Excellence in Compliance Testing

Certification Test Report

FCC ID: ONTJETIDC24US
IC: 10491A-JETIDC24US

FCC Rule Part: 15.247
ISED Canada Radio Standards Specification: RSS-247

ACS Report Number: 16-2031.W06.2A

Manufacturer: Esprit Model
Model: JETIDC24US

Test Begin Date: **May 17, 2016**
Test End Date: **June 22, 2016**

Report Issue Date: August 3, 2016

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

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This report contains 87 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247.

1.2 Manufacturer Information

Esprit Model, Inc.
1240 Clearmont St. NW
Palm Bay, FL 32905, USA

1.3 Product description

The Esprit Model JETIDC24US is a 900 MHz/2.4 GHz transceiver with telemetry for radio control model toys. For the 2.4 GHz mode of operation, the EUT includes two transceiver boards providing two antenna ports on each board. The transceivers transmit sequentially only. This report documents the compliance of the EUT for the 2.4 GHz mode of operation.

Technical Details

Mode of Operation:	2.4 GHz FH/DSSS
Frequency Range:	2405 MHz - 2480 MHz
Number of Channels:	16
Channel Separation:	5 MHz
Modulations:	O-QPSK
Antenna Type/Gain:	Whip Antenna, 2.1 dBi
Input Power:	3.3 VDC (internal battery), 12 VDC Power Supply

Model Number: JETIDC24US

Test Sample Serial Number(s): 155100470

Test Sample Condition: The equipment was provided in good condition without any physical damage.

1.4 Test Methodology and Considerations

The unit was evaluated at the antenna ports as well as for radiated and power line conducted emissions for each transceiver board and antenna port. The antennas and transceiver board combinations are identified as AP1, AP2, AS1, and AS2 in this document. AP1 and AP2 correspond to antennas 1 and 2 of the primary board, while AS1 and AS2 refer to the antennas of the secondary board. Where applicable, the data is provided for the worst case configuration. The power settings used for the evaluation for all board and antenna configurations are listed below:

Channel 11 (2405 MHz): 14
Channel 18 (2440 MHz): 7
Channel 26 (2480 MHz): 15

Preliminary radiated emissions measurements were performed with the unit standalone as well as when powered through the wall adapter. The standalone evaluation was performed in three orthogonal orientations. The final measurements were performed for the EUT standalone in the orientation leading to the highest emissions. Additional preliminary measurements were performed at the channels adjacent to the extreme channels using the settings defined in the product Theory of Operation. These channels

were found to be in compliance as well. Per the manufacturer, there is no co-transmission condition between the 2.4 GHz and 900 MHz radios. Therefore, intermodulation product investigation is not applicable.

The RF conducted measurements were performed with an RF cable adapter at the antenna port. The measurements were performed for all the available RF ports.

Power line conducted emissions were measured for each transmitter board. Data is reported for the configuration leading to the highest emissions as compared to the limits.

The EUT was evaluated separately to the unintentional emissions test requirements. In order to meet the requirements, ferrites were implemented on the cables to the accessory equipment. The results and modification details are documented separately in a Declaration of Conformity / Verification test report.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

FCC Test Firm Registration #: 475089
Innovation, Science and Economic Development Canada Lab Code: 4175C

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1533 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl flooring.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flush with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1060 Multi-device Controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

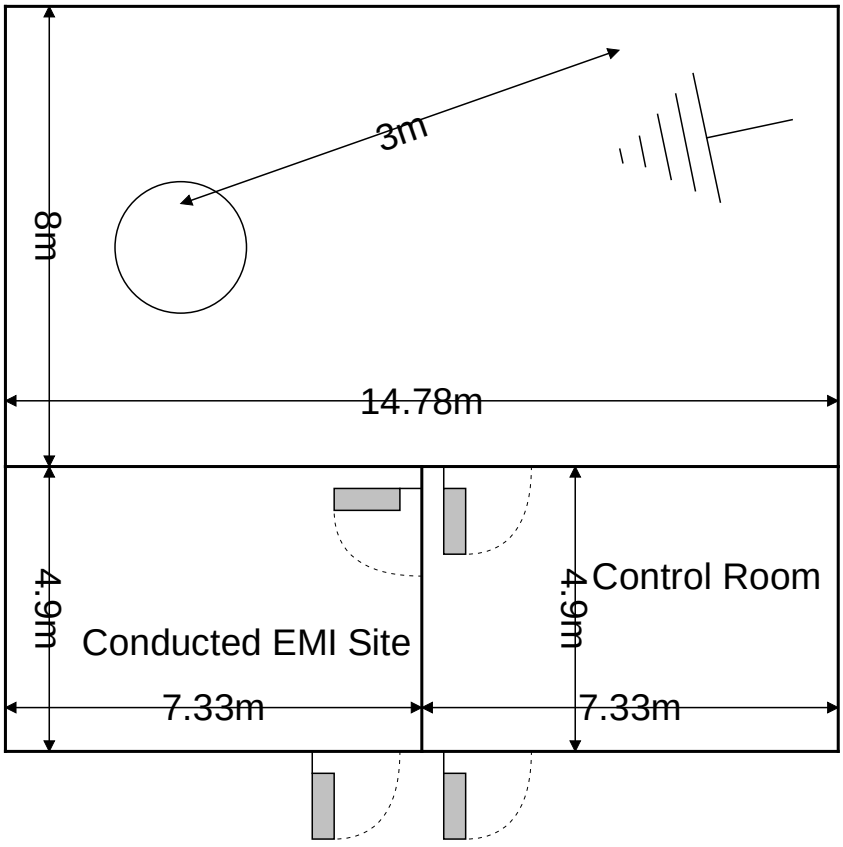


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m^3. The power line conducted emission site includes two LISNs: a Solar Model 8028-50 50 Ω/50 µH and an EMCO Model 3825/2R, which are installed as shown in the figure below. For evaluations requiring 230 V, 50 Hz AC input, a Polarad LISN (S/N 879341/048) is used in conjunction with a California Instruments signal generator Model 2001RP-OP1.

A diagram of the room is shown below in figure 2.3.2-1:

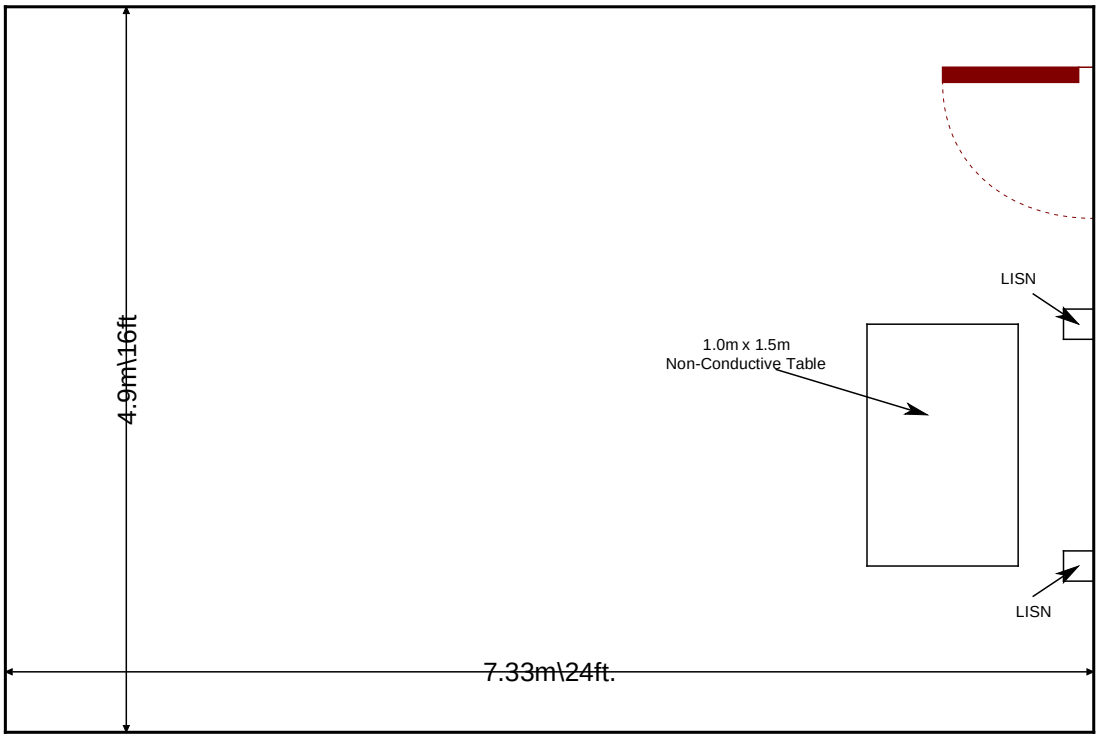


Figure 2.3.2-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40 GHz.
- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2016
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-247 — Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015.
- Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, November 2014.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
78	EMCO	6502	Antennas	9104-2608	5/11/2016	5/11/2018
523	Agilent	E7405	Spectrum Analyzers	MY45103293	12/26/2014	12/26/2016
653	Suhner	SF-102A	Cables	0944/2A	9/15/2015	9/15/2016
2002	EMCO	3108	Antennas	2147	11/19/2015	11/19/2017
2004	EMCO	3146	Antennas	1385	11/19/2015	11/19/2017
2006	EMCO	3115	Antennas	2573	4/14/2015	4/14/2017
2008	COM-Power	AH-826	Antennas	81009	NCR	NCR
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	11/18/2015	11/18/2016
2022	EMCO	LISN3825/2R	LISN	1095	9/14/2015	9/14/2017
2045	ACS Boca	Conducted Cable Set	Cable Set	2045	11/11/2015	11/11/2016
2070	Mini Circuits	VHF-8400+	Filter	2070	11/17/2015	11/17/2016
2072	Mini Circuits	VHF-3100+	Filter	30737	11/17/2015	11/17/2016
2082	Teledyne Storm Products	90-010-048	Cables	2082	4/21/2016	4/21/2017
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	11/16/2015	11/16/2016
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/9/2015	12/9/2016
2095	ETS Lindgren	TILE4! - Version 4.2.A	Software	85242	NCR	NCR
2111	Aeroflex Inmet	40AH2W-20	Attenuator	2111	7/22/2015	7/22/2016
2121	ACS Boca	Radiated Cable Set	Cable Set	2121	8/22/2015	8/22/2016
RE619	Rhode & Schwarz	ESU26	Spectrum Analyzers	1302.6005K26 Ser. 100190	11/5/2014	11/5/2016
3004	Teseq	CFL 9206A	Attenuators	34720	10/7/2015	10/7/2016

NCR=No Calibration Required

5 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment (Radiated Emissions)

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Esprit Model	JETIDC24US	155100470

Table 5-2: EUT and Support Equipment (Power Line Conducted Emissions)

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Esprit Model	JETIDC24US	155100470
2	EUT Switching AC Adapter	SUNNY Computer Technology Europe s.r.o.	SYS1428-2412-W2	G150711008524
3	Ferrite	Laird	28A0807-0A2	N/A

Table 5-3: Cable Description (Power Line Conducted Emissions)

Cable #	Cable Type	Length	Shield	Termination
A	Power	1.40 m	No	EUT to AC Adapter
B	Extension Power Cord	1.82 m	No	EUT AC Adapter to AC Mains

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

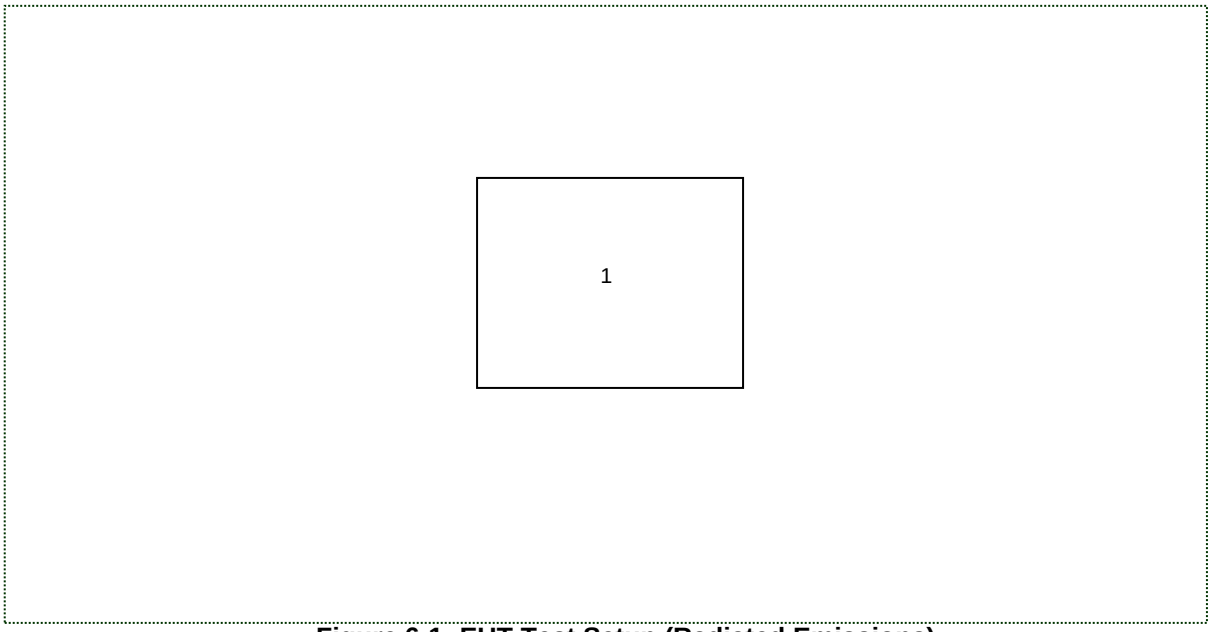


Figure 6-1: EUT Test Setup (Radiated Emissions)

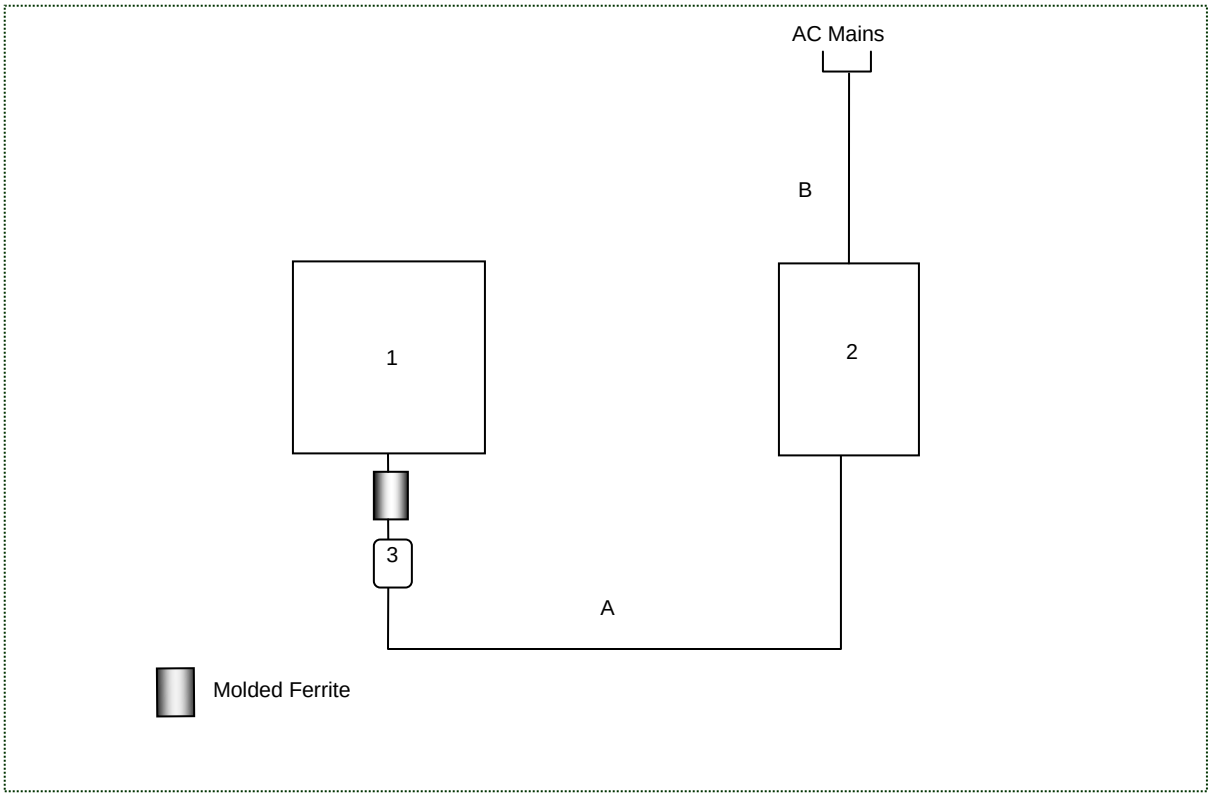


Figure 6-2: EUT Test Setup (Power Line Conducted Emissions)

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The EUT uses 2.1 dBi whip antennas for the 2.4 GHz transceivers. The antennas and the transceiver boards use u.FL. connectors thus meeting the requirements of FCC 15.203.

7.2 Power Line Conducted Emissions – FCC: Section 15.207; ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.2.2 Measurement Results

Results are shown below.

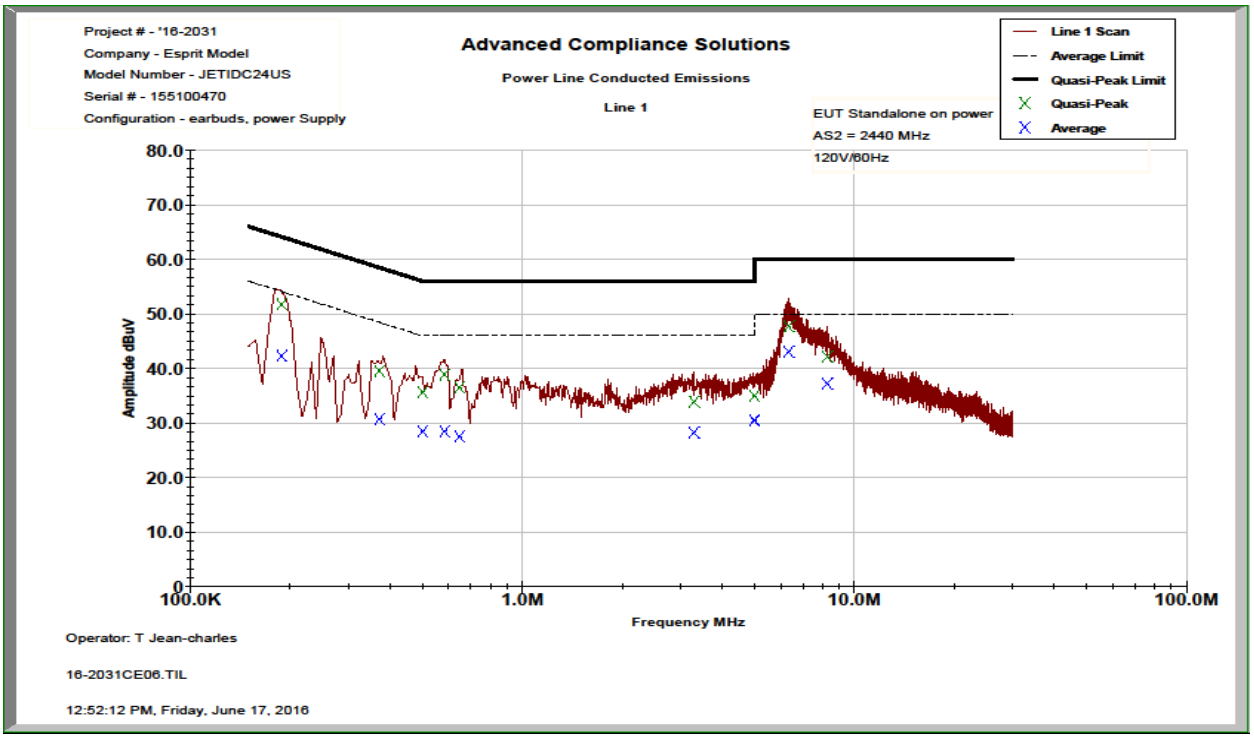


Figure 7.2.2-1: Conducted Emissions Results – Line 1

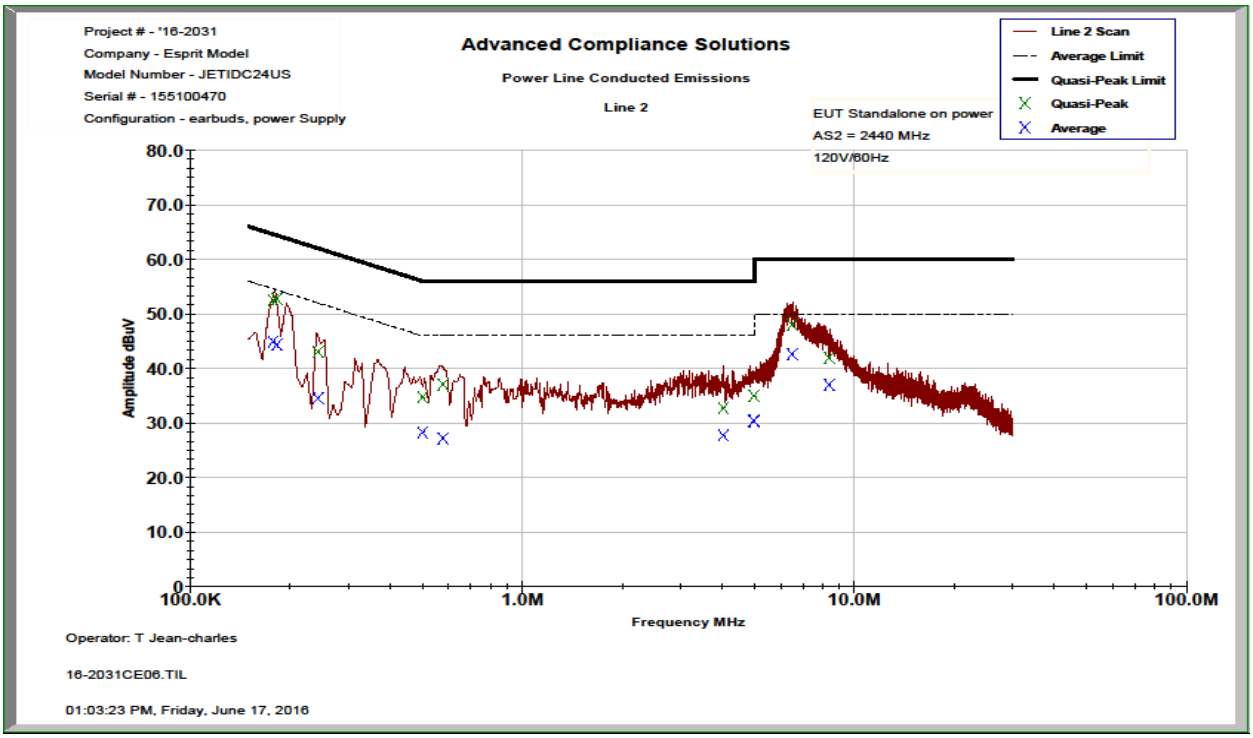


Figure 7.2.2-2: Conducted Emissions Results – Line 2

Table 7.2.2-1: Conducted EMI Results

☒ Line 1 ☒ Line 2 ☐ Line 3
☐ Line 4
☐ To Ground ☒ Floating
☐ Telecom Port _____
☒ dBµV ☐ dBµA

Plot Number: 16-2031CE06
Power Supply Description: 12 VDC Sunny Power Supply

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
Line 1									
0.1887	41.497	32.051	10.20	51.70	42.25	64.09	54.09	12.4	11.8
0.371988	29.324	20.531	10.20	39.53	30.73	58.46	48.46	18.9	17.7
0.5018	25.46	18.269	10.20	35.66	28.47	56.00	46.00	20.3	17.5
0.584424	28.676	18.282	10.20	38.88	28.49	56.00	46.00	17.1	17.5
0.648	26.314	17.352	10.20	36.51	27.55	56.00	46.00	19.5	18.4
3.29446	23.59	17.947	10.35	33.94	28.30	56.00	46.00	22.1	17.7
5.0056	24.539	20.118	10.44	34.98	30.56	60.00	50.00	25.0	19.4
5.0086	24.529	19.971	10.44	34.97	30.41	60.00	50.00	25.0	19.6
6.35554	37.202	32.559	10.50	47.71	43.06	60.00	50.00	12.3	6.9
8.2909	31.577	26.608	10.60	42.18	37.21	60.00	50.00	17.8	12.8
Line 2									
0.17795	42.359	34.68	10.22	52.58	44.90	64.58	54.58	12.0	9.7
0.182674	42.542	34.127	10.22	52.77	44.35	64.36	54.36	11.6	10.0
0.2433	32.83	24.333	10.22	43.05	34.55	61.98	51.98	18.9	17.4
0.5013	24.554	18.087	10.21	34.76	28.29	56.00	46.00	21.2	17.7
0.5783	26.859	16.993	10.21	37.07	27.21	56.00	46.00	18.9	18.8
4.03332	22.311	17.306	10.44	32.75	27.75	56.00	46.00	23.2	18.3
4.9949	24.463	19.972	10.44	34.91	30.41	56.00	46.00	21.1	15.6
4.9963	24.45	19.837	10.44	34.89	30.28	56.00	46.00	21.1	15.7
6.50624	37.429	32.068	10.57	48.00	42.64	60.00	50.00	12.0	7.4
8.41139	31.308	26.33	10.64	41.95	36.97	60.00	50.00	18.1	13.0

* Note: Results are reported for the EUT configuration leading to the worst case emissions.

7.3 Peak Output Power - FCC Section 15.247(b)(1); ISED Canada: RSS-247 5.4(2)

7.3.1 Measurement Procedure (Conducted Method)

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The display values were corrected for cable and external attenuation.

For hopping devices with less than 75 hopping channels, the RF output power limit is 0.125 W or 20.97 dBm.

7.3.2 Measurement Results

Results are shown below.

Table 7.3.2-1: RF Output Power – AP1

Frequency (MHz)	Power (dBm)
2405	8.90
2440	19.04
2480	3.56

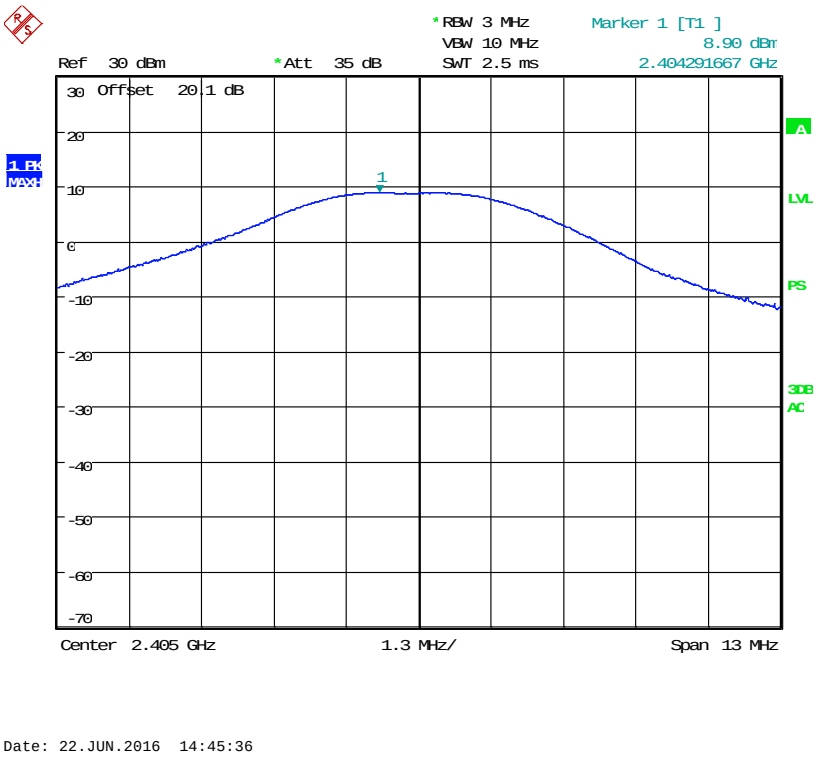


Figure 7.3.2-1: RF Output Power - Low Channel – AP1

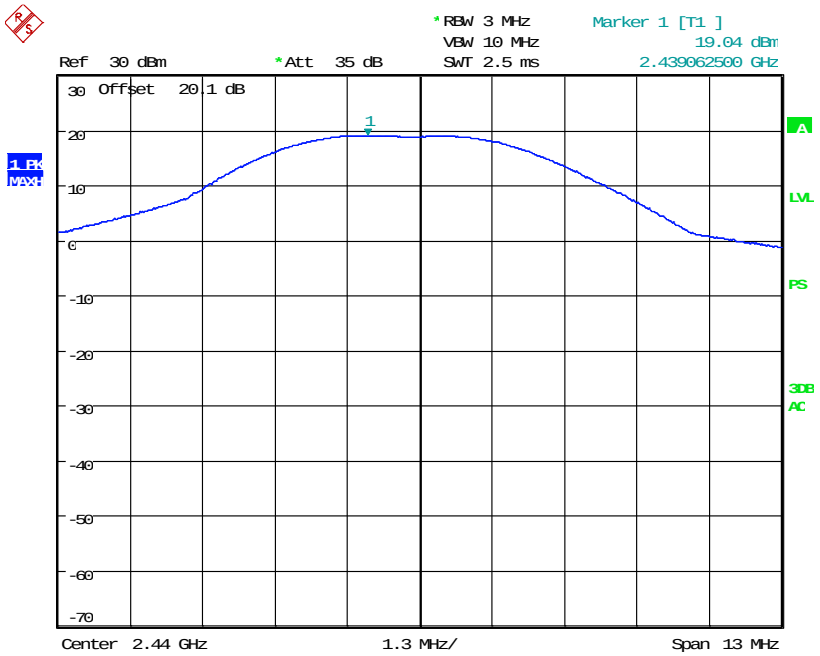


Figure 7.3.2-2: RF Output Power - Middle Channel – AP1

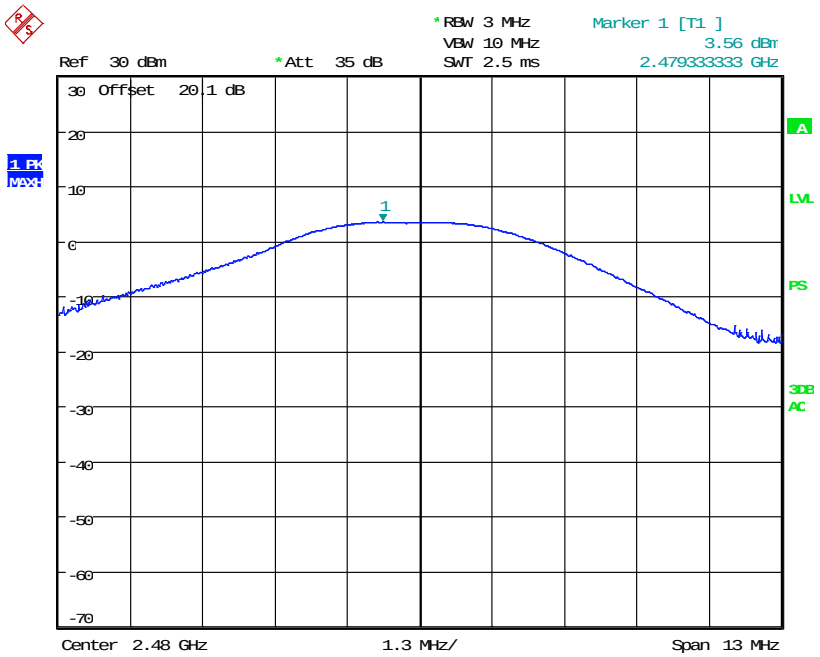


Figure 7.3.2-3: RF Output Power - High Channel – AP1

Table 7.3.2-2: RF Output Power – AP2

Frequency (MHz)	Power (dBm)
2405	10.36
2440	18.88
2480	3.97

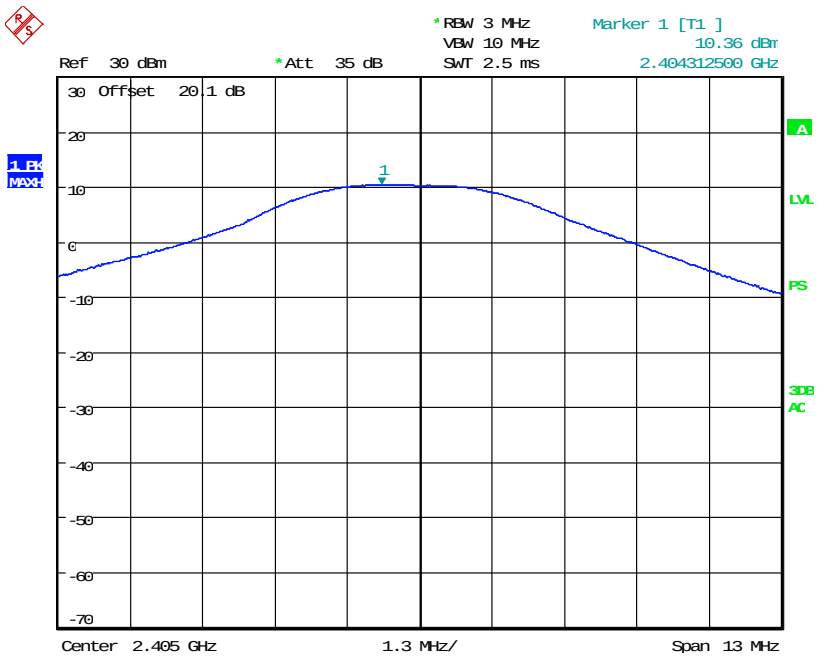


Figure 7.3.2-4: RF Output Power - Low Channel – AP2

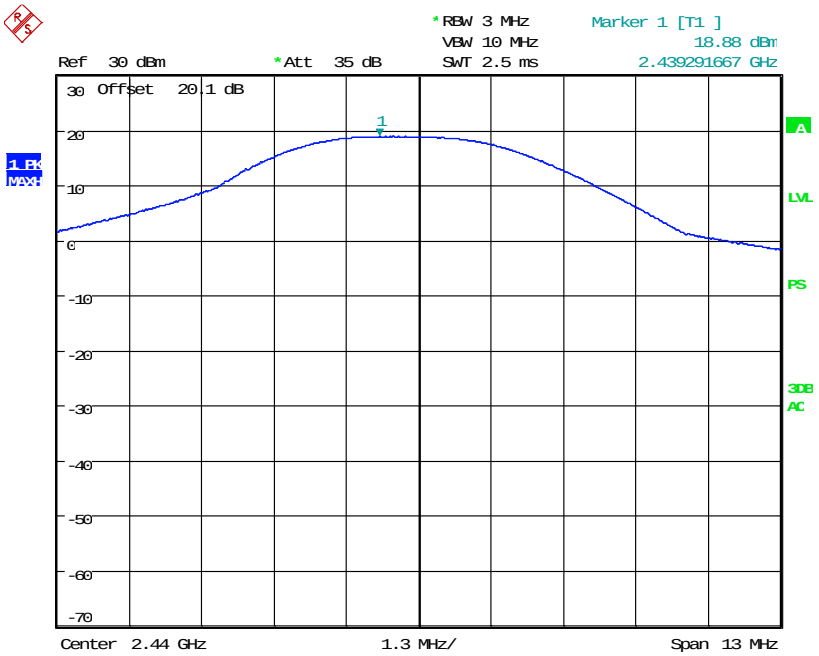


Figure 7.3.2-5: RF Output Power - Middle Channel – AP2

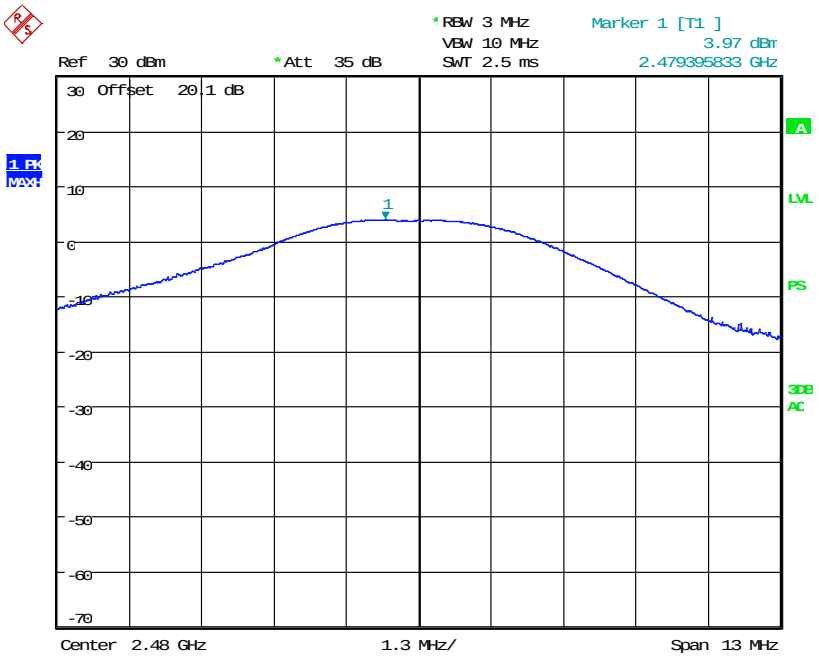


Figure 7.3.2-6: RF Output Power - High Channel – AP2

Table 7.3.2-3: RF Output Power AS1

Frequency (MHz)	Power (dBm)
2405	9.62
2440	19.25
2480	4.86

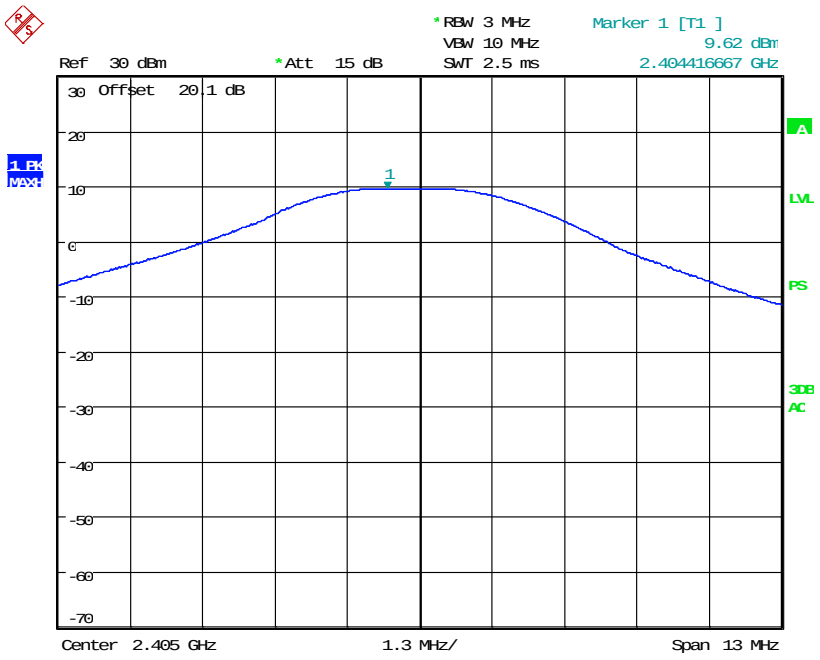


Figure 7.3.2-7: RF Output Power - Low Channel – AS1

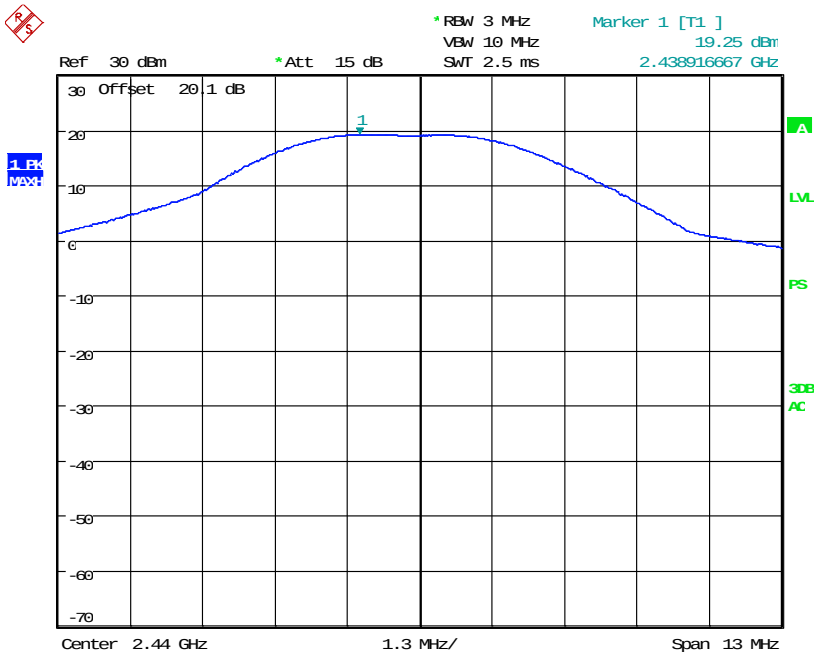


Figure 7.3.2-8: RF Output Power - Middle Channel – AS1

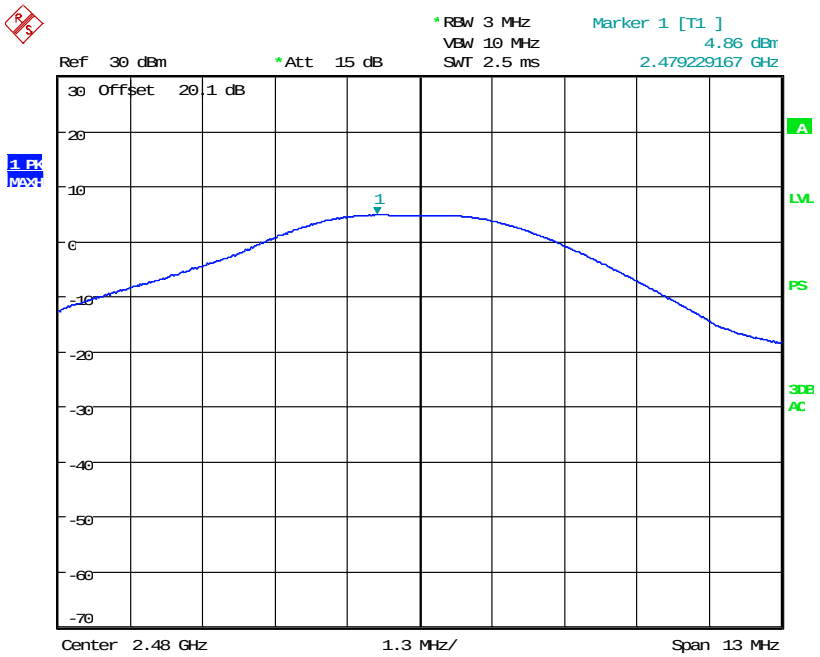


Figure 7.3.2-9: RF Output Power - High Channel – AS1

Table 7.3.2-4: RF Output Power – AS2

Frequency (MHz)	Power (dBm)
2405	11.11
2440	19.64
2480	6.39

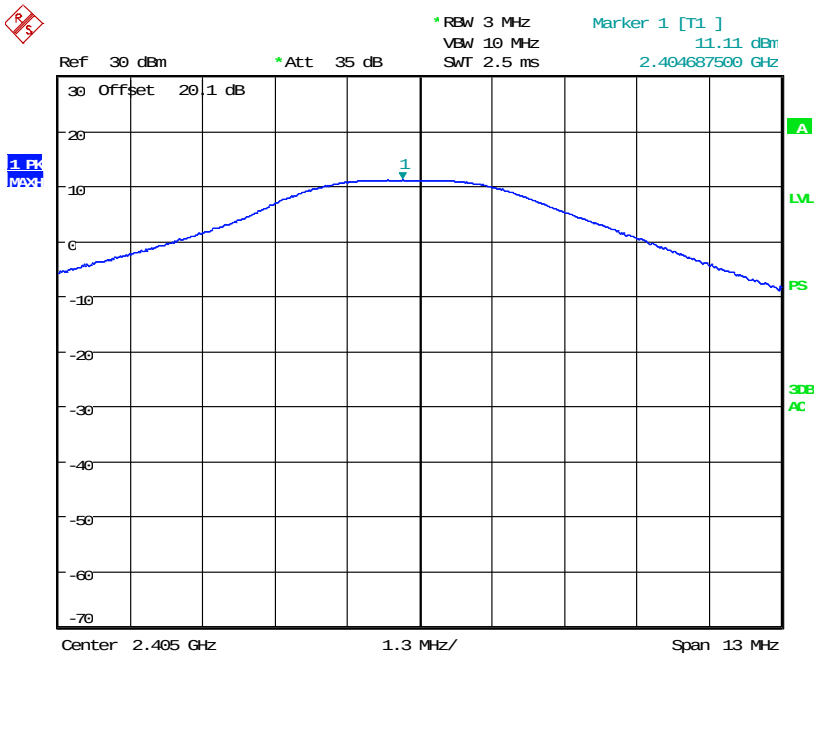


Figure 7.3.2-10: RF Output Power - Low Channel – AS2

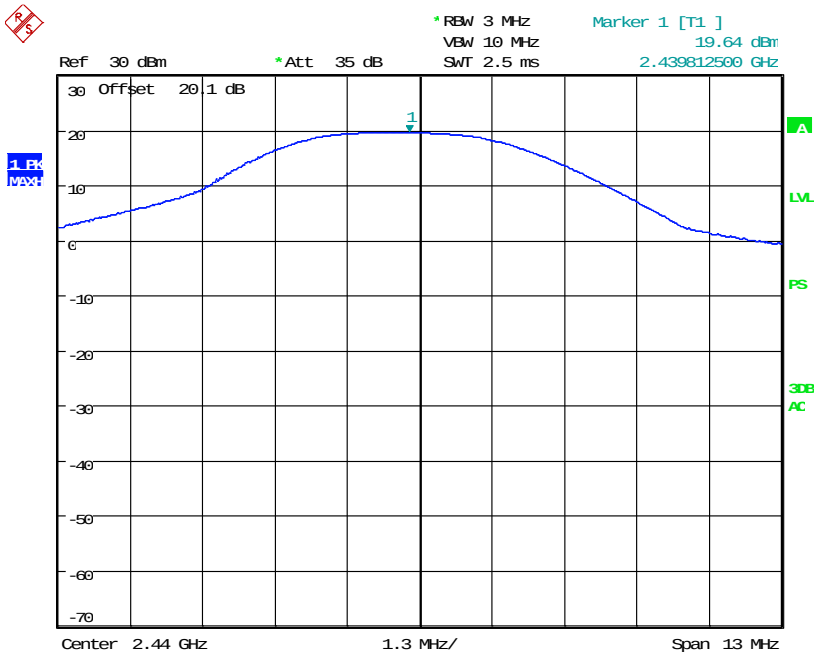


Figure 7.3.2-11: RF Output Power - Middle Channel – AS2

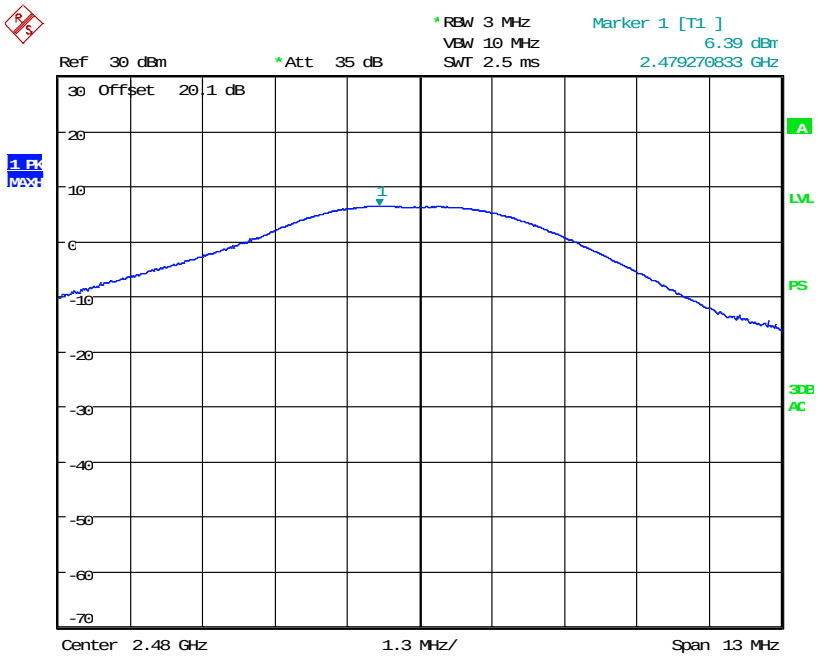


Figure 7.3.2-12: RF Output Power - High Channel – AS2

7.4 Channel Usage Requirements

7.4.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1); ISED Canada: RSS-247 5.1(2)

7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW was set to approximately 30% of the channel spacing.

7.4.1.2 Measurement Results

Results are shown below.

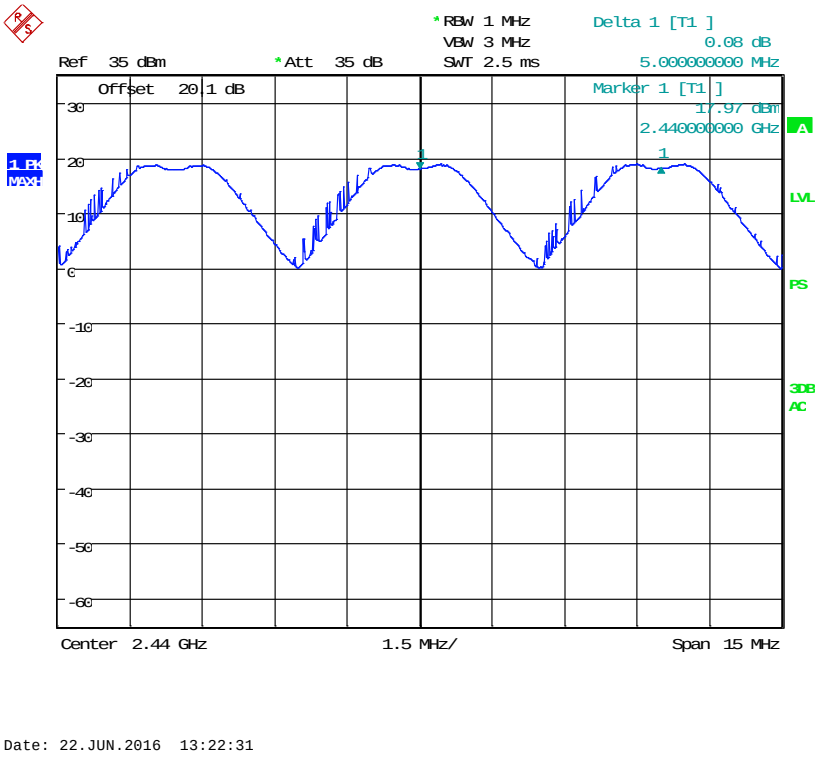


Figure 7.4.1.2-1: Carrier Frequency Separation – AP1

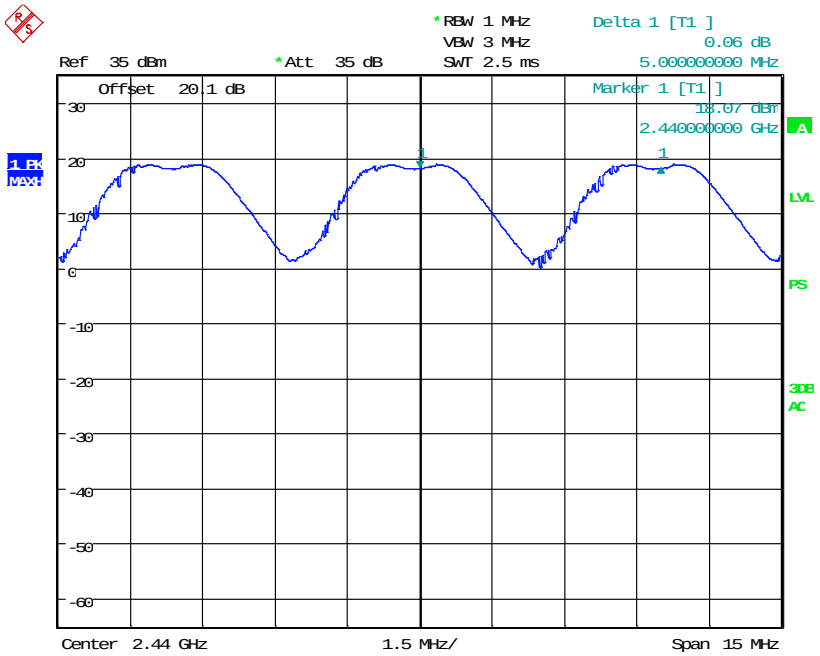


Figure 7.4.1.2-2: Carrier Frequency Separation – AP2

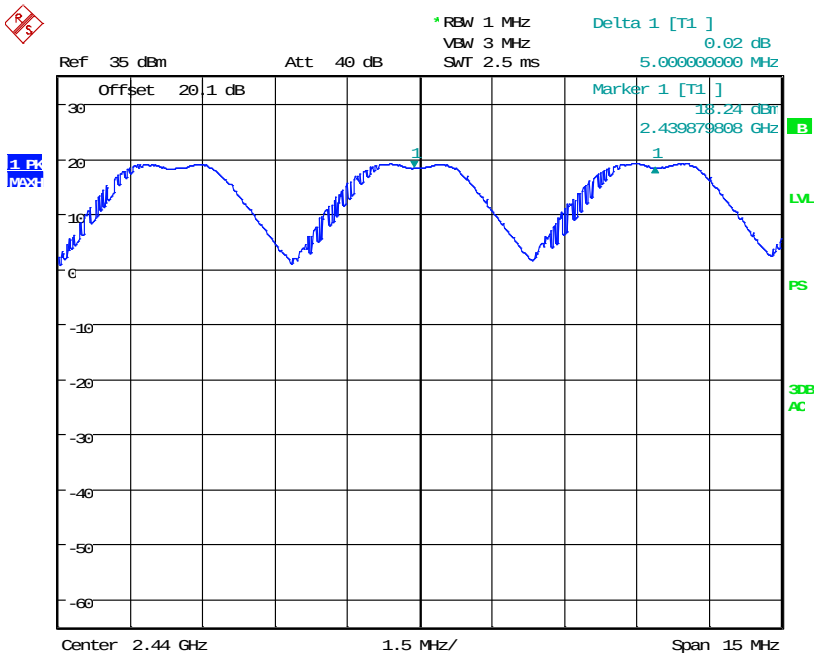


Figure 7.4.1.2-3: Carrier Frequency Separation – AS1

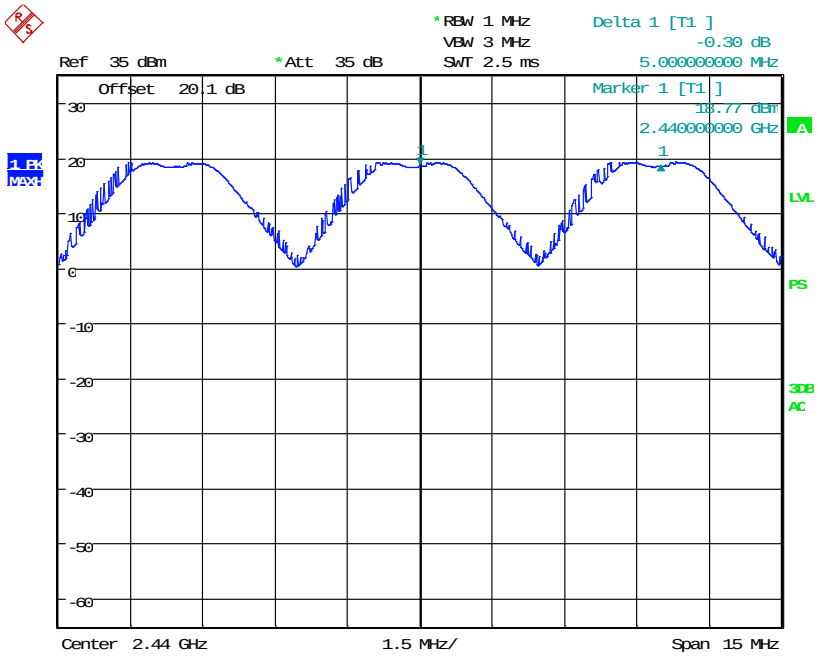


Figure 7.4.1.2-4: Carrier Frequency Separation – AS2

7.4.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(iii); ISED Canada: RSS-247 5.1(4)

7.4.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer through suitable attenuation. The span of the spectrum analyzer was set wide enough to capture the number of hopping channels. The peak detector max hold function was enabled for the measurements.

7.4.2.2 Measurement Results

Results are shown below.

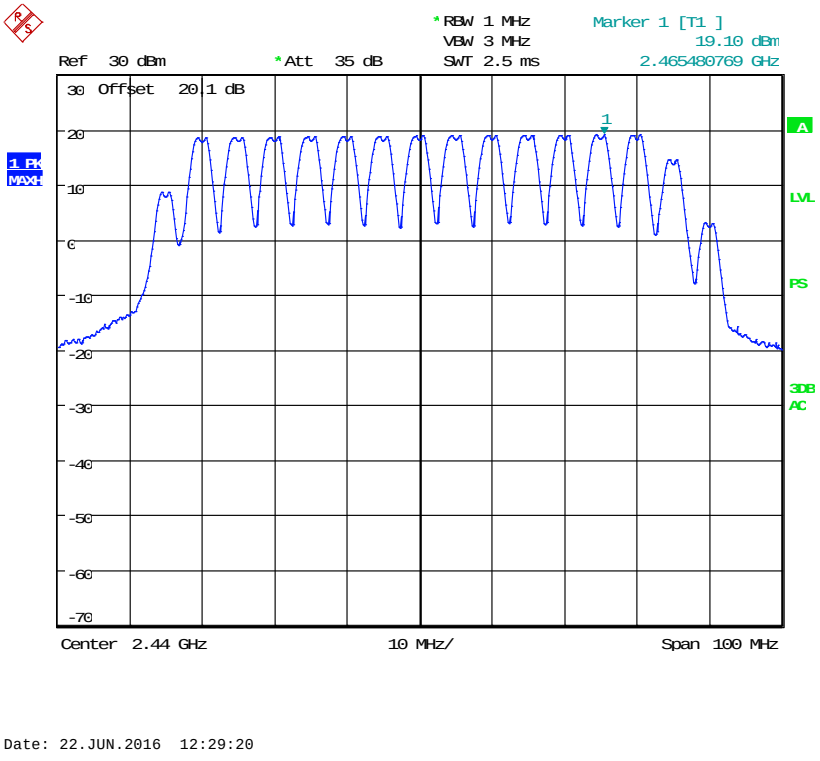


Figure 7.4.2.2-1: Number of Hopping Channels – AP1

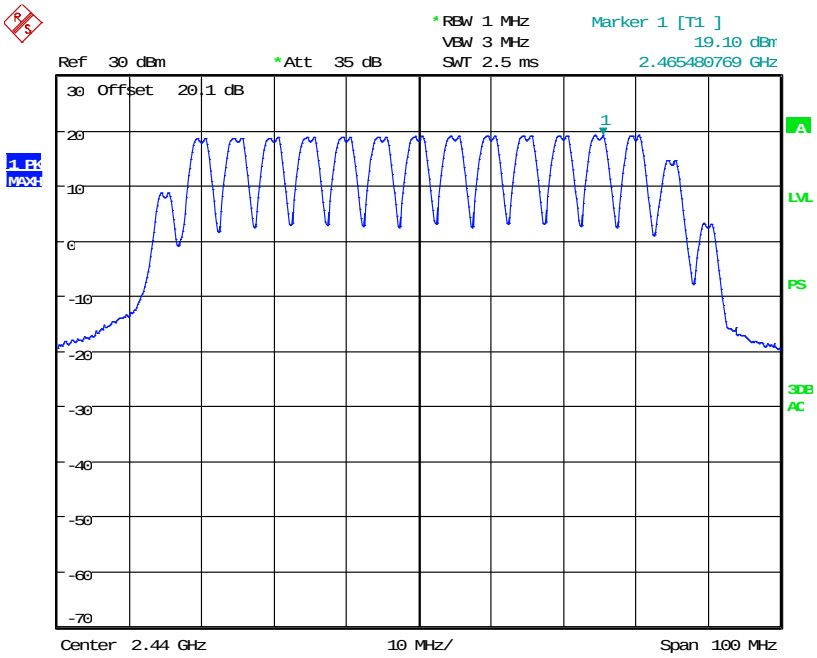


Figure 7.4.2.2-2: Number of Hopping Channels – AP2

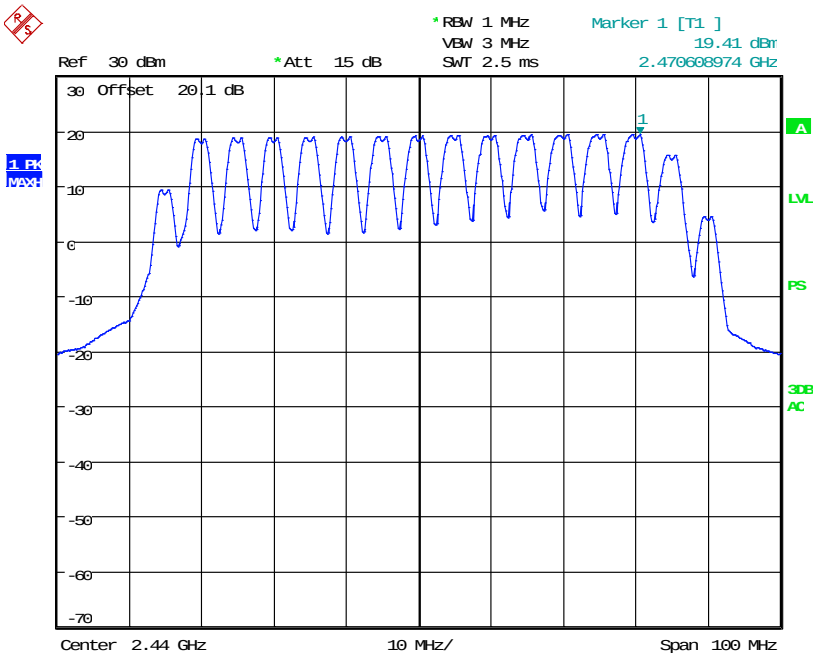


Figure 7.4.2.2-3: Number of Hopping Channels – AS1

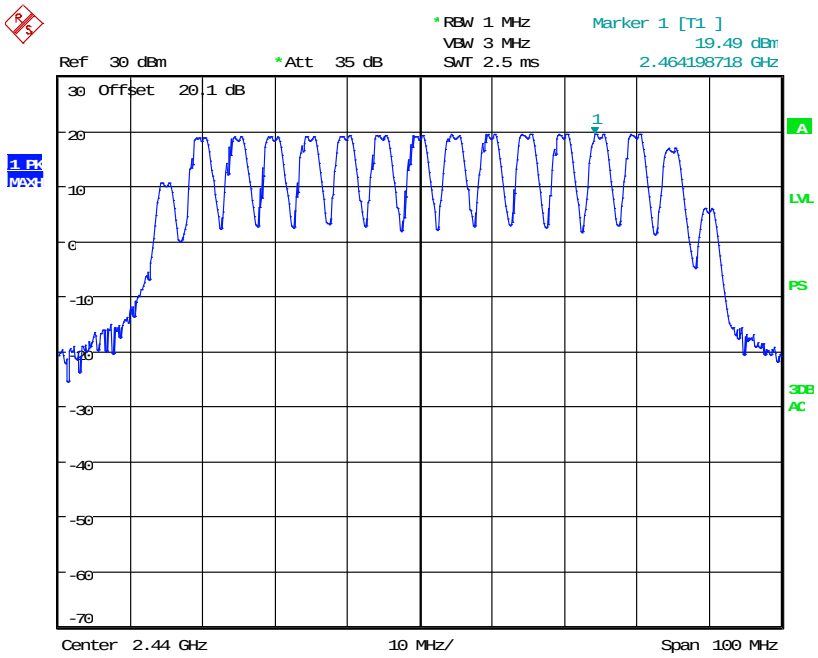


Figure 7.4.2.2-4: Number of Hopping Channels – AS2

7.4.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(iii); ISED Canada: RSS-247 5.1(4)

7.4.3.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set 0 Hz centered on a hopping channel. The RBW was set to less or equal to the channel spacing and the sweep time adjusted to capture the entire dwell time per channel with peak detector max hold function.

7.4.3.2 Measurement Results

Results are shown below.

Table 7.4.3.2-1 Dwell Time on a 6.4 Second Cycle

Mode of Operation	Number of Hops Per Sec. (NHPS)	Number of Hops per Channel Per Sec. (NHPCPS)	Number of hops on a 6.4 s Cycle (NHPC)	Measured Dwell Times (ms)	Dwell Times on a 6.4 s Cycle (ms)	Limit (ms)	Status
AP1	100	6.25	40	2.012179	80.49	400	PASS
AP2	100	6.25	40	2.003205	80.13	400	PASS
AS1	100	6.25	40	2.012179	80.49	400	PASS
AS2	100	6.25	40	2.003205	80.13	400	PASS

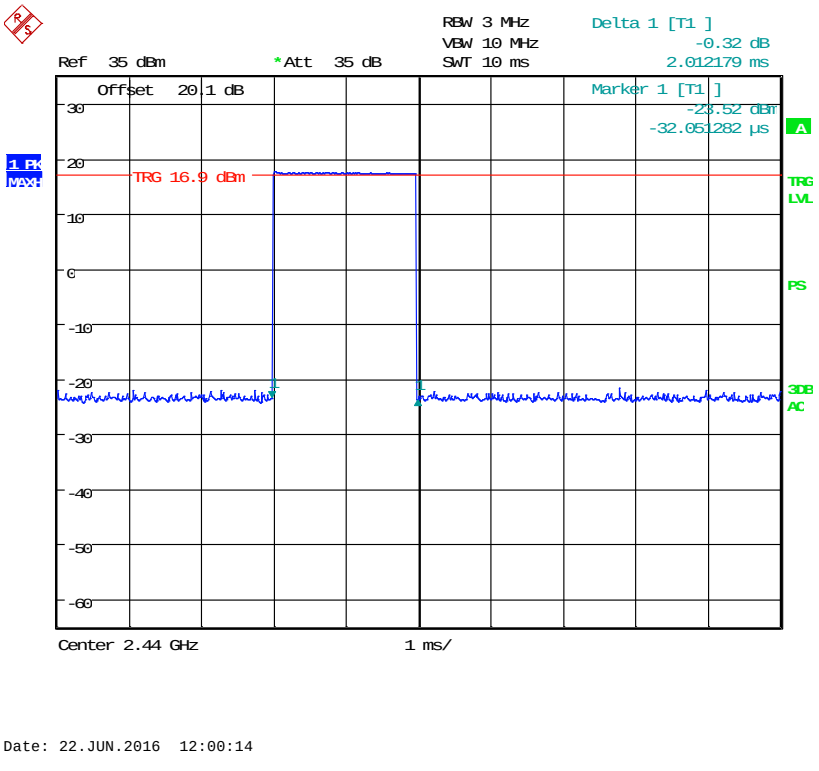


Figure 7.4.3.2-1: Channel Dwell Time – AP1

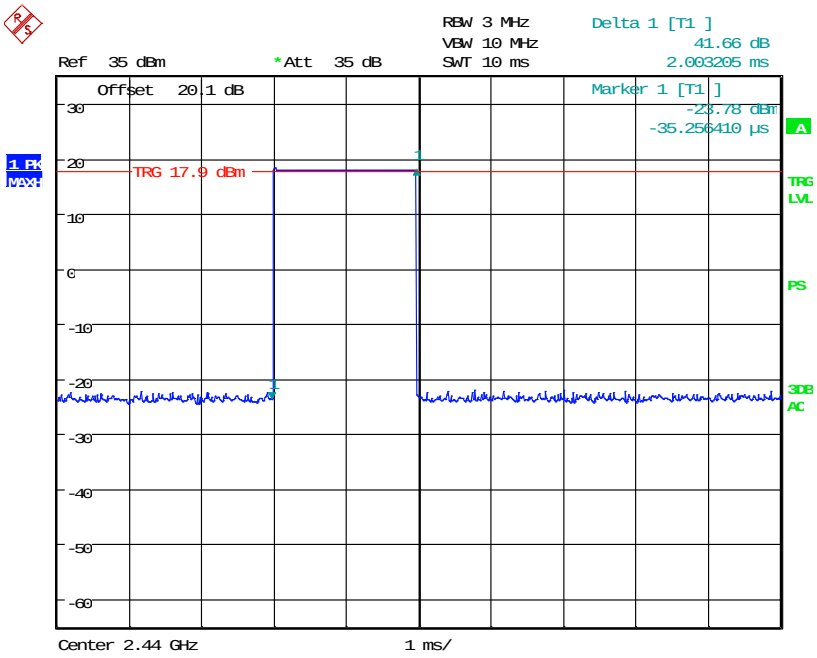


Figure 7.4.3.2-2: Channel Dwell Time – AP2

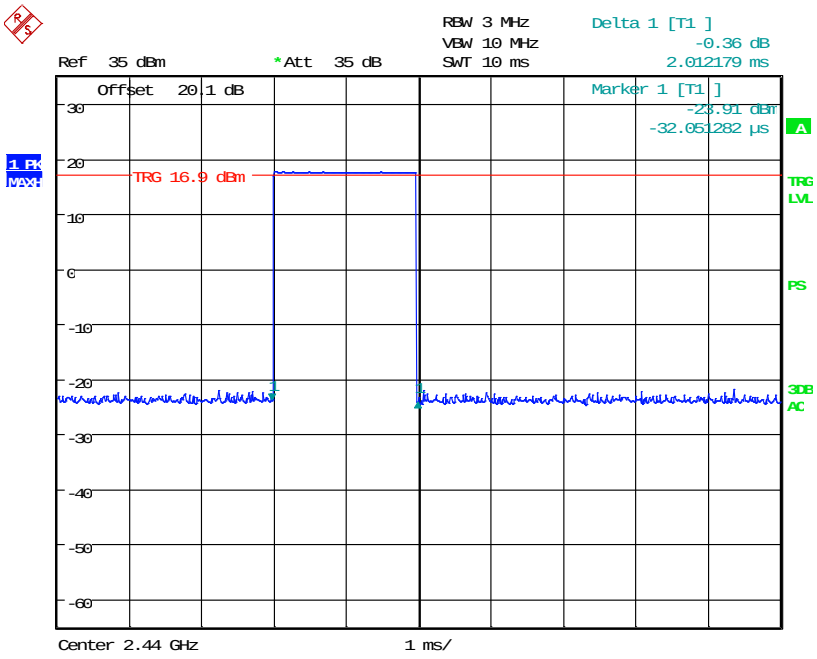


Figure 7.4.3.2-3: Channel Dwell Time – AS1

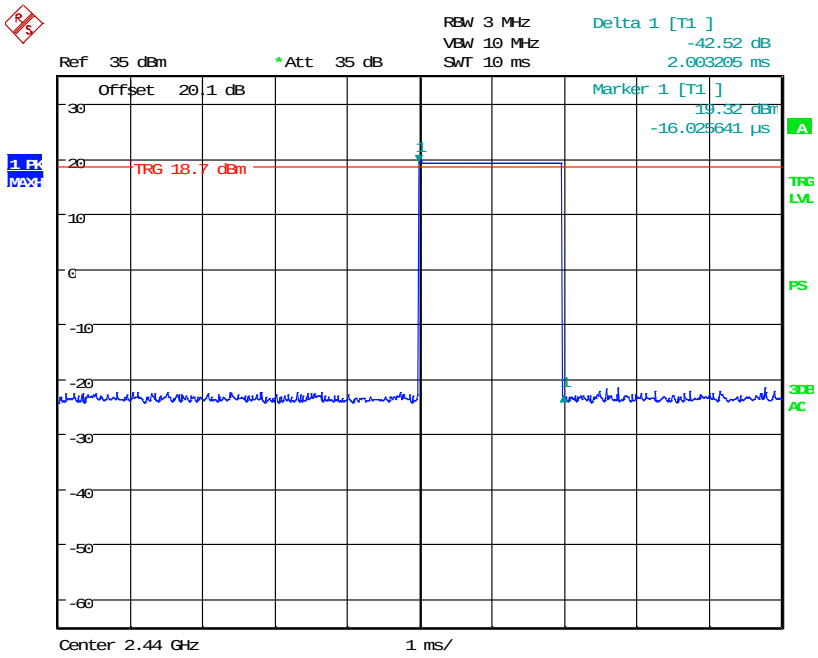


Figure 7.4.3.2-4: Channel Dwell Time – AS2

7.4.4 20dB / 99% Bandwidth - FCC: Section 15.247(a)(1); ISED Canada: RSS-247 5.1(1)

7.4.4.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The spectrum analyzer span was set to 2 to 5 times the estimated bandwidth of the emission. The RBW was set to 1% to 5% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. The N dB function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission, including the emissions skirts. The RBW was to 1% to 5% of the approximate emission bandwidth. The trace was set to max hold with a sample detector. The occupied 99% bandwidth was measured by using the 99% bandwidth equipment function of the spectrum analyzer.

7.4.4.2 Measurement Results

Results are shown below.

Table 7.4.4.2-1: 20dB / 99% Bandwidth – AP1

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
2405	2580.128	2435.897
2440	2612.179	2467.949
2480	2628.205	2628.205

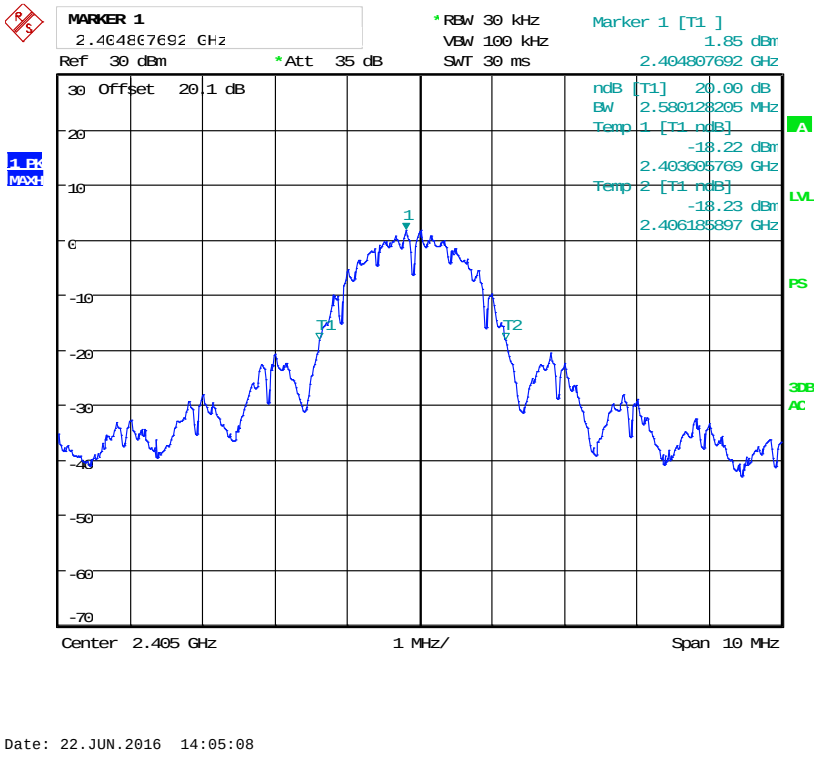


Figure 7.4.4.2-1: 20dB BW Low Channel – AP1

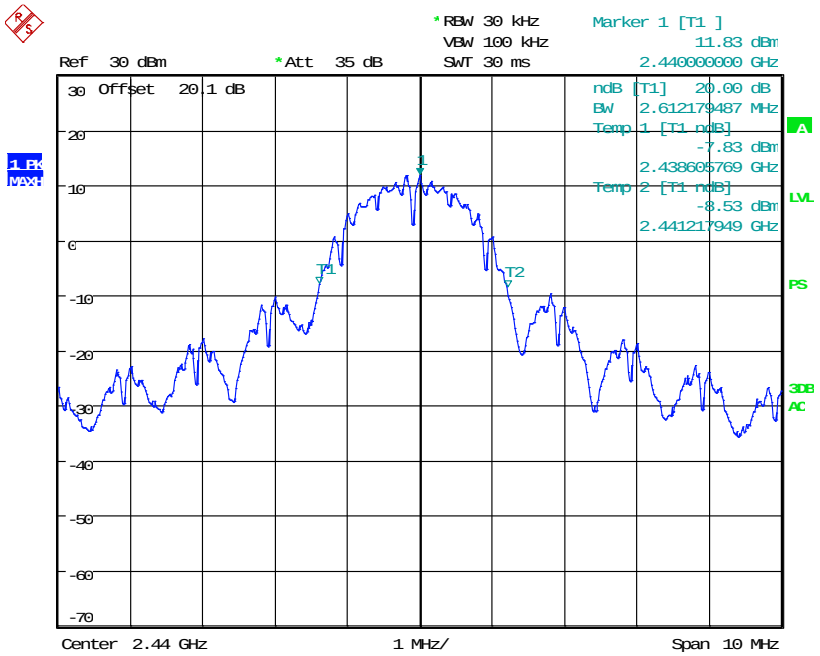


Figure 7.4.4.2-2: 20dB BW Middle Channel – AP1

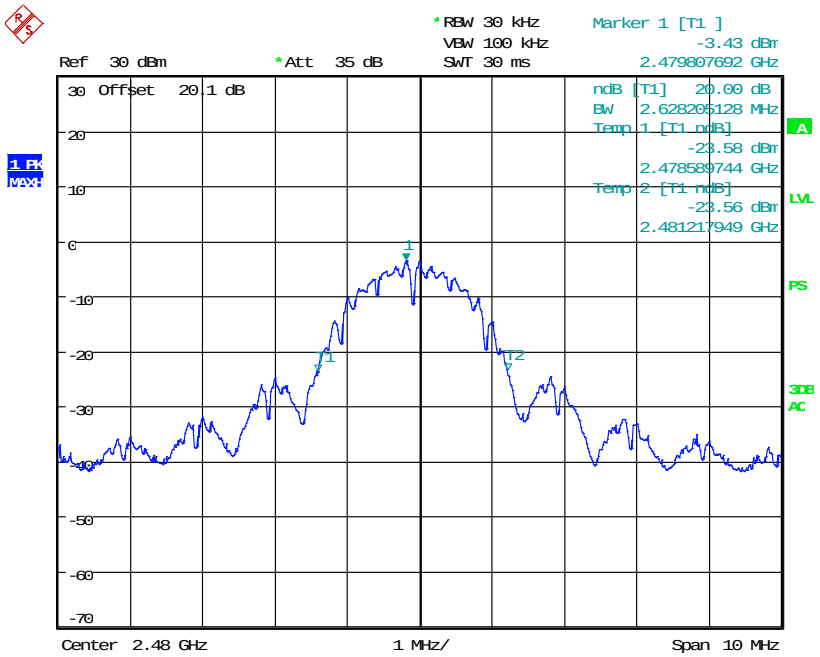


Figure 7.4.4.2-3: 20dB BW High Channel – AP1

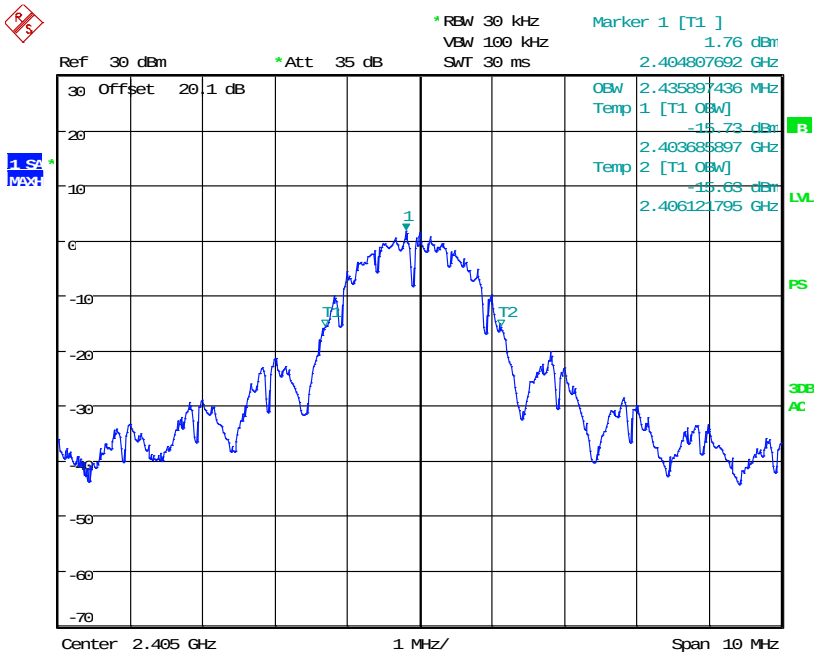


Figure 7.4.4.2-4: 99% OBW Low Channel – AP1

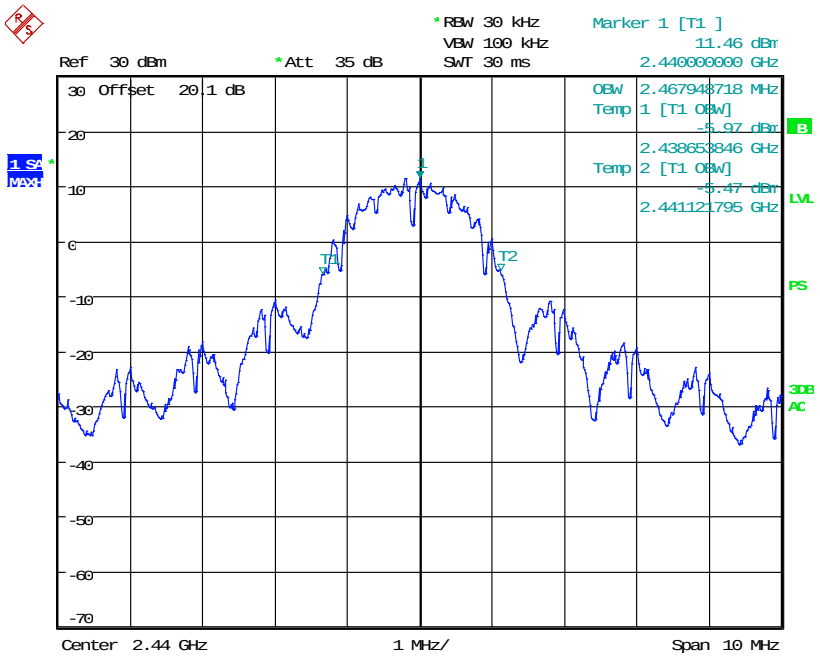


Figure 7.4.4.2-5: 99% OBW Middle Channel – AP1

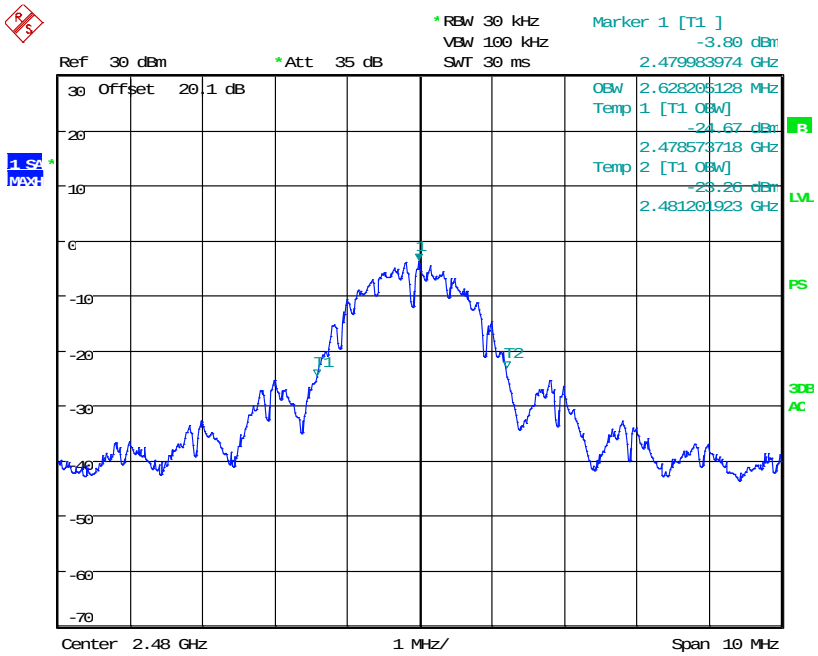


Figure 7.4.4.2-6: 99% OBW High Channel – AP1

Table 7.4.4.2-2: 20dB / 99% Bandwidth – AP2

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
2405	2580.128	2435.897
2440	2596.154	2451.923
2480	2628.205	2564.103

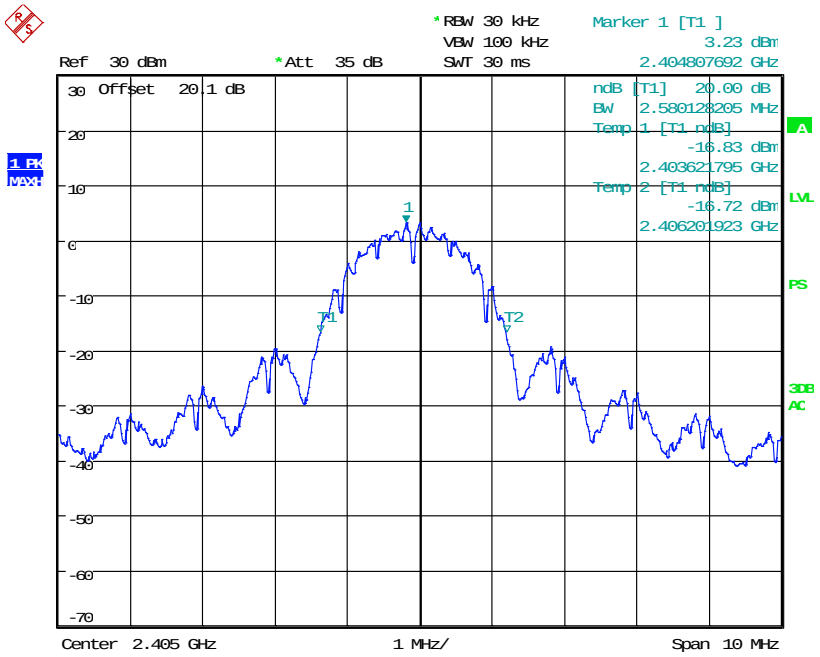


Figure 7.4.4.2-7: 20dB BW Low Channel – AP2

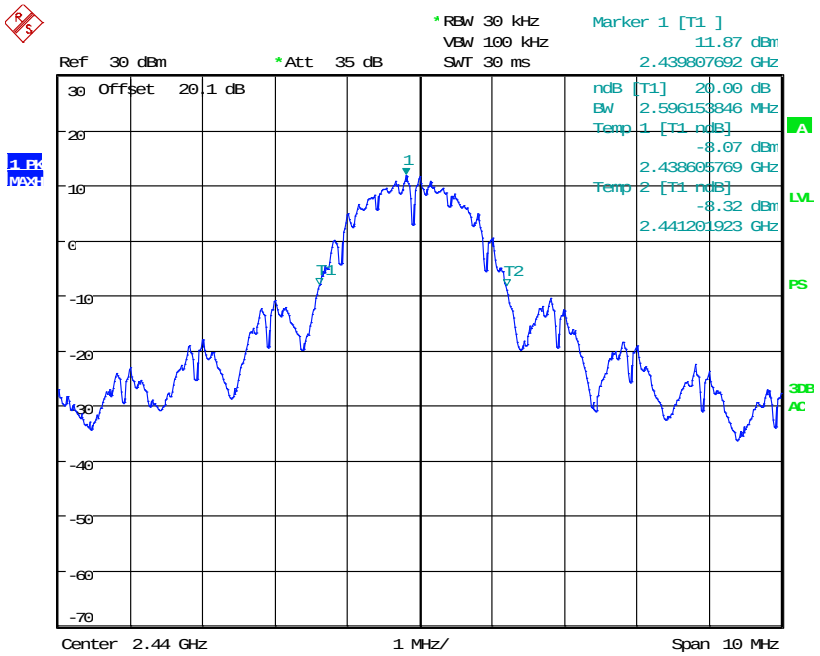


Figure 7.4.4.2-8: 20dB BW Middle Channel – AP2

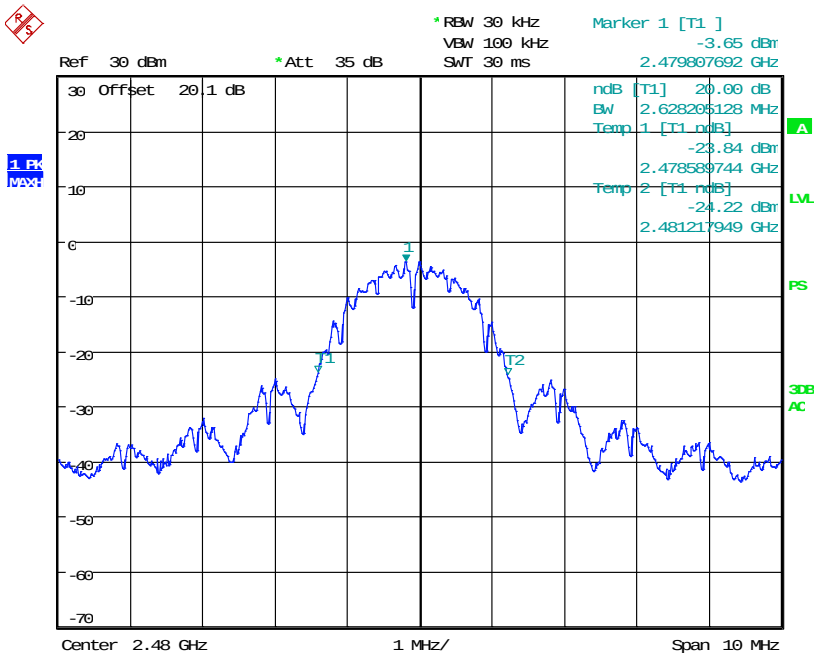


Figure 7.4.4.2-9: 20dB BW High Channel – AP2

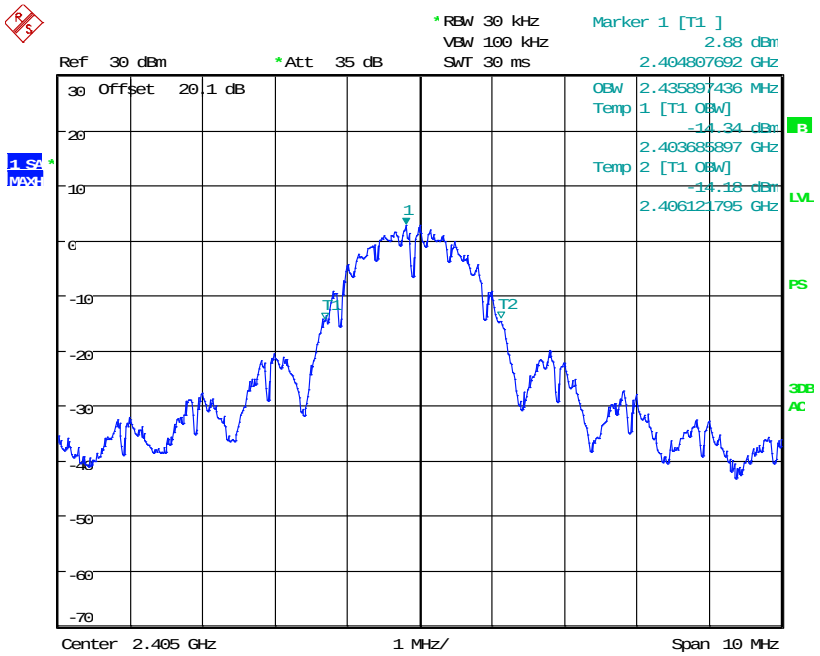


Figure 7.4.4.2-10: 99% OBW Low Channel – AP2

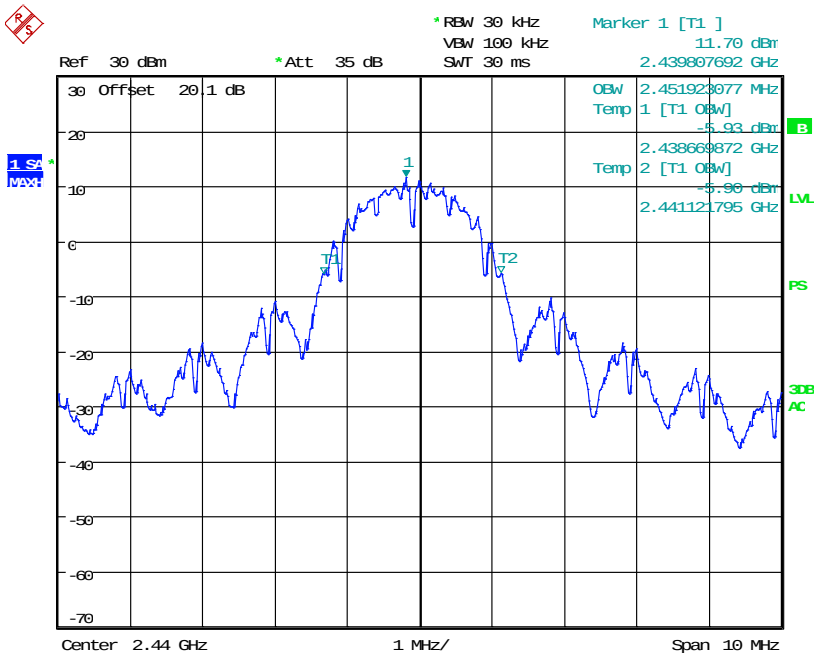


Figure 7.4.4.2-11: 99% OBW Middle Channel – AP2

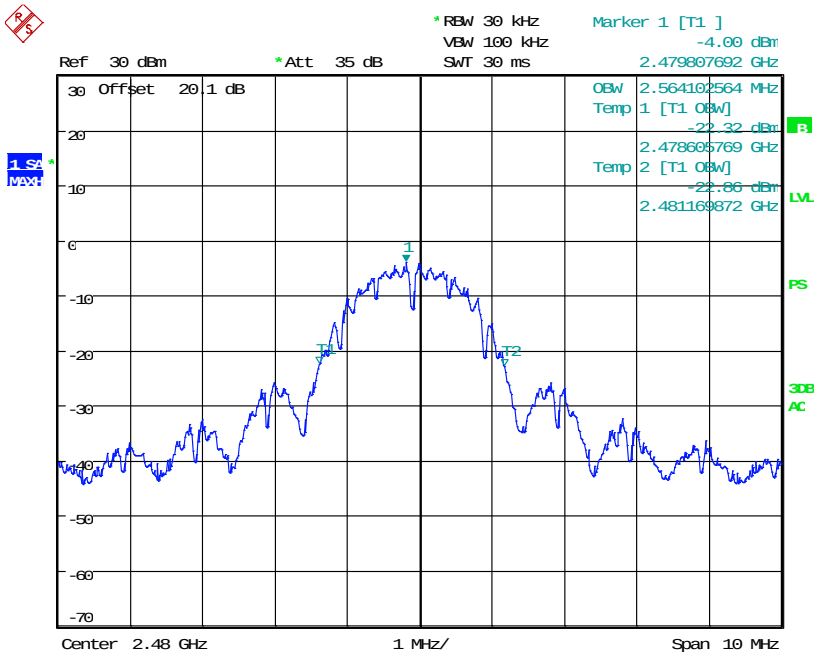


Figure 7.4.4.2-12: 99% OBW High Channel – AP2

Table 7.4.4.2-3: 20dB / 99% Bandwidth – AS1

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
2405	2596.154	2435.897
2440	2612.179	2467.949
2480	2644.231	2532.051

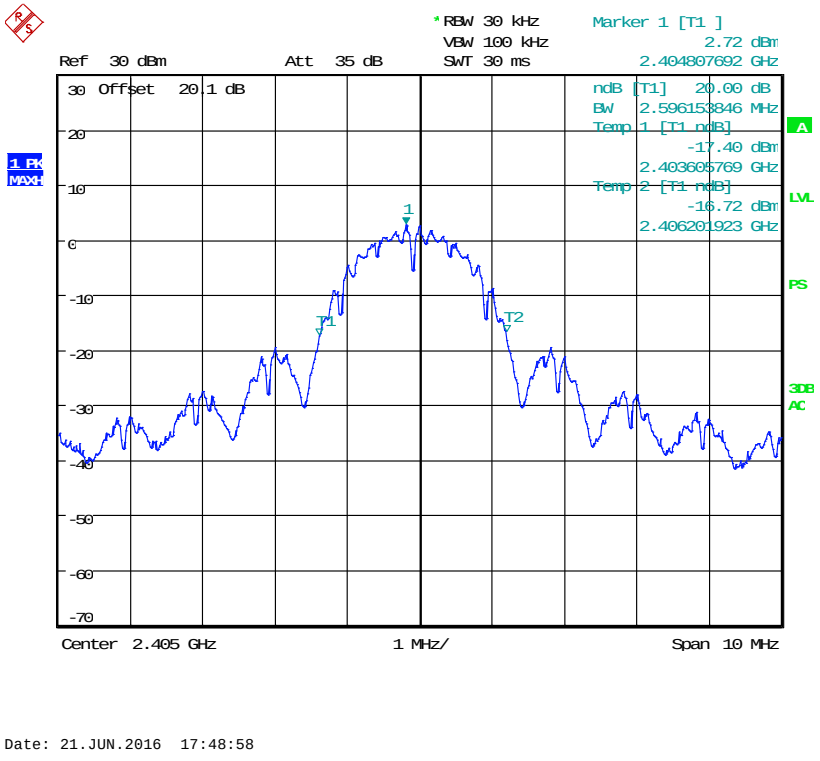


Figure 7.4.4.2-13: 20dB BW Low Channel – AS1

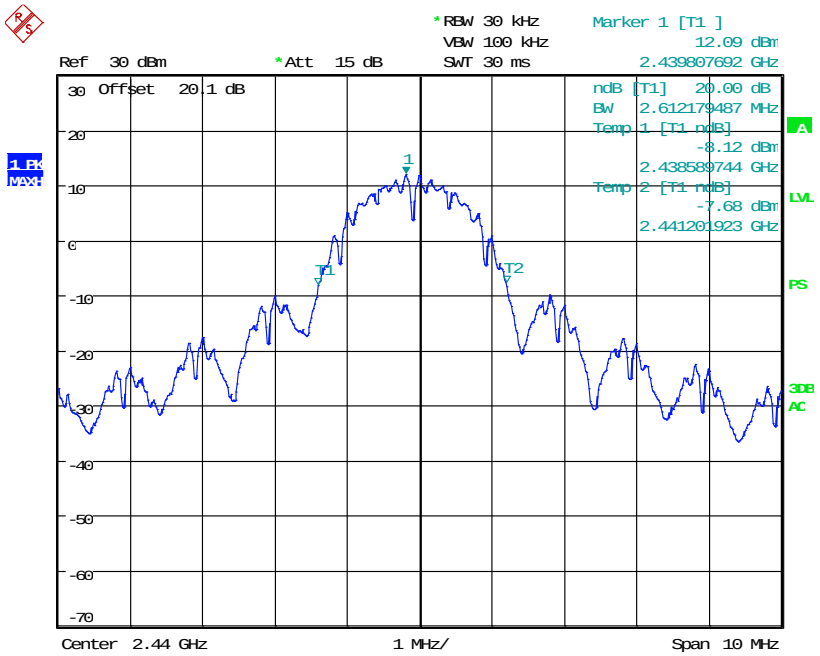


Figure 7.4.4.2-14: 20dB BW Middle Channel – AS1

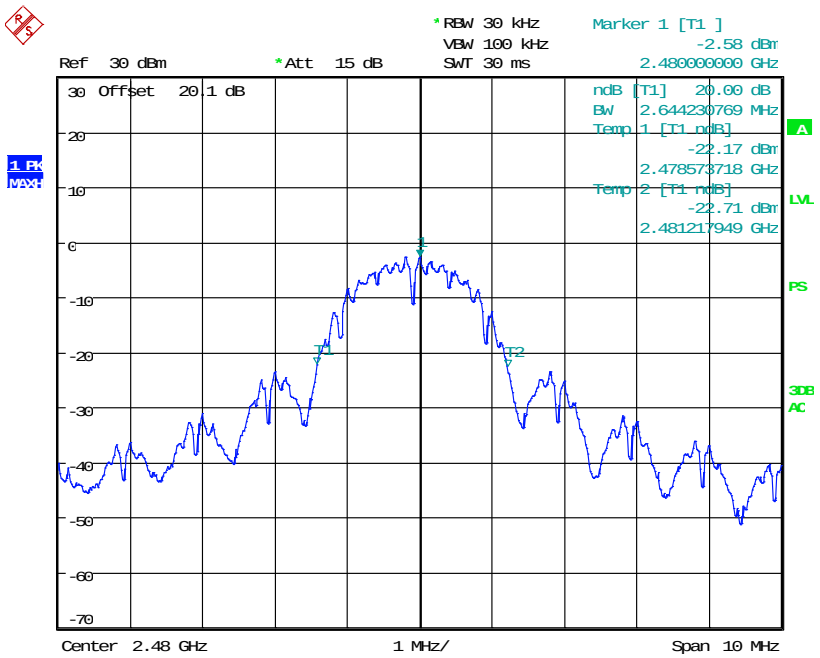


Figure 7.4.4.2-15: 20dB BW High Channel – AS1

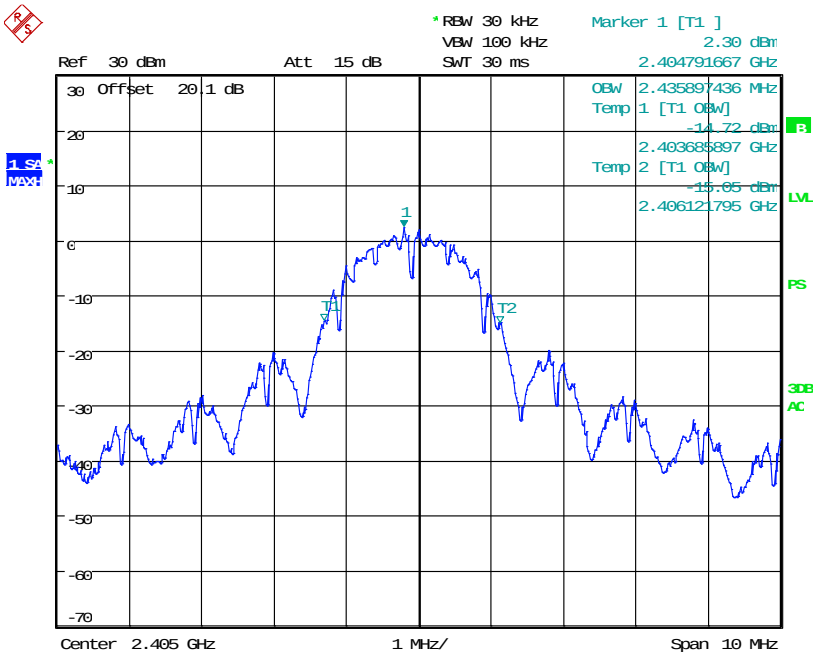


Figure 7.4.4.2-16: 99% OBW Low Channel – AS1

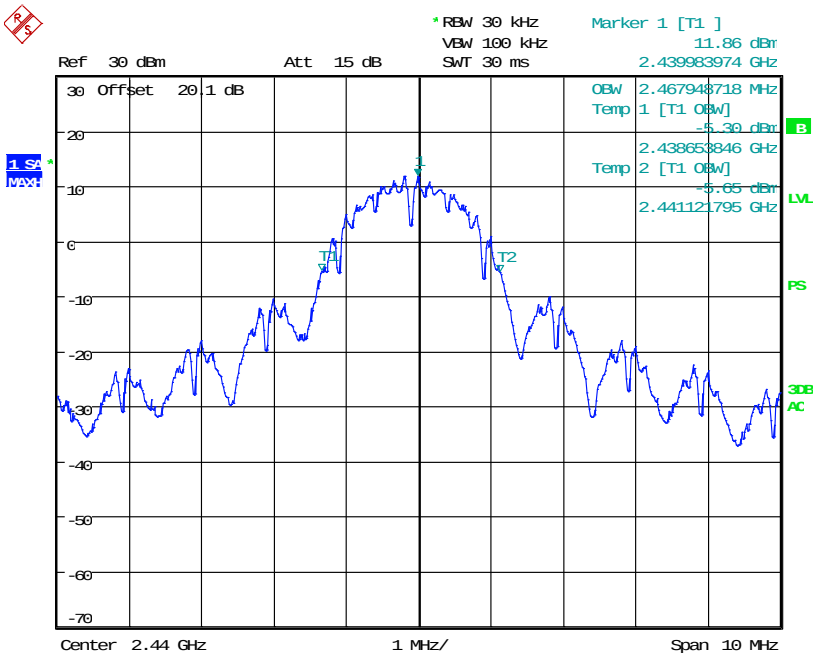


Figure 7.4.4.2-17: 99% OBW Middle Channel – AS1

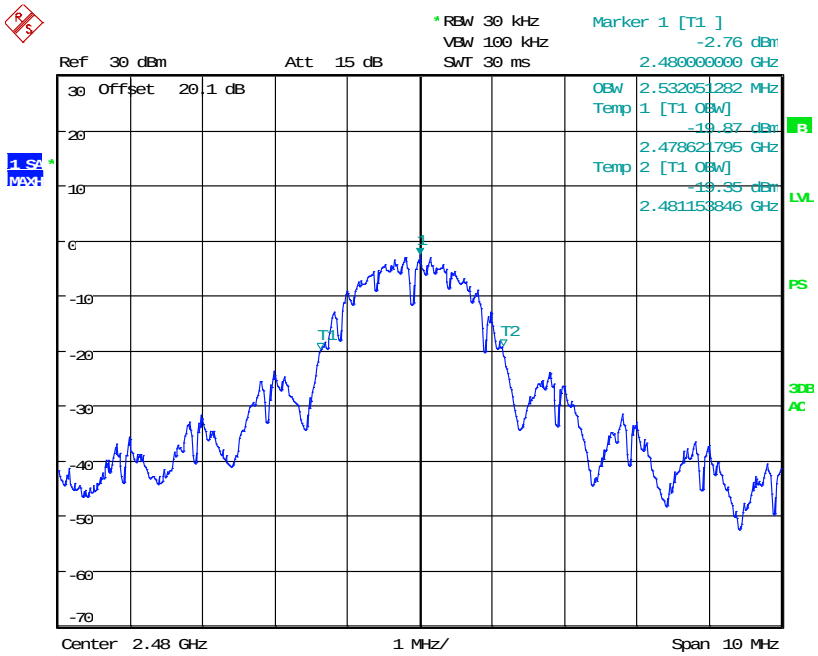


Figure 7.4.4.2-18: 99% OBW High Channel – AS1

Table 7.4.4.2-4: 20dB / 99% Bandwidth – AS2

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
2405	2596.154	2435.897
2440	2612.179	2483.974
2480	2612.179	2548.077

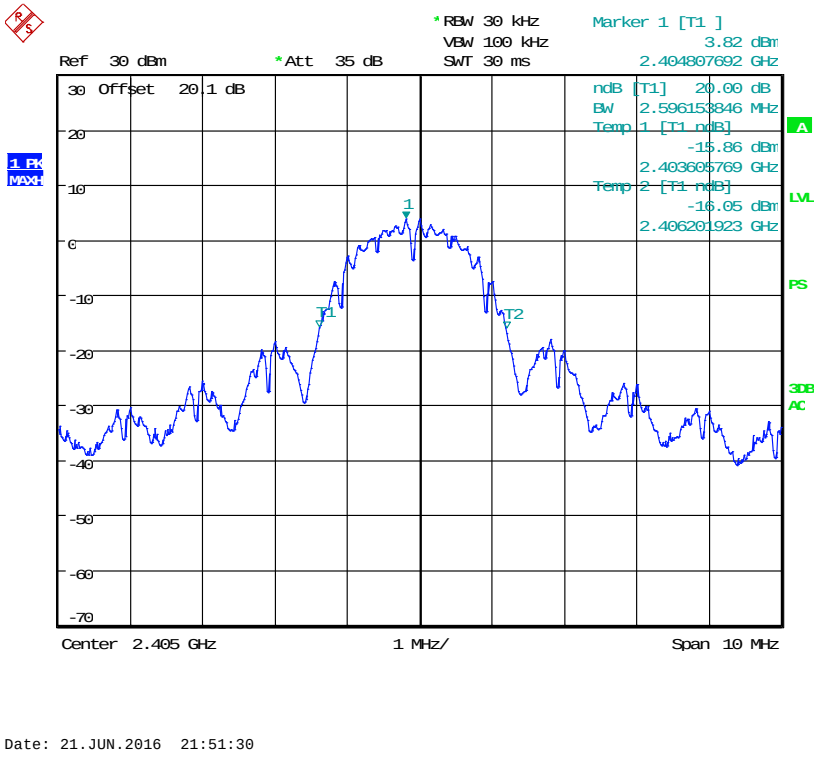


Figure 7.4.4.2-19: 20dB BW Low Channel – AS2

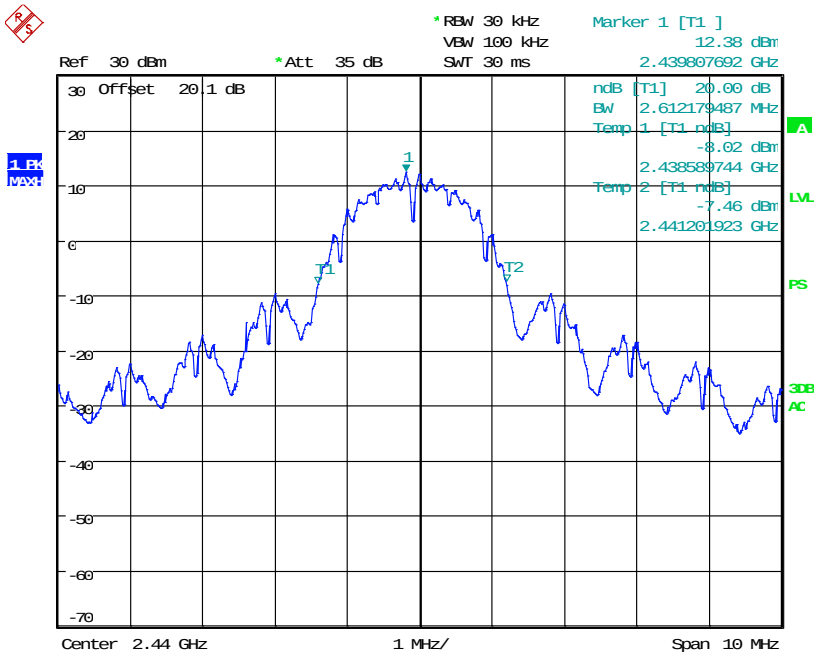


Figure 7.4.4.2-20: 20dB BW Middle Channel – AS2

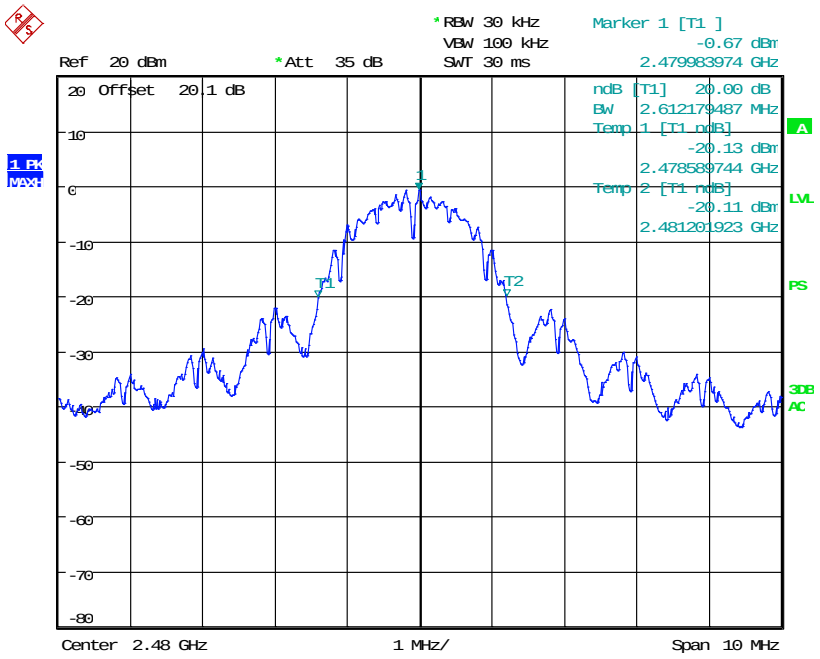


Figure 7.4.4.2-21: 20dB BW High Channel – AS2

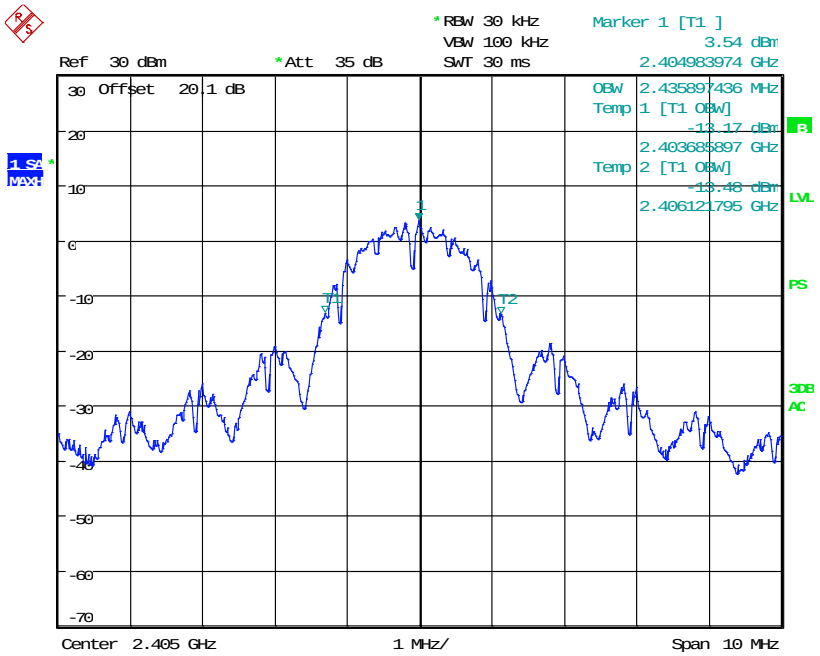


Figure 7.4.4.2-22: 99% OBW Low Channel – AS2

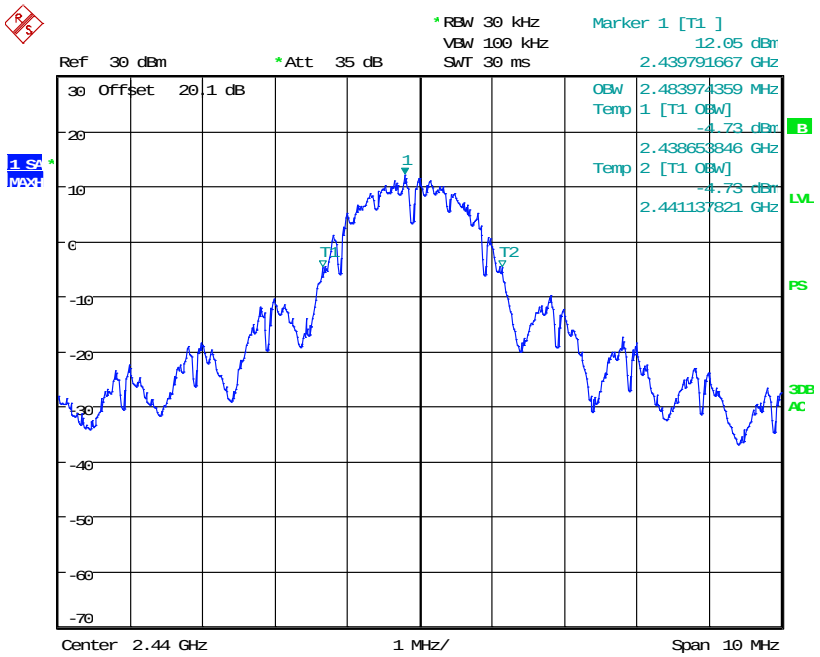


Figure 7.4.4.2-23: 99% OBW Middle Channel – AS2

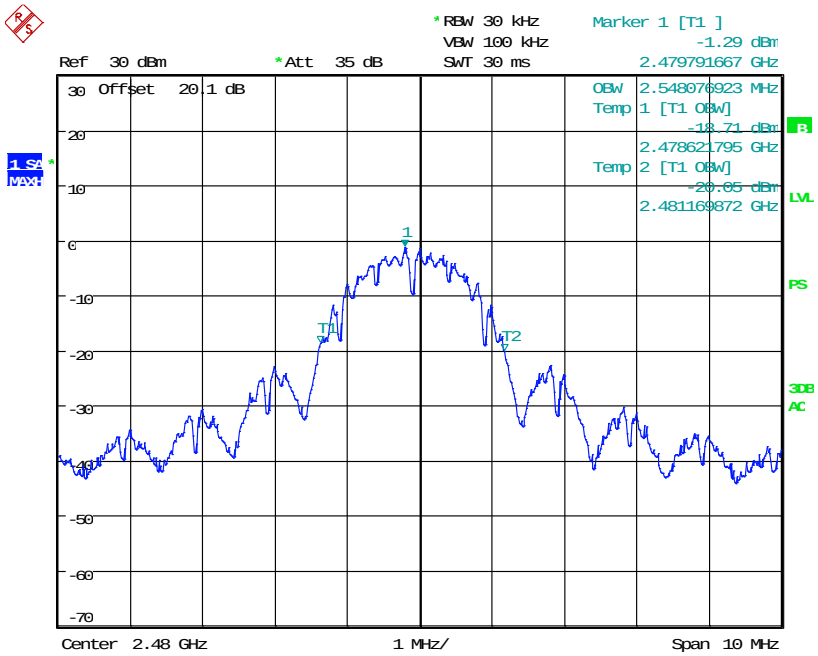


Figure 7.4.4.2-24: 99% OBW High Channel – AS2

7.5 Band-Edge Compliance and Spurious Emissions

7.5.1 Band-Edge Compliance of RF Conducted Emissions – FCC 15.247(d); ISED Canada: RSS-247 5.5

7.5.1.1 Measurement Procedure

The RF output port of the EUT was connected to the input of the spectrum analyzer through suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to >= 300 kHz.

7.5.1.2 Measurement Results

Results are shown below.

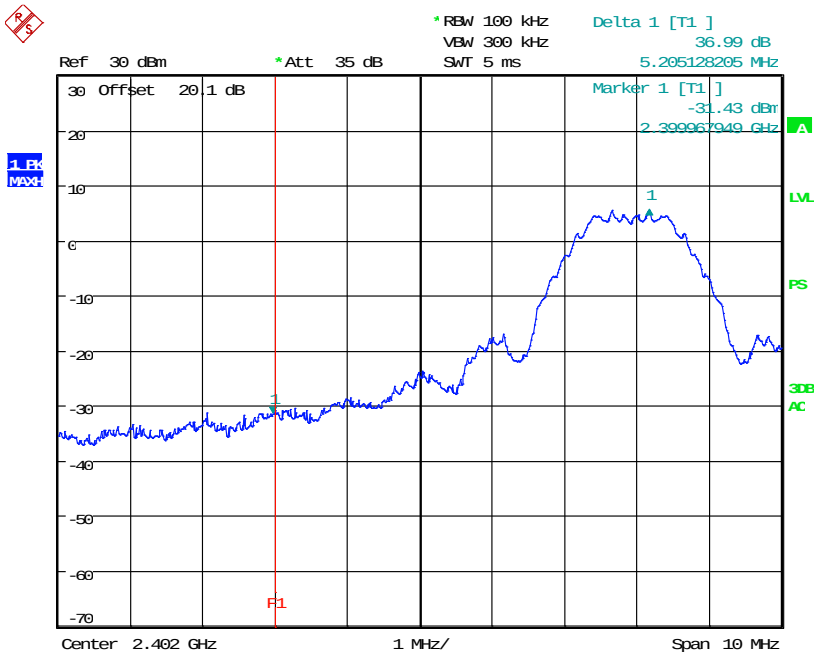


Figure 7.5.1.2-1: Lower Band-edge – Continuous Mode – AP1

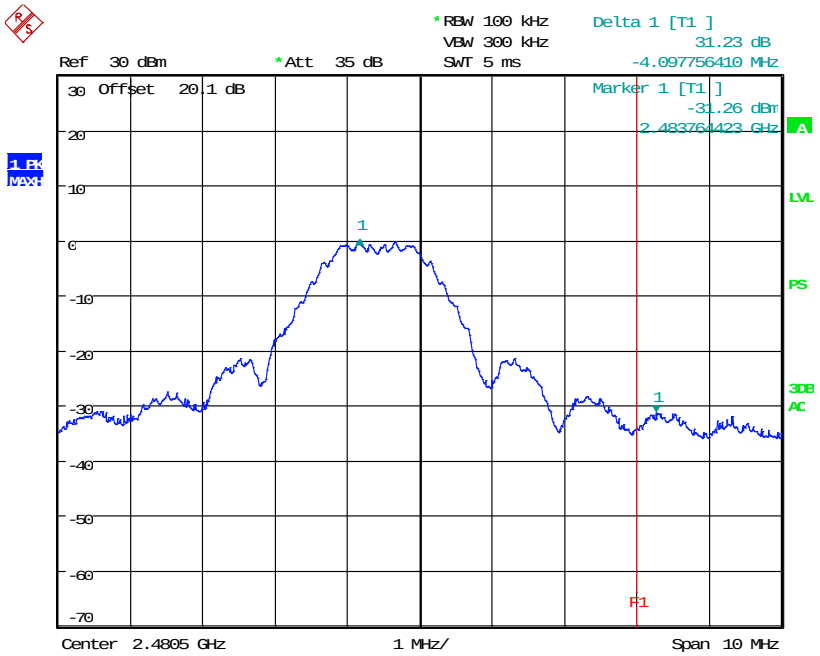


Figure 7.5.1.2-2: Upper Band-edge – Continuous Mode – AP1

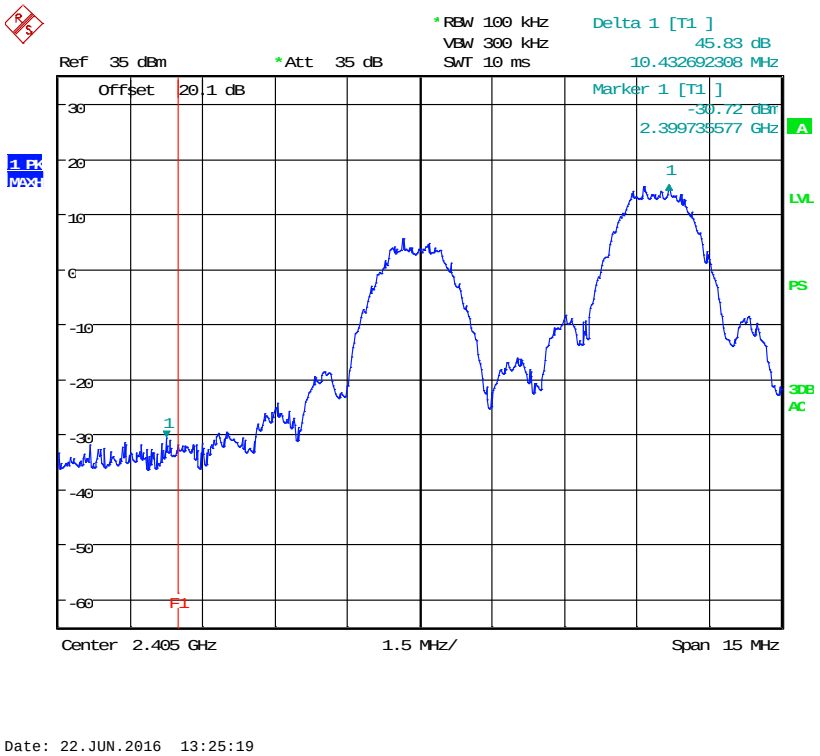


Figure 7.5.1.2-3: Lower Band-edge – Hopping Mode – AP1

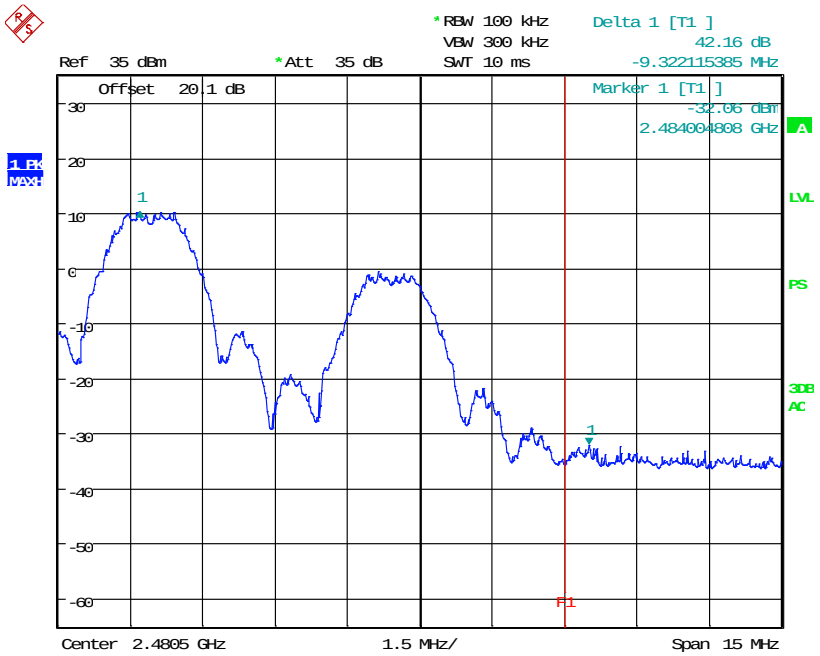


Figure 7.5.1.2-4: Upper Band-edge – Hopping Mode – AP1

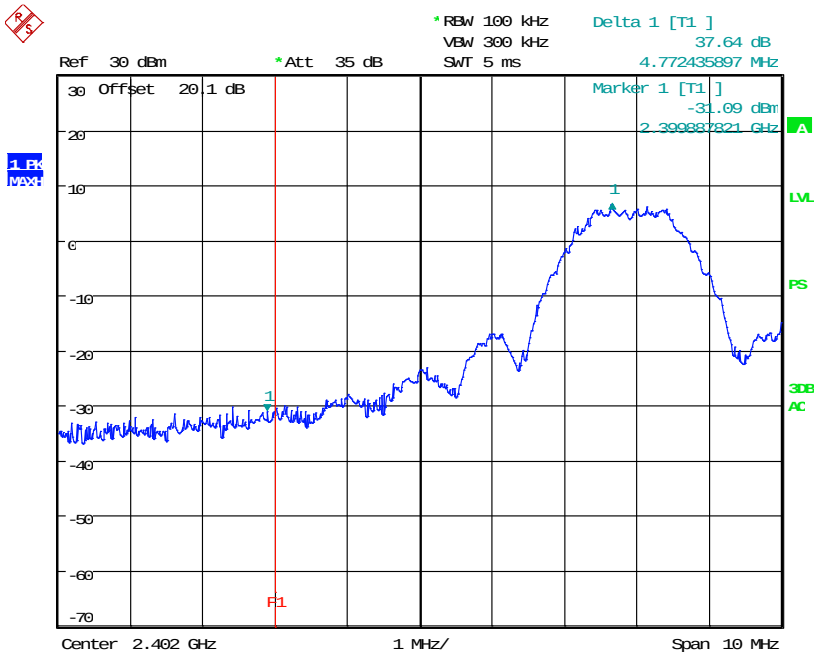


Figure 7.5.1.2-5: Lower Band-edge – Continuous Mode – AP2

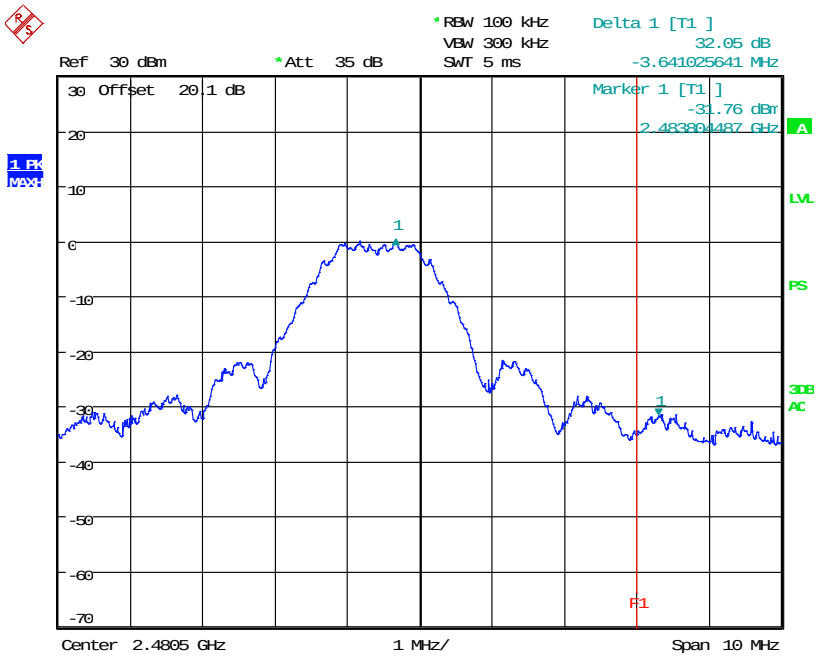


Figure 7.5.1.2-6: Upper Band-edge – Continuous Mode – AP2

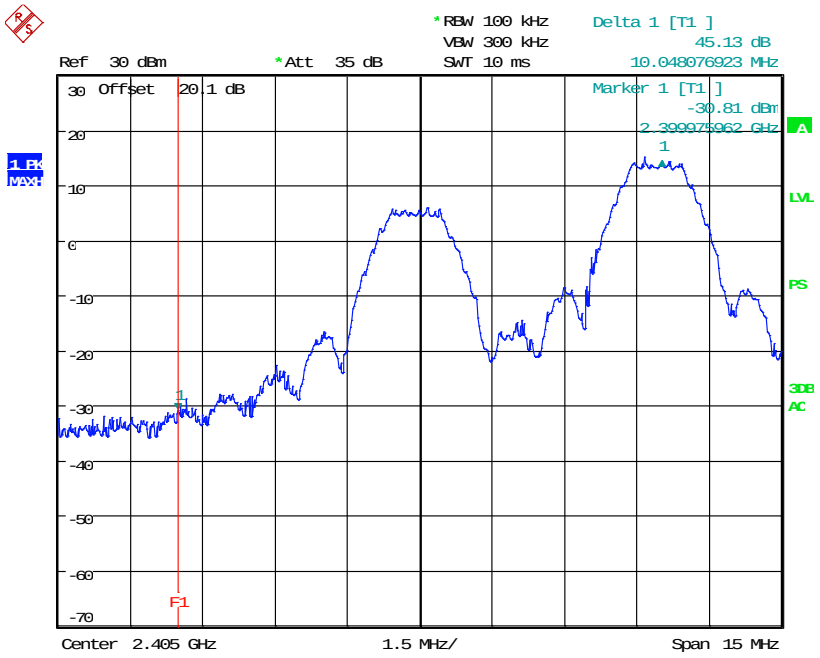


Figure 7.5.1.2-7: Lower Band-edge – Hopping Mode – AP2

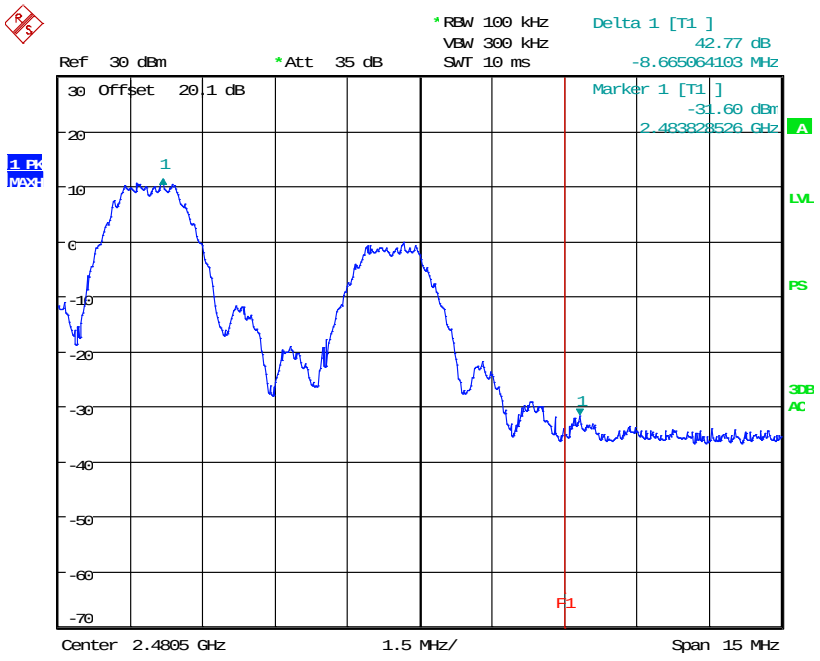


Figure 7.5.1.2-8: Upper Band-edge – Hopping Mode – AP2

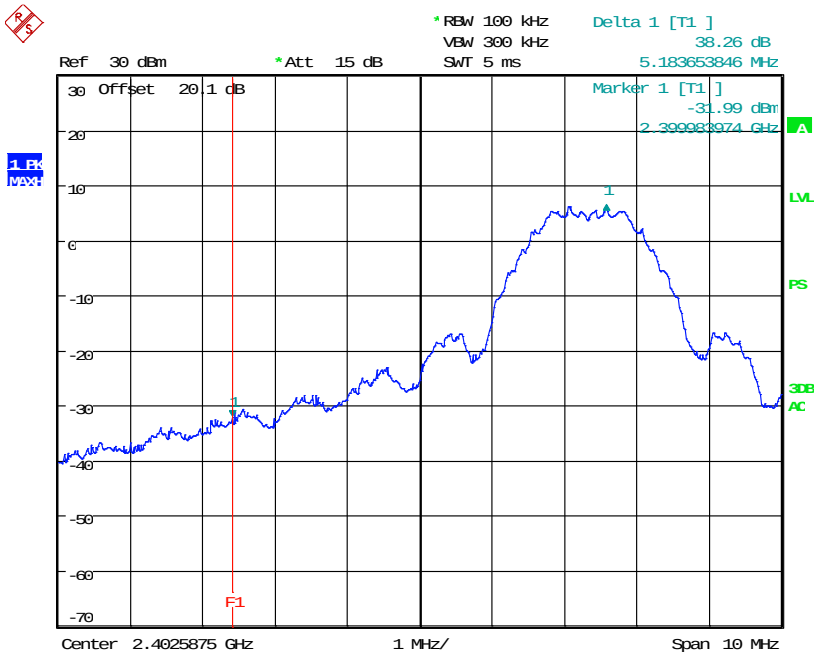


Figure 7.5.1.2-9: Lower Band-edge – Continuous Mode – AS1

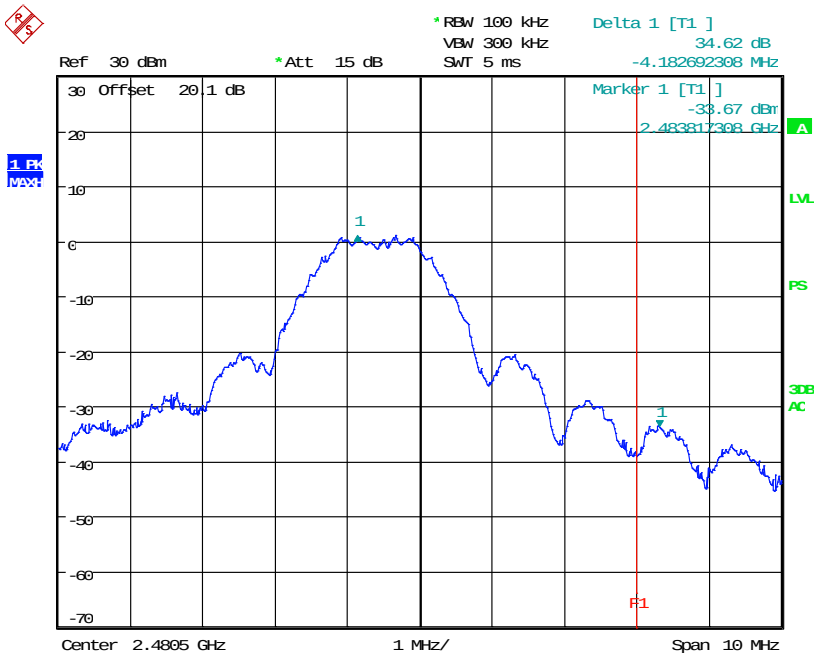


Figure 7.5.1.2-10: Upper Band-edge – Continuous Mode – AS1

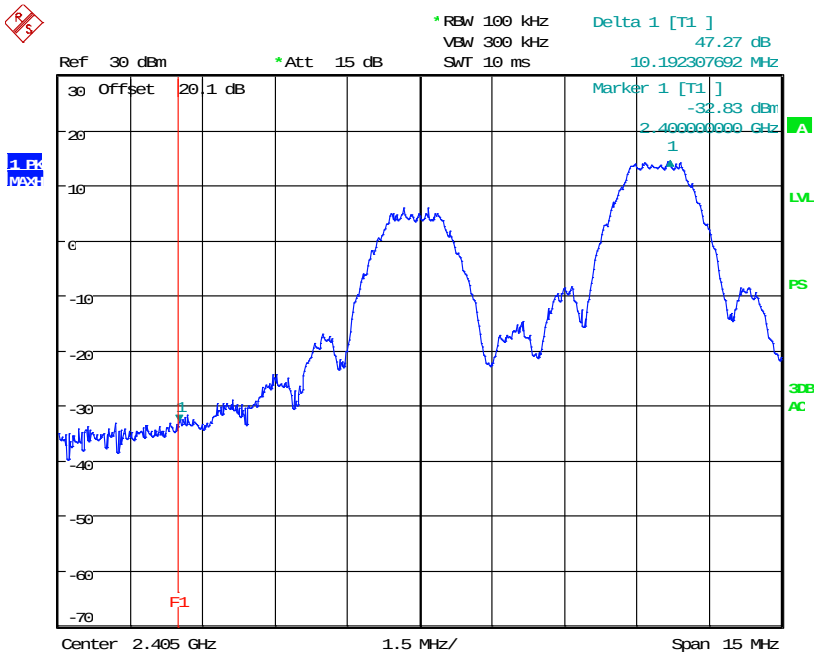


Figure 7.5.1.2-11: Lower Band-edge – Hopping Mode – AS1

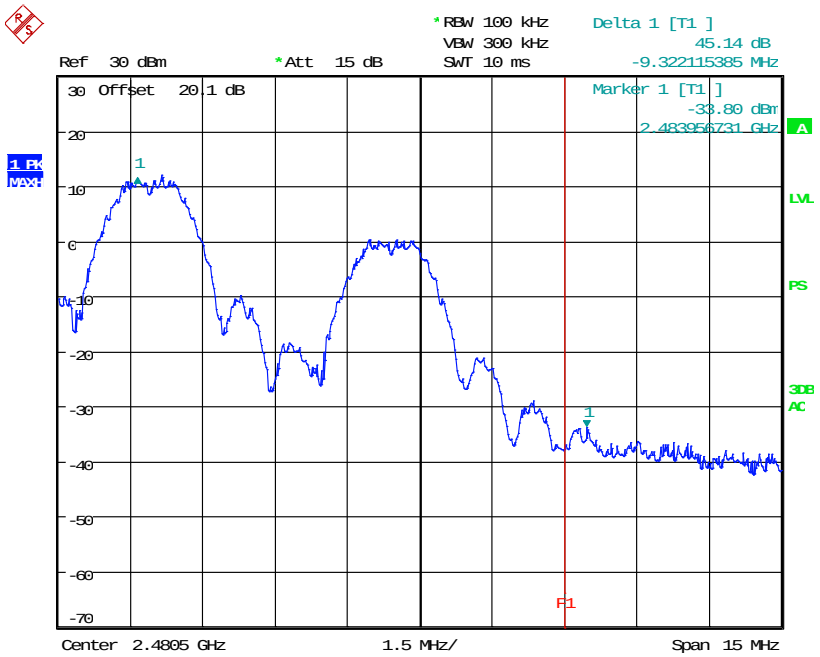


Figure 7.5.1.2-12: Upper Band-edge – Hopping Mode – AS1

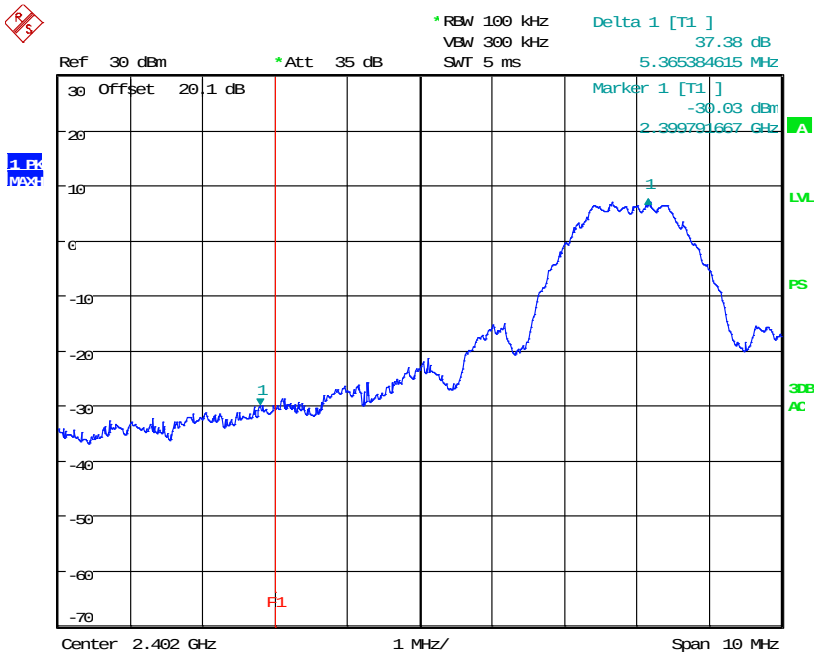


Figure 7.5.1.2-13: Lower Band-edge – Continuous Mode – AS2

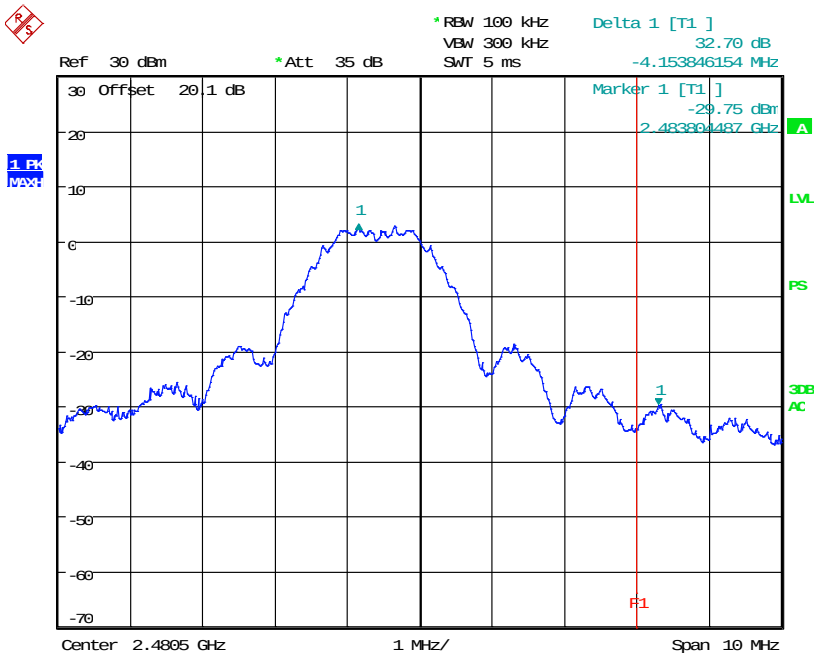


Figure 7.5.1.2-14: Upper Band-edge – Continuous Mode – AS2

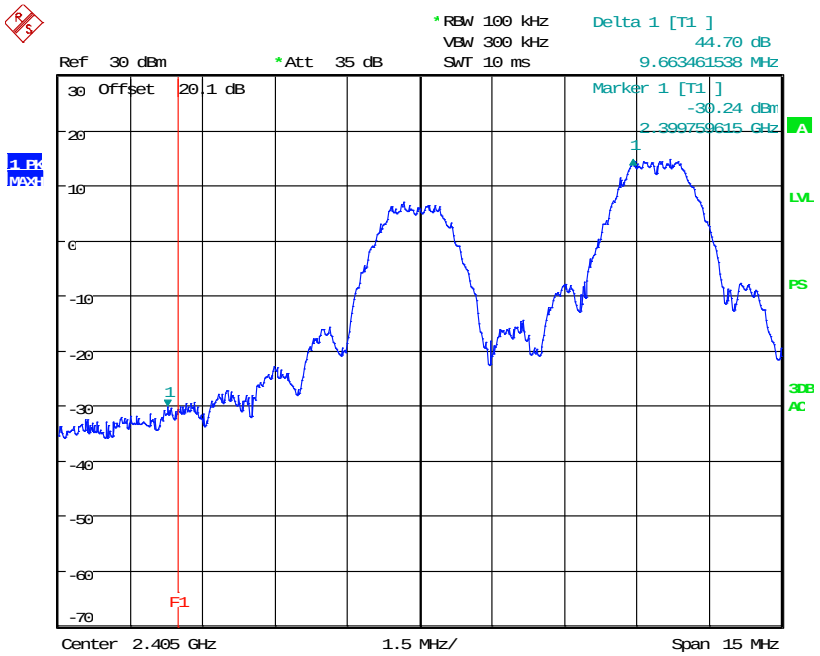


Figure 7.5.1.2-15: Lower Band-edge – Hopping Mode – AS2

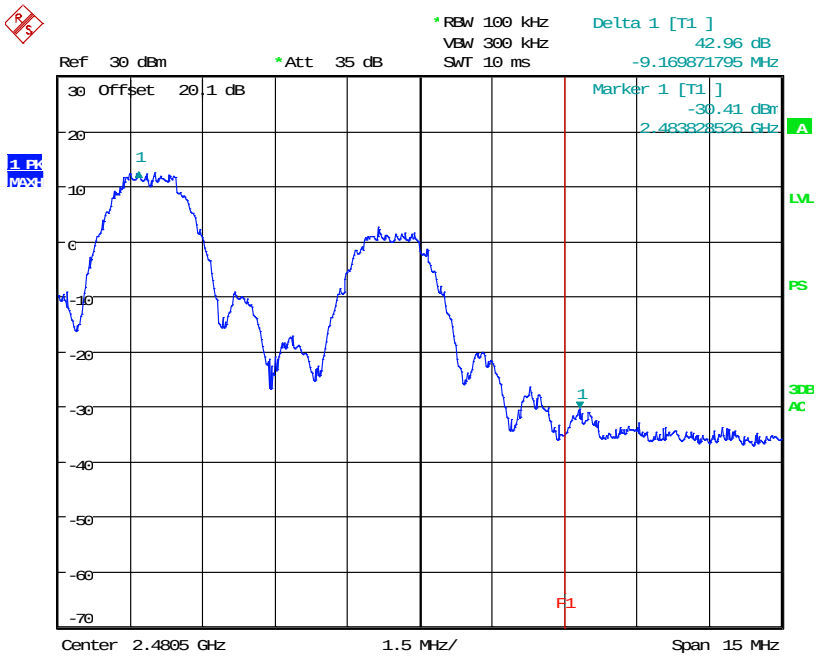


Figure 7.5.1.2-16: Upper Band-edge – Hopping Mode – AS2

7.5.2 RF Conducted Spurious Emissions – FCC 15.247(d); ISED Canada: RSS-247 5.5

7.5.2.1 Measurement Procedure

The RF output port of the EUT was connected to the spectrum analyzer input using a 20 dB attenuator. The EUT was investigated for conducted spurious emissions from 30MHz to 26 GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100 kHz. A peak detector function was used with the trace set to max hold. The levels were corrected for cable and attenuator losses.

7.5.2.2 Measurement Results

Results are shown below.

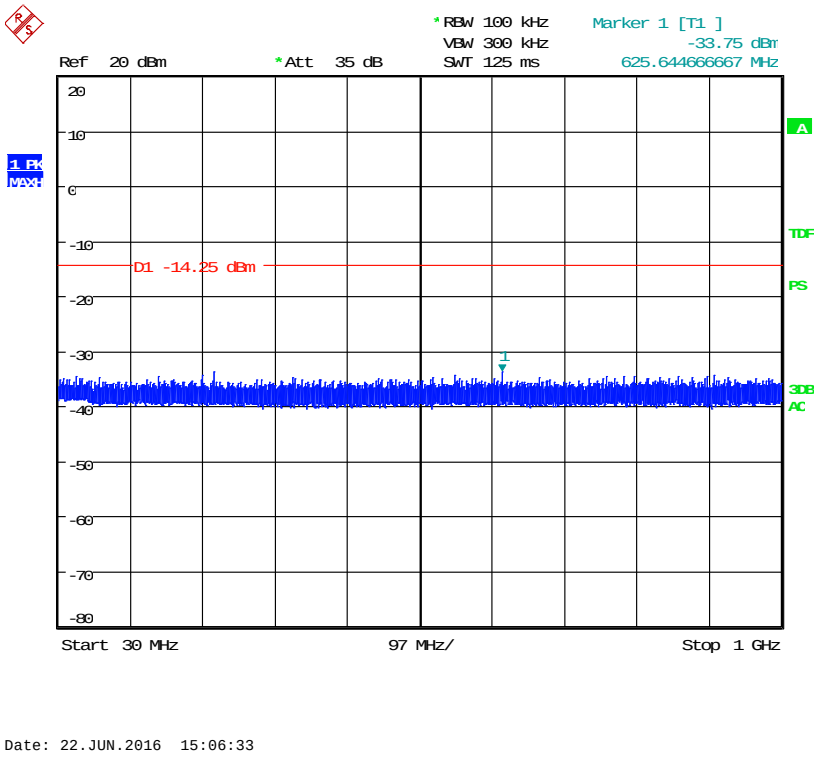


Figure 7.5.2.2-1: 30 MHz – 1 GHz – Low Channel – AP1

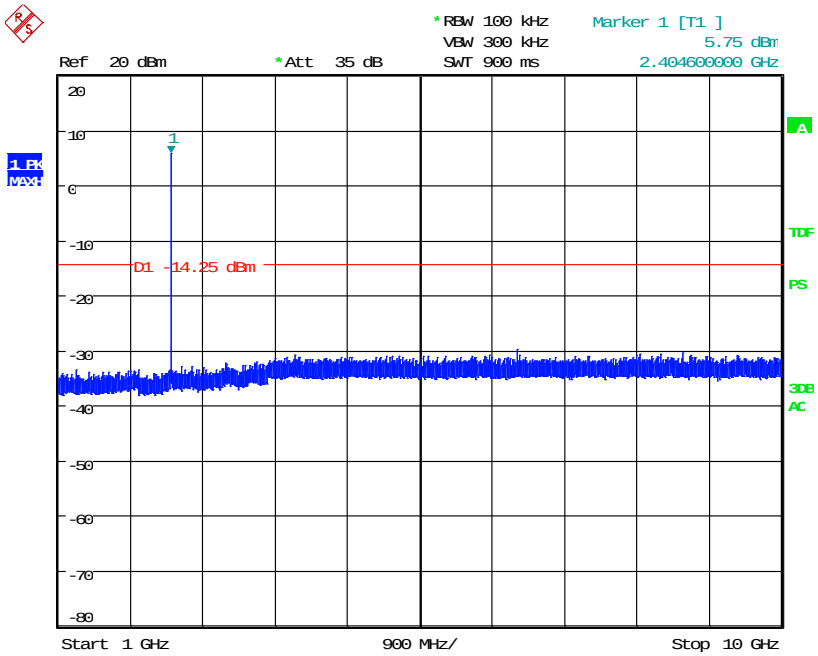


Figure 7.5.2.2-2: 1 GHz –10 GHz – Low Channel – AP1

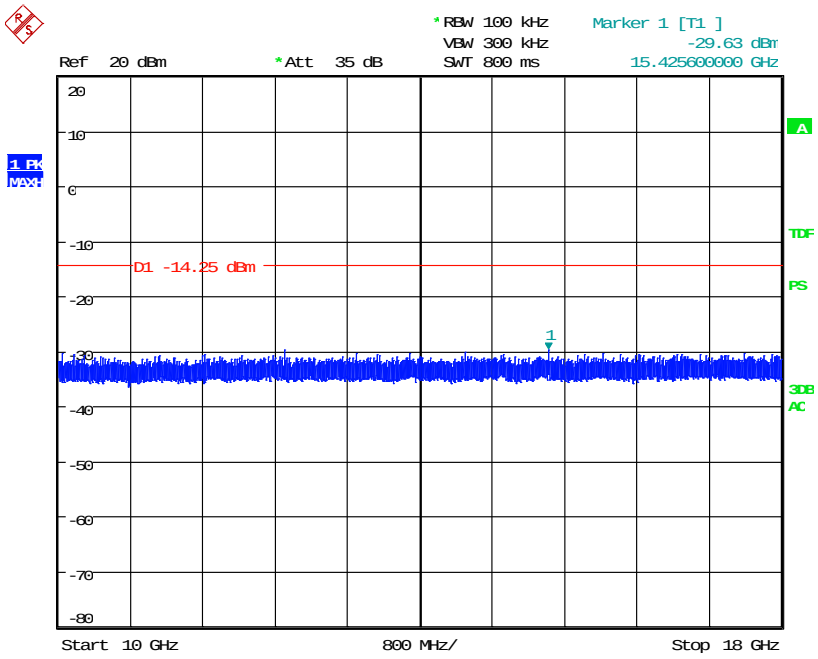


Figure 7.5.2.2-3: 10 GHz – 18 GHz – Low Channel – AP1

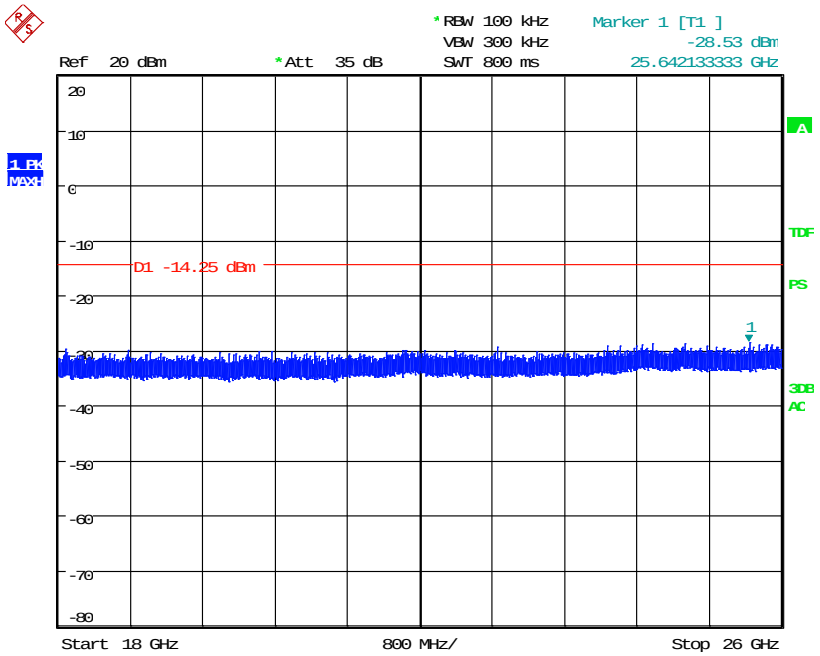


Figure 7.5.2.2-4: 18 GHz –26 GHz – Low Channel – AP1

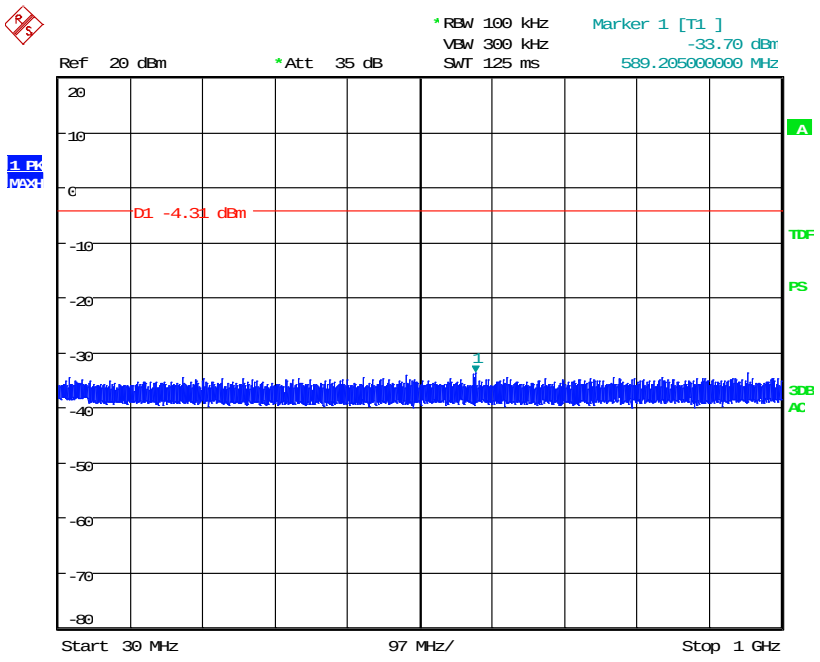


Figure 7.5.2.2-5: 30 MHz – 1 GHz – Middle Channel – AP1

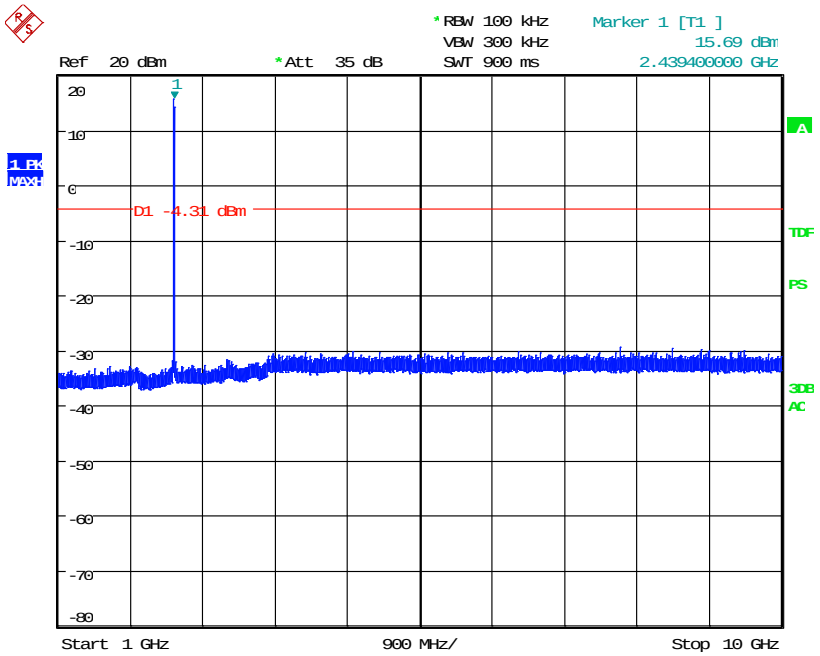


Figure 7.5.2.2-6: 1 GHz –10 GHz – Middle Channel – AP1

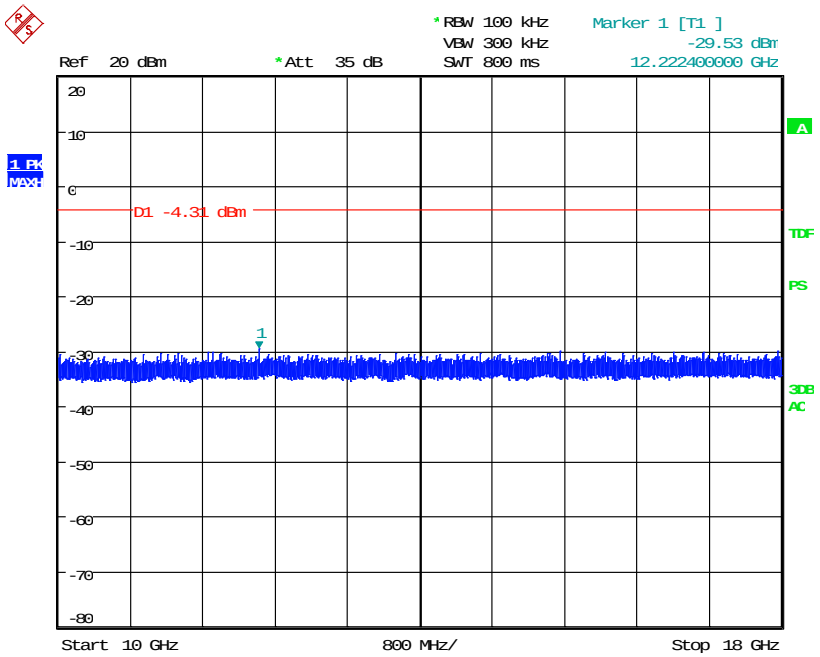
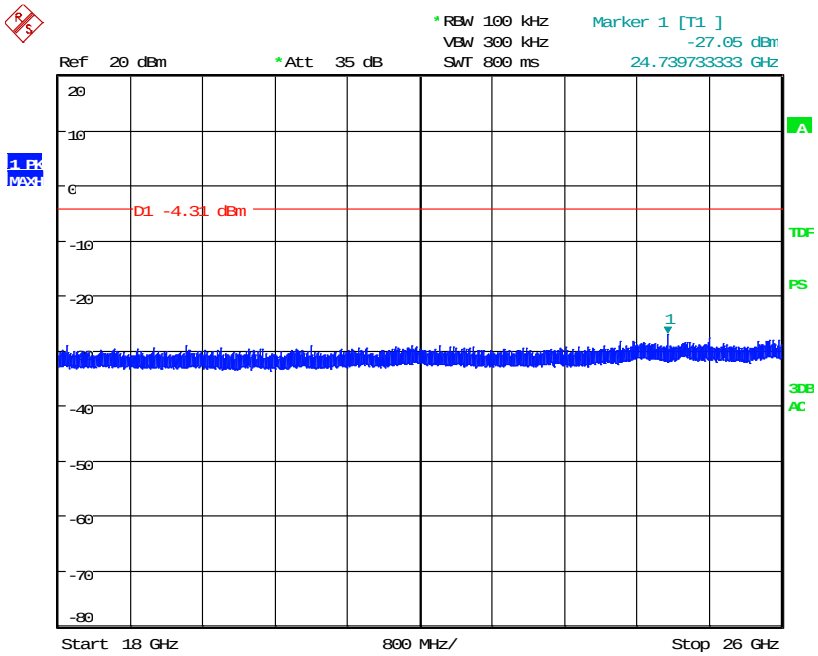
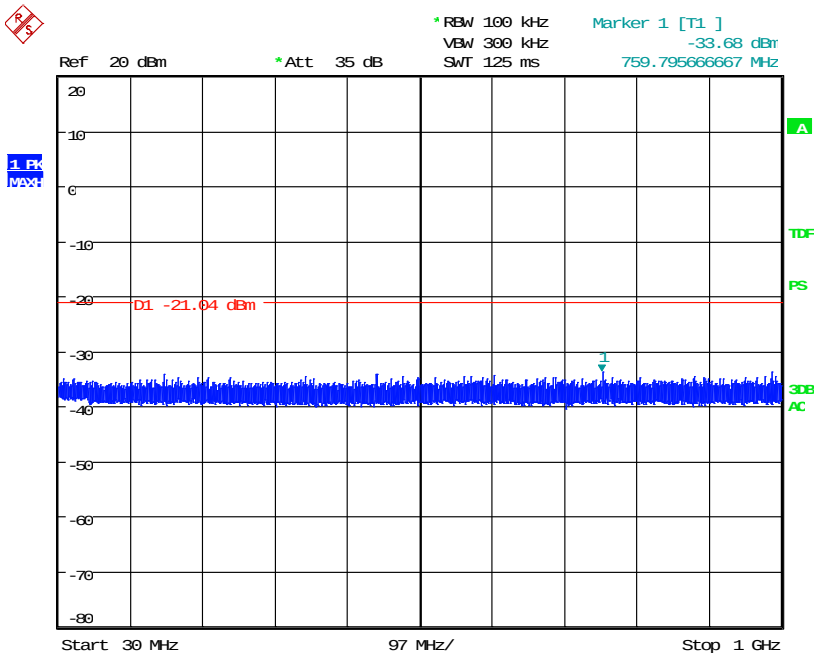


Figure 7.5.2.2-7: 10 GHz – 18 GHz – Middle Channel – AP1



Date: 22.JUN.2016 16:23:15

Figure 7.5.2.2-8: 18 GHz –26 GHz – Middle Channel – AP1



Date: 22.JUN.2016 16:31:36

Figure 7.5.2.2-9: 30 MHz – 1 GHz – High Channel – AP1

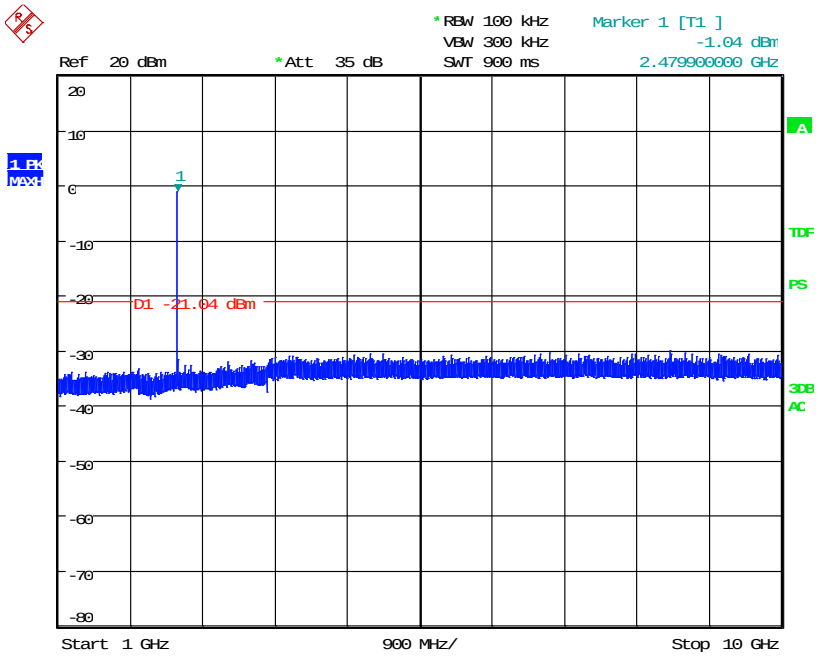


Figure 7.5.2.2-10: 1 GHz –10 GHz – High Channel – AP1

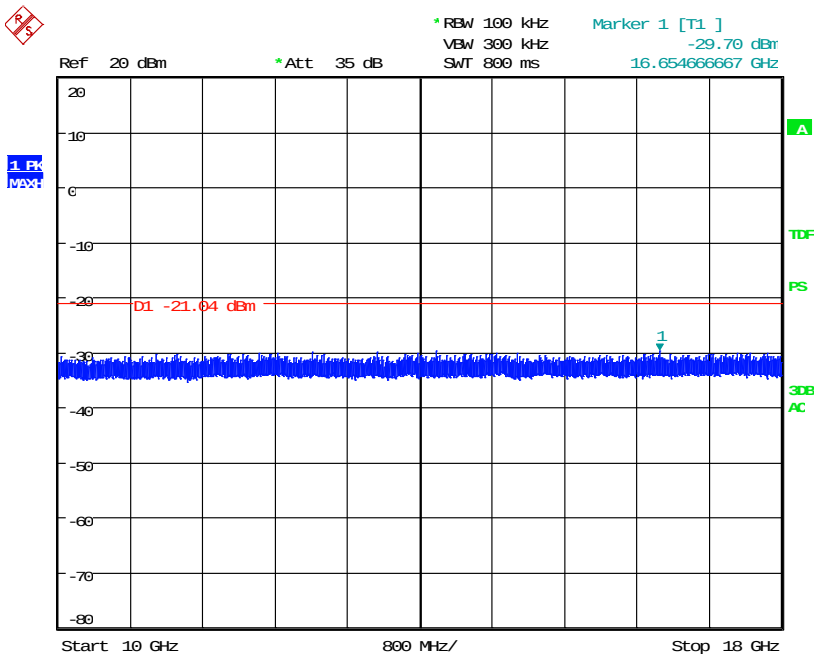


Figure 7.5.2.2-11: 10 GHz – 18 GHz – High Channel – AP1

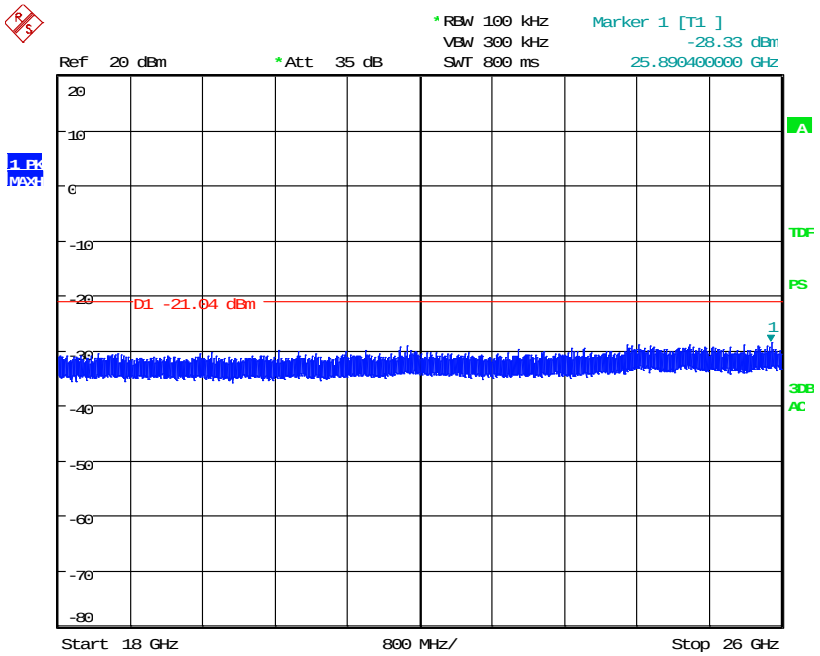


Figure 7.5.2.2-12: 18 GHz –26 GHz – High Channel – AP1

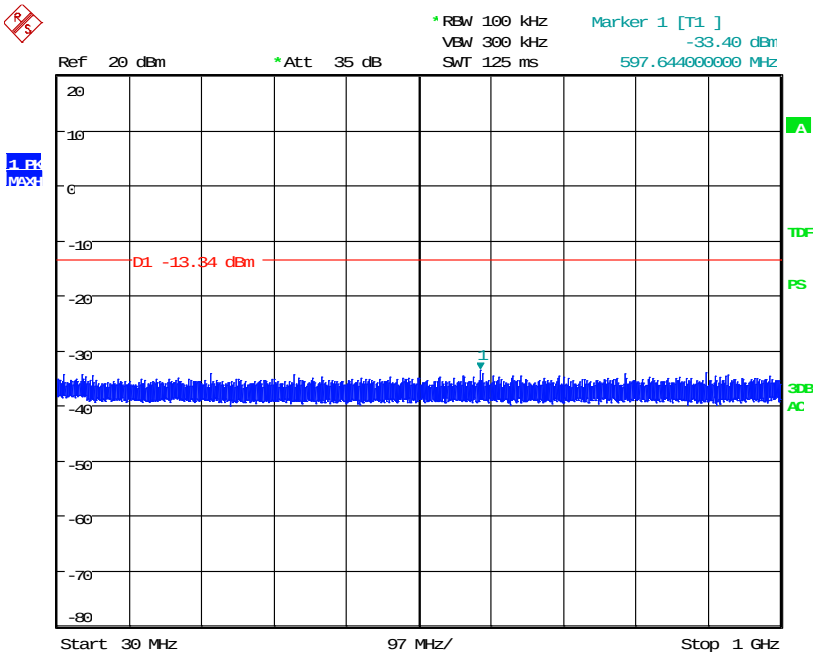


Figure 7.5.2.2-13: 30 MHz – 1 GHz – Low Channel – AP2

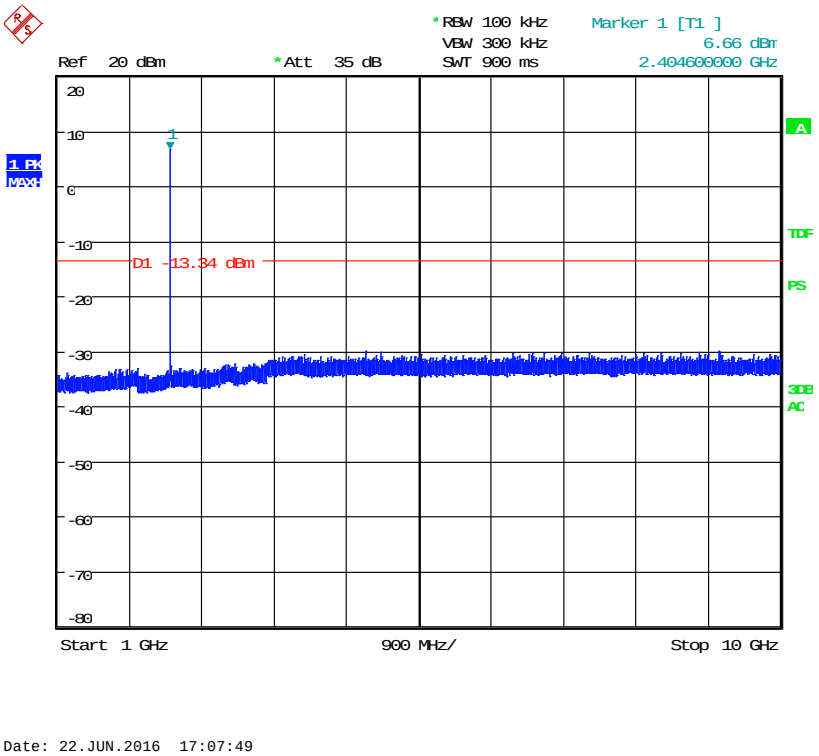


Figure 7.5.2.2-14: 1 GHz –10 GHz – Low Channel – AP2

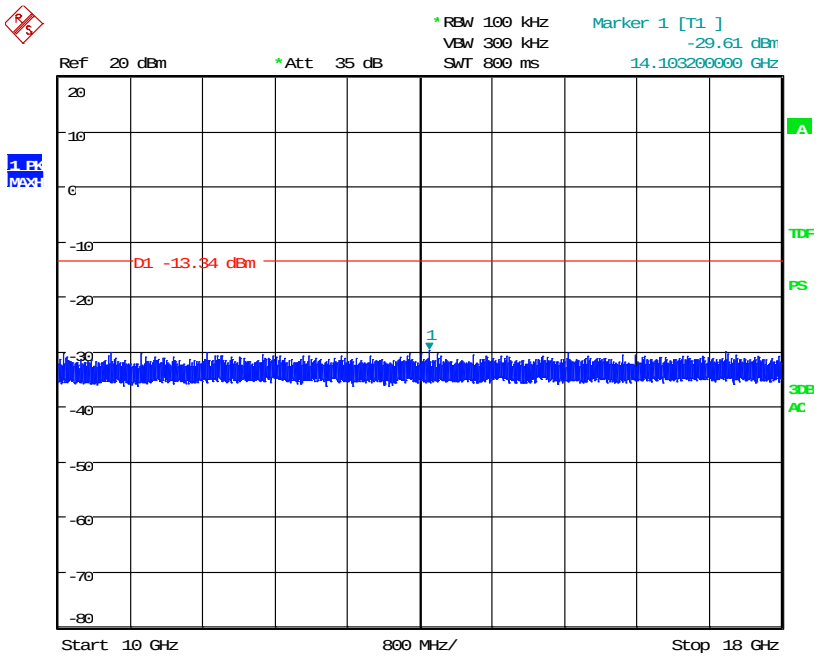


Figure 7.5.2.2-15: 10 GHz – 18 GHz – Low Channel – AP2

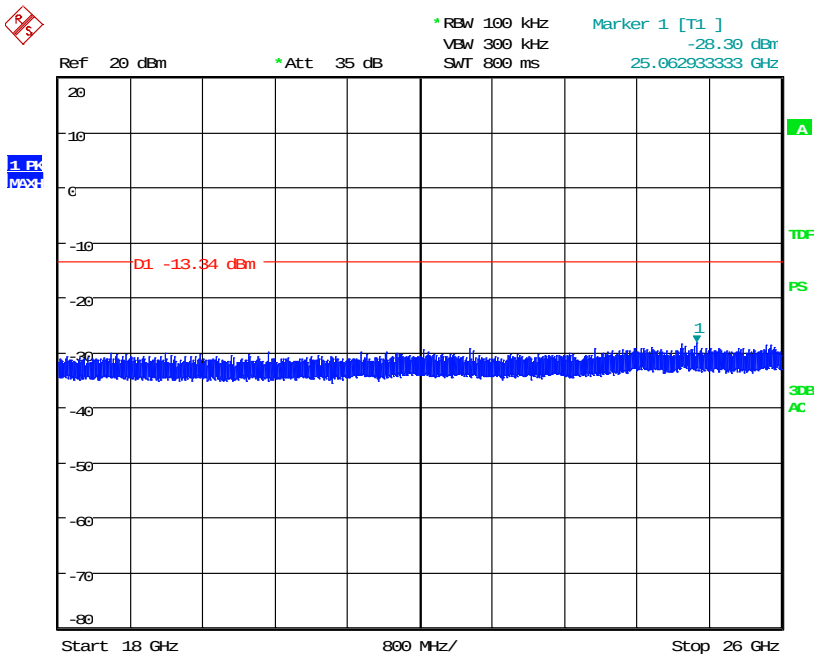


Figure 7.5.2.2-16: 18 GHz –26 GHz – Low Channel – AP2

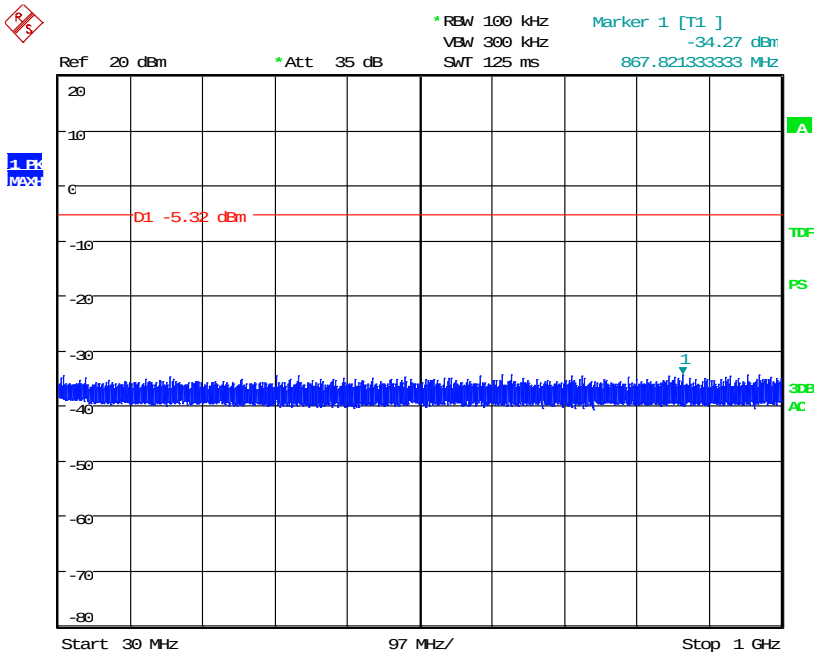


Figure 7.5.2.2-17: 30 MHz – 1 GHz – Middle Channel – AP2

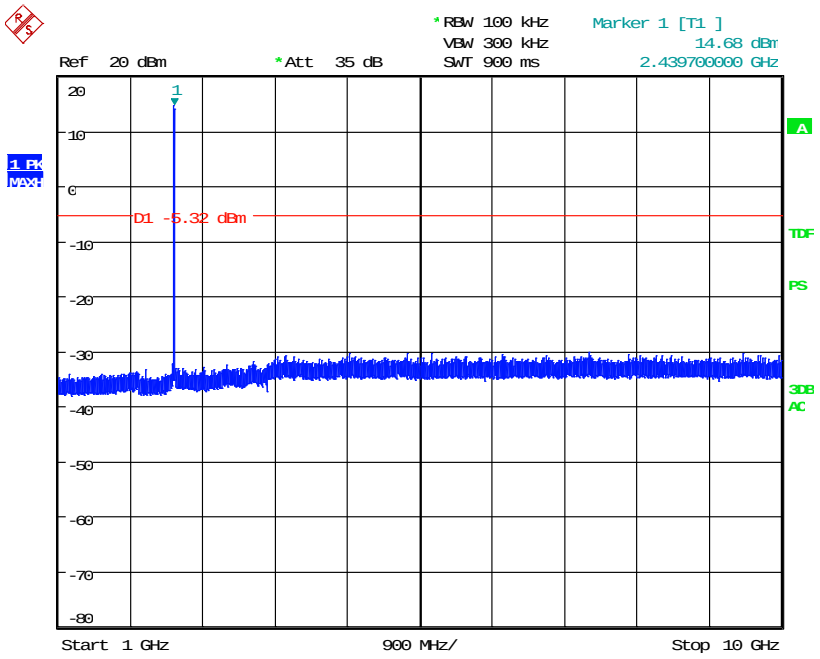


Figure 7.5.2.2-18: 1 GHz –10 GHz – Middle Channel – AP2

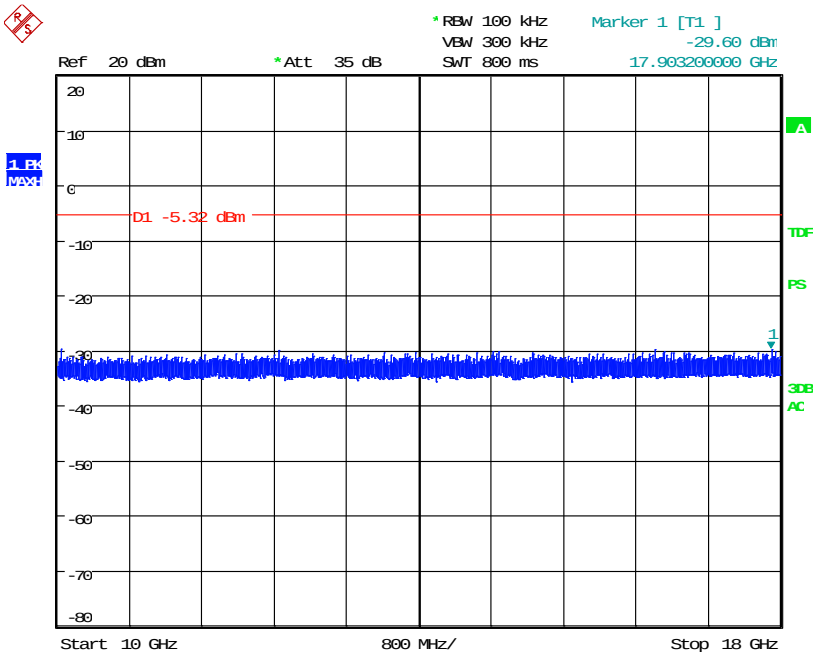


Figure 7.5.2.2-19: 10 GHz – 18 GHz – Middle Channel – AP2

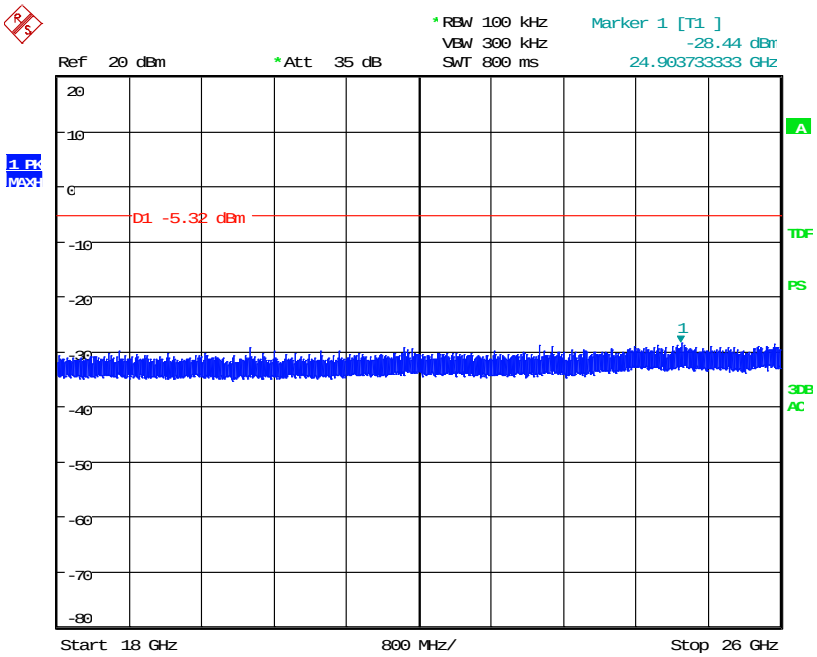


Figure 7.5.2.2-20: 18 GHz –26 GHz – Middle Channel – AP2

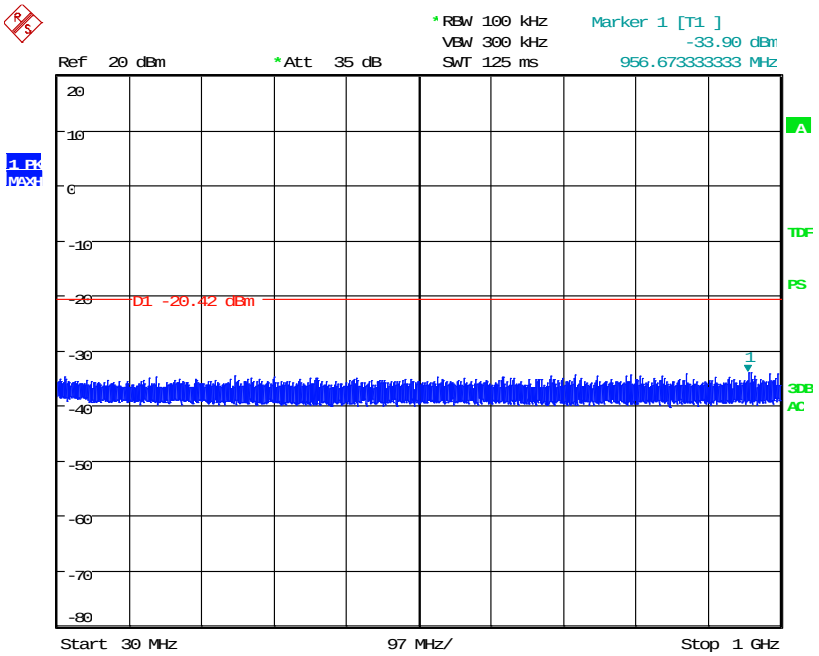


Figure 7.5.2.2-21: 30 MHz – 1 GHz – High Channel – AP2

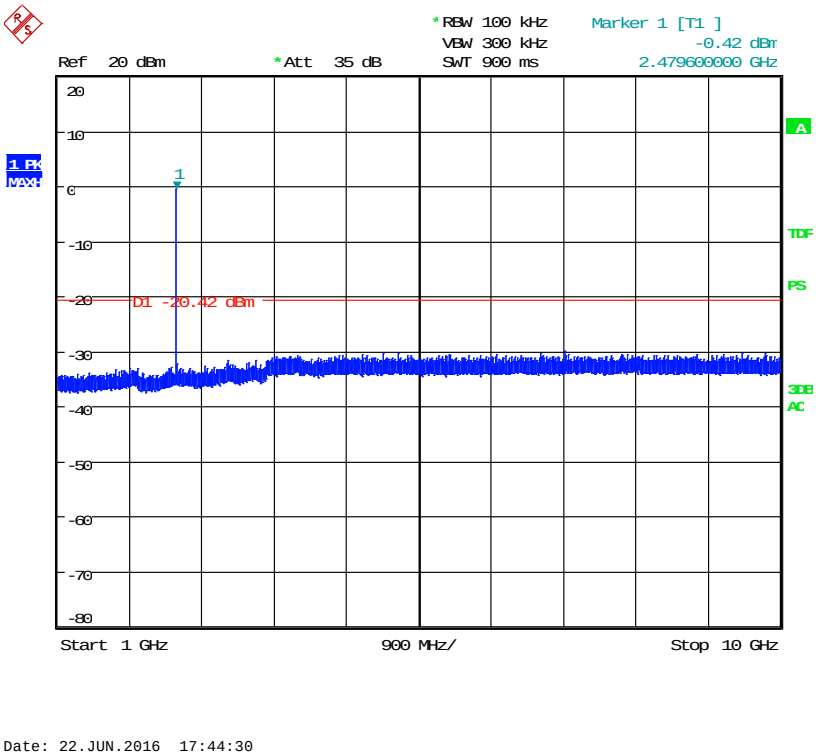


Figure 7.5.2.2-22: 1 GHz –10 GHz – High Channel – AP2

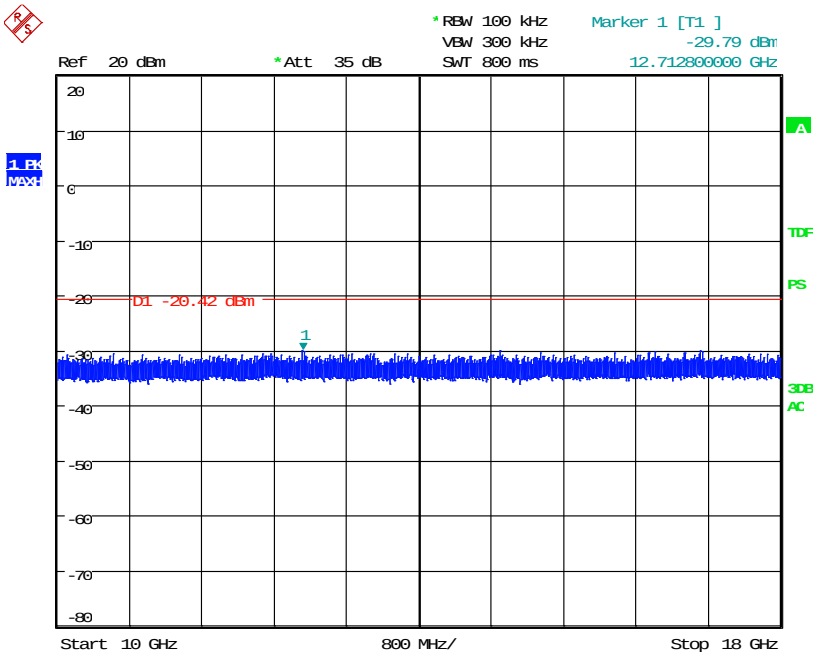


Figure 7.5.2.2-23: 10 GHz – 18 GHz – High Channel – AP2

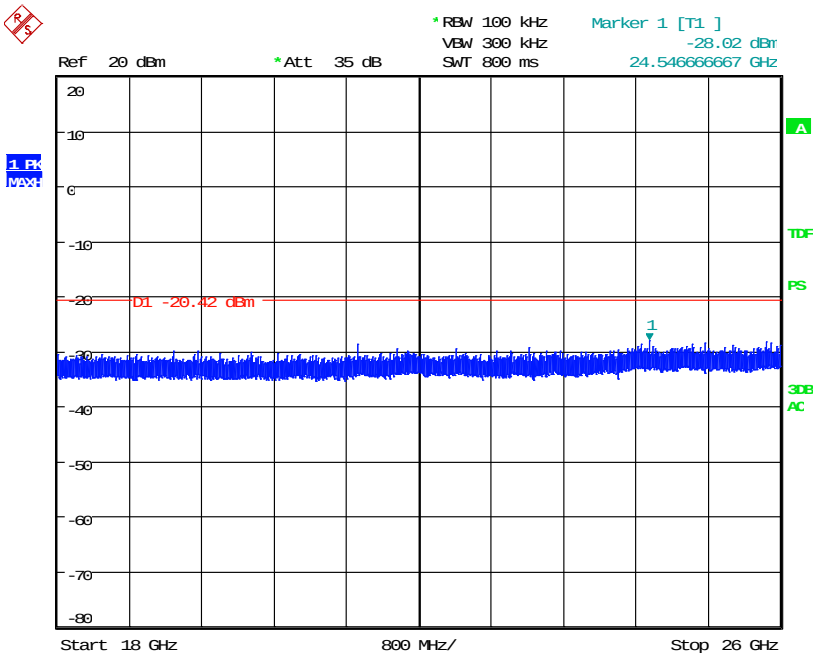


Figure 7.5.2.2-24: 18 GHz –26 GHz – High Channel – AP2

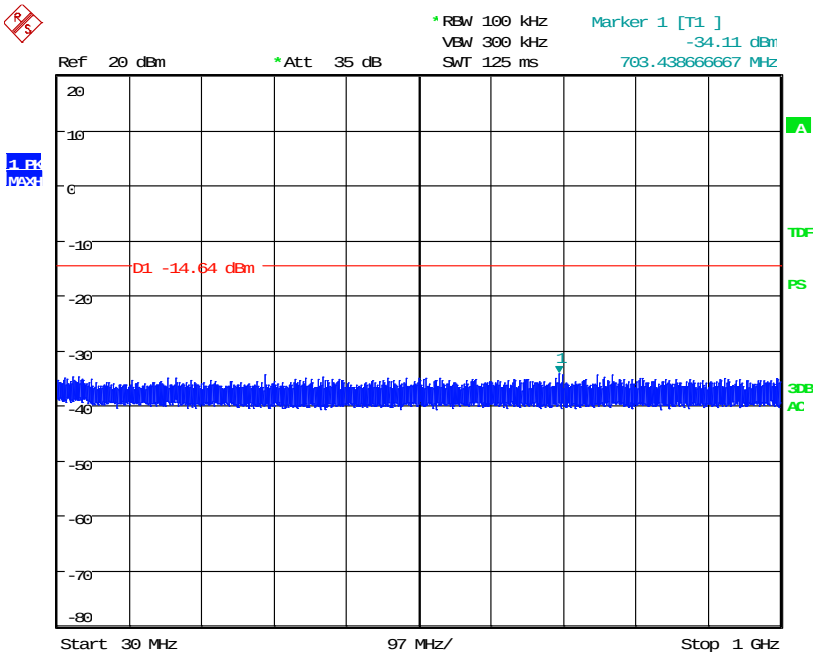


Figure 7.5.2.2-25: 30 MHz – 1 GHz – Low Channel – AS1

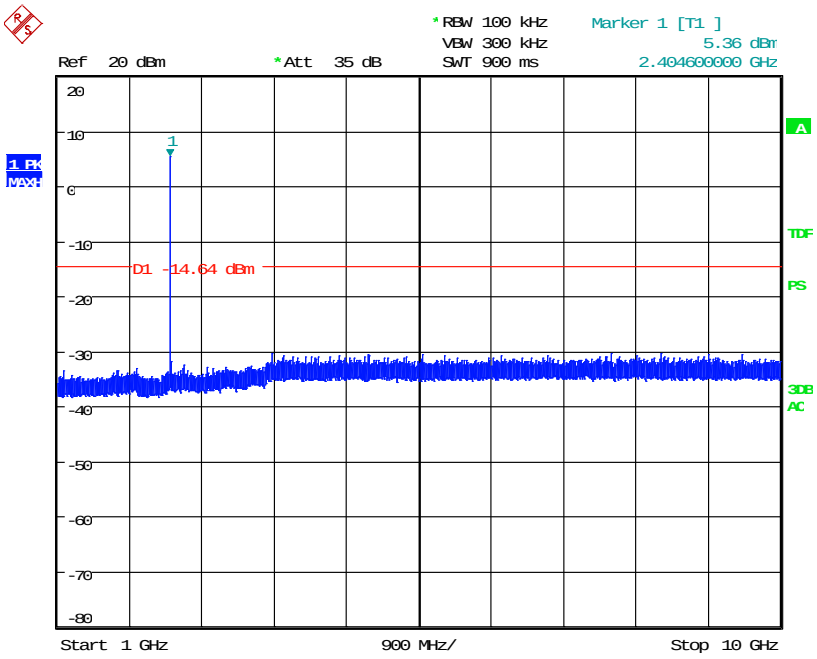


Figure 7.5.2.2-26: 1 GHz –10 GHz – Low Channel – AS1

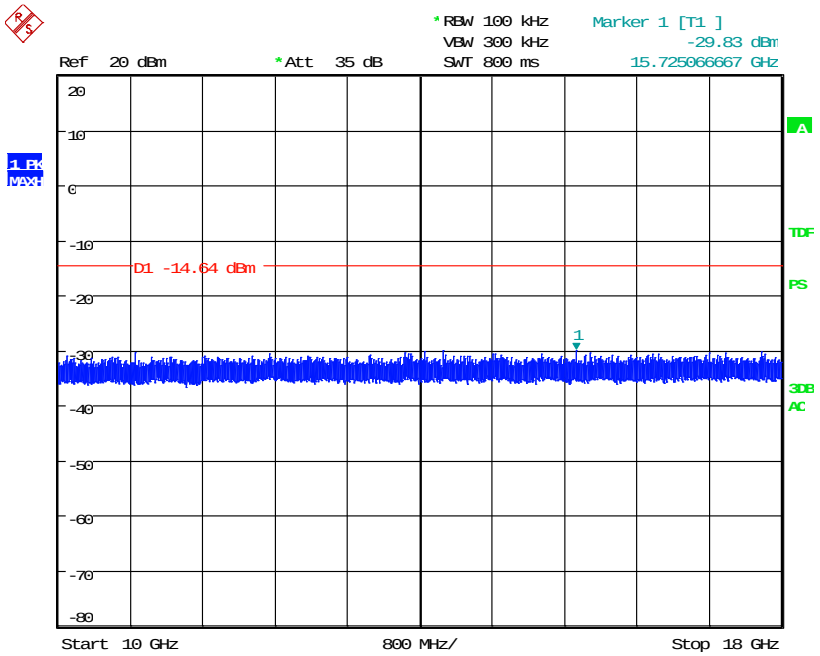


Figure 7.5.2.2-27: 10 GHz – 18 GHz – Low Channel – AS1

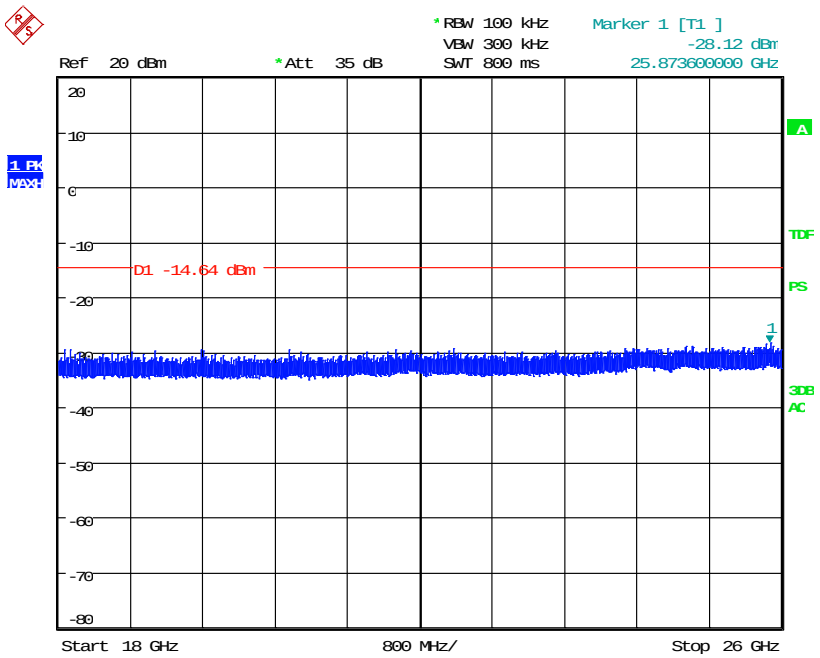


Figure 7.5.2.2-28: 18 GHz –26 GHz – Low Channel – AS1

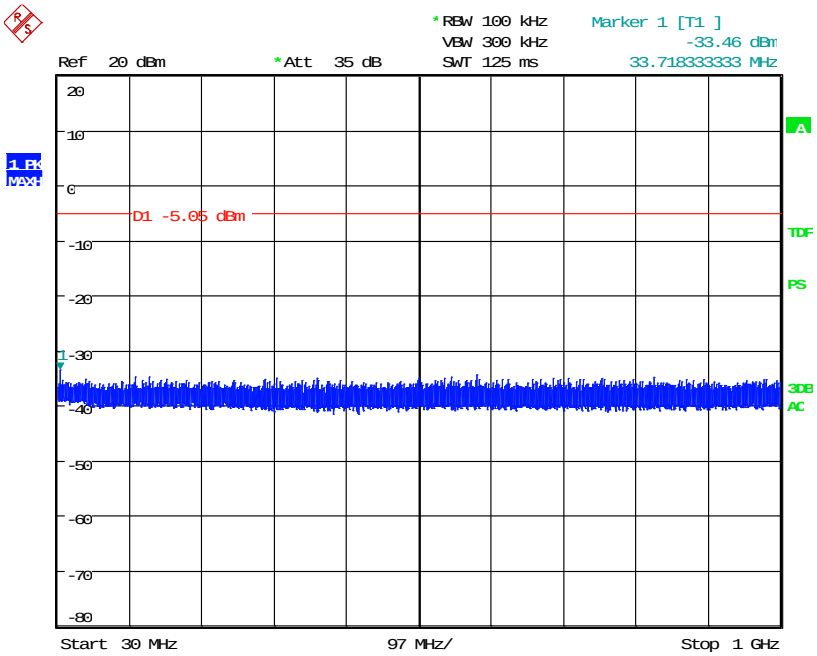


Figure 7.5.2.2-29: 30 MHz – 1 GHz – Middle Channel – AS1

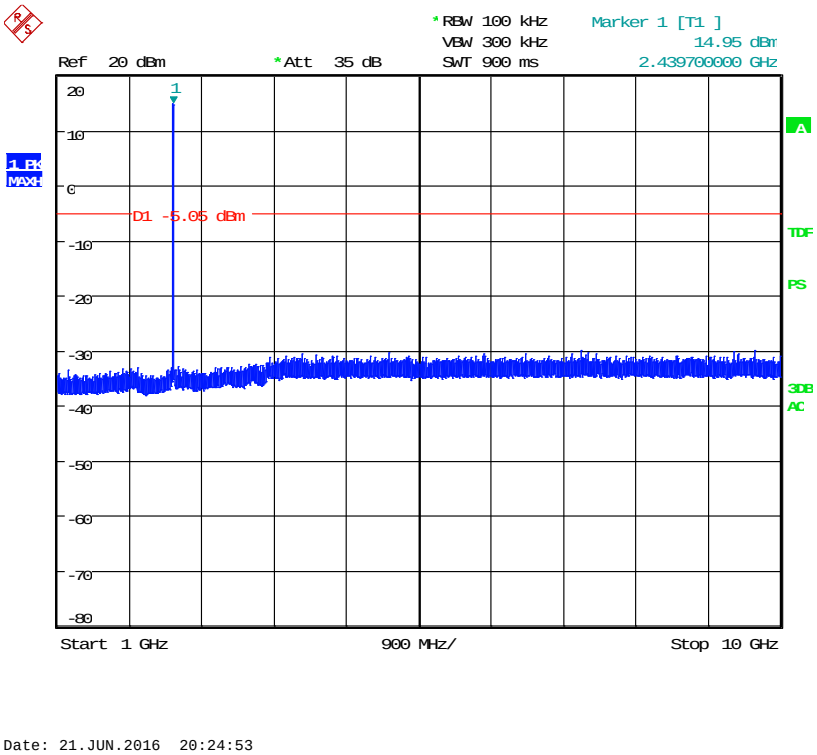


Figure 7.5.2.2-30: 1 GHz –10 GHz – Middle Channel – AS1

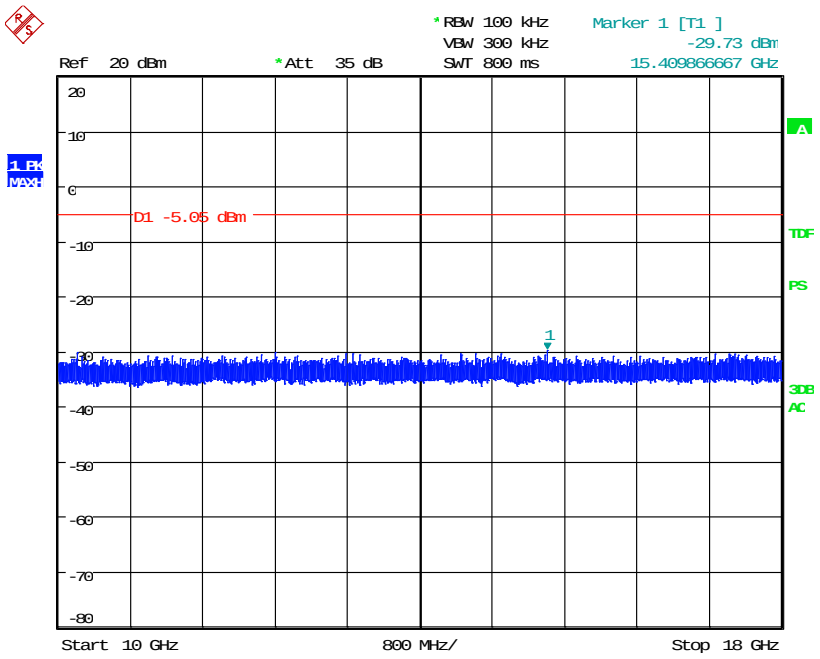


Figure 7.5.2.2-31: 10 GHz – 18 GHz – Middle Channel – AS1

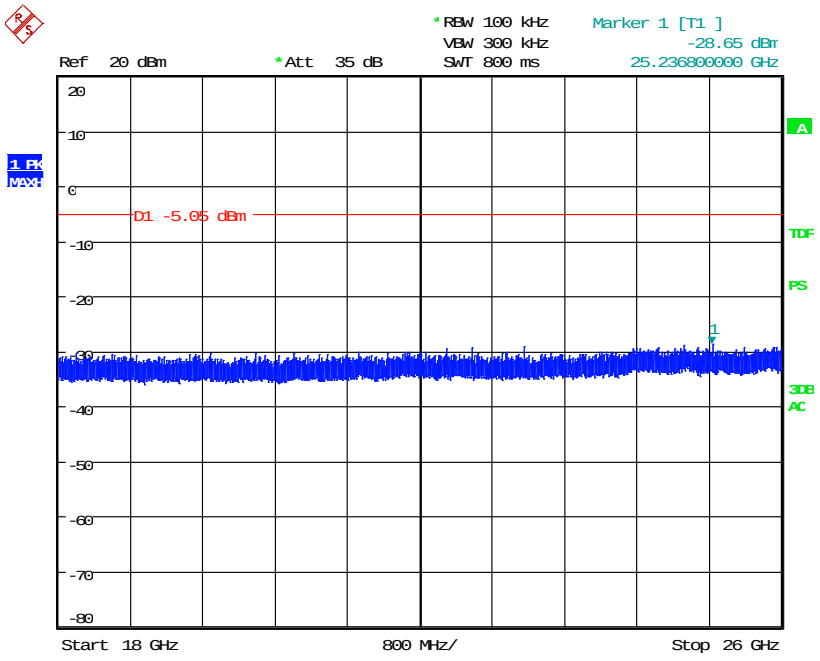


Figure 7.5.2.2-32: 18 GHz –26 GHz – Middle Channel – AS1

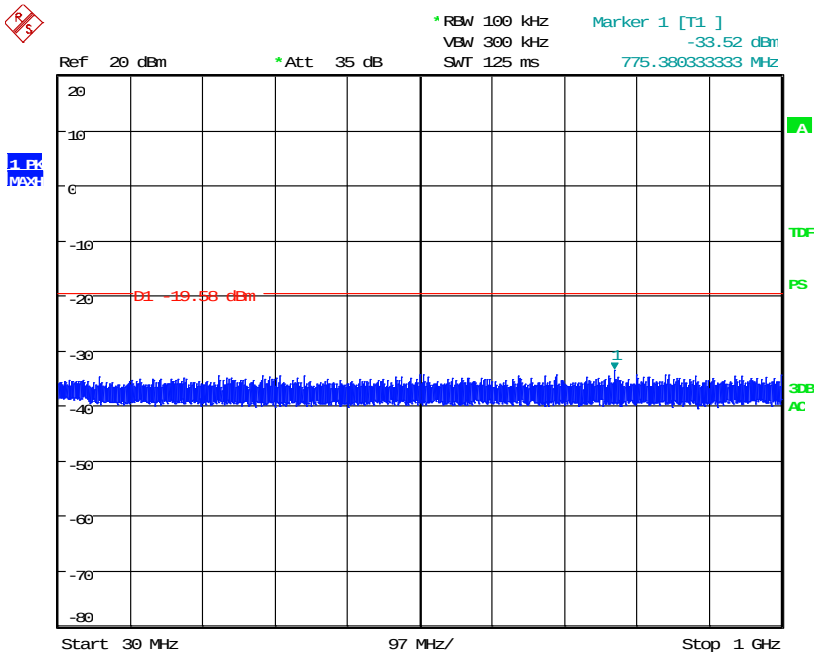


Figure 7.5.2.2-33: 30 MHz – 1 GHz – High Channel – AS1

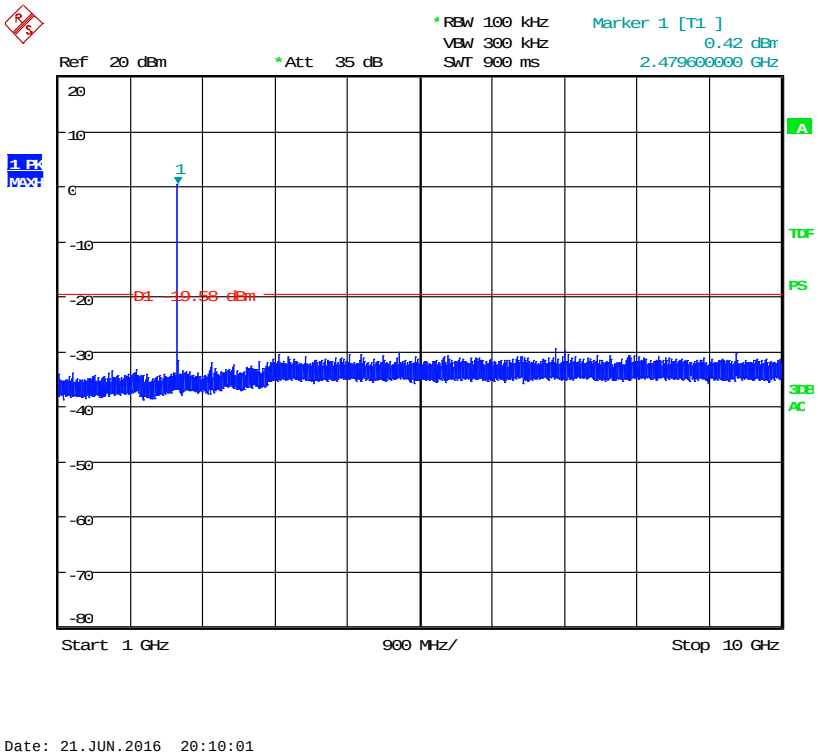


Figure 7.5.2.2-34: 1 GHz –10 GHz – High Channel – AS1

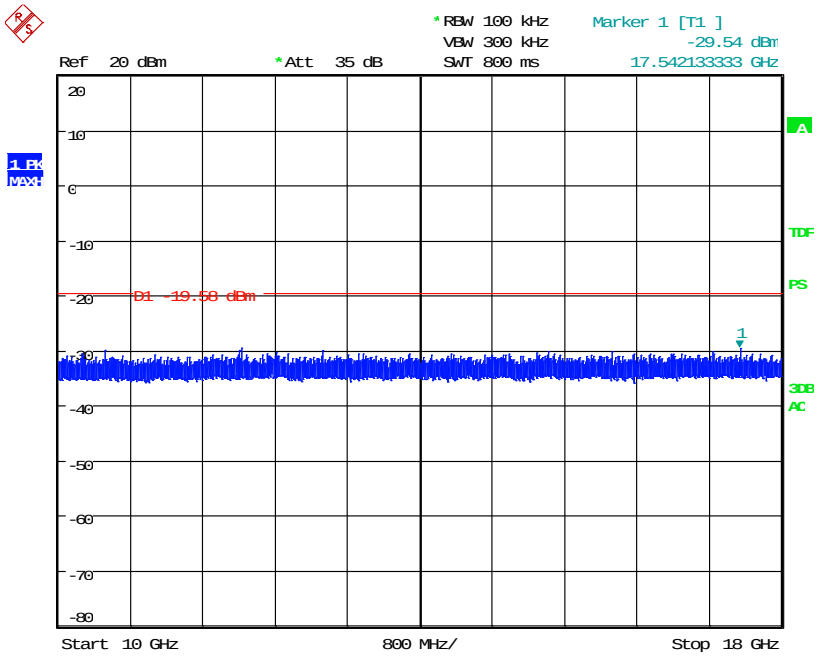


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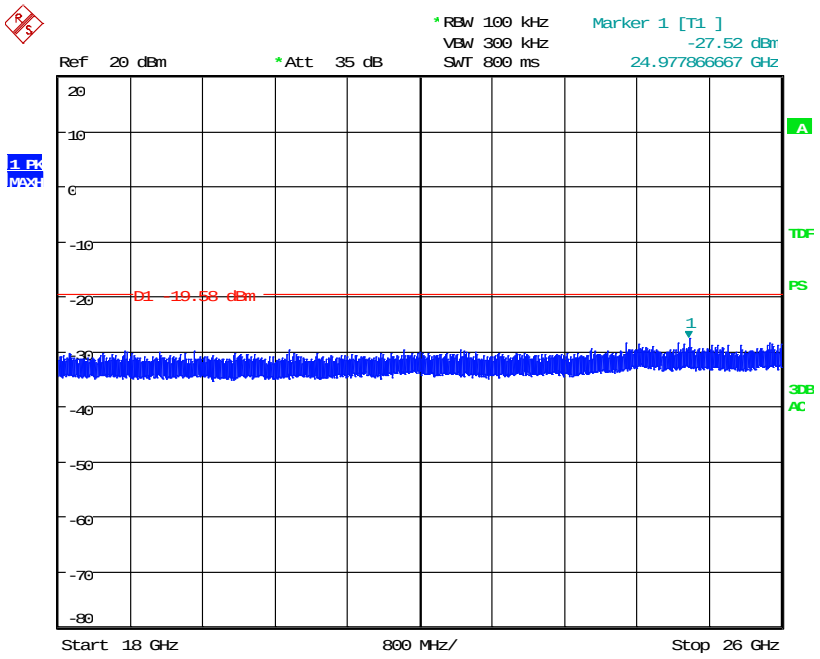
Figure 7.5.2.2-35: 10 GHz – 18 GHz – High Channel – AS1



Date: 21.JUN.2016 20:19:23

Figure 7.5.2.2-36: 18 GHz –26 GHz – High Channel – AS1

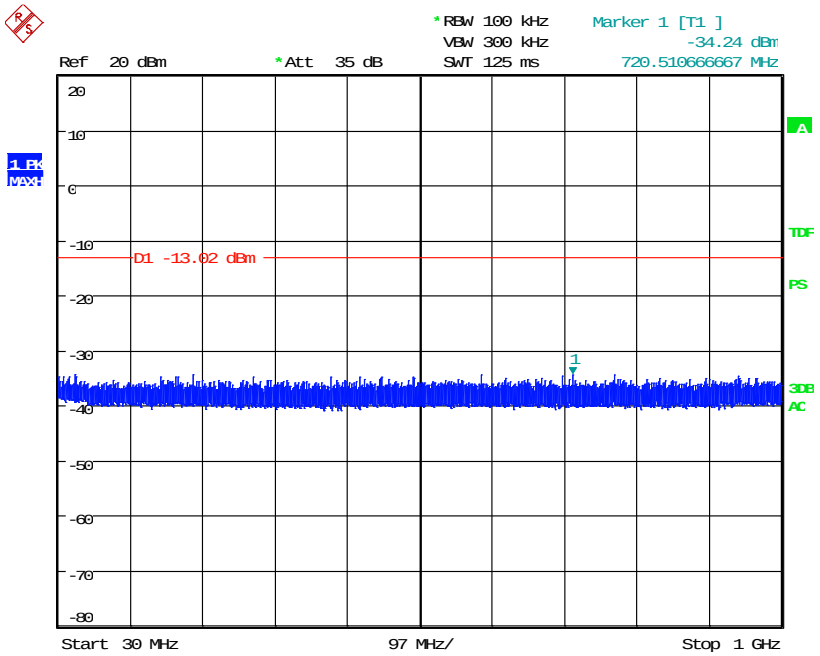


Figure 7.5.2.2-37: 30 MHz – 1 GHz – Low Channel – AS2

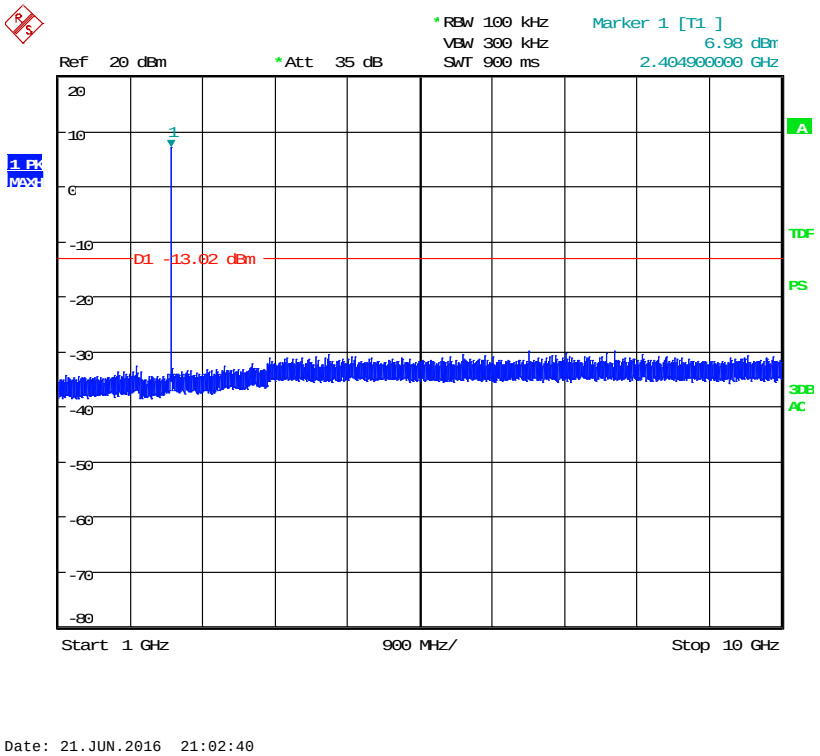


Figure 7.5.2.2-38: 1 GHz –10 GHz – Low Channel – AS2

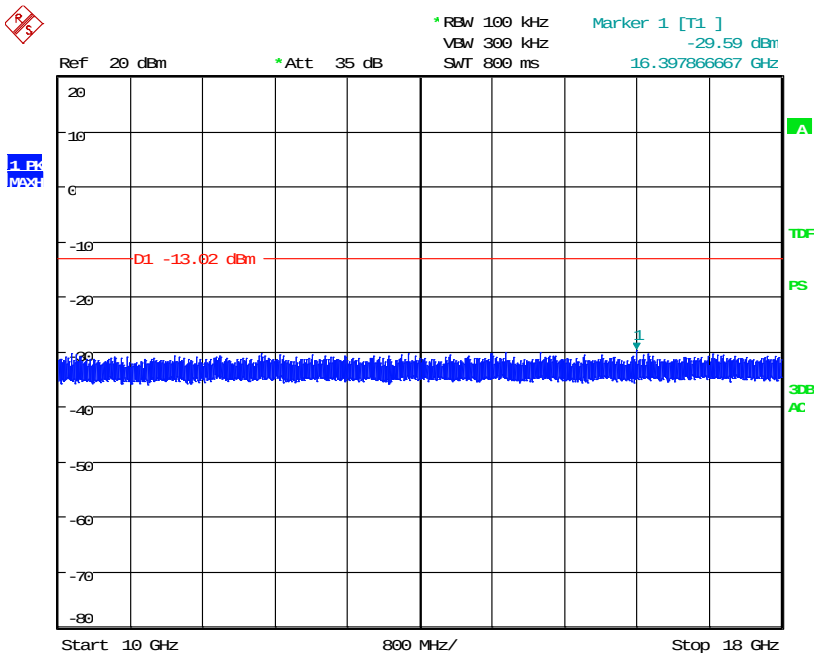


Figure 7.5.2.2-39: 10 GHz – 18 GHz – Low Channel – AS2

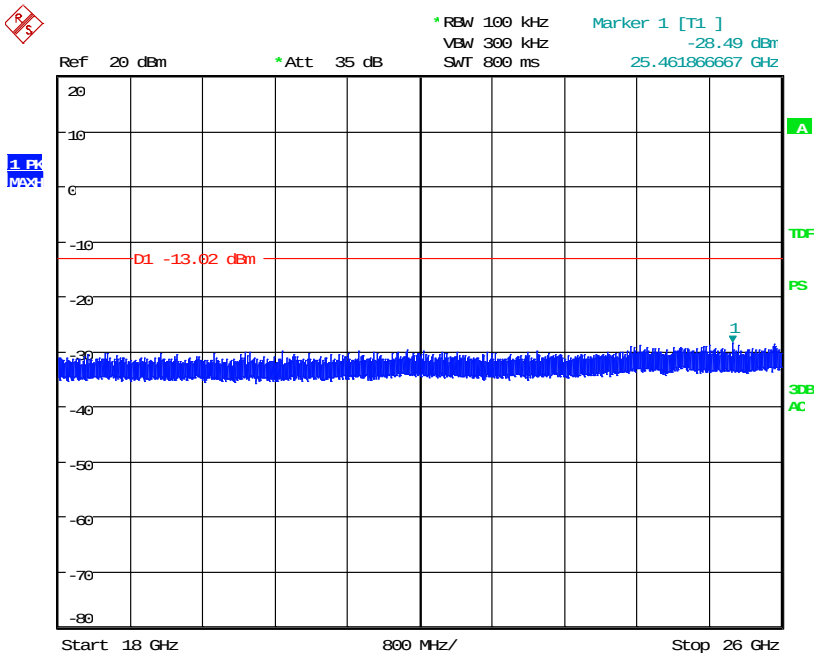


Figure 7.5.2.2-40: 18 GHz –26 GHz – Low Channel – AS2

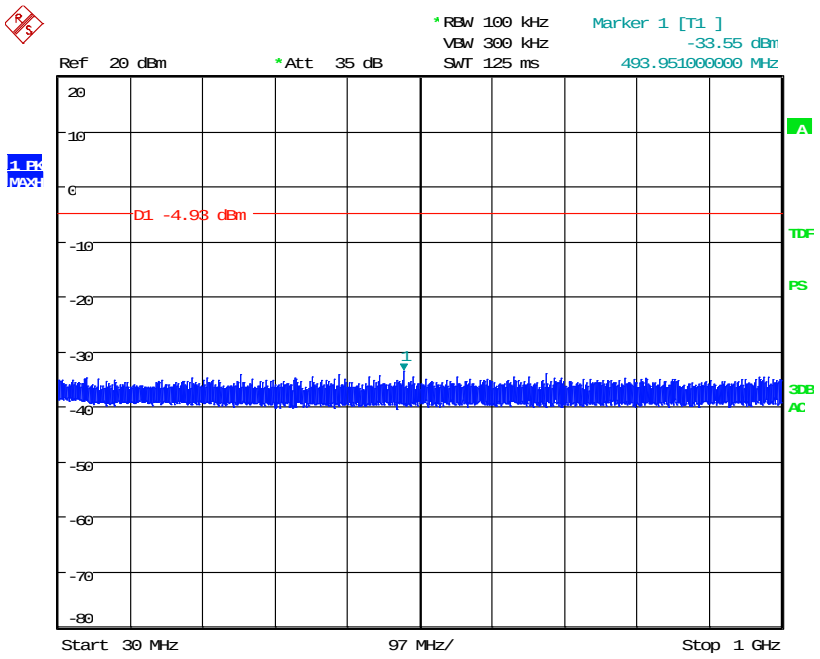


Figure 7.5.2.2-41: 30 MHz – 1 GHz – Middle Channel – AS2

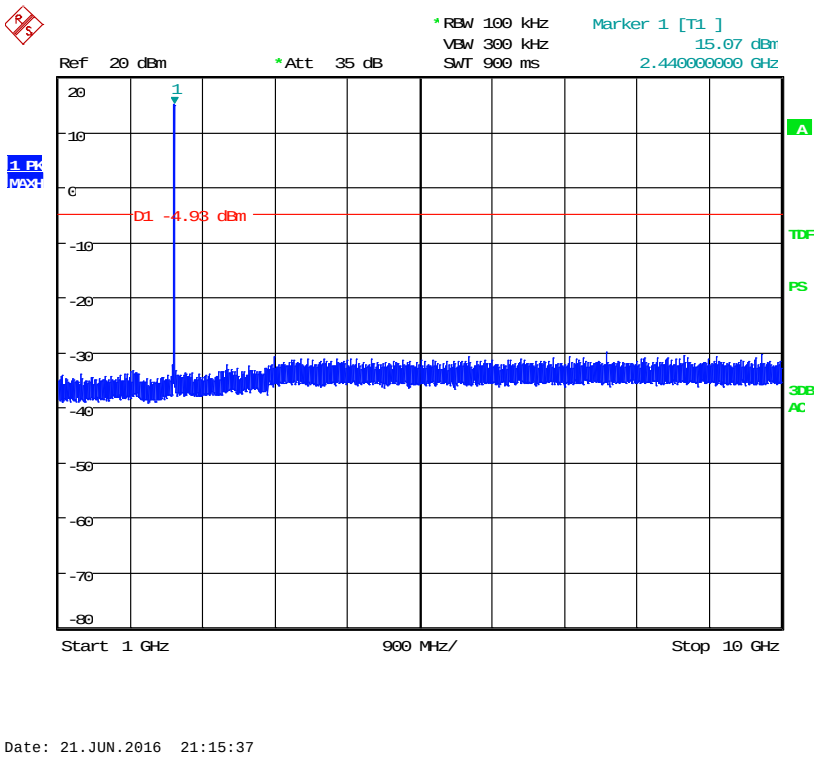


Figure 7.5.2.2-42: 1 GHz –10 GHz – Middle Channel – AS2

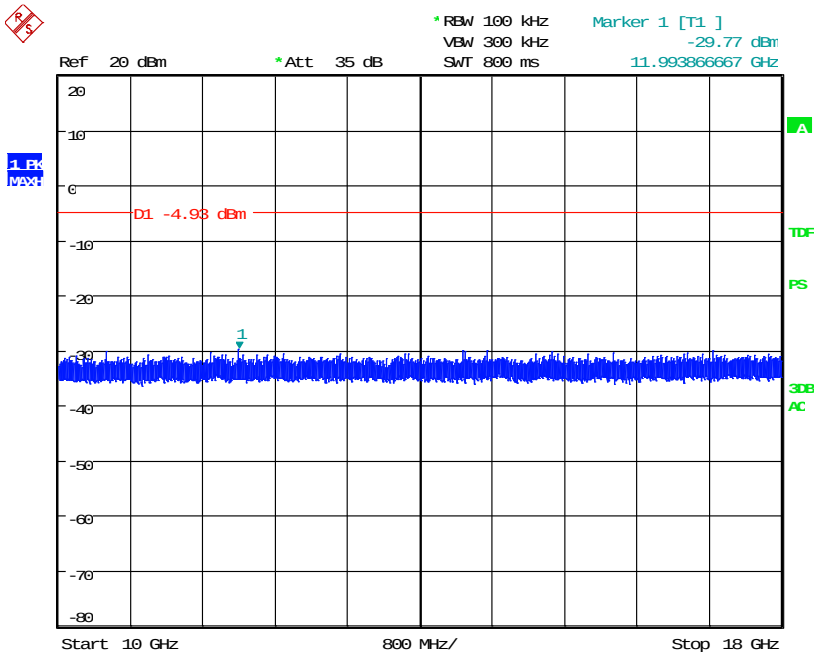


Figure 7.5.2.2-43: 10 GHz – 18 GHz – Middle Channel – AS2

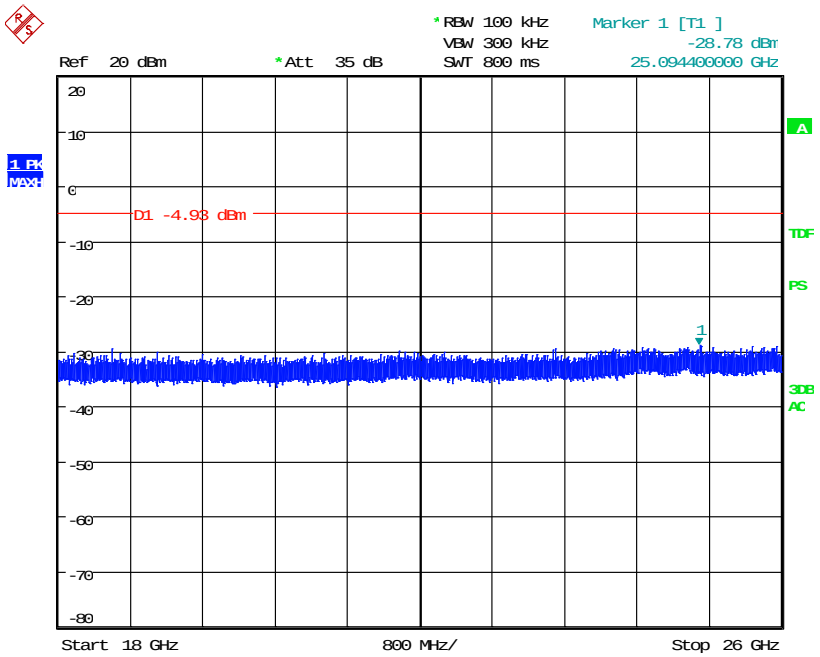


Figure 7.5.2.2-44: 18 GHz –26 GHz – Middle Channel – AS2

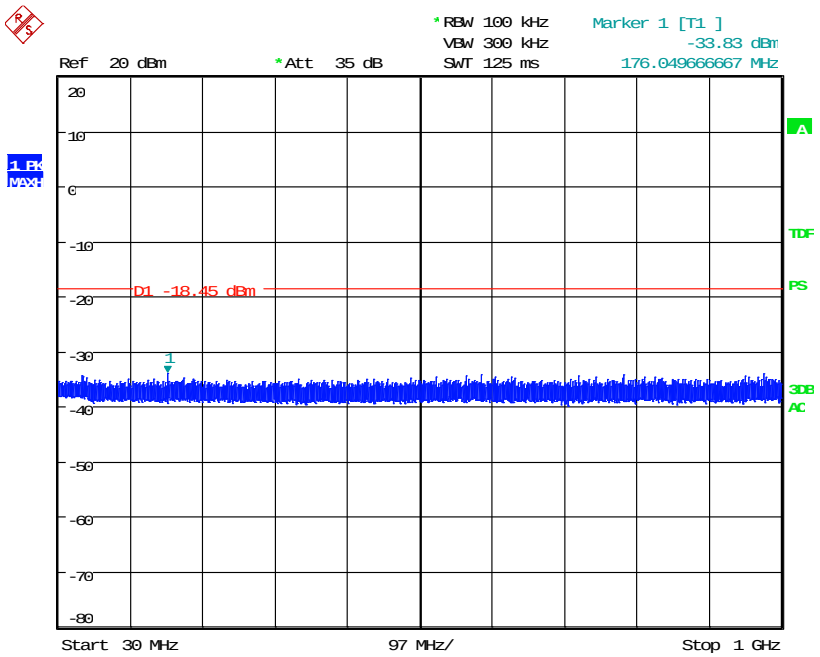


Figure 7.5.2.2-45: 30 MHz – 1 GHz – High Channel – AS2

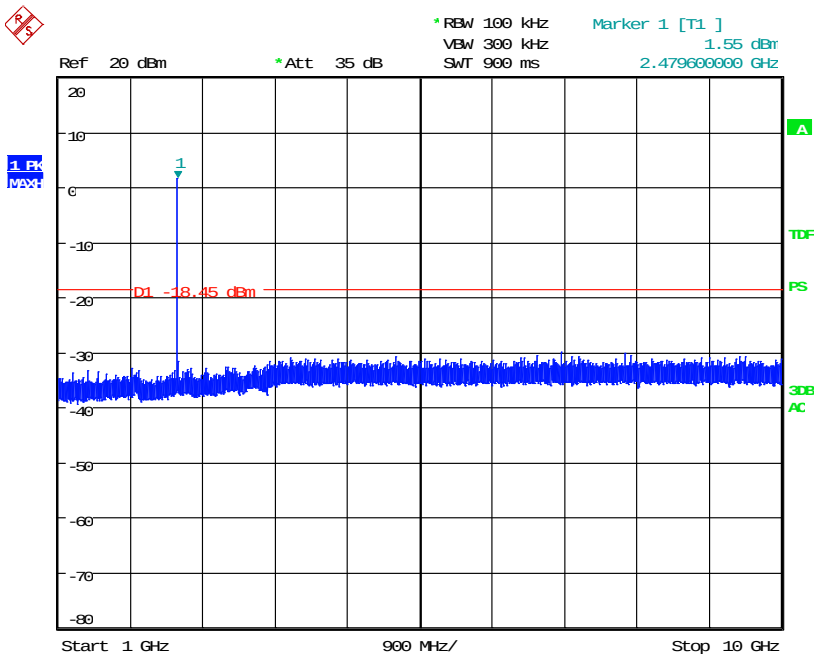


Figure 7.5.2.2-46: 1 GHz –10 GHz – High Channel – AS2

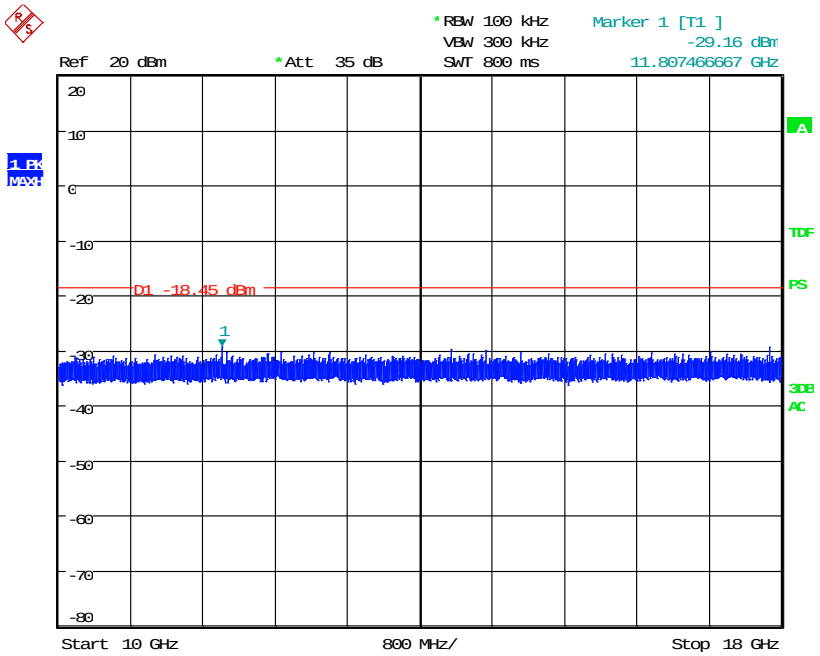


Figure 7.5.2.2-47: 10 GHz – 18 GHz – High Channel – AS2

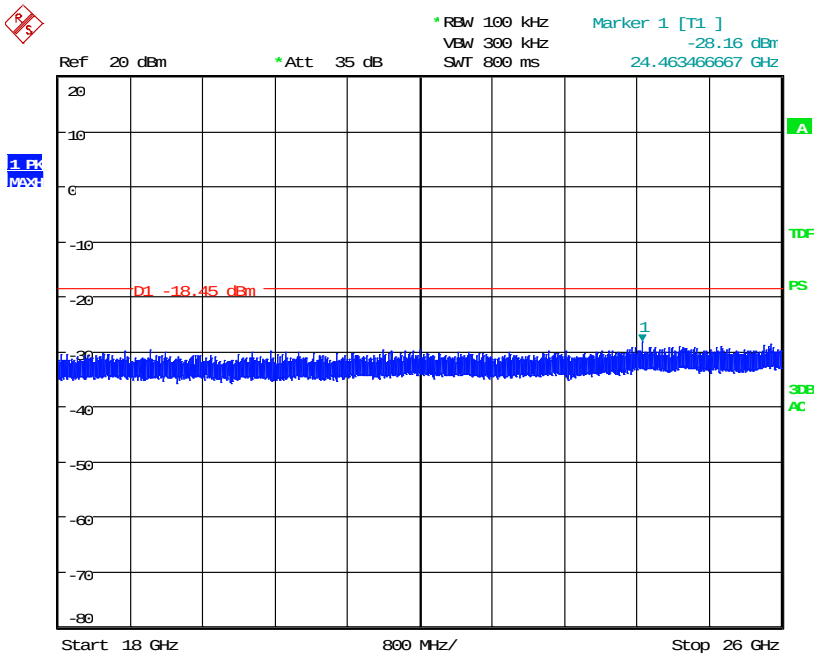


Figure 7.5.2.2-48: 18 GHz –26 GHz – High Channel – AS2

7.5.3 Radiated Spurious Emissions within the Restricted Bands - FCC Sections 15.205, 15.209; ISED Canada: RSS-Gen 8.9, 8.10

7.5.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 26 GHz, 10 times the highest fundamental frequency. Each emission found in the restricted band as defined by FCC Section 15.205 and Innovation, Science and Economic Development (ISED) Canada RSS-Gen 8.10, including any emissions at the operational band-edge, was compared to the radiated emission limits as defined in FCC Section 15.209 and ISED Canada RSS-Gen 8.9.

For measurements below 30 MHz, the receive antenna height was set to 1m and the EUT was rotated through 360 degrees. The resolution bandwidth of the spectrum analyzer was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

For measurements above 30 MHz, the EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak measurements made with RBW and VBW of 1 MHz and 3 MHz respectively. Average measurements were collected in the linear amplitude scale with VBW of 30 Hz.

The EUT was caused to generate a continuous carrier signal on the hopping channel. The average measurements were corrected using the logarithm of the dwell time over 100 ms period. The calculation for the dwell time correction factor is provided in Section 7.5.3.3 of this test report.

7.5.3.2 Measurement Results

Band-edge and radiated spurious emissions found in the band of 9 kHz to 26 GHz are reported in the tables below.

Table 7.5.3.2-1: Radiated Spurious Emissions Tabulated Data – AP1

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2405 MHz										
2390	70.26	50.42	H	-5.60	64.66	10.89	74.0	54.0	9.3	43.1
2390	64.95	46	V	-5.60	59.35	6.47	74.0	54.0	14.7	47.5
4810	48.71	38.60	H	2.94	51.65	7.61	74.0	54.0	22.4	46.4
4810	50.68	41.75	V	2.94	53.62	10.76	74.0	54.0	20.4	43.2
12025	46.02	35.29	H	16.58	62.60	17.95	83.5	63.5	20.9	45.6
12025	44.45	33.75	V	16.58	61.03	16.41	83.5	63.5	22.5	47.1
19240	43.49	30.70	H	10.60	54.09	7.38	83.5	63.5	29.4	56.1
19240	43.75	31.65	V	10.60	54.35	8.33	83.5	63.5	29.1	55.2
Middle Channel = 2440 MHz										
4880	49.86	40.24	H	3.18	53.04	9.49	74.0	54.0	21.0	44.5
4880	50.65	41.45	V	3.18	53.83	10.70	74.0	54.0	20.2	43.3
7320	45.29	32.45	H	8.84	54.13	7.36	74.0	54.0	19.9	46.6
7320	47.69	36.48	V	8.84	56.53	11.39	74.0	54.0	17.5	42.6
12200	42.70	30.30	H	16.53	59.23	12.90	83.5	63.5	24.3	50.6
12200	44.28	30.42	V	16.53	60.81	13.02	83.5	63.5	22.7	50.5
19520	42.38	29.64	V	11.00	53.38	6.71	83.5	63.5	30.1	56.8
High Channel = 2480 MHz										
2483.5	73.62	62.78	H	-5.15	68.47	23.70	74.0	54.0	5.5	30.3
2483.5	65.42	54.11	V	-5.15	60.27	15.03	74.0	54.0	13.7	39.0
4960	31.54	31.61	H	3.46	35.00	1.14	74.0	54.0	39.0	52.9
4960	43.87	31.10	V	3.46	47.33	0.63	74.0	54.0	26.7	53.4

Notes:

- **All emissions above 19.52 GHz were attenuated below the limits and the noise floor of the measurement equipment.**
- **The average measurements were further corrected using duty cycle correction factor of 20*log(2.012/100).**
- **The emissions above 10 GHz were performed at a test distance of 1m. The limits are corrected accordingly using a distance correction factor of 20*log(3/1).**

Table 7.5.3.2-2: Radiated Spurious Emissions Tabulated Data – AP2

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2405 MHz										
2390	66.33	46.58	H	-5.60	60.73	7.05	74.0	54.0	13.3	46.9
2390	74.94	53.39	V	-5.60	69.34	13.86	74.0	54.0	4.7	40.1
4810	50.48	41.24	H	2.94	53.42	10.25	74.0	54.0	20.6	43.7
4810	51.50	42.07	V	2.94	54.44	11.08	74.0	54.0	19.6	42.9
12025	41.62	28.90	H	16.58	58.20	11.56	83.5	63.5	25.3	51.9
12025	42.19	29.31	V	16.58	58.77	11.97	83.5	63.5	24.7	51.5
19240	43.48	30.40	H	10.60	54.08	7.08	83.5	63.5	29.4	56.4
19240	44.05	30.79	V	10.60	54.65	7.47	83.5	63.5	28.8	56.0
Middle Channel = 2440 MHz										
4880	48.70	38.12	H	3.18	51.88	7.37	74.0	54.0	22.1	46.6
4880	49.02	38.80	V	3.18	52.20	8.05	74.0	54.0	21.8	45.9
7320	45.50	32.94	H	8.84	54.34	7.85	74.0	54.0	19.7	46.1
7320	47.98	36.98	V	8.84	56.82	11.89	74.0	54.0	17.2	42.1
12200	42.76	30.37	H	16.53	59.29	12.97	83.5	63.5	24.2	50.5
12200	45.09	32.26	V	16.53	61.62	14.86	83.5	63.5	21.9	48.6
19520	43.58	30.53	H	11.00	54.58	7.60	83.5	63.5	28.9	55.9
19520	43.74	31.24	V	11.00	54.74	8.31	83.5	63.5	28.8	55.2
High Channel = 2480 MHz										
2483.5	67.78	56.04	H	-5.15	62.63	16.96	74.0	54.0	11.4	37.0
2483.5	72.76	61.86	V	-5.15	67.61	22.78	74.0	54.0	6.4	31.2

Notes:

- **All emissions above 19.52 GHz were attenuated below the limits and the noise floor of the measurement equipment.**
- **The average measurements were further corrected using duty cycle correction factor of 20*log(2.012/100).**
- **The emissions above 10 GHz were performed at a test distance of 1m. The limits are corrected accordingly using a distance correction factor of 20*log(3/1).**

Table 7.5.3.2-3: Radiated Spurious Emissions Tabulated Data – AS1

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2405 MHz										
2390	70.44	50.11	H	-5.60	64.84	10.58	74.0	54.0	9.2	43.4
2390	65.81	46.75	V	-5.60	60.21	7.22	74.0	54.0	13.8	46.8
4810	45.55	34.40	H	2.94	48.49	3.41	74.0	54.0	25.5	50.6
4810	45.22	32.94	V	2.94	48.16	1.95	74.0	54.0	25.8	52.0
12025	45.43	34.63	H	16.58	62.01	17.29	83.5	63.5	21.5	46.2
12025	45.07	34.60	V	16.58	61.65	17.26	83.5	63.5	21.8	46.2
19240	43.58	31.30	H	10.60	54.18	7.98	83.5	63.5	29.3	55.5
19240	45.77	34.17	V	10.60	56.37	10.85	83.5	63.5	27.1	52.7
Middle Channel = 2440 MHz										
4880	44.49	31.79	H	3.18	47.67	1.04	74.0	54.0	26.3	53.0
4880	46.00	33.61	V	3.18	49.18	2.86	74.0	54.0	24.8	51.1
7320	47.33	35.92	H	8.84	56.17	10.83	74.0	54.0	17.8	43.2
7320	51.06	40.94	V	8.84	59.90	15.85	74.0	54.0	14.1	38.1
12200	45.00	33.65	H	16.53	61.53	16.25	83.5	63.5	22.0	47.2
12200	45.73	34.14	V	16.53	62.26	16.74	83.5	63.5	21.2	46.8
19520	42.74	29.79	H	11.00	53.74	6.86	83.5	63.5	29.8	56.6
19520	43.38	30.78	V	11.00	54.38	7.85	83.5	63.5	29.1	55.7
High Channel = 2480 MHz										
2483.5	73.86	63.02	H	-5.15	68.71	23.94	74.0	54.0	5.3	30.1
2483.5	69.85	58.75	V	-5.15	64.70	19.67	74.0	54.0	9.3	34.3
4960	42.73	30.18	V	3.46	46.19	-0.29	74.0	54.0	27.8	54.3

Notes:

- **All emissions above 19.52 GHz were attenuated below the limits and the noise floor of the measurement equipment.**
- **The average measurements were further corrected using duty cycle correction factor of 20*log(2.012/100).**
- **The emissions above 10 GHz were performed at a test distance of 1m. The limits are corrected accordingly using a distance correction factor of 20*log(3/1).**

Table 7.5.3.2-4: Radiated Spurious Emissions Tabulated Data – AS2

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2405 MHz										
2390	77.44	55.41	H	-5.60	71.84	15.88	74.0	54.0	2.2	38.1
2390	71.23	49.74	V	-5.60	65.63	10.21	74.0	54.0	8.4	43.8
4810	46.65	35.68	H	2.94	49.59	4.69	74.0	54.0	24.4	49.3
4810	47.28	36.74	V	2.94	50.22	5.75	74.0	54.0	23.8	48.2
Middle Channel = 2440 MHz										
4880	47.02	35.92	H	3.18	50.20	5.17	74.0	54.0	23.8	48.8
4880	48.60	38.34	V	3.18	51.78	7.59	74.0	54.0	22.2	46.4
7320	48.58	38.55	H	8.84	57.42	13.46	74.0	54.0	16.6	40.5
7320	53.01	43.81	V	8.84	61.85	18.72	74.0	54.0	12.2	35.3
12200	46.39	36.02	H	16.53	62.92	18.62	83.5	63.5	20.6	44.9
12200	47.42	37.27	V	16.53	63.95	19.87	83.5	63.5	19.6	43.6
High Channel = 2480 MHz										
2483.5	75.23	64.24	H	-5.15	70.08	25.16	74.0	54.0	3.9	28.8
2483.5	66.53	55.23	V	-5.15	61.38	16.15	74.0	54.0	12.6	37.9

Notes:

- **All emissions above 12.2 GHz were attenuated below the limits and the noise floor of the measurement equipment.**
- **The average measurements were further corrected using duty cycle correction factor of 20*log(2.012/100).**
- **The emissions above 10 GHz were performed at a test distance of 1m. The limits are corrected accordingly using a distance correction factor of 20*log(3/1).**

7.5.3.3 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U = Uncorrected Reading
R_C = Corrected Level
AF = Antenna Factor
CA = Cable Attenuation
AG = Amplifier Gain
DC = Duty Cycle Correction Factor

Duty Cycle Correction Factor
DC = 20*log(2.012/100) = -33.93 dB

Example Calculation: Peak
Corrected Level: 70.26+ (-5.6) = 64.66 dBµV/m
Margin: 74 dBuV/m – 64.66 dBµV/m = 9.3 dB

Example Calculation: Average
Corrected Level: 50.42 + (-5.6) – 33.93= 10.89 dBµV/m
Margin: 54 dBuV/m – 10.89 dBµV/m = 43.1 dB

8 CONCLUSION

In the opinion of ACS, Inc., the JETIDC24US manufactured by Esprit Model meets the requirements of FCC Part 15 subpart C and ISED Canada Radio Standards Specification RSS-247.

END REPORT