



BUREAU
VERITAS

Test Report No.: RF160815N007-1



Certificate # 2951.01

TEST REPORT

Applicant:	Sensoro Co., Ltd.
Address:	Room 2807, Building 1B, Wangjing SOHO, No 10 Wangjing Street, Chaoyang District, Beijing City, China

Manufacturer or Supplier	Sensoro Co., Ltd.
Address	Room 2807, Building 1B, Wangjing SOHO, No 10 Wangjing Street, Chaoyang District, Beijing City, China
Product:	Node
Brand Name:	SENSORO
Model:	4AA-02E
Additional Model & Model Difference:	N/A
Date of tests:	Aug. 15, 2016 ~ Jan. 04, 2017

the tests have been carried out according to the requirements of the following standard:

FCC Part 15, Subpart C (Section 15.249)

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Prepared by Breeze Jiang Project Engineer / EMC Department	Approved by Glyn He Supervisor / EMC Department

Date: Jul. 10, 2017

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BUREAU
VERITAS

Test Report No.: RF160815N007-1

TABLE OF CONTENTS

RELEASE CONTROL RECORD	3
1 SUMMARY OF TEST RESULTS.....	4
2 MEASUREMENT UNCERTAINTY	4
3 GENERAL INFORMATION	5
3.1 GENERAL DESCRIPTION OF EUT	5
3.2 DESCRIPTION OF TEST MODES	6
3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS	6
3.4 DESCRIPTION OF SUPPORT UNITS	6
4. TEST TYPES AND RESULTS.....	7
4.1 RADIATED EMISSION MEASUREMENT	7
4.1.1 LIMITS OF RADIATED EMISSION MEASUREMENT	7
4.1.2 TEST INSTRUMENTS.....	8
4.1.3 TEST PROCEDURES	9
4.1.4 DEVIATION FROM TEST STANDARD	9
4.1.5 TEST SETUP.....	10
4.1.6 EUT OPERATING CONDITIONS.....	11
4.1.7 TEST RESULTS	12
4.2 20DB BANDWIDTH MEASUREMENT	17
4.2.1 LIMITS OF 20DB BANDWIDTH MEASUREMENT	17
4.2.2 TEST INSTRUMENTS.....	17
4.2.3 TEST PROCEDURE.....	18
4.2.4 DEVIATION FROM TEST STANDARD	18
4.2.5 TEST SETUP.....	18
4.2.6 EUT OPERATING CONDITIONS	18
4.2.7 TEST RESULTS	19
4 PHOTOGRAPHS OF THE TEST CONFIGURATION.....	22
5 APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB.....	23



BUREAU
VERITAS

Test Report No.: RF160815N007-1

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF160815N007-1	Original release	Jul. 10, 2017



BUREAU
VERITAS

Test Report No.: RF160815N007-1

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC PART 15, SUBPART C (SECTION 15.249)			
STANDARD SECTION	TEST TYPE AND LIMIT	RESULT	REMARK
§15.203	Antenna Requirement	PASS	No antenna connector is used
§15.207 (a)	Conducted Emission	N/A	Powered by battery
§15.205	Restricted Band of Operation	PASS	Compliant
§15.209 §15.249(a)	Radiated Emission	PASS	Compliant
§15.215(c)	20dB Bandwidth Test	PASS	Compliant

2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Radiated emissions	9KHz ~ 30MHz	2.90dB
	30MHz ~ 1GHz	3.83dB
	1GHz ~ 18GHz	4.93dB
	18GHz ~ 40GHz	4.80dB

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



BUREAU
VERITAS

Test Report No.: RF160815N007-1

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Node
MODEL NO.	4AA-02E
FCC ID	2ADYO-S0002X
NOMINAL VOLTAGE	DC 3V(2*1.5V AA series-parallel) from Battery
MODULATION TECHNOLOGY	FSK
OPERATING FREQUENCY	902.3 - 927.9MHz
ANTENNA TYPE	Spring Antenna, 3dBi gain
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	N/A

NOTE:

- 1 For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
- 2 For the test results, the EUT had been tested with all conditions, but only the worst case was shown in test report.
- 3 Please refer to the EUT photo document (Reference No.: 160815N007) for detailed product photo.



BUREAU
VERITAS

Test Report No.: RF160815N007-1

3.2 DESCRIPTION OF TEST MODES

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and packet type. The worst case was found when the EUT was positioned on X axis for radiated emission. The EUT was tested under the following mode.

Following channel was selected for the test as listed below.

TESTED CHANNEL	TESTED FREQUENCY
Low	902.3MHz
Middle	915.1MHz
High	927.9MHz

Note: The more detailed channel, please refer to the product specifications

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE	26deg. C, 50%RH	DC 3.0V from New Battery	Breeze Jiang
BW	26deg. C, 50%RH	DC 3.0V from New Battery	Breeze Jiang
PLC	-	-	-

3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.249)

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

3.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	N/A	N/A	N/A	N/A	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	N/A



BUREAU
VERITAS

Test Report No.: RF160815N007-1

4. TEST TYPES AND RESULTS

4.1 RADIATED EMISSION MEASUREMENT

4.1.1 LIMITS OF RADIATED EMISSION MEASUREMENT

Emissions radiated outside of the specified bands, shall be according to the general radiated limits in 15.209 as following:

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

According to §15.249(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field strength of fundamental (milli-volts/meter)	Field strength of harmonics (micro-volts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.



BUREAU
VERITAS

Test Report No.: RF160815N007-1

4.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR7	101494	Apr. 05,16	Apr. 04, 17
Signal and Spectrum Analyzer	Rohde&Schwarz	FSV7	102331	Nov. 04,16	Nov. 03, 17
Bilog Antenna (30MHz~1GHz)	Teseq	CBL 6111D	30643	Jul. 16, 16	Jul. 15, 17
Loop antenna (9KHz ~30MHz)	Daze	ZN30900A	0708	Mar. 12,16	Mar. 11, 17
Amplifier (9kHz-1GHz)	SONOMA	310D	186955	Mar. 04,16	Mar. 03, 17
Horn Antenna (1GHz -18GHz)	ETS -Lindgren	3117	00062558	May 18,16	May 17, 17
GPS Generator+ Antenna	TOJOIN	GNSS-5000A	E1-010119	Aug. 08, 15	Aug. 07, 17
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	NSEMC003	Mar. 12,16	Mar. 11, 18
Test Software	ADT	ADT_Radiated V7.6.15.9.2	N/A	N/A	N/A
Horn Antenna	SCHWARZBEC K	BBHA 9170	BBHA9170242	Mar. 12,16	Mar. 11, 17
Horn Antenna (18GHz-40GHz)	SCHWARZBEC K	BBHA 9170	BBHA9170242	Mar. 15,16	Mar. 14, 17
Pre-Amplifier (1GHz-18GHz)	HP	8449B	3008A00409	Apr. 25,16	Apr. 24, 17
Pre-Amplifier (18GHz-40GHz)	EMCI	EMC 184045	980102	Nov. 04,16	Nov. 03, 17
Test Software	ADT	ADT_Radiated V7.6.15.9.2	N/A	N/A	N/A

NOTE:

1. The test was performed in 966 Chamber.
2. The calibration interval of the above test instruments is 12 or 24 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
3. The horn antenna is used only for the measurement of emission frequency above 1GHz if tested.
4. The FCC Site Registration No. is 502831.



BUREAU
VERITAS

Test Report No.: RF160815N007-1

4.1.3 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 1.5 meters(above 1GHz) and 0.8 meters(below 1GHz) above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

NOTE:

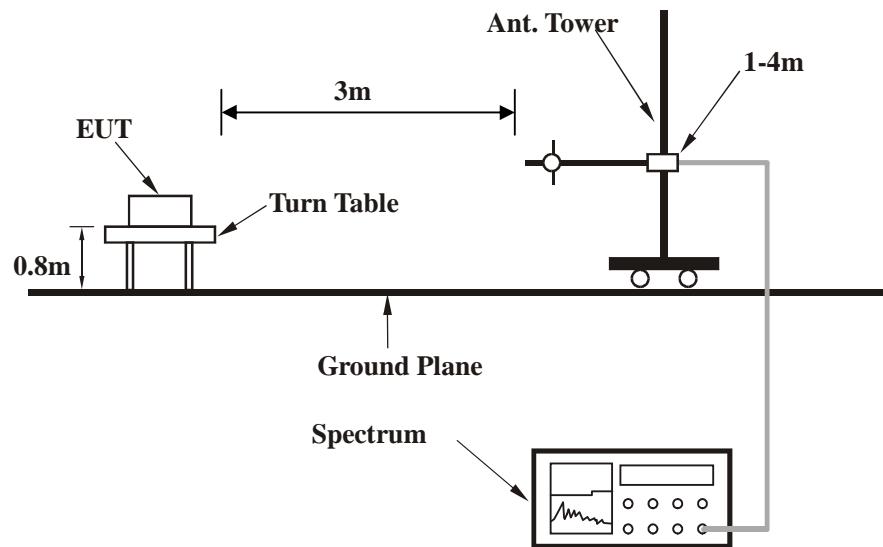
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.
5. The testing of the EUT was performed on all 3 orthogonal axes; the worst-case test configuration was reported on the file test setup photo.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation.

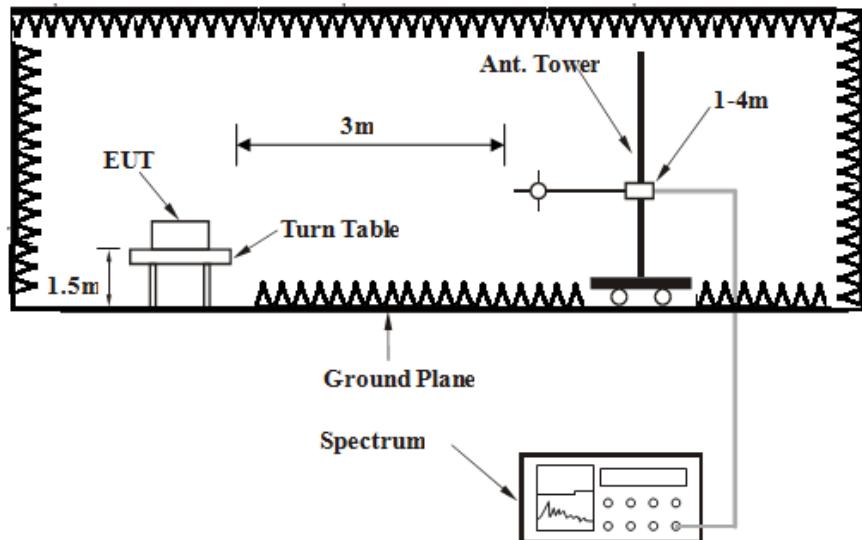
4.1.5 TEST SETUP

Below 1GHz test setup



Note: For the actual test configuration, please refer to the attached file (Test Setup Photo).

Above 1GHz test setup



Note: For the actual test configuration, please refer to the attached file (Test Setup Photo).



BUREAU
VERITAS

Test Report No.: RF160815N007-1

4.1.6 EUT OPERATING CONDITIONS

- a. Set the EUT under placed them on a testing table.
- b. Set the transmitter part of EUT under transmission condition continuously at specific channel frequency.
- c. The necessary accessories enable the EUT in full functions.



BUREAU
VERITAS

Test Report No.: RF160815N007-1

4.1.7 TEST RESULTS

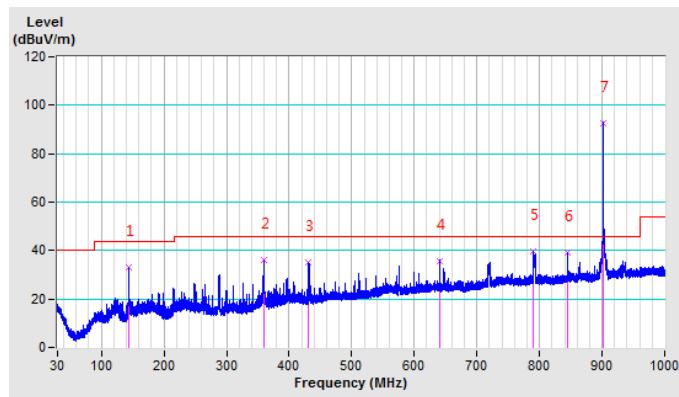
BELOW 1GHz DATA:

EUT TEST CONDITION		MEASUREMENT DETAIL		
CHANNEL	TX Low Channel	FREQUENCY RANGE		9KHz ~ 1GHz
TEST VOLTAGE	DC 3V from Battery	DETECTOR FUNCTION		Quasi-Peak

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	144.13	33.20 QP	43.50	-10.30	100	349	50.21	-17.01
2	359.19	35.95 QP	46.00	-10.05	100	345	46.24	-10.29
3	431.03	35.10 QP	46.00	-10.90	100	277	43.75	-8.65
4	639.95	35.62 QP	46.00	-10.38	100	298	38.71	-3.09
5	790.24	39.72 QP	46.00	-6.28	100	219	39.54	0.18
6	845.07	39.01 QP	46.00	-6.99	100	261	38.43	0.58
7	*902.27	91.54 QP	94.00	-2.46	100	156	89.89	1.65

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.





BUREAU
VERITAS

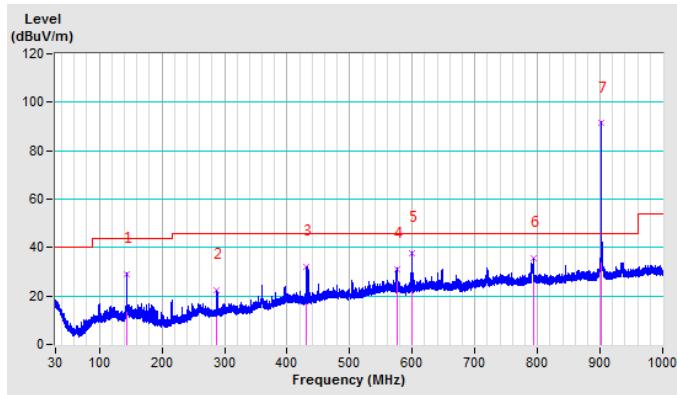
Test Report No.: RF160815N007-1

EUT TEST CONDITION		MEASUREMENT DETAIL		
CHANNEL	TX Low Channel	FREQUENCY RANGE		9KHz ~ 1GHz
TEST VOLTAGE	DC 3V from Battery	DETECTOR FUNCTION		Quasi-Peak

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	144.10	29.17 QP	43.50	-14.33	100	15	46.18	-17.01
2	287.35	22.47 QP	46.00	-23.53	100	32	36.21	-13.74
3	431.03	32.01 QP	46.00	-13.99	100	55	40.66	-8.65
4	576.11	31.17 QP	46.00	-14.83	100	68	35.26	-4.09
5	599.97	37.75 QP	46.00	-8.25	100	115	41.62	-3.87
6	792.97	35.59 QP	46.00	-10.41	100	84	35.50	0.09
7	*902.27	90.33 QP	94.00	-3.67	100	247	88.68	1.65

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.



BUREAU
VERITAS

Test Report No.: RF160815N007-1

ABOVE 1GHz DATA:

EUT TEST CONDITION		MEASUREMENT DETAIL		
CHANNEL		TX Low Channel		FREQUENCY RANGE 1 ~ 10GHz
TEST VOLTAGE		DC 3V from Battery		DETECTOR FUNCTION Peak (PK) Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	1804.60	50.55 PK	74.00	-23.45	2.00 H	332	50.22	0.33
2	1804.60	50.55 AV	54.00	-3.45	2.00 H	332	50.22	0.33
3	2706.90	44.55 PK	74.00	-29.45	2.00 H	43	41.62	2.93
4	2706.90	44.55 AV	54.00	-9.45	2.00 H	43	41.62	2.93
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	1804.60	51.81 PK	74.00	-22.19	1.00 V	306	51.48	0.33
2	1804.60	81.81 AV	54.00	-2.19	1.00 V	306	51.48	0.33
3	2706.90	49.73 PK	74.00	-24.27	1.00 V	127	46.80	2.93
4	2706.90	49.73 AV	54.00	-4.27	1.00 V	127	46.80	2.93

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.



BUREAU
VERITAS

Test Report No.: RF160815N007-1

EUT TEST CONDITION		MEASUREMENT DETAIL		
CHANNEL		TX Middle Channel		FREQUENCY RANGE 1 ~ 10GHz
TEST VOLTAGE		DC 3V from Battery		DETECTOR FUNCTION Peak (PK) Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	1830.20	50.10 PK	74.00	-23.90	2.00 H	270	49.42	0.68
2	1830.20	50.10 AV	54.00	-3.90	2.00 H	270	49.42	0.68
3	2745.30	46.62 PK	74.00	-27.38	2.00 H	15	43.75	2.87
4	2745.30	46.62 AV	54.00	-7.38	2.00 H	15	43.75	2.87
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	1830.20	45.76 PK	74.00	-28.24	1.00 V	32	45.08	0.68
2	1830.20	45.76 AV	54.00	-8.24	1.00 V	32	45.08	0.68
3	2745.30	46.85 PK	74.00	-27.15	1.00 V	185	43.98	2.87
4	2745.30	46.85 AV	54.00	-7.15	1.00 V	185	43.98	2.87

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.



BUREAU
VERITAS

Test Report No.: RF160815N007-1

EUT TEST CONDITION			MEASUREMENT DETAIL		
CHANNEL		TX High Channel		FREQUENCY RANGE	1 ~ 10GHz
TEST VOLTAGE		DC 3V from Battery		DETECTOR FUNCTION	Peak (PK) Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	1855.80	49.23 PK	74.00	-24.77	2.00 H	18	48.37	0.86
2	1855.80	49.23 AV	54.00	-4.77	2.00 H	18	48.37	0.86
3	2783.70	46.27 PK	74.00	-27.73	2.00 H	174	43.25	3.02
4	2783.70	46.27 AV	54.00	-7.73	2.00 H	174	43.25	3.02
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	1855.80	50.80 PK	74.00	-23.20	1.00 V	160	49.94	0.86
2	1855.80	50.80 AV	54.00	-3.20	1.00 V	160	49.94	0.86
3	2783.70	47.85 PK	74.00	-26.15	1.00 V	177	44.83	3.02
4	2783.70	47.85 AV	54.00	-6.15	1.00 V	177	44.83	3.02

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.



BUREAU
VERITAS

Test Report No.: RF160815N007-1

4.2 20dB BANDWIDTH MEASUREMENT

4.2.1 LIMITS OF 20dB BANDWIDTH MEASUREMENT

According to FCC 15.215(c), must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

4.2.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Power Sensor	Keysight	U2021XA	MY55060016	May 04,16	May 03,17
Power Sensor	Keysight	U2021XA	MY55060018	May 04,16	May 03,17
Digital Multimeter	FLUKE	15B	A1220010DG	Oct. 13, 16	Oct.12, 17
Humid & Temp Programmable Tester	Haida	HD-2257	110807201	Sep.05,16	Sep. 04,17
Oscilloscope	Agilent	DSO9254A	MY51260160	Nov. 04,16	Nov. 03,17
Signal Analyzer	Rohde & Schwarz	FSV7	102331	Nov. 04,16	Nov. 03,17
Signal Generator	Agilent	N5183A	MY50140980	Nov. 04,16	Nov. 03,17
Agile Signal Generator	Agilent	8645A	Agilent	Apr. 22, 16	Apr. 21, 17
ESG Vector Signal Generator	Agilent	E4438C	MY49072505	Aug. 08,16	Aug. 07,17

NOTE:

1. The test was performed in RF Oven room.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRRGT/CHINA and NIM/CHINA.



BUREAU
VERITAS

Test Report No.: RF160815N007-1

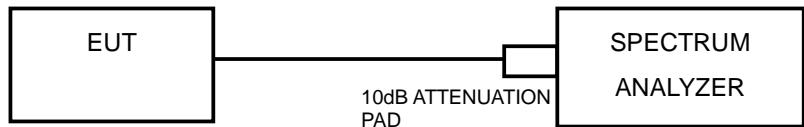
4.2.3 TEST PROCEDURE

- a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
- d. Repeat above procedures until all frequencies measured were complete.

4.2.4 DEVIATION FROM TEST STANDARD

No deviation.

4.2.5 TEST SETUP



4.2.6 EUT OPERATING CONDITIONS

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.



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Test Report No.: RF160815N007-1

4.2.7 TEST RESULTS

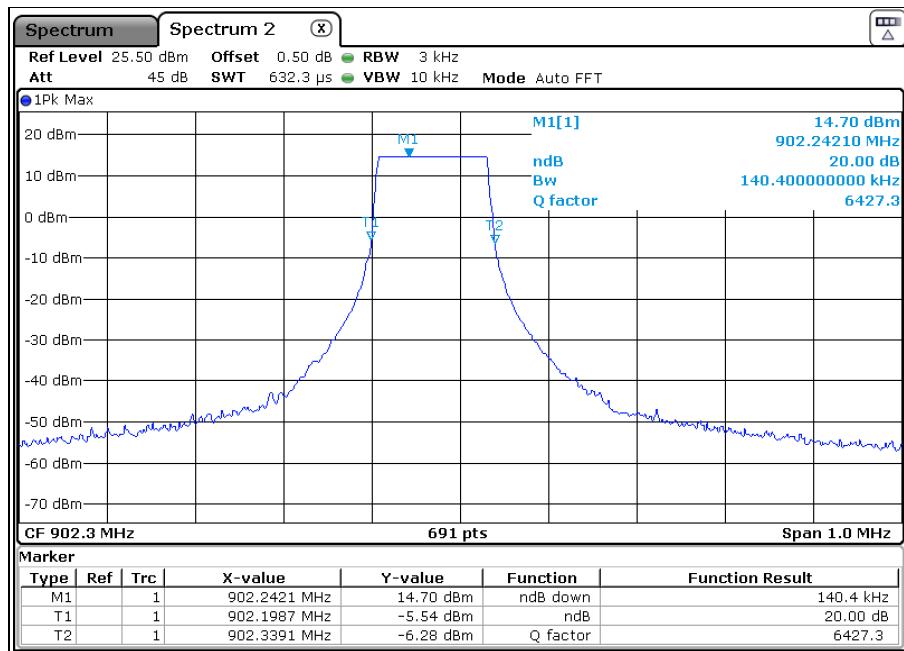
CHANNEL	CHANNEL FREQUENCY (MHz)	20dB BANDWIDTH (MHz)
Low	902.3	0.1404
Middle	915.1	0.1389
High	927.9	0.1404



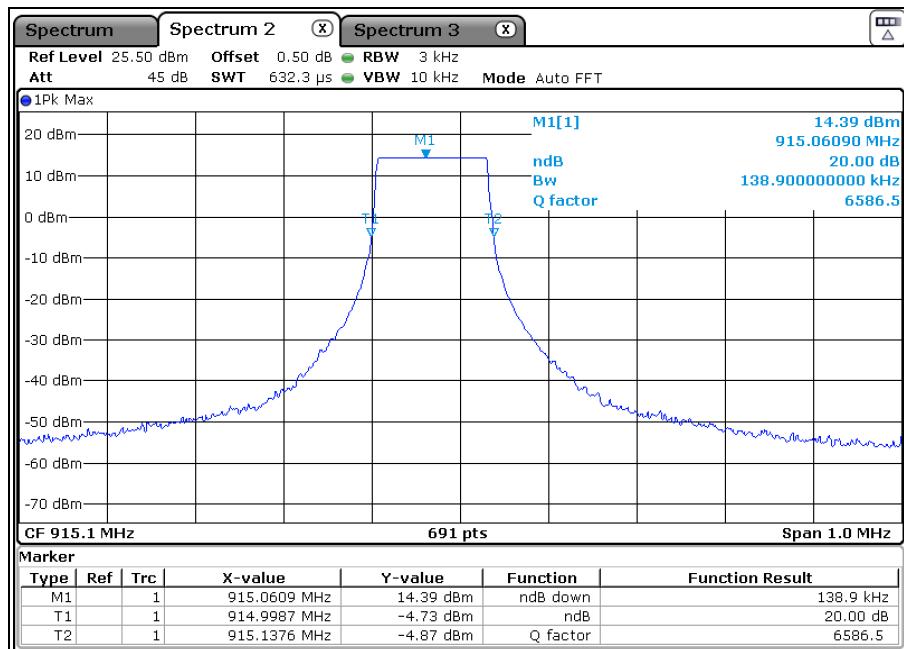
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Test Report No.: RF160815N007-1

Test Data: Low channel



Test Data: Middle channel

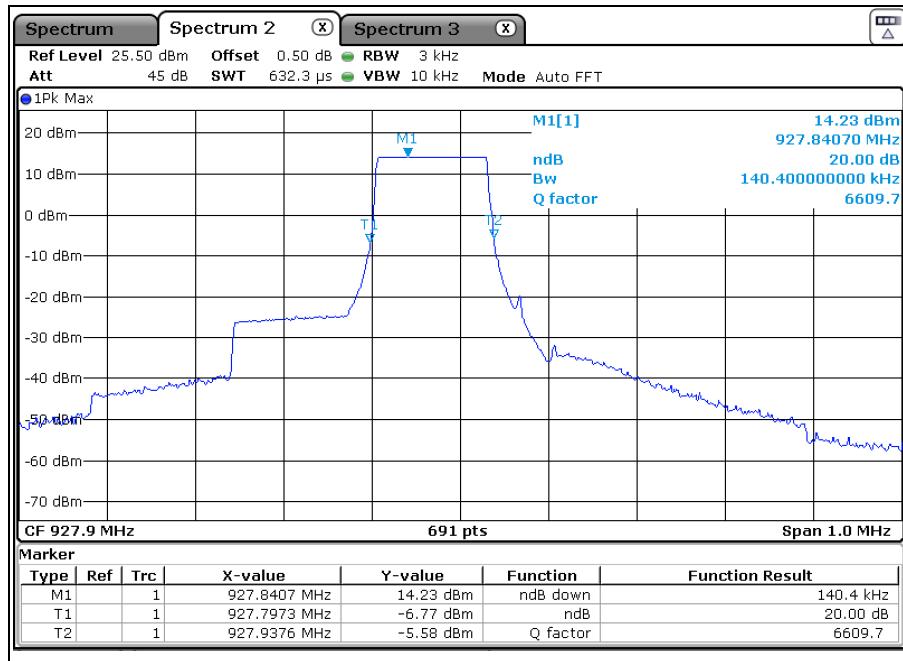




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Test Report No.: RF160815N007-1

Test Data: High channel





Test Report No.: RF160815N007-1

4 PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the attached file (Test Setup Photo).



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Test Report No.: RF160815N007-1

5 APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications are made to the EUT by the lab during the test.

---END---