

TEST REPORT

Report No.: SHATBL2404001W01

Applicant : Star Systems International Limited

Product Name : Tarvos Pro

Brand Name : SSI

Model Name : HRD31000

FCC ID : 2AA7KTARVOSPRO31000

Test Standard : 47 CFR Part 90.353

Date of Test : Nov. 28,2023~Apr. 24,2024

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(Chris Xu)

Report Approved by : Ghost Li.
(Ghost Li)

Authorized Signatory : Terry Yang
(Terry Yang)



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REVISION HISTORY

Rev.	Issue Date	Revisions	Revised by
A0	2024.04.24	Initial Release	Ghost Li

DECLARATION OF REPORT

1. The device has been tested by ATBL, and the test results show that the equipment under test (EUT) is in compliance with the requirements of 47 CFR FCC Part 90.353. And it is applicable only to the tested sample identified in the report.
2. This report shall not be reproduced except in full, without the written approval of ATBL, this document only be altered or revised by ATBL, personal only, and shall be noted in the revision of the document.
3. The general information of EUT in this report is provided by the customer or manufacture, ATBL is only responsible for the test data but not for the information provided by the customer or manufacture.
4. The results in this report is only apply to the sample as tested under conditions. The customer or manufacturer is responsible for ensuring that the additional production units of this model have the same electrical and mechanical components.
5. In this report, '☐' indicates that EUT does not support content after '☐', and '☑' indicates that it supports content after '☑'.

SUMMARY OF TEST RESULT

Report Section	Standard Section	Test Item	Judgment	Remark
3.1	Part 90.205	ERP Power	PASS	--
3.2	Part 90.209	Occupied Bandwidth	PASS	--
3.3	Part 90.210	Spurious emission at Antenna terminals	PASS	--
3.4	Part 90.210	Radiated Spurious emissions	PASS	--
3.5	Part 90.213	Frequency Stability	PASS	--

Note: All tests are according to TIA-603-D

1. GENERAL DESCRIPTION

1.1. Applicant

Name : Star Systems International Limited
Address : Unit 7, 8/F, Vanta Industrial Centre, 21-33 Tai Lin Pai Road, Kwai Chung, NT, Hong Kong

1.2. Manufacturer

Name : Star Systems International Limited
Address : Unit 7, 8/F, Vanta Industrial Centre, 21-33 Tai Lin Pai Road, Kwai Chung, NT, Hong Kong

1.3. Factory

Name : SumoSys Inc
Address : Unit 3B-C, Philexcel Business Park Annex, Clark Freeport Zone,
Pampanga 2023 Philippines

1.4. General Information of EUT

General Information	
Equipment Name	Tarvos Pro
Brand Name	SSI
Model Name	HRD31000
Series Model	HRD310XY(X,Y=0-9, A-Z, a-z, blank)
Model Difference	Different in Antenna option, and names are different between models, everything else is the same.
Adapter	Model: MIT-09G-56D Brand: MsTronic Input: 90-264 V Output: 56 V Manufacturer: MStronic Co., Ltd.
Battery	Model: BR-1225A/BN Brand: Panasonic Battery Rated Voltage: 3 V Charge Limit Voltage: N/A Capacity: 48 mAh Manufacturer: Panasonic
Modulation Technique	FHSS
Temperature Range	-40°C to +70°C
Hardware Version	R1
Software Version	1.1.1.32641
RF ID Protocols	Frequency
Dense reader mode ISO-18000-63	911.25MHz-920.25MHz
Single reader mode ISO-18000-63	911.75MHz-919.25MHz
Low data rate ISOB-40k	911.75MHz-919.75MHz
High data rate ISOB-80k	912.75MHz-918.75MHz
Unmodulated ISO1374	902.75MHz,903.25MHz,910.75MHz-920.75MHz
PS111	915.75MHz
Title 21	913.75MHz-917.75MHz

Remark:

The above information of EUT was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

Table for Filed Antenna
Antenna 1(External Antenna)

Ant.	Brand	Model Name	Antenna Name	Connector	Gain (dBi)	Antenna Cable loss (dB)	Antenna combination(dB)
1	SSI	Tarvos Pro (HRD31000)	Avior	N/A	15	4	11
2	SSI	Tarvos Pro (HRD31000)	Avalon	N/A	13	4	9
3	SSI	Tarvos Pro (HRD31000)	Cheetah	N/A	12	4	8
4	SSI	Tarvos Pro (HRD31000)	Kuma	N/A	10	4	6
5	SSI	Tarvos Pro (HRD31000)	Bobcat	N/A	8	4	4

Antenna 2(Internal Antenna)

Ant.	Brand	Model Name	Antenna Name	Connector	Gain (dBi)	Antenna Cable loss (dB)	Antenna combination(dB)
1	SSI	Tarvos Pro (HRD31000)	Avalon	SMA Type	13	0	13

Note:

- 1.Internal antenna port only with Avalon (SMA Type).
- 2.The worst antenna with external antenna port is Avior, report only shows the worst antenna data.
- 3.The antenna information refer the manufacturer provide report, applicable only to the tested sample identified in the report. Due to the incorrect antenna information, a series of problems such as the accuracy of the test results will be borne by the customer.
- 4.The EUT internal antenna, external antenna,Simultaneous transmission is not supported.
- 5.Antenna gain, all provided by customer.

1.5. Modification of EUT

No modifications are made to the EUT during all test items.

1.6. Laboratory Information

Company Name	:	Shanghai ATBL Technology Co., Ltd.
Address	:	Building 8, No.160 Basheng Road, Waigaoqiao Free Trade Zone, Pudong New Area, Shanghai
Telephone	:	+86(0)21-51298625

1.7. Applicable Standards

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

47 CFR Subpart §90.353

Remark:

All test items were verified and recorded according to the standards and without any deviation during the test.

2. TEST CONFIGURATION OF EUT

2.1. Carrier Frequency Channel

Operation Frequency of channel					
Dense reader mode for ISOC FM2 640					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
04	911.25	11	914.75	18	918.25
05	911.75	12	915.25	19	918.75
06	912.25	13	915.75	20	919.25
07	912.75	14	916.25	21	919.75
08	913.25	15	916.75	22	920.25
09	913.75	16	917.25		
10	914.25	17	917.75		
Single reader mode for ISOC FM0 640					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
05	911.75	11	914.75	17	917.75
06	912.25	12	915.25	18	918.25
07	912.75	13	915.75	19	918.75
08	913.25	14	916.25	20	919.25
09	913.75	15	916.75		
10	914.25	16	917.25		
Low data rate ISOB-40k					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
05	911.75	11	914.75	17	917.75
06	912.25	12	915.25	18	918.25
07	912.75	13	915.75	19	918.75
08	913.25	14	916.25	20	919.25
09	913.75	15	916.75	21	919.75
10	914.25	16	917.25		

Operation Frequency of channel					
High data rate ISOB-80k					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
05	911.75	11	914.75	17	917.75
06	912.25	12	915.25	18	918.25
07	912.75	13	915.75	19	918.75
08	913.25	14	916.25	--	--
09	913.75	15	916.75	--	--
10	914.25	16	917.25	--	--
Unmodulated ISO-10374					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	902.75	09	913.75	17	917.75
02	903.25	10	914.25	18	918.25
03	910.75	11	914.75	19	918.75
04	911.25	12	915.25	20	919.25
05	911.75	13	915.75	21	919.75
06	912.25	14	916.25	22	920.25
07	912.75	15	916.75	23	920.75
08	913.25	16	917.25	--	--
PS111					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
13	915.75	--	--	--	--
Title 21					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
09	913.75	12	915.25	15	916.75
10	914.25	13	915.75	16	917.25
11	914.75	14	916.25	17	917.75

2.2. Test Modes

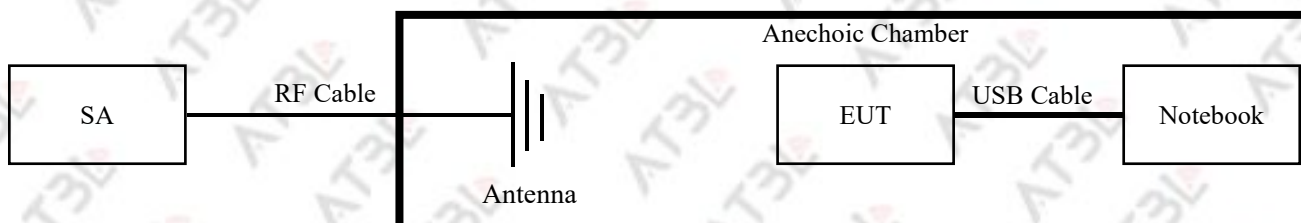
The table below is showing all test modes to demonstrate in compliance with the standard.

Test Mode	Modulation Type	Frequency
Mode 1	Dense Reader mode ISOC FM2 640	Low Channel(911.25MHz)
		High Channel(920.25MHz)
Mode 2	Single Reader mode ISOC FM0 640	Low Channel(911.75MHz)
		High Channel(919.25MHz)
Mode 3	Low data rate ISOB-40k	Low Channel(911.75MHz)
		High Channel(919.75MHz)
Mode 4	High data rate ISOB-80k	Low Channel(912.75MHz)
		High Channel(918.75MHz)
Mode 5	Unmodulated ISO1374	Low Channel(902.75MHz)
		High Channel(903.25MHz)
		Low Channel(910.75MHz)
		High Channel(920.75MHz)
Mode 6	PS111	915.75MHz
Mode 7	Title 21	Low Channel(913.75MHz)
		High Channel(917.75MHz)

Remark: To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or tes configuration mode(s) mentioned above was evaluated respectively.
only worst case was recorded in the test report.

2.3. Block Diagram of Test System

2.3.1. For Radiated Spurious Emission



2.3.2. For Conducted Test



2.4. Description of Support Units

NO.	Unit	Manufacturer	Model	ID or Specification	Description	Note
1	PC	DELL	G15	N/A	1.2m unshielded	Support units
2	RF cable	N/A	N/A	9KHz-18GHz	1.6m shielded	Support units
3	Network cable	N/A	N/A	N/A	1.5m shielded	Support units

2.5. Test Software and Power Level

During the test, the channel and power control software provided by the customer is used to control the operation channel and output power level.

2.6. EUT Operating Conditions

For radiated spurious emission and conducted test, the engineering test program was provided and make the EUT to continuous transmit/receive.

2.7. Equipment List

2.7.1. For Radiated Spurious Emission

Equipment Name	Manufacturer	Model	Serial No.	Equipment No.	Calibration Until
Signal analyzer	Agilent	N9020A	MY50200811	SHATBL-E017	2024.07.09
Amplifier	JPT	JPA0118-55-303A	1910001800055000	SHATBL-E006	2024.07.09
Amplifier	JPT	JPA-10M1G32	21010100035001	SHATBL-E005	2024.07.09
Antenna/Turn table Controller	Brilliant	N/A	N/A	SHATBL-E007	N/A
Loop Antenna	Daze	ZN30900C	20077	SHATBL-E042	2024.07.09
Bilog Antenna	SCHWARZBECK	VULB 9168	01174	SHATBL-E008	2024.07.09
Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120D	02334	SHATBL-E009	2024.07.09
Horn Antenna	COM-POWER	AH-1840	10100008	SHATBL-E043	2024.07.09
Thermometer	DeLi	N/A	N/A	SHATBL-E015	2024.07.09
Test Software	FALA	EMC-RI	N/A	SHATBL-E046	N/A

2.7.2 For Conducted RF Test

Equipment Name	Manufacturer	Model	Serial No.	Equipment No.	Calibration Until
Signal analyzer	Agilent	N9020A	MY50200811	SHATBL-E017	2024.07.09
Attenuator	Keleto	AP-DC01G-2W-N-20dB	N/A	DGATBL-W41	2025.02.15
Power meter	keysight	U2021XA	MY55520005	SHATBL-E062	2024.07.09

2.8. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	RF output power, conducted	$\pm 0.6\text{dB}$
2	Conducted spurious emissions	$\pm 0.6\text{dB}$
3	All emissions, radiated 30MHz-1GHz	$\pm 4.6\text{dB}$
4	All emissions, radiated 1GHz-6GHz	$\pm 5.2\text{dB}$
5	All emissions, radiated 6GHz-18GHz	$\pm 4.4\text{dB}$
6	Occupied bandwidth	4%Hz

3. TEST RESULT

3.1. Maximum Transmitter Power

3.1.1. Limit

LMS Systems operation pursuant to subpart M of this part in the 902-927.25MHz band will be authorized a maximum of 30 watts ERP. LMS equipment operating in the 927.25-928MHz band will be authorized a maximum of 300 watts ERP. ERP must be measured as peak envelope power. Antenna heights will be as specified in FCC Part 90.353(h)

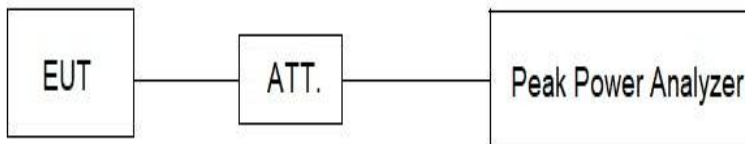
3.1.2. Test Procedure

- 1 Set analyzer center frequency to channel center frequency.
- 2 Set the RBW to:1MHz>=RBW.
- 3 Set the VBW>=3RBW.
- 4 Detector=Peak
- 5 Sweep time=auto couple.
- 6 Trace mode=max hold.
- 7 Allow trace to fully stabilize.
- 8 Use the peak marker function to determine the maximum amplitude level.

3.1.3. Test Conditions

The EUT is transmitting through a antenna cable with a stated loss of 3dB. All Firmware setting is 33dBm.

3.1.4. Test Setup



3.1.5. Test Result of Maximum Transmitter Power

Please refer to the Appendix A.

Note:

1. The EUT is transmitting through a long enough antenna cable with a stated loss of 12dB into the antenna with type N connector 15dBi gain.
2. $EIRP = \text{conducted power} + \text{antenna gain} - \text{cable loss}$; $ERP = EIRP - 2.15$.
3. Worst case modulation used by the device.
4. KDB 594280. Professional installation or authorized service personnel is required to configure radio parameters of the transmitter using the software for adjusting total EIRP (30W) power at local installation to ensure compliance with FCC Rules.

3.2. Occupied Bandwidth

3.2.1. Limit

The maximum authorized bandwidth shall be 12MHz for non-multilateration LMS operations in the band 909.75-921.75MHz and 2MHz in the band 902.00-904.00MHz. The maximum authorized bandwidth for multilateration LMS operations shall be 5.75MHz in the 904.00-909.75MHz band; 2MHz in the 919.75-921.75 MHz band; 5.75MHz in the 921.75-927.25MHz band and its associated 927.25-927.5MHz narrowband forward link; and 8MHz if the 919.75-921.75MHz and 921.75-927.25MHz bands and their associated 927.25-927.5MHz and 927.5-927.75MHz narrowband forward links are aggregated.

3.2.2. Test Procedure

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The Centre frequency of the channel under test
Detector	Peak
RBW	For 26 dB Bandwidth:100kHz For 99% Bandwidth:1% to 5% of the occupied bandwidth
VBW	For 26 dB Bandwidth: $\geq 3 \times \text{RBW}$ For 99% Bandwidth:approximately $3 \times \text{RBW}$
Trace	Max hold
Sweep	Auto

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points(upper and lower frequencies) that are attenuated by 6dB and 99% relative to the maximum level measured in the fundamental emission.

3.2.3. Test Result of Number of Hopping Frequencies

Please refer to the Appendix A.

3.3. Frequency stability

3.3.1. Limit

However, the device meets the following condition:

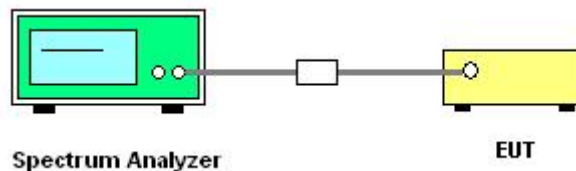
Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40kHz from the Band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.

Frequency tolerances measurements are taken for information purpose. Frequency must be maintained from -30°C to $+50^{\circ}\text{C}$. The EUT is monitored at each 10°C increment. At each temperature, the device is checked after a stabilization period required for the device to reach the temperature.

3.3.2. Test Procedure

- 1 Set analyzer center frequency to channel center frequency.
- 2 Set the RBW to: $30\text{kHz}=\text{RBW}$
- 3 Set the VBW $\geq 3*\text{RBW}$
- 4 Detector=Peak
- 5 Sweep time=auto couple.
- 6 Trace mode=max hold
- 7 Allow trace to fully stabilize.
- 8 Use the peak marker function to determine the maximum amplitude level.

3.3.3. Test Setup



3.3.4. Measurement Result

Please refer to the Appendix A.

3.4. Field strength of spurious emissions

3.4.1. Limit

For all other transmitters authorized under subpart M that operate in the 902-928MHz band, the peak power of any emission shall be attenuated below the power of the highest emission contained within the licensee's sub-band in accordance with the following schedule:

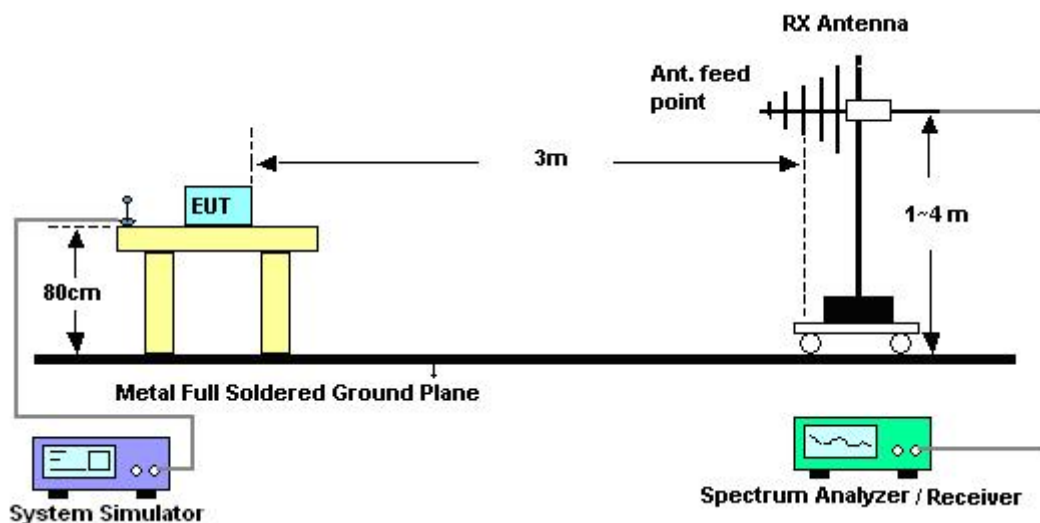
- 1 On any frequency within the authorized bandwidth: Zero dB.
- 2 On any frequency outside the licensee's sub-band edges: $55 + 10 \log(P)$ dB, where (P) is the highest emission (watts) of the transmitter inside the licensee's sub-band.

3.4.2. Test Procedure

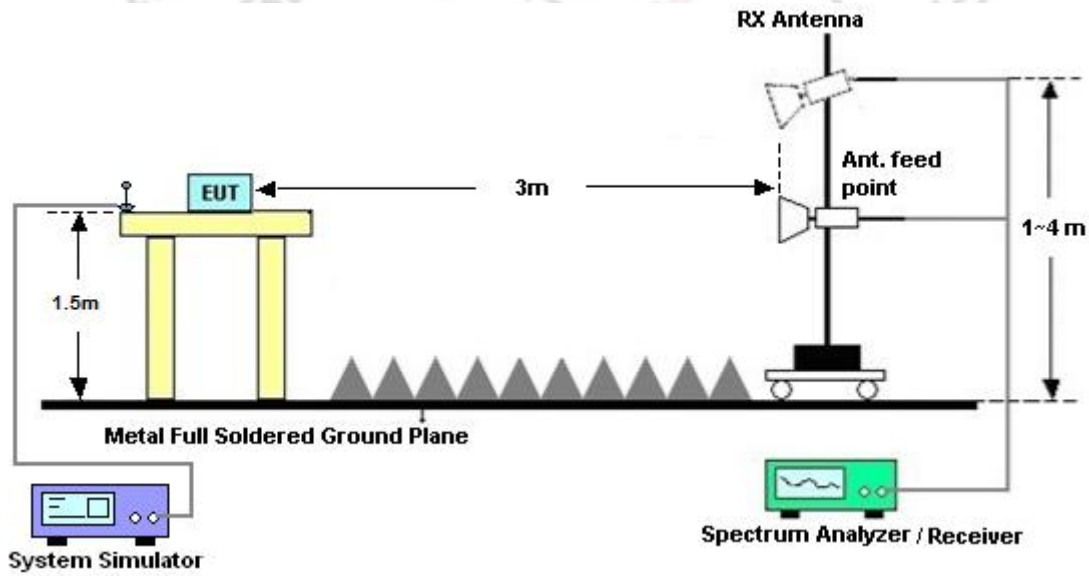
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.

3.4.3. Test Setup

3.4.3.1. For radiated emissions from 30MHz to 1GHz



3.4.3.2. For radiated emissions above 1GHz



3.4.4. Test Result of spurious emission

Please refer to the Appendix B.

Remark: only worst case was recorded in the test report.

Have enough margin was no recorded in the test report.

3.5. Spurious emission at antenna terminals

3.5.1. Limit

On any frequency outside the licensee's sub-band edges: $55 + 10 \log(P)$ dB, where (P) is the highest emission(watts) of the transmitter inside the licensee's sub-band.

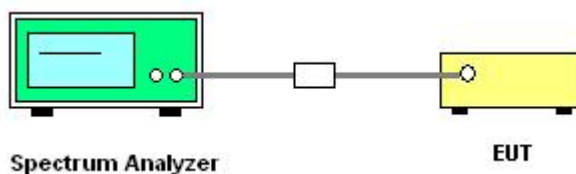
3.5.2. Test Procedure

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30MHz to 10 th carrier harmonic
RB/VB (emission in the restricted band)	100kHz/300kHz
Trace-Mode:	Max hold

For Band edge

Spectrum Parameter	Setting
Detector	Peak
RB/VB (emission in the restricted band)	100kHz/300kHz
Trace-Mode:	Max hold

3.5.3. Test Setup



3.5.4. Test Result of spurious emission at antenna terminal

Please refer to the Appendix A.

3.6 Receiver Spurious Emissions

3.6.1 Test Limit

Radiated emission measurements shall be performed with the receiver antenna connected to the receiver antenna ports. The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver(e.g. local oscillator, intermediate or carrier frequency), or 30MHz,whichever is higher, to at least five times the highest tunable or local oscillator frequency, whichever is higher ,without exceeding 40GHz.

Spurious emissions from receivers shall not exceed the radiated emissions limits shown in table 3.

Table 3- Receiver radiated emissions limits

Frequency (MHz)	Field strength (uV/m at 3 m)
30-88	100
88-216	150
216-960	200
Above 960	500

Note 1: Measurements for compliance with the limits in table 3 may be performed at distances other than 3 meters, in accordance with section 3.4.3.

3.6.2 Test Procedure

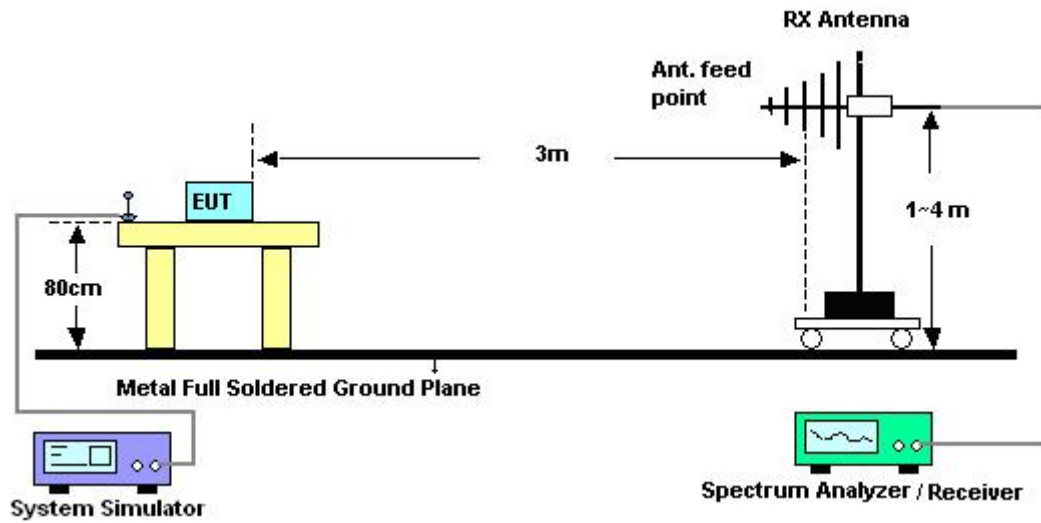
- The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
- The EUT was placed on the top of a rotating table 0.8 meters(above 1GHz is 1.5m)above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- The height of the equipment shall be 0.8m(above 1GHz is 1.5m); the height of the test antenna shall vary between 1m to 4m. horizontal and vertical polarizations of the antenna are set to make the measurement.
- The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- For the actual test configuration, please refer to the related Item-EUT Test Photos.

Note:

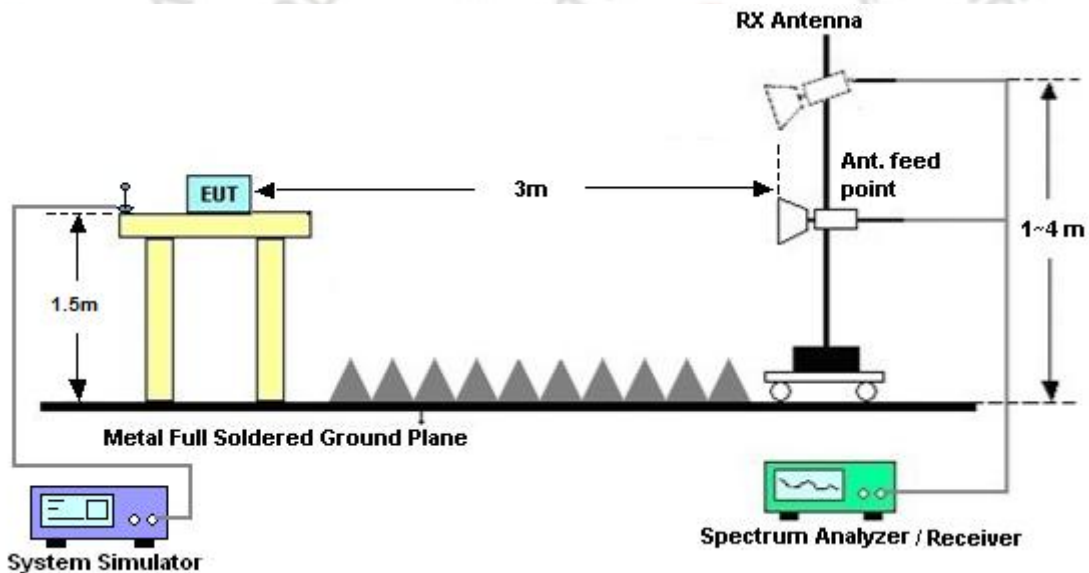
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

3.6.3 TEST SETUP

For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.6.3 TEST RESULT

Please refer to the Appendix B.

Note: All mode has been tested, only show the worst case in this report.

4. TEST SETUP PHOTOGRAPHS

Please refer to the Appendix C.

5. PHOTOGRAPHS OF EUT

Please refer to the Appendix D.

*****END OF THE REPORT*****