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Report On

FCC and IC Testing of the
Ericsson Remote Radio Unit LTE and NB-IoT KRC 161 276/1 & KRC 161 276/2,
RRUS 11 B2 (1900 MHz), with compatible Main Unit in a Base Station
configuration in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 24,
Industry Canada RSS-GEN and Industry Canada RSS-133

COMMERCIAL-IN-CONFIDENCE

FCC ID: TA8AKRC161276-1 and TA8AKRC161276-2
IC ID: 287AB-AS1612761 and 287AB-AS1612762

PREPARED BY

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APPROVED BY

Steve Scarfe
Authorised Signatory

DATED

24 April 2018

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April 2018



Product Service

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SECTION 1

REPORT INFORMATION



Product Service

1.1 REPORT DETAILS

Manufacturer	Ericsson
Address	Torshamnsgatan 23 Kista SE-16480 Stockholm Sweden
Product Name	RRUS 11 B2
Product Number	KRC 161 276/1 & KRC 161 276/2
IC Model Name	AS1612761 & AS1612762
Serial Number(s)	CF83262617
Software Version	xrus_NBIoT_GB_SA_for_FCC_test (based on CXP9013268/6 R66BM)
Hardware Version	R3B
Test Specification/Issue/Date	FCC CFR 47 Part 2: 2017 FCC CFR 47 Part 24: 2017 Industry Canada RSS-GEN: Issue 4: 2014 Industry Canada RSS-133: Issue 6: 2013
Start of Test	27 March 2018
Finish of Test	09 April 2018
Name of Engineer(s)	Ashok Kumar Joe Santos
Related Document(s)	KDB 971168 D01 v02r02 KDB 662911 D01 v02r01



Product Service

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of results for each configuration, in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 24, Industry Canada RSS-GEN and Industry Canada RSS-133 is shown below.

Section	Specification Clause				Test Description	Result
	FCC CFR 47 Part 2	FCC CFR 47 Part 24	RSS- GEN	RSS- 133		
2.1	2.1046	24.232 (a)	-	6.4	Maximum Peak Output Power and Peak to Average Ratio - Conducted	Pass
2.2	2.1049	24.238 (b)	6.6	-	Occupied Bandwidth	Pass
2.3	2.1051	24.238 (b)	-	6.5	Band Edge	Pass
2.4	2.1051	24.238 (a)	-	6.5	Transmitter Spurious Emissions	Pass
2.5	-	-	-	6.5	Radiated Emissions	Pass



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1.3 CONFIGURATION DESCRIPTION

Configuration	RAT	No. Of carriers	Carrier Bandwidth	Carrier Frequency Configuration (MHz)		
				Bottom	Middle	Top
A	LTE+NB IoT GB	1	10 MHz	1935.0	-	1985.0
A	LTE+NB IoT GB	1	15 MHz	1937.5	-	1982.5
A	LTE+NB IoT GB	1	20 MHz	1940.0	-	1980.0
B	NB IoT SA	1	0.18 MHz	1930.2	1960.0	1989.8



Product Service

1.4 DECLARATION OF BUILD STATUS

MAIN EUT		
MANUFACTURING DESCRIPTION	Radio Unit	
MANUFACTURER	Ericsson AB	
PRODUCT NAME	RRUS11 B2	
PART NUMBER	KRC 161 276/1	KRC 161 276/2
IC Model Name	AS1612761	AS1612762
SERIAL NUMBER	-	CF83262617
HARDWARE VERSION	-	R3B
SOFTWARE VERSION	-	xrus_NBIoT_GB_SA_for_FCC_test (based on CXP9013268/6 R66BM)
TRANSMITTER OPERATING RANGE	1930 to 1990 MHz	
MODULATIONS	QPSK, 16QAM, 64QAM, 256QAM	
INTERMEDIATE FREQUENCIES	-	
ITU DESIGNATION OF EMISSION	10 MHz BW channel ¹ : 9M50F9W	10 MHz BW channel ¹ : 9M50F9W
	15 MHz BW channel ¹ : 14M1F9W	15 MHz BW channel ¹ : 14M1F9W
	20 MHz BW channel ¹ : 18M5F9W	20 MHz BW channel ¹ : 18M5F9W
	NB-IoT SA channel: 210KW7D	NB-IoT SA channel: 210KW7D
OUTPUT POWER (RMS) (W or dBm)	1x30W ¹ (per port)	1x40W ¹ (per port)
	NB-IoT SA 1x20W	NB-IoT SA 1x20W
FCC ID	TA8AKRC161276-1	TA8AKRC161276-2
IC ID	287AB-AS1612761	287AB-AS1612762
TECHNICAL DESCRIPTION (a brief description of the intended use and operation)	Base station radio	

¹ Including 2 NB-IoT GB carriers.

Signature

Linda Grell

Date

2018-04-17

No responsibility will be accepted by TÜV SÜD Product Service UK Limited as to the accuracy of the information declared in this document by the manufacturer.

1.5 PRODUCT INFORMATION

1.5.1 Technical Description

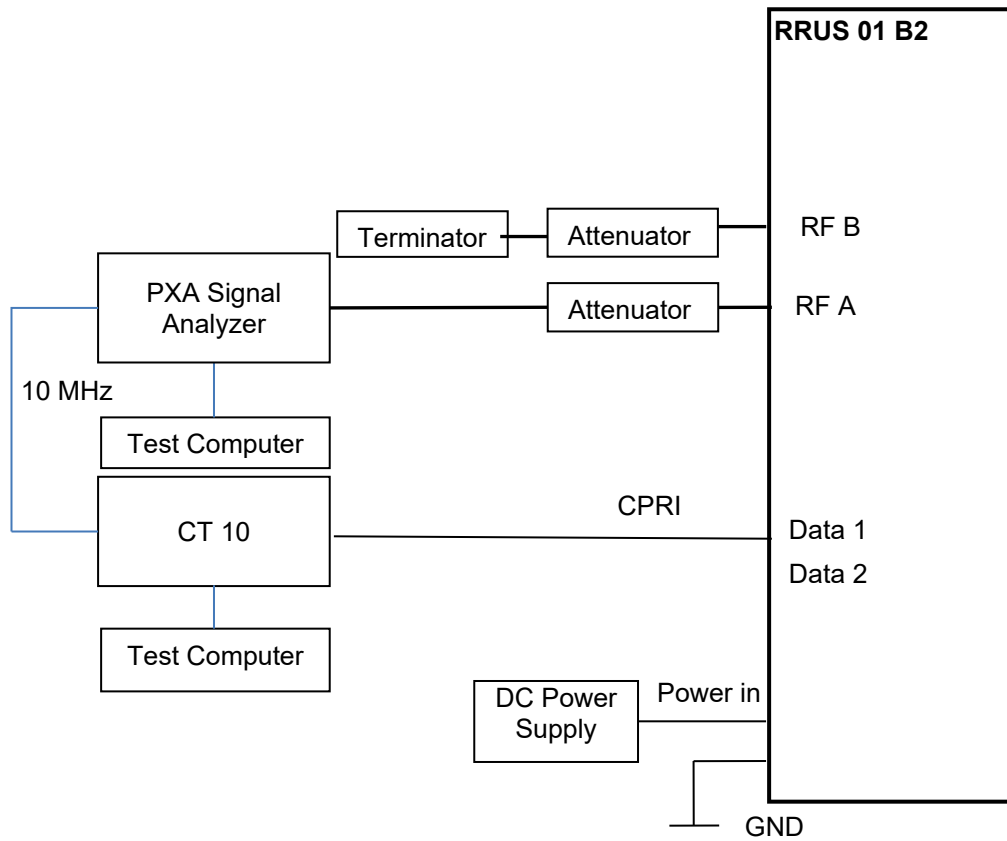
The Equipment Under Test (EUT) KRC 161 276/1 & KRC 161 276/2 is an Ericsson AB Radio Unit working in the public mobile service (Band) band which provides communication connections to (Band) network. The KRC 161 276/1 & KRC 161 276/2 operates from a -48V DC supply.

The Equipment Under Test (EUT) is shown in the photograph below. A full technical description can be found in the Manufacturer's documentation.



Equipment Under Test

1.6 TEST SETUP





Product Service

1.7 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure, test laboratories or a chamber as appropriate.

The EUT was powered from a -48V DC supply.

FCC Measurement Facility Registration Number
90987 Octagon House, Fareham Test Laboratory

Industry Canada Facility Registration Number
2932B, Site#2932B-1

1.8 DEVIATION FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.9 MODIFICATION RECORD

No modifications were made to the EUT during testing.



Product Service

SECTION 2

TEST DETAILS



Product Service

2.1 MAXIMUM PEAK OUTPUT POWER AND PEAK TO AVERAGE RATIO - CONDUCTED

2.1.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1046
FCC CFR 47 Part 24, Clause 24.232 (a)
Industry Canada RSS-133, Clause 6.4

2.1.2 Date of Test and Modification State

09 April 2018 - Modification State 0

2.1.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.4 Environmental Conditions

Ambient Temperature 22.4°C
Relative Humidity 42.1%

2.1.5 Test Method

All measurements were made in accordance with FCC KDB 971168 D01, clause 5.2.1 and summed in accordance with FCC KDB 662911 D01.

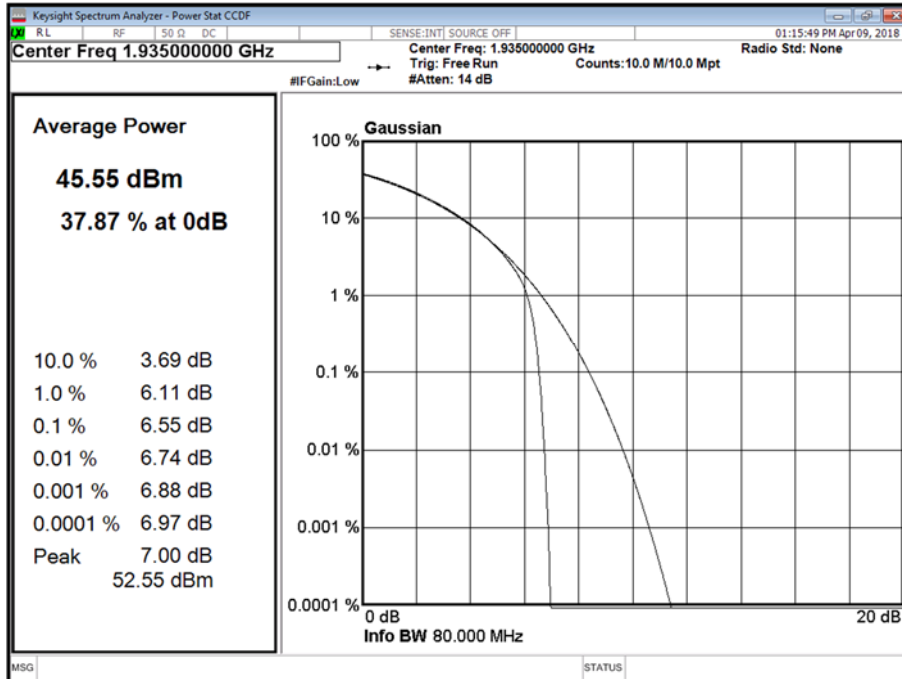
2.1.6 Test Results

Configuration A

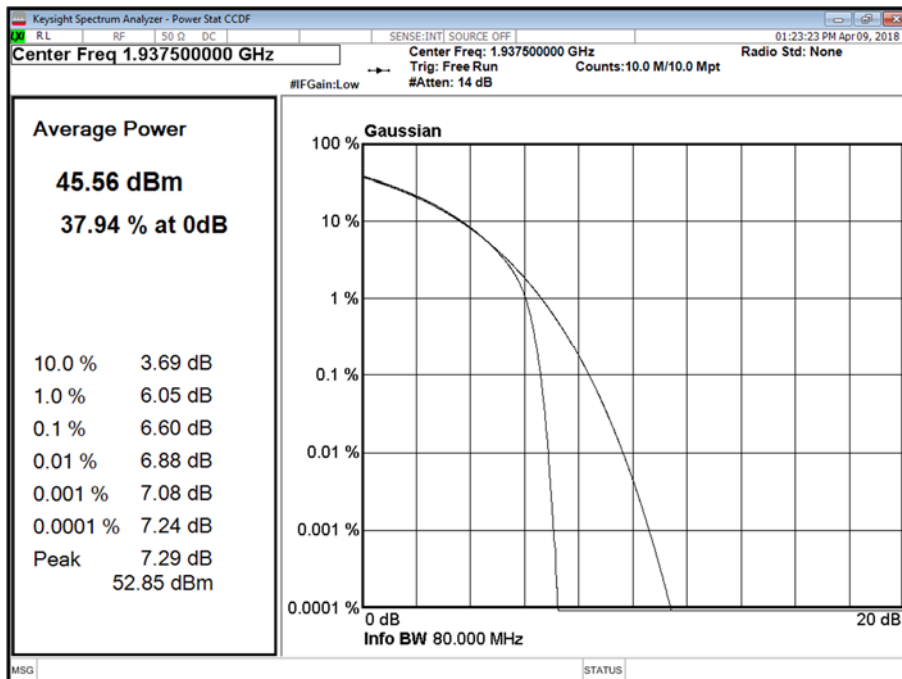
Maximum Output Power 46 dBm

Antenna	LTE / NB-IoT Modulation	LTE / NB-IoT Carrier Bandwidth	Peak to Average Ratio (PAR) / Output Power		
			Channel Position B		
			PAR (dB)	Average Power	
				dBm	dBm/MHz
A	L:64QAM / N:QPSK	L:10.0 MHz / N:180 kHz	6.55	45.55	-
A	L:64QAM / N:QPSK	L:15.0 MHz / N:180 kHz	6.60	45.56	-
A	L:64QAM / N:QPSK	L:20.0 MHz / N:180 kHz	6.71	45.48	-

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position B



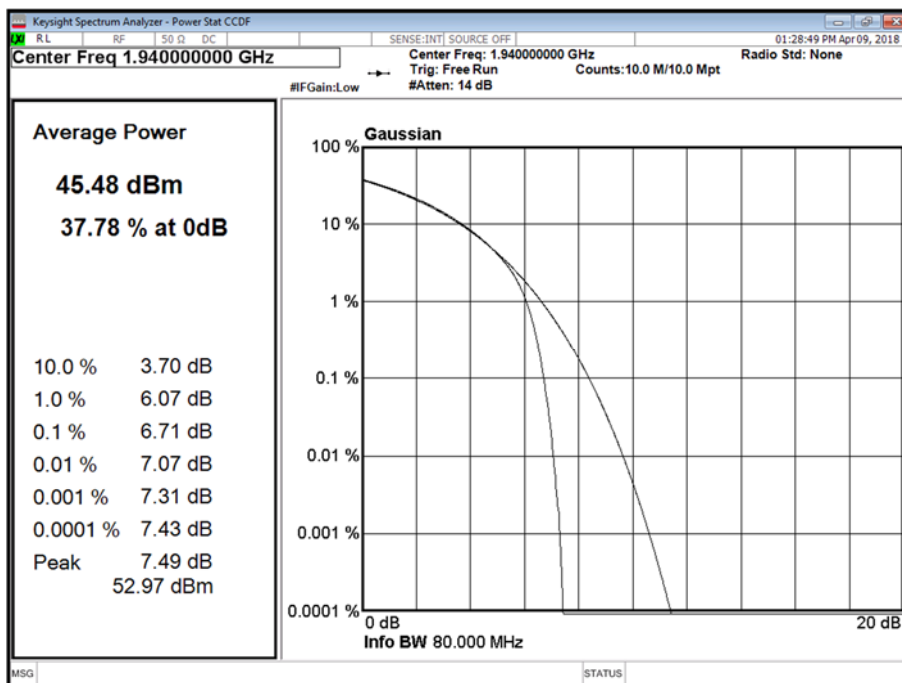
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position B





Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position B

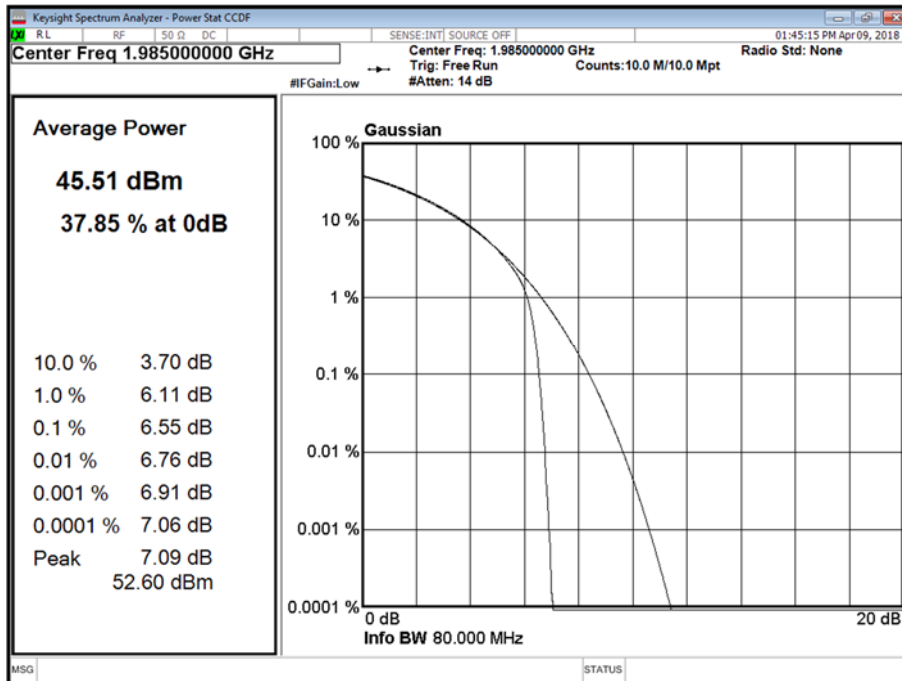


Configuration A

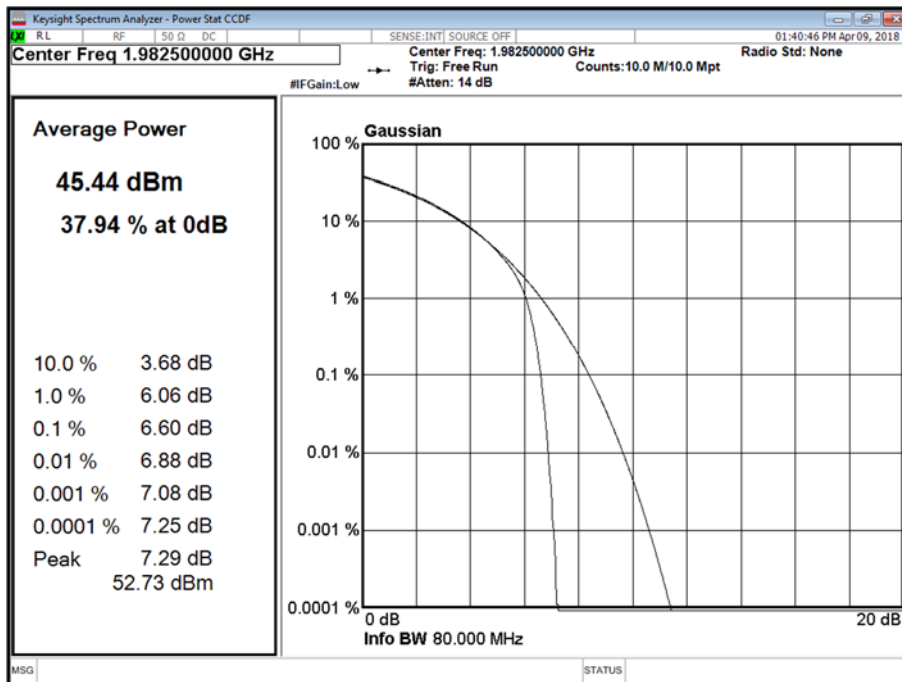
Maximum Output Power 46 dBm

Antenna	LTE / NB-IoT Modulation	LTE / NB-IoT Carrier Bandwidth	Peak to Average Ratio (PAR) / Output Power		
			Channel Position T		
			PAR (dB)	Average Power	
				dBm	dBm/MHz
A	L:64QAM / N:QPSK	L:10.0 MHz / N:180 kHz	6.55	45.51	-
A	L:64QAM / N:QPSK	L:15.0 MHz / N:180 kHz	6.60	45.44	-
A	L:64QAM / N:QPSK	L:20.0 MHz / N:180 kHz	6.68	45.48	-

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position T



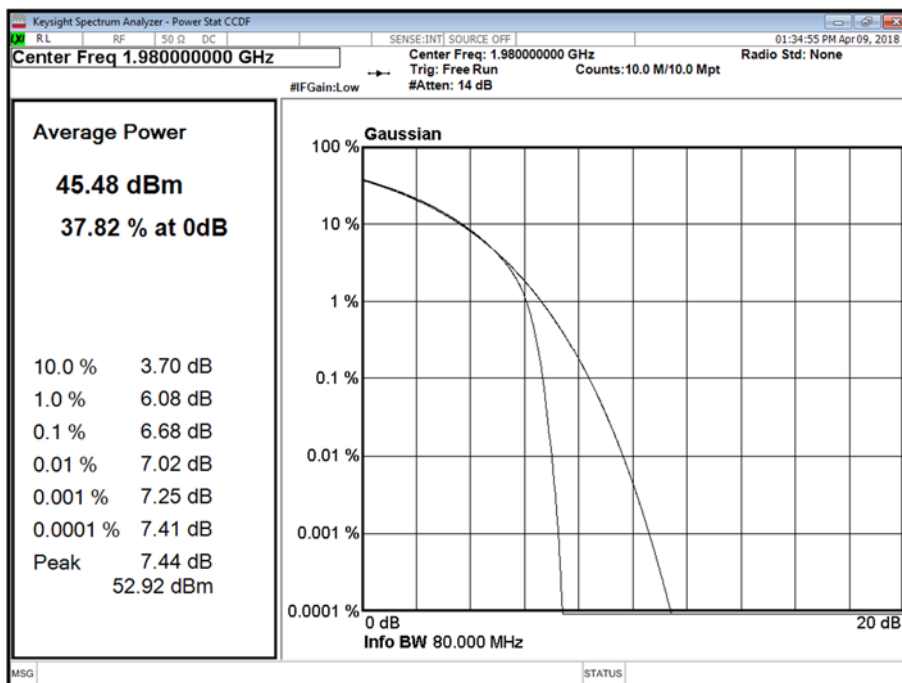
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position T





Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:20.0 MHz / N:180 kHz - Channel Position T



Configuration B

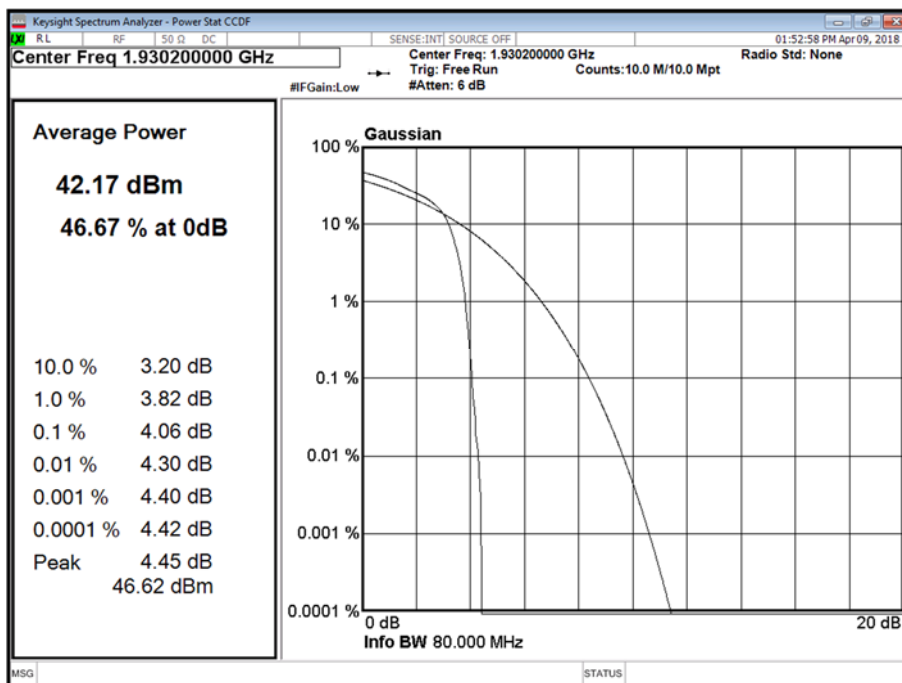
Maximum Output Power 43 dBm

Antenna	NB-IoT SA Modulation	NB-IoT SA Carrier Bandwidth	Peak to Average Ratio (PAR) / Output Power		
			Channel Position B		
			PAR (dB)	Average Power	
				dBm	dBm/MHz
A	N:QPSK	N:180 kHz	4.06	42.17	-



Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz - Channel Position B



Configuration B

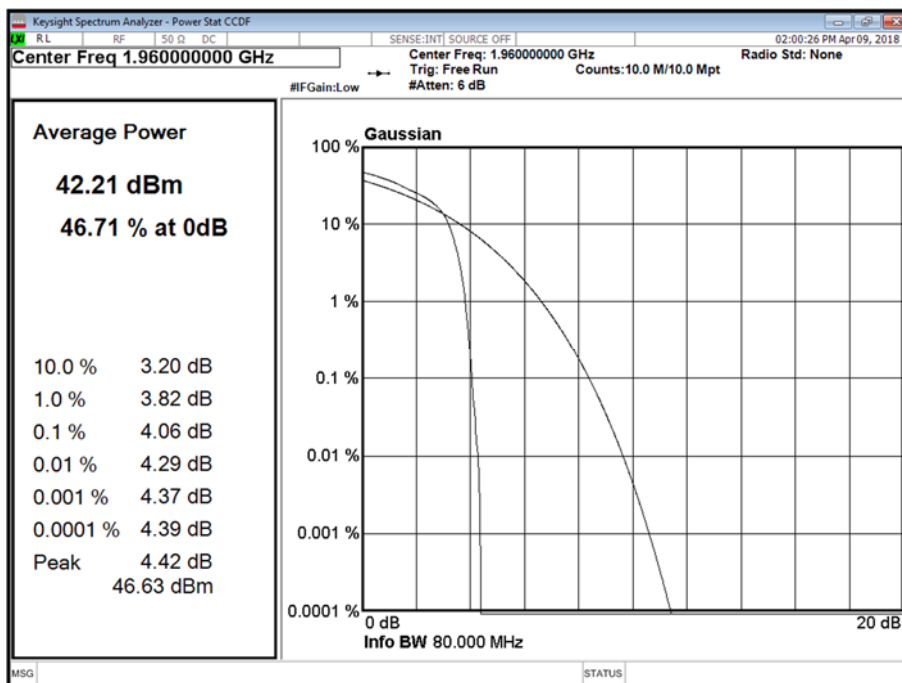
Maximum Output Power 43 dBm

Antenna	NB-IoT SA Modulation	NB-IoT SA Carrier Bandwidth	Peak to Average Ratio (PAR) / Output Power		
			Channel Position M		
			PAR (dB)	Average Power	
				dBm	dBm/MHz
A	N:QPSK	N:180 kHz	4.06	42.21	-



Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz - Channel Position M



Configuration B

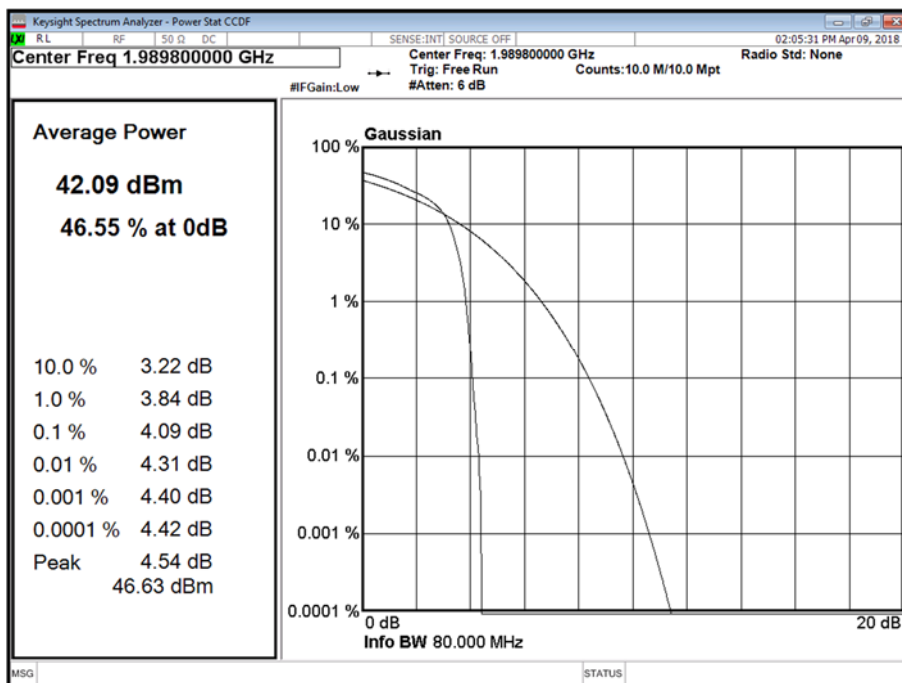
Maximum Output Power 43 dBm

Antenna	NB-IoT SA Modulation	NB-IoT SA Carrier Bandwidth	Peak to Average Ratio (PAR) / Output Power		
			Channel Position T		
			PAR (dB)	Average Power	
				dBm	dBm/MHz
A	N:QPSK	N:180 kHz	4.09	42.09	-



Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position T



Limit	
Peak Power	≤500 W or ≤+57 dBm
Peak to Average Ratio	13 dB



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2.2 OCCUPIED BANDWIDTH

2.2.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1049
FCC CFR 47 Part 24, Clause 24.238 (b)
Industry Canada RSS-GEN, Clause 6.6

2.2.2 Date of Test and Modification State

09 April 2018 - Modification State 0

2.2.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.4 Environmental Conditions

Ambient Temperature 22.4°C
Relative Humidity 42.1%

2.2.5 Test Method

All measurements were made in accordance with FCC KDB 971168 D01.

2.2.6 Test Results

Configuration A

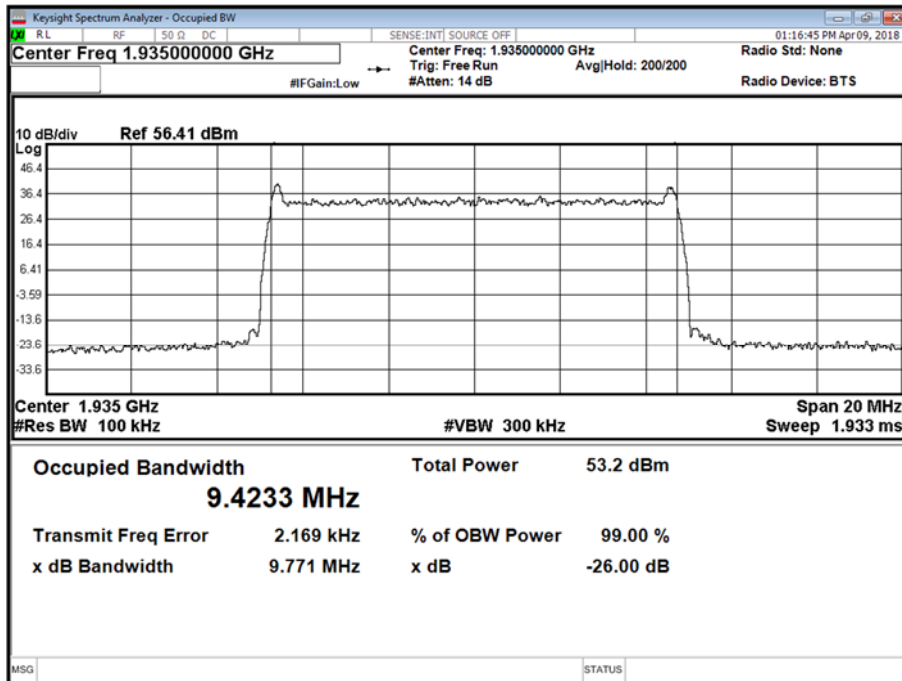
Maximum Output Power 46 dBm

Antenna	LTE / NB-IoT Modulation	LTE / NB-IoT Carrier Bandwidth	Result (KHz)					
			Channel Position B		Channel Position M		Channel Position T	
			Occupied Bandwidth	-26 dB Bandwidth	Occupied Bandwidth	-26 dB Bandwidth	Occupied Bandwidth	-26 dB Bandwidth
A	L:64QAM / N:QPSK	L:10.0 MHz / N:180 kHz	9,423.30	9,771.00	-	-	9,421.00	9,809.00
A	L:64QAM / N:QPSK	L:15.0 MHz / N:180 kHz	14,028.00	14,780.00	-	-	14,023.00	14,730.00
A	L:64QAM / N:QPSK	L:20.0 MHz / N:180 kHz	18,463.00	19,560.00	-	-	18,454.00	19,500.00

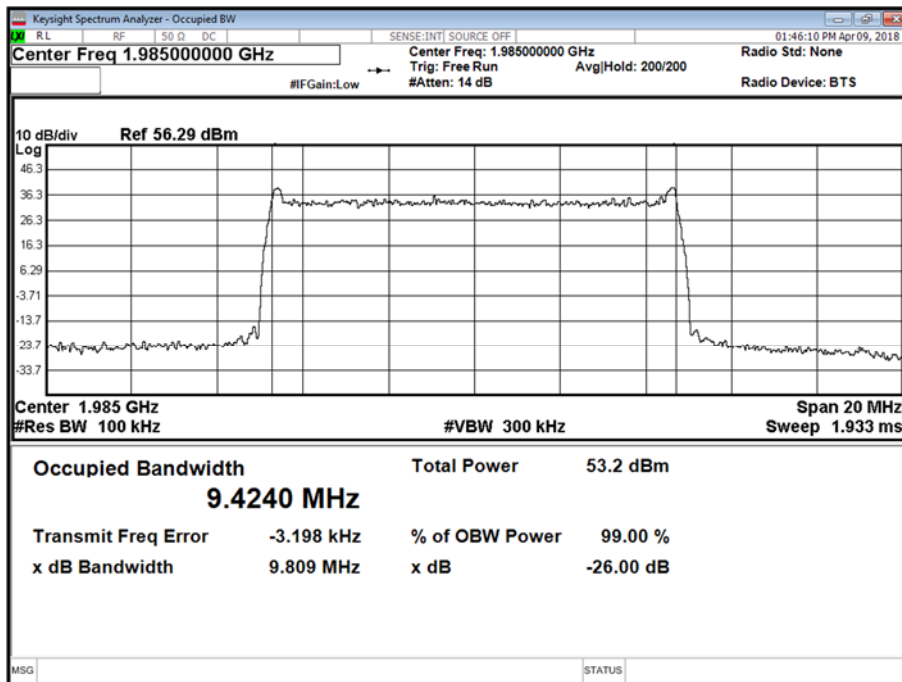


Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position B



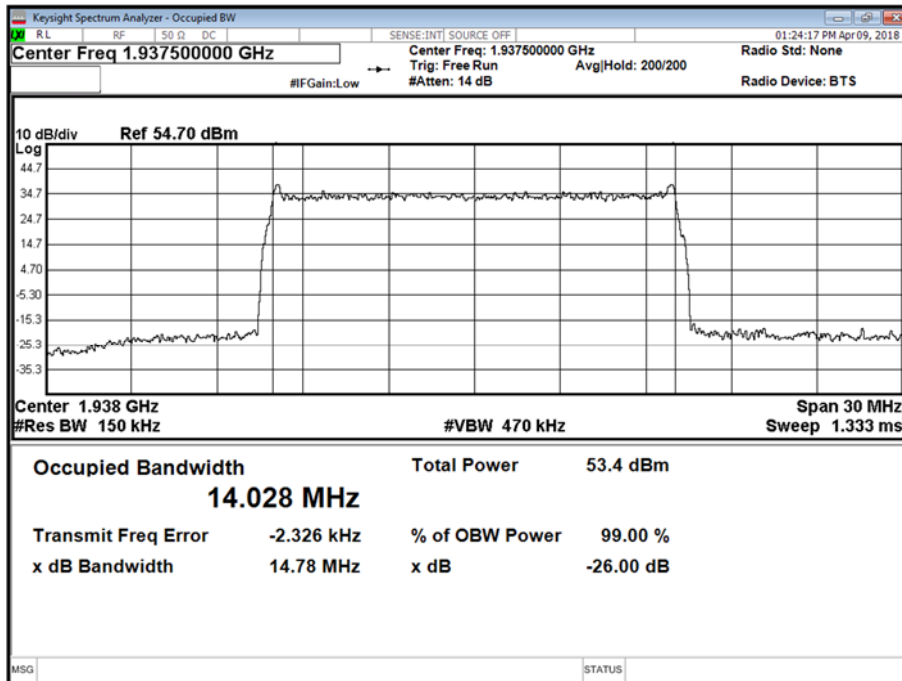
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position T



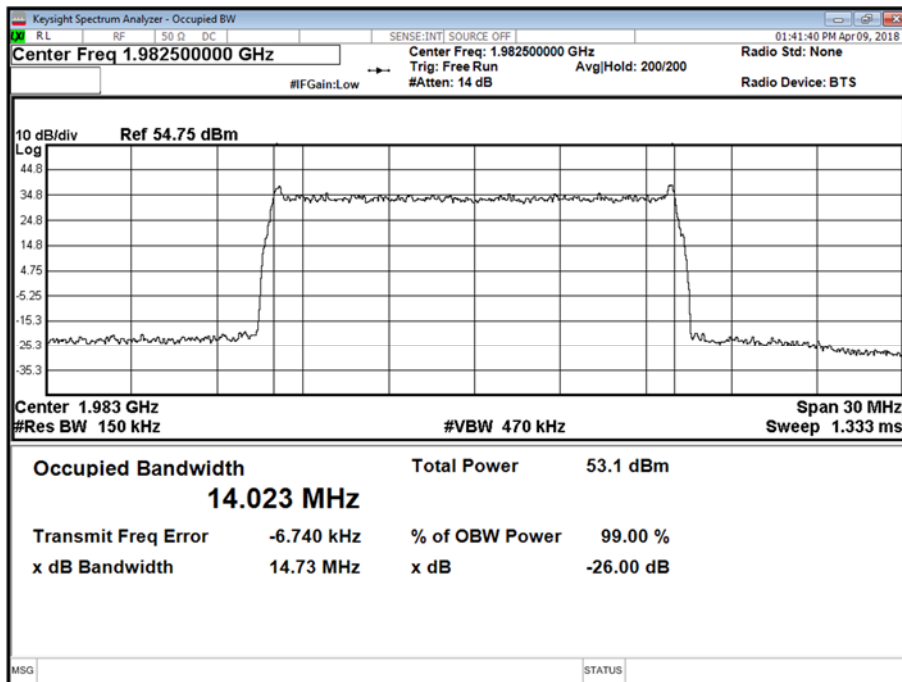


Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position B



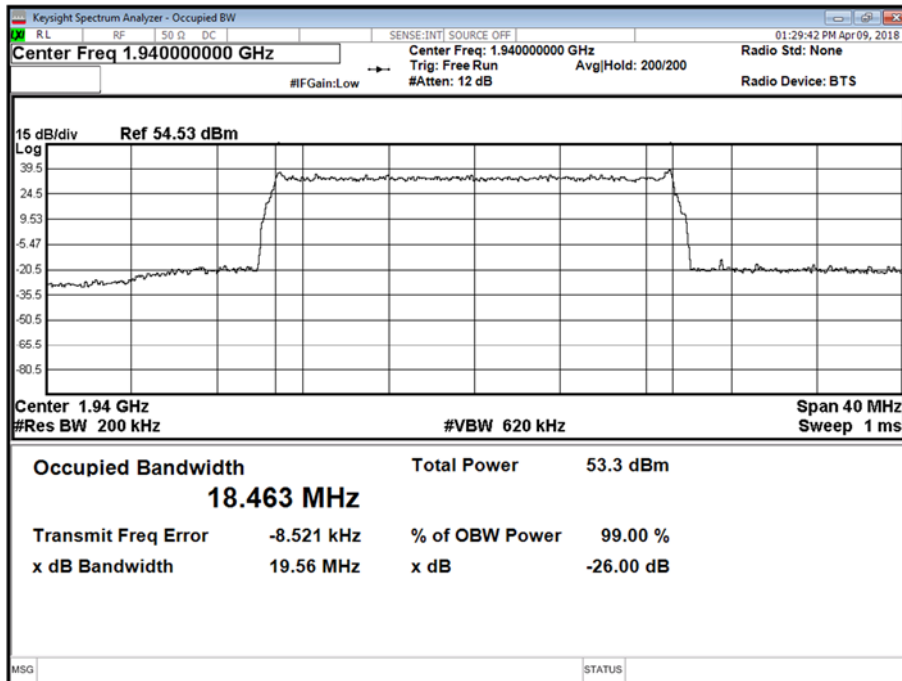
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position T



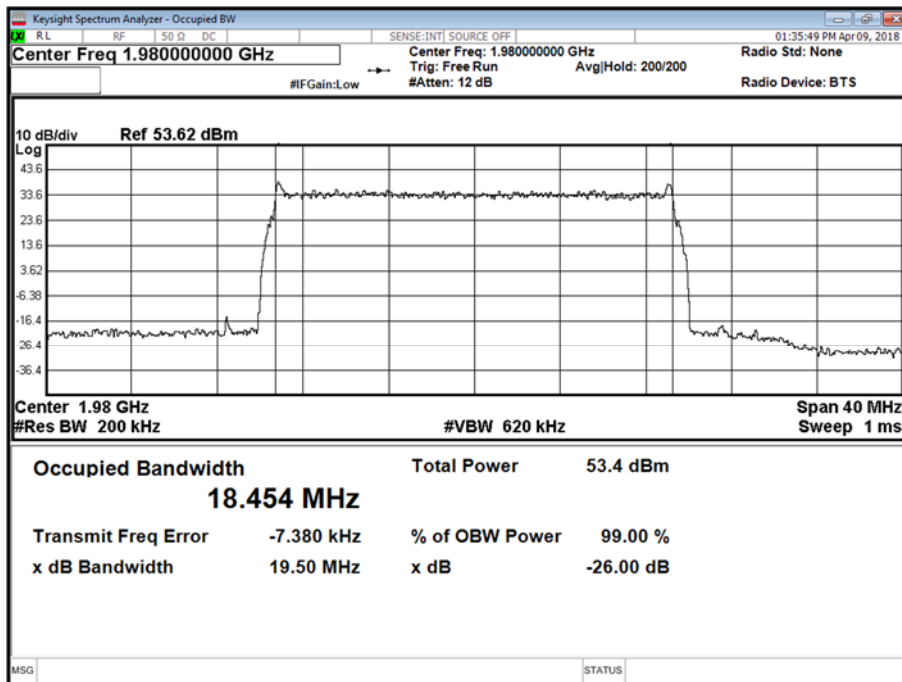


Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position B



Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position T





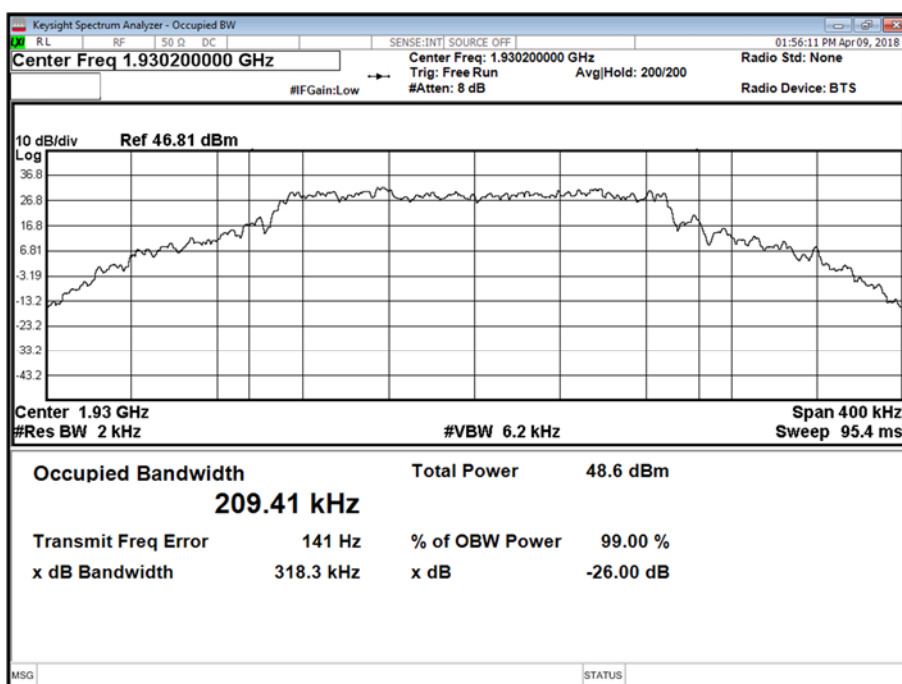
Product Service

Configuration B

Maximum Output Power 43 dBm

Antenna	NB-IoT SA Modulation	NB-IoT SA Carrier Bandwidth	Result (KHz)					
			Channel Position B		Channel Position M		Channel Position T	
			Occupied Bandwidth	-26 dB Bandwidth	Occupied Bandwidth	-26 dB Bandwidth	Occupied Bandwidth	-26 dB Bandwidth
A	N:QPSK	N:180 kHz	209.41	318.30	209.48	318.30	209.36	318.30

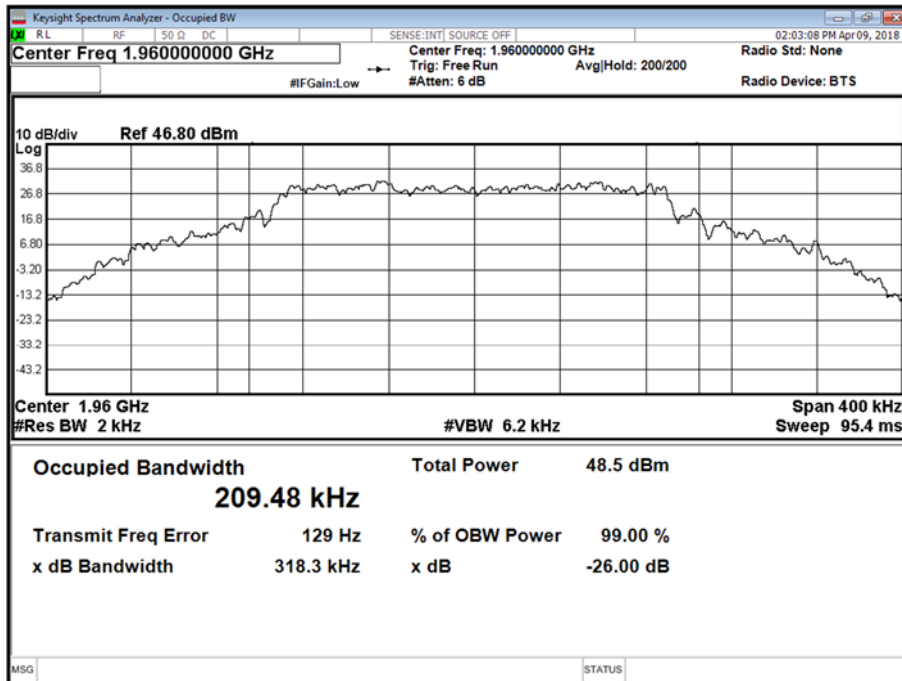
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz - Channel Position B



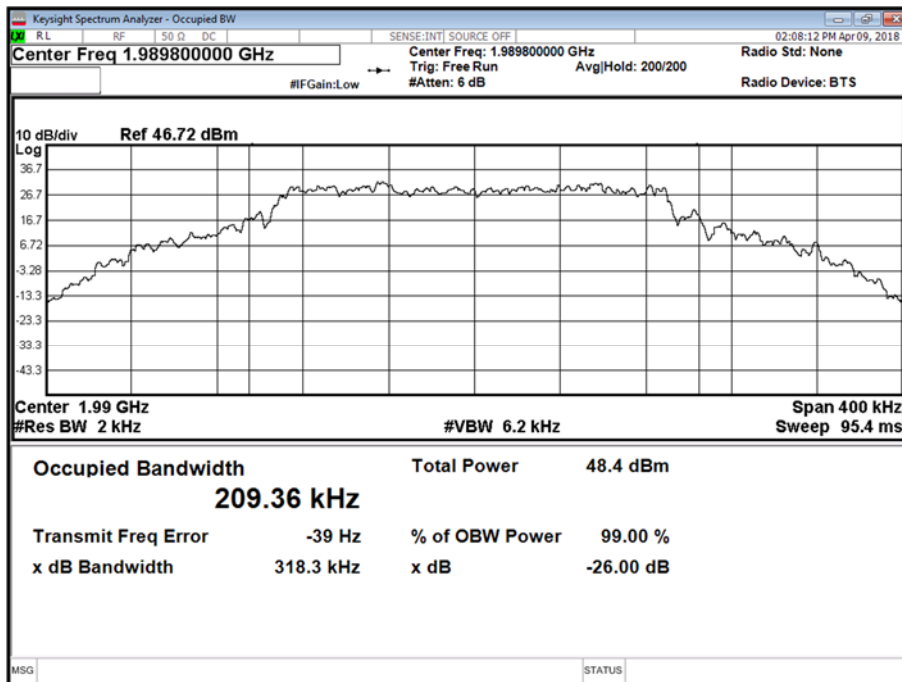


Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz - Channel Position M



Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz - Channel Position T





Product Service

2.3 BAND EDGE

2.3.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1051
FCC CFR 47 Part 24, Clause 24.238 (b)
Industry Canada RSS-133, Clause 6.5

2.3.2 Date of Test and Modification State

09 April 2018 - Modification State 0

2.3.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.4 Environmental Conditions

Ambient Temperature 22.4°C
Relative Humidity 42.1%

2.3.5 Test Method

All measurements were made in accordance with FCC KDB 971168 D01.

Each antenna port has been declared as being equivalent, therefore measurements were made on one antenna port only. To account for this, the limit was tightened by $10 * \log(N)$, where N is equal to the number of MIMO antenna ports.

For four port, the limit was calculated as being $-13 \text{ dBm} - 10 * \log(4) = -19 \text{ dBm}$.

For dual port, the limit was calculated as being $-13 \text{ dBm} - 10 * \log(2) = -16 \text{ dBm}$.

2.3.6 Test Results

Configuration A

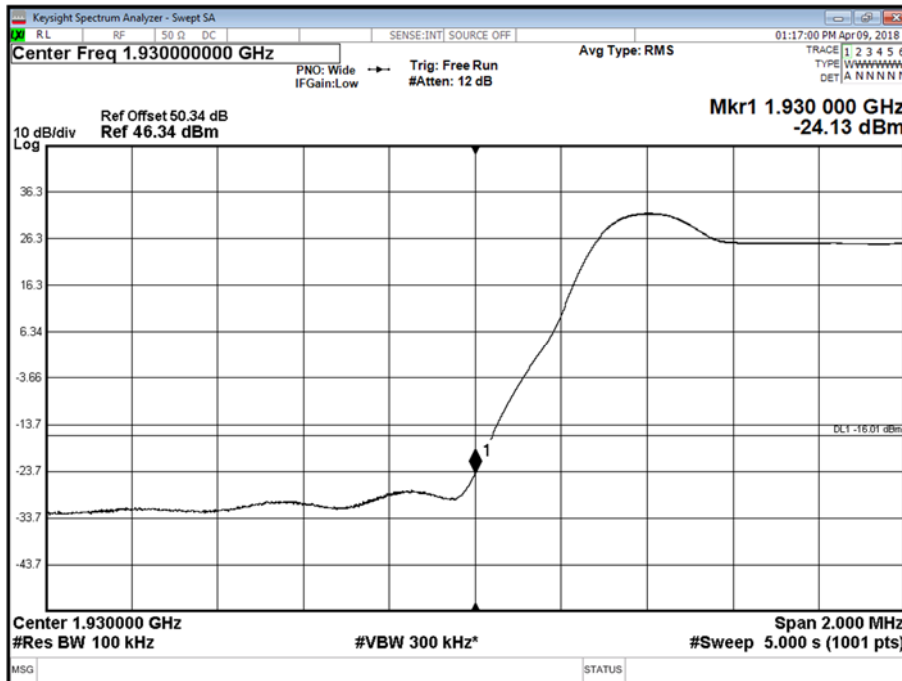
Maximum Output Power 46 dBm

Antenna	LTE / NB-IoT Modulation	LTE / NB-IoT Carrier Bandwidth	Band Edge (MHz)	
			Channel Position B	Channel Position T
A	L:64QAM / N:QPSK	L:10.0 MHz / N:180 kHz	1,930.0	1,990.0
A	L:64QAM / N:QPSK	L:15.0 MHz / N:180 kHz	1,930.0	1,990.0
A	L:64QAM / N:QPSK	L:20.0 MHz / N:180 kHz	1,930.0	1,990.0

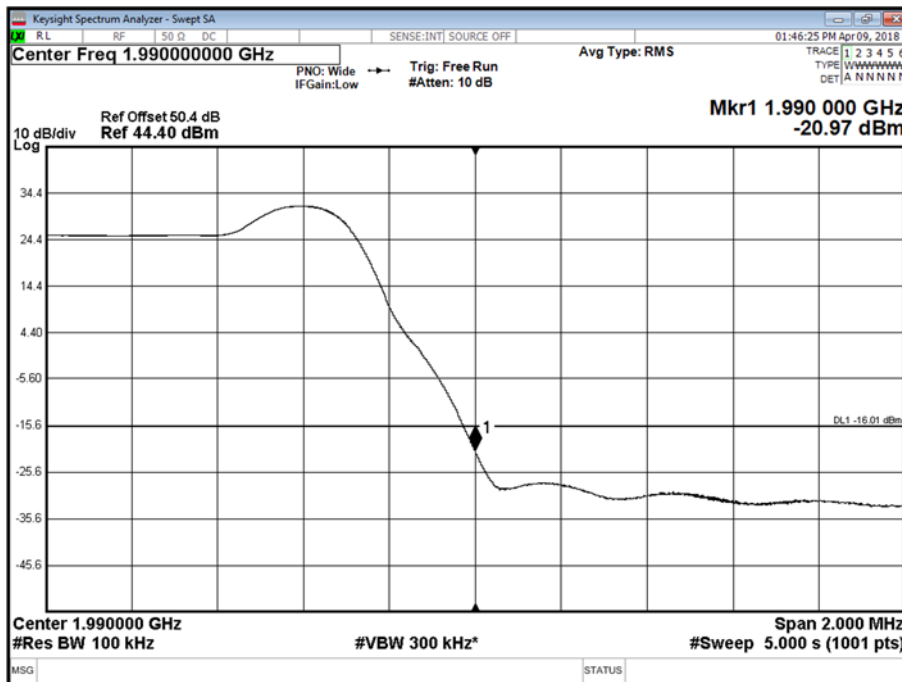


Product Service

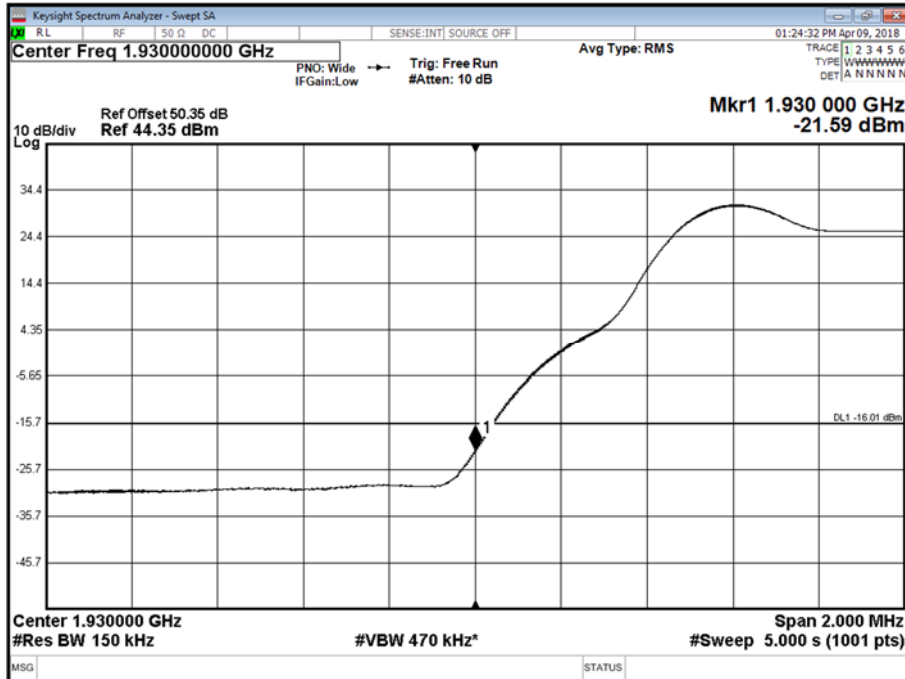
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position B



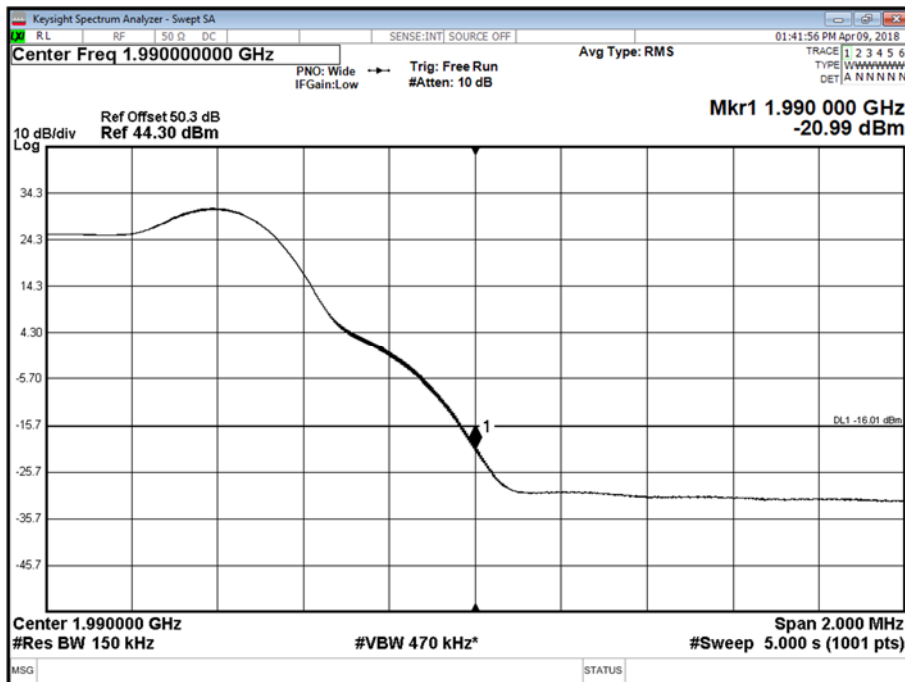
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position T



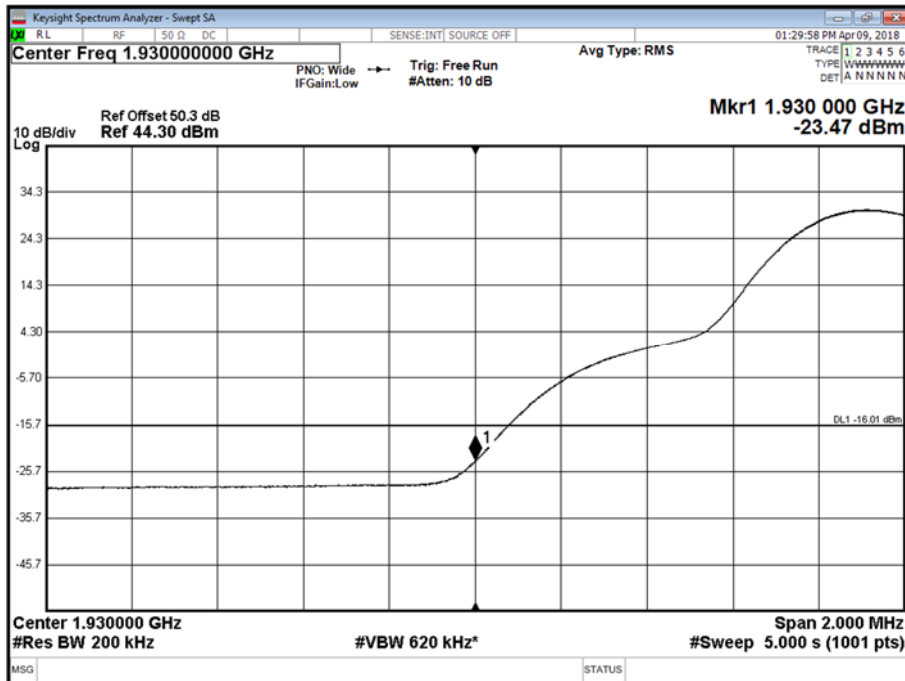
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position B



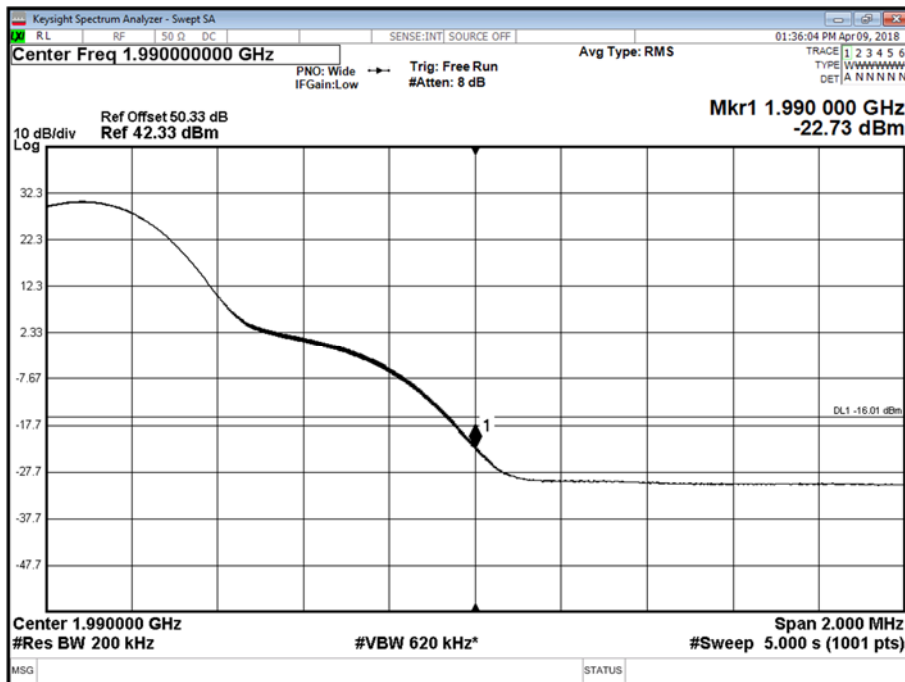
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position T



Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:20.0 MHz / N:180 kHz - Channel Position B



Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:20.0 MHz / N:180 kHz - Channel Position T





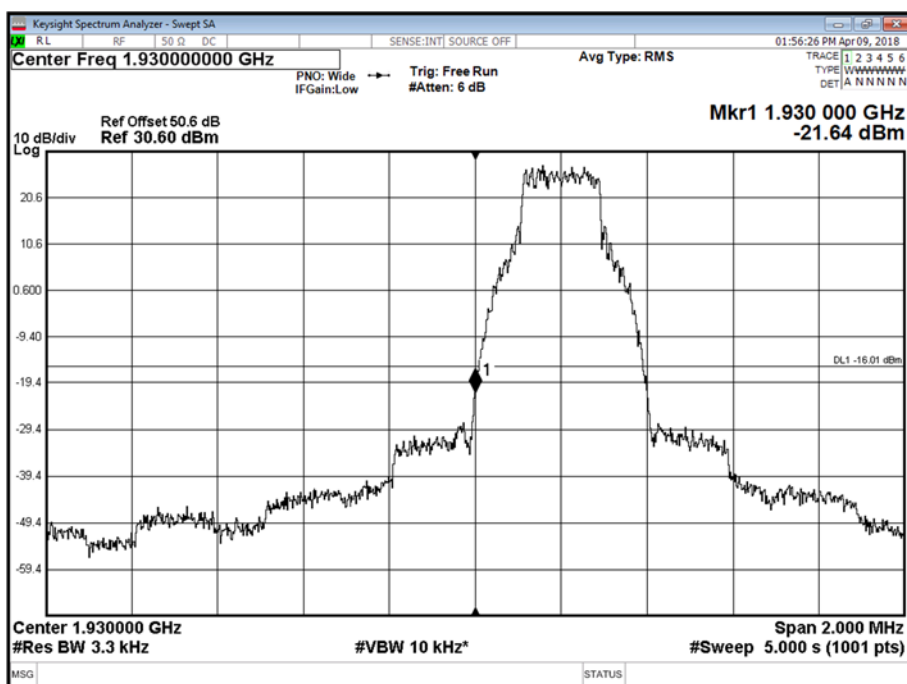
Product Service

Configuration B

Maximum Output Power 43 dBm

Antenna	NB-IoT SA Modulation	NB-IoT SA Carrier Bandwidth	Band Edge (MHz)	
			Channel Position B	Channel Position T
A	N:QPSK	N:180 kHz	1,930.0	1,990.0

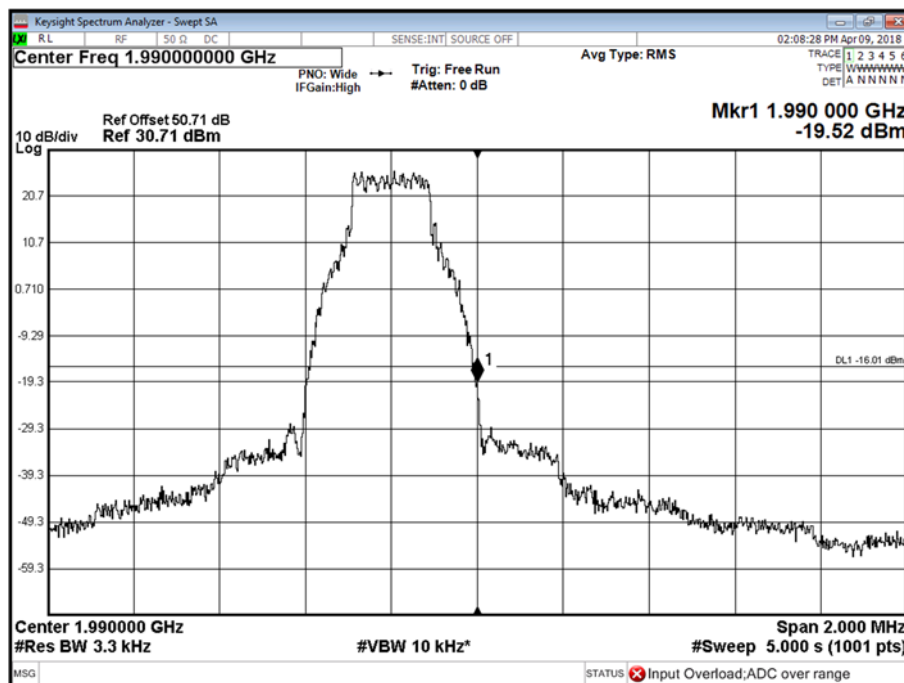
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz - Channel Position B





Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position T



Limit MIMO	-19 dBm
------------	---------



Product Service

2.4 TRANSMITTER SPURIOUS EMISSIONS

2.4.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1051
FCC CFR 47 Part 24, Clause 24.238 (a)
Industry Canada RSS-133, Clause 6.5

2.4.2 Date of Test and Modification State

09 April 2018 - Modification State 0

2.4.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.4 Environmental Conditions

Ambient Temperature	22.4°C
Relative Humidity	42.1%

2.4.5 Test Method

All measurements were made in accordance with FCC KDB 971168 D01.

Each antenna port has been declared as being equivalent, therefore measurements were made on one antenna port only. To account for this, the limit was tightened by $10 * \log(N)$, where N is equal to the number of MIMO antenna ports.

For four port, the limit was calculated as being $-13 \text{ dBm} - 10 * \log(4) = -19 \text{ dBm}$.

For dual port, the limit was calculated as being $-13 \text{ dBm} - 10 * \log(2) = -16 \text{ dBm}$.

2.4.6 Test Results

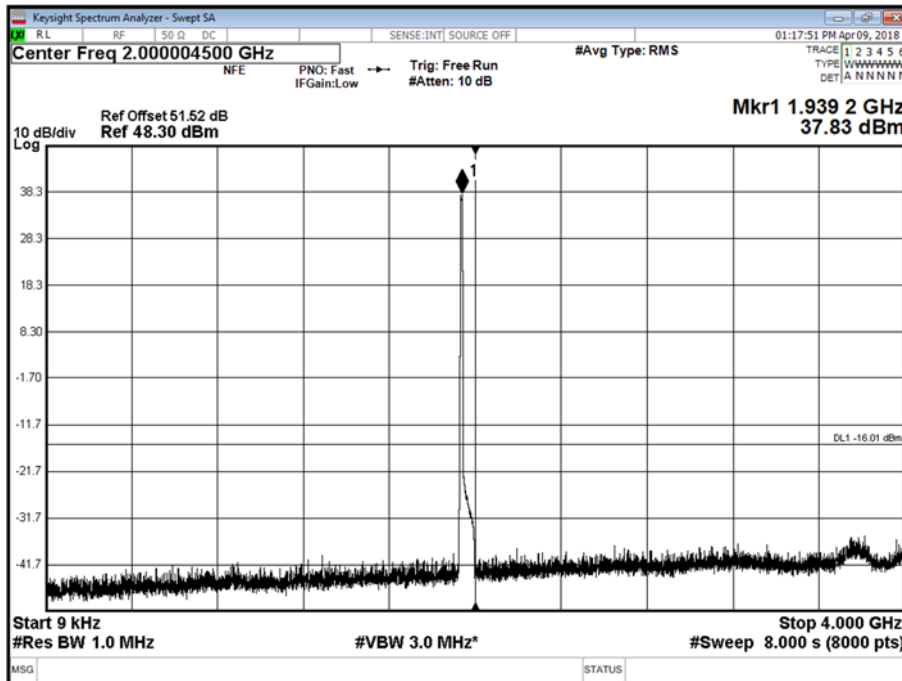
Configuration A

Maximum Output Power 46 dBm

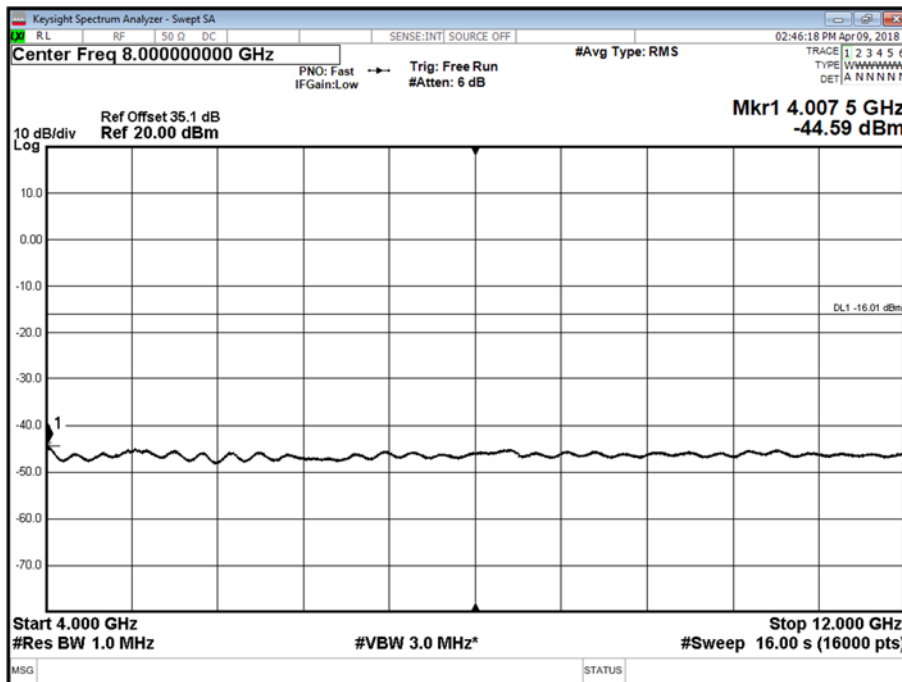


Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position B - Band 1 - Range 0.009 to 4000 MHz



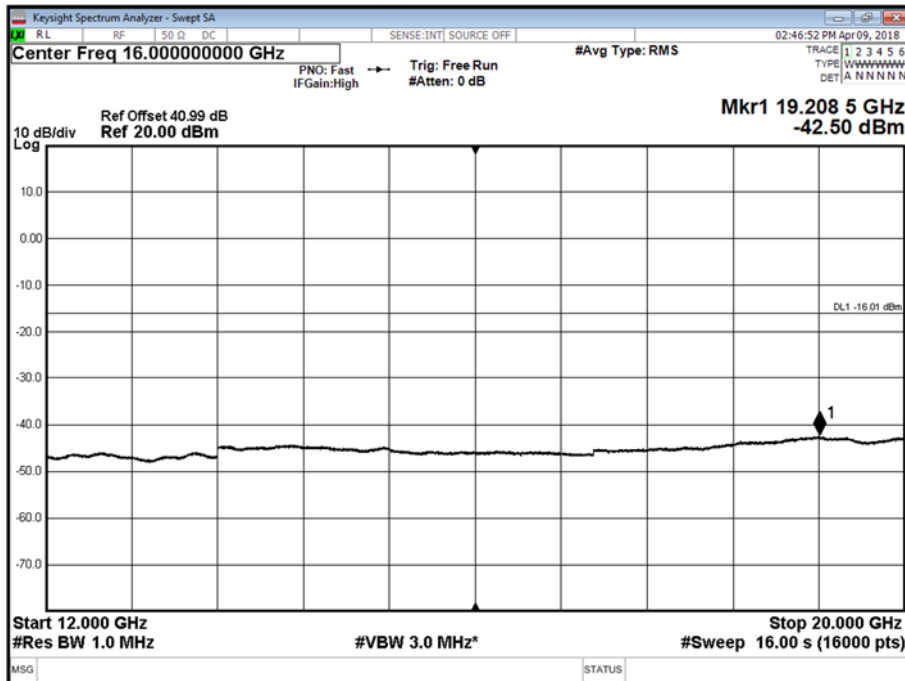
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position B - Band 2 - Range 4000 to 12000 MHz



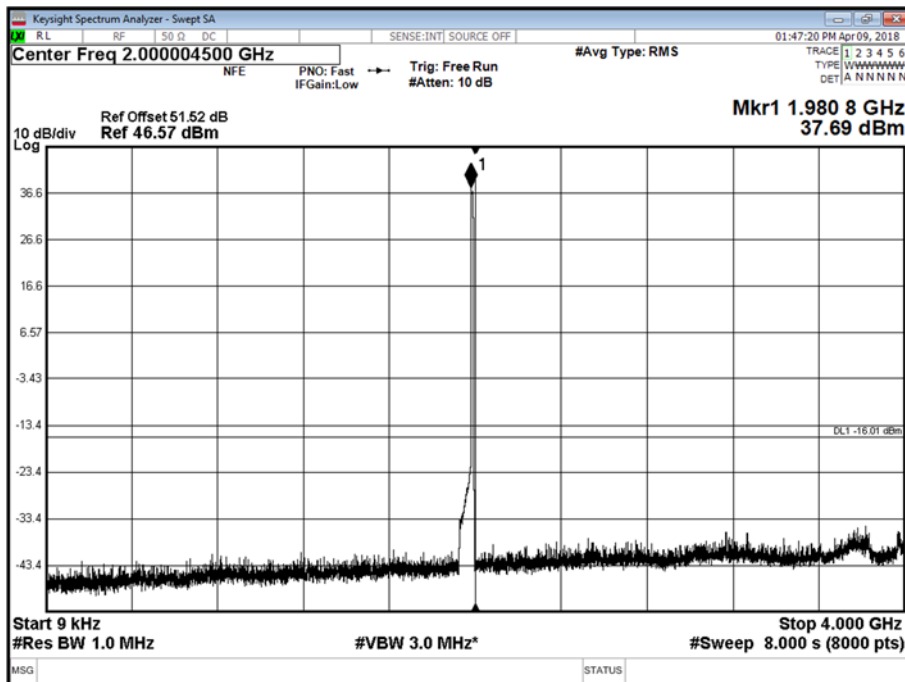


Product Service

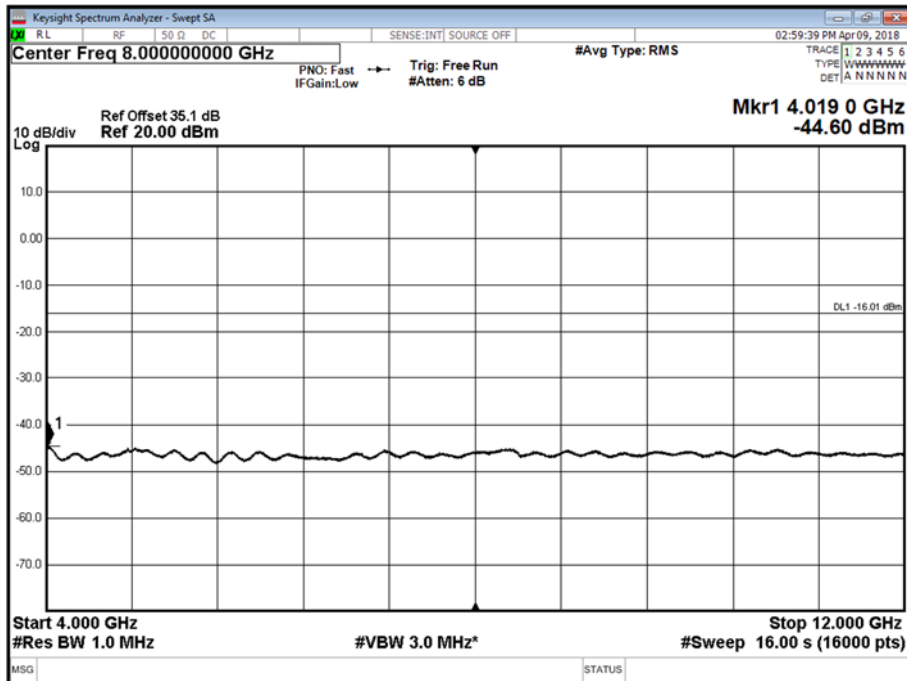
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position B - Band 3 - Range 12000 to 20000 MHz



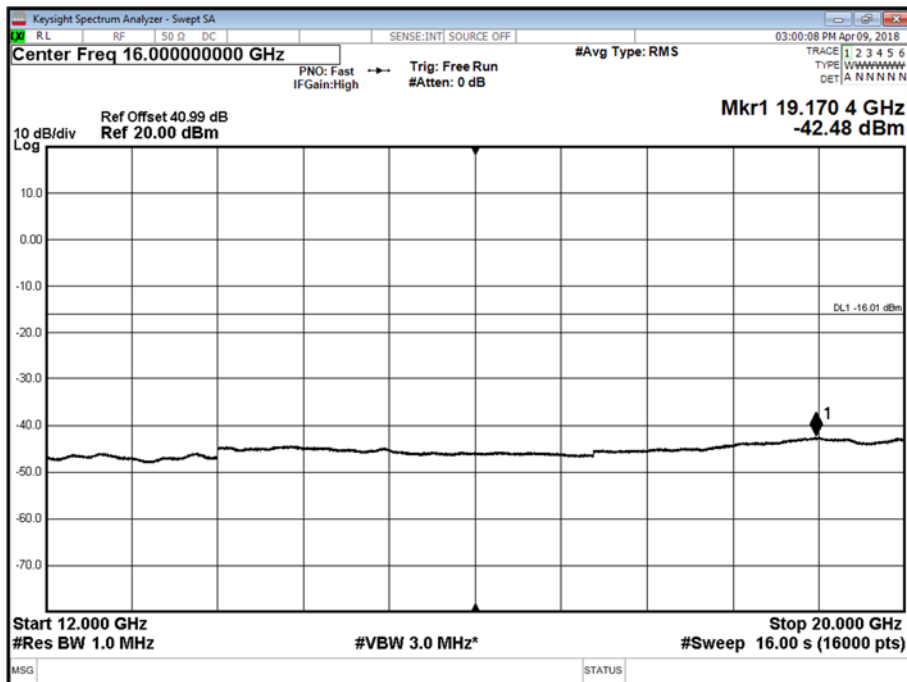
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position T - Band 1 - Range 0.009 to 4000 MHz



Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position T - Band 2 - Range 4000 to 12000 MHz



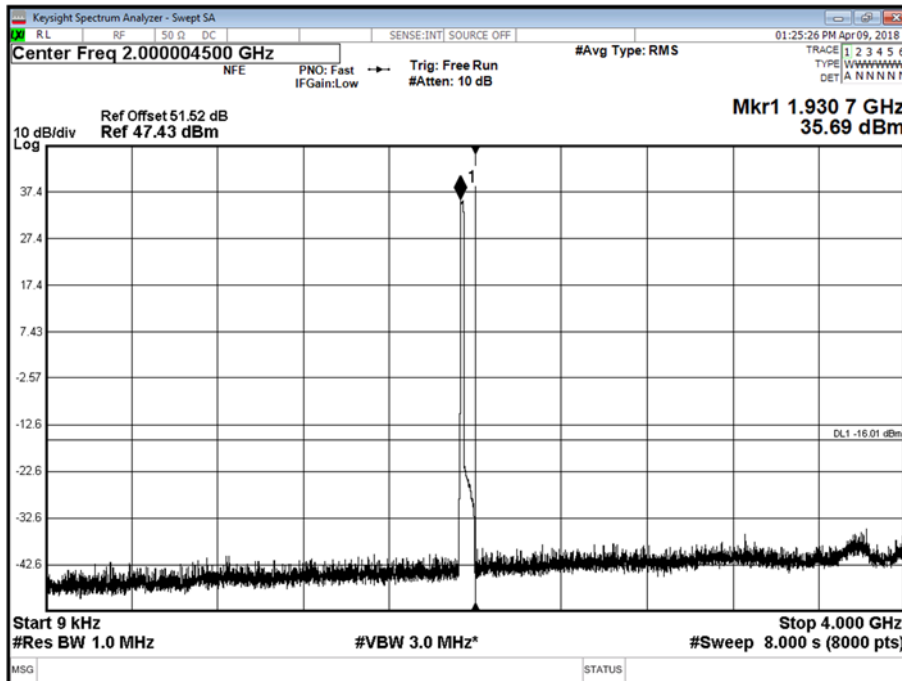
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position T - Band 3 - Range 12000 to 20000 MHz



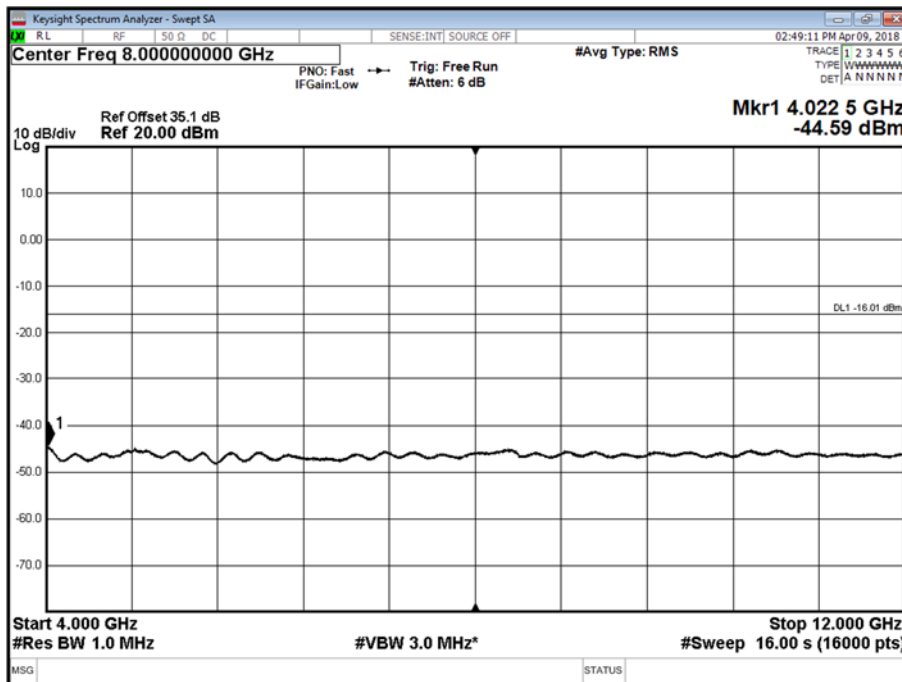


Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position B - Band 1 - Range 0.009 to 4000 MHz



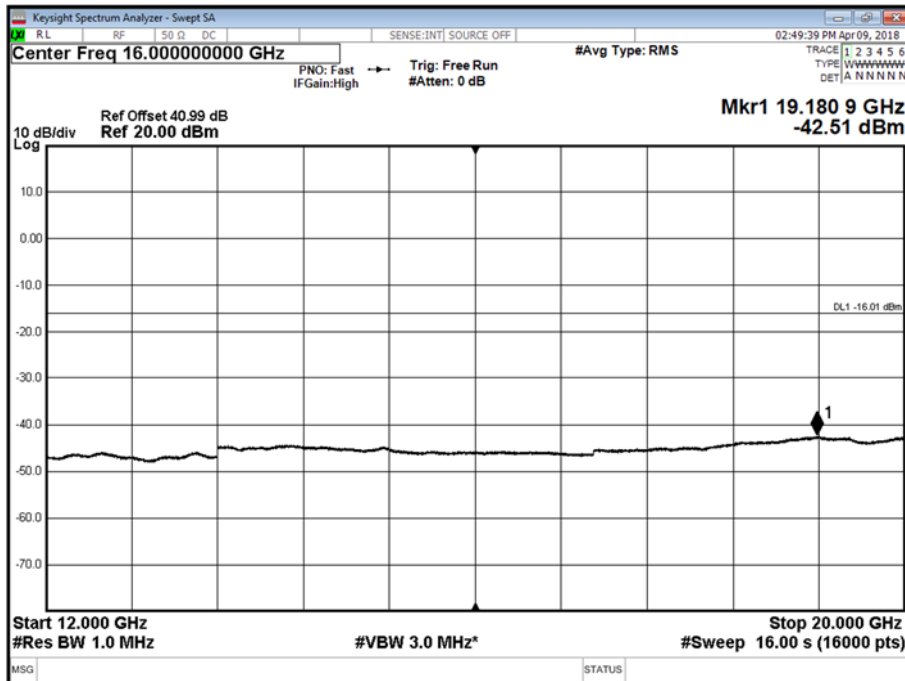
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position B - Band 2 - Range 4000 to 12000 MHz



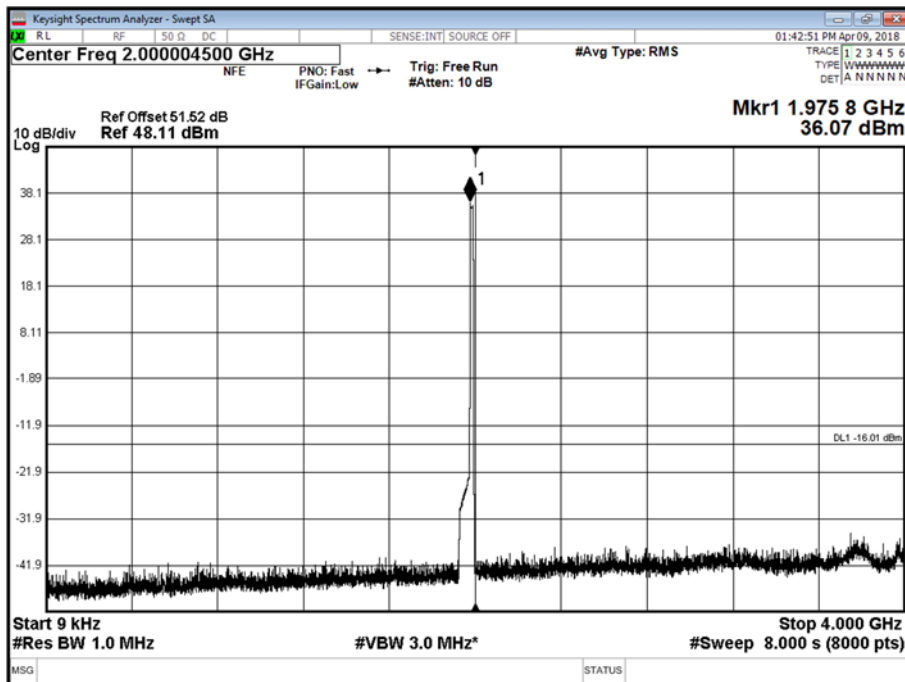


Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position B - Band 3 - Range 12000 to 20000 MHz



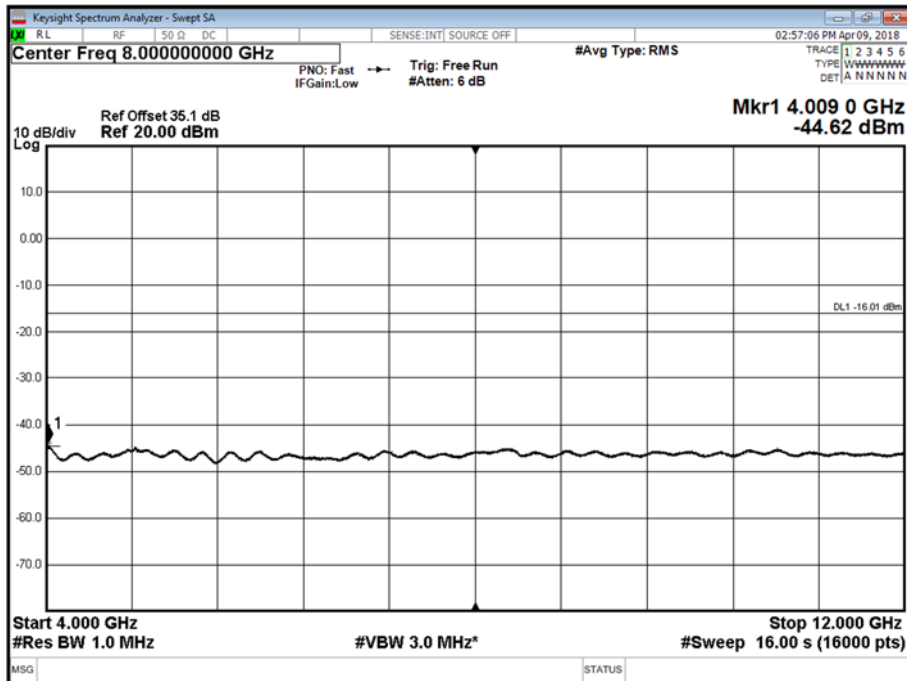
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position T - Band 1 - Range 0.009 to 4000 MHz



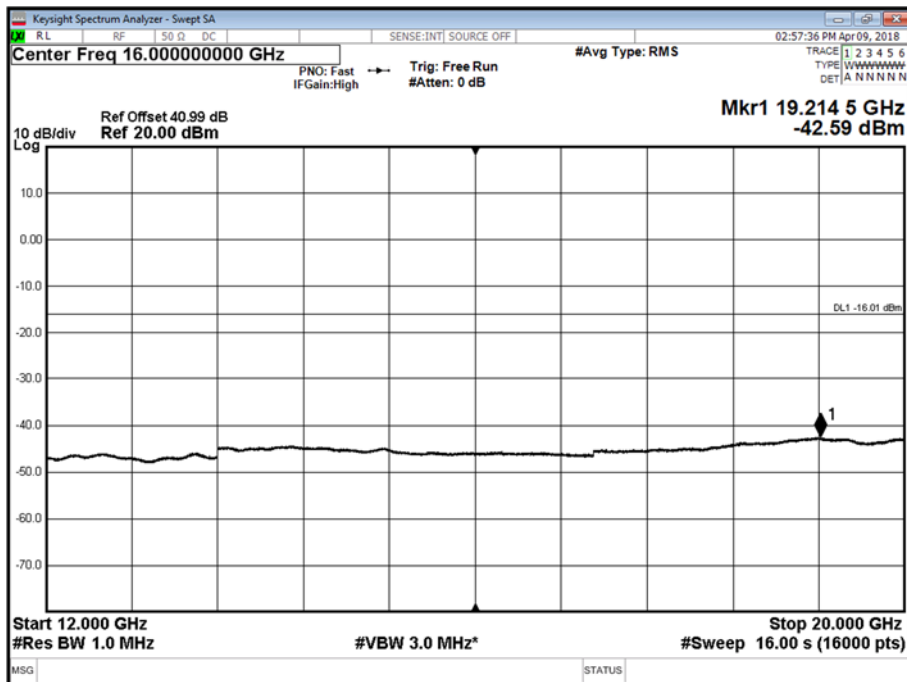


Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position T - Band 2 - Range 4000 to 12000 MHz



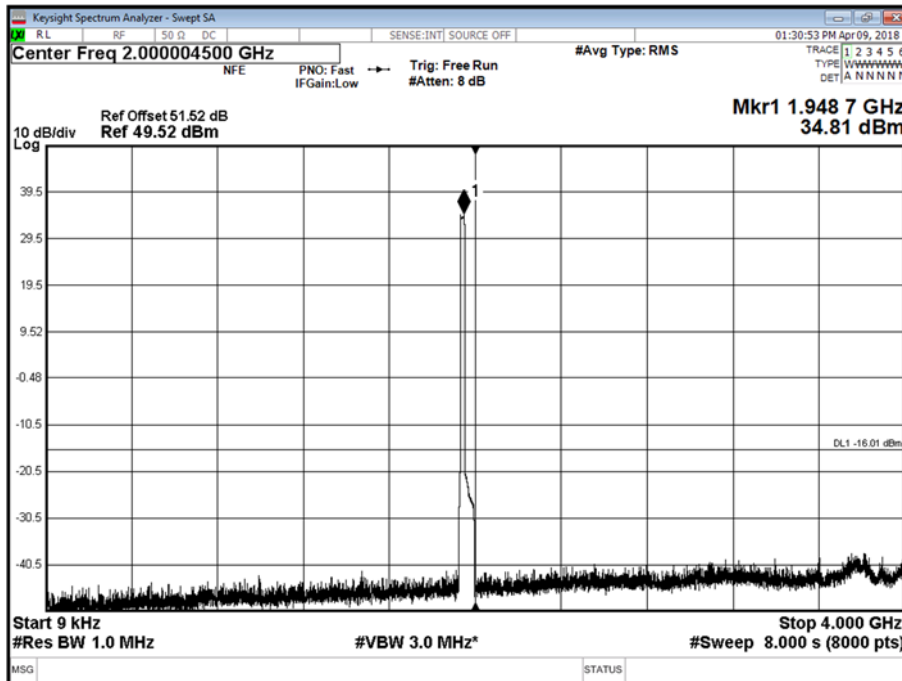
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position T - Band 3 - Range 12000 to 20000 MHz



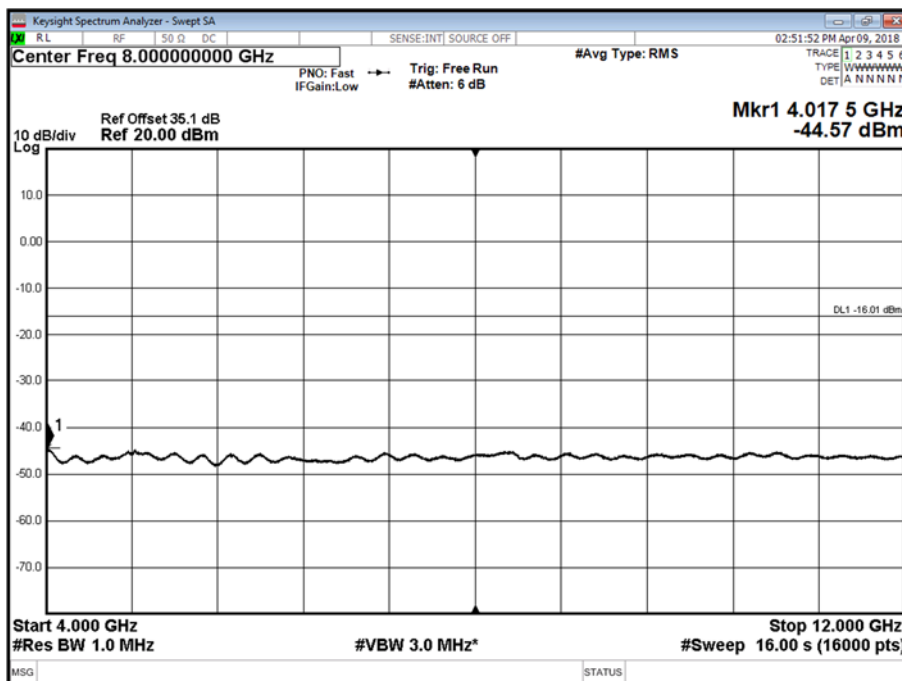


Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position B - Band 1 - Range 0.009 to 4000 MHz



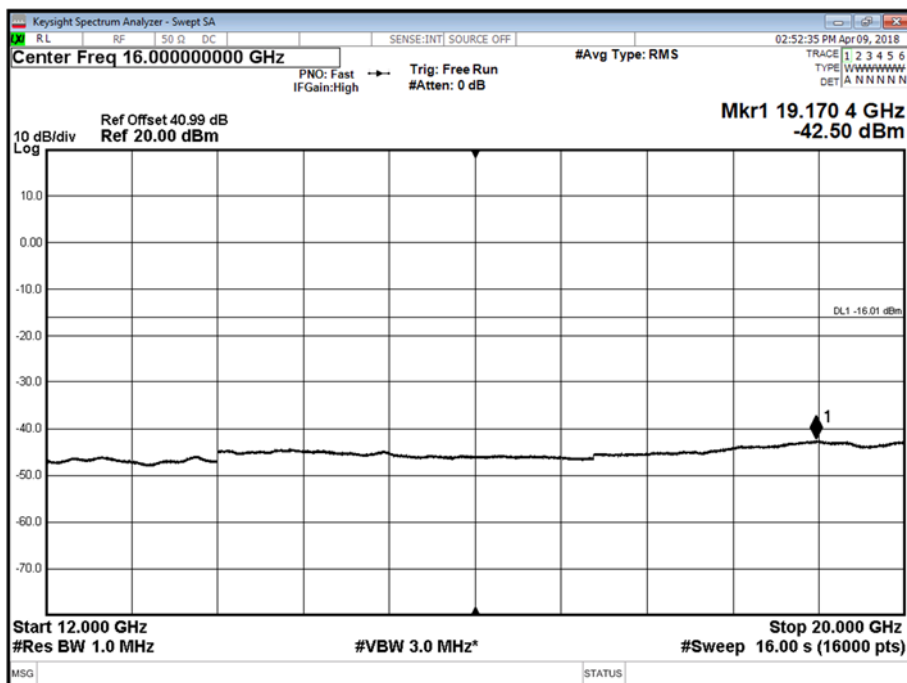
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position B - Band 2 - Range 4000 to 12000 MHz



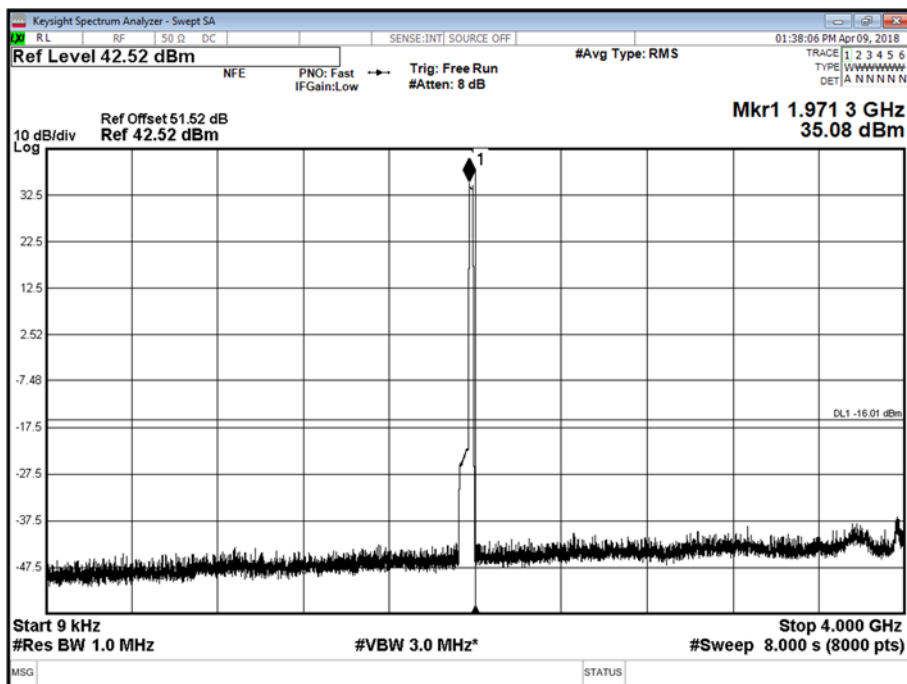


Product Service

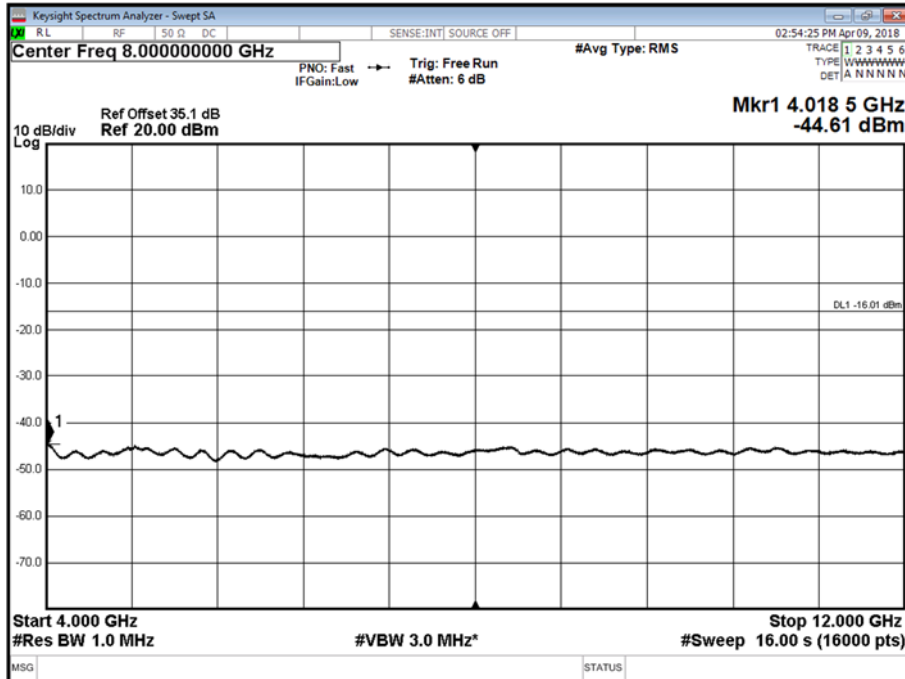
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position B - Band 3 - Range 12000 to 20000 MHz



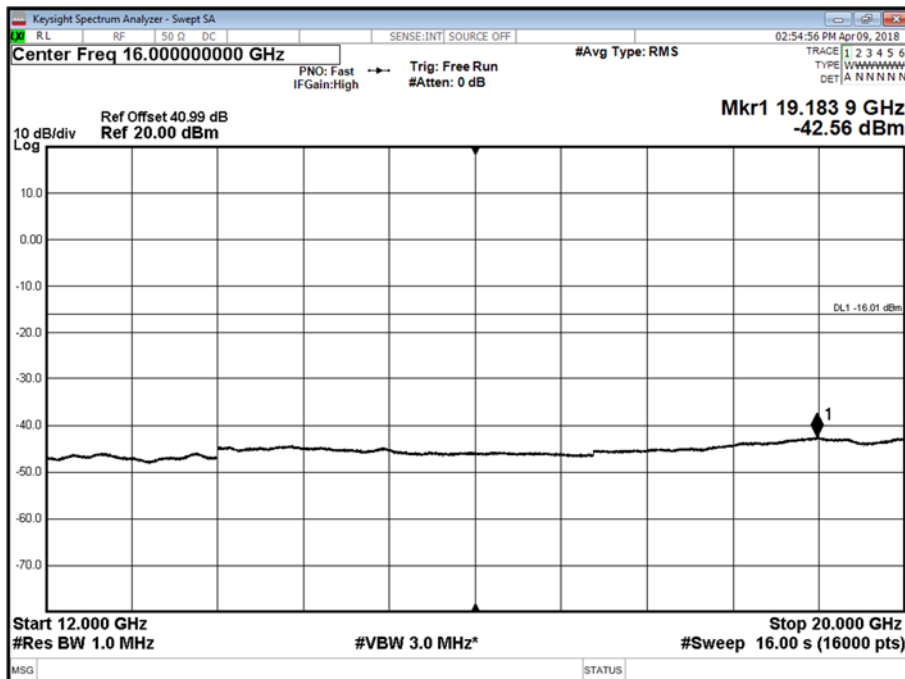
Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position T - Band 1 - Range 0.009 to 4000 MHz



Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position T - Band 2 - Range 4000 to 12000 MHz



Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position T - Band 3 - Range 12000 to 20000 MHz



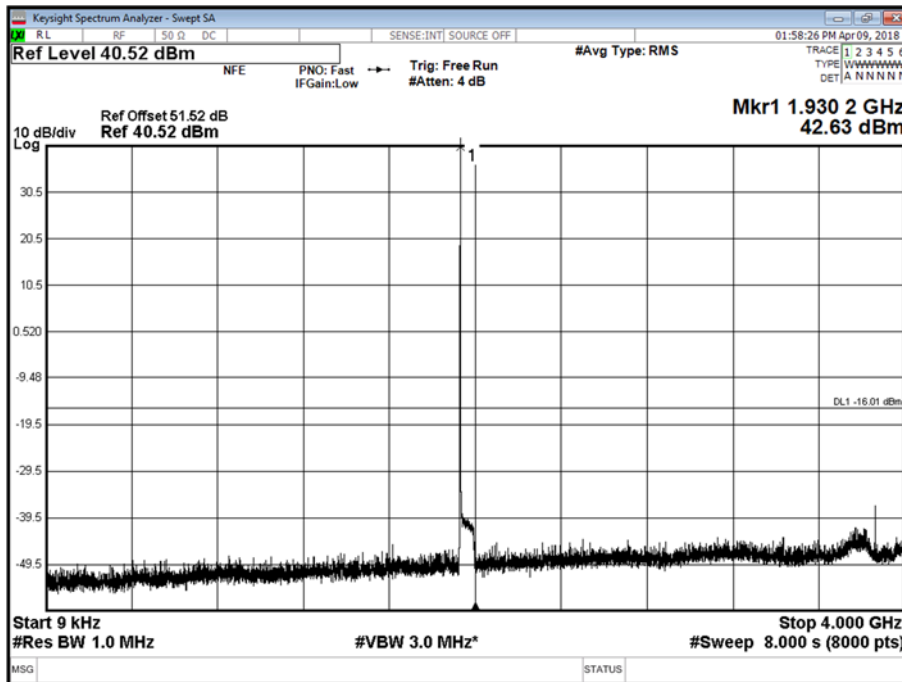


Product Service

Configuration B

Maximum Output Power 43 dBm

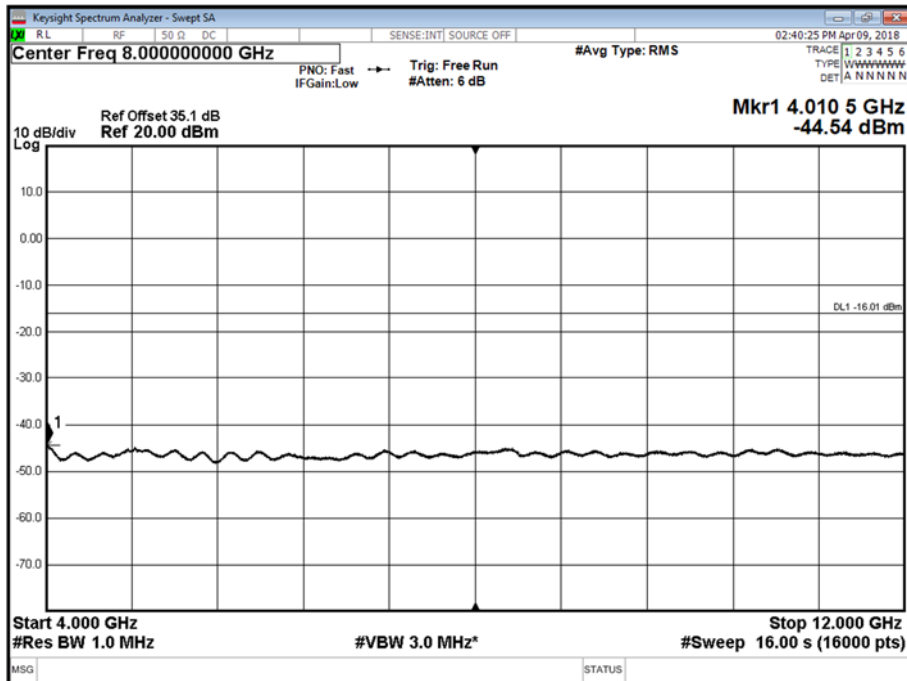
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position B - Band 1 - Range 0.009 to 4000 MHz



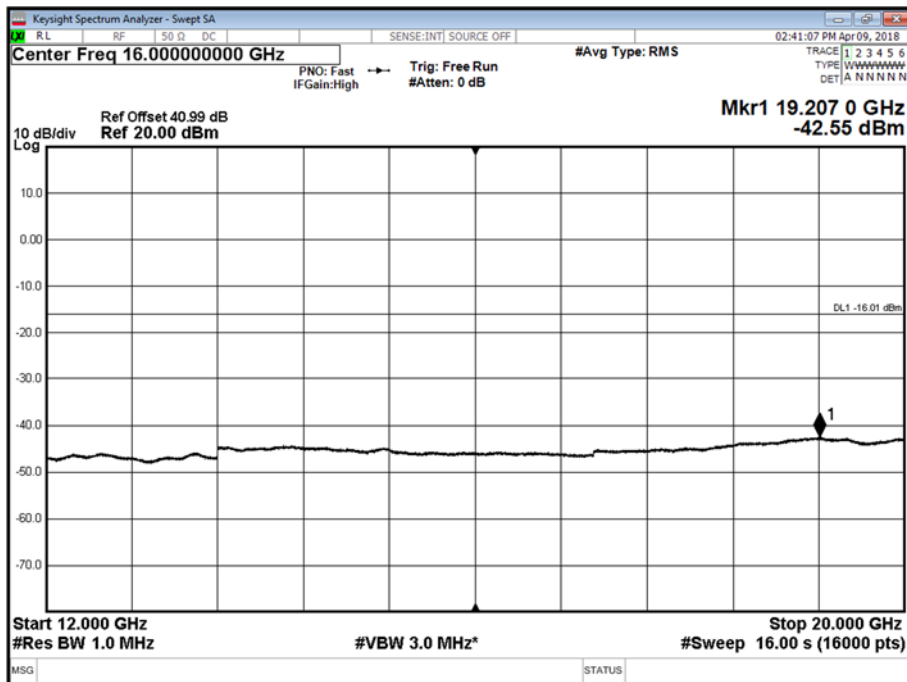


Product Service

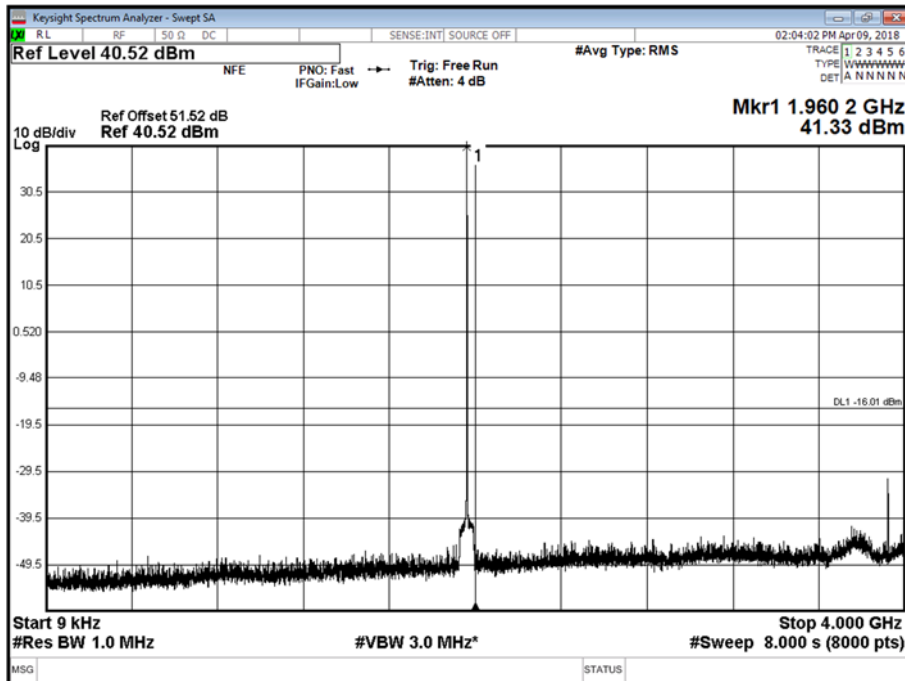
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position B - Band 2 - Range 4000 to 12000 MHz



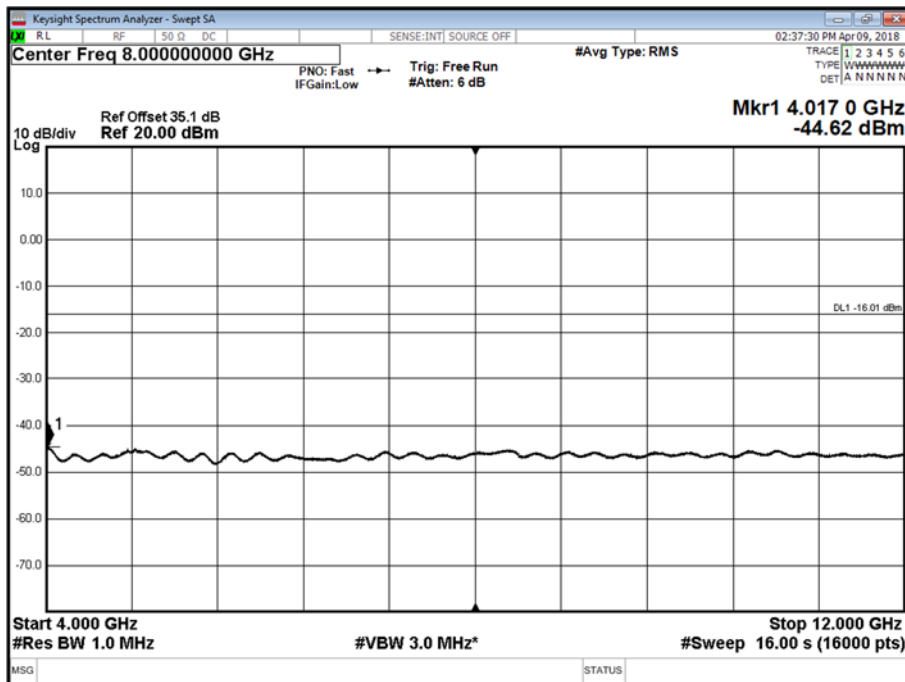
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position B - Band 3 - Range 12000 to 20000 MHz



Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position M - Band 1 - Range 0.009 to 4000 MHz



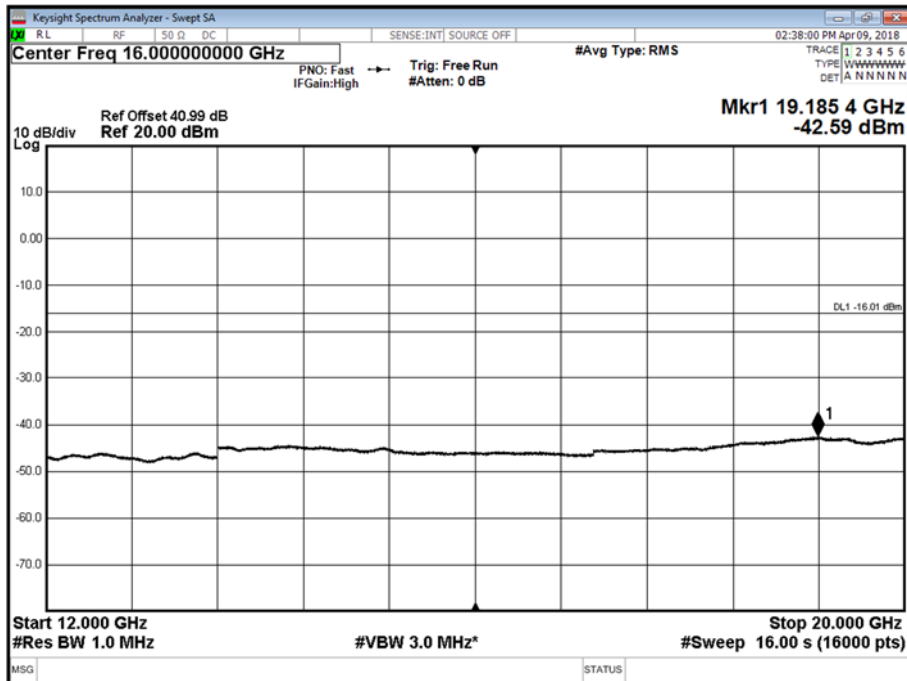
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position M - Band 2 - Range 4000 to 12000 MHz



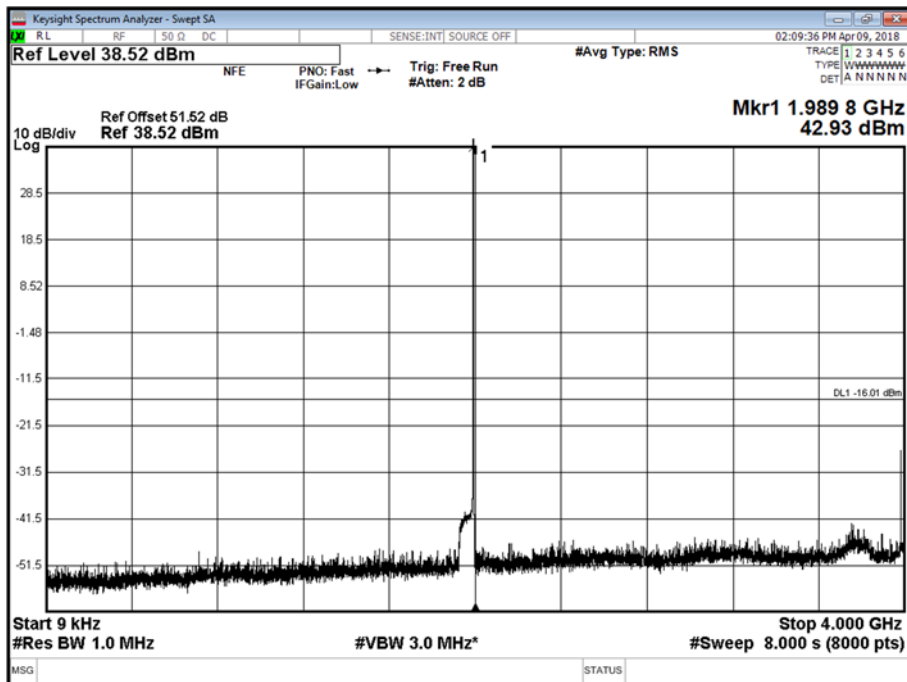


Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz - Channel Position M - Band 3 - Range 12000 to 20000 MHz



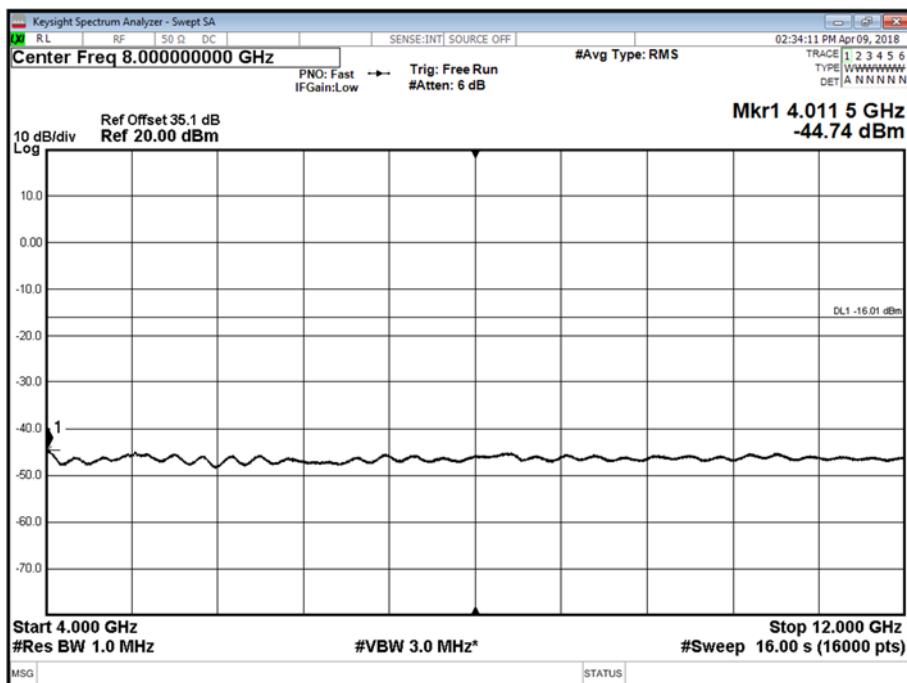
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz - Channel Position T - Band 1 - Range 0.009 to 4000 MHz



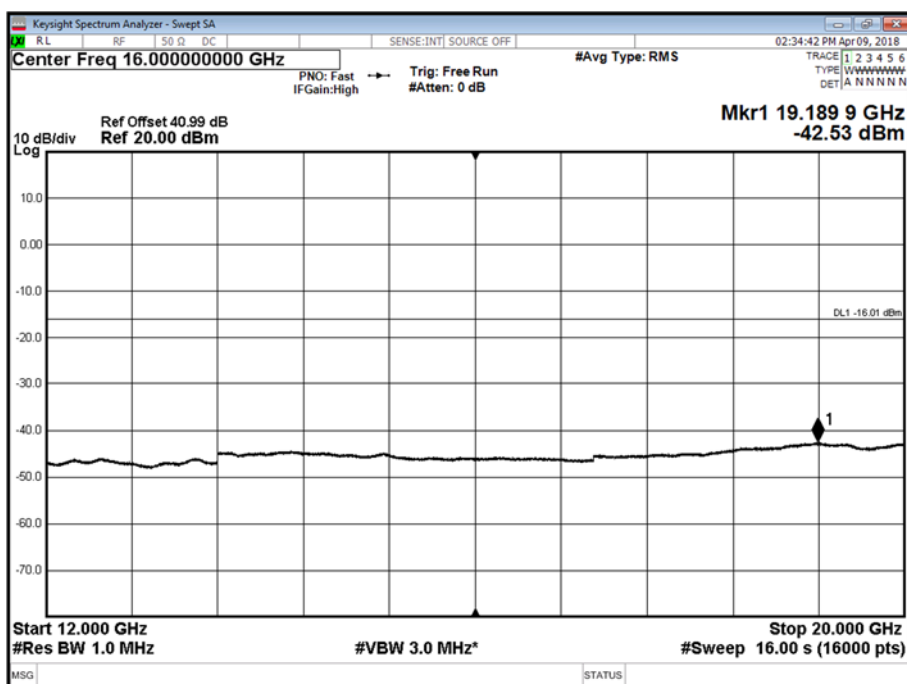


Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position T - Band 2 - Range 4000 to 12000 MHz



Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position T - Band 3 - Range 12000 to 20000 MHz



Limit MIMO

-16dBm



Product Service

2.5 RADIATED EMISSIONS

2.5.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1053
FCC CFR 47 Part 24, Clause 24.238
Industry Canada RSS-133, Clause 6.5

2.5.2 Date of Test and Modification State

27 March 2018 - Modification State 0

2.5.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.4 Environmental Conditions

Ambient Temperature	21.0°C
Relative Humidity	31.0%

2.5.5 Test Method

The test was applied in accordance with test method requirements of ANSI/TIA-603-C-2004.

A preliminary profile of the Spurious Radiated Emissions was obtained by operating the EUT on a remotely controlled turntable within the chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations.

The Applicant declared that the highest internally generated frequency would be up to 2000MHz and so the upper limit for measurement was calculated at 10 times this, which is 20GHz.

Emissions identified within the range 30MHz – 20GHz were then formally measured using a Peak detector as the worst case.

In the frequency Range 30MHz – 1GHz, the measurement was performed with a resolution bandwidth of 100kHz.

In the frequency Range 1GHz – 20GHz, the measurement was performed with a resolution bandwidth of 1MHz.

The measurements were performed at a 3m distance unless otherwise stated.

The limits for Spurious Emissions have been calculated, as shown below using the following formula:

Field Strength of Carrier - $(43 + 10\log(P))$ dB

Where:

Field Strength is measured in dBμV/m

P is measured Transmitter Power in Watts



Product Service

Determination of Spurious Emission Limit

As the EUT does not have an integral antenna, the field strength of the carrier has been calculated assuming that the power is to be fed to a half-wave tuned dipole as per 2.1053 (a).

$$E_{(v/m)} = (30 \times G_i \times P_o)^{0.5} / d$$

Where G_i is the antenna gain of an ideal half-wave dipole,
 P_o is the power out of the transceiver in W,
 d is the measurement distance in meter.

Therefore at 3m measurement distance the field strength using the lowest transceiver output power would be:

$$E_{(v/m)} = (30 \times 1.64 \times 40)^{0.5} / 3 = 25.61 \text{ V/m} = 148.17 \text{ dB}\mu\text{V/m}$$

As per 24.238(1)) the spurious emission must be attenuated by $43 + 10\log(P_o)$ dB this gives:

$$43 + 10\log(40) = 59.02 \text{ dB}$$

Therefore the limit at 3m measurement distance is:

$$148.17 - 59.02 = 89.15 \text{ dB}\mu\text{V/m}$$

This limit has been used to determine Pass or Fail for the harmonics measured and detailed in the following results.

2.5.6 Test Results

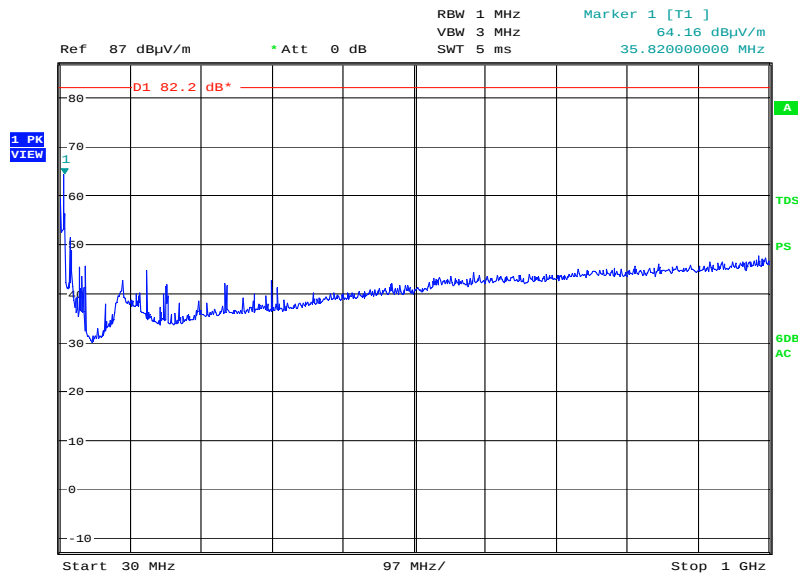
Configuration A

Maximum Output Power 46 dBm



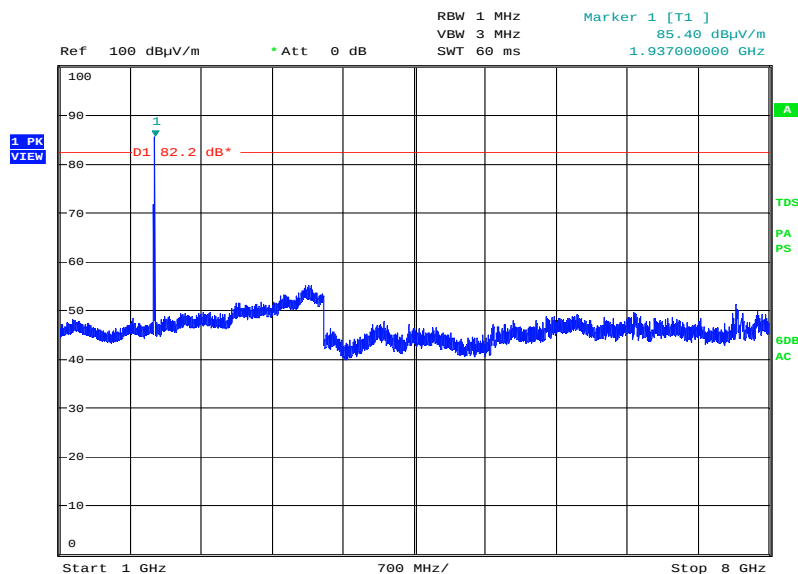
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position B - Band 1 - Range 0.009 to 1000 MHz



Date: 27.MAR.2018 18:00:20

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position B - Band 2 - Range 1000 to 8000 MHz

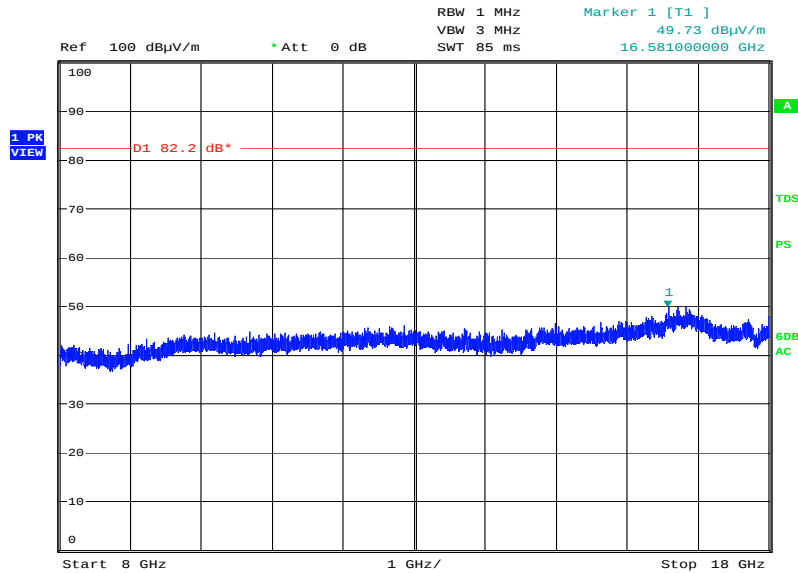


Date: 27.MAR.2018 19:53:30



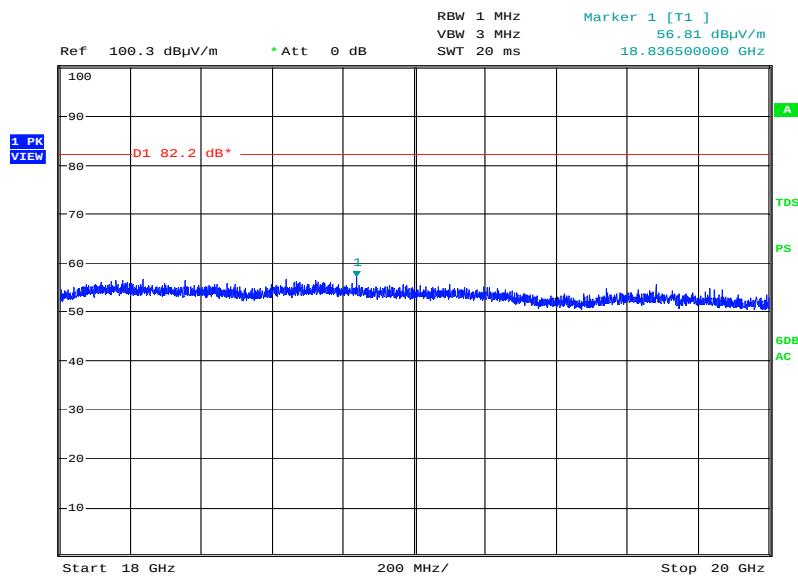
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position B - Band 3 - Range 8000 to 18000 MHz



Date: 27.MAR.2018 20:32:19

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position B - Band 4 - Range 18000 to 20000 MHz

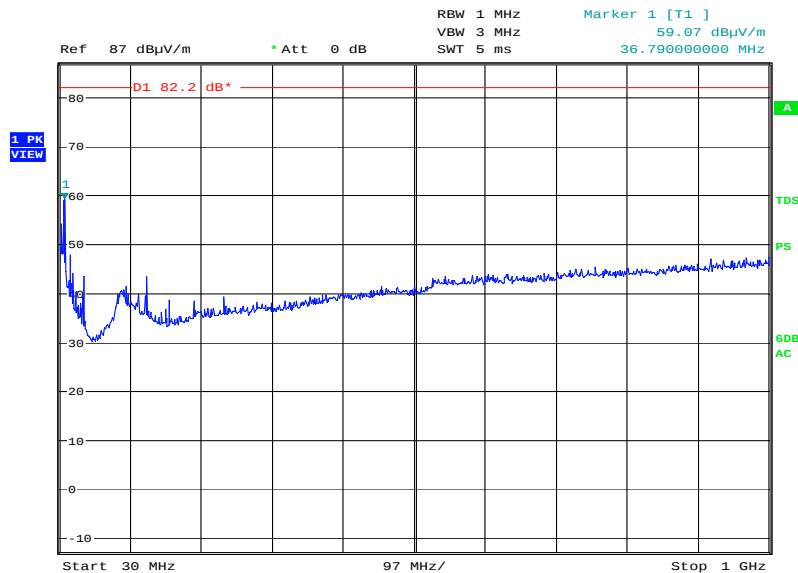


Date: 27.MAR.2018 23:06:57



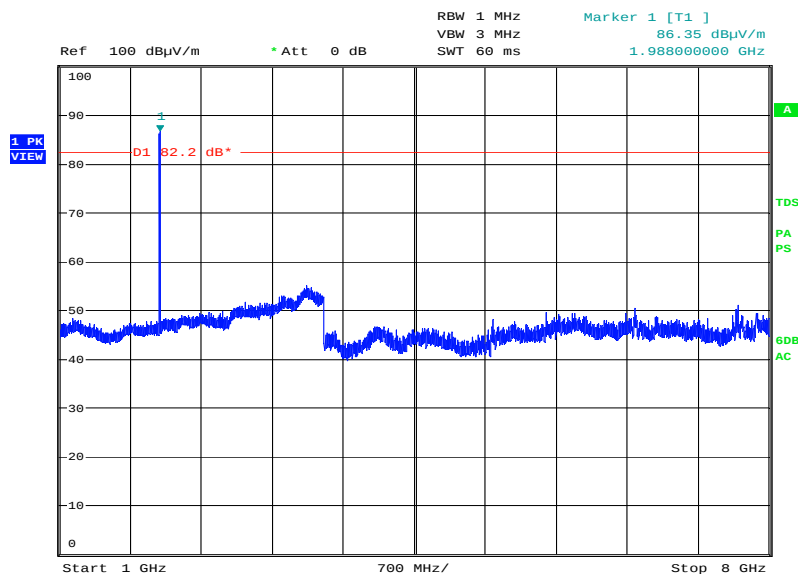
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position T - Band 1 - Range 0.009 to 1000 MHz



Date: 27.MAR.2018 17:55:36

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position T - Band 2 - Range 1000 to 8000 MHz

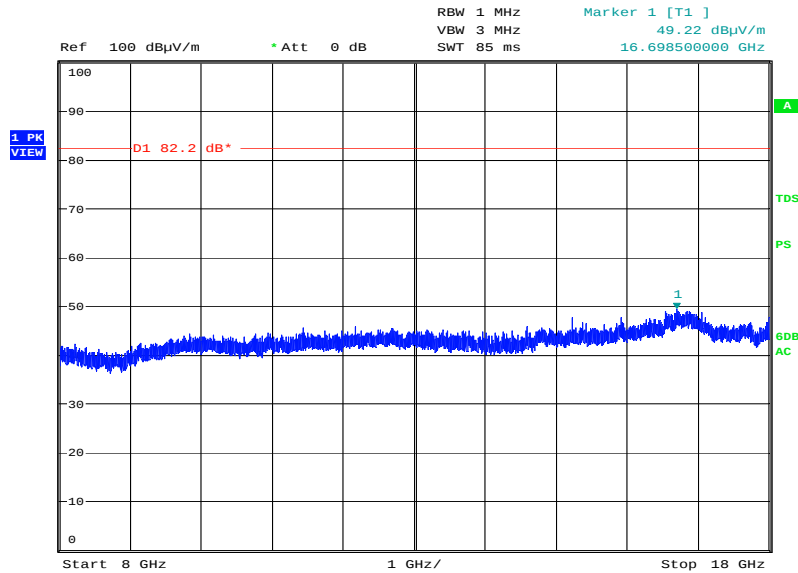


Date: 27.MAR.2018 19:49:09



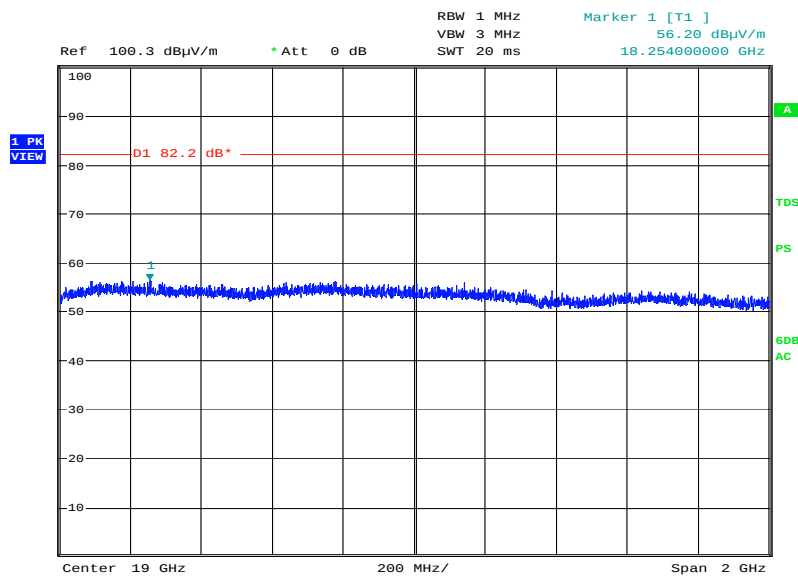
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position T - Band 3 - Range 8000 to 18000 MHz



Date: 27.MAR.2018 21:14:46

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position T - Band 4 - Range 18000 to 20000 MHz

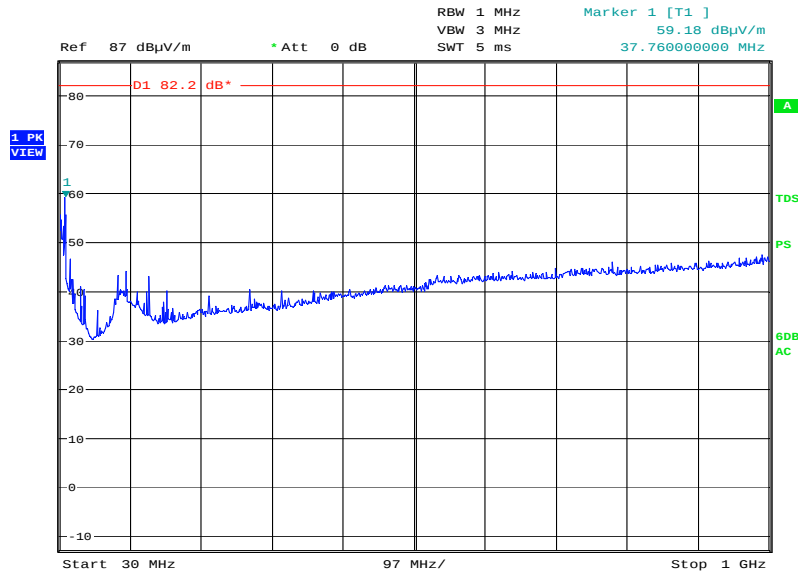


Date: 27.MAR.2018 23:02:56



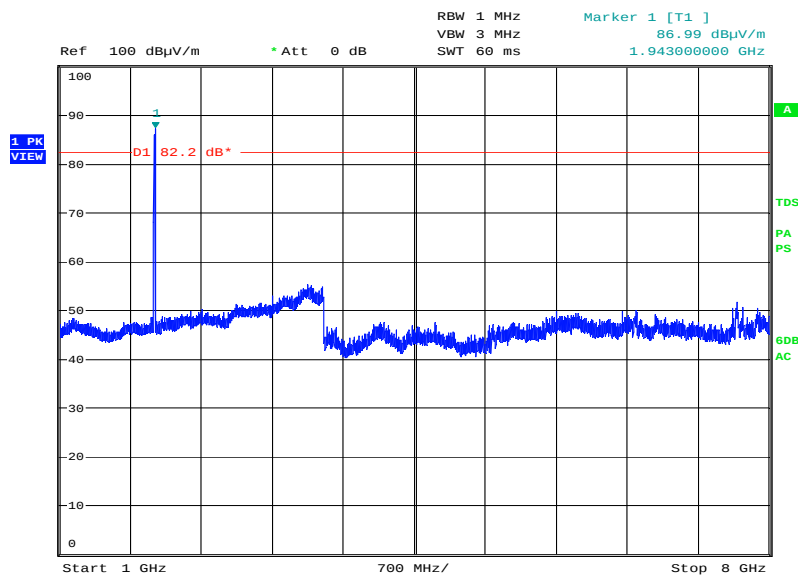
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position B - Band 1 - Range 0.009 to 1000 MHz



Date: 27.MAR.2018 18:05:28

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position B - Band 2 - Range 1000 to 8000 MHz

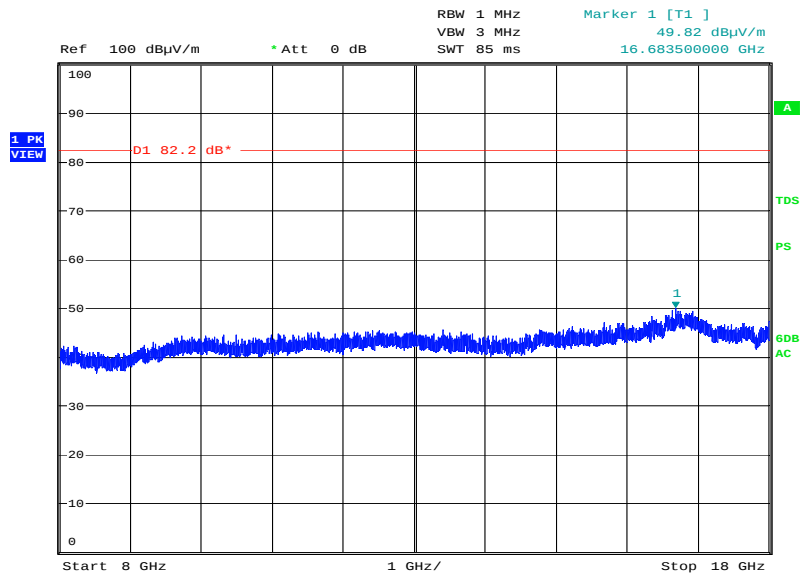


Date: 27.MAR.2018 19:44:14



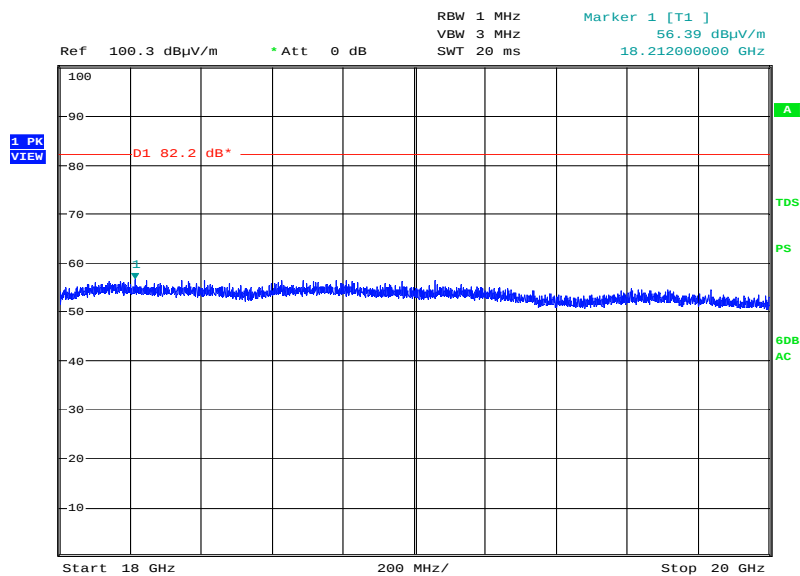
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position B - Band 3 - Range 8000 to 18000 MHz



Date: 27.MAR.2018 21:19:54

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position B - Band 4 - Range 18000 to 20000 MHz

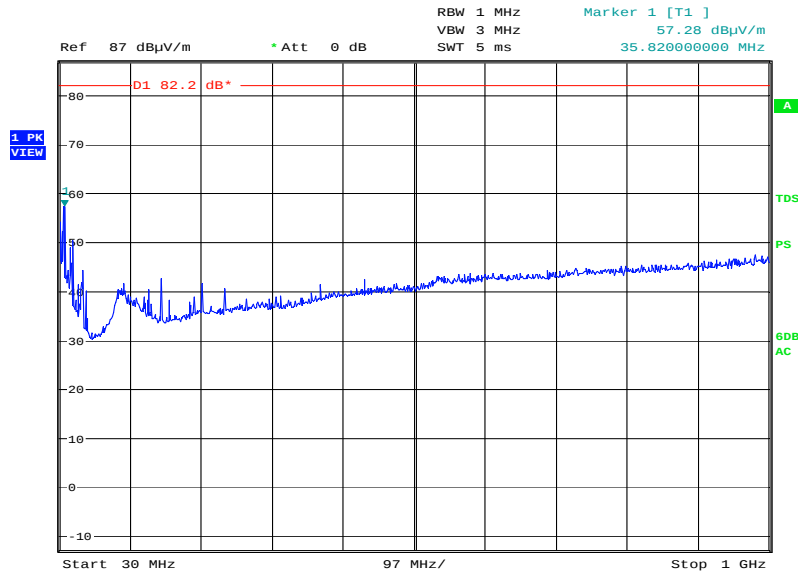


Date: 27.MAR.2018 22:57:09



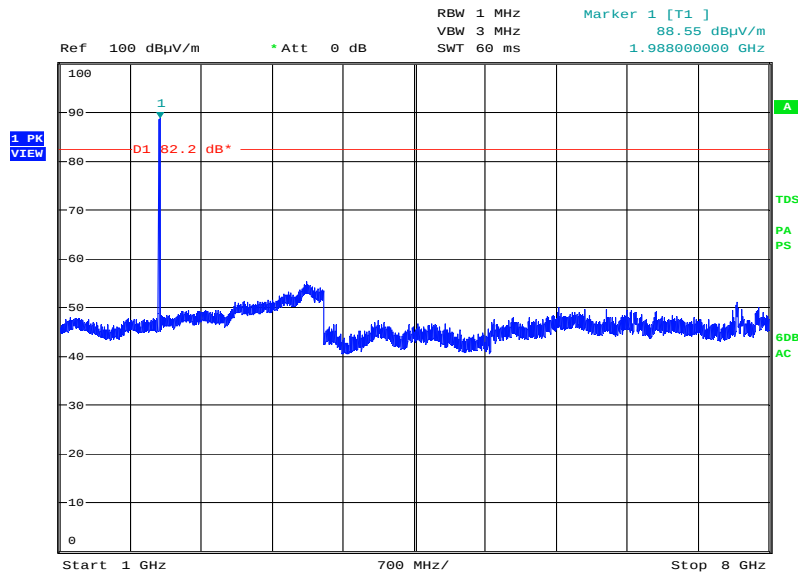
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position T - Band 1 - Range 0.009 to 1000 MHz



Date: 27.MAR.2018 18:10:47

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position T - Band 2 - Range 1000 to 8000 MHz

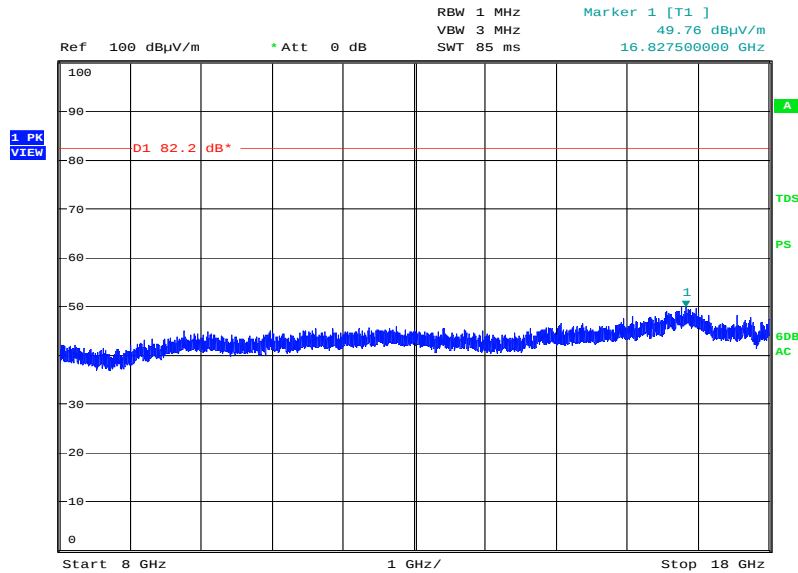


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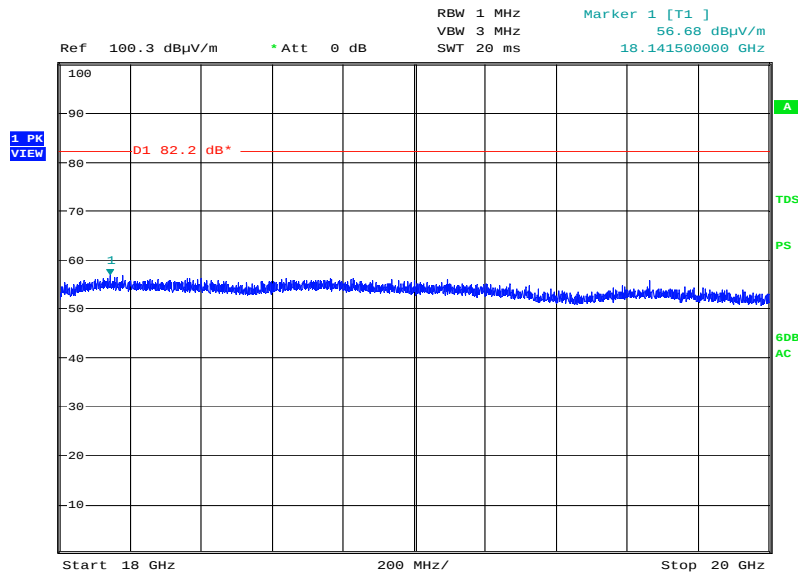
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position T - Band 3 - Range 8000 to 18000 MHz



Date: 27.MAR.2018 21:26:00

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position T - Band 4 - Range 18000 to 20000 MHz

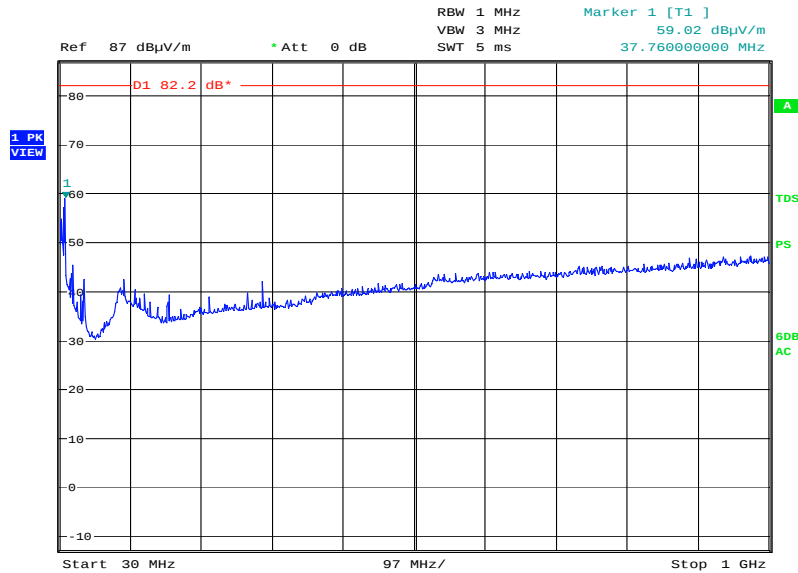


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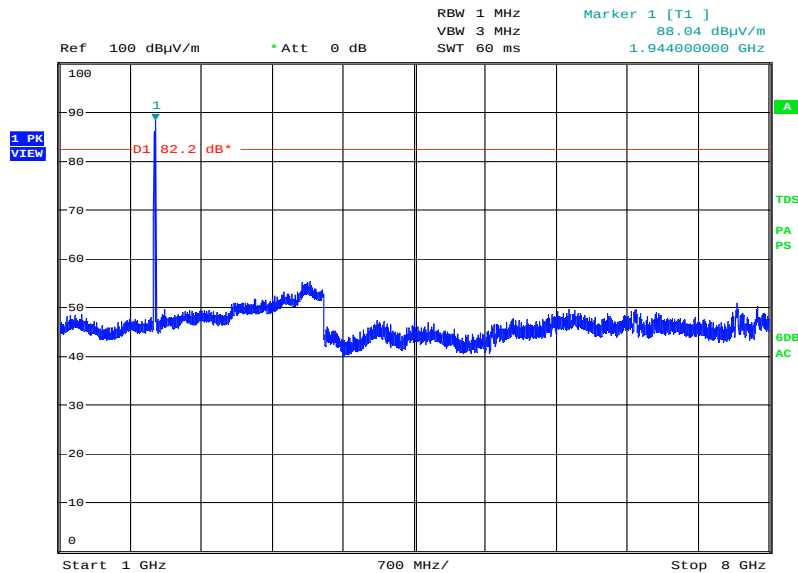
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position B - Band 1 - Range 0.009 to 1000 MHz



Date: 27.MAR.2018 18:17:15

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth
L:20.0 MHz / N:180 kHz - Channel Position B - Band 2 - Range 1000 to 8000 MHz

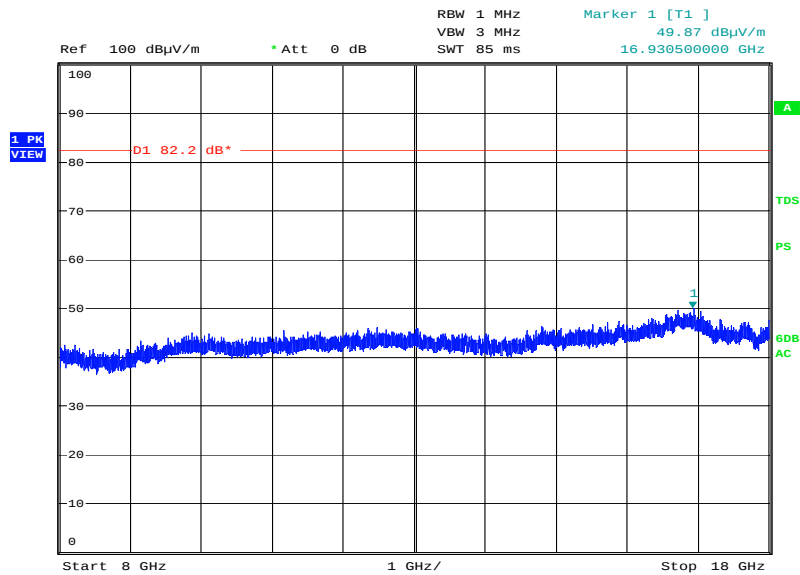


Date: 27.MAR.2018 19:32:41



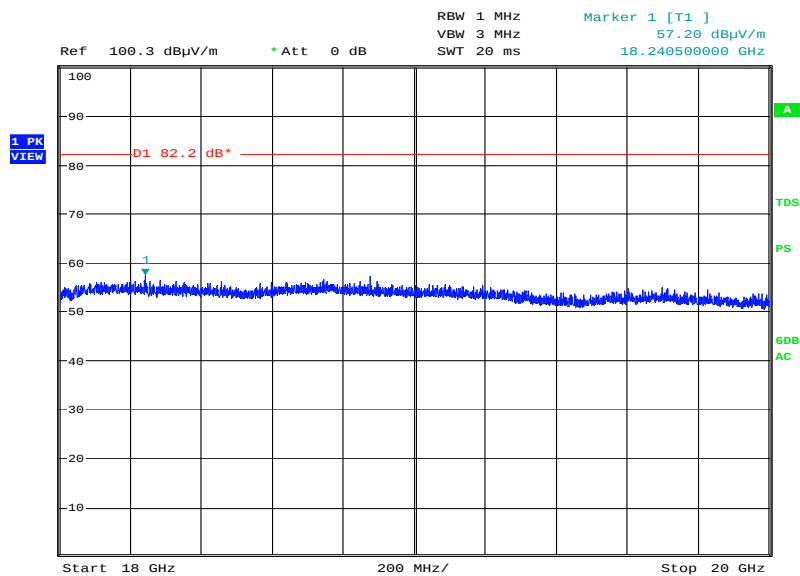
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:20.0 MHz / N:180 kHz - Channel Position B - Band 3 - Range 8000 to 18000 MHz



Date: 27.MAR.2018 21:32:19

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:20.0 MHz / N:180 kHz - Channel Position B - Band 4 - Range 18000 to 20000 MHz

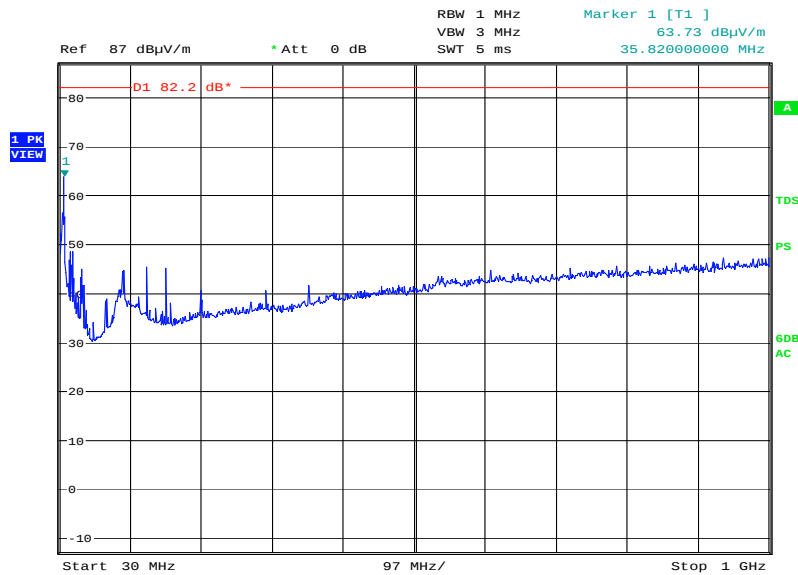


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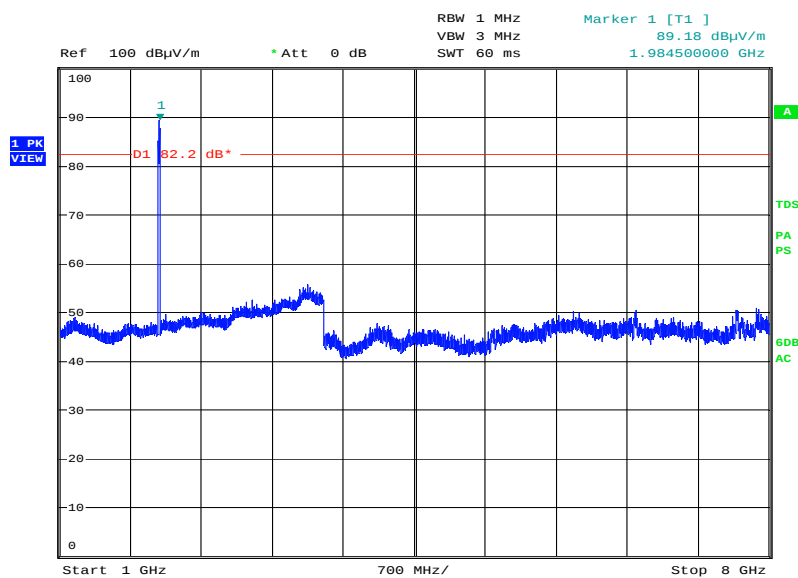
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:20.0 MHz / N:180 kHz - Channel Position T - Band 1 - Range 0.009 to 1000 MHz



Date: 27.MAR.2018 18:21:41

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:20.0 MHz / N:180 kHz - Channel Position T - Band 2 - Range 1000 to 8000 MHz

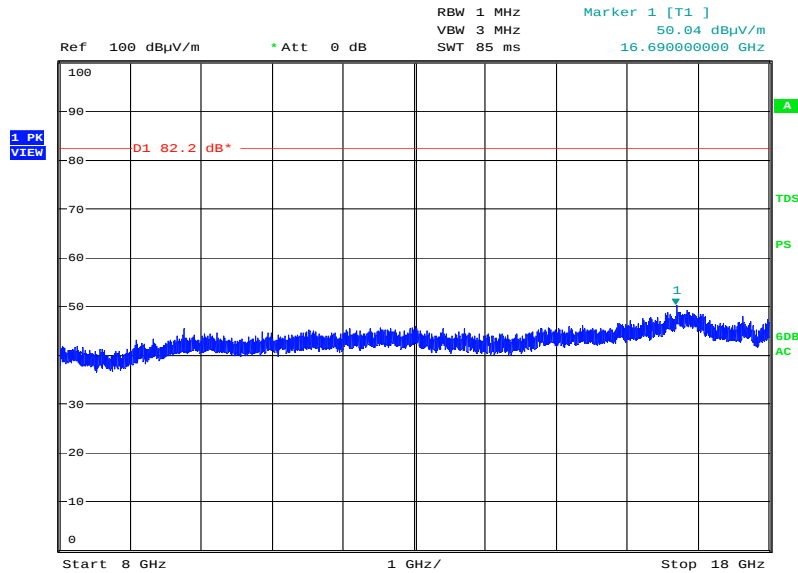


Date: 27.MAR.2018 19:26:25



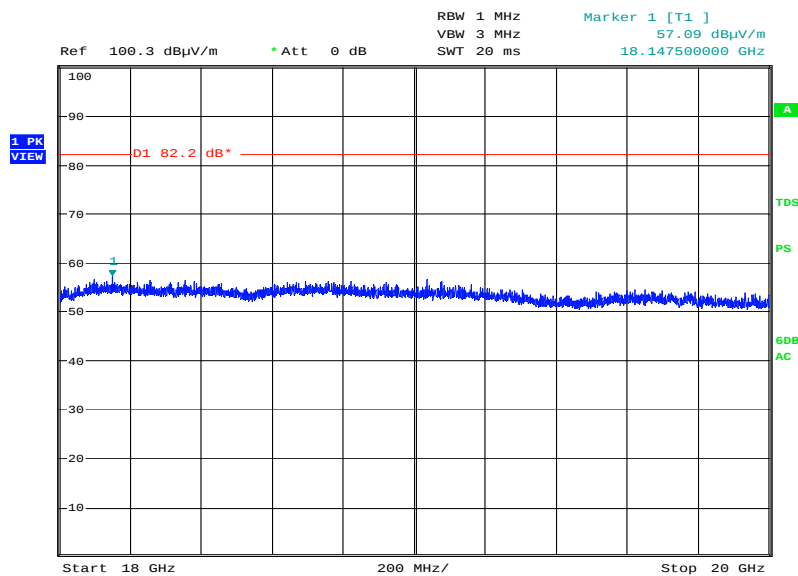
Product Service

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:20.0 MHz / N:180 kHz - Channel Position T - Band 3 - Range 8000 to 18000 MHz



Date: 27.MAR.2018 21:36:43

Antenna A - LTE / NB-IoT Modulation L:64QAM / N:QPSK - LTE / NB-IoT Carrier Bandwidth L:20.0 MHz / N:180 kHz - Channel Position T - Band 4 - Range 18000 to 20000 MHz

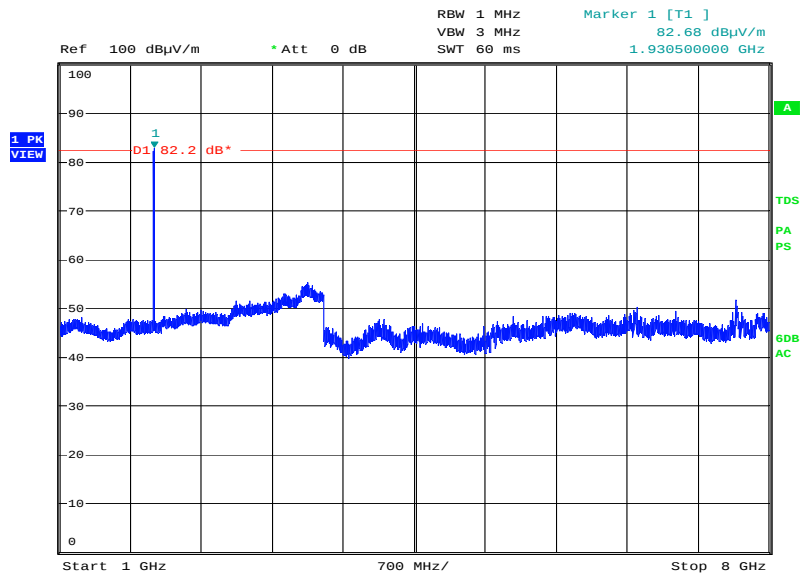


Date: 27.MAR.2018 22:34:15



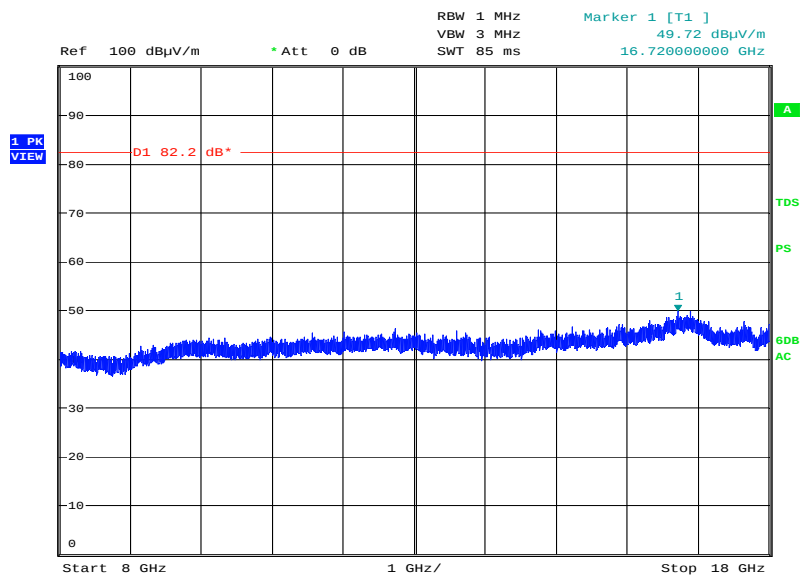
Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position B - Band 2 - Range 1000 to 8000 MHz



Date: 27.MAR.2018 19:57:37

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position B - Band 3 - Range 8000 to 18000 MHz

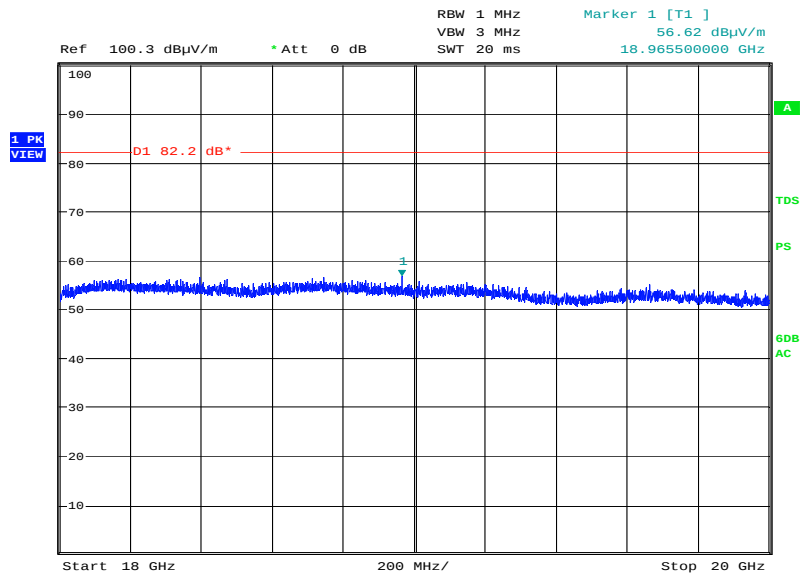


Date: 27.MAR.2018 21:40:22



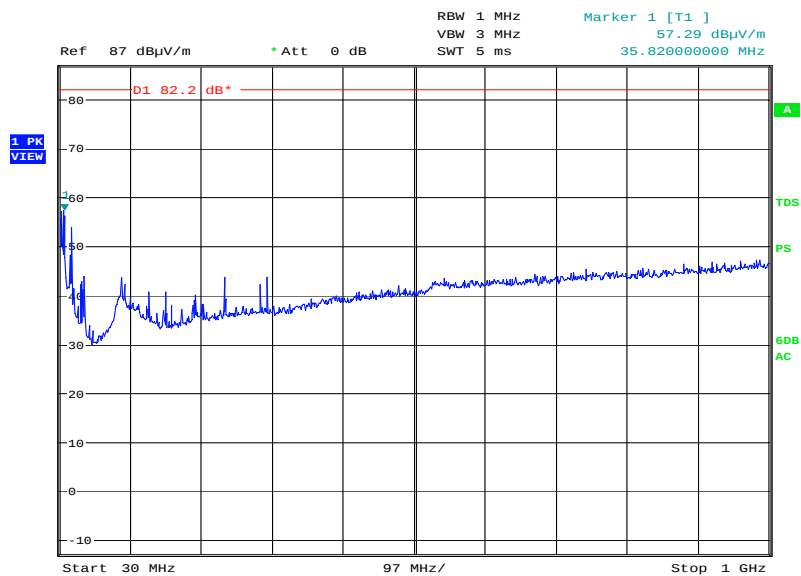
Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position B - Band 4 - Range 18000 to 20000 MHz



Date: 27.MAR.2018 23:11:11

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position M - Band 1 - Range 30 to 1000 MHz

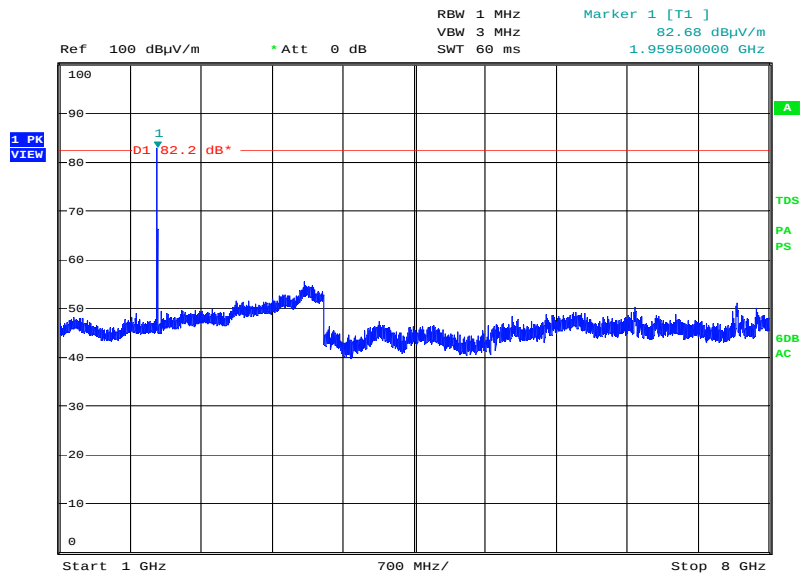


Date: 27.MAR.2018 18:32:25



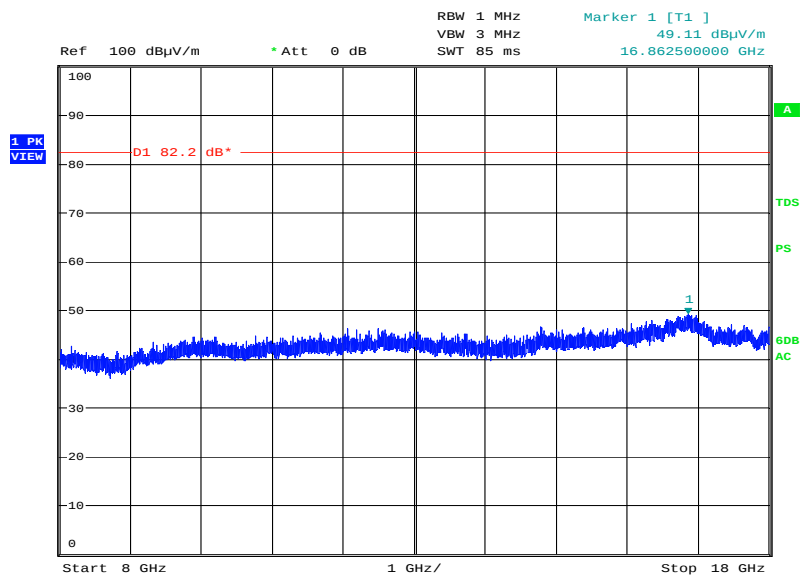
Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position M - Band 2 - Range 1000 to 8000 MHz



Date: 27.MAR.2018 20:01:13

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position M - Band 3 - Range 8000 to 18000 MHz

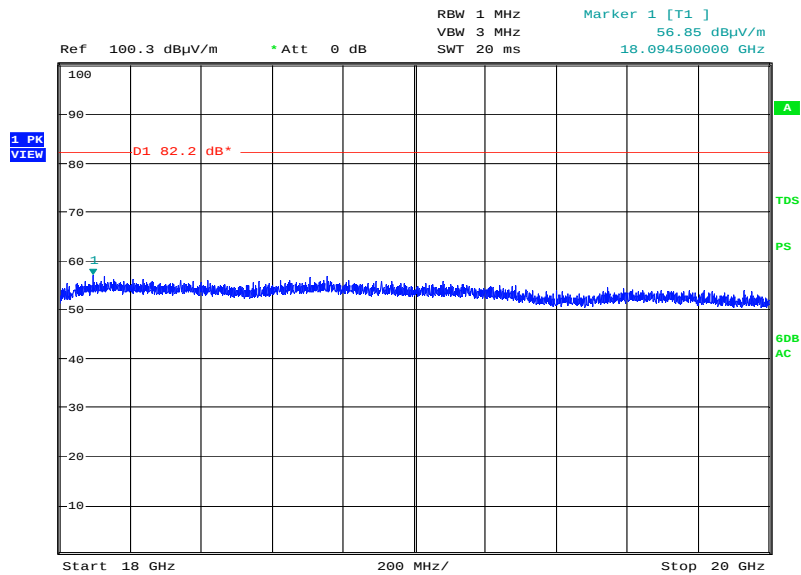


Date: 27.MAR.2018 21:44:11



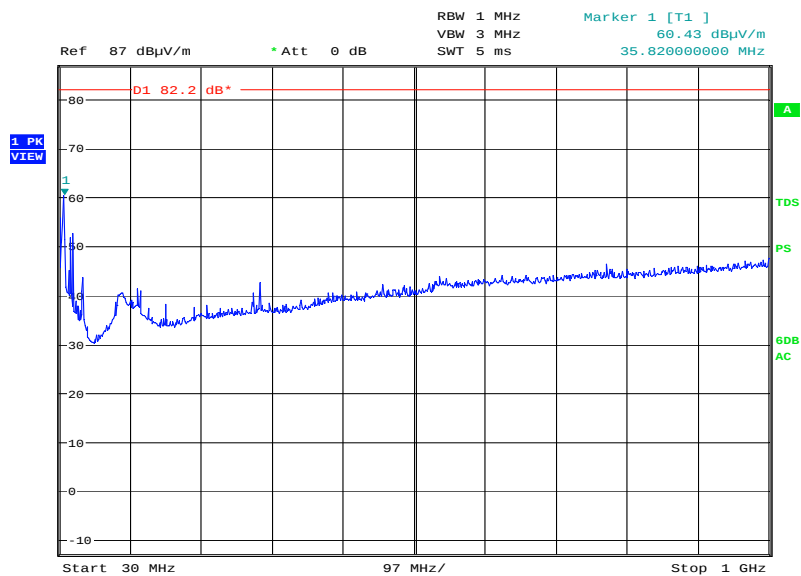
Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position M - Band 4 - Range 18000 to 20000 MHz



Date: 27.MAR.2018 23:14:55

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position T - Band 1 - Range 30 to 1000 MHz

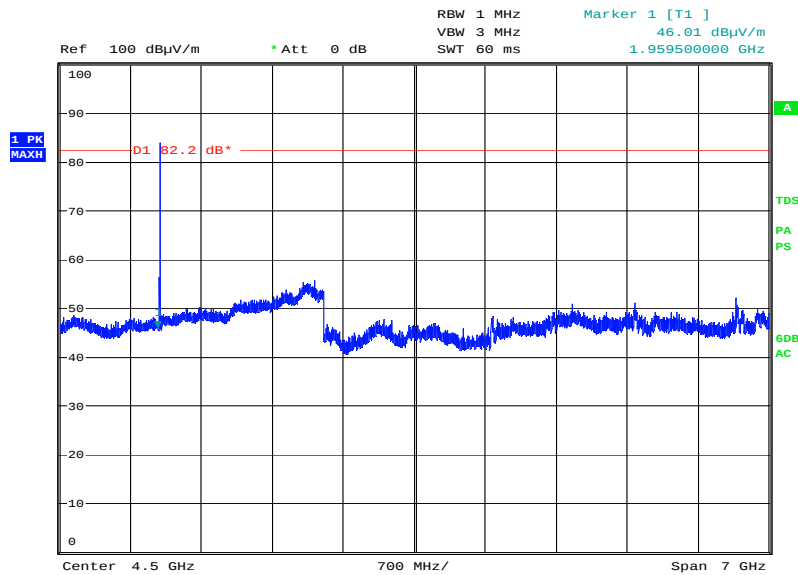


Date: 27.MAR.2018 18:28:57



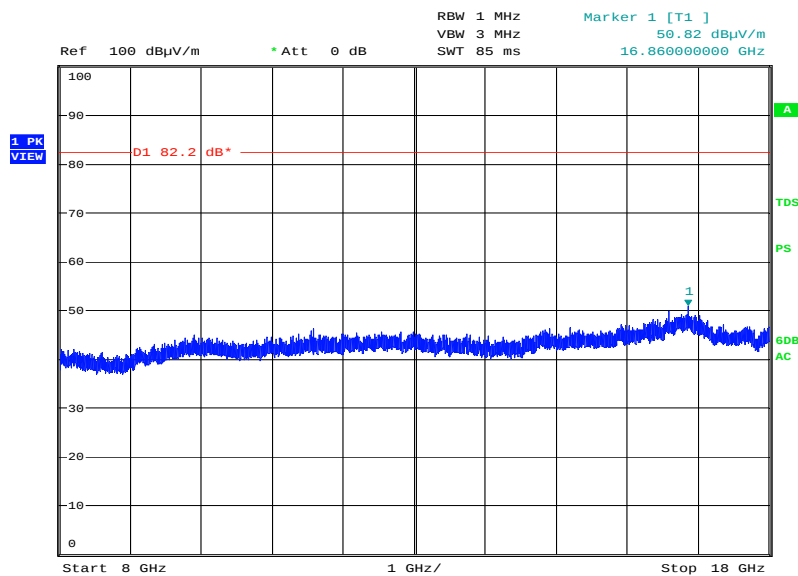
Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position T - Band 2 - Range 1000 to 8000 MHz



Date: 27.MAR.2018 20:10:44

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position T - Band 3 - Range 8000 to 18000 MHz

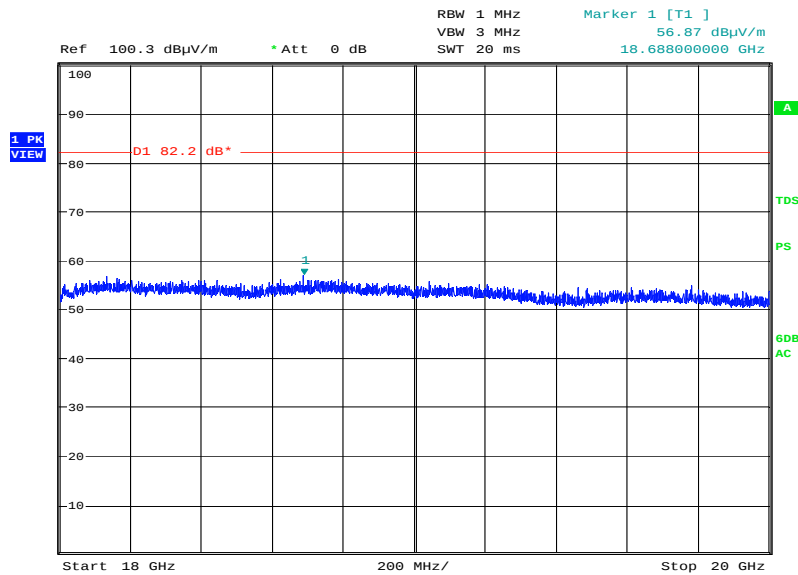


Date: 27.MAR.2018 21:48:02



Product Service

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position T - Band 4 - Range 18000 to 20000 MHz



Date: 27.MAR.2018 23:18:50



Product Service

SECTION 3

TEST EQUIPMENT USED



Product Service

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Maximum Peak Output Power and Peak to Average Ratio - Conducted					
Spectrum Analyser	Keysight	PXA	MY49430624	12	30-Jun-2018
Spectrum Analyser	Keysight	PXA	MY54410231	12	30-Nov-2018
Network Analyser	Rohde&Schwarz	ZVA40	TE3548	12	02-Oct-2018
Calibration unit	Rohde&Schwarz	ZV-Z54	TE4368	12	19-Sep-2018
High Pass filter	K&L	11SH10-3000/X18000-0/0	4412	-	OP MON
Attenuator	Weinschel	47-10-34	BU0642	-	OP MON
Attenuator	Weinschel	48-10-43	CH9195	-	OP MON
Attenuator	Weinschel	48-30-43	CH9182	-	OP MON
RF Load	weinschel	WA49-40-33	A1565	-	OP MON
Power Meter	Agilent	N1911A	MY45101617	-	OP MON
Power Supply	Delta	BML 901 250/1	BW96903167	-	OP MON
Wideband Power Sensor	Agilent	N1921A	MY45242699	-	OP MON
Hygrometer	RS	TE3220	0427452	12	30-Aug-2018
Digital Volt Meter	White gold	79 III	TE00190	12	24-Nov-2018
Occupied Bandwidth					
Maximum Peak Output Power and Peak to Average Ratio - Conducted					
Spectrum Analyser	Keysight	PXA	MY49430624	12	30-Jun-2018
Spectrum Analyser	Keysight	PXA	MY54410231	12	30-Nov-2018
Network Analyser	Rohde&Schwarz	ZVA40	TE3548	12	02-Oct-2018
Calibration unit	Rohde&Schwarz	ZV-Z54	TE4368	12	19-Sep-2018
High Pass filter	K&L	11SH10-3000/X18000-0/0	4412	-	OP MON
Attenuator	Weinschel	47-10-34	BU0642	-	OP MON
Attenuator	Weinschel	48-10-43	CH9195	-	OP MON
Attenuator	Weinschel	48-30-43	CH9182	-	OP MON
RF Load	weinschel	WA49-40-33	A1565	-	OP MON
Power Meter	Agilent	N1911A	MY45101617	-	OP MON
Power Supply	Delta	BML 901 250/1	BW96903167	-	OP MON
Wideband Power Sensor	Agilent	N1921A	MY45242699	-	OP MON
Hygrometer	RS	TE3220	0427452	12	30-Aug-2018
Digital Volt Meter	White gold	79 III	TE00190	12	24-Nov-2018
Band Edge					
Spectrum Analyser	Keysight	PXA	MY49430624	12	30-Jun-2018
Spectrum Analyser	Keysight	PXA	MY54410231	12	30-Nov-2018
Network Analyser	Rohde&Schwarz	ZVA40	TE3548	12	02-Oct-2018
Calibration unit	Rohde&Schwarz	ZV-Z54	TE4368	12	19-Sep-2018
High Pass filter	K&L	11SH10-3000/X18000-0/0	4412	-	OP MON
Attenuator	Weinschel	47-10-34	BU0642	-	OP MON
Attenuator	Weinschel	48-10-43	CH9195	-	OP MON
Attenuator	Weinschel	48-30-43	CH9182	-	OP MON



Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
RF Load	weinschel	WA49-40-33	A1565	-	OP MON
Power Meter	Agilent	N1911A	MY45101617	-	OP MON
Power Supply	Delta	BML 901 250/1	BW96903167	-	OP MON
Wideband Power Sensor	Agilent	N1921A	MY45242699	-	OP MON
Hygrometer	RS	TE3220	0427452	12	30-Aug-2018
Digital Volt Meter	White gold	79 III	TE00190	12	24-Nov-2018
Transmitter Spurious Emissions					
Spectrum Analyser	Keysight	PXA	MY49430624	12	30-Jun-2018
Spectrum Analyser	Keysight	PXA	MY54410231	12	30-Nov-2018
Network Analyser	Rohde&Schwarz	ZVA40	TE3548	12	02-Oct-2018
Calibration unit	Rohde&Schwarz	ZV-Z54	TE4368	12	19-Sep-2018
High Pass filter	K&L	11SH10-3000/X18000-0/0	4412	-	OP MON
Attenuator	Weinschel	47-10-34	BU0642	-	OP MON
Attenuator	Weinschel	48-10-43	CH9195	-	OP MON
Attenuator	Weinschel	48-30-43	CH9182	-	OP MON
RF Load	weinschel	WA49-40-33	A1565	-	OP MON
Power Meter	Agilent	N1911A	MY45101617	-	OP MON
Power Supply	Delta	BML 901 250/1	BW96903167	-	OP MON
Waveguide	F.M.I	18-25 GHz	N/A	-	OP MON
Wideband Power Sensor	Agilent	N1921A	MY45242699	-	OP MON
Hygrometer	RS	TE3220	0427452	12	30-Aug-2018
Digital Volt Meter	White gold	79 III	TE00190	12	24-Nov-2018
Radiated Emissions					
Antenna (Bilog)	Schaffner	CBL6143	287	24	18-Apr-18
Antenna 18-40GHz (Double Ridge Guide)	Q-Par Angus Ltd	QSH 180K	1511	24	07-Dec-18
Pre-Amplifier	Phase One	PS04-0086	1533	12	12-Jan-19
18GHz - 40GHz Pre-Amplifier	Phase One	PS04-0087	1534	12	02-Feb-19
Screened Room (5)	Rainford	Rainford	1545	36	09-Jun-18
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-18
Tilt Antenna Mast	mature GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	mature GmbH	NCD	3917	-	TU
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	18-Oct-18
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	01-Mar-19
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-19

N/A – Not Applicable

O/P Mon – Output Monitored with Calibrated Equipment



Product Service

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	Frequency / Parameter	MU
Conducted Maximum Peak Output Power	30 MHz to 20 GHz Amplitude	± 0.1 dB
Conducted Emissions	30 MHz to 20 GHz Amplitude	± 2.3 dB
Frequency Stability	30 MHz to 2 GHz	± 5.0 Hz
Occupied Bandwidth	Up to 20 MHz Bandwidth	± 1.1 Hz
Band Edge	30 MHz to 20 GHz Amplitude	± 2.3 dB
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.1dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Worst case error for both Time and Frequency measurement 12 parts in 10 ⁶		



Product Service

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



Product Service

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA
(Not UKAS Accredited).

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Product Service

ANNEX A

MODULE LIST



Product Service

Configurations A and B			
Product	Product No	R-State	Serial No
CT10	LPC102487/1	R1C	TO1F307249
RRUS11 B2	KRC 161 276/2	R3B	CF83262617
Software Version:	xrus_NBIoT_GB_SA_for_FCC_test (based on CXP9013268/6 R66BM)		