TEST REPORT

N°: **18347346-787863-B (FILE#5149548)** Version: **01**

Subject	Electromagnetic compatibility tests according to the standards: **FCC CFR 47 Part 15, Subpart B** **ANSI C63.4 / ANSI C63.4a**
Issued to	**ProMinent GmBH** Im Schuhmachergewann 5 -11 69123 - HEIDELBERG GERMANY
Apparatus under test	
Product	**Controller for cooling tower managements**
Trade mark	**ProMinent GmBH**
Manufacturer	**ProMinent GmBH**
Model under test	**AEGIS S**
Serial number	**230923459**
FCCID	**2BBPH-AEGIS-S**
IC	**NC**
Conclusion	See Test Program chapter
Test date	March 22, 2023 to March 23, 2023
Test location	LCIE Grenoble
FCC Test site	FR0008 - 197516 (MOI)
ISED Test site	6500A (MOI)
Sample receipt date	March 22, 2023
Composition of document	25 pages
Document issued on	November 29, 2023

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PUBLICATION HISTORY

Version	Date	Author	Modification
01	November 29, 2023	Jonathan SARTO	Creation of the document

Each new edition of this test report replaces and cancels the previous edition. The control of the old editions of report is under responsibility of client.

SUMMARY

1. TEST PROGRAM

1.1. FCC PART15B

Standard:

- ✓ **FCC Part 15, Subpart B (Digital Devices)**
- ✓ **ANSI C63.4 (2014) / ANSI C63.4a (2017)**

1.1.1. Requirements for disturbance emissions – Class B

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance 150kHz-30MHz **FCC §15.107 / ICES-003**	**Access: AC power**			**PASS**
	Frequency	**Quasi-peak**	**Average**	
	150-500kHz	66 to 56 dBµV	56 to 46 dBµV	
	0.5-5MHz	56 dBµV	46 dBµV	
	5-30MHz	60 dBµV	50 dBµV	
Radiated emissions 30MHz-1GHz **FCC §15.109**	**Access: Enclosure port of ancillary equipment**			**PASS**
	Frequency	**Quasi-peak @3m**		
	30MHz-88MHz	40.0 dBµV/m		
	88MHz-216MHz	43.5 dBµV/m		
	216MHz-960MHz	46.0 dBµV/m		
	Above 960MHz	54.0 dBµV/m		
Radiated emissions 1GHz-13GHz* **FCC §15.109 / ICES-003**	**Access: Enclosure port of ancillary equipment**			**PASS**
	Frequency	**Peak @3m**	**Average @3m**	
	1- 13GHz	74.0 dBµV/m	54.0 dBµV/m	

NA: Not Applicable / NP: Not Performed, not requested by the customer (It cannot be taken into account for the declaration of conformity)
[D]: Divergence, the last version is used to make it possible to test the product with the standard which describes the current state of the art and thus to answer as well as possible his environment of final use.
§15.33: The highest internal source of a testing device is defined like more the highest frequency generated or used in the testing device or on which the testing device works or agrees.
- If the highest frequency of the internal sources of the testing device is lower than 108 MHz, measurement must be only performed until 1GHz.
- If the highest frequency of the internal sources of the testing device ranges between 108 MHz and 500 MHz, measurement must be only performed until 2GHz.
- If the highest frequency of the internal sources of the testing device ranges between 500 MHz and 1 GHz, measurement must be only performed until 5GHz.

If the highest frequency of the internal sources of the testing device is above 1 GHz, measurement must be only performed until 5 times the highest frequency or 40 GHz, while taking smallest of both.
Special condition for intentional radiator:

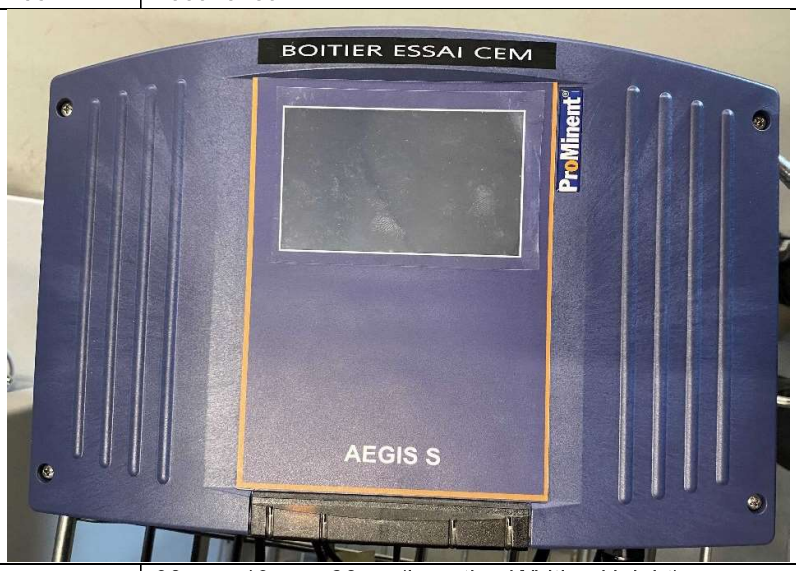
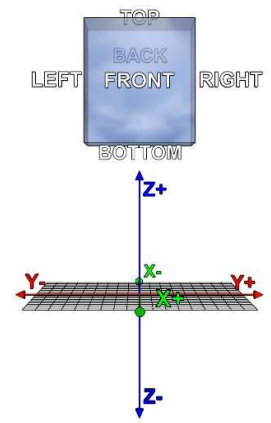
- For a composite system comprised of a digital device using a clock frequency of 1 GHz as the highest frequency for the digital logic and an intentional radiator operating at 2.4 GHz, the composite is required to be investigated to the upper frequency of 24 GHz (in this case, 10 times the intentional radiator frequency is the higher frequency).

- For a composite system comprised of a digital device using a clock frequency of 2 GHz as the highest frequency for the digital logic and an intentional radiator operating at 913 MHz, the composite is required to be investigated to the upper frequency of 10 GHz (in this case, 5 times the unintentional radiator clock frequency is the higher frequency).

2. EQUIPMENT UNDER TEST: CONFIGURATION (DECLARED BY PROVIDER)

2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES)

Equipment under test (EUT):

Model under test :	**AEGIS S**
Serial Number:	**230923459**
	
Dimensions:	36cm x 10cm x 26cm (Length x Width x Height)
Type :	Panel / Rack / Cabinet (considered like table-top)

Power supply:
During all the tests, EUT is supplied by V_{nom}: **230VAC**
For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	Reference / Sn	Comments
Supply1	AC	100-240V 50/60Hz 6.5A	-	-

NC: Not communicated by provider

Earth:

Access	Type	Length (m)	Width (m)	Thickness (m)	Under test	Comments
None						

NC: Not communicated by provider

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
Supply1	3wires (L+N+PE)	3	No	No	Yes	-
Access1	RS485	10	No	Yes	Yes	-
Access2	RJ45 Ethernet	5	No	Yes	Yes	-
Access3	RI1	1	Yes	No	No	-
Access4	RI2	1	Yes	No	No	-
Access5	AI1	1	Yes	No	No	-
Access6	DI1	1	Yes	No	No	-
Access7	Led	1	Yes	No	No	-
Access8	USB	-	Yes	Yes	No	Only for maintenance

NC: Not communicated by provider

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Laptop	ASUS	-	-
Wireless router	TP-LINK TL-WR841N	-	For WIFI communication
Radio communication analyser 2G/3G/4G	ANRITSU MT8820C	-	For GSM communication

NC: Not communicated by provider

2.2. RADIO FREQUENCY - EQUIPMENT INFORMATION (301489)

Type of equipment:	Stand-alone
Equipment intended for use as a:	Fixed use

ETSI 301 489-17	
RF module:	ESP-WROOM-02D
Frequency band:	2400 MHz to 2483.5 MHz – 2.4GHz Band
Antenna type:	Internal
Standby mode*:	Yes
*Tests in standby, receiver or other mode to show conformity to unintentional emissions don't perform like asked by provider.	
Host and radio device testing together:	Yes
Mode under test:	Wifi - 802.11b
All frequency bands/modes aren't tested in final product like asked by provider.	
Control signals:	See §criteria and control of good functioning
Level of wanted signal:	>30dB above declared Maximum Usable Sensitivity (MUS)
Exclusion bands:	2.4 GHz band: [2 280 MHz-2 603.5MHz]

ETSI 301 489-52			
RF module:	SIM900		
Frequency band:	**2G** ☑ GSM900 TX: 880 MHz to 915MHz Idle: 925 MHz to 960 MHz ☐ DCS1800 TX:1710 MHz to 1785 MHz Idle:1805 MHz to 1880 MHz	**3G** ☐ 3G Band VIII TX: 882 MHz to 913 MHz Idle: 927 MHz to 960 MHz ☐ 3G Band I TX: 1922 MHz to 1978 MHz Idle: 2112 MHz to 2168 MHz	**4G** ☐ Band 3 Tx: 1710MHz to 1785MHz Idle: 1805MHz to 1880MHz ☐ Band 7 Tx: 2500MHz to 2570MHz Idle: 2620MHz to 2690MHz ☐ Band 20 Tx: 832MHz to 862MHz Idle: 791MHz to 821MHz
Frequency band under test:	2G - GSM900		
All frequency bands/modes aren't tested in final product like asked by provider.			
Antenna type:	Internal		
Standby mode*:	Yes		
*Tests in standby, receiver or other mode to show conformity to unintentional emissions don't perform like asked by provider.			
Control signals:	See §criteria and control of good functioning		
Level of wanted signal:	>40dB above declared reference sensitivity.		
Exclusion bands:	**GSM / DCS – 2G**		
	TX: 5 x Channel width ± either side of operating frequency RX: [$Band_{RX}$*(lower)* – 200kHz] MHz to [$Band_{RX}$*(upper)* + 200kHz] MHz		
	UTRA 3G		
	TX: 5 x Channel width ± either side of operating frequency RX: [$Band_{RX}$*(lower)* – 5MHz] MHz to [$Band_{RX}$*(upper)* + 5MHz] MHz		
	E-UTRA – 4G		
	TX: 5 x Channel width ± either side of operating frequency RX: [$Band_{RX}$*(lower)* – 20MHz] MHz to [$Band_{RX}$*(upper)* + 20MHz] MHz		

2.3. EUT CONFIGURATION

Hardware information			
Highest internal frequency (PLL, Quartz, Clock, Microprocessor…):	**$F_{Highest}$:**	**216**	**MHz**
Software (if applicable):	**V. :**	1.19	
Time necessary for the EUT to be exercised and to respond:	**Dwell:**	**1**	**s**

NC: Not communicated by provider

Running mode n°1:

Setup:
EUT is powered and functional with radio communication.

Control: visually on EUT.

2.4. EQUIPMENT MODIFICATIONS DURING THE TESTS

Modification: change of board for pass to compliant the conducted emission tests.

2.5. FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow:

FS = RA + AF + CF – AG

Where *FS = Field Strength*
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain

2.6. TEST DISTANCE EXTRAPOLATION – FCC/ISED

The field strength is extrapolated to the new measurement distance using formula from FCC Part15.31 (f) and §6.5-6.6 RSS-GEN:

Below 30MHz,

$$FS_{\text{limit}} = FS_{\text{max}} - 40\log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right)$$

Above 30MHz,

$$FS_{\text{limit}} = FS_{\text{max}} - 20\log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right)$$

Where:
FS_{limit} is the calculation of field strength at the limit distance, expressed in dBµV/m
FS_{max} is the measured field strength, expressed in dBµV/m
$d_{measure}$ is the distance of the measurement point from the EUT
d_{limit} is the reference limit distance

2.7. CALIBRATION DATE

The calibration intervals are extended at 12+2 months. This extended interval is based on the fact that there is sufficient calibration data to statistically establish a trend or based on experience of use of the test equipment to assure good measurement results for a longer period

3. MEASUREMENT OF CONDUCTED EMISSION

3.1. TEST CONDITIONS

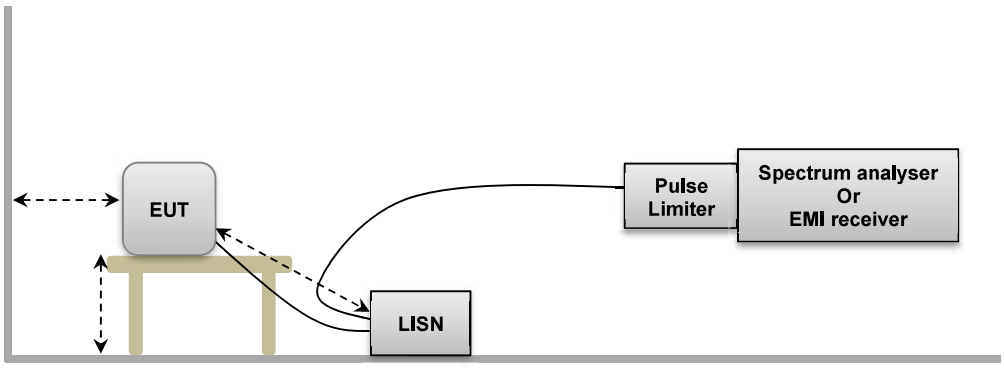
Date of test	:	March 23, 2023	March 27, 2023
Test performed by	:	Jonathan SARTO	Jonathan SARTO
Atmospheric pressure (hPa)	:	995	994
Relative humidity (%)	:	38	42
Ambient temperature (°C)	:	23	21

3.2. TEST SETUP

Test procedure:
☑ ANSI C63.10 & FCC Part 15 subpart B

The EUT and auxiliaries are set 80cm above the ground on the non-conducting table (Table-top equipment) at 80cm from the LISN, the cable has been shorted to 1meter length. The distance between the EUT and the vertical ground plane is 40cm. Measurement is made with a receiver in peak mode. This was followed by a Quasi-Peak, i.e. CISPR measurement for any strong signal. If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary. Interconnecting cables and equipment's were moved to position that maximized emission. The EUT is powered like specified in following table, through a LISN (measure); auxiliaries are powered by another LISN.

Type	Measurement performed:	
☑ AC / ☐ DC (Auxiliary used)	☑ 120VAC/60Hz	☐ 240VAC/50Hz
☐ USB (Laptop auxiliary)	☐ 120VAC/60Hz (Laptop auxiliary)	☐ 240VAC/50Hz (Laptop auxiliary)



Test setup of AC Power Line Conducted Emissions

Photo of AC Power Line Conducted Emissions

3.3. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
BAT EMC	NEXIO	v3.21.0.32	L1000115		
Cable + self	_	_	A5329578	05/22	05/23
EMC comb generator	LCIE SUD EST	_	A3169098		
LISN	ROHDE & SCHWARZ	ENV216	C2320291	08/22	08/23
LISN	ROHDE & SCHWARZ	ENV216	C2320123	08/22	08/23
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	03/23	03/25
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	01/21	05/23
Transient limiter	ROHDE & SCHWARZ	ESH3-Z2	A7122204	08/22	08/24

3.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

3.5. TEST RESULTS – RUNNING MODE N°1

Mains terminals:

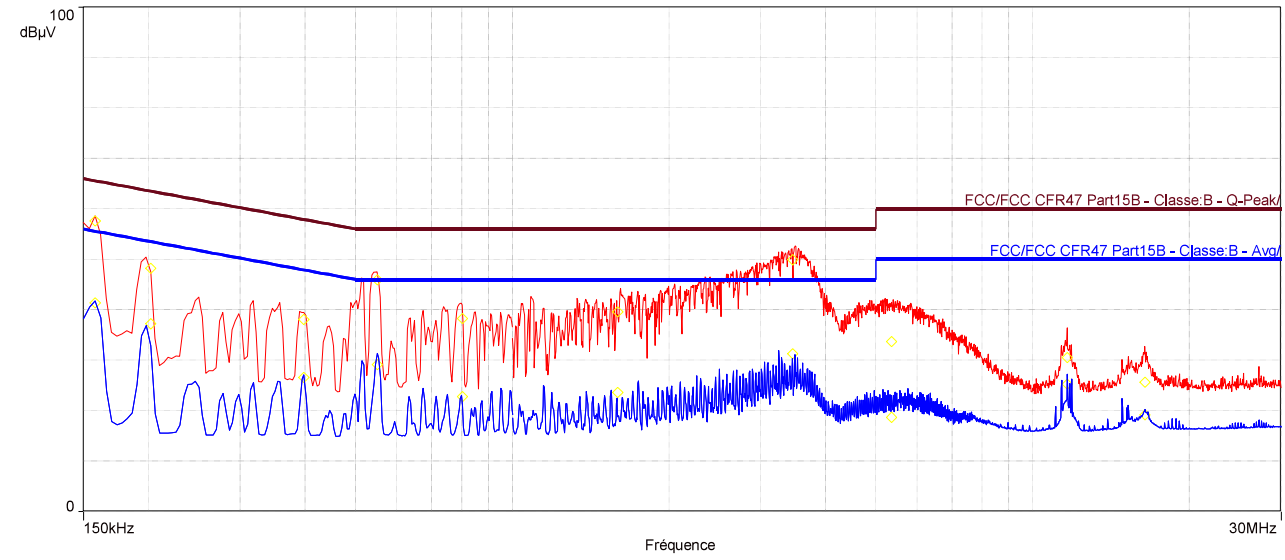
SUPPLY1

Measurements are performed on the phase (L1) and neutral (N) of the power line.

Results: (PEAK detection)

Graph identifier		Line	Comments	
Emc#	1	Phase	120VAC/60Hz	See below
Emc#	2	Neutral	120VAC/60Hz	See below
Emc#	3	Phase	240VAC/50Hz	See below
Emc#	4	Neutral	240VAC/50Hz	See below

CONDUCTED EMISSIONS					
Graph name:	Emc#1	**Test configuration:**			
Limit:	FCC CFR47 Part15B	Running mode 1			
Class:	B				
Frequency range: [150kHz - 30MHz]					
Voltage / Frequency:	120V/60Hz	**RBW:**	10kHz	**VBW:**	30kHz
Line:	**Phase**	**Trace color & detector:**		PEAK	AVG

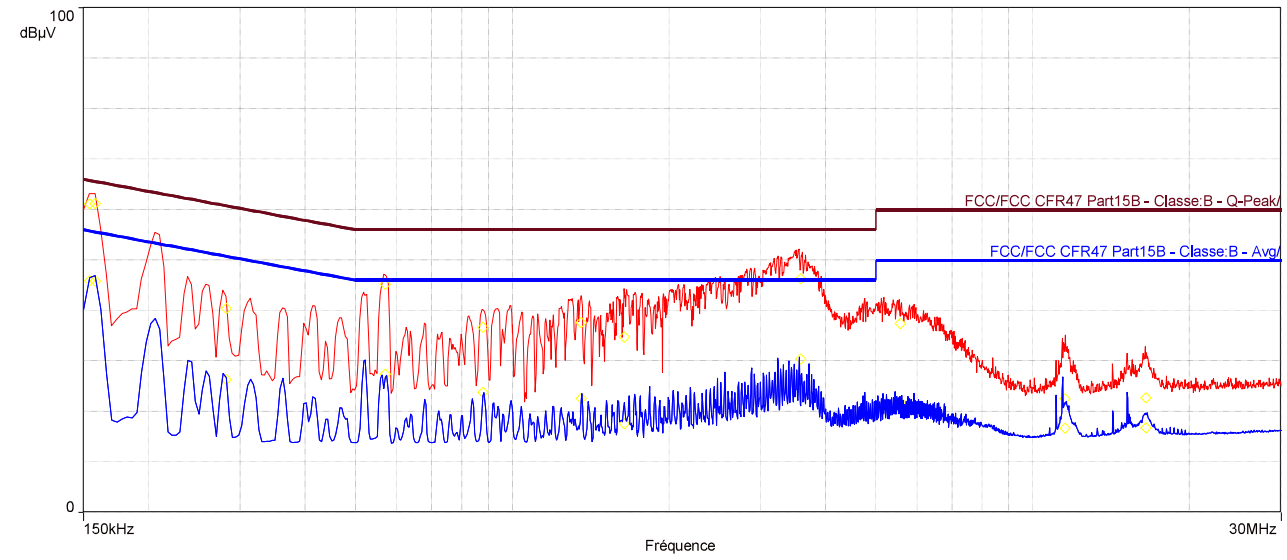


Spurious emissions

Frequency (MHz)	Q-Peak (dBµV)	Lim.Q-Peak (dBµV)	Q-Peak-Lim.Q-Peak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)	Correction (dB)
0.158	57.6	65.6	**-7.9**	41.4	55.6	**-14.2**	19.5
0.202	48.2	63.5	**-15.3**	37.2	53.5	**-16.3**	19.5
0.398	38.1	57.9	**-19.8**	26.6	47.9	**-21.3**	19.4
0.550	45.9	56.0	**-10.1**	29.2	46.0	**-16.8**	19.5
0.802	38.2	56.0	**-17.8**	22.8	46.0	**-23.2**	19.5

Frequency (MHz)	Q-Peak (dBµV)	Lim.Q-Peak (dBµV)	Q-Peak-Lim.Q-Peak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)	Correction (dB)
1.596	39.6	56.0	**-16.4**	23.6	46.0	**-22.4**	19.6
3.456	49.9	56.0	**-6.1**	31.3	46.0	**-14.7**	19.8
5.356	33.8	60.0	**-26.2**	18.7	50.0	**-31.3**	19.9
11.652	30.6	60.0	**-29.4**	25.3	50.0	**-24.7**	20.3
16.428	25.6	60.0	**-34.4**	19.2	50.0	**-30.8**	20.6

CONDUCTED EMISSIONS			
Graph name:	Emc#2	**Test configuration:**	
Limit:	FCC CFR47 Part15B	Running mode 1	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	120V/60Hz	**RBW:** 10kHz	**VBW:** 30kHz
Line:	**Neutral**	**Trace color & detector:**	PEAK AVG

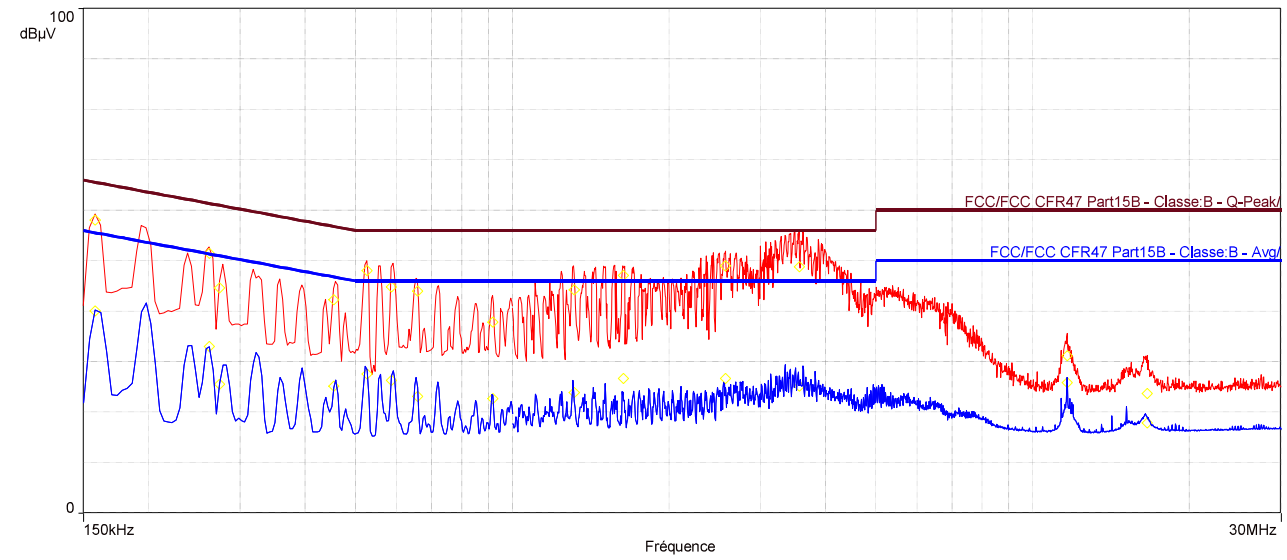


Spurious emissions

Frequency (MHz)	Q-Peak (dBµV)	Lim.Q-Peak (dBµV)	Q-Peak-Lim.Q-Peak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)	Correction (dB)
0.154	61.1	65.8	**-4.6**	46.0	55.8	**-9.8**	19.4
0.158	61.2	65.6	**-4.3**	45.8	55.6	**-9.8**	19.4
0.282	40.4	60.8	**-20.4**	26.3	50.8	**-24.5**	19.4
0.570	45.2	56.0	**-10.8**	27.4	46.0	**-18.6**	19.4
0.878	36.7	56.0	**-19.3**	23.8	46.0	**-22.2**	19.4
1.356	37.6	56.0	**-18.4**	22.6	46.0	**-23.4**	19.4
1.640	34.7	56.0	**-21.3**	17.6	46.0	**-28.4**	19.6
3.580	46.3	56.0	**-9.7**	30.4	46.0	**-15.6**	19.7

Frequency (MHz)	Q-Peak (dBµV)	Lim.Q-Peak (dBµV)	Q-Peak-Lim.Q-Peak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)	Correction (dB)
5.568	37.5	60.0	**-22.5**	21.8	50.0	**-28.2**	19.9
11.540	22.5	60.0	**-37.5**	16.6	50.0	**-33.4**	20.3
16.500	22.7	60.0	**-37.3**	16.7	50.0	**-33.3**	20.6

CONDUCTED EMISSIONS			
Graph name:	Emc#3	**Test configuration:**	
Limit:	FCC CFR47 Part15B	Running mode 1	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	240V/50Hz	**RBW:** 10kHz	**VBW:** 30kHz
Line:	**Phase**	**Trace color & detector:**	PEAK AVG

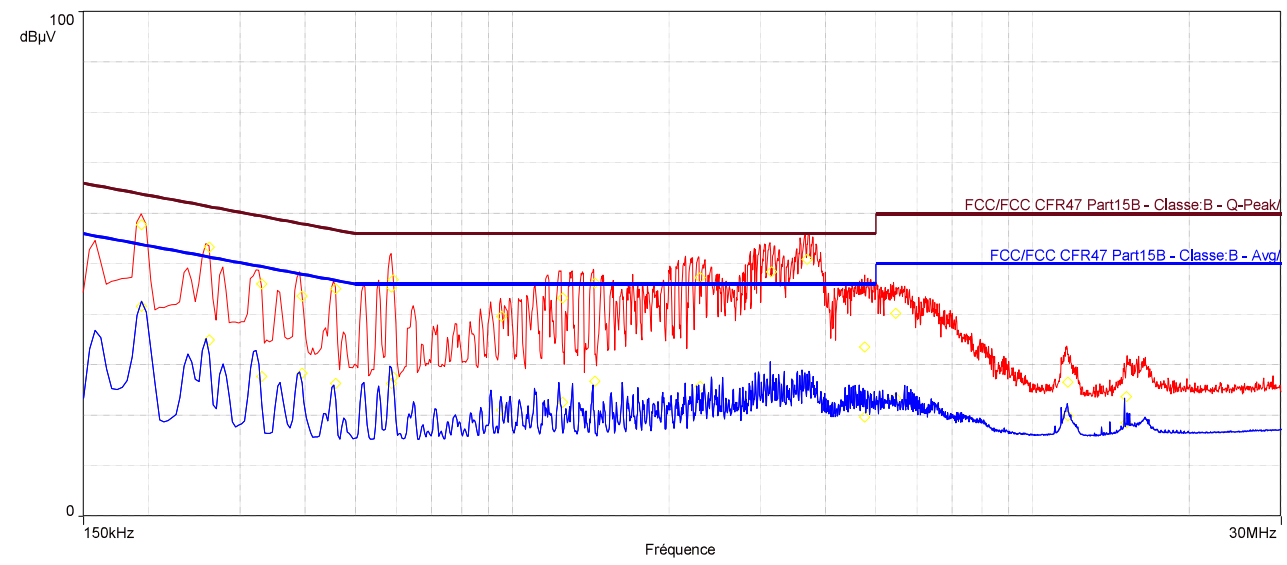


Spurious emissions

Frequency (MHz)	Q-Peak (dBµV)	Lim.Q-Peak (dBµV)	Q-Peak-Lim.Q-Peak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)	Correction (dB)
0.158	58.0	65.6	**-7.5**	40.1	55.6	**-15.4**	19.5
0.262	51.4	61.4	**-9.9**	33.0	51.4	**-18.4**	19.4
0.274	44.7	61.0	**-16.3**	25.5	51.0	**-25.4**	19.5
0.454	42.3	56.8	**-14.5**	25.2	46.8	**-21.6**	19.4
0.526	48.0	56.0	**-8.0**	27.6	46.0	**-18.4**	19.5
0.586	44.8	56.0	**-11.2**	26.3	46.0	**-19.7**	19.5
0.658	44.0	56.0	**-12.0**	23.1	46.0	**-22.9**	19.5
0.918	37.9	56.0	**-18.1**	22.7	46.0	**-23.3**	19.5
1.316	44.3	56.0	**-11.7**	23.9	46.0	**-22.1**	19.4
1.636	47.1	56.0	**-8.9**	26.7	46.0	**-19.3**	19.6

Frequency (MHz)	Q-Peak (dBµV)	Lim.Q-Peak (dBµV)	Q-Peak-Lim.Q-Peak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)	Correction (dB)
2.564	49.0	56.0	**-7.0**	26.7	46.0	**-19.3**	19.7
3.556	48.8	56.0	**-7.2**	25.2	46.0	**-20.8**	19.8
11.648	31.2	60.0	**-28.8**	25.9	50.0	**-24.1**	20.3
16.612	23.7	60.0	**-36.3**	17.9	50.0	**-32.1**	20.6

CONDUCTED EMISSIONS			
Graph name:	Emc#4	**Test configuration:**	
Limit:	FCC CFR47 Part15B	Running mode 1	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	240V/50Hz	**RBW:** 10kHz	**VBW:** 30kHz
Line:	**Neutral**	**Trace color & detector:**	PEAK AVG



Spurious emissions

Frequency (MHz)	Q-Peak (dBµV)	Lim.Q-Peak (dBµV)	Q-Peak-Lim.Q-Peak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)	Correction (dB)
0.194	57.8	63.9	**-6.1**	41.6	53.9	**-12.3**	19.4
0.262	53.4	61.4	**-8.0**	34.9	51.4	**-16.4**	19.4
0.330	46.1	59.4	**-13.4**	27.6	49.4	**-21.8**	19.4
0.394	43.6	58.0	**-14.4**	28.4	48.0	**-19.6**	19.4
0.458	45.1	56.7	**-11.6**	26.3	46.7	**-20.5**	19.4
0.586	45.3	56.0	**-10.7**	26.3	46.0	**-19.7**	19.4
0.590	46.8	56.0	**-9.2**	27.6	46.0	**-18.4**	19.4
0.954	39.7	56.0	**-16.3**	21.1	46.0	**-24.9**	19.4
1.248	43.2	56.0	**-12.8**	22.6	46.0	**-23.4**	19.4

Frequency (MHz)	Q-Peak (dBµV)	Lim.Q-Peak (dBµV)	Q-Peak-Lim.Q-Peak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)	Correction (dB)
1.440	46.2	56.0	**-9.8**	26.8	46.0	**-19.2**	19.4
2.296	47.3	56.0	**-8.7**	25.7	46.0	**-20.3**	19.6
3.152	48.4	56.0	**-7.6**	26.0	46.0	**-20.0**	19.7
3.684	50.9	56.0	**-5.1**	26.1	46.0	**-19.9**	19.7
4.752	33.5	56.0	**-22.5**	19.6	46.0	**-26.4**	19.8
5.452	40.2	60.0	**-19.8**	23.4	50.0	**-26.6**	19.9
11.676	26.6	60.0	**-33.4**	19.9	50.0	**-30.1**	20.3
15.128	23.7	60.0	**-36.3**	18.5	50.0	**-31.5**	20.5

3.6. CONCLUSION

The sample of the equipment **AEGIS S**, Sn : **230923459**, tested in the configuration presented in this test report **satisfies** to requirements of the product family standard applied (See §Test Program) for conducted emissions.

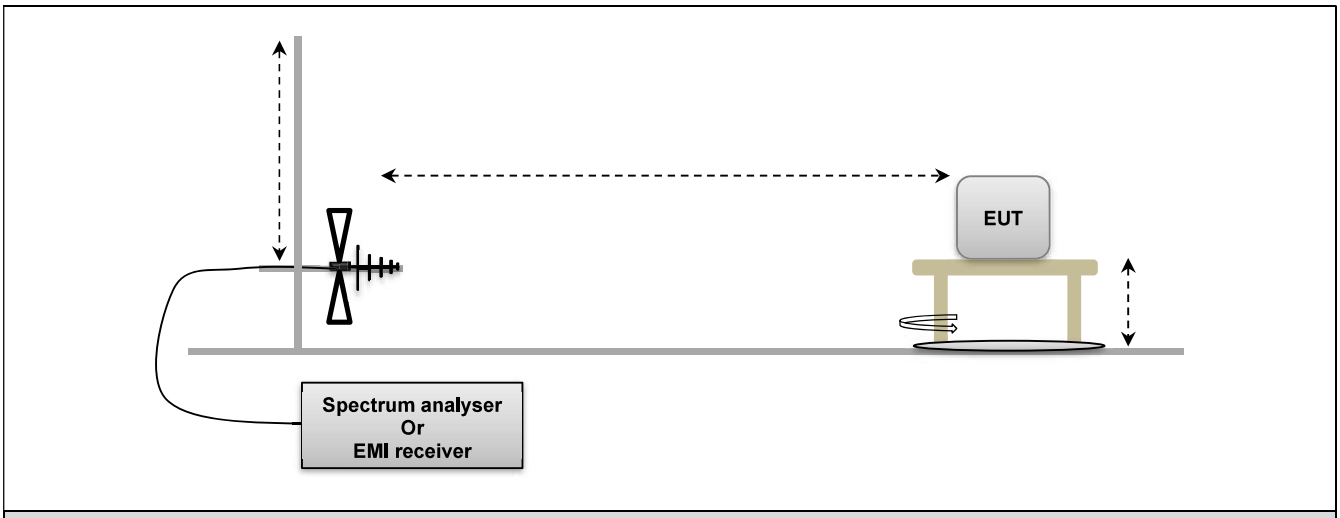
4. MEASUREMENT OF RADIATED EMISSION

4.1. TEST CONDITIONS

Date of test	:	March 22, 2023
Test performed by	:	Jonathan SARTO
Atmospheric pressure (hPa)	:	996
Relative humidity (%)	:	36
Ambient temperature (°C)	:	23

4.2. TEST SETUP

The EUT and auxiliaries are set 80cm above the ground on the non-conducting table (Table-top equipment).
The EUT is powered by V_{nom}.



Test setup of Radiated Emission

Same setup is used in semi anechoic chamber during pre-characterization, with a distance of 3m between EUT and antenna.

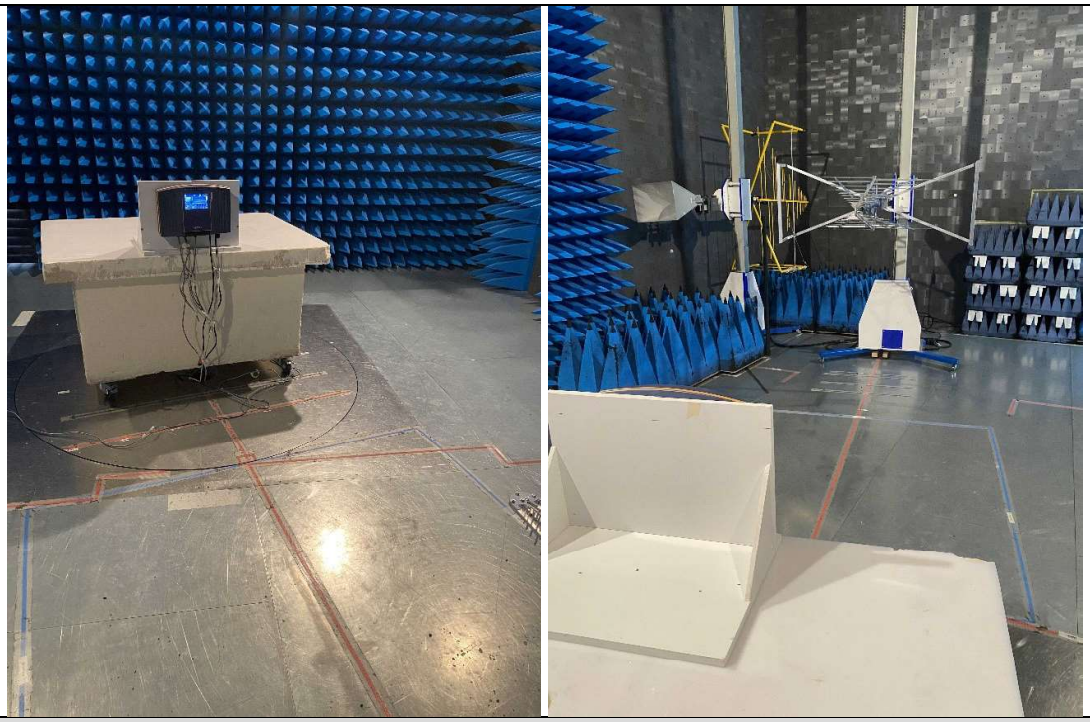


Photo in anechoic chamber – Frequency <1GHz

Photo on OATS

Photo in anechoic chamber – Frequency >1GHz

4.3. TEST METHOD

4.3.1. 30MHz –1GHz

Pre-qualification measurement

A pre-scan of all the setup has been performed in a 3 meters semi-anechoic chamber. Test is performed with antenna centered on EUT in horizontal (H) and vertical (V) polarization, continuous linear turntable azimuth search was performed with 360 degrees range. Measurements are performed on all axis of EUT used in normal configuration. The pre-characterization graphs are obtained in PEAK detection.

Qualification

The installation of EUT is identical than for pre-qualification measurements on an Open Area Test Site with a 10 meters distance between EUT and antenna. In this case, it corrected according to requirements of 15.209.e), M@3m = M@10m+10.5dB. Test is performed in horizontal (H) and vertical (V) polarization and the height antenna is varied from 1m to 4m. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurements are performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.

4.3.2. 1GHz – 13GHz:

Pre-qualification measurement

A pre-scan of all the setup has been performed in a 3 meters full anechoic chamber. Test is performed with antenna centered on EUT in horizontal (H) and vertical (V) polarization, continuous linear turntable azimuth search was performed with 360 degrees range. Measurements are performed on all axis of EUT used in normal configuration. The pre-characterization graphs are obtained in PEAK and AVERAGE detection.

Qualification

The installation of EUT is identical for pre-characterization measurements. Test is performed in horizontal (H) and vertical (V) polarization and the height antenna is on mast, varied from 1m to 4m.
Minimal beamwidth of the measurement antenna used: ETS3115 / w@3m=2.1m<14GHz / w@3m=0.9m<18GHz
Continuous linear turntable azimuth search was performed with 360 degrees range. Measurements are performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.

4.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Amplifier 100kHz - 18GHz	LCIE SUD EST	_	A7085027	11/20	03/23
Antenna Bi-log	ROHDE & SCHWARZ	HL562E	C2040287	06/21	06/23
Antenna horn 18GHz	EMCO	3115	C2042027	04/22	04/25
Antenna mast (Cage#1)	MATURO Gmbh	AM 4.0	F2000407		
BAT EMC	NEXIO	v3.21.0.32	L1000115		
Cable 0.75m	SUCOFLEX	18GHz	A5329920	05/22	05/23
Cable 2.2m N	SUCOFLEX	SF118A/2x11N/2.2M	A5329989	05/22	05/23
CALCUL_FACTEURS	LCIE SUD EST	V4	L2000035		
Comb EMR HF	YORK	CGE01	A3169114		
Diameter 2m / Height 2.5m	LCIE	VSWR 1GHz - 18GHz	D3044016_VSWR	09/22	09/25
Emission Cable	SUCOFLEX	18GHz	A5329899	03/22	03/23
Radiated emission comb generator	BARDET	_	A3169050		
Semi-Anechoic chamber #1	SIEPEL	ANE	D3044016_ANE	03/21	03/24
Semi-Anechoic chamber #1	SIEPEL	_	D3044016	07/22	07/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	09/20	06/23
Table C1/OATS	MATURO Gmbh	_	F2000437		
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	01/21	05/23
Turntable chamber (Cage#1)	MATURO Gmbh	TT 2.0 SI	F2000406		
Turntable controller (Cage#1)	MATURO Gmbh	Control Unit	F2000408		
Antenna Bi-log	CHASE	CBL6111A	C2040172	04/22	04/24
Antenna Mat (OATS)	ETS Lingren	2071-2	F2000392		
Biconic Antenna	EATON	94455-1	C2040234	03/21	03/23
Cable (OATS)	_	1GHz	A5329623	09/22	09/23
Emission Cable	RADIALEX		A5329061	08/22	08/23
Emission Cable	MICRO-COAX	1GHz	A5329656	08/22	08/23
OATS	_	_	F2000409	07/22	07/23
Receiver 20-1000MHz	ROHDE & SCHWARZ	ESVS30	A2642006	05/22	05/24
Table C1/OATS	LCIE	_	F2000445		

Turntable (OATS)	ETS Lingren	Model 2187	F2000403		
Turntable / Mast controller (OATS)	ETS Lingren	Model 2066	F2000372		

4.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

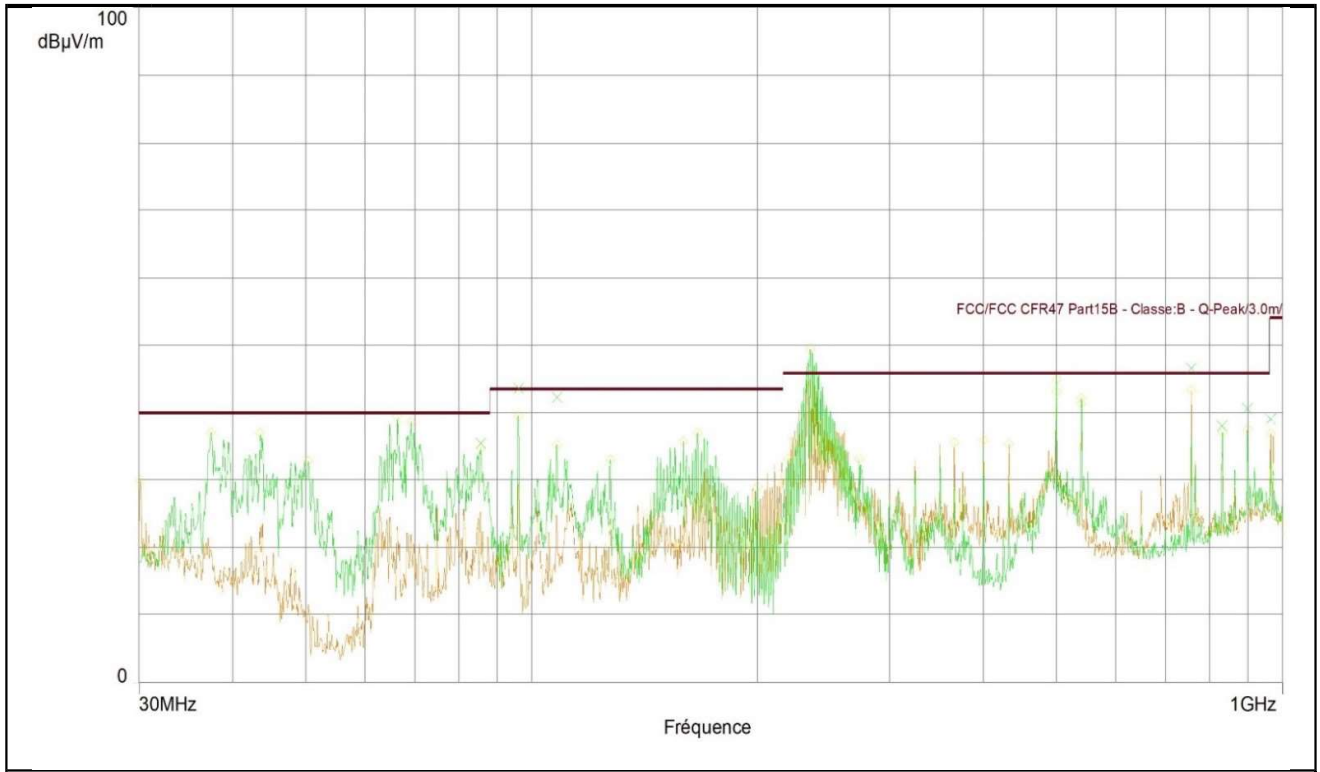
4.6. TEST RESULTS – RUNNING MODE N°1

4.6.1. 30MHz –1GHz

Pre-qualification measurement

Graph identifier	Polarization	EUT position	Comments	
Emr# 1	Horizontal & Vertical	Axis XY	-	See below

RADIATED EMISSIONS			
Graph name:	Emr#1	**Test configuration:**	
Limit:	FCC CFR47 Part15B	Running mode 1	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW:** 100kHz	**VBW:** 300kHz
Azimuth: 0° - 360°	**Trace color & detector:** F<GHz: Only Peak detector: Antenna Polarization: Vertical Horizontal		



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)	Lim.Q-Peak (dBµV/m)	Height	Polarization	Correction (dB)
37.412	37.1	40.0	1.5	Vertical	-10.8
43.515	37.0	40.0	1.5	Vertical	-14.6
50.434	32.8	40.0	1.5	Vertical	-19.2
66.312	39.5	40.0	1.5	Vertical	-18.2
69.117	38.7	40.0	1.5	Vertical	-17.6
85.539	34.8	40.0	1.5	Vertical	-15.5
96.028	39.5	43.5	1.5	Vertical	-15.1
108.030	35.2	43.5	1.5	Vertical	-14.2
127.240	33.1	43.5	1.5	Vertical	-14.5
159.217	35.8	43.5	1.5	Vertical	-16.6
166.272	36.9	43.5	1.5	Vertical	-16.4
200.120	28.9	43.5	1.5	Vertical	-16.1
219.880	33.2	46.0	1.5	Vertical	-16.0
235.000	49.5	46.0	1.5	Vertical	-14.6
272.960	33.2	46.0	1.5	Vertical	-13.3
500.040	45.0	46.0	1.5	Vertical	-6.8
540.080	42.2	46.0	1.5	Vertical	-6.5
831.440	37.1	46.0	1.5	Vertical	-3.2
897.880	37.5	46.0	1.5	Vertical	-2.0
30.119	29.8	40.0	1.5	Horizontal	-6.6
365.760	35.5	46.0	1.5	Horizontal	-10.4
400.000	35.9	46.0	1.5	Horizontal	-9.4
432.240	35.4	46.0	1.5	Horizontal	-8.6
500.040	43.1	46.0	1.5	Horizontal	-6.8
540.120	41.3	46.0	1.5	Horizontal	-6.5
756.200	43.3	46.0	1.5	Horizontal	-4.5
964.320	36.9	54.0	1.5	Horizontal	-1.1

Qualification

The frequency list is created from the results obtained during the pre-qualification.
Measurements are performed using a QUASI-PEAK detection.

Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Remark
37.4	22.8	QP	V	12	100	14.6	37.4	40.0	-2.6	
43.5	19.2	QP	V	66	100	14.0	33.2	40.0	-6.8	
50.4	23.7	QP	V	260	100	12.5	36.2	40.0	-3.8	
66.3	24.3	QP	V	315	185	7.9	32.2	40.0	-7.8	
69.1	29.5	QP	V	0	140	7.6	37.1	40.0	-2.9	
85.5	24.5	QP	V	85	113	11.4	35.9	40.0	-4.1	Measure performed at 3m
96	23.4	QP	V	0	118	13.3	36.7	43.5	-6.8	Measure performed at 3m
108	22.1	QP	V	255	138	13.3	35.4	43.5	-8.1	Measure performed at 3m

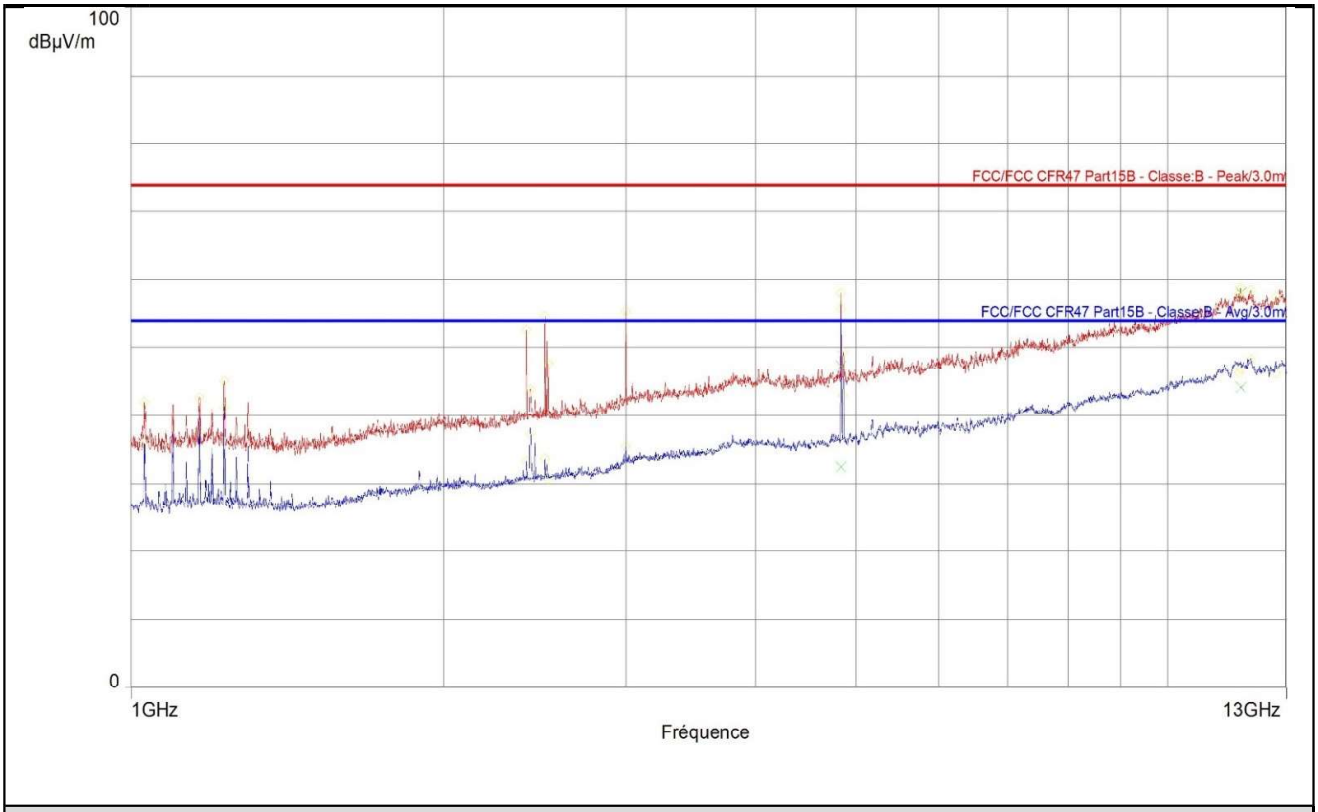
Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Remark
127.2	21.0	QP	V	286	100	14.6	35.6	43.5	-7.9	
159.2	19.3	QP	V	0	100	20.0	39.3	43.5	-4.2	
166.3	20.2	QP	V	360	150	19.6	39.8	43.5	-3.7	
200	19.8	QP	V	0	177	20.5	40.3	43.5	-3.2	
235	19.2	QP	H	0	194	14.4	33.6	46.0	-12.4	
365.8	20.9	QP	H	188	206	19.6	40.5	46.0	-5.5	
400	22.8	QP	H	208	189	21.1	43.9	46.0	-2.1	with ferrite WE 7427151 (2pass) on RS485
500	20.8	QP	H	216	130	23.7	44.5	46.0	-1.5	
540	21.3	QP	H	243	100	24.6	45.9	46.0	-0.1	
755.9	13.8	QP	H	0	125	29.3	43.1	46.0	-2.9	Measure performed at 3m
831.4	4.8	QP	V	0	100	31.2	36.0	46.0	-10.0	Measure performed at 3m
897.9	7.0	QP	V	0	143	31.4	38.4	46.0	-7.6	Measure performed at 3m
964.3	1.9	QP	H	0	103	34.0	35.9	54.0	-18.1	Measure performed at 3m

4.6.2. 1GHz - 13GHz

Pre-qualification measurement

Graph identifier	Polarization	EUT position	Comments	
Emr# 2	Horizontal & Vertical	Axis XY	-	See below

RADIATED EMISSIONS					
Graph name:	Emr#2	**Test configuration:**			
Limit:	FCC CFR47 Part15B	C1 - FSV (H+V) [1-13]GHz			
Class:	B				
Frequency range: [1GHz - 13GHz]					
Antenna polarization:	Horizontal & Vertical	**RBW:**	1MHz	**VBW:**	3MHz
Azimuth: 0° - 360°	**Trace color & detector:** F>GHz: for both Antenna Polarization: detector: PEAK AVG				



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)	Lim.Peak (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Height	Polarization	Correction (dB)
1030.312	42.0	74.0	35.8	54.0	1.0	Vertical	1.0
1230.156	45.1	74.0	41.3	54.0	1.0	Vertical	1.8
2425.312	43.8	74.0	37.2	54.0	1.0	Vertical	4.8
2506.250	54.7	74.0	33.7	54.0	1.0	Vertical	5.1
2997.656	55.4	74.0	35.4	54.0	1.0	Vertical	7.6
4860.469	49.4	74.0	43.0	54.0	1.0	Vertical	11.6
11710.031	58.0	74.0	46.3	54.0	1.0	Vertical	24.2
12008.406	58.5	74.0	48.2	54.0	1.0	Vertical	24.3
1163.438	42.7	74.0	37.6	54.0	1.0	Horizontal	1.6
2405.156	52.6	74.0	33.3	54.0	1.0	Horizontal	4.9

Frequency (MHz)	Peak (dBµV/m)	Lim.Peak (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Height	Polarization	Correction (dB)
2525.156	47.7	74.0	30.7	54.0	1.0	Horizontal	5.2
4834.375	58.1	74.0	55.8	54.0	1.0	Horizontal	11.6
11745.469	58.8	74.0	46.9	54.0	1.0	Horizontal	24.2
12695.938	57.6	74.0	46.2	54.0	1.0	Horizontal	24.0

Qualification

The frequency list is created from the results obtained during the pre-qualification.
Measurements are performed using a PEAK and AVERAGE detection.

Frequency (MHz)	Level Peak (dBµV/m)	Limit Peak (dBµV/m)	Margin (dB)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin (dB)	Height (m)	Azimuth (°)	Polarization	Correction (dB)
4833.944	47.3	74.0	**-26.7**	32.5	54.0	**-21.5**	1.6	283.8	Horizontal	11.6
11745.766	58.1	74.0	**-15.9**	44.1	54.0	**-9.9**	1.1	0.0	Horizontal	24.2

4.7. CONCLUSION

The sample of the equipment **AEGIS S**, Sn : **230923459**, tested in the configuration presented in this test report **satisfies** to requirements of the product family standard applied (See §Test Program) for radiated emissions.

5. UNCERTAINTIES CHART

Type de mesure / Kind of measurement	Incertitude élargie laboratoire / Wide uncertainty laboratory (k=2) ±x	Incertitude limite du CISPR / CISPR uncertainty limit ±y
Mesure des perturbations conduites en tension sur le réseau d'énergie (monophasé /triphasé) 150kHz-30MHz *Measurement of conducted disturbances in voltage on the power port (single & three phases)150kHz-30MHz* LISN 50Ω/50µH Capacitive Voltage Probe	 3.3dB 3.7dB	 3.4dB 3.9dB
Mesure du champ électrique rayonné en cage de Faraday semi-anéchoïque de 30MHz à 1GHz *Measurement of radiated electric field in half-anechoic Faraday room From 30MHz to 1GHz*	6.3dB	6.3dB
Mesure du champ électrique rayonné en cage de Faraday anéchoïque de 1GHz à 6GHz *Measurement of radiated electric field in full-anechoic Faraday room From 1GHz à 6GHz*	5.2dB	5.2dB
Mesure du champ électrique rayonné en cage de Faraday anéchoïque de 6GHz à 18GHz *Measurement of radiated electric field in full-anechoic Faraday room From 6GHz to 18GHz*	5.5dB	5.5dB
Mesure du champ électrique rayonné sur le site en espace libre de Moirans 30MHz – 1GHz. *Measurement of radiated electric field on the Moirans open area test site 30MHz – 1GHz.*	6.3dB	6.3dB

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par le CISPR, la conformité de l'échantillon est établie directement par les niveaux limites applicables. Ce tableau regroupe l'ensemble des incertitudes maximales pour les essais réalisables dans le laboratoire, qu'ils aient été ou non réalisés dans le cadre du présent rapport / *The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the CISPR. The conformity of the sample is directly established by the applicable limits values. This table includes all uncertainties maximum feasible for testing in the laboratory, whether or not made in this report*

Note - L'incertitude de mesure instrumentale est déterminée selon la CISPR 16-4-2. / *The instrumentation measurement uncertainty is determined according to CISPR16-4-2*