



REGULATORY COMPLIANCE TEST REPORT

**FCC CFR47 Part 27: MISCELLANEOUS
WIRELESS COMMUNICATION SERVICES**

Report No.: PULO01-U2 Rev A

Company: Puloli Inc.

Model Name: RU700A 1.0

REGULATORY COMPLIANCE TEST REPORT

Company: Puloli Inc.

Model Name: RU700A 1.0

To: FCC CFR47 Part 27 Miscellaneous Wireless Communication Services

Test Report Serial No.: PULO01-U2 Rev A

This report supersedes: NONE

Applicant: Puloli Inc
649 Mission Street Ste 416
San Francisco, California 94105
USA

Issue Date: 23rd May 2019

This Test Report is Issued Under the Authority of:

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MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



1.2. RECOGNITION

MiCOM Labs, Inc has widely recognized wireless testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA countries. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	US0159 Listing #: 4143A-2 4143A-3
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	APEC MRA 2	RCB 210
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

EU MRA – European Union Mutual Recognition Agreement.

NB – Notified Body

APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement. Recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

Phase I - recognition for product testing

Phase II – recognition for both product testing and certification

1.3. PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-02.pdf>



United States of America – Telecommunication Certification Body (TCB)
Industry Canada – Certification Body, CAB Identifier – US0159
Europe – Notified Body (NB), NB Identifier - 2280
Japan – Recognized Certification Body (RCB), RCB Identifier - 210

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	15 th May 2019	Initial Draft
Draft #2	22 nd May 2019	
Rev A	23 rd May 2019	Initial Release
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In the above table the latest report revision will replace all earlier versions.

3. TEST RESULT CERTIFICATE

Manufacturer: Puloli, Inc. 649 Mission Street Ste 416 San Francisco, CA 94105 USA	Tested By: MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model: RU700A 1.0	Telephone: +1 925 462 0304
Type Of Equipment: 3GPP NB-IoT	Fax: +1 925 462 0306
S/N's: 1749002312	
Test Date(s): 10 th – 16 th May 2019	Website: www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 27	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:



Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	FCC 47 CFR Part 27	2019	Miscellaneous Wireless Communications Services
II	A2LA	August 2018	R105 - Requirement's When Making Reference to A2LA Accreditation Status
III	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
IV	ANSI C63.4	2014	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
V	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
VI	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
VII	FCC 47 CFR Part 2.1033	2016	FCC requirements and rules regarding photographs and test setup diagrams.
VIII	KDB 971168 D01 V02r01	27th October, 2017	Measurement Guidance for Certification of Licensed Digital Transmitters
VIV	KDB 971168 D01 V03r01	9 th April 2018	Measurement Guidance for Certification of Licensed Digital Transmitters

4.2. Test and Uncertainty Procedure

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

Details	Description
Purpose:	Test of the Puloli Inc. RU700A 1.0 to FCC CFR 47 Part 27. Miscellaneous Wireless Communications Services
Applicant:	Puloli, Inc. 649 Mission Street Ste 416 San Francisco, CA 94105 USA
Manufacturer:	Puloli Inc.
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	PULO02-U2
Date EUT received:	10 th May 2019
Standard(s) applied:	FCC CFR 47 Part 27
Dates of test (from - to):	10 th – 16 th May 2019
No of Units Tested:	1
Product Family Name:	RU700A
Model(s):	RU700A 1.0
Location for use:	Indoors
Declared Frequency Range(s):	787-788 MHz;
Type of Modulation:	BPSK, QPSK
EUT Modes of Operation:	NB IoT
Declared Nominal Output Power (dBm):	+23 dBm
Transmit/Receive Operation:	Transceiver Half Duplex
Rated Input Voltage and Current:	5Vdc 2A
Operating Temperature Range:	0°C - 40°C
ITU Emission Designator:	200KG2D
Equipment Dimensions:	65mm x 77 mm x 28.5 mm
Weight:	100g
Hardware Rev:	1.0
Software Rev:	1.18.1.r1

5.2. Scope Of Test Program

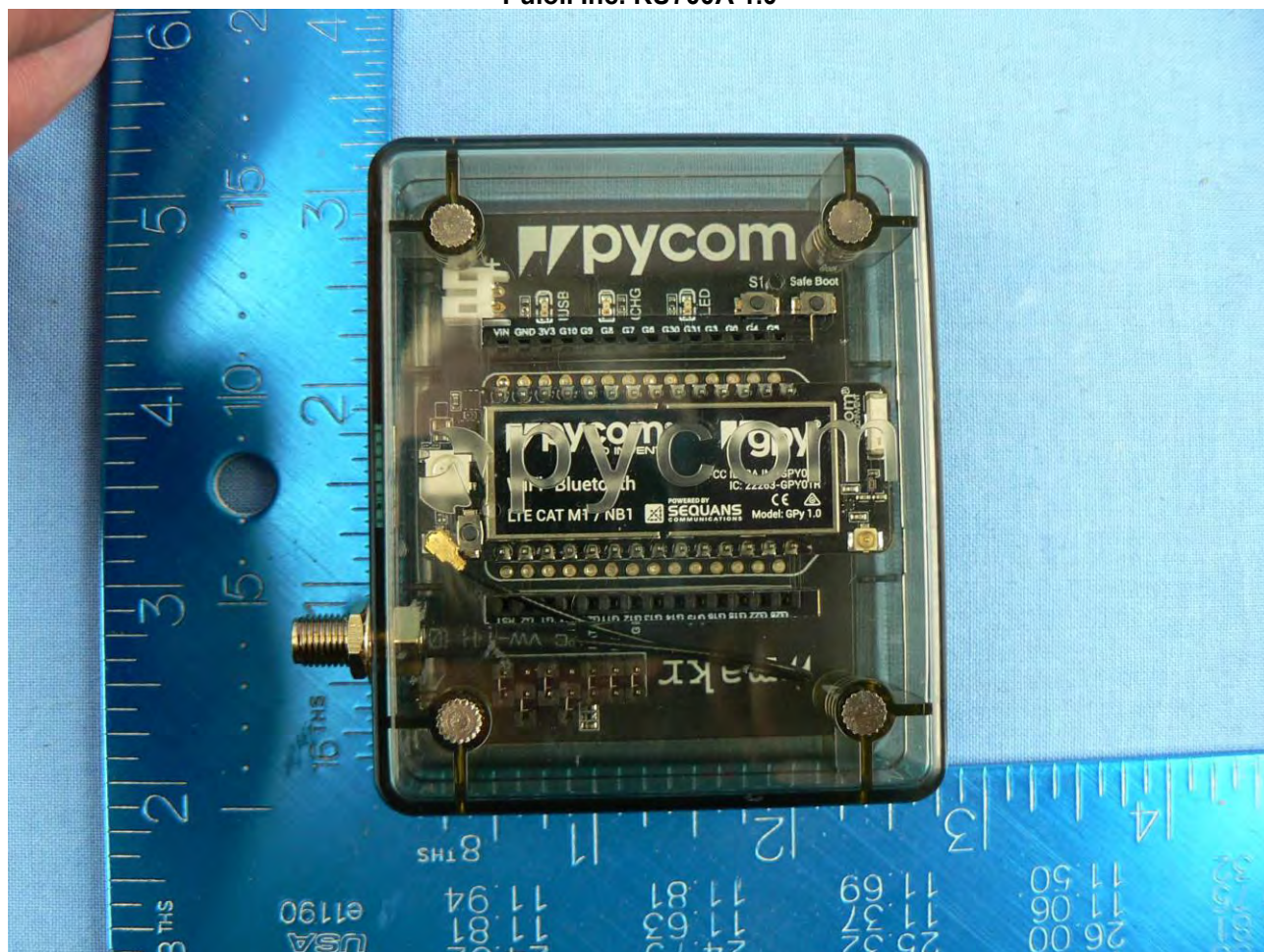
Puloli Inc.RU700A 1.0

The scope of the test program was to test the Puloli Inc RU700A 1.0 configurations in the frequency ranges 787-788 MHz; for compliance against the following specification:

FCC CFR 47 Part 27

Miscellaneous Wireless Communications Services

Puloli Inc. RU700A 1.0



5.3. Equipment Model(s) and Serial Number(s)

Type (EUT/Support)	Equipment Description	Mfr	Model No.	Serial No.
EUT	IoT end point	Puloli Inc.	RU700A 1.0	1749002312
EUT	Power Supply	ICV	AC Adapter	--
Support	Base Station	Nutaq	PicoSDR2x2E	--
Support	HDMI Monitor	ASUS	VS228	--
Support	Keyboard	Dell		--

5.4. External A.C/D.C. Power Adaptor

AC/DC Adaptor
Manufacturer: ICV Model: ICV-U0510E-1 I: 100 – 240 V _{AC} , 0.3 A 50/60 Hz O: +5 V _{DC} 2.0 A

5.5. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
External	Linx Technologies	ANT-LTE-WS	Dipole	-1.78 (avg)	N/A	N/A	N/A	698-960
External	Proxicast	ANT-128-001	Yagi	11dBi (pk)- 6dB pad = 5dBi	N/A	60° Vert 90° Hor	N/A	700-2700

BF Gain - Beamforming Gain
 Dir BW - Directional BeamWidth
 X-Pol - Cross Polarization

5.6. Cabling and I/O Ports

Port Type	Max Cable Length	# of Ports	Screened	Conn Type	Data Type	Bit Rate	Environment
dc	1m	1	Yes	USB Micro	dc Power	N/A	Power
RF	Up to 25m (Yagi only)	1	Yes	SMA	N/A	N/A	End-User
GPIO	< 3m	2	No	GPIO			End-User

5.7. Test Configurations

Results for the following configurations are provided in this report:

Operational Mode(s) (NB IoT)	Bandwidth (kHz)	Channel Frequency (MHz)		
		Low	Mid	High
787 - 788 MHz				
BPSK	3.75	787.2	787.5	787.8
BPSK	15	787.2	787.5	787.8
QPSK	3.75	787.2	787.5	787.8
QPSK	15	787.2	787.5	787.8
QPSK	180	787.2	787.5	787.8

A comparison between QPSK and BPSK modulation types was performed for power and bandwidth, no difference was found and QPSK was selected as the conducted test mode. Radiated testing was performed on BPSK and QPSK operational modes.

5.8. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. Issue with 2nd harmonic falling within the GPS frequency band

As a result, the following modifications were required to bring the equipment into compliance:

Output power was tested on the RU700A device and it was found that a power reduction was required due to a non-compliant 2nd harmonic falling within the GPS band (1559 – 1610 MHz). This influenced both the following antennas:

- 1).. Dipole -1.78 dBi
- 2).. Yagi 11.0 dBi

In order to bring the RU700A into compliance the following fix was implemented:

- i).. Dipole antenna output power was reduced 6 dB from +23 dBm to +17dBm
- ii).. Yagi antenna gain was also reduced 6 dB by adding a 6 dB attenuator to the antenna. Output power was reduced 3 dB from +23 dBm to +20 dBm.

The output power results reported in Section 9.4 'Conducted Output Power' reflect the above situation

5.9. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

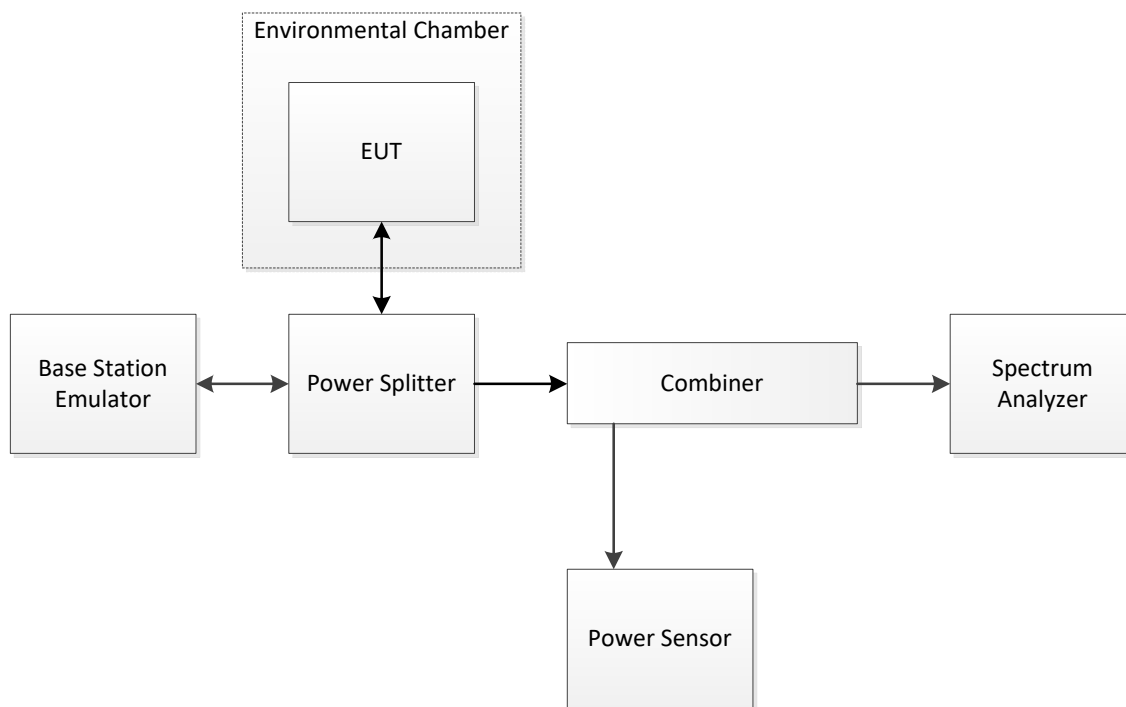
6. TEST SUMMARY

List of Measurements

Section(s)	Test Items	Description	Result	Test Report Section
2.1033(c)	Type of Modulation	Modulation type	Complies	View Data
2.1033(c)	Channel Bandwidth	26dB & 99% Emission Bandwidth	Complies	View Data
2.1055, 27.54	Transmitter Frequency Stability	Frequency contained within band of interest	Complies	View Data
2.1046, 27.50 (10)	Transmitter Output Power	Power Measurement	Complies	View Data
Emissions				
2.1051, 27.53(c)	Transmitter Unwanted Emissions	Conducted Spurious Emissions	Complies	View Data
27.53(c)	Transmitter Unwanted Emissions	Radiated Transmitter Spurious Emissions	Complies	View Data
15.109	Digital Emissions	Digital Emissions < 1GHz	Complies - Class A	View Data
15.107	AC Wireline	Powerline Emissions	Complies - Class A	View Data

7. TEST EQUIPMENT CONFIGURATION(S)

7.1. Conducted Test Setup



Conducted Test Setup

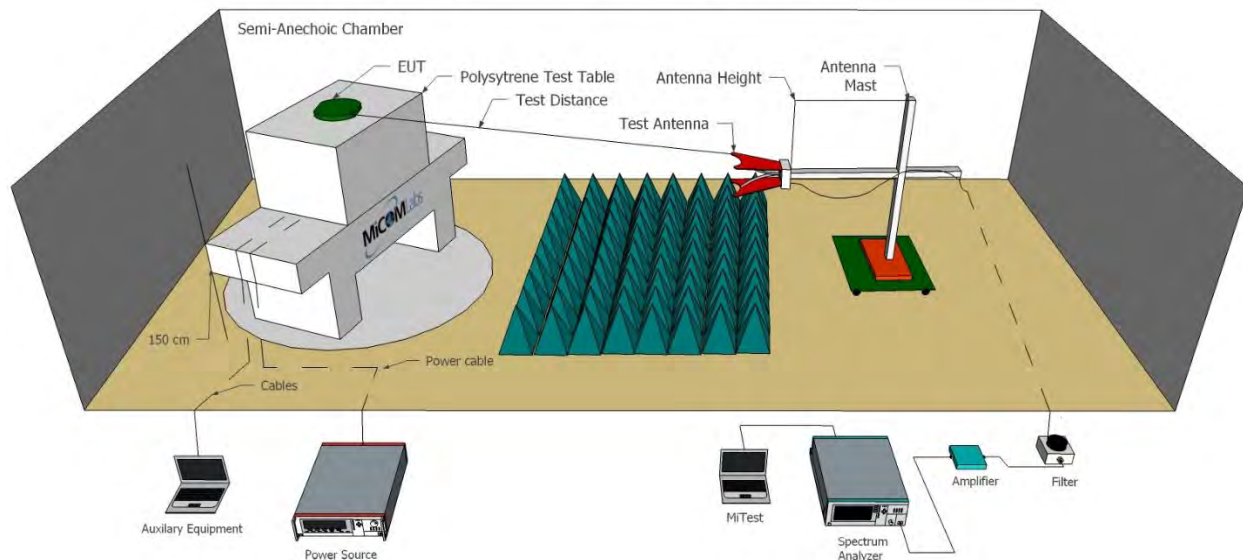
A full system calibration was performed on the test station and any resulting system losses (or gains) were considered in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
249	Resistance Thermometer	Thermotronics	GR2105-02	9340 #2	30 Oct 2019
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2019
405	DC Power Supply 0-60V	Agilent	6654A	MY4001826	Cal when used
408	USB to GPIB interface	National Instruments	GPIB-USB HS	14C0DE9	Not Required
461	Spectrum Analyzer	Agilent	E4440A	MY46185537	20 Sep 2019
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2019
75	Environmental Chamber	Thermatron	SE-300-2-2	27946	24 Feb 2020

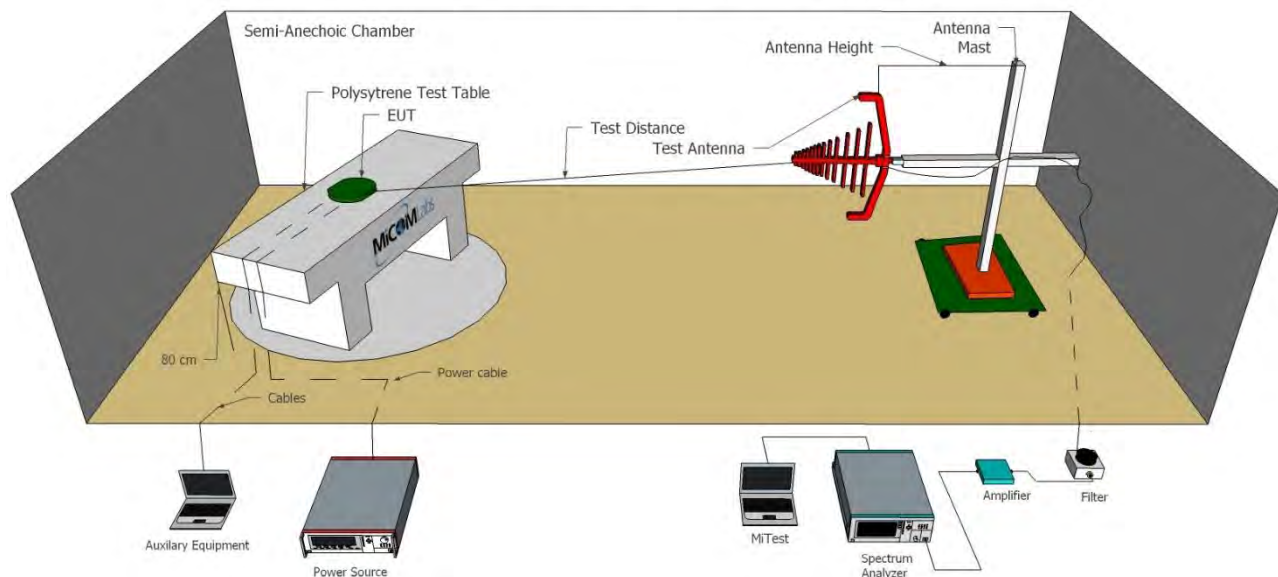
7.2. Radiated Emissions - 3m Chamber

The following tests were performed using the radiated test set-up shown in the diagram below.
Radiated emissions above and below 1GHz.

Radiated Emissions Above 1GHz Test Setup



Radiated Emissions Below 1GHz Test Setup

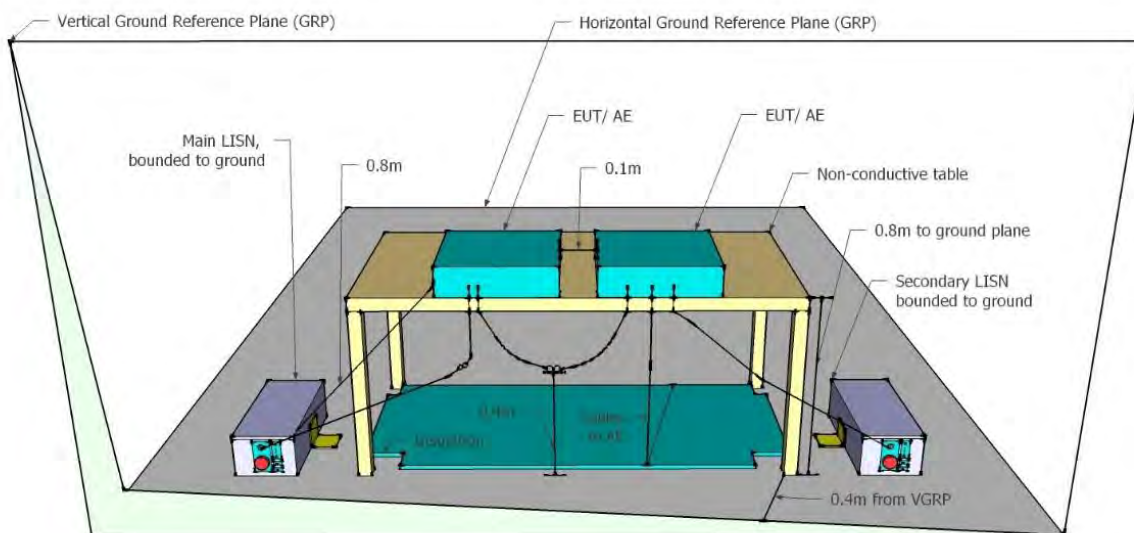


A full system calibration was performed on the test station and any resulting system losses (or gains) were considered in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
298	3M Radiated Emissions Chamber Maintenance Check	MiCOM	3M Chamber	298	21 Apr 2020
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	4 Apr 2020
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2019
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	12 Apr 2020
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	12 Oct 2019
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	12 Apr 2020
410	Desktop Computer	Dell	Inspiron 620	WS38	Not Required
411	Mast/Turntable Controller	Sunol Sciences	SC98V	060199-1D	Not Required
412	USB to GPIB Interface	National Instruments	GPIB-USB HS	11B8DC2	Not Required
413	Mast Controller	Sunol Science	TWR95-4	030801-3	Not Required
415	Turntable Controller	Sunol Sciences	Turntable Controller	None	Not Required
416	Gigabit ethernet filter	ETS-Lingren	Gigafoil 260366	None	Not Required
447	MiTest Rad Emissions Test Software	MiCOM	Rad Emissions Test Software Version 1.0	447	Not Required
462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	9 Oct 2019
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	9 Oct 2019
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	9 Oct 2019
465	Low Pass Filter DC-1000 MHz	Mini-Circuits	NLP-1200+	VUU01901402	9 Oct 2019
480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	24 Aug 2019
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	24 Aug 2019
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2019
518	Cable - Amp to Antenna	SRC Haverhill	157-3051574	518	24 Aug 2019

7.3. ac Wireline Emissions

Test Setup – Power Input / Output Port



A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
184	Pulse Limiter	Rhode & Schwarz	ESH3Z2	357.8810.52	6 Oct 2019
190	LISN (two-line V-network)	Rhode & Schwarz	ESH3Z5	836679/006	18 Oct 2019
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	2 Jul 2019
295	Conducted Emissions Chamber Maintenance Check	MiCOM	Conducted Emissions Chamber	295	19 Jun 2019
307	BNC-CABLE	Megaphase	1689 1GVT4	15F50B002	11 Jun 2019
316	Dell desktop computer workstation	Dell	Desktop	WS04	Not Required
372	AC Variable PS	California Instruments	1251P	L06951	Cal when used
388	LISN (3 Phase) 9kHz - 30MHz	Rohde & Schwarz	ESH2-Z5	892107/022	20 Oct 2019
496	MiTest Conducted Emissions test software.	MiCOM	Conducted Emissions Test Software Version 1.0	496	Not Required
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2019

8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using state-of-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by [MiTest](#). [MiTest](#) is an automated test system developed by MiCOM Labs. [MiTest](#) is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.



The Patented MiCOM Labs “[MiTest](#)” Automated Test System“

9. TEST RESULTS

9.1. Type of Modulation

Conducted Test Conditions for Type of Modulation			
Standard:	FCC CFR 47:Part 27	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	Type of Modulation	Rel. Humidity (%):	32 - 45
Standard Section(s):	2.1033(c)	Pressure (mBars):	999 - 1001
Reference Document(s):			
Test Procedure for Type of Modulation			
The type of a digital modulation employed for the Puloli RU700A 1.0 is QPSK, BPSK.			
Requirement			
Equipment certified under the standard shall employ digital modulation			

9.2. 26dB & 99% Bandwidth

Conducted Test Conditions 26dB & 99% Bandwidth			
Standard:	FCC CFR 47:Part 27	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	99 % Occupied Bandwidth	Rel. Humidity (%):	32 - 45
Standard Section(s):	2.1033(c)	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		
Test Procedure for Channel Bandwidth Measurement			
The 26dB & 99 % channel bandwidth is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. The Resolution Bandwidth was set to approximately 1% or greater of the emission bandwidth.			
Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.			
Limits			
The channel bandwidth shall be equal to or greater than 1 MHz and shall be reported by the certification applicant. Based on the channel bandwidth, the channel edge shall be used as reference point in the measurement of the transmitter unwanted emission power.			

Equipment Configuration for 26 dB & 99% Bandwidth

Variant:	NB IoT	Duty Cycle (%):	85
Data Rate:	3.75 KHz	Antenna Gain (dBi):	Not Applicable
Modulation:	QPSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 26 dB Bandwidth (KHz)			
	Port(s)			
MHz	a	b	c	d
787.11188	44.008	--	--	--
787.41188	41.303	--	--	--
787.88813	44.008	--	--	--

Test Frequency	Measured 99% Bandwidth (KHz)			
	Port(s)			
MHz	a	b	c	d
787.11188	42.926	--	--	--
787.41188	42.926	--	--	--
787.88813	42.745	--	--	--

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for 26 dB & 99% Bandwidth

Variant:	NB IoT	Duty Cycle (%):	85
Data Rate:	15 KHz	Antenna Gain (dBi):	Not Applicable
Modulation:	QPSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 26 dB Bandwidth (KHz)			
	Port(s)			
MHz	a	b	c	d
787.1175	169.749	--	--	--
787.4175	167.735	--	--	--
787.8825	155.11	--	--	--

Test Frequency	Measured 99% Bandwidth (KHz)			
	Port(s)			
MHz	a	b	c	d
787.1175	127.455	--	--	--
787.4175	127.455	--	--	--
787.8825	128.056	--	--	--

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for 26 dB & 99% Bandwidth

Variant:	NB IoT	Duty Cycle (%):	85
Data Rate:	180 KHz	Antenna Gain (dBi):	Not Applicable
Modulation:	QPSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 26 dB Bandwidth (KHz)			
	Port(s)			
MHz	a	b	c	d
787.11188	267.535	--	--	--
787.41188	265.130	--	--	--
787.88813	260.922	--	--	--

Test Frequency	Measured 99% Bandwidth (KHz)			
	Port(s)			
MHz	a	b	c	d
787.11188	186.373	--	--	--
787.41188	187.575	--	--	--
787.88813	186.373	--	--	--

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

9.3. Transmitter Frequency Stability

Conducted Test Conditions for Transmitter Frequency Stability			
Standard:	FCC CFR 47 Part 27	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	Transmitter Frequency Stability	Rel. Humidity (%):	32 - 45
Standard Section(s):	FCC 2.1055, 27.54	Pressure (mBars):	999 - 1001
Reference Document(s):			
Test Procedure for Transmitter Frequency Stability Transmitter Frequency Stability testing was performed over nominal voltage and ambient temperature except at room temperature where the voltage was varied ±10% and results reported for a single antenna port.			
Definition The center frequency is the center of the channel declared by the manufacturer as part of the declared channel plan(s).			
Limits The applicant shall ensure frequency stability by showing that fundamental emissions are maintained within the frequency band of operation when tested at the temperature and supply voltage variations specified in the relevant standard FCC Part 2.1055 and 27.54.			

Measurement Results for Transmitter Frequency Stability
Operating Mode: 3.75 KHz QPSK

Test Frequency:	787.411875 MHz	Measured Frequency	Frequency Error	
Temperature	Voltage	MHz	KHz	PPM
0°C	5 Vdc	787.41187580	0.750	0.095
+10°C	5 Vdc	787.41187275	-2.250	-0.286
20°C	5 Vdc	787.41187375	-1.250	-0.159
20°C	4.5 Vdc	787.41187375	-1.250	-0.159
20°C	5.5 Vdc	787.41187025	-4.750	-0.603
+30°C	5 Vdc	787.41187125	-3.750	-0.476
+40°C	5 Vdc	787.41187375	-1.250	-0.159

9.4. Conducted Output Power

Conducted Test Conditions for Fundamental Emission Output Power			
Standard:	FCC CFR 47 Part 27	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	Output Power	Rel. Humidity (%):	32 - 45
Standard Section(s):	FCC 27.50 (10)	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Fundamental Emission Output Power Measurement

In the case of average power measurements an average power sensor was utilized.

Testing was performed under ambient conditions at nominal voltage only. Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured, summed (Σ) and reported.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Supporting Information

Calculated Power = A + G + Y+ 10 log (1/x) dBm

A = Total Power [$10*\text{Log}_{10} (10^{a/10} + 10^{b/10} + 10^{c/10} + 10^{d/10})$]
G = Antenna Gain
Y = Beamforming Gain
x = Duty Cycle (average power measurements only)

Limits for Fundamental Emission Output Power

(10) Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

ERP in dBm = 10 * LOG (P/1mW) = 10*LOG(3000) = 34.77 dBm

The following modifications were required to bring the equipment into compliance:

1. Issue with 2nd harmonic falling within the GPS frequency band

As a result, the following modifications were required to bring the equipment into compliance:

Output power was tested on the RU700A device and it was found that a power reduction was required due to a non-compliant 2nd harmonic falling within the GPS band (1559 – 1610 MHz). This influenced both the following antennas:

- 1).. Dipole -1.78 dBi
- 2).. Yagi 11.0 dBi

In order to bring the RU700A into compliance the following fix was implemented:

- i).. Dipole antenna output power was reduced 6 dB from +23 dBm to +17dBm
- ii).. Yagi antenna gain was also reduced 6 dB by adding a 6 dB attenuator to the antenna. Output power was reduced 3 dB from +23 dBm to +20 dBm.

The output power results reported in Section 9.4 'Conducted Output Power' reflect the above situation

Equipment Configuration for Peak Output Power

Variant:	NB IoT	Duty Cycle (%):	85.0
Data Rate:	3.75 KHz	Antenna Gain (dBi):	-1.78 (Dipole)
Modulation:	QPSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s)	ERP	ERP Limit	Margin	EUT Power Setting
	Port(s)								
MHz	a	b	c	d	dBm	dBm	dBm	dB	
787.111875	17.86	--	--	--	17.86	18.22	34.77	-16.55	17
787.411875	17.99	--	--	--	17.99	18.35	34.77	-16.42	17
787.888125	17.44	--	--	--	17.44	17.80	34.77	-16.97	17

Equipment Configuration for Peak Output Power

Variant:	NB IoT	Duty Cycle (%):	85.0
Data Rate:	3.75 KHz	Antenna Gain (dBi):	5 (Yagi)
Modulation:	QPSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s)	ERP	ERP Limit	Margin	EUT Power Setting
	Port(s)								
MHz	a	b	c	d	dBm	dBm	dBm	dB	
787.111875	20.86	--	--	--	20.86	28.00	34.77	-6.77	20
787.411875	20.99	--	--	--	20.99	28.13	34.77	-6.64	20
787.888125	20.44	--	--	--	20.44	27.58	34.77	-7.19	20

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	± 1.33 dB

The above measurements include a Duty Cycling correction factor of 0.7 dB.

*Power reduced to meet TX Spurious Limit in GPS band

Equipment Configuration for Peak Output Power

Variant:	NB IoT	Duty Cycle (%):	85.0
Data Rate:	15 KHz	Antenna Gain (dBi):	-1.78 (Dipole)
Modulation:	QPSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s)	ERP	ERP Limit	Margin	EUT Power Setting
	Port(s)								
MHz	a	b	c	d	dBm	dBm	dBm	dB	
787.1175	17.67	--	--	--	17.67	18.03	34.77	-16.74	17
787.4175	17.70	--	--	--	17.70	18.06	34.77	-16.71	17
787.8825	17.26	--	--	--	17.26	17.62	34.77	-17.15	17

Equipment Configuration for Peak Output Power

Variant:	NB IoT	Duty Cycle (%):	85.0
Data Rate:	15 KHz	Antenna Gain (dBi):	5 (Yagi)
Modulation:	QPSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s)	ERP	ERP Limit	Margin	EUT Power Setting
	Port(s)								
MHz	a	b	c	d	dBm	dBm	dBm	dB	
787.1175	20.67	--	--	--	20.67	27.81	34.77	-6.96	20
787.4175	20.70	--	--	--	20.70	27.84	34.77	-6.93	20
787.8825	20.26	--	--	--	20.26	27.40	34.77	-7.37	20

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	± 1.33 dB

The above measurements include a Duty Cycling correction factor of 0.7 dB.

*Power reduced to meet TX Spurious Limit in GPS band

Equipment Configuration for Peak Output Power

Variant:	NB IoT	Duty Cycle (%):	85.0
Data Rate:	180 KHz	Antenna Gain (dBi):	-1.78 (Dipole)
Modulation:	QPSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s)	ERP	ERP Limit	Margin	EUT Power Setting
	Port(s)								
MHz	a	b	c	d	dBm	dBm	dBm	dB	
787.2	17.21	--	--	--	17.21	17.57	34.77	-17.2	17
787.5	17.17	--	--	--	17.17	17.53	34.77	-17.24	17
787.8	17.17	--	--	--	17.17	17.53	34.77	-17.24	17

Equipment Configuration for Peak Output Power

Variant:	NB IoT	Duty Cycle (%):	85.0
Data Rate:	180 KHz	Antenna Gain (dBi):	5 (Yagi)
Modulation:	QPSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s)	ERP	ERP Limit	Margin	EUT Power Setting
	Port(s)								
MHz	a	b	c	d	dBm	dBm	dBm	dB	
787.2	20.21	--	--	--	20.21	27.35	34.77	-7.42	20
787.5	20.17	--	--	--	20.17	27.31	34.77	-7.46	20
787.8	20.17	--	--	--	20.17	27.31	34.77	-7.46	20

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	± 1.33 dB

The above measurements include a Duty Cycling correction factor of 0.7 dB.

*Power reduced to meet TX Spurious Limit in GPS band

9.5. Emissions

9.5.1. Conducted Emissions

9.5.1.1. Conducted Spurious Emissions

Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47: Part 27	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	Transmitter Unwanted Emissions	Rel. Humidity (%):	32 - 45
Standard Section(s):	FCC 2.1051, 27.53(C),	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Transmitter Conducted Spurious and Band-Edge Emissions Measurement
The Transmitter Unwanted Emissions were measurement conductively. Testing was performed on individual antenna ports and limits applied to each plot respectively.
Testing was performed under ambient conditions at nominal voltage only.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document, however output power was (in all cases) set for +23 dBm.

Limits Transmitter Conducted Spurious and Band-Edge Emissions
(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the 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, in accordance with the following:
(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;
(2) On any frequency outside the 776-788 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;
(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;
(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;
(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;
(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

Only worst-case modes were examined for band-edge and spurious emissions. 3.75 kHz single tone and 15 kHz 'all tones' (180 kHz bandwidth).

Equipment Configuration for Conducted Spurious Emissions - Peak

Variant:	NB IoT	Duty Cycle (%):	85
Data Rate:	3.75 KHz	Antenna Gain (dBi):	Not Applicable
Modulation:	QPSK	Beam Forming Gain (Y):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency MHz	Operating Tones	Frequency Range MHz	Conducted Spurious Emissions - Peak (dBm)							
			Port a		Port b		Port c		Port d	
			SE	Limit	SE	Limit	SE	Limit	SE	Limit
787.111875	First	30.0 - 763	-56.3	-13.0	--	--	--	--	--	--
	First	763 - 775	-65.84	-35.0	--	--	--	--	--	--
	First*	775 - 786.9*	-26.59	-13.0	--	--	--	--	--	--
	First	786.9 - 787	-20.62	-13.0	--	--	--	--	--	--
787.888125	Last	788 - 788.1	-24.82	-13.0	--	--	--	--	--	--
	Last*	788.1 - 793*	-25.76	-13.0	--	--	--	--	--	--
	Last	793.5 - 805	-62.32	-35.0	--	--	--	--	--	--
	Last	805 - 10,000	-48.94	-13.0	--	--	--	--	--	--

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB

*RBW reduced to 50 kHz, additional 3dB added to integrate over 100 kHz RBW

**Note All measurements in this table include a 0.7dB duty cycle correction factor.

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Conducted Spurious Emissions - Peak

Variant:	NB IoT	Duty Cycle (%):	85
Data Rate:	180 KHz	Antenna Gain (dBi):	Not Applicable
Modulation:	QPSK	Beam Forming Gain (Y):	Not Applicable
TPC:	Not Applicable	Tested By:	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency MHz	Operating Tones	Frequency Range MHz	Conducted Spurious Emissions - Peak (dBm)							
			Port a		Port b		Port c		Port d	
			SE	Limit	SE	Limit	SE	Limit	SE	Limit
787.2	All	30.0 - 763	-56.30	-13.0	--	--	--	--	--	--
	All	763 - 775	-71.87	-35.0	--	--	--	--	--	--
	All	775 - 786.9	-16.58	-13.0	--	--	--	--	--	--
	All	786.9 - 787	-18.86	-13.0	--	--	--	--	--	--
787.8	All	788 - 788.1	-18.92	-13.0	--	--	--	--	--	--
	All	788.1 - 793	-14.59	-13.0	--	--	--	--	--	--
	All	793.5 - 805	-66.70	-35.0	--	--	--	--	--	--
	All	805 - 10,000	-48.94	-13.0	--	--	--	--	--	--

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB

*Note All measurements in this table include a 0.7dB duty cycle correction factor.

Note: click the links in the above matrix to view the graphical image (plot).

9.5.2. Radiated Emissions

Radiated Test Conditions for Radiated Spurious and GPS Emissions			
Standard:	FCC CFR 47: Part 27	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	Radiated Spurious	Rel. Humidity (%):	32 - 45
Standard Section(s):	FCC 2.1051, 27.53(c), 27.53(f)	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Spurious Emissions

Radiated emissions for restricted bands above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned. Measurements on any restricted band frequency or frequencies above 1 GHz are based on the use of measurement instrumentation employing peak and average detectors. All measurements were performed using a resolution bandwidth of 1 MHz.

Test configuration and setup for Radiated Spurious and Band-Edge Measurement were per the Radiated Test Set-up specified in this document.

Limits

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the 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, in accordance with the following:

- (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;
- (2) On any frequency outside the 776-788 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;

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation:

EUT needs Antenna connected to receive base station signals to transmit.

9.5.2.2. TX Spurious

Dipole Antenna 30-1000 MHz

Equipment Configuration for Radiated Spurious Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.80	Data Rate:	3.75 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz

Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	787.95	113.32	6.33	-6.00	113.65	Fundamental	Vertical	100	0	--	--	--
#2	788.00	67.37	6.33	-6.00	67.70	MaxQP	Vertical	135	179	82.2	-14.5	Pass
#3	788.10	69.56	6.33	-6.10	69.79	MaxQP	Vertical	104	305	82.2	-12.4	Pass
#4	788.16	66.45	6.33	-6.10	66.68	MaxQP	Vertical	224	3	82.2	-15.6	Pass
#5	788.22	64.77	6.33	-6.10	65.00	MaxQP	Vertical	152	311	82.2	-17.2	Pass
#6	788.27	59.57	6.33	-6.10	59.80	MaxQP	Vertical	156	204	82.2	-22.4	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor.

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Radiated Spurious Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.80	Data Rate:	15 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	787.95	113.25	6.33	-6.00	113.58	Fundamental	Vertical	100	0	--	--	--
#2	788.07	72.37	6.33	-6.10	72.60	MaxAvg	Vertical	122	191	82.2	-9.6	Pass
#3	788.11	69.69	6.33	-6.10	69.92	MaxAvg	Vertical	194	203	82.2	-12.3	Pass
#4	788.17	66.00	6.33	-6.10	66.23	MaxAvg	Vertical	157	305	82.2	-16.0	Pass
#5	788.25	64.32	6.33	-6.10	64.55	MaxAvg	Vertical	127	301	82.2	-17.7	Pass
#6	788.32	61.71	6.33	-6.10	61.94	MaxAvg	Vertical	138	326	82.2	-20.3	Pass
Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor.												

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Radiated Spurious Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.80	Data Rate:	3.75 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	787.95	113.17	6.33	-6.00	113.50	Fundamental	Vertical	100	0	--	--	
#2	788.00	67.63	6.33	-6.00	67.96	MaxAvg	Vertical	131	100	82.2	-14.3	Pass
#3	788.10	70.56	6.33	-6.10	70.79	MaxAvg	Vertical	125	179	82.2	-11.4	Pass
#4	788.25	65.43	6.33	-6.10	65.66	MaxAvg	Vertical	138	288	82.2	-16.6	Pass
#5	788.34	59.66	6.33	-6.10	59.89	MaxAvg	Vertical	123	311	82.2	-22.3	Pass
#6	788.44	56.85	6.33	-6.10	57.08	MaxAvg	Vertical	167	311	82.2	-25.2	Pass
Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW												

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Radiated Spurious Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.80	Data Rate:	15 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	787.95	112.83	6.33	-6.00	113.16	Fundamental	Vertical	100	0	--	--	--
#2	788.00	71.03	6.33	-6.00	71.36	MaxAvg	Vertical	120	180	82.2	-10.9	Pass
#3	788.13	69.66	6.33	-6.10	69.89	MaxAvg	Vertical	125	179	82.2	-12.3	Pass
#4	788.16	66.66	6.33	-6.10	66.89	MaxAvg	Vertical	148	296	82.2	-15.3	Pass
#5	788.33	63.72	6.33	-6.10	63.95	MaxAvg	Vertical	126	209	82.2	-18.3	Pass
#6	788.44	61.96	6.33	-6.10	62.19	MaxAvg	Vertical	133	315	82.2	-20.0	Pass
Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW												

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Radiated Spurious Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.80	Data Rate:	180 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	787.84	113.72	6.33	-6.00	114.05	Fundamental	Vertical	100	0	--	--	--
#2	788.00	74.77	6.33	-6.00	75.10	MaxAvg	Vertical	111	188	82.2	-7.1	Pass
#3	788.11	66.88	6.33	-6.10	67.11	MaxAvg	Vertical	148	291	82.2	-15.1	Pass
#4	788.15	65.77	6.33	-6.10	66.00	MaxAvg	Vertical	159	305	82.2	-16.2	Pass
#5	788.25	64.40	6.33	-6.10	64.63	MaxAvg	Vertical	133	275	82.2	-17.6	Pass
#6	788.30	63.37	6.33	-6.10	63.60	MaxAvg	Vertical	144	181	82.2	-18.6	Pass
Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor.												

Note: click the links in the above matrix to view the graphical image (plot).

Dipole Antenna 1-10 GHz

Equipment Configuration for Transmitter Spurious Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	3.75 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1574.95	90.78	-1.43	-16.56	68.79	Peak (Scan)	Horizontal	100	132	82.2	*	Pass

Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	15 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1574.89	87.09	-1.43	-16.56	69.10	Peak (Scan)	Horizontal	100	40	82.2	*	Pass
Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.												

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Spurious Emissions

Antenna:	dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	3.75 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1574.91	82.33	-1.43	-16.56	64.34	Peak (Scan)	Horizontal	100	0	82.2	*	Pass
Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.												

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Spurious Emissions

Antenna:	dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	15 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1574.91	82.33	-1.43	-16.56	64.34	Peak (Scan)	Horizontal	100	0	82.2	*	Pass
Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.												

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Spurious Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	180 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1574.89	92.65	-1.43	-16.56	74.66	Peak (Scan)	Horizontal	100	36	82.2	*	Pass
Test Notes: EUT powered up linked to Base station via antenna. Multicarrier.												

Note: click the links in the above matrix to view the graphical image (plot).

*1559-1610 MHz is in GPS band with limit measured separately.

Yagi Antenna 30-1000 MHz

Equipment Configuration for Radiated Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.80	Data Rate:	3.75 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	757.82	69.78	6.26	-6.50	69.54	MaxQP	Vertical	100	277	82.2	-12.7	Pass
#2	787.84	114.01	6.33	-6.00	114.34	Fundamental	Horizontal	100	0	--	--	--
#3	788.00	72.99	6.33	-6.00	73.32	MaxQP	Horizontal	100	356	82.2	-8.9	Pass
#4	788.22	65.19	6.33	-6.10	65.42	MaxQP	Horizontal	100	37	82.2	-16.8	Pass
#5	788.88	56.35	6.33	-6.10	56.58	MaxQP	Horizontal	100	0	82.2	-25.7	Pass
#6	789.54	48.17	6.33	-6.00	48.50	MaxQP	Horizontal	101	5	82.2	-33.7	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Radiated Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.80	Data Rate:	15 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	757.78	62.09	6.26	-6.50	61.85	MaxAvg	Horizontal	101	5	82.2	-20.4	Pass
#2	787.84	121.98	6.33	-6.00	122.31	Fundamental	Horizontal	100	0	--	--	--
#3	788.00	77.07	6.33	-6.00	77.40	MaxAvg	Horizontal	100	356	82.2	-4.8	Pass
#4	788.10	74.37	6.33	-6.10	74.60	MaxAvg	Horizontal	100	356	82.2	-7.6	Pass
#5	788.24	68.94	6.33	-6.10	69.17	MaxAvg	Horizontal	100	37	82.2	-13.1	Pass
#6	788.42	61.69	6.33	-6.10	61.92	MaxAvg	Horizontal	100	0	82.2	-20.3	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Radiated Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.80	Data Rate:	3.75 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	757.85	66.11	6.26	-6.50	65.87	MaxAvg	Vertical	101	341	82.2	-16.4	Pass
#2	787.80	121.98	6.33	-6.00	122.31	Fundamental	Horizontal	100	0	--	--	--
#3	788.00	76.47	6.33	-6.00	76.80	MaxAvg	Horizontal	202	4	82.2	-5.4	Pass
#4	788.10	74.67	6.33	-6.10	74.90	MaxAvg	Horizontal	100	356	82.2	-7.3	Pass
#5	788.25	68.89	6.33	-6.10	69.12	MaxAvg	Horizontal	212	0	82.2	-13.1	Pass
#6	788.77	64.46	6.33	-6.10	64.69	MaxAvg	Horizontal	101	357	82.2	-17.5	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Radiated Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.80	Data Rate:	15 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	757.75	66.84	6.26	-6.50	66.60	MaxAvg	Vertical	109	231	82.2	-15.6	Pass
#2	787.84	121.92	6.33	-6.00	122.25	Fundamental	Horizontal	100	0	--	--	--
#3	788.06	76.27	6.33	-6.10	76.50	MaxAvg	Horizontal	106	357	82.2	-5.7	Pass
#4	788.13	74.67	6.33	-6.10	74.90	MaxAvg	Horizontal	104	18	82.2	-7.3	Pass
#5	788.24	72.27	6.33	-6.10	72.50	MaxAvg	Horizontal	104	10	82.2	-9.7	Pass
#6	788.46	64.47	6.33	-6.10	64.70	MaxAvg	Horizontal	184	2	82.2	-17.5	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Radiated Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.80	Data Rate:	180 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	757.77	67.33	6.26	-6.50	67.09	MaxAvg	Vertical	106	338	82.2	-15.1	Pass
#2	787.84	122.14	6.33	-6.00	122.47	Fundamental	Horizontal	100	0	--	--	--
#3	788.00	79.17	6.33	-6.00	79.50	MaxAvg	Horizontal	113	3	82.2	-2.7	Pass
#4	788.13	76.57	6.33	-6.10	76.80	MaxAvg	Horizontal	101	2	82.2	-5.4	Pass
#5	788.23	73.74	6.33	-6.10	73.97	MaxAvg	Horizontal	117	350	82.2	-8.3	Pass
#6	788.30	73.73	6.33	-6.10	73.96	MaxAvg	Horizontal	110	0	82.2	-8.3	Pass
#7	788.39	69.13	6.33	-6.10	69.36	MaxAvg	Horizontal	114	10	82.2	-12.9	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor.

Note: click the links in the above matrix to view the graphical image (plot).

Yagi Antenna 1-10 GHz

Equipment Configuration for Transmitter Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	3.75 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1574.87	74.42	-1.43	-16.56	56.43	Peak (Scan)	Horizontal	100	0	82.2	*	Pass

Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	15 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1574.96	73.50	-1.43	-16.56	55.51	Peak (Scan)	Horizontal	100	0	82.2	*	Pass
Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.												

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	3.75 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1574.84	73.34	-1.43	-16.56	55.35	Peak (Scan)	Horizontal	100	0	82.2	*	Pass
Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.												

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	15 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1575.00	73.14	-1.43	-16.57	55.14	Peak (Scan)	Horizontal	100	0	82.2	*	Pass
Test Notes: EUT powered up linked to Base station via antenna*1559-1610 MHz is in GPS band with separate limit measured separately.												

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	15 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1575.00	73.14	-1.43	-16.57	55.14	Peak (Scan)	Horizontal	100	0	82.2	*	Pass
Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.												

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Spurious Emissions

Antenna:	Yagi	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	180 KHz
Power Setting:	23	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1574.87	80.66	-1.43	-16.56	62.67	Peak (Scan)	Horizontal	100	0	82.2	*	Pass
Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.												

Note: click the links in the above matrix to view the graphical image (plot).

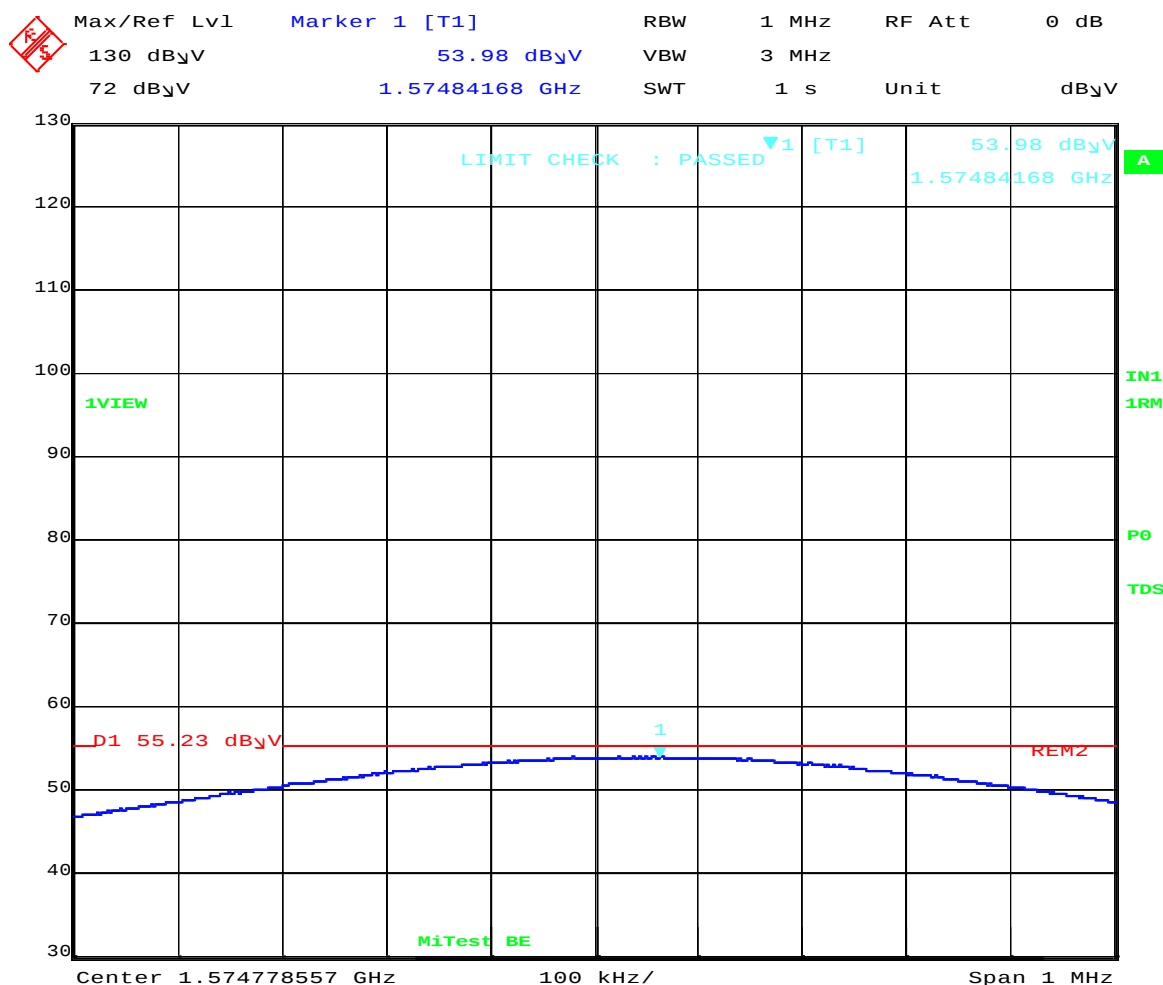
9.5.2.3. GPS Emissions

Dipole Antenna

Equipment Configuration for GPS Band Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	3.75 KHz
Power Setting:	17	Tested By:	JMH

Test Measurement Results



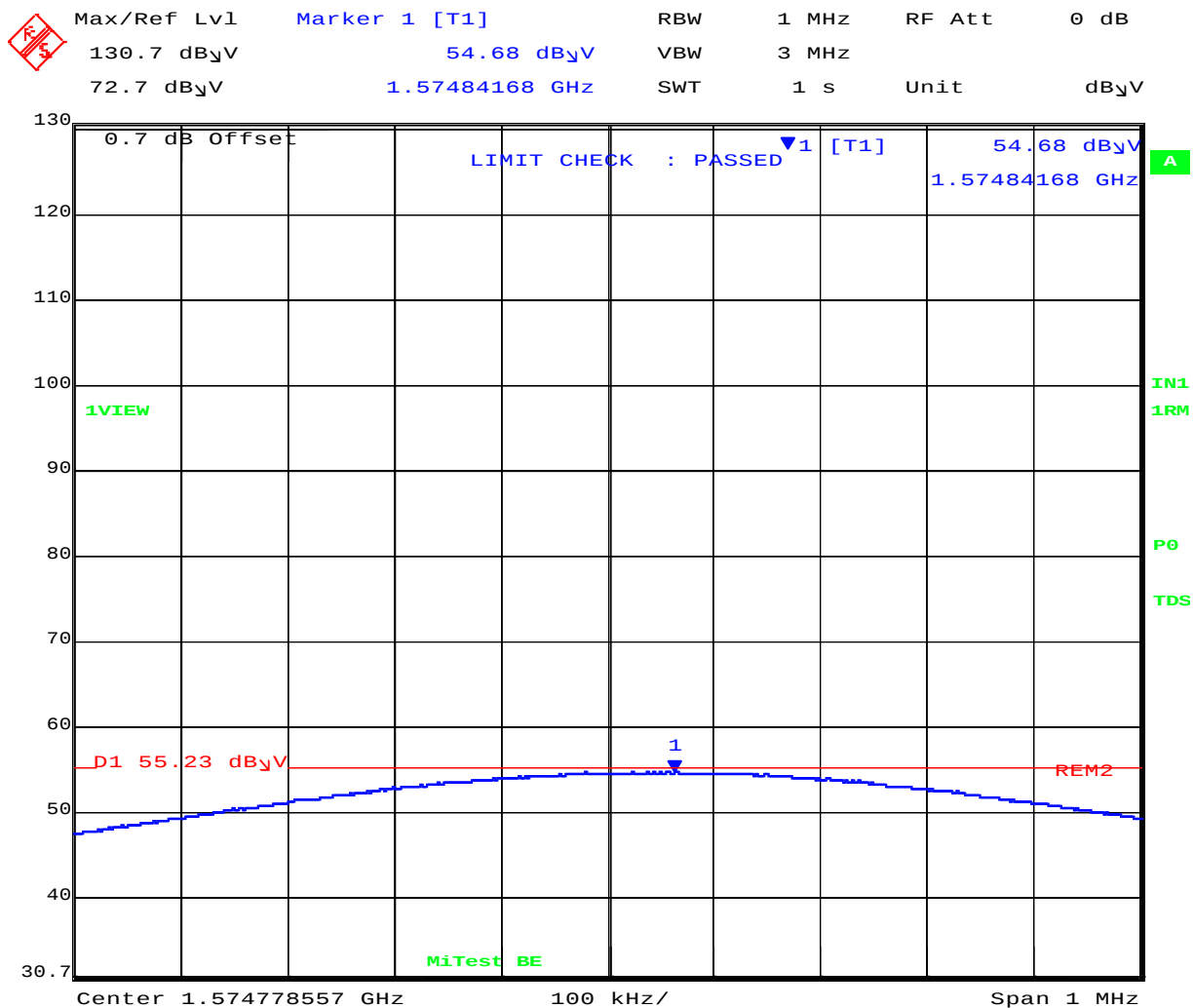
Date: 10.MAY.2019 11:50:44

53.98 dB μ V/m + 0.7 (Duty Cycle) = 54.68 dB μ V/m Corrected Value

Equipment Configuration for GPS Band Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	15 KHz
Power Setting:	17	Tested By:	JMH

Test Measurement Results



Date: 10.MAY.2019 11:54:48

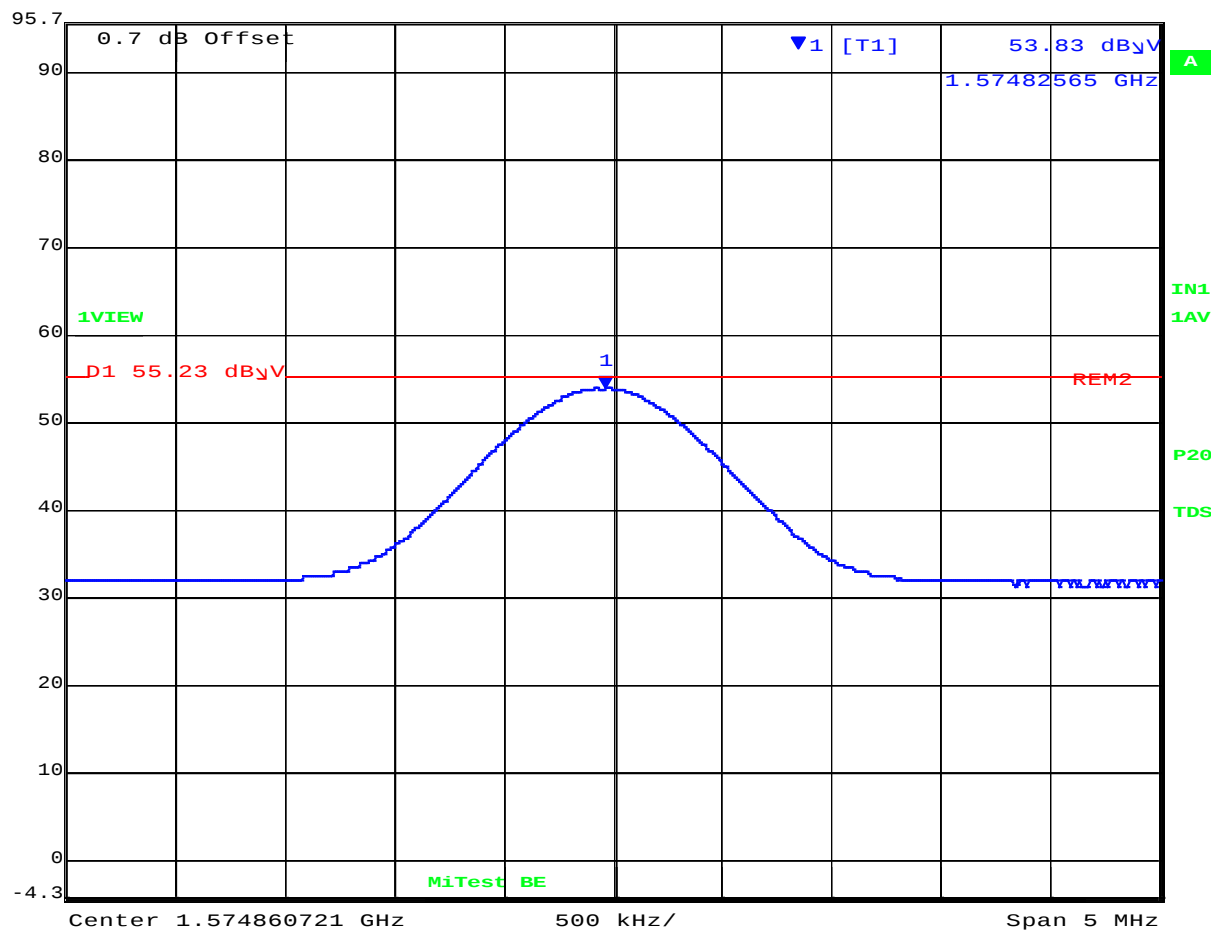
*Measurement includes +0.7dB offset for Duty Cycle Correction

Equipment Configuration for GPS Band Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	3.75 KHz
Power Setting:	17	Tested By:	JMH

Test Measurement Results


 Max/Ref Lvl **Marker 1 [T1]** RBW 1 MHz RF Att 0 dB
 95.7 dB_{yV} 53.83 dB_{yV} VBW 3 MHz
 72.7 dB_{yV} 1.57482565 GHz SWT 10 s Unit dB_{yV}



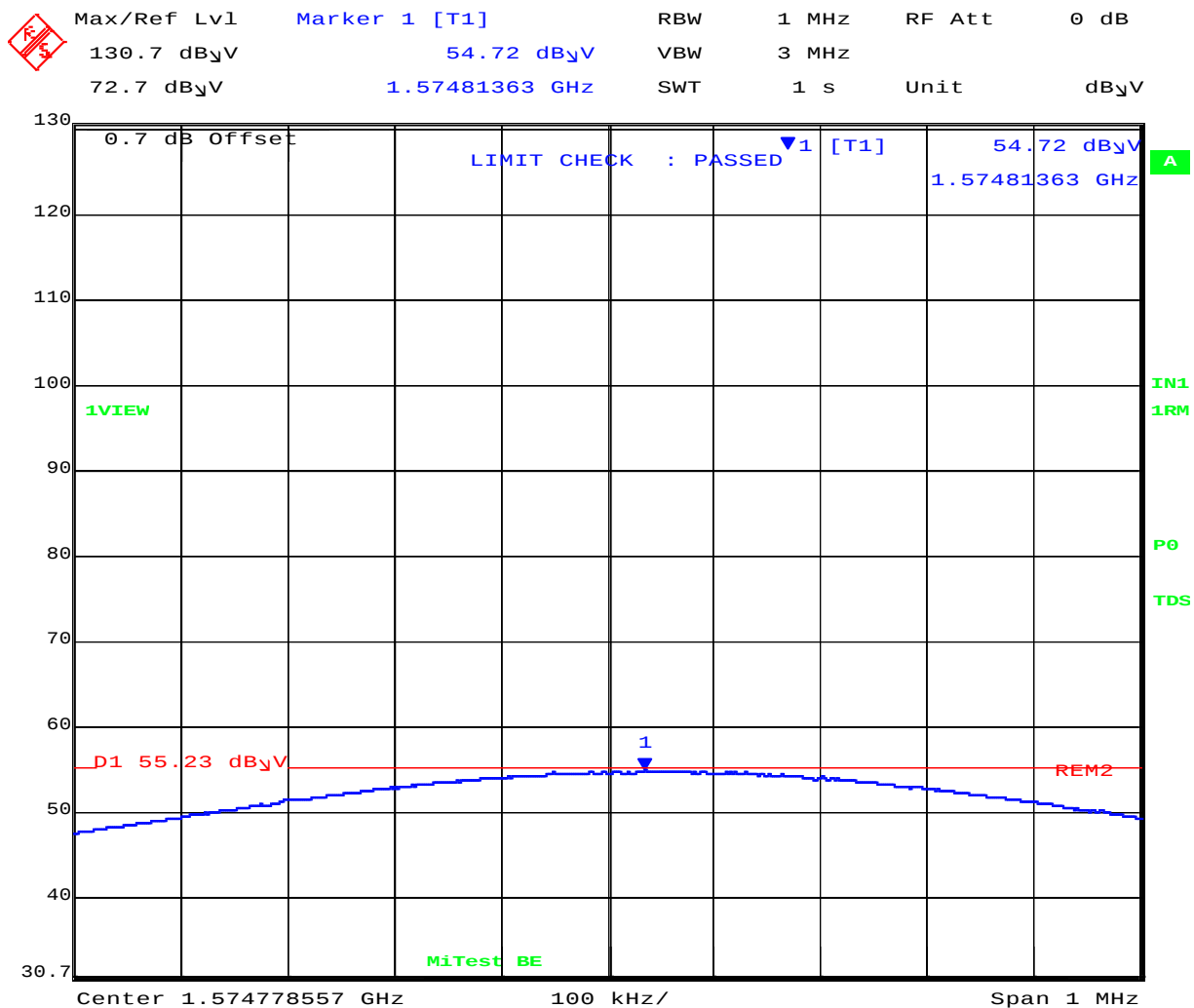
Date: 10.MAY.2019 15:42:43

*Measurement includes +0.7dB offset for Duty Cycle Correction

Equipment Configuration for GPS Band Emissions

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	15 KHz
Power Setting:	17	Tested By:	JMH

Test Measurement Results



Date: 10.MAY.2019 11:56:58

*Measurement includes +0.7dB offset for Duty Cycle Correction

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	180 KHz
Power Setting:	17	Tested By:	JMH

	Max/Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	0 dB
	95.7 dB μ V	52.73 dB μ V	VBW	3 MHz		
	72.7 dB μ V	1.57498096 GHz	SWT	10 s	Unit	dB μ V



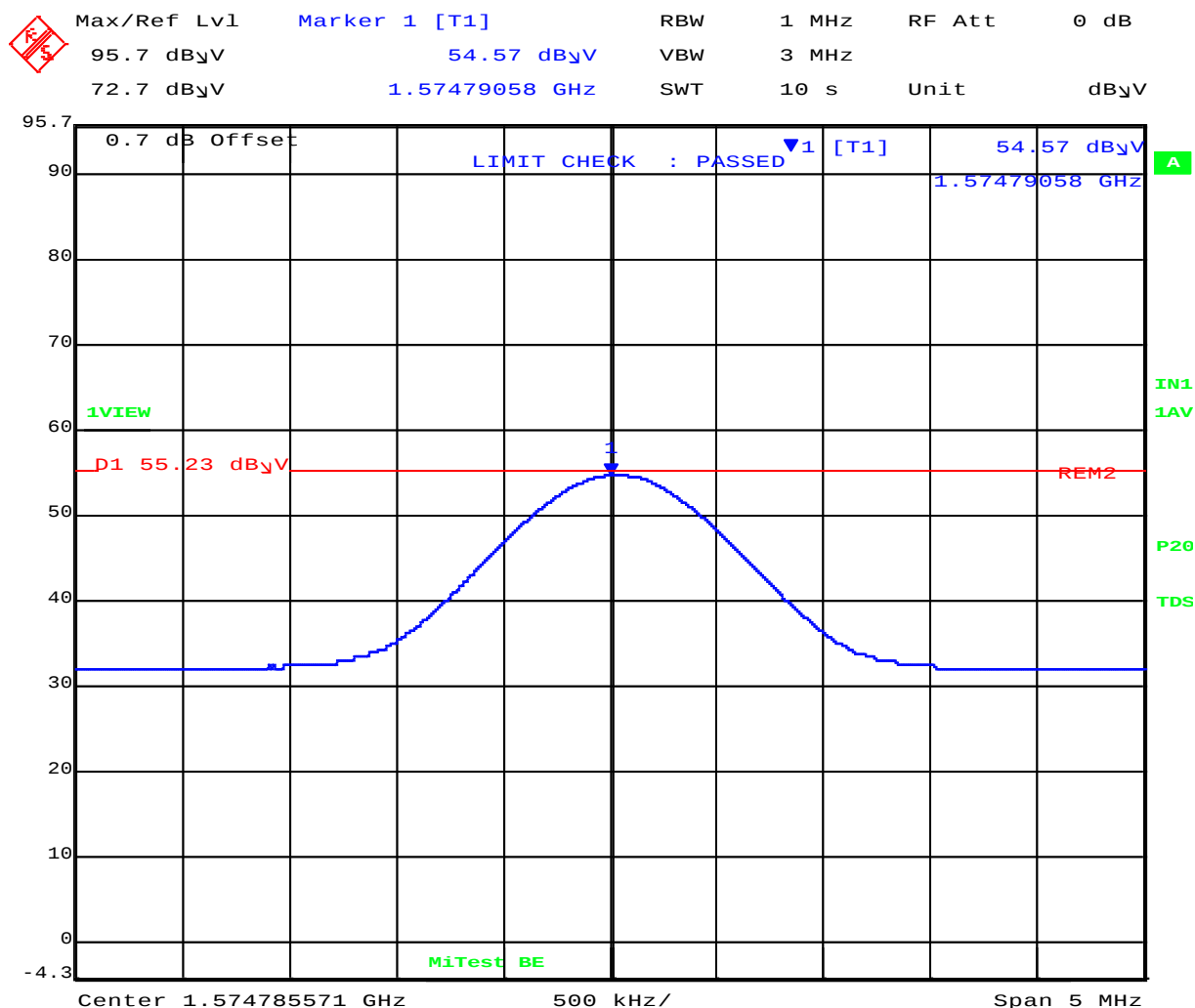
MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

Yagi Antenna

Equipment Configuration for GPS Band Emissions

Antenna:	Yagi + 6dB Pad	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	3.75 KHz
Power Setting:	20	Tested By:	JMH

Test Measurement Results



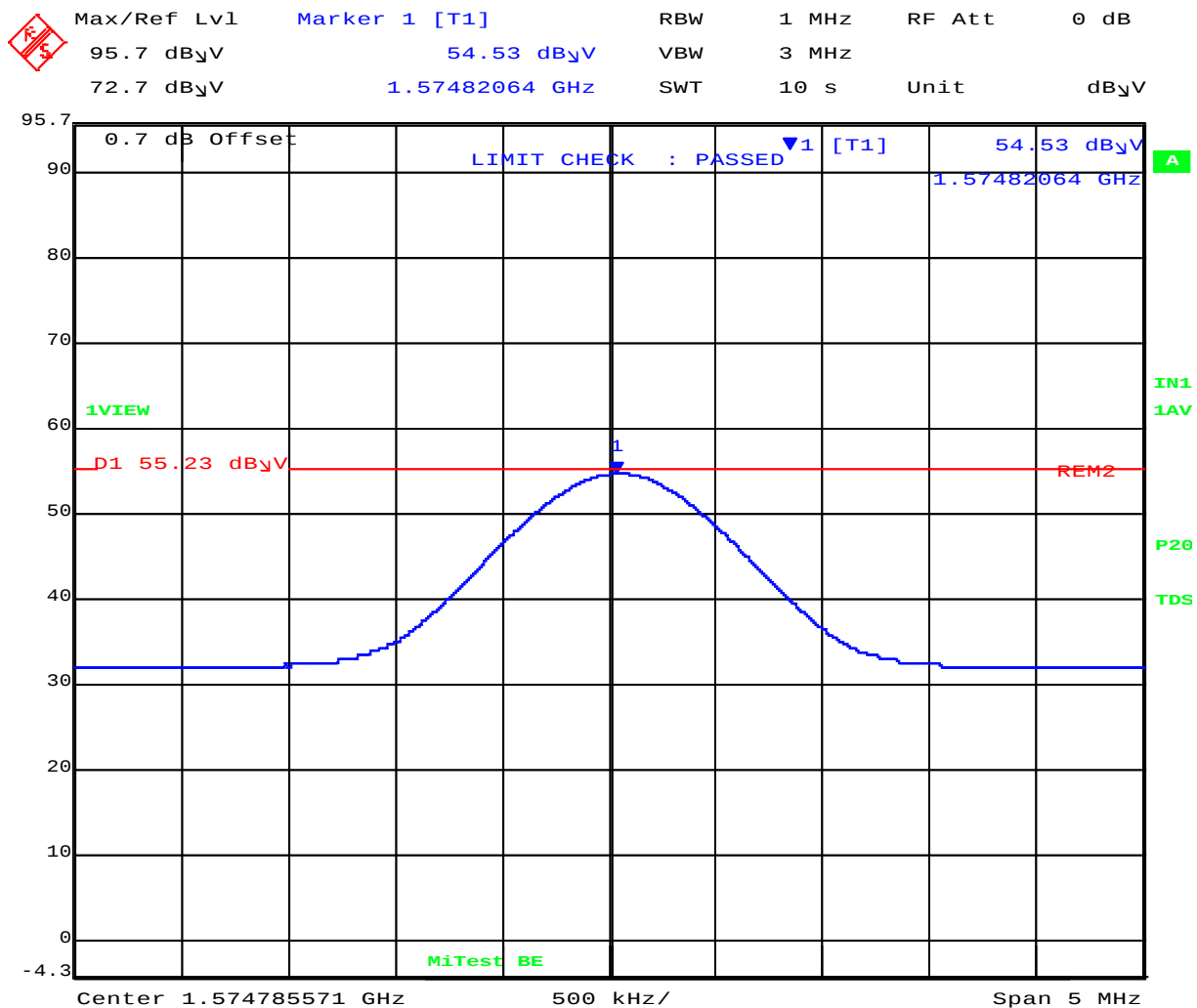
Date: 13.MAY.2019 10:12:46

*Measurement includes +0.7dB offset for Duty Cycle Correction

Equipment Configuration for GPS Band Emissions

Antenna:	Yagi + 6dB Pad	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	BPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	15 KHz
Power Setting:	20	Tested By:	JMH

Test Measurement Results



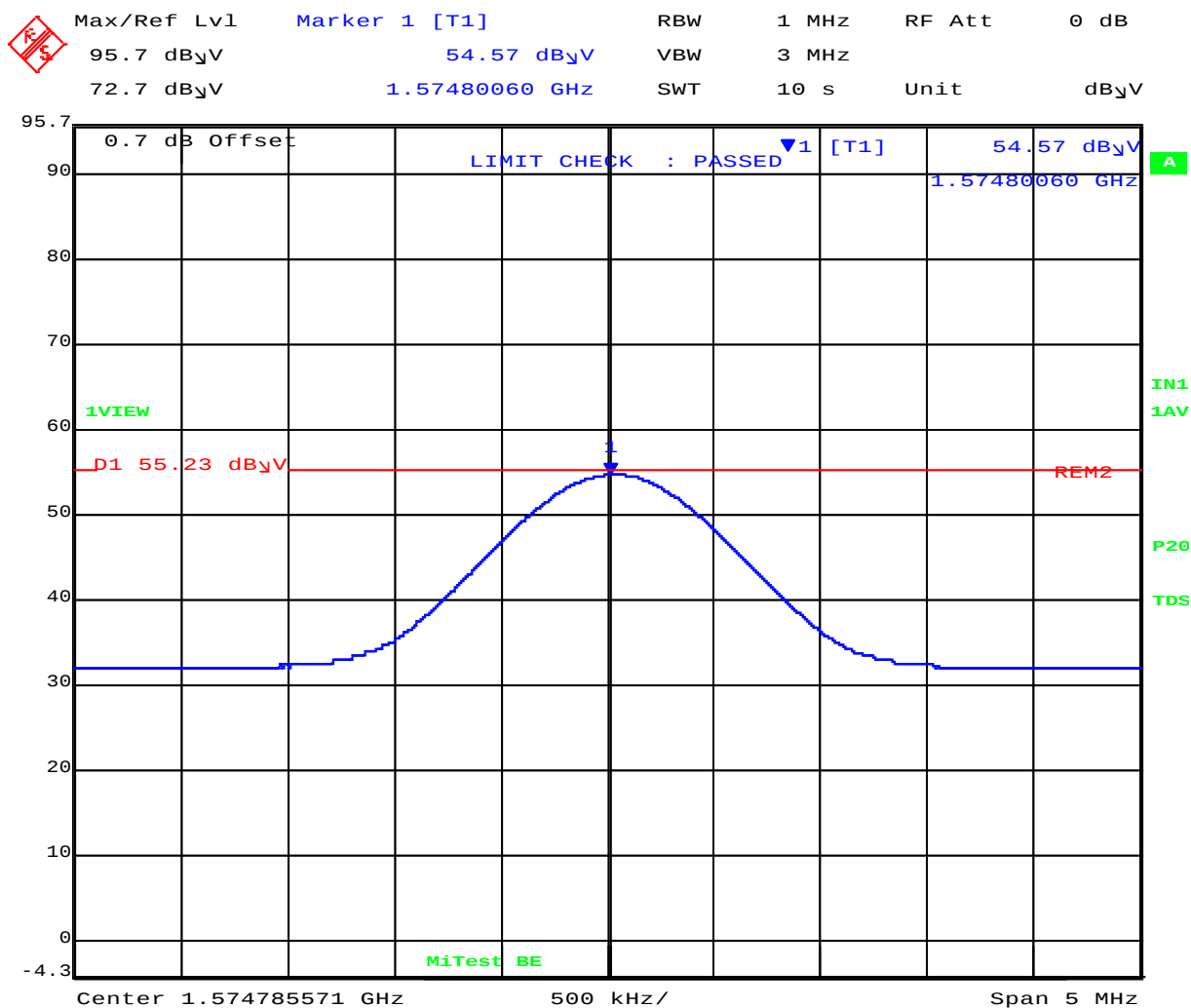
Date: 13.MAY.2019 10:03:13

*Measurement includes +0.7dB offset for Duty Cycle Correction

Equipment Configuration for GPS Band Emissions

Antenna:	Yagi + 6dB Pad	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	3.75 KHz
Power Setting:	20	Tested By:	JMH

Test Measurement Results



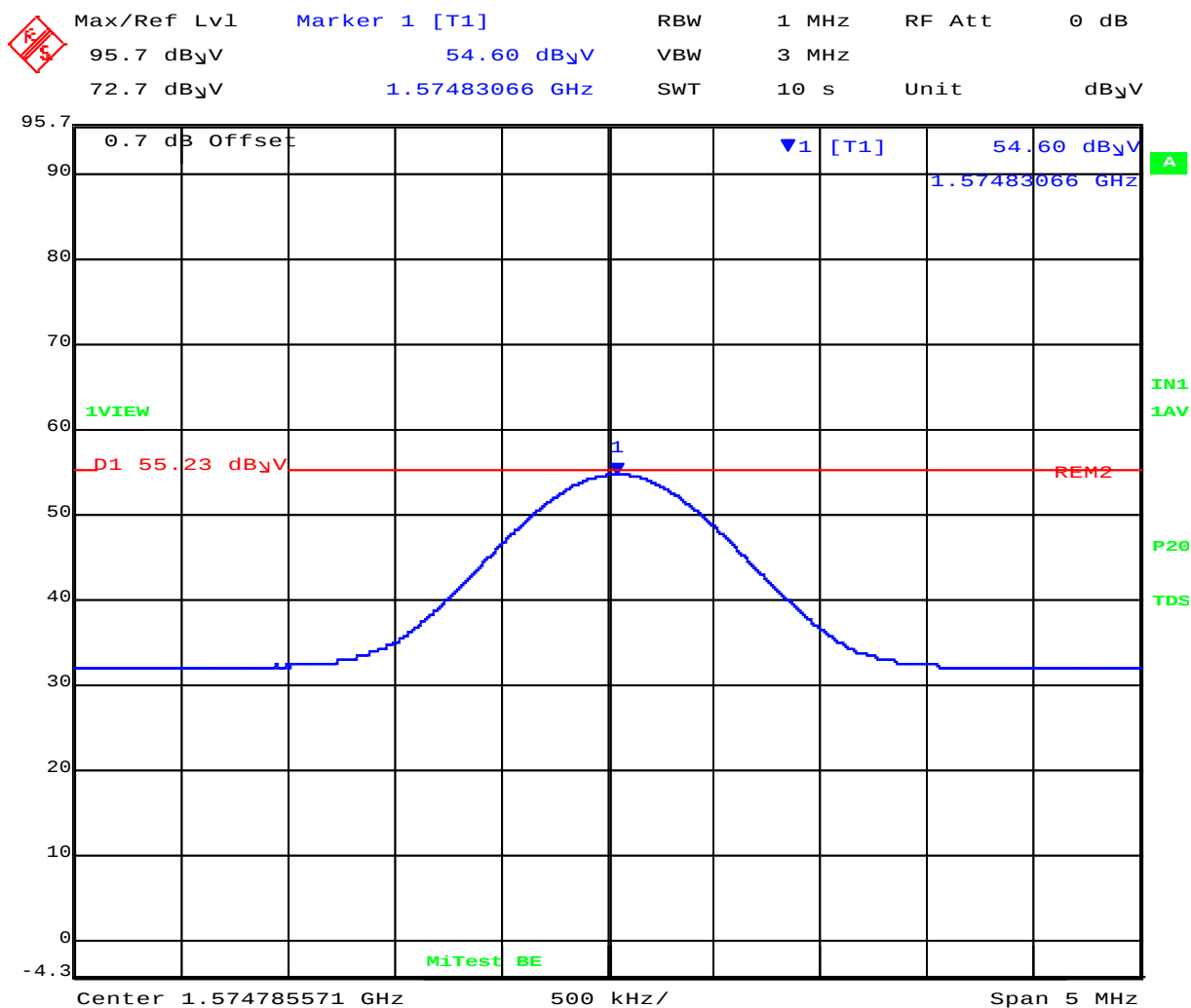
Date: 13.MAY.2019 09:34:17

*Measurement includes +0.7dB offset for Duty Cycle Correction

Equipment Configuration for GPS Band Emissions

Antenna:	Yagi + 6dB Pad	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	15 KHz
Power Setting:	20	Tested By:	JMH

Test Measurement Results



Date: 13.MAY.2019 09:44:56

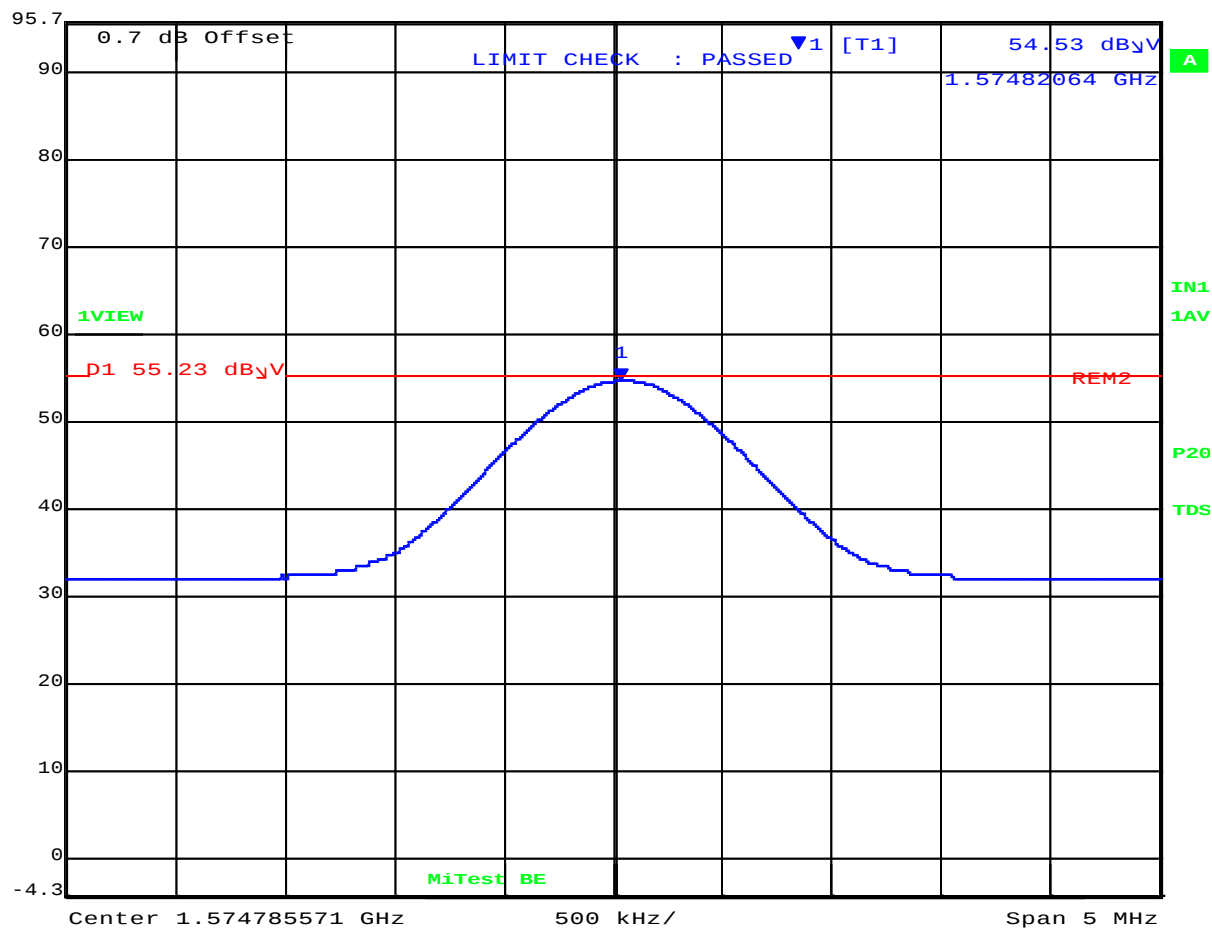
*Measurement includes +0.7dB offset for Duty Cycle Correction

Equipment Configuration for GPS Band Emissions

Antenna:	Yagi + 6dB Pad	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	QPSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	85
Channel Frequency (MHz):	787.50	Data Rate:	180 KHz
Power Setting:	20	Tested By:	JMH

Test Measurement Results


 Max/Ref Lvl **Marker 1 [T1]** RBW 1 MHz RF Att 0 dB
 95.7 dB μ V 54.53 dB μ V VBW 3 MHz
 72.7 dB μ V 1.57482064 GHz SWT 10 s Unit dB μ V



Date: 13.MAY.2019 10:03:13

*Measurement includes +0.7dB offset for Duty Cycle Correction

9.5.3. Digital Emissions

Test Conditions for Digital Emissions			
Standard:	FCC CFR 47:15.109	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	Radiated Emissions Limits	Rel. Humidity (%):	32 - 45
Standard Section(s):	15.109 (a)	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Emissions Measurement

Test Procedure

Testing 30 – 1,000 MHz was performed in an anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode.

Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR Compliant receiver. Emissions from 30 MHz – 1000 MHz are measured utilizing a CISPR compliant quasi-peak detector with a tuned receiver, using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed.

15.109 Radiated limits.

((a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Quasi-peak Limit (dB μ V/m)	Measurement Distance (meters)
30 to 88	40	3
88-216	43.5	3
216-960	46	3
960-1000	54	3

(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:

Frequency(MHz)	Quasi-peak Limit (dB μ V/m)	Measurement Distance (meters)
30 to 88	49.5	3
88-216	54	3
216-960	56.5	3
960-1000	60	3

Traceability

Laboratory Measurement Uncertainty	
Measurement uncertainty	+5.6/ -4.5 dB

Digital Emissions 30-1000 MHz Class A

Equipment Configuration for Radiated Digital Emissions (Class A)

Antenna:	Dipole	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	NA
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	NA
Channel Frequency (MHz):	0.00	Data Rate:	NA
Power Setting:	NA	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	32.55	32.76	3.54	-9.40	26.90	MaxQP	Vertical	98	268	49.5	-22.6	Pass
#2	193.02	48.11	4.43	-16.50	36.04	MaxQP	Vertical	98	356	54.0	-18.0	Pass
#3	207.94	46.81	4.49	-17.20	34.10	MaxQP	Vertical	113	4	54.0	-19.9	Pass
#4	320.02	49.29	4.91	-13.90	40.30	MaxQP	Vertical	99	51	57.0	-16.7	Pass

Test Notes: EUT powered by AC/DC PS.

Note: click the links in the above matrix to view the graphical image (plot).

Digital Emissions 1-10 GHz Class A

Equipment Configuration for Digital Emissions 1-10 GHz

Antenna:	Not Applicable	Variant:	NB IOT
Antenna Gain (dBi):	Not Applicable	Modulation:	Not Applicable
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	Not Applicable
Channel Frequency (MHz):	0.00	Data Rate:	Not Applicable
Power Setting:	Not Applicable	Tested By:	JMH

Test Measurement Results

1000.00 - 10000.00 MHz

Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	6064.07	68.53	-2.84	-10.00	55.69	Max Peak	Vertical	178	32	80.0	-24.3	Pass
#2	6064.07	68.33	-2.84	-10.00	55.49	Max Avg	Vertical	178	32	60.0	-4.5	Pass
#3	6068.87	71.37	-2.85	-9.84	57.68	Max Peak	Horizontal	101	295	80.0	-22.3	Pass
#4	6068.87	69.94	-2.85	-9.84	57.25	Max Avg	Horizontal	101	295	60.0	-2.8	Pass
#5	6068.92	71.29	-2.85	-9.84	58.60	Max Peak	Vertical	123	194	80.0	-21.4	Pass
#6	6068.92	68.30	-2.85	-9.84	55.61	Max Avg	Vertical	123	194	60.0	-4.4	Pass

Test Notes: EUT powered up

Note: click the links in the above matrix to view the graphical image (plot).

9.5.4. AC Wireline Emissions

Test Conditions for AC Mains Conducted Emissions			
Standard:	FCC CFR 47:15.107	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	AC Mains Conducted Limits	Rel. Humidity (%):	32 - 45
Standard Section(s):	15.107 (a)	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Method

The test method shall be in accordance with ANSI C63.4 and the Artificial Mains Networks (AMNs) shall be connected to the AC mains power source. The measurement frequency range extends from 150 kHz to 30 MHz. When the EUT is a transmitter operating at frequencies below 30 MHz, then the exclusion band for transmitters applies for measurements in the transmit mode of operation.

Test Procedure for AC Mains Conducted Emissions Measurement

The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

15.107 Conducted limits.

(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

(b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms LISN. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	79	66
0.5-30	73	60

Traceability

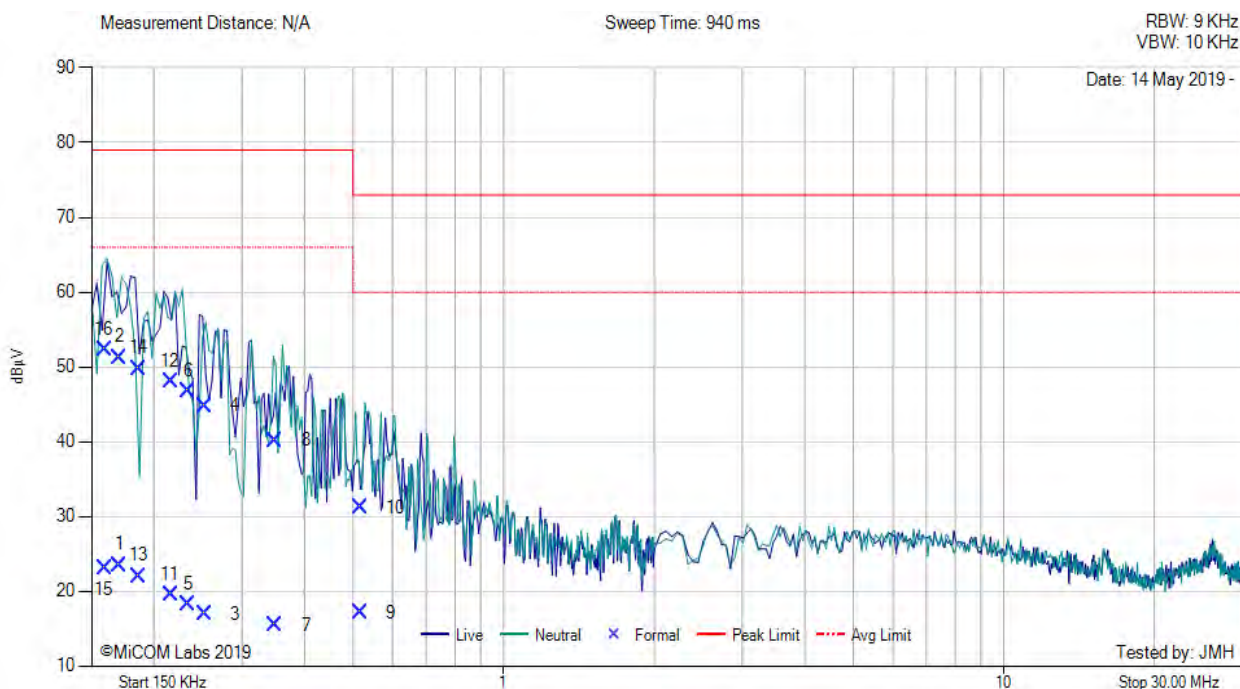
All conducted emission measurements are traceable to national standards. The uncertainty of measurement at a confidence level of not less than 95 %, with a coverage factor of k=2, in the range 9 kHz – 30 MHz (Average & Quasi-peak) is ± 2.64 dB.

Laboratory Measurement Uncertainty	
Measurement uncertainty	± 2.64 dB

Model:	RU700A 1.0	Configuration tested:	AC/DC PS
Input power:	120V _{AC} /60Hz	Standard:	FCC Class A



Variant: , Test Freq: 0.00 MHz



Num	Frequency MHz	Raw dBμV	Cable Loss dB	Factor dB	Total Correction dBμV	Corrected Value dBμV	Measurement Type	Line	Limit dBμV/m	Margin dB	Pass /Fail
1	0.170	13.55	0.05	9.92	9.97	23.52	Max Avg	Neutral	66.0	-42.5	Pass
2	0.170	41.31	0.05	9.92	9.97	51.28	Max Qp	Neutral	79.0	-27.7	Pass
3	0.253	6.98	0.07	9.92	9.99	16.97	Max Avg	Live	66.0	-49.0	Pass
4	0.253	34.80	0.07	9.92	9.99	44.79	Max Qp	Live	79.0	-34.2	Pass
5	0.234	8.30	0.07	9.92	9.99	18.29	Max Avg	Neutral	66.0	-47.7	Pass
6	0.234	36.72	0.07	9.92	9.99	46.71	Max Qp	Neutral	79.0	-32.3	Pass
7	0.350	5.57	0.04	9.92	9.96	15.53	Max Avg	Neutral	66.0	-50.5	Pass
8	0.350	30.21	0.04	9.92	9.96	40.17	Max Qp	Neutral	79.0	-38.8	Pass
9	0.516	7.08	0.09	9.92	10.01	17.09	Max Avg	Neutral	60.0	-42.9	Pass
10	0.516	21.16	0.09	9.92	10.01	31.17	Max Qp	Neutral	73.0	-41.8	Pass
11	0.216	9.56	0.06	9.92	9.98	19.54	Max Avg	Neutral	66.0	-46.5	Pass
12	0.216	38.09	0.06	9.92	9.98	48.07	Max Qp	Neutral	79.0	-30.9	Pass
13	0.186	12.09	0.06	9.92	9.98	22.07	Max Avg	Neutral	66.0	-43.9	Pass
14	0.186	39.80	0.06	9.92	9.98	49.78	Max Qp	Neutral	79.0	-29.2	Pass
15	0.159	13.11	0.05	9.92	9.97	23.08	Max Avg	Neutral	66.0	-42.9	Pass
16	0.159	42.36	0.05	9.92	9.97	52.33	Max Qp	Neutral	79.0	-26.7	Pass

Test Notes: Powered by AC DC PS

A. APPENDIX - GRAPHICAL IMAGES

A.1. 26 dB & 99% Bandwidth

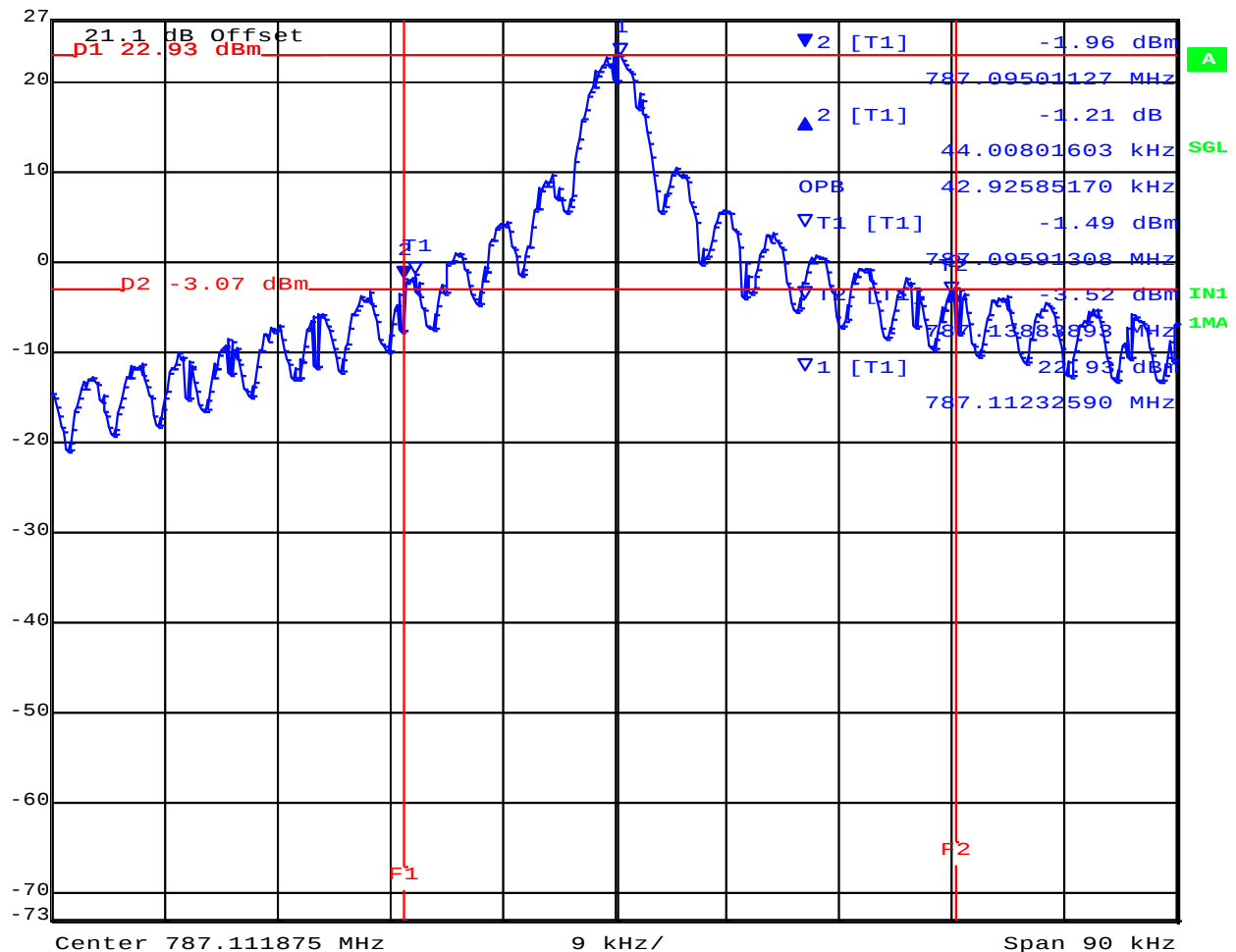


26 dB & 99% BANDWIDTH

Variant: NB IoT 3.75 KHz, Channel: 787.11188 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Delta 2 [T1] RBW 1 kHz RF Att 20 dB
 Ref Lvl -1.21 dB VBW 10 kHz
 27 dBm 44.00801603 kHz SWT 20 s Unit dBm



Center 787.111875 MHz 9 kHz/ Span 90 kHz

Date: 15.MAY.2019 16:50:22

[back to matrix](#)

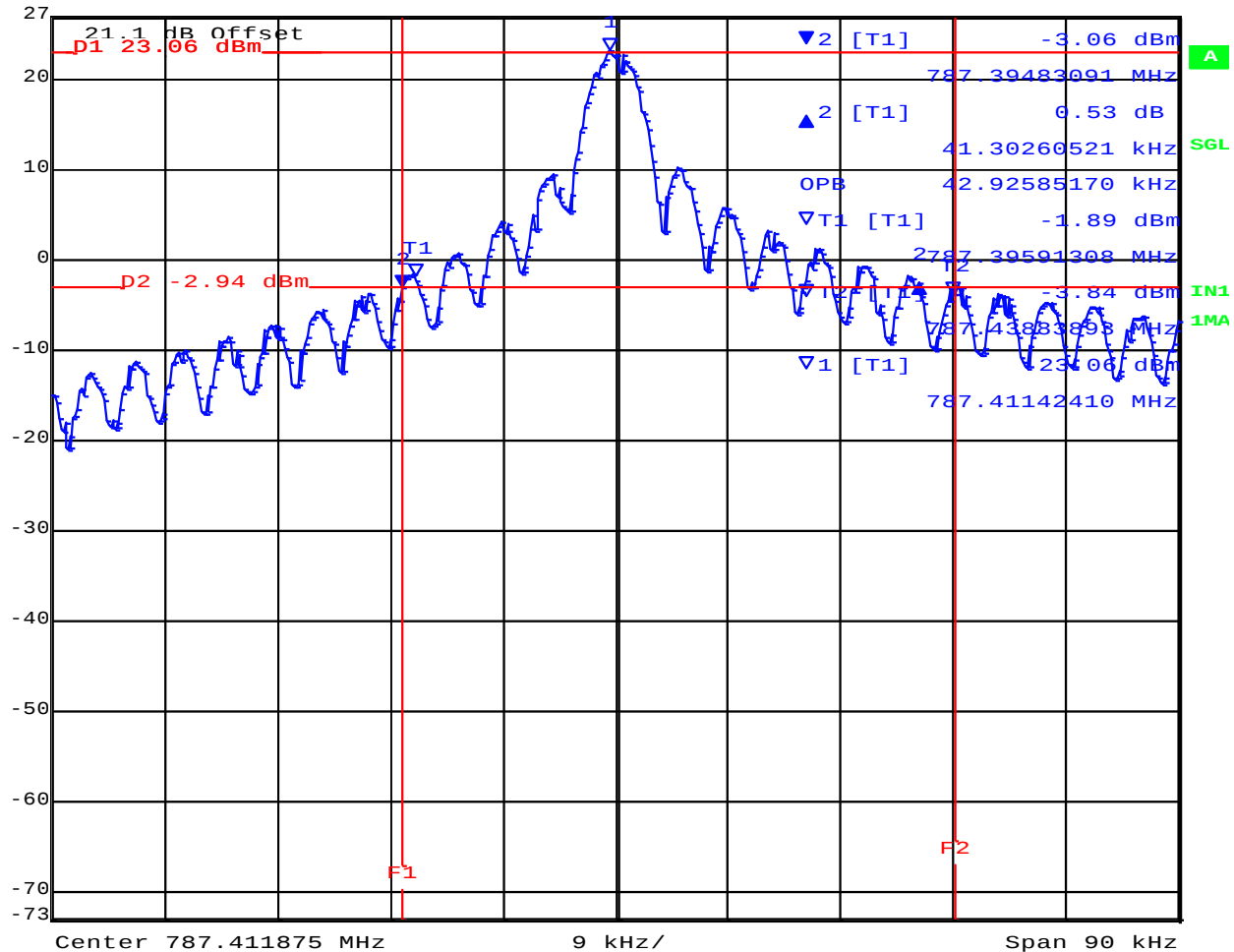


26 dB & 99% BANDWIDTH

Variant: NB IoT 3.75 KHz, Channel: 787.41188 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Delta 2 [T1] RBW 1 kHz RF Att 20 dB
 Ref Lvl 0.53 dB VBW 10 kHz
 27 dBm 41.30260521 kHz SWT 20 s Unit dBm



Date: 15.MAY.2019 16:42:43

[back to matrix](#)

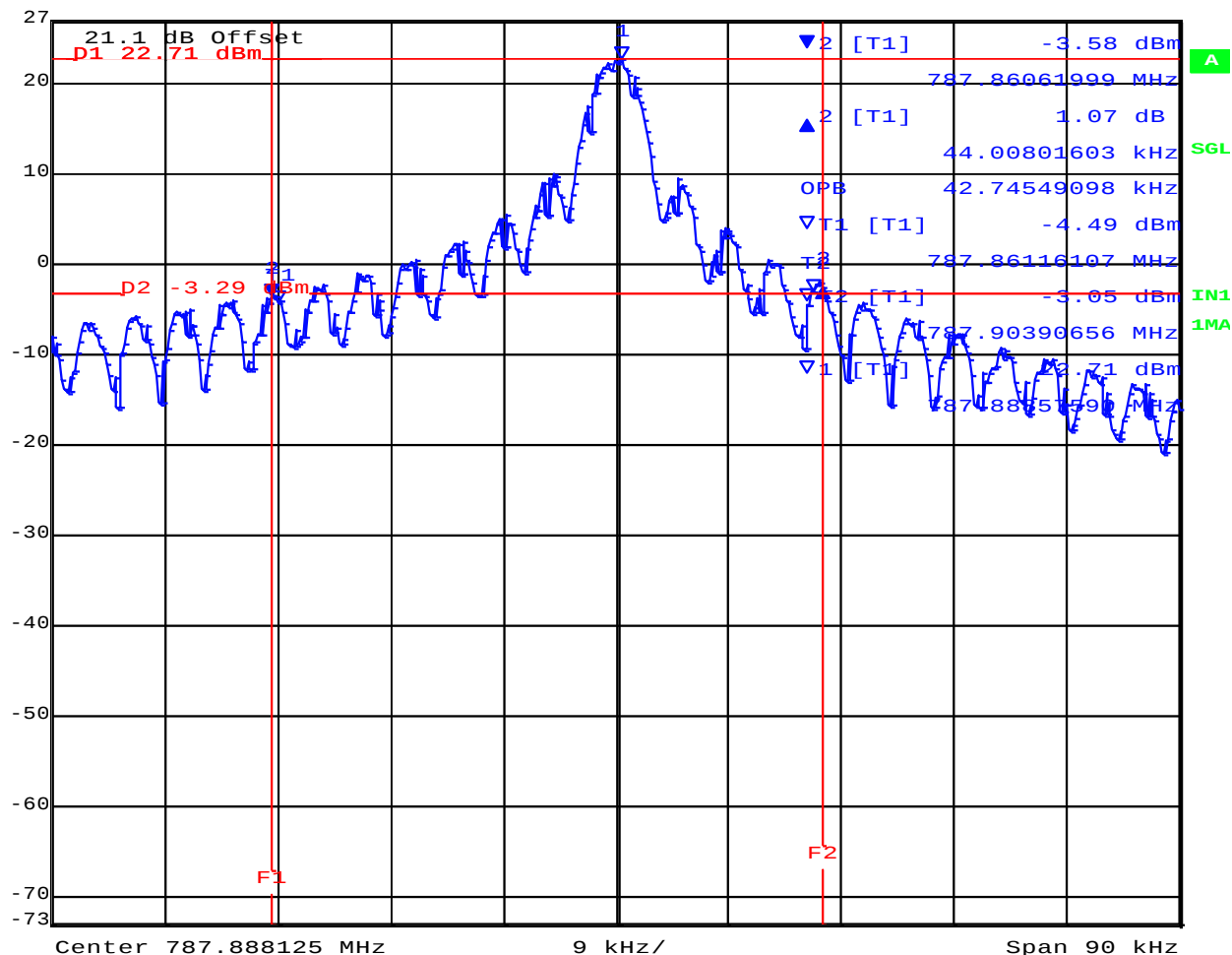
26 dB & 99% BANDWIDTH



Variant NB IoT 3.75 KHz, Channel: 787.88813 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Delta 2 [T1] RBW 1 kHz RF Att 20 dB
 Ref Lvl 1.07 dB VBW 10 kHz
 27 dBm 44.00801603 kHz SWT 20 s Unit dBm



Date: 15.MAY.2019 17:01:11

Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 2425.619 MHz : -11.605 dBm M2 : 2425.988 MHz : -5.416 dBm Delta1 : 689 KHz : 0.927 dB T1 : 2425.379 MHz : -24.326 dBm T2 : 2426.573 MHz : -21.875 dBm OBW : 1.194 MHz	Channel Frequency: 2426.00 MHz

[back to matrix](#)

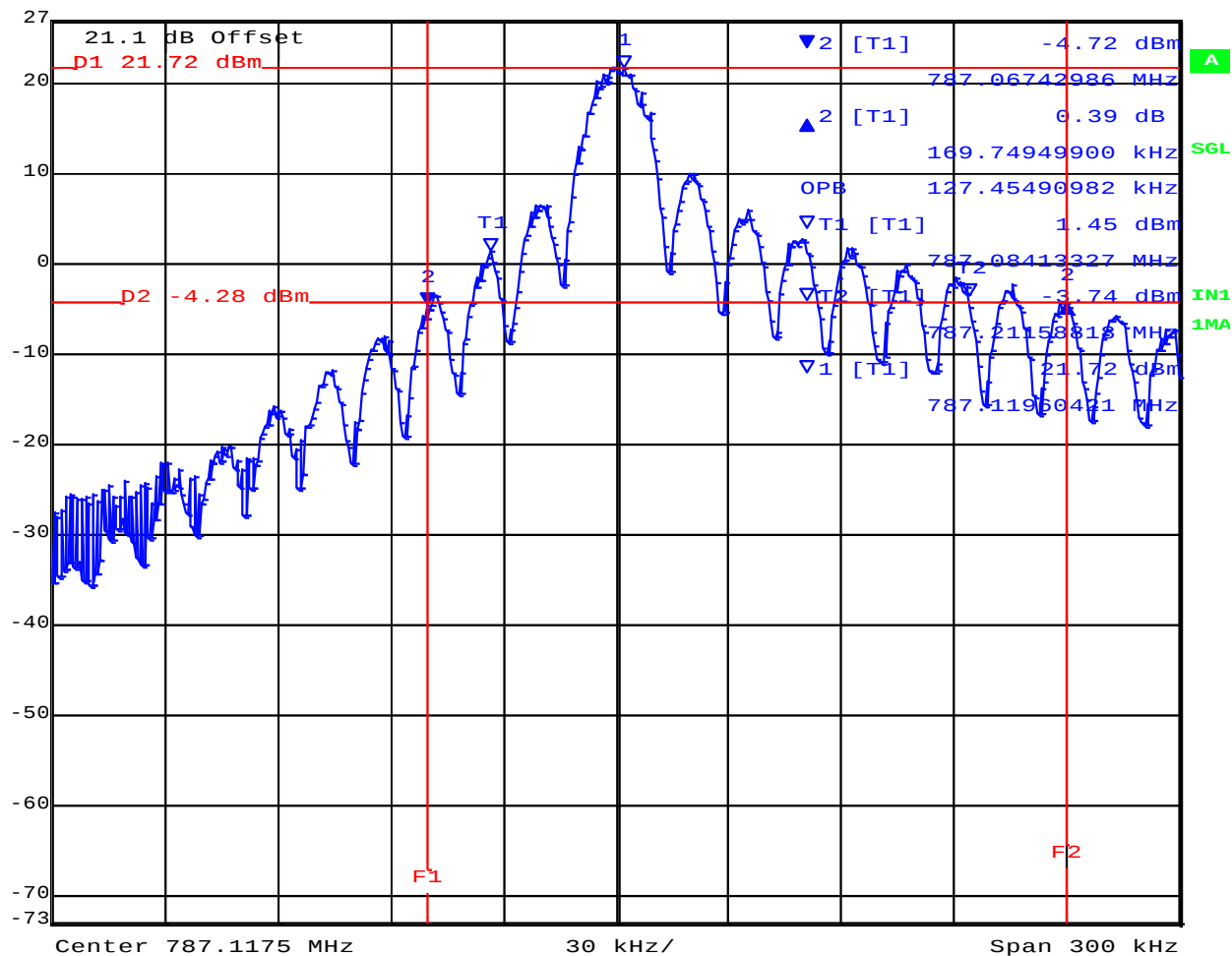
26 dB & 99% BANDWIDTH



Variant: NB IOT 15 KHz, Channel: 787.1175 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



	Delta 2 [T1]	RBW	2 kHz	RF Att	20 dB
Ref Lvl	0.39 dB	VBW	10 kHz		
27 dBm	169.74949900 kHz	SWT	20 s	Unit	dBm



Date: 15.MAY.2019 17:18:25

[back to matrix](#)

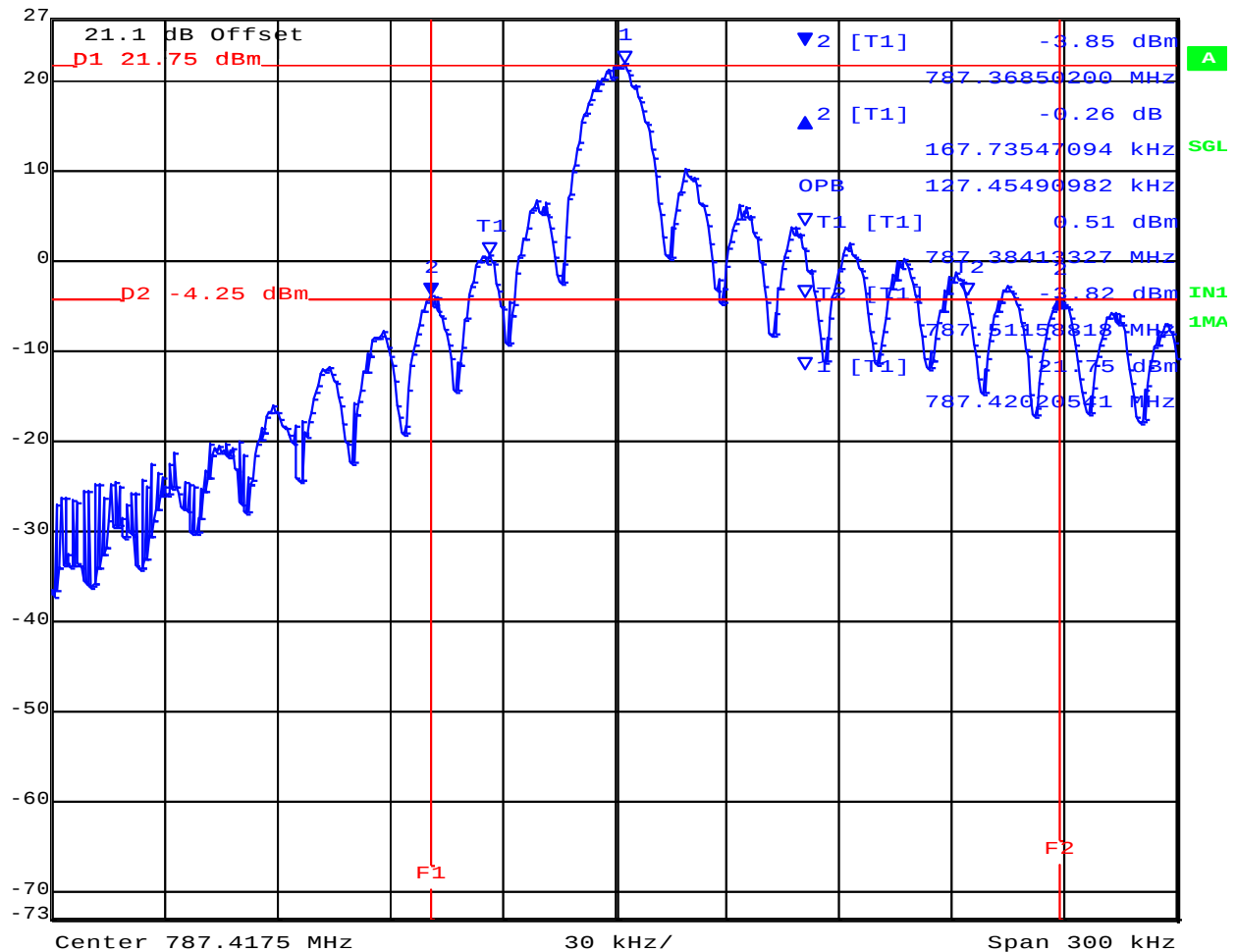


26 dB & 99% BANDWIDTH

Variant NB IOT 15 KHz, Channel: 787.4175 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Delta 2 [T1]
Ref Lvl -0.26 dB
27 dBm 167.73547094 kHz
RBW 2 kHz
VBW 10 kHz
SWT 20 s
RF Att 20 dB
Unit dBm



Date: 15.MAY.2019 17:25:34

[back to matrix](#)

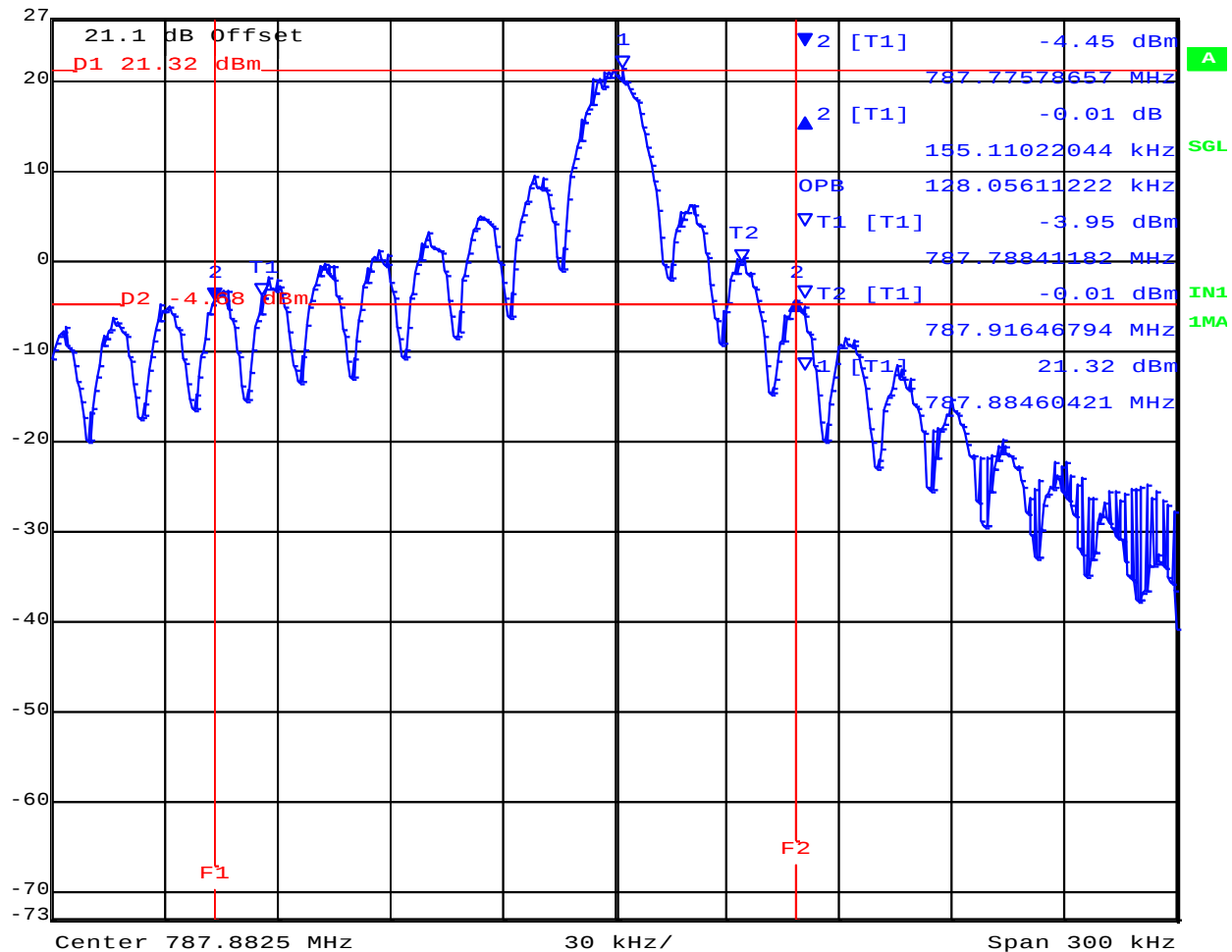


26 dB & 99% BANDWIDTH

Variant NB IOT 15 KHz, Channel: 787.8825 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Delta 2 [T1] RBW 2 kHz RF Att 20 dB
 Ref Lvl -0.01 dB VBW 10 kHz
 27 dBm 155.11022044 kHz SWT 20 s Unit dBm



Date: 15.MAY.2019 17:31:08

[back to matrix](#)

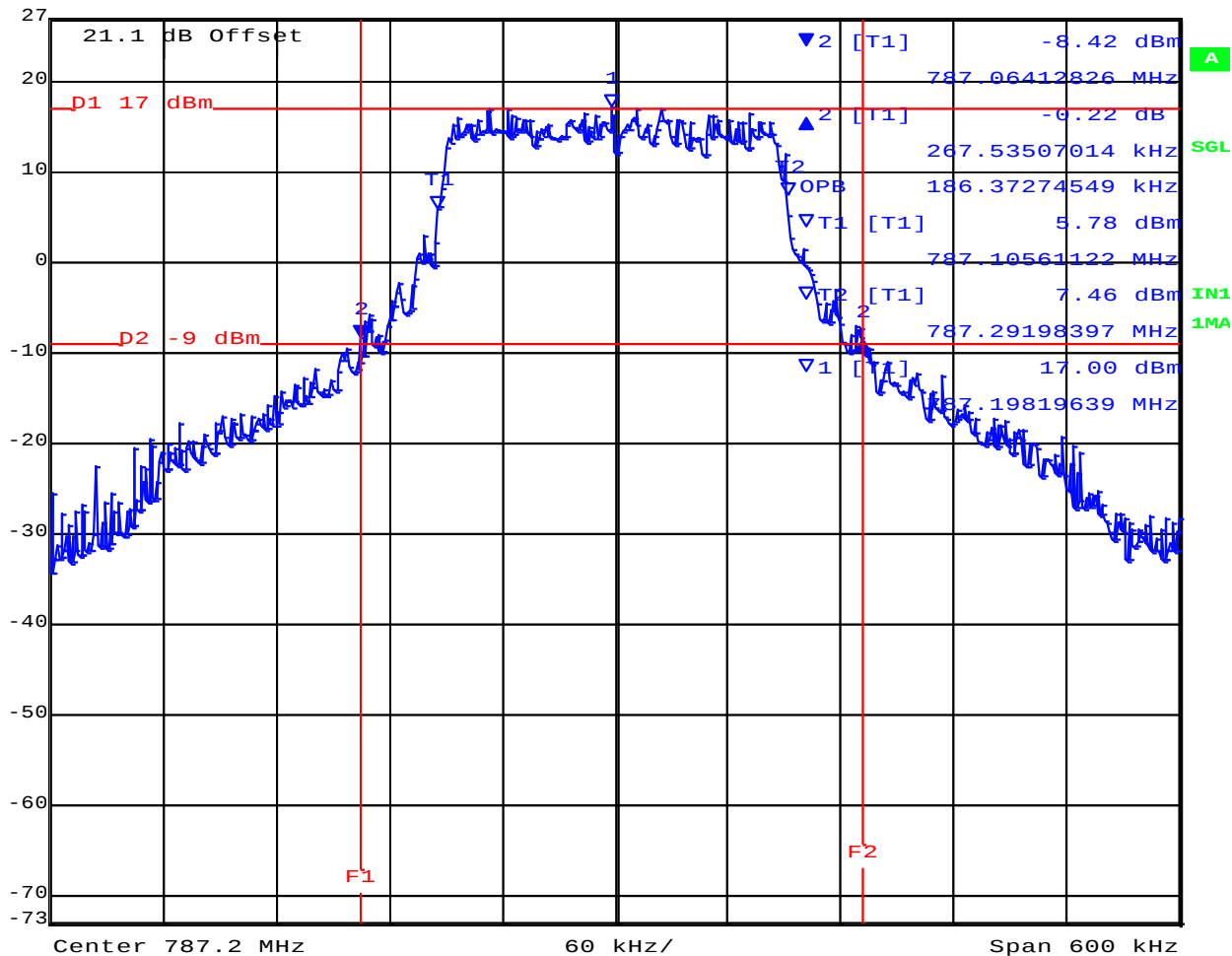
26 dB & 99% BANDWIDTH



Variant: NB IOT 180 KHz, Channel: 787.2 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Delta 2 [T1]
 Ref Lvl 27 dBm
 -0.22 dB
 267.53507014 kHz
 RBW 5 kHz
 VBW 20 kHz
 SWT 15 s
 RF Att 20 dB
 Unit dBm



Date: 15.MAY.2019 16:16:58

[back to matrix](#)

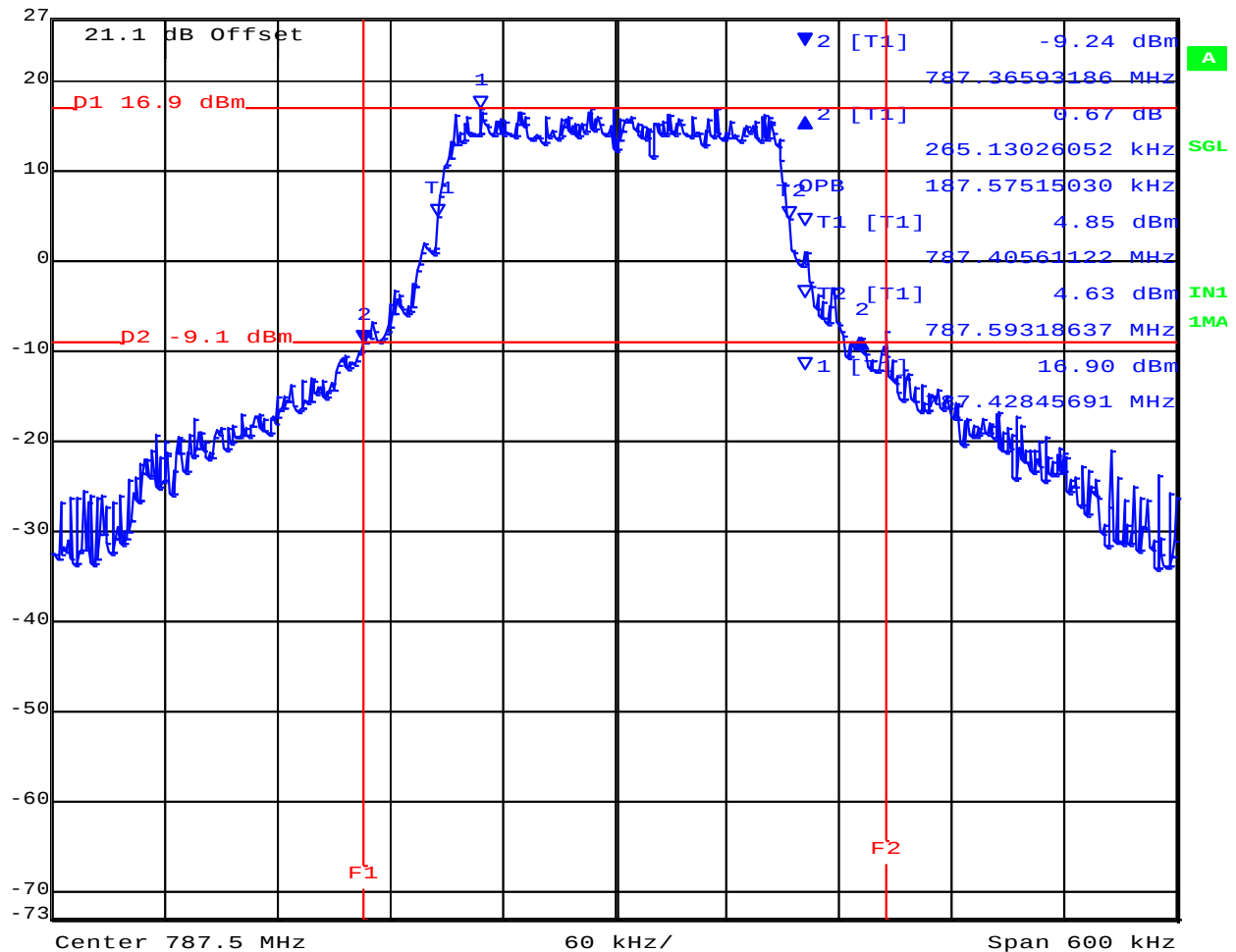


26 dB & 99% BANDWIDTH

Variant NB IOT 180 KHz, Channel: 787.5 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Delta 2 [T1]
 Ref Lvl 0.67 dB
 27 dBm 265.13026052 kHz
 RBW 5 kHz RF Att 20 dB
 VBW 20 kHz
 SWT 15 s Unit dBm



Date: 15.MAY.2019 16:12:39

[back to matrix](#)

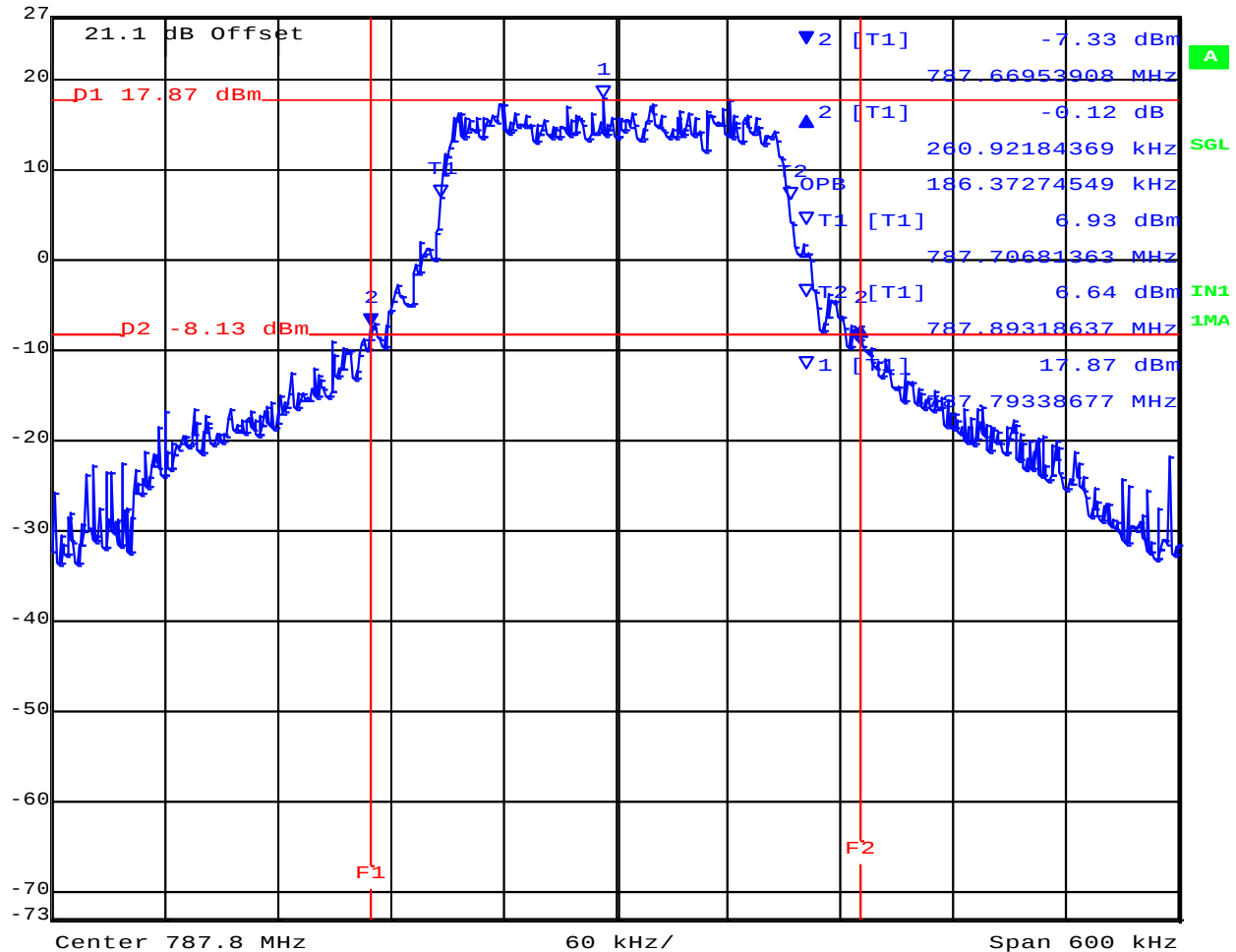
26 dB & 99% BANDWIDTH



Variant NB IOT 180 KHz, Channel: 787.8 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Delta 2 [T1]
Ref Lvl 27 dBm
Delta 2 [T1] -0.12 dB
260.92184369 kHz
RBW 5 kHz
VBW 20 kHz
SWT 15 s
RF Att 20 dB
Unit dBm



Date: 15.MAY.2019 16:22:23

[back to matrix](#)

A.2. Emissions

A.2.1. Conducted Emissions

A.2.1.1. Conducted Spurious Emissions

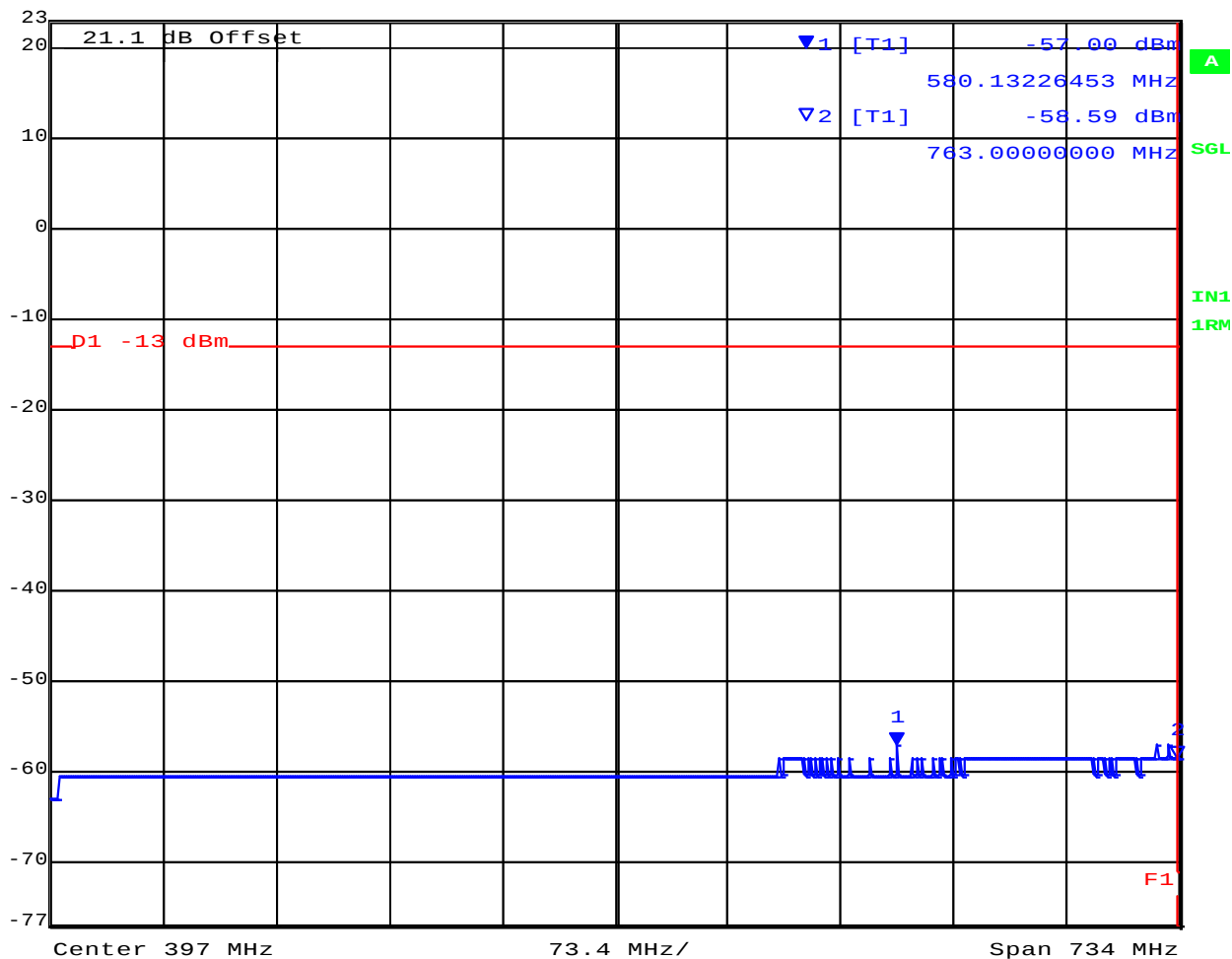


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.111875 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1] RBW 100 kHz RF Att 20 dB
 -57.00 dBm VBW 300 kHz
 23 dBm 580.13226453 MHz SWT 20 s Unit dBm



Date: 16.MAY.2019 11:22:42

[back to matrix](#)

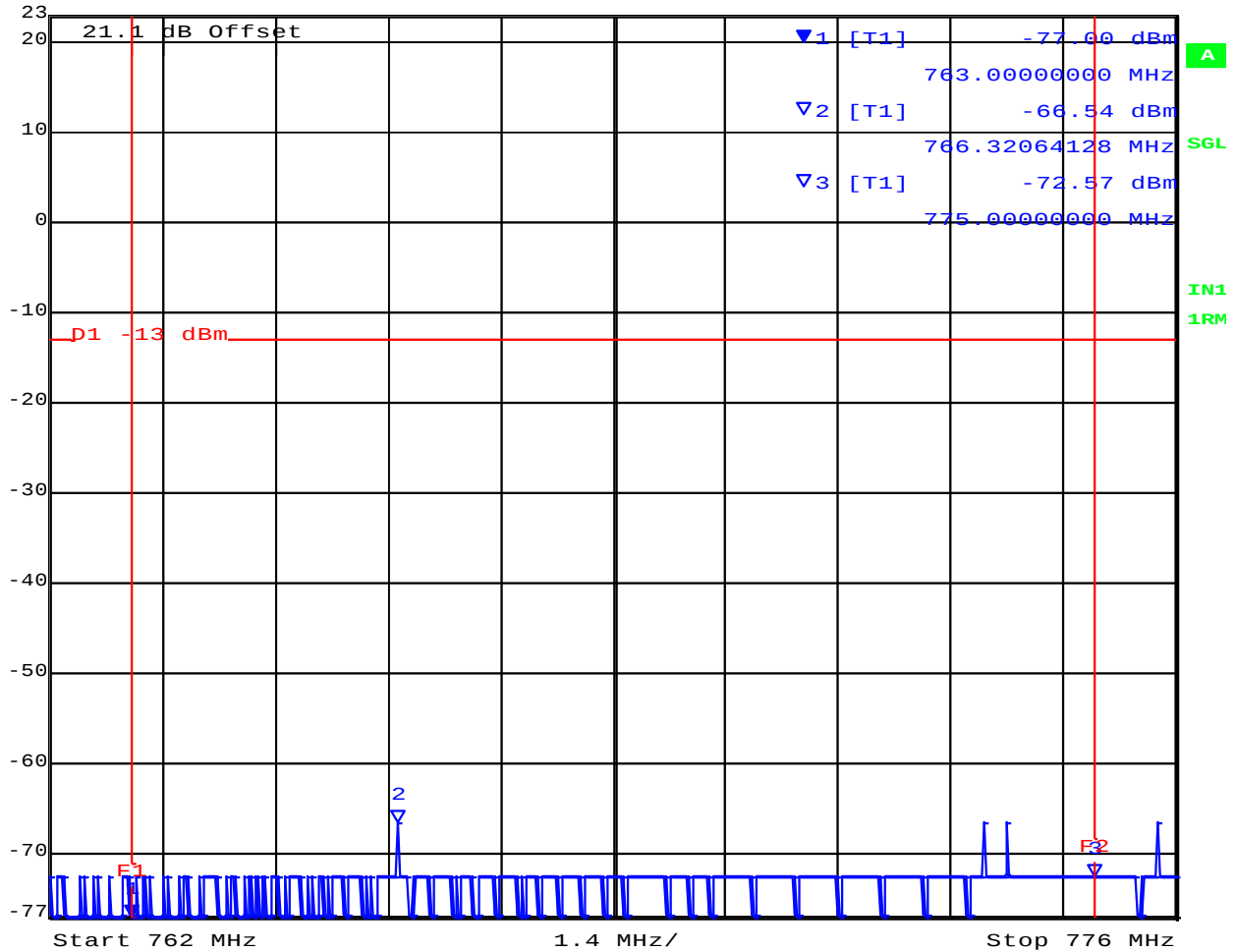


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.111875 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl -77.00 dBm
 23 dBm 763.00000000 MHz
 RBW 10 kHz RF Att 20 dB
 VBW 30 kHz
 SWT 20 s Unit dBm



Date: 16.MAY.2019 11:13:42

[back to matrix](#)

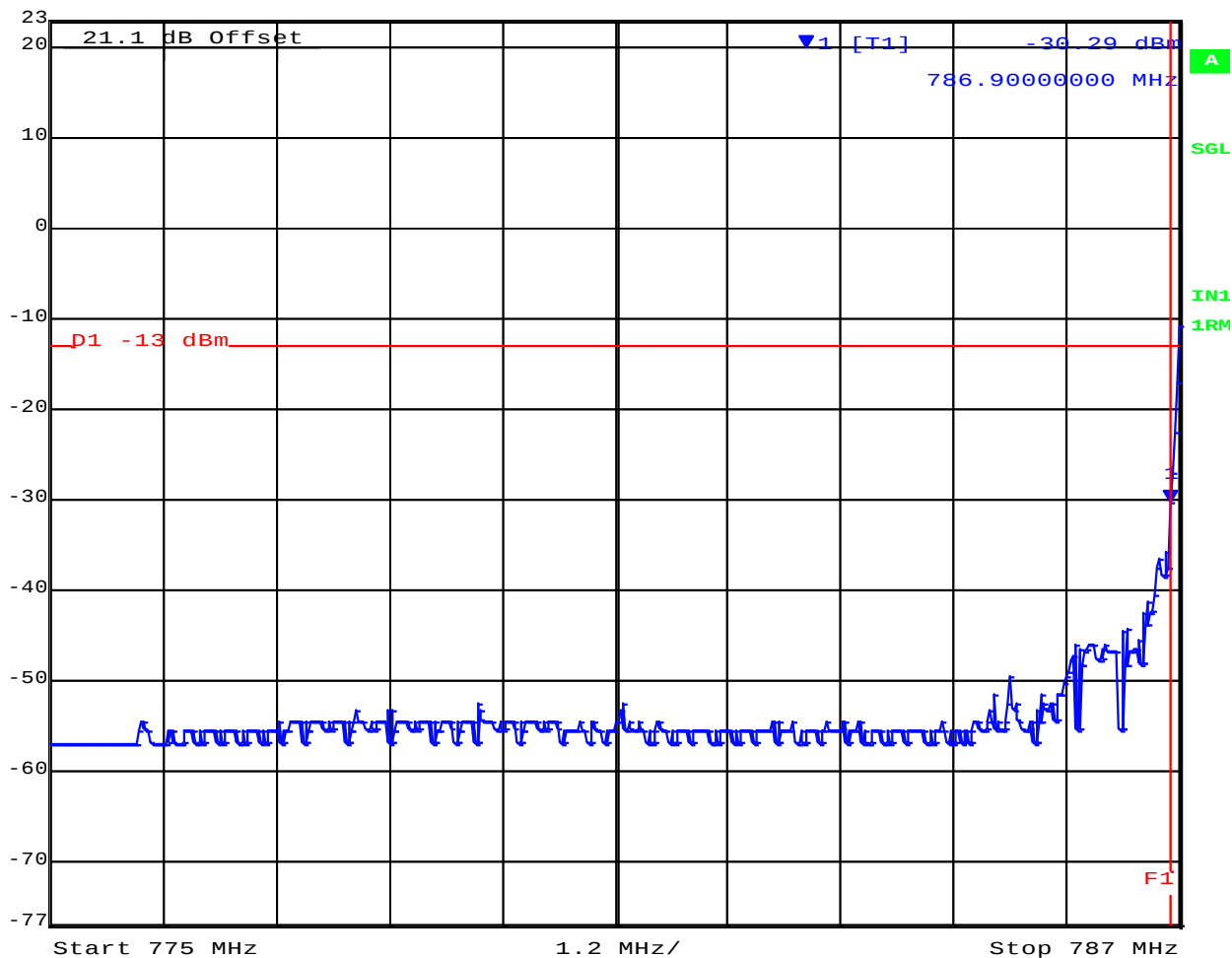


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.111875 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl 23 dBm
 -30.29 dBm
 786.90000000 MHz
 RBW 50 kHz
 VBW 200 kHz
 SWT 20 s
 RF Att 20 dB
 Unit dBm



Date: 16.MAY.2019 13:16:52

[back to matrix](#)

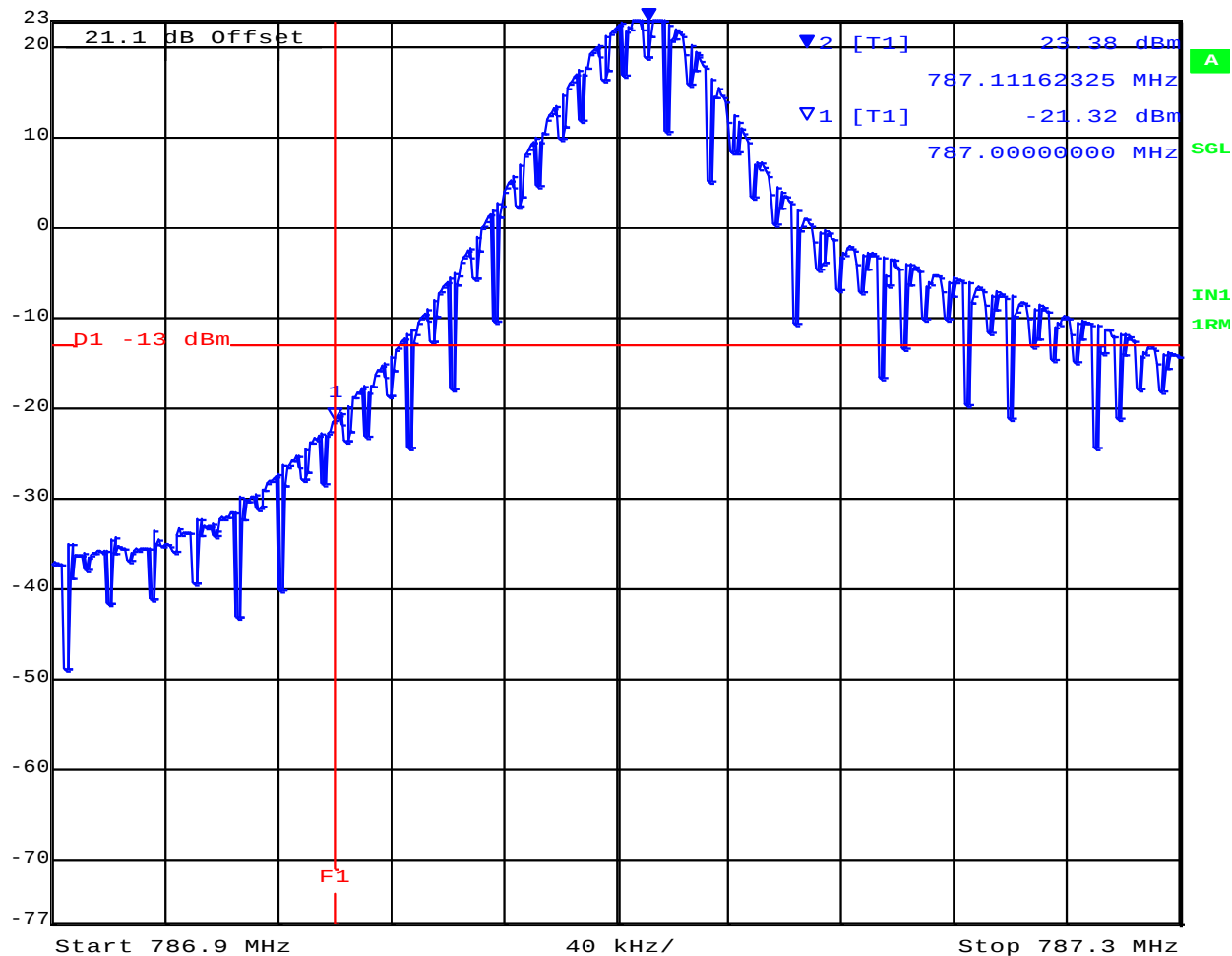


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.111875 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 2 [T1]
 Ref Lvl 23.38 dBm
 23 dBm 787.11162325 MHz
 RBW 30 kHz RF Att 20 dB
 VBW 100 kHz
 SWT 20 s Unit dBm



Date: 16.MAY.2019 10:00:18

[back to matrix](#)

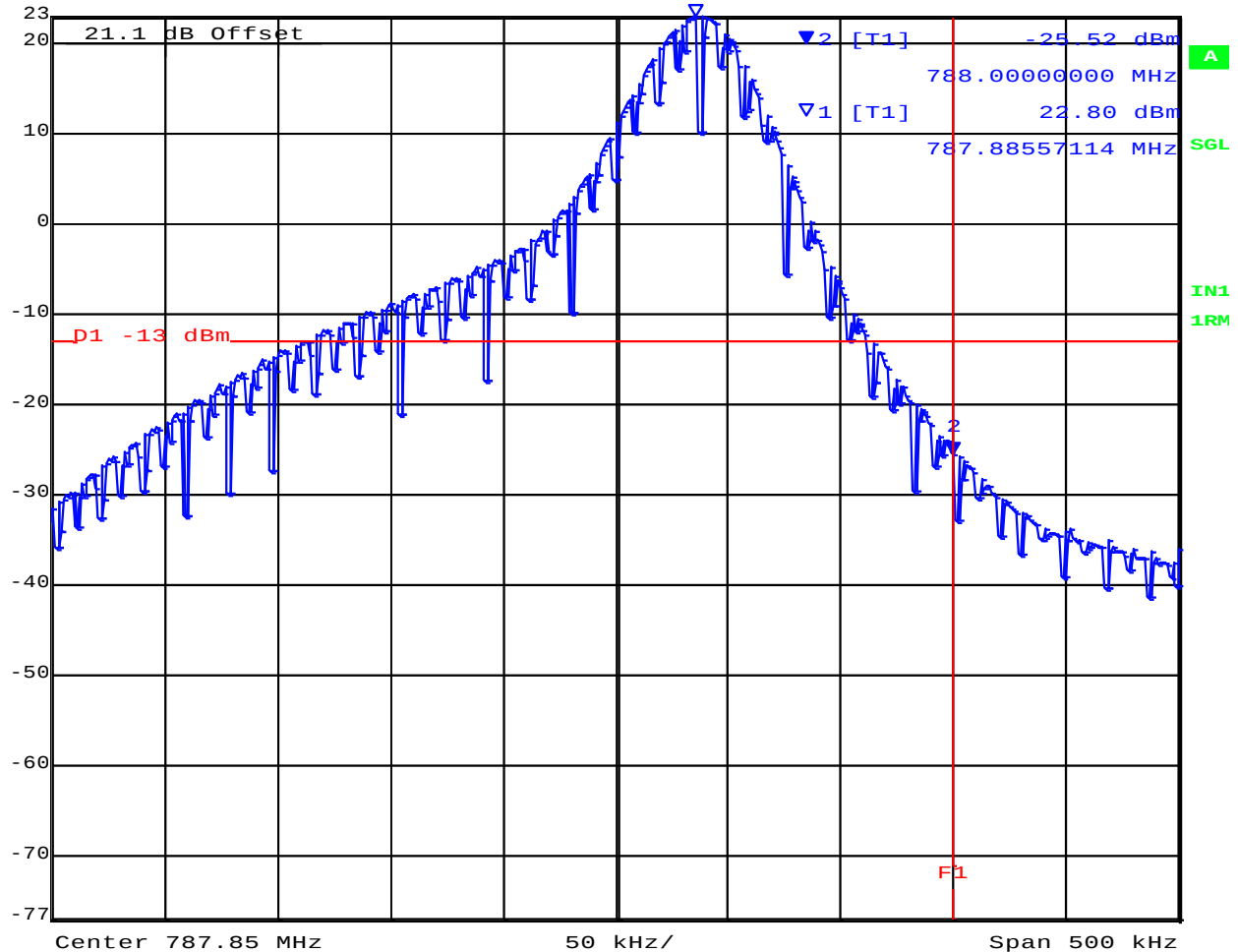


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.888125 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 2 [T1]
 Ref Lvl -25.52 dBm
 23 dBm 788.00000000 MHz
 RBW 30 kHz RF Att 20 dB
 VBW 100 kHz
 SWT 20 s Unit dBm



Date: 16.MAY.2019 10:16:18

[back to matrix](#)

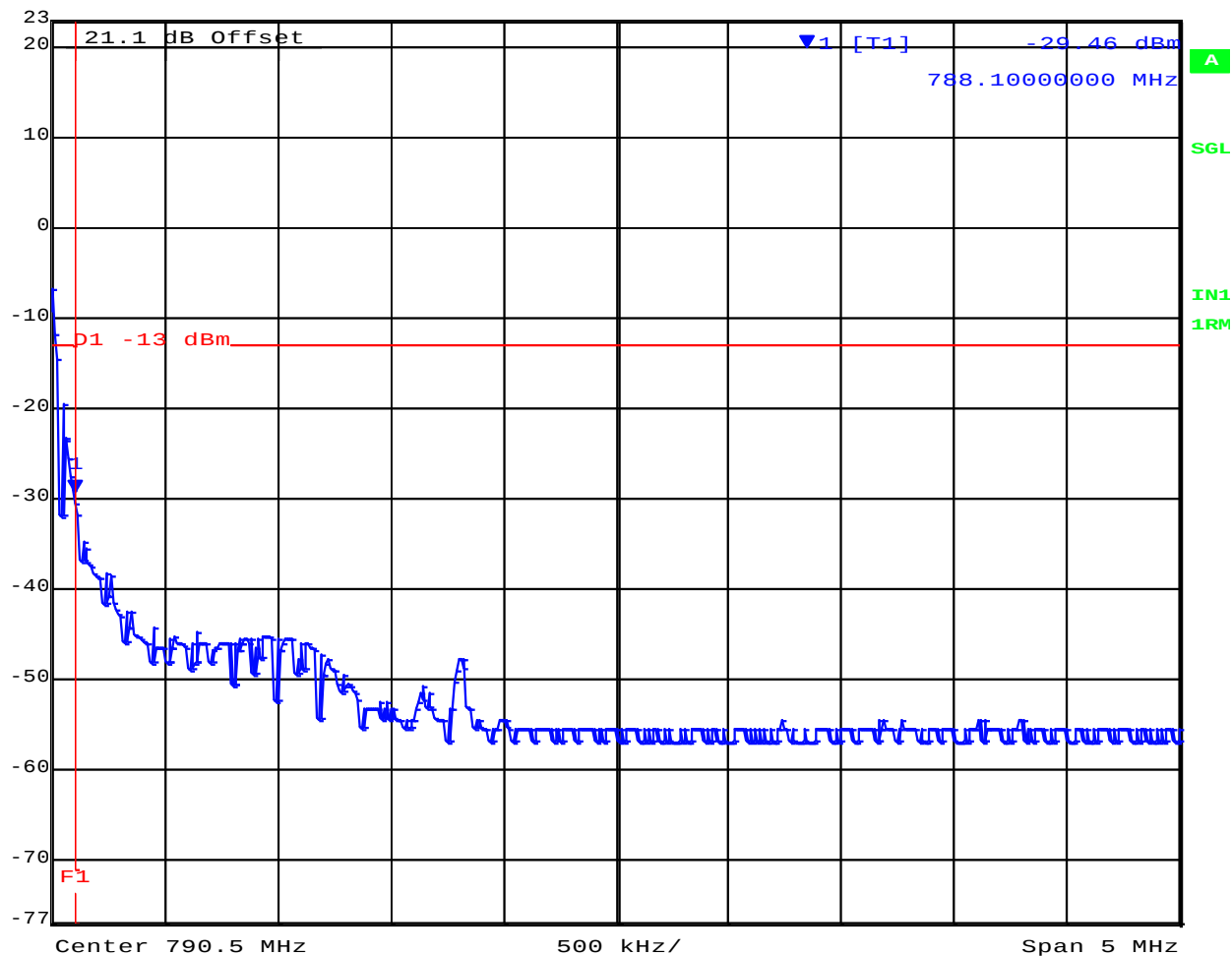


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.888125 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl 23 dBm
 -29.46 dBm
 788.10000000 MHz
 RBW 50 kHz
 VBW 200 kHz
 SWT 20 s
 RF Att 20 dB
 Unit dBm



Date: 16.MAY.2019 13:12:30

[back to matrix](#)

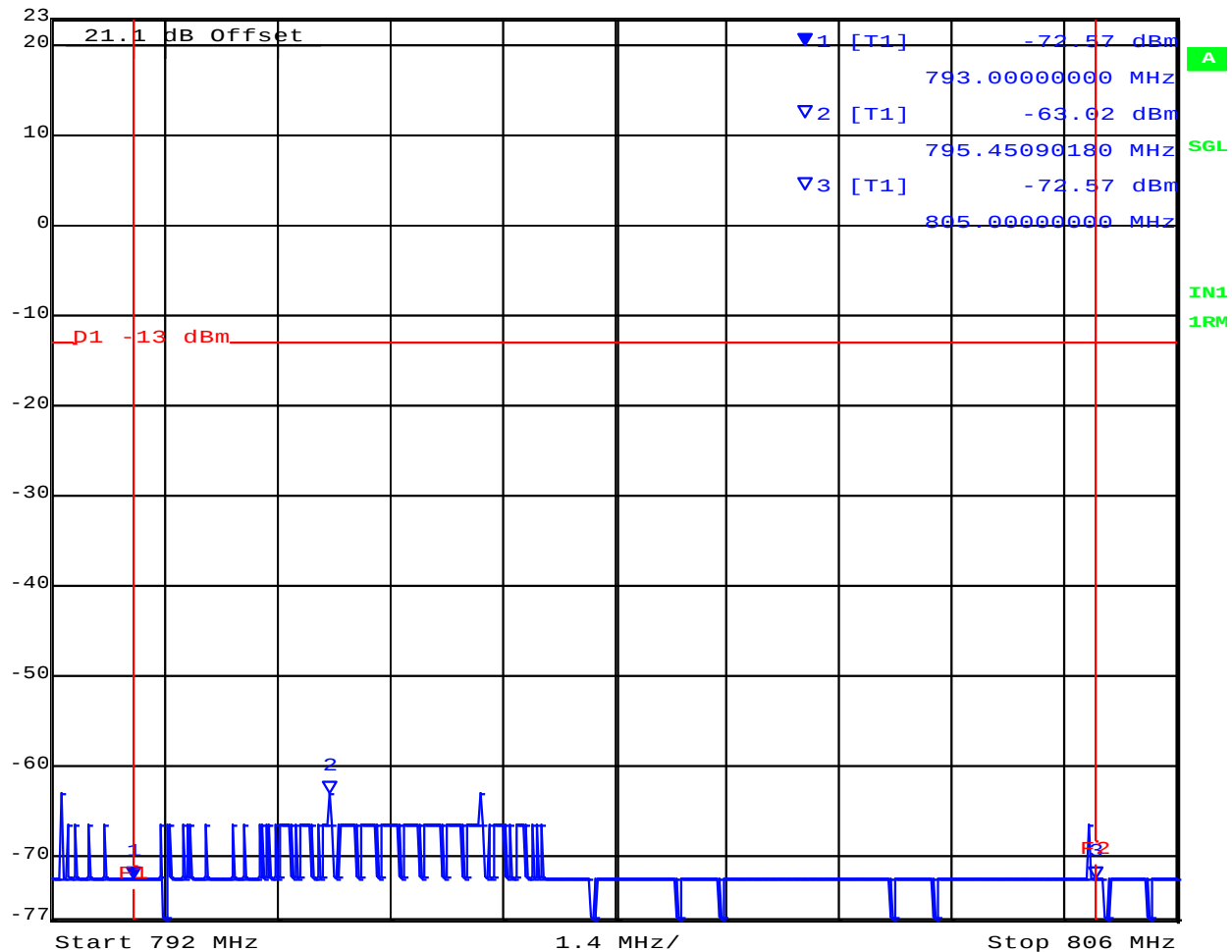


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.888125 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl 23 dBm
 -72.57 dBm
 793.00000000 MHz
 RBW 10 kHz
 VBW 30 kHz
 SWT 20 s
 RF Att 20 dB
 Unit dBm



Date: 16.MAY.2019 11:06:41

[back to matrix](#)

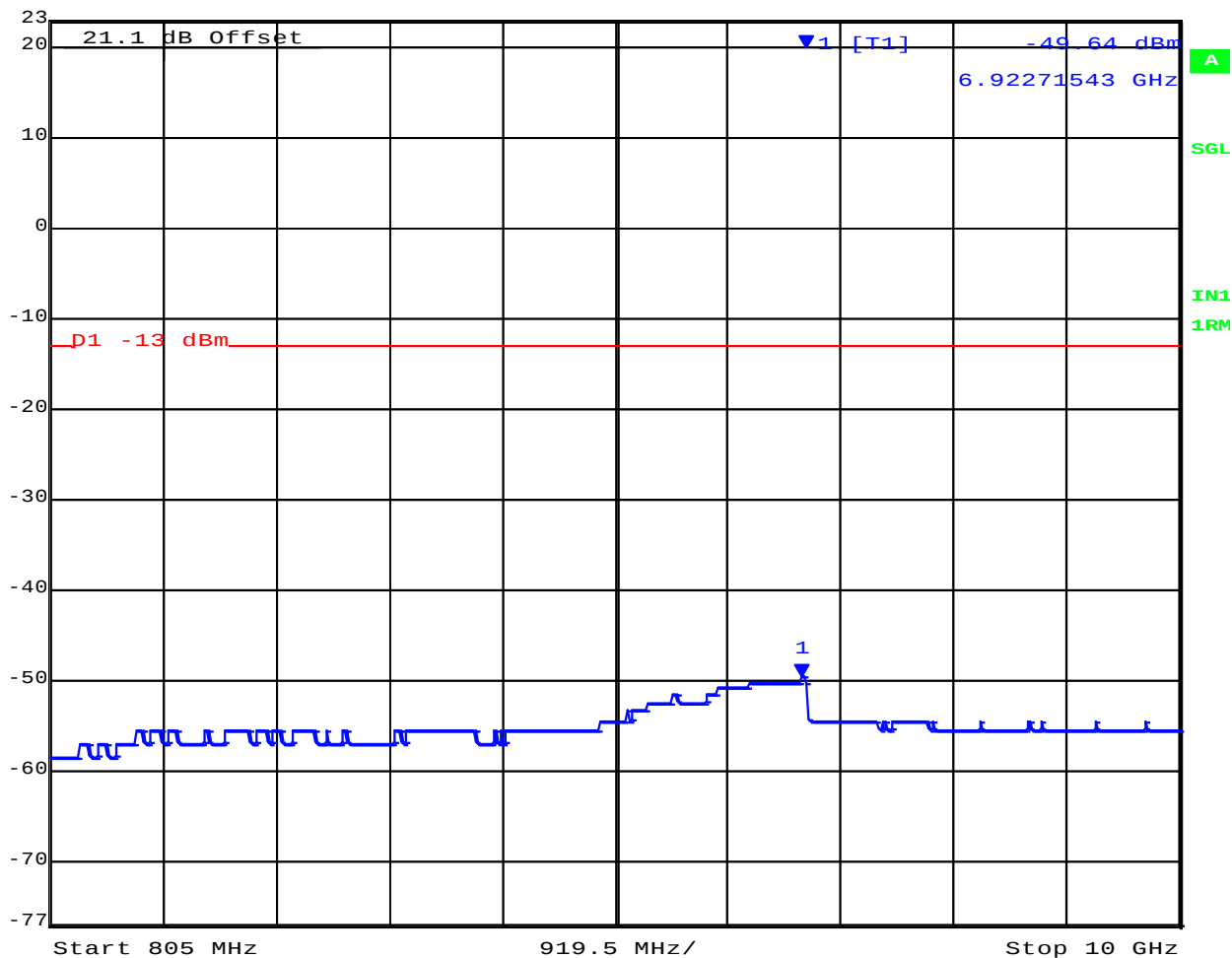


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.888125 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl 23 dBm
 -49.64 dBm
 6.92271543 GHz
 RBW 100 kHz
 VBW 300 kHz
 SWT 20 s
 RF Att 20 dB
 Unit dBm



Date: 16.MAY.2019 11:27:19

[back to matrix](#)

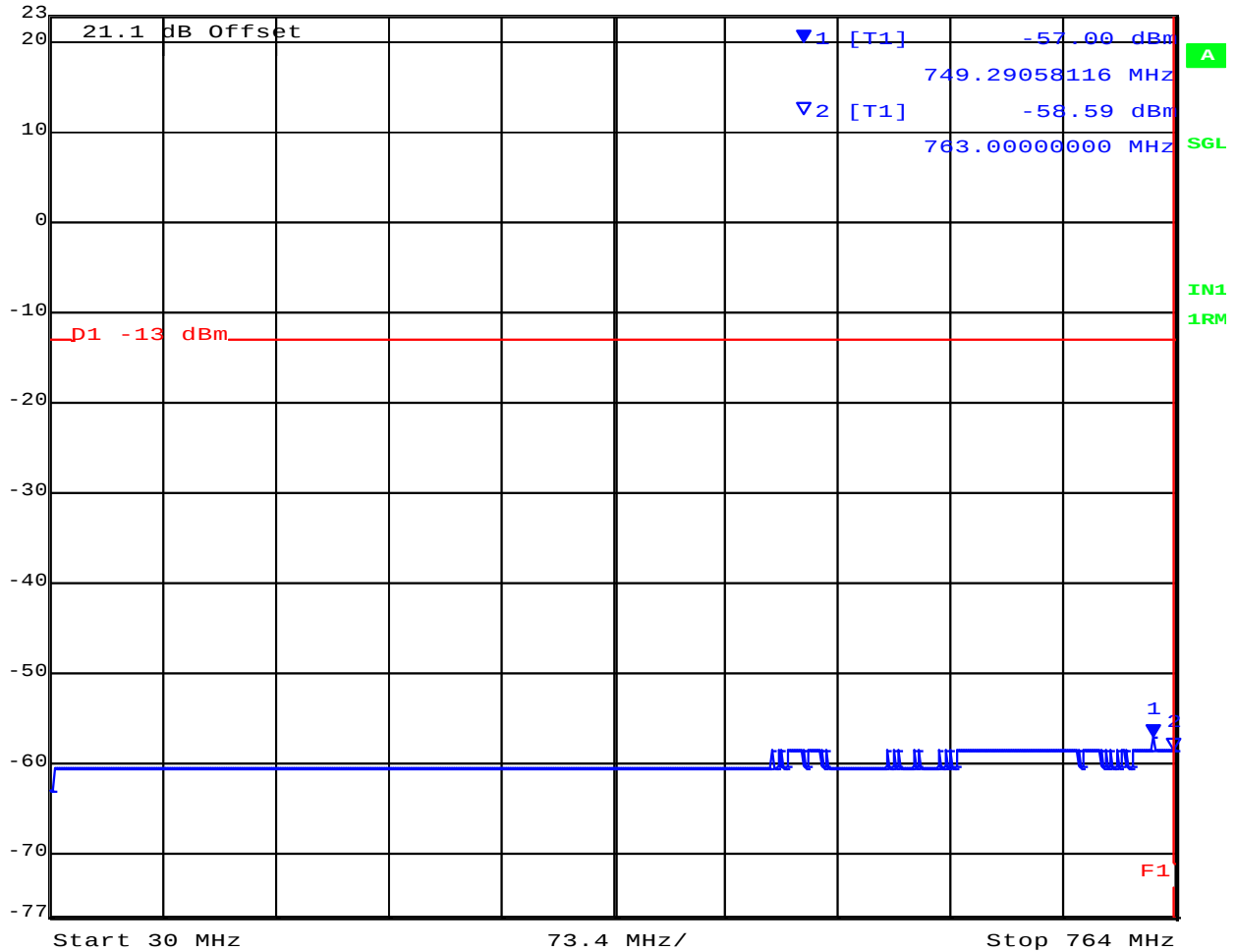


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.2 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl -57.00 dBm
 23 dBm 749.29058116 MHz
 RBW 100 kHz RF Att 20 dB
 VBW 300 kHz
 SWT 20 s Unit dBm



Date: 16.MAY.2019 11:20:25

[back to matrix](#)

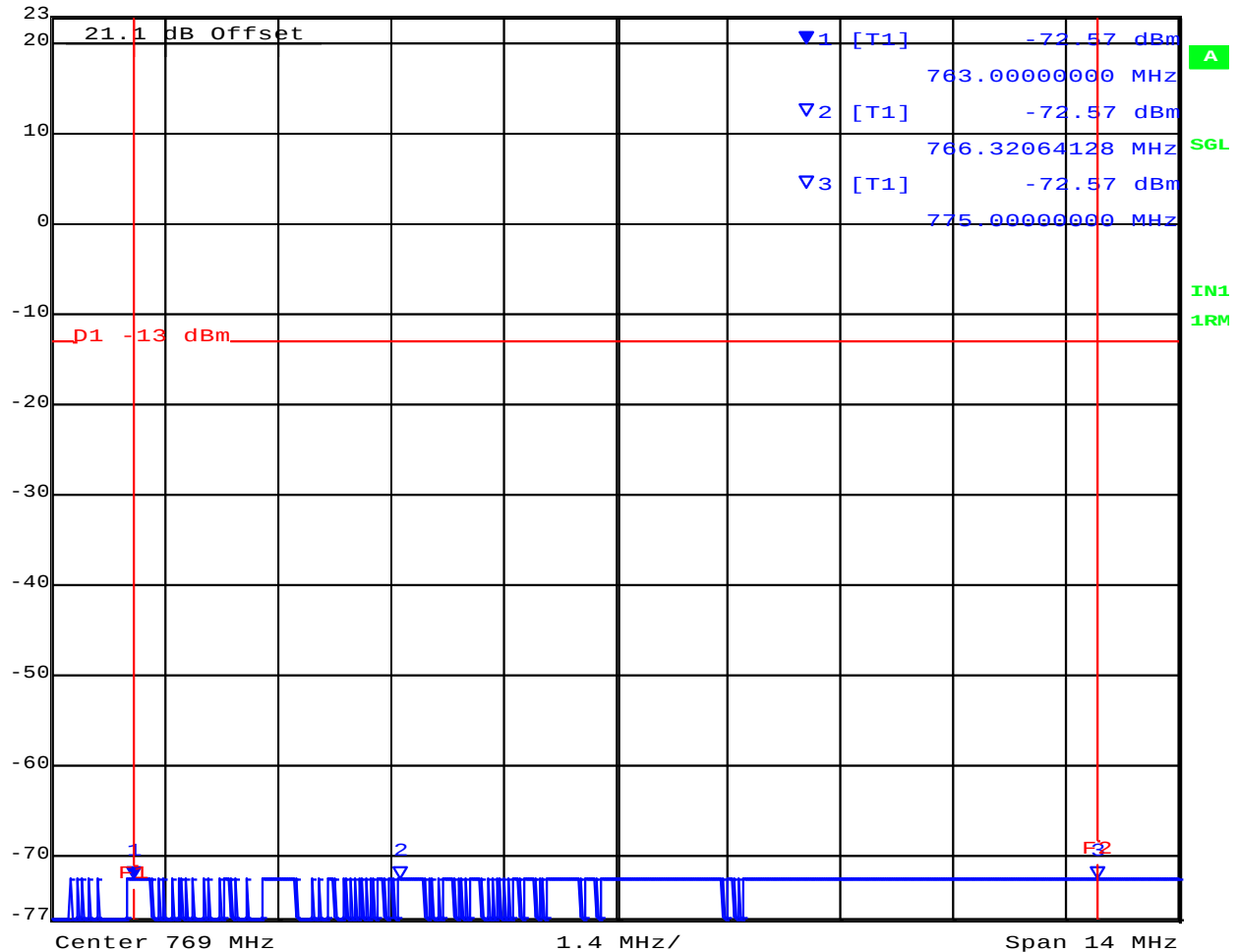


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.2 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl 23 dBm
 -72.57 dBm
 763.00000000 MHz
 RBW 10 kHz
 VBW 30 kHz
 SWT 20 s
 RF Att 20 dB
 Unit dBm



Date: 16.MAY.2019 11:16:57

[back to matrix](#)

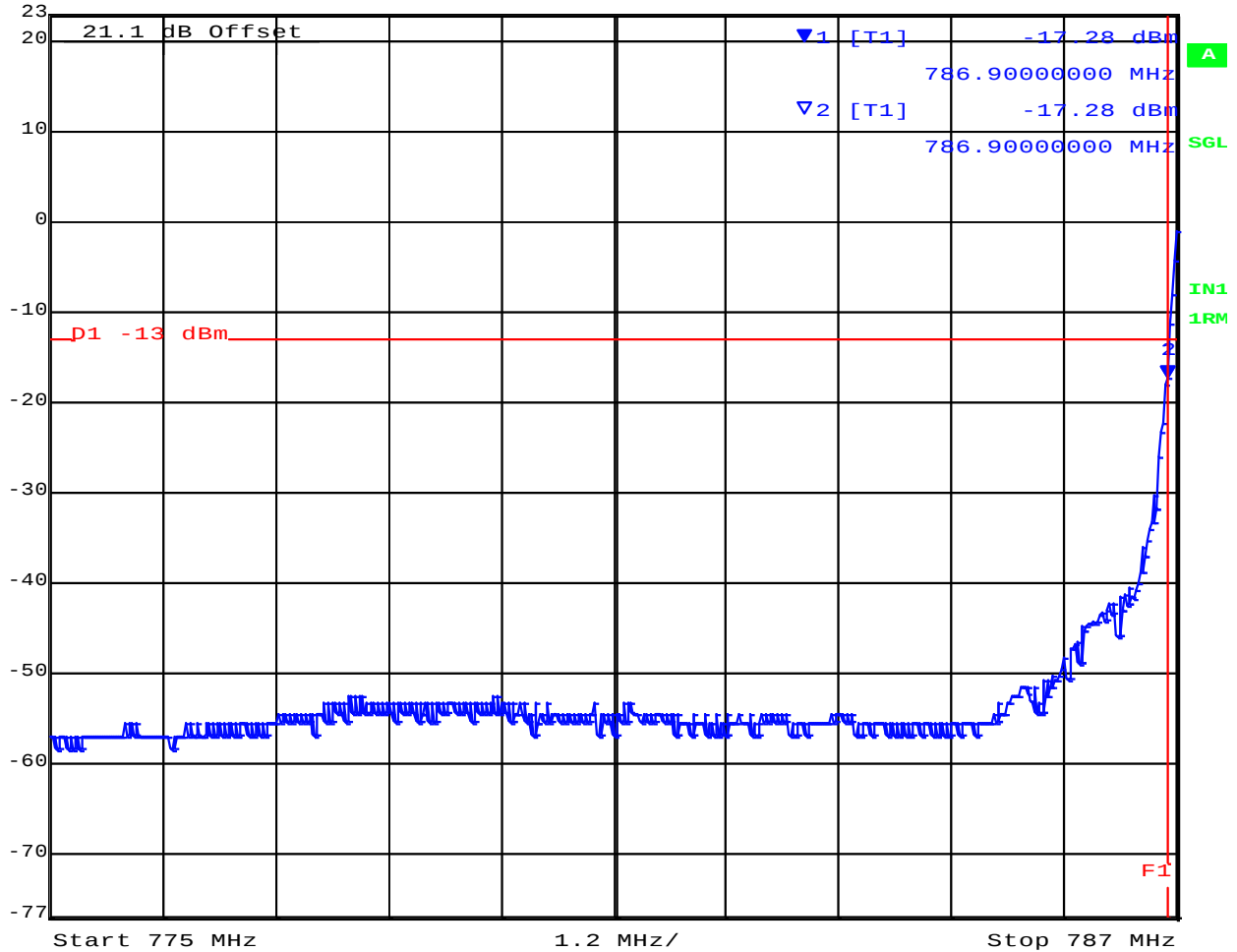


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.2 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl -17.28 dBm
 23 dBm 786.90000000 MHz
 RBW 100 kHz RF Att 20 dB
 VBW 300 kHz
 SWT 20 s Unit dBm



Date: 16.MAY.2019 10:33:48

[back to matrix](#)

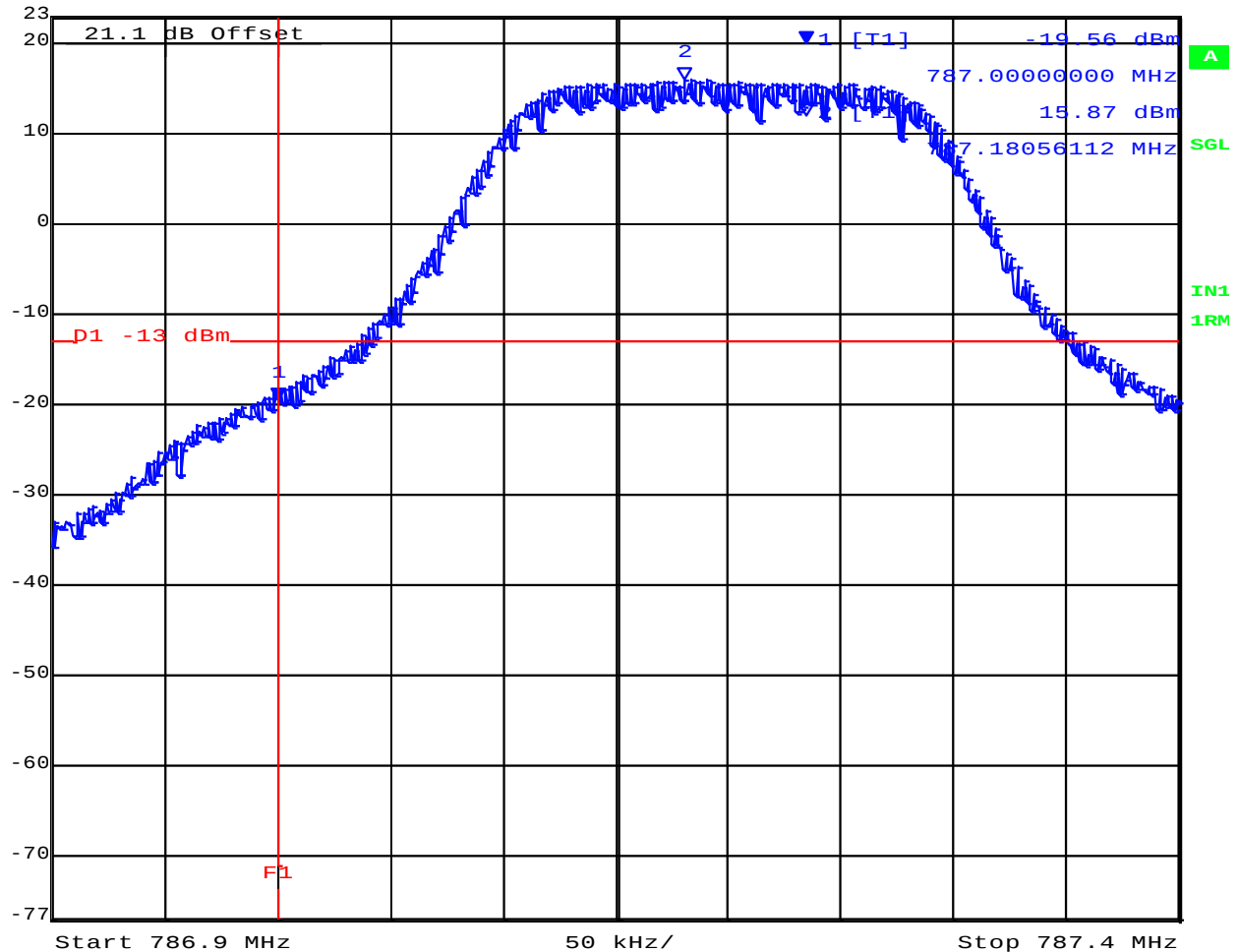


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.2 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl -19.56 dBm
 23 dBm 787.00000000 MHz
 RBW 30 kHz RF Att 20 dB
 VBW 100 kHz
 SWT 20 s Unit dBm



Date: 16.MAY.2019 10:22:12

[back to matrix](#)

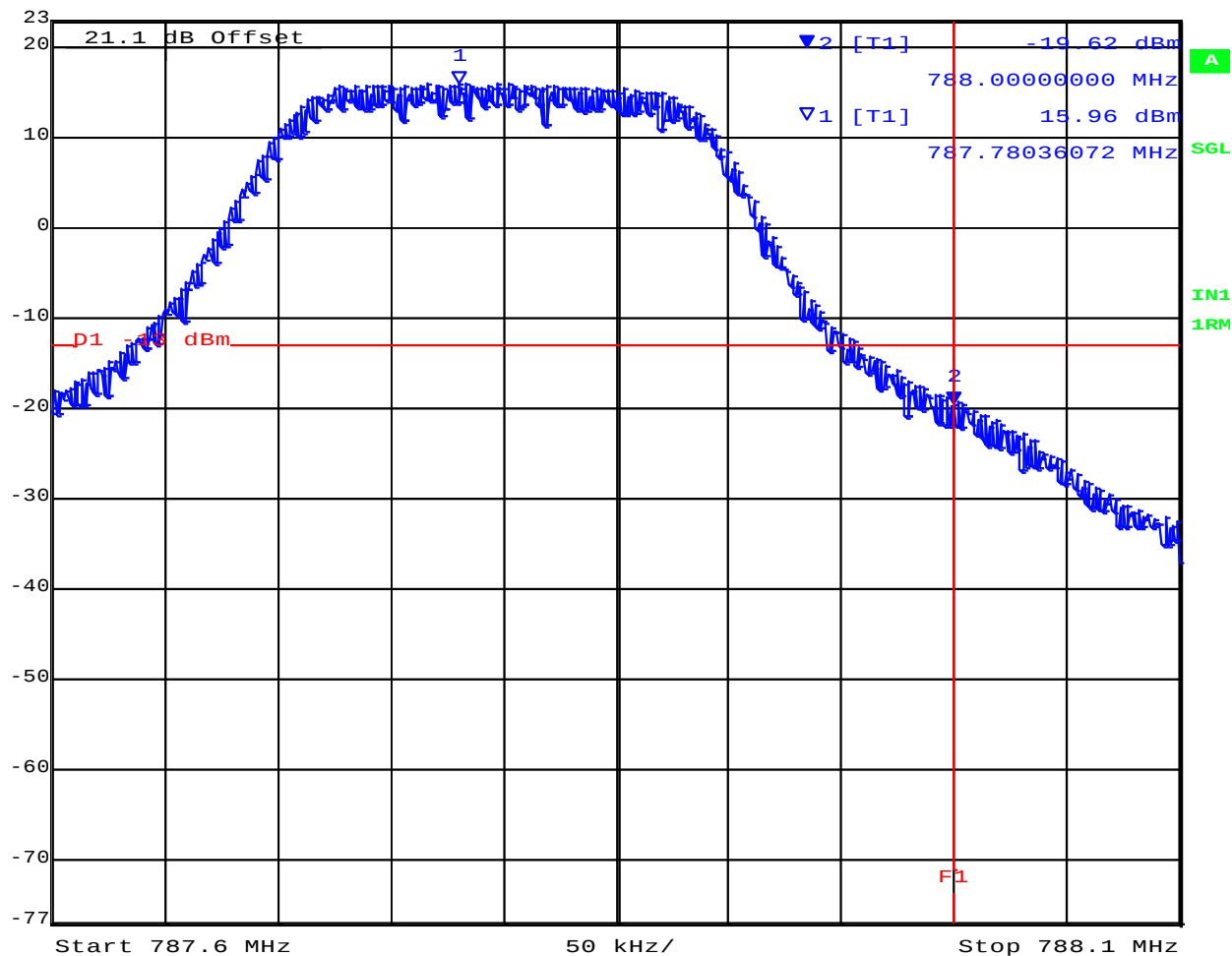
CONDUCTED SPURIOUS EMISSIONS - PEAK



Variant: NB IoT 180 KHz, Channel: 787.8 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



	Marker 2 [T1]	RBW	30 kHz	RF Att	20 dB
Ref Lvl	-19.62 dBm	VBW	100 kHz		
23 dBm	788.00000000 MHz	SWT	20 s	Unit	dBm



Date: 16.MAY.2019 10:11:17

[back to matrix](#)

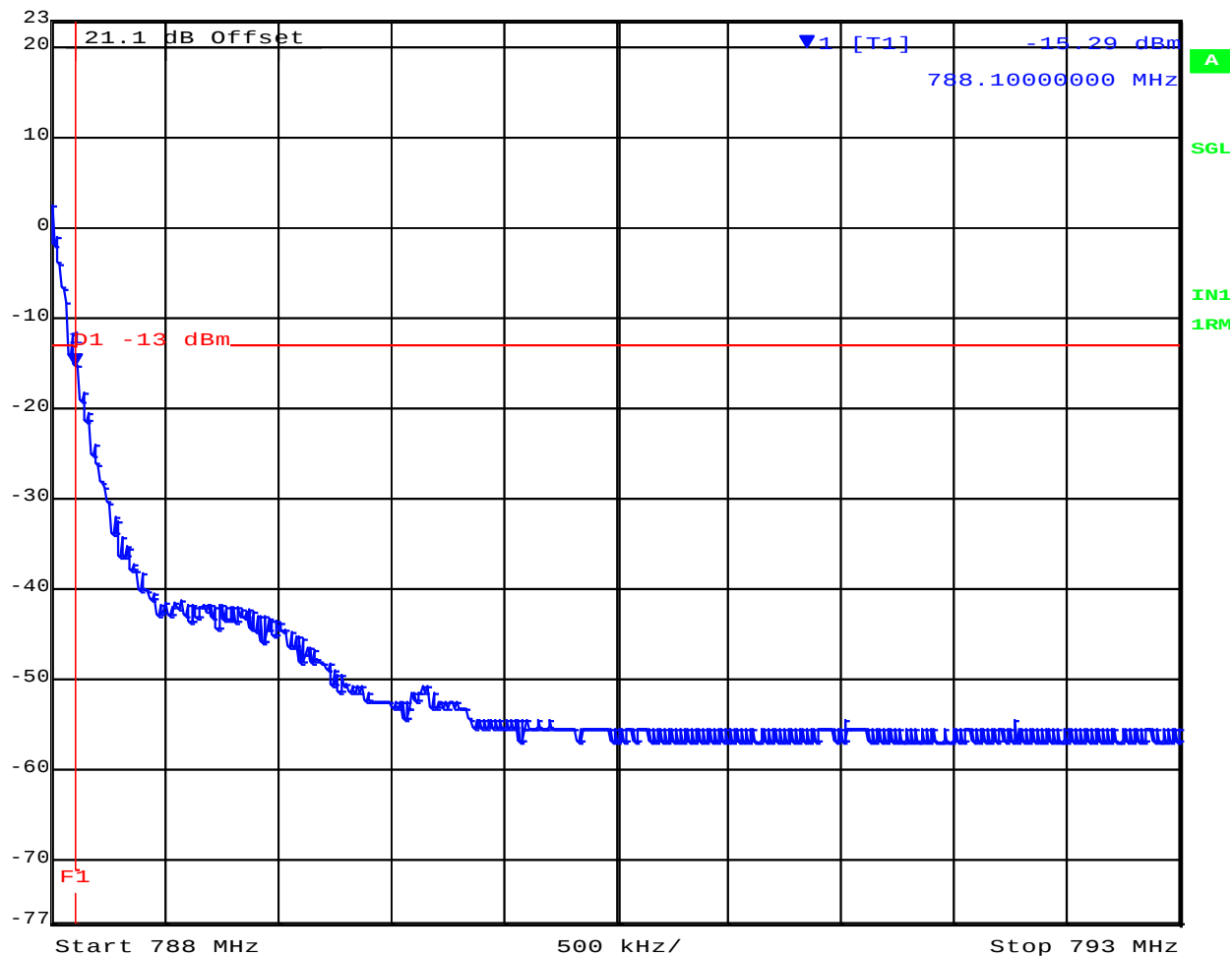


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.8 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl 23 dBm
 -15.29 dBm
 788.10000000 MHz
 RBW 100 kHz
 VBW 300 kHz
 SWT 20 s
 RF Att 20 dB
 Unit dBm



Date: 16.MAY.2019 10:58:44

[back to matrix](#)

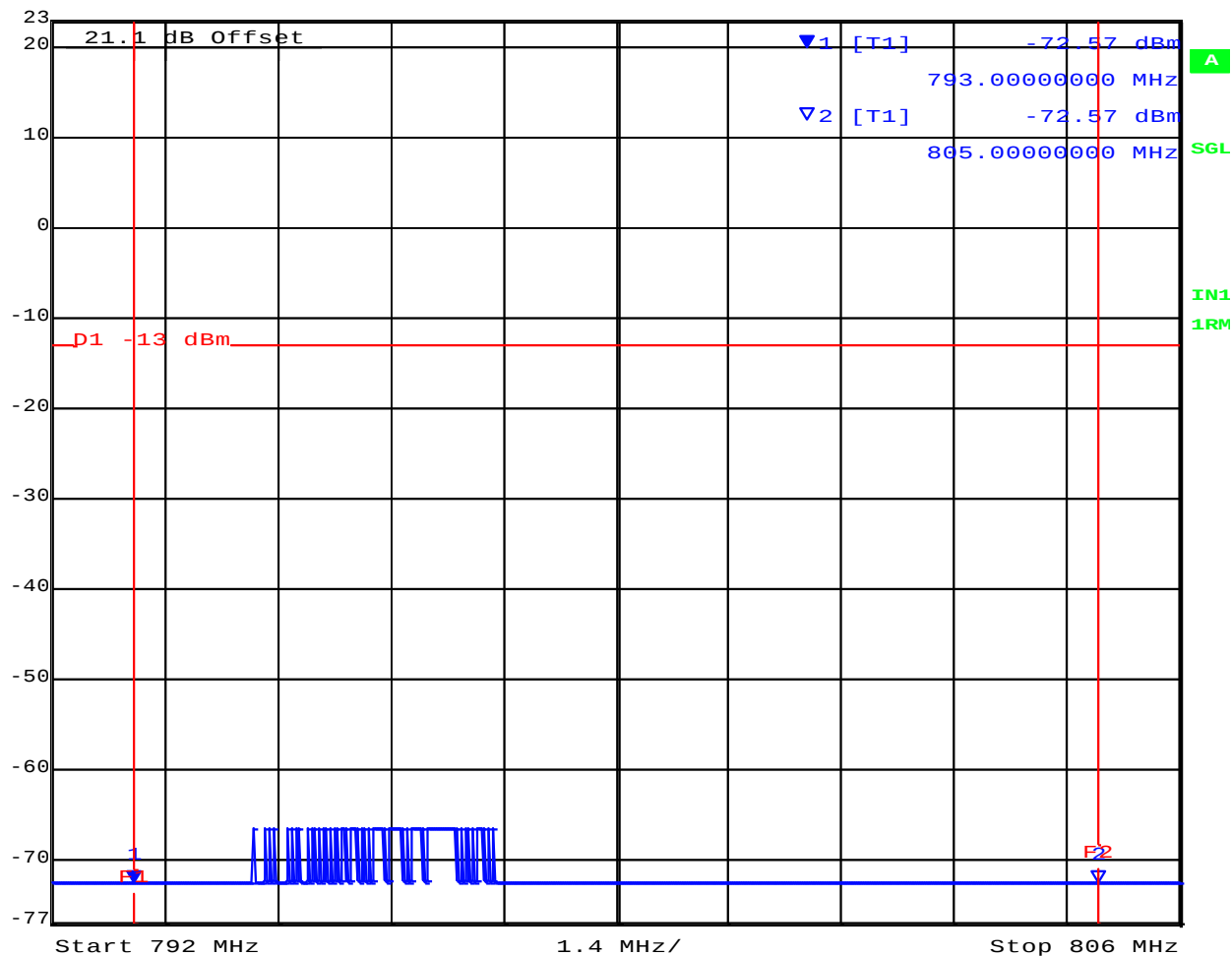


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.8 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl 23 dBm
 -72.57 dBm
 793.00000000 MHz
 RBW 10 kHz
 VBW 30 kHz
 SWT 20 s
 RF Att 20 dB
 Unit dBm



Date: 16.MAY.2019 11:02:47

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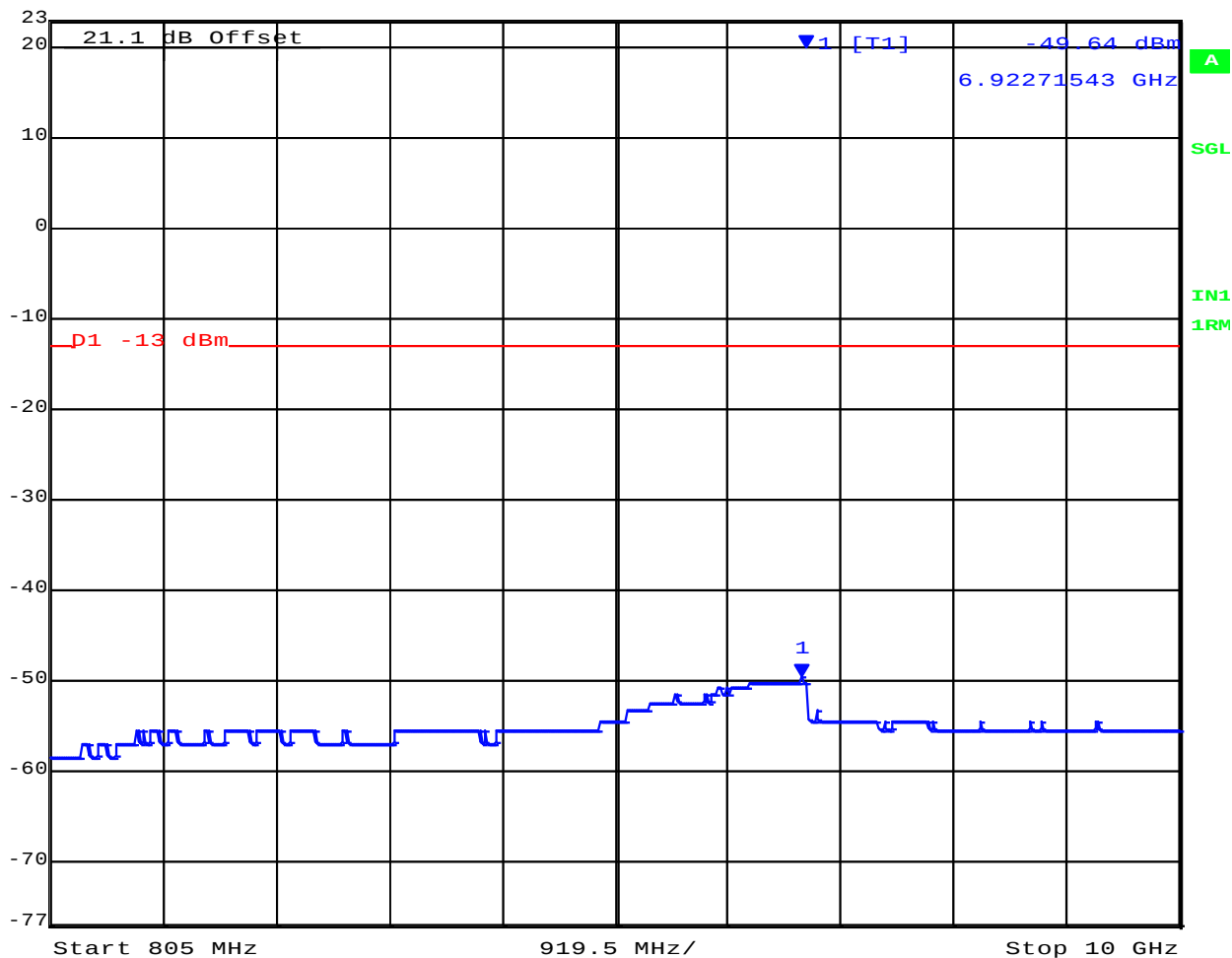


CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.8 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Marker 1 [T1]
 Ref Lvl 23 dBm
 -49.64 dBm
 6.92271543 GHz
 RBW 100 kHz
 VBW 300 kHz
 SWT 20 s
 RF Att 20 dB
 Unit dBm



Date: 16.MAY.2019 11:30:06

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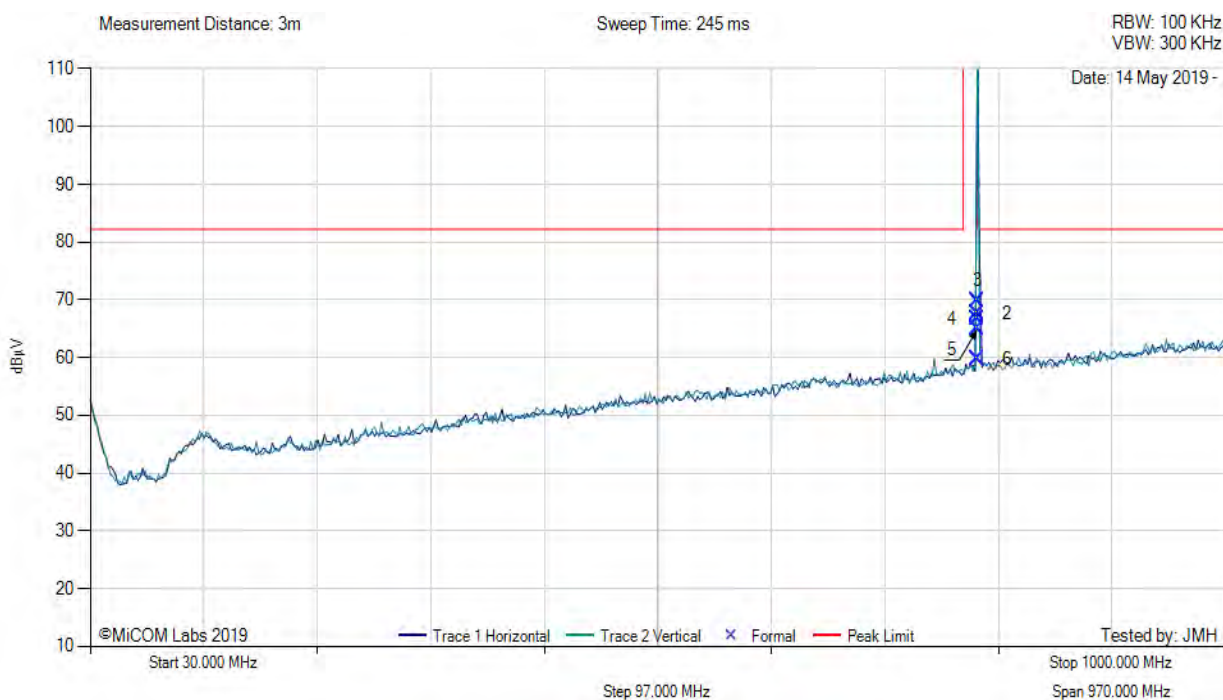
A.2.2. Radiated Emissions

A.2.2.2. TX Spurious Emissions

Dipole Antenna 30-1000 MHz



Variant: NB IOT BPSK 3.75 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



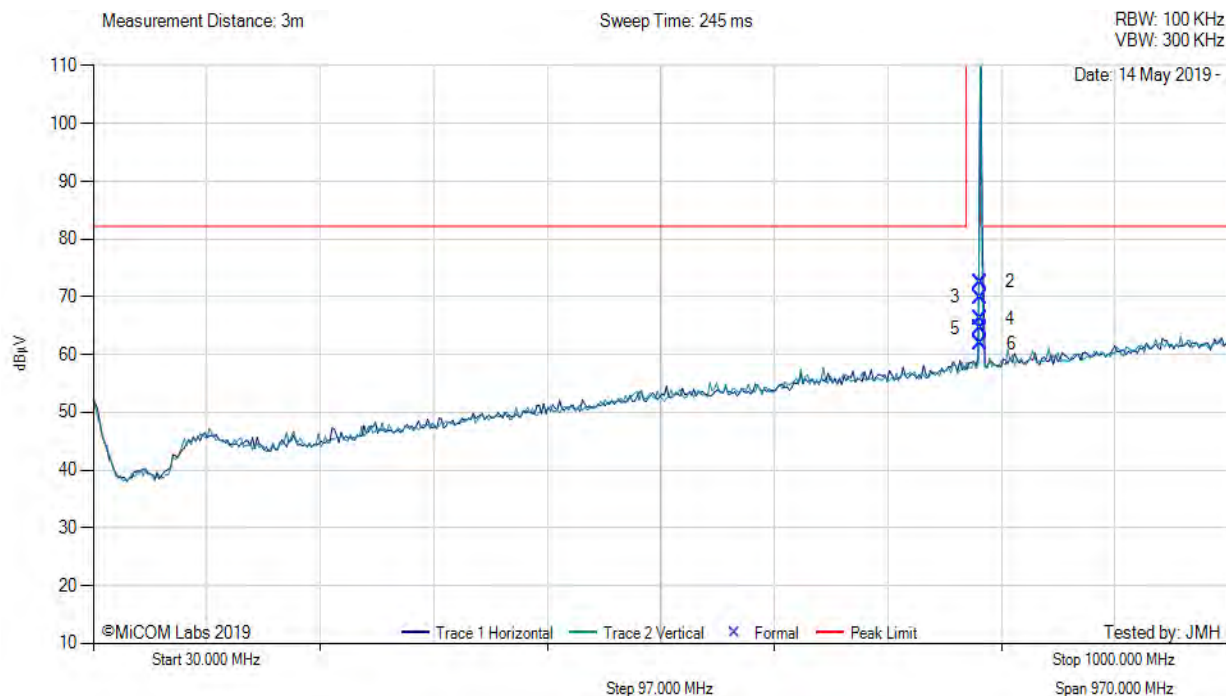
30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	787.95	113.32	6.33	-6.00	113.65	Fundamental	Vertical	100	0	--	--	
2	788.00	67.37	6.33	-6.00	67.70	MaxQP	Vertical	135	179	82.2	-14.5	Pass
3	788.10	69.56	6.33	-6.10	69.79	MaxQP	Vertical	104	305	82.2	-12.4	Pass
4	788.16	66.45	6.33	-6.10	66.68	MaxQP	Vertical	224	3	82.2	-15.6	Pass
5	788.22	64.77	6.33	-6.10	65.00	MaxQP	Vertical	152	311	82.2	-17.2	Pass
6	788.27	59.57	6.33	-6.10	59.80	MaxQP	Vertical	156	204	82.2	-22.4	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction.

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Variant: NB IOT BPSK 15 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



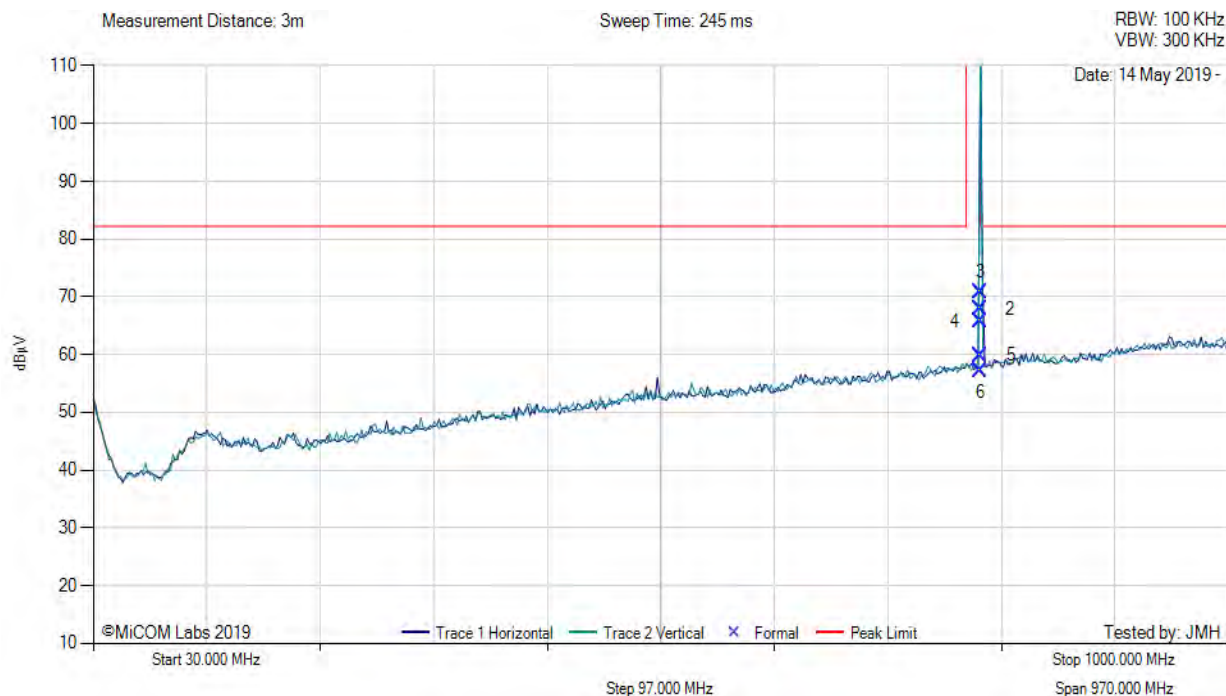
30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	787.95	113.25	6.33	-6.00	113.58	Fundamental	Vertical	100	0	--	--	
2	788.07	72.37	6.33	-6.10	72.60	MaxAvg	Vertical	122	191	82.2	-9.6	Pass
3	788.11	69.69	6.33	-6.10	69.92	MaxAvg	Vertical	194	203	82.2	-12.3	Pass
4	788.17	66.00	6.33	-6.10	66.23	MaxAvg	Vertical	157	305	82.2	-16.0	Pass
5	788.25	64.32	6.33	-6.10	64.55	MaxAvg	Vertical	127	301	82.2	-17.7	Pass
6	788.32	61.71	6.33	-6.10	61.94	MaxAvg	Vertical	138	326	82.2	-20.3	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction.

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Variant: NB IOT QPSK 3.75 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



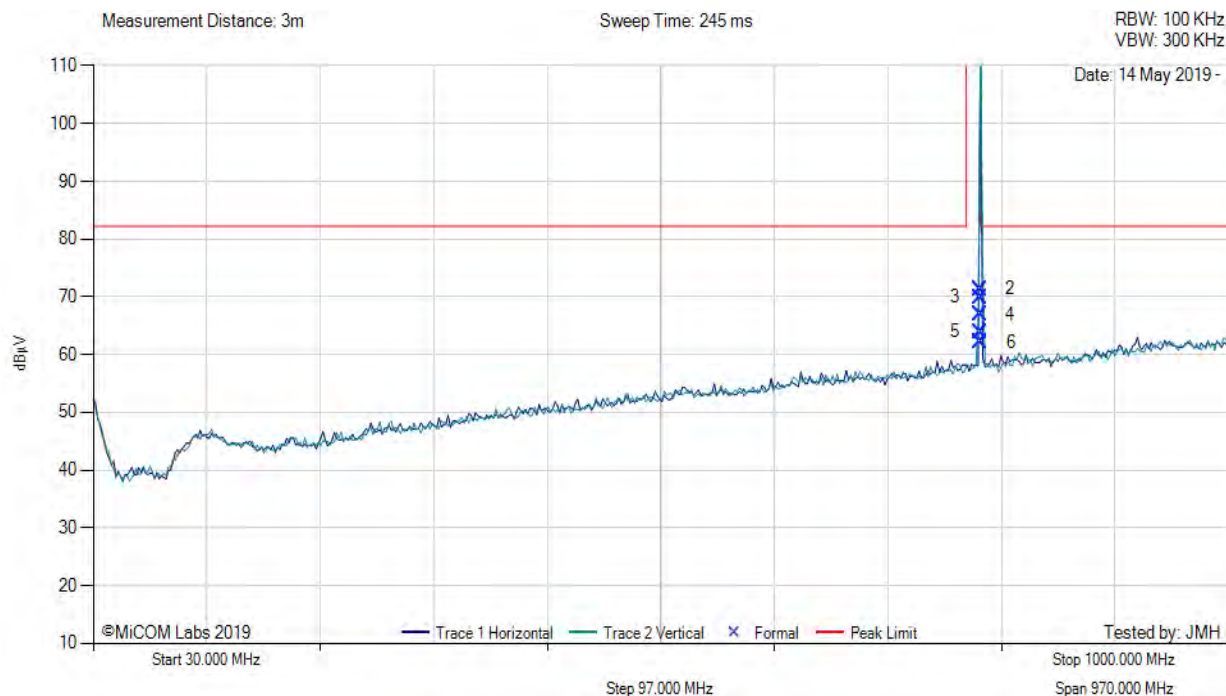
30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	787.95	113.17	6.33	-6.00	113.50	Fundamental	Vertical	100	0	--	--	
2	788.00	67.63	6.33	-6.00	67.96	MaxAvg	Vertical	131	100	82.2	-14.3	Pass
3	788.10	70.56	6.33	-6.10	70.79	MaxAvg	Vertical	125	179	82.2	-11.4	Pass
4	788.25	65.43	6.33	-6.10	65.66	MaxAvg	Vertical	138	288	82.2	-16.6	Pass
5	788.34	59.66	6.33	-6.10	59.89	MaxAvg	Vertical	123	311	82.2	-22.3	Pass
6	788.44	56.85	6.33	-6.10	57.08	MaxAvg	Vertical	167	311	82.2	-25.2	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

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Variant: NB IOT QPSK 15 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



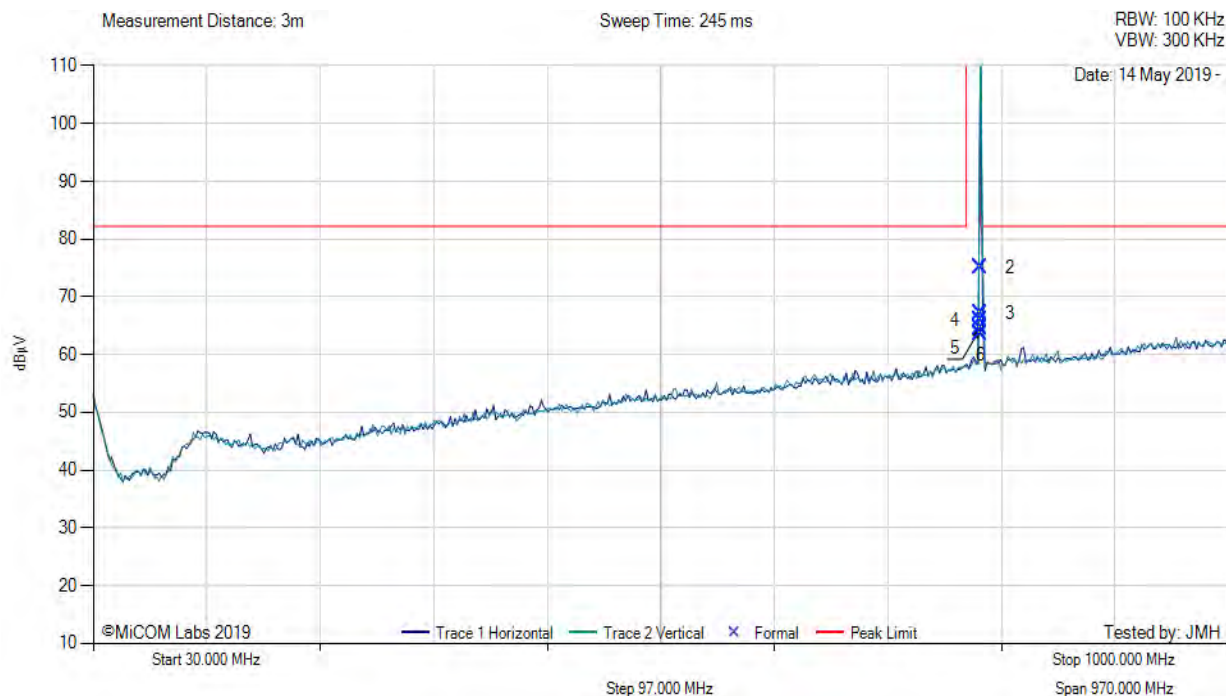
30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	787.95	112.83	6.33	-6.00	113.16	Fundamental	Vertical	100	0	--	--	
2	788.00	71.03	6.33	-6.00	71.36	MaxAvg	Vertical	120	180	82.2	-10.9	Pass
3	788.10	69.66	6.33	-6.10	69.89	MaxAvg	Vertical	125	179	82.2	-12.3	Pass
4	788.16	66.66	6.33	-6.10	66.89	MaxAvg	Vertical	148	296	82.2	-15.3	Pass
5	788.33	63.72	6.33	-6.10	63.95	MaxAvg	Vertical	126	209	82.2	-18.3	Pass
6	788.44	61.96	6.33	-6.10	62.19	MaxAvg	Vertical	133	315	82.2	-20.0	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

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Variant: NB IOT QPSK 180 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	787.84	113.72	6.33	-6.00	114.05	Fundamental	Vertical	100	0	--	--	
2	788.00	74.77	6.33	-6.00	75.10	MaxAvg	Vertical	111	188	82.2	-7.1	Pass
3	788.11	66.88	6.33	-6.10	67.11	MaxAvg	Vertical	148	291	82.2	-15.1	Pass
4	788.15	65.77	6.33	-6.10	66.00	MaxAvg	Vertical	159	305	82.2	-16.2	Pass
5	788.25	64.40	6.33	-6.10	64.63	MaxAvg	Vertical	133	275	82.2	-17.6	Pass
6	788.30	63.37	6.33	-6.10	63.60	MaxAvg	Vertical	144	181	82.2	-18.6	Pass

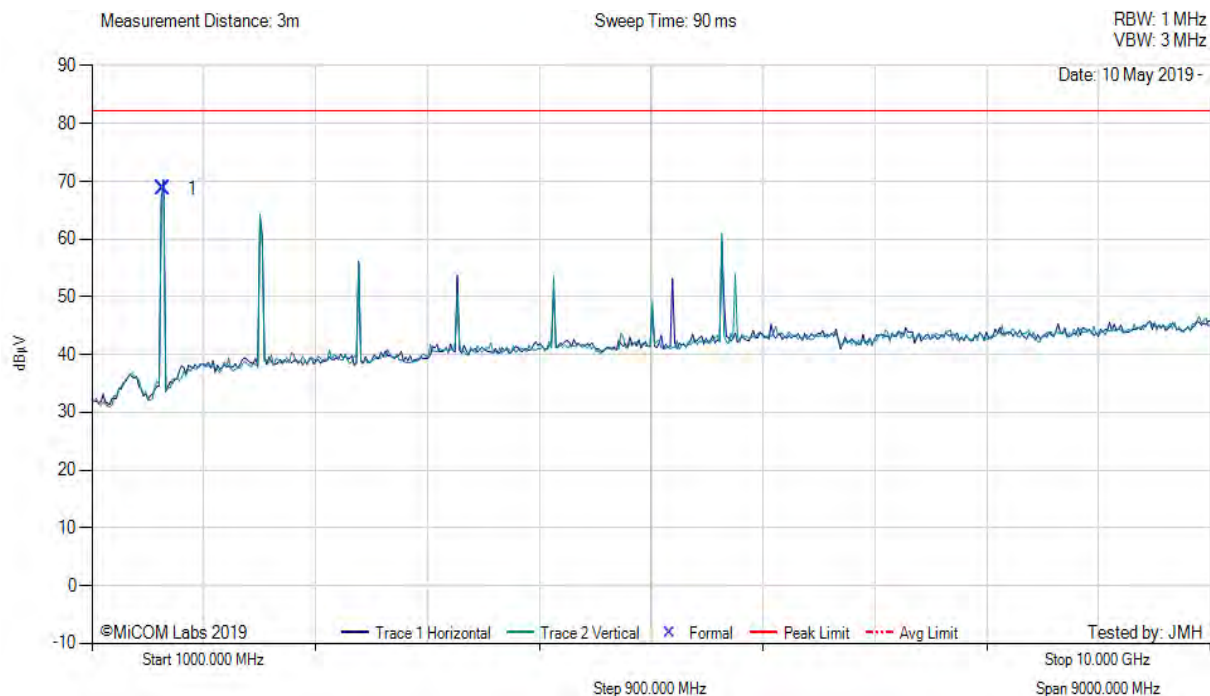
Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction.

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Dipole Antenna 1-10 GHz



Variant: NB IOT BPSK 3.75 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass/Fail
1	1574.95	90.78	-1.43	-16.56	68.79	Peak (Scan)	Horizontal	100	132	82.2	*	Pass

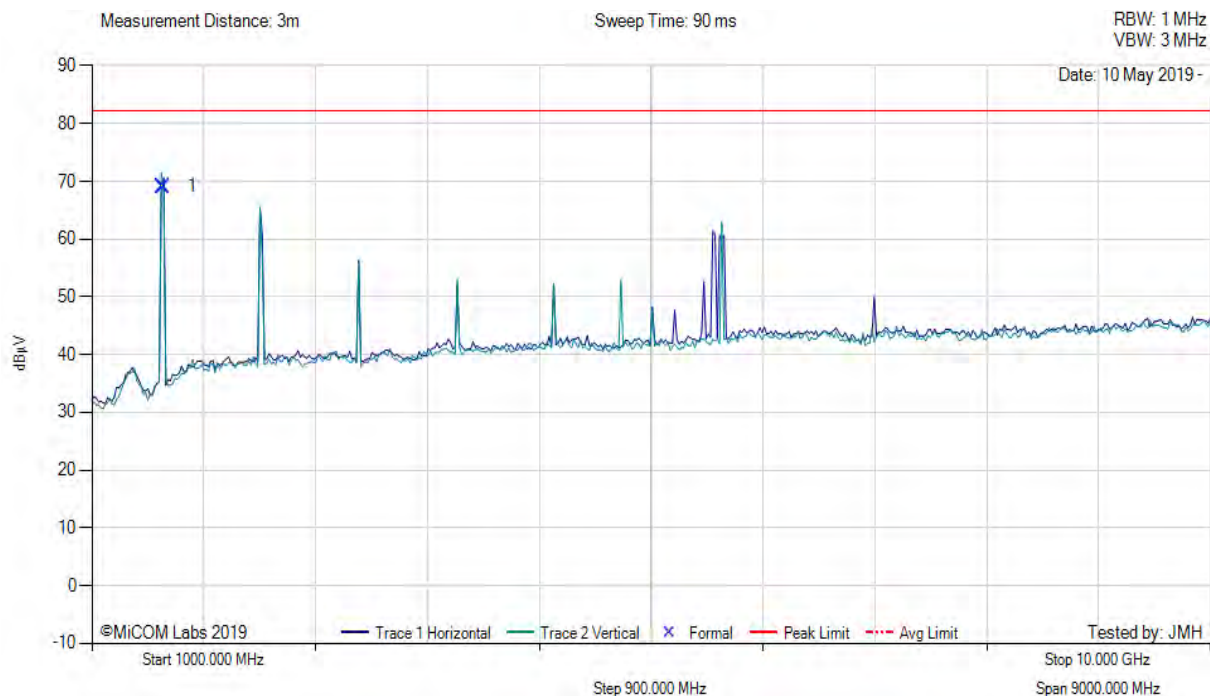
Test Notes: EUT powered up linked to Base station via antenna. 1577 MHz has separate limit and is tested separately

*1559-1610 MHz has separate limits, See GPS Band Emissions in Section 9.5.2.3

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Variant: NB IOT BPSK 15 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



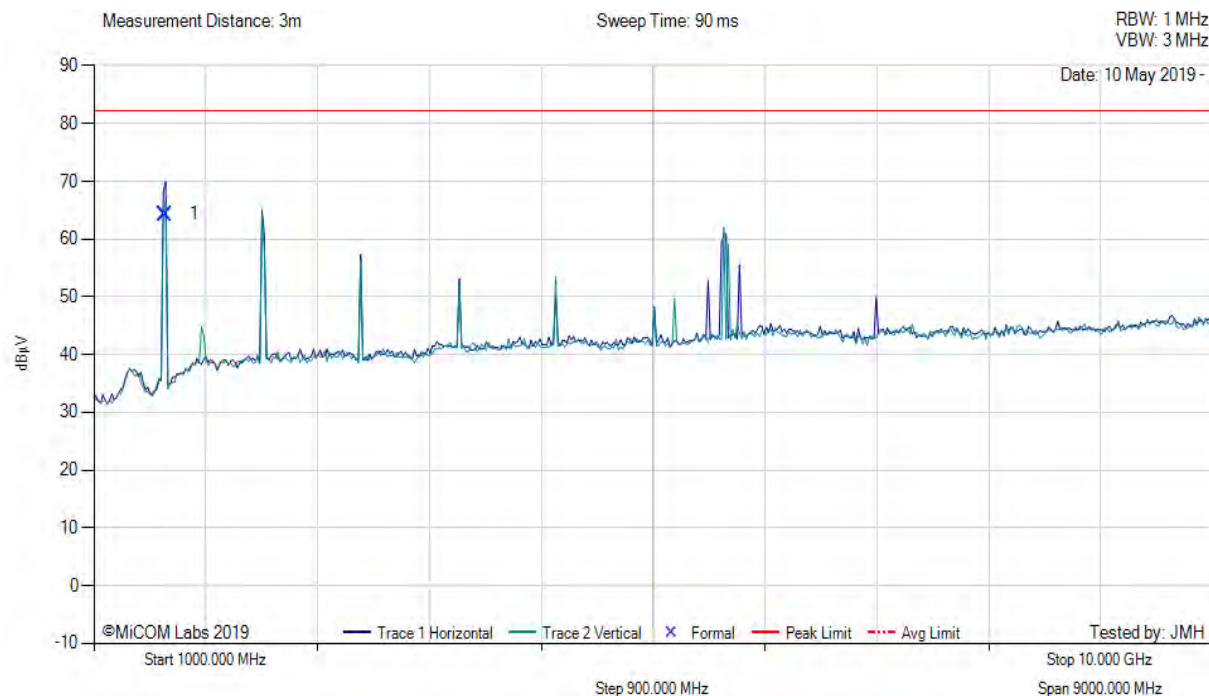
1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1574.89	87.09	-1.43	-16.56	69.10	Peak (Scan)	Horizontal	100	40	82.2	*	Pass

Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

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Variant: NB IOT QPSK 3.75 KHz, Test Freq: 787.50 MHz, Antenna: dipole, Power Setting: 23, Duty Cycle (%): 85



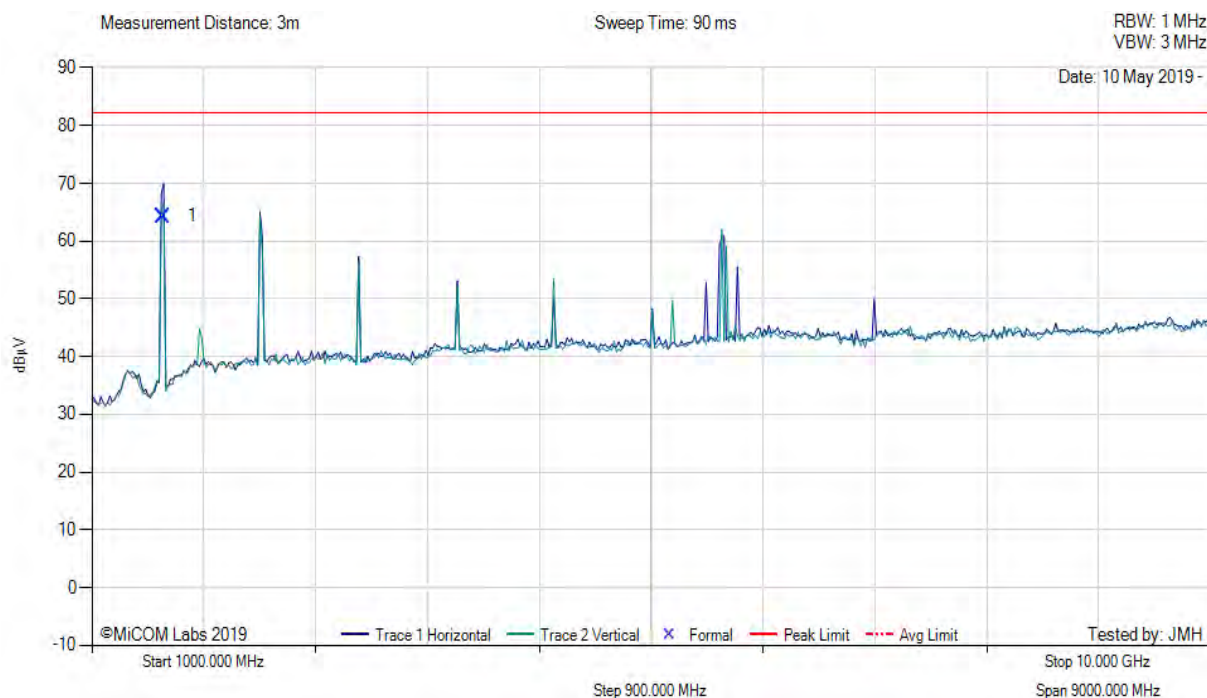
1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1574.91	82.33	-1.43	-16.56	64.34	Peak (Scan)	Horizontal	100	0	82.2	*	Pass

Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

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Variant: NB IOT QPSK 15 KHz, Test Freq: 787.50 MHz, Antenna: dipole, Power Setting: 23, Duty Cycle (%): 85



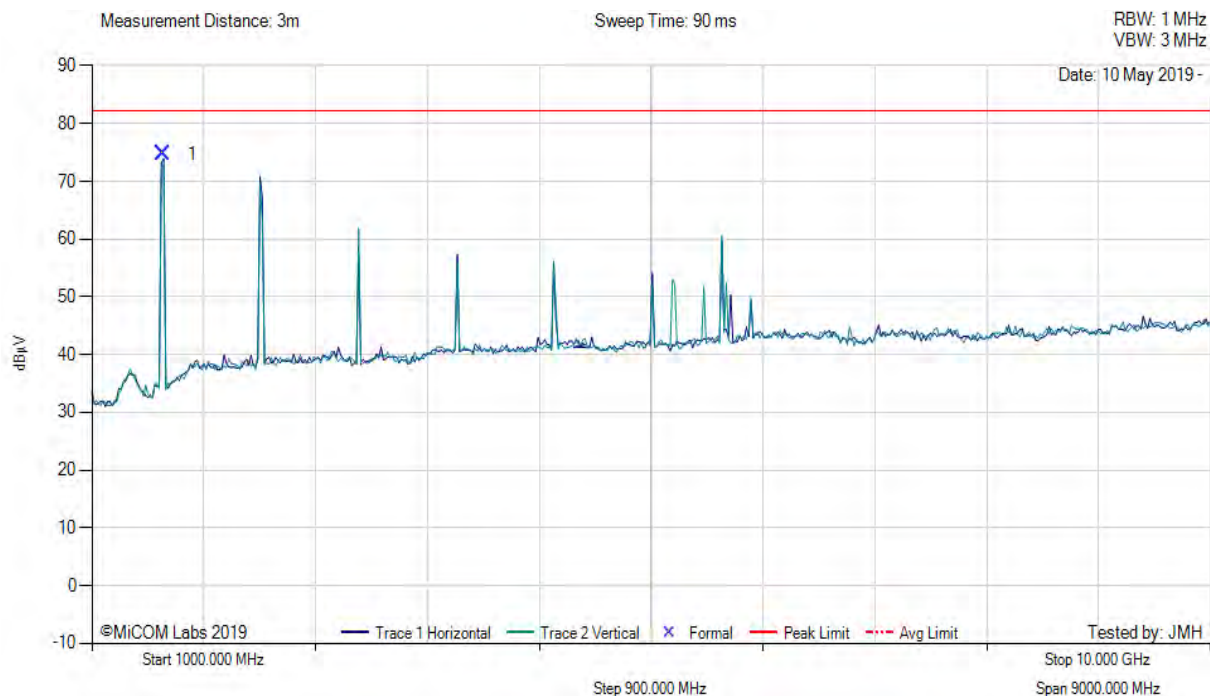
1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1574.91	82.33	-1.43	-16.56	64.34	Peak (Scan)	Horizontal	100	0	82.2	*	Pass

Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

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Variant: NB IOT QPSK 180 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1574.89	92.65	-1.43	-16.56	74.66	Peak (Scan)	Horizontal	100	36	82.2	*	Pass

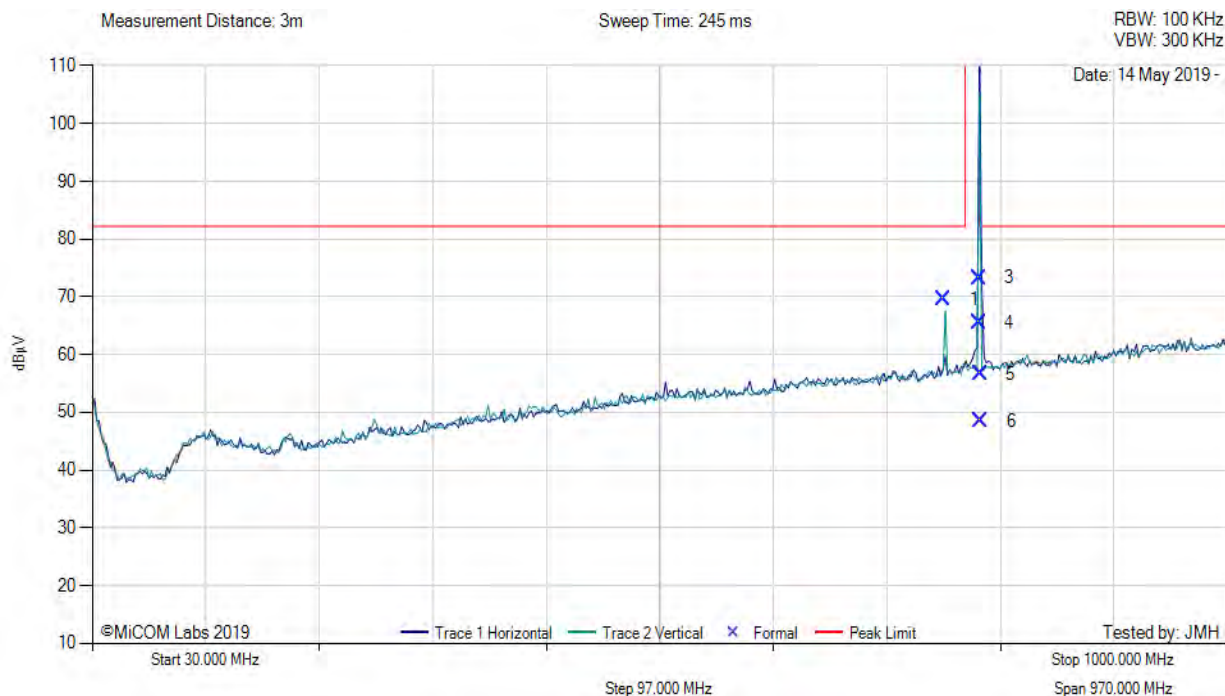
Test Notes: EUT powered up linked to Base station via antenna. Multicarrier. *1559-1610 MHz is in GPS band with separate limit measured separately.

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Yagi Antenna 30-1000 MHz



Variant: NB IOT BPSK 3.75 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



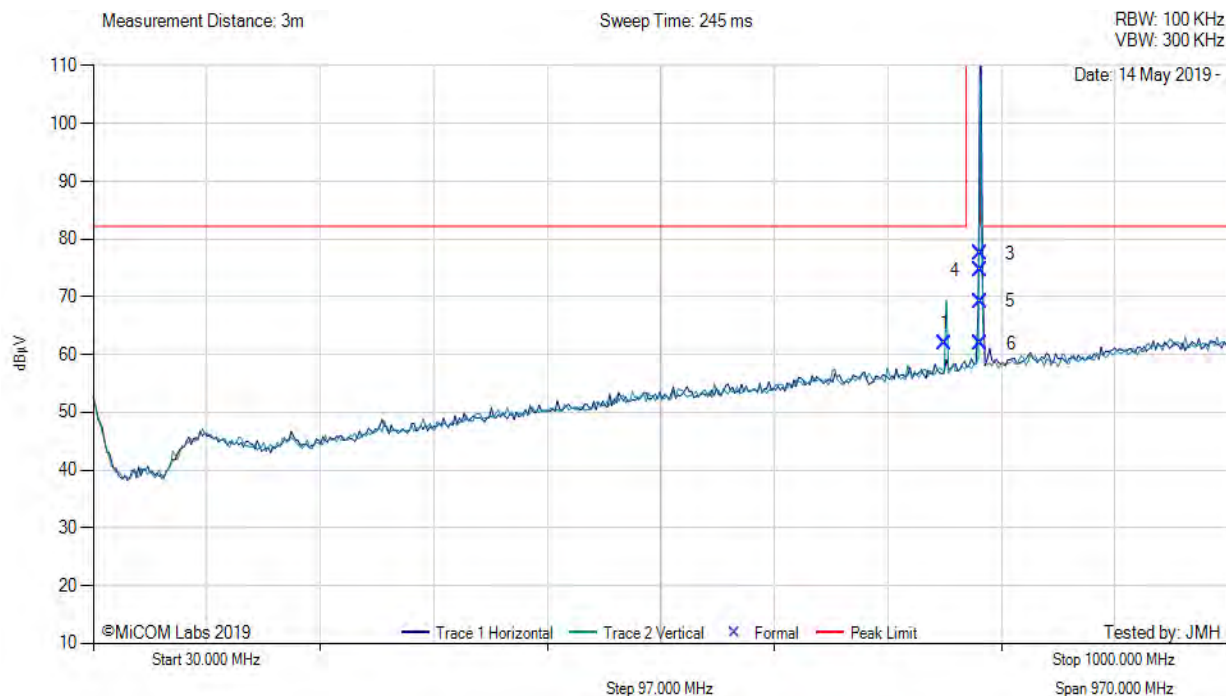
30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	757.82	69.78	6.26	-6.50	69.54	MaxQP	Vertical	100	277	82.2	-12.7	Pass
2	787.84	114.01	6.33	-6.00	114.34	Fundamental	Horizontal	100	0	--	--	
3	788.00	72.99	6.33	-6.00	73.32	MaxQP	Horizontal	100	356	82.2	-8.9	Pass
4	788.22	65.19	6.33	-6.10	65.42	MaxQP	Horizontal	100	37	82.2	-16.8	Pass
5	788.88	56.35	6.33	-6.10	56.58	MaxQP	Horizontal	100	0	82.2	-25.7	Pass
6	789.54	48.17	6.33	-6.00	48.50	MaxQP	Horizontal	101	5	82.2	-33.7	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

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Variant: NB IOT BPSK 15 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



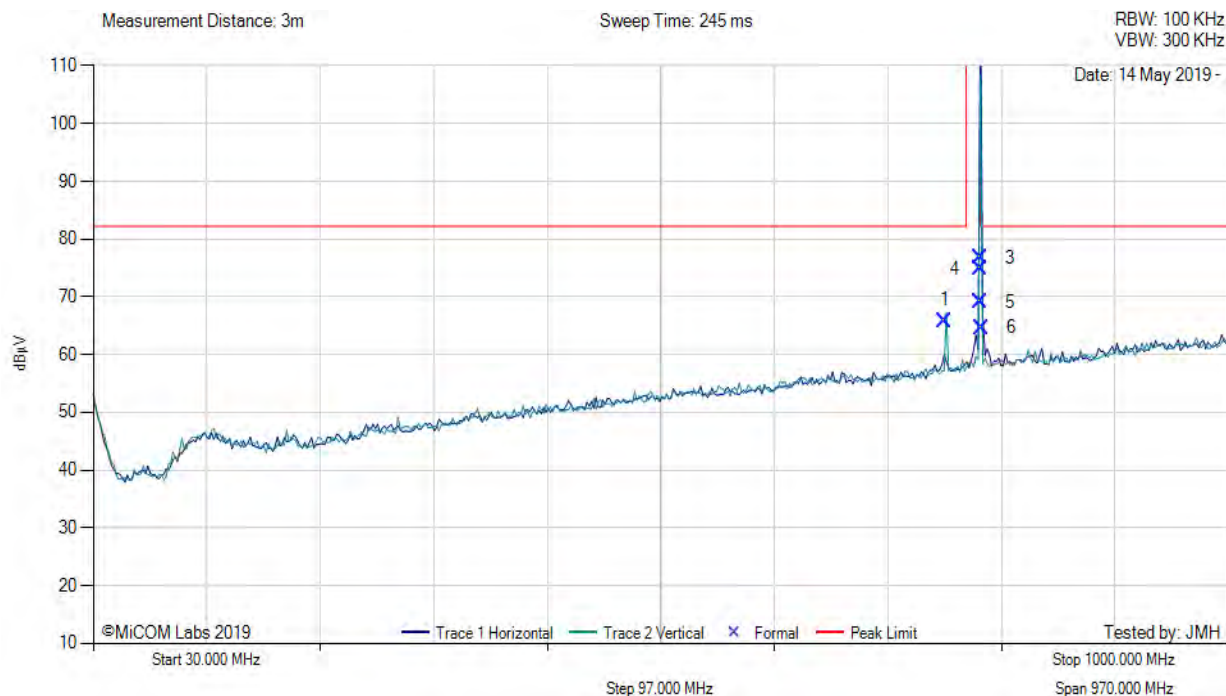
30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	757.78	62.09	6.26	-6.50	61.85	MaxAvg	Horizontal	101	5	82.2	-20.4	Pass
2	787.84	121.98	6.33	-6.00	122.31	Fundamental	Horizontal	100	0	--	--	
3	788.00	77.07	6.33	-6.00	77.40	MaxAvg	Horizontal	100	356	82.2	-4.8	Pass
4	788.10	74.37	6.33	-6.10	74.60	MaxAvg	Horizontal	100	356	82.2	-7.6	Pass
5	788.24	68.94	6.33	-6.10	69.17	MaxAvg	Horizontal	100	37	82.2	-13.1	Pass
6	788.42	61.69	6.33	-6.10	61.92	MaxAvg	Horizontal	100	0	82.2	-20.3	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

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Variant: NB IOT QPSK 3.75 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



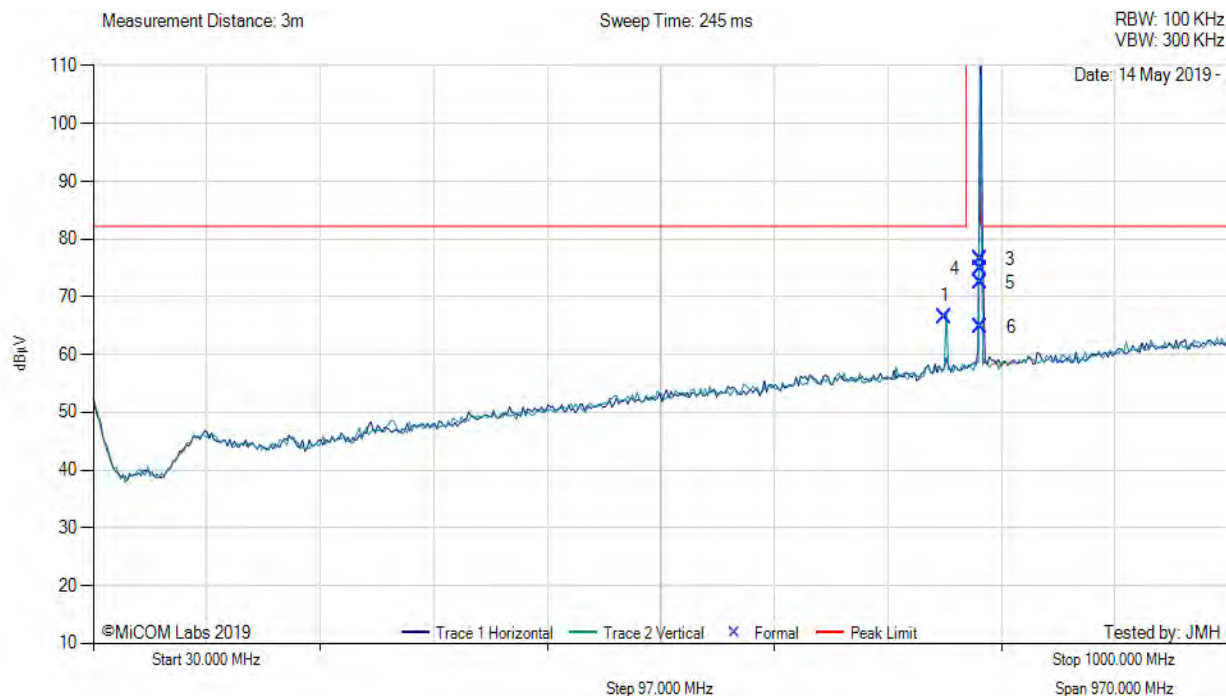
30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	757.85	66.11	6.26	-6.50	65.87	MaxAvg	Vertical	101	341	82.2	-16.4	Pass
2	787.80	121.98	6.33	-6.00	122.31	Fundamental	Horizontal	100	0	--	--	
3	788.00	76.47	6.33	-6.00	76.80	MaxAvg	Horizontal	202	4	82.2	-5.4	Pass
4	788.10	74.67	6.33	-6.10	74.90	MaxAvg	Horizontal	100	356	82.2	-7.3	Pass
5	788.25	68.89	6.33	-6.10	69.12	MaxAvg	Horizontal	212	0	82.2	-13.1	Pass
6	788.77	64.46	6.33	-6.10	64.69	MaxAvg	Horizontal	101	357	82.2	-17.5	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

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Variant: NB IOT QPSK 15 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



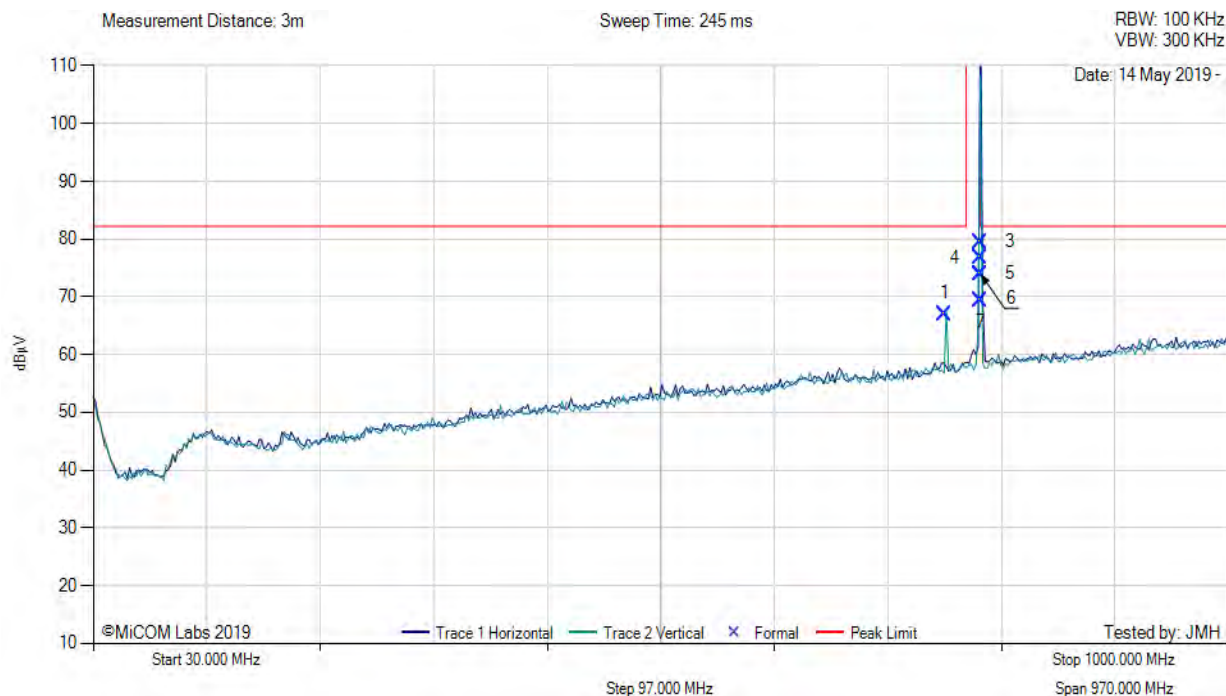
30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	757.75	66.84	6.26	-6.50	66.60	MaxAvg	Vertical	109	231	82.2	-15.6	Pass
2	787.84	121.92	6.33	-6.00	122.25	Fundamental	Horizontal	100	0	--	--	
3	788.06	76.27	6.33	-6.10	76.50	MaxAvg	Horizontal	106	357	82.2	-5.7	Pass
4	788.13	74.67	6.33	-6.10	74.90	MaxAvg	Horizontal	104	18	82.2	-7.3	Pass
5	788.24	72.27	6.33	-6.10	72.50	MaxAvg	Horizontal	104	10	82.2	-9.7	Pass
6	788.46	64.47	6.33	-6.10	64.70	MaxAvg	Horizontal	184	2	82.2	-17.5	Pass

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

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Variant: NB IOT QPSK 180 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	757.77	67.33	6.26	-6.50	67.09	MaxAvg	Vertical	106	338	82.2	-15.1	Pass
2	787.84	122.14	6.33	-6.00	122.47	Fundamental	Horizontal	100	0	--	--	
3	788.00	79.17	6.33	-6.00	79.50	MaxAvg	Horizontal	113	3	82.2	-2.7	Pass
4	788.13	76.57	6.33	-6.10	76.80	MaxAvg	Horizontal	101	2	82.2	-5.4	Pass
5	788.23	73.74	6.33	-6.10	73.97	MaxAvg	Horizontal	117	350	82.2	-8.3	Pass
6	788.30	73.73	6.33	-6.10	73.96	MaxAvg	Horizontal	110	0	82.2	-8.3	Pass
7	788.39	69.13	6.33	-6.10	69.36	MaxAvg	Horizontal	114	10	82.2	-12.9	Pass

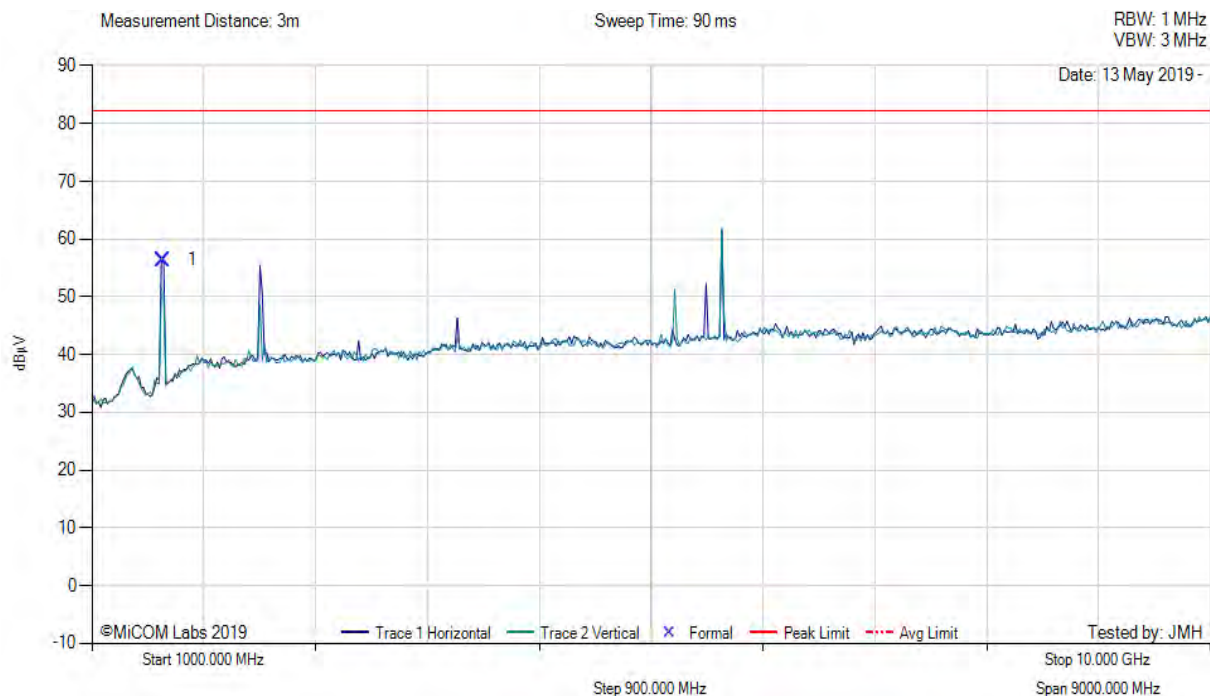
Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction

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Yagi Antenna 1-10 GHz



Variant: NB IOT BPSK 3.75 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



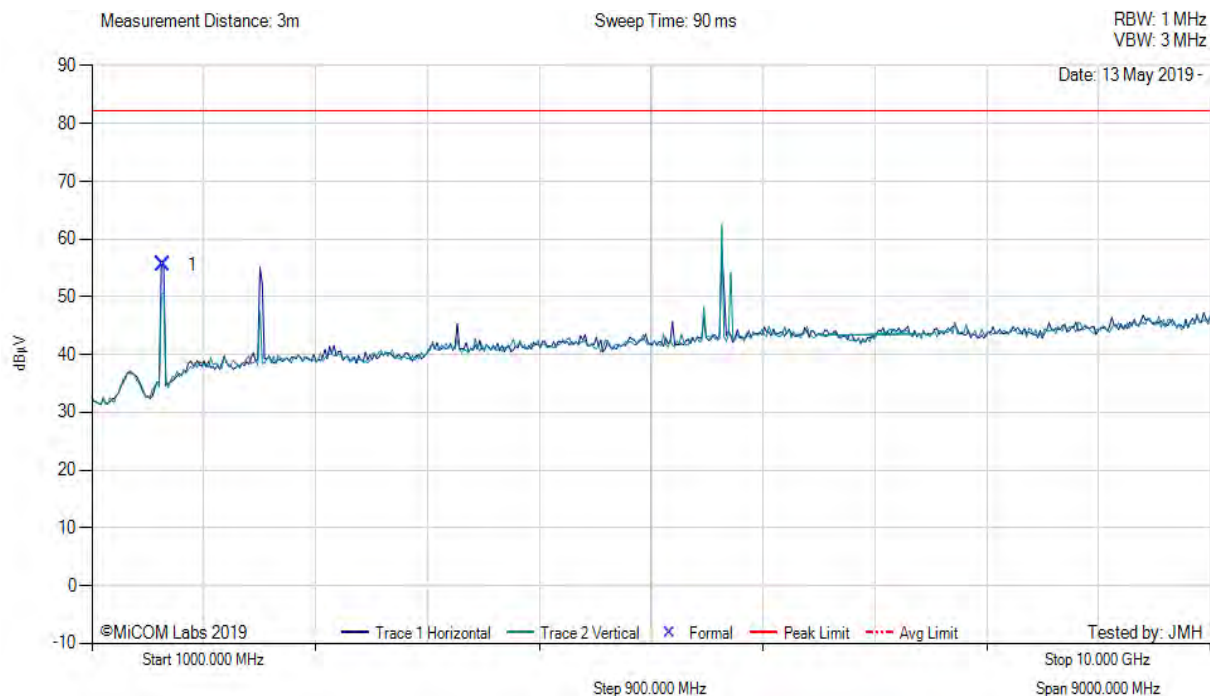
1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1574.87	74.42	-1.43	-16.56	56.43	Peak (Scan)	Horizontal	100	0	82.2	*	Pass

Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

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Variant: NB IOT BPSK 15 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



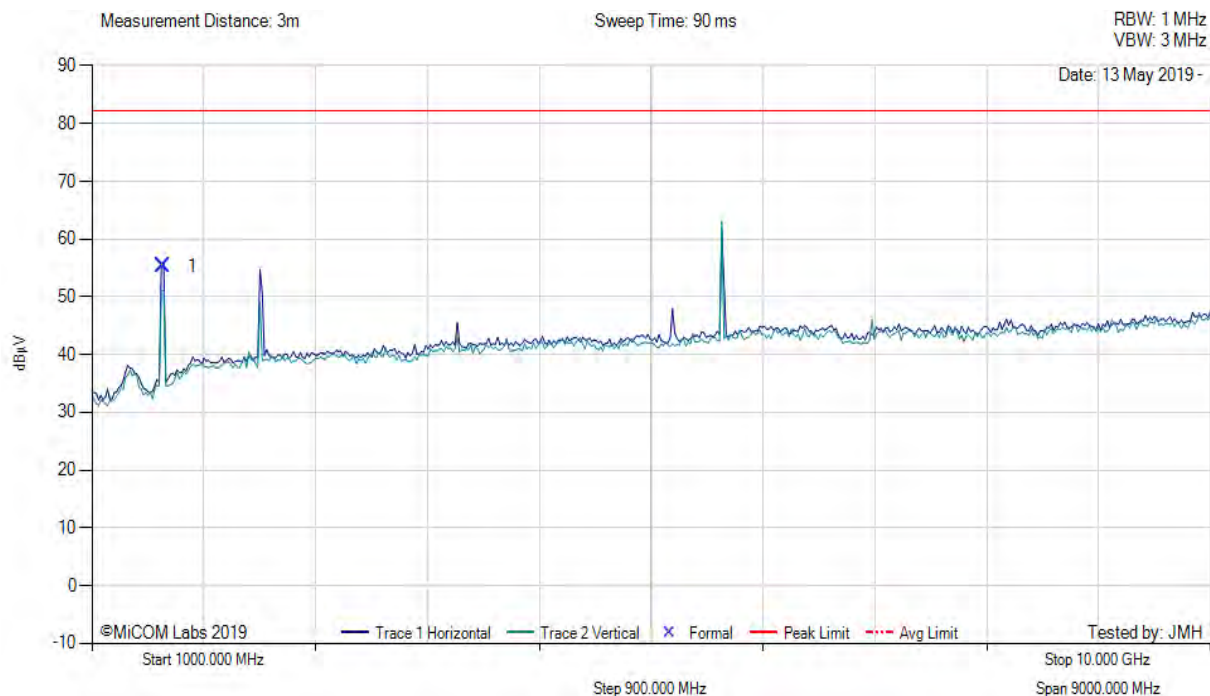
1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1574.96	73.50	-1.43	-16.56	55.51	Peak (Scan)	Horizontal	100	0	82.2	*	Pass

Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

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Variant: NB IOT QPSK 3.75 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



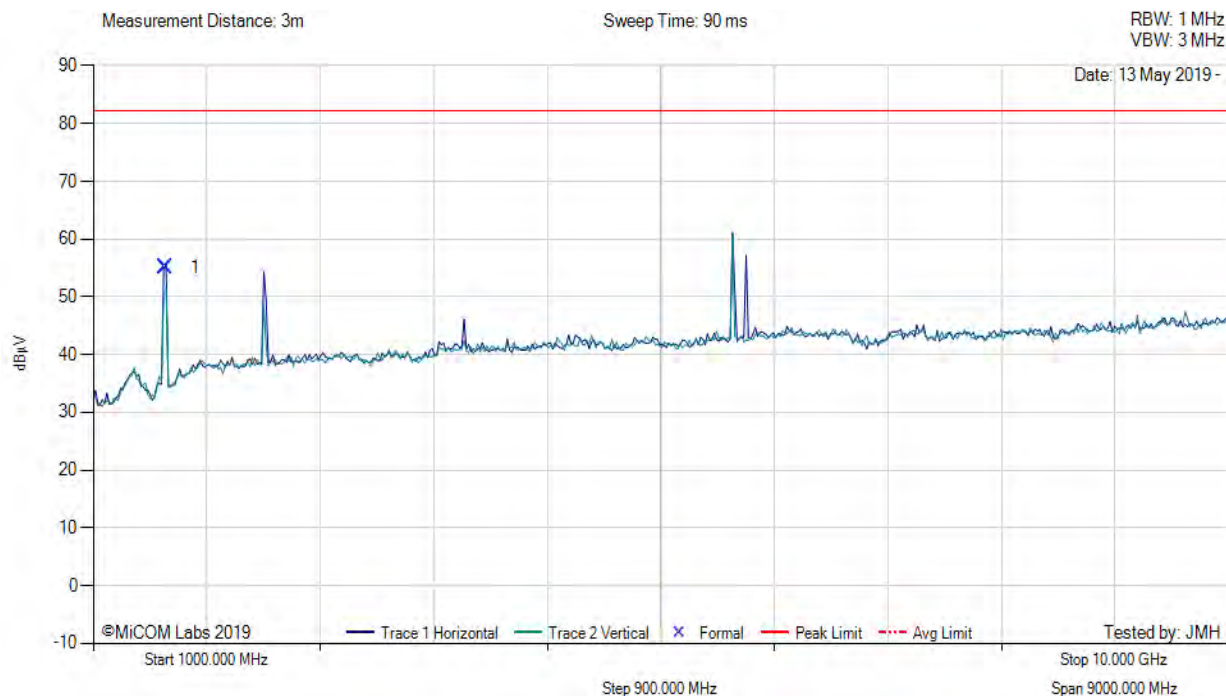
1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1574.84	73.34	-1.43	-16.56	55.35	Peak (Scan)	Horizontal	100	0	82.2	*	Pass

Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

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Variant: NB IOT QPSK 15 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



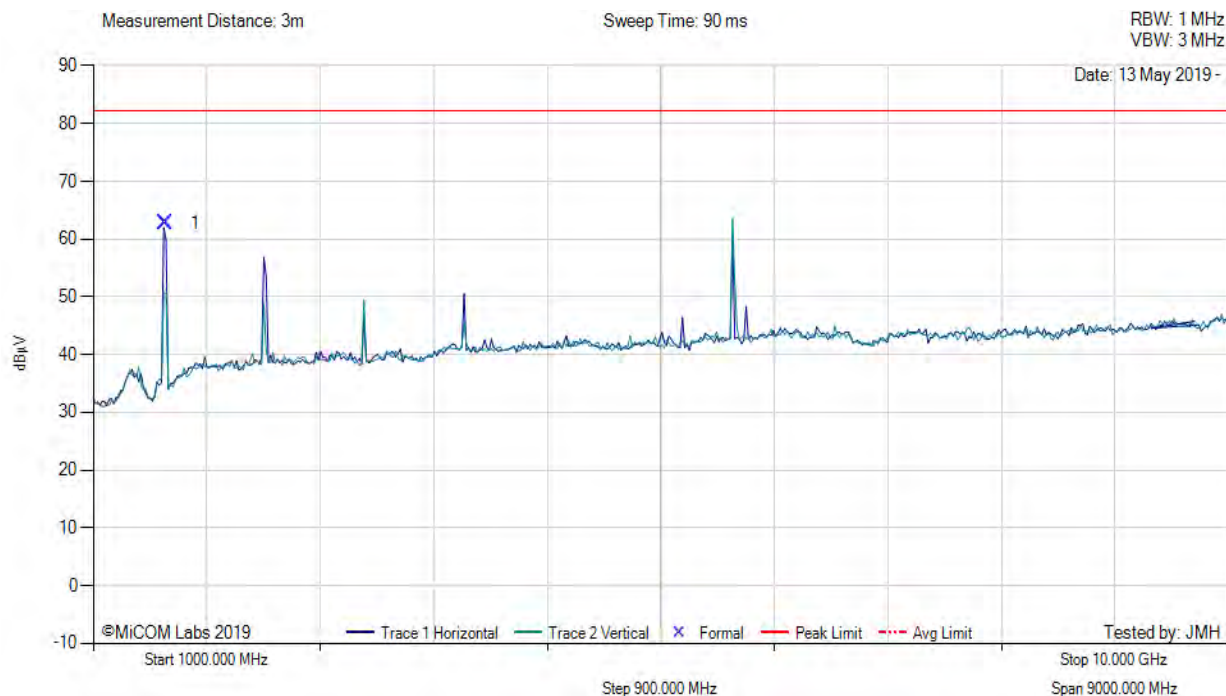
1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1575.00	73.14	-1.43	-16.57	55.14	Peak (Scan)	Horizontal	100	0	82.2	*	Pass

Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

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Variant: NB IOT QPSK 180 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1574.87	80.66	-1.43	-16.56	62.67	Peak (Scan)	Horizontal	100	0	82.2	*	Pass

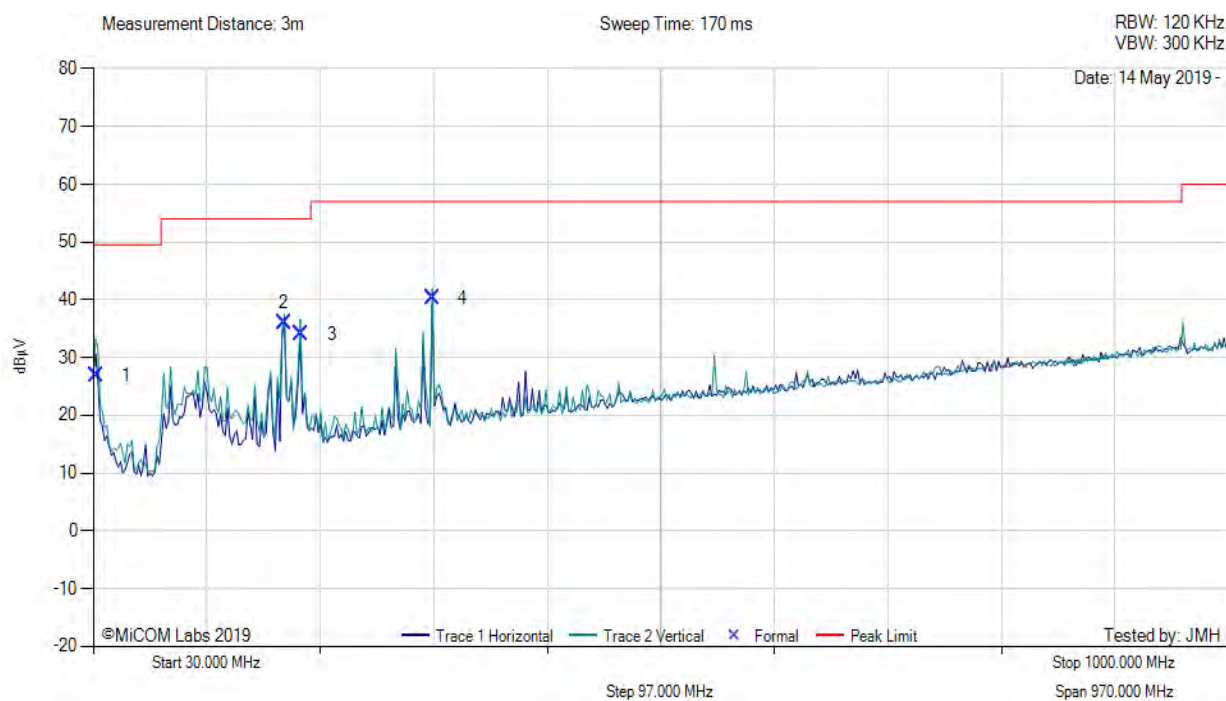
Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

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A.2.3. Digital Emissions



Variant: NB IOT, Test Freq: 0.00 MHz, Power Setting: NA, Duty Cycle (%): NA



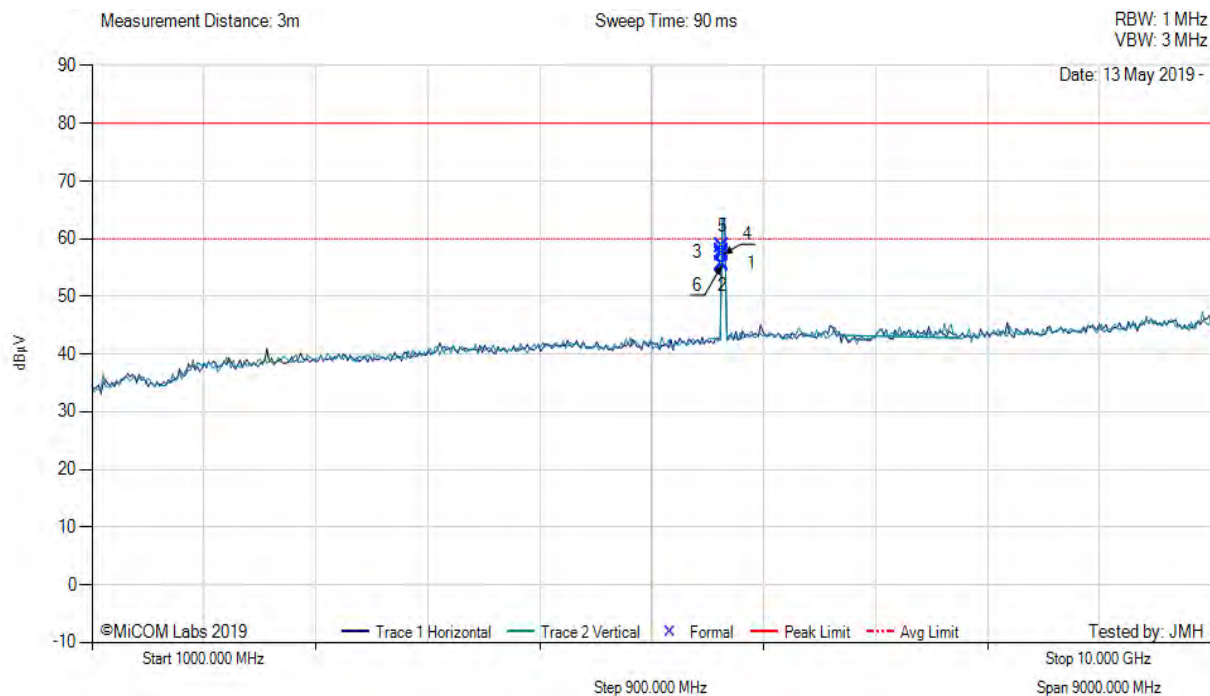
30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	32.55	32.76	3.54	-9.40	26.90	MaxQP	Vertical	98	268	49.5	-22.6	Pass
2	193.02	48.11	4.43	-16.50	36.04	MaxQP	Vertical	98	356	54.0	-18.0	Pass
3	207.94	46.81	4.49	-17.20	34.10	MaxQP	Vertical	113	4	54.0	-19.9	Pass
4	320.02	49.29	4.91	-13.90	40.30	MaxQP	Vertical	99	51	57.0	-16.7	Pass

Test Notes: EUT powered by AC/DC PS.

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Variant: NB IOT, Test Freq: 0.00 MHz, Power Setting: Not Applicable, Duty Cycle (%): 80



1000.00 - 10000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	6064.07	68.53	-2.84	-10.00	55.69	Max Peak	Vertical	178	32	80.0	-24.3	Pass
2	6064.07	68.33	-2.84	-10.00	55.49	Max Avg	Vertical	178	32	60.0	-4.5	Pass
3	6068.87	71.37	-2.85	-9.84	57.68	Max Peak	Horizontal	101	295	80.0	-22.3	Pass
4	6068.87	69.94	-2.85	-9.84	57.25	Max Avg	Horizontal	101	295	60.0	-2.8	Pass
5	6068.92	71.29	-2.85	-9.84	58.60	Max Peak	Vertical	123	194	80.0	-21.4	Pass
6	6068.92	68.30	-2.85	-9.84	55.61	Max Avg	Vertical	123	194	60.0	-4.4	Pass

Test Notes: EUT powered up

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