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Radio Test Report – AIR 3246 B2 B25

371364-1TRFWL-R1

Applicant:

Ericsson Canada

Product:

AIR 3246

Models:

AIR 3246 B2 B25

Part numbers:

KRD 901 192/1

FCC ID:	ISED Reg. Number	HVIN:
TA8AKRD901192-1	287AB-AS9011921	AS9011921

Requirements/Summary:

Standard	Environmental phenomenon	Compliance
FCC 47 CFR Part 24, Subpart E	Broadband Personal Communications Services (PCS)	Yes
RSS-133 Issue 6 A1, Jan 18, 2018	2 GHz Personal Communications Services	Yes

Tested by:	Andrey Adelberg, Senior EMC/Wireless Specialist
Reviewed by:	Kevin Rose, Wireless/EMC Specialist
Date of issue:	April 10, 2019
Reviewer signature	

Two test locations

Company name	Nemko Canada Inc.	
Address	303 River Road	349 Terry Fox
City	Ottawa	Ottawa
Province	Ontario	Ontario
Postal code	K1V 1H2	K2K 2V6
Country	Canada	Canada
Telephone	+1 613 737 9680	+1 613 963 8000
Facsimile	+1 613 737 9691	
Toll free	+1 800 563 6336	
Website	www.nemko.com	
Site number	FCC test site registration number: CA2040, IC: 2040A-4 (3 m semi anechoic chamber)	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this reAnt Are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Ericsson Canada Inc.
Address	349 Terry Fox Drive
City	Ottawa
Province/State	Ontario
Postal/Zip code	K2K 2V6
Country	Canada

1.2 Test specifications

FCC 47 CFR Part 24, Subpart E	Broadband Personal Communications Services (PCS)
FCC 47 CFR Part 2	Frequency Allocations and Radio Treaty Maters; General Rules and Regulations
SRSP-510, Issue 5, Feb 2009	Technical Requirements for Personal Communications Services (PCS) in the Bands 1850–1915 MHz and 1930–1995 MHz
RSS-133 Issue 6 A1, Jan 18, 2018	2 GHz Personal Communications Services
RSS-Gen, Issue 5, April 2018	General Requirements for Compliance of Radio Apparatus

1.3 Test method

ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
KDB 662911 D01	Multiple Transmitter Output v02r01
KDB 662911 D02	MIMO with Cross-Polarized Antennas v01

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested.

EUT Configuration(s):

LTE: 5, 10, 15, 20 MHz (1–3 Carriers)

LTE + NB IoT (GB, IB): 5, 10, 15, 20 MHz (NB IoT BW = 200 kHz)

This report applies to the AIR 3246 B2 B25 with model number KRD 901 192/1.

See “Summary of test results” for full details.

1.5 Exclusions

None

1.6 Test report revision history

Revision #	Details of changes made to test report
TRFWL-R1	Original report issued

Section 2. Summary of test results

2.1 FCC Part 24 test results

Part	Test description	Verdict
§24.229	Frequencies	Pass[1]
§24.232(a)(2)	Power and antenna height limits for base stations with BW greater than 1 MHz	Pass
§24.235	Frequency stability	Pass
§24.238(a)	Emission limitations for Broadband PCS equipment – out of band emissions	Pass
§2.1049	Occupied bandwidth	Pass

Notes: [1]EUT transmits within 1930–1995 MHz frequency range

2.2 RSS-133 test results

Part	Test description	Verdict
6.1	Frequency Plan	Pass[1]
6.2	Types of Modulation	Pass[2]
6.3	Frequency stability	Pass
6.4	Transmitter Output Power and Equivalent Isotropically Radiated Power	Pass
6.5	Transmitter Unwanted Emissions	Pass
6.6	Receiver Spurious Emissions	Pass
RSS-Gen, 6.7	Occupied bandwidth	Pass

Notes: [1]EUT transmits within 1930–1995 MHz frequency range

[2]EUT employs digital modulation (QPSK to 256-QAM)

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	March 26, 2019
Nemko sample ID number	None

3.2 EUT information

Product name	AIR 3246
Model	AIR 3246 B2 B25
Part number	KRD 901 192/1
Revision	R2A
Serial number	C82A586740 (RA Radio) C82A586284 (Emission Radio)
Antenna ports	32 TX/RX Ports
RF BW / IBW	IBW DL: 65 MHz IBW UL: 65 MHz
FDD	80 MHz
Frequency	LTE TX (DL): 1930–1995 MHz LTE RX (UL): 1850–1915 MHz
Nominal O/P per antenna port Up to 20 MHz Carrier BW	Single Carrier: 1 × 5 W (37 dBm)
Accuracy (nominal)	±0.1 ppm
Nominal voltage	−48 V_{DC} @ 40 A (max)
RAT	LTE: SC, MC, MIMO IoT: IB, GB
Modulation	LTE: QPSK, 16 QAM, 64 QAM, 256 QAM
Channel bandwidth	LTE: 5, 10, 15, 20 MHz
Maximum combined OBW per port	N/A
CPRI	10 Gbps
Channel raster	LTE: 100 kHz
Regulatory requirements	Radio: FCC Part 2, 24, RSS-Gen, RSS-133
	EMC: FCC Part 15, ICES-003
	Safety: IEC/EN 62368-1, UL/CSA 62368-1 IEC/EN 60950-22, UL 50E IEC/EN 60529
Emission Designator:	LTE: 5M00W7D, 10M0W7D, 15M0W7D, 20M0W7D
Supported Configurations	SC, MC, MIMO, Carrier Aggregation
Operating temperature	−40 °C to +55 °C
Total Power based on IBW	32 × 5 W
Supported carrier / port	LTE: (1-3), IoT (1-2)

3.3 Product description and theory of operation

EUT description of the methods used to exercise the EUT and all relevant ports:

Description/theory of operation	The AIR 3246 B2 B25 (KRD 901 192/1) is a multi-standard remote radio forming part of the Ericsson RBS (Radio Base Station) equipment. The AIR 3246 provides radio access for mobile and fixed devices and is designed for the outdoor environment. The AIR 3246 operates over 32 TX/RX ports connected directly into an integrated antenna. Radio unit installation is designed for pole, wall or mast mount options. A fiber optic interface provides the RRU/RBS control and digital interface between the Radio and the RBS. The AIR 3246 product is convection cooled and shall be mounted vertically. Output RF Power is rated at 32 × 5 W. Altitude during operation: Below 4000 m ***Test Configuration:*** KRC 161 786/1: The radio functionality and performance are evaluated without the antenna attached. This alternate configuration replaces the antenna with the Ericsson RDNB (Radio Distribution Network Board) to allow access to the RF Ports for compliance measurements. All RF paths / components are identical. The RDNB is an ODM supplied assembly.

Ant Description

Port	Description
ANT 1-32	RF Output ports from 1 to 32
Alarm	Alarm
Data 1	Optical Interface Data 1
Data 2	Optical Interface Data 2
Data 3	Optical Interface Data 3
Data 4	Optical Interface Data 4
DC Input	−48 V_{DC}
MMI	Display - Radio Status
GND	Ground

Physical

Dimensions	1490 mm x 400 mm x 240 mm (H × W × D)
Weight	100 kg
Operating Temperature	−40 to +55 °C
Mounting	Pole, Wall Mount
Cooling	Convection (forced air)

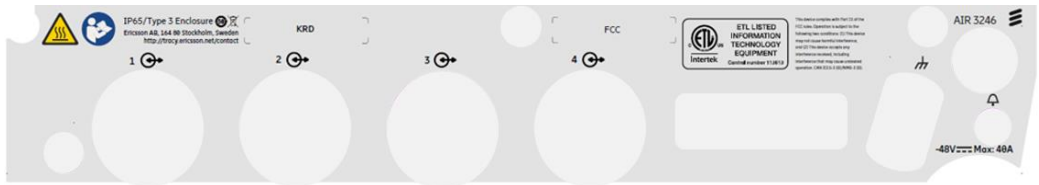
Software details: CXP9013268%19-R75KB

Radio Hardware Configuration

Product: KRD 901 192/1	R2A	KRC 161 786/1	R2A	Description
KRY 901 410/25	R1B	KRY 901 410/25	R1B	Radio Unit
ROA 128 6510/25	R1B	ROA 128 6510/25	R1B	PCB/Radio Board B66
NTB 101 0110/66	R1B	NTB 101 0110/66	R1B	Parts
KRF 901 328	R1B	KRF 901 328	R1A	Filter Unit
KRY 901 420/66	R2A	KRY 901 420/66	R2A	FIB/PSU
ROA 128 6520/66	R1J	ROA 128 6520/66	R1J	PCB FIB/PSU
NTB 101 0120/66	R1C	NTB 101 0120/66	R1C	Parts
KRE 105 290	R2	*KRE 105 288*	R1A	Antenna / *RDNB Fixture*
NTB 101 0100/66	R1B	NTB 101 0100/66	R1B	Parts

Product Identification Label

FCC ID: TA8AKRD901192-1
IC: 287AB-AS9011921
AS9011921



3.4 EUT test details

EUT setup/configuration rationale:

Down link

RAT	Modulation	Performance Requirement	Test Model / Configuration
LTE	QPSK	N/A	E-TM1.1
LTE	16QAM	N/A	E-TM3.2
LTE	64QAM	N/A	E-TM3.1
LTE	256QAM	N/A	E-TM3.1a

Up link

RAT	Modulation	Performance Requirement	Input Signal	Test Model / Configuration
LTE	QPSK	N/A		E-UTRA-UL

Carrier Configurations:

Single carrier

Bandwidth, MHz	LTE Transmit / DL, MHz					
	B	EARFCN	M	EARFCN	T	EARFCN
5	1932.5	*8065*	1962.5	*8365*	1992.5	*8665*
10	1935.0	*8090*	1962.5	*8365*	1990.0	*8640*
15	1937.5	*8115*	1962.5	*8365*	1987.5	*8615*
20	1940.0	*8140*	1962.5	*8365*	1985.0	*8590*

Bandwidth, MHz	LTE Receive / UL, MHz					
	B	EARFCN	M	EARFCN	T	EARFCN
5	1852.5	*26065*	1882.5	*26365*	1912.5	*26665*
10	1855.0	*26090*	1882.5	*26365*	1910.0	*26640*
15	1857.5	*26115*	1882.5	*26365*	1907.5	*26615*
20	1860.0	*26140*	1882.5	*26365*	1905.0	*26590*

LTE 2-Carriers for spurious emissions

Bandwidth, MHz	Transmit / DL, MHz											
	B1	EARFCN	B2	EARFCN	B3	EARFCN	T3	EARFCN	T1	EARFCN	T1	EARFCN
5	1932.5	*8065*	1937.5	*8115*	1960.0	*8340*	1965.0	*8390*	1987.5	*8615*	1992.5	*8665*
10	1935.0	*8090*	1945.0	*8190*	1957.5	*8315*	1967.5	*8415*	1980.0	*8540*	1990.0	*8640*
15	1937.5	*8115*	1952.5	*8265*	1955.0	*8290*	1970.0	*8440*	1972.5	*8465*	1987.5	*8615*
20	1940.0	*8140*	1960.0	*8340*	1952.5	*8265*	1972.5	*8465*	1965.0	*8390*	1985.0	*8590*

Bandwidth, MHz	Receive / UL, MHz											
	B1	EARFCN	B2	EARFCN	B3	EARFCN	T3	EARFCN	T2	EARFCN	T1	EARFCN
5	1852.5	*26065*	1857.5	*26115*	1880.0	*26340*	1885.0	*26390*	1907.5	*26615*	1912.5	*26665*
10	1855.0	*26090*	1865.0	*26190*	1877.5	*26315*	1887.5	*26415*	1900.0	*26540*	1910.0	*26640*
15	1857.5	*26115*	1872.5	*26265*	1875.0	*26290*	1890.0	*26440*	1892.5	*26465*	1907.5	*26615*
20	1860.0	*26140*	1880.0	*26340*	1872.5	*26265*	1892.5	*26465*	1885.0	*26390*	1905.0	*26590*

LTE 3-Carriers for spurious emissions

Bandwidth, MHz	Transmit / DL, MHz					
	B	EARFCN	M	EARFCN	T	EARFCN
5	1932.5	*8115*	1957.5	*8315*	1982.5	*8565*
	1937.5	*8065*	1962.5	*8365*	1987.5	*8615*
	1942.5	*8165*	1967.5	*8415*	1992.5	*8665*
10	1935.0	*8190*	1952.5	*8115*	1970.0	*8440*
	1945.0	*8090*	1962.5	*8365*	1980.0	*8540*
	1955.0	*8290*	1972.5	*8465*	1990.0	*8640*
15	1937.5	*8265*	1947.5	*8215*	1957.5	*8315*
	1952.5	*8115*	1962.5	*8365*	1972.5	*8465*
	1967.5	*8415*	1977.5	*8515*	1987.5	*8615*
20	1940.0	*8340*	1942.5	*8165*	1945.0	*9190*
	1960.0	*8140*	1962.5	*8365*	1965.0	*8390*
	1980.0	*8540*	1982.5	*8565*	1985.0	*8590*

Bandwidth, MHz	Receive / UL, MHz					
	B	EARFCN	M	EARFCN	T	EARFCN
5	1852.5	*26065*	1877.5	*26315*	1902.5	*26565*
	1857.5	*26115*	1882.5	*26365*	1907.5	*26615*
	1862.5	*26165*	1887.5	*26415*	1912.5	*26665*
10	1855.0	*26090*	1872.5	*26265*	1890.0	*26440*
	1865.0	*26190*	1882.5	*26365*	1900.0	*26540*
	1875.0	*26290*	1892.5	*26465*	1910.0	*26640*
15	1857.5	*26115*	1867.5	*26215*	1877.5	*26315*
	1872.5	*26265*	1882.5	*26365*	1892.5	*26465*
	1887.5	*26415*	1897.5	*26515*	1907.5	*26615*
20	1860	*26140*	1862.5	*26165*	1865.0	*26190*
	1880	*26340*	1882.5	*26365*	1885.0	*26390*
	1900	*26540*	1902.5	*26565*	1905.0	*26590*

EUT Monitoring Method / Equipment:

Support equipment	**Node EMC Test System** - Anritsu MS 2691 VSA/Sig Gen - HP Laptop - Timing and Synchronization box (GPS) - Ethernet Switch - Isolation Transformer **RBS 6601, BFM 901 009/1:** - DUS 4101 KDU 137 624/ 11, R4G, S/N: T48X68357 - DUS SW: CXP102051/27-R18A179 - Input Voltage: −48 V_{DC}

3.5 EUT setup diagram

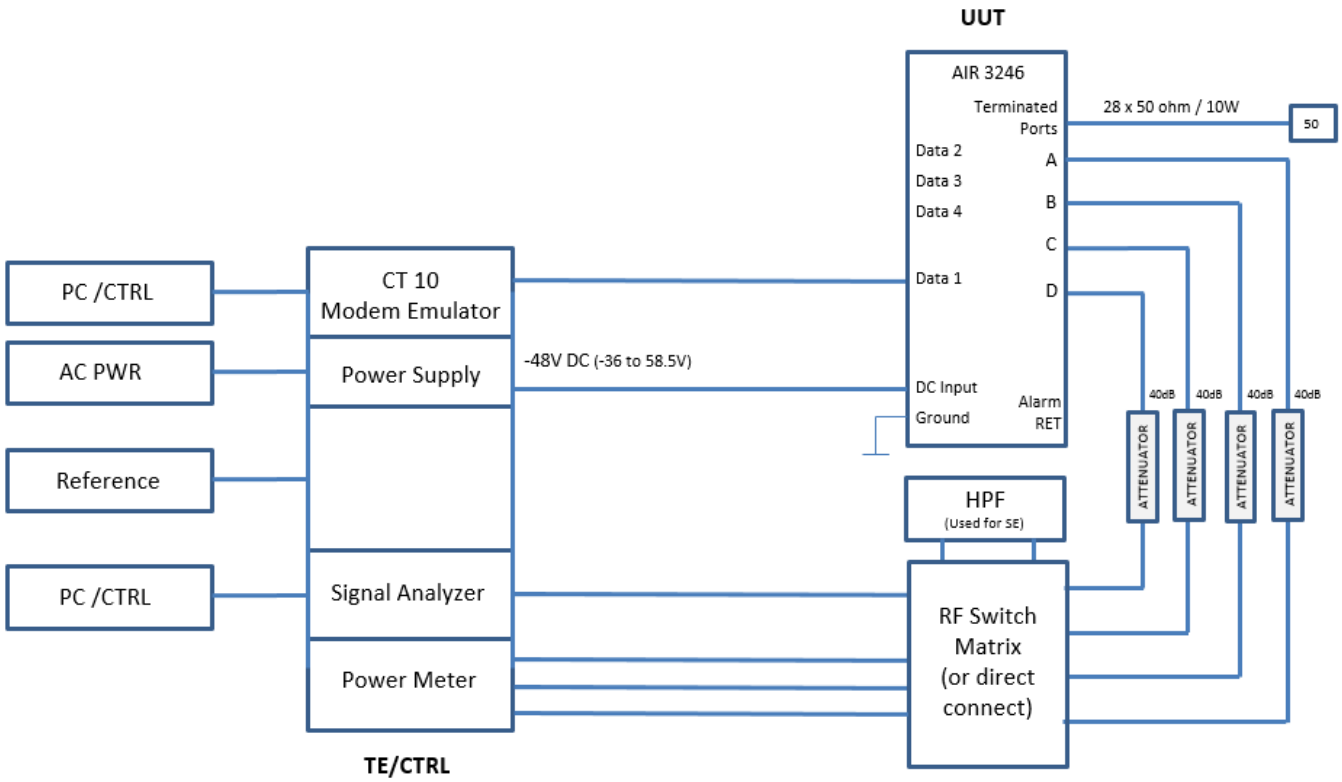


Figure 3.5-1: *Setup diagram – Radio Compliance*

3.6 Setup photographs

Figure 3.6-1: *Test / Measurement Equipment - Set up for Radio Compliance Testing*

Figure 3.6-2: *EUT Set-up for Radio Compliance Testing*

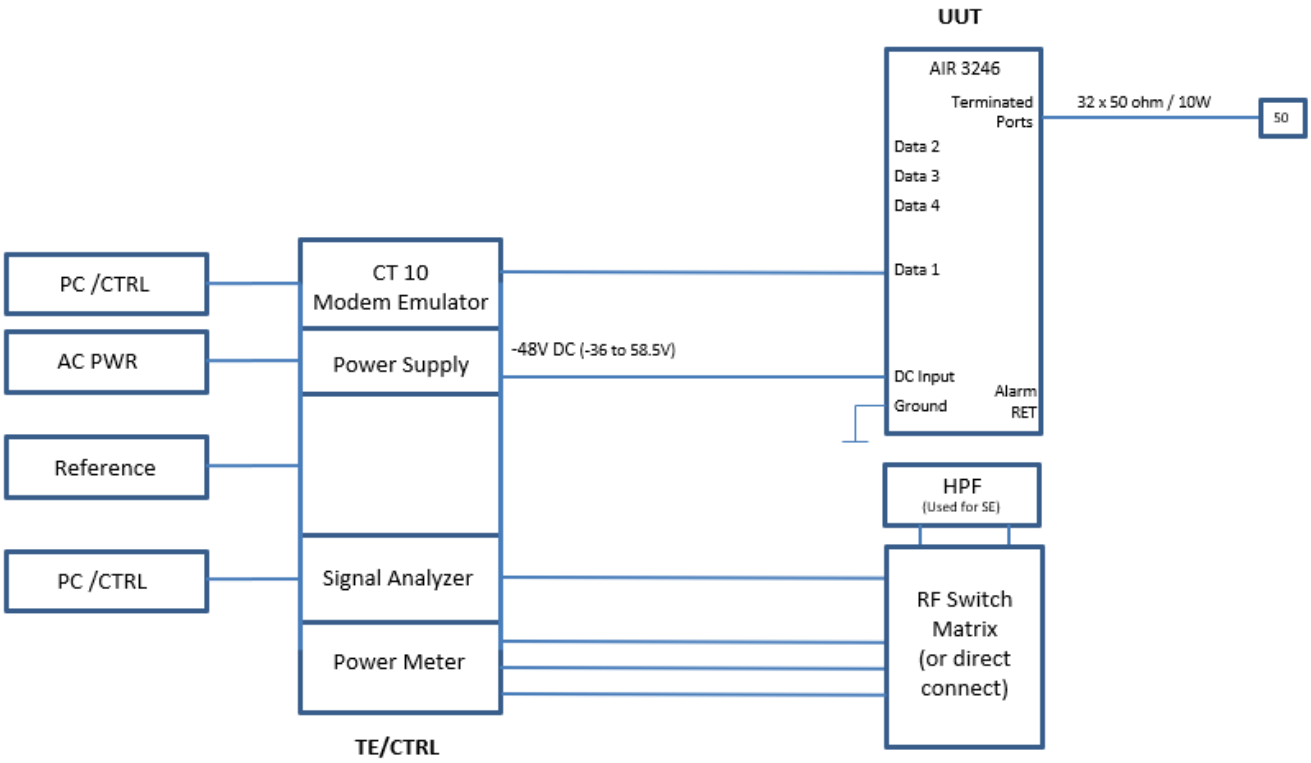


Figure 3.6-3: *EUT Set-up for Radiated Compliance Testing*

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

The output power was measured on all 32 antenna ports, to find the port with the highest output power and perform the rest of the testing on that one representing antenna port.

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
DMM	Digital Multimeter	34401A	US36048294	1 year	NCR
Spectrum Analyser	Keysight	PXA N9030A	MY55410202	1 year	13-Sept-19
PSU (DC)	Xantrex	XKW60-50	1001425551	NCR	NCR
USB Power Sensor	Keysight	U2044XA	MY58090002	1 year	16-Apr-19
USB Power Sensor	Keysight	U2044XA	MY58040008	1 year	16-Apr-19
USB Power Sensor	Keysight	U2044XA	MY57510012	1 year	15-Apr-19
USB Power Sensor	Keysight	U2044XA	MY57520003	1 year	15-Apr-19
RF Swtich	Ericsson	RARFSW4X1	1	NCR	NCR
Switch Driver	Hewlett Packard	11713A	3748A06076	NCR	NCR
PSU (DC)	Leader	730-3D	9801135	NCR	NCR
CT10	Ericsson	Testing Equipment	T01F311639	NCR	NCR
Thermometer	Fluke	52 K/J Thermocouple	FA002290	1 year	Sep. 11/19
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Jan. 24/20
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	May 26/19
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Jan. 3/20
Horn with Preamp (1–18 GHz)	ETS-Lindgren	3117	FA002840	1 year	Nov. 4/19
50 Ω coax cable	C.C.A.	None	FA002555	1 year	May 1/19
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	1 year	Oct. 9, 2019
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 24.232(a)(2) and RSS-133, 6.4 Transmitter output power (EIRP) and antenna height

8.1.1 Definitions and limits

§24.232(a)(2)

Base stations with an emission bandwidth greater than 1 MHz are limited to 1640 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

(2) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; see table below.

(b)(1) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, with an emission bandwidth of 1 MHz or less are limited to 3280 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

(d) Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

RSS-133, Section 6.4

The equivalent isotropically radiated power (e.i.r.p.) for transmitters shall not exceed the limits given in SRSP-510.
In addition, the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

SRSP-510, Section 5.1

5.1.1 Base stations

For base stations with a channel bandwidth greater than 1 MHz, the maximum e.i.r.p. is limited to 3280 watts/MHz e.i.r.p. (i.e., no more than 3280 watts e.i.r.p. in any 1 MHz band segment) with an antenna height above average terrain (HAAT) up to 300 metres. Fixed or base stations operating in urban areas are limited to a maximum allowable e.i.r.p. of 1640 watts/MHz e.i.r.p. Base station antenna heights above average terrain may exceed 300 metres with a corresponding reduction in e.i.r.p. according to the following table.

Table 8.1-1: *Reduction to Maximum Allowable E.I.R.P. for HAAT > 300 m*

HAAT (m)	Maximum EIRP, W/MHz
HAAT ≤ 300	1640
300 < HAAT ≤ 500	1070
500 < HAAT ≤ 1000	490
1000 < HAAT ≤ 1500	270
1500 < HAAT ≤ 2000	160

8.1.2 Test summary

Test date	March 26, 2019
Test engineer	Andrey Adelberg

8.1.3 Observations, settings and special notes

Output power was measured with RMS power meter.
Antenna sub-array gain is 10.5 dBi with uncorrelated signals.
Test receiver settings for PSD measurements:

Detector mode	RMS
Resolution bandwidth	1 MHz
Video bandwidth	>RBW
Measurement mode	Power over emission bandwidth
Trace mode	Averaging
Measurement time	Auto

8.1.4 Test data

Table 8.1-2: *Output power measurement results*

Antenna port	RF output power, dBm	RF output power, W	Antenna port	RF output power, dBm	RF output power, W
0,0,1	37.10	5.13	2,0,1	37.17	5.21
0,0,0	37.23	5.28	2,0,0	37.26	5.32
0,1,1	37.09	5.12	2,1,1	37.00	5.01
0,1,0	36.82	4.81	2,1,0	36.87	4.86
0,2,1	37.15	5.19	2,2,1	37.22	5.27
0,2,0	37.20	5.25	2,2,0	37.13	5.16
0,3,1	36.99	5.00	2,3,1	37.00	5.01
0,3,0	36.81	4.80	2,3,0	36.95	4.95
X,0,1	37.16	5.20	3,0,1	37.28	5.35
X,0,0	37.08	5.11	3,0,0	37.28	5.35
X,1,1	37.06	5.08	3,1,1	37.14	5.18
X,1,0	36.83	4.82	3,1,0	37.05	5.07
X,2,1	37.27	5.33	**3,2,1**	**37.29**	**5.36**
X,2,0	37.22	5.27	3,2,0	37.14	5.18
X,3,1	36.91	4.91	3,3,1	37.17	5.21
X,3,0	36.73	4.71	3,3,0	36.75	4.73

Note: it was determined, that antenna port 3,2,1 has the highest power level, therefore all the testing was performed on this representative port.

Table 8.1-3: *Output power density measurement results for Single Carrier configuration*

Remarks	Frequency, MHz	RF power density, dBm/MHz	Antenna gain, dBi	EIRP, dBm/MHz	EIRP limit, dBm/MHz	Margin, dB
QPSK, 5 MHz, Low channel	1932.5	29.53	10.50	40.03	62.15	22.12
16QAM, 5 MHz, Low channel	1932.5	30.02	10.50	40.52	62.15	21.63
64QAM, 5 MHz, Low channel	1932.5	29.49	10.50	39.99	62.15	22.16
256QAM, 5 MHz, Low channel	1932.5	29.58	10.50	40.08	62.15	22.07
QPSK, 5 MHz, Mid channel	1962.5	30.56	10.50	41.06	62.15	21.09
QPSK, 5 MHz, High channel	1992.5	30.04	10.50	40.54	62.15	21.61
QPSK, 10 MHz, Low channel	1935.0	27.33	10.50	37.83	62.15	24.32
16QAM, 10 MHz, Low channel	1935.0	27.55	10.50	38.05	62.15	24.10
64QAM, 10 MHz, Low channel	1935.0	27.33	10.50	37.83	62.15	24.32
256QAM, 10 MHz, Low channel	1935.0	27.17	10.50	37.67	62.15	24.48
QPSK, 10 MHz, Mid channel	1962.5	27.84	10.50	38.34	62.15	23.81
QPSK, 10 MHz, High channel	1990.0	27.62	10.50	38.12	62.15	24.03
QPSK, 15 MHz, Low channel	1937.5	25.64	10.50	36.14	62.15	26.01
16QAM, 15 MHz, Low channel	1937.5	26.35	10.50	36.85	62.15	25.30
64QAM, 15 MHz, Low channel	1937.5	25.54	10.50	36.04	62.15	26.11
256QAM, 15 MHz, Low channel	1937.5	25.45	10.50	35.95	62.15	26.20
QPSK, 15 MHz, Mid channel	1962.5	26.11	10.50	36.61	62.15	25.54
QPSK, 15 MHz, High channel	1987.5	25.76	10.50	36.26	62.15	25.89
QPSK, 20 MHz, Low channel	1940.0	24.59	10.50	35.09	62.15	27.06
16QAM, 20 MHz, Low channel	1940.0	24.79	10.50	35.29	62.15	26.86
64QAM, 20 MHz, Low channel	1940.0	24.54	10.50	35.04	62.15	27.11
256QAM, 20 MHz, Low channel	1940.0	24.55	10.50	35.05	62.15	27.10
QPSK, 20 MHz, Mid channel	1962.5	25.01	10.50	35.51	62.15	26.64
QPSK, 20 MHz, High channel	1985.0	24.69	10.50	35.19	62.15	26.96

Table 8.1-4: *Output power density measurement results for Multi-Carrier operation (2 carriers)*

Remarks	Frequency, MHz	RF power density, dBm/MHz	Antenna gain, dBi	EIRP, dBm/MHz	EIRP limit, dBm/MHz	Margin, dB
QPSK, 5 MHz, 2C on the bottom	1932.5 + 1937.5	27.21	10.50	37.71	62.15	24.44
QPSK, 5 MHz, 2C in the middle	1960 + 1965	27.54	10.50	38.04	62.15	24.11
QPSK, 5 MHz, 2C on the top	1987.5 + 1992.5	27.38	10.50	37.88	62.15	24.27
QPSK, 10 MHz, 2C on the bottom	1935 + 1945	24.36	10.50	34.86	62.15	27.29
QPSK, 10 MHz, 2C in the middle	1957.5 + 1967.5	24.54	10.50	35.04	62.15	27.11
QPSK, 10 MHz, 2C on the top	1980 + 1990	24.59	10.50	35.09	62.15	27.06
QPSK, 15 MHz, 2C on the bottom	1937.5 + 1952.5	22.76	10.50	33.26	62.15	28.89
QPSK, 15 MHz, 2C in the middle	1955 + 1970	23.23	10.50	33.73	62.15	28.42
QPSK, 15 MHz, 2C on the top	1972.5 + 1987.5	22.79	10.50	33.29	62.15	28.86
QPSK, 20 MHz, 2C on the bottom	1940 + 1960	21.61	10.50	32.11	62.15	30.04
QPSK, 20 MHz, 2C in the middle	1952.5 + 1972.5	21.60	10.50	32.10	62.15	30.05
QPSK, 20 MHz, 2C on the top	1965 + 1985	21.50	10.50	32.00	62.15	30.15

Table 8.1-5: *Output power density measurement results for Multi-Carrier operation (3 carriers)*

Remarks	Frequency, MHz	RF power density, dBm/MHz	Antenna gain, dBi	EIRP, dBm/MHz	EIRP limit, dBm/MHz	Margin, dB
QPSK, 5 MHz, 3C on the bottom	1932.5 + 1937.5 + 1942.5	25.16	10.50	35.66	62.15	26.49
QPSK, 5 MHz, 3C in the middle	1957.5 + 1962.5 + 1967.5	25.72	10.50	36.22	62.15	25.93
QPSK, 5 MHz, 3C on the top	1982.5 + 1987.5 + 1992.5	25.73	10.50	36.23	62.15	25.92
QPSK, 10 MHz, 3C on the bottom	1935 + 1945 + 1955	22.69	10.50	33.19	62.15	28.96
QPSK, 10 MHz, 3C in the middle	1952.5 + 1962.5 + 1972.5	22.91	10.50	33.41	62.15	28.74
QPSK, 10 MHz, 3C on the top	1970 + 1980 + 1990	22.93	10.50	33.43	62.15	28.72
QPSK, 15 MHz, 3C on the bottom	1937.5 + 1952.5 + 1967.5	20.94	10.50	31.44	62.15	30.71
QPSK, 15 MHz, 3C in the middle	1947.5 + 1962.5 + 1977.5	20.83	10.50	31.33	62.15	30.82
QPSK, 15 MHz, 3C on the top	1957.5 + 1972.5 + 1987.5	20.91	10.50	31.41	62.15	30.74
QPSK, 20 MHz, 3C on the bottom	1940 + 1960 + 1980	19.47	10.50	29.97	62.15	32.18
QPSK, 20 MHz, 3C in the middle	1942.5 + 1962.5 + 1982.5	19.58	10.50	30.08	62.15	32.07
QPSK, 20 MHz, 3C on the top	1945 + 1965 + 1985	19.58	10.50	30.08	62.15	32.07

Table 8.1-6: *Output power density measurement results for Single-Carrier operation with IoT*

Remarks	Frequency, MHz	RF power density, dBm/MHz	Antenna gain, dBi	EIRP, dBm/MHz	EIRP limit, dBm/MHz	Margin, dB
QPSK, 5 MHz, IB IoT on the bottom	1932.5	30.07	10.50	40.57	62.15	21.58
QPSK, 5 MHz, IB IoT in the middle	1962.5	31.42	10.50	41.92	62.15	20.23
QPSK, 5 MHz, IB IoT on the top	1992.5	30.26	10.50	40.76	62.15	21.39
QPSK, 10 MHz, GB IoT on the bottom	1935.0	26.48	10.50	36.98	62.15	25.17
QPSK, 10 MHz, GB IoT in the middle	1962.5	27.50	10.50	38.00	62.15	24.15
QPSK, 10 MHz, GB IoT on the top	1990.0	26.91	10.50	37.41	62.15	24.74
QPSK, 15 MHz, GB IoT on the bottom	1937.5	25.11	10.50	35.61	62.15	26.54
QPSK, 15 MHz, GB IoT in the middle	1962.5	25.76	10.50	36.26	62.15	25.89
QPSK, 15 MHz, GB IoT on the top	1987.5	25.28	10.50	35.78	62.15	26.37
QPSK, 20 MHz, GB IoT on the bottom	1940.0	24.68	10.50	35.18	62.15	26.97
QPSK, 20 MHz, GB IoT in the middle	1962.5	24.79	10.50	35.29	62.15	26.86
QPSK, 20 MHz, GB IoT on the top	1985.0	24.34	10.50	34.84	62.15	27.31

Table 8.1-7: *Total EIRP calculation*

Maximum PSD sum[3], dBm/MHz	Antenna Gain, dBi	Antenna Array Column Gain[1], dB	EIRP per polarization[2], dBm/MHz	EIRP per polarization, W/MHz	Limit, W/MHz	Margin, dB
42.601	10.500	6.000	59.101	813.018	1640.000	3.047

Notes: [1] Antenna Array Column Gain = 10 Log(4)
[2]EIRP = PSD Sum + Antenna Gain + Antenna Array Column Gain
[3]Maximum PSD sum was calculated as worst-case scenario, as if all 16 antennas (one polarization array) had the same highest measured power level:

$$30.56 \text{ dBm/MHz} + 10 \times \text{Log}_{10}(16) = 42.601 \text{ dBm/MHz}$$

Table 8.1-8: *EIRP calculation for Macro Narrow beams*

Maximum PSD sum, dBm/MHz	Antenna Gain, dBi	EIRP per polarization, dBm/MHz	EIRP per polarization, W/MHz
42.601	22	64.601	2884.696

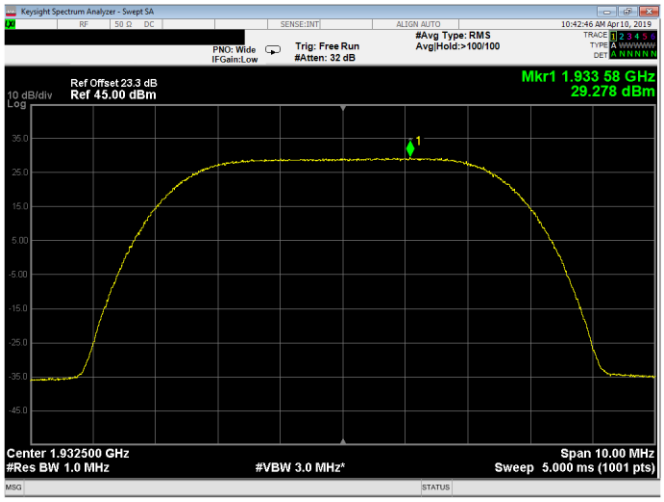


Figure 8.1-1: *PSD sample plot, single carrier 5 MHz bandwidth*

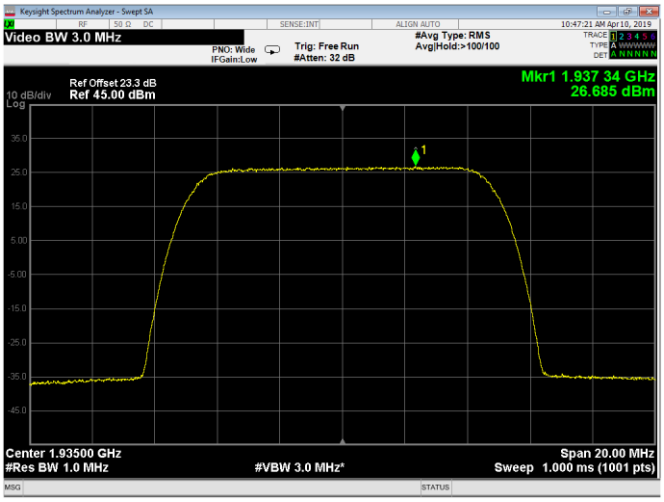


Figure 8.1-2: *PSD sample plot, single carrier 10 MHz bandwidth*

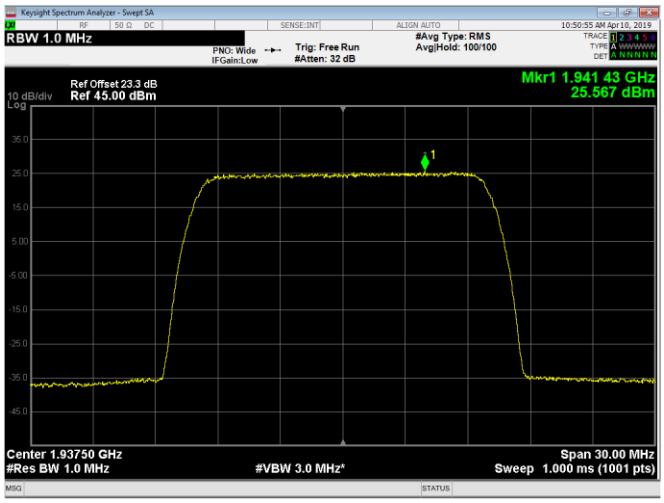


Figure 8.1-3: *PSD sample plot, single carrier 15 MHz bandwidth*

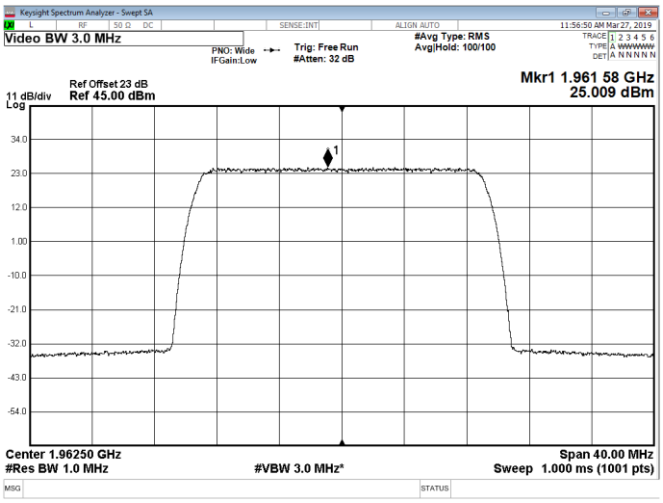


Figure 8.1-4: *PSD sample plot, single carrier 20 MHz bandwidth*

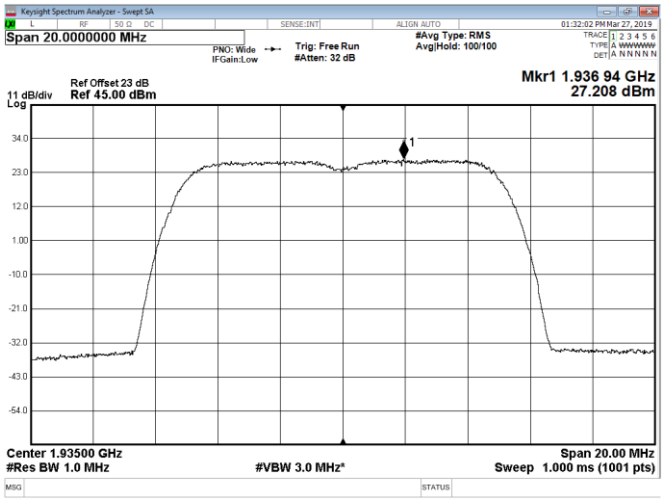


Figure 8.1-5: *PSD sample plot, 2-carrier 5 MHz channel bandwidth*

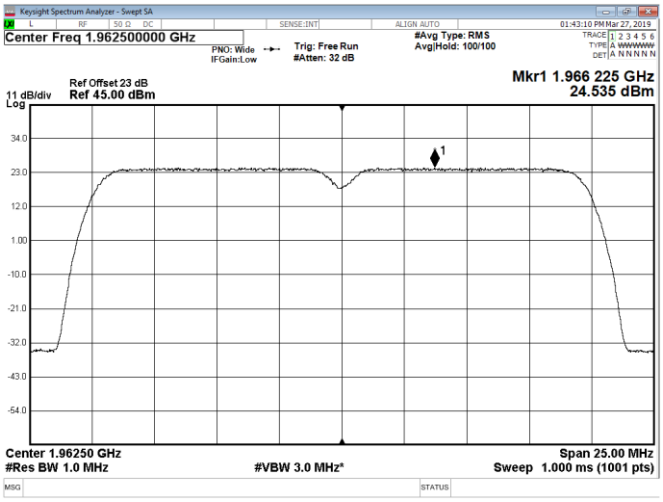


Figure 8.1-6: *PSD sample plot, 2-carrier 10 MHz channel bandwidth*

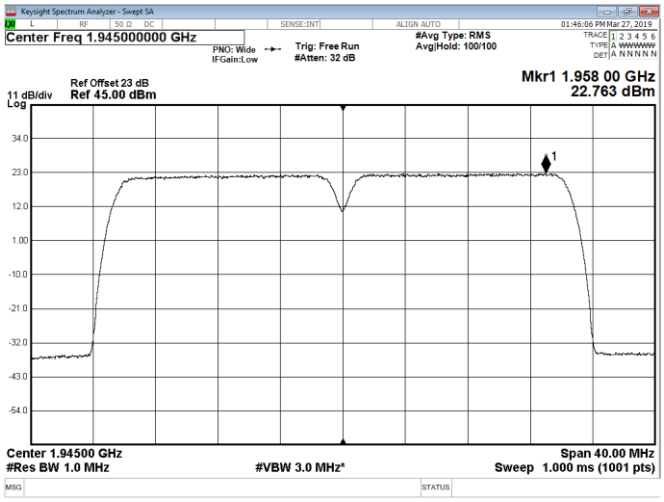


Figure 8.1-7: *PSD sample plot, 2-carrier 15 MHz channel bandwidth*

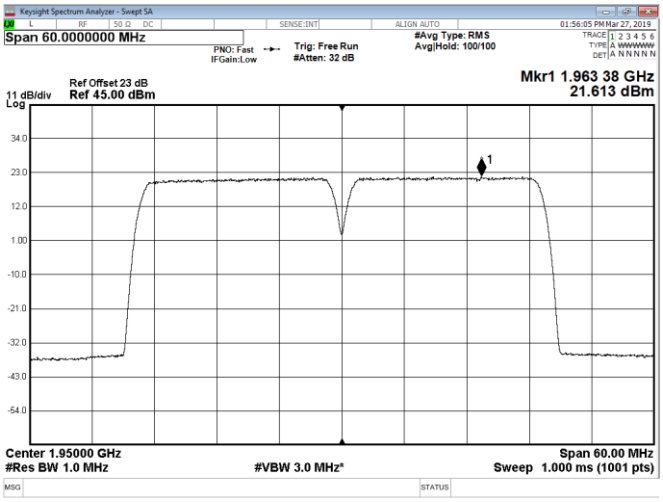


Figure 8.1-8: *PSD sample plot, 2-carrier 20 MHz channel bandwidth*

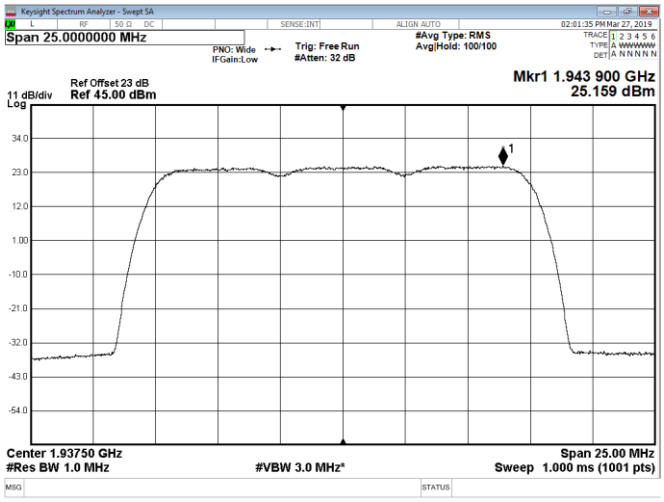


Figure 8.1-9: *PSD sample plot, 3-carrier 5 MHz channel bandwidth*

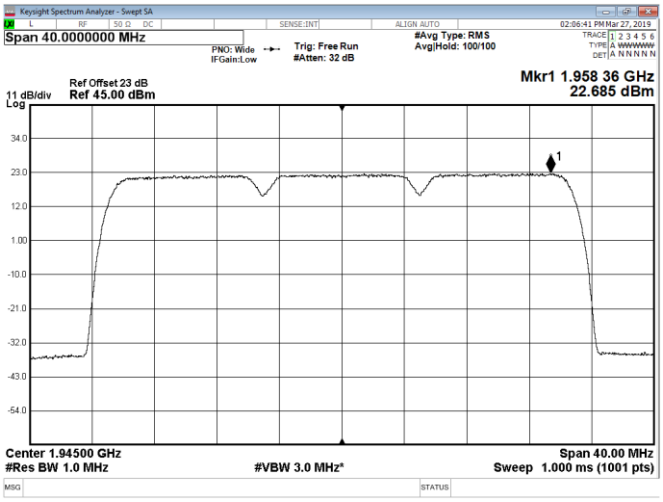


Figure 8.1-10: *PSD sample plot, 3-carrier 10 MHz channel bandwidth*

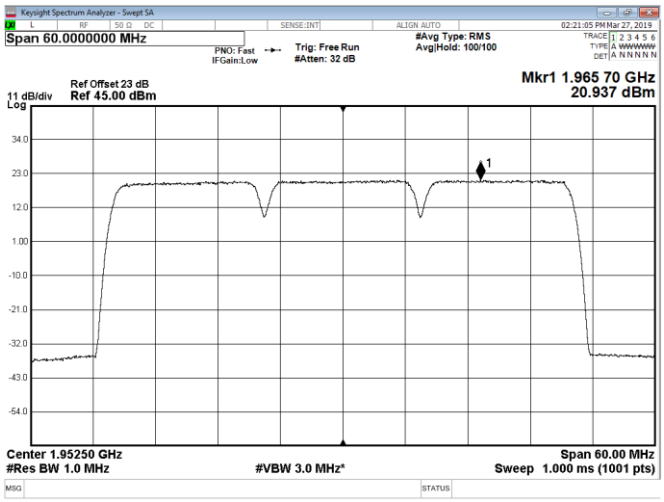


Figure 8.1-11: *PSD sample plot, 3-carrier 15 MHz channel bandwidth*

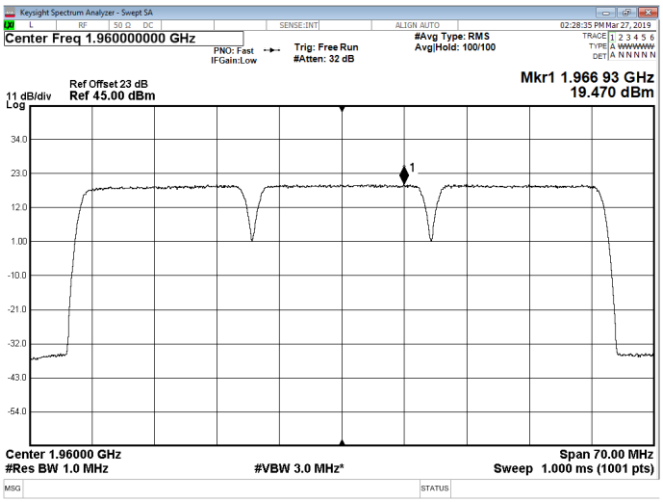


Figure 8.1-12: *PSD sample plot, 3-carrier 20 MHz channel bandwidth*

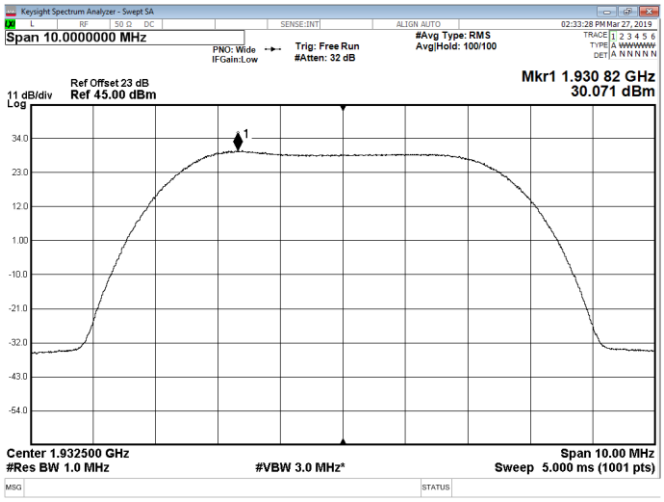


Figure 8.1-13: *PSD sample plot, 5 MHz channel bandwidth with IoT*

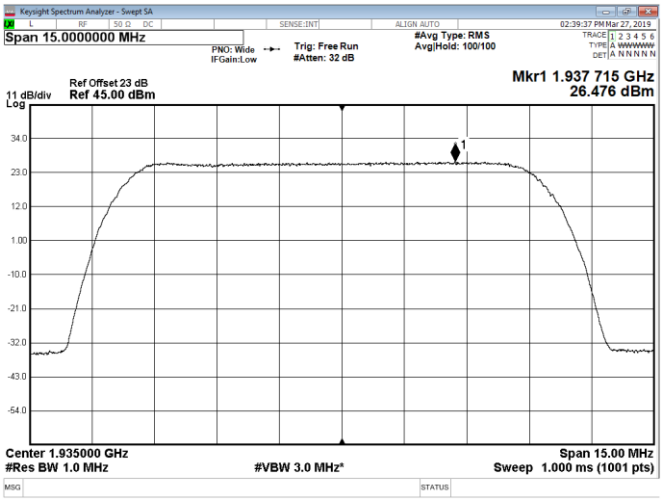


Figure 8.1-14: *PSD sample plot, 10 MHz channel bandwidth with IoT*

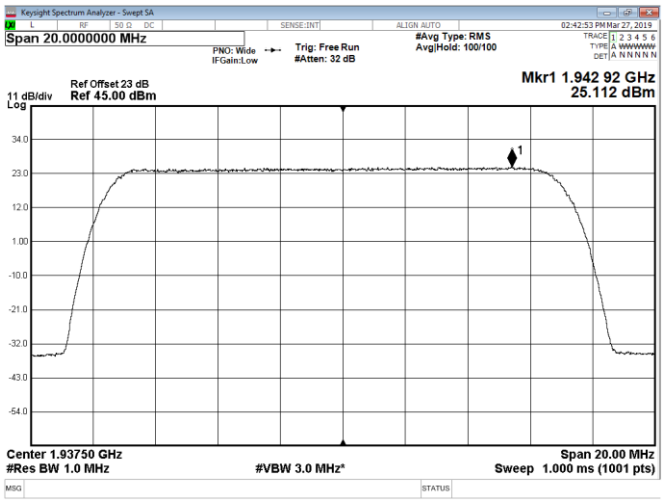


Figure 8.1-15: *PSD sample plot, 15 MHz channel bandwidth with IoT*

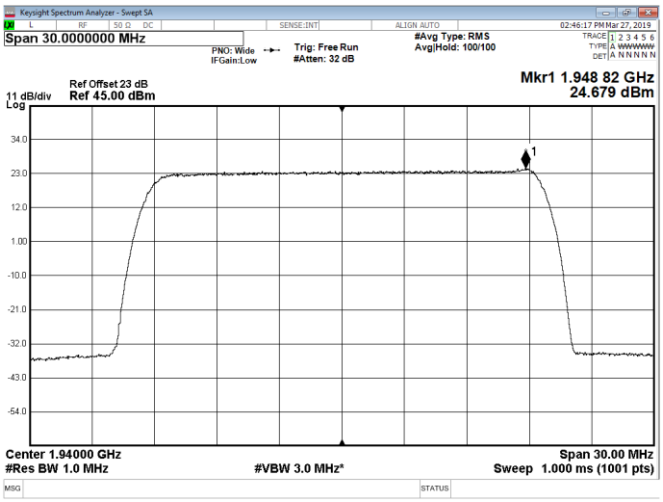


Figure 8.1-16: *PSD sample plot, 20 MHz channel bandwidth with IoT*

Table 8.1-9: *Complementary Cumulative Distribution Function (CCDF) of the PAPR reduction measurement results for single carrier operation*

Remarks	Frequency, MHz	0.1% CCDF, dB	PAPR reduction limit, dB	Margin, dB
QPSK, 5 MHz, Low channel	1932.5	6.89	13.00	6.11
16QAM, 5 MHz, Low channel	1932.5	6.88	13.00	6.12
64QAM, 5 MHz, Low channel	1932.5	6.89	13.00	6.11
256QAM, 5 MHz, Low channel	1932.5	6.9	13.00	6.10
QPSK, 5 MHz, Mid channel	1962.5	6.81	13.00	6.19
QPSK, 5 MHz, High channel	1992.5	6.86	13.00	6.14
QPSK, 10 MHz, Low channel	1935.0	6.97	13.00	6.03
16QAM, 10 MHz, Low channel	1935.0	6.96	13.00	6.04
64QAM, 10 MHz, Low channel	1935.0	6.98	13.00	6.02
256QAM, 10 MHz, Low channel	1935.0	6.98	13.00	6.02
QPSK, 10 MHz, Mid channel	1962.5	6.82	13.00	6.18
QPSK, 10 MHz, High channel	1990.0	6.88	13.00	6.12
QPSK, 15 MHz, Low channel	1937.5	7.06	13.00	5.94
16QAM, 15 MHz, Low channel	1937.5	7.03	13.00	5.97
64QAM, 15 MHz, Low channel	1937.5	7.06	13.00	5.94
256QAM, 15 MHz, Low channel	1937.5	7.08	13.00	5.92
QPSK, 15 MHz, Mid channel	1962.5	6.84	13.00	6.16
QPSK, 15 MHz, High channel	1987.5	6.91	13.00	6.09
QPSK, 20 MHz, Low channel	1940.0	7.15	13.00	5.85
16QAM, 20 MHz, Low channel	1940.0	7.15	13.00	5.85
64QAM, 20 MHz, Low channel	1940.0	7.16	13.00	5.84
256QAM, 20 MHz, Low channel	1940.0	7.15	13.00	5.85
QPSK, 20 MHz, Mid channel	1962.5	6.84	13.00	6.16
QPSK, 20 MHz, High channel	1985.0	6.94	13.00	6.06

Table 8.1-10: *Complementary Cumulative Distribution Function (CCDF) of the PAPR reduction measurement results for Single-Carrier operation with IoT*

Remarks	Frequency, MHz	0.1% CCDF, dB	PAPR reduction limit, dB	Margin, dB
QPSK, 5 MHz, IB IoT on the bottom	1932.5	6.90	13.00	6.10
QPSK, 5 MHz, IB IoT in the middle	1962.5	6.82	13.00	6.18
QPSK, 5 MHz, IB IoT on the top	1992.5	6.87	13.00	6.13
QPSK, 10 MHz, GB IoT on the bottom	1935.0	7.17	13.00	5.83
QPSK, 10 MHz, GB IoT in the middle	1962.5	7.02	13.00	5.98
QPSK, 10 MHz, GB IoT on the top	1990.0	7.06	13.00	5.94
QPSK, 15 MHz, GB IoT on the bottom	1937.5	7.20	13.00	5.80
QPSK, 15 MHz, GB IoT in the middle	1962.5	6.97	13.00	6.03
QPSK, 15 MHz, GB IoT on the top	1987.5	7.06	13.00	5.94
QPSK, 20 MHz, GB IoT on the bottom	1940.0	7.31	13.00	5.69
QPSK, 20 MHz, GB IoT in the middle	1962.5	7.02	13.00	5.98
QPSK, 20 MHz, GB IoT on the top	1985.0	7.11	13.00	5.89

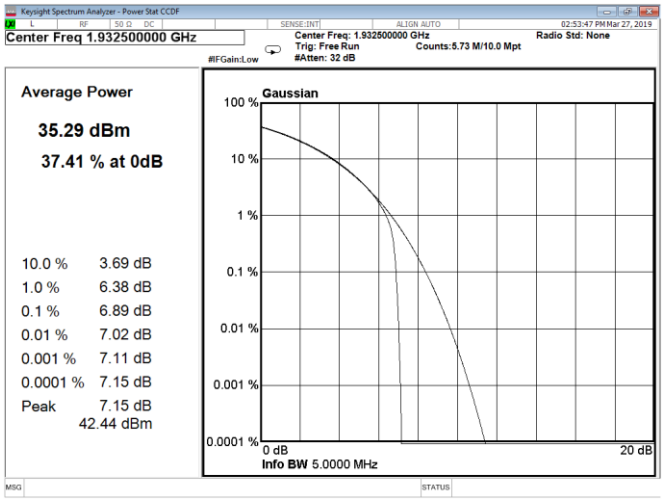


Figure 8.1-17: *CCDF sample plot, 5 MHz channel*

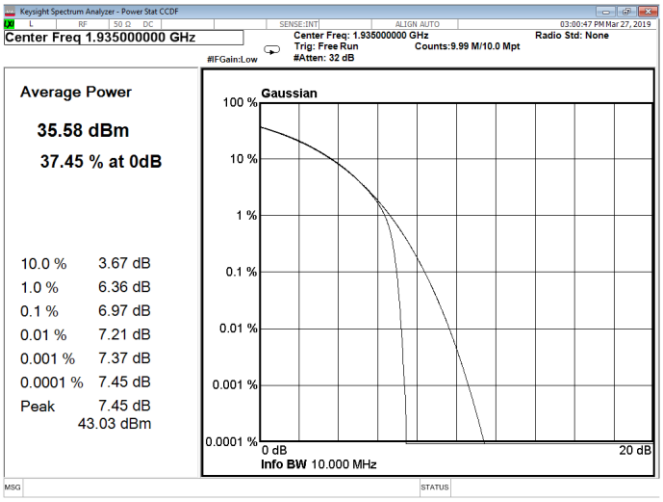


Figure 8.1-18: *CCDF sample plot, 10 MHz channel*

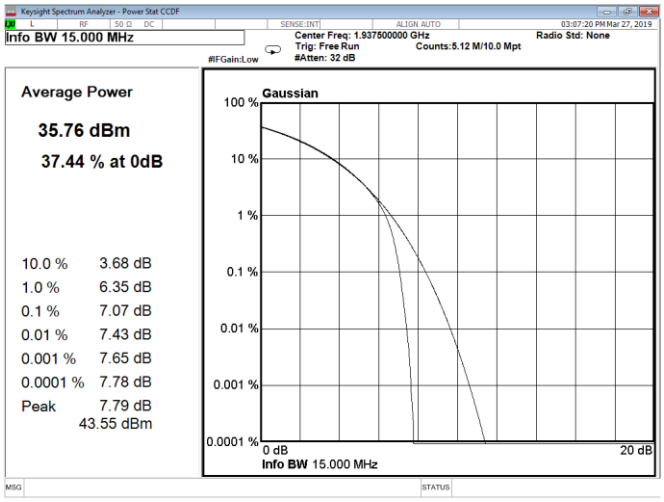


Figure 8.1-19: *CCDF sample plot, 15 MHz channel*

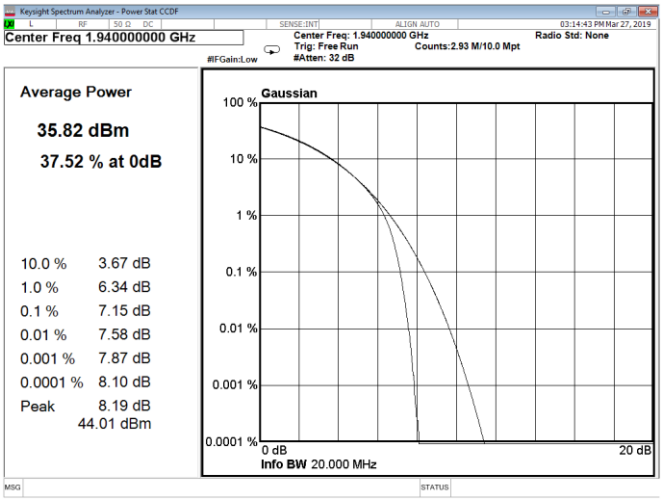


Figure 8.1-20: *CCDF sample plot, 20 MHz channel*

8.2 FCC 24.238(a) and RSS-133, 6.5.1 Spurious out-of-band emissions

8.2.1 Definitions and limits

FCC:
Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

(b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-133, Section 6.5.1:
i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.
ii. After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB. If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

8.2.2 Test summary

Test date	March 28, 2019

8.2.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
All measurements were performed using an average (RMS) detector.
Limit line was adjusted for MIMO operation by 15.05 dB (for *32* ports: 10 × Log_{10}(*32*)): −13 dBm – 15.05 dB = −28.05 dBm
RBW 1 MHz, VBW was wider than RBW.

8.2.4 Test data

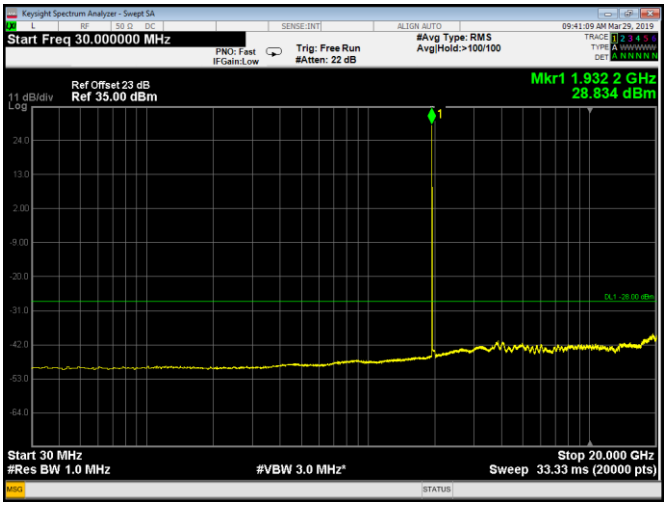


Figure 8.2-1: *Conducted spurious emissions, QPSK, single carrier, 5 MHz, low channel*

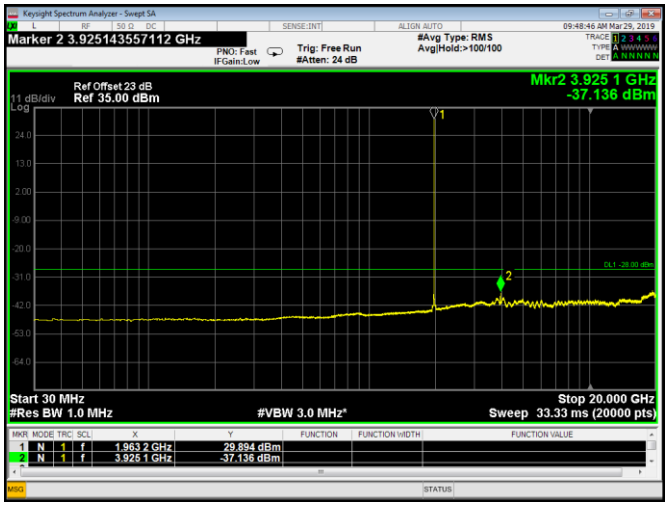


Figure 8.2-2: *Conducted spurious emissions, QPSK, single carrier, 5 MHz, mid channel*

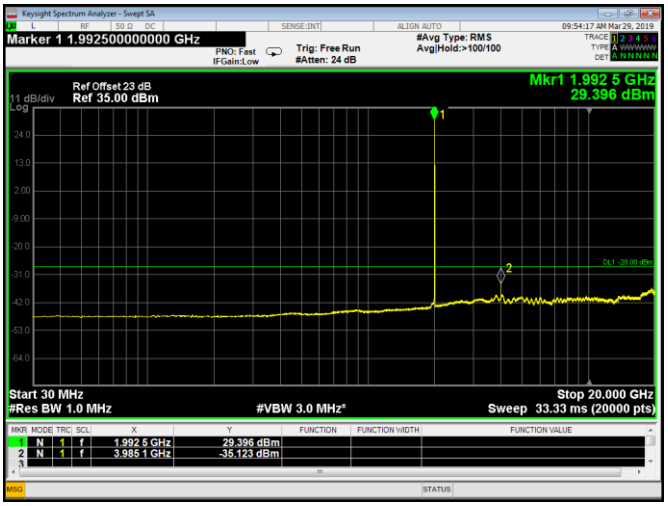


Figure 8.2-3: *Conducted spurious emissions, QPSK, single carrier, 5 MHz, high channel*

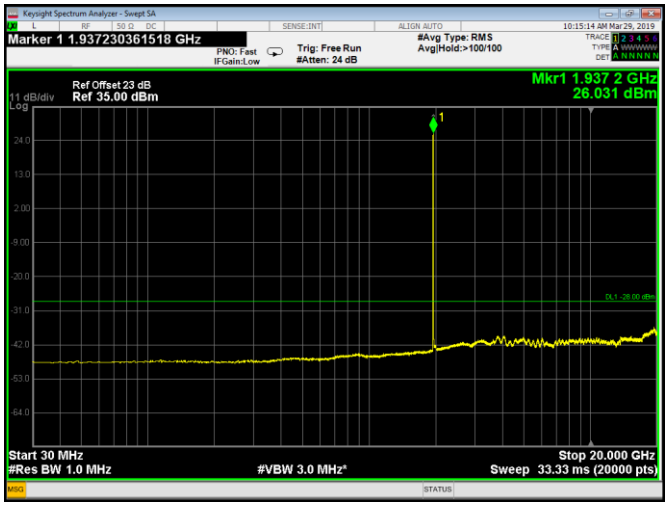


Figure 8.2-4: *Conducted spurious emissions, QPSK, single carrier, 10 MHz, low channel*

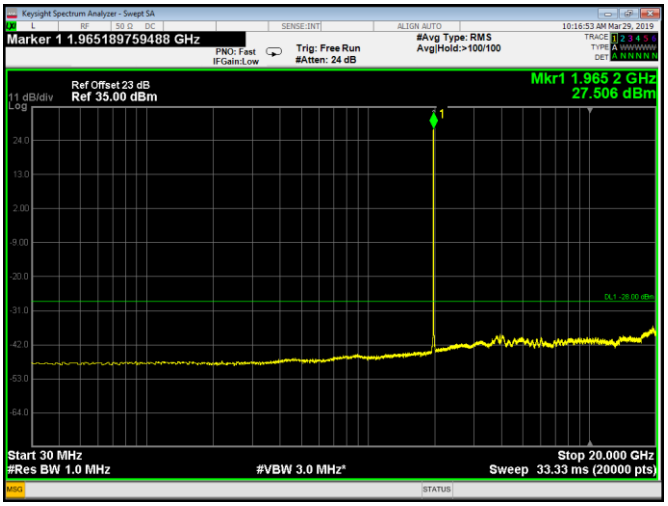


Figure 8.2-5: *Conducted spurious emissions, QPSK, single carrier, 10 MHz, mid channel*

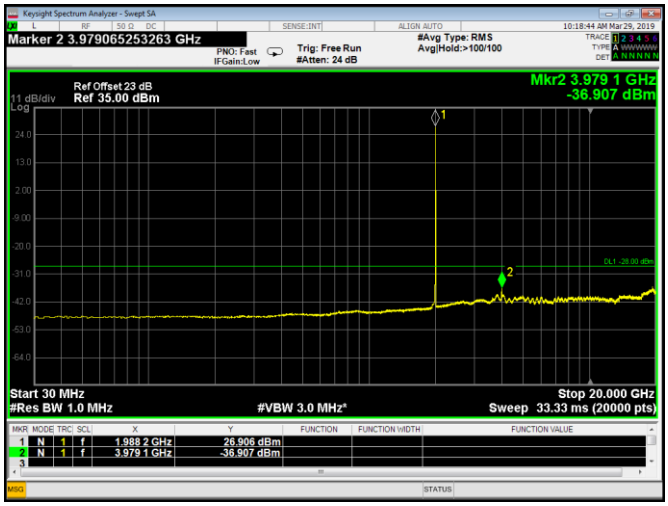


Figure 8.2-6: *Conducted spurious emissions, QPSK, single carrier, 10 MHz, high channel*

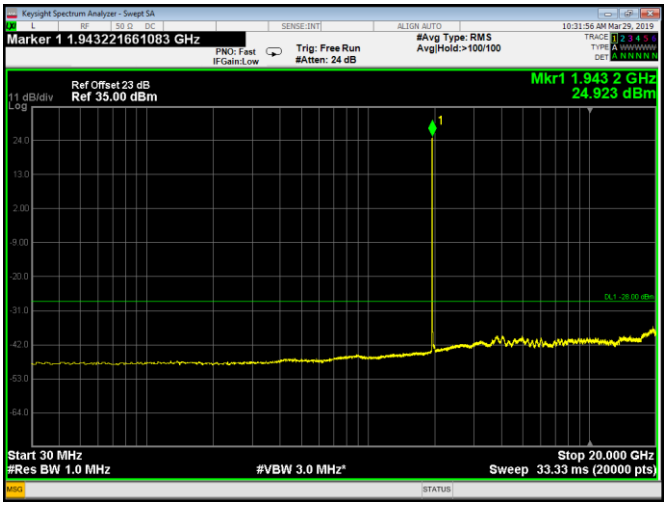


Figure 8.2-7: *Conducted spurious emissions, QPSK, single carrier, 15 MHz, low channel*

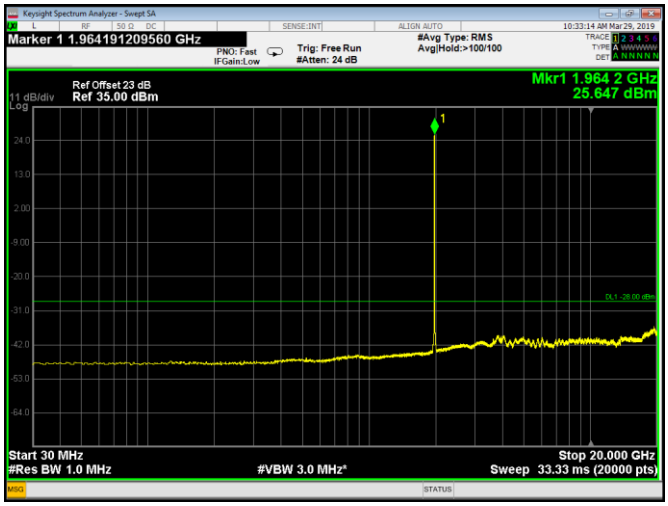


Figure 8.2-8: *Conducted spurious emissions, QPSK, single carrier, 15 MHz, mid channel*

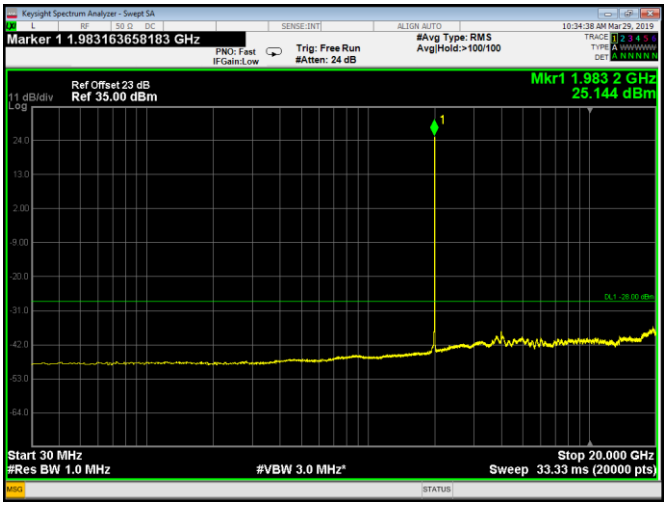


Figure 8.2-9: *Conducted spurious emissions, QPSK, single carrier, 15 MHz, high channel*

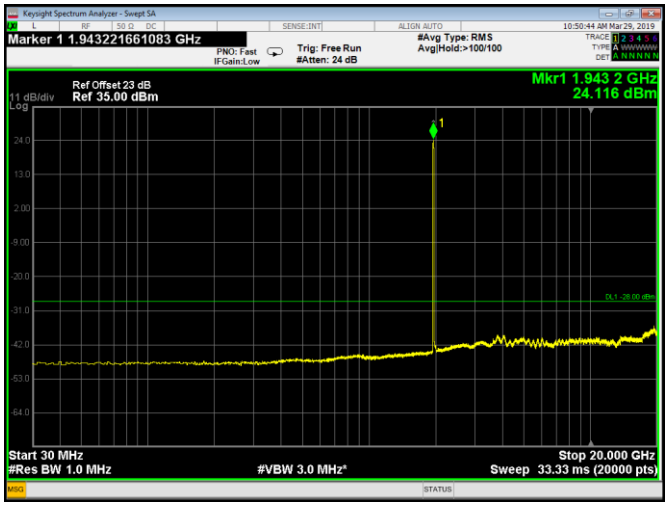


Figure 8.2-10: *Conducted spurious emissions, QPSK, single carrier, 20 MHz, low channel*

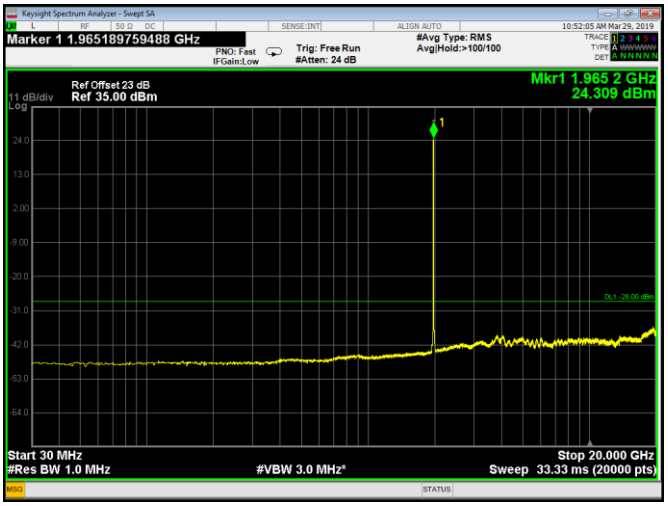


Figure 8.2-11: *Conducted spurious emissions, QPSK, single carrier, 20 MHz, mid channel*

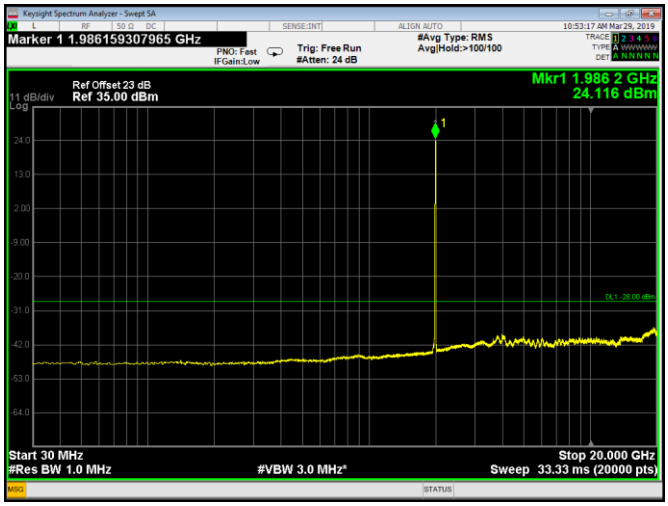


Figure 8.2-12: *Conducted spurious emissions, QPSK, single carrier, 20 MHz, high channel*

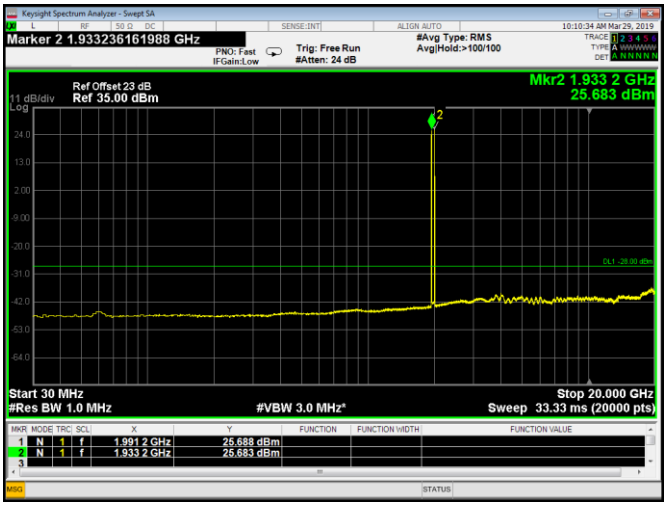


Figure 8.2-13: *Conducted spurious emissions, QPSK, 2-carrier, 5 MHz, low and high channels*

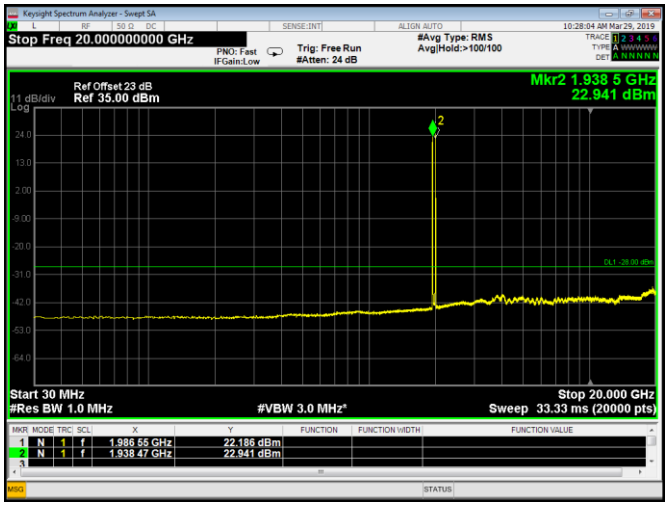


Figure 8.2-14: *Conducted spurious emissions, QPSK, 2-carrier, 10 MHz, low and high channels*

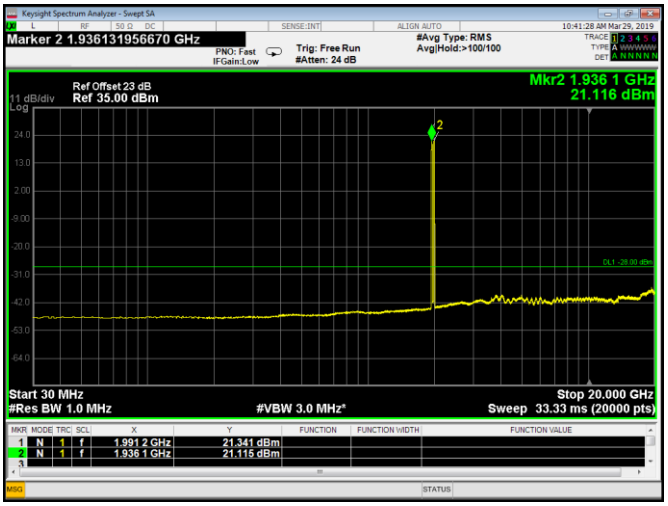


Figure 8.2-15: *Conducted spurious emissions, QPSK, 2-carrier, 15 MHz, low and high channels*

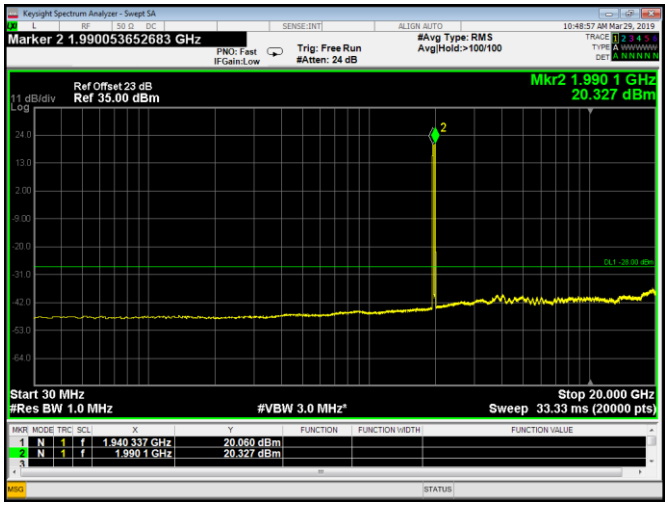


Figure 8.2-16: *Conducted spurious emissions, QPSK, 2-carrier, 20 MHz, low and high channels*

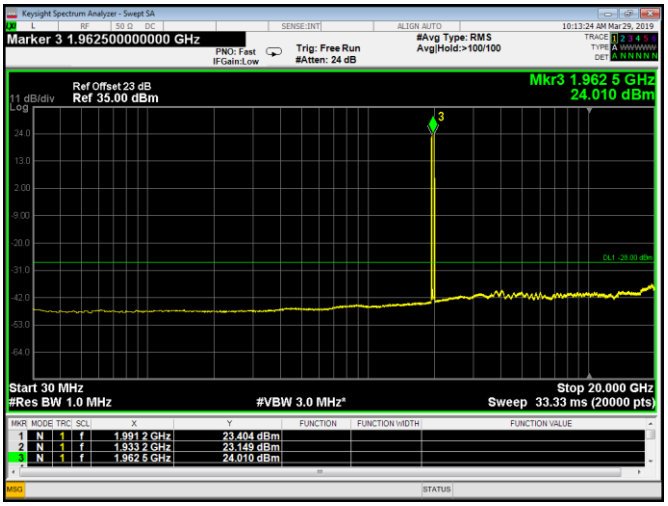


Figure 8.2-17: *Conducted spurious emissions, QPSK, 3-carrier, 5 MHz, low, mid and high channels*

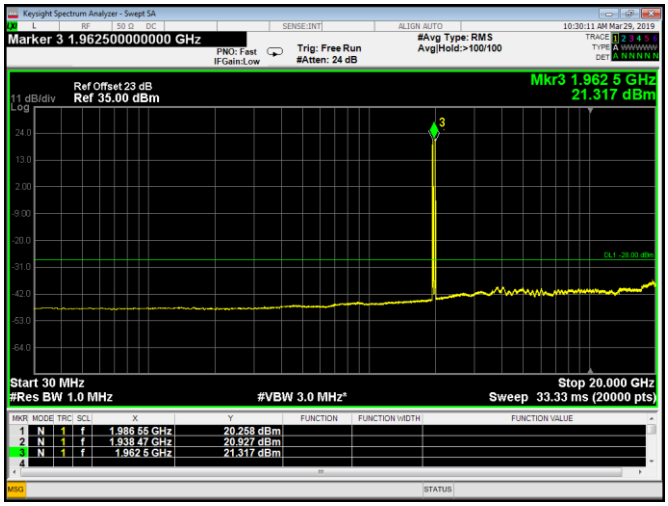


Figure 8.2-18: *Conducted spurious emissions, QPSK, 3-carrier, 10 MHz, low, mid and high channels*

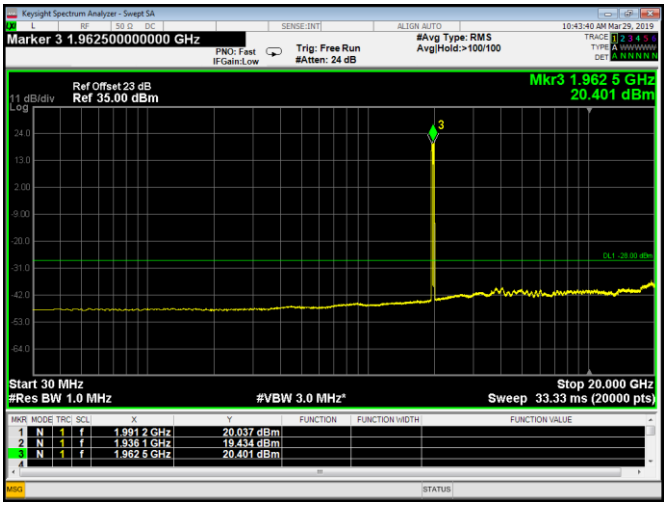


Figure 8.2-19: *Conducted spurious emissions, QPSK, 3-carrier, 15 MHz, low, mid and high channels*

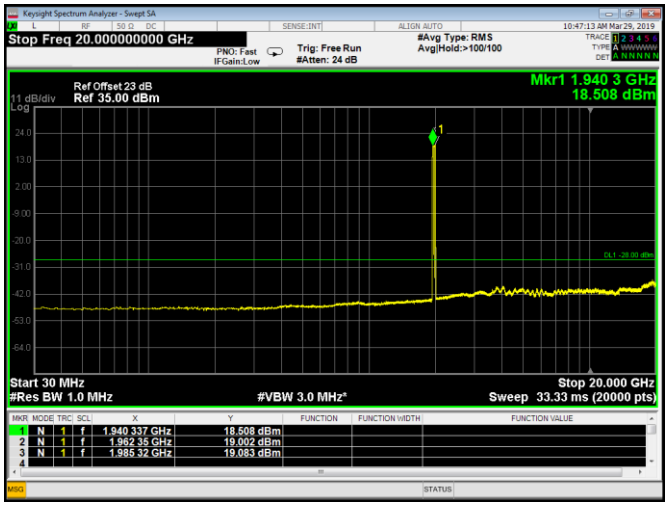


Figure 8.2-20: *Conducted spurious emissions, QPSK, 3-carrier, 20 MHz, low, mid and high channels*

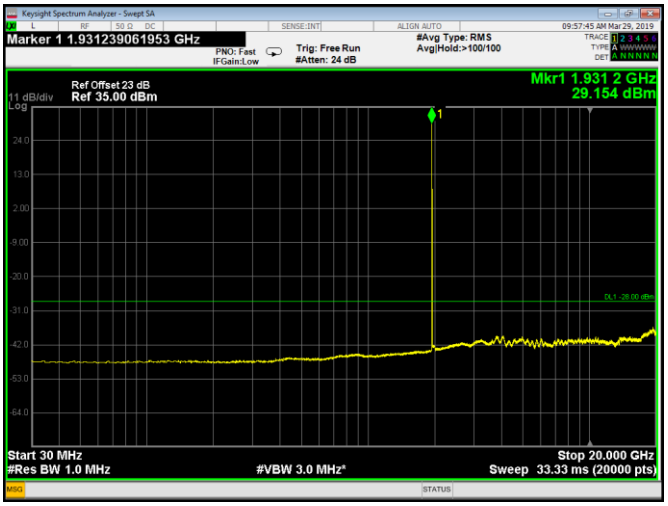


Figure 8.2-21: *Conducted spurious emissions, QPSK, single carrier with IoT, 5 MHz, low channel*

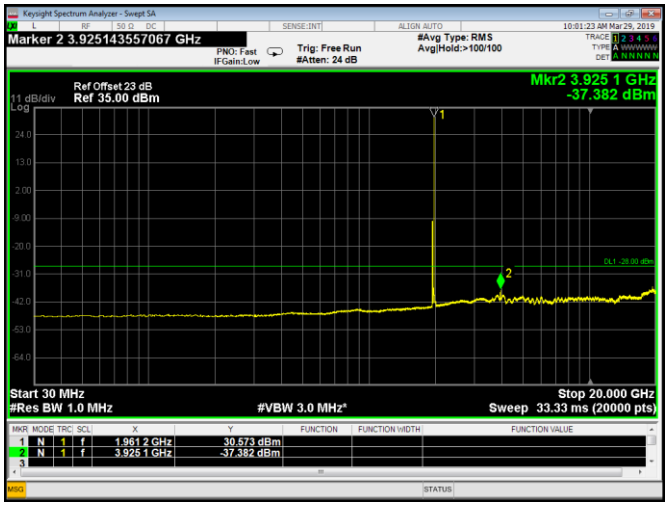


Figure 8.2-22: *Conducted spurious emissions, QPSK, single carrier with IoT, 5 MHz, mid channel*

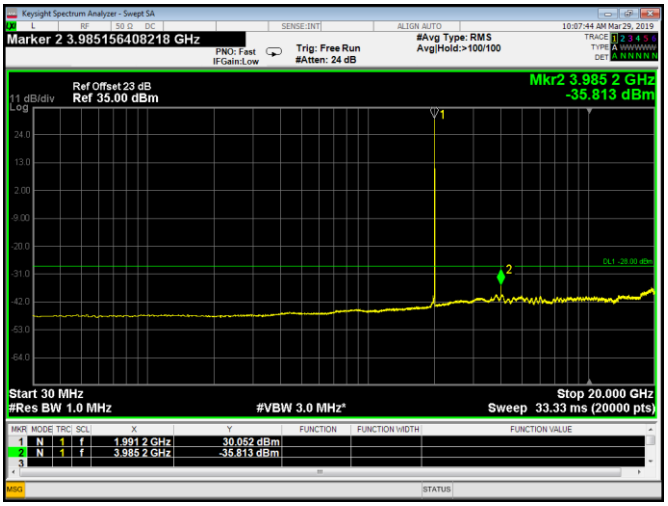


Figure 8.2-23: *Conducted spurious emissions, QPSK, single carrier with IoT, 5 MHz, high channel*

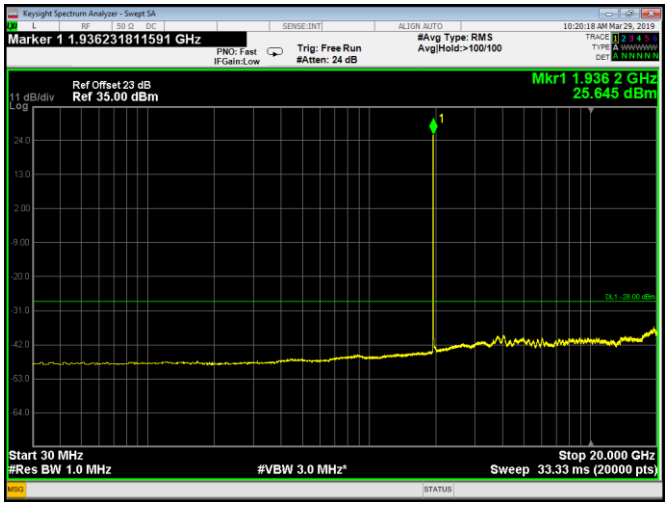


Figure 8.2-24: *Conducted spurious emissions, QPSK, single carrier and IoT, 10 MHz, low channel*

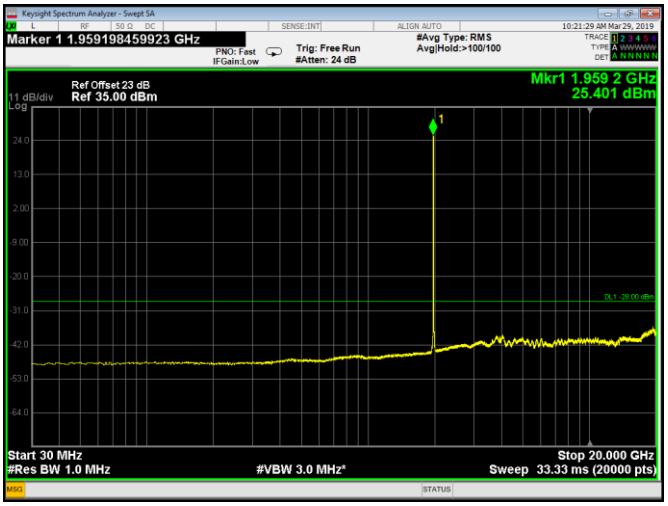


Figure 8.2-25: *Conducted spurious emissions, QPSK, single carrier with IoT, 10 MHz, mid channel*

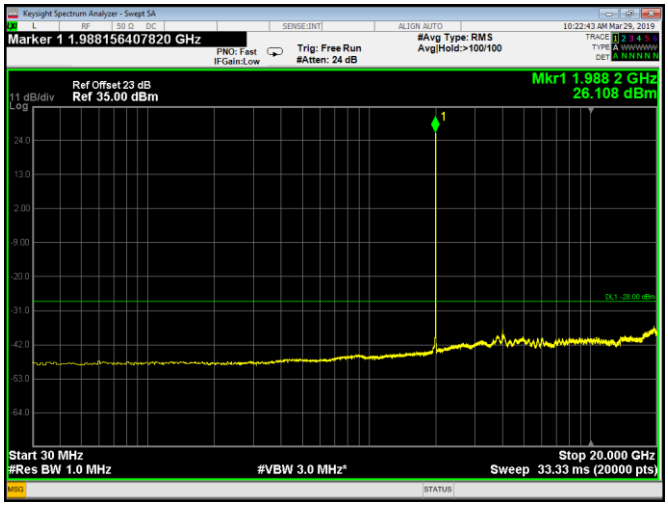


Figure 8.2-26: *Conducted spurious emissions, QPSK, single carrier with IoT, 10 MHz, high channel*

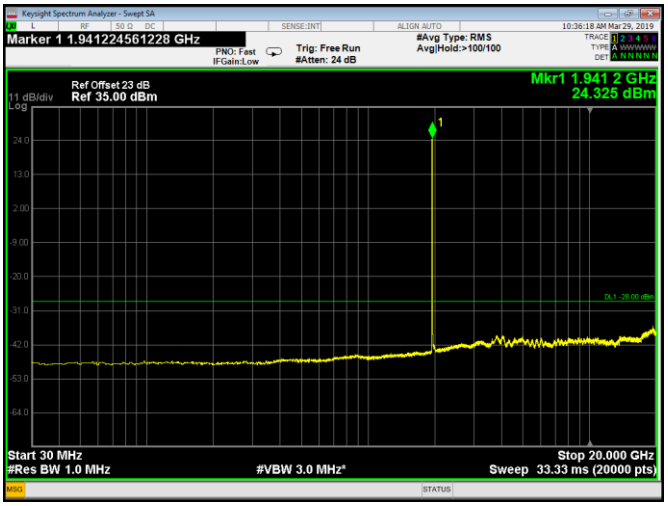


Figure 8.2-27: *Conducted spurious emissions, QPSK, single carrier with IoT, 15 MHz, low channel*

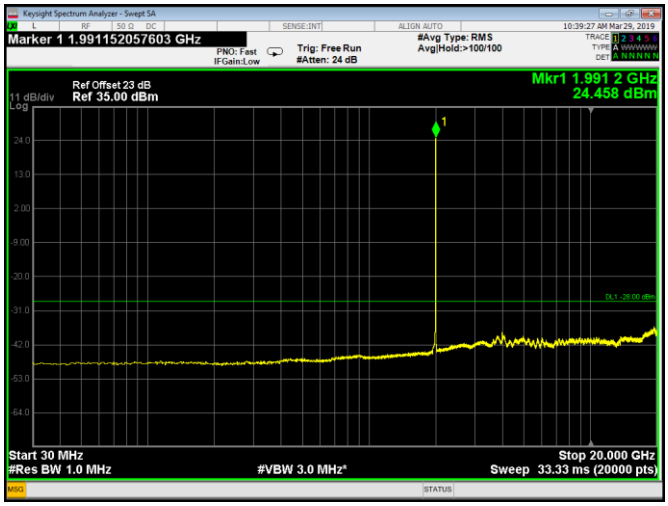


Figure 8.2-28: *Conducted spurious emissions, QPSK, single carrier and IoT, 15 MHz, mid channel*

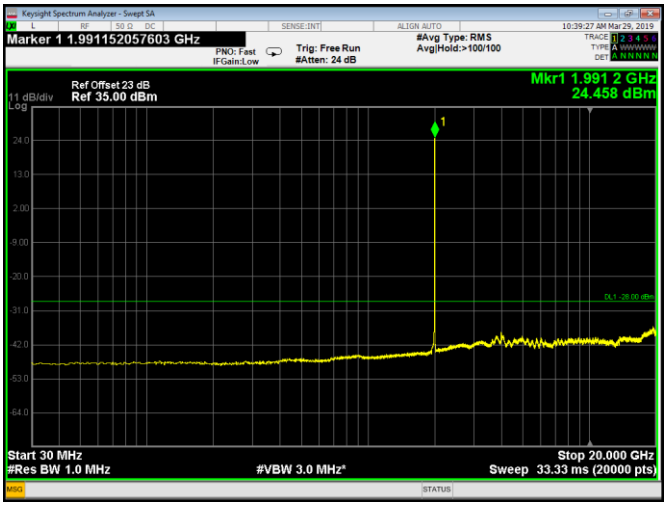


Figure 8.2-29: *Conducted spurious emissions, QPSK, single carrier with IoT, 15 MHz, high channel*

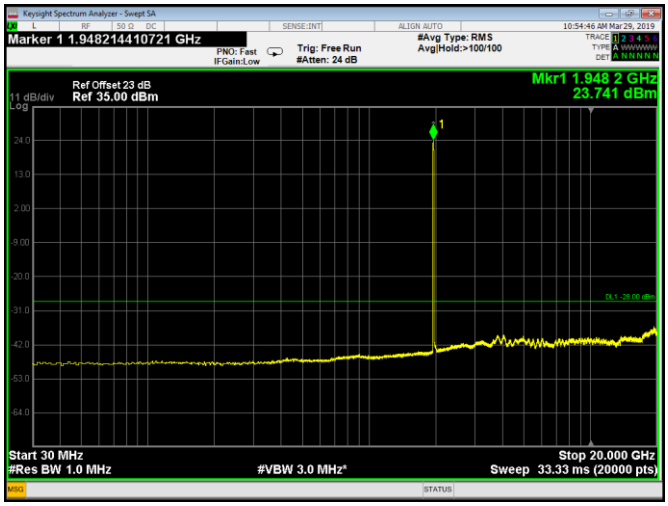


Figure 8.2-30: *Conducted spurious emissions, QPSK, single carrier with IoT, 20 MHz, low channel*

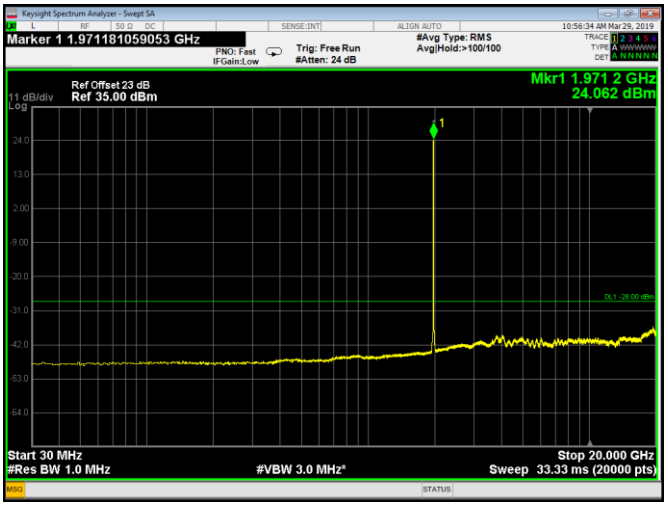


Figure 8.2-31: *Conducted spurious emissions, QPSK, single carrier with IoT, 20 MHz, mid channel*

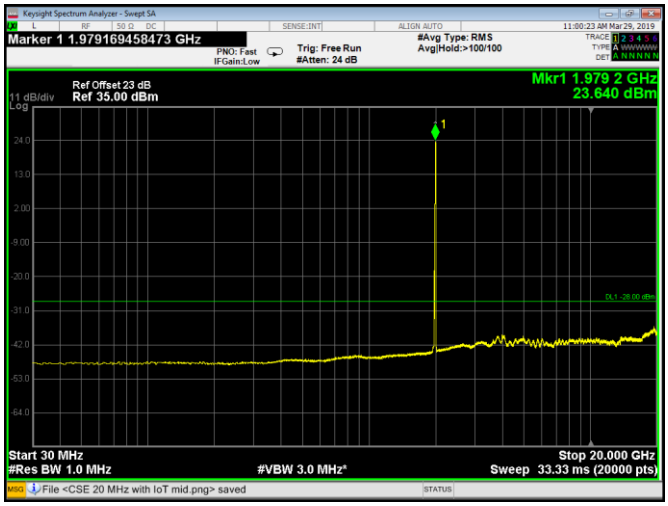


Figure 8.2-32: *Conducted spurious emissions, QPSK, single carrier and IoT, 20 MHz, high channel*