



FCC RADIO TEST REPORT

FCC ID : RAX-AIOS5V
Equipment : HEOS 5.X Platform Module
Brand Name : Arcadyan
Model Name : WN9722BAC22-DM (AIOS5.0V)
Applicant : Arcadyan Technology Corporation
No.8, Sec.2, Guangfu Rd., Hsinchu, 30071 Taiwan
Manufacturer : Arcadyan Technology Corporation
No.8, Sec.2, Guangfu Rd., Hsinchu, 30071 Taiwan
Standard : 47 CFR FCC Part 15.247

The product was received on Aug. 26, 2020, and testing was started from Aug. 28, 2020 and completed on Aug. 31, 2020. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.


Approved by: Sam Chen

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



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Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
1.1.2	15.203	Antenna Requirement	PASS	-
3.1	15.207	AC Power-line Conducted Emissions	PASS	-
3.2	15.247(d)	Emissions in Restricted Frequency Bands	PASS	-

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

None

Reviewed by: Sam Chen
Report Producer: Sandy Chuang



1 General Description

1.1 Information

1.1.1 RF General Information

Frequency Range (MHz)	IEEE Std. 802.11	Ch. Frequency (MHz)	Channel Number
2400-2483.5	b, g, n (HT20)	2412-2462	1-11 [11]
2400-2483.5	n (HT40)	2422-2452	3-9 [7]

Band	Mode	BWch (MHz)	Nant
2.4-2.4835GHz	802.11b	20	2
2.4-2.4835GHz	802.11g	20	2
2.4-2.4835GHz	802.11n HT20	20	2
2.4-2.4835GHz	802.11n HT40	40	2

Note:

- ♦ 11b mode uses a combination of DSSS-DBPSK, DQPSK, CCK modulation.
- ♦ 11g, HT20 and HT40 use a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM modulation.
- ♦ BWch is the nominal channel bandwidth.

**1.1.2 Antenna Information**

Set	Port	Brand	P/N	Antenna Type	Connector	Gain (dBi)
1	1, 2	Airgain	N2420DG3-T2L-PK1-G30U	PIFA Antenna	I-PEX	Note 1
2	1, 2	Airgain	N2420DG3-T2L-PK1-G100U	PIFA Antenna	I-PEX	
3	1, 2	Airgain	N2420DG3-T2L-PK1-G600U	PIFA Antenna	I-PEX	
4	1, 2	Airgain	N2425D-T2L-PK1-G30U	PIFA Antenna	I-PEX	
5	1, 2	Airgain	N2425D-T2R-PK1-G150U	PIFA Antenna	I-PEX	
6	1, 2	Airgain	N2425D-T2R-PK1-G30U	PIFA Antenna	I-PEX	
7	1, 2	Airgain	N2425D-T2R-PK1-G500U	PIFA Antenna	I-PEX	
8	1, 2	LITE	503021-0123-0BC	Dipole Antenna	I-PEX	
9	1, 2	LITE	501301-0019-1BC (300mm antenna cable: 510411-5210-24C)	Dipole Antenna	I-PEX	
10	1, 2	LITE	501301-0019-1BC (500mm antenna cable: 510411-5300-23C)	Dipole Antenna	I-PEX	
11	1, 2	LITE	503021-0003-0BC (200mm antenna cable)	Dipole Antenna	I-PEX	
12	1, 2	LITE	503021-0013-0BC (500mm antenna cable)	Dipole Antenna	I-PEX	
13	1, 2	LITE	501301-0019-1BC (200mm antenna cable: 510411-5310-23C)	Dipole Antenna	I-PEX	
14	1, 2	LITE	503021-0113-0BC (300mm antenna cable)	Dipole Antenna	I-PEX	



Note 1:

Set	Port	Antenna Gain (dBi)		Cable Loss (dB)		True Gain (dBi)	
		WLAN 2.4GHz / BT	WLAN 5GHz	WLAN 2.4GHz / BT	WLAN 5GHz	WLAN 2.4GHz / BT	WLAN 5GHz
1	1, 2	3.1	3.66	0.105	0.147	2.995	3.513
2	1, 2	3.1	3.66	0.35	0.49	2.75	3.17
3	1, 2	3.1	3.66	2.1	2.94	1	0.72
4	1, 2	1.9	3.5	0.105	0.147	1.795	3.353
5	1, 2	1.9	3.5	0.525	0.735	1.375	2.765
6	1, 2	1.9	3.5	0.105	0.147	1.795	3.353
7	1, 2	1.9	3.5	1.75	2.45	0.15	1.05
8	1, 2	-	-	-	-	2.55	2.35
9	1, 2	3.48	4.29	0.72	1.66	2.76	2.63
10	1, 2	3.48	4.29	1.49	1.7	1.99	2.59
11	1, 2	-	-	-	-	2.52	3.04
12	1, 2	-	-	-	-	1.74	1.68
13	1, 2	-	-	-	-	2.64	2.86
14	1, 2	-	-	-	-	2.35	2.44

Note 2: The above information was declared by manufacturer.

Note 3: The EUT has thirteen sets of antenna, and each set contains two antennas.

<For WLAN 2.4GHz Band>

For IEEE 802.11b/g/n mode <2TX/2RX>:

Port 1 and Port 2 will transmit/receive the same signal simultaneously.

Port 1 and Port 2 can be used as transmitting/receiving antennas.

<For WLAN 5GHz Band>

For IEEE 802.11a/n/ac mode <2TX/2RX>:

Port 1 and Port 2 will transmit/receive the same signal simultaneously.

Port 1 and Port 2 can be used as transmitting/receiving antennas.

<For Bluetooth>

For bluetooth mode <1TX/1RX>:

Only Port 1 can be used as transmitting/receiving antenna.



1.1.3 EUT Operational Condition

EUT Power Type	From host system		
Beamforming Function	<input type="checkbox"/> With beamforming	<input checked="" type="checkbox"/> Without beamforming	
Function	<input checked="" type="checkbox"/> Point-to-multipoint	<input type="checkbox"/> Point-to-point	

Note: The above information was declared by manufacturer.

1.1.4 Table for Class II Change

This product is an extension of original one reported under Sporton project number: FR010205AA.

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
Adding four sets of Dipole antenna. (set 11~14)	1. AC power-line conducted emissions (Antenna set 11) 2. Emissions in Restricted Frequency Bands below 1GHz (Antenna set 11)



1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR FCC Part 15
- ♦ ANSI C63.10-2013

The following reference test guidance is not within the scope of accreditation of TAF.

- ♦ FCC KDB 558074 D01 v05r02
- ♦ FCC KDB 662911 D01 v02r01
- ♦ FCC KDB 414788 D01 v01r01

1.3 Testing Location Information

Testing Location		
<input type="checkbox"/>	HWA YA	ADD : No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL : 886-3-327-3456 FAX : 886-3-327-0973
<input checked="" type="checkbox"/>	JHUBEI	ADD : No.8, Lane 724, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C. TEL : 886-3-656-9065 FAX : 886-3-656-9085

Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
Radiated	03CH06-CB	Stim Sung	24.2-25°C / 54-58%	Aug. 28, 2020
AC Conduction	CO01-CB	Max Lin	21~23°C / 59~60%	Aug. 31, 2020

Test site Designation No. TW0006 with FCC.
Test site registered number IC 4086D with Industry Canada.

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	2.0 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	5.6 dB	Confidence levels of 95%



2 Test Configuration of EUT

2.1 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	AC power-line conducted emissions
Condition	AC power-line conducted measurement for line and neutral
Operating Mode	Normal Link
	There are two modes, one is WLAN 2.4GHz+Bluetooth, the other is WLAN 5GHz+Bluetooth. After evaluating, WLAN 2.4GHz + Bluetooth has been evaluated to be the worst case at AC power-line conducted emissions test, Consequently, measurement will follow this same test mode
1	EUT in Z axis_WLAN 2.4GHz + Bluetooth + antenna set 11

The Worst Case Mode for Following Conformance Tests	
Tests Item	Emissions in Restricted Frequency Bands
Test Condition	Radiated measurement If EUT consist of multiple antenna assembly (multiple antenna are used in EUT regardless of spatial multiplexing MIMO configuration), the radiated test should be performed with highest antenna gain of each antenna type.
Operating Mode < 1GHz	Normal Link
	There are two modes, one is WLAN 2.4GHz+Bluetooth, the other is WLAN 5GHz+Bluetooth. After evaluating, WLAN 5GHz + Bluetooth has been evaluated to be the worst case at Emissions in Restricted Frequency Bands test, Consequently, measurement will follow this same test mode
1	EUT in Z axis_WLAN 5GHz + Bluetooth + antenna set 11

2.2 EUT Operation during Test

During the test, the EUT operation to normal function.

2.3 Accessories

N/A



2.4 Support Equipment

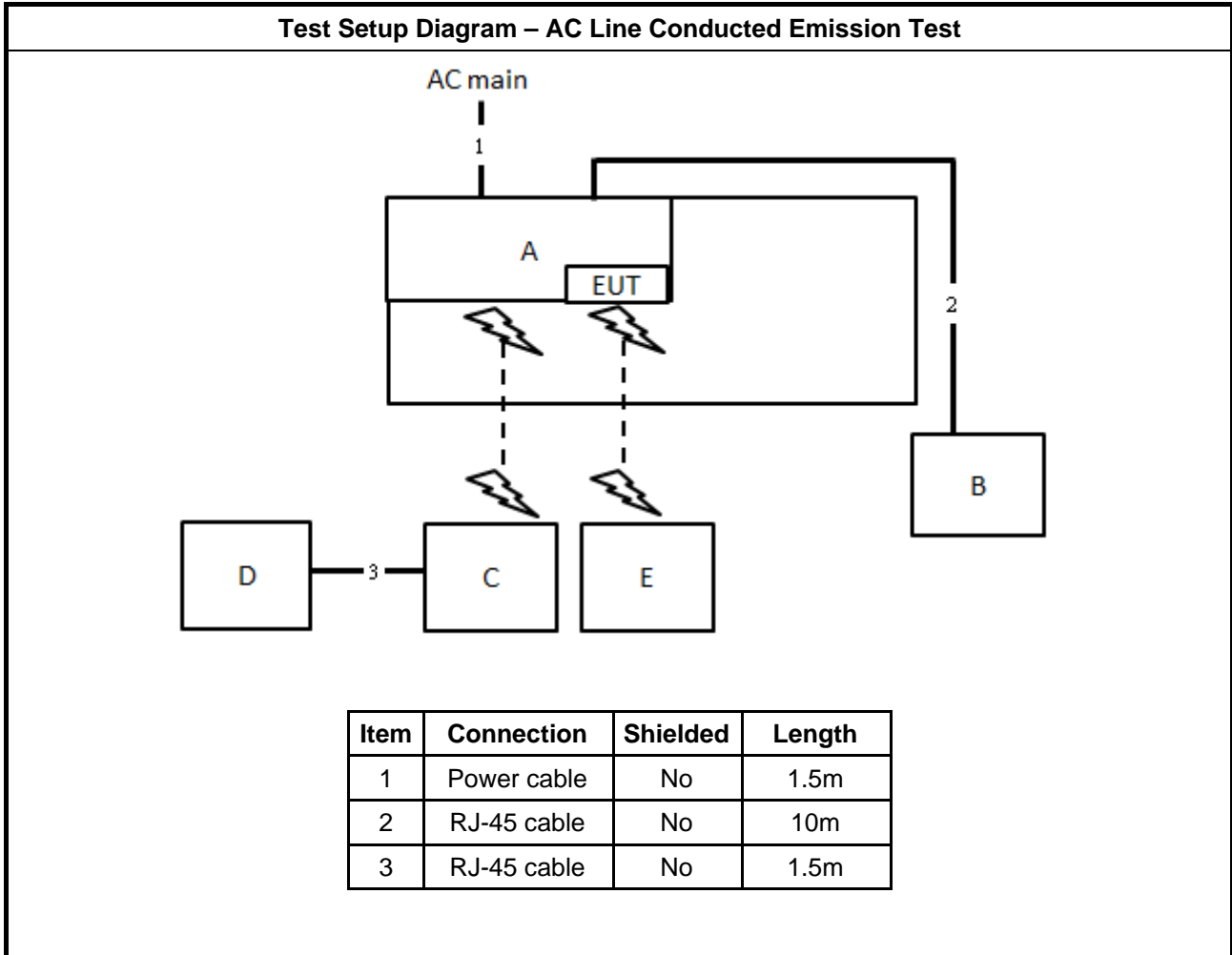
For AC Conduction:

Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID
A	Fixture	Arcadyan	WN9722A-DM Test Jig	N/A
B	LAN NB	DELL	E6430	N/A
C	AP Router	ASUS	RP-N53	MSQ-RPN53
D	AP NB	DELL	E6430	N/A
E	Bluetooth Test Set	Anritsu	MT8852B	N/A

For Radiated:

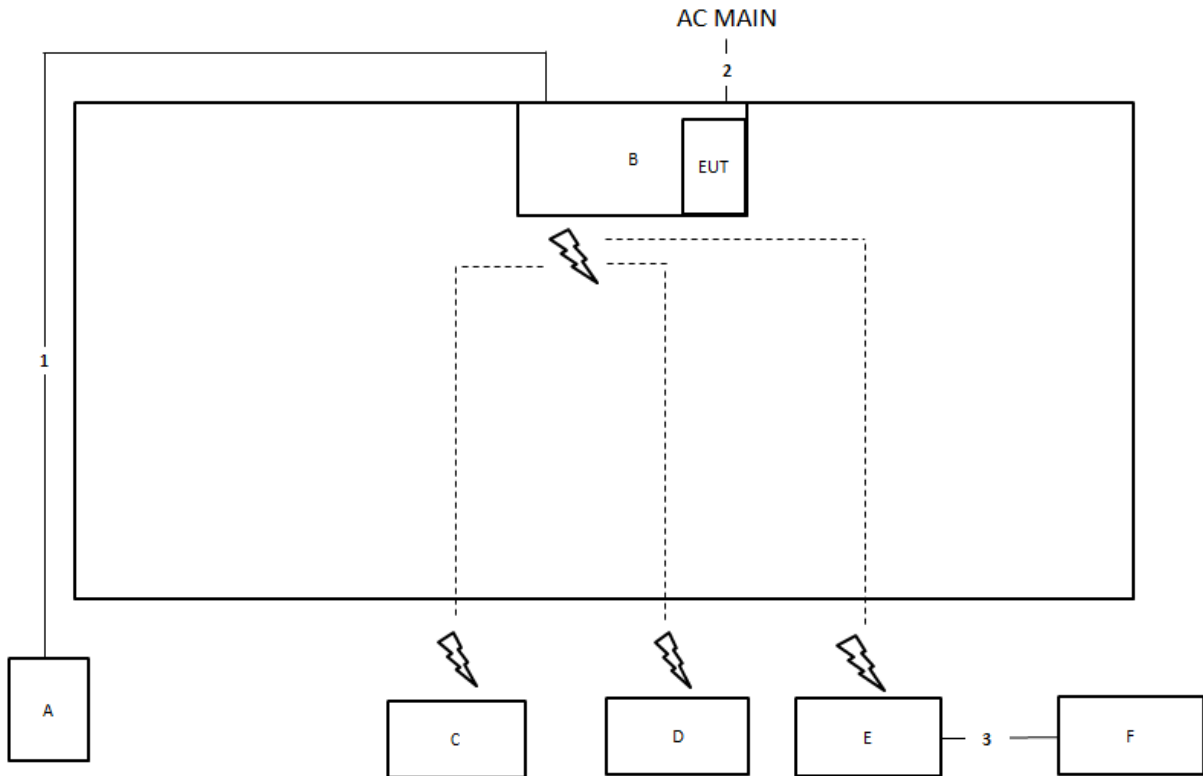
Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID
A	LAN NB	DELL	E4300	N/A
B	Fixture	Arcadyan	WN9722A-DM Test Jig	N/A
C	5G NB	DELL	E4300	N/A
D	Bluetooth Test Set	Anritsu	MT8852B	N/A
E	WLAN AP	D-LINK	DIR860L	KA2IR860LA1
F	NB	DELL	E4300	N/A

2.5 Test Setup Diagram





Test Setup Diagram - Radiated Test



Item	Connection	Shielded	Length
1	RJ-45 cable	No	10m
2	Power cable	No	1.5m
3	RJ-45 cable	No	1.5m



3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 AC Power-line Conducted Emissions Limit

AC Power-line Conducted Emissions Limit		
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: * Decreases with the logarithm of the frequency.

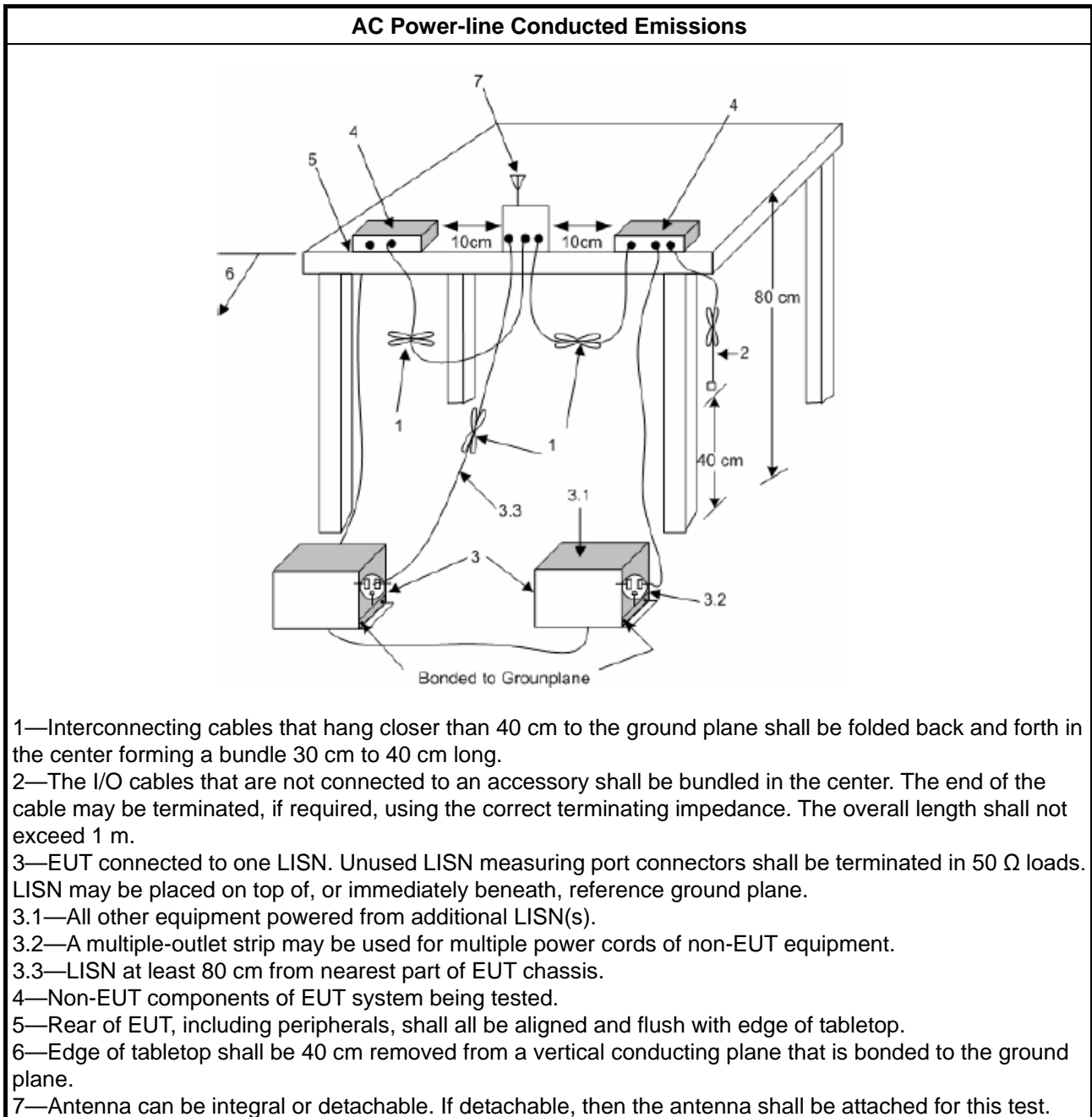
3.1.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

Test Method
<input checked="" type="checkbox"/> Refer as ANSI C63.10-2013, clause 6.2 for AC power-line conducted emissions.

3.1.4 Test Setup



3.1.5 Measurement Results Calculation

The measured Level is calculated using:

- a. Corrected Reading: LISN Factor (LISN) + Attenuator (AT/AUX) + Cable Loss (CL) + Read Level (Raw) = Level
- b. Margin = -Limit + Level

3.1.6 Test Result of AC Power-line Conducted Emissions

Refer as Appendix A



3.2 Emissions in Restricted Frequency Bands

3.2.1 Emissions in Restricted Frequency Bands Limit

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

Note 3: Using the distance of 1m during the test for above 18 GHz, and the test value to correct for the distance factor at 3m.

3.2.2 Measuring Instruments

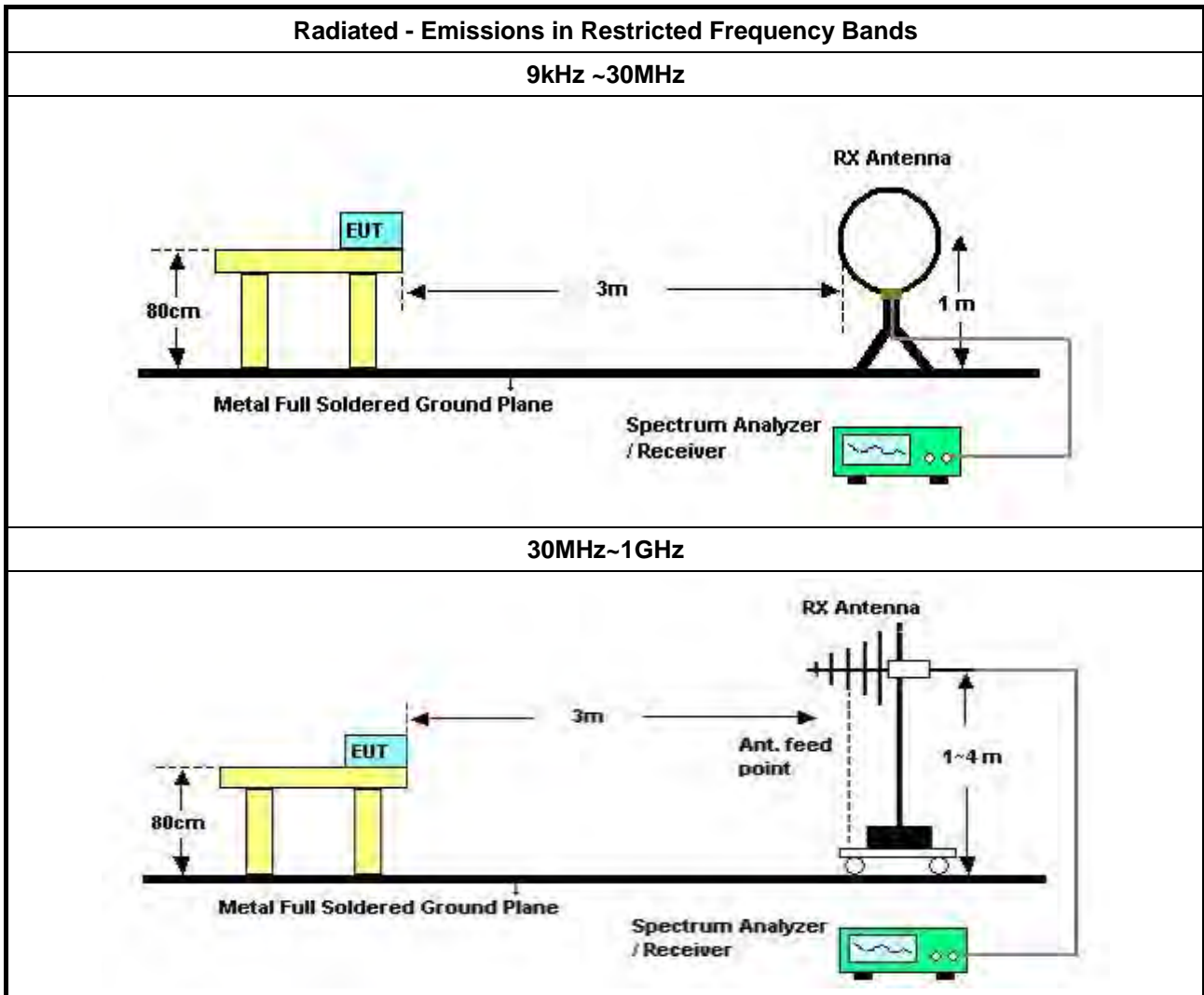
Refer a test equipment and calibration data table in this test report.



3.2.3 Test Procedures

Test Method	
<ul style="list-style-type: none"> ▪ The average emission levels shall be measured in [duty cycle \geq 98 or duty factor]. 	
<ul style="list-style-type: none"> ▪ Refer as ANSI C63.10, clause 6.10.3 band-edge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band. 	
<ul style="list-style-type: none"> ▪ For the transmitter unwanted emissions shall be measured using following options below: 	
	<ul style="list-style-type: none"> ▪ Refer as FCC KDB 558074, clause 8.6 for unwanted emissions into restricted bands.
<input type="checkbox"/>	Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.1(trace averaging for duty cycle \geq 98%).
<input type="checkbox"/>	Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.2(trace averaging + duty factor).
<input checked="" type="checkbox"/>	Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.3(Reduced VBW \geq 1/T).
<input type="checkbox"/>	Refer as ANSI C63.10, clause 11.12.2.5.3 (Reduced VBW). VBW \geq 1/T, where T is pulse time.
<input type="checkbox"/>	Refer as ANSI C63.10, clause 7.5 average value of pulsed emissions.
<input checked="" type="checkbox"/>	Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.4 measurement procedure peak limit.
<ul style="list-style-type: none"> ▪ For the transmitter band-edge emissions shall be measured using following options below: 	
	<ul style="list-style-type: none"> ▪ Refer as FCC KDB 558074 clause 8.7 & C63.10 clause 11.13.1, When the performing peak or average radiated measurements, emissions within 2 MHz of the authorized band edge may be measured using the marker-delta method described below.
	<ul style="list-style-type: none"> ▪ Refer as FCC KDB 558074, clause 8.7 (ANSI C63.10, clause 6.10.6) for marker-delta method for band-edge measurements.
	<ul style="list-style-type: none"> ▪ Refer as FCC KDB 558074, clause 8.7 for narrower resolution bandwidth (100kHz) using the band power and summing the spectral levels (i.e., 1 MHz).
	<ul style="list-style-type: none"> ▪ For conducted unwanted emissions into restricted bands (absolute emission limits). Devices with multiple transmit chains using options given below: (1) Measure and sum the spectra across the outputs or (2) Measure and add 10 log(N) dB
	<ul style="list-style-type: none"> ▪ For FCC KDB 662911 The methodology described here may overestimate array gain, thereby resulting in apparent failures to satisfy the out-of-band limits even if the device is actually compliant. In such cases, compliance may be demonstrated by performing radiated tests around the frequencies at which the apparent failures occurred.

3.2.4 Test Setup



3.2.5 Measurement Results Calculation

The measured Level is calculated using:

Corrected Reading: Antenna factor (AF) + Cable loss (CL) + Read level (Raw) - Preamp factor (PA)(if applicable) = Level

3.2.6 Emissions in Restricted Frequency Bands (Below 30MHz)

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to KDB414788 Radiated Test Site, and the result came out very similar.

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

The radiated emissions were investigated from 9 kHz or the lowest frequency generated within the device, up to the 10th harmonic or 40 GHz, whichever is appropriate.

3.2.7 Test Result of Emissions in Restricted Frequency Bands

Refer as Appendix B



4 Test Equipment and Calibration Data

Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.45GHz	Feb. 26, 2020	Feb. 25, 2021	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 25, 2019	Dec. 24, 2020	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Feb. 25, 2020	Feb. 24, 2021	Conduction (CO01-CB)
Pulse Limiter	Rohde&Schwarz	ESH3-Z2	100430	9kHz ~ 30MHz	Jan. 31, 2020	Jan. 30, 2021	Conduction (CO01-CB)
COND Cable	Woken	Cable	Low cable-CO01	9kHz ~ 30MHz	May 20, 2020	May 19, 2021	Conduction (CO01-CB)
Software	SPORTON	SENSE	V5.10.7	-	N.C.R.	N.C.R.	Conduction (CO01-CB)
Bilog Antenna with 6 dB attenuator	TESEQ & EMCI	CBL6112D & N-6-06	37878 & AT-N0606	20MHz ~ 2GHz	Aug. 02, 2020	Aug. 01, 2021	Radiation (03CH06-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Apr. 13, 2020	Apr. 12, 2021	Radiation (03CH06-CB)
Pre-Amplifier	EMCI	EMC330N	980391	20MHz ~ 3GHz	May 21, 2020	May 20, 2021	Radiation (03CH06-CB)
Spectrum analyzer	R&S	FSP40	100080	9kHz~40GHz	Oct. 21, 2019	Oct. 20, 2020	Radiation (03CH06-CB)
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	May 13, 2020	May 12, 2021	Radiation (03CH06-CB)
RF Cable-low	HUBER+SUHNER	RG402	Low Cable-05+24	30MHz~1GHz	Oct. 07, 2019	Oct. 06, 2020	Radiation (03CH06-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH06-CB)

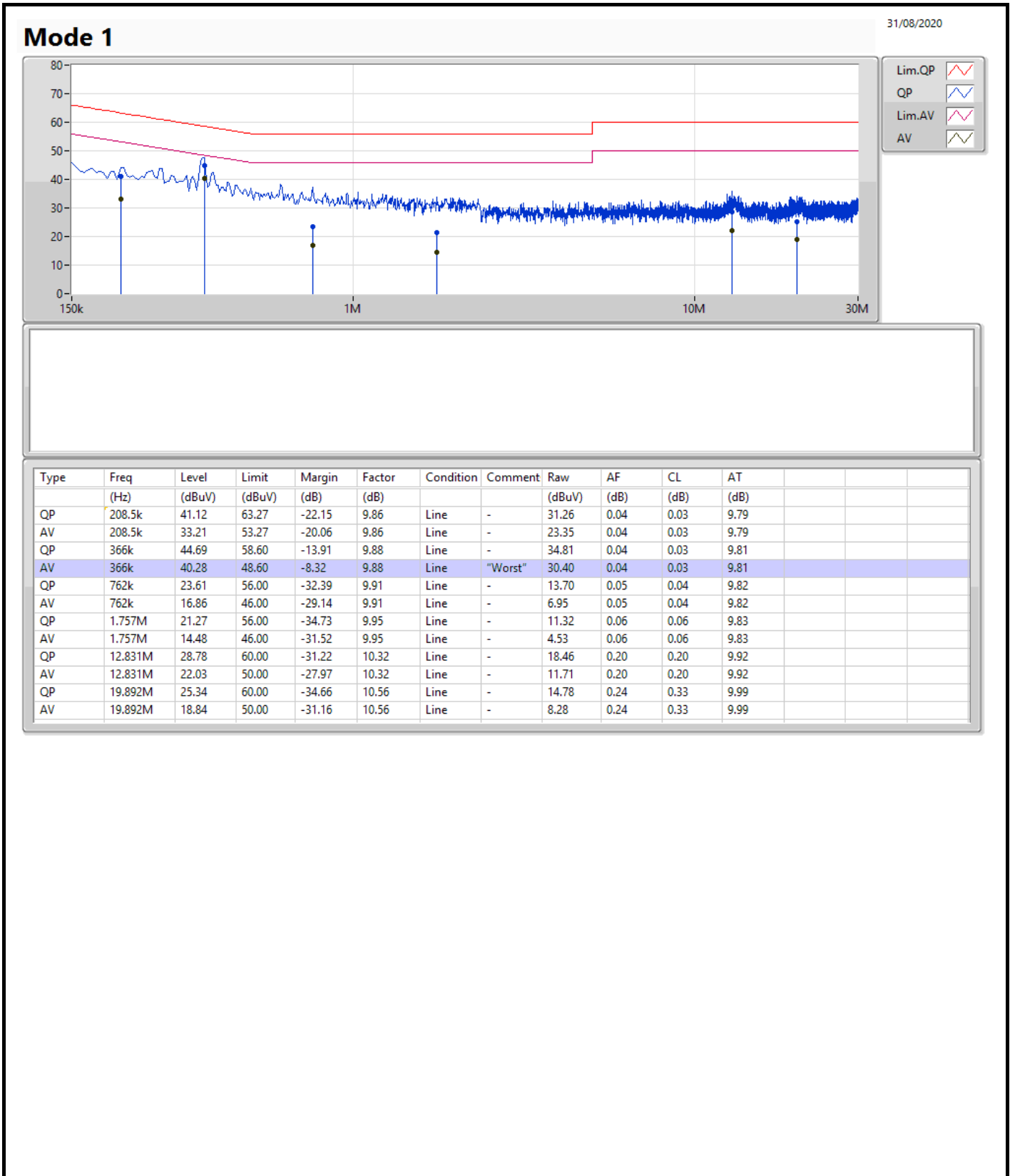
Note: Calibration Interval of instruments listed above is one year.

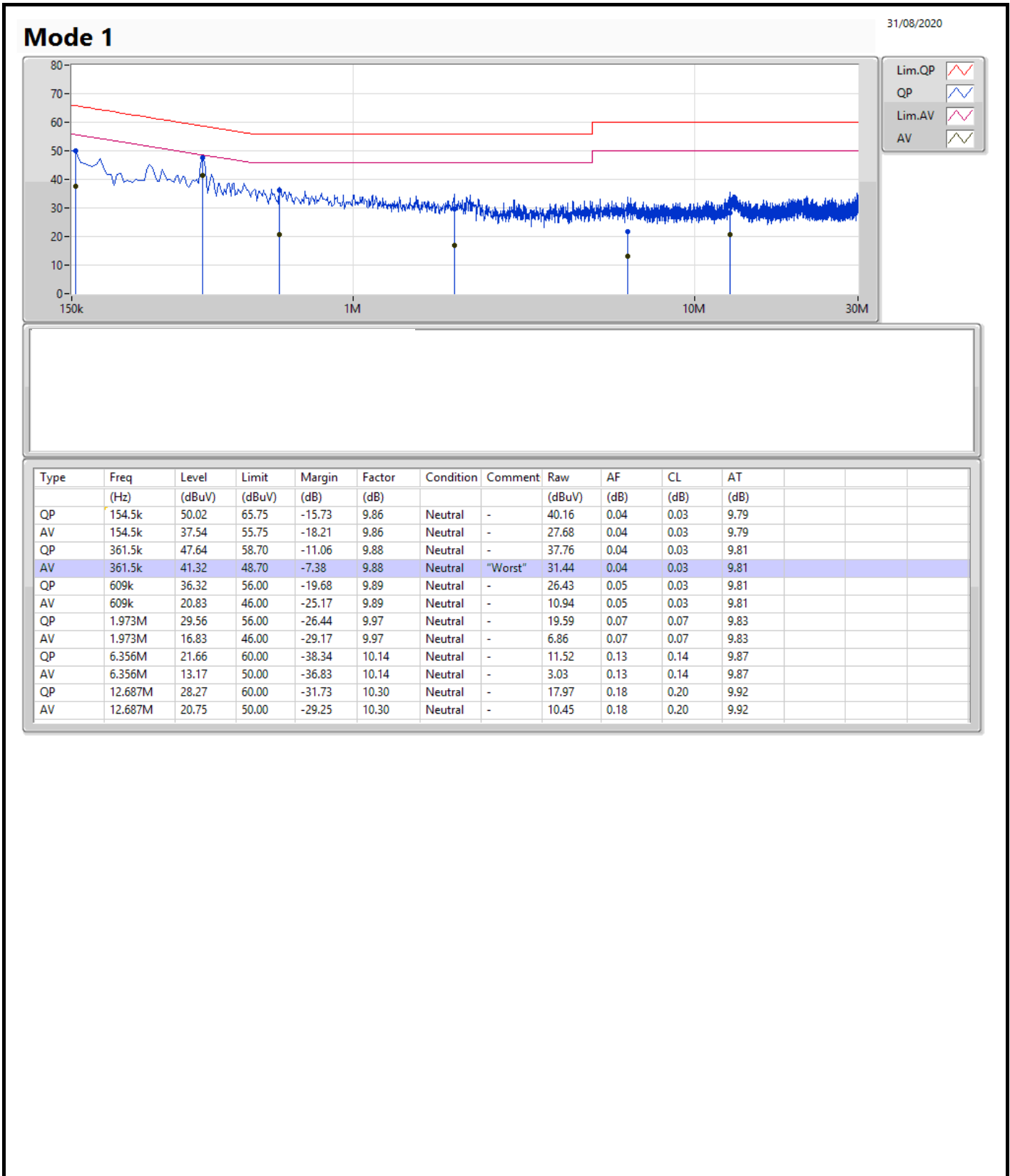
N.C.R means Non-Calibration required.



Summary

Mode	Result	Type	Freq (Hz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Condition
Mode 1	Pass	AV	361.5k	41.32	48.70	-7.38	Neutral

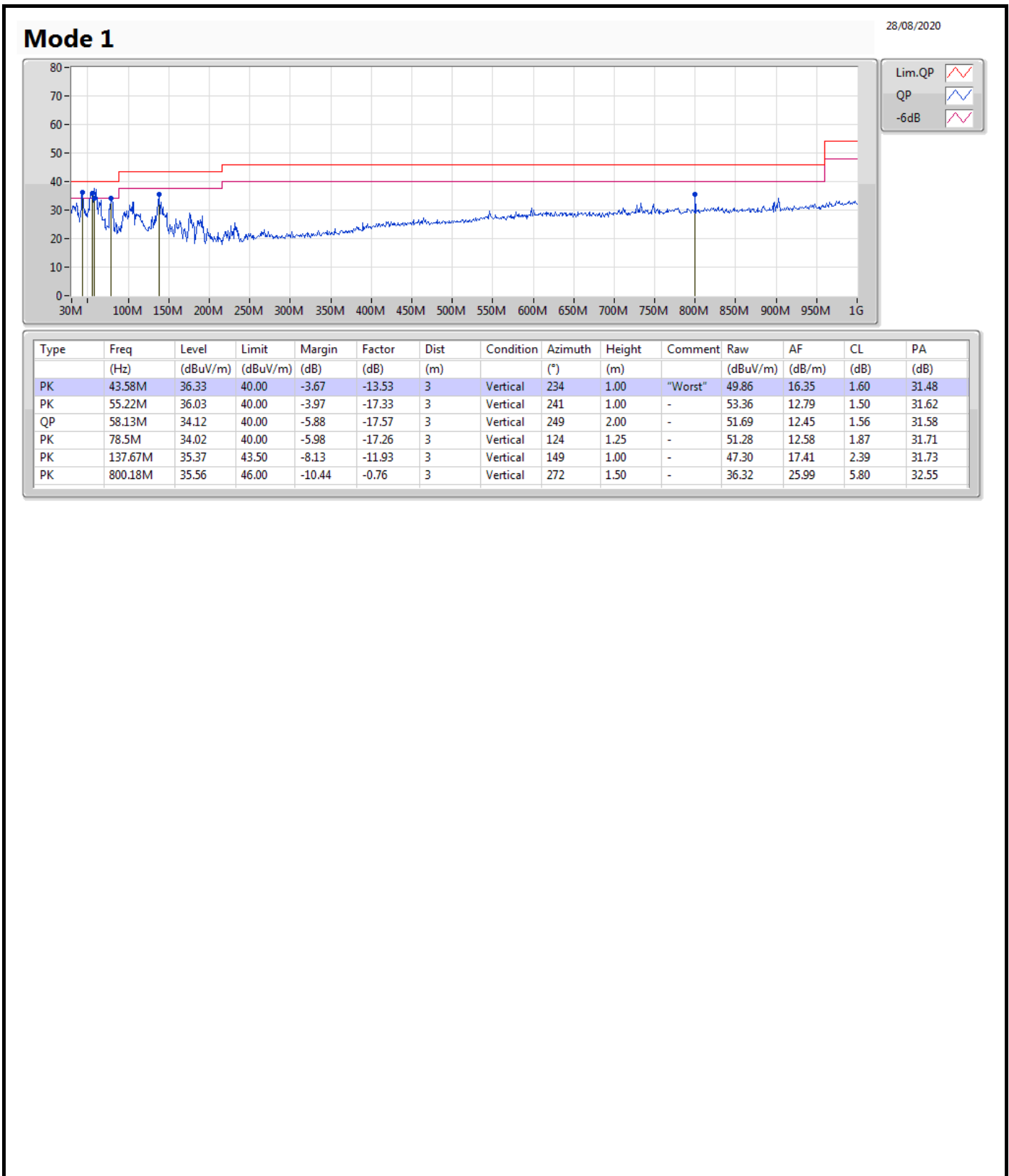






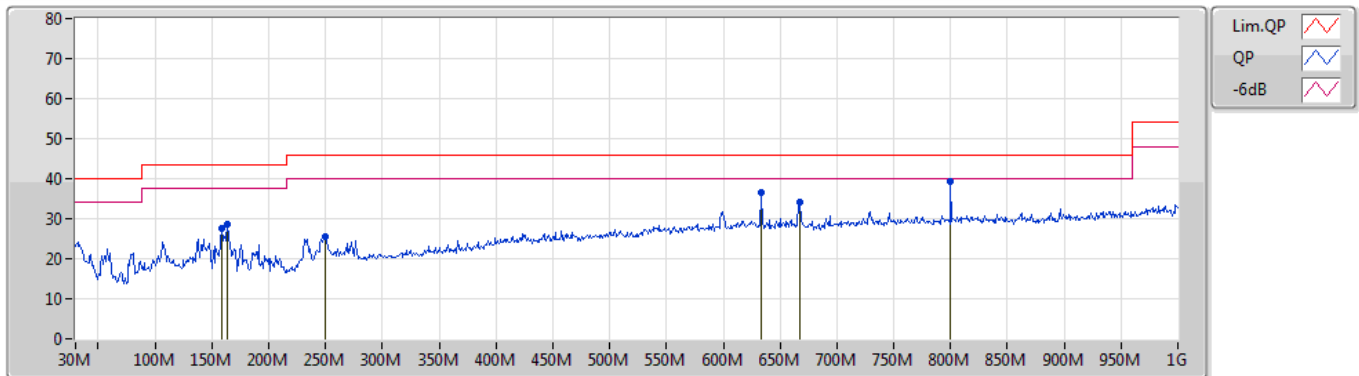
Summary

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Condition
Mode 1	Pass	PK	43.58M	36.33	40.00	-3.67	Vertical



Mode 1

28/08/2020



Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment	Raw (dBuV/m)	AF (dB/m)	CL (dB)	PA (dB)
PK	159.01M	27.48	43.50	-16.02	-13.22	3	Horizontal	78	3.00	-	40.70	16.00	2.59	31.81
PK	163.86M	28.51	43.50	-14.99	-13.32	3	Horizontal	255	3.00	-	41.83	15.84	2.64	31.80
PK	250.19M	25.61	46.00	-20.39	-10.39	3	Horizontal	91	1.50	-	36.00	18.19	3.20	31.78
PK	633.34M	36.49	46.00	-9.51	-1.68	3	Horizontal	1	2.00	-	38.17	25.42	5.30	32.40
PK	667.29M	34.02	46.00	-11.98	-1.84	3	Horizontal	0	2.00	-	35.86	25.18	5.43	32.45
PK	800.18M	39.47	46.00	-6.53	-0.76	3	Horizontal	102	1.25	"Worst"	40.23	25.99	5.80	32.55