FCC TEST REPORT

Test report No.:	EMC- FCC- R0206
FCC ID:	2ADYU-ELT-2000
Type of equipment:	Endoscope Leak Tester
Model Name:	ELT-2000
Applicant:	DIABELL COMPANY LIMITED
FCC Rule Part(s):	FCC Part 15 Subpart C 15.225
Frequency Range:	13.560 3 ㎒
Test result:	Complied

The above equipment was tested by EMC compliance Testing Laboratory for compliance with the requirements of FCC Rules and Regulations.
The results of testing in this report apply to the product/system which was tested only.
Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Date of receipt: 2014. 12. 03

Date of test: 2014. 12. 27 ~ 2015. 01. 05 Issued date: 2015. 01. 16

Tested by: NAM, TAEK YONG

Approved by: YU, SANG HOON

80-5, Sin-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea
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[Contents]

1. Client information

Applicant:	DIABELL COMPANY LIMITED
Address:	105, Anyangcheonseo-ro, Manan-gu, Anyang-si, Gyeonggi-do, Korea
Telephone number:	+82-31-380-4323
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Contact person:	Lee Jong Yeon / jaylee@diabell.co.kr

Manufacturer:	ORACOM Co.,Ltd.
Address:	372, IHWA-RO, Pyeongtaek-si, Gyeonggi-do, Korea

2. Laboratory information

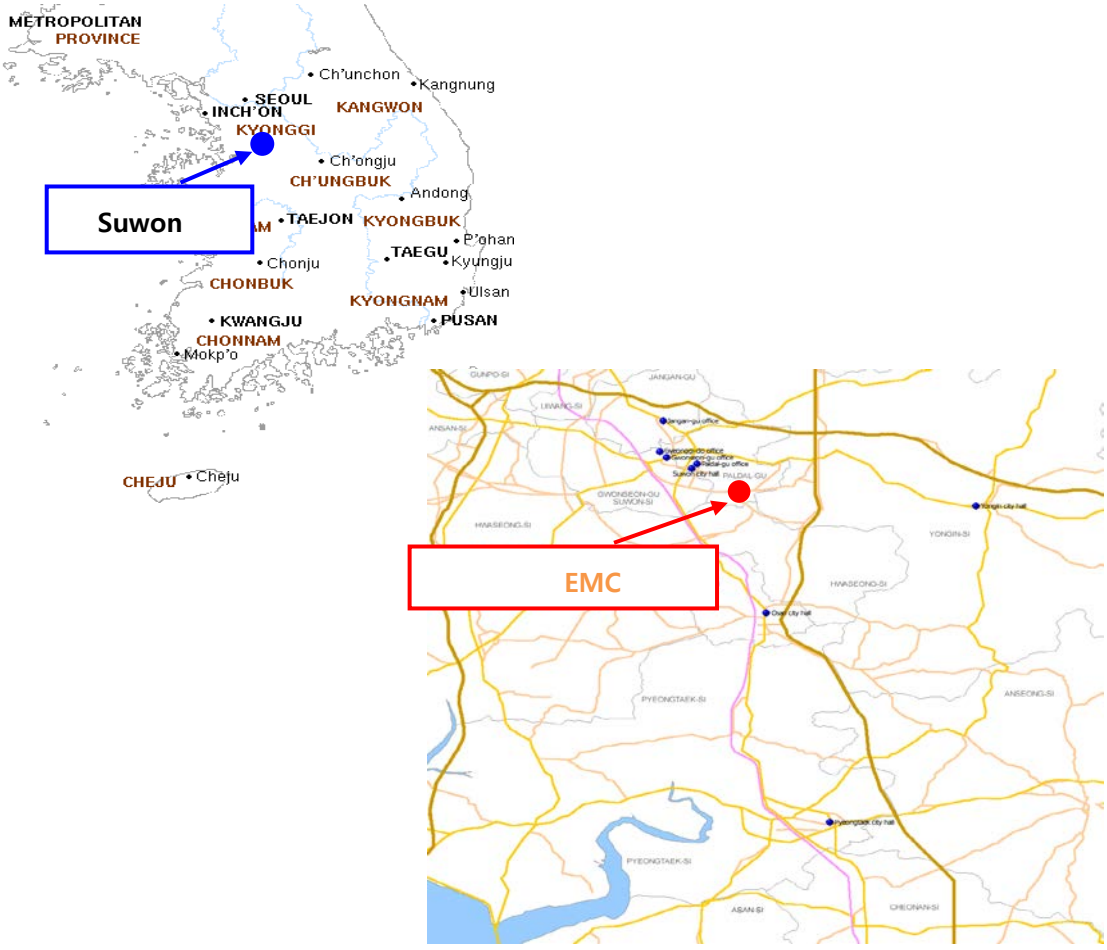
Address

EMC compliance Ltd.
80-5, Sin-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea
Telephone Number: 82-70-5008-1021 Facsimile Number: 82-505-299-8311

Certificate

KOLAS No.: 231
FCC Site Designation No.: KR0040
FCC Site Registration No.: 687132
VCCI Site Registration No.: R-3327, G-198, C-3706, T-1849
IC Site Registration No.:8035A-2

SITE MAP



3. Description of E.U.T.

3.1 Basic description

Applicant:	DIABELL COMPANY LIMITED
Address of Applicant	105, Anyangcheonseo-ro, Manan-gu, Anyang-si, Gyeonggi-do, Korea
Manufacturer	ORACOM Co.,Ltd.
Address of Manufacturer	372, IHWA-RO, Pyeongtaek-si, Gyeonggi-do, Korea
Type of equipment	Endoscope Leak Tester
Basic Model	ELT-2000
Serial number	N/A

3.2 General description

Operating Frequency	13.560 3 ㎒
Frequency Range	13.553 ㎒ ~ 13.567 ㎒
Type of Modulation	ASK
Number of Channels	1 channel
Type of Antenna	Loop Antenna
Power supply	DC 3.7 V (Battery) * , DC 5 V (Adaptor) *
Operating temperature	-20℃ ~ 50 ℃

*Declared by applicant

3.3 Test frequency

frequency	13.560 3 ㎒

4. Summary of test results

4.1 Standards & results

Rule Reference	Parameter	Status
15.203	Antenna Requirement	C
15.225 (a)	In-band Fundamental Emission	C
15.225 (b)	In-band Spurious Emission	C
15.225 (c)	In-band Spurious Emission	C
15.225 (d) 15.209	Out-of–band Spurious Emission	C
15.225 (e)	Frequency Stability Tolerance	C
15.207	Conducted Emissions	C

Note: C=complies
NC= Not complies
NT=Not tested
NA=Not Applicable

4.2 Uncertainty

Measurement Item	Expanded Uncertainty U = KUc (K = 2)	
Radiated Spurious Emissions	30 ㎒ ~ 300 ㎒:	+ 4.94 dB, - 5.06 dB
		+ 4.93 dB, - 5.05 dB
	300 ㎒ ~ 1 000 ㎒:	+ 4.97 dB, - 5.08 dB
		+ 4.84 dB, - 4.96 dB
Conducted Emissions	9 ㎑ ~ 150 ㎑:	± 3.75 dB
	150 ㎑ ~ 30 ㎒:	± 3.36 dB

5. Test results

5.1 Antenna Requirement

5.1.1 Regulation

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

5.1.2 Result

-Complied

The Loop antenna is an integral antenna, and no antenna other than that furnished by the responsible party shall be used with the device.

5.2 In-band Fundamental Emission

5.2.1 Minimum Standard

15.225 (a) The field strength of any emission within the band 13.553-13.567 ㎒ shall not exceed 15,848 microvolts/meter at 30 meters.

5.2.2 Measurement Procedure

Test Procedure The Radiated Electric Field Strength intensity has been measured on semi anechoic chamber with a ground plane and at a distance of 3m.

Frequency : From 9 ㎑ to 30 ㎒ at distance 3m The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

Frequency : From 30 ㎒ to 1 ㎓ at distance 3m The measuring antenna height varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for both vertical and horizontal antenna polarization.

Measurements were performed with a QP, PK, and AV detector. The radiated emission measurements were made with the following detector function of the test receiver
(below 1 ㎓).

Frequency	9 - 90 ㎑	90 - 110 ㎑	150 - 490 ㎑	490 ㎑ - 30 ㎒	30 ㎒ -1 ㎓
Detecter type	PK/AV	QP	PK/AV	QP	QP
IF bandwidth	200 ㎐	200 ㎐	9 ㎑	9 ㎑	120 ㎑

* Part 15 Section 15.31 (f)(2) (9 ㎑ - 30 ㎒)
[Limit at 3m]=[Limit at 300m]-40 x log(3[m]/300[m])
[Limit at 3m]=[Limit at 30m]-40 x log (3[m]/30[m])

5.2.3 Test Result

- **Complies**

Voltage [v]	Frequency [㎒]	Reading [dBμV]	Correction Factor [dB]	field strength dBuV/m at 3 m	Limit dBuV/m at 3 m	Margin [dB]
3.7	13.560 3	91.1	-11.5	79.6	124	44.9
5.0	13.560 3	90.6	-11.5	79.1	124	44.5

Note: Field strength limit was calculated with 40 dB/dec

5.3 In-band Spurious Emission

5.3.1 Regulation

15.225 (b) With in the bands 13.410-13.553 ㎒ and 13.567-13.710 ㎒, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

15.225 (c) With in the bands 13.110-13.410 ㎒ and 13.710-14.010 ㎒, the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

5.3.2 Test Result

- Complied

DC 3.7 V
Measurement Distance: 3 m

Frequency	Receiver Bandwidth	Reading	Pol.	Factor	Limit	Result	Margin
[㎒]	[㎑]	[dB(㎶)]	[V/H]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
QP DATA.							
13.400	9	56.4	H	-11.5	80.5	44.9	35.6
13.552	9	77.7	H	-11.5	90.5	66.2	24.3
13.570	9	72.6	H	-11.5	90.5	61.1	29.4
13.718	9	55.2	H	-11.5	80.5	43.7	36.8

DC 5 V
Measurement Distance: 3 m

Frequency	Receiver Bandwidth	Reading	Pol.	Factor	Limit	Result	Margin
[㎒]	[㎑]	[dB(㎶)]	[V/H]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
QP DATA.							
13.404	9	60.8	H	-11.5	80.5	49.3	31.2
13.550	9	76.4	H	-11.5	90.5	64.9	25.6
13.569	9	83.4	V	-11.5	90.5	71.9	18.6
13.715	9	58.4	V	-11.5	80.5	46.9	33.6

Margin (dB) = Limit – Actual
[Resultl = Reading – Amp Gain + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. AF/CL = Antenna Factor and Cable Loss

5.4 Out-of-band Spurious Emission

5.4.1 Regulation

15.225 (d) The Field Strength of any emissions appearing outside of the 13.110-14.010 ㎒ band shall not exceed the general radiated emission limits in 15.209

Frequency (㎒)	Field Strength (㎶/m)	Measurement distance (meters)
0.009-0.490	2400/F(㎑)	300
0.490-1.705	24000/F(㎑)	30
1.705-30.0	30(29.54 ㏈㎶/m)	30
30.0-88.0	100(40 ㏈㎶/m)	3
88-216	150(43.5 ㏈㎶/m)	3
216-960	200 (46 ㏈㎶/m)	3
Above 960	500 (53.98 ㏈㎶/m)	3

5.4.2 Measurement Procedure

The spurious emissions from the EUT will be measured on an 10 ㎞ Anechoic chamber in the frequency range of 9 ㎑ to 30 ㎒ using a tuned receiver and a shielded loop antenna.
The antenna was positioned 3, 10 or 30 meters horizontally from the EUT.
Measurements haver been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions.
In the case where larger measuring distances are required the results will extrapolated based on the values measuring on the closer distances according to Section 15.31 (f) (2) [2].

The final measurement will be performed with an EMI Riceiver set to Quasi Peak detector except for the frequency bands 9 ㎑ to 90 ㎑ and 110 to 490 ㎑ where an average detector will be used according to Section 15.209 (d) [2].

The final lever, expressed in ㏈㎶/m, is arrived at by taking the reading from the EMI receiver (Level ㏈㎶) and adding the antenna correction factor and cable loss fator (Factor ㏈) to it. This result then has to be compared with the relevant FCC limit. The resolution bandwith during the measurement is as follows:
9 ㎑ – 150 ㎑: ResBW: 200 ㎐
150 ㎑ – 30 ㎒: ResBW: 9 ㎑

The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.

The EUT was placed on the top of the 0.8 meter height, 1 x 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
The antenna polarization was also changed from vertical to horizontal. The spectrum was canned from 30 to 1 000 ㎒ using the BILOG antenna. To obain the final measurement data, the EUT was arranged on a turntable situated on a 10 m chamber. The EUT was tested at a distance 3 meters.
Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

5.4.3 Test Result

-Complied

Measurement Distance: 3 m

DC 3.7 V

-Below 30 ㎒

Frequency	Receiver Bandwidth	Reading	Pol.	Factor	Limit	Result	Margin
[㎒]	[㎑]	[dB(㎶)]	[V/H]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
QP DATA.							
0.021	0.2	83.4	V	-11.8	118.1	71.6	46.5
0.495	9.0	53.1	V	-12.8	73.8	40.3	33.5
27.123	9.0	42.8	H	-10.7	69.5	32.1	37.4

-Above 30 ㎒

Frequency	Receiver Bandwidth	Reading	Pol.	Factor	Limit	Result	Margin
[㎒]	[㎑]	[dB(㎶)]	[V/H]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
QP DATA.							
66.375	120	36.8	V	-13.3	40.0	23.5	16.5
88.443	120	36.5	H	-16.3	43.5	20.2	23.3
628.975	120	38.1	H	-11.5	46.0	26.6	19.4
978.417	120	22.9	H	-0.5	54.0	22.4	31.6

Margin (dB) = Limit – Actual
[Resultl = Reading – Amp Gain + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. AF/CL = Antenna Factor and Cable Loss

* The spurious emission at the frequency does not fall in the restricted bands.
** The measured result is within the test standard limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95 % level of confidence. However, the result indicates that compliance is more probable than non-compliance.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

DC 5 V

-Below 30 ㎒

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB(㎶)]	Pol. [V/H]	Factor [dB]	Limit [dB(㎶/m)]	Result [dB(㎶/m)]	Margin [dB]
QP DATA.							
0.031	0.2	94.2	V	-12.2	118.1	82.0	36.1
0.590	9.0	43.9	V	-12.8	73.8	31.1	42.7
27.121	9.0	42.6	V	-10.7	69.5	31.9	37.6

-Above 30 ㎒

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB(㎶)]	Pol. [V/H]	Factor [dB]	Limit [dB(㎶/m)]	Result [dB(㎶/m)]	Margin [dB]
QP DATA.							
44.308	120	44.9	V	-13.3	40.0	31.6	8.4
189.808	120	33.8	H	-16.3	43.5	17.5	26.0
352.525	120	39.7	H	-11.5	46.0	28.2	17.8
985.571	120	29.1	H	-0.5	54.0	28.6	25.4

Margin (dB) = Limit – Actual
[Resultl = Reading – Amp Gain + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. AF/CL = Antenna Factor and Cable Loss

* The spurious emission at the frequency does not fall in the restricted bands.
** The measured result is within the test standard limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95 % level of confidence. However, the result indicates that compliance is more probable than non-compliance.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

5.5 Frequency tolerance

5.5.1 Regulation

15.225 (e) The frequency tolerance of the carrier signal shall be maintained within ±0.01 % of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.5.2 Test Result

- **Complied**

DC 3.7 V

VOLTAGE (%)	POWER (V)	TEMP (℃)	FREQ (㎐)	FREQ.DEV (㎐)	Deviation (%)
100	3.7	20	13 560 278	22	0.000 16
		-20	13 560 367	-67	-0.000 49
		-10	13 560 367	-67	-0.000 49
		0	13 560 365	-65	-0.000 48
		10	13 560 361	-61	-0.000 45
		20	13 560 309	-9	-0.000 07
		25	13 560 297	3	0.000 02
		30	13 560 286	14	0.000 10
		40	13 560 270	30	0.000 22
		50	13 560 250	50	0.000 37

DC 5 V

VOLTAGE (%)	POWER (V)	TEMP (℃)	FREQ (㎐)	FREQ.DEV (㎐)	Deviation (%)
100	5	20	13 560 280	20	0.000 15
		-20	13 560 367	-67	-0.000 49
		-10	13 560 366	-66	-0.000 49
		0	13 560 365	-65	-0.000 48
		10	13 560 361	-61	-0.000 45
		20	13 560 309	-9	-0.000 07
		25	13 560 296	4	0.000 03
		30	13 560 284	16	0.000 12
		40	13 560 272	28	0.000 21
		50	13 560 249	51	0.000 38
85	4.25	20	13 560 279	21	0.000 15
115	5.75	20	13 560 279	21	0.000 15

5.6 Conducted Emission

5.6.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (㎒)	Conducted limit (㏈μV)	
	Qausi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

5.6.2 Measurement Procedure

1) The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 ㎝ in which is located 40 ㎝ away from the vertical wall and 1.5m away from the side wall of the shielded room.

2) Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μ H LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.

3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.

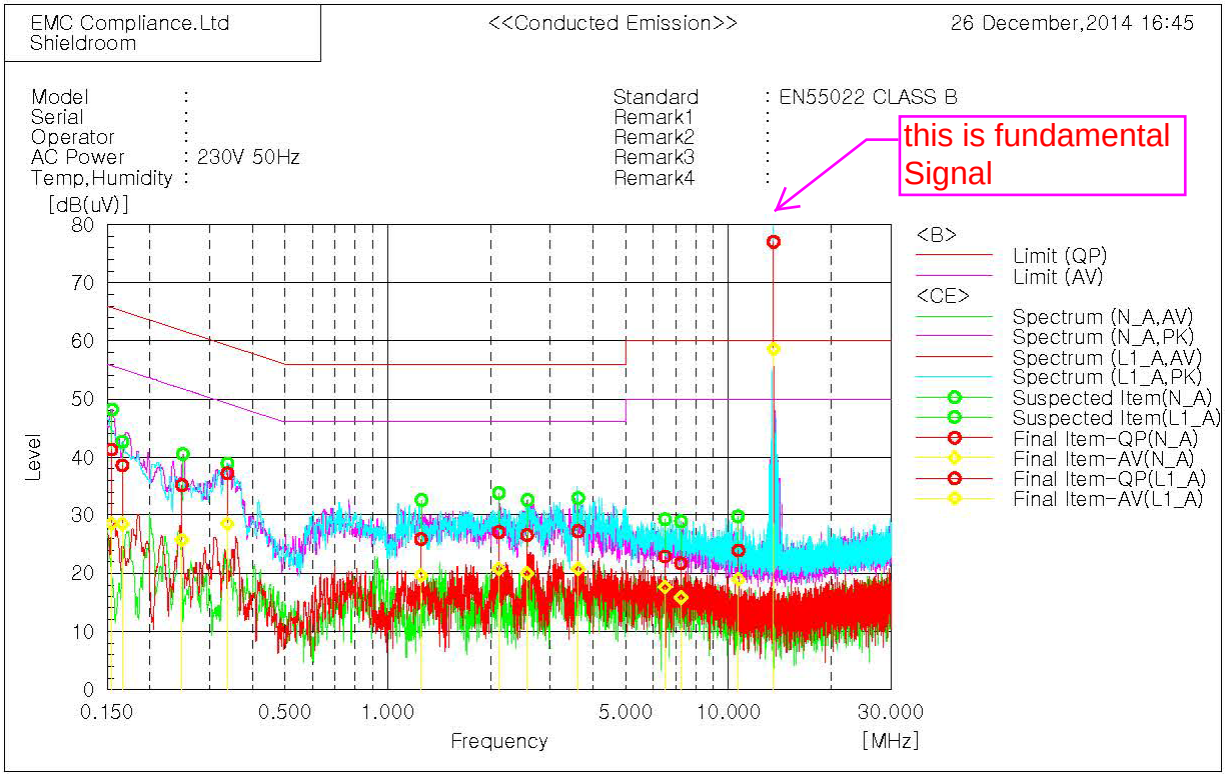
4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 ㎒ to 30 ㎒.

5) The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 ㎑ or to QUASI-PEAK and AVERAGE within a bandwidth of 9 ㎑. The EUT was in transmitting mode during the measurements.

5.6.3 Test Result

- Complied

Figure4. plot of Conducted Emission



Final Result

--- N_A Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.15448	30.8	18.0	10.5	41.3	28.5	65.8	55.8	24.5	27.3
2	0.24859	24.5	15.1	10.6	35.1	25.7	61.8	51.8	26.7	26.1
3	2.56451	12.6	6.0	14.0	26.6	20.0	56.0	46.0	29.4	26.0
4	3.61982	12.7	6.3	14.5	27.2	20.8	56.0	46.0	28.8	25.2
5	7.25068	7.1	1.2	14.6	21.7	15.8	60.0	50.0	38.3	34.2

--- L1_A Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.16656	28.1	18.0	10.5	38.6	28.5	65.1	55.1	26.5	26.6
2	0.33854	26.6	17.9	10.6	37.2	28.5	59.2	49.2	22.0	20.7
3	1.25265	13.6	7.4	12.3	25.9	19.7	56.0	46.0	30.1	26.3
4	2.12128	13.1	6.9	13.9	27.0	20.8	56.0	46.0	29.0	25.2
5	6.51044	7.6	2.4	15.3	22.9	17.7	60.0	50.0	37.1	32.3
6	10.66896	7.4	2.5	16.5	23.9	19.0	60.0	50.0	36.1	31.0
7	13.56363	60.6	42.2	16.4	77.0	58.6	60.0	50.0	-17.0	-8.6

6. Test equipment used for test

	Description	Manufacturer	Model No.	Serial No.	Next Cal Date.
■	Temp & Humid Chamber	ESPEC CORP.	SH-661	92003300	15.03.10
■	DC Power Supply	Agilent	66312A	SG43000104	15.03.11
■	Spectrum Analyzer	R&S	FSP40	100209	15.11.07
■	Spectrum Analyzer	Agilent	E4440A	MY44303500	15.06.10
■	EMI Test Receiver	Schwarzbeck	ESR7	101078	15.02.24
■	TWO-LINE V-NETWORK	R&S	ENV216	101358	15.10.04
■	Signal generator	R&S	SMR40	100007	15.06.10
■	Amplifier	Sonoma Instrument	310N	293004	15.09.25
■	Loop Antenna	R&S	HFH2-Z2	100355	15.06.19
■	Bi-Log Antenna	Schwarzbeck	VULB9163	552	16.05.14
■	Attenuator	HP	8491A	16861	15.07.01
■	Turn Table	Innco Systems	DT2000S-1t	79	-
■	Antenna Mast	Innco Systems	MA4000-EP	303	-