GENTEX CORPORATION

A Smarter Vision®

Technical Report to the FCC
Gentex Corporation

Model: UAGTMC
FCC ID: NZLUAGTMC
ISED: 4112A-UAGTMC

1/24/19

A report concerning approval for Gentex Corporation model UAGTMC
Please issue grant immediately upon review.

Measurements Made by:

Bolay Pannell
Digitally signed by Bolay Pannell
Date: 2020.01.28 13:09:44 -05'00'

Bolay Pannell
Senior EMC Test Engineer
Gentex Corporation

Measurements Reviewed by:

Daniel Brasier
Digitally signed by Daniel Brasier
Date: 2020.01.28 13:04:23 -05'00'

Dan Brasier
Senior EMC Test Engineer
Gentex Corporation

Report and Application Prepared by:

Brian Miller
Digitally signed by Brian Miller
Date: 2020.01.28 09:08:45 -05'00'

Brian Miller
Corporate labs Ground Leader – Wireless Regulatory
Gentex Corporation

Report Approved and Submitted by:

Craig Harder, NCT, Lab Manager - Electromagnetic Compatibility
Digitally signed by Craig Harder, NCT, Lab Manager - Electromagnetic Compatibility
Date: 2020.01.28 12:56:37 -05'00'

Craig Harder
Lab Manager - EMC Lab
Gentex Corporation

GENTEX CORPORATION

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Test Report Revision

REV Number	Date	Author	Description
1.0	10/24/19	Brian Miller	Initial Release.
2.0	1/13/19	Brian Miller	Performed additional testing in Flat and Side orientations per Notified Body feedback.
3.0	1/24/19	Brian Miller	Additional updates per Notified Body feedback.

Results relate only to the items tested as received.

Compliance has been evaluated based on the Lab Manual section 7.6.2. The decision rule used regarding measurement uncertainty was to determine results solely on whether the measured values met the defined acceptance criteria without factoring in measurement uncertainty values.

1. General Information

1.1. Product Description

The Gentex Corporation Integrated Toll Module OEM device that is installed into an overhead area of the automobile. The installation is provided by trained technicians during the course of the manufacture of the automobile. It is powered by the 12 Volt system of the automobile.

The unit is designed for the periodic operation as a toll module.

The unit is supplied to the automobile manufacturer without harness. For testing purposes a typical assembly and 2-conductor cable harness were used to power to the unit.

The unit is only operational when interrogated by a reader operating in the same protocol.

The antenna system is an integral part of the unit. It cannot be altered nor replaced by the user. Service of this system is only available from the Automobile Manufacturer's Dealerships and Gentex Corporation.

1.2. Related Grants

This device will have functionality that is covered under 47 CFR Part 90 and ISED Canada RSS-137. The device will have FCC ID # of NZLUAGTMC and ISED ID # of 4112A-UAGTMC.

1.3. Test Methodology

Radiated Emissions testing was performed according to ANSI C63.4:2014. The power source for this product is a 12V automotive vehicle battery, thus conducted emissions measurements are not required.

The unit is supplied to the automobile manufacturer without harness. For testing purposes a 2-conductor cable harness was used to interface to the unit.

The DUT was tested in receive mode only.

1.4. Test Facility

The 3-meter semi-anechoic chamber where these measurements were taken is located on the grounds of Gentex Corporation's Corporate Labs, in the city of Zeeland, county of Ottawa, state of Michigan, United States of America.

For radiated measurements above 1 GHz, RF absorbing material is placed between the antenna and EUT in accordance with ANSI C63.4:2014 Section 5.5 and chamber manufacturer's instructions.

Tabletop testing was conducted on a 3m turntable described in the site recertification report. The 3m chamber has been added to our A2LA scope of accreditation on 4/18/2019 and includes accreditation to ANSI C63.4:2014, ANSI C63.10:2013, and C63.26:2015. Our 3m chamber is registered with the ISED under Site# 4112A-2 and FCC under registration number 357351.

Corporate Mailing/Shipping Address
Gentex Corporation
600 N. Centennial Street
Zeeland, MI 49464

Site Address
Gentex Corporation
380 Riley Street
Zeeland, MI 49464

1.5. Accreditation

The Gentex Corporate EMC Lab is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation (A2LA). Our laboratory scope and accreditation certificate #2529.01 are available from their web site www.a2la.org. Our scope of accreditation covers ANSI C63.4:2014, ANSI C63.10:2013, ANSI C63.26:2015 and Radiated Emissions at 3m, FCC 47 CFR Part 90, ISED RSS-137.

2. Product Labeling

2.1. Identifiers

The FCC Identifier assigned is FCC ID: NZLUAGTMC. The ISED certification number is 4112A-UAGTMC. These identifiers will be labeled on the product housing.

The label will be printed on a label, which will be placed on the exterior of the housing and permanently affixed.

Because of the small size of the device and because the installation is inside a portion of the automobile, the following statements will appear in the user's manual. Refer to attachment "Users Manual.pdf" for the entire text of the user's manual.

> "The receiver portion of the device complies with FCC rule Part 15. Operation is subject to the following two conditions:
> (1) This device may not cause harmful interference,
> (2) This device must accept any interference that may be received including interference that may cause undesired operation.
> WARNING: The transmitter has been tested and complies with FCC and ISED rules. Changes or modifications not expressly approved by the party responsible for the compliance could void the user's authority to operate the device."
>
> This equipment complies with FCC and ISED radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must be at least 20cm from the user and must not be co-located or operating in conjunction with any other antenna or transmitter.

The term "ISED:" before the certification/registration number only signifies that ISED technical specifications were met.

ISED: 4112A-UAGTMC FCC ID: NZLUAGTMC

2.2. Label Drawing and Location on Product

The label drawing is included in the "Label.pdf" attachment.

A diagram showing the location of the label on the assembly is included in the "Label Location.pdf" attachment.

3. Test Configuration

Radiated Emission measurements presented in the report were made in accordance with ANSI C63.4-2014. The EUT was placed on a 1 x 1.5m non-metallic table elevated 80cm above a conducting ground plane for measurements below 1GHz and elevated to 1.5m for measurements above 1GHz. The harness was run straight down from the center of the turntable to a power supply connection sitting at the base of the table. The power supply is located beneath the floor of the chamber.

For radiated measurements above 1 GHz, RF absorbing material is placed between the antenna and EUT in accordance with ANSI C63.4:2014 Section 5.5 and chamber manufacturer's instructions.

4. Conducted Emissions Measurements

Conducted Measurements are not required for this product.

5. Radiated Emissions Data

5.1. Date(s) Tested: 10/24/19, 1/9/19

5.2. Test Method Deviations: None.

5.3. Temperature and Humidity conditions

	Measured Value	Unit
Temperature	22.8	ºC
Humidity	41.1	%R.H.

5.4. Summary of Results

Measurement		Margin	Frequency (MHz)
Worst case Digital Emission	38.45 dBuV/m	5.05dB	214.15

- **Measurement Uncertainty:** The standard uncertainty of measurement has been determined in accordance with the ISO Guide to the Expression of Uncertainty in Measurements. The estimation of measurement uncertainty reported is the expanded uncertainty for a coverage factor of k=2.26 and confidence interval of approximately 95%.

  Expanded Uncertainty $U_{(k=2.26)}$ is as follows:

  - Radiated Emissions – Bicon (30-250 MHz): 4.5 dB
  - Radiated Emissions – LPA (250-1000 MHz): 4.2 dB
  - Radiated Emissions – DRWG (1-18 GHz): 5.0 dB
  - Frequency: 0.15ppm

5.5. Test Equipment Setup and Procedure

5.5.1. Test Equipment Used

Description	Model #	ID Number	Last Cal Date	Cal Due
EMCO Biconical Antenna [30-250 MHz]	3110B	H6189	7/16/18	7/16/21
EMCO LPA Antenna [250-1000MHz]	3148	H6192	7/16/18	7/16/21
Com-Power Double Ridged Waveguide [1-18GHz]	AH-118	7182	12/4/18	12/4/21
Rohde & Schwarz EMI Receiver	ESR26	6595	9/12/19	10/12/20
Cables, attenuator and port feed through	various	3M Port Combo	3/31/19	3/31/20
Miteq Preamplifier	AMF-4D-0050100-24-10P	S/N:2053240	3/31/19	3/31/20
3m Chamber SW	N/A	SW30	3/31/19	3/31/20
Miteq Preamplifier	AM-1300	1429993	12/31/19	12/31/20

EMI Receiver Settings Emissions:

Detector Function:	Quasi-Peak below 1GHz Average above 1GHz
Resolution Bandwidth:	120 kHz (below 1GHz) 1MHz (above 1GHz)

EMI Receiver (in Spectrum Analyzer mode) Settings Occupied Bandwidth:

Detector:	Quasi-Peak
Resolution Bandwidth:	1 MHz (to determine peak level) 10 kHz (to determine occupied bandwidth)
Video Bandwidth:	3 MHz (to determine peak level) 30 kHz (to determine occupied bandwidth)

For the testing, the EUT was placed at the center of a non-conducting table 80cm above the ground plane pursuant to ANSI C63.4:2014 for stand-alone equipment. The 2-conductor harness was run straight down from the center of the turntable to a power supply sitting at the base of the table.

Equipment is placed in one of the three orthogonal orientations, End, Side, and Flat where applicable. The DUT was tested in in-vehicle position only similar to the flat orientation, see test setup photos for details. These orientations are described below in Figure 6.2.1.

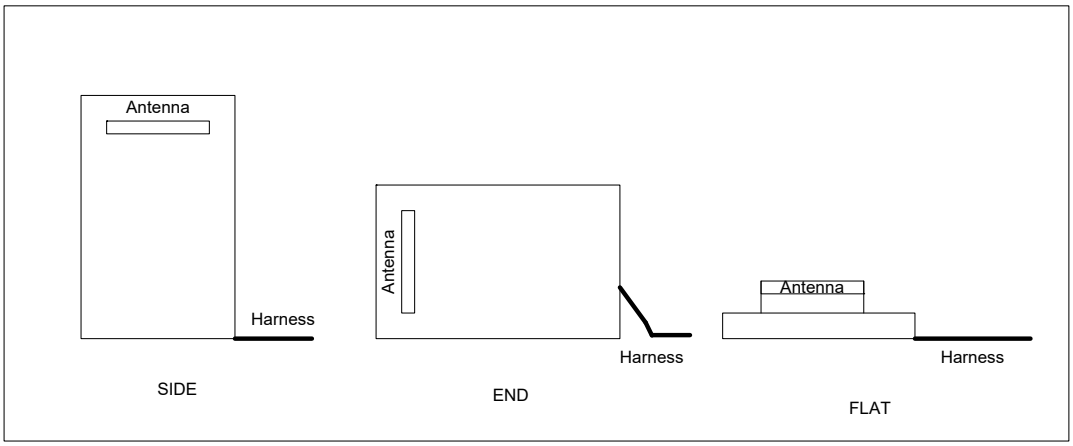


Figure 6.2.1 EUT Orthogonal Orientations

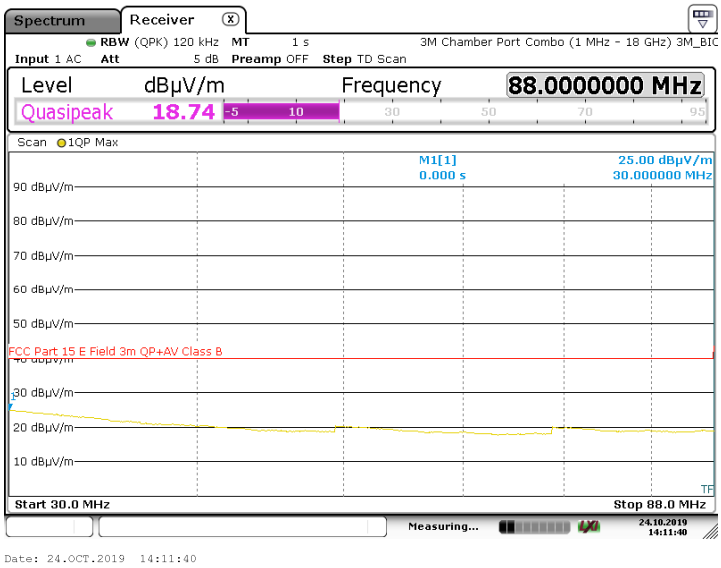
While in the prescribed orientation, the vertical antenna positioner sweeps in elevation from 1 to 4m in height until the operator finds the peak. The 3m turntable is then rotated through 360 degrees until a peak is found. The table is stopped at the peak location and the peak in elevation re-verified. Procedure is repeated for applicable orientations/measurement antenna polarizations.

6. Class B Emissions

The transmitter spurious radiation emissions were measured in a 3m semi-anechoic chamber. The design utilizes permanently attached antenna system and offers no provision antenna replacement. The DUT was placed on a turntable elevated as required above the ground plane at a distance of 3 meters from the measurement antenna. The turntable was rotated through 360 degrees to locate the position registering the maximum amplitude emission. The frequency spectrum was then searched for spurious emissions generated from the transmitter. Raising and lowering the measurement antenna and rotating the turntable to maximize the emission. A Loop antenna was used for measuring emissions from 0.009 to 30 MHz, Biconical Antenna for 30-300 MHz, Log Antenna for 300-1000 MHz, and Double Ridge Wave Guide Horn for 1-9 GHz. Emissions were measured in dBuV/m at 3 meters.

Data was taken per 47CFR Part 2.1051 and applicable parts of 47CFR Part 15B. The DUT demonstrated compliance with the specifications of Paragraphs 47CFR 2.1051, 2.1057.

Test Mode	Detector	Orientation	Frequency (MHz)		Antenna Polarization	Peak Frequency (MHz)	Peak Emission (dBuV/m)	Limit (dBuV/m)	Margin
			Start	Stop					
RX	Quasi-Peak	End	30	88	Horizontal	88	25	40	-15.00
RX	Quasi-Peak	End	30	88	Vertical	88	19.05	40	-20.95
RX	Quasi-Peak	End	88	216	Horizontal	216	26.89	43.5	-16.61
RX	Quasi-Peak	End	88	216	Vertical	216	21.12	43.5	-22.38
RX	Quasi-Peak	End	216	1000	Horizontal	959.76	36.75	46	-9.25
RX	Quasi-Peak	End	216	1000	Vertical	716.67	36.86	46	**-9.14**
RX	Quasi-Peak	End	960	1000	Horizontal	980.04	38.82	54	-15.18
RX	Quasi-Peak	End	960	1000	Vertical	980.03	38.8	54	-15.20
RX	Average	End	1000	5000	Horizontal	4200	27.35	54	-26.65
RX	Average	End	1000	5000	Vertical	1600	27.35	54	-26.65



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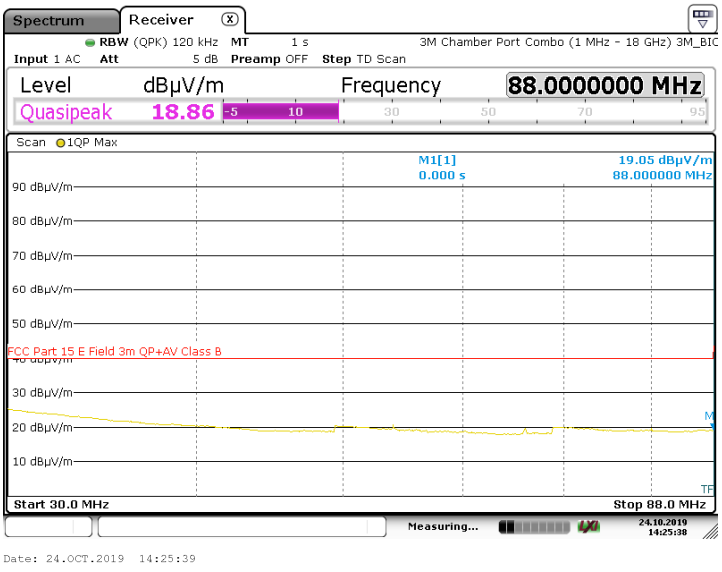
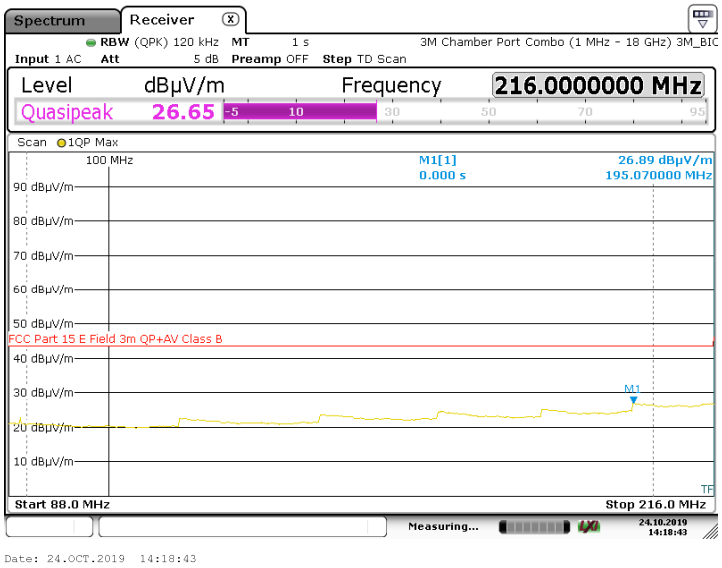


Vertical Polarization



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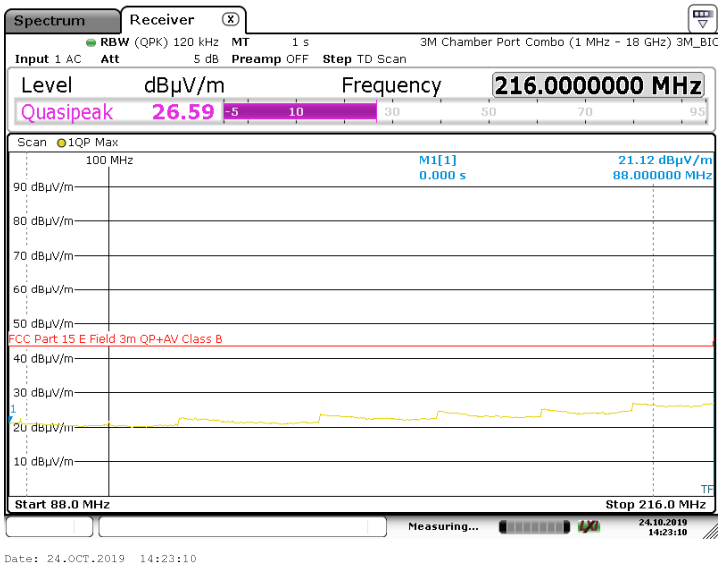

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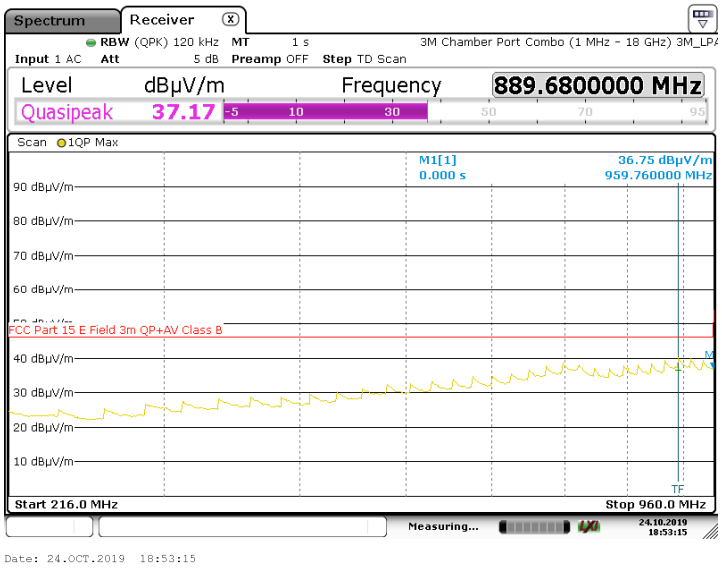

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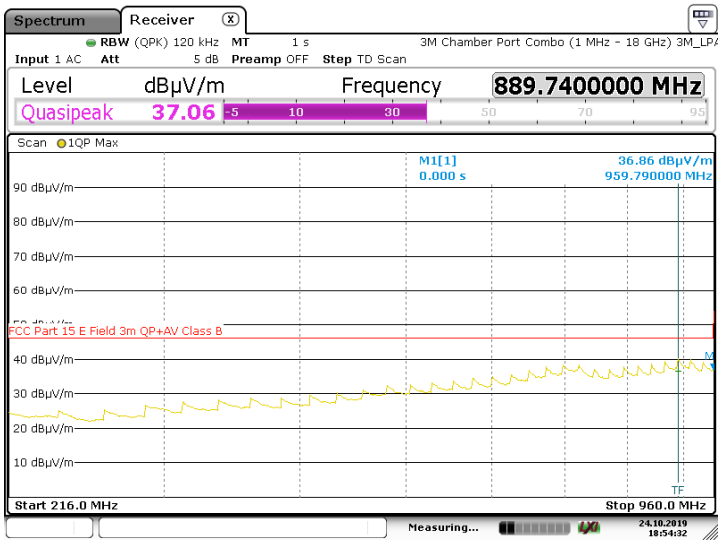

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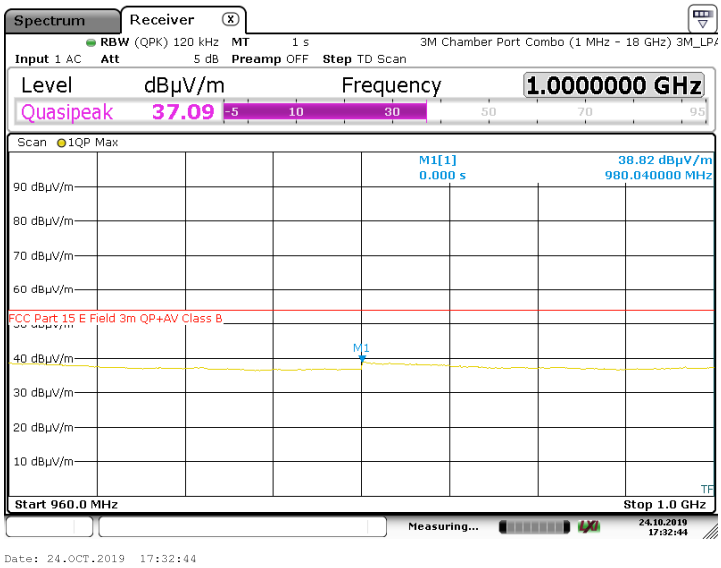

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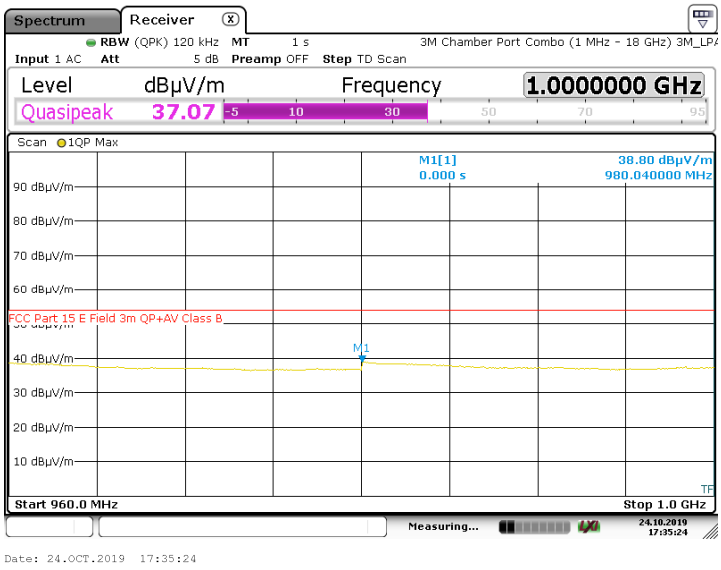

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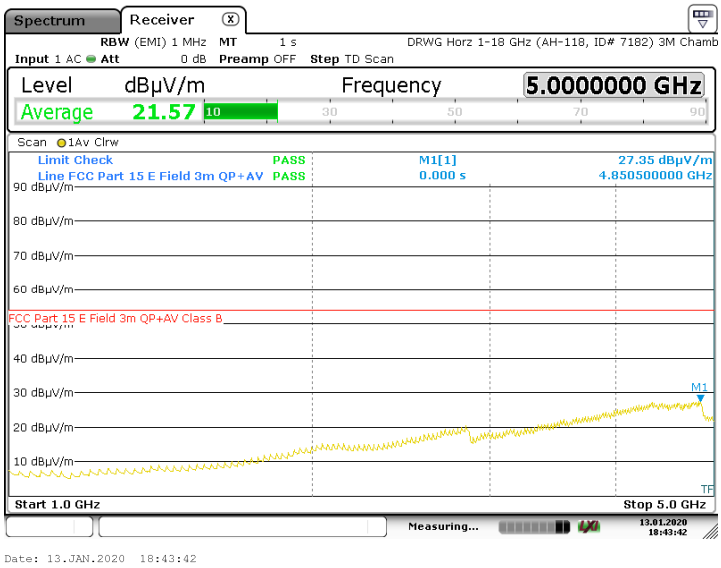

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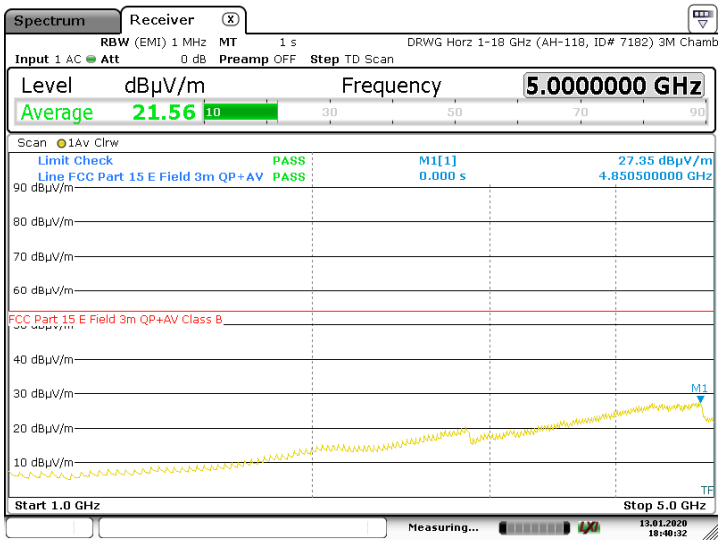
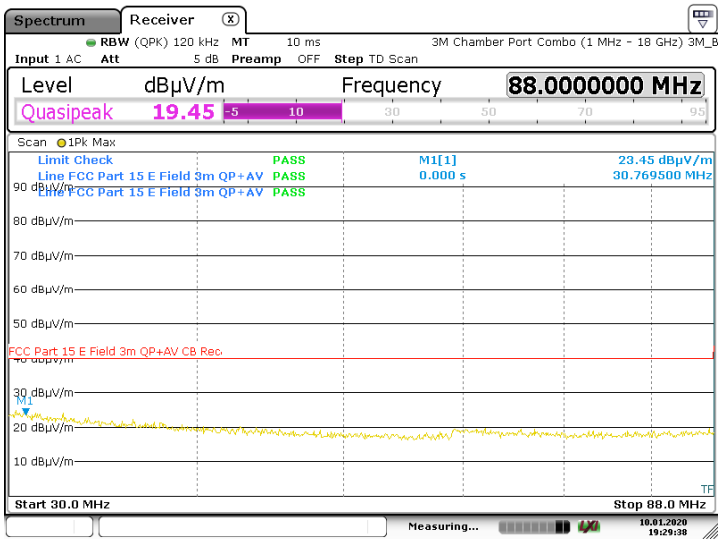


Date: 13.JAN.2020 18:40:32

Vertical Polarization

Test Mode	Detector	Orientation	Frequency (MHz)		Antenna Polarization	Peak Frequency (MHz)	Peak Emission (dBuV/m)	Limit (dBuV/m)	Margin
			Start	Stop					
RX	Quasi-Peak	Flat	30	88	Horizontal	30.76	23.45	40	-16.55
RX	Quasi-Peak	Flat	30	88	Vertical	30.76	24.48	40	-15.52
RX	Quasi-Peak	Flat	88	216	Horizontal	214.15	38.45	43.5	-5.05
RX	Quasi-Peak	Flat	88	216	Vertical	212.5	37.9	43.5	-5.60
RX	Quasi-Peak	Flat	216	1000	Horizontal	884.61	38.84	46	-7.16
RX	Quasi-Peak	Flat	216	1000	Vertical	885.3	38.85	46	-7.15
RX	Average	Flat	1000	5000	Horizontal	4850	27.34	54	-26.66
RX	Average	Flat	1000	5000	Vertical	4850	27.34	54	-26.66



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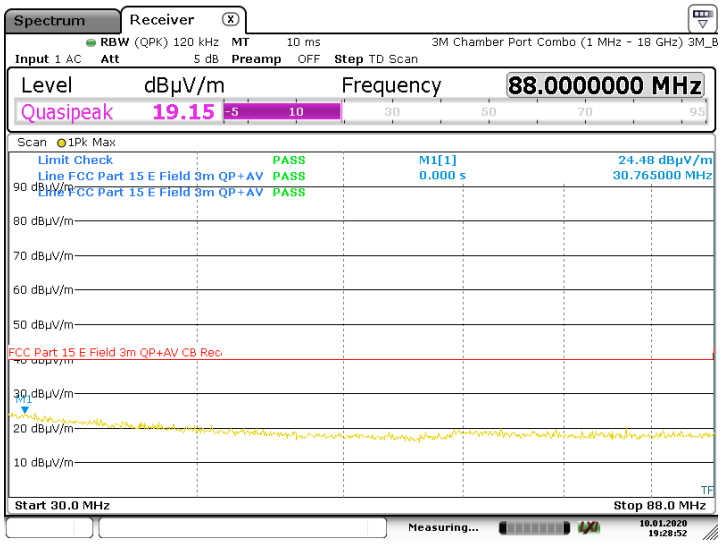

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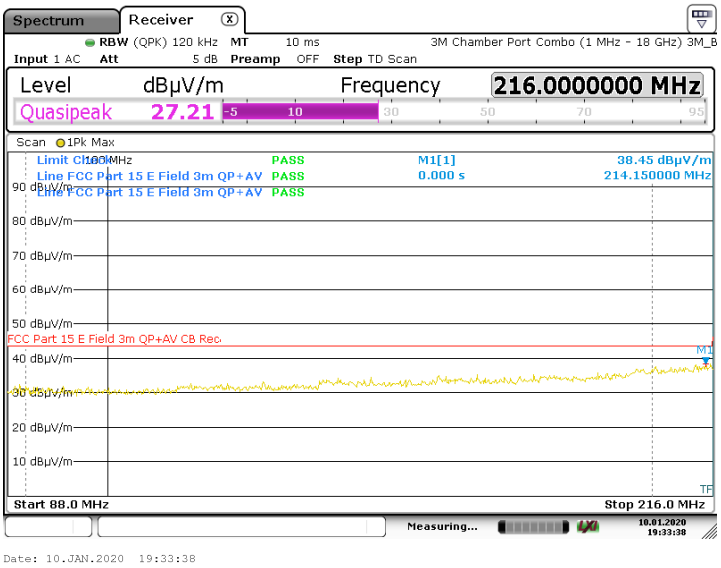

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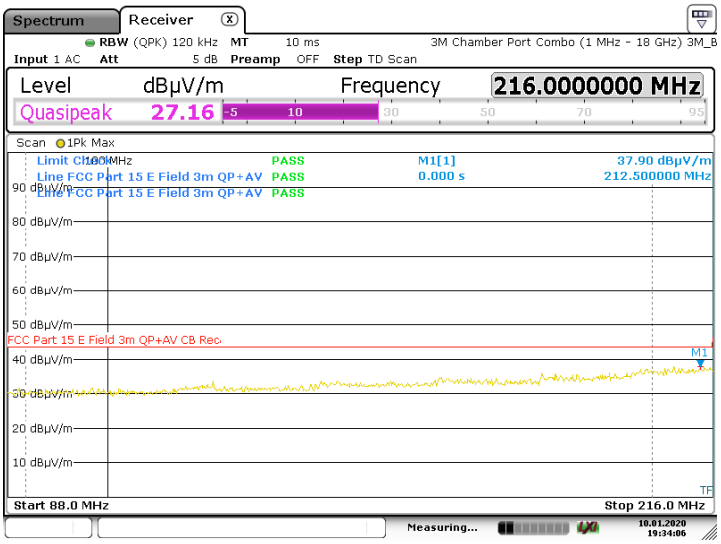

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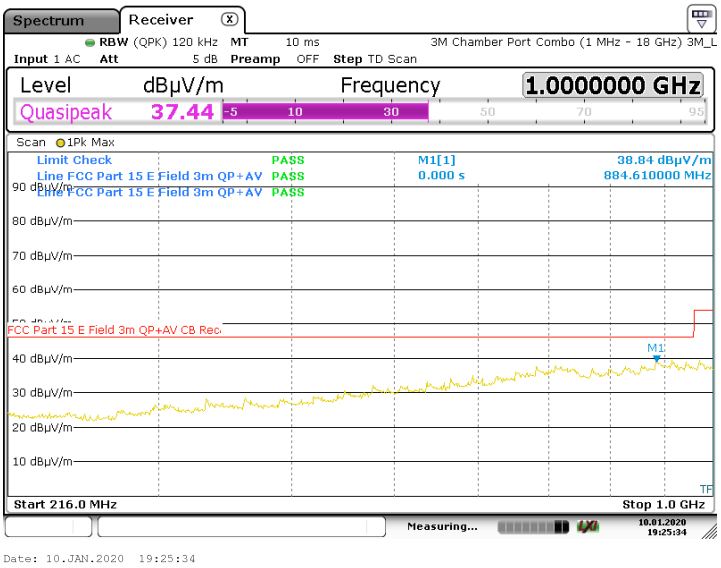

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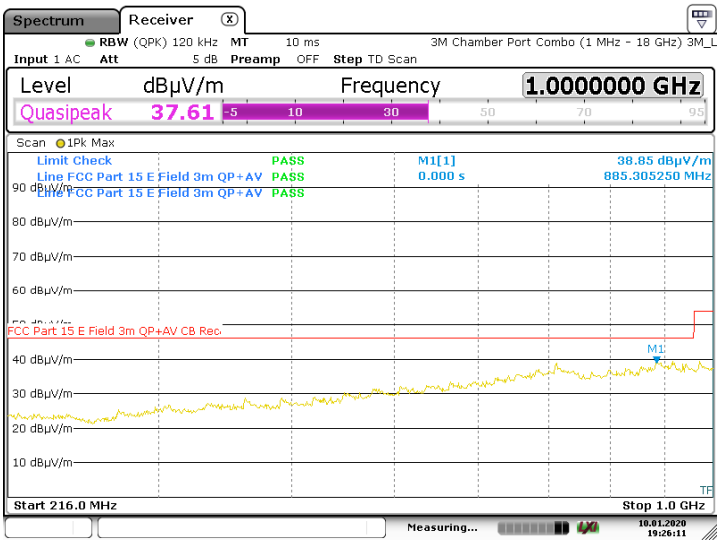

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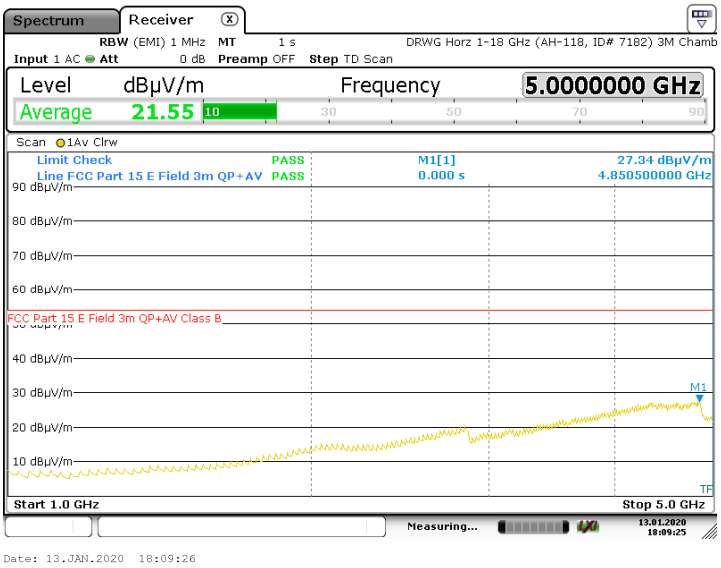

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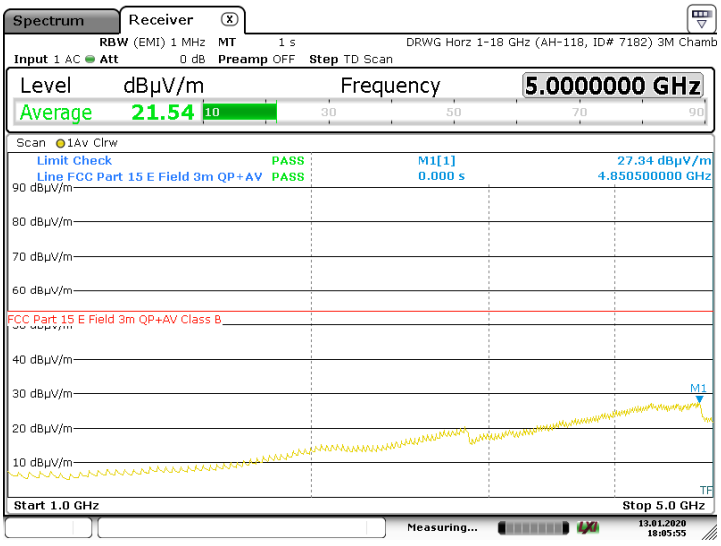

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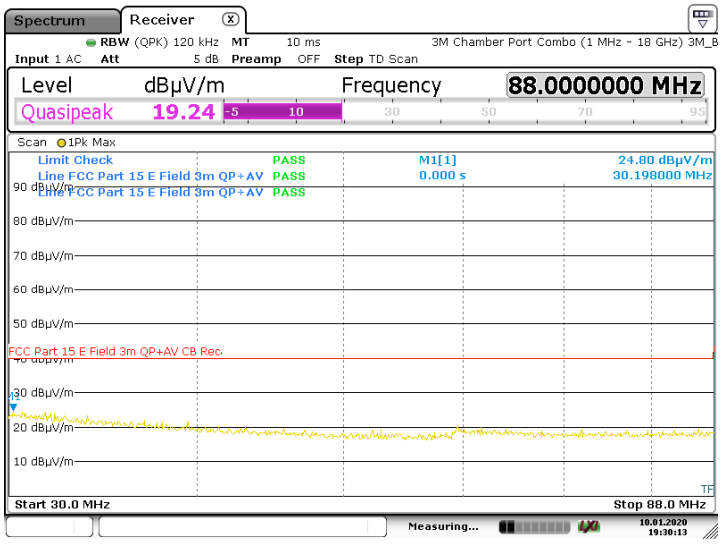
Vertical Polarization

Test Mode	Detector	Orientation	Frequency (MHz)		Antenna Polarization	Peak Frequency (MHz)	Peak Emission (dBuV/m)	Limit (dBuV/m)	Margin
			Start	Stop					
RX	Quasi-Peak	Side	30	88	Horizontal	30.19	24.8	40	-15.20
RX	Quasi-Peak	Side	30	88	Vertical	43.97	21.04	40	-18.96
RX	Quasi-Peak	Side	88	216	Horizontal	212.8	37.99	43.5	-5.51
RX	Quasi-Peak	Side	88	216	Vertical	213.85	38.19	43.5	**-5.31**
RX	Quasi-Peak	Side	216	1000	Horizontal	886.06	39.36	46	-6.64
RX	Quasi-Peak	Side	216	1000	Vertical	912.96	38.8	46	-7.20
RX	Average	Side	1000	5000	Horizontal	4850	27.35	54	-26.65
RX	Average	Side	1000	5000	Vertical	4850	27.35	54	-26.65



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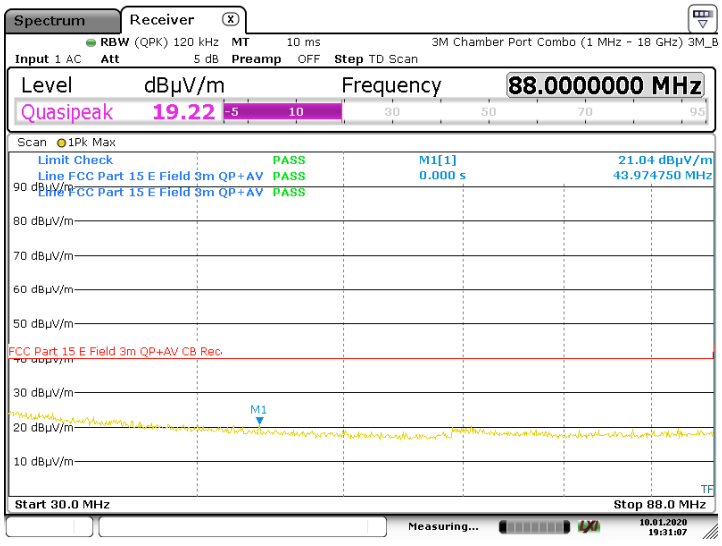

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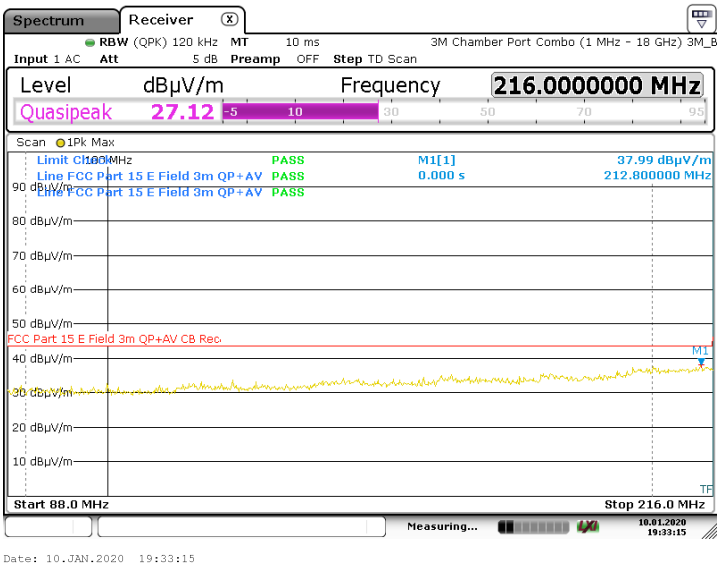

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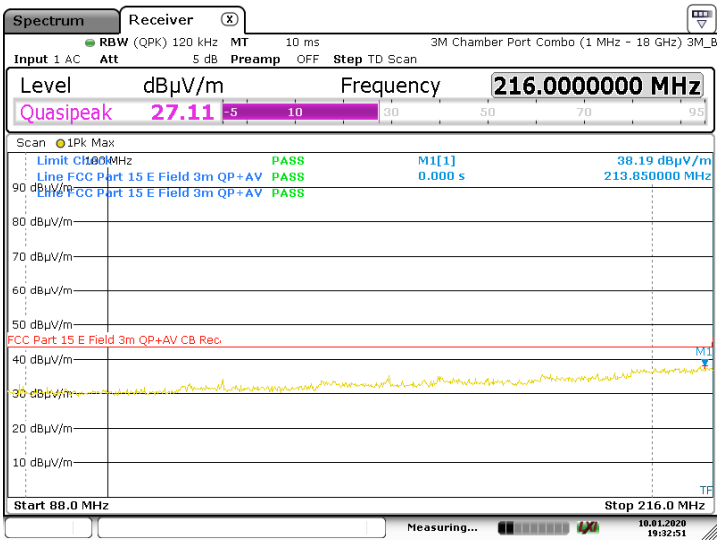

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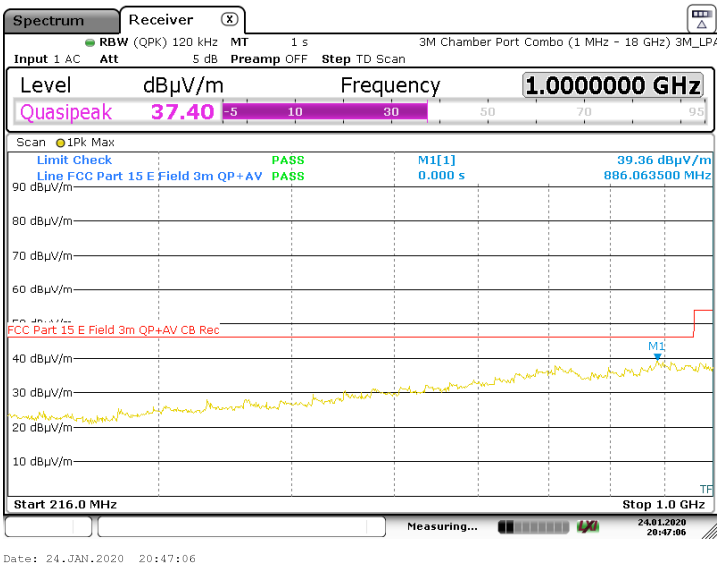

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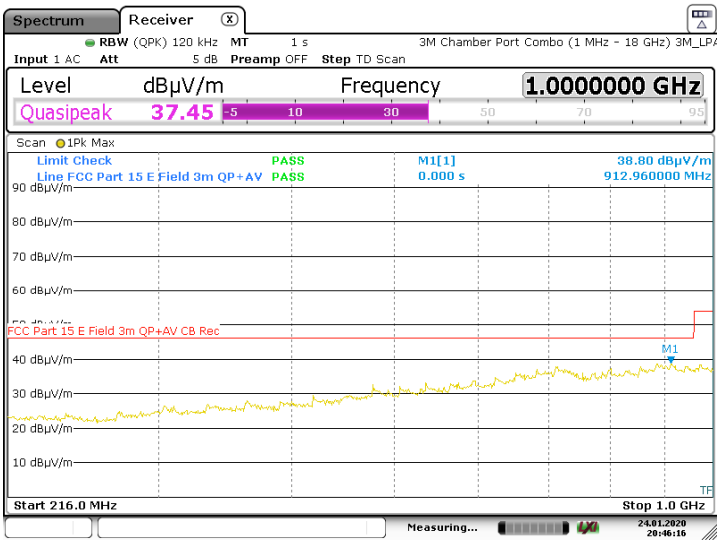

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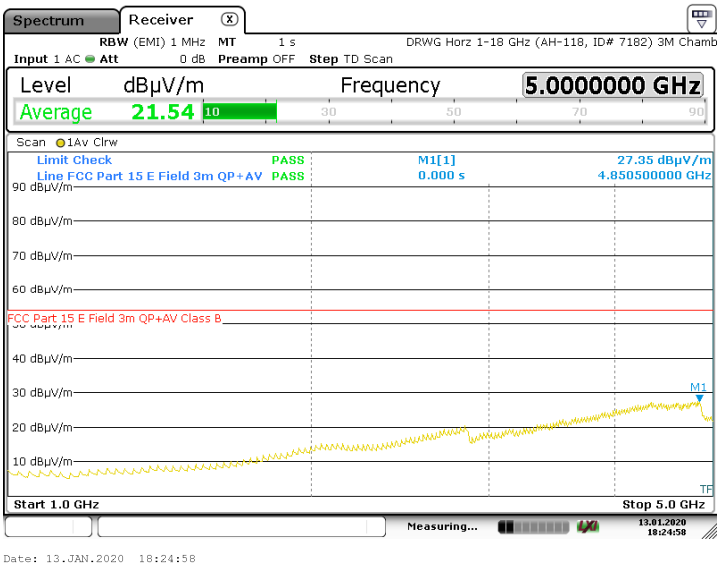

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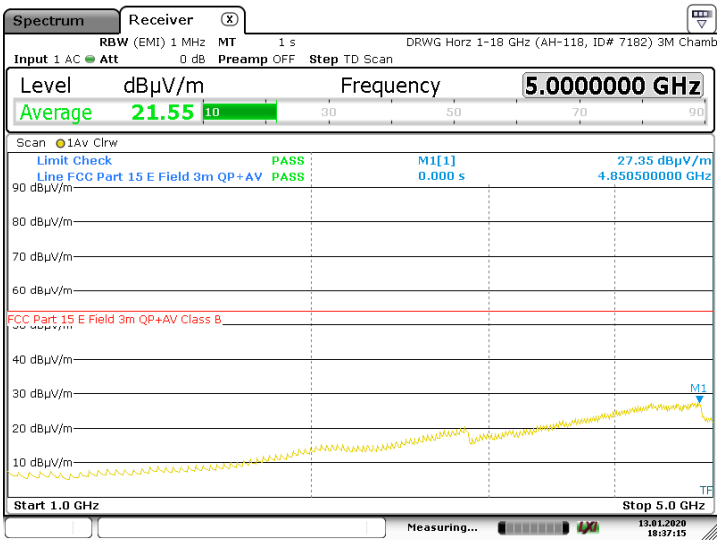

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Vertical Polarization