Onwa Marine Electronics Co. Ltd.

Pubian industrial zone,Shanwei City, Guangdong Province

EN 60945:2002

Maritime navigation and radiocommunication equipment and systems
— General requirements—Methods of testing and required test results

MEASUREMENT AND TEST REPORT

Model : KAP866

Feb. 15, 2012

This Report Concerns: Original Report	**Equipment Type:** Autopilot System
Report Number: ONWA-RD-P1102304-03 **Test Date:** Feb. 03-14, 2012 **Test Engineer :** Leo Wu **Reviewed By :** Mark Luen **Prepared By :** Shanwei R&D Dept.	

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1 Executive Summary & EUT information

The purpose of this test program was to demonstrate compliance of the Autopilot System (KAP866), against the current Stipulated Standards.

EUT Information

EUT Description :	Autopilot System
Model No. :	KAP866
Serial No. :	N/A
Input Power :	DC13.8V
Classification Per Stipulated Test Standard :	Exposed to the weather (formerly class X)

2 TECHNICAL DETAILS

Purpose	Compliance testing of Autopilot System with stipulated standards
Laboratory performing the tests	Onwa Marine Electronics Co. Ltd.
Test report reference number	ONWA-RD-P1102304-03
Date EUT received	Feb. 03, 2012
Standard applied	EN60945:2002
Dates of test (from – to)	Feb. 03-14, 2012
No of Units	#1
Equipment Category	Exposed to the weather (formerly class X)
Trade Name	ONWA®
RF Operating Frequency (ies)	NIL
Rated Input Power	DC13.8V

3 MODIFICATION

None

4 TEST SUMMARY

The product was tested in accordance with the following specifications. The Pass / Fail Criteria for the immunity tests were specified in Annex Ciii.

All Testing has been performed according to below product classification:

Exposed to the weather (formerly class X)

Test Results Summary

Test Standard	Description	Pass/Fail
EN 60945:2002	Vibration	Pass
EN 60945:2002	Dry Heat	Pass
EN 60945:2002	Low Temperature	Pass
EN 60945:2002	Compass Safe Distance	Pass
EN 60945:2002	Acoustic Noise	Pass
EN 60945:2002	Safety, Protection Against Hazardous Voltage	Pass

Emissions			
Test Standard	**Description**	**Product Class**	**Pass/Fail**
EN 60945:2002	Conducted Emissions	See Above	Pass
	Radiated Emission	See Above	Pass

Immunity			
Test Standard	**Description**	**Criterion**	**Pass/Fail**
EN 60945:2002	Electrostatic Discharge Immunity	B	Pass
	Radiated Emission	A	Pass
	Conducted Disturbance Immunity	A	Pass
	Electrical Fast Transient / Burst Immunity	B	Pass
	Surge Immunity	N/A	N/A
	Voltage interruption	C	Pass

5 MEASUREMENTS, EXAMINATION AND DERIVED RESULTS

EN 60945: 2002 –Vibration

The unit was fixed to a vibration fixture via its front fixings and then bolted to the vibrator table.

The unit was then subjected to a sinusoidal resonance search test in each of three mutually perpendicular axes. The vibration levels were: 3 Hz to 13.2 Hz at 1 mm peak displacement, 13.2 Hz to 100 Hz at 0.7g peak acceleration Sweep rate 0.5 octaves/minute.

EN 60945: 2002 – Dry Heat

The powered unit was installed in a climatic chamber at ambient conditions. The unit was then subjected to the following temperature cycle.

1. +25℃ to +55℃ at 1℃ per minute
2. +55℃ for 16 hours, after 15 hours the unit was functioned.
3. +55℃ to +25℃ at 1℃ per minute
4. +25℃ for a minimum of 1 hour

EN 60945: 2002– Damp Heat

The un-powered unit was installed in a climatic chamber at ambient conditions.

The unit was then subjected to the following temperature and humidity cycle.

1.Increase from normal room temperature and relative humidity to 41℃ and 90% relative humidity (rh) over a period of 3 hours

2.+41℃/90%rh for 16 hours, after 14 hours the unit was powered and functioned.

3.+41℃/90%rh to normal room temperature and relative humidity over a period in excess of 1 hour

EN 60945: 2002– Low Temperature

The no running unit was installed in a climatic chamber at ambient conditions. The unit was then subjected to the following temperature cycle.

1. +25℃ to -15℃ at 1℃ per minute
2. -15℃ for 16 hours, after 14 hours at -15℃ the unit was powered and functioned for the remaining 2 hours at -15℃.
3. -15℃ to +25℃ at 1℃ per minute
4. +25℃ for a minimum of 1 hour

EN 60945: 2002 – Section 11.2 – Compass Safe Distance

Conformity declared by the manufacturer in the manual, the test was waived.

EN 60945: 2002 – Section 11.1 – Acoustic Noise

The measurements were taken using AWA6270+ Sound Level Meter at 1m from the equipment under test in accordance with the specification.

EN 60945: 2002 – Section 12.1 – Safety, Protection against Hazardous Voltage

Insertion of the jointed finger, straight and in a bent position, was tested in every potential access point of the unit.

Test Items	Description
Vibration	The unit showed no sign of damage or deterioration on completion of the test. After testing, performance check and operation correctly.
Dry Heat	
Low Temperature	
Compass Safe Distance	N/A
Acoustic Noise	The sound pressure level from the powered EUT showed no increase above the ambient noise level of 53.5dB (A) (The limit is 60dB (A)).
Safety, Protection Against Hazardous Voltage	There was no location on the Unit at which the Test Finger could be inserted

5.1 Conducted Emissions Test Result

Note:

1. All possible modes of operation were investigated. Only the 6 worst case emissions measured, using the correct CISPR and Average detectors, are reported. All other emissions were relatively insignificant.

2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.

3. Conducted Emissions Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 9kHz – 30MHz (Average & Quasi-peak) is ±3.86dB.

4. Environmental Conditions Temperature 26℃

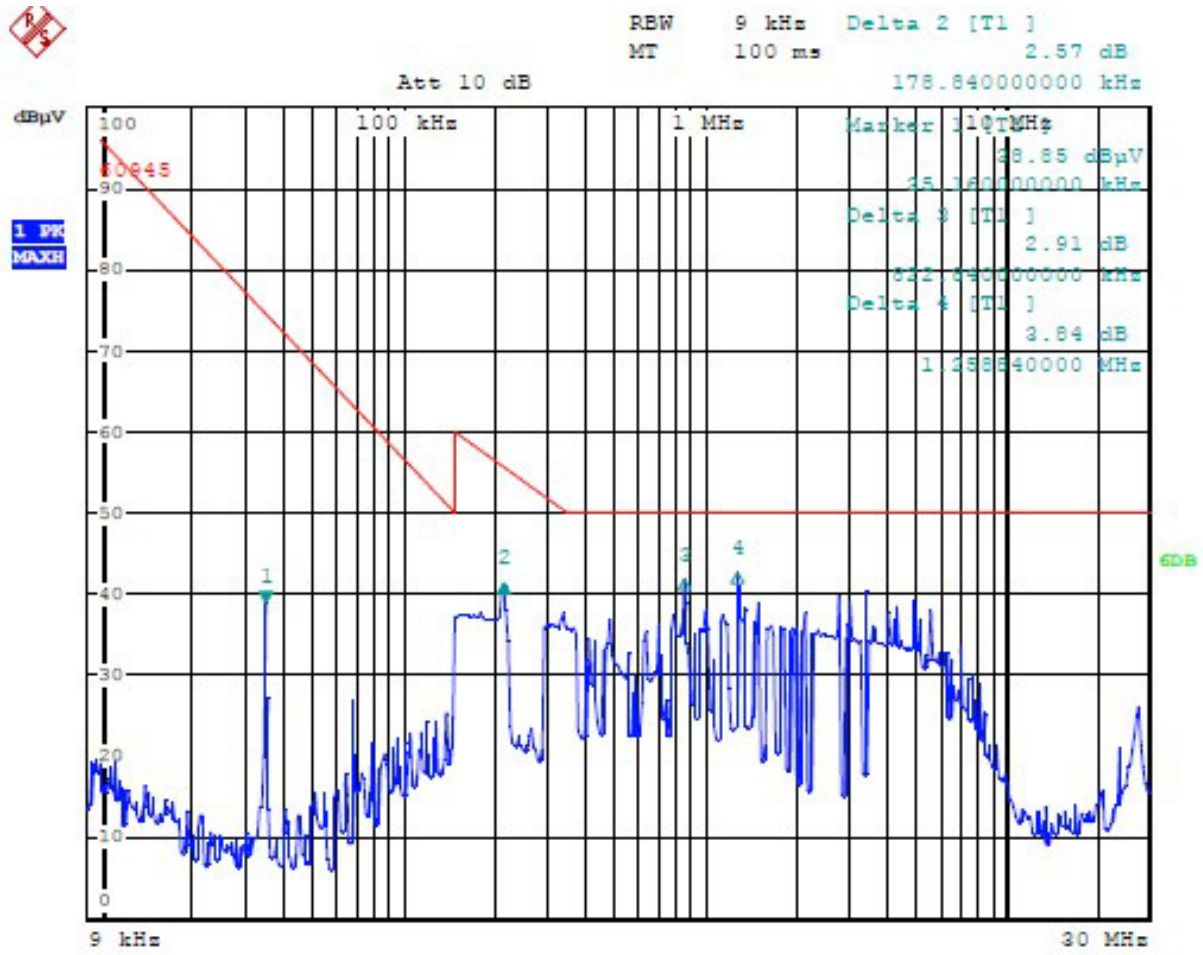
Relative Humidity 52%

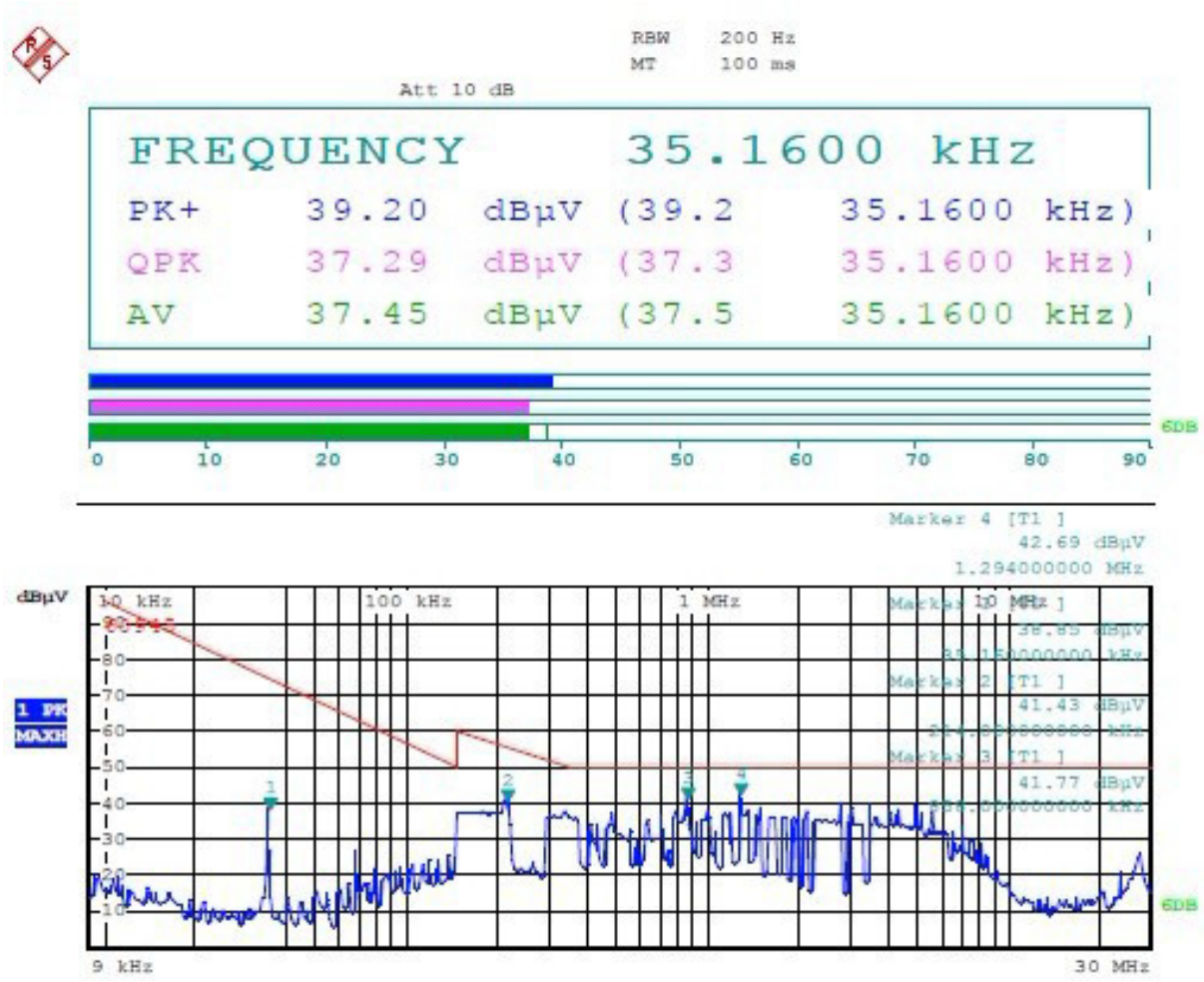
Atmospheric Pressure 1013mba

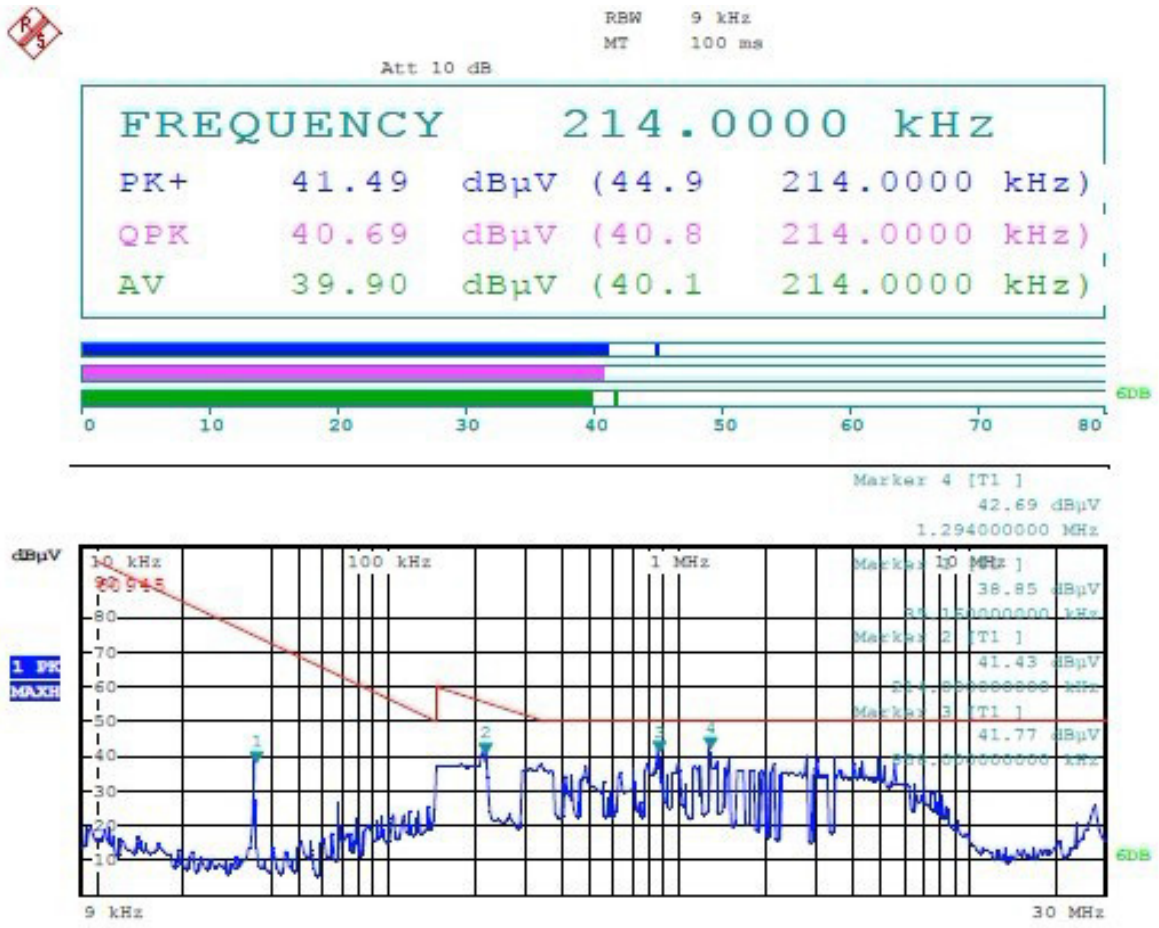
5. Test Date : Feb. 6th~14th 2012

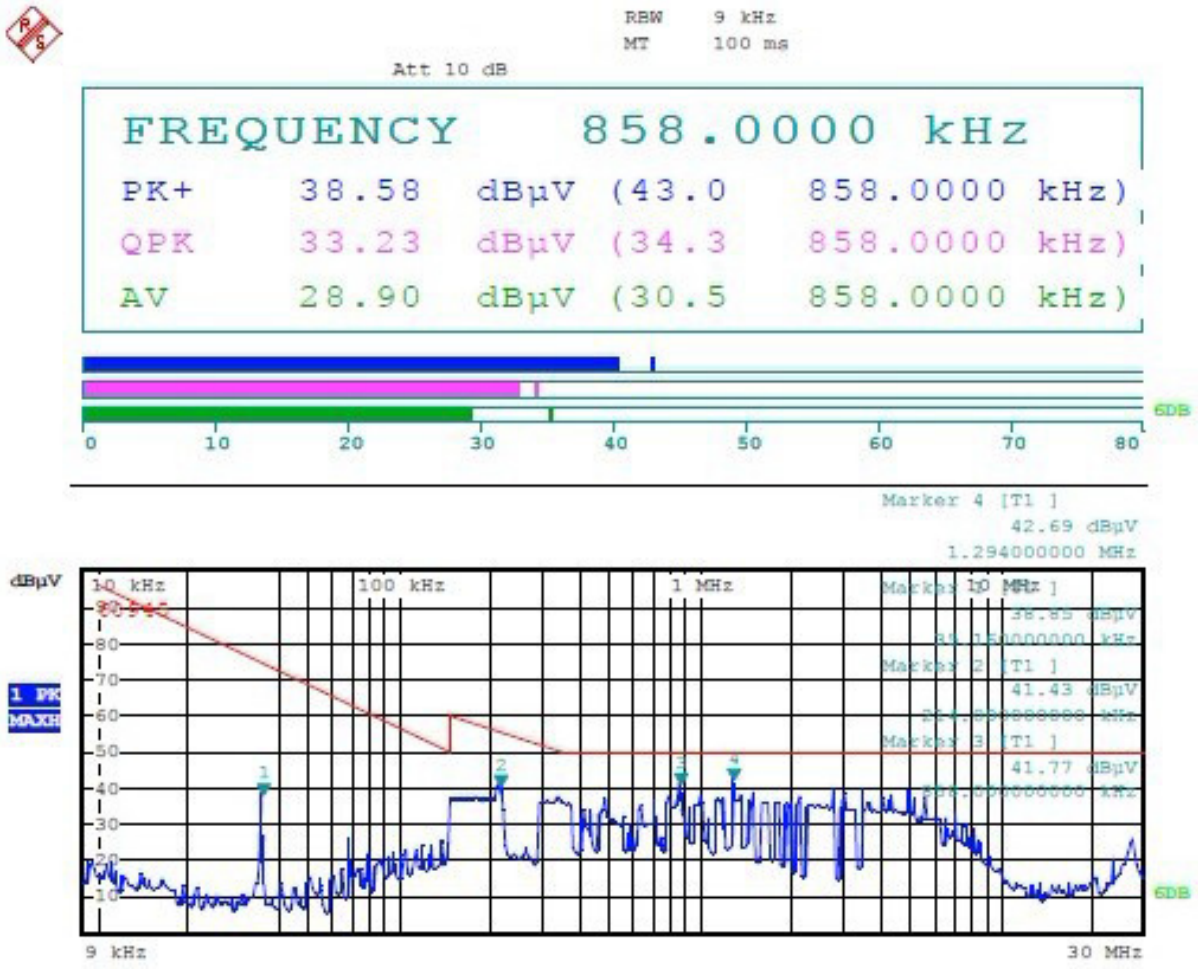
Tested By : Jerry Wu

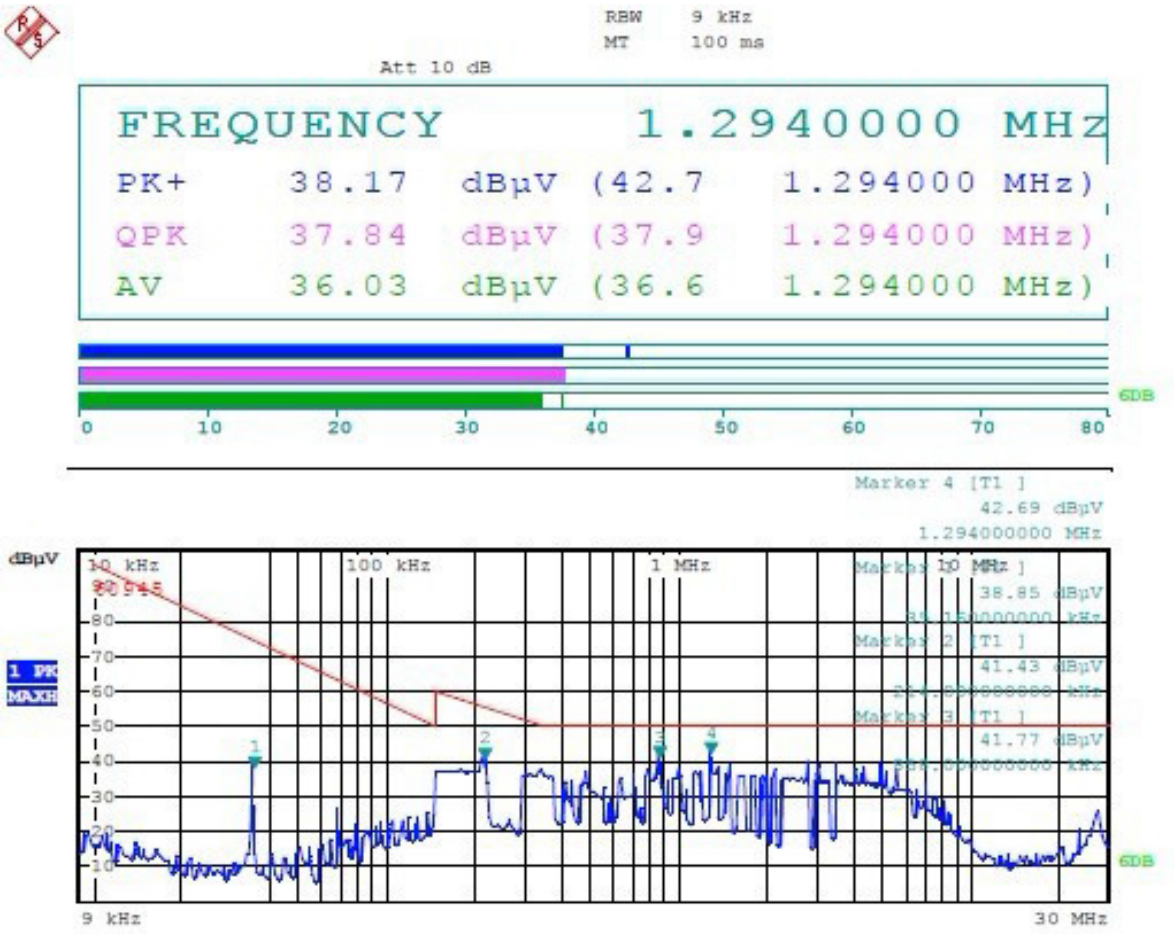
5.1.1 Test Result Complying For EN60945:2002

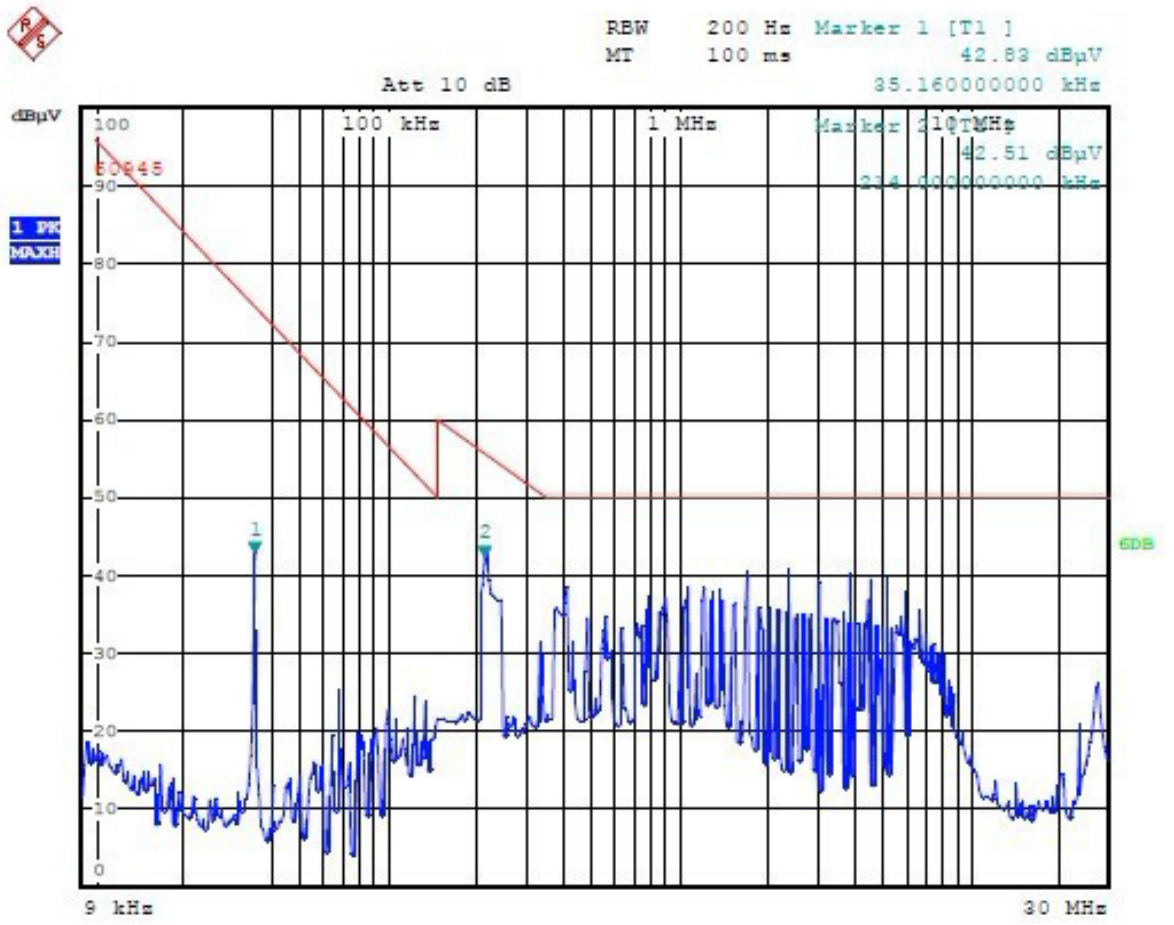


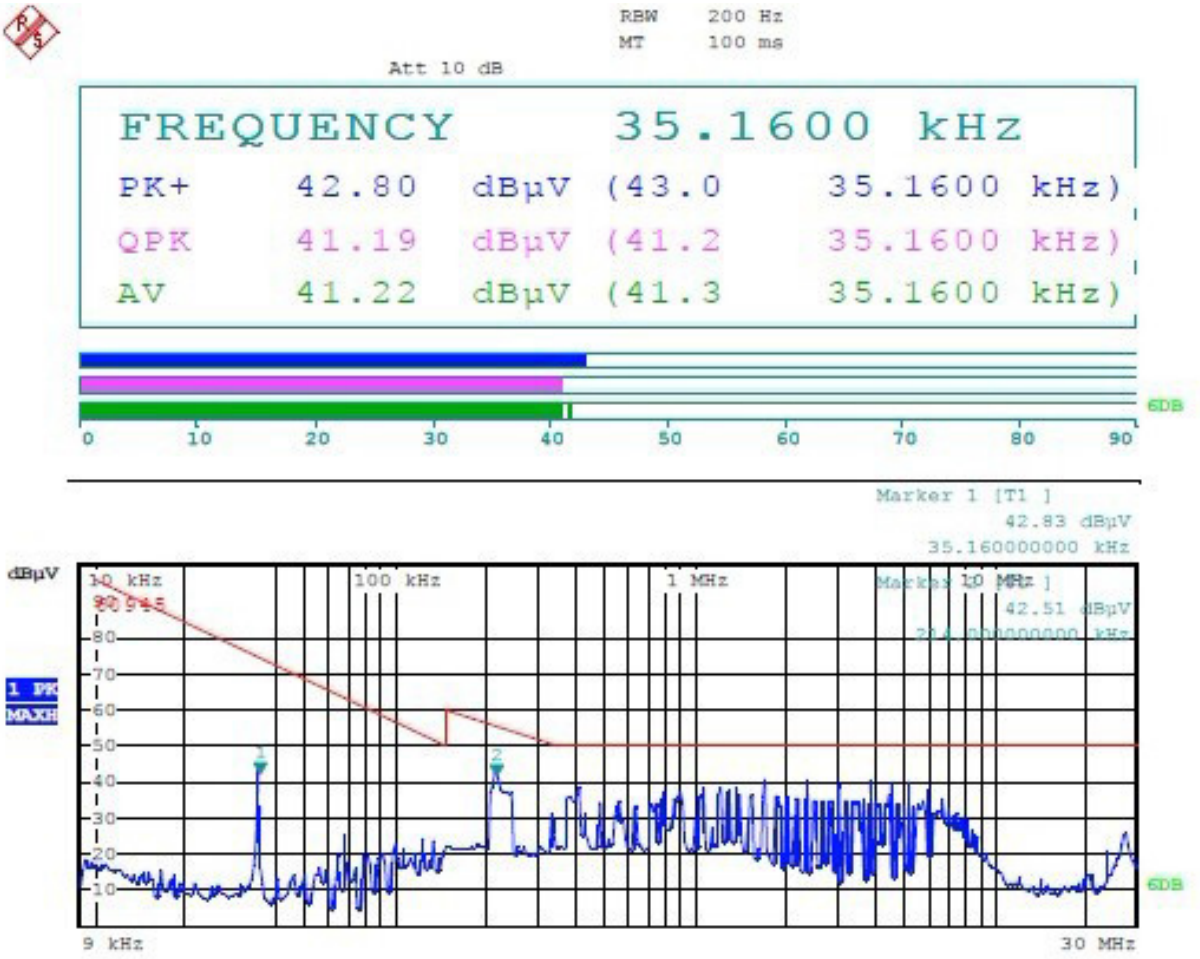


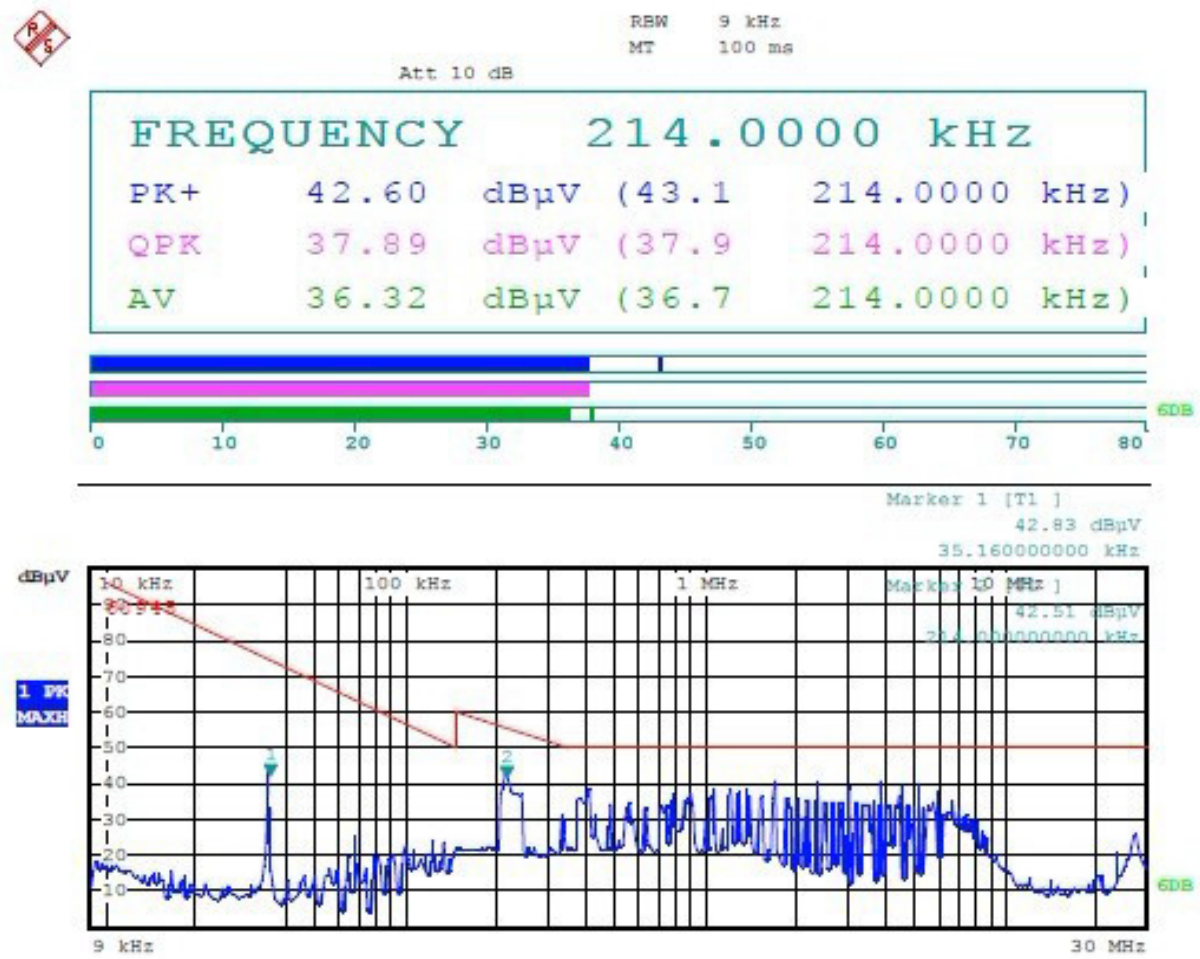

RBW 9 kHz
MT 100 ms
Att 10 dB
FREQUENCY 214.0000 kHz
PK+ 41.49 dBµV (44.9 214.0000 kHz)
QPK 40.69 dBµV (40.8 214.0000 kHz)
AV 39.90 dBµV (40.1 214.0000 kHz)
6DB
0 10 20 30 40 50 60 70 80
Marker 4 [T1]
42.69 dBµV
1.294000000 MHz
dBµV
10 kHz
100 kHz
1 MHz
10 MHz
Marker 1 [T1]
38.85 dBµV
Marker 2 [T1]
41.43 dBµV
Marker 3 [T1]
41.77 dBµV
1 PK
MAXH
9 kHz
30 MHz


RBW 9 kHz
MT 100 ms
Att 10 dB
FREQUENCY 858.0000 kHz
PK+ 38.58 dBµV (43.0 858.0000 kHz)
QPK 33.23 dBµV (34.3 858.0000 kHz)
AV 28.90 dBµV (30.5 858.0000 kHz)
6DB
0 10 20 30 40 50 60 70 80
Marker 4 [T1]
42.69 dBµV
1.294000000 MHz
dBµV
10 kHz
100 kHz
1 MHz
10 MHz
Marker 1 [T1]
38.85 dBµV
Marker 2 [T1]
41.43 dBµV
Marker 3 [T1]
41.77 dBµV
1 PK
MAXH
9 kHz
30 MHz


RBW 9 kHz
MT 100 ms
Att 10 dB
FREQUENCY 1.2940000 MHz
PK+ 38.17 dBµV (42.7 1.294000 MHz)
QPK 37.84 dBµV (37.9 1.294000 MHz)
AV 36.03 dBµV (36.6 1.294000 MHz)
6DB
0 10 20 30 40 50 60 70 80
Marker 4 [T1]
42.69 dBµV
1.294000000 MHz
dBµV
10 kHz
100 kHz
1 MHz
10 MHz
Marker 1 [T1]
38.85 dBµV
Marker 2 [T1]
41.43 dBµV
Marker 3 [T1]
41.77 dBµV
1 PK
MAXH
6DB
9 kHz
30 MHz


RBW 200 Hz
MT 100 ms
Marker 1 [T1]
42.83 dBµV
35.160000000 kHz
Att 10 dB
dBµV
100 kHz
1 MHz
10 MHz
Marker 2 [T1]
42.51 dBµV
1 PK
MAXH
6DB
9 kHz
30 MHz


RBW 200 Hz
MT 100 ms
Att 10 dB
FREQUENCY 35.1600 kHz
PK+ 42.80 dBµV (43.0 35.1600 kHz)
QPK 41.19 dBµV (41.2 35.1600 kHz)
AV 41.22 dBµV (41.3 35.1600 kHz)
6DB
0 10 20 30 40 50 60 70 80 90
Marker 1 [T1]
42.83 dBµV
35.160000000 kHz
dBµV
10 kHz
100 kHz
1 MHz
10 MHz
42.51 dBµV
1 PK
MAXH
6DB
9 kHz
30 MHz


RBW 9 kHz
MT 100 ms
Att 10 dB
FREQUENCY 214.0000 kHz
PK+ 42.60 dBµV (43.1 214.0000 kHz)
QPK 37.89 dBµV (37.9 214.0000 kHz)
AV 36.32 dBµV (36.7 214.0000 kHz)
6DB
0 10 20 30 40 50 60 70 80
Marker 1 [T1]
42.83 dBµV
35.160000000 kHz
dBµV
10 kHz
100 kHz
1 MHz
10 MHz
42.51 dBµV
1 PK
MAXH
6DB
9 kHz
30 MHz

5.2 Radiated Emissions Test Results

Note:

1. All possible modes of operation were investigated. Only the 6 worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.

2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.

3. Radiated Emissions Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 150kHz – 18GHz (QP only @ 3m & 10m) is +6dB/-6dB (for EUTs < 0.5m X 0.5m X 0.5m).

4. Environmental Conditions Temperature 24℃

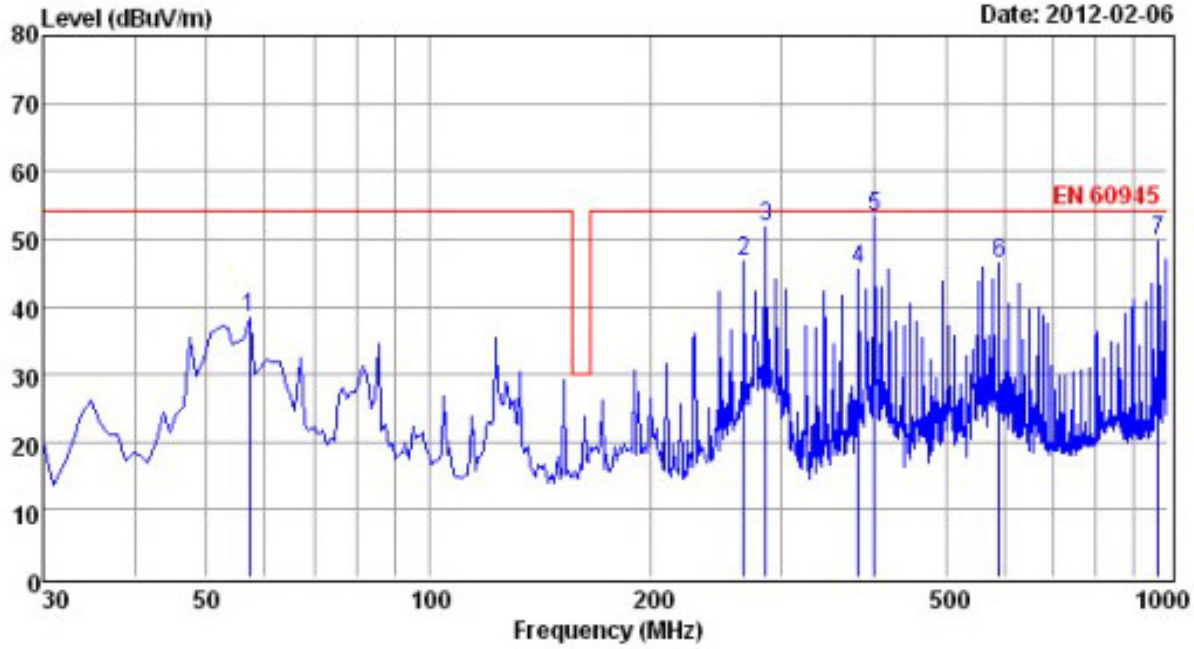
Relative Humidity 56%

Atmospheric Pressure 1012mba

5. Test Date : Feb.6th~14th 2012

Tested By : Wills

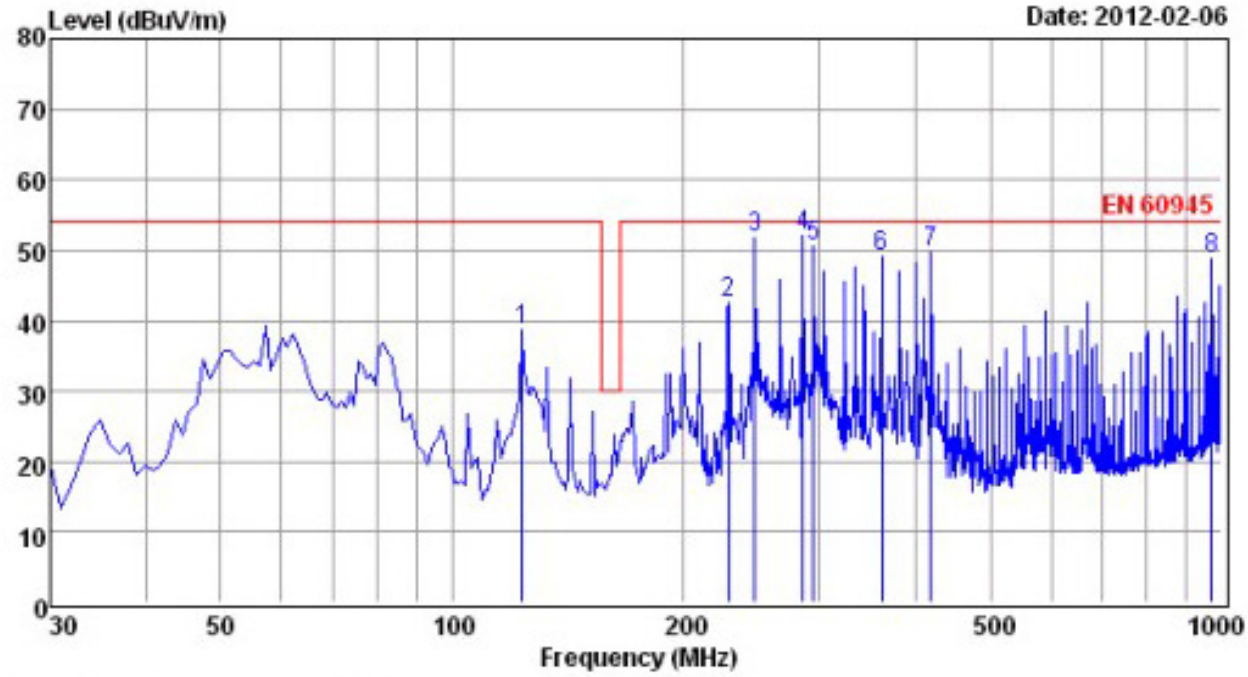
5.2.1 Test Result Complying For EN60945:2002



Env. /Ins: 24℃/56%
EUT:
Test Mode: On
Operator: Willis
Memo:
pol: VERTICAL

	Freq.	Reading	CabLos	AntFac	PreFac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dB	dBuV/m	dBuV/m	dB	
1	57.16	55.20	0.47	12.88	30.15	38.40	54.00	-15.60	Peak
2	266.68	63.47	1.00	12.26	30.17	46.56	54.00	-7.44	Peak
3	286.08	68.25	1.00	12.79	30.16	51.88	54.00	-2.12	Peak
4	381.14	59.70	1.18	14.62	30.11	45.39	54.00	-8.61	Peak
5	400.54	67.19	1.20	15.07	30.10	53.36	54.00	-0.64	Peak
6	590.66	56.57	1.54	18.28	30.00	46.39	54.00	-7.61	Peak
7	971.87	56.34	2.04	21.56	30.14	49.80	54.00	-4.20	Peak

Note: 1. All readings are Quasi-peak values.
2. Measured = Reading + Antenna Factor + Cable Loss - Amp Factor.
3. The emission levels that ate 20dB below the official limit are not reported.



Env. /Ins: 24℃/56%
EUT:
Test Mode: On
Operator: Willis
Memo:
pol: HORIZONTAL

	Freq.	Reading	CabLos	AntFac	PreFac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dB	dBuV/m	dBuV/m	dB	
1	123.12	58.24	0.70	10.00	30.20	38.74	54.00	-15.26	Peak
2	228.85	60.34	0.93	11.59	30.19	42.67	54.00	-11.33	Peak
3	247.28	68.98	0.97	12.08	30.18	51.85	54.00	-2.15	Peak
4	286.08	68.32	1.00	12.79	30.16	51.95	54.00	-2.05	Peak
5	294.81	66.73	1.08	12.96	30.15	50.62	54.00	-3.38	Peak
6	361.74	63.54	1.17	14.44	30.12	49.03	54.00	-4.97	Peak
7	418.97	63.09	1.32	15.45	30.09	49.77	54.00	-4.23	Peak
8	971.87	55.27	2.04	21.56	30.14	48.73	54.00	-5.27	Peak

Note: 1. All readings are Quasi-peak values.
2. Measured = Reading + Antenna Factor + Cable Loss - Amp Factor.
3. The emission levels that ate 20dB below the official limit are not reported.

5.3 EN 60945:2002 Electrostatic Discharge Immunity Results

Notes

1. Please refer to the Pass/Fail criteria to interpret the results.

2. Environmental Conditions Temperature 24℃

Relative Humidity 56%

Atmospheric Pressure 1019mba

3. Human Body Model Storage Capacitor 150pF

Discharge Resistor 330Ω

No. of Discharges / Point, Level & 10 air discharges

4. Discharge Details Polarity 25 contact discharges

Discharge Interval 1 second

5. Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 2kV, 4kV, 6kV, 8kV, 10kV is 7.12%.

Test Date: Feb., 6th ~14th,2012

Tested By : Jerry Wu

Discharge Type	Test Severity Level	Results
Air Discharges	2kV, 4kV , 8kV	Pass
Direct Contact Discharges	2kV, 4KV, 6KV	Pass
Indirect Contact Discharges	2kV, 4KV, 6KV	Pass

5.4 EN 60945:2002 Radiated Immunity Results

Notes

1. Please refer to the Pass/Fail criteria to interpret the results.

2. Environmental Conditions Temperature 25.5℃

Relative Humidity 56%

Atmospheric Pressure 1016mba

3. Radiated Immunity Details Frequency Step 1% of fundamental

Sweep Rate

≤1.5*10-3decades/s

4. The test was carried out on one surface. The surface selected to face the source of the interference signal is the one anticipated to be the most susceptible.

5. Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 80MHz-3GHz, test level ranges from 3V/m to 10V/m, is ±0.74V/m.

Test Date: Feb., 6th ~14th,2012

Tested By : Jerry Wu

6. the performance criteria A shall apply

Sides Tested	Frequency Range	Test Severity Level	Result
Front(H)	80MHz – 2GHz	10V/m, 80% AM (400Hz)	Pass
Front (V)	80MHz – 2GHz	10V/m, 80% AM (400Hz)	Pass
Right(H)	80MHz – 2GHz	10V/m, 80% AM (400Hz)	Pass
Right(V)	80MHz – 2GHz	10V/m, 80% AM (400Hz)	Pass
Left (H)	80MHz – 2GHz	10V/m, 80% AM (400Hz)	Pass
Left (V)	80MHz – 2GHz	10V/m, 80% AM (400Hz)	Pass
Back (H)	80MHz – 2GHz	10V/m, 80% AM (400Hz)	Pass
Back (V)	80MHz – 2GHz	10V/m, 80% AM (400Hz)	Pass

5.7 EN 60945:2002 Electrical Fast Transient/Burst Immunity Test Results

Notes

1. Please refer to the Pass/Fail criteria to interpret the results.

2. Environmental Conditions Temperature 22℃

Relative Humidity 52%

Atmospheric Pressure 1001mba

3. EFT/B Test Details Test Duration/Level & Polarity 1minute

4. Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, test level ranges from ±0.5kV to ±1kV 10V/m, is 1.2%.

5. Test Date: Feb., 6th ~14th,2012

Tested By : Jerry Wu

the performance criteria B shall apply.

Cable	Test Severity Level	Results
DC Power Input Port		
L1	N/A	N/A
L2	N/A	N/A
L1-L2	N/A	N/A

Cable	Test Severity Level	Results
Signal Cable	±1KV	PASS

5.8 EN 60945:2002 Surge Immunity Results

Notes

1. Please refer to the Pass/Fail criteria to interpret the results.

2. Environmental Conditions Temperature 25℃

Relative Humidity 46.5%

Atmospheric Pressure 1003mba

3. Surge Test Details Repetion Rate At least 1 per minute

Open-Circuit Voltage Waveform 1.2/50 us

Short-Circuit Current Waveform 8/20 us

Phase Angels 0°, 90°, 180°,270°

4. Test Date: Feb., 6th ~14th,2012

Tested By : Jerry Wu

Cable	Test Severity Level	Results
DC Power Input Port		
L1-L2	N/A	N/A

5.9 EN 60945:2002 Voltage Dips And interruption Immunity Results

Notes

1. Please refer to the Pass/Fail criteria to interpret the results.

2. Environmental Conditions Temperature 26℃

Relative Humidity 46%

Atmospheric Pressure 1013mba

3. Test Date: Feb., 6th ~14th,2012

Tested By : Jerry Wu

* Performance criteria C shall apply.

	Duration	Test Severity Level (Reduction)	Result
Short Interruptions	60s	> 95%	Pass

5.10 EN 60945:2002 Conducted Disturbance Immunity Results

Notes

1. Please refer to the Pass/Fail criteria to interpret the results.

2. Environmental Conditions Temperature 26℃

Relative Humidity 56%

Atmospheric Pressure 1022mba

3. Conduced Immunity Details Frequency Step 50kHz in the range 150kHz to 5MHz,

1% frequency increment of the

momentary frequency in the range

5MHz to 80MHz.

Sweep Rate ≤1.5*10-3decades/s

4. Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, test level 3Vrms and 10Vrms, frequency raging from 150kHz to 80MHz, is ±0.93dB.

5. Test Date: Feb., 6th ~14th,2012

Tested By : Jerry Wu

the performance criteria A shall apply.

Cable	Frequency Range	Test Severity Level	Result
DC power port	150kHz - 80MHz	3V, 80% AM (400Hz)	Pass
		10V, 80% AM (400Hz)	
	150kHz - 80MHz	At frequencies below:2MHz, 3MHz, 4MHz, 6.2MHz, 8.2MHz, 12.6MHz, 16.5MHz, 18.8MHz, 22MHz, 25MHz	Pass

Annex A. TEST INSTRUMENTATION

Annex A.i. TEST INSTRUMENTATION & GENERAL PROCEDURES			
Instrument	**Model**	**Serial#**	**Valid Date**
Conducted Emissions			
R&S Receiver	ESPI 3	153201	2013.01.10
Com-Power LISN	LI 115	230012	2012.10.23
Com-Power LIMITER	LI 115	162004	2012.10.23
Radiated Emissions			
R&S Receiver	ESPI 3	112301	2012.08.15
EMCO Loop Antenna	6509	40012-223	2012.06.23
Sunol Sciences, Inc. Antenna(30MHz~2GHz)	JB1	H200144	2012.10.23
HP Pre-amplifier	8447F	1862520	2012.08.15
Electrostatic Discharge Immunity			
ESD Tester	NSG437	113	2012.06.23
RF Radiated Immunity			
IFR Signal Generator	2023B	2012356	2012.06.23
AR Power Amplifier	50W1000B	40005	2012.08.15
Power Amplifier	JXTXLB-10180	G562223	2013.01.10
Sunol Sciences, Inc. Antenna(30MHz~2GHz)	JB1	H12000	2012.10.23
Conducted Disturbance Immunity			
Power Amplifier (1~1000MHz)	50W1000B	3HL3300467	2013.01.10
Signal Generator	2023B	3HL3300466	2012.06.23
COM-POWER CDN	CDN M3-25	3HL3300465	2012.06.23
Bulk Current Injection Probe	F-120-3B	11	2012.06.23
Electrical Fast Transient/BurstImmunity			
EFT/B Generator	NSG1025	4H556000	2012.10.23
Coupling Decoupling Network	CDN 125	2J333561	2012.08.15
Voltage Dips Immunity			
Dip/Interruption Generator	PACS-1	2L005893	2013.01.10
Sound level meter	AWA6270+	186660	2012.10.23

Annex A.ii. CONDUCTED EMISSIONS TEST DESCRIPTION

Test Set-up

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 0.8m high, non-metallic support, as shown in Annex B.

2. The power supply for the EUT was fed through a 50 /50 H EUT LISN, connected to filtered mains.

3.The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.

4. All other supporting equipments were powered separately from another main supply.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.

2. A scan was made on the NEUTRAL line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver.

3. High peaks, relative to the limit line, were then selected.

4. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 KHz. For the tests, only Quasi-peak measurements were made; while for CISPR/EN tests, both Quasi-peak and Average measurements were made.

5. Steps 2 to 4 were then repeated for the LIVE line (for AC mains) or DC line (for DC power).

Sample Calculation Example

At 20 MHz limit =250uV = 47.96 dBuV
Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.20 dB
Q-P reading obtained directly from EMI Receiver = 40.00 dBuV
(Calibrated for system losses)
Therefore, Q-P margin = 47.96 – 40.00 = 7.96 i.e. 7.96 dB below limit

Annex A. iii RADIATED EMISSIONS TEST DESCRIPTION

EUT Characterisation

EUT characterisation, over the frequency range from 30MHz to 2GHz, was done in order to minimise radiated emissions testing time while still maintaining high confidence in the test results

The EUT was placed in the chamber, at a height of about 0.8m non-metallic support. Its radiated emissions frequency profile was observed, using a spectrum analyzer /receiver with the appropriate broadband antenna placed 3m away from the EUT. Radiated emissions from the EUT were maximised by rotating the turntable manually, changing the antenna polarisation and manipulating the EUT cables while observing the frequency profile on the spectrum analyzer / receiver. Frequency points at which maximum emissions occurred, clock frequencies and operating frequencies were then noted for the formal radiated emissions test at the Open Area Test Site (OATS).

Test Set-up

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 0.8m high, non-metallic support as shown in Annex B.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:

a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.

b. The EUT was then rotated to the direction that gave the maximum emission.

c. Finally, the antenna height was adjusted to the height that gave the maximum emission.

3. A Quasi-peak measurement was then made for that frequency point.
4. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.
5. The frequency range covered was from 30MHz to 2GHz, using Antenna JB-1 for frequencies from 30MHz to 2000MHz.

Sample Calculation Example

At 300 MHz limit =37.00 dBuV/m
Log-periodic antenna factor & cable loss at 300 MHz = 18.50 dB
Q-P reading obtained directly from EMI Receiver = 30.00 dBuV/m
(Calibrated level including antenna factors & cablelosses)
Therefore, Q-P margin = 37.00 – 30.00 = 7.00 i.e. 7dB below limit

Annex A.iv. ELECTROSTATIC DISCHARGE IMMUNITY TEST DESCRIPTION (EN61000-4-2:1998)

Test Set-up

1. The test set-up was in accordance with the standard.
2. The electrostatic discharge (ESD) gun was loaded with the correct charging / discharge network specified by the standard.
3. A 0.8m high, non-metallic support was used as a test bench. The EUT and supporting equipment were placed on the test bench, isolated from the ground plane.
4. The VCP was grounded to the ground plane via two 470 k “bleed” resistors at each end of the ground cable.

Test Method

1. Direct Air & Contact Discharge

Applications of direct air and contact discharges to the discharge points specified by the customer were carried out in the following manner:

a. The EUT was switched on and allowed to warm up to its normal operating condition.

b. The test discharge points are shown in the ESD Test Points Section of Annex B.

c. For air discharges, the charged rounded electrode was positioned at a distance away from the test point and moved towards the EUT at a steady rate until a discharge was made or until the electrode touched the EUT, whichever occurs first.

d. For contact discharges, the pointed electrode was applied directly to the test point, in contact with the conductive surface of the EUT. The discharges were then made with the electrode in contact with the EUT.

e. The required number of positive and negative discharges was applied at each test point; with a one second interval between discharges.

f. The EUT was monitored during the test in accordance with the Pass / Fail criteria declared by the customer.

2. Indirect Coupling Plane Discharges

Indirect applications of discharges using the VCP were performed on the sides of the EUT in the following manner:

a. The EUT was switched on and allowed to warm up to its normal operating condition.

b. The discharges to the VCP were made 0.1m away from one side of the EUT.

c. The required numbers of positive and negative discharges were applied at each test point; with a one second interval between discharges.

d. The EUT was monitored during the test in accordance with the Pass / Fail criteria declared by the customer.

e. The test was then repeated on the remaining necessary sides of the EUT.

Annex A.v. RADIATED IMMUNITY TEST DESCRIPTION (EN61000-4-3:1998)

Test Set-up

1. The EUT was set up inside a semi-anechoic chamber in accordance with the standard.
2. The EUT was placed on top of a 0.8m high, non-metallic support in a typical configuration.
3. An isotropic field probe was placed adjacent to the EUT.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The EUT was exercised and monitored in the manner specified by the customer.
3. All test instruments were PC controlled, via their IEEE 488.2 bus interfaces, and the test conducted in the following manner:

a. The testing frequencies were swept over the required frequency range, with a step frequency equal to 1% of fundamental. The sweep rate was $< 1.5 \times 10^{-3}$ decades/s.

b. For each frequency tested, the incident power to the antenna was adjusted to the required unmodulated test level, as established during the chamber calibration. With the incident power at the correct level, the 80% AM 400Hz AF was switched on for the specified dwell time.

4. The EUT was continuously monitored during the test in accordance with the Pass / Fail criteria declared by the customer.
5. The test was done in both horizontal and vertical antenna polarizations, and for all necessary sides of the EUT.

Annex A.vii. ELECTRICAL FAST TRANSIENT/BURST IMMUNITY TEST DESCRIPTION

Test Set-up

1. The test set-up was in accordance with the standard.

2. The test was performed using an EFT/B generator.

3. The EFT/B generator was placed on top of the ground plane and connected to the protective earth.

4. a. The EUT was placed on top of a 0.1m high, non-metallic support, and placed at least 0.5m away from the walls of the room and other conductive surfaces.

b. The required power was supplied to the EUT via direct connection to the EFT/B generator.

c. The interference via a clamp coupled with the signal lines.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.

2. a.The EFT/B test system has a built-in coupling/decoupling network which couples the generated EFT bursts into the EUT power supply lines connected to it or bursts into the EUT signal lines via the Clamp.

b. The EFT bursts were coupled to the selected lines (one at a time) of the EUT for the necessary test duration.

c. The EUT was monitored during the test in accordance with the Pass / Fail criteria declared by the customer.

Annex A.viii SURGE IMMUNITY TEST DESCRIPTION

Test Set-up

1. The EUT was placed on a 0.1m high, non-metallic support.

2. The test was performed using a voltage surge generator, mains, and signal line coupling/decoupling networks that were compliant with the standard.

3. The voltage surge generator and coupling/decoupling networks were connected to the same protective earth.

4. The test level was set with the surge generator's HV output open-circuited.

5. For testing of the mains line, the mains coupling/decoupling network was inserted into the line. The voltage surge generator HV output cables were connected to the mains coupling/decoupling network, which has the necessary resistor/capacitor configurations (as required by the standard) built-in. The settings on the mains coupling/decoupling network were selected to give the required resistor/capacitor configuration as follows:

a. An 18μF capacitor in series with the output of the generator for differential (line-to-line) mode testing.

b. A 10 Ohm resistor and 9μF capacitor in series with the output of the generator for common (line-to-ground) mode testing.

6. For testing of the signal lines, the signal line coupling/decoupling network was inserted into the line. The voltage surge generator HV output cables were connected to the signal line coupling/decoupling network, which has the necessary resistor/capacitor/gas arrestor configurations (as required by the standard) built-in. The settings on this network were selected to give the required resistor/capacitor/gas arrestor configuration as reflected in the standard.

Test Method

1. The power supply to EUT was switched on and allowed to warm up to its normal operating condition.

2. The correct open-circuit test level was set with the surge generator disconnected from the coupling network.

3. The output of the generator was then reconnected back to the coupling network.

4. Five discharges, generated by the voltage surge generator, were made on each relevant line, for each polarity, at each test level, with the relevant discharge interval.

5. The EUT was observed during, and checked after the test to determine the result.

Annex A.ix CONDUCTED DISTURBANCE IMMUNITY TEST DESCRIPTION

Calibration Set-up & Method

1. A pre-test calibration was necessary in order to determine the signal generator and power amplifier setting to give the desired injected interference level.

2. The relevant CDN was placed on a Ground Reference Plane (GRP), with the base of the CDN in electrical contact with it.

3. The auxiliary equipment end of the CDN was terminated with a 150 load, while the EUT end of the CDN was connected to a spectrum analyzer via a 150 /50 adapter. The injection port of the CDN was connected to the output of the power amplifier supplying the interference signal.

4. With a fixed amplifier gain setting, the output power level from the power amplifier to the spectrum analyzer was adjusted, via a signal generator connected to the RF input of the power amplifier, to achieve the desired test level at the spectrum analyzer over the required frequency range.

Test Set-up

1. The EUT and auxiliary equipment were placed on top of the GRP and isolated from it by a 0.1m thick insulating support as shown in Annex B.

2. The test system includes a RF signal generator, a power amplifier, attenuators, a spectrum analyzer and various types of Coupling and Decoupling Networks (CDNs).

3. The EUT's Cables Under Test (CUT) were cut in order to insert the CDNs into the line. The cable lengths were kept as short as possible to maintain a distance of 0.1m to 0.3m between the EUT and the CDNs.

4. The interconnecting cables between the EUT, CDNs and auxiliary equipment were kept at a height of 3cm to 5cm above the GRP.

5. The CDNs were placed on the GRP, in direct electrical contact with it.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.

2. The interfering signal was swept from 150 kHz to 80MHz, with a step frequency equal to 1% of fundamental. The sweep rate was 1.5 X 10.
decades/s.

3. The output power level from the power amplifier to the CDN was adjusted through the signal generator so that the incident power reached the same level as that established during calibration. Once the incident power to the CDN reached the calibrated level, the 80% AM 400Hz AF was switched on for the specified dwell time.

4. The EUT was continuously monitored during the test in accordance with the PASS/FAIL criteria declared by the customer.

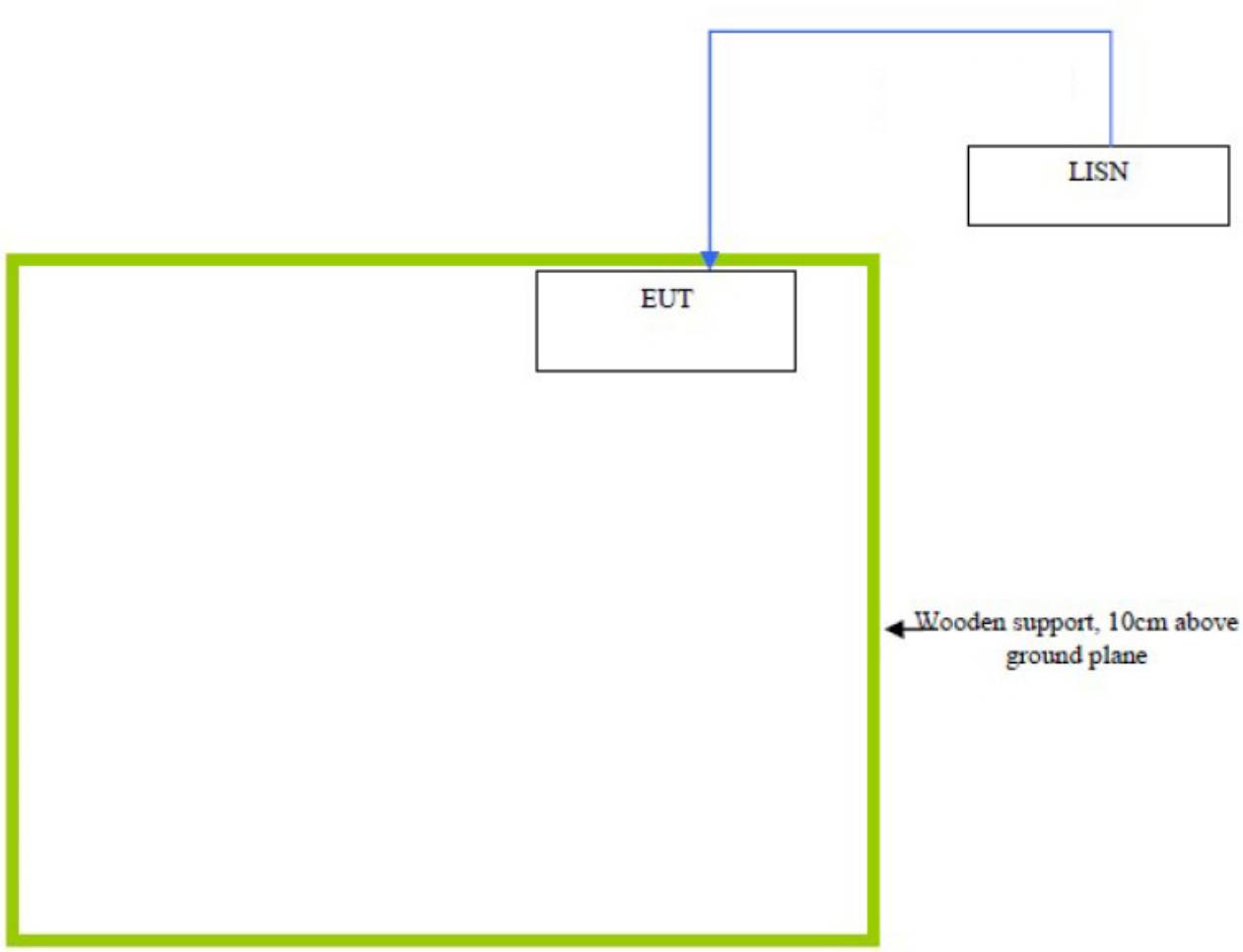
Annex B. TEST SETUP AND SUPPORTING
EUT TEST CONDITIONS

Annex B. i. SUPPORTING EQUIPMENT DESCRIPTION

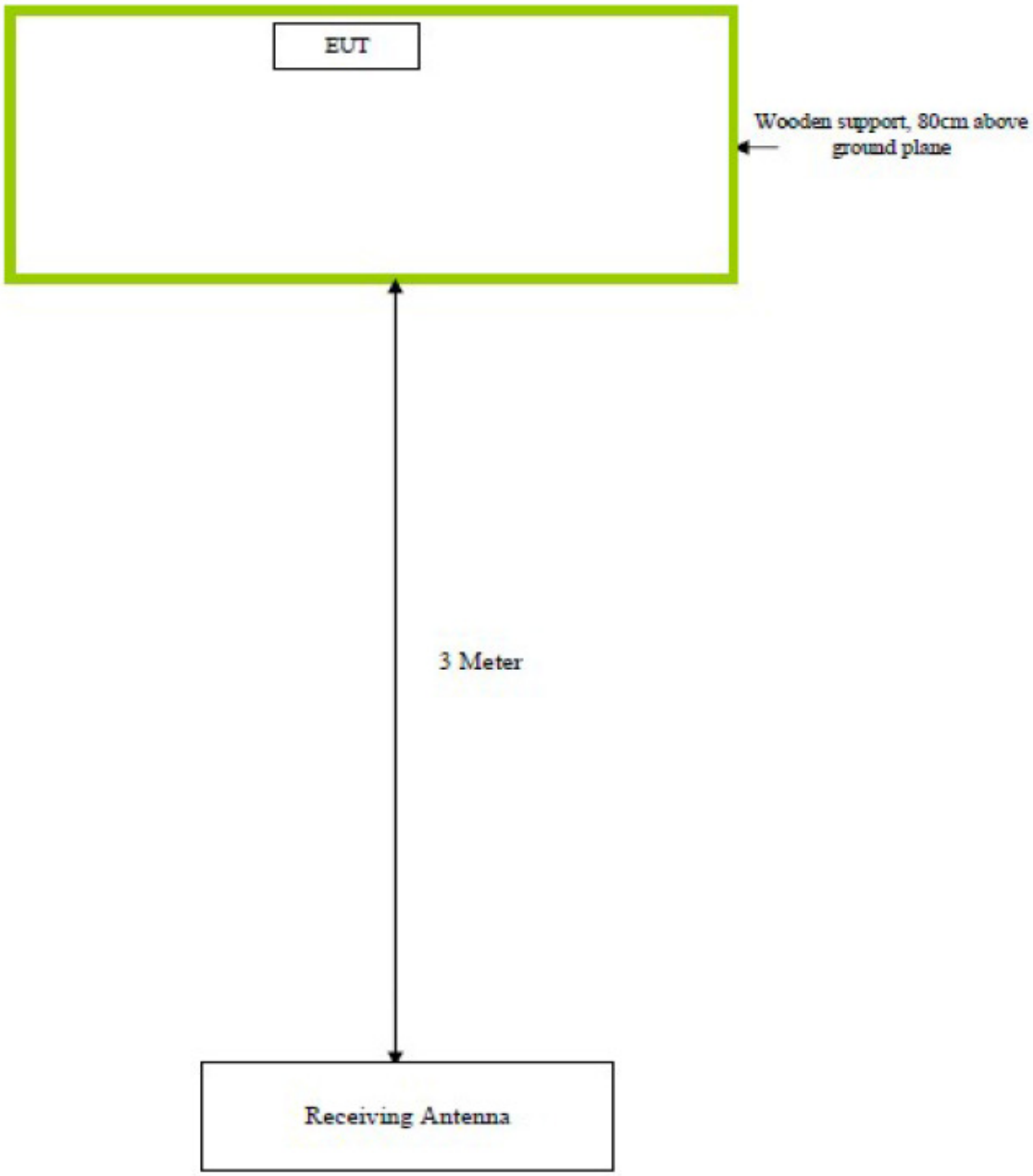
The following is a description of supporting equipment and details of cables used with the EUT.

Equipment Description (Including Brand Name)	Model & Serial Number	Cable Description (List Length, Type & Purpose)
N/A	N/A	N/A

Block Configuration Diagram for Conducted Emissions



Block Configuration Diagram for Radiated Emissions



Annex B.ii. EUT OPERATING CONDITIONS

The following is the description of how the EUT is exercised during testing

Test	Description Of Operation
Emissions	The EUT is worked to stimulate the worst case.
Immunity	The EUT is worked under the normal condition

Annex B.iii. PASS/FAIL CRITERIA&MONITORING METHODS

For compliance to the immunity requirements of the Directive, the EUT must comply with the correct Performance Criteria (A, B or C) stipulated in the relevant standard.

Performance Criteria A – the equipment should continue as intended without operator intervention. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment id used as intended.

Performance Criteria B – After the test, the equipment shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed, after the application of the phenomena below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level mat be replaced by a permissible loss of performance.

During the test, degradation of performance is allowed. However, no change of operating state or store data is allowed to persist after the test.

If the minimum performance level (or the permissible performance loss) is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment id used as intended.

Performance Criteria C – Loss of function is allowed, provided the function is self-recoverable, or can be operation of the control by the user in accordance with the manufacturer's instruction.

Function, and/or information stored in non-volatile memory, or protested by a battery, shall not be lost.

Please refer to the standard for the full Performance Criteria description.