Measurement of RF Emissions from a Model No. CDMRAA0101E3 (ARQ2-UGDO) Automotive Transceiver for Garage Door Control Transmitter

For	The Chamberlain Group, Inc. 300 Windsor Dr Oak Brook, IL 60523
P.O. Number	4900067654
Date Tested	November 17 – December 1, 2020
Test Personnel	Tylar Jozefczyk
Test Specification	FCC "Code of Federal Regulations" Title 47 Part15, Subpart C Industry Canada RSS-GEN Industry Canada RSS-210

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Approved By: Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894

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REVISION HISTORY

Revision	Date	Description
—	18 JAN 2021	Initial release
A	25 JAN 2021 By TMJ	- Report number updated from 2004380-01 to 2004380-01 Rev. A throughout test report. - Section 3.1: updated ISED UPN from “266A-9757” to “2666A-9757”.
B	01 FEB 2021 By TMJ	- Report number updated from 2004380-01 Rev. A to 2004380-01 Rev. B throughout test report. - Section 3.1: updated and edited “EUT Identification” table with the following: o Corrected value in “Device Type” from ‘Digitally Modulated Transmission Device’ to ‘Remote Controlled Device’. o Removed “Conducted Output Power” row. o Changed “Rated Output Power” to “Output Power” and corrected value from -0.59dB to 79.03dBμV/m. o Removed “6dB Bandwidth” row. o Corrected value in “Occupied Bandwidth (99% CBW)” from 1.04MHz to 314.27kHz.
C	02 FEB 2021 By TMJ	- Report number updated from 2004380-01 Rev. B to 2004380-01 Rev. C throughout test report. - Revision History Table: Updated second row for Revision A (showed incorrectly as “Report number updated from 2004380-01 to 2004380-01 Rev. B throughout test report”; has been updated to the correct “Report number updated from 2004380-01 to 2004380-01 Rev. A throughout test report”).

Measurement of RF Emissions from an Automotive Transceiver for Garage Door Control, Model No. CDMRAA0101E3 (ARQ2-UGDO) Transmitter

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on an Automotive Transceiver for Garage Door Control, Model No. CDMRAA0101E3 (ARQ2-UGDO) (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was designed to transmit in the 300-433.92MHz range using an integral antenna. The EUT was manufactured and submitted for testing by The Chamberlain Group, Inc. located in Oak Brook, IL.

1.2. Purpose

The test series was performed to determine if the EUT meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.231 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2014.

1.3. Deviations, Additions and Exclusions

There were no deviations, additions to, or exclusions from the test specification during this test series.

1.4. EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by The American Association for Laboratory Accreditation (A2LA). A2LA Certificate Number: 1786.01.

1.5. Laboratory Conditions

The temperature at the time of the test was 23^{o}C and the relative humidity was 14%.

2. APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C
- 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 40GHz"
- Industry Canada Radio Standards Specification, RSS-Gen, “General Requirements for Compliance of Radio Apparatus”, Issue 5, March 2019
- Industry Canada Radio Standards Specification, RSS-210, “License-Exempt Radio Apparatus: Category I Equipment”, Issue 10, December 2019

3. EUT SETUP AND OPERATION

3.1. General Description

The EUT was identified as follows:

EUT Identification	
Product Description	ARQ2 Automotive Transceiver for Garage Door Control
Model Number	CDMRAA0101E3 (ARQ2-UGDO)
Serial Number	SMP-77482
Device Type	Remote Control Transmitter

Band of Operation	300 – 433.92MHz
Firmware Version	0.26
Output Power	79.03dBμV/m
Antenna Type	Copper trace monopole; Chip
Antenna Gain (dBi)	0.5dBi
Occupied Bandwidth (99% CBW)	314.27kHz
Size of EUT	1.75” x 1.5”
Product FCC ID and ISED UPN	FCC ID: HBW9757 ISED UPN: 2666A-9757

3.1.1. Power Input

The EUT obtained 12VDC through 1m unshielded leads.

3.1.2. Grounding

The EUT was ungrounded during the tests.

3.2. Operational Mode

For all tests, the EUT was placed on an 80cm high non-conductive stand and was energized.

Mode	Description
Tx	The EUT was powered on and set to transmit at one of the frequencies in the table below.

Frequency	Code Format	Duty Cycle (Theoretical)
315MHz	IntelliCode (Keeloq based)	24.1%
390MHz		
318MHz	Mega-Code	17.0%
315MHz	Rolling Code (D Code)	31.0%
390MHz		
390MHz	Billion Code (A Code)	46.0%
310MHz	Secure Code (Keeloq based)	24.1%
310MHz	Rolling Code (E Code)	21.5%
315MHz		
390MHz		
372.5MHz	Rolling Code (Keeloq Based)	24.1%
310MHz	8 Position DIP Switch	24.5%
315MHz	9 Position DIP Switch	35.0%
310MHz	10 Position DIP Switch (Multicode)	39.4%
390MHz	12 Position DIP Switch	50.1%
390MHz	7 Position DIP Switch	30.2%
390MHz	8 Position DIP Switch	32.5%
300MHz	10 Position DIP Switch (Multicode)	39.4%
390MHz	9 Position DIP Switch	35.0%
390MHz	9 Position DIP Switch	50.1%
303MHz	Fixed long code	39.8%
372.5MHz	Rolling Code (Keeloq Based)	24.1%
310MHz		11.1%
315MHz	Synergy fixed code	25.6%
433.92MHz	EX series fixed code	46.6%

3.3. EUT Modifications

No modifications were required for compliance to the FCC 15.231 requirements.

4. Test Facility and Test Instrumentation

4.1. Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

4.2. Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1.

Conducted and radiated emission measurements were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths and detector functions specified by the FCC. The receiver bandwidth was 120kHz for the 30MHz to 1GHz radiated emissions data and 1MHz for the 1GHz to 4GHz radiated emissions data.

4.3. Calibration Traceability

Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.4. Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence) are presented below:

Measurement Type	Expanded Measurement Uncertainty
Conducted disturbance (mains port) (150 kHz – 30 MHz)	2.7
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2

5. Test Procedures

5.1. Powerline Conducted Emissions

5.1.1. Requirements

Since the EUT was powered by DC power with no provisions for AC power, no conducted emissions tests are required.

5.2. Duty Cycle Factor Measurements

5.2.1. Procedures

The duty cycle factor is used to convert peak detected readings to average readings. This factor is computed from the time domain trace of the pulse modulation signal. Since this EUT utilizes a rolling code modulation, the duty is calculated based on the worst case. The following procedure was used to measure a representative sample:

1) With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed

on the spectrum analyzer.

2) The pulse width is measured, and a plot of this measurement is recorded.
3) Next the number of pulses in the word period is measured and a plot is recorded.
4) Finally, the length of the word period is measured, and a third plot is recorded. If the word period exceeds 100msec, the word period is limited to 100msec.
5) The pulse width and number of pulses for the word period are used to compute the on-time. The duty cycle is then computed as the (on-time/ word period).
6) The duty cycle factor is computed from the duty cycle.

5.2.2. Results

The plots of the duty cycles for each code used at each frequency are shown on data pages 16 through 90. Since the plots were made for rolling codes, the duty cycle factor shown on the plots may not show the worst case but was found to be no greater than the worst case duty cycle factor as calculated.

Frequency	Code Format	Duty Cycle (Calculated)
315MHz	IntelliCode (Keeloq based)	-12.84dB
390MHz		-12.38dB
318MHz	Mega-Code	-16.48dB
315MHz	Rolling Code (D Code)	-13.15dB
390MHz		-13.74dB
390MHz	Billion Code (A Code)	-6.19dB
310MHz	Secure Code (Keeloq based)	-12.32dB
310MHz	Rolling Code (E Code)	-16.48dB
315MHz		-16.48dB
390MHz		-16.06dB
372.5MHz	Rolling Code (Keeloq Based)	-12.765dB
310MHz	8 Position DIP Switch	-15.92dB
315MHz	9 Position DIP Switch	-7.85dB
310MHz	10 Position DIP Switch (Multicode)	-6.878dB
390MHz	12 Position DIP Switch	-6.00dB
390MHz	7 Position DIP Switch	-10.75dB
390MHz	8 Position DIP Switch	-9.897dB
300MHz	10 Position DIP Switch (Multicode)	-6.878dB
390MHz	9 Position DIP Switch (Chamberlain)	-10.75dB
390MHz	9 Position DIP Switch (Genie)	-6.00dB
303MHz	Fixed long code	-6.44dB
372.5MHz	Rolling Code (Keeloq Based)	-12.41dB
310MHz		-18.416dB
315MHz	Synergy fixed code	-12.128dB
433.92MHz	EX series fixed code	-6.196dB

5.3. Radiated Measurements

5.3.1.Requirements

The EUT must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.205 et seq.

FCC 15.231(b) has the following radiated emission limits:

Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)

40.66-40.70	2,250	225
70-130	1,250	125
130-174	[1]1,250 to 3,750	[1]125 to 375
174-260	3,750	375
260-470	[1] 3,750 to 12,500	[1]375 to 1,250
Above 470	12,500	1,250

[1] = Linear interpolations

In addition, emissions appearing in the restricted bands of operation listed in paragraph 15.205(a) shall not exceed the general requirements shown in paragraph 15.209.

RSS-210 (A.1.2) has the following radiated emission limits:

Fundamental Frequency (MHz) – Excluding Restricted Frequency Bands Specified in RSS-Gen	Field Strength of Fundamental (microvolts/meter)
70-130	1,250
130-174	1,250 to 3,750[1]
174-260[1]	3,750
260-470[1]	3,750 to 12,500[1]
Above 470	12,500

[1] = Linear interpolation with frequency, f, in MHz:
For 130-174 MHz: Field Strength (μV/m) = (56.82 × f) − 6136
For 260-470 MHz: Field Strength (μV/m) = (41.67 × f) − 7083

All measurements are specified at a distance of 3 meters.

5.3.2.Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

A preliminary radiated emissions test was performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the EUT. The entire frequency range from 30MHz to 4GHz was investigated using a peak detector function. The data was then processed by the computer to calculate equivalent field intensity.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 4GHz. Between 30MHz and 1GHz, a tuned dipole antenna was used as the pick-up device. A broadband double ridged waveguide antenna was used as the pick-up device for all frequencies above 1GHz. All significant broadband and narrowband signals were measured and recorded. The peak detected levels were converted to average levels using a duty cycle factor which was computed from the pulse train.

To ensure that maximum or worst case, emission levels were measured, the following steps were taken:

1) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
2) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
3) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.
4) For hand-held or body-worn devices, the EUT was rotated through three orthogonal axes to determine

which orientation produces the highest emission relative to the limit.

5.3.3. Results

The preliminary plots are presented on data pages 91 through 190. The plots are presented for a reference only and are not used to determine compliance.

The final open area radiated levels are presented on data pages 191 through 215. As can be seen from the data, all emissions measured from the EUT were within the specification limits. The emissions level closest to the limit (worst case) occurred at 390MHz (when testing the 12 DIP Switch code) and was 0.22dB within the limit. Photographs of the test configuration which yielded the highest or worst case radiated emission levels are shown in Figures 2 and 3.

5.4. Occupied Bandwidth Measurements

5.4.1. Requirement

In accordance with FCC 15.231(c), all emissions within 20dB of the peak amplitude level of the center frequency are required to be within a band less than 0.25% of the center frequency wide. Also, in accordance with RSS-210 A.1.3, the 99% bandwidth of momentarily operated devices shall be less than or equal to 0.25% of the center frequency for devices operating between 70MHz and 900MHz.

5.4.2. Procedures

The EUT was placed on an 80cm high non-conductive stand. The unit was set to transmit continuously. With an antenna positioned nearby, occupied bandwidth emissions were displayed on the spectrum analyzer. The resolution bandwidth was set to 30kHz and span was set to 2MHz. The frequency spectrum near the fundamental was plotted.

5.4.3. Results

The plots of the emissions near the fundamental frequency are presented on data pages 216 through 265. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

6. OTHER TEST CONDITIONS

6.1. Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated.

6.2. Disposition of the EUT

The EUT and all associated equipment were returned to The Chamberlain Group, Inc. upon completion of the tests.

7. CONCLUSIONS

It was determined that The Chamberlain Group, Inc. Automotive Transceiver for Garage Door Control, Model No. CDMRAA0101E3 (ARQ2-UGDO) did fully meet the specified requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.231 et seq. for Intentional Radiators, when tested per ANSI C63.4-2014.

8. CERTIFICATION

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the EUT at the test date. Any electrical or mechanical modification made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

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

9. EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
CDZ3	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	N/A	
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHz	10/20/2020	10/20/2021
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	5/13/2020	5/13/2022
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	3/23/2020	3/23/2021
SMAW	DC POWER SUPPLY	VOLTEQ	HY3020EX	02177910	30VDC/20A	NOTE 1	
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	

I/O: Initial Only
N/A: Not Applicable
Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

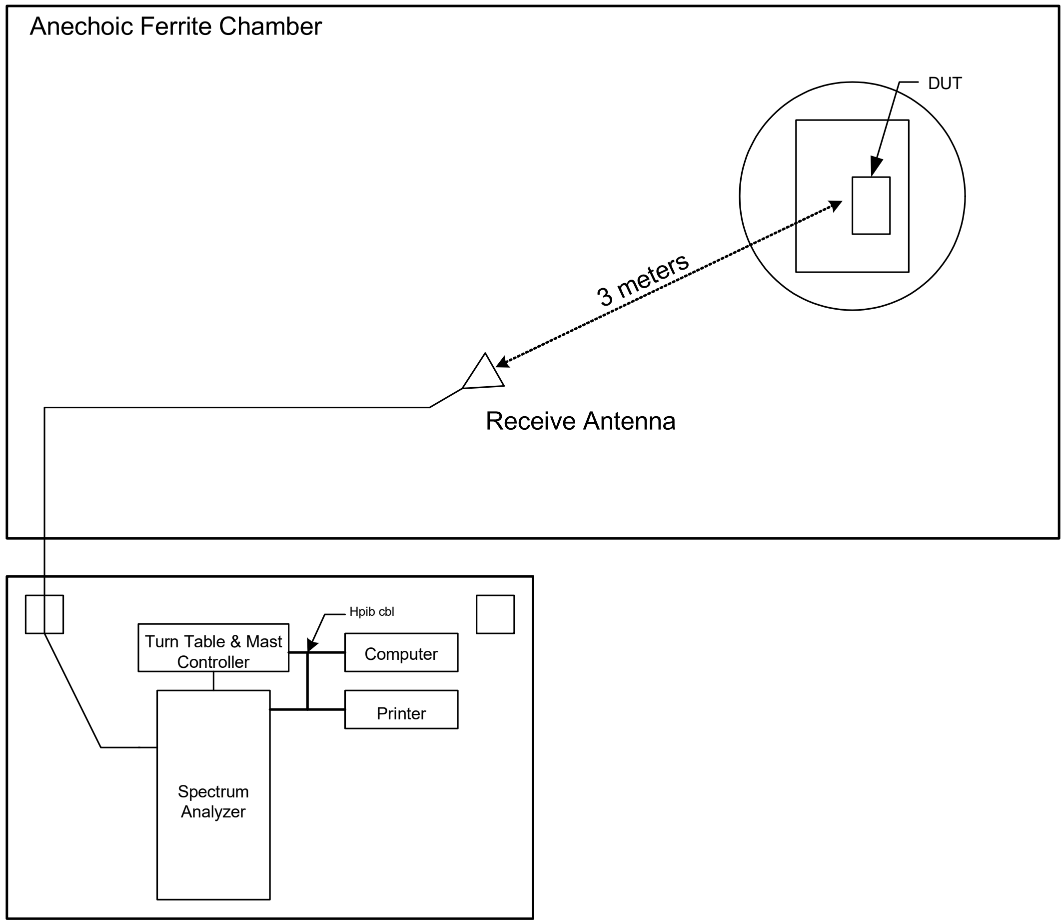


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

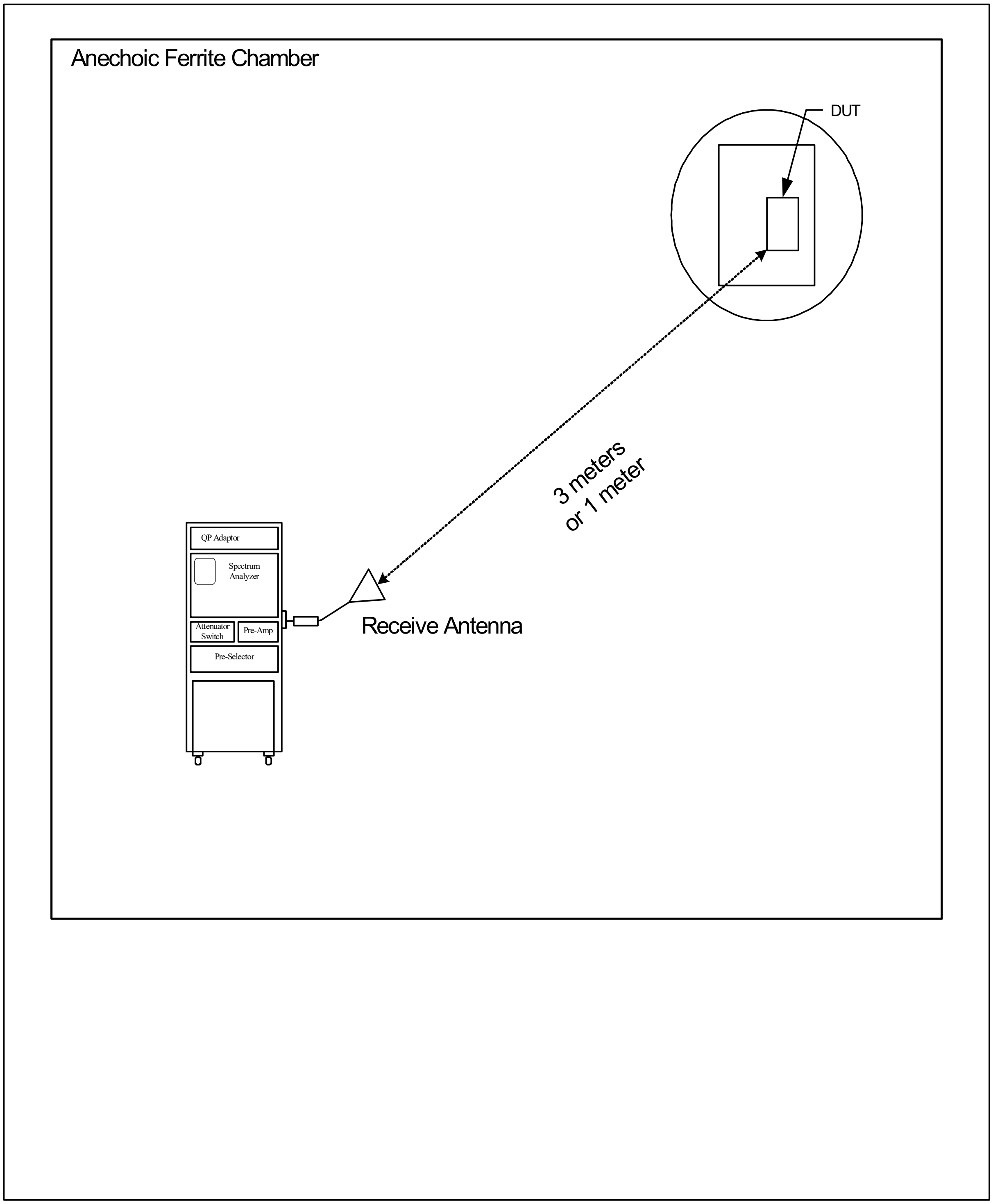
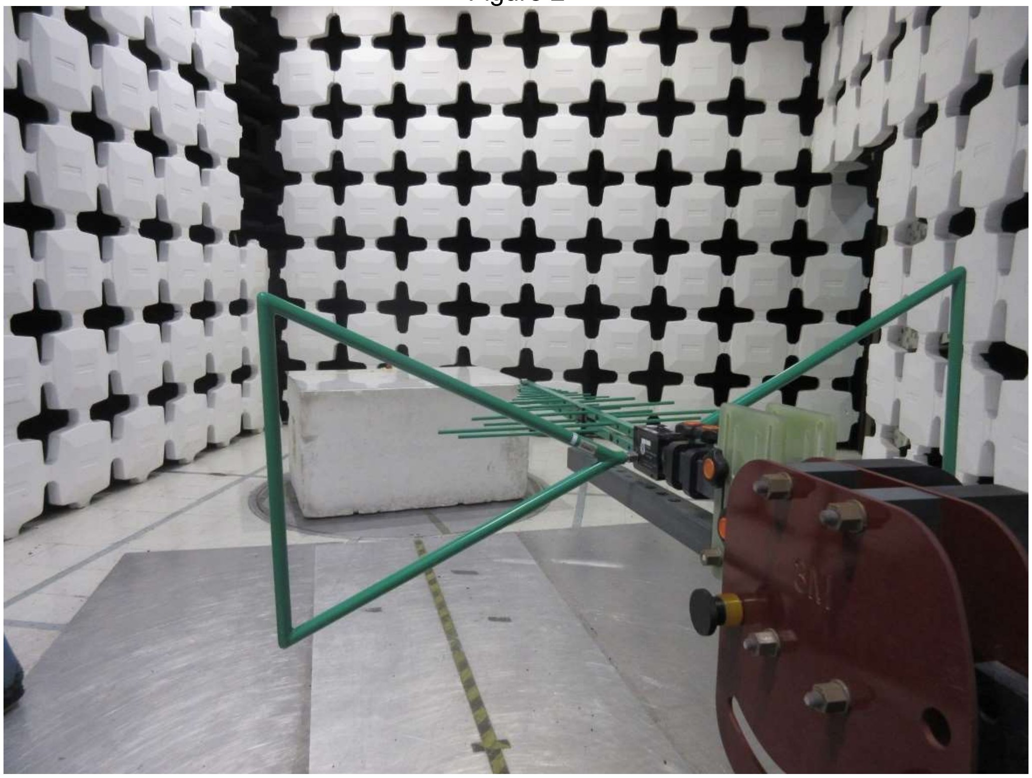
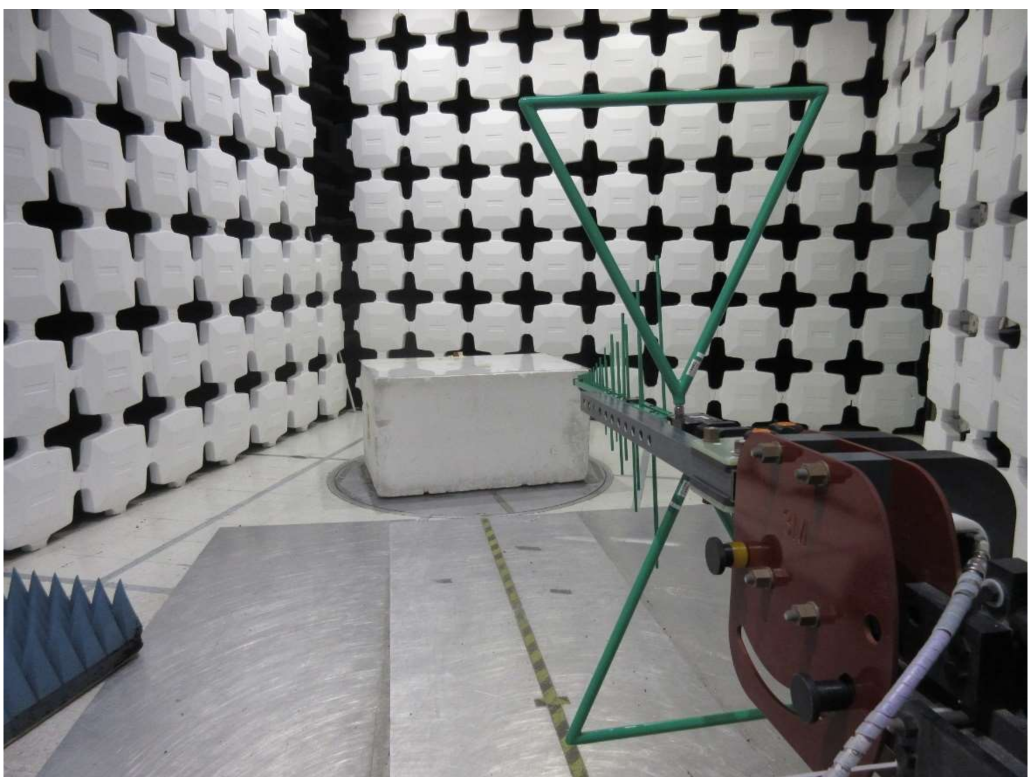

Anechoic Ferrite Chamber
DUT
3 meters
or 1 meter
QP Adaptor
Spectrum Analyzer
Attenuator Switch
Pre-Amp
Pre-Selector
Receive Antenna

Figure 2

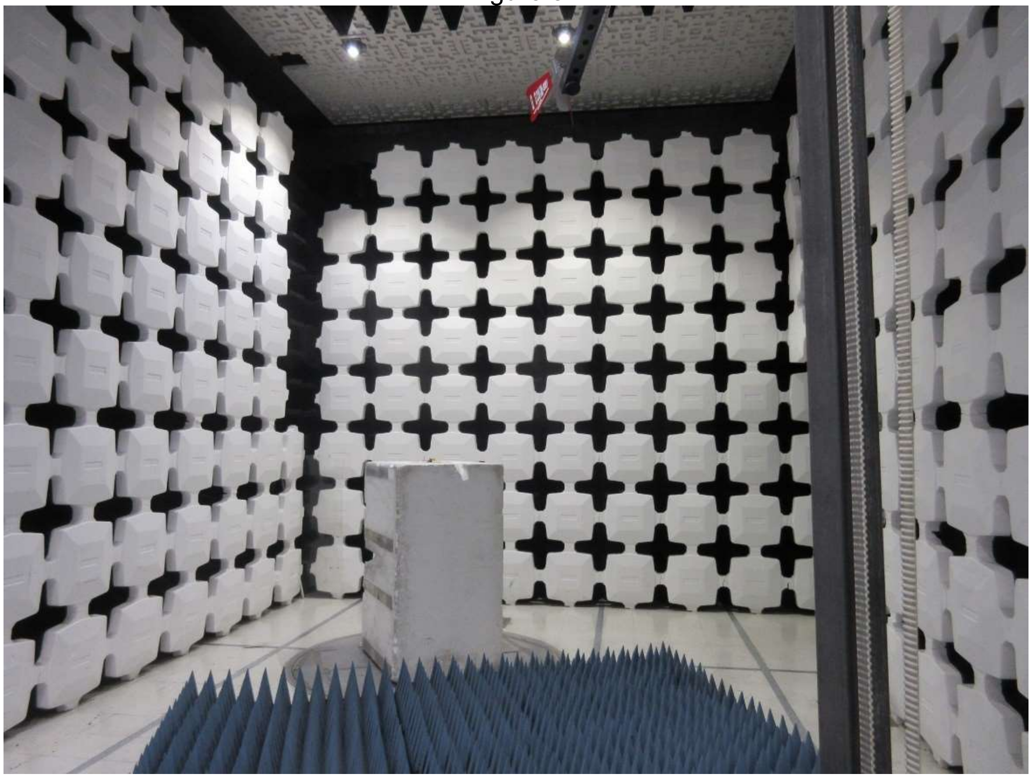


Test Setup for Radiated Emissions, 30MHz to 1GHz – Horizontal Polarization

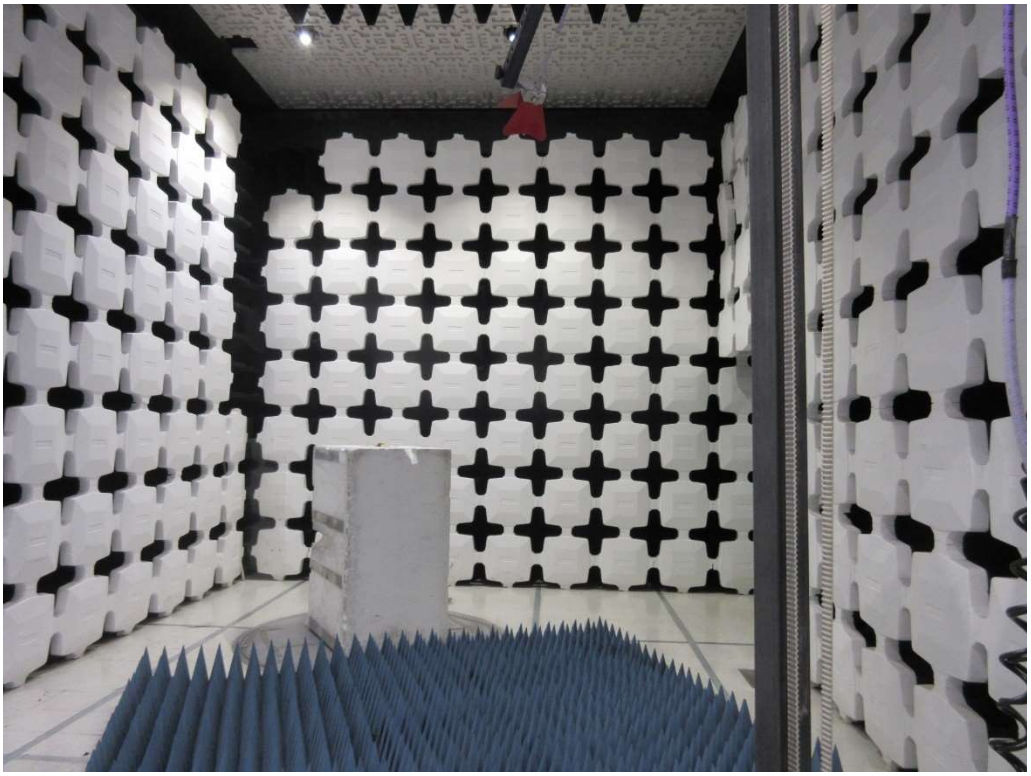


Test Setup for Radiated Emissions, 30MHz to 1GHz – Vertical Polarization

Figure 3



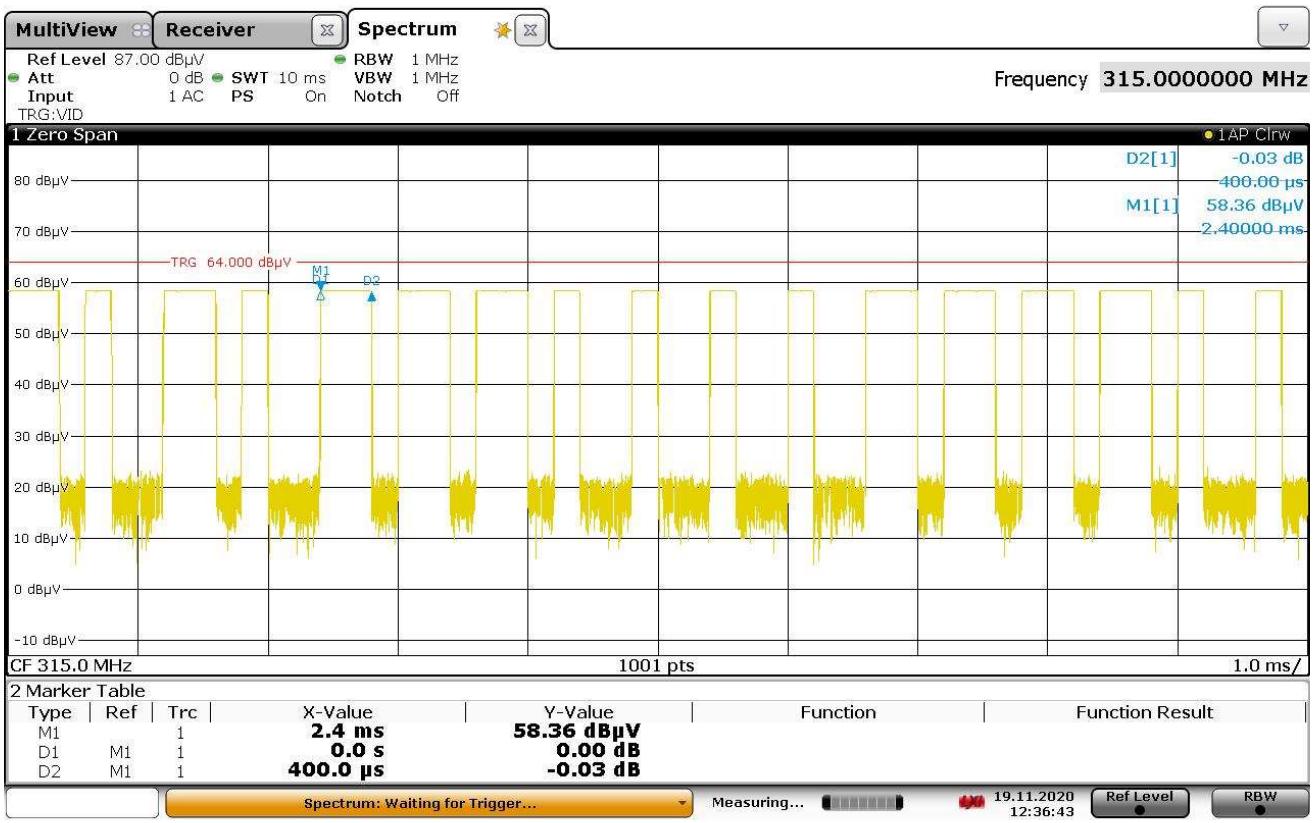
Test Setup for Radiated Emissions, 1 to 4GHz – Horizontal Polarization



Test Setup for Radiated Emissions, 1 to 4GHz – Vertical Polarization

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	315MHz (IntelliCode)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Wide Pulse = 400µs = 0.4ms

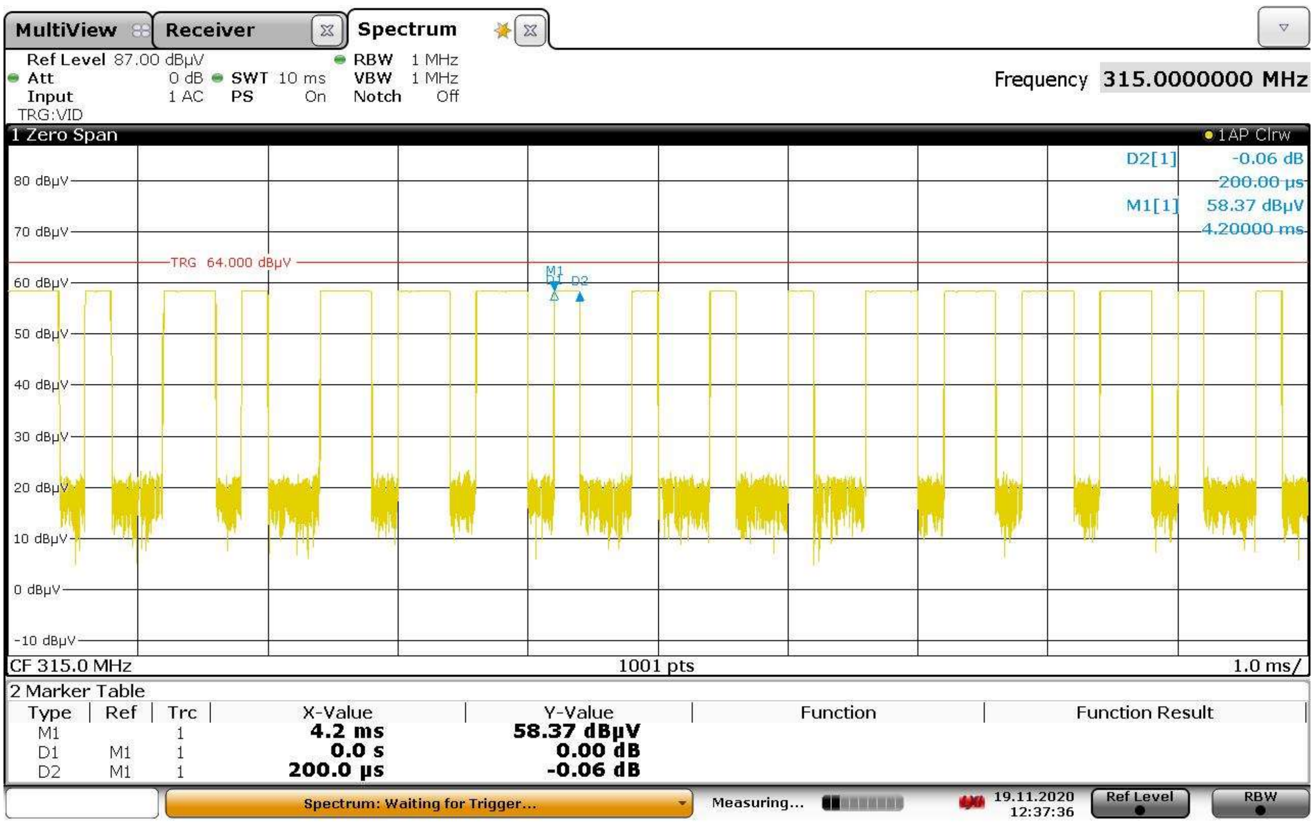
DUTY CYCLE – WIDE PULSE



12:36:44 19.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	315MHz (IntelliCode)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Narrow Pulse = 200μs = 0.2ms

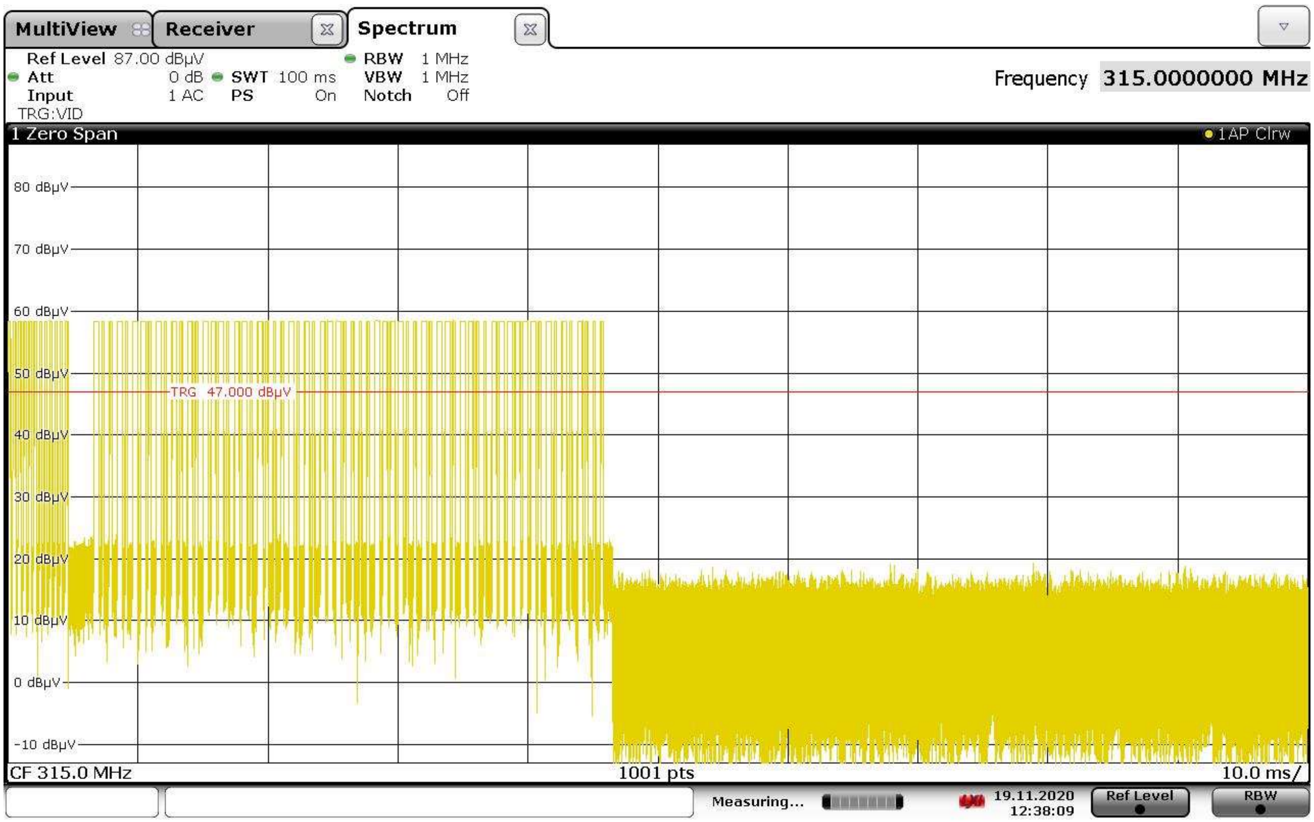
DUTY CYCLE – NARROW PULSE



12:37:37 19.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	315MHz (IntelliCode)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Duty Cycle Calculation: 36 × 0.4ms = 14.4ms 42 × 0.2ms = 8.4ms 14.4+8.4 = 22.8 D.C = 20log(22.8/100) = **-12.84dB**

DUTY CYCLE



12:38:10 19.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	390MHz (IntelliCode)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Wide Pulse = 390µs = 0.39ms

DUTY CYCLE – WIDE PULSE

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	0.0 s	102.54 dBµV		
D1	M1	1	0.0 s	0.00 dB		
D2	M1	1	390.0 µs	0.02 dB		

20:39:41 17.11.2020

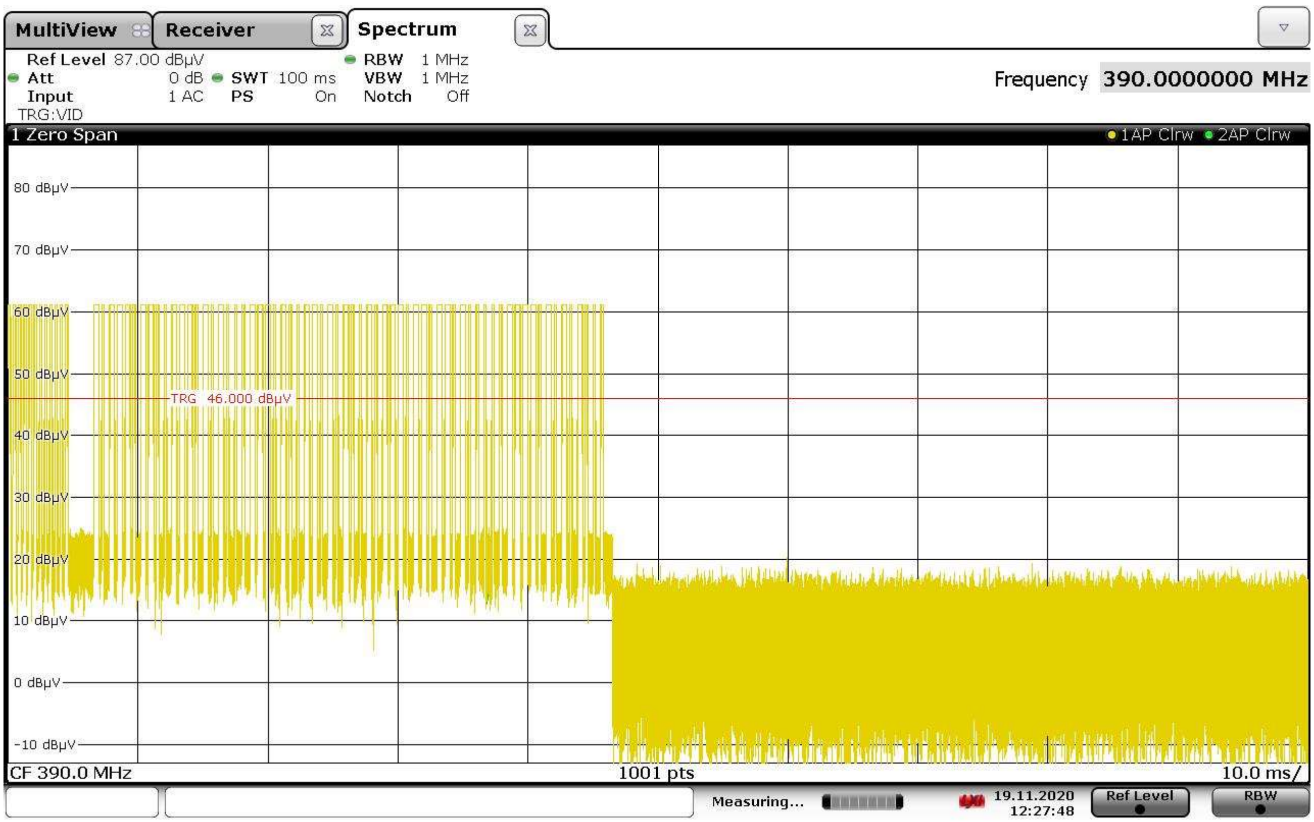
DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	390MHz (IntelliCode)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Narrow Pulse = 190µs = 0.19ms

DUTY CYCLE – NARROW PULSE

20:40:35 17.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	390MHz (IntelliCode)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Duty Cycle Calculation: 35 × 0.39ms = 13.65ms 43 × 0.19ms = 8.6ms 13.65 + 8.6 + 1.79 = 20.5ms D.C = 20log(20.5/100) = **-12.38dB**

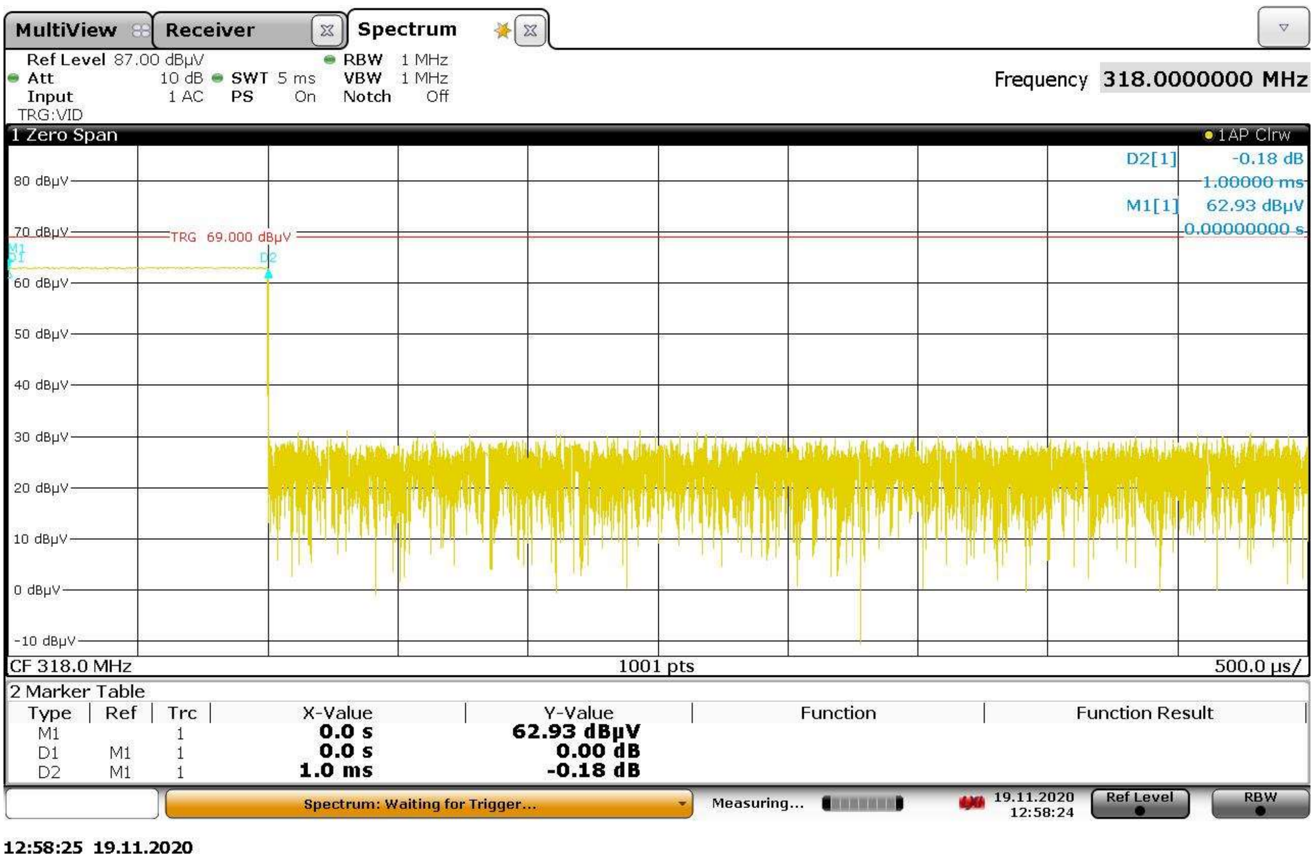
DUTY CYCLE



12:27:49 19.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	318MHz (MegaCode)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Wide Pulse = 1.0ms

DUTY CYCLE – WIDE PULSE



DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	318MHz (MegaCode)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Duty Cycle Calculation: 15 × 1.0ms = 15.0ms D.C = 20log(15/100) = **-16.478dB**

DUTY CYCLE

12:59:29 19.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	315MHz (D Code)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Wide Pulse = 1.5ms

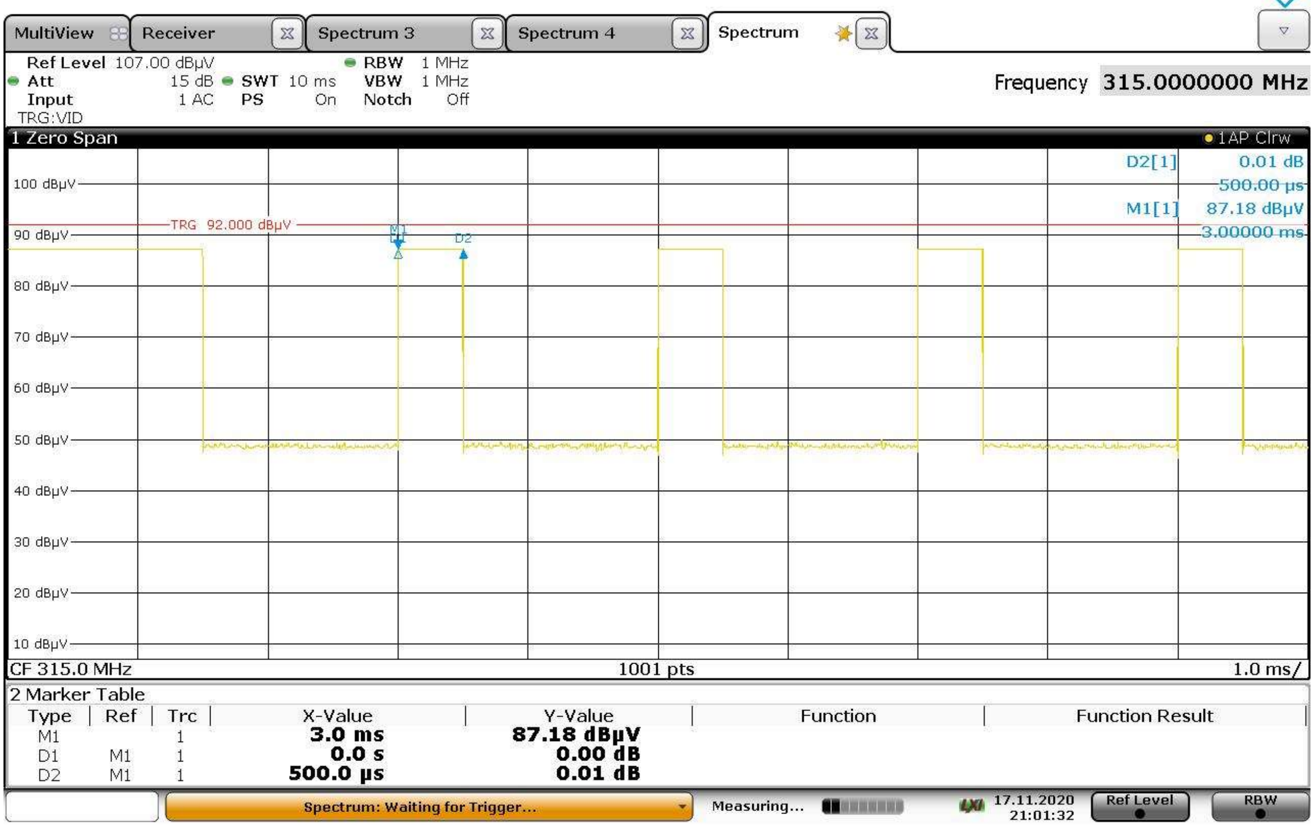
DUTY CYCLE – WIDE PULSE

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	0.0 s	87.18 dBµV		
D1	M1	1	0.0 s	0.00 dB		
D2	M1	1	1.5 ms	-1.41 dB		

21:01:00 17.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	315MHz (D Code)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Narrow Pulse 1 = 500µs = 0. 5ms

DUTY CYCLE – NARROW PULSE 1



Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	3.0 ms	87.18 dBµV		
D1	M1	1	0.0 s	0.00 dB		
D2	M1	1	500.0 µs	0.01 dB		

21:01:32 17.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	315MHz (D Code)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Narrow Pulse 2 = 1.0ms

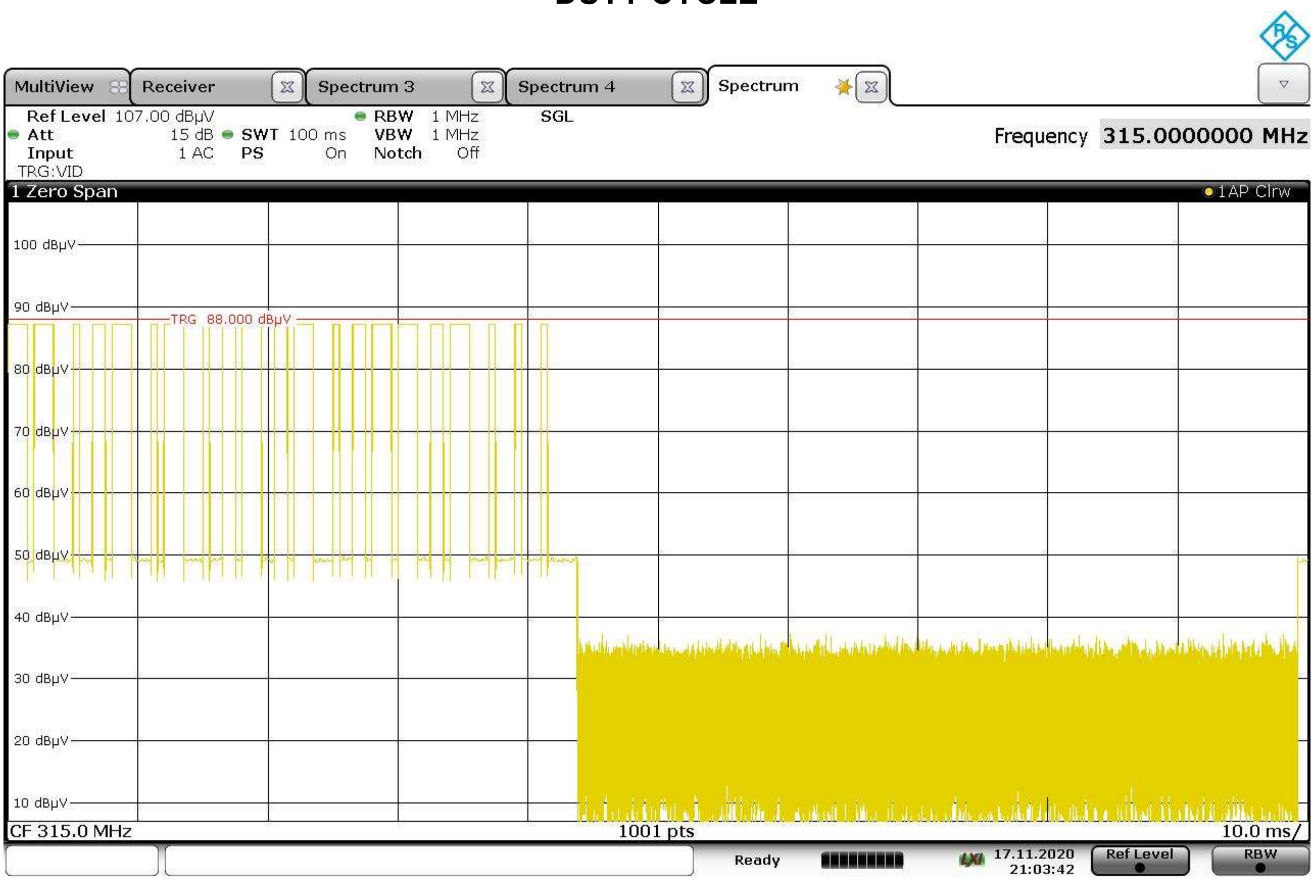
DUTY CYCLE – NARROW PULSE 2

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	5.5 ms	87.21 dBµV		
D1	M1	1	0.0 s	0.00 dB		
D2	M1	1	1.0 ms	-0.01 dB		

21:02:15 17.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	315MHz (D Code)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Duty Cycle Calculation: 9 × 1.5ms = 13.5ms 5 × 0. 5ms = 2.5ms 6 × 1.0ms = 6.0ms 13.5 + 2.5 + 6.0 = 22.0ms D.C = 20log(22/100) = **-13.15dB**

DUTY CYCLE



21:03:42 17.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	390MHz (D Code)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Wide Pulse = 1.49ms

DUTY CYCLE – WIDE PULSE

20:55:29 17.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	390MHz (D Code)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Narrow Pulse = 510µs = 0.51ms

DUTY CYCLE – NARROW PULSE 1

20:56:33 17.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	390MHz (D Code)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Narrow Pulse = 1.01ms

DUTY CYCLE – NARROW PULSE 2

20:57:08 17.11.2020

DATA PAGE	
MANUFACTURER	The Chamberlain Group, Inc.
EUT	Automotive Transceiver for Garage Door Control
MODEL NO.	CDMRAA0101E3 (ARQ2-UGDO)
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx
FREQUENCY TESTED	390MHz (D Code)
DATE TESTED	November 17, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Duty Cycle Calculation: 8 × 1.49ms = 11.92ms 9 × 0. 51ms = 4.59ms 4 × 1.01ms = 4.04ms 11.92 + 4.59 + 4.04 = 20.55ms D.C = 20log(20.55/100) = **-13.74dB**

DUTY CYCLE