

Prüfbericht-Nr.: Test Report No.:	JP21R26X 001	Auftrags-Nr.: Order No.:	150241312	Seite 1 von 78 Page 1 of 78
Kunden-Referenz-Nr.: Client Reference No.:	N/A	Auftragsdatum: Order Date:	2021-03-31	
Auftraggeber: Client:	NEC Corporation 1753 Shimonumabe, Nakahara-ku, Kawasaki City, Kanagawa, 211-8666 Japan			
Prüfgegenstand: Test Item:	5G NR FR1 Base Station Sub6 Massive MIMO RU			
Bezeichnung / Typ-Nr.: Identification / Type No.:	MB5420-m5770-62	Serien-Nr.: Serial No.:	(NWA-A10688)	
Auftrags-Inhalt: Order Content:	Radio Testing			
Prüfgrundlage: Test Specification:	FCC 47 CFR Part 2 FCC 47 CFR Part 27 ANSI C63.26-2015 KDB Publication No. 971168 D01 KDB Publication No. 662911 D01			
Wareneingangsdatum: Date of Receipt:	2021-04-12			
Prüfmuster-Nr.: Test Sample No.:	A003033089, A003032912, A003033063, A003033033, A003033021, A003032997, A003033078			
Prüfzeitraum: Testing Period:	2021-04-20 - 2021-06-01			
Ort der Prüfung: Place of Testing:	Yokohama EMC Laboratory			
Prüflaboratorium: Testing Laboratory:	TÜV Rheinland Japan Ltd.			
Prüfergebnis*: Test Result*:	Pass			
Überprüft von: Reviewed by:		Genehmigt von: Authorized by:		
Datum: 2021-06-18 Date:	Daisuke Watanuki	Datum: 2021-06-18 Date:	Pin Zhang	
Stellung / Position:	Inspector	Stellung / Position:	Reviewer	
Sonstiges / Other:				
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the Test Item at Delivery:				
		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet * Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
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REVISIONS

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JP21R26X 001	2021-06-18	Original document

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1. General Remarks

1.1 Test Specifications

Table 1: Test Summary

Test	Specifications	Result
Radio: FCC 47 CFR Part 2 FCC 47 CFR Part 27 ANSI C63.26-2015 KDB Publication No. 971168 D01 KDB Publication No. 662911 D01		
RF Output Power	FCC §2.1046, §27.50 (j)	Pass
Modulation Characteristics	FCC §2.1047	Pass
Occupied Bandwidth	FCC §2.1049	Pass
Out-of-Band Emission	FCC §2.1051, §27.53 (l)	Pass
Conducted Spurious Emission	FCC §2.1051, §27.53 (l)	Pass
Radiated Spurious Emissions	FCC §2.1053, §27.53 (l)	Pass
Frequency Stability	FCC §2.1055, §27.54	Pass

1.2 Test Report Purpose

The purpose of this test report is to show compliance of the EUT (Equipment Under Test) with the requirements of the FCC rules listed in section 1.1.

1.3 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: Photographs of the Test Set-up

2. Test Sites

2.1 Test Facilities

TÜV Rheinland Japan Ltd. – Global Technology Assessment Center
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The test facility is recognized by the Federal Communications Commission (FCC) as Accredited Testing Laboratory under designation number JP0017.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2017.

2.2 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
For Conducted Test							
Spectrum Analyzer	Agilent	E4447A	MY482500 05	BT-8267	1 year	2020-12-04	2021-12-04
Spectrum Analyzer	Rohde & Schwarz	FSW85	101545	9015254	1 year	2020-12-08	2021-12-08
Spectrum Analyzer	Rohde & Schwarz	FSW85	101326	-	1 year	2021-05-27	2022-05-27
RF Switch Box	TUV	TUV SW BOX No.1	-	G18054 35	1 year	2020-07-10	2021-07-10
Temperature Chamber	Voetsch	VT 4018	58566025 090010	BT-8012	1 year	2020-06-29	2021-06-29
For Radiated Radio Test							
Radiated Emission Measurement Soft-ware (below 30MHz)	Toyo Corporation	EP5/ME	Ver. 5.2.10	RF-0172	1 year	2021-02-16	2022-02-16
Radiated Emission Measurement Soft-ware (above 30MHz)	Toyo Corporation	EP7/RE	VER. 8.0.90	RF-0026	1 year	2021-02-16	2022-02-16
EMI Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2021-03-12	2022-03-12
EMI Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	1 year	2020-08-17	2021-08-17
RF Selector (10m Chamber)	Toyo Corporation	NS4900	0703-182	RF-0029	1 year	2021-02-16	2022-02-16
Loop Antenna with Amplifier, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	1 year	2021-04-24	2022-04-24
Trilog Antenna No. 2, 30-1000MHz	Schwarzbeck	VULB 9168	9168-475	RF-0462	1 year	2021-04-28	2022-04-28
5dB Attenuator	Pasternack	PE7047-5	-	RF-0731	1 year	2021-04-28	2022-04-28
Low Noise Preamplifier, 9kHz-1GHz	TSJ	MLA-10K01-B01-35	1370750	RF-0253	1 year	2021-01-06	2022-01-06
Low Pass Filter, DC-1GHz	R&K	LP1000CH 3	12104001	RF-0515	1 year	2021-01-06	2022-01-06
Horn Antenna, 1-8GHz	Schwarzbeck	BBHA 9120 D	1059	RF-0553	1 year	2021-04-03	2022-04-03
Horn Antenna with Preamplifier, 8-18GHz (RX)	Toyo Corporation	HAP06-18W	00000025	RF-0065	1 year	2021-04-03	2022-04-03
High Pass Filter, 8-18GHz	Micro-Tronics	HPM50107	006	RF-0334	1 year	2021-04-03	2022-04-03
Horn Antenna with Preamplifier, 18-26.5GHz (RX)	Toyo Corporation	HAP18-26N	00000010	RF-0070	1 year	2021-04-03	2022-04-03

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
Horn Antenna with Preamplifier, 26.5 -40GHz (RX)	Toyo Corporation	HAP26-40N	00000007	RF-0069	1 year	2021-04-03	2022-04-03
10dB Attenuator	Huber + Suhner	6610_SMA-50-1/199_NE	-	RF-0762	1 year	2021-03-17	2022-03-17
10dB Attenuator	Huber + Suhner	6610_SMA-50-1/199_NE	-	RF-0763	1 year	2021-03-17	2022-03-17
High Pass Filter	Reactel	9HS-X5.7G/23G S11	-	BT-8601	1 year	2021-05-16	2022-05-16
Constant Voltage Constant Frequency Stabilizers and Power Accessories							
CVCF (10m Chamber)	NF Corporation	ES2000U	9067307	RF-0212	1 year	2021-03-12	2022-03-12
CVCF Booster (10m Chamber)	NF Corporation	ES2000B	9074408	RF-0213	1 year	2021-03-12	2022-03-12
DC Power Supply	Kikusui	PWR800L	NA003235	PV-0039	N/A	N/A	N/A
True RMS Multimeter	Fluke	87V	97680450	RF-0282	1 year	2021-03-23	2022-03-23

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025 has been confirmed before testing.

2.3 Measurement Uncertainty

Table 3: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Antenna Port Conducted Emission	20Hz - 40GHz	±1.5dB
Radiated Emission	30MHz - 1GHz	±3.8dB at 3m ±5.0dB at 10m
Radiated Emission	Above 1GHz	±4.5dB at 3m

Note:

The measurement instrumentation uncertainty (MIU) was determined according to CISPR 16-4-2 and ETSI TR 100-028. All MIU values mentioned in the above table are smaller than the uncertainty budgets specified by CISPR 16-4-2 and ETSI TR 100-028, therefore compliance for all emission measurements is deemed to occur if no measured disturbance level exceeds the disturbance limit.

3. General Product Information

3.1 Product Function and Intended Use

The **EUT** (Equipment Under Test) is a 5G Sub6 Massive MIMO product supporting Full Digital Beamforming with 64 Antenna Elements. Fronthaul interface is compliant to O-RAN Option 7-2x Category B.

3.2 Ratings and System Details

FCC ID:	DI4A1068801
Radio standard:	3GPP TS 38 104 Version 16
Frequency range:	3800 - 3900MHz
Channel Frequency:	3849.99MHz
Output power (conducted):	34dBm per port
Output power (EIRP):	69.6dBm
Antenna port:	32TRX
Antenna path loss:	1dB
Antenna gain:	21.6dBi (Max.)
Antenna type:	Pattern array antenna
Antenna mounting type:	Internal
Beamforming:	Beam steering width (Azimuth): ± 60 degrees Beam steering width (Elevation): ± 3 degrees SRS based real time beamforming. Maximum antenna gain of 21.6dBi is achieved by pointing the array to the front direction.
Modulation type:	QPSK, 16QAM, 64QAM, 256QAM
Modulation / spreading:	TDD DL : OFDMA(CP-OFDM) UL: OFDMA(CP-OFDM)/SC FDMA(DFT Spread OFDM)
Bandwidth:	100MHz
Subcarrier spacing:	30kHz
Number of component Carriers:	1
Number of channels:	1
Rated temperature:	-40 to +55°C
Rated voltage:	DC -48V
Rated input Power:	730W
Protection class:	III
Test voltage:	DC -48V

Dimension (approx.):	H515mm x W362mm x D80mm
Environment:	Residential and commercial/industrial environment
Interfaces:	Fronthaul Interface: ORAN 7 2x CAT B External Alarm interface: general purpose connector 4input ports Antenna Control RET(Remote Electrical Tilt): AISG v2.0

3.3 Noise Generating and Noise Suppressing Parts

The highest frequency generated or used by the EUT is 3900MHz as radio portion.

3.4 Submitted Documents and Information

Following documents have been submitted by the client:

Block Diagram, BOM, Label and location.

Following information provided in this test report has been submitted by the client:

- client name and address;
- EUT identification, ratings, system details, and description of product function and intended use;
- information related to noise generating and noise suppressing parts (if any).

4. Test Setup and Operation Modes

4.1 Test Methodology

The test methodology used is based on the requirements of 47 CFR Part 2 and Part 27.

The test methods, which have been used, are based on ANSI C63.26.

For details, see under each test item.

4.2 Operation Modes

The basic operation modes used for testing are:

A. EUT transmits a modulated signal of 3849.99MHz with the highest power and the highest duty cycle.

- Configurations:
 - QPSK (NR-FR1-TM1.1)
 - 16QAM (NR-FR1-TM3.2)
 - 64QAM (NR-FR1-TM3.1)
 - 256QAM (NR-FR1-TM3.1a)

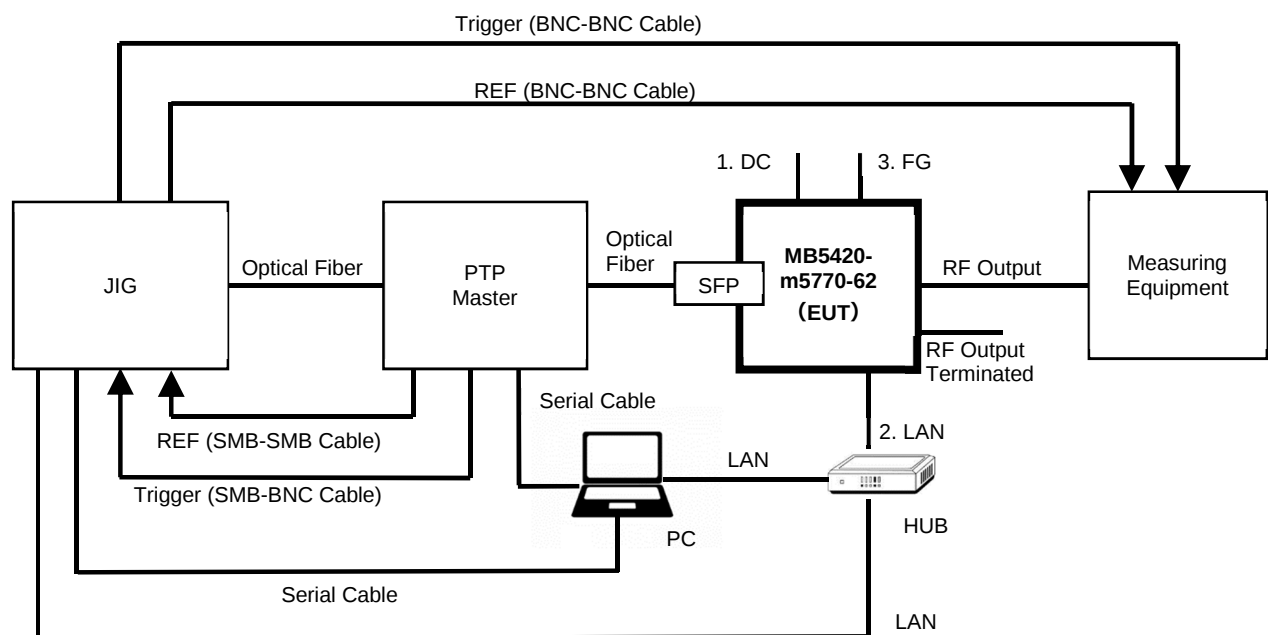
4.3 Physical Configuration for Testing

The test system was configured in a typical fashion (as a customer would normally use it).

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10.

Figure 1: Block Diagram

1. Conducted test:



2. Radiated radio test:

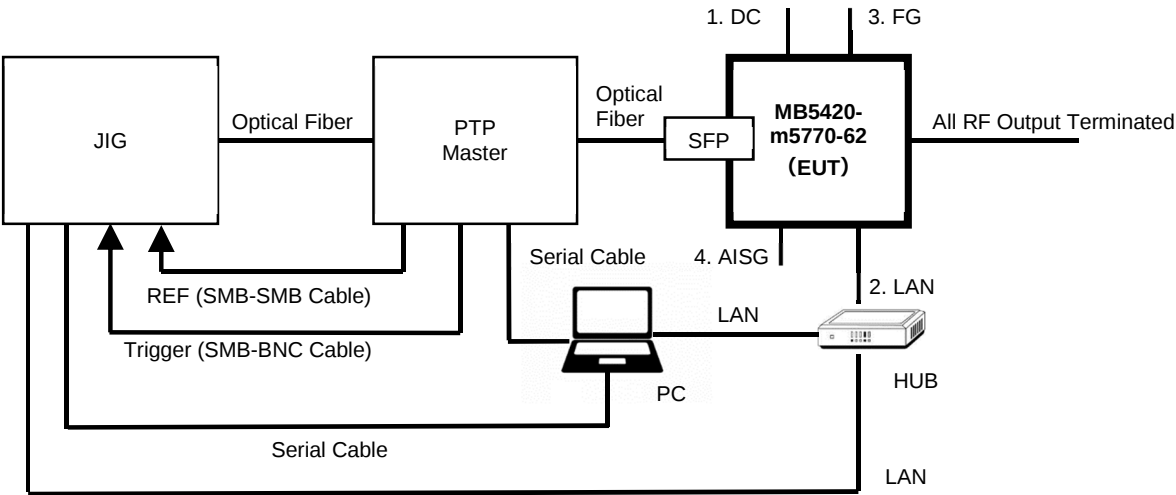


Table 4: Interfaces present on the EUT

EUT Interfaces (present during testing):	Cable Length (Measured)	Un-Shielded	Shielded
1. DC power cable	10.5 m	☒	☐
2. Ethernet cable	7.0 m	☒	☐
3. Earth cable	3.3 m	☒	☐
4. AISG cable	5.0 m	☐	☒

For more details, refer to section: Photographs of the Test Setup.

4.4 Test Software

Software used for testing:

Tera Term version 4.105 (SVN# 8433) by Tera Term Project.

Zodiac_Asteria_bittrue version release_R15053.

This software was running on the external tablet PC to enable the operation mode listed in section 4.2 as appropriate.

4.5 Special Accessories and Auxiliary Equipment

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

1. Product: Network HUB
Manufacturer: Allied Telesis
Model: GS908XL
Rated Voltage: AC 100-240V
Input Current: 0.2A
Frequency: 50/60Hz
Protection Class: I
Serial Number: RF-0633

2. Product: Laptop PC
Manufacturer: Dell
Model: Latitude E6230
Rated Voltage: DC 19.5V
Input Current: 3.34A
Protection Class: III
Serial Number: 9B1Q7W1

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3. Product: PTP Master (see photo below)



4. Product: Jig (see photo below)



5. Product: Attenuator 5W, 30dB (32 pieces)
Manufacturer: Mini Circuits
Model: BW-S30W5+
Frequency: DC-18GHz

6. Product: 50 ohm Terminator (32 pieces)

7. Product: SFP Module
Manufacturer: INNO LIGHT
Model: TR-PY85S-V00
Serial Number: INKBZ0210058

4.6 Countermeasures to achieve Compliance

No additional measures were employed to achieve compliance.

5. Test Results RADIO

5.1 Conducted Measurements at Antenna Port

5.1.1 RF Output Power (Power Density)

RESULT:

PASS

Date of testing: 2021-04-29

Ambient temperature: 22°C

Relative humidity: 65%

Atmospheric pressure: 1005hPa

Requirements:

FCC 27.50 (j)(1)-(5)

(1) The power of each fixed or base station transmitting in the 3700-3980 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to an equivalent isotropically radiated power (EIRP) of 3280 Watts/MHz. This limit applies to the aggregate power of all antenna elements in any given sector of a base station.

(2) The power of each fixed or base station transmitting in the 3700-3980 MHz band and situated in any geographic location other than that described in paragraph (j)(1) of this section is limited to an EIRP of 1640 Watts/MHz. This limit applies to the aggregate power of all antenna elements in any given sector of a base station.

(4) Equipment employed must be authorized in accordance with the provisions of §27.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (j)(5) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(5) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, and any other relevant factors, so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

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Test procedure:
ANSI C63.26 §5.2.4

Table 5: RF Output Power (Power Density), Average Power

TX Port	RF Power [dBm/MHz]			
	QPSK_TM1.1	16QAM_TM3.2	64QAM_TM3.1	256QAM_TM3.1a
0	12.55	12.92	12.84	13.18
1	11.03	12.67	12.43	12.90
2	12.64	12.85	12.76	13.21
3	12.40	12.89	12.77	13.01
4	12.20	13.01	12.79	13.06
5	12.50	13.15	13.35	13.47
6	12.14	12.22	12.14	12.75
7	12.66	12.87	12.74	12.54
8	12.51	12.12	12.55	12.43
9	11.64	12.78	12.68	12.77
10	12.49	12.67	12.65	12.75
11	12.11	12.55	12.02	12.71
12	12.24	12.20	12.68	12.76
13	12.41	12.60	12.64	12.65
14	12.48	12.73	12.61	12.75
15	12.35	12.37	12.40	12.46
16	12.53	12.69	12.79	12.73
17	12.98	12.99	12.99	12.99
18	12.69	12.87	12.84	12.83
19	12.22	12.54	12.79	12.90
20	12.69	12.93	13.09	13.13
21	11.70	12.85	12.44	12.52
22	12.78	13.00	12.80	12.88
23	12.55	12.59	12.32	12.81
24	12.27	12.41	12.40	12.63
25	12.03	12.31	12.20	12.53
26	12.68	12.72	12.82	12.30
27	12.59	12.72	12.97	12.68
28	12.82	12.72	13.09	12.50
29	12.59	12.61	12.87	12.72
30	12.68	12.65	13.09	12.76
31	12.72	12.79	13.36	12.73
Total Power [dBm/MHz]	27.47	27.75	27.78	27.84
Antenna Path Loss [dB]	1.00	1.00	1.00	1.00
Antenna Gain [dBi]	21.60	21.60	21.60	21.60
EIRP [dBm/MHz]	48.07	48.35	48.38	48.44
Limit [W/MHz]	1640	1640	1640	1640
Limit [dBm/MHz]	62.15	62.15	62.15	62.15
Margin [dB/MHz]	14.08	13.80	13.77	13.71

Note: EIRP [dBm/MHz] = Total Power [dBm/MHz] - Antenna Path Loss [dB] + Antenna Gain [dBi]

Duty Cycle Factor (see clause 5.1.8) and measurement system path loss are accounted for the results.

Table 6: Peak-to-Average Ratio (PAR)

TX Port	Peak-to-Average Ratio (PAR) [dB]			
	QPSK_TM1.1	16QAM_TM3.2	64QAM_TM3.1	256QAM_TM3.1a
Associated with highest RF Power	8.49	8.29	8.26	8.25
Associated with Lowest RF Power	8.40	8.21	8.35	8.40
Limit	≤13	≤13	≤13	≤13

Note: Refer to Modulation Characteristics for testing plots.

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5.1.2 RF Output Power (Channel Power)

RESULT:

PERFORMED

Date of testing: 2021-04-29

Ambient temperature: 22°C
Relative humidity: 65%
Atmospheric pressure: 1005hPa

Test procedure:
ANSI C63.26 §5.2.4

Note:
This test is for reference purpose.

Table 7: RF Output Power (Channel Power), Average Power

TX Port	RF Power [dBm]			
	QPSK_TM1.1	16QAM_TM3.2	64QAM_TM3.1	256QAM_TM3.1a
0	32.55	32.92	32.84	33.18
1	31.03	32.67	32.43	32.90
2	32.64	32.85	32.76	33.21
3	32.40	32.89	32.77	33.01
4	32.20	33.01	32.79	33.06
5	32.50	33.15	33.35	33.47
6	32.14	32.22	32.14	32.75
7	32.66	32.87	32.74	32.54
8	32.51	32.12	32.55	32.43
9	31.64	32.78	32.68	32.77
10	32.49	32.67	32.65	32.75
11	32.11	32.55	32.02	32.71
12	32.24	32.20	32.68	32.76
13	32.41	32.60	32.64	32.65
14	32.48	32.73	32.61	32.75
15	32.35	32.37	32.40	32.46
16	32.53	32.69	32.79	32.73
17	32.98	32.99	32.99	32.99
18	32.69	32.87	32.84	32.83
19	32.22	32.54	32.79	32.90
20	32.69	32.93	33.09	33.13
21	31.70	32.85	32.44	32.52
22	32.78	33.00	32.80	32.88
23	32.55	32.59	32.32	32.81
24	32.27	32.41	32.40	32.63
25	32.03	32.31	32.20	32.53
26	32.68	32.72	32.82	32.30
27	32.59	32.72	32.97	32.68
28	32.82	32.72	33.09	32.50
29	32.59	32.61	32.87	32.72
30	32.68	32.65	33.09	32.76
31	32.72	32.79	33.36	32.73
Total Power [dBm]	47.47	47.75	47.78	47.84
Total Power [W]	55.85	59.51	59.96	60.83
Antenna Path Loss [dB]	1.00	1.00	1.00	1.00
Antenna Gain [dBi]	21.60	21.60	21.60	21.60
EIRP [dBm]	68.07	68.35	68.38	68.44

Note: EIPR [dBm] = Total Power [dBm] - Antenna Path Loss [dB] + Antenna Gain [dBi]

Duty Cycle Factor (see clause 5.1.8) and measurement system path loss are accounted for the results.

5.1.3 Modulation Characteristics

RESULT:

PASS

Date of testing: 2021-05-01

Ambient temperature: 23°C

Relative humidity: 53%

Atmospheric pressure: 1004hPa

Requirements:

FCC 2.1047(d)

A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Test procedure:

ANSI C63.26 §5.3

Note:

Test was conducted on the TX Ports associated with the highest and lowest RF Power.

Figure 2: Modulation Characteristics, QPSK_TM1.1, TX Port 17

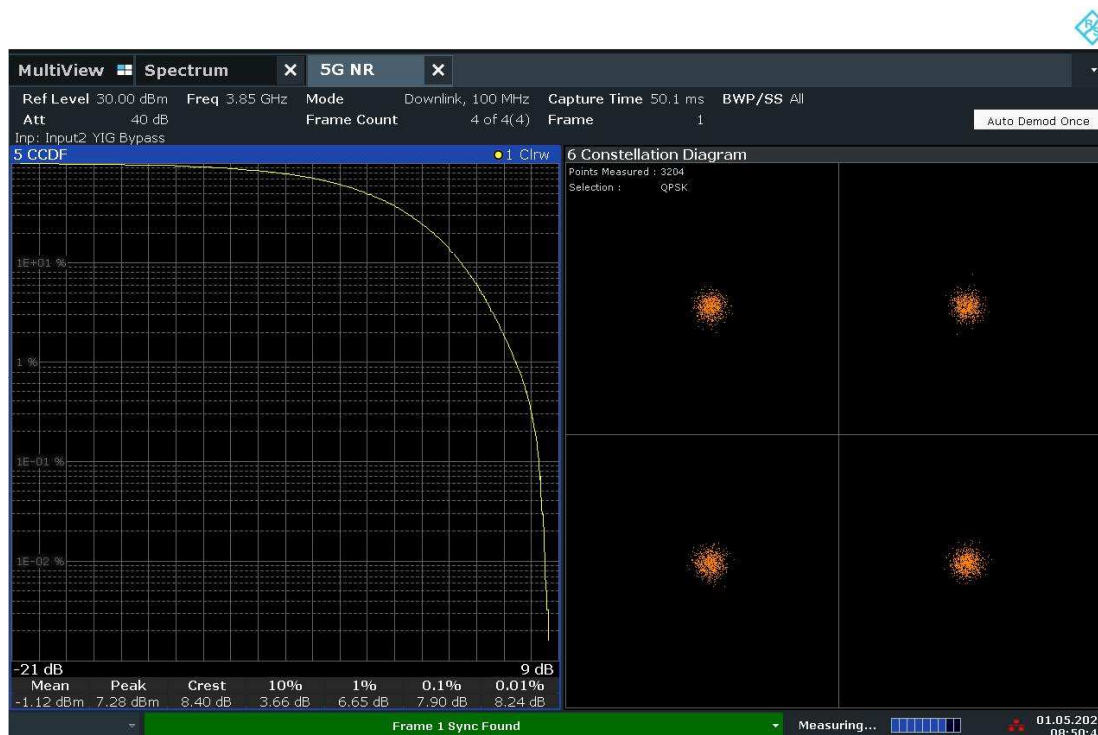


Figure 3: Modulation Characteristics, QPSK_TM1.1, TX Port 1

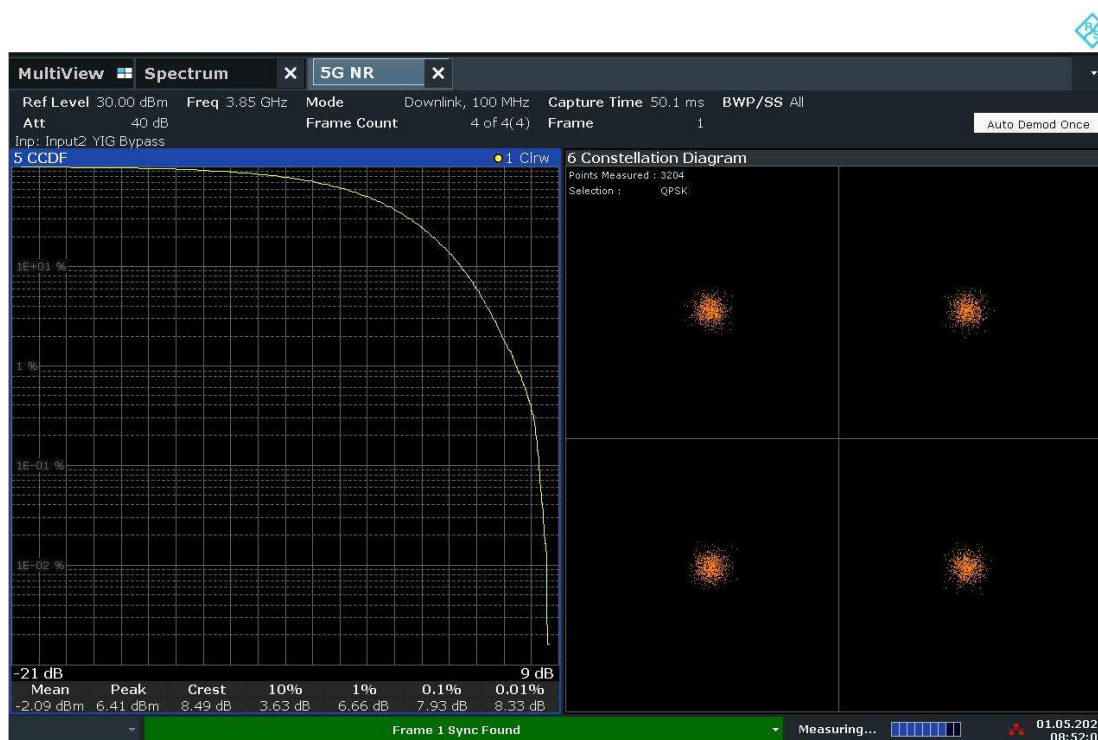


Figure 4: Modulation Characteristics, 16QAM_TM3.2, TX Port 5

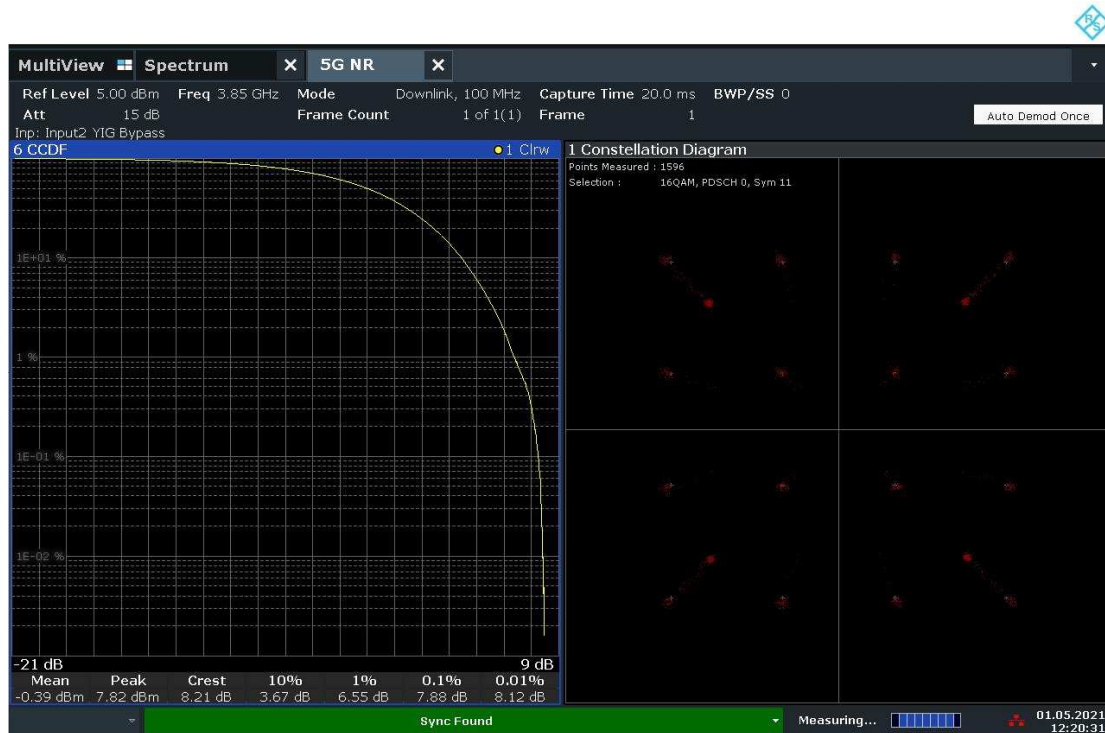
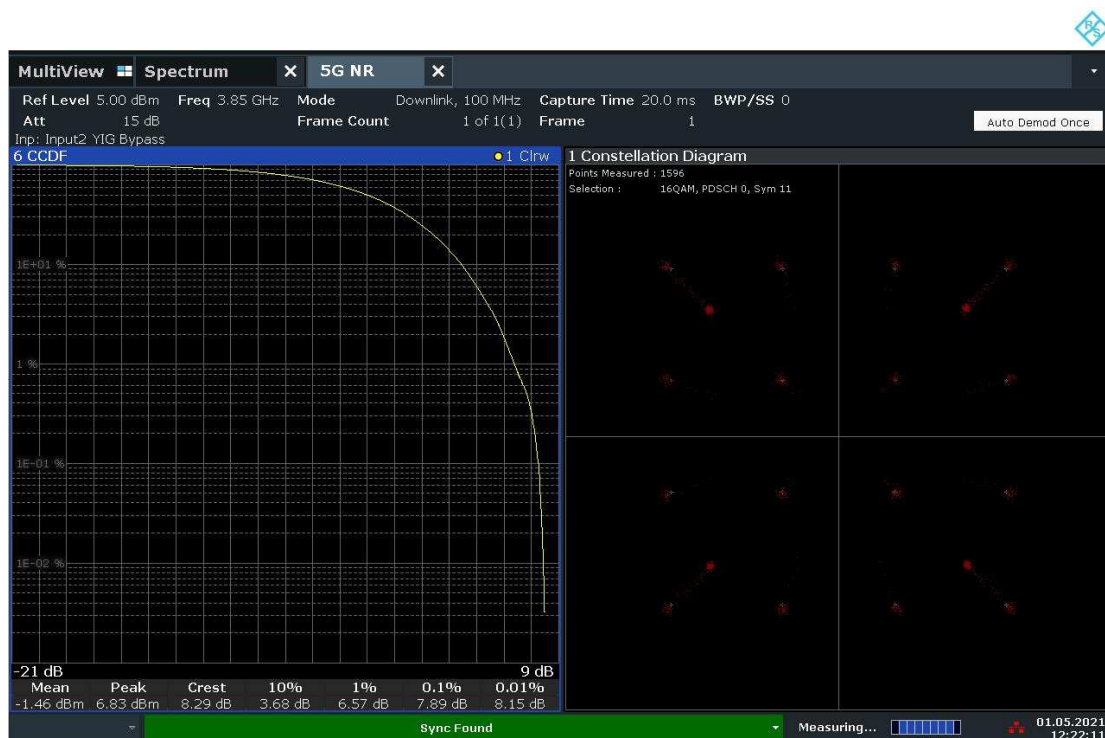


Figure 5: Modulation Characteristics, 16QAM_TM3.2, TX Port 8



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Figure 6: Modulation Characteristics, 64QAM_TM3.1, TX Port 5

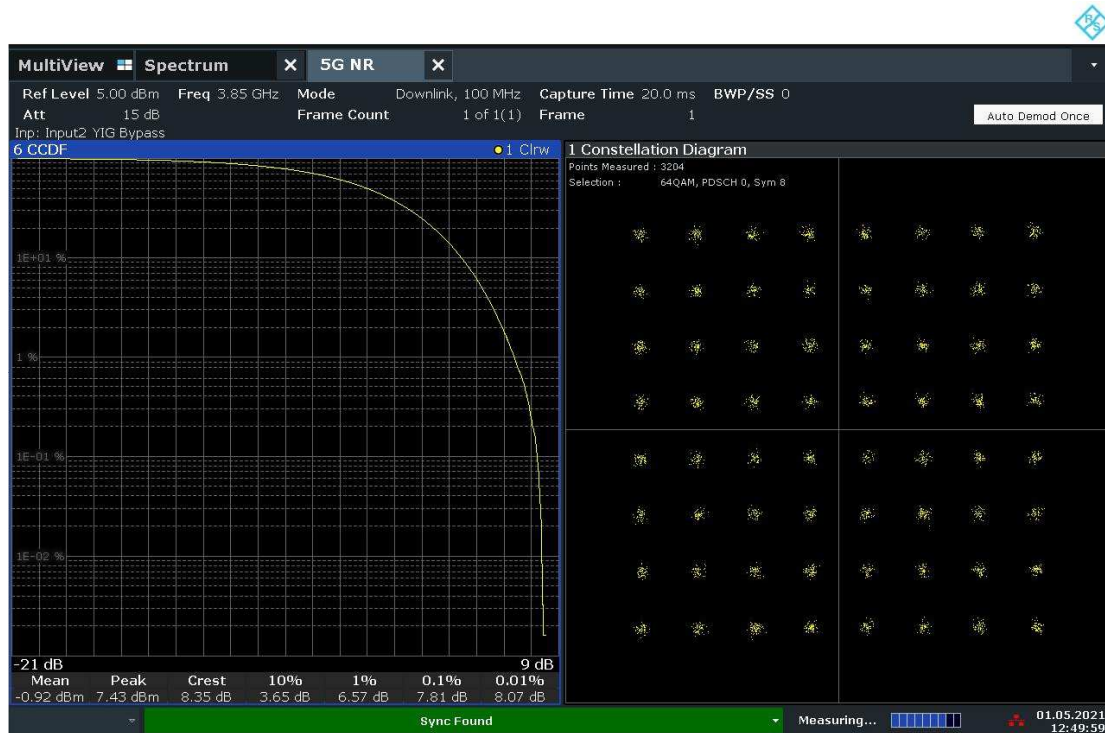
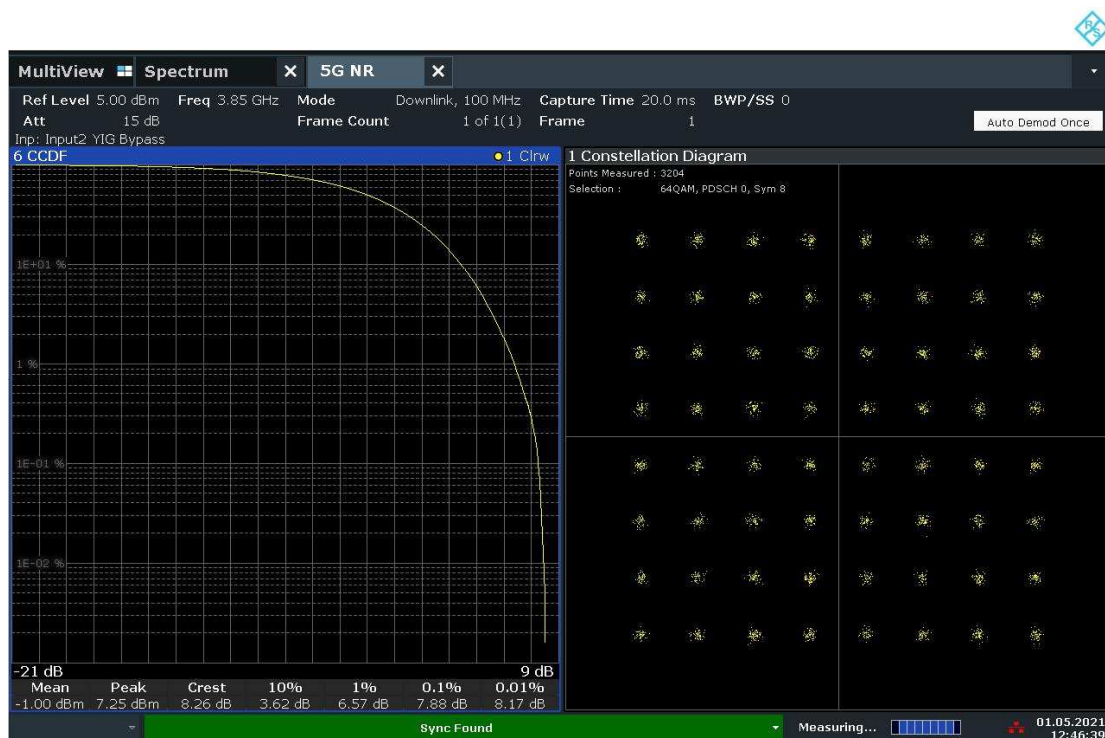


Figure 7: Modulation Characteristics, 64QAM_TM3.1, TX Port 11



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Figure 8: Modulation Characteristics, 256QAM_TM3.1a, TX Port 5

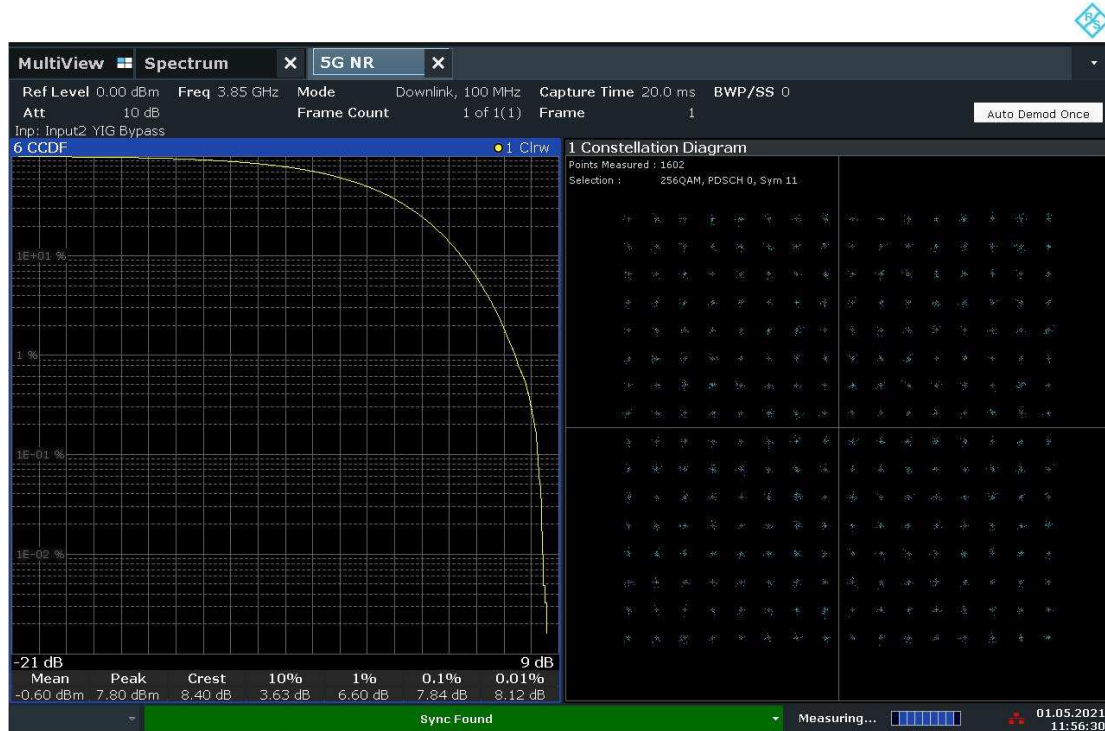
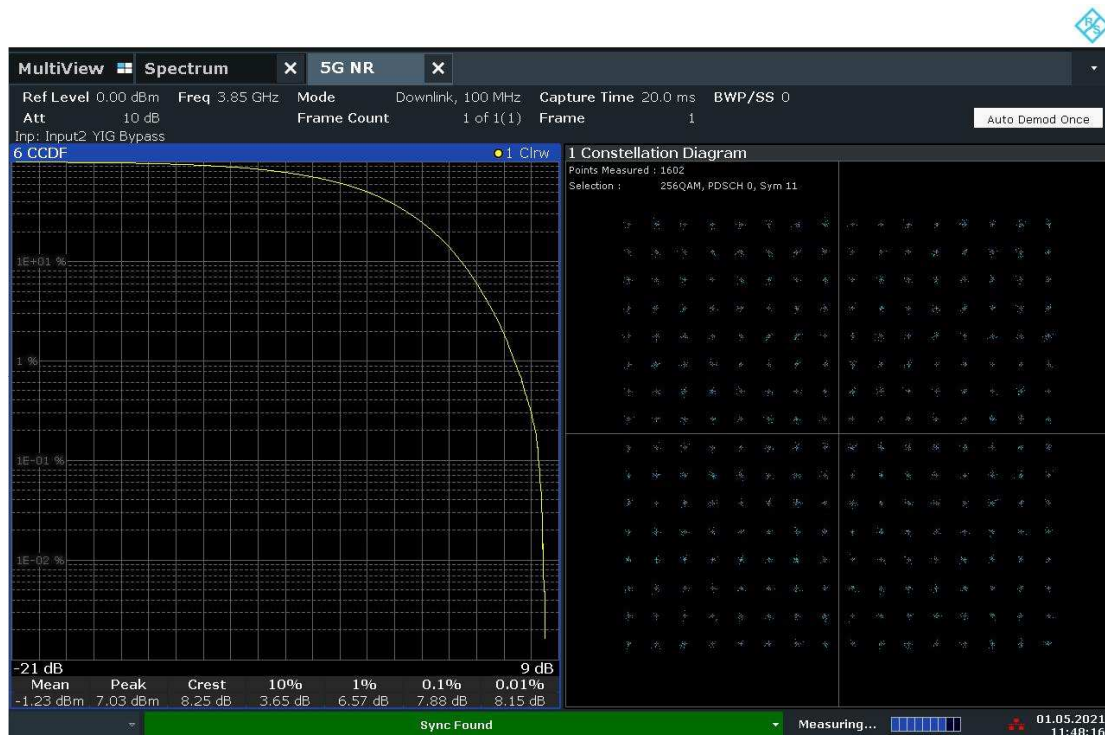


Figure 9: Modulation Characteristics, 256QAM_TM3.1a, TX Port 26



5.1.4 99% Occupied Bandwidth

RESULT:

PASS

Date of testing: 2021-04-29, 2021-05-12

Ambient temperature: 22, 24°C
Relative humidity: 65, 51%
Atmospheric pressure: 1005, 1017hPa

Requirements:

FCC 2.1049

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

Test procedure:

ANSI C63.26 §5.4.4

Note:

The test was performed on 2 randomly chosen TX Ports.

Table 8: 99% Occupied Bandwidth

TX Port	99% Occupied Bandwidth [MHz]			
	QPSK_TM1.1	16QAM_TM3.2	64QAM_TM3.1	256QAM_TM3.1a
6	95.1656	94.7505	95.1969	95.1120
23	95.2344	94.8134	95.2866	95.2280

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Figure 10: 99% Occupied Bandwidth, QPSK_TM1.1, TX Port 6

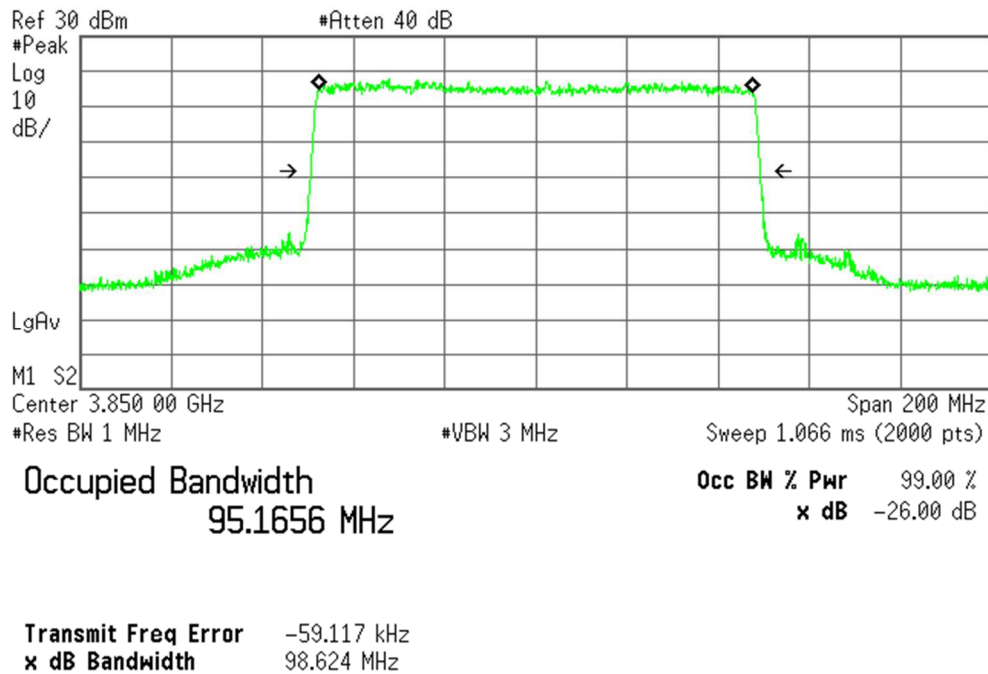
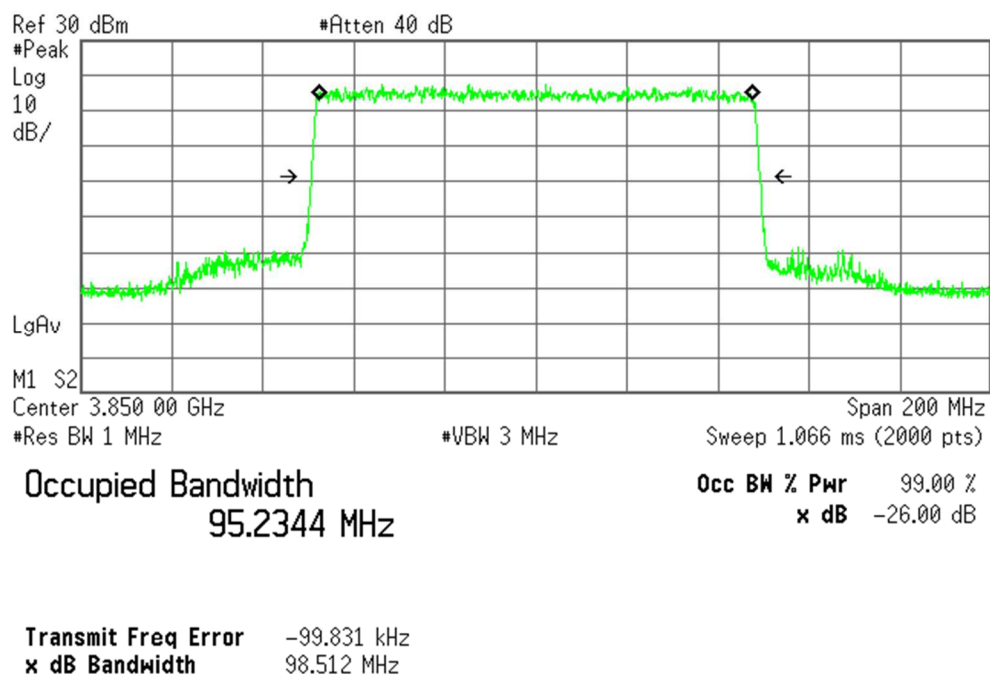


Figure 11: 99% Occupied Bandwidth, QPSK_TM1.1, TX Port 23



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Figure 12: 99% Occupied Bandwidth, 16QAM_TM3.2, TX Port 6

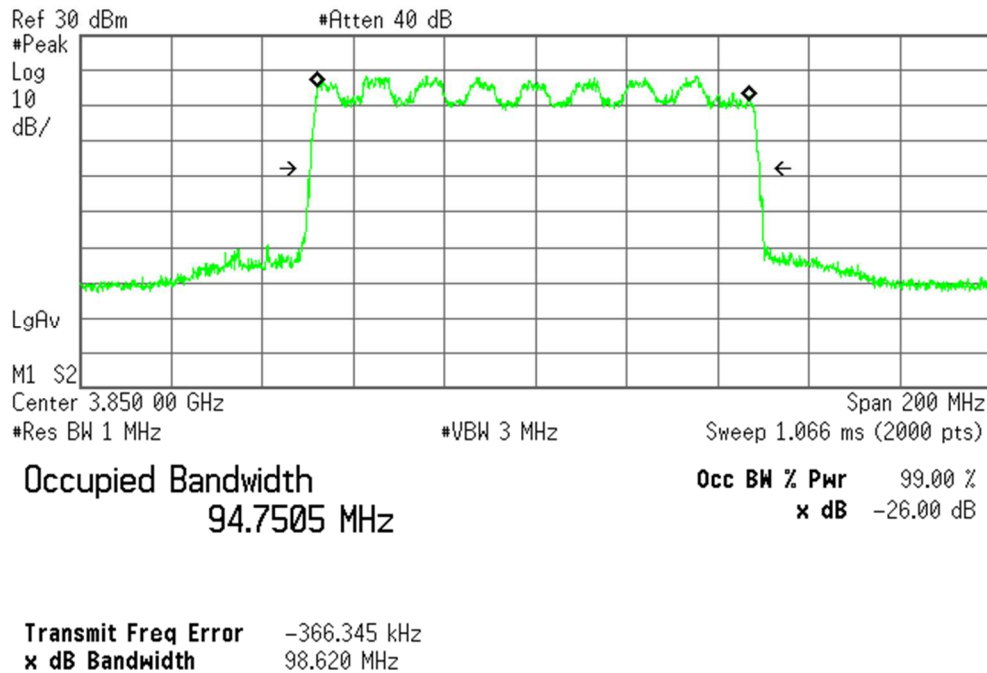


Figure 13: 99% Occupied Bandwidth, 16QAM_TM3.2, TX Port 23

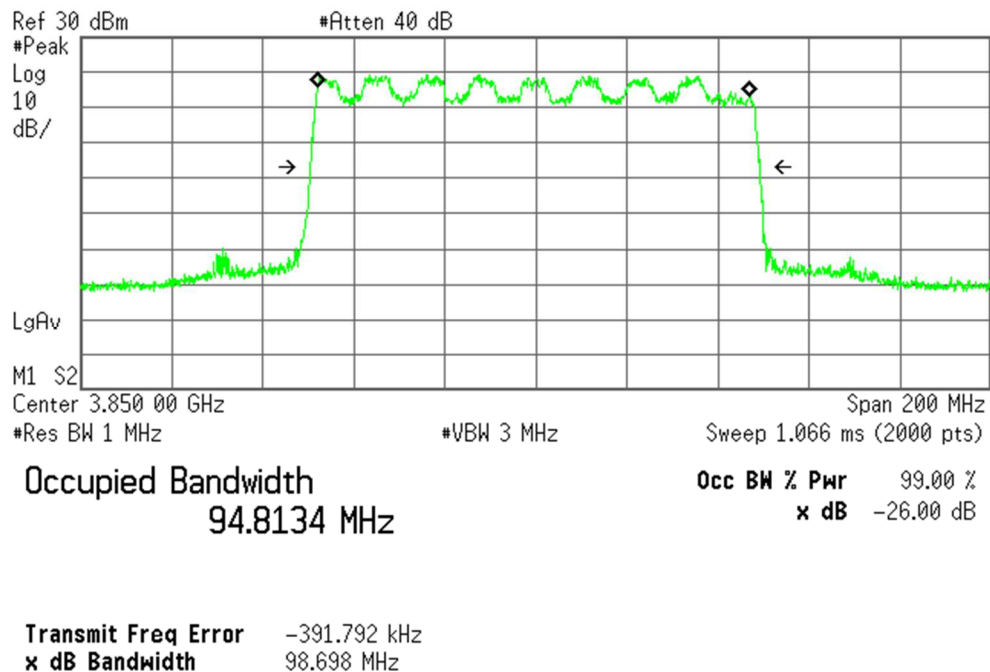


Figure 14: 99% Occupied Bandwidth, 64QAM_TM3.1, TX Port 6

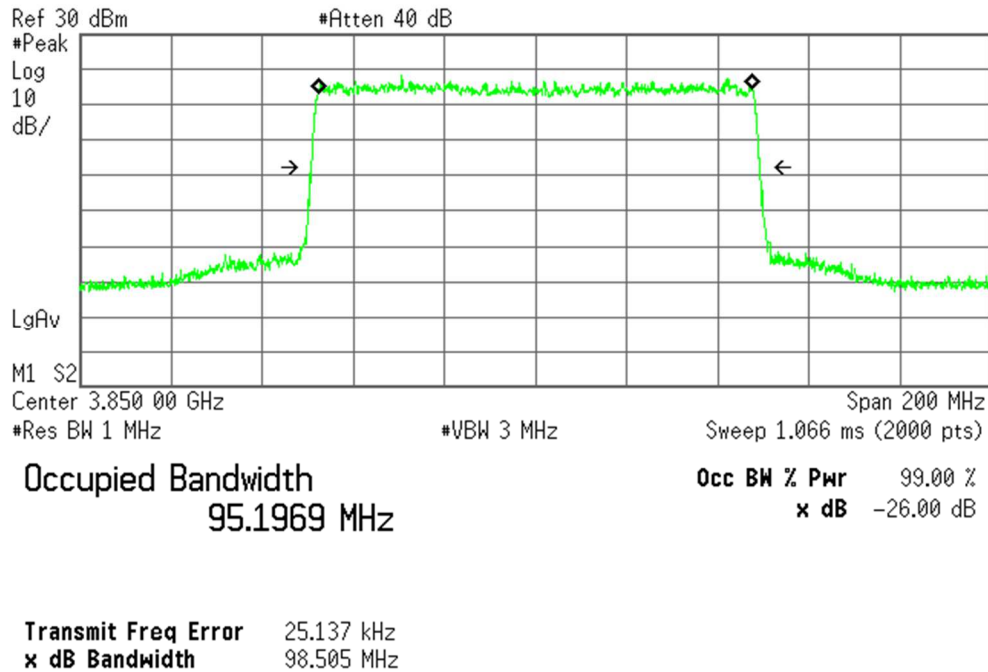
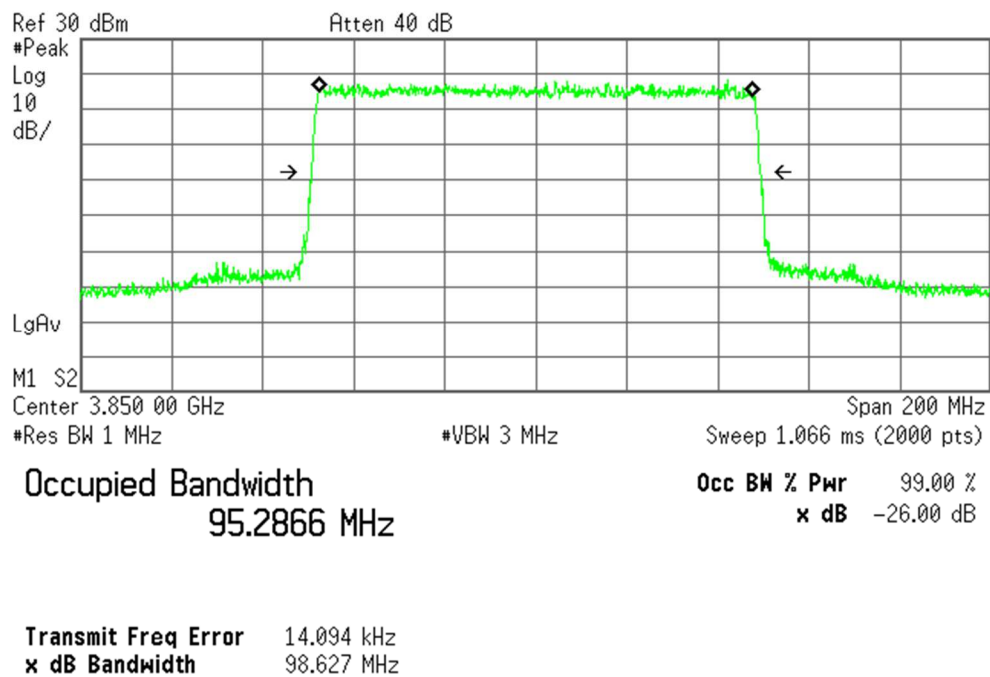


Figure 15: 99% Occupied Bandwidth, 64QAM_TM3.1, TX Port 23



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Figure 16: 99% Occupied Bandwidth, 256QAM_TM3.1a, TX Port 6

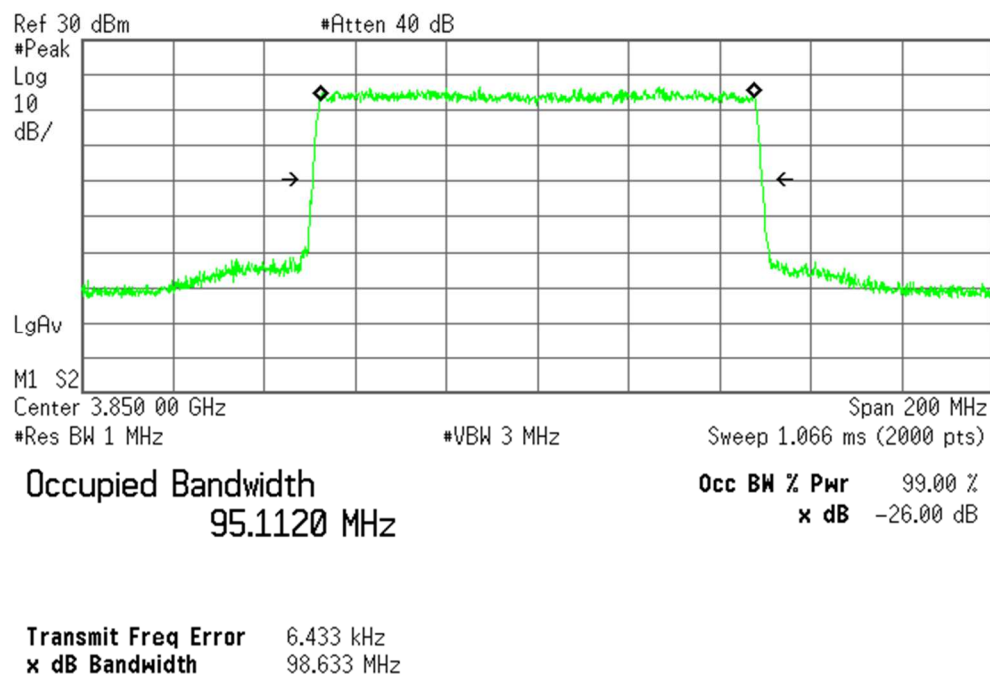
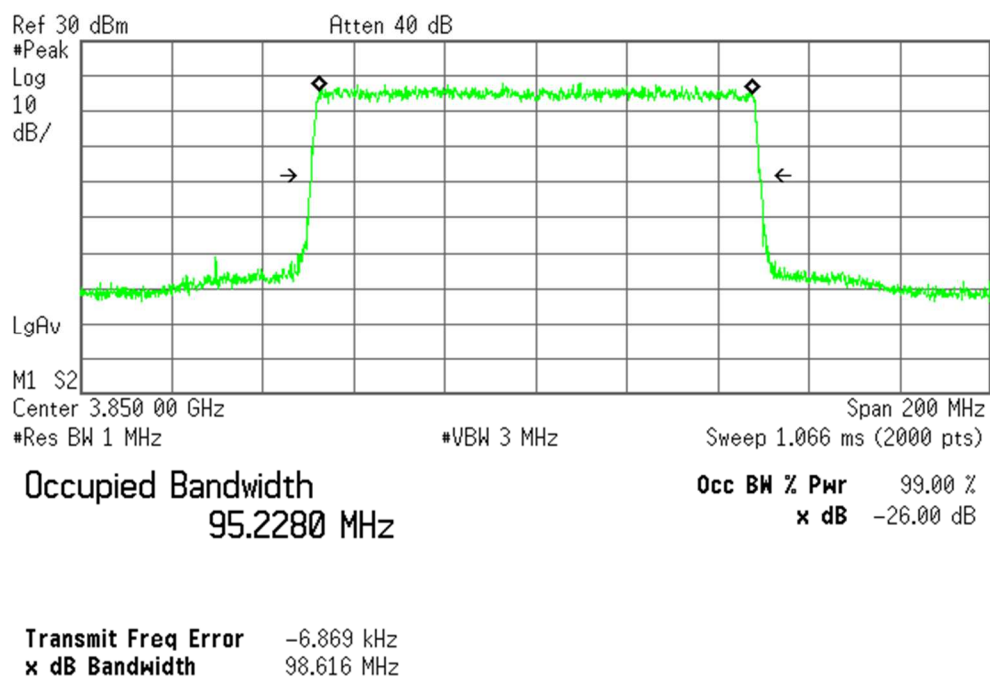


Figure 17: 99% Occupied Bandwidth, 256QAM_TM3.1a, TX Port 23



5.1.5 Out-of-Band Emission

RESULT:

PASS

Date of testing: 2021-05-11

Ambient temperature: 22°C
Relative humidity: 53%
Atmospheric pressure: 1013hPa

Requirements:

FCC 27.53(l)(1)

For base station operations in the 3700-3980 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed -13 dBm/MHz. Compliance with this paragraph (l)(1) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Test procedure:

ANSI C63.26 §5.7.3

Note:

This test covers the emission in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block.

Since the EUT has 32 TX ports, the emission limit for one TX port is -28dBm/MHz (-13dBm/MHz divided by 32).

The test is done on TX port 6, 7, 22, and 23, which are the 4 ports of the same PCB board. The EUT has 8 identical PCB boards.

RBW of 1MHz was used for the test.

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Table 9: Out-of-Band Emission, QPSK_TM1.1

TX Port	Out-of-Band Emission [dBm/MHz]		Limit [dBm/MHz]
	3799 - 3800MHz	3900 - 3901MHz	
6	-33.91	-35.04	≤-28
7	-33.07	-33.86	≤-28
22	-33.16	-33.79	≤-28
23	-35.92	-36.48	≤-28

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Figure 18: Out-of-Band Emission, QPSK_TM1.1, TX Port 6

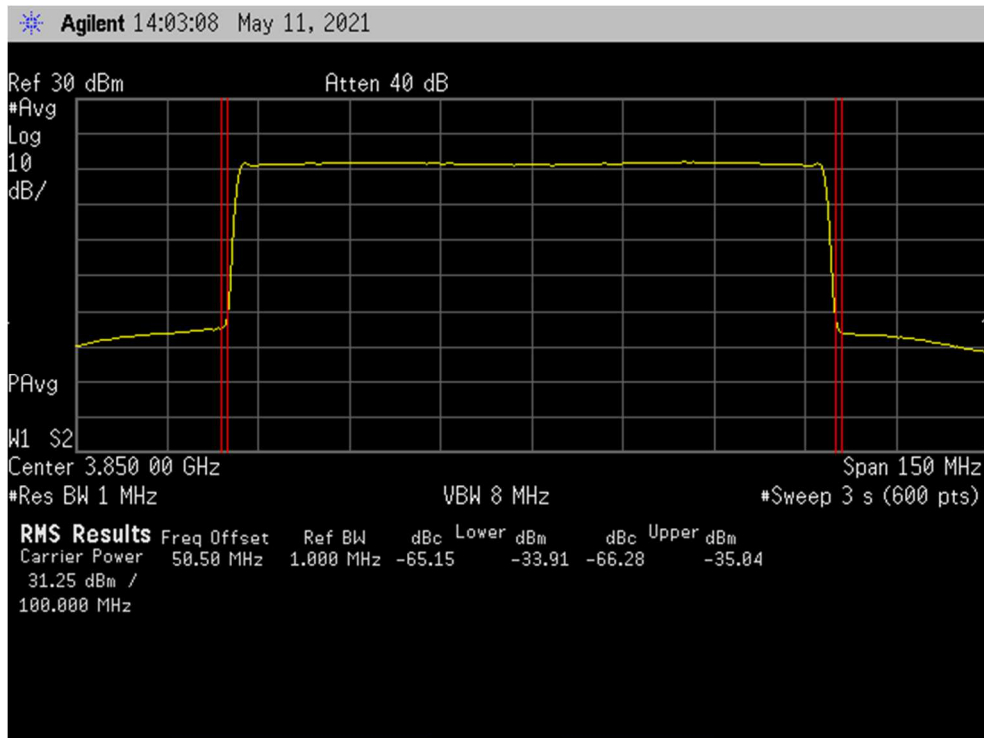


Figure 19: Out-of-Band Emission, QPSK_TM1.1, TX Port 7

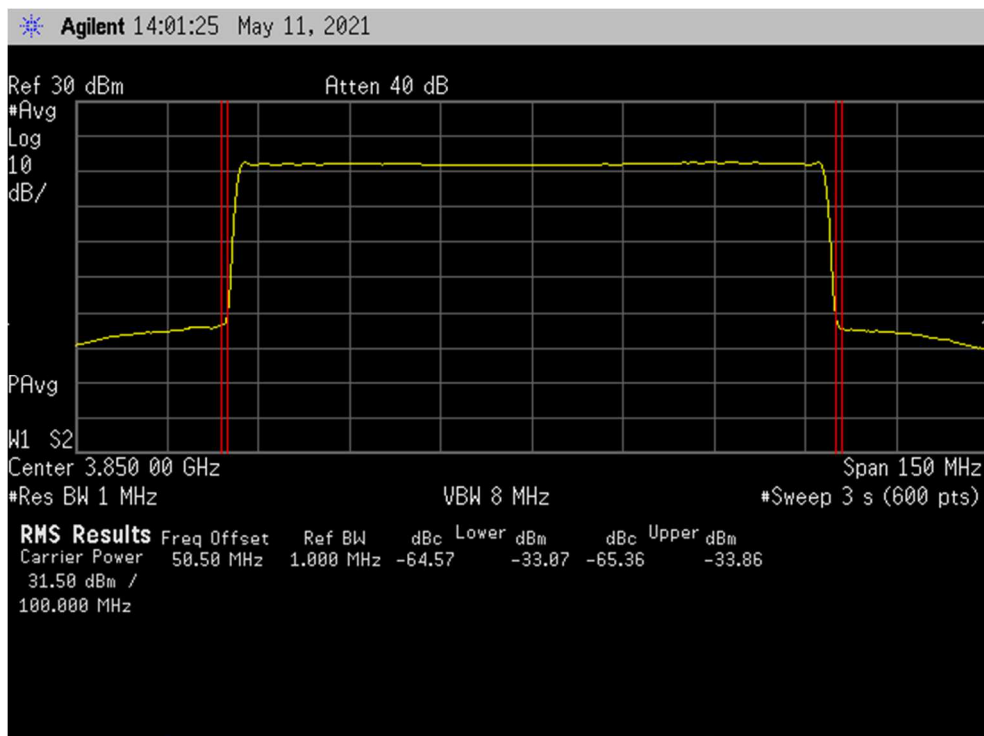


Figure 20: Out-of-Band Emission, QPSK_TM1.1, TX Port 22

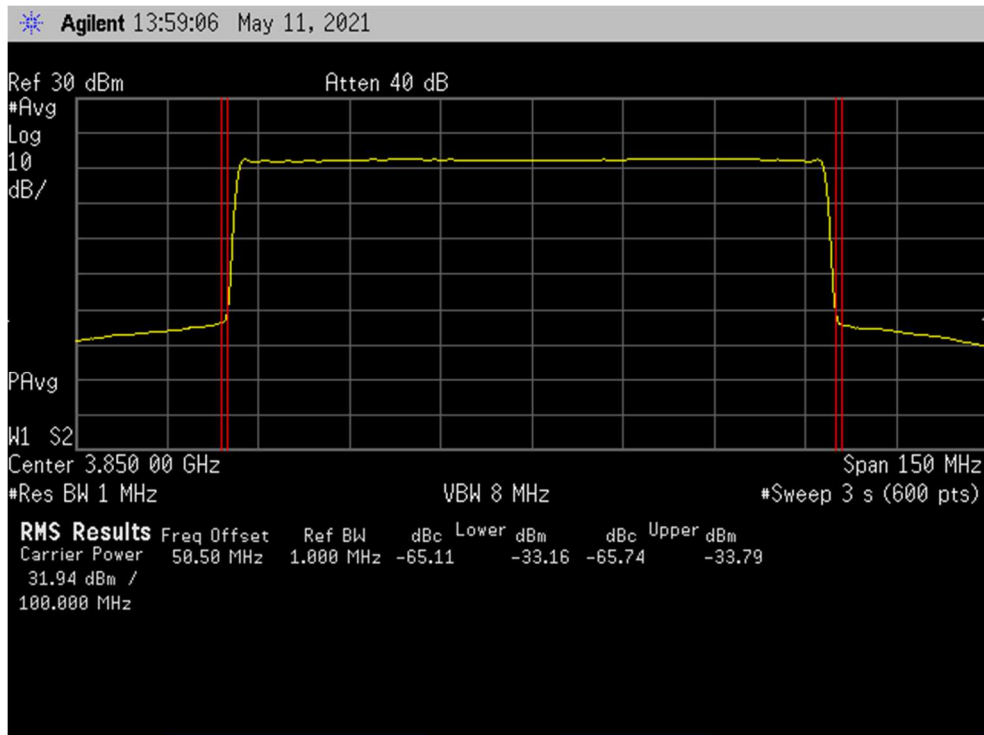
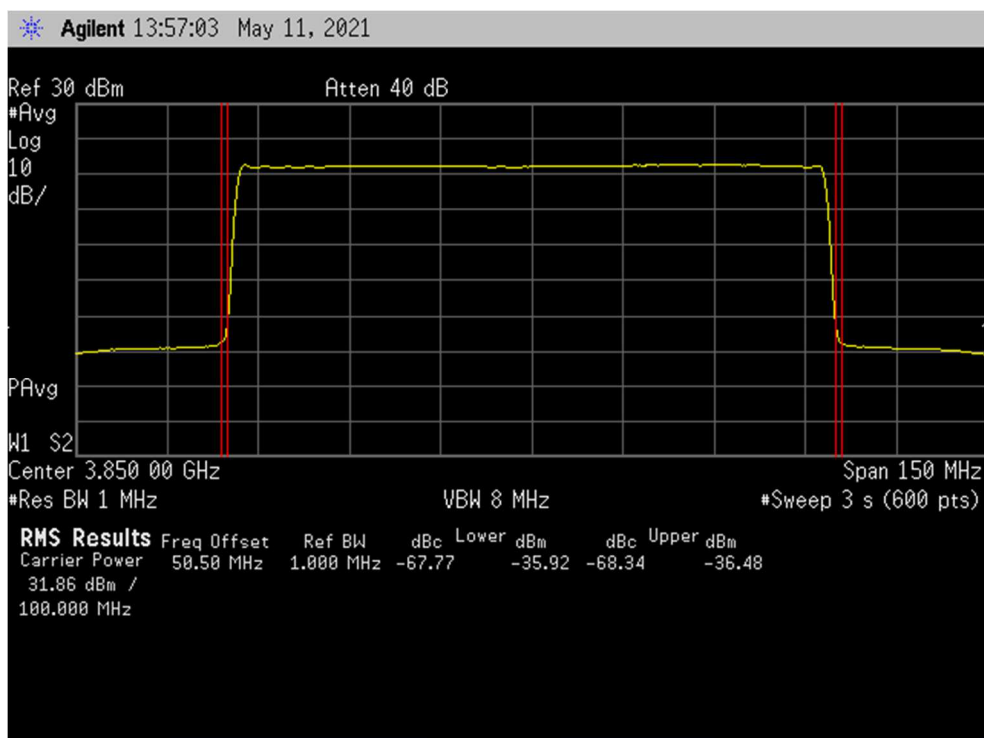


Figure 21: Out-of-Band Emission, QPSK_TM1.1, TX Port 23



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Table 10: Out-of-Band Emission, 16QAM_TM3.2

TX Port	Out-of-Band Emission [dBm/MHz]		Limit [dBm/MHz]
	3799 - 3800MHz	3900 - 3901MHz	
6	-33.28	-34.10	≤-28
7	-31.73	-32.88	≤-28
22	-32.20	-33.77	≤-28
23	-34.76	-36.64	≤-28

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Figure 22: Out-of-Band Emission, 16QAM_TM3.2, TX Port 6

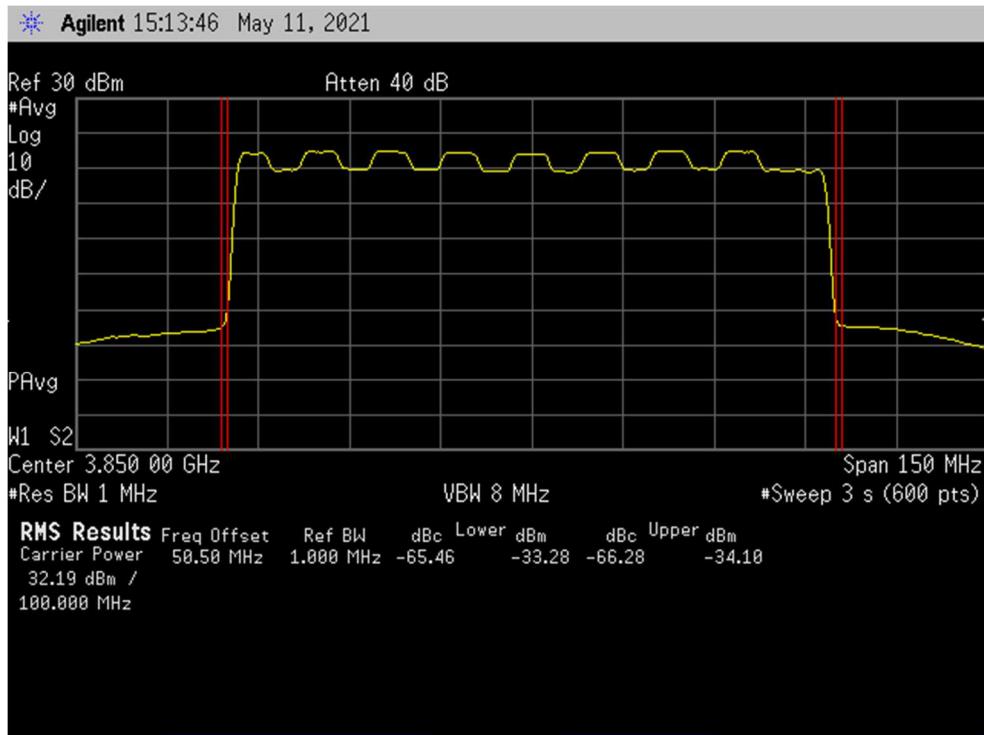


Figure 23: Out-of-Band Emission, 16QAM_TM3.2, TX Port 7

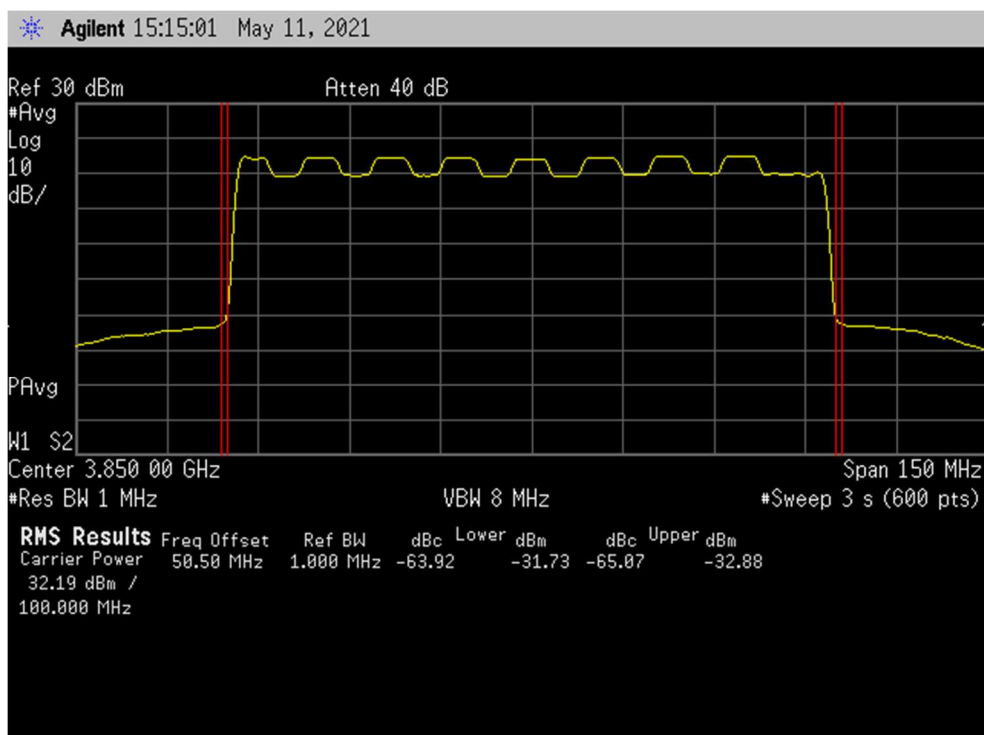


Figure 24: Out-of-Band Emission, 16QAM_TM3.2, TX Port 22

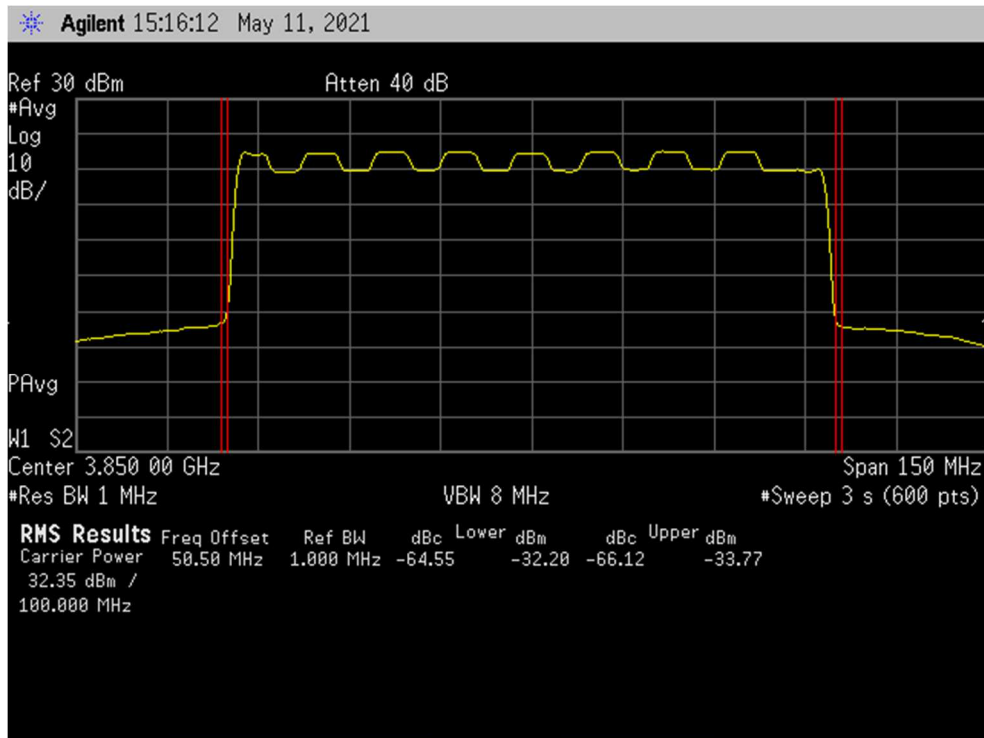
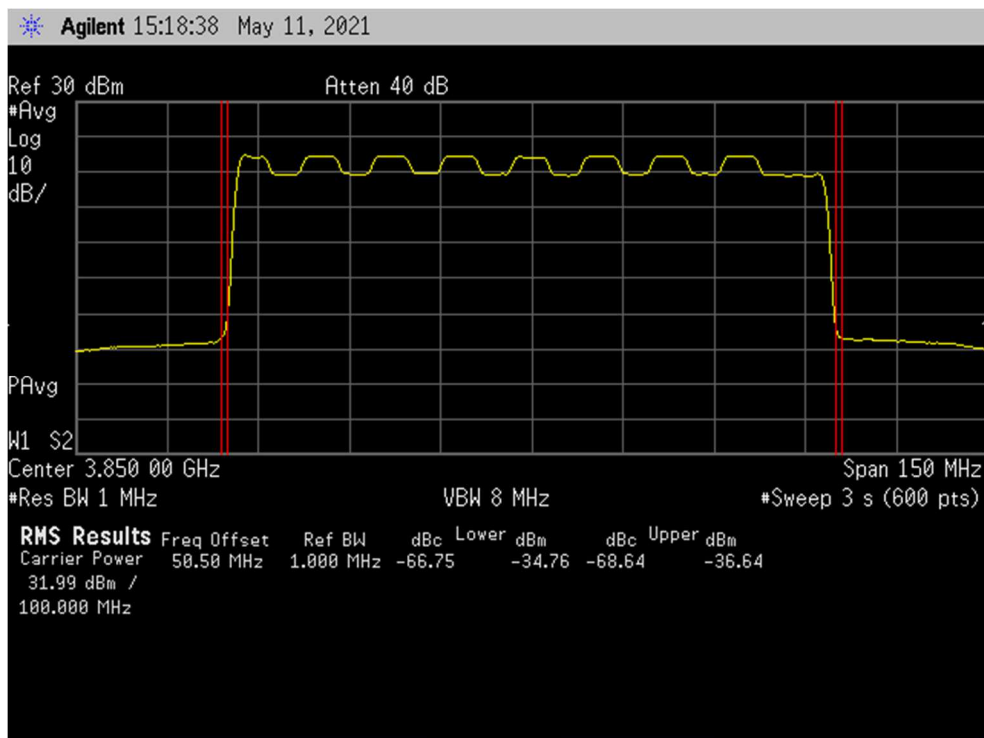


Figure 25: Out-of-Band Emission, 16QAM_TM3.2, TX Port 23



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Table 11: Out-of-Band Emission, 64QAM_TM3.1

TX Port	Out-of-Band Emission [dBm/MHz]		Limit [dBm/MHz]
	3799 - 3800MHz	3900 - 3901MHz	
6	-35.23	-34.66	≤-28
7	-32.21	-32.22	≤-28
22	-32.33	-32.63	≤-28
23	-36.00	-34.82	≤-28

Figure 26: Out-of-Band Emission, 64QAM_TM3.1, TX Port 6

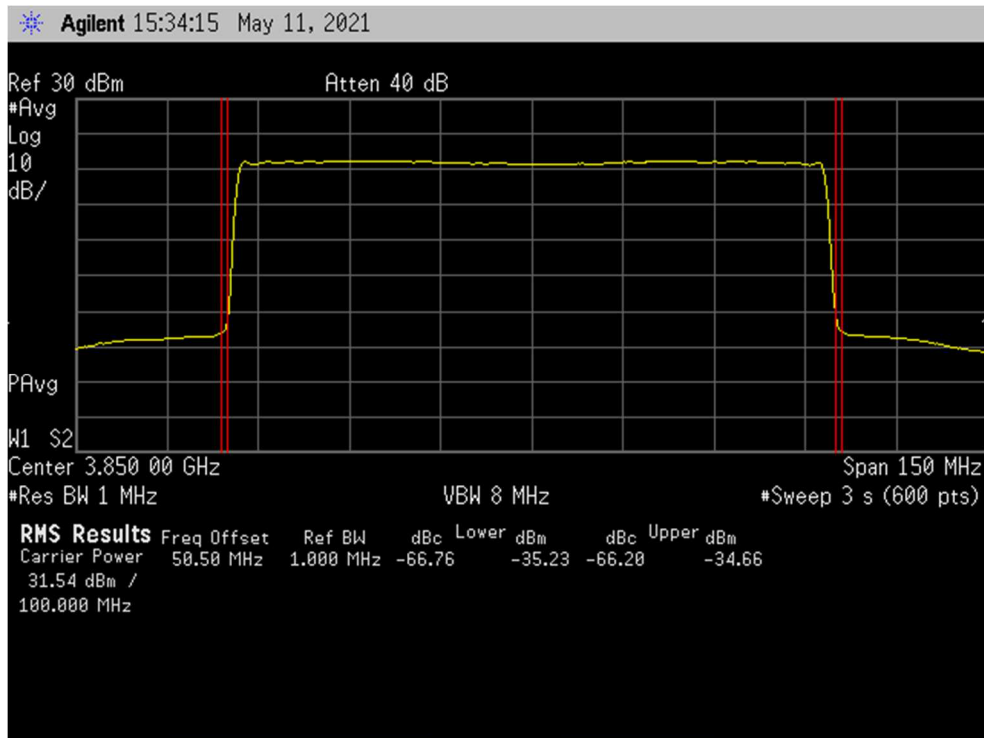


Figure 27: Out-of-Band Emission, 64QAM_TM3.1, TX Port 7

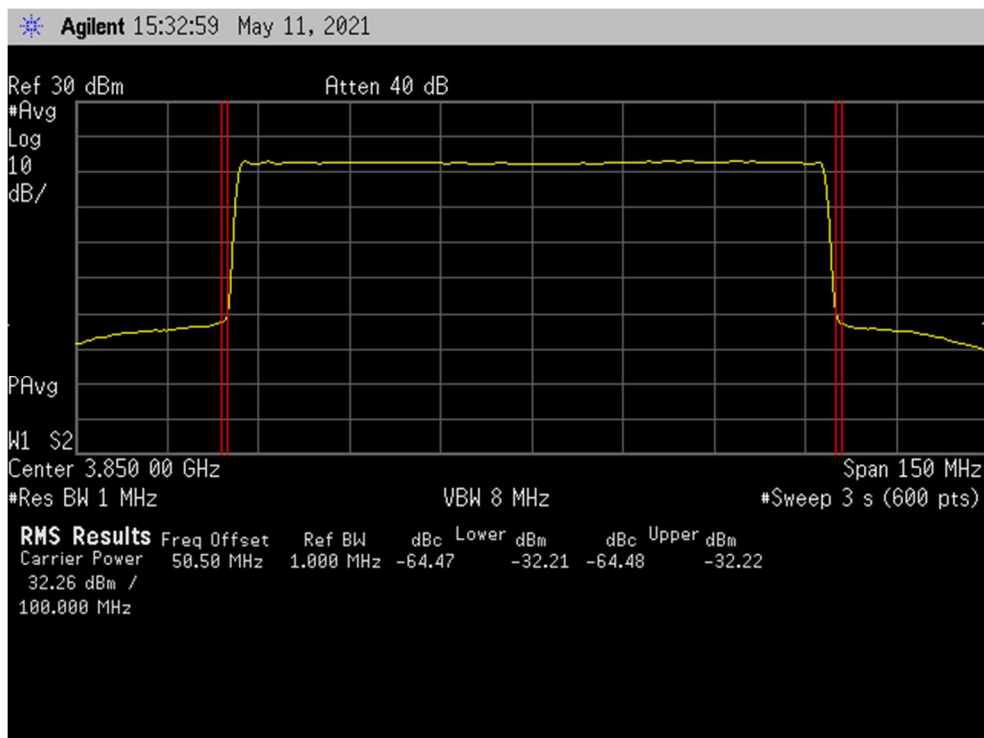


Figure 28: Out-of-Band Emission, 64QAM_TM3.12, TX Port 22

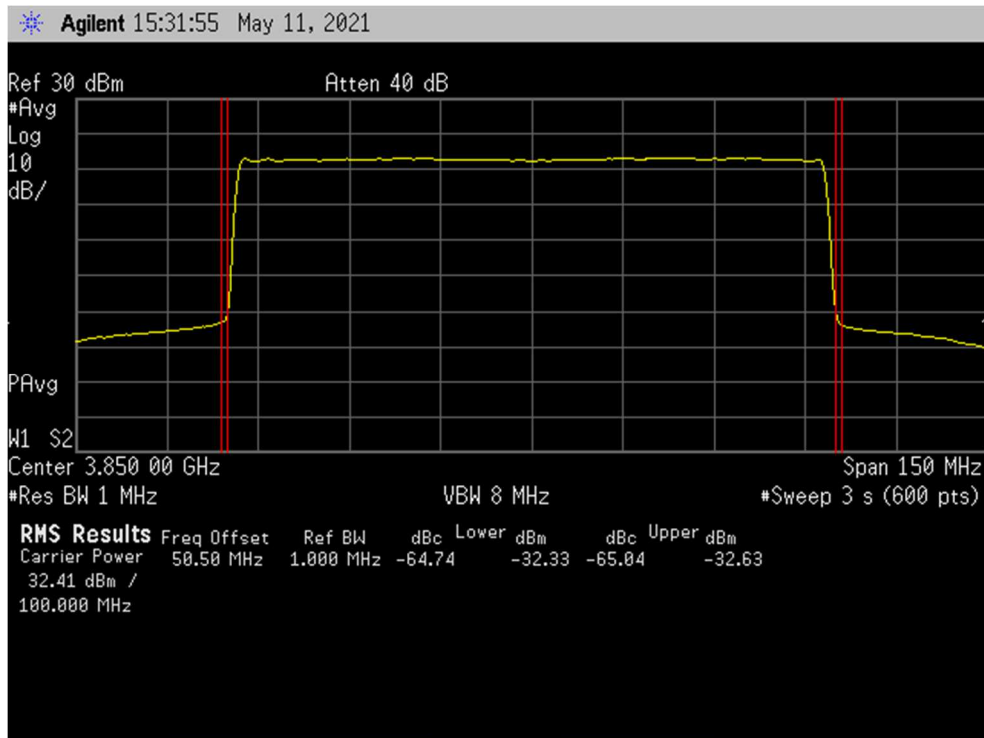
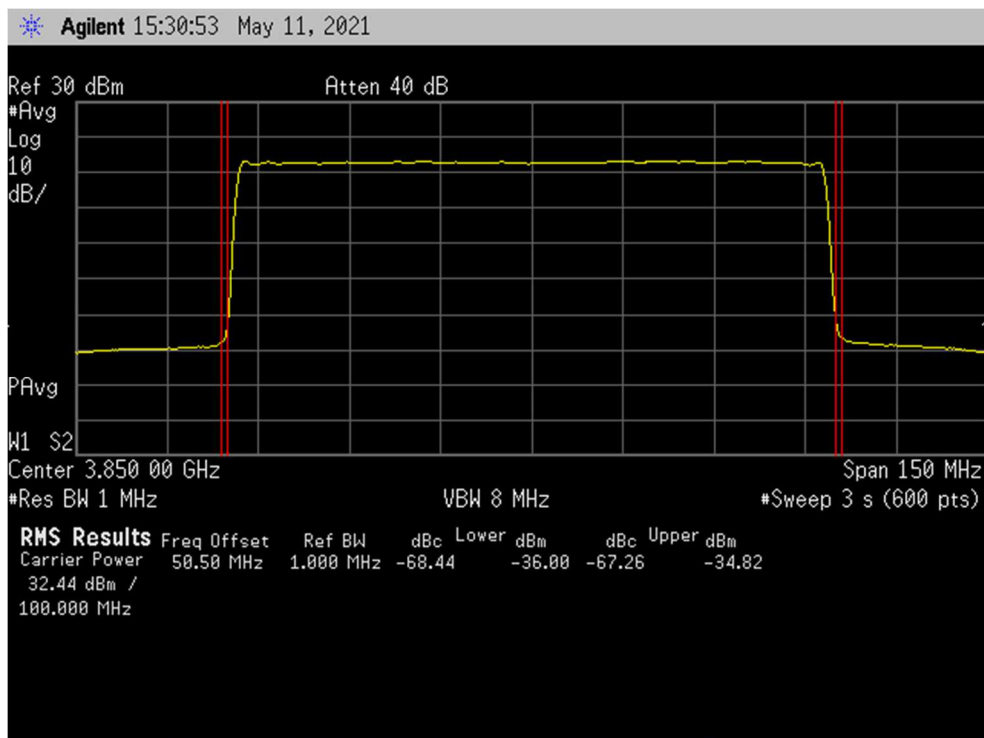


Figure 29: Out-of-Band Emission, 64QAM_TM3.1, TX Port 23



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Table 12: Out-of-Band Emission, 256QAM_TM3.1a

TX Port	Out-of-Band Emission [dBm/MHz]		Limit [dBm/MHz]
	3799 - 3800MHz	3900 - 3901MHz	
6	-34.10	-34.13	≤-28
7	-31.79	-32.67	≤-28
22	-32.51	-33.45	≤-28
23	-35.86	-35.94	≤-28

Figure 30: Out-of-Band Emission, 256QAM_TM3.1a, TX Port 6

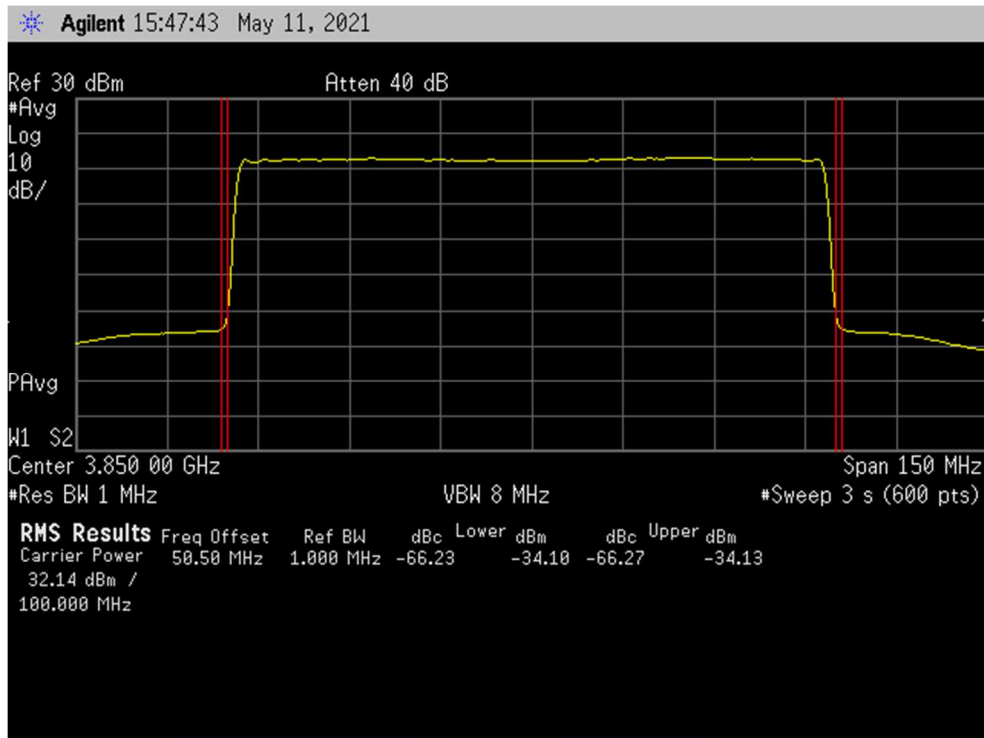
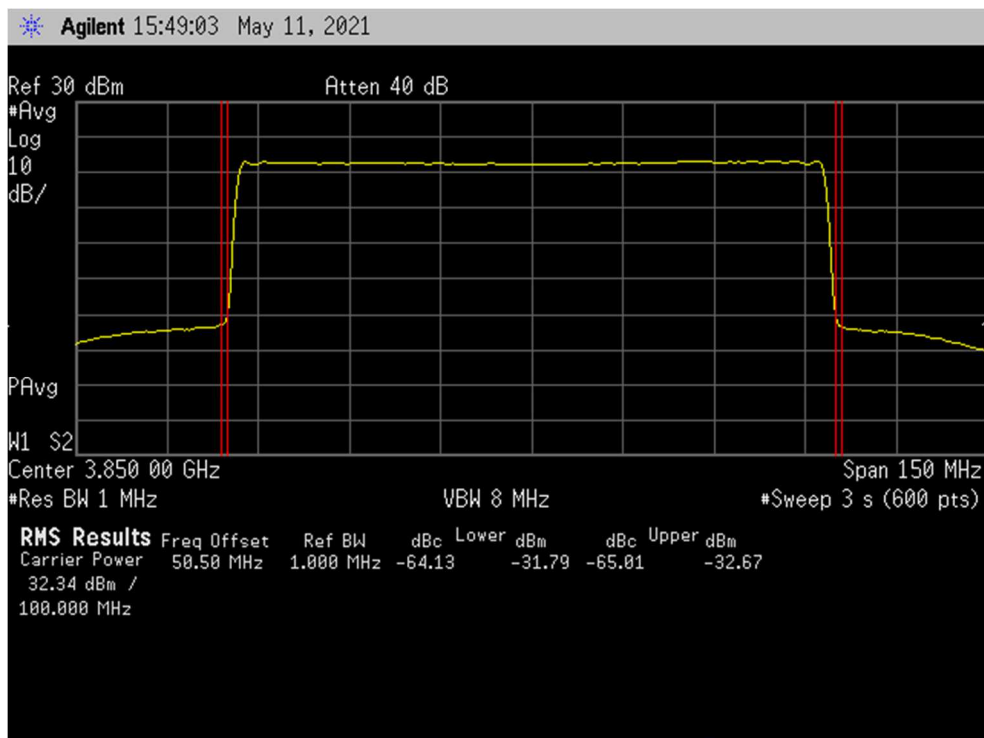


Figure 31: Out-of-Band Emission, 256QAM_TM3.1a, TX Port 7



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Figure 32: Out-of-Band Emission, 256QAM_TM3.1a, TX Port 22

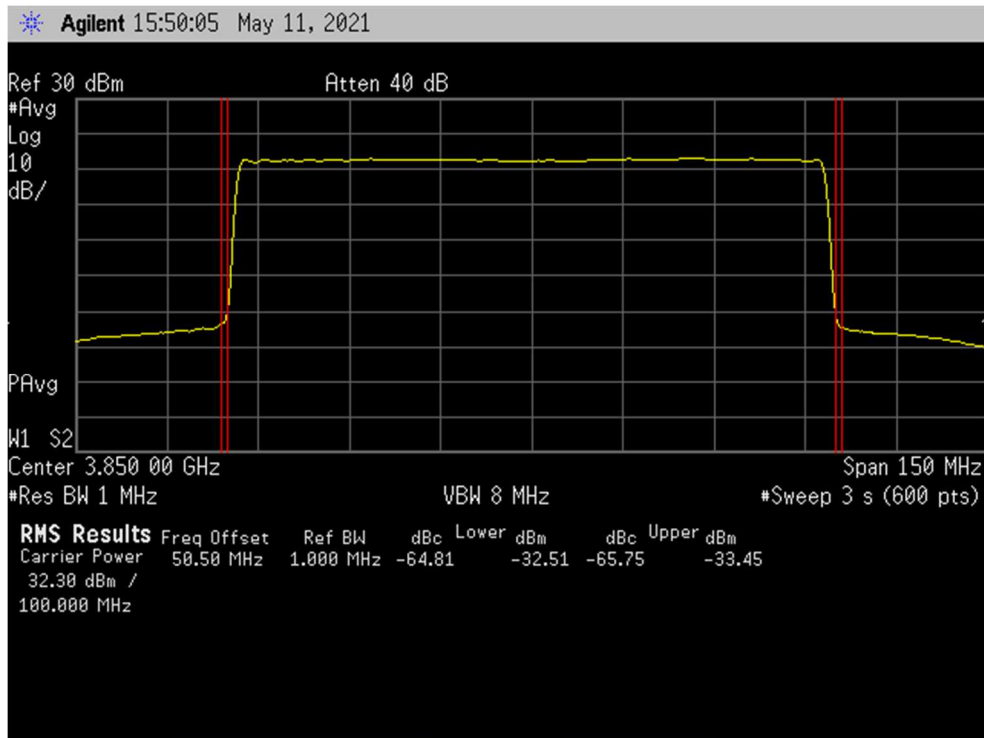
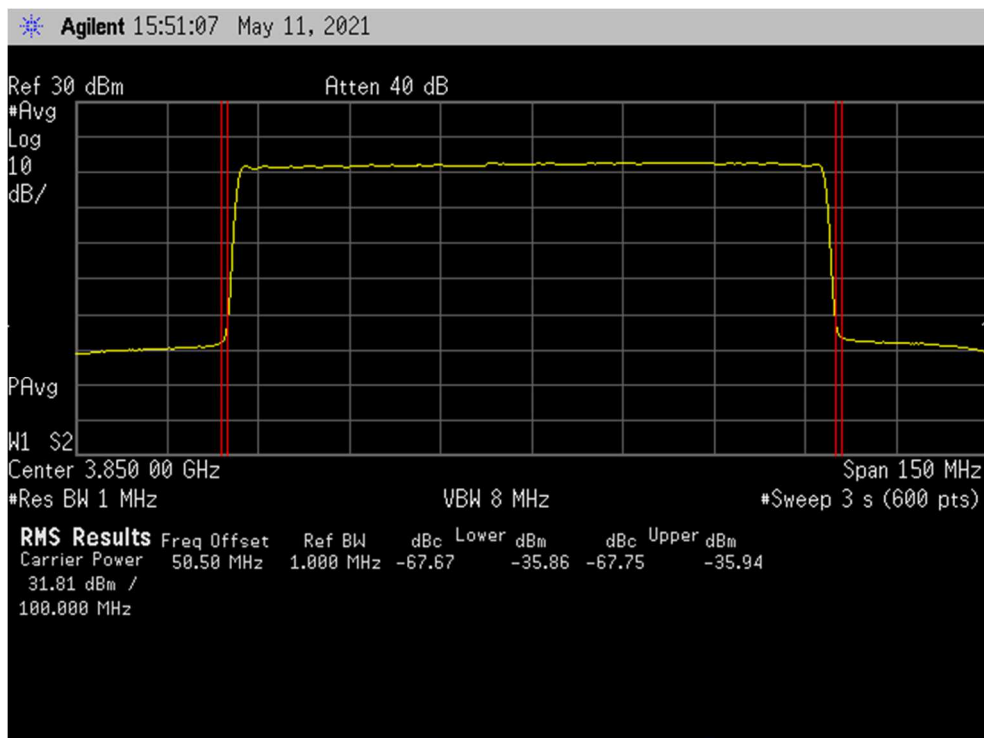


Figure 33: Out-of-Band Emission, 256QAM_TM3.1a, TX Port 23



5.1.6 Conducted Spurious Emission

RESULT:

PASS

Date of testing: 2021-04-28

Ambient temperature: 21°C
Relative humidity: 58%
Atmospheric pressure: 1016hPa

Requirements:

FCC 27.53(l)(1)

For base station operations in the 3700-3980 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed -13 dBm/MHz. Compliance with this paragraph (l)(1) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Test procedure:

ANSI C63.26 §5.7.4

Note:

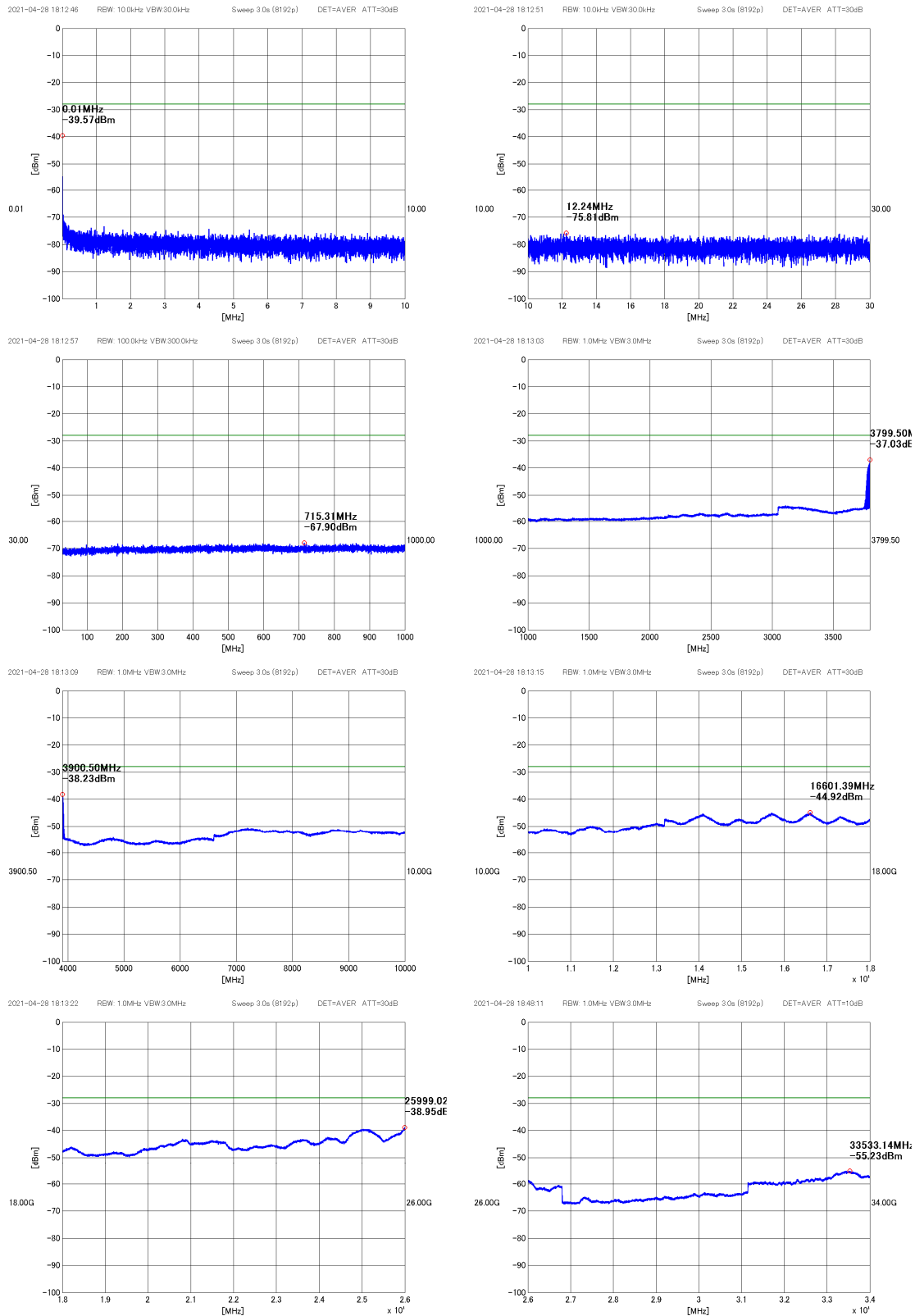
Since the EUT has 32 TX ports, the emission limit for one TX port is -28dBm/MHz (-13dBm/MHz divided by 32).

The test is done on TX port 6, 7, 22, and 23, which are the 4 ports of the same PCB board. The EUT has 8 identical PCB boards.

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Figure 34: Conducted Spurious Emission, 9kHz - 39GHz, QPSK_TM1.1, TX Port 6



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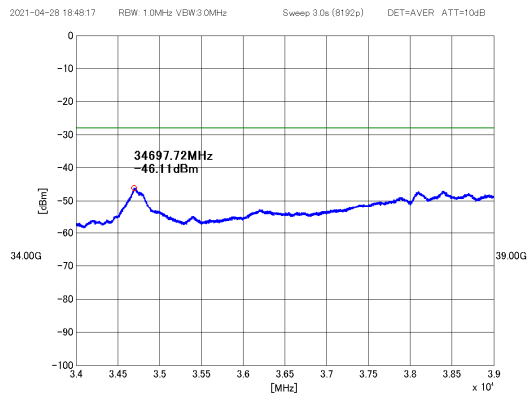
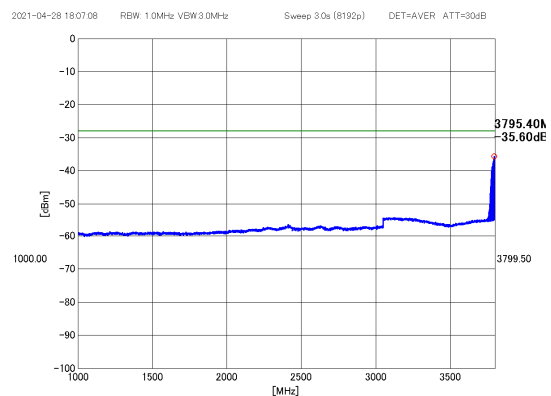
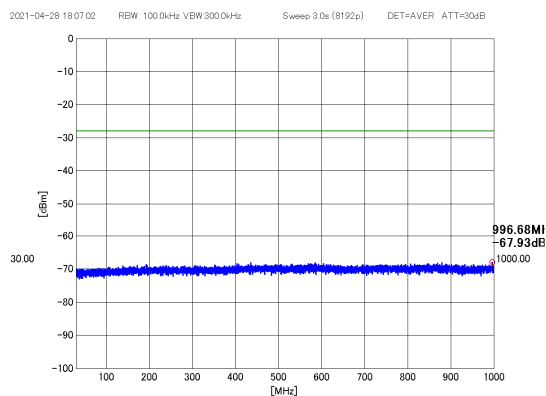
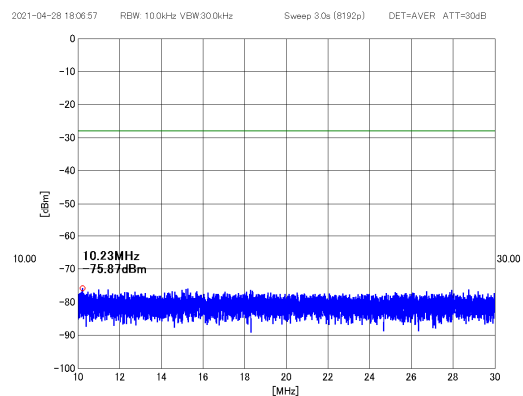
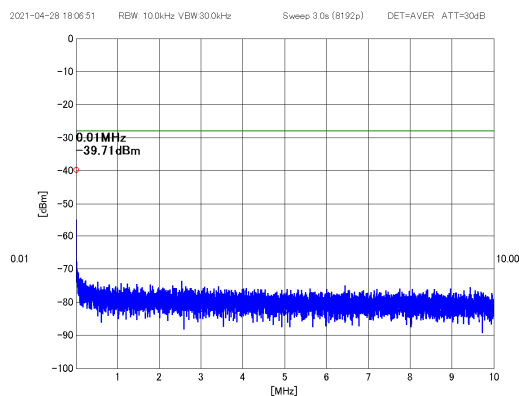
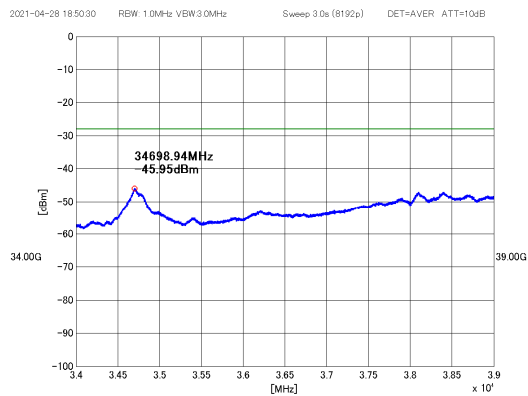
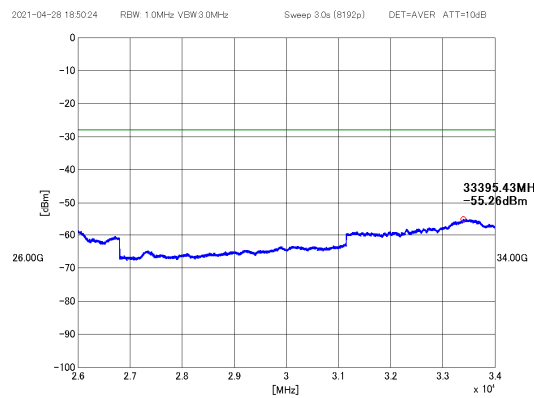
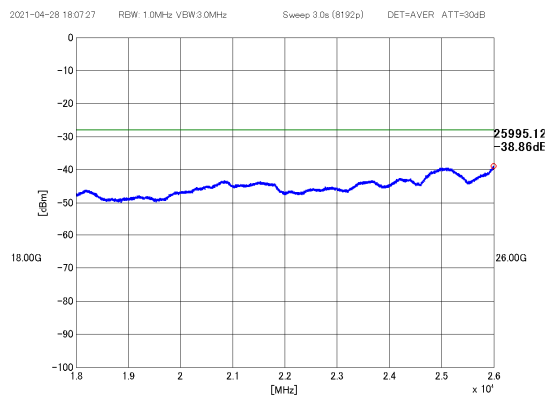
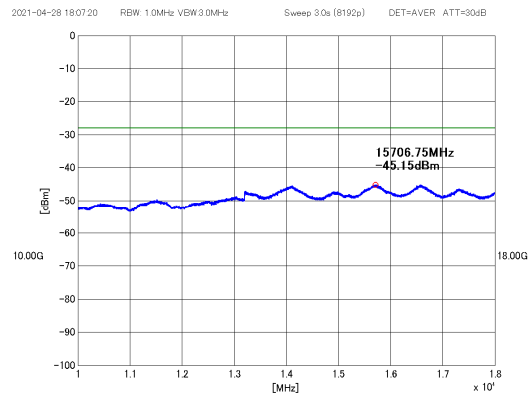
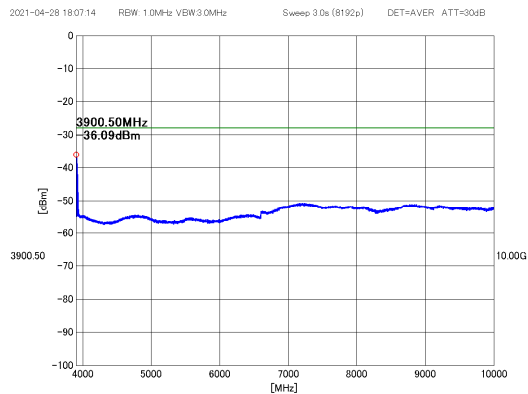


Figure 35: Conducted Spurious Emission, 9kHz - 39GHz, QPSK_TM1.1, TX Port 7



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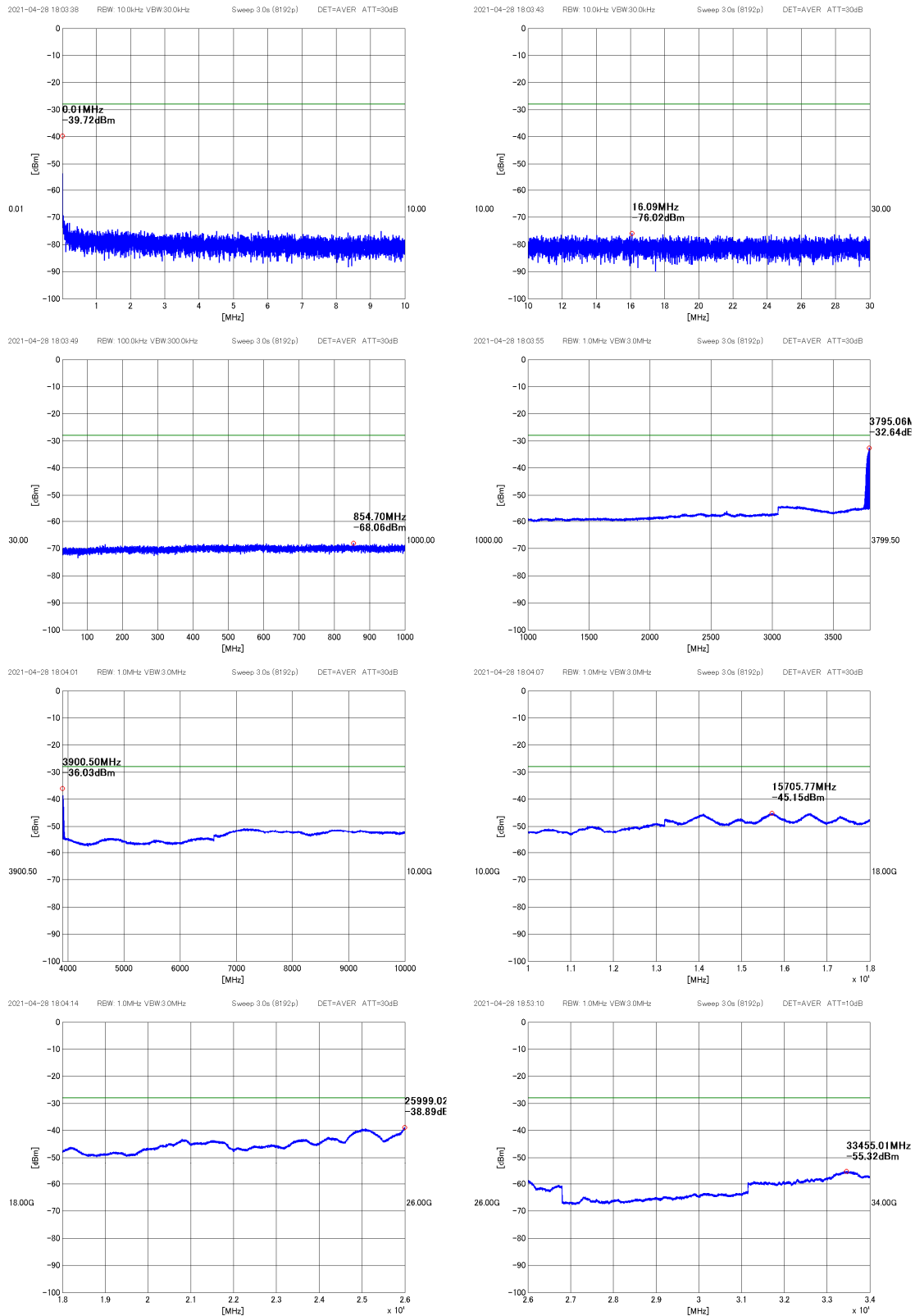


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Figure 36: Conducted Spurious Emission, 9kHz - 39GHz, QPSK_TM1.1, TX Port 22



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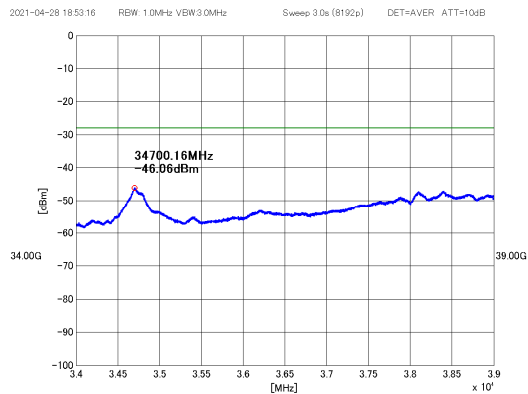
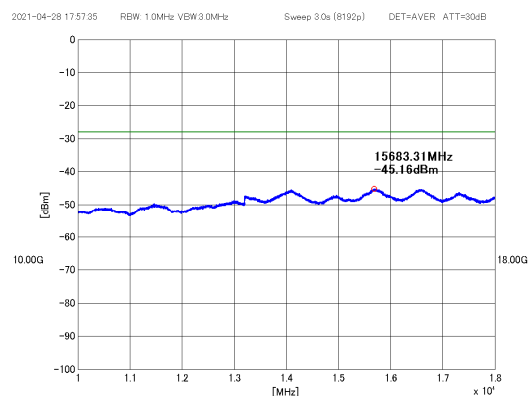
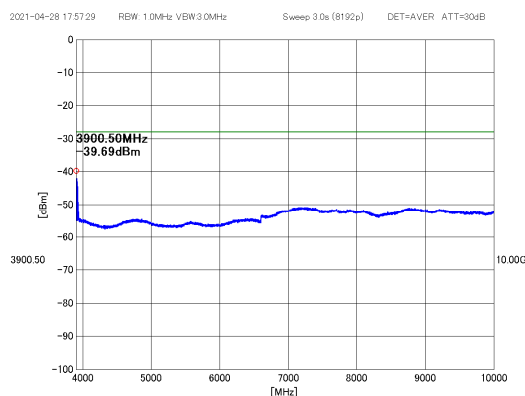
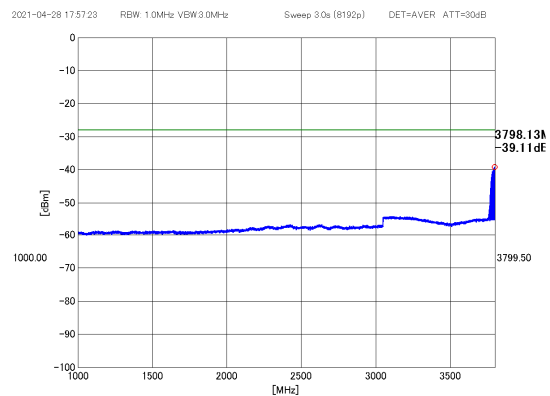
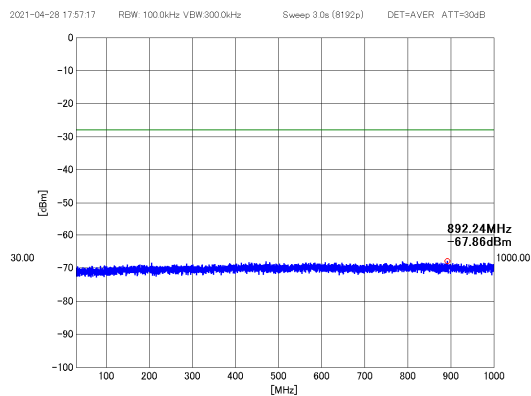
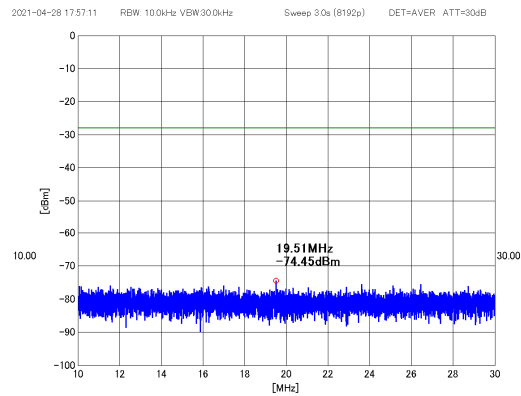
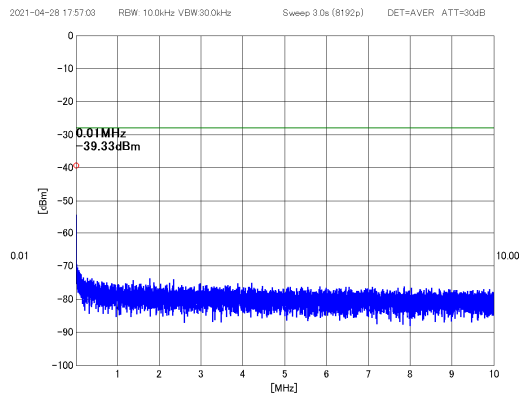


Figure 37: Conducted Spurious Emission, 9kHz - 39GHz, QPSK_TM1.1, TX Port 23



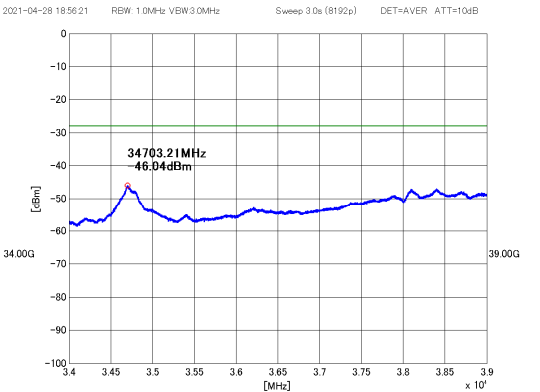
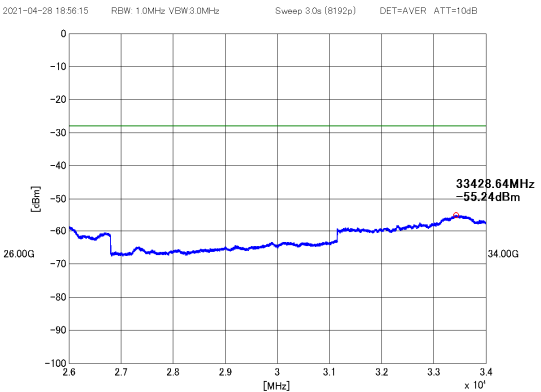
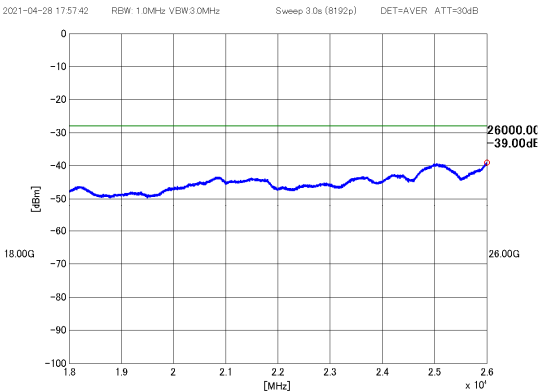
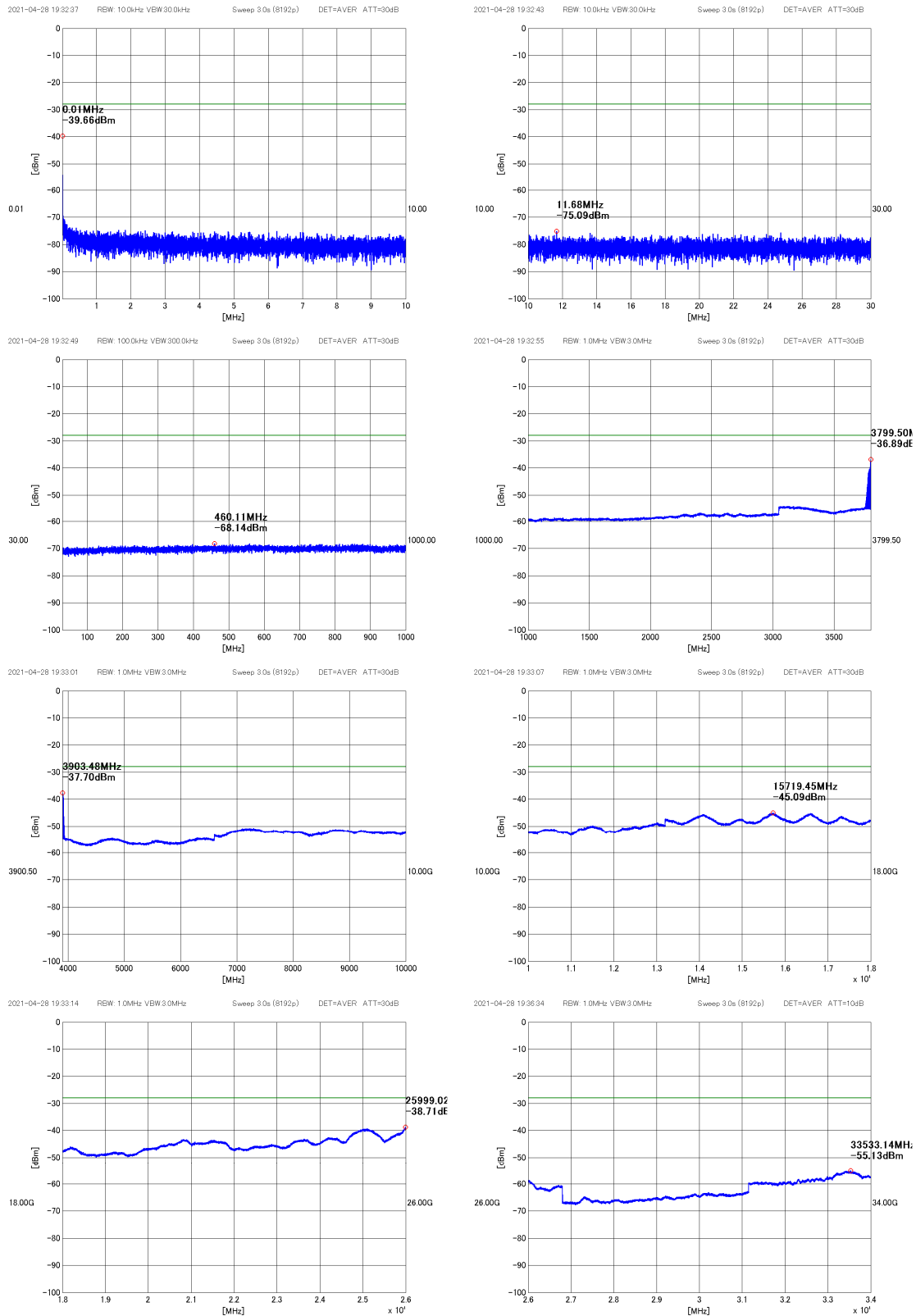


Figure 38: Conducted Spurious Emission, 9kHz - 39GHz, 16QAM_TM3.2, TX Port 6



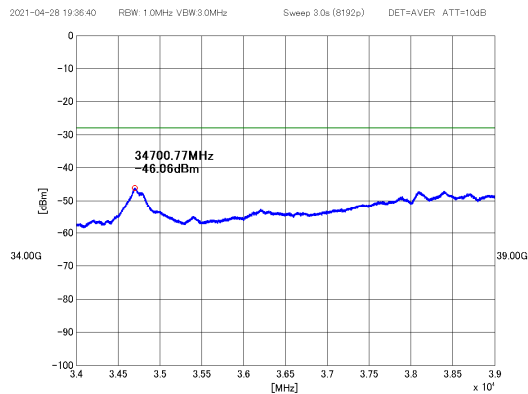
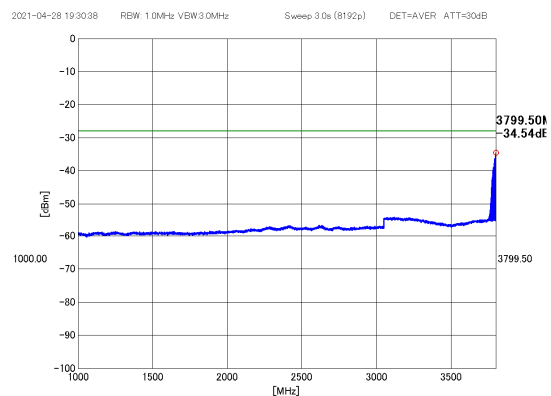
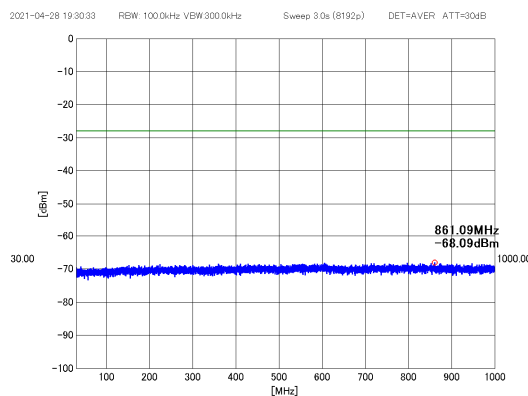
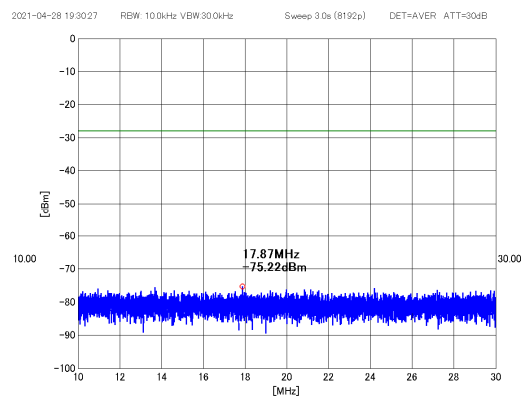
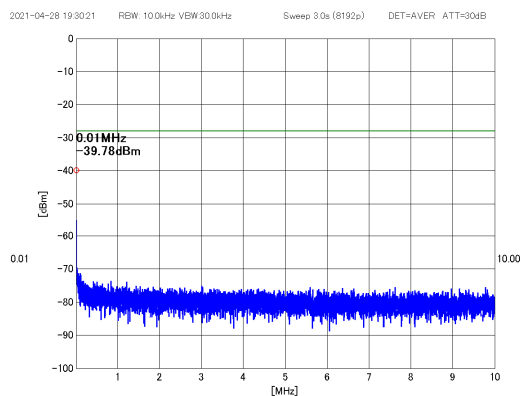


Figure 39: Conducted Spurious Emission, 9kHz - 39GHz, 16QAM_TM3.2, TX Port 7



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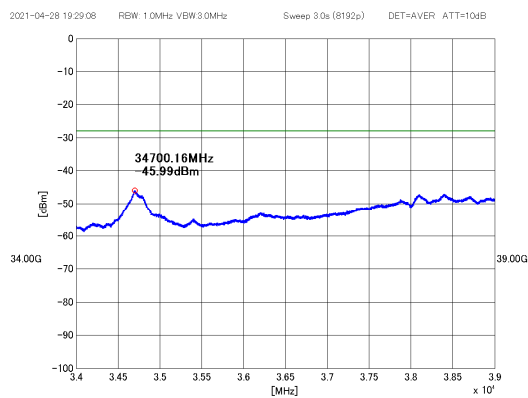
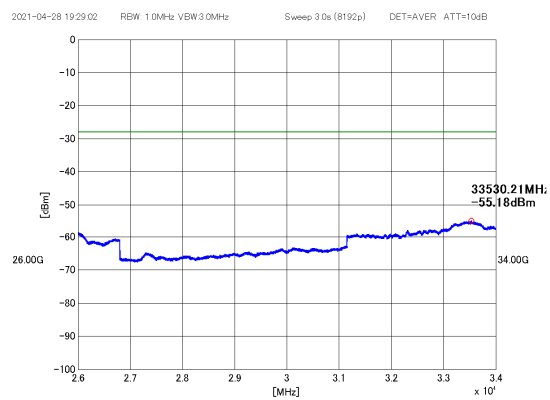
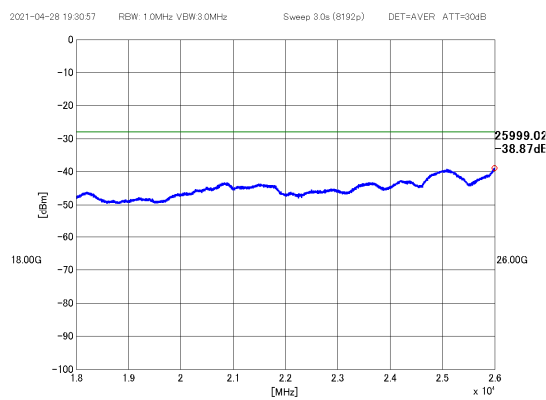
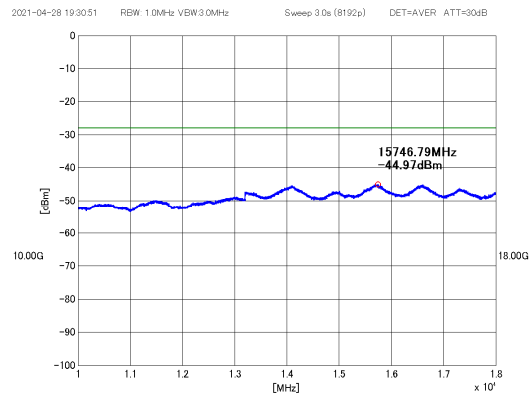
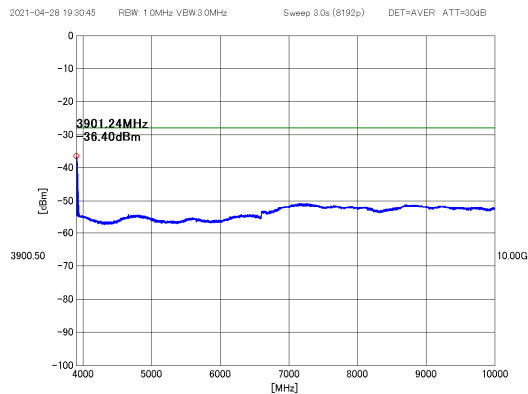
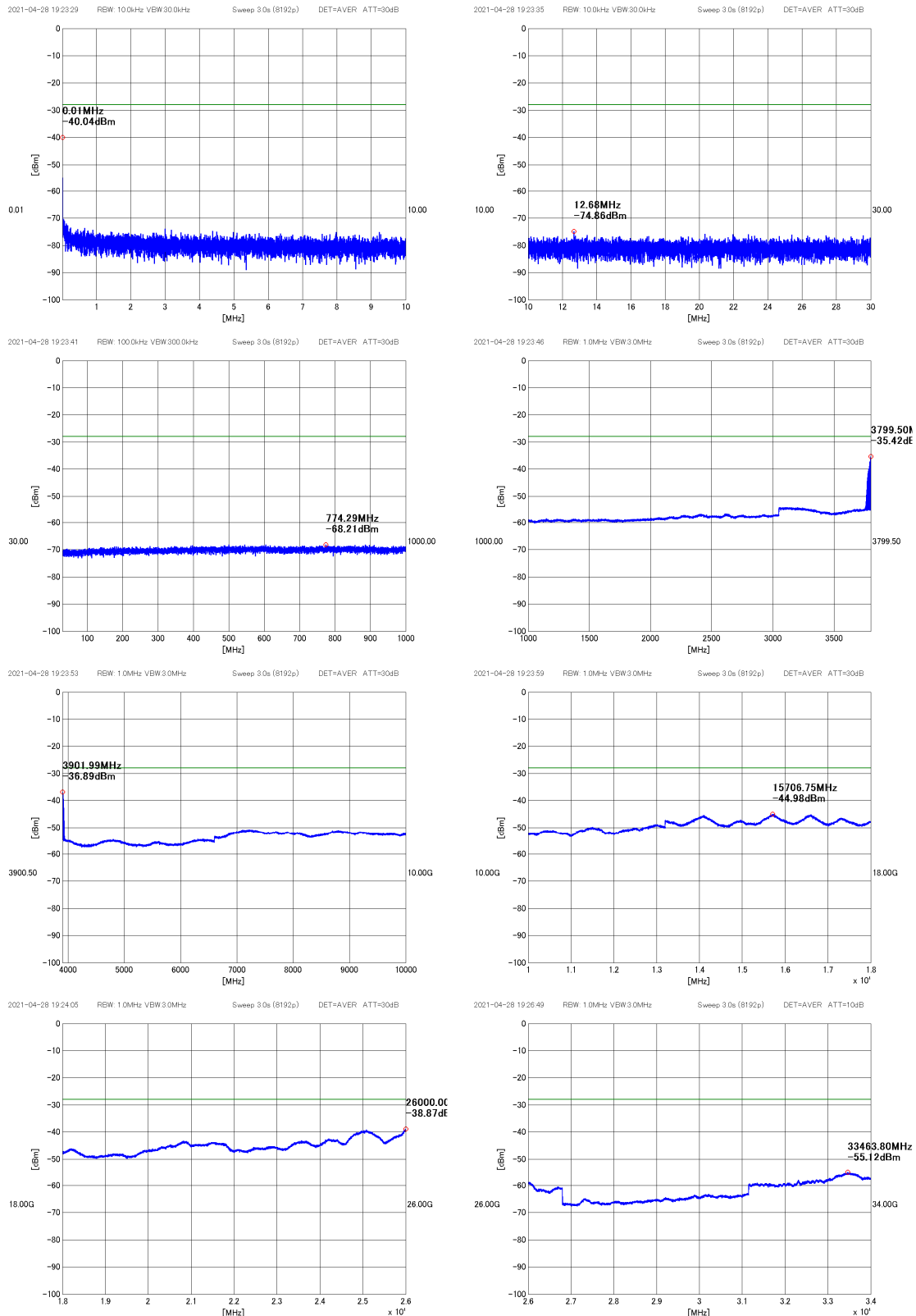


Figure 40: Conducted Spurious Emission, 9kHz - 39GHz, 16QAM_TM3.2, TX Port 22



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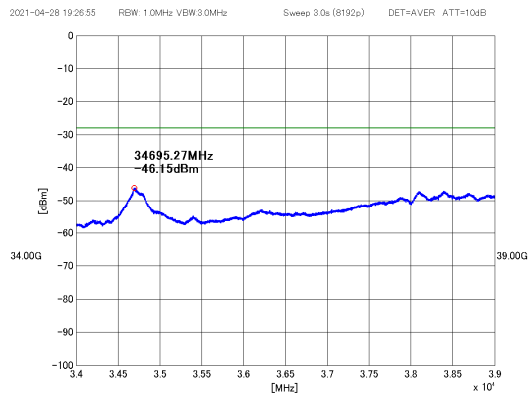
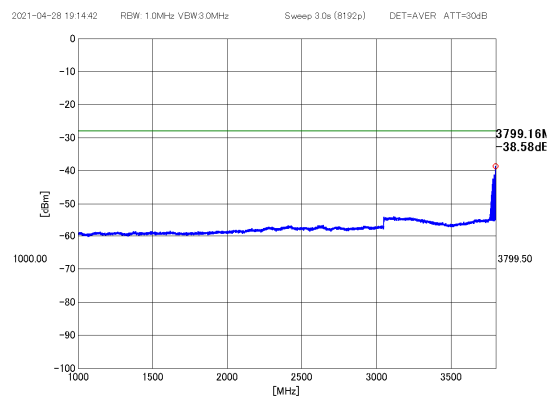
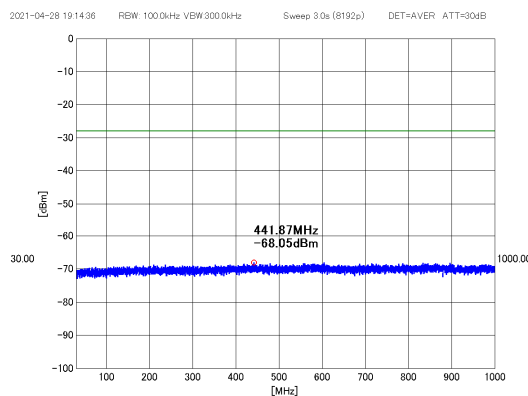
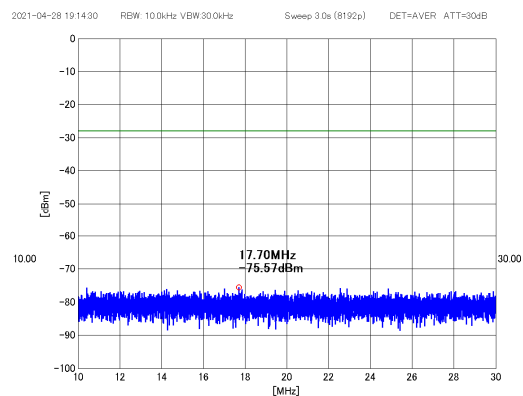
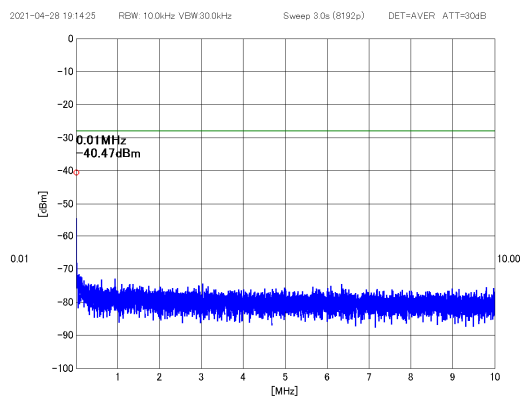


Figure 41: Conducted Spurious Emission, 9kHz - 39GHz, 16QAM_TM3.2, TX Port 23



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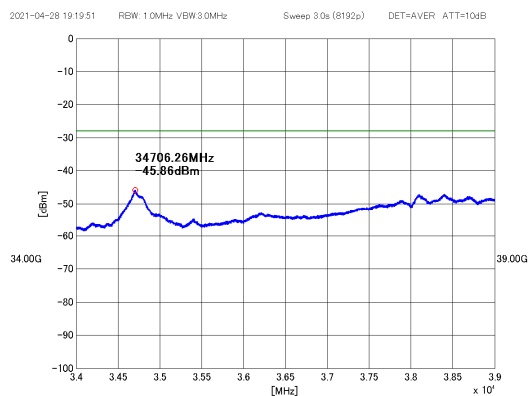
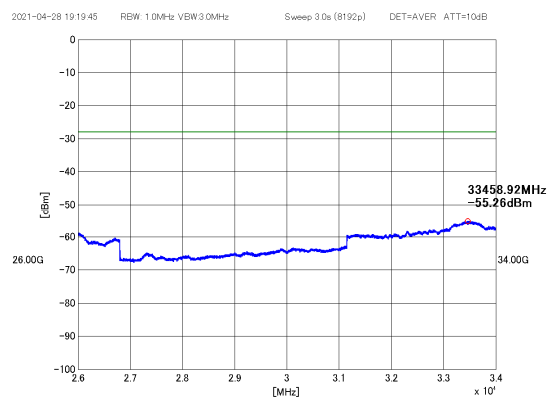
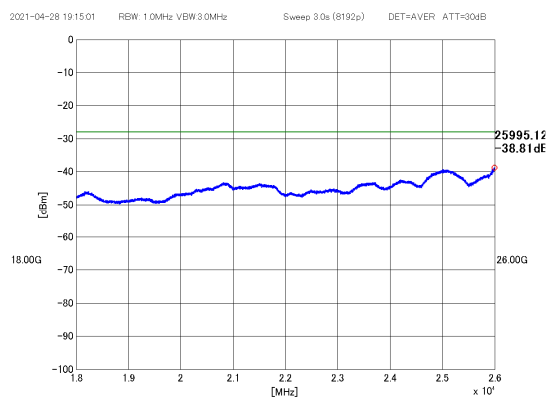
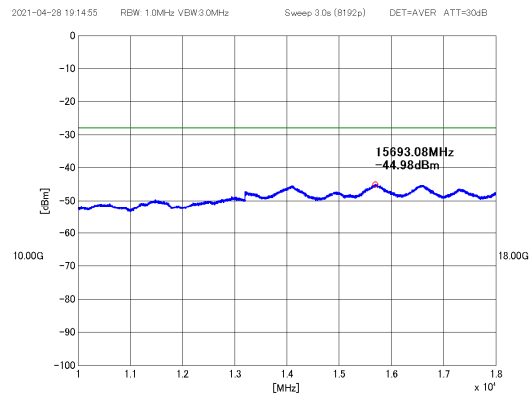
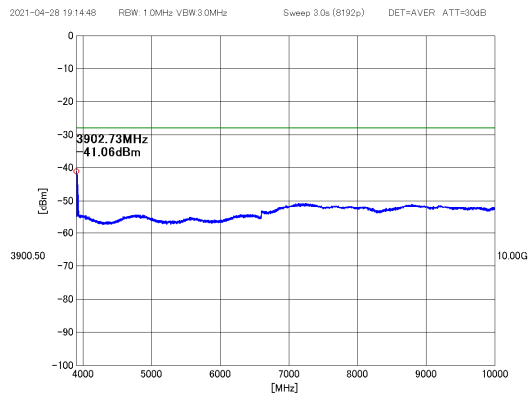
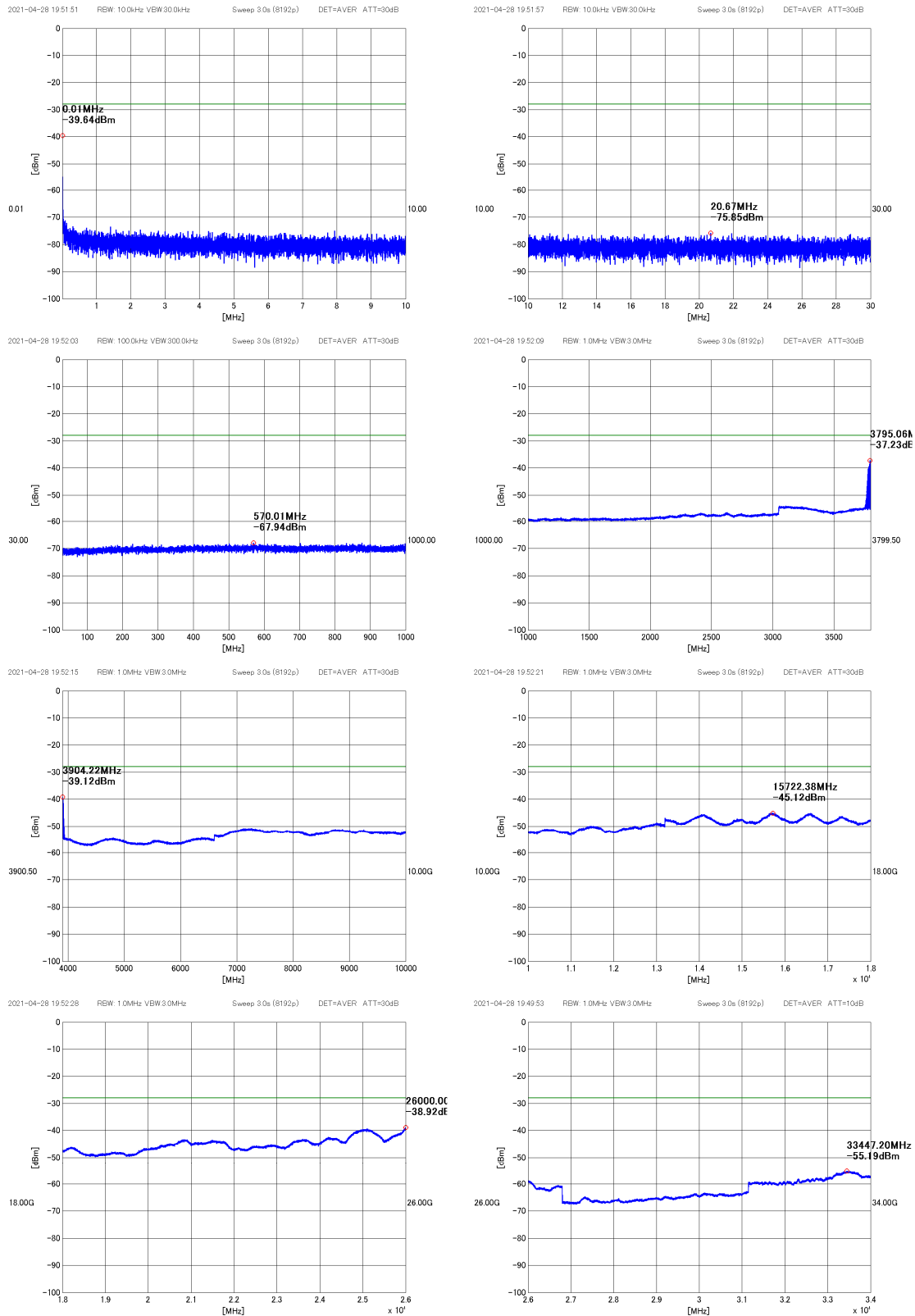


Figure 42: Conducted Spurious Emission, 9kHz - 39GHz, 64QAM_TM3.1, TX Port 6



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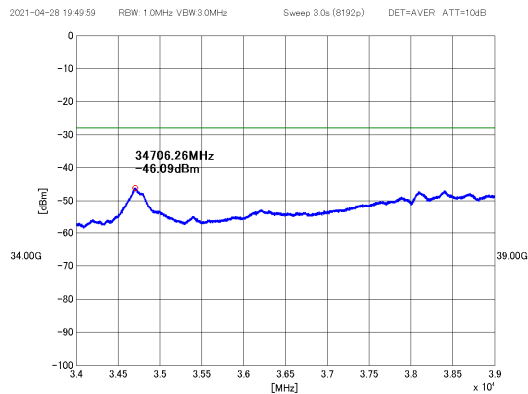
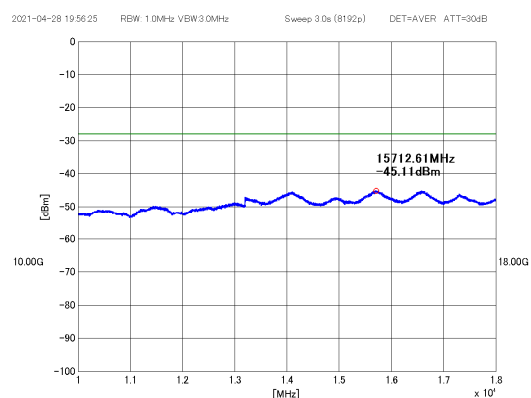
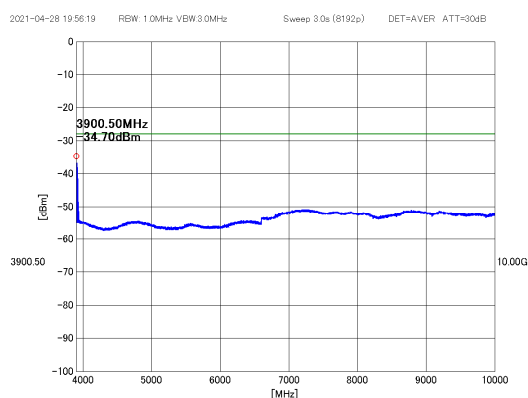
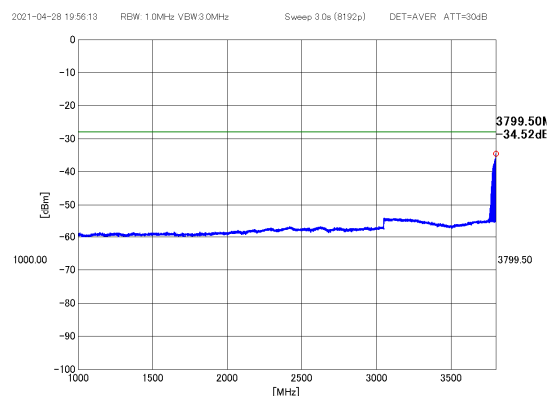
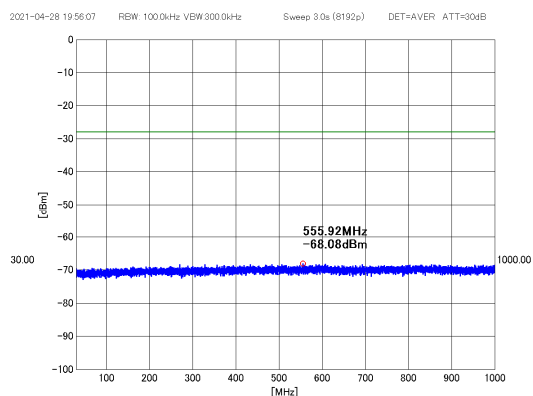
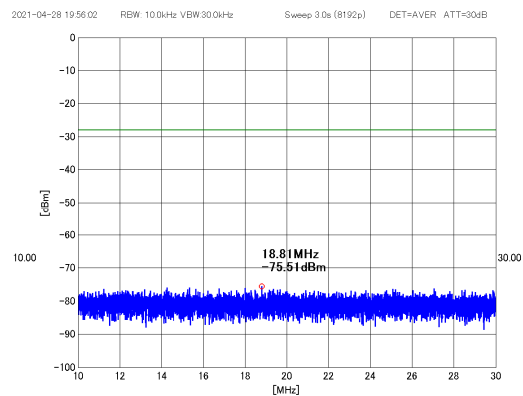
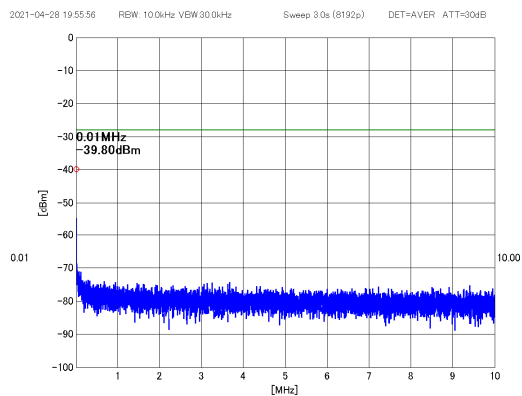


Figure 43: Conducted Spurious Emission, 9kHz - 39GHz, 64QAM_TM3.1, TX Port 7



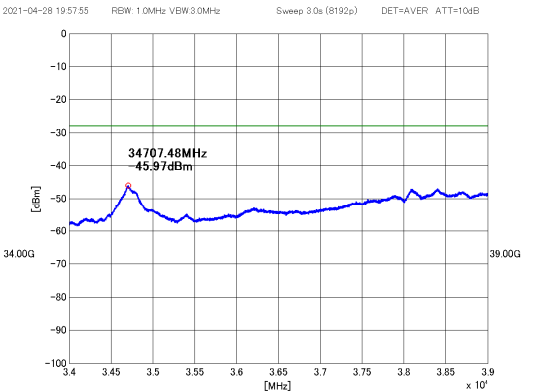
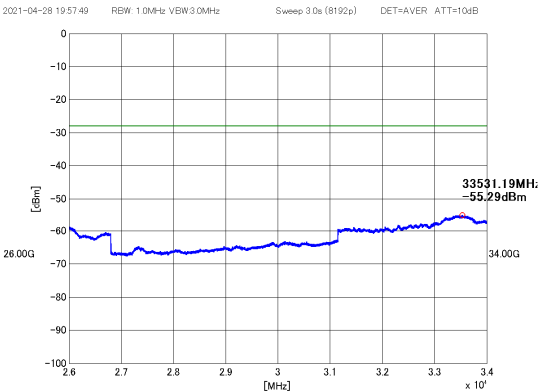
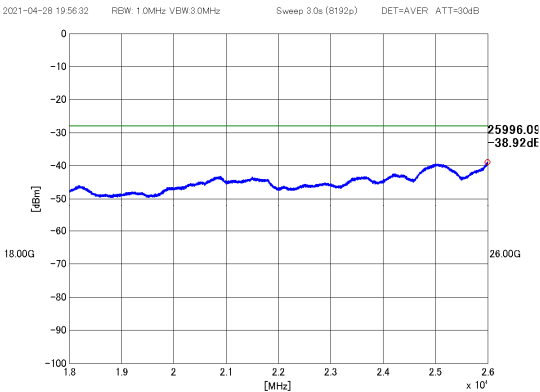
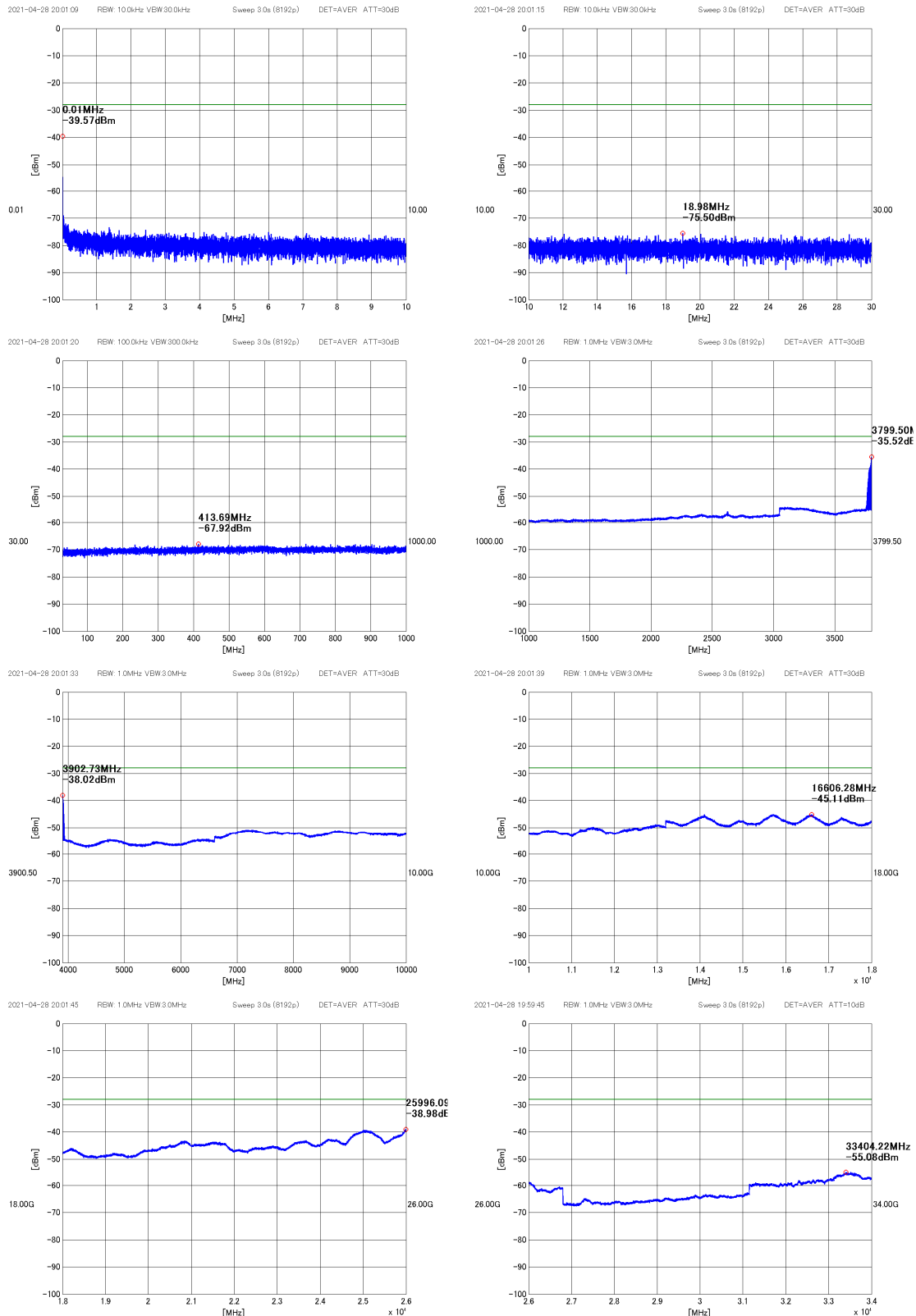


Figure 44: Conducted Spurious Emission, 9kHz - 39GHz, 64QAM_TM3.1, TX Port 22



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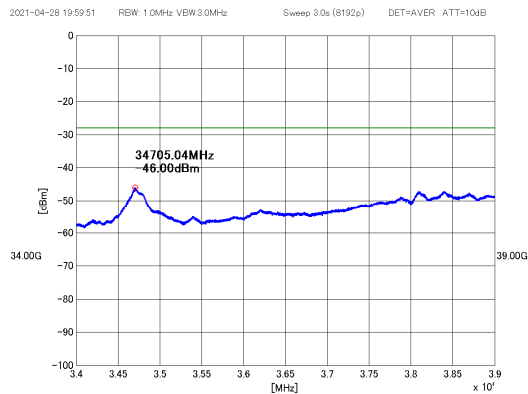
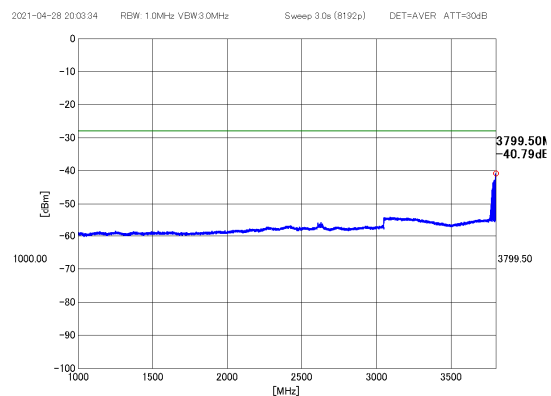
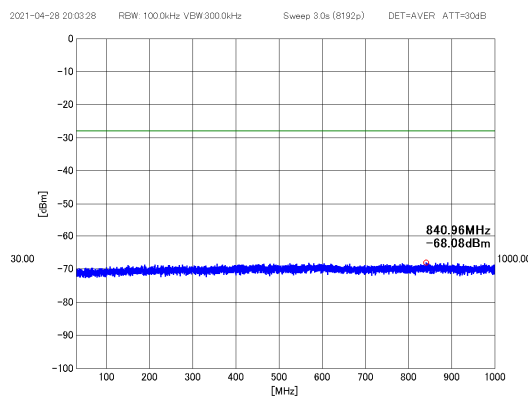
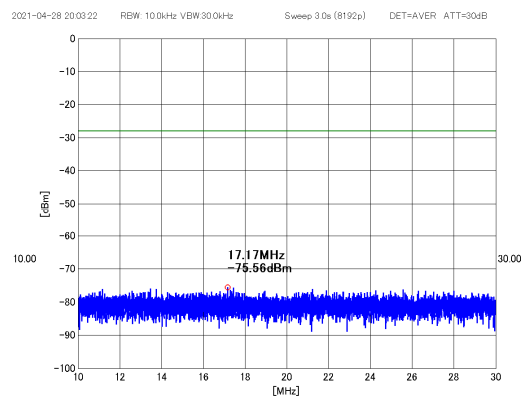
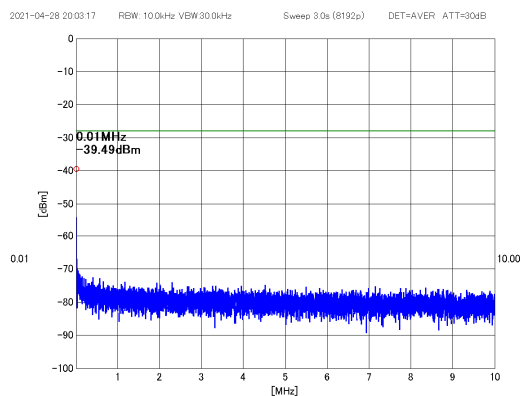
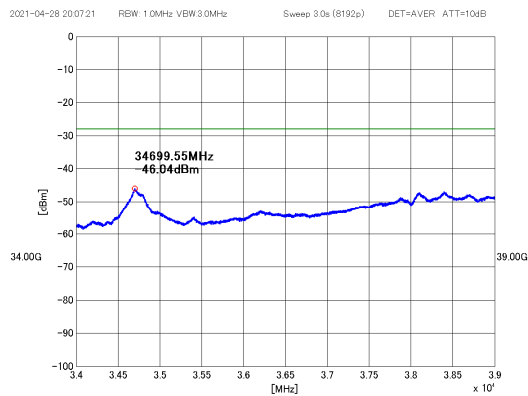
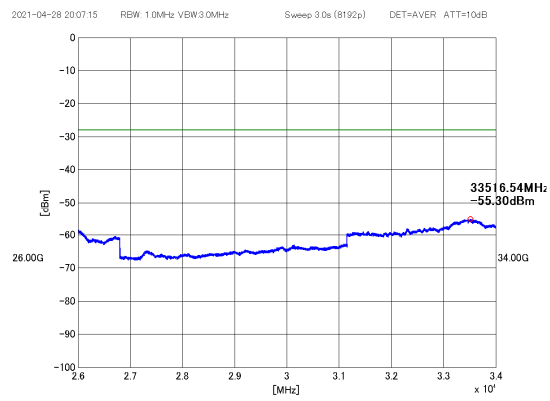
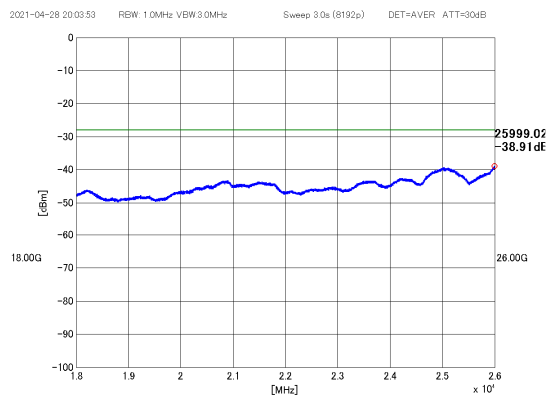
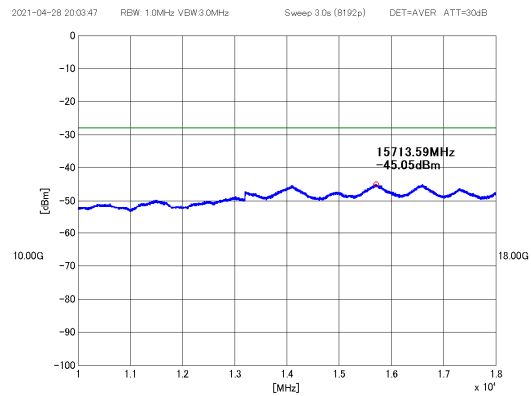
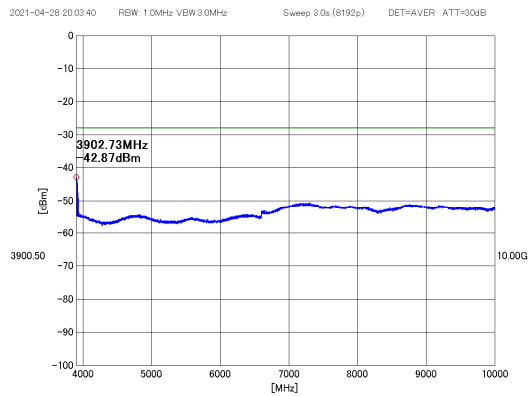


Figure 45: Conducted Spurious Emission, 9kHz - 39GHz, 64QAM_TM3.1, TX Port 23



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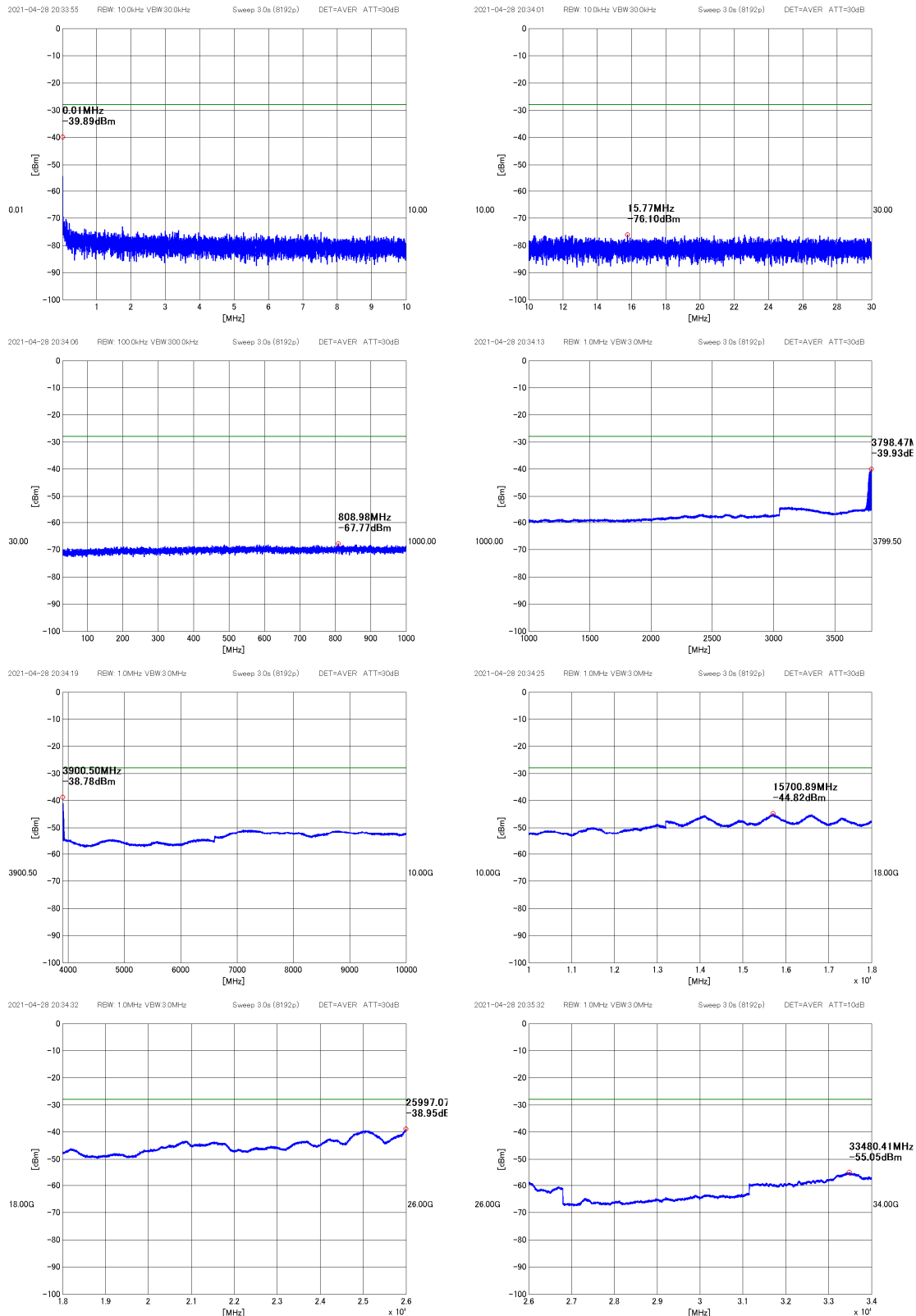


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Figure 46: Conducted Spurious Emission, 9kHz - 39GHz, 256QAM_TM3.1a, TX Port 6



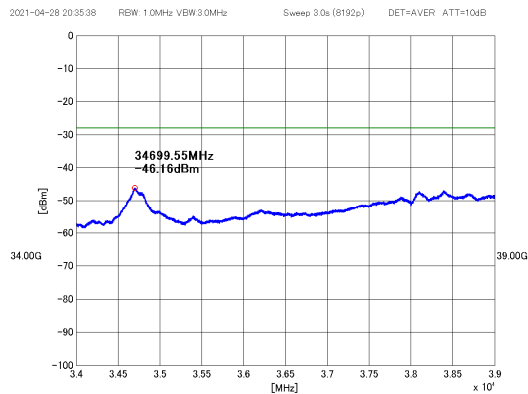
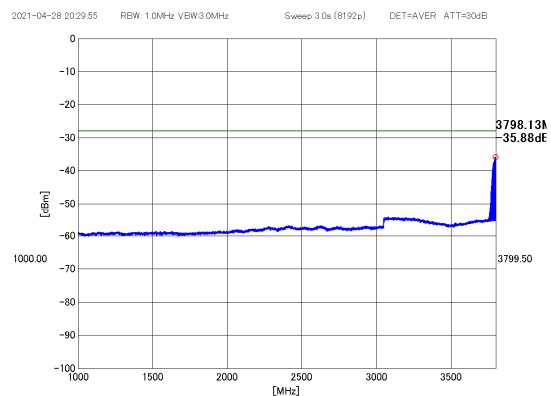
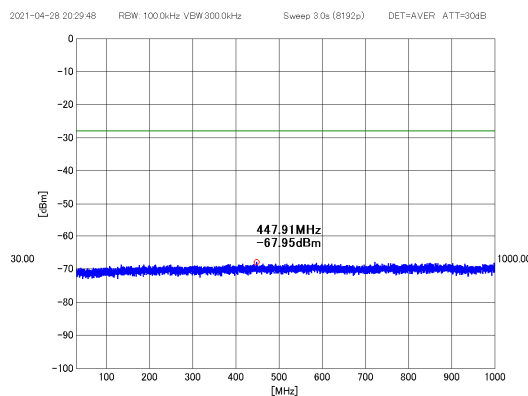
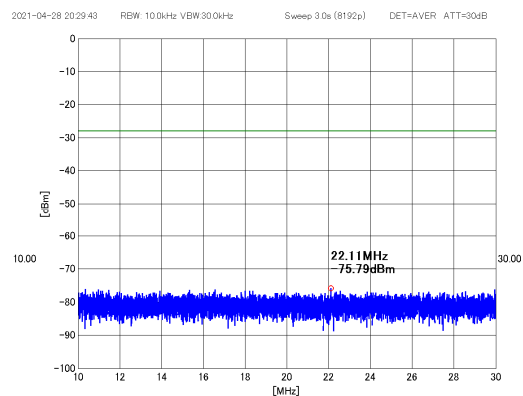
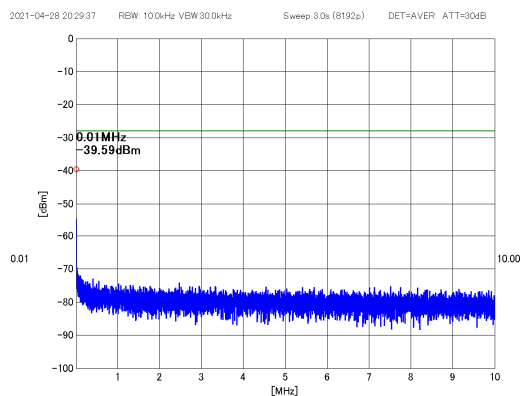
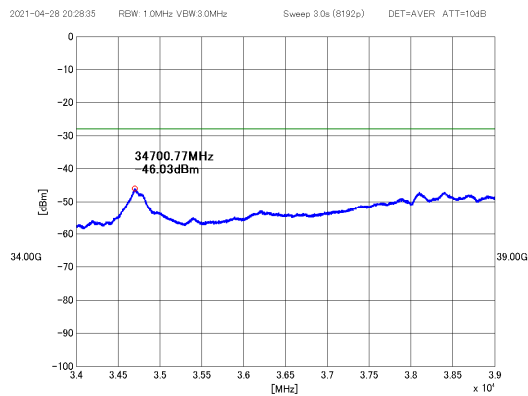
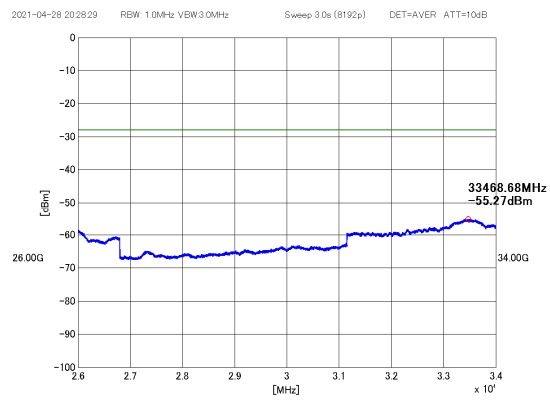
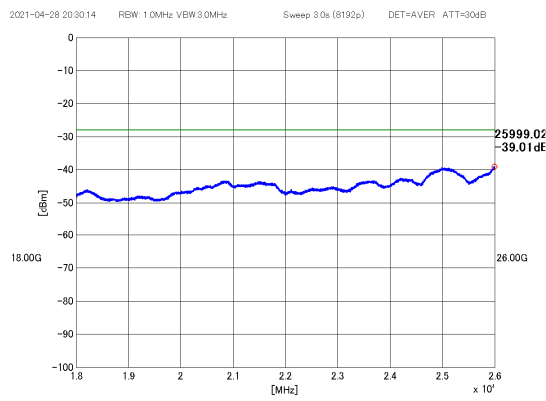
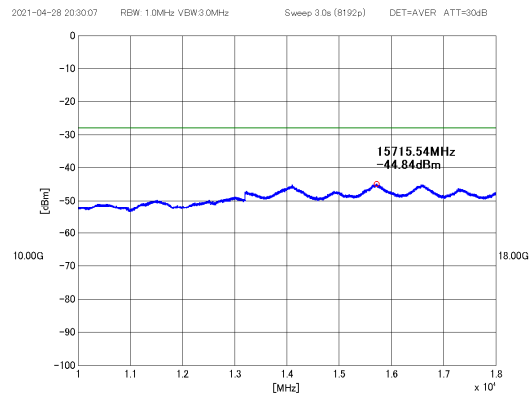
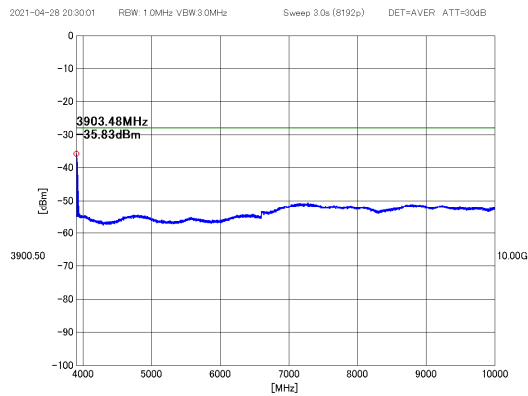


Figure 47: Conducted Spurious Emission, 9kHz - 39GHz, 256QAM_TM3.1a, TX Port 7



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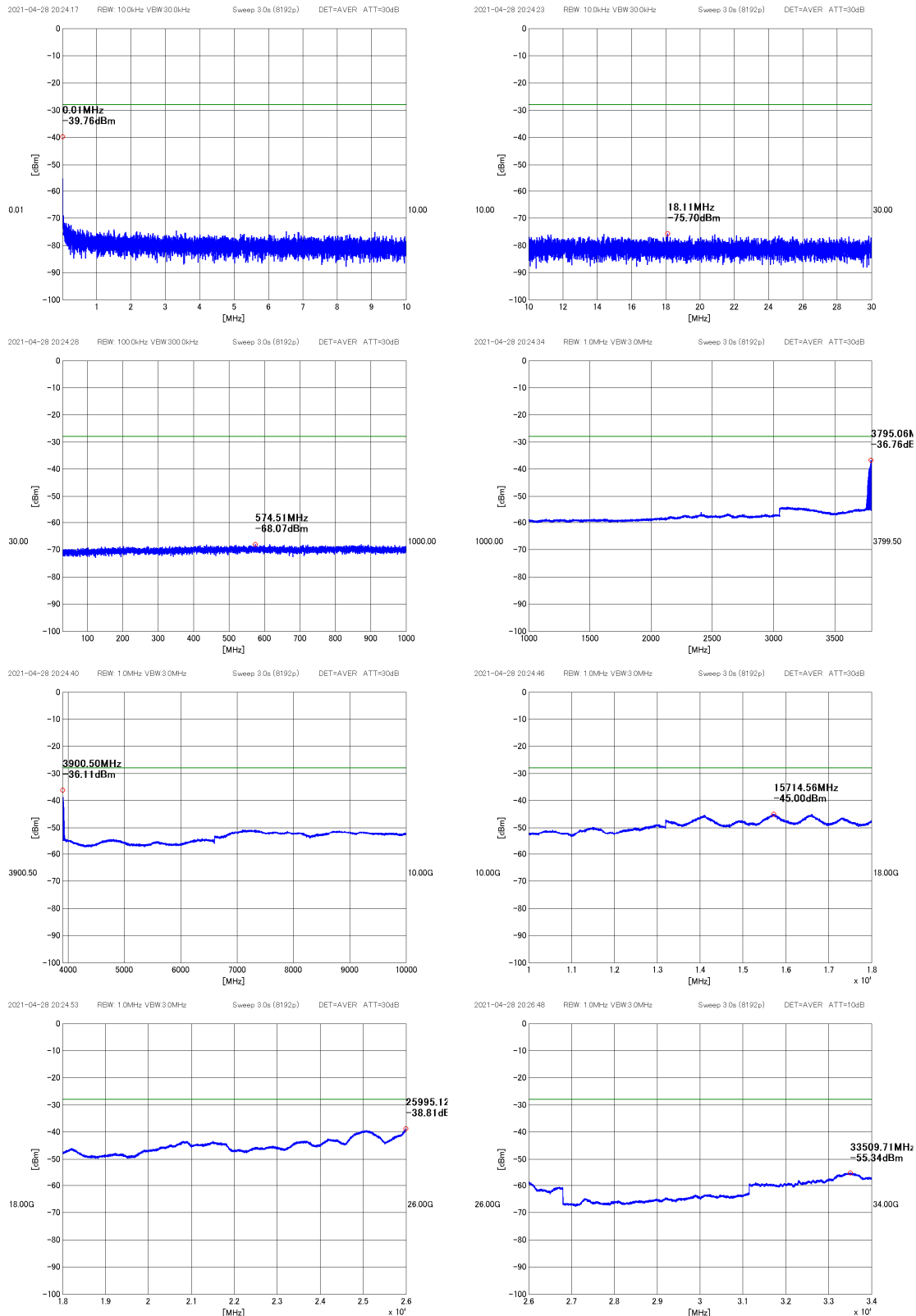


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Figure 48: Conducted Spurious Emission, 9kHz - 39GHz, 256QAM_TM3.1a, TX Port 22



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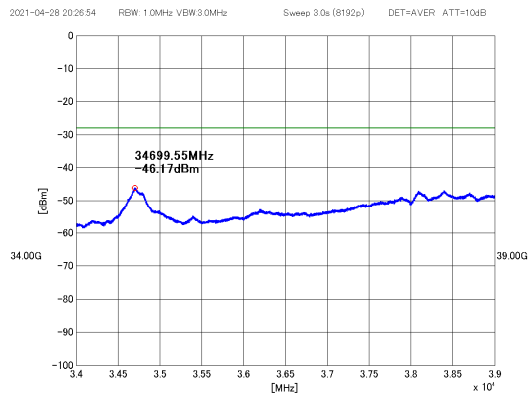
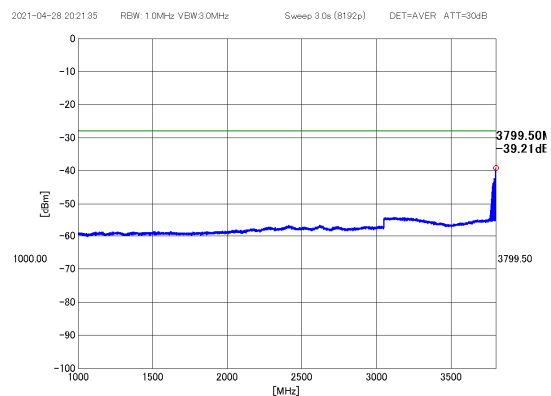
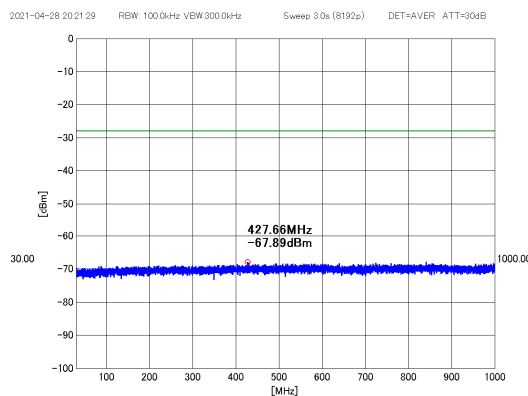
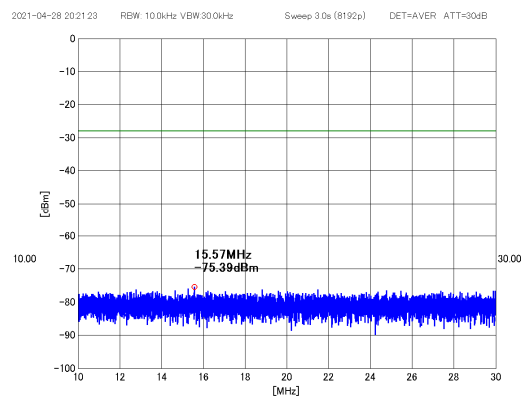
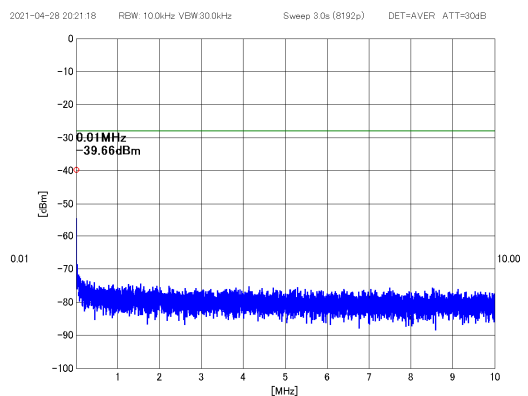
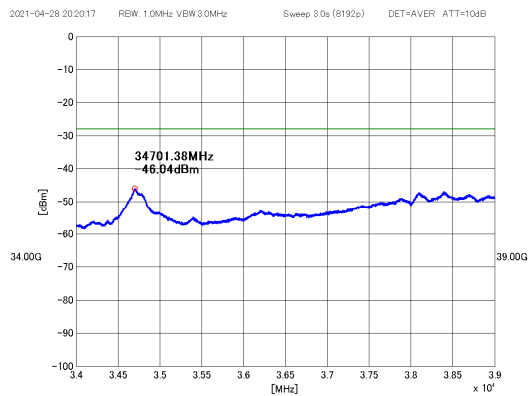
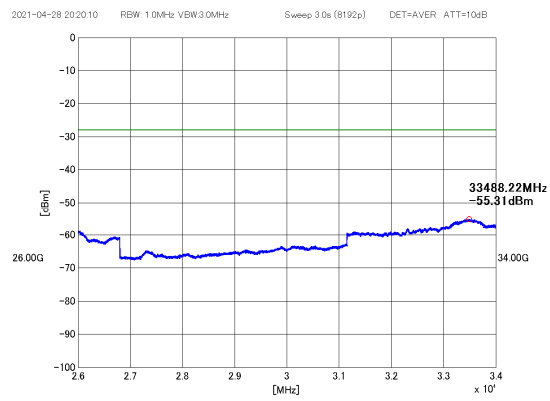
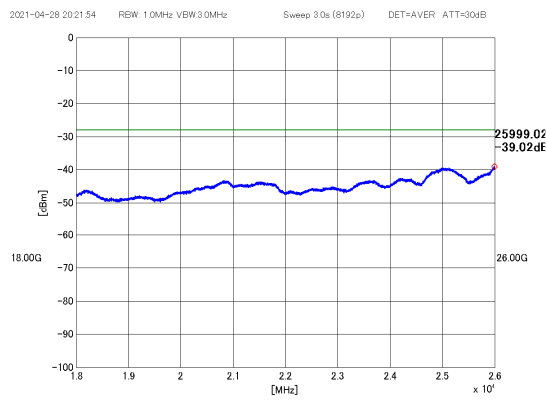
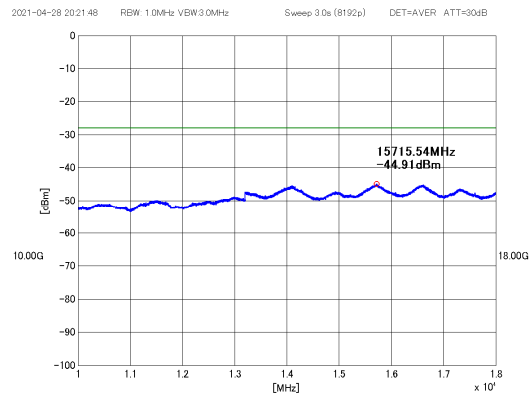
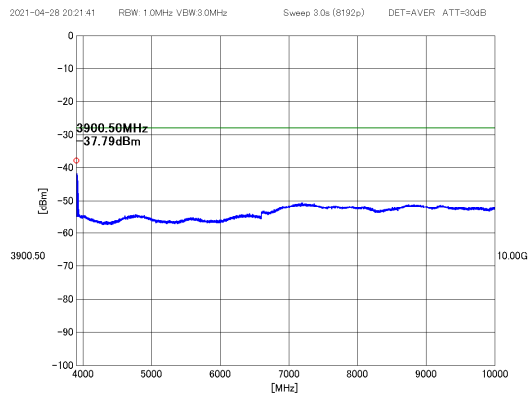


Figure 49: Conducted Spurious Emission, 9kHz - 39GHz, 256QAM_TM3.1a, TX Port 23



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5.1.7 Frequency Stability

RESULT:

PASS

Date of testing: 2021-05-03, 2021-06-01

Ambient temperature: 21, 23°C
Relative humidity: 40, 63%
Atmospheric pressure: 1010, 1014hPa

Requirements:

FCC 27.54

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Test procedure:

ANSI C63.26 §5.6

Note:

The carrier frequency was measured at different temperatures and voltages. The deviation was calculated against rated carrier frequency.

Verdict:

The rated carrier frequency is 3849.99MHz with frequency tolerance of 0.05ppm, i.e. $\pm 192.5\text{Hz}$.

The maximum deviation of carrier frequency is 66.01Hz thus met the limit of frequency tolerance.

Table 13: Deviation of Carrier Frequency from -40°C to 55°C with Nominal Voltage

Voltage [V]	-48						
Time [min]	0.0	0.5	1.0	1.5	2.0	2.5	3.0
Degree [°C]	Deviation of Carrier Frequency [Hz]						
-40.0	4.51	-14.16	35.28	41.87	-38.81	33.64	13.44
-30.0	22.35	-35.08	-0.78	66.01	-23.41	22.19	53.85
-20.0	-17.65	8.06	49.01	32.26	-7.79	21.49	36.17
-10.0	-18.07	13.25	41.01	39.55	-39.02	42.20	6.79
0.0	30.14	-44.64	40.57	22.77	32.91	-5.48	-2.23
10.0	13.92	6.92	54.44	55.60	-23.05	31.78	34.49
20.0	1.40	29.79	20.19	3.48	-49.05	37.56	13.48
25.0	-2.35	4.14	-0.60	12.45	11.29	-1.80	10.98
35.0	63.46	-27.50	14.35	30.83	-7.89	11.04	54.77
45.0	7.15	-14.99	42.40	49.59	-20.00	28.95	29.92
55.0	10.61	-19.97	56.84	39.51	-39.12	26.46	20.74

Note: the bold number shows the maximum deviation.

Table 14: Deviation of Carrier Frequency at 25°C with +15% of Nominal Voltage

Voltage [V]	-55.2						
Time [min]	0.0	0.5	1.0	1.5	2.0	2.5	3.0
Degree [°C]	Deviation of Carrier Frequency [Hz]						
25.0	-4.06	-14.54	27.50	42.97	-21.19	44.57	28.46

Table 15: Deviation of Carrier Frequency at 25°C with -15% of Nominal Voltage

Voltage [V]	-40.8						
Time [min]	0.0	0.5	1.0	1.5	2.0	2.5	3.0
Degree [°C]	Deviation of Carrier Frequency [Hz]						
25.0	15.18	-11.58	44.50	11.39	-43.93	15.78	43.47

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5.1.8 Duty Cycle

RESULT:

PERFORMED

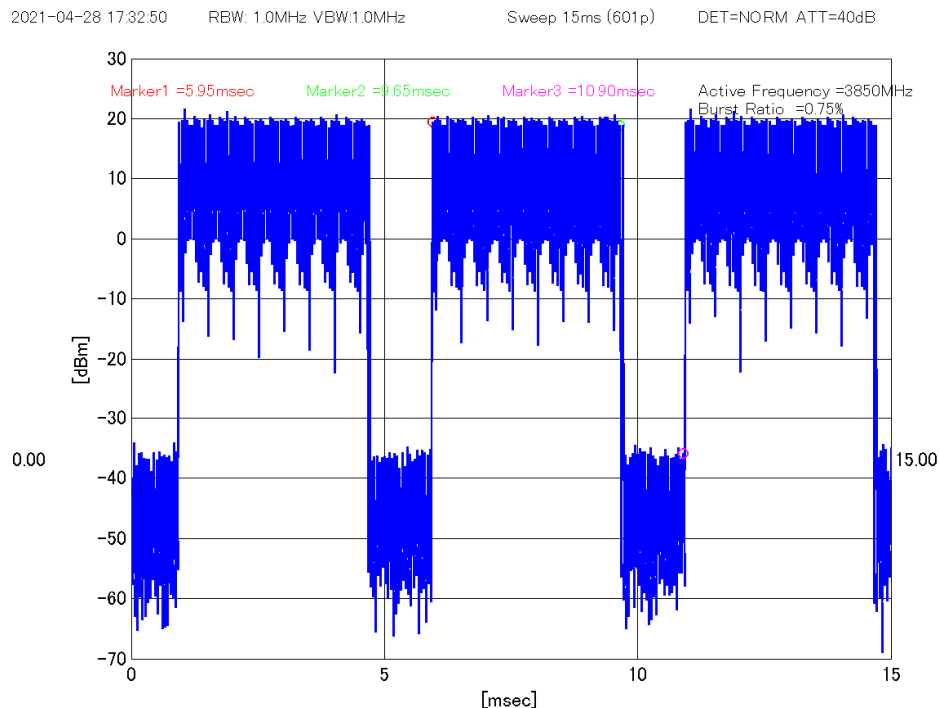
Date of testing: 2021-04-28, 2021-04-29

Ambient temperature: 21, 22°C
Relative humidity: 58, 65%
Atmospheric pressure: 1016, 1005hPa

Table 16: Duty Cycle

	QPSK_TM1.1	16QAM_TM3.2	64QAM_TM3.1	256QAM_TM3.1a
On-Time [ms]	3.70	3.73	3.73	3.74
Period [ms]	4.95	5.01	5.01	5.04
Duty Cycle	74.7%	74.5%	74.5%	74.2%
Duty Cycle Factor [dB]	1.27	1.28	1.28	1.30

Figure 50: Duty Cycle, QPSK_TM1.1



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Figure 51: Duty Cycle, 16QAM_TM3.2

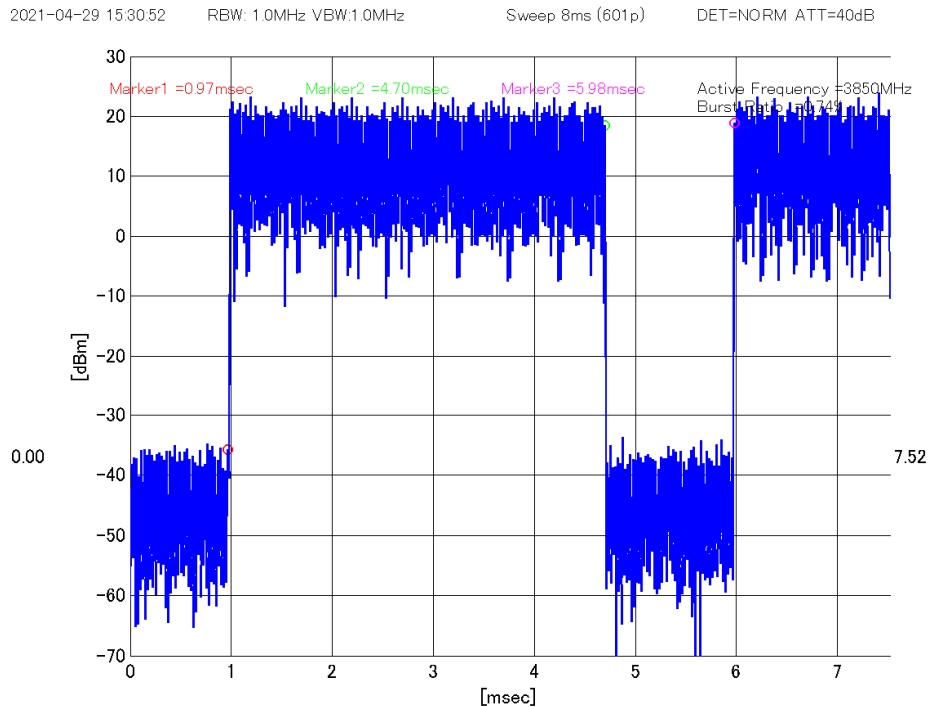


Figure 52: Duty Cycle, 64QAM_TM3.1

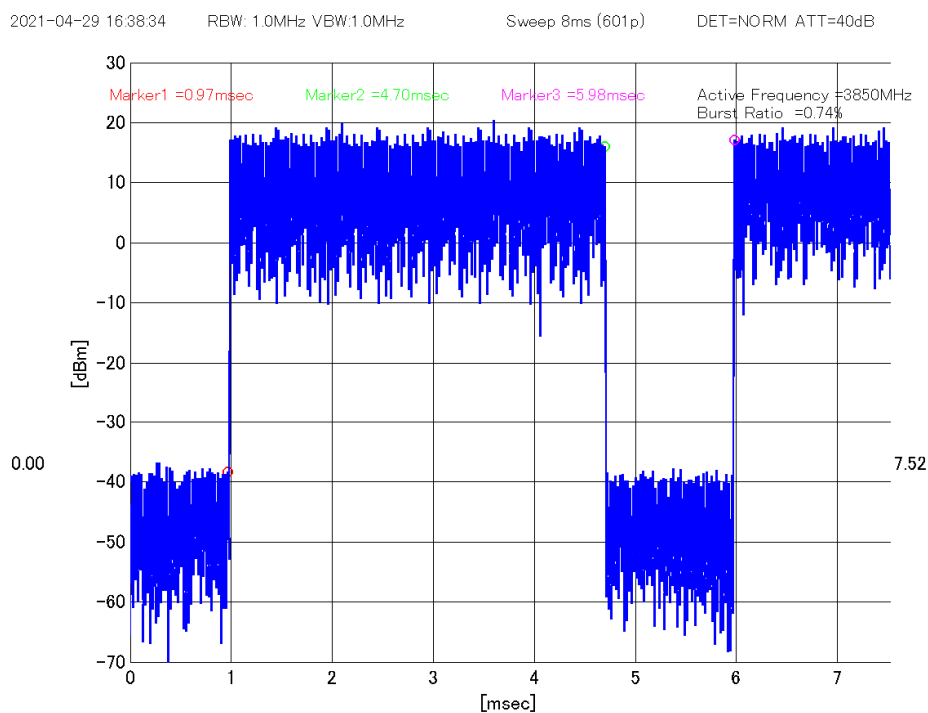
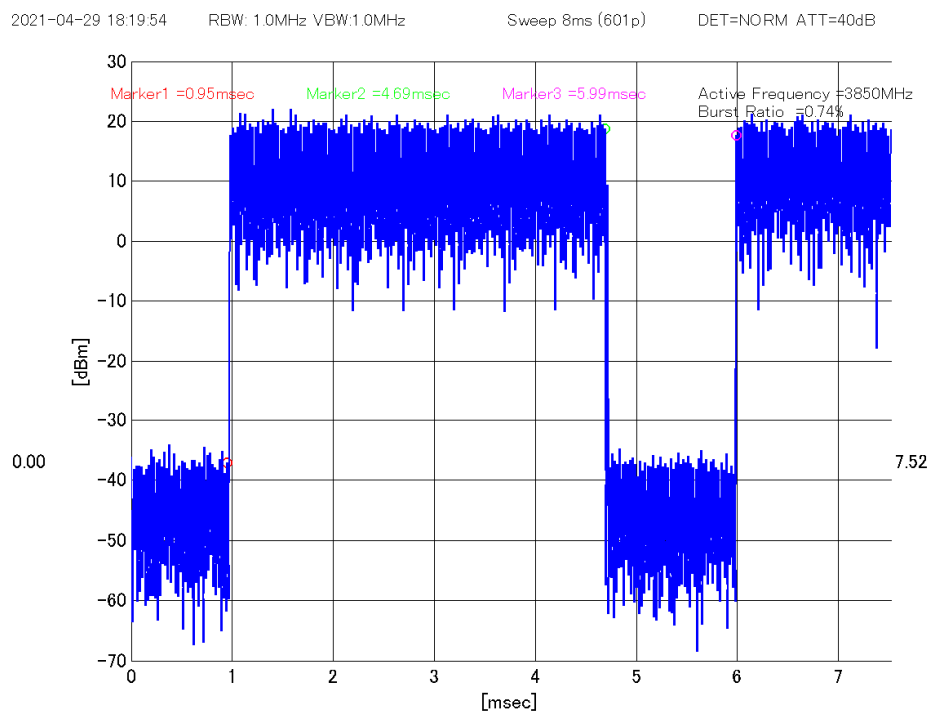


Figure 53: Duty Cycle, 256QAM_TM3.1a



5.2 Radiated Measurements

5.2.1 Radiated Spurious Emissions of Transmitter

RESULT:

PASS

Date of testing: 2021-04-20, 2021-04-21, 2021-04-22

Ambient temperature: 22, 22, 22°C

Relative humidity: 37, 35, 38%

Atmospheric pressure: 1012, 1016, 1016hPa

Frequency range: 9kHz - 39GHz

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Requirements:

FCC 27.53(l)(1)

For base station operations in the 3700-3980 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed -13 dBm/MHz. Compliance with this paragraph (l)(1) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater.

Test procedure:

ANSI C63.26 §5.5.4

Note:

The test was performed in a validated anechoic chamber. Field strength at 3m distance was measured. The field strength limit is calculated from the conducted limit in FCC 27.53(l)(1) according to ANSI C63.26 Annex C as following:

$$\text{Field Strength Limit (V/m)} = \text{SQRT}(\text{EIRP} \times 30) / d = 0.012925 \text{ V/m}$$

$$\text{Field Strength Limit (dBuV/m)} = 82.23 \text{ dBuV/m}$$

Radiated spurious emissions with margin less than 20dB are reported below.

Table 17: Radiated Spurious Emissions, 9kHz - 39GHz, Horizontal and Vertical Antenna Orientations, QPSK_TM1.1

Freq. [MHz]	Antenna Orientation	Reading [dBμV]	Factor [dB(1/m)]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]
15399.940	V	54.4	14.7	69.1	82.2	13.1	100	330
15399.970	H	54.6	14.7	69.3	82.2	12.9	175	339
30799.828	H	82.9	-20.2	62.7	82.2	19.5	155	322

Note: Level = Reading + Factor

Table 18: Radiated Spurious Emissions, 9kHz - 39GHz, Horizontal and Vertical Antenna Orientations, 16QAM_TM3.2

Freq. [MHz]	Antenna Orientation	Reading [dBμV]	Factor [dB(1/m)]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]
15399.950	H	58.5	14.7	73.2	82.2	9.0	169	306
15399.990	V	57.0	14.7	71.7	82.2	10.5	164	353

Note: Level = Reading + Factor

Table 19: Radiated Spurious Emissions, 9kHz - 39GHz, Horizontal and Vertical Antenna Orientations, 64QAM_TM3.1

Freq. [MHz]	Antenna Orientation	Reading [dBμV]	Factor [dB(1/m)]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]
15399.980	V	58.9	14.7	73.6	82.2	8.6	188	317
15399.990	H	60.0	14.7	74.7	82.2	7.5	186	339
19660.770	V	74.2	-11.3	62.9	82.2	19.3	198	0
30799.990	H	82.9	-20.2	62.7	82.2	19.5	148	287

Note: Level = Reading + Factor

Table 20: Radiated Spurious Emissions, 9kHz - 39GHz, Horizontal and Vertical Antenna Orientations, 256QAM_TM3.1a

Freq. [MHz]	Antenna Orientation	Reading [dBμV]	Factor [dB(1/m)]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]
15399.970	V	58.3	14.7	73.0	82.2	9.2	192	304
15399.950	H	55.7	14.7	70.4	82.2	11.8	201	10

Note: Level = Reading + Factor

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