Compliance Department - EMC Test Report

Report reference: BE2019176

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FORM0144 / Revision 2

Requested by:

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Project

Equipment Under Test (EUT):	Utility - 25
EMC Test plan / Standard:	CISPR 25:2008

Authorized signatories:

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Pedro Moreno	**David Ortiz**
Compliance Engineer	**Compliance Manager**

Dates and Testing site

EUT reception	2019-06-14
Initial test date:	2019-07-09
Final test date:	2019-07-18
Testing site:	Compliance department – IDNEO Technologies

Sample References:

Sample #1:	Model: Utility – 25
	Manufacturer: Lazer Lamps

Revision history:

Document Reference	Date	Description
V01.00-ENG	22/07/2019	Document delivery

INDEX

1 Introduction

This document collects EMC tests results for the project Utility - 25, according to standard/test validation plan: CISPR 25:2008.

2 Summary Results

Test CISPR 25	Results
Conducted emissions (CE)	PASS
Radiated emissions (RE)	PASS

Table 1. Summary results.

3 Referenced documents

Document Reference	Version	Document
CISPR 25	2008	Vehicles, boats and internal combustion engines – Radio disturbance characteristics – Limits and methods of measurement for the protection of on-board receivers

Table 2. Referenced documents.

4 General conditions

Unless otherwise specifications, tests have been done at following conditions:

Supply voltage:	13.0 ± 1.0 V_{DC}	26.0 ± 2.0 V_{DC}
Temperature	22 ºC ± 3 ºC.	
Humidity	30% – 70%	

Table 3. General conditions.

5 System description and validation requirements

5.1 Equipment Under Test (EUT)

Figure 1. EUT – Utility - 25. Front view

Figure 2. EUT – Utility - 25. Rear view

5.2 Pin-out

Pin	Signal description
1	VCC
2	GND

Table 4. Pin-out information.

5.3 Operational modes

According to the agreement with the costumer, the following operating modes have been tested:

5.3.1 12V mode

- The Utility – 25 lamp powered by battery of 12VDC and power supply (with 13.5VDC) in parallel.

5.3.2 24V mode

- The Utility – 25 lamp powered by two batteries of 12VDC each one and power supply (with 27VDC) in parallel.

5.4 Matrix of samples under test

Test	Sample
	#1
Conducted emissions (CE)	X
Radiated emissions (RE)	X

Table 5. Matrix of samples under test for 12V.

5.5 Details about measurement uncertainty

In case of measurement results close to the limit, there is the possibility, that due to the measurement uncertainty Ux = k *σt (σt = $\sqrt{\sigma_1^2 + \sigma_2^2 + ... + \sigma_n^2}$ standard deviation of the total accumulated error), at a confidence level of 95% (k =2), the limits are indeed exceeded.

Measurement uncertainties calculation is available at Customer's request.

6 Test Results

6.1 Conducted emissions (CE)

6.1.1 Test purpose

This test is intended to check that radio frequency conducted emissions are below the set limit.

6.1.2 Test Information

Test Site	SAR 1
Test Date	2019-07-09
Temperature	23ºC
Humidity	43%
Test Engineer	Pedro Moreno
Harness length	0.2 m
Operation Mode 1	12V
Operation Mode 2	24V

Table 6. CE Test – CISPR 25. Test Information.

6.1.3 Limit Line

All emissions limits must be bellow limits defined for (Class 5 applied to 12V mode and Class 4 applied to 24V mode):

Service / Band	Frequency MHz	Levels in dB(µV)									
		Class 1		Class 2		Class 3		Class 4		Class 5	
		Peak	Quasi-peak	Peak	Quasi-peak	Peak	Quasi-peak	Peak	Quasi-peak	Peak	Quasi-peak
BROADCAST											
LW	0,15 - 0,30	110	97	100	87	90	77	80	67	70	57
MW	0,53 - 1,8	86	73	78	65	70	57	62	49	54	41
SW	5,9 - 6,2	77	64	71	58	65	52	59	46	53	40
FM	76 - 108	62	49	56	43	50	37	44	31	38	25
TV Band I	41 - 88	58	-	52	-	46	-	40	-	34	-
MOBILE SERVICES											
CB	26 - 28	68	55	62	49	56	43	50	37	44	31
VHF	30 - 54	68	55	62	49	56	43	50	37	44	31
VHF	68 - 87	62	49	56	43	50	37	44	31	38	25

Table 7. CE Test – CISPR 25. Limits Lines for Peak and Quasi-Peak detector.

Service / Band	Frequency MHz	Levels in dB(µV)				
		Class 1	Class 2	Class 3	Class 4	Class 5
		AVG	AVG	AVG	AVG	AVG
BROADCAST						
LW	0,15 - 0,30	90	80	70	60	50
MW	0,53 - 1,8	66	58	50	42	34
SW	5,9 - 6,2	57	51	45	39	33
FM	76 - 108	42	36	30	24	18
TV Band I	41 - 88	48	42	36	30	24
MOBILE SERVICES						
CB	26 - 28	48	42	36	30	24
VHF	30 - 54	48	42	36	30	24
VHF	68 - 87	42	36	30	24	18

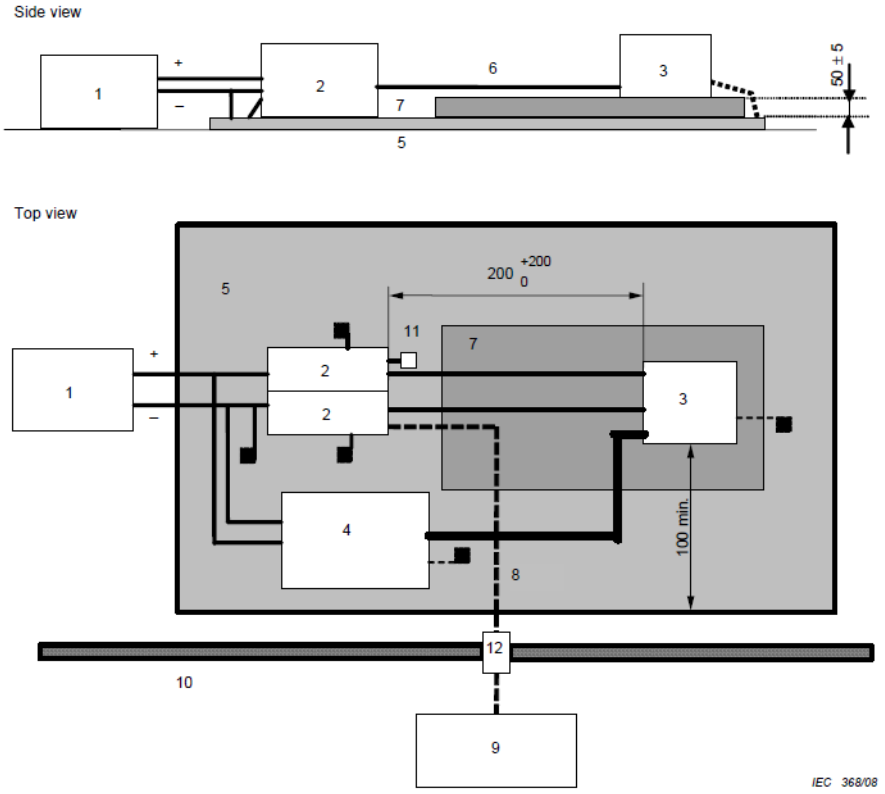
Table 8. CE Test – CISPR 25. Limits Lines for Average detector.

6.1.4 Measurements parameters

Service / Frequency range MHz		Peak detection			Quasi-peak detection			Average detection		
		BW at -6 dB	Step size	Dwell time	BW at -6 dB	Step size	Dwell time	BW at -6 dB	Step size	Dwell time
AM broadcast and mobile services	0,15 - 30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms
FM broadcast	76 - 108	120 kHz	50 kHz	5 ms	120 kHz	50 kHz	1 s	120 kHz	50 kHz	5 ms
Mobile services	30 to 1 000									
TV Band I	41 – 88									
TV Band III	174 – 230									
TV Band IV/V	470 – 890									
DAB	171 - 245									
DTTV	470 - 770	120 kHz	50 kHz	5 ms	Does not apply	Does not apply	Does not apply	120 kHz	50 kHz	5 ms
Mobile service	1 000 - 2 500	120 kHz	50 kHz	5 ms	Does not apply	Does not apply	Does not apply	120 kHz	50 kHz	5 ms
GPS L1 civil	1 567 – 1 583	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply	9 kHz	5 kHz	5 ms
NOTE For emissions generated by brush commutator motors without an electronic control unit, the maximum step size may be increased up to 5 times the bandwidth.										

Table 9. CE Test – CISPR 25. Measurement parameters.

6.1.5 Test Setup



Key

1 Power supply (may be placed on the ground plane)
2 Artificial network
3 EUT (housing grounded if required in test plan)
4 Load simulator (metallic casing grounded if required in test plan)
5 Ground plane
6 Power supply lines
7 Low relative permittivity support ($\varepsilon_r \leq 1,4$)
8 High-quality coaxial cable e.g. double-shielded (50 Ω)
9 Measuring instrument
10 Shielded enclosure
11 50 Ω load
12 Bulkhead connector

NOTE The EUT housing ground lead, when required in the test plan, should not be longer than 150 mm.

Figure 3. CE Test – CISPR 25. Schematic Test Setup.

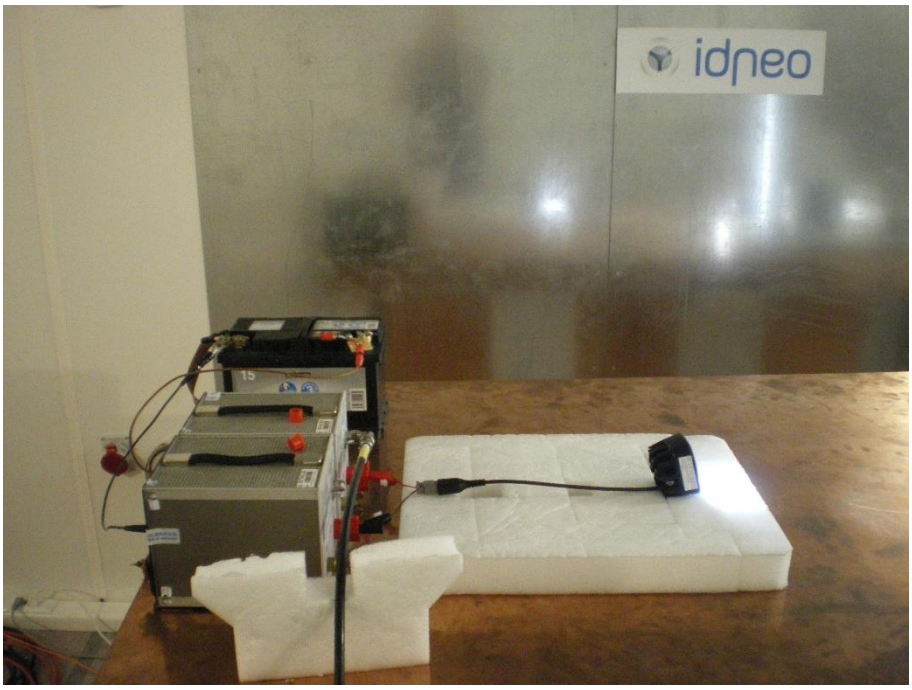


Figure 4. CE Test – CISPR 25. Test Setup for 12V Mode.

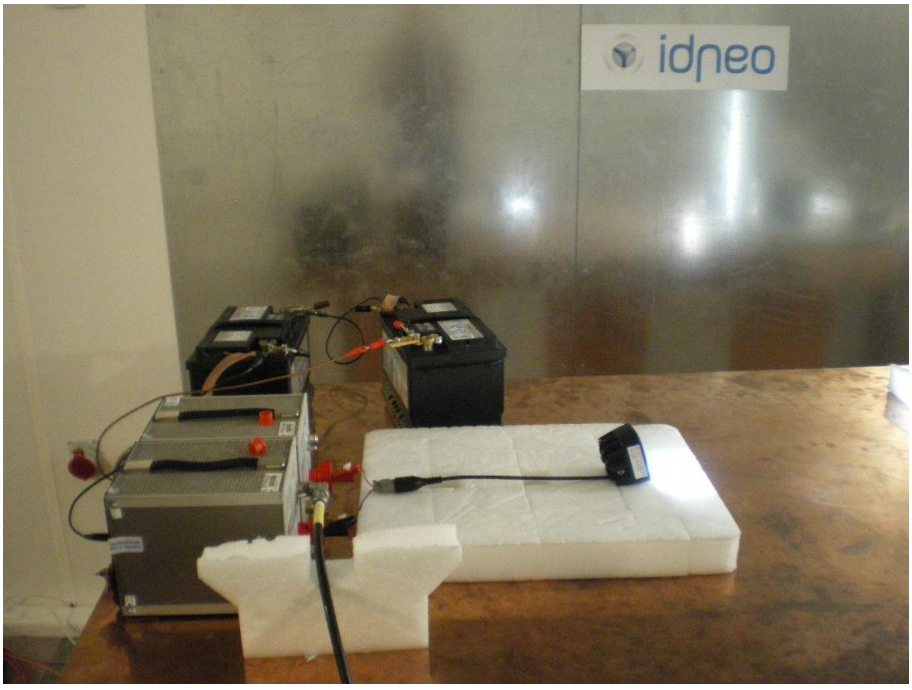


Figure 5. CE Test – CISPR 25. Test Setup for 24V Mode.

6.1.6 Test Results

Sample	Operational mode	Frequency Range [MHz]	Application Point	Result		
				PK	QPK	AVG
#1	12 V (Class 5)	0.15 – 108	VCC	PASS	PASS	PASS
			GND	PASS	PASS	PASS
	24 V (Class 4)	0.15 – 108	VCC	PASS	PASS	PASS
			GND	PASS	PASS	PASS

Table 10. RE Test. Test Results. Sample #1.

6.1.6.1 Ambient noise measurements – 12 V Mode

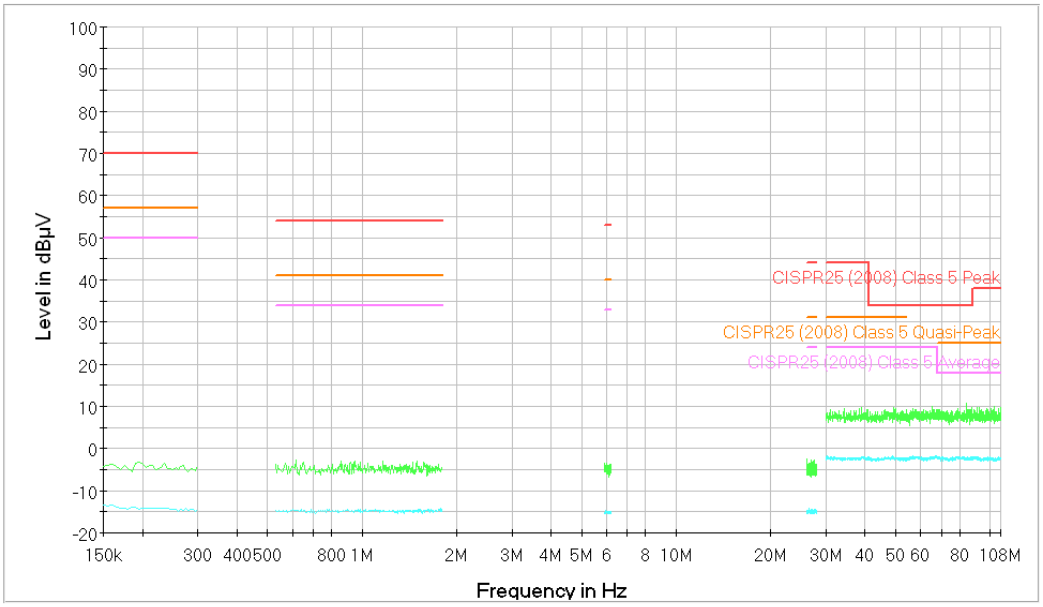


Figure 6. Ambient measurement. GND. 12V Mode. Peak and Average measurements.

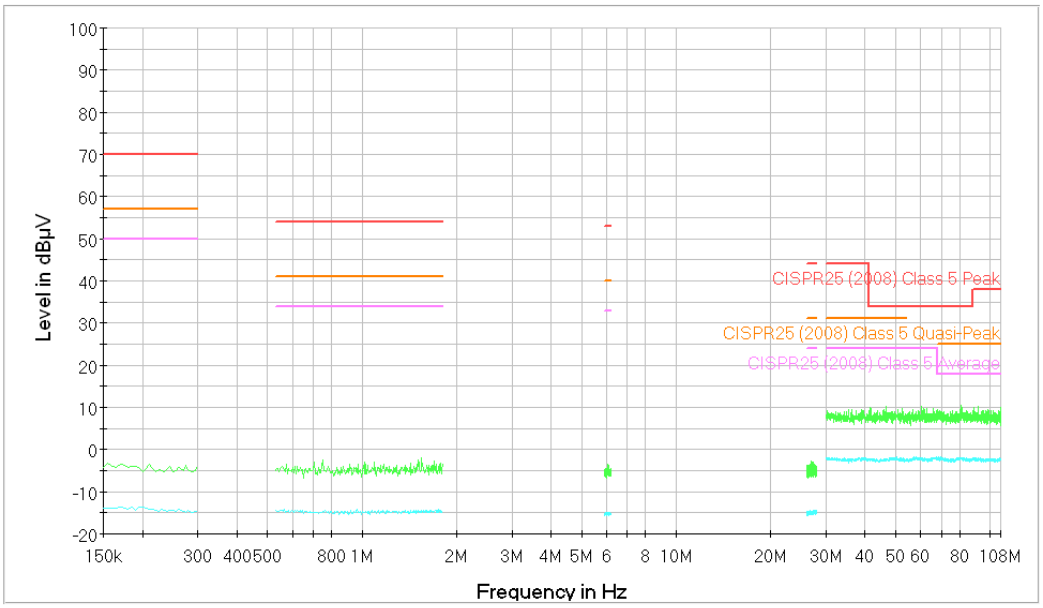


Figure 7. Ambient measurement. VCC. 12V Mode. Peak and Average measurements.

6.1.6.2 Tests Graphs. Sample #1. 12V Mode

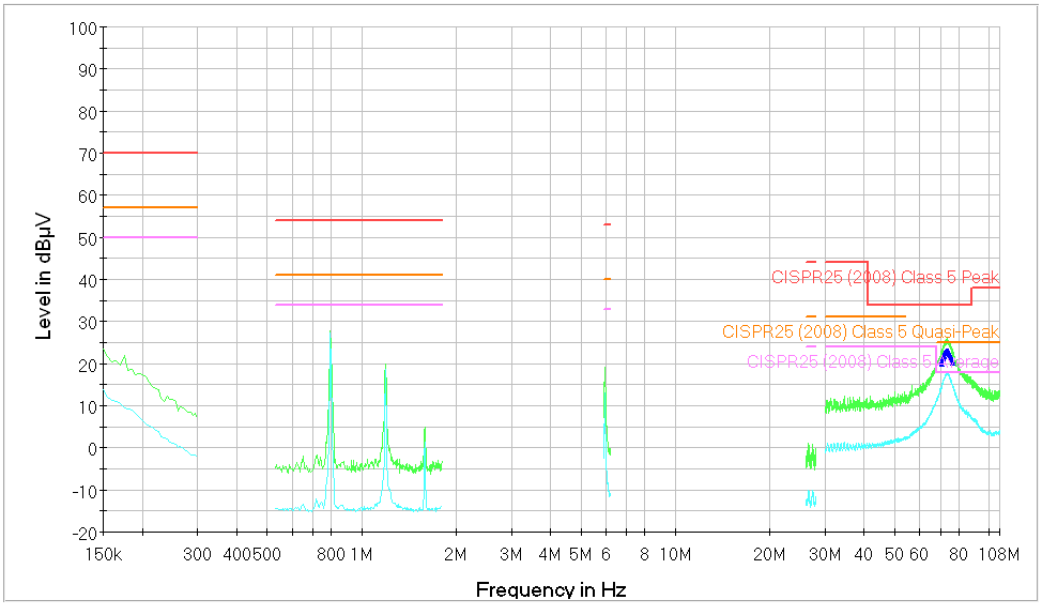


Figure 8. Test measurement. GND. 12V Mode. Peak, Quasi-Peak and Average measurements.

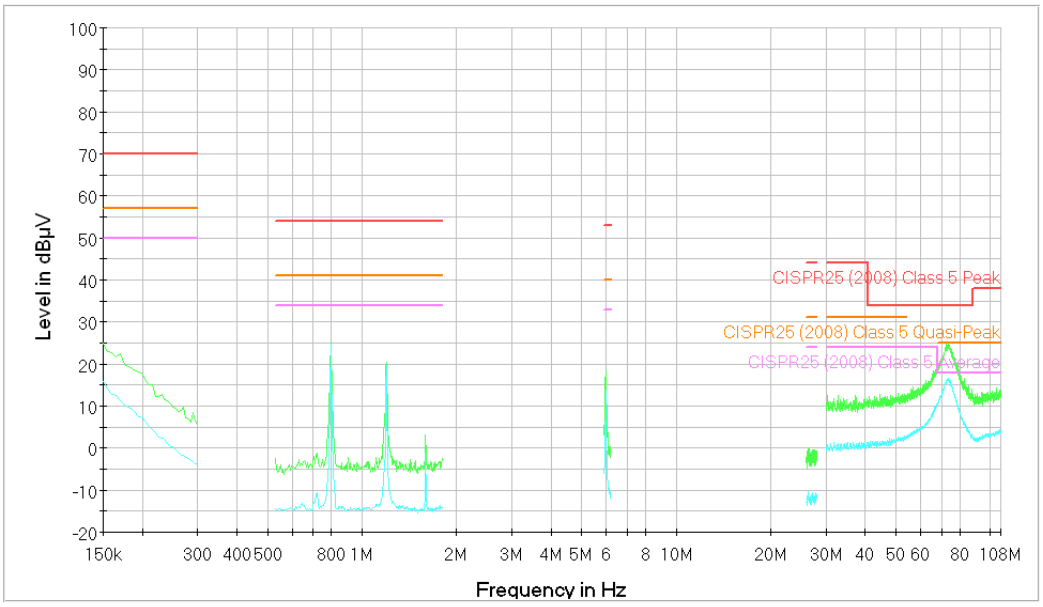


Figure 9. Test measurement. VCC. 12V Mode. Peak and Average measurements.

6.1.6.3 Ambient noise measurements – 24 V Mode

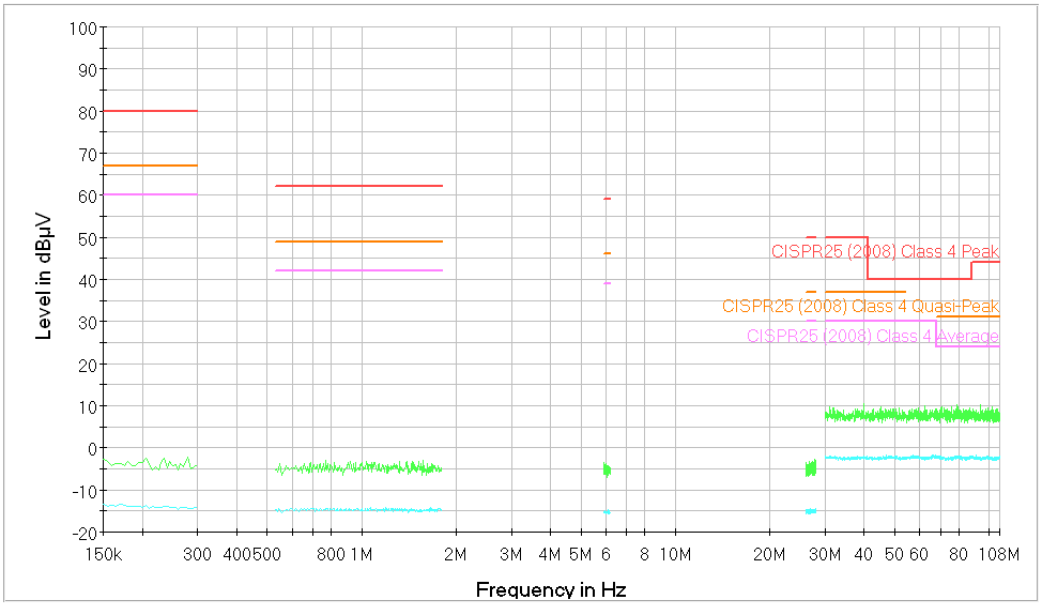


Figure 10. Ambient measurement. GND. 24V Mode. Peak and Average measurements.

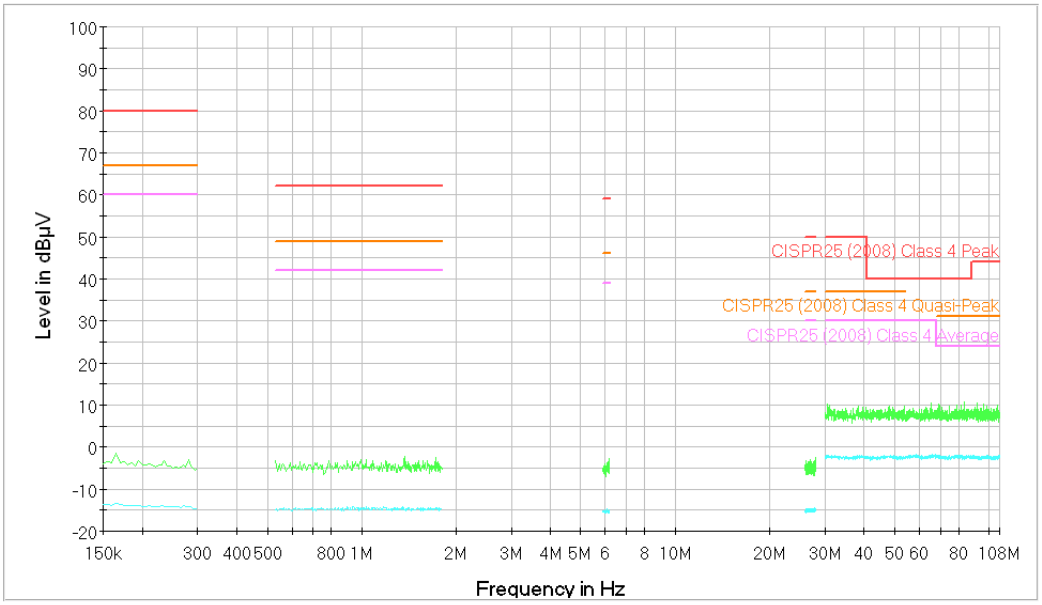


Figure 11. Ambient measurement. VCC. 24V Mode. Peak and Average measurements.

6.1.6.4 Tests Graphs. Sample #1. 24V Mode

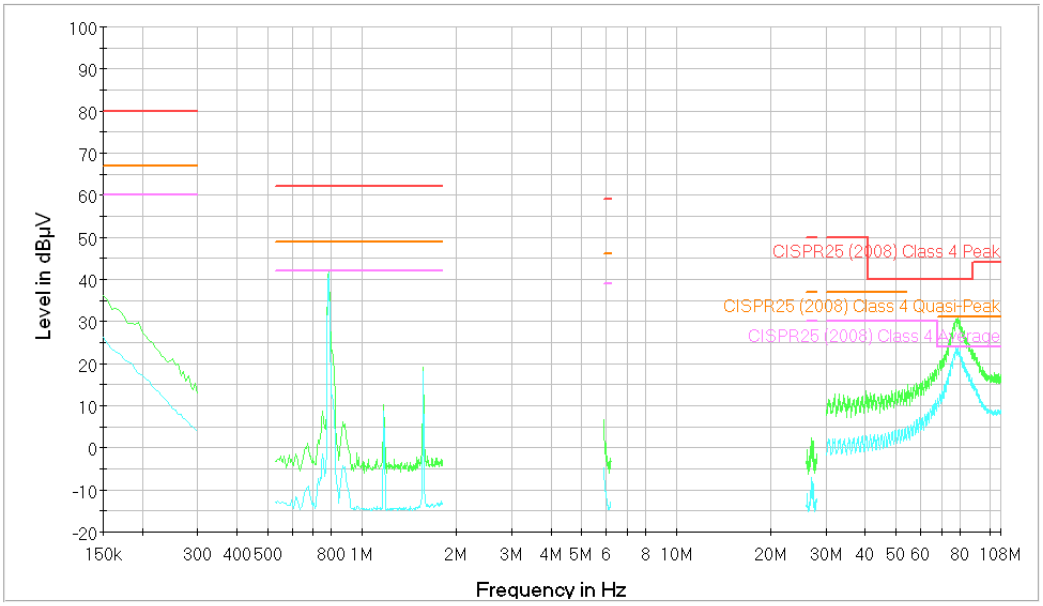


Figure 12. Test measurement. GND. 24V Mode. Peak and Average measurements.

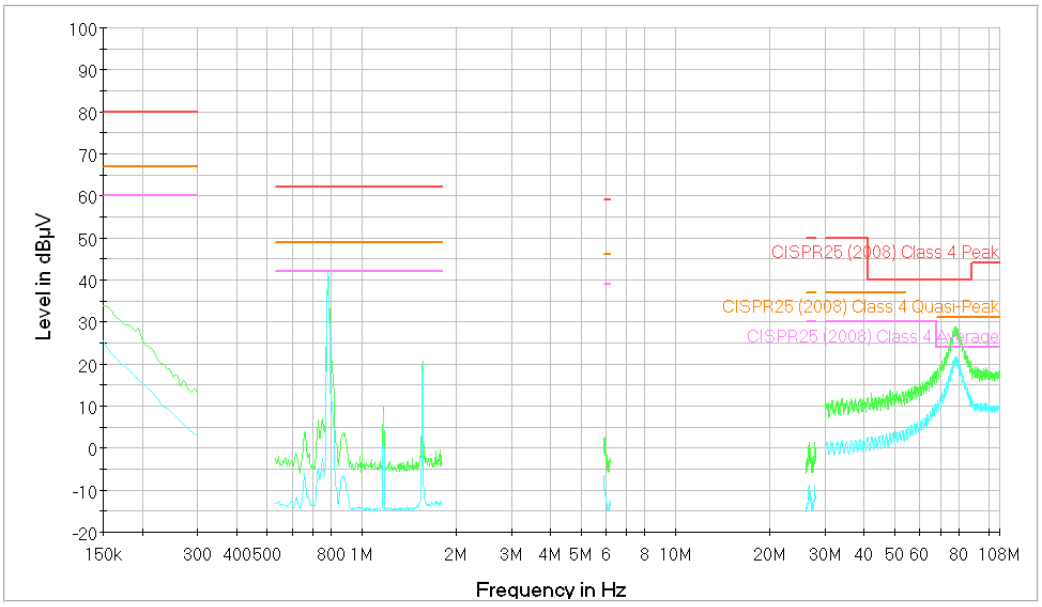


Figure 13. Test measurement. VCC. 24V Mode. Peak and Average measurements.

6.2 Radiated emissions (RE)

6.2.1 Test purpose

This test is intended to check that radio frequency radiated emissions are below the set limit.

6.2.2 Test Information

Test Site	SAR 1
Test Date	2019-07-10 and 2019-07-18
Temperature	24ºC
Humidity	54%
Test Engineer	Pedro Moreno
Antenna Distance	1 m
Harness length	1.7 m
Operation Mode 1	12V (Class 5 applied)
Operation Mode 2	24V (Class 4 applied)

Table 11. RE Test – CISPR 25. Test Information.

6.2.3 Limit Lines

All emissions limits must be bellow limits defined for (Mode 12V Class 5, Mode 24V Class 4):

Service / Band	Frequency MHz	Levels in dB(µV/m)									
		Class 1		Class 2		Class 3		Class 4		Class 5	
		Peak	Quasi-peak	Peak	Quasi-peak	Peak	Quasi-peak	Peak	Quasi-peak	Peak	Quasi-peak
BROADCAST											
LW	0,15 - 0,30	86	73	76	63	66	53	56	43	46	33
MW	0,53 - 1,8	72	59	64	51	56	43	48	35	40	27
SW	5,9 - 6,2	64	51	58	45	52	39	46	33	40	27
FM	76 - 108	62	49	56	43	50	37	44	31	38	25
TV Band I	41 - 88	52	-	46	-	40	-	34	-	28	-
TV Band III	174 - 230	56	-	50	-	44	-	38	-	32	-
DAB III	171 - 245	50	-	44	-	38	-	32	-	26	-
TV Band IV/	468 - 944	65	-	59	-	53	-	47	-	41	-
DTTV	470 - 770	69	-	63	-	57	-	51	-	45	-
DAB L band	1447 - 1494	52	-	46	-	40	-	34	-	28	-
SDARS	2320 - 2345	58	-	52	-	46	-	40	-	34	-
MOBILE SERVICES											
CB	26 - 28	64	51	58	45	52	39	46	33	40	27
VHF	30 - 54	64	51	58	45	52	39	46	33	40	27
VHF	68 - 87	59	46	53	40	47	34	41	28	35	22
VHF	142 -175	59	46	53	40	47	34	41	28	35	22
Analogue UHF	380 - 512	62	49	56	43	50	37	44	31	38	25
RKE	300 - 330	56	-	50	-	44	-	38	-	32	-
RKE	420 - 450	56	-	50	-	44	-	38	-	32	-
Analogue UHF	820 - 960	68	55	62	49	56	43	50	37	44	31
GSM 800	860 - 895	68	-	62	-	56	-	50	-	44	-
EGSM/GSM 900	925 - 960	68	-	62	-	56	-	50	-	44	-
GPS L1 civil	1567 - 1583	-	-	-	-	-	-	-	-	-	-
GSM 1800 (PCN)	1803 - 1882	68	-	62	-	56	-	50	-	44	-
GSM 1900	1850 - 1990	68	-	62	-	56	-	50	-	44	-
3G / IMT 2000	1900 - 1992	68	-	62	-	56	-	50	-	44	-
3G / IMT 2000	2010 - 2025	68	-	62	-	56	-	50	-	44	-
3G / IMT 2000	2108 - 2172	68	-	62	-	56	-	50	-	44	-
Bluetooth/802.11	2400 - 2500	68	-	62	-	56	-	50	-	44	-

NOTE 1 All values listed in this table are valid for the bandwidths in Tables 1 and 2. If measurements have to be performed with different bandwidths than those specified in Tables 1 and 2 because of noise floor requirements, then applicable limits should be defined in the test plan.

NOTE 2 Where multiple bands use the same limits the user shall select the appropriate bands over which to test. When the test plan includes bands that overlap the test plan shall define the applicable limit.

Table 12. RE Test – CISPR 25. Limit lines for Peak and Quasi-Peak detector.

Service / Band	Frequency MHz	Levels in dB(µV)				
		Class 1	Class 2	Class 3	Class 4	Class 5
		AVG	AVG	AVG	AVG	AVG
BROADCAST						
LW	0,15 - 0,30	90	80	70	60	50
MW	0,53 - 1,8	66	58	50	42	34
SW	5,9 - 6,2	57	51	45	39	33
FM	76 - 108	42	36	30	24	18
TV Band I	41 - 88	48	42	36	30	24
MOBILE SERVICES						
CB	26 - 28	48	42	36	30	24
VHF	30 - 54	48	42	36	30	24
VHF	68 - 87	42	36	30	24	18

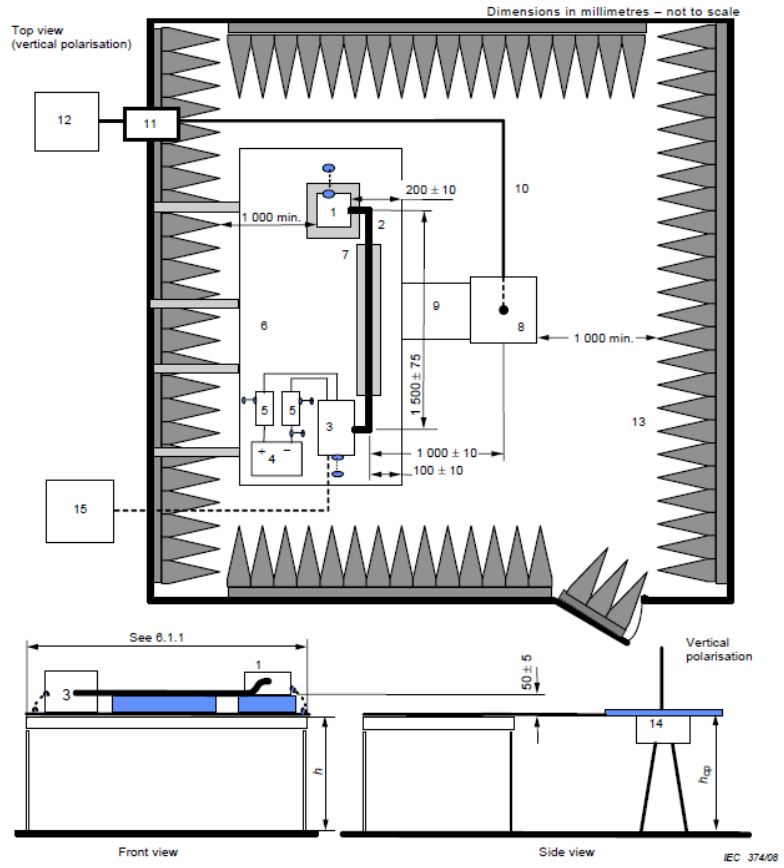
Table 13. RE Test – CISPR 25. Limit lines for Average detector.

6.2.4 Measurements parameters

Service / Frequency range MHz		Peak detection			Quasi-peak detection			Average detection		
		BW at -6 dB	Step size	Dwell time	BW at -6 dB	Step size	Dwell time	BW at -6 dB	Step size	Dwell time
AM broadcast and mobile services	0,15 - 30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms
FM broadcast	76 - 108	120 kHz	50 kHz	5 ms	120 kHz	50 kHz	1 s	120 kHz	50 kHz	5 ms
Mobile services	30 to 1 000									
TV Band I	41 – 88									
TV Band III	174 – 230									
TV Band IV/V	470 – 890									
DAB	171 - 245									
DTTV	470 - 770	120 kHz	50 kHz	5 ms	Does not apply	Does not apply	Does not apply	120 kHz	50 kHz	5 ms
Mobile service	1 000 - 2 500	120 kHz	50 kHz	5 ms	Does not apply	Does not apply	Does not apply	120 kHz	50 kHz	5 ms
GPS L1 civil	1 567 – 1 583	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply	9 kHz	5 kHz	5 ms
NOTE For emissions generated by brush commutator motors without an electronic control unit, the maximum step size may be increased up to 5 times the bandwidth.										

Table 14. RE Test – CISPR 25. Measurement parameters.

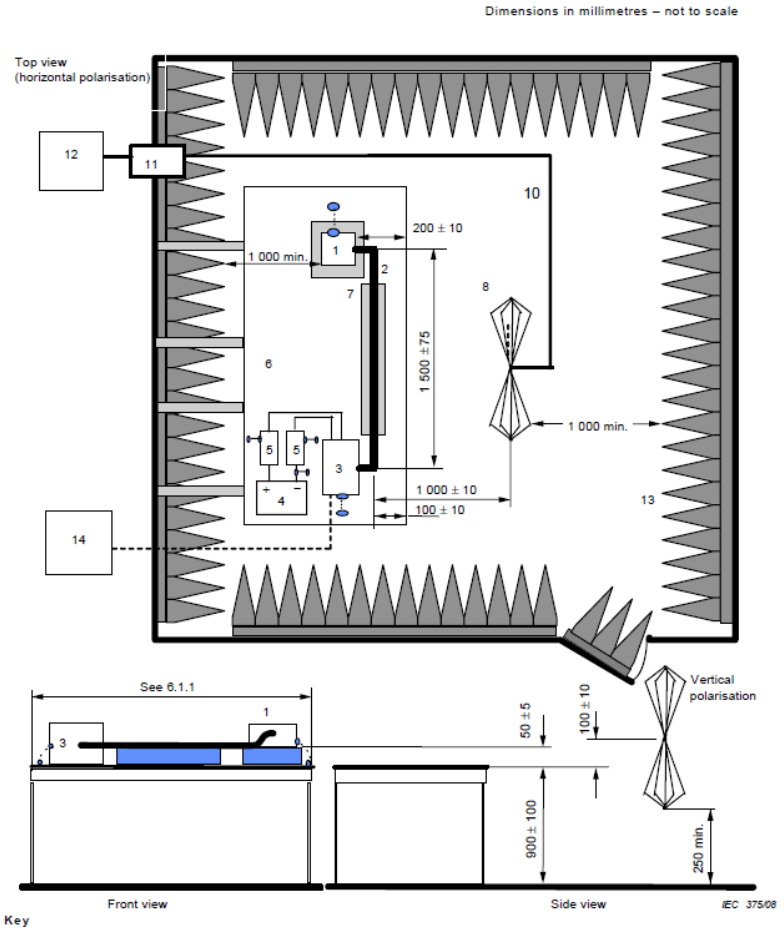
6.2.5 Test Setup



Key

1 EUT (grounded locally if required in test plan)
2 Test harness
3 Load simulator (placement and ground connection according to 6.4.2.5)
4 Power supply (location optional)
5 Artificial network (AN)
6 Ground plane (bonded to shielded enclosure)
7 Low relative permittivity support ($\varepsilon_r \leq 1,4$)
8 Rod antenna with counterpoise (dimensions: 600 mm by 600 mm typical)
h = (900 ± 100) mm
$h_{cp} = h + (+10 / -20)$ mm
9 Grounding connection (full width bond between counterpoise and ground plane)
10 High-quality coaxial cable e.g. double-shielded (50 Ω)
11 Bulkhead connector
12 Measuring instrument
13 RF absorber material
14 Antenna matching unit (the preferred location is below the counterpoise; if above the counterpoise then the base of the antenna rod shall be at the height of the ground plane)
15 Stimulation and monitoring system

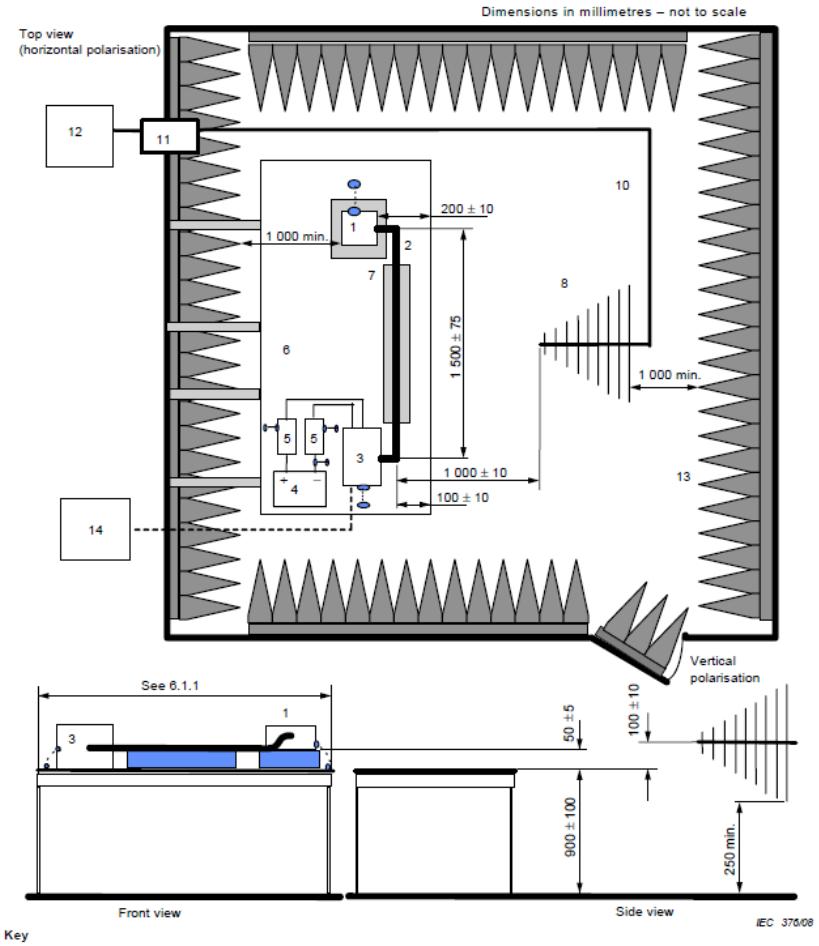
Figure 14. RE Test – CISPR 25. Schematic Test Setup from 100 kHz to 30MHz.



Key

1 EUT (grounded locally if required in test plan)
2 Test harness
3 Load simulator (placement and ground connection according to 6.4.2.5)
4 Power supply (location optional)
5 Artificial network (AN)
6 Ground plane (bonded to shielded enclosure)
7 Low relative permittivity support ($\varepsilon_r \leq 1,4$)
8 Biconical antenna
10 High-quality coaxial cable e.g. double-shielded (50 Ω)
11 Bulkhead connector
12 Measuring instrument
13 RF absorber material
14 Stimulation and monitoring system

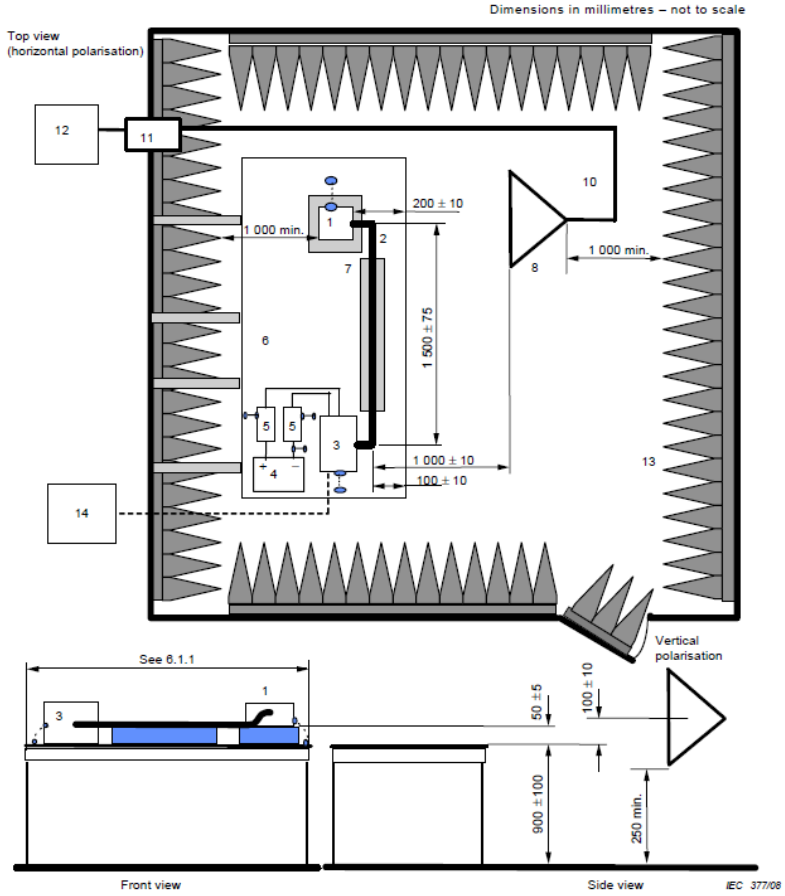
Figure 15. RE Test – CISPR 25. Schematic Test Setup from 30MHz to 200MHz.



Key

1 EUT (grounded locally if required in test plan)
2 Test harness
3 Load simulator (placement and ground connection according to 6.4.2.5)
4 Power supply (location optional)
5 Artificial network (AN)
6 Ground plane (bonded to shielded enclosure)
7 Low relative permittivity support ($\varepsilon_r \leq 1{,}4$)
8 Log-periodic antenna
10 High-quality coaxial cable e.g. double-shielded (50 Ω)
11 Bulkhead connector
12 Measuring instrument
13 RF absorber material
14 Stimulation and monitoring system

Figure 16. RE Test – CISPR 25. Schematic Test Setup from 200MHz to 1GHz.



Key

1 EUT (grounded locally if required in test plan)
2 Test harness
3 Load simulator (placement and ground connection according to 6.4.2.5)
4 Power supply (location optional)
5 Artificial network (AN)
6 Ground plane (bonded to shielded enclosure)
7 Low relative permittivity support ($\varepsilon_r \leq 1,4$)
8 Horn antenna
10 High-quality coaxial cable e.g. double-shielded (50 Ω)
11 Bulkhead connector
12 Measuring instrument
13 RF absorber material
14 Stimulation and monitoring system

Figure 17. RE Test – CISPR 25. Schematic Test Setup from 1GHz to 2GHz.

Figure 18. RE Test – CISPR 25. Test Setup applied for 12V from 100 kHz to 30MHz.

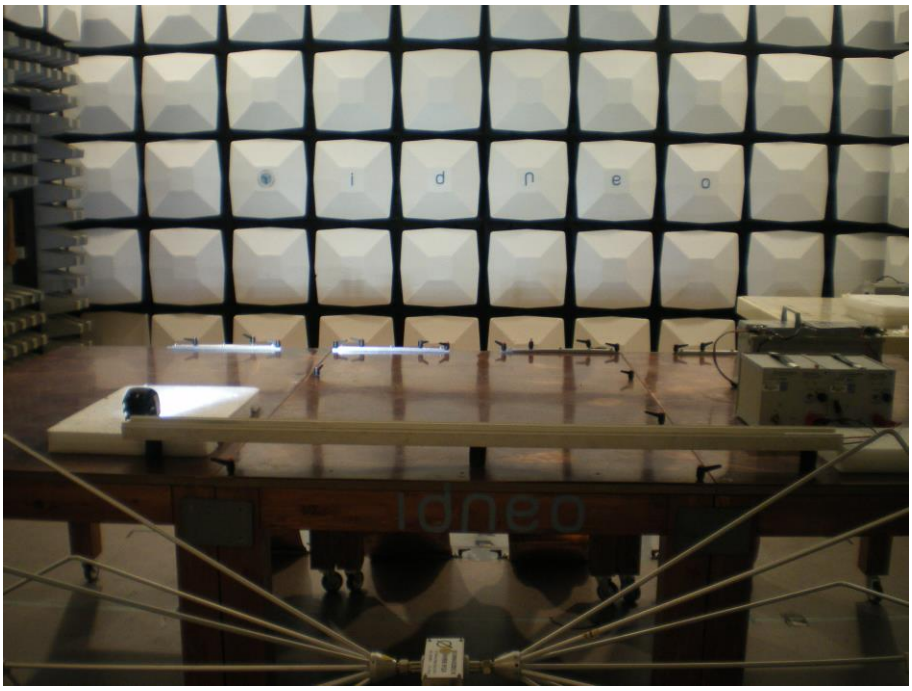


Figure 19. RE Test – CISPR 25. Test Setup applied for 12V 30MHz to 200MHz.

Figure 20. RE Test – CISPR 25. Test Setup applied for 12V from 200MHz to 1GHz.

Figure 21. RE Test – CISPR 25. Test Setup applied for 12V from 1GHz to 2GHz.

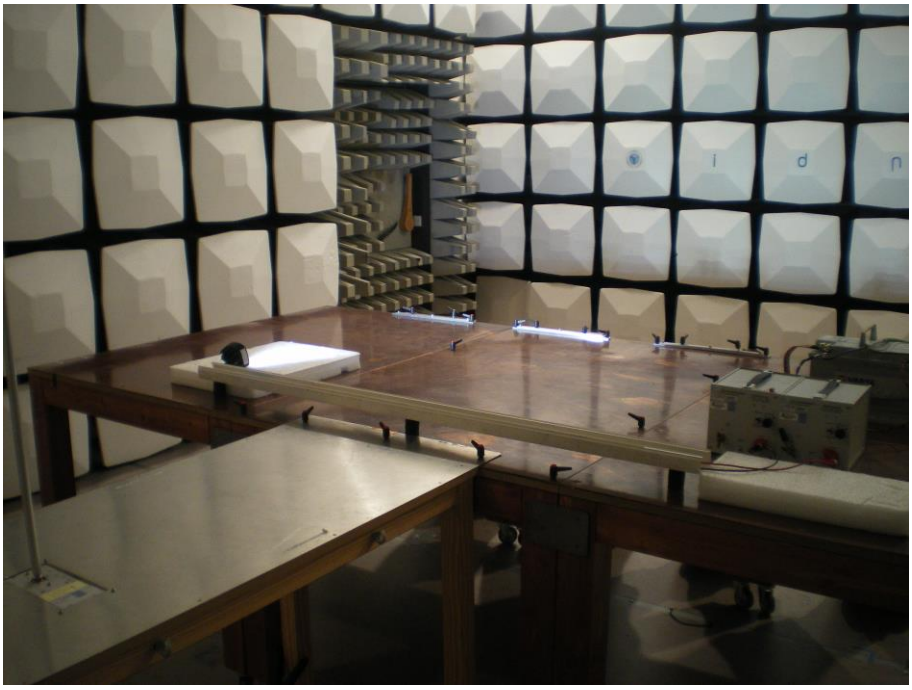


Figure 22. RE Test – CISPR 25. Test Setup applied for 24V from 100 kHz to 30MHz.

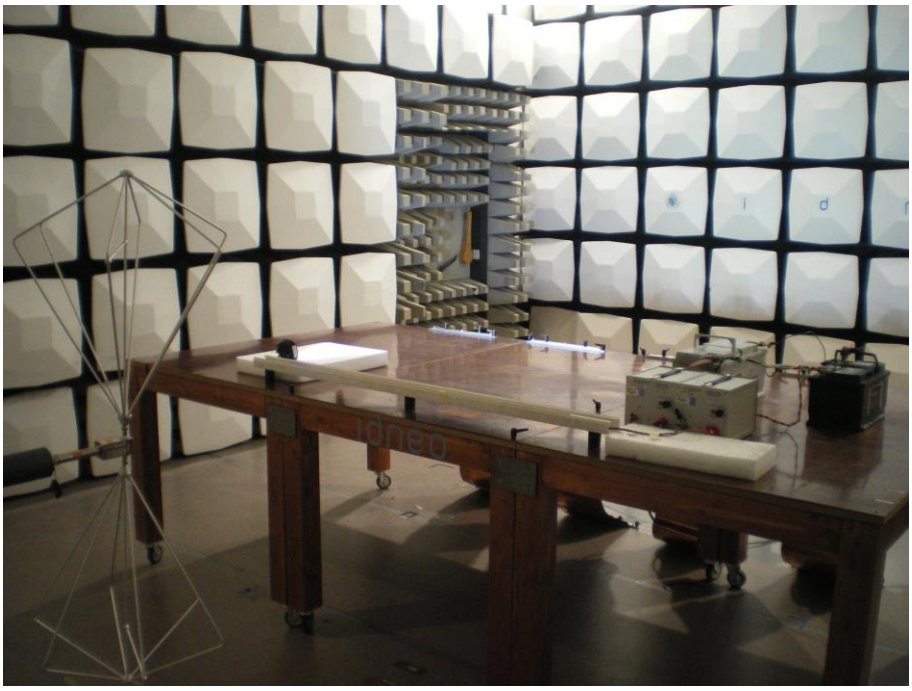


Figure 23. RE Test – CISPR 25. Test Setup applied for 24V 30MHz to 200MHz.

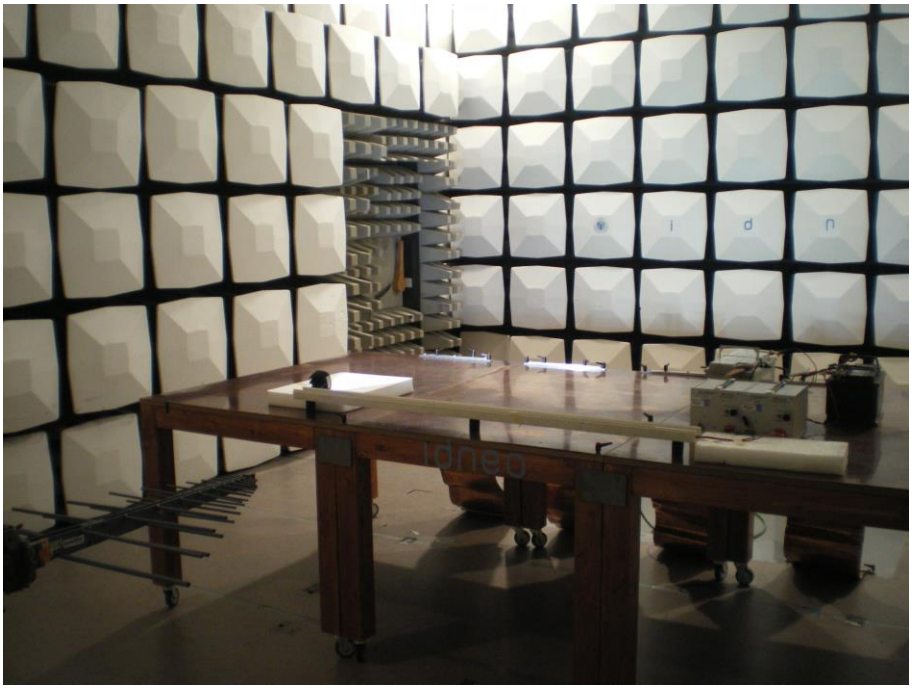


Figure 24. RE Test – CISPR 25. Test Setup applied for 24V from 200MHz to 1GHz.

Figure 25. RE Test – CISPR 25. Test Setup applied for 24V from 1GHz to 2GHz.

6.2.6 Test Results

Sample	Operational mode	Frequency Range [MHz]	Polarization	Result		
				PK	QPK	AVG
#1	12V (Class 5 applied)	0.15 – 30	--	PASS	PASS	PASS
		30 – 200	H	PASS	PASS	PASS
			V	PASS	PASS	PASS
		200 – 1000	H	PASS	PASS	PASS
			V	PASS	PASS	PASS
		1000 – 2500	H	PASS	--	PASS
			V	PASS	--	PASS
	24V (Class 4 applied)	0.15 – 30	--	PASS	PASS	PASS
		30 – 200	H	PASS	PASS	PASS
			V	PASS	PASS	PASS
		200 – 1000	H	PASS	PASS	PASS
			V	PASS	PASS	PASS
		1000 – 2500	H	PASS	--	PASS
			V	PASS	--	PASS

Table 15. RE Test – CISPR 25. Test Results. Sample #1.

6.2.6.1 Ambient noise measurements – 12V Mode (Class 5 applied)

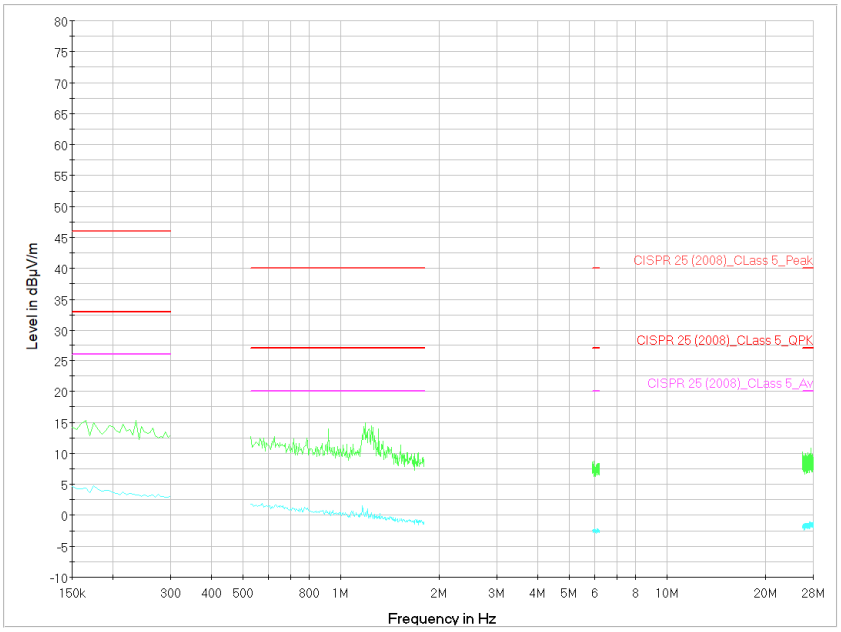


Figure 26. RE Test – CISPR 25. Ambient measurement. From 100kHz to 30MHz . Peak and Average measurements.

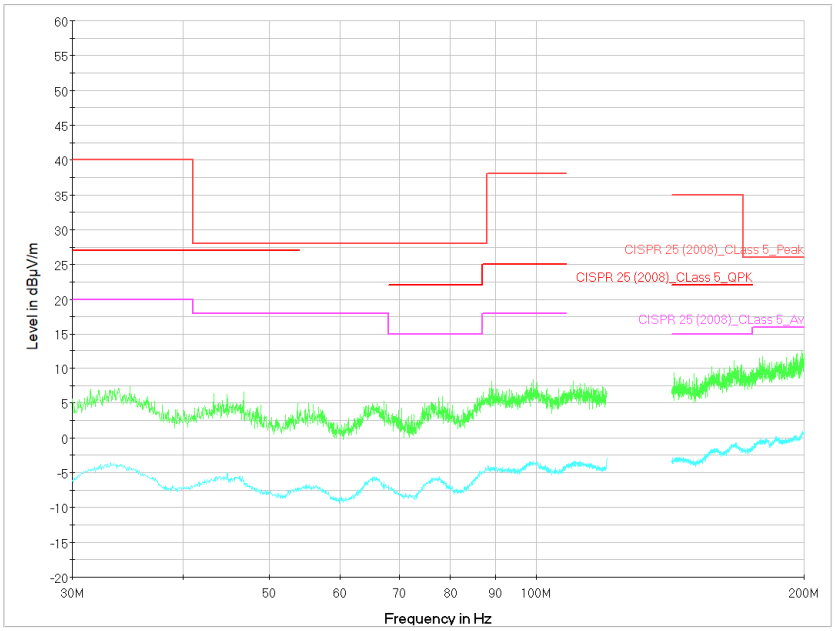


Figure 27. RE Test – CISPR 25. Ambient measurement. From 30MHz to 200MHz . Horizontal polarization. Peak and Average measurements.

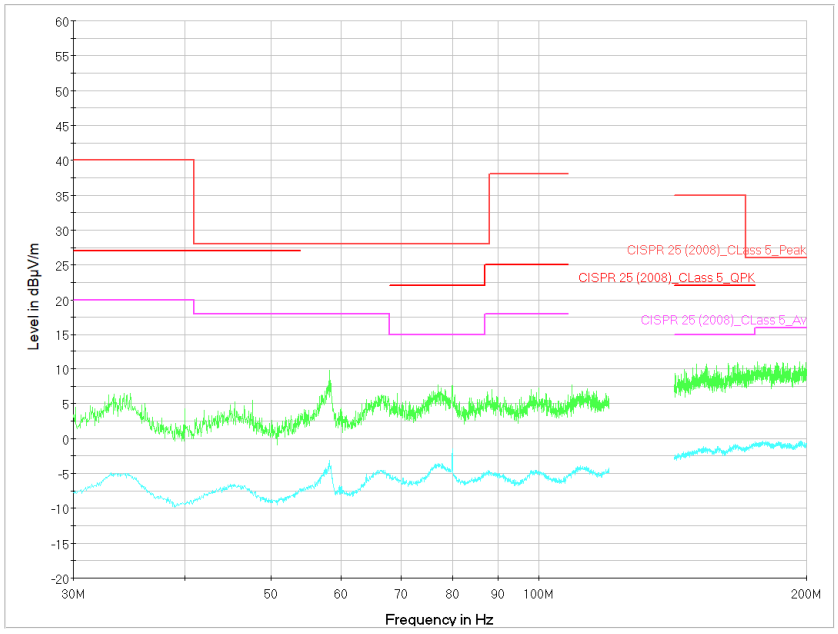


Figure 28. RE Test – CISPR 25. Ambient measurement. From 30MHz to 200MHz . Vertical polarization. Peak and Average measurements.

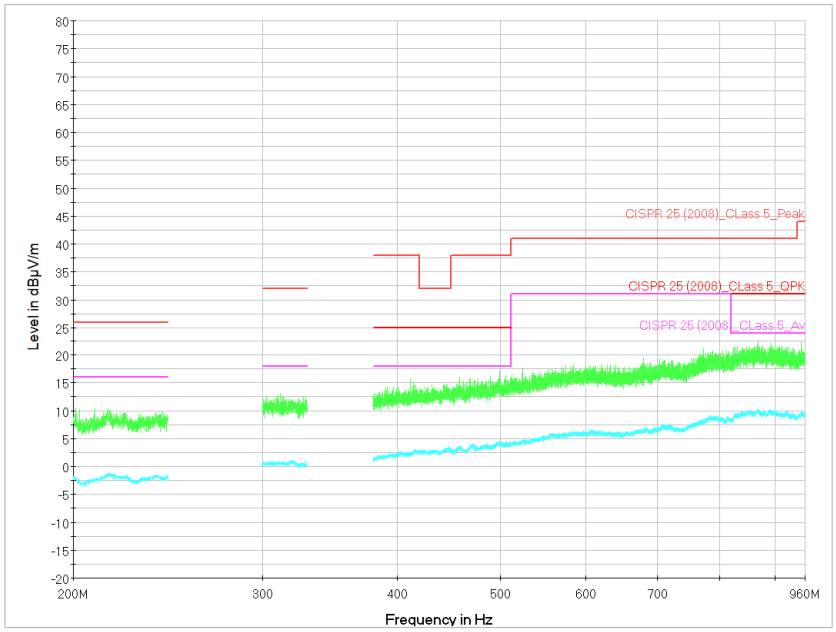


Figure 29. RE Test – CISPR 25. Ambient measurement. From 200MHz to 1000MHz . Horizontal polarization. Peak and Average measurements.

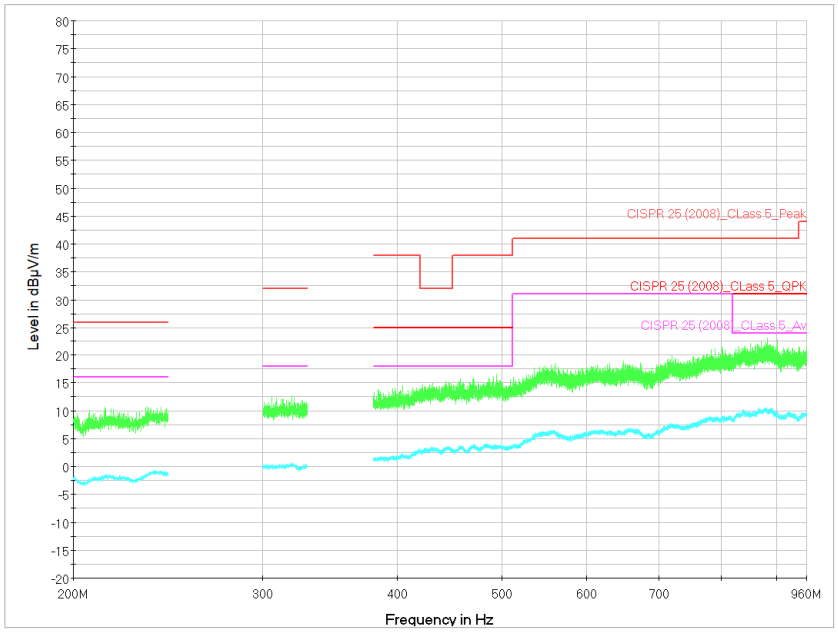


Figure 30. RE Test – CISPR 25. Ambient measurement. From 200MHz to 1000MHz . Vertical polarization. Peak and Average measurements.

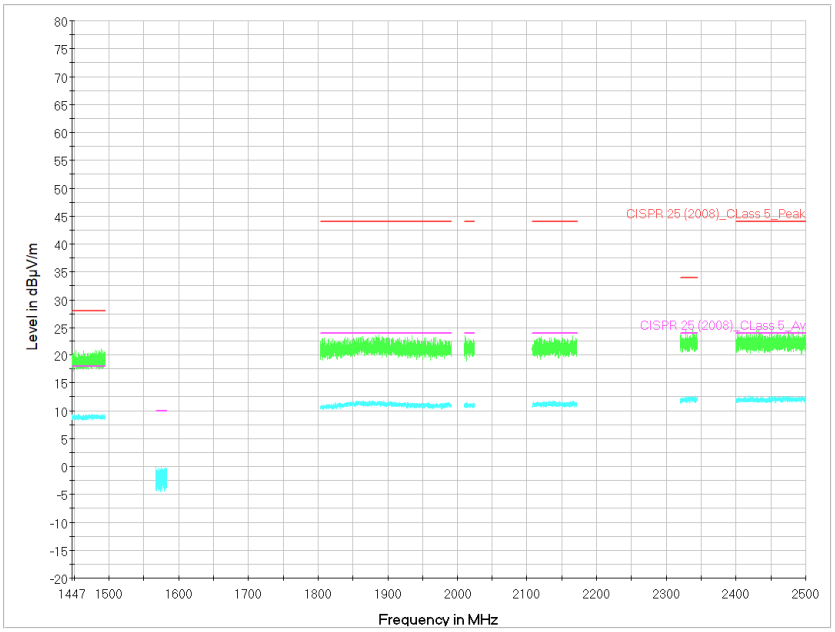


Figure 31. RE Test – CISPR 25. Ambient measurement. From 1000MHz to 2500MHz . Horizontal polarization. Peak and Average measurements.

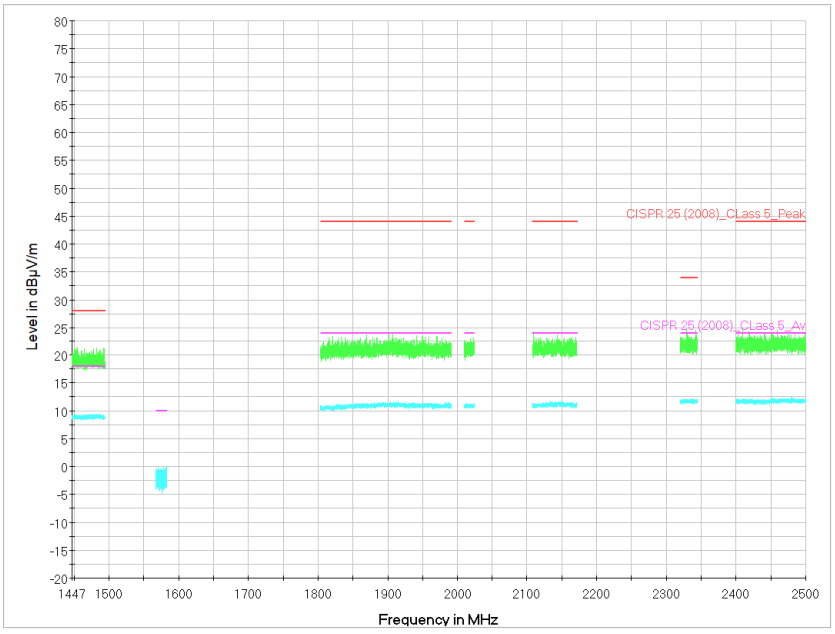


Figure 32. RE Test – CISPR 25. Ambient measurement. From 1000MHz to 2500MHz . Vertical polarization. Peak and Average measurements.

6.2.6.2 Tests Graphs. Sample #1 – 12V Mode (Class 5 applied)

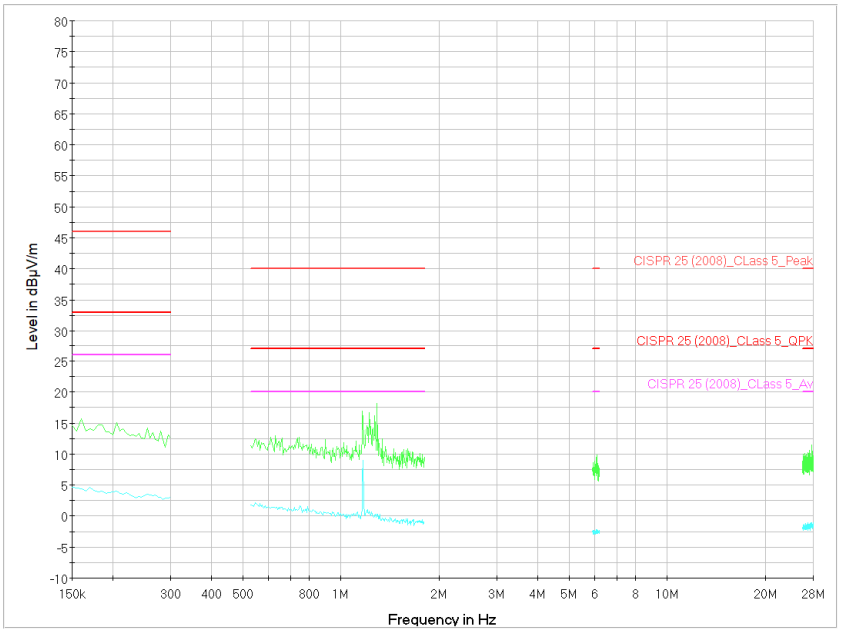


Figure 33. Sample #1 measurement. 12V Mode. From 100kHz to 30MHz Horizontal polarization. Peak and Average measurements.
Result: PASS (measurements below limits)

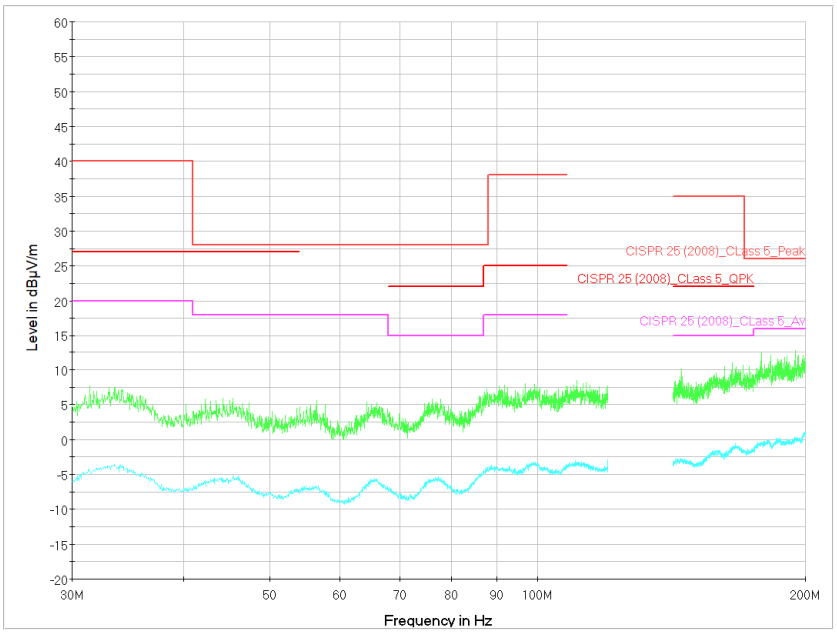


Figure 34. Sample #1 measurement. 12V Mode. From 30MHz to 200MHz Horizontal polarization. Peak and Average measurements.
Result: PASS (measurements below limits)

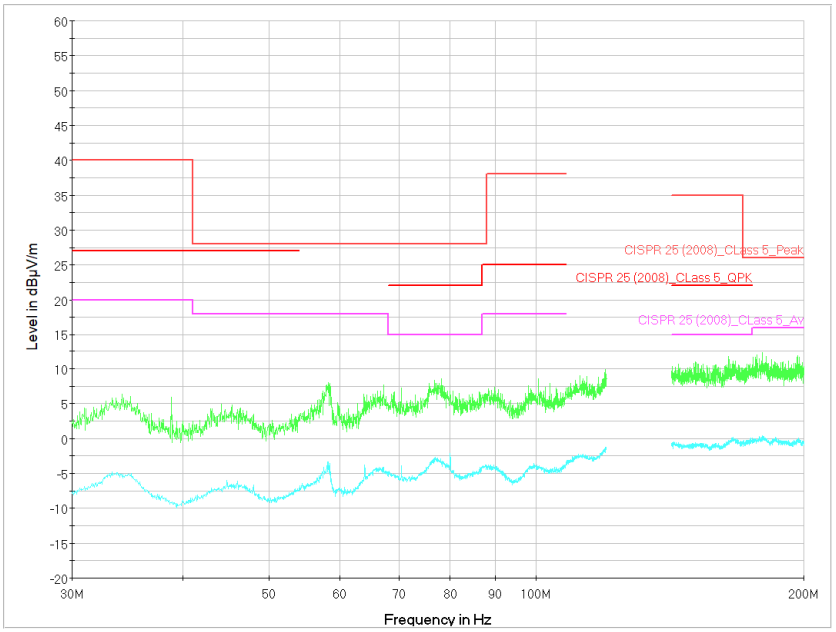


Figure 35. Sample #1 measurement. 12V Mode. From 30MHz to 200MHz
Vertical polarization. Peak and Average measurements.
Result: PASS (measurements below limits)

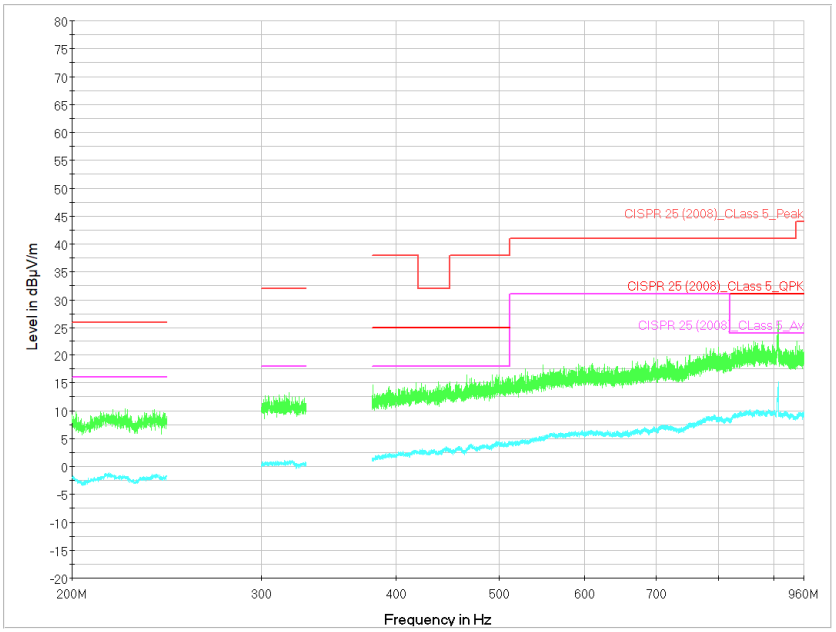


Figure 36. Sample #1 measurement. 12V Mode. From 200MHz to 1GHz
Horizontal polarization. Peak and Average measurements.
Result: PASS (measurements below limits)

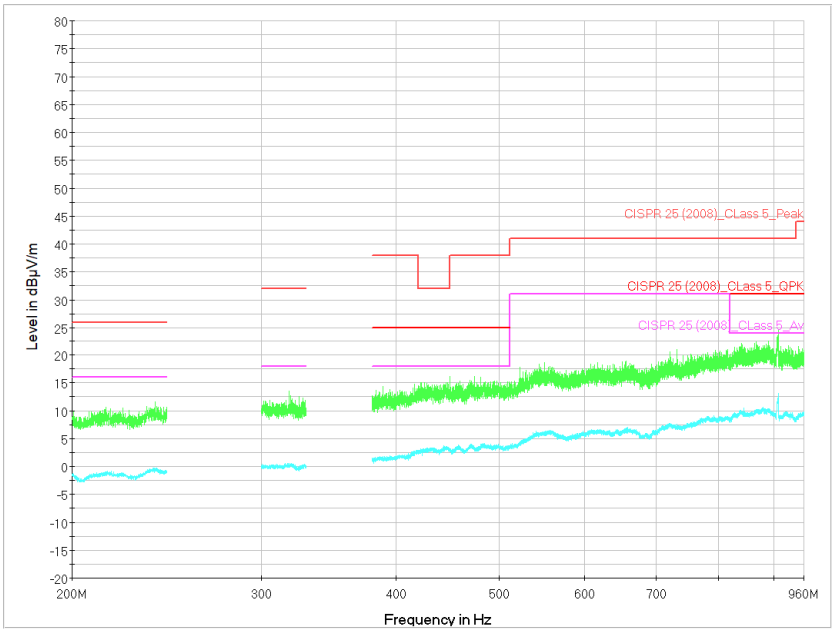


Figure 37. Sample #1 measurement. 12V Mode. From 200MHz to 1GHz
Vertical polarization. Peak and Average measurements.
Result: PASS (measurements below limits)

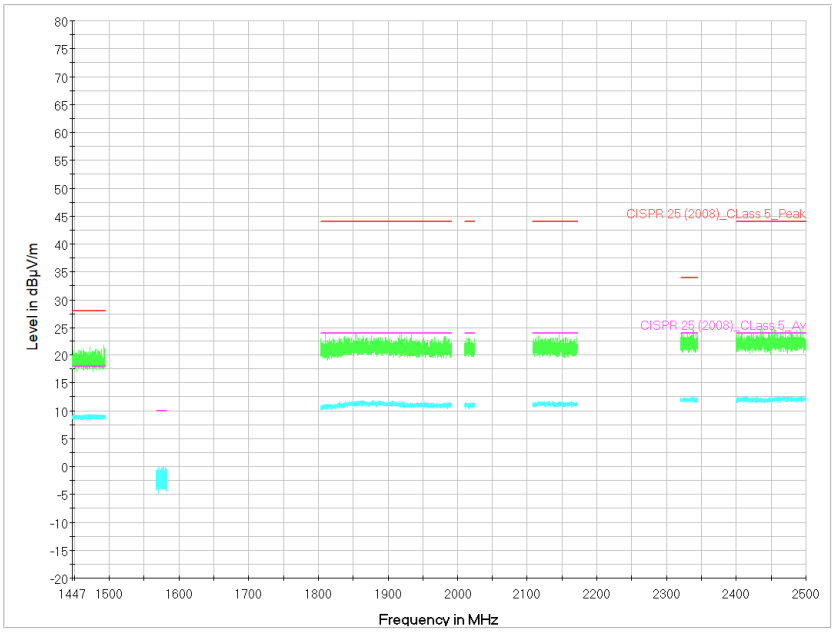


Figure 38. Sample #1 measurement. 12V Mode. From 1GHz to 2.5GHz
Horizontal polarization. Peak and Average measurements.
Result: PASS (measurements below limits)

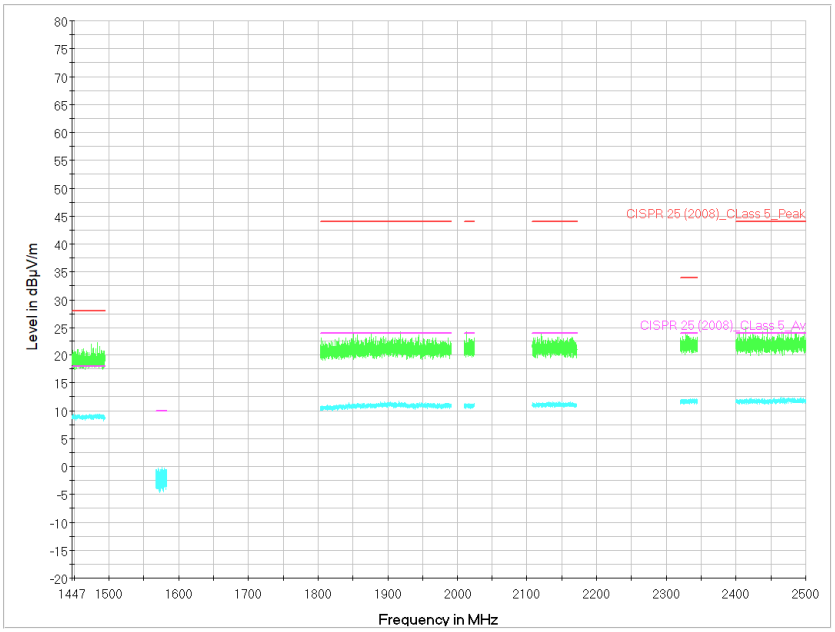


Figure 39. Sample #1 measurement. 12V Mode. From 1GHz to 2.5GHz Vertical polarization. Peak and Average measurements.
Result: PASS (measurements below limits)

7 Equipments

Radiated Emissions				
SAR1				
ID Equip.	**Model**	**Type**	**Manufacturer**	**Serial Number**
562	RE Path	Cable EMI radiated emissions SAR1-CR1	Huber Suhner	562
693	413 7617	Thermohygrometer	RS	C02054
715	SAR1	Semi-Anechoic Room	Albatross-projects	T162
1066	3x1,5m	Conductive Table		
893	NNBM 8124-200	V-Network 5uH+1Ohm	Schwarzbeck	NNBM8124-047
894	NNBM 8124-200	V-Network 5uH+1Ohm	Schwarzbeck	NNBM8124-048
907	12V 60Ah540A	Automotive battery	Autoequip Plus	907
973	HL223	Logoperiodic Antenna	Rohde&Schwarz	100258
974	VHBB 9124	Biconic Antenna	Rohde&Schwarz	395
CR1				
ID Equip.	**Model**	**Type**	**Manufacturer**	**Serial Number**
421	ESCI3	EMI Test Receiver	Rohde&Schwarz	100129
691	413 7617	Thermohygrometer	RS	C02055
708	CR1	Control Room	Albatross-projects	T162
930	EMC32 Software	EMS Software	Rohde&Schwarz	Version 8.54.0

Conducted Emissions				
SR1				
ID Equip.	**Model**	**Type**	**Manufacturer**	**Serial Number**
854	EMC32-E+Software	EMS Software	Rohde&Schwarz	854
689	608-H1	Thermohygrometer	Testo	45053712
550	W10.03	CE Path: Cable Conducted Emi	R&S	550
835	NNBM 8126	LISN CISPR-25	Schwarzbeck	8126D138
836	NNBM 8126	LISN CISPR-25	Schwarzbeck	8126D139

8 Glossary

DUT	Device Under Test
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
LISN	Line Impedance Stability Network
ISO	International Standard Organization
CISPR	Comité International Spécial des Perturbations Radioélectriques
JASO	Japanese Automotive Standards Organization
DV	Design Validation
PV	Product Validation
VCC	Battery
GND	Ground
HW	Hardware
SW	Software
ESD	Electrostatic Discharges
RF	Radio Frequency
BNC	Bayonet Neill-Concelman (RF connector)
CAN	Controller-Area Network (vehicle bus standard)
LIN	Local Interconnect Network (vehicle bus standard)
USB	Universal Serial Bus (connection and communication)