SGS Korea Co., Ltd.
4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
Tel. +82 31 428 5700 / Fax. +82 31 427 2370
http://www.sgsgroup.kr

TEST REPORT

of

IC RSS-102 Issue 5, SPR-002 Issue 1 and Notice 2020-DRS0012

IC Certification: 1551E-EG6500

Equipment Under Test	:	IBU
Model Name	:	EG6500
Variant Model Name(s)	:	-
Applicant	:	DENSO Korea Corporation
Manufacturer	:	DENSO Korea Corporation
Date of Receipt	:	2021.03.05
Date of Test(s)	:	2021.03.12 ~ 2021.04.13
Date of Issue	:	2021.05.17

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

1) The results of this test report are effective only to the items tested.
2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
3) This test report cannot be reproduced, except in full, without prior written permission of the Company.

Tested by: Nancy Park

Technical Manager: Jinhyoung Cho

SGS Korea Co., Ltd. Gunpo Laboratory

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- CAB Identifier: KR0150

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Phone No. : +82 31 688 0901
Fax No. : +82 31 688 0921

1.2. Details of Applicant

Applicant : DENSO Korea Corporation
Address : 3, Cheomdansaneop-ro, Masanhappo-gu, Chang-won-si, Gyeongsangnam-do, Korea, 51176
Contact Person : Ha, Chang-su
Phone No. : +82 55 220 9321

1.3. Details of Manufacturer

Company : Same as applicant
Address : Same as applicant

1.4. Description of EUT

Kind of Product		IBU
Model Name		EG6500
Serial Number		954A0-M6690
Power Supply		DC 12.0 V
Frequency Range		Tx: 125.00 ㎑, Rx: 433.92 ㎒
Antenna Type	**Tx**	Coil Antenna
	Rx	PCB pattern antenna
Antenna Serial Number		DRV: 82657-M6000 AST: 82667-M6000 BUM: 95420-S6200 INT1, INT2: 95420-S6000 TNK: 95420-J7200 IMMO: 93500-M6000
H/W Version		1.0
S/W Version		1.0

1.5. Declarations by the manufacturer

- The EUT has 7 transmit antennas and one receive antenna.
- The transmit antennas can not operate at the same time.

1.6. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Electric and Magnetic field Probe analyzer	NARDA	EHP 200AC	170WX91017	Nov. 16, 2020	Annual	Nov. 16, 2021
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.

1.7. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Electric Field	± 19.78 %
Magnetic Field	± 13.66 %

Uncertainty figures are valid to a confidence level of 95 %.

1.8. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL001929	2021.04.14	Initial
1	F690501-RF-RTL001929-1	2021.05.17	Revised the measurement procedure

1.9. Device Characterization

In accordance with Clause 6.3 of SPR-002, emissions that are less than 20 dBc may be omitted from the assessment. Following measurement and assessment was performed additional as measurement at 10 cm cannot have 20 dBc difference between fundamental peak and spurious emission.

a) Characterization using radiated measurements in the 9 kHz to 30 MHz ranges as per RSS-210.

In accordance with test report F690501-RF-RTL001928, RSS-210 test report, measurements of fundamental and spurious emission were utilized for the device characterization as below. Radiated measurements at 3 m had enough dynamic between fundamental and noise floor. All the emissions within 20 dBc from the peak of fundamental are listed in following tables. Each emission peak within 20 dBc from the maximum peak of each configuration was measured additionally and summated with the multiple frequency summation equation.

DRV Antenna

Below 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m or 30 m	Limit (dBμV/m) at 300 m or 30 m	Margin (dB)
0.020	26.20	Average	H	18.20	0.10	44.50	-35.50	41.58	77.08
0.035	30.20	Average	H	17.89	0.11	48.20	-31.80	36.72	68.52
1.385	21.40	Quasi Peak	H	18.14	0.22	39.76	-0.24	24.78	25.02

- Maximum fundamental emission level at 3 m: 71.75 dBμV/m
- No emission within 20 dBc from the fundamental emission.

AST Antenna

Below 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m or 30 m	Limit (dBμV/m) at 300 m or 30 m	Margin (dB)
0.021	24.70	Average	H	18.17	0.10	42.97	-37.03	41.16	78.19
0.035	30.10	Average	H	17.89	0.11	48.10	-31.90	36.72	68.62
1.637	17.50	Quasi Peak	H	18.16	0.24	35.90	-4.10	23.32	27.42

- Maximum fundamental emission level at 3 m: 72.55 dBμV/m
- No emission within 20 dBc from the fundamental emission.

BUM Antenna

Below 30 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m) at 300 m or 30 m	Margin (dB)
0.017	22.40	Average	H	18.29	0.10	40.79	-39.21	43.00	82.21
0.035	28.90	Average	H	17.89	0.11	**46.90**	-33.10	36.72	69.82
0.198	12.70	Average	H	17.80	0.16	30.66	-49.34	21.67	71.01

- Maximum fundamental emission level at 3 m: 65.05 dB㎶/m
- 0.035 ㎒ shall be additionally measured.

INT1 Antenna

Below 30 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m) at 300 m or 30 m	Margin (dB)
0.021	24.30	Average	H	18.17	0.10	42.57	-37.43	41.16	78.59
0.035	30.50	Average	H	17.89	0.11	48.50	-31.50	36.72	68.22
0.280	10.30	Average	H	17.80	0.16	28.26	-51.74	18.66	70.40

- Maximum fundamental emission level at 3 m: 71.65 dB㎶/m
- No emission within 20 dB c from the fundamental emission.

INT2 Antenna

Below 30 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m) at 300 m or 30 m	Margin (dB)
0.020	23.70	Average	H	18.20	0.10	42.00	-38.00	41.58	79.58
0.035	30.00	Average	H	17.89	0.11	48.00	-32.00	36.72	68.72
0.252	17.30	Average	H	17.80	0.16	35.26	-44.74	19.58	64.32

- Maximum fundamental emission level at 3 m: 70.75 dB㎶/m
- No emission within 20 dB c from the fundamental emission.

TNK Antenna

Below 30 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m) at 300 m or 30 m	Margin (dB)
0.021	23.70	Average	H	18.17	0.10	41.97	-38.03	41.16	79.19
0.035	29.70	Average	H	17.89	0.11	47.70	-32.30	36.72	69.02
0.252	18.70	Average	H	17.80	0.16	36.66	-43.34	19.58	62.92

- Maximum fundamental emission level at 3 m: 71.85 dB㎶/m
- No emission within 20 ㏈c from the fundamental emission.

IMMO Antenna

Below 30 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m) at 300 m or 30 m	Margin (dB)
0.019	30.90	Average	H	18.23	0.10	**49.23**	-30.77	42.03	72.80
0.035	31.00	Average	H	17.89	0.11	**49.00**	-31.00	36.72	67.72
0.067	22.90	Average	H	17.85	0.13	**40.88**	-39.12	31.08	70.20
0.374	26.70	Average	H	17.76	0.17	**44.63**	-35.37	16.15	51.52
1.172	21.40	Quasi Peak	H	18.12	0.20	**39.72**	-0.28	26.23	26.51
2.323	17.60	Quasi Peak	H	18.23	0.29	**36.12**	-3.88	30.00	33.88

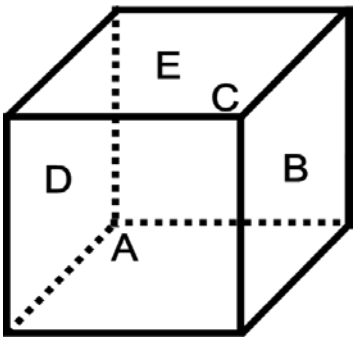
- Maximum fundamental emission level at 3 m: 50.25 dB㎶/m
- 0.019 ㎒, 0.035 ㎒, 0.067 ㎒, 0.374 ㎒, 1.172 ㎒ and 2.323 ㎒ shall be additionally measured.

2. Nerve Stimulation Exposure Evaluation

2.1. Test Setup

2.1.1. Isotropic Probe Test Setup

The measurement probe (EHP-200AC) is a regular hexahedron and supports 3-axis isotropic probe.



A: Front of measurement probe
B: Right of measurement probe
C: Rear of measurement probe
D: Left of measurement probe
E: Top of measurement probe
*****Bottom of measurement probe is not used to measure RF exposure condition owing to connection with a stick.

In order to demonstrate the probe perturbation is not affecting the measurements,
- For one of the sides of EUT several measurements be made at various distances, starting further away and then moving closer.

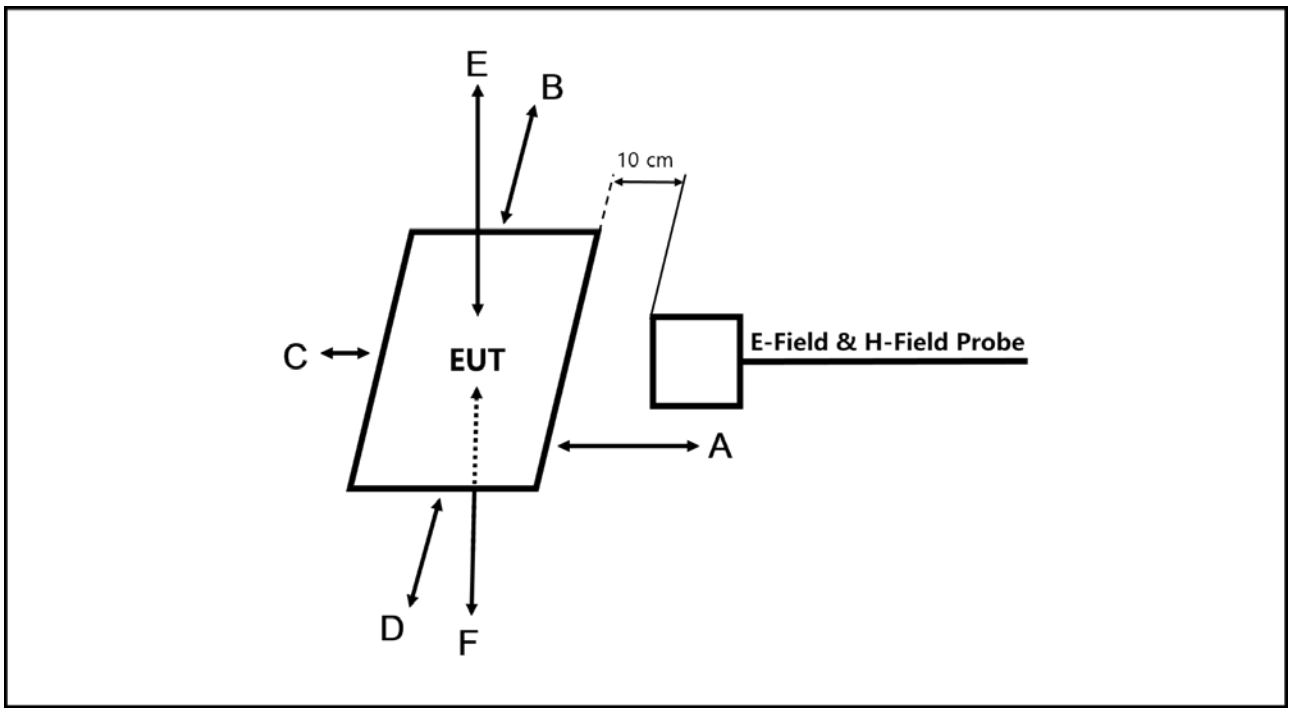
□ □ Further away: measurement distance of EUT was confirmed until isotropic probe could not read fundamental level anymore (Not detected level).
□ □ Moving closer: measurement isotropic probe directly contacts with sides of EUT (0 cm)
□ □ When the worst level of EUT's sides is found out, several measurements should be checked through various distance (1 cm step).

- At 0 cm distance, measurement isotropic probe was investigated by rotating the probe through various angles for one of the EUT's sides as below.

Measurement Point	**A**	**B**	**C**	**D**	**E**
Direction	Front	Right	Rear	Left	Top
Measurement Point	**A to B**	**B to C**	**C to D**	**D to A**	**N/A**
Direction	Front to Right	Right to Rear	Rear to Left	Left to Front	-
Measurement Point	**A to E**	**B to E**	**C to E**	**D to E**	**N/A**
Direction	Front to Top	Right to Top	Rear to Top	Left to Top	-

- When the worst angle among all angles was found, RF exposure measurement should be adjusted from worst angle.

2.1.2. EUT Test Setup



2.2. Measurement procedure

a) The RF exposure test was performed in anechoic chamber.
b) The measurement probe was placed at test distance (10 ㎝) which is between the edge of the device and the edge of the probe.
c) The highest emission level was recorded and compared with limit as soon as measurement of each points (A, B, C, D, E, F) were completed.
d) The EUT were measured according to the dictates of SPR-002 Issue 1 and Notice 2020-DRS0012.
1) Section 6.6.1.2 of SPR-002 Issue 1,
Measurement Method When the RBW of the Measurement Probe is Less Than the 99 % OBW
a) Set the measurement frequency of the measurement probe to the fundamental frequency of the device under test.
b) Set the span to encompass the entire emission bandwidth.
c) Set the RBW to approximately equal to but greater than 1 % of the 99 % OBW of the fundamental emission.
d) Set the detector to Peak and trace display to Max-Hold.
e) Allow the spectrum to fill; for pulsing devices this may require an increased monitoring period.
f) Capture the trace and sum the spectrum levels (in voltage or current units) at intervals equal to the RBW, extending across the entire spectrum. Alternatively, this may be accomplished using an integration function on the measurement probe.
g) Repeat steps (b) to (f) while scanning a parallel plane at the measurement distance on each side of the device to find the peak level.
h) Repeat steps (b) to (g) for any frequencies where the field value is greater than -20 ㏈c below the maximum level identified.
i) If there are multiple frequencies transmitted by the device under test, use equations (2) and (3) to determine compliance.
Note: When scanning around the entire device, the location found to be the maximum for the E- or H-Field may not be the same location as the opposite field.

2.3. Limit

In case of transmitters operating between 0.003-10 ㎒, meeting the exemption from routine RF Exposure evaluation, shall demonstrate compliance to the instantaneous limits in Section 4 of RSS-102 Issue 5.

For the purpose of this standard, Industry Canada has adopted the SAR and RF field strength limits established in Health Canada's RF exposure guideline, Safety Code 6.[18]

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (㎒)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	**83**	**90**	-	**Instantaneous***
0.1-10	-	**0.73/ *f***	-	**6****
1.1-10	87/ $f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $f^{0.25}$	0.1540/ $f^{0.25}$	8.944/ $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619$f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10^{-4} $f^{0.5}$	6.67 x 10^{-5} f	616000/ $f^{1.2}$

Note: f is frequency in ㎒.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

Remark;

1. When the EUT is operating in the range of 0.1 to 10 ㎒, the limit of 0.73/f (A/m rms) should be observed for 6 minute reference period, but the maximum instantaneous level of the unit is lower than the reference limit and no further testing is required.

2.4. E and H field strength

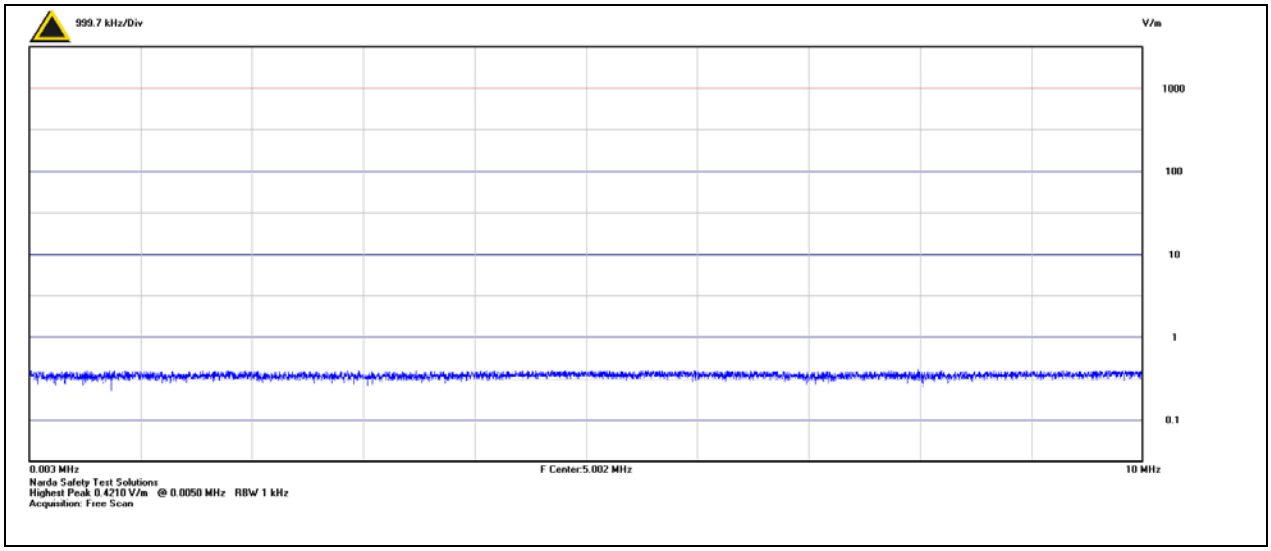
Ambient temperature	:	(23 ± 1) ℃
Relative humidity	:	47 % R.H.

2.4.1. E and H field strength 3 ㎑ to 10 ㎒ at from the edges surrounding the EUT

- Test plots

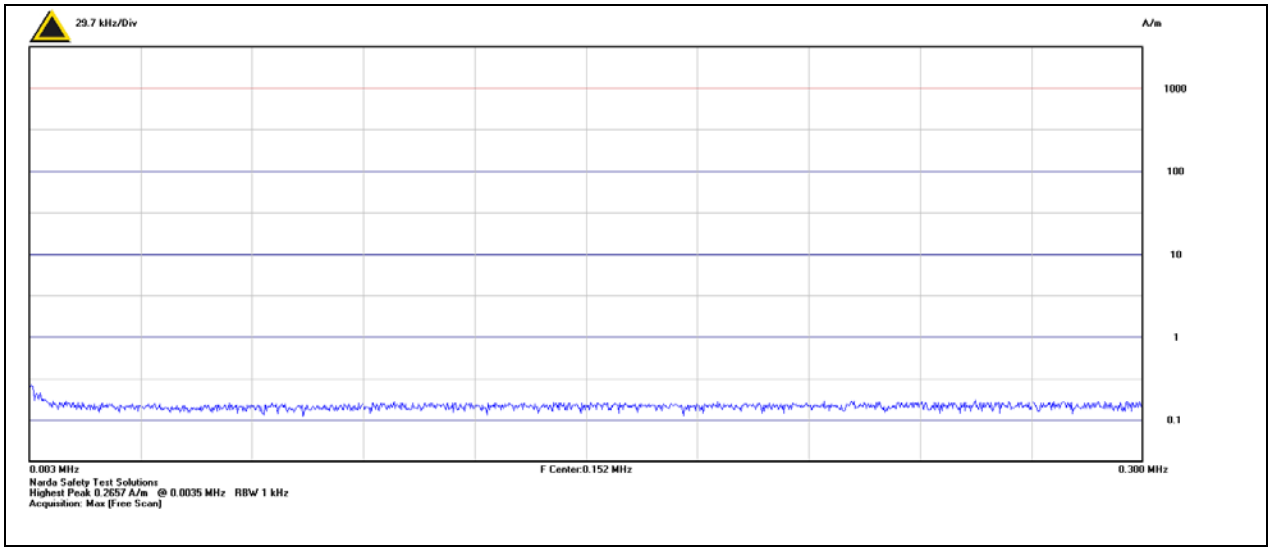
E-field

3 ㎑ ~ 10 ㎒

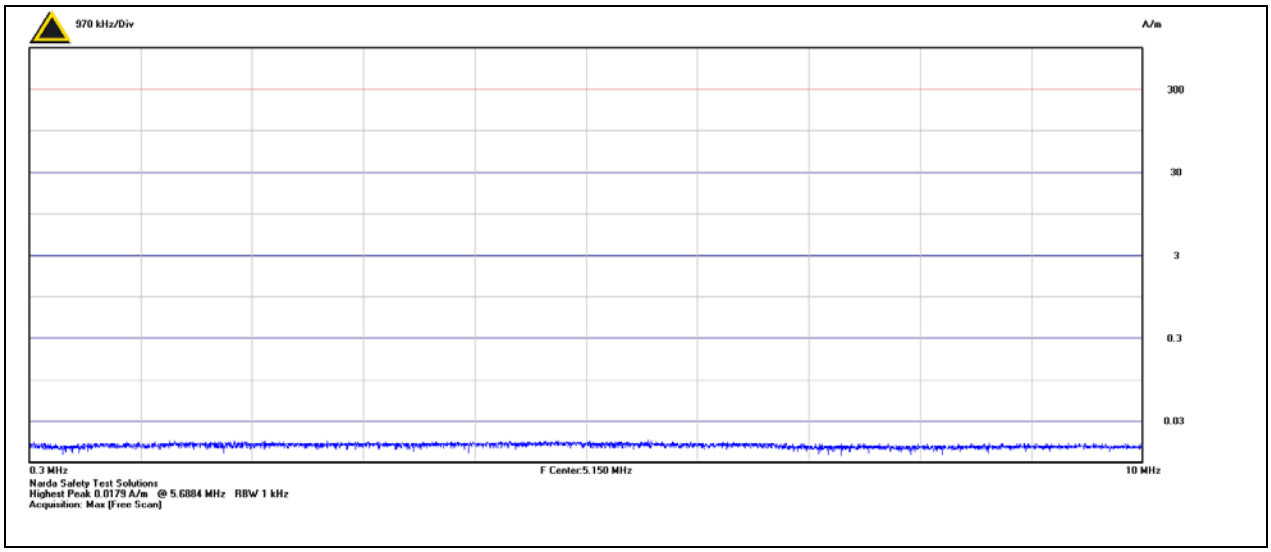


H-field

3 ㎑ ~ 300 ㎑



300 ㎑ ~ 10 ㎒



Remark;

1. Additional frequencies are investigated based on device characterization in Clause 1.9. Additionally measured frequencies are summed with the multiple frequency summation to ensure device complies requirements in 3 ㎑ ~ 10 ㎒ frequency range with all emissions.
2. The EUT operates at approximately 2 % duty cycle with 10 ms on time and 480 ms off time.
   Above test results have a long sweep time, so it is difficult to capture EUT's fundamental signal.
   This measurement demonstrates there is no other emission in measurement with 20 ㏈c dynamic range.

2.4.2. E-Field Strength at from the edges surrounding the EUT

DRV Antenna

Frequency Range (㎑)	Probe Position A (V/m)	Probe Position B (V/m)	Probe Position C (V/m)	Probe Position D (V/m)	Probe Position E (V/m)	Probe Position F (V/m)	Limits (V/m)
125	21.02	30.60	26.11	27.52	31.24	32.79	83

AST Antenna

Frequency Range (㎑)	Probe Position A (V/m)	Probe Position B (V/m)	Probe Position C (V/m)	Probe Position D (V/m)	Probe Position E (V/m)	Probe Position F (V/m)	Limits (V/m)
125	22.27	25.48	10.63	26.08	7.15	19.41	83

BUM Antenna

Frequency Range (㎑)	Probe Position A (V/m)	Probe Position B (V/m)	Probe Position C (V/m)	Probe Position D (V/m)	Probe Position E (V/m)	Probe Position F (V/m)	Limits (V/m)
125	24.08	13.66	29.68	21.87	27.52	27.42	83
0.035	0.38	0.37	0.39	0.39	0.39	0.41	

INT1 Antenna

Frequency Range (㎑)	Probe Position A (V/m)	Probe Position B (V/m)	Probe Position C (V/m)	Probe Position D (V/m)	Probe Position E (V/m)	Probe Position F (V/m)	Limits (V/m)
125	13.35	25.72	29.60	35.40	31.56	**37.31**	83

INT2 Antenna

Frequency Range (㎑)	Probe Position A (V/m)	Probe Position B (V/m)	Probe Position C (V/m)	Probe Position D (V/m)	Probe Position E (V/m)	Probe Position F (V/m)	Limits (V/m)
125	19.09	31.51	29.44	29.77	36.23	35.61	83

TNK Antenna

Frequency Range (㎑)	Probe Position A (V/m)	Probe Position B (V/m)	Probe Position C (V/m)	Probe Position D (V/m)	Probe Position E (V/m)	Probe Position F (V/m)	Limits (V/m)
125	17.86	34.80	28.68	22.54	33.04	31.80	83

IMMO Antenna

Frequency Range (㎑)	Probe Position A (V/m)	Probe Position B (V/m)	Probe Position C (V/m)	Probe Position D (V/m)	Probe Position E (V/m)	Probe Position F (V/m)	Limits (V/m)
125	0.44	0.40	0.40	0.39	0.40	0.60	83
0.019	0.42	0.41	0.41	0.44	0.39	0.40	
0.035	0.38	0.38	0.39	0.38	0.38	0.38	
0.067	0.38	0.35	0.36	0.37	0.38	0.37	
0.374	0.36	0.37	0.38	0.38	0.38	0.37	
1.172	0.38	0.38	0.38	0.39	0.37	0.37	
2.323	0.35	0.37	0.38	0.35	0.37	0.38	

Remark;

1. Emissions were assessed at worst limits by comparing the limits of 0.003 ㎒ ~ 10 ㎒ and 0.1 ㎒ ~ 10 ㎒ in Section 4 of RSS-102 Issue 5.

Multiple Frequency Summation

BUM Antenna: (29.68 / 83) + (0.41 / 83) = 0.36 ≤ 1.0
IMMO Antenna: (0.60 / 83) + (0.44 / 83) + (0.39 / 83) + (0.38 / 83) + (0.38 / 83) + (0.39 / 83) + (0.38 / 83)
= 0.04 ≤ 1.0

2.4.3. H-Field Strength at from the edges surrounding the EUT

DRV Antenna

Frequency Range (㎑)	Probe Position A (A/m)	Probe Position B (A/m)	Probe Position C (A/m)	Probe Position D (A/m)	Probe Position E (A/m)	Probe Position F (A/m)	Limits (A/m)
125	0.974	0.428	0.748	0.436	0.704	0.614	5.84

AST Antenna

Frequency Range (㎑)	Probe Position A (A/m)	Probe Position B (A/m)	Probe Position C (A/m)	Probe Position D (A/m)	Probe Position E (A/m)	Probe Position F (A/m)	Limits (A/m)
125	**1.205**	0.317	0.668	0.320	0.408	0.567	5.84

BUM Antenna

Frequency Range (㎑)	Probe Position A (A/m)	Probe Position B (A/m)	Probe Position C (A/m)	Probe Position D (A/m)	Probe Position E (A/m)	Probe Position F (A/m)	Limits (A/m)
125	0.266	0.288	0.258	0.344	0.447	0.412	5.84
0.035	0.162	0.162	0.162	0.162	0.162	0.169	20.86

INT1 Antenna

Frequency Range (㎑)	Probe Position A (A/m)	Probe Position B (A/m)	Probe Position C (A/m)	Probe Position D (A/m)	Probe Position E (A/m)	Probe Position F (A/m)	Limits (A/m)
125	0.689	0.380	0.542	0.370	0.384	0.497	5.84

INT2 Antenna

Frequency Range (㎑)	Probe Position A (A/m)	Probe Position B (A/m)	Probe Position C (A/m)	Probe Position D (A/m)	Probe Position E (A/m)	Probe Position F (A/m)	Limits (A/m)
125	0.395	0.397	0.592	0.404	0.463	0.404	5.84

TNK Antenna

Frequency Range (㎑)	Probe Position A (A/m)	Probe Position B (A/m)	Probe Position C (A/m)	Probe Position D (A/m)	Probe Position E (A/m)	Probe Position F (A/m)	Limits (A/m)
125	0.642	0.463	0.753	0.499	0.447	0.534	5.84

IMMO Antenna

Frequency Range (㎑)	Probe Position A (A/m)	Probe Position B (A/m)	Probe Position C (A/m)	Probe Position D (A/m)	Probe Position E (A/m)	Probe Position F (A/m)	Limits (A/m)
125	0.180	0.180	0.169	0.174	0.167	0.180	5.84
0.019	0.190	0.184	0.187	0.190	0.179	0.181	38.42
0.035	0.162	0.165	0.162	0.168	0.164	0.158	20.86
0.067	0.164	0.161	0.159	0.157	0.157	0.164	10.90
0.374	0.015	0.016	0.016	0.016	0.016	0.016	1.95
1.172	0.016	0.015	0.015	0.015	0.015	0.015	0.62
2.323	0.016	0.015	0.016	0.015	0.015	0.015	0.31

Remark;

1. Emissions were assessed at worst limits by comparing the limits of 0.003 ㎒ ~ 10 ㎒ and 0.1 ㎒ ~ 10 ㎒ in Section 4 of RSS-102 Issue 5.

Multiple Frequency Summation

BUM Antenna: (0.447 / 5.84) + (0.169 / 20.86) = 0.085 ≤ 1.0
IMMO Antenna: (0.180 / 5.84) + (0.190 / 38.42) + (0.168 / 20.86) + (0.164 / 10.90) + (0.016 / 1.95)
+ (0.016 / 0.62) + (0.016 / 0.31) = 0.144 ≤ 1.0

Note;

For the Multiple Frequency Summation, the worst level value for each test condition was selected and calculated.

According to SPR-002 Issue 1, 7,
The RLs for nerve stimulation are based on the total r.m.s. level. This requires that all frequency components from the apparatus be integrated together using equation (2) or (3), depending on the measurement performed. The sum of the ratios must be less than or equal to 1.

Multiple frequency components may be harmonic emissions of the fundamental or multiple transmitters and their harmonics within a single device. Harmonic emissions that are less than 20 dB c may be omitted from the assessment.

$$\sum (E_m / E_{RL}) \leq 1 \quad (2)$$

where:

E_m = Measured electric field at a specific frequency.
E_{RL} = Reference level limit for the electric field at the measurement frequency.

$$\sum (H_m / H_{RL}) \leq 1 \quad (3)$$

where:

H_m = Measured magnetic field at a specific frequency.
H_{RL} = Reference level limit for the magnetic field at the measurement frequency.

- End of the Test Report -