

# **FCC Compliance of CDP-TX-05M-R, CDP-RX-05M-R 915 MHz**

## **Application Note**

**Version 1.0 (Nov 2017)**

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**CIRCUIT DESIGN, INC.,**

7557-1 Hotaka, Azumino-city  
Nagano 399-8303 JAPAN  
Tel: + +81-(0)263-82-1024  
Fax: + +81-(0)263-82-1016

e-mail: [info@circuitdesign.jp](mailto:info@circuitdesign.jp)  
<http://www.cdt21.com>

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## 1. INTRODUCTION

### 1.1 Important notice

This application note was written in line with the related regulations and standards as of 2017.

### 1.2 Application of Part 15.249 under FCC Part 15

The FCC Part 15.249 describes the operation of low power, non-licensed devices in the 902-928 MHz band. This application note shows how Circuit Design's CDP-TX-05M-R and CDP-RX-05M-R 915 MHz can comply with the FCC Part 15.249 standards.

Note: the CDP-TX-05M-R, CDP-RX-05M-R 915 MHz does not have FCC marking. This application note shows one method of demonstrating how the module can meet the standard. The actual test must be performed by the end user.

## 2. TEST SETUP

### 2.1 Transmitter parameters

The serial numbers of the 3 modules, their output power, gain of antenna used and frequency output are shown below.

Serial number	Contact power output (mW) / (dBm)	Output Frequency (MHz)	Antenna gain (dBi)
A00040187	1.34 / 1.271	914.700	2.14
A00040224	1.32 / 1.205	914.700	2.14
A00040230	1.32 / 1.205	914.700	2.14

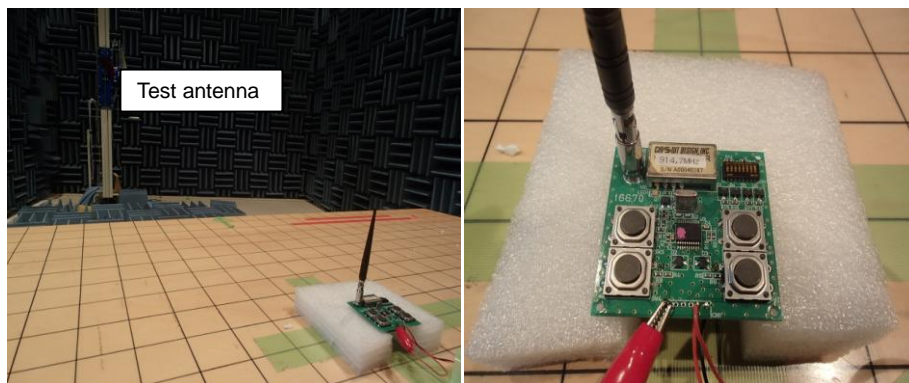
Conditions:

- Spectrum analyser RBW = 10kHz
- Measuring frequency: All frequencies up to the required harmonic of the fundamental as described in part 15.249 under FCC part 15.
- Measurements for both horizontal (H) and vertical (V) test antenna polarizations.
- Antenna used: 1/4 lambda antenna with gain of approximately 2.14 dBi
- Module and antenna mounted on dedicated testboard, no housing
- Facilities used: Circuit Design Inc, anechoic chamber. The test configuration (with respect to DUT height, distance from test antenna etc.) follows the guidelines described.

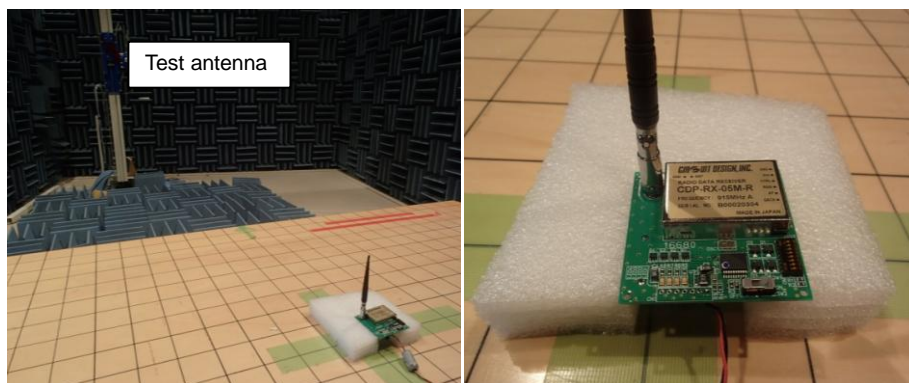
## 2.2 Receiver parameters

- Three receiver modules.
- Spectrum analyser RBW = 10kHz
- Measuring frequency: All frequencies up to and including the 5<sup>th</sup> harmonic of the fundamental as described in part 15.109 under FCC part 15.
- Measurements for both horizontal (H) and vertical (V) test antenna polarisations.
- Antenna used: 1/4 lambda antenna with gain of approximately 2.14 dBi
- Module and antenna mounted on dedicated test board, no housing
- Facilities used: Circuit Design Inc, anechoic chamber. The test configuration (with respect to DUT height, distance from test antenna etc.) follows the guidelines described.

## 2.3 Test Setup



Transmitter test board (CDP-TX-05M-R)



Receiver test board (CDP-RX-05M-R)

Our test boards for the CDP-TX-05M-R and CDP-RX-05M-R was used to mount the module and antenna. The power to the test board was achieved by using a regulated power supply of 3V and the test board's external port used to continuously emit a transmitting modulated signal from the transmitter module. Details of the test board are shown on our website.

### 3. TEST RESULT

#### 3.1 Transmitter results – Field strength at fundamental frequency

Below are the results for the transmitter emitted field strength with the permitted limit. Distance between transmitter and test antenna was 3m. Height of transmitter above ground was 0.8m.

Fundamental frequency = 914.700 MHz

Tests performed at ambient temperature, voltage supply of DC 3V.

SN.	Contact Power (mW) / dBm	H (μV/m)	V (μV/m)	Limit (μV/m)
A00040187	1.34 / 1.271	46890	71430	50000
A00040224	1.32 / 1.205	47000	73970	
A00040230	1.32 / 1.205	43130	59570	

#### 3.2 Transmitter results – Field strength at harmonics

Below are the results for the transmitter emitted field strength of the harmonics with the permitted limit.

Distance between transmitter and test antenna was 3m. Height of transmitter above ground was 0.8m.

Start measurement frequency at f1 = 915.000 MHz

Tests performed at ambient temperature, voltage supply of DC 3V.

Freq. (MHz)	SN. A00040187		SN. A00040224		SN. A00040230		Limit (μV/m)
	H (μV/m)	V (μV/m)	H (μV/m)	V (μV/m)	H (μV/m)	V (μV/m)	
f1   915	45330	65210	38100	56530	43990	43950	50000
f2   1829	390.98	393.41	151.18	237.99	240.82	275.04	500
f3   2744	174.36	219.13	178.46	234.07	130.99	247.29	500
f4   3659	121.27	125.47	122.29	119.45	116.61	117.83	500
f5   4574	155.81	184.50	156.98	180.93	145.16	143.30	500
f6   5488	300.88	362.16	228.38	278.20	223.56	237.19	500
f7   6403	297.41	300.16	291.94	285.00	263.97	281.90	500
f8   7318	486.24	483.34	471.41	487.08	437.22	473.21	500

FCC requires measurements up to the 10<sup>th</sup> harmonic.

**3.3 Receiver results – locally emitted frequency**

Below are results for locally emitted emission level with the permitted limit. This refers to leakage of the local oscillator from within the receiver causing it to become an unintentional radiator. The level of this emission and its harmonics are shown below.

Distance between receiver and test antenna was 3m. Height of receiver above ground was 0.8m.

SN.	Emitted frequency (MHz)	H (µV/m)	V (µV/m)	Limit (µV/m)
B00020304	893	50.41	41.83	200
B00020796	893	78.40	57.94	
B00020797	893	56.56	61.30	

**3.4 Receiver results – harmonics of the locally emitted frequency**

Below are measurement results for the harmonics of the locally emitted frequency with the permitted limit.

Freq (MHz)	B00020304		B00020796		B00020797		Limit (µV/m)
	H (µV/m)	V (µV/m)	H (µV/m)	V (µV/m)	H (µV/m)	V (µV/m)	
f1 915	60.03	36.37	31.75	46.68	57.08	36.24	200
f2 1829	26.64	26.85	27.43	28.06	27.49	27.03	500
f3 2744	53.32	52.60	56.64	56.18	53.19	57.58	500
f4 3659	116.20	109.35	116.12	123.01	117.52	118.18	500
f5 4574	138.76	143.42	142.17	135.55	141.51	141.56	500

**4. CONCLUSION**

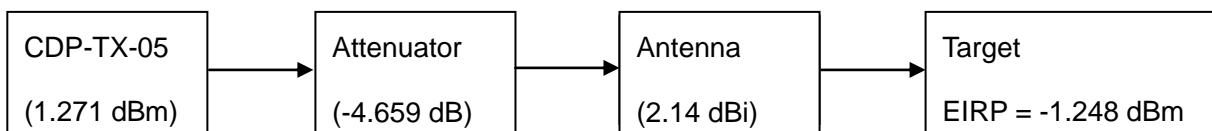
The receiver CDP-RX-05M-R satisfies the limits for FCC part 15.109.

Regarding the transmitter, the fundamental frequency field emission at 3m distance from the CDP-TX-05M-R exceeds the limit set in part 15.249 of the FCC regulation. By inserting an attenuator or by using an antenna with negative gain, the emission can fall within the specified limit. It is possible to predict the value by calculation.

By using a formula, we can calculate the equivalent EIRP for a field value E at distance d:

$$P(\text{dBm}) = 20 \times \log [E(\mu\text{V/m}) \times d(\text{m})] - 104.77 \quad \text{where } d \text{ is distance, } E \text{ is field value}$$

By using the value limit in part 15.249 of 50000µV/m (50mV/m) at 3m gives the required EIRP of -1.248 dBm (0.75 mW). If we assume the antenna used has gain of 2.14 dBi, required contact power is -1.248 – 2.14 = -3.388 dBm (0.45 mW). However the contact power of the CDP-TX-05M-R transmitter exceeds this value (1.271 dBm (1.34 mW)). By allowing this slightly higher output power, the user can compensate for non-ideal conditions (e.g. antenna placement, attenuation by transmitter housing etc.) that would reduce the emission level. If conditions are ideal and assuming antenna has a gain of 2.14 dBi, it is possible to calculate the attenuator value required to reduce the contact power so that EIRP falls within the FCC limit as shown below.



**5. REVISION HISTORY**

<b>Version</b>	<b>Date</b>	<b>Description</b>	<b>Remark</b>
<b>1.0</b>	<b>Nov. 2017</b>	<b>The first issue</b>	

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