



Measurement of RF Emissions from a Model No. 001D7922-2 Universal Garage Door Remote Transmitter

For	Chamberlain Group, Inc. 300 Windsor Dr. Oak Brook, IL 60523
P.O. Number	4900067654
Date Tested	February 27 & 28, 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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**THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE
WRITTEN APPROVAL OF ELITE ELECTRONIC ENGINEERING INCORPORATED.**

REVISION HISTORY

Revision	Date	Description
—	27 Mar 2020	Initial release

Measurement of RF Emissions from a Universal Garage Door Remote, Model No. 001D7922-2 Transmitter

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on a Universal Garage Door Remote, Model No. 001D7922-2, (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was designed to transmit at approximately 303MHz using an integral antenna. The EUT was manufactured and submitted for testing by Chamberlain Group, Inc. located in Oak Brook, IL.

1.2. Purpose

The test series was performed to determine if the EUT meets Class 2 Permissive Change requirements of the radiated RF emission requirements of 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 21.5°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 9 kHz to 40 GHz"
- 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 is a Chamberlain Group, Inc. Universal Garage Door Remote, Model No. 001D7922-2. A block diagram of the EUT setup is shown as Figure 1.

3.1.1. Power Input

The EUT obtained 3VDC from a cell battery.

3.1.2. Grounding

Since the EUT was powered with 3VDC from a cell battery, it 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 the 303MHz frequency using the Guardian Fix Code.

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. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

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 internal batteries and has no AC connections, 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 cycle are shown on data pages 15 through 17. The duty cycle factor was computed to be -12.12dB. Since the plots were made for a rolling code, 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.

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 ($\mu\text{V/m}$) = $(56.82 \times f) - 6136$

For 260-470 MHz: Field Strength ($\mu\text{V/m}$) = $(41.67 \times f) - 7083$

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 18 through 21. The plots are presented for a reference only, and are not used to determine compliance.

The final open area radiated levels is presented on data page 22. 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 303MHz and was 5.33dB within the limit. Photographs of the test configuration which

yielded the highest or worst case radiated emission levels are shown on Figures 3 and 4.

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 23 and 24. As can be seen from the data pages, 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 Chamberlain Group, Inc. upon completion of the tests.

7. CONCLUSIONS

It was determined that the Chamberlain Group, Inc. Universal Garage Door Remote, Model No. 001D7922-2 did fully meet the Class 2 Permissive Change requirements of radiated emission requirements of 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

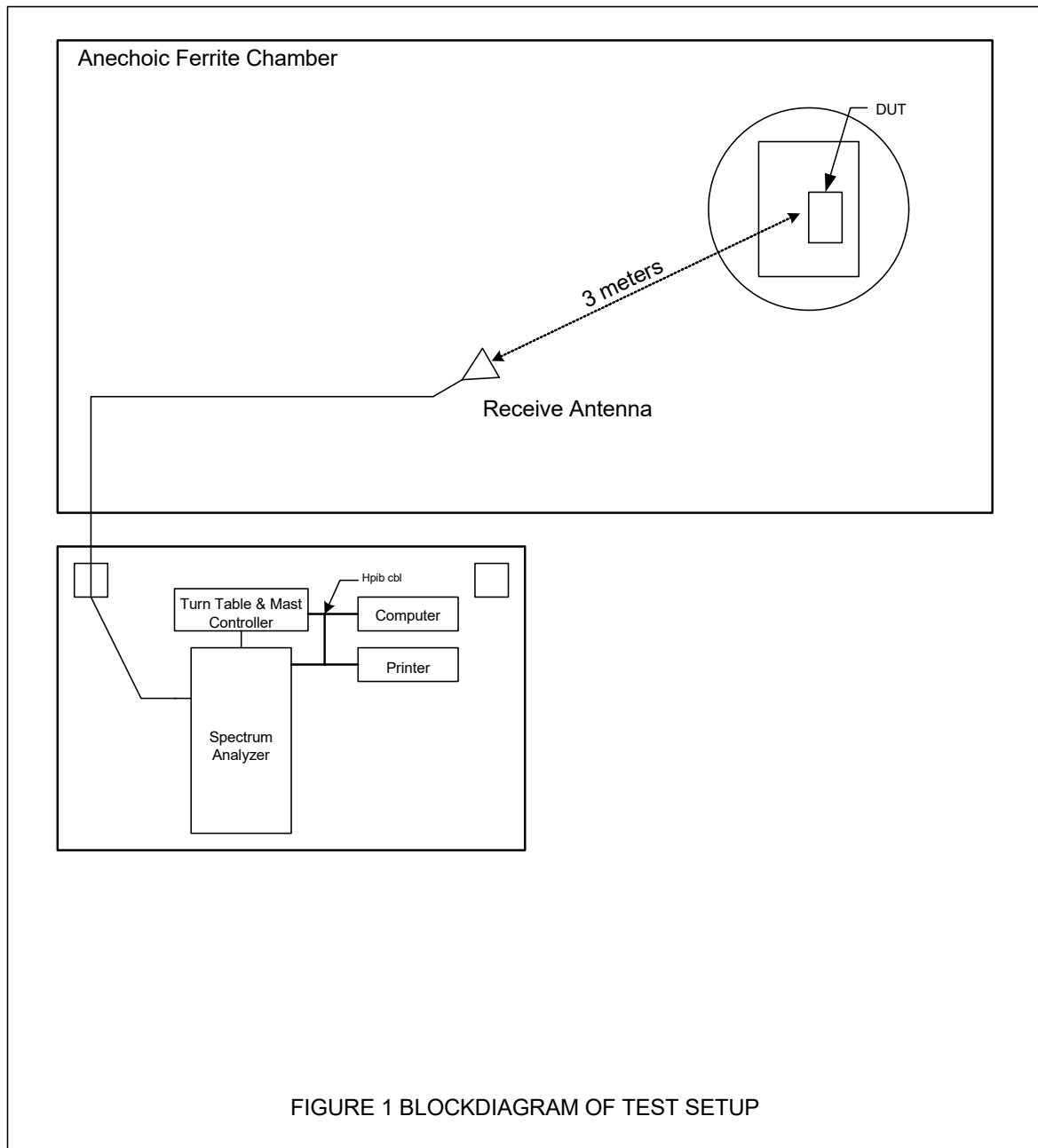
Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
CDX8	COMPUTER	ELITE	WORKSTATION			N/A	
NTA4	BILOG ANTENNA	TESEQ	6112D	46660	20-2000GHZ	9/23/2019	9/23/2020
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	4/10/2018	4/10/2020
PHA0	MAGNETIC FIELD PROBE	ELECTRO-METRICS	EM-6882	134	22-230MHZ	NOTE 1	
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	3/23/2020	3/23/2021
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.



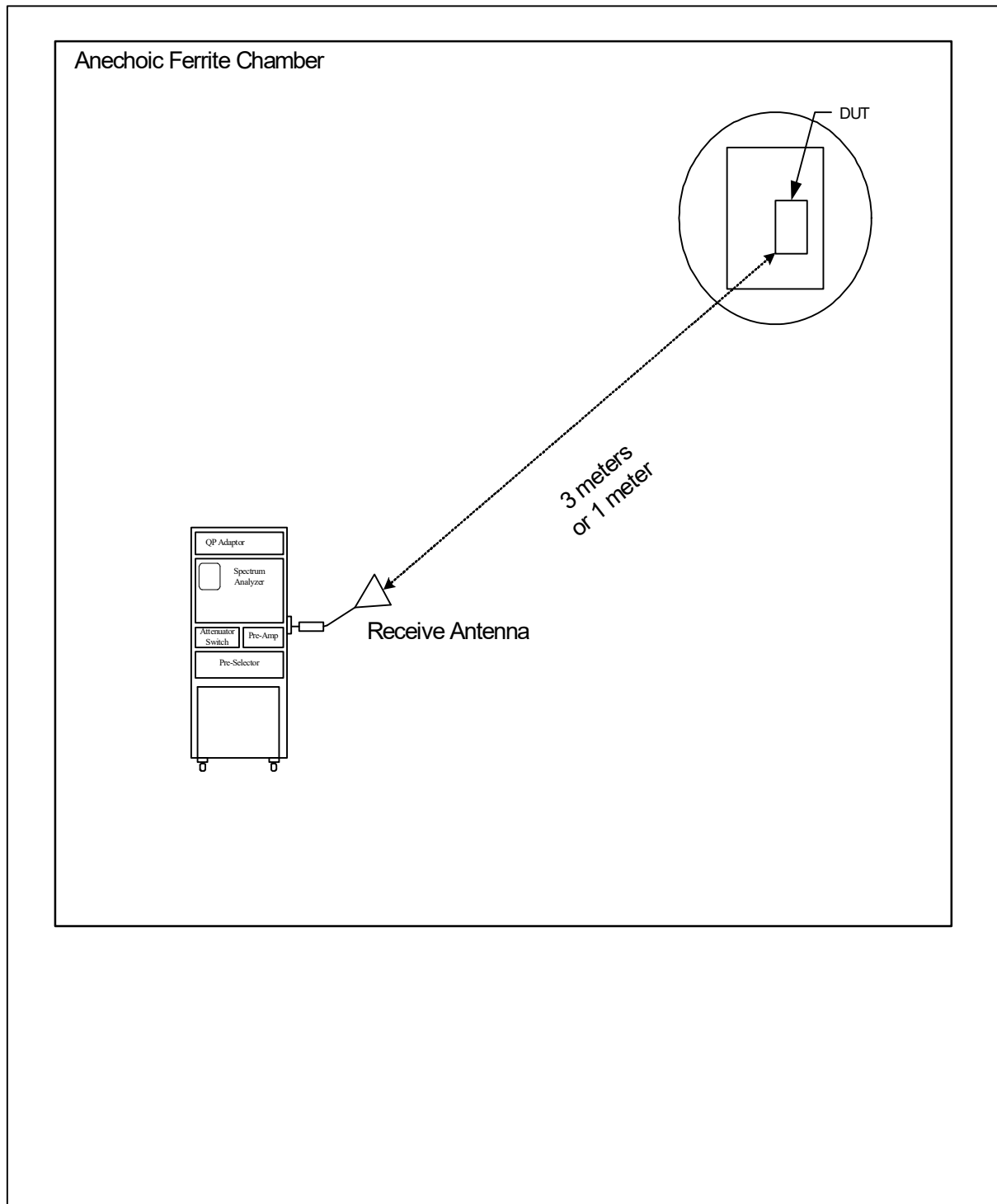


Figure 2



Test Item



Test Item

Figure 3



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



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

Figure 4



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

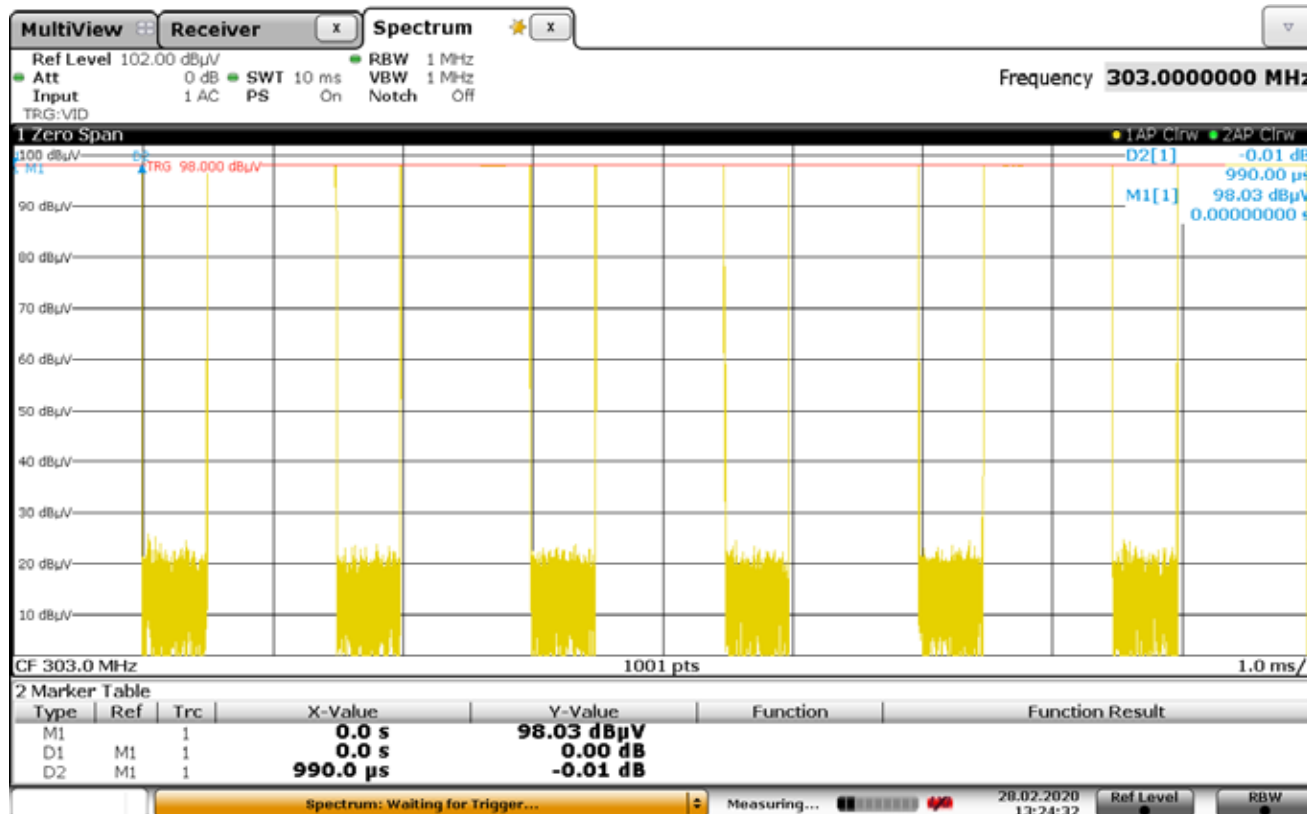


Test Setup for Radiated Emissions, 1 to 4GHz – Vertical Polarization

DATA PAGE

MANUFACTURER	Chamberlain Group, Inc.
EUT	Universal Garage Door Remote
MODEL NO.	001D7922-2
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx – 303MHz (Guardian Fix Code)
DATE TESTED	February 28, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Wide Pulse = 990µs = 0.99ms

DUTY CYCLE – WIDE PULSE

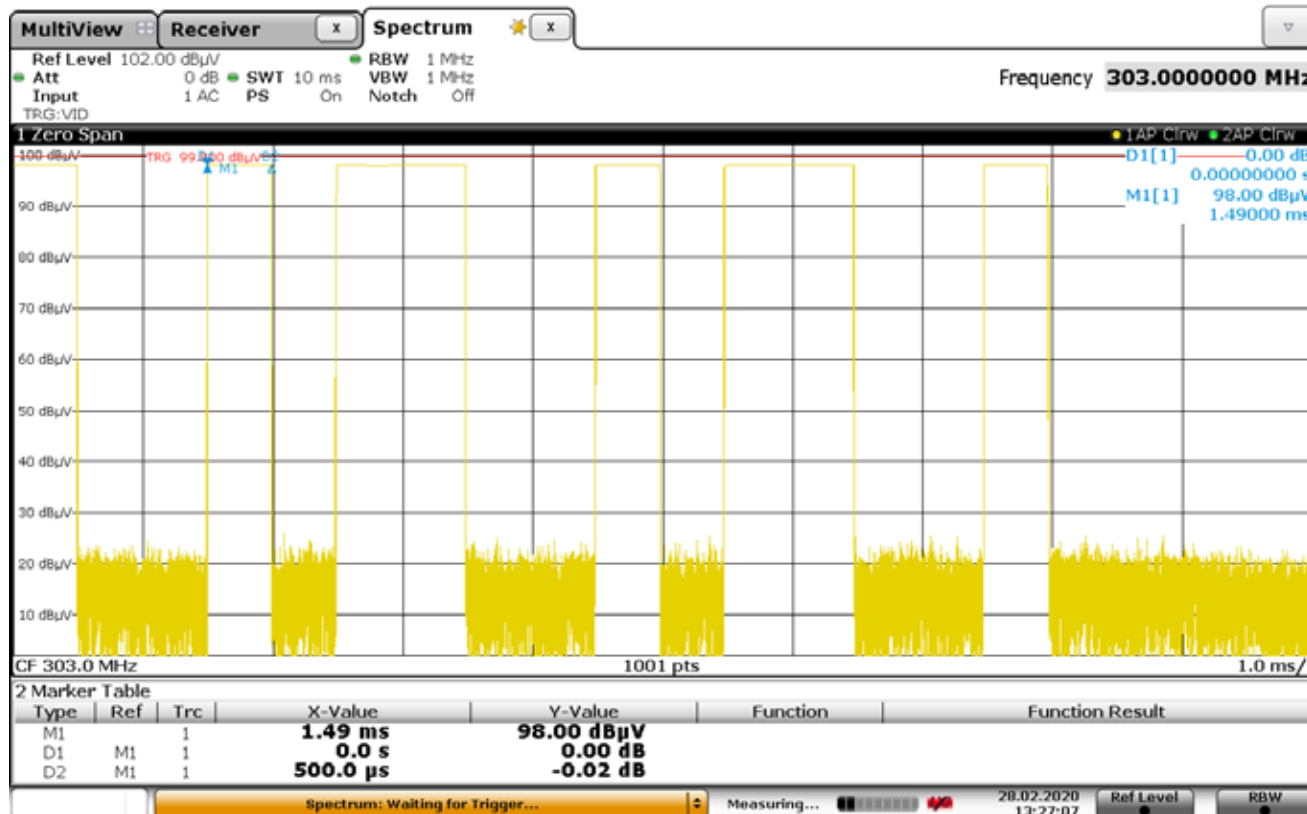


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DATA PAGE

MANUFACTURER	Chamberlain Group, Inc.
EUT	Universal Garage Door Remote
MODEL NO.	001D7922-2
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx – 303MHz (Guardian Fix Code)
DATE TESTED	February 28, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Narrow Pulse = 500µs = 0.5ms

DUTY CYCLE – NARROW PULSE

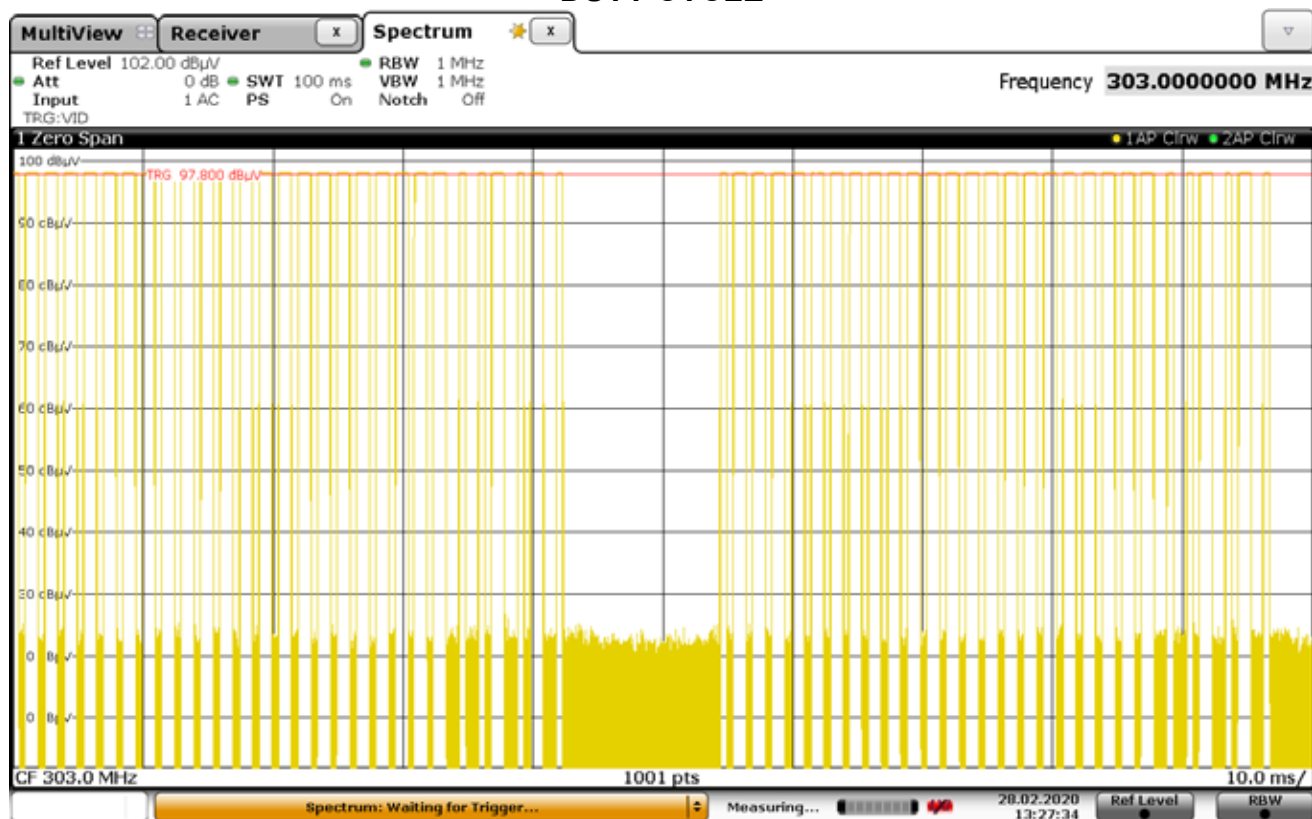


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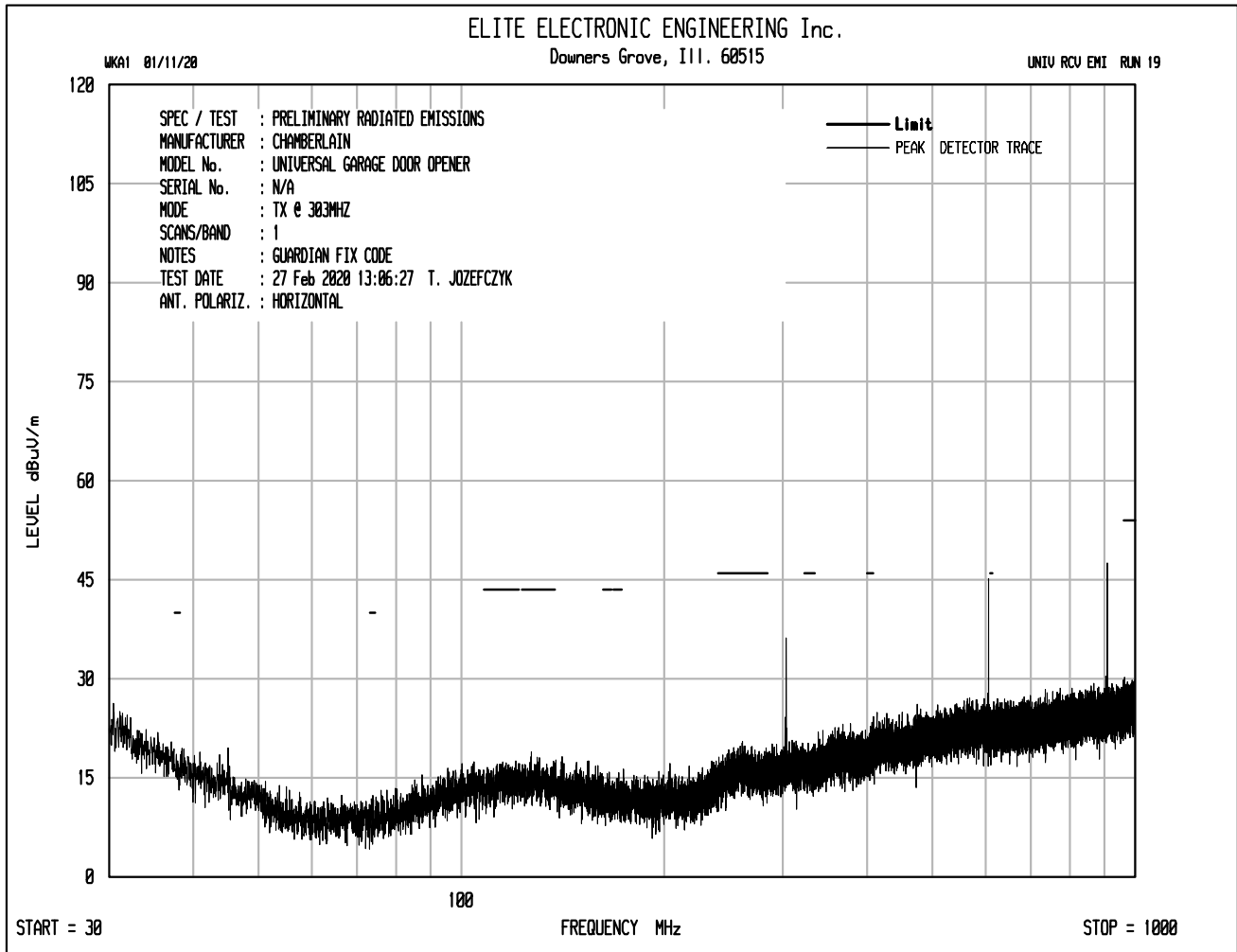
DATA PAGE

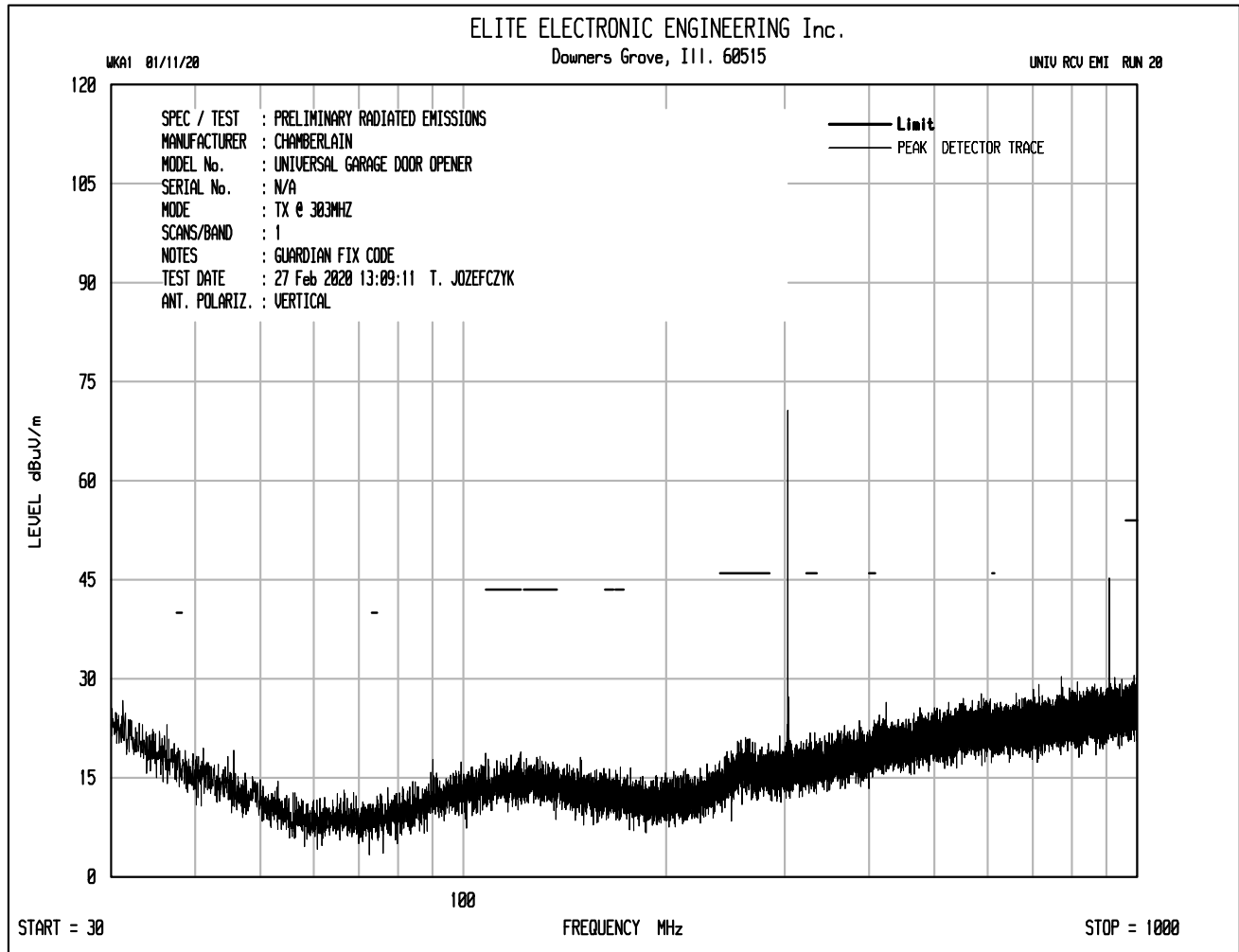
MANUFACTURER	Chamberlain Group, Inc.
EUT	Universal Garage Door Remote
MODEL NO.	001D7922-2
TEST	FCC §15.231, RSS-210 Duty Cycle
MODE	Tx – 303MHz (Guardian Fix Code)
DATE TESTED	February 28, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Duty Cycle Calculation: $23 \times 0.99\text{ms} = 22.77\text{ms}$ $4 \times 0.5\text{ms} = 2\text{ms}$ $22.77 + 2 = 24.77\text{ms}$ $\text{D.C} = 20\log(24.77/100) = -12.12\text{dB}$

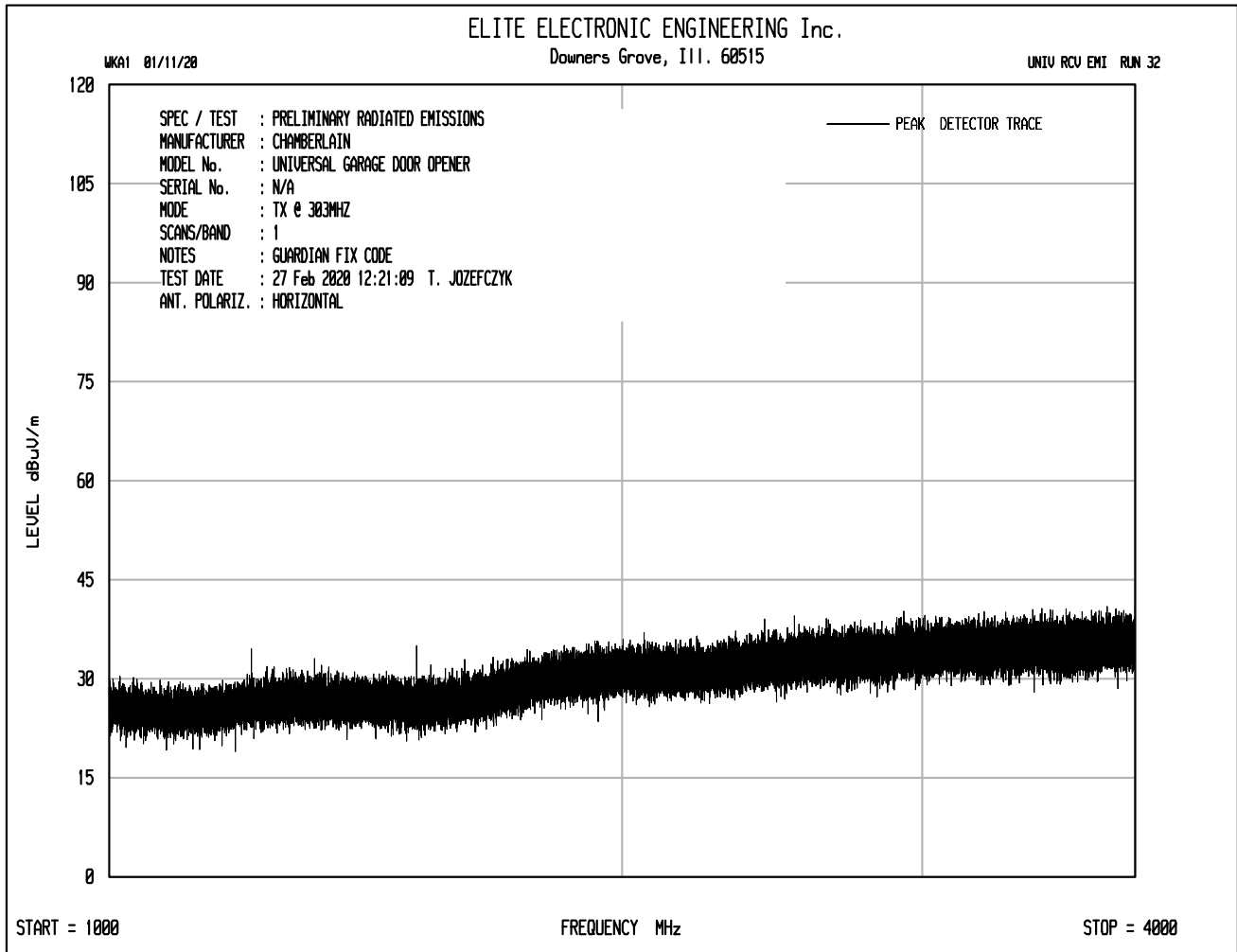
DUTY CYCLE

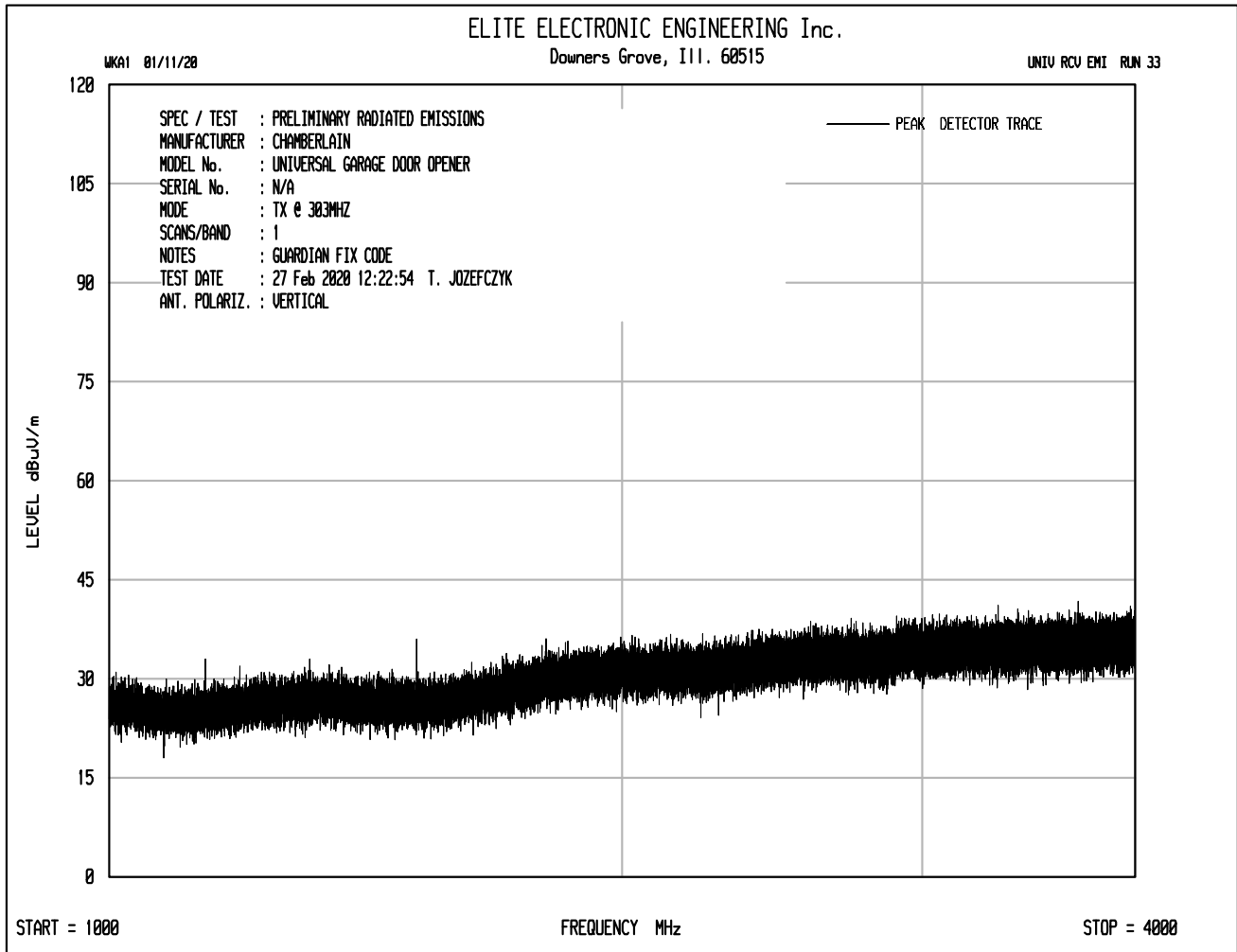


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DATA PAGE

MANUFACTURER	Chamberlain Group, Inc.
EUT	Universal Garage Door Remote
MODEL NO.	001D7922-2
TEST	FCC §15.231, RSS-210 Radiated Spurious Emissions - Harmonics
MODE	Tx – 303MHz (Guardian Fix Code)
DATE TESTED	February 27, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	Duty Cycle = -12.12dB

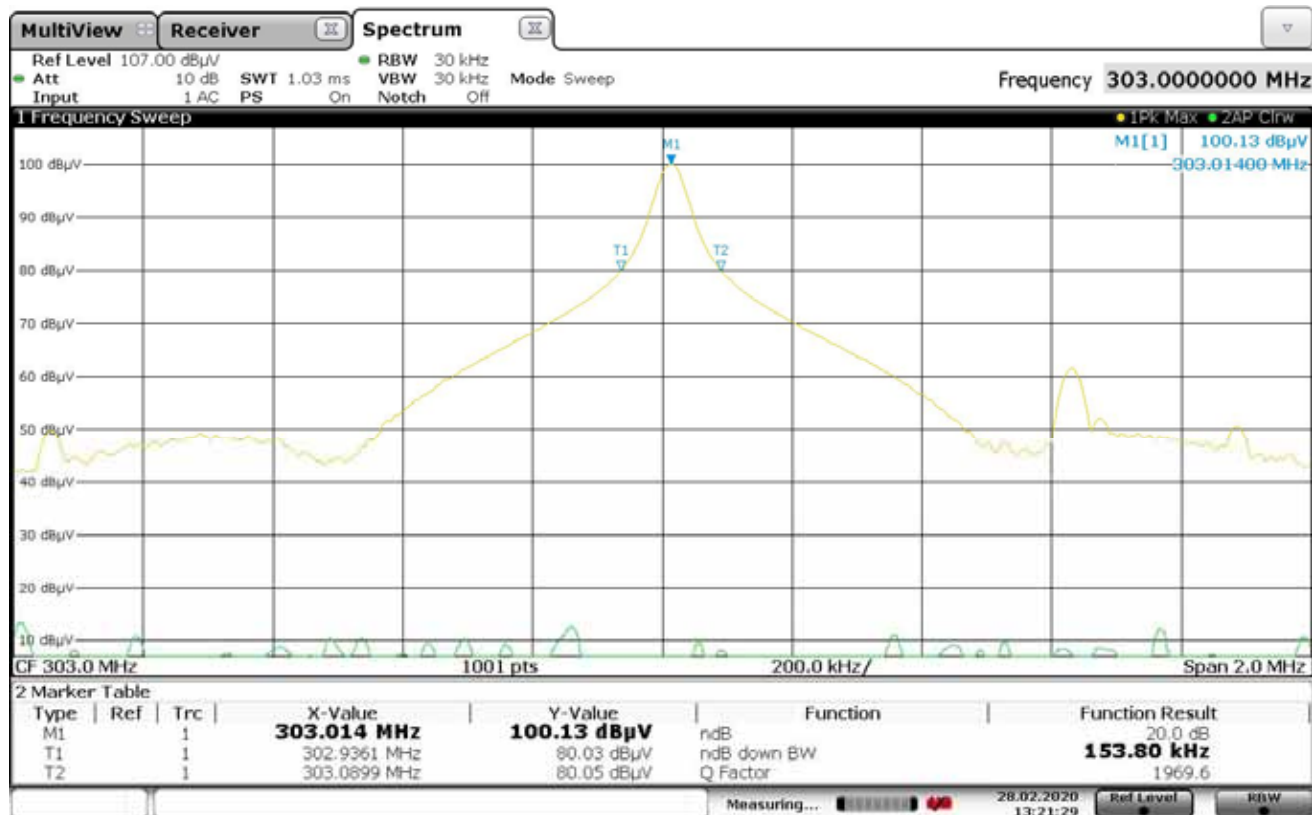
RADIATED SPURIOUS EMISSIONS

Freq. (MHz)	Ant. Pol.	Meter Reading (dBμV)	Ambient	CBL Fac. (dB)	Ant. Fac. (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBμV/m)	Total (μV/m)	Limit (μV/m)	Margin (dB)
303.00	H	54.81		1.79	19.48	0.00	-12.12	63.95	1576.39	5541.67	-10.92
303.00	V	60.40		1.79	19.48	0.00	-12.12	69.54	3000.30	5541.67	-5.33
606.00	H	22.56		2.46	24.85	0.00	-12.12	37.75	77.20	554.17	-17.12
606.00	V	13.53		2.46	24.85	0.00	-12.12	28.72	27.30	554.17	-26.15
909.00	H	28.92		2.89	26.69	0.00	-12.12	46.38	208.43	554.17	-8.49
909.00	V	28.86		2.89	26.69	0.00	-12.12	46.32	207.00	554.17	-8.55
1212.00	H	21.06	Ambient	3.05	28.66	0.00	-12.12	40.65	107.76	500.00	-13.33
1212.00	V	21.22	Ambient	3.05	28.66	0.00	-12.12	40.81	109.77	500.00	-13.17
1515.00	H	23.27		3.16	27.79	0.00	-12.12	42.10	127.36	500.00	-11.88
1515.00	V	22.15		3.16	27.79	0.00	-12.12	40.98	111.95	500.00	-13.00
1818.00	H	21.28	Ambient	3.25	30.63	0.00	-12.12	43.04	141.93	554.17	-11.83
1818.00	V	21.73	Ambient	3.25	30.63	0.00	-12.12	43.49	149.48	554.17	-11.38
2121.00	H	21.77	Ambient	3.32	31.45	0.00	-12.12	44.43	166.48	554.17	-10.45
2121.00	V	21.50	Ambient	3.32	31.45	0.00	-12.12	44.16	161.39	554.17	-10.72
2424.00	H	21.70	Ambient	3.39	32.30	0.00	-12.12	45.27	183.46	554.17	-9.60
2424.00	V	21.96	Ambient	3.39	32.30	0.00	-12.12	45.53	189.03	554.17	-9.34
2727.00	H	23.04	Ambient	3.71	32.52	0.00	-12.12	47.15	227.88	500.00	-6.83
2727.00	V	23.04	Ambient	3.71	32.52	0.00	-12.12	47.15	227.88	500.00	-6.83
3030.00	H	23.38	Ambient	4.18	32.68	0.00	-12.12	48.11	254.50	554.17	-6.76
3030.00	V	22.59	Ambient	4.18	32.68	0.00	-12.12	47.32	232.38	554.17	-7.55

DATA PAGE

MANUFACTURER	Chamberlain Group, Inc.
EUT	Universal Garage Door Remote
MODEL NO.	001D7922-2
TEST	FCC §15.231, RSS-210 20dB Bandwidth
MODE	Tx – 303MHz (Guardian Fix Code)
DATE TESTED	February 28, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	20dB BW = 153.8kHz Max allowed BW = (0.25% BW = 757.5kHz)

20DB BANDWIDTH

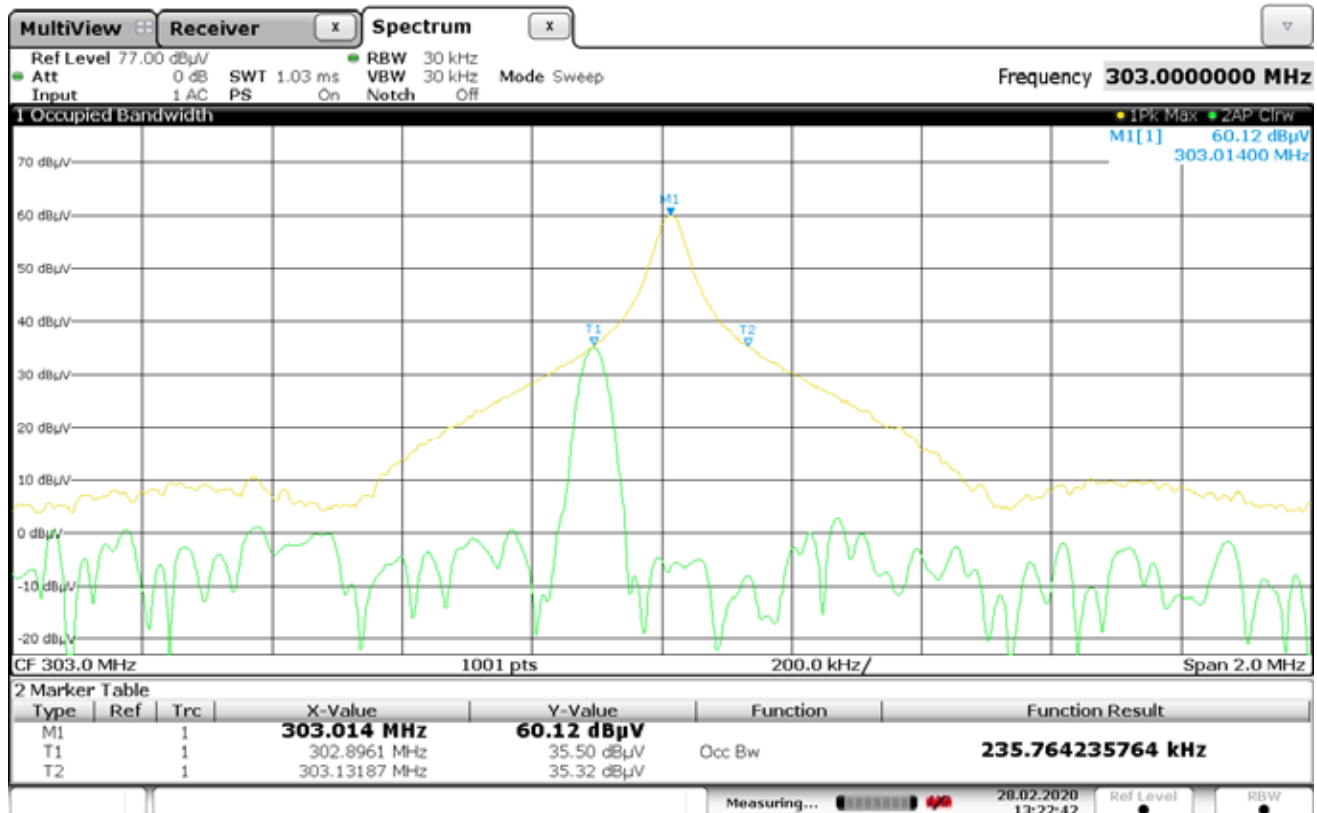


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DATA PAGE

MANUFACTURER	Chamberlain Group, Inc.
EUT	Universal Garage Door Remote
MODEL NO.	001D7922-2
TEST	FCC §15.231, RSS-210 99% Bandwidth
MODE	Tx – 303MHz (Guardian Fix Code)
DATE TESTED	February 28, 2020
TEST PERFORMED BY	Tylar Jozefczyk
NOTES	99% BW = 235.76kHz Max Allowed BW = (0.25% BW = 757.5kHz)

99% BANDWIDTH



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