

ISED CABid: ES1909
Lab. Company Number: 4621A

Test Report No:
80874RRF.004A1

Test Report

USA FCC Part 24

CANADA RSS-133

(*) Identification of item tested	LTE Cat 1 bis data module
(*) Trademark	u-blox
(*) Model and /or type reference	LEXI-R10001D
Other identification of the product	FCC ID: XPYUBX24AD02 IC: 8595A-UBX24AD02
(*) Features	LTE Cat1 bis, Wi-fi Scan / Locate HW version: UBX-463AD0 SW version: 01.07.A01.00
Applicant	u-blox AG Zürcherstrasse 68, CH-8800 Thalwil, Switzerland
Test method requested, standard	USA FCC Part 24 (10-1-23 Edition). CANADA RSS-133 Issue 7, Jul. 2024. ANSI C63.26-2015. KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	José Manuel Gómez Galván EMC Consumer & RF Lab. Manager
Date of issue	2025-04-24
Report template No.	FDT08_24 (*) "Data provided by the client"



Index

Competences and guarantees3

General conditions3

Uncertainty3

Data provided by the client.....3

Usage of samples4

Test sample description4

Identification of the client.....6

Testing period and place.....6

Document history6

Environmental conditions6

Remarks and comments7

Testing verdicts.....8

Summary8

Appendix A: Test results for FCC 24 / RSS-133.....9

Competences and guarantees

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DEKRA Testing and Certification is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory, CABid: ES1909, Company Number: 4621A, with the appropriate scope of accreditation that covers the performed tests in this report.

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Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample consists of a Cat1 bis data only module for industrial IoT applications.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: The client.

Id	Control Number	Description	Model	Serial N°	Date Reception	of	Application
S/01 & S/02	80874_045	Evaluation board	LEXI-R10001D	---	2025-01-30		Equipment under test
S/01 & S/02	80874_046	AC/DC	--	--	2025-01-30		Auxiliary device
S/02	80874_049	Antenna	Taoglass GSA_8835	--	2025-01-30		Equipment under test

Notes referenced to samples during the project:

Id	Type
S/01	Conducted tests
S/02	Radiated tests

Test sample description

Ports.....:	Port name and description	Cable				
		Specified max length [m]	Attached during test	Shielded		
	USB	2	☒	☒		
Supplementary information to the ports.....:	-					
Rated power supply	Voltage and Frequency		Reference poles			
	☐ AC:	☐	☐	☐	☐	☐
	☒ DC: Min: 3.3, Typical: 3.8, Max: 4.5					
Rated Power.....:	-					
Clock frequencies.....:	26 MHz					
Other parameters	-					
Software version.....:	01.07.A01.00					
Hardware version	UBX-463AD0					
Dimensions in cm (W x H x D) ...:	1.6 x 0.2 x 1.6					
Mounting position	☐	Table top equipment				
	☐	Wall/Ceiling mounted equipment				
	☐	Floor standing equipment				
	☐	Hand-held equipment				
	☒	Other: Industrial modem component				
Modules/parts.....:	Module/parts of test item		Type	Manufacturer		
	-		-	-		

Accessories (not part of the test item) :	Description	Type	Manufacturer
	Power supply unit	UUX324-1215	Unifive
	Antenna	GSA.8835	Taoglass
Documents as provided by the applicant :	Description	File name	Issue date
	-	-	-

Identification of the client

u-blox AG
Zürcherstrasse 68, CH-8800 Thalwil, Switzerland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2025-02-10
Date (finish)	2025-02-20

Document history

Report number	Date	Description
80874RRF.004	2025-04-08	First release.
80874RRF.004A1	2025-04-24	Second release. Modification due to typos. This test reports cancels and replaces to 80874RRF.004

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the semi-anechoic chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Antonio Maireles, Carmen Vázquez
Used instrumentation:

Control No.	Equipment	Next Calibration
08002	TEMPERATURE CHAMBER BINDER MK 56	2026-02-12
09555	TWO CHANNEL POWER SUPPLY, 32V, 10/5A, 188W ROHDE AND SCHWARZ HMP2020	N/A
07794	SIGNAL AND SPECTRUM ANALYZER 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2025-04-21
08912	WIDEBAND RADIO COMMUNICATION TESTER ROHDE AND SCHWARZ CMW500	2025-10-05
06043	POWER DIVIDER, DC-26 GHz TEKTRONIX 5333	N/A
06792	SHIELDED ROOM ETS LINDGREN S101	N/A
06609	TEMPERATURE AND HUMIDITY PROBE HW GROUP HWg-STE	2025-04-22
06615	TEMPERATURE AND HUMIDITY PROBE HW GROUP HWg-STE	2025-04-04
06165	EMI TEST RECEIVER 9 kHz-7 GHz ROHDE AND SCHWARZ ESR7	2025-12-27
07611	PREAMPLIFIER BOX INTERNO -	2026-01-23
04578	HYBRID BILOG ANTENNA 30 MHz - 6 GHz ETS LINDGREN 3142E	2026-06-01
07692	ATTENUATOR 3 dB, 2 W, DC, 18 GHz TECHNIWAVE TWTS2G	2026-02-03
04716	SIGNAL AND SPECTRUM ANALYZER 2 Hz - 50 GHz ROHDE AND SCHWARZ FSW50	2026-08-02
05705	PRE-AMPLIFIER G>40dB, 1-18 GHz BONN ELEKTRONIK BLMA 0118-1M	2025-07-18
04611	HORN ANTENNA 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2026-01-16
08856	PRE-AMPLIFIER G>30 dB, 17-40 GHz BONN ELEKTRONIK BLMA 1840-4A	2025-02-27
04657	HORN ANTENNA 18-40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2026-06-12
04848	EMC/RF Testing SW ROHDE AND SCHWARZ EMC32	N/A

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

Appendix A: LTE Cat 1bis Band 2

FCC 24 / RSS-133		
Requirement – Test case	Verdict	Remark
FCC 24.232 / RSS-133 6.4: RF Output Power	P	--
FCC 2.1047 / RSS-133 6.2: Modulation characteristics	P	--
FCC 24.235 / RSS-133 6.3: Frequency stability	P	--
FCC 2.1049: Occupied Bandwidth	P	--
FCC 24.238 / RSS-133 6.5: Spurious emissions at antenna terminals	P	--
FCC 24.238 / RSS-133 6.5: Spurious emissions at antenna terminals at Block Edges	P	--
FCC 24.238 / RSS-133 6.5: Radiated Emissions	P	--
<u>Supplementary information and remarks:</u> None.		

Appendix A: Test results for FCC 24 / RSS-133

INDEX

TEST CONDITIONS11

RF Output Power11

Frequency Stability16

Modulation Characteristics19

Occupied Bandwidth21

Spurious Emissions at Antenna Terminals48

Spurious Emissions at Antenna Terminals at Block Edges53

Radiated Emissions57

TEST CONDITIONS

POWER SUPPLY (*):

Vnominal: 3.8 Vdc
Vminimum: 3.3 Vdc
Vmaximum: 4.5 Vdc
Type of Power Supply: DC External (USB).

ANTENNA (*):

MIDDLE BAND		ANTENNA TYPE
LTE Cat 1bis Bands 2	-1.41 dBi	External (Taoglass GSA_8835 (standard reference antenna provided with EVK))

TEST FREQUENCIES:

LTE Cat 1bis Band 2. QPSK and 16QAM:

	Channel per BW=(Frequency, MHz)			
	BW=5 MHz	BW=10 MHz	BW=15 MHz	BW=20 MHz
Low	18625 (1852.5)	18650 (1855)	18675 (1857.5)	18700 (1860)
Middle	18900 (1880)	18900 (1880)	18900 (1880)	18900 (1880)
High	19175 (1907.5)	19150 (1905)	19125 (1902.5)	19100 (1900)

RF Output Power

Limits

FCC § 2.1046 and § 24.232:

Mobile/portable stations are limited to 2 Watts (33 dBm) Effective Isotropic Radiated Power (E.I.R.P.).
The peak-to-average ratio (PAR) of the transmission shall not exceed 13 dB.

RSS-133 Clause 6.4:

Mobile stations and hand-held portables are limited to 2 watts maximum e.i.r.p. The peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the High PAPR during periods of continuous transmission.

Method

The conducted RF output power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

The peak-to-average power ratio (PAPR) is measured using an attenuator, power splitter and spectrum analyser with a Complementary Cumulative Distribution Function implemented.

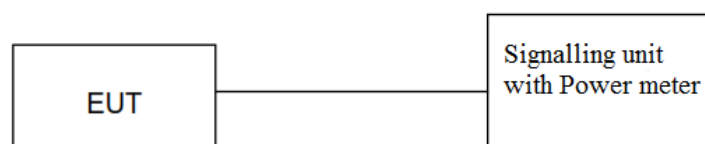
The maximum equivalent isotropically radiated power (e.i.r.p.) is calculated by adding the declared maximum antenna gain (dBi).

The maximum effective radiated power e.r.p. is calculated from the maximum equivalent isotropically radiated power (e.i.r.p.) by subtracting 2.15 dB:

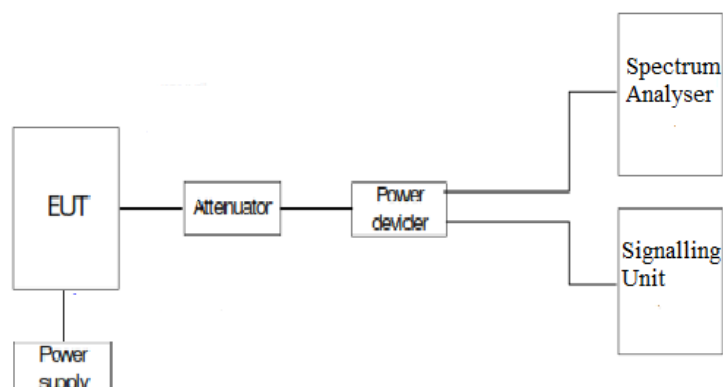
$$\text{E.R.P.} = \text{E.I.R.P.} - 2.15 \text{ dB}$$

Test Setup

1. CONDUCTED AVERAGE POWER:



2. PEAK-TO-AVERAGE POWER RATIO (PAPR):



Results

1. CONDUCTED AVERAGE POWER:

LTE Cat 1bis Band 2: worst case of RF Power was found on BW=20 MHz

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
20	Low 18700	1860	QPSK	1	0	23,36		
				1	49	23,36		
				1	99	23,64	22,23	20,08
				50	0	22,53		
				50	24	22,54		
				50	49	22,61		
				100	0	22,62		
			16-QAM	1	0	22,51		
				1	49	22,52		
				1	99	22,71	21,3	19,15
				50	0	Not supported		
				50	24	Not supported		
				50	49	Not supported		
				100	0	Not supported		
	Middle 18900	1880	QPSK	1	0	23,42		
				1	49	23,5	22,09	19,94
				1	99	23,14		
				50	0	22,6		
				50	24	22,62		
				50	49	22,51		
				100	0	22,56		
			16-QAM	1	0	22,34	20,93	18,78
				1	49	22,33		
				1	99	22,05		
				50	0	Not supported		
				50	24	Not supported		
				50	49	Not supported		
				100	0	Not supported		
	High 19100	1900	QPSK	1	0	22,98		
				1	49	23,41	22	19,85
				1	99	22,89		
				50	0	22,35		
				50	24	22,39		
				50	49	22,16		
				100	0	22,22		
			16-QAM	1	0	22,04		
				1	49	22,53	21,12	18,97
				1	99	21,95		
				50	0	Not supported		
				50	24	Not supported		
				50	49	Not supported		
				100	0	Not supported		

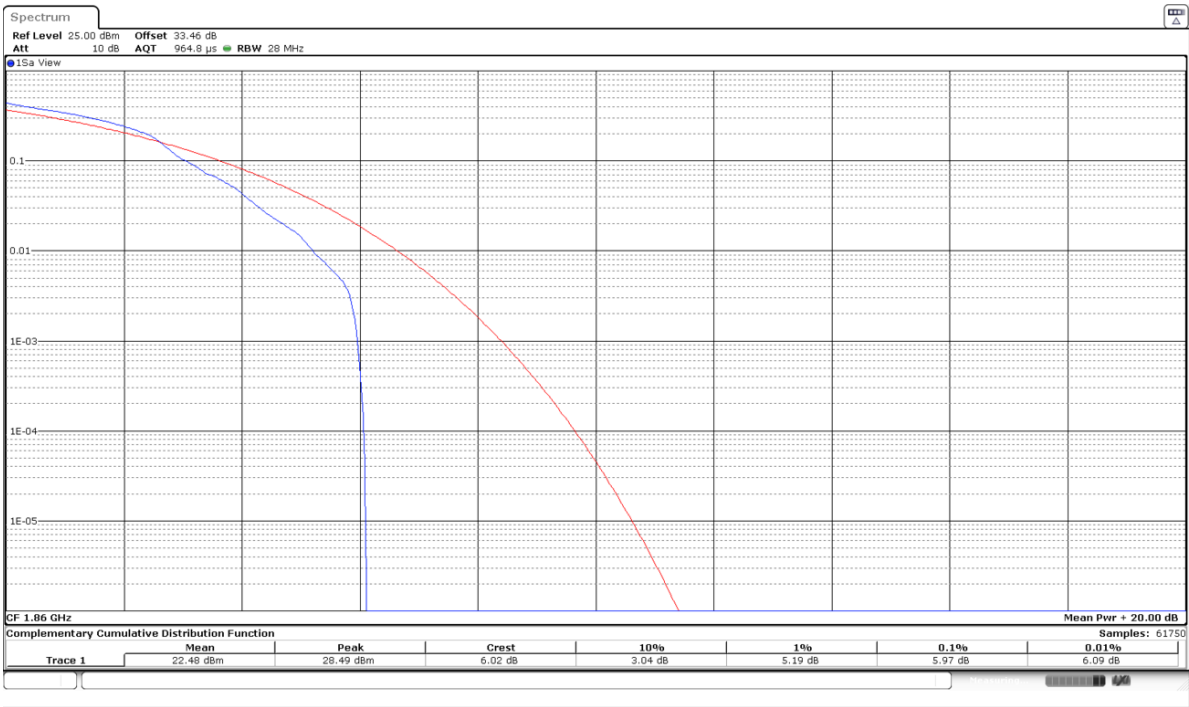
Measurement uncertainty (dB) <±0.941

2. PEAK-TO-AVERAGE POWER RATIO (PAPR)

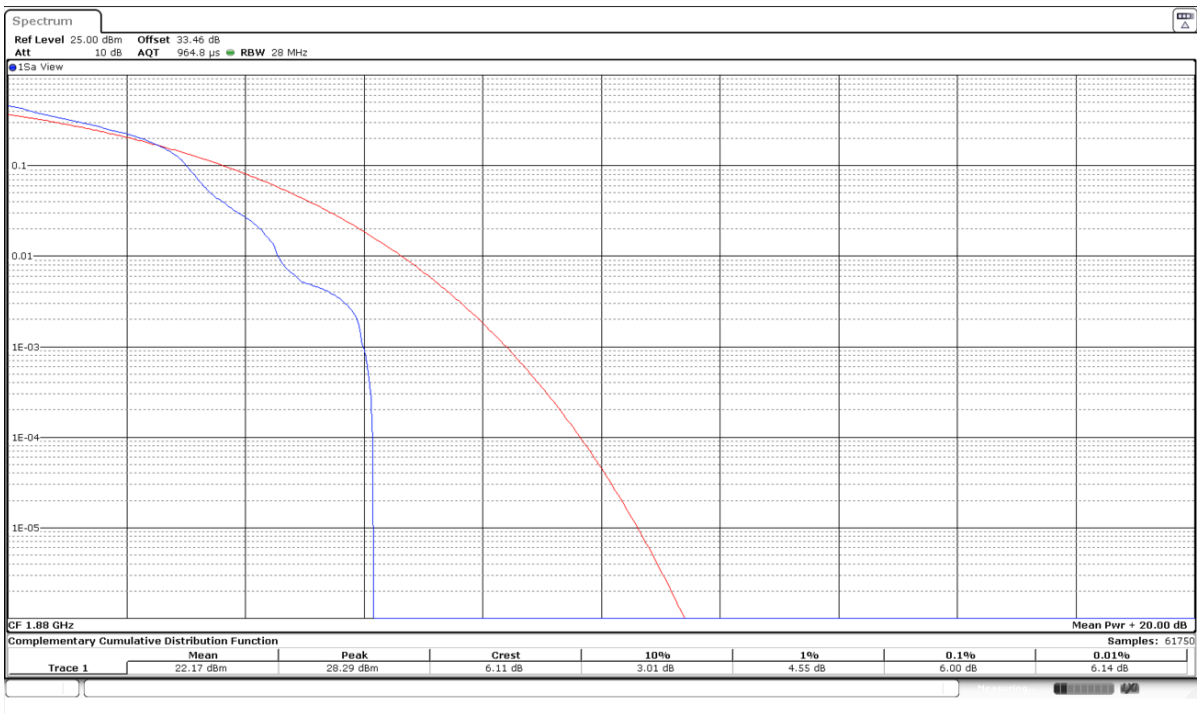
LTE Cat-1bis Band 2:

Worst-case of PAPR is BW=20 MHz, High Channel, 16QAM, RB Size=1, RB Offset=49.

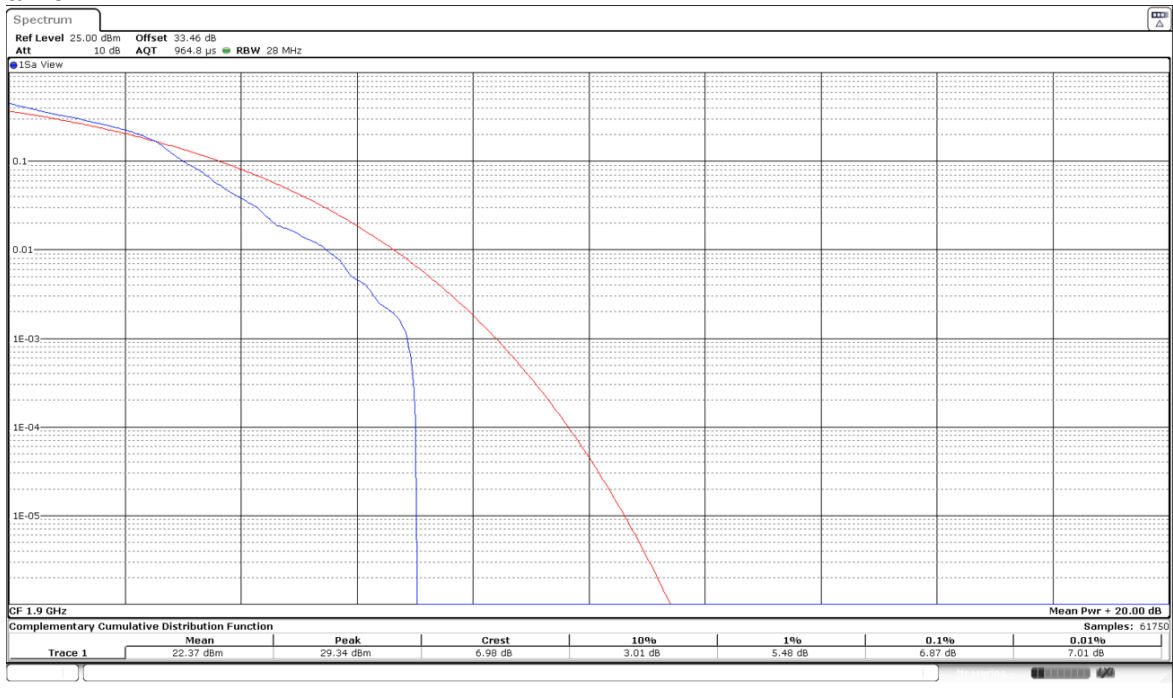
Low Channel:



Middle Channel:



High Channel:



16QAM	Low	Middle	High
PAPR (dB)	5.97	6	6.87

Verdict

Pass

Frequency Stability

Limits

FCC §2.1055 and §24.235. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

RSS-133, Clause 6.3. The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations.

Method

The frequency tolerance measurements over temperature variations were made over the temperature range of -40°C to $+85^{\circ}\text{C}$. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10°C steps from -40°C up to $+85^{\circ}\text{C}$.

The supply voltage was varied between 85% and 115% of nominal voltage.

Temperature and voltage range of testing has been extended to the maximum and minimum values declared by customer.

The EUT was set in "Radio Resource Control (RRC) mode" on the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.

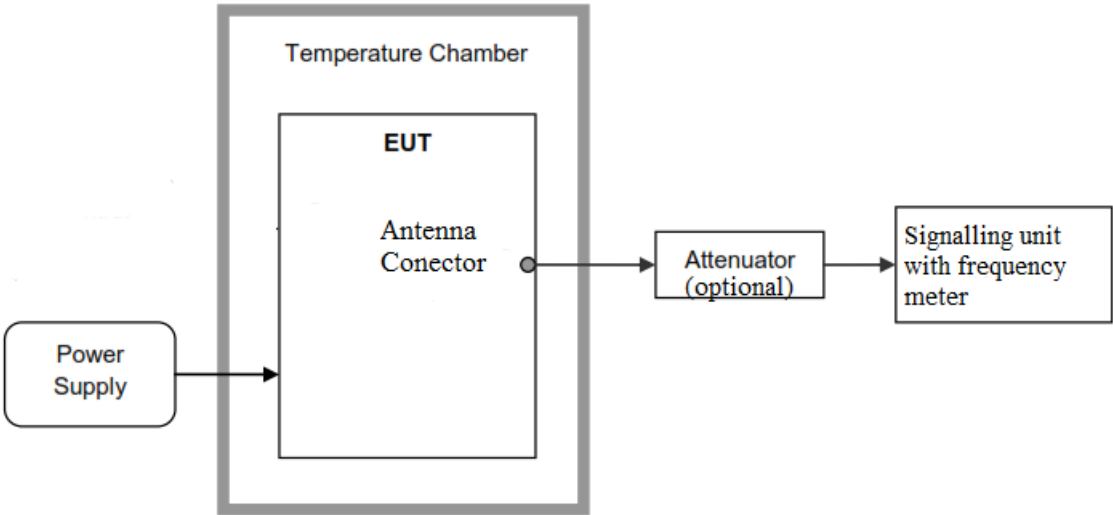
The worst case LTE Cat-1bis mode for conducted power was used for the test.

In order to check that the frequency stability is sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point is established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the LOW and HIGH channels of operation are identified as fL and fH respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of fL and fH to check that the resulting frequencies remain within the band.

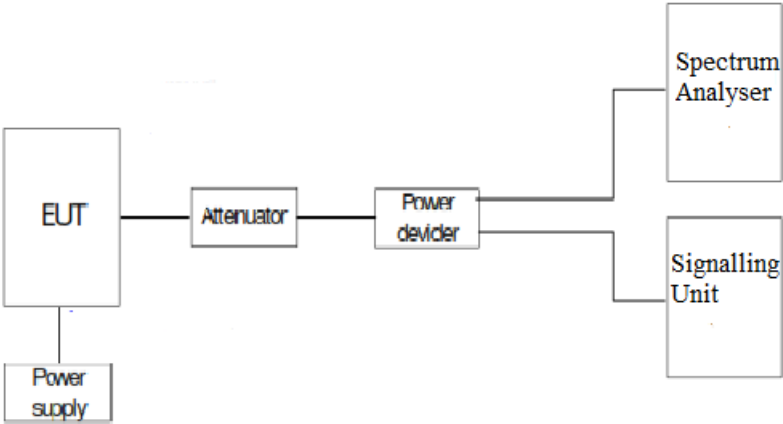
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

Test Setup

Frequency tolerance:



Reference points f_L and f_H :



Results

LTE Cat-1bis Band 2:

The worst case modulation in terms of Frequency Stability is BW=1.4 MHz, QPSK, RB Size=1, RB Offset=0.

1. FREQUENCY TOLERANCE:

- Frequency stability over temperature variations.

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
85 [#]	-3,32	-0,001765957
80 [#]	3,45	0,001835106
70 [#]	-3,52	-0,00187234
60 [#]	-3,36	-0,001787234
50	5,82	0,003095745
40	2,37	0,001260638
30	-4,73	-0,002515957
20	-1,14	-0,000606383
10	-2,09	-0,001111702
0	-2,35	-0,00125
-10	3,1	0,001648936
-20	5,82	0,003095745
-30	4,31	0,002292553
-40 [#]	3,81	0,002026596

- Frequency stability over voltage variations.

Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	4,5	2,9	0,001542553
Vmin	3,23	-1,03	-0,000547872

2. REFERENCE FREQUENCY POINTS fL AND fH:

The worst-case frequency offsets added or subtracted per band and bandwidth:

fL (MHz)	1850,0330
fH (MHz)	1909,9837

The reference frequency points fL and fH stay within the authorized blocks for the band above.

Measurement uncertainty (Hz): <±223.94

Verdict

PASS

Modulation Characteristics

Limits

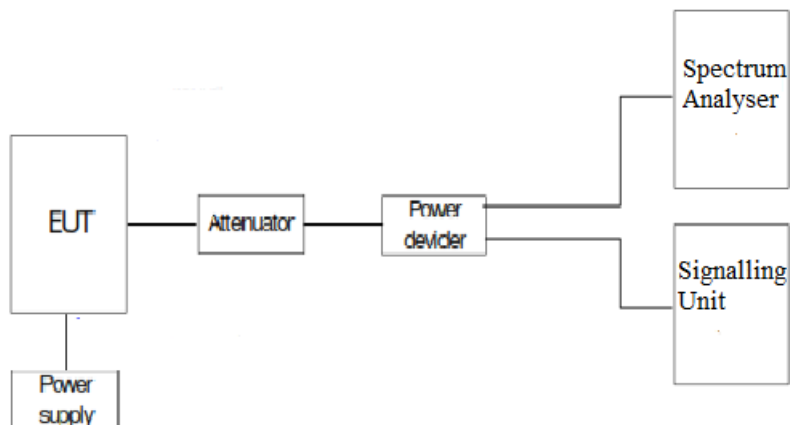
FCC §2.1047.

RSS-133. Clause 6.2. Equipment certified under this standard shall use digital modulation.

Method

For LTE Cat-1bis the EUT operates with QPSK and 16QAM modes in which the information is digitised and coded into a bit stream. The RF transmission is multiplexed using *Orthogonal Frequency Division Multiplexing (OFDM)* using different possible arrangement of subcarriers (Resource Blocks RB).

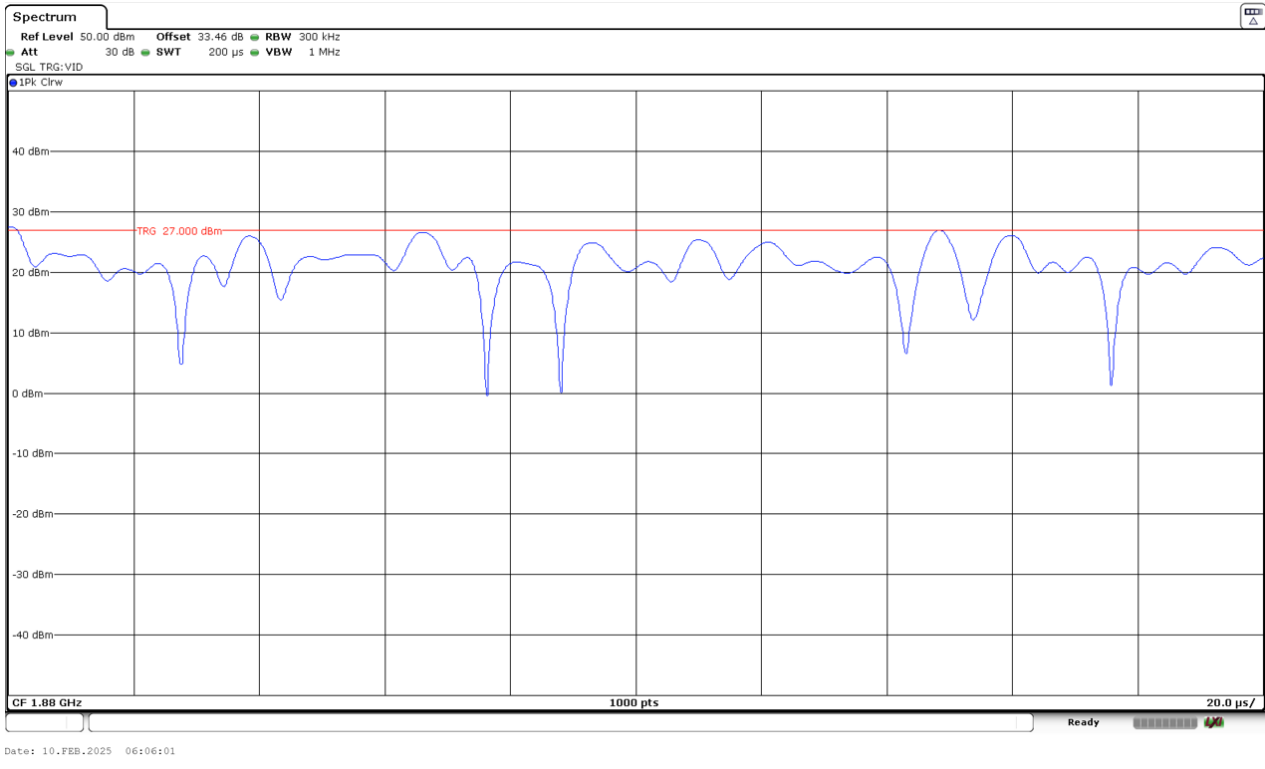
Test Setup



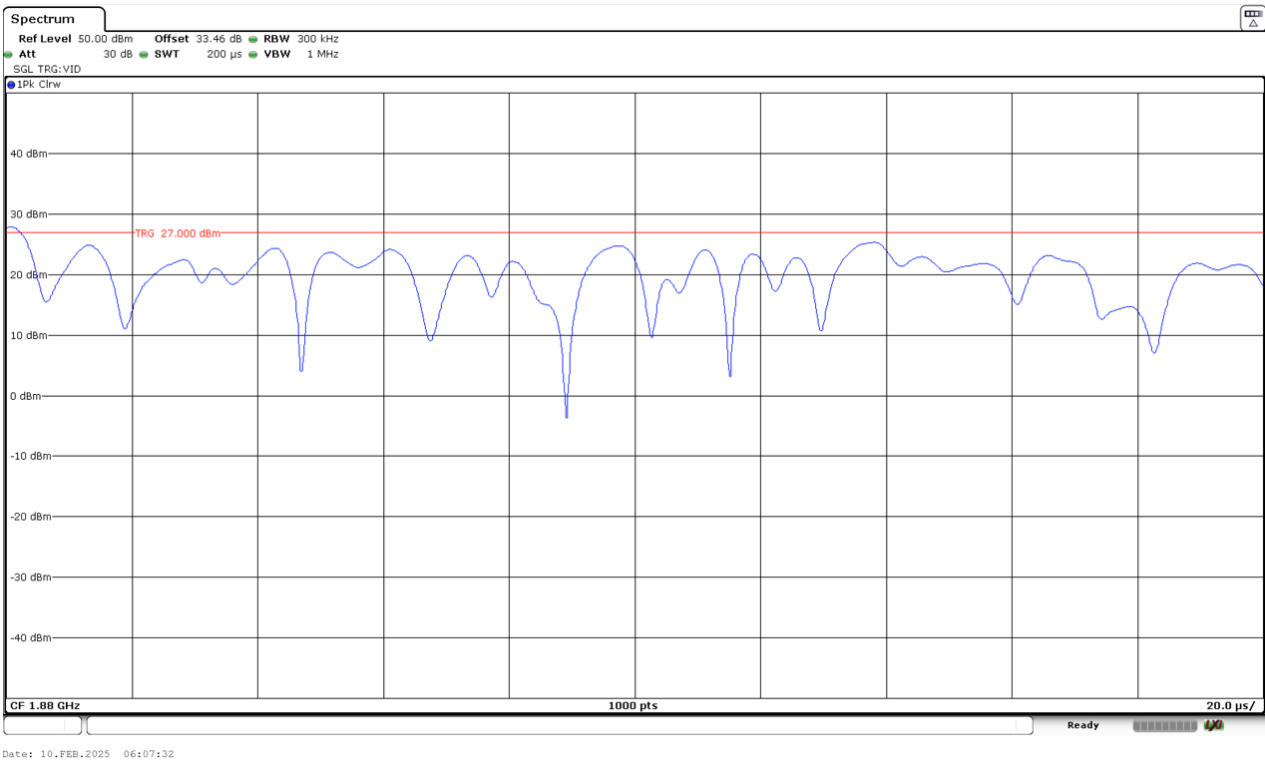
Results

The following plots show the modulation schemes in the EUT.

LTE Cat-1bis Band 2: BW = 1.4 MHz. QPSK.



LTE Cat-1bis Band 2: BW = 1.4 MHz. 16QAM.



Occupied Bandwidth

Limits

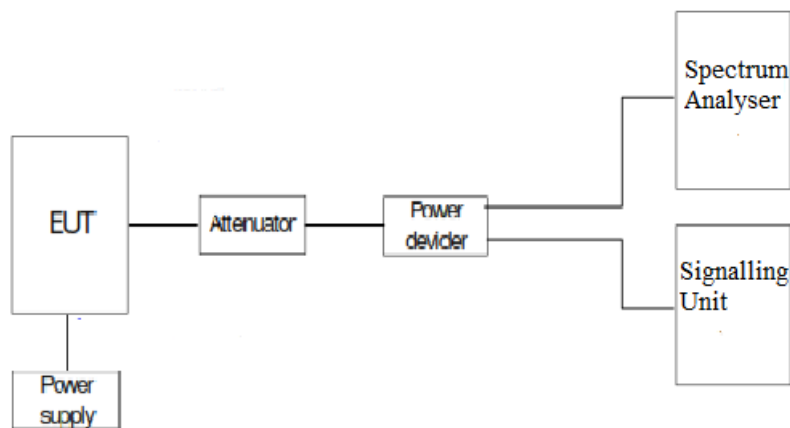
FCC §2.1049. Measurements required: Occupied bandwidth.

RSS-Gen, Clause 6.7.

Method

The occupied bandwidth measurement was performed at the output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.

Test Setup



Results

The worst case of occupied bandwidth corresponds to all Resource Blocks (RB) offset 0 regardless the Bandwidth selected.

LTE Cat-1bis Band 2:

BW=1.4 MHz. QPSK. RB Size=max

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	1,089771	1,079507	1,082306
-26 dBc Bandwidth (MHz)	1,275442	1,253049	1,266111
Measurement uncertainty (kHz)	<±5.20		

BW=1.4 MHz. 16QAM. RB Size=max

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	1,081373	1,082306	1,077641
-26 dBc Bandwidth (MHz)	1,268910	1,264245	1,265178
Measurement uncertainty (kHz)	<±5.20		

BW=3 MHz. QPSK. RB Size=max

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	2,693102	2,689104	2,697101
-26 dBc Bandwidth (MHz)	2,947020	2,943020	2,963010
Measurement uncertainty (kHz)	<±5.20		

BW=3 MHz. 16QAM. RB Size=max

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	2,6891	2,6891	2,6811
-26 dBc Bandwidth (MHz)	2,8950	2,9470	2,9610
Measurement uncertainty (kHz)	<±5.20		

BW=5 MHz. QPSK. RB Size=max

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	4,511829	4,508497	4,508497
-26 dBc Bandwidth (MHz)	5,261580	5,021660	5,094970
Measurement uncertainty (kHz)	<±5.20		

BW=5 MHz. 16QAM. RB Size=max

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	4,511829	4,508497	4,508497
-26 dBc Bandwidth (MHz)	5,341550	5,291570	5,034990
Measurement uncertainty (kHz)	<±5.20		

BW=10 MHz. QPSK. RB Size=max

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	9,01033	8,99034	8,99034
-26 dBc Bandwidth (MHz)	10,10330	10,07664	10,08331
Measurement uncertainty (kHz)	<±5.20		

BW=10 MHz. 16QAM. RB Size=max

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	4,531823	4,531823	4,525158
-26 dBc Bandwidth (MHz)	5,524830	5,531490	5,478170
Measurement uncertainty (kHz)	<±5.20		

BW=15 MHz. QPSK. RB Size=max

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	13,415528	13,405531	13,395535
-26 dBc Bandwidth (MHz)	14,685100	14,845050	15,024990
Measurement uncertainty (kHz)	<±5.20		

BW=15 MHz. 16QAM. RB Size=max

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	4,548484	4,538487	4,538487
-26 dBc Bandwidth (MHz)	5,538150	5,568140	5,538150
Measurement uncertainty (kHz)	<±5.20		

BW=20 MHz. QPSK. RB Size=max

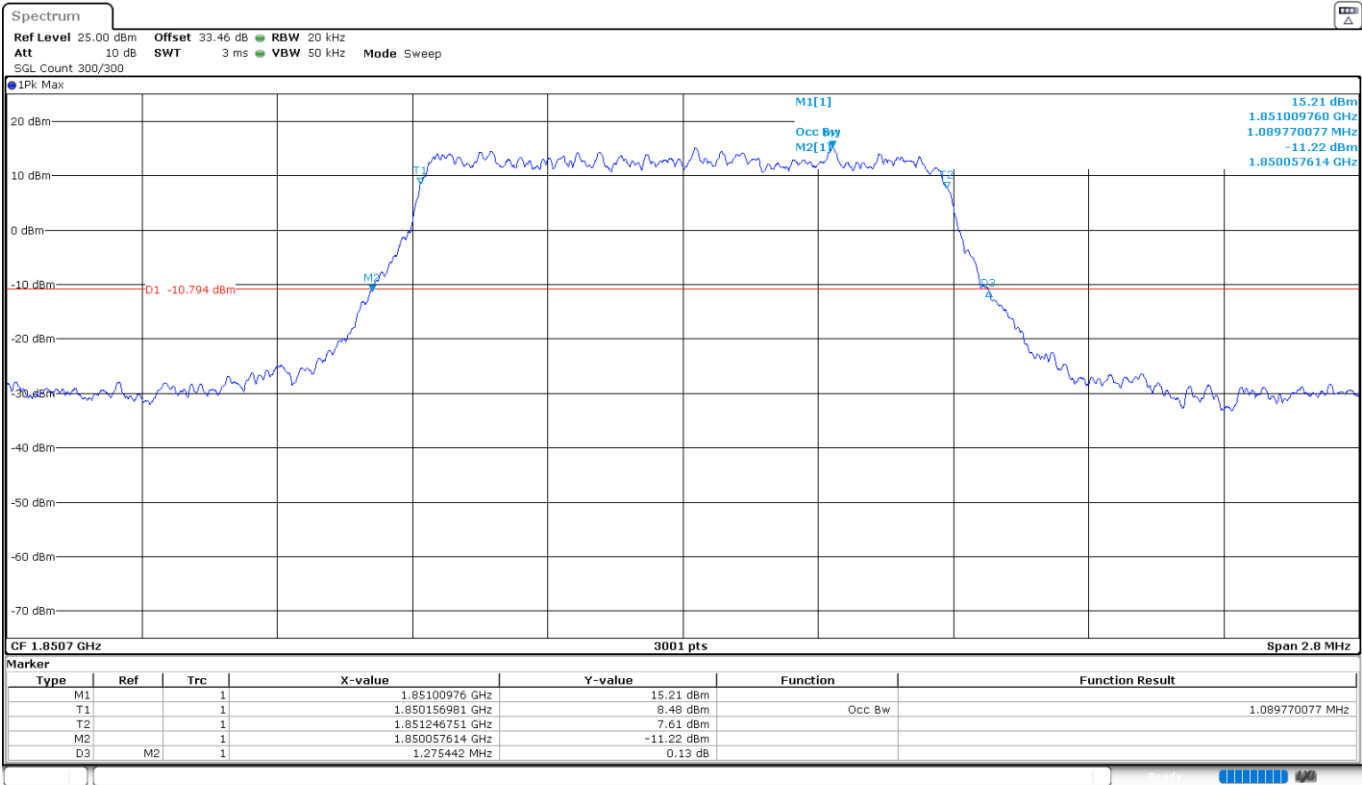
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	17,887371	17,900700	17,847384
-26 dBc Bandwidth (MHz)	19,833400	20,033300	19,686800
Measurement uncertainty (kHz)	<±5.20		

BW=20 MHz. 16QAM. RB Size=max

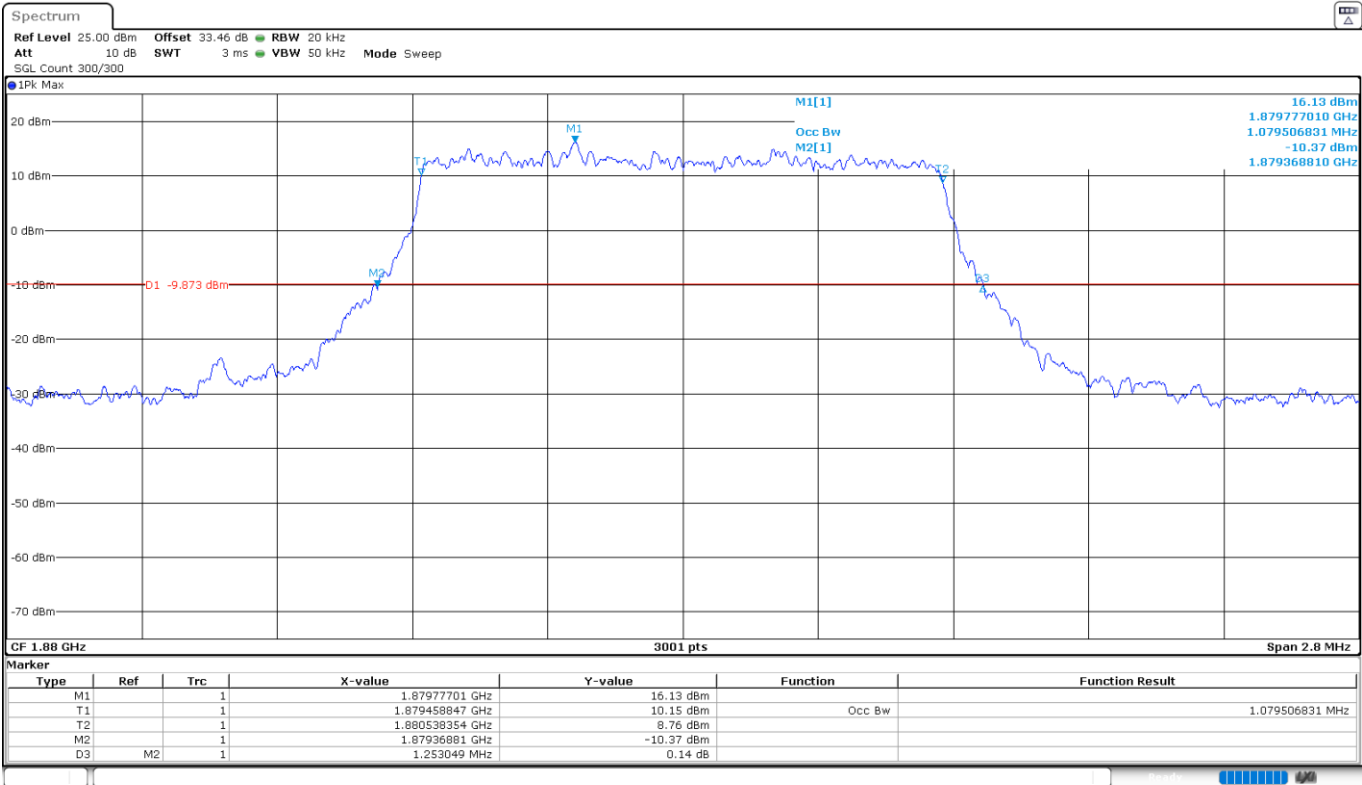
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	4,531823	4,545152	4,531823
-26 dBc Bandwidth (MHz)	5,891400	5,851400	5,864700
Measurement uncertainty (kHz)	<±5.20		

BW=1.4 MHz. QPSK. RB Size=max

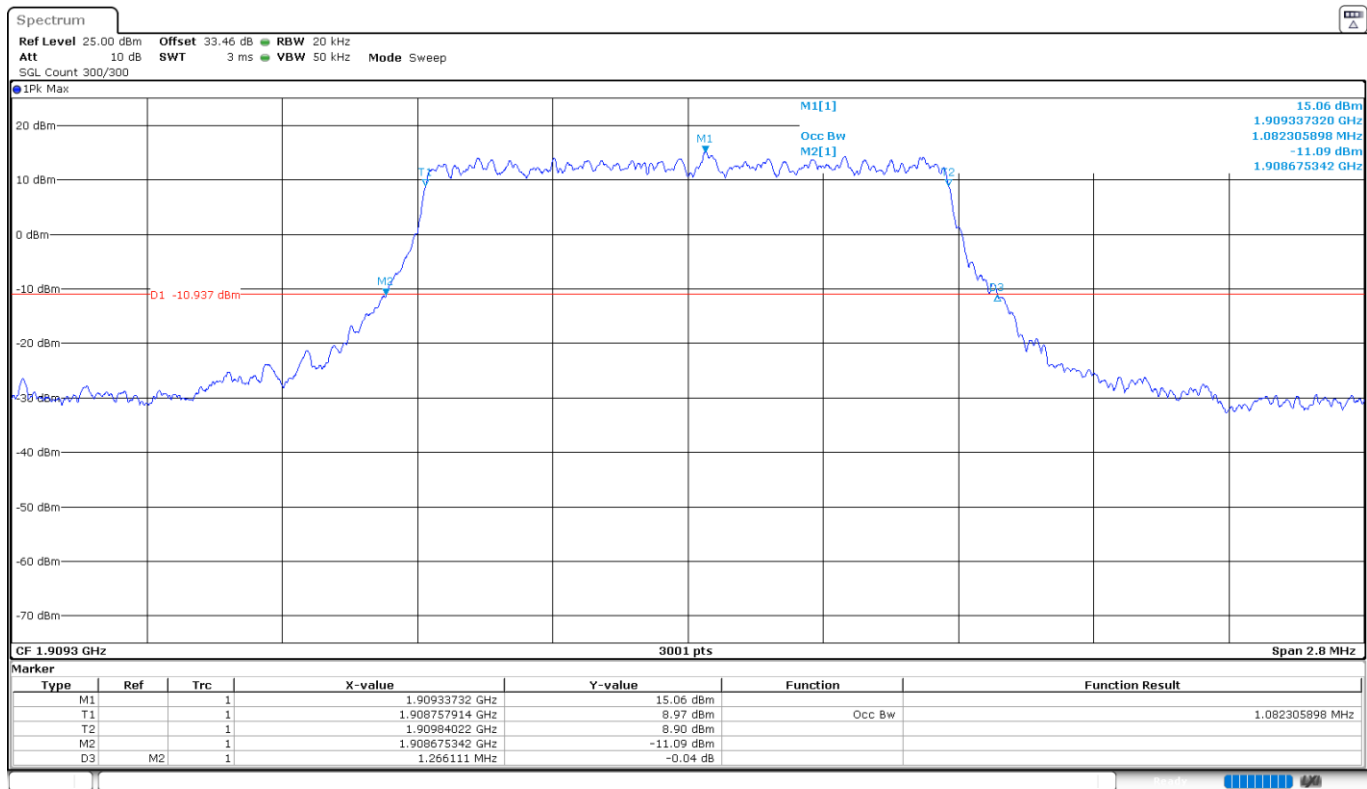
Low Channel:



Middle Channel:

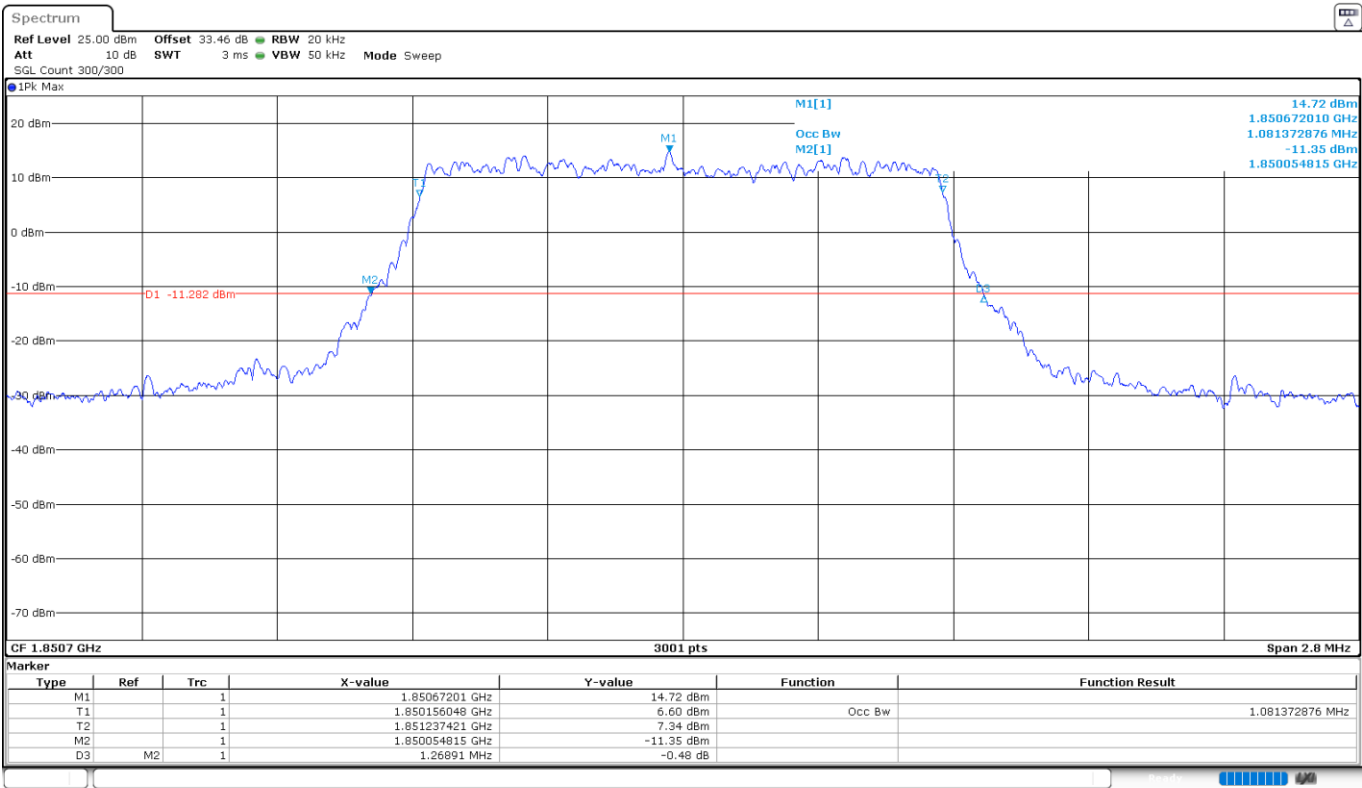


High Channel:

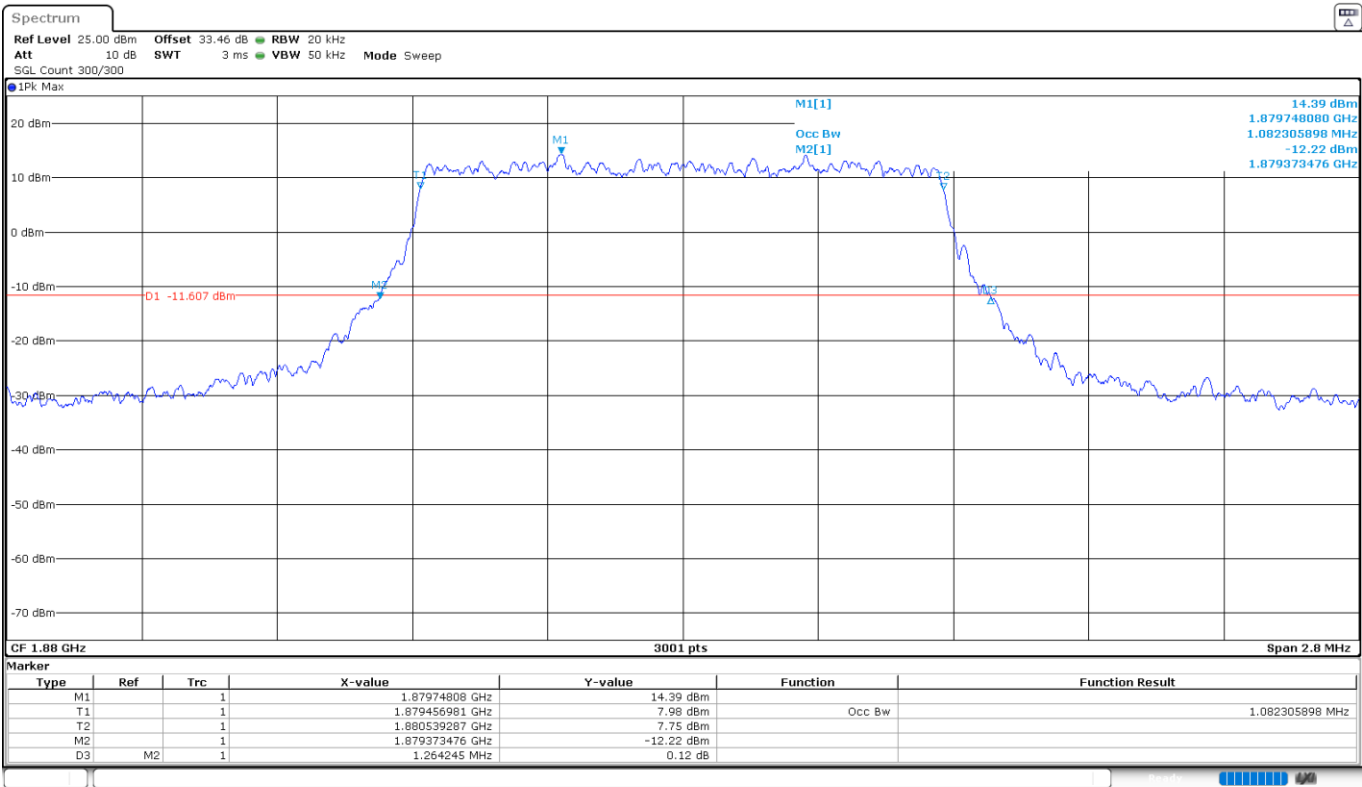


BW=1.4 MHz. 16QAM. RB Size=max

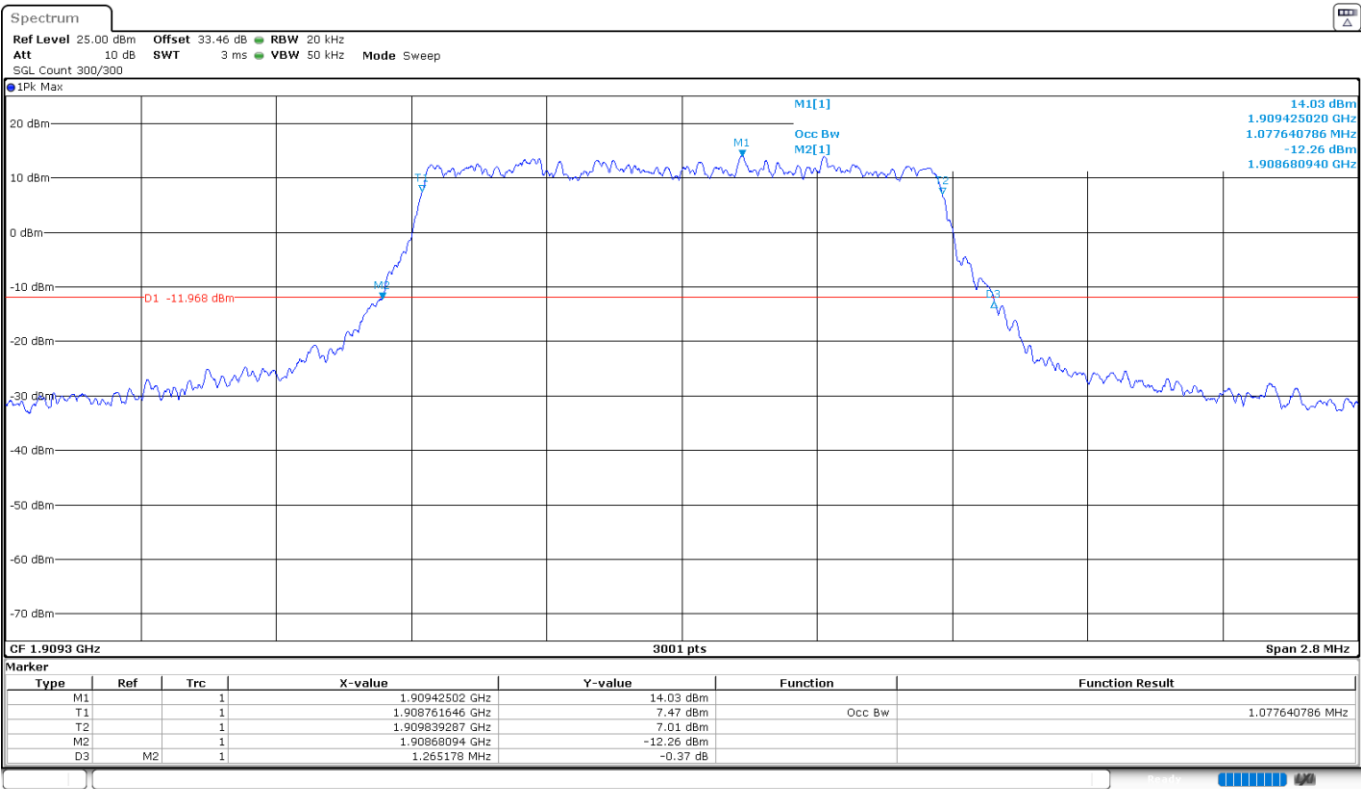
Low Channel:



Middle Channel:

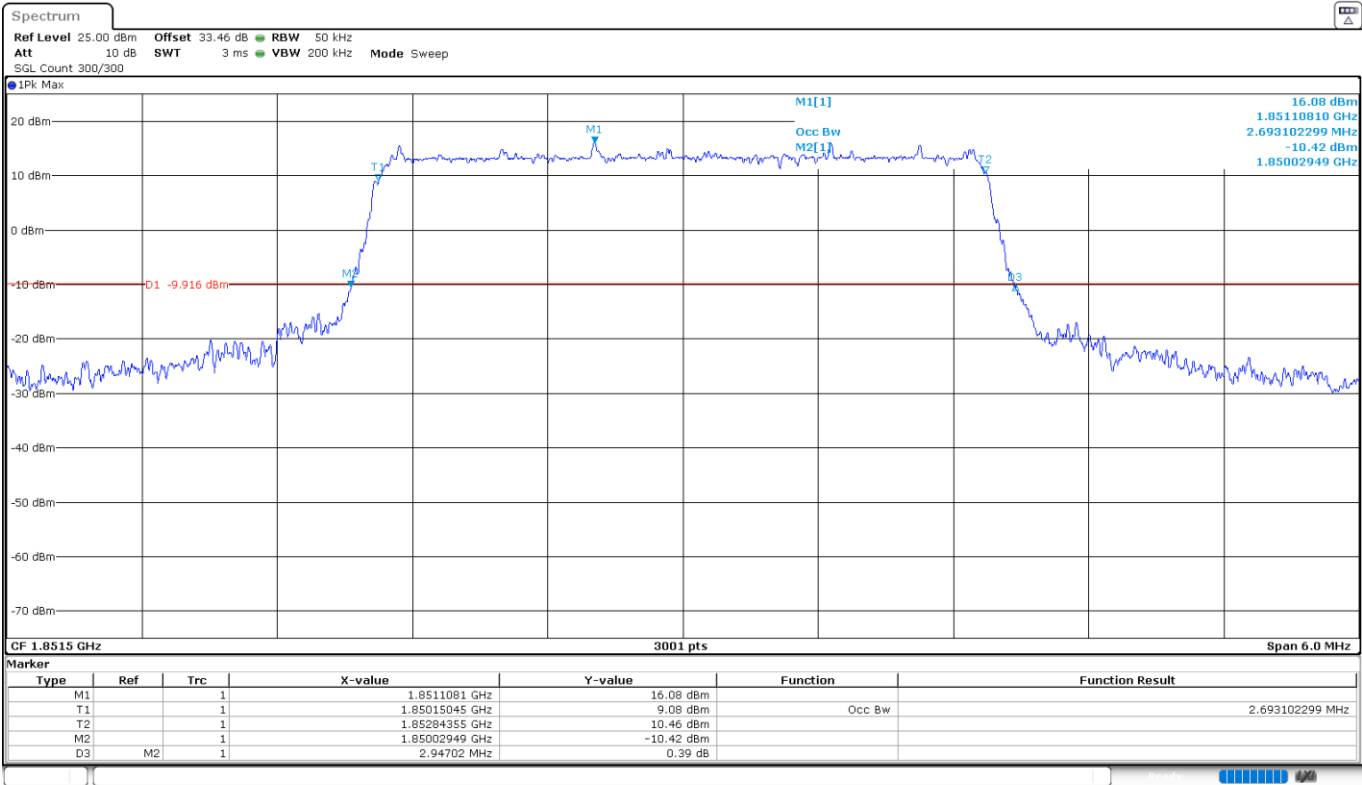


High Channel:

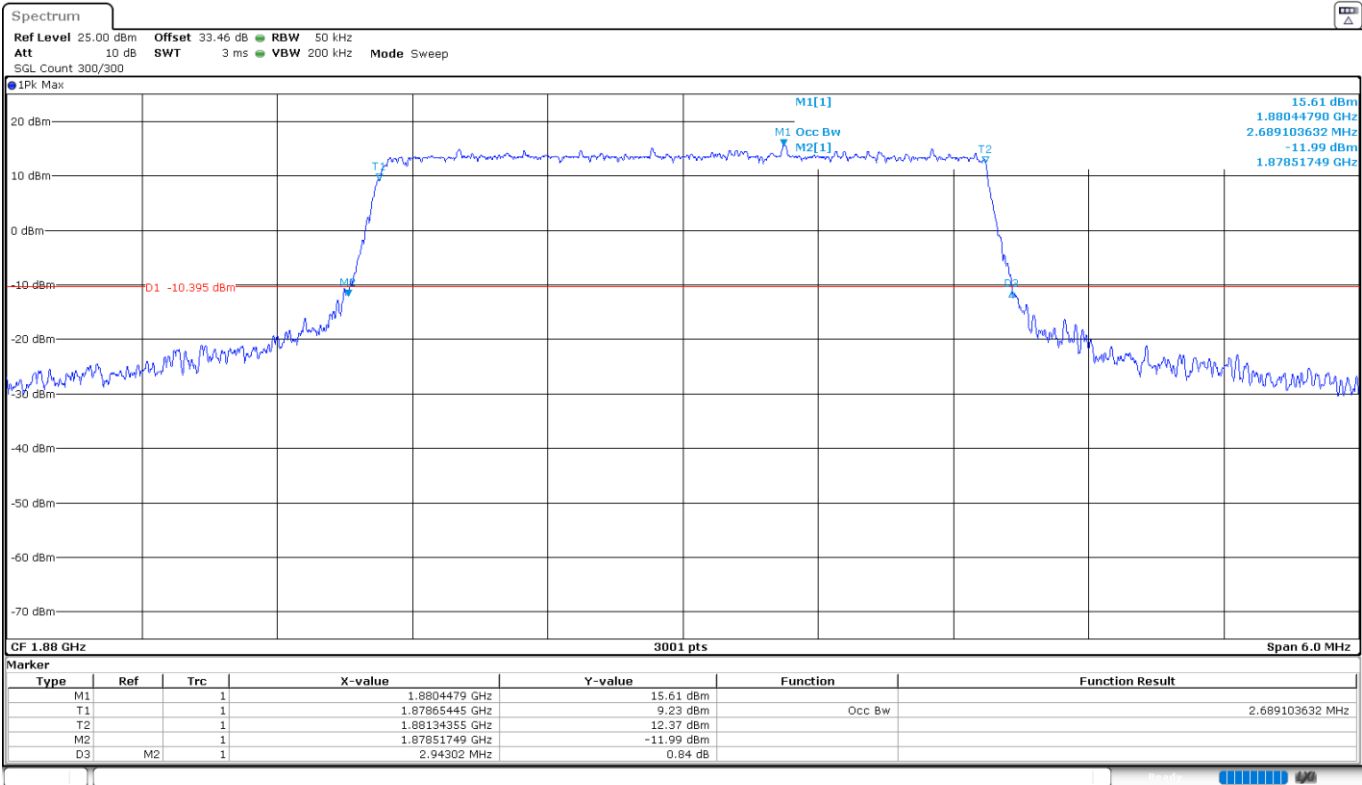


BW=3 MHz. QPSK. RB Size=max

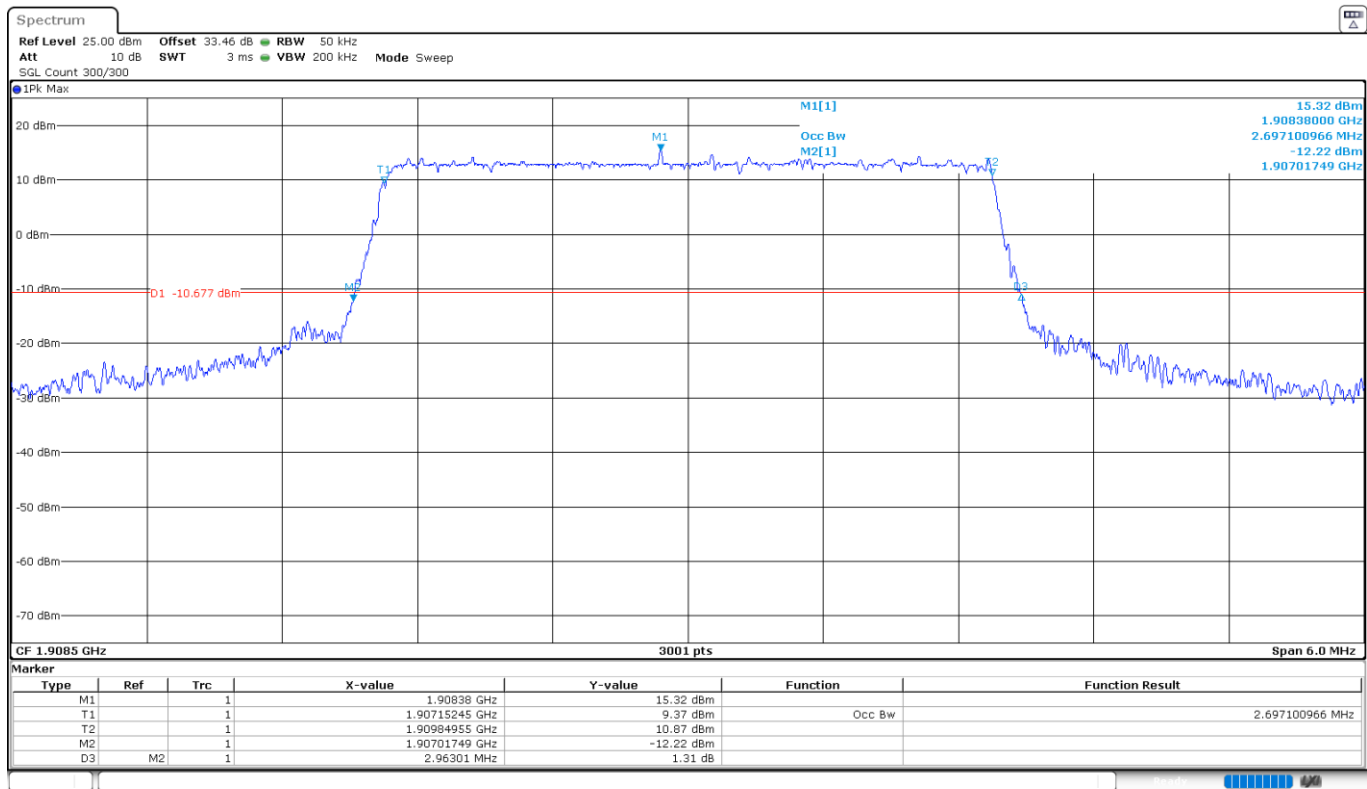
Low Channel:



Middle Channel:

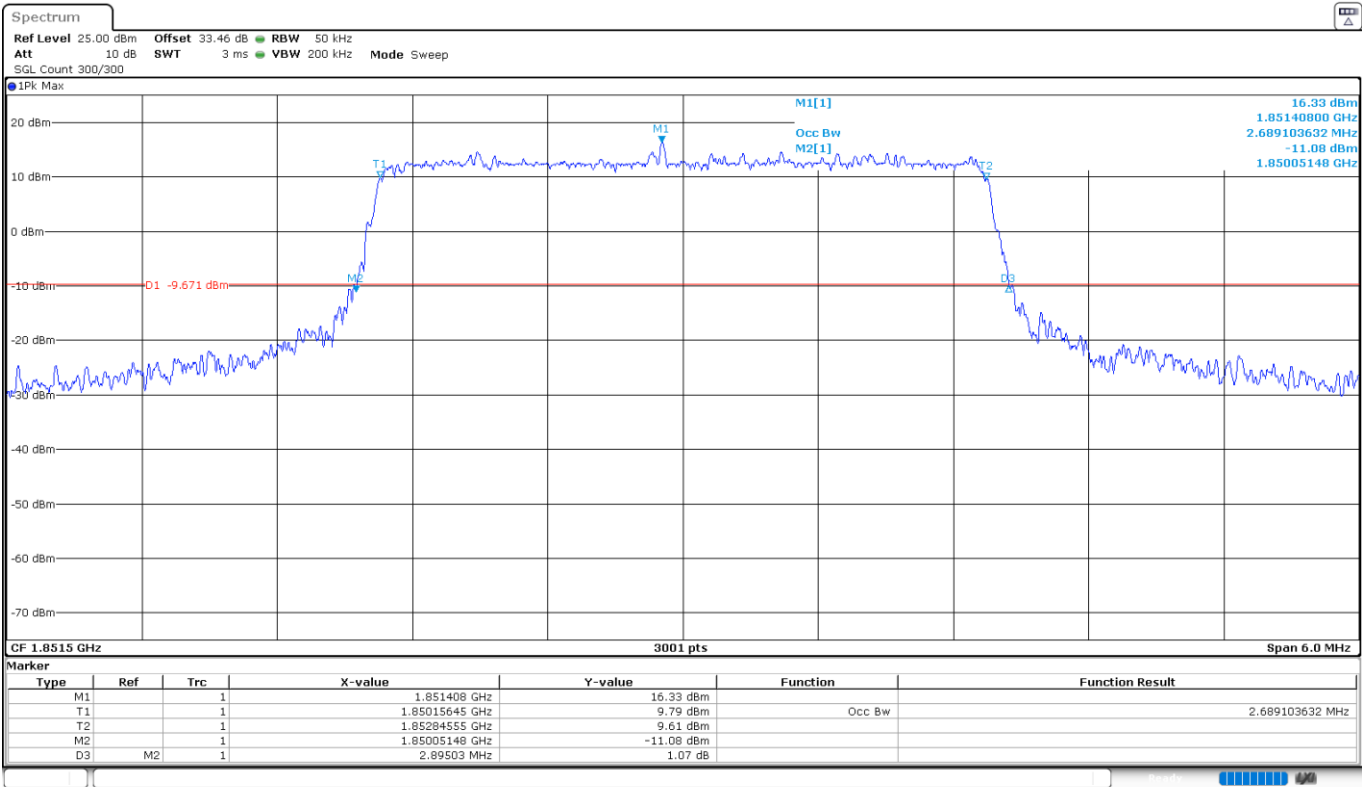


High Channel:

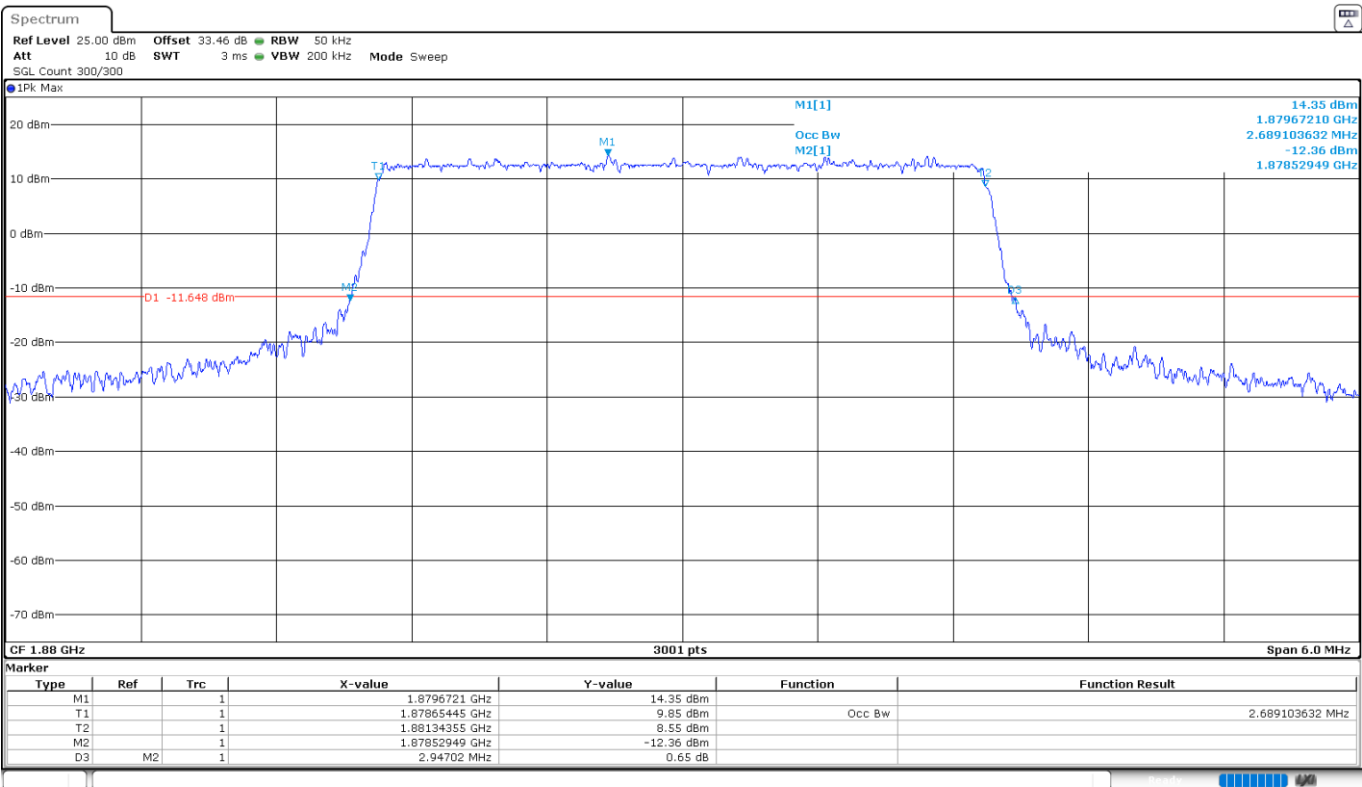


BW=3 MHz. 16QAM. RB Size=max

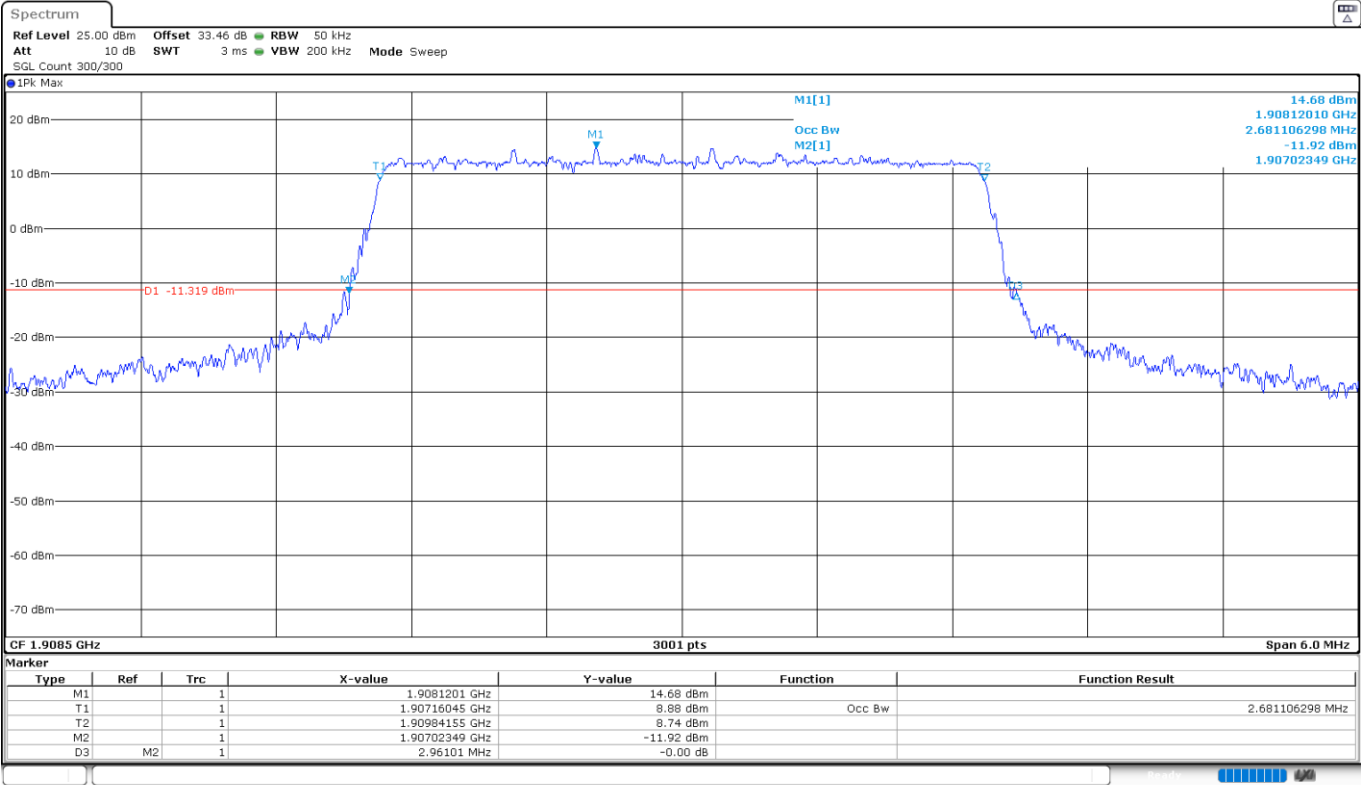
Low Channel:



Middle Channel:

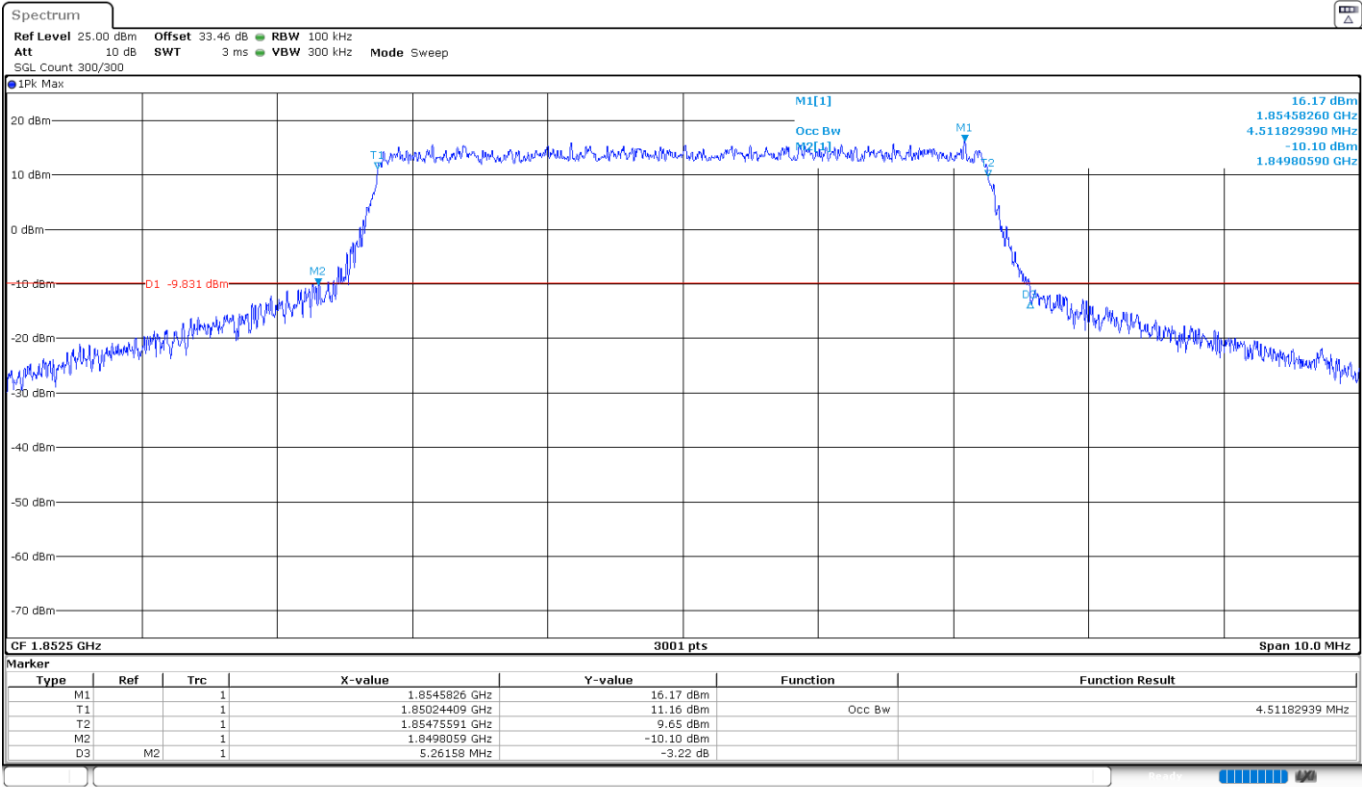


High Channel:

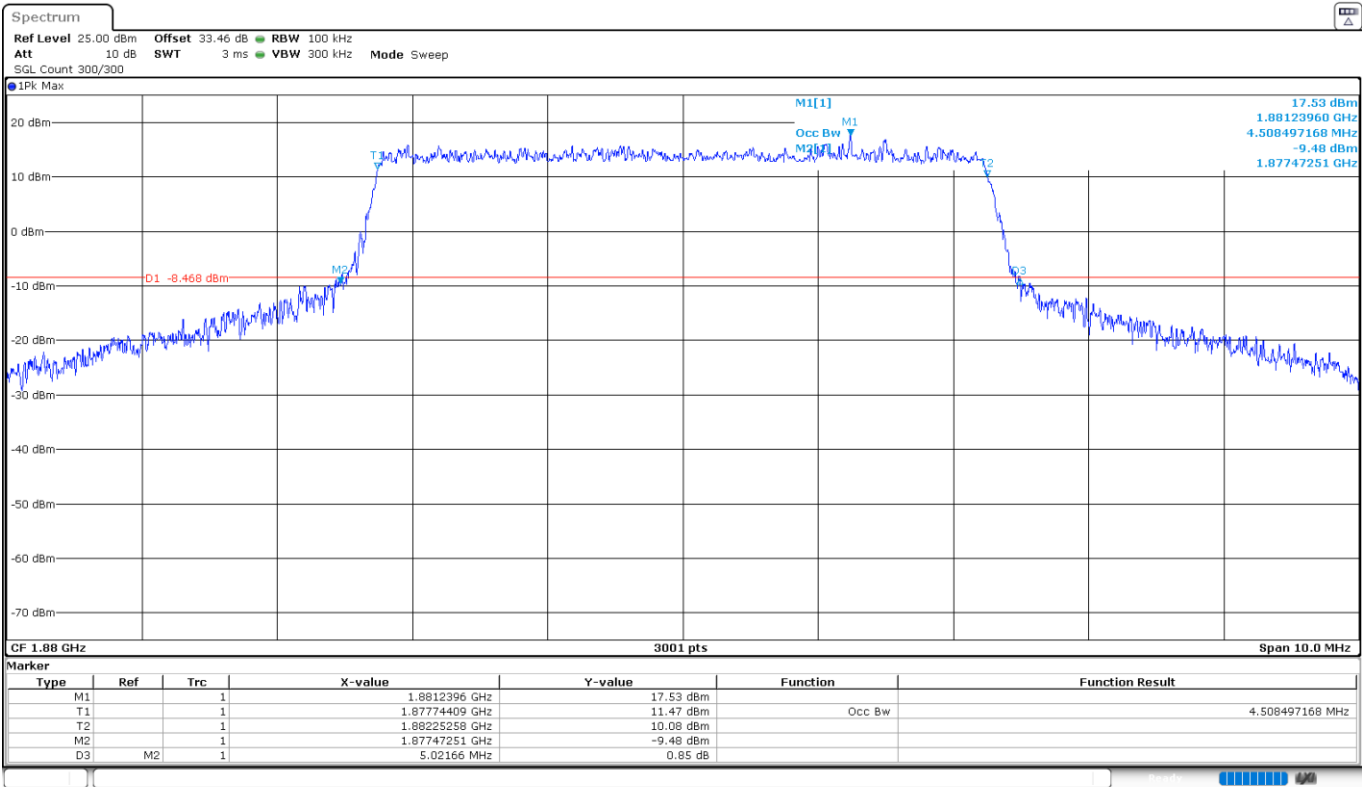


BW=5 MHz. QPSK. RB Size=max

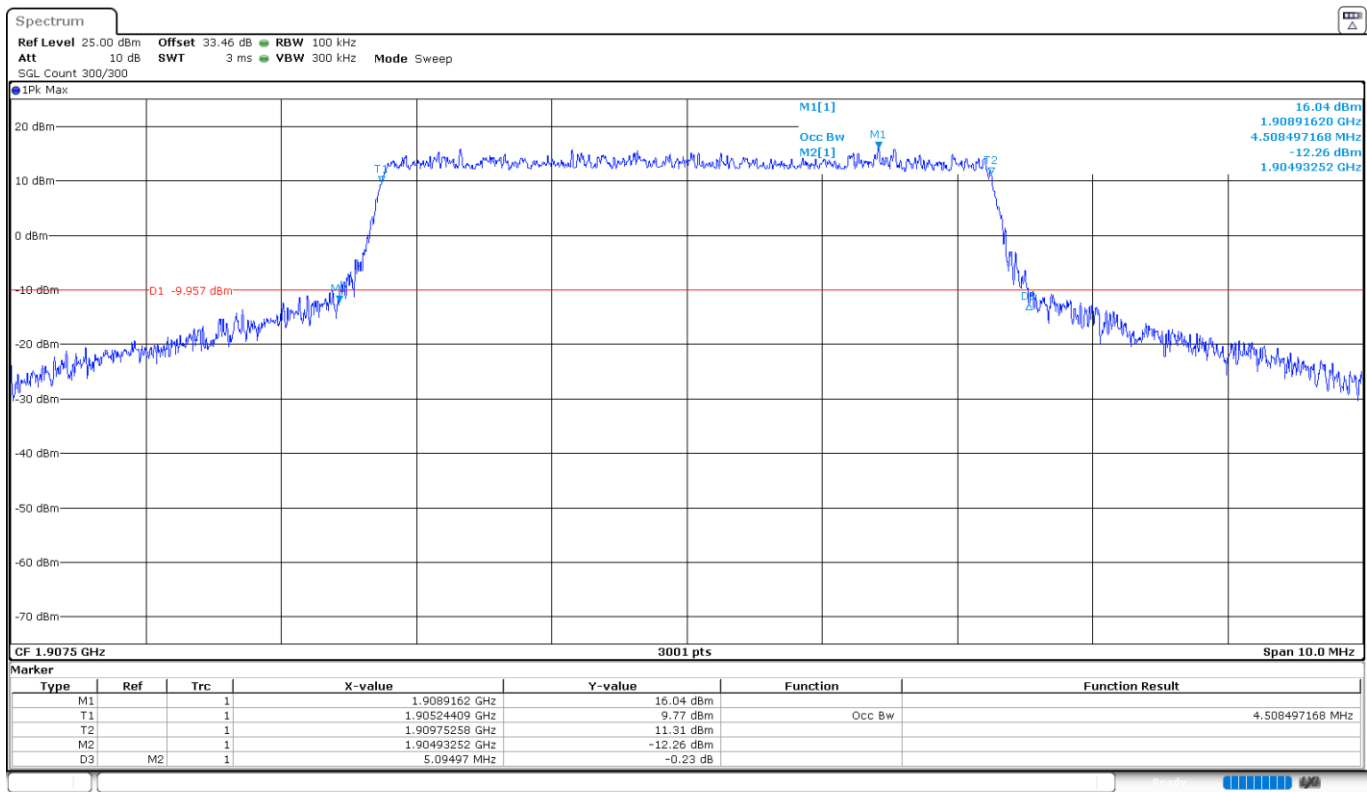
Low Channel:



Middle Channel:

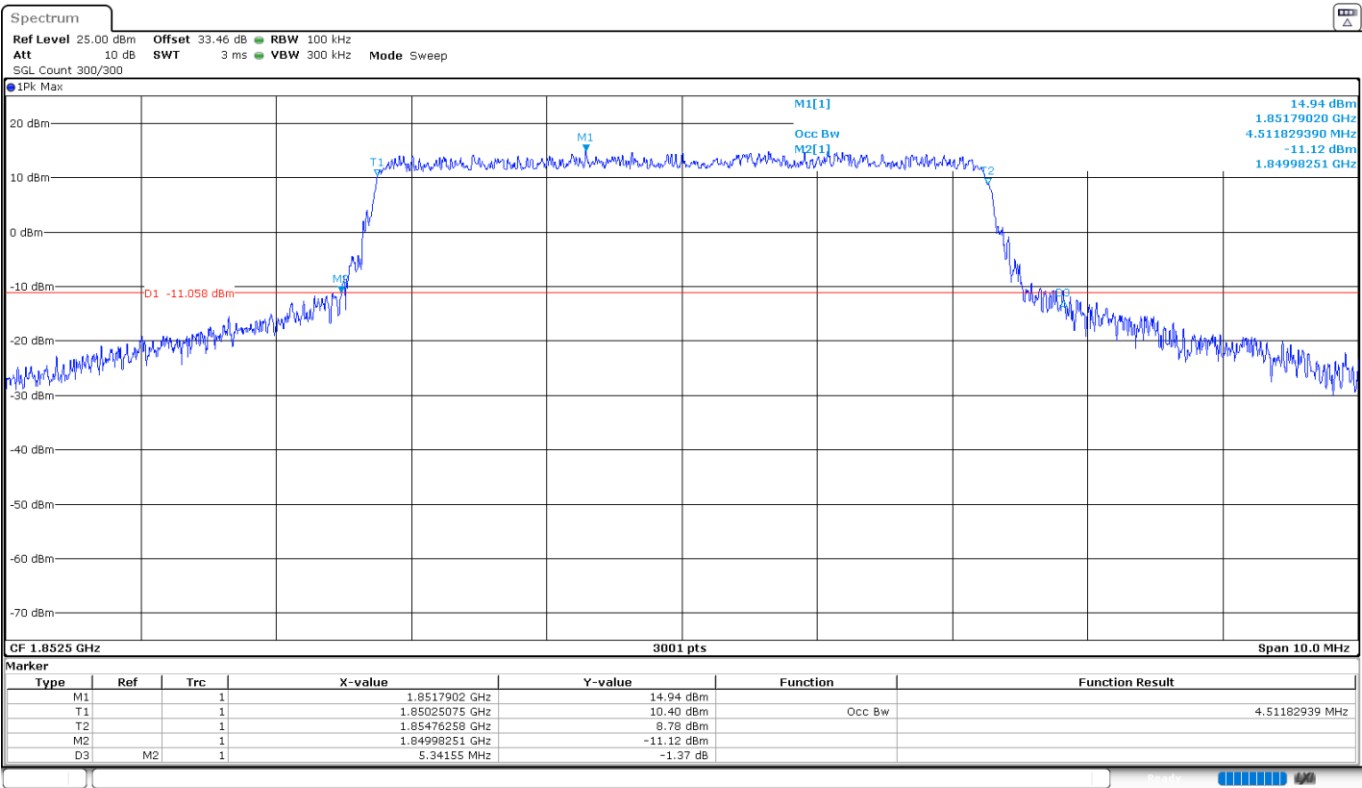


High Channel:

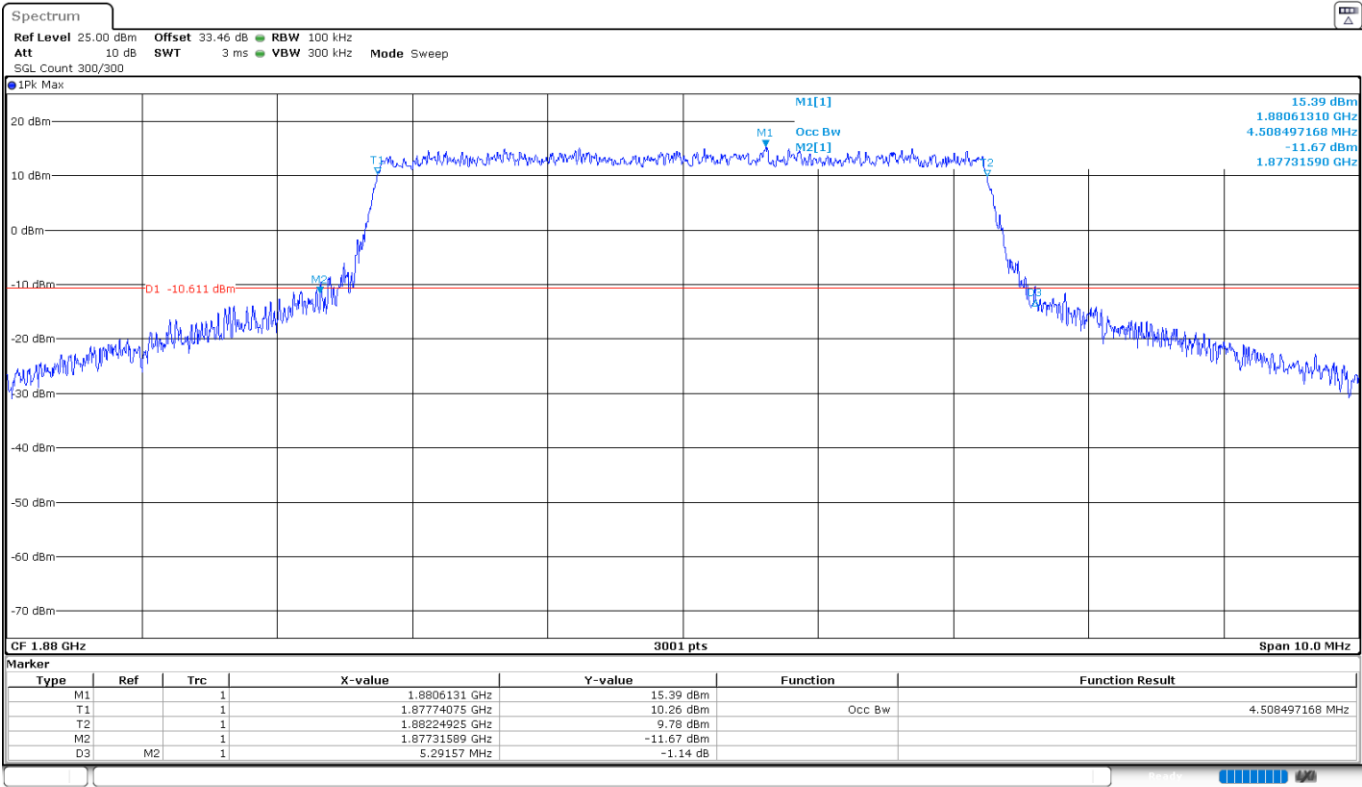


BW=5 MHz. 16QAM. RB Size=max

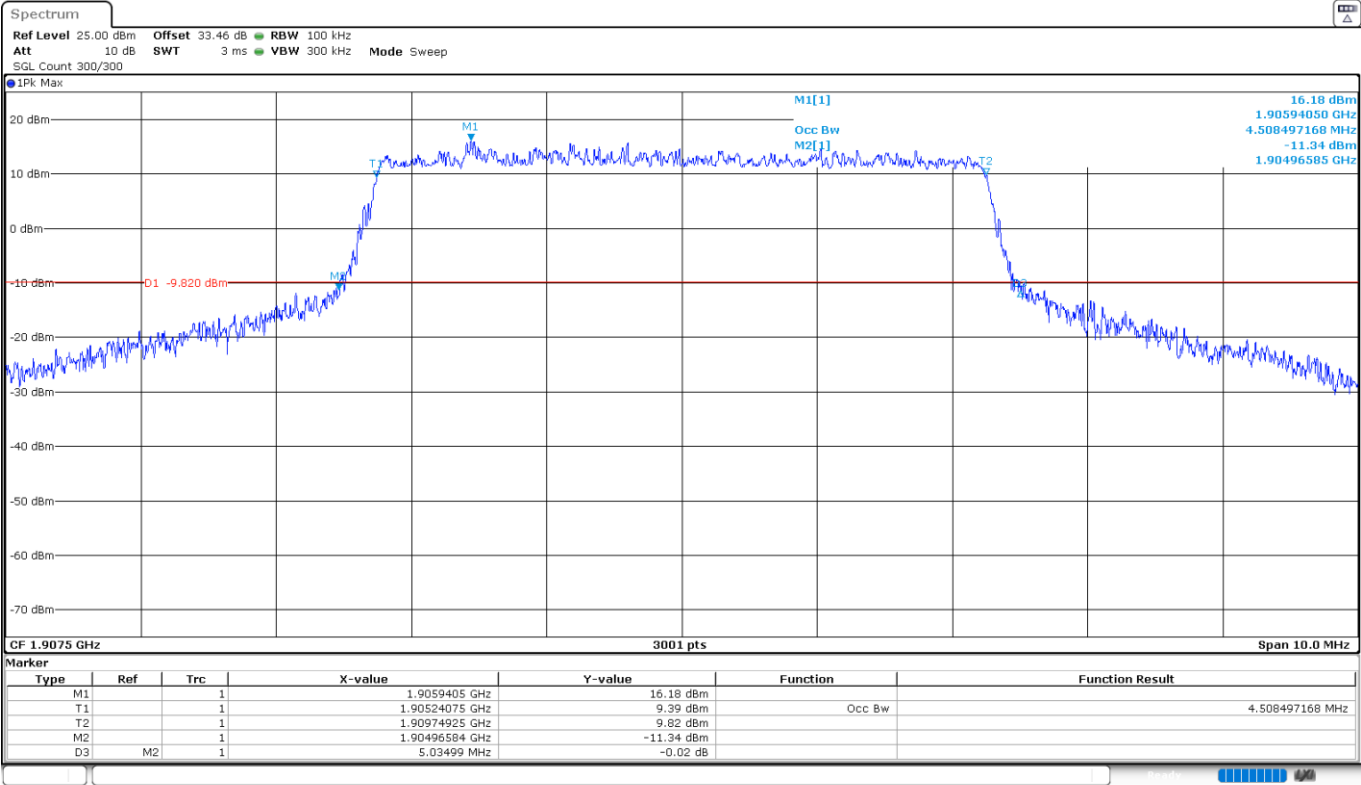
Low Channel:



Middle Channel:

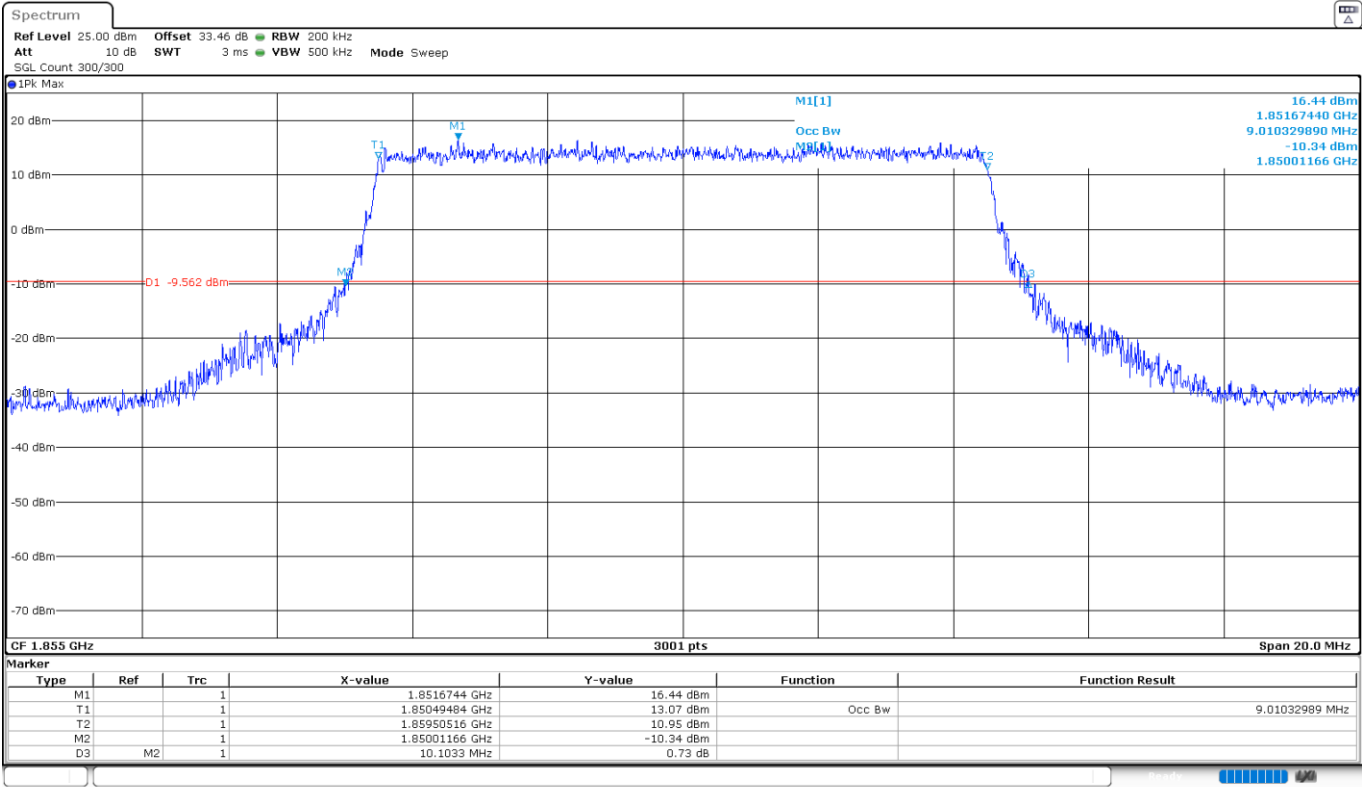


High Channel:

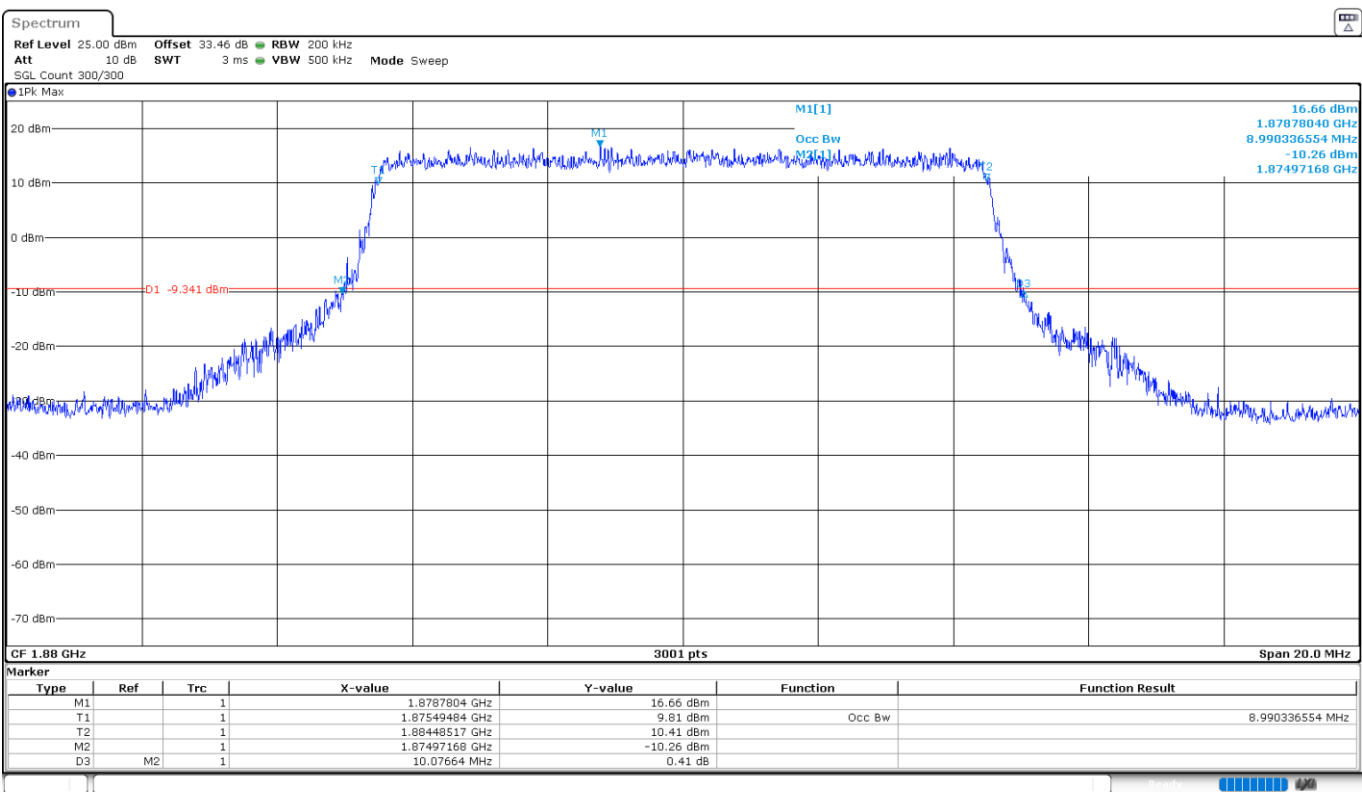


BW=10 MHz. QPSK. RB Size=max

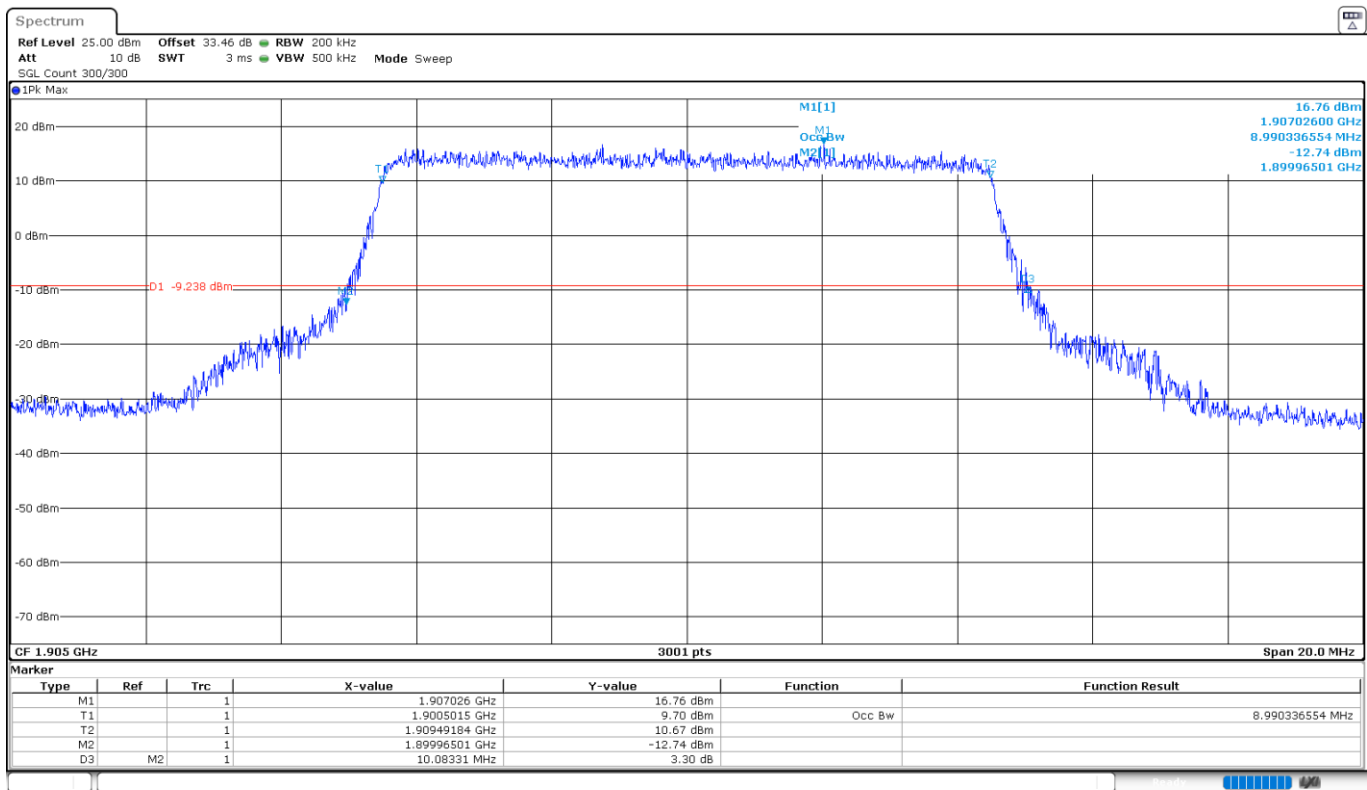
Low Channel:



Middle Channel:

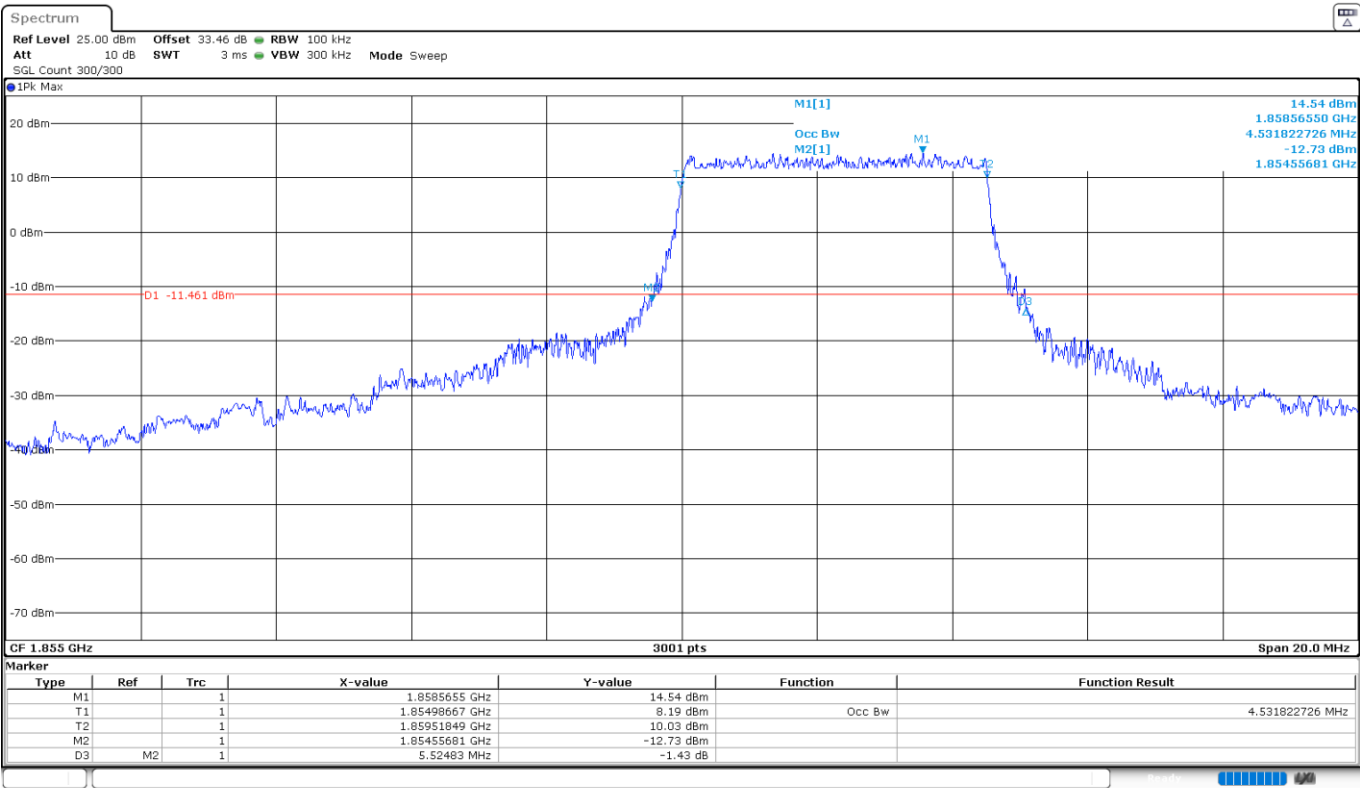


High Channel:

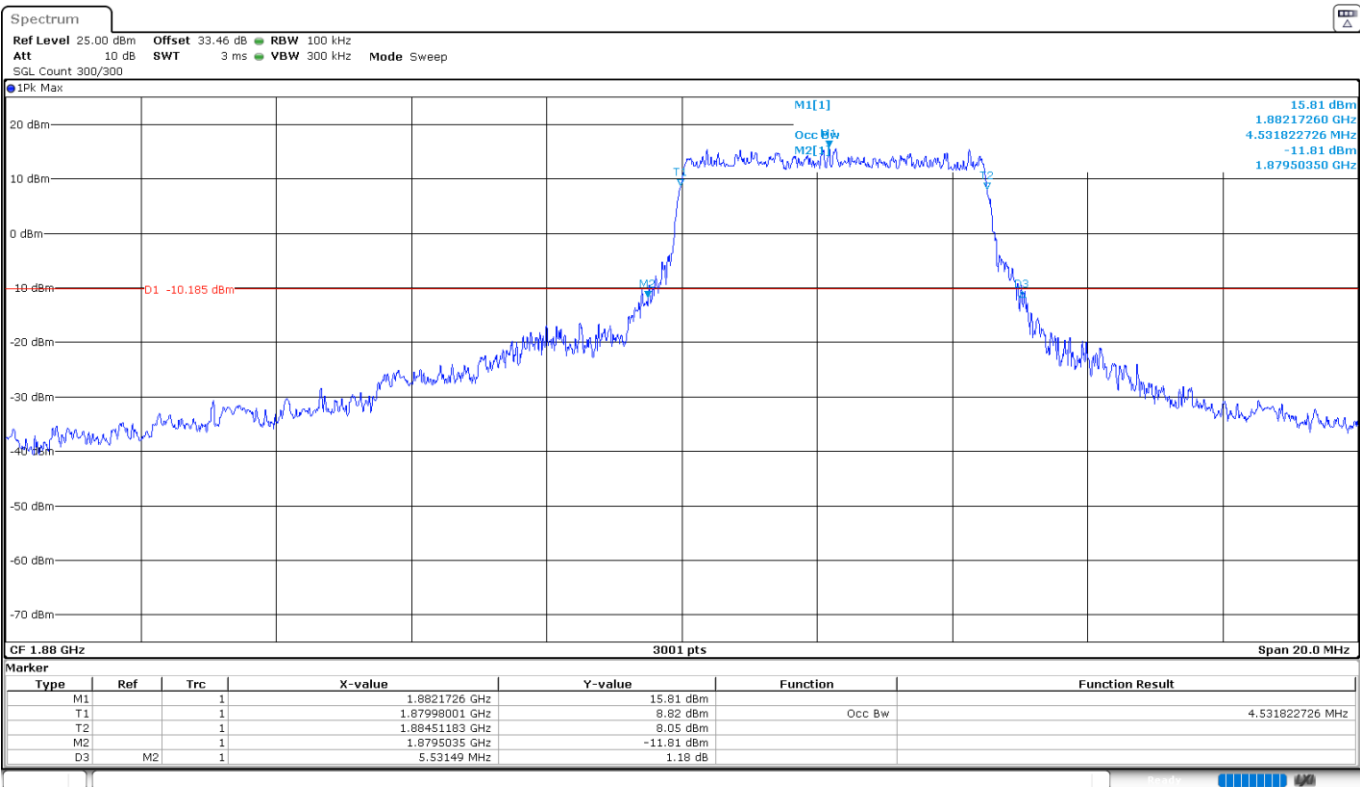


BW=10 MHz. 16QAM. RB Size=max

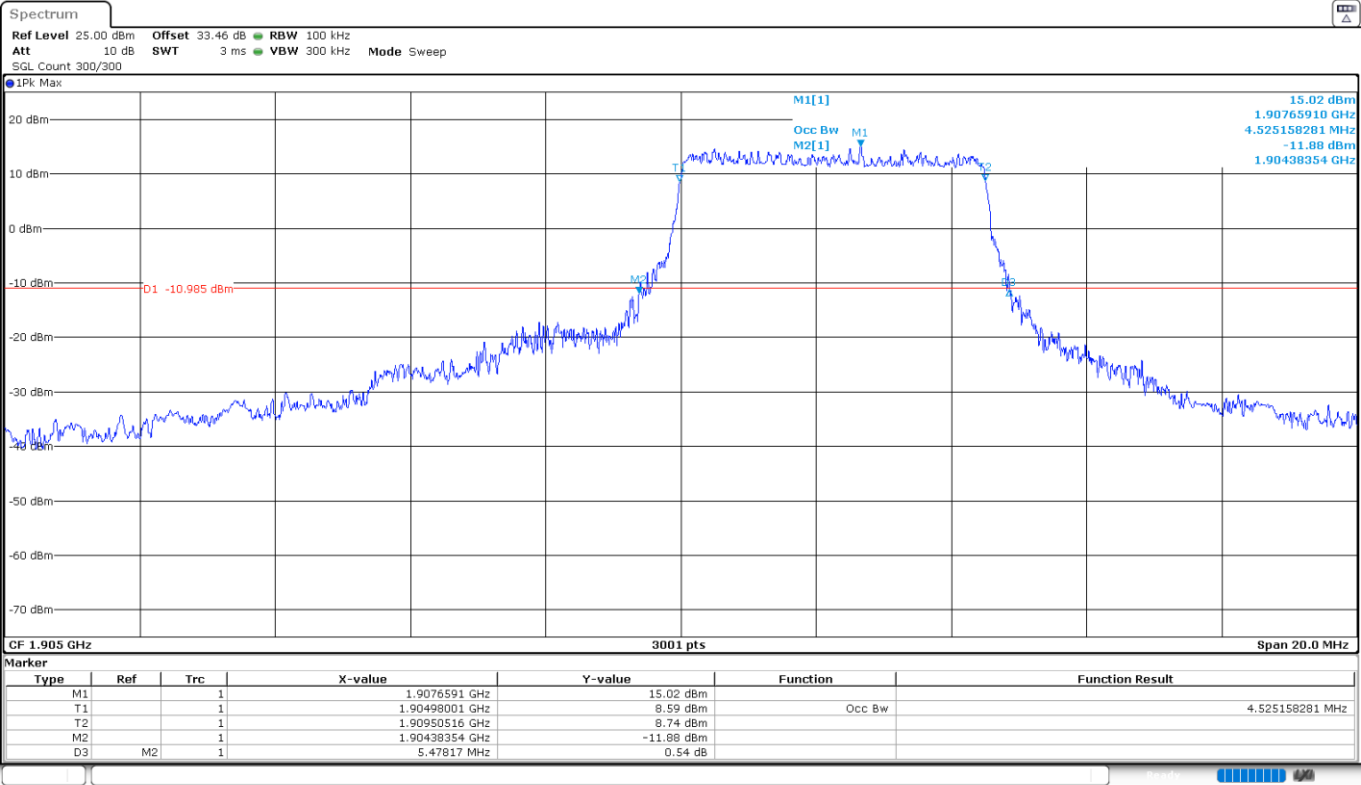
Low Channel:



Middle Channel:

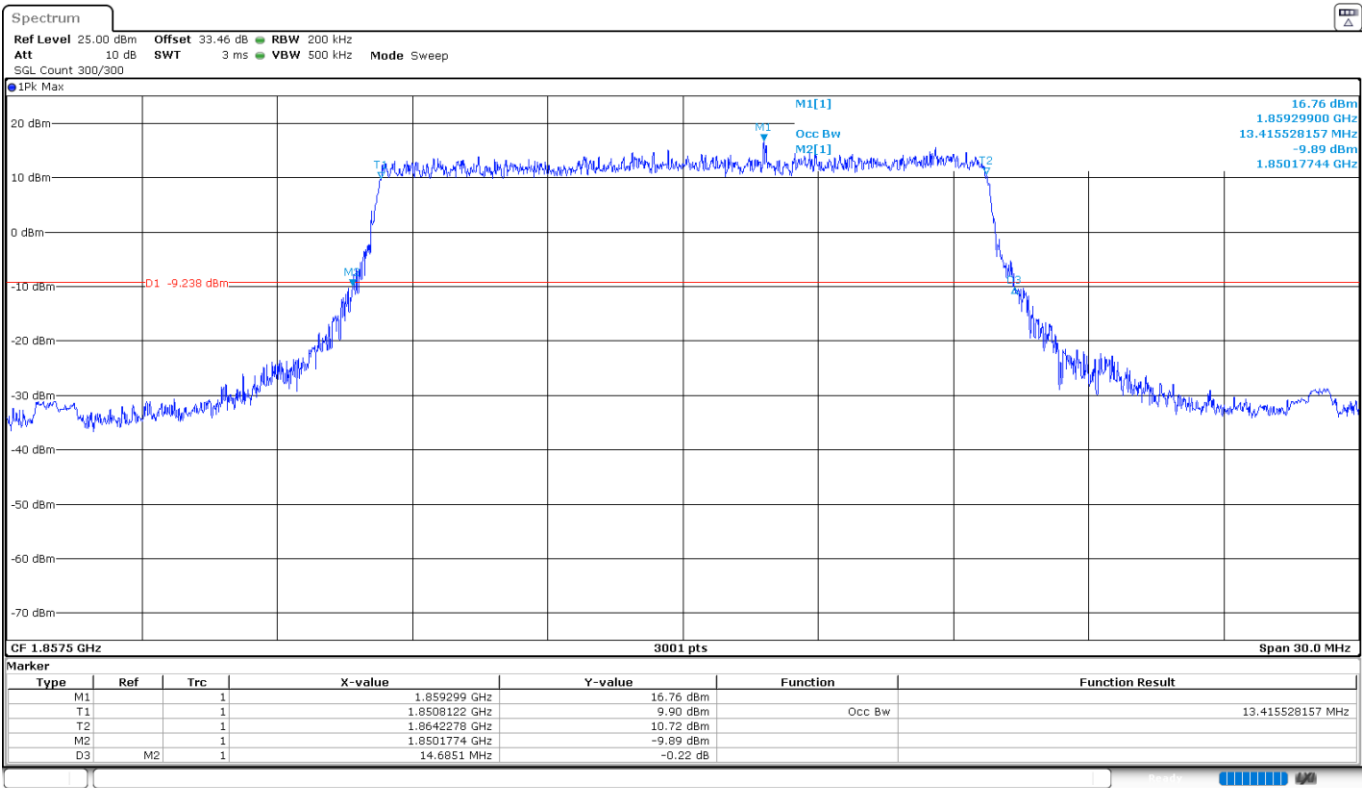


High Channel:

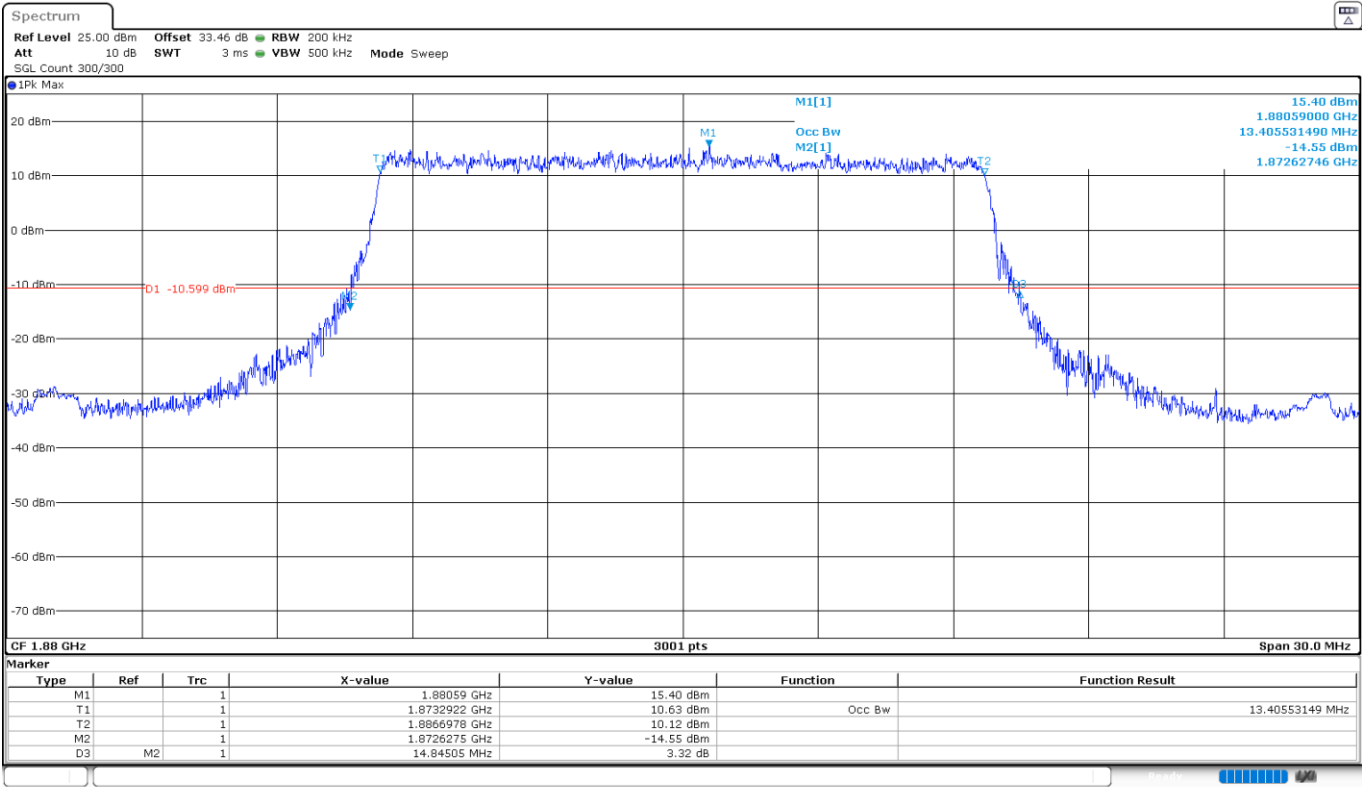


BW=15 MHz. QPSK. RB Size=max

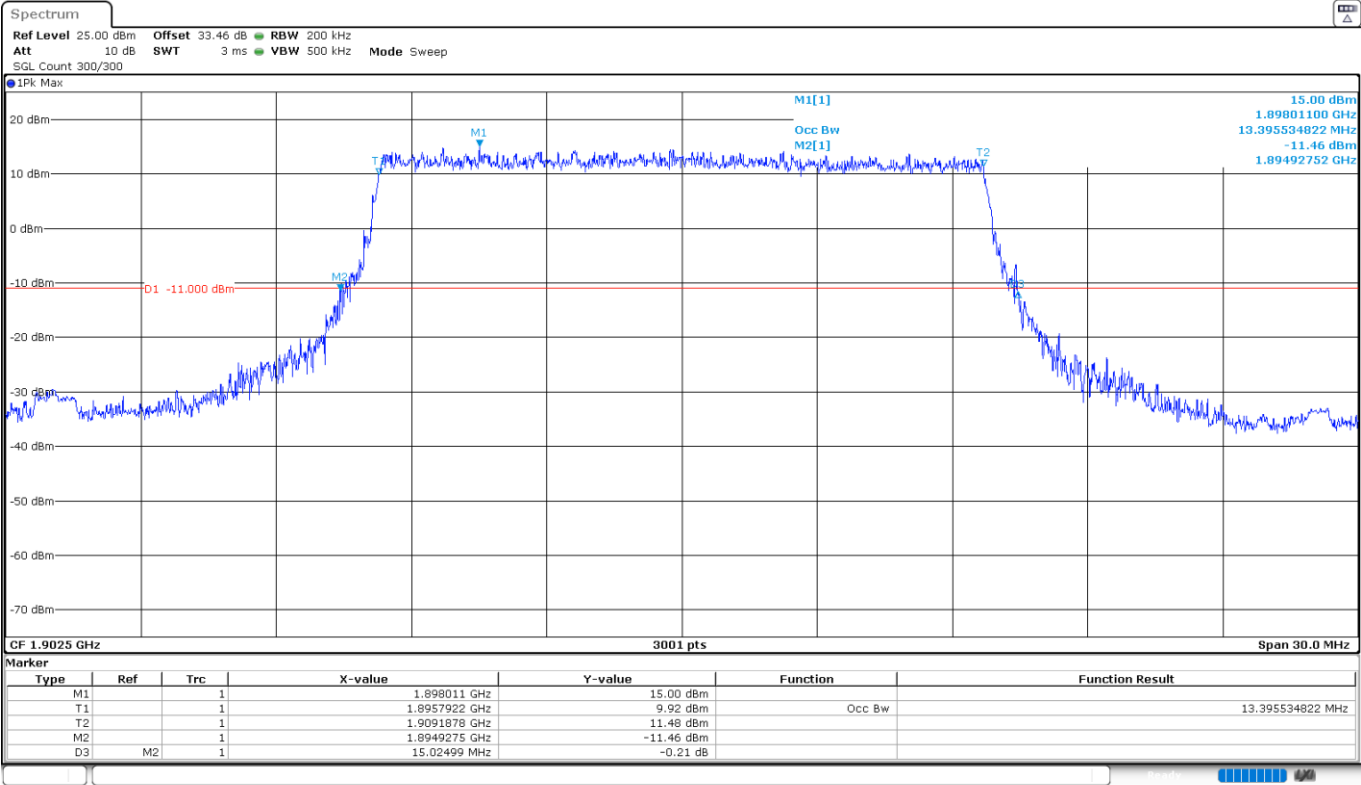
Low Channel:



Middle Channel:

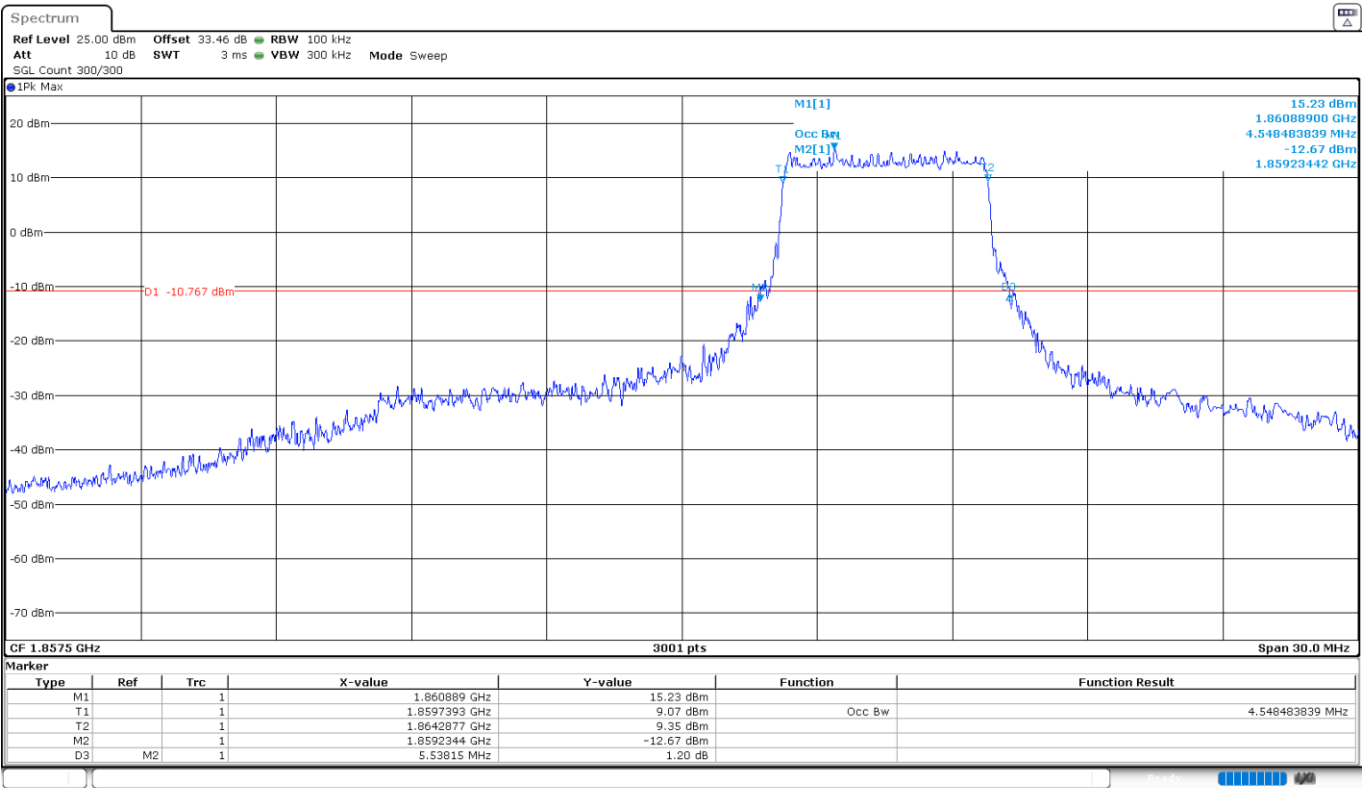


High Channel:

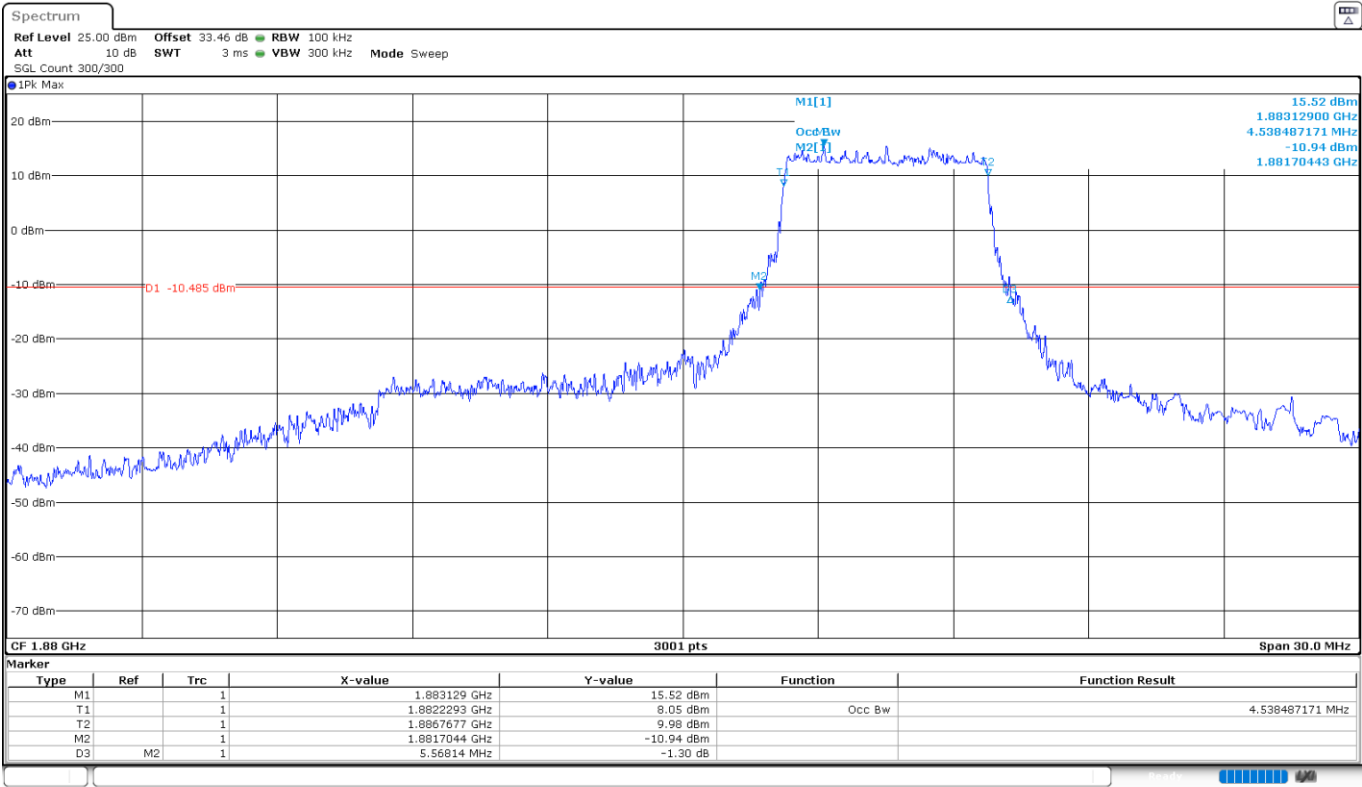


BW=15 MHz. 16QAM. RB Size=max

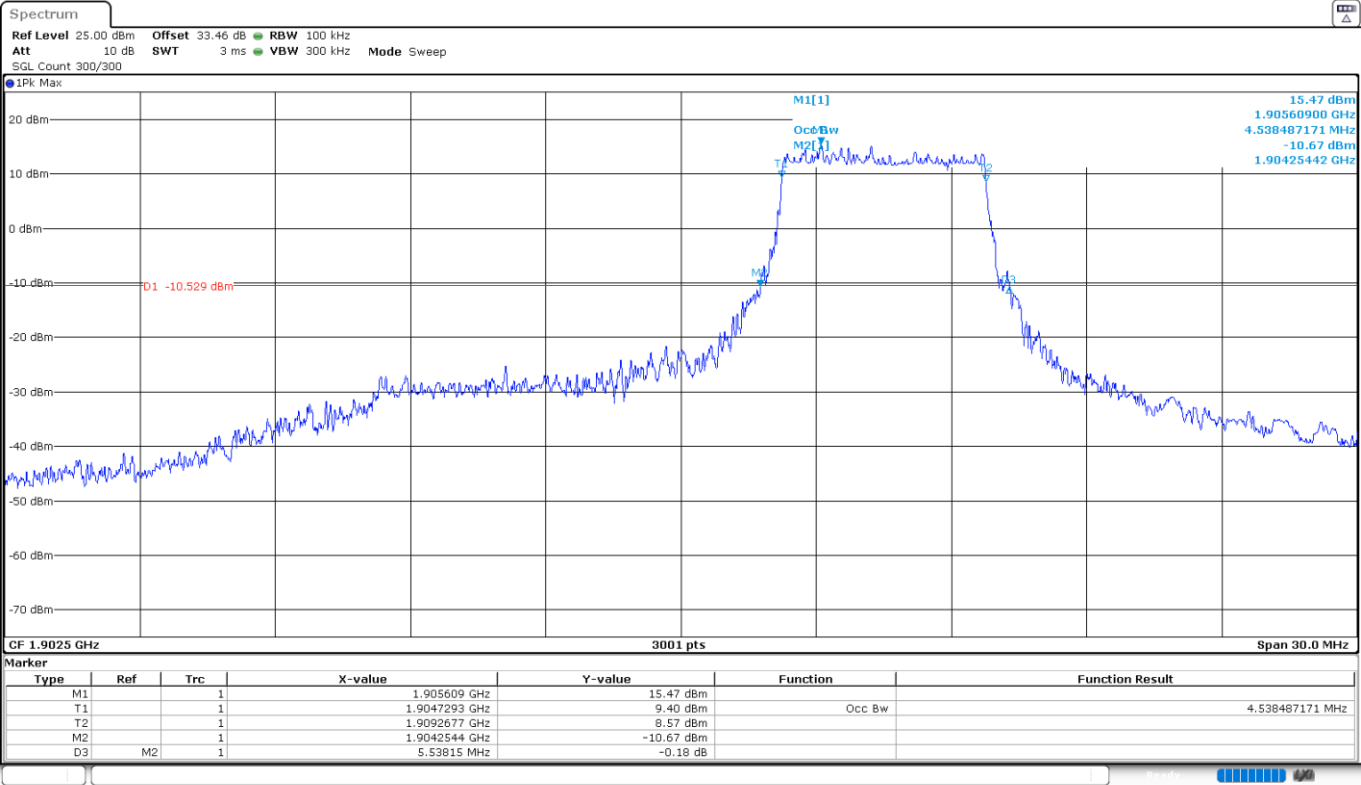
Low Channel:



Middle Channel:

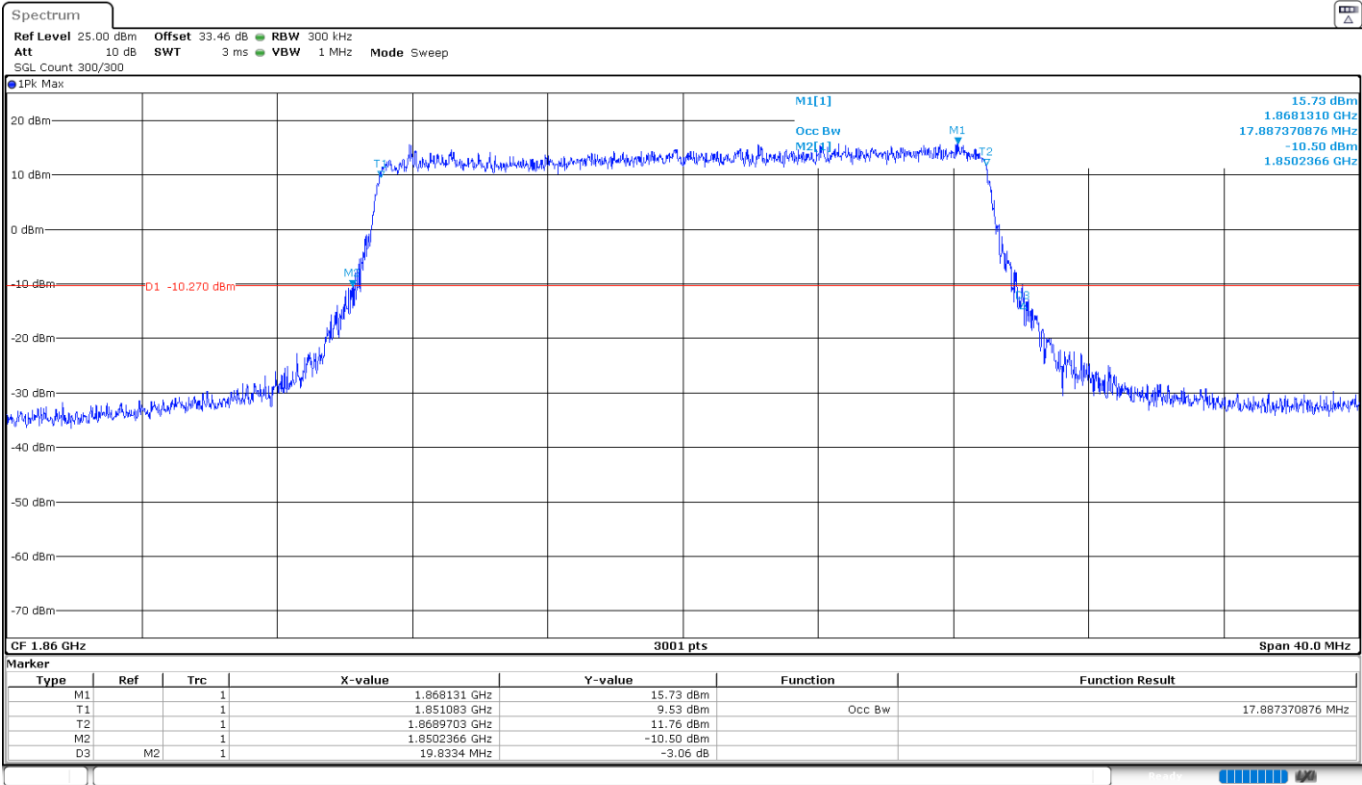


High Channel:

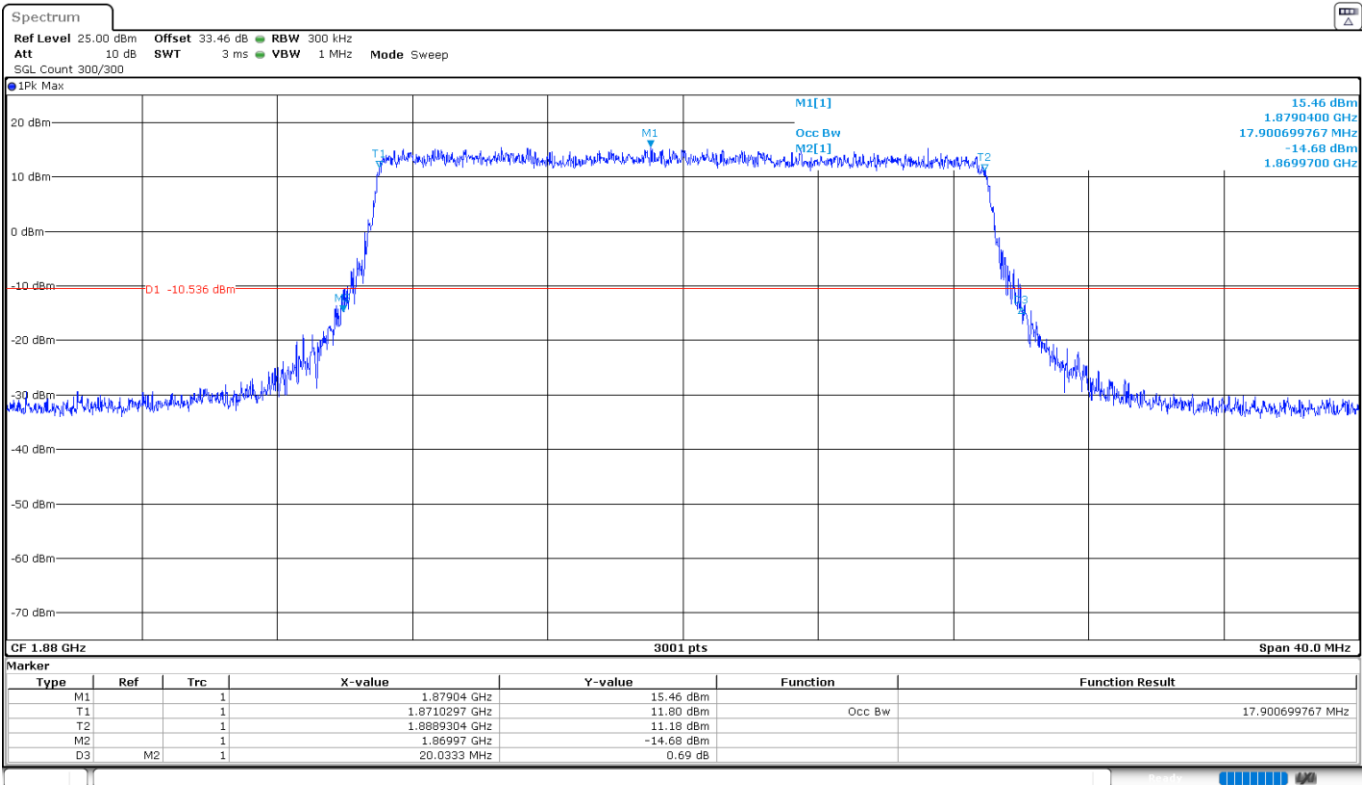


BW=20 MHz. QPSK. RB Size=max

Low Channel:



Middle Channel:



High Channel:

