



Test report No:
NIE: 64610RRF.004A1

Partial Test report

REFERENCE STANDARD:
USA FCC Part 22 & Part 90
CANADA IC RSS-132

(*) Identification of item tested	nRF9160 IOT Module
(*) Trademark	nRF91
(*) Model and /or type reference tested	nRF9160
Other identification of the product	SW version: mfw_nrf9160_1.1.2-148 HW version: nRF9160-SICA-B1A FCC ID: 2ANPO00NRF9160 IC: 24529-NRF9160 IMEI TAC: 35265610
(*) Features	LTE Cat-M1, LTE-NB1, GPS
Applicant	NORDIC SEMICONDUCTOR ASA Otto Nielsens Vel 12, 7052 Trondheim, Norway
Test method requested. standard	USA FCC Part 22 10-1-18 Edition. USA FCC Part 90 10-1-18 Edition. CANADA IC RSS-132 Issue 3, Jan. 2013. ANSI C63.26 – 2015 KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018.
Approved by (name / position & signature)	Rafael López Martín EMC Consumer & RF Lab. Manager
Date of issue	2020-08-25
Report template No	FDT08_22 (*) "Data provided by the client"

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Competences and guarantees

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Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification 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 nRF9160 IOT Module.

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.

Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
64610D/002	nRF9160 IOT Module	nRF9160	IMEI: 352656102628230	2020/04/14

1. Sample S/01 has undergone the following test(s):

All tests indicated in Appendix A for GEN2 device.

Auxiliary sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
59965/013	nRF9160 IOT Module	nRF9160	IMEI: 352656100299349	2019/03/25

1. Sample S/02 has undergone the following test(s):

Auxiliary sample to perform measurements for GEN1 device for conducted RF output power comparison indicated in appendix A.

Test sample description

Ports..... :	Port name and description		Cable				
			Specified length [m]	Attached during test	Shielded		
	LTE RF		2	☒	☒		
	GPS		2	☐	☐		
	BTLE			☐	☐		
			☐	☐			
Supplementary information to the ports..... :	N/A						
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
☒	DC: 3.0-5.5V						
Rated Power	1W						
Clock frequencies.....	32kHz, 32MHz						
Other parameters	--						
Software version	mfw_nrf9160_1.1.2_148						
Hardware version	nRF9160-SICA-B1A						

Dimensions in cm (L x W x D).....:	11x16x1.1mm		
Mounting position	☐	Table top equipment	
	☐	Wall/Ceiling mounted equipment	
	☐	Floor standing equipment	
	☐	Hand-held equipment	
	☒	Other: SMD Module	
Modules/parts.....:	Module/parts of test item	Type	Manufacturer
	N/A		
Accessories (not part of the test item)	Description	Type	Manufacturer
	N/A		
Documents as provided by the applicant	Description	File name	Issue date
	User manual	4418_1315-v1.2 /2020-04-30- nRF9160_Objective_ Product_Spec	30-Apr-2020
	Cover markings	nRF9160_SiP marking	15-Jun-2020

Copy of marking plate:



Identification of the client

NORDIC SEMICONDUCTOR ASA
Otto Nielsens Vei 12, 7052 Trondheim, NORWAY

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-05-18
Date (finish)	2020-05-19

Document history

Report number	Date	Description
64610RRF.004	2020-07-08	First release
64610RRF.004A1	2020-08-25	Second release: modification of sw and hw version and DC voltage range declared by manufacturer in "Test sample description". Correction on Vnom voltage value in "Test conditions". Inclusion of conducted RF output power comparison between GEN2 and GEN1 devices. This modification test report cancels and replaces the test report 64610RRF.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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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. = 35 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Cristina Calle and Nicolás Salguero.

Used instrumentation:

Conducted Measurements

		Last Cal. date	Cal. due date
1.	DC power supply R&S NGPE 40/40	2018/02	2021/02
2.	Universal Radio communication Tester ROHDE AND SCHWARZ CMW50	2020/04	2021/04

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	Híbrido Bilog antenna SUNOL SCIENCES CORPORATION JB6	2017/09	2020/09
3.	Broadband Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2019/11	2022/11
4.	Signal and Spectrum Analyser ROHDE AND SCHWARZ FSV40	2019/09	2021/09
5.	EMI Test Receiver 9kHz – 7GHz ROHDE AND SCHWARZ ESR7	2019/10	2021/10
6.	RF pre-amplifier, G>40dB, 1-18 GHz BONN ELEKTRONIK BLMA 0118-1M	2020/05	2021/05
7.	Universal Radio communication Tester ROHDE AND SCHWARZ CMW50	2020/04	2021/04

Testing verdicts

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

Summary

FCC PART 22/IC RSS-132 PARAGRAPH		
Requirement – Test case	Verdict	Remark
Clause 22.913/RSS-132 Clause 5.4: RF output power	P	(2)
Clause 2.1047/RSS-132 Clause 5.2: Modulation characteristics	NM	(1)
Clause 22.355/RSS-132 Clause 5.3: Frequency stability	NM	(1)
Clause 2.1049: Occupied Bandwidth	NM	(1)
Clause 22.917/RSS-132 Clause 5.5: Spurious emissions at antenna terminals	NM	(1)
Clause 22.917/RSS-132 Clause 5.5: Radiated emissions	P	(2)
<u>Supplementary information and remarks:</u> (1) Test not requested. (2) Peak-to-average power ratio (PAPR) was not tested. Only RF Output Power and Radiated emissions tests were tested in the worst case		

FCC PART 90 PARAGRAPH		
Requirement – Test case	Verdict	Remark
Clause 90.635 (b): RF output power	P	(2)
Clause 2.1047: Modulation characteristics	NM	(1)
Clause 90.213 Frequency stability	NM	(1)
Clause 2.1049: Occupied Bandwidth	NM	(1)
Clause 90.691 Spurious emissions at antenna terminals (Emission mask requirements for EA-based systems)	NM	(1)
Clause 90.691: Radiated emissions	P	(2)
<u>Supplementary information and remarks:</u> (1) Test not requested. (2) Only RF Output Power and Radiated emissions tests were tested in the worst case.		

Appendix A: Test results for FCC Part 22 & 90 / RSS-132

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TEST CONDITIONS

Power supply (V):

Vnominal = 3.8 Vdc

Type of power supply = DC Voltage from external power supply

Type of antenna = Integral antenna.

Declared Gain for antenna = +2.6 dBi.

TEST FREQUENCIES:

814-824MHz Band:

NB-IoT. $\pi/2$ - BPSK AND $\pi/4$ - QPSK MODULATION (BAND 26)

Channel (Frequency. MHz)	
Lowest	Highest
26692	26788
(814.2)	(823.8)

Cross-rule channel (824MHz):

NB-IoT. $\pi/2$ - BPSK AND $\pi/4$ - QPSK MODULATION (BAND 26)

Channel (Frequency. MHz)
26790
(824)

824-849MHz Band:

NB IoT. $\pi/2$ - BPSK AND $\pi/4$ - QPSK MODULATION (BAND 5)

Channel (Frequency. MHz)		
Lowest	Middle	Highest
20402 (824.2)	20525 (836.5)	20648 (848.8)

NB IoT. $\pi/2$ - BPSK AND $\pi/4$ - QPSK MODULATION (BAND 26)

Channel (Frequency. MHz)		
Lowest	Middle	Highest
26792 (824.2)	26915 (836.5)	27038 (848.8)

NOTE: Band 26 is completely included in band 5, so the channels of band 5 were tested to give conformity to the assigned block.

RF Output Power

SPECIFICATION

FCC §2.1046 and §22.913. The Effective Radiated Power (E.R.P.) of mobile transmitter and auxiliary test transmitter must not exceed 7 Watts (38.45 dBm E.R.P.).

RSS-132. Clause 5.4. The equivalent isotropically radiated power (e.i.r.p.) for mobile equipment shall not exceed 11.5 watts (38.45 dBm E.R.P.).

FCC §90.635. The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

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 R&S CMU200 and CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

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

Conducted average power.



RESULTS

MAXIMUM OUTPUT POWER (CONDUCTED).

814-824 MHz Band:

Ch	Freq. (MHz)	Modulation	BW (kHz)	Num. tone	Offset Tone	Average Power (dBm)
26692	814.2	$\pi/2$ - BPSK	3.75	1	0	23.01
				1	47	22.97
			15	1	0	23.04
				1	11	23.03
		$\pi/4$ - QPSK	3.75	1	0	23.00
				1	47	22.95
			15	1	0	23.05
				1	11	23.06
				3	0	22.94
				3	6	22.92
				6	0	22.06
				6	6	22.09
				12	0	21.09
26740	819	$\pi/2$ - BPSK	3.75	1	0	22.94
				1	47	22.87
			15	1	0	23.01
				1	11	23.03
		$\pi/4$ - QPSK	3.75	1	0	22.93
				1	47	22.89
			15	1	0	23.03
				1	11	23.04
				3	0	22.94
				3	6	22.83
				6	0	22.01
				6	6	22.08
				12	0	21.03
26788	823.8	$\pi/2$ - BPSK	3.75	1	0	22.93
				1	47	22.92
			15	1	0	22.99
				1	11	22.98
		$\pi/4$ - QPSK	3.75	1	0	22.99
				1	47	22.94
			15	1	0	22.99
				1	11	23.00
				3	0	22.92
				3	6	22.83
				6	0	22.02
				6	6	22.07
				12	0	21.07

Cross-rule channel (824MHz):

Ch	Freq. (MHz)	Modulation	BW (kHz)	Num. tone	Offset Tone	Average Power (dBm)
26790	824	$\pi/2$ - BPSK	3.75	1	0	22.98
				1	47	22.92
			15	1	0	23.00
				1	11	22.98
		$\pi/4$ - QPSK	3.75	1	0	22.99
				1	47	22.94
			15	1	0	23.01
				1	11	23.02
				3	0	22.99
				3	6	22.93
				6	0	22.06
				6	6	22.06
				12	0	21.11

824-849MHz Band:

Ch	Freq. (MHz)	Modulation	BW (kHz)	Num. tone	Offset Tone	Average Power (dBm)
20402	824.2	$\pi/2$ - BPSK	3.75	1	0	22.94
				1	47	22.90
			15	1	0	22.94
				1	11	22.96
		$\pi/4$ - QPSK	3.75	1	0	22.95
				1	47	22.92
			15	1	0	22.95
				1	11	22.96
				3	0	22.91
				3	6	22.97
				6	0	22.00
				6	6	21.99
				12	0	21.02
20525	836.5	$\pi/2$ - BPSK	3.75	1	0	22.89
				1	47	22.84
			15	1	0	22.80
				1	11	22.80
		$\pi/4$ - QPSK	3.75	1	0	22.88
				1	47	22.83
			15	1	0	22.82
				1	11	22.79
				3	0	22.81
				3	6	22.84
				6	0	21.94
				6	6	21.93
				12	0	20.98
20648	848.8	$\pi/2$ - BPSK	3.75	1	0	22.77
				1	47	22.71
			15	1	0	22.81
				1	11	22.8
		$\pi/4$ - QPSK	3.75	1	0	22.78
				1	47	22.73
			15	1	0	22.78
				1	11	22.79
				3	0	22.69
				3	6	22.80
				6	0	21.88
				6	6	21.83
				12	0	20.92

814-824 MHz Band:

Channel	Measured maximum average power (dBm) at antenna port	Maximum declared antenna gain (dBi)	Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	Maximum effective radiated power E.R.P. (dBm)
Lowest	23.06	+2.6	25.66	23.51
Middle	23.04	+2.6	25.64	23.49
Highest	23.00	+2.6	25.60	23.45
Measurement uncertainty (dB)	<±1.58			

Cross-rule channel (824MHz):

Channel	Measured maximum average power (dBm) at antenna port	Maximum declared antenna gain (dBi)	Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	Maximum effective radiated power E.R.P. (dBm)
26790 (824)	23.02	+2.6	25.62	23.47
Measurement uncertainty (dB)	<±1.58			

824-849MHz Band:

Channel	Measured maximum average power (dBm) at antenna port	Maximum declared antenna gain (dBi)	Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	Maximum effective radiated power E.R.P. (dBm)
Lowest	22.97	+2.6	25.57	23.42
Middle	22.89	+2.6	25.49	23.34
Highest	22.81	+2.6	25.41	23.26
Measurement uncertainty (dB)	<±1.58			

Verdict: PASS

GEN2 AND GEN1 OUTPUT POWER COMPARISON (CONDUCTED).

LTE 814-824 MHz Band

The results in the next table shows the maximum difference between GEN2 and GEN1 devices for conducted output power measurements.

Maximum conducted output power difference between GEN2 and GEN1 (dB)	0.38
---	------

Measurement uncertainty (dB)	<±1.58
------------------------------	--------

LTE Cross-rule channel (824MHz).

The results in the next table shows the maximum difference between GEN2 and GEN1 devices for conducted output power measurements.

Maximum conducted output power difference between GEN2 and GEN1 (dB)	0.24
---	------

Measurement uncertainty (dB)	<±1.58
------------------------------	--------

LTE 824-849MHz Band.

The results in the next table shows the maximum difference between GEN2 and GEN1 devices for conducted output power measurements.

Maximum conducted output power difference between GEN2 and GEN1 (dB)	0.39
---	------

Measurement uncertainty (dB)	<±1.58
------------------------------	--------

Radiated emissions

SPECIFICATION

FCC § 22.917

RSS-132. Clause 5.5.

FCC §2.1051, §90.691

Emission mask requirements for EA-based systems.

For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10\log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

METHOD

The measurement was performed with the EUT inside an anechoic chamber. The spectrum was scanned from 30 MHz to at least the 10th harmonic of the highest frequency generated within the equipment.

The EUT was placed on a 1 meter high non-conductive stand at a 3 meter distance from the measuring antenna.

Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum field strength (dBμV/m) is measured and recorded.

The maximum field strength (dBμV/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

$EIRP (dBm) = E (dB\mu V/m) + 20\log(D) - 104.8$; where D is the measurement distance (in the far field region) in m. $D = 3 \text{ m}$

Measurement Limit:

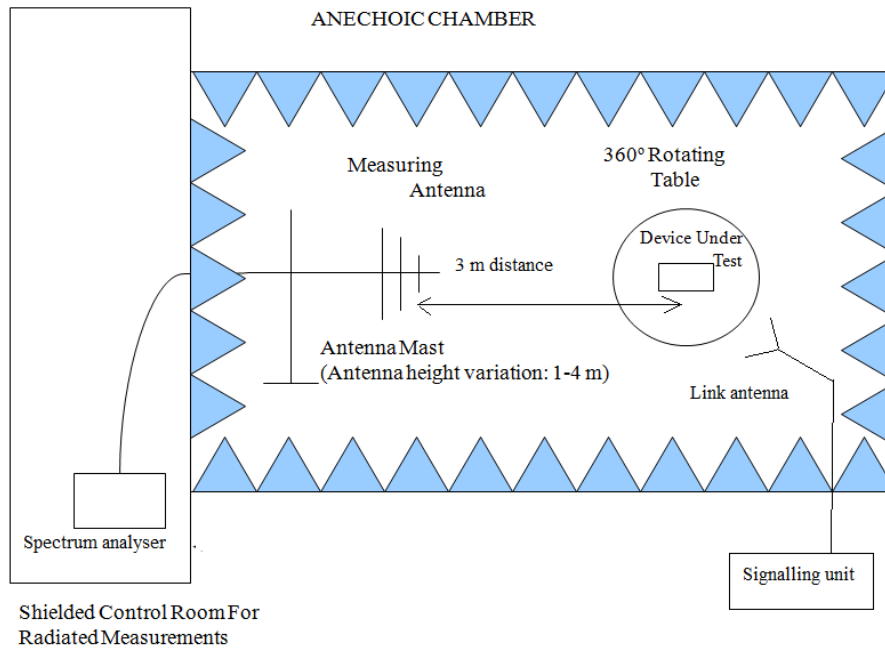
According to specification. the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

At P_o transmitting power. the specified minimum attenuation becomes $43+10\log (P_o)$. and the level in dBm relative P_o becomes:

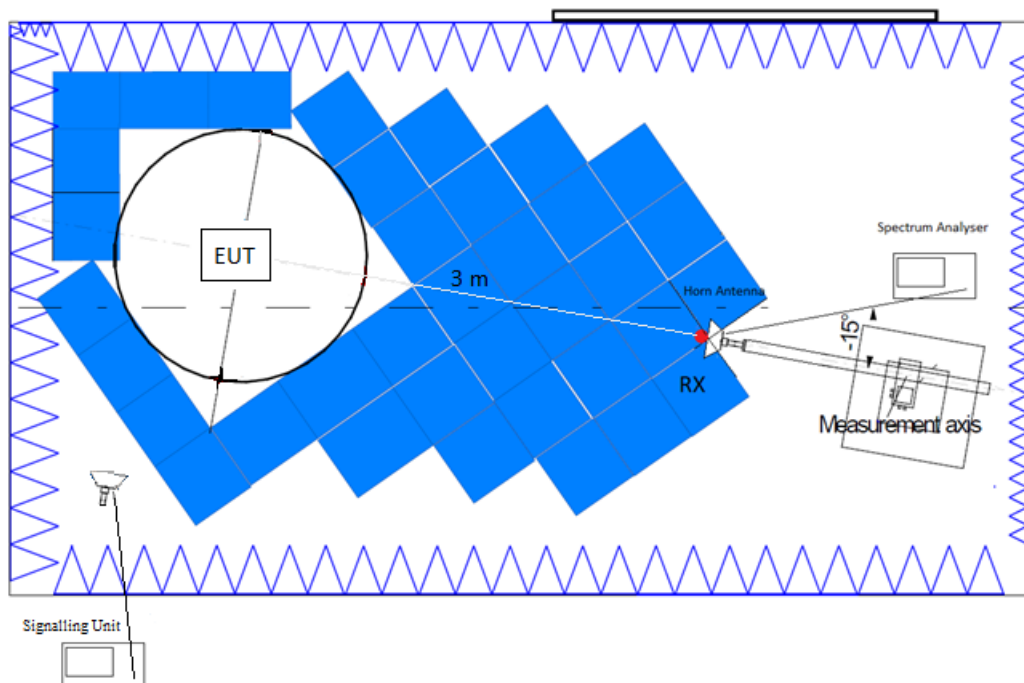
$P_o (dBm) - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = - 13 \text{ dBm}$

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

814-824MHz Band:

Preliminary measurements determined that 1 tone of 15kHz (QPSK) as the worst case. The results in the next tables shows the results for this configuration.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

Frequency range 1 GHz-10 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

Frequency range 1 GHz-10 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

Frequency range 1 GHz-10 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

Measurement uncertainty (dB)	<±4.65 for $f < 1\text{GHz}$ <±4.98 for $f \geq 1\text{ GHz up to } 10\text{ GHz}$
------------------------------	---

Verdict: PASS

824-849MHz Band:

Preliminary measurements determined that 1 tones of 15kHz (BPSK) as the worst case. The results in the next tables shows the results for this configuration.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

Frequency range 1 GHz-10 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

Frequency range 1 GHz-10 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

Frequency range 1 GHz-10 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

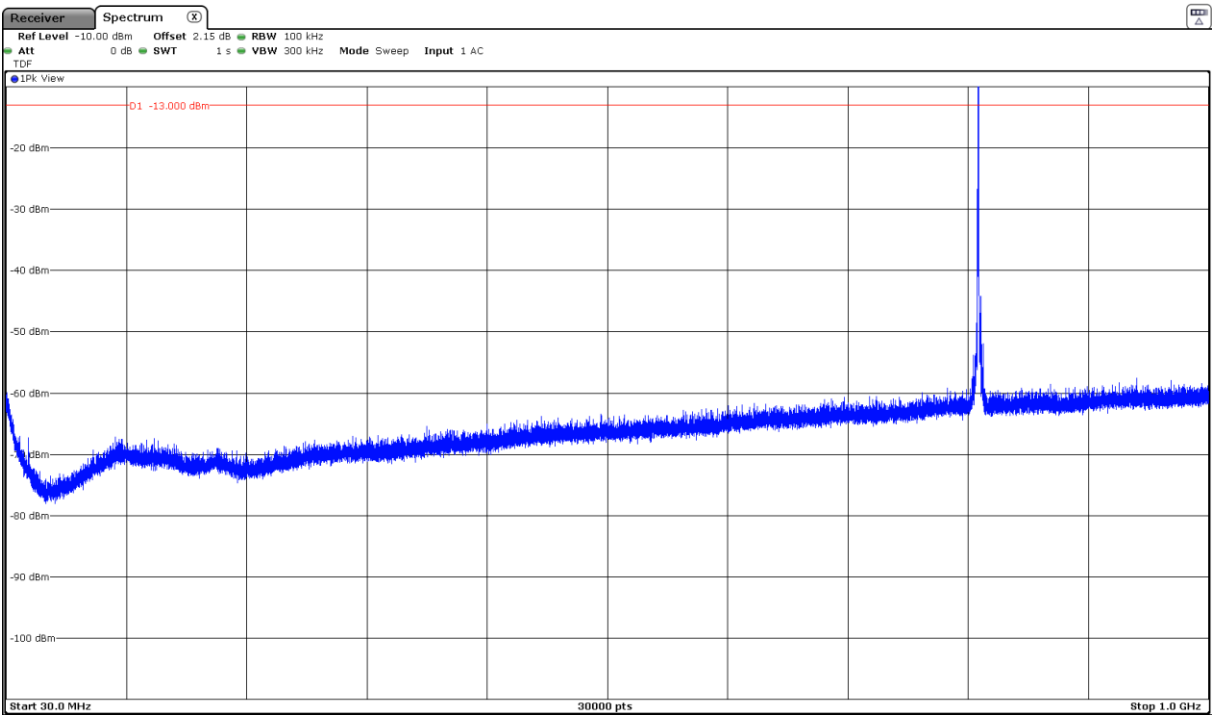
Measurement uncertainty (dB)	<±4.65 for f < 1GHz <±4.98 for f ≥ 1 GHz up to 10 GHz
------------------------------	--

Verdict: PASS

814-824MHz Band:

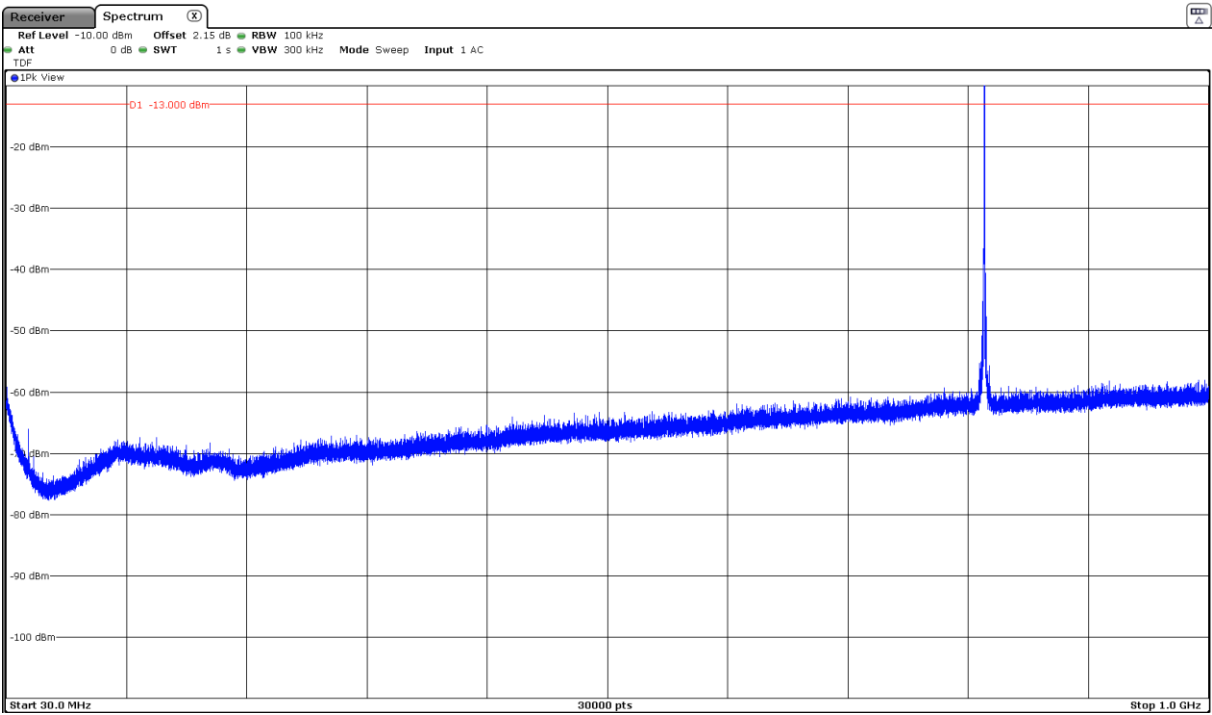
FREQUENCY RANGE 30 MHz-1000 MHz.

CHANNEL: LOWEST



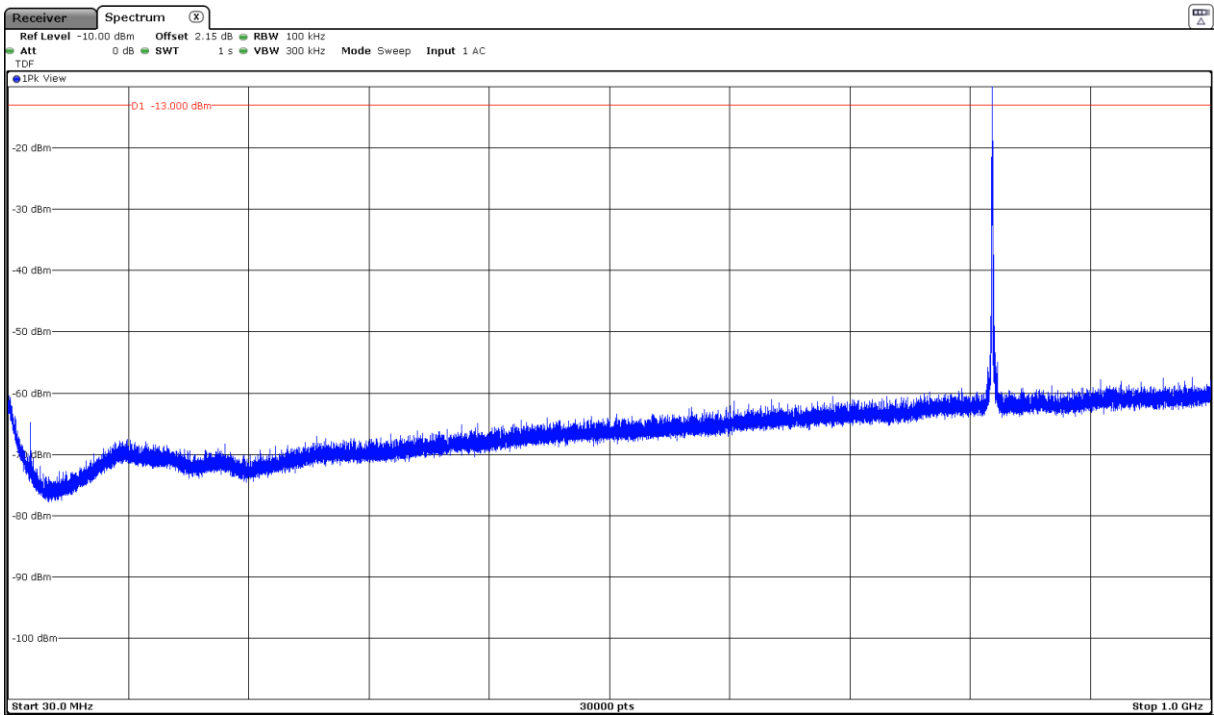
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

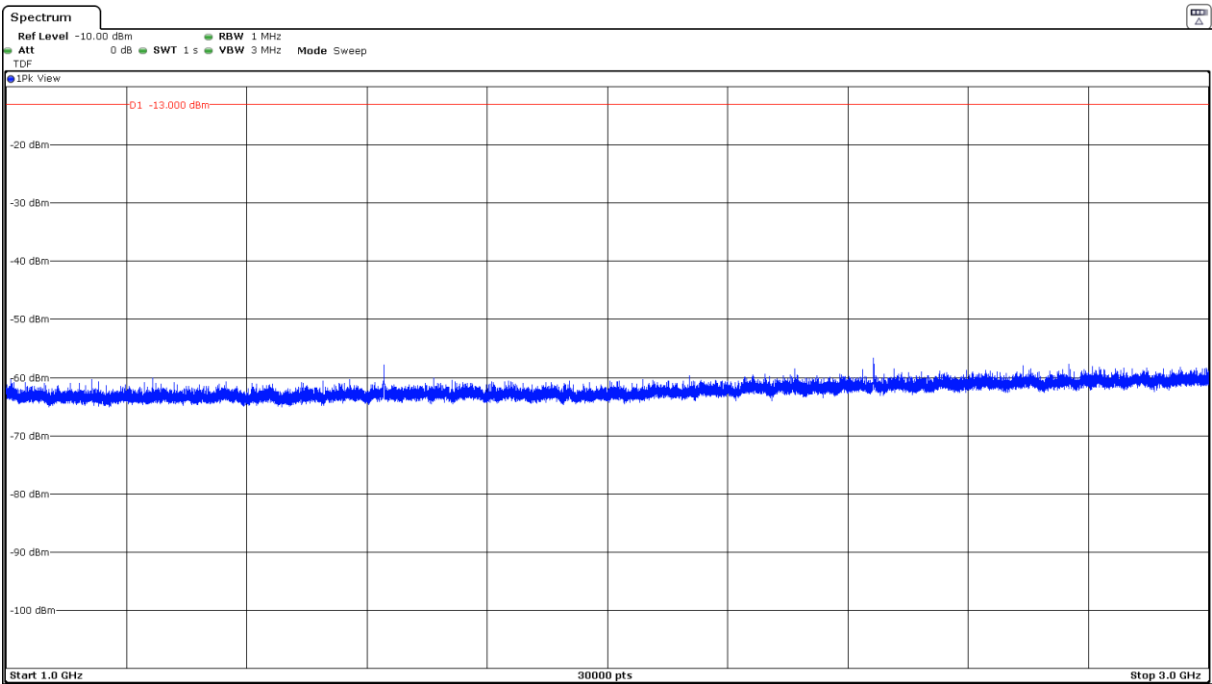
CHANNEL: HIGHEST



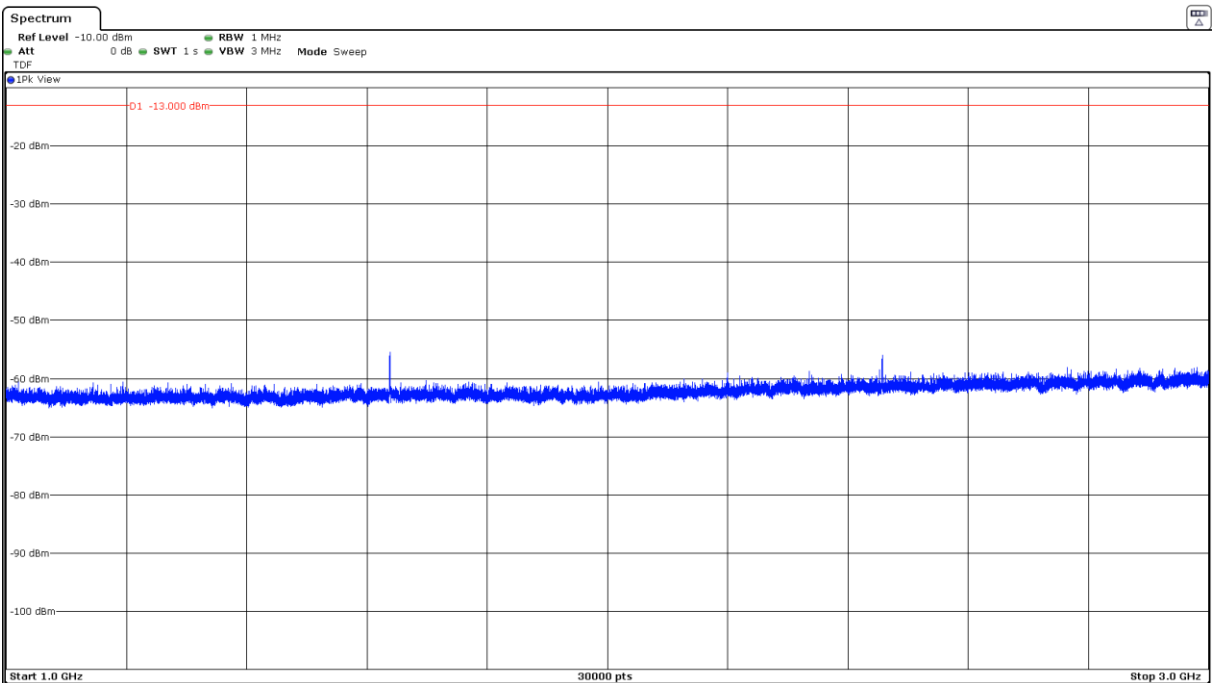
Note: The peak above the limit is the carrier frequency.

FREQUENCY RANGE 1 GHz to 3 GHz.

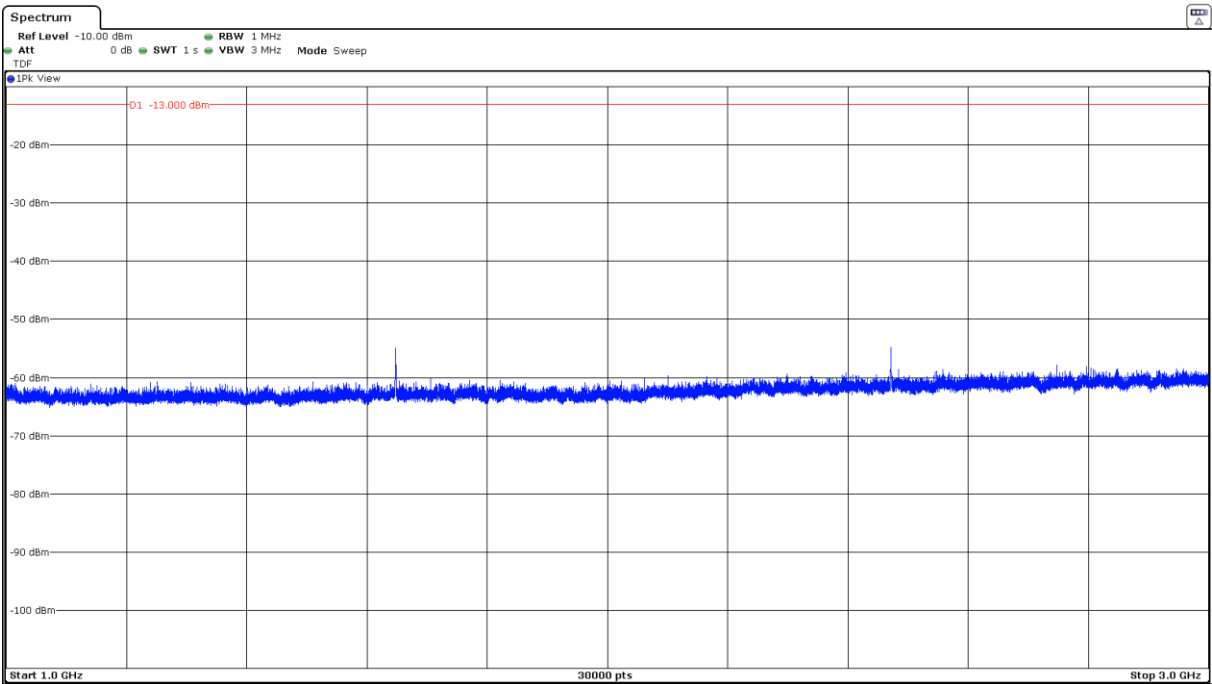
CHANNEL: LOWEST



CHANNEL: MIDDLE

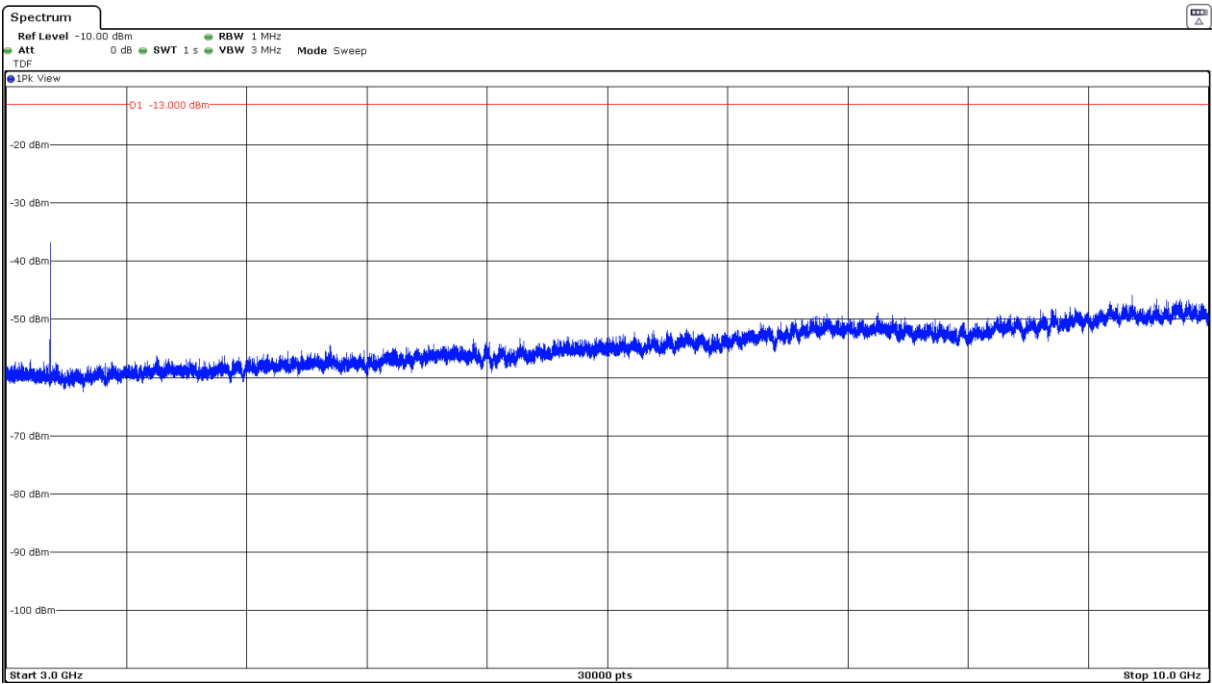


CHANNEL: HIGHEST

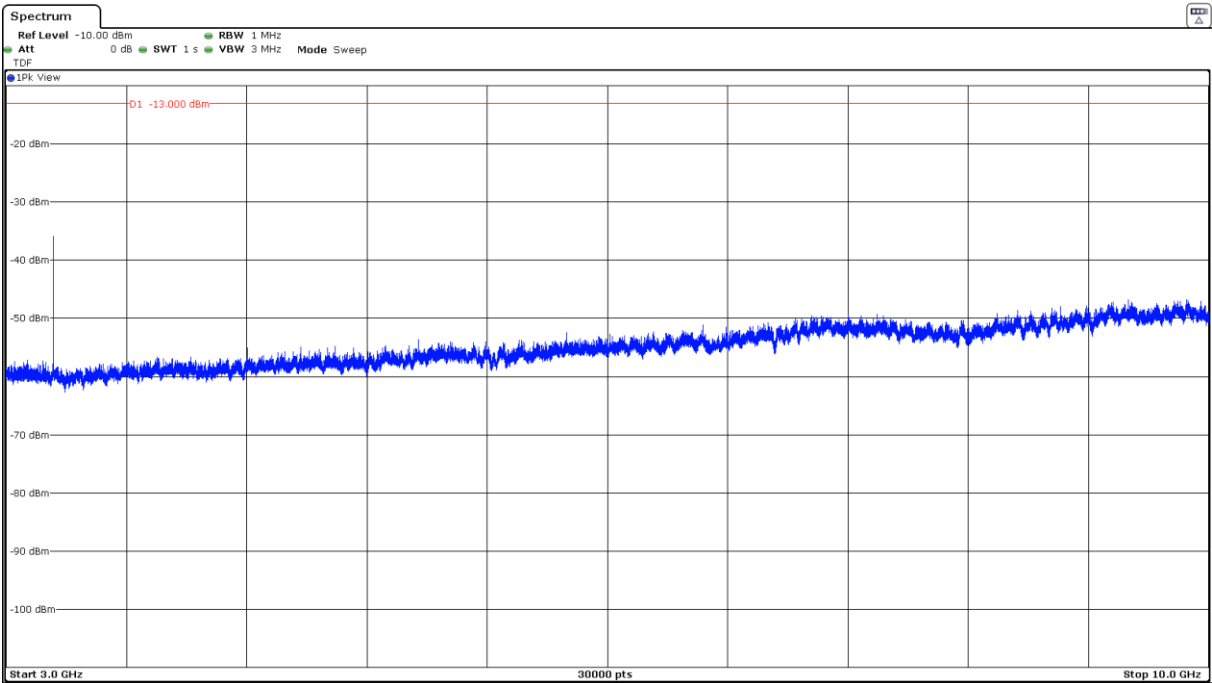


FREQUENCY RANGE 3 GHz to 10 GHz.

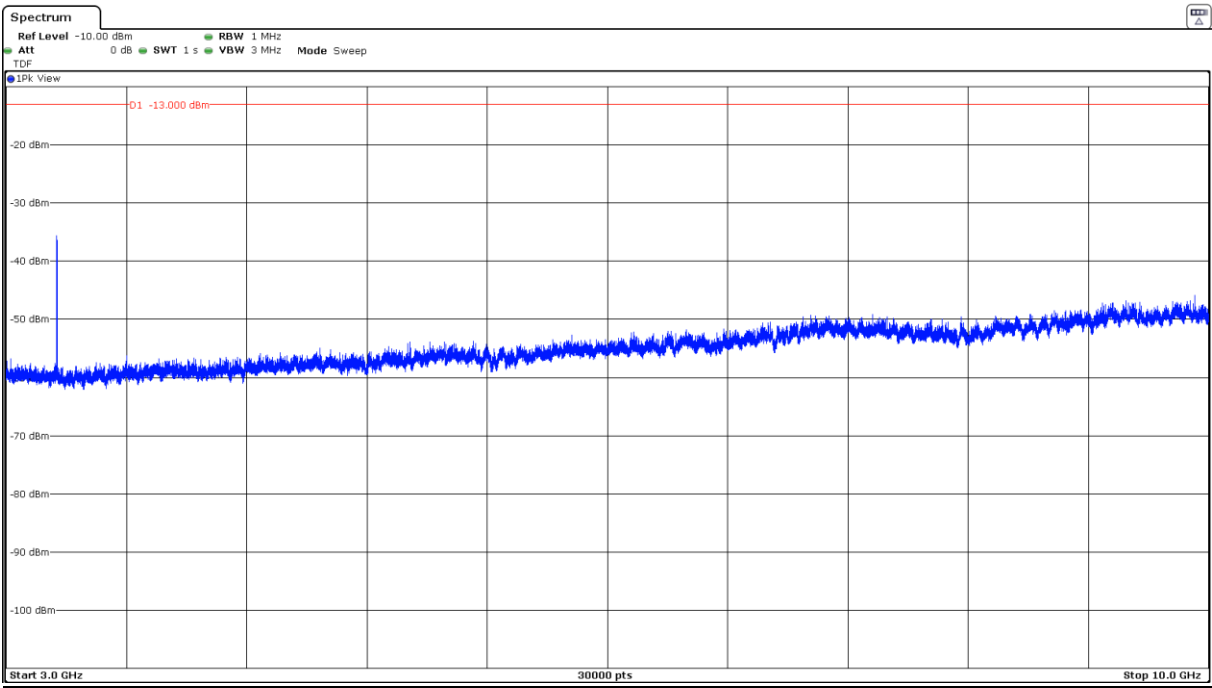
CHANNEL: LOWEST



CHANNEL: MIDDLE



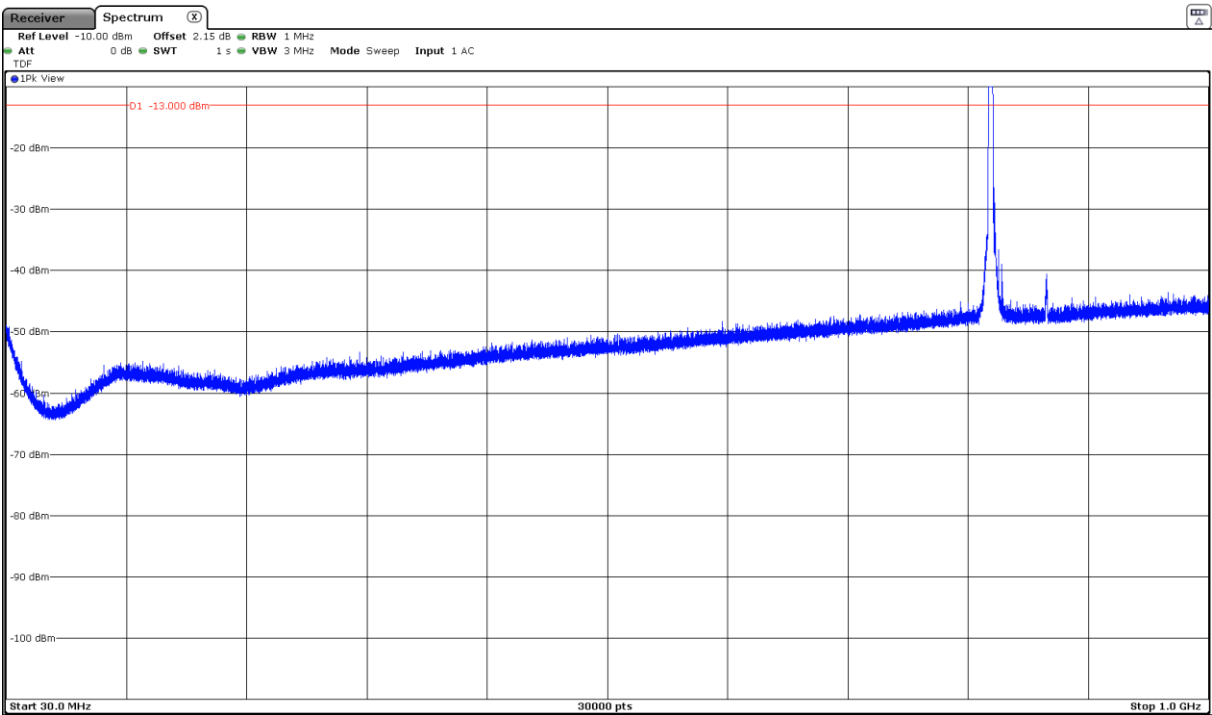
CHANNEL: HIGHEST



824-849MHz Band:

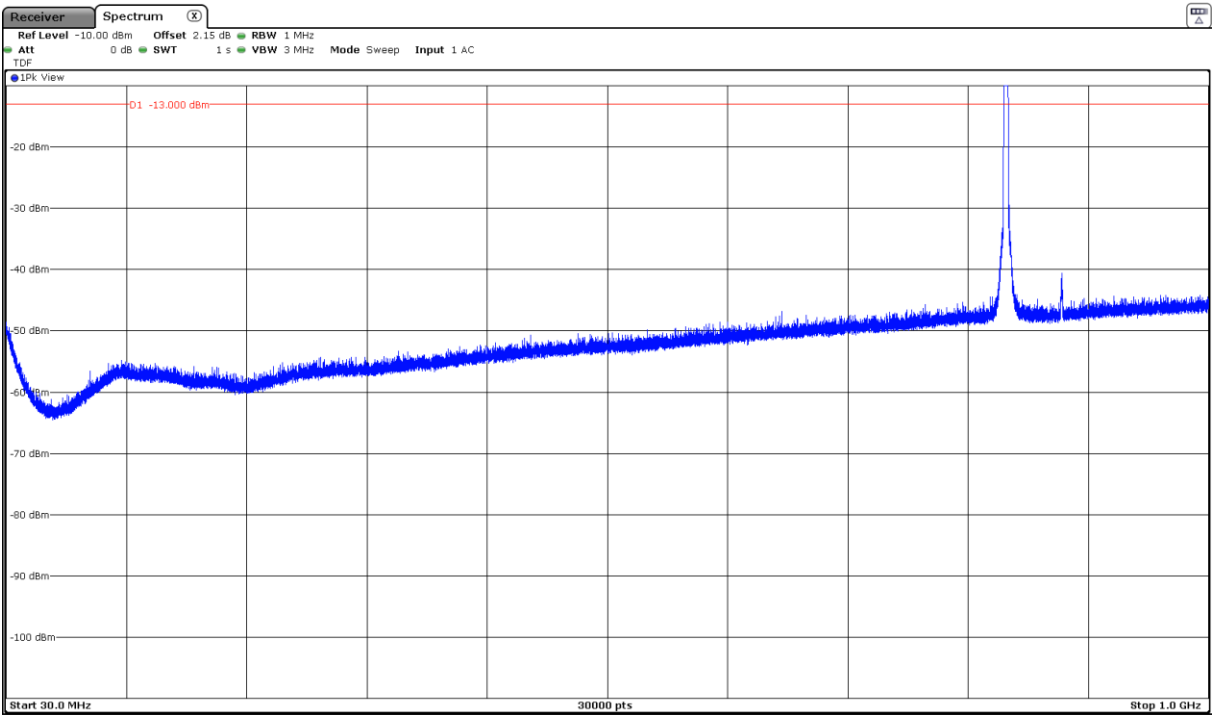
FREQUENCY RANGE 30 MHz-1000 MHz.

CHANNEL: LOWEST



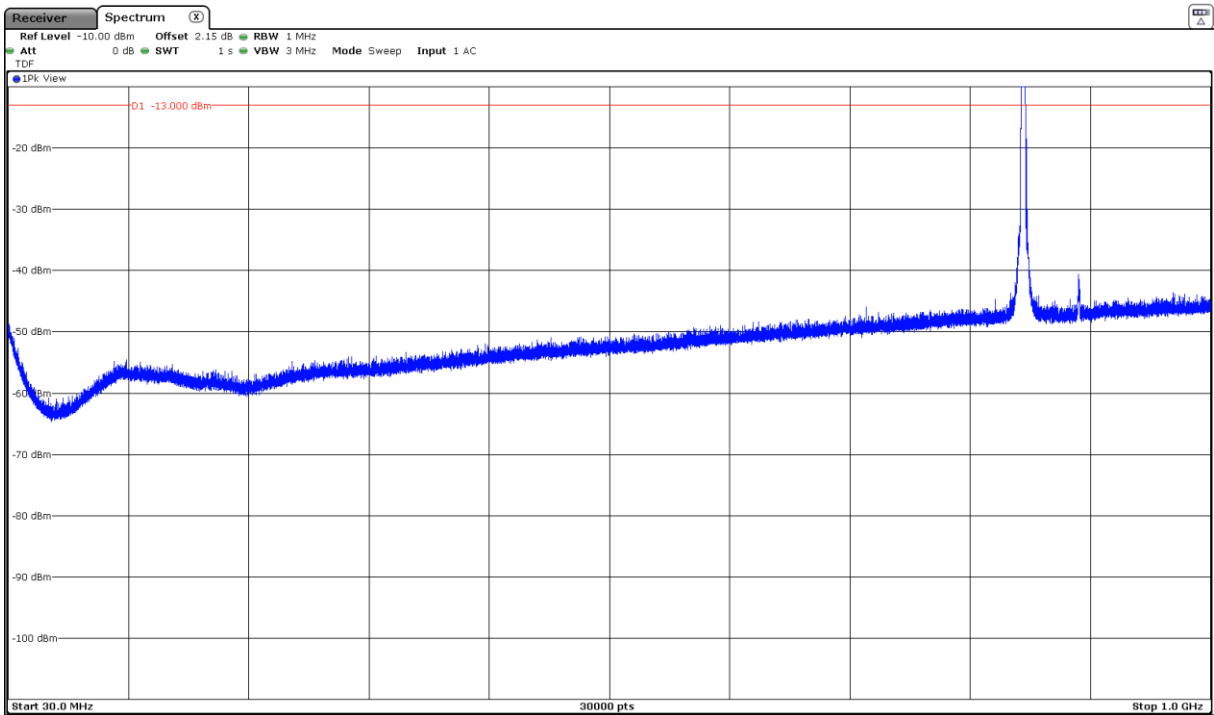
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

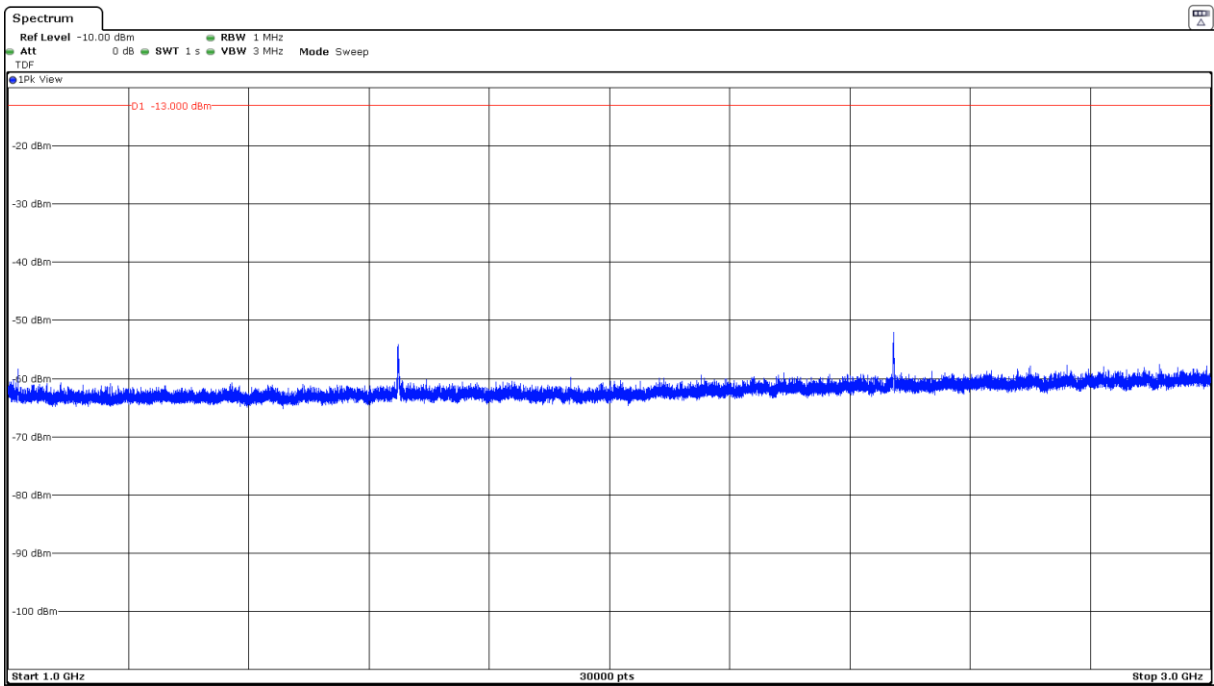
CHANNEL: HIGHEST



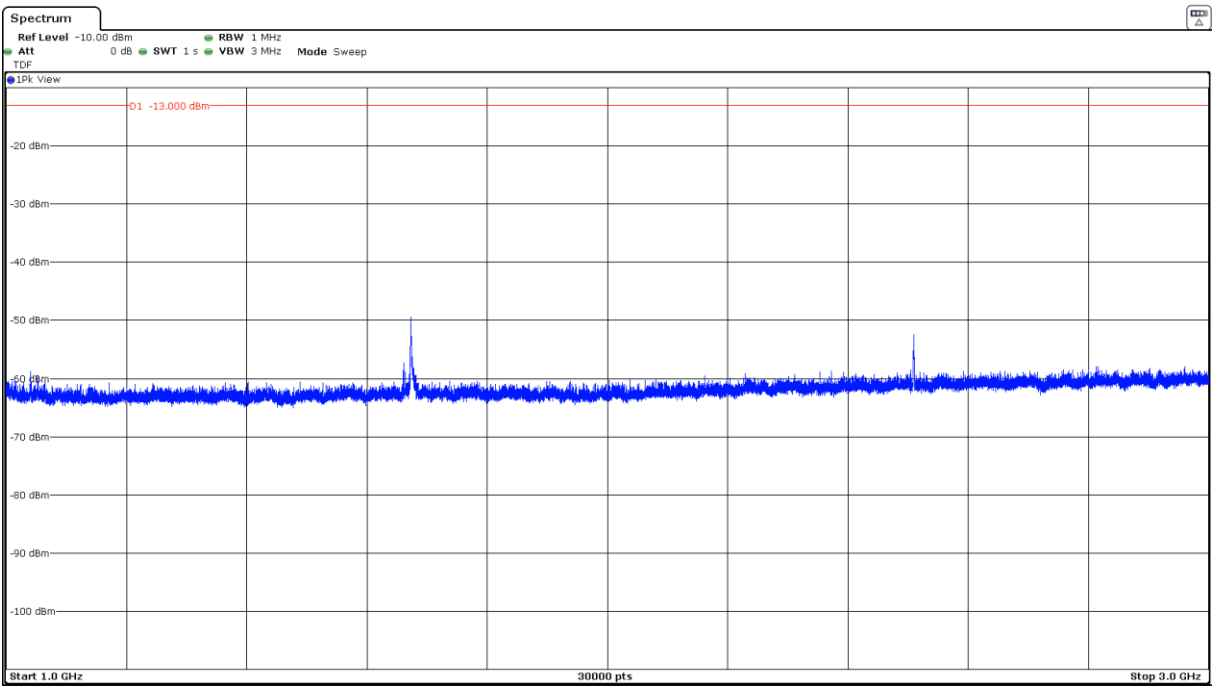
Note: The peak above the limit is the carrier frequency.

FREQUENCY RANGE 1 GHz to 3 GHz.

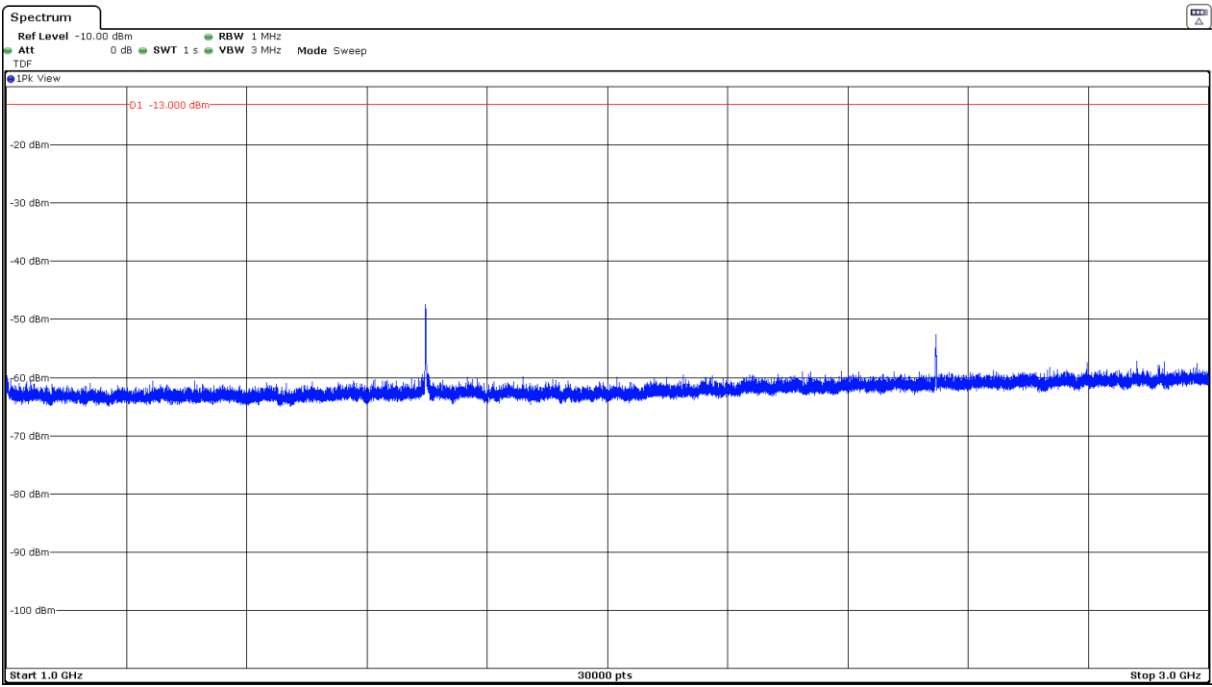
CHANNEL: LOWEST



CHANNEL: MIDDLE

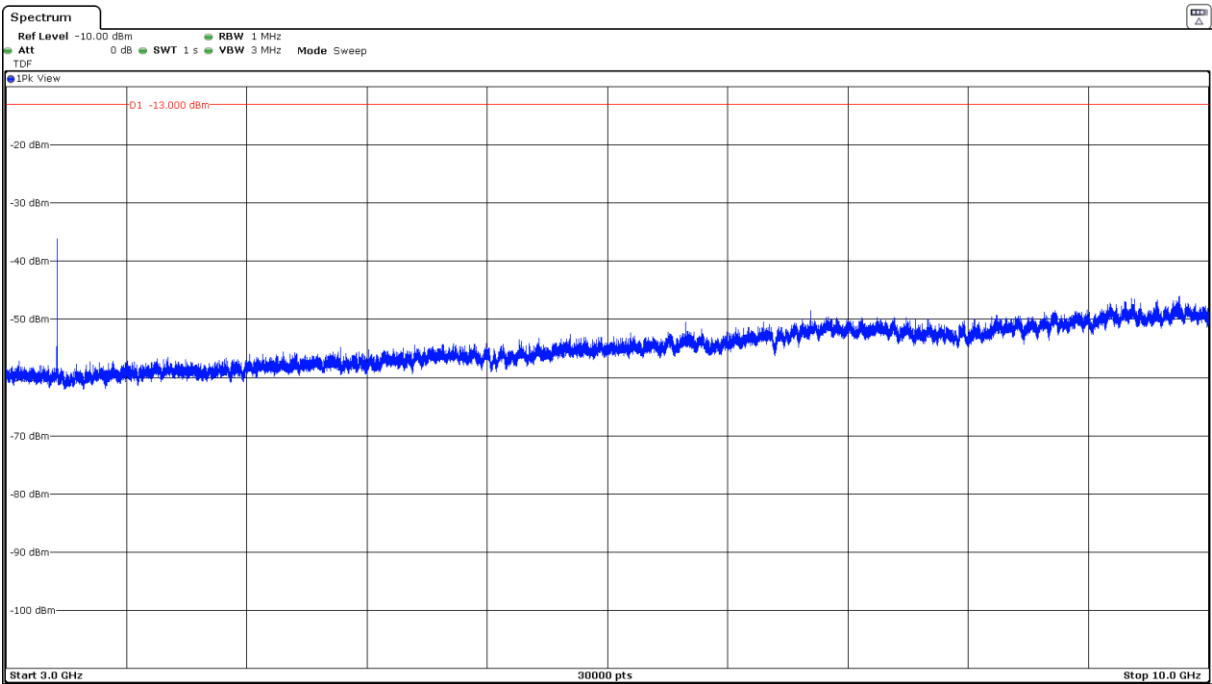


CHANNEL: HIGHEST

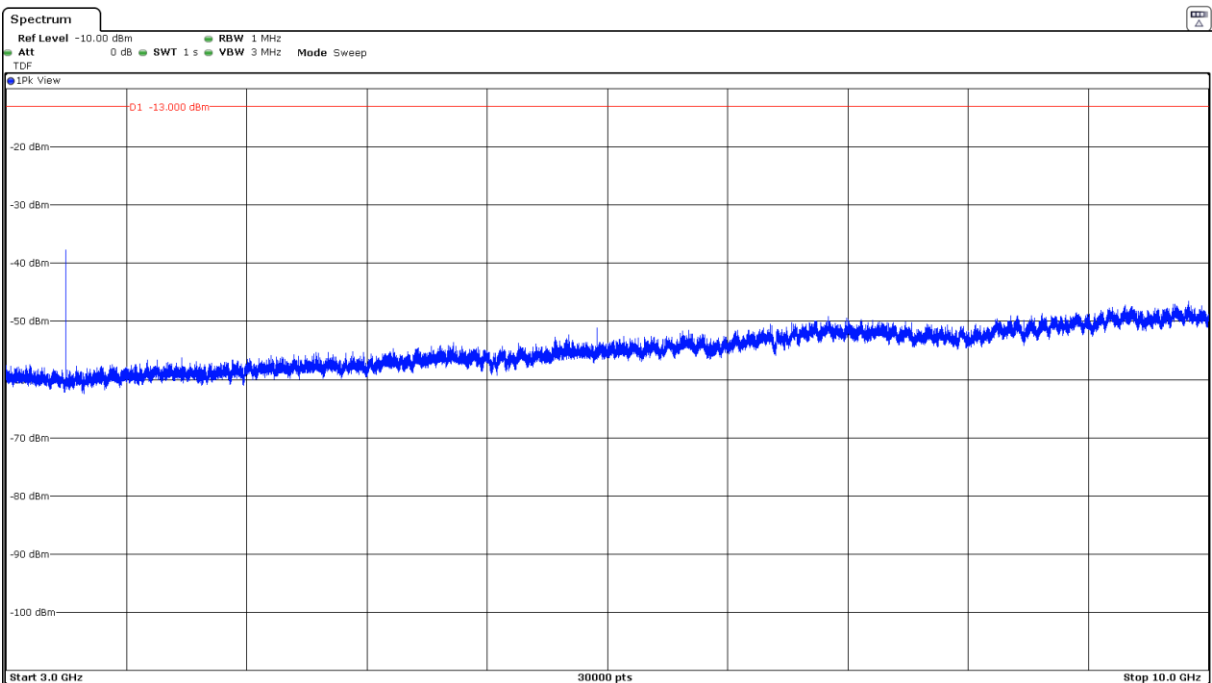


FREQUENCY RANGE 1 GHz to 3 GHz.

CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST

