Certification Test Report

FCC ID: SDBCL200
IC: 2220A-CL200

FCC Rule Part: 15.209
ISED Canada's Radio Standards Specification: RSS-210

TÜV SÜD Report Number: RD72160198.500

Manufacturer: Sensus USA, Inc.
Model: CL200

Test Begin Date: September 14, 2020
Test End Date: September 15, 2020

Report Issue Date: September 18, 2020

A2LA Cert. No. 2955.18

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, ANSI, or any agency of the Federal Government.

Prepared by:

Chris Gormley
RF Wireless Engineer
TÜV SÜD America Inc.

Reviewed by:

Kirby Munroe
Technical Manager, US Wireless
TÜV SÜD America, Inc.

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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 and Innovation, Science and Economic Development Canada Radio Standards Specification RSS-210.

1.2 Product Description

The CommandLink CL200 is a device that is used for installing and walk-by reading of RF devices which are installed in conjunction with water, gas, and electric meters via a wireless link. Typically the CL200 is used by the Utility or third party professional installation personnel. The CL200 will communicate to the RF devices either through an 895 kHz inductive transmitter interface or a 900 MHz licensed band RF link. This report addresses the 895 kHz inductive transmitter only. A separate report will address the 900 MHz licensed operation.

Technical Information:
Operating Frequency: 895kHz
Modulation: AM (OOK)
Antenna: Inductive Coupler

Manufacturer Information:
Sensus USA, Inc.
639 Davis Drive
Morrisville, NC 27560

EUT Serial Numbers: CL50300539

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 EUT was evaluated in all 3 orthogonal orientations X, Y, and Z-planes. The results presented in this document represented the worse-case orientation, which was the Z-plane.

The EUT was tested standalone, and a power supply was used to keep the EUT charged.

The client provided a PC to configure the EUT.

2 TEST FACILITIES

2.1 Location

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

TÜV SÜD America Inc.
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America Inc. (Durham) is accredited to ISO/IEC 17025 by A2LA accreditation program, and has been issued certificate number 2955.18 in recognition of this accreditation. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC and Innovation, Science and Economic Development (ISED) Canada.

FCC Designation Number: US1245
FCC Test Firm Registration Number: 238628
ISED Canada Company 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:

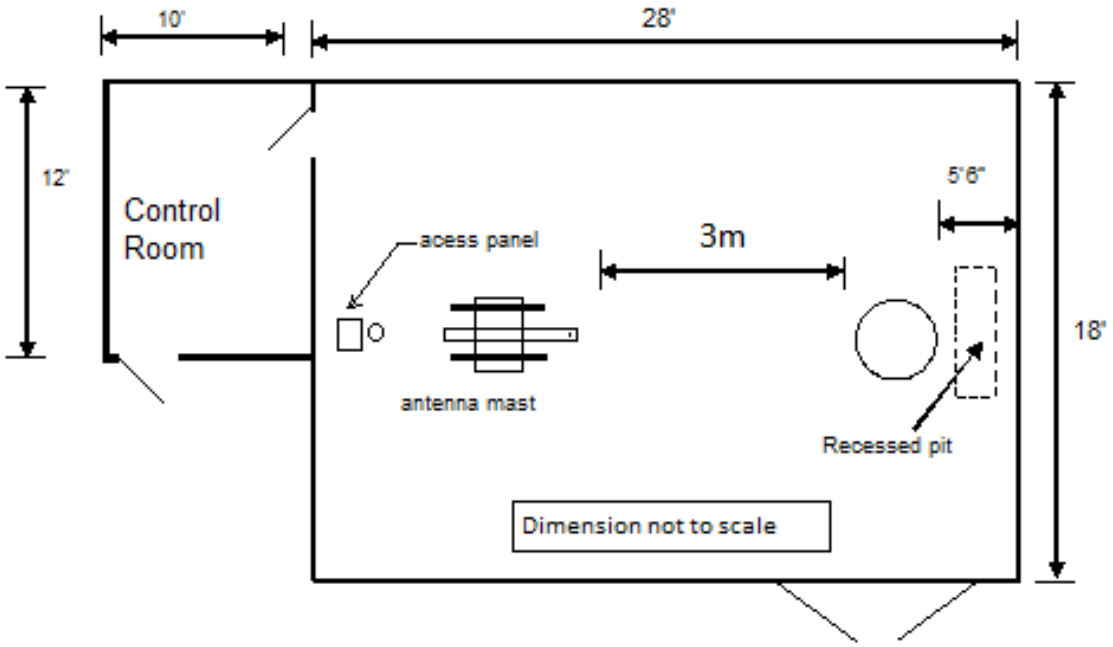


Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

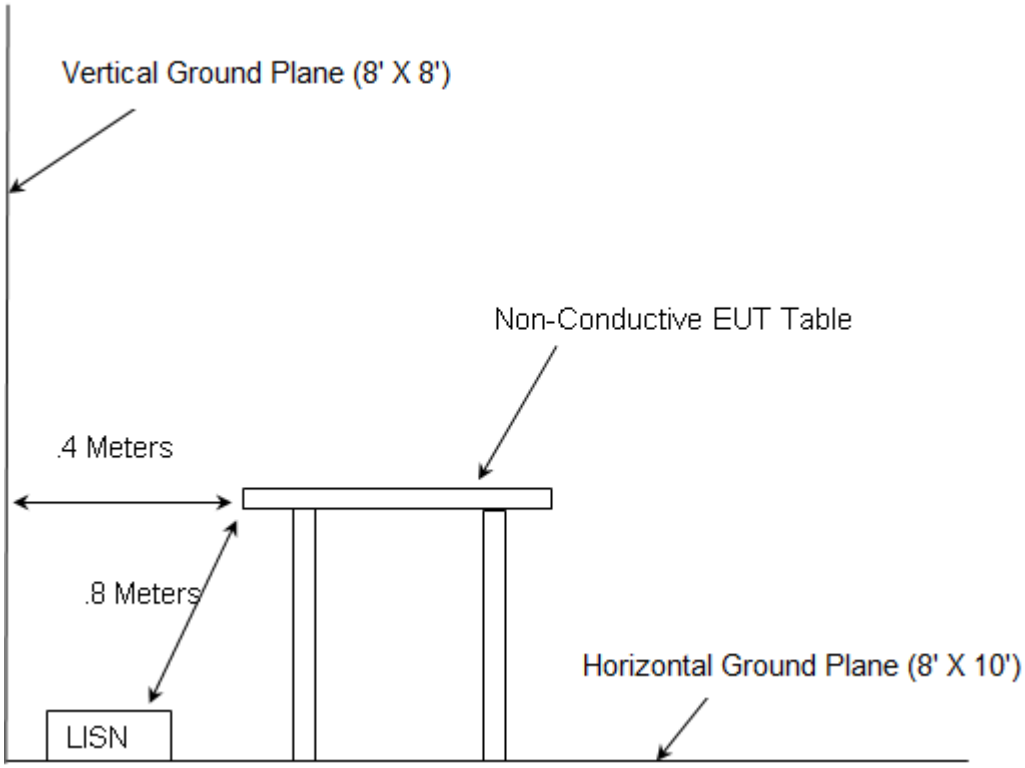


Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: 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, 2020
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2020
- ISED Canada Radio Standards Specification: RSS-210, License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 10 December 2019
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, March 2019, Amendment 1

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

Asset ID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
DEMC3002	Rohde & Schwarz	ESU40	Receiver	100346	1/22/2020	1/22/2021
DEMC3011	Rohde & Schwarz	ENV216	LISN	3011	1/22/2020	1/22/2021
DEMC3012	Rohde & Schwarz	EMC32-EB	Software	100731	NCR	NCR
DEMC3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/27/2020	1/27/2021
DEMC3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/27/2020	1/27/2021
DEMC3051	Mountain View Cable	BMS-RG400-264.0-BMS	Cable	3051	1/27/2020	1/27/2021
DEMC3054	Mountain View Cable	BMS-RG400-36.0-BMS	Cable	3054	1/24/2020	1/24/2021
DEMC3155	Com-Power Corp.	AL-130R	Active Loop	10160004	6/12/2020	6/12/2021
DEMC3161	TESEQ	CBL-6112D	Antenna	51323	2/18/2020	2/18/2021

NCR = No Calibration Required
DMAS MT-25 RF absorber material was used on the floor for all final measurements above 1 GHz.
Asset DEMC3002: Firmware Version: ESU40 is 4.73 SP4
Asset DEMC3012: Software Version: EMC32-B is 10.50.00

5 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Sensus	CL200	See Section 1.2
2	Wall Wart	Wall Industries, Inc.	GPSU15U-1	EJ-0150794 B1823R

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	DC Power Cable	1.5m	No	1 to 2

6 6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

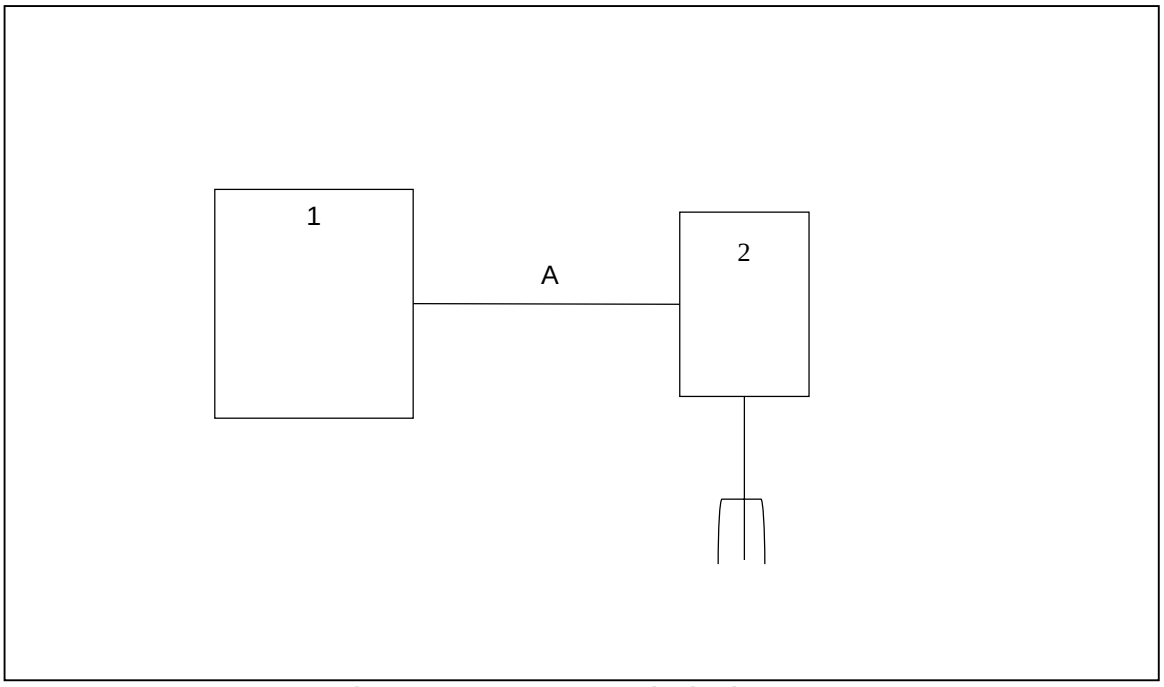


Figure 6-1: Test Setup Block Diagram

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 a permanent 22uH coil thus satisfying Part 15.203.

7.2 Power Line Conducted Emissions – FCC: 15.207; ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

ANSI C63.10-2013 section 6 was the guiding document for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

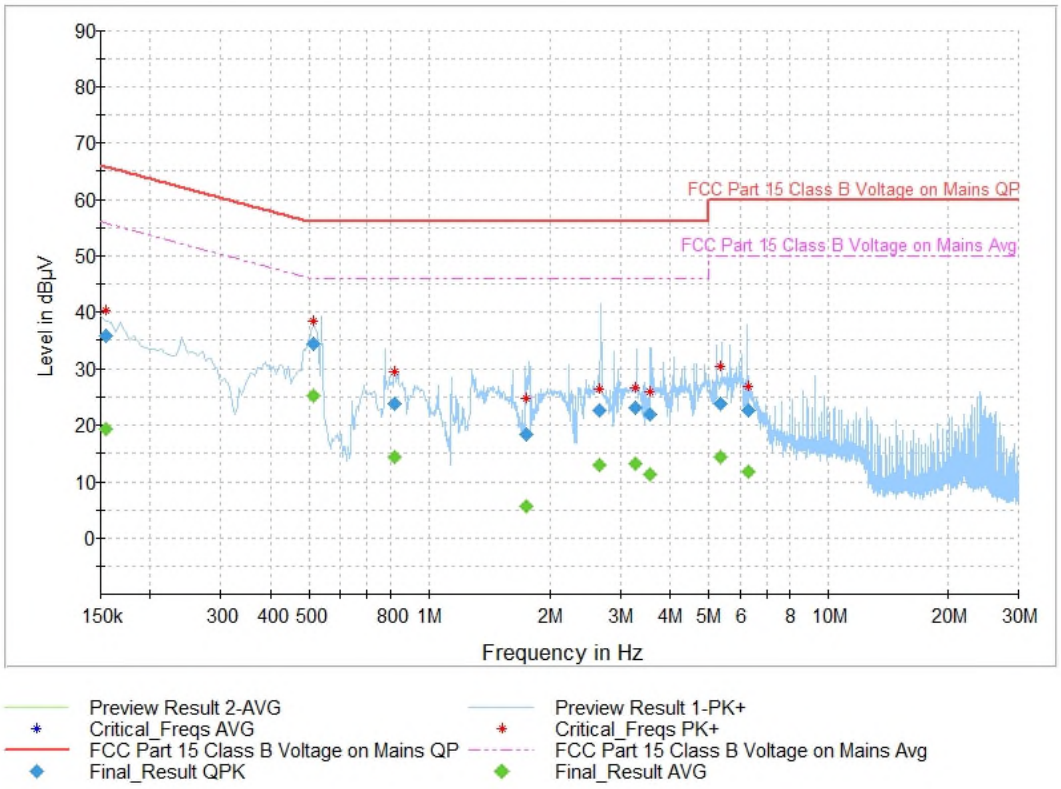
7.2.2 Measurement Results

Performed by: Chris Gormley

Table 7.2.2-1: Conducted EMI Results – Line and Neutral

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.154500	35.79	---	65.75	29.97	N	OFF	9.6
0.154500	---	19.36	55.75	36.40	N	OFF	9.6
0.514500	34.28	---	56.00	21.72	N	OFF	9.6
0.514500	---	25.21	46.00	20.79	N	OFF	9.6
0.820500	23.86	---	56.00	32.14	L1	OFF	9.6
0.820500	---	14.50	46.00	31.50	L1	OFF	9.6
1.738500	---	5.52	46.00	40.48	N	OFF	9.7
1.738500	18.34	---	56.00	37.66	N	OFF	9.7
2.652000	22.70	---	56.00	33.30	L1	OFF	9.8
2.652000	---	12.99	46.00	33.01	L1	OFF	9.8
3.264000	---	13.17	46.00	32.83	N	OFF	9.8
3.264000	23.13	---	56.00	32.87	N	OFF	9.8
3.570000	---	11.36	46.00	34.64	N	OFF	9.8
3.570000	22.10	---	56.00	33.90	N	OFF	9.8
5.365500	---	14.40	50.00	35.60	N	OFF	9.8
5.365500	23.87	---	60.00	36.13	N	OFF	9.8
6.292500	---	11.91	50.00	38.09	N	OFF	9.9
6.292500	22.59	---	60.00	37.41	N	OFF	9.9

Figure 7.2.2-1: AC Powerline Conducted Emissions Profile



7.3 20dB / 99% Bandwidth – FCC: Section 15.215(c) / IC: RSS-Gen Section 6.7

7.3.1 Measurement Procedure

The spectrum analyzer span was set to approximately 2 times the estimated bandwidth of the emission. The RBW was to ≥ 1% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission and approximately 20dB below the peak level. The RBW was to ~ 1% to 3% of the approximate emission width. The trace was set to max hold with a peak detector active. The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth.

7.3.2 Measurement Results

Results are shown below in table 7.2.2-1 and Figure 7.2.2-1 to 7.2.2-2:

Table 7.3.2-1: 20dB / 99% Bandwidth

Frequency (kHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
895	31.09	34.215

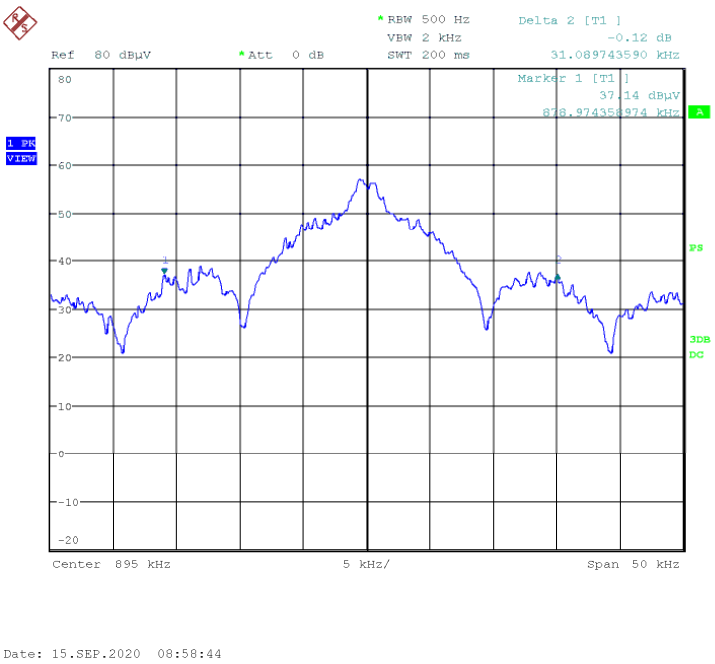


Figure 7.3.2-1: 20dB Bandwidth

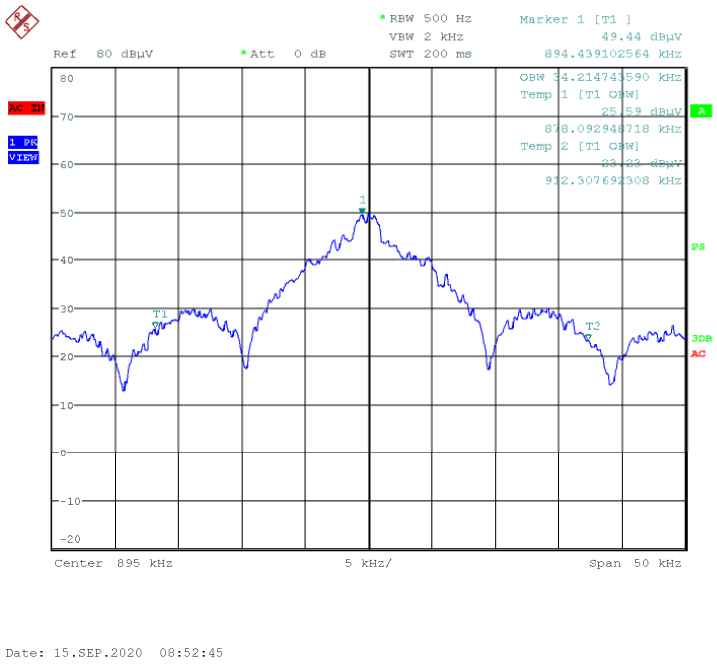


Figure 7.3.2-2: 99% Bandwidth

7.4 Radiated Emissions – FCC CFR 47 Part 15.209; RSS-210 Section 7.3, RSS-Gen Section 8.9

7.4.1 Measurement Procedure

Section 15.33(a)(4) specifies, if the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to frequency specified in 15.33(b)(1) for unintentional radiators. The upper frequency range for the digital device is 1000MHz which greater than the 10th harmonic of the fundamental frequency. The upper frequency range measured was 1000MHz.

Measurements below 30MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360º and the loop antenna rotated about the vertical axis to maximize each emission. The magnetic loop receiving antenna was positioned with its lowest height 1 meter above the ground.

The spectrum analyzer's resolution and video bandwidth was set to 200 Hz and 600 Hz respectively for frequencies below 150 kHz and 9 kHz and 30 kHz respectively for frequencies above 150 kHz and below 30 MHz. For measurements in the frequency bands 9-90 kHz and 110-490 kHz, an average detector was used. When average measurements are specified, the peak emissions were also compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. All other emissions were measured using a Quasi-peak detector. The final measurements were then corrected by antenna correction factors and cable loss for comparison to the limits.

Measurements above 30 MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. 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 1000 MHz, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz.

7.4.2 Distance Correction for Measurements Below 30 MHz – Part 15.31

Radiated measurements were performed at a distance closer than 30m as required, according to Part 15.209. Therefore, a correction factor was applied to account for propagation loss at the specified distance. The propagation loss was determined by using the square of an inverse linear distance extrapolation factor (40dB/decade) according to 15.31. A sample calculation of the distance correction factor is shown below for limits expressed at a 30m measurement distance.

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30) = 40*Log = -40dB

7.4.3 Measurement Results

Performed by: Chris Gormley

Table 7.4.3-1: 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		(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
0.895	------	48.40	Parallel	14.00	---------	62.40	--------	68.6	--------	6.2
0.895	------	51.50	Perpendicular	14.00	---------	65.50	--------	68.6	--------	3.1
0.895	------	47.70	Ground Parallel	14.00	---------	61.70	--------	68.6	--------	6.9
1.79	------	47.30	Parallel	14.46	---------	61.76	--------	69.5	---------	7.74
1.79	------	39.70	Perpendicular	14.46	---------	54.16	--------	69.5	---------	15.34
1.79	------	35.60	Ground Parallel	14.57	---------	50.17	--------	69.5	---------	19.33
2.685	------	34.20	Parallel	14.57	---------	48.77	--------	69.5	---------	20.73
2.685	------	26.80	Perpendicular	14.57	---------	41.37	--------	69.5	---------	28.13
2.685	------	23.20	Ground Parallel	14.57	---------	37.77	--------	69.5	---------	31.73
3.58	------	19.70	Parallel	14.66	---------	34.36	--------	69.5	---------	35.14
3.58	------	15.80	Perpendicular	14.66	---------	30.46	--------	69.5	---------	39.04
4.475	------	18.80	Parallel	14.65	---------	33.45	--------	69.5	---------	36.05
5.37	------	19.00	Parallel	14.53	---------	33.53	--------	69.5	---------	35.97

Note: All other emissions related to the transmitter were attenuated more than 20dB from the limit.

7.4.3.1 Sample Calculation:

$RC = RU + CF_T$

Where:

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

Example Calculation: Quasi-peak

Corrected Level: 48.40 + 14.00 = 62.40dBuV/m
Margin: 68.6dBuV/m – 62.40dBuV/m = 6.20dB

7.4.4 Emission Plots

For each of the following plots, Trace 1 was used for Parallel, Trace 2 was used for Perpendicular, and Trace 3 was used for Ground Parallel.

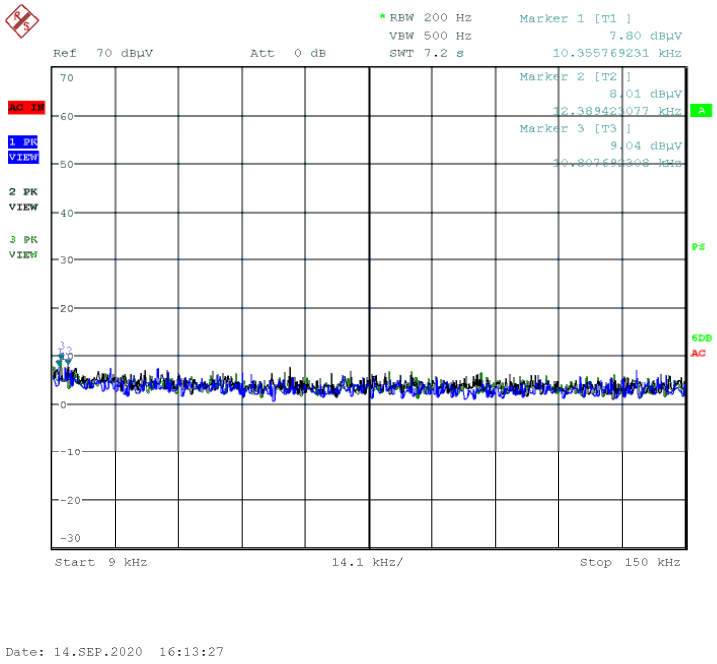


Figure 7.4.4-1: Emission Profile from 9kHz to 150kHz – Z axis

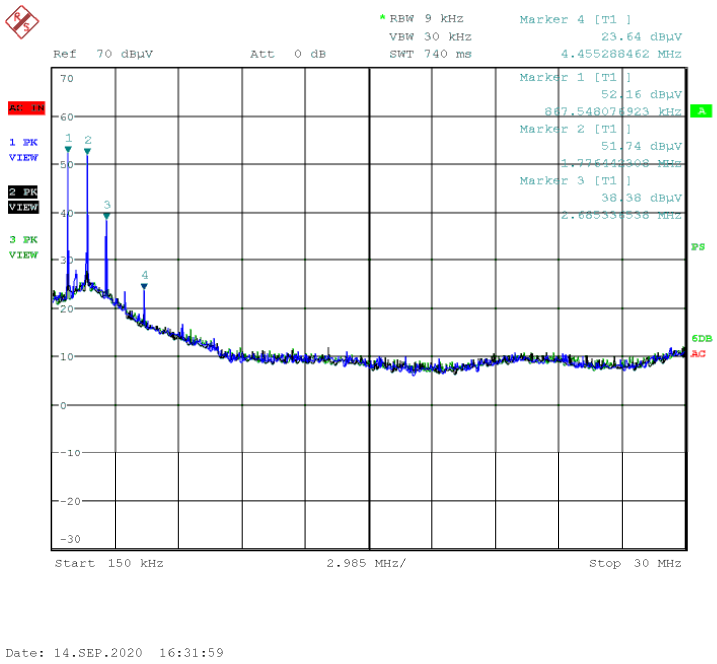


Figure 7.4.4-2: Emission Profile from 150kHz to 30MHz – Z axis

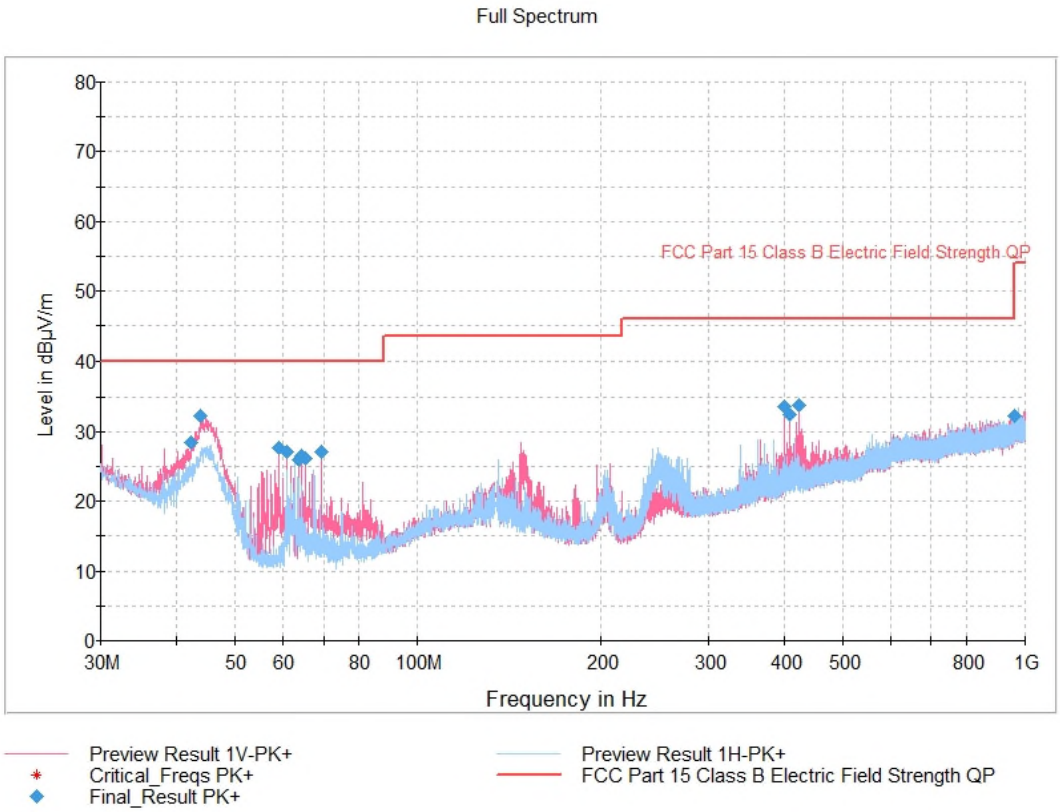


Figure 7.4.4-2: Emission Profile from 30MHz to 1GHz – Z axis

8 MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

Parameter	U_{lab}
Occupied Channel Bandwidth	**± 0.004%**
RF Conducted Output Power	**± 0.689 dB**
Power Spectral Density	**±0.5 dB**
Antenna Port Conducted Emissions	**± 2.717 dB**
Radiated Emissions	**± 5.877 dB**
Temperature	**± 0.860 °C**
Radio Frequency	**±2.832 x 10-8**
AC Power Line Conducted Emissions	**±2.85**

9 CONCLUSION

In the opinion of TÜV SÜD America Inc. the CL200, manufactured by Sensus USA, Inc. meets the requirements of FCC Part 15 subpart C and ISED Canada Radio Standards Specification: RSS-210 for the tests documented herein.

END REPORT