Excellence in Compliance Solutions

Class II Change Test Report

FCC ID: P2SCMIU-VZW-1

FCC Rule Part: 15.247

ACS Report Number: 16-3031.W04.1A

Manufacturer: Neptune Technology Group
Model: CMIU-ATT
Variant to CMIU-VZW

Test Begin Date: May 24, 2016
Test End Date: May 26, 2016

Report Issue Date: August 5, 2016

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code AT-1921

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

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This report contains 13 pages

TABLE OF CONTENTS

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations per the permissive change guidelines.

1.2 Product Description

The CMIU product is a wireless device which interfaces with a water meter to provide water meter readings over a commercial LTE network. This CMIU utilizes two independently activated RF radiating devices which have been integrated into the product:

- LTE Cellular radio module (LE910-NA) (FCC preapproved) manufactured by Telit Wireless Solutions (FCC ID RI7LE910NA)
- BTLE radio using the (nRF8001) integrated circuit manufactured by Nordic Semiconductor

The device is powered by an internal battery with a 3.6 VDC output; 3.6 VDC from the battery is used to power the BTLE Radio. The CMIU uses the integrated LTE radio module (preapproved) which allows it to wirelessly connect and send data over a cellular carrier network. The CMIU uses the integrated BTLE radio to transmit / receive data for the purposes of installation and maintenance sessions.

This report addresses the BTLE radio only. Due to the change in normal orientation, the removal of the internal cellular antenna, and the addition of the external cellular antenna from the original submittal the Radiated Spurious Emissions were evaluated. RF Conducted measurements were not performed.

Technical Information:

Detail	Description
Frequency Range	2402 to 2480 MHz
Number of Channels	3 advertising 37 data
Modulation Format	GFSK (F1D)
Data Rates	To 1 Mbps
Number of Inputs/Outputs	1 Input / 1 Output
Operating Voltage	3.6 Vdc
Antenna Type / Gain	Loaded monopole/ -1.5 dBi peak

Manufacturer Information:
Neptune Technology Group
1600 Alabama Highway 229
Tallassee, AL 36078

EUT Serial Numbers: ACS 1

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

For radiated emissions the normal (flat) orientation of the EUT was evaluated with the external antenna placed based on the final installations. The EUT was powered with a DC bench supply due to current restrictions with using a battery while in test mode.

The EUT is a battery operated device therefore AC power line conducted emissions testing was not performed.

Radiated inter-modulation testing was evaluated for all combinations of simultaneous transmission between the pre-approved Telit Wireless Solutions LTE Cellular radio module (LE910-NA) and the BLE radio. All emissions were found to be in compliance.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1921 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

FCC Registered Test Site Number: 637011
ISED Canada Test Site Registration Number: 20446

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using short #6 copper wire. The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

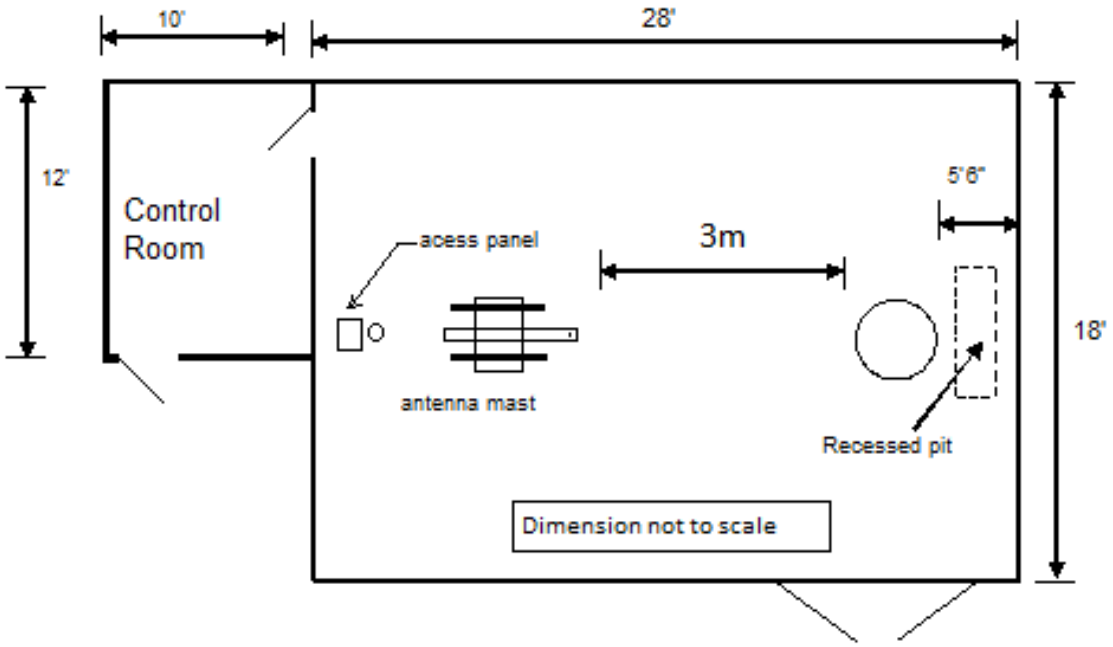

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 10' sheet galvanized steel horizontal ground reference plane (GRP) bonded every 6" to an 8' X 8' aluminum vertical ground plane.

A diagram of the room is shown below in figure 2.4-1:

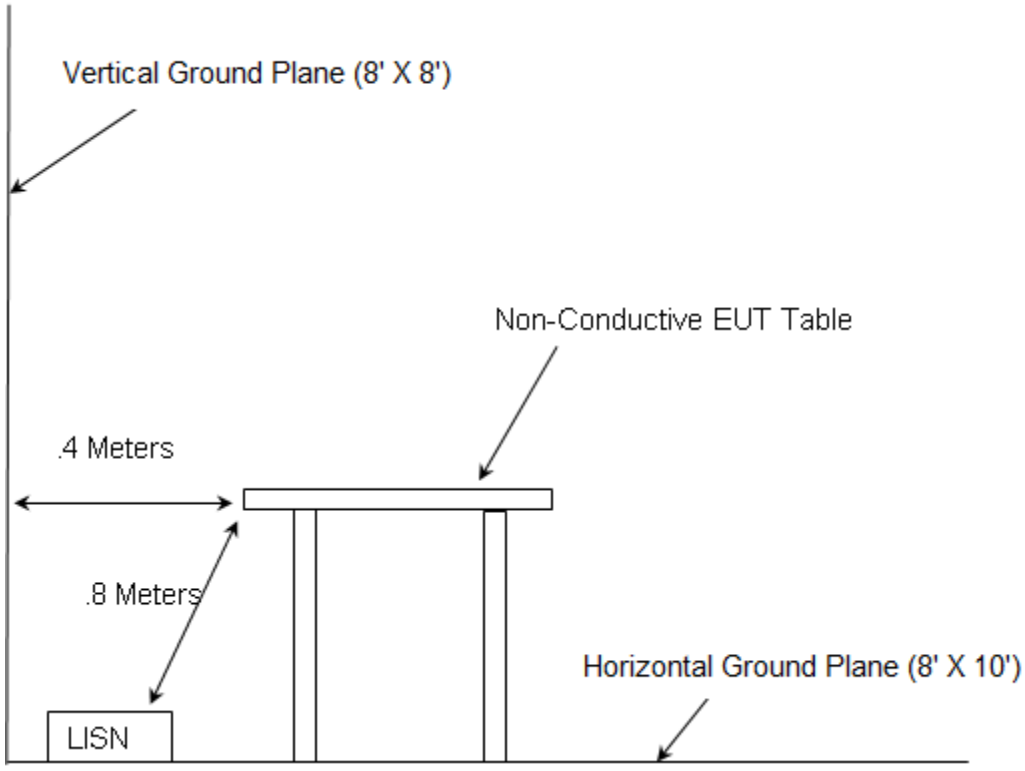

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014 - American National Standard for Methods of Measurement of Radio-Noise Emissions from low-voltage electrical and electronic equipment in the range of 9kHz to 40 GHz.
- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2016
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- FCC KDB 558074 D01 DTS Meas Guidance v03r05 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 8, 2016

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
277	Emco	93146	Antennas	9904-5199	9/2/2014	9/2/2016
626	EMCO	3110B	Antennas	9411-1945	2/29/2016	2/28/2017
3002	Rohde & Schwarz	ESU40	Receiver	100346	1/8/2016	1/8/2017
3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	6/29/2015	6/29/2016
3007	Rohde & Schwarz	TS-PR26	Amplifiers	100051	6/29/2015	6/29/2016
3012	Rohde & Schwarz	EMC32-EB	Software	100731	2/2/2016	8/2/2016
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/26/2016	1/26/2017
3027	Micro-Tronics	BRM50702	Filter	175	12/21/2015	12/21/2016
3033	Hasco, Inc.	HLL142-S1-S1-36	Cables	1435	1/7/2016	1/7/2017
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	12/22/2015	12/22/2016
3045	Aeroflex Inmet	18N10W-20	Attenuator	1437	1/8/2016	1/8/2017
3055	Rohde & Schwarz	3005	Cables	3055	12/30/2015	12/30/2016
3057	Advanced Technical Materials	42-441-6/BR	Antennas	R110602	NCR	NCR

DMAS MT-25 RF absorber material was used on the floor for all final measurements above 1 GHz.
NCR = No Calibration Required
Firmware Version: ESU40 is 4.73 SP4
Software Version: EMC32-B is 9.15

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Neptune	CMIU-ATT	ACS 1
2	External Antenna	Ethertronics	1003450D0-AS10L0613	ACS 3
3	DC Supply	Sorensen	QRD-20-4	Asset 315

Notes:

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

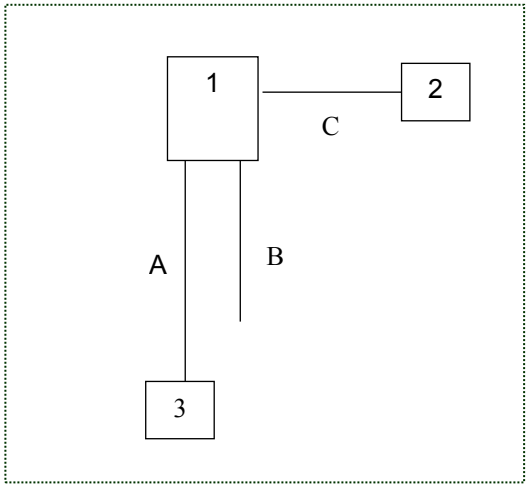

Figure 6-1: Test Setup Block Diagram

Table 6-1: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Power Cable	180cm	No	EUT to Power Supply
B	Control Cable	40cm	No	EUT to Resistive Termination
C	Coax Cable	30cm	Yes	EUT to Antenna

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC 15.203

The antenna is integral to the device and cannot be removed or replaced by the end user. The peak gain of the antenna is -1.5 dBi.

7.2 Emission Levels – FCC 15.247(d), 15.205, 15.209

7.2.1 Emissions into Non-restricted Frequency Bands

7.2.1.1 Measurement Procedure

The unwanted emissions into non-restricted bands were measured conducted in accordance with FCC KDB 558074 D01 DTS Measurement Guidance v03r05. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 300 kHz. Span was set to 1.5 times the DTS bandwidth. The trace was set to max hold with a peak detector active. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 20 dBc limit. The spectrum span was then adjusted for the measurement of spurious emissions from 30 MHz to 25GHz, 10 times the highest fundamental frequency. Additionally a prescan was performed from 9 kHz or the lowest frequency generated to 30 MHz.

Band-edge compliance was determined using the conducted marker-delta method in which the radio frequency power that is produced by the EUT is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

7.2.1.2 Measurement Results

This test is not required based on the EUT changes.

7.2.2 Emissions into Restricted Frequency Bands

7.2.2.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30MHz to 25GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a RBW of 120 kHz and a VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

7.2.2.2 Duty Cycle Correction

For average radiated measurements, using a 3.1% duty cycle, the measured level was reduced by a factor 30.17dB. The duty cycle correction factor is determined using the formula: 20log (3.1/100) = - 30.17dB.

A detailed analysis of the duty cycle timing is provided in the Theory of Operation accompanying the application for certification.

7.2.2.3 Measurement Results

Table 7.5.2.3-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
4804	52.20	52.20	H	6.16	58.36	28.19	74.0	54.0	15.6	25.8
4804	56.00	56.00	V	6.16	62.16	31.99	74.0	54.0	11.8	22.0
2390	49.60	49.60	H	-1.70	47.90	17.73	74.0	54.0	26.1	36.3
2390	46.10	46.10	V	-1.70	44.40	14.23	74.0	54.0	29.6	39.8
Middle Channel										
4880	50.10	50.10	H	6.17	56.27	26.10	74.0	54.0	17.7	27.9
4880	54.40	54.40	V	6.17	60.57	30.40	74.0	54.0	13.4	23.6
7320	50.10	50.10	H	8.83	58.93	28.76	74.0	54.0	15.1	25.2
7320	47.00	47.00	V	8.83	55.83	25.66	74.0	54.0	18.2	28.3
High Channel										
4960	49.60	49.60	H	6.19	55.79	25.62	74.0	54.0	18.2	28.4
4960	50.80	50.80	V	6.19	56.99	26.82	74.0	54.0	17.0	27.2
7440	50.62	50.62	H	9.36	59.98	29.80	74.0	54.0	14.0	24.2
7440	57.00	57.00	V	9.36	66.36	36.18	74.0	54.0	7.6	17.8
2483.5	58.00	58.00	H	-1.47	56.53	26.36	74.0	54.0	17.5	27.6
2483.5	58.10	58.10	V	-1.47	56.63	26.46	74.0	54.0	17.4	27.5

Note: The average levels correspond to the peak measurements which were further corrected using the duty cycle correction factor.

7.2.2.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Peak

Corrected Level: 52.20 + 6.16 = 58.36dBuV/m
Margin: 74dBuV/m – 58.36dBuV/m = 15.64dB

Example Calculation: Average

Corrected Level: 52.20 + 6.16 - 30.17 = 28.19dBuV
Margin: 54dBuV – 28.19dBuV = 25.8dB

8 CONCLUSION

In the opinion of ACS, Inc. the CMIU-ATT, manufactured by Neptune Technology Group meets the requirements of FCC Part 15 subpart C.

END REPORT