



FCC CFR 47 Part 15 Test Report

APPLICANT	APTIV SERVICES US, LLC.
ADDRESS	2151 E. LINCOLN ROAD M/S C4W KOKOMO INDIANA 46902 USA
MODEL NUMBER	L2C0082R
PRODUCT DESCRIPTION	Next Generation RTM.
DATE SAMPLE RECEIVED	1/31/2020
FINAL TEST DATE	1/31/2020
PREPARED BY	Tim Royer
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Report Version	Description	Issue Date
232UT20_TestReport	---	Initial Issue	02/26/2020

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.

This report relates only to the Equipment Under Test (EUT) sample(s) tested.

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GENERAL REMARKS

Summary

The device under test does:

- ☒ Fulfill the general approval requirements as identified in this test report and was selected by the customer.
- ☐ Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669
Designation #: US1070

Tested by:

A blue ink signature of Tim Royer is written over a circular purple stamp. The stamp contains the text "TIMCO ENGINEERING, INC." around the perimeter and "US1070" in the center.

Name and Title Tim Royer, Project Manager / EMC Testing Engineer

Date 02/26/2020

GENERAL INFORMATION

EUT Information

EUT Description	Next Generation RTM.		
Model Number	L2C0082R		
EUT Power Source	☐ 110-120Vac, 50-60Hz	☒ DC Power (12 V)	☐ Battery Operated
Test Item	☐ Prototype	☐ Pre-Production	☒ Production
Type of Equipment	☐ Fixed	☒ Mobile	☐ Portable
Test Frequencies	n/a		
Test Conditions	The temperature was 26°C Relative humidity of 50%.		
Modification to the EUT	No Modification to EUT.		
Applicable Standards	FCC CFR 47 Part 15.109, RSS-GEN, ICES-003 s. 6.2 & 6.1. Referring to ANSI C63.4-2014 for Test Procedures		
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA. Designation #: US1070		

Peripherals Used in Testing

Description	Type	Connector	Length
n/a	n/a	n/a	n/a

Test Results Summary

Standard	Test	Result
FCC Part 15.109	Radiated Emissions	Pass
FCC Part 15.107	AC Powerline Conducted Emissions	N/A

RADIATED SPURIOUS EMISSIONS

RULES PART NO.: FCC PART 15.109 & ICES-003 § 6.2

REQUIREMENTS:

Frequency MHz	Limits
30 – 88	40.0 dB μ V/m measured @ 3 meters
88 – 216	43.5 dB μ V/m measured @ 3 meters
216 – 960	46.0 dB μ V/m measured @ 3 meters
Above 960	54.0 dB μ V/m measured @ 3 meters

Method of Measurement for Radiated Emissions:

The test procedure used for radiated emissions is described ANSI C63.4 using a spectrum analyzer. The resolution bandwidth used was 100 kHz with an appropriate sweep speed. The analyzer was calibrated in dB above a microvolt at the output of the antenna. All cable loss and antenna factors were calibrated to provide plots with correction factors applied to results using the formula and example described below. The video bandwidth of the analyzer was always greater than or equal to the resolution bandwidth, and a peak detector with max hold was used

The unit under test was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The table used for radiated measurements is capable of continuous rotation. When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes. The frequency was scanned from 30 MHz to 1.0 GHz... The EUT was measured in three parts of the tunable band of EUT and (3) orthogonal planes when necessary.

Radiated Emissions Test Setup:

EUT setup and arrangement was completed as described in ANSI C63.4. Exploratory measurements were taken following different peripheral placement and cable manipulations as described in ANSI C63.4. A photo is provided of the Test setup to record the exact peripheral equipment and cable manipulation arrangement found to produce the highest possible level of radiated emissions.

Formula of Conversion Factors:

The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dB μ V) to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

Field Strength Correction Factor Conversion Example:

Freq (MHz)	Meter Reading	+ ACF	+CL	= FS
33	20 dB μ V	+ 10.36 dB/m	+0.40 dB	=30.76 dB μ V/m @ 3m

RADIATED EMISSIONS

RADIATED EMISSIONS TEST DATA:

The following plots represent the maximum emissions found when taking final measurements following the procedure described in ANSI C63.4. The final measurements were preceded by taking exploratory measurements described in ANSI C63.4. The plots include the limit line for radiated emissions as required by FCC part 15.109 & ICES-003 § 6.2.

RADIATED SPURIOUS EMISSIONS

Scanned 30 MHz to 200 MHz

Test Data: Field Strength Plot, Horiz. Polarity



04.Feb 20 12:57

Test Spec: CISPR 22 Radiated Disturbances

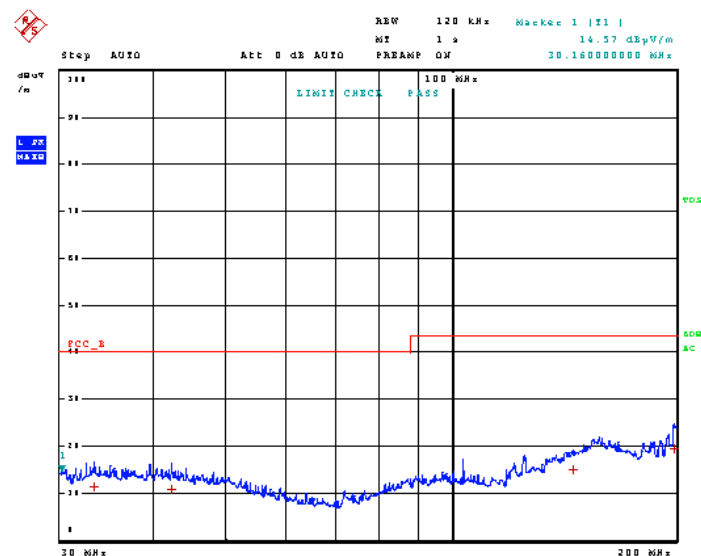
Polarity

Vertical

Stepped Scan (1 Range)

Scan Start: 30 MHz
Scan Stop: 200 MHz
Detector: Trace 1: MAX PEAK
Transducer: TDS_01

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
30.000000 MHz	200.000000 MHz	40.00 kHz	120.00 kHz	50 μ s	Auto	20 dB	INPUT1



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RADIATED SPURIOUS EMISSIONS

Test Data: Field Strength Table, Horiz. Polarity

04.Feb 20 12:57

Test Spec CISPR 22 Radiated Disturbances

Polarity

Vertical

Final Measurement

Meas Time: 1 s

Margin: 25 dB

Subranges: 4

Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	33.200000000 MHz	11.48	Quasi Peak	-28.52
1	42.240000000 MHz	10.80	Quasi Peak	-29.20
1	145.400000000 MHz	15.00	Quasi Peak	-28.50
1	198.840000000 MHz	19.47	Quasi Peak	-24.03

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RADIATED SPURIOUS EMISSIONS

Test Data: Field Strength Plot, Vert. Polarity



04.Feb.20 12:55

Test Spec: CISPR 22 Radiated Disturbances

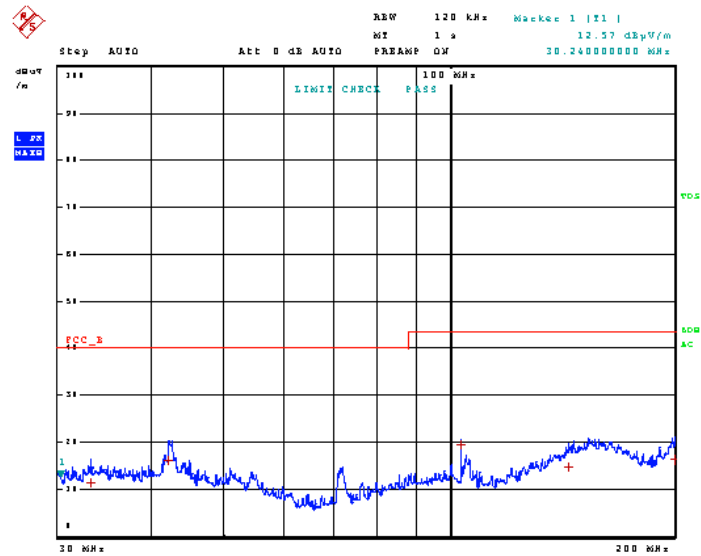
Polarity

Vertical

Stepped Scan (1 Range)

Scan Start: 30 MHz
Scan Stop: 200 MHz
Detector: Trace 1: MAX PEAK
Transducer: TDS_01

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
30.000000 MHz	200.000000 MHz	40.00 kHz	120.00 kHz	50 μ s	Auto	20 dB	INPUT1



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RADIATED SPURIOUS EMISSIONS

Test Data: Field Strength Table, Vert. Polarity

04.Feb 20 12:55

Test Spec CISPR 22 Radiated Disturbances

Polarity

Vertical

Final Measurement

Meas Time: 1 s

Margin: 25 dB

Subranges: 5

Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	33.120000000 MHz	11.50	Quasi Peak	-28.50
1	42.160000000 MHz	16.10	Quasi Peak	-23.90
1	103.720000000 MHz	19.38	Quasi Peak	-24.12
1	144.560000000 MHz	14.82	Quasi Peak	-28.68
1	199.680000000 MHz	16.31	Quasi Peak	-27.19

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RADIATED SPURIOUS EMISSIONS

Scanned 200 MHz to 1000 MHz

Test Data: Field Strength Plot, Horiz. Polarity



04.Feb 20 13:00

Test Spec: CISPR 22 Radiated Disturbances

Polarity:

Horizontal

Time Domain Scan (1 Range)

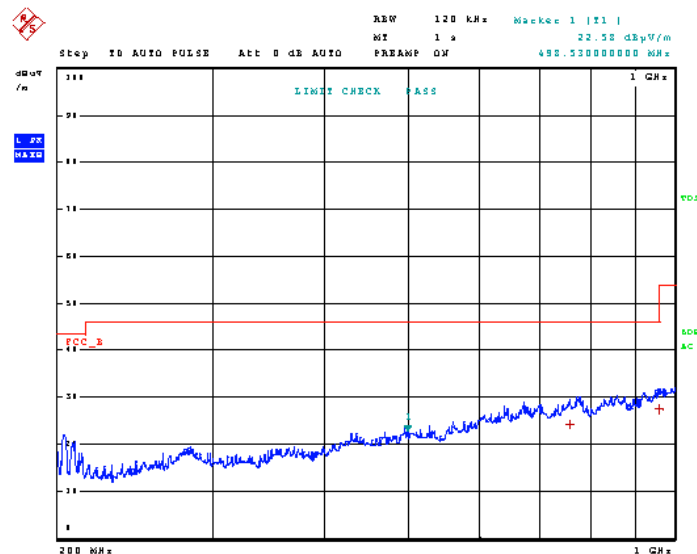
Scan Start: 200 MHz

Scan Stop: 1 GHz

Detector: Trace 1: MAX PEAK

Transducer: TDS_01

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
200.000000 MHz	1.000000 GHz	30.00 kHz	120.00 kHz	50 μ s	Auto	20 dB	INPUT1



RADIATED SPURIOUS EMISSIONS

Test Data: Field Strength Table, Horiz. Polarity

04.Feb 20 13:00

Test Spec CISPR 22 Radiated Disturbances

Polarity

Horizontal

Final Measurement

Meas Time: 1 s

Margin: 20 dB

Subranges: 2

Trace	Frequency	Level (dB μ V/m)	Detector	Delta Limit/dB
1	761.000000000 MHz	24.26	Quasi Peak	-21.74
1	958.700000000 MHz	27.49	Quasi Peak	-18.51

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RADIATED SPURIOUS EMISSIONS

Test Data: Field Strength Table, Vert. Polarity

04.Feb 20 12:59

Test Spec CISPR 22 Radiated Disturbances

Polarity
Horizontal

Final Measurement

Meas Time: 1 s
Margin: 20 dB
Subranges: 2

Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	752.180000000 MHz	24.24	Quasi Peak	-21.76
1	951.590000000 MHz	26.64	Quasi Peak	-19.36

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RADIATED SPURIOUS EMISSIONS

Scanned 1 GHz to 12 GHz

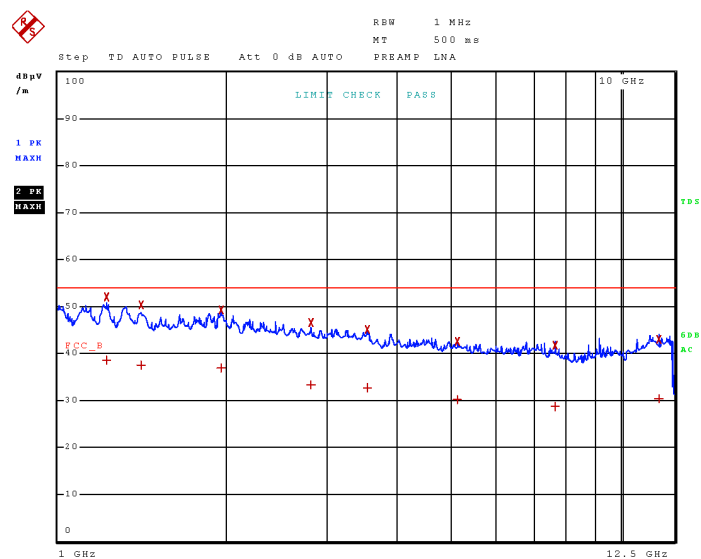
Test Data: Field Strength Plot, Horiz. Polarity

26.Feb 20 16:00

Time Domain Scan (1 Range)

Scan Start: 1 GHz
Scan Stop: 12.5 GHz
Detector: Trace 1: MAX PEAK Trace 2: MAX PEAK
Transducer: TDS_05

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
1.000000 GHz	12.500000 GHz	250.00 kHz	1.00 MHz	100 μ s	Auto	35 dB	INPUT1



RADIATED SPURIOUS EMISSIONS

Test Data: Field Strength Table, Horiz. Polarity

26.Feb 20 16:00

Final Measurement

Meas Time: 500 ms
Margin: 40 dB
Subranges: 16

Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	1.220500000 GHz	38.64	CISPR Averag	-15.36
2	1.220500000 GHz	51.94	Max Peak	
1	1.407250000 GHz	37.48	CISPR Averag	-16.52
2	1.407250000 GHz	50.24	Max Peak	
1	1.951000000 GHz	36.95	CISPR Averag	-17.05
2	1.951000000 GHz	49.24	Max Peak	
1	2.820250000 GHz	33.38	CISPR Averag	-20.62
2	2.820250000 GHz	46.60	Max Peak	
1	3.555750000 GHz	32.60	CISPR Averag	-21.40
2	3.555750000 GHz	45.07	Max Peak	
1	5.123000000 GHz	30.05	CISPR Averag	-23.95
2	5.123000000 GHz	42.45	Max Peak	
1	7.651500000 GHz	28.72	CISPR Averag	-25.28
2	7.651500000 GHz	41.68	Max Peak	
1	11.716750000 GHz	30.31	CISPR Averag	-23.69
2	11.716750000 GHz	43.05	Max Peak	

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RADIATED SPURIOUS EMISSIONS

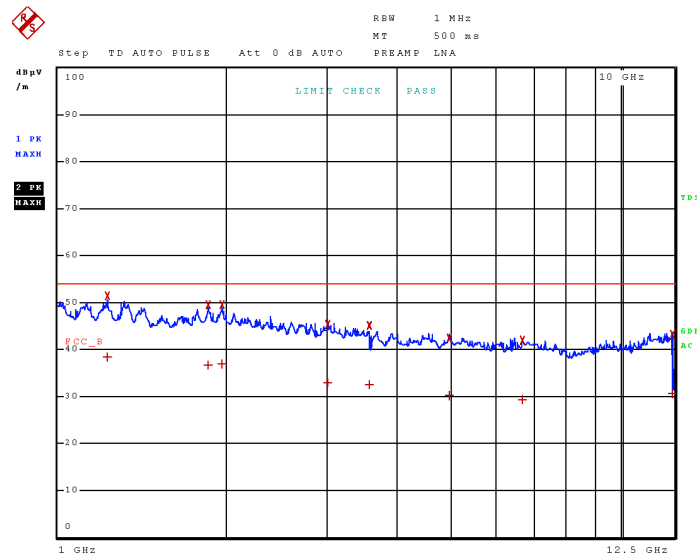
Test Data: Field Strength Plot, Vert. Polarity

26.Feb 20 16:01

Time Domain Scan (1 Range)

Scan Start: 1 GHz
Scan Stop: 12.5 GHz
Detector: Trace 1: MAX PEAK Trace 2: MAX PEAK
Transducer: TDS_05

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
1.000000 GHz	12.500000 GHz	250.00 kHz	1.00 MHz	100 μ s	Auto	35 dB	INPUT1



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RADIATED SPURIOUS EMISSIONS

Test Data: Field Strength Table, Vert. Polarity

26.Feb 20 16:01

Final Measurement

Meas Time: 500 ms
Margin: 40 dB
Subranges: 16

Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	1.225000000 GHz	38.42	CISPR Averag	-15.58
2	1.225000000 GHz	51.30	Max Peak	
1	1.851000000 GHz	36.73	CISPR Averag	-17.27
2	1.851000000 GHz	49.51	Max Peak	
1	1.961000000 GHz	36.91	CISPR Averag	-17.09
2	1.961000000 GHz	49.43	Max Peak	
1	3.023000000 GHz	32.98	CISPR Averag	-21.02
2	3.023000000 GHz	45.32	Max Peak	
1	3.578250000 GHz	32.48	CISPR Averag	-21.52
2	3.578250000 GHz	44.99	Max Peak	
1	4.966000000 GHz	30.18	CISPR Averag	-23.82
2	4.966000000 GHz	42.33	Max Peak	
1	6.690750000 GHz	29.40	CISPR Averag	-24.60
2	6.690750000 GHz	41.84	Max Peak	
1	12.375750000 GHz	30.54	CISPR Averag	-23.46
2	12.375750000 GHz	43.13	Max Peak	

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POWER LINE CONDUCTED INTERFERENCE

Rule Part No.: FCC Part 15.107

Requirements:

Frequency MHz	Quasi Peak Limits (dBμV)	Average Limits (dBμV)
0.15 – 0.5	66 – 56 *	56 – 46 *
0.5 – 5.0	56	46
5.0 – 30	60	50
* Limit decreases with logarithm of frequency		

Method of Measurement:

The procedure used was ANSI C63.4 using a 50uH LISN. Both lines were observed. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed. The spectrum was scanned from 0.15 to 30 MHz.

The following plots represent the emissions for power line conducted. Both lines were observed.

Test Results: N/A

POWER LINE CONDUCTED INTERFERENCE

TEST EQUIPMENT LIST

Device	Manufacturer	Model	SN	Calibration Date	Cal Due Date
EMI Test Receiver R & S ESIB 40 firmware v 4.34.3 BIOS v3.3	Rohde & Schwarz	ESIB 40	100274	07/22/19	07/22/21
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Coaxial Cable - Chamber 3 cable set (backup)	Micro-Coax	Chamber 3 cable set (backup)	KMKM-0244-02 KMKM-0670-01 KFKF-0197-00	02/27/19	02/27/21
CHAMBER	Panashield	3M	N/A	03/15/19	03/15/21
Antenna: Active Loop	ETS-Lindgren	6502	00062529	12/11/17	12/11/20
Antenna: Biconical 1096	Eaton	94455-1	1096	08/01/17	08/01/20
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/26/17	07/26/20
Ant: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	01/30/17	01/30/20

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF REPORT