FCC PART 20.21 & PART 27

TEST REPORT

For

Intelibs, Inc.

1500 Stony Brook Road, #320, Stony Brook, NY 11794, USA

FCC ID: Z69D01T4JX6

Report Type: Permissive II Change Report	**Product Type:** Medium Power Remote Unit (MRU)

Prepared By:	Christian McCaig Test Engineer
Report Number:	R2003133
Report Date:	2020-04-02
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ACCREDITED
CERTIFICATE #3297.02

* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*".

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2003133	Original	2020-03-24
1	R2003133	Updated §1.1, §1.3	2020-04-02

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Intelibs Inc.* and their product model: MRU, FCC ID: Z69D01T4JX6, which will henceforth be referred to as the EUT (Equipment under Test). The EUT is a medium power remote unit (MRU). The EUT operates in the frequency range of 728-746 MHz, 746-757 MHz, 862-869 MHz, 869-894 MHz, 1930-1995 MHz, and 2110-2180 MHz.

1.2 Mechanical Description

The EUT measured approximately 36.5 cm (L) x 28 cm (W) x 16 cm (H)

The test data gathered are from typical production sample, serial number: MRU19A014

1.3 Objective

This type approval report was prepared on behalf of *Intelibs, Inc.* in accordance with Part 2, Subpart J, Part 20.21, and Part 27 of the Federal Communication Commission's rules.

This permissive change application is for the purpose of extending the original frequency range 2110-2155 MHz to 2110-2180 MHz through software modification. The objective was to determine compliance with FCC rules for RF output power, occupied bandwidth, spurious emissions at antenna terminal, field strength of spurious radiation and band edge in the new frequency range.

1.4 Related Submittal(s)/Grant(s)

None

1.5 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

Part 20.21 – Signal Boosters
Part 27 - Miscellaneous Wireless Communication Services

Applicable Standards: TIA/EIA603-E, FCC KDB 935210.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
Temperature	±2 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.7 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02),*** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to TIA/EIA-603-E.
The final qualification test was performed with the EUT operating at normal mode.

2.2 EUT Exercise Software

There was no exercise software with the EUT; signal was sent through EUT using a signal generator.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 EUT Internal Configuration

Manufacturer	Description	Model	Serial Number
Intelibs	DC/DC Converter	HDAS-MRU-DCCON	MRU-DCCON19A014
Intelibs	Low Band High Power Amplifier	HDAS-LO-HPA-33	MRU-LOHPA19A014
Intelibs	High Band High Power Amplifier	HDAS-HI-HPA-33	MRU-HIHPA19A014
Intelibs	RF/Optic Module	HDAS-MRU-ROM	MRU-ROM19A014
Intelibs	Quad Band Multiplexer	HDAS-MRU-QMUX	MRU-QMUX19A014

2.5 Remote Support Equipment List and Details

Manufacturer	Descriptions	Models	Serial Numbers
Intelibs	RF over Fiber Main Link Unit	ROF-ML-4CH-DC	RFML19A008

2.6 Power Supply and Line Filters

Manufacturer	Descriptions	Models	Serial Numbers
Tri-Mag, LLC	AC Power Adapter w/ PoE Cable	L6R200D-480	-

2.7 Interface Ports and Cabling

Cable Description	Length (m)	From	To
RF cable	< 1	Signal Generator	Support Equipment
RF cable	< 1	EUT Output	Spectrum Analyzer
Fiber Optic Cable	1	Support Equipment	EUT Input

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1091	RF Exposure	Compliant
§2.1046, §27.50	RF Output Power	Compliant
§2.1049	26 dB Occupied Bandwidth	Compliant
§2.1053, §27.53	Spurious Radiated Emissions	Compliant
§2.1053, §27.53	Spurious Emissions at Antenna Terminals	Compliant
§2.1053, §27.53	Band Edge & Intermodulation	Compliant
§2.1055, §27.54	Frequency Stability	N/A[1]
§20.21	Out of Band Rejection	Compliant

[1] The EUT is a signal booster.

4 FCC §1.1307(b) (1) & §2.1091 - RF Exposure

4.1 Applicable Standards

FCC §2.1091, (a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b).

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

Note: f = frequency in MHz
* = Plane-wave equivalent power density

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

4.3 Test Results

2110-2180 MHz

Maximum peak output power at antenna input terminal (dBm):	33.43
Maximum peak output power at antenna input terminal (mW):	2202.93
Prediction distance (cm):	110
Prediction frequency (MHz):	2111.68
Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density at predication frequency and distance (mW/cm^2):	0.458
MPE limit for uncontrolled exposure at predication frequency (mW/cm^2):	1.0

Results

The power density level at 110 cm is below the MPE uncontrolled exposure limits with a 15 dBi antenna gain.

5 FCC §2.1046 & §27.50 - RF Output Power

5.1 Applicable Standards

According to FCC §27.50 (b) (2), fixed and base stations transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth of 1 MHz or less must not exceed an ERP of 1000 watts and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

According to FCC §27.50 (b) (4), fixed and base stations transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section.

According to FCC §27.50 (c) (1), for transmitters in the 698-746 MHz band, fixed and base stations transmitting a signal with an emission bandwidth of 1 MHz or less must not exceed an effective radiated power (ERP) of 1000 watts and an antenna height of 305 m height above average terrain (HAAT), except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

According to FCC §27.50 (c) (3), for transmitters in the 698-746 MHz band, fixed and base stations transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section.

According to FCC §27.50 (d) (2), the power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less.

(ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

5.2 Test Procedure

Conducted:

The signal generator was connected to the support equipment and the support equipment was connected to the EUT through a fiber cable. The output of the EUT was connected to a spectrum analyzer through appropriate attenuation.

5.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Rohde & Schwarz	Analyzer, Spectrum	FSQ26	200749	2019-11-07	2 years
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2018-07-25	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2020-02-11	1 year

Note: Equipment was calibrated for each test.
***Statement of Traceability*:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

5.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Christian McCaig 2020-03-20 in the RF Site.

5.5 Test Results

2110-2180 MHz

Signal Type	AGC	Input Power (dBm)	Output Power[1] (dBm)	Gain (dB)	EIRP[1] (dBm)
Broadband	Off	-11.5	33.39	44.89	48.39
	On	-8	33.43	41.43	48.43
Narrowband	Off	-11.5	32.86	44.36	47.86
	On	-8	33.38	41.38	48.38

Note[1]: output power was measured as average value.
Note[2]: EIRP=Conducted Output Power (dBm) + Antenna Gain (dBi), the maximum gain of the antenna that applies to this device is 15 dBi.

6 FCC §2.1049 – Occupied Bandwidth

6.1 Applicable Standards

Requirements: FCC §2.1049

6.2 Test Procedure

The signal generator was connected to the support equipment and the support equipment was connected to the EUT through a fiber cable. The output of the EUT was connected to a spectrum analyzer through appropriate attenuation.

The resolution bandwidth of the spectrum analyzer was set to at least 1 to 5% of the anticipated OBW and the 26 dB & 99% bandwidth was recorded.

6.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Rohde & Schwarz	Analyzer, Spectrum	FSQ26	200749	2019-11-07	2 years
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2018-07-25	2 year
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2020-02-11	1 year

Note: Equipment was calibrated for each test.

***Statement of Traceability*:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

6.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Christian McCaig 2020-03-20 in the RF Site.

6.5 Test Results

2110–2180 MHz

99% OBW

Signal Type	AGC	OBW (kHz)	
		Input	Output
Broadband	off	4110	4107
	on	4107	4110
Narrowband	off	241	244
	on	242	244

26 dB OBW

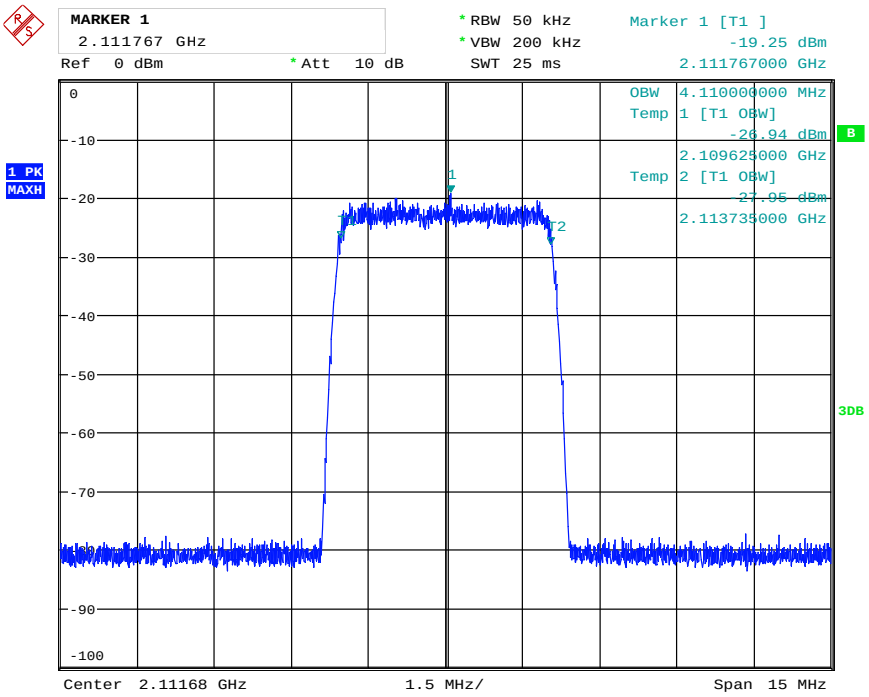
Signal Type	AGC	OBW (kHz)	
		Input	Output
Broadband	off	4455	4455
	on	4455	4458
Narrowband	off	306	309
	on	308	302

Please refer to the following plots.

99% OBW

Broadband Signal AGC off

Input



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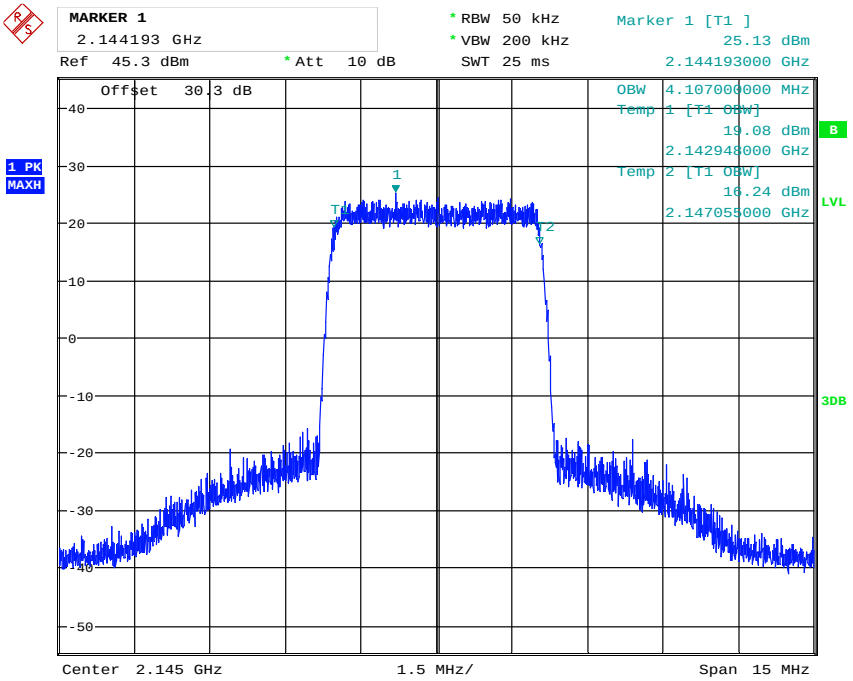
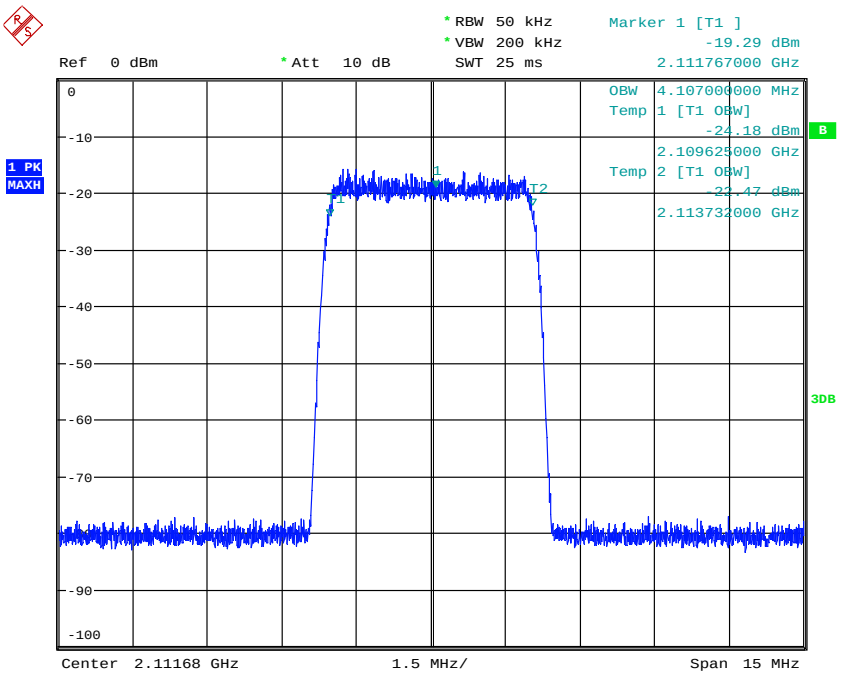


Broadband Signal AGC on

Input



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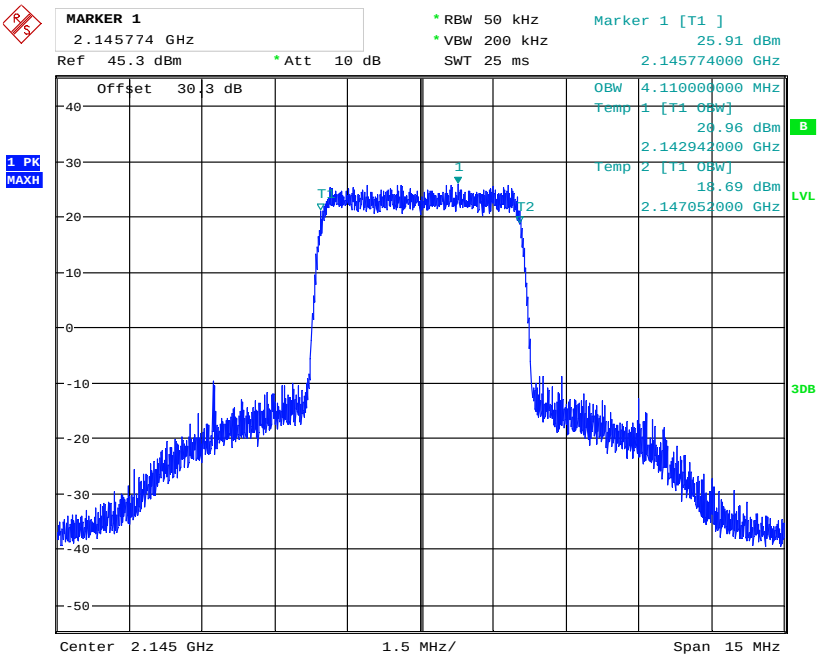

Narrowband Signal AGC off

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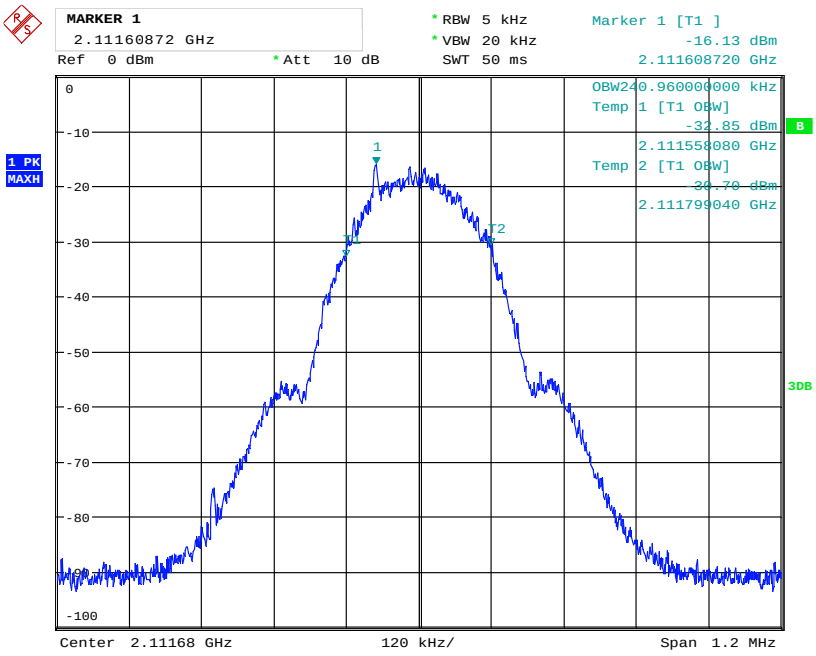

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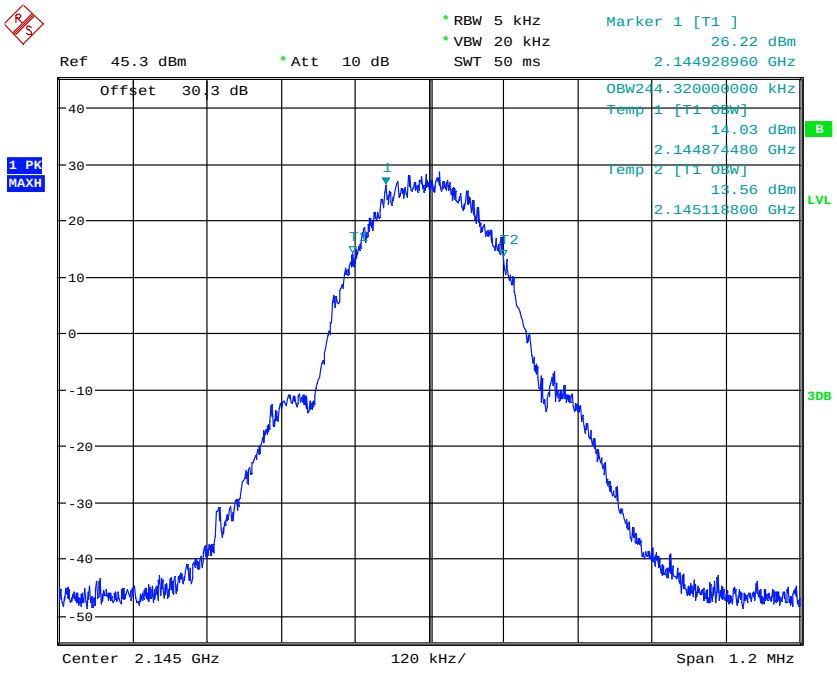
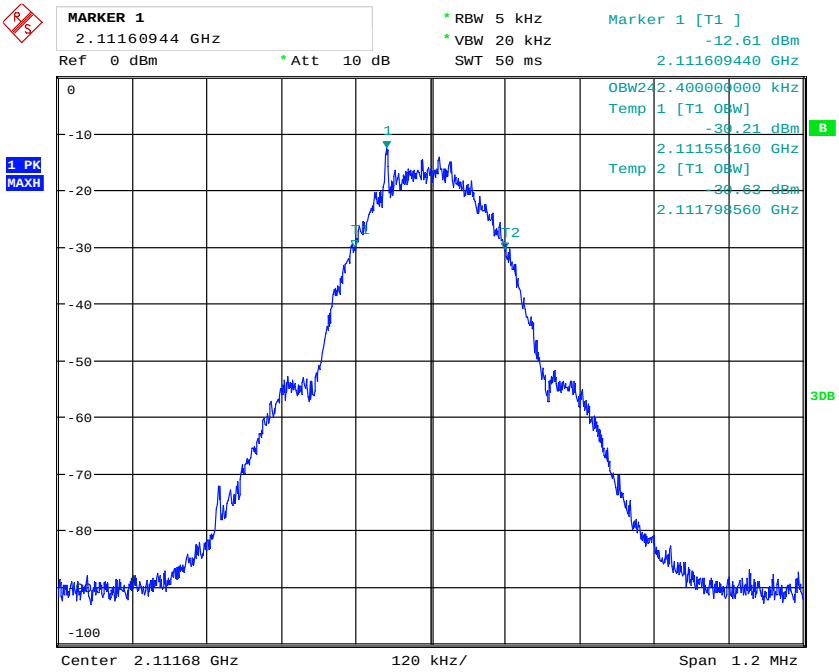


Narrowband Signal AGC on

Input



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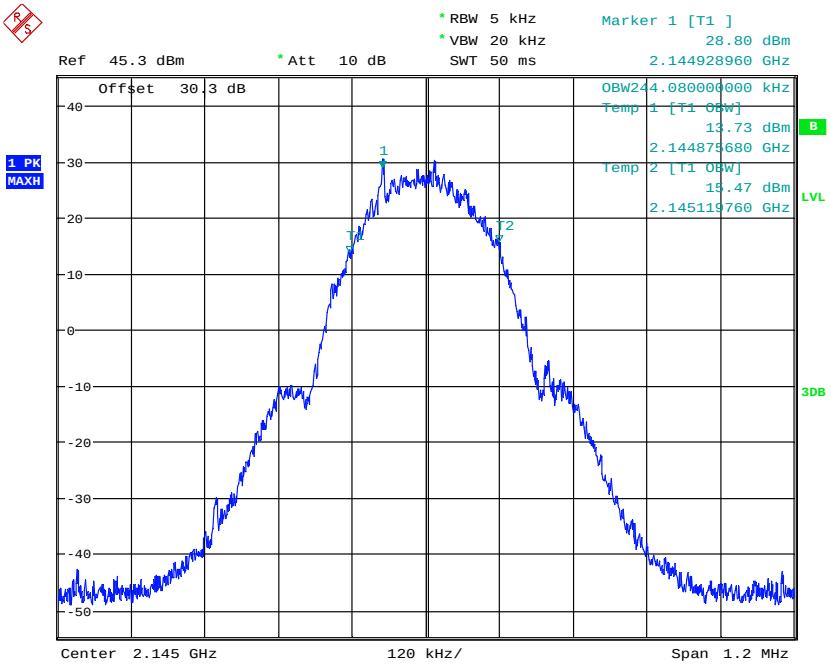
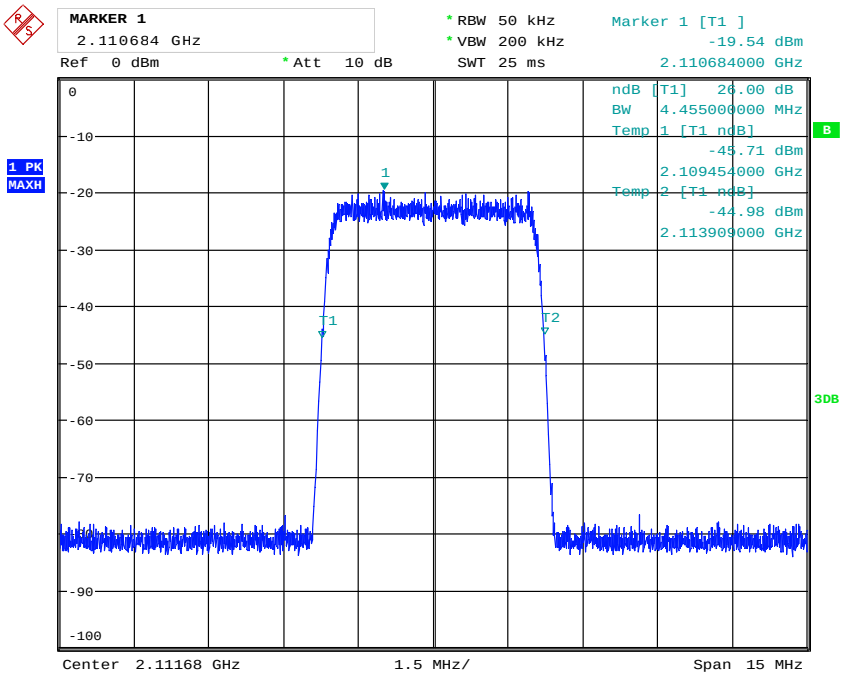


26 dB Bandwidth

Broadband Signal AGC off
Input



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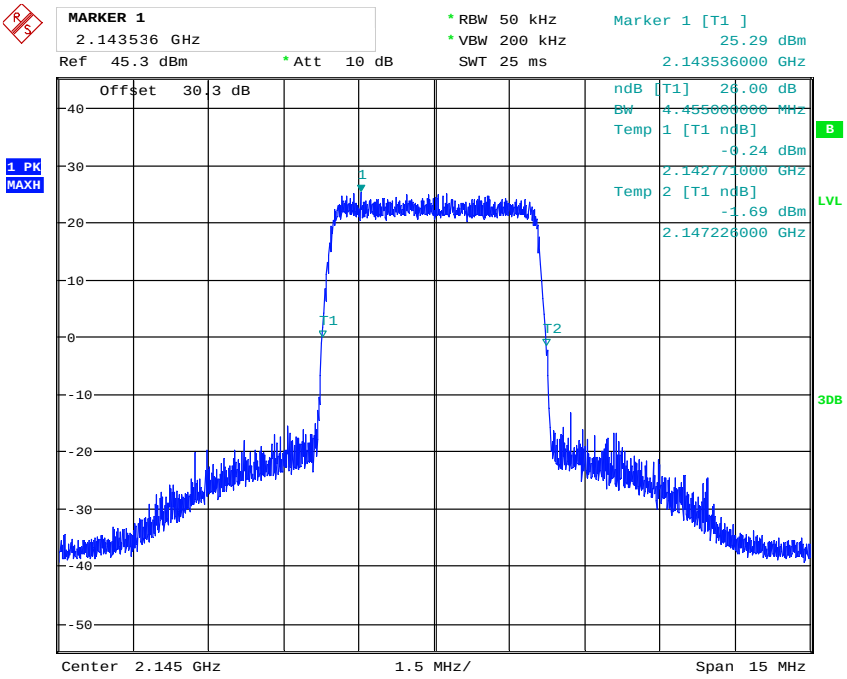

Broadband Signal AGC on

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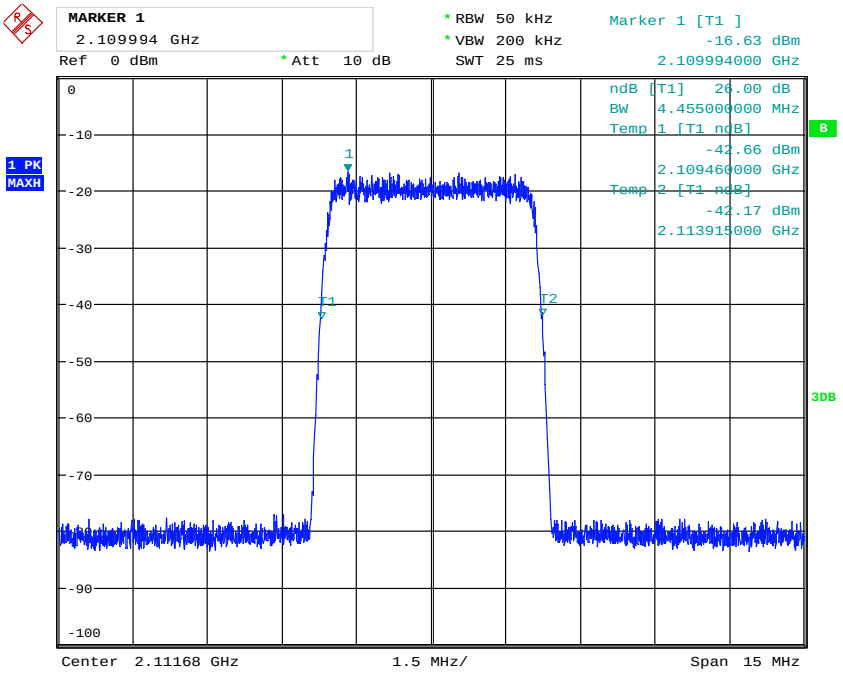

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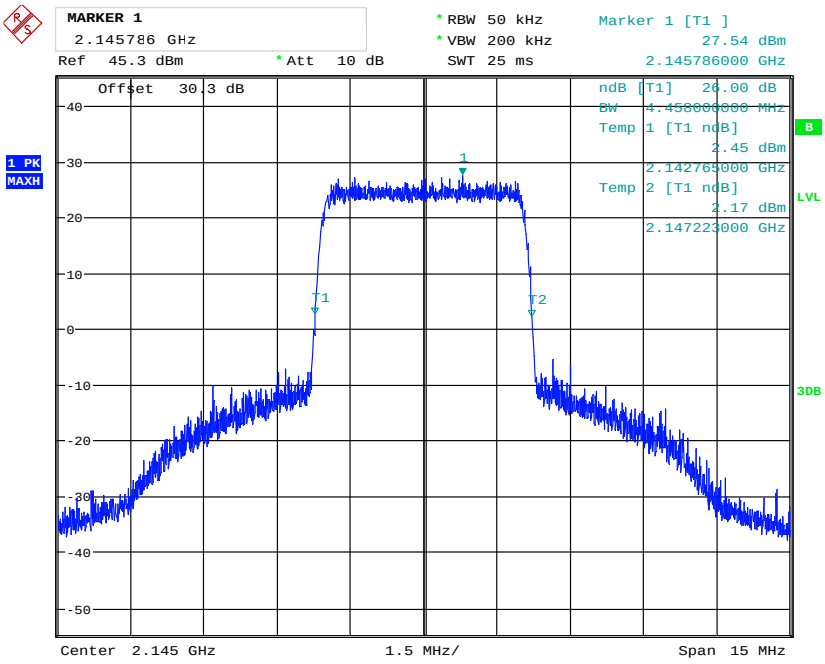
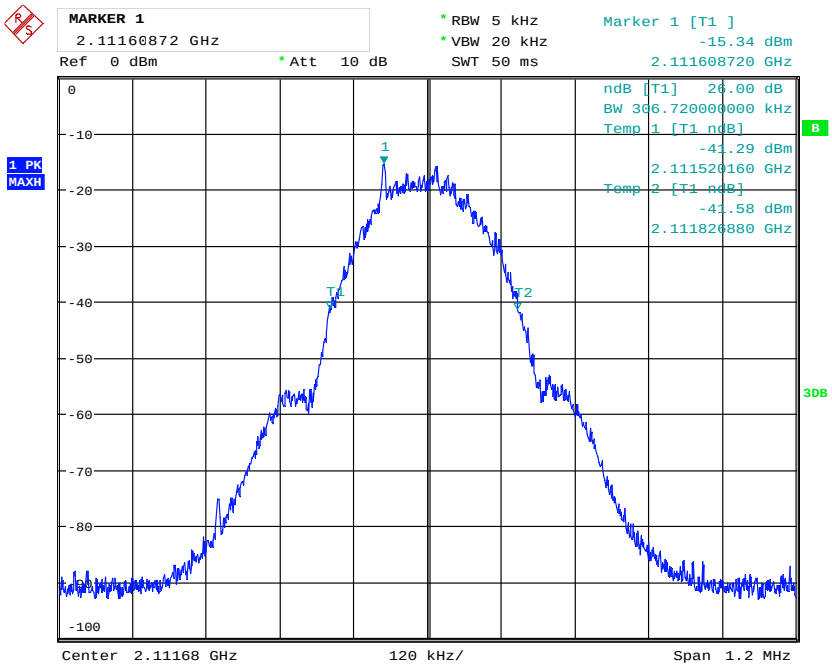


Narrowband Signal AGC off

Input



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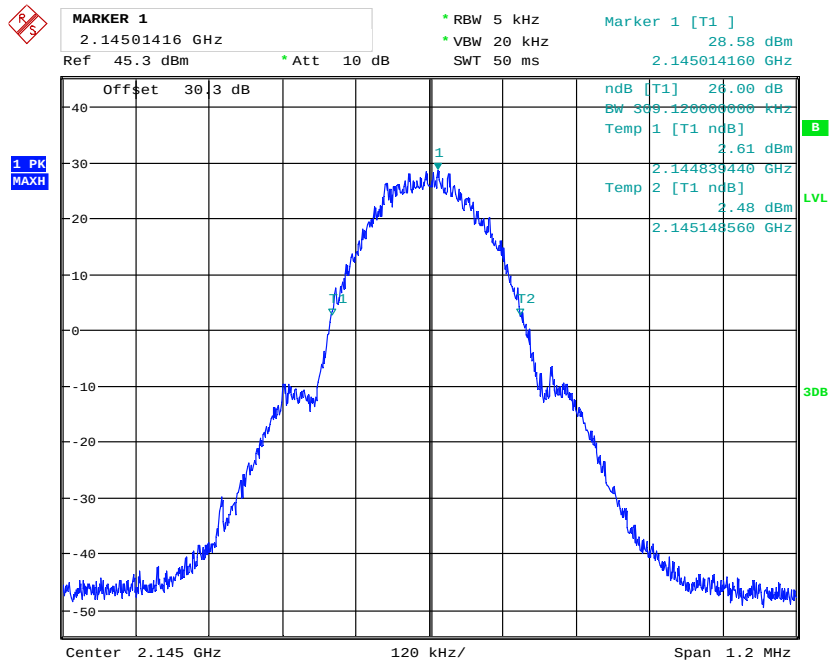
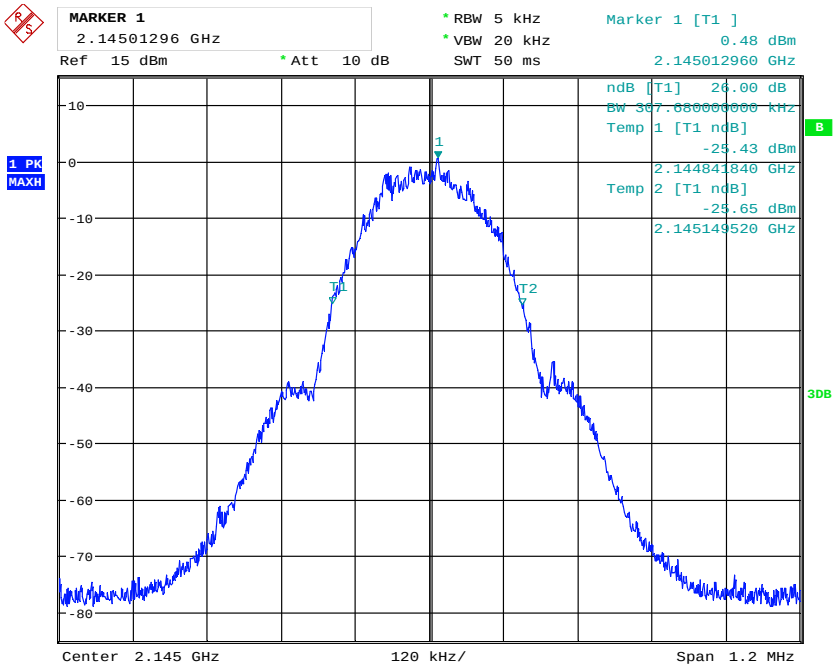


Narrowband Signal AGC on

Input



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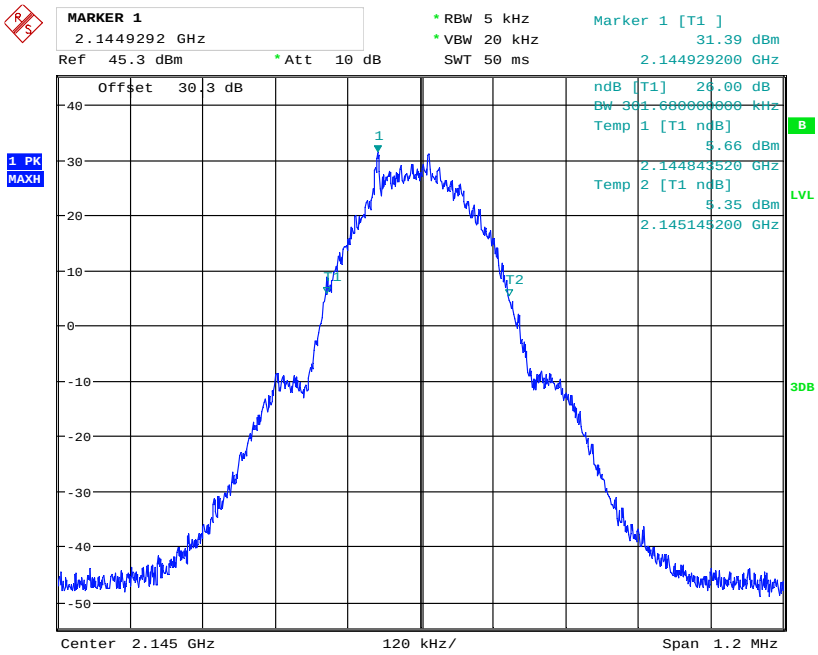


7 FCC §2.1053 & §27.53 - Spurious Radiated Emissions

7.1 Applicable Standards

According to FCC §27.53(c)(1), on any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB.

According to FCC §27.53 (g), for operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

According to FCC §27.53 (h)(1), for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

7.2 Test Procedure

The transmitter was place onto a Styrofoam block. The unit was normally transmitting with a 50 ohm terminator connected to the antenna terminal.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

Emissions were investigated up to the tenth harmonic of the fundamental frequency.

After the emissions were found, the EUT was removed and replaced by a substituting antenna. A signal generator was connected to the substituting antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001) – the absolute level
Spurious attenuation limit in dB = 43 + 10 Log_{10} (power out in Watts)

7.3 Test Equipment List and Details

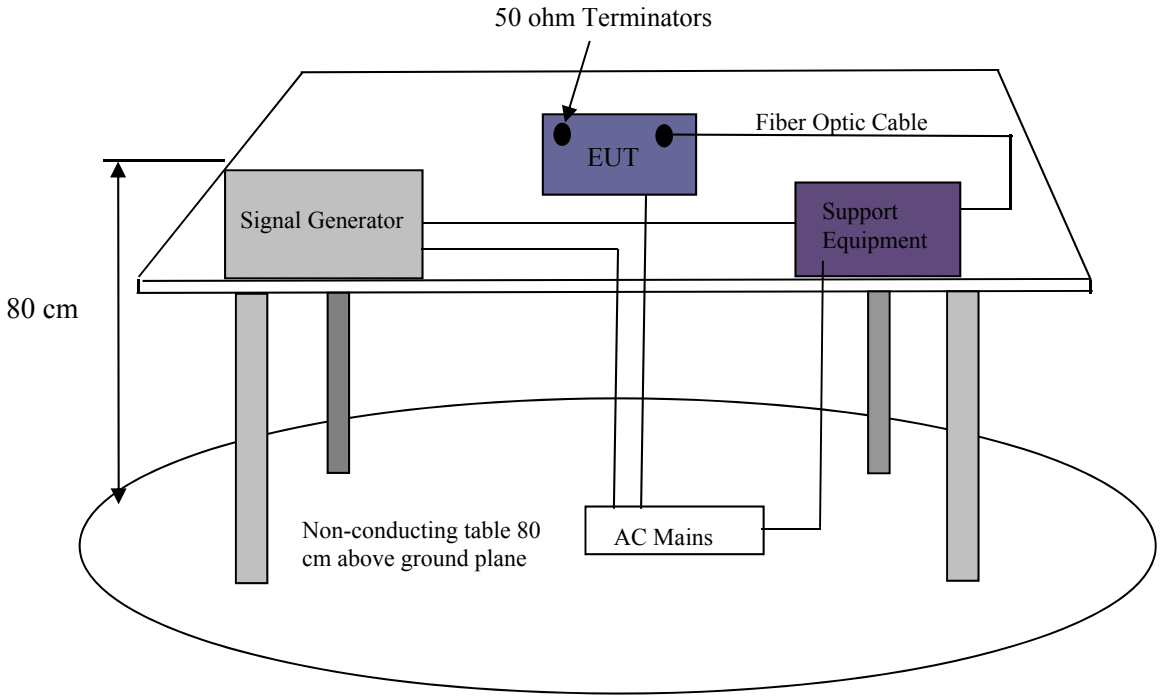
Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	MY48250238	2019-06-26	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2019-11-20	2 years
Agilent	Amplifier, Pre	8447D	2443A04374	2019-08-13	1 year
HP/ Agilant	Pre Amplifier	8449B OPT HO2	3008A0113	2019-09-30	1year
ETS Lindgren	Antenna, Horn	3117	00218973	2019-02-13	2 years
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2019-04-02	2 years
Agilent	Generator, Signal	E4438C	MY45091309	2019-11-15	1 year
HP	Generator, Signal	83650B	3614A00276	2019-04-12	1 year
COM-POWER	Antenna, Dipole	AD-100 DB-4	721033DB1/2/3/4	2019-03-06	2 years
IW Microwave	150 Series 2.92mm Cable	KPS1501AN-3780-KPS	DC 1925	2019-09-11	1 year
MDP DIgital	Times Microwave LMR 400 UltraFex Coaxial Cable 35\'	LMR400UF	BACL1904161	2019-04-16	1 year
Wisewave	Antenna, Horn	ARH-4223-02	10555-01	2020-02-27	2 years
Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2020-02-05	2 years
-	SMA cable	-	C0003	Each Time[1]	Each Time[1]
-	SMA cable	-	C0006	Each Time[1]	Each Time[1]

[1]*Note: This equipment was calibrated for each test.*

***Statement of Traceability*:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

7.4 Test Setup Block Diagram

Radiated Emissions Testing



7.5 Test Environmental Conditions

Temperature:	20-21°C
Relative Humidity:	47-49 %
ATM Pressure:	101.4-101.6 kPa

The testing was performed by Christian McCaig on 2020-03-23 in 5 Meter Chamber 3.

7.6 Test Results

Carrier Wave Signal

Low Channel (2110.2 MHz)

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dBd/dBi)	Cable Loss (dB)	Absolute Level (dBm)		
72.26	81.6	80	200	H	72.26	-29.37	0	0.1	-29.47	-13	-16.47
72.26	86.6	160	100	V	72.26	-18.6	0	0.1	-18.7	-13	-5.7
95	72.32	190	200	H	95	-36.49	0	0.12	-36.61	-13	-23.61
95	69.75	120	135	V	95	-32.04	0	0.12	-32.16	-13	-19.16
176	59.85	135	260	H	176	-45.23	0	0.12	-45.35	-13	-32.35
176	61.21	225	220	V	176	-42.09	0	0.12	-42.21	-13	-29.21
6330	48.1	0	100	H	6330	-50.36	11.101	1.22	-40.479	-13	-27.479
6330	48.18	0	100	V	6330	-50.55	11.101	1.22	-40.669	-13	-27.669
4220	48.38	0	100	H	4220	-53.43	10.293	1.18	-44.317	-13	-31.317
4220	49.28	0	100	V	4220	-52.98	10.293	1.18	-43.867	-13	-30.867
1751	50.68	0	100	H	1751	-56.74	7.877	0.9	-49.763	-13	-36.763
1751	51.07	0	100	V	1751	-56.33	7.877	0.9	-49.353	-13	-36.353

Middle Channel (2145 MHz)

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dBd/dBi)	Cable Loss (dB)	Absolute Level (dBm)		
72.26	81.91	80	280	H	72.26	-29.06	0	0.1	-29.16	-13	-16.16
72.26	86.74	160	100	V	72.26	-18.46	0	0.1	-18.56	-13	-5.56
95	72.22	190	200	H	95	-36.59	0	0.12	-36.71	-13	-23.71
95	69.65	120	135	V	95	-32.14	0	0.12	-32.26	-13	-19.26
176	59.74	135	115	H	176	-45.34	0	0.12	-45.46	-13	-32.46
176	61.2	225	190	V	176	-42.1	0	0.12	-42.22	-13	-29.22
6435	47.85	0	100	H	6435	-50.61	11.101	1.22	-40.729	-13	-27.729
6435	47.76	0	100	V	6435	-50.97	11.101	1.22	-41.089	-13	-28.089
4290	50.02	0	100	H	4290	-51.79	10.293	1.18	-42.677	-13	-29.677
4290	50.18	0	100	V	4290	-52.08	10.293	1.18	-42.967	-13	-29.967
1751	51.02	0	100	H	1751	-56.4	7.877	0.9	-49.423	-13	-36.423
1751	50.94	0	100	V	1751	-56.46	7.877	0.9	-49.483	-13	-36.483

High Channel (2179.8 MHz)

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dBd/dBi)	Cable Loss (dB)	Absolute Level (dBm)		
72.26	81.39	80	280	H	72.26	-29.58	0	0.1	-29.68	-13	-16.68
72.26	86.58	160	100	V	72.26	-18.62	0	0.1	-18.72	-13	-5.72
95	71.03	190	200	H	95	-37.78	0	0.12	-37.9	-13	-24.9
95	70.85	120	135	V	95	-30.94	0	0.12	-31.06	-13	-18.06
176	57.85	135	115	H	176	-47.23	0	0.12	-47.35	-13	-34.35
176	57.78	225	190	V	176	-45.52	0	0.12	-45.64	-13	-32.64
6540	47.33	0	100	H	6540	-51.13	11.101	1.22	-41.249	-13	-28.249
6540	47.44	0	100	V	6540	-51.29	11.101	1.22	-41.409	-13	-28.409
4360	48.66	0	100	H	4360	-53.15	10.293	1.18	-44.037	-13	-31.037
4360	48.39	0	100	V	4360	-53.87	10.293	1.18	-44.757	-13	-31.757
1751	50.47	0	100	H	1751	-56.95	7.877	0.9	-49.973	-13	-36.973
1751	50.59	0	100	V	1751	-56.81	7.877	0.9	-49.833	-13	-36.833

8 FCC §2.1051 & §27.53 - Spurious Emissions at Antenna Terminals

8.1 Applicable Standards

According to FCC §27.53(c)(1), on any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB.

According to FCC §27.53 (g), for operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

According to FCC §27.53 (h)(1), for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

8.2 Test Procedure

The signal generator was connected to the support equipment and the support equipment was connected to the EUT through a fiber cable. The output of the EUT was connected to a spectrum analyzer through appropriate attenuation.

The resolution bandwidth of the spectrum analyzer was set 100 KHz or greater for 700 MHz frequency band and for 2100 MHz band. Sufficient scans were taken to show any out of band emissions up to 10^{th} harmonic.

8.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Rohde & Schwarz	Analyzer, Spectrum	FSQ26	200749	2019-11-07	2 years
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2018-07-25	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2020-02-11	1 year

Note: Equipment was calibrated for each test.
***Statement of Traceability*:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

8.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Christian McCaig 2020-03-20 in the RF Site.

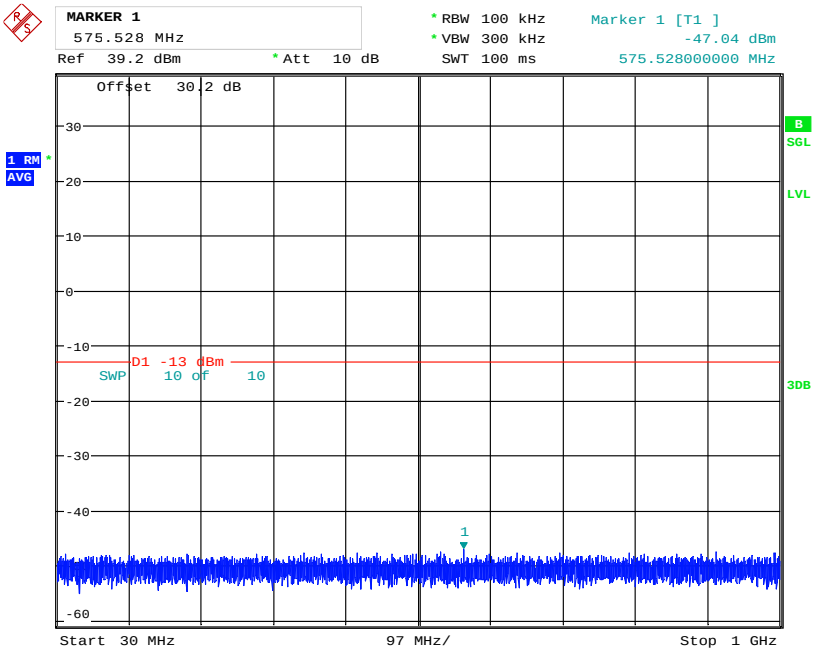
8.5 Test Results

Please refer to the following plots.

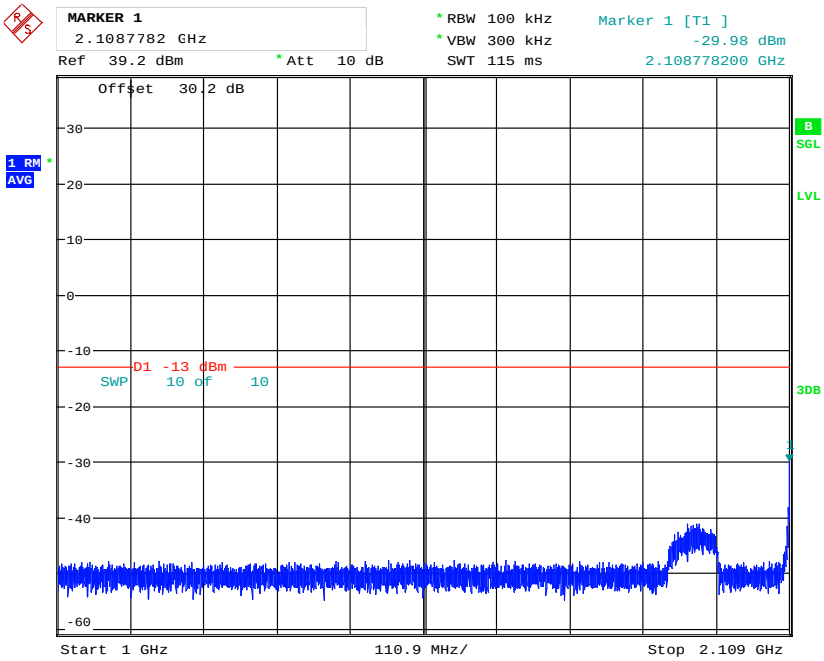
Broadband Signal

Low Channel

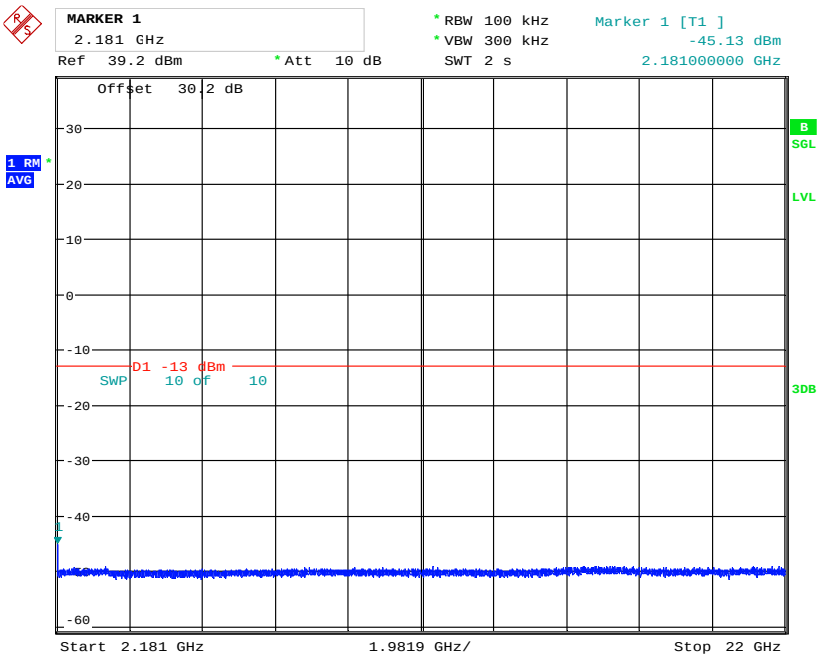
30 MHz-1 GHz



1GHz-2.109 GHz

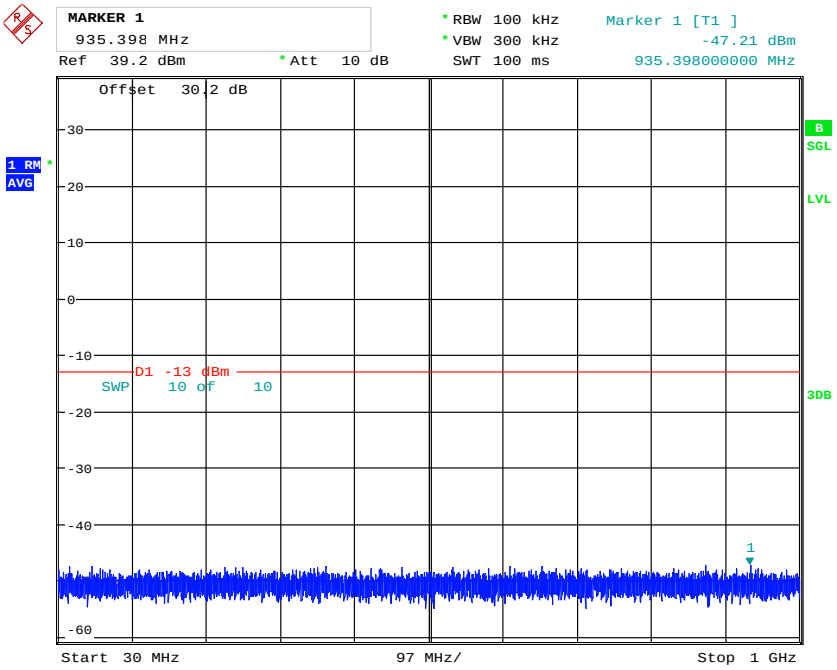


2.181GHz- 22 GHz

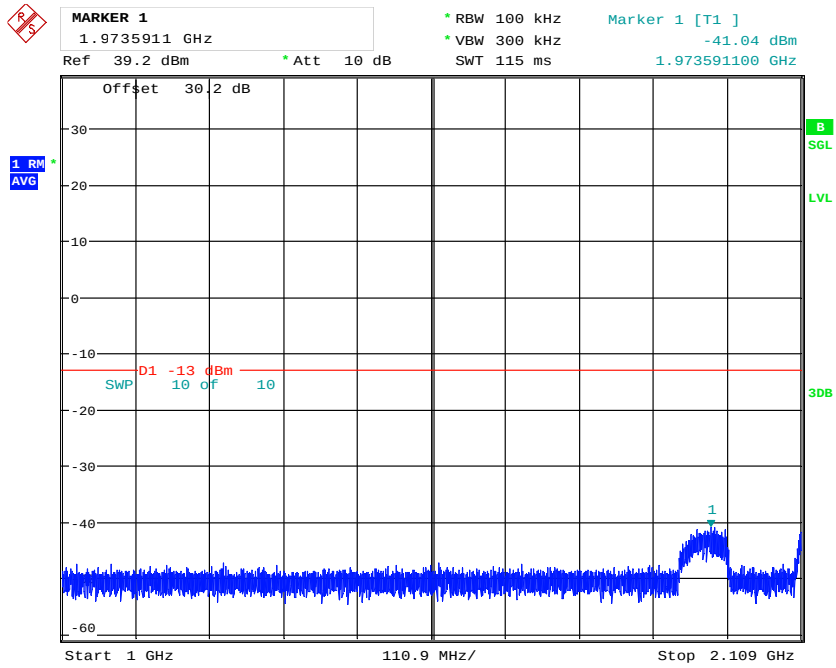


Middle Channel

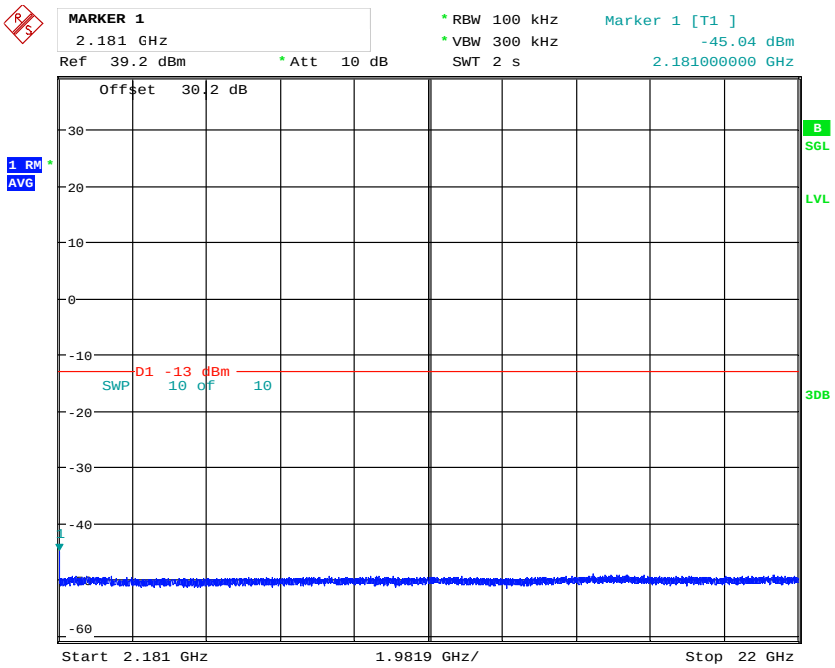
30 MHz-1 GHz



1GHz-2.109 GHz

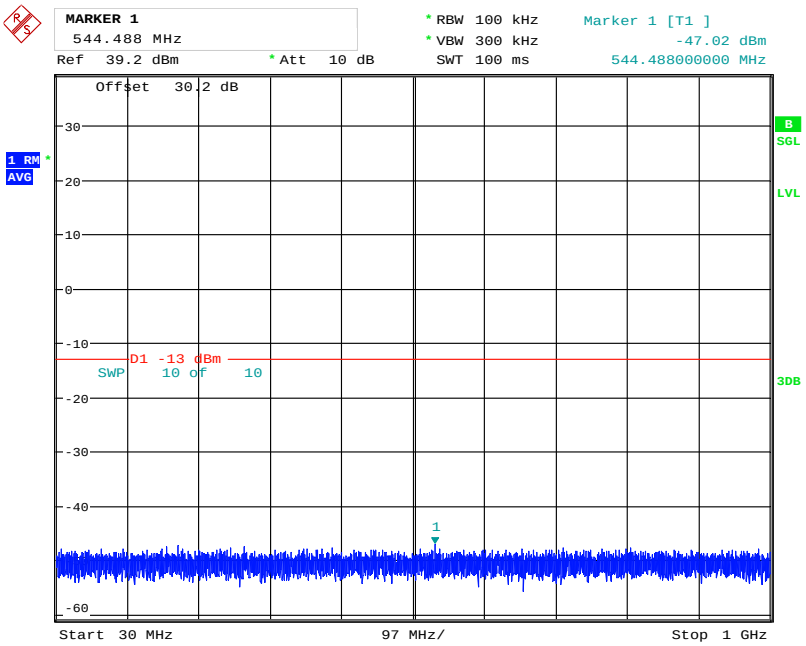


2.181GHz- 22 GHz

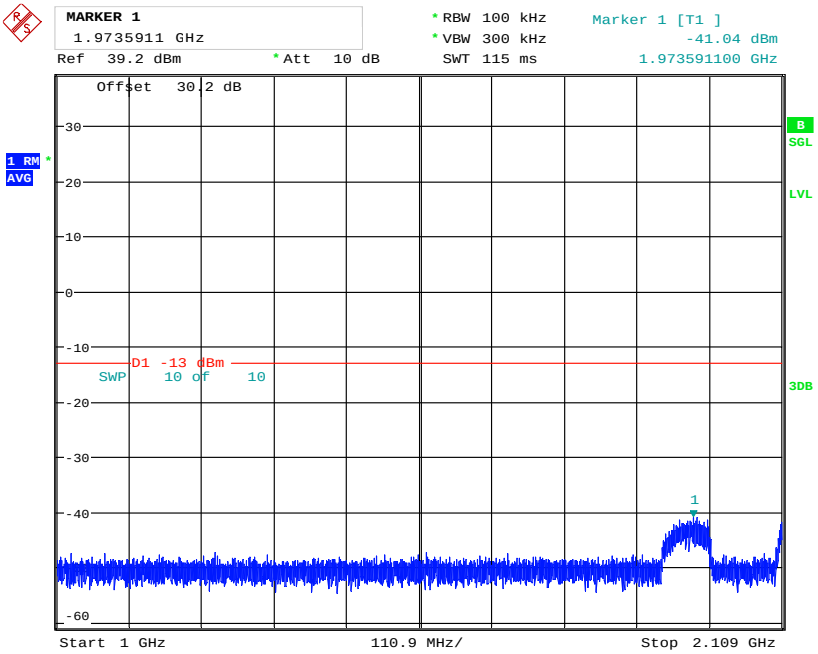


High Channel

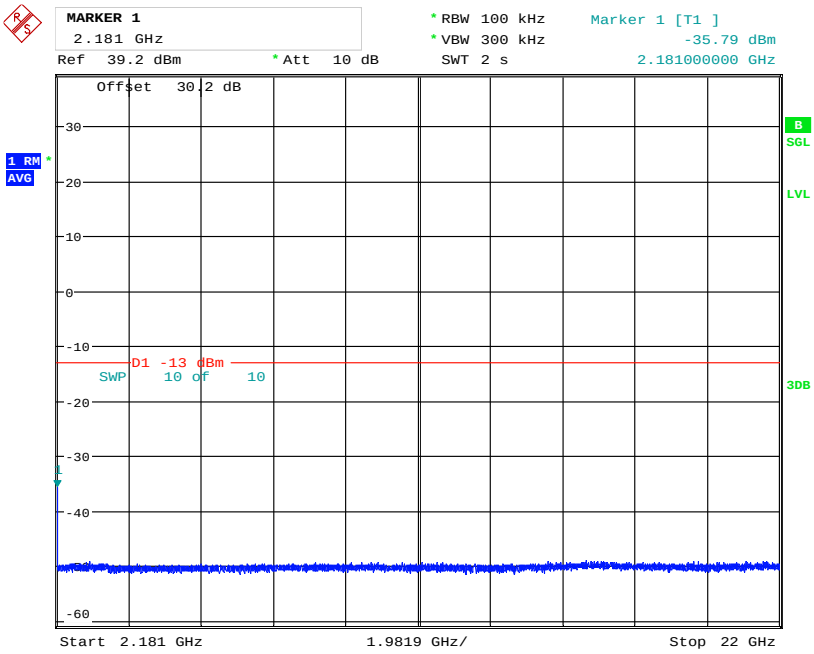
30 MHz-1 GHz



1GHz-2.109 GHz



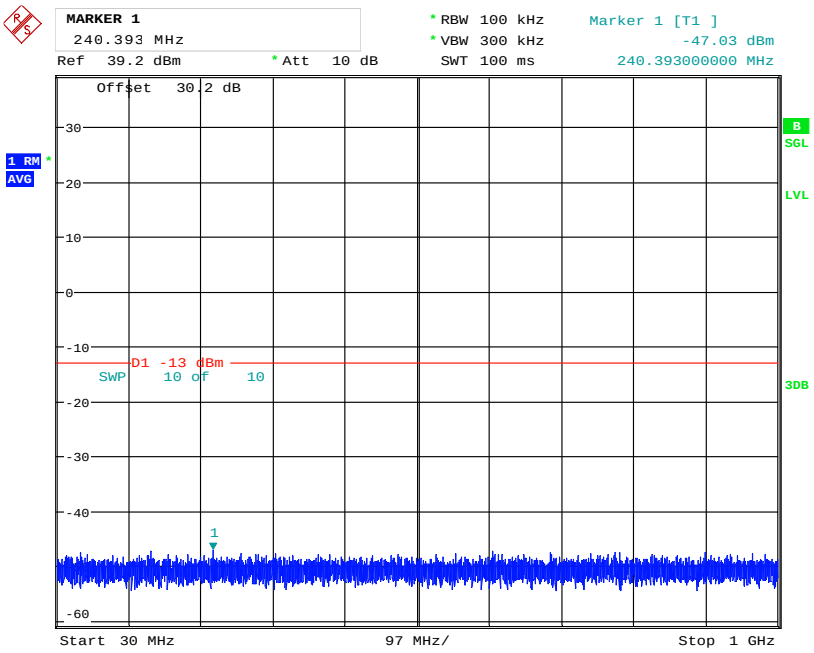
2.181GHz- 22 GHz



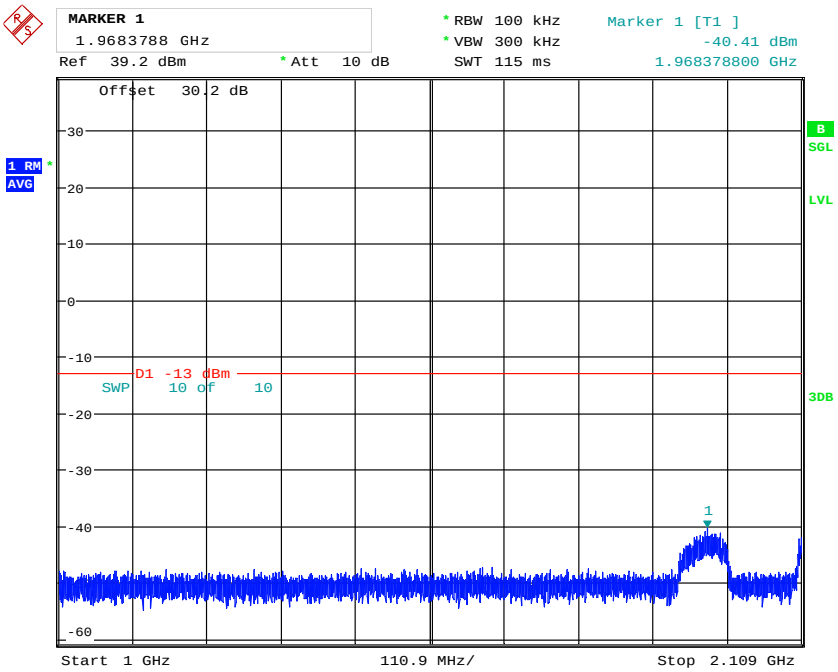
Narrowband signal

Low Channel

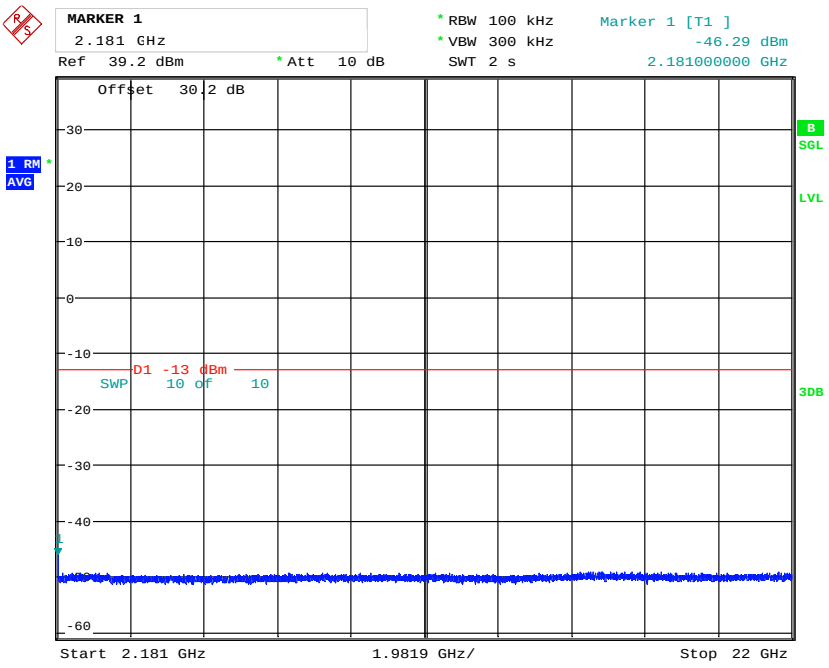
30 MHz-1 GHz



1GHz-2.109 GHz

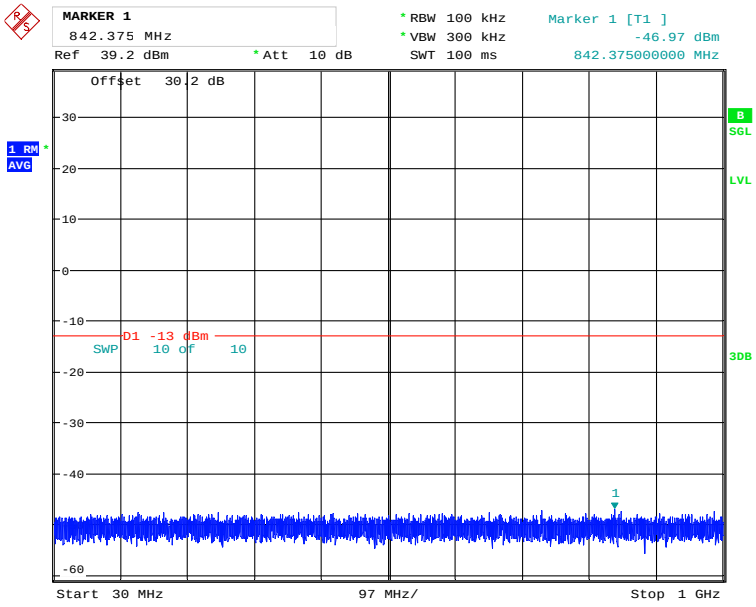


2.181GHz- 22 GHz



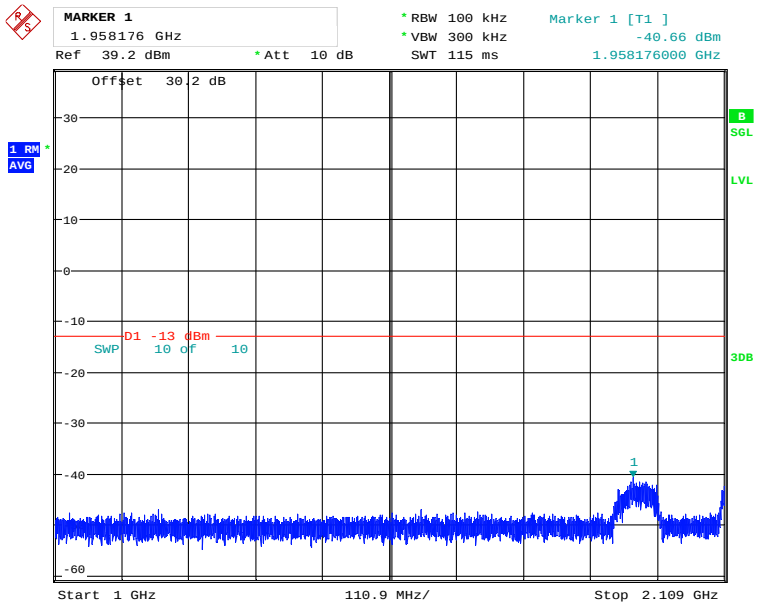
Middle Channel

30 MHz-1 GHz



Date: 2.JAN.2003 16:31:03

1GHz-2.109 GHz



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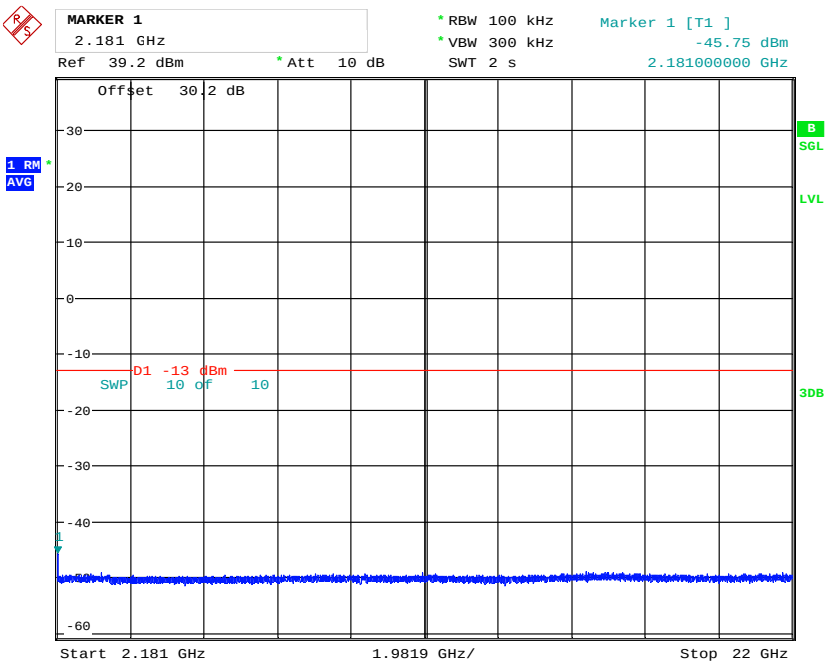
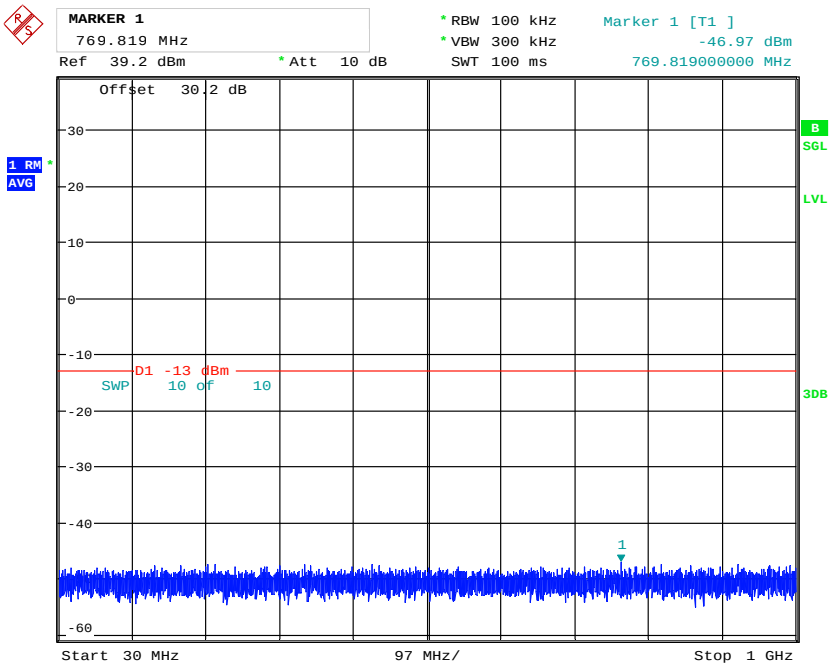
2.181GHz- 22 GHz

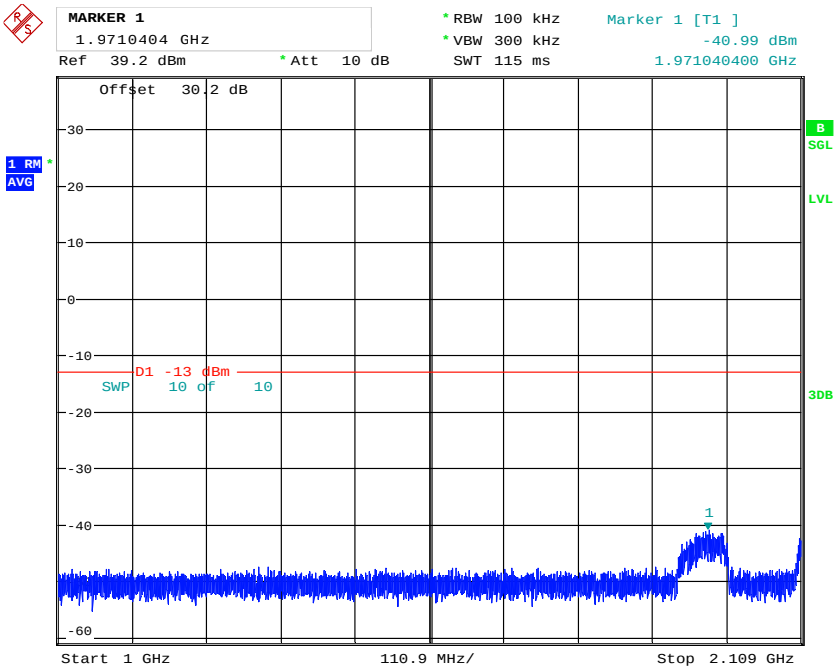


High Channel

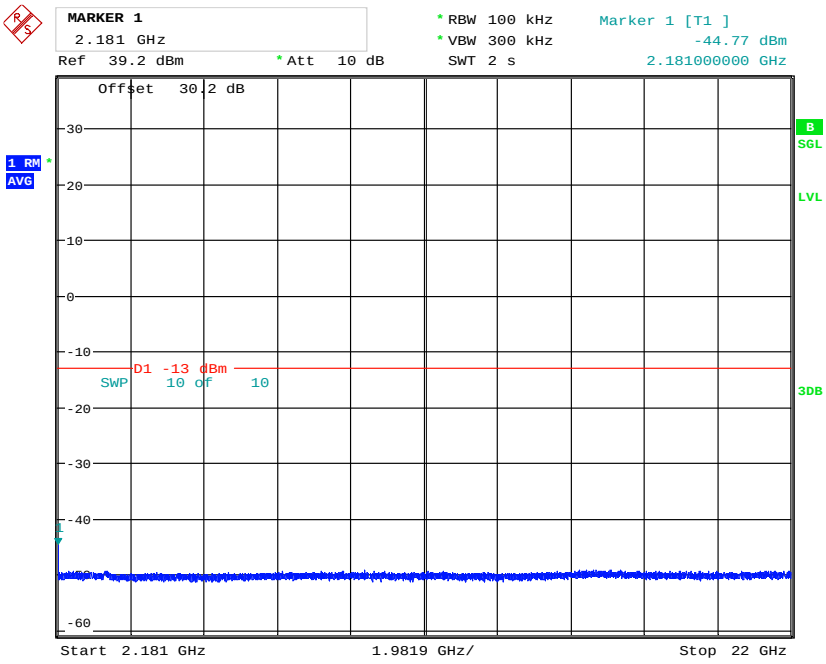
30 MHz-1 GHz



1GHz-2.109 GHz



2.181GHz- 22 GHz



Note: For above 1 GHz measurements, a 1 MHz RBW was declared to be used by standard, but compliance was ensured with the 100 kHz RBW. Conversion from 100 kHz to 1 MHz RBW adds 10dB to the value of the measurement. As all measurements were more than 10 dB from the limit, compliance was shown.

9 FCC §27.53 - Band Edge & Intermodulation

9.1 Applicable Standards

According to FCC §27.53(c)(1), on any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB.

According to FCC §27.53 (g), for operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

According to FCC §27.53 (h)(1), for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

9.2 Test Procedure

The signal generator was connected to the support equipment and the support equipment was connected to the EUT through a fiber cable. The output of the EUT was connected to a spectrum analyzer through appropriate attenuation.

The center frequency of the spectrum analyzer was set according to center frequency of the EUT to be transmitted.

9.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Rohde & Schwarz	Analyzer, Spectrum	FSQ26	200749	2019-11-07	2 years
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2018-07-25	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2020-02-11	1 year
Agilent	MXG Signal Generator	N5182A	MY501403905	2020-01-16	1 year
Agilent	Generator, Signal	E4438C	MY45091309	2020-11-15	1 year
-	SMA cable	-	C0003	Each Time[1]	Each Time[1]
Mini Circuits	Combiner	15542	ZFSC-2-10G	Not Required	-

[1]*Note: This equipment was calibrated for each test.*
***Statement of Traceability*:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

9.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Christian McCaig 2020-03-20 in the RF Site.

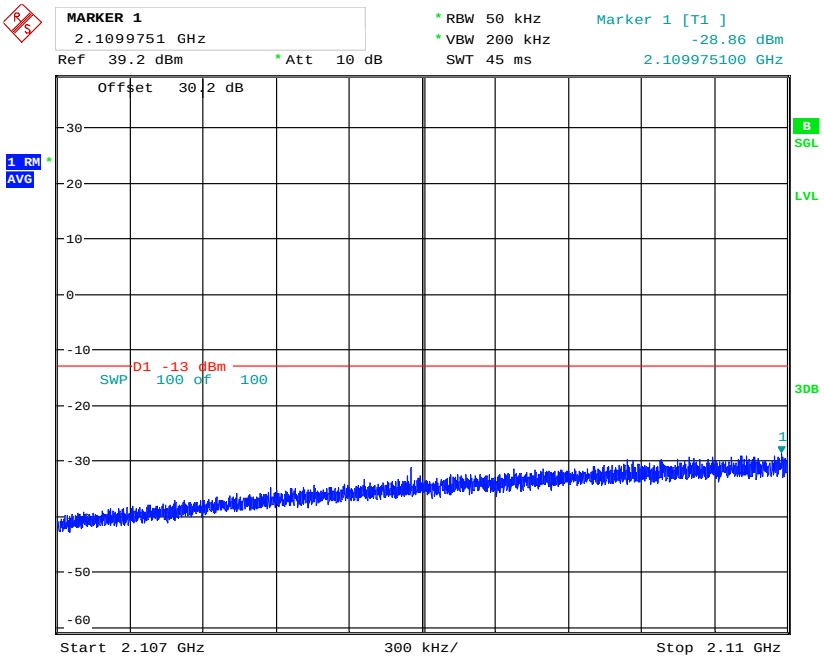
9.5 Test Results

Please refer to the following plots.

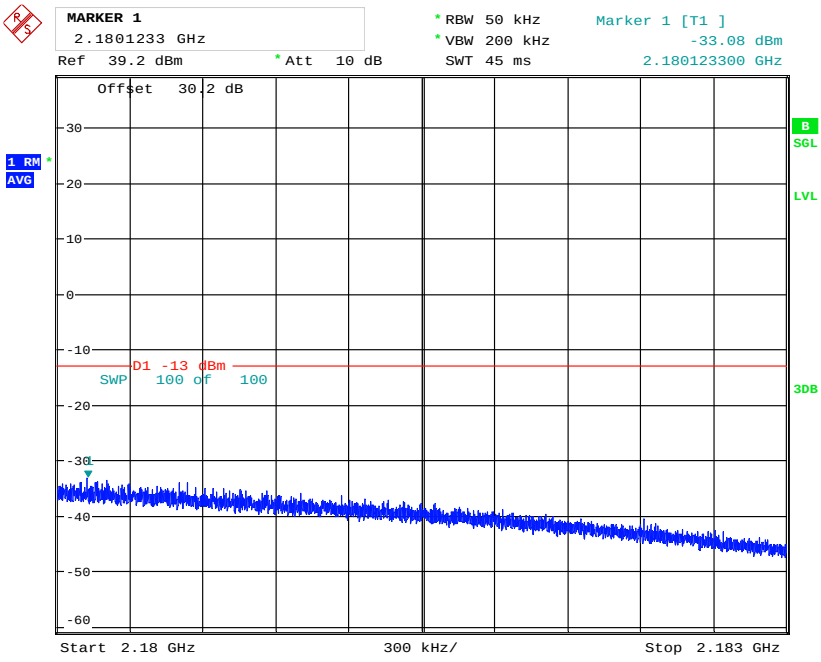
Broadband Signal

AGC Off

Lower Band Edge

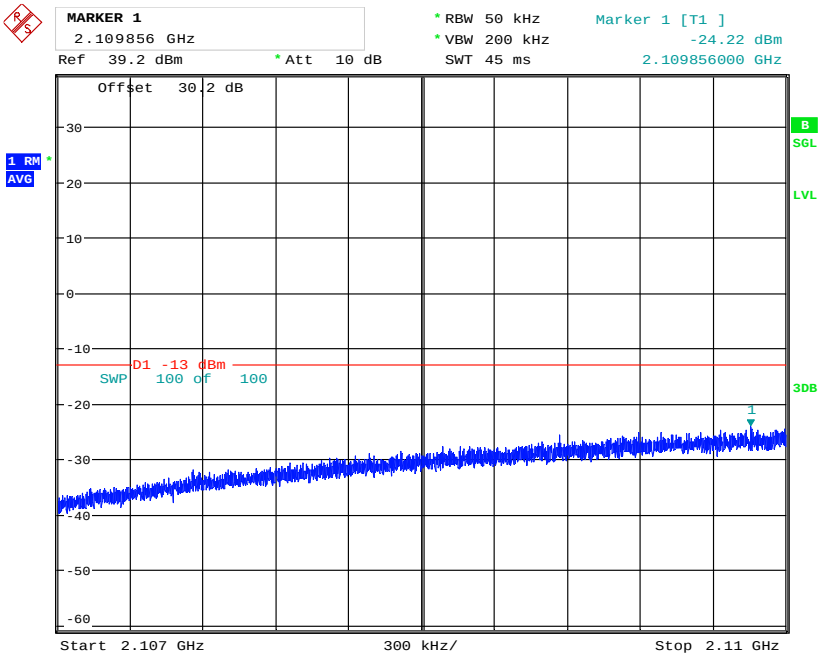


Upper Band Edge

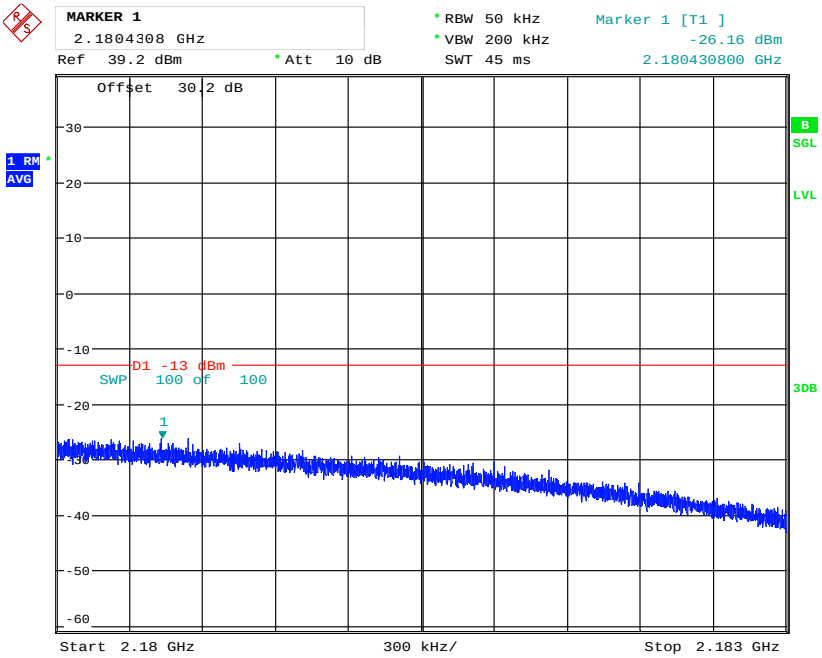


AGC On

Lower Band Edge



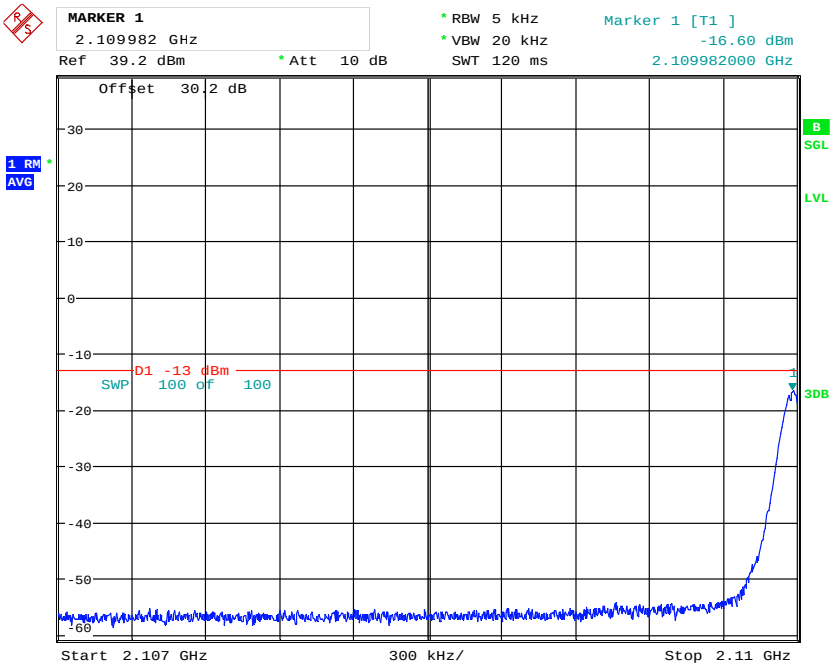
Upper Band Edge



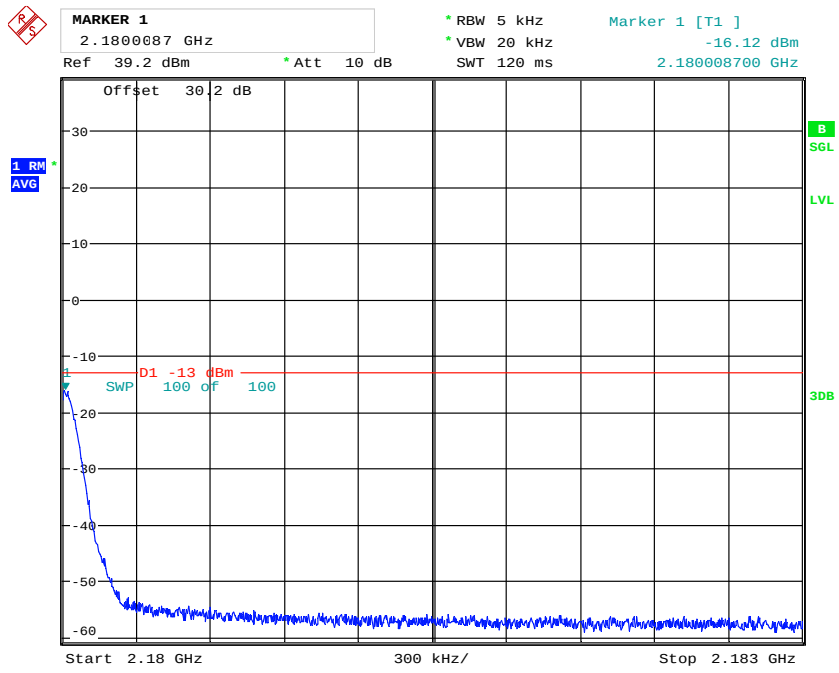
Narrowband Signal

AGC Off

Lower Band Edge

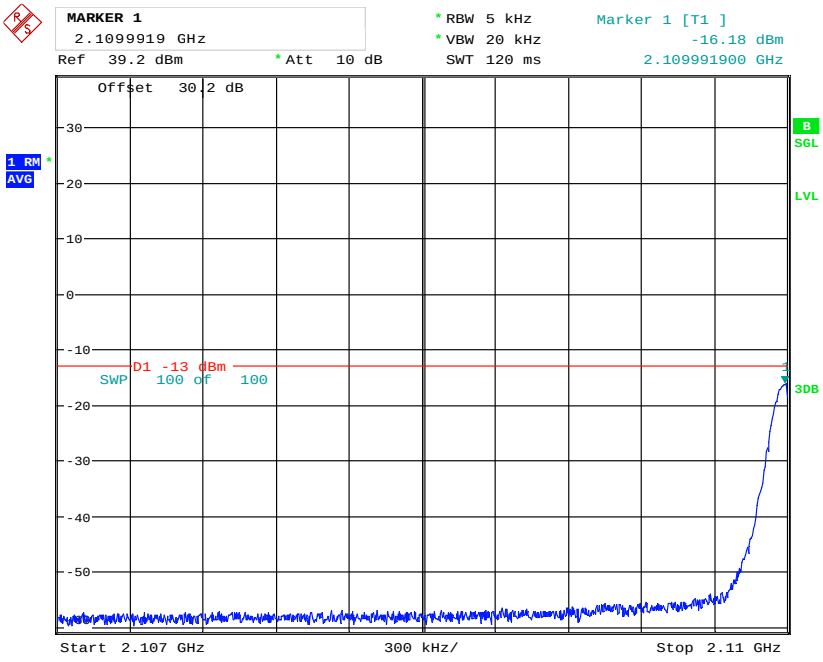


Upper Band Edge

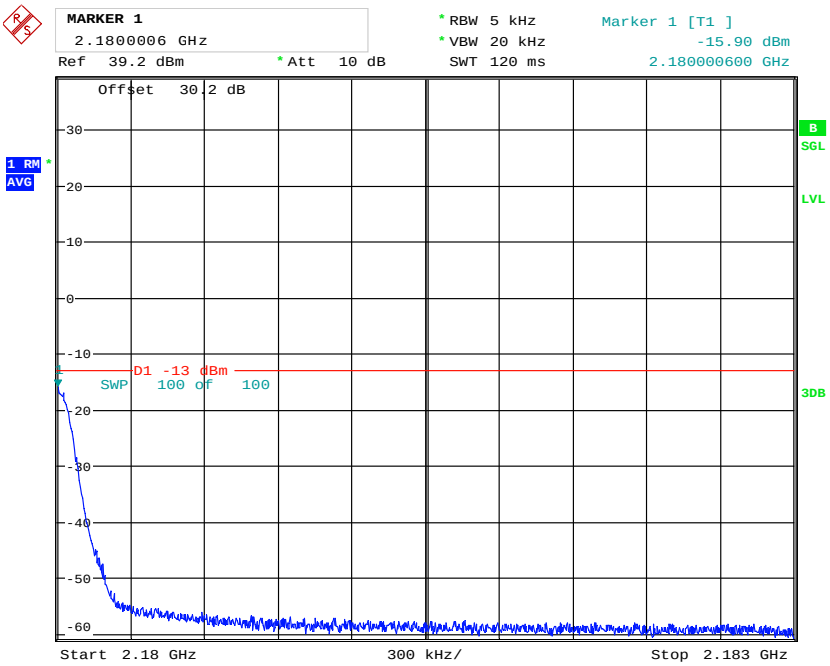


AGC On

Lower Band Edge



Upper Band Edge

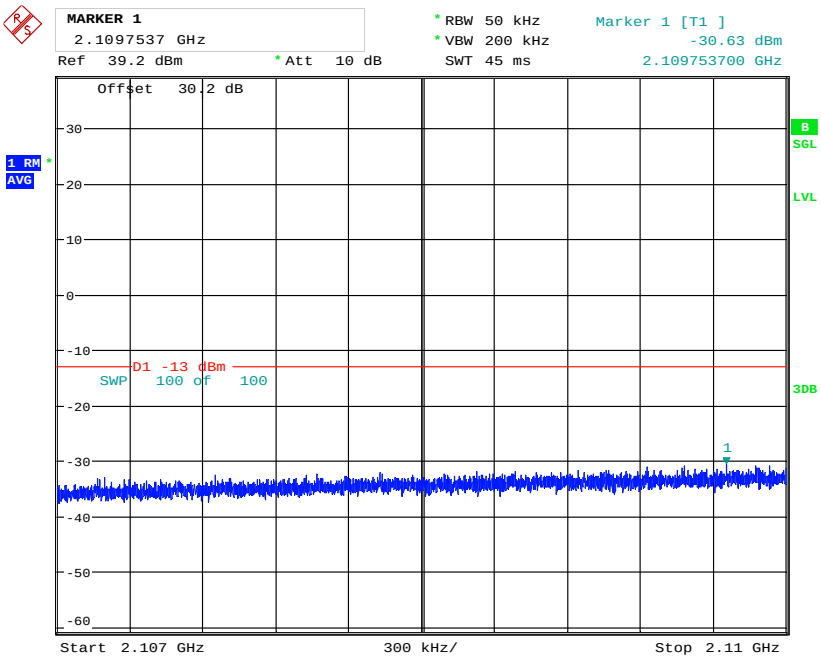


Intermodulation:

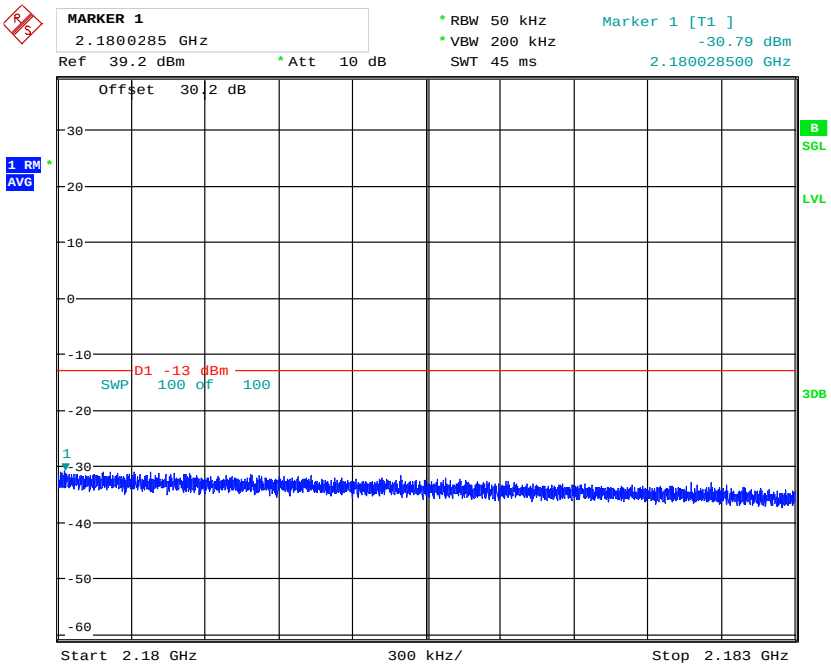
Broadband signal

AGC Off

Low Channel

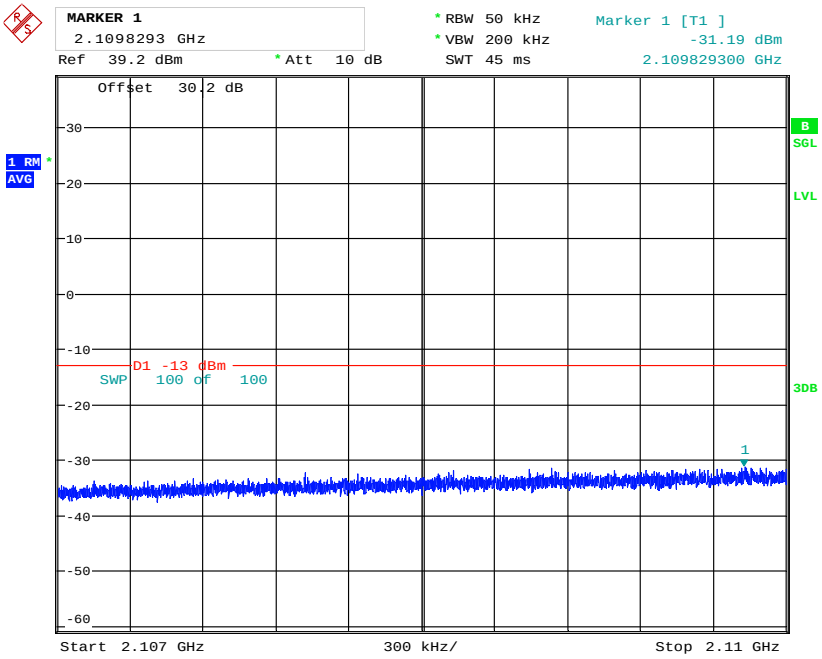


High Channel

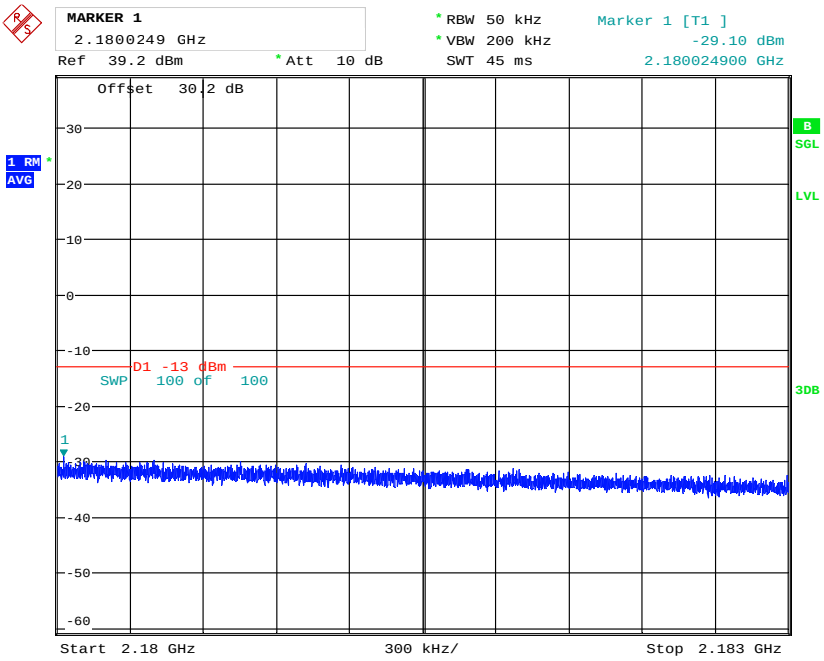


AGC On

Low Channel



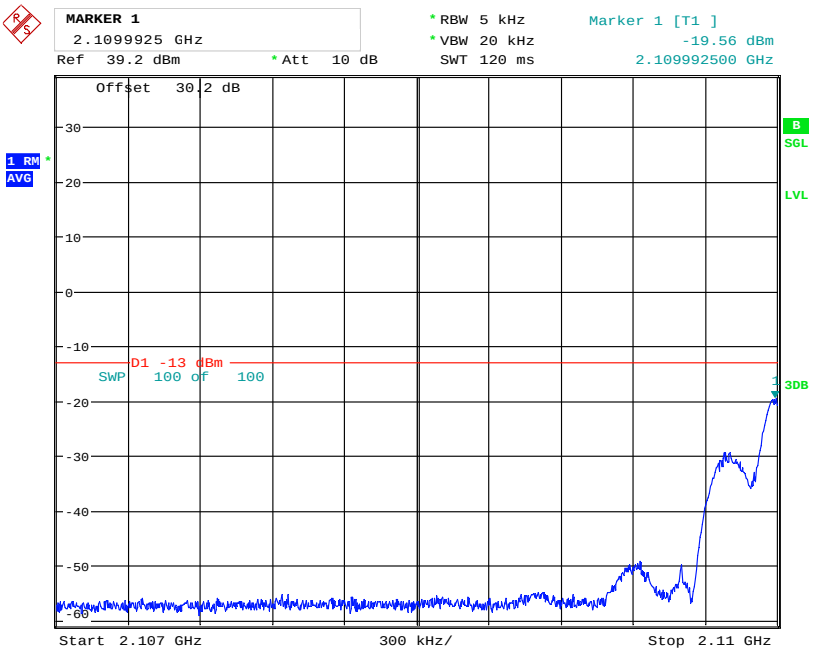
High Channel



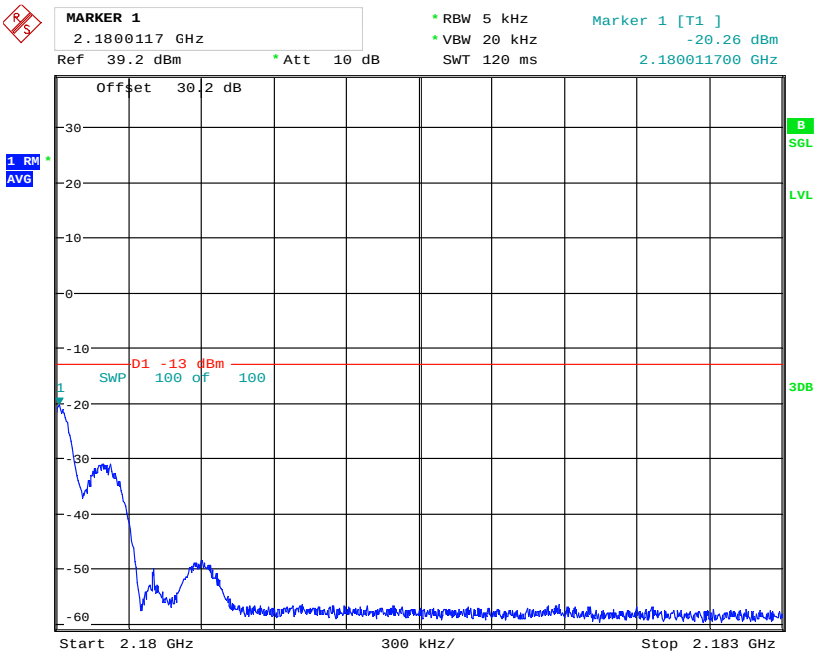
Narrowband Signal

AGC Off

Low Channel

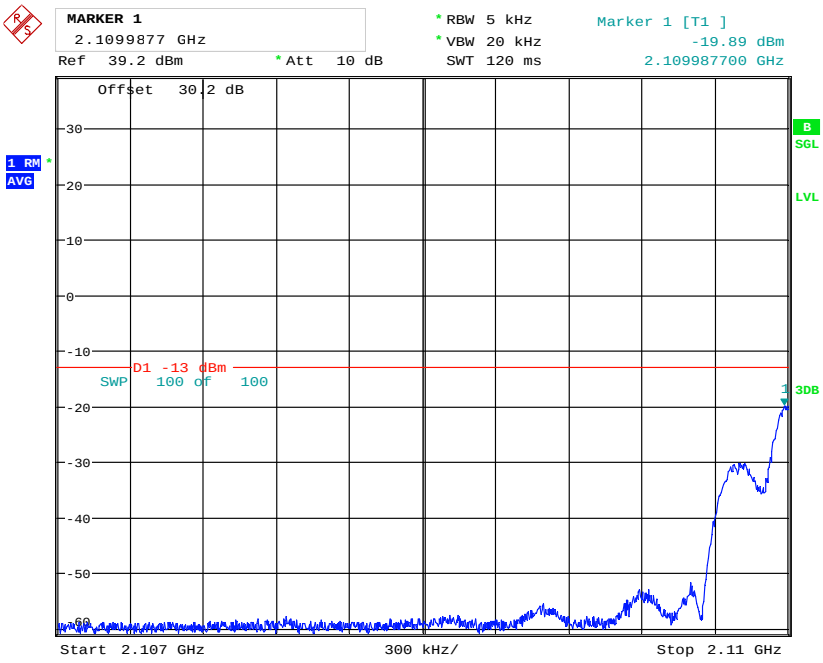


High Channel

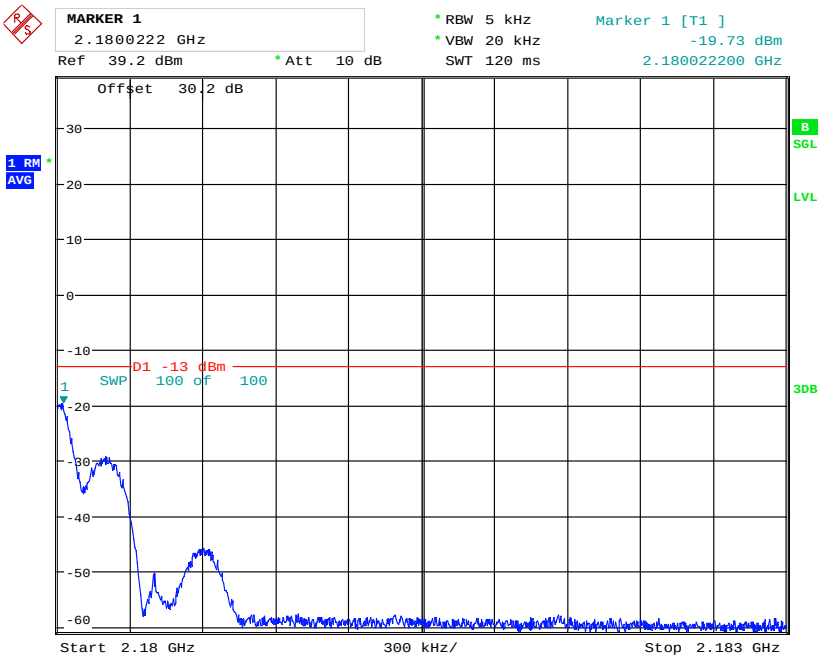


AGC On

Low Channel



High Channel



10 FCC §20.21 - Out of Band Rejection

10.1 Applicable Standard

According to FCC Part 20.21, a frequency selective booster shall have −20 dB at the band edge referenced to the gain in the center of the pass band of the booster, where band edge is the end of the licensee's allocated spectrum.

10.2 Test Procedure

KDB 935210 D05, Section 3.3.

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The span of the spectrum analyzer was set to be wide enough in order to capture the spectrum of entire operating band.

10.3 Test Equipment List and Details

Manufacturer	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Rohde & Schwarz	Analyzer, Spectrum	FSQ26	200749	2019-11-07	2 years
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2018-07-25	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2020-02-11	1 year

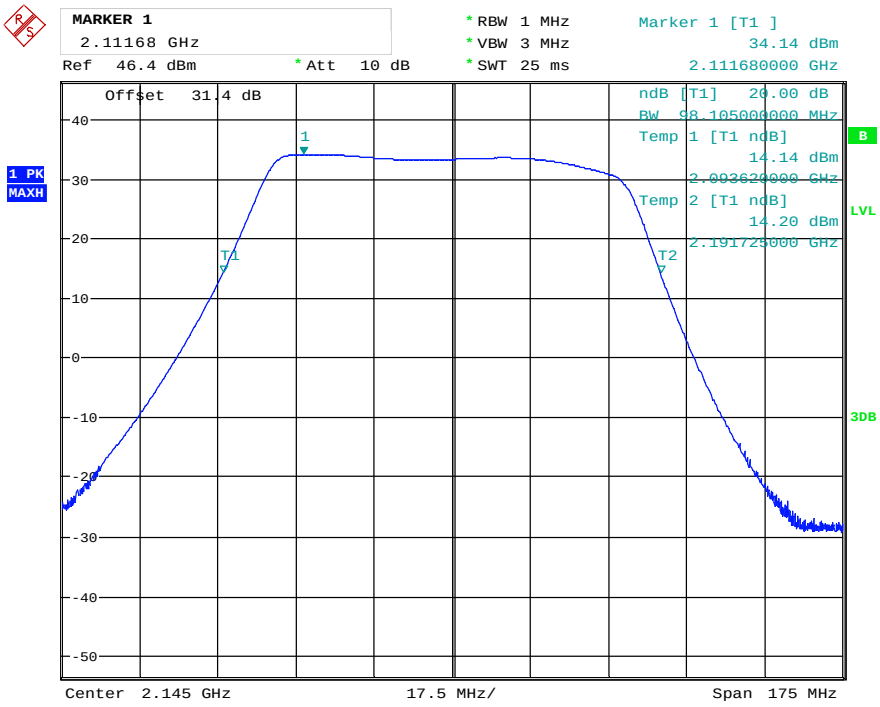
Note: Equipment was calibrated for each test.
***Statement of Traceability*:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

10.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Christian McCaig on 2020-03-19 in the RF Site.

10.5 Test Results



11 Annex A (Normative) - EUT Setup Photographs

Please refer to the attachment

12 Annex B (Normative) – EUT External Photographs

Please refer to the attachment

13 Annex C (Normative) – EUT Internal Photographs

Please refer to the attachment

14 Annex D (Normative) – A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA R222 - *Specific Requirements EPA ENERGY STAR Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 2nd day of October 2018.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2020
Revised June 5, 2019

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

Please follow the web link below for a full ISO 17025 scope

https://www.a2la.org/scopepdf/3297-02.pdf

--- END OF REPORT ---