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Test report : 03/387/10
Item tested : NE-W11E
Type of equipment : Access Point Unit (Wireless LAN)
Client : Keyence Corporation

Tested according to : **FCC part 15, subpart C**
DTS Transmitter
2412 - 2462 MHz

Date of issue : 2003.09.29

Authorised by : 
Kjell G. Haga
Managing Director


Frode Sveinsen
Technical Supervisor

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1 GENERAL INFORMATION

1.1 Tested by

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1.2 Client Information

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Fax : +81 6 6379 2222

Contact:

Name : Hiroaki Yamamoto
Telephone : +81 6 6325 6684
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1.3 Manufacturer (if other than client)

Name : Keyence corporation
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Telephone : +81 6 6379 1111
Fax : +81 6 6379 2222
E-mail : yamamotoh@keyance.co.jp

2 Test Information

2.1 Tested Item

Name :	Keyence (Access point unit (Wireless LAN)
Model/version :	NE-W11E
Serial number :	Not stated
Hardware identity and/or version:	NE-W11E
Software identity and/or version :	None
Frequency Range :	2412 - 2462 MHz
Tunable Bands :	1
Number of Channels :	11
Modulation :	DSSS
Emissions Designator :	22M0F7D
User Frequency Adjustment :	User Software controlled.
Rated Output Power :	63.1mW
Grantee Code	RF4
Equipment code	0718

Remarks

The NE-W11E has only one antenna. The received items for testing:

- 2 pcs. Of NE-W11E
- 1 pc. Of Laptop pc with communication software
- 2 pc. Of peripheral unit for EMC testing (not used for FCC testing)
- 2 pcs. Of Ethernet cable

2.2 Test Environment

2.1.1 Normal test condition

Temperature:	21 – 25 °C
Relative humidity:	26 – 50 %
Normal test voltage:	24 V dc
Extreme test voltage	20.4 Vdc – 27.6 Vdc

The values are the limit registered during the test period.

2.3 Test Period

Item received date:	2003-08-04
Test period :	2003-08-25 to 2003-09-01 and.2003-09-25

2.4 Test Equipment

See list of test equipments in annex no. 1.

3 TEST REPORT SUMMARY

3.1 Test Summary

Manufacturer: Keyence Corporation

Model No.: NE-W11E

Serial No.: Not stated

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 for Direct Sequence Spread Spectrum (DSSS) devices. Radiated tests were conducted in accordance with ANSI C63.4-1992. Radiated tests were made in a semi-anechoic chamber at measuring distances of 3 and 10 metres. A description of the test site is on file with the FCC (Registration no: 994405).

☒ New Submission☒ Production Unit☐ Class II Permissive Change☐ Pre-production Unit

DTS Equipment Code

☒ Family Listing

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

COMLAB

NEMKO COMLAB REF: 03/387/10

TESTED BY:


G. Suhanthakumar, Test engineer

DATE:

29/2/03

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3.2 Test Summary

Name of test	Paragraph #	Result
Supply voltage variations	15.31 (e)	Complied
Number of operating frequencies	15.31 (m)	Complied
Conducted Emission (Receiver)	15.107(a)	ref. 15.207(a)
Radiated Emission limits (receiver)	15.109(a)	ref. 15.209(a)
Antenna requirement	15.203	Complied ²
Radiated emissions limits for restricted bands	15.205(a)	Complied
Powerline Conducted Emission	15.207(a)	Complied
Radiated emission limits	15.209(a)	Complied
Bandwidth	15.247(a)(2)	Complied
Peak Power Output	15.247(b)(3)	Complied
Power Spectral Density	15.247(d)	Complied
Out-of-band emissions (Antenna Conducted)	15.247(c)	N/A ¹
Out-of-band emissions (Radiated)	15.247(c)	Complied

¹ The tested equipment has integrated antennas only.

² The antenna is detachable, but using a non-standard coupling.

3.3 Other Comments

The measurements are done with a laptop PC connected to the EUT. The laptop and the software for communication/test mode is delivered for testing by the manufacturer. The measurements are performed at channels near top ch1, near middle ch 6 and near bottom ch 11. The EUT complies at these channels.

3.4 Description of modification for Modification Filing

Not Applicable.

3.5 Family List Rational

NE-W01E.

According to the manufacturer the NE-W01E and NE-W11E, have the same electrical specifications e.g. the electrical circuit, used parts and PCB design. The difference between each model is the type of the power supply and number of antennas. The model NE-W11E's power supply is 24 Vdc and single antenna for TX and RX. Please see annex 9 for declaration of identity. Test report for NE-W01E is 03/387/7.

4 TEST RESULTS

4. 1 Powerline Conducted Emissions , Para. No.: 15.207 (a)

Test Performed By: G.Suwanthakumar	Date of Test: 25. Sep. 2003
------------------------------------	-----------------------------

Test set up:

The test is performed in a shielded chamber with a size of 2 x2 meters.

The EUT was placed on a table according to ANSI standard.

Cable configuration during test:

The cables were arranged according to ANSI C63.4-1992 (CISPR 22).

EUT mode during test:

EUT was in normal operating mode during the test. Tested at the DC power supply. **Conducted Emission at Mains Port of DC power supply:**

For line "L1"		For line "N"	
Frequency of emission (KHz)	Levels (QP) (dBμV)	Frequency of emission (KHz)	Levels (QP) (dBμV)
2570	6.94	6250	8,41
4659	6.66	7500	8,95
5010	9.78	1010	9.12
9778	9.58	1370	8.16

Limits

Frequency of emission (MHz)	Conducted Limit (dBμV)	
	Quasi -Peak	Average
0.15 – 0.5	66 to 56	56 to 46
0.5 - 5	56	46
5 - 30	60	50
Measurement Uncertainty	+ 2.9 / - 4.1 dB	+ 2.9 / - 4.1 dB

Results:

See annex 10 page 1 & 2

Tolerance mask1: QP detector

Tolerance mask2: AV detector

Comments:

When ever the PEAK emissions closer to the AV limit is detected when using the "PEAK" detector, then the Q-peak measurements are performed for that particluer frequency.

Test Equipment Used: 9, 10, 11, 12, 16

4. 2 Bandwidth, Para. No.: 15.247 (a)(2)

Test Performed By: G.Suhandhakumar

Date of Test: 14. Aug 2003

Measurement Data:

Test Conditions		Bandwidth at 6 dB (MHz)		
		Ch1	Ch6	Ch11
$T_{nom}(.23.^{\circ}C)$	$V_{nom}(24.Vdc)$	10.26	9.45	10.02

Test Results: Passed, See annex 2

Power supply variation within 85 % to 115% of nominal value has no influence.

Requirements:

The minimum 6 dBbandwidth shall be at least 500 KHz.

Test equipments used: 1, 2, 3, 4, 5, 6, 7, 8, 13, 14, 15

4. 3 Peak Power Output, Para. No.: 15.247 (b)(3)

Test Performed By: G.Suhandhakumar	Date of Test: 15. Aug 2003
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Rated output power level (maximum) 63.1mW

Test Conditions		Calculated Transmitter Power , EIRP (W)		
		Ch1	Ch 6	Ch11
$T_{nom}(..23.^{\circ}C)$	$V_{nom}(..24Vdc)$	0.014	0.024	0.059

Test Results: Passed.

Power supply variation within 85 % to 115% of nominal value has no influence on Peak output power.

Measurement Data:

The maximum field strength of fundamental, RBW=5MHz , Ch 1 : 100.72 dB μ V/m

The maximum field strength of fundamental, RBW=5MHz Ch 6 : 102.97 dB μ V/m

The maximum field strength of fundamental, RBW=5MHz Ch 11 : 106.91 dB μ V/m

Calculated Data:

With 6 dB bandwidth (RBW=10MHz) correction $\{20 \log (10/5)\}$

- The maximum field strength of fundamental in V/m $(10^{((100.72+6)/20)} \times 1^{-6})$ Ch1: 0.217V/m
- The maximum field strength of fundamental in V/m $(10^{((102.97+6)/20)} \times 1^{-6})$ Ch6: 0.281V/m
- The maximum field strength of fundamental in V/m $(10^{((106.91+6)/20)} \times 1^{-6})$ Ch11: 0.442V/m

Calculated maximum EIRP using free field formula:

- Ch1: P(EIRP) watts: $(3 \times 0.217)^2 / 30 = 0.014$ Watts
- Ch6: P(EIRP) watts: $(3 \times 0.281)^2 / 30 = 0.024$ Watts
- Ch11: P(EIRP) watts: $(3 \times 0.442)^2 / 30 = 0.059$ Watts

The maximum power is obtained at Vertical polarization and measured at 3 meter.

The antenna gain of the measurement antenna and cable loss have been taken into consideration.

See Annex 3

Requirements:

The maximum peak output power for DS systems shall not exceed the following limits:

For systems using DSSS in the 2400 - 2483.5 MHz band: less than or equal to 1 watt

Test equipments used: 1, 2, 3, 4, 5, 6, 7, 8, 13, 14, 15

4. 4 Out-of-band emissions (Radiated), Para. No.: 15.247 (c)

Test Performed By: G.Suhanthakumar	Date of Test: 14. Aug 2003
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Test Results: Passed, see annex 4

All three channels (Ch1, Ch6 & Ch11)

Measurement Data:

Below 20 dB

Requirements:

No greater than –20dBc

The Test equipments used: 1, 2, 3, 4, 5, 6, 7, 8, 13, 14, 15

4. 4 Power Spectral Density (PSD), Para. No.: 15.247 (d)**Test Performed By: G.Suhanthakumar****Date of Test: 25. Sep 2003****Test Results: Passed****Measured and Calculated Data:**

The alternative test procedures in point 2) A , B and formula 1 described in guidance on measurements for Digital Transmission Systems is used.

EUT's antenna gain G : 0.1 dBi --> $10^{(0.01)} = 1.023$

Ch1:

- The measured peak level at RBW= 3kHz, VBW= 10kHz, Span =300kHz, Sweep= 100sec is 39.8 dB μ V/m
- The caculated field strength E = Peak level + cable loss+antenna factor(AF)
 $= 39.8 \text{ dB}\mu\text{V/m} + 7\text{dB} + 28.3 \text{ dB}\mu\text{V/m}$
 $= 75.1 \text{ dB}\mu\text{V/m} = 5.69 \text{ mV/m}$

The caculated PSD using formula $P = (E \times d)^2 / (30 \times G) = (0.00569\text{V/m} \times 3)^2 / (30 \times 1.023) = 9.49\mu$ Watts

PSD in dBm = $10\log (P/1\text{mW}) = -20.22 \text{ dBm}$

Ch6:

- The measured peak level at RBW= 3kHz, VBW= 10kHz, Span =300kHz, Sweep= 100sec is 40.4 dB μ V/m
- The caculated field strength E = Peak level + cable loss+antenna factor(AF)
 $= 40.4 \text{ dB}\mu\text{V/m} + 7\text{dB} + 28.3 \text{ dB}\mu\text{V/m}$
 $= 75.7 \text{ dB}\mu\text{V/m} = 6.095\text{mV/m}$

The caculated PSD using formula $P = (E \times d)^2 / (30 \times G) = (0.006095\text{V/m} \times 3)^2 / (30 \times 1.023) = 10.89\mu$ Watts

PSD in dBm = $10\log (P/1\text{mW}) = -19.63 \text{ dBm}$

Ch11:

- The measured peak level at RBW= 3kHz, VBW= 10kHz, Span =300kHz, Sweep= 100sec is 45.21 dB μ V/m
- The caculated field strength E = Peak level + cable loss+antenna factor(AF)
 $= 45.21 \text{ dB}\mu\text{V/m} + 7\text{dB} + 28.3 \text{ dB}\mu\text{V/m}$
 $= 80.51 \text{ dB}\mu\text{V/m} = 10.61 \text{ mV/m}$

The caculated PSD using formula $P = (E \times d)^2 / (30 \times G) = (0.01061\text{V/m} \times 3)^2 / (30 \times 1.023) = 33.01\mu$ Watts

PSD in dBm = $10\log (P/1\text{mW}) = -14.81 \text{ dBm}$

Requirements:

No greater than +8 dBm in any 3kHz band

Test equipments used: 1, 2, 3, 4, 5, 6, 7, 8, 13, 14, 15

4. 5 Radiated Emissions , Para. No.: 15.209 (a)

Test Performed By: G.Suwanthakumar	Date of Test: 25. Sep 2003
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Test results: Passed

Three channels are measured (Ch1, Ch 6 & Ch 11). Annex 6 for frequency 9kHz to 30 MHz.

Measurement Data:**Radiated Emission 30 – 1 GHz(Peak)****Measured with Peak Detector**

Frequency	EUT ant	RF channel	Field strength, Peak, 10 metres Maximum peak value detected	Dist. corr. ¹ factor	Duty cycle	Limit	Margi n
MHz	Left	1, 6, 11	dB μ V/m	dB	dB	dB μ V/m	dB
30 – 88		6	23	10.5		40	6.5
88 – 216			21.3	10.5		43.5	11.7
216 – 960		6	32.2	10.5		43.5	0.8
960 - 1000			32.5	10.5		46	3
30 – 88		1	20	10.5		40	9.5
88 – 216			21.2	10.5		43.5	11.8
216 – 960		1	31.2	10.5		43.5	1.8
960 - 1000			32.0	10.5		46	3.5
30 – 88		11	22.6	10.5		40	6.9
88 – 216			24.5	10.5		43.5	8.5
216 – 960		11	30.4	10.5		43.5	3.1
960 - 1000			31.6	10.5		46	4.4

¹⁾ Measured at 10 meters.

Attached graph only for Ch 6. , see annex 5

Correction factor from 10 meter to 3 meter : $20 \log (10/3) = 10.4575 \text{ dB}$

In the colum 4 peak values are given for 10 meter and values in the the margin colum is corrected for 3 meter. E.g.: $40 - (23+10.5) = 6.5 \text{ dB}$

Radiated Emission 1 – 25 GHz(Peak)**Measured with Peak Detector**

Frequency	EU T ant	RF channe l	Field strength, Peak, 3 & 1 metres Maximum Peak value detected	Dist. corr. ¹ factor	Duty cycle	Limit	Margi n
GHz	Left	1, 6, 11	dB μ V/m	dB	dB	dB μ V/m	dB
4.82		6	49.26	0		54	4.74
7.23		6	48.75	0		54	5.25
9.65		6	51.96	0		54	2.04
12.06		6	30.18	0		54	23.82
14.47		6	29.61	0		54	24.39
16.88		6	29.84	0		54	24.16
19.29		6	30.6	-9.5		54	32.9
21.71		6	58.6	-9.5		54	4.9
25		6	47.05	-9.5		54	16.45
4.87		1	46.8	0		54	7.2
7.31		1	34.2	0		54	19.8
9.748		1	29.8	0		54	24.2
12.18		1	26.4	0		54	27.6
14.62		1	21.9	0		54	32.1
17.05		1	20.4	0		54	33.6
19.5		1	29.6	-9.5		54	33.9
21.9		1	46.8	-9.5		54	16.7
24.37		1	34.2	-9.5		54	29.3
4.92		11	49.2	0		54	4.8
7.38		11	49.5	0		54	4.5
9.848		11	47.2	0		54	6.8
12.31		11	33.4	0		54	20.6
14.77		11	29.8	0		54	24.2
17.23		11	26.4	0		54	27.6
19.69		11	40.7	-9.5		54	22.8
22.15		11	45.3	-9.5		54	18.2
24.6		11	39.6	-9.5		54	23.9

¹⁾ 1 – 18 GHz Measured at 3 meters. Above 18 GHz at 1 meter

Correction factor for distance: $20 \log (3/1) = 9.5$ dB

In the column 4 peak values are given for 3 meters and 1 meter and values in the the margin column is corrected: 3 meter E.g.: $54 - 49.26 = 4.74$ dB; for 1 meter $54 - (57.35 - 9.5) = 6.15$ dB

1) Duty Cycle calculation according to RF burst Para 15.35 (c) :Tx on : 0.252 ms ; $20 \log (252\mu\text{s}/1.3478\text{ms}) = -14.56\text{dB}$, see annex 7

Maximum duty cycle according to Para 15.35 (b): -20 dB

Radiated emission 1- 25 GHz, Average**Measured with Peak Detector**

Frequency	EU T ant	RF channe l	Field strength, Peak, 3 & 1 metres Maximum Peak value detected	Dist. corr. ¹ factor	Duty cycle	Limit	Margi n
GHz	Left	1, 6, 11	dB μ V/m	dB	dB	dB μ V/m	dB
4.82		6	49.26	0	-14.56	54	19.3
7.23		6	48.75	0	-14.56	54	19.81
9.65		6	51.96	0	-14.56	54	16.6
12.06		6	30.18	0	-14.56	54	38.38
14.47		6	29.61	0	-14.56	54	38.95
16.88		6	29.84	0	-14.56	54	38.72
19.29		6	30.6	-9.5	-14.56	54	47.46
21.71		6	58.6	-9.5	-14.56	54	19.46
25		6	47.05	-9.5	-14.56	54	31.01
4.87		1	46.8	0	-14.56	54	21.76
7.31		1	34.2	0	-14.56	54	34.36
9.748		1	29.8	0	-14.56	54	38.76
12.18		1	26.4	0	-14.56	54	42.16
14.62		1	21.9	0	-14.56	54	46.66
17.05		1	20.4	0	-14.56	54	48.16
19.5		1	29.6	-9.5	-14.56	54	48.46
21.9		1	46.8	-9.5	-14.56	54	31.26
24.37		1	34.2	-9.5	-14.56	54	43.86
4.92		11	49.2	0	-14.56	54	19.36
7.38		11	49.5	0	-14.56	54	19.06
9.848		11	47.2	0	-14.56	54	21.36
12.31		11	33.4	0	-14.56	54	35.16
14.77		11	29.8	0	-14.56	54	38.76
17.23		11	26.4	0	-14.56	54	42.16
19.69		11	40.7	-9.5	-14.56	54	37.36
22.15		11	45.3	-9.5	-14.56	54	32.76
24.6		11	39.6	-9.5	-14.56	54	38.46

¹⁾ 1 – 18 GHz Measured at 3 meters. Above 18 GHz at 1 meterCorrection factor for distance: $20 \log (3/1) = 9.5 \text{ dB}$

In the column 4 peak values are given for 3 meters and 1 meter and values in the margin column is corrected: 3 meter E.g.: $54 - (49.26 - 14.56) = 19.3 \text{ dB}$; for 1 meter : $54 - (30.6 - 9.5 - 14.56) = 47.46 \text{ dB}$

Radiated Emission at 2483.5MHz (Average)

Frequency MHz	RF channel	Dist. corr. ¹ factor dB	Field strength, Peak, 3 metres Maximum value detected dB μ V/m	Duty cycle dB	Limit dB μ V/m	Margin dB
2483.5	1	0	60	-14.5	54	8.5

From 2nd harmonics to 7th harmonics a highpass filter together with a preamp is used. Beyond 7th harmonic filter is not used only preamplifier is used. For these measurements a peak detector is used

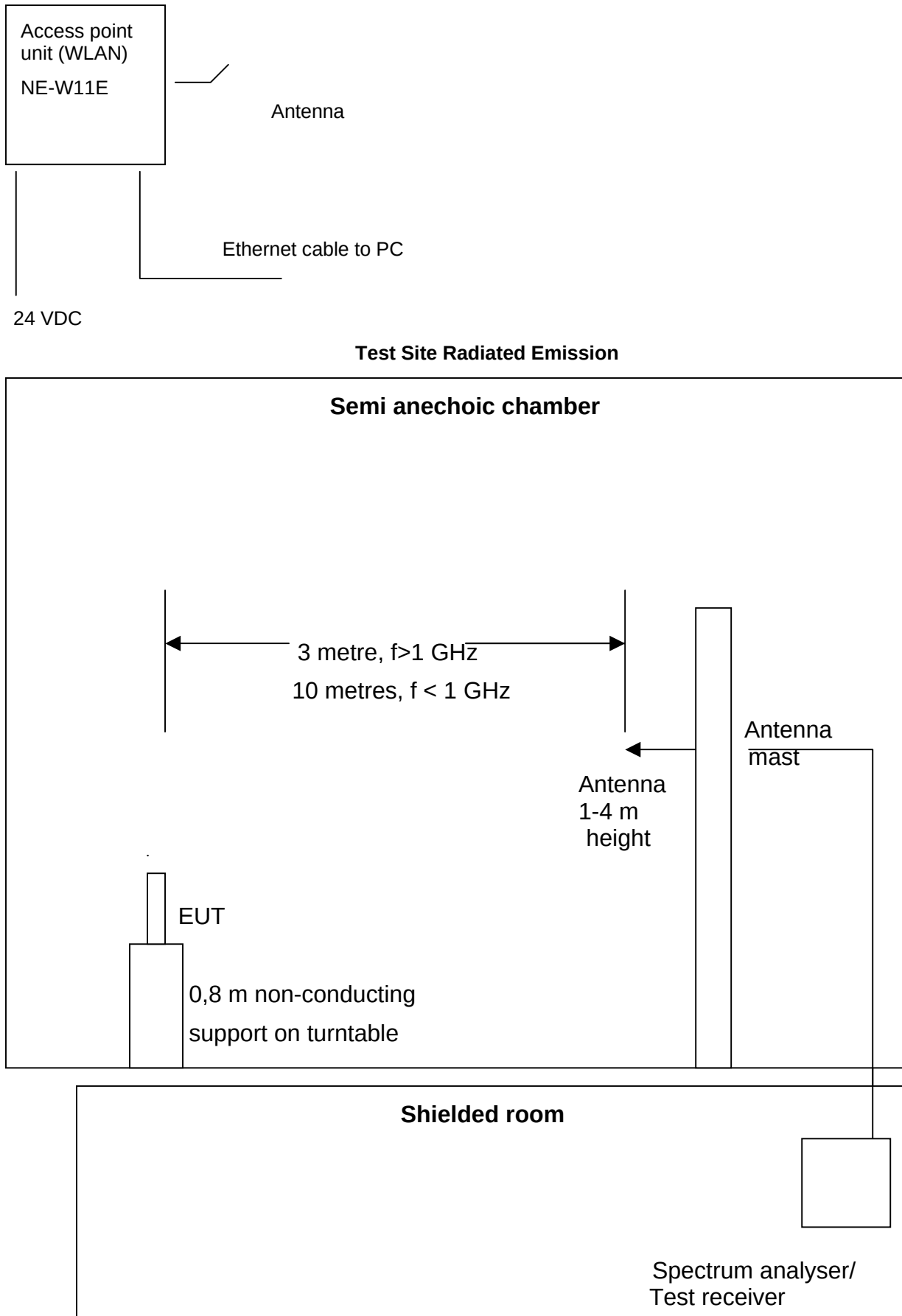
The measurement above 18GHz is done at 1 m distance (the noise is mostly from the spectrum analyser).

Requirements: As specified in section 15.35 (c), 15.205(a), 15.209(a) 15.247 (c)

The Test equipments used: 1, 2, 3, 4, 5, 6, 7, 8, 13, 14, 15

5 BLOCK DIAGRAM

System set up



PHOTOGRAPH OF TEST SETUP

Powerline Conducted Emission measurements



Radiated measurements

Test Equipment Used

To facilitate inclusion on each page of the test cases, each item of test equipment used for related tests are identified (numbered) by the Test Laboratory.

No.	Ref. No	Description	Manufacturer	Type
1.	1330	Antenna Horn	EMCO	3115
2.	1410	Shielded room	ETS Euroshield	Semi-anechoic
3.	1329	Antenna Horn	EMCO	3116
4.	1261	Antenna Log-periodic	R&S	HL 223
5.	1262	Antenna, biconical	EMCO	3104C (modif.)
6.	1337	Spektrum Analyzer	R&S	FSEK
7.	1336	Generator, RF	R&S	SMP04
8.	1038	Attenuator	Suhner	6810.17.A
9.	1076	Two-line V-network	R&S	ESH3-Z5
10.	1237	EMI-Receiver	R&S	ESN
11.	1226	Antenna Horn	EMCO	3115
12.	285	Antenna, loop	R&S	HFH2-Z2
13.	1322	Amplifier RF	HP	HP8449B
14.	-	HPFilter	Trilithic inc.	4HC3000/18000-1-KK
15.	086	Antenna Horn	EMCO	3116
16.		DC power supply	Øltronix	