FCC RF Exposure Evaluation

1. Product Information

FCC ID:	2AANYVG710	
Product name	InVehicle Gateway	
Test Model number	VG710	
Power supply	24 Vdc From Adapter Input AC120V/60Hz	
Modulation Type	WIFI	802.11b : DSSS 802.11g/n/a/ac : OFDM
	GPRS/EGPRS	GMSK, 8PSK
	WCDMA	BPSK
	LTE	QPSK, 16QAM
Antenna Type	Sucker Antenna For LTE Dipole Antenna For WIFI	
Antenna Gain	For WIFI: Dipole Antenna type with 3dBi gain For GSM/WCDMA/LTE: Sucker antenna Main antenna: 2.5dBi AUX-Only RX: 2.5dBi	
Hardware version	V12	
Software version	V1.0.0	
FCC Operation frequency	WIFI	2412MHz~2462MHz 5180MHz~5240MHz 5745MHz~5825MHz
	GPRS/EGPRS	850:824.2 MHz ~ 848.8 MHz 1900:1850.2 MHz ~ 1909.8MHz
	WCDMA	826.4 MHz ~ 846.6 MHz (FOR WCDMA 850) 1712.4 MHz ~ 1752.6 MHz (FOR WCDMA 1700) 1852.4 MHz ~ 1907.6 MHz (FOR WCDMA 1900)
	LTE	LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz LTE Band 13: 779.5 MHz ~ 784.5 MHz
Exposure category	General population/uncontrolled environment	
EUT Type	Production Unit	

2. Evaluation method and Limit

According to ANSI/IEEE C95.1-1992, the Criteria Listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	$*900/f^2$	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

The MPE was calculated at **20 cm** to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:
S = Power Density
P = Output Power at Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

According to KDB Publication 447498 D01, Section 7.2
Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to the MPE limit at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios.

3. Conducted Power

3.1 Test Setup Block Diagram for WWAN

3.2 Test Setup Block Diagram for WLAN

3.3 Test Procedure

WWAN:

1) The EUT was directly connected to the Base Station and antenna output port as show in the Block diagram;

2) Reading average power in RMS detector.

WLAN/RLAN

1) The EUT was directly connected to the spectrum analyser and antenna output port as show in the Block diagram;

2) Reading average power in RMS detector.

3.3 Measurement Equipment

Item	Equipment	Manufacturer	Model No.	Inventory No.	Last Cal.	Next Cal.
1	Base Station	R&S	CMW500	164998	2020-01-15	2021-01-14
2	Spectrum Analyzer	Keysight	N9010A	MY56070788	2020-01-15	2021-01-14

For WLAN

Frequency Range(MHz)	Mode	Rate	Declared maximum conducted peak Output Power(dBm)	Max. positive tolerance according to manufacturer
2412~2462	802.11b	1 Mbps	16	1
2412~2462	802.11g	6 Mbps	21	1
2412~2462	802.11n	MCS8	25	1

	HT20			
2422~2452	802.11n HT40	MCS8	23	1

For RLAN

Frequency Range(MHz)	Mode	Rate	Declared maximum conducted average Output Power(dBm)	Max. positive tolerance according to manufacturer
5180~5240	802.11a	6 Mbps	14	1
5180~5240	802.11 nHT20/ acVHT20	MCS8/ MCS8	17	1
5190~5230	802.11nHT40/ acVHT40	MCS8	17	1
5210~5210	802.11 acVHT80	MCS8	17	1
5745~5825	802.11a	6 Mbps	15.5	1.5
5745~5825	802.11 nHT20/ acVHT20	MCS8/ MCS8	18.5	1
5755~5795	802.11nHT40/ acVHT40	MCS8	19	1
5775~5775	802.11 acVHT80	MCS8	19	1

For WWAN

Band	Channel	PCL	Slot	Power(dBm)	EIRP/ERP(dBm)	Max. positive tolerance according to manufacturer
GPRS850	128	5	1	33.26	33.61	1
GPRS850	128	5	2	33.19	33.54	1
GPRS850	128	5	3	33.11	33.46	1
GPRS850	128	5	4	32.97	33.32	1
GPRS850	189	5	1	33.29	33.64	1
GPRS850	189	5	2	33.26	33.61	1
GPRS850	189	5	3	33.17	33.52	1
GPRS850	189	5	4	33.05	33.40	1
GPRS850	251	5	1	33.52	33.87	1
GPRS850	251	5	2	33.51	33.86	1
GPRS850	251	5	3	33.43	33.78	1
GPRS850	251	5	4	33.28	33.63	1
GPRS1900	512	0	1	29.80	32.30	1
GPRS1900	512	0	2	29.70	32.20	1
GPRS1900	512	0	3	29.62	32.12	1
GPRS1900	512	0	4	29.50	32.00	1
GPRS1900	661	0	1	30.05	32.55	1
GPRS1900	661	0	2	30.05	32.55	1
GPRS1900	661	0	3	30.00	32.50	1
GPRS1900	661	0	4	29.91	32.41	1
GPRS1900	810	0	1	30.17	32.67	1

GPRS1900	810	0	2	30.17	32.67	1
GPRS1900	810	0	3	30.13	32.63	1
GPRS1900	810	0	4	30.05	32.55	1

Band	Channel	PCL	Slot	Power(dBm)	EIRP/ERP(dBm)	Max. positive tolerance according to manufacturer
EGPRS850	128	8	1	26.75	27.10	1
EGPRS850	128	8	2	26.71	27.06	1
EGPRS850	128	8	3	26.46	26.81	1
EGPRS850	128	8	4	26.42	26.77	1
EGPRS850	189	8	1	26.85	27.20	1
EGPRS850	189	8	2	26.72	27.07	1
EGPRS850	189	8	3	26.54	26.89	1
EGPRS850	189	8	4	26.47	26.82	1
EGPRS850	251	8	1	27.23	27.58	1
EGPRS850	251	8	2	27.15	27.50	1
EGPRS850	251	8	3	27.09	27.44	1
EGPRS850	251	8	4	26.92	27.27	1
EGPRS1900	512	2	1	25.54	28.04	1
EGPRS1900	512	2	2	25.61	28.11	1
EGPRS1900	512	2	3	25.27	27.77	1
EGPRS1900	512	2	4	25.08	27.58	1
EGPRS1900	661	2	1	25.71	28.21	1
EGPRS1900	661	2	2	25.72	28.22	1
EGPRS1900	661	2	3	25.66	28.16	1
EGPRS1900	661	2	4	25.53	28.03	1
EGPRS1900	810	2	1	25.83	28.33	1
EGPRS1900	810	2	2	25.80	28.30	1
EGPRS1900	810	2	3	25.85	28.35	1
EGPRS1900	810	2	4	25.54	28.04	1

Band	Channel	Power(dBm)	EIRP/ERP(dBm)	Max. positive tolerance according to manufacturer
Band II	9262	23.71	26.21	1
Band II	9400	23.40	25.90	1
Band II	9538	23.72	26.22	1
Band IV	1312	23.88	26.38	1
Band IV	1413	24.14	26.64	1
Band IV	1513	24.07	26.57	1
Band V	4132	24.64	24.99	1
Band V	4182	24.46	24.81	1
Band V	4233	24.38	24.73	1

Band	Channel	SubTest	Power(dBm)	EIRP/ERP(dBm)	Max. positive tolerance according to manufacturer
Band II	9262	HSDPA_Sub1	22.71	25.21	1
Band II	9262	HSDPA_Sub2	22.03	24.53	1
Band II	9262	HSDPA_Sub3	22.22	24.72	1
Band II	9262	HSDPA_Sub4	22.21	24.71	1
Band II	9400	HSDPA_Sub1	22.45	24.95	1
Band II	9400	HSDPA_Sub2	21.91	24.41	1
Band II	9400	HSDPA_Sub3	21.94	24.44	1
Band II	9400	HSDPA_Sub4	21.69	24.19	1
Band II	9538	HSDPA_Sub1	22.83	25.33	1
Band II	9538	HSDPA_Sub2	22.19	24.69	1
Band II	9538	HSDPA_Sub3	22.17	24.67	1
Band II	9538	HSDPA_Sub4	22.06	24.56	1
Band IV	1312	HSDPA_Sub1	22.91	25.41	1
Band IV	1312	HSDPA_Sub2	22.40	24.90	1
Band IV	1312	HSDPA_Sub3	22.38	24.88	1
Band IV	1312	HSDPA_Sub4	22.41	24.91	1
Band IV	1413	HSDPA_Sub1	23.11	25.61	1
Band IV	1413	HSDPA_Sub2	22.51	25.01	1
Band IV	1413	HSDPA_Sub3	22.48	24.98	1
Band IV	1413	HSDPA_Sub4	22.67	25.17	1
Band IV	1513	HSDPA_Sub1	23.06	25.56	1
Band IV	1513	HSDPA_Sub2	22.58	25.08	1
Band IV	1513	HSDPA_Sub3	22.55	25.05	1
Band IV	1513	HSDPA_Sub4	22.57	25.07	1
Band V	4132	HSDPA_Sub1	23.62	23.97	1
Band V	4132	HSDPA_Sub2	23.15	23.50	1
Band V	4132	HSDPA_Sub3	23.15	23.50	1
Band V	4132	HSDPA_Sub4	23.18	23.53	1
Band V	4182	HSDPA_Sub1	23.48	23.83	1
Band V	4182	HSDPA_Sub2	22.97	23.32	1
Band V	4182	HSDPA_Sub3	23.00	23.35	1
Band V	4182	HSDPA_Sub4	22.95	23.30	1
Band V	4233	HSDPA_Sub1	23.43	23.78	1
Band V	4233	HSDPA_Sub2	22.79	23.14	1
Band V	4233	HSDPA_Sub3	22.93	23.28	1
Band V	4233	HSDPA_Sub4	22.91	23.26	1

Band	Channel	SubTest	Power(dBm)	EIRP/ERP(dBm)	Max. positive tolerance according to manufacturer
Band II	9262	HSUPA_Sub1	22.58	25.08	1
Band II	9262	HSUPA_Sub2	21.85	24.35	1
Band II	9262	HSUPA_Sub3	22.03	24.53	1
Band II	9262	HSUPA_Sub4	22.12	24.62	1
Band II	9262	HSUPA_Sub5	22.01	24.51	1
Band II	9400	HSUPA_Sub1	22.21	24.71	1
Band II	9400	HSUPA_Sub2	22.02	24.52	1
Band II	9400	HSUPA_Sub3	21.64	24.14	1
Band II	9400	HSUPA_Sub4	21.72	24.22	1
Band II	9400	HSUPA_Sub5	21.53	24.03	1
Band II	9538	HSUPA_Sub1	22.68	25.18	1
Band II	9538	HSUPA_Sub2	22.13	24.63	1
Band II	9538	HSUPA_Sub3	21.86	24.36	1
Band II	9538	HSUPA_Sub4	21.82	24.32	1
Band II	9538	HSUPA_Sub5	21.79	24.29	1
Band IV	1312	HSUPA_Sub1	22.72	25.22	1
Band IV	1312	HSUPA_Sub2	22.31	24.81	1
Band IV	1312	HSUPA_Sub3	22.43	24.93	1
Band IV	1312	HSUPA_Sub4	22.29	24.79	1
Band IV	1312	HSUPA_Sub5	22.26	24.76	1
Band IV	1413	HSUPA_Sub1	22.95	25.45	1
Band IV	1413	HSUPA_Sub2	22.52	25.02	1
Band IV	1413	HSUPA_Sub3	22.38	24.88	1
Band IV	1413	HSUPA_Sub4	22.21	24.71	1
Band IV	1413	HSUPA_Sub5	22.11	24.61	1
Band IV	1513	HSUPA_Sub1	22.85	25.35	1
Band IV	1513	HSUPA_Sub2	22.42	24.92	1
Band IV	1513	HSUPA_Sub3	22.19	24.69	1
Band IV	1513	HSUPA_Sub4	22.42	24.92	1
Band IV	1513	HSUPA_Sub5	22.15	24.65	1
Band V	4132	HSUPA_Sub1	22.96	23.31	1
Band V	4132	HSUPA_Sub2	22.83	23.18	1
Band V	4132	HSUPA_Sub3	22.74	23.09	1
Band V	4132	HSUPA_Sub4	22.91	23.26	1
Band V	4132	HSUPA_Sub5	22.86	23.21	1
Band V	4182	HSUPA_Sub1	23.32	23.67	1
Band V	4182	HSUPA_Sub2	23.13	23.48	1
Band V	4182	HSUPA_Sub3	22.82	23.17	1
Band V	4182	HSUPA_Sub4	22.73	23.08	1
Band V	4182	HSUPA_Sub5	22.59	22.94	1
Band V	4233	HSUPA_Sub1	23.21	23.56	1

Band V	4233	HSUPA_Sub2	22.81	23.16	1
Band V	4233	HSUPA_Sub3	22.76	23.11	1
Band V	4233	HSUPA_Sub4	22.51	22.86	1
Band V	4233	HSUPA_Sub5	22.38	22.73	1

Band	Bandwidth	Modulation	Channel	RB Configuration	Result(dBm)	EIRP/ ERP(dBm)	Tolerance According to manufacturer
Band2	1.4MHz	QPSK	18607	1RB#0	23.01	25.51	2
Band2	3MHz	QPSK	18615	1RB#14	22.81	25.31	2
Band2	5MHz	QPSK	19175	1RB#0	23.13	25.63	2
Band2	10MHz	QPSK	18650	1RB#0	23.03	25.53	2
Band2	15MHz	QPSK	18675	1RB#0	23.28	25.78	2
Band2	20MHz	QPSK	18700	1RB#0	23.47	25.97	2
Band4	1.4MHz	QPSK	19957	1RB#0	23.29	25.79	2
Band4	3MHz	QPSK	20175	1RB#0	23.37	25.87	2
Band4	5MHz	QPSK	20175	1RB#0	23.41	25.91	2
Band4	10MHz	QPSK	20175	1RB#0	23.58	26.08	2
Band4	15MHz	QPSK	20175	1RB#0	23.87	26.37	2
Band4	20MHz	QPSK	20175	1RB#0	24.13	26.63	2
Band5	1.4MHz	QPSK	20407	1RB#2	23.79	24.14	1.5
Band5	3MHz	QPSK	20525	1RB#8	23.72	24.07	1.5
Band5	5MHz	QPSK	20425	1RB#24	23.82	24.17	1.5
Band5	10MHz	QPSK	20525	1RB#24	23.66	24.01	1.5
Band12	1.4MHz	QPSK	23017	1RB#0	23.02	23.37	1.5
Band12	3MHz	QPSK	23025	1RB#14	22.97	23.32	1.5
Band12	5MHz	QPSK	23035	1RB#12	23.00	23.35	1.5
Band12	10MHz	QPSK	23060	1RB#24	23.01	23.36	1.5
Band13	5MHz	QPSK	23205	1RB#12	21.76	22.61	1.5
Band13	10MHz	QPSK	23230	1RB#24	21.78	22.63	1.5

4. Evaluation Results

Collocated WWAN and other Wireless							For FCC	
Band	**Frequency (MHz)**	**Antenna Gain (dBi)**	**Maximum Power (dBm)**	**Maximum EIRP (dBm)**	**Maximum EIRP (W)**	**Average EIRP (mW)**	**Power Density at 20cm (mW/cm^2)**	**Limit (mW/cm^2)**
GPRS 850 (1 Tx slot)	824	2.5	34.0	34.350	2.729	562.341	0.112	0.549

EGPRS 850 (1 Tx slot)	824	2.5	28.0	28.350	0.685	141.254	0.028	0.549
GPRS 1900 (1 Tx slot)	1850	2.5	31.0	33.500	2.239	281.838	0.056	1.000
EGPRS 1900 (1 Tx slot)	1850	2.5	27.0	29.500	0.891	112.202	0.022	1.000
WCDMA Band 5	804	2.5	25.0	25.360	0.344	562.341	0.112	0.536
WCDMA Band 4	1710	2.5	25.0	27.500	0.562	562.341	0.112	1.000
WCDMA Band 2	1850	2.5	25.0	27.500	0.562	562.341	0.112	1.000
LTE Band 12	700	2.5	23.1	23.460	0.222	363.078	0.072	0.466
LTE Band 5	824	2.5	24.0	24.360	0.273	446.684	0.089	0.549
LTE Band 4	1710	2.5	24.5	27.000	0.501	501.187	0.100	1.000
LTE Band 2	1850	2.5	24.00	26.500	0.447	446.684	0.089	1.000
LTE Band 13	777	2.5	22.0	22.360	0.172	281.838	0.056	0.518
2.4GHz WLAN	2412	3.0	26.0	29.000	0.794	794.328	0.158	1.000
5.8GHz RLAN	5745	3.0	20.0	23.000	0.200	199.526	0.040	1.000
5.2GHz RLAN	5180	3.0	18.0	21.000	0.126	125.893	0.025	1.000

For WIFI 2.4G, WIFI 5G and LTE can transmit simultaneously, the total evaluation result as below:

Collocated WWAN and other Wireless							For FCC	
No.	**Configurations**	**Maximum MPE Value (mw/cm^2)**				**Limits(mw/cm^2)**	**Margin(mw/cm^2)**	**PASS/Fail**
		WWAN	**WLAN**	**RLAN**	**Transmit simultaneously**			
1	GPRS 850	0.112	0.158	0.040	0.402	1	0.60	PASS
2	GPRS 1900	0.056	0.158	0.040	0.254	1	0.75	PASS
3	WCDMA Band 5	0.112	0.158	0.040	0.407	1	0.59	PASS
4	WCDMA Band 4	0.112	0.158	0.040	0.310	1	0.69	PASS
5	WCDMA Band 2	0.112	0.158	0.040	0.310	1	0.69	PASS
6	LTE Band 12	0.072	0.158	0.040	0.353	1	0.65	PASS
7	LTE Band 5	0.089	0.158	0.040	0.360	1	0.64	PASS
8	LTE Band 4	0.100	0.158	0.040	0.298	1	0.70	PASS
9	LTE Band 2	0.089	0.158	0.040	0.287	1	0.71	PASS
10	LTE Band 13	0.056	0.158	0.040	0.306	1	0.69	PASS

Remark:

1. Output power including tune up tolerance;

5. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure.

.....THE END OF REPORT.....