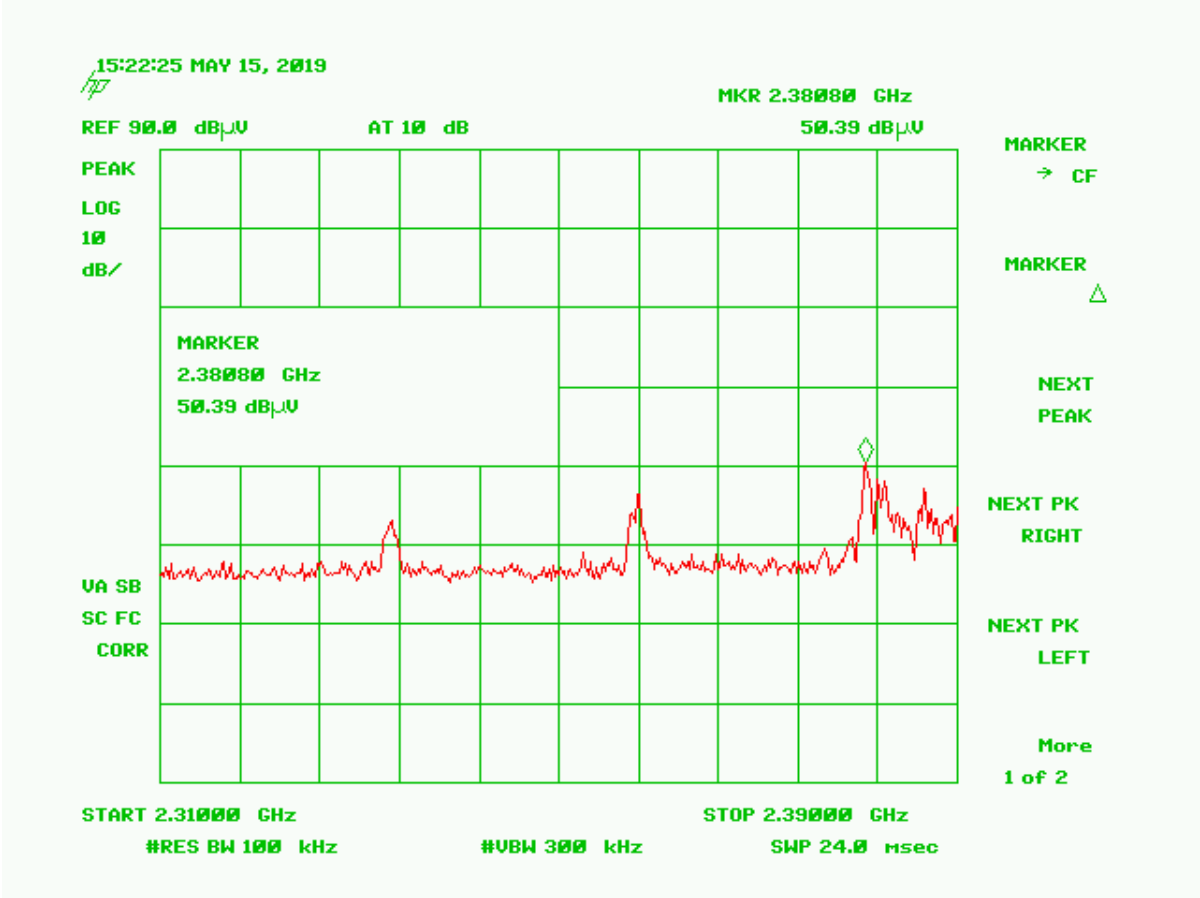


Figure 4. RadiatedLow Channel Restricted Band - Peak

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2380.80	50.39	-5.22	45.17	74.0	3.0m./HORZ	28.8	**PK**

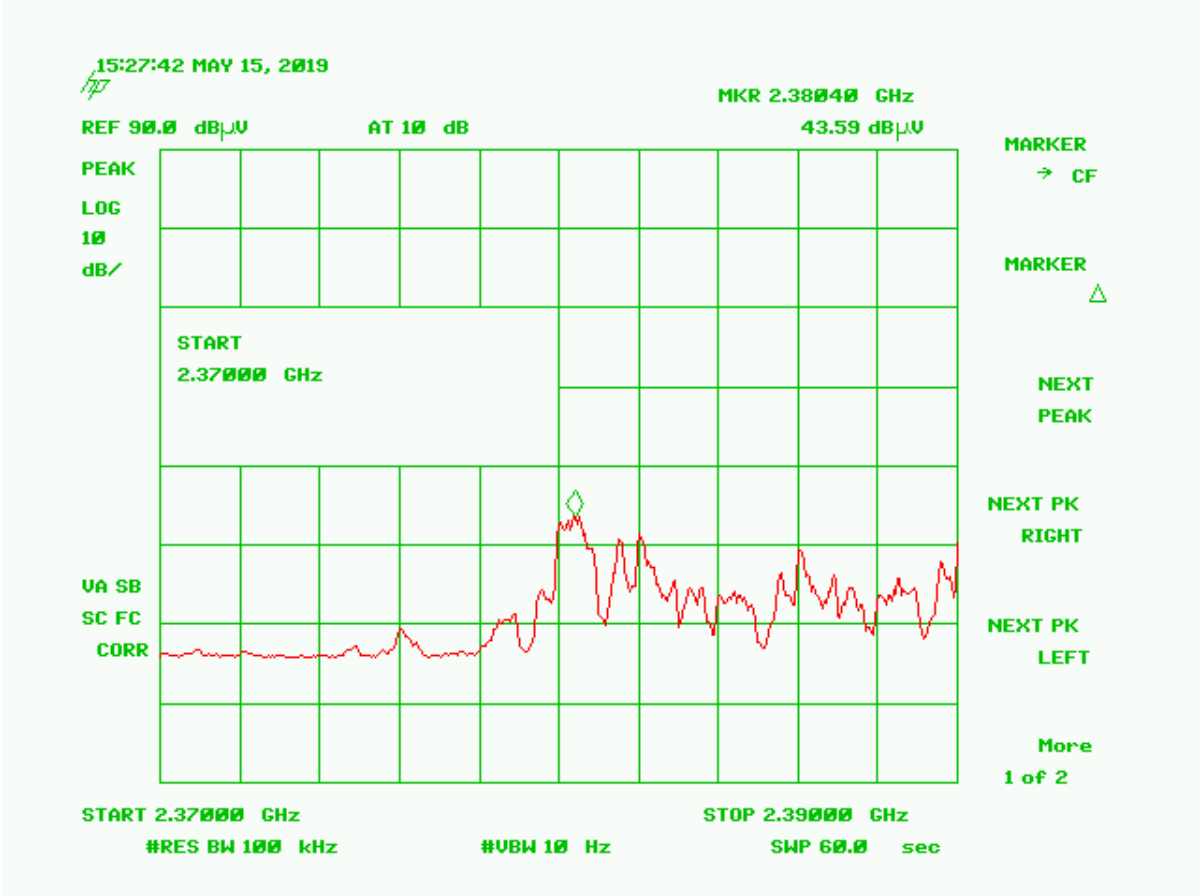


Figure 5. Radiated Low Channel Restricted Band –Average

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2380.40	43.59	-5.22	38.37	54.0	3.0m./HORZ	15.6	**AVG**

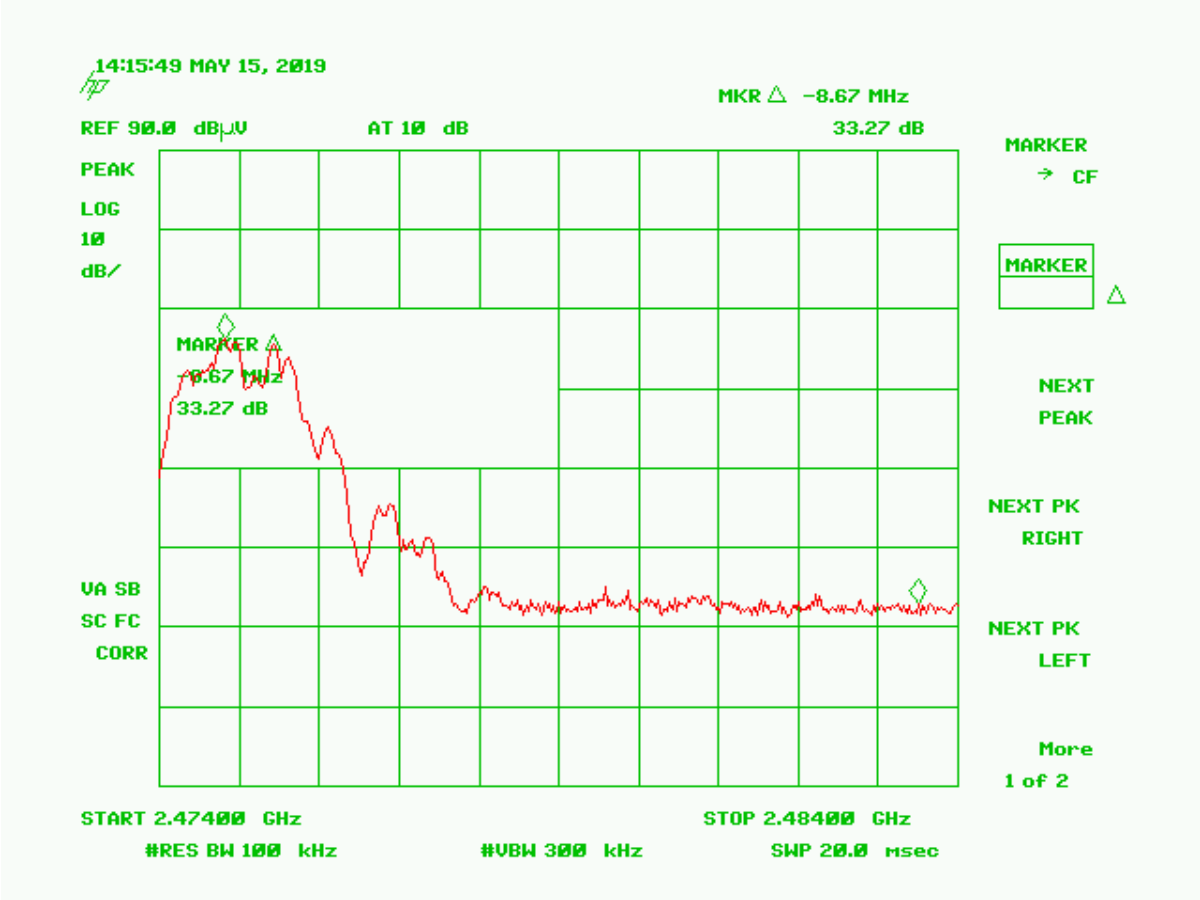


Figure 6. Band Edge Compliance, High Channel Delta – Peak

Higher band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	33.27	dB
Band Edge Limit	20.00	dB
Band Edge Margin	13.27	dB

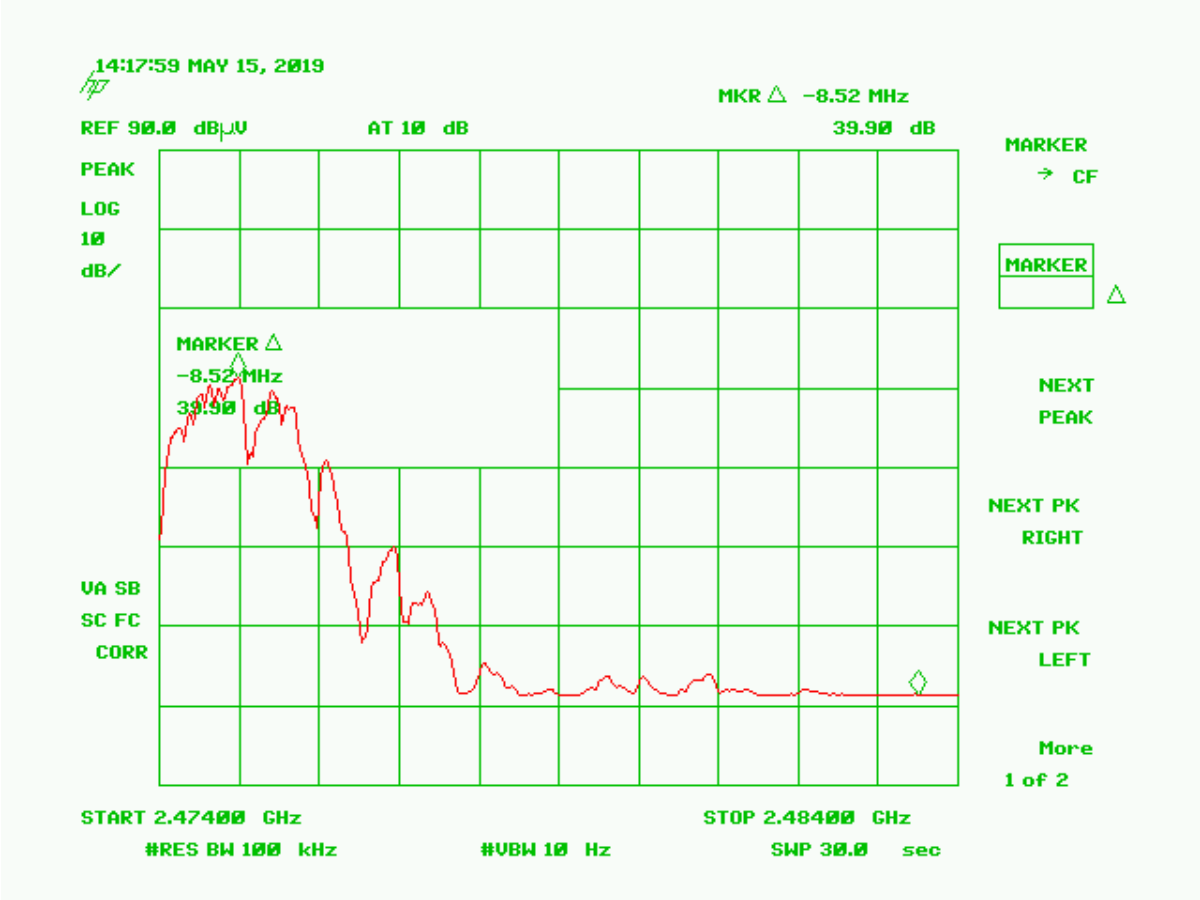


Figure 7. Band Edge Compliance, High Channel Delta – Average

Higher band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	39.90	dB
Band Edge Limit	20.00	dB
Band Edge Margin	19.90	dB

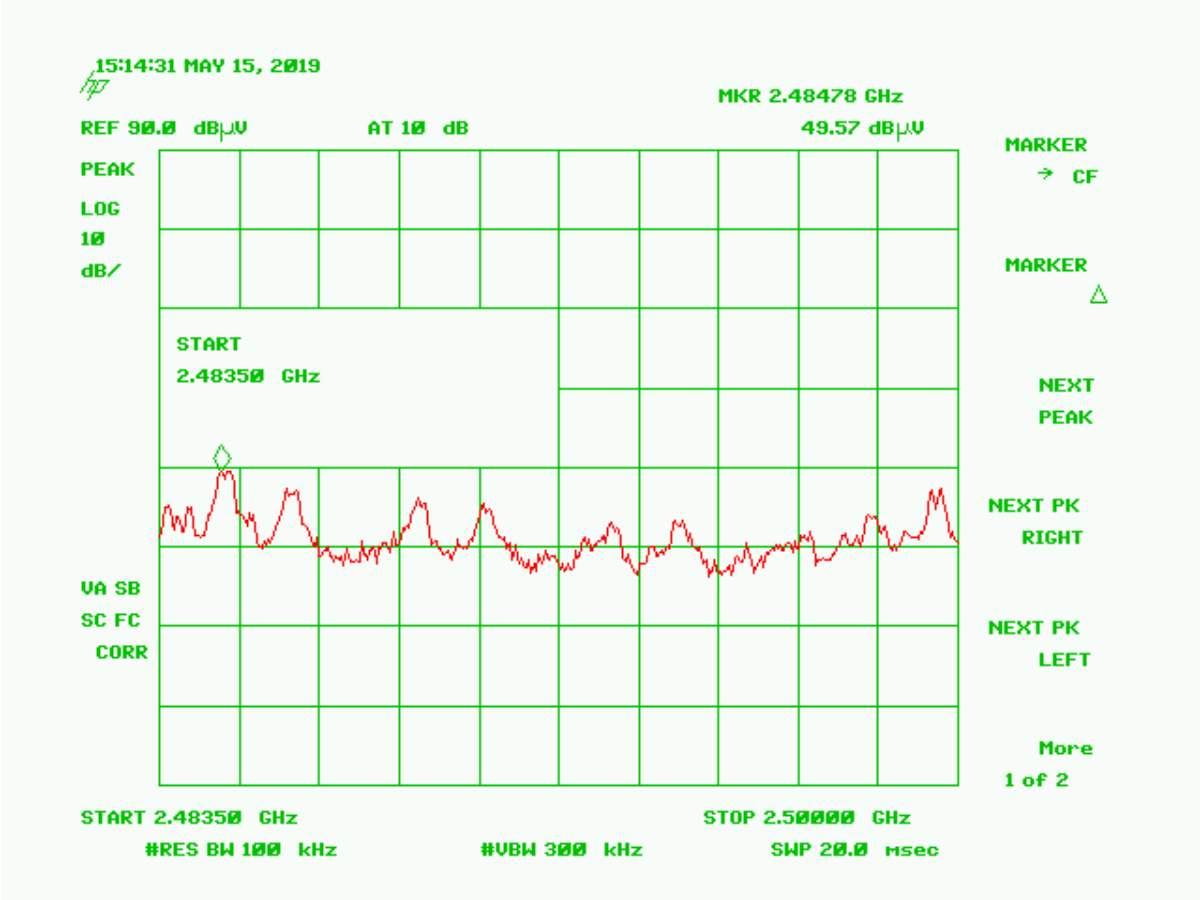


Figure 8. Radiated High Channel Restricted Band – Peak

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2484.78	49.57	-4.19	45.38	74.0	3.0m./HORZ	28.6	**PK**

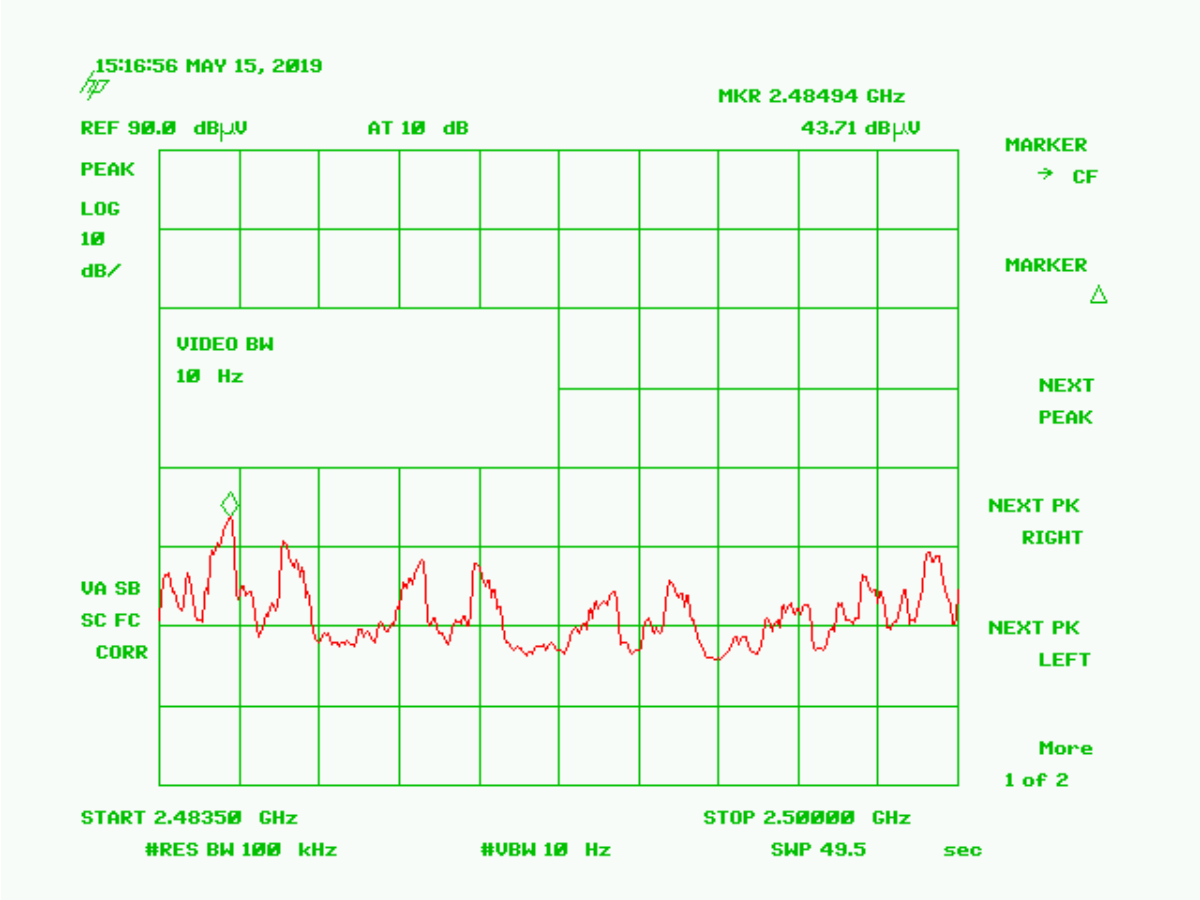


Figure 9. Radiated High Channel Restricted Band – Average

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2484.94	43.71	-4.19	39.52	54.0	3.0m./HORZ	14.5	**AVG**

2.11 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2:2011. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.11.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.78 dB.

Conducted Emissions measurement was not applicable for this project.

2.11.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ± 5.40 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.19 dB

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna (1-18 GHz) is ±5.08dB.

The measurement uncertainty (with a 95% confidence level) for this test using a mini Horn Antenna (> 18 GHz) is ±5.08dB.

3 Conclusions

The EUT is deemed to have met the requirements of the standards cited within the test report when tested as detailed in the present test report.