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EMC Test Report

Application for Grant of Equipment Authorization

Industry Canada RSS-Gen Issue 4 / RSS 210 Issue 9
FCC Part 15 Subpart C

RFID Model SRFAX01

IC CERTIFICATION #:	11508A-SRFAX01
FCC ID:	2AAZF-SRFAX01
APPLICANT:	Intuitive Surgical Inc. 1266 Kifer Road Building 101 Sunnyvale, CA 94086
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-3
REPORT DATE:	March 16, 2016
REISSUE DATE:	November 4, 2016
FINAL TEST DATES:	February 29 and March 1, 2016
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A2LA ACCREDITED
Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	March 16, 2016	First release	
1.0	November 4, 2016	Updated RSS-210 references to Issue 9. Updated FCC reference to 15.209. Clarified AC conducted emissions setup.	MEH

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SCOPE

An electromagnetic emissions test has been performed on the Intuitive Surgical Inc. RFID Model SRFAX01, pursuant to the following rules:

Industry Canada RSS-Gen Issue 4
RSS 210 Issue 9 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in National Technical Systems - Silicon Valley test procedures:

ANSI C63.10-2013

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification. Class II devices are required to meet the appropriate technical requirements but are exempt from certification requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Intuitive Surgical Inc. RFID Model SRFAX01 complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 4
RSS 210 Issue 9 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Intuitive Surgical Inc. RFID Model SRFAX01 and therefore apply only to the tested sample. The sample was selected and prepared by Michael Quillopo of Intuitive Surgical Inc..

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

DEVICES OPERATING UNDER THE GENERAL LIMITS

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.209	RSS 210 4.4 – RSS-GEN Table 5	Transmitter Fundamental Signal Emissions, 13.56 MHz	0.20 dBµV/m @ 13.560 MHz	Refer to table in limits section	Complies
15.209	RSS 210 4.4 – RSS-GEN Table 4 and 5	Transmitter Radiated Spurious Emissions, 9kHz - 150 MHz	24.2 dBµV/m @ 63.51 MHz (-15.8 dB)	Refer to table in limits section	Complies

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Integral Antenna	Unique or integral antenna required	Complies
15.207	RSS GEN Table 3	AC Conducted Emissions	47.8 dBµV @ 0.495 MHz (-8.3 dB)	Refer to page 16	Complies
15.109	RSS GEN 7.1.2 Table 2	Receiver spurious emissions	N/A – Receiver tunes below 30MHz		
-	RSS 102	RF Exposure Requirements	Refer to RSS 102 declaration	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSS GEN 8.3	User Manual		Statement for products with detachable antenna	Complies
-	RSP 100 RSS GEN 6.6	Occupied Bandwidth	192 Hz	Information only	N/A

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission (field strength)	dBµV/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dBµV	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Intuitive Surgical Inc. RFID Model SRFAX01 is an RFID 13.56MHz transceiver module for use in the Endoscopic Instrument Control System, model IS4000, intended to assist in the accurate control of endoscopic instruments.

It would be installed in and powered from the Patient Side Cart (PSC). The electrical rating for the PSC is 100-230V, 50/60Hz, 12A.

The sample was received on February 29, 2016 and tested on February 29 and March 1, 2016. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Intuitive Surgical	SRFAX01	RFID Module	-	2AAZF-SRFAX01

ANTENNA SYSTEM

The antenna is integral to the module.

ENCLOSURE

The EUT has no enclosure. It is designed to be mounted in the PSC of the IS4000 system.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Silicon Valley.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Dell	Latitude E6410	Laptop	GYN8XN1	-

No remote support equipment was used during testing.

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Laptop USB	EUT	Power/Data Cable	Shielded	2.1

EUT OPERATION

During testing, the EUT was configured to continuously transmit in a read/write cycle at 13.56MHz.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 3	US0027	2845B-3	41039 Boyce Road Fremont, CA 94538-2435

ANSI C63.4 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.10. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers. The software used for radiated and conducted emissions measurements is NTS EMI Test Software (rev 2.10)

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.10 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor as specified in ANSI C63.4. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.10, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

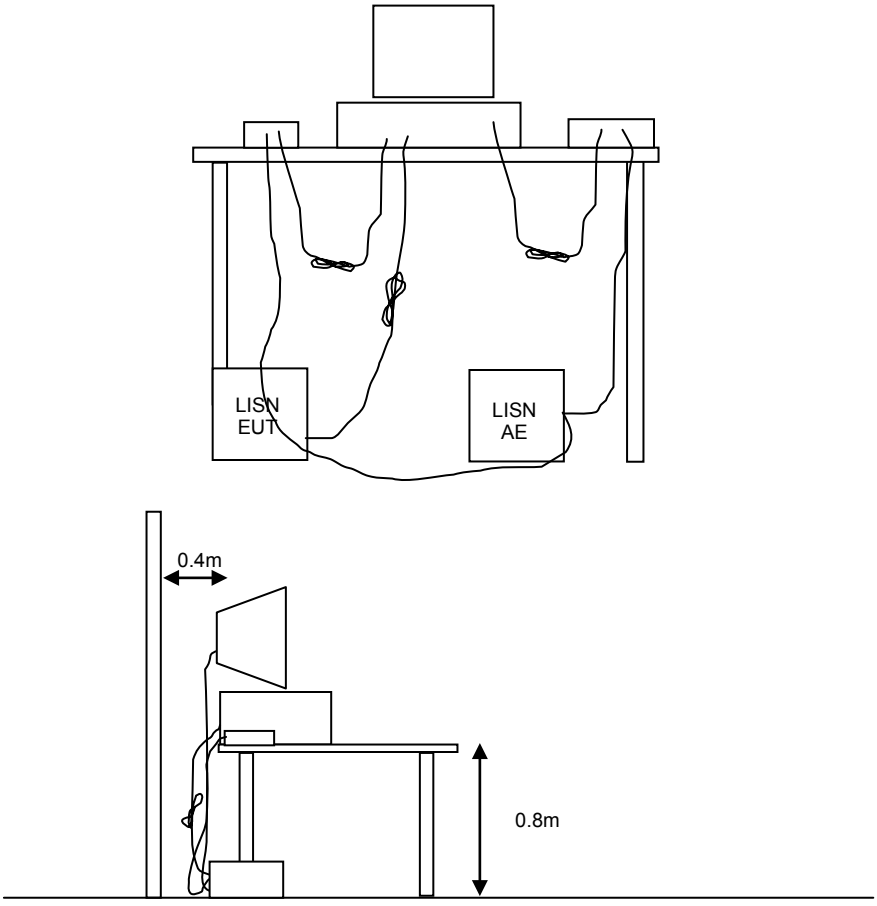


Figure 1 Typical Conducted Emissions Test Configuration

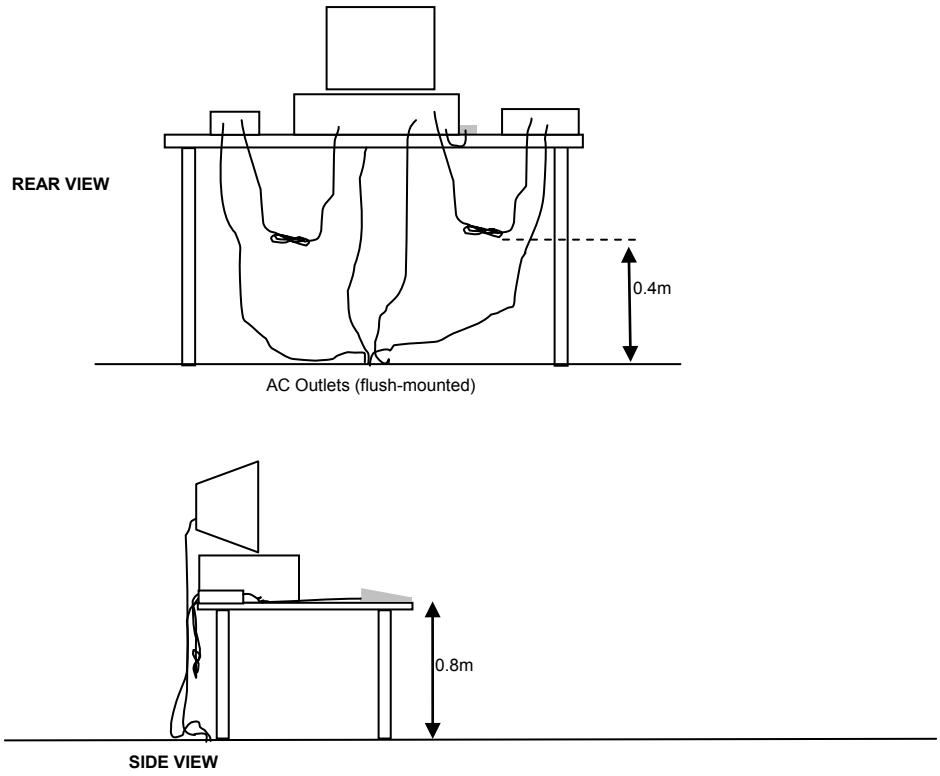
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

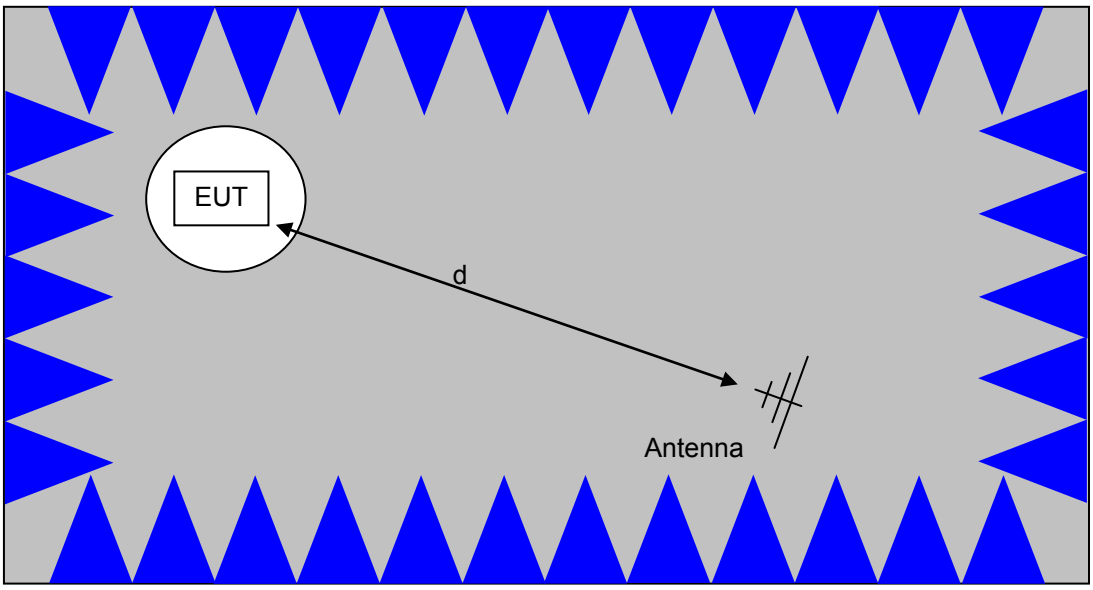
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

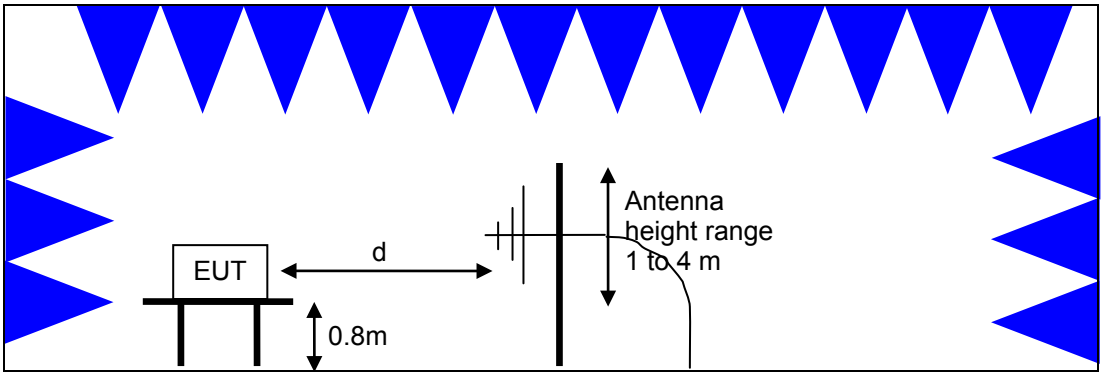


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

BANDWIDTH MEASUREMENTS

The 6dB, 20dB, 26dB and/or 99% signal bandwidth are measured using the bandwidths recommended by ANSI C63.10 and RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(a), RSS GEN

The table below shows the limits for the emissions on the AC power line from an intentional radiator and a receiver.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1] (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

[1] The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of d (meters) from the equipment under test:

$$E = \frac{1000000 \sqrt{30 P}}{d} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

For a measurement at 3m the conversion from a logarithmic value for field strength (dBuV/m) to an eirp power (dBm) is -95.3dB.

Appendix A Test Equipment Calibration Data

Radiated Emissions, .009 - 30 MHz, 29-Feb-16

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	6/20/2015	6/20/2016
EMCO	Magnetic Loop Antenna, 9 kHz-30 MHz	AL-130	3003	7/24/2014	7/24/2016

Radiated Spurious Emissions, 30 - 150 MHz, 01-Mar-16

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
NTS	NTS EMI Software (rev 2.10)	N/A	0		N/A
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1657	6/25/2014	6/25/2016
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	6/20/2015	6/20/2016
Com-Power	Preamplifier, 30-1000 MHz	PA-103	2465	9/1/2015	9/1/2016

Conducted Emissions - AC Power Ports, 01-Mar-16

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
NTS	NTS EMI Software (rev 2.10)	N/A	0		N/A
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1594	5/14/2015	5/14/2016
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	6/20/2015	6/20/2016
Fischer Custom Comm	LISN, 25A, 150kHz to 30MHz, 25 Amp,	FCC-LISN-50-25-2-09	2001	7/24/2015	7/24/2016

Appendix B Test Data

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Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Product	RFID Model SRFAX01	T-Log Number:	T100834
System Configuration:	-	Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Emissions Standard(s):	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	-
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Intuitive Surgical Inc.

Product

RFID Model SRFAX01

Date of Last Test: 3/8/2016

Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Model:	RFID Model SRFAX01	T-Log Number:	T100834
		Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	N/A

Radiated Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualifications testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT was located on the turntable for radiated emissions testing. The EUT was tested in all three orthogonal orientations.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 21 °C

Rel. Humidity: 35 %

Summary of Results

Run #	Test Performed	Limit	Result	Value / Margin
1	Fundamental Signal Field Strength / Spectral Mask	FCC 15.209 & RSS 210/RSS GEN	Pass	0.20 dBµV/m @ 13.560 MHz (-29.3 dB)
2	Transmitter Radiated Spurious Emissions, 9kHz - 30 MHz, E-Field	FCC 15.209 & RSS 210/RSS GEN	Pass	13.9 dBµV/m @ 0.933 MHz (-17.7 dB)
3	Transmitter Radiated Spurious Emissions, 30 - 150 MHz	FCC 15.209 & RSS 210/RSS GEN	Pass	24.2 dBµV/m @ 63.51 MHz (-15.8 dB)
4	99% Bandwidth (center channel)	RSS-GEN	Pass	192 Hz

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Model:	RFID Model SRFAX01	T-Log Number:	T100834
		Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	N/A

Run #1: Fundamental Signal Field Strength / Spectral Mask

Date of Test: 2/29/2016
Test Engineer: John Caizzi
Test Location: Chamber 3

Config. Used: 1
Config Change: none
EUT Voltage: 5 VDC (USB)

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
12.56 - 14.56 MHz	3	30	40.0

Fundamental Field Strength

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
13.558	-5.5	C	29.5	-35.0	PK	110	1.27	EUT hor
13.560	0.0	O	29.5	-29.5	PK	181	1.27	EUT hor
13.560	0.2	O	29.5	-29.3	PK	24	1.27	EUT side
13.559	-4.9	C	29.5	-34.4	PK	126	1.27	EUT side
13.560	-7.2	C	29.5	-36.7	PK	98	1.27	EUT vert
13.561	-0.3	O	29.5	-29.8	PK	172	1.27	EUT vert

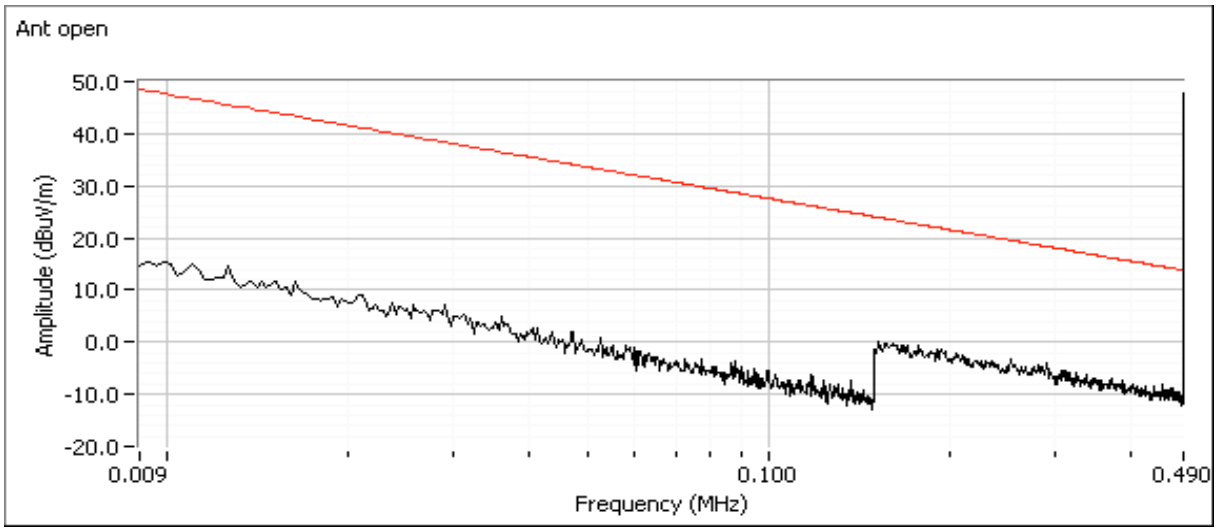
Note 1:	For all measurements, RBW = 10 kHz, VBW = 30 kHz. Peak detector, instead of QP, was used, since level was so low.
Note 2	Measurements compared to the spurious emissions limit, not the fundamental field strength limit, which is 84 dBuV/m at the highest point of the mask. Since this fundamental level was below the spurious limit, mask measurerments were not done.

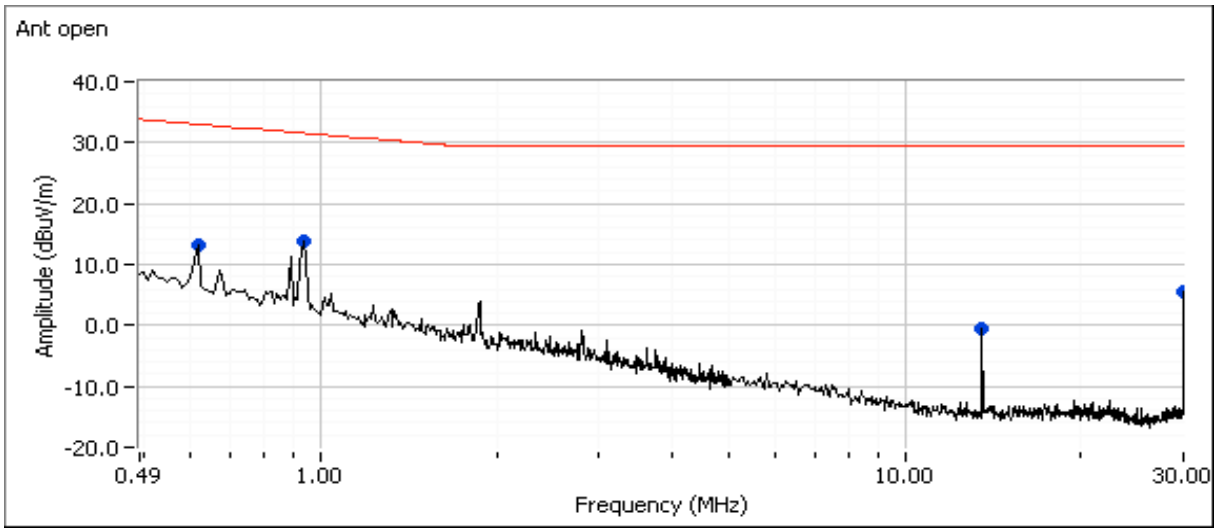
Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Model:	RFID Model SRFAX01	T-Log Number:	T100834
		Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	N/A

Run #2: 9 kHz - 30 MHz E-Field Radiated Emissions

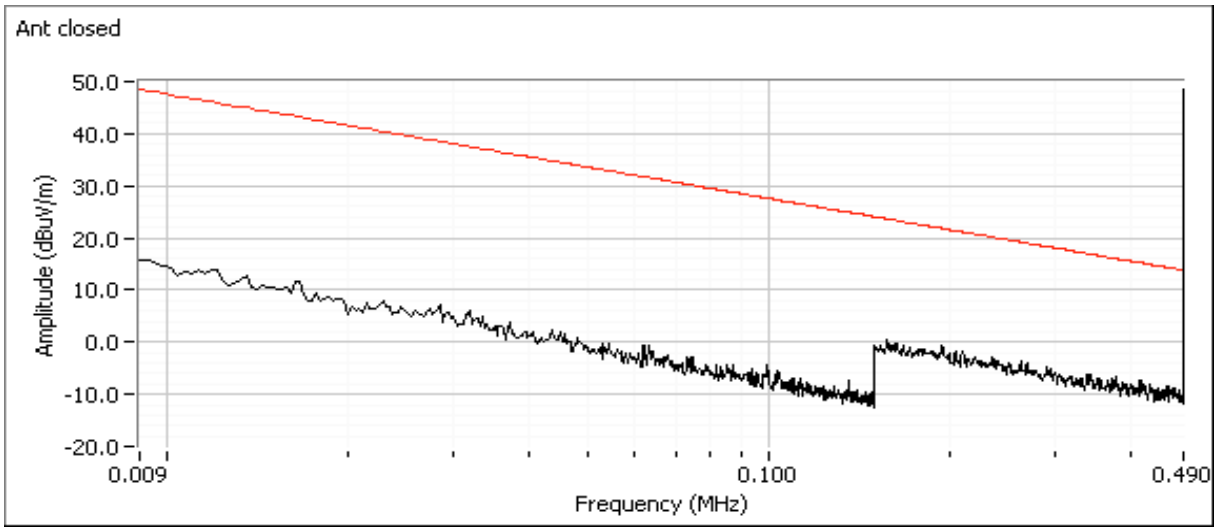
Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
0.009 - 0.490 MHz	10	300	-59.1
0.490 - 1.705 MHz	3	30	-40.0
1.705 - 30.0 MHz	3	30	-40.0

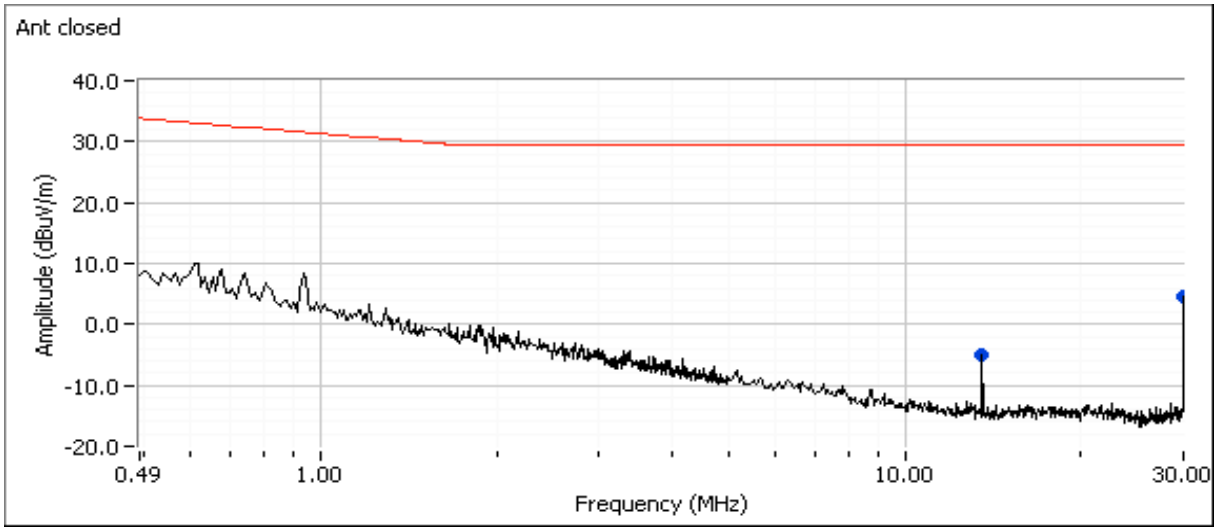
Note - the extrapolation factor is based on 40log(test distance/limit distance) as permitted by FCC 15.31





Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Model:	RFID Model SRFAX01	T-Log Number:	T100834
		Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	N/A





Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Model:	RFID Model SRFAX01	T-Log Number:	T100834
		Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	N/A

Preliminary readings

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
0.617	*13.1*	*O*	*33.0*	*-19.9*	*Peak*	*76*	*1.27*	
0.933	*13.9*	*O*	*31.6*	*-17.7*	*Peak*	*107*	*1.27*	
13.567	*-0.5*	*O*	*29.5*	*-30.0*	*Peak*	*203*	*1.27*	*Fundamental*
13.567	*-5.0*	*C*	*29.5*	*-34.5*	*Peak*	*114*	*1.27*	*Fundamental*

Note 1:	The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, with a peak limit 20dB above the average limit.
Note 1:	QP measurements not taken since all peak readings were > 17 dB below QP limit.
Note:	"Emission" observed at 30MHz was investigated and found to be an artifact of the measurement system changing the RBW at 30MHz

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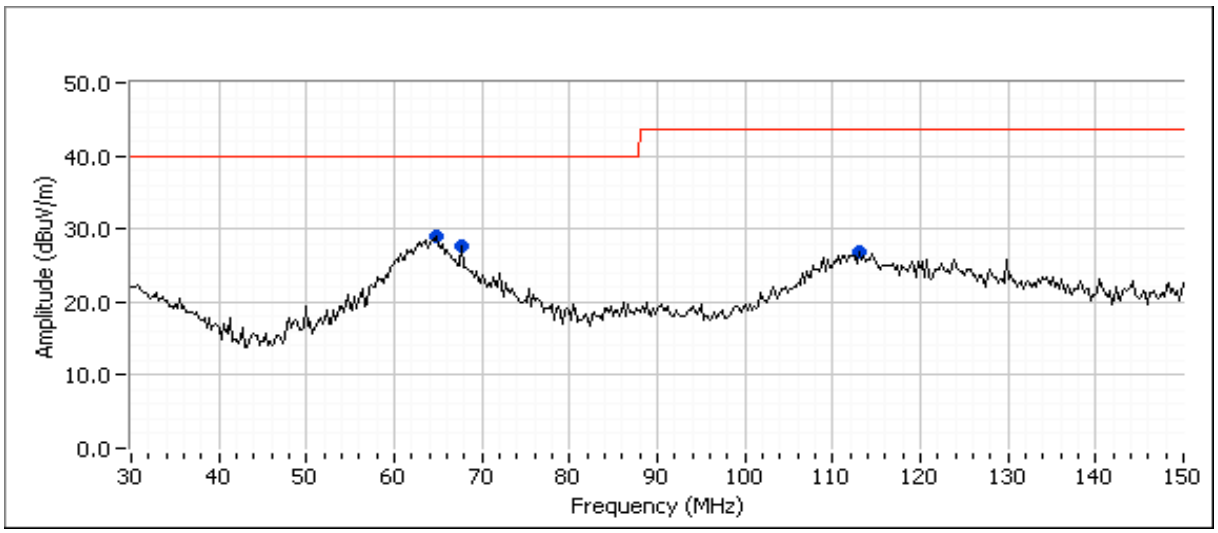
Model:	RFID Model SRFAX01	T-Log Number:	T100834
		Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	N/A

Run #3a: Maximized Readings - Transmitter Spurious Emissions, 30 - 150 MHz

Date of Test: 3/1/2016
Test Engineer: John Caizzi
Test Location: Chamber 3

Config. Used:
Config Change: none
EUT Voltage: 5 VDC (USB)

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
30 - 150 MHz	3	3	0.0



Preliminary Readings

Frequency	Level	Pol	RSS 210 / FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
63.509	28.9	V	40.0	-11.1	Peak	293	1.0	
67.797	27.6	H	40.0	-12.4	Peak	163	1.5	
110.797	26.8	H	43.5	-16.7	Peak	112	1.0	

Maximized readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	RSS 210 / FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
63.509	24.2	V	40.0	-15.8	QP	360	1.00	
67.797	23.1	H	40.0	-16.9	QP	171	1.00	
110.797	25.6	H	43.5	-17.9	QP	108	1.00	

Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Model:	RFID Model SRFAX01	T-Log Number:	T100834
		Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	N/A

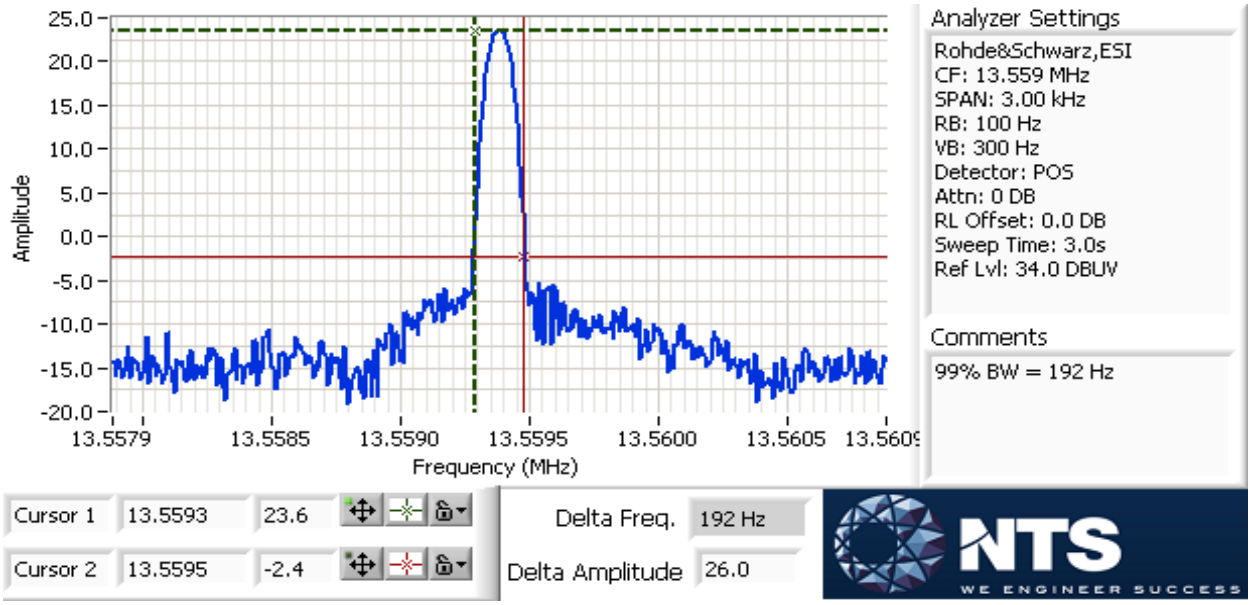
Run #4: Bandwidth Measurement(s)

Date of Test: 2/29/2016
Test Engineer: John Caizzi
Test Location: Chamber 3

Config. Used: 1
Config Change: none
EUT Voltage: 5 VDC (USB)

Power Setting	Frequency (MHz)	Resolution Bandwidth	Video Bandwidth	99% Bandwidth
Max	13.56	100Hz	300Hz	192

Note 1:	99% bandwidth measured in accordance with RSS GEN, with RB > 1% of the span and VB > 3xRB



Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Model:	RFID Model SRFAX01	T-Log Number:	T100834
		Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	-

Conducted Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/1/2016
Test Engineer: John Caizzi
Test Location: Chamber 3

Config. Used: 1
Config Change: none
EUT Voltage: 5 VDC (USB)

General Test Configuration

For tabletop equipment, the EUT host system was located on a styrofaom table inside the semi-anechoic chamber, 40 cm from a vertical coupling plane and 80cm from the LISN.

Ambient Conditions:

Temperature: 22 °C
Rel. Humidity: 35 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	CE, AC Power, 120V/60Hz	15.207	Pass	47.8 dBµV @ 0.495 MHz (-8.3 dB)

Modifications Made During Testing

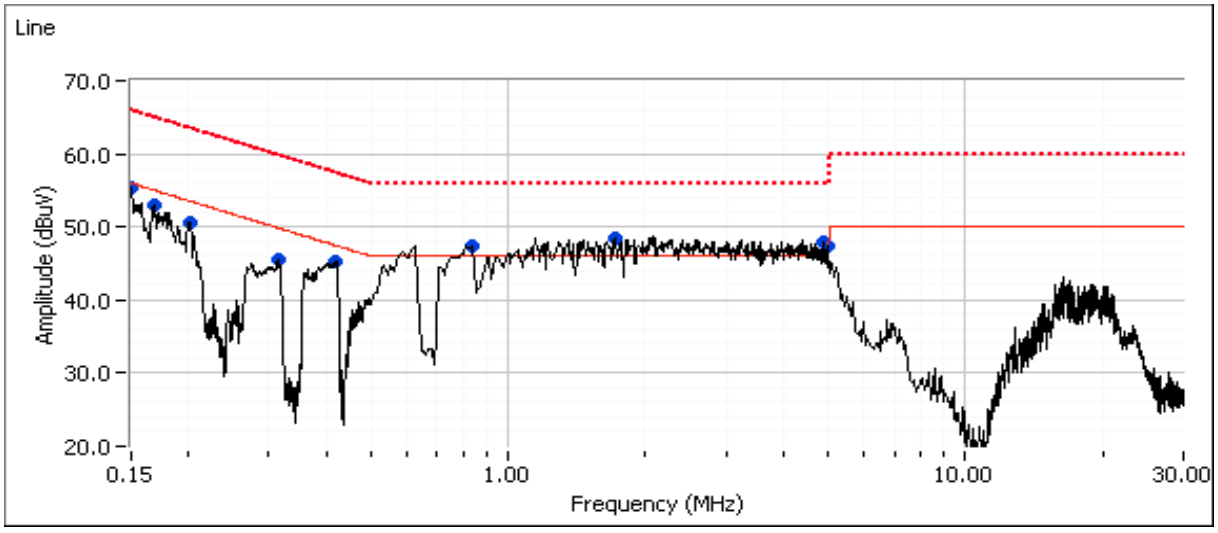
No modifications were made to the EUT during testing

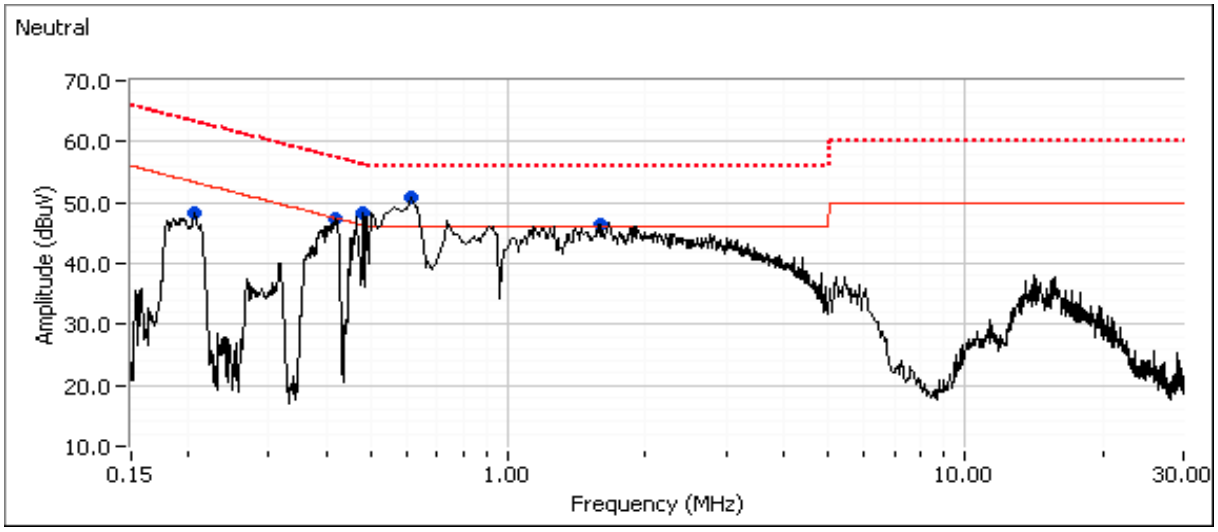
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Model:	RFID Model SRFAX01	T-Log Number:	T100834
		Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	-

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz





Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Model:	RFID Model SRFAX01	T-Log Number:	T100834
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Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	-

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	AC	FCC 15.207		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
1.760	48.4	Line	46.0	2.4	Peak	
4.902	48.0	Line	46.0	2.0	Peak	
4.988	47.5	Line	46.0	1.5	Peak	
0.823	47.4	Line	46.0	1.4	Peak	
0.154	55.5	Line	56.0	-0.5	Peak	
0.167	53.0	Line	55.0	-2.0	Peak	
0.417	45.2	Line	47.4	-2.2	Peak	
0.202	50.6	Line	53.6	-3.0	Peak	
0.309	45.4	Line	49.9	-4.5	Peak	
0.496	40.1	Line	46.0	-5.9	Peak	
0.562	50.8	Neutral	46.0	4.8	Peak	
0.485	48.2	Neutral	46.3	1.9	Peak	
1.570	46.5	Neutral	46.0	0.5	Peak	
0.418	47.2	Neutral	47.4	-0.2	Peak	
0.203	48.3	Neutral	53.3	-5.0	Peak	

Client:	Intuitive Surgical Inc.	Job Number:	JD100654
Model:	RFID Model SRFAX01	T-Log Number:	T100834
		Project Manager:	Deepa Shetty
Contact:	Michael Quillopo	Project Coordinator:	-
Standard:	15.209 / RSS-210 Annex 4.4 / EN 300 330 / EN 302 291	Class:	-

Final quasi-peak and average readings

Frequency	Level	AC	FCC 15.207		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
1.760	28.1	Line	46.0	-17.9	AVG	
1.760	43.8	Line	56.0	-12.2	QP	
4.902	28.2	Line	46.0	-17.8	AVG	
4.902	38.1	Line	56.0	-17.9	QP	
4.988	28.6	Line	46.0	-17.4	AVG	
4.988	36.6	Line	56.0	-19.4	QP	
0.823	30.2	Line	46.0	-15.8	AVG	
0.823	44.4	Line	56.0	-11.6	QP	
0.154	29.1	Line	65.8	-36.7	QP	
0.154	11.5	Line	55.8	-44.3	AVG	
0.167	13.3	Line	55.1	-41.8	AVG	
0.167	28.1	Line	65.1	-37.0	QP	
0.417	31.0	Line	47.5	-16.5	AVG	
0.417	43.1	Line	57.5	-14.4	QP	
0.202	39.2	Line	53.5	-14.3	AVG	
0.202	47.6	Line	63.5	-15.9	QP	
0.309	29.9	Line	50.0	-20.1	AVG	
0.309	40.5	Line	60.0	-19.5	QP	
0.495	31.2	Line	46.1	-14.9	AVG	
0.495	47.8	Line	56.1	-8.3	QP	
0.562	26.7	Neutral	46.0	-19.3	AVG	
0.562	46.5	Neutral	56.0	-9.5	QP	
0.485	22.5	Neutral	46.3	-23.8	AVG	
0.485	42.6	Neutral	56.3	-13.7	QP	
1.570	25.3	Neutral	46.0	-20.7	AVG	
1.570	42.1	Neutral	56.0	-13.9	QP	
0.418	33.1	Neutral	47.5	-14.4	AVG	
0.418	45.2	Neutral	57.5	-12.3	QP	
0.203	35.3	Neutral	53.5	-18.2	AVG	
0.203	44.4	Neutral	63.5	-19.1	QP	

End of Report

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