



Radio Frequency Exposure Evaluation Report

For:
Collins Aerospace

Marketing Name:
CCR-3000

Model Name:
AP-151 Rev A

Product Description:
Cabin Connect Router

FCC ID: Contain N7NEM91
Contain TK4WLE3002HX
IC: Contain 2417C-EM91
Contain 7849A-WLE3002HX

Applied Rules and Standards:
CFR Part Part1 (1.1307 & 1.1310), Part 2 (2.1091),
FCC KDB 447498 D01 General RF Exposure Guidance v06
ISED RSS-102 Issue 6

REPORT #: EMC_ARINC_001_23001_RF_Exposure

DATE: 2024-07-25



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1 **Assessment**

This RF Exposure evaluation report provides evidence for compliance of the below identified device with the RF Exposure limits for mobile devices as defined in FCC CFR Part 1 (1.1307 & 1.1310), Part 2 (2.1091) and IC standard RSS-102 issue 6 under worst case conditions (measured or rated RF output power, antenna gain, distance towards human body, multiple transmitter information as presented by the applicant). In addition, maximum antenna gain or minimum distance towards the human body is calculated respectively, where relevant.

The device meets the limits as stipulated by the above given FCC and IC rule parts based on available specifications for worst case conditions at 20cm distance to the body.

Company	Description	Model #
Collins Aerospace	Cabin Connect Router	AP-151 Rev A

Responsible for the Report:

2024-07-25	Compliance	Cheng Song (EMC Engineer)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
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EMC Lab Manager:	Alvin Ilarina
Responsible Project Leader:	Rami Saman

2.2 Identification of the Client

Client's Name:	Collins Aerospace
Street Address:	1901 W 143rd St.
City/Zip Code	Burnsville MN 55306
Country	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	CCX Technologies Inc.
Manufacturers Address:	1565 Carling Ave, Suite 700
City/Zip Code	Ottawa, Ontario
Country	Canada

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	AP-151 Rev A
Marketing Name:	CCR-3000
HW Version:	822-3742-00x
SW Version:	1.9.0.2
FCC ID:	Contain N7NEM91 Contain TK4WLE3002HX
IC:	Contain 2417C-EM91 Contain 7849A-WLE3002HX
FWIN:	N/A
HVIN:	WLE3002HX
PMN:	N/A
Product Description:	Cabin Connect Router
Power Supply / Rated operating Voltage Range:	20.5/28/32.2 VDC
Operating Temperature Range	-40C +70C
Sample Revision	production-red label
EUT Dimensions	5.18 inches x 4.64 inches x 1.90 inches (L x W x H) (132 mm x 118mm x 49mm)
Note: All information provided by the client.	

3.2 Radio Specifications

Embedded Radio Technologies	Sierra Wireless EM9191, Compex Systems WLE3002HX
Frequency Range / number of channels:	Cell LTE/3G/4G: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 34, 38, 39, 40, 41, 42, 43, 46, 48, 66, 7 5G NR: n2, n5, n7, n25, n38, n41, n48, n66, n71, n77, n78 WiFi: 2.4GHz/5GHz
Antenna Type / Gain	IK-201, IK -200; The antenna specifications and gain details can be found in the datasheets provided by the client.
Note: All information provided by the client.	

4. RF Exposure Limits and FCC and IC Basic Rules

4.1 Routine Environmental Evaluation Categorical Exclusion Limits according to FCC 1.1307(b)(3)(i)(B), and FCC 1.1307(b)(3)(ii)(B)

Single RF sources is exempt if the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

4.2 Field reference level (FRL) exposure exemption limits according to RSS-102 Issue 6, section 6.6

Field reference level (FRL) exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm (i.e. mobile devices), except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum EIRP. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the EIRP was derived.

5 Evaluations

5.1 Analysis of RF Exposure for simultaneous transmission

FCC RF Exposure

Radio	Tech-Band	Freq-Low _[GHz]	Pwr _[dBm]	Ant-G _[dBi]	EIRP _[W]	ERP _[mW]	FCC 2.1093(c)(1) P _{th} _[mW] = ERP _{20cm}	P/P _{th} ratio
Cellular	UMTS II	1.8524	24.50	3.40	0.617	375.84	3060.00	0.123
	UMTS IV	1.7124	24.50	3.40	0.617	375.84	3060.00	0.123
	UMTS V	0.8264	24.50	1.00	0.355	216.27	1685.86	0.167
	LTE 2	1.8507	24.00	3.40	0.550	334.97	3060.00	0.109
	LTE 4	1.7107	24.00	3.40	0.550	334.97	3060.00	0.109
	LTE 5	0.8247	24.00	1.00	0.316	192.75	1682.39	0.149
	LTE 7	2.5025	24.80	2.90	0.589	358.92	3060.00	0.117
	LTE 12	0.6997	24.00	0.50	0.282	171.79	1427.39	0.176
	LTE 13	0.7795	24.00	0.50	0.282	171.79	1590.18	0.158
	LTE 14	0.7905	24.00	0.50	0.282	171.79	1612.62	0.156
	LTE 17	0.7065	24.00	0.50	0.282	171.79	1441.26	0.174
	LTE 25	1.8507	24.00	3.40	0.550	334.97	3060.00	0.109
	LTE 26	0.8190	24.00	1.00	0.316	192.75	1670.76	0.150
	LTE 30	2.3075	24.00	3.40	0.550	334.97	3060.00	0.109
	LTE 41	2.4985	24.80	2.90	0.589	358.92	3060.00	0.117
	LTE 48	3.5525	24.80	4.30	0.813	495.45	3060.00	0.162
	LTE 66	1.7107	24.00	3.40	0.550	334.97	3060.00	0.109
	LTE 71	0.6655	24.00	-0.70	0.214	130.32	1357.62	0.185
	5G NR n2 (NSA)	1.8550	24.50	3.40	0.617	375.84	3060.00	0.123
	5G NR n5 (NSA)	0.8290	24.50	1.00	0.355	216.27	1691.16	0.167
	5G NR n7 (NSA)	2.5050	24.50	2.90	0.550	334.97	3060.00	0.109
	5G NR n25 (NSA)	1.8550	24.50	3.40	0.617	375.84	3060.00	0.123
	5G NR n41 (NSA)	2.5010	24.50	2.90	0.550	334.97	3060.00	0.109
	5G NR n66 (NSA)	1.7150	24.50	3.40	0.617	375.84	3060.00	0.123
	5G NR n71 (NSA)	0.6680	24.50	-0.70	0.240	146.22	1362.72	0.207
Radio	Tech-Band	Freq-Low _[GHz]	Pwr _[dBm]	AG _[dBi]	EIRP _[W]	ERP _[mW]	FCC 2.1093(c)(1) P _{th} _[mW] = ERP _{20cm}	P/P _{th} ratio
WLAN	2.4 GHz	2.4120	22.75	5.70	0.700	426.58	3060.00	0.139
	5 GHz UNII-1	5.1800	21.46	5.29	0.473	288.40	3060.00	0.094
	5 GHz UNII-2a	5.2600	16.25	5.29	0.143	86.90	3060.00	0.028
	5 GHz UNII-2c	5.5000	19.03	4.03	0.202	123.31	3060.00	0.040
	5 GHz UNII-3	5.7450	24.60	4.03	0.729	444.63	3060.00	0.145

Note1: The values of the output power are leveraged from the
WLAN module report with report no. 2301RSU014-U4 and
Cellular module report with report no. FA021501

Note2: The antenna gain values are provided by client in the document "Gains"

Note3: The calculation is based on the distance of 20cm

Verdict:

The worst-case scenario for simultaneous transmission involves 5G NR n71, WLAN 2.4GHz, and WiFi 5GHz in the UNII-3 band. The sum of the fractional contributions to the applicable thresholds is 0.492, which is less than 1. Therefore, the equipment complies with RF exposure exemption requirements for a distance of 20 cm.

IC RF Exposure

Radio	Tech-Band	Freq-Low [MHz]	Pwr _[dBm]	Power _[W]	Ant-G [dBi]	EIRP _[W]	Exemption limit for Routine Evaluation	Exemption (Y/N)	EIRP _[W] /Limit
Cellular	UMTS II	1852.40	24.50	0.28	3.40	0.62	2.24	Yes	0.275
	UMTS IV	1712.40	24.50	0.28	3.40	0.62	2.12	Yes	0.290
	UMTS V	826.40	24.50	0.28	1.00	0.35	1.29	Yes	0.275
	LTE 2	1850.70	24.00	0.25	3.40	0.55	2.24	Yes	0.245
	LTE 4	1710.70	24.00	0.25	3.40	0.55	2.12	Yes	0.259
	LTE 5	824.70	24.00	0.25	1.00	0.32	1.29	Yes	0.245
	LTE 7	2502.50	24.80	0.30	2.90	0.59	2.75	Yes	0.214
	LTE 12	699.70	24.00	0.25	0.50	0.28	1.15	Yes	0.245
	LTE 13	779.50	24.00	0.25	0.50	0.28	1.24	Yes	0.227
	LTE 14	790.50	24.00	0.25	0.50	0.28	1.25	Yes	0.225
	LTE 17	706.50	24.00	0.25	0.50	0.28	1.16	Yes	0.243
	LTE 25	1850.70	24.00	0.25	3.40	0.55	2.24	Yes	0.245
	LTE 26	819.00	24.00	0.25	1.00	0.32	1.28	Yes	0.246
	LTE 30	2307.50	24.00	0.25	3.40	0.55	2.60	Yes	0.211
	LTE 41	2498.50	24.80	0.30	2.90	0.59	2.75	Yes	0.214
	LTE 48	3552.50	24.80	0.30	4.30	0.81	3.50	Yes	0.232
	LTE 66	1710.70	24.00	0.25	3.40	0.55	2.12	Yes	0.259
	LTE 71	665.50	24.00	0.25	-0.70	0.21	1.11	Yes	0.192
	5G NR n2 (NSA)	1855.00	24.50	0.28	3.40	0.62	2.24	Yes	0.275
	5G NR n5 (NSA)	829.00	24.50	0.28	1.00	0.35	1.29	Yes	0.274
WLAN	5G NR n7 (NSA)	2505.00	24.50	0.28	2.90	0.55	2.75	Yes	0.200
	5G NR n25 (NSA)	1855.00	24.50	0.28	3.40	0.62	2.24	Yes	0.275
	5G NR n41 (NSA)	2501.00	24.50	0.28	2.90	0.55	2.75	Yes	0.200
	5G NR n66 (NSA)	1715.00	24.50	0.28	3.40	0.62	2.13	Yes	0.290
	5G NR n71 (NSA)	668.00	24.50	0.28	-0.70	0.24	1.12	Yes	0.215
	2.4 GHz	2412.00	22.75	0.1884	5.70	0.70	2.68	Yes	0.261
	5 GHz UNII-1	5180.00	21.46	0.1400	5.29	0.47	4.53	Yes	0.105
	5 GHz UNII-2a	5260.00	16.25	0.0422	5.29	0.14	4.57	Yes	0.031
	5 GHz UNII-2c	5500.00	19.03	0.0800	4.03	0.20	4.71	Yes	0.043
	5 GHz UNII-3	5745.00	24.60	0.2884	4.03	0.73	4.86	Yes	0.150

Note1: The values of the output power are leveraged from the
WLAN module report with report no. 2301RSU014-U4 and
Cellular module report with report no. FA021501

Note2: The antenna gain values are provided by client in the document "Gains"

Note3: The calculation is based on the distance of 20cm

Verdict:

The worst-case scenario for simultaneous transmission involves 5G NR n66, WLAN 2.4GHz, and WiFi 5GHz in the UNII-3 band. The Total Exposure Ratio calculated is 0.701, which is below the limit of 1. Therefore, the equipment complies with RF exposure exemption requirements for a distance of 20 cm.

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FCC ID: Contain N7NEM91
Contain TK4WLE3002HX



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IC: Contain 2417C-EM91
Contain 7849A-WLE3002HX

6 History

Date	Report Name	Changes to report	Prepared by
2024-07-25	EMC_ARINC_001_23001_RF_Exposure	Initial Version	Cheng Song

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