

TEST REPORT

of

FCC Part 15 Subpart C §15.247
IC RSS-247 Issue 2 and RSS-Gen Issue 5

FCC ID: 2ABFG-IESD301W
IC Certification: 11626A-IESD301W

Equipment Under Test : Access Controller
Model Name : IES-D301W
Variant Model Name(s) : Refer to the page 3
Applicant : iRevo-ASSA ABLOY Korea
Manufacturer : iRevo-ASSA ABLOY Korea
Date of Receipt : 2021.01.06
Date of Test(s) : 2021.02.10 ~ 2021.03.10
Date of Issue : 2021.05.11

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

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- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
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Report Number: F690501-RF-RTL002085

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

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- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

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1.2. Details of Applicant

Applicant : iRevo-ASSA ABLOY Korea

Address : 205-29, Gasan Digital 1-ro, Geumcheon-gu, Seoul, Korea, 08052

Contact Person : Jang, Soo-kyung

Phone No. : +82 2 2107 5741

1.3. Details of Manufacturer

Company : Same as applicant

Address : Same as applicant

1.4. Description of EUT

Kind of Product	Access Controller
Model Name	IES-D301W
Variant Model	BCT/A1
Serial Number	Conducted: 001,002 Radiated: 003,004
Power Supply	DC 12 V ~ 24 V
Frequency Range	2 402 MHz ~ 2 480 MHz (Bluetooth Low Energy)
Modulation Technique	GFSK
Number of Channels	40 channels (Bluetooth Low Energy)
Antenna Type	Chip Antenna
Antenna Gain	0.66 dBi
H/W Version	1.0
S/W Version	1.0

1.5. Introduction of Test Data Reuse

This report referenced from the FCC ID: 2ABFG-IESD300W and IC Certification: 11626A-IESD300W. The applicant takes full responsibility that the test data as referenced in this report represent compliance for this FCC ID and IC Certification.

1.6. Difference

The FCC ID: 2ABFG-IESD301W and IC Certification: 11626A-IESD301W shares the same enclosure and circuit board as FCC ID: 2ABFG-IESD300W and IC Certification: 11626A-IESD300W. The BT antennas and surrounding circuitry and layout are identical between these two units.

After confirming through preliminary radiated emissions and conducted power that the performance of the FCC ID: 2ABFG-IESD300W and IC Certification: 11626A-IESD300W remains representative of FCC ID: 2ABFG-IESD301W and IC Certification: 11626A-IESD301W.

The test data of FCC ID: 2ABFG-IESD300W and IC Certification: 11626A-IESD300W being submitted for this application to cover LE features.

1.7. Spot Check Data

Mode	Test item	Frequency (MHz)	Limit	Original model	Spot check model	Deviation (dB)	Remark	
				IES-D300W	IES-D301W			
				FCC ID: 2ABFG-IESD300W IC Certification: 11626A-IESD300W	FCC ID: 2ABFG-IESD301W IC Certification: 11626A-IESD301W			
LE	PHY 1M	Conducted power	2 402	30 dB m	7.42 dB m	7.69 dB m	0.27	-
		Band edge	2 480	54 dB μ V/m	49.09 dB μ V/m	49.48 dB μ V/m	0.39	-
		Spurious	2 402	74 dB μ V/m	55.69 dB μ V/m	52.08 dB μ V/m	-3.61	-
	PHY 2M	Conducted power	2 402	30 dB m	7.41 dB m	7.67 dB m	0.26	-
		Band edge	2 480	54 dB μ V/m	50.64 dB μ V/m	51.56 dB μ V/m	0.81	-
		Spurious	2 440	54 dB μ V/m	47.64 dB μ V/m	47.54 dB μ V/m	-0.10	-

1.8. Reference Detail

Reference applicant that contains the reused reference data in the individual test report:

Mode	Reference FCC ID / IC Certification	Application type	Reference test report number	Exhibit type	Variant test report number	Data reuse
LE	FCC ID: 2ABFG-IESD300W IC Certification 11626A-IESD300W	Original grant	F690501-RF-RTL002082 (LE)	Test Report	F690501-RF-RTL002085 (LE)	All

1.9. Manufacturer Declaration

The Bluetooth version of the EUT is 5.0, the PHY 1M and 2M are supported.

1.10. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMR40	100272	Jun. 18, 2020	Annual	Jun. 18, 2021
Signal Generator	R&S	SMBV100A	255834	Jun. 03, 2020	Annual	Jun. 03, 2021
Spectrum Analyzer	R&S	FSV30	103210	Dec. 07, 2020	Annual	Dec. 07, 2021
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 04, 2020	Annual	Sep. 04, 2021
Attenuator	AEROFLEX / INMET	FAS-12-10	1	Jun. 01, 2020	Annual	Jun. 01, 2021
High Pass Filter	Wainwright Instrument GmbH	WHK3.0/18G-10SS	344	May 18, 2020	Annual	May 18, 2021
High Pass Filter	Wainwright Instrument GmbH	WHNX7.5/26.5G-6SS	15	Jun. 05, 2020	Annual	Jun. 05, 2021
Low Pass Filter	Mini-Circuits	NLP-1200+	V9500401023-2	Jun. 01, 2020	Annual	Jun. 01, 2021
Power Sensor	R&S	NRP-Z81	101421	Dec. 23, 2020	Annual	Dec. 23, 2021
DC Power Supply	Agilent	U8002A	MY54110041	Sep. 17, 2020	Annual	Sep. 17, 2021
Preamplifier	H.P.	8447F	2944A03909	Aug. 06, 2020	Annual	Aug. 06, 2021
Signal Conditioning Unit	R&S	SCU-18	10117	Jun. 10, 2020	Annual	Jun. 10, 2021
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	May 08, 2020	Annual	May 08, 2021
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 22, 2019	Biennial	Aug. 22, 2021
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	396	Mar. 21, 2019	Biennial	Mar. 21, 2021
Horn Antenna	R&S	HF906	100326	Feb. 04, 2021	Annual	Feb. 04, 2022
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA 9170	9170-540	Nov. 26, 2020	Annual	Nov. 26, 2021
Test Receiver	R&S	ESU26	100368	Nov. 05, 2020	Annual	Nov. 05, 2021
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/38330516/L	N.C.R.	N/A	N.C.R.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/38330516/L	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L x W x H (9.6 m x 6.4 m x 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	RFONE	MWX221-NMSNMS (4 m)	J1023142	Dec. 01, 2020	Semi-Annual	Jun. 01, 2021
Coaxial Cable	RFONE	PL520-NMNM-10M (10 m)	20200324001	Dec. 01, 2020	Semi-Annual	Jun. 01, 2021
Coaxial Cable	Rosenberger	LA1-C006-1500	131014 10/20	Feb. 19, 2021	Semi-annual	Aug. 19, 2021

1.11. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part15 Subpart C, IC RSS-247 Issue 2 and RSS-Gen Issue 5			
Section in FCC	Section in IC	Test Item(s)	Result
15.205(a) 15.209 15.247(d)	RSS-247 Issue 2 5.5 RSS-Gen Issue 5 8.9	Transmitter Radiated Spurious Emissions and Conducted Spurious Emission	Complied
15.247(a)(2)	RSS-247 Issue 2 5.2(a) RSS-Gen Issue 5 6.7	6 dB Bandwidth & 99 % Bandwidth	Complied
15.247(b)(3)	RSS-247 Issue 2 5.4(d)	Maximum Peak Conducted Output Power	Complied
15.247(e)	RSS-247 Issue 2 5.2(b)	Power Spectral Density	Complied
15.207	RSS-Gen Issue 5 8.8	AC Power Line Conducted Emission	N/A ¹⁾

Note;

- 1) The AC power line test was not performed because the EUT uses DC power line for operation.
- 2) All tests were performed with two voltages referring to ANSI C63.10-2013 clause 5.13 c)
 $12 \times (100-15) \% = 10.2 \text{ V}$, $24 \times (100+15) \% = 27.6 \text{ V}$.

1.12. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL002085	2021.05.11	Initial

1.13. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedure for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 15.247 Meas Guidance v05r02 were used in the measurement of the DUT.

1.14. Sample Calculation

Where relevant, the following sample calculation is provided:

1.14.1. Conducted Test

$$\text{Offset value (dB)} = \text{Attenuator (dB)} + \text{Cable loss (dB)}$$

1.14.2. Radiation Test

$$\text{Field strength level (dB}_{\mu\text{V/m}}) = \text{Measured level (dB}_{\mu\text{V}}) + \text{Antenna factor (dB)} + \text{Cable loss (dB)} - \text{Amplifier gain (dB)} + \text{Duty factor (dB)}$$

1.15. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty	
RF Output Power	± 0.44 dB	
Conducted Spurious Emission	± 0.71 dB	
Occupied Bandwidth	± 38.80 kHz	
Power Spectral Density	± 0.60 dB	
Radiated Emission, 9 kHz to 30 MHz	H	± 3.66 dB
	V	± 3.66 dB
Radiated Emission, below 1 GHz	H	± 4.90 dB
	V	± 4.82 dB
Radiated Emission, above 1 GHz	H	± 3.62 dB
	V	± 3.64 dB

Uncertainty figures are valid to a confidence level of 95 %.

1.16. Information of Software for test

Using the software of nRF DTM (Version 0.10.2) to testing of EUT.

1.17. Information of Variant Model

Model Name	Description
IES-D301W	- Basic Model
BCT/A1	- Same as basic model, but the difference in marketing purposes

1.18. Conclusion of worst-case (Bluetooth 5.0)

Mode	Voltage	Mode	Frequency (MHz)	Packet length (Byte)	RF Output Power (dBm)
GFSK	DC 10.2 V	PHY 1M	2 402	37	7.40
				255	<u>7.40</u>
		PHY 2M		37	7.39
				255	<u>7.40</u>
	DC 27.6 V	PHY 1M		37	7.41
				255	<u>7.42</u>
		PHY 2M		37	7.40
				255	<u>7.41</u>

Remark;

According to ANSI C63.10-2013 Clause 5.13 c),
 the test voltages are $12 \times (100-15) \% = 10.2 \text{ V}$, $24 \times (100+15) \% = 27.6 \text{ V}$.
 All modes were investigated.
 For PHY 1M and PHY 2M, 255 bytes is tested as worst condition.

1.19. Duty Cycle of EUT

Regarding to KDB 558074 D01 15.247 Meas Guidance v05r02, 6, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below;
 Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

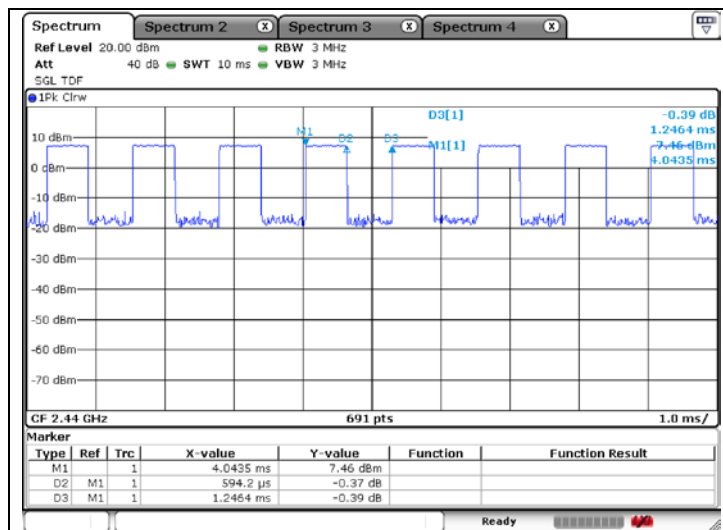
Test Mode	PHY 1M	PHY 2M
Duty Cycle (%)	47.67	50.00
Correction Factor (dB)	3.22	3.01

Remark;

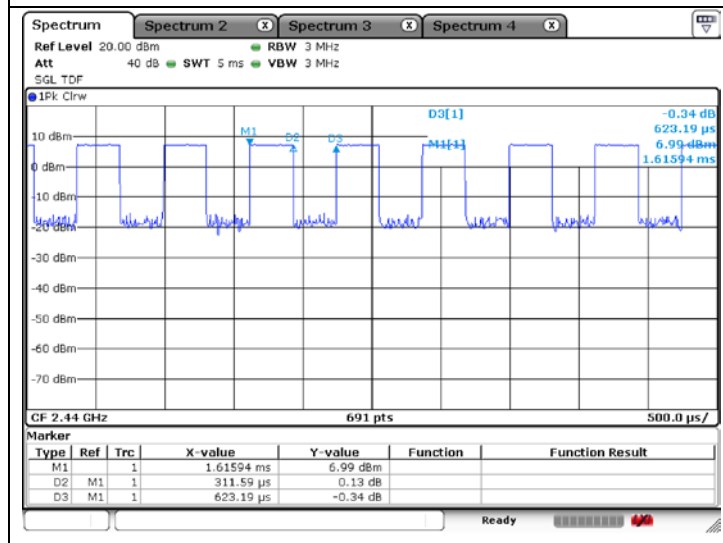
- Duty Cycle (%) = (Tx on time / Tx on + off time) x 100
- Correction Factor (dB) = 10 log (1 / Duty Cycle)

- Test plots

PHY 1M



PHY 2M

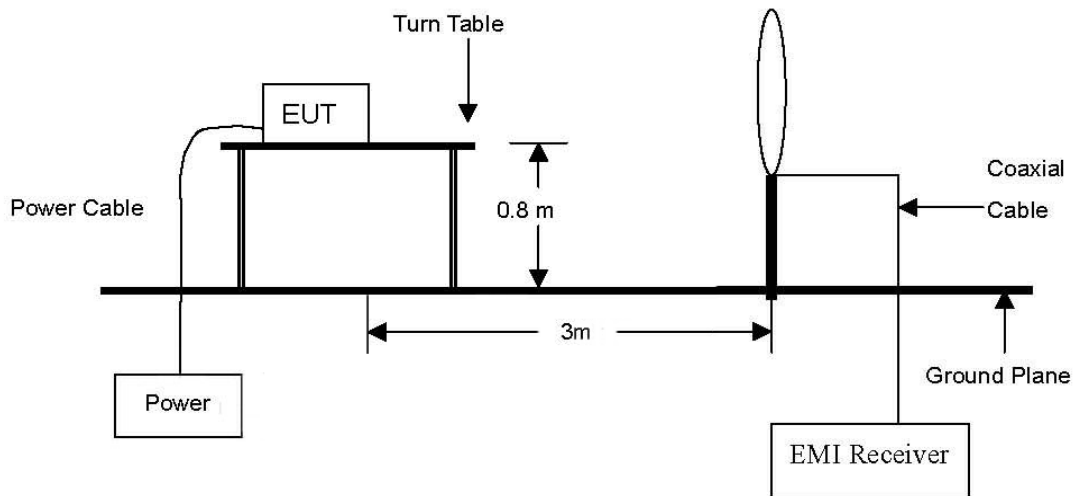


2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emissions

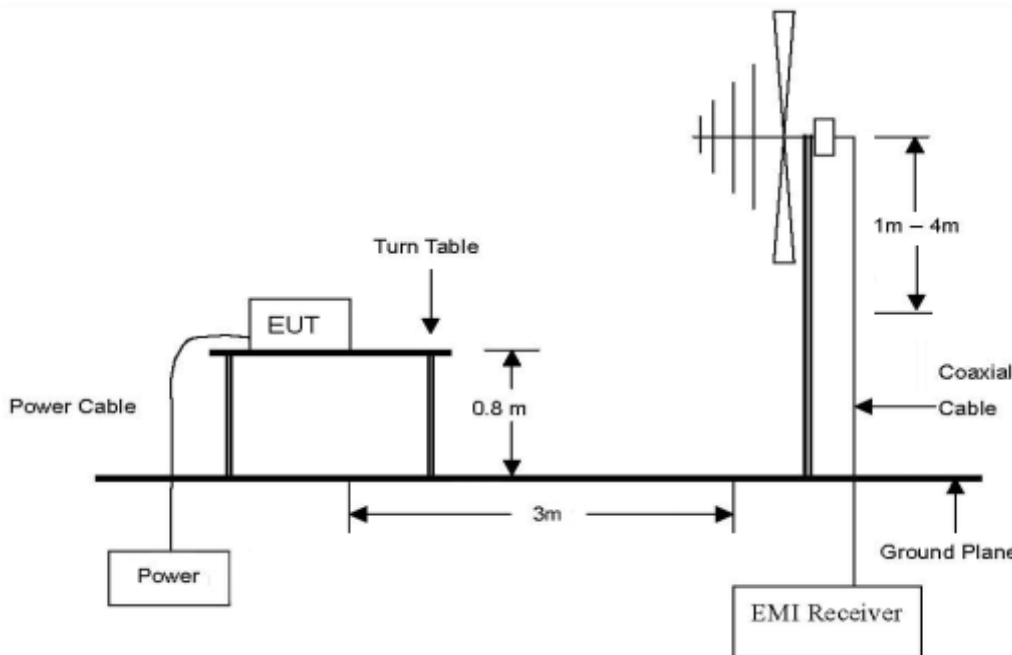
2.1. Test Setup

2.1.1. Transmitter Radiated Spurious Emissions

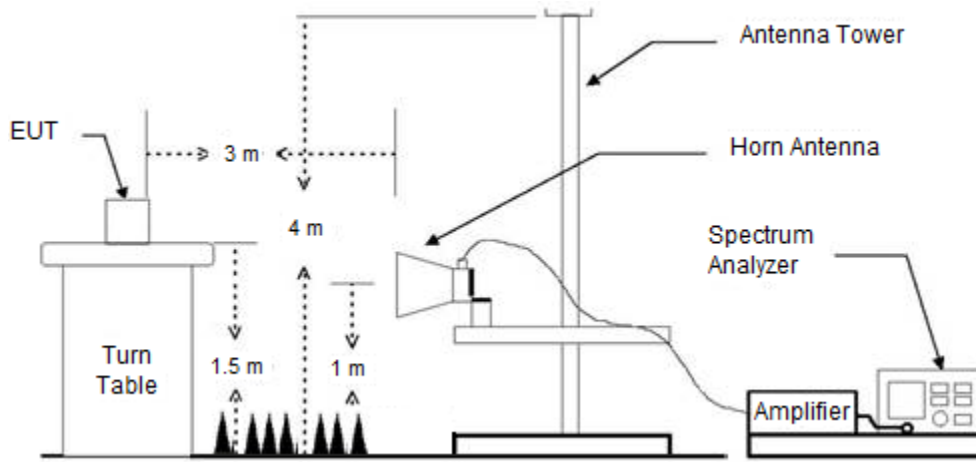
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 MHz to 30 MHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 GHz to the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.



2.1.2. Conducted Spurious Emissions



2.2. Limit

2.2.1. FCC

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emission which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (Meters)
0.009-0.490	2 400/F(kHz)	300
0.490-1.705	24 000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

2.2.2. IC

According to RSS-247 Issue 2, 5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

According to RSS-Gen Issue 5, 8.9, except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter’s fundamental emission.

Table 5 – General Field Strength Limits at frequencies above 30 MHz

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$ at 3 m)
30-88	100
88-216	150
216-960	200
Above 960	500

Table 6 – General Field Strength Limits at frequencies below 30 MHz

Frequency	Magnetic Field Strength (H-Field) ($\mu\text{A}/\text{m}$)	Measurement Distance (meters)
9-490 kHz ¹	6.37/F (F in kHz)	300
490-1 705 kHz	63.7/F (F in kHz)	30
1.705-30 MHz	0.08	30

Note¹: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates in section 11.11 & 11.12 of ANSI C63.10-2013 and only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

2.3.1. Test Procedures for emission below 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from above 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 GHz and 1.5 meters above the ground at a 3 meter anechoic chamber test site above 1 GHz. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note;

All modes and channels were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

1. Unwanted Emissions into Non-Restricted Frequency Bands

- The Reference Level Measurement refer to section 11.11.2

Set analyzer center frequency to DTS channel center frequency, SPAN ≥ 1.5 times the DTS bandwidth, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold.

- Unwanted Emissions Level Measurement refer to section 11.11.3

Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold.

2. Unwanted Emissions into Restricted Frequency Bands

- Peak Power measurement procedure refer to section 11.12.2.4

Set RBW = as specified in Table 9, VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = auto, Trace = Max hold.

Table 9 – RBW as a function of frequency

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1 000 MHz	100 kHz to 120 kHz
> 1 000 MHz	1 MHz

If the peak – detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

- Average Power measurements procedure refer to section 11.12.2.5.2

The EUT shall be configured to operate at the maximum achievable duty cycle.

Measure the duty cycle D of the transmitter output signal as described in section 11.6.

Set RBW = 1 MHz, VBW $\geq 3 \times$ RBW, Detector = RMS, if span / (# of points in sweep) $\leq (RBW/2)$.

Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied then the detector mode shall be set to peak.

Averaging type = power (i.e., RMS).

As an alternative the detector and averaging type may be set for linear voltage averaging.

Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used. Sweep time = auto, Perform a trace average of at least 100 traces.

A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

- 1) If power averaging (rms) mode was used in step f), then the applicable correction factor is $[10 \log (1 / D)]$, where D is the duty cycle.

3. Definition of DUT Axis.

Definition of the test orthogonal plan for EUT was described in the test setup photo.

The test orthogonal plan of EUT is **Y – axis** during radiation test.

2.3.3. Test Procedures for Conducted Spurious Emissions

Per the guidance of ANSI C63.10-2013, section 11.11.1 & 11.11.2 & 11.11.3, the reference level for out of band emissions is established from the plots of this section since the band edge emissions are measured with a RBW of 100 kHz. This reference level is then used as the limit in subsequent plots for out of band spurious emissions shown in section 2.4.3. The limit for out of band spurious emission at the band edge is 20 dB below the fundamental emission level measured in a 100 kHz bandwidth.

1. Conducted Emissions at Band Edge

- The Measurement refer to section 11.11.3

Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = Auto couple, Trace mode = Max hold, The trace was allowed to stabilize.

2. Conducted Spurious Emissions

- The Measurement refer to section 11.11.3

Start frequency was set to 9 kHz and stop frequency was set to 25 GHz (separated into two plots per channel), RBW = 1 MHz, VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold, The trace was allowed to stabilize.

3. TDF function

- For plots showing conducted spurious emissions from 9 kHz to 25 GHz, all path loss of wide frequency range was investigated and compensated to spectrum analyzer as TDF function. So, the reading values shown in plots were final result.

2.4. Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

2.4.1. Radiated Spurious Emission below 1 000 MHz

The frequency spectrum from 9 kHz to 1 000 MHz was investigated. All reading values are peak values.

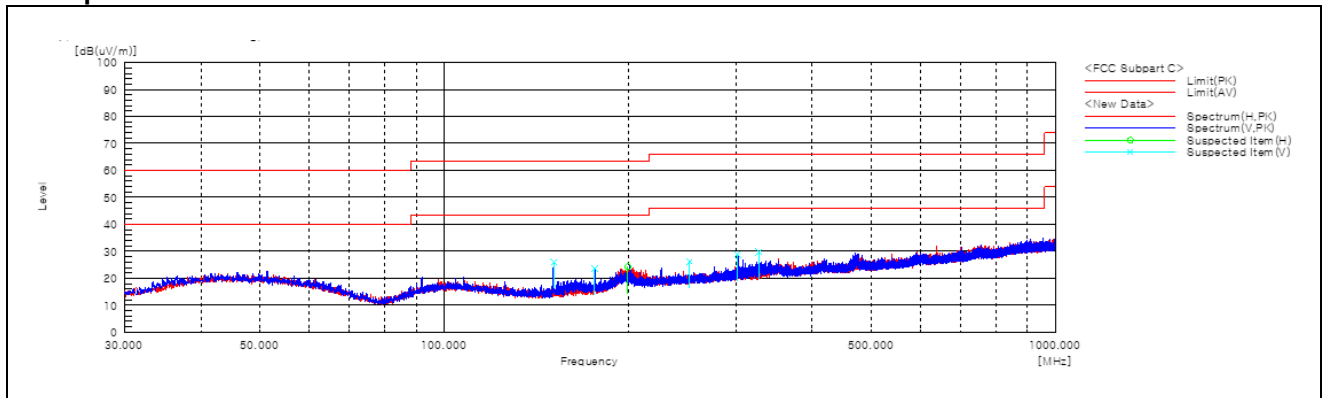
- Test voltage: DC 10.2 V

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
151.05	38.30	Peak	V	13.91	-26.18	26.03	43.50	17.47
176.19	34.60	Peak	V	14.92	-25.91	23.61	43.50	19.89
199.75	33.00	Peak	H	17.03	-25.70	24.33	43.50	19.17
251.73	33.20	Peak	V	18.27	-25.38	26.09	46.00	19.91
301.92	34.80	Peak	V	19.20	-25.03	28.97	46.00	17.03
327.06	34.90	Peak	V	19.82	-25.11	29.61	46.00	16.39
Above 400.00	Not detected	-	-	-	-	-	-	-

Remark;

- Spurious emissions for all channels were investigated and almost the same below 1 GHz.
- Reported spurious emissions are in **PHY 1M / 255 bytes / Low channel** as worst case among other channels.
- Radiated spurious emission measurement as below.
(Actual = Reading + AF + AMP + CL)
- According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.

- Test plot



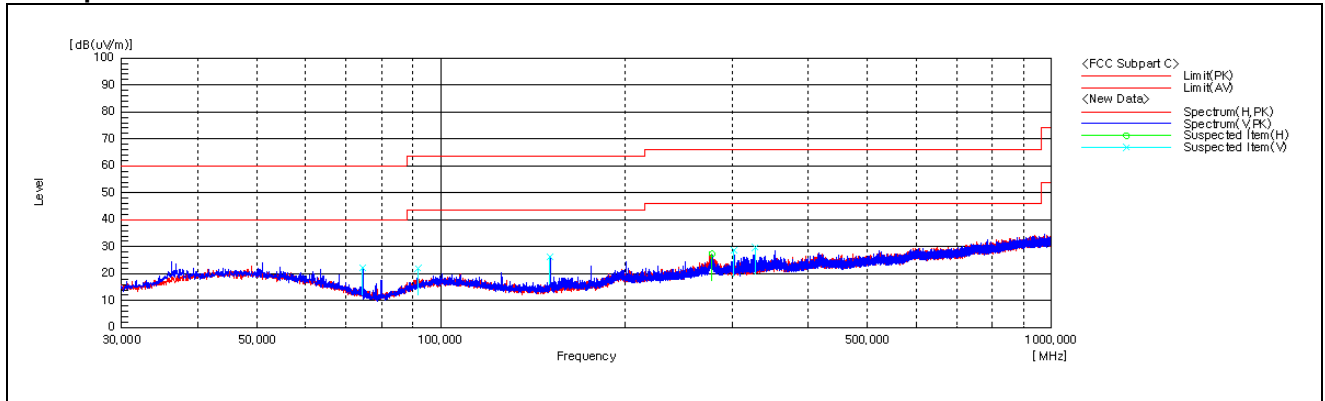
- Test voltage: DC 27.6 V

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
74.58	36.40	Peak	V	12.67	-26.96	22.11	40.00	17.89
151.01	38.50	Peak	V	13.90	-26.18	26.22	43.50	17.28
278.04	33.70	Peak	H	18.76	-25.17	27.29	46.00	18.71
302.13	34.70	Peak	V	19.20	-25.03	28.87	46.00	17.13
327.02	35.00	Peak	V	19.82	-25.11	29.71	46.00	16.29
Above 400.00	Not detected	-	-	-	-	-	-	-

Remark;

1. Spurious emissions for all channels were investigated and almost the same below 1 GHz.
2. Reported spurious emissions are in **PHY 1M / 255 bytes / Low channel** as worst case among other channels.
3. Radiated spurious emission measurement as below.
(Actual = Reading + AF + AMP + CL)
4. According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.

- Test plot



2.4.2. Radiated Spurious Emission above 1 000 MHz

The frequency spectrum above 1 000 MHz was investigated. All reading values are peak and average values.

- Test voltage: DC 10.2 V

PHY 1M (255 bytes)

Low Channel (2 402 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 310.00	19.58	Peak	V	28.00	6.06	-	53.64	74.00	20.36
*2 310.00	9.96	Average	V	28.00	6.06	3.22	47.24	54.00	6.76
*2 380.54	21.89	Peak	V	28.12	6.18	-	56.19	74.00	17.81
*2 365.42	11.01	Average	V	28.06	6.20	3.22	48.49	54.00	5.51
*2 390.00	19.38	Peak	V	28.16	6.14	-	53.68	74.00	20.32
*2 390.00	9.90	Average	V	28.16	6.14	3.22	47.42	54.00	6.58

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
7 206.92	53.43	Peak	H	35.91	-33.65	-	55.69	74.00	18.31
Above 7 300.00	Not detected	-	-	-	-	-	-	-	-

Middle Channel (2 440 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

High Channel (2 480 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 483.50	22.16	Peak	V	28.33	6.21	-	56.70	74.00	17.30
*2 483.50	10.54	Average	V	28.33	6.21	3.22	48.30	54.00	5.70
*2 483.64	21.67	Peak	V	28.33	6.21	-	56.21	74.00	17.79
*2 483.97	11.33	Average	V	28.33	6.21	3.22	49.09	54.00	4.91
*2 500.00	20.61	Peak	V	28.30	6.27	-	55.18	74.00	18.82
*2 500.00	10.43	Average	V	28.30	6.27	3.22	48.22	54.00	5.78

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

PHY 2M (255 bytes)

Low Channel (2 402 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 310.00	21.04	Peak	V	28.00	6.06	-	55.10	74.00	18.90
*2 310.00	9.59	Average	V	28.00	6.06	3.01	46.66	54.00	7.34
*2 386.10	22.81	Peak	V	28.14	6.16	-	57.11	74.00	16.89
*2 359.85	11.09	Average	V	28.04	6.19	3.01	48.33	54.00	5.67
*2 390.00	20.07	Peak	V	28.16	6.14	-	54.37	74.00	19.63
*2 390.00	10.36	Average	V	28.16	6.14	3.01	47.67	54.00	6.33

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

Middle Channel (2 440 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

High Channel (2 480 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 483.50	23.19	Peak	V	28.33	6.21	-	57.73	74.00	16.27
*2 483.50	13.09	Average	V	28.33	6.21	3.01	50.64	54.00	3.36
*2 483.64	23.72	Peak	V	28.33	6.21	-	58.26	74.00	15.74
*2 483.61	12.72	Average	V	28.33	6.21	3.01	50.27	54.00	3.73
*2 500.00	19.71	Peak	V	28.30	6.27	-	54.28	74.00	19.72
*2 500.00	10.58	Average	V	28.30	6.27	3.01	48.16	54.00	5.84

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

- Test voltage: 27.6 V

PHY 1M (255 bytes)

Low Channel (2 402 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 310.00	19.50	Peak	V	28.00	6.06	-	53.56	74.00	20.44
*2 310.00	9.85	Average	V	28.00	6.06	3.22	47.13	54.00	6.87
*2 337.70	22.48	Peak	V	28.00	6.12	-	56.60	74.00	17.40
*2 337.80	11.43	Average	V	28.00	6.12	3.22	48.77	54.00	5.23
*2 390.00	21.43	Peak	V	28.16	6.14	-	55.73	74.00	18.27
*2 390.00	10.31	Average	V	28.16	6.14	3.22	47.83	54.00	6.17

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
7 206.70	53.37	Peak	H	35.91	-33.65	-	55.63	74.00	18.37
Above 7 300.00	Not detected	-	-	-	-	-	-	-	-

Middle Channel (2 440 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

High Channel (2 480 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 483.50	23.48	Peak	V	28.33	6.21	-	58.02	74.00	15.98
*2 483.50	10.96	Average	V	28.33	6.21	3.22	48.72	54.00	5.28
*2 483.55	23.68	Peak	V	28.33	6.21	-	58.22	74.00	15.78
*2 483.52	11.28	Average	V	28.33	6.21	3.22	49.04	54.00	4.96
*2 500.00	20.40	Peak	V	28.30	6.27	-	54.97	74.00	19.03
*2 500.00	9.89	Average	V	28.30	6.27	3.22	47.68	54.00	6.32

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

PHY 2M (255 bytes)

Low Channel (2 402 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 310.00	20.42	Peak	V	28.00	6.06	-	54.48	74.00	19.52
*2 310.00	9.62	Average	V	28.00	6.06	3.01	46.69	54.00	7.31
*2 382.22	22.99	Peak	V	28.13	6.17	-	57.29	74.00	16.71
*2 359.22	10.86	Average	V	28.04	6.19	3.01	48.10	54.00	5.90
*2 390.00	20.92	Peak	V	28.16	6.14	-	55.22	74.00	18.78
*2 390.00	10.15	Average	V	28.16	6.14	3.01	47.46	54.00	6.54

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

Middle Channel (2 440 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

High Channel (2 480 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 483.50	24.56	Peak	V	28.33	6.21	-	59.10	74.00	14.90
*2 483.50	11.90	Average	V	28.33	6.21	3.01	49.45	54.00	4.55
*2 484.12	23.85	Peak	V	28.33	6.21	-	58.39	74.00	15.61
*2 483.88	11.99	Average	V	28.33	6.21	3.01	49.54	54.00	4.46
*2 500.00	21.35	Peak	V	28.30	6.27	-	55.92	74.00	18.08
*2 500.00	10.24	Average	V	28.30	6.27	3.01	47.82	54.00	6.18

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

Remarks;

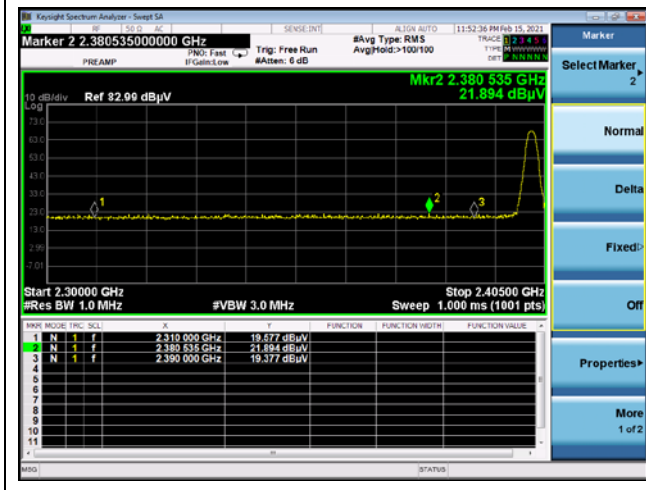
1. "*" means the restricted band.
2. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + CL + (DF) or Reading + AF + AMP + CL + (DF).
5. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 dB.
6. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.
7. AF = Antenna Factor, CL = Cable Loss, DF = Duty Correction Factor.

- Test plots

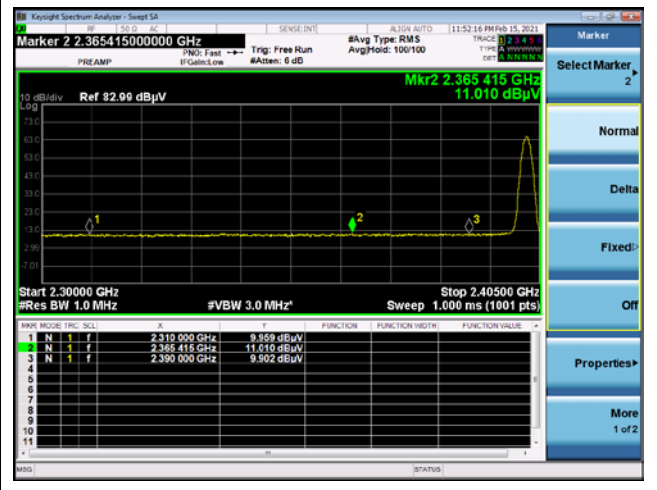
Test voltage: DC 10.2 V

PHY 1M (255 bytes)

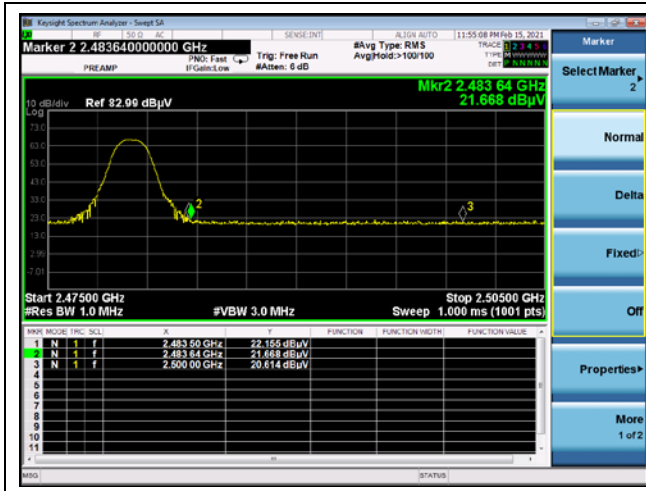
Low channel band edge (Peak)



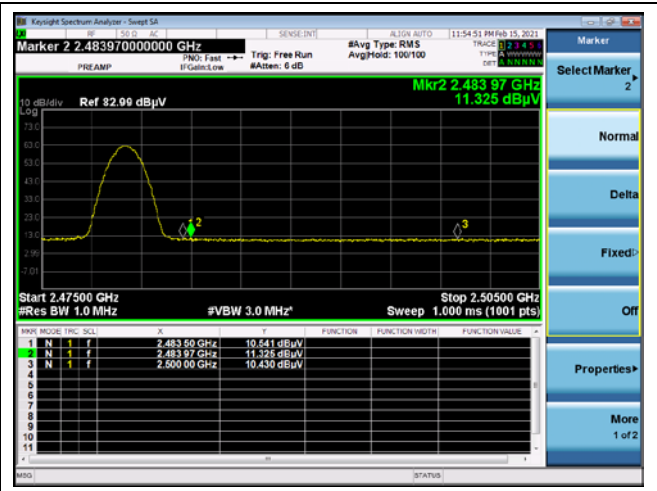
Low channel band edge (Average)



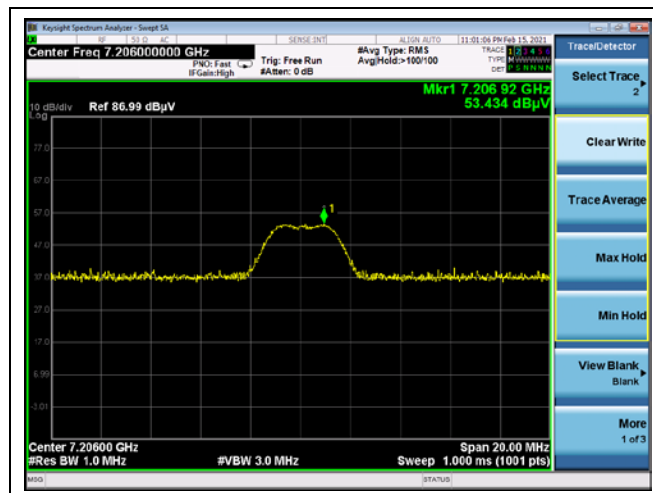
High channel band edge (Peak)



High channel band edge (Average)

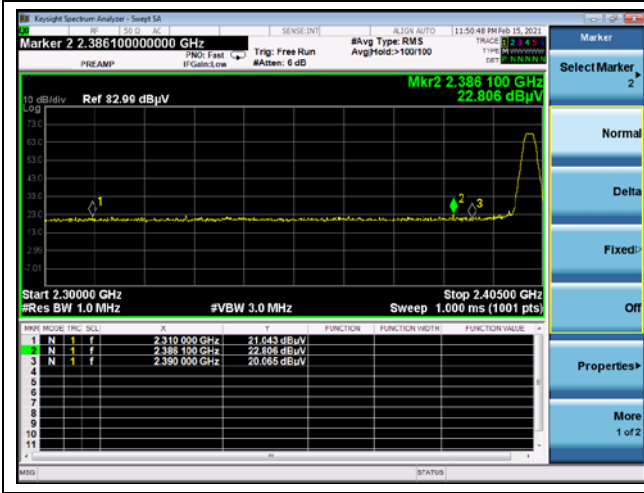


Low channel 3rd harmonic (Peak)

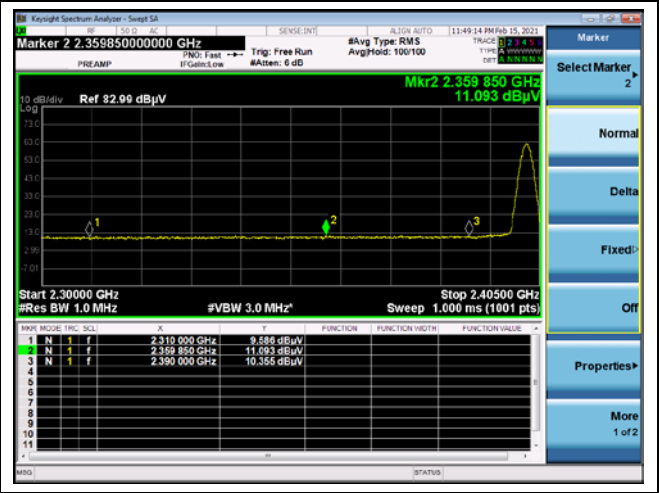


PHY 2M (255 bytes)

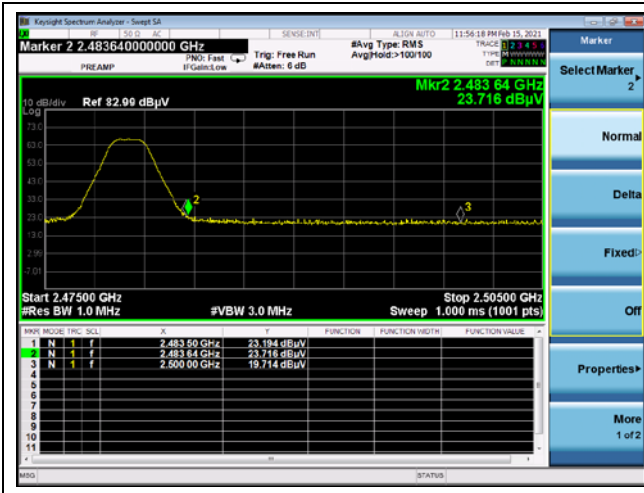
Low channel band edge (Peak)



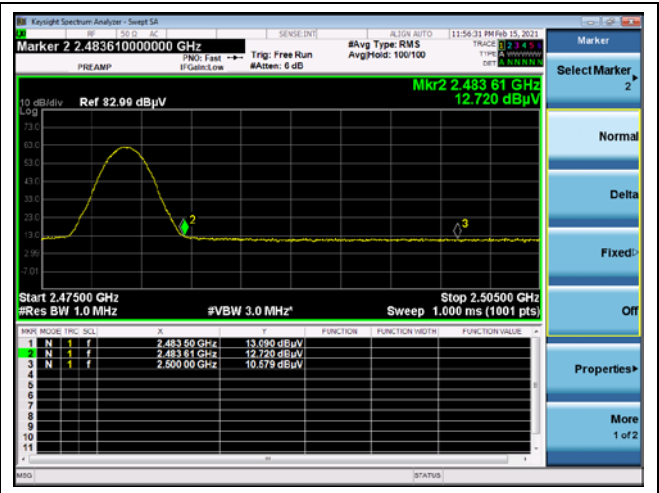
Low channel band edge (Average)



High channel band edge (Peak)



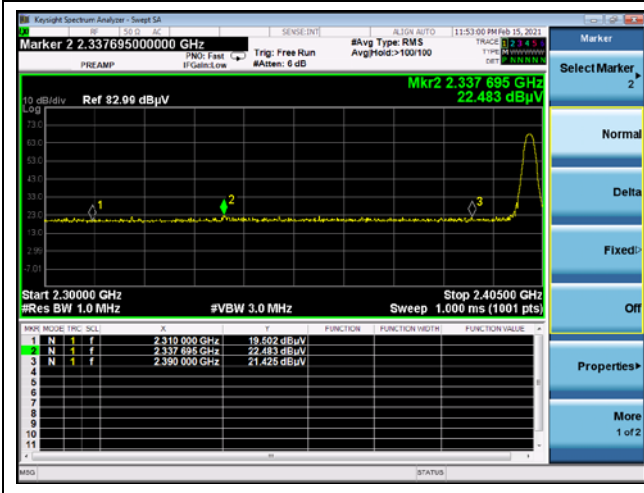
High channel band edge (Average)



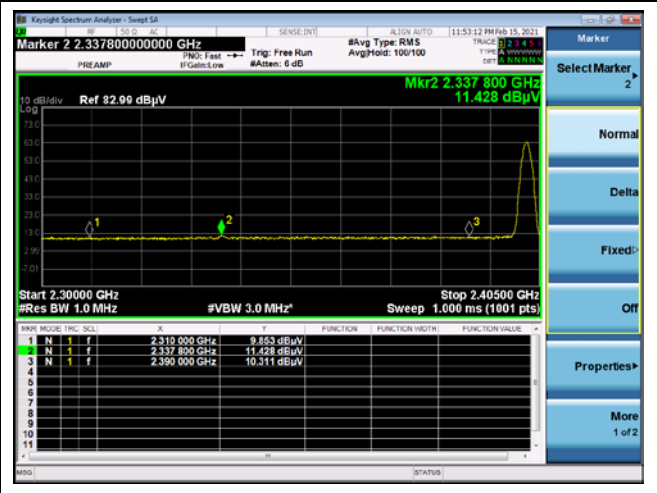
Test voltage: DC 27.6 V

PHY 1M (255 bytes)

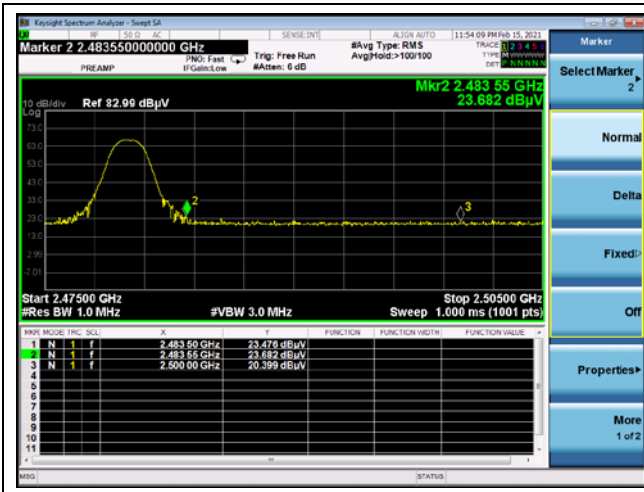
Low channel band edge (Peak)



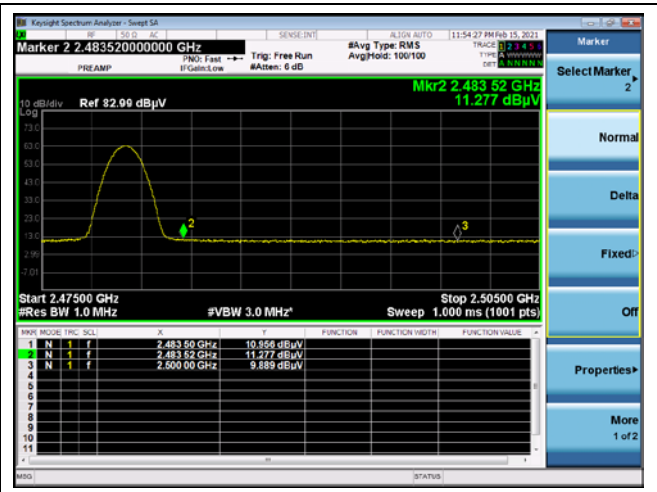
Low channel band edge (Average)



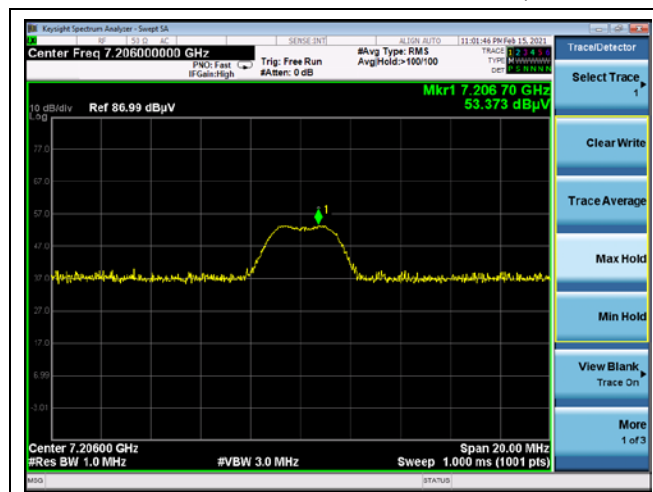
High channel band edge (Peak)



High channel band edge (Average)

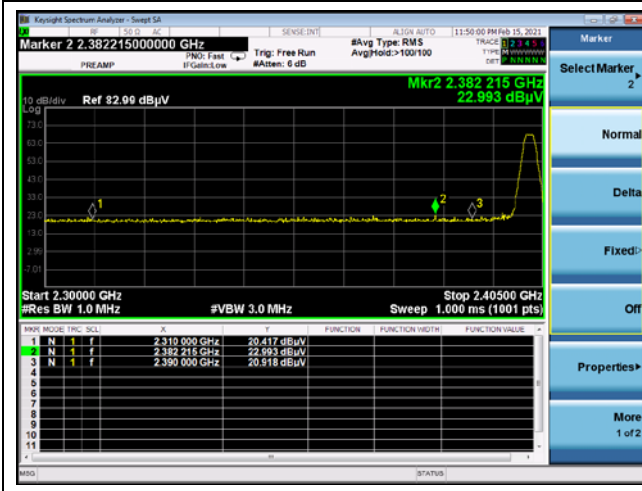


Low channel 3rd harmonic (Peak)

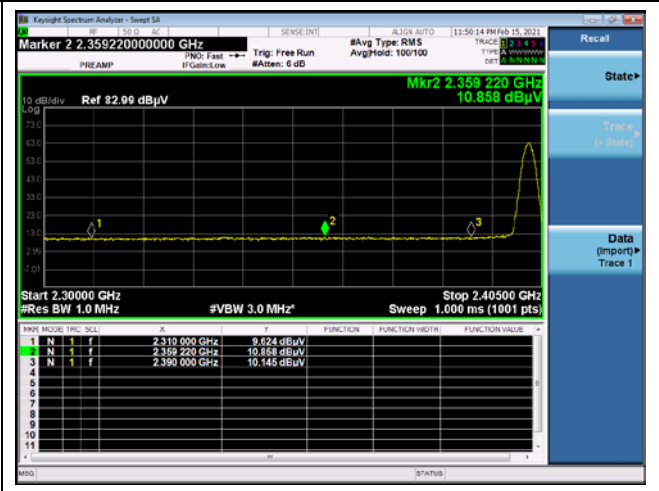


PHY 2M (255 bytes)

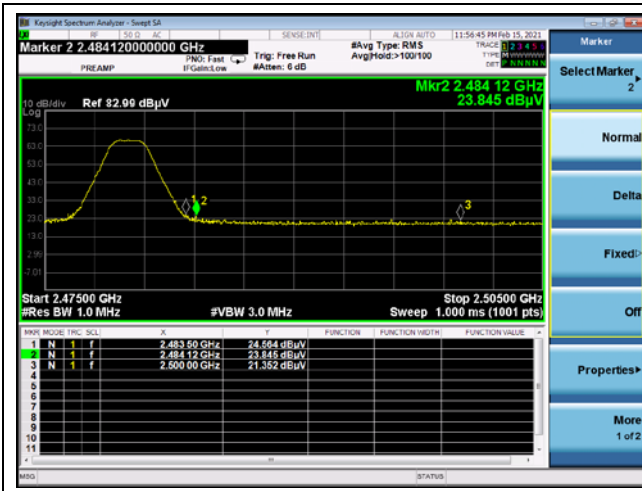
Low channel band edge (Peak)



Low channel band edge (Average)



High channel band edge (Peak)



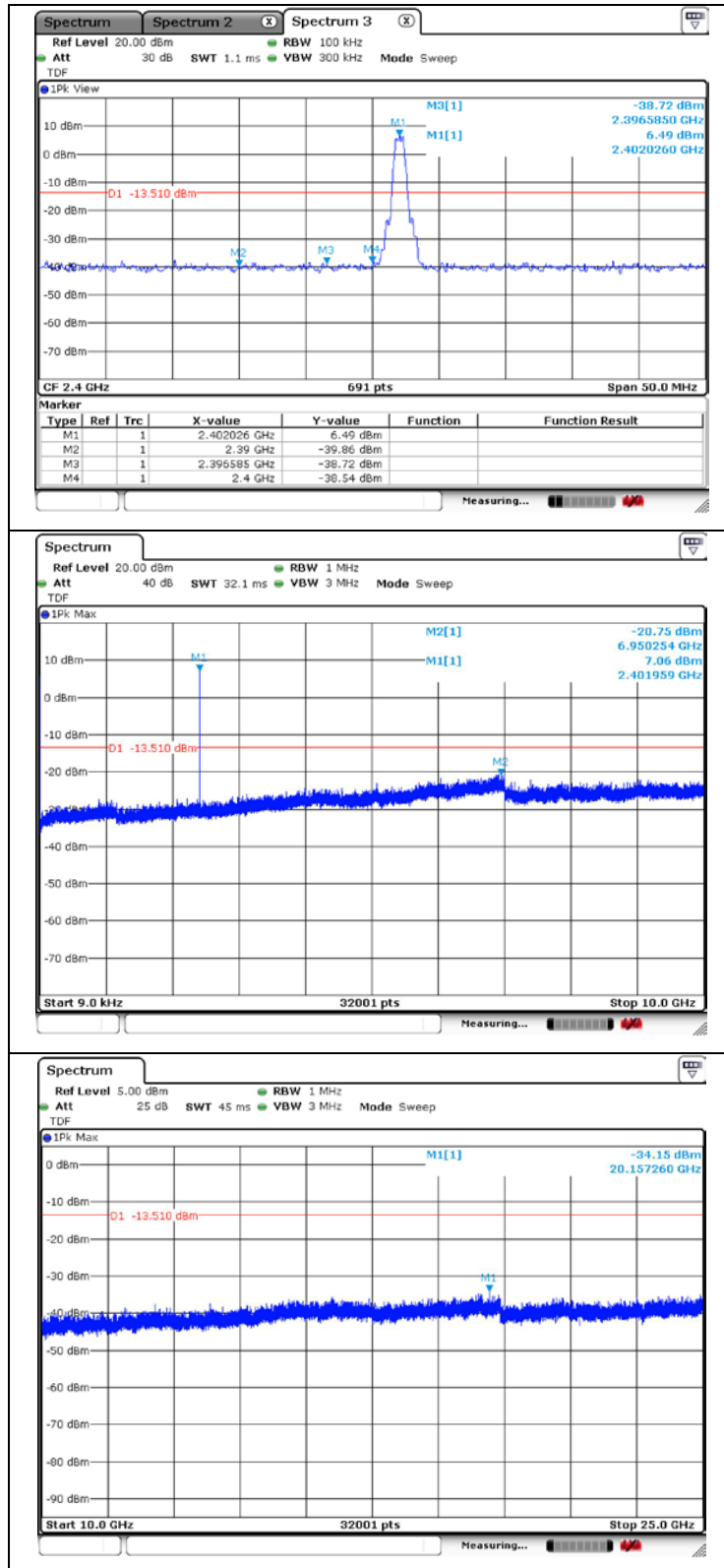
High channel band edge (Average)



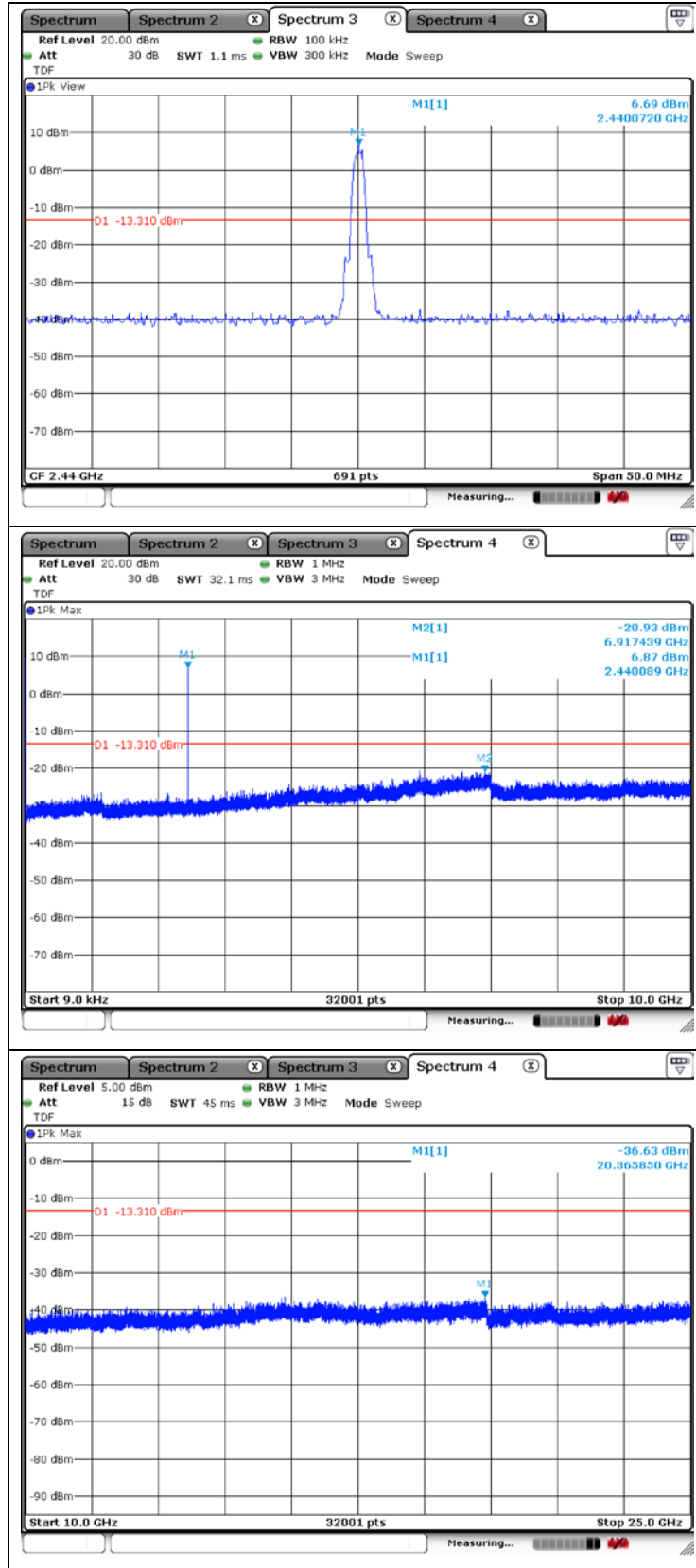
2.4.3. Plot of Conducted Spurious Emissions

Test voltage: DC 10.2 V

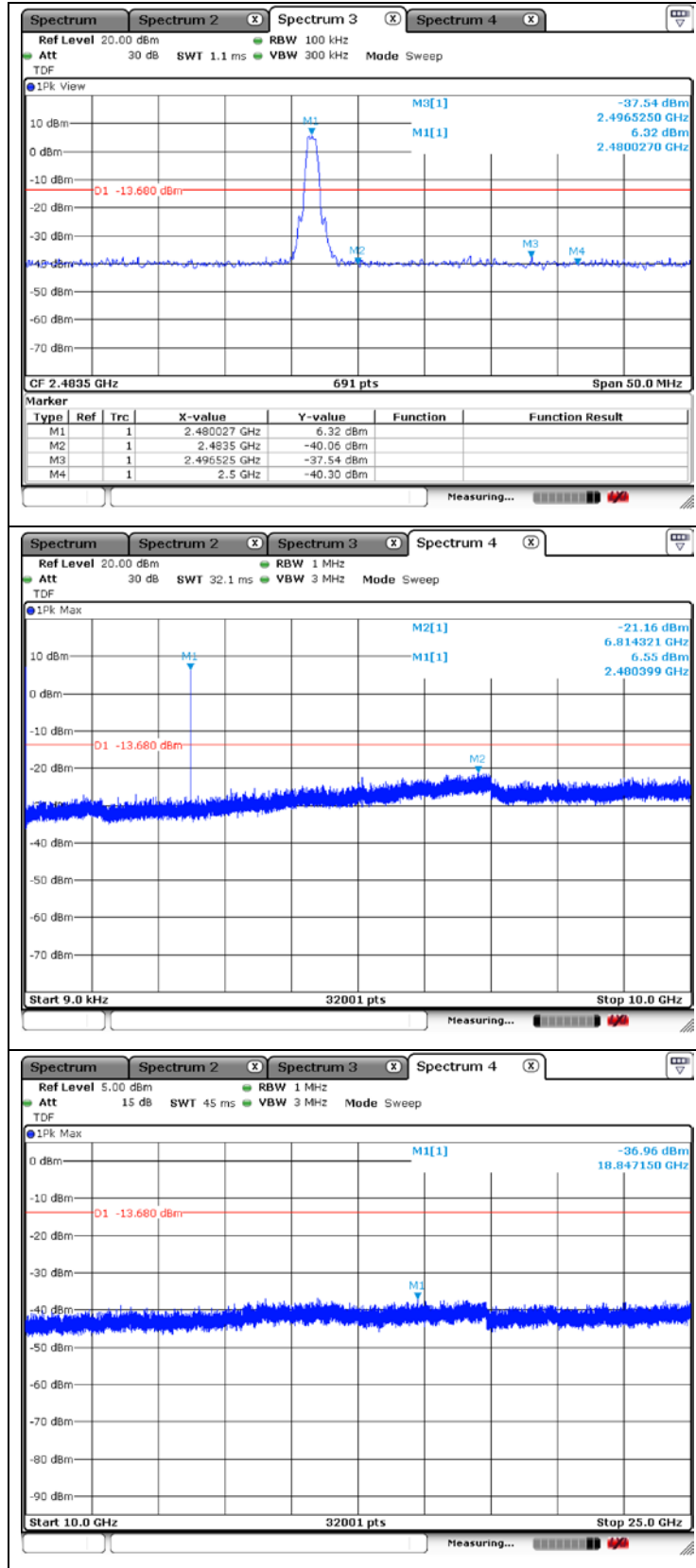
PHY 1M (255 bytes)
 Low Channel



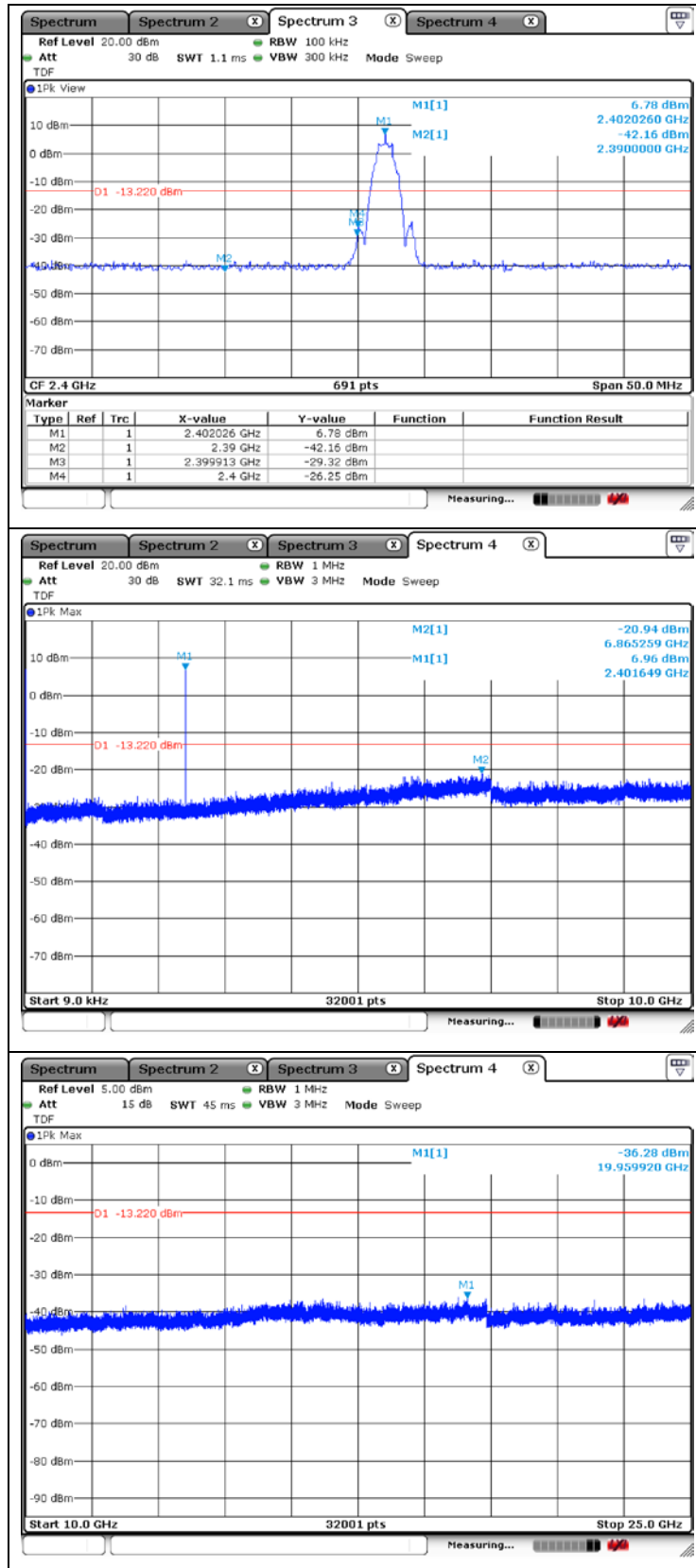
Middle Channel



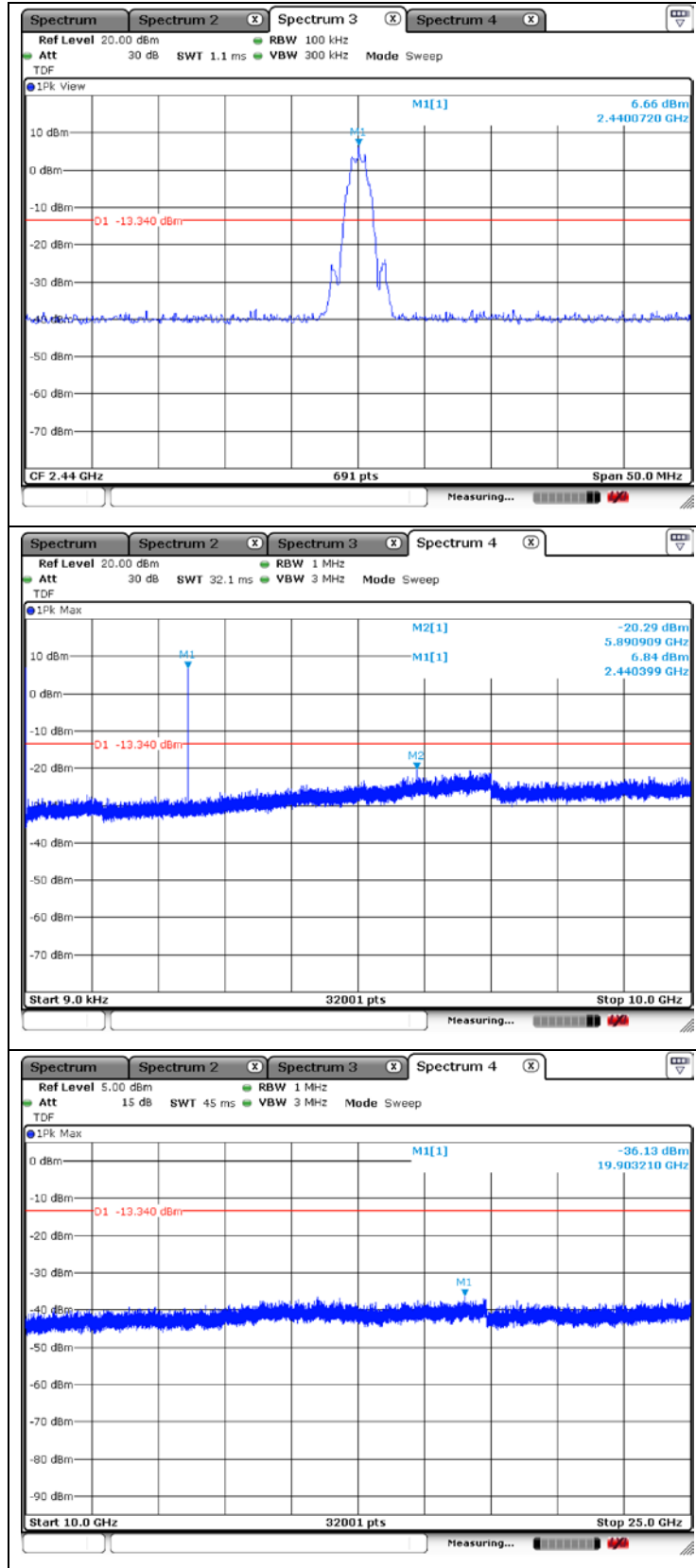
High Channel



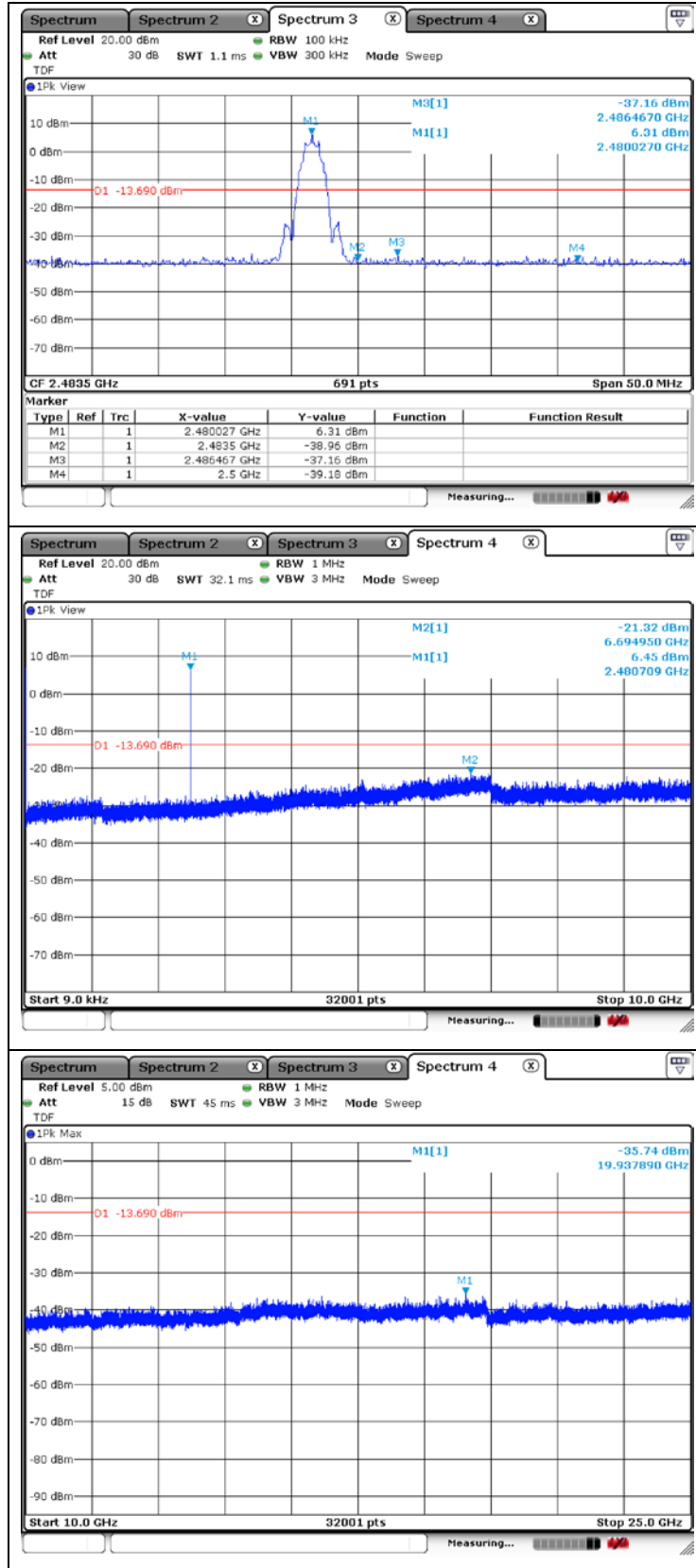
PHY 2M (255 bytes)
 Low Channel



Middle Channel

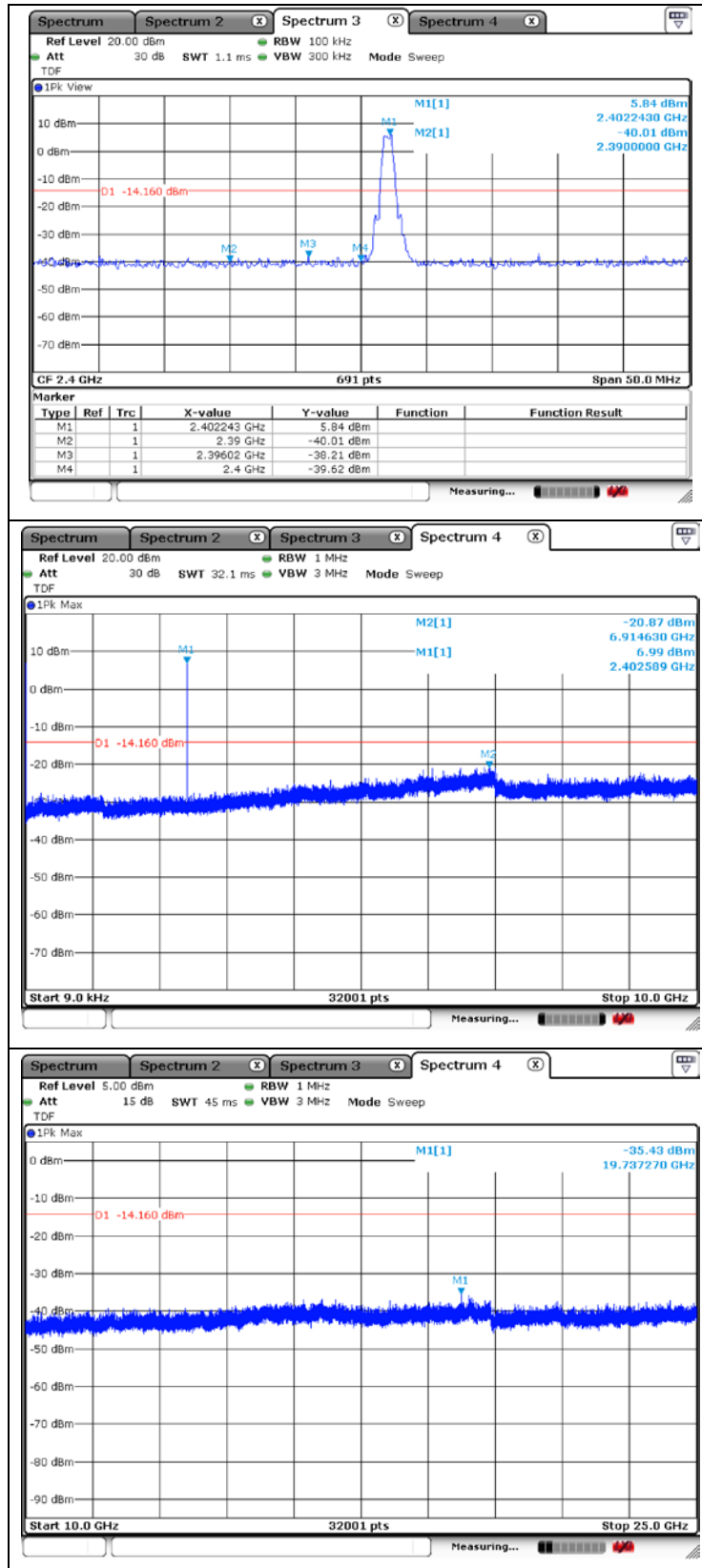


High Channel

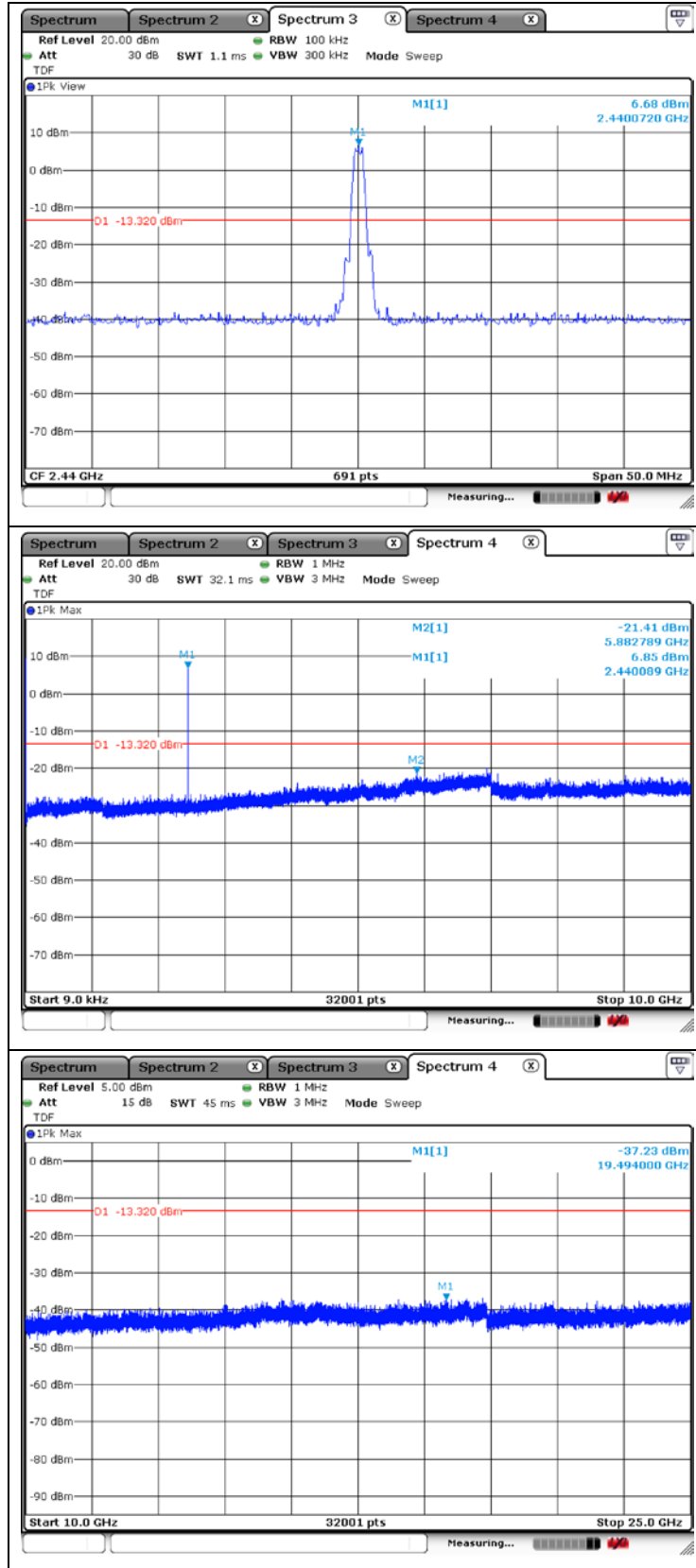


Test voltage: DC 27.6 V

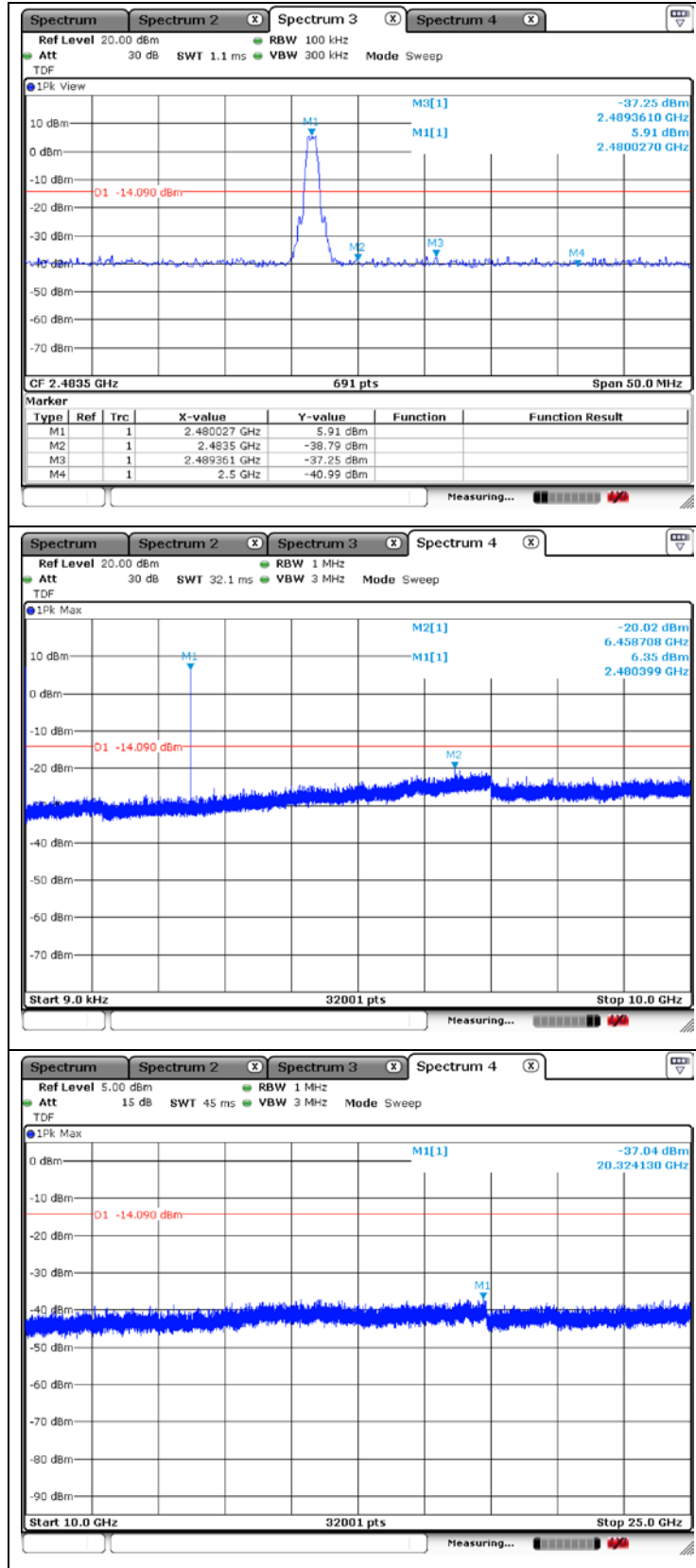
PHY 1M (255 bytes)
 Low Channel



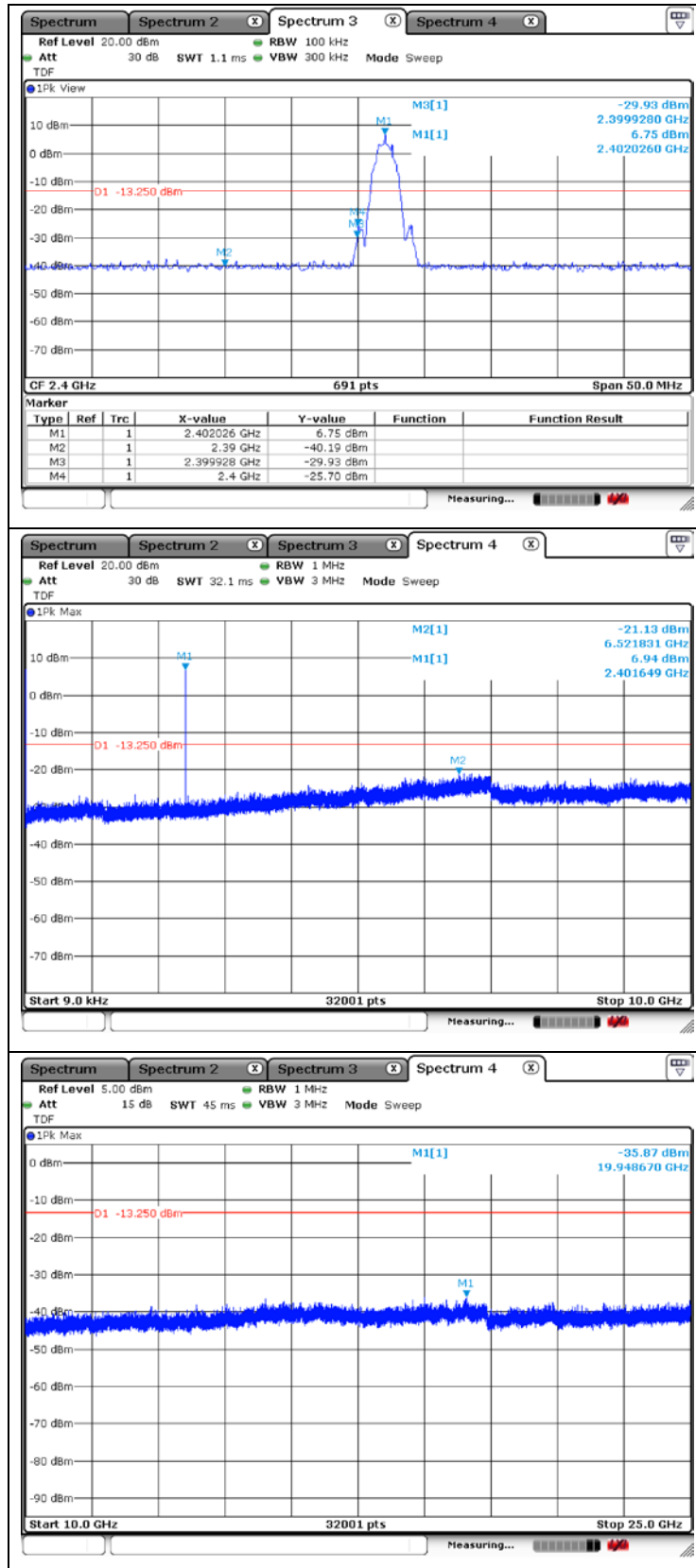
Middle Channel



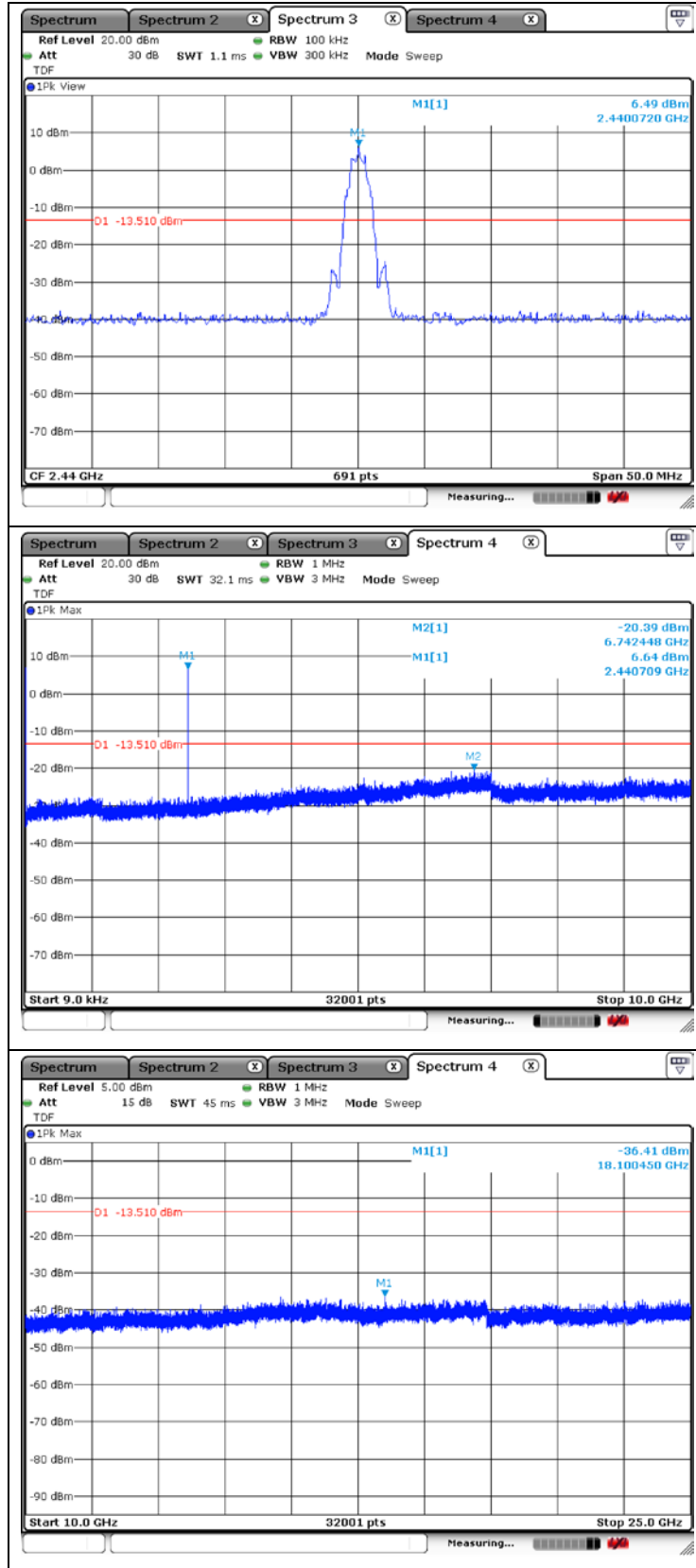
High Channel



PHY 2M (255 bytes)
 Low Channel



Middle Channel



High Channel

