FCC/IC TEST REPORT

Test report No.:	EMC- FCC- R0181
FCC ID:	SY5SMK35
IC:	8325A-SMK35
Type of equipment:	Smart Key ECU
Model Name:	SMK 3.5
Applicant:	Continental Automotive Systems Corporation
FCC Rule Part(s):	FCC Part 15 Subpart C Section 15.209 IC RSS-210, Issue 8:2010
Frequency Range:	125 ㎑ (Tx) 433.92 ㎒ (Rx)
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. 09. 02

Date of test: 2014. 09. 05 ~ 09. 10

Issued date: 2014. 09. 22

Tested by: AHN, BYUNG WOO

Approved by: YU, SANG HOON

[Contents]

1. Client information

Applicant : Continental Automotive Systems Corporation

Address : 29, Siemens-Road, Icheon-City, Gyeonggi-Do, 467-080, Korea

Telephone number : +82-31-645-4864

Facsimile number : +82-31-637-0371

Contact person : SungMin Jang

Manufacturer: Continental Automotive Systems Corporation

Address : 29, Siemens-Road, Icheon-City, Gyeonggi-Do, 467-080, Korea

2. Laboratory information

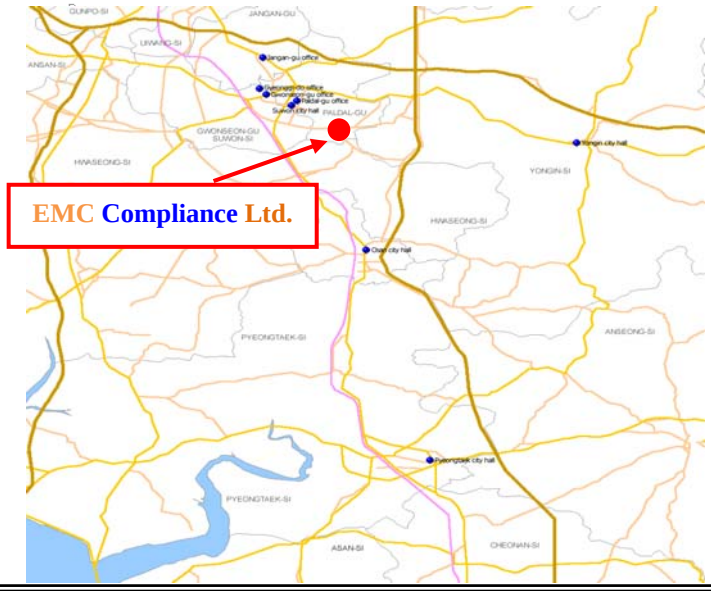
Address

EMC compliance Ltd.
480-5, Sin-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea, 433-390, Korea
Telephone Number: 82-31-336-9919 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 :	Continental Automotive Systems Corporation
Address of Applicant:	29, Siemens-Road, Icheon-City, Gyeonggi-Do, 467-080, Korea
Manufacturer:	Continental Automotive Systems Corporation
Address of Manufacturer:	29, Siemens-Road, Icheon-City, Gyeonggi-Do, 467-080, Korea
Type of equipment:	Smart Key ECU
Basic Model:	SMK 3.5
Serial number:	N/A

3.2 General description

Frequency	125 ㎑ (Tx), 433.92 ㎒ (Rx)
Type of Modulation	ASK
Number of Channels	1 channel
Type of Antenna	LF Antenna
Power supply	DC 12 V

3.3 Test frequency

	Frequency
Low frequency	-
Middle frequency	**125 ㎑**
High frequency	-

4. Summary of test results

4.1 Standards & results

FCC Rule Reference	IC Rule	Parameter	Report Section	Test Result
15.203	7.1.2	Antenna Requirement	5.1	C
15.209	4.8	Field Strength of Fundamental	5.2	C
15.209	4.9	Radiated Emissions	5.3	C
15.207	N/A	Conducted Emissions	5.5	N/A*
N/A	4.6.1	Occupied bandwidth	5.6	C
N/A	4.10	Receiver Spurious Emission	5.7	C

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

*The test is not applicable since the EUT is not the device that is designed to be connected to the public utility(AC) power line(This EUT is automotive device)

4.2 Uncertainty

Measurement Item	Expanded Uncertainty U = KUc (K = 2)	
Conducted RF power	± 1.30 dB	
Conducted Spurious Emissions	± 3.04 ㏀	
Radiated Spurious Emissions	30 ㎒ ~ 180 ㎒	± 3.16 dB
	180 ㎒ ~ 4 ㎓	± 3.05 dB
	4 ㎓ ~ 12.75 ㎓	± 3.12 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

Using special antenna jack and has no general access to end user after it has been installed.

5.2 Field Strength of Fundamental Emissions

5.2.1 Regulation

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (㎒)	Field strength (μV/m @ 3m)	Distance(m)
0.009-0.490	2400/F(㎑)	300
0.490-1.705	24000/F(㎑)	30
1.705-30	30	30
30–88	100**	3
88–216	150**	3
216–960	200**	3
Above 960	500	3

**Except as provided in paragraph(g).fundamental emissions from intentional radiators operating under the section shall not be located in the frequency bands 54-72 ㎒. 76-88 ㎒. 174-216 ㎒ or 470-806 ㎒. However, Operation within these frequency bands is permitted under other sections of this part. e.g.,
Section 15.231 and 15.241.

**Limit : 2400/125=19.2 uV/m @ 300m
Distance Correction Factor = 40log(test distance /specific distance)

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.

On any frequency or frequencies below or equal to 1000 ㎒, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrument using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Interference (CISPR) of the International Electrotechnical Commission. As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, as long as the same bandwidths as indicated for CISPR quasi-peak measurements are employed.(15.35(a))

below 1㎓ : quasi-peak

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

5.2.3 Test Result

-Complied

ANT 1 _INT 1
Measurement Distance: 3 m

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB (μV)]	Pol. [V/H]	Factor [dB]	Limit [dB (μV/m)]	Result [dB (μV/m)]	Margin [dB]
QP DATA.							
0.125	0.2	94.5	H	-12.1	105.67	82.4	23.27

*worstcase Horizontal

ANT 2 _INT 2
Measurement Distance: 3 m

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB (μV)]	Pol. [V/H]	Factor [dB]	Limit [dB (μV/m)]	Result [dB (μV/m)]	Margin [dB]
QP DATA.							
0.125	0.2	94.2	H	-12.1	105.67	82.1	23.57

*worstcase Horizontal

ANT 3 _Bumper
Measurement Distance: 3 m

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB (μV)]	Pol. [V/H]	Factor [dB]	Limit [dB (μV/m)]	Result [dB (μV/m)]	Margin [dB]
QP DATA.							
0.125	0.2	95.0	H	-12.1	105.67	82.9	22.77

*worstcase Horizontal

ANT 4 _Immo
Measurement Distance: 3 m

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB (μV)]	Pol. [V/H]	Factor [dB]	Limit [dB (μV/m)]	Result [dB (μV/m)]	Margin [dB]
QP DATA.							
0.125	0.2	79.6	H	-12.1	105.67	67.5	38.17

*worstcase Horizontal

ANT 5 _DRV
Measurement Distance: 3 m

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB (μV)]	Pol. [V/H]	Factor [dB]	Limit [dB (μV/m)]	Result [dB (μV/m)]	Margin [dB]
QP DATA.							
0.125	0.2	95.3	H	-12.1	105.67	83.2	22.47

*worstcase Horizontal

ANT 6 _AST
Measurement Distance: 3 m

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB (μV)]	Pol. [V/H]	Factor [dB]	Limit [dB (μV/m)]	Result [dB (μV/m)]	Margin [dB]
QP DATA.							
0.125	0.2	97.5	H	-12.1	105.67	85.4	20.27

*worstcase Horizontal

ANT 7 _Reav
Measurement Distance: 3 m

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB (μV)]	Pol. [V/H]	Factor [dB]	Limit [dB (μV/m)]	Result [dB (μV/m)]	Margin [dB]
QP DATA.							
0.125	0.2	96.2	H	-12.1	105.67	84.1	21.57

*worstcase Horizontal

Margin (dB) = Limit – Actual
[Resultl = Reading – Amp Gain + Attenuator + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. ATT = Attenuation (10 dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

5.3 Radiated Emissions

5.3.1 Regulation

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (㎒)	Field strength (μV/m @ 3 m)	Distance(m)
0.009-0.490	2400/F(㎑)	300
0.490-1.705	24000/F(㎑)	30
1.705-30	30	30
30–88	100**	3
88–216	150**	3
216–960	200**	3
Above 960	500	3

**Except as provided in paragraph(g).fundamental emissions from intentional radiators operating under the section shall not be located in the frequency bands 54-72 ㎒. 76-88 ㎒. 174-216 ㎒ or 470-806 ㎒. However, Operation within these frequency bands is permitted under other sections of this part. e.g.,
Section 15.231 and 15.241.

**Limit : 2400/125=17.78uV/m @ 300 m
Distance Correction Factor ㅈ = 40log(test distance /specific distance)

5.3.2 Measurement Procedure

The spurious emissions from the EUT will be measured on an open area test site 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 have 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 measured on the closer distances according to Section 15.31 (f) (2) [2].

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

5.3.3 Test Result

-Complied

AST_ANT (Worst Case)
Measurement Distance: 3 m
-Below 30㎒

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB (μV)]	Pol. [V/H]	Factor [dB]	Limit [dB (μV/m)]	Result [dB (μV/m)]	Margin [dB]
QP DATA.							
Below 30 ㎒	Not detected	-	-	-	-	-	-

-Above 30㎒

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB (μV)]	Pol. [V/H]	Factor [dB]	Limit [dB (μV/m)]	Result [dB (μV/m)]	Margin [dB]
QP DATA.							
39.82	120	26.0	H	-14.3	40.0	11.7	28.3
124.58	120	31.0	V	-15.3	43.5	15.7	27.8
191.87	120	31.3	V	-15.4	43.5	15.9	27.6
293.84	120	29.4	V	-11.1	46.0	18.3	27.7

Margin (dB) = Limit – Actual
[Resultl = Reading – Amp Gain + Attenuator + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), 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.

5.4 Conducted Emission- N/A

5.4.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected tothe 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 50μH/50Ω 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 (dBμV)	
	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.

5.4.2 Measurement Procedure

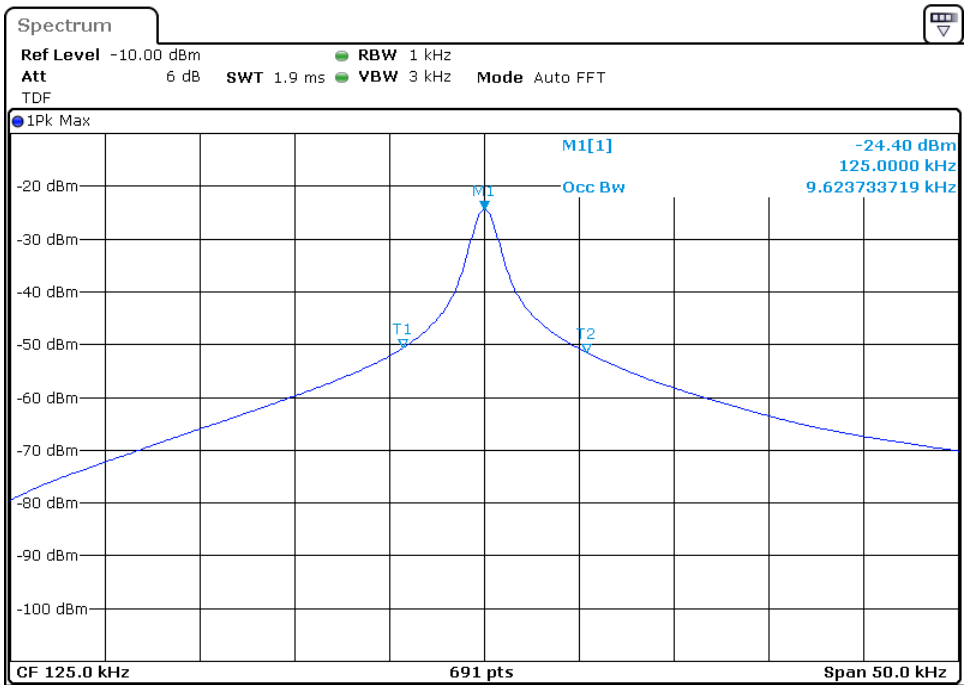
1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μH LISN, which is 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.

5.5 Occupied bandwidth

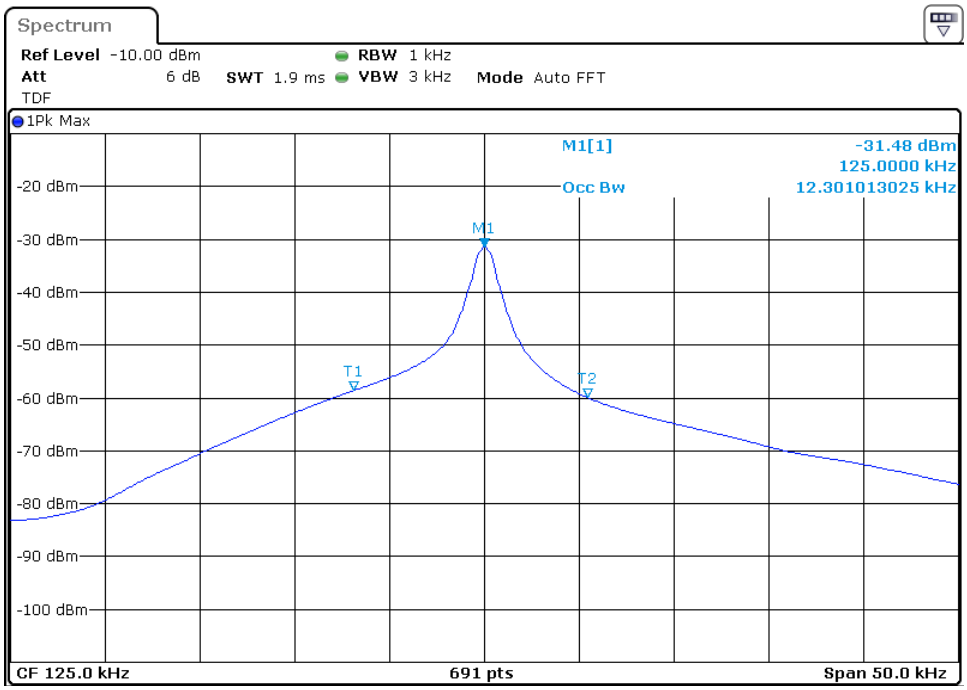
5.5.1 Test Result

-Complied

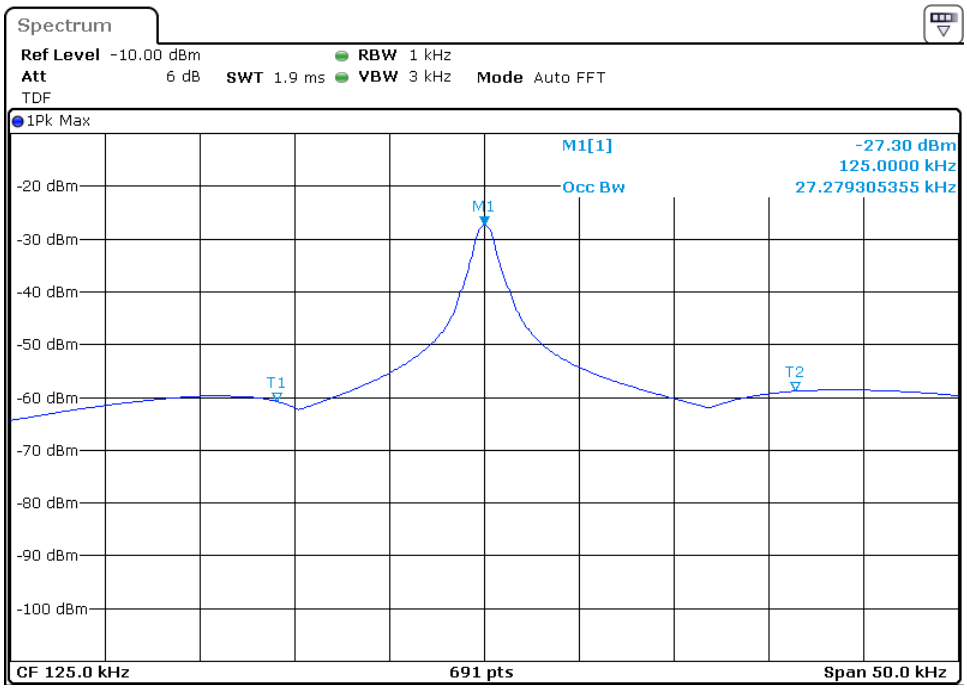
ANT 1_INT 1



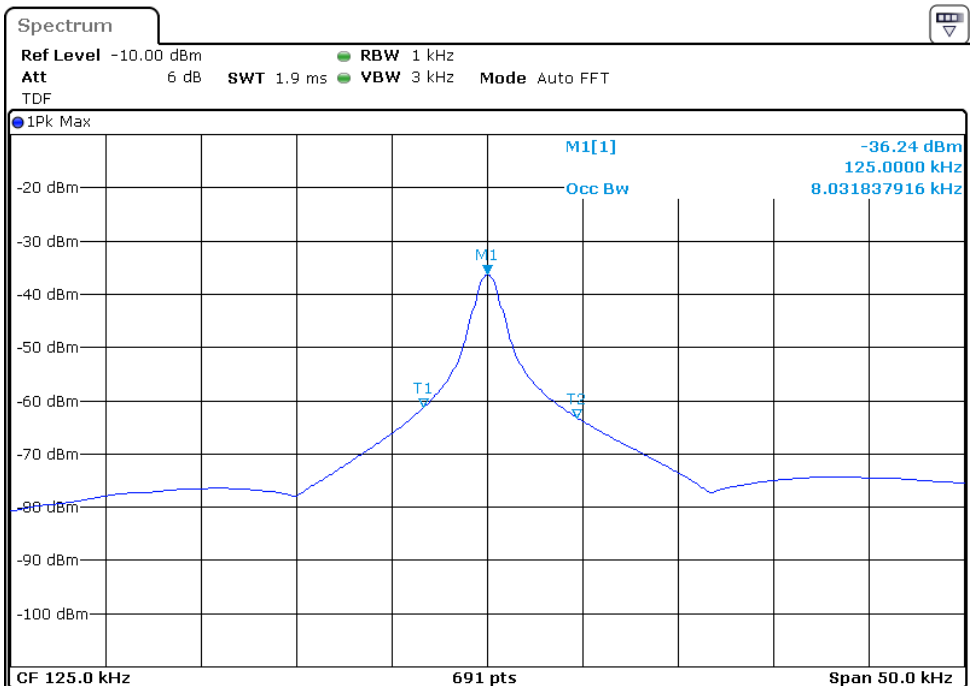
ANT 2_INT 2



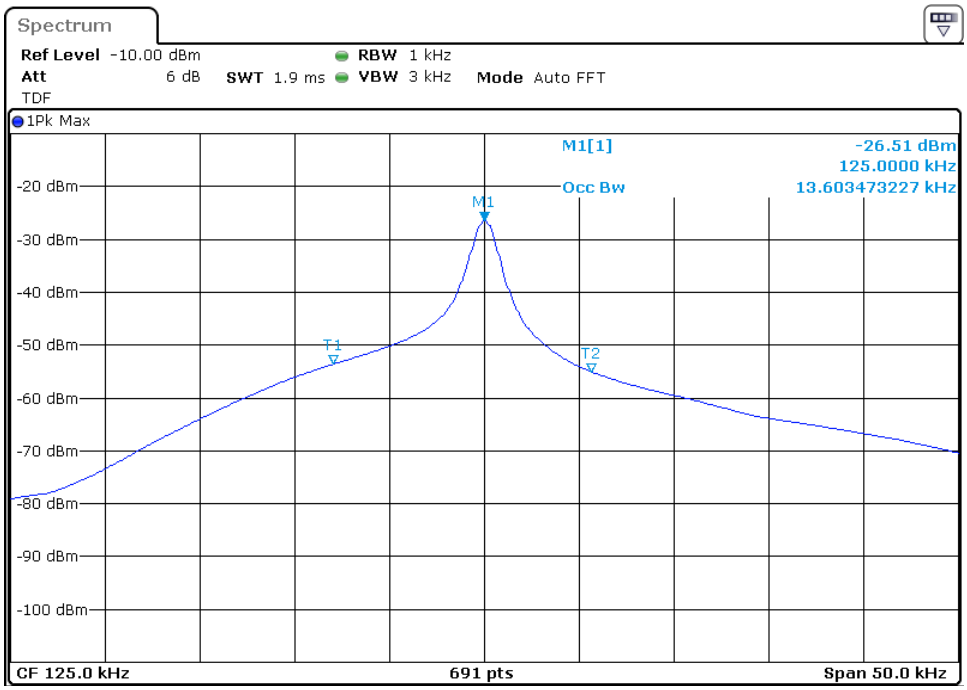
ANT 3_Bumper



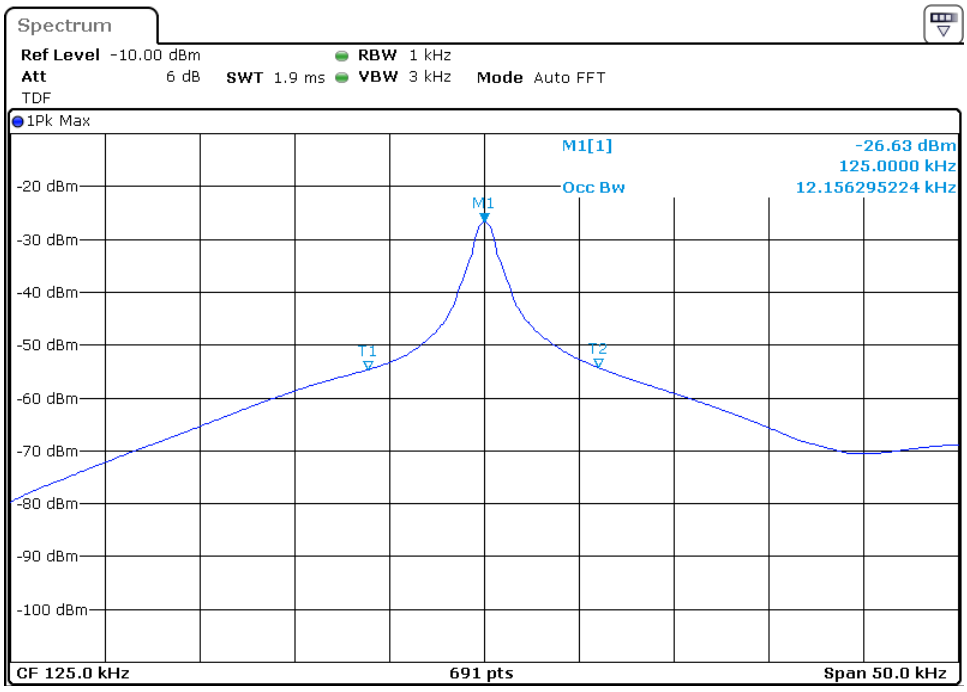
ANT 4_Immo



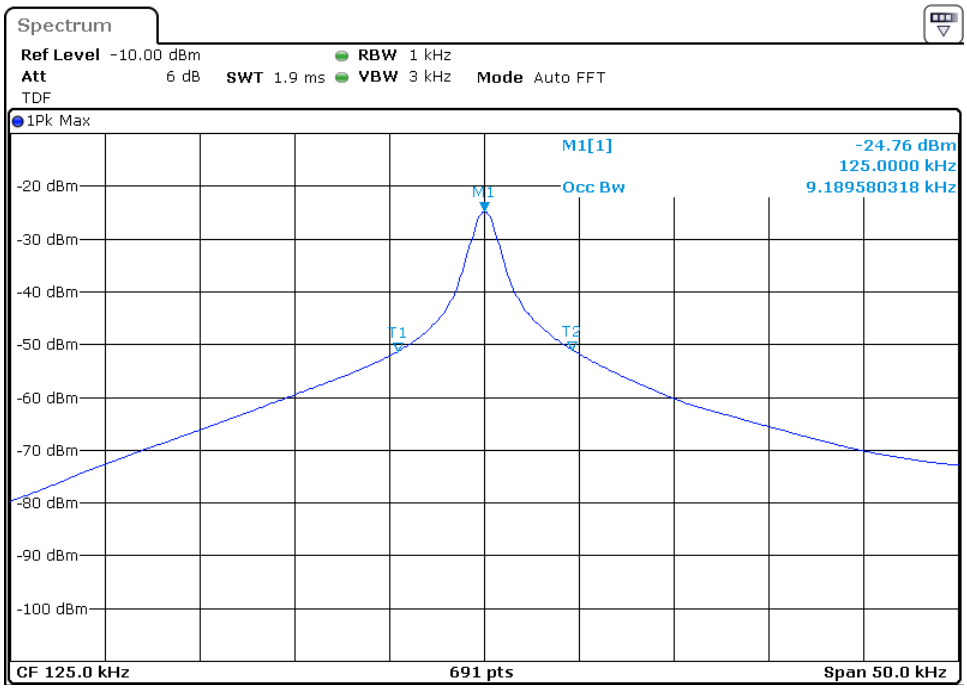
ANT 5_DRV



ANT 6_AST



ANT 7_Reav



5.6 Receiver Spurious Emission

5.6.1 Measurement Procedure

The receiver shall be operated in the normal receive mode near the mid-point of the band in which the receiver is designed to operate. Radiated emission measurements are to be performed on a test site registered with Industry Canada. As an alternative, the conducted measurement method may be used when the antenna is detachable. In such a case, the receiver spurious signal may be measured at the antenna port. If the receiver is super-regenerative, stabilize it by coupling to it an unmodulated carrier on the receiver frequency (antenna conducted measurement) or by transmitting an unmodulated carrier on the receiver frequency from an antenna in the proximity of the receiver (radiated measurement). Taking care not to overload the receiver, vary the amplitude and frequency of the stabilizing signal to obtain the highest level of the spurious emissions from the receiver. For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 ㎒, whichever is higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is higher, without exceeding 40 ㎓. For emissions below 1000 ㎒, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth. Above 1000 ㎒, measurements shall be performed using an average detector with a minimum resolution bandwidth of 1 ㎒.

5.6.2 Receiver Spurious Emission Limits

Receivers shall comply with the limits of spurious emissions set out in this section, measured over the frequency range determined in accordance with Section 4.10.

5.6.3 Radiated Limits

Radiated spurious emission measurements shall be performed with the receiver antenna connected to the receiver antenna terminals.
Spurious emissions from receivers shall not exceed the radiated limits shown in the table elow:

Table 2: Radiated Limits of Receiver Spurious Emissions

Frequency (㎒)	Field Strength (microvolts/m at 3 metres)*
30-88	100
88-216	150
216-960	200
Above 960	500

*Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 7.2.7.

5.6.4 Test Result

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 1㎓							
30.485	120	V	43.9	-17.1	26.8	40.0	13.2
66.618	120	V	40.7	-16.4	24.3	40.0	15.7
74.984	120	V	38.9	-19.1	19.8	40.0	20.2
79.470	120	V	38.7	-19.8	18.9	40.0	21.1
Above 1 ㎓	**Not Detected**	-	-	-	-	-	-

6. Test equipment used for test

	Description	Manufacturer	Model No.	Serial No.	Next Cal Date.
■	Temp & Humid Chamber	ESPEC CORP.	SH-641	92005476	14.12.23
■	DC Power Supply	Agilent	E3632A	MY40004399	15.01.09
■	Spectrum Analyzer	R&S	FSV30	100914	15.08.05
■	Signal generator	R&S	SMR40	100007	15.06.10
■	Test Receiver	R&S	ESCI7	100732	15.01.27
■	LOOP Antenna	R&S	HFH2-Z2	100355	15.06.19
■	Amplifier	SONOMA INSTRUMENT	310	284608	15.04.16
■	Bi-Log Antenna	SCHWARZBECK	VULB9168	440	16.08.28
■	3 dB Attenuator	HP	8491B	22981	15.03.04
■	Antenna Mast	Innco Systems	MA4000-EP	303	-
■	Horn antenna	ETS.lindgren	3117	155787	15.02.26
■	Broadband Preamplifier	SCHWARZBECK	BBV9718	9718-233	15.04.22
■	Bi-Log Antenna	Schwarzbeck	VULB9168	552	15.05.14
■	Amplifier	SONOMA INSTRUMENT	310	293004	15.09.25
■	Attenuator	HP	8491A	MY52460424	15.07.23
■	Antenna Mast	Innco Systems	MA4000-EP	-	-
■	Turn Table	Innco Systems	DT2000	-	-