Radio Frequency Exposure Evaluation Report

For:

Pearl Automation Inc.

Model Name: / Model Number**:**

RearVision Camera Frame / P110

Product Description:

RearVision consists of 2 main components. The "Car Adapter", which is an accessory that connects to the vehicle's OBD-II diagnostic port, and the "Camera Frame" which is an accessory that is mounted at the license plate of the vehicle. The "Car Adapter" will relay information from the "Camera Frame" and vehicle environmental and state information over Bluetooth/WiFi, and that information will be relayed to the phone over Bluetooth/WiFi and displayed to the driver via the phone app.

FCC ID: 2AG6M-P110

Per:
CFR Part 1 (1.1307 &1.1310), Part 2 (2.1091),
FCC KDB 447498 D01 General RF Exposure Guidance v06

Report number: EMC_PEARL_004_16001_FCC_MPE
DATE: September 28, 2016

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4   Contents

1   Assessment

This RF Exposure evaluation report provides information about 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 5 under given 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.

Company	Description	Model #
Pearl Automation Inc.	RearVision consists of 2 main components. The "Car Adapter", which is an accessory that connects to the vehicle's OBD-II diagnostic port, and the "Camera Frame" which is an accessory that is mounted at the license plate of the vehicle. The "Car Adapter" will relay information from the "Camera Frame" and vehicle environmental and state information over Bluetooth/WiFi, and that information will be relayed to the phone over Bluetooth/WiFi and displayed to the driver via the phone app.	RearVision Camera Frame / P110

Responsible for the Test Laboratory:

September 28, 2016	Compliance	Franz Engert (Manager RC&EMC)	
Date	**Section**	**Name**	**Signature**

Responsible for the Report:

September 28, 2016	Compliance	James Donnellan (Sr. Engineer)	
Date	**Section**	**Name**	**Signature**

2   Administrative Data

2.1   Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
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Manager Compliance Services:	Franz Engert
Project Engineer:	James Donnellan

2.2 Identification of the Client / Manufacturer

Applicant's Name:	Pearl Automation Inc.
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City/Zip Code	Scotts Valley, CA 95066
Country	USA
Contact Person:	Hagan O'Connor / Erturk Kocalar
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2.3   Identification of the Manufacturer

Manufacturer's Name:	Dongguan Primax Electronic & Telecommunications Products Co., Ltd
Manufacturers Address:	Liu Wu District, Shek Kit Town,
City/Zip Code	DongGuan City, Guang Dong,
Country	China

3   Equipment under Assessment

3.1   Specification of the Equipment under Test

Model #:	P110
HW Version :	DVT1B
SW Version :	001.668
FCC-ID :	2AG6M-P110
Product Description:	RearVision Camera Frame
Regulatory Band:	ISM: 2400MHz – 2483.5MHz UNII-1 5150 MHz – 5250 MHz UNII-3 5725 MHz – 5825 MHz
Channels Used:	802.11, ISM, 2412 MHz (Ch. 1) – 2462 (Ch.11), 11 channels BTLE, ISM, 2402MHz (Ch. 0) – 2482MHz (Ch. 39), 40 channels 802.11, UNII-1, 36,40,44,48 (20MHz), 38 (40MHz) 802.11, UNII-3,149, 153, 157, 161,165 (20MHz), 151, 159 (40MHz)
Type(s) of Modulation:	802.11b with CCK, DQPSK, DBPSK + DSSS 802.11 g/a/n with QBSK, BPSK, 16 QAM, 64 QAM + OFDM BTLE with GMSK BT legacy not supported according to operational description
Modes of Operation:	Communicates with and transmits video traffic to the RearVision Car Adapter module
Antenna Type:	1 Custom internal PCB Trace Antenna. For RF conducted measurements, a temporary connection was made from measurement equipment to the 50Ohm UFL port of the EUT.
Max. Declared Antenna Gain:	Documented max antenna gain: 2.4GHz = 5 dBi
Max. Conducted Output Power per declaration	17dBm + 2dB tolerance for 802.11b mid channel
Power Supply:	Internal Li-ion Rechargeable Battery (Solar)
Rated Operating Voltage Range:	Vmin: 2.8 V DC - Vmax: 4.2V DC USB 4.4 VDC - 5.25 VDC
Operating Temperature Range:	Tlow: -20° - Tmax: 45° C
Other Radios included in the Device:	5G WLAN BT 4.0
Sample Revision:	■Prototype; □Production; □Pre-Production

3.2   EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	A2A6170576	DVT1B	001.668	Radiated Sample
2	A2A61008K4	DVT1B	001.668	Conducted Sample

4   RF Exposure Limits - EMC (ERP/EIRP) Limits - FCC and IC Basic Rules

For the specific described radio apparatus the following basic limits and rules apply:

4.1   Power Density Limits acc. to FCC 1.1310(e) / IC RSS-102 i5, cl. 4:

FCC

Frequency Range (MHz)	Power density (mW/cm²)	Averaging time (minutes)
300 – 1500	f (MHz) /1500	30
1500 – 100.000	1.0	30

IC

Frequency Range (MHz)	Power density (W/m²)	Averaging time (minutes)
300 – 6000	$0.02619 \times f\,(MHz)^{0.6834}$	6

4.2   FCC Categorical Exclusion and IC Routine Environmental Evaluation Exemption Thresholds

FCC § 2.1091(c)
operating frequency < 1.5GHz: excluded if ERP < 1.5W / 31.8dBm (EIRP: 33.9);
operating frequency > 1.5GHz: excluded if ERP < 3.0W / 34.8dBm (EIRP: 36.9);

IC RSS-102, cl. 2.5
300MHz < = operating frequency < 6 GHz: exempted if $EIRP < 0.0131 \times f\,(MHz)^{0.6834}$ W

When a device (mobile or fixed application) qualifies for the FCC categorical exclusion provision of § 2.1091(c) estimation of RF exposure compliance for example per plane wave power density formula (see below) is permitted.   Otherwise, further MPE evaluation (measurement or simulation) would be required for TCB approval.

Industry Canada RSS-102 does generally not require further RF exposure evaluation for fixed or mobile applications which stay below the above given exemption limits.

Note that the thresholds for FCC categorical exclusion and IC routine evaluation exemption are no compliance limits but determine the ERP/EIRP limit above which further MPE evaluation (e.g. E or H field measurement) or simulation would be required to show compliance.

4.3   RF Exposure Estimation (MPE Estimation)

Having available the source based average output power and peak antenna gain or the ERP/EIRP of the specified device and for a known minimum distance of its radiating structures from the body of persons according to its use cases (at least 20cm) the power density at that distance can be estimated by the following formula for plane-wave equivalent conditions (far-field conditions), when ground reflection is neglected.

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

where: S = power density (mW/cm^2 or W/m^2)
         P = power input to the antenna (mW or W)
         G = power gain of the antenna in the direction of interest relative to an isotropic radiator
         R = distance to the center of radiation of the antenna (cm or m)

5   Evaluations

5.1   Routine Environmental Evaluation Applicability - Categorical Exclusion per FCC § 2.1091(c)

Powers and tolerances taken from "Pearl RearVision RF Module Tune-Up Information" all measured powers were below these values.

Antenna gains taken from "OP_Des_Pearl_RearVision_Technical_Specs-A"

Transmission Mode	Worst case DC (%)	Maximum declared conducted power + tune up	Tune up toleerance [dB]	Worst case gain [dBi]	EIRP [dBm]	FCC/IC Limits for Routine Environmental Evaluation Applicability, EIRP (dBm)	Exempt from Routine evaluation (Yes/No)
ISM, 802.11b	100	17	2	5	24	36.9/34.3	Yes
ISM, 802.11g	100	13	2	5	20	36.9/34.3	Yes
ISM, 802.11n	100	12	2	5	19	36.9/34.3	Yes
UNII1, 802.11a	100	13	2	6	21	36.9/26.5	Yes
UNII1, 802.11n(20)	100	12	2	6	20	36.9/26.5	Yes
UNII1, 802.11n(40)	100	12	2	6	20	36.9/26.5	Yes
UNII3, 802.11a	100	13	2	6	21	36.9/26.9	Yes
UNII3, 802.11n(20)	100	12	2	6	20	36.9/26.9	Yes
UNII3, 802.11n(40)	100	12	2	6	20	36.9/26.9	Yes
ISM, BTLE	100	8	2	5	15	36.9/34.3	Yes

Conclusion:
- **For operation of a single transmitter the equipment qualifies for the categorical exclusion provision of FCC § 2.1091(c) and is exempted from further RF exposure routine evaluation acc. to IC RSS-102 section 2.5.2.**

5.2 Compliance with FCC and IC Plane Wave Power Density Limits - single transmitters

Power Density Calculation for a distance between the transmitter and the human body of 20cm				
Band of Operation (MHz)	**max EIRP (dBm)**	**Power Density (mW/cm^2)**	**FCC/IC Limit (mW/cm^2)**	**Verdict**
ISM, 802.11b	24	0.05	1.00 / 0.53	Pass
ISM, 802.11g	20	0.02	1.00 / 0.53	Pass
ISM, 802.11n	19	0.02	1.00 / 0.53	Pass
UNII1, 802.11a	21	0.03	1.00 /0.9	Pass
UNII1, 802.11n(20)	20	0.02	1.00 /0.9	Pass
UNII1, 802.11n(40)	20	0.02	1.00 /0.9	Pass
UNII3, 802.11a	21	0.03	1.00/ 0.97	Pass
UNII3, 802.11n(20)	20	0.02	1.00/ 0.97	Pass
UNII3, 802.11n(40)	20	0.02	1.00/ 0.97	Pass
ISM, BTLE	15	0.01	1.00 / 0.53	Pass

Note: comparison with IC limits is provided for information only but not required according to the result of section 5.1

Conclusion:

- **The equipment respects the FCC and IC Plane Wave Power Density Limits for the minimum distance between the antenna and the human body of 20cm, and above.**

5.3   Simultaneous Transmission Evaluation

According to "OP_Des_Pearl_RearVision_Technical_Specs-A" simultaneous transmission can only occur between n BTLE in ISM band and 802.11 in UNII bands.

Power Density Calculation for a distance between the transmitter and the human body of 20cm						
Band of Operation (MHz)	Power Density (mW/cm^2)	IC Limit worst case (mW/cm^2)	Single transmitter MPE ratio	simultaneous transmitter MPE ratio	FCC/IC Limit ratio	Verdict
UNII1, 802.11a	0.03	0.90	0.03	0.04	1	PASS
UNII1, 802.11n(20)	0.02	0.90	0.02	0.03	1	PASS
UNII1, 802.11n(40)	0.02	0.90	0.02	0.03	1	PASS
UNII3, 802.11a	0.03	0.97	0.03	0.04	1	PASS
UNII3, 802.11n(20)	0.02	0.97	0.02	0.03	1	PASS
UNII3, 802.11n(40)	0.02	0.97	0.02	0.03	1	PASS

Conclusion:
- **The equipment qualifies for the exclusion from further simultaneous transmission MPE evaluation (measurement or simulation as appropriate and agreed on with FCC/IC)**

6   Revision History

Date	Report Name	Changes to report	Report prepared by
September 28, 2016	EMC_PEARL-004-16001_FCC_MPE	First Version	James Donnellan