RADIO TEST REPORT

Test Report No. 14423514S-B

Customer	**Panasonic Automotive Systems Co., Ltd.**
Description of EUT	**AV Control Unit for In-Vehicle Infotainment**
Model Number of EUT	**AM2202**
FCC ID	**ACJ932AM2202**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied (Refer to SECTION 3)**
Issue Date	**August 8, 2022**
Remarks	**Wireless LAN (2.4 GHz band) parts** **Spot check:** **Maximum Peak Output Power,** **Average Output Power**

Representative Test Engineer	**Approved By**
Yosuke Murakami Engineer	Shinichi Takano Engineer

CERTIFICATE 1266.03

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.

☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 14423514S-B

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14423514S-B	August 8, 2022	-

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	ICES	Interference-Causing Equipment Standard
AC	Alternating Current	IEC	International Electrotechnical Commission
AFH	Adaptive Frequency Hopping	IEEE	Institute of Electrical and Electronics Engineers
AM	Amplitude Modulation	IF	Intermediate Frequency
Amp, AMP	Amplifier	ILAC	International Laboratory Accreditation Conference
ANSI	American National Standards Institute	ISED	Innovation, Science and Economic Development Canada
Ant, ANT	Antenna	ISO	International Organization for Standardization
AP	Access Point	JAB	Japan Accreditation Board
ASK	Amplitude Shift Keying	LAN	Local Area Network
Atten., ATT	Attenuator	LIMS	Laboratory Information Management System
AV	Average	MCS	Modulation and Coding Scheme
BPSK	Binary Phase-Shift Keying	MRA	Mutual Recognition Arrangement
BR	Bluetooth Basic Rate	N/A	Not Applicable
BT	Bluetooth	NIST	National Institute of Standards and Technology
BT LE	Bluetooth Low Energy	NS	No signal detect.
BW	BandWidth	NSA	Normalized Site Attenuation
Cal Int	Calibration Interval	NVLAP	National Voluntary Laboratory Accreditation Program
CCK	Complementary Code Keying	OBW	Occupied Band Width
Ch., CH	Channel	OFDM	Orthogonal Frequency Division Multiplexing
CISPR	Comite International Special des Perturbations Radioelectriques	P/M	Power meter
CW	Continuous Wave	PCB	Printed Circuit Board
DBPSK	Differential BPSK	PER	Packet Error Rate
DC	Direct Current	PHY	Physical Layer
D-factor	Distance factor	PK	Peak
DFS	Dynamic Frequency Selection	PN	Pseudo random Noise
DQPSK	Differential QPSK	PRBS	Pseudo-Random Bit Sequence
DSSS	Direct Sequence Spread Spectrum	PSD	Power Spectral Density
EDR	Enhanced Data Rate	QAM	Quadrature Amplitude Modulation
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	QP	Quasi-Peak
EMC	ElectroMagnetic Compatibility	QPSK	Quadri-Phase Shift Keying
EMI	ElectroMagnetic Interference	RBW	Resolution Band Width
EN	European Norm	RDS	Radio Data System
ERP, e.r.p.	Effective Radiated Power	RE	Radio Equipment
EU	European Union	RF	Radio Frequency
EUT	Equipment Under Test	RMS	Root Mean Square
Fac.	Factor	RSS	Radio Standards Specifications
FCC	Federal Communications Commission	Rx	Receiving
FHSS	Frequency Hopping Spread Spectrum	SA, S/A	Spectrum Analyzer
FM	Frequency Modulation	SG	Signal Generator
Freq.	Frequency	SVSWR	Site-Voltage Standing Wave Ratio
FSK	Frequency Shift Keying	TR	Test Receiver
GFSK	Gaussian Frequency-Shift Keying	Tx	Transmitting
GNSS	Global Navigation Satellite System	VBW	Video BandWidth
GPS	Global Positioning System	Vert.	Vertical
Hori.	Horizontal	WLAN	Wireless LAN

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SECTION 1: Customer Information

Company Name	Panasonic Automotive Systems Co., Ltd.*1)
Address	4261, Ikonobe-cho, Tsuzuki-ku, Yokohama-shi, Kanagawa-ken 224-8520, Japan
Telephone Number	+81-70-3179-1127
Contact Person	Yoshinori Nagatani

*1) The Grantee name in the FCC application is “Panasonic Corporation of North America”.

The information provided from the customer is as follows;
- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	AV Control Unit for In-Vehicle Infotainment
Model Number	AM2202
Serial Number	Refer to SECTION 4.2
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	July 20, 2022
Test Date	July 25, 2022

2.2 Product Description

General Specification

Rating	DC 13.2 V
Operating temperature	-30 deg. C to +60 deg. C

Radio Specification

Bluetooth (BR / EDR)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	FHSS (GFSK, π/4 DQPSK, 8 DPSK)
Antenna Type	Pattern antenna
Antenna Gain	2 dBi

WLAN (IEEE802.11b/11g/11n-20)

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	DSSS, OFDM
Antenna Type	Pattern antenna
Antenna Gain	2 dBi

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C FCC Part 15 final revised on April 1, 2022 and effective May 2, 2022
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(b)(3)	See data.	Complied a)	Conducted
	ISED: RSS-Gen 6.12	**ISED:** RSS-247 5.4(d)			
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593. * In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.					
a) Refer to APPENDIX 1 (data of Maximum Peak Output Power)					
Symbols: Complied The data of this test item has enough margin, more than the measurement uncertainty. Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.					

FCC Part 15.31 (e)

The equipment provides the wireless transmitter with stable power supply.
Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

The equipment and its antenna comply with the requirement since the antenna is built in the equipment and it cannot be replaced by end users. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to Standard

No addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k = 2$.

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector) SPM-13	1.3 dB
Power Measurement above 1 GHz (Peak Detector) SPM-13	1.3 dB
Voltage	0.97 %

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 Japan
Telephone: +81 463 50 6400
A2LA Certificate Number: 1266.03
(FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
No.1 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 Shielded room	-	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	-	2.55 x 4.1 x 2.5	-	-

3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Test operating mode was determined as follows according to "Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009.

Mode	Remarks*
IEEE 802.11b (11b)	2 Mbps, PN9
IEEE 802.11g (11g)	48 Mbps, PN9
IEEE 802.11n 20 MHz BW (11n-20)	MCS 4 (Long GI), PN9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Low Channel) (Refer to 14337817S-A report)	
*Power of the EUT was set by the software as follows; Power Setting: Fixed Software: SI ver. 07851 (Date: 2022.05 09, Storage location: EUT memory) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

*The Details Of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Maximum Peak Output Power	Tx 11b Tx 11g Tx 11n-20	2412 MHz 2437 MHz 2462 MHz

4.2 Configuration and Peripherals

This page has been submitted for separate exhibit (refer to APPENDIX 4).

SECTION 5: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument Used
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *1)	-	Power Meter (Sensor: 160 MHz BW)
*1) Reference data							

The test results and limit are rounded off to two decimals place, so some differences might be observed.
The equipment and cables were not used for factor 0 dB of the data sheets.

Test Data : APPENDIX
Test Result : Pass

APPENDIX 1: Test Data

Maximum Peak Output Power

Test place	Shonan EMC Lab. No.1 Measurement Room
Date	July 25, 2022
Temperature / Humidity	24 deg. C / 42 % RH
Engineer	Yosuke Murakami
Mode	Tx

11b

2 Mbps (worst)

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	3.15	1.75	9.87	14.77	29.99	30.00	1000	15.23	2.00	16.77	47.53	36.02	4000	19.25
2437	3.21	1.76	9.87	14.84	30.48	30.00	1000	15.16	2.00	16.84	48.31	36.02	4000	19.18
2462	3.24	1.76	9.87	14.87	30.69	30.00	1000	15.13	2.00	16.87	48.64	36.02	4000	19.15

11g

48 Mbps (worst)

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	9.35	1.75	9.87	20.97	125.03	30.00	1000	9.03	2.00	22.97	198.15	36.02	4000	13.05
2437	9.23	1.76	9.87	20.86	121.90	30.00	1000	9.14	2.00	22.86	193.20	36.02	4000	13.16
2462	9.30	1.76	9.87	20.93	123.88	30.00	1000	9.07	2.00	22.93	196.34	36.02	4000	13.09

11n-20 (SISO)

MCS 4 (Long G.I.) (worst)

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	9.06	1.75	9.87	20.68	116.95	30.00	1000	9.32	2.00	22.68	185.35	36.02	4000	13.34
2437	9.00	1.76	9.87	20.63	115.61	30.00	1000	9.37	2.00	22.63	183.23	36.02	4000	13.39
2462	8.92	1.76	9.87	20.55	113.50	30.00	1000	9.45	2.00	22.55	179.89	36.02	4000	13.47

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

e.i.r.p. Result = Conducted Power Result + Antenna Gain

All comparison were carried out on same frequency and measurement factors.

Average Output Power
(Reference data for RF Exposure)

Test place	Shonan EMC Lab. No.1 Measurement Room
Date	July 25, 2022
Temperature / Humidity	24 deg. C / 42 % RH
Engineer	Yosuke Murakami
Mode	Tx

11b

5.5 Mbps (worst)

(*1)

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	0.45	1.75	9.87	12.07	16.11	0.00	12.07	16.11
2437	0.49	1.76	9.87	12.12	16.29	0.00	12.12	16.29
2462	0.48	1.76	9.87	12.11	16.26	0.00	12.11	16.26

11g

54 Mbps (worst)

(*1)

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-1.39	1.75	9.87	10.23	10.54	0.00	10.23	10.54
2437	-1.43	1.76	9.87	10.20	10.47	0.00	10.20	10.47
2462	-1.41	1.76	9.87	10.22	10.52	0.00	10.22	10.52

11n-20 (SISO)

MCS 7 (Long G.I.) (worst)

(*1)

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-2.43	1.75	9.87	9.19	8.30	0.00	9.19	8.30
2437	-2.28	1.76	9.87	9.35	8.61	0.00	9.35	8.61
2462	-2.47	1.76	9.87	9.16	8.24	0.00	9.16	8.24

Sample Calculation:

Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

Result (Burst power average) = Result (Time average) + Duty factor

(*1) Power was measured with using the gate function of power meter.

APPENDIX 2: Test Instruments

Test Equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	KTS-08	145095	Digital Tester	SANWA	PC500	7019224	2022/04/07	12
AT	SAT10-16	160494	Attenuator	Weinschel Corp.	54A-10	83420	2021/12/07	12
AT	SCC-G65	196942	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803416/2	2022/03/01	12
AT	SOS-28	191846	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
AT	SPM-13	169910	Power Meter	Keysight Technologies Inc	8990B	MY51000448	2022/01/25	12
AT	SPSS-06	169911	Power sensor	Keysight Technologies Inc	N1923A	MY57270004	2022/01/25	12
AT	SRENT-09	150461	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46186392	2022/03/14	12
AT	STM-G9	171616	Terminator	Weinschel - API Technologies Corp	M1459A	89025	2022/05/12	12

***Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

The expiration date of the calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item: AT: Antenna Terminal Conducted