Radio Exposure Evaluation Report

Contains FCC ID	:	**RI7LN920**
FCC ID		**UDX-600173020**
Equipment	:	**Z4C Teleworker Gateway**
Brand Name	:	**CISCO**
Model Name	:	**Z4C-HW**
Applicant	:	**Cisco Systems, Inc. 170 West Tasman Drive, San Jose, CA 95134 USA**
Manufacturer	:	**Cisco Systems, Inc. 170 West Tasman Drive, San Jose, CA 95134 USA**
Standard	:	**47 CFR FCC Part 2 Subpart J, section 2.1091**

The product was received on Oct. 25, 2024, and testing was started from Nov. 04, 2024 and completed on Nov. 19, 2024. We, SPORTON INTERNATIONAL INC. Hsinhua Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in 47 CFR FCC Part 2 Subpart J, section 2.1091 and shown compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. Hsinhua Laboratory, the test report shall not be reproduced except in full.

Approved by: Jackson Tsai

SPORTON INTERNATIONAL INC. Hsinhua Laboratory
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History of this test report

Report No.	Version	Description	Issued Date
FA4O2509	01	Initial issue of report	Feb. 04, 2025

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
2	-	Exposure evaluation	PASS	-

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
None

Reviewed by: Barry Hsiao

Report Producer: Debby Hung

1 General Description

1.1 Information

1.1.1 EUT General Information

RF General Information			
Evaluation Mode	**Frequency Range (MHz)**	**Operating Frequency (MHz)**	**Modulation Type**
2.4GHz WLAN	2400-2483.5	2412-2462	802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) VHT: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
5GHz WLAN	5150-5250 5250-5350 5470-5725 5725-5850	5180-5240 5260-5320 5500-5700 5745-5825	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)

RF General Information		
Evaluation Mode	**Frequency Range (MHz)**	**Modulation Type**
LTE Band 2	1850 - 1910	LTE: QPSK / 16QAM / 64QAM / 256QAM
LTE Band 4	1710 - 1755	
LTE Band 5	824 - 849	
LTE Band 7	2500 - 2570	
LTE Band 12	699 - 716	
LTE Band 13	777 - 787	
LTE Band 14	788 - 798	
LTE Band 17	704 - 716	
LTE Band 25	1850 - 1915	
LTE Band 26	814 - 849	
LTE Band 30	2305 - 2315	
LTE Band 38	2570 - 2620	
LTE Band 41	2496 - 2690	
LTE Band 66	1710 - 1780	
LTE Band 71	663 - 698	

1.1.2 Antenna Information

Ant.	Brand	Model Name	Antenna Type	Connector	Support
1	SERCOMM	6172005ZWA	PIFA	I-Pex	2.4G+5G
2	SERCOMM	61720060WA	PIFA	I-Pex	2.4G+5G
3	AWAN	7102A0563000	Dipole	Reverse SMA	WWAN
4	AWAN	7102A0563000	Dipole	Reverse SMA	WWAN

Ant.	Port	Gain (dBi)	
		2.4G	5G
1	1	3.3	5.4
2	2	3.4	4.3

Ant.	Port	Gain (dBi)						
		LTE Band 2	LTE Band 4	LTE Band 5	LTE Band 7	LTE Band 12	LTE Band 13	LTE Band 14
3	1	3.78	3.19	2.08	2.75	1.3	1.8	1.8
4	2	2.53	3.16	-0.77	2.96	0.2	-1.7	-1.7

Ant.	Port	Gain (dBi)							
		LTE Band 17	LTE Band 25	LTE Band 26	LTE Band 30	LTE Band 66	LTE Band 71	LTE Band 38	LTE Band 41
3	1	1.3	3.78	2.08	2.57	3.19	1.83	2.64	3.17
4	2	0.2	2.53	-0.77	2.24	3.16	2.06	2.83	2.96

Note 1: The EUT has four antennas.

For 2.4GHz function:

For IEEE 802.11 b/g/n/VHT/ax mode (2TX/2RX)

Ant. 1 (port 1) and Ant. 2 (port 2) could transmit/receive simultaneously.

For 5GHz function:

For IEEE 802.11 a/n/ac/ax mode (2TX/2RX)

Ant. 1 (port 1) and Ant. 2 (port 2) could transmit/receive simultaneously.

For WWAN 4G function (1TX/2RX):

Ant. 3 (port 1) and Ant. 4 (port 2) could transmit/receive simultaneously.

Note 2: Directional gain information

	Maximum Output Power	Power Spectral Density
Non-BF	Directional gain = Max.gain + array gain. For power measurements on IEEE 802.11 devices Array Gain = 0 dB (i.e., no array gain) for N ANT ≤ 4	$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{SS}}\left\{\sum_{k=1}^{N_{ANT}} g_{j,k}\right\}^2}{N_{ANT}}\right]$
BF	$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{SS}}\left\{\sum_{k=1}^{N_{ANT}} g_{j,k}\right\}^2}{N_{ANT}}\right]$	$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{SS}}\left\{\sum_{k=1}^{N_{ANT}} g_{j,k}\right\}^2}{N_{ANT}}\right]$

1.1.3 Accessories

Accessories				
AC Adapter 1	Brand Name	FSP	Model Name	FSP050-DWAA1
	Power Rating	I/P: 100 - 240 Vac, 1.6 A ,50/60Hz, O/P: 54.0 Vdc, 0.93 A,50 W		
	DC Power Cable	1.5 meter, non-shielded cable, with ferrite core		
AC Adapter 2	Brand Name	UMEC	Model Name	UP0451H-54PP
	Power Rating	I/P: 100 - 240 Vac, 2A ,50/60Hz, O/P: 54.0 Vdc, 0.92 A,50 W		
	DC Power Cable	1.5 meter, non-shielded cable, w/o ferrite core		
AC Adapter 3	Brand Name	LITEON	Model Name	PA-1500-54C1
	Power Rating	I/P: 100 - 240 Vac 50/60 Hz, 1.5 A, O/P: 54.0 Vdc, 0.925 A 50W		
	DC Power Cable	1.5 meter, non-shielded cable, w/o ferrite core		
RJ45 Cable	Brand Name	NIENYI	Model Name	PLUG RJ45 8P8C 1000mm BLACK CAT.5E Patch Cord LFP
	Category	Cat5e	In/Out door	Indoor
	Signal line	1.0 meter, non-shielded cable		

Reminder: Regarding to more detail and other information, please refer to user manual.

1.1.4 Table for Permissive Change

This product is an extension of original one reported under Sporton project number: FA350604-01.

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
WIFI antenna optimize layout change due to wifi antenna modify	All RF test items

1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR FCC Part 2 Subpart J, section 2.1091
- KDB 447498 D04 Interim General RF Exposure Guidance v01

The following reference test guidance is not within the scope of accreditation of TAF.

- 47 CFR Part 1.1307
- 47 CFR Part 1.1310

1.3 Testing Location

Test Lab.：Sporton International Inc. Hsinhua Laboratory			
☒	Hsinhua **(TAF:** 3785**)**	**ADD:** No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan (R.O.C.)	
		TEL: 886-3-327-3456	**FAX:** 886-3-327-0973
	Test site Designation No. TW3785 with FCC.		
☒	**Wenhua 3rd.**	**ADD:** No. 58, Aly. 75, Ln. 564, Wenhua 3rd Rd., Guishan Dist. Taoyuan City 333, Taiwan (R.O.C.)	
	(TAF: 3785**)**	**TEL:** 886-3-327-0868	
	Test site Designation No. TW0036 with FCC.		

2 Maximum Permissible Exposure

2.1 Limit of Maximum Permissible Exposure

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm²)	Averaging Time |E|²,|H|² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f²)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm²)	Averaging Time |E|²,|H|² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f²)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	F/1500	30
1500-100,000	-	-	1.0	30

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

Multiple Transmitters Condition
Co-location as simultaneously transmitting (co-transmitting) and the evaluation shall be consider that simultaneous transmissions from co-located devices the individual transmitters are evaluated separately. After sum of the individual value (basic restriction / reference level) are measured/calculated also have to under basic restriction / reference level.
Co-transmitting mode: 2.4GHz WLAN + 5GHz WLAN + LTE

2.2 RF Exposure Exempt Measurement

Option	Refer Std.	Exemption Exposure Thresholds (TL)
A	§1.1307(b)(3)(i)(A)	Available maximum time-averaged power is no more than 1 mW
B	§1.1307(b)(3)(i)(B)	$\mathrm{P}th(mW)=\begin{cases} ERP_{20cm}(d/20cm)^{x} \rightarrow d \le 20cm \\ ERP_{20cm} \rightarrow 20cm < d \le 40cm \end{cases}$ $x=-\log_{10}\left(\frac{60}{ERP_{20cm}\sqrt{f}}\right)$ and f is in GHz $\begin{cases} ERP_{20cm}: 0.3GHz \le f < 1.5GHz \rightarrow 2040f(mW) \\ ERP_{20cm}: 1.5GHz \le f \le 6GHz \rightarrow 3060(mW) \end{cases}$
C	§1.1307(b)(3)(i)(C)	$\begin{cases} 0.3 \sim 1.34MHz \rightarrow ERP(\mathrm{W}) = 1920R^2 \\ 1.34 \sim 30MHz \rightarrow ERP(\mathrm{W}) = 3450R^2/f^2 \\ 30 \sim 300MHz \rightarrow ERP(\mathrm{W}) = 3.83R^2 \\ 300 \sim 1500MHz \rightarrow ERP(\mathrm{W}) = 0.0128R^2 f \\ 1500 \sim 100000MHz \rightarrow ERP(\mathrm{W}) = 19.2R^2 \end{cases}$ f is in MHz; R is in m; $\mathrm{R} > \lambda/2\pi$

2.3 Multiple RF Sources Exposure

Refer Std.	Exemption Exposure Thresholds (TL)
§1.1307(b)(3)(ii)(A)	The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required)
§1.1307(b)(3)(ii)(B)	$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}}+\sum_{j=1}^{b}\frac{ERP_j}{ERP_{th,j}}+\sum_{k=1}^{c}\frac{Evaluated_k}{ExposureLimit_k}\le 1$ a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(B) of this section for P , including existing exempt transmitters and those being added. b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added. c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters. P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive). $P_{th,i}$ = the exemption threshold power (P_{th}) according to paragraph §1.1307(b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i. ERP_j = the ERP of fixed, mobile, or portable RF source j. $ERP_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least λ/2π according to the applicable formula of paragraph §1.1307 (b)(3)(i)(C) of this section. $Evaluated_k$ = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure. $Evaluated\ Limit_k$ = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k, as applicable from § 1.1310 of this chapter.

2.4 MPE Calculation Method

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:

E (V/m) = $\frac{\sqrt{30 \times P \times G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

E = Electric field (V/m)

P = RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

Pd = $\frac{30 \times P \times G}{377 \times d^2}$

2.5 Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

<Non-Beamforming>
WLAN 2.4GHz Function:

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;G1D	3.40	22.94	26.34	0.50	294.442	20	B	3060.0	0.09625
2.4G;D1D	3.40	23.20	26.60	0.50	312.608	20	B	3060.0	0.10219

WLAN 5GHz Function:

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
5.2G;D1D	5.40	22.81	28.21	0.50	452.898	20	B	3060.0	0.14804
5.3G;D1D	5.40	22.98	28.38	0.50	470.977	20	B	3060.0	0.15395
5.6G;D1D	5.40	22.55	27.95	0.50	426.580	20	B	3060.0	0.13944
5.8G;D1D	5.40	22.80	28.20	0.50	451.856	20	B	3060.0	0.14770

<Beamforming>
WLAN 2.4GHz Function:

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;D1D	6.36	22.31	28.67	0.50	503.501	20	B	3060.0	0.16458

WLAN 5GHz Function:

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
5.2G;D1D	7.88	22.81	30.69	0.50	801.678	20	B	3060.0	0.26205
5.3G;D1D	7.88	21.86	29.74	0.50	644.169	20	B	3060.0	0.21057
5.6G;D1D	7.88	22.06	29.94	0.50	674.528	20	B	3060.0	0.22049
5.8G;D1D	7.88	22.80	30.68	0.50	799.834	20	B	3060.0	0.26145

Note 1: Option A, B and C refer as clause 2.2
Note 2: For option B, Pth(mW) convert to TL ERP(mW); For option C, ERP(W) convert to TL ERP(mW)
Note 3: TL Ratio=Tune-up ERP(mW)/TL ERP(mW)

LTE Function:

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	S (mW/cm²)	S Limit (mW/cm²)	Option	TL ERP (mW)	TL Ratio
LTE Band 2	3.78	23.50	27.28	0.50	365.69	20	0.11932	1.00000	B	3060.000	0.11951
LTE Band 4	3.19	23.50	26.69	0.50	319.23	20	0.10417	1.00000	B	3060.000	0.10433
LTE Band 5	2.08	23.50	25.58	0.50	247.24	20	0.08067	0.54933	B	1680.960	0.14708
LTE Band 7	2.96	23.50	26.46	0.50	302.77	20	0.09879	1.00000	B	3060.000	0.09894
LTE Band 12	1.30	23.50	24.80	0.50	206.59	20	0.06741	0.46600	B	1425.960	0.14488
LTE Band 13	1.80	23.50	25.30	0.50	231.80	20	0.07564	0.51800	B	1585.080	0.14624
LTE Band 14	1.80	23.50	25.30	0.50	231.80	20	0.07564	0.52533	B	1607.520	0.14420
LTE Band 17	1.30	23.50	24.80	0.50	206.59	20	0.06741	0.46933	B	1436.160	0.14385
LTE Band 25	3.78	23.50	27.28	0.50	365.69	20	0.11932	1.00000	B	3060.000	0.11951
LTE Band 26	2.08	23.50	25.58	0.50	247.24	20	0.08067	0.54933	B	1680.960	0.14708
LTE Band 30	2.57	23.00	25.57	0.50	246.67	20	0.08049	1.00000	B	3060.000	0.08061
LTE Band 38	3.19	23.50	26.69	0.50	319.23	20	0.10417	1.00000	B	3060.000	0.10433
LTE Band 41	2.06	23.50	25.56	0.50	246.10	20	0.08030	1.00000	B	3060.000	0.08042
LTE Band 66	2.83	23.50	26.33	0.50	293.84	20	0.09588	1.00000	B	3060.000	0.09603
LTE Band 71	3.17	23.50	26.67	0.50	317.77	20	0.10369	0.44200	B	1352.520	0.23495
LTE Band 5C	2.08	24.00	26.08	0.50	277.40	20	0.09052	0.54933	B	1680.960	0.16503
LTE Band 7C	2.96	24.00	26.96	0.50	339.71	20	0.11085	1.00000	B	3060.000	0.11102
LTE Band 38C	3.19	23.50	26.69	0.50	319.23	20	0.10417	1.00000	B	3060.000	0.10433
LTE Band 41C	2.06	24.00	26.06	0.50	276.13	20	0.09010	1.00000	B	3060.000	0.09024

2.4GHz WLAN + 5GHz WLAN + LTE Function:

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (mW)	Distance (cm)	Option	TL EIRP (mW)	TL Ratio
2.4G;D1D	6.36	22.31	28.67	0.50	503.501	20	B	3060.0	0.16458
5.2G;D1D	7.88	22.81	30.69	0.50	801.678	20	B	3060.0	0.26205
LTE Band 71	3.17	23.50	26.67	0.50	317.77	20	B	1352.520	0.23495
Sum TL Ratio_B	0.66158								
Ratio Limit	1.00000								

Note 1: Option A, B and C refer as clause 2.2
Note 2: For option B, Pth(mW) convert to TL ERP(mW); For option C, ERP(W) convert to TL ERP(mW)
Note 3: TL Ratio=Tune-up ERP(mW)/TL ERP(mW)
Note 4: Refer as clause 2.3 Multiple RF Sources Exposure. Please follow below option and sum TL ration table.

Option	Sum TL Ratio_B	Option	Sum TL Ratio_C	Option	Sum TL Ratio_E
B	$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}}$	C	$\sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}}$	E	$\sum_{k=1}^{c} \frac{Evaluated_k}{ExposureLimit_k}$

Note: The above antenna gain was declared by manufacturer.

———THE END———