FCC TEST REPORT

For

Vogo

VOKKERO GUARDIAN US CAN

Test Model: VO8320D

List Model No.: VO8320A, VO8320B, VO8320C, VO8320E, VO8320F, VO8320G, VO8320H, VO8320I, VO8320J

Prepared for	:	Vogo
Address	:	101, place Pierre Duhem, Immeuble Les Centuries II, 34000 Montpellier, France
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Address	:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Shajing Street, Baoan District, Shenzhen, China
Tel	:	(+86)755-82591330
Fax	:	(+86)755-82591332
Web	:	www.LCS-cert.com
Mail	:	webmaster@LCS-cert.com
Date of receipt of test sample	:	Aug 05, 2019
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	Aug 05, 2019~ June 11, 2020
Date of Report	:	July 01,2020

FCC/ISED TEST REPORT
FCC CFR 47 PART 15 C (15.247)

Report Reference No.	:	**LCS190801032AEA**
Date of Issue.....	:	July 01,2020
Testing Laboratory Name.....	:	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address.....	:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Shajing Street, Baoan District, Shenzhen, China
Testing Location/ Procedure.....	:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name.....	:	**Vogo**
Address.....	:	101, place Pierre Duhem, Immeuble Les Centuries II, 34000 Montpellier, France
Test Specification		
Standard.....	:	FCC CFR 47 PART 15 C (15.247)
Test Report Form No.....	:	LCSEMC-1.0
TRF Originator.....	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF.....	:	Dated 2011-03

EUT Description.....	:	**VOKKERO GUARDIAN US CAN**
Trade Mark.....	:	VOKKERO
Test Model.....	:	VO8320D
Ratings.....	:	Adapter 100-240V AC~50/60Hz,1.3A Battery Li-Polymer 3.7VDC
Result	:	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Jack Liu	Jin Wang	Gavin Liang
Jack Liu / File administrators	Jin Wang/ Technique principal	Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. : **LCS190801032AEA**	July 01,2020 Date of issue

Test Model.....	:	VO8320D
EUT.....	:	VOKKERO GUARDIAN US CAN
Applicant.....	**:**	**Vogo**
Address.....	:	**101, place Pierre Duhem, Immeuble Les Centuries II, 34000 Montpellier, France**
Telephone.....	:	
Fax.....	:	
Manufacturer.....	**:**	**Vogo**
Address.....	:	**101, place Pierre Duhem, Immeuble Les Centuries II, 34000 Montpellier, France**
Telephone.....	:	
Fax.....	:	
Factory.....	**:**	/
Address.....	:	/
Telephone.....	:	
Fax.....	:	

Test Result	**Positive**

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Revision	Issue Date	Revisions	Revised By
000	July 01,2020	Initial Issue	Gavin Liang

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	:	VOKKERO GUARDIAN US CAN
Model No.	:	VO8320D, VO8320A, VO8320B, VO8320C, VO8320E, VO8320F, VO8320G, VO8320H, VO8320I, VO8320J
Model Declaration	:	PCB board, structure and internal of these model(s) are the same, So no additional models were tested.
Test Model	:	VO8320D
Power Supply	:	Adapter 100-240V AC~50/60Hz,1.3A Battery Li-Polymer 3.7VDC
Hardware Version	:	V1
Software Version	:	V02.05.11
SRD	:	
Frequency Range	:	902-928MHz
Spectrum	:	FHSS/DTS/ Hybrid
Modulation:		
Spacing channel:	:	Not Applicable - 6dB bandwidth >= 500kHz for DTS systems
Antenna Description	:	0dBi ,Integrated Monopole Antenna

1.2. Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	Certificate
MEAN WELL ENTERPRISES CO.,LTD.	AC/DC Adapter	GST90A12	GST90A12-P1M	CE

1.3. External I/O Cable

I/O Port Description	Quantity	Cable

1.4. Description of Test Facility

FCC Registration Number is 254912.

Industry Canada Registration Number is 9642A.

EMSD Registration Number is ARCB0108.

UL Registration Number is 100571-492.

TUV SUD Registration Number is SCN1081.

TUV RH Registration Number is UA 50296516-001.

NVLAP Accreditation Code is 600167-0.

FCC Designation Number is CN5024.

CAB identifier is CN0071.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.5. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the LCS quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1.6. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	±3.10dB	(1)
		30MHz~200MHz	±2.96dB	(1)
		200MHz~1000MHz	±3.10dB	(1)
		1GHz~26.5GHz	±3.80dB	(1)
		26.5GHz~40GHz	±3.90dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	±1.63dB	(1)
Power disturbance	:	30MHz~300MHz	±1.60dB	(1)

(1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.7. Description of Test Modes

The different modes are called O2O-1, O2O-2, O2O-3, O2O-4 and O2O-5 and are described in the following table :

	H1	A1	H2	A2	H3	A3	C1
	Min	Min	Min	Min	Min	Min	Min
	Max	Max	Max	Max	Max	Max	Max
	916,698	902,188	903,688	902,75	902,188	903,313	902,188
	927,573	916,063	927,313	926,375	917,938	917,563	927,688
1	916,698	910,813	903,688	915,875	917,938	917,563	910,813
2	917,448	910,063	911,188	904,625	917,188	916,813	921,688
3	920,448	908,938	925,063	920,75	910,438	903,313	917,563
4	923,073	902,938	917,938	923,375	917,563	904,813	926,938
5	917,823	910,438	922,063	902,75	906,688	905,563	916,438
6	927,198	911,188	926,938	922,25	908,188	913,438	914,938
7	921,198	907,813	904,438	913,25	915,313	905,188	917,188
8	921,948	911,563	905,563	917,75	916,813	903,688	927,688
9	917,073	905,188	909,313	923,75	910,063	914,563	906,313
10	926,448	915,688	907,813	915,5	902,938	909,688	915,688
11	922,323	913,813	927,313	926,375	908,938	915,313	908,563
12	927,573	908,188	909,688	922,625	911,563	912,313	903,688
13	921,573	912,313	906,688	913,625	904,813	908,563	909,313
14	925,323	914,938	912,688	910,625	910,813	912,688	905,188
15	924,573	905,938	910,063	923	907,063	916,438	912,313
16	922,698	903,688	904,813	907,25	905,938	913,813	915,313
17	923,823	906,313	912,313	914,375	914,938	911,188	902,188
18	926,823	908,563	916,813	911	911,188	906,688	914,563
19	925,698	914,188	926,563	921,5	915,688	913,063	924,313
20	920,823	915,313	924,313	907,625	909,313	907,438	923,188
21	926,073	909,313	915,313	916,625	902,563	908,188	922,063
22	924,948	907,063	906,313	908,375	916,063	914,188	911,188
23	923,448	904,438	914,938	926	907,813	909,313	906,688
24	918,198	912,688	905,188	920,375	913,063	906,313	909,688
25	924,198	902,188	925,438	917,375	902,188	910,813	904,813
26		905,563		908,75		914,938	925,813
27		916,063					904,438
28							907,063
29							905,938
30							920,938
31							913,063
32							926,563

Tables Hybrid and DTS channels

O2O-1	Frequencies : 902,1MHz / 927,9MHz
O2O-2	Frequencies : 902,1MHz / 903.95MHz / 927.9MHz
O2O-3	Frequency : 927,75MHz
O2O-4	Frequency : 902,25MHz
O2O-5	Frequencies : 902,1MHz / 903.95MHz / 927.9MHz

AC conducted emission pre-test at both at AC 120V/60Hz and AC 240V/50Hz modes, recorded worst case.

Worst-case mode and channel used for 150 KHz-30 MHz power line conducted emissions was the mode and channel with the highest output power that was determined to be TX

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be TX

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR PART 15C 15.207, 15.209, 15.247 and DA 00-705.

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the normal operating mode for Hopping Numbers and Dwell Time test and a continuous transmits mode for other tests.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209, 15.247 under the FCC Rules Part 15 Subpart C.

2.3. General Test Procedures

2.3.1 Conducted Emissions

The EUT is directly placed on the ground. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turntable, which is directly placed on the ground. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013

2.4. Test Sample

The application provides 2 samples to meet requirement;

Sample Number	Description
Sample 1	Engineer sample – continuous transmit
Sample 2	Normal sample – Intermittent transmit

3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmits condition.

3.2. EUT Exercise Software

The system was configured for testing in a continuous transmits condition and change test channels by software (VOKKERO Guardian) provided by application.

3.3. Special Accessories

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULTS

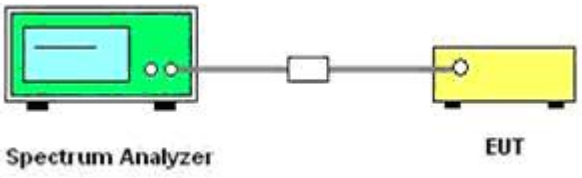
Applied Standard: FCC Part 15 Subpart C				
FCC Rules	Description of Test	Test Sample	Result	Remark
§15.247(b)(3)	Maximum Conducted Output Power	Sample 1	Compliant	Appendix A.1
§15.247(e)/(f)	Power Density	Sample 1	Compliant	Appendix A.3
§15.247(a)(2)	6 dB Bandwidth	Sample 1	Compliant	Appendix A.2
§15.247(f)	Time Of Occupancy (Dwell Time)	Sample 2	Compliant	Appendix A.4
§15.209, §15.205	Conducted Spurious Emissions and Band Edges Test	Sample 1	Compliant	Appendix A.5 Appendix A.6
§15.209, §15.247(d)	Radiated Spurious Emissions	Sample 1	Compliant	Note 1
§15.205	Emissions at Restricted Band	Sample 1	Compliant	Appendix A.7
§15.207(a)	AC Conducted Emissions	Sample 1	Compliant	Note 1
§15.203	Antenna Requirements	Sample 1	Compliant	Note 1
§15.247(i)§2.1093	RF Exposure	Sample 1	Compliant	Note 2

Remark:
1. Note 1 – Test results inside test report;
2. Note 2 – Test results in other test report (RF Exposure Evaluation).

5. MEASUREMENT RESULTS

5.1. Peak Power

5.1.1 Block Diagram of Test Setup



5.1.2 Limit

According to § 15.247 (b) (3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

5.1.3 Test Procedure

The transmitter output (antenna port) was connected to the spectrum analyzer. According to ANSI C63.10:2013 Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices; this is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

a) Use the following spectrum analyzer settings:

1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.

2) RBW > 20 dB bandwidth of the emission being measured.

3) VBW ≥ RBW.

4) Sweep: Auto.

5) Detector function: Peak.

6) Trace: Max hold.

b) Allow trace to stabilize.

c) Use the marker-to-peak function to set the marker to the peak of the emission.

d) The indicated level is the peak output power, after any corrections for external attenuators and cables.

5.1.4 Test Results

PASS

Please refer to Appendix A.1

Remark:

1) Test results including cable loss;

5.2. 6dB BANDWIDTH

5.2.1 Limit

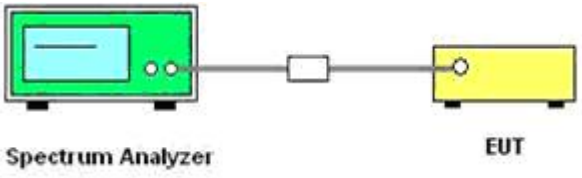
For O2O3 and O2O4 (DTS) :

According to §15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.

For O2O1, O2O2 and O2O5 (Hybrid systems) :

There is no requirement for this type of hybrid system to comply with the 500kHz minimum bandwidth normally associated with a DTS device.

5.2.2 Block Diagram of Test Setup



5.2.3 Test Procedure

6dB bandwidth test procedure :

1). Span = approximatively 2 to 3 times the 6dB Bandwidth, centered on a channel.

2). RBW=VBW=100kHz .

3). Detector function = peak.

4). Trace = max hold.

5.2.4 Test Results

5.2.4.1 6dB Bandwidth

PASS

Please refer to Appendix A.2

Remark:

1. *Test results including cable loss;*
2. *6dB bandwidth recorded worst case for each mode.*

5.3. POWER DENSITY

5.3.1 Limit

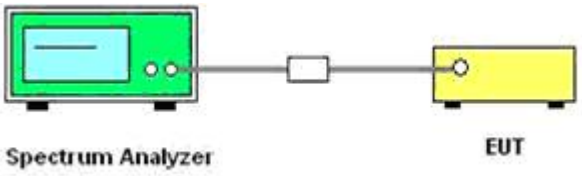
For O2O3 and O2O4 (DTS) :

According to §15.247 (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

For O2O1, O2O2 and O2O5 (Hybrid systems) :

According to §15.247 (f) hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.3.2 Block Diagram of Test Setup



5.3.3 Test Procedure

1). Span=1MHz

2) RBW=3kHz, VBW=30kHz

3) Detector: RMS

4) Trace : Average (power)

5) Trigger on level (Discontinued Emission)

5.3.4 Test Results

PASS

Please refer to Appendix A.3

Remark:

1). Test results including cable loss;

2). Power density recorded worst case for each mode.

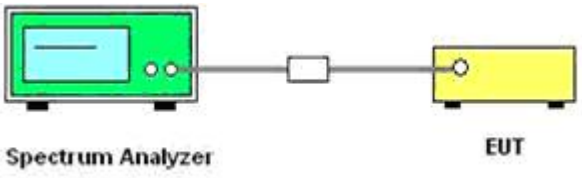
5.4. Number of Hopping Frequency / Time of Occupancy (Dwell Time)

5.4.1 Limit

According FCC part 15.247 OET guidance, there is no minimum hopping channel in Hybrid mode. And there is no Hoping in DTS which is a specific mode.

According §15.247 (f), hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4.

5.4.2 Block Diagram of Test Setup



5.4.3 Test Procedure

1). Place the EUT on the table and set it in transmitting mode.

2). Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer.

3). Set center frequency of Spectrum Analyzer = operating frequency.

4). Set the Spectrum Analyzer as RBW/VBW=1MHz/3MHz, Span = 0Hz, Sweep = auto.

5). Repeat above procedures until all frequency measured was complete.

5.4.4 Test Results

PASS

Please refer to Appendix A.4

Remark:

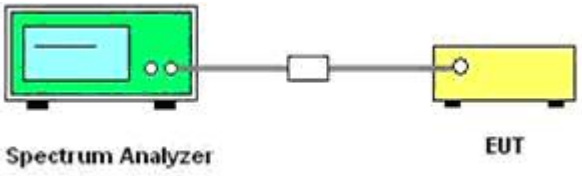
1. *Test results including cable loss;*

5.5. Conducted Spurious Emissions and Band Edges Test

5.5.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

5.5.2 Block Diagram of Test Setup



5.5.3 Test Procedure

Span =2 MHz.

RBW = 100 kHz.

VBW ≥ [3 x RBW].

Detector = RMS (power averaging)

Averaging type = power

Sweep time = auto.

Trace : average

5.5.4 Test Results of Conducted Spurious Emissions

PASS

Please refer to Appendix A.5 for conducted spurious emission.

Please refer to Appendix A.6 for conducted band edge.

Remark:
1). Test results including cable loss;
2). Measured at difference Packet Type for each mode and recorded worst case for each mode.
3). "---"means that the fundamental frequency not for 15.209 limits requirement.
4). Not recorded emission from 9 KHz to 30 MHz as emission level at least 20dBc lower than emission limit.

5.6. Restricted Band Emission Limit

5.6.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
\1\ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293.	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(\2\)
13.36-13.41			

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

\2\ Above 38.6

According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

5.6.2. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10^{th} carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

5.6.3. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 0.8 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Premeasurement:

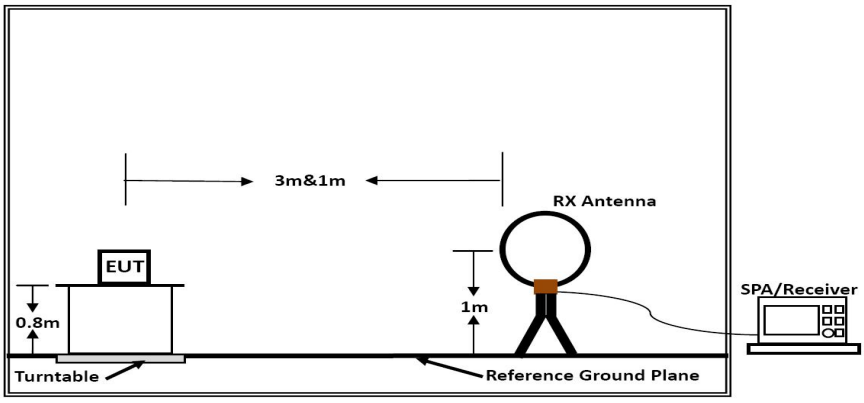
--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

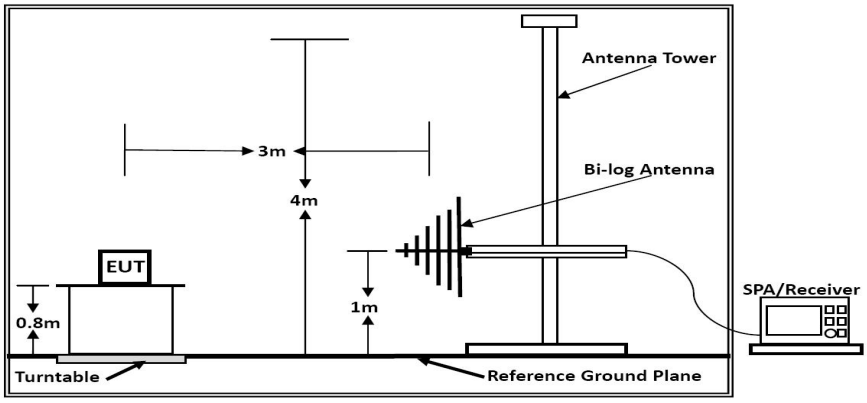
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

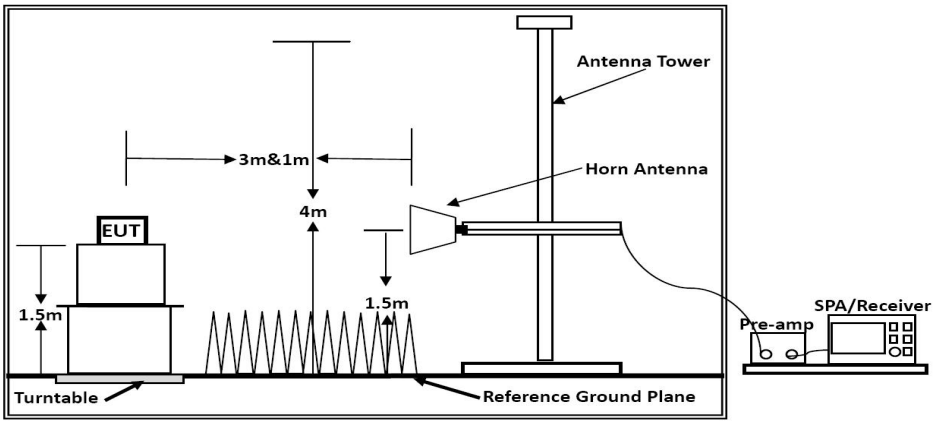
5.6.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1m.

Distance extrapolation factor = 20 log (specific distance [3m] / test distance [1.5m]) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

5.6.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.6.6. Results of Radiated Emissions (9 KHz~30MHz)

Temperature	23.1℃	Humidity	53.9%
Test Engineer	David Luo	Configurations	DTS mode

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor.

5.6.7. Results of Radiated Emissions (30 MHz – 1000 MHz)

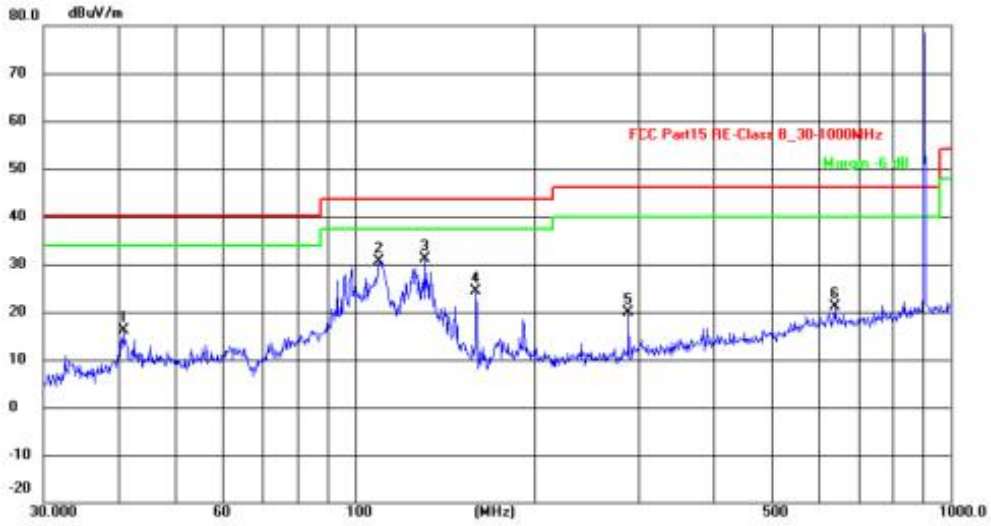
PASS.

Only record the worst test result in this report.

The test data please refer to following page.

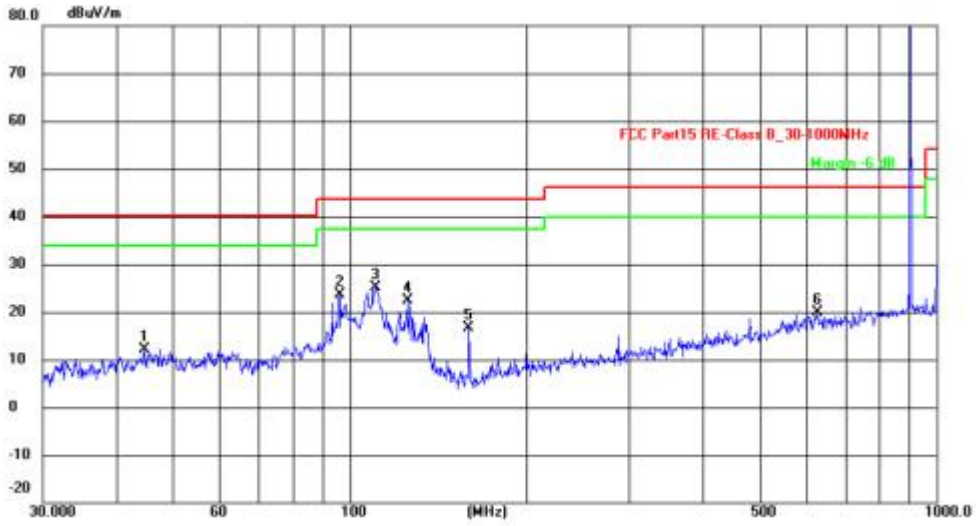
Below 1GHz

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	40.8445	32.41	-16.27	16.14	40.00	-23.86	QP
2	109.7959	48.51	-17.77	30.74	43.50	-12.76	QP
3	131.2965	52.08	-20.97	31.11	43.50	-12.39	QP
4	159.7844	45.10	-20.76	24.34	43.50	-19.16	QP
5	287.9904	34.65	-14.84	19.81	46.00	-26.19	QP
6	640.6110	29.61	-8.39	21.22	46.00	-24.78	QP

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	44.7433	27.73	-15.65	12.08	40.00	-27.92	QP
2	96.0985	41.73	-18.04	23.69	43.50	-19.81	QP
3	110.9570	43.04	-17.95	25.09	43.50	-18.41	QP
4	125.4457	42.75	-20.30	22.45	43.50	-21.05	QP
5	159.7844	37.37	-20.76	16.61	43.50	-26.89	QP
6	627.2737	28.30	-8.35	19.95	46.00	-26.05	QP

Note:

1). Pre-scan all modes and recorded the worst case results in this report Low Channel of DTS mode.

2). Emission level (dBuV/m) = 20 log Emission level (uV/m).

3). Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4).needs BRC filters prevents instrument overload.

5). DTS and Hybrid mode were tested,the report the worst mode of DTS

5.6.8. Results of Radiated Emissions (1 GHz – 26 GHz)

Note: All the modes have been tested and recorded worst mode in the report.

The worst test result for Channel 902.1 MHz

Freq. MHz	Reading dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab. Los dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
1804.2	55.10	32.21	34.19	3.58	56.70	74.00	-17.30	Peak	Horizontal
1804.2	41.98	32.21	34.19	3.58	43.58	54.00	-10.42	Average	Horizontal
1804.2	56.45	33.16	35.06	3.96	58.51	74.00	-15.49	Peak	Vertical
1804.2	42.51	33.16	35.06	3.96	44.57	54.00	-9.43	Average	Vertical

The worst test result for Channel 903.95 MHz

Freq. MHz	Reading dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab. Los dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
1807.9	60.72	32.21	34.19	3.58	62.32	74.00	-11.68	Peak	Horizontal
1807.9	42.64	32.21	34.19	3.58	44.24	54.00	-9.76	Average	Horizontal
1807.9	55.84	33.16	35.06	3.96	57.90	74.00	-16.10	Peak	Vertical
1807.9	40.71	33.16	35.06	3.96	42.77	54.00	-11.23	Average	Vertical

The worst test result for Channel 927.9 MHz

Freq. MHz	Reading dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab. Los dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
1855.8	54.81	32.21	34.19	3.58	56.41	74.00	-17.59	Peak	Horizontal
1855.8	45.06	32.21	34.19	3.58	46.66	54.00	-7.34	Average	Horizontal
1855.8	55.14	33.16	35.06	3.96	57.20	74.00	-16.80	Peak	Vertical
1855.8	42.88	33.16	35.06	3.96	44.94	54.00	-9.06	Average	Vertical

Notes:

1). Measuring frequencies from 9 KHz~10th harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30 MHz.

2). Radiated emissions measured in frequency range from 9 KHz~10th harmonic (ex. 26GHz) were made with an instrument using Peak detector mode.

3). 18~25GHz at least have 20dB margin. No recording in the test report.

4). DTS and Hybrid mode were tested,the report the worst mode of DTS

5.7. AC Power Line Conducted Emissions

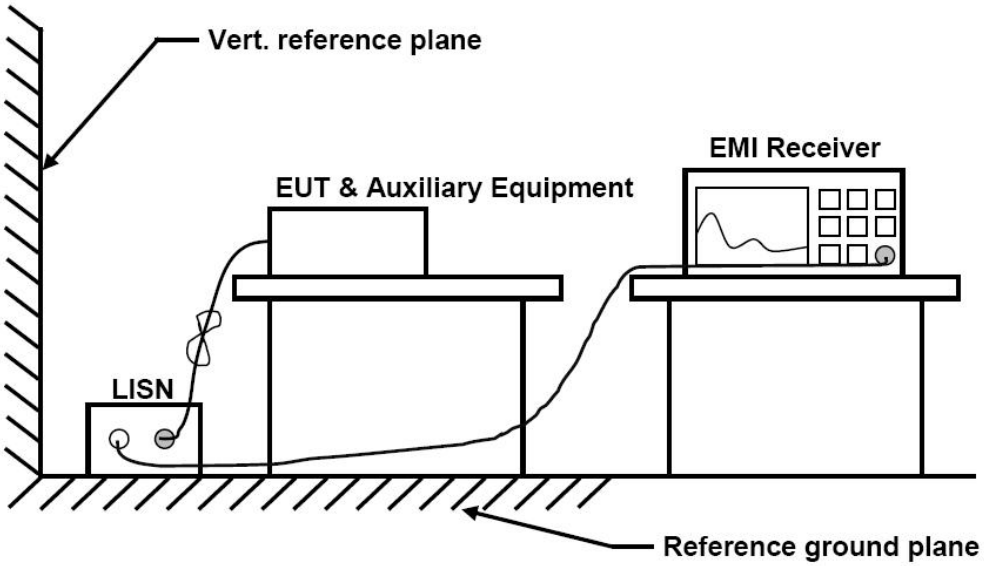
5.7.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

5.7.2 Block Diagram of Test Setup



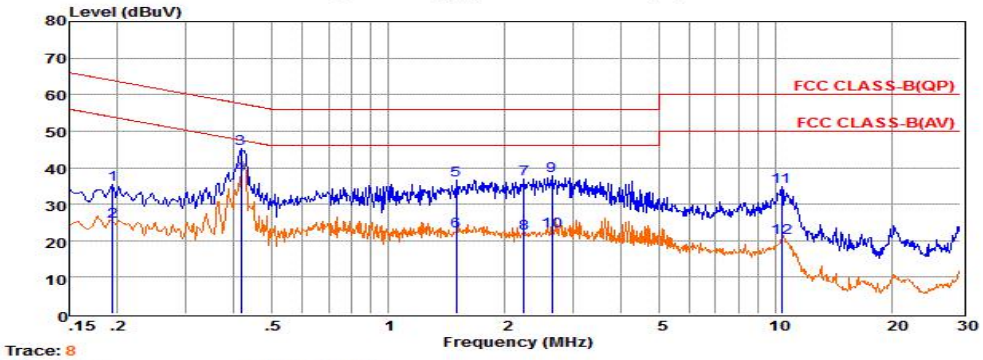
5.7.3 Test Results

PASS.

The test data please refer to following page.

AC Conducted Emission of charge from Adapter mode @ AC 120V/60Hz (worst case)

Line

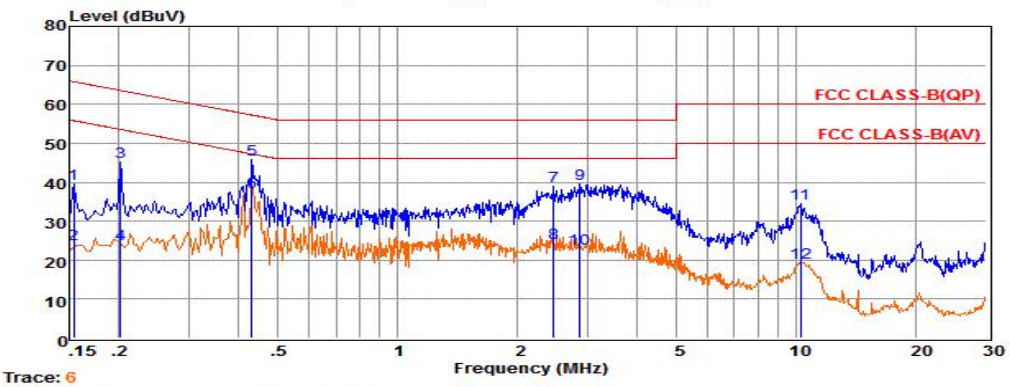


Trace: 8
Env. Ins: 24.8*/54.8%
Pol: LINE

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.19	15.86	9.62	0.02	10.00	35.50	63.84	-28.34	QP
2	0.19	5.76	9.62	0.02	10.00	25.40	53.84	-28.44	Average
3	0.42	25.57	9.62	0.04	10.00	45.23	57.51	-12.28	QP
4	0.42	18.50	9.62	0.04	10.00	38.16	47.50	-9.34	Average
5	1.50	16.94	9.64	0.05	10.00	36.63	56.00	-19.37	QP
6	1.50	3.03	9.64	0.05	10.00	22.72	46.00	-23.28	Average
7	2.24	17.31	9.64	0.05	10.00	37.00	56.00	-19.00	QP
8	2.24	2.41	9.64	0.05	10.00	22.10	46.00	-23.90	Average
9	2.65	18.11	9.64	0.05	10.00	37.80	56.00	-18.20	QP
10	2.65	2.95	9.64	0.05	10.00	22.64	46.00	-23.36	Average
11	10.34	14.92	9.69	0.08	10.00	34.69	60.00	-25.31	QP
12	10.34	1.02	9.69	0.08	10.00	20.79	50.00	-29.21	Average

Remarks: 1. Measured = Reading + LISNFac + Cable Loss + Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

Neutral



Trace: 6
Env. Ins: 24.8*/54.8%
Pol: NEUTRAL

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.15	19.84	9.69	0.02	10.00	39.55	65.78	-26.23	QP
2	0.15	4.28	9.69	0.02	10.00	23.99	55.77	-31.78	Average
3	0.20	25.73	9.59	0.02	10.00	45.34	63.54	-18.20	QP
4	0.20	4.56	9.59	0.02	10.00	24.17	53.53	-29.36	Average
5	0.43	26.28	9.62	0.04	10.00	45.94	57.24	-11.30	QP
6	0.43	17.83	9.62	0.04	10.00	37.49	47.24	-9.75	Average
7	2.46	19.27	9.64	0.05	10.00	38.96	56.00	-17.04	QP
8	2.46	4.71	9.64	0.05	10.00	24.40	46.00	-21.60	Average
9	2.87	19.87	9.64	0.06	10.00	39.57	56.00	-16.43	QP
10	2.87	3.25	9.64	0.06	10.00	22.95	46.00	-23.05	Average
11	10.23	14.63	9.72	0.08	10.00	34.43	60.00	-25.57	QP
12	10.23	-0.50	9.72	0.08	10.00	19.30	50.00	-30.70	Average

Remarks: 1. Measured = Reading + LISNFac + Cable Loss + Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

****Note:*

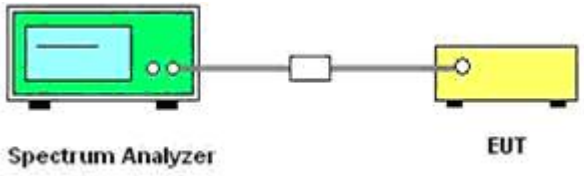
1) Pre-scan all modes and recorded the worst case results in this report (DTS mode).

5.8. Restrict-band Band-edge Measurements

5.8.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

5.8.2. Test Setup Layout



5.8.3. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of Spectrum Analyzer.

5.8.4. Test Procedures

According to KDB 412172 section 1.1 Field Strength Approach (linear terms):
eirp = p_t x g_t = $(E \times d)^2/30$
Where:
p_t = transmitter output power in watts,
g_t = numeric gain of the transmitting antenna (unit less),
E = electric field strength in V/m,
d = measurement distance in meters (m).
erp = eirp/1.64 = $(E \times d)^2/(30 \times 1.64)$
Where all terms are as previously defined.

1). Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2). Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to an EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3). Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz for peak detector and RBW=1MHz, VBW=1/B for Peak detector.
4). Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5). Repeat above procedures until all measured frequencies were complete.
6). Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
7). Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
8). Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).
9). For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10). Compare the resultant electric field strength level to the applicable regulatory limit.
11). Perform radiated spurious emission test duress until all measured frequencies were complete.

5.8.5. Test Results

PASS

Please refer to Appendix A.7

5.9. Standard Applicable

5.9.1 Standard Applicable

There is no minimum number of hopping channels associated with this type of hybrid system. While there is not a specific minimum limit, the hop sequence is required to appear as pseudorandom per section 15.247 (a) (1)

5.9.2 EUT Pseudorandom Frequency Hopping Sequence Requirement

The device meet Pseudorandom Frequency Hopping Sequence requirement, please refer to Operation Description for Pseudorandom Frequency Hopping Sequence.

5.10. Antenna Requirement

5.10.1 Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

5.10.2 Antenna Connected Construction

5.10.2.1. Standard Applicable

According to § 15.203 & RSS-Gen, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

5.10.2.2. Antenna Connector Construction

The gains of antenna used for transmitting is 0dBi, and the antenna is a Integrated Monopole Antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details, meet RSS-Gen antenna requirement.

5.10.2.3. Results: Compliance.

6. SUMMARY OF TEST EQUIPMENT

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	MXA Signal Analyzer	Agilent	N9020A	MY49100060	2019-11-22	2020-11-21
2	DC Power Supply	Agilent	E3642A	N/A	2019-11-14	2020-11-13
3	Temperature & Humidity Chamber	GUANGZHOU GOGNWEN	GDS-100	70932	2019-10-09	2020-10-08
4	EMI Test Software	AUDIX	E3	/	N/A	N/A
5	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2019-06-12	2020-06-11
6	Positioning Controller	MF	MF-7082	/	2019-06-12	2020-06-11
7	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2018-07-26	2021-07-25
8	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2018-07-26	2021-07-25
9	Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1925	2018-07-02	2021-07-01
10	EMI Test Receiver	R&S	ESR 7	101181	2019-06-12	2020-06-11
11	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2019-11-14	2020-11-13
12	Broadband Preamplifier	/	BP-01M18G	P190501	2019-07-01	2020-06-30
13	RF Cable-R03m	Jye Bao	RG142	CB021	2019-06-12	2020-06-11
14	RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	2019-06-12	2020-06-11
15	EMI Test Receiver	R&S	ESPI	101840	2020-06-10	2021-06-09
16	Artificial Mains	R&S	ENV216	101288	2019-06-12	2020-06-11
17	10dB Attenuator	SCHWARZBECK	MTS-IMP-136	261115-001-0032	2020-06-10	2021-06-09
Note: All equipment is calibrated through CHINA CEPREI LABORATORY and GUANGZHOU LISAI CALIBRATION AND TEST CO., LTD.						

7. TEST SETUP PHOTOGRAPHS OF EUT

Please refer to separated files for Test Setup Photos of the EUT.

8. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

9. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

Appendix A

RF Test Data (Conducted Measurement)

Product Name: VOKKERO GUARDIAN US CAN

Trade Mark: VOKKERO

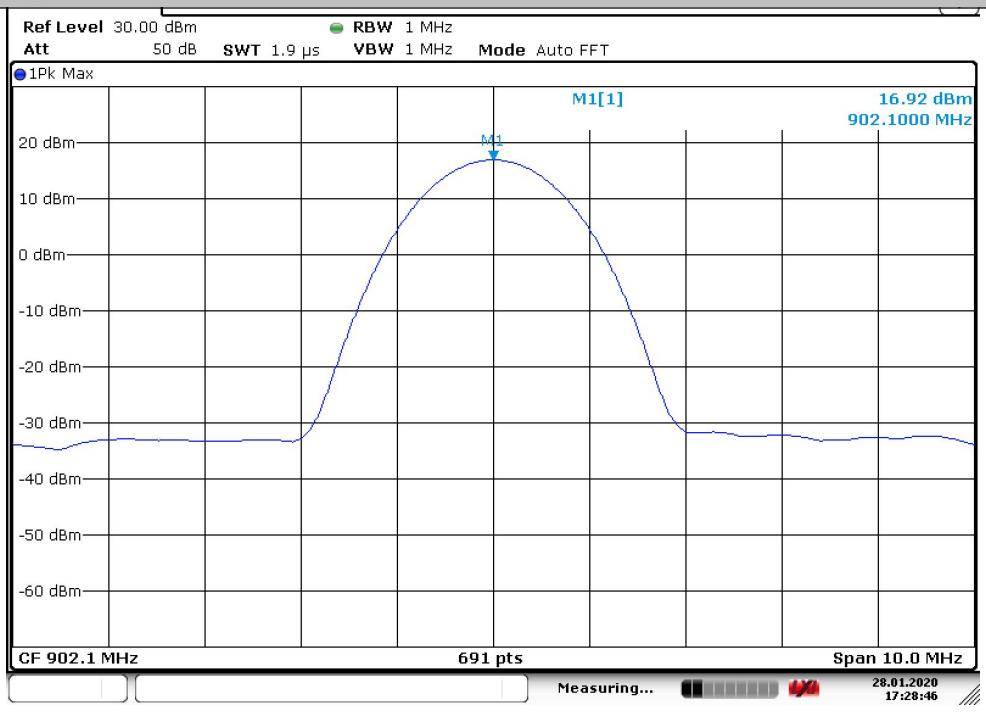
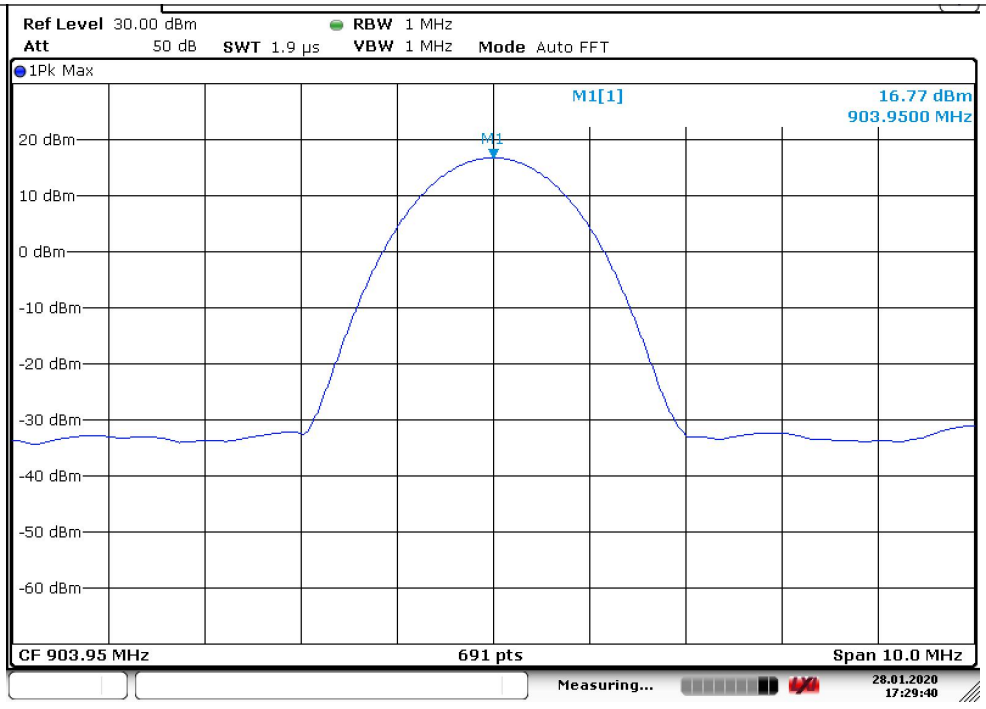
Test Model: VO8320D

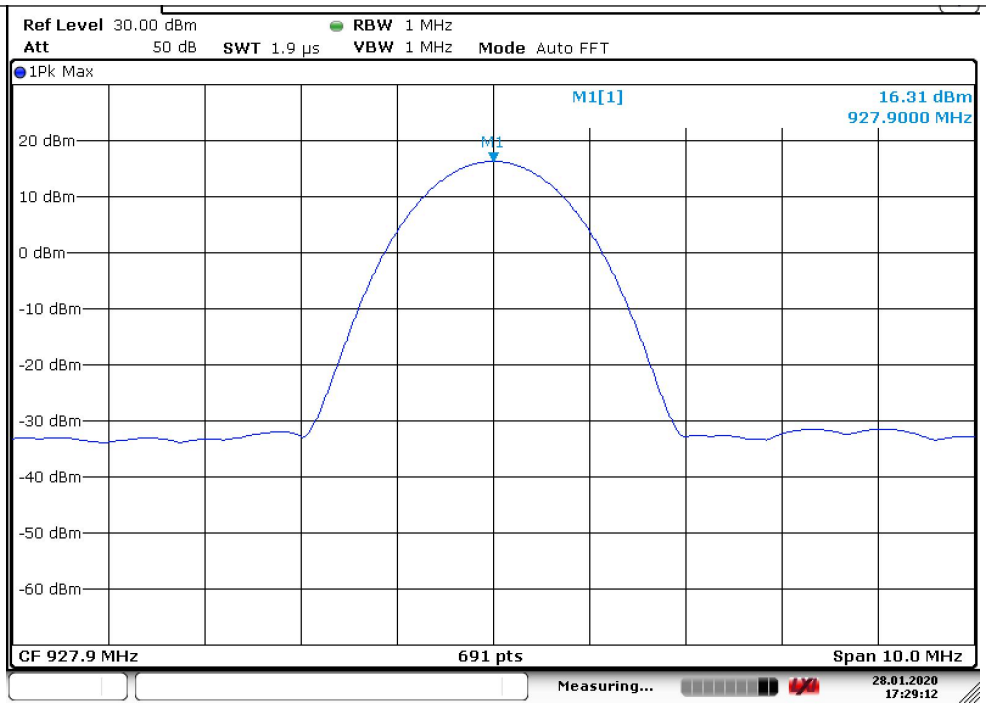
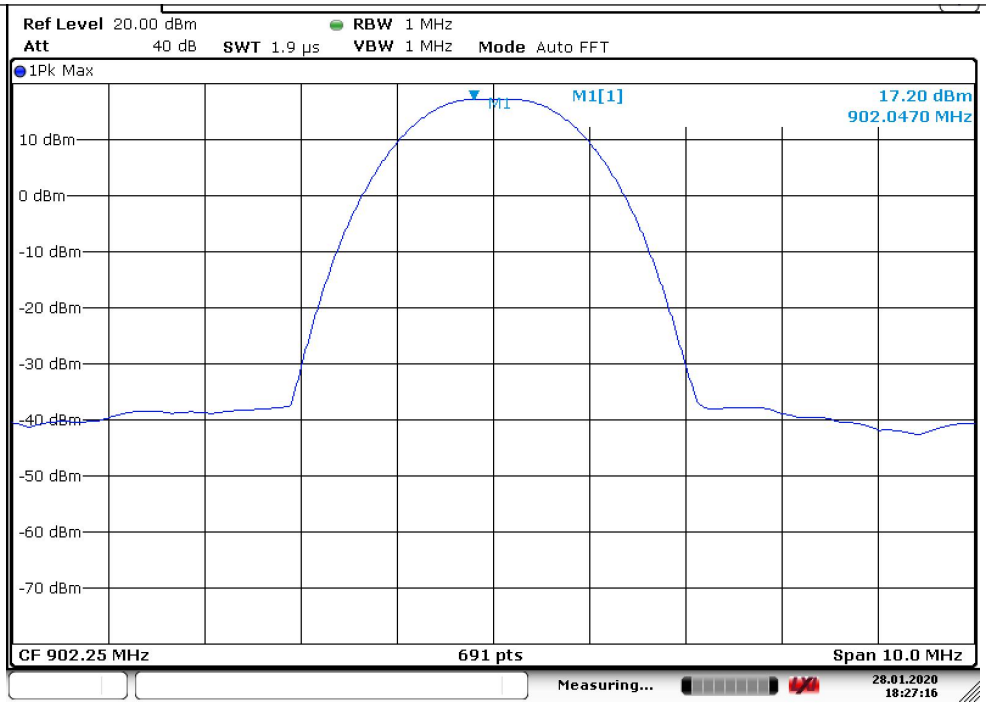
Environmental Conditions

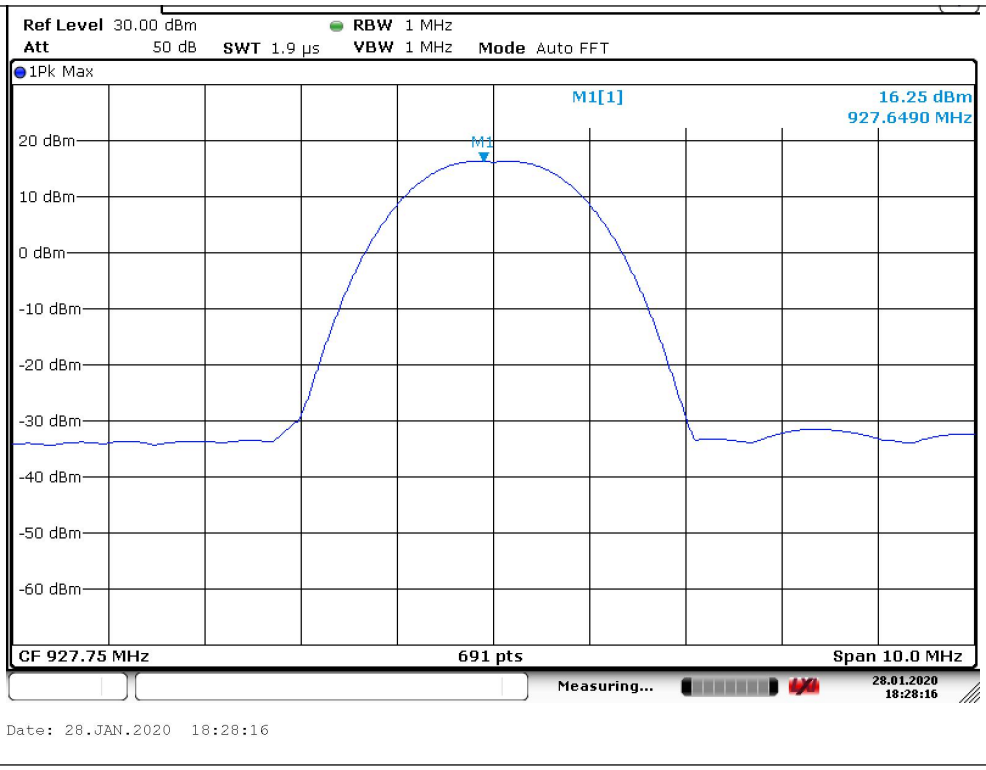
Temperature:	23.8 ° C
Relative Humidity:	53.7%
ATM Pressure:	100.0 kPa
Test Engineer:	David Luo
Supervised by:	Jayden.Zhuo

A.1 Maximum Peak Output Power (dBm)

Mode	Channel.	Maximum Peak Output Power [dBm]	Limit [dBm]	Verdict
HYBRID	902.100	16.92	30	PASS
	903.950	16.77	30	PASS
	927.900	16.31	30	PASS
DTS	902.25	17.2	30	PASS
	927.75	16.25	30	PASS

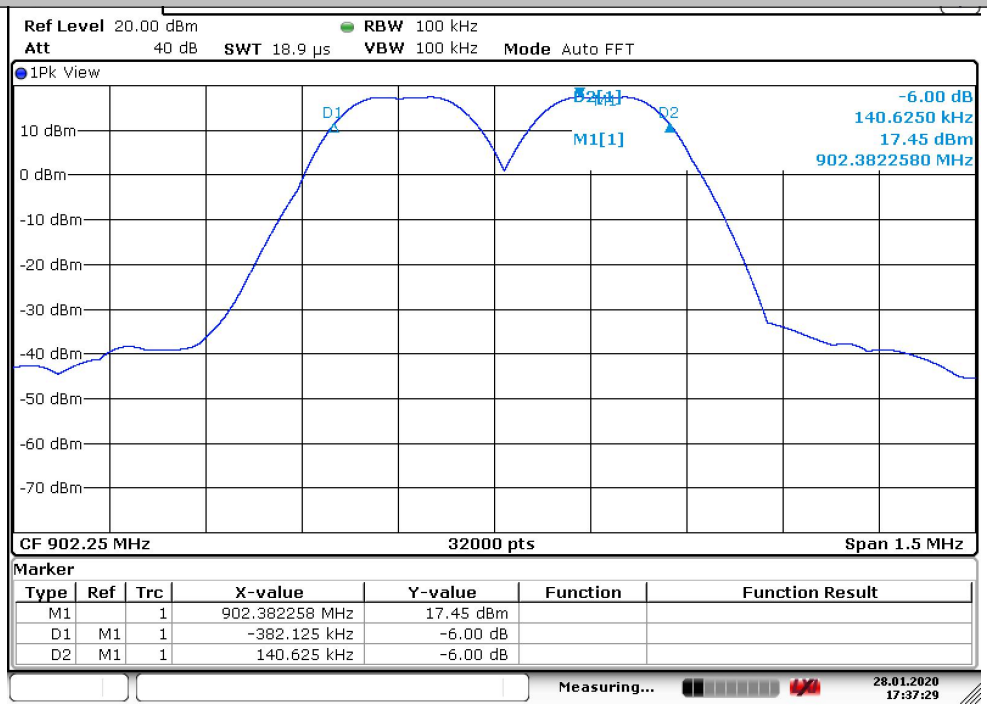
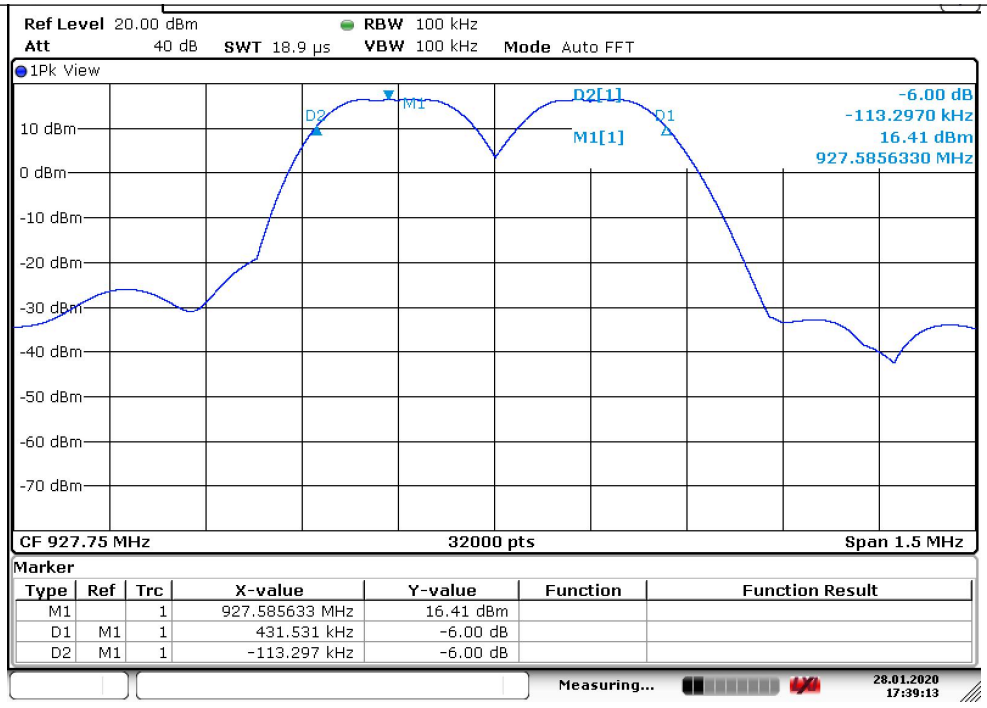
Test Graphs	
HYBRID 902.1MHz	 Date: 28.JAN.2020 17:28:47
HYBRID 903.950MHz	 Date: 28.JAN.2020 17:29:40

HYBRID 927.900MHz	 Date: 28.JAN.2020 17:29:13
DTS 902.25MHz	 Date: 28.JAN.2020 18:27:17

DTS 927.75MHz	

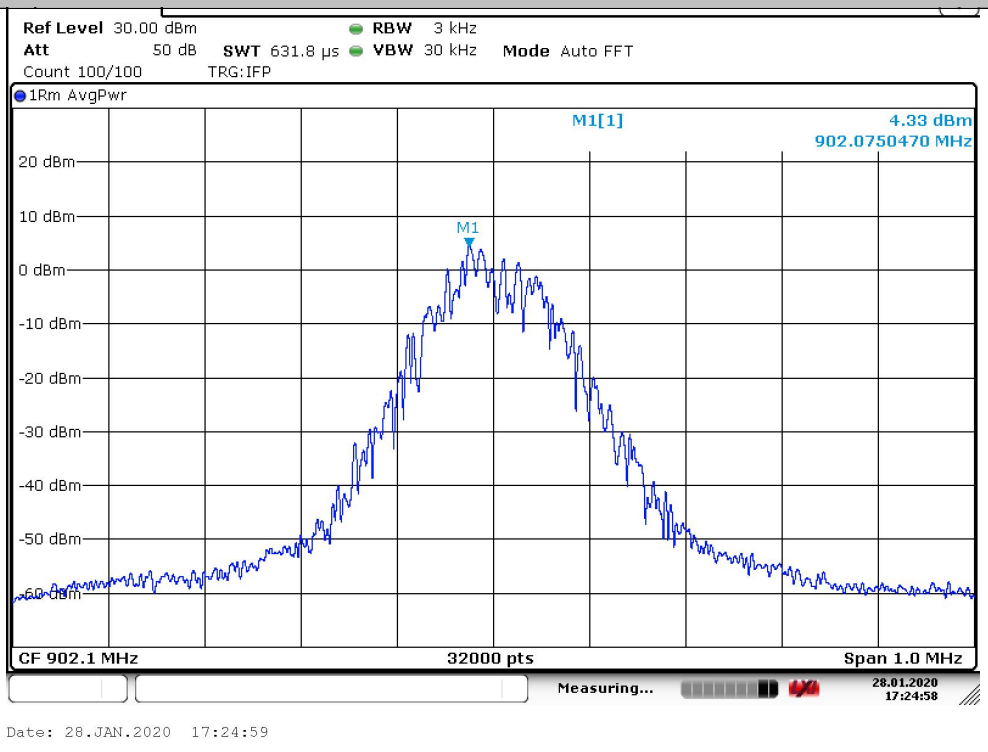
A.2 6dB BANDWIDTH

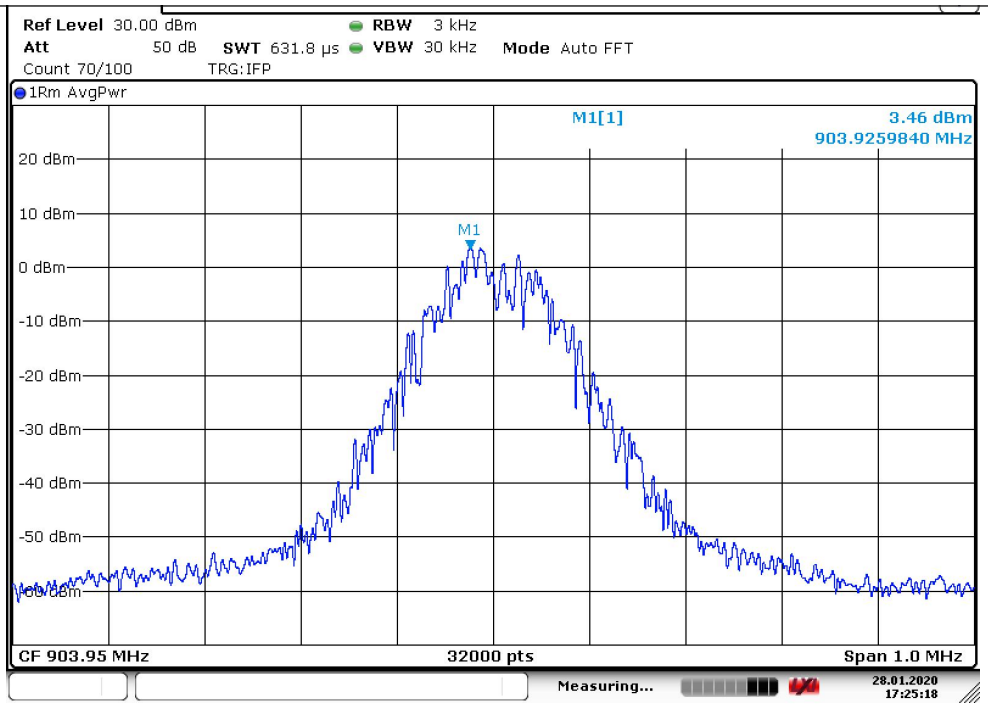
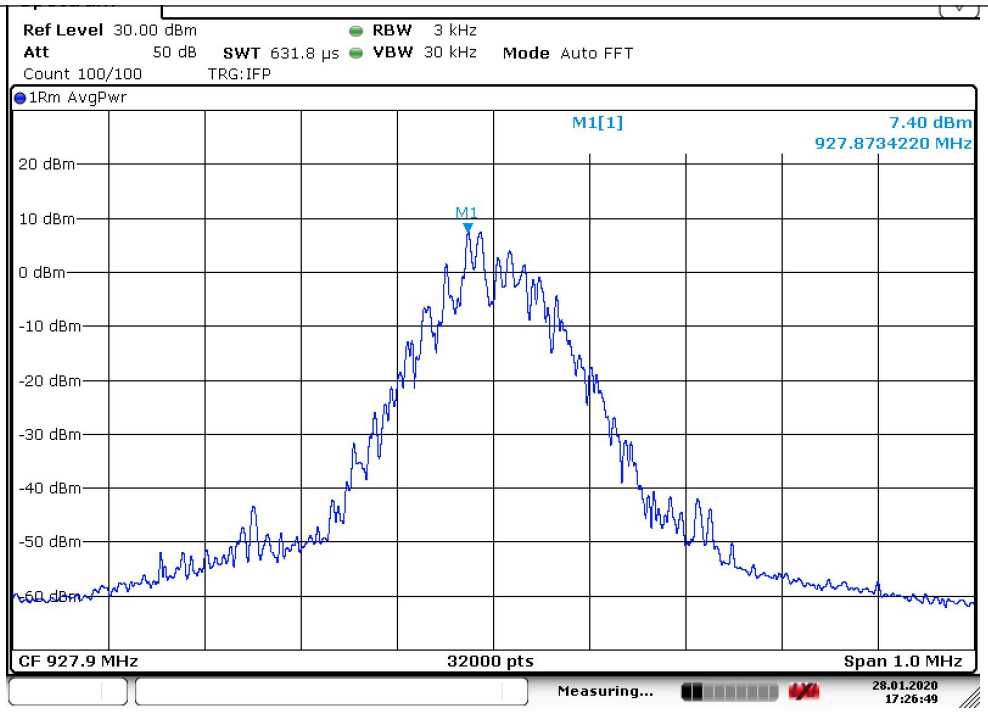
Mode	Channel.	6dB Bandwidth (KHz)	Limit (kHz)	Verdict
DTS	902.25MHz O2O-4	522.75	>=500	PASS
	927.75MHz O2O-3	544.8	>=500	PASS

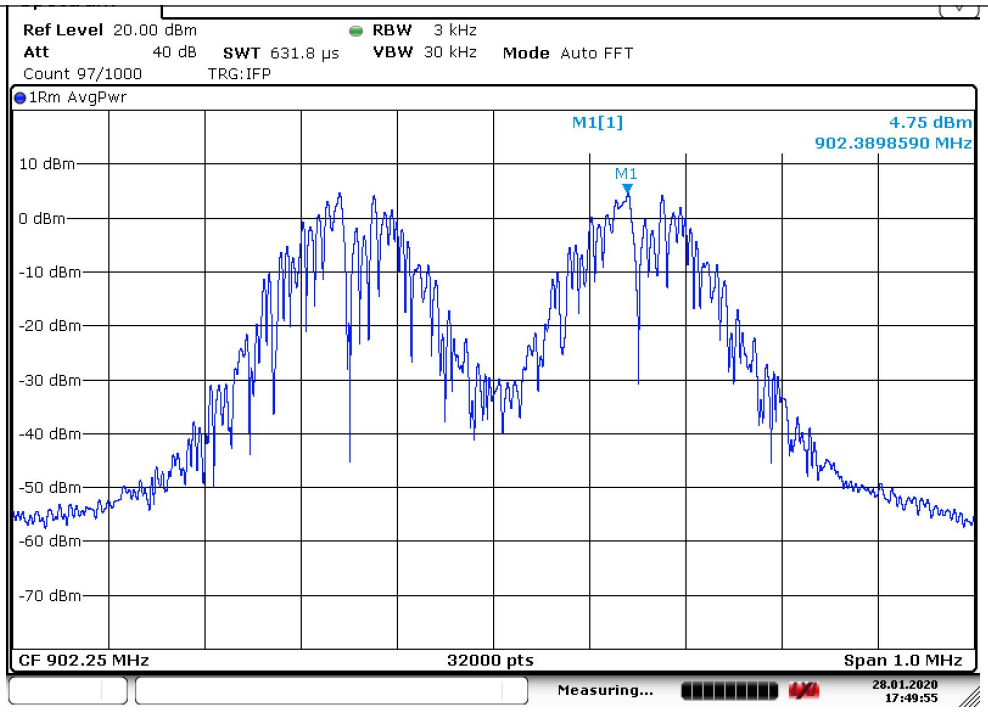
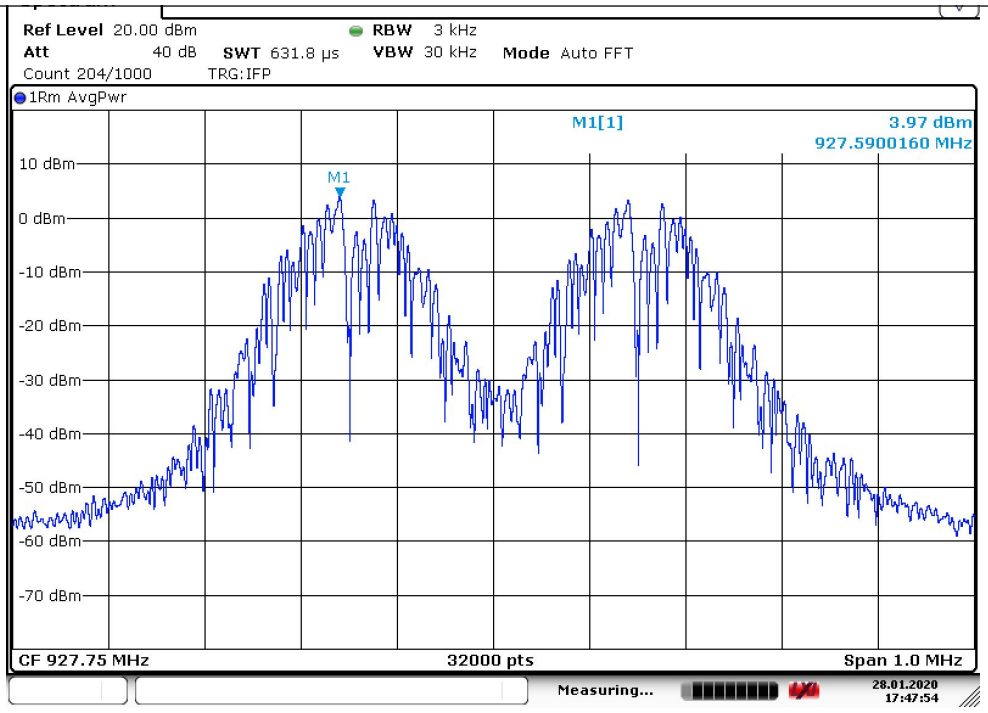
Test Graphs	
DTS / O2O-4 902.25MHz	 Date: 28.JAN.2020 17:37:30
DTS / O2O-3 927.75MHz	 Date: 28.JAN.2020 17:39:13

A.3 POWER DENSITY

Mode	Channel.	Power density (dBm)	Limit [MHz]	Verdict
HYBRID	902.100	4.33	8dBm/3kHz	PASS
	903.950	3.46	8dBm/3kHz	PASS
	927.900	7.4	8dBm/3kHz	PASS
DTS	902.25	4.75	8dBm/3kHz	PASS
	927.75	3.97	8dBm/3kHz	PASS

Test Graphs	
HYBRID 902.1MHz	

HYBRID 903.95MHz	 Date: 28.JAN.2020 17:25:19
HYBRID 927.900MHz	 Date: 28.JAN.2020 17:26:49

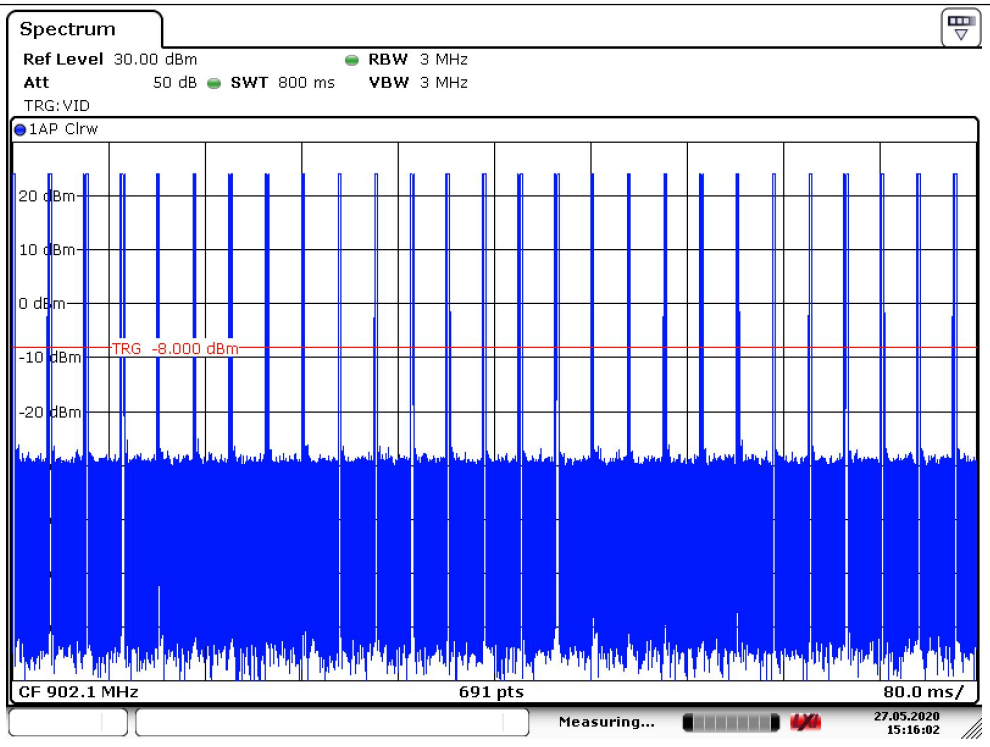
DTS 902.25MHz	 Date: 28.JAN.2020 17:49:55
DTS 927.75MHz	 Date: 28.JAN.2020 17:47:55

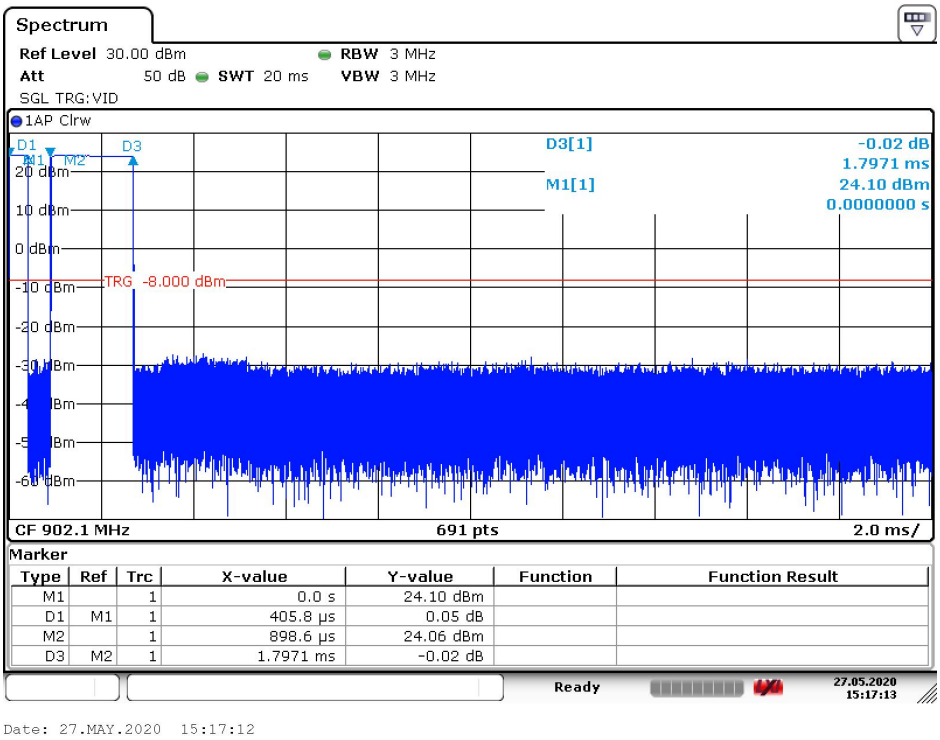
A.4 Dwell Time

Mode	Channel.	Max Burst Width (ms/hop/channel)	Max Number of Hop in a period time equal to the number of hopping frequencies multiplied by 0,4 sec	Dwell Time (s)	Limit (s)	Verdict
HYBRID O2O-1	902.1	2,2	27	0,059	0,4	PASS
	927,9	1,8	27	0,049	0,4	PASS
HYBRID O2O - 2	902,1	1,8	40	0,072	0,4	PASS
	903,95	1,8	40	0,072	0,4	PASS
	927,9	1,8	40	0,072	0,4	PASS
HYBRID O2O - 5	902,1	2,2	20	0,044	0,4	PASS
	903,95	2,7	20	0,054	0,4	PASS
	927,9	4	20	0,080	0,4	PASS

Test Graphs

HYBRID O2O-1 902,1

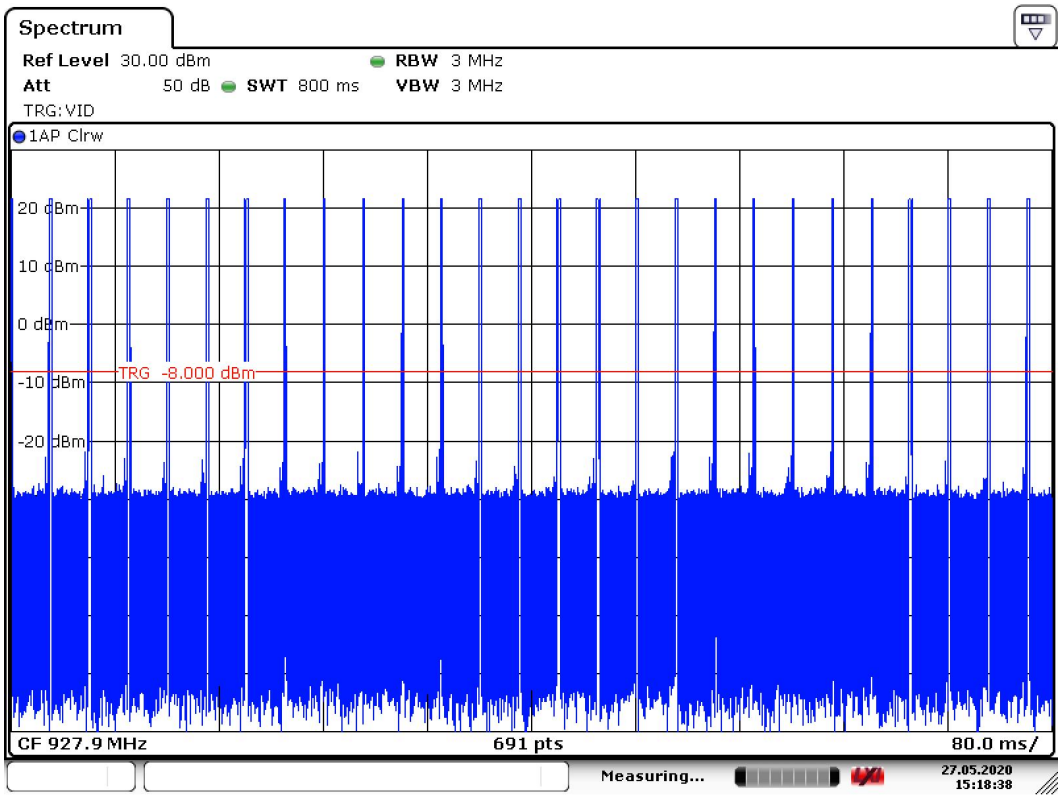




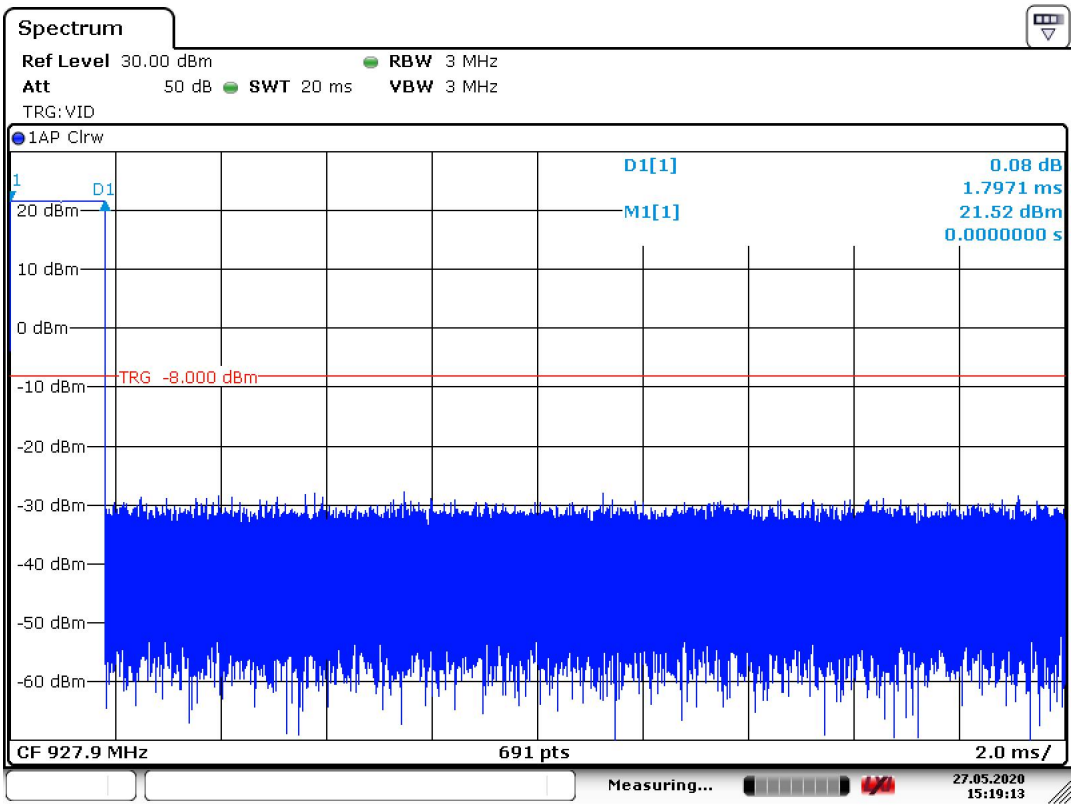
Date: 27.MAY.2020 15:17:12

(the maximum pluse length for a burst）

HYBRID
O2O-1
927,9

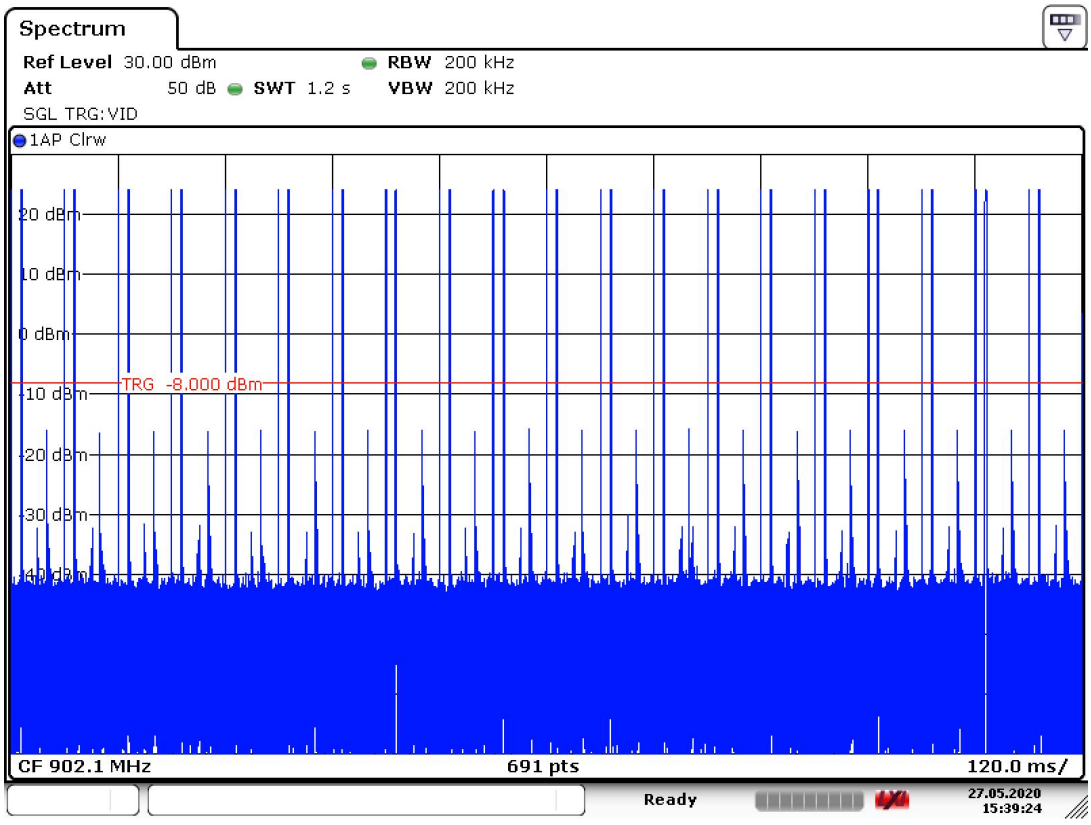


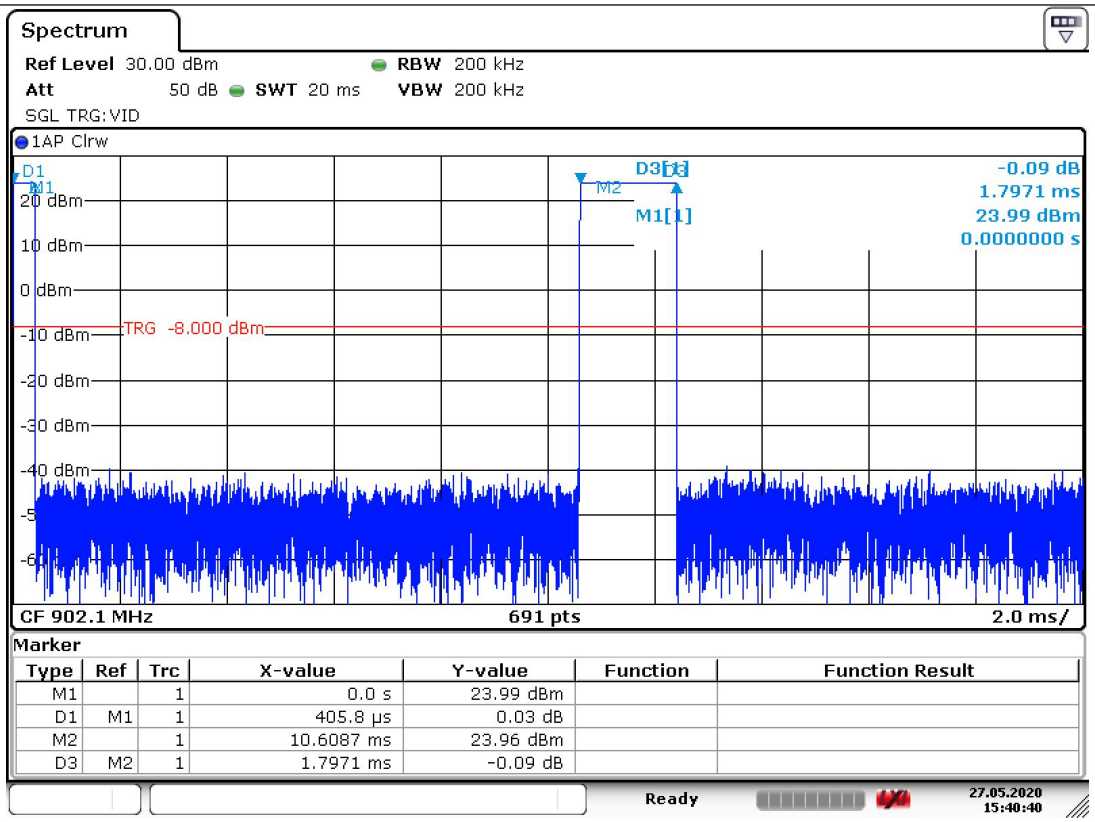
Date: 27.MAY.2020 15:18:38



(the maximum pluse length for a burst）

HYBRID
O2O-2
902,1

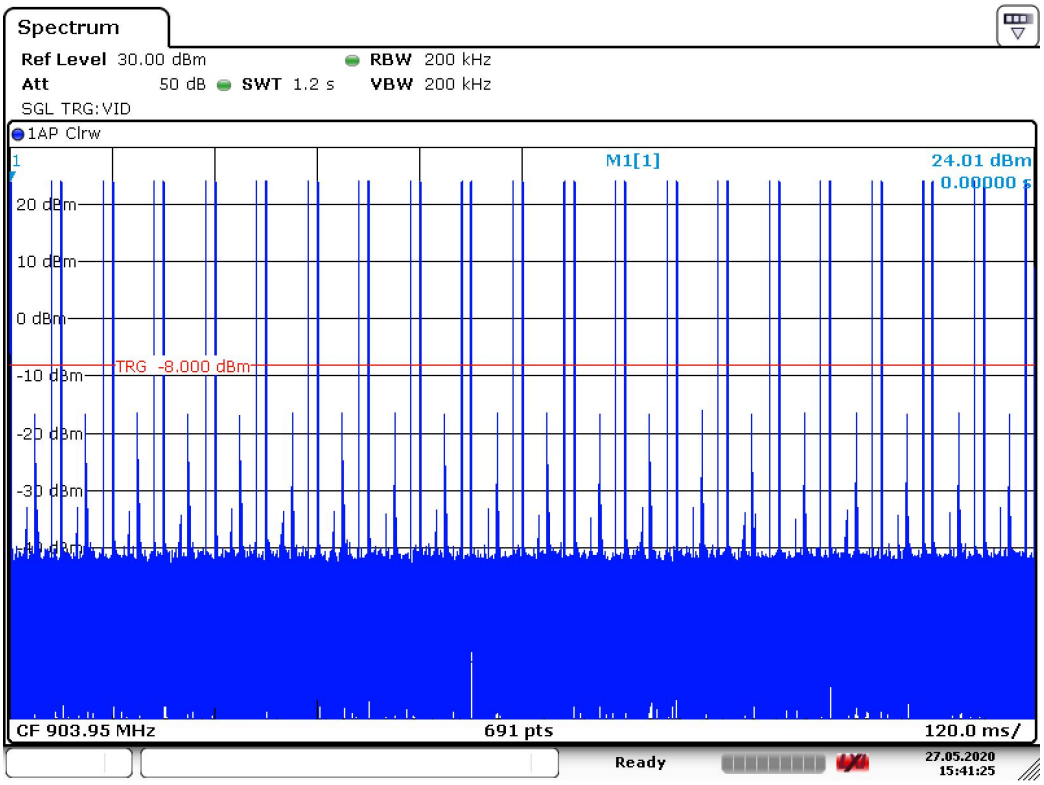




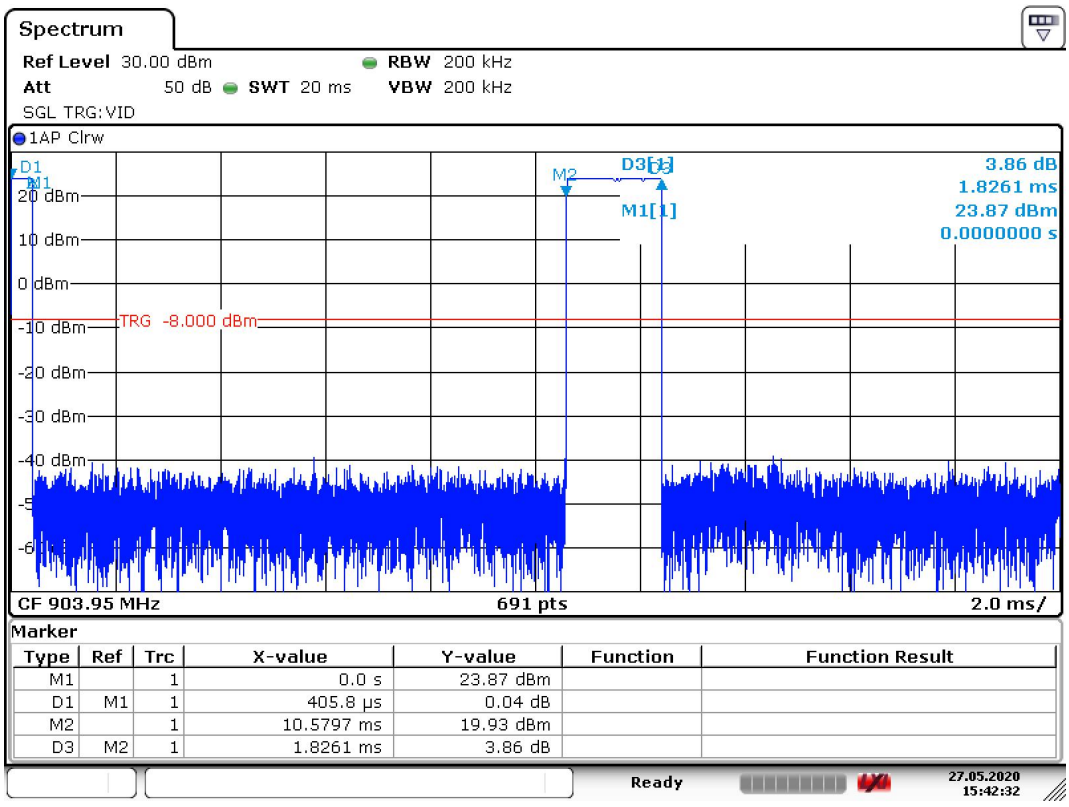
Date: 27.MAY.2020 15:40:40

(the maximum pluse length for a burst）

HYBRID
O2O-2
903,95



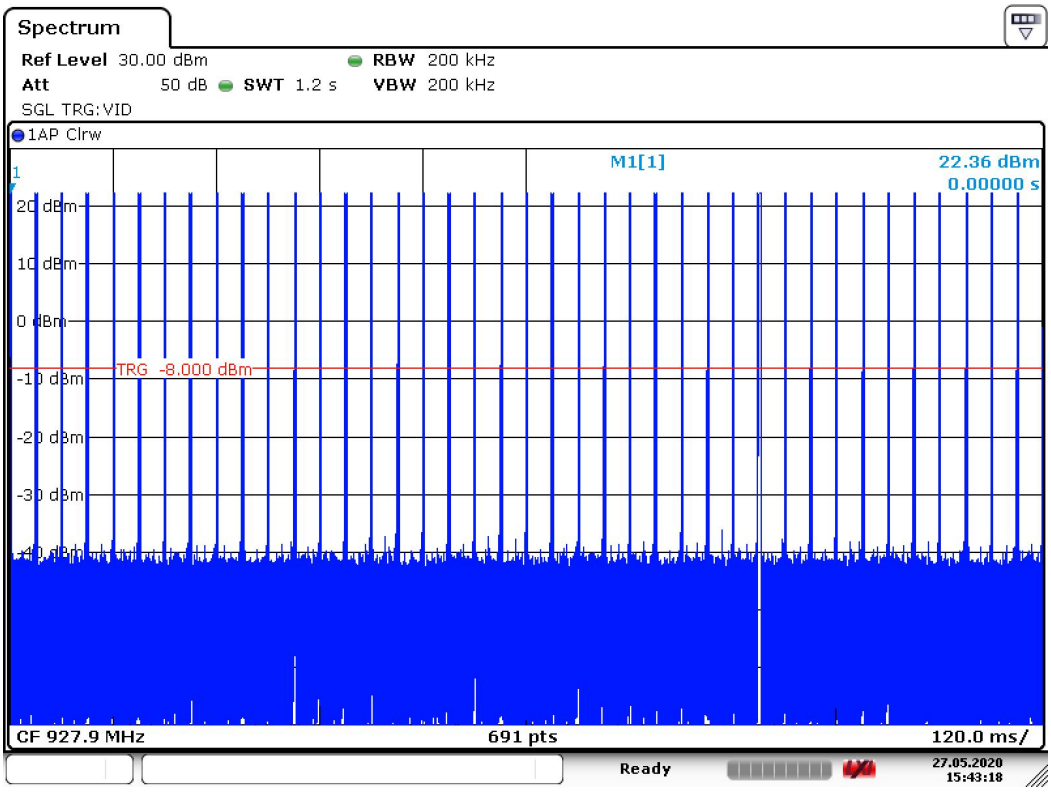
Date: 27.MAY.2020 15:41:24



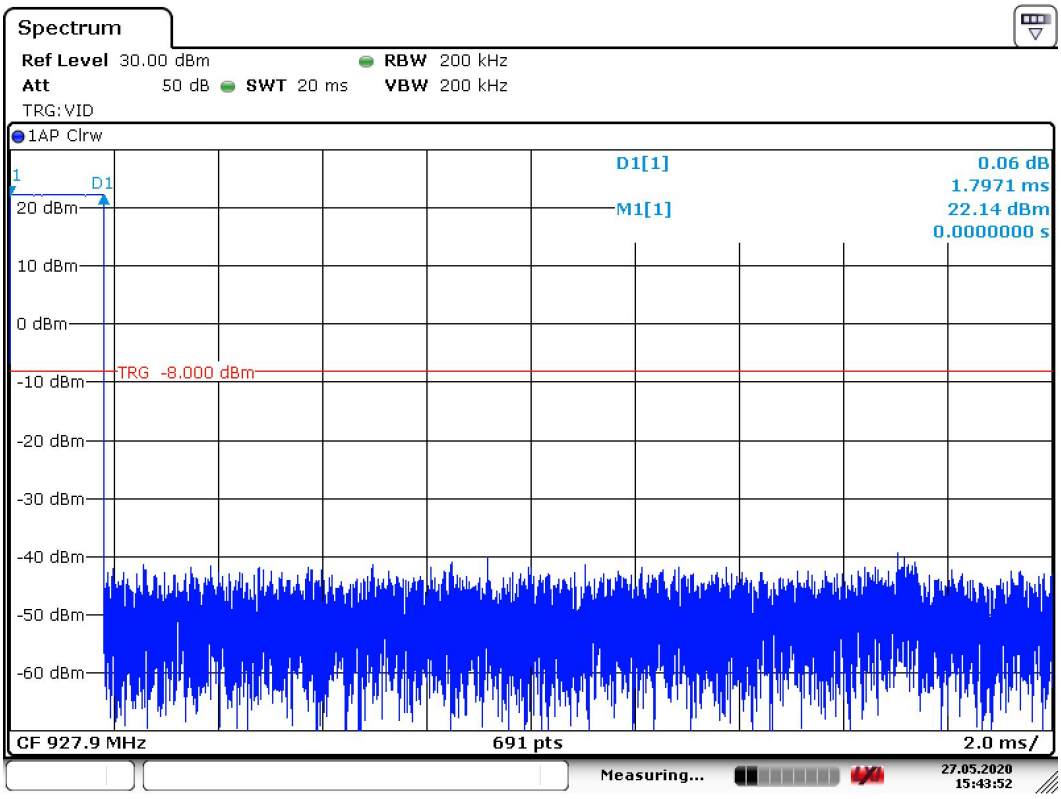
Date: 27.MAY.2020 15:42:32

(the maximum pluse length for a burst）

HYBRID
O2O-2
927,9



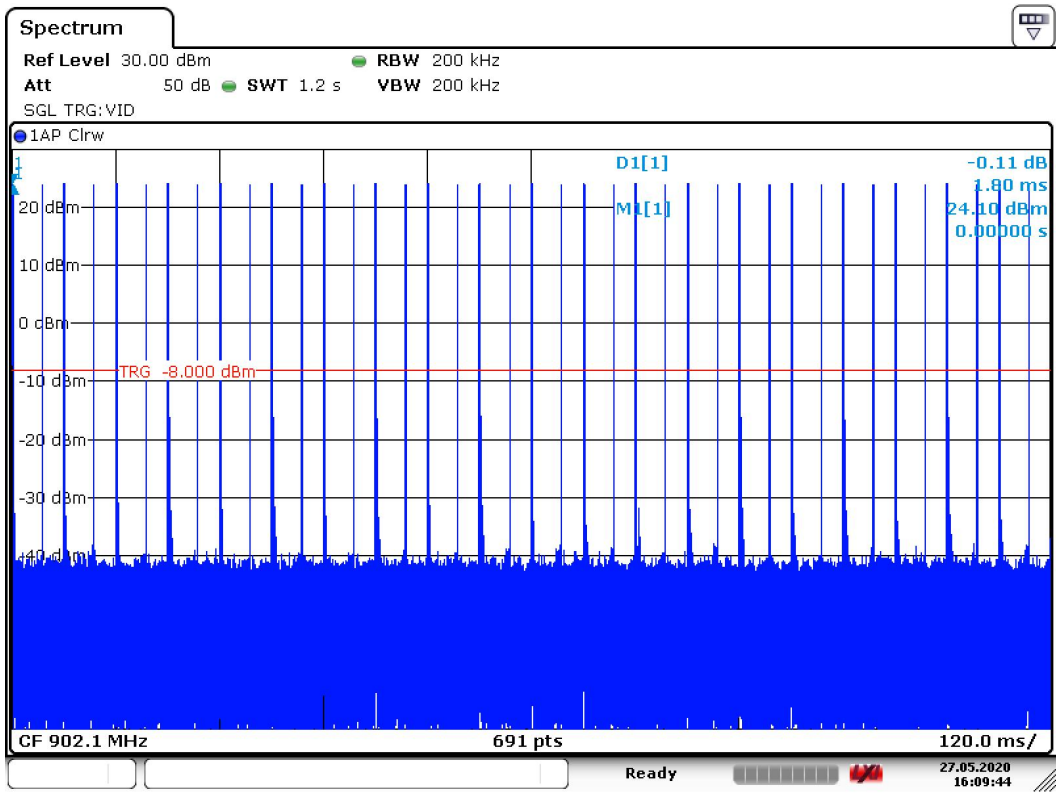
Date: 27.MAY.2020 15:43:18



Date: 27.MAY.2020 15:43:52

(the maximum pluse length for a burst）

HYBRID
O2O-5
902,1



Date: 27.MAY.2020 16:09:44