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Report On

FCC and IC Testing of the
Ericsson Remote Radio Unit LTE and NB-IoT GB KRC 161 298/1, RUS 02 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: TA8AKRC161298-1
IC ID: 287AB-AS1612981

PREPARED BY

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APPROVED BY

Steve Scarfe
Authorised Signatory

DATED

27 April 2018

Document 75941448 Report 02 Issue 1

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	RUS 02 B2
Product Number	KRC 161 298/1
IC Model Name	AS1612981
Serial Number(s)	CA73209104
Software Version	CXP9013268_9-R71DK.xlf
Hardware Version	R1G
Test Specification/Issue/Date	FCC CFR 47 Part 2: 2016 FCC CFR 47 Part 24: 2016 Industry Canada RSS-GEN: Issue 4: 2014 Industry Canada RSS-133: Issue 6: 2013
Start of Test	26 March 2018
Finish of Test	10 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	-	-	-	-	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



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1.4 DECLARATION OF BUILD STATUS

MAIN EUT	
MANUFACTURING DESCRIPTION	Remote Radio Unit
MANUFACTURER	Ericsson AB
PRODUCT NAME	RUS 02 B2
PART NUMBER	KRC 161 298/1
IC Model Name	AS1612981
SERIAL NUMBER	CA73209104
HARDWARE VERSION	R1G
SOFTWARE VERSION	CXP9013268_9-R71DK.xlf
TRANSMITTER OPERATING RANGE	1930 to 1990 MHz
MODULATIONS	LTE: QPSK, 16QAM, 64QAM, 256QAM
INTERMEDIATE FREQUENCIES	-
ITU DESIGNATION OF EMISSION	10 MHz BW channel ¹ : 9M45F9W
	15 MHz BW channel ¹ : 14M1F9W
	20 MHz BW channel ¹ : 18M5F9W
	NB-IoT SA 200 kHz BW channel: 210KW7D
OUTPUT POWER (RMS) (W or dBm)	1x80W ¹
	NB-IoT SA 1x20W
FCC ID	TA8AKRC161298-1
IC ID	287AB-AS1612981
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

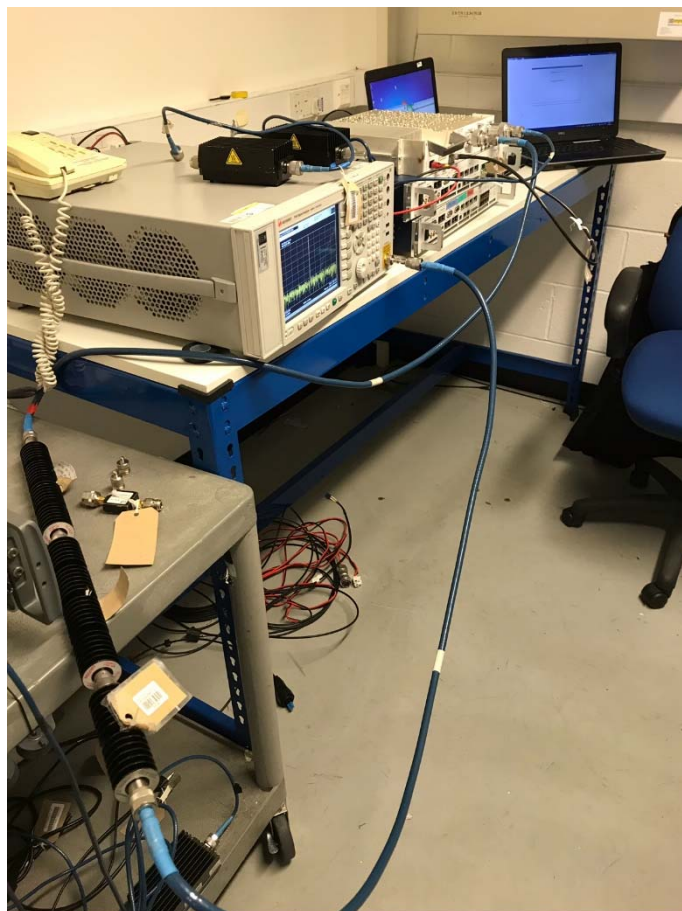
No responsibility will be accepted by TÜV SÜD Product Service UK Limited as to the accuracy of the information declared in this document by the manufacturer.

1.5 PRODUCT INFORMATION

1.5.1 Technical Description

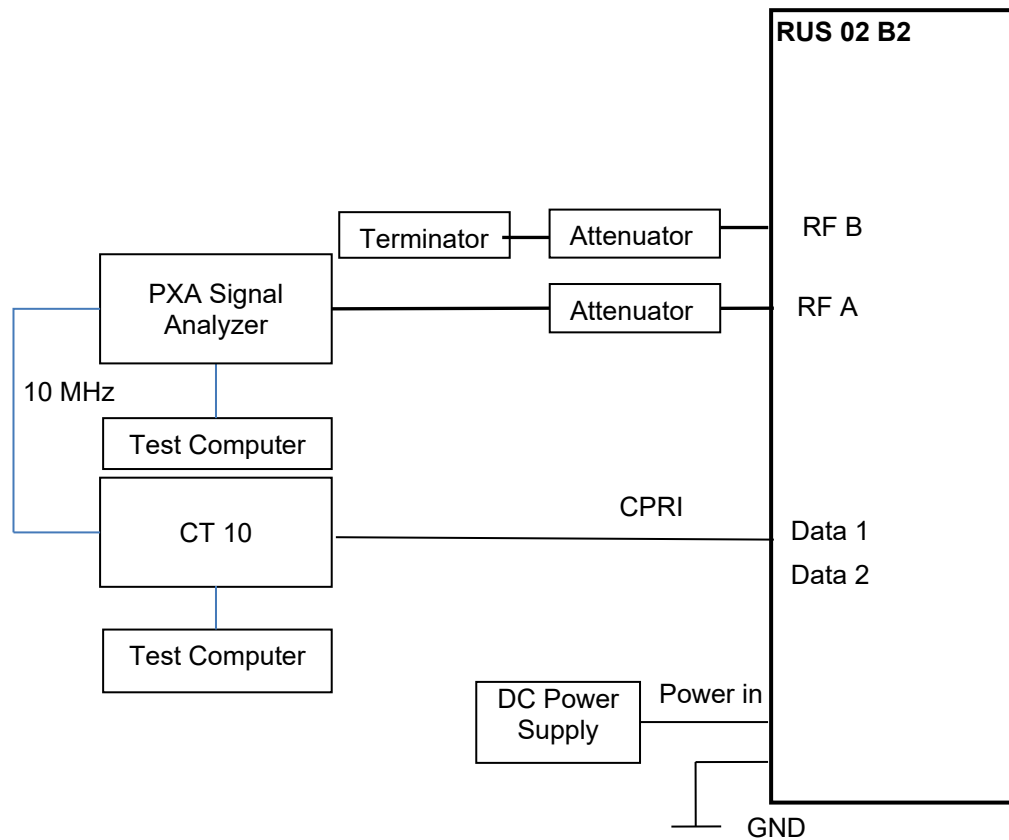
The Equipment Under Test RUS 02 B2 KRC 161 298/1 is an Ericsson AB Radio Unit working in the public mobile service 1930-1990 MHz band which provides communication connections to 1930-1990 MHz network. The RUS 02 B2 KRC 161 298/1 operates from a -48V DC supply.

The Equipment Under Test RUS 02 B2 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





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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.



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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

10 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 23.1 - 24.1°C
Relative Humidity 41 - 42.2%

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

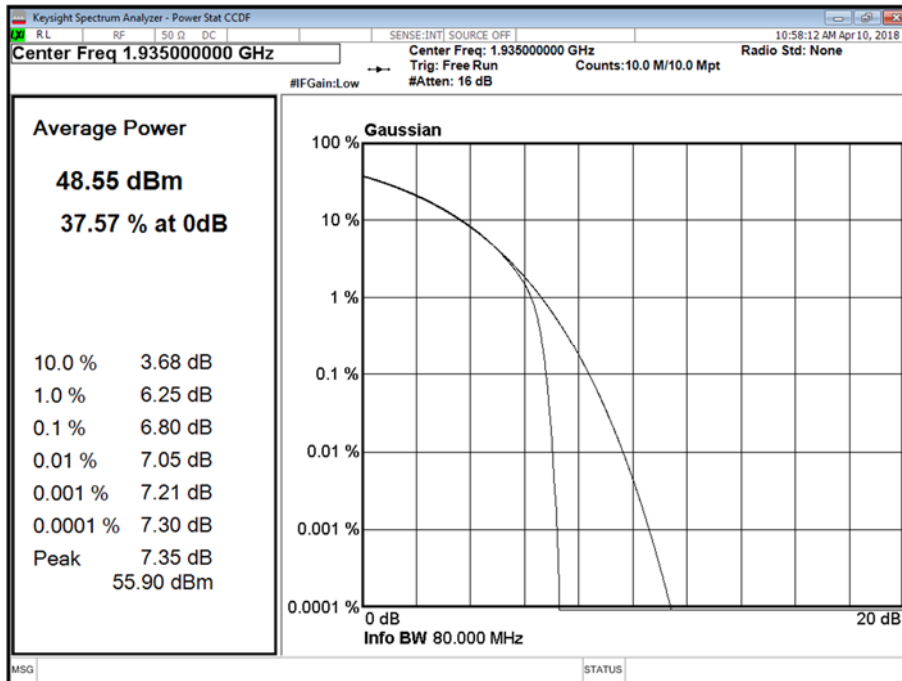
Maximum Output Power 49 dBm

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	6.80	48.27	-
A	L:64QAM / N:QPSK	L:15.0 MHz / N:180 kHz	6.85	48.71	-
A	L:64QAM / N:QPSK	E:20.0 MHz / N:180 kHz	6.92	48.56	-

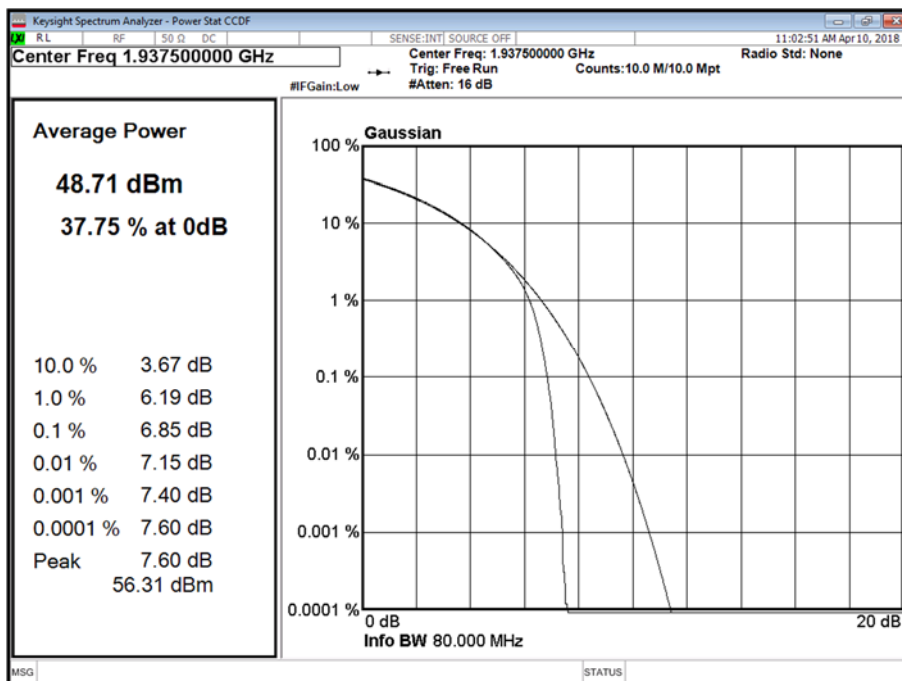


Product Service

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



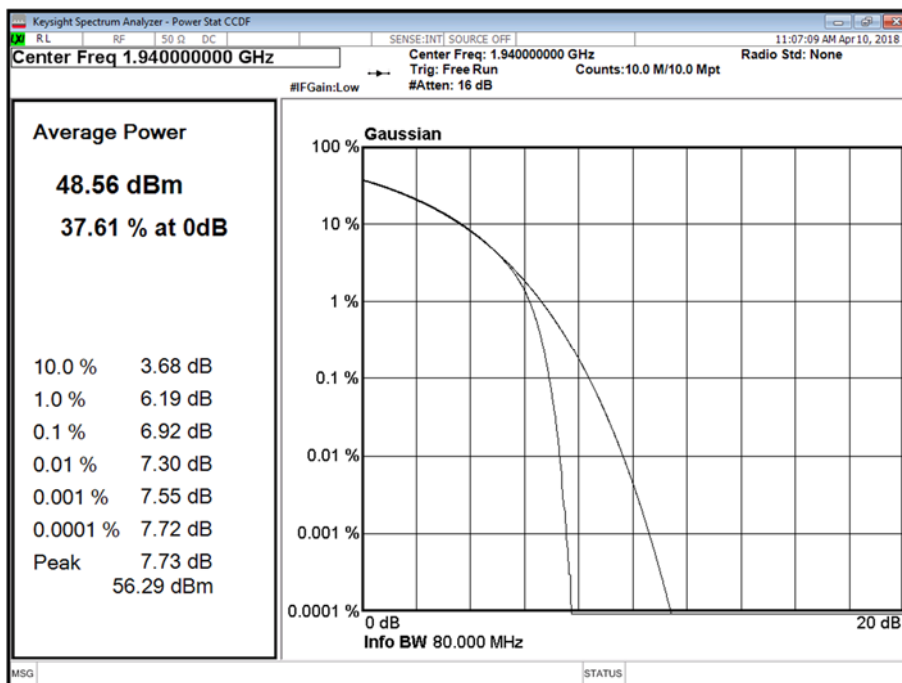
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position B





Product Service

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

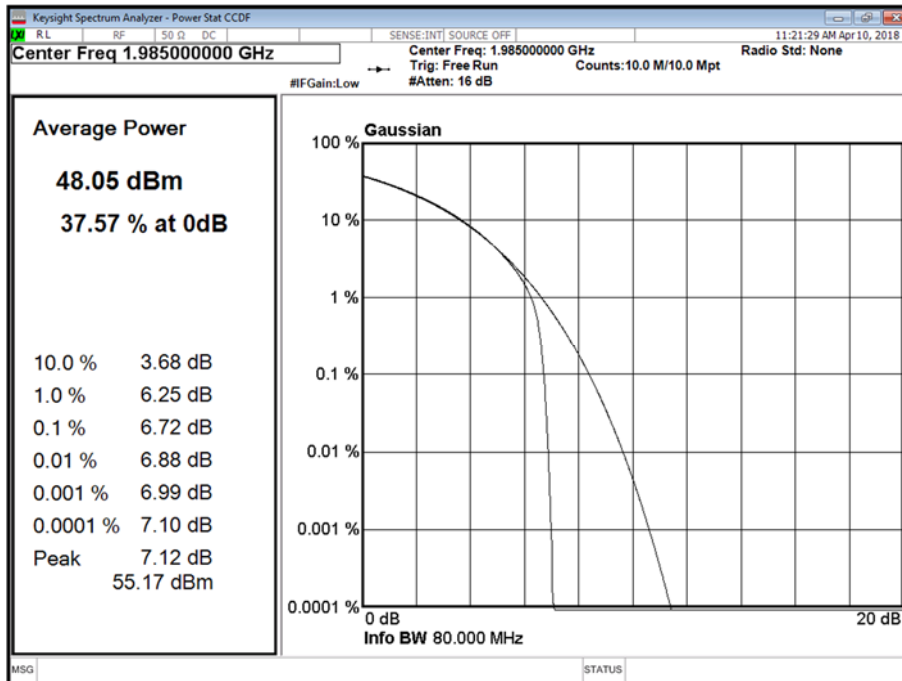


Configuration A

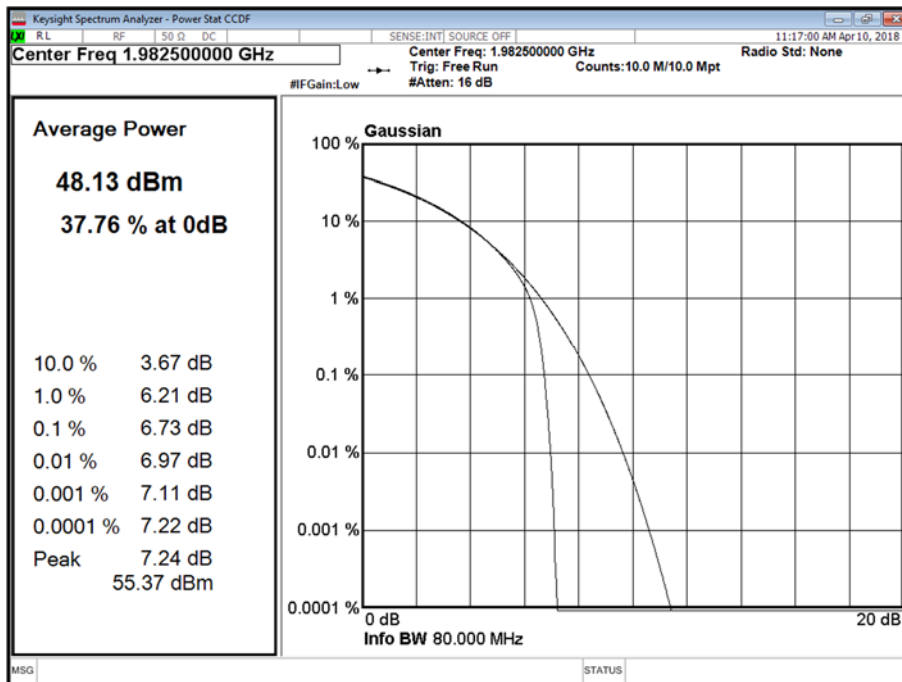
Maximum Output Power 49 dBm

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	6.72	48.05	-
A	L:64QAM / N:QPSK	L:15.0 MHz / N:180 kHz	6.73	48.13	-
A	L:64QAM / N:QPSK	E:20.0 MHz / N:180 kHz	6.76	48.37	-

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



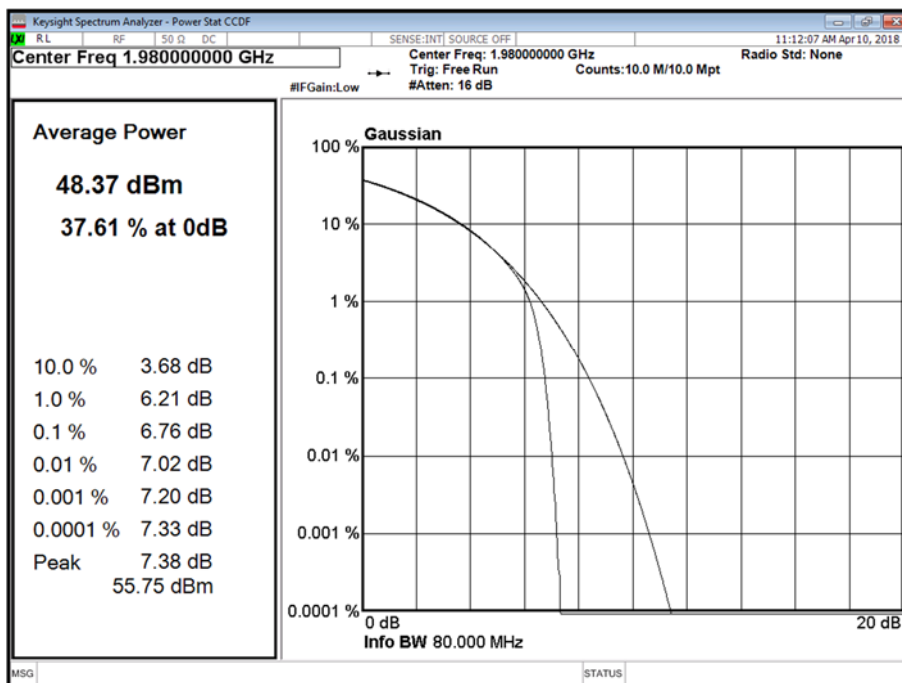
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position T





Product Service

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



Configuration B

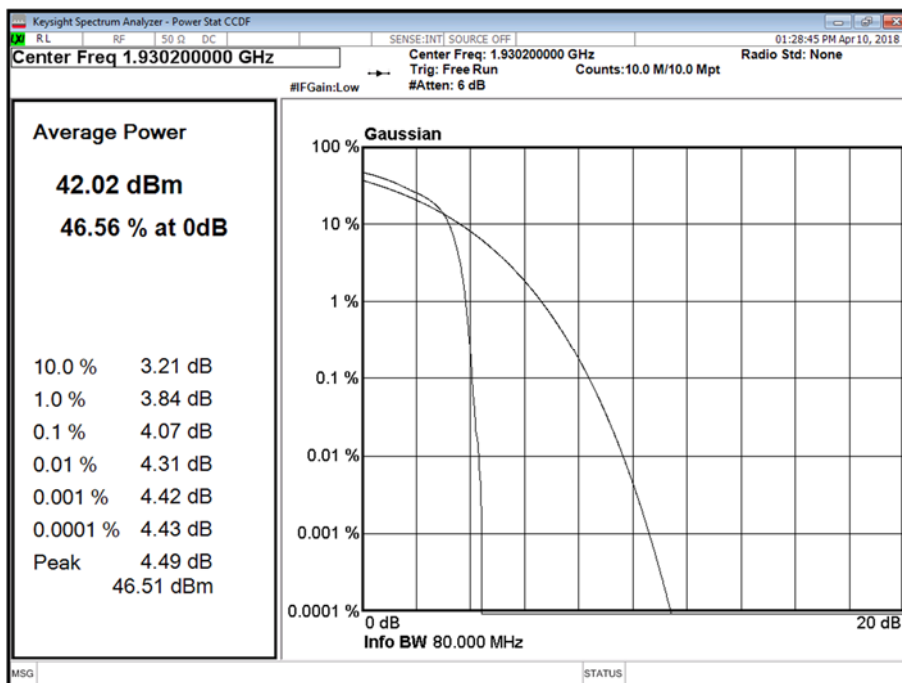
Maximum Output Power 43 dBm

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	4.07	42.02	-



Product Service

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



Configuration B

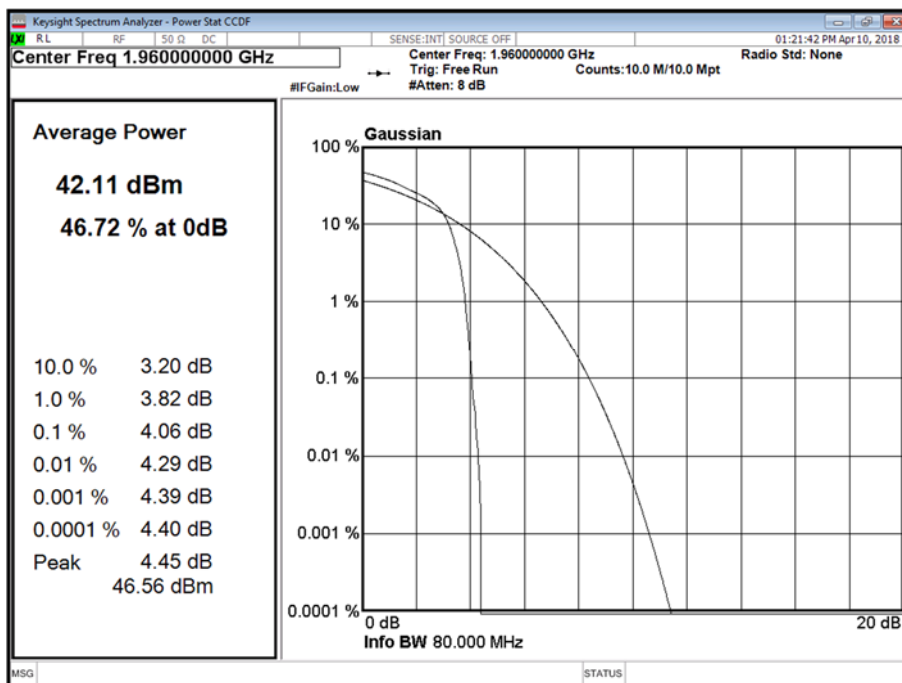
Maximum Output Power 43 dBm

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	42.11	-



Product Service

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



Configuration B

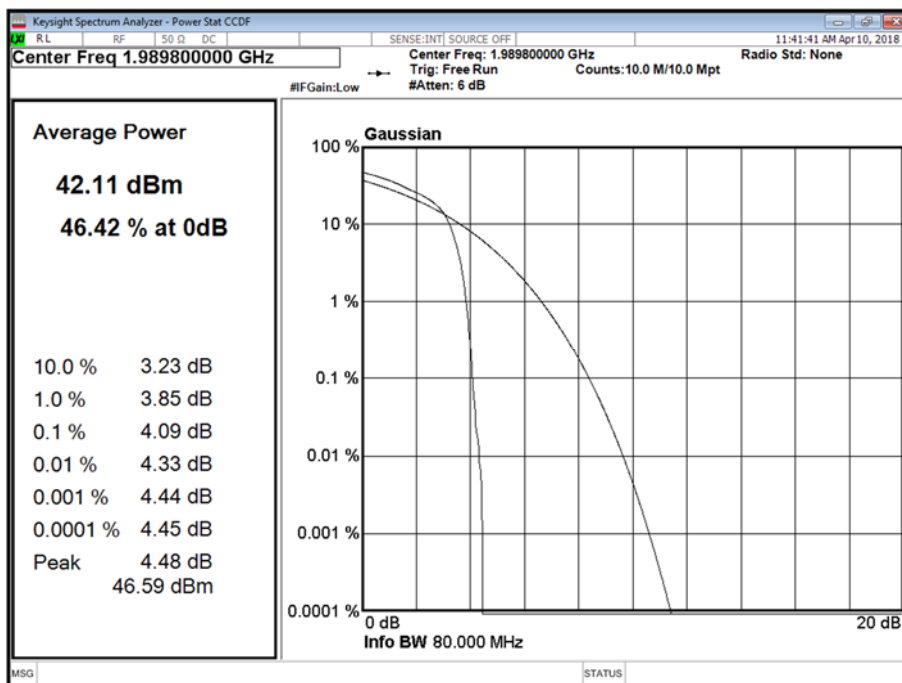
Maximum Output Power 43 dBm

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	42.11	-



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

10 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 23.1 - 24.1°C
Relative Humidity 41 - 42.2%

2.2.5 Test Method

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

2.2.6 Test Results

Configuration A

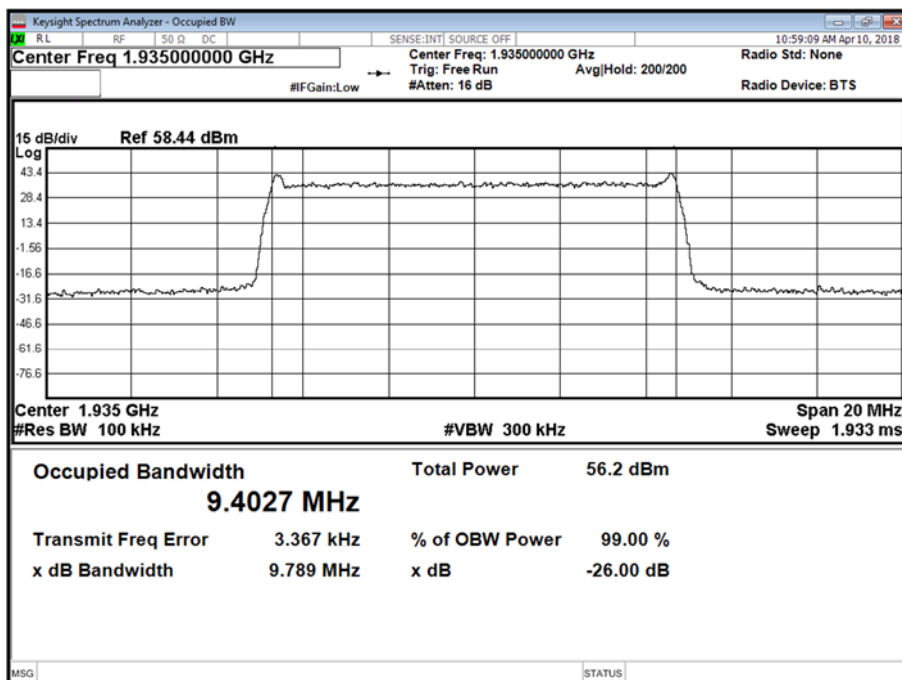
Maximum Output Power 49 dBm

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	9,403.70	9,771.00	-	-	9,399.70	9,788.00
A	L:64QAM / N:QPSK	L:15.0 MHz / N:180 kHz	14,016.00	14,580.00	-	-	14,013.00	14,570.00
A	L:64QAM / N:QPSK	E:20.0 MHz / N:180 kHz	18,448.00	19,340.00	-	-	18,460.00	19,450.00

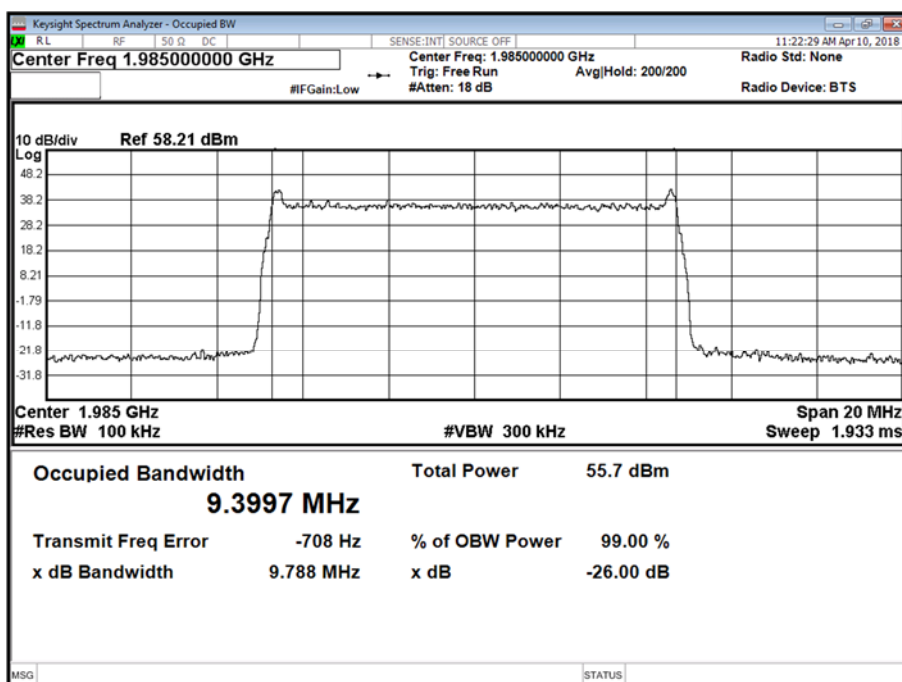


Product Service

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



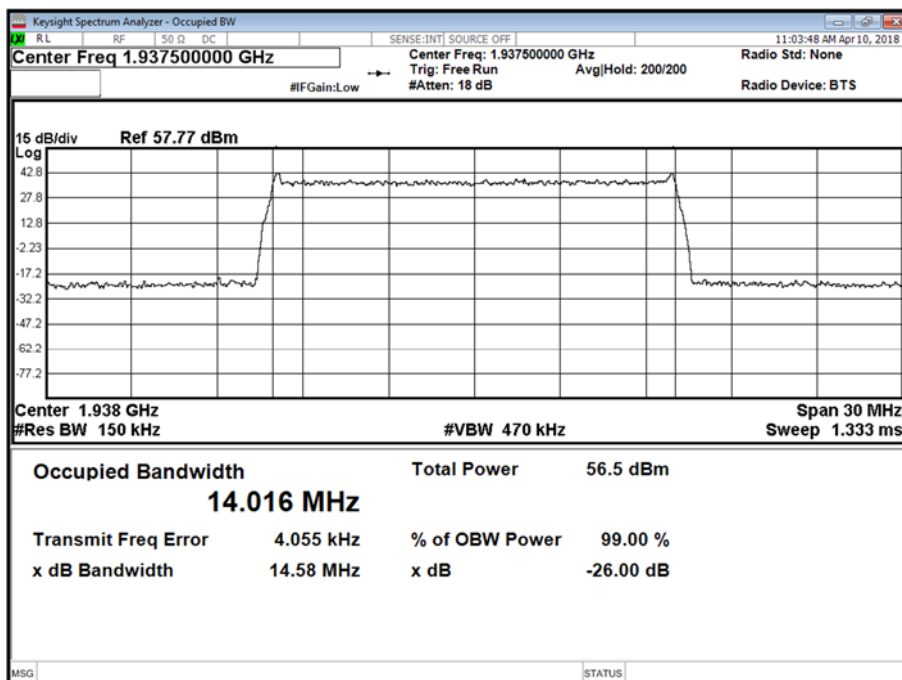
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position T



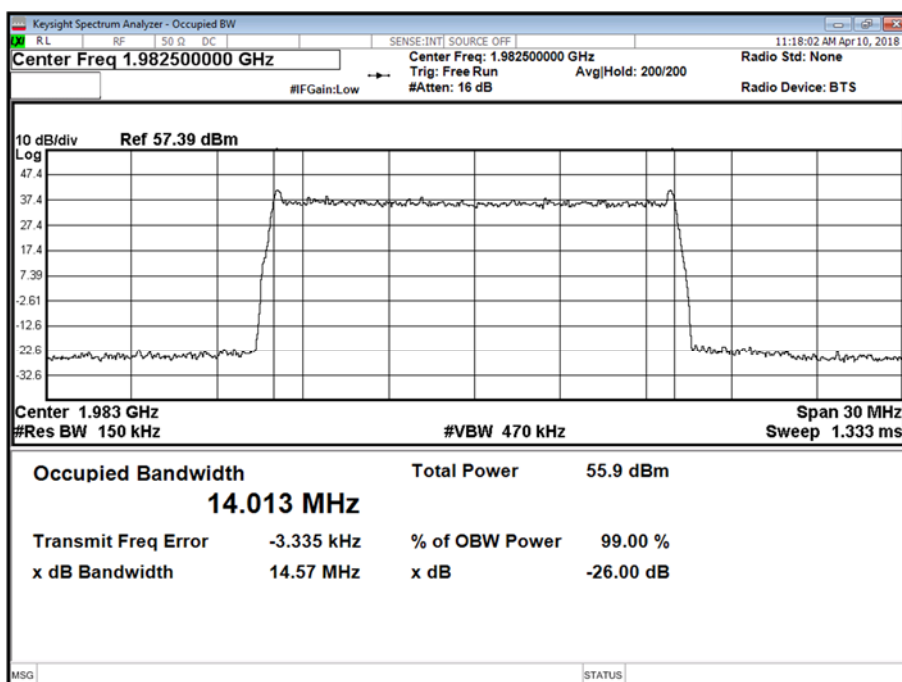


Product Service

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



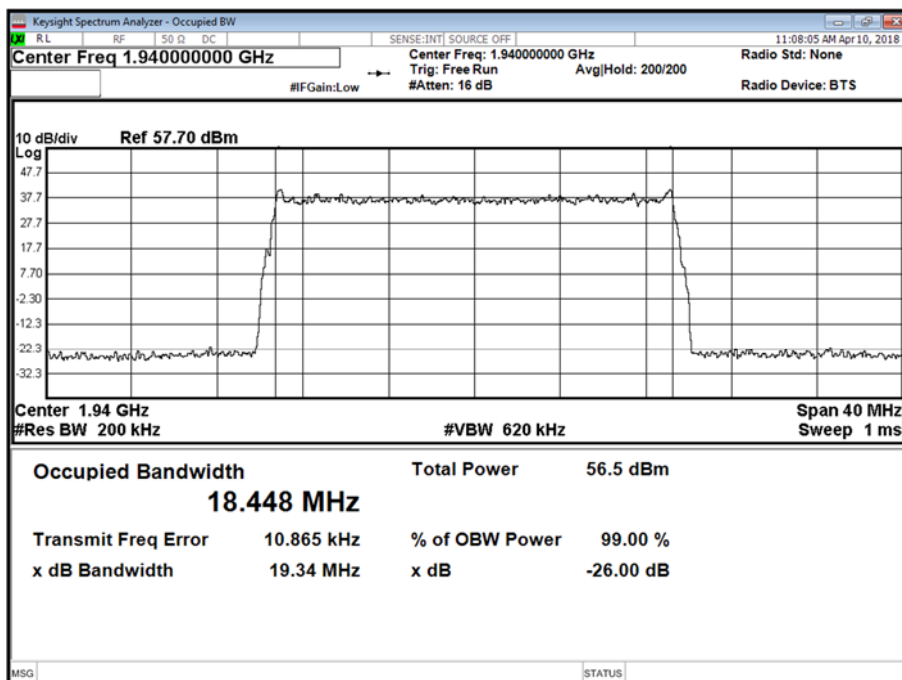
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position T



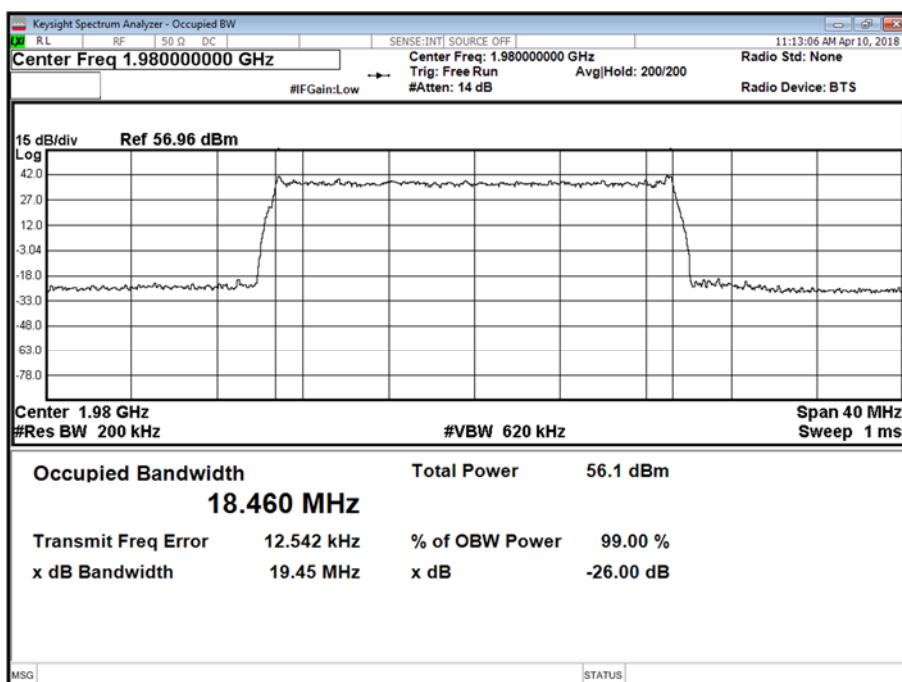


Product Service

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



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





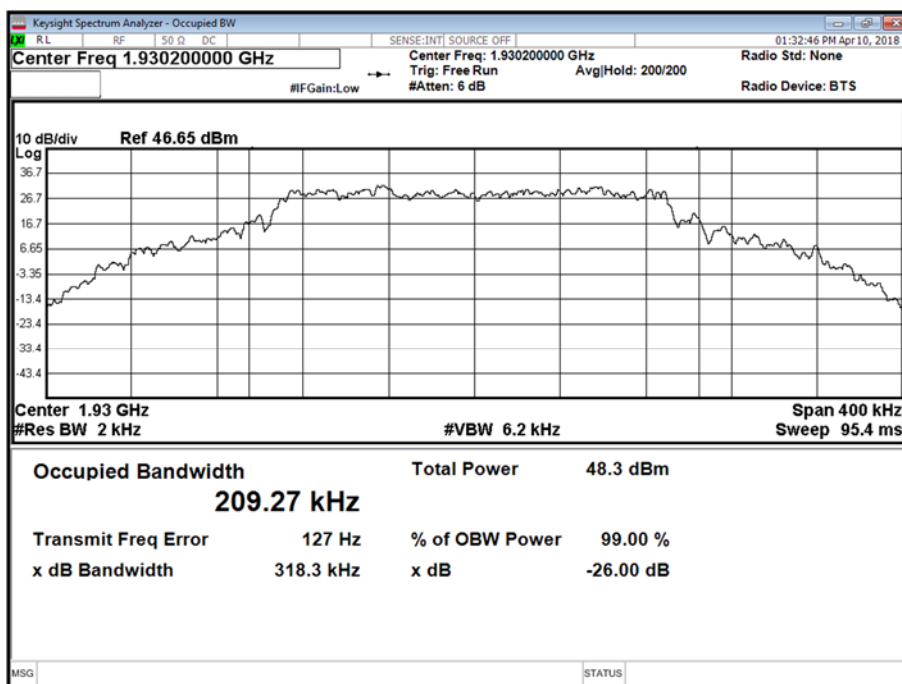
Product Service

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	209.27	318.30	209.41	318.30	209.46	318.30

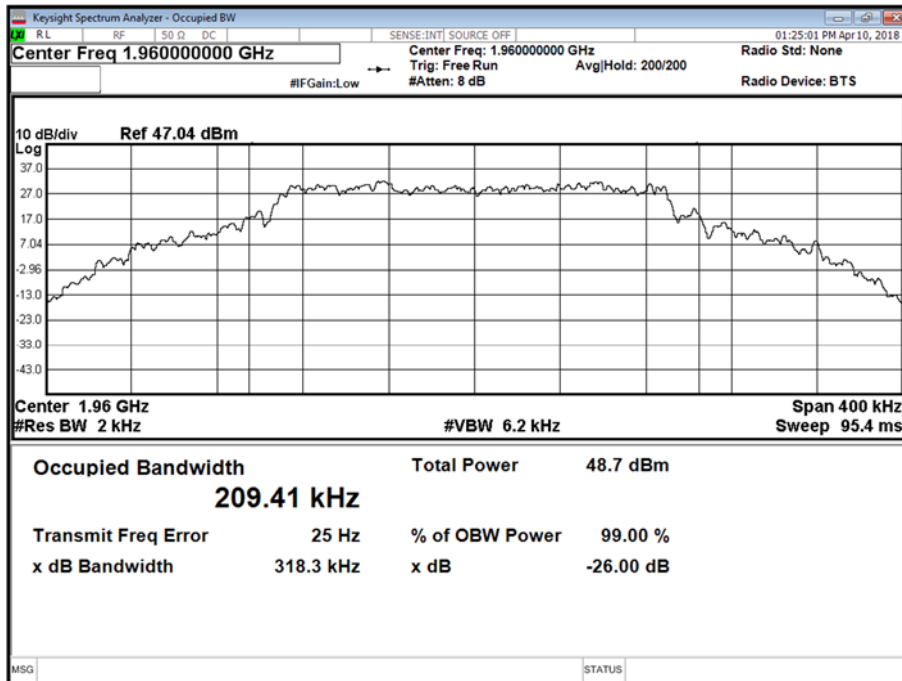
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz - Channel Position B



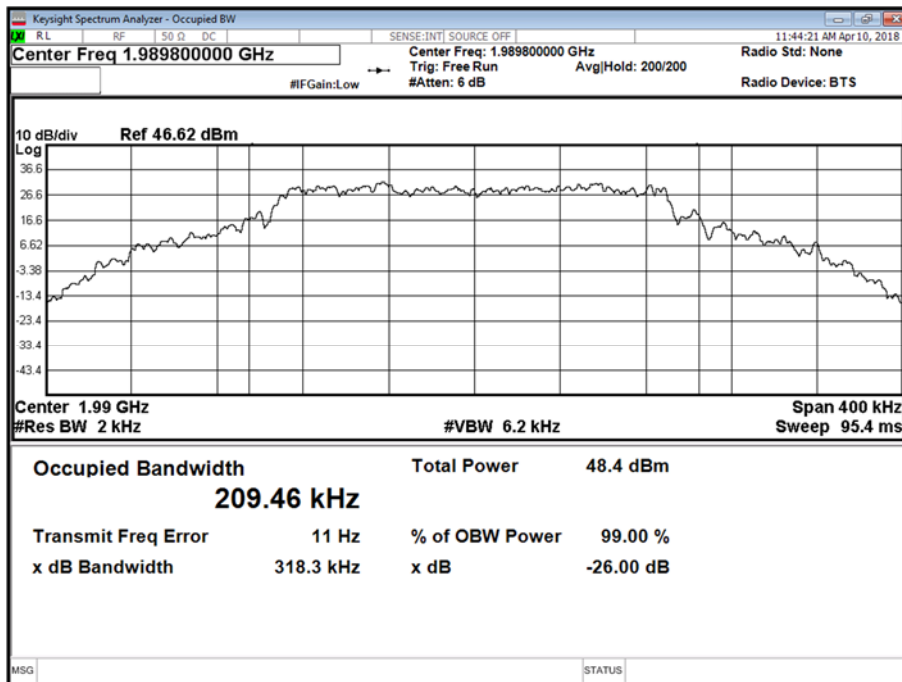


Product Service

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

10 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 23.1 - 24.1°C
Relative Humidity 41 - 42.2%

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

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

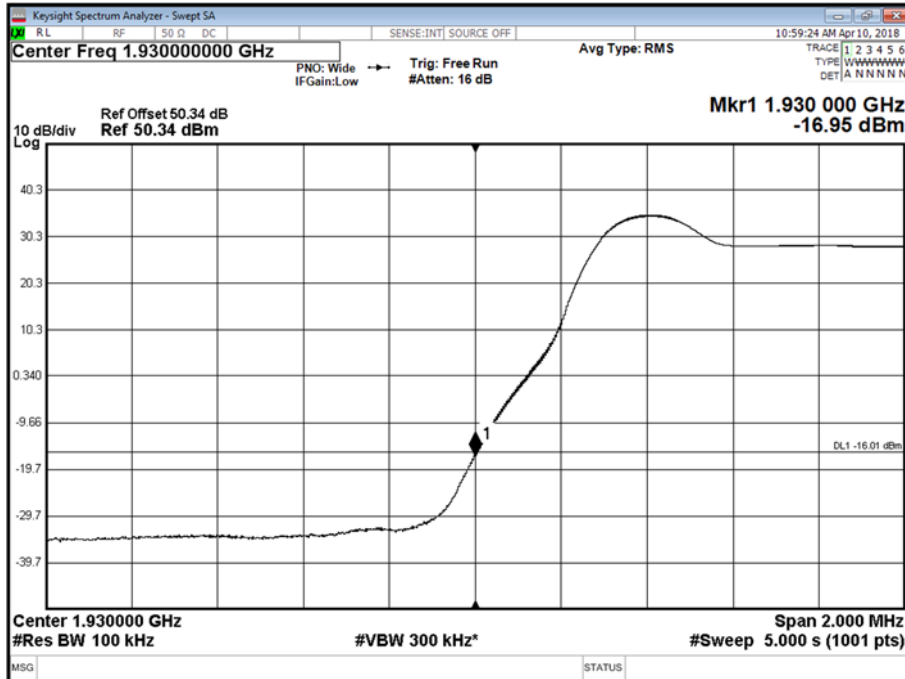
2.3.6 Test Results

Configuration A

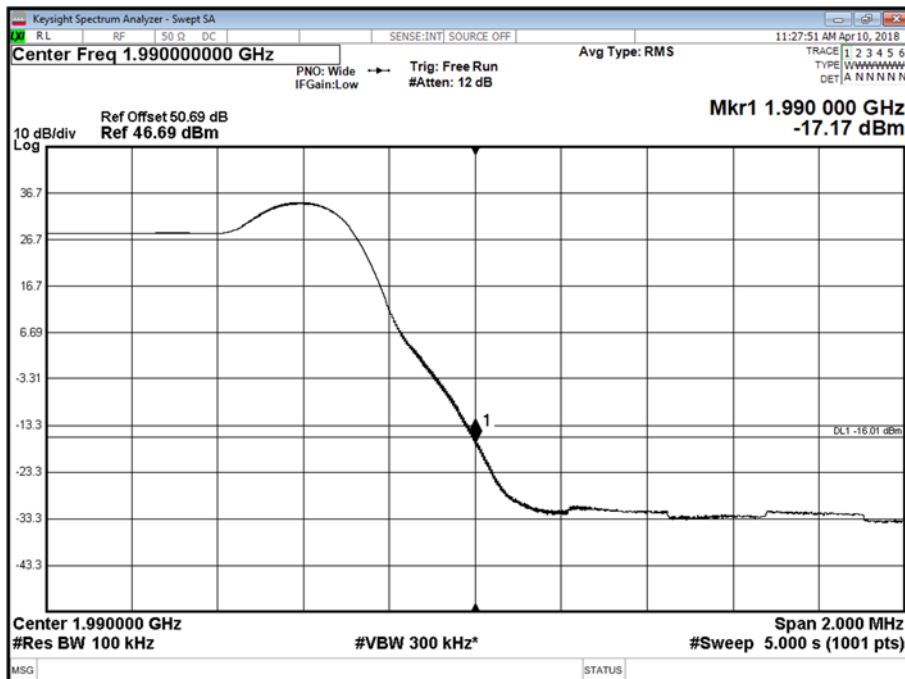
Maximum Output Power 49 dBm

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	1,935.0	1,985.0
A	L:64QAM / N:QPSK	L:15.0 MHz / N:180 kHz	1,937.5	1,982.5
A	L:64QAM / N:QPSK	E:20.0 MHz / N:180 kHz	1,940.0	1,980.0

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



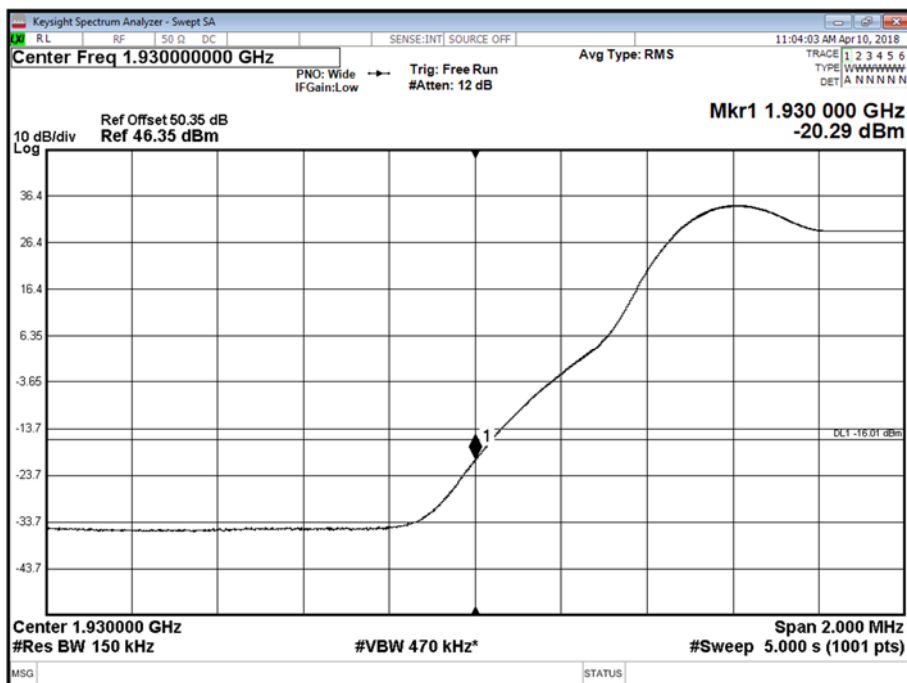
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position T



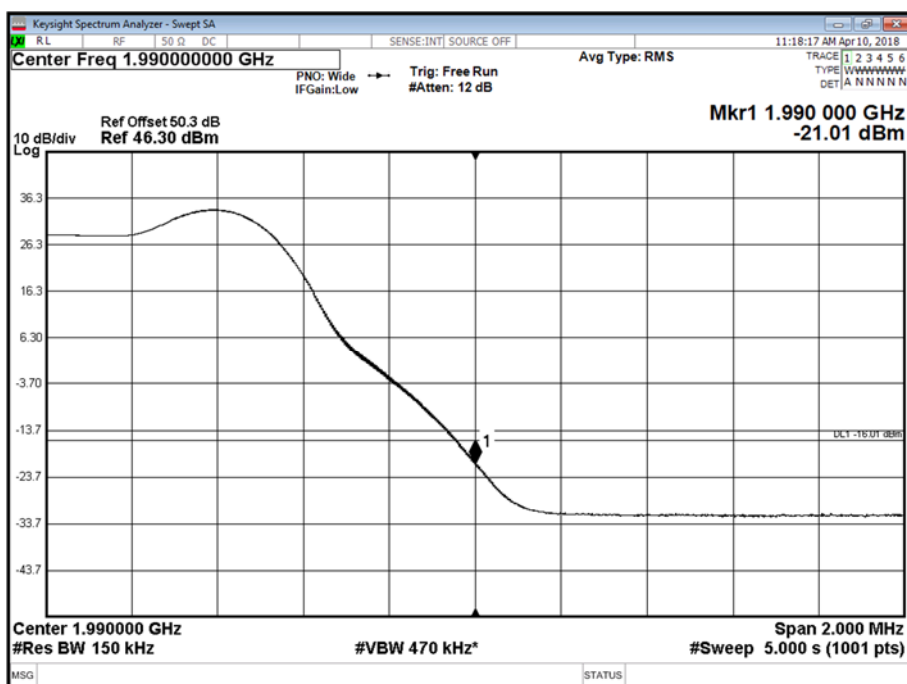


Product Service

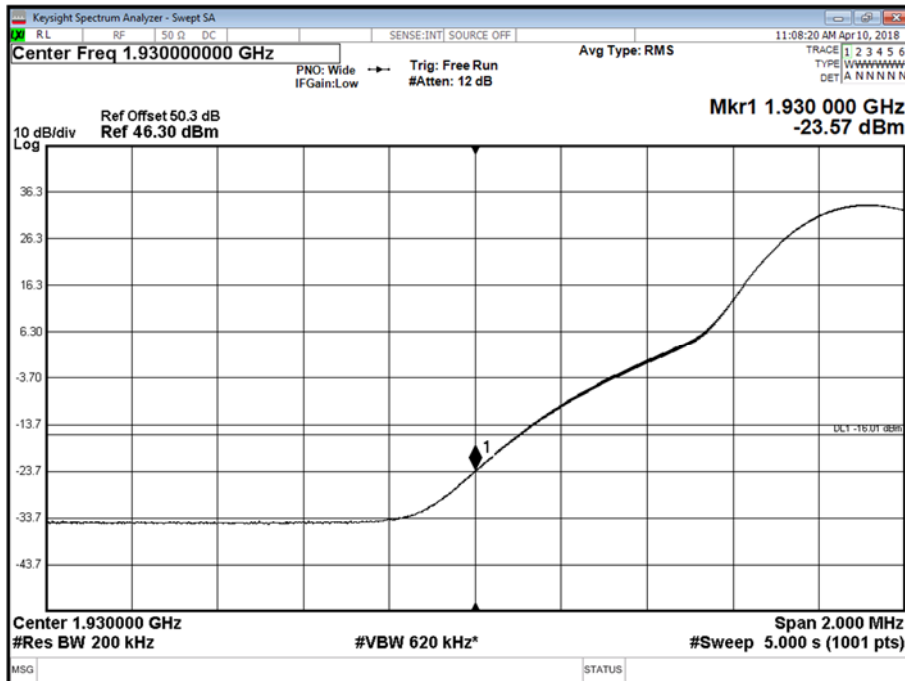
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position B



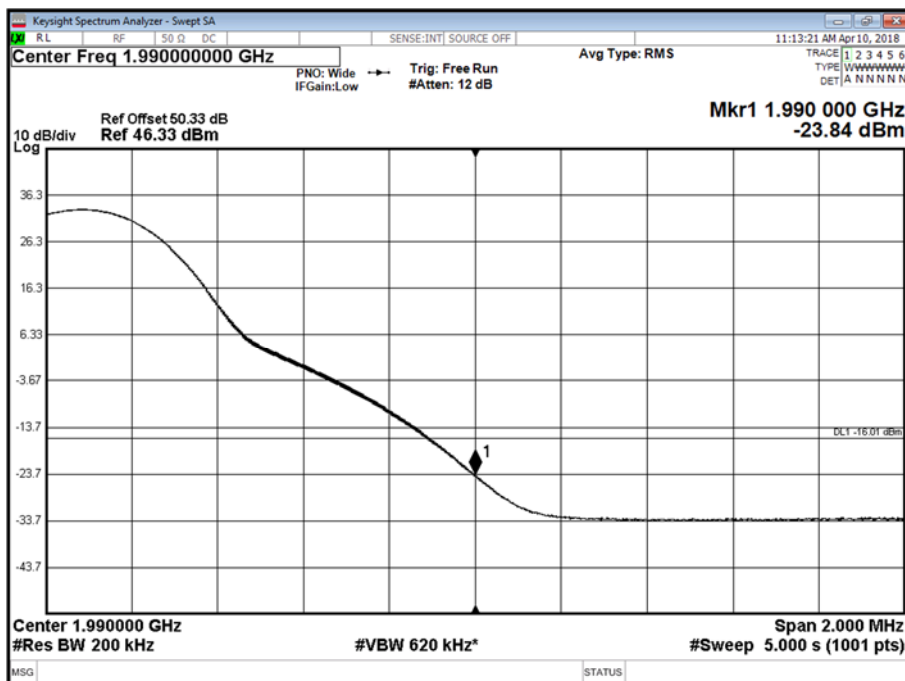
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position T



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



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





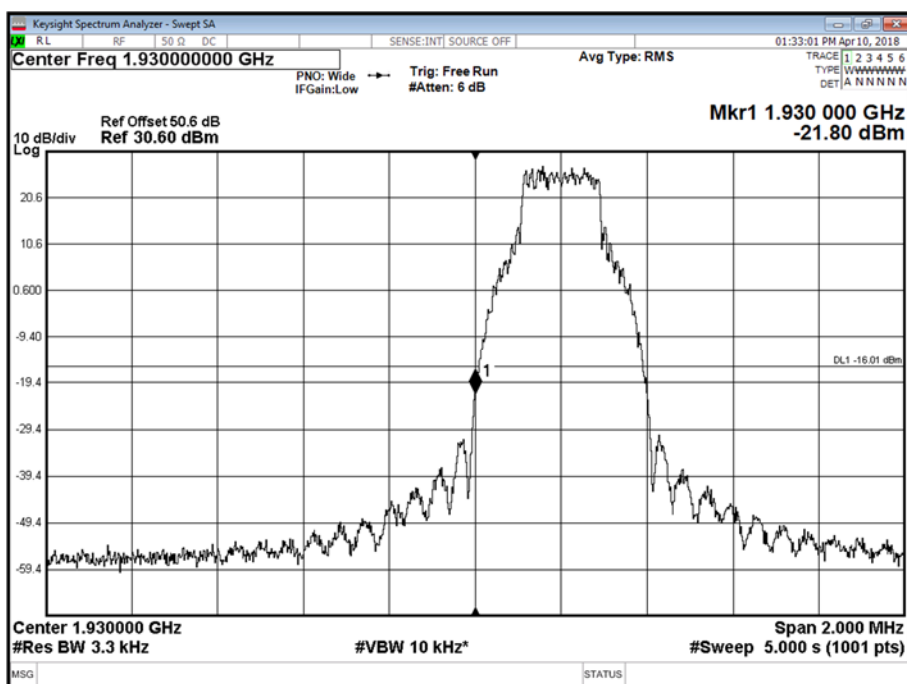
Product Service

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	1,930.2	1,989.8

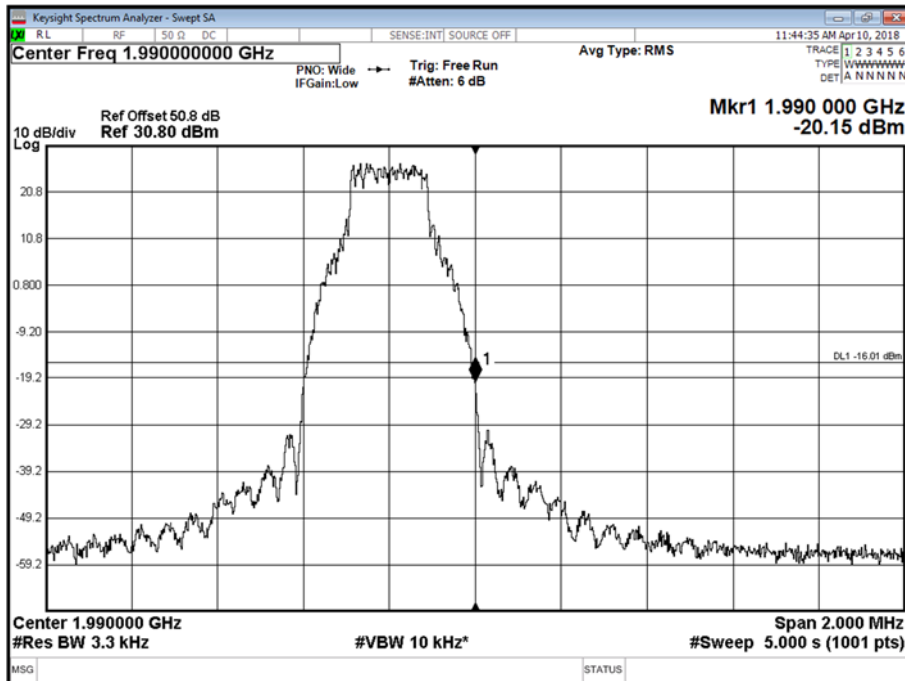
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz - Channel Position B





Product Service

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



Limit MIMO	-16 dBm
------------	---------



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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

10 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	23.1 - 24.1°C
Relative Humidity	41 - 42.2%

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

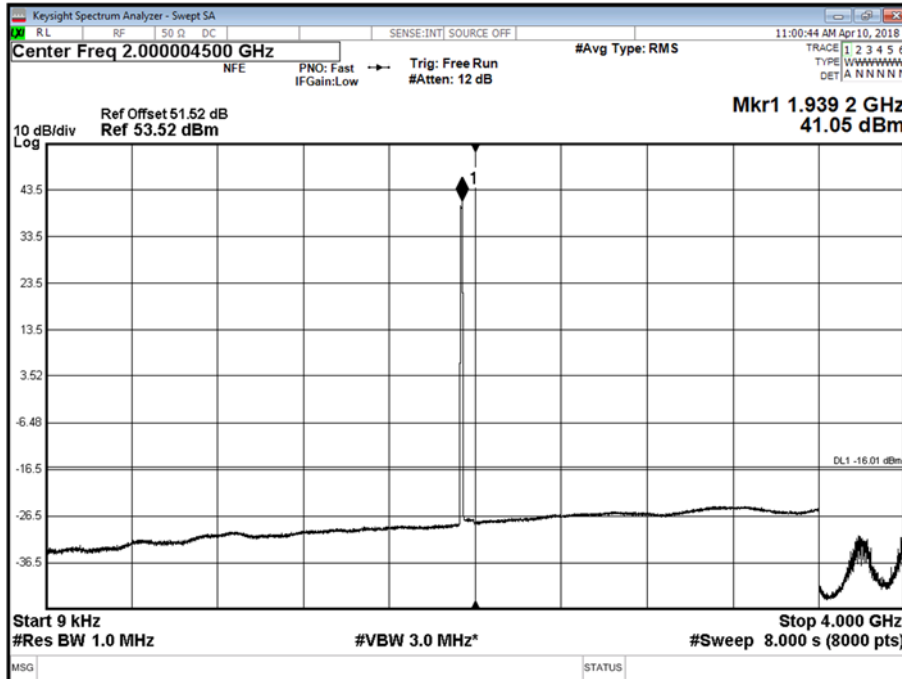
For dual ports, the limit was calculated as being $-13 \text{ dBm} - 10 * \log(2) = -16 \text{ dBm}$.

2.4.6 Test Results

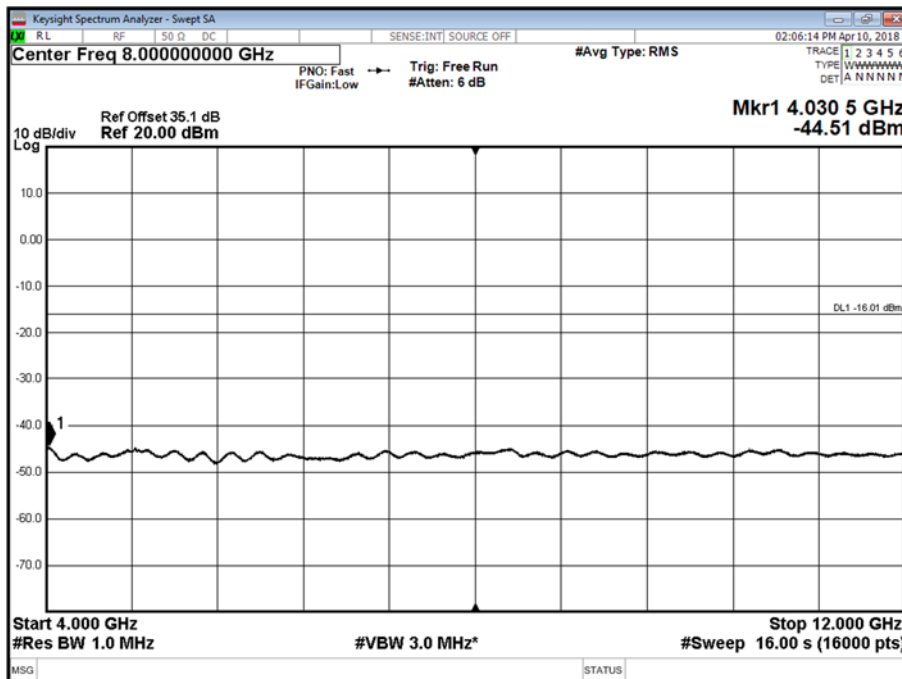
Configuration A

Maximum Output Power 49 dBm

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



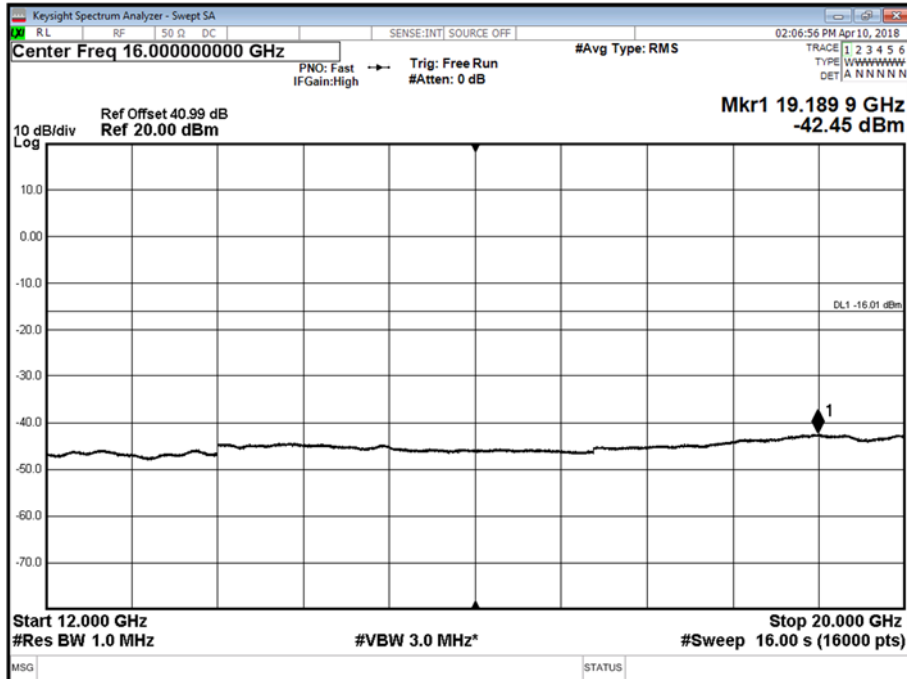
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
L:10.0 MHz / N:180 kHz - Channel Position B - Band 2 - Range 4000 to 12000 MHz



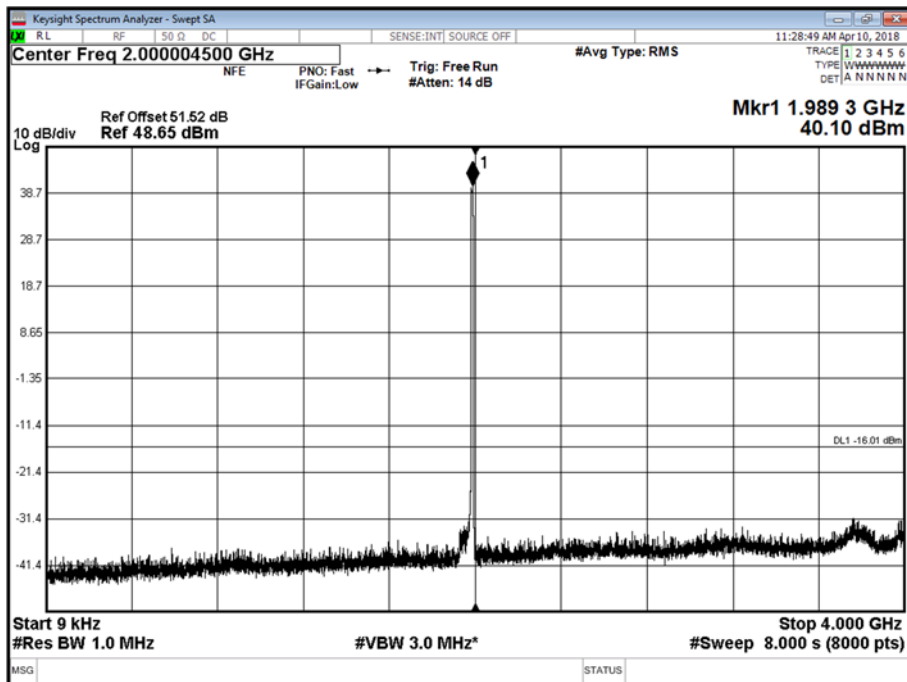


Product Service

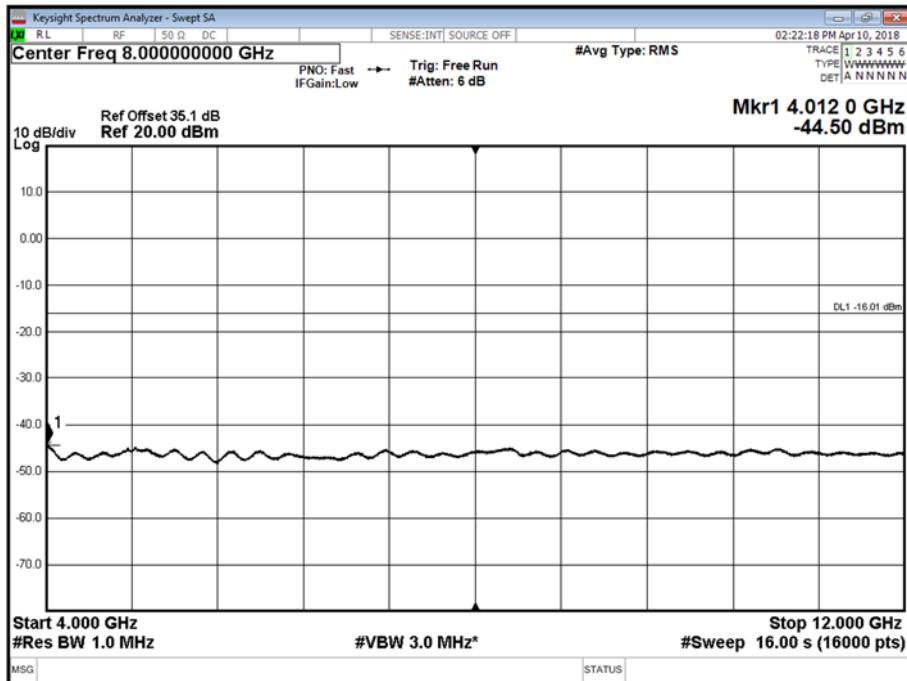
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position B - Band 3 - Range 12000 to 20000 MHz



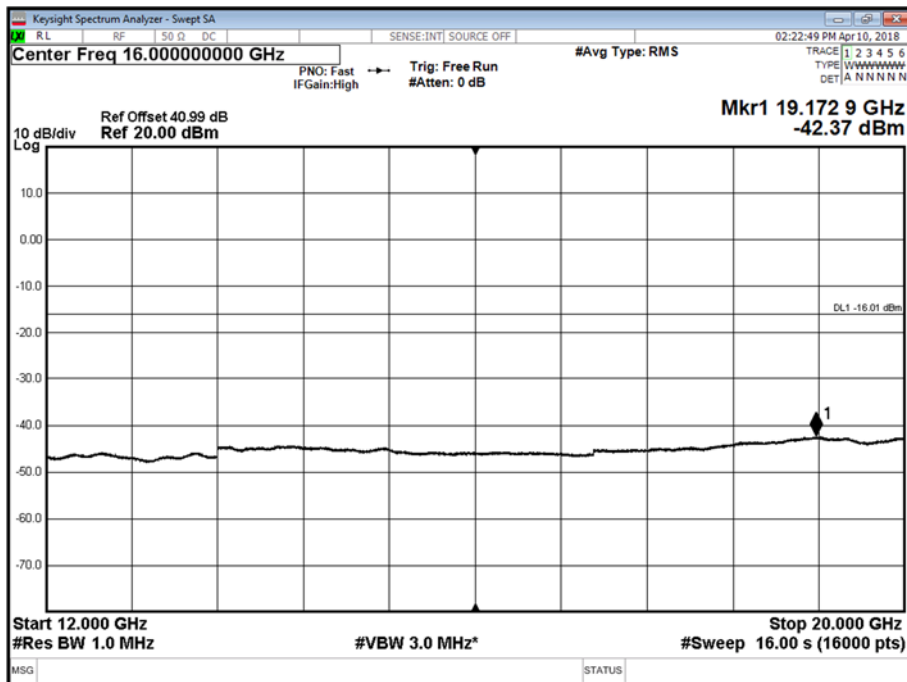
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position T - Band 1 - Range 0.009 to 4000 MHz



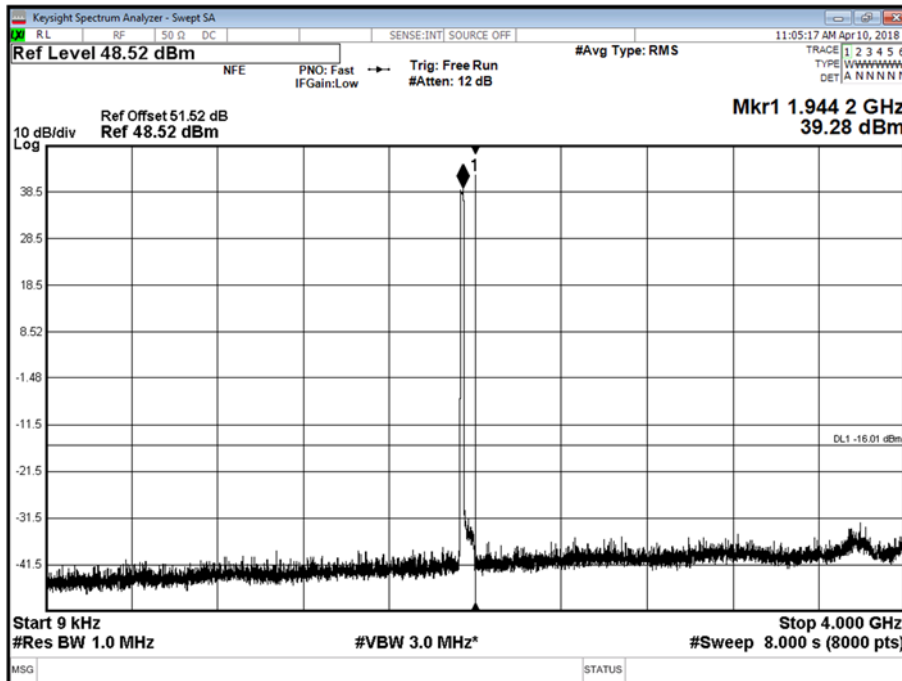
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position T - Band 2 - Range 4000 to 12000 MHz



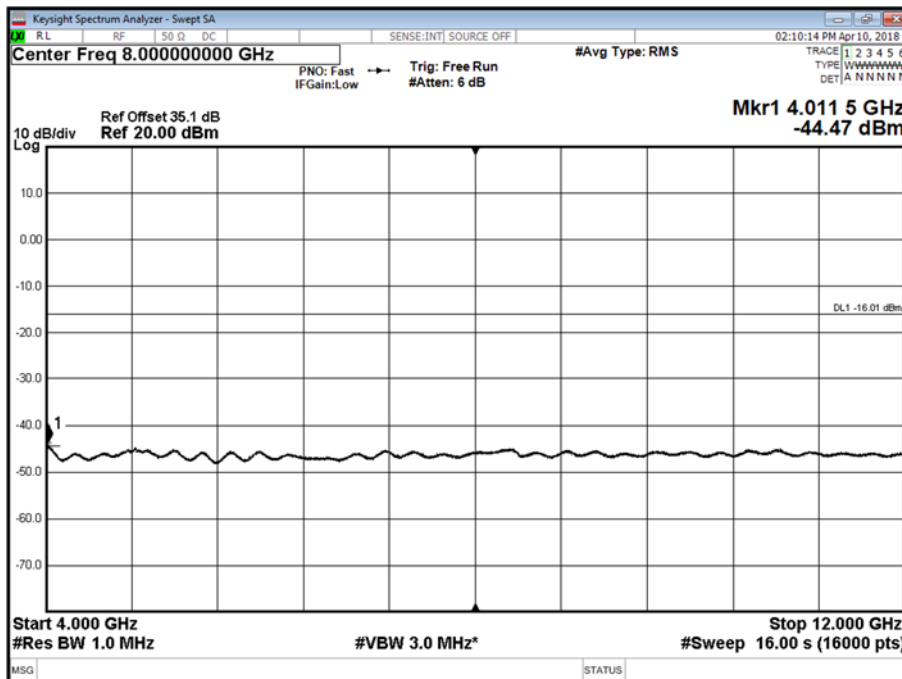
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth L:10.0 MHz / N:180 kHz - Channel Position T - Band 3 - Range 12000 to 20000 MHz



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



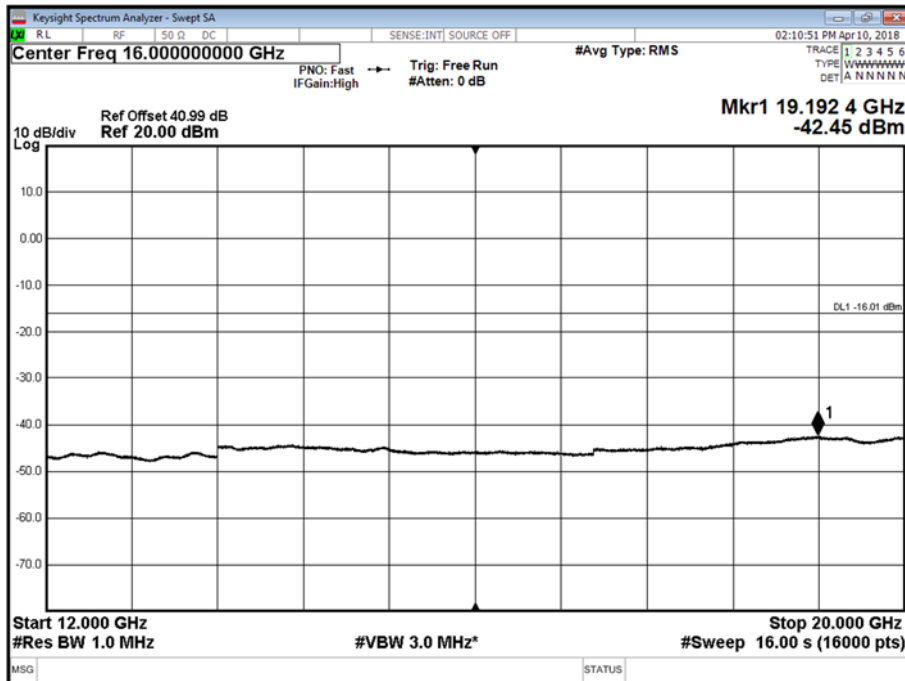
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position B - Band 2 - Range 4000 to 12000 MHz



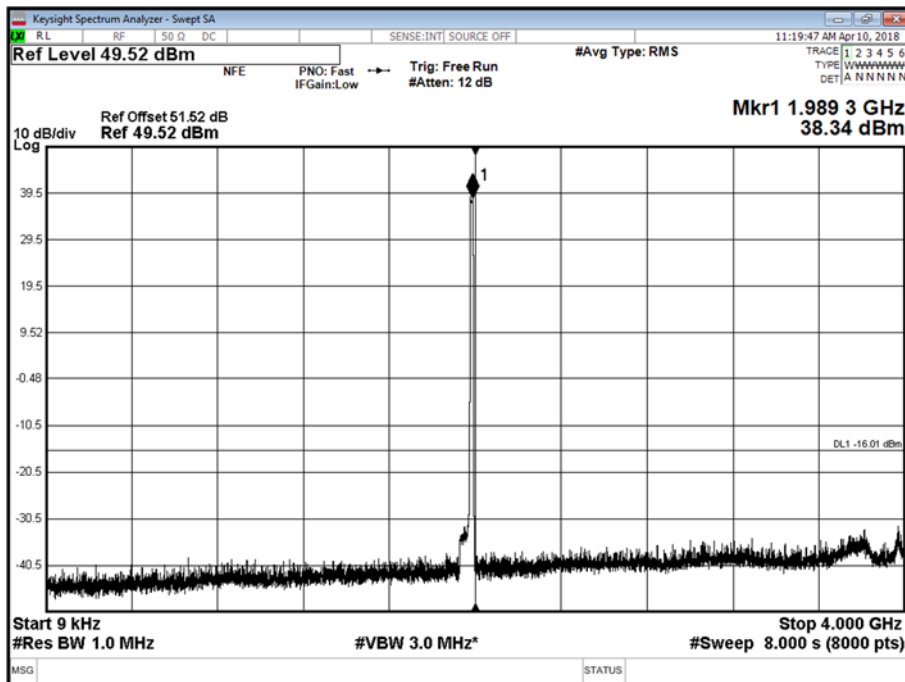


Product Service

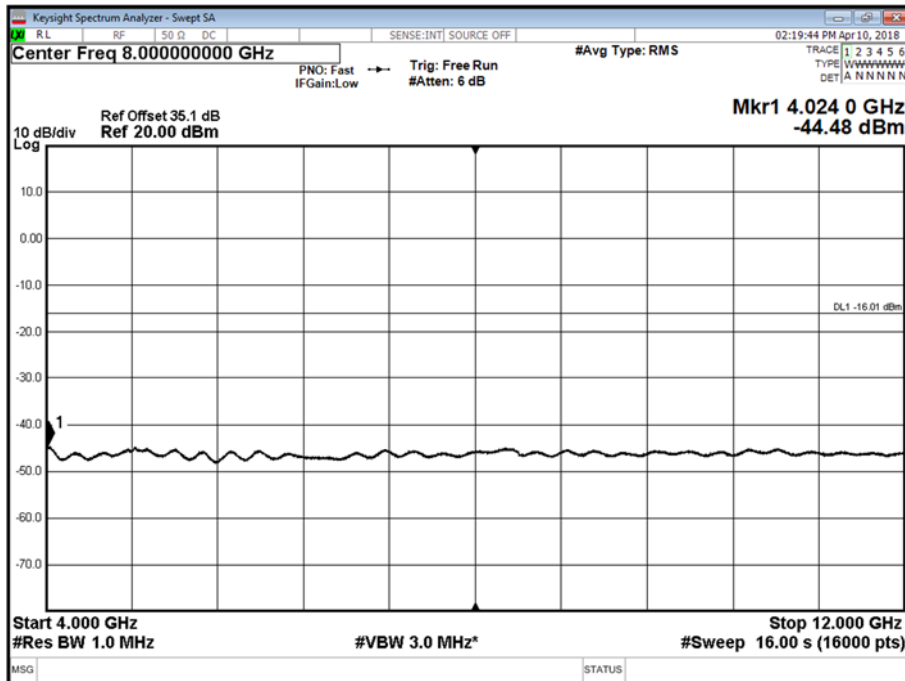
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position B - Band 3 - Range 12000 to 20000 MHz



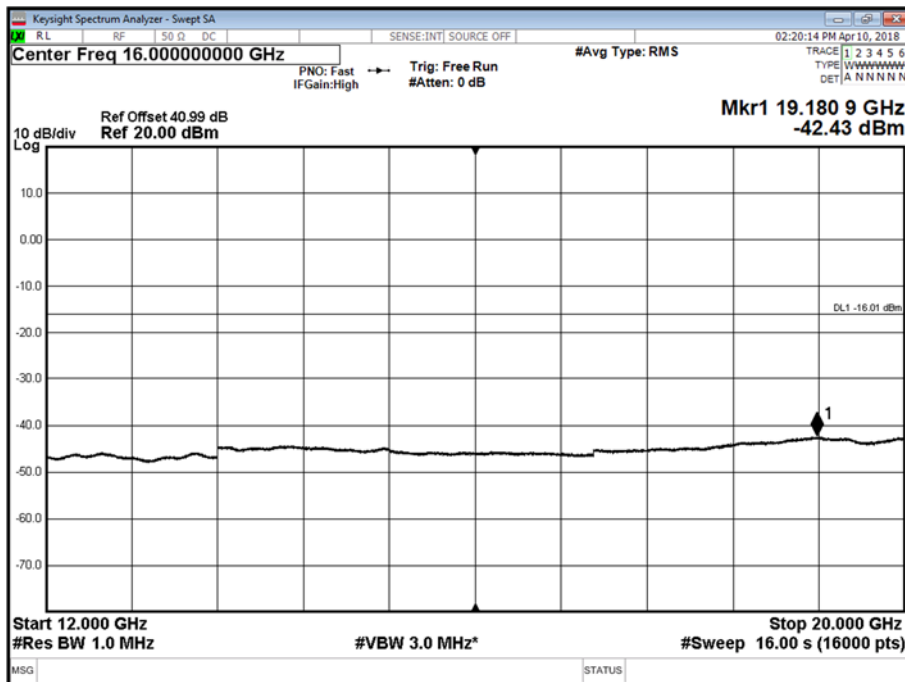
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth L:15.0 MHz / N:180 kHz - Channel Position T - Band 1 - Range 0.009 to 4000 MHz



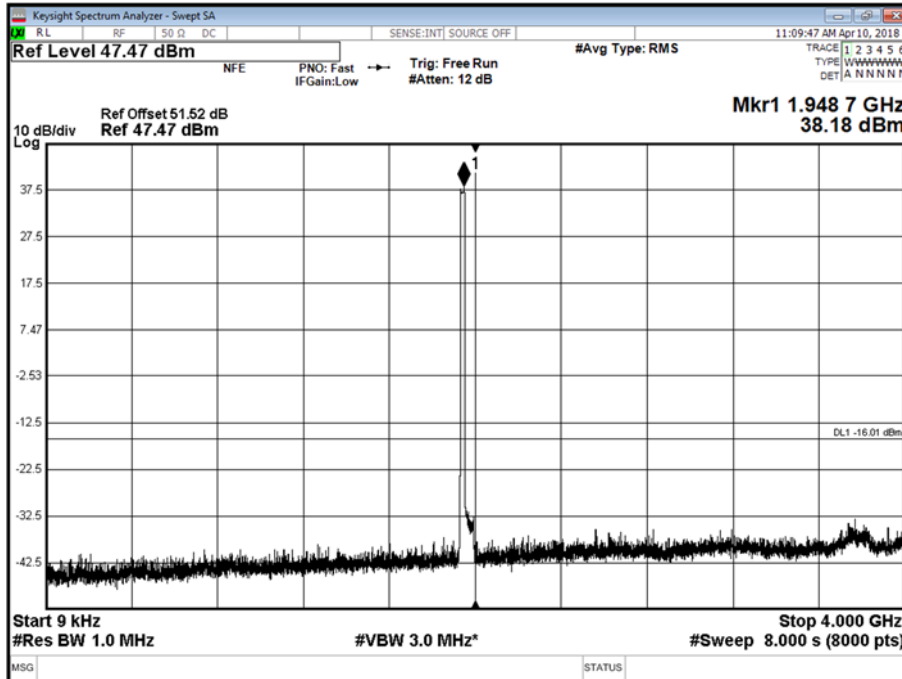
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position T - Band 2 - Range 4000 to 12000 MHz



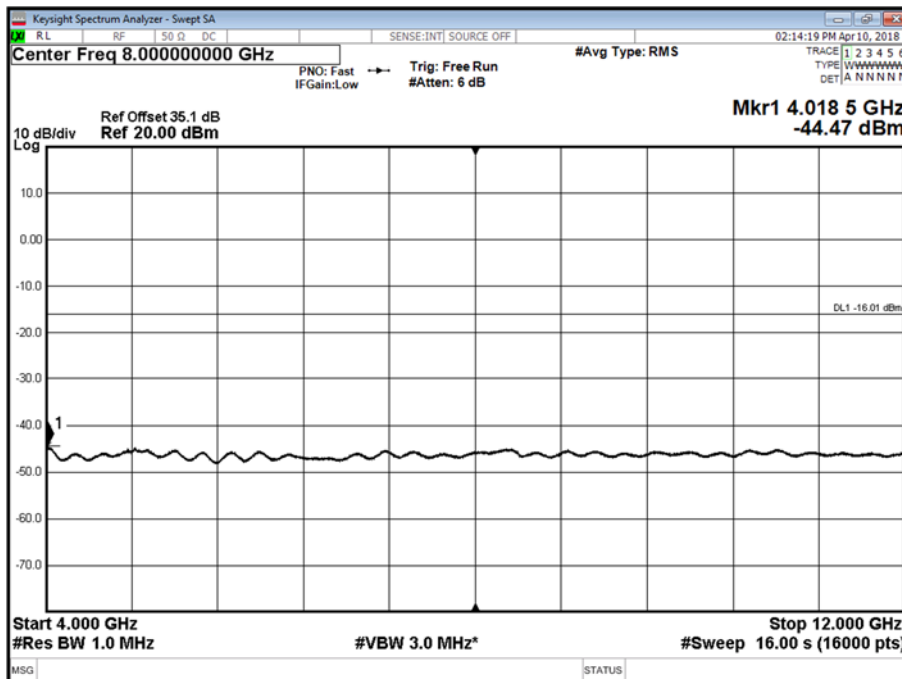
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
L:15.0 MHz / N:180 kHz - Channel Position T - Band 3 - Range 12000 to 20000 MHz



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



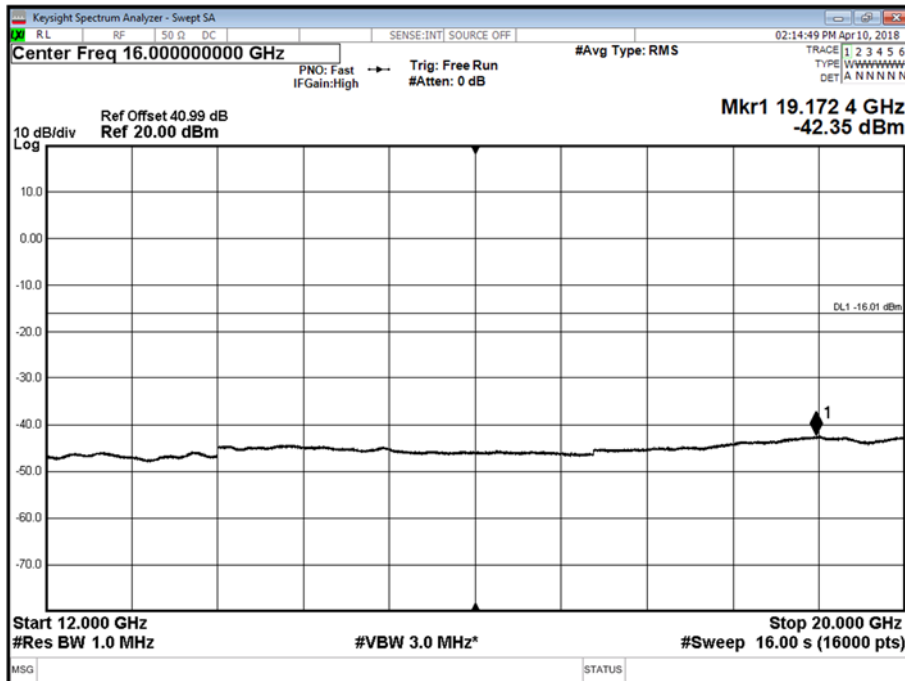
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
E:20.0 MHz / N:180 kHz - Channel Position B - Band 2 - Range 4000 to 12000 MHz



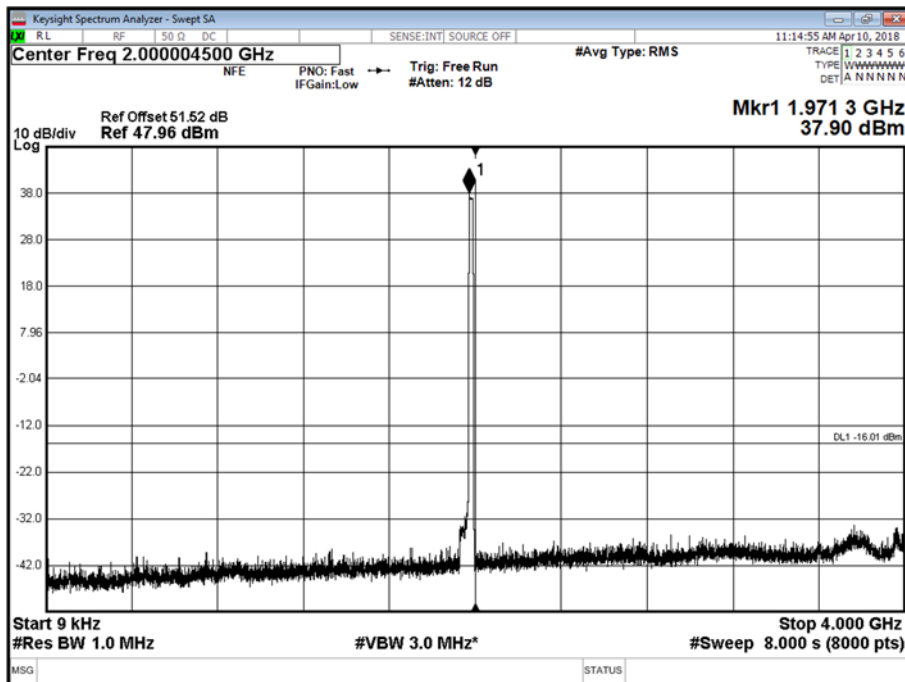


Product Service

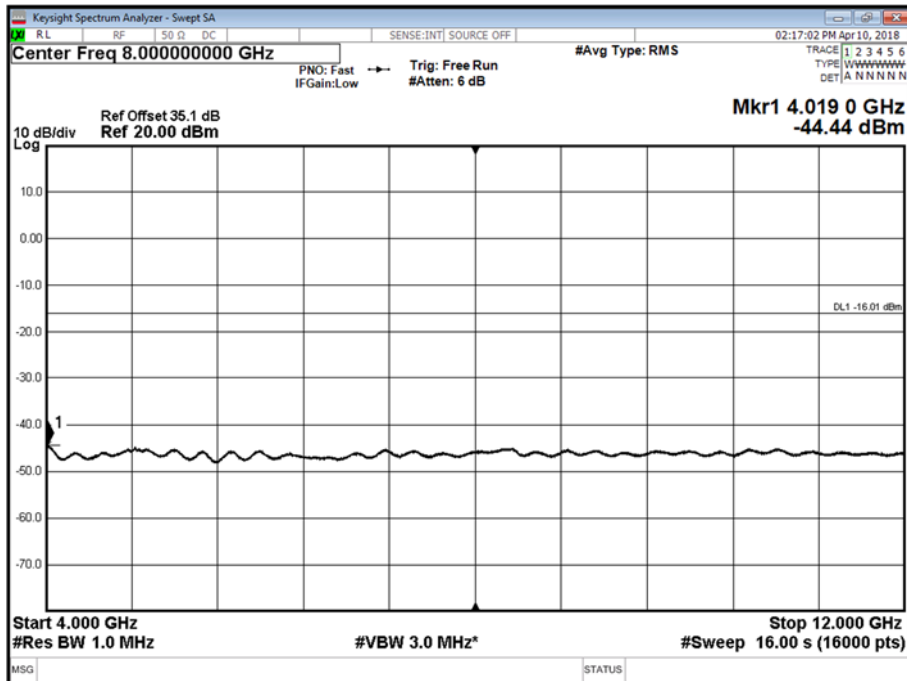
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
E:20.0 MHz / N:180 kHz - Channel Position B - Band 3 - Range 12000 to 20000 MHz



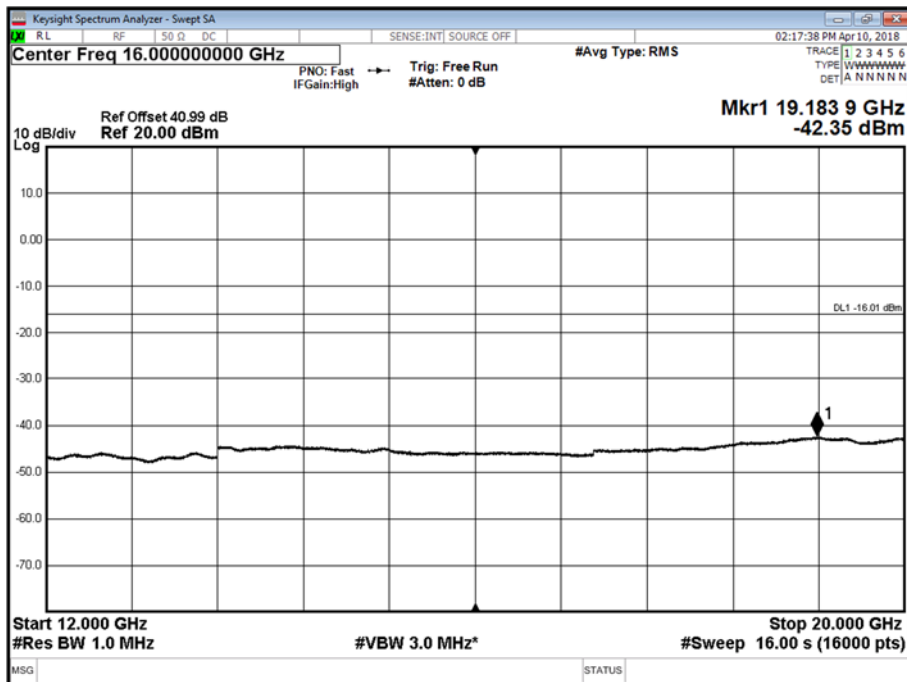
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
E:20.0 MHz / N:180 kHz - Channel Position T - Band 1 - Range 0.009 to 4000 MHz



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



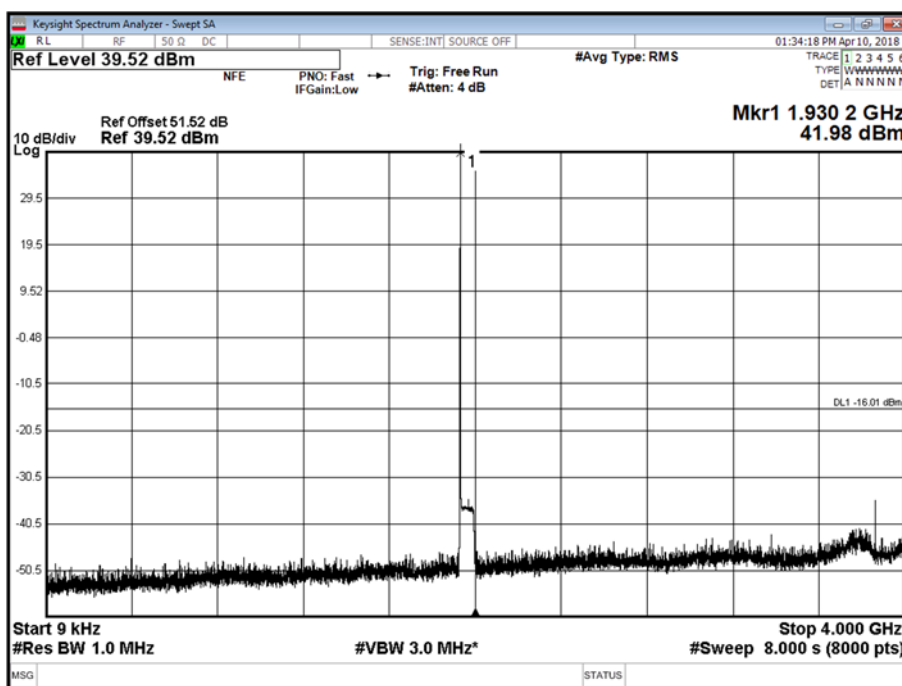
Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
E:20.0 MHz / N:180 kHz - Channel Position T - Band 3 - Range 12000 to 20000 MHz



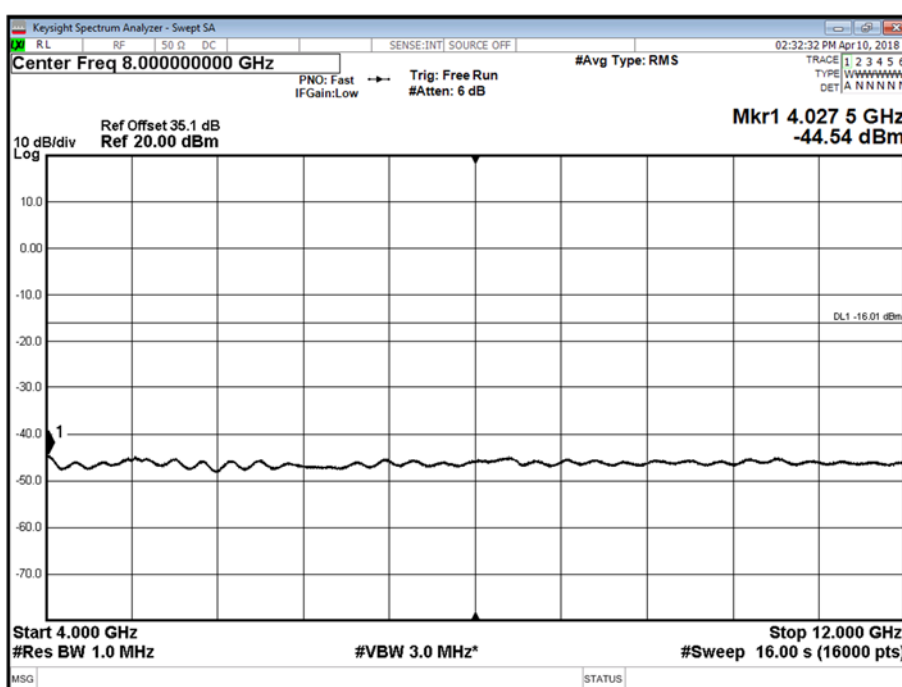
Configuration B

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



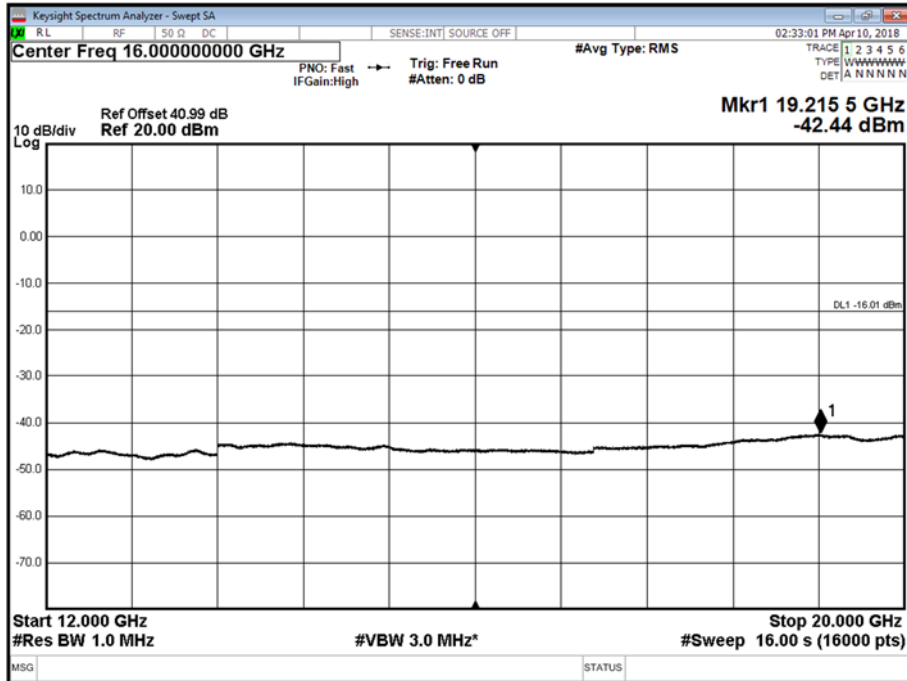
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position B - Band 2 - Range 4000 to 12000 MHz



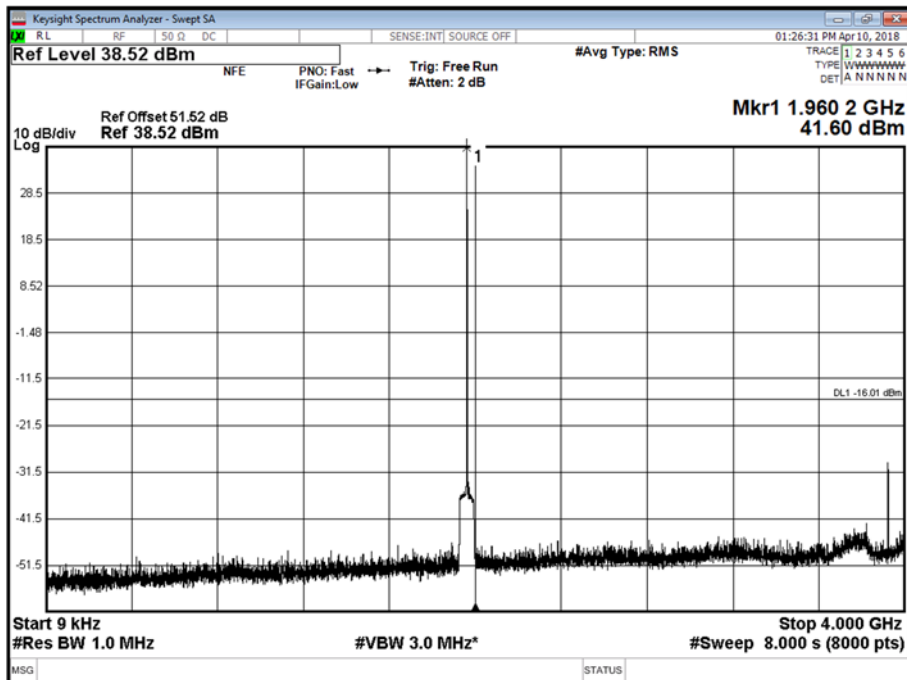


Product Service

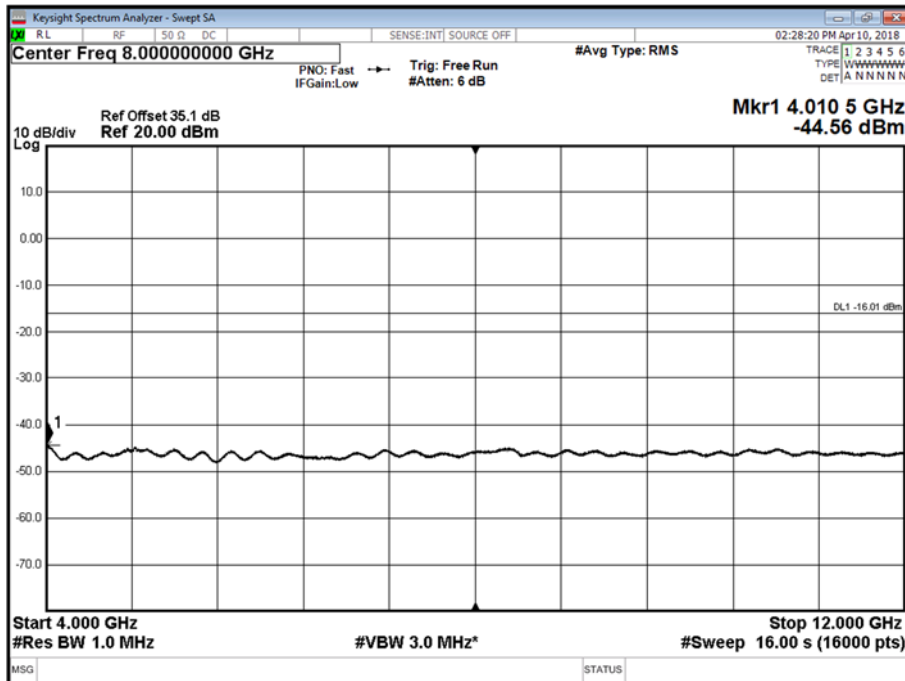
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position B - Band 3 - Range 12000 to 20000 MHz



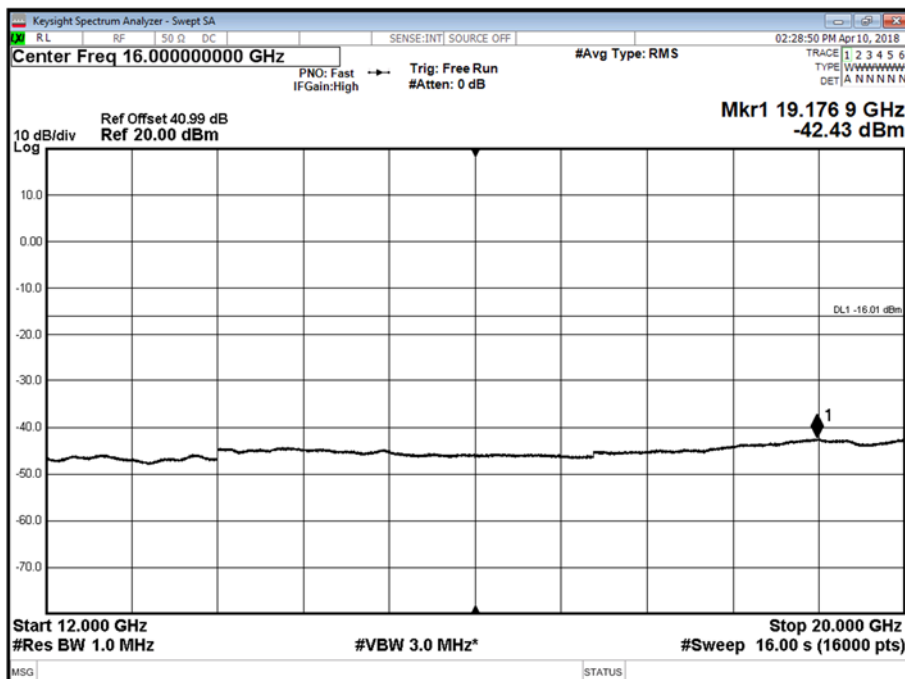
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position M - Band 1 - Range 0.009 to 4000 MHz



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



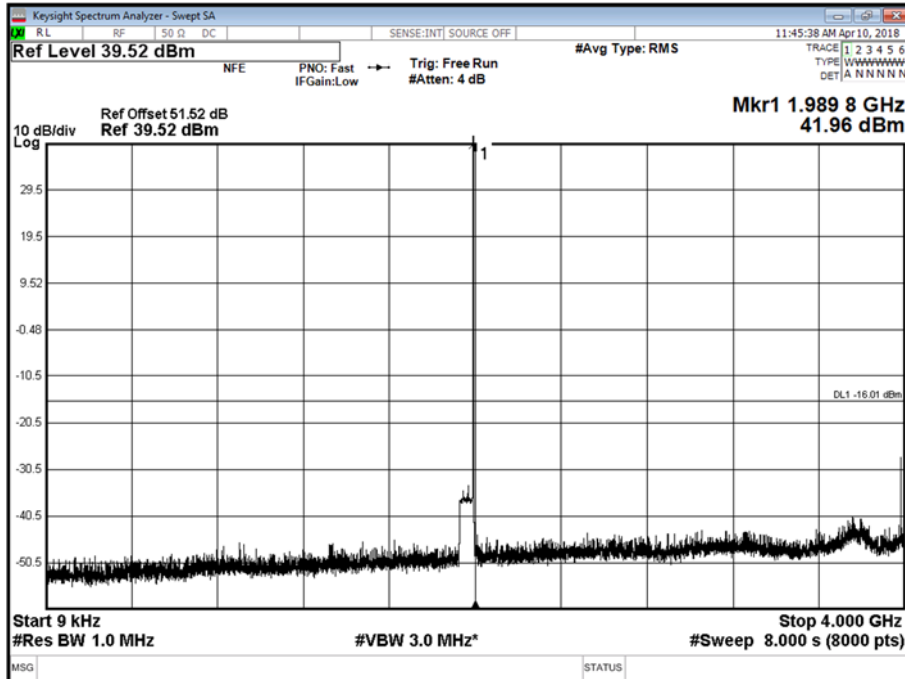
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position M - Band 3 - Range 12000 to 20000 MHz



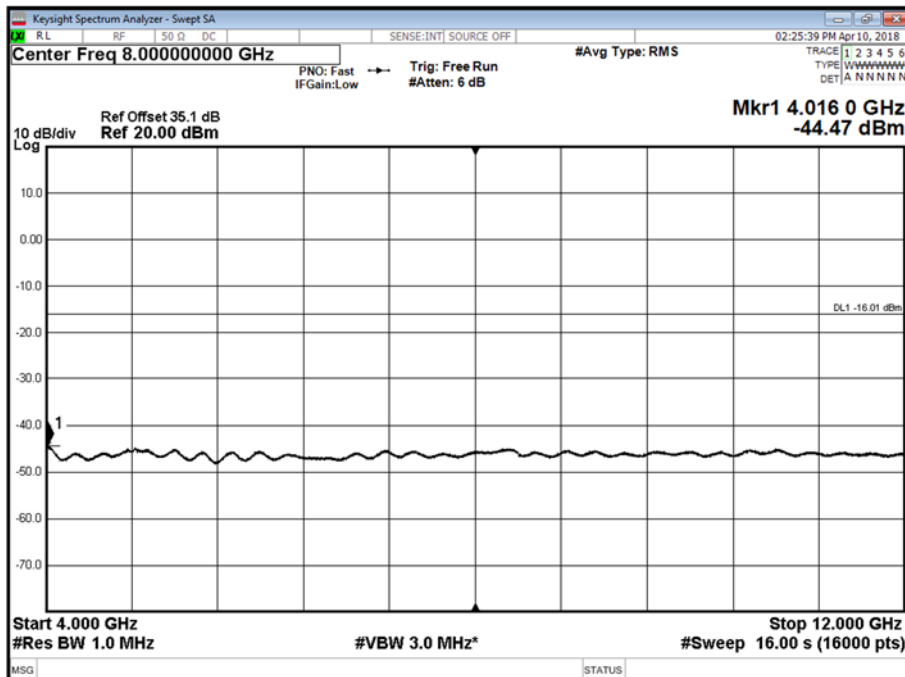


Product Service

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



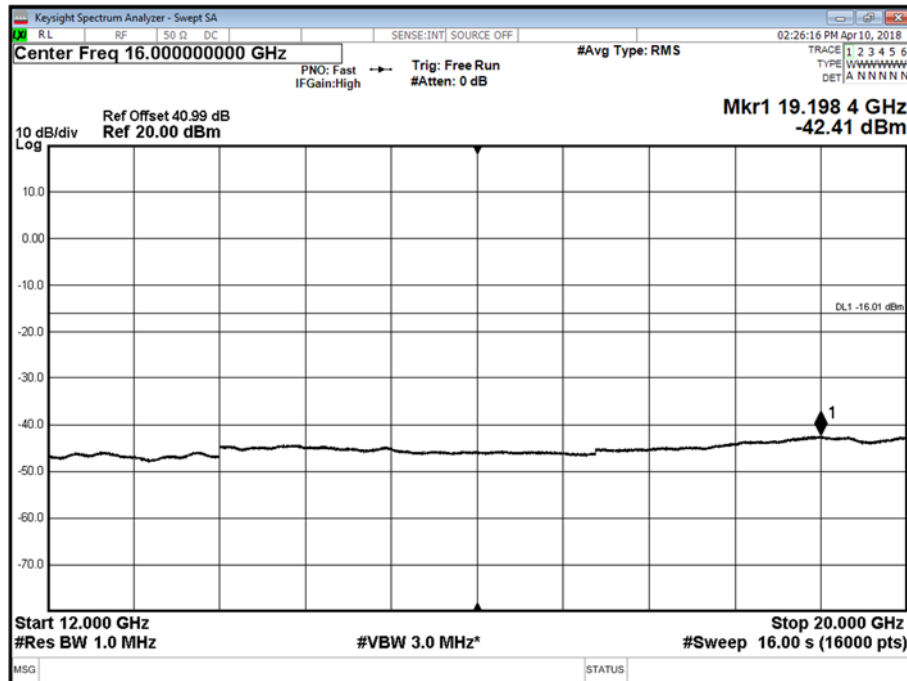
Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position T - Band 2 - Range 4000 to 12000 MHz





Product Service

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

26 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°C
Relative Humidity	31%

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:

$$E_{(v/m)} = (30 \times 1.64 \times 80)^{0.5} / 3 = 36.221 \text{ V/m} = 151.18 \text{ dB}\mu\text{V/m}$$

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

$$43 + 10\log(80) = 62.03 \text{ dB}$$

Therefore the limit at 3m measurement distance is:

$$151.18 - 62.03 = 89.15 \text{ dB}\mu\text{V/m}$$

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

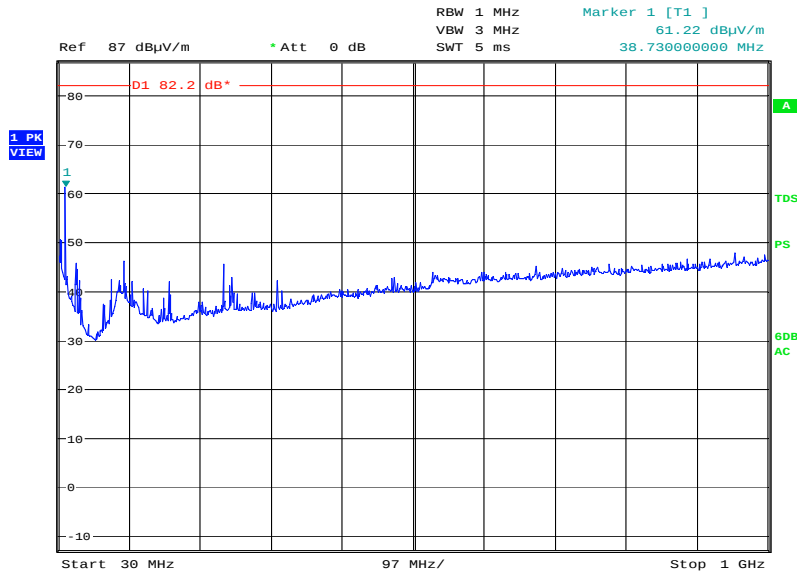
Configuration A

Maximum Output Power 49 dBm



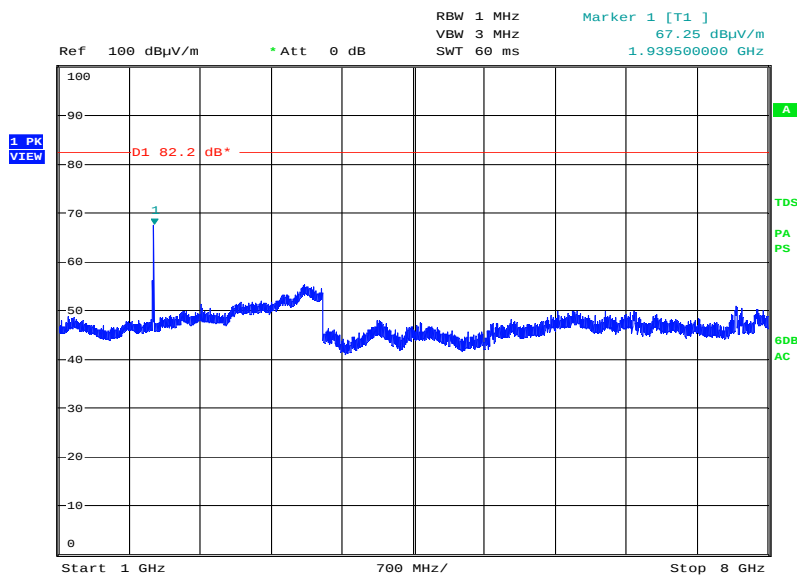
Product Service

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 30 to 4000 MHz



Date: 27.MAR.2018 16:35:14

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

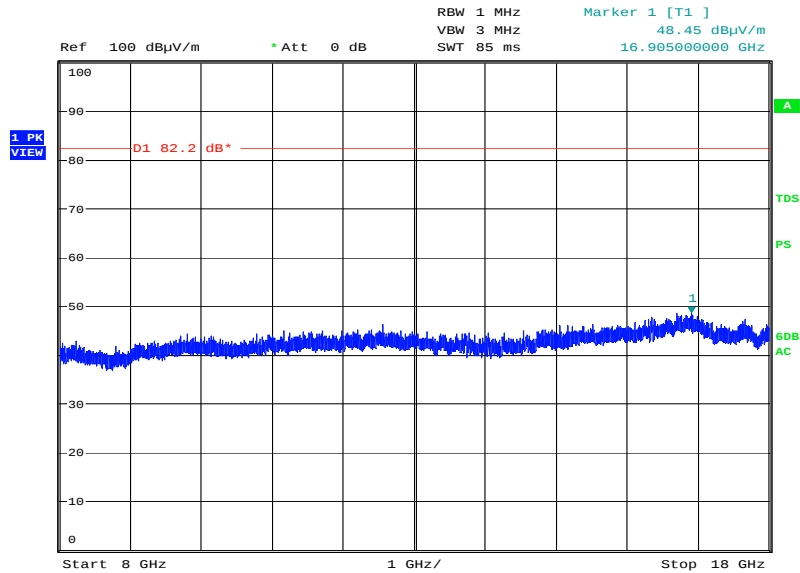


Date: 26.MAR.2018 11:12:02



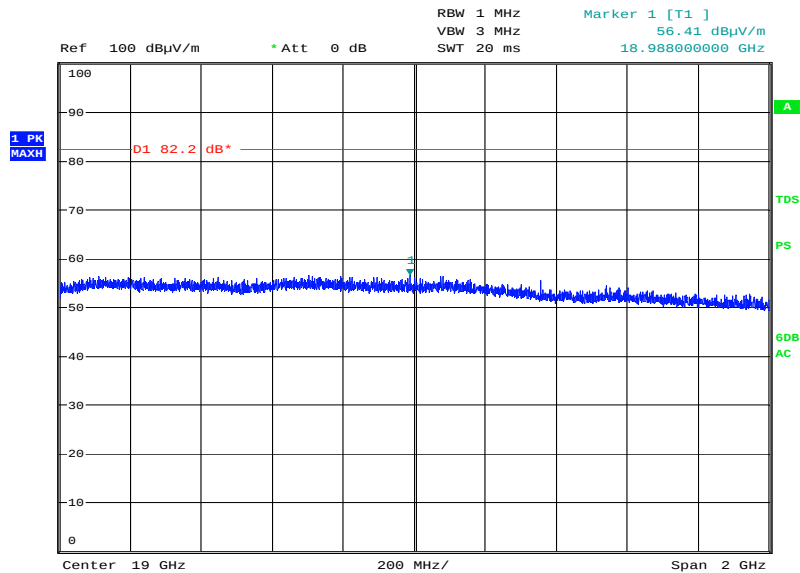
Product Service

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: 26.MAR.2018 15:05:24

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

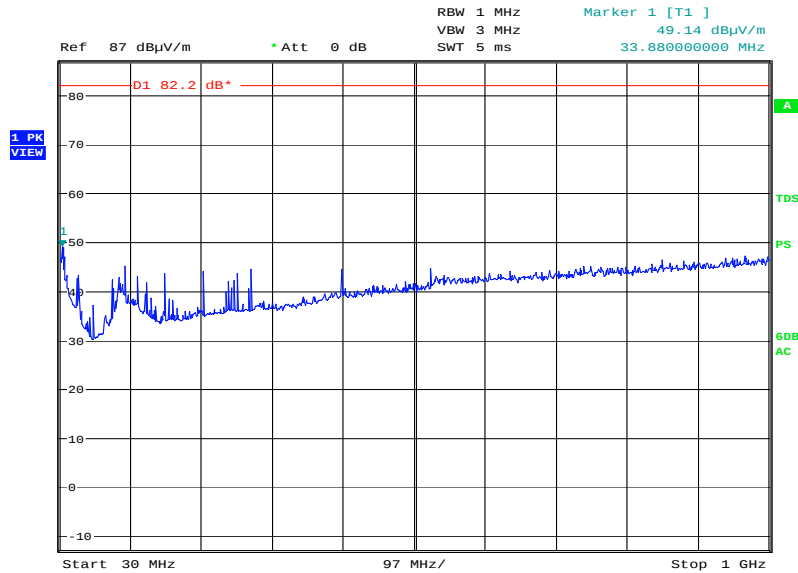


Date: 27.MAR.2018 13:44:56



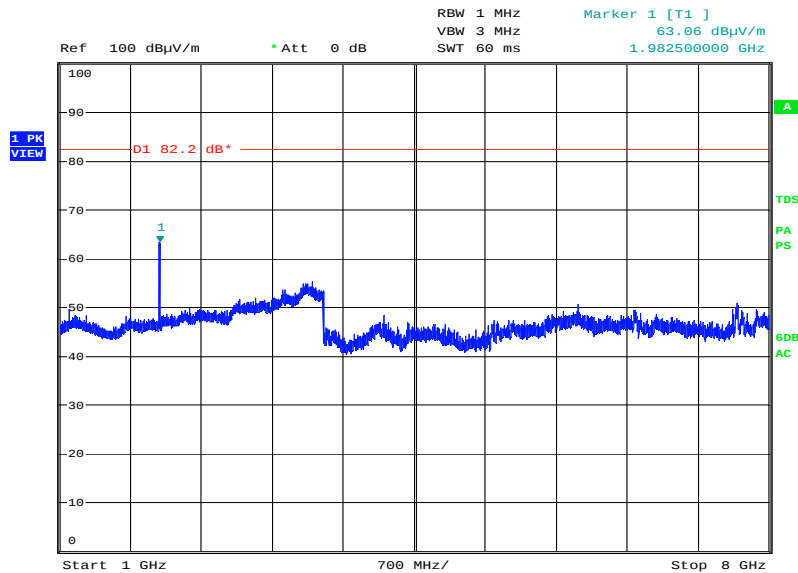
Product Service

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 30 to 4000 MHz



Date: 27.MAR.2018 16:26:30

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

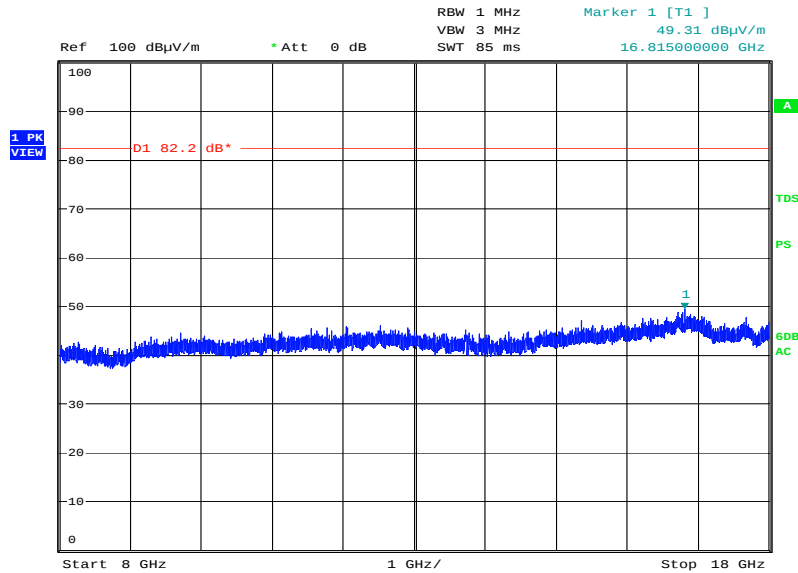


Date: 26.MAR.2018 11:25:49



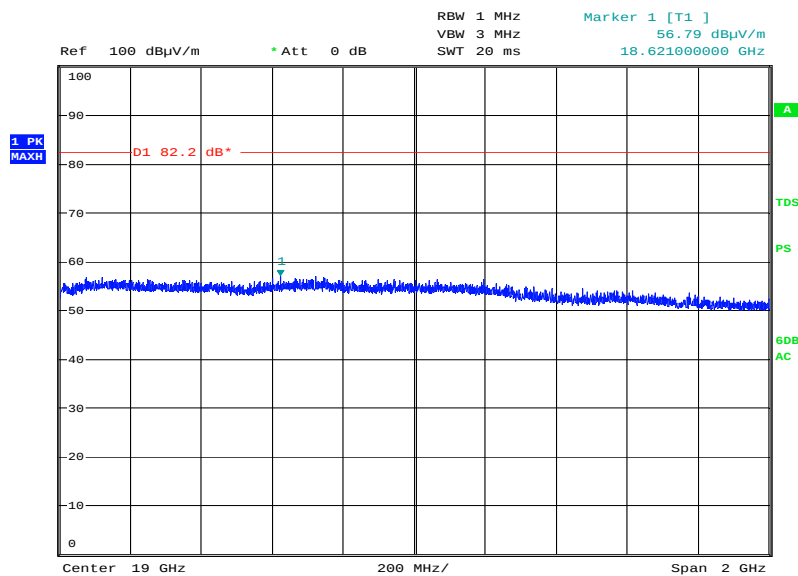
Product Service

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: 26.MAR.2018 15:00:01

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

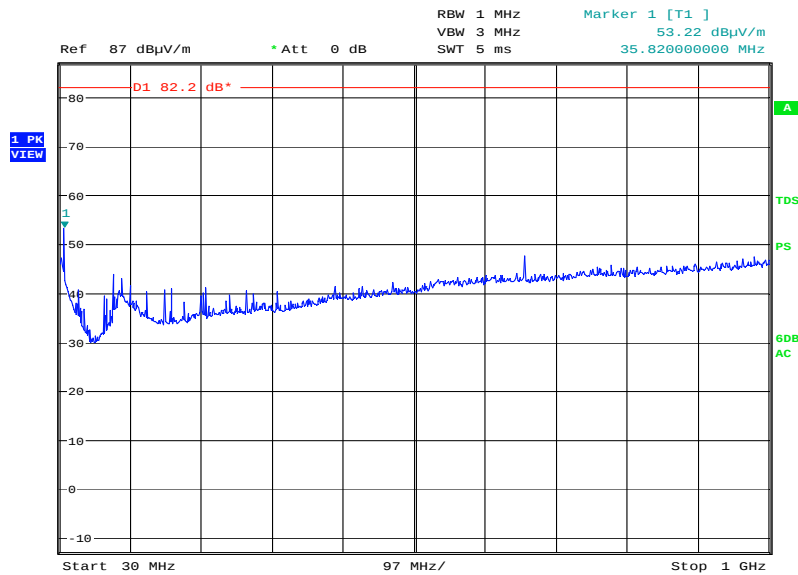


Date: 27.MAR.2018 13:53:11



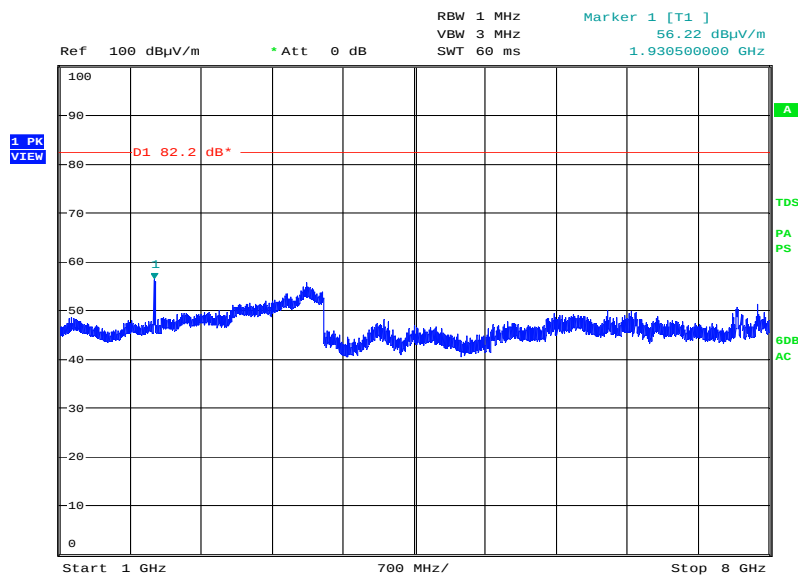
Product Service

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 30 to 4000 MHz



Date: 27.MAR.2018 16:16:24

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

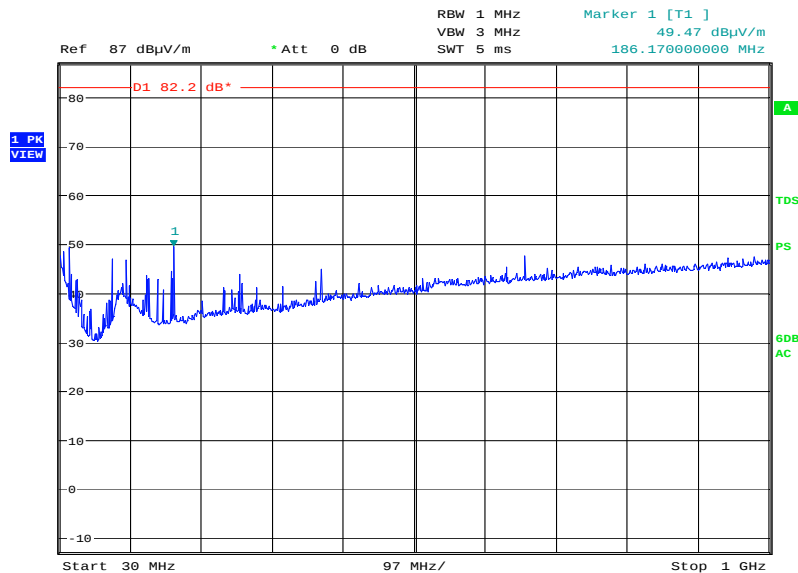


Date: 26.MAR.2018 11:34:06



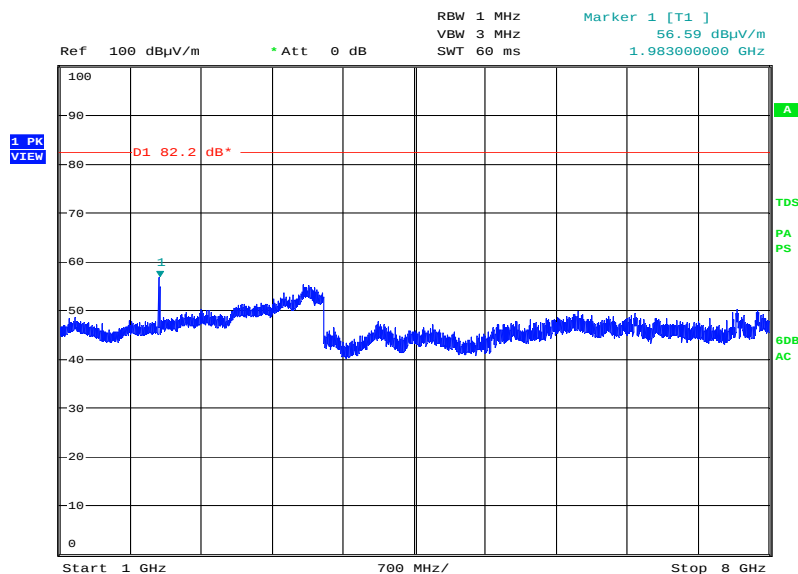
Product Service

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 30 to 4000 MHz



Date: 27.MAR.2018 16:21:59

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

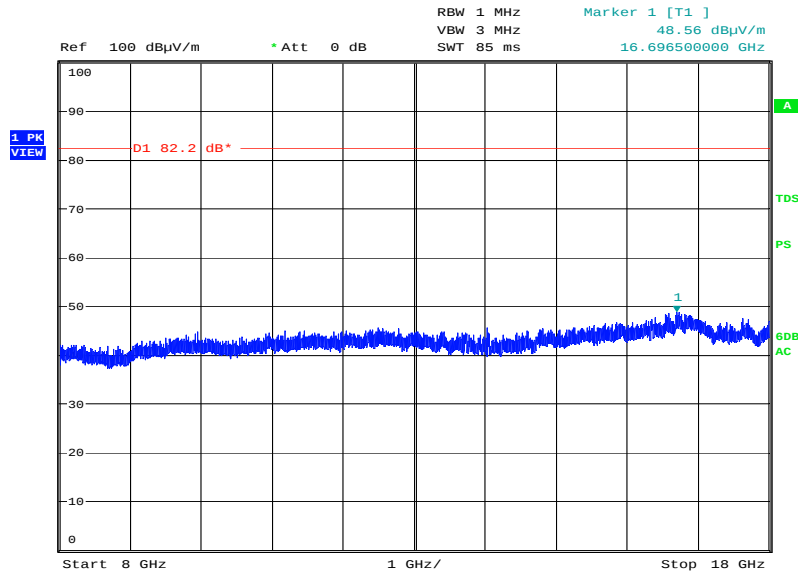


Date: 26.MAR.2018 11:41:15



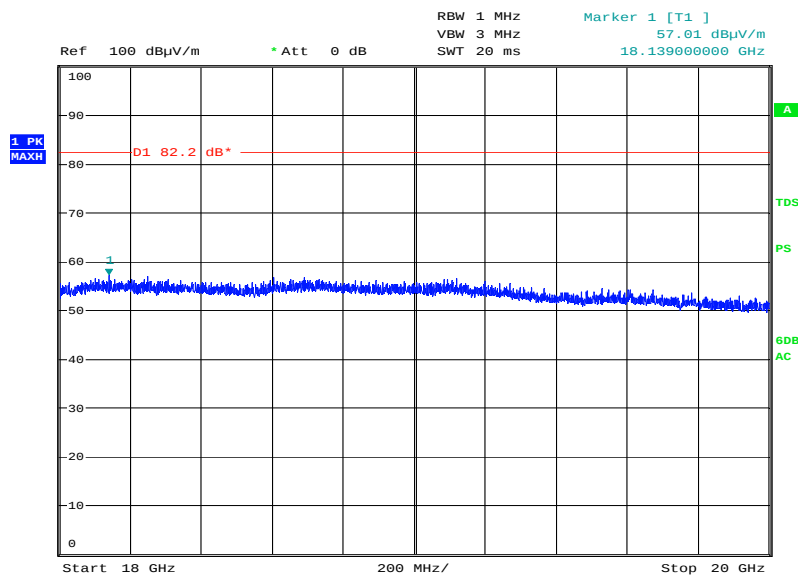
Product Service

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: 26.MAR.2018 14:39:46

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 120000 MHz

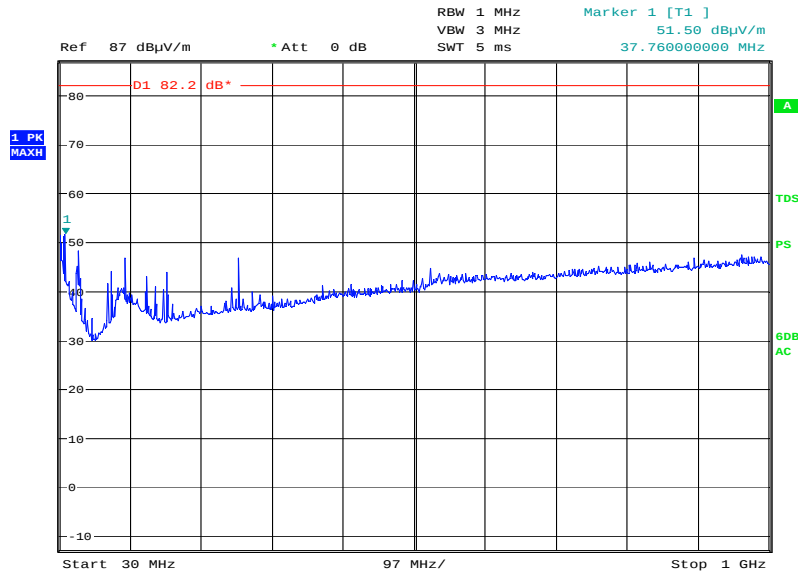


Date: 27.MAR.2018 14:21:44



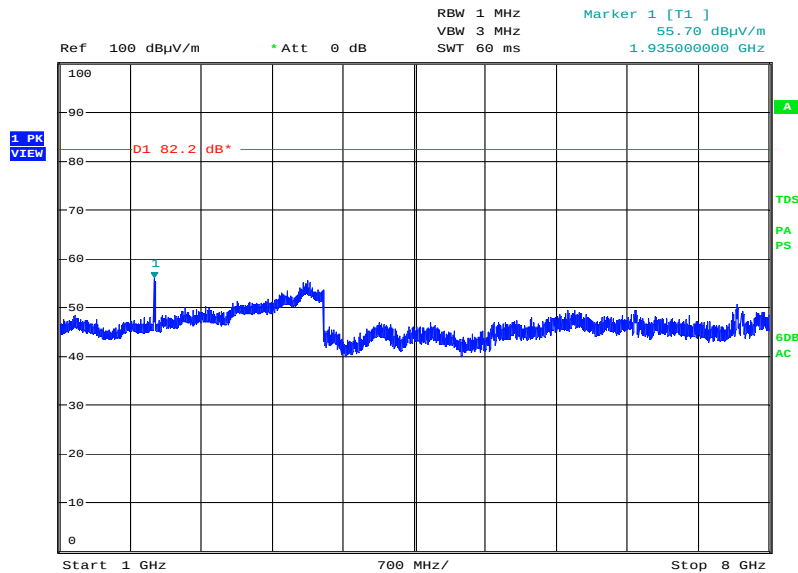
Product Service

Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
E:20.0 MHz / N:180 kHz - Channel Position B - Band 1 - Range 30 to 4000 MHz



Date: 27.MAR.2018 16:11:32

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

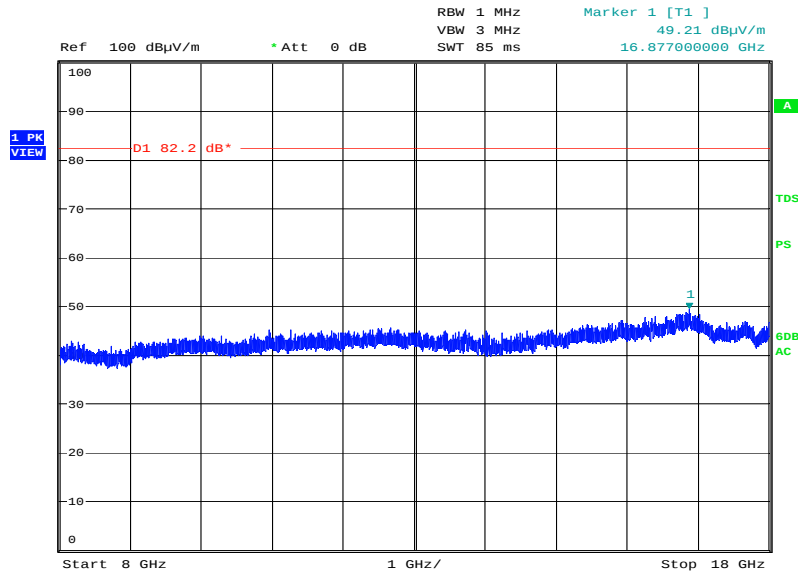


Date: 26.MAR.2018 11:47:01



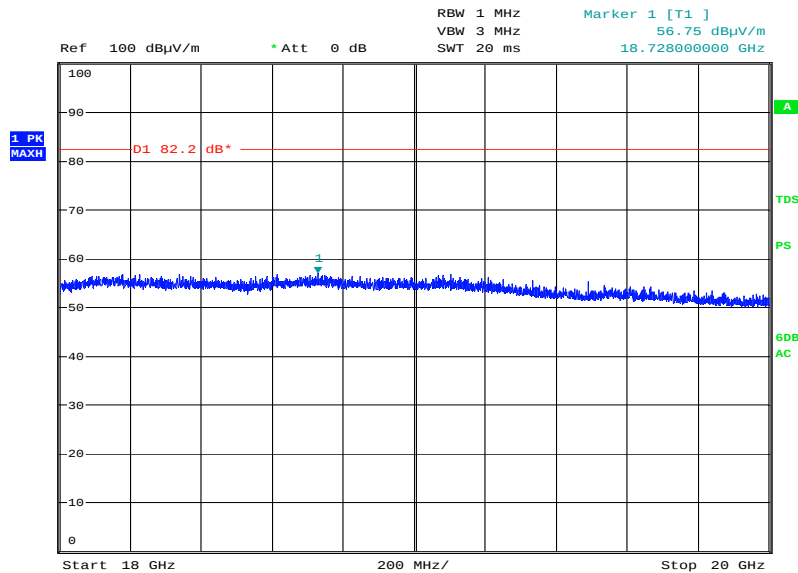
Product Service

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



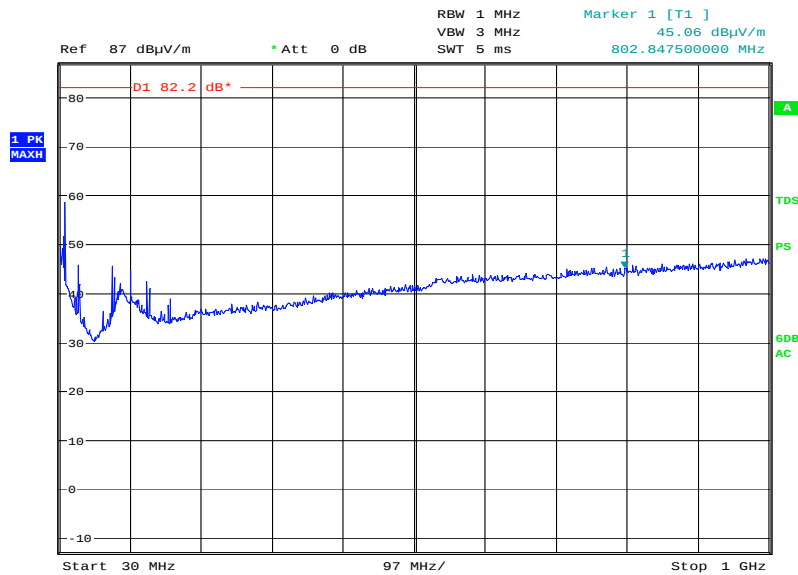
Date: 26.MAR.2018 14:25:10

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



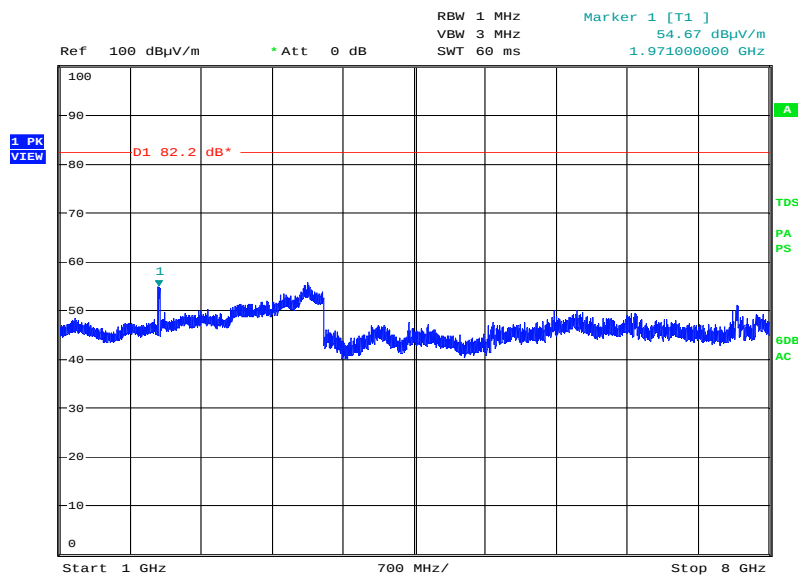
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Antenna A - LTE + NB-IoT Modulation L:64QAM / N:QPSK - LTE + NB-IoT Carrier Bandwidth
E:20.0 MHz / N:180 kHz - Channel Position T - Band 1 - Range 30 to 4000 MHz



Date: 27.MAR.2018 16:06:47

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



Date: 26.MAR.2018 11:54:45



The screenshot displays a spectrum analyzer interface. The main plot shows a noisy signal centered at 16.8855 GHz. A red horizontal line indicates a peak level of 82.2 dBm. The signal is labeled 'D1 82.2 dB*'.

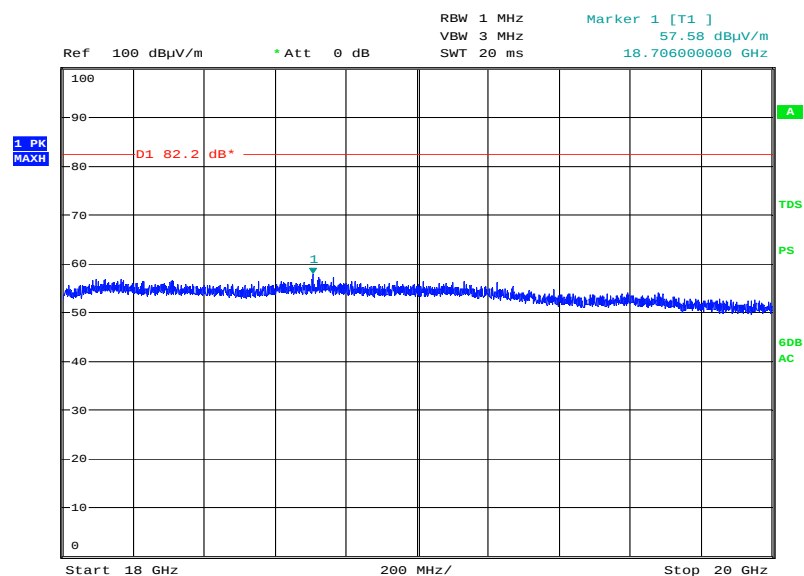
Parameters:

- Ref: 100 dBμV/m
- * Att: 0 dB
- RBW: 1 MHz
- VBW: 3 MHz
- SWT: 85 ms
- Marker 1 [T1]: 48.65 dBμV/m
- Frequency: 16.885500000 GHz

Plot Details:

- Y-axis: Power level in dB (0 to 100).
- X-axis: Frequency in GHz (Start 8 GHz, Stop 18 GHz, 1 GHz/div).
- Signal: Blue trace showing noise floor and a peak at 82.2 dBm.
- Grid: 10 dB vertical divisions, 1 GHz horizontal divisions.

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

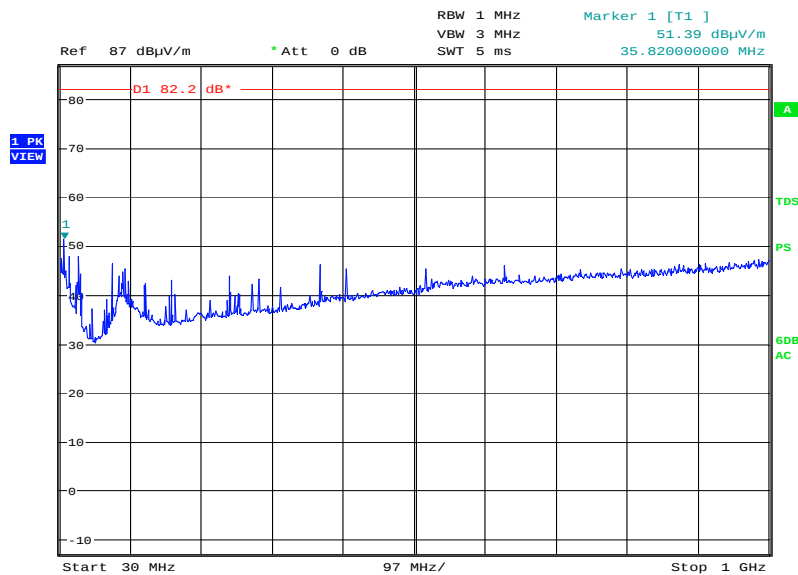


Date: 27.MAR.2018 14:37:48

Configuration B

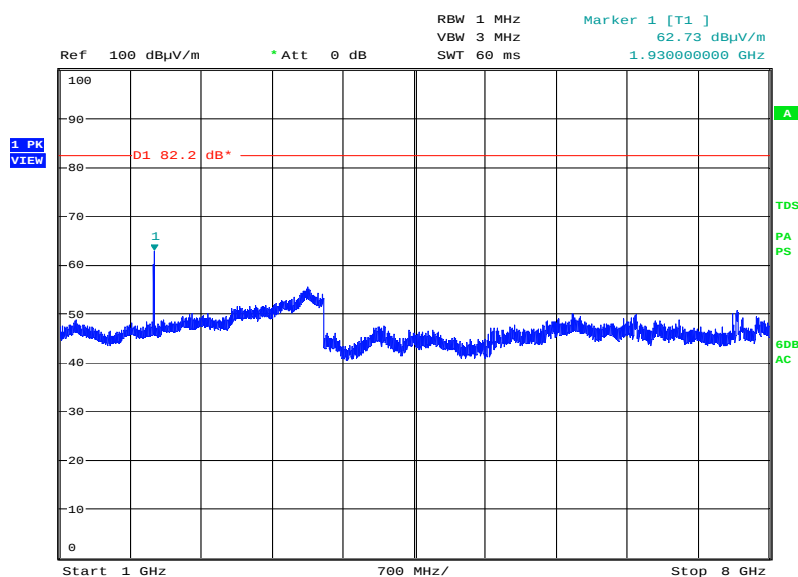
Maximum Output Power 43 dBm

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position B - Band 1 - Range 30 to 4000 MHz



Date: 27.MAR.2018 16:42:40

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

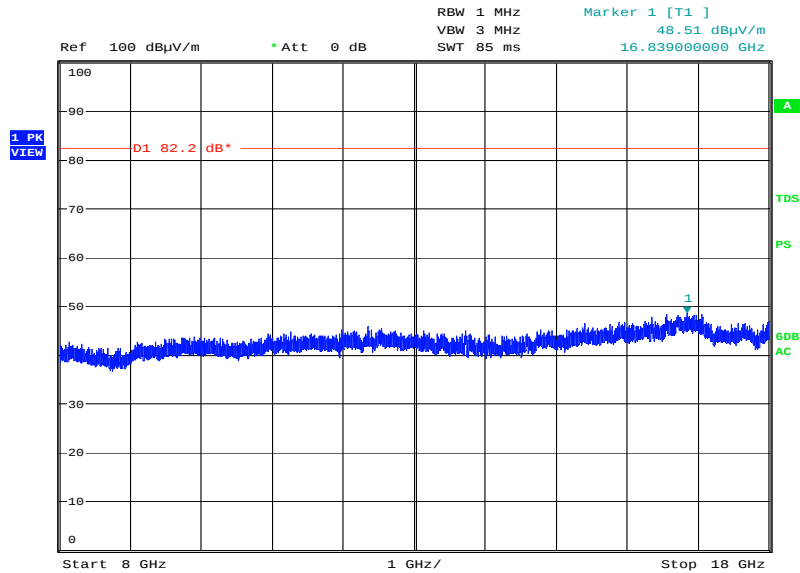


Date: 26.MAR.2018 12:08:02



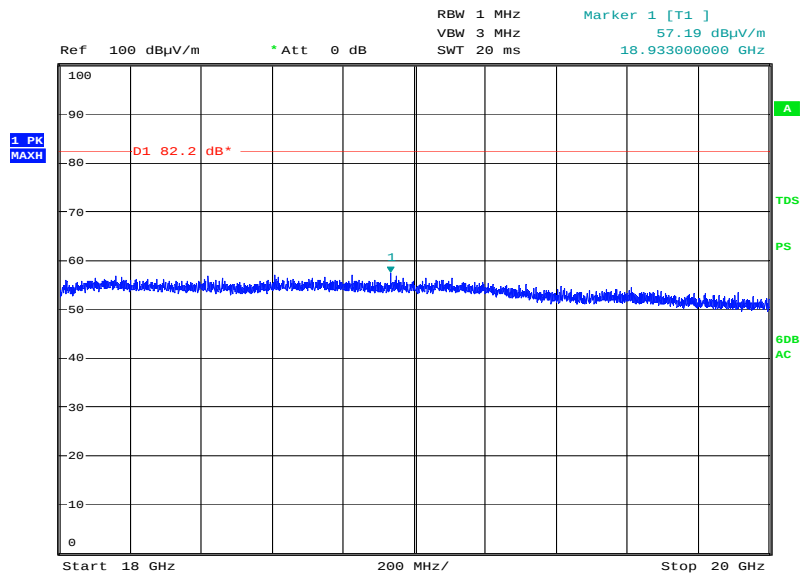
Product Service

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



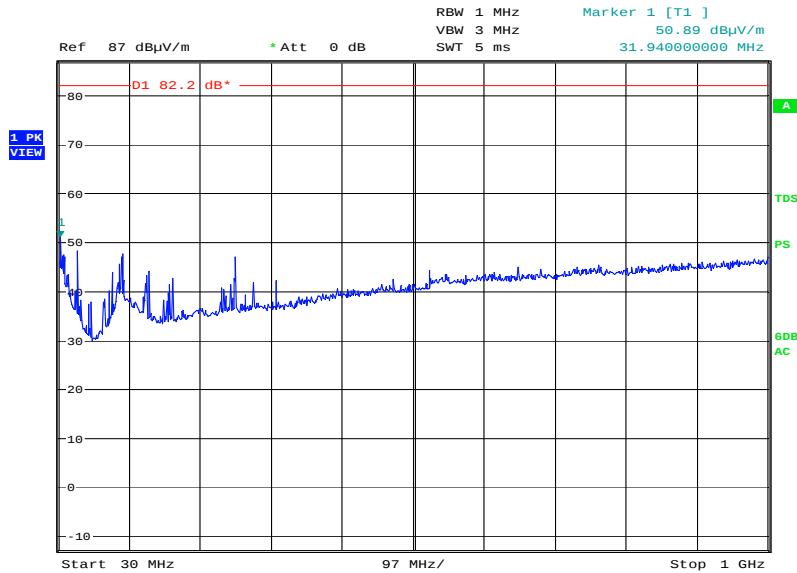
Date: 26.MAR.2018 15:10:06

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



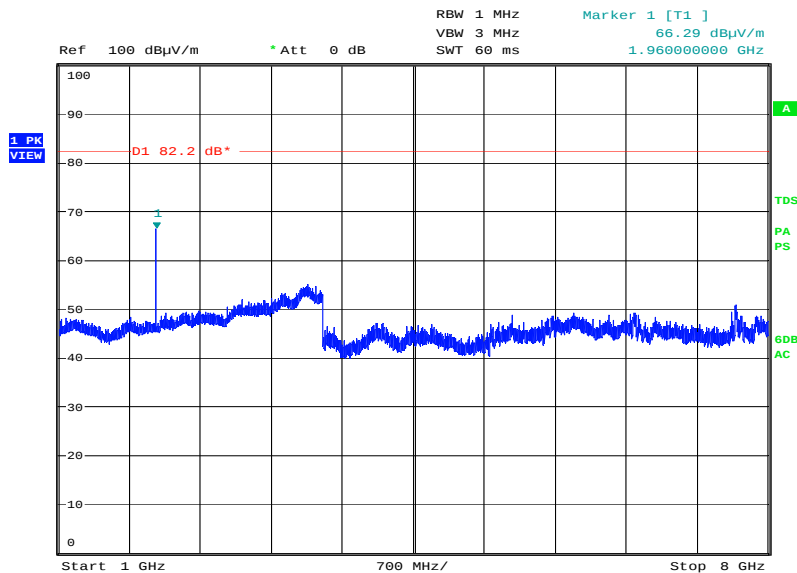
Date: 27.MAR.2018 14:42:41

Antenna A - NB-IoT SA Modulation N:QPSK - NB-IoT SA Carrier Bandwidth N:180 kHz -
Channel Position M - Band 1 - Range 30 to 4000 MHz



Date: 27.MAR.2018 16:53:25

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

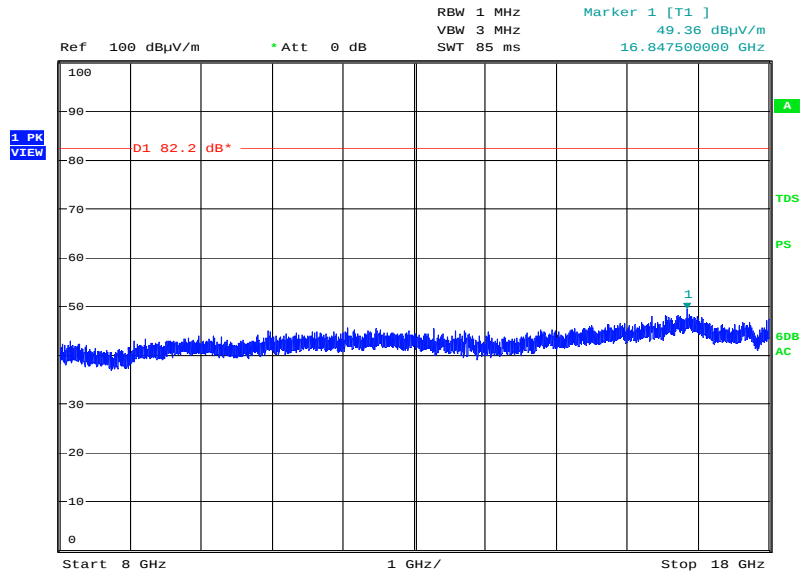


Date: 26.MAR.2018 13:21:23



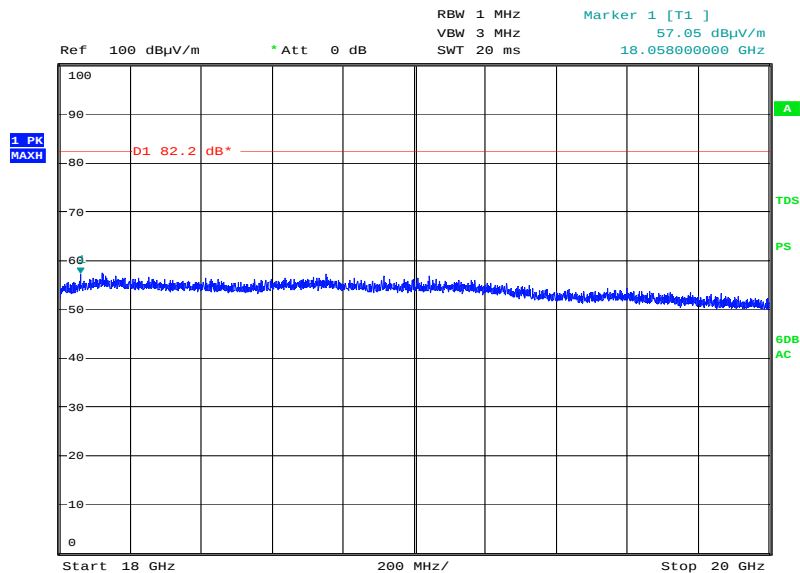
Product Service

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: 26.MAR.2018 15:20:08

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 14:47:58



Ref 87 dBμV/m * Att 0 dB RBW 1 MHz VBW 3 MHz SWT 5 ms Marker 1 [T1] 47.44 dBμV/m 35.82000000 MHz

1 PK VIEW

80 -70 -60 -50 -40 -30 -20 -10

D1 82.2 dB*

Center 515 MHz 97 MHz/ Span 970 MHz

PS 6DB AC

Date: 27.MAR.2018 16:47:45



Product Service

SECTION 3

TEST EQUIPMENT USED

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	-	O/P Mon
Attenuator	Weinschel	47-10-34	BU0642	-	O/P Mon
Attenuator	Weinschel	48-10-43	CH9195	-	O/P Mon
Attenuator	Weinschel	48-30-43	CH9182	-	O/P Mon
RF Load	weinschel	WA49-40-33	A1565	-	O/P Mon
Power Meter	Agilent	N1911A	MY45101617	-	O/P Mon
Power Supply	Delta	BML 901 250/1	BW96903167	-	O/P Mon
Wideband Power Sensor	Agilent	N1921A	MY45242699	-	O/P 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	-	O/P Mon
Attenuator	Weinschel	47-10-34	BU0642	-	O/P Mon
Attenuator	Weinschel	48-10-43	CH9195	-	O/P Mon
Attenuator	Weinschel	48-30-43	CH9182	-	O/P Mon
RF Load	weinschel	WA49-40-33	A1565	-	O/P Mon
Power Meter	Agilent	N1911A	MY45101617	-	O/P Mon
Power Supply	Delta	BML 901 250/1	BW96903167	-	O/P Mon
Wideband Power Sensor	Agilent	N1921A	MY45242699	-	O/P 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	-	O/P Mon
Attenuator	Weinschel	47-10-34	BU0642	-	O/P Mon
Attenuator	Weinschel	48-10-43	CH9195	-	O/P Mon
Attenuator	Weinschel	48-30-43	CH9182	-	O/P Mon



Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
RF Load	weinschel	WA49-40-33	A1565	-	O/P Mon
Power Meter	Agilent	N1911A	MY45101617	-	O/P Mon
Power Supply	Delta	BML 901 250/1	BW96903167	-	O/P Mon
Wideband Power Sensor	Agilent	N1921A	MY45242699	-	O/P 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	-	O/P Mon
Attenuator	Weinschel	47-10-34	BU0642	-	O/P Mon
Attenuator	Weinschel	48-10-43	CH9195	-	O/P Mon
Attenuator	Weinschel	48-30-43	CH9182	-	O/P Mon
RF Load	weinschel	WA49-40-33	A1565	-	O/P Mon
Power Meter	Agilent	N1911A	MY45101617	-	O/P Mon
Power Supply	Delta	BML 901 250/1	BW96903167	-	O/P Mon
Waveguide	F.M.I	18-25 GHz	N/A	-	O/P Mon
Wideband Power Sensor	Agilent	N1921A	MY45242699	-	O/P 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-2018
Antenna 18-40GHz (Double Ridge Guide)	Q-Par Angus Ltd	QSH 180K	1511	24	07-Dec-2018
Pre-Amplifier	Phase One	PS04-0086	1533	12	12-Jan-2019
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	02-Feb-2019
Screened Room (5)	Rainford	Rainford	1545	36	09-Jun-2018
Turntable Controller	Inn-Co GmbH	CO 4000	1606	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Tilt Antenna Mast	matur GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	matur GmbH	NCD	3917	-	TU
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	18-Oct-2018
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	01-Mar-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019

TU – Traceability Unscheduled
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



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 & B			
Product	Product No	R-State	Serial No
CT10	LPC102487/1	R1C	TO1F307249
RUS 02 B2	KRC 161 298/1	R1G	CA73209104
Software Version:		CXP9013268_9-R71DK.xlf	