Measurement of RF Interference from a Part No. LM18454441 Key Fob

For	Snap-On Tools Corporation 2801 80th Street Kenosha, WI 53143
P.O. Number	130-1YC004557
Date Received	12/17/2019
Date Tested	1/21/2019
Test Personnel	Javier Cardenas
Specification	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.231 for Digital Modulation Intentional Radiators Operating Periodically Within the Band 40.66-40.70 MHz and Above 70 MHz FCC “Code of Federal Regulations” Title 47, Part15, Subpart 15B, Section 15.107 and 15.109 for Receivers Industry Canada RSS-210 Industry Canada RSS-GEN

Test Report By:

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REVISION HISTORY

Revision	Date	Description
—	11 Feb 2019	Initial release

Measurement of RF Emissions from a Key Fob, Part No. LM18454441

1. INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Snap-On Tools Corporation Key Fob, Part No. LM18454441 (hereinafter referred to as the EUT). The EUT contains a digital modulation transceiver. The transceiver was designed to periodically transmit and receive in 40.66-40.70 MHz and above 70 MHz band using an internal antenna. The receiver is a super heterodyne receiver with an intermediate frequency of 381kHz. The EUT was manufactured and submitted for testing by Snap-On Tools Corporation located in Kenosha, WI.

1.2 Purpose

The test series was performed to determine if the EUT meets the conducted RF emission requirements, radiated RF emissions requirements, and additional provisions of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109, for receivers and Subpart C, Sections 15.207 and 15.231 for Intentional Radiators Operating within the 40.66-40.70 MHz and above 70 MHz band.

The test series was also performed to determine if the EUT meets the conducted RF emission requirements of the Innovation, Science, and Economic Development Canada Radio Standards Specification, RSS-Gen, Section 8.8 and the radiated RF emission requirements of the Innovation, Science, and Economic Development Canada Radio Standards Specification, RSS-210, Annex 1 for transmitters. Testing was performed in accordance with ANSI C63.10-2013.

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 Lab Code: 1786-01.

1.5 Laboratory Conditions

The temperature at the time of the test was 20°C and the relative humidity was 18%.

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, Subparts B and 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”

- ANSI C63.10-2013, "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices”

- Innovation, Science, and Economic Development Canada Radio Standards Specification, RSS-Gen, “General Requirements for Compliance of Radio Apparatus”, Issue 5, April 2018

- Innovation, Science, and Economic Development Canada Radio Standards Specification, RSS-210, "License-exempt Radio Apparatus: Category I Equipment", Issue 9, August 2016

3. EUT SET-UP AND OPERATION

3.1 General Description

The EUT is a Key Fob, Part No. LM18454441. A block diagram of the EUT setup is shown as Figure 1.

3.1.1 Power Input

The EUT obtained 3VDC from a coin cell battery.

3.1.2 Grounding

The EUT was ungrounded during the tests.

3.2 Operational Mode

The EUT was energized. The unit was programmed to transmit and receive at 433.92MHz.

3.3 EUT Modifications

No modifications were required for compliance.

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 tests were performed with an EMI receiver utilizes the bandwidths and detectors specified in the requirements.

4.3 Calibration Traceability

Test equipment is maintained and calibrated on a regular basis with a calibration interval not greater than two years. All calibrations are traceable to the International System Units (SI).

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	4.3

site) (30 MHz – 1000 MHz)	
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 Receiver

5.1.1 Powerline Conducted Emissions

Since the EUT was powered by internal batteries and has no connections to AC power, no conducted emissions tests are required.

5.1.2 Radiated Measurements

5.1.2.1 Requirements

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Section 15.109(a), all radio frequency emissions from a receiver shall be below the limits shown on the following table:

RADIATION LIMITS FOR A RECEIVER

Frequency MHz	Distance between EUT And Antenna in Meters	Field Strength uV/m	Field Strength dBuV/m
30-88	3	100	40
88-216	3	150	43.5
216-960	3	200	46
Above 960	3	500	54

Note: The tighter limit shall apply at the edge between the two frequency bands.

5.1.2.2 Procedures

Testing was performed separately on a low, middle, and high channel. The emissions in the frequency range of 30MHz to 2.5GHz were measured and plotted using a ‘screen-dump’ utility.
Testing was performed with the antenna of the EUT in place.

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.

Since a quasi-peak detector and an average detector require long integration times, it is not practical to automatically sweep through the quasi-peak and average levels. Therefore, radiated emissions from the EUT were first scanned using a peak detector and automatically plotted. The frequencies where significant emission levels were noted were then remeasured using the quasi-peak detector or average detector.

The broadband measuring antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on an 80cm high non-conductive stand. The frequency range from 30MHz to 1GHz was investigated using a peak detector function with the bilog antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The frequency range from 1GHz to 2.5GHz was investigated using a peak detector function with the double ridged waveguide antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The maximum levels for each antenna polarization were plotted.

Final radiated emissions were performed on all significant broadband and narrowband emissions found in the preliminary sweeps using the following methods:

1) Measurements from 30MHz to 1GHz were made using a quasi-peak detector and a broadband bilog antenna. Measurements above 1GHz were made using an average detector and a broadband double ridged waveguide antenna.

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

    a) The EUT was rotated so that all of its sides were exposed to the receiving antenna.

    b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

    c) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

    d) 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.

5.1.2.3 Results

The preliminary plots and final radiated levels are presented on pages 17 and 22. The plots are presented for a reference only, and are not used to determine compliance. As can be seen from the data, all emissions measured from the EUT were within the specification limits. Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown in Figure 3 and Figure 4.

5.2 Transmitter

5.2.1 Powerline Conducted Emissions

5.2.1.1 Requirements

Since the EUT was powered by internal batteries and has no connections to AC power, no conducted emissions tests are required.

5.2.2 Periodic Operation Measurements

5.2.2.1 Requirements

Per 15.231(a)(1) and RSS-210 Annex A1.1, a manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than five(5) seconds of being released. Also, a transmitter activated automatically shall cease transmission within 5 seconds after activation.

5.2.2.2 Procedures

The spectrum analyzer was set up to display the time domain trace. The EUT was set to transmit normally. The Spectrum analyzer was used to record the amount of time that the EUT remained active following activation.

5.2.2.3 Results

The plot of the periodic timing is shown on data page 23. The data shows that the EUT ceased operation within the allotted time.

5.2.3 20dB Bandwidth

5.2.3.1 Requirements

In accordance with paragraph 15.231(c) and RSS-Gen Annex A1.3, 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.

5.2.3.2 Procedures

The EUT was placed next to a near-field probe. The unit was programmed to transmit separately in each of the modes listed in section 3.3 of this document. The resolution bandwidth was set to 30 kHz and span was set to 300kHz. The frequency spectrum near the fundamental was plotted.

5.2.3.3 Results

The plot of the emissions near the fundamental frequency is presented on data page 24. As can be seen from these data pages, each transmitter met the occupied bandwidth requirements. The 99% bandwidth measurement was 379.62MHz.

5.2.4 Duty Cycle Factor Measurements

5.2.4.1 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.

With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer. This trace is obtained by tuning center frequency to the transmitter frequency and then setting a zero span width with 1msec/div (adjust this for what you need). The amplitude settings are adjusted so that the on/off transitions clear the 4th division from the bottom of the display. The markers are set at the beginning and end of the “on-time”. The trace is recorded.

Next the spectrum analyzer center frequency is set to the transmitter frequency with a zero span width and 10msec/div. This shows if the word is longer than 100msec or shorter than 100msec. If the word period is less than 100msec, the display is set to show at least one word. The on-time and off-time are then measured. The on-time is total time signal level exceeds the 4th division. Off-time is time under for the word period. The duty cycle is then computed as the (On-time/ word period) where the word period = (On-time + Off-time).

5.2.4.2 Results

The plots of the duty cycle are shown on data pages 26 and 28.

The EUT transmits a 5.6msec pulse followed by a second pulse at more than 500ms later. Since a word is greater than 100 msec long, the duty cycle factor was computed over a 100msec interval. Duty Cycle Calculation = 20 Log((21x0.75ms + 25x1.6ms)/100ms) = -5.1dB

5.2.5 Radiated Spurious Emissions Measurements

5.2.5.1 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. and RSS-Gen Annex A, Table A1.

Paragraph 15.231(b) and RSS-Gen Annex A, Table A1 has the following radiated emission limits:

Fundamental Frequency MHz	Field Intensity uV/m @ 3 meters	Field Strength Harmonics and Spurious @ 3 meters
260 to 470	3,750 to 12,500*	375 to 1,250*

For 433.92MHz, the limit at the fundamental is 10996.7uV/m @ 3m and the limit on the harmonics is 1099.7uV/m @ 3m.

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.

5.2.5.2 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 the 10th harmonic of the transmitter 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 the 10th harmonic. Between 30MHz and 1000MHz, a bilog 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.

5.2.5.3 Results

Preliminary radiated emissions plots with the EUT transmitting at 433.92MHz are shown on pages 29 through 32. Final radiated emissions data are presented on data page 33. As can be seen from the data, all emissions measured from the EUT were within the specification limits. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown in Figures 3 through 4.

6. CONCLUSIONS

It was determined that Snap-On Tools Corporation Key Fob transmitters, Model No. LM18454441 did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.205 et seq. for Intentional Radiators, when tested per ANSI C63.10-2013.

It was also determined that Snap-On Tools Corporation Key Fob, Model No. LM18454441 transmitter, did fully

meet the conducted RF emission requirements of the Innovation, Science, and Economic Development Canada Radio Standards Specification, RSS-Gen, Section 8.8 and the radiated RF emission requirements of the Innovation, Science, and Economic Development Canada Radio Standards Specification, RSS-210, Annex 1 for transmitters, when tested per ANSI C63.10-2013.

7. 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.

8. ENDORSEMENT DISCLAIMER

This report must not be used to claim product certification, approval, or endorsement by A2LA, 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	4/5/2018	4/5/2019
CDX8	COMPUTER	ELITE	WORKSTATION			N/A	
GRB0	1MHZ, LISN SIGNAL CHECKER	ELITE	LISNCHKR1M	1	1MHZ	1/9/2019	1/9/2021
MEA3	MICRO-OHM METER	KEITHLEY	580	772667	10UOHM-200KOHM	6/13/2018	6/13/2019
NTA4	BILOG ANTENNA	TESEQ	6112D	46660	20-2000GHZ	9/5/2018	9/5/2019
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	5/31/2018	5/31/2020
PLF3	CISPR16 50UH LISN	ELITE	CISPER16/70A	003	.15-30MHz	5/7/2018	5/7/2019
PLF5	CISPR16 50UH LISN	ELITE	CISPR16/15A	006	.15-30MHz	5/7/2018	5/7/2019
RBG3	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101592	2HZ-44GHZ	2/20/2018	2/20/2019
XLQ7	5W, 50 OHM TERMINATION	JFW INDUSTRIES	50T-052	---	DC-2GHZ	6/28/2018	6/28/2020

Note: N/A – Not Applicable

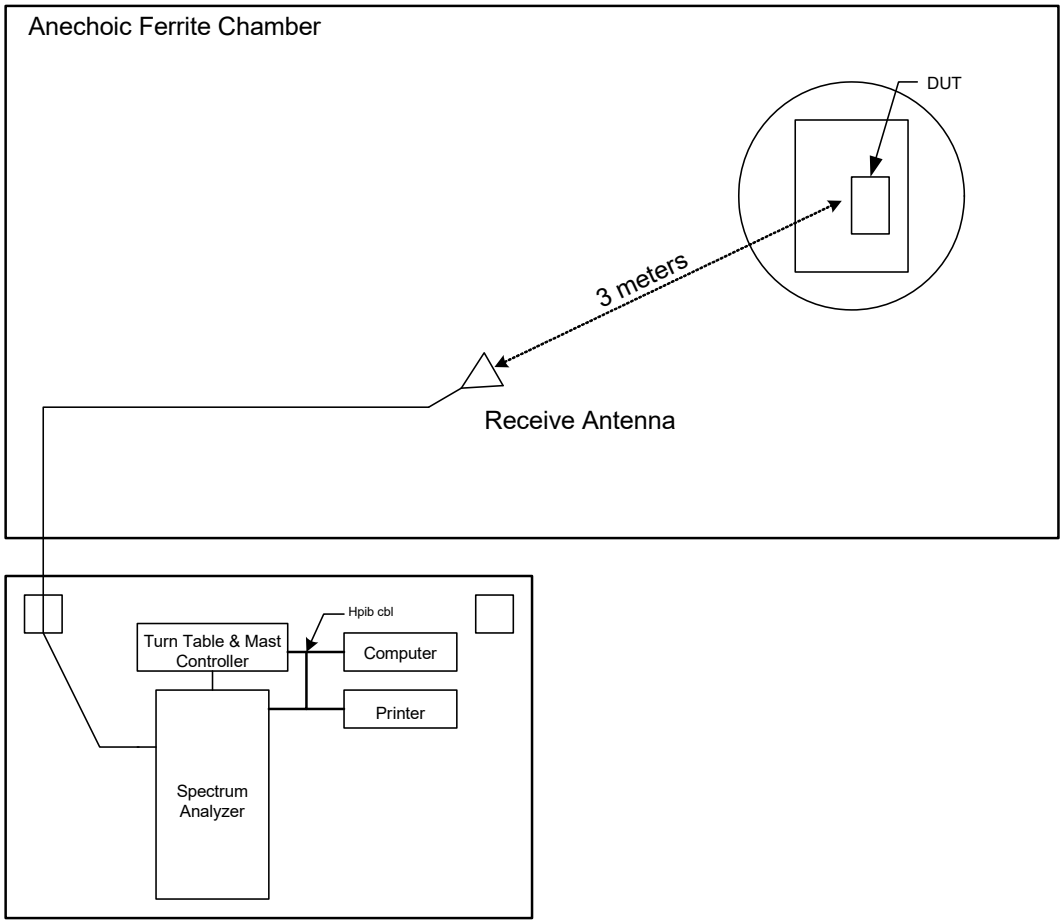
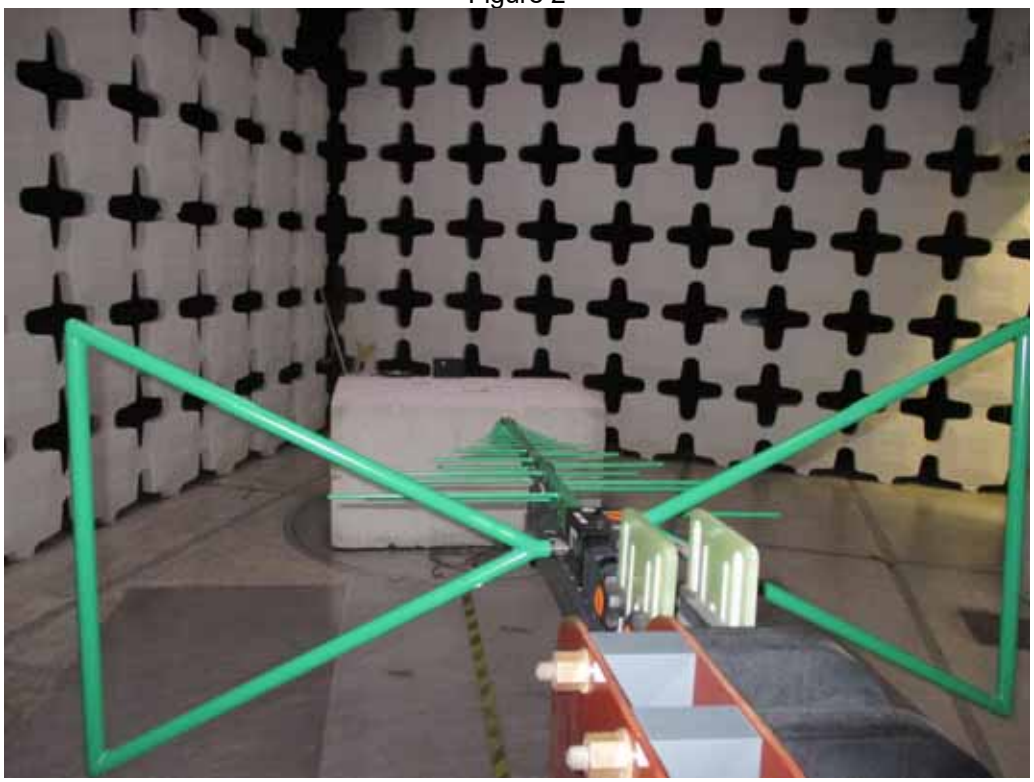
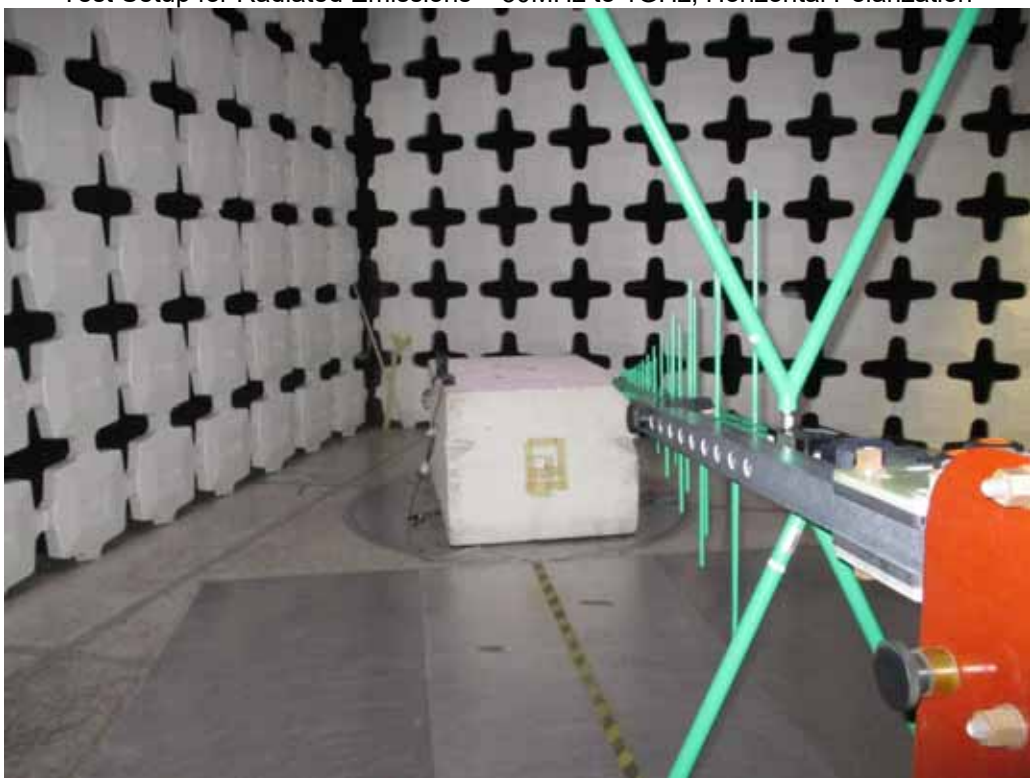


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 2

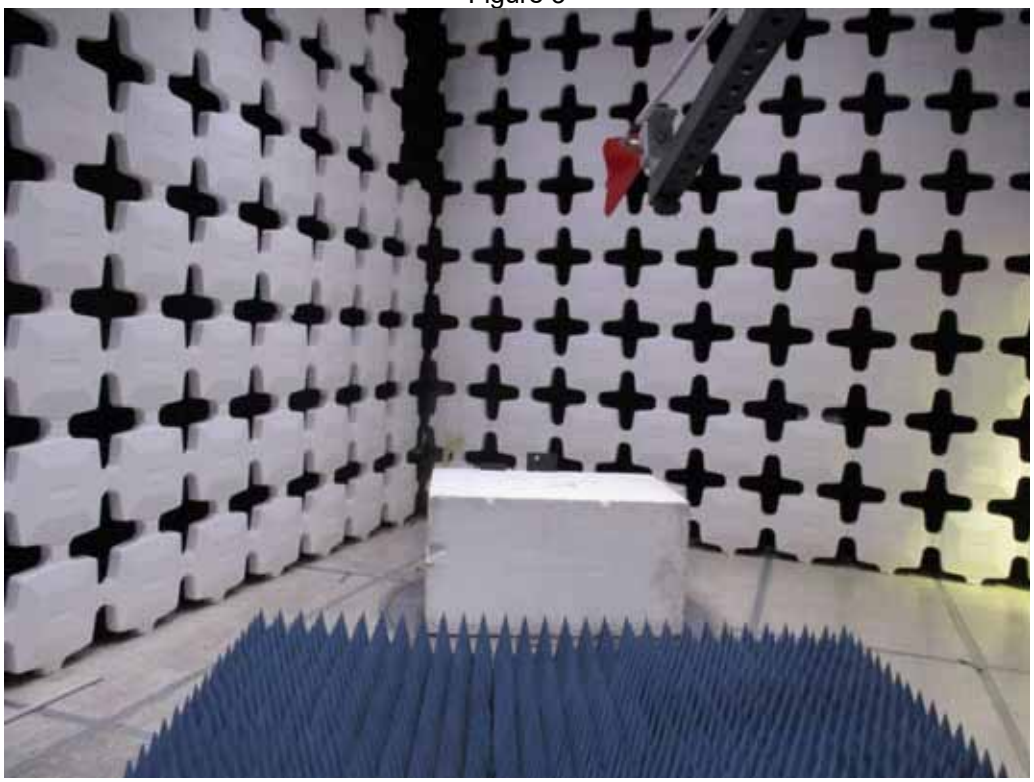


Test Setup for Radiated Emissions – 30MHz to 1GHz, Horizontal Polarization



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

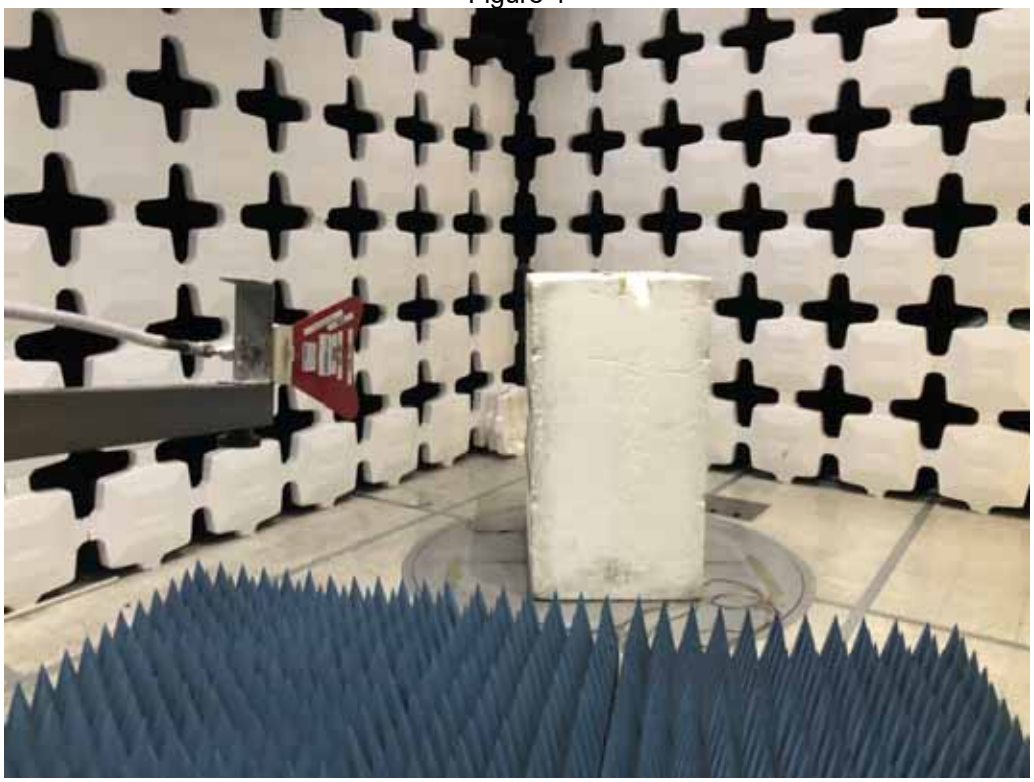
Figure 3



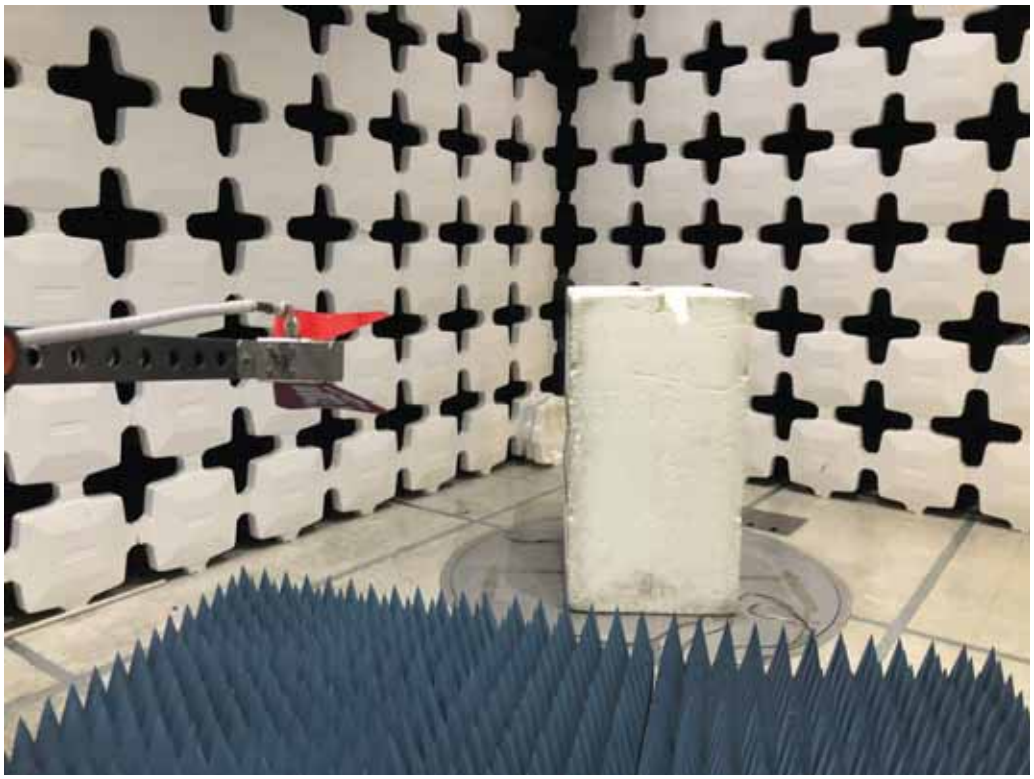
Test Setup for Radiated Emissions – 1GHz to 2.5GHz, Horizontal Polarization

Test Setup for Radiated Emissions – 1GHz to 2.5GHz, Vertical Polarization

Figure 4



Test Setup for Radiated Emissions – 1GHz to 5GHz, Horizontal Polarization –Tx @ 433.92MHz



Test Setup for Radiated Emissions – 1GHz to 5GHz, Vertical Polarization –Tx @ 433.92MHz

FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

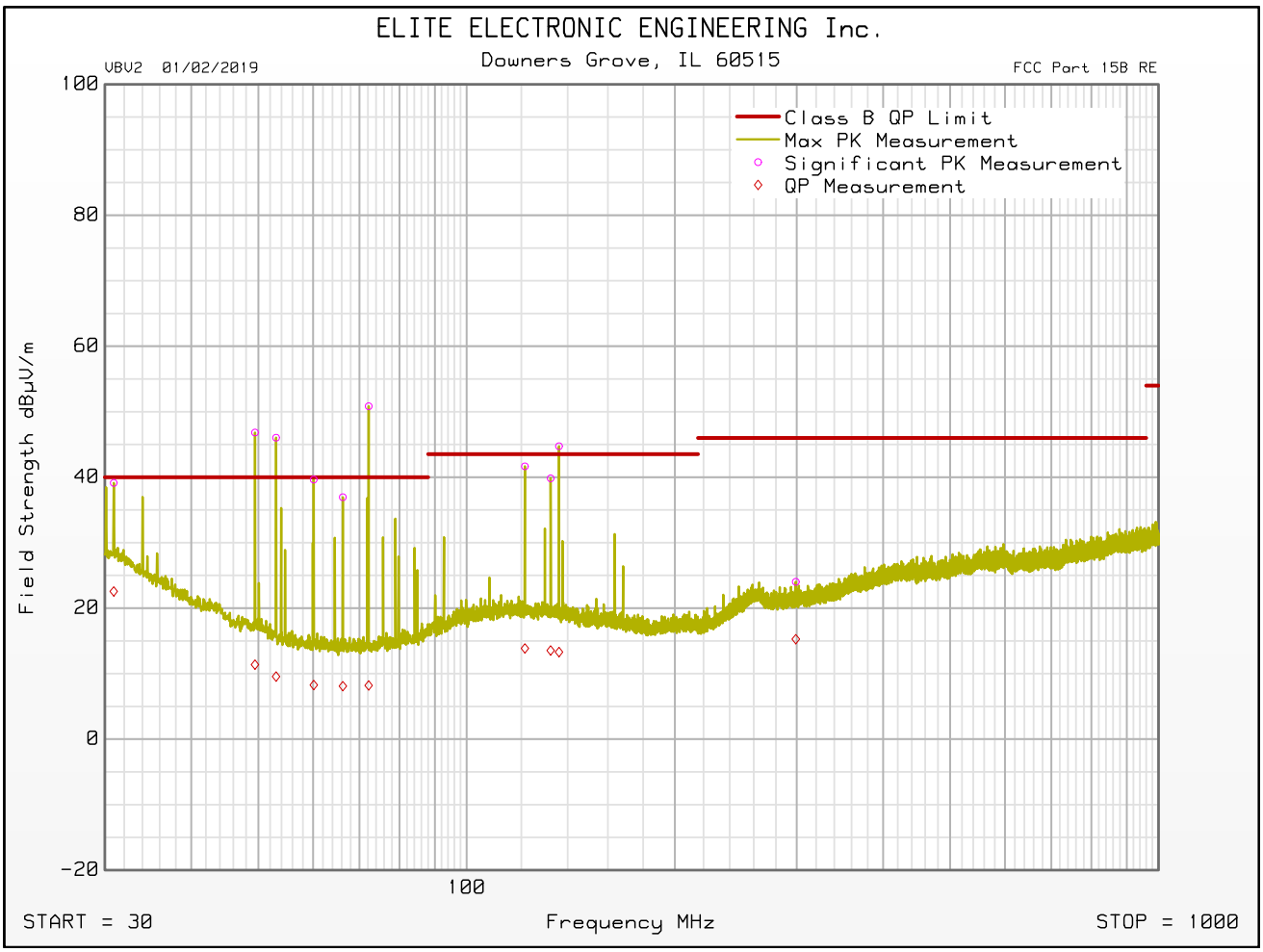
Manufacturer : Snap-On Tools Corporation
Model : LM18454441
Serial Number : N/A
DUT Mode : Tx OFF
Turntable Step Angle (°): 45
Mast Positions (cm) : 120, 200, 340
Scan Type : Stepped Scan
Test RBW : 120 kHz
Prelim Dwell Time (s) : 0.0009
Notes : 2.0dBm
Test Engineer : J. Cardenas
Test Date : Jan 21, 2019 02:54:46 PM

Freq MHz	Peak Mtr Rdg dBuV	QP Mtr Rdg dBuV	Ant Fac dB	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	QP Total dBµV/m	QP Limit dBµV/m	QP Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °
30.900	14.5	-2.1	24.2	0.0	0.4	0.0	39.1	22.6	40.0	-17.4	V	200	0
49.440	32.0	-3.5	14.5	0.0	0.4	0.0	46.8	11.4	40.0	-28.6	V	200	270
53.040	32.3	-4.2	13.4	0.0	0.4	0.0	46.0	9.6	40.0	-30.4	V	200	270
60.120	26.9	-4.5	12.4	0.0	0.4	0.0	39.6	8.3	40.0	-31.7	V	200	180
66.240	24.2	-4.7	12.4	0.0	0.4	0.0	36.9	8.1	40.0	-31.9	V	200	90
72.180	37.9	-4.7	12.5	0.0	0.4	0.0	50.8	8.2	40.0	-31.8	V	200	270
121.420	23.1	-4.7	18.1	0.0	0.5	0.0	41.7	13.9	43.5	-29.7	V	200	270
132.280	21.5	-4.8	17.8	0.0	0.5	0.0	39.8	13.5	43.5	-30.0	V	200	0
136.000	26.6	-4.8	17.6	0.0	0.5	0.0	44.7	13.3	43.5	-30.2	V	200	135
299.100	4.1	-4.6	19.2	0.0	0.8	0.0	24.0	15.3	46.0	-30.7	V	340	315
547.020	3.3	-5.2	24.9	0.0	1.1	0.0	29.3	20.8	46.0	-25.2	H	120	180
938.880	4.3	-4.2	26.8	0.0	1.5	0.0	32.6	24.1	46.0	-21.9	H	120	135

FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

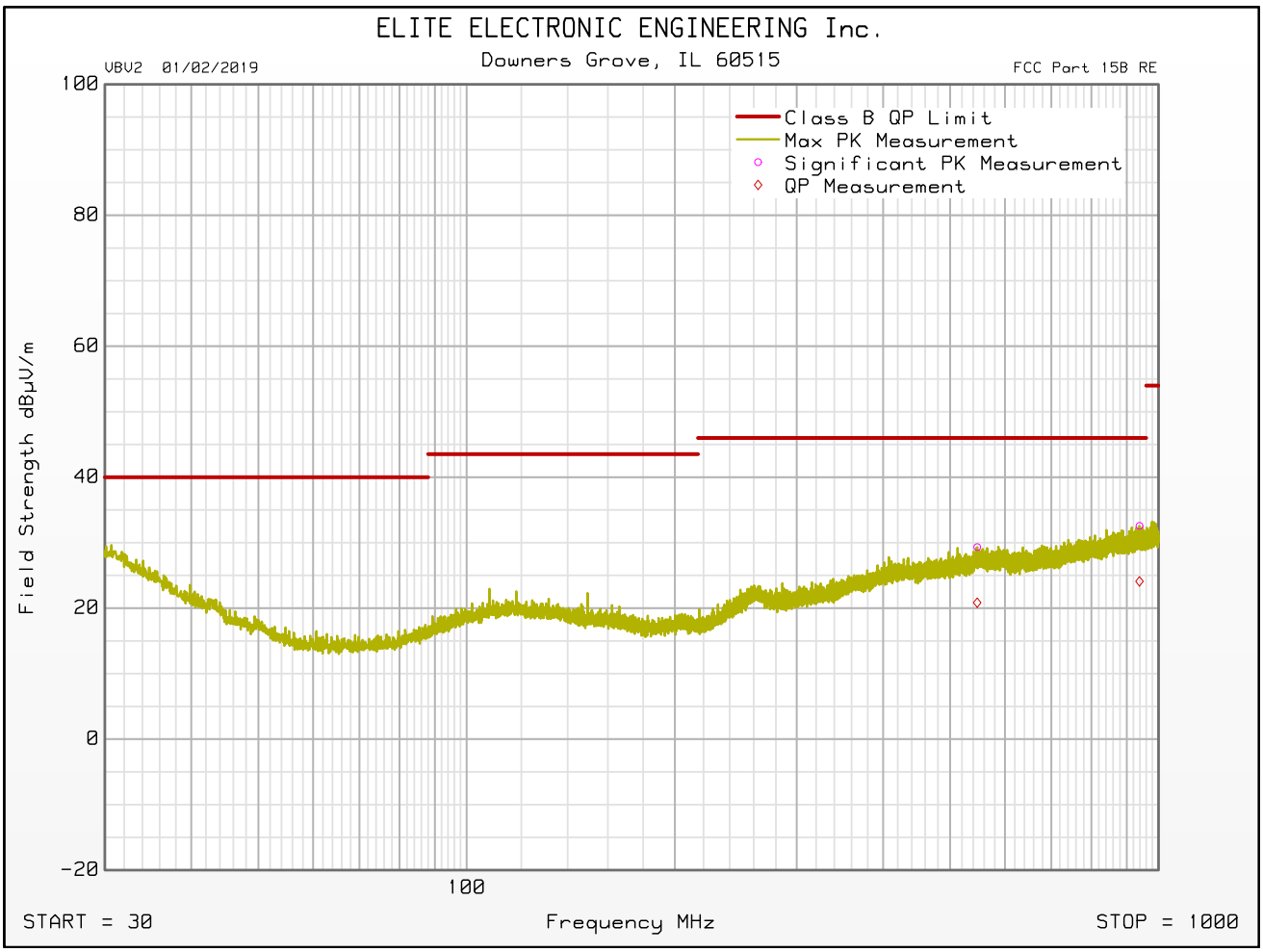
Manufacturer	:	Snap-On Tools Corporation
Model	:	LM18454441
Serial Number	:	N/A
DUT Mode	:	Tx OFF
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Ant. Polarization(s)	:	V
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0009
Notes	:	2.0dBm
Test Engineer	:	J. Cardenas
Test Date	:	Jan 21, 2019 02:54:46 PM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

Manufacturer	:	Snap-On Tools Corporation
Model	:	LM18454441
Serial Number	:	N/A
DUT Mode	:	Tx OFF
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Ant. Polarization(s)	:	H
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0009
Notes	:	2.0dBm
Test Engineer	:	J. Cardenas
Test Date	:	Jan 21, 2019 02:54:46 PM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

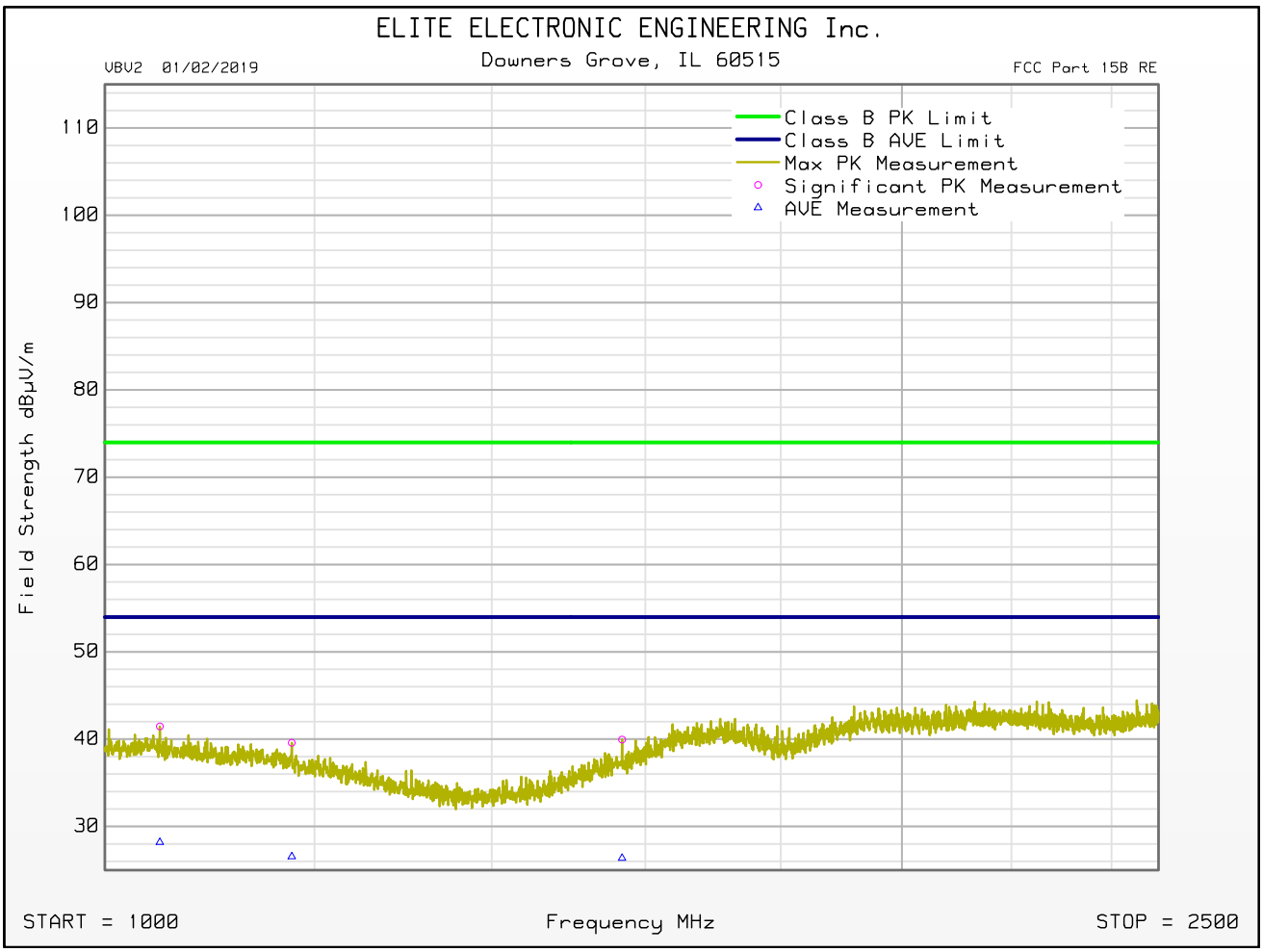
Manufacturer	:	Snap-On Tools Corporation
Model	:	LM18454441
Serial Number	:	N/A
DUT Mode	:	Tx OFF
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	2.0dBm
Test Engineer	:	J. Cardenas
Test Date	:	Jan 22, 2019 12:17:39 PM

Freq MHz	Peak Mtr Rdg dBuV	Average Mtr Rdg dBuV	Ant Fac dB	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	Peak Limit dBµV/m	Peak Lim Mrg dB	Average Total dBµV/m	Average Limit dBµV/m	Average Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °
1049.000	51.8	38.6	29.1	-41.0	1.6	0.0	41.5	74.0	-32.5	28.2	54.0	-25.8	V	200	135
1176.500	48.9	35.8	29.8	-40.8	1.7	0.0	39.6	74.0	-34.4	26.5	54.0	-27.4	V	200	45
1568.000	49.0	35.4	29.2	-40.2	2.0	0.0	39.9	74.0	-34.0	26.4	54.0	-27.6	V	200	180
1658.000	51.5	38.0	29.6	-40.2	2.1	0.0	43.1	74.0	-30.9	29.5	54.0	-24.5	H	340	180
2001.000	49.6	36.7	32.4	-39.9	2.3	0.0	44.4	74.0	-29.6	31.5	54.0	-22.4	H	200	45
2177.500	48.7	35.4	33.5	-39.9	2.4	0.0	44.7	74.0	-29.3	31.5	54.0	-22.5	H	120	45

FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

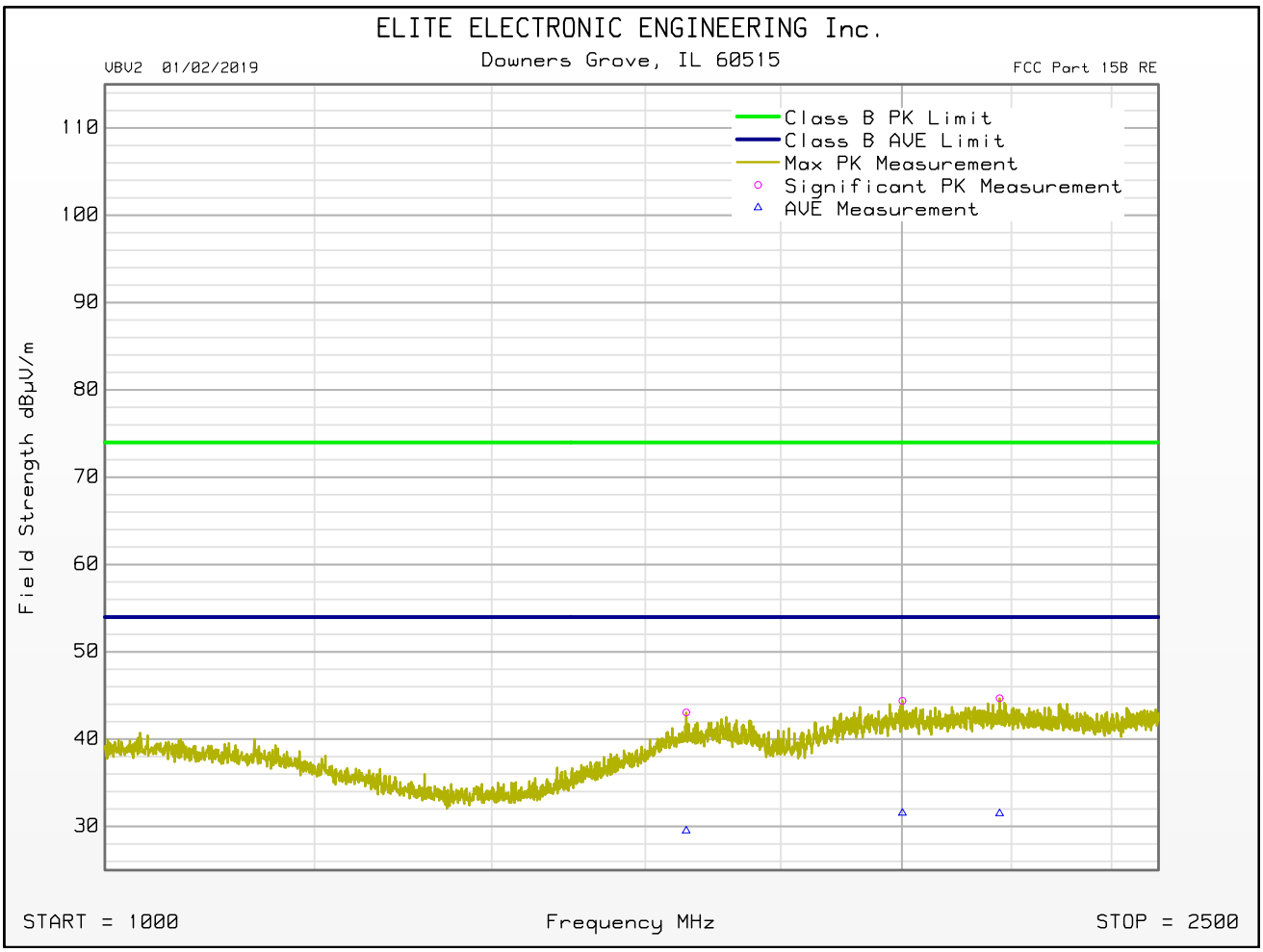
Manufacturer	:	Snap-On Tools Corporation
Model	:	LM18454441
Serial Number	:	N/A
DUT Mode	:	Tx OFF
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Ant. Polarization(s)	:	V
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	2.0dBm
Test Engineer	:	J. Cardenas
Test Date	:	Jan 22, 2019 12:17:39 PM

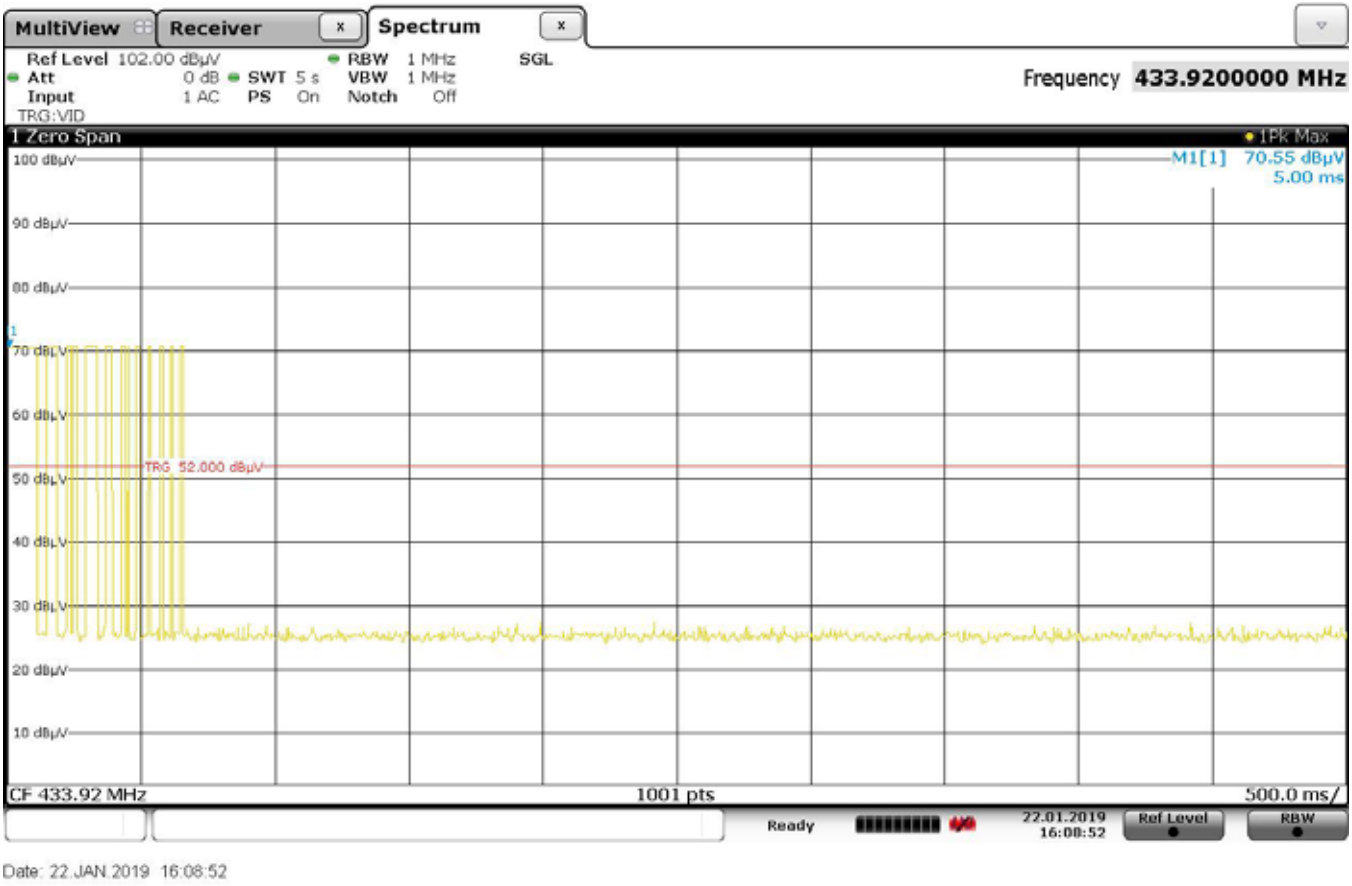


FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

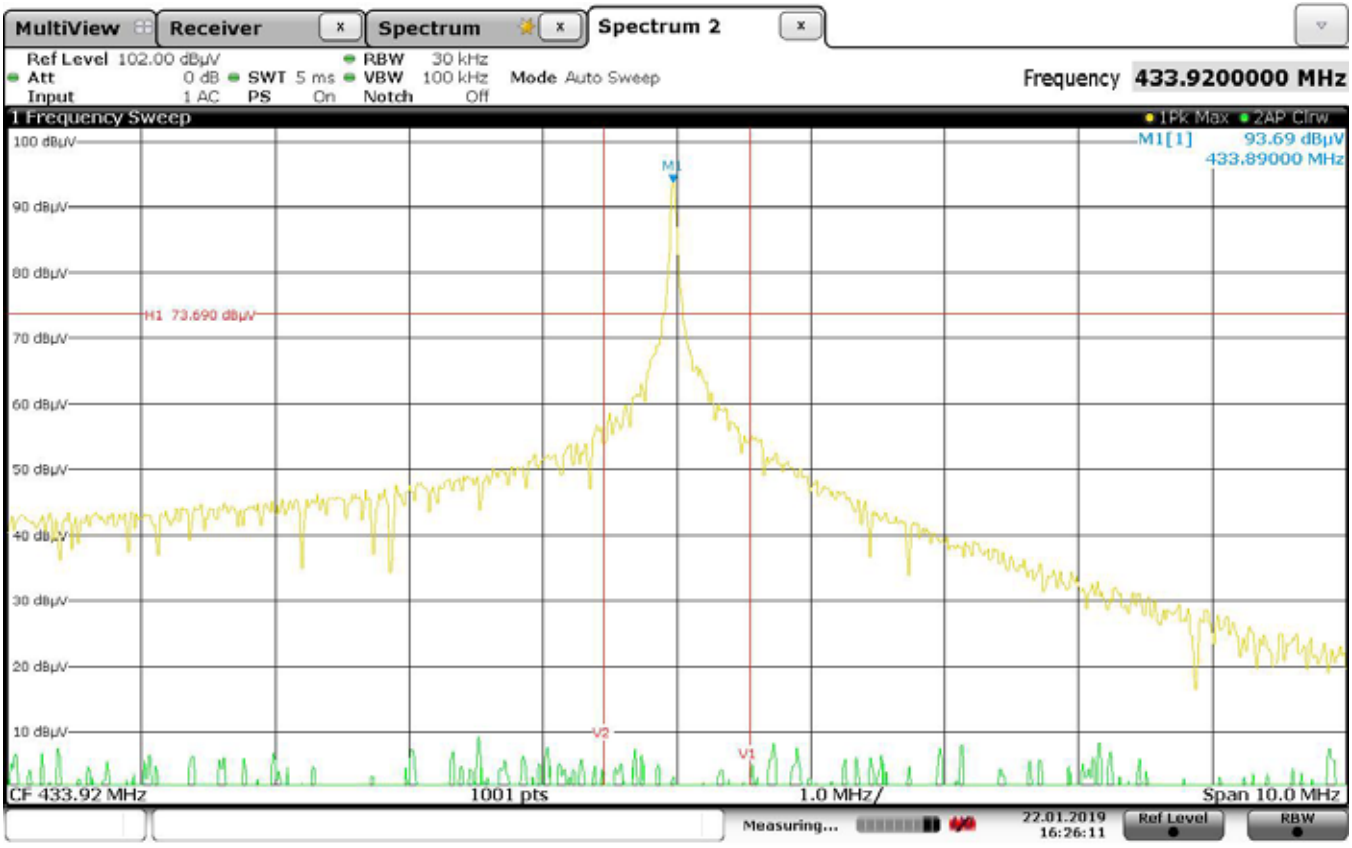
Manufacturer	:	Snap-On Tools Corporation
Model	:	LM18454441
Serial Number	:	N/A
DUT Mode	:	Tx OFF
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Ant. Polarization(s)	:	H
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	2.0dBm
Test Engineer	:	J. Cardenas
Test Date	:	Jan 22, 2019 12:17:39 PM





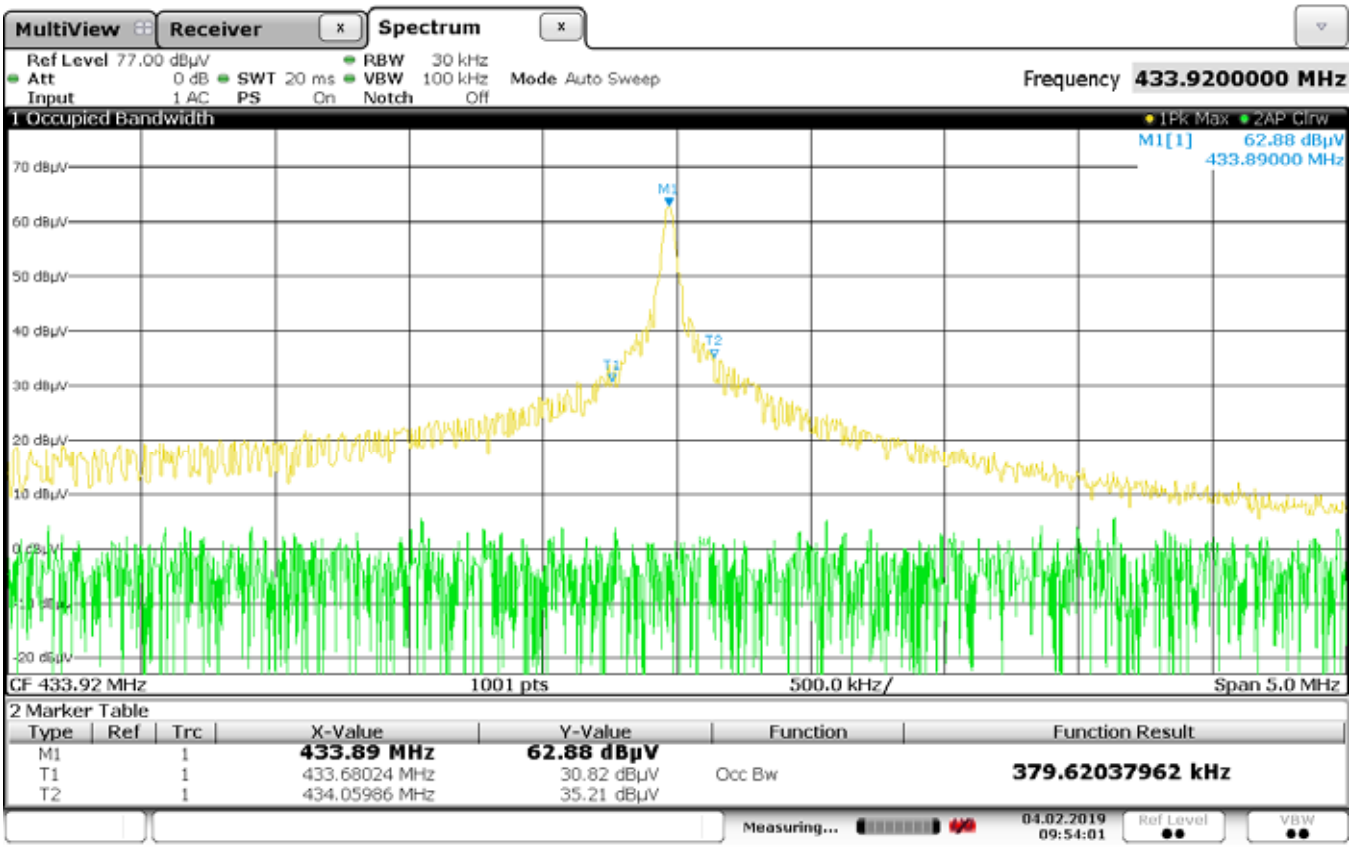
Date: 22.JAN.2019 16:08:52

Manufacturer : Snap-On Tools Corporation
Model Number : LM18454441
Serial Number : N/A
Test : **Periodic Operation Measurement**
Mode : Tx 433.92MHz
Date : Jan 22,2019
Notes :



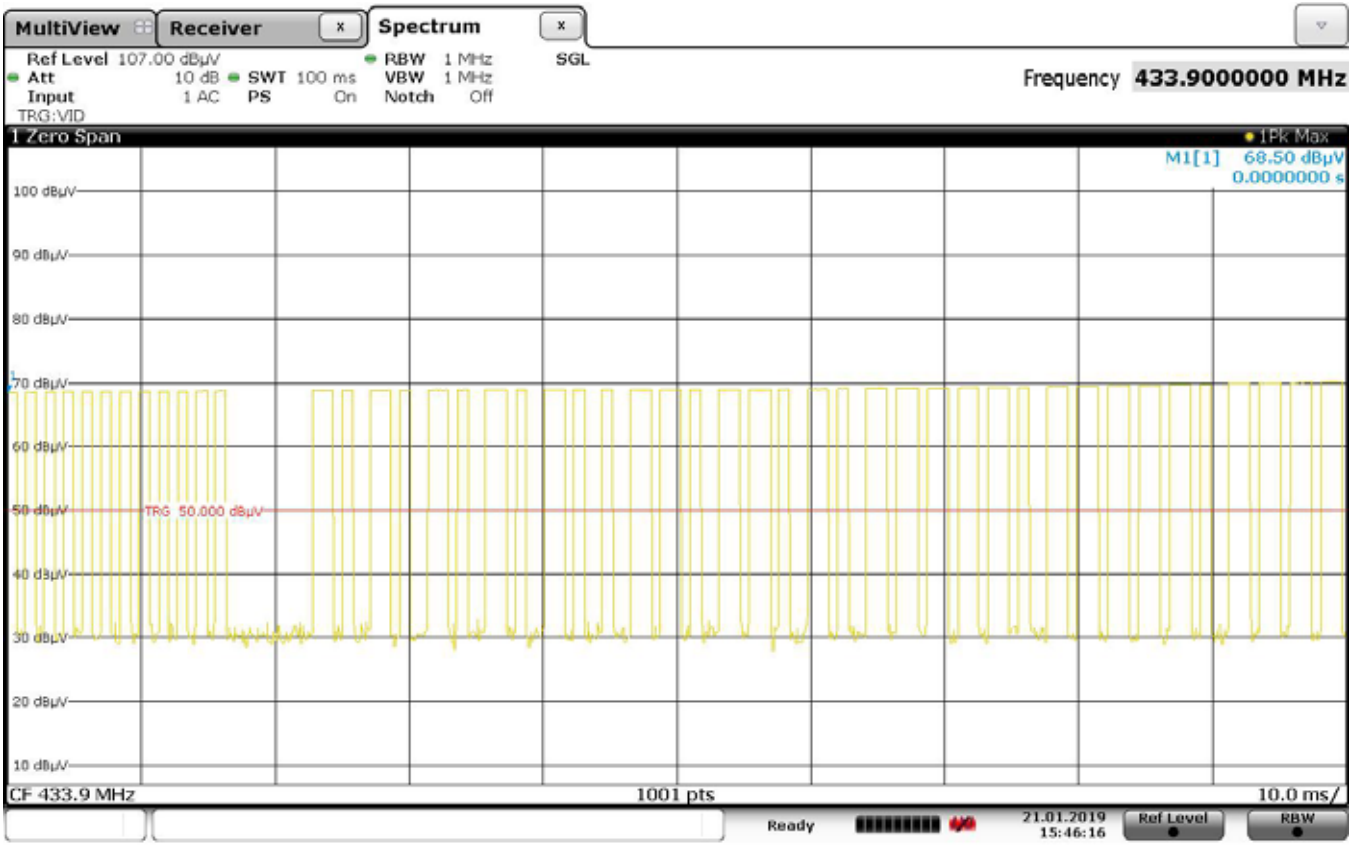
Date: 22.JAN.2019 16:26:11

Manufacturer : Snap-On Tools Corporation
Model Number : LM18454441
Serial Number : N/A
Test : **20dB Bandwidth**
Mode : Tx 433.92MHz
Date : Jan 22,2019
Notes : The two vertical lines sit at 0.25% of the fundamental
: frequency



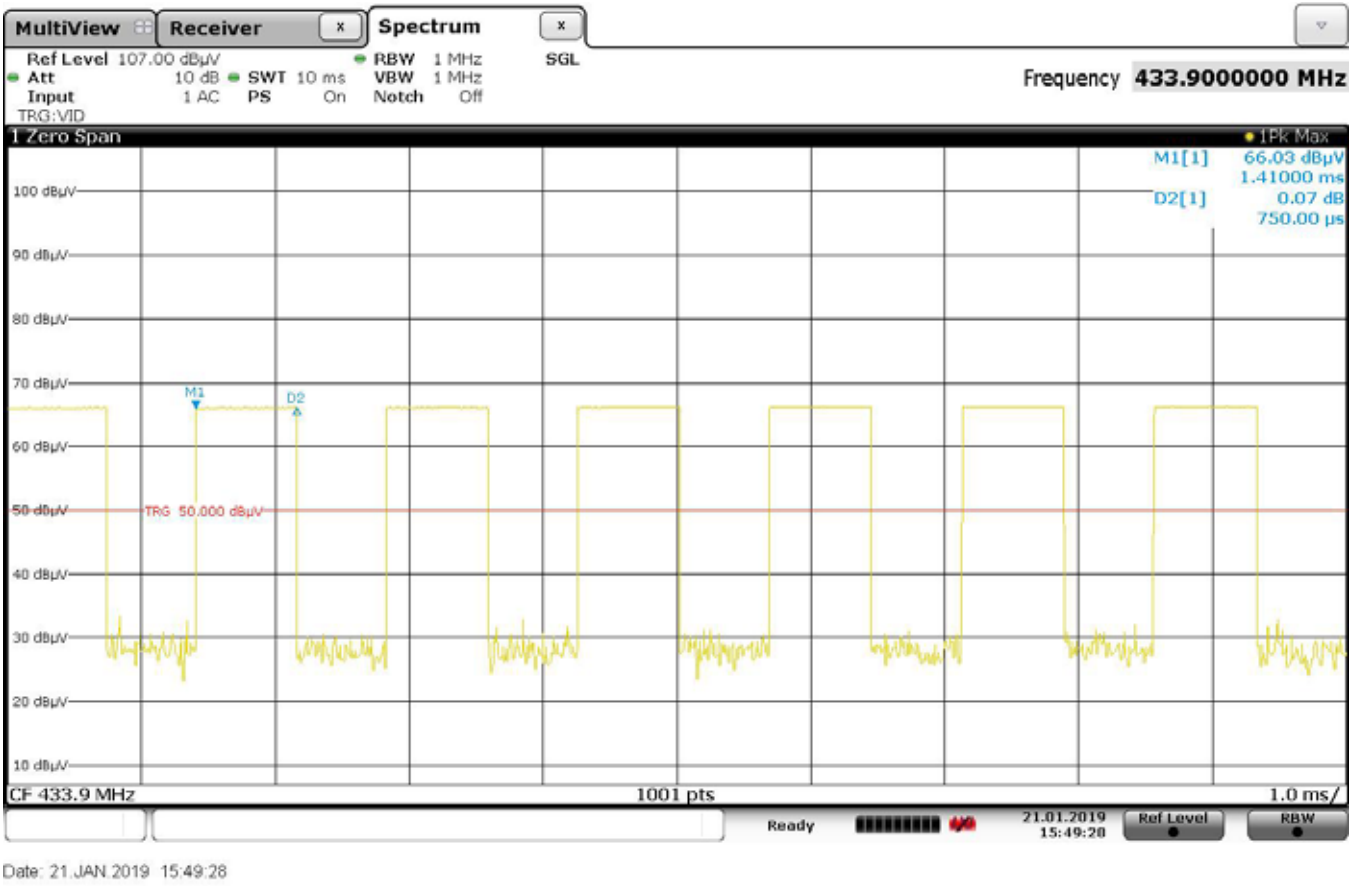
Date: 4.FEB.2019 09:54:02

Manufacturer : Snap-On Tools Corporation
Model Number : LM18454441
Serial Number : N/A
Test : **99% Bandwidth**
Mode : Tx 433.92MHz
Parameters : 99% BW = 306.69MHz
Date : Jan 22,2019
Notes



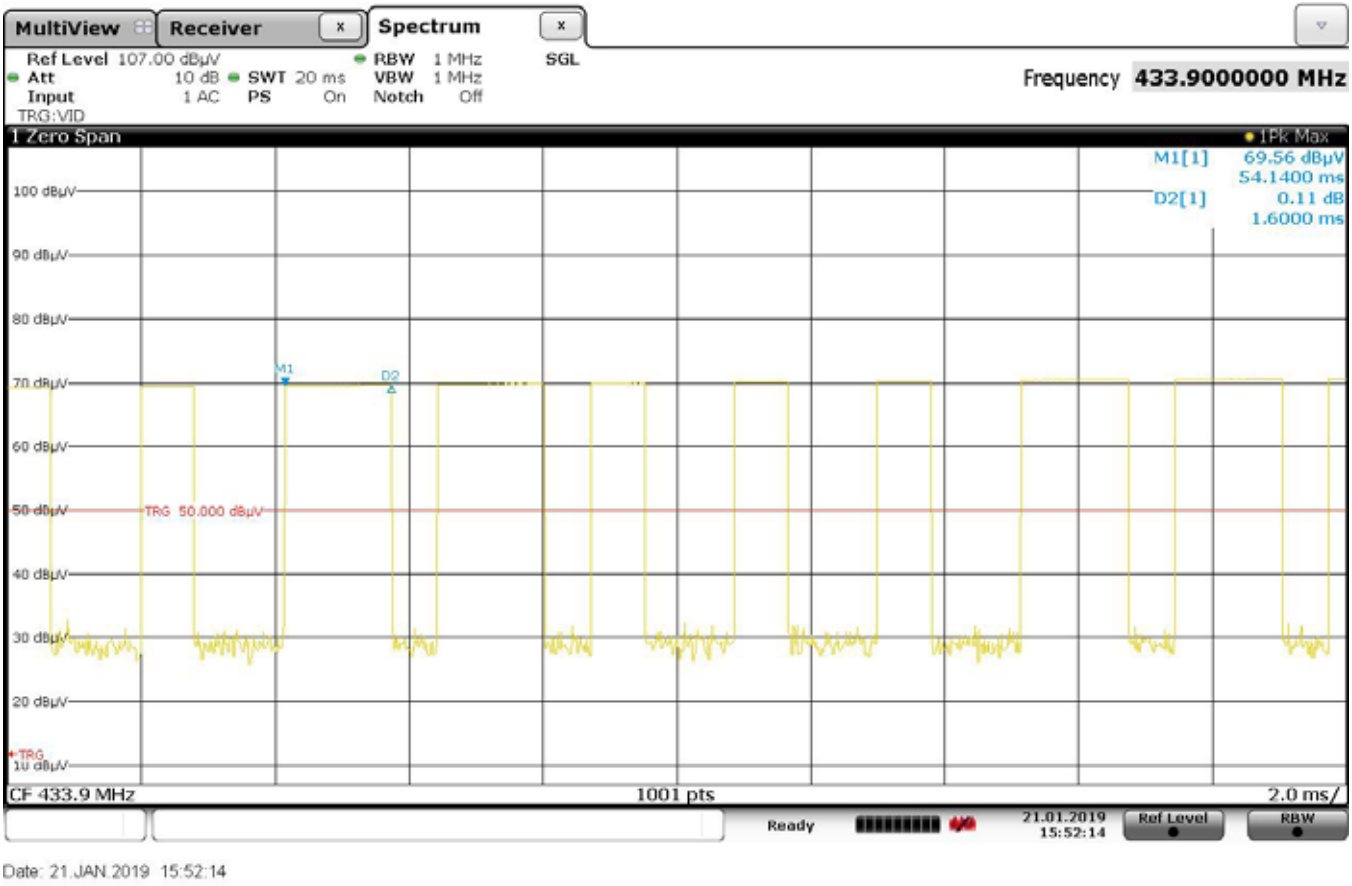
Date: 21.JAN.2019 15:46:16

Manufacturer : Snap-On Tools Corporation
Model Number : LM18454441
Serial Number : N/A
Test : **Duty Cycle Calculation – Number of Pulses**
Mode : Tx 433.92MHz
Parameters : “Short” Pulse Qty = 21; “Long” Pulse Qty = 25
Date : Jan 22,2019
Notes : 100ms Sweep Time



Date: 21.JAN.2019 15:49:28

Manufacturer : Snap-On Tools Corporation
Model Number : LM18454441
Serial Number : N/A
Test : **Duty Cycle Calculation – "Short" Pulse Length**
Mode : Tx 433.92MHz
Parameters : Length = 0.75ms
Date : Jan 22,2019
Notes :



Date: 21.JAN.2019 15:52:14

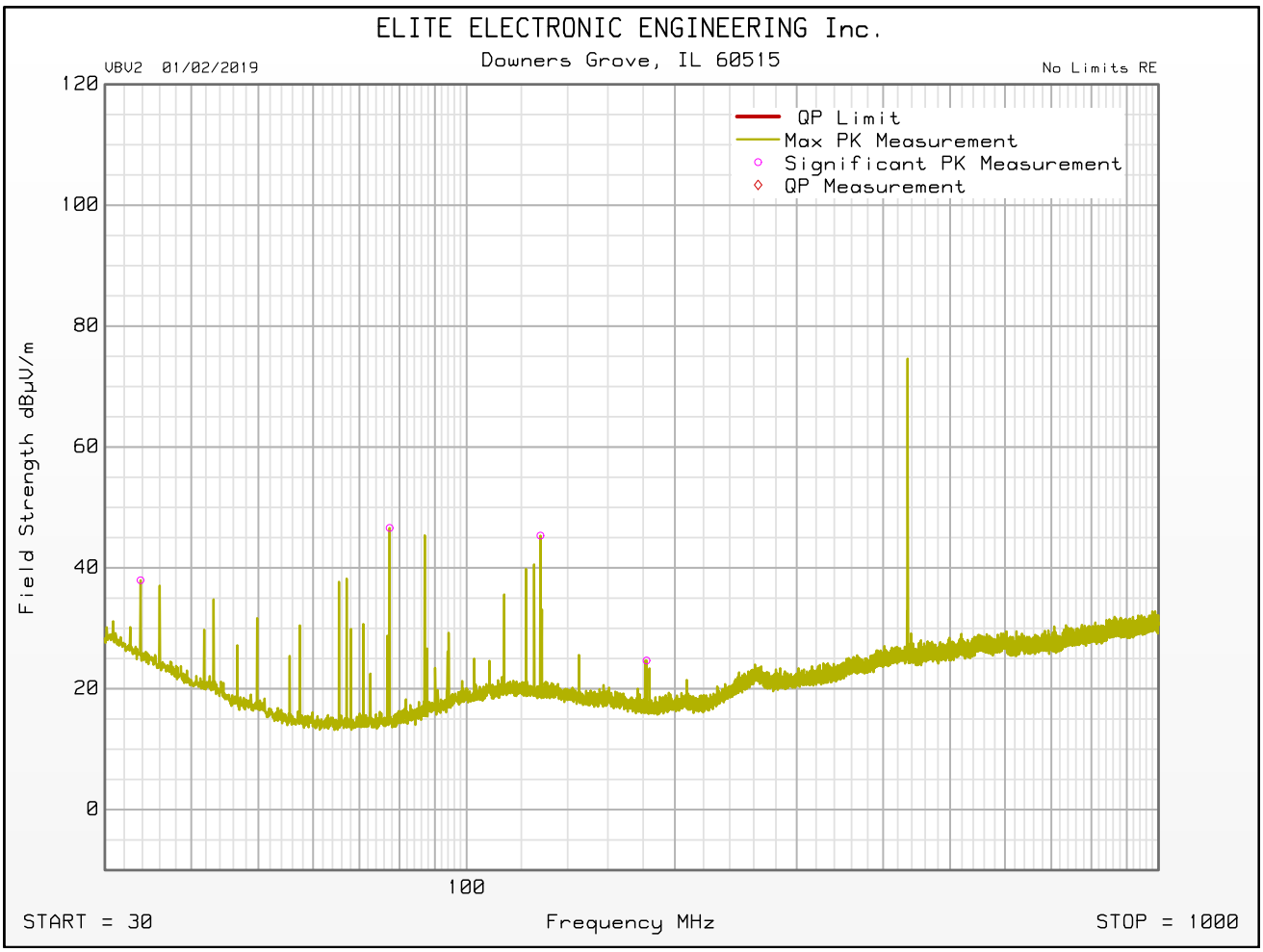
Manufacturer : Snap-On Tools Corporation
Model Number : LM18454441
Serial Number : N/A
Test : **Duty Cycle Calculation – "Long" Pulse Length**
Mode : Tx 433.92MHz
Parameters : Length = 1.6ms
Date : Jan 22,2019
Notes :

Duty Cycle Calculation = 20 Log((21x0.75ms + 25x1.6ms)/100ms) = -5.1

Preliminary Radiated RF Emissions

SW ID/Rev: VBV2 01/02/2019

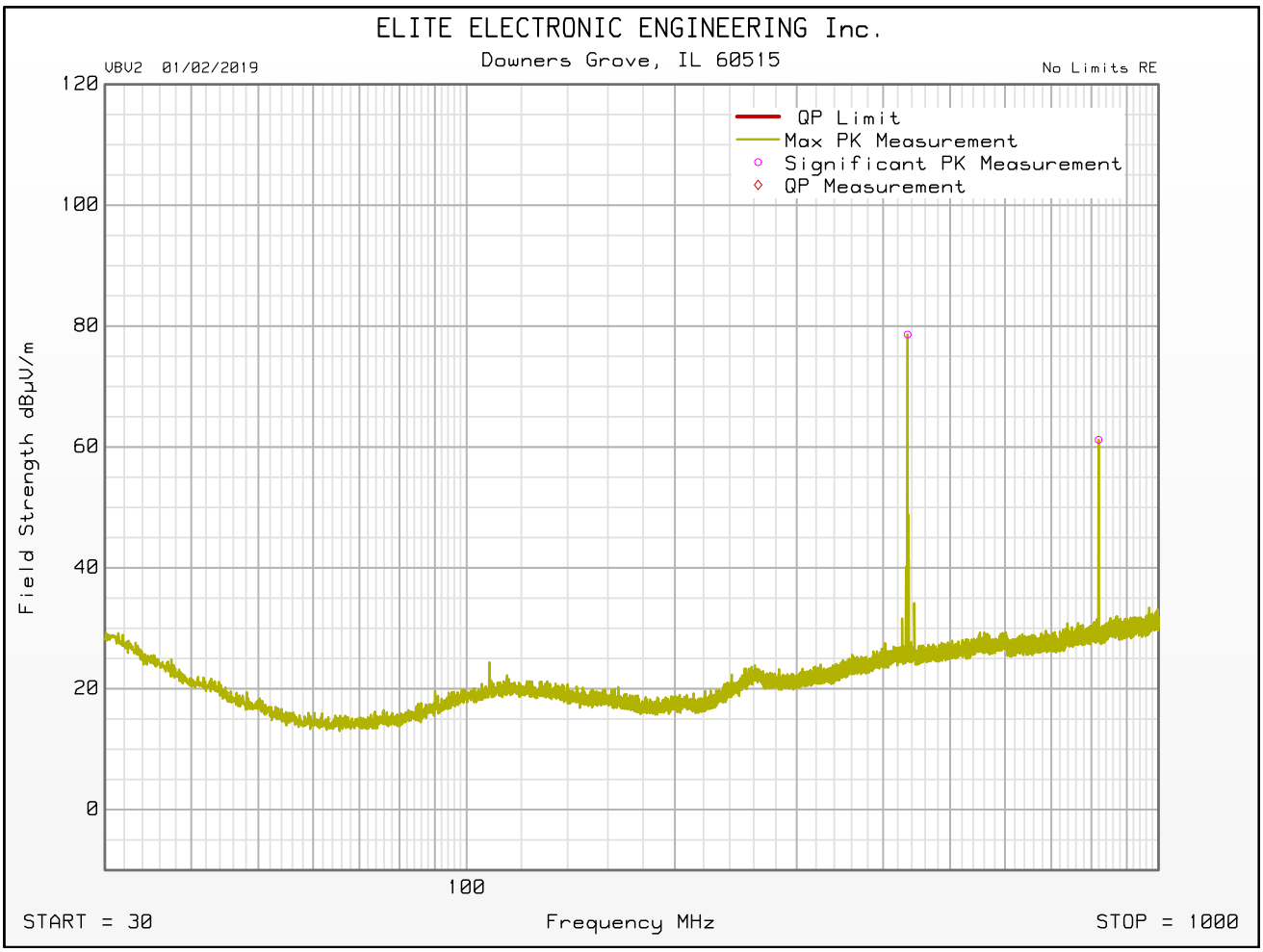
Manufacturer	:	Snap-On Tools Corporation
Model	:	LM18454441
Serial Number	:	N/A
DUT Mode	:	Tx 433.92MHz
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Ant. Polarization(s)	:	V
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0009
Notes	:	2.0dBm
Test Engineer	:	J. Cardenas
Test Date	:	Jan 21, 2019 02:17:14 PM



Preliminary Radiated RF Emissions

SW ID/Rev: VBV2 01/02/2019

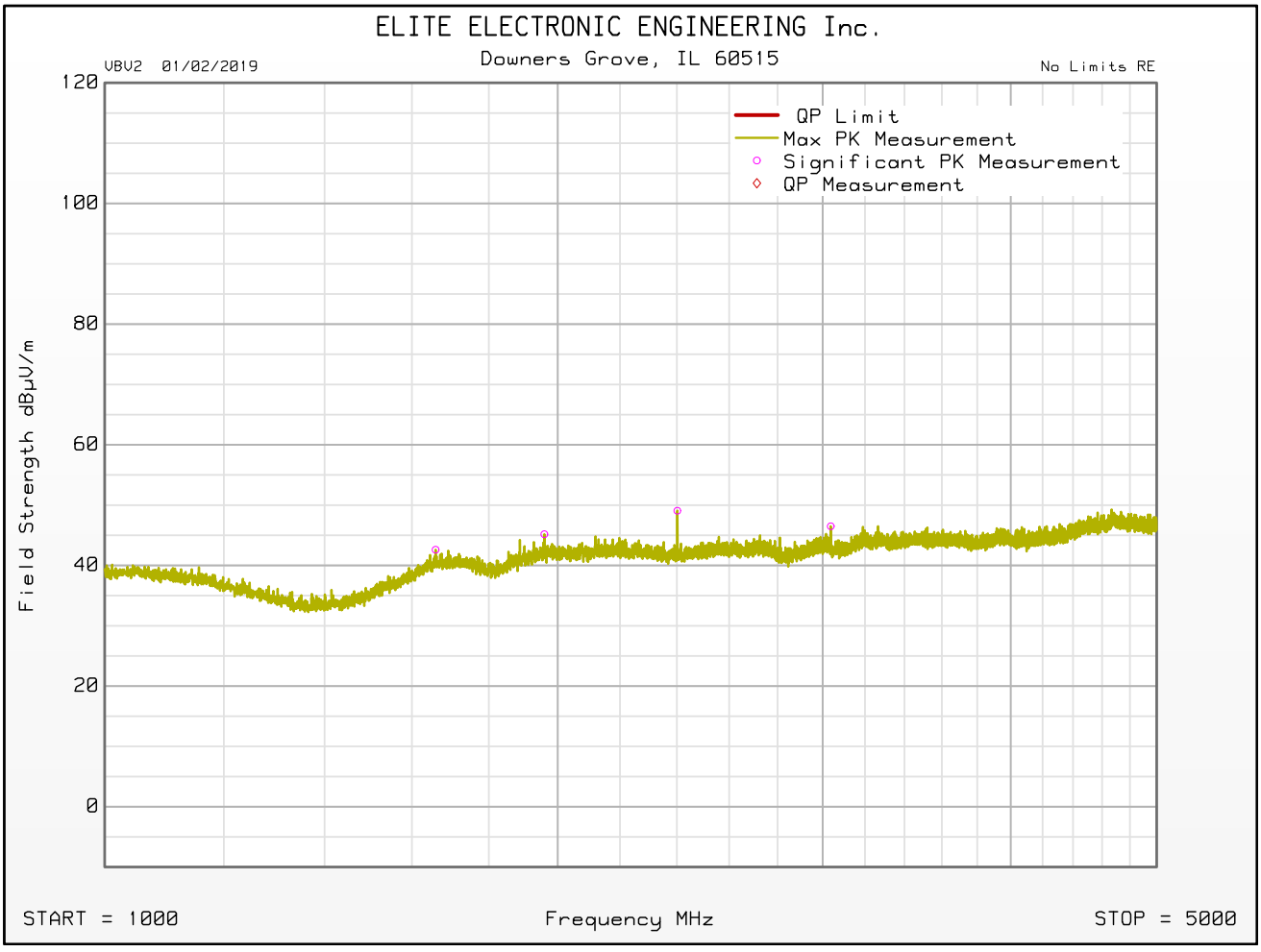
Manufacturer	:	Snap-On Tools Corporation
Model	:	LM18454441
Serial Number	:	N/A
DUT Mode	:	Tx 433.92MHz
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Ant. Polarization(s)	:	H
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0009
Notes	:	2.0dBm
Test Engineer	:	J. Cardenas
Test Date	:	Jan 21, 2019 02:17:14 PM



Preliminary Radiated RF Emissions

SW ID/Rev: VBV2 01/02/2019

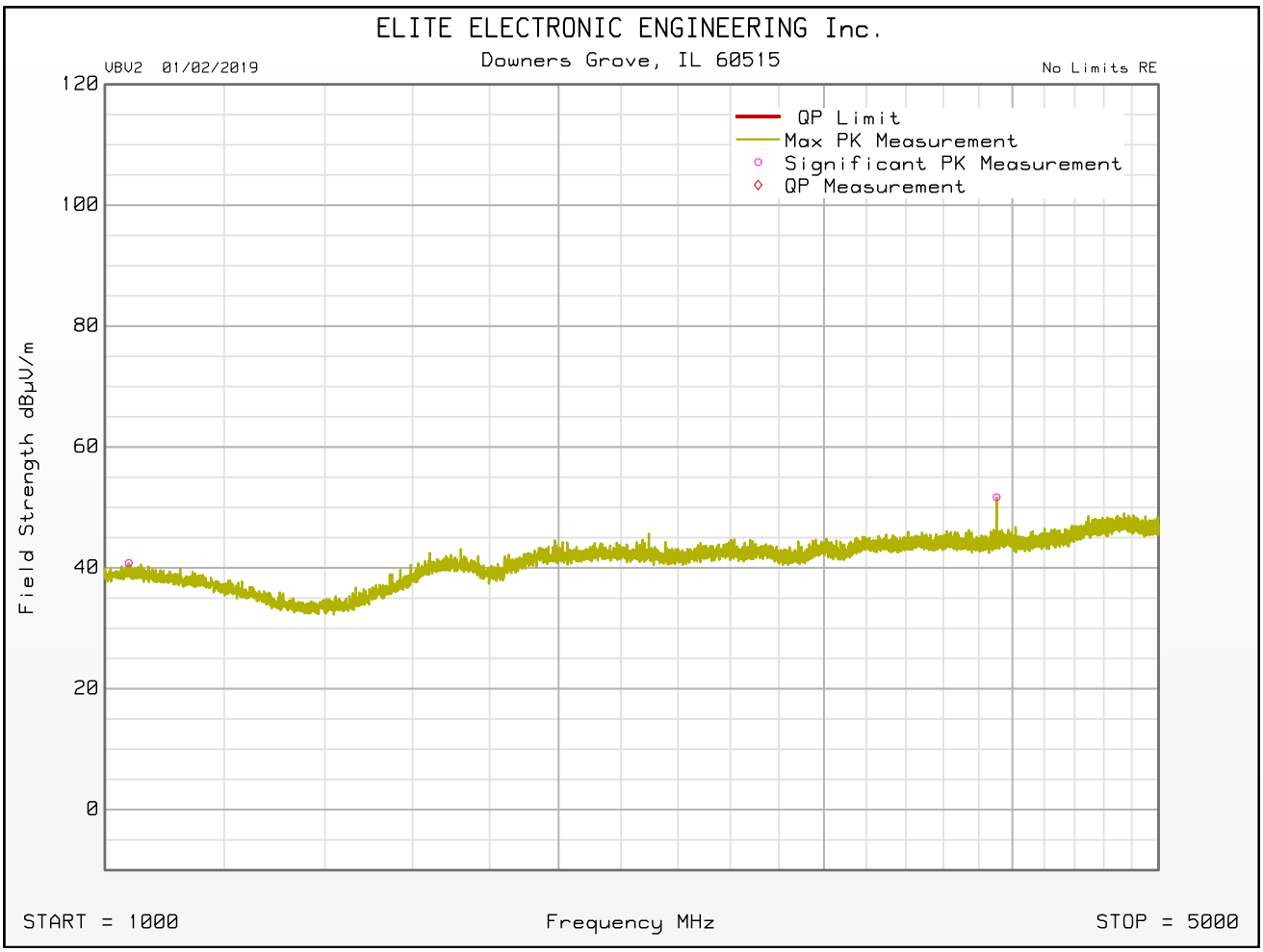
Manufacturer	:	Snap-On Tools Corporation
Model	:	LM18454441
Serial Number	:	N/A
DUT Mode	:	Tx 433.92MHz
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Ant. Polarization(s)	:	V
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	2dBm
Test Engineer	:	J. Cardenas
Test Date	:	Jan 21, 2019 04:29:34 PM



Preliminary Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

Manufacturer	:	Snap-On Tools Corporation
Model	:	LM18454441
Serial Number	:	N/A
DUT Mode	:	Tx 433.92MHz
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Ant. Polarization(s)	:	H
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	2dBm
Test Engineer	:	J. Cardenas
Test Date	:	Jan 21, 2019 04:29:34 PM



Manufacturer : Snap-On Tools Corporation
Test Item : Key Fob
Model No. : LM18454441
Serial No. : N/A
Mode : Tx @ 433.92MHz
Test Specification : FCC-15.231, RSS-210 Radiated Emissions
Notes :

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Margin (dB)
433.920	H	62.1		1.1	22.5	0.0	-5.1	80.6	10715.1	10996.7	-0.2
433.920	V	52.5		1.1	22.5	0.0	-5.1	71.0	3552.2	10996.7	-9.8
867.840	H	15.3		1.5	26.3	0.0	-5.1	38.0	79.8	1099.7	-22.8
867.840	V	11.8	*	1.5	26.3	0.0	-5.1	34.5	53.3	1099.7	-26.3
1301.760	H	38.0	*	1.9	29.5	-40.6	-5.1	23.7	15.3	500.0	-30.3
1301.760	V	37.8	*	1.9	29.5	-40.6	-5.1	23.5	14.9	500.0	-30.5
1735.680	H	42.7		2.2	30.5	-40.1	-5.1	30.2	32.3	1099.7	-30.6
1735.680	V	42.5		2.2	30.5	-40.1	-5.1	29.9	31.4	1099.7	-30.9
2169.600	H	51.7		2.5	33.4	-39.9	-5.1	42.6	134.3	1099.7	-18.3
2169.600	V	49.2		2.5	33.4	-39.9	-5.1	40.1	101.2	1099.7	-20.7
2603.520	H	48.2		2.7	33.3	-39.8	-5.1	39.3	92.5	1099.7	-21.5
2603.520	V	47.1		2.7	33.3	-39.8	-5.1	38.2	80.9	1099.7	-22.7
3037.440	H	45.0		3.0	33.9	-39.6	-5.1	37.2	72.4	1099.7	-23.6
3037.440	V	46.8		3.0	33.9	-39.6	-5.1	39.0	89.2	1099.7	-21.8
3471.360	H	54.4		3.2	34.1	-39.2	-5.1	47.3	232.6	1099.7	-13.5
3471.360	V	49.3		3.2	34.1	-39.2	-5.1	42.2	129.3	1099.7	-18.6
3905.280	H	48.7		3.4	34.7	-39.2	-5.1	42.5	133.3	500.0	-11.5
3905.280	V	52.3		3.4	34.7	-39.2	-5.1	46.0	200.5	500.0	-7.9
4339.200	H	42.8		3.5	35.1	-39.2	-5.1	37.1	71.9	500.0	-16.8
4339.200	V	43.0		3.5	35.1	-39.2	-5.1	37.4	74.0	500.0	-16.6

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + DC