

Supplemental “Transmit Simultaneously” Test Report

Report No.: RFBCKS-WTW-P23030625-2

FCC ID: RF41689A

Test Model: WS-A01

Received Date: 2023/3/22

Test Date: 2023/5/30 ~ 2023/6/8

Issued Date: 2023/10/31

Applicant: Keyence Corporation

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**FCC Registration /
Designation Number:** 723255 / TW2022



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Table of Contents

Release Control Record	3
1 Certificate of Conformity	4
2 Summary of Test Results	5
2.1 Measurement Uncertainty	5
2.2 Modification Record	5
3 General Information	6
3.1 General Description of EUT	6
3.1.1 Test Mode Applicability and Tested Channel Detail	9
3.2 Description of Support Units	11
3.2.1 Configuration of System under Test	12
4 Test Types and Results	13
4.1 Radiated Emission and Bandedge Measurement	13
4.1.1 Limits of Radiated Emission and Bandedge Measurement	13
4.1.2 Test Instruments	14
4.1.3 Test Procedures	16
4.1.4 Deviation from Test Standard	16
4.1.5 Test Setup	17
4.1.6 EUT Operating Conditions	18
4.1.7 Test Results	19
4.2 Conducted Emission Measurement	22
4.2.1 Limits of Conducted Emission Measurement	22
4.2.2 Test Instruments	22
4.2.3 Test Procedures	23
4.2.4 Deviation from Test Standard	23
4.2.5 Test Setup	23
4.2.6 EUT Operating Conditions	23
4.2.7 Test Results	24
4.3 Conducted Out of Band Emission Measurement	26
4.3.1 Limits of Conducted Out of Band Emission Measurement	26
4.3.2 Test Setup	26
4.3.3 Test Instruments	26
4.3.4 Test Procedures	26
4.3.5 Deviation from Test Standard	26
4.3.6 EUT Operating Conditions	26
4.3.7 Test Results	26
5 Pictures of Test Arrangements	28
Appendix – Information of the Testing Laboratories	29

Release Control Record

Issue No.	Description	Date Issued
RFBCKS-WTW-P23030625-2	Original release.	2023/10/31

1 Certificate of Conformity

Product: Industrial Wireless System

Brand: KEYENCE

Test Model: WS-A01

Sample Status: Engineering sample

Applicant: Keyence Corporation

Test Date: 2023/5/30 ~ 2023/6/8

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)

47 CFR FCC Part 15, Subpart E (Section 15.407)

ANSI C63.10: 2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Vito Lung , Date: 2023/10/31
Vito Lung / Specialist

Approved by : May Chen , Date: 2023/10/31
May Chen / Manager

2 Summary of Test Results

FCC Part 15, Subpart C, E (SECTION 15.247, 15.407)			
FCC Clause	Test Item	Result	Remarks
15.207 15.407(b)(6)	AC Power Conducted Emission	PASS	Meet the requirement of limit. Minimum passing margin is -9.56dB at 0.44688MHz.
15.205 / 15.209 / 15.247(d) 15.407(b) (1/2/3/4(i/ii)/6)	Radiated Emissions and Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is -7.7dB at 11490.00MHz.

Note:

Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 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	Expanded Uncertainty (k=2) ($\pm$)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.9 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.1 dB
	30MHz ~ 1GHz	5.4 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	5.0 dB
	18GHz ~ 40GHz	5.3 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Industrial Wireless System
Brand	KEYENCE
Test Model	WS-A01
Status of EUT	Engineering sample
Power Supply Rating	12 Vdc from power adapter
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 256QAM for OFDM in VHT mode 1024QAM for OFDMA in 11ax mode
Modulation Technology	DSSS, OFDM, OFDMA
Transfer Rate	802.11b: up to 11 Mbps 802.11a/g: up to 54 Mbps 802.11n: up to 300 Mbps VHT: up to 400 Mbps 802.11ac: up to 866.7 Mbps 802.11ax: up to 2401.9 Mbps
Operating Frequency	2.4GHz: 2.412 GHz ~ 2.462 GHz 5GHz: 5.18 GHz ~ 5.24 GHz 5.745 GHz ~ 5.825 GHz 6GHz: 5.955 GHz ~ 6.415 GHz 6.435 GHz ~ 6.525 GHz 6.535 GHz ~ 6.865 GHz 6.875 GHz ~ 7.115 GHz
Number of Channel	2.4GHz: 802.11b, 802.11g, 802.11n (HT20), VHT20, 802.11ax (HE20): 11 802.11n (HT40), VHT40, 802.11ax (HE40): 7 5GHz: 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20): 9 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40): 4 802.11ac (VHT80), 802.11ax (HE80): 2 6GHz: 802.11a, 802.11ax (HE20): 59 802.11ax (HE40): 29 802.11ax (HE80): 14 802.11ax (HE160): 7
Antenna Type	Refer to Note
Antenna Connector	Refer to Note

Note:

1. There are WLAN (2.4 GHz) and WLAN (5 GHz) and WLAN (6 GHz) technology used for the EUT.
2. Simultaneously transmission condition.

Condition	Technology		
1	WLAN (2.4 GHz)	WLAN (5 GHz)	WLAN (6 GHz)

3. The antenna information is listed as below.

Antenna No.	RF Chain No.	Antenna Net Gain (dBi)	Frequency Range (GHz)	Antenna Type	Connector Type
DB1	Chain 0	3.79	2.4~2.4835	PIFA	ipex(MHF)
		5.07	5.15~5.25		
		5.07	5.25~5.35		
		5.31	5.47~5.725		
		5.46	5.725~5.85		
DB2	Chain 1	2.84	2.4~2.4835	PIFA	ipex(MHF)
		4.77	5.15~5.25		
		4.77	5.25~5.35		
		5.64	5.47~5.725		
		5.64	5.725~5.85		
SB1	Chain 0	3.63	5.955-6.415	PIFA	ipex(MHF)
		3.5	6.435-6.525		
		3.5	6.535-6.865		
		4.2	6.875-7.115		
SB2	Chain 1	4.35	5.955-6.415	PIFA	ipex(MHF)
		3.2	6.435-6.525		
		3.2	6.535-6.865		
		4.4	6.875-7.115		

4. The EUT incorporates a MIMO function:

2.4 GHz Band		
Modulation Mode	TX & RX Configuration	
802.11b	2TX	2RX
802.11g	2TX	2RX
802.11n (HT20)	2TX	2RX
802.11n (HT40)	2TX	2RX
VHT20	2TX	2RX
VHT40	2TX	2RX
802.11ax (HE20)	2TX	2RX
802.11ax (HE40)	2TX	2RX
5 GHz Band		
Modulation Mode	TX & RX Configuration	
802.11a	2TX	2RX
802.11n (HT20)	2TX	2RX
802.11n (HT40)	2TX	2RX
802.11ac (VHT20)	2TX	2RX
802.11ac (VHT40)	2TX	2RX
802.11ac (VHT80)	2TX	2RX
802.11ax (HE20)	2TX	2RX
802.11ax (HE40)	2TX	2RX
802.11ax (HE80)	2TX	2RX
6 GHz Band		
Modulation Mode	TX & RX Configuration	
802.11a	1TX Diversity	2RX
802.11ax (HE20)	2TX	2RX
802.11ax (HE40)	2TX	2RX
802.11ax (HE80)	2TX	2RX
802.11ax (HE160)	2TX	2RX

5. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.
6. Detail antenna specification please refer to antenna datasheet and/or antenna measurement report.

3.1.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE≥1G	RE<1G	PLC	OB	
-	√	√	√	√	-

Where **RE≥1G**: Radiated Emission above 1GHz
PLC: Power Line Conducted Emission

RE<1G: Radiated Emission below 1GHz
OB: Conducted Out-Band Emission Measurement

Radiated Emission Test (Above 1GHz):

- ☒ The tested configurations represent the worst-case mode from all possible combinations by the maximum power.
- ☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
2.4GHz : 802.11b + 5GHz : 802.11a + 6GHz : 802.11ax (HE160)	6	OFDM	BPSK
	149	OFDM	BPSK
	15	OFDMA	BPSK

Radiated Emission Test (Below 1GHz):

- ☒ The tested configurations represent the worst-case mode from all possible combinations by the maximum power.
- ☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
2.4GHz : 802.11b + 5GHz : 802.11a + 6GHz : 802.11ax (HE160)	6	OFDM	BPSK
	149	OFDM	BPSK
	15	OFDMA	BPSK

Power Line Conducted Emission Test:

☒ The tested configurations represent the worst-case mode from all possible combinations by the maximum power.

☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
2.4GHz: 802.11b + 5GHz: 802.11a + 6GHz: 802.11ax (HE160)	6	OFDM	BPSK
	149	OFDM	BPSK
	15	OFDMA	BPSK

Conducted Out-Band Emission Measurement:

☒ The tested configurations represent the worst-case mode from all possible combinations by the maximum power.

☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
2.4GHz: 802.11b + 5GHz: 802.11a	6	OFDM	BPSK
	149	OFDM	BPSK

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested By
RE≥1G	25deg. C, 68%RH	120Vac, 60Hz	Sampson Chen
RE<1G	25deg. C, 71%RH	120Vac, 60Hz	Nick Tsou
PLC	26deg. C, 68%RH	120Vac, 60Hz	Tom Yang
OB	25deg. C, 60%RH	120Vac, 60Hz	John Peng

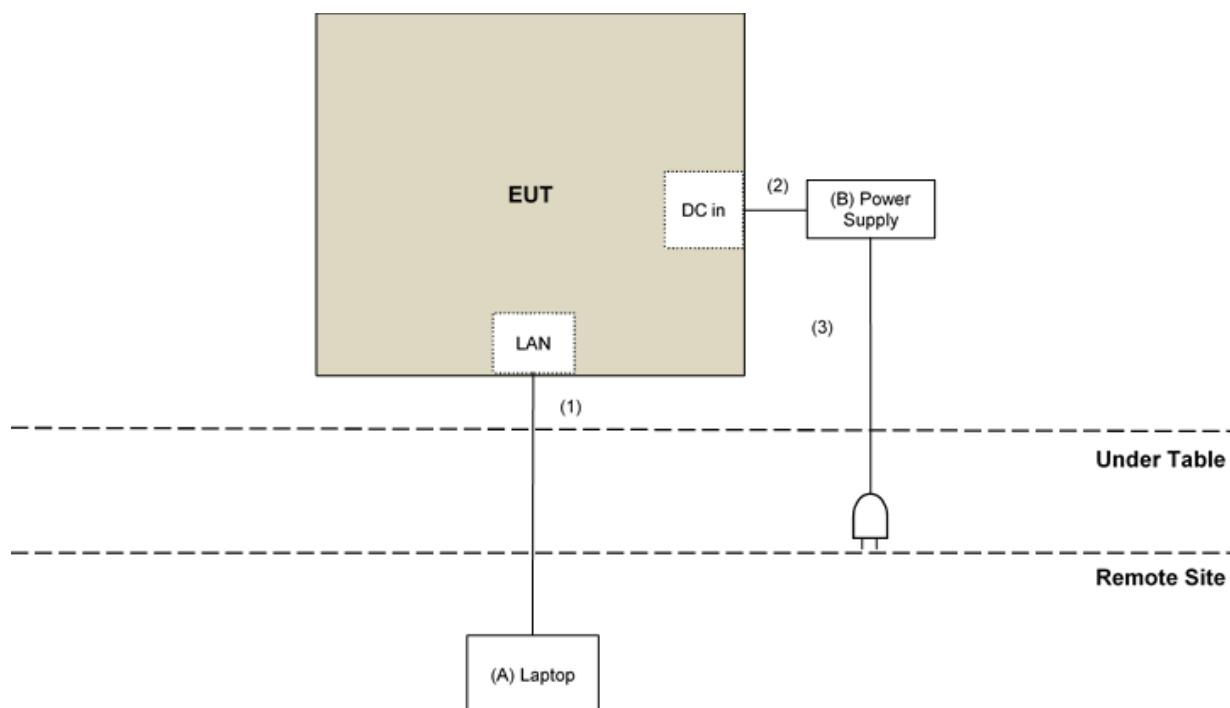
3.2 Description of Support Units

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.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	Laptop	Lenovo	81A4	YD02YN22	PD93165NGU	Provided by Lab
B	PSU	Keyence	MS2-H50	N/A	N/A	Supplied by applicant

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	RJ-45	1	10	No	0	Provided by Lab
2	DC Cable	1	0.7	No	0	Supplied by applicant
3	AC Power Cable	1	1.7	No	0	Supplied by applicant

3.2.1 Configuration of System under Test



4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

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

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. 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.

Limits of unwanted emission out of the restricted bands

Applicable To		Limit	
789033 D02 General UNII Test Procedure New Rules v02r01		Field Strength at 3m	
		PK:74 (dBuV/m)	AV:54 (dBuV/m)
Frequency Band	Applicable To	EIRP Limit	Equivalent Field Strength at 3m
5150~5250 MHz	15.407(b)(1)	PK:-27 (dBm/MHz)	PK:68.2(dBuV/m)
5250~5350 MHz	15.407(b)(2)		
5470~5725 MHz	15.407(b)(3)		
5725~5850 MHz	15.407(b)(4)(i)	PK:-27 (dBm/MHz) ^{*1} PK:10 (dBm/MHz) ^{*2} PK:15.6 (dBm/MHz) ^{*3} PK:27 (dBm/MHz) ^{*4}	PK: 68.2(dBuV/m) ^{*1} PK:105.2 (dBuV/m) ^{*2} PK: 110.8(dBuV/m) ^{*3} PK:122.2 (dBuV/m) ^{*4}
	15.407(b)(4)(ii)	Emission limits in section 15.247(d)	
^{*1} beyond 75 MHz or more above of the band edge.		^{*2} below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above.	
^{*3} below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above.		^{*4} from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.	

Note:

The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000\sqrt{30P}}{3} \mu\text{V/m, where P is the eirp (Watts).}$$

4.1.2 Test Instruments

For Radiated Emission test:

Description & Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Spectrum Analyzer KEYSIGHT	N9030B	MY57142938	2023/4/6	2024/4/5
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Boresight Antenna Tower & Turn Table Max-Full	MF-7802BS	MF780208530	NA	NA
Pre_Amplifier Agilent	8447D	2944A10636	2023/3/12	2024/3/11
LOOP ANTENNA Electro-Metrics	EM-6879	264	2023/2/21	2024/2/20
RF Coaxial Cable JYEBO	5D-FB	LOOPCAB-001	2022/12/19	2023/12/18
RF Coaxial Cable JYEBO	5D-FB	LOOPCAB-002	2022/12/19	2023/12/18
Pre_Amplifier EMCI	EMC330N	980701	2023/2/18	2024/2/17
Trilog Broadband Antenna Schwarzbeck	VULB 9168	9168-406	2022/10/21	2023/10/20
RF Coaxial Cable COMMATE/PEWC	8D	966-4-1	2023/2/18	2024/2/17
RF Coaxial Cable COMMATE/PEWC	8D	966-4-2	2023/2/18	2024/2/17
RF Coaxial Cable COMMATE/PEWC	8D	966-4-3	2023/2/18	2024/2/17
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-ATT5-03	2022/12/28	2023/12/27
Horn Antenna Schwarzbeck	BBHA 9120D	9120D-783	2022/11/13	2023/11/12
Pre_Amplifier EMCI	EMC12630SE	980688	2022/10/4	2023/10/3
RF Cable-Frequency Range : 1-26.5GHz EMCI	EMC104-SM-SM-1200	160922	2022/12/15	2023/12/14
RF Coaxial Cable EMCI	EMC104-SM-SM-2000	180502	2023/3/27	2024/3/26
RF Coaxial Cable EMCI	EMC104-SM-SM-6000	210704	2022/11/4	2023/11/3
Pre_Amplifier EMCI	EMC184045SE	980387	2022/12/28	2023/12/27
Horn Antenna Schwarzbeck	BBHA 9170	9170-739	2022/11/13	2023/11/12
RF Cable-Frequency range: 1-40GHz EMCI	EMC102-KM-KM-1200	160924	2022/12/28	2023/12/27
RF Coaxial Cable EMCI	EMC-KM-KM-4000	200214	2023/2/20	2024/2/19

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in 966 Chamber No. 4.
3. Tested Date: 2023/5/30 ~ 2023/6/5

For other test items:

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Fixed Attenuator Woken	MDCS18N-10	MDCS18N-10-01	2023/3/27	2024/3/26
Power Meter Anritsu	ML2495A	1529002	2022/6/22	2023/6/21
Pulse Power Sensor Anritsu	MA2411B	1726434	2022/6/22	2023/6/21

- NOTE:**
1. The test was performed in Oven room 2.
 2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
 3. Tested Date: 2023/6/8

4.1.3 Test Procedures

For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. 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. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case 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 Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. 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 height of antenna 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 quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

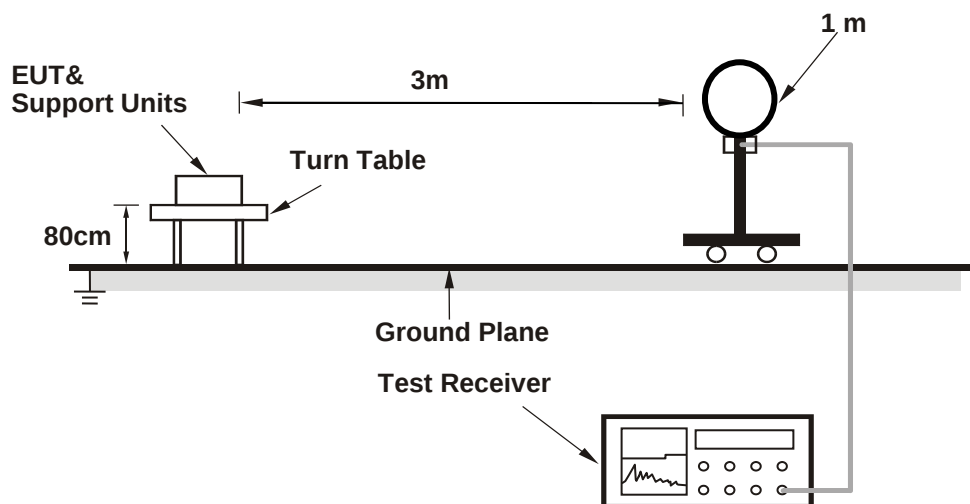
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

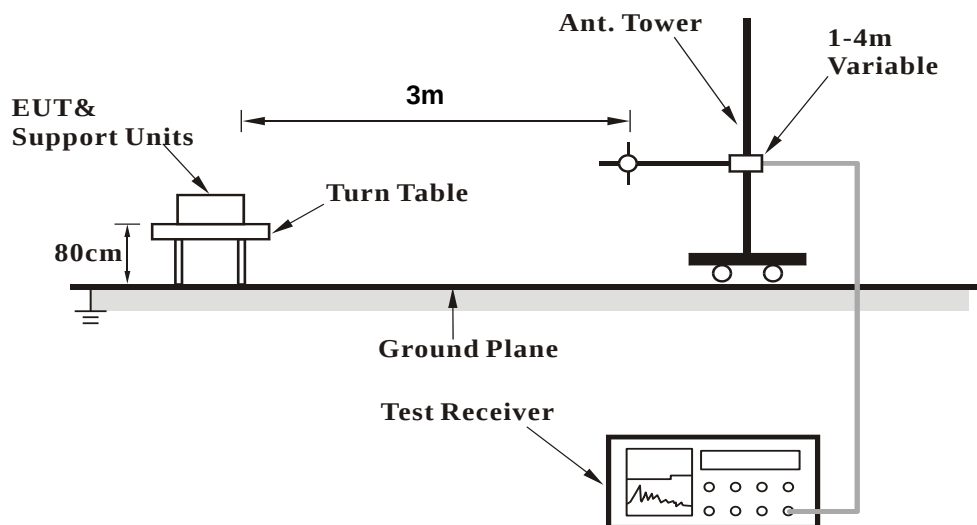
No deviation.

4.1.5 Test Setup

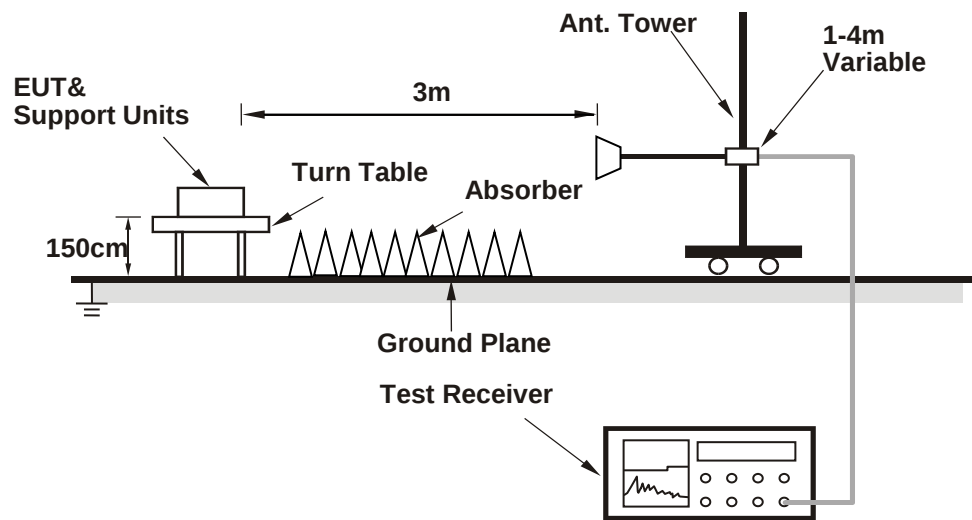
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



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

4.1.6 EUT Operating Conditions

- Connected the EUT with the Laptop which is placed on remote site.
- Controlling software (AccessMTool Version 3.2.1.4) has been activated to set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz Data:

FREQUENCY RANGE	1GHz ~ 40GHz	DETECTOR FUNCTION	Peak (PK) Average (AV)
-----------------	--------------	-------------------	---------------------------

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4874.00	39.2 PK	74.0	-34.8	1.71 H	360	36.1	3.1
2	4874.00	34.1 AV	54.0	-19.9	1.71 H	360	31.0	3.1
3	7311.00	40.2 PK	74.0	-33.8	1.27 H	224	31.4	8.8
4	7311.00	30.6 AV	54.0	-23.4	1.27 H	224	21.8	8.8
5	11490.00	57.7 PK	74.0	-16.3	1.24 H	46	42.4	15.3
6	11490.00	45.9 AV	54.0	-8.1	1.24 H	46	30.6	15.3
7	#17235.00	53.5 PK	88.2	-34.7	1.47 H	50	37.3	16.2
8	#17235.00	41.8 AV	68.2	-26.4	1.47 H	50	25.6	16.2
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4874.00	40.3 PK	74.0	-33.7	1.83 V	47	37.2	3.1
2	4874.00	32.0 AV	54.0	-22.0	1.83 V	47	28.9	3.1
3	7311.00	42.5 PK	74.0	-31.5	2.05 V	214	33.7	8.8
4	7311.00	30.5 AV	54.0	-23.5	2.05 V	214	21.7	8.8
5	11490.00	58.6 PK	74.0	-15.4	2.77 V	140	43.3	15.3
6	11490.00	46.3 AV	54.0	-7.7	2.77 V	140	31.0	15.3
7	#17235.00	50.2 PK	88.2	-38.0	1.47 V	56	34.0	16.2
8	#17235.00	38.7 AV	68.2	-29.5	1.47 V	56	22.5	16.2

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) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " # ": The radiated frequency is out of the restricted band.

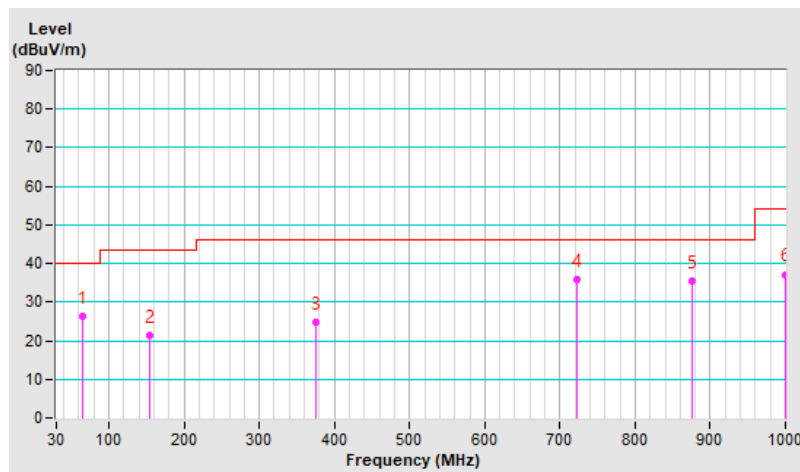
Below 1GHz Data:

FREQUENCY RANGE	30kHz ~ 1GHz	DETECTOR FUNCTION	Quasi-Peak (QP)
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Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	64.15	26.4 QP	40.0	-13.6	3.00 H	124	40.0	-13.6
2	153.44	21.3 QP	43.5	-22.2	2.00 H	89	33.7	-12.4
3	375.00	24.8 QP	46.0	-21.2	1.00 H	156	35.1	-10.3
4	723.39	35.8 QP	46.0	-10.2	1.00 H	360	39.1	-3.3
5	875.01	35.3 QP	46.0	-10.7	1.50 H	202	36.5	-1.2
6	1000.00	37.2 QP	54.0	-16.8	1.50 H	81	37.0	0.2

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) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The emission levels were very low against the limit of frequency range 9 kHz ~ 30 MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

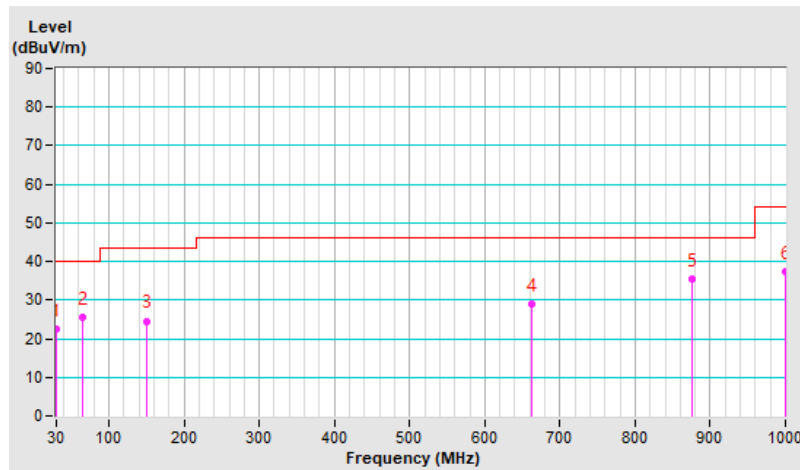


FREQUENCY RANGE	30kHz ~ 1GHz	DETECTOR FUNCTION	Quasi-Peak (QP)
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Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	30.00	22.6 QP	40.0	-17.4	1.50 V	150	36.4	-13.8
2	64.53	25.4 QP	40.0	-14.6	2.00 V	207	39.1	-13.7
3	150.53	24.6 QP	43.5	-18.9	1.00 V	70	37.0	-12.4
4	661.79	28.9 QP	46.0	-17.1	1.50 V	135	33.1	-4.2
5	875.06	35.4 QP	46.0	-10.6	1.00 V	88	36.6	-1.2
6	1000.00	37.5 QP	54.0	-16.5	1.50 V	273	37.3	0.2

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) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The emission levels were very low against the limit of frequency range 9 kHz ~ 30 MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.2.2 Test Instruments

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
TEST RECEIVER R&S	ESCS 30	847124/029	2022/10/14	2023/10/13
LISN R&S	ESH3-Z5	848773/004	2022/10/18	2023/10/17
50 ohm terminal resistance NA	NA	EMC-01	2022/9/27	2023/9/26
RF Coaxial Cable JYEBO	5D-FB	COCCAB-001	2022/8/24	2023/8/23
Fixed attenuator STI	STI02-2200-10	005	2022/8/24	2023/8/23
Software BVADT	BVADT_Cond_V7.3.7.4	NA	NA	NA

Note: 1. The test was performed in Conduction 1.

2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

3. Tested Date: 2023/6/5

4.2.3 Test Procedures

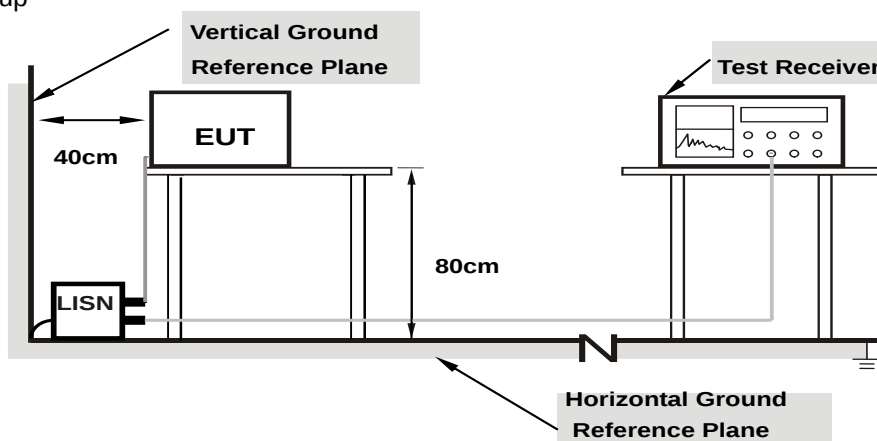
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.

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

4.2.6 EUT Operating Conditions

Same as 4.1.6.

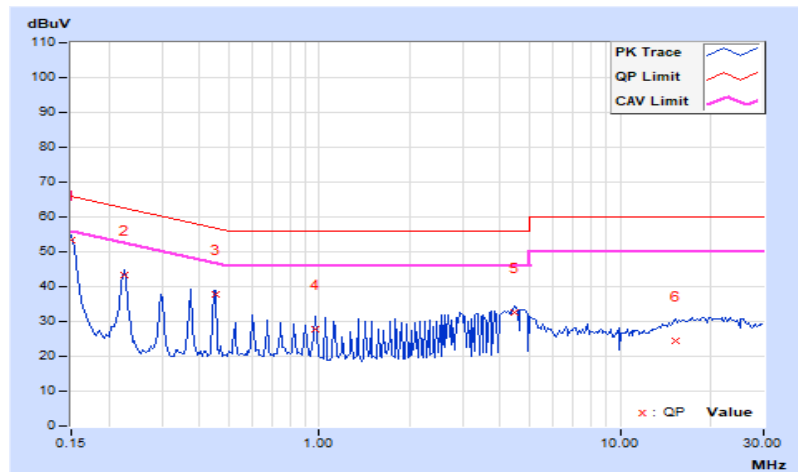
4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
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Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	9.97	43.24	33.10	53.21	43.07	66.00	56.00	-12.79	-12.93
2	0.22422	9.97	33.53	24.70	43.50	34.67	62.66	52.66	-19.16	-17.99
3	0.45078	9.98	27.76	27.24	37.74	37.22	56.86	46.86	-19.12	-9.64
4	0.97031	10.01	17.82	17.82	27.83	27.83	56.00	46.00	-28.17	-18.17
5	4.48828	10.20	22.44	21.03	32.64	31.23	56.00	46.00	-23.36	-14.77
6	15.26172	10.76	13.76	11.58	24.52	22.34	60.00	50.00	-35.48	-27.66

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

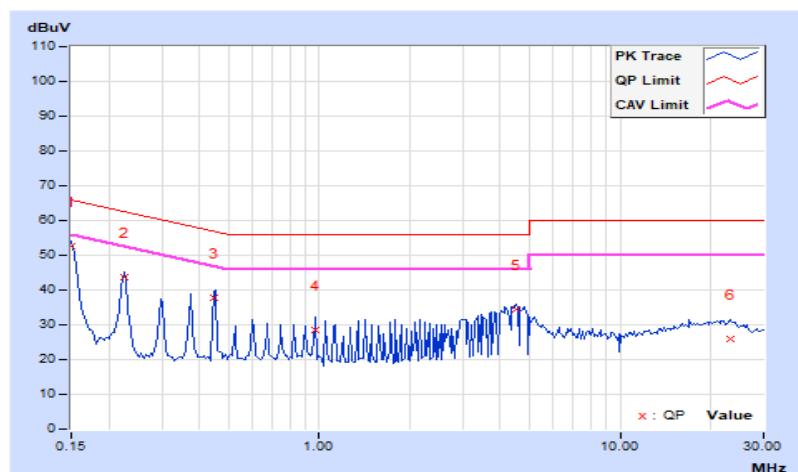


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.01	42.67	33.46	52.68	43.47	66.00	56.00	-13.32	-12.53
2	0.22422	10.02	33.61	25.77	43.63	35.79	62.66	52.66	-19.03	-16.87
3	0.44688	10.03	27.78	27.34	37.81	37.37	56.93	46.93	-19.12	-9.56
4	0.97031	10.06	18.29	18.00	28.35	28.06	56.00	46.00	-27.65	-17.94
5	4.49219	10.23	24.13	23.12	34.36	33.35	56.00	46.00	-21.64	-12.65
6	23.27734	10.85	15.07	12.02	25.92	22.87	60.00	50.00	-34.08	-27.13

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

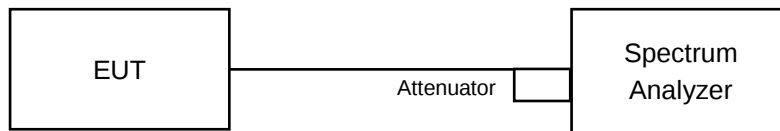


4.3 Conducted Out of Band Emission Measurement

4.3.1 Limits of Conducted Out of Band Emission Measurement

Below 30dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedures

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW $\geq$ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW $\geq$ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

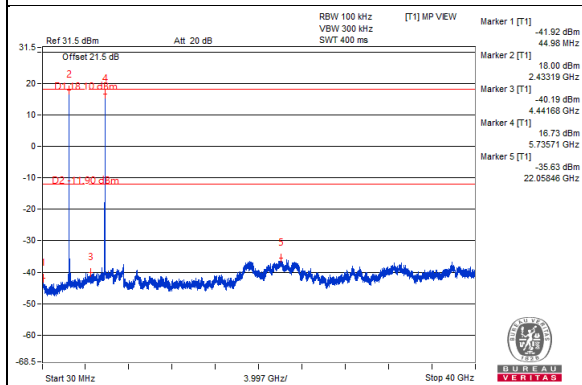
The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

4.3.7 Test Results

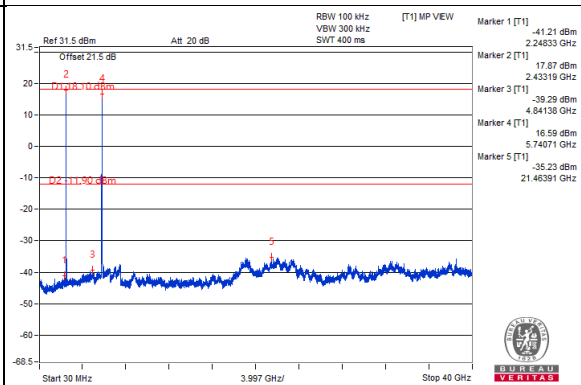
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 30dB offset below D1. It shows compliance with the requirement.

2.4GHz_802.11b CH6 + 5GHz_802.11a CH149

Chain 0



Chain 1



5 Pictures of Test Arrangements

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

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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