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Qolsys
TEST REPORT

SCOPE OF WORK
EMC TESTING – SRF RADIO CARD

REPORT NUMBER
104022271LEX-001

ISSUE DATE

11/27/2019

PAGES
38

DOCUMENT CONTROL NUMBER
Non-Specific EMC Report Shell Rev. December 2017

EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 104022271LEX-001
Project Number: G104022271

Report Issue Date: 11/27/2019

Model(s) Tested: SRF Radio Card

Standards: FCC Part 15.231
RSS-210 Issue 9

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Dr.
Lexington, KY 40510
USA

Client:
Qolsys
1900 the Alameda Ste 420
San Jose, CA 95126-1437
USA

Report prepared by

Ben Coolbear,
Engineer

Report reviewed by

Bryan Taylor,
Engineering Team Leader

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Page	Test full name	FCC Reference	IC Reference	Result
8	Duty Cycle Correction Factor	ANSI C63.10: 2013	ANSI C63.10: 2013	---
9	Transmission Timing Measurements	§ 15.231(a)	RSS-210 (A1.1.1)	Pass
11	Occupied Bandwidth	§ 15.231(c)	RSS-210 (A1.1.3)	Pass
14	Radiated Emissions	§ 15.231(b)	RSS-210 (A1.1.2)	Pass
25	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.2)	Pass
31	Conducted Emission Limits	§ 15.207	RSS-Gen (7.2.4)	Pass

3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Qolsys
Address:	1900 the Alameda Ste 420 San Jose, CA 95126-1437 USA
Contact:	Mark Skeen
Telephone:	1+(408)857-8415
Email:	markjskeen@gmail.com
Manufacturer Information	
Manufacturer Name:	Qolsys
Manufacturer Address:	1900 the Alameda Ste 420 San Jose, CA 95126-1437 USA

4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	SRF Radio Card
Model Number	QS-SRF319
Serial Number	DUT#1
Receive Date	08/01/2019
Test Start Date	08/01/2019
Test End Date	11/26/2019
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	5 VDC /1 A (Battery or AC power adapter)
Number of Phases	1
Description of Equipment Under Test (provided by client)	
SRC Module which transmits at 319.5MHz	

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Normal Operation TX 319.5MHz Signal
2	SRF Card Continuously transmitting, via a command issued from a test laptop.
3	Transmitter in idle mode

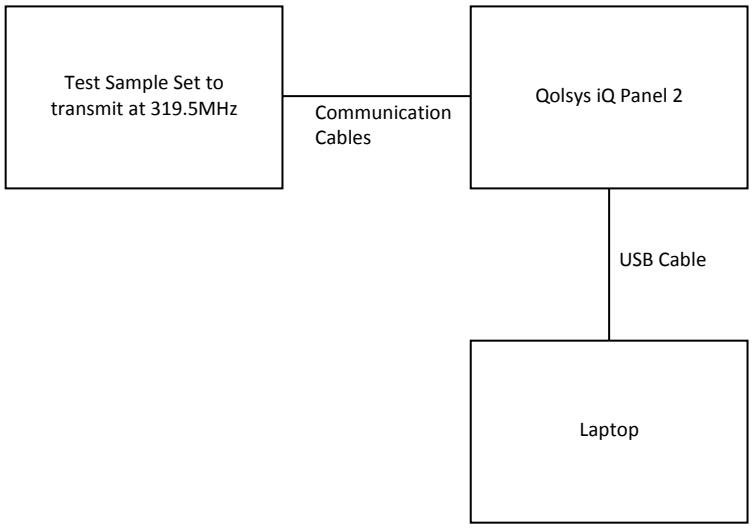
5 System Setup and Method

5.1 Method:

Configuration as required by ANSI C63.4:2014, and ANSI C63.10:2013.

Cables					
Qty	**Description**	**Length**	**Shielding**	**Ferrites**	**Termination**
1	Communication Cables	15cm	No	No	iQ Panel2
1	USB Cable	0.5m	Yes	None	Laptop

5.2 EUT Block Diagram:



6 Duty Cycle Correction Factor

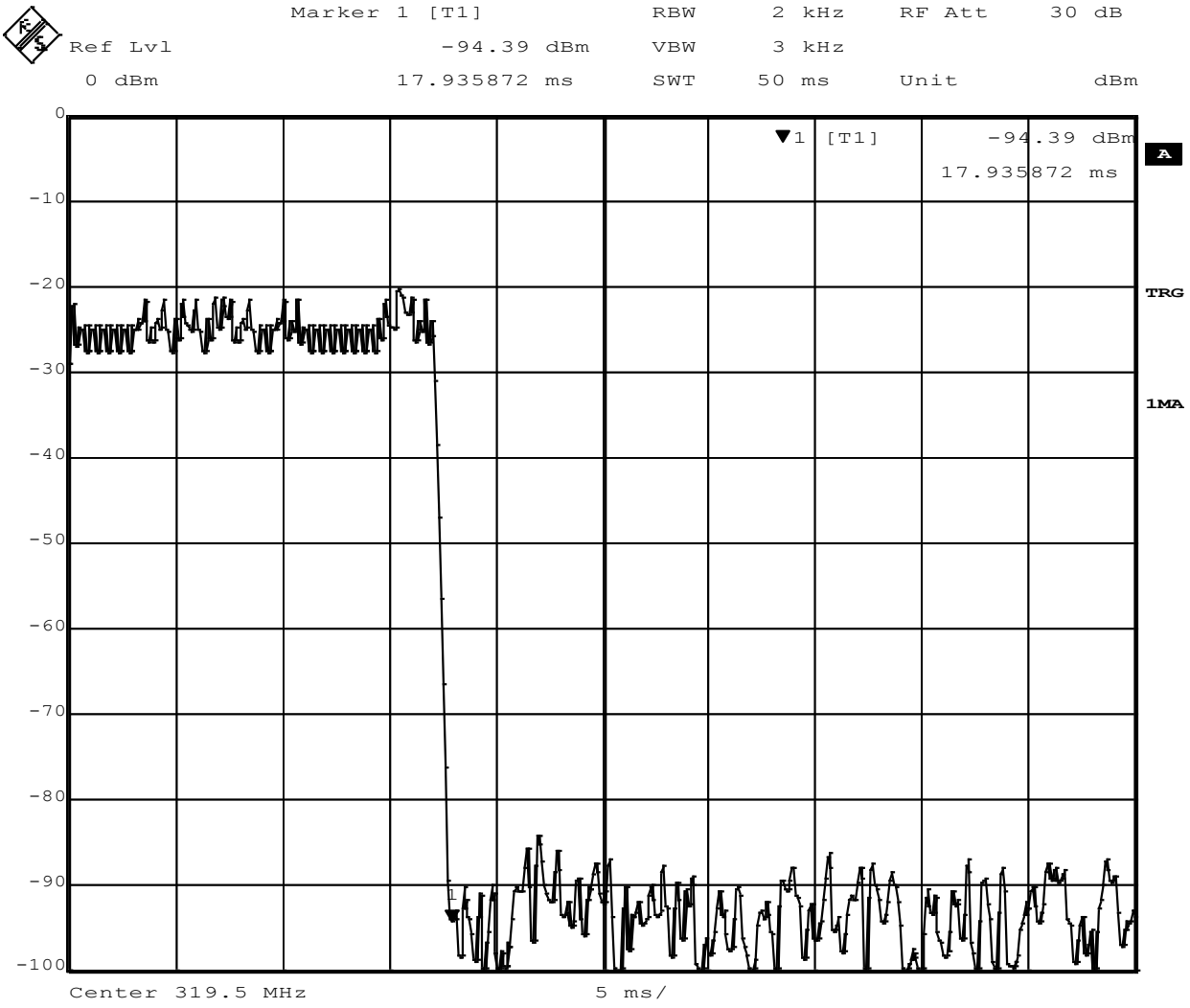
6.1 Test Procedure

ANSI C63.10: 2013 Section 7.5 was followed for measuring the duty cycle and calculating the duty cycle correction factor. When necessary the duty cycle correction factor was used to compute the average value of pulsed emissions during the radiated testing.

6.2 Test Equipment Used:

Description	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	Rohde & Schwarz	FSEK	10/12/2018	10/12/2019

6.3 Duty Cycle Correction Factor Results (319.5MHz):



Pulse On Time = 17.93mS
DCF = 20log (17.93mS/100mS) = -14.93

7 Transmission Timing

§ 15.231(a):

The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

7.1 Test Procedure

The sample was set up in its normal operating mode. A small antenna connected to a spectrum analyzer was placed in close proximity to the sample. The scope was configured to trigger when the sample transmitted data. Conditions 1, 2, and 3 above were used to evaluate compliance.

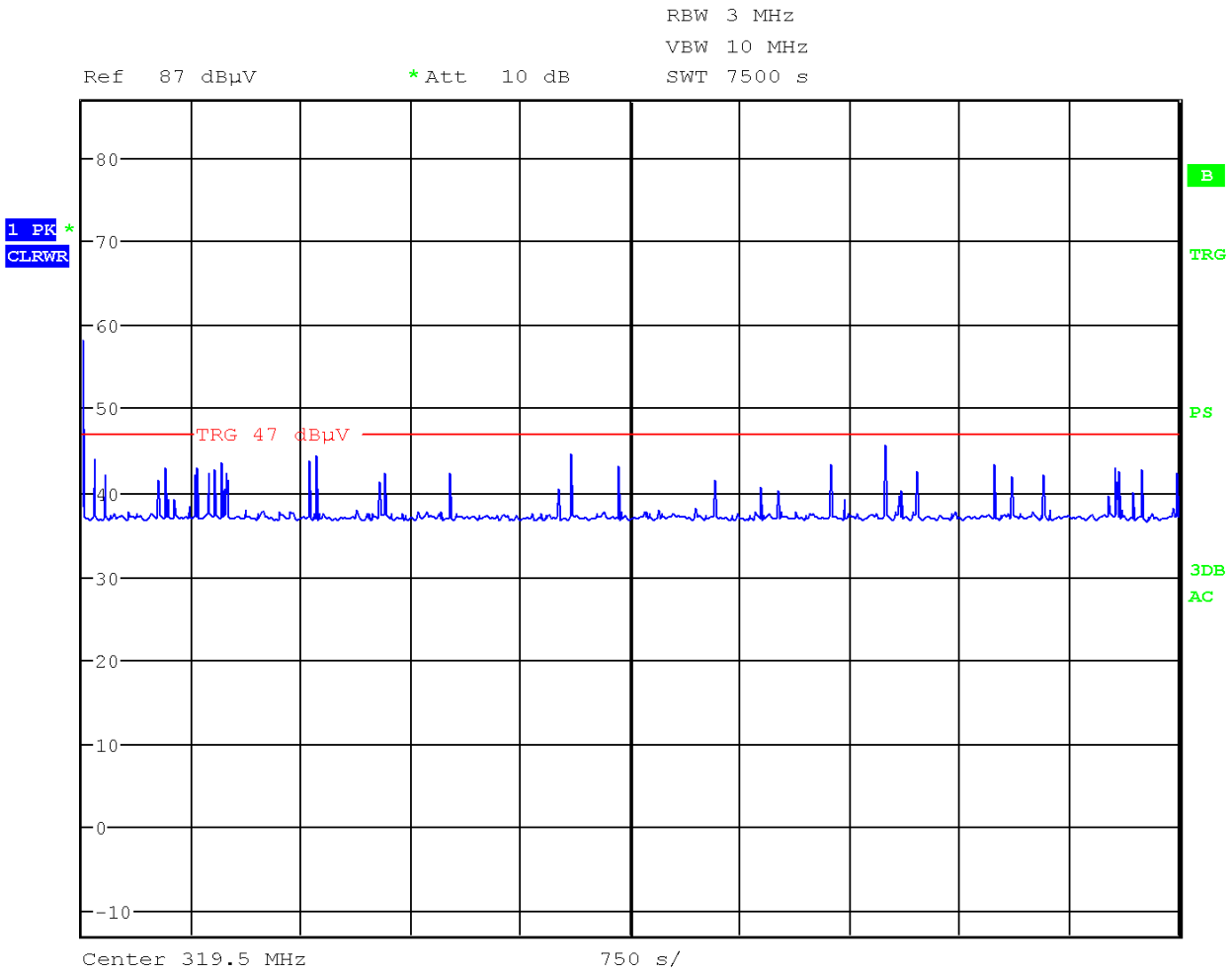
7.2 Test Equipment Used:

Description	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	Rohde & Schwarz	FSEK	10/12/2018	10/12/2019

7.1 Transmission Timing Results

The device is used in a security system and is automatically triggered when a door or window is opened. The transmitter automatically stops transmitting within 5 second of activation

No transmissions occurred during the one hour sweep.



8 Occupied Bandwidth

8.1 Test Limits

§ 15.231(c): The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

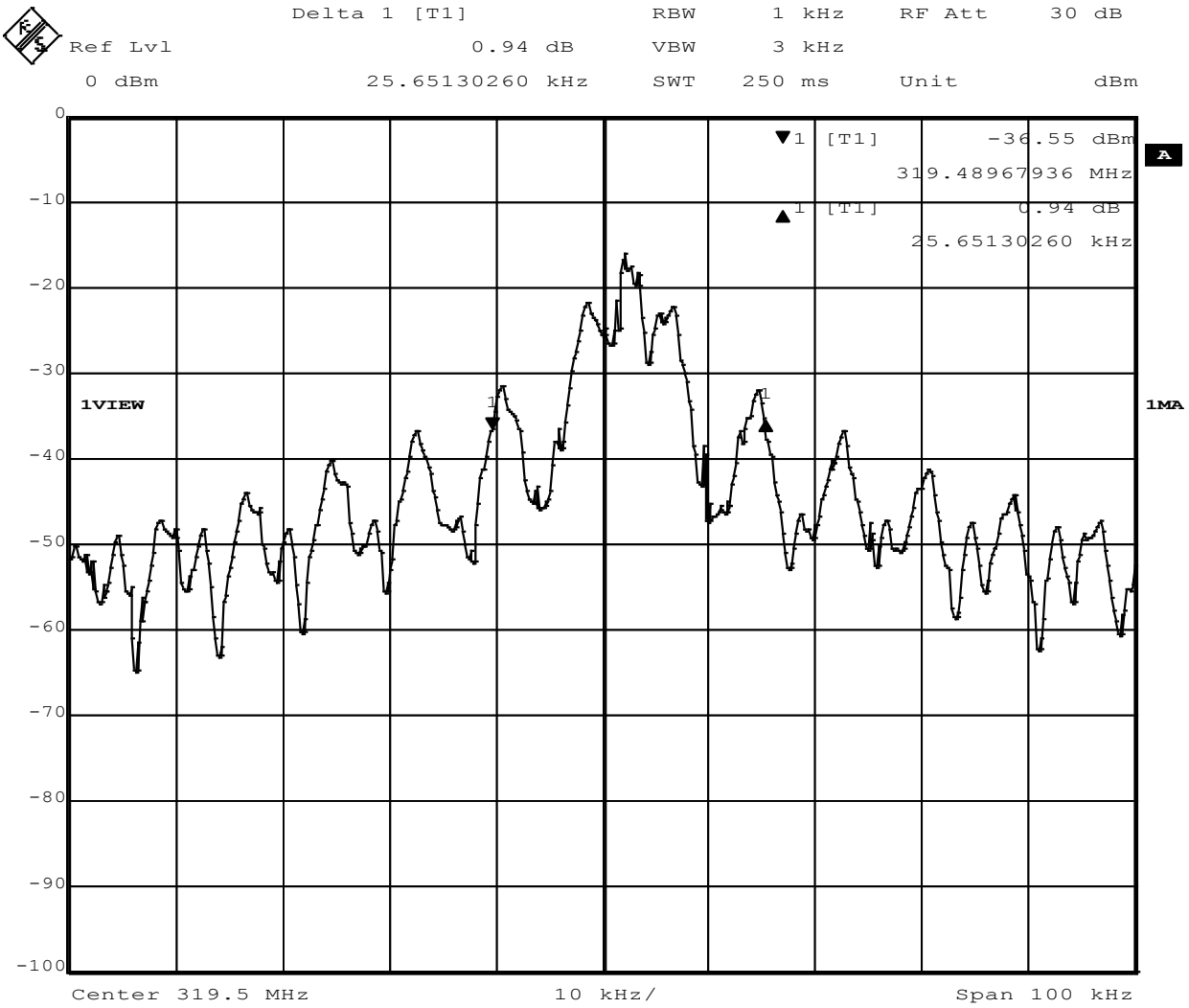
8.2 Test Procedure

ANSI C63.10: 2013

8.3 Test Equipment Used:

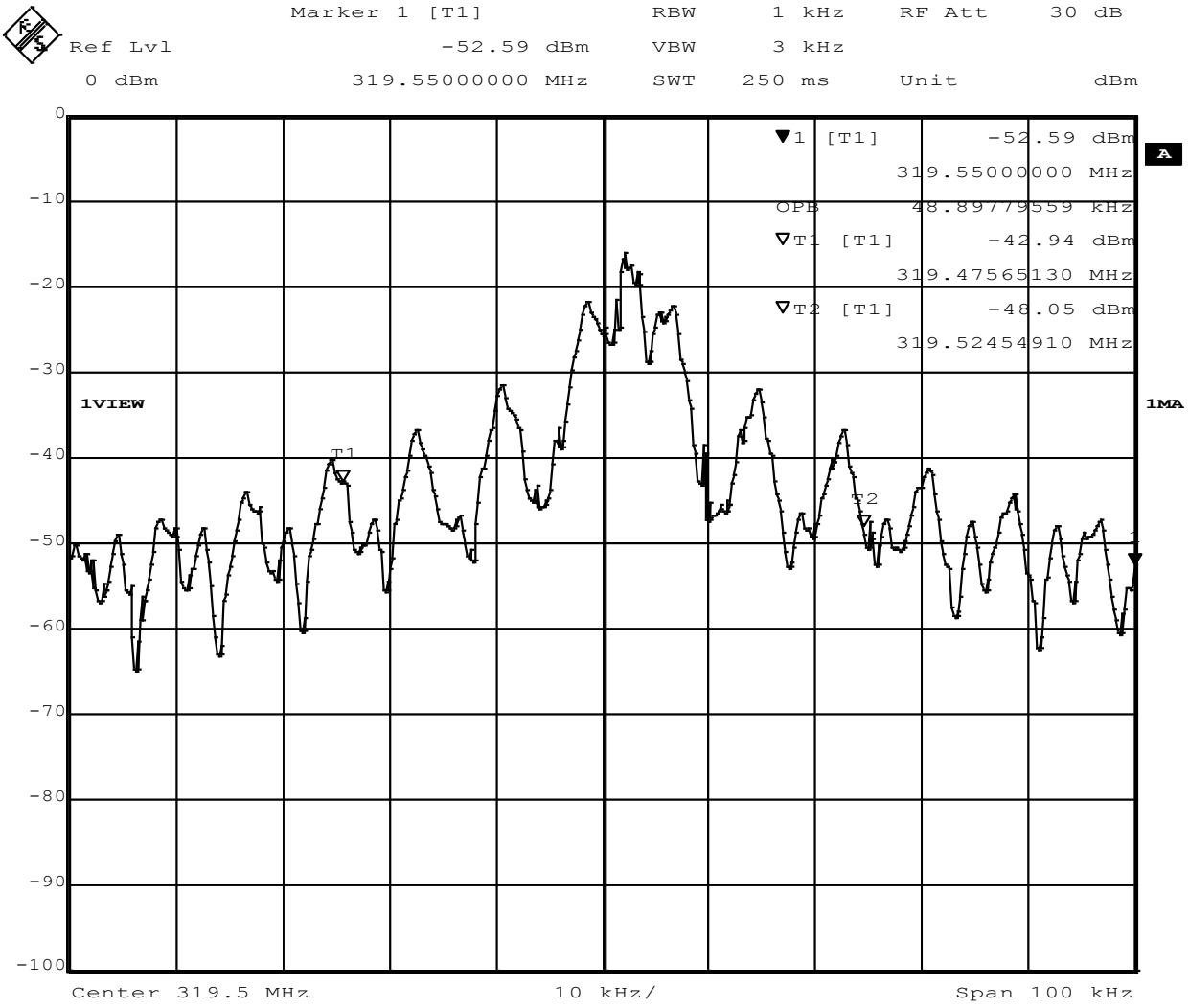
Description	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	Rohde & Schwarz	FSEK	10/12/2018	10/12/2019

8.4 Results: 20dB Bandwidth Measurement



319.5MHz 20dB Bandwidth = 25.65kHz

8.5 Results: 99% dB Bandwidth Measurement



319.5MHz 99% Bandwidth = 48.89kHz

9 Radiated Emissions (Transmitter)

9.1 Test Limits

§ 15.231(b): The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	[1]1,250 to 3,750	[1]125 to 375
174-260	3,750	375
260-470	[1]3,750 to 12,500	[1]375 to 1,250
Above 470	12,500	1,250

[1]Linear interpolations.

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

Part 15.205(a): Restricted Bands of Operations

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	2655–2900	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	[2]
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

Part 15.209(a): Field Strength Limits for Restricted Bands of Operation

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

9.2 Test Procedure

ANSI C63.10: 2013

9.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBμV/m
RA = Receiver Amplitude in dBμV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBμV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBμV/m
Level in μV/m = Common Antilogarithm [(38.78 dBμV/m)/20] = 86.89 μV/m

9.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESU40	9/18/2019	9/18/2020
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/26/2018	11/26/2019
Bilog Antenna	3133	ETS	3142C	5/13/2019	5/13/2020
Horn Antenna	00154521	ETS	3117	6/7/2019	6/7/2020
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use
EMC Software	Version 9.15.02	Rohde&Schwarz	EMC32	Time of Use	Time of Use
High Pass Filter	1	Wainwright	WHKX12-2533.85-2710-18000-40SS	Time of Use	Time of Use

9.5 Test Results:

The fundamental emission at 319.5MHz met the limit for the fundamental frequency from FCC Part 15.231(b). All spurious emissions not falling into the restricted bands met the limits outlined in FCC Part 15.231(b). Additionally, all emissions falling within restricted bands of operation were found to be below the limit specified in Part 15.209(a). The emissions listed in the following tables are the worst case emissions and were investigated with the sample positioned in three orthogonal axis in order to report the highest possible field strength.

Fundamental Peak Measurements

Power Setting	Frequency (MHz)	Peak Meas. (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Polarity (V/H)	Azimuth (deg)
1	319.5	76.102	95.89	-19.788	102	H	61.75
1	319.5	64.782	95.89	-31.108	103	V	150.5

Fundamental Average Measurements

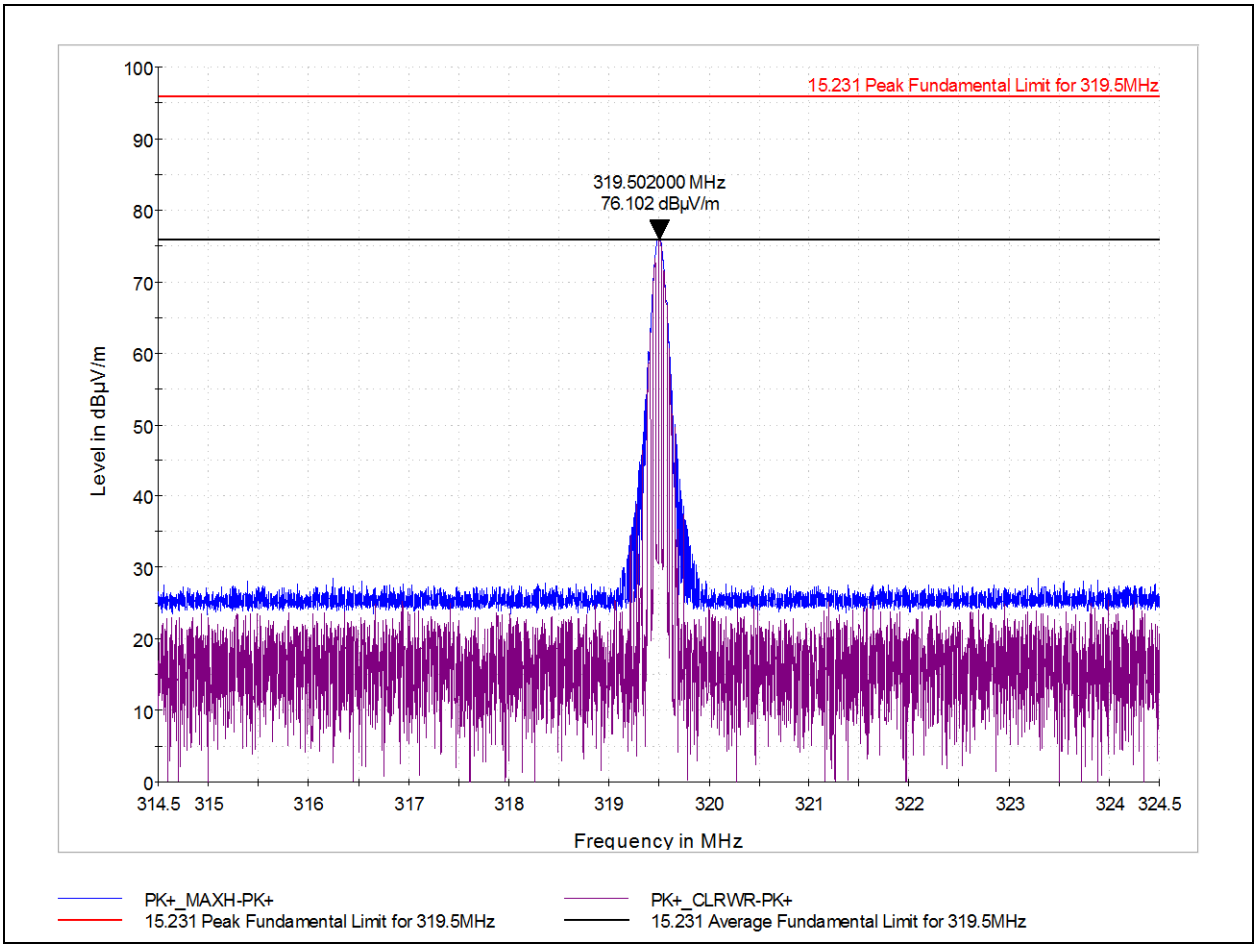
Power Setting	Frequency (MHz)	Peak Meas. (dBuV/m)	Duty Cycle Correction Factor (dB)	Average Meas. (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Polarity (V/H)	Azimuth (deg)
1	319.5	76.102	-14.93	61.172	75.89	14.718	102	H	61.75
1	319.5	64.782	-14.93	49.852	75.89	26.038	103	V	150.5

Test Personnel:	Ben Coolbear, Bryan Taylor	Test Date:	11/26/2019
Supervising/Reviewing Engineer:			15.231 / RSS-210 Fundamental
(Where Applicable)	NA	Limit Applied:	Limit for 319.5MHz
Product Standard:	FCC Part 15.231 / RSS-210	Ambient Temperature:	22.4 °C
Input Voltage:	120 VAC into iQ Panel	Relative Humidity:	31.4 %
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	987.5mbar

Deviations, Additions, or Exclusions: None

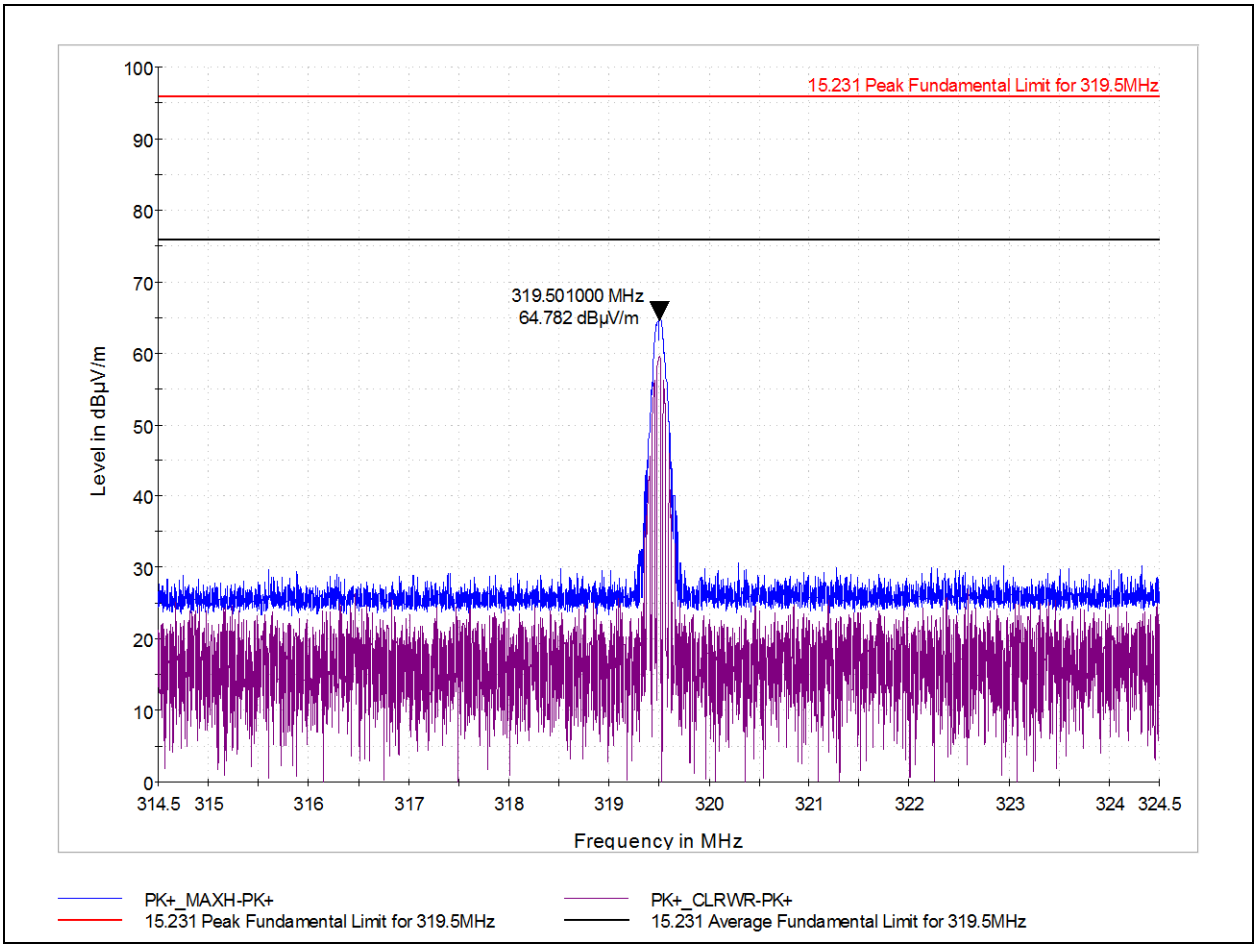
Note: Average emission was calculated by applying the duty cycle correction factor of -14.93 to the MaxPeak measurement

Fundamental Sweep (Horizontal Polarity)



Fundamental at 319.5MHz
Peak Detection
Power Setting of 1
Peak Detection
Horizontal Polarity

Fundamental Sweep (Vertical Polarity)



Fundamental at 319.5MHz
Peak Detection
Power Setting of 1
Peak Detection
Vertical Polarity

Spurious Peak Measurements (15.231 Limit)

Power Setting	Frequency (MHz)	Peak Meas. (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Polarity (V/H)	Azimuth (deg)
1	961.1	41.553	75.89	-34.337	105	H	132
1	674.96	38.671	75.89	-37.219	120	V	145
1	863.42	40.068	75.89	-35.822	103	V	150.5
1	1277.5	44.23	75.89	-31.66	309	H	344
1	1597.5	41.65	75.89	-34.24	257	H	278
1	1916.5	37.39	75.89	-38.5	175	H	0
1	2145	45.22	75.89	-30.67	294	V	205
1	2281	42.64	75.89	-33.25	301	V	182
1	2432	39.74	75.89	-36.15	291	H	13
1	2682.5	53.62	75.89	-22.27	213	V	209
1	3186	42.24	75.89	-33.65	388	V	243
1	3514.5	40.98	75.89	-34.91	247	V	317

Spurious Average Measurements (15.231 Limit)

Power Setting	Frequency (MHz)	Peak Meas. (dBuV/m)	Duty Cycle Correction Factor (dB)	Average Meas. (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Polarity (V/H)	Azimuth (deg)
1	961.1	41.553	-14.93	26.623	55.89	29.267	105	H	132
1	674.96	38.671	-14.93	23.741	55.89	32.149	120	V	145
1	863.42	40.068	-14.93	25.138	55.89	30.752	103	V	150.5
1	1277.5	44.23	-14.93	29.3	55.89	26.59	309	H	344
1	1597.5	41.65	-14.93	26.72	55.89	29.17	257	H	278
1	1916.5	37.39	-14.93	22.46	55.89	33.43	175	H	0
1	2145	45.22	-14.93	30.29	55.89	25.6	294	V	205
1	2281	42.64	-14.93	27.71	55.89	28.18	301	V	182
1	2432	39.74	-14.93	24.81	55.89	31.08	291	H	13
1	2682.5	53.62	-14.93	38.69	55.89	17.2	213	V	209
1	3186	42.24	-14.93	27.31	55.89	28.58	388	V	243
1	3514.5	40.98	-14.93	26.05	55.89	29.84	247	V	317

Test Personnel:	Ben Coolbear, Bryan Taylor	Test Date:	11/26/2019
Supervising/Reviewing Engineer:			15.231 / RSS-210 Spurious Limit for
(Where Applicable)	NA	Limit Applied:	319.5MHz
Product Standard:	FCC Part 15.231 / RSS-210	Ambient Temperature:	22.4 °C
Input Voltage:	120 VAC into iQ Panel	Relative Humidity:	31.4 %
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	987.5mbar

Deviations, Additions, or Exclusions: None
Note: Average emission was calculated by applying the duty cycle correction factor of -14.93 to the MaxPeak measurement

Spurious Peak Measurements (Restricted Band Limit)

Power Setting	Frequency (MHz)	Peak Meas. (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Polarity (V/H)	Azimuth (deg)
1	961.1	41.553	74	-32.447	105	H	132
1	1597.5	41.65	74	-32.35	257	H	278
1	2281	42.64	74	-31.36	301	V	182

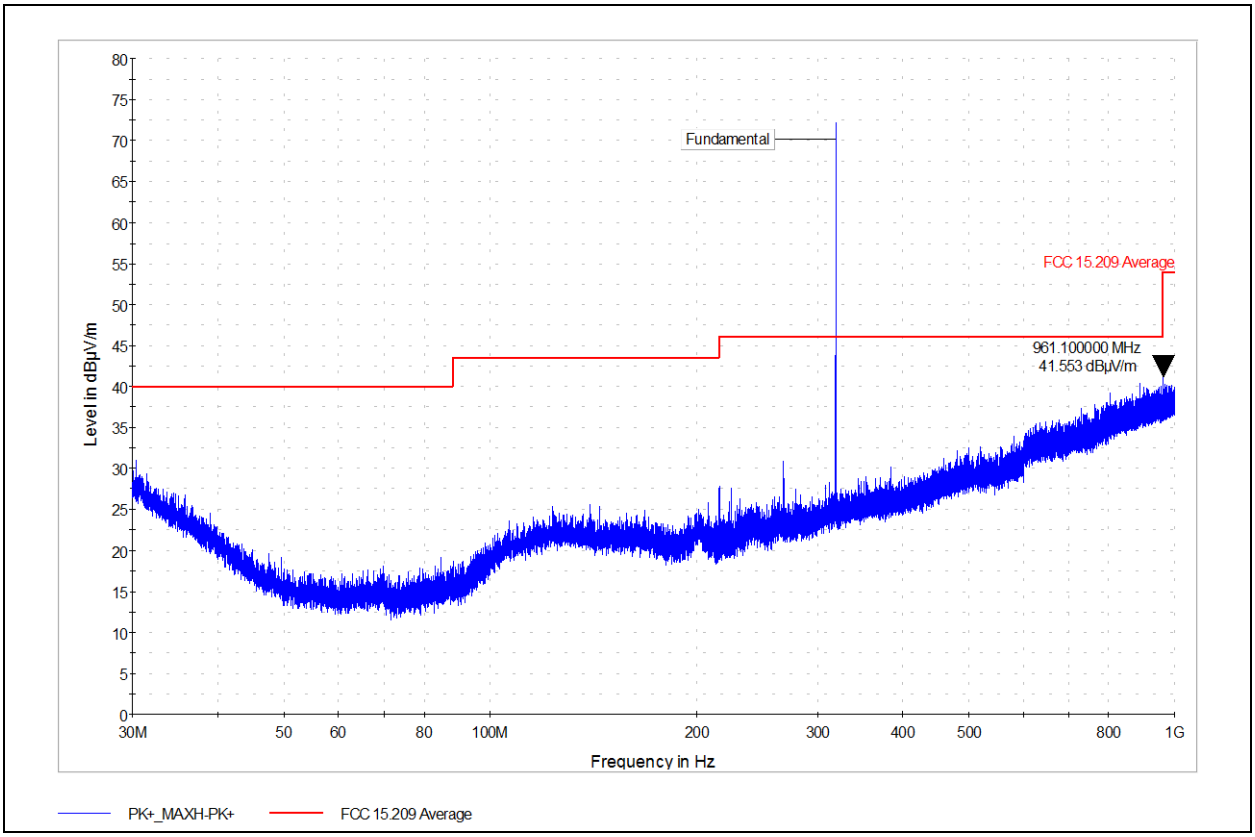
Spurious Average Measurements (Restricted Band Limit)

Power Setting	Frequency (MHz)	Peak Meas. (dBuV/m)	Duty Cycle Correction Factor (dB)	Average Meas. (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Polarity (V/H)	Azimuth (deg)
1	961.1	41.553	-14.93	26.623	54	27.377	105	H	132
1	1597.5	41.65	-14.93	26.72	54	27.28	257	H	278
1	2281	42.64	-14.93	27.71	54	26.29	301	V	182

Test Personnel:	Ben Coolbear, Bryan Taylor	Test Date:	11/26/2019
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	15.231 / RSS-210 Spurious Limit for 319.5MHz
Product Standard:	FCC Part 15.231 / RSS-210	Ambient Temperature:	22.4 °C
Input Voltage:	120 VAC into iQ Panel	Relative Humidity:	31.4 %
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	987.5mbar

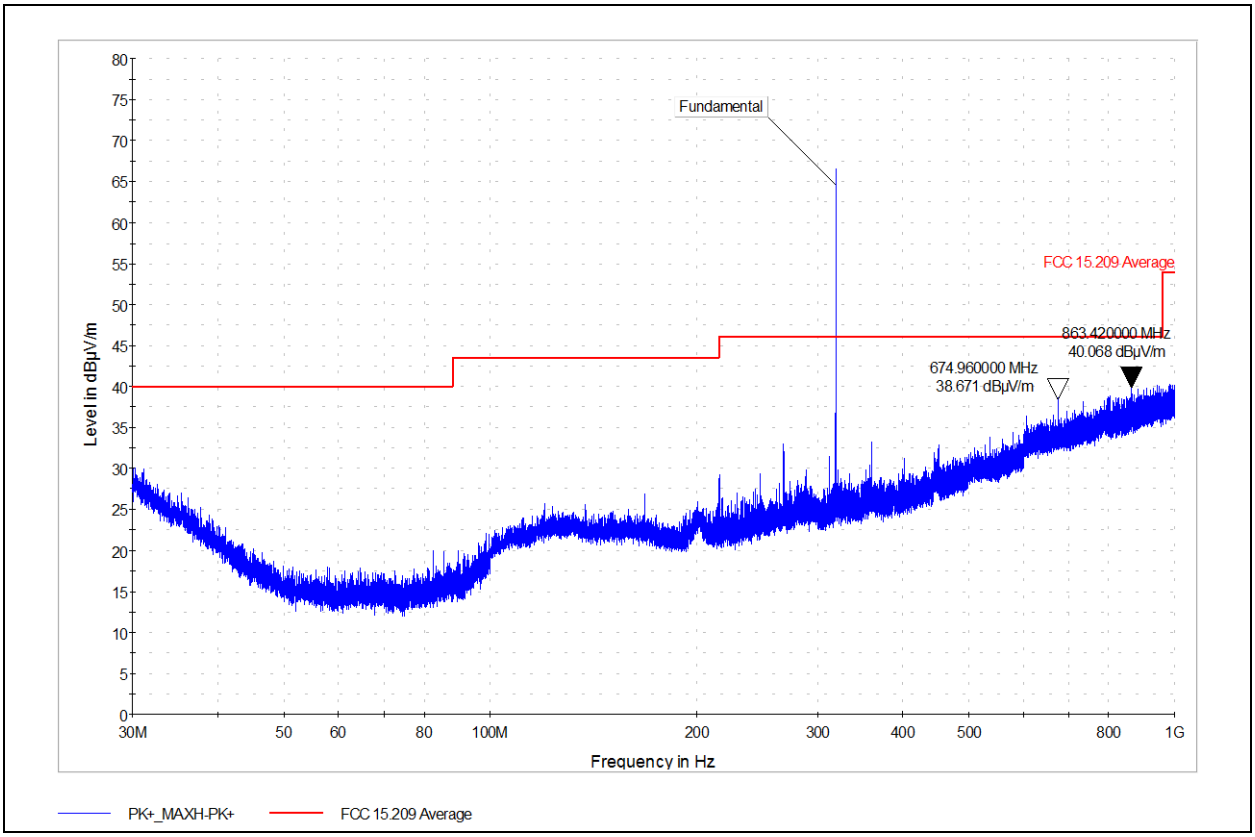
Deviations, Additions, or Exclusions: None
Note: Average emission was calculated by applying the duty cycle correction factor of -14.93 to the MaxPeak measurement

Spurious Sweep (Horizontal Polarity)



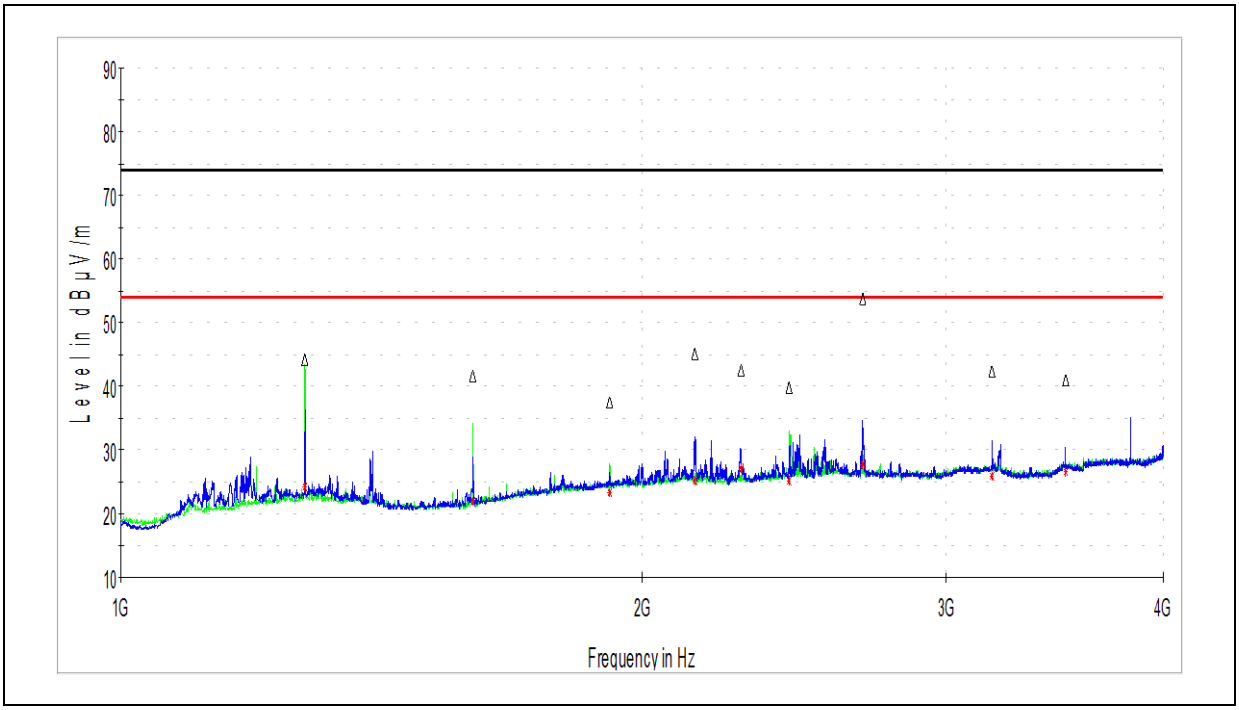
Power Setting of 1
Peak Detection
Horizontal Polarity

Spurious Sweep (Vertical Polarity)



Power Setting of 1
Peak Detection
Vertical Polarity

Spurious Sweep (Vertical and Horizontal Polarity)



Power Setting of 1
Peak Detection
Vertical Polarity (Blue Trace)
Horizontal Polarity (Green Trace)

9.6 Antenna Requirement per FCC Part 15.203

Test Limits

§ 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

9.7 Results:

The sample tested met the antenna requirement. The antenna made use of a unique antenna connector not commonly available.

10 Radiated Emissions, (Idle Mode)

10.1 Method

Tests are performed in accordance with ANSI C63.4:2014.

TEST SITE: 10m ALSE

Site Designation: 10m Chamber

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	3.9dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.0dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.7dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required.

10.2 Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG

Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

10.3 Test Equipment Used:

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	9/18/2018	9/18/2019
Bilog Antenna	3133	ETS	3142C	5/13/2019	5/13/2020
Horn Antenna	3780	ETS Lindgren	3117	6/7/2019	6/7/2020
System Controller	4096	ETS Lindgren	2090	Verify at Time of Use	Verify at Time of Use
System Controller	3957	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
3m Cable Antenna→Preamp	3074			11/26/2018	11/26/2019
3m Cable Preamplifier	3918	Rohde & Schwarz	TS-PR18	11/26/2018	11/26/2019
3m Cable Preamp→Chamber	2588			11/26/2018	11/26/2019
3m Cable Chamber→Control Room	2593			11/26/2018	11/26/2019
3m Cable Control Room→Receiver	2592			11/26/2018	11/26/2019

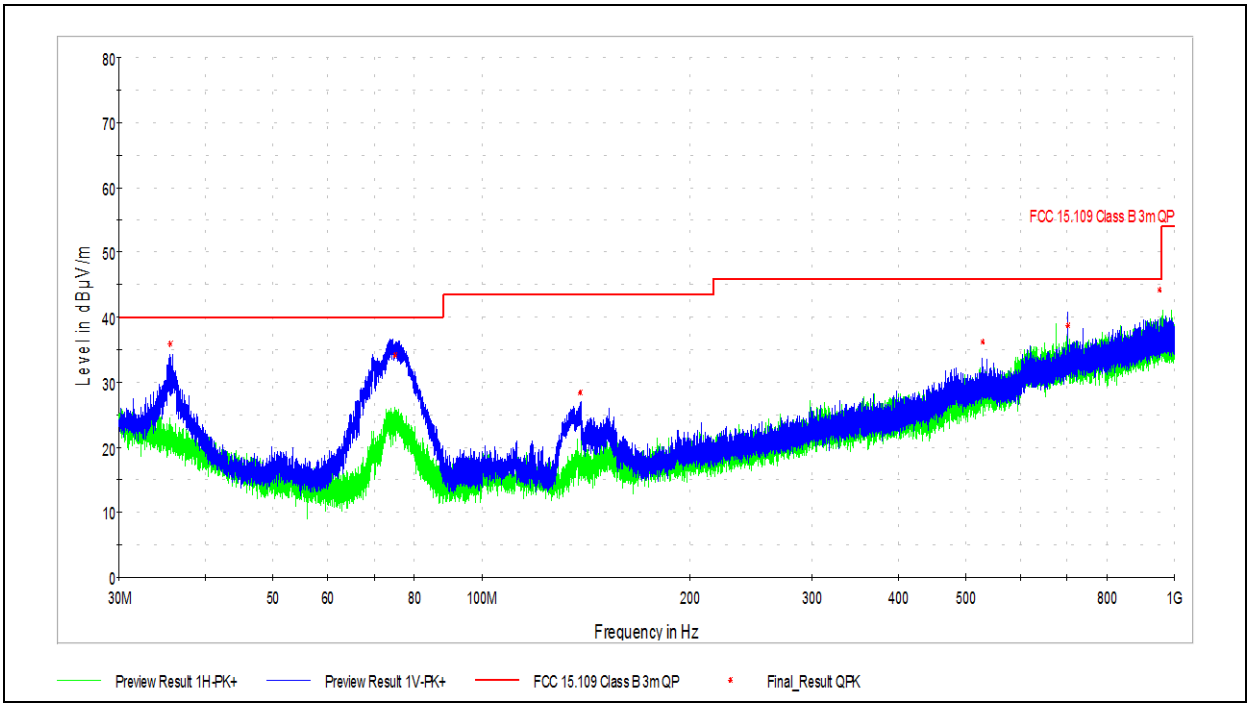
10.4 Software Utilized:

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

10.5 Results:

The sample tested was found to Comply.

10.6 Plots/Data: Radiated Emissions, 30MHz – 1GHz (Transmitters Idle)

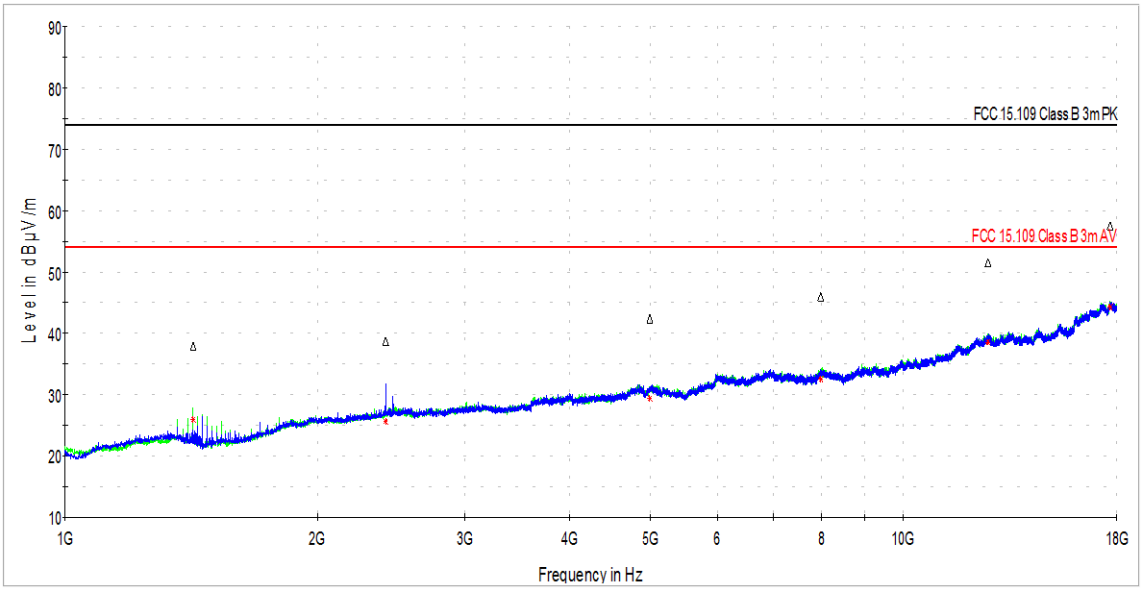


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.558000	35.86	40.00	4.14	120.000	109.8	V	293.0	20.8
75.080000	34.27	40.00	5.73	120.000	107.9	V	268.0	14.9
138.740000	28.35	43.52	15.17	120.000	104.6	V	186.0	15.2
528.830000	36.25	46.02	9.77	120.000	212.9	V	247.0	29.0
701.660000	38.76	46.02	7.26	120.000	224.5	V	128.0	31.0
951.540000	44.26	46.02	1.76	120.000	228.0	H	332.0	35.4

Test Personnel:	Ben Coolbear	Test Date:	08/01/2019
Supervising/Reviewing Engineer: (Where Applicable)	Bryan Taylor	Limit Applied:	Class B
Product Standard:	FCC Part 15B ICES-003 Issue 6	Ambient Temperature:	26.4 °C
Input Voltage:	120 VAC	Relative Humidity:	39.2 %
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	986.1 mbar

Deviations, Additions, or Exclusions: None

10.7 Plots/Data: Radiated Emissions, 1GHz – 18GHz (Transmitters Idle)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1420.500000	37.88	73.98	36.10	1000.000	100.0	H	268.0	-2.1
2411.000000	38.61	73.98	35.37	1000.000	100.0	V	284.0	3.1
4991.000000	42.29	73.98	31.69	1000.000	100.0	H	0.0	7.2
7972.500000	45.89	73.98	28.09	1000.000	100.0	H	108.0	11.6
12647.000000	51.54	73.98	22.44	1000.000	100.0	H	286.0	18.9
17689.500000	57.43	73.98	16.55	1000.000	128.0	H	96.0	25.1

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1420.500000	25.85	53.98	28.13	1000.000	100.0	H	268.0	-2.1
2411.000000	25.54	53.98	28.44	1000.000	100.0	V	284.0	3.1
4991.000000	29.41	53.98	24.57	1000.000	100.0	H	0.0	7.2
7972.500000	32.41	53.98	21.57	1000.000	100.0	H	108.0	11.6
12647.000000	38.56	53.98	15.42	1000.000	100.0	H	286.0	18.9
17689.500000	44.20	53.98	9.78	1000.000	128.0	H	96.0	25.1

Test Personnel:	Ben Coolbear	Test Date:	08/01/2019
Supervising/Reviewing Engineer: (Where Applicable)	Bryan Taylor	Limit Applied:	Class B
Product Standard:	FCC Part 15B ICES-003 Issue 6	Ambient Temperature:	26.4 °C
Input Voltage:	120 VAC	Relative Humidity:	39.2 %
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	986.1 mbar

Deviations, Additions, or Exclusions: None

11 Conducted Emissions

11.1 Method

Tests are performed in accordance with ANSI C63.4:2014, and ANSI C63.10:2013.

TEST SITE: Ground Plane

Site Designation: Ground Plane

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	3.1dB	3.4dB

As shown in the table above our conducted emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required.

11.2 Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBµV
RF = Reading from receiver in dBµV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBµV to µV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in µV
NF = Net Reading in dBµV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBµV
$UF = 10^{(49.1\ dB\mu V / 20)}$ = 285.1 µV/m

11.3 Test Equipment Used:

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	9/18/2018	9/18/2019
LISN	2508	Fischer Custom Communication	FCC-LISN-50-50-2M	4/10/2019	4/10/2020
Coaxial Cable (COND 3)	6026			11/26/2018	11/26/2019

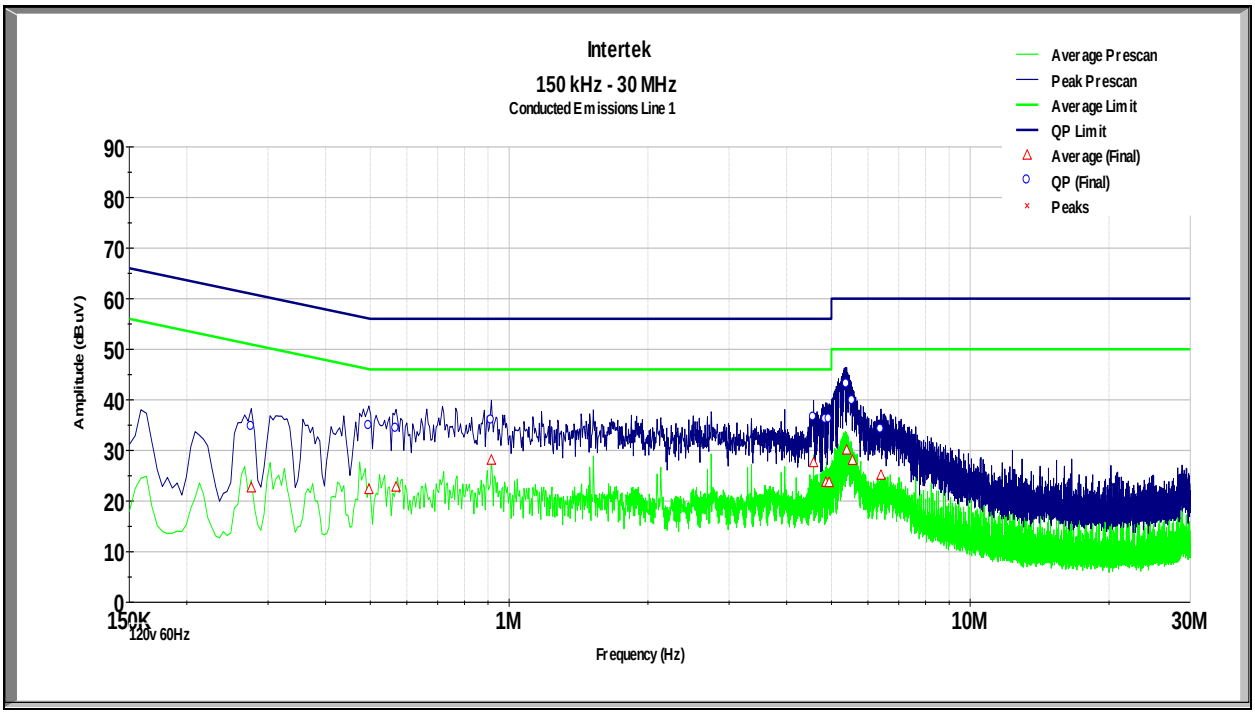
11.4 Software Utilized:

Name	Manufacturer	Version
TILE	ETS Lindgren	V7.0.6.545

11.5 Results:

The sample tested was found to Comply.

11.6 Plots/Data: Conducted Emissions (Idle Mode, Line 1)

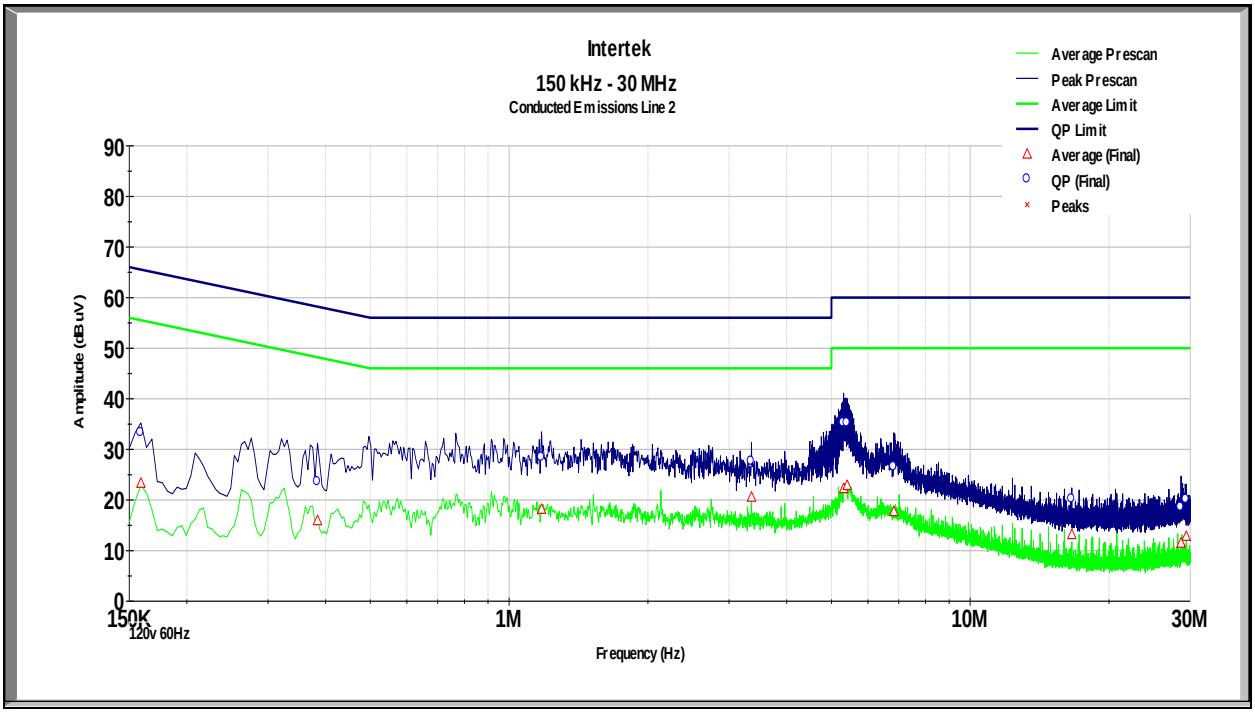


Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.276	34.642	62.400	27.758	22.579	52.400	29.821
0.497	34.802	56.100	21.298	22.263	46.100	23.837
0.569	34.286	56.000	21.714	22.738	46.000	23.262
0.915	35.901	56.000	20.099	28.073	46.000	17.927
4.574	36.476	56.000	19.524	27.578	46.000	18.422
4.862	36.079	56.000	19.921	23.674	46.000	22.326
4.942	36.120	56.000	19.880	23.625	46.000	22.375
5.397	43.008	60.000	16.992	30.044	50.000	19.956
5.555	39.750	60.000	20.250	28.024	50.000	21.976
6.405	34.092	60.000	25.908	25.064	50.000	24.936

Test Personnel:	Ben Coolbear	Test Date:	08/16/2019
Supervising/Reviewing Engineer: (Where Applicable)	Bryan Taylor	Limit Applied:	Class B
Product Standard:	FCC Part 15B ICES-003 Issue 6	Ambient Temperature:	26.4 °C
Input Voltage:	120V, 60Hz	Relative Humidity:	39.2 %
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	986.1 mbar

Deviations, Additions, or Exclusions: None

11.7 Plots/Data: Conducted Emissions (Idle Mode, Line 2)

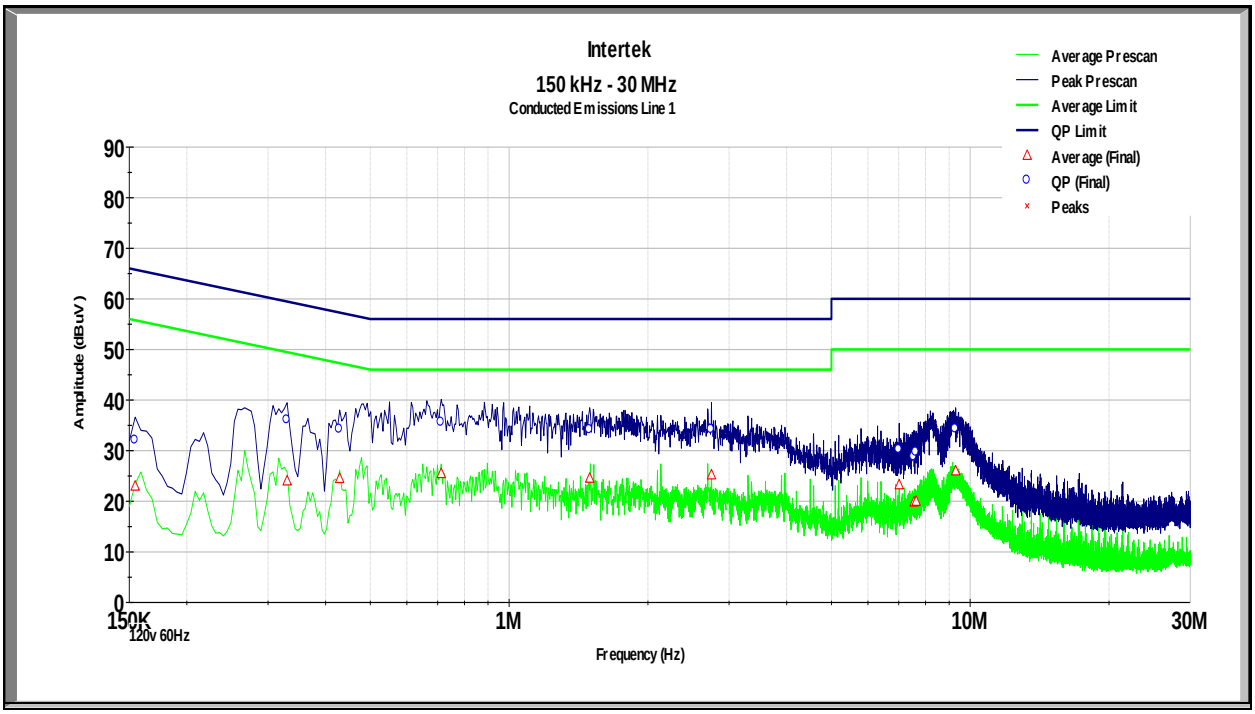


Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.159	33.243	65.743	32.500	23.270	55.743	32.473
0.384	23.536	59.314	35.778	15.895	49.314	33.419
1.176	28.348	56.000	27.652	18.147	46.000	27.853
3.354	27.574	56.000	28.426	20.543	46.000	25.457
5.316	35.150	60.000	24.850	22.227	50.000	27.773
5.410	35.135	60.000	24.865	22.863	50.000	27.137
6.828	26.472	60.000	33.528	17.679	50.000	32.321
16.614	20.124	60.000	39.876	13.140	50.000	36.860
28.657	18.480	60.000	41.520	11.462	50.000	38.538
29.418	20.004	60.000	39.996	12.808	50.000	37.192

Test Personnel:	Ben Coolbear	Test Date:	08/16/2019
Supervising/Reviewing Engineer: (Where Applicable)	Bryan Taylor	Limit Applied:	Class B
Product Standard:	FCC Part 15B ICES-003 Issue 6	Ambient Temperature:	26.4 °C
Input Voltage:	120V, 60Hz	Relative Humidity:	39.2 %
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	986.1 mbar

Deviations, Additions, or Exclusions: None

11.8 Plots/Data: Conducted Emissions (TX Mode, Line 1)

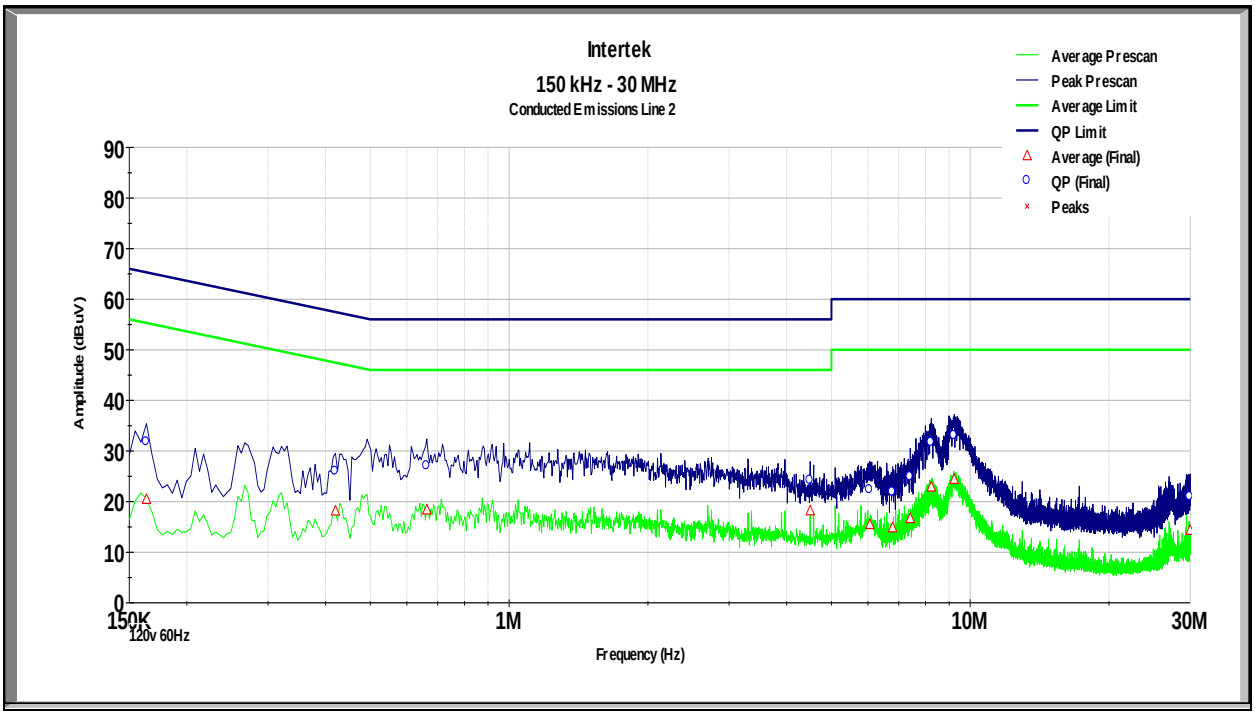


Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.155	31.998	65.871	33.873	22.984	55.871	32.888
0.330	35.980	60.857	24.877	23.996	50.857	26.861
0.429	34.142	58.029	23.887	24.483	48.029	23.545
0.713	35.539	56.000	20.461	25.463	46.000	20.537
1.496	34.018	56.000	21.982	24.553	46.000	21.447
2.747	34.105	56.000	21.895	25.222	46.000	20.778
7.017	30.119	60.000	29.881	23.254	50.000	26.746
7.553	28.691	60.000	31.309	19.831	50.000	30.169
7.635	29.600	60.000	30.400	19.977	50.000	30.023
9.300	34.213	60.000	25.787	25.970	50.000	24.030

Test Personnel:	Ben Coolbear	Test Date:	08/16/2019
Supervising/Reviewing Engineer: (Where Applicable)	Brayn Taylor	Limit Applied:	FCC Part 15.207
Product Standard:	FCC Part 15:207	Ambient Temperature:	26.4 °C
Input Voltage:	120V, 60Hz	Relative Humidity:	39.2 %
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	986.1 mbar

Deviations, Additions, or Exclusions: None

11.9 Plots/Data: Conducted Emissions (TX Mode, Line 2)



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.164	31.708	65.614	33.906	20.417	55.614	35.197
0.420	25.901	58.286	32.384	18.112	48.286	30.174
0.663	26.984	56.000	29.016	18.326	46.000	27.674
4.497	24.128	56.000	31.872	18.162	46.000	27.838
6.059	22.272	60.000	37.728	15.461	50.000	34.539
6.787	21.781	60.000	38.219	14.813	50.000	35.187
7.413	24.799	60.000	35.201	16.635	50.000	33.365
8.233	31.561	60.000	28.439	22.881	50.000	27.119
9.232	32.929	60.000	27.071	24.368	50.000	25.632
29.976	20.861	60.000	39.139	14.316	50.000	35.684

Test Personnel:	Ben Coolbear	Test Date:	08/16/2019
Supervising/Reviewing Engineer: (Where Applicable)	Bryan Taylor	Limit Applied:	FCC Part 15.207
Product Standard:	FCC Part 15.207	Ambient Temperature:	26.4 °C
Input Voltage:	120V, 60Hz	Relative Humidity:	39.2 %
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	986.1 mbar

Deviations, Additions, or Exclusions: None

12 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	±3.9dB	
Radiated emissions, 1 to 18 GHz	±4.2dB	
Radiated emissions, 18 to 40 GHz	±4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	±2.8dB	

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	11/27/2019	104022271LEX-001	**Error! Objects cannot be created from editing field codes.**	BCT	Original Issue