

Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 8:2010

&

FCC Part 15 Subpart C:2010
Unlicensed Intentional Radiators

on the

Elkay Communication Base Station



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Testing produced for

ELKAY®

Elkay Manufacturing Co.

See *Appendix A* for full customer & EUT details.





Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

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Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Report Scope

This report addresses the EMC testing and test results of the Elkay Communication Base Station, which is an interface between their line of water coolers and a cloud database. This unit is herein referred to as EUT (Equipment Under Test). Testing is performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:


RSS 210 Issue 8:2010
FCC Part 15 Subpart C:2014

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.


Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Summary


The results contained in this report relate only to the item(s) tested.

EUT FCC Certification #, FCC ID:	2AC8R-BSNAE
EUT Industry Canada Certification #, IC:	12430A-BSNAE
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Raymond Lee Au

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-Gen	Restricted Bands for intentional operation	QuasiPeak Average	Pass See Justification
FCC 15.207	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-Gen	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(a)1 RSS-210 A8.1(b)	Channel carrier separation	> 20dB Bandwidth	Pass
FCC 15.247(a)(1)i RSS-210 A8.1(c)	20dB BW < 250 kHz	≥ 50 channels	Pass
FCC 15.247(a)(1)i RSS-210 A8.1(c)	Average time of occupancy	≤ 0.4s/20s	Pass
FCC 15.247(a)(1)i RSS-210 A8.1(c)	Max 20dB Bandwidth	≤ 500 kHz	Pass
FCC 15.247(b)2 RSS-210 A8.4(1)	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS-210 A8.4(5)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-210 A8.5	Antenna conducted spurious	< 20 dBc	Pass
FCC 15.247(g) RSS-210 A8.1	FHSS compliance	Complies using continuous data.	Pass
FCC 15.247(h) RSS-210 A8.1	FHSS intelligence	LBT used. No other coordination used.	Pass
Overall Result			PASS

Client	Elkay Manufacturing Co.	
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Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

All tests were performed by Raymond Lee Au.

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

Justifications, Descriptions, Deviations & Notes

The following justifications for tests not performed or deviations from the above listed specifications apply:

For the antenna requirement specified in FCC 15.203 (RSS 210 section 5.5), the antenna uses a reverse SMA connector.


The EUT consists of a single 15.247 transmitter designed to operate between 902.7 MHz and 927.3 MHz.

For the Restricted Bands of operation, the EUT consists of a single 15.247 transmitter designed to operate between 902.7 MHz and 927.3 MHz.

The EUT is not a hybrid system; FCC 15.247 (f) does not apply.


The EUT was scanned in the three orthogonal axes for the worst case radiated emissions results. Testing was also performed with the antenna in the three orthogonal positions. The worst case results are presented in this report.

The antenna gain for the 15.247 transmitter is < 6dBi.

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Applicable Standards, Specifications and Methods

ANSI C63.4:2003	- Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2009	- American national standard for testing unlicensed wireless devices
CFR 47 FCC 15	- Code of Federal Regulations – Radio Frequency Devices
CISPR 22:2008	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
ICES-003:2012	- Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
ISO 17025:2005	- General Requirements for the competence of testing and calibration laboratories
RSS-GEN	General Requirements and Information for the Certification of Radio Apparatus
RSS 210:2010	- Issue 8: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power Licence-Exempt Radiocommunication Devices

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Sample calculation(s)


Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)

Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)

Margin = 8 dB

Document Revision Status

Release 1 - November 28, 2014
Initial release.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxillary Equipment.

BW – Bandwidth. Unless otherwise stated, this is refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity


EUT – Equipment Under Test

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line impedance stabilization network

NCR – No Calibration Required

RF – Radio Frequency


Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

Calibrations and Accreditations


The measurement site used is registered with Federal Communications Commission (FCC) and Industry Canada (IC). This site is calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The semi-anechoic chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

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Testing Environmental Conditions and Dates

Following were the environmental conditions in the facility during time of testing –

Date	Test	Init.	Temperature (°C)	Humidity (%)	Pressure (kPa)
Sept. 2 – 5 , 2014	All	RA	20-25°C	30-45%	100 -103kPa

Client	Elkay Manufacturing Co.	
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Detailed Test Results Section

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

20dB Bandwidth of Frequency Hopping Systems

Purpose

The purpose of this test is to find the 20dB bandwidth occupied by a hopping channel. The energy contained within the 20dB bandwidth must remain within the channel in which it transmits. This helps ensure the utilization of the frequency allocation is sufficiently narrow, and is not occupying excessive spectrum. It also helps to prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information


Limits & Method

The limits and requirements are as specified in FCC 15.247(a)(1)i & RSS-210 A8.1(c).

These include the following:

1. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
2. For frequency hopping systems operating in the 902-928 MHz band:
 - a. If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.
 - b. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.
3. For frequency hopping systems operating in the 902-928 MHz band:
 - a. If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.
 - b. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

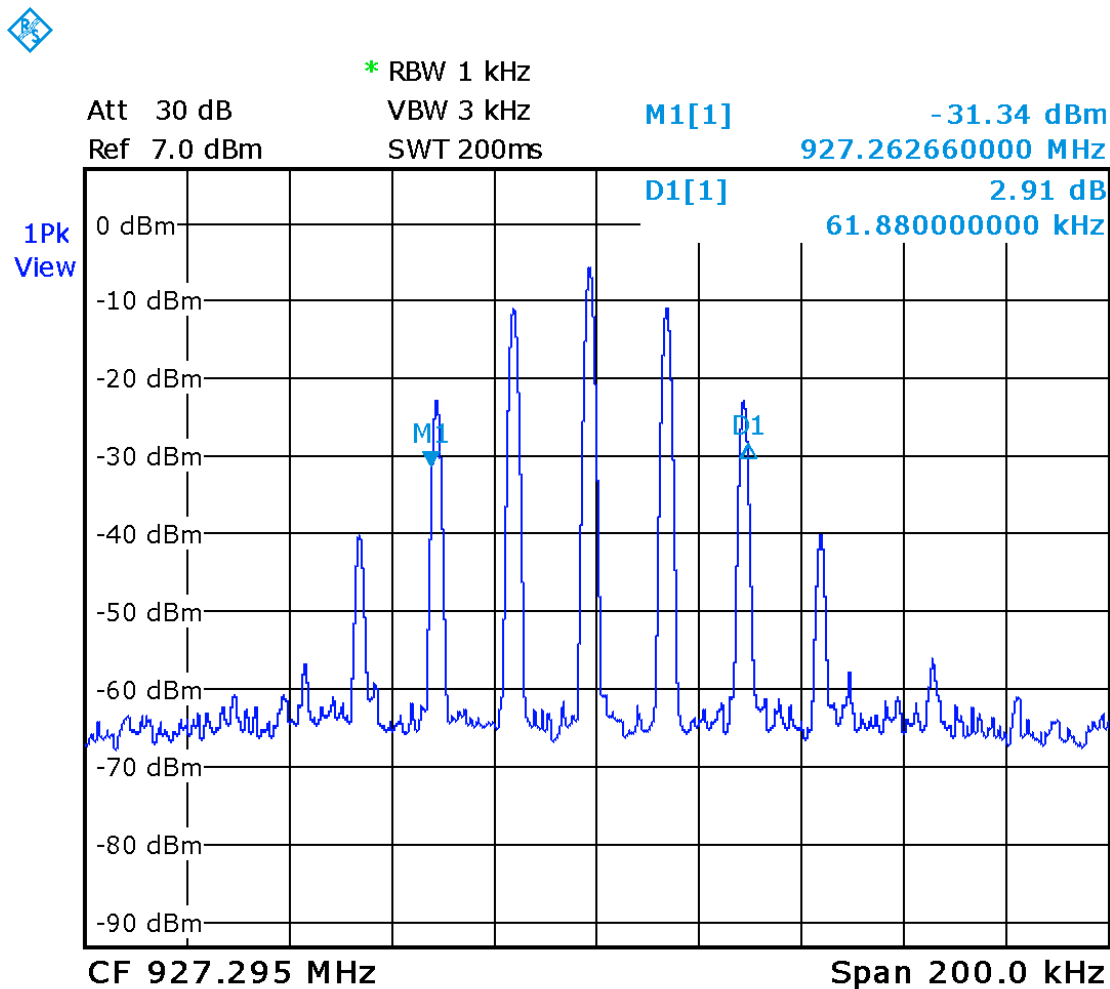
The method is described in ANSI C63.10, 6.9.1.


Client	Elkay Manufacturing Co.	
Product	Base Station	
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Max 20dB Bandwidth

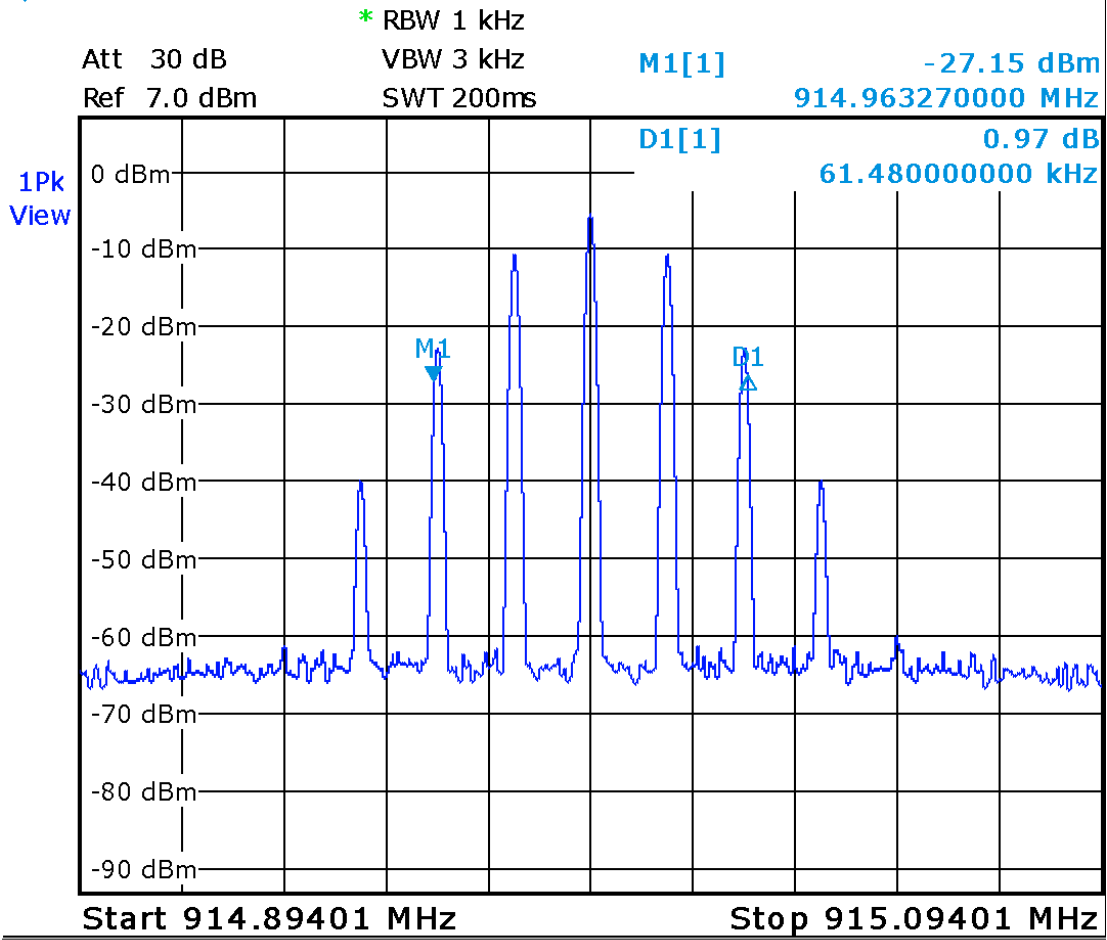
The graphs below show the 20dB bandwidth during the operation of the device. This is measured by a max hold on the spectrum analyzer and a video bandwidth at least 3x the resolution bandwidth. Bandwidths are shown for low, middle and high channels. These measurements are peak measurement. The EUT is set to transmit continuous modulated data at maximum power.


High Channel
20dB BW = 61.88 kHz



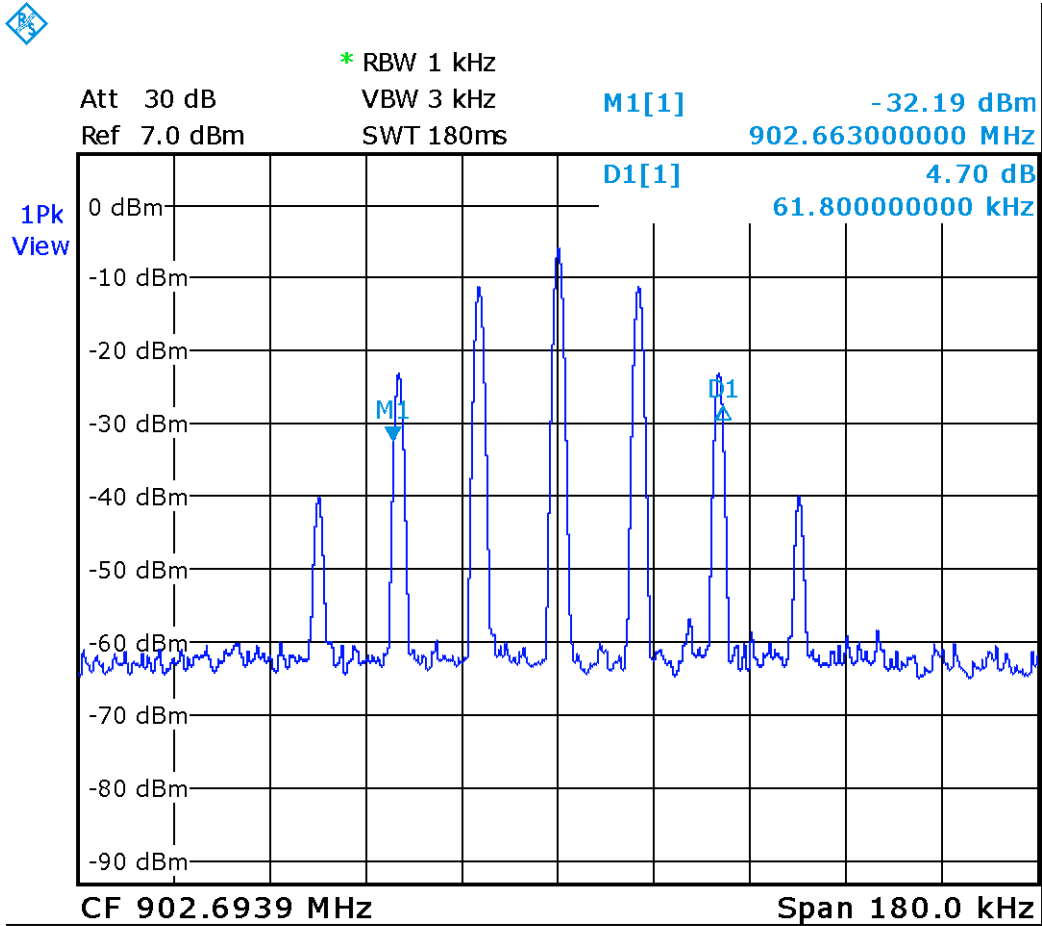
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Mid Channel
20dB BW = 61.48 kHz



Client	Elkay Manufacturing Co.	
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Low Channel
20dB BW = 61.8 kHz



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Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

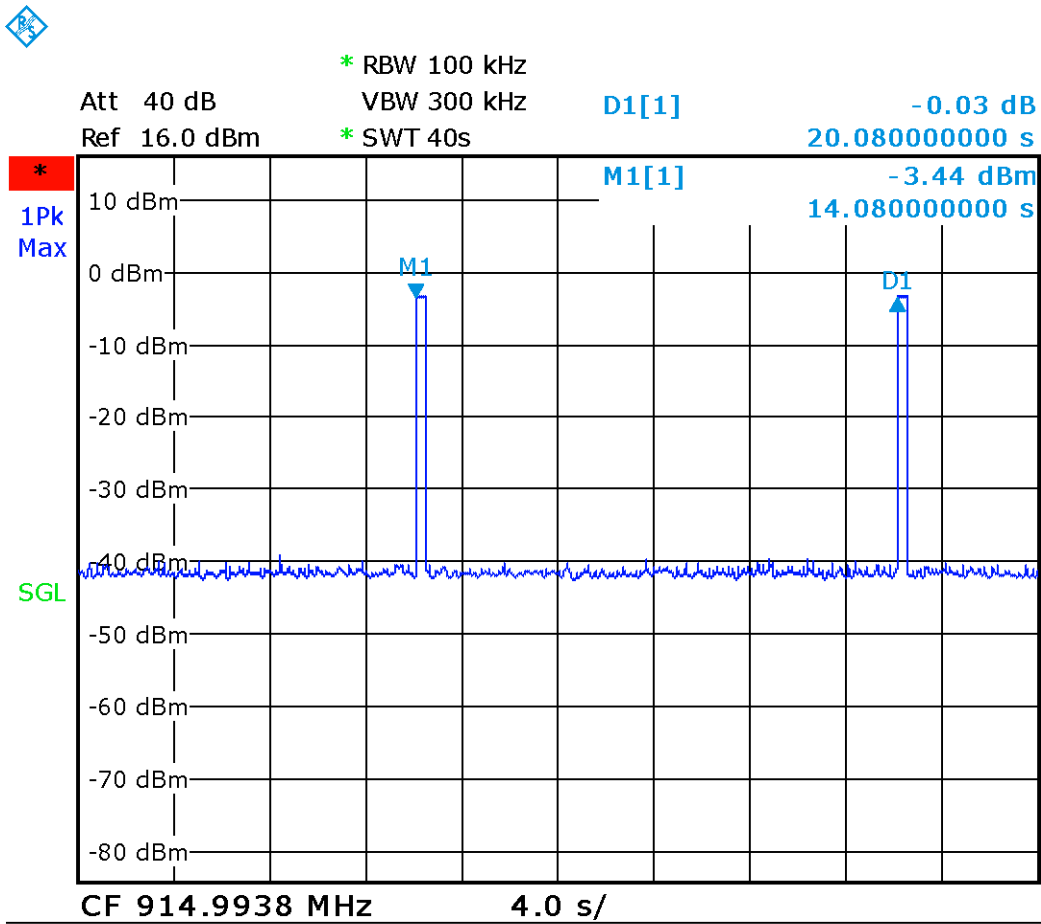
Average Time of Occupancy


The following plots show the time of occupancy in a channel.

Transmissions in a channel within a 40s time window.

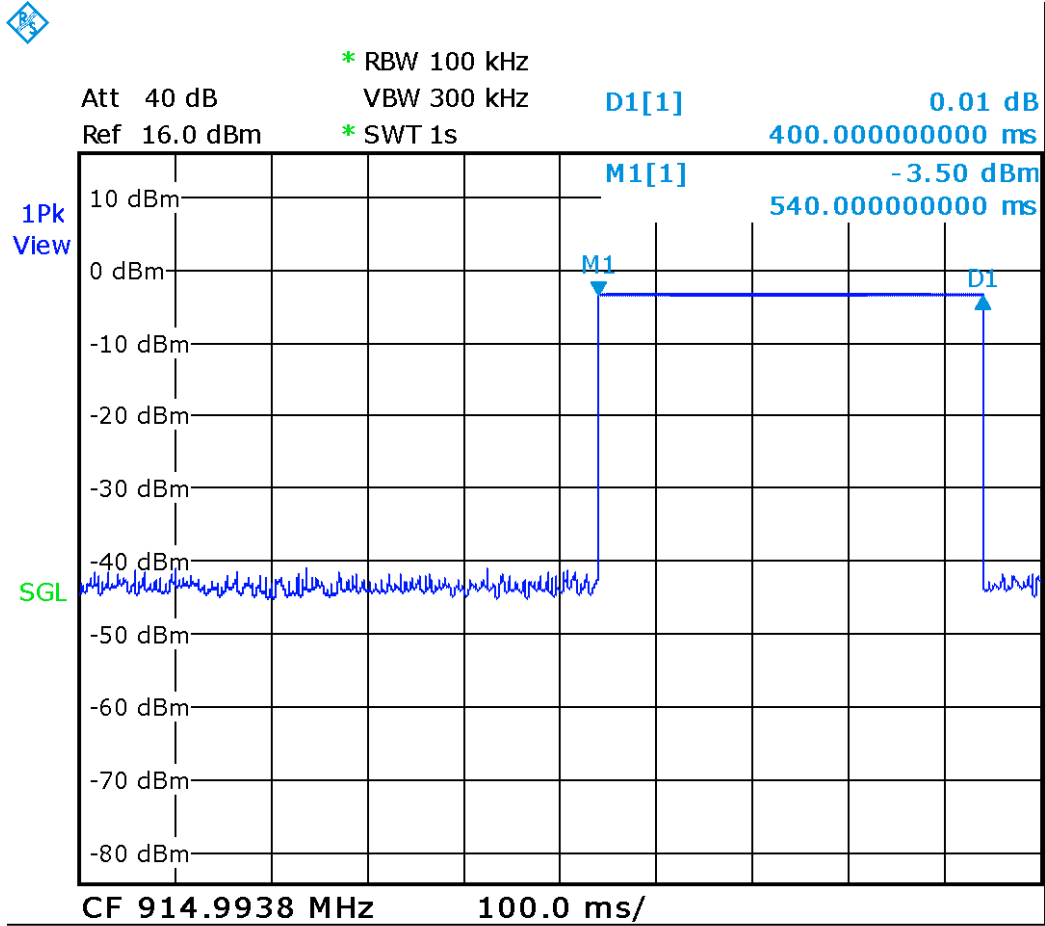
Transmissions are 20s apart.


Maximum number of transmissions in 20s = 1



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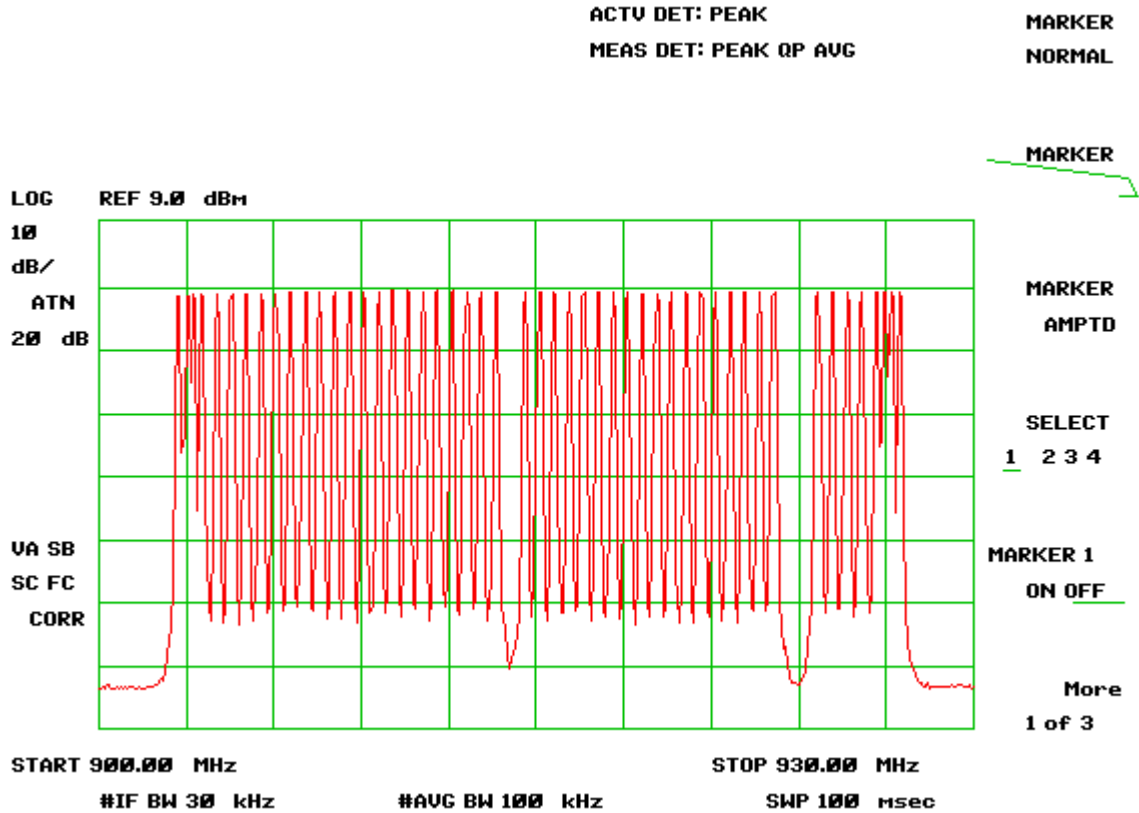
Transmission on time.
The on time for each transmission = 400ms ≤ 0.4s.




Client	Elkay Manufacturing Co.	
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Number Of Channels

The following plot shows the number of channels used by the EUT. The EUT is set to frequency hopping. The EUT uses 50 hopping channels.



Note: See photo exhibits for photos showing the test set-up.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Results

The EUT passed. The maximum 20 dB BW measured was 61.88 kHz. The EUT uses 50 hopping frequencies, and the time of occupancy on a channel is 0.4 seconds within a 20 second period.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov. 15, 2013	Nov. 15, 2015	GMEC 160
Spectrum Analyzer	85650A	HP	Jan. 23, 2013	Jan. 23, 2015	GEMC 170

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Maximum Peak Envelope Conducted Power - FHSS

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, that the maximum power does not exceed an amount which may create an excessive power level.


Limits

The limits are defined in FCC Part 15.247(b)2 and RSS 210 A8.4(1).

1. For frequency hopping systems operating in the 902-928 MHz band:
 - a. For systems employing at least 50 hopping channels: 1 watt
 - b. For systems employing less than 50 hopping channels, but at least 25 hopping channels: 0.25 watts

Results

The EUT passed. The peak power measured is 26.7 dBm (467.7 mW).


Client	Elkay Manufacturing Co.	
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Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

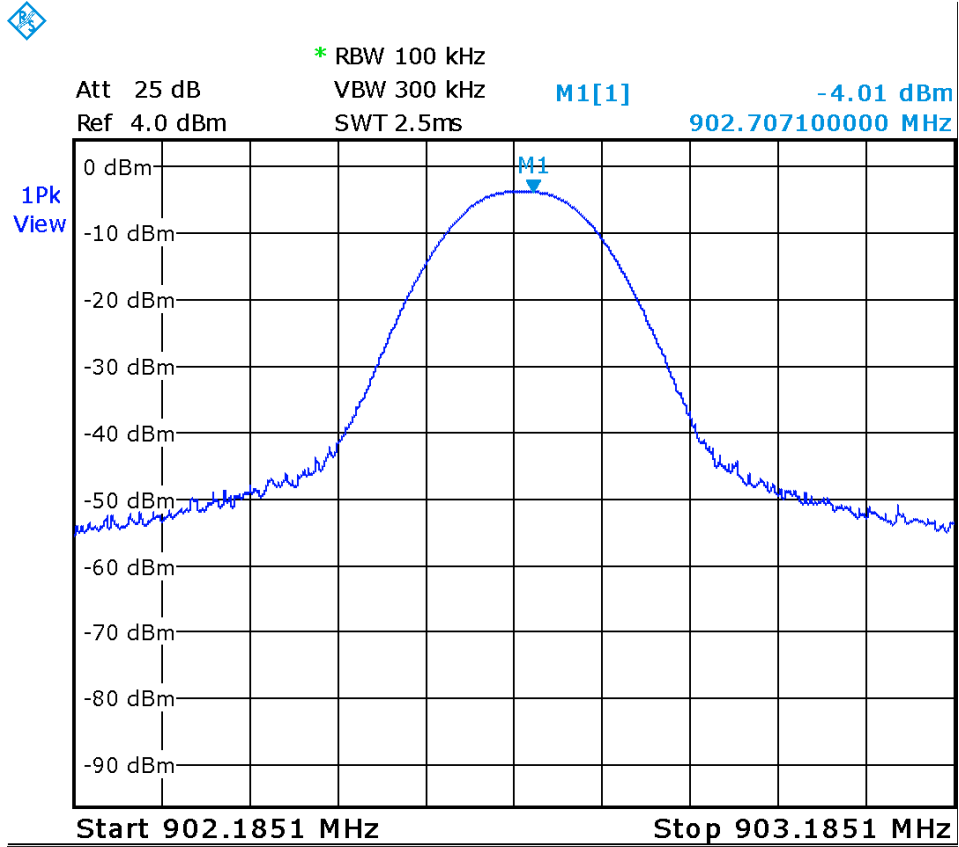
Table(s)

The table below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. Peak detector was used with max hold. The EUT was transmitting continuous modulated data at maximum output power.

Maximum Peak Envelope Conducted Power – Table 1


Band	Channel	Frequency (MHz)	Received Reading (dBm)	External Attenuation (dB)	Cable loss (dB)	Output Power (dBm)
Low	37	902.7	-4.01	30	0.3	26.3
Middle	21	915.0	-3.59	30	0.3	26.7
High	39	927.3	-3.71	30	0.3	26.6

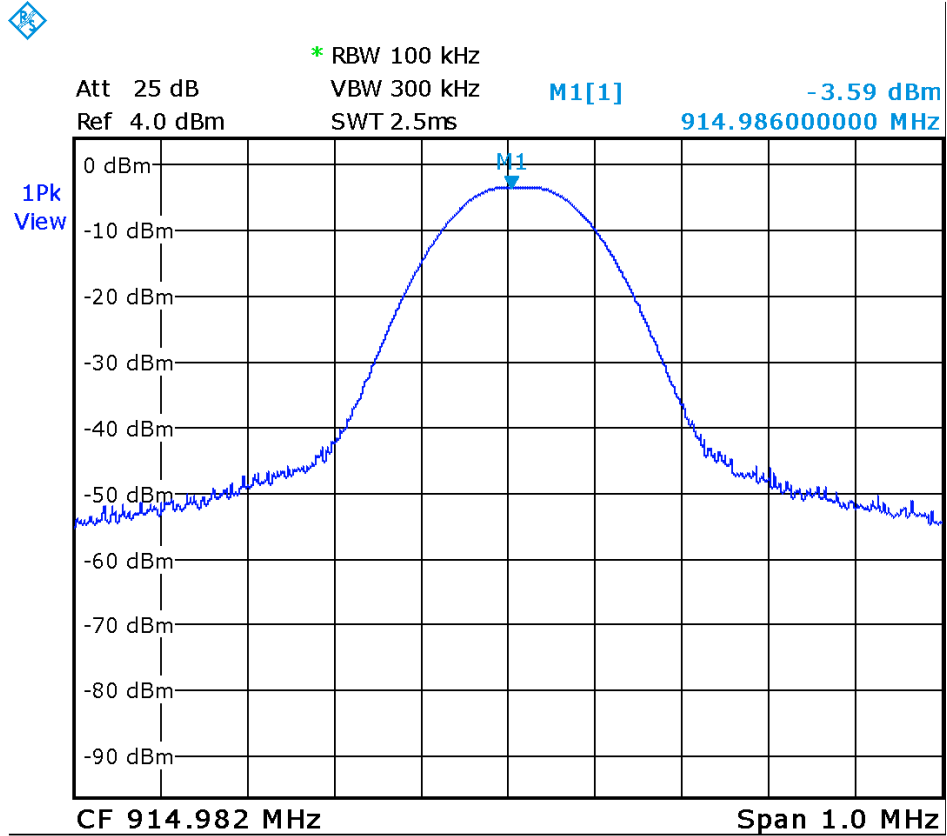
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	



Low Channel


Note: 30 dB for external attenuation losses added to value shown above.

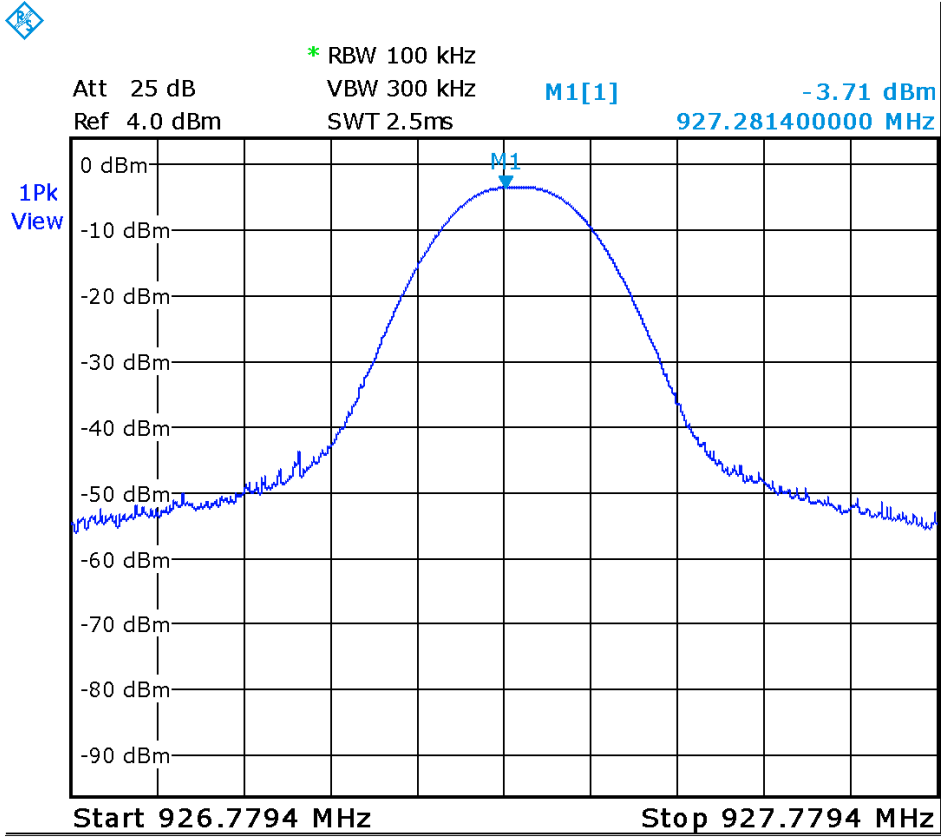
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	



Mid Channel

Note: 30 dB for external attenuation losses added to value shown above.


Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	



High Channel

Note: 30 dB for external attenuation losses added to value shown above.


Note: See photo exhibits for photos showing the test set-up.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	2013-11-15	2015-11-15	GMEC 160
Power Head	PH 2000	AR	2013-02-07	2015-02-07	GEMC 15
Power meter	PM 2002	AR	2013-02-07	2015-02-07	GEMC 16
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Channel Carrier Separation for Frequency Hopping Systems

Purpose

The purpose of this test is to ensure that the RF energy of frequency hopping systems is sufficiently spread over a spectrum and that the radio energy is not overly dense. This limit helps allow for other spread spectrum devices to co-exist in the same frequency spectrum. This also helps prevent corruption of data by ensuring adequate channel separation to distinguish the reception of the intended information.

Limits

The limits are as defined in 47 CFR FCC Part 15 Section 15.247(a)1 and RSS-210 A8.1(b).

1. Frequency hopping systems in the 902 MHz -928 MHz band shall have hopping channel carrier frequencies separated by a minimum of:

The greater value of:


- a. A minimum of 25 kHz,
- or
- b. The 20 dB bandwidth of the hopping channel,

The 20 dB BW of the system was measured to be 61.88 kHz.

Channels must be separated by at least 61.8 kHz.

Results

The EUT passed the requirements of channel carrier separation, and exceeds the 20 dB BW of the EUT. The 20 dB BW was measured to be 61.8 kHz, and the device has a channel spacing of at least 200.0 kHz.

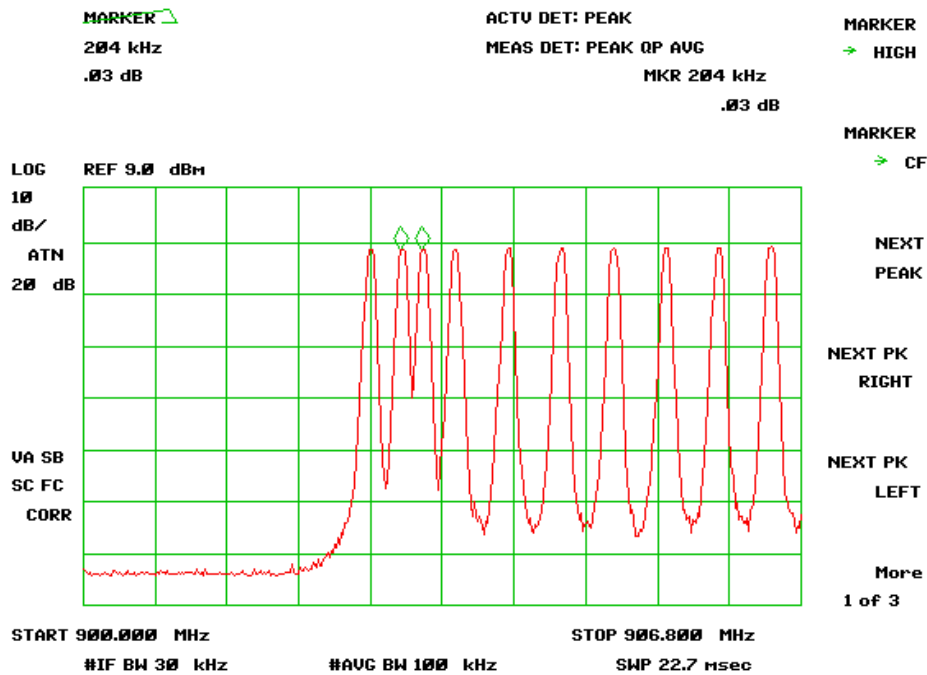
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Graph(s)

The graphs shown below show the channel spacing during the operation of the device. This is measured by a max hold on the spectrum analyzer with peak detector function. 30 dB of external attenuation is used at the spectrum analyzer input. The EUT is transmitting at maximum output power with frequency hopping enabled.

Markers in the following plots are set between the closest adjacent channels in the plot.

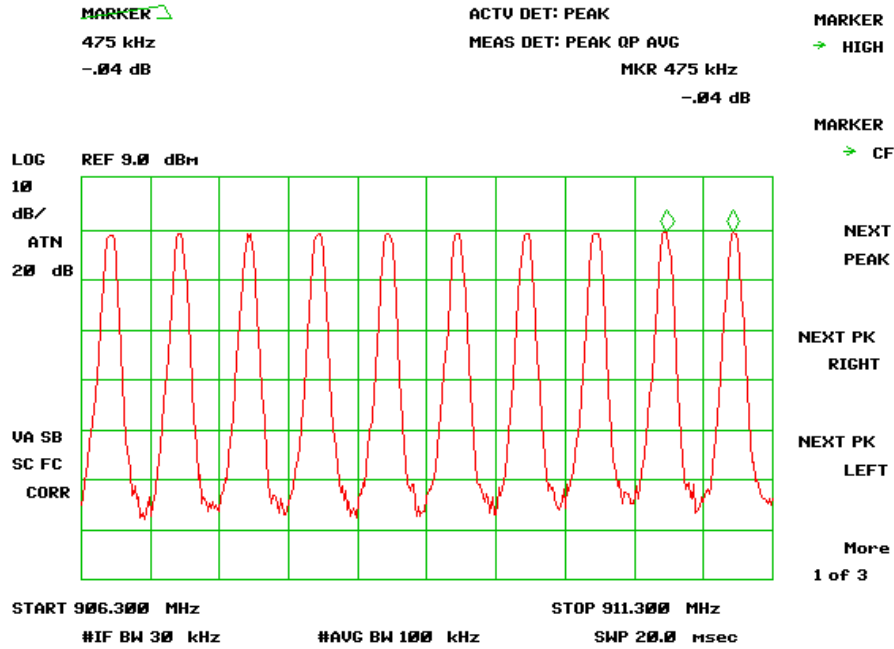
Channel Separation
900 MHz – 906.8 MHz



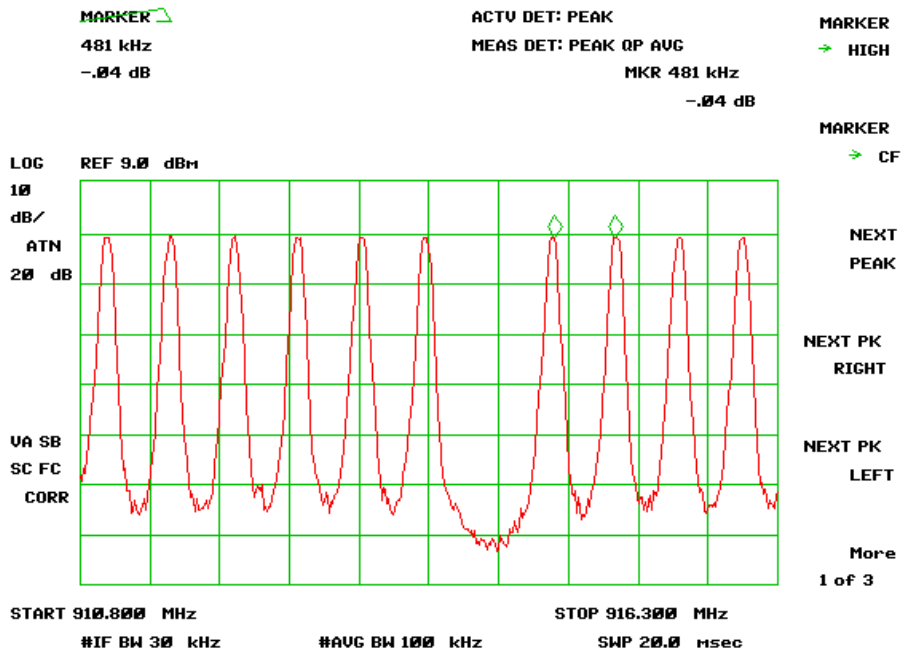
Client	Elkay Manufacturing Co.
Product	Base Station
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Channel Separation
906.3 MHz – 911.3 MHz



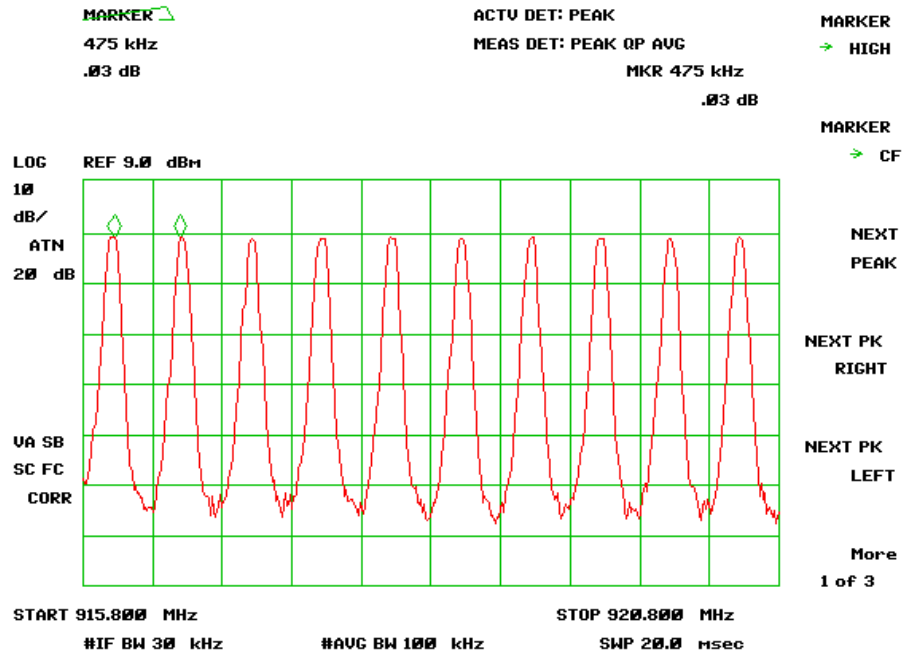
Channel Separation
910.8 MHz – 916.3 MHz



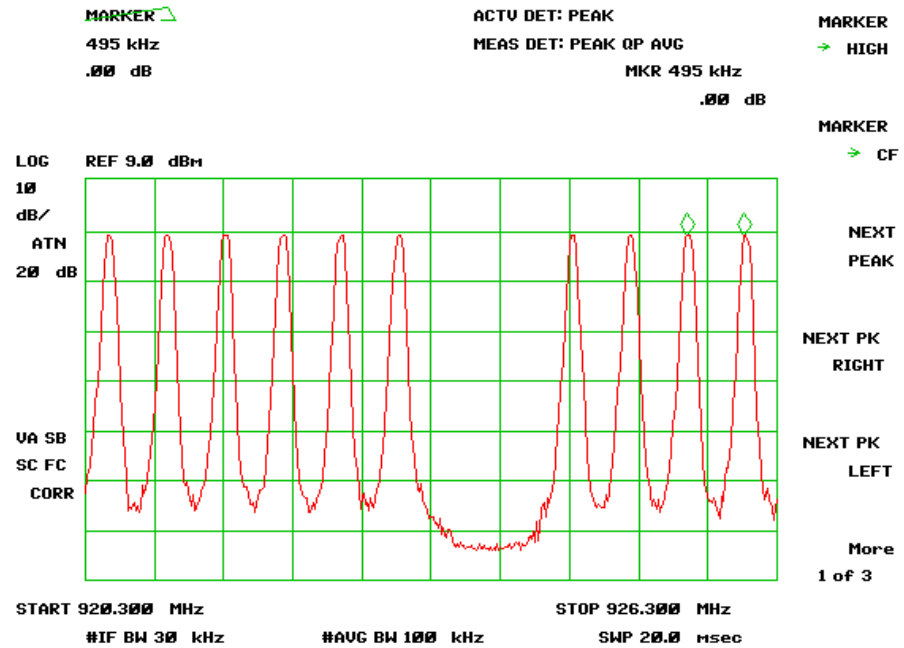
Client	Elkay Manufacturing Co.
Product	Base Station
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014




Channel Separation 915.8 MHz – 920.8 MHz

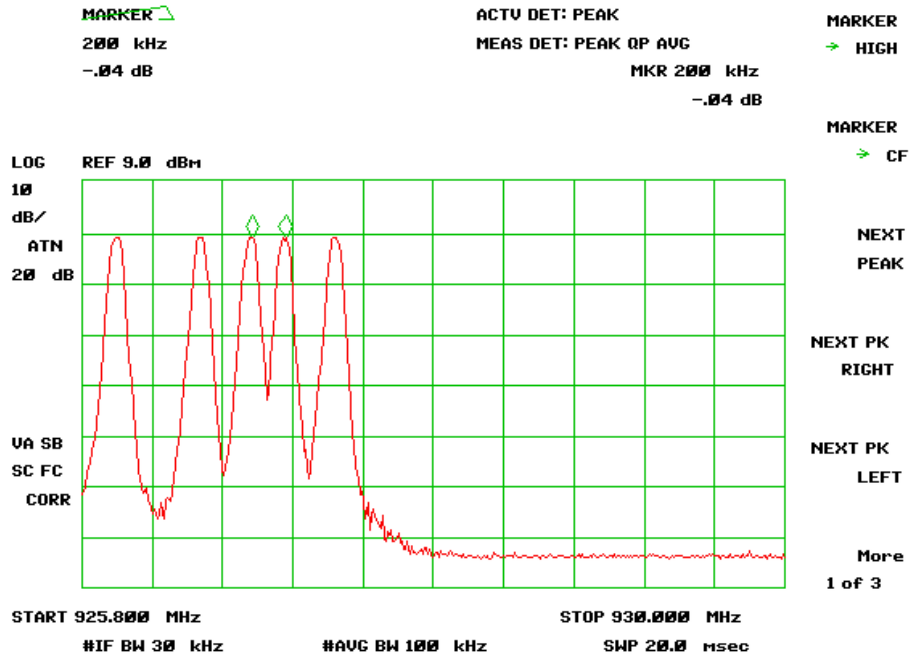


Channel Separation 920.3 MHz – 926.3 MHz




Client	Elkay Manufacturing Co.	
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Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Channel Separation
925.8 MHz – 930 MHz




Note: See photo exhibits for photos showing the test set-up.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	85650A	HP	Jan. 23, 2013	Jan. 23, 2015	GEMC 170
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Antenna Spurious Conducted Emissions (-20 dBc Requirement)

Purpose


The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.

Limits

The limits are defined in 15.247(d) and RSS-210 A8.5. In any 100 kHz band outside the frequency band in which the intentional radiator is operating, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious conducted emissions are to be evaluated up to the 10th harmonic. This -20 dBc requirement also applies at the ‘band edge’ or 902 MHz and 928 MHz.

Results

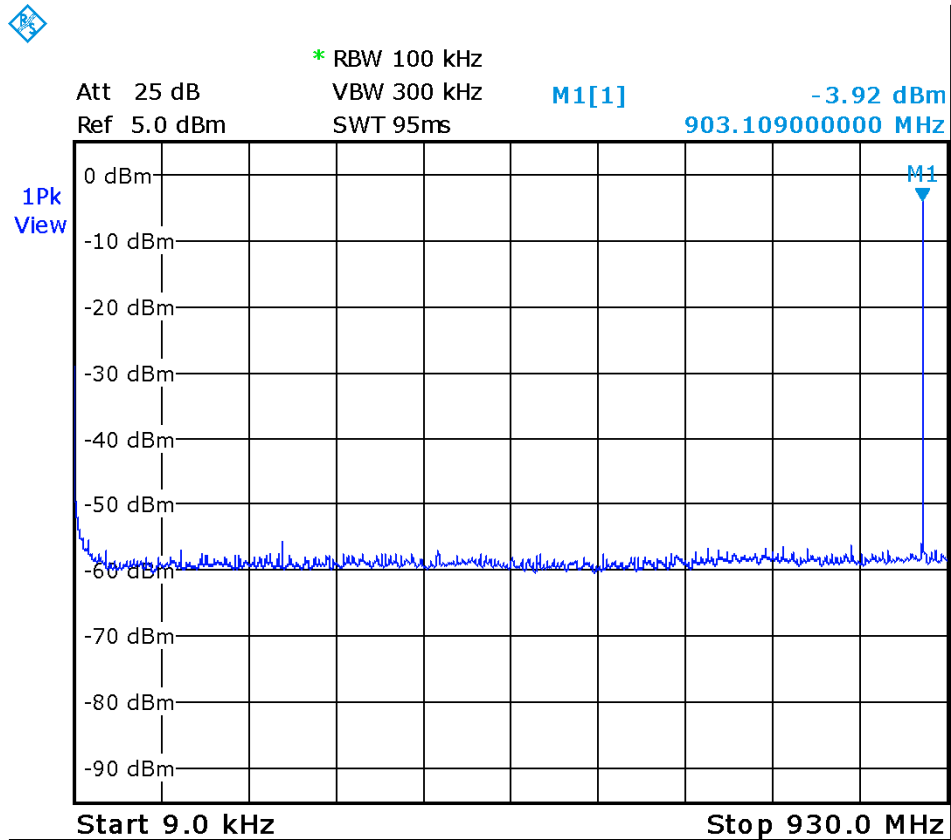
The EUT passes. Low, middle and high band was measured. The worst case is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 902 MHz in the low band, and for the high band edge at 928 MHz in the high band.


Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Graph(s)

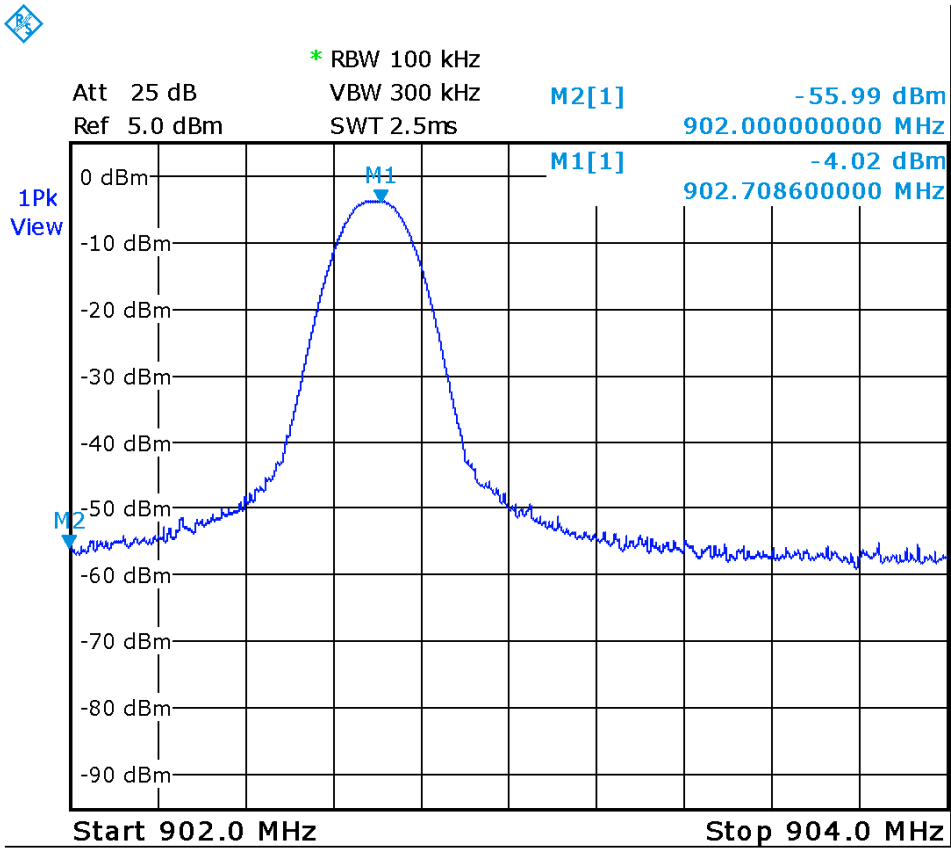
The graphs shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT at max output power, continuous transmission of data. Note there was 30 dB of external attenuation during this measurement.


Frequencies below fundamental
9 kHz – 930 MHz, Low Channel



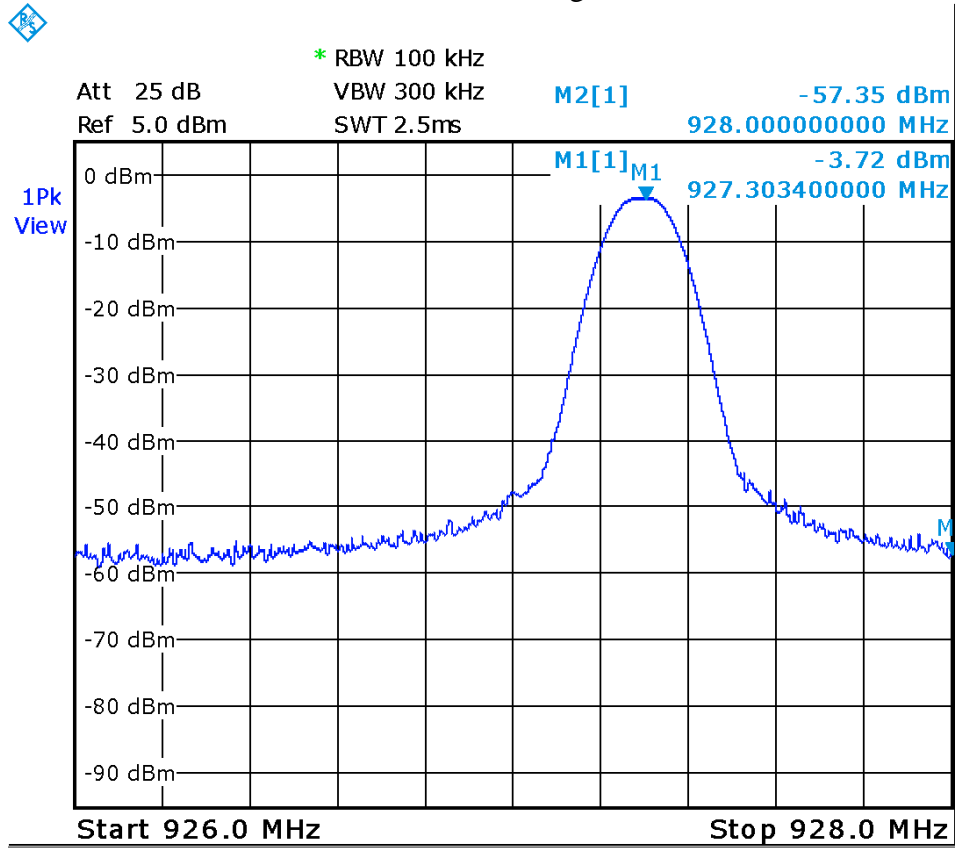
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Low Channel, Lower Band Edge
902 MHz – 904 MHz, Low Channel



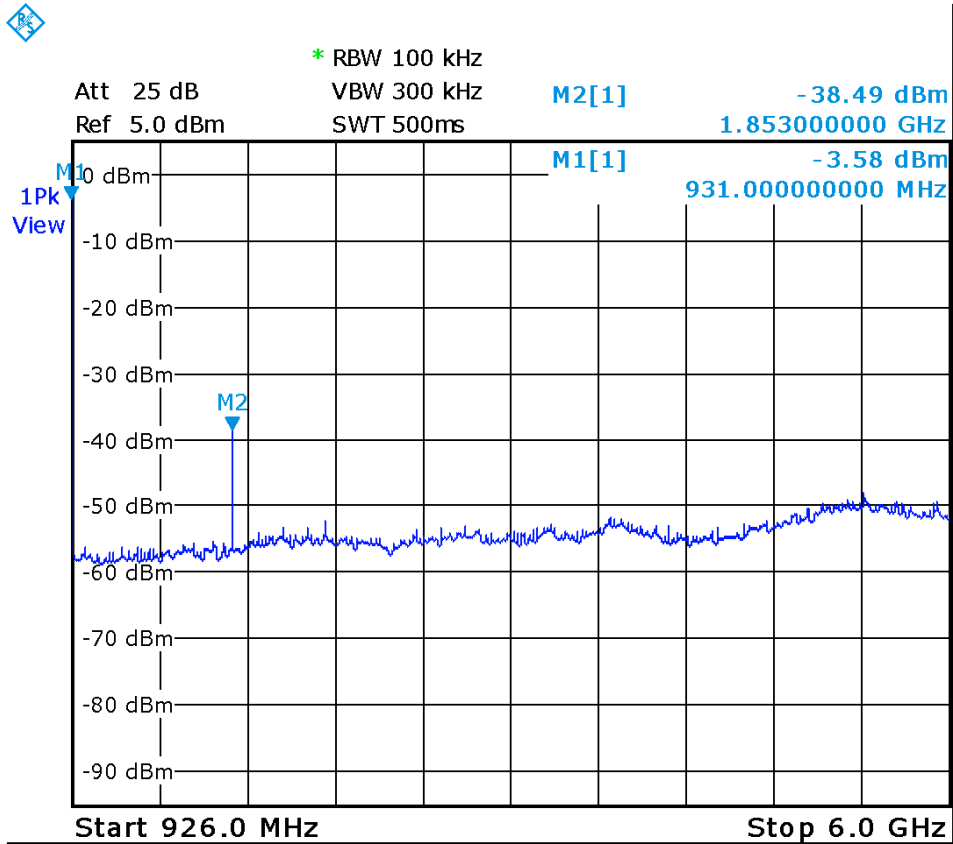
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


High Channel, Upper Band Edge
926 MHz – 928 MHz, High Channel



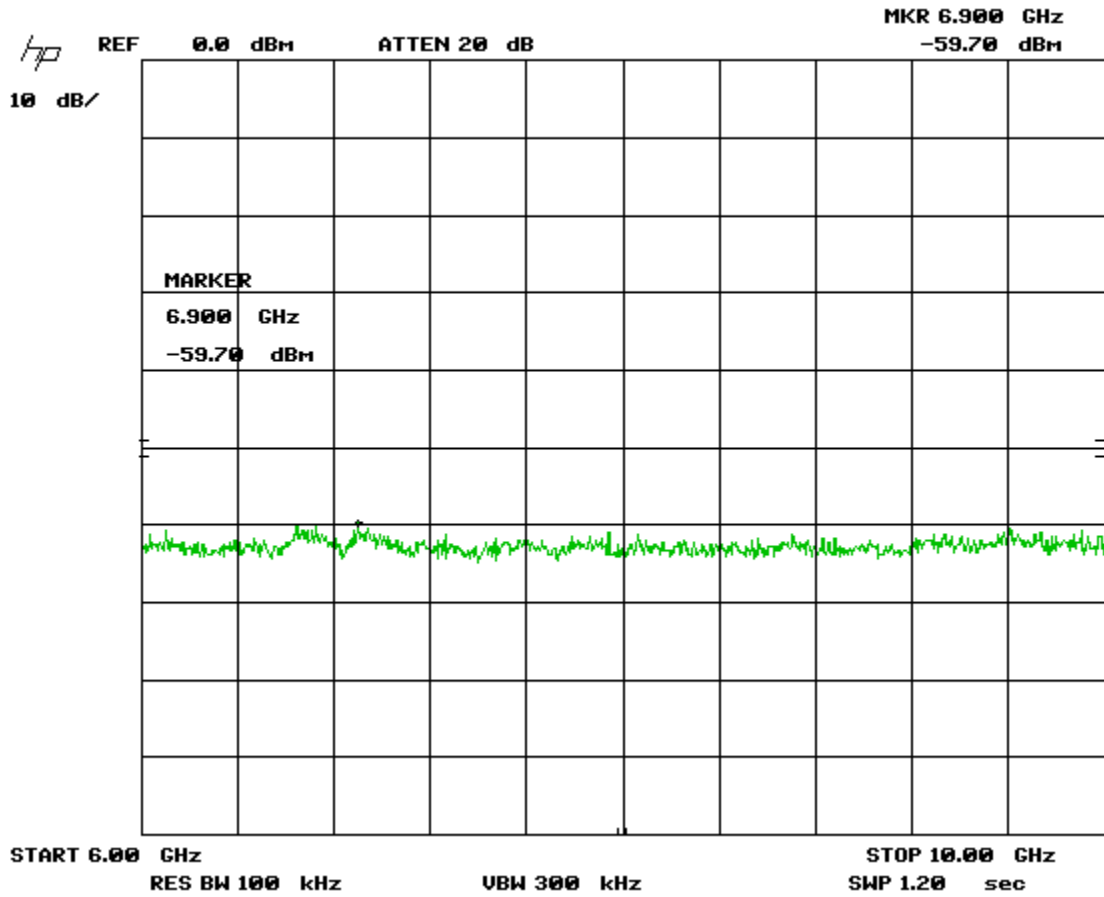
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Frequencies above fundamental
926 MHz – 6 GHz, High Channel



Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Frequencies above fundamental
6 GHz – 10 GHz, High Channel




Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2013-01-22	2015-01-22	GEMC 169
Quasi Peak Adapter	85650A	HP	2013-01-23	2015-01-23	GEMC 170
Spectrum Analyzer	ESL6	Rohde & Schwarz	2013-11-15	2015-11-15	GEMC 160
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Radiated Emissions – 15.247, 15.209

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limit(s) and Method

The method is as defined in ANSI C63.4:2003.

The limits are as defined in FCC Part 15, Section 15.209 and RSS-GEN:


The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

0.009 MHz – 0.490 MHz, 2400/F(kHz) uV/m at 300 m¹
0.490 MHz – 1.705 MHz, 24000/F(kHz) uV/m at 30 m¹
1.705 MHz – 30 MHz, 30 uV/m at 30 m¹
30 MHz – 88 MHz, 100 uV/m (40.0 dBuV/m¹) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m¹) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.0 dBuV/m¹) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m¹) at 3 m
Above 1000 MHz, 500 uV/m (54 dBuV/m²) at 3m
Above 1000 MHz, 500 uV/m (74 dBuV/m³) at 3m

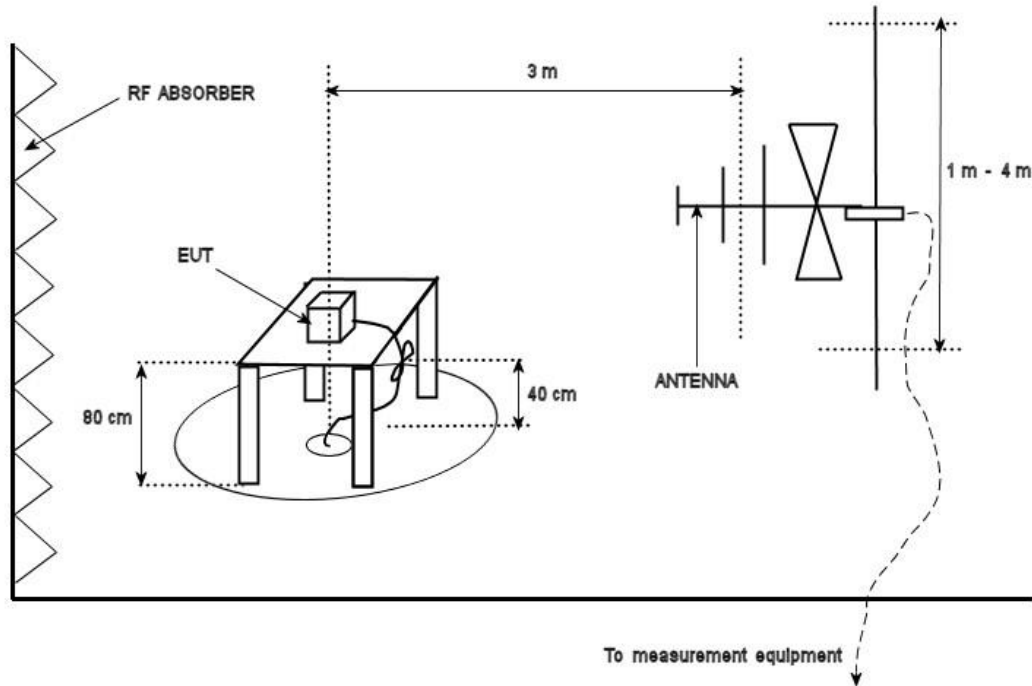
¹Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1.

²Limit is with 1 MHz measurement bandwidth and using an Average detector.

³Limit is with 1 MHz measurement bandwidth and using a Peak detector.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Typical Radiated Emissions Setup




Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graphs shown below are maximized peak measurement graphs, measured with a resolution bandwidth greater than or equal to, the final required detector and over a full 0-360° rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Devices scanned may be scanned at alternate test distances, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m/3m) is applied.

See final measurement section for all measurements.

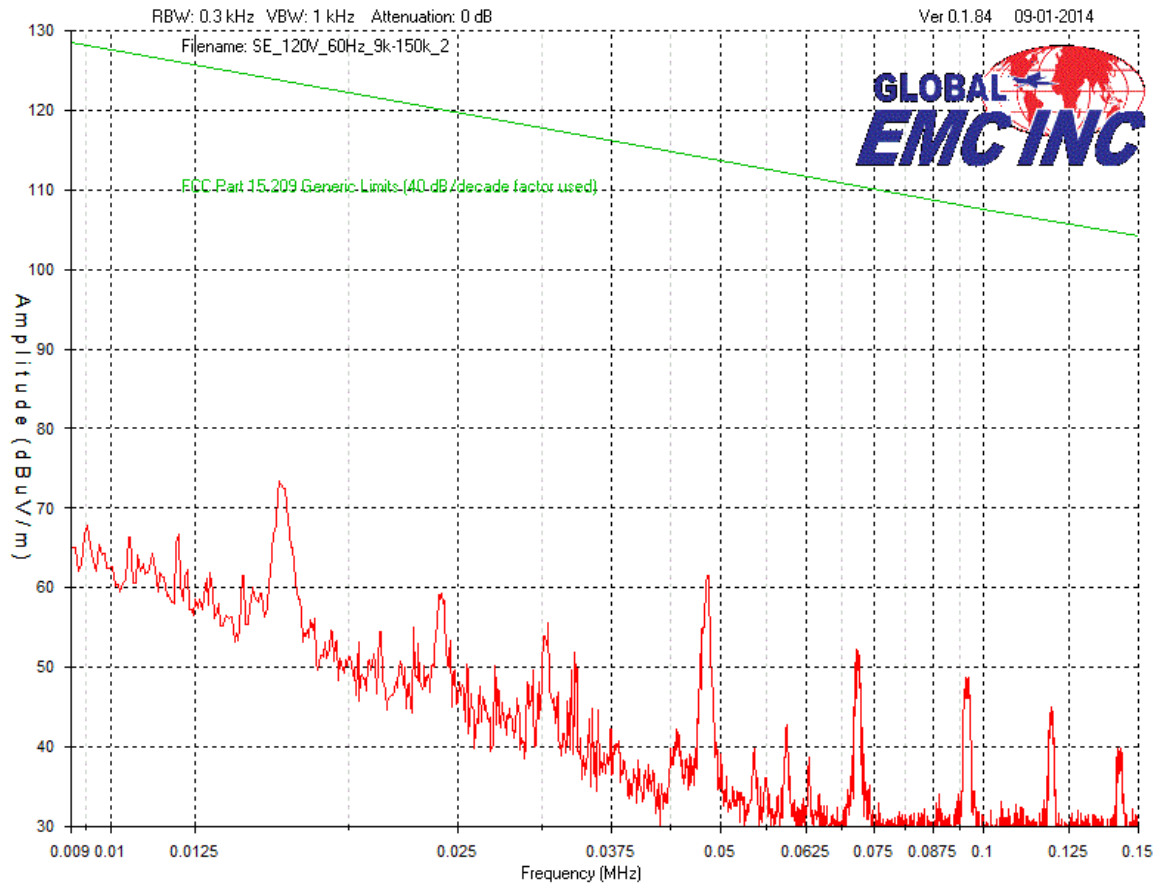
Low, middle, and high channels were scanned. Worst case is presented.


All transmitters in EUT are on and transmitting continuous modulated data at maximum power.

The measurement distance is 3m.

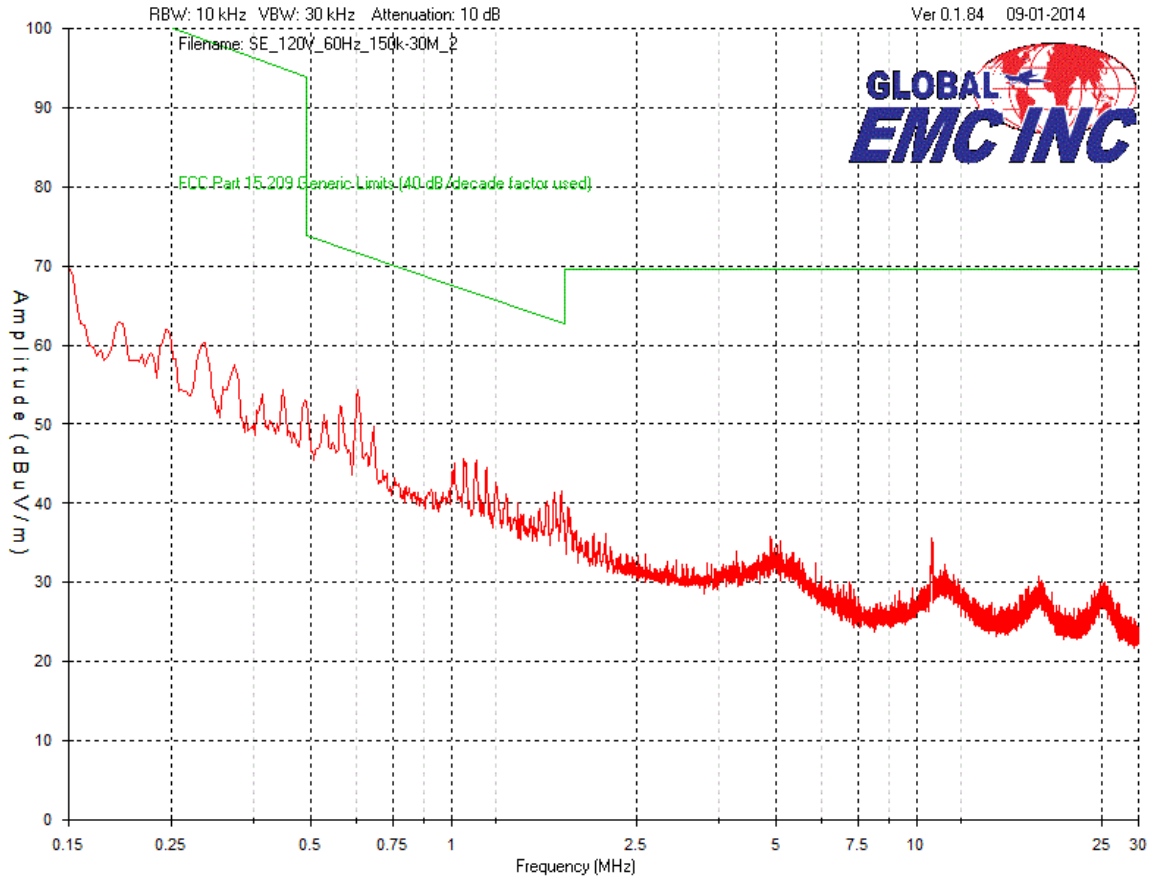
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph
9 kHz to 150 kHz



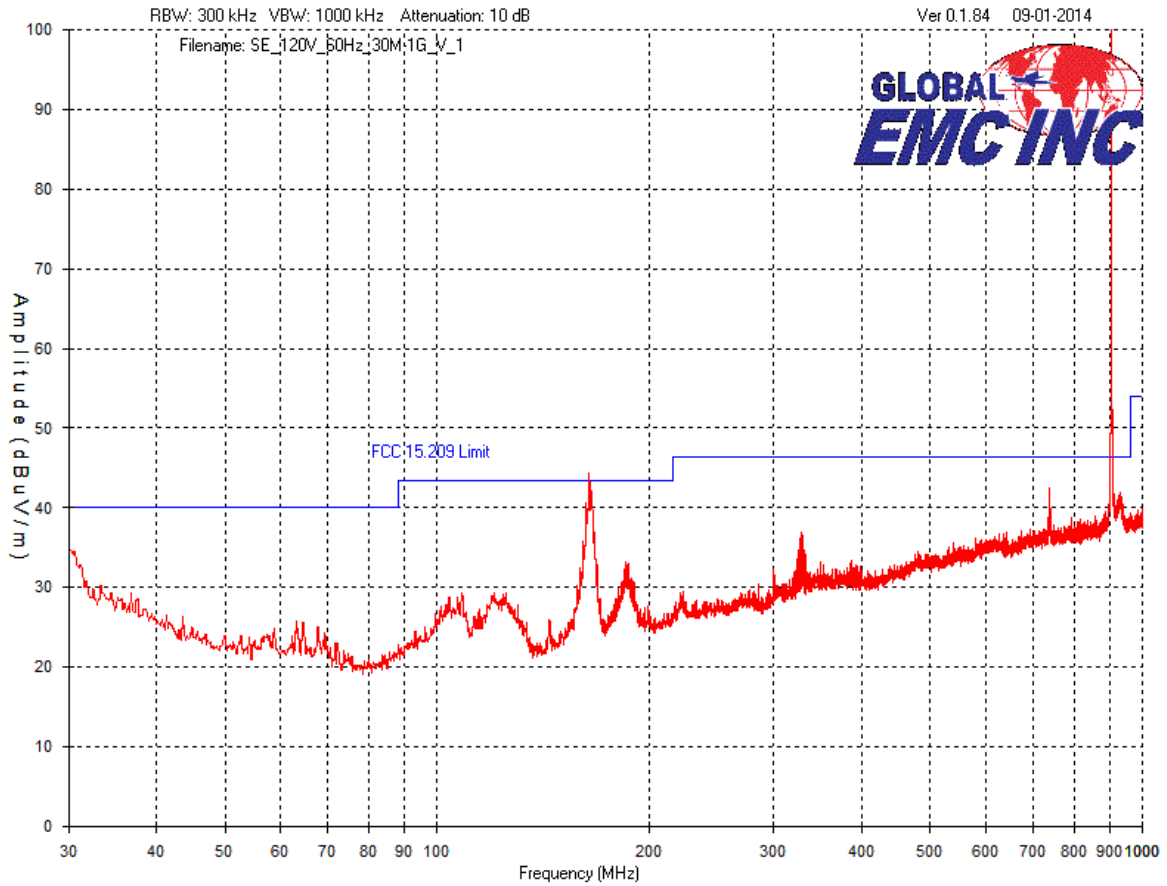
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Peak Emissions Graph
150 kHz to 30 MHz




Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

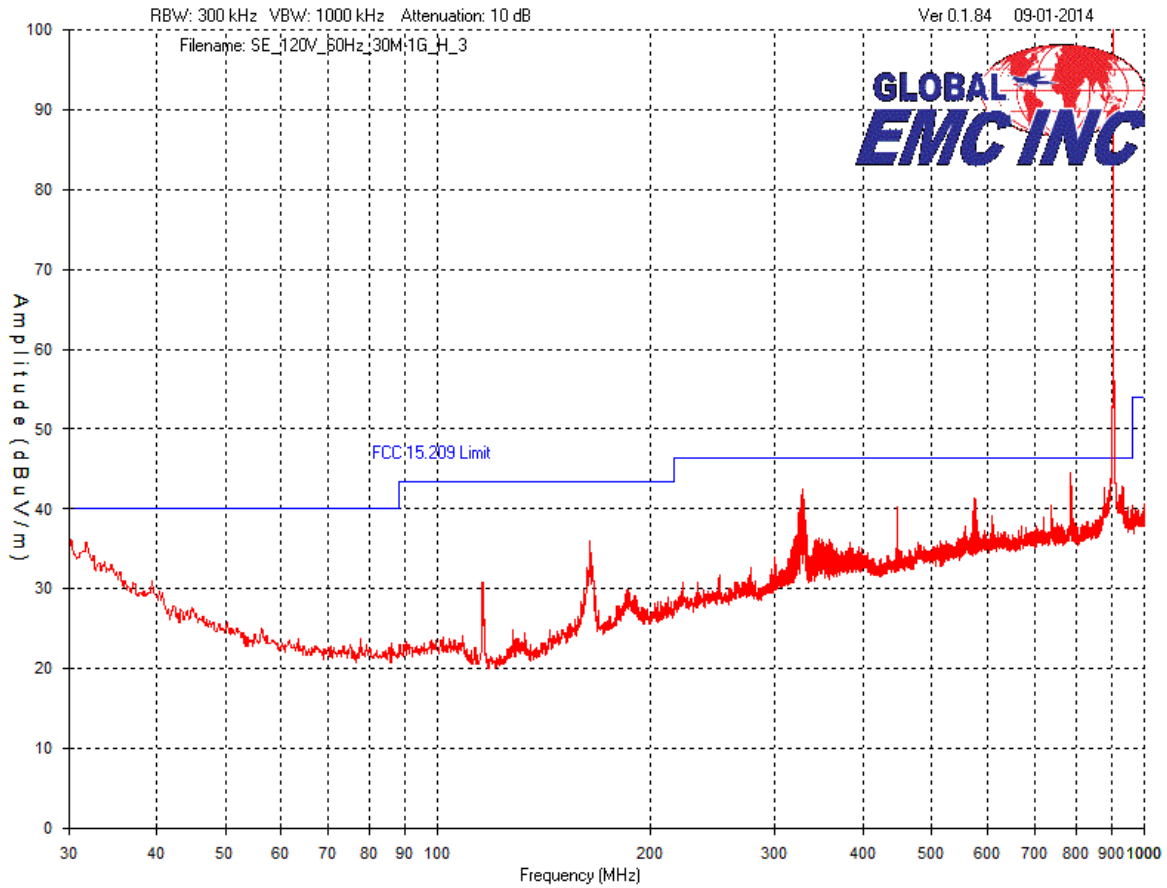
Peak Emissions Graph
Vertical Antenna Polarity
30 MHz to 1 GHz




Please reference final tabular data in *Table 2* (page 59).

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

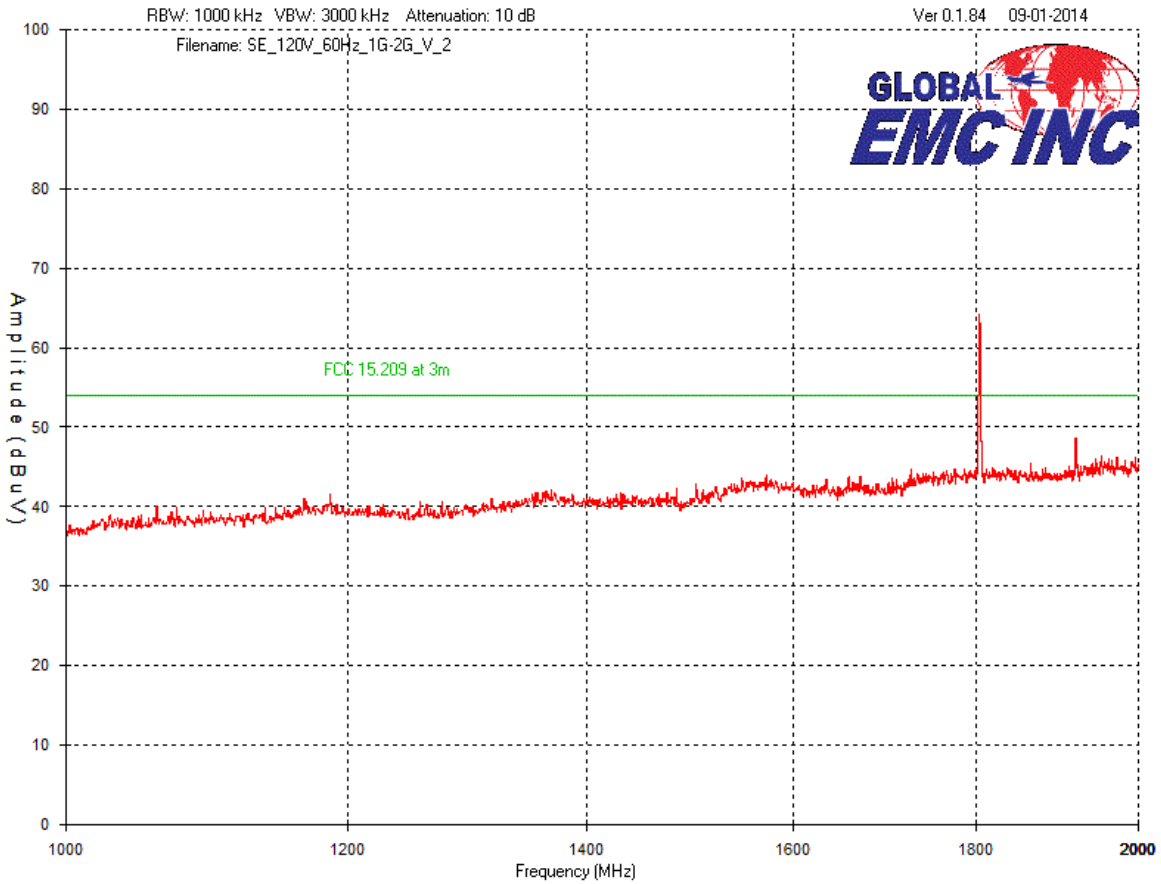
Peak Emissions Graph
Horizontal Antenna Polarity
30 MHz to 1 GHz




Please reference final tabular data in *Table 2* (page 59).

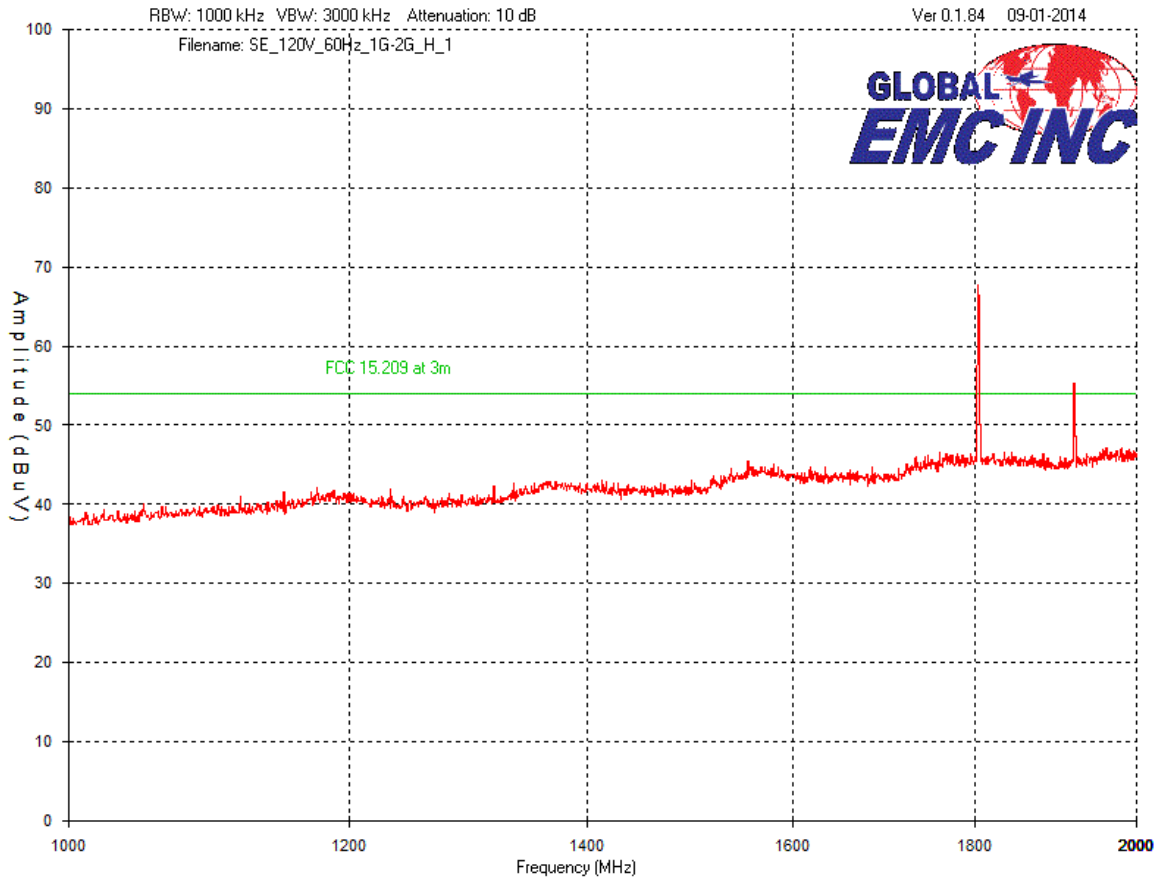
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph
 Vertical Antenna Polarity
 1 GHz to 2 GHz



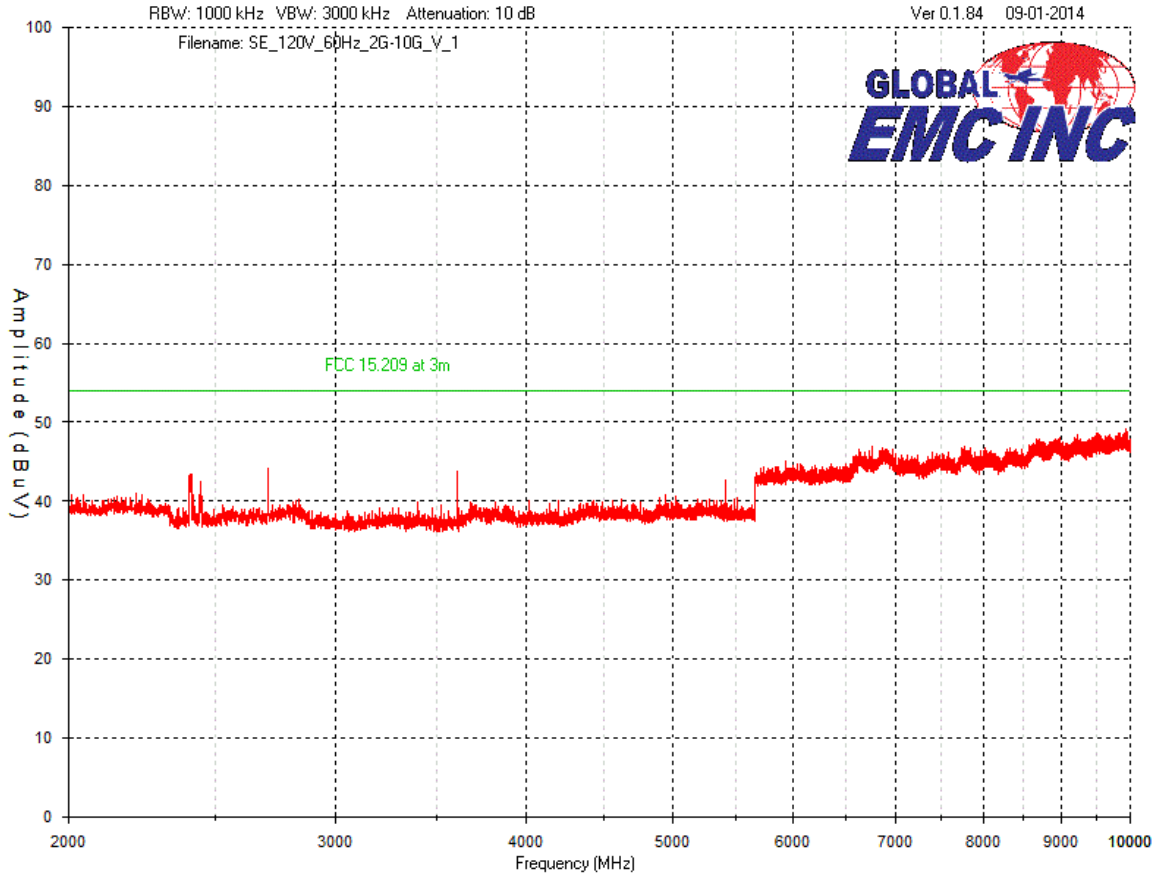
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph
Horizontal Antenna Polarity
1 GHz to 2 GHz



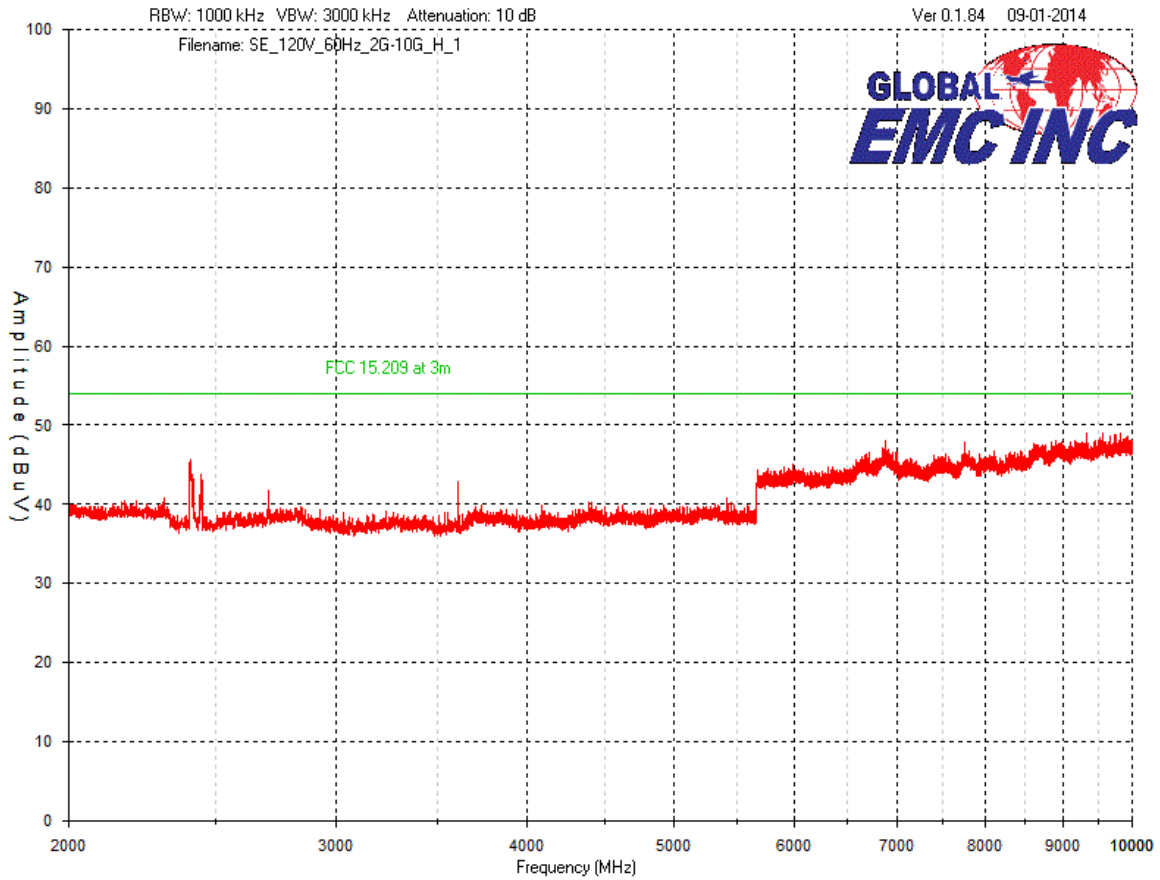
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph
Vertical Antenna Polarity
2 GHz to 10 GHz



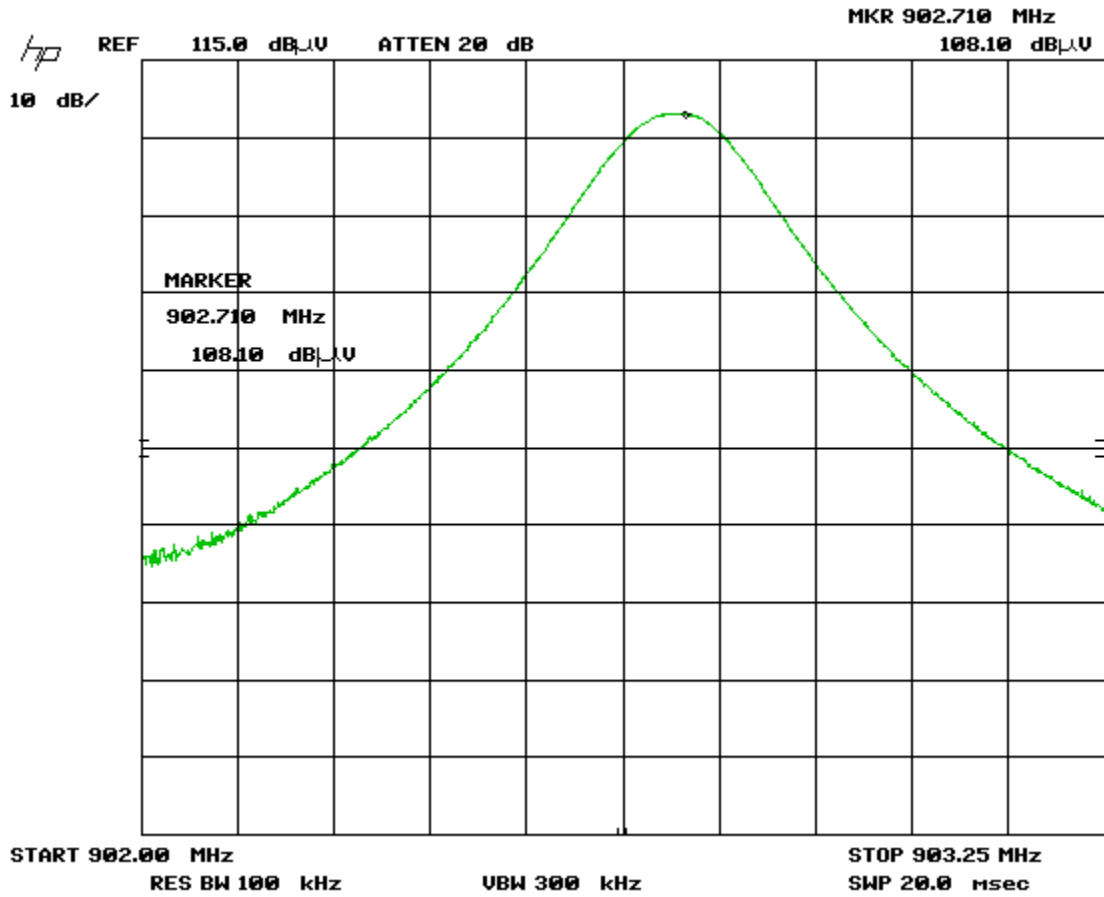
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph
Horizontal Antenna Polarity
2 GHz to 10 GHz



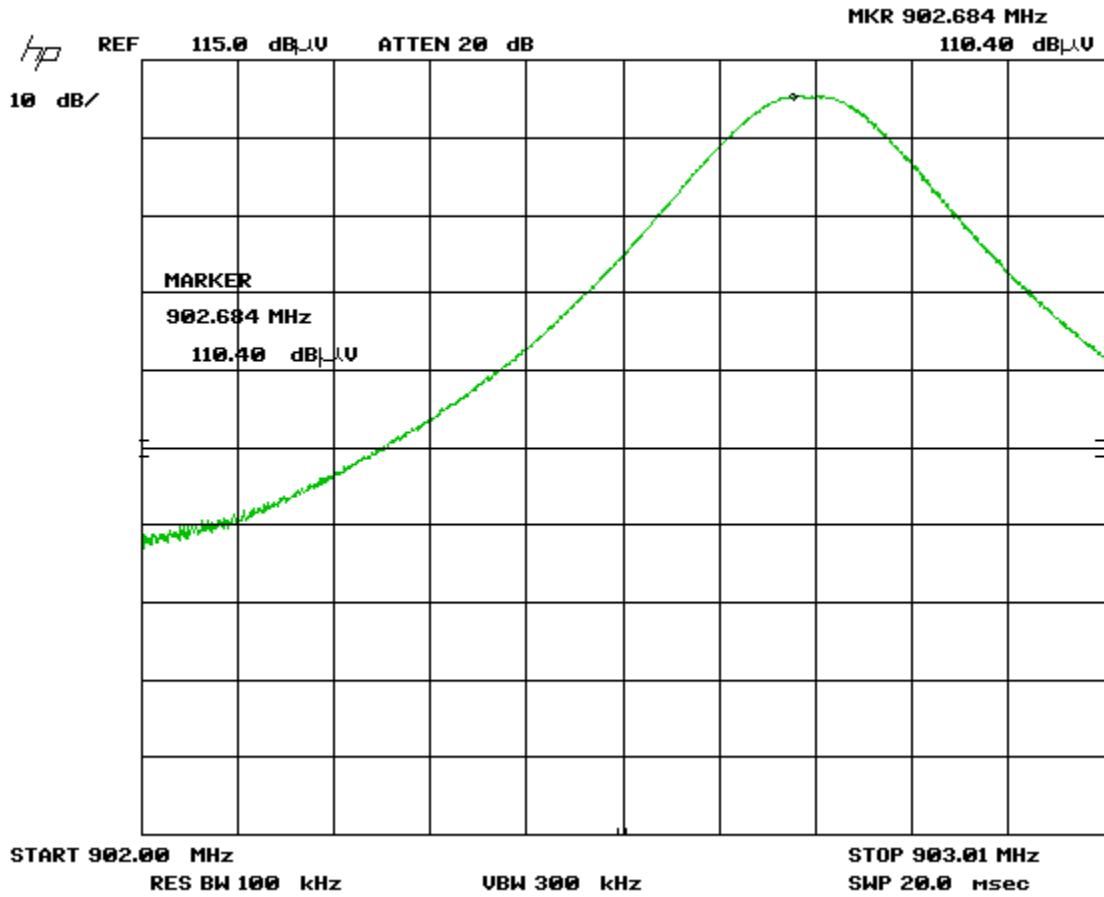
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph, Vertical Antenna Polarity
EUT Output: Low Channel



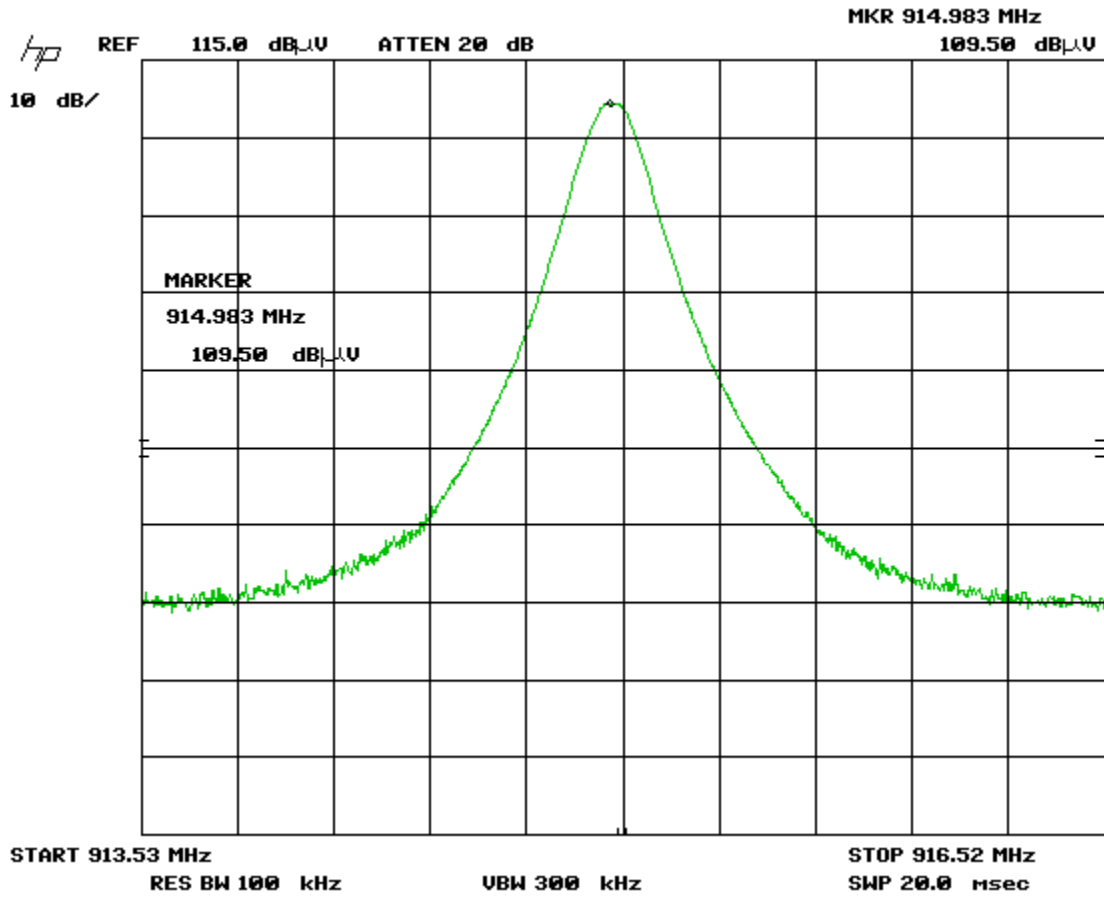
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph, Horizontal Antenna Polarity
EUT Output: Low Channel



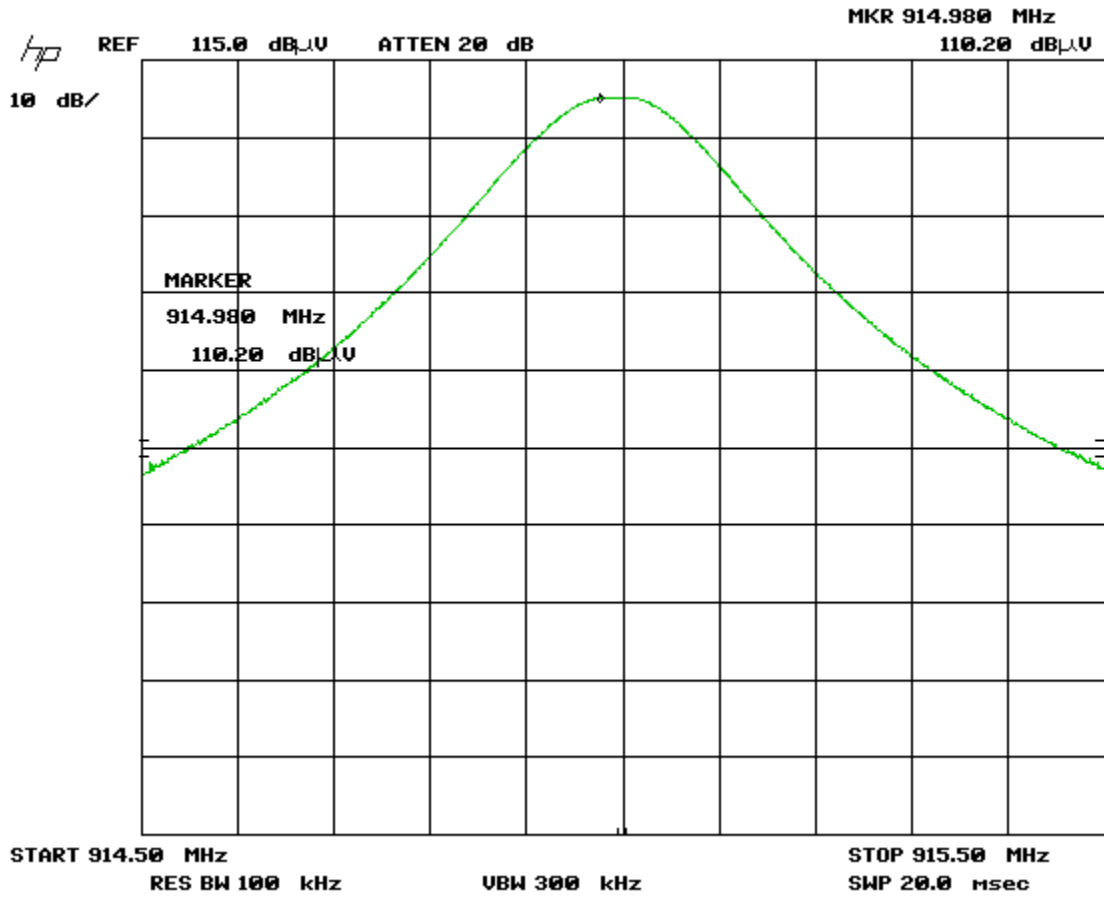
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph, Vertical Antenna Polarity
EUT Output: Middle Channel



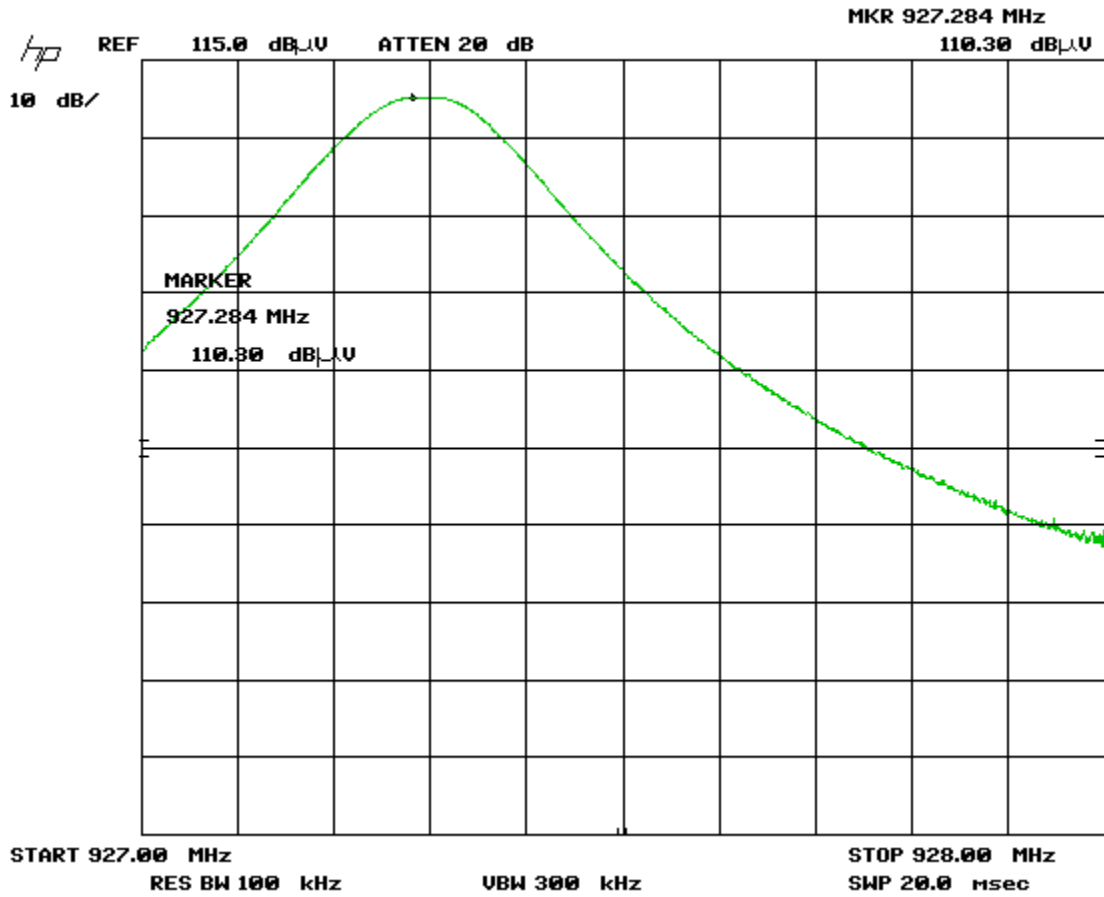
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph, Horizontal Antenna Polarity
EUT Output: Middle Channel



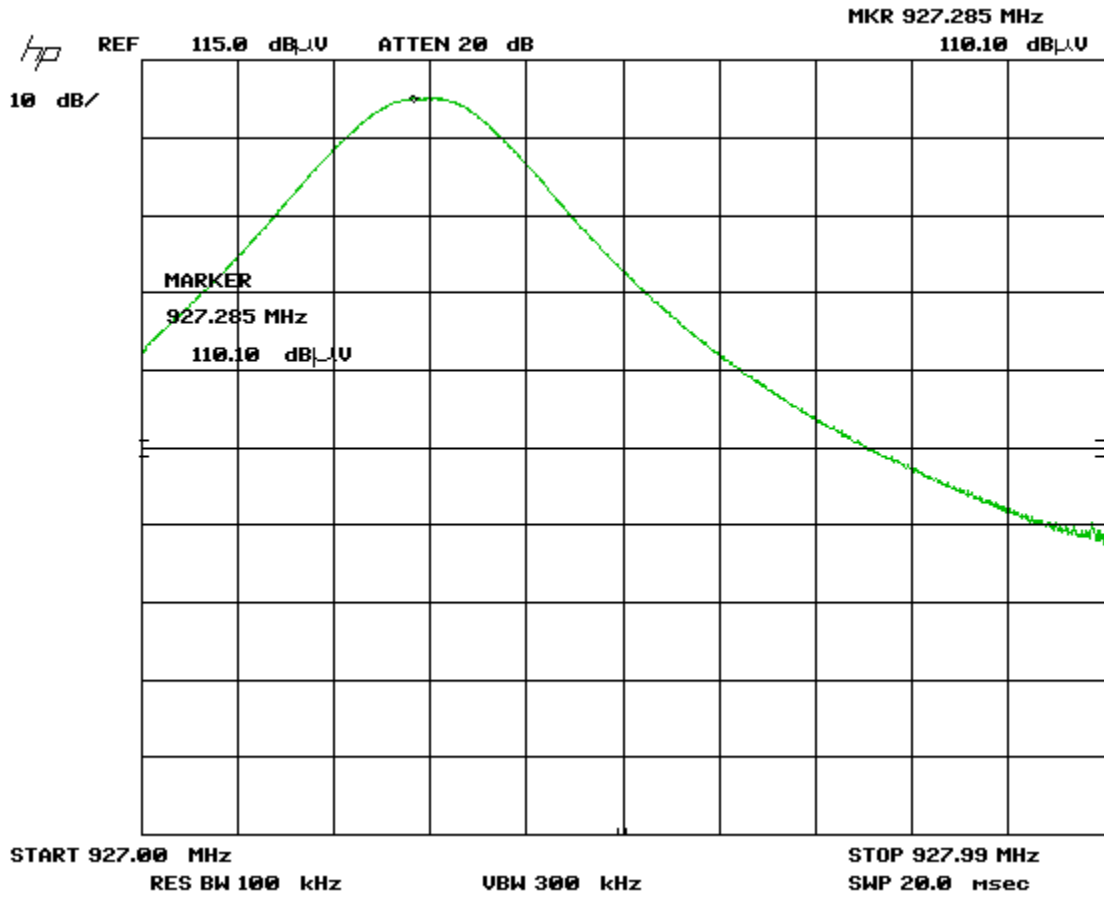
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph, Vertical Antenna Polarity
EUT Output: High Channel1



Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Peak Emissions Graph, Horizontal Antenna Polarity
EUT Output: High Channel1




Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Final Measurements


Radiated Emissions - 15.247 - Table 1 Fundamental & Harmonics 3m measurement distance

Test Frequency (MHz)	Detection mode	Antenna polarity (Horz/Vert)	Raw signal dB(μV)	Antenna factor dB	Cable loss dB + Pre-selector	Attenuator dB	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result
Low Channel – Fundamental Emissions											
902.7	Peak	Horz	110.4	23.4	2.3	10.0	29.9	116.2	125.20	9.0	Pass
902.7	Peak	Vert	108.1	22.3	2.3	10.0	29.9	112.8	125.20	12.4	Pass
Low Channel – Low Restricted Band Edge											
614	QP	Horz	27.0	20.5	1.9	10.0	29.9	29.5	46.00	16.5	Pass
614	QP	Vert	27.0	19.8	1.9	10.0	29.9	28.8	46.00	17.2	Pass
Low Channel - Harmonics											
<i>2nd Harmonic</i>											
1805.4	Peak	Horz	80.0	30.2	3.6	0.0	34.0	79.8	96.2 [†]	16.4	Pass
1805.4	Peak	Vert	78.5	28.7	3.6	0.0	34.0	76.8	92.8 [†]	16.0	Pass
<i>3rd Harmonic</i>											
2708.1	Peak	Horz	49.6	26.6	4.7	0.0	33.8	47.1	73.90	26.8	Pass
2708.1	Avg	Horz	44.1	26.6	4.7	0.0	33.8	41.6	53.90	12.3	Pass
2708.1	Peak	Vert	51.5	26.5	4.7	0.0	33.8	48.9	73.90	25.0	Pass
2708.1	Avg	Vert	46.7	26.5	4.7	0.0	33.8	44.1	53.90	9.8	Pass
<i>Harmonics above the 3rd are under the limits and the noise floor.</i>											
Mid channel – Fundamental Emissions											
915	Peak	Horz	110.2	23.4	2.3	10.0	29.9	116.0	125.20	9.2	Pass
915	Peak	Vert	109.5	22.3	2.3	10.0	29.9	114.2	125.20	11.0	Pass
Mid Channel – Harmonics											
<i>2nd Harmonic</i>											
1830	Peak	Horz	75.8	30.1	3.7	0.0	34.0	75.6	96.0 [†]	20.4	Pass
1830	Peak	Vert	73.9	28.7	3.7	0.0	34.0	72.3	94.2 [†]	21.9	Pass
<i>3rd Harmonic</i>											
2745	Peak	Horz	48.8	26.8	4.7	0.0	33.8	46.5	73.90	27.4	Pass
2745	Avg	Horz	40.6	26.8	4.7	0.0	33.8	38.3	53.90	15.6	Pass
2745	Peak	Vert	51.0	26.8	4.7	0.0	33.8	48.7	73.90	25.2	Pass
2745	Avg	Vert	46.9	26.8	4.7	0.0	33.8	44.6	53.90	9.3	Pass

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

<i>Harmonics above the 3rd are under the limits and the noise floor.</i>											
High Channel – Fundamental Emissions											
927.3	Peak	Horz	110.1	23.6	2.3	6.0	29.9	112.1	125.20	13.1	Pass
927.3	Peak	Vert	110.3	22.5	2.3	10.0	29.9	115.2	125.20	10.0	
High Channel – High Restricted Band Edge											
960	QP	Horz	35.0	22.7	2.4	0.0	29.7	30.4	46.00	15.6	Pass
960	QP	Vert	35.1	19.8	1.9	0.0	29.9	26.9	46.00	19.1	Pass
High Channel – Harmonics											
<i>2nd Harmonic</i>											
1854.6	Peak	Horz	80.7	30.1	3.7	0.0	33.9	80.6	92.1 [†]	11.5	Pass
1854.6	Peak	Vert	80.1	28.6	3.7	0.0	33.9	78.5	95.2 [†]	16.7	Pass
<i>3rd Harmonic</i>											
2781.9	Peak	Horz	49.4	26.7	4.8	0.0	33.8	47.1	73.90	26.8	Pass
2781.9	Avg	Horz	43.3	26.7	4.8	0.0	33.8	41.0	53.90	12.9	Pass
2781.9	Peak	Vert	50.2	26.6	4.8	0.0	33.8	47.8	73.90	26.1	Pass
2781.9	Avg	Vert	44.3	26.6	4.8	0.0	33.8	41.9	53.90	12.0	Pass
<i>Harmonics above the 3rd are under the limits and the noise floor.</i>											

† 2nd harmonic frequency is not in the restricted bands specified in 15.205. Limit shown is 20 dB from the fundamental emission measured.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Radiated Emissions - 15.247 - Table 2
Other spurious measurements
3m measurement distance

Test Frequency (MHz)	Detection mode	Raw signal dB(μV)	Antenna factor (dB)	Attenuator factor (dB)	Cable loss dB + Pre-selector	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result
Vertical Antenna Polarity										
164.3	QP	53.9	9.6	6	1	-30.1	40.4	43.5	3.1	Pass
738.5	Peak	43.4	20.9	6	2.1	-29.9	42.5	46.4	3.9	Pass
30.1	Peak	42.4	16.2	6	0.5	-30	35.1	40	4.9	Pass
328.5	Peak	45.5	14.3	6	1.4	-30.3	36.9	46.4	9.5	Pass
330.0	Peak	45.2	14.4	6	1.4	-30.3	36.7	46.4	9.7	Pass
326.9	Peak	44.8	14.3	6	1.4	-30.3	36.2	46.4	10.2	Pass
Horizontal Antenna Polarity										
786.9	Peak	44	22.3	6	2.1	-29.9	44.5	46.4	1.9	Pass
328.4	Peak	50.8	14.6	6	1.4	-30.3	42.5	46.4	3.9	Pass
30.2	Peak	41.4	18.2	6	0.5	-30	36.1	40	3.9	Pass
326.8	Peak	50	14.6	6	1.4	-30.3	41.7	46.4	4.7	Pass
574.2	Peak	43.7	19.6	6	1.8	-29.8	41.3	46.4	5.1	Pass
329.9	Peak	49.5	14.6	6	1.4	-30.3	41.2	46.4	5.2	Pass
1920.3	Peak	55.3	30.1	0	3.7	-33.9	55.2	74	18.8	Pass
1920.3	Avg.	43.8	30.1	0	3.7	-33.9	43.7	54	10.3	Pass


Notes:

Peak = Peak reading

QP = Quasi-Peak reading.

Avg. = Average reading


Where peak readings are under quasi-peak or average limits, the EUT is deemed to have passed the requirements and no respective readings are necessary.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	85650A	HP	Jan. 23, 2013	Jan. 23, 2015	GEMC 170
Quasi-Peak Detector	8566B	HP	Jan. 22, 2013	Jan. 22, 2015	GEMC 169
Loop Antenna 30Hz – 1MHz	EM 6871	Electro-Metrics	Feb. 5, 2013	Feb. 5, 2015	GEMC 70
Loop Antenna 100kHz – 30MHz	EM 6872	Electro-Metrics	Feb. 5, 2013	Feb. 5, 2015	GEMC 71
BiLog Antenna	3142-C	ETS	Feb 4, 2013	Feb 4, 2015	GEMC 137
Q-Par Horn 1.5GHz -18 GHz	6878/24	Q-par	Sept. 10, 2014	Sept. 10, 2016	GEMC 6365
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	Sept. 9, 2014	Sept. 9, 2016	GEMC 6403
Pre-amp 1-26GHz	HP 8449B	HP	Sept. 9, 2014	Sept. 9, 2016	GEMC 6351
RF Cable 7m	LMR-400-7M- 50OHM-MN- MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M- 50OHM-MN- MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400- 0.5M-50OHM- MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev1.doc"

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

The limits are as defined in 47 CFR FCC Part 15 Section 15.207


Method is as defined in ANSI C64:2003

Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

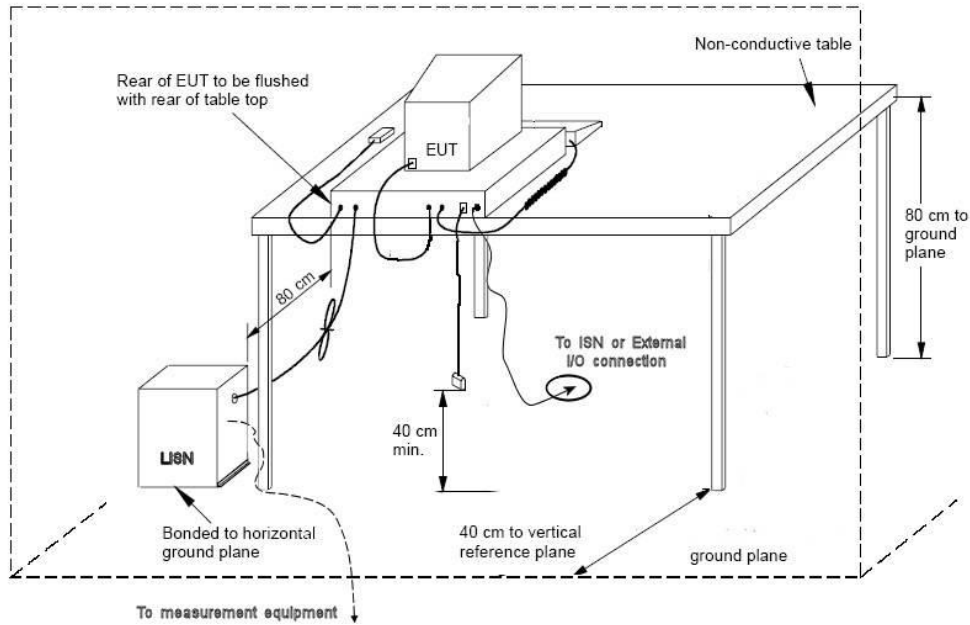
The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Typical Setup Diagram




Measurement Uncertainty

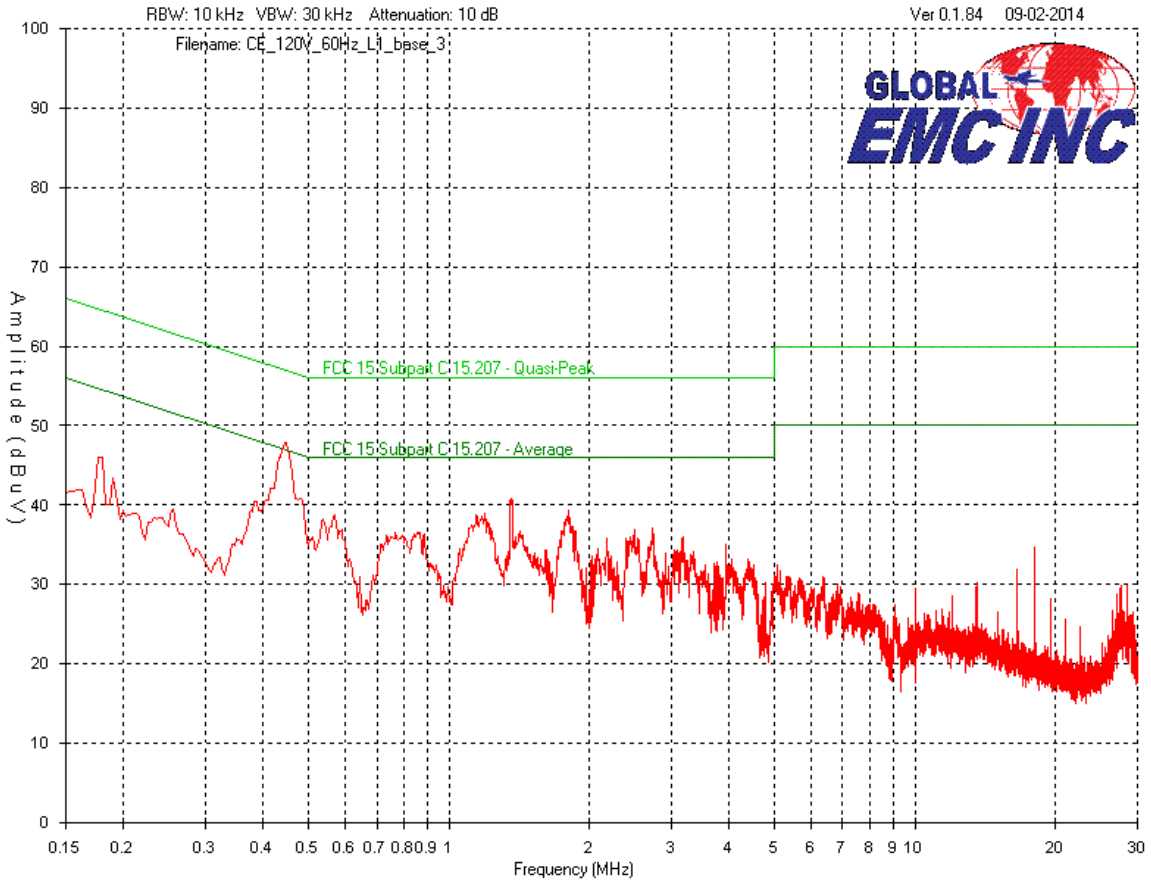
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ± 3.6 dB with a 'k=2' coverage factor and a 95% confidence level.


Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graphs shown below are peak measurement graphs, measured with a resolution bandwidth greater than or equal to the final required detector. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings. Power line conducted emissions were performed with the transmitter transmitting with constant modulated data at maximum power.

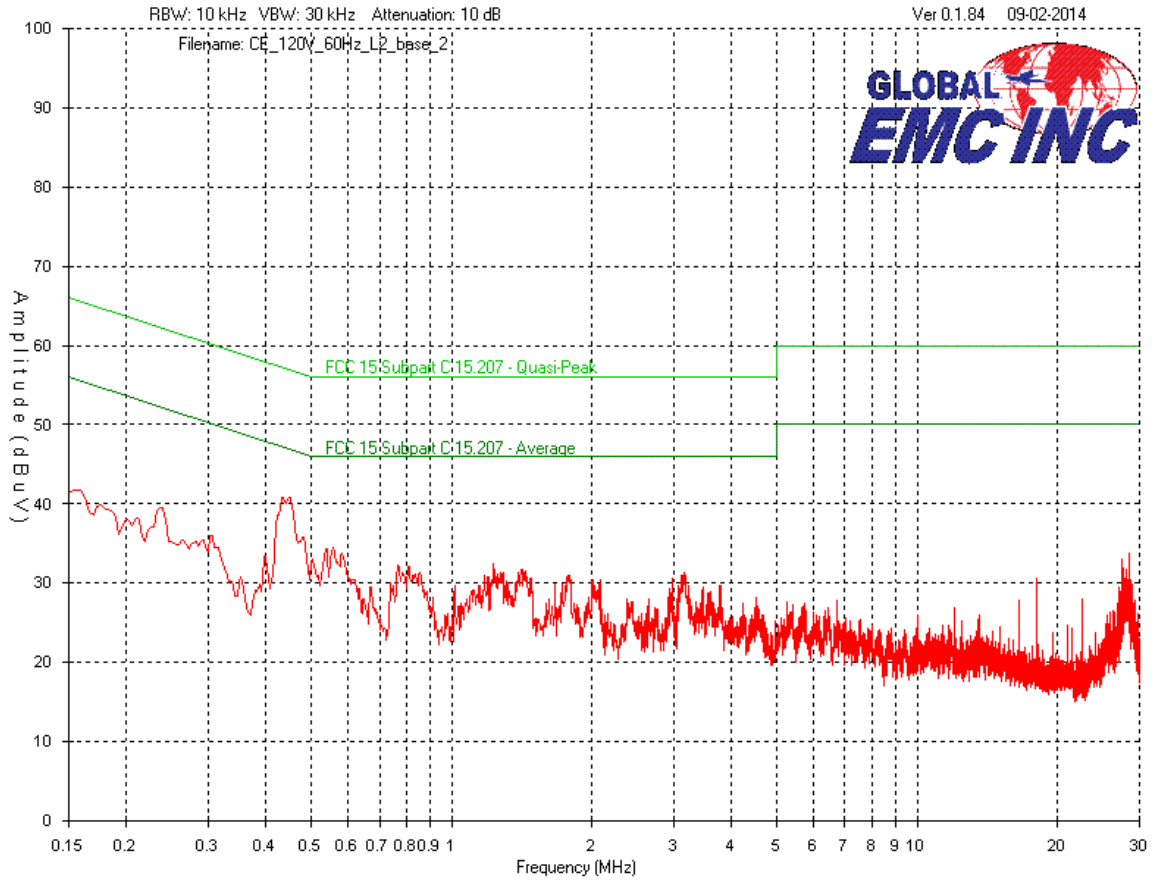
Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Peak Emissions Graph - Line 1
120V_{AC}, 60Hz



Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Peak Emissions Graph - Line 2
120V_{AC}, 60Hz



Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Final Measurements

Emissions Table 120V_{AC}, 60Hz

Test Frequency (MHz)	Detector	Received signal (dB μ V)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dB μ V)	Quasi-Peak Emission limit (dB μ V)	Average Emission limit (dB μ V)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Phase Line											
0.446	Peak	37.7	10	0.1	0.1	47.9	57	---	9.1	---	Pass
0.446	Avg.	32.46	10	0.1	0.1	42.66	---	47	---	4.34	Pass
1.36	Peak	30.7	10	0.1	0.1	40.9	56	46	15.1	5.1	Pass
1.81	Peak	29.1	10	0.1	0.1	39.3	56	46	16.7	6.7	Pass
1.19	Peak	28.8	10	0.1	0.1	39	56	46	17	7	Pass
0.177	Peak	35.9	10	0.1	0.1	46.1	64.6	54.6	18.5	8.5	Pass
2.74	Peak	26.9	10	0.1	0.1	37.1	56	46	18.9	8.9	Pass
Neutral Line											
0.433	Peak	30.6	10	0.1	0.1	40.8	57.2	47.2	16.4	6.4	Pass
1.23	Peak	22.2	10	0.1	0.1	32.4	56	46	23.6	13.6	Pass
0.768	Peak	22.2	10	0.1	0.1	32.4	56	46	23.6	13.6	Pass
0.153	Peak	31.6	10	0.1	0.1	41.8	65.8	55.8	24	14	Pass
3.17	Peak	21.2	10	0.1	0.1	31.4	56	46	24.6	14.6	Pass
1.78	Peak	20.9	10	0.1	0.1	31.1	56	46	24.9	14.9	Pass


Notes:

Peak = Peak readings

QP = Quasi-Peak readings

Avg. = Average readings


Where peak readings are under quasi-peak and/or average limits, the EUT passes the respective requirements, and no quasi-peak or average measurements are required.

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	2013-11-15	2015-11-15	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	2013-02-06	2015-02-06	GEMC 65
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Elkay Manufacturing Co.	
Product	Base Station	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Appendix A – EUT Summary

For further details for filing purposes, refer to filing package.

General EUT Description

Client Details	
Organization / Address	Elkay Manufacturing Co. 2222 Camden Ct. Oakbrook, Illinois United States of America 60523
Contact	Rene Laude
Phone	708-786-5067
Email	rene.laude@elkay.com
EUT (Equipment Under Test) Details	
EUT Name / Model	Base Station / 1000001858
Mains input voltage range(s)	115V, 60Hz
Rated input current	4.2 A
Transmit Frequencies	902.7 – 927.3 MHz
Basic EUT functionality description	The EUT is a Communication Base Station interface between the company's line of water coolers/drinking fountains and the cloud database. It wirelessly communicates at the 900 MHz range.
Modes of operation	On mode.
Available connectors on EUT	RJ45 Mini-USB
Dimensions of product (approx.)	EUT: L: 23.5cm, W: 13cm, H: 4cm Antenna: L: 14cm
Separation distance from operator	20cm

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see photo exhibits.