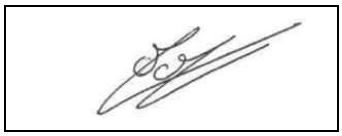
TEST REPORT

N°: 172196-764260-A(FILE#1807603) **Version: 04**

Subject	**Electromagnetic compatibility tests according to the standards:** **FCC CFR 47 Part 15, Subpart B** **ANSI C63.4 (2014)** **ICES-003 (2020)**
Issued to	**MADE** 167 impasse de la garrigue 83210 - LA FARLEDE FRANCE
Apparatus under test	
Product	**High Voltage line Volumetric detector**
Trade mark	**DETECT LINE NG**
Manufacturer	**Made SA**
Family range	**DETECT LINE NG**
Model under test	**DLGU_STD_100**
Serial number	**258**
FCCID	**2A38S-DLGU**
Conclusion	See Test Program chapter
Test date	April 14, 2021
Test location	LCIE Grenoble
FCC Test site	FR0008
ISED Test site	FR0008 - 6500A
Sample receipt date	April 14, 2021
Composition of document	17 pages
Document issued on	April 4, 2022

Written by :
Majid MOURZAGH
Tests operator



Approved by :
Anthony MERLIN
Technical manager

PUBLICATION HISTORY

Version	Date	Author	Modification
01	April 20, 2021	Hamza GHAFILI	Creation of the document
02	April 29, 2021	Hamza GHAFILI	Update the report with the following informations: • Page 5: Correct the dimensions of the EUT
03	March 23, 2021	Majid MOURZAGH	Add FCCID number
04	April 4, 2022	Majid MOURZAGH	Add pictures on test setup RADIATED EMISSION

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. REQUIREMENTS FOR DISTURBANCE EMISSIONS

Standard:

- ✓ **FCC Part 15, Subpart B (Digital Devices)**
- ✓ **ANSI C63.4 (2014)**
- ✓ **ICES-003 (2020)**

Requirements for disturbance emissions – Class B

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance 150kHz-30MHz **FCC §15.107**	**Access: AC power**			**NA**
	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 @10m**		
	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- 40GHz* **FCC §15.109**	**Access: Enclosure port of ancillary equipment**			**NA**
	Frequency	**Peak @3m**	**Average @3m**	
	1- 40GHz	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)

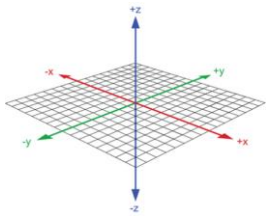
2.1. INFORMATIONS

The EUT is composed of the following 3 elements :

		
Display box	Central unit	Sensor
120mmx110mmx65mm	*160mmx155mmx85mm*	*D80mmxH100mm*

2.2. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES)

Equipment under test (EUT):

Model under test :	**DLGU_STD_100**
Serial Number:	**258**
 	
Dimensions display box:	*120mmx110mmx65mm (Length x Width x Height)*
Dimensions central unit:	*160mmx155mmx85mm (Length x Width x Height)*
Dimensions sensor:	*80mmx100mm (diameter x Height)*

Power supply:
During all the tests, EUT is supplied by V_{nom}: **12 and 24 VDC**
For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	Reference / Sn	Comments
Supply	Battery	12 – 24 VDC	-	-

NC: Not communicated by provider

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
Supply	M12 5 pts	10	No	No	No	Battery cable
Access1	M12 8 pts	3	No	No	No	Connection of the display box
Access2	M8 3 pts	15	No	Yes	No	Remote sensor cable

NC: Not communicated by provider

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Battery 12 VDC	YUASA NP7-12	-	-
Battery 12 VDC	RSpro 537-5488	-	-

NC: Not communicated by provider

2.3. EUT CONFIGURATION

Hardware information			
Highest internal frequency (PLL, Quartz, Clock, Microprocessor…):	**$F_{Highest}$:**	**16**	**MHz**
Firmware (if applicable):	**V. :**	**SNGU V111**	
Software (if applicable):	**V. :**	**NA**	
Time necessary for the EUT to be exercised and to respond:	**Dwell:**	**1**	**s**

NC: Not communicated by provider

Running mode n°1:

Setup description:
Once powered up to 12 or 24 VDC, the system is operational.
Detection of the proximity of a line.
Led flashes every time the sensor interacts with the central unit.

2.4. EQUIPMENT MODIFICATIONS DURING THE TESTS

None

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. CALIBRATION DATE

The calibration intervals are extended at 12+1 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

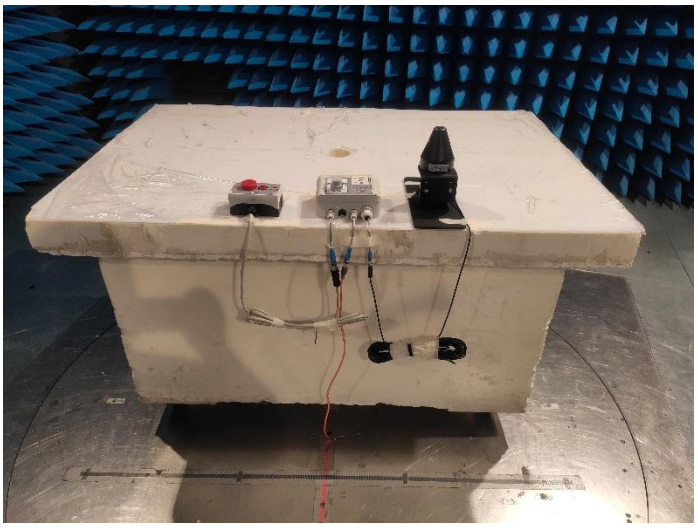
3. MEASUREMENT OF RADIATED EMISSION

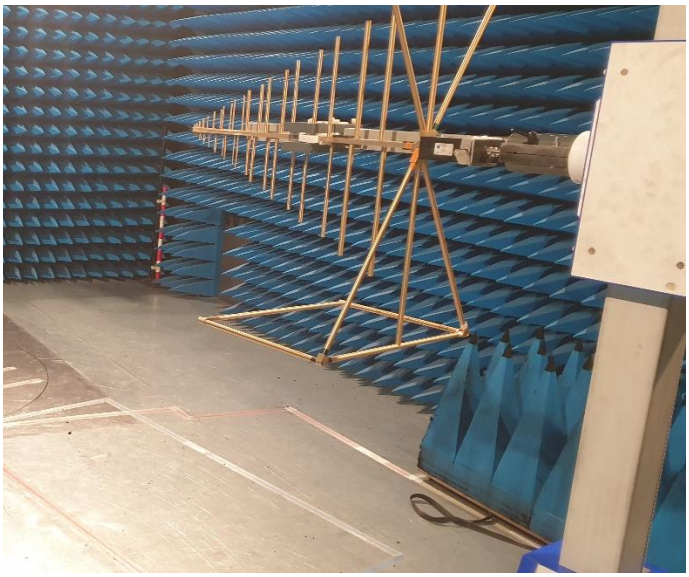
3.1. ENVIRONMENTAL CONDITIONS

Date of test	:	April 14, 2021
Test performed by	:	Hamza GHAFILI
Atmospheric pressure (hPa)	:	1002
Relative humidity (%)	:	34
Ambient temperature (°C)	:	23

3.2. 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 in anechoic chamber – Frequency <1GHz

Test setup on OATS

3.3. TEST METHOD

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.

3.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Amplifier 10kHz - 18GHz	LCIE SUD EST	_	A7085028	01/21	01/22
Antenna Bi-log	AH System	SAS-521-7	C2040180	02/21	02/23
Antenna Bi-Log XWing	CHASE	CBL6140	C2040158		
Antenna horn 18GHz	EMCO	3115	C2042027	04/18	04/21
Antenna mast (Cage#1)	MATURO Gmbh	AM 4.0	F2000407		
BAT EMC	NEXIO	v3.19.1.23	L1000115		
Cable 0.75m	SUCOFLEX	18GHz	A5329920	03/21	03/22
Cable 2.2m N	SUCOFLEX	SF118A/2x11N/2.2M	A5329989	11/20	11/21
CALCUL_FACTEURS	LCIE SUD EST	V4	L2000035		
Diameter 2m / Height 2.5m	LCIE	WSWR 1GHz - 6GHz	D3044016_VSWR	07/19	07/22
Emission Cable	SUCOFLEX	18GHz	A5329899	11/20	11/21
HF Radiated emission comb generator	LCIE SUD EST	_	A3169088		
Radiated emission comb generator	BARDET	_	A3169050		
Semi-Anechoic chamber #1	SIEPEL	_	D3044016	07/19	07/22
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	09/20	09/22
Table C1/OATS	MATURO Gmbh	_	F2000437		
Thermo-hygrometer (C1)	OREGON	WMR 80	B4206013	09/20	09/22
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	01/21	01/23
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	C2040051	06/19	06/21

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Antenna Mat (OATS)	ETS Lingren	2071-2	F2000392		
Biconic Antenna	EATON	94455-1	C2040234	03/21	03/23
Cable (OATS)	_	1GHz	A5329623	05/20	05/21
Emission Cable	MICRO-COAX	1GHz	A5329656	08/20	08/21
Emission Cable	SUCOFLEX	6GHz	A5329061	06/20	06/21
OATS	_	_	F2000409	04/20	04/21
Receiver 20-1000MHz	ROHDE & SCHWARZ	ESVS30	A2642006	03/20	03/22
Turntable (OATS)	ETS Lingren	Model 2187	F2000403		
Turntable / Mast controller (OATS)	ETS Lingren	Model 2066	F2000372		

3.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

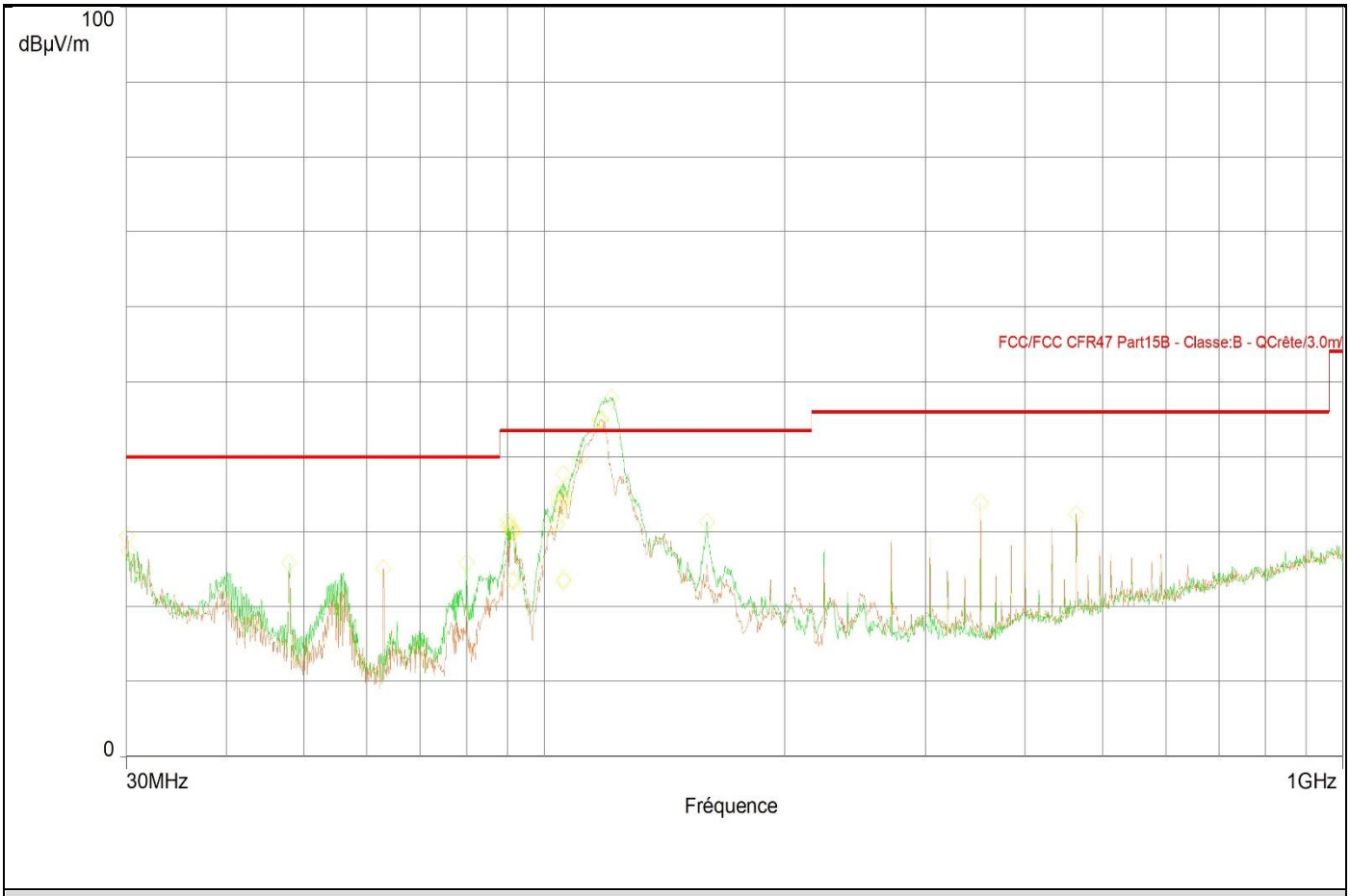
None

3.6. TEST RESULTS – RUNNING MODE N°1

3.6.1. 30MHz –1GHz *Pre-qualification measurement*

Graph identifier		Polarization	EUT position	Comments	
Emr#	1	Vertical+Horizontal	Axis XY	V_{nom} = 12 VDC	See below
Emr#	2	Vertical+Horizontal	Axis XY	V_{nom} = 24 VDC	See below

RADIATED EMISSIONS			
Graph name:	Emr#1	**Test configuration:**	
Limit:	FCC CFR47 Part15B	Powered by 12V	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz

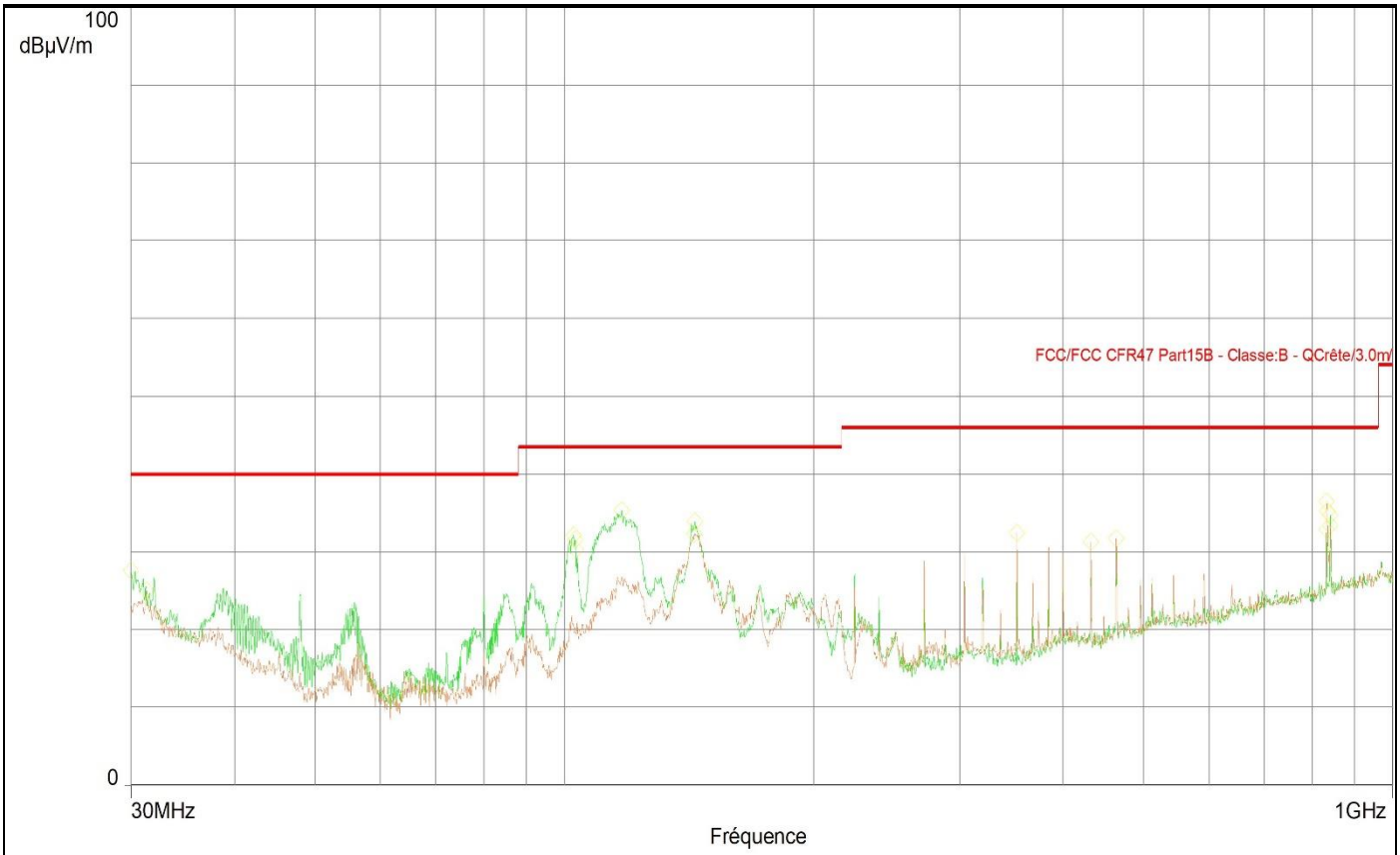


Spurious emissions

Frequency (MHz)	Peak (dBµV/m)	Lim.QPeak (dBµV/m)	Peak-Lim.QPeak (dB)	Hauteur (m)	Polarization	Correction (dB)
30.085	29.5	40.0	-10.5	1.6	Horizontal	-4.4
62.980	25.1	40.0	-14.9	1.6	Horizontal	-16.0

Frequency (MHz)	Peak (dBµV/m)	Lim.QPeak (dBµV/m)	Peak-Lim.QPeak (dB)	Hauteur (m)	Polarization	Correction (dB)
90.843	29.9	43.5	-13.6	1.6	Horizontal	-10.6
91.166	30.5	43.5	-13.0	1.6	Horizontal	-10.6
91.812	29.9	43.5	-13.6	1.6	Horizontal	-10.6
101.961	30.9	43.5	-12.6	1.6	Horizontal	-8.6
103.899	31.0	43.5	-12.5	1.6	Horizontal	-8.2
104.222	32.1	43.5	-11.4	1.6	Horizontal	-8.1
104.545	33.5	43.5	-10.0	1.6	Horizontal	-8.1
104.868	33.6	43.5	-9.9	1.6	Horizontal	-8.1
105.191	34.2	43.5	-9.3	1.6	Horizontal	-8.0
105.497	34.7	43.5	-8.8	1.6	Horizontal	-7.9
106.143	34.2	43.5	-9.3	1.6	Horizontal	-7.7
110.886	39.6	43.5	-3.8	1.6	Horizontal	-6.8
117.295	44.9	43.5	1.4	1.6	Horizontal	-5.4
117.601	45.0	43.5	1.5	1.6	Horizontal	-5.4
117.941	45.0	43.5	1.4	1.6	Horizontal	-5.3
352.000	33.9	46.0	-12.1	1.6	Horizontal	-6.9
464.000	32.4	46.0	-13.6	1.6	Horizontal	-3.3
30.204	27.4	40.0	-12.6	1.6	Vertical	-4.5
48.003	25.8	40.0	-14.2	1.6	Vertical	-13.2
79.997	25.9	40.0	-14.1	1.6	Vertical	-12.8
90.520	30.8	43.5	-12.7	1.6	Vertical	-10.7
90.843	30.1	43.5	-13.4	1.6	Vertical	-10.6
91.489	30.0	43.5	-13.5	1.6	Vertical	-10.6
103.899	35.0	43.5	-8.5	1.6	Vertical	-8.2
121.460	47.8	43.5	4.4	1.6	Vertical	-4.8
159.999	31.3	43.5	-12.2	1.6	Vertical	-2.9

RADIATED EMISSIONS			
Graph name:	Emr#2	**Test configuration:**	
Limit:	FCC CFR47 Part15B	Powered by 24V	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)	Lim.QPeak (dBµV/m)	Peak-Lim.QPeak (dB)	Hauteur (m)	Polarization	Correction (dB)
31.326	25.0	40.0	-15.0	1.6	Horizontal	-5.0
143.475	32.3	43.5	-11.2	1.6	Horizontal	-1.8
352.000	32.5	46.0	-13.5	1.6	Horizontal	-6.9
432.040	31.3	46.0	-14.7	1.6	Horizontal	-4.2
464.000	31.8	46.0	-14.2	1.6	Horizontal	-3.3
832.600	36.5	46.0	-9.5	1.6	Horizontal	1.3
834.120	35.2	46.0	-10.8	1.6	Horizontal	1.3

Frequency (MHz)	Peak (dBµV/m)	Lim.QPeak (dBµV/m)	Peak-Lim.QPeak (dB)	Hauteur (m)	Polarization	Correction (dB)
841.360	33.3	46.0	-12.7	1.6	Horizontal	1.4
30.000	27.6	40.0	-12.4	1.6	Vertical	-4.4
102.658	32.1	43.5	-11.4	1.6	Vertical	-8.5
102.981	31.5	43.5	-12.0	1.6	Vertical	-8.4
103.304	30.2	43.5	-13.3	1.6	Vertical	-8.4
117.329	35.3	43.5	-8.2	1.6	Vertical	-5.4
143.798	33.9	43.5	-9.6	1.6	Vertical	-1.8
832.800	32.8	46.0	-13.2	1.6	Vertical	1.3
841.240	34.8	46.0	-11.2	1.6	Vertical	1.4

3.6.2. 30MHz –1GHz Qualification

The frequency list is created from the results obtained during the pre-qualification.
Measurements are performed using a QUASI-PEAK detection.
The worst case measurement was by powering the product at 12 VDC (V_{nom}=12 VDC)

Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Gain/Loss Factor (dB)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.14	16	QP	V	360	100	-	14.0	30.0	40.0	**-10.0**
30.53	14.0	QP	H	360	400	-	14.1	28.1	40.0	**-11.9**
48	22	QP	V	360	100	-	12.9	34.9	40.0	**-5.1**
48	16.7	QP	H	360	400	-	12.9	29.6	40.0	**-10.4**
79.63	24.5	QP	V	360	100	-	9.4	33.9	40.0	**-6.1**
111.94	24.7	QP	V	360	100	-	12.8	37.5	43.5	**-6.0**
117.69	13.1	QP	H	260	400	-	12.9	26.0	43.5	**-17.5**
117.69	22	QP	V	360	100	-	12.9	34.9	43.5	**-8.6**
118.37	15.1	QP	H	310	400	-	12.9	28.0	43.5	**-15.5**
120.85	22.1	QP	V	300	100	-	13.2	35.3	43.5	**-8.2**
120.87	13.2	QP	H	10	400	-	13.2	26.4	43.5	**-17.1**
160	12	QP	V	110	100	-	19.8	31.8	43.5	**-11.7**
352	20.0	QP	V	89	100	-	18.9	38.9	46.0	**-7.1**
352	17.6	QP	H	360	400	-	18.9	36.5	46.0	**-9.5**
464	18.9	QP	V	360	100	-	22.5	41.4	46.0	**-4.6**
464	16.7	QP	H	360	400	-	22.5	39.2	46.0	**-6.8**
NB: The qualification was performed in the worst case mode (V_{nom}=12 VDC)										

Qualification on 3 meters semi anechoic chamber, as the frequency is located in an FM bands :

Frequency (MHz)	Mes.Peak (dBµV/m)	Mes.Q-Peak (dBµV/m)	Limite (dBµV/m)	Mes.-Lim. (dB)	Hauteur (m)	Polarization	Correction (dB)
91.495	23.7	23.4	43.5	-20.1	1.2	Horizontal	-10.6
105.802	23.6	23.4	43.5	-20.1	1.0	Horizontal	-7.8
90.193	30.8	31.6	43.5	-11.9	1.0	Vertical	-10.7
105.861	35.7	37.7	43.5	-5.8	1.0	Vertical	-7.8

3.7. CONCLUSION

The sample of the equipment **DLGU**_STD_**100**, Sn : **258**, tested in the configuration presented in this test report **satisfies** to requirements of the product family standard applied (See §Test Program) for radiated emissions.

4. 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) 10kHz-150kHz *Measurement of conducted disturbances in voltage on the power port (single & three phases)10kHz-150kHz*	3.27dB	3.8dB
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*	3.29dB	3.4dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication *Measurement of conducted disturbances in voltage on the telecommunication port.*	3.26dB	5dB
Mesure des perturbations discontinues conduites en tension *Measurement of discontinuous conducted disturbances in voltage*	3.33dB	3.4dB
Mesure des perturbations conduites en courant *Measurement of conducted disturbances in current*	2.67dB	2.9dB
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*	5.06dB	5.3dB
Mesure du champ électrique rayonné en cage de Faraday semi-anéchoïque de 1GHz à 6GHz *Measurement of radiated electric field in half-anechoic Faraday room From 1GHz à 6GHz*	5.18dB	5.2dB
Mesure du champ électrique rayonné en cage de Faraday semi-anéchoïque de 6GHz à 18GHz *Measurement of radiated electric field in half-anechoic Faraday room From 6GHz to 18GHz*	5.21dB	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.*	5.2dB	6.3dB
Mesure du champ électrique rayonné IN SITU de 30 à 1000 MHz *IN SITU measurement of radiated electric field from 30 to 1000MHz*	A l'étude / Under consideration	5.2dB
Mesure de la puissance perturbatrice *Measurement of disturbance power*	3.32dB	4.5dB
Mesure des harmoniques de courant *Measurement of current harmonics*	11.11%	/
Mesure du flicker *Flicker measurement*	9.26%	/

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*