Elite

Measurement of RF Emissions from a Liftmaster Jackshaft Garage Door Opener Model No. 8500W Transmitter

For	Chamberlain Group, Inc. 300 Windsor Dr. Oak Brook, IL 60523
P.O. Number	4900047049
Date Tested	August 7 - 11, 2017
Test Personnel	Tylar Jozefczyk
Test Specification	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Frequency Hopping Spread Spectrum Intentional Radiators Operating within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz Industry Canada RSS-GEN Industry Canada RSS-247

Test Report By: Tylar Jozefczyk
EMC Engineer

Requested By: Bill Carey
Chamberlain Group, Inc.

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

Elite Electronic Engineering Inc.
1516 CENTRE CIRCLE
DOWNERS GROVE, IL 60515
TEL: 630 - 495 - 9770
FAX: 630 - 495 - 9785
www.elitetest.com

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REVISION HISTORY

Revision	Date	Description
—	25 Aug 2017	Initial release

Measurement of RF Emissions from a Liftmaster Jackshaft Garage Door Opener, Model No. 8500W Transmitter

1. INTRODUCTION

1.1. Scope of Tests

This report represents the results of the series of radio interference measurements performed on a Chamberlain Group, Inc. Liftmaster Jackshaft Garage Door Opener, Model No. 8500W, Serial No. 2700000476, transmitter (hereinafter referred to as the EUT). The EUT is a frequency hopping spread spectrum transmitter. The transmitter was designed to transmit in the 902-928 MHz band using an internal 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 the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Intentional Radiators. The test series was also performed to determine if the EUT meets the conducted RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 8.8 and the radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-247, Section 5 for transmitters. 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 24.7^{o}C and the relative humidity was 38%.

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, dated 4 August 2017
- 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"
- ANSI C63.10-2013, "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"
- Industry Canada Radio Standards Specification, RSS-Gen, “General Requirements for Compliance of Radio Apparatus”, Issue 4, November 2014
- Industry Canada Radio Standards Specification, RSS-247, “Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices”, Issue 2, February 2017

3. EUT SETUP AND OPERATION

3.1. General Description

The EUT is a Chamberlain Group, Inc., Liftmaster Jackshaft Garage Door Opener, Model No. 8500W. A block diagram of the EUT setup is shown as Figure 1.

3.1.1.Power Input
The EUT obtained 120VAC 60Hz power via a 3 wire, 6 foot long, shielded power cord.

3.1.2.Peripheral Equipment
The following peripheral equipment was submitted with the EUT:

Item	Description
HP 8470pi Laptop	Controls Wi-Fi

3.1.3.Signal Input/Output Leads
The following interconnect cables were submitted with the EUT:

Item	Description
12V Lock	10 ft. cable
Cable Tension Monitor	10 ft. cable
Photo eyes	33.5 ft. cable
Wall Control	33.5 ft. cable

3.1.4.Grounding
The EUT was grounded only through the third wire of its input power cord.

3.2. Operational Mode
For all tests the EUT and all peripheral equipment were placed on an 80cm high non-conductive stand. The EUT and all peripheral equipment were energized. The unit was programmed to operate in one of the following modes:

- Transmit at 902.25MHz (Mode 6)
- Transmit at 914.75MHz (Mode 7)
- Transmit at 926.75MHz (Mode 8)
- Frequency Hopping Enabled (Mode 5)

Tx – The EUT was set to transmit at one frequency.
FHSS – The EUT was set to hop through all frequencies.

3.3. EUT Modifications
No modifications were required for compliance to FCC 15.247.

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 C63.4-2013 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 1000MHz radiated emissions data and 1MHz for the 1000MHz to 5000MHz 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.

The measurement uncertainty for these tests is presented below:

Conducted Emissions Measurements		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1

Radiated Emissions Measurements		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4

5. TEST PROCEDURES

5.1. Powerline Conducted Emissions

5.1.1. Requirements

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Per 15.207(a) and Industry Canada RSS-Gen section 7.2.4, all radio frequency voltages on the power lines of a transmitter shall be below the values shown below when using a quasi-peak or average detector:

Frequency MHz	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.5	66 decreasing with logarithm of frequency to 56	56 decreasing with logarithm of frequency to 46
0.5 - 5	56	46
5 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.
Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the EUT is considered to have met both requirements and measurements do not need to be performed using the Average detector.

5.1.2. Procedures

The interference on each power lead of the EUT was measured by connecting the measuring equipment to the appropriate meter terminal of the Line Impedance Stabilization Network (LISN). The meter terminal of the LISN not under test was terminated with 50 ohms.

a) The EUT was operated in the FHSS mode.

b) Measurements were first made on the 120VAC high line.

c) The frequency range from 150 kHz to 30 MHz was broken up into smaller frequency sub-bands.

d) Conducted emissions measurements were taken on the first frequency sub-band using a peak detector.

e) The data thus obtained was then searched by the computer for the highest levels. Any emissions levels that were within 10dB of the average limit were then measured again using both a quasi-peak detector and an average detector. (If no peak readings were within 10dB of the average limit, quasi-peak and average readings were taken on the highest emissions levels measured during the peak detector scan.)

f) Steps (d) and (e) were repeated for the remainder of the frequency sub-bands until the entire frequency range from 150kHz to 30MHz was investigated. The peak trace was automatically plotted. The plot also shows quasi-peak and average readings that were taken on discrete frequencies. A table showing the quasi-peak and average readings was also generated. This tabular data compares the quasi-peak and average conducted emissions to the applicable conducted emissions limits.

g) Steps (c) through (f) were repeated on the 120VAC return line.

5.1.3.Results

The plots and tabular data of the peak, quasi-peak, and average conducted voltage levels acquired from each input power line with the EUT operated in the FHSS mode are shown on pages 22 through 25. All power line conducted emissions measured from the EUT were within the specification limits. The emissions level closest to the limit (worst case) occurred at 245kHz. The emissions level at this frequency was 11.2dB within the limit.

A photograph of the test configuration which yielded the highest or worst case conducted emission level is shown as Figure 2.

5.2. 20dB Bandwidth

5.2.1.Requirement

Per 15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Per section 15.247(a)(1)(i), for frequency hopping systems operating in the 902-928MHz band, the 20dB bandwidth shall be measured for determination of the carrier frequency separation limits and must not exceed 500 kHz. If the 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping channels. If the 20dB bandwidth of the hopping channel is 250kHz or greater (but not greater than 500kHz), the system shall use at least 25 hopping channels.

5.2.2.Procedures

The output of the EUT was connected to the spectrum analyzer through 39.25dB of attenuation.

With the hopping function disabled, the EUT was allowed to transmit continuously. The frequency hopping channel was set separately to low, middle, and high hopping channels. The resolution bandwidth (RBW) was set to > to 1% of the 20 dB BW. The span was set to approximately 2 to 3 times the 20 dB bandwidth.

The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's display was plotted using a 'screen dump' utility.

5.2.3.Results

The plots on pages 26 through 31 show the 20dB bandwidth and 99% bandwidth. The maximum 20dB bandwidth was measured to be 247.8kHz, while the maximum 99% bandwidth was measured to be 215.78kHz.

Therefore, since the 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping channels.

5.3. Carrier Frequency Separation

5.3.1. Requirements

Per section 15.247 (a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

5.3.2. Procedures

The output of the EUT was connected to the spectrum analyzer through 39.25dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to > to 1% of the span. The peak detector and 'Max-Hold' function were engaged. The span was set wide enough to capture the peaks of at least two adjacent channels. When the trace had stabilized after multiple scans, the marker-delta function was used to determine the separation between the peaks of the adjacent channels. The analyzer's display was plotted using a 'screen dump' utility

5.3.3. Results

Page 32 shows the carrier frequency separation. As can be seen from this plot, the carrier frequency separation is 497.5kHz, which is greater than the 20dB bandwidth (247.8kHz).

5.4. Number of Hopping Frequencies

5.4.1. Requirements

Per section 15.247(a)(1)(i), for frequency hopping systems operating in the 902-928MHz band, the 20dB bandwidth shall be measured for determination of the carrier frequency separation limits and must not exceed 500 kHz. If the 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping channels. If the 20dB bandwidth of the hopping channel is 250kHz or greater (but not greater than 500kHz), the system shall use at least 25 hopping channels.

5.4.2. Procedures

The output of the EUT was connected to the spectrum analyzer through 39.25dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to > to 1% of the span. The peak detector and 'Max-Hold' function were engaged. The span was set wide enough to capture the entire frequency band of operation.

The EUT’s signal was allowed to stabilize after multiple scans. The number of hopping frequencies was counted. The analyzer's display was plotted using a 'screen dump' utility.

5.4.3. Results

Page 33 shows the number of hopping frequencies. As can be seen from this plot, the number of hopping frequencies is 50, which is the minimum number of required hopping frequencies for systems with a 20dB bandwidth less than 250kHz.

5.5. Time of Occupancy

5.5.1. Requirements

Per section 15.247(a)(1)(i), for frequency hopping systems operating in the 902-928MHz band, if the 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

5.5.2. Procedures

The output of the EUT was connected to the spectrum analyzer through 39.25dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to 1MHz. The peak detector and 'Max-Hold' function were engaged. With the span set to 0Hz, the sweep time was adjusted to capture a single event in order to measure the dwell time per hop. The analyzer's display was plotted using a 'screen dump' utility. Then, the sweep time was expanded to 20 seconds to capture the number of hops in the appropriate sweep time. A single sweep was made. The analyzer's display was plotted using a 'screen dump' utility.

The dwell time in the specified time period was then calculated from dwell time per hop multiplied by the number of hops in the specified time period.

5.5.3. Results

Pages 34 and 35 show the plots for the time of occupancy (dwell time). As can be seen from the plots, the time of occupancy can be determined by 1.28ms multiplied by 90 hops. This calculated value is equal to 0.115 seconds, which is less than the 0.4 seconds maximum allowed.

5.6. Peak Output Power

5.6.1. Requirements

Per section 15.247(b)(2), for frequency hopping systems operating in the 902-928MHz band and employing at least 50 hopping channels, the maximum peak output conducted power shall not be greater than 1W (30dBm). Per section 15.247(b)(4), this limit is based on the use of antennas with directional gains that do not exceed 6dBi. Since the limit allows for a 6dBi antenna gain, the maximum EIRP can be increased by 6dB to 4 Watt (36dBm).

If transmitting antennas of directional gain greater than 6dBi are used, the conducted output power from the intentional radiator shall be reduced below 30dBm by the amount in dB that the directional gain of the antenna exceeds 6dBi.

5.6.2. Procedures

For frequency hopping systems using the antenna conducted emissions method, the output of the EUT was connected to the spectrum analyzer through 40.19dB of attenuation. With the hopping function disabled, the EUT was allowed to transmit continuously. The frequency hopping channel was set separately to low, middle, and high hopping channels. The resolution bandwidth (RBW) was set to greater than the 20dB bandwidth. The span was set to approximately 5 times the 20 dB bandwidth. The 'Max-Hold' function was engaged. The maximum meter reading was recorded. The peak power output was calculated for the low, middle and high hopping frequencies.

For the radiated emissions method, the EUT was placed on the non-conductive stand and set to transmit. A dipole antenna (double ridged waveguide antenna for all measurements above 1GHz) was placed at a test distance of 3 meters from the EUT. The resolution bandwidth (RBW) of the spectrum analyzer was set to greater than the 20dB bandwidth. The span was set to approximately 5 times the 20 dB bandwidth. The EUT was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The peak power output was measured for the low, middle and high hopping frequencies.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, a second dipole antenna (double ridged waveguide antenna for all measurements above 1GHz) was then set in place of the EUT and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was then corrected to compensate for cable loss (and antenna gain for all measurements above 1GHz), as required. The peak power output was calculated for low, middle, and high hopping frequencies.

5.6.3.Results

For the antenna conducted emissions method, the results are presented on pages 36 through 40. The maximum peak conducted output power from the transmitter was 0.018W (12.5dBm), which is below the 1 Watt limit.

For the radiated emissions method, the results are presented on page 39. The maximum EIRP measured from the transmitter was 0.024W (13.8dBm), which is below the 4 Watt limit.

5.7. Duty Cycle Factor Measurements

5.7.1.Requirements

Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

5.7.2.Procedures

a) The EUT was placed on the non-conductive stand and set to transmit continuously.
b) A double ridged waveguide antenna was positioned at a 3 meter distance from the EUT. The output of the antenna was connected to the input of a spectrum analyzer.
c) The center frequency of the spectrum analyzer was set to the transmit frequency of the EUT.
d) The frequency span of the spectrum analyzer was set to 0Hz so that the time domain trace of the transmitted pulse of the EUT was displayed on the spectrum analyzer.
e) The sweep time of the spectrum analyzer was adjusted so that the beginning and end of a single pulse could be seen on the display of the spectrum analyzer.
f) The single sweep function of the spectrum analyzer was used multiple times to determine the maximum pulse width of the EUT.
g) The maximum pulse width display of the spectrum analyzer was recorded and then plotted using a 'screen dump' utility.
h) The sweep time of the spectrum analyzer was then adjusted to 100msec.
i) The single sweep function of the spectrum analyzer was used multiple times to determine the maximum number of transmitted pulses that occurred in a 100msec time period.
j) The maximum number of pulses transmitted in a 100msec time period was recorded and then plotted using a ‘screen dump’ utility.
k) The duty cycle correction was calculated using the following equation:

   Duty Cycle Correction Factor (dB) = D.C. (dB)

   D.C. (dB) = 20 x log [((pulse width (msec)) x (#pulses in a 100msecperiod)) / 100msec]

5.7.3.Results

Duty cycle plots are shown on pages 30 and 31. The EUT transmits a 1.28ms signal 6 times in a 100msec period. This results in a duty cycle correction factor of -22.29dB.

5.8. Antenna Conducted Spurious Emissions

5.8.1.Procedures

The output of the EUT was connected to the spectrum analyzer through 39.25dB of attenuation. The frequency hopping function was disabled. The resolution bandwidth (RBW) was set to 100kHz. The peak detector and 'Max-Hold' function were engaged. The emissions in the frequency range from 30MHz to 10GHz was observed and plotted separately with the EUT transmitting at low, middle and high hopping frequencies.

5.8.2. Results

The results of the antenna conducted emissions levels were plotted. These plots are presented on pages 40 through 42. These plots show that the spurious emissions were at least 20 dB below the level of the fundamental.

5.9. Radiated Spurious Emissions Measurements

5.9.1. Requirements

Per section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Paragraph 15.209(a) has the following radiated emission limits:

Frequency MHz	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30.0-88.0	100	3
88.0-216.0	150	3
216.0-960.0	200	3
Above 960	500	3

5.9.2. 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 C63.4-2013 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.

Preliminary radiated emissions tests were 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 10.0GHz (10GHz used for 902-928MHz range) was investigated using a peak detector function.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 10.0GHz (10GHz used for 902-928MHz range).

1) For all harmonics not in the restricted bands, the following procedure was used:
   a) The field strength of the fundamental was measured using a dipole antenna. The dipole antenna was positioned at a 3 meter distance from the EUT. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
   b) The field strengths of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. A peak detector with a resolution bandwidth of 100 kHz was used on

the spectrum analyzer.

c) To ensure that maximum or worst case emission levels at the fundamental and harmonics were measured, the following steps were taken when measuring the fundamental emissions and the spurious emissions:
   i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
   ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
   iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
   iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer, the measuring antenna was not raised or lowered to ensure maximized readings. Instead the EUT was rotated through all axes to ensure the maximum readings were recorded for the EUT.

d) All harmonics not in the restricted bands must be at least 20 dB below levels measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) is not required.

2) For all emissions in the restricted bands, the following procedure was used:
   a) The field strengths of all emissions below 1 GHz were measured using a bi-log antenna. The bi-log antenna was positioned at a 3 meter distance from the EUT. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
   b) The field strengths of all emissions above 1 GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.
   c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when taking all measurements:
      i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
      ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
      iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
      iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer, the measuring antenna was not raised or lowered to ensure maximized readings. Instead the EUT was rotated through all axes to ensure the maximum readings were recorded for the EUT.
   d) For all radiated emissions measurements below 1 GHz, if the peak reading is below the limits listed in 15.209(a), no further measurements are required. If however, the peak readings exceed the limits listed in 15.209(a), then the emissions are remeasured using a quasi-peak detector.
   e) For all radiated emissions measurements above 1 GHz, the peak readings must comply with the 15.35(b) limits. 15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).
   f) Next, for all radiated emissions measurements above 1GHz, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector. An average reading was taken.

If the dwell time per channel of the hopping signal is less than 100msec, then the reading obtained with the 10 Hz video bandwidth may be further adjusted by a “duty cycle correction factor”, derived from 20*log(dwell time/100msec). These readings must be no greater than the limits specified in 15.209(a).

5.9.3.Results

Preliminary radiated emissions plots with the EUT transmitting at 902.25MHz, 914.75MHz, and 926.75MHz are shown on pages 43 through 54. Final radiated emissions data are presented on data pages 55 through 63.

As can be seen from the data, all emissions measured from the EUT were within the specification limits. The emissions level closet to the limit (worst case) occurred at 2744.25MHz. The emissions level at this frequency was -1.9dB within the limit. See data pages 35 through 46 for details. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown as figure 3 and figure 4.

5.10. Band Edge Compliance

5.10.1. Requirement

Per section 15.247(d), the emissions at the band-edges must be at least 20dB below the highest level measured within the band but attenuation below the general limits listed in 15.209(a) is not required.

5.10.2. Procedures

1.1.1.1 Low Band Edge

1) The EUT was set up inside the test chamber on a non-conductive stand.
2) A broadband measuring antenna was placed at a test distance of 3 meters from the EUT.
3) The EUT was set to transmit continuously at the channel closest to the low band-edge (hopping function disabled).
4) The EUT was maximized for worst case emissions at the measuring antenna. The maximum meter reading was recorded.
5) To determine the band edge compliance, the following spectrum analyzer settings were used:
    a. Center frequency = low band-edge frequency.
    b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
    c. Resolution bandwidth (RBW) ≥ 1% of the span.
    d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
    e. The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the left of the center frequency (band-edge) must be below the display line.)
    f. The analyzer's display was plotted using a 'screen dump' utility.

6) Step 5) was repeated with the frequency hopping function enabled.

1.1.1.2 High Band Edge

1) The EUT was set up inside the test chamber on a non-conductive stand.
2) A broadband measuring antenna was placed at a test distance of 3 meters from the EUT.
3) The EUT was set to transmit continuously at the channel closest to the high band-edge (hopping function disabled).
4) The EUT was maximized for worst case emissions at the measuring antenna.
5) To determine the band edge compliance, the following spectrum analyzer settings were used:
    a. Center frequency = high band-edge frequency.
    b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
    c. Resolution bandwidth (RBW) ≥ 1% of the span.
    d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
    e. The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the right of the center frequency (band-edge) must be below the display

line.)

f. The analyzer's display was plotted using a 'screen dump' utility.

6) Step 5) was repeated with the frequency hopping function enabled.

In accordance with paragraph 15.247(d), the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

5.10.3. Results

Pages 64 through 69 show the radiated band-edge compliance results. As can be seen from these plots, the emissions at the low end band edge and the high end band edge are within the 20 dB down limits.

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. Liftmaster Jackshaft Garage Door Opener, Model No. 8500W, frequency hopping spread spectrum transmitter, Serial No. 2700000476, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Intentional Radiators Operating within the 902-928 MHz band, when tested per ANSI C63.4-2013.

It was also determined that the Chamberlain Group, Inc. Liftmaster Jackshaft Garage Door Opener, Model No. 8500W, frequency hopping spread spectrum transmitter, Serial No. 2700000476, did fully meet the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen Section 8.8 and RSS-247 Section 5, for transmitters, when tested per ANSI C63.4-2013.

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
APW11	PREAMPLIFIER	PMI	PE2-35-120-5R0-10-12-SFF	PL11685/1241	1GHZ-20GHZ	3/22/2017	3/22/2018
CDW5	DESKTOP COMPUTER	ELITE	PENTIUM 4	006	3.8GHZ	N/A	
CDY0	WORKSTATION	ELITE	WORKSTATION		WINDOWS 7	N/A	
GRB0	1MHZ, LISN SIGNAL CHECKER	ELITE	LISNCHKR1M	1	1MHZ	1/12/2017	1/12/2018
MEA0	MICRO-OHM METER	KEITHLEY	580	674866	10UOHM-200KOHM	7/6/2017	7/6/2018
NSDS0	UNIVERSAL SPHERICAL DIPOLE SOURCE	AET	USDS-H	----	10MHz-12GHz	NOTE 1	
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHz	3/23/2016	8/23/2017
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	4/4/2016	4/4/2018
PLF2	CISPR16 50UH LISN	ELITE	CISPR16/70A	002	.15-30MHz	5/4/2017	5/4/2018
PLF4	CISPR16 50UH LISN	ELITE	CISPR16/70A	003	.15-30MHz	5/4/2017	5/4/2018
RAKG	RF SECTION	HEWLETT PACKARD	85462A	3549A00284	0.009-6500MHZ	3/8/2017	3/8/2018
RAKH	RF FILTER SECTION	HEWLETT PACKARD	85460A	3448A00324	---	3/8/2017	3/8/2018
RBE1	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU26	100096	20Hz-26GHz	6/8/2017	6/8/2018
RBG0	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101533	10HZ-44GHZ	11/10/2016	11/10/2017
RBG3	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101592	2HZ-44GHZ	1/11/2017	1/11/2018
SES0	24VDC POWER SUPPLY	P-TRANS	FS-32024-1M	001	18-27VDC	NOTE 1	
T2DE	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-34	BN1032	DC-18GHZ	8/24/2016	8/24/2018
T2DL	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-34	BS0910	DC-18GHZ	6/13/2016	6/13/2018
VBR8	CISPR EN FCC CE VOLTAGE.exe						
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
XLTJ	5W, 50 OHM TERMINATION	JFW INDUSTRIES	50T-052	---	DC-2GHZ	1/14/2016	1/14/2018
XPQ3	HIGH PASS FILTER	K&L MICROWAVE	4IH30-1804/T10000-0	4	1.8GHZ-10GHZ	9/14/2016	9/14/2017

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.

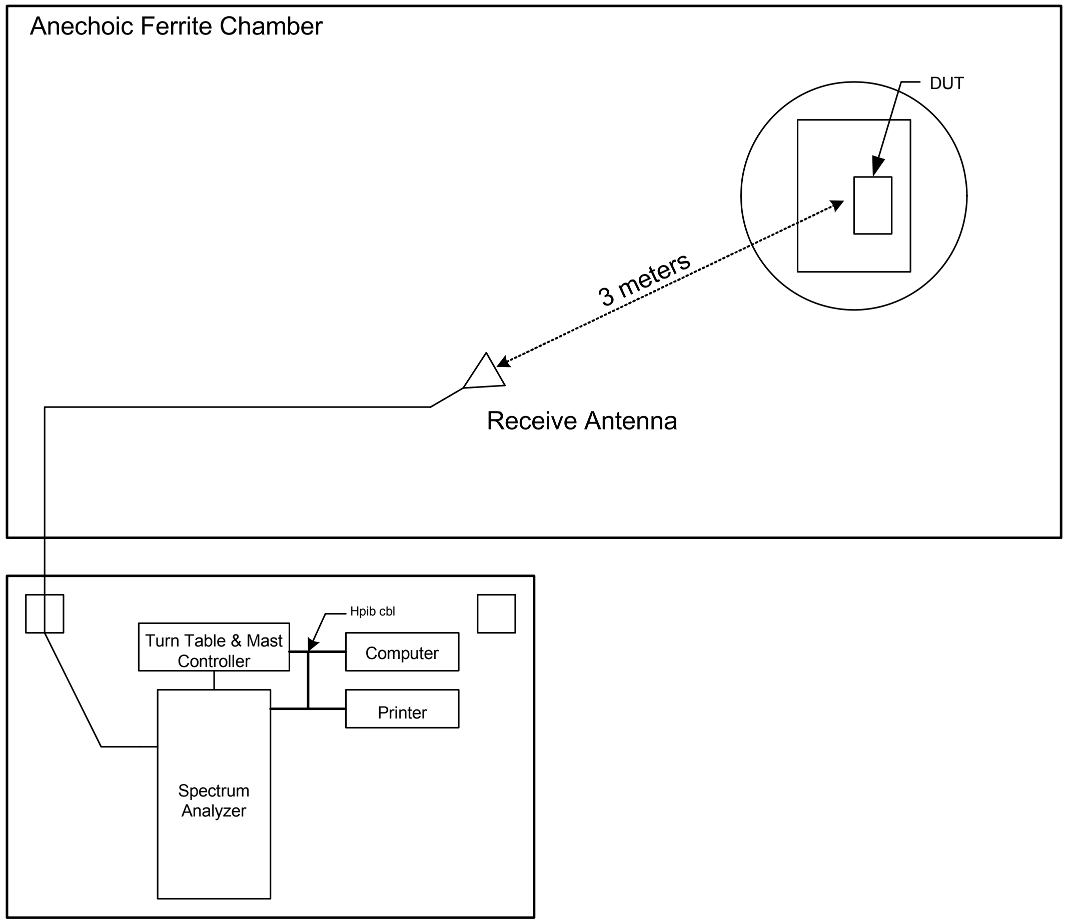


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

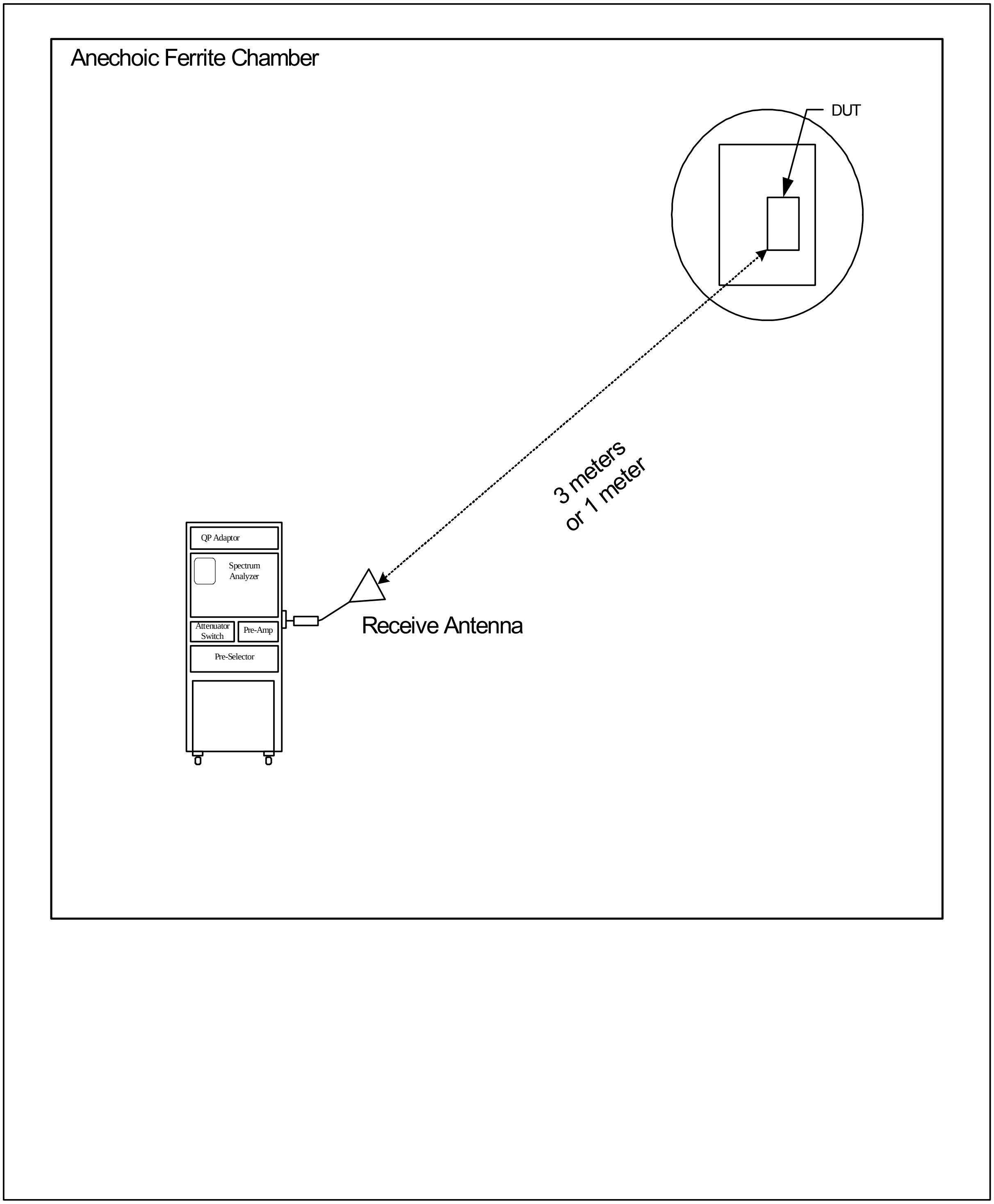

Anechoic Ferrite Chamber
DUT
3 meters
or 1 meter
QP Adaptor
Spectrum
Analyzer
Attenuator
Switch
Pre-Amp
Pre-Selector
Receive Antenna

Figure 2

Test Setup for Conducted Emissions

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 - 10GHz – Horizontal Polarization

Test Setup for Radiated Emissions, 1 - 10GHz – Vertical Polarization

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 04/23/2015

Manufacturer	:	CHAMBERLAIN
Model	:	8500W
DUT Revision	:	1.0
Serial Number	:	2700000476
DUT Mode	:	FHSS
Line Tested	:	120VAC HIGH LINE
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	
Test Engineer	:	T. Jozefczyk
Limit	:	Class B
Test Date	:	Aug 09, 2017 09:55:02 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 10 dB margin below limit

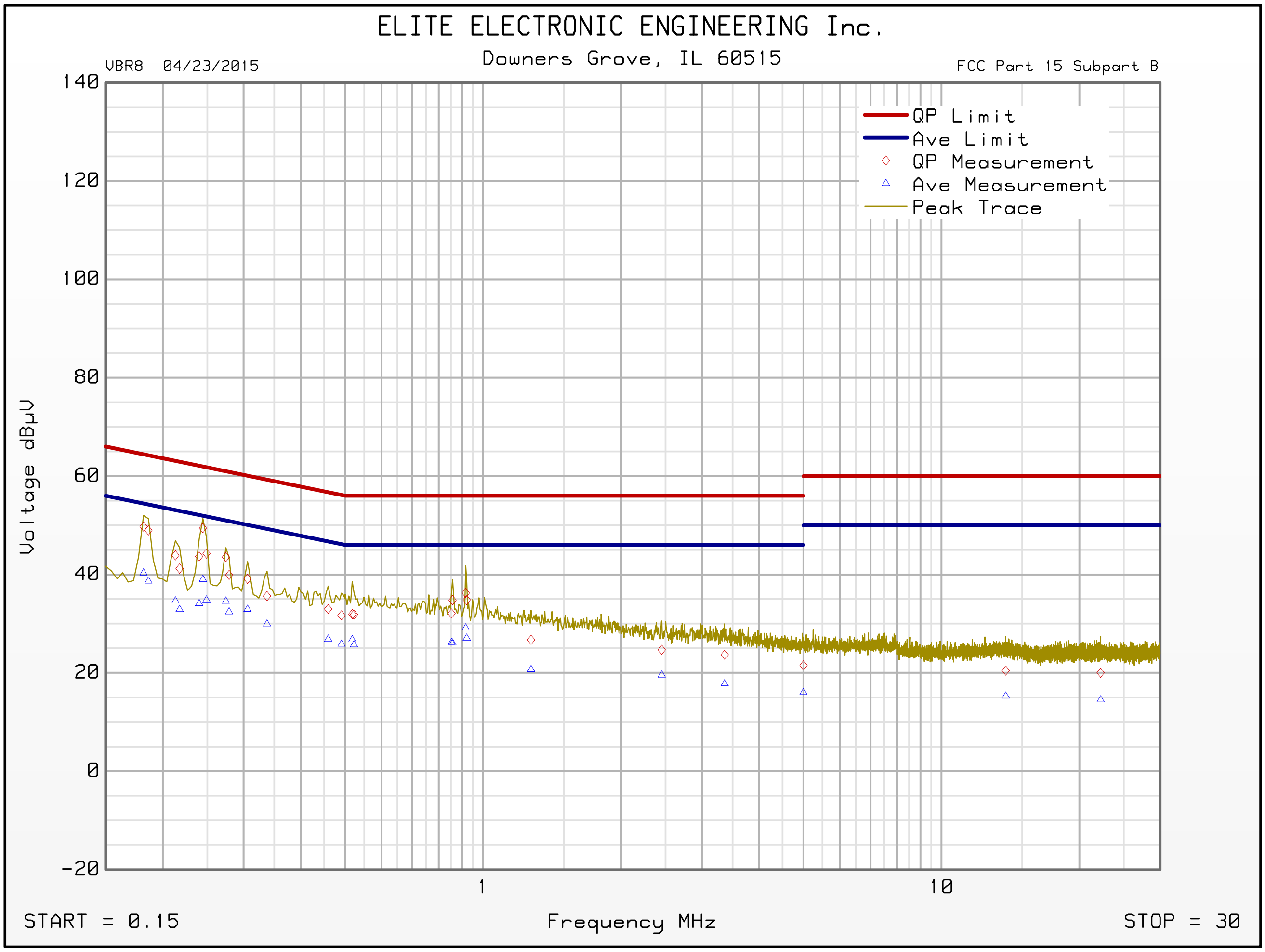
Freq MHz	Quasi-peak Level dBμV	Quasi-peak Limit dBμV	Excessive Quasi-peak Emissions	Average Level dBμV	Average Limit dBμV	Excessive Average Emissions
0.245	49.4	61.9		39.0	51.9	
0.275	43.5	61.0		34.6	51.0	
0.518	31.9	56.0		26.7	46.0	
0.916	36.2	56.0		29.1	46.0	
1.273	26.7	56.0		20.7	46.0	
2.453	24.7	56.0		19.5	46.0	
3.365	23.7	56.0		17.8	46.0	
5.000	21.5	56.0		16.0	46.0	
13.815	20.5	60.0		15.3	50.0	
22.253	20.0	60.0		14.5	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VBR8 04/23/2015

Manufacturer	:	CHAMBERLAIN
Model	:	8500W
DUT Revision	:	1.0
Serial Number	:	2700000476
DUT Mode	:	FHSS
Line Tested	:	120VAC HIGH LINE
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	
Test Engineer	:	T. Jozefczyk
Limit	:	Class B
Test Date	:	Aug 09, 2017 09:55:02 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 04/23/2015

Manufacturer	:	CHAMBERLAIN
Model	:	8500W
DUT Revision	:	1.0
Serial Number	:	2700000476
DUT Mode	:	FHSS
Line Tested	:	120VAC NEUTRAL LINE
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	
Test Engineer	:	T. Jozefczyk
Limit	:	Class B
Test Date	:	Aug 09, 2017 10:02:32 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 10 dB margin below limit

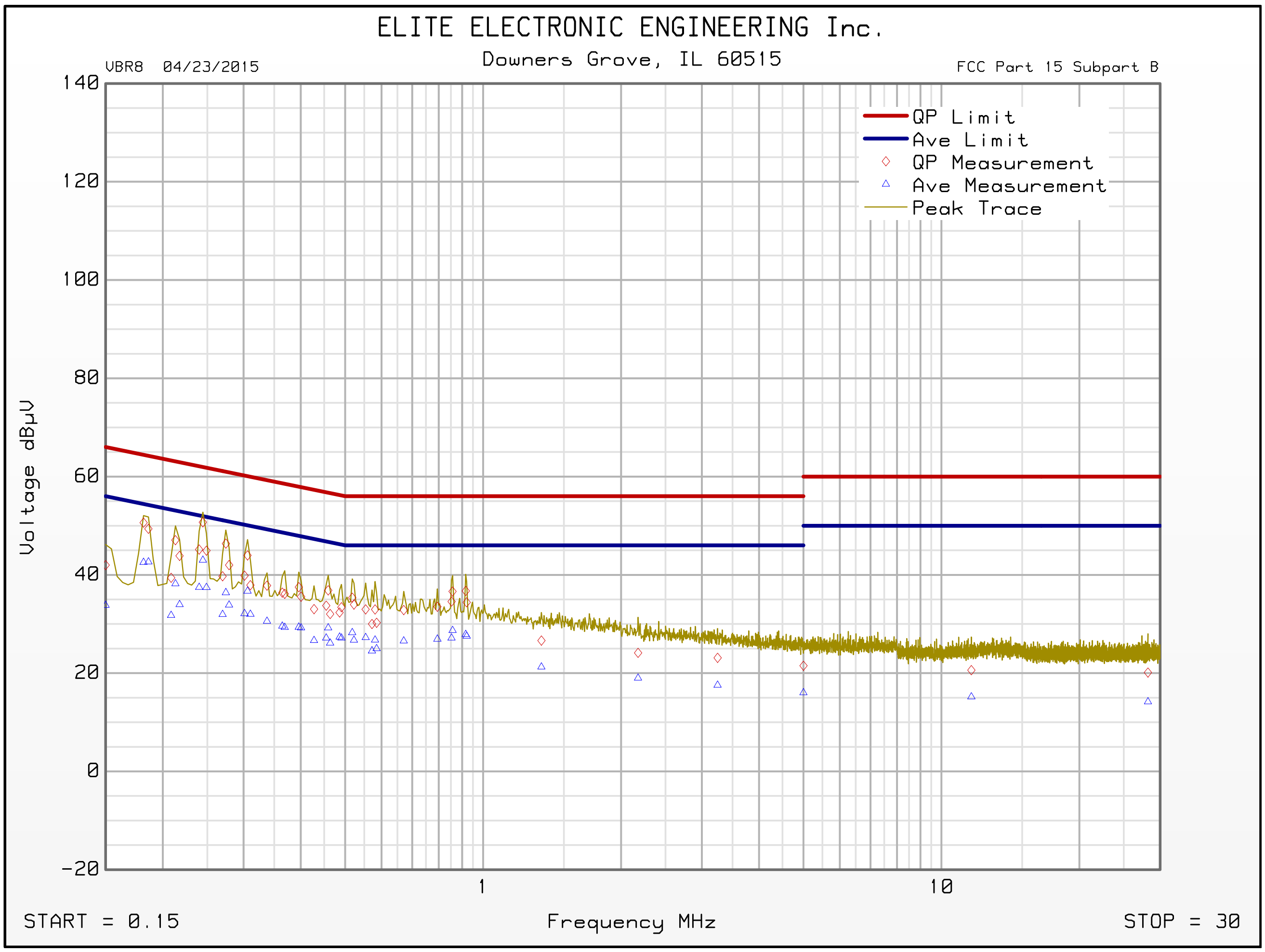
Freq MHz	Quasi-peak Level dBμV	Quasi-peak Limit dBμV	Excessive Quasi-peak Emissions	Average Level dBμV	Average Limit dBμV	Excessive Average Emissions
0.245	50.7	61.9		43.0	51.9	
0.275	46.4	61.0		36.4	51.0	
0.518	35.4	56.0		28.2	46.0	
0.916	36.7	56.0		27.9	46.0	
1.340	26.6	56.0		21.2	46.0	
2.178	24.1	56.0		19.0	46.0	
3.248	23.1	56.0		17.6	46.0	
5.000	21.5	56.0		16.0	46.0	
11.624	20.6	60.0		15.2	50.0	
28.225	20.1	60.0		14.2	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

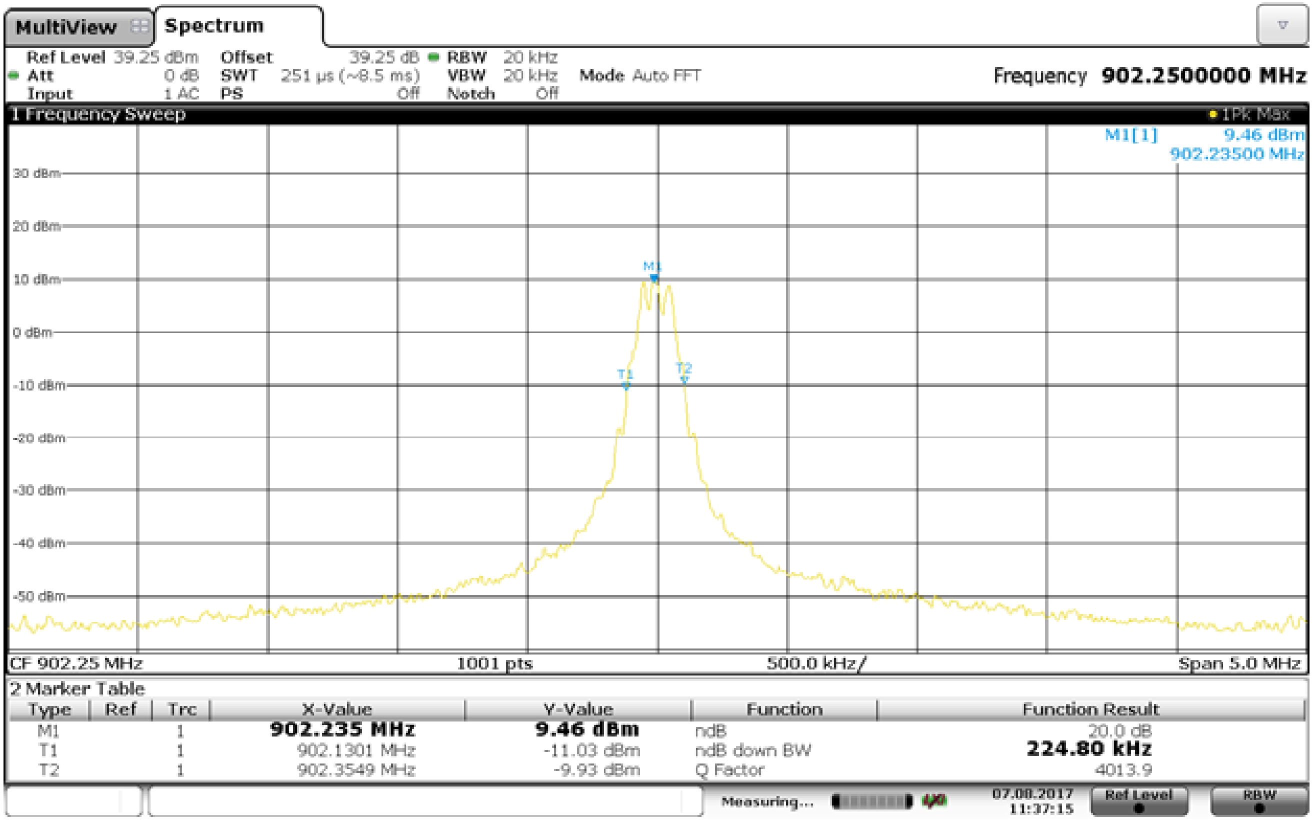
Cumulative Data

VBR8 04/23/2015

Manufacturer	:	CHAMBERLAIN
Model	:	8500W
DUT Revision	:	1.0
Serial Number	:	2700000476
DUT Mode	:	FHSS
Line Tested	:	120VAC NEUTRAL LINE
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	
Test Engineer	:	T. Jozefczyk
Limit	:	Class B
Test Date	:	Aug 09, 2017 10:02:32 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

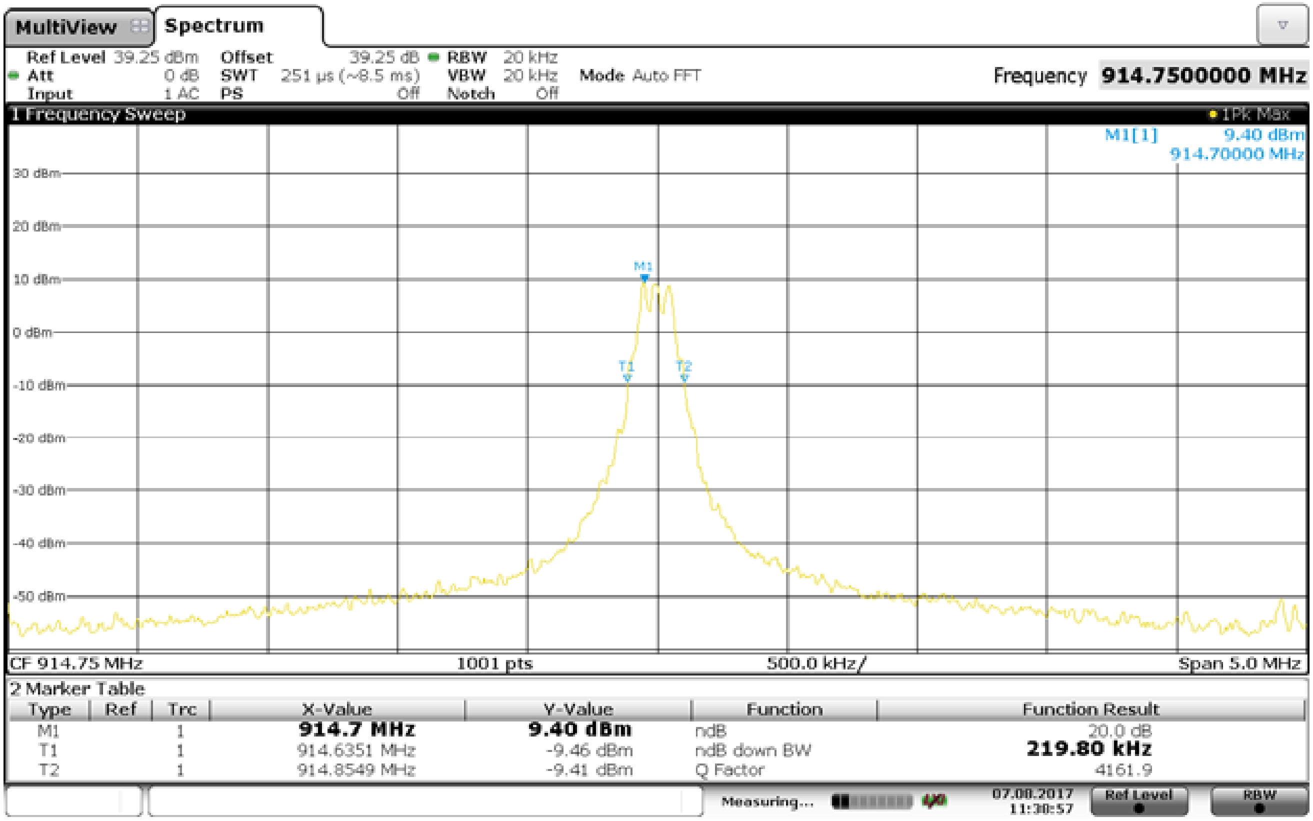


Date: 7.AUG.2017 11:37:15

20dB BANDWIDTH

MANUFACTURER	:	Chamberlain Group, Inc.
TEST ITEM	:	Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER	:	8500W
TEST MODE	:	Tx – 902.25MHz
	:	20dB BW = 224.80kHz

NOTES

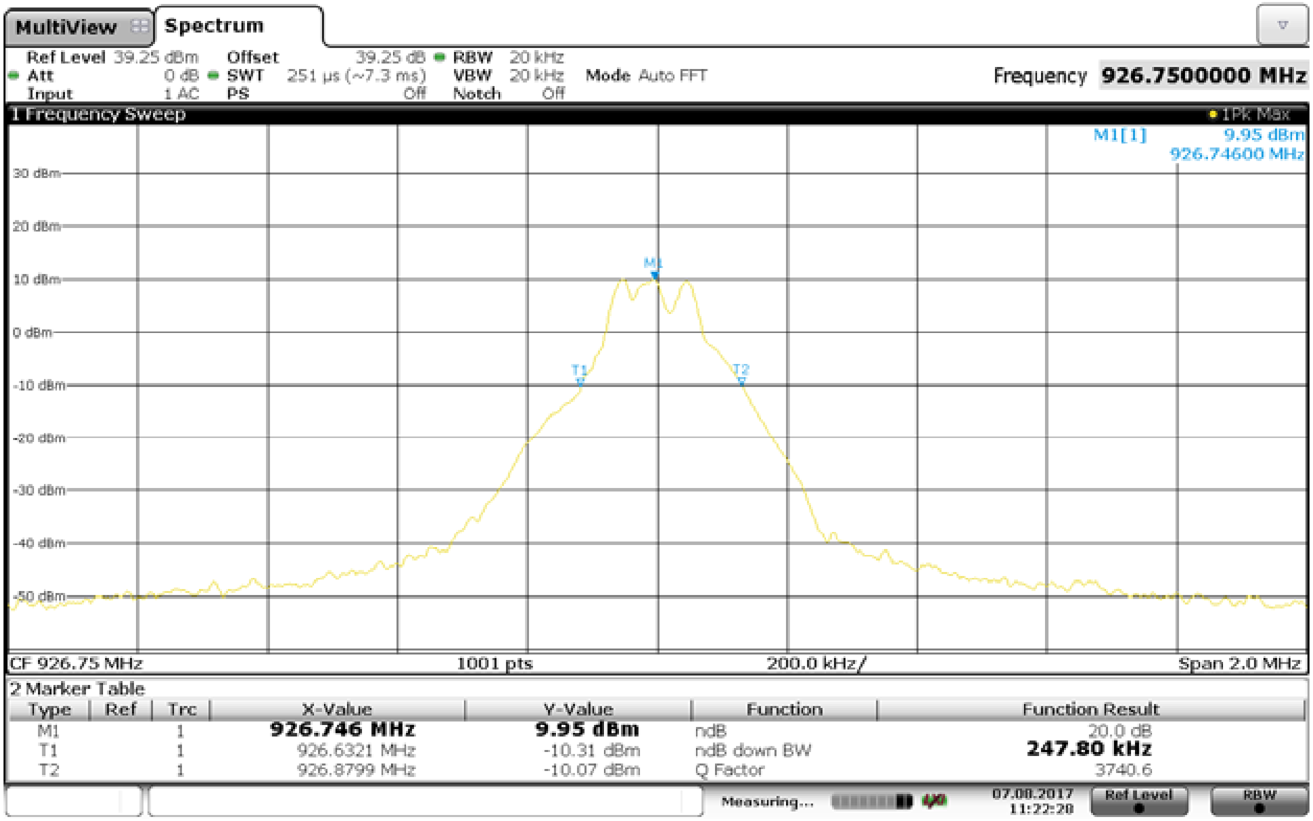


Date: 7.AUG.2017 11:38:57

20dB BANDWIDTH

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 914.75MHz
: 20dB BW = 219.80kHz

NOTES

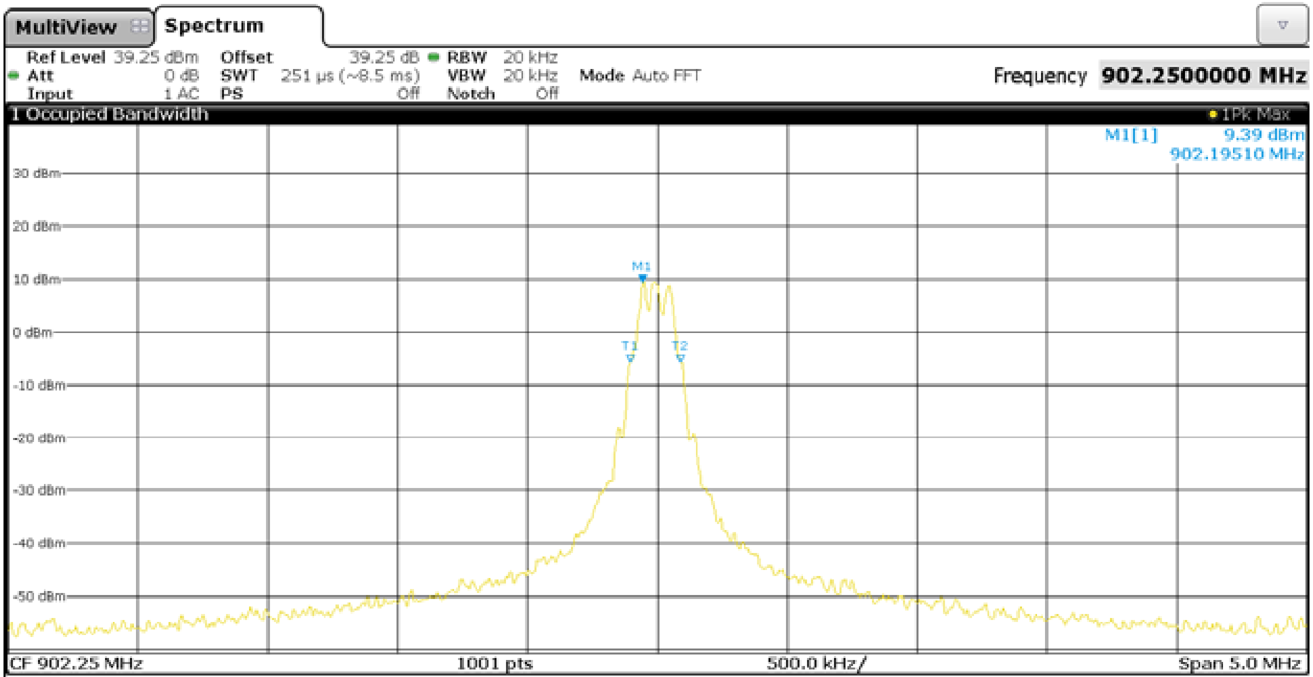


Date: 7.AUG.2017 11:22:28

20dB BANDWIDTH

MANUFACTURER	:	Chamberlain Group, Inc.
TEST ITEM	:	Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER	:	8500W
TEST MODE	:	Tx – 926.75MHz
	:	20dB BW = 247.80kHz

NOTES



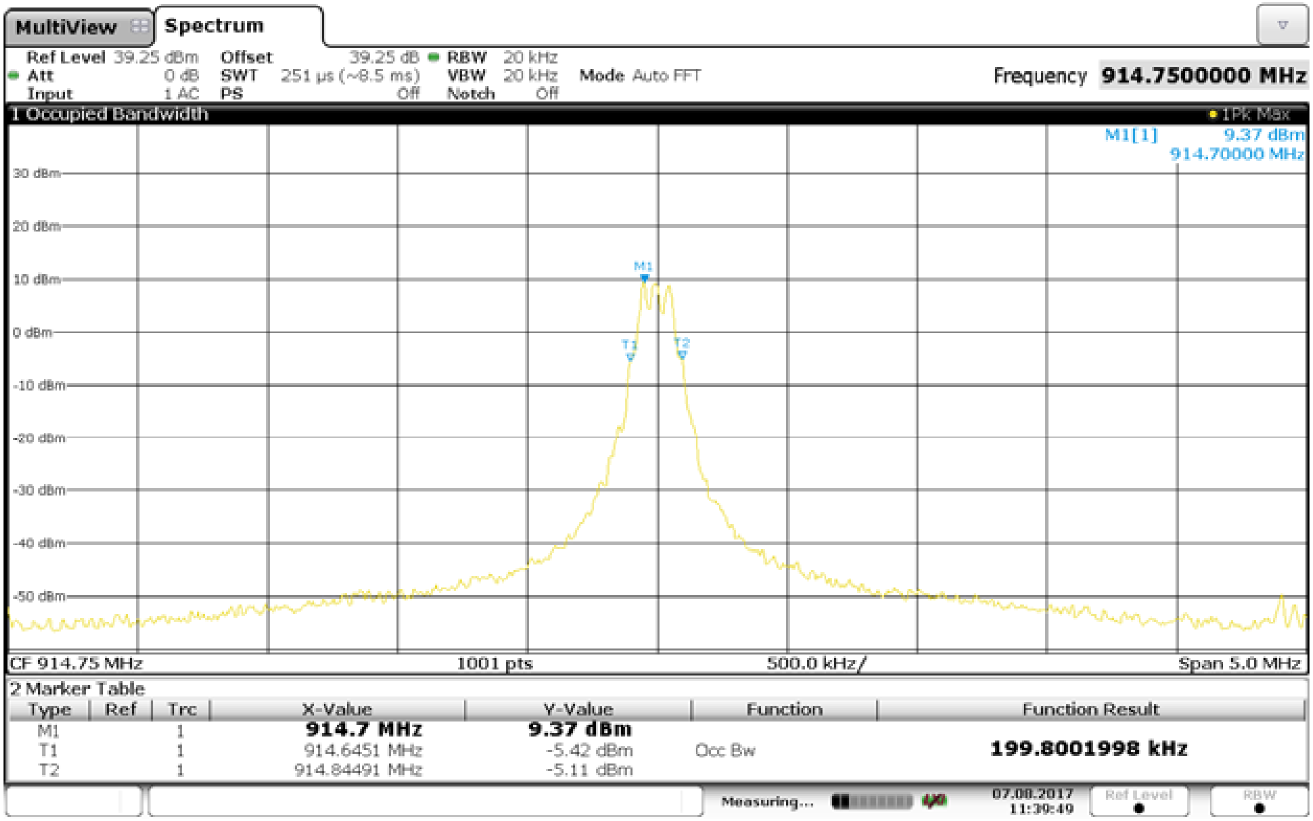
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	902.1951 MHz	9.39 dBm		
T1		1	902.1451 MHz	-5.72 dBm	Occ Bw	194.805194805 kHz
T2		1	902.33991 MHz	-5.74 dBm		

Date: 7.AUG.2017 11:35:29

99% BANDWIDTH

MANUFACTURER	:	Chamberlain Group, Inc.
TEST ITEM	:	Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER	:	8500W
TEST MODE	:	Tx – 902.25MHz
	:	99% BW = 194.81kHz

NOTES

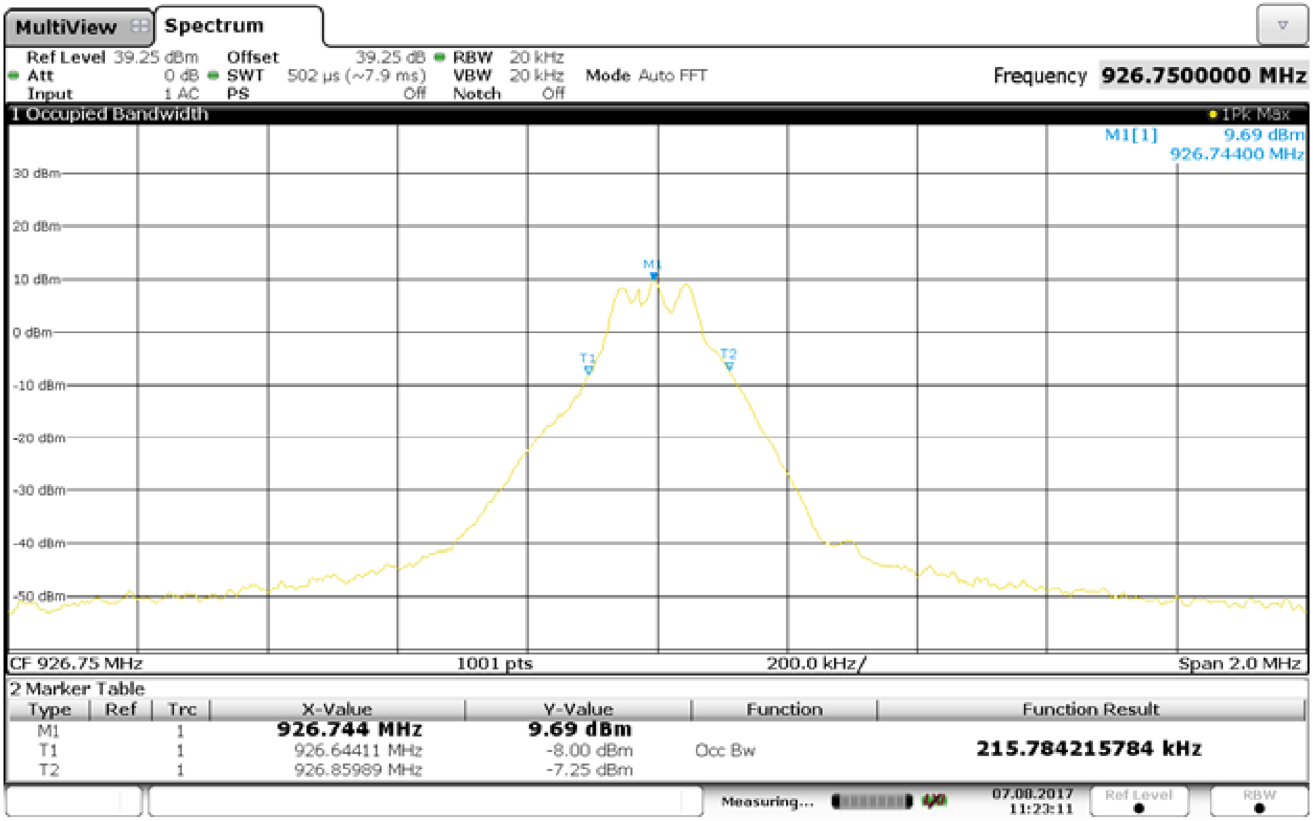


Date: 7.AUG.2017 11:39:49

99% BANDWIDTH

MANUFACTURER	:	Chamberlain Group, Inc.
TEST ITEM	:	Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER	:	8500W
TEST MODE	:	Tx – 914.75MHz
	:	99% BW = 199.8kHz

NOTES

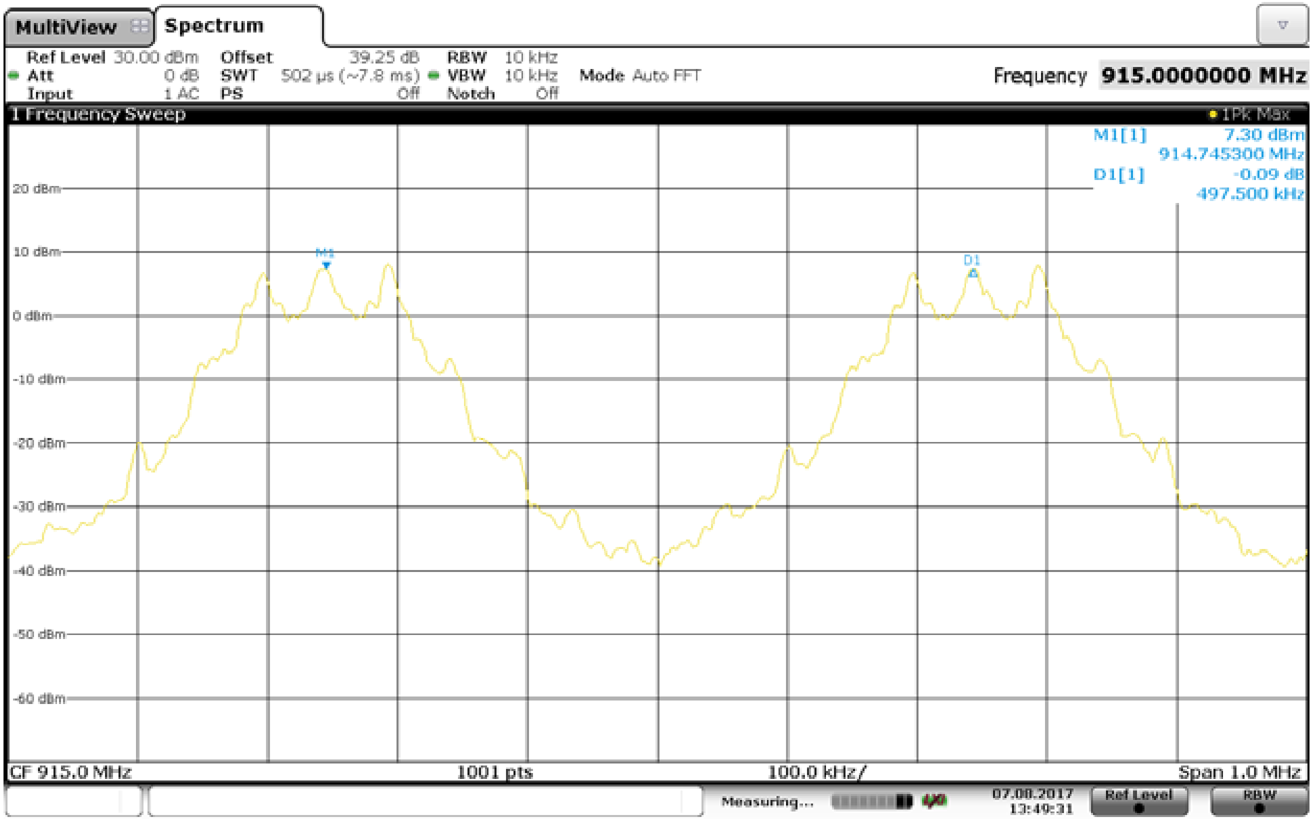


Date: 7.AUG.2017 11:23:11

99% BANDWIDTH

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 926.75MHz
: 99% BW = 215.78kHz

NOTES

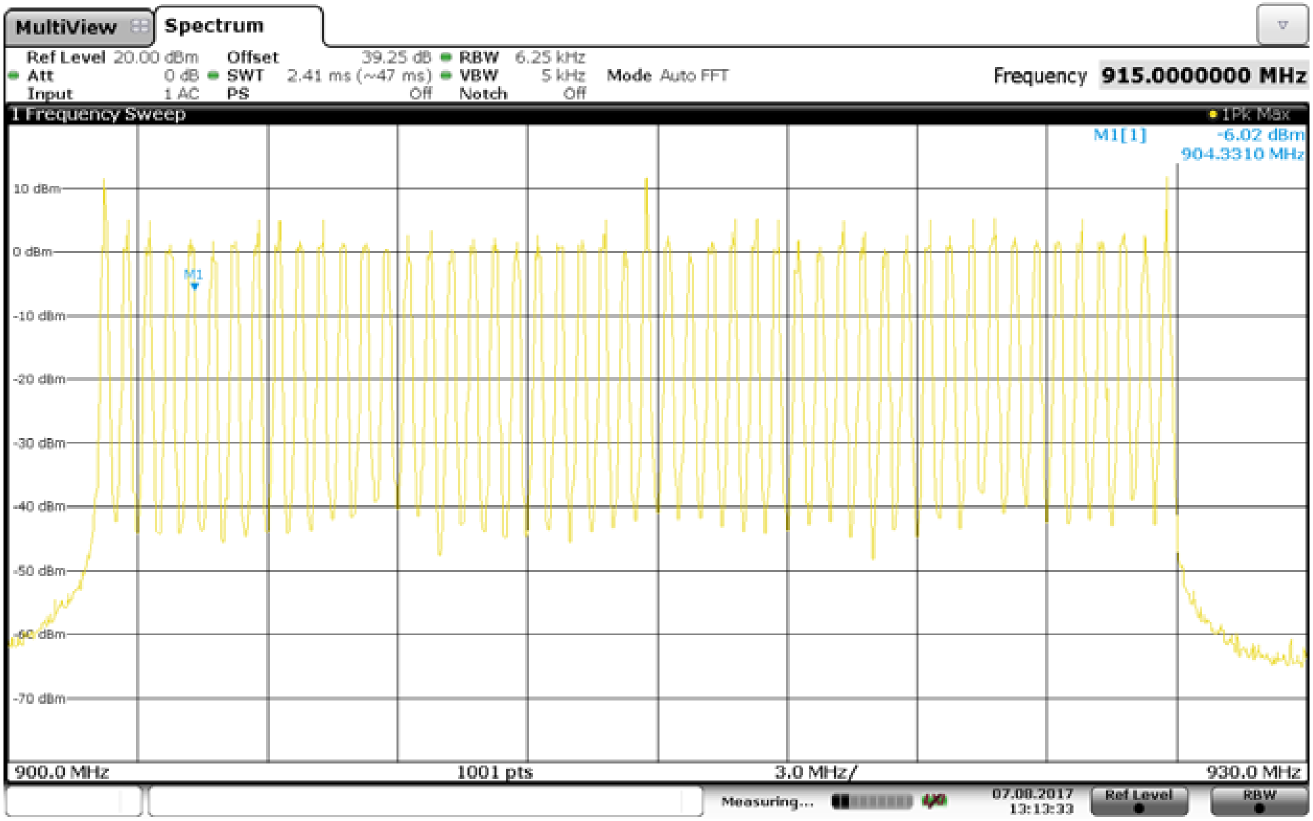


Date: 7.AUG.2017 13:49:30

CARRIER FREQUENCY SEPARATION

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : FHSS
: CFS = 497.5kHz

NOTES

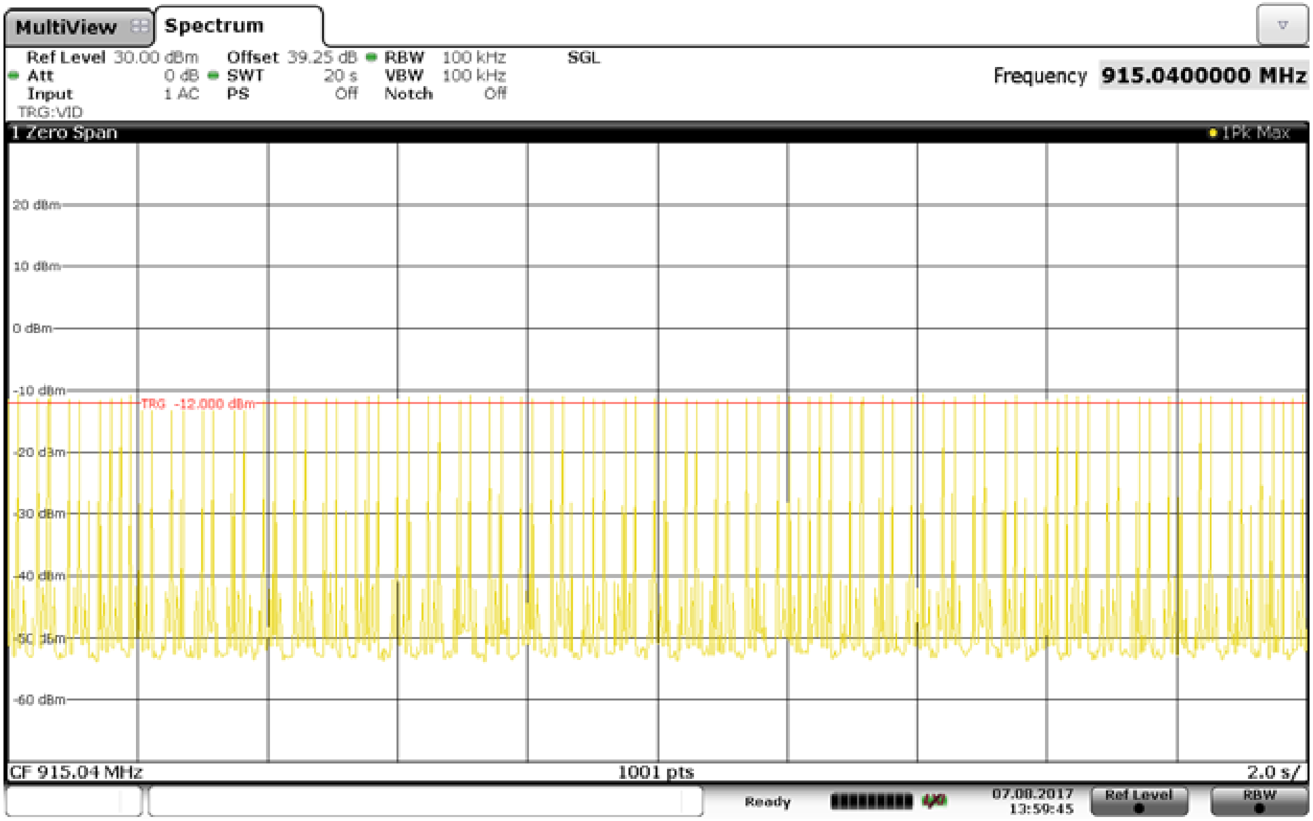


Date: 7.AUG.2017 13:13:33

NUMBER OF HOPPING FREQUENCIES

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : FHSS
: Number of hopping frequencies = 50

NOTES

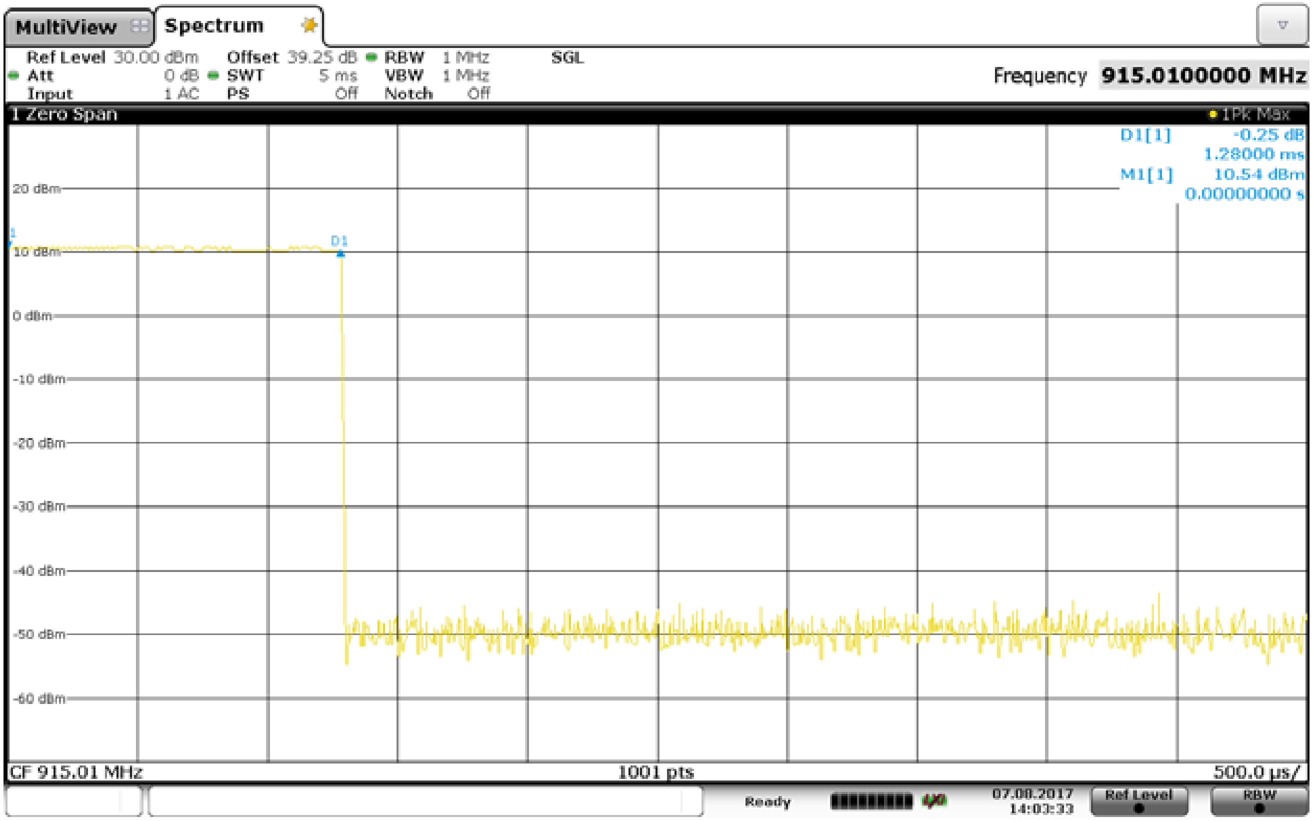


Date: 7.AUG.2017 13:59:46

TIME OF OCCUPANCY

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : FHSS

NOTES: Number of hopping pulses in during the time of occupancy, which was found to be 90 pulses in a span of 20s.

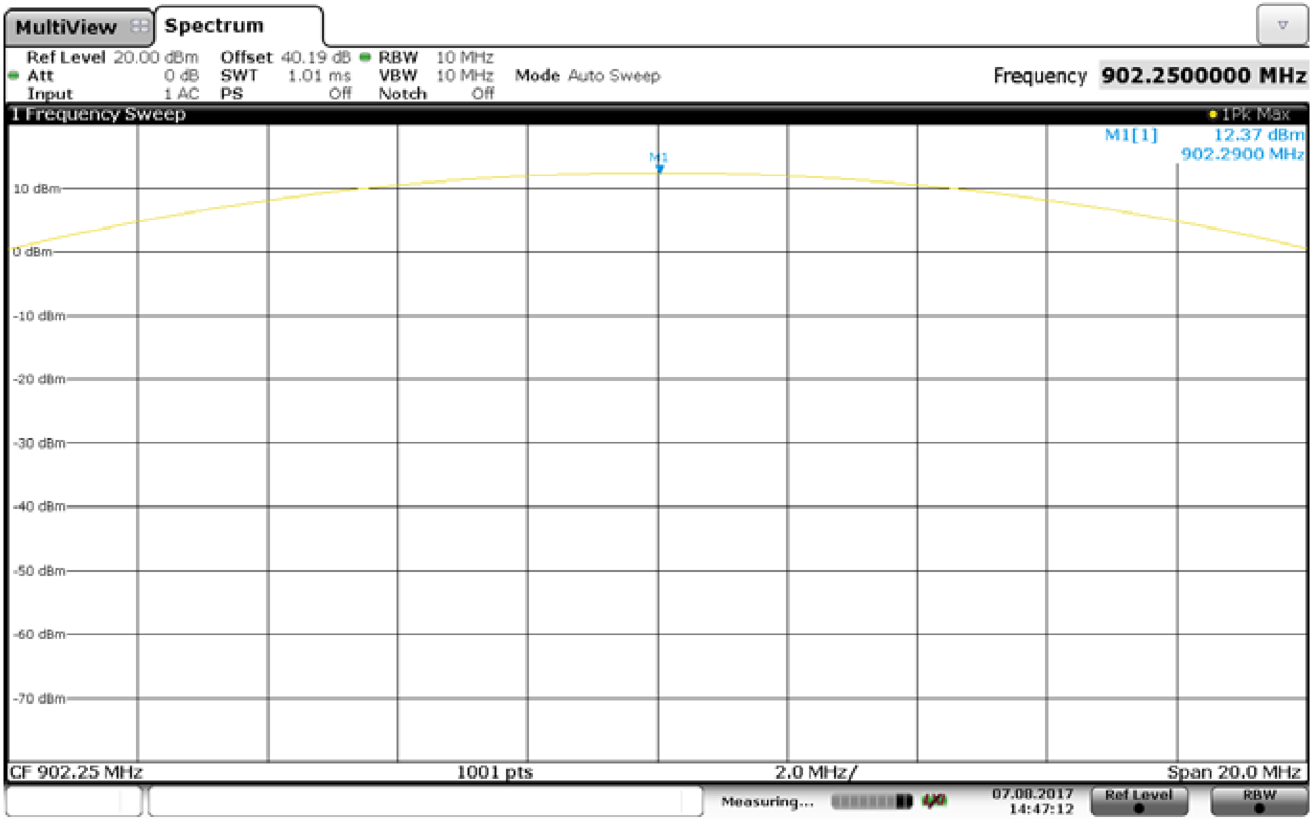


Date: 7.AUG.2017 14:03:34

TIME OF OCCUPANCY - PULSE

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : FHSS

NOTES: Length of time a pulse occurs in the time of occupancy, which was 1.28ms.

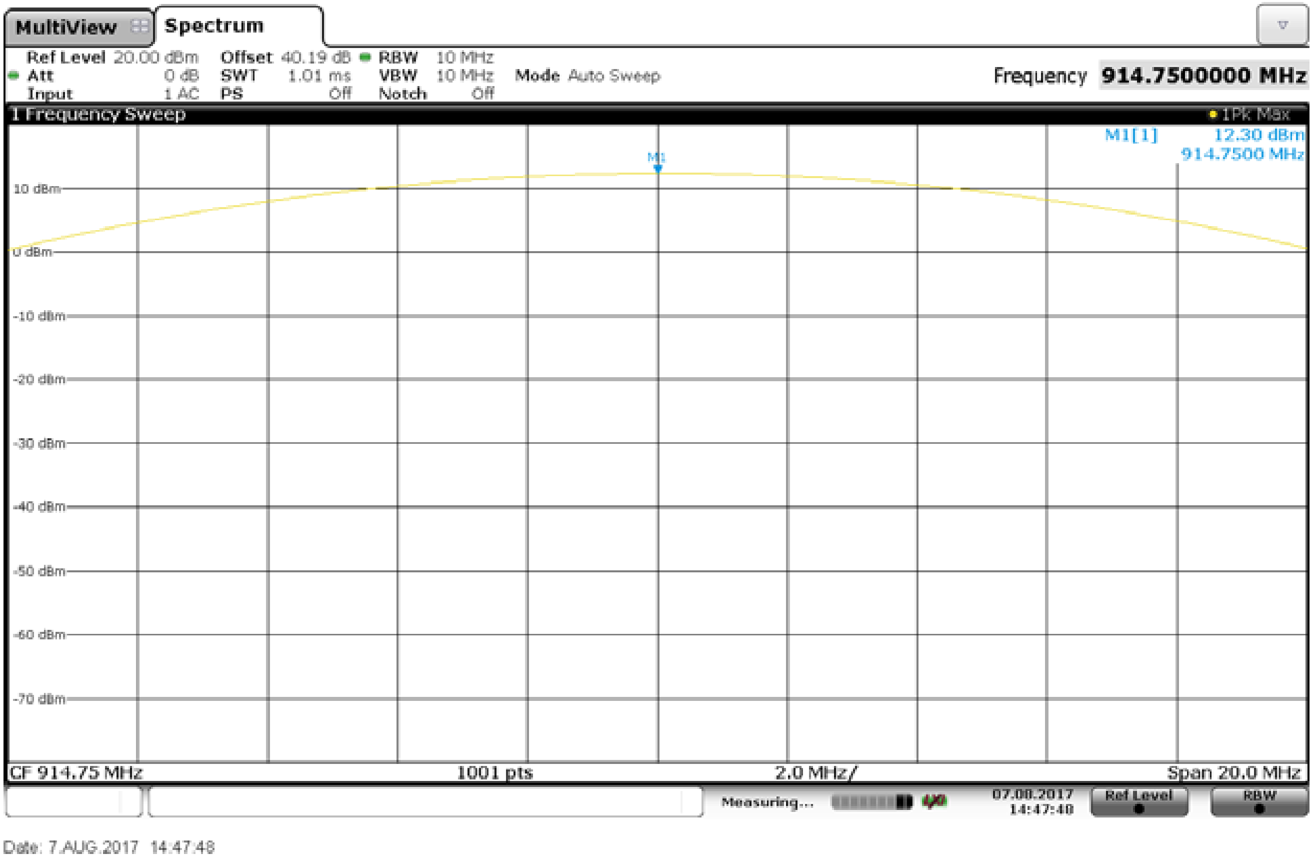


Date: 7.AUG.2017 14:47:12

PEAK OUTPUT POWER

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 902.25MHz
: Power output = 12.37dBm

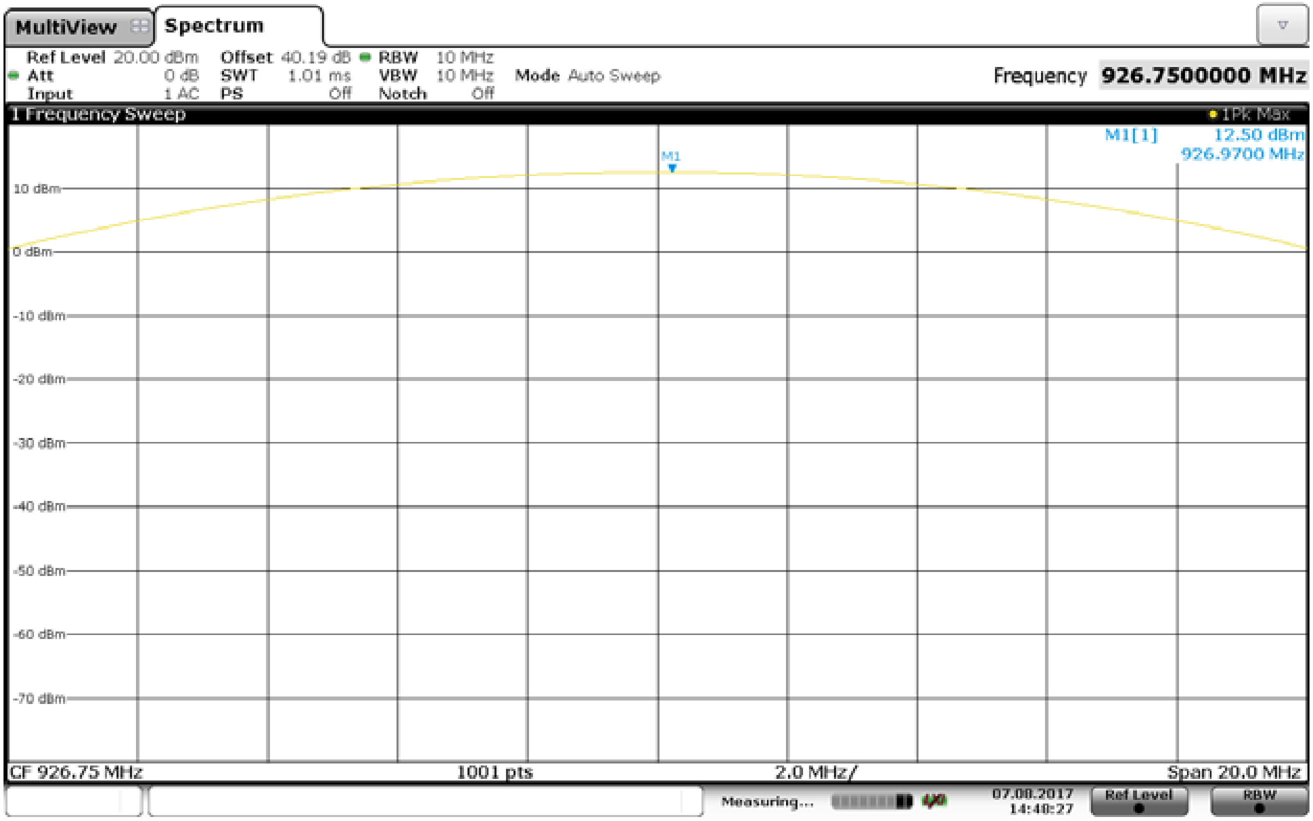
NOTES



PEAK OUTPUT POWER

MANUFACTURER	:	Chamberlain Group, Inc.
TEST ITEM	:	Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER	:	8500W
TEST MODE	:	Tx – 914.75MHz
	:	Power output = 12.30dBm

NOTES



Date: 7.AUG.2017 14:48:27

PEAK OUTPUT POWER

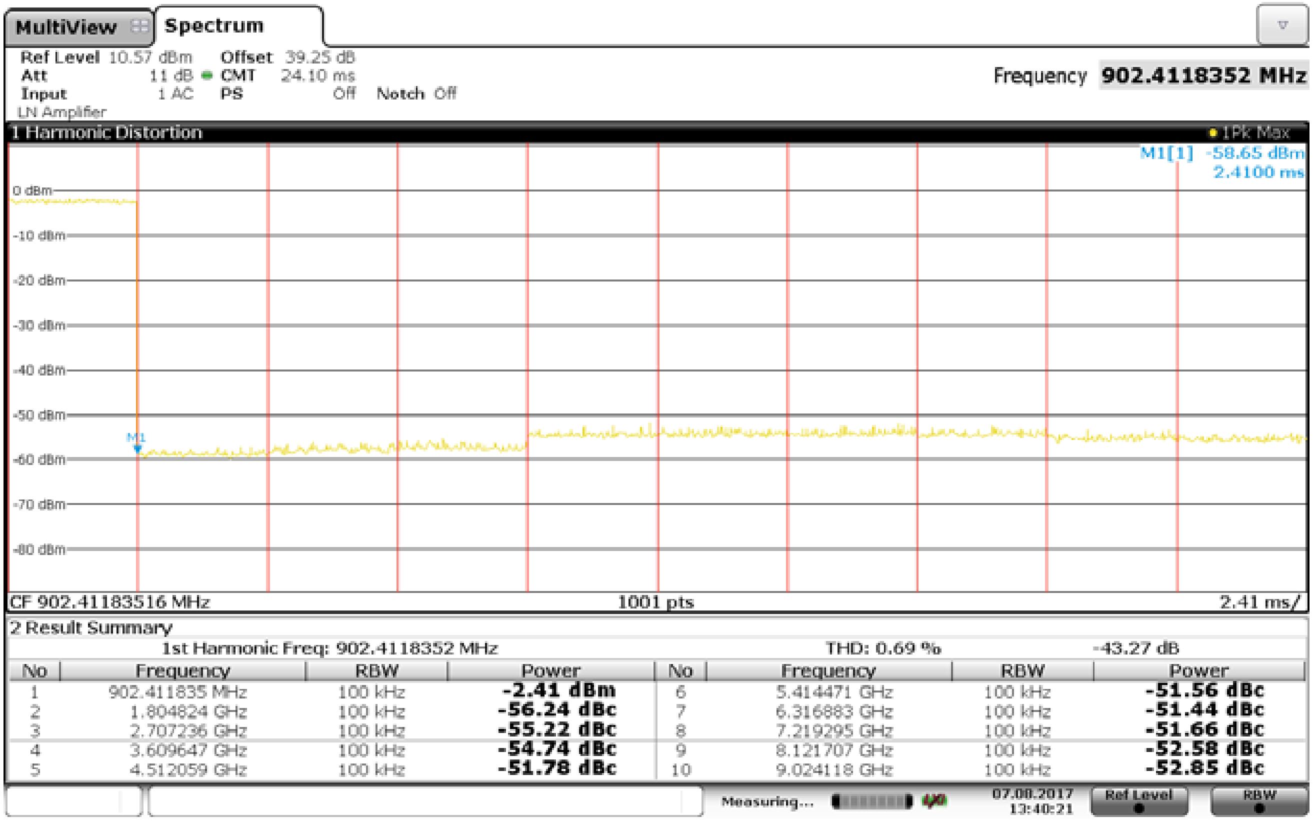
MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 926.75MHz
: Power output = 12.50dBm

NOTES

DATA PAGE

Manufacturer : Chamberlain Group, Inc.
Test Item : Liftmaster Garage Door Opener
Model No. : 8160 GDO with 001D8621-1 Logic Board
Mode : Tx
Test Specification : FCC-15.247, RSS-247 Peak Output Power
Date : August 11, 2017

Freq. (MHz)	Ant Pol	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dBd)	Cable Loss (dB)	EIRP (dBm)
902.25	H	9.8	2.2	1.6	10.3
902.25	V	12.0	2.2	1.6	12.5
914.75	H	13.0	2.2	1.6	13.5
914.75	V	12.7	2.2	1.6	13.2
926.75	H	12.6	2.2	1.7	13.0
926.75	V	13.3	2.2	1.7	13.8



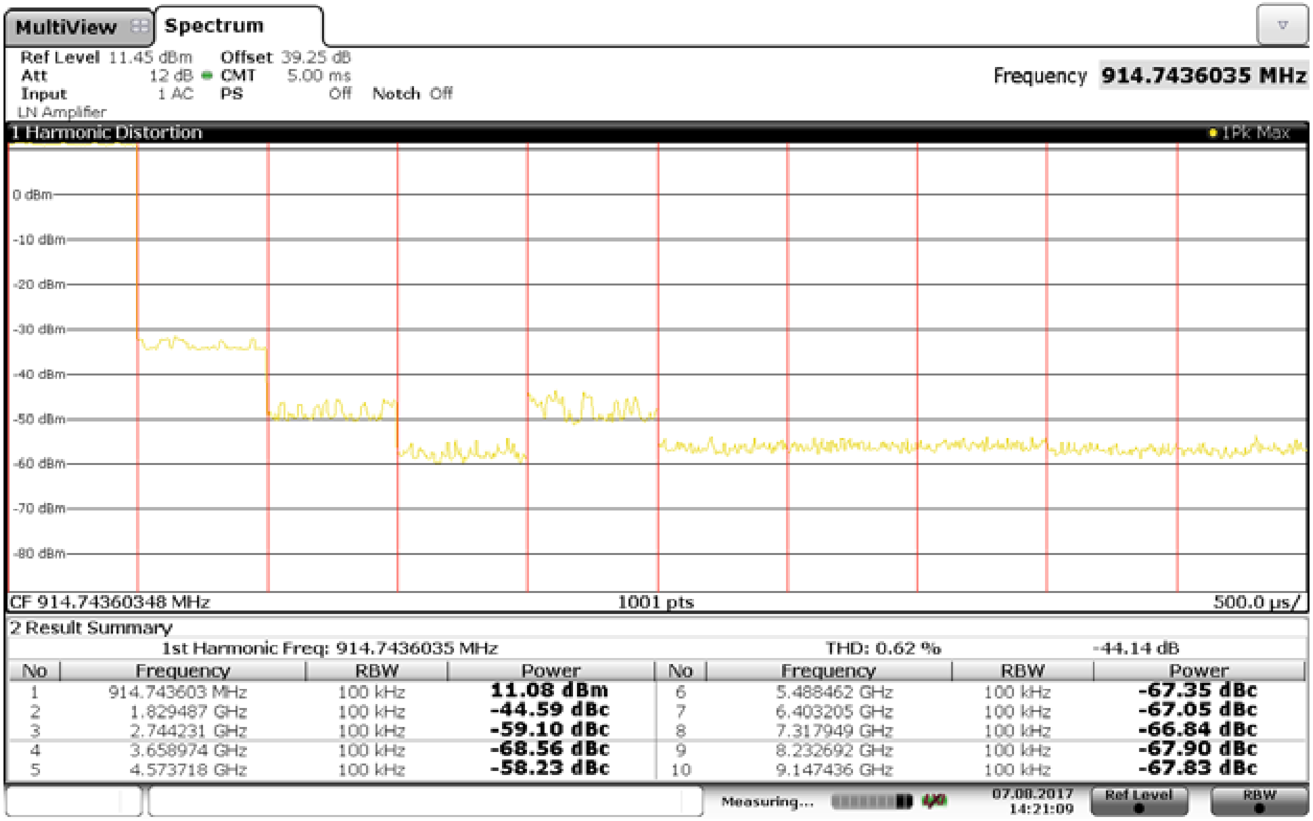
No	Frequency	RBW	Power	No	Frequency	RBW	Power
1	902.411835 MHz	100 kHz	-2.41 dBm	6	5.414471 GHz	100 kHz	-51.56 dBc
2	1.804824 GHz	100 kHz	-56.24 dBc	7	6.316883 GHz	100 kHz	-51.44 dBc
3	2.707236 GHz	100 kHz	-55.22 dBc	8	7.219295 GHz	100 kHz	-51.66 dBc
4	3.609647 GHz	100 kHz	-54.74 dBc	9	8.121707 GHz	100 kHz	-52.58 dBc
5	4.512059 GHz	100 kHz	-51.78 dBc	10	9.024118 GHz	100 kHz	-52.85 dBc

Date: 7.AUG.2017 13:40:22

ANTENNA CONDUCTED SPURIOUS EMISSIONS

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 902.25MHz

NOTES

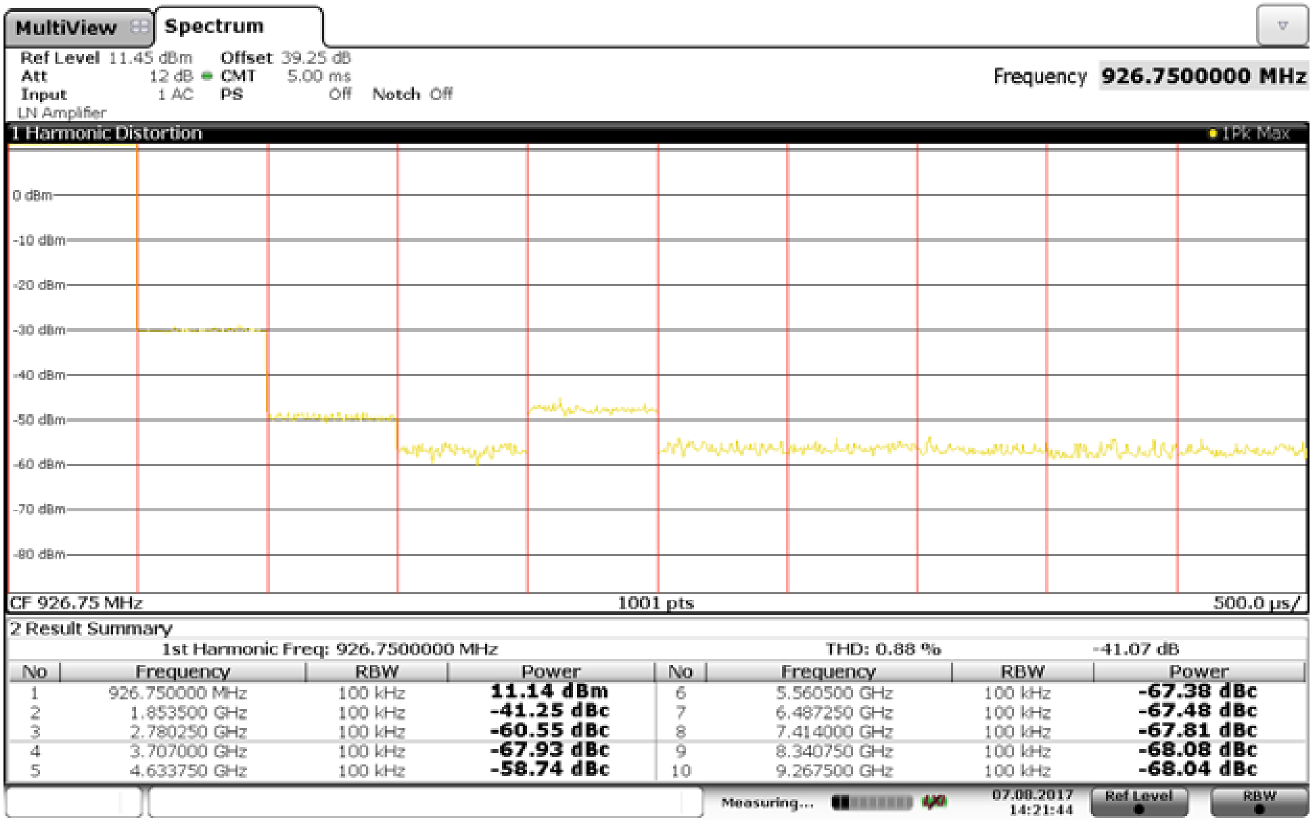


Date: 7.AUG.2017 14:21:09

ANTENNA CONDUCTED SPURIOUS EMISSIONS

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 914.75MHz

NOTES

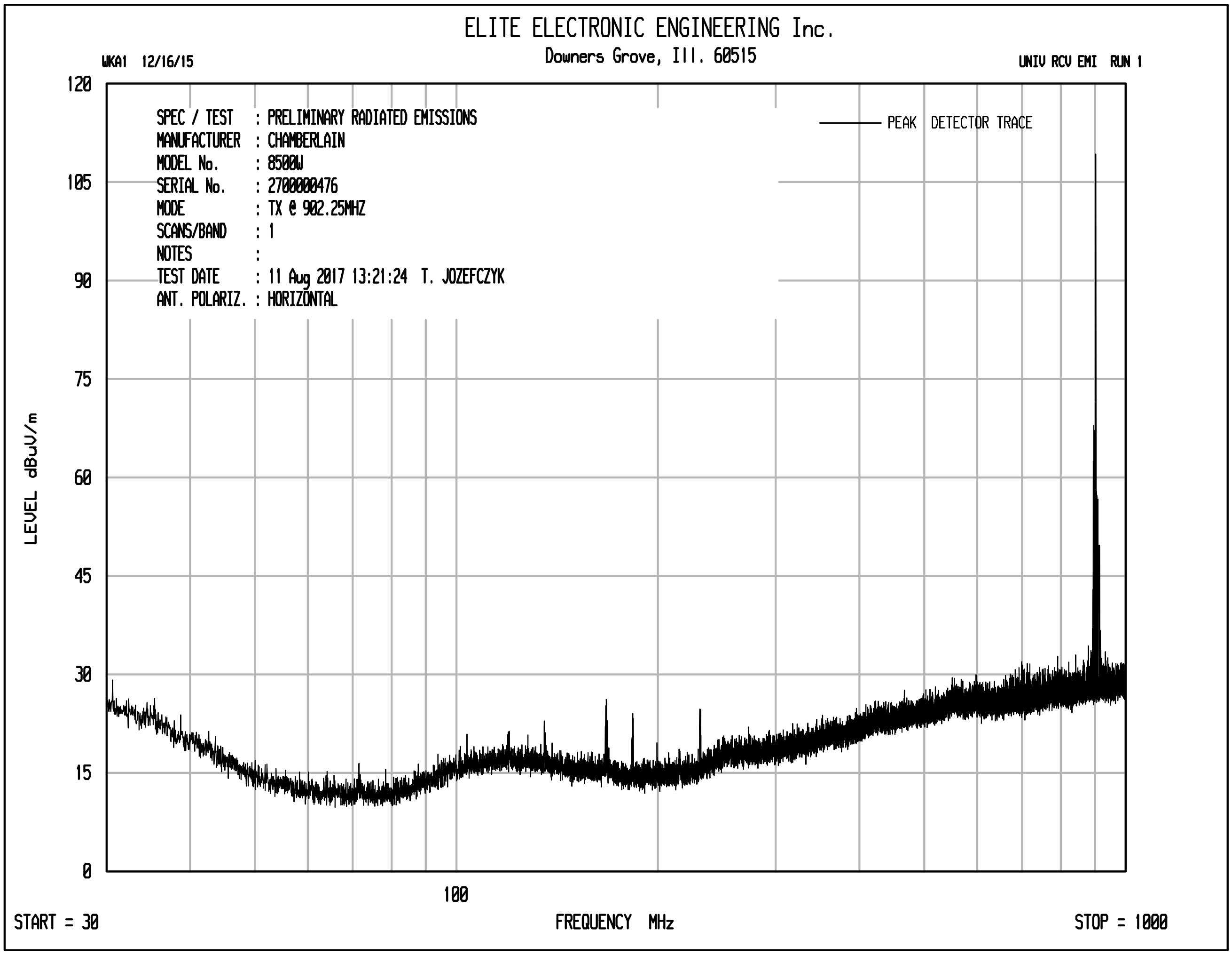


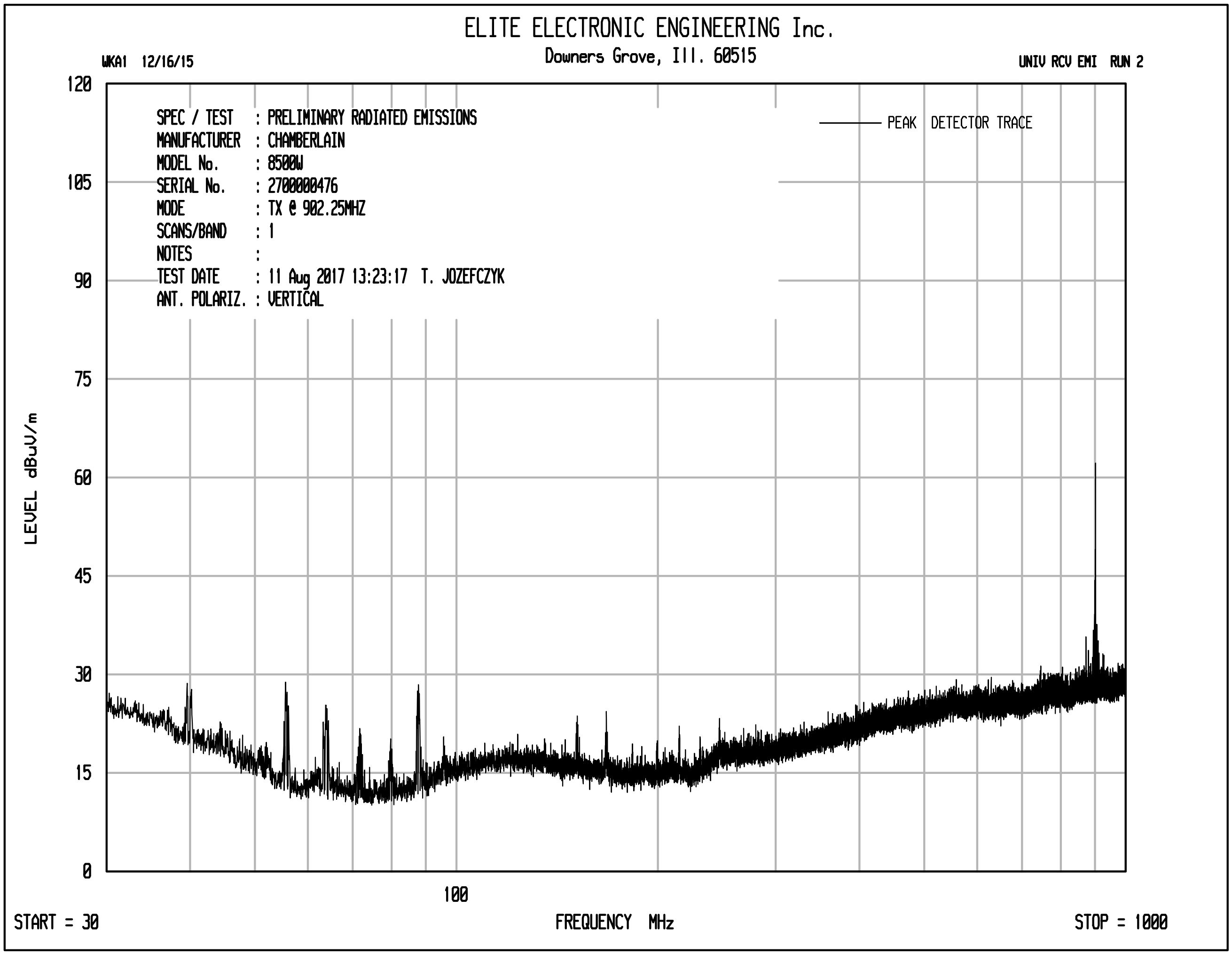
Date: 7.AUG.2017 14:21:43

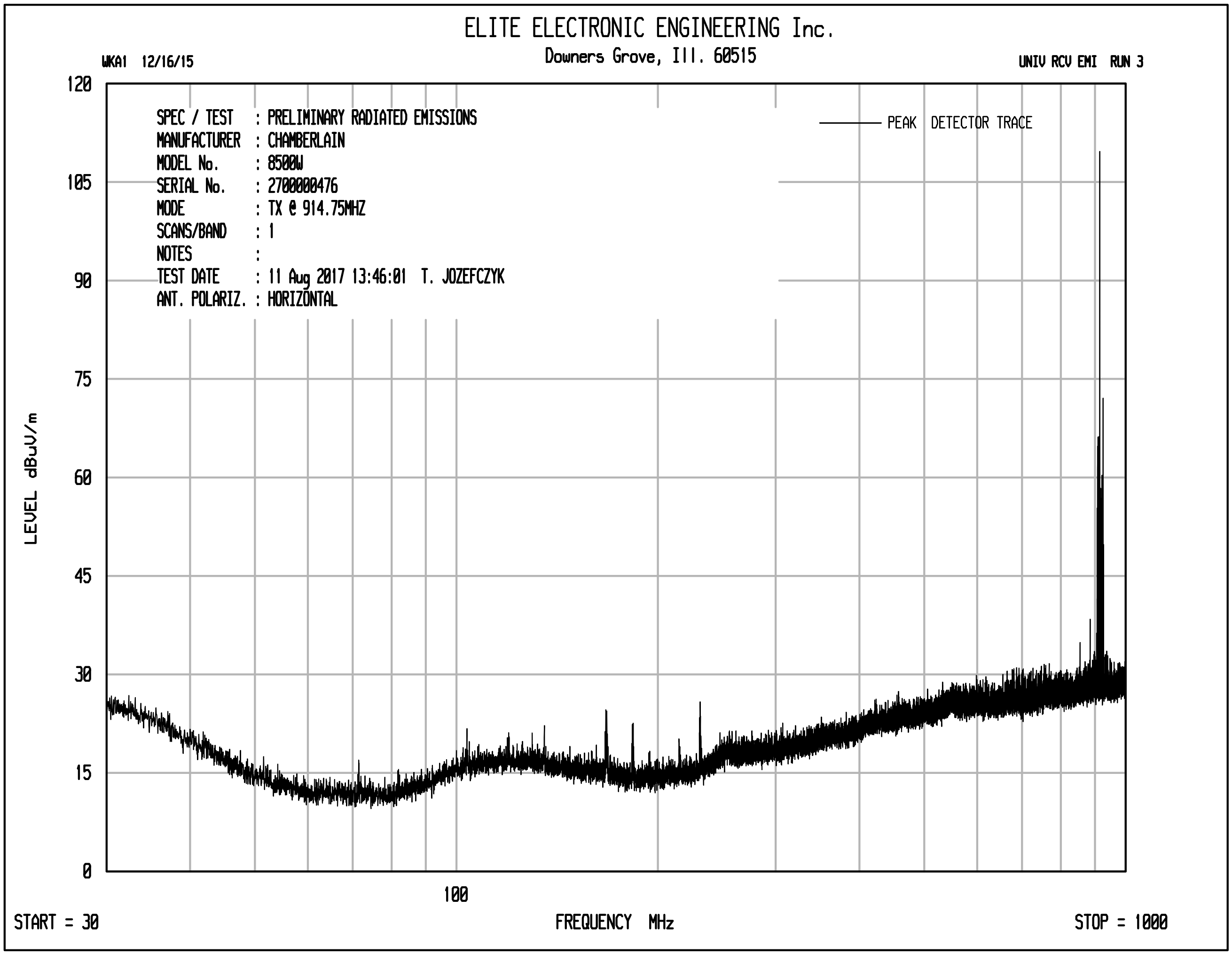
ANTENNA CONDUCTED SPURIOUS EMISSIONS

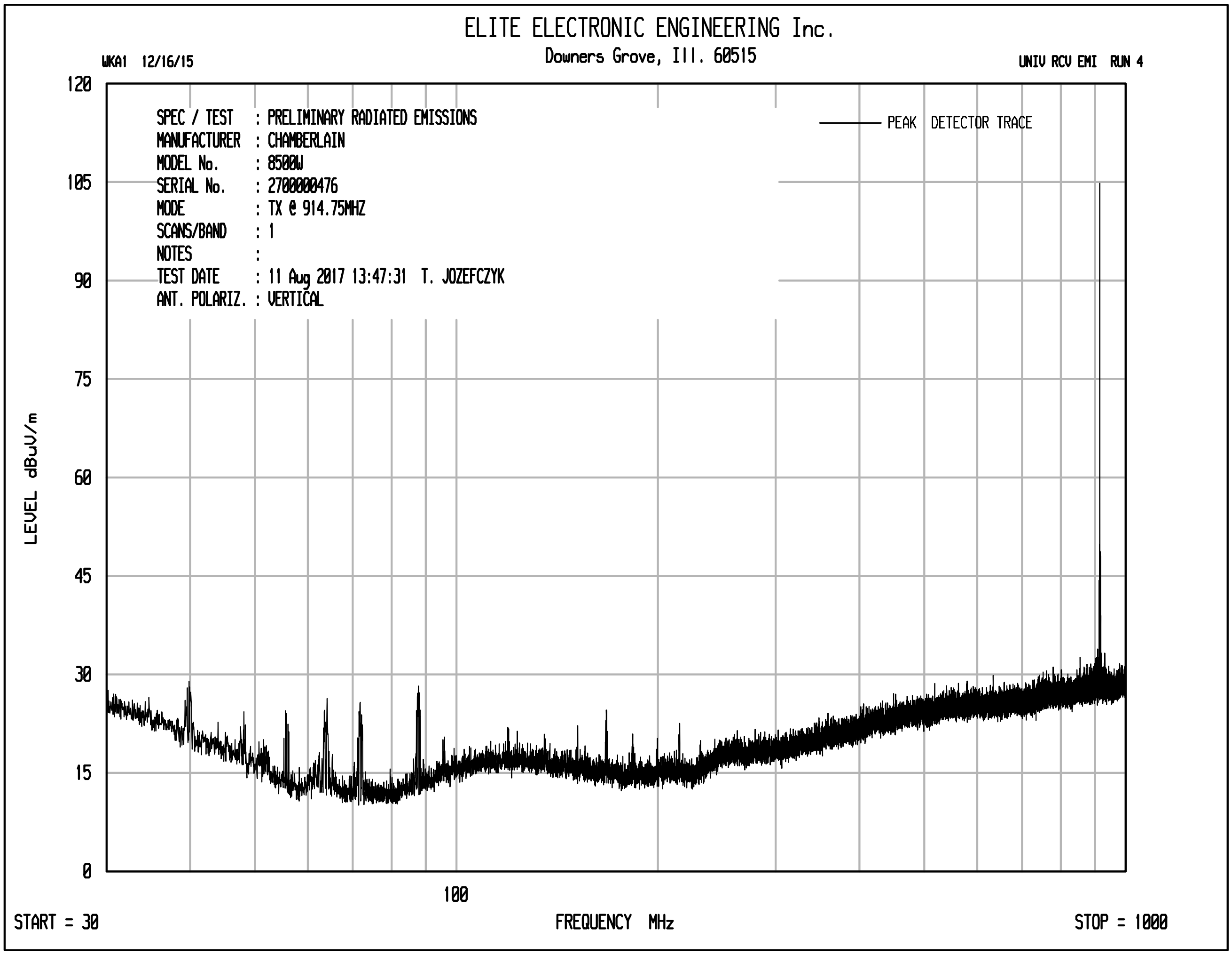
MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 926.75MHz

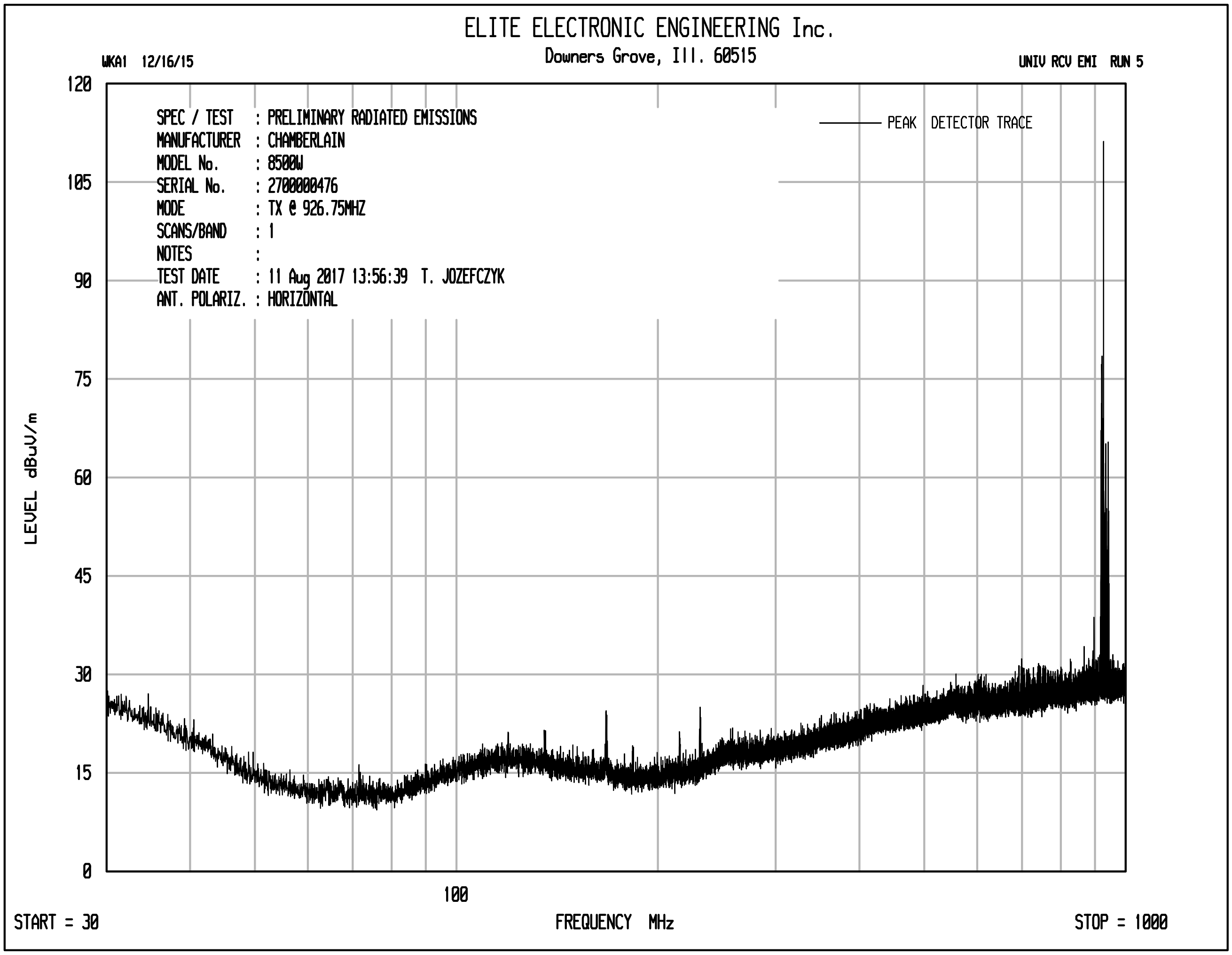
NOTES

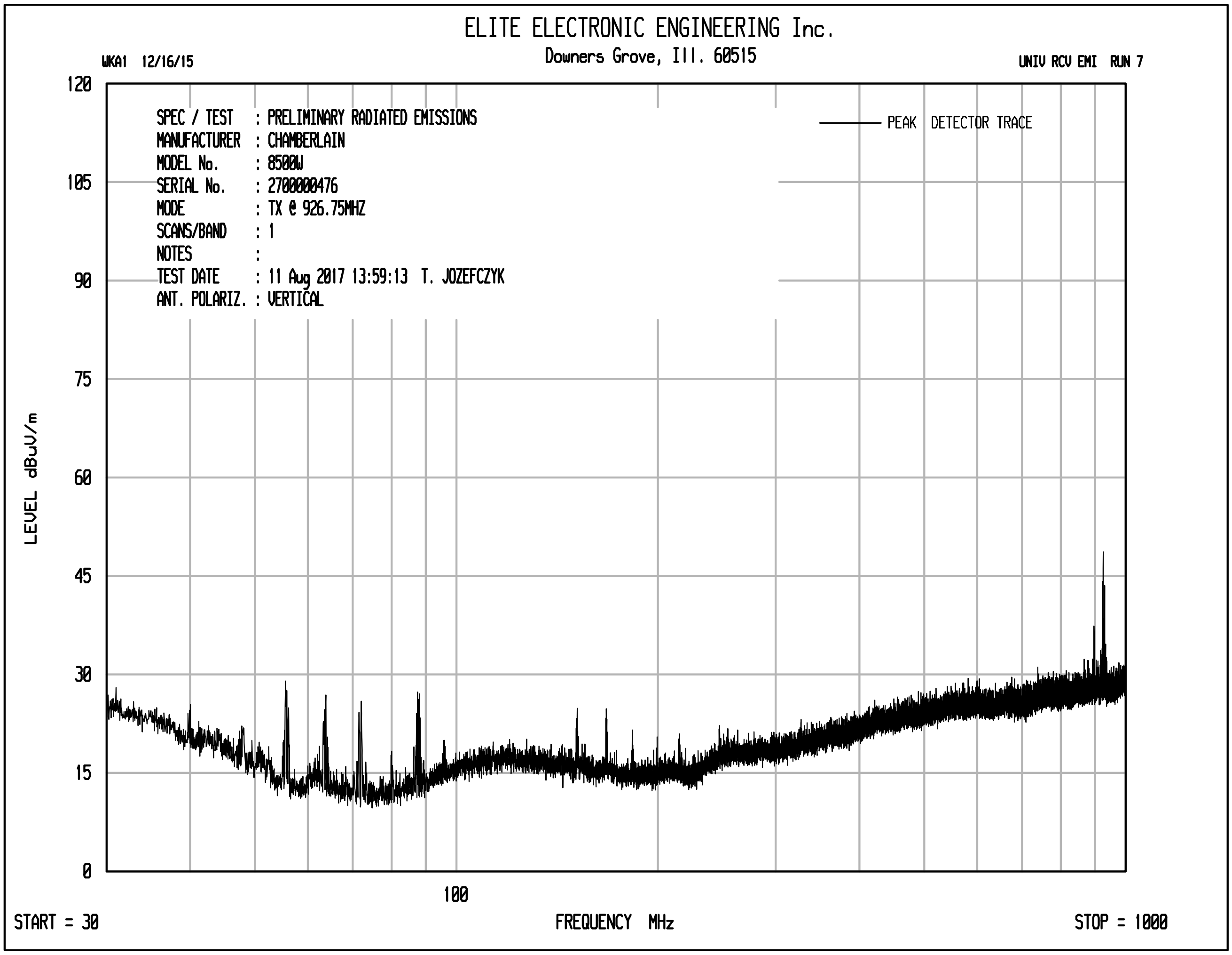

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 1
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 902.25MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 11 Aug 2017 13:21:24 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

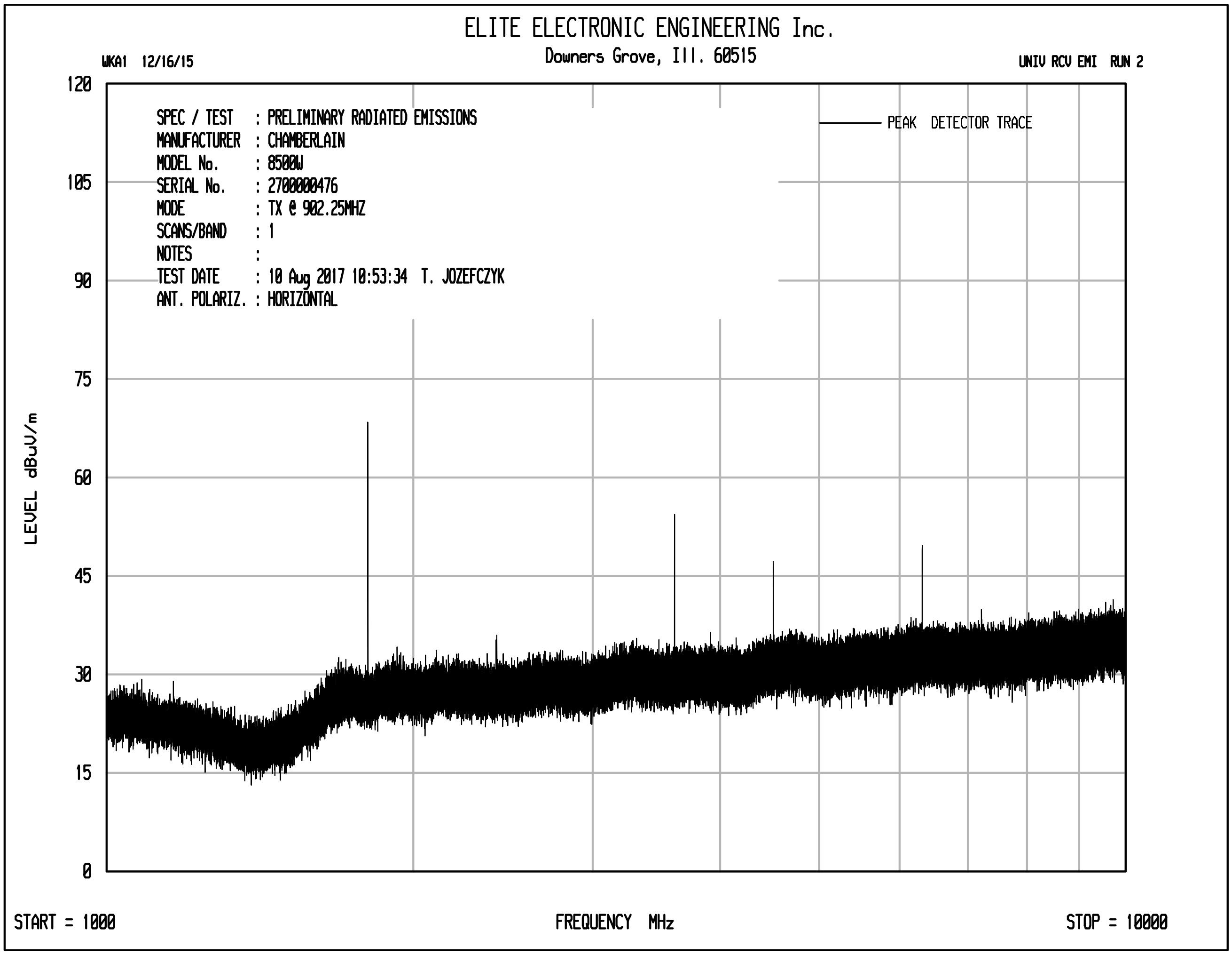

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 2
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 902.25MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 11 Aug 2017 13:23:17 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

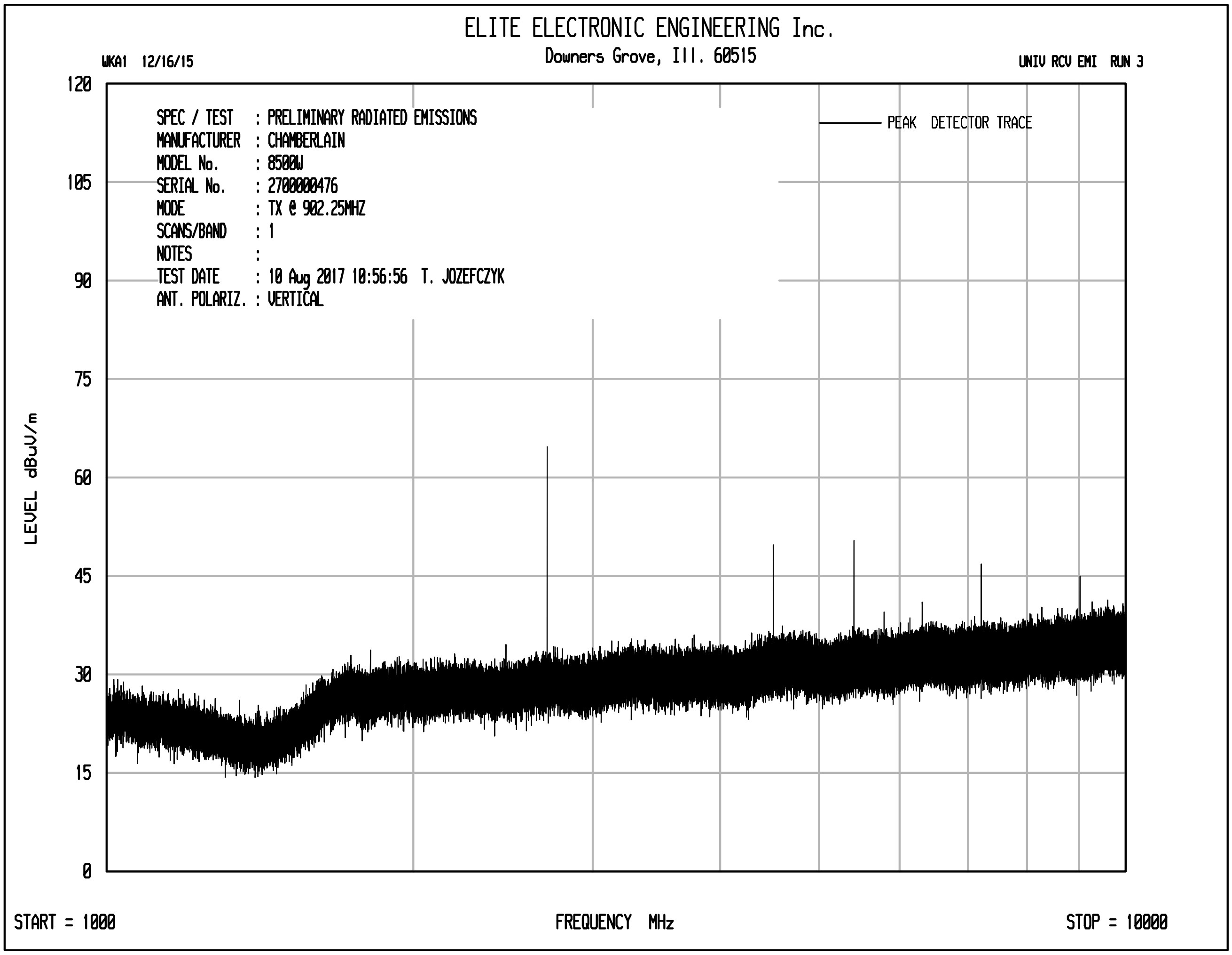

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 3
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 914.75MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 11 Aug 2017 13:46:01 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

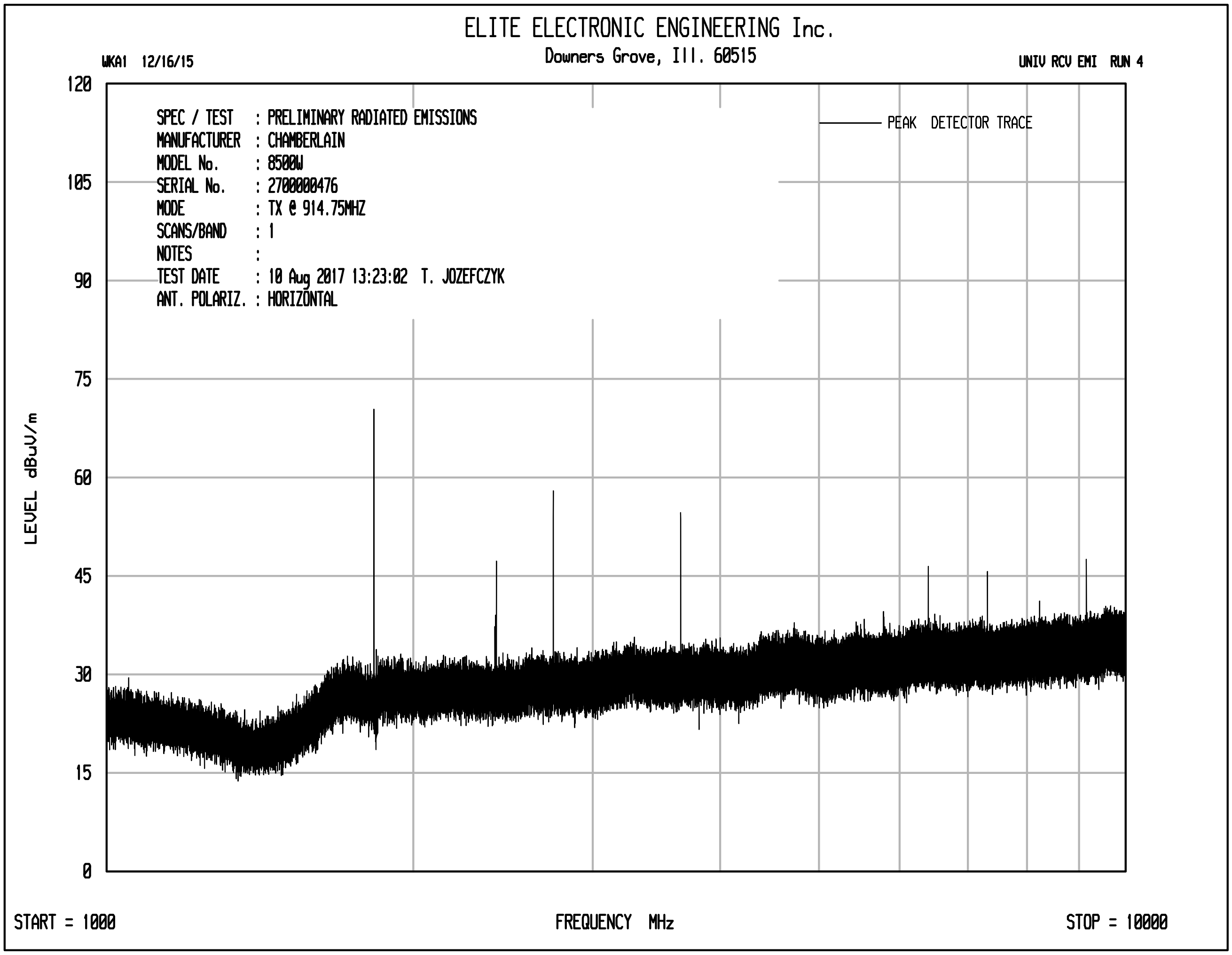

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 4
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 914.75MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 11 Aug 2017 13:47:31 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 5
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 926.75MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 11 Aug 2017 13:56:39 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

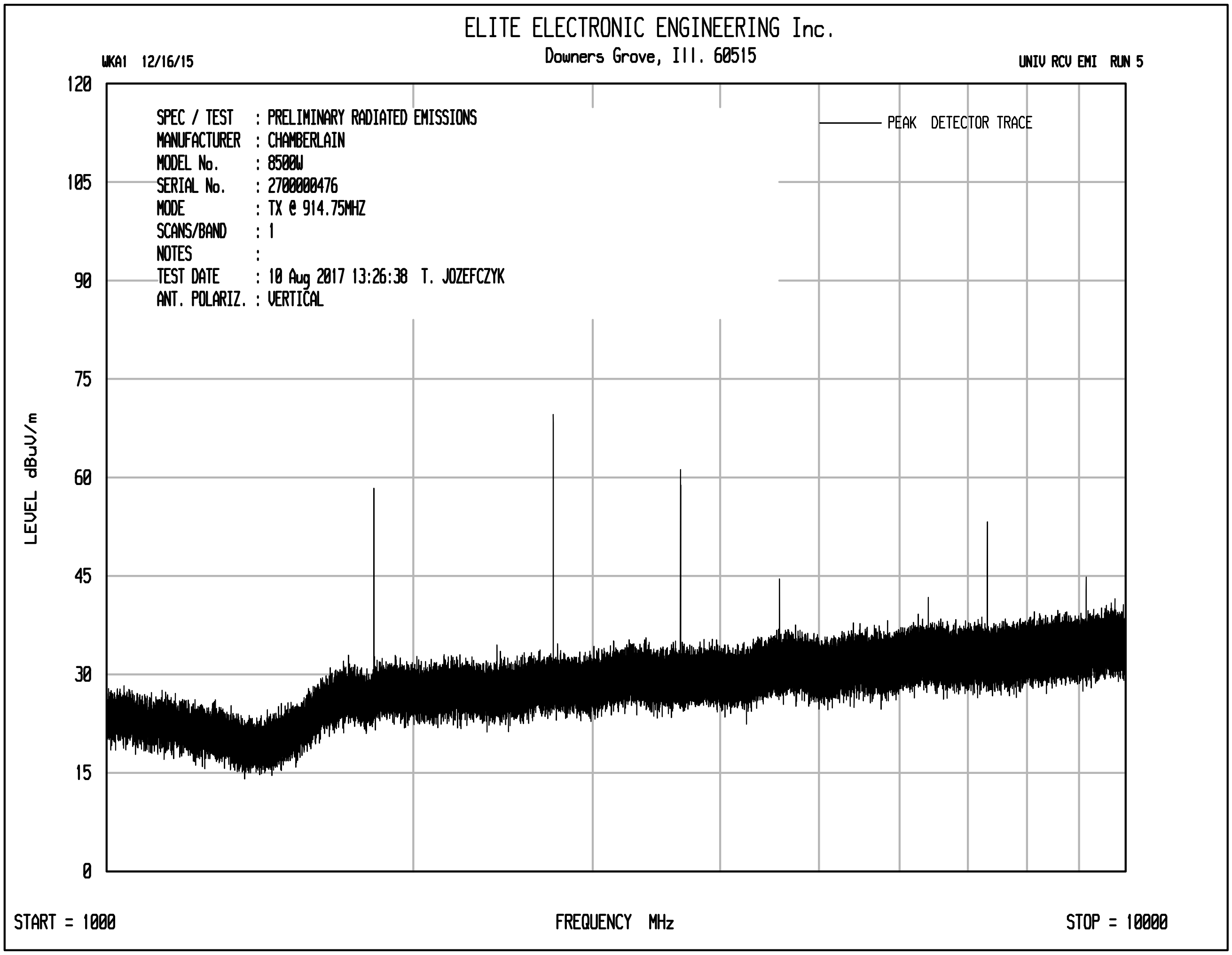

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 7
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 926.75MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 11 Aug 2017 13:59:13 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

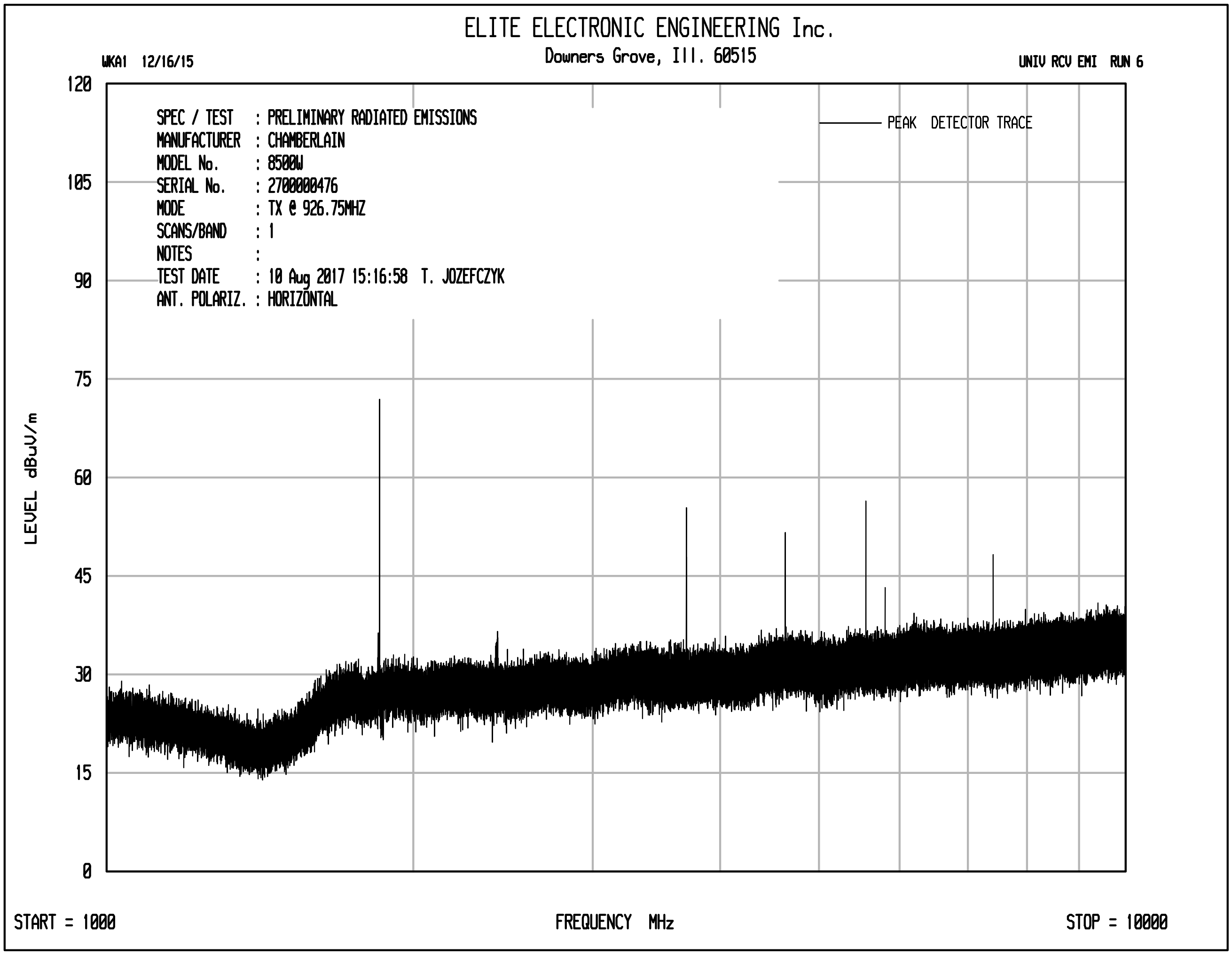

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 2
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 902.25MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 10 Aug 2017 10:53:34 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

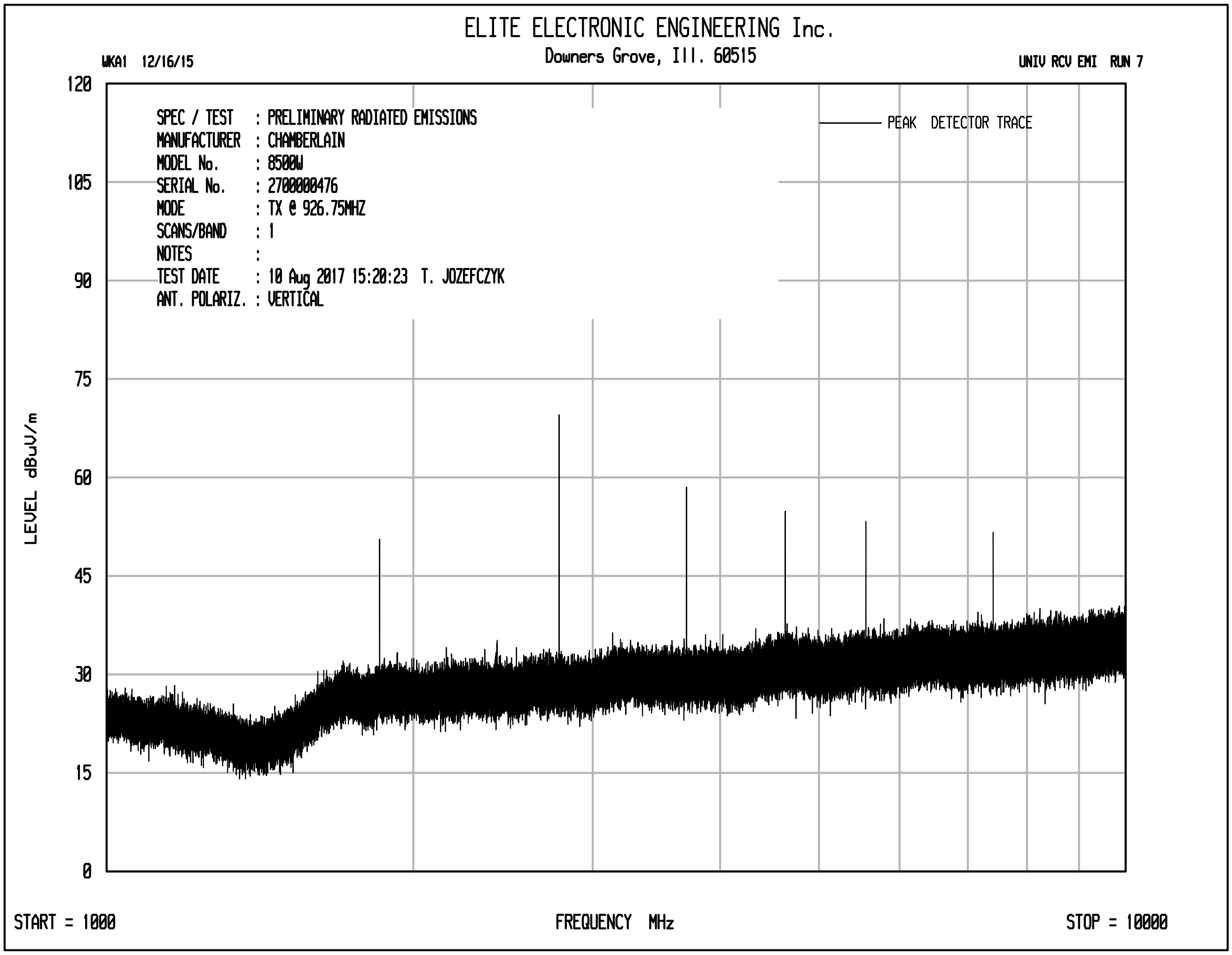

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 3
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 902.25MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 10 Aug 2017 10:56:56 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000



ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 4
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 914.75MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 10 Aug 2017 13:23:02 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 5
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 914.75MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 10 Aug 2017 13:26:38 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 6
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 926.75MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 10 Aug 2017 15:16:58 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 7
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 8500W
SERIAL No. : 2700000476
MODE : TX @ 926.75MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 10 Aug 2017 15:20:23 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

DATA PAGE

Manufacturer : Chamberlain Group, Inc.
Test Item : Liftmaster Jackshaft Garage Door Opener
Model No. : 8500W
Mode : Transmit at 902.25MHz
Test Specification : FCC-15.247, RSS-247 Radiated Spurious Emissions - Harmonics

Freq. MHz	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
902.25	H	H	79.4	2.0	26.5	0.0	107.9	249717.4	
902.25	V	V	81.6	2.0	26.5	0.0	110.1	320589.1	
1804.50	H	81.8	2.9	30.2	-40.0	74.9	5568.6	32058.9	-15.2
1804.50	V	75.5	2.9	30.2	-40.0	68.6	2699.3	32058.9	-21.5
6315.75	H	58.8	5.6	35.5	-39.4	60.5	1058.4	32058.9	-29.6
6315.75	V	56.7	5.6	35.5	-39.4	58.4	829.2	32058.9	-31.7
7218.00	H	55.5	6.1	35.7	-39.4	57.8	779.8	32058.9	-32.3
7218.00	V	55.2	6.1	35.7	-39.4	57.5	753.3	32058.9	-32.6

DATA PAGE

Manufacturer : Chamberlain Group, Inc.
Test Item : Liftmaster Jackshaft Garage Door Opener
Model No. : 8500W
Mode : Transmit at 902.25MHz
Test Specification : FCC-15.247, RSS-247 Radiated Spurious Emissions – Restricted Band

Freq. MHz	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2706.75	H	70.7	3.7	32.5	-39.8	67.1	2254.8	5000.0	-6.9
2706.75	V	75.6	3.7	32.5	-39.8	72.0	3959.2	5000.0	-2.0
3609.00	H	65.3	4.3	33.0	-39.2	63.3	1461.7	5000.0	-10.7
3609.00	V	67.3	4.3	33.0	-39.2	65.4	1859.3	5000.0	-8.6
4511.25	H	65.9	4.7	34.0	-39.2	65.4	1872.7	5000.0	-8.5
4511.25	V	67.4	4.7	34.0	-39.2	66.9	2207.9	5000.0	-7.1
5413.50	H	62.8	5.1	34.9	-39.4	63.4	1477.2	5000.0	-10.6
5413.50	V	61.1	5.1	34.9	-39.4	61.7	1217.5	5000.0	-12.3
8120.25	H	50.5	6.5	35.7	-39.4	53.3	464.1	5000.0	-20.6
8120.25	V	52.0	6.5	35.7	-39.4	54.9	553.5	5000.0	-19.1
9022.50	H	52.7	6.5	36.1	-39.3	56.0	629.0	5000.0	-18.0
9022.50	V	51.6	6.5	36.1	-39.3	54.9	558.0	5000.0	-19.0

DATA PAGE

Manufacturer : Chamberlain Group, Inc.
Test Item : Liftmaster Jackshaft Garage Door Opener
Model No. : 8500W
Mode : Transmit at 902.25MHz
Test Specification : FCC-15.247, RSS-247 Radiated Spurious Emissions – Restricted Band Averages

Freq. MHz	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2706.75	H	49.98	3.7	32.5	-39.8	-22.3	24.1	15.9	500.0	-29.9
2706.75	V	52.0	3.7	32.5	-39.8	-22.3	26.1	20.2	500.0	-27.9
3609.00	H	47.1	4.3	33.0	-39.2	-22.3	22.8	13.9	500.0	-31.1
3609.00	V	48.1	4.3	33.0	-39.2	-22.3	23.8	15.5	500.0	-30.2
4511.25	H	46.8	4.7	34.0	-39.2	-22.3	24.0	15.9	500.0	-30.0
4511.25	V	48.1	4.7	34.0	-39.2	-22.3	25.3	18.4	500.0	-28.7
5413.50	H	45.6	5.1	34.9	-39.4	-22.3	24.0	15.8	500.0	-30.0
5413.50	V	44.7	5.1	34.9	-39.4	-22.3	23.0	14.1	500.0	-31.0
8120.25	H	36.7	6.5	35.7	-39.4	-22.3	17.2	7.3	500.0	-36.7
8120.25	V	37.6	6.5	35.7	-39.4	-22.3	18.1	8.0	500.0	-35.9
9022.50	H	37.5	6.5	36.1	-39.3	-22.3	18.5	8.4	500.0	-35.5
9022.50	V	38.2	6.5	36.1	-39.3	-22.3	19.2	9.1	500.0	-34.8

DATA PAGE

Manufacturer : Chamberlain Group, Inc.
Test Item : Liftmaster Jackshaft Garage Door Opener
Model No. : 8500W
Mode : Transmit at 914.75MHz
Test Specification : FCC-15.247, RSS-247 Radiated Spurious Emissions - Harmonics

Freq. MHz	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
914.75	H	82.6	2.1	26.5	0.0	111.2	362792.2		
914.75	V	81.7	2.1	26.5	0.0	110.2	325205.5		
1829.50	H	83.1	2.9	30.4	-40.0	76.4	6600.1	36279.2	-14.8
1829.50	V	75.8	2.9	30.4	-40.0	69.2	2877.7	36279.2	-22.0
5488.50	H	62.4	5.2	34.8	-39.4	63.0	1420.1	36279.2	-28.1
5488.50	V	62.9	5.2	34.8	-39.4	63.5	1490.5	36279.2	-27.7
6403.25	H	58.0	5.7	35.5	-39.4	59.8	974.0	36279.2	-31.4
6403.25	V	55.0	5.7	35.5	-39.4	56.8	689.5	36279.2	-34.4

DATA PAGE

Manufacturer : Chamberlain Group, Inc.
Test Item : Liftmaster Jackshaft Garage Door Opener
Model No. : 8500W
Mode : Transmit at 914.75MHz
Test Specification : FCC-15.247, RSS-247 Radiated Spurious Emissions – Restricted Band

Freq. MHz	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2744.25	H	70.8	3.7	32.5	-39.7	67.3	2313.3	5000.0	-6.7
2744.25	V	75.6	3.7	32.5	-39.7	72.1	4015.4	5000.0	-1.9
3659.00	H	63.6	4.3	33.0	-39.2	61.7	1213.5	5000.0	-12.3
3659.00	V	69.0	4.3	33.0	-39.2	67.1	2264.9	5000.0	-6.9
4573.75	H	66.6	4.7	34.2	-39.2	66.3	2056.2	5000.0	-7.7
4573.75	V	66.8	4.7	34.2	-39.2	66.4	2096.8	5000.0	-7.5
7318.00	H	54.3	6.2	35.7	-39.4	56.7	687.4	5000.0	-17.2
7318.00	V	56.1	6.2	35.7	-39.4	58.5	842.8	5000.0	-15.5
8232.75	H	50.5	6.5	35.8	-39.4	53.4	465.6	5000.0	-20.6
8232.75	V	50.2	6.5	35.8	-39.4	53.0	448.7	5000.0	-20.9
9147.50	H	53.1	6.6	36.2	-39.3	56.6	673.1	5000.0	-17.4
9147.50	V	52.5	6.6	36.2	-39.3	55.9	625.3	5000.0	-18.1

DATA PAGE

Manufacturer : Chamberlain Group, Inc.
Test Item : Liftmaster Jackshaft Garage Door Opener
Model No. : 8500W
Mode : Transmit at 914.75MHz
Test Specification : FCC-15.247, RSS-247 Radiated Spurious Emissions – Restricted Band Averages

Freq. MHz	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2744.25	H	49.90	3.7	32.5	-39.7	-22.3	24.1	16.0	500.0	-29.9
2744.25	V	52.2	3.7	32.5	-39.7	-22.3	26.4	20.9	500.0	-27.6
3659.00	H	45.6	4.3	33.0	-39.2	-22.3	21.4	11.7	500.0	-32.6
3659.00	V	48.8	4.3	33.0	-39.2	-22.3	24.6	17.0	500.0	-29.4
4573.75	H	47.7	4.7	34.2	-39.2	-22.3	25.1	18.0	500.0	-28.9
4573.75	V	47.9	4.7	34.2	-39.2	-22.3	25.3	18.3	500.0	-28.7
7318.00	H	39.7	6.2	35.7	-39.4	-22.3	19.9	9.8	500.0	-34.1
7318.00	V	41.6	6.2	35.7	-39.4	-22.3	21.7	12.2	500.0	-32.2
8232.75	H	35.4	6.5	35.8	-39.4	-22.3	16.0	6.3	500.0	-38.0
8232.75	V	35.8	6.5	35.8	-39.4	-22.3	16.4	6.6	500.0	-37.5
9147.50	H	39.6	6.6	36.2	-39.3	-22.3	20.7	10.8	500.0	-33.3
9147.50	V	39.0	6.6	36.2	-39.3	-22.3	20.1	10.1	500.0	-33.9

DATA PAGE

Manufacturer : Chamberlain Group, Inc.
Test Item : Liftmaster Jackshaft Garage Door Opener
Model No. : 8500W
Mode : Transmit at 926.75MHz
Test Specification : FCC-15.247, RSS-247 Radiated Spurious Emissions - Harmonics

Freq. MHz	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
926.75	H	81.8	2.1	26.5	0.0	110.4	331001.2		
926.75	V	82.2	2.1	26.5	0.0	110.7	344611.3		
1853.50	H	83.2	3.0	30.6	-40.0	76.8	6913.3	34461.1	-14.0
1853.50	V	78.3	3.0	30.6	-40.0	71.9	3928.1	34461.1	-18.9
5560.50	H	63.2	5.2	34.8	-39.4	63.9	1566.1	34461.1	-26.8
5560.50	V	64.7	5.2	34.8	-39.4	65.4	1861.4	34461.1	-25.3
6487.25	H	55.0	5.7	35.5	-39.4	56.8	690.8	34461.1	-34.0
6487.25	V	52.6	5.7	35.5	-39.4	54.4	523.4	34461.1	-36.4
9267.50	H	52.5	6.6	36.2	-39.3	56.0	633.2	34461.1	-34.7
9267.50	V	53.3	6.6	36.2	-39.3	56.9	698.3	34461.1	-33.9

DATA PAGE

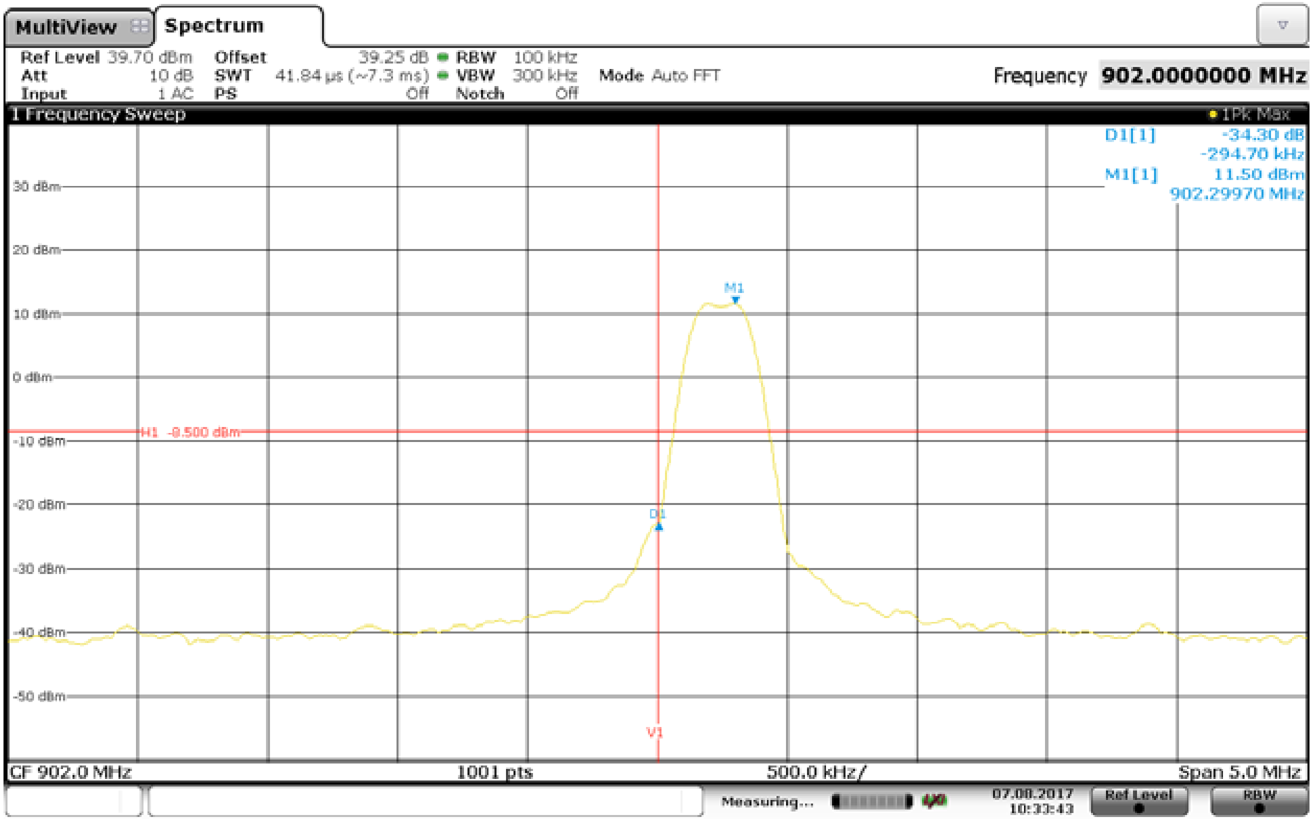
Manufacturer : Chamberlain Group, Inc.
Test Item : Liftmaster Jackshaft Garage Door Opener
Model No. : 8500W
Mode : Transmit at 926.75MHz
Test Specification : FCC-15.247, RSS-247 Radiated Spurious Emissions – Restricted Band

Freq. MHz	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2780.25	H	70.7	3.7	32.5	-39.7	67.2	2289.0	5000.0	-6.8
2780.25	V	75.2	3.7	32.5	-39.7	71.7	3851.6	5000.0	-2.3
3707.00	H	64.2	4.3	33.1	-39.2	62.3	1309.4	5000.0	-11.6
3707.00	V	68.3	4.3	33.1	-39.2	66.4	2096.9	5000.0	-7.5
4633.75	H	63.8	4.8	34.3	-39.3	63.6	1516.1	5000.0	-10.4
4633.75	V	67.6	4.8	34.3	-39.3	67.5	2361.7	5000.0	-6.5
7414.00	H	53.3	6.2	35.6	-39.4	55.8	613.2	5000.0	-18.2
7414.00	V	55.4	6.2	35.6	-39.4	57.8	778.2	5000.0	-16.2
8340.75	H	51.4	6.5	35.8	-39.4	54.2	515.4	5000.0	-19.7
8340.75	V	49.7	6.5	35.8	-39.4	52.6	425.7	5000.0	-21.4

DATA PAGE

Manufacturer : Chamberlain Group, Inc.
Test Item : Liftmaster Jackshaft Garage Door Opener
Model No. : 8500W
Mode : Transmit at 926.75MHz
Test Specification : FCC-15.247, RSS-247 Radiated Spurious Emissions – Restricted Band Averages

Freq. MHz	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2780.25	H	49.24	3.7	32.5	-39.7	-22.3	23.5	14.9	500.0	-30.5
2780.25	V	51.4	3.7	32.5	-39.7	-22.3	25.6	19.1	500.0	-28.4
3707.00	H	46.2	4.3	33.1	-39.2	-22.3	22.1	12.7	500.0	-31.9
3707.00	V	47.6	4.3	33.1	-39.2	-22.3	23.5	14.9	500.0	-30.5
4633.75	H	46.2	4.8	34.3	-39.3	-22.3	23.8	15.5	500.0	-30.2
4633.75	V	47.6	4.8	34.3	-39.3	-22.3	25.2	18.1	500.0	-28.8
7414.00	H	39.6	6.2	35.6	-39.4	-22.3	19.7	9.7	500.0	-34.3
7414.00	V	40.9	6.2	35.6	-39.4	-22.3	21.1	11.3	500.0	-32.9
8340.75	H	35.6	6.5	35.8	-39.4	-22.3	16.2	6.5	500.0	-37.8
8340.75	V	35.8	6.5	35.8	-39.4	-22.3	16.3	6.6	500.0	-37.6

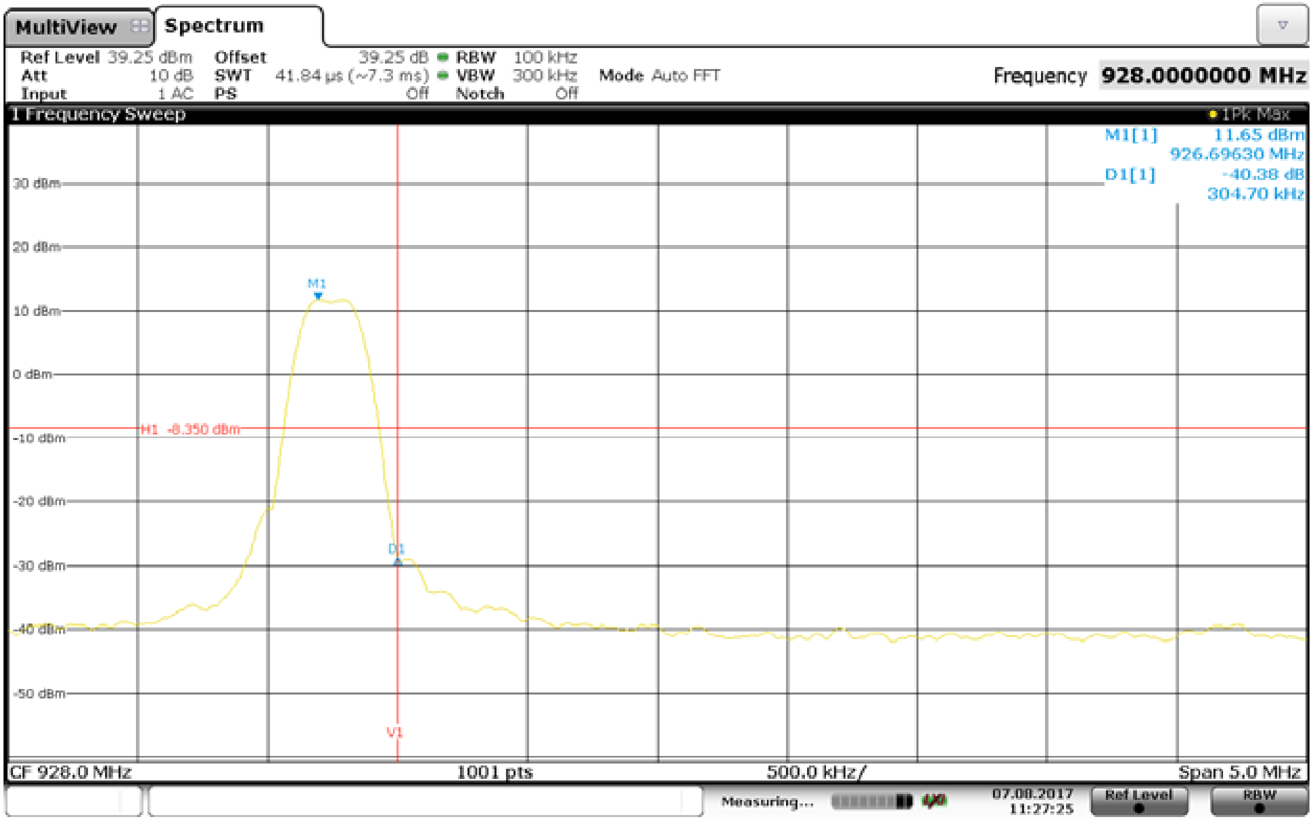


Date: 7.AUG.2017 10:33:42

BAND EDGE – CONDUCTED

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 902.25MHz

NOTES

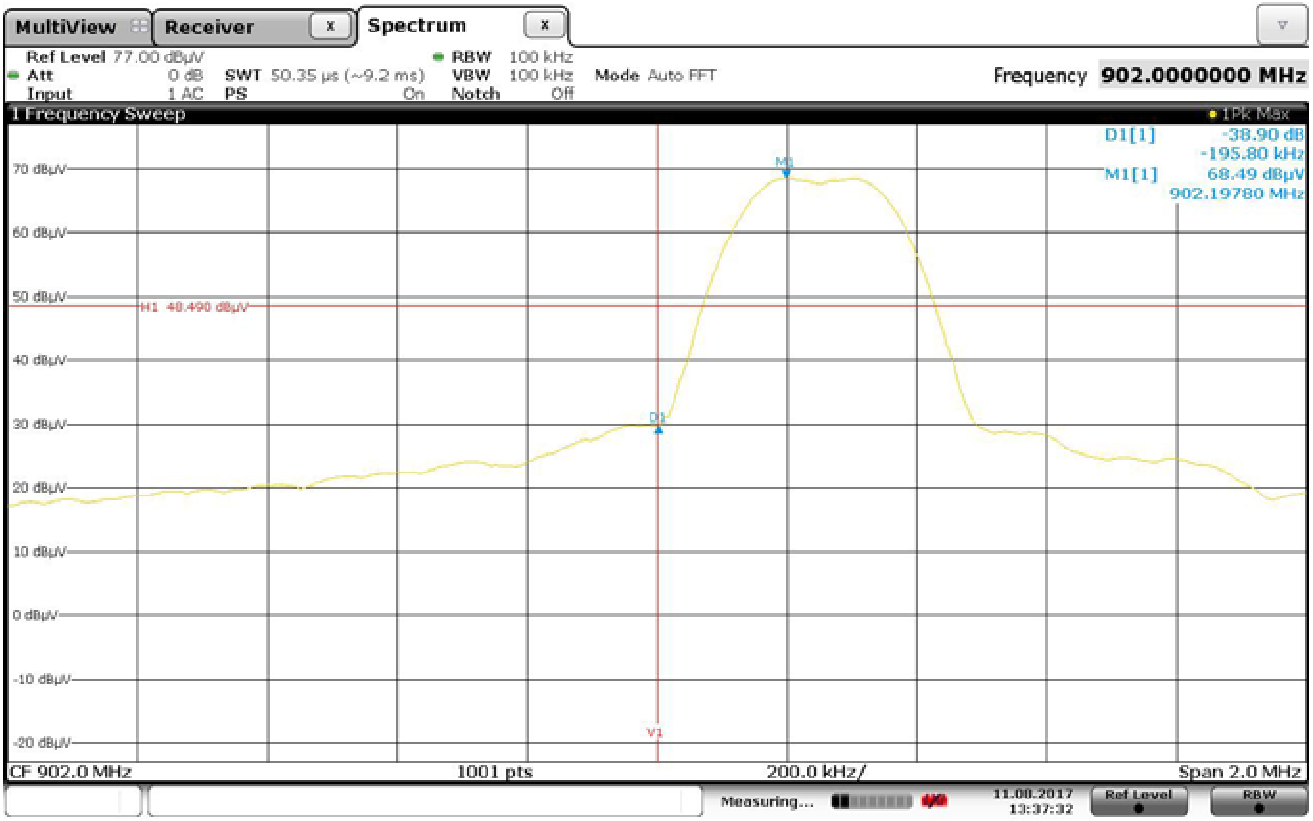


Date: 7.AUG.2017 11:27:25

BAND EDGE – CONDUCTED

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 925.75MHz

NOTES

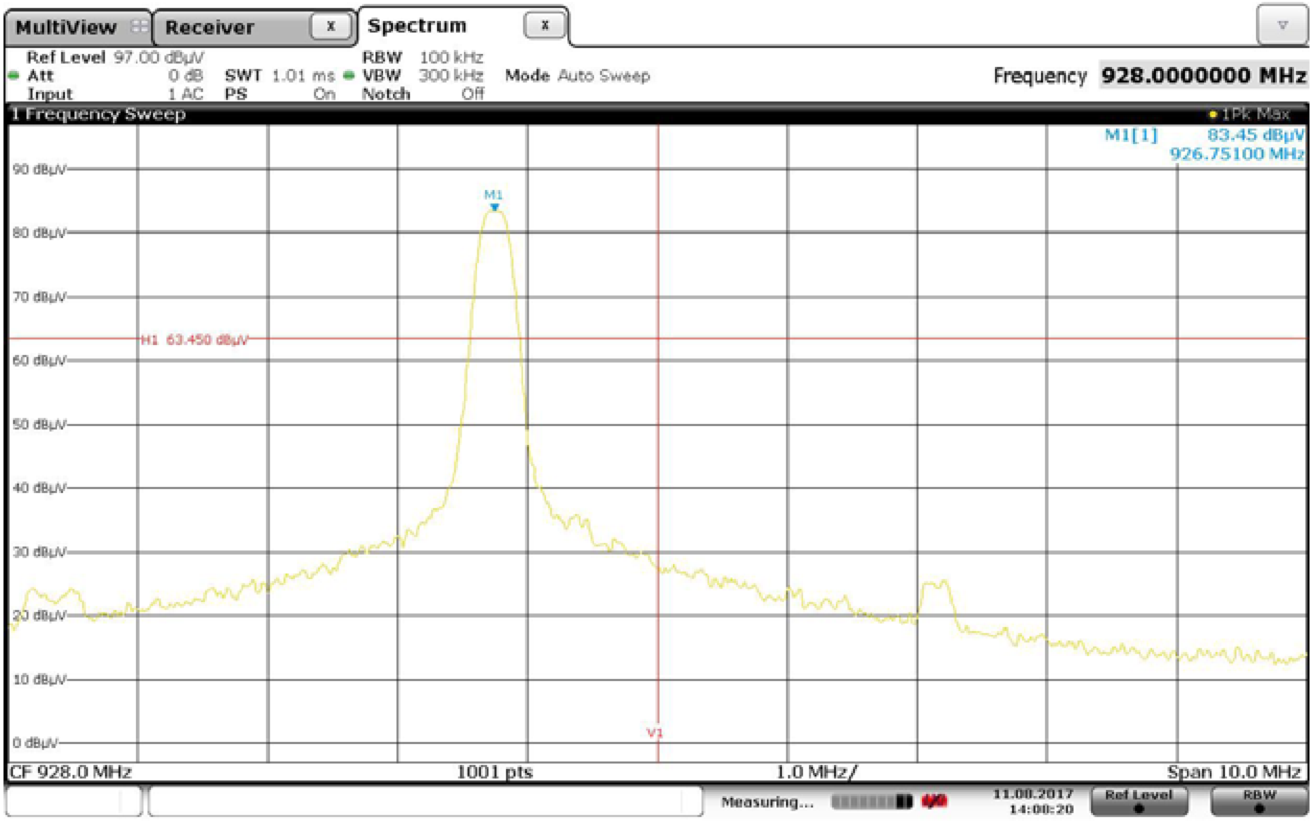


Date: 11.AUG.2017 13:37:32

BAND EDGE – RADIATED

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 902.25MHz

NOTES

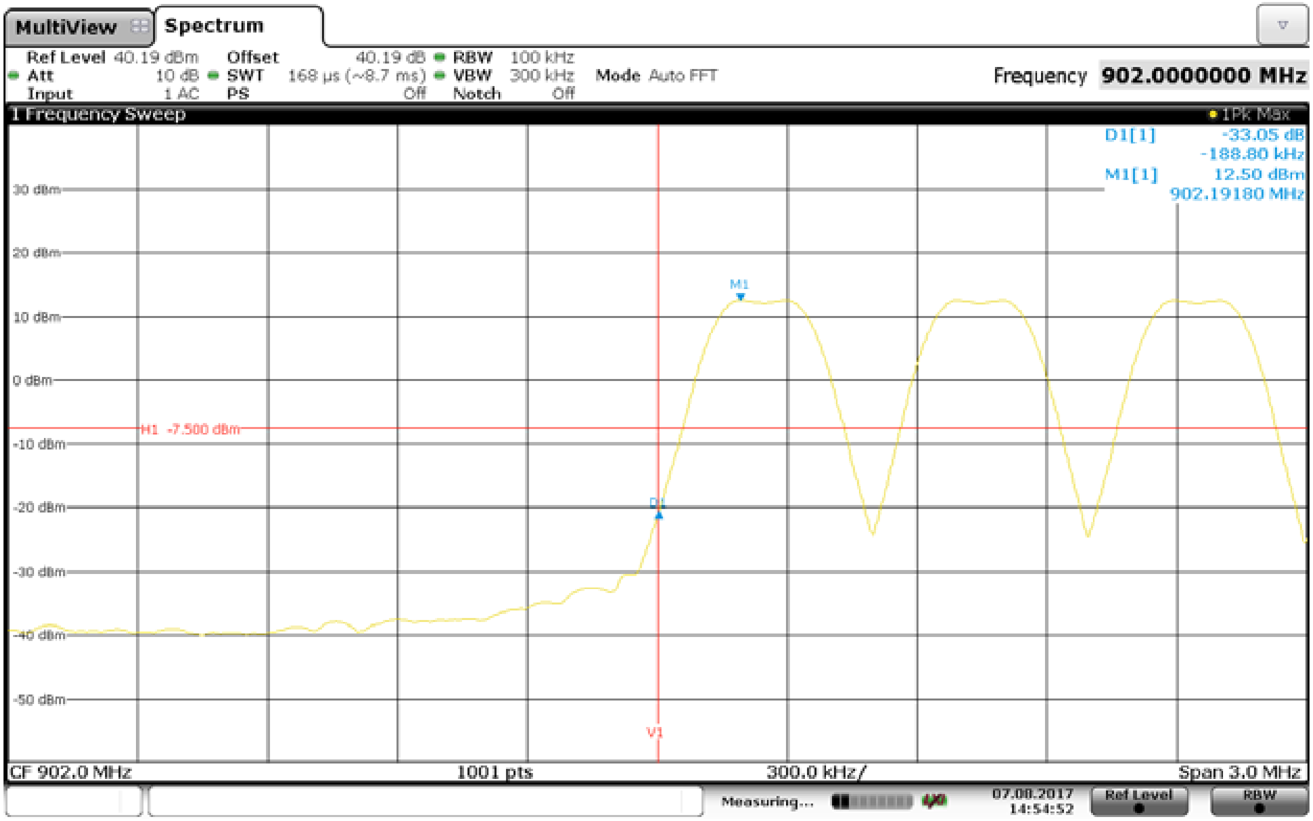


Date: 11.AUG.2017 14:08:20

BAND EDGE – RADIATED

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : Tx – 925.75MHz

NOTES

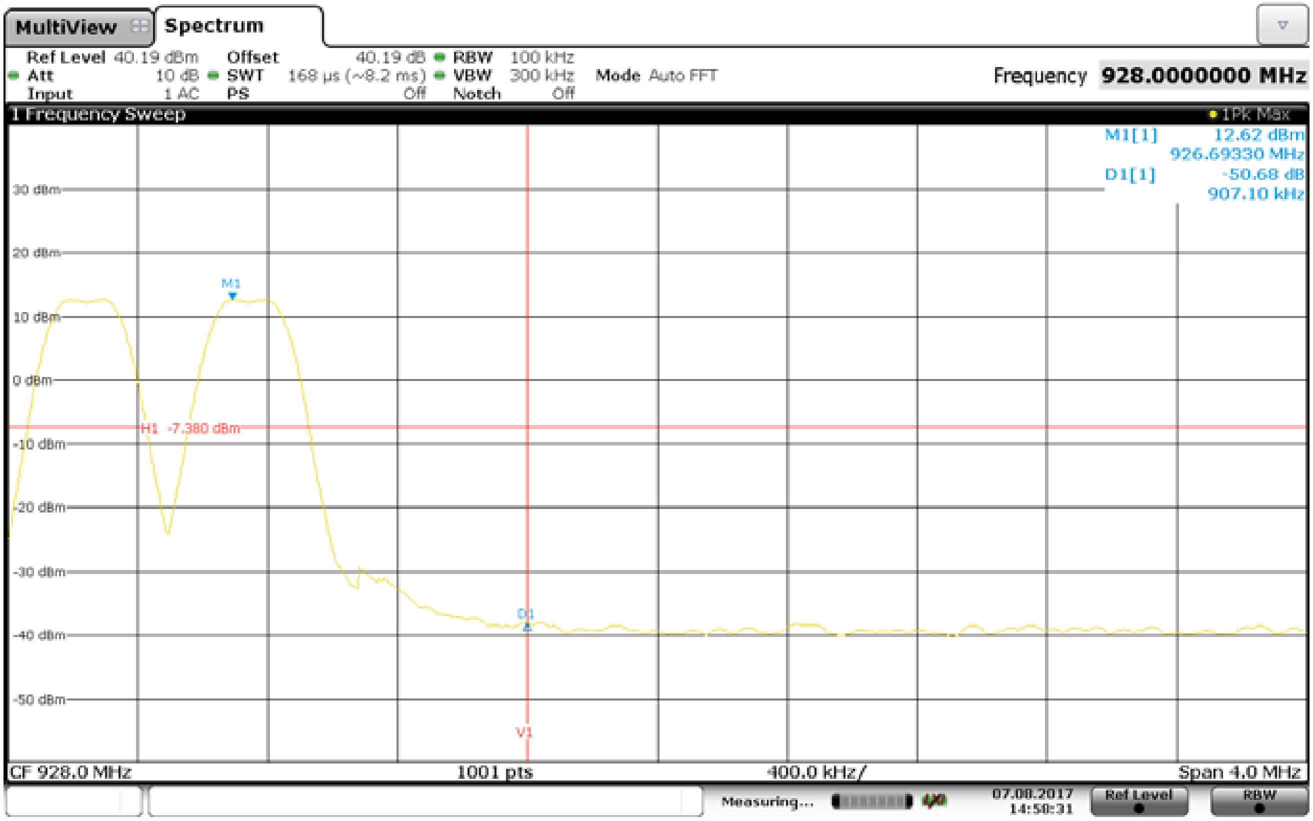


Date: 7.AUG.2017 14:54:52

BAND EDGE – FHSS (CONDUCTED)

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : FHSS

NOTES



Date: 7.AUG.2017 14:58:31

BAND EDGE – FHSS (CONDUCTED)

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : Liftmaster Jackshaft Garage Door Opener
MODEL NUMBER : 8500W
TEST MODE : FHSS

NOTES