FCC Test Report

FOR:
Qolsys, Inc.

Model Name:
QS-ZWAVEAH

Product Description:
The Equipment under Test is a module, model number QS-ZWAVEAH that contains a Zwave radio

FCC ID: 2AAJXQS-ZWAVEAH

Applied Rules and Standards:
47 CFR Part 15.249

REPORT #: EMC_QOLSY-006-20001_15.249_R1

DATE: 2020-10-28

A2LA Accredited

IC recognized #
3462B-2

***CETECOM* Inc.**
411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.
Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: info@cetecom.com ◆ http://www.cetecom.com
CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

TABLE OF CONTENTS

1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.249 of Title 47 of the Code of Federal Regulations.

No deviations were ascertained.

Company	Description	Model #
Qolsys, Inc.	The Equipment under Test is a module, model number QS-ZWAVEAH that contains a Zwave radio	QS-ZWAVEAH

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2020-10-28	Compliance	Cindy Li (EMC Lab Manager)	Cindy Li Digitally signed by cindy.li@cetecom.com DN: CN=cindy.li@cetecom.com Reason: I have reviewed this document Location: your signing location here Date: 2020-10-28 16:16:07 Foxit Reader Version: 10.0.1

Responsible for the Report:

Date	Section	Name	Signature
2020-10-28	Compliance	Yuchan Lu (Test Engineer)	Yuchan Lu Digitally signed by: Yuchan Lu DN: CN = Yuchan Lu email = Yuchan.Lu@cetecom.com C = US O = CETECOM Inc. OU = EMC Date: 2020.10.28 15:44:34 -07'00'

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Cindy Li
Responsible Project Leader:	Akanksha Baskaran

2.2 Identification of the Client

Client's Name:	Qolsys, Inc.
Street Address:	1900 The Alameda Ste 420
City/Zip Code	San Jose, CA 95126
Country	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Client
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	QS-ZWAVEAH
HW Version :	Rev. F
SW Version :	6.04
FCC-ID :	2AAJXQS-ZWAVEAH
FWIN:	6.81.03
HVIN:	QS-ZWAVEAH
PMN:	Zwave Module
Product Description:	The Equipment under Test is a module, model number QS-ZWAVEAH that contains a Zwave radio
Frequency Range / number of channels:	919.8MHz, 921.4MHz
Radio Information:	ZWAVE: Module Name: Zwave Module Module Number: QS-ZWAVEAH Modulation: FSK
Modes of Operation:	ZWAVE
Antenna Information as declared:	PCB wire Antenna, Max Gain: 2 dBi
Max Output Power:	Peak: 919.8MHz: 88.835 dBuV/m = 0.000229 W 921.4MHz: 89.098 dBuV/m = 0.000244 W
Power Supply/ Rated Operating Voltage Range:	Vmin: 3 VDC/ Vnom: 3.3 VDC / Vmax: 3.6 VDC
Operating Temperature Range	Low 0ºC, Nominal 25ºC, High 40ºC
Other Radios included in the device:	N/A
Sample Revision	☐Prototype Unit; ☐Production Unit; ■Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	QC171174900014	Rev. F	6.04	919.8MHz Conducted RF
2	QC171174900003	Rev. F	6.04	919.8MHz Radiated
3	QC171174900129	Rev. F	6.04	921.4MHz Conducted RF
4	QC171174900019	Rev. F	6.04	921.4MHz Radiated

3.3 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1	The radio of the EUT was configured to a fixed channel transmission at 919.8 MHz with highest possible duty cycle using software that is not available to the end user. The measurement equipment was connected to the 50 ohm RF port of the EUT.
2	EUT#2	The radio of the EUT was configured to a fixed channel transmission at 919.8 MHz with highest possible duty cycle using software that is not available to the end user. The internal antenna was connected.
3	EUT#3	The radio of the EUT was configured to a fixed channel transmission at 921.4 MHz with highest possible duty cycle using software that is not available to the end user. The measurement equipment was connected to the 50 ohm RF port of the EUT.
4	EUT#4	The radio of the EUT was configured to a fixed channel transmission at 921.4 MHz with highest possible duty cycle using software that is not available to the end user. The internal antenna was connected.

3.4 Support Equipment

SE #	Description
1	AC/DC Converter, Manufacture: Sure-Power, Model: SW-070100AB
2	Qolsys, Model: IQPanel2, P/N QS9202-4208-840
3	Laptop,

3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on channels at 919.8 MHz and 921.4 MHz. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.249 of Title 47 of the Code of Federal Regulations.

This test report is to support a request for new equipment authorization under the FCC ID: 2AAJXQS-ZWAVEAH.

Testing procedures are based on ANSI C63.10 (2013) – "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices" – IEEE Standards Association, Accredited by the American National Standards Institute

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.215(c)	20 dB Bandwidth; 99% Occupied Bandwidth	Nominal	ZWAVE	■	☐	☐	Complies
§15.249(a)(c)	Transmitter Output Power	Nominal	ZWAVE	■	☐	☐	Complies
§15.249(a)(c)(d)(e); §15.209; §15.205	Radiated Transmitter Spurious Emissions and Restricted Bands	Nominal	ZWAVE	■	☐	☐	Complies

Note: NA= Not Applicable; NP= Not Performed.

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

9 kHz to 30 MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

Conducted measurement

150 kHz to 30 MHz	±0.7 dB (LISN)
RF conducted measurement	±0.5 dB

According to TR 102 273 a multiplicative propagation of error is assumed for RF measurement systems. For this reason the RMS method is applied to dB values and not to linear values as appropriate for additive propagation of error. Also used: http://physics.nist.gov/cuu/Uncertainty/typeb.html. The above calculated uncertainties apply to direct application of the Substitution method. The Substitution method is always used when the EUT comes closer than 3 dB to the limit.

6.1 Environmental Conditions During Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25° C
- Relative humidity: 40-60%

6.2 Dates of Testing:

09/09/2020 – 09/23/2020

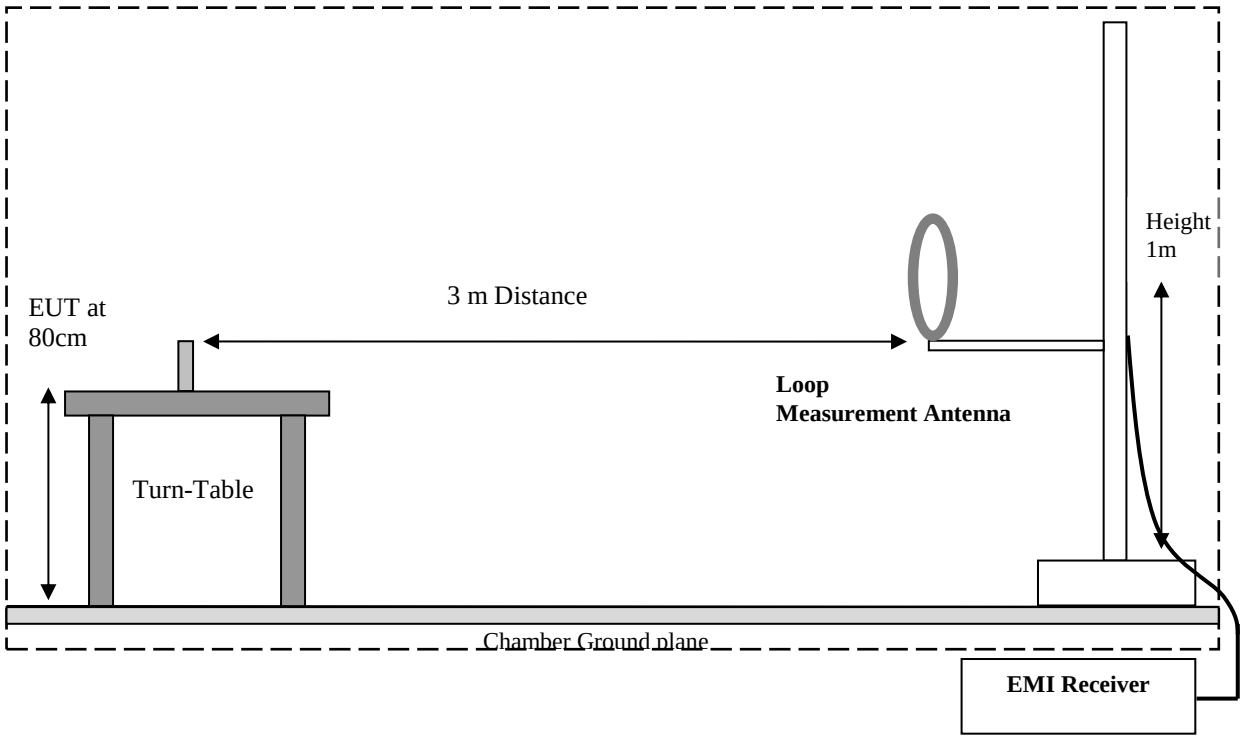
7 Measurement Procedures

7.1 Radiated Measurement

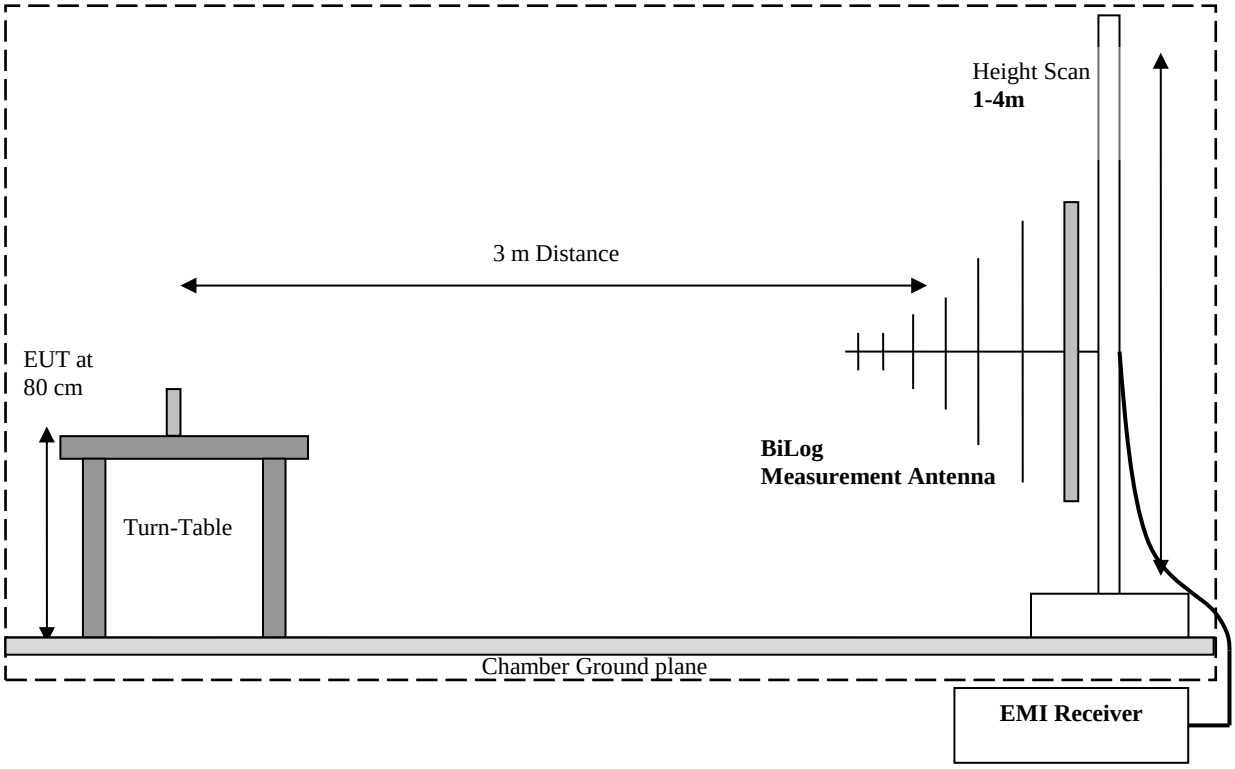
The radiated measurement is performed according to ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

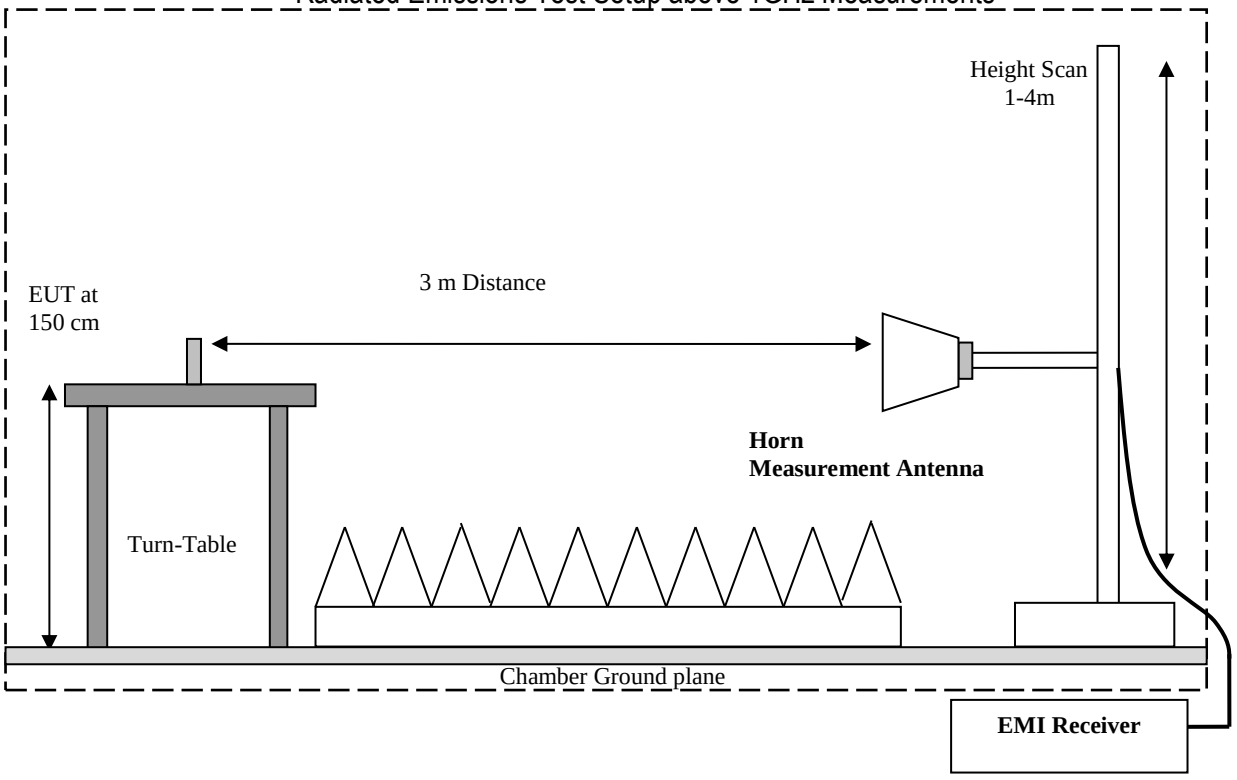
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

FS (dBµV/m) = Measured Value on SA (dBµV) + Cable Loss (dB) + Antenna Factor (dB/m)

Example:

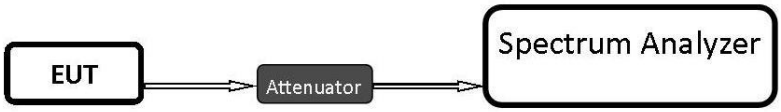
Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

7.2 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.4 (2014)

7.3 RF Conducted Measurement Procedure

Testing procedures are based on ANSI C63.10 (2013) – "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices" – IEEE Standards Association, Accredited by the American National Standards Institute



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the assigned channels and for worst case modulation schemes.

8 Test Result Data

8.1 Transmitter Output Power

8.1.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer settings:

- RBW = 100 kHz
- VBW ≥ 3 x RBW
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold
- Use peak marker function to determine the peak amplitude level

8.1.2 Limits:

FCC §15.249

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

(c) Field strength limits are specified at a distance of 3 meters.

Linear to log conversion:

- E = 20*log(Field strength of fundamental)
  where
  - E is the electric field strength in dBµV/m
  - Field strength of fundamental is in µV/m

The Field Strength of fundamental at a distance of 3 meters shall not exceed the following levels:

- 94 dB(µV/m) for fundamental frequency,

8.1.3 Test conditions and setup:

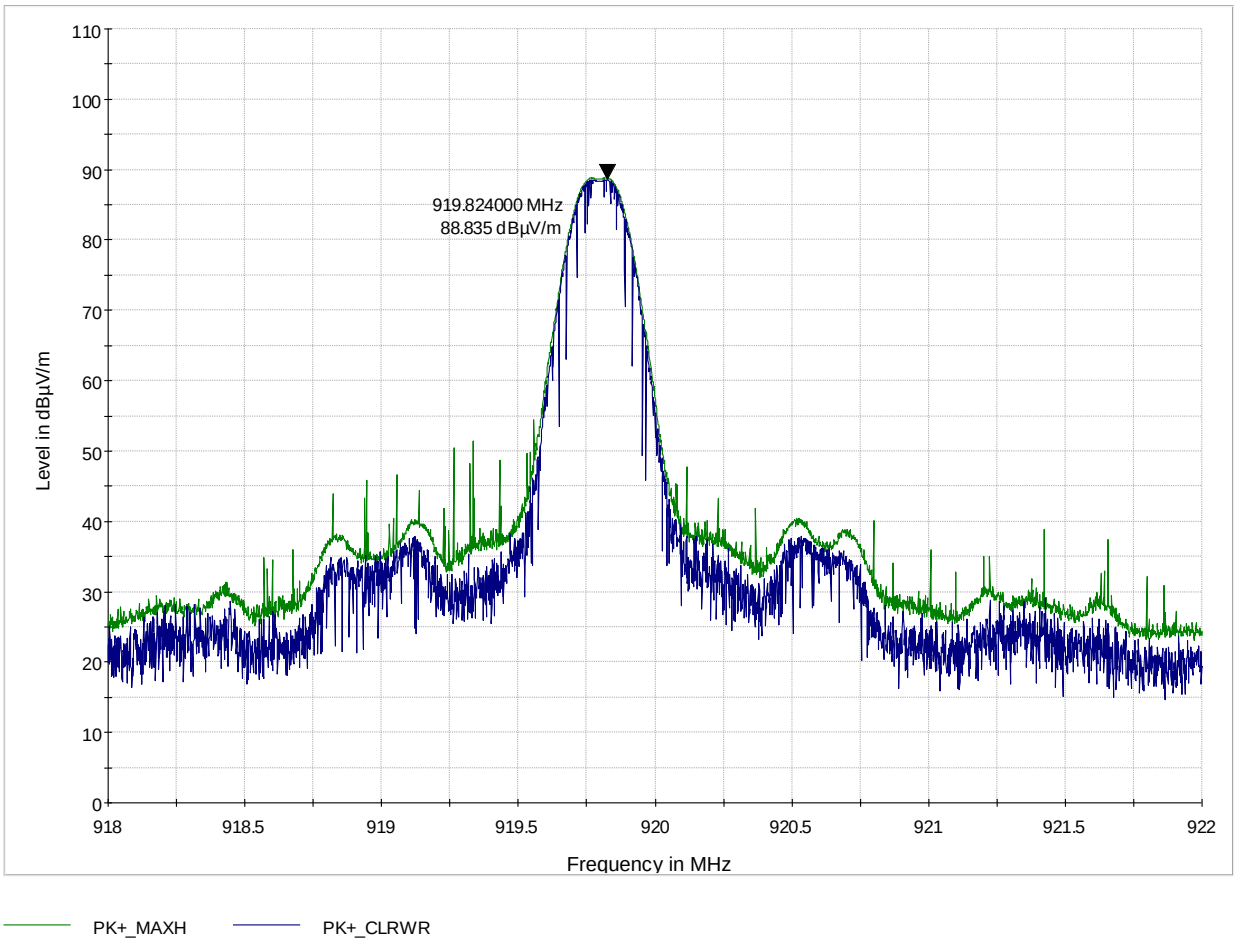
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
23.8°C	1, 3	ZWAVE	5 VDC	2 dBi

8.1.4 Measurement result:

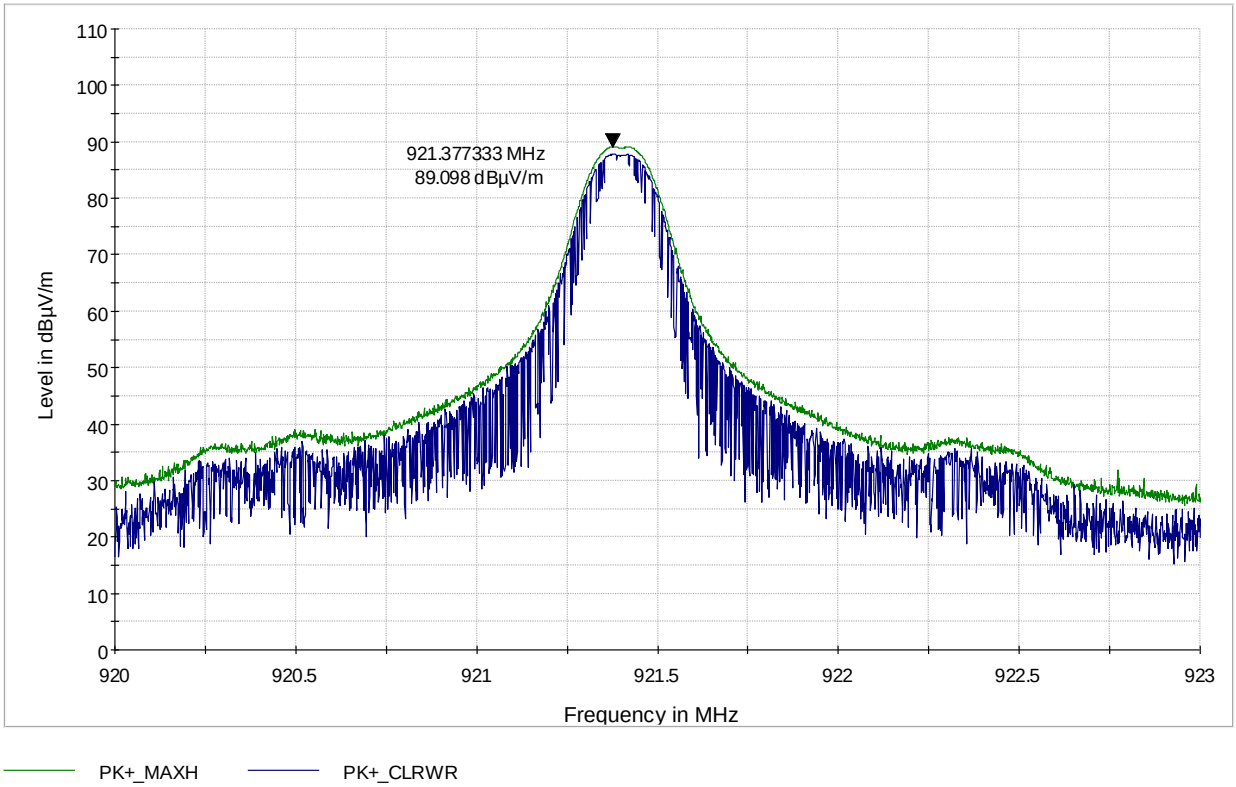
Plot #	Frequency (MHz)	Maximum Peak Transmitter Output Power (dBuV/m)	Limit (dBuV/m)	Result
1	919.8	88.835	94	Pass
2	921.4	89.098	94	Pass

8.1.5 Measurement Plots:

Plot #1	
Channel / 919.8 MHz	**Modulation/Packet Type: ZWAVE**



Plot #2	
Channel 921.4 MHz	**Modulation/Packet Type: ZWAVE**



8.2 Duty cycle

8.2.1 Measurement according to ANSI C63.10 (2013)

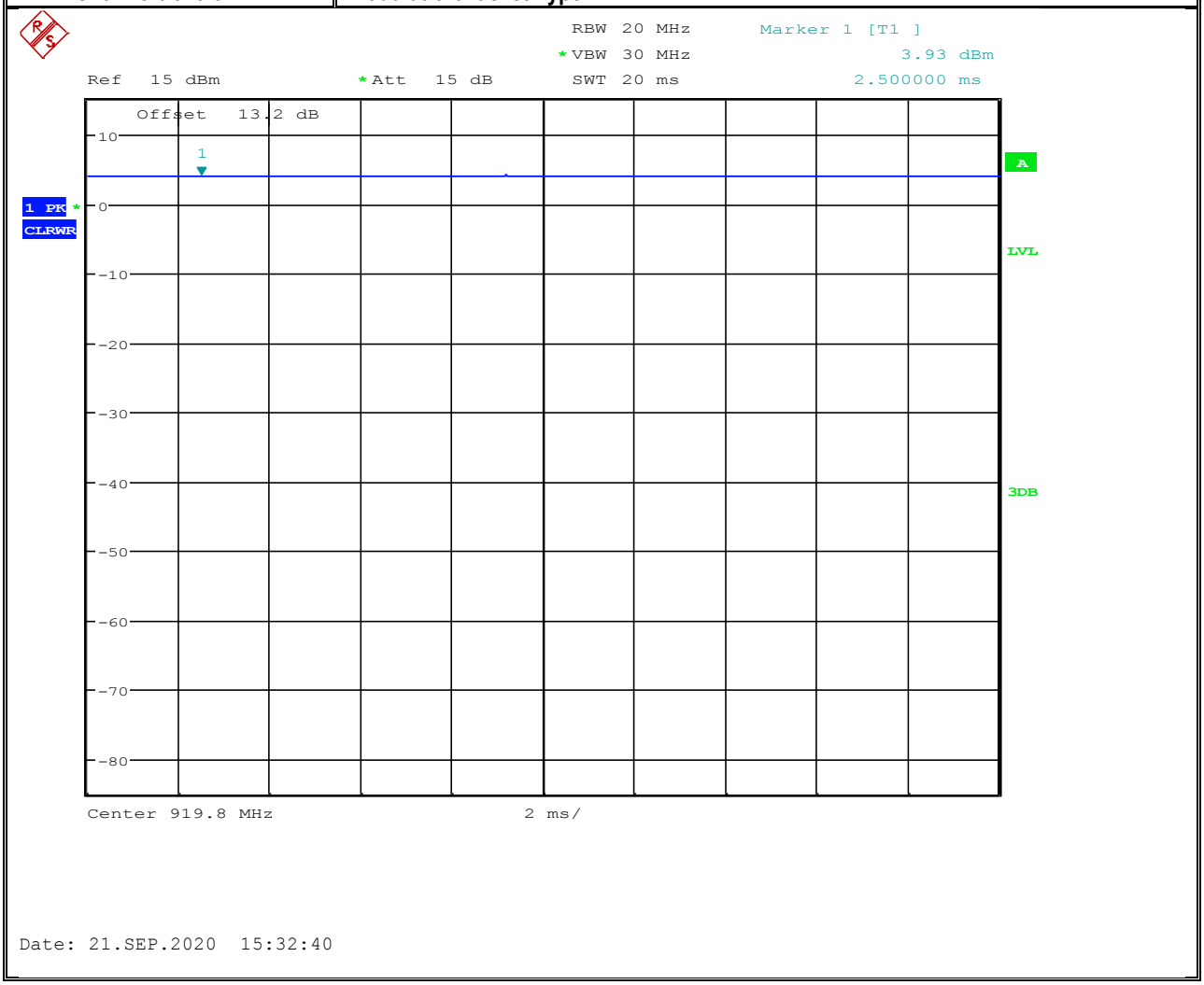
Spectrum Analyzer settings:

- Set the center frequency and of the instrument to the center frequency of the transmission
- Zero span
- Set RBW >=OBW if possible; otherwise, set RBW to the largest available value
- Detector = Peak or average

8.2.2 Measurement result

Duty cycle measurement

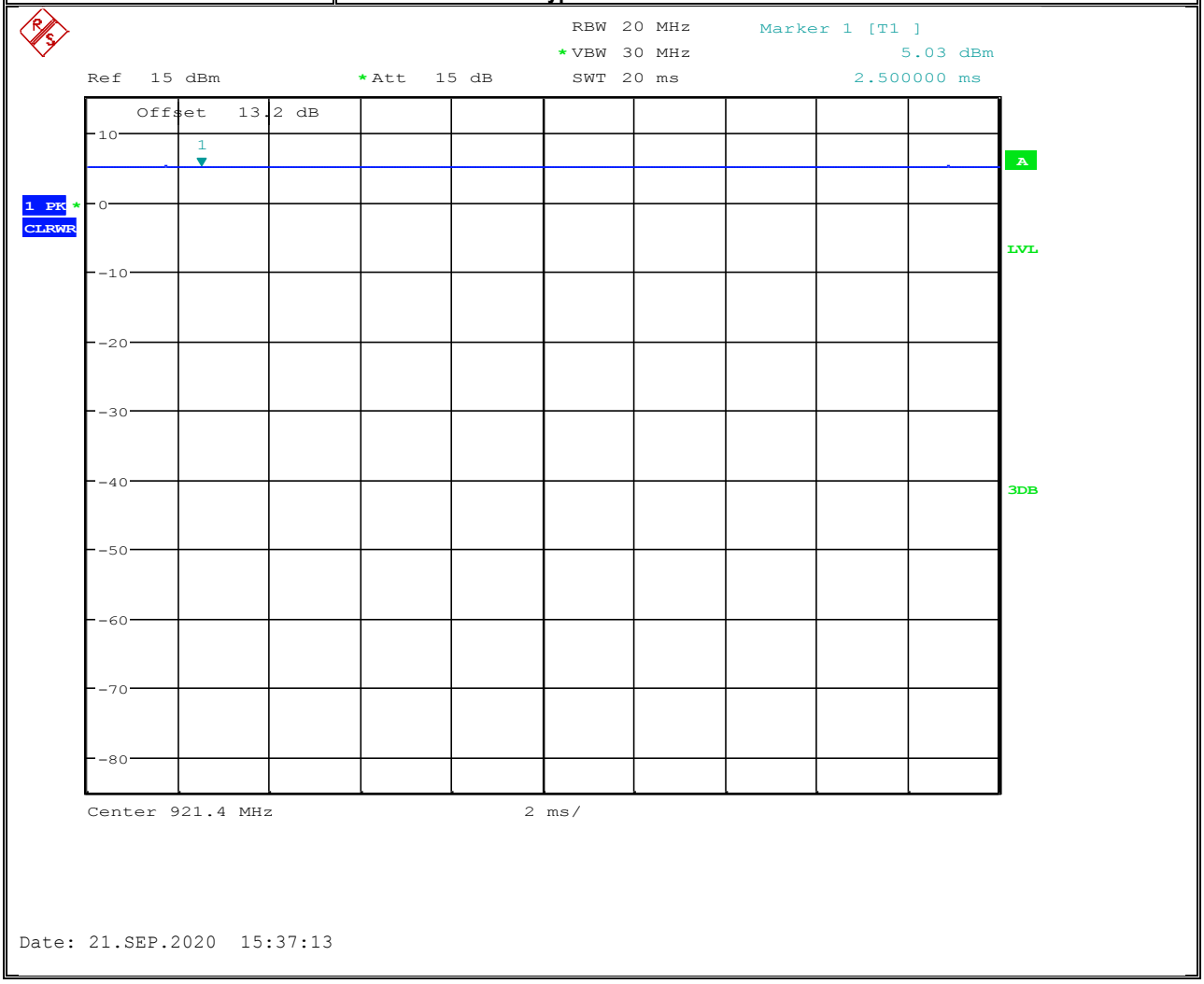
Channel / 919.8 MHz	Modulation/Packet Type: ZWAVE



Duty cycle = 100%
Duty cycle correction factor = 0 dB

Duty cycle measurement

Channel / 921.4 MHz	Modulation/Packet Type: ZWAVE



Duty cycle = 100%
Duty cycle correction factor = 0 dB

8.3 Emission Bandwidth 20dB and 99% Occupied Bandwidth

8.3.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer settings:

20 dB Bandwidth:

- Set frequency = nominal EUT channel center frequency
- Set Span = 2 x to 5 x OBW
- Set RBW = 1% to 5% of OBW
- Set the video bandwidth (VBW) ≈ 3 x RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Determine the reference value by setting spectrum analyzer marker to the highest level of the displayed trace
- Determine the "-20 dB down amplitude" using [(reference value) – 20]
- Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "-20 dB down amplitude"

99% Occupied Bandwidth:

- Set frequency = nominal EUT channel center frequency
- Set Span = 1.5 x to 5.0 x OBW
- Set RBW = 1% to 5% of OBW
- Set the video bandwidth (VBW) ≈ 3 x RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth
- If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

8.3.2 Limits:

FCC §15.215(c)

- Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

8.3.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22.0°C	1, 3	ZWAVE	5 VDC

8.3.4 Measurement result:

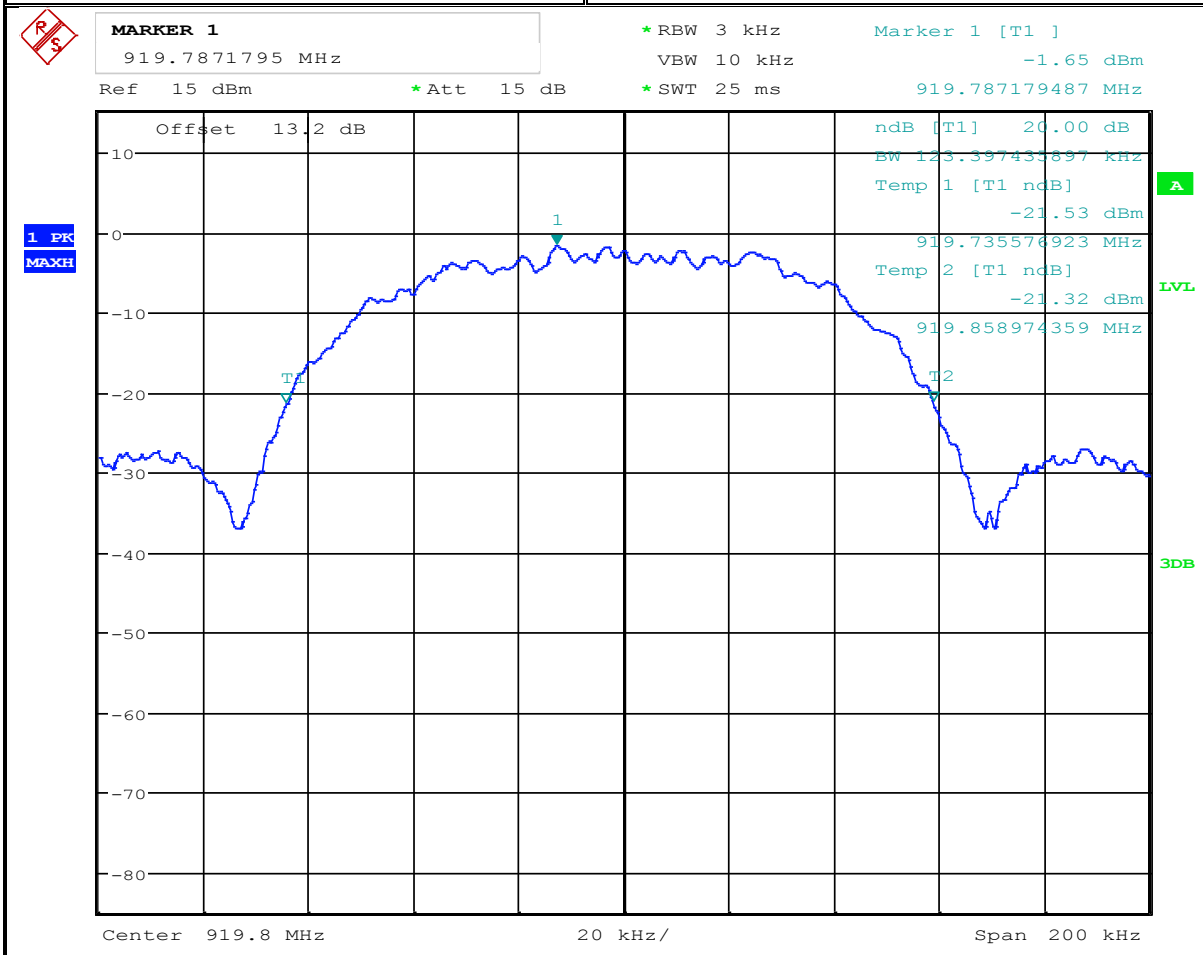
Plot #	Frequency (MHz)	20dB Emissions Bandwidth (kHz)	Result
1	919.8	123.397	Pass
2	921.4	91.346	Pass

Plot #	Frequency (MHz)	99% Occupied Bandwidth (kHz)	Result
3	919.8	110.256	Pass
4	921.4	87.821	Pass

8.3.5 Measurement Plots:

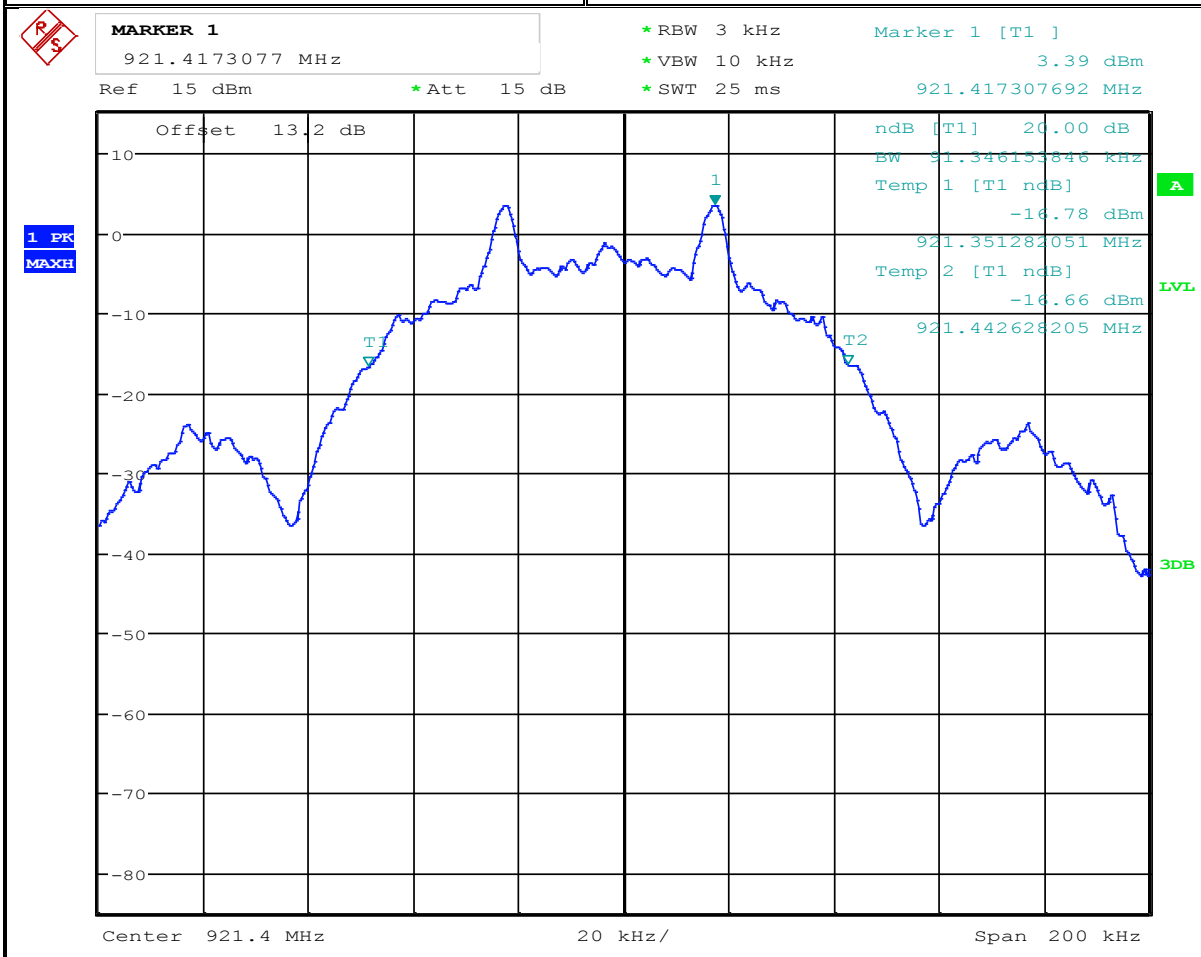
Plot #1

919.8 MHz	Mode: ZWAVE



Plot #2

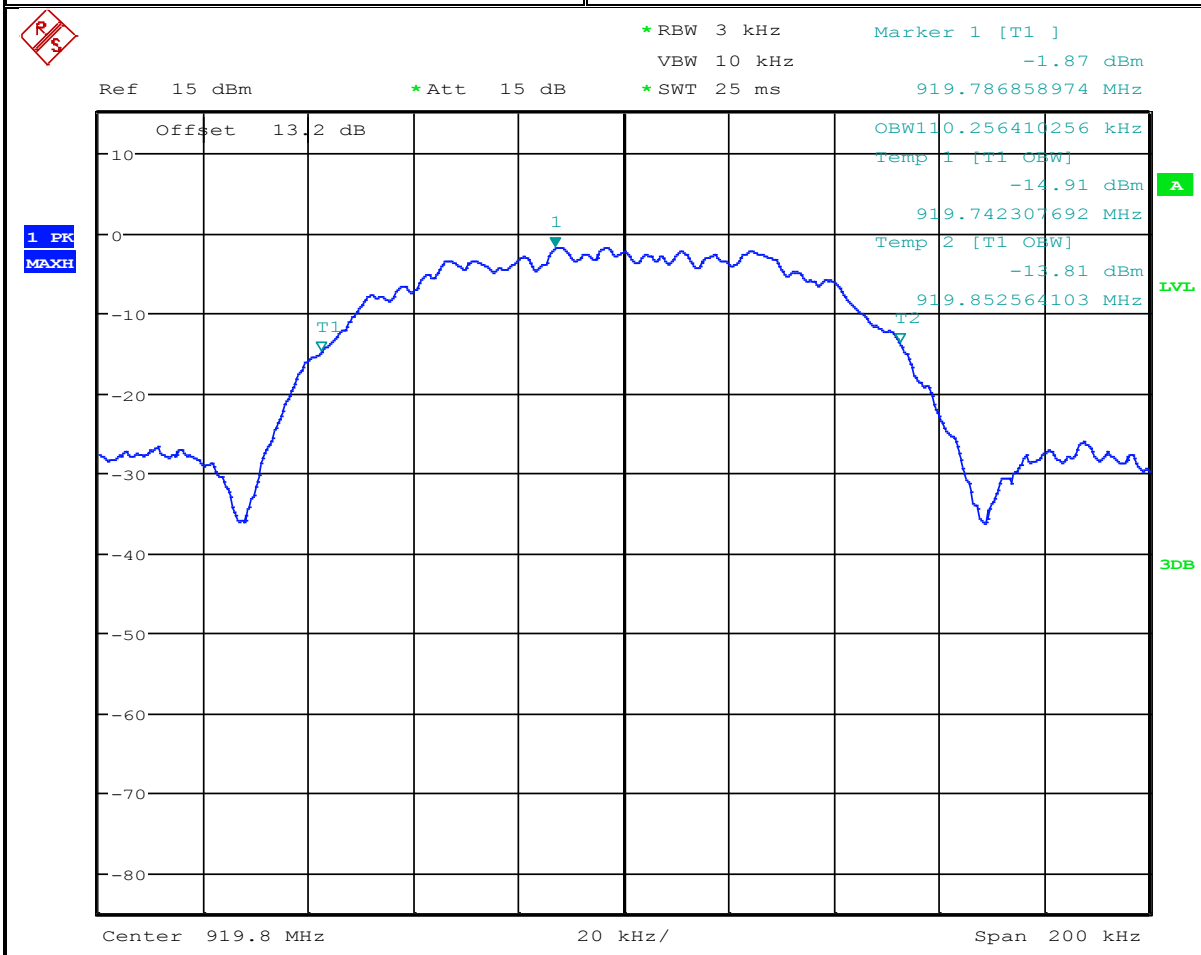
921.4 MHz	Mode: ZWAVE



Date: 21.SEP.2020 15:40:27

Plot #3

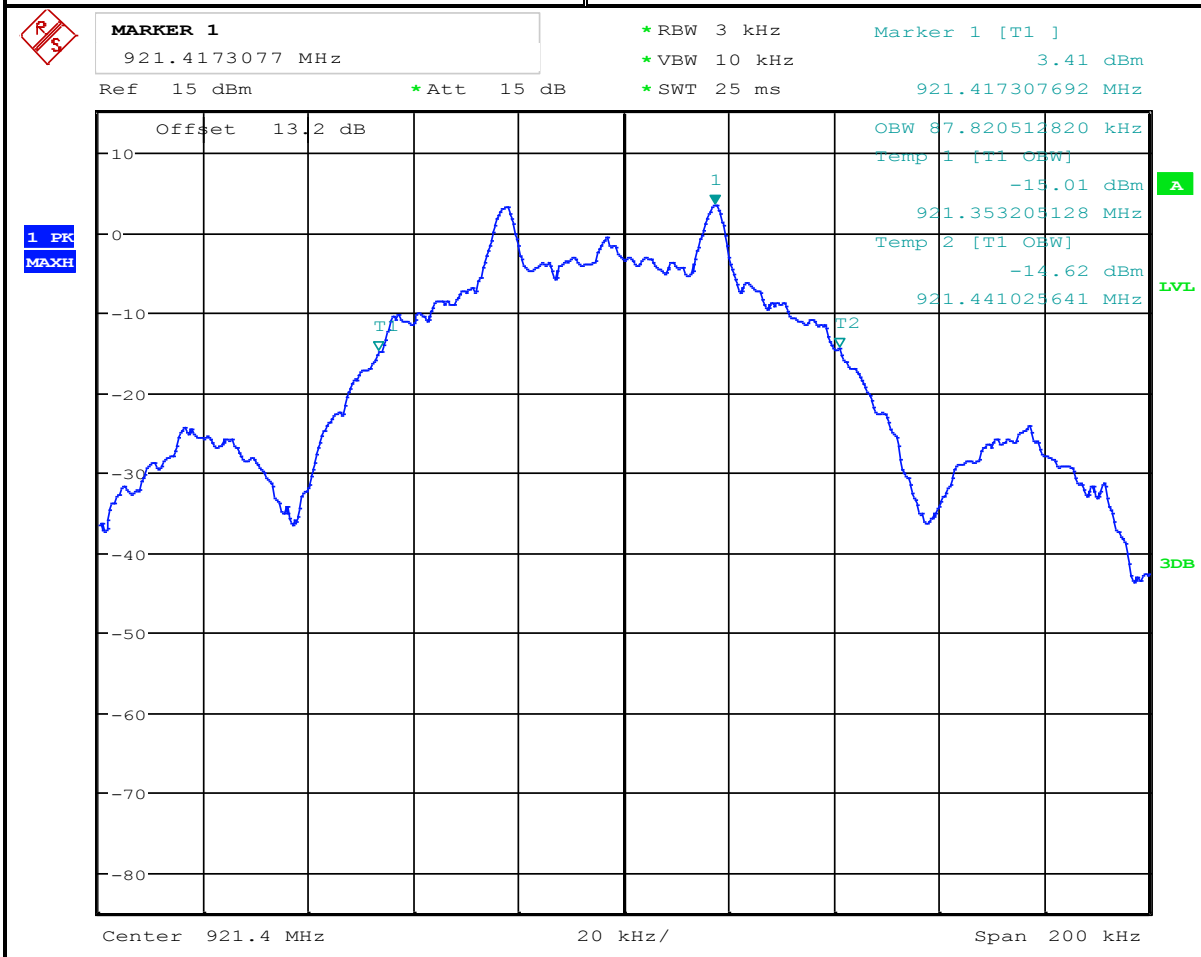
919.8 MHz	Mode: ZWAVE



Date: 21.SEP.2020 15:28:45

Plot #4

921.4 MHz	Mode: ZWAVE



Date: 21.SEP.2020 15:39:47

8.4 Radiated Transmitter Spurious Emissions and Restricted Bands

8.4.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector: Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW= 120 KHz (<1GHz)

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1 MHz

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the assigned channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing frequencies below 30 MHz at distance other than the specified in the standard, the limit conversion is calculated by using the FCC materials for the ANSI 63 committee issued on January, 27 1991.

8.4.2 Limits:

FCC §15.249

- (a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

- (c) Field strength limits are specified at a distance of 3 meters.
- (d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
- (e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not

exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

FCC §15.209

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)	Field strength @ 3m (dBµV/m)
0.009–0.490	2400/F(kHz) / ---------	300	-
0.490–1.705	24000/F(kHz) / --------	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40 dBµV/m
88–216	150	3	43.5 dBµV/m
216–960	200	3	46 dBµV/m
Above 960	500	3	54 dBµV/m

FCC §15.205

- Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

- Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
  *PEAK LIMIT= 74 dBµV/m
  *AVG. LIMIT= 54 dBµV/m

8.4.3 Test conditions and setup:

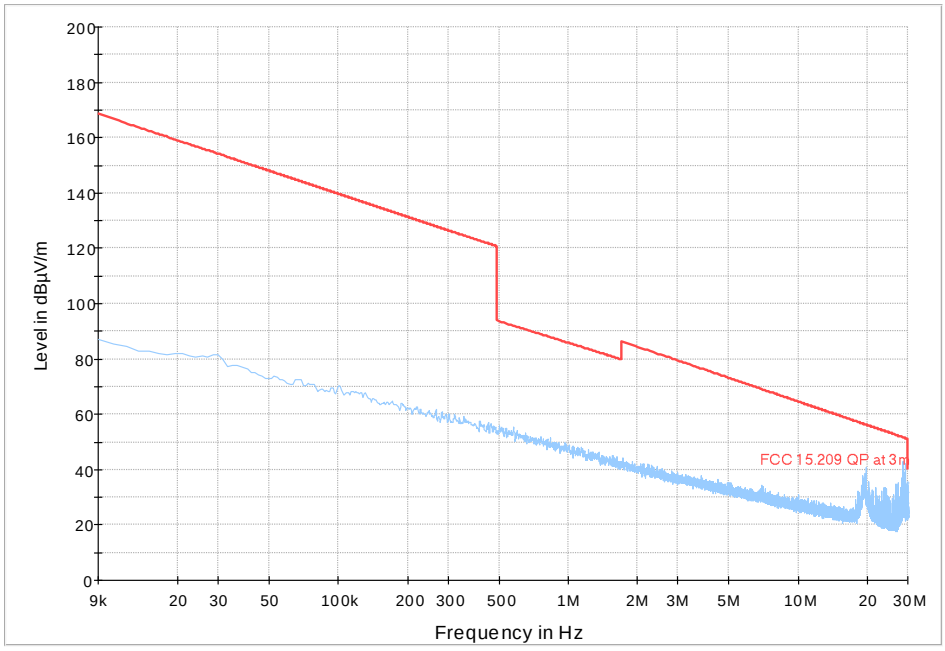
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23.8° C	2, 4	ZWAVE	5 VDC

8.4.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1	919.8MHz	9kHz – 30MHz	See section 8.4.2	Pass
2		30MHz – 1GHz	See section 8.4.2	Pass
3		1GHz -3GHz	See section 8.4.2	Pass
4		3GHz – 18GHz	See section 8.4.2	Pass
5	921.4MHz	9kHz – 30MHz	See section 8.4.2	Pass
6		30MHz – 1GHz	See section 8.4.2	Pass
7		1GHz -3GHz	See section 8.4.2	Pass
8		3GHz – 18GHz	See section 8.4.2	Pass

8.4.5 Measurement Plots:

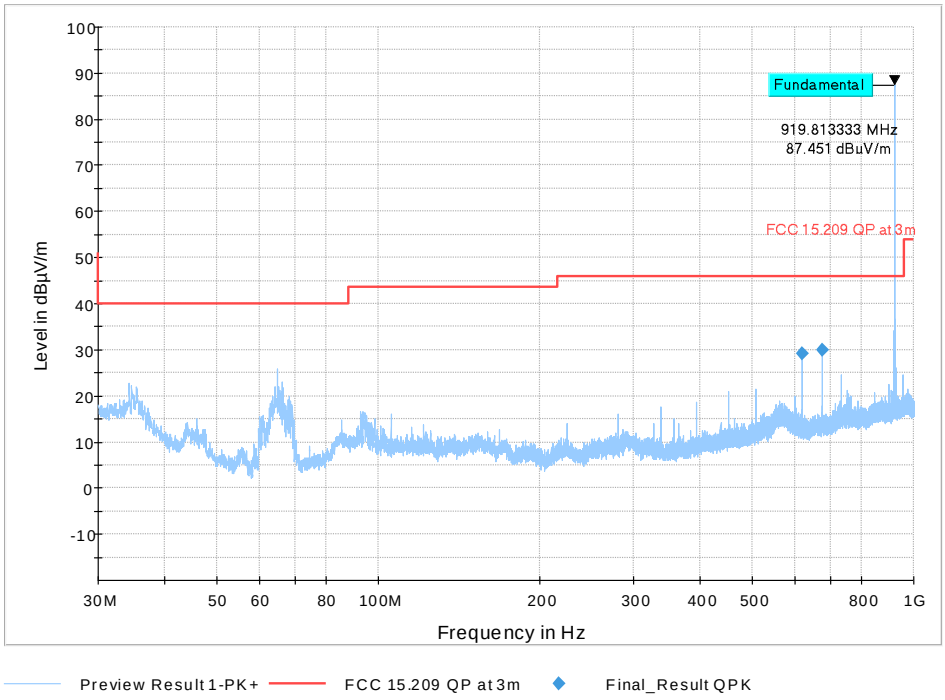
Plot #1 Radiated Emissions: 9 KHz – 30 MHz		
Modulation: ZWAVE	**Channel: 919.8 MHz**	**100% Duty Cycle**



Plot #2 Radiated Emissions: 30 MHz – 1GHz		
Modulation: ZWAVE	**Channel: 919.8 MHz**	**100% Duty Cycle**

Final_Result

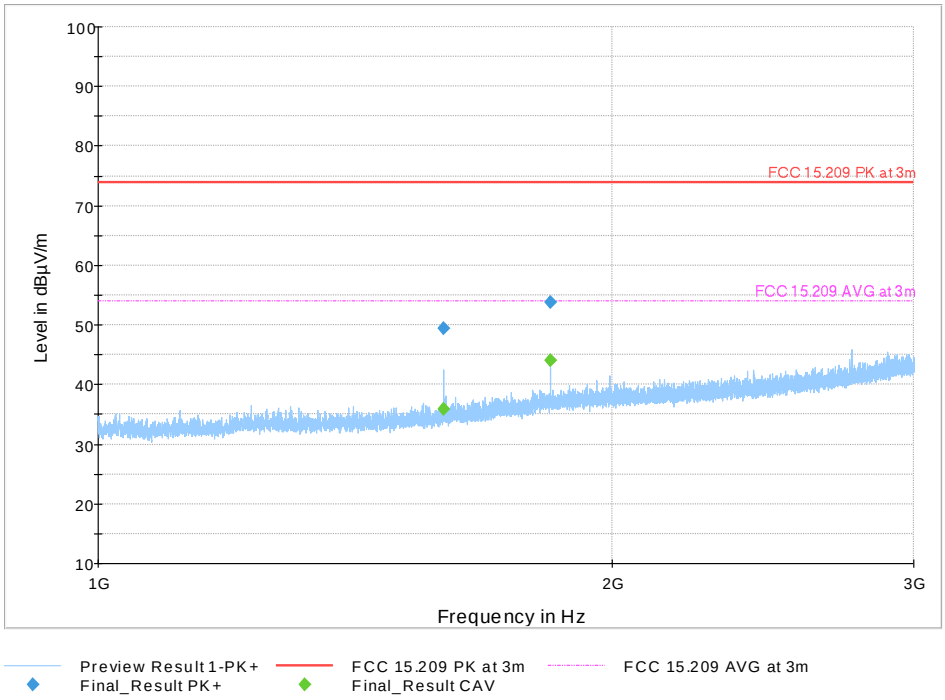
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
618.693	29.07	46.02	16.95	500.0	120.000	174.0	H	8.0	-13.2	
674.953	30.07	46.02	15.95	500.0	120.000	159.0	H	10.0	-11.8	



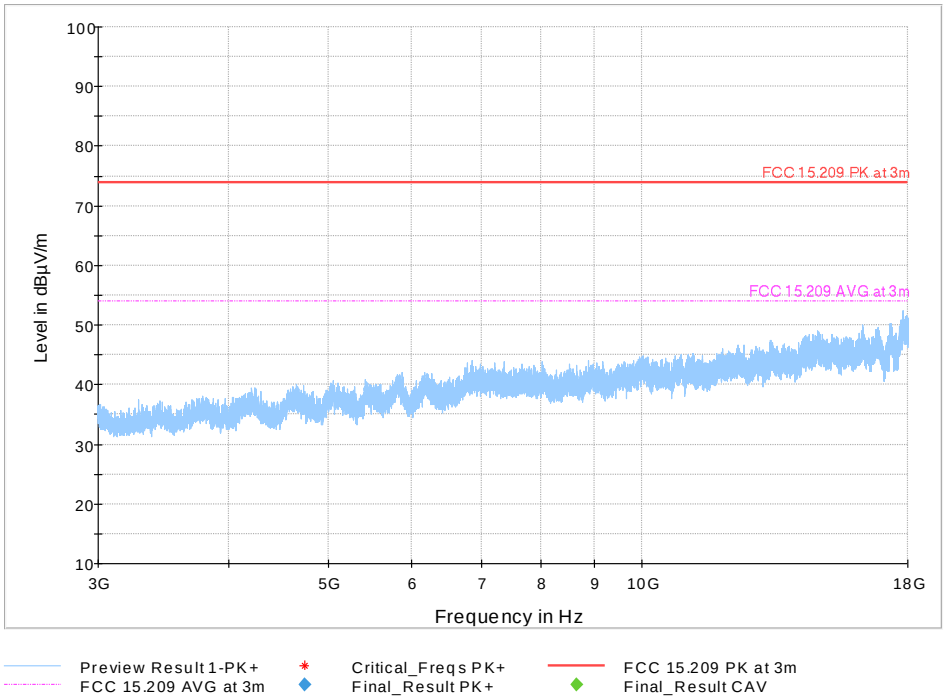
Plot #3 Radiated Emissions: 1-3 GHz		
Modulation: ZWAVE	**Channel: 919.8 MHz**	**100% Duty Cycle**

Final_Result

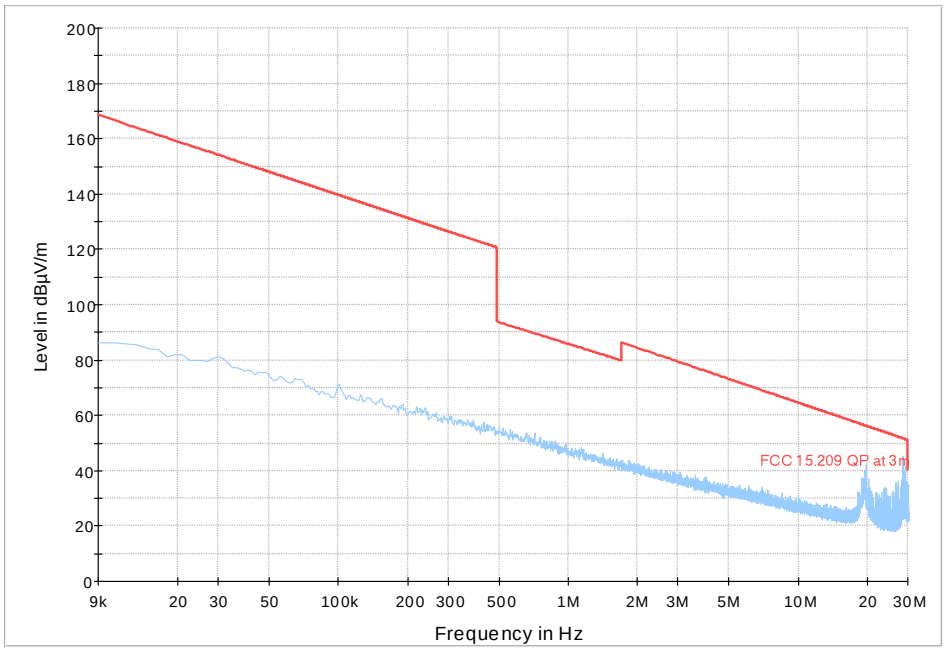
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
1592.857	---	35.93	53.98	18.05	500.0	1000.000	100.0	V	148.0	29.3	
1592.857	49.44	---	73.98	24.54	500.0	1000.000	100.0	V	148.0	29.3	
1839.571	---	44.07	53.98	9.91	500.0	1000.000	278.0	V	234.0	30.9	
1839.571	53.75	---	73.98	20.23	500.0	1000.000	278.0	V	234.0	30.9	



Plot #4 Radiated Emissions: 3-18 GHz		
Modulation: ZWAVE	**Channel: 919.8 MHz**	**100% Duty Cycle**



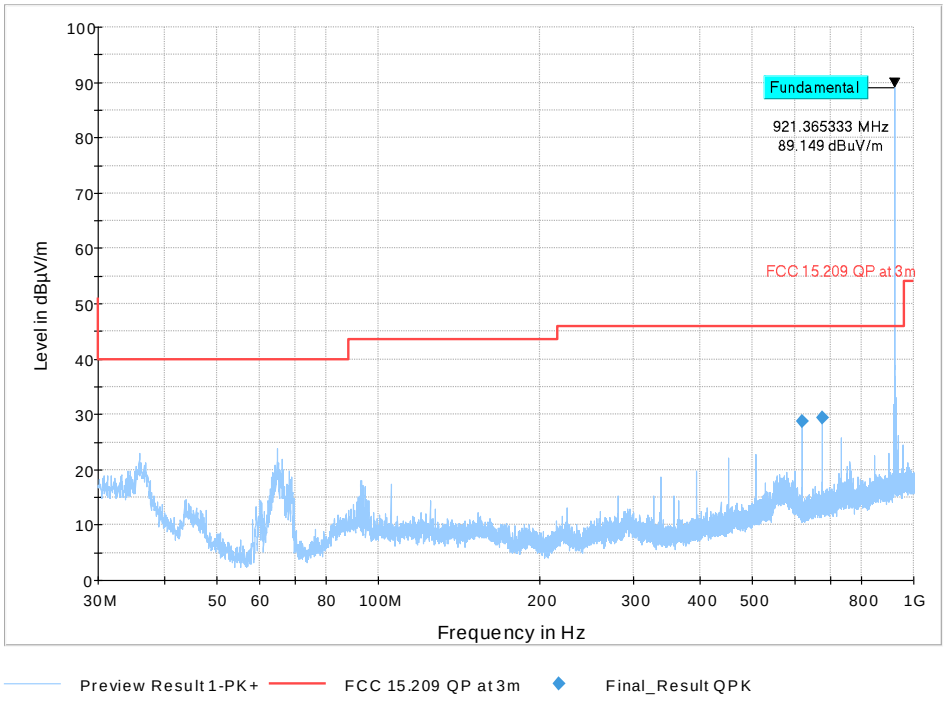
Plot #5 Radiated Emissions: 9 KHz – 30 MHz		
Modulation: ZWAVE	**Channel: 921.4 MHz**	**100% Duty Cycle**



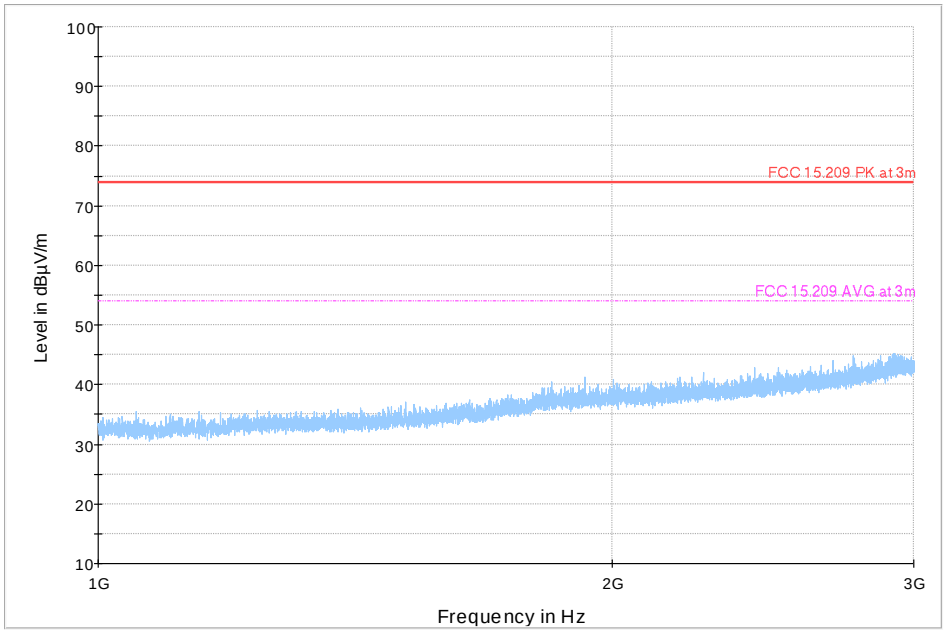
Plot #6 Radiated Emissions: 30 MHz – 1GHz		
Modulation: ZWAVE	**Channel: 921.4 MHz**	**100% Duty Cycle**

Final_Result

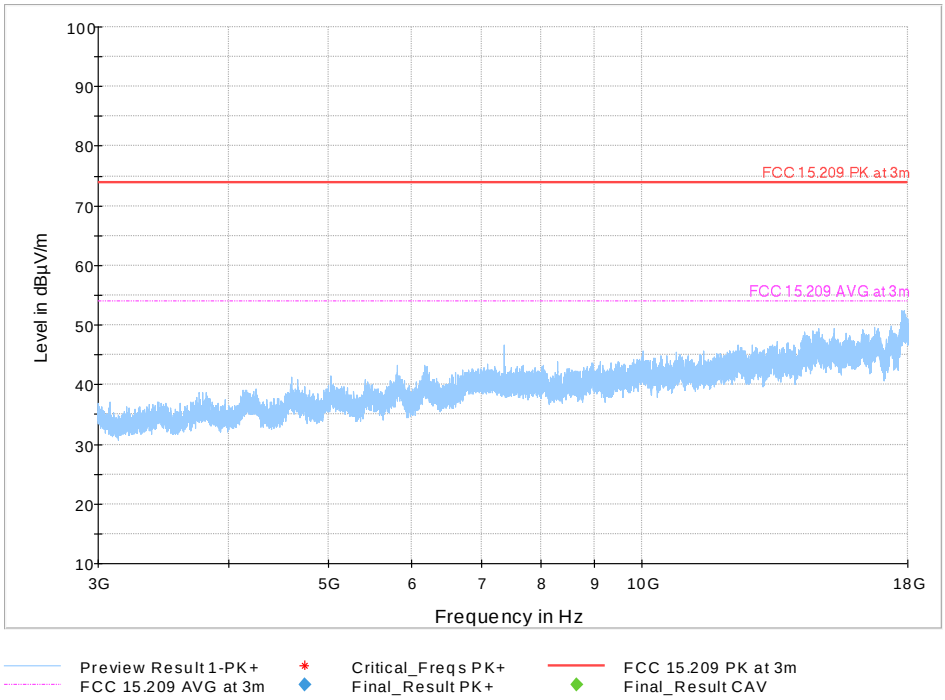
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
618.693	28.78	46.02	17.24	500.0	120.000	201.0	H	10.0	-13.2	
674.953	29.46	46.02	16.56	500.0	120.000	159.0	H	10.0	-11.8	



Plot #7 Radiated Emissions: 1-3 GHz		
Modulation: ZWAVE	**Channel: 921.4 MHz**	**100% Duty Cycle**



Plot #8 Radiated Emissions: 3-18 GHz		
Modulation: ZWAVE	**Channel: 921.4 MHz**	**100% Duty Cycle**



8.5 AC Power line Conducted Emissions according to CFR 47 Part 15.107

Spectrum Analyzer Setting	
Frequency band	150 kHz – 30 MHz
Resolution Bandwidth	9 kHz
Detector (Exploratory Measurements)	Peak, Average
Detector (Final Measurements)	Quasi-Peak, Average
Trace Mode	Max Hold
Step Size	4 kHz
Measurement Time	20 ms

8.5.1 Measurement Procedure:

- The EUT and accessories are placed on a non-conducting table 80 cm above the horizontal ground plane and 40 cm from the vertical ground plane.
- Cables that hang closer than 40 cm to the ground plane are gathered into a 30 cm to 40 cm long bundle.
- The power cable of the EUT is connected to the LISN.
- The 6 highest emissions within 20 dB of the limit are noted.

8.5.2 Limits:

Class A Limits		
Frequency of emission (MHz)	**Conducted Limit (dBµV)**	
	Quasi-peak	**Average**
0.15-0.5	79	66
0.5-30	73	60

Class B Limits		
Frequency of emission (MHz)	**Conducted Limit (dBµV)**	
	Quasi-peak	**Average**
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency

8.5.3 Test Summary:

Environmental Conditions	
Ambient Temperature:	23.9° C
Relative Humidity:	40%
Atmospheric Pressure:	1012 mbar

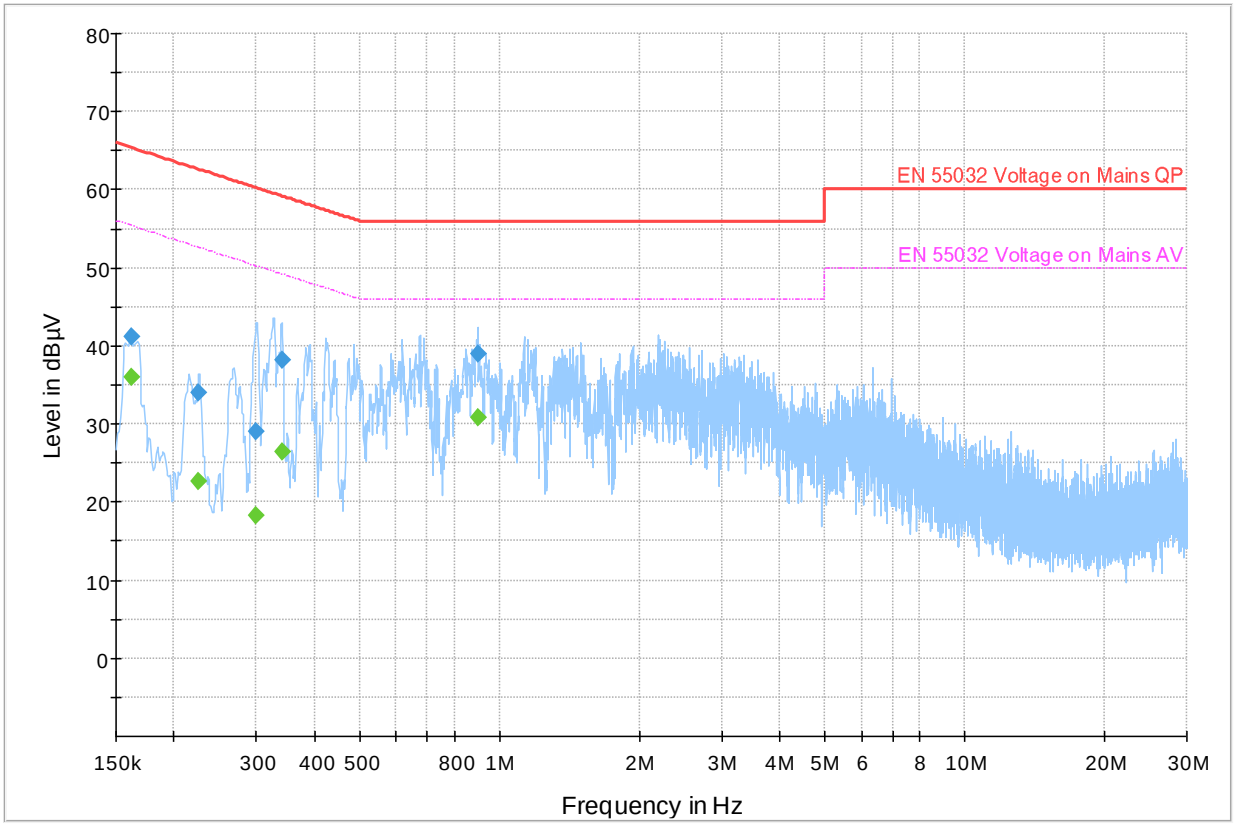
Test Results							
Plot #	**EUT Set-Up #**	**EUT operating mode**	**Detector (Peak / AVG / QP)**	**Line Under Test**	**Power Supply Input**	**Comments**	**Result**
1	2	RX Mode	Peak & AVG	Line &Return	110V AC	-	Pass
2	4	RX Mode	Peak & AVG	Line &Return	110V AC	-	Pass

8.5.4 Measurement Plots:

Plot # 1

Final_Result

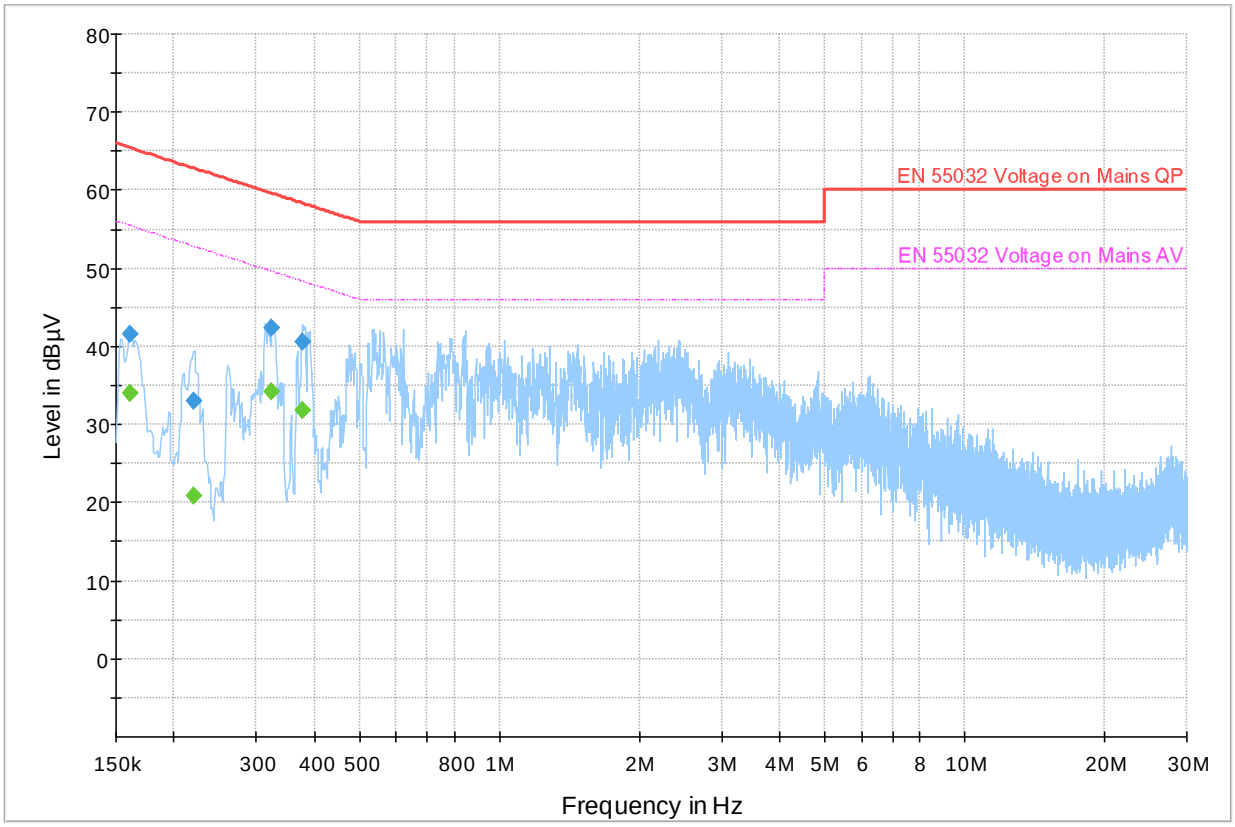
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)	Comment
0.162	---	36.06	55.38	19.31	500.0	9.000	L1	GND	10.5	
0.162	41.24	---	65.38	24.14	500.0	9.000	L1	GND	10.5	
0.226	---	22.74	52.61	29.86	500.0	9.000	L1	GND	10.1	
0.226	33.91	---	62.61	28.70	500.0	9.000	L1	GND	10.1	
0.300	29.04	---	60.23	31.20	500.0	9.000	N	GND	10.1	
0.300	---	18.25	50.23	31.99	500.0	9.000	N	GND	10.1	
0.341	---	26.46	49.18	22.72	500.0	9.000	L1	GND	10.0	
0.341	38.16	---	59.18	21.02	500.0	9.000	L1	GND	10.0	
0.899	39.07	---	56.00	16.93	500.0	9.000	L1	GND	10.0	
0.899	---	30.80	46.00	15.20	500.0	9.000	L1	GND	10.0	



Plot # 2

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)	Comment
0.161	---	34.01	55.43	21.42	500.0	9.000	L1	GND	10.5	
0.161	41.48	---	65.43	23.95	500.0	9.000	L1	GND	10.5	
0.220	32.96	---	62.81	29.84	500.0	9.000	N	GND	10.2	
0.220	---	20.77	52.81	32.03	500.0	9.000	N	GND	10.2	
0.325	---	34.18	49.58	15.40	500.0	9.000	L1	GND	10.0	
0.325	42.28	---	59.58	17.30	500.0	9.000	L1	GND	10.0	
0.377	40.50	---	58.34	17.85	500.0	9.000	L1	GND	10.0	
0.377	---	31.76	48.34	16.59	500.0	9.000	L1	GND	10.0	



9 Test setup photos

Setup photos are included in supporting file name: “EMC_QOLSY-006-20001_15.249_Setup_Photos_R1.pdf”

10 Test Equipment And Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
PASSIVE LOOP ANTENNA	ETS LINDGREN	6507	00161344	3 YEARS	10/26/2017
BILOG ANTENNA	TESEO	CBL 6141B	41106	3 YEARS	11/01/2017
HORN ANTENNA	ETS.LINDGREN	3115	00035111	3 YEARS	04/17/2019
HORN ANTENNA	ETS LINDGREN	3117	00169547	3 YEARS	09/01/2020
HORN ANTENNA	ETS LINDGREN	3116C	00169535	3 YEARS	09/24/2017
WIDEBAND RADIO COMMUNICATION	R&S	CMW500	109825	3 YEARS	02/12/2018
SIGNAL ANALYZER	R&S	FSV 40	101022	2 YEARS	07/15/2019
COMPACT DIGITAL BAROMETER	CONTROL COMPANY	10510-922	200236891	3 YEARS	04/13/2020
DIGITAL THRMOMETER	CONTROL COMPANY	36934-164	191871994	2 YEARS	01/10/2019
LINE IMPEDANCE STABILIZATION NETWORK	FCC	FCC-LISN-50-25-2-08	08014	3 YEARS	07/19/2019

Note: Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated “N/A” for cal status either do not specifically require calibration or is internally characterized before use.

11 History

Date	Template Revision	Changes to report	Prepared by
2020-10-15	EMC_QOLSY-006-20001_15.249	Initial Version	Yuchan Lu
2020-10-28	EMC_QOLSY-006-20001_15.249_R1	Delete IC ID and Canada references, Updated Field strength setting information	Yuchan Lu

<<< The End >>>