FCC Test Report

FCC ID	:	**2AJ4H-T822**
Equipment	:	**TPMS Display**
Model No.	:	**TIY-082002**
Brand Name	:	**TYC-TIY, Artotek (For marketing purpose)**
Applicant	:	**I YUAN PRECISION INDUSTRIAL CO., LTD.**
Address	:	**NO.24, Dinghu Rd., Guishan Dist., Taoyuan City 33378, Taiwa(R.O.C.)**
Standard	:	**47 CFR FCC Part 15.209**
Received Date	:	**Jun. 10, 2021**
Tested Date	:	**Jun. 10 ~ Jun. 24, 2021**

We, International Certification Corporation, would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by: **Approved by:**

Along Chen / Assistant Manager **Gary Chang / Manager**

Testing Laboratory 2732

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Release Record

Report No.	Version	Description	Issued Date
FR161004	Rev. 01	Initial issue	Aug. 03, 2021

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV/m at 3m]: 0.880MHz 34.46 (Margin -21.54dB) - QP	Pass
15.209	Radiated Emissions	[dBuV/m at 3m]: 46.49MHz 36.99 (Margin -3.01dB) - PK	Pass
15.215 (c)	20dB bandwidth	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	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:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information			
Modulation	**Ch. Frequency (kHz)**	**Channel Number**	**Data Rate**
Pulse-width modulation	125	1	3906 bps

1.1.2 Antenna Details

Ant. No.	Brand	Model	Type	Connector	Gain (dBi)	Remark
1	TIY	A082002-N08	Monopole	---	---	---

1.1.3 EUT Operational Condition

Supply Voltage	5.1Vdc from battery

1.1.4 Accessories

Accessories		
No.	**Equipment**	**Description**
1	USB battery box	Brand: TIY Model: A082002-D01 I/P:6V O/P: 5.1V / 500mA
2	USB cable	Brand: TIY Model: A082001-C08 Line: 1m non-shielded without core

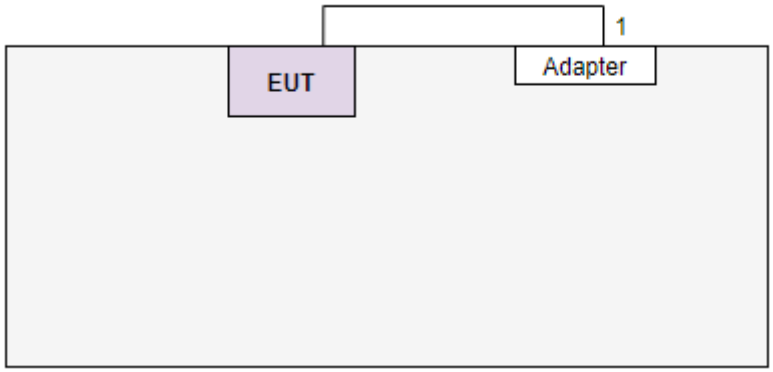
1.1.5 Test Tool and Power Setting

Test tool	Hardware control
Setting	Default

1.2 Local Support Equipment List

Support Equipment List					
No.	**Equipment**	**Brand**	**Model**	**FCC ID**	**Remarks**
1	Adapter	Samsung	ETA-U90JWs	---	Provided by applicant.

1.3 Test Setup Chart

Test Setup Diagram	
	
No.	**Signal cable / Length (m)**
1	USB, 1m non-shielded.

1.4 The Equipment List

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Tested Date	Jun. 24, 2021				
Instrument	**Brand**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101658	Feb. 08, 2021	Feb. 07, 2022
LISN	R&S	ENV216	101579	Mar. 17, 2021	Mar. 16, 2022
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Dec. 29, 2020	Dec. 28, 2021
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 21, 2020	Oct. 20, 2021
50 ohm terminal (Support Unit)	NA	50	04	May 25, 2021	May 24, 2022
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	Jun. 10, 2021				
Instrument	**Brand**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101657	Mar. 12, 2021	Mar. 11, 2022
Spectrum Analyzer	R&S	FSV40	101498	Dec. 04, 2020	Dec. 03, 2021
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 17, 2020	Nov. 16, 2021
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jul. 10, 2020	Jul. 09, 2021
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 11, 2020	Dec. 10, 2021
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 06, 2020	Nov. 05, 2021
Preamplifier	EMC	EMC02325	980225	Jul. 03, 2020	Jul. 02, 2021
Preamplifier	Agilent	83017A	MY39501308	Sep. 26, 2020	Sep. 25, 2021
Preamplifier	EMC	EMC184045B	980192	Jul. 21, 2020	Jul. 20, 2021
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 06, 2020	Oct. 05, 2021
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 06, 2020	Oct. 05, 2021
LF cable 11M	EMC	EMCCFD400-NW-NW-11000	200801	Oct. 06, 2020	Oct. 05, 2021
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160502	Oct. 06, 2020	Oct. 05, 2021
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Oct. 06, 2020	Oct. 05, 2021
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Oct. 06, 2020	Oct. 05, 2021
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

47 CFR FCC Part 15.209
ANSI C63.10-2013

1.6 Deviation from Test Standard and Measurement Procedure

None

1.7 Measurement Uncertainty

The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty	
Parameters	**Uncertainty**
AC conducted emission	±2.92 dB
Radiated emission ≤ 30MHz	±2.3 dB
Radiated emission > 30MHz	±3.41 dB

2 Test Configuration

2.1 Testing Facility

Test Laboratory	International Certification Corporation
Test Site	CO01-WS, 03CH01-WS
Address of Test Site	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- ISED#: 10807A
- CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Modulation Mode	Test Frequency (kHz)	Test Configuration
AC Conducted Emissions	Pulse-width modulation	125	---
Radiated Emissions	Pulse-width modulation	125	---
	Pulse-width modulation	125	---
20dB bandwidth	Pulse-width modulation	125	---

NOTE:
1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X,Y, and Z-plane. The **X-plane** results were found as the worst case and were shown in this report.
2. USB battery box and adapter had been covered during the pretest. The worst type is **Adapter**, and only its data was record in this test report.

3 Transmitter Test Results

3.1 Conducted Emissions

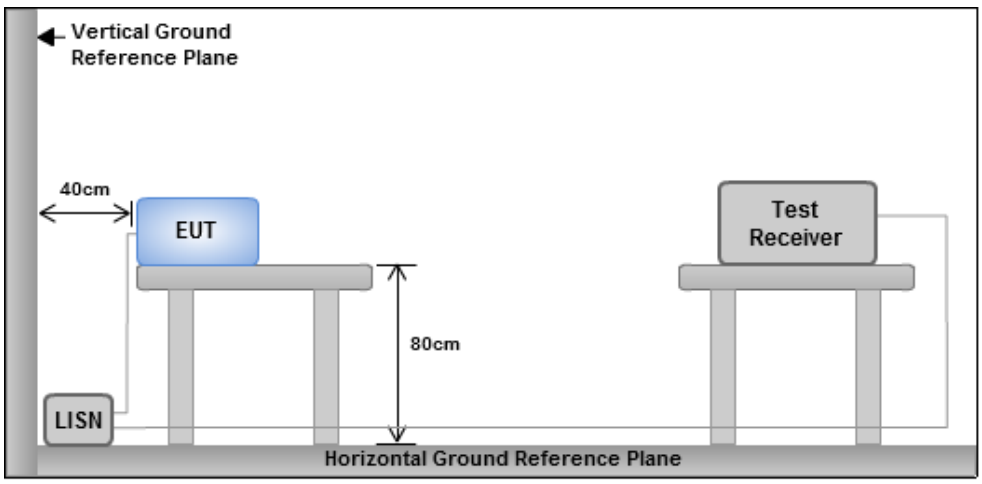
3.1.1 Limit of Conducted Emissions

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 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V / 60Hz.

3.1.3 Test Setup



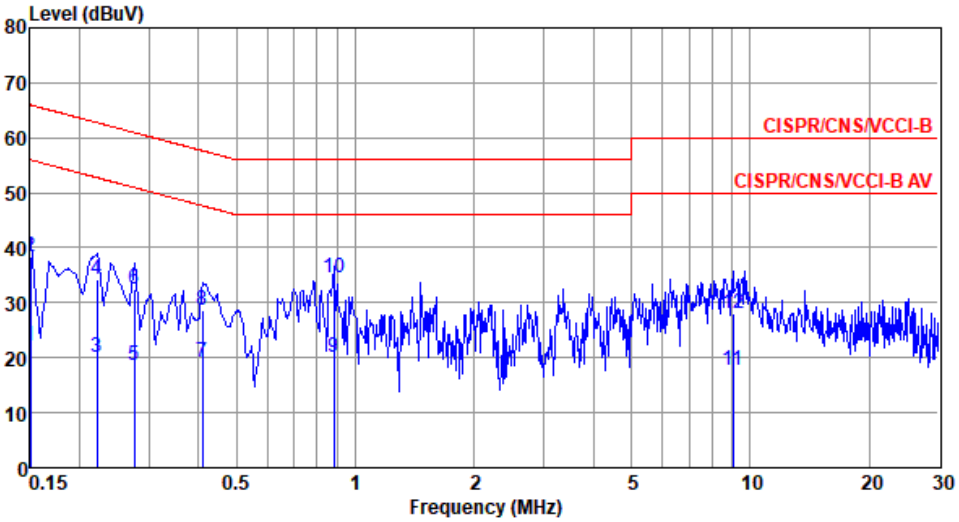
Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.1.4 Test Result of Conducted Emissions

Power Phase	Line

Test by : Joe Liao Temperature: 22°C Humidity: 68%

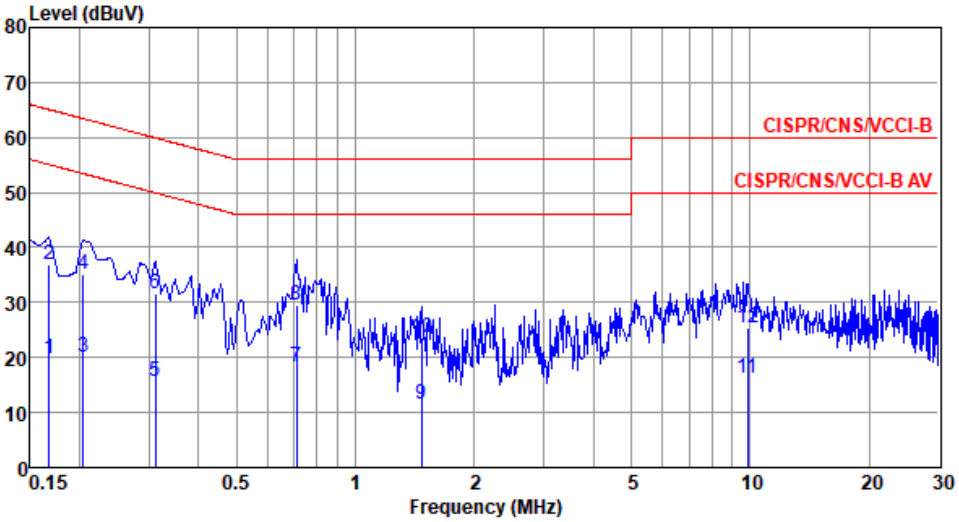


	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.150	22.16	56.00	-33.84	12.28	9.83	0.05	Average
2	0.150	38.38	66.00	-27.62	28.50	9.83	0.05	QP
3	0.222	19.93	52.74	-32.81	10.02	9.85	0.06	Average
4	0.222	34.26	62.74	-28.48	24.35	9.85	0.06	QP
5	0.276	18.67	50.94	-32.27	8.74	9.86	0.07	Average
6	0.276	32.43	60.94	-28.51	22.50	9.86	0.07	QP
7	0.410	19.22	47.64	-28.42	9.25	9.89	0.08	Average
8	0.410	28.52	57.64	-29.12	18.55	9.89	0.08	QP
9	0.880	19.97	46.00	-26.03	9.88	9.98	0.11	Average
10*	0.880	34.46	56.00	-21.54	24.37	9.98	0.11	QP
11	9.059	17.79	50.00	-32.21	7.30	10.10	0.39	Average
12	9.059	28.05	60.00	-31.95	17.56	10.10	0.39	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Power Phase	Neutral

Test by : Joe Liao Temperature: 22°C Humidity: 68%



	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.168	19.67	55.08	-35.41	9.80	9.82	0.05	Average
2	0.168	36.87	65.08	-28.21	27.00	9.82	0.05	QP
3	0.204	20.20	53.45	-33.25	10.31	9.83	0.06	Average
4	0.204	35.00	63.45	-28.45	25.11	9.83	0.06	QP
5	0.312	15.69	49.93	-34.24	5.78	9.84	0.07	Average
6	0.312	31.61	59.93	-28.32	21.70	9.84	0.07	QP
7	0.708	18.23	46.00	-27.77	8.26	9.87	0.10	Average
8*	0.708	29.55	56.00	-26.45	19.58	9.87	0.10	QP
9	1.472	11.55	46.00	-34.45	1.48	9.92	0.15	Average
10	1.472	23.69	56.00	-32.31	13.62	9.92	0.15	QP
11	9.861	16.26	50.00	-33.74	5.77	10.09	0.40	Average
12	9.861	25.27	60.00	-34.73	14.78	10.09	0.40	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

3.2 Radiated Emissions

3.2.1 Limit of Radiated Emissions

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	29.54	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit
Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.2.2 Test Procedures

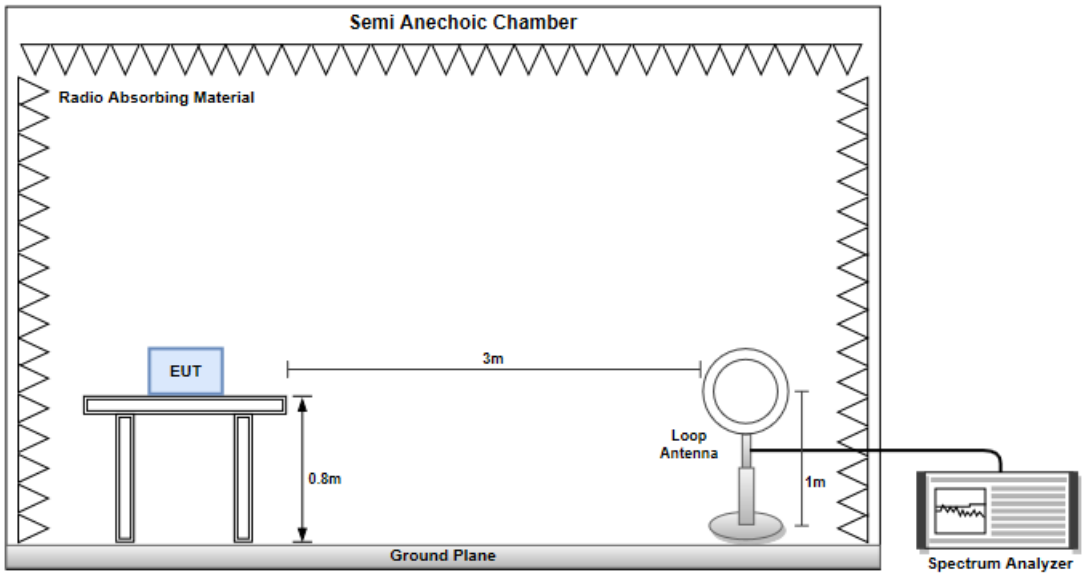
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at a height of 0.8 m test table above the ground plane.
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

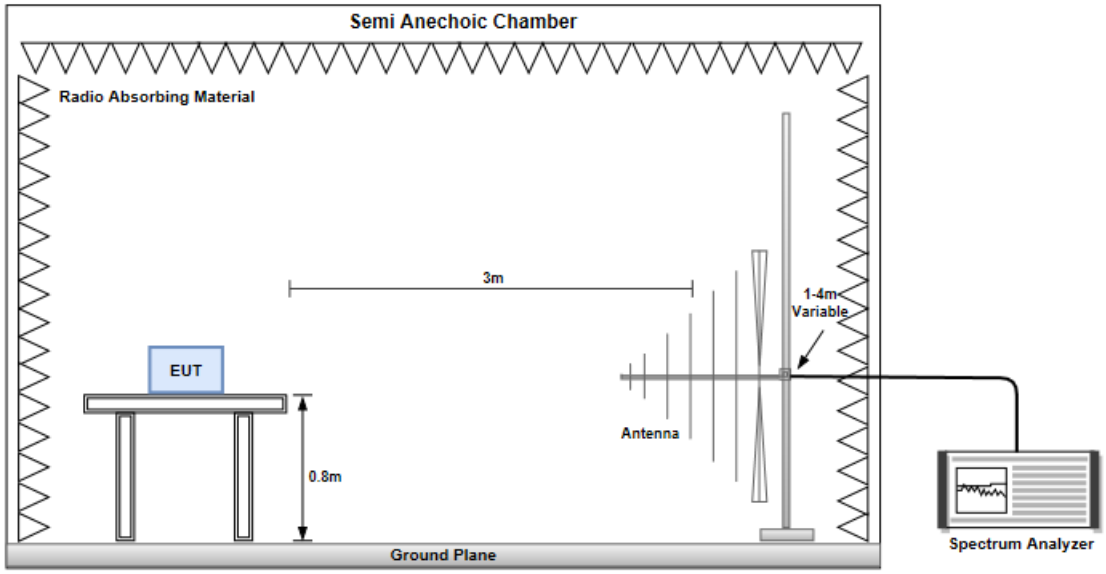
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. Correction values between measurement from the semi-anechoic chamber and open-field test site have been confirmed and added to the factor.

3.2.3 Test Setup

Radiated Emissions below 30MHz



Radiated Emissions below 1 GHz



3.2.4 Transmitter Radiated Unwanted Emissions (9kHz ~ 30MHz)

Ambient Condition	25°C / 66%	Tested By	Aska Huang

Polarization		Loop Open					
Frequency (MHz)		Emission Level dBuV/m	Limit (dBuV/m)	Margin (dB)	SA Reading (dBuV/m)	Factor	Remark
1	0.125	92.04	105.67	-13.63	70.26	21.78	PK
2	0.125	92.03	105.67	-13.64	70.25	21.78	AV
3	0.375	58.14	88.68	-30.54	36.42	21.72	PK
4	0.375	57.54	88.68	-31.14	35.82	21.72	AV
5	0.625	51.24	71.69	-20.45	29.57	21.67	QP
6	16.834	27.49	49.54	-22.05	3.60	23.89	QP

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m)

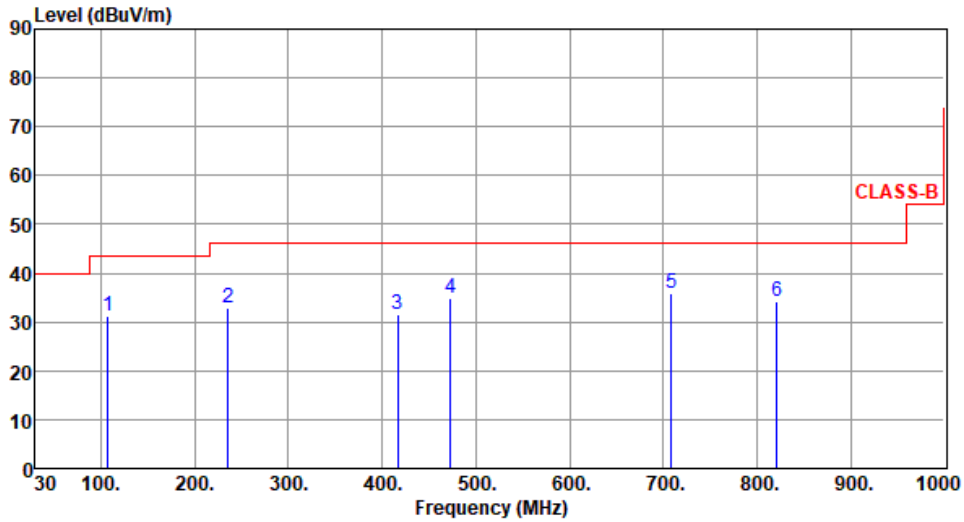
Polarization		Loop Close					
Frequency (MHz)		Emission Level dBuV/m	FS max Limit (dBuV/m)	Margin (dB)	SA Reading (dBuV/m)	Factor	Remark
1	0.125	86.66	105.67	-19.01	64.88	21.78	PK
2	0.125	86.64	105.67	-19.03	64.86	21.78	AV
3	0.375	54.24	88.68	-34.44	32.52	21.72	PK
4	0.375	53.22	88.68	-35.46	31.50	21.72	AV
5	0.625	46.19	71.69	-25.50	24.52	21.67	QP
6	16.834	28.04	49.55	-21.51	3.79	24.25	QP

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB).
*Factor includes antenna factor and cable loss.
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.2.5 Transmitter Radiated Unwanted Emissions (Above 30MHz)

Polarization	Horizontal	Test Freq. (kHz)	125

Test By :Aska Huang Temperature(℃):25 Humidity(%):66

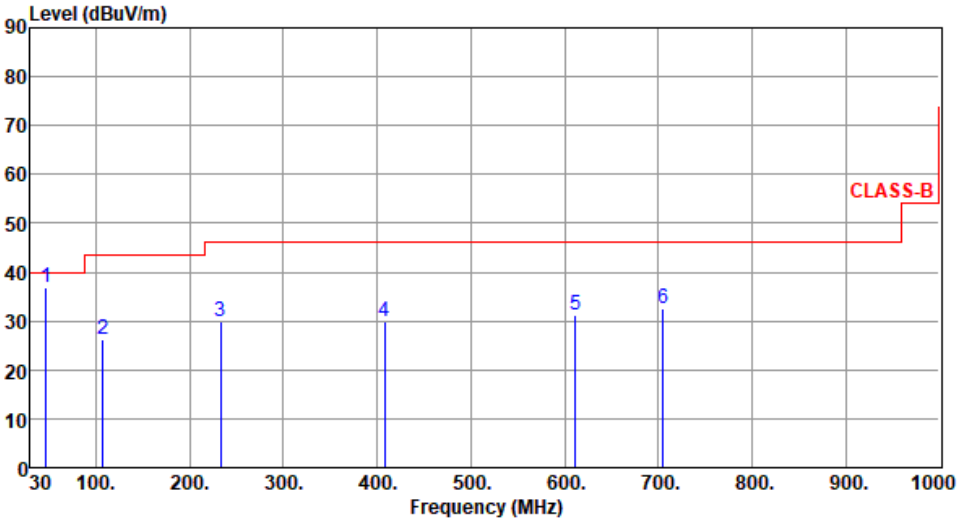


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	107.60	31.31	43.50	-12.19	43.54	-12.23	Peak	---	---
2	235.64	32.99	46.00	-13.01	43.91	-10.92	Peak	---	---
3	417.03	31.41	46.00	-14.59	36.77	-5.36	Peak	---	---
4	473.29	34.98	46.00	-11.02	38.78	-3.80	Peak	---	---
5	709.00	35.71	46.00	-10.29	35.25	0.46	Peak	---	---
6	821.52	34.18	46.00	-11.82	31.45	2.73	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m)

Polarization	Vertical	Test Freq. (kHz)	125

Test By :Aska Huang Temperature(℃):25 Humidity(%):66



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	46.49	36.99	40.00	-3.01	45.32	-8.33	Peak	---	---
2	107.60	26.34	43.50	-17.16	38.57	-12.23	Peak	---	---
3	232.73	29.73	46.00	-16.27	41.02	-11.29	Peak	---	---
4	408.30	29.83	46.00	-16.17	35.51	-5.68	Peak	---	---
5	612.00	31.23	46.00	-14.77	31.94	-0.71	Peak	---	---
6	705.12	32.46	46.00	-13.54	32.10	0.36	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m)

3.3 20dB and Occupied Bandwidth

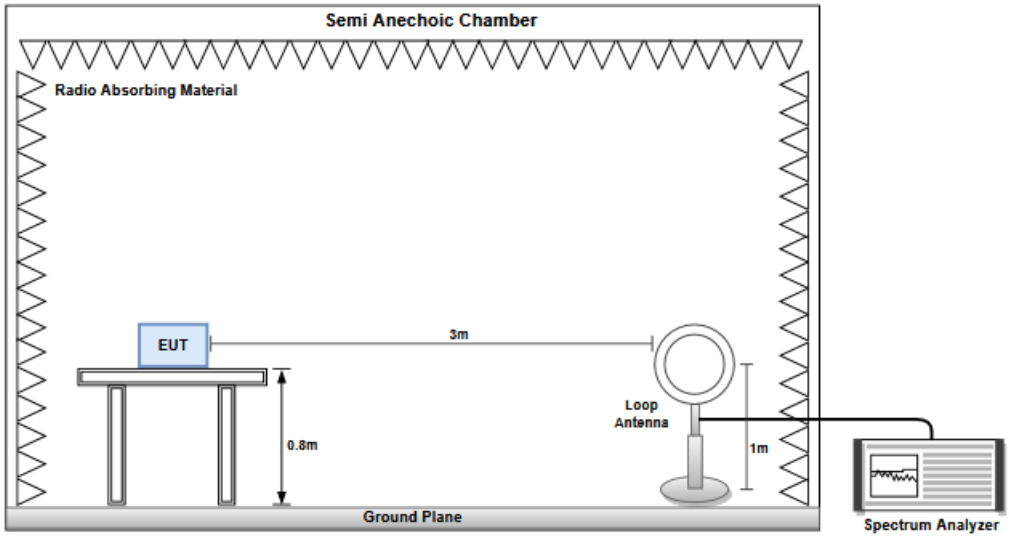
3.3.1 Limit of 20dB Bandwidth

The upper and lower frequency of the 20dB bandwidth shall within 13.553~13.567 MHz

3.3.2 Test Procedures

1. Set resolution bandwidth (RBW) = 1 kHz, Video bandwidth = 3 kHz.
2. Detector = Peak, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20dB relative to the maximum level measured in the fundamental emission.

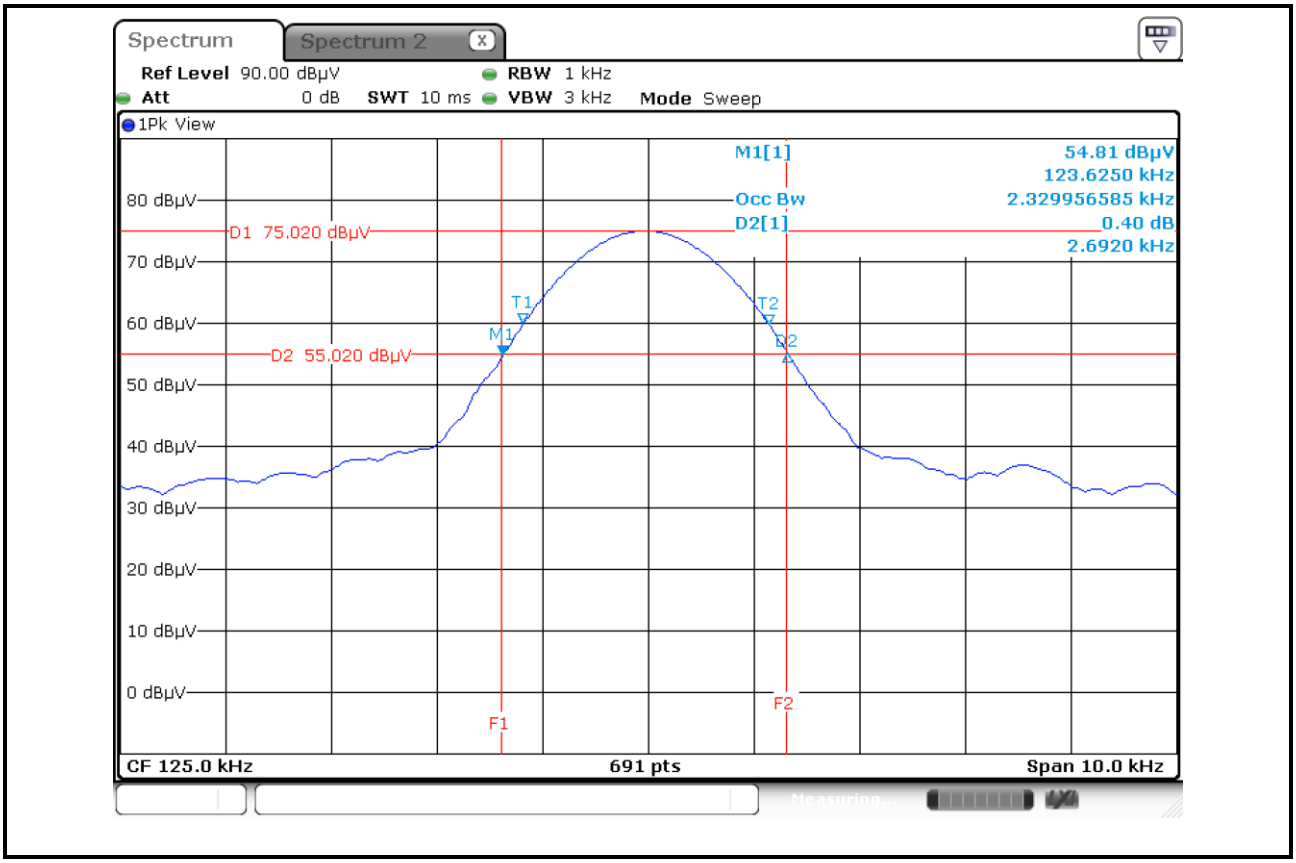
3.3.3 Test Setup



3.3.4 Test Result of 20dB and Occupied Bandwidth

Ambient Condition	25°C / 66%	Tested By	Aska Huang

Frequency(kHz)	20dB Bandwidth (kHz)	99% Occupied BW (kHz)
125	2.69	2.33



4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corporation (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

Linkou

Tel: 886-2-2601-1640

No.30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan (R.O.C.)

Kwei Shan

Tel: 886-3-271-8666

No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

No.2-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

Kwei Shan Site II

Tel: 886-3-271-8640

No.14-1, Lane 19, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 333, Taiwan (R.O.C.)

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666
Fax: 886-3-318-0345
Email: ICC_Service@icertifi.com.tw

==END==