3.4 Transmitter Conducted Output power

3.4.1 Specification

- FCC Part 2.1046
- FCC Part 27.50 (a)(1)(i)

3.4.2 Test Description

The method used is as detailed in FCC KDB 971168

The measurement were performed in max output power transmitting mode at all channel of the 2350 MHz ~ 2360 MHz frequency ranges.

Peak Power Output not exceed 2000W(63dBm)

The EUT output power was connected to the spectrum analyzer through appropriate attenuator. The output power was measured using a spectrum analyzer CHANNEL POWER function.

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB

Transmitter Conducted Output power was measured under the three types of modulation mode which are QPSK, 16QAM and 64QAM, and resource block was 50.

3.4.3 Test Procedure

The test procedure used is as detailed in FCC KDB 935210 D05 V01 3.5.2 e)

The EUT antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable.

The EUT RF output was modulated. Special attention was taken to prevent spectrum analyzer RF input overload.

3.4.4 Test equipment list

Equipment	Model Name	Manufacturer
EUT	HX-WCS-SISO	Corning Optical Communications Wireless Inc.
MHU	HX-WCS-MHU	Corning Optical Communications Wireless Inc.
Signal Generator	N5182A	Agilent
Spectrum Analyzer	N9020A	Agilent
Attenuator	PE7019-20	Pasternack
DC Power Supply	6674A	Agilent

3.4.5 Test condition

- Test place: Shield room
- Test environment: 22.5 °C, 44 % R.H.

3.4.6 Test results

- **Port1**

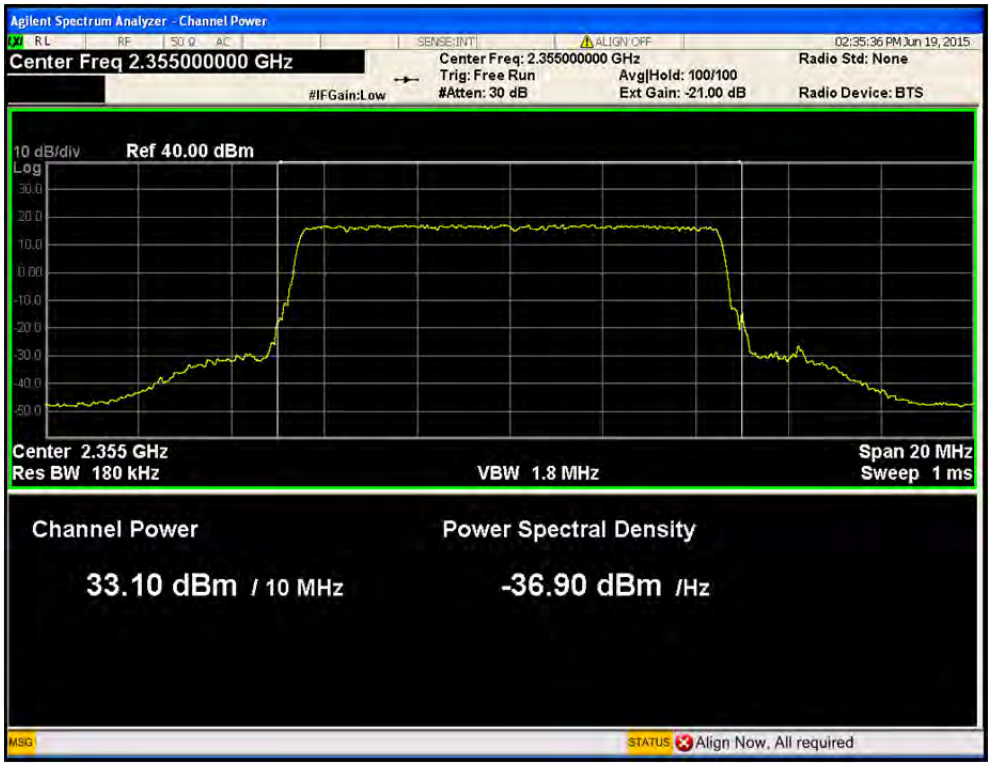
WCS Block	Bandwidth [MHz]	Frequency [MHz]	Modulation	Conducted Output Level [dBm]	EIRP [dBm]
A+B	10	2 355.0	QPSK	33.10	48.10
			16QAM	32.98	47.99
			64QAM	33.06	48.06
A	5	2 352.5	QPSK	33.06	48.06
			16QAM	32.98	47.98
			64QAM	32.97	47.97
B	5	2 357.5	QPSK	32.99	47.99
			16QAM	32.98	47.98
			64QAM	33.01	48.01

- **Port1 - PAPR**

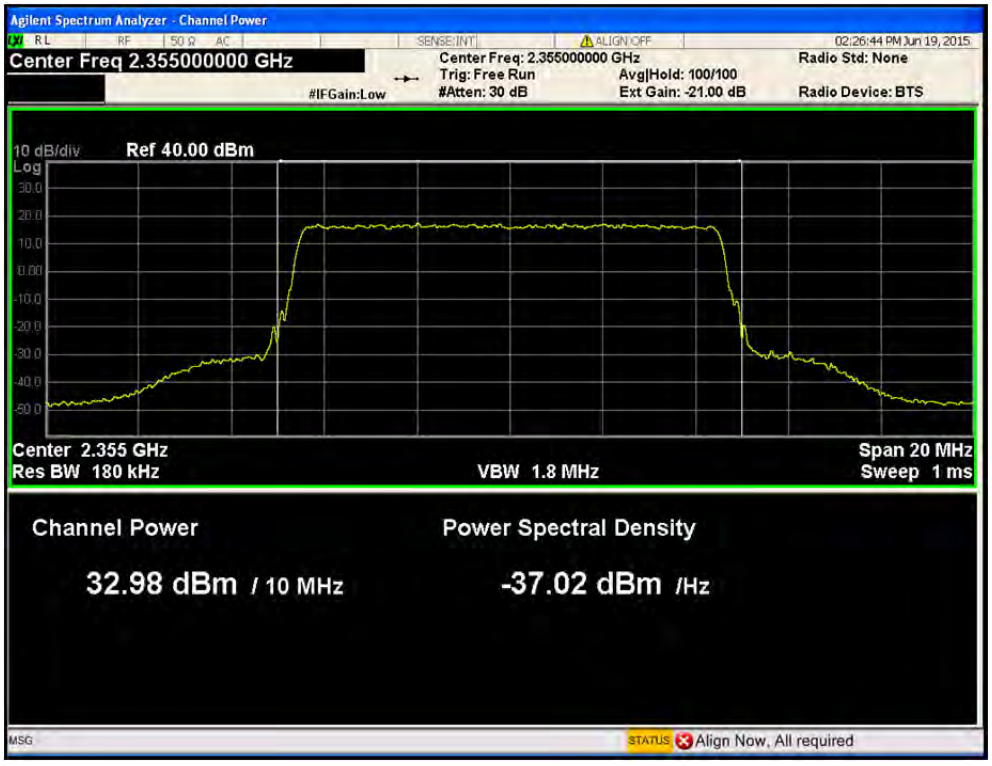
WCS Block	Bandwidth [MHz]	Frequency [MHz]	Modulation	Average Power Level [dBm]	PAPR [dB]
A+B	10	2 355.0	QPSK	32.95	10.33
			16QAM	32.98	10.26
			64QAM	32.93	10.43
A	5	2 352.5	QPSK	32.97	10.05
			16QAM	32.97	10.28
			64QAM	32.97	10.19
B	5	2 357.5	QPSK	32.99	9.92
			16QAM	33.00	10.13
			64QAM	33.00	10.18

3.4.7 Test Plots

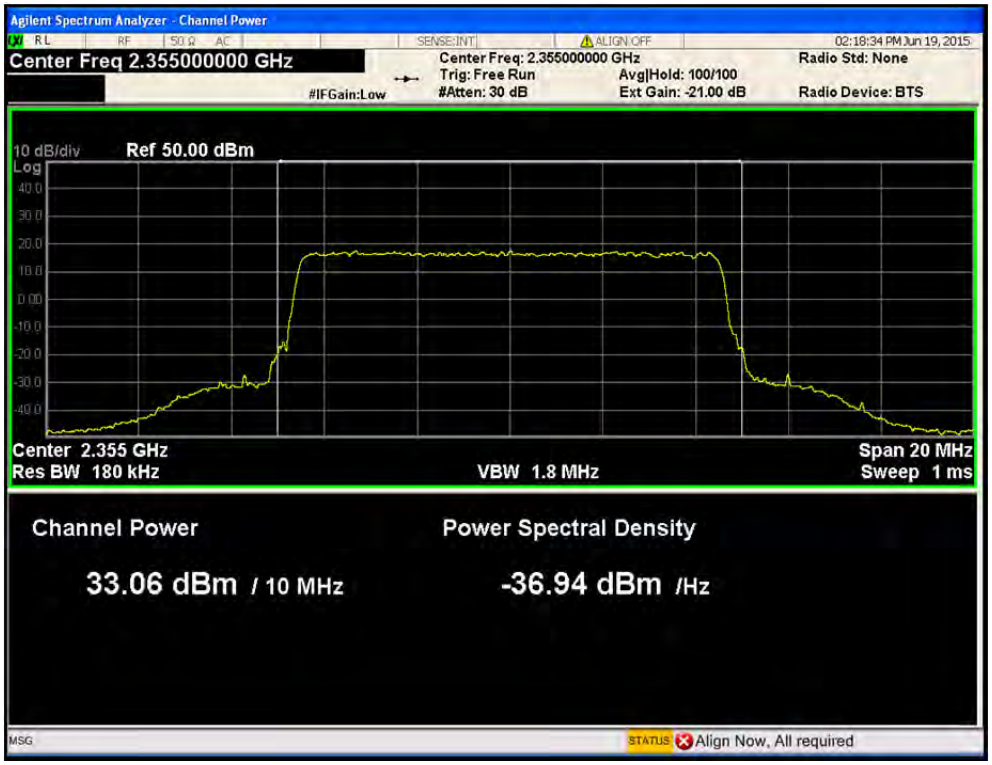
- **Port1 / LTE 10 MHz / 2 355 MHz / QPSK**



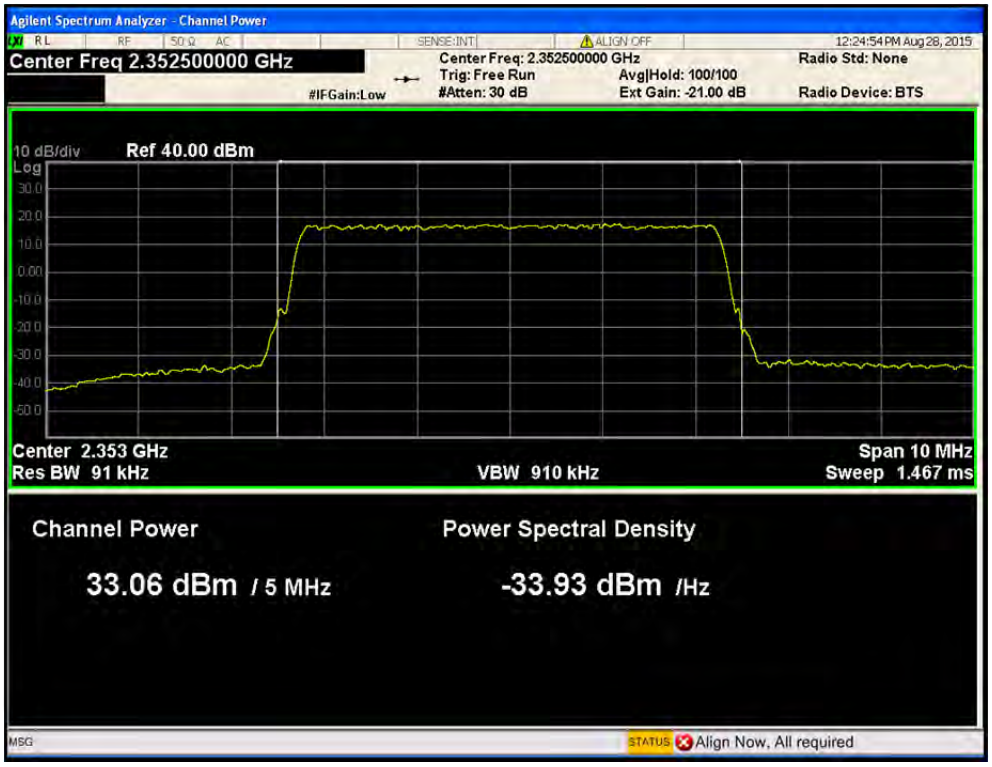
- **Port1 / LTE 10 MHz / 2 355 MHz / 16QAM**



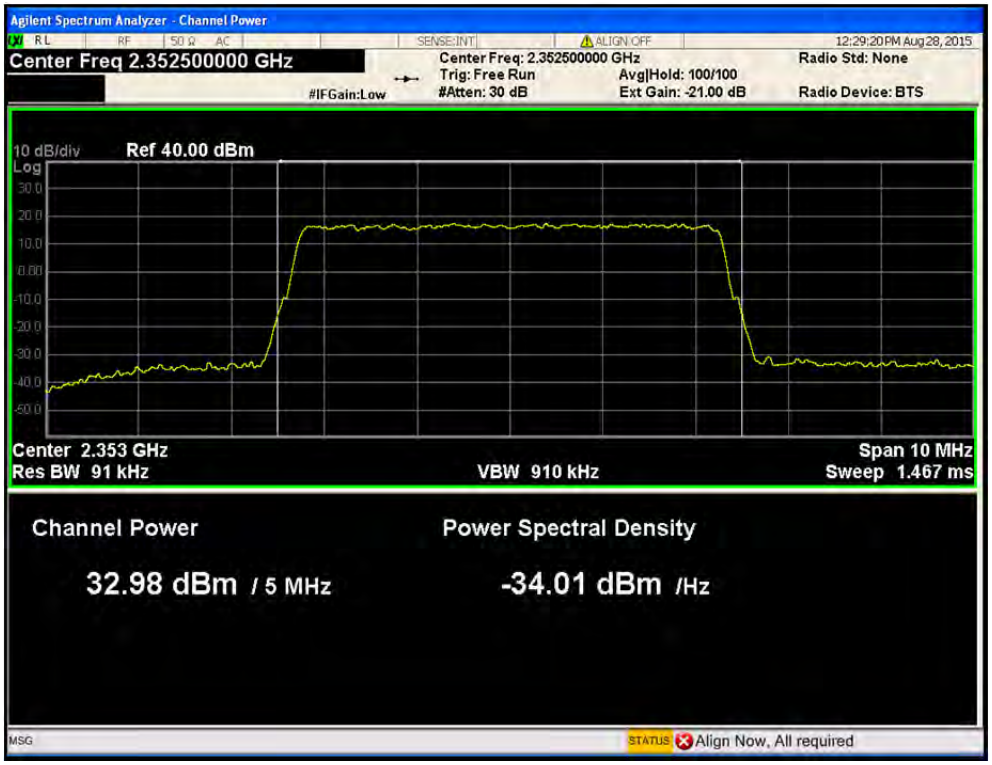
- **Port1 / LTE 10 MHz / 2 355 MHz / 64QAM**



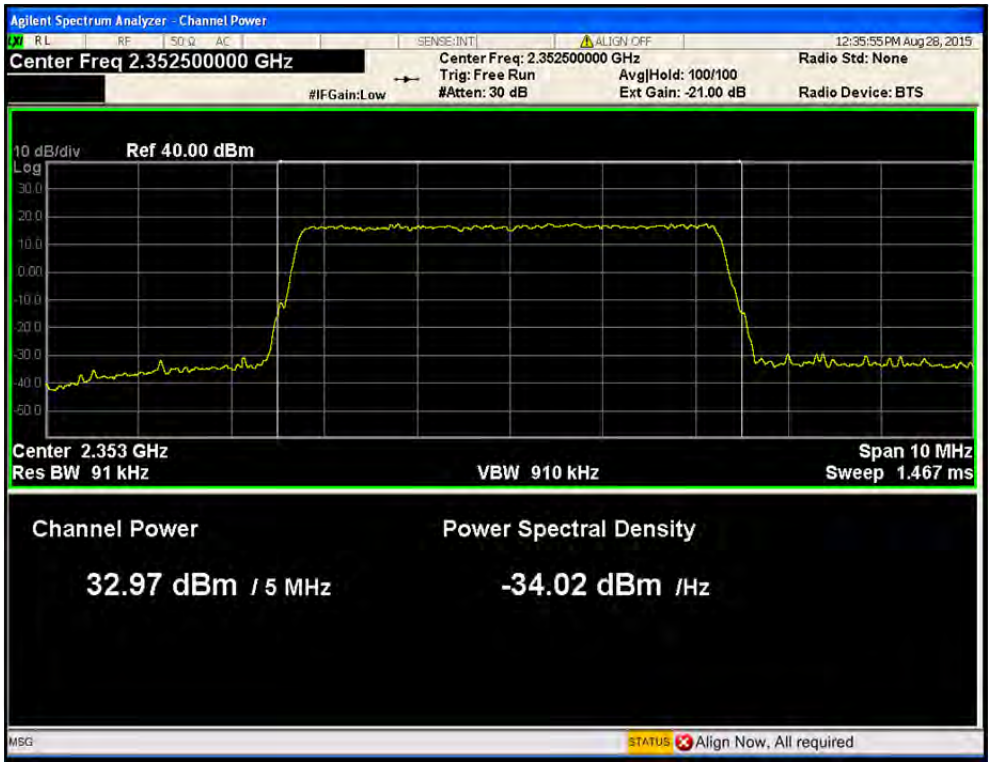
- **Port1 / LTE 5 MHz / 2 352.5 MHz / QPSK**



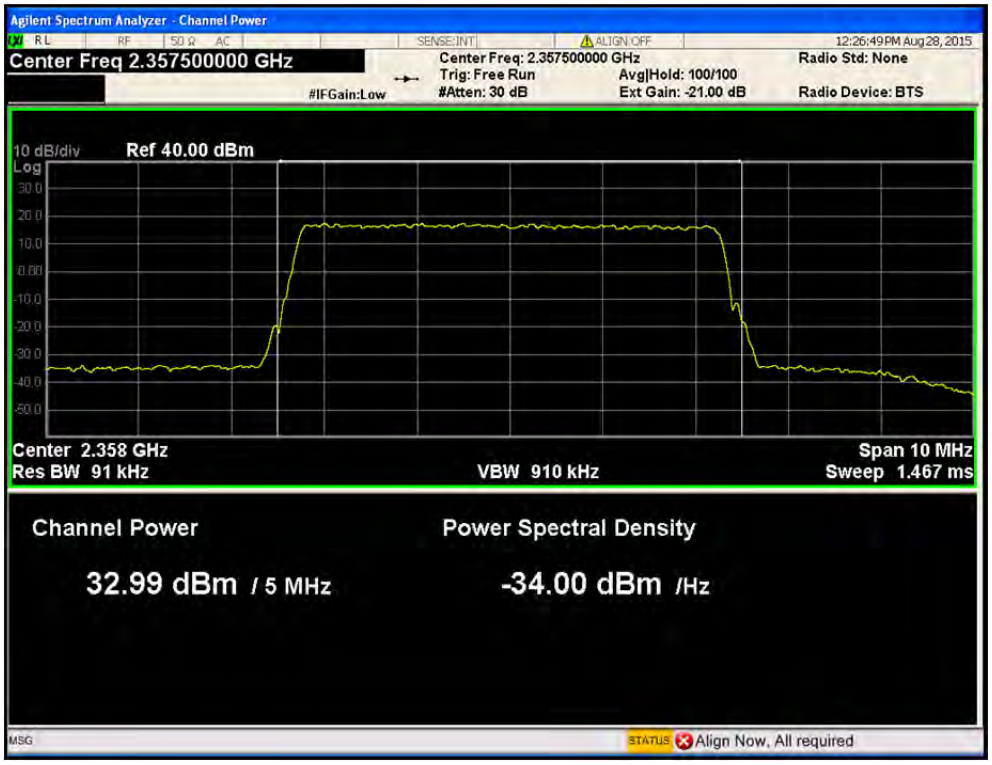
- **Port1 / LTE 5 MHz / 2 352.5 MHz / 16QAM**



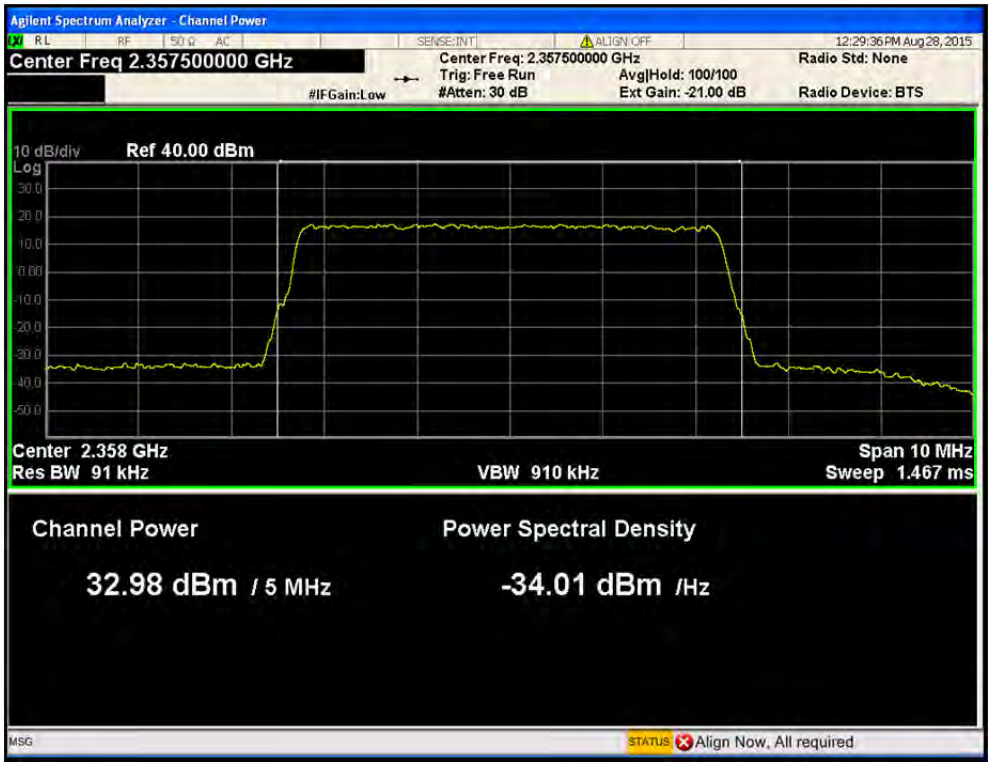
- **Port1 / LTE 5 MHz / 2 352.5 MHz / 64QAM**



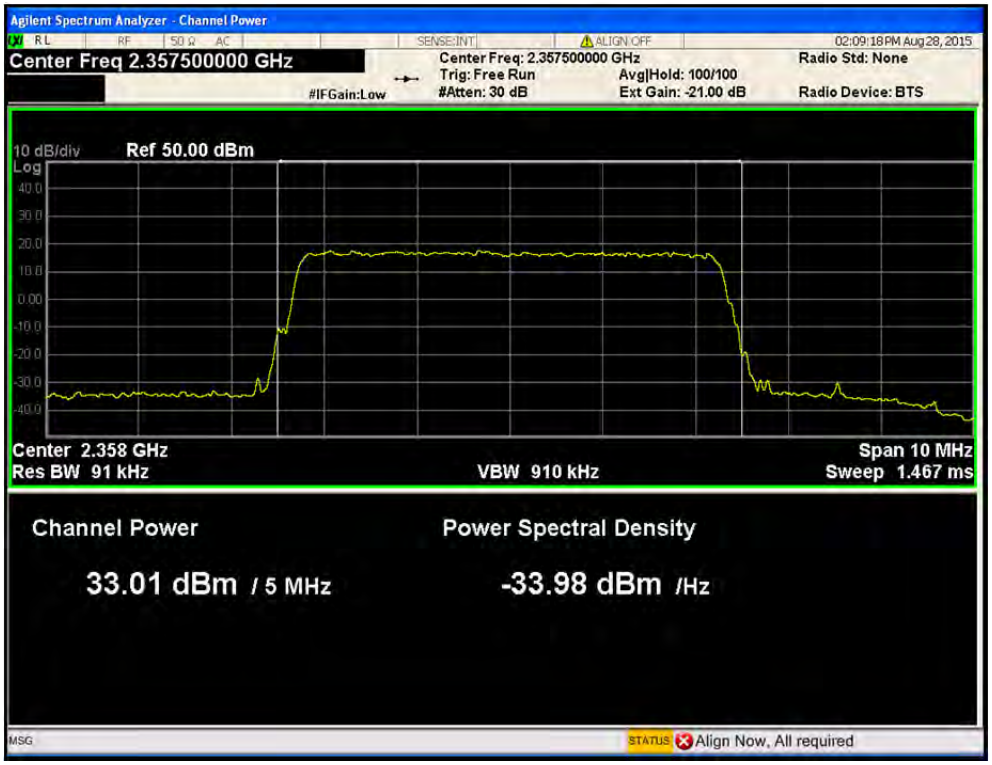
- **Port1 / LTE 5 MHz / 2 357.5 MHz / QPSK**



- **Port1 / LTE 5 MHz / 2 357.5 MHz / 16QAM**



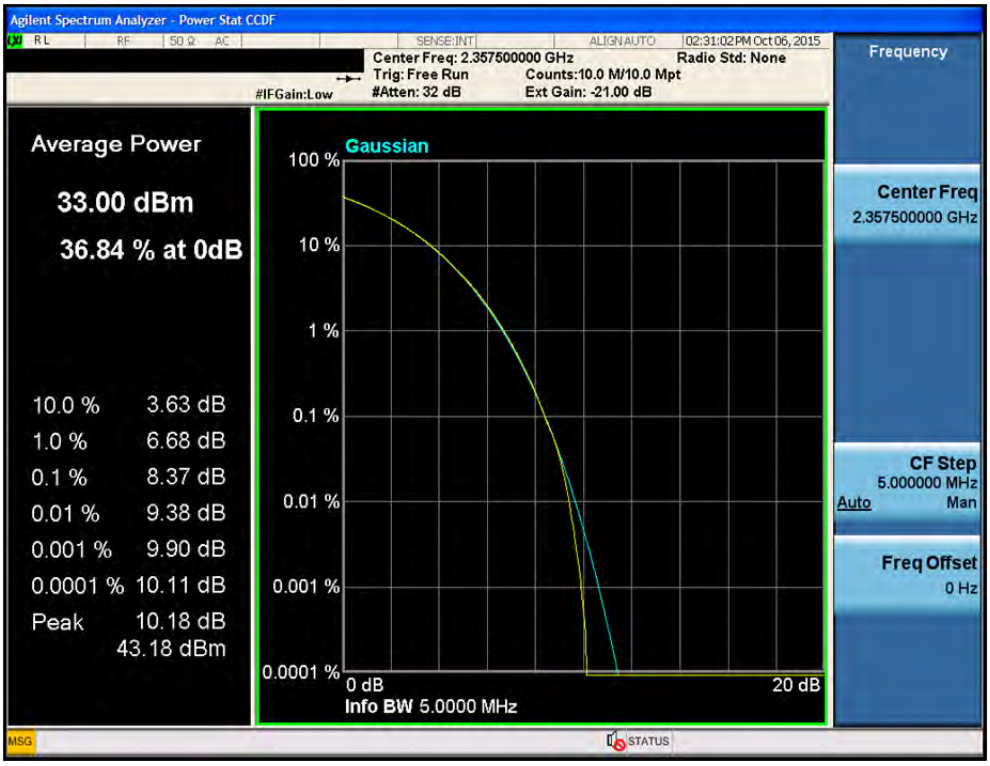
- **Port1 / LTE 5 MHz / 2 357.5 MHz / 64QAM**



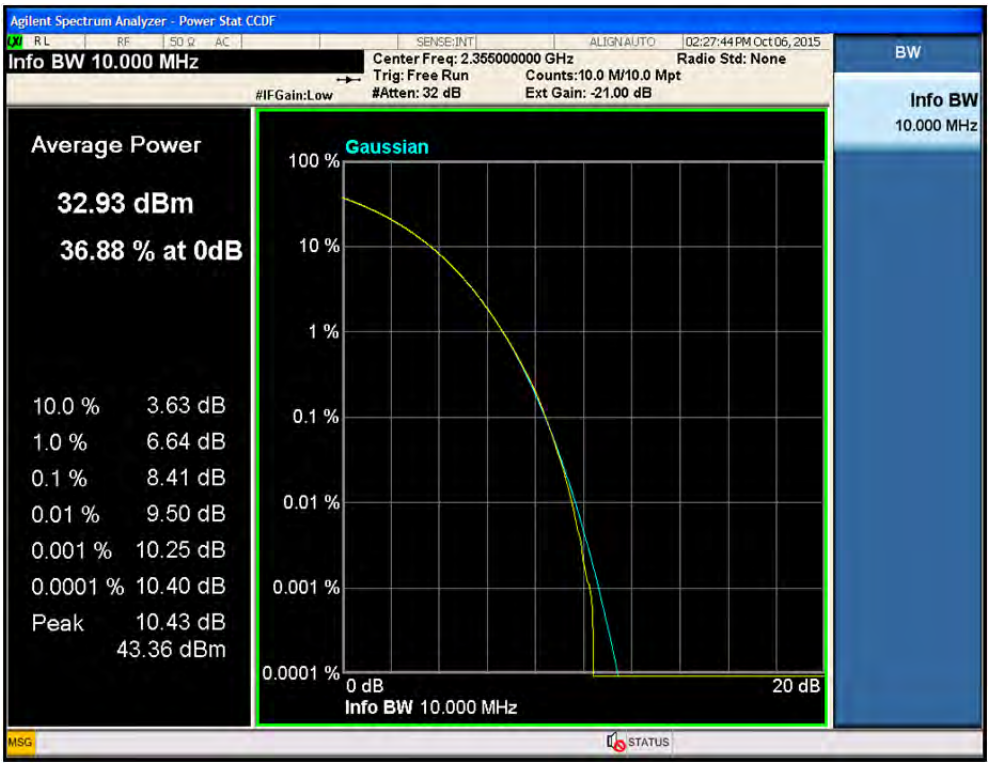
3.4.8 PAPR Test Plots

- **Port1 / LTE 5 MHz / 2 352.5 MHz / 64QAM**

- **Port1 / LTE 5 MHz / 2 357.5 MHz / 64QAM**



- **Port1 / LTE 10 MHz / 2 355 MHz / 64QAM**



3.5 Radiated spurious emission

3.5.1 Specification

- FCC Part 2.1053
- FCC Part 27.53

3.5.2 Test Description

The highest gain antenna to be used with the EUT was tested for final measurements. The EUT was configured for the lowest and the highest transmit frequency. For each configuration, the spectrum was scanned throughout the specified range. While scanning, emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis, and adjusting the measurement antenna height and polarization (per ANSI C63. 10:2009). A preamp and high pass filter were used for this test in order to provide sufficient measured sensitivity.

For licensed transmitters, the FCC reference TIA/EIA-603 as the measurement procedure standard. TIA/EIA-603 Section 2.2.12 describes a method for measuring radiated spurious emission that utilizes an antenna substitution method:

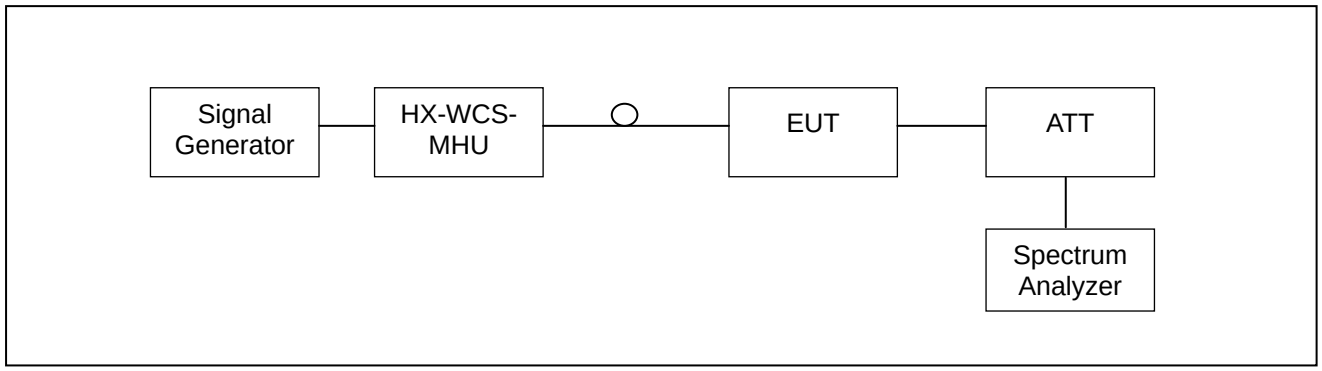
At an approved test site, the transmitter is place on a remotely controlled turntable, and the measurement antenna is place 3 meters from the transmitter.

The transmitter is place on a remotely controlled turntable, and the measurement antenna is placed 3 meters from the transmitter. The turntable azimuth is varied to maximize the level of spurious emissions. The height of the measurement antenna is also varied from 1 to 4 meters. The amplitude and frequency of the highest emission are noted. The transmitter is then replaced with a 1/2 wave dipole that is successively tuned to each of the highest spurious emission for emissions below 1 GHz, and a horn antenna for emission above 1 GHz.

A signal generator is connected to the dipole (horn antenna for frequency above 1GHz), and its output is adjusted to match the level previously noted for each frequency. The output of the signal generator is recorded, and by factoring in the cable loss to the antenna and its gain; the power(dBm) into an ideal 1/2 wave dipole antenna is determined for each radiated emission.

Radiated spurious emission was measured under the three types of modulation mode which are QPSK, 16QAM and 64QAM, and resource block was 50.

3.5.3 Set-Up



3.5.4 Test equipment list

Equipment	Model Name	Manufacturer
EUT	HX-WCS-SISO	Corning Optical Communications Wireless, Inc.
MHU	HX-WCS-MHU	Corning Optical Communications Wireless Inc.
Signal Generator	N5182A	Agilent
Spectrum Analyzer	N9020A	Agilent
EMI Test Receiver	ESS	R&S
Bi-conical Antenna	VHA9103	R&S
Spectrum Analyzer	FSP	R&S
Log Periodic Antenna	VULP9118A	R&S
Turn table	DS 1500 S-1t-O	Innco GmbH
Antenna mast	MA4000-O	Innco GmbH
Controller	CO 2000	Innco GmbH

3.5.5 Test condition

• Test place: Shield room
• Test environment: 23.0 °C, 43 % R.H.

3.5.6 Test results

• Modulation mode: QPSK

Frequency [MHz]	S/A [dBuV]	S/G [dBm]	Antenna gain [dBi]	Antenna polarity [H/V]	Cable loss [dB]	Total Level [dBm]	Limit [dBuV]	Margin [dB]
49.77	26.00	-65.77	1.37	H	1.13	-65.53	-13.00	52.53
141.32	18.10	-78.87	1.08	H	1.97	-79.76	-13.00	66.76
244.12	14.40	-81.45	0.79	H	2.46	-83.12	-13.00	70.12
268.45	14.50	-82.02	0.63	H	2.47	-83.86	-13.00	70.86
302.29	25.10	-60.66	0.40	H	2.80	-63.06	-13.00	50.06
309.63	16.70	-71.53	0.49	V	2.90	-73.94	-13.00	60.94
331.77	22.20	-64.65	0.73	H	2.77	-66.69	-13.00	53.69

• Modulation mode: 16QAM

Frequency [MHz]	Reading [dBuV]	Antenna polarity [H/V]	Antenna gain [dBi]	Cable loss [dB]	Level [dBuV]	Level [dBm]	Limit [dBuV]	Margin [dB]
49.77	26.20	-65.39	1.37	H	1.13	-65.15	-13.00	52.15
141.32	18.30	-77.56	1.08	H	1.97	-78.45	-13.00	65.45
244.11	14.30	-81.53	0.79	H	2.46	-83.20	-13.00	70.20
268.43	14.50	-82.04	0.63	H	2.47	-83.88	-13.00	70.88
302.28	25.00	-60.65	0.40	H	2.80	-63.05	-13.00	50.05
309.64	16.70	-71.52	0.49	V	2.90	-73.93	-13.00	60.93
331.78	22.00	-65.89	0.73	H	2.77	-67.93	-13.00	54.93

• Modulation mode: 64QAM

Frequency [MHz]	Reading [dBuV]	Antenna polarity [H/V]	Antenna gain [dBi]	Cable loss [dB]	Level [dBuV]	Level [dBm]	Limit [dBuV]	Margin [dB]
49.78	26.30	-65.48	1.37	H	1.13	-65.24	-13.00	52.24
141.31	18.20	-77.45	1.08	H	1.97	-78.34	-13.00	65.34
244.11	14.30	-81.53	0.79	H	2.46	-83.20	-13.00	70.20
268.44	14.40	-82.01	0.63	H	2.47	-83.85	-13.00	70.85
302.28	25.20	-60.46	0.40	H	2.80	-62.86	-13.00	49.86
331.75	16.80	-71.41	0.49	V	2.90	-73.82	-13.00	60.82
331.78	22.10	-64.76	0.73	H	2.77	-66.80	-13.00	53.80

3.6 Frequency stability

3.6.1 Specification

- FCC Rules Part 2.1055
- FCC Rules Part 27.54

3.6.2 Test Description

A direct connect measurement was made between the EUT antenna cable and a spectrum analyzer. The spectrum analyzer is equipped with a precision frequency reference that exceeds the stability requirement of the EUT.

Measurements were made at the edges of the main transmit bands as called out on the data sheets. Testing was done with an absence of modulation in a CW mode of operation.

The primary supply voltage was varied from 85 % to 115 % of the nominal voltage using a temperature chamber, the transmit frequency was recorded at the extremes of the specified temperature (-30℃ to +50℃)

3.6.3 Test Procedure

The EUT was set up to the applicable test frequency with modulation. The EUT antenna terminal was conducted to the spectrum analyzer through an external attenuator (at the output test) and an appropriate coaxial cable.

The MAKER function was using for these evaluation.

3.6.4 Test equipment list

Equipment	Model Name	Manufacturer
EUT	HX-WCS-SISO-PLUS	Corning Optical Communications Wireless Inc.
MHU	HX-WCS-MHU	Corning Optical Communications Wireless Inc.
Signal Generator	N5182A	Agilent
Spectrum Analyzer	N9020A	Agilent
Attenuator	PE7019-20	Pasternack
DC power supply	6674A	Agilent
Temp. / Humid. Chamber	SJ-1016-TH	Seo Jin

3.6.5 Test condition

• Test place: Temperature and Humidity Chamber
• Test environment: -30℃ to +50℃

3.6.6 Test result

• Port1 / LTE 10 MHz / 2 355.0 MHz

Voltage [%]	Supplied power [Vdc]	Temperature [ºC]	Frequency [MHz]	Deviation [ppm]	Limit [ppm]
85	40.8	-30	2 355.0	-0.007 400	1.50
		-20		0.016 200	
		-10		0.002 000	
		0		0.014 600	
		+10		0.008 500	
		+20 (ref.)		0.013 000	
		+30		0.003 300	
		+40		0.020 100	
		+50		0.002 000	
100	48.0	-30		0.001 700	
		-20		0.004 400	
		-10		0.000 100	
		0		-0.000 500	
		+10		0.005 100	
		+20 (ref.)		-0.016 200	
		+30		0.011 300	
		+40		0.000 300	
		+50		-0.005 100	
115	55.2	-30		-0.005 200	
		-20		-0.000 200	
		-10		0.011 400	
		0		-0.007 300	
		+10		-0.025 300	
		+20 (ref.)		0.019 299	
		+30		0.000 300	
		+40		-0.005 100	
		+50		-0.005 200	

• Port1 / LTE 10 MHz / 2 352.5 MHz

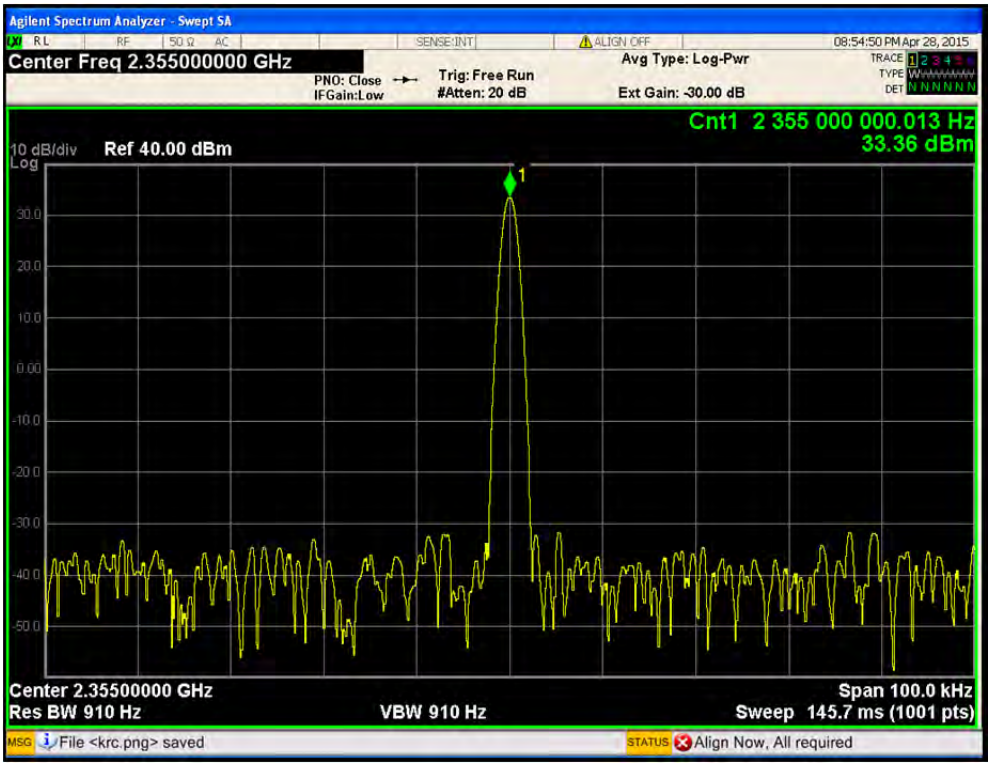
Voltage [%]	Supplied power [Vdc]	Temperature [°C]	Frequency [MHz]	Deviation [ppm]	Limit [ppm]
85	40.8	-30	2 352.5	-0.032 700	1.50
		-20		0.008 699	
		-10		-0.026 700	
		0		-0.014 500	
		+10		-0.005 799	
		+20 (ref.)		-0.005 700	
		+30		0.001 599	
		+40		0.000 999	
		+50		0.001 699	
100	48.0	-30		0.017 799	
		-20		0.022 200	
		-10		0.009 600	
		0		0.010 099	
		+10		0.028 699	
		+20 (ref.)		-0.016 399	
		+30		-0.009 900	
		+40		-0.008 299	
		+50		-0.001 100	
115	55.2	-30		0.019 199	
		-20		0.001 299	
		-10		0.024 799	
		0		0.000 100	
		+10		-0.007 800	
		+20 (ref.)		0.020 599	
		+30		-0.010 600	
		+40		-0.004 199	
		+50		0.016 699	

• Port1 / LTE 5 MHz / 2 357.5 MHz

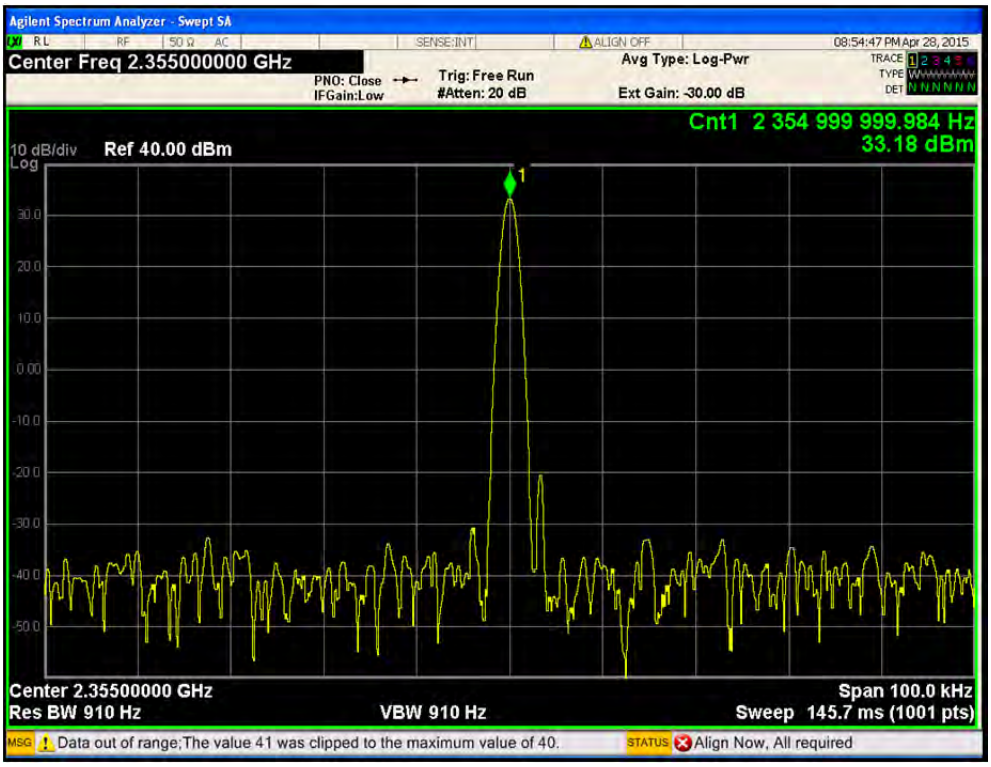
Voltage [%]	Supplied power [Vdc]	Temperature [°C]	Frequency [MHz]	Deviation [ppm]	Limit [ppm]
85	40.8	-30	2 357.5	0.003 300	1.50
		-20		-0.020 699	
		-10		-0.004 199	
		0		0.020 899	
		+10		-0.000 899	
		+20 (ref.)		-0.016 300	
		+30		-0.004 600	
		+40		0.011 600	
		+50		0.004 199	
100	48.0	-30		0.016 099	
		-20		-0.019 499	
		-10		-0.021 699	
		0		0.007 299	
		+10		0.034 399	
		+20 (ref.)		-0.004 099	
		+30		0.020 699	
		+40		-0.018 099	
		+50		-0.000 400	
115	55.2	-30		-0.014 800	
		-20		-0.010 200	
		-10		0.011 600	
		0		0.002 200	
		+10		-0.011 000	
		+20 (ref.)		-0.004 099	
		+30		0.000 400	
		+40		-0.017 399	
		+50		-0.009 300	

3.6.7 Test Plots

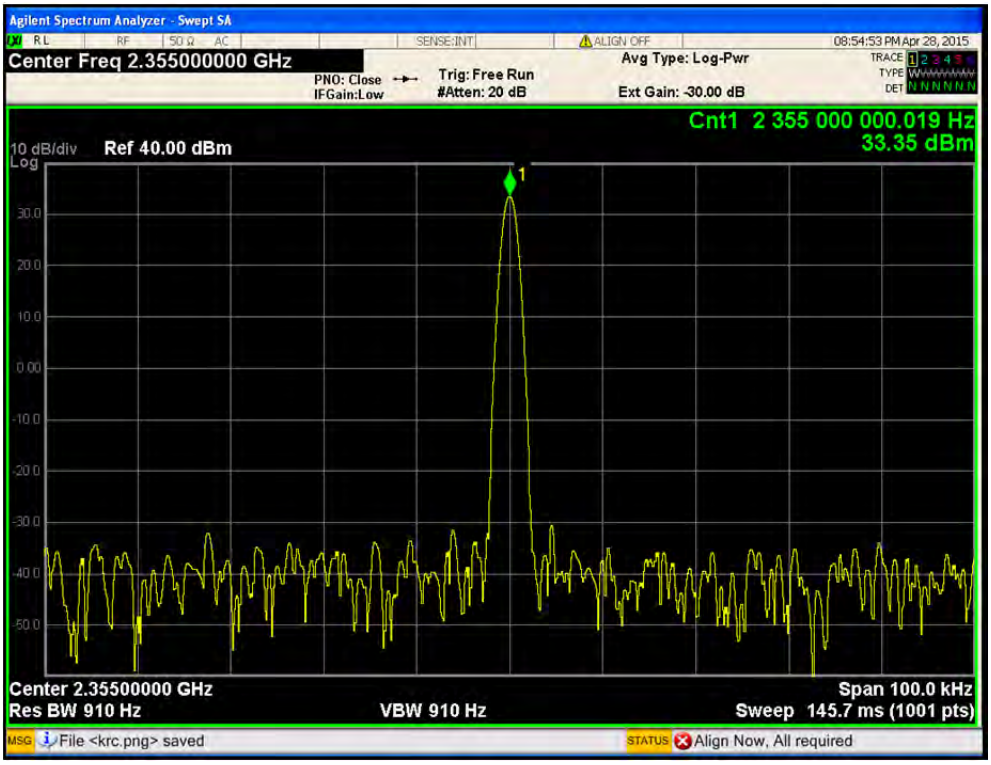
- **Port1 / LTE 10 MHz / 2 355 MHz / 85 % of nominal voltage**



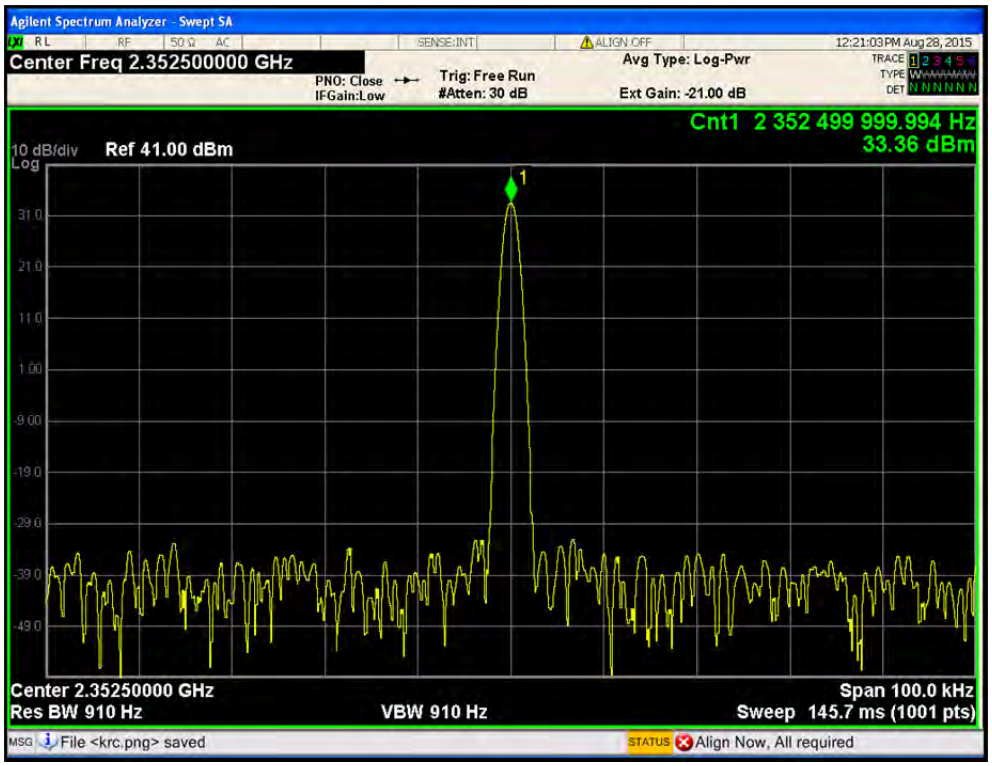
- **Port1 / LTE 10 MHz / 2 355 MHz / 100 % of nominal voltage**



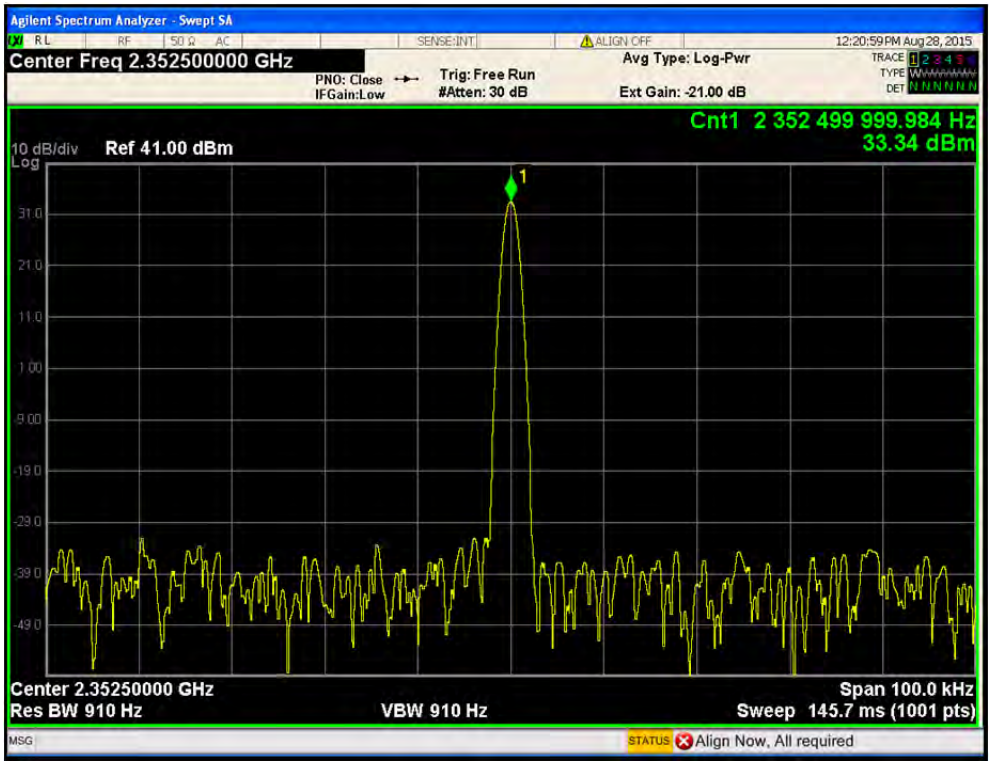
- **Port1 / LTE 10 MHz / 2 355 MHz / 115 % of nominal voltage**



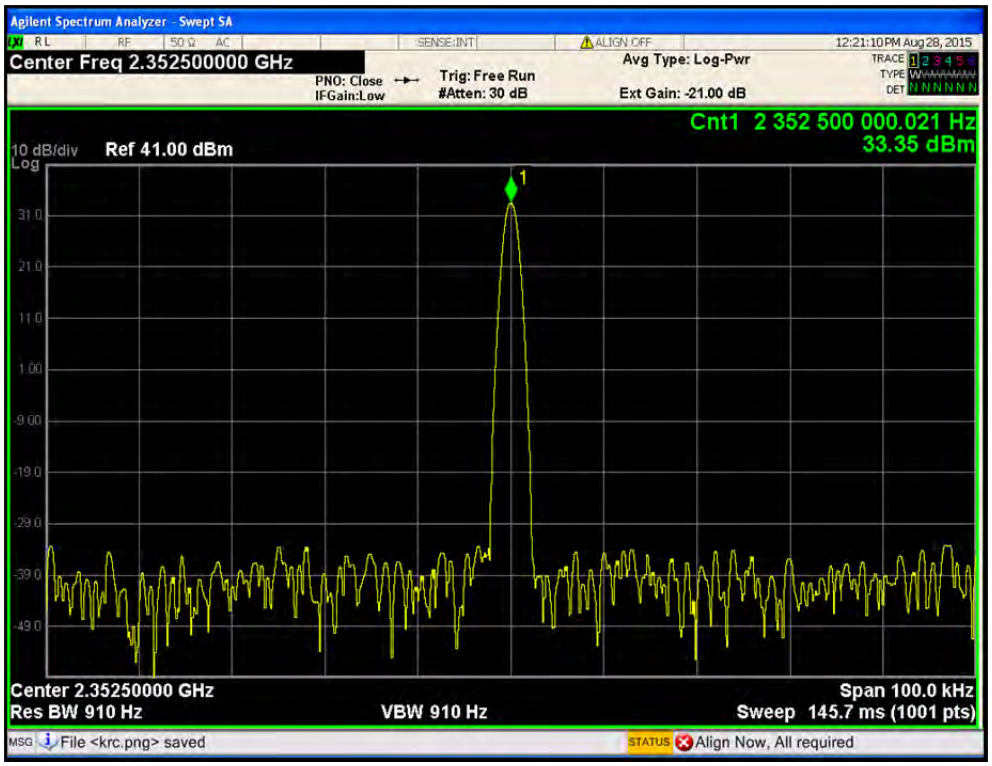
- **Port1 / LTE 5 MHz / 2 352.5MHz / 85 % of nominal voltage**



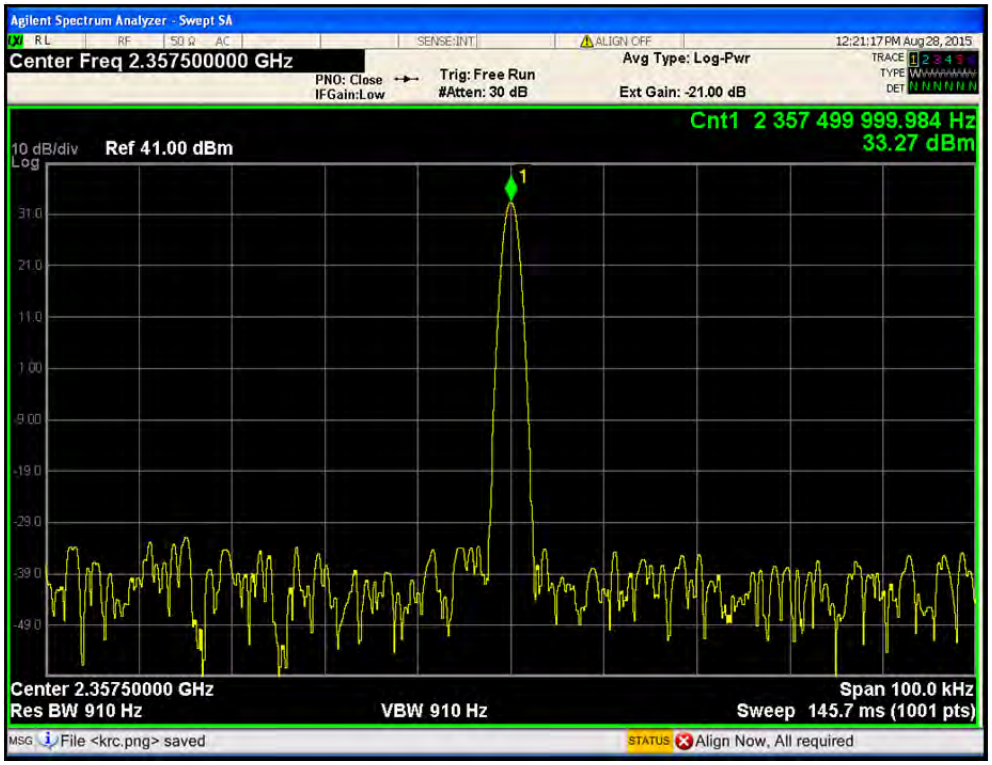
- **Port1 / LTE 5 MHz / 2 352.5 MHz / 100 % of nominal voltage**



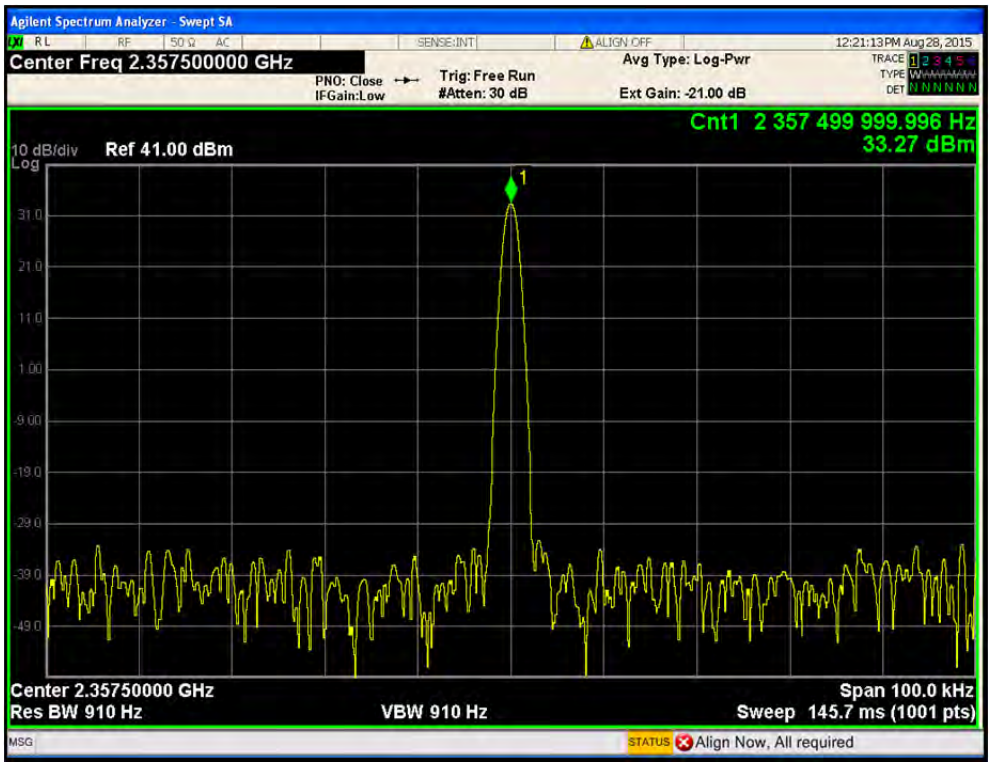
- **Port1 / LTE 5 MHz / 2 352.5 MHz / 115 % of nominal voltage**



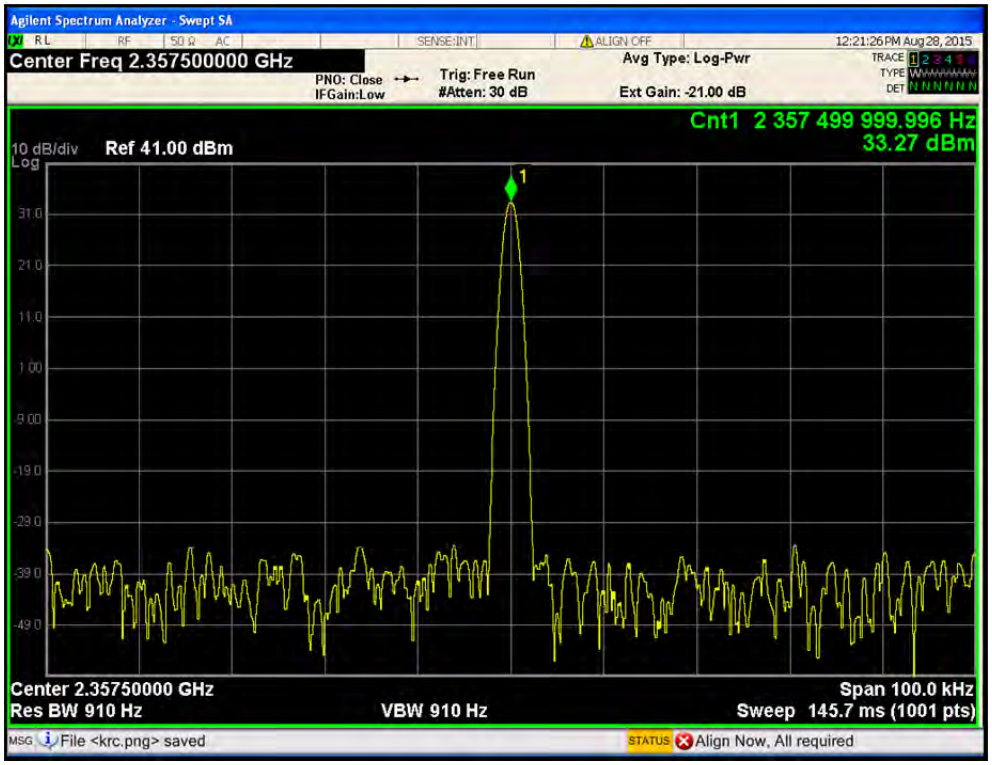
- **Port1 / LTE 5 MHz / 2 357.5 MHz / 85 % of nominal voltage**



- **Port1 / LTE 5 MHz / 2 357.5 MHz / 100 % of nominal voltage**



- **Port1 / LTE 5 MHz / 2 357.5 MHz / 115 % of nominal voltage**



3.7 Out of band rejection

3.7.1 Specification

• KDB935210 D02 V03

3.7.2 Test Description

The method used is as detailed in FCC KDB 935210 D03 V03

A direct connect measurement was made between the EUT antenna cable and a spectrum

Testing was done with an absence of modulation in a sweep CW mode of operation.

3.7.3 Test Procedure

The EUT was set up to the applicable test frequency. The EUT antenna terminal was conducted to the spectrum analyzer through an external attenuator (at the output test) and an appropriate coaxial cable.

The MAKER function and Trace MAX HOLD was using for these evaluation.

3.7.4 Test equipment list

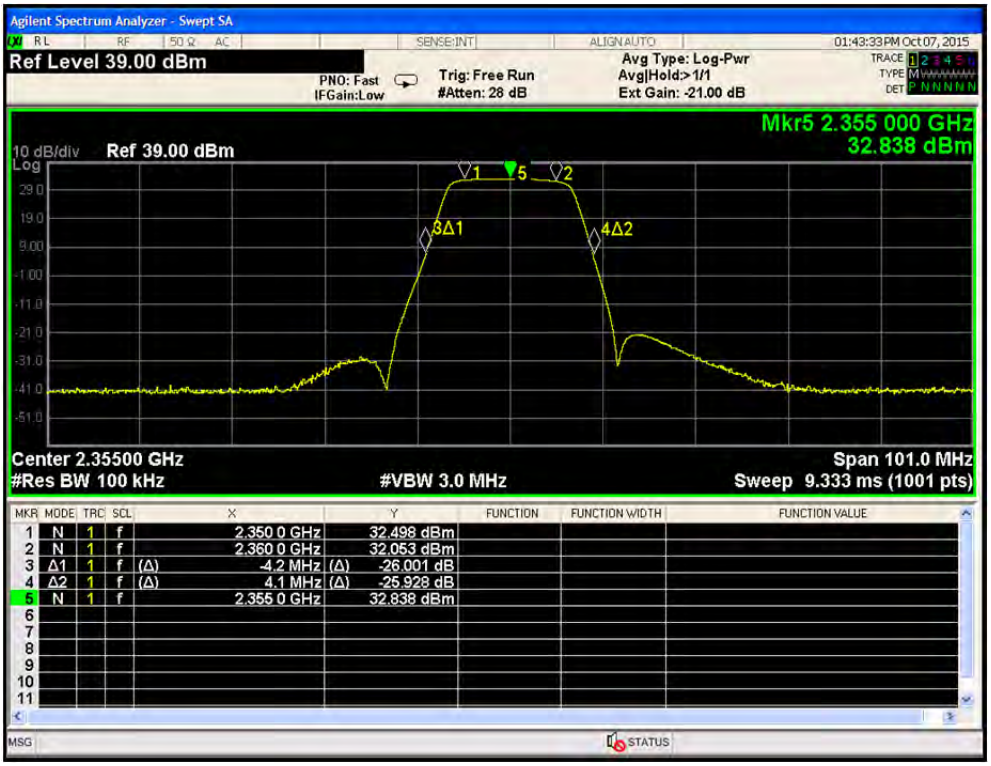
Equipment	Model Name	Manufacturer
EUT	HX-WCS-MIMO	Corning Optical Communications Wireless Inc.
MHU	HX-WCS-MHU	Corning Optical Communications Wireless Inc.
Signal Generator	N5182A	Agilent
Spectrum Analyzer	N9020A	Agilent
Attenuator	PE7019-20	Pasternack
DC power supply	6674A	Agilent
Divider	1580-1	Weinschel

3.7.5 Test condition

• Test place: Temperature and Humidity Chamber
• Test environment: 30℃ to +50℃

3.7.6 Test Plots

- **Port1**



4. RF exposure statement

According to FCC Part1 Section 1.1307~1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Frequency Range [MHz]	Electric Field Strength [V/m]	Magnetic Field Strength [A/m]	Power Density [mW/cm^2]	Averaging Time [minute]
Limits for General Population/Uncontrolled Exposure				
0.3 – 1.34	614	1.63	100	30
1.34 – 30	824/f	2.19/f	180/f^2	30
30 – 300	27.5	0.073	0.2	30
300 – 1500	-	-	f/1500	30
1500 – 100 000	-	-	1.0	30

Limits for General Population/Uncontrolled Exposure

Here, f = frequency in MHz

4.1 Friis transmission formula

$$P_d = (P_{out} \times G) / (4\pi r^2)$$

P_d = Power density
P_{out} = power input to antenna
G = power gain
r = distance to the center of radiation of the antenna

4.2 Information of Antenna

- **Service antenna model name: D5777i / Galtronics Corporation Ltd.**

Electrical Specification		
Frequency Range		2360 MHz ~ 2700 MHz
Polarization		Dual slant 45°
Band Width		910 MHz
Gain		≥ 15 dBi
Beam width	Horizontal	27°
	Vertical	27°
VSWR		≤ 1.7:1
Impedance		50 Ω
IMD (3rd)		-150dBc (@ 2x43dBm)
Maximum input power		250 W

Mechanical Specification	
Operating Temperature	-40° ~ +70°
Weight	~10 kg
Length	787 mm
Width	627 mm
Height	145 mm
RoHS	compliant
Ingress Protection	IP65(Outdoor)
Radome Color	White
Wind Survival Rating	241 km/h

4.3 Calculation of MPE at 115 cm

Port	WCS Block	Frequency [MHz]	Output power [dBm]	Antenna gain [dBi]	EIRP		Power density [mW/cm^2]	Limit [mW/cm^2]
					[dBm]	[W]		
1	A+B	2 355.0	33.10	15.00	48.10	64.56	0.388 700	1
			32.98	15.00	47.98	62.80	0.378 107	
			33.06	15.00	48.06	63.97	0.385 136	
	A	2 352.5	33.06	15.00	48.06	63.97	0.385 136	
			32.98	15.00	47.98	62.80	0.378 107	
			32.97	15.00	47.97	62.66	0.377 237	
	B	2 357.5	32.99	15.00	48.00	63.09	0.379 852	
			32.98	15.00	47.98	62.80	0.378 107	
			33.01	15.00	48.01	63.24	0.388 700	

5. Test equipment list

The listing below denotes the test equipment for the test(s).

No.	Equipment	Model	Manufacturer	Serial Number	Calibration Due date
1	Spectrum analyzer	N9020A	Agilent	MY48010456	2016.01.20
2	Spectrum analyzer	FSP	R&S	10060	2016.08.28
3	Signal generator	N5182A	Agilent	MY49060695	2016.01.19
4	Attenuator	AF115A-09-34	Weinschel	18405	2016.01.20
5	Attenuator	PE7019-20	Pasternack	TEMP_4	2015.08.21
6	Biconical antenna	VHA9103	Schwarzbeck	2217	2015.11.15
7	Log-Periodic antenna	VULP9118A	Schwarzbeck	382	2015.11.15
8	Horn antenna	BBHA-9120D	Schwarzbeck	395	2016.08.06
9	Horn antenna	FR6517	Orbit Technology	0511106	2016.08.07
10	EMI Test Receiver	ESS	R&S	833776/011	2016.08.26
11	Preamp	8449B	Agilent	3008A02013	2016.04.16
12	RF Amplifier	SCU01	R&S	10020	2016.08.26
13	Turn table	DS 1500 S-1t-O	Innco GmbH	N/A	N/A
14	Turn table	ALL1.5TT	Airlink Lab	N/A	N/A
15	Antenna mast	MA4000-O	Innco GmbH	N/A	N/A
16	Antenna mast	ALL2.2MA	Airlink Lab	N/A	N/A
17	Controller	CO 2000	Innco GmbH	N/A	N/A
18	Controller	ALL-TC-V1.0	Airlink Lab	N/A	N/A
19	DC power supply	6674A	Agilent	3537A01582	2016.01.19
20	Divider	1503	Weinschel	QS033	2016.01.28

