

Test report No:
 NIE: 59563RAN.002A1

Assessment report

RF EXPOSURE REPORT ACCORDING TO FCC 47 CFR Part 2.1093 ISED RSS -102 Issue 5:2015

Identification of item tested	Communication system module for Personal Protections Equipment (PPE) including BT, Proprietary wireless intercom communications and Level Dependent protection.
Trademark	Pro1
Model and /or type reference	Pro1
Other identification of the product	FCC ID: Q95ER24 IC: 4668A-ER24 HW Version: 1.0 SW Version: 1.0
Features	BT 4.2, Proprietary wireless intercom, Level Dependent.
Manufacturer	CARDO SYSTEMS LTD 811 E. Plano Parkway, suite 110A. Plano TX. 75074, USA.
Test method requested, standard	FCC 47 CFR Part 2.1093. Radiofrequency radiation exposure evaluation: portable devices. ISED RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager
Date of issue	2019-07-04
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Data provided by the client

The sample consists of a PCB based module that can be integrated into Personal Protections Equipment (PPE). The module got 2 radios – BT 4.2 Radio and 2.4GHz Proprietary wireless intercom communications radio. Module can also support aux Audio input of 2 way radio. Module can also support Level Dependent electronics supporting EN352-4.

DEKRA declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Identification of the client

CARDO SYSTEMS LTD

811 E. Plano Parkway, suite 110A. Plano TX. 75074, USA.

Document history

Report number	Date	Description
59563RAN.002	2019-04-17	First release
59563RAN.002A1	2019-07-04	Second release. Bluetooth antenna gain updated to 2.0 dBi instead of 2.2 dBi

General description of the device under evaluation

The device under evaluation consists of a PCB based module that can be integrated into Personal Protections Equipment (PPE). The module integrates two radios: Bluetooth 4.2 radio and 2.4GHz Proprietary wireless intercom communications radio.

The equipment specifications declared by the manufacturer for each supported feature are:

Mode	Frequency (MHz)	Max. output power (dBm)	Duty Cycle (%)	Max. average output power (dBm)	Antenna Peak gain (dBi)	Cable Loss (dB)	Average E.I.R.P (dBm)	Average E.I.R.P (mW)
Bluetooth BR/EDR/LE	2402- 2480	4.3	83.3	3.51	+2.0	N/A	5.51	3.55
Proprietary	2405- 2470	19.0	3.5	4.44	+2.3	1.3	5.44	3.5

Table 1: Declared output power and antenna gain values

Assessment summary

Radiofrequency radiation exposure limits					
FCC 47 CFR § 2.1093 & ISED RSS-102 Issue 5 (2015-03)					
Band (MHz)	Technology	Band	VERDICT (Pass/Fail)	FCC minimum distance compliance (mm)	ISED minimum distance compliance (mm)
2450	Bluetooth BR/EDR/LE	ISM	Pass	5	5
2450	Proprietary	ISM	Pass	5	5
2450	Simultaneous Transmission Bluetooth + Proprietary	ISM	Pass	5	15

Table 2: Assessment summary

Appendix A: FCC RF Exposure

FCC SAR test exclusion considerations for portable devices

As stated by the FCC (47 CFR §2.1093), human exposure to RF emissions from portable devices, which are defined as transmitting devices to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user, must be evaluated with respect to the FCC-adopted limits for SAR.

According to FCC OET KDB 447498 D01 General RF Exposure Guidance:

Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition is satisfied.

- For distances ≤ 50 mm

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$$\left[\frac{\text{max. power of channel, including tune-up tolerance, mW}}{[\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR}} \right] \cdot$$

Where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table:

MHz	5	10	15	20	25	30	35	40	45	50	mm
150	39	77	116	155	194	232	271	310	349	387	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	164	192	219	246	274	
450	22	45	67	89	112	134	157	179	201	224	
835	16	33	49	66	82	98	115	131	148	164	
900	16	32	47	63	79	95	111	126	142	158	
1500	12	24	37	49	61	73	86	98	110	122	
1900	11	22	33	44	54	65	76	87	98	109	
2450	10	19	29	38	48	57	67	77	86	96	
3600	8	16	24	32	40	47	55	63	71	79	
5200	7	13	20	26	33	39	46	53	59	66	
5400	6	13	19	26	32	39	45	52	58	65	
5800	6	12	19	25	31	37	44	50	56	62	

Table 3: SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

- For distances > 50 mm

For 100 MHz to 6 GHz frequencies and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following:

1) [Power allowed at numeric threshold for 50 mm in table 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz

2) [Power allowed at numeric threshold for 50 mm in table 1) + (test separation distance - 50 mm)·10] mW, at > 1500 MHz and ≤ 6 GHz

Approximate SAR test exclusion power thresholds at selected frequencies and test separation distances are illustrated in the following table

MHz	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	mm
100	474	481	487	494	501	507	514	521	527	534	541	547	554	561	567	SAR Test Exclusion Threshold (mW)
150	387	397	407	417	427	437	447	457	467	477	487	497	507	517	527	
300	274	294	314	334	354	374	394	414	434	454	474	494	514	534	554	
450	224	254	284	314	344	374	404	434	464	494	524	554	584	614	644	
835	164	220	275	331	387	442	498	554	609	665	721	776	832	888	943	
900	158	218	278	338	398	458	518	578	638	698	758	818	878	938	998	
1500	122	222	322	422	522	622	722	822	922	1022	1122	1222	1322	1422	1522	
1900	109	209	309	409	509	609	709	809	909	1009	1109	1209	1309	1409	1509	
2450	96	196	296	396	496	596	696	796	896	996	1096	1196	1296	1396	1496	
3600	79	179	279	379	479	579	679	779	879	979	1079	1179	1279	1379	1479	
5200	66	166	266	366	466	566	666	766	866	966	1066	1166	1266	1366	1466	
5400	65	165	265	365	465	565	665	765	865	965	1065	1165	1265	1365	1465	
5800	62	162	262	362	462	562	662	762	862	962	1062	1162	1262	1362	1462	

Table 4: SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and > 50 mm

- For frequencies below 100 MHz

The following may be considered for SAR test exclusion:

1) For test separation distances > 50 mm and < 200 mm, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by [1 + log(100/f(MHz))]

2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by ½

Approximate SAR test exclusion power thresholds at selected frequencies and test separation distances are illustrated in the following table

MHz	< 50	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	m m
100	237	474	481	487	494	501	507	514	521	527	534	541	547	554	561	567	m W
50	308	617	625	634	643	651	660	669	677	686	695	703	712	721	729	738	
10	474	948	961	975	988	1001	1015	1028	1041	1055	1068	1081	1095	1108	1121	1135	
1	711	1422	1442	1462	1482	1502	1522	1542	1562	1582	1602	1622	1642	1662	1682	1702	
0.1	948	1896	1923	1949	1976	2003	2029	2056	2083	2110	2137	2164	2191	2218	2245	2272	
0.05	1019	2039	2067	2095	2123	2151	2179	2207	2235	2263	2291	2319	2347	2375	2403	2431	
0.01	1185	2370	2403	2437	2470	2504	2537	2571	2604	2638	2671	2705	2739	2773	2807	2841	

Table 5: SAR Test Exclusion Thresholds for frequencies < 100 MHz

FCC Evaluation Results

The evaluation according to a minimum intended use distance of 0 mm (5mm applied for the evaluation according to KDB 447498 D01 General RF Exposure Guidance) will be as follow:

Technology	Max Declared Conducted Output Power (dBm)		Min. Test Distance (mm)	Freq. (GHz)	Result	Test Exclusion
	(dBm)	(mW)				
Bluetooth BR/EDR/LE	3.51	2.24	5	2.48	0.71	Pass
Proprietary	4.44	2.78	5	2.47	0.88	Pass

Table 6: FCC Evaluation Result

Both computed values are < 3.0, so according to KDB 447498 D01 – General RF Exposure Guidance, these modes qualify for Standalone SAR test exclusion for 1-g SAR and 10-g Extremity SAR.

Simultaneous transmission assessment:

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^n \frac{S_i}{SAR_{exclusion\ threshold_i}} < 1$$

Where

S_i is the computed value from SAR test exclusion formula of each source;
 $SAR_{exclusion\ threshold_i}$ is the limit for test exclusion.

The device under evaluation is able to transmit simultaneously using Bluetooth and Proprietary transmitters, therefore the worst case multiple frequencies calculation will be as follow:

$$\frac{0.71}{3} + \frac{0.88}{3} = 0.53 < 1 \text{ Limit}$$

As the compliance criteria is fulfilled, the device is in compliance with the KDB 447498 D01.

Appendix B: ISED RF Exposure

ISED SAR test exclusion considerations

According to “RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)”, paragraph “2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation”, the device operates below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1:

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance^{4,5}

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

ISED Evaluation Results

According to paragraph “2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation”, the exemption limits for the applicable separation distance have been calculated by linear interpolation for the following operating frequencies:

Technology	Frequency (MHz)	Simultaneous transmission not enabled		Simultaneous transmission enabled	
		Distance (mm)	Exemption Limits (mW)	Distance (mm)	Exemption Limits (mW)
Bluetooth	2402	5	4.26	15	15.26
	2440	5	4.05	15	15.05
	2480	5	3.95	15	15.03
Proprietary	2405	5	4.25	15	15.25
	2440	5	4.05	15	15.05
	2470	5	3.97	15	15.02

Table 7: ISED Exemption Limits

When simultaneous transmission between Bluetooth and Proprietary is disabled, “Exemption Limits for Routine Evaluation – SAR Evaluation” for the minimum compliance distance of 5mm is met. The evaluation and exemption limits for each operating frequency and technology will be as follow:

Technology	Frequency (MHz)	Max. average EIRP (dBm)	Max. average EIRP (mW)	ISED Exemption Limits (mW)	Verdict
Bluetooth BR/EDR/LE	2402	5.51	3.55	4.26	Pass
	2440	5.51	3.55	4.05	Pass
	2480	5.51	3.55	3.95	Pass
Proprietary	2405	5.44	3.50	4.25	Pass
	2440	5.44	3.50	4.05	Pass
	2470	5.44	3.50	3.97	Pass

Table 8: ISED Evaluation Result

As all operating frequencies comply with SAR Test Exclusion Thresholds, according to the standard “ISED RSS-102 Issue 5 (2015-03)”, SAR testing is not required.

Simultaneous transmission assessment:

When simultaneous transmission between Bluetooth and Proprietary is enabled, “Exemption Limits for Routine Evaluation – SAR Evaluation” is met at 15mm.

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^n \frac{S_i}{15mm-SAR\text{exclusionthreshold}_i} < 1$$

Where

S_i is the maximum output power of each source;
 $15mm-SAR\text{exclusion threshold}_i$ is the limit for test exclusion.

The device under evaluation is able to transmit simultaneously using Bluetooth and Proprietary transmitters, therefore the worst case multiple frequencies calculation will be as follow:

$$\frac{3.55}{15.03} + \frac{3.50}{15.02} = 0.47 < 1\text{Limit}$$

As the compliance criteria is fulfilled, the device is in compliance with the ISED RSS-102 Issue 5 (2015-03).