41039 Boyce Road
Fremont, CA. 94538

510-578-3500 Phone
510-440-9525 Fax

EMC Test Report

Application for Grant of Equipment Authorization

Innovation, Science and Economic Development Canada
RSS-Gen Issue 5 / RSS-210 Issue 10
FCC Part 15 Subpart C

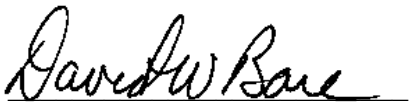
Model: SCWCX01

ISED CERTIFICATION #:	11508A-SCWCX01
FCC ID:	2AAZF-SCWCX01
APPLICANT:	Intuitive Surgical Inc. 1266 Kifer Road Building 101 Sunnyvale, CA 94086
TEST SITE(S):	NTS Labs LLC 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-3; 2845B-4, 2845B-5, 2845B-7
PROJECT NUMBER:	PR172107
REPORT DATE:	August 7, 2023
RE-ISSUED DATE:	December 15, 2023
FINAL TEST DATES:	June 20, 28 and 29, 2023
TOTAL NUMBER OF PAGES:	41

ACCREDITED
Testing Cert #0214.26

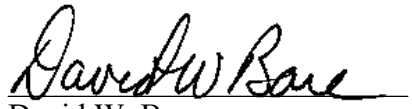
VALIDATING SIGNATORIES

PROGRAM MGR



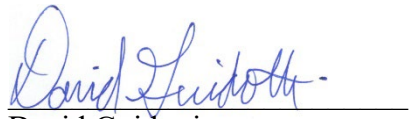
David W. Bare
Chief Engineer

TECHNICAL REVIEWER:



David W. Bare
Chief Engineer

FINAL REPORT PREPARER:



David Guidotti
Senior Technical Writer

QUALITY ASSURANCE DELEGATE

Gary Izard
Senior Technical Writer

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	August 7, 2023	First release	
1	November 6, 2023	Corrected typographical error in FCC ID on page 9, added spurious emissions expressed in dBµA/m for RSS-GEN table 6 limits, added screen capture and description of the calculation used to report the carrier frequency for frequency stability	dwb
2	December 15, 2023	Included missing updated data above.	dwb

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SCOPE

An electromagnetic emissions test has been performed on the Intuitive Surgical Inc. model SCWCX01, pursuant to the following rules:

RSS-Gen Issue 5
RSS-210 Issue 10 "Licence-Exempt Radio Apparatus: 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 NTS Labs LLC 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.

NTS Labs LLC is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise.

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. model SCWCX01 complied with the requirements of the following regulations:

RSS-Gen Issue 5
RSS-210 Issue 10 "Licence-Exempt Radio Apparatus: 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. model SCWCX01 and therefore apply only to the tested sample. The sample was selected and prepared by Tony Permsombut 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 IN THE 13.56 MHZ BAND

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.225	RSS-210 B.6	Transmitter Fundamental Signal Emissions, 13.56 MHz	28.7 dBµV/m @ 13.561 MHz (-55.3 dB)	Refer to table in limits section	Complies
15.209	RSS-GEN	Transmitter Radiated Spurious Emissions, 0.009 - 150 MHz	39.7 dBµV @ 94.888 MHz (-3.8)	Refer to table in limits section	Complies
15.225	RSS-210 B.6	Frequency Stability	59.1 ppm	100 ppm	Complies
Note 1 Pass/Fail criteria defined by standards listed above.					

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 4	AC Conducted Emissions	42.2 dBµV @ 24.324 MHz (-7.8 dB)	Refer to page 18	Complies
-	RSS-GEN 8.4	User Manual	-	Statement of Compliance	Complies
-	RSP 100 RSS-GEN 6.7	Occupied Bandwidth	192 kHz	Information only	N/A
Note 2 Pass/Fail criteria defined by standards listed above.					

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
Radiated emission (field strength)	dBµV/m	0.009 to 30 MHz	± 5.5 dB
		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. model SCWCX01, hereafter referred to as EUT, is a combination of active NFC tag 13.56 MHz and Wireless Power Transfer (WPT) 120 - 148.5 kHz transmitter (aka. Phone Charger) for use in da Vinci Surgical System (an endoscopic instrument control system) which is intended to assist in the accurate control of endoscopic instruments. The active NFC tag is designed to assist with touchless login to da Vinci Surgical System using mobile phone or tablet without manual PIN entry. The WPT is designed to charge mobile phone or tablet. Since the EUT would be installed in da Vinci Surgical System cart during normal operation and could be placed in any position, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 12 Volts DC.

The sample was received on May 3, 2023 and tested on June 20, 28 and 29, 2023. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Intuitive Surgical	SCWCX01	NFC Transceiver	FNV22280098	2AAZF-SCWCX01

ANTENNA SYSTEM

The antenna system consists of a loop antenna.

ENCLOSURE

The EUT has no enclosure. It is designed to be installed within the enclosure of a medical instrument.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Labs LLC.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
BK Precision	1550	Power Supply	238B21160	-
Google	Pixel 6	Phone	355273352135002	A4RG9S9B
Wurth Elektronik	760308MP2	WPT Load	6006650176	-

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
DC Input	Power Supply	Two wire	Unshielded	0.3
Power Supply AC	Mains	Three wire	Unshielded	1.6

EUT OPERATION

During testing, the EUT was constantly transmitting at 140 kHz and communicating with the phone at 13.56 MHz.

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 6.2 of RSS-GEN, NTS Labs LLC has been recognized as an accredited test laboratory by the Commission and Innovation, Science and Economic Development Canada. A description of the facilities employed for testing is maintained by NTS Labs LLC.

Site	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 7	US1031	US0027	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. Results from testing performed in this chamber have been correlated with results from an open area test site. 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

Software is used to view and convert 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 Labs, LLC EMI Test Software (rev 2.10)

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.

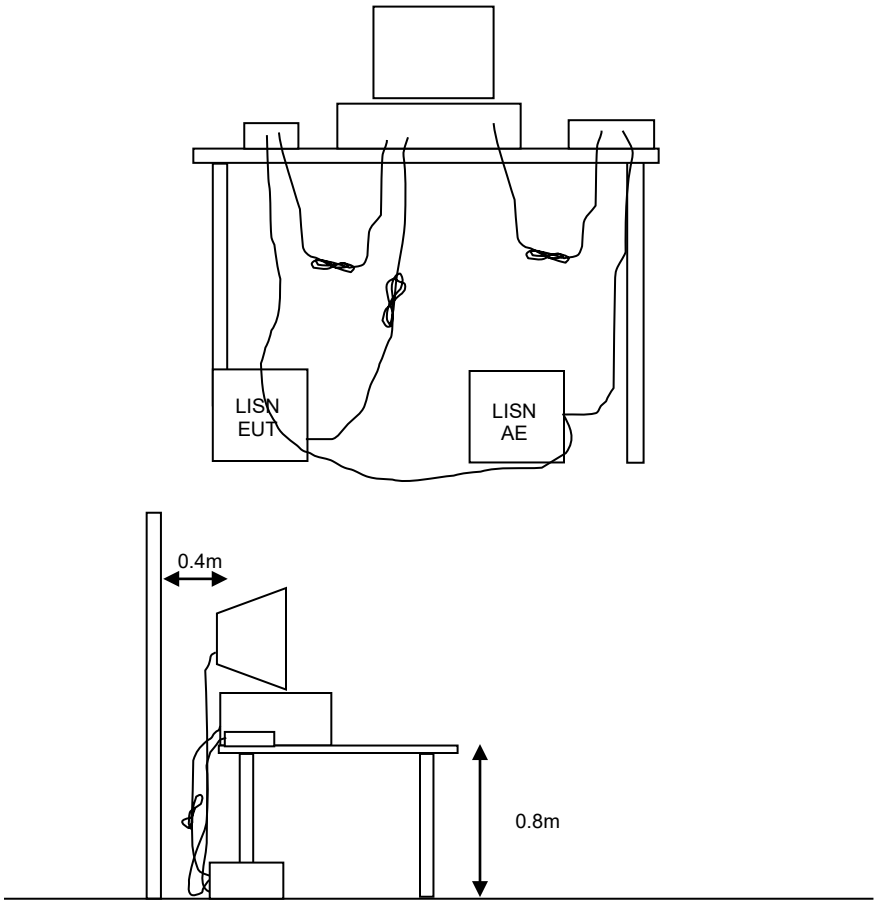


Figure 1 Typical Conducted Emissions Test Configuration

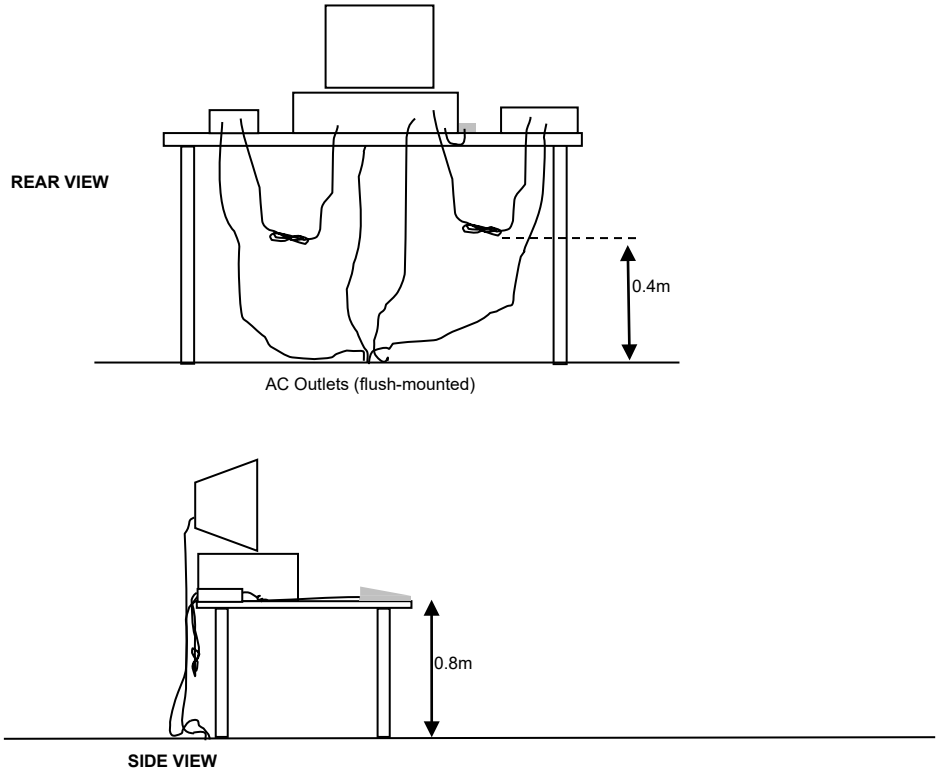
RADIATED EMISSIONS

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.

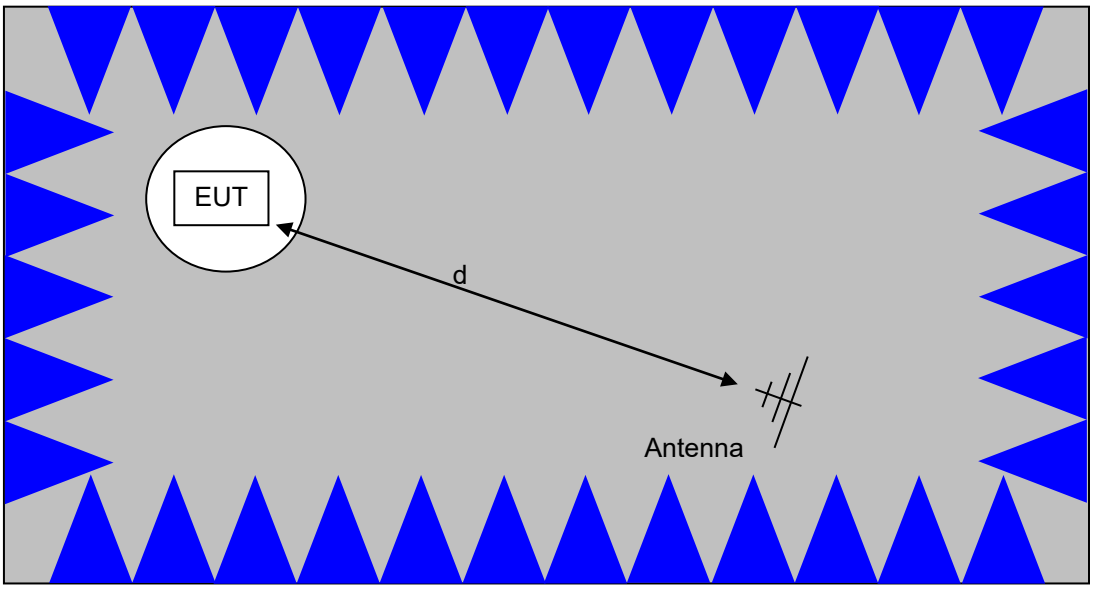
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

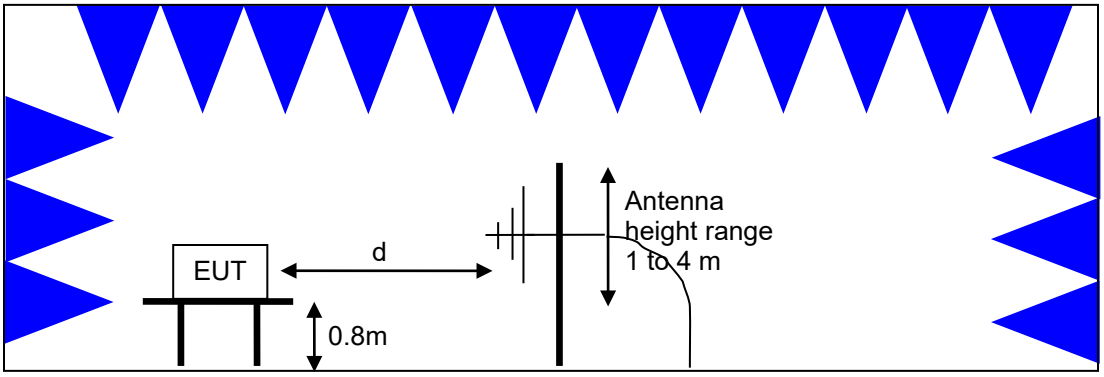


Typical Test Configuration for Radiated Field Strength Measurements



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), AND 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

TRANSMITTER FUNDAMENTAL EMISSIONS SPECIFICATION LIMITS – 13.56 MHZ

The table below shows the limits for the fundamental emission in the 13.56 MHz band per FCC §15.225 and RSS-210 B.6. All emissions outside these bands shall meet the general field strength requirements in the following table.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m)
13.110 - 13.410, 13.710 – 14.010	106 @ 30m	40.5 @ 30m
13.410 – 13.553, 13.567 – 13.710	334 @ 30m	50.5 @ 30m
13.553 – 13.567	15848 @ 30m	84.0 @ 30m

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 the limits for all emissions from a low power device operating under the general rules of RSS-GEN (Tables 5 and 6) and FCC §15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m)
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

Note: RSS-GEN expresses the limits below 30 MHz in terms of magnetic field strength but are equivalent to the values in the table for electric field strength above assuming a 377 ohm field impedance.

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 15.205, RSS-GEN Table7

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

Appendix A Test Equipment Calibration Data

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Radiated Emissions, .009 - 30 MHz, 20-Jun-23					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	N/A
ETS-Lindgren	EMC Chamber #7, Inner Dimensions (LxWxH): 24' x 38' x 20'	CH 7 (FACT-5)	WC055569	8/8/2022	11/6/2023
Rhode & Schwarz	Loop Antenna	HFH2-Z2	WC062457	2/17/2022	2/17/2024
Rohde & Schwarz	EMI Test Receiver, 20Hz-40GHz	ESI	WC068000	7/21/2022	7/21/2023
Radiated Emissions, 30 - 1,000 MHz, 20-Jun-23					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	N/A
ETS-Lindgren	EMC Chamber #7, Inner Dimensions (LxWxH): 24' x 38' x 20'	CH 7 (FACT-5)	WC055569	8/8/2022	11/6/2023
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	WC064582	8/18/2022	3/24/2025
Com-Power	Preamplifier, 1-1000 MHz	PAM-103	WC064733	5/24/2023	5/24/2024
Rohde & Schwarz	EMI Test Receiver, 20Hz-40GHz	ESI	WC068000	7/21/2022	7/21/2023
Bandwidth, 28-Jun-23					
Rohde & Schwarz	Spectrum Analyzer	FSQ26	WC055662	12/11/2022	12/31/2023
Stability, 29-Jun-23					
National Technical Systems	NTS Capture Analyzer Software (rev 4.0)	N/A	WC022706	N/A	N/A
Rohde & Schwarz	Spectrum Analyzer	FSQ26	WC055662	12/11/2022	12/31/2023
Watlow	Environmental Chamber Controller	F4	WC066185	6/2/2022	7/2/2023
Envirotronics	EMC Chamber #10 (Lab #3)	SH16C	WC071534	N/A	N/A

Appendix B Test Data

TL172107-RA-SCWCX01 Pages 23 - 40

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Product	SCWCX01	T-Log Number:	TL172107-RA-SCWCX01
System Configuration:		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Emissions Standard(s):	FCC part, RSS-210	Class:	-
Immunity Standard(s):	-	Environment:	Radio

EMC Test Data

For The

Intuitive Surgical Inc.

Product

SCWCX01

Date of Last Test: 7/20/2023

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

RSS-GEN and FCC Part 15.225

Occupied Bandwidth and Frequency Stability

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.

General Test Configuration

All measurements are made with a an RF probe located next to the antenna of the EUT connected to the measurement instrument via an attenuator or dc-block if necessary. For frequency stability measurements the EUT was placed inside an environmental chamber.

Radiated measurements are made with the EUT located on a non-conductive table, 3m from the measurement antenna.

Ambient Conditions:

Temperature: 21-22 °C
Rel. Humidity: 38-40 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	99% or Occupied Bandwidth	-	-	192 kHz
2	Frequency Stability	100 ppm	Pass	59.1 ppm

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.

Date of Test: 6/28 & 6/29/2023
Test Engineer: David Bare
Test Location: Frement EMC Lab #4

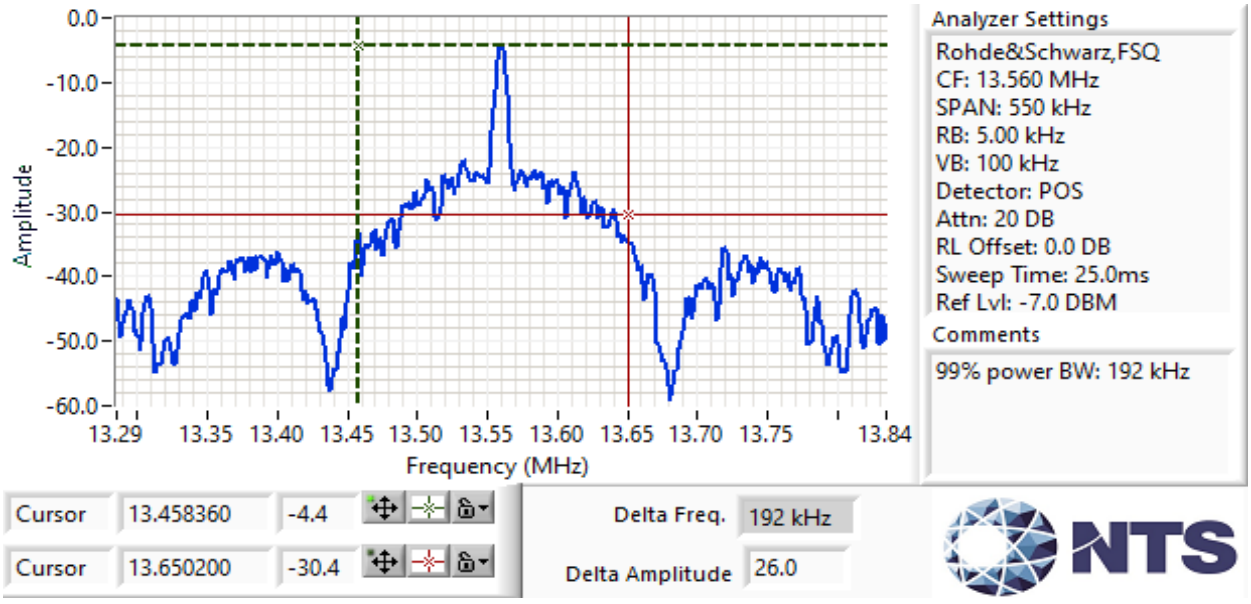
Config. Used: 1
Config Change: Used phone as reader
EUT Voltage: 12 VDC

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

Run #1: Signal Bandwidth

Frequency (kHz)	Resolution Bandwidth	Bandwidth (kHz)	
			99%
13.56	5 kHz		192

Note 1:	99% bandwidth measured in accordance with ANSI C63.10, with RB between 1% and 5% of the measured bandwidth and VB ≥ 3*RB and Span ≥ 1.5% and ≤ 5% of measured bandwidth.



Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

Run #2: Frequency Stability

Nominal Frequency: 13.560 MHz

Frequency Stability Over Temperature

The EUT was soaked at each temperature for a minimum of 30 minutes prior to making the measurements to ensure the EUT and chamber had stabilized at that temperature.

Temperature	Frequency Measured	Drift	
(Celsius)	(MHz)	(Hz)	(ppm)
-20	13.56040	401	29.6
-10	13.55968	-317	23.4
0	13.55960	-401	29.6
10	13.56000	0	0.0
20	13.56040	401	29.6
30	13.55960	-401	29.6
40	13.55920	-801	59.1
50	13.55920	-801	59.1
Worst case:		-801	59.1

Note: 0.01% = 100 ppm

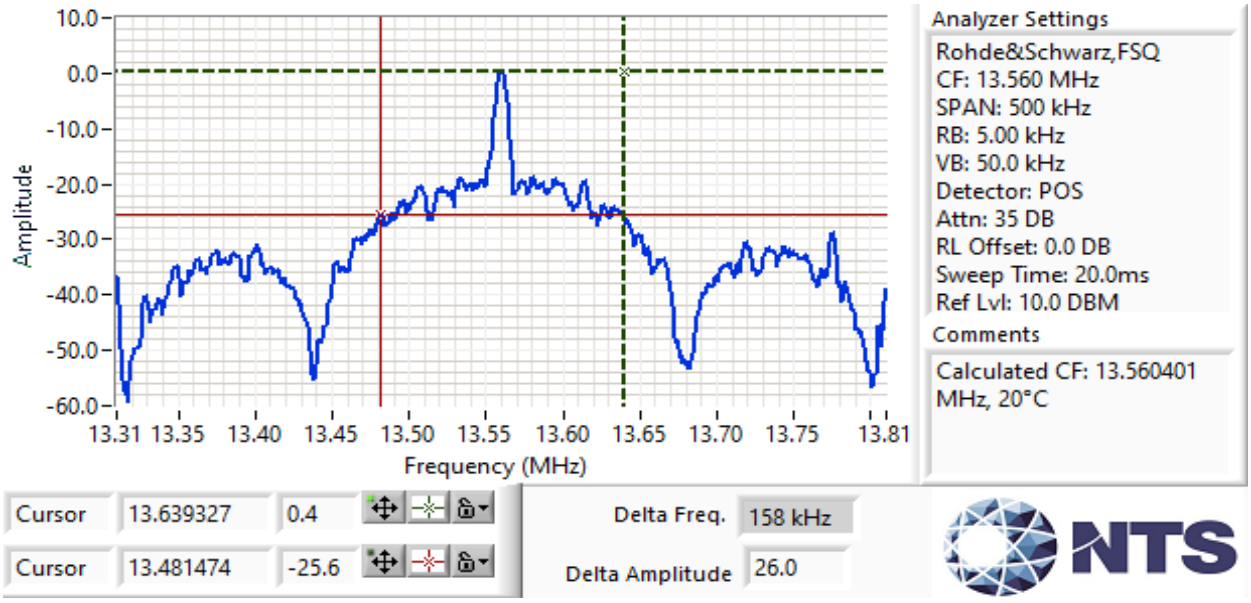
Frequency Stability Over Input Voltage @ 20°C

Nominal Voltage of host unit is 12.0V

Voltage	Frequency Measured	Drift	
(AC)	(MHz)	(Hz)	(ppm)
85%	13.55599	-4	-0.3
115%	13.56000	0	0.0
Worst case:		-4	-0.3

Note 1:	The EUT cannot trasnmit an unmodulated signal, thus the carrier frequency was calculated from the 26 dB down points of the modulation. See plot below.

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-



Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

Radiated Emissions

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

Test Specific Details

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

Date of Test: 6/20/2023
Test Engineer: Rafael Varelas
Test Location: Fremont Chamber #7

Config. Used: 1
Config Change: None
Host Unit Voltage 120V/60Hz

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing.
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: 23.4 °C
Rel. Humidity: 38 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
4	Radiated Emissions 0.009- 30 MHz	FCC part 15.225 / RSS-210/GEN	Pass	19.9 dBµV/m @ 22.205 MHz (-9.6 dB)
5	Transmitter Radiated Spurious Emissions, 30 - 300 MHz	FCC 15.209/RSS GEN	Pass	39.7 dBµV/m @ 94.89 MHz (-3.8 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

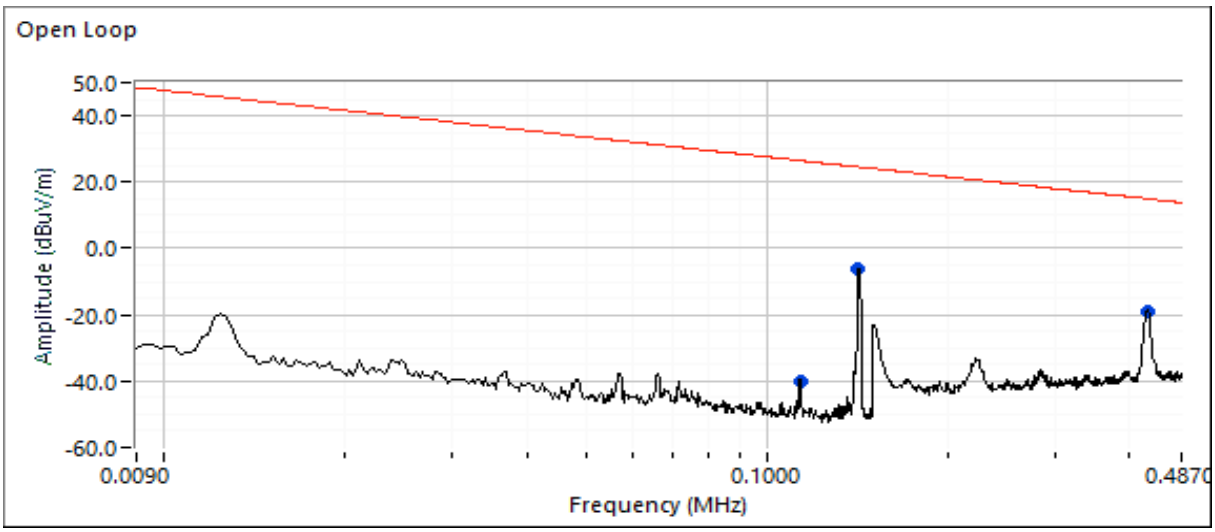
Deviations From The Standard

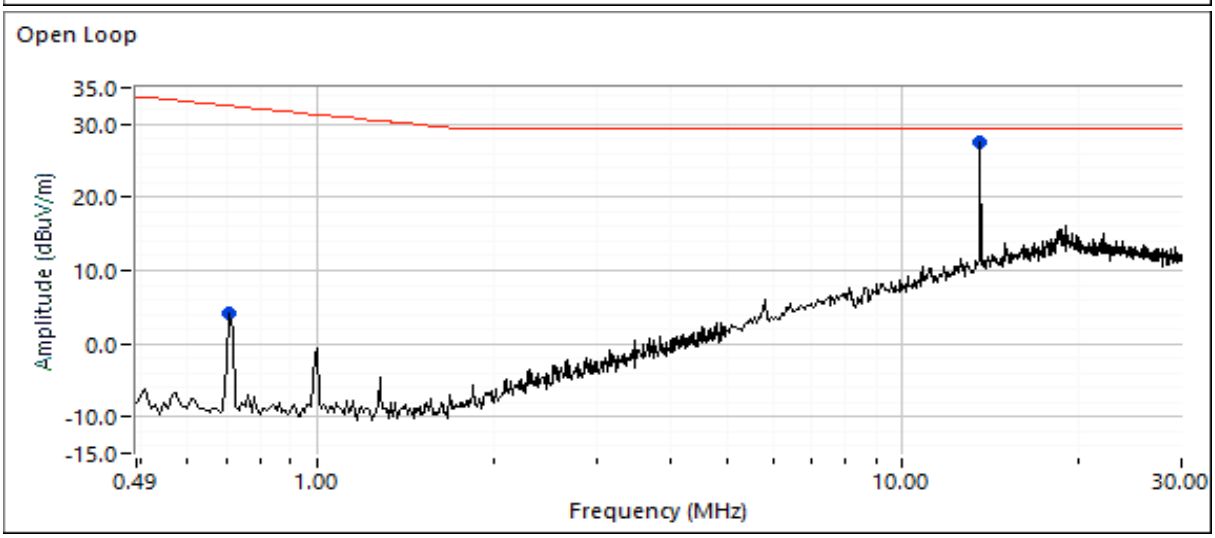
No deviations were made from the requirements of the standard.

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

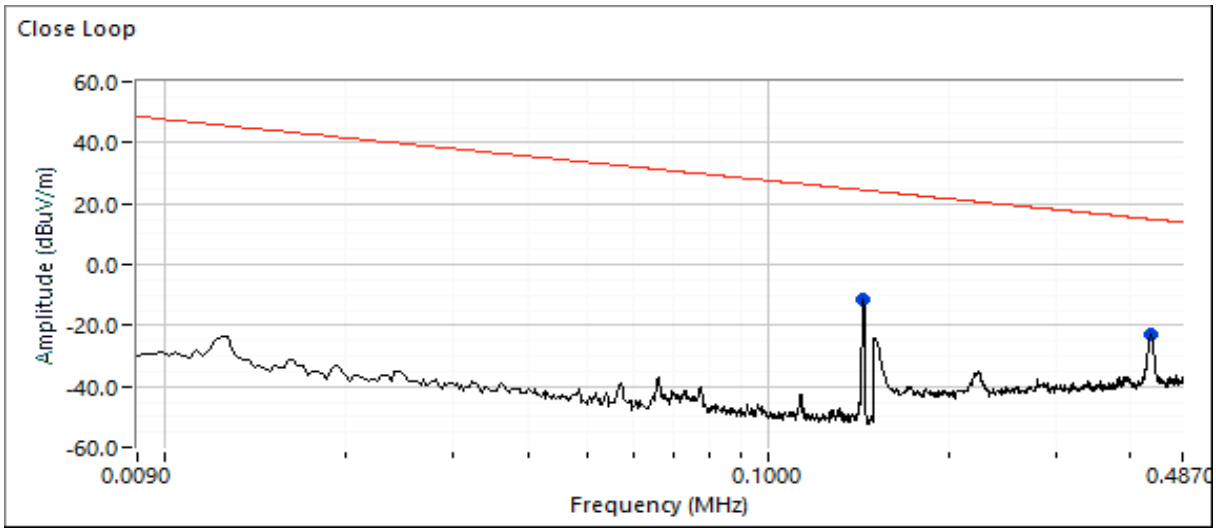
Run #4: Preliminary Radiated Emissions, 0.009 - 30 MHz, FCC part 15
PS: BK Precision, w Pixel 6A phone and Wurth Load, SCUP-05(120kHz-160kHz), w/o inductor 3.3uH

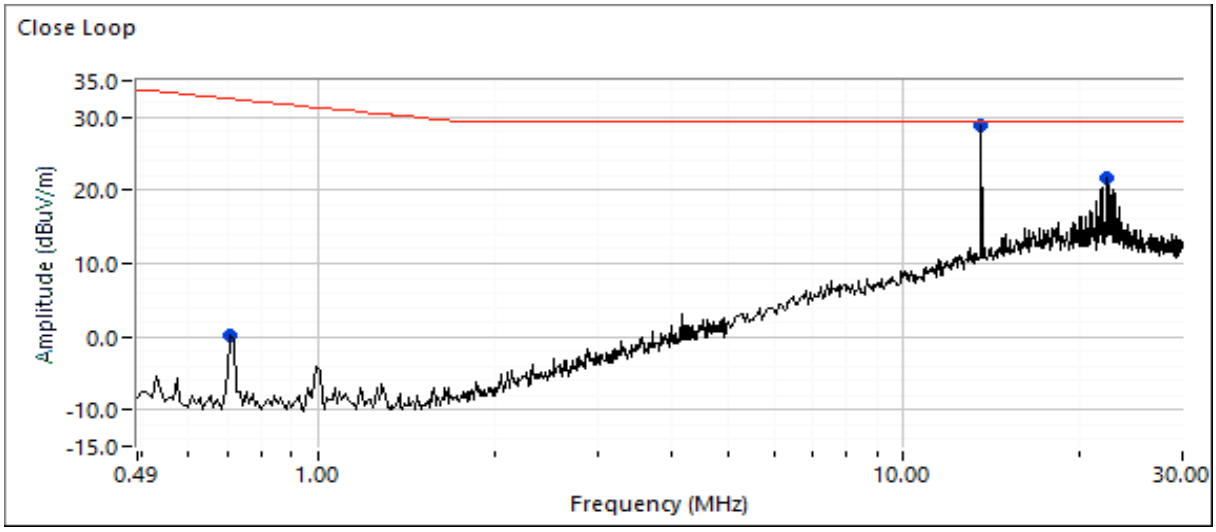
Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
0.009 - 0.490MHz	3	300	Per ANSI C63.10
0.49 - 30 MHz	3	30	Per ANSI C63.10





Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-





Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

Run #4a: Preliminary Radiated Emissions, 0.009 - 30 MHz, FCC part 15
PS: BK Precision, w Pixel 6A phone and Wurth Load, SCUP-05(120kHz-160kHz), w/o inductor 3.3uH

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
0.009 - 0.490MHz	3	300	Per ANSI C63.10
0.49 - 30 MHz	3	30	Per ANSI C63.10

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	FCC 15.225/209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	PK/QP/AVG	degrees	meters	
0.113	-40.0	O	26.5	-66.5	Peak	257	1.0	
0.142	-6.4	O	24.6	-31.0	Peak	62	1.0	
0.143	-11.7	C	24.4	-36.1	Peak	133	1.0	
0.427	-19.1	O	14.9	-34.0	Peak	72	1.0	
0.430	-22.9	C	14.9	-37.8	Peak	147	1.0	
0.707	*4.1*	O	*32.5*	-28.4	*Peak*	*70*	*1.0*	
0.707	*0.2*	C	*32.5*	-32.3	*Peak*	*123*	*1.0*	
13.561	27.5	O	84.0	-56.5	Peak	1	1.0	
13.561	28.9	C	84.0	-55.1	Peak	264	1.0	
22.205	21.7	C	29.5	-7.8	Peak	245	1.0	

Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	FCC 15.225/209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	PK/QP/AVG	degrees	meters	
0.142	-7.4	O	24.6	-32.0	QP	63	1.0	QP (1.00s)
0.143	-12.8	H	24.5	-37.3	QP	131	1.0	QP (1.00s)
0.427	-19.9	O	15.0	-34.9	QP	73	1.0	QP (1.00s)
0.430	-23.3	H	14.9	-38.2	QP	145	1.0	QP (1.00s)
13.561	28.7	C	84.0	-55.3	QP	265	1.0	QP (1.00s)
13.561	27.2	O	84.0	-56.8	QP	2	1.0	QP (1.00s)
22.205	19.9	C	29.5	-9.6	QP	246	1.0	QP (1.00s)

Note 1:	O: Open Loop and C: Close Loop

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

Run #4b: Preliminary Radiated Emissions, 0.009 - 30 MHz, RSS-GEN & RSS-210
PS: BK Precision, w Pixel 6A phone and Wurth Load, SCUP-05(120kHz-160kHz), w/o inductor 3.3uH

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
0.009 - 0.490MHz	3	300	Per ANSI C63.10
0.49 - 30 MHz	3	30	Per ANSI C63.10

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	RSS-GEN		Detector	Azimuth	Height	Comments
MHz	dBµA/m	v/h	Limit	Margin	PK/QP/AVG	degrees	meters	
0.113	-91.5	O	-25.0	-66.5	Peak	257	1.0	
0.142	-57.9	O	-27.0	-30.9	Peak	62	1.0	
0.143	-63.2	C	-27.0	-36.2	Peak	133	1.0	
0.427	-70.6	O	-36.5	-34.1	Peak	72	1.0	
0.430	-74.4	C	-36.6	-37.8	Peak	147	1.0	
0.707	*-47.4*	O	*-20.9*	*-26.5*	*Peak*	*70*	*1.0*	
0.707	*-51.3*	C	*-20.9*	*-30.4*	*Peak*	*123*	*1.0*	
22.205	-29.8	C	-21.9	-7.9	Peak	245	1.0	

Frequency	Level	Pol	RSS-210		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	PK/QP/AVG	degrees	meters	
13.561	27.5	O	84.0	-56.5	Peak	1	1.0	
13.561	28.9	C	84.0	-55.1	Peak	264	1.0	

Maximized quasi-peak readings (includes manipulation of EUT interface cables)

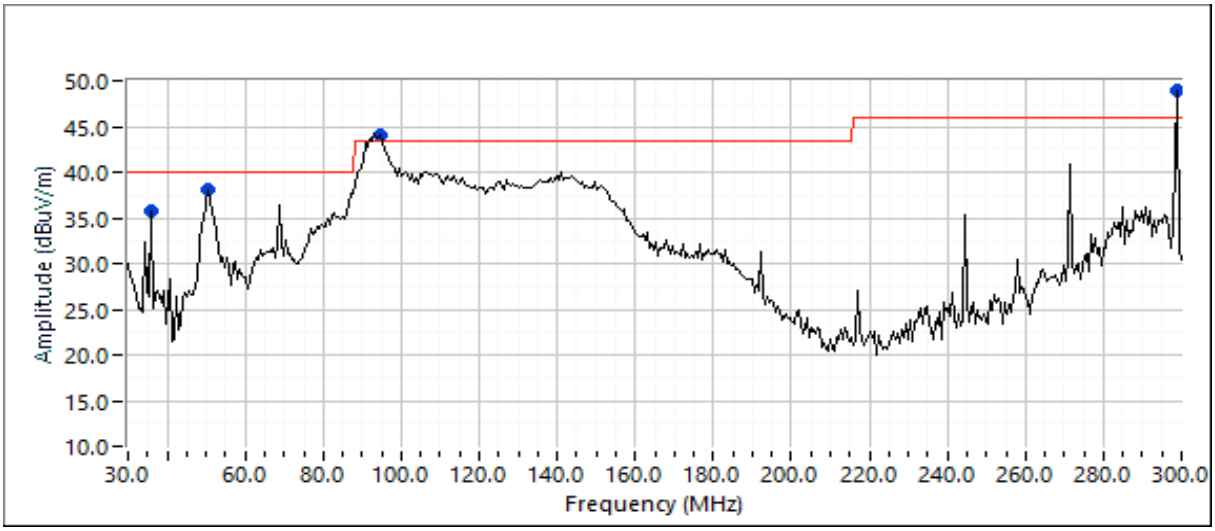
Frequency	Level	Pol	RSS-GEN		Detector	Azimuth	Height	Comments
MHz	dBµA/m	v/h	Limit	Margin	PK/QP/AVG	degrees	meters	
0.142	-58.9	O	-27.0	-31.9	QP	63	1.0	QP (1.00s)
0.143	-64.3	H	-27.0	-37.3	QP	131	1.0	QP (1.00s)
0.427	-71.4	O	-36.5	-34.9	QP	73	1.0	QP (1.00s)
0.430	-74.8	H	-36.6	-38.2	QP	145	1.0	QP (1.00s)
22.205	-31.6	C	-21.9	-9.7	QP	246	1.0	QP (1.00s)

Frequency	Level	Pol	RSS-210		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	PK/QP/AVG	degrees	meters	
13.561	28.7	C	84.0	-55.3	QP	265	1.0	QP (1.00s)
13.561	27.2	O	84.0	-56.8	QP	2	1.0	QP (1.00s)

Note 1:	O: Open Loop and C: Close Loop

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

Run #5: Radiated Spurious Emissions, 30 - 300 MHz, FCC 15.209/RSS-GEN
PS: BK Precision, w Pixel 6A phone and Wurth Load, SCUP-05(120kHz-160kHz), w/o inductor 3.3uH



Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

Preliminary peak readings captured during pre-scan

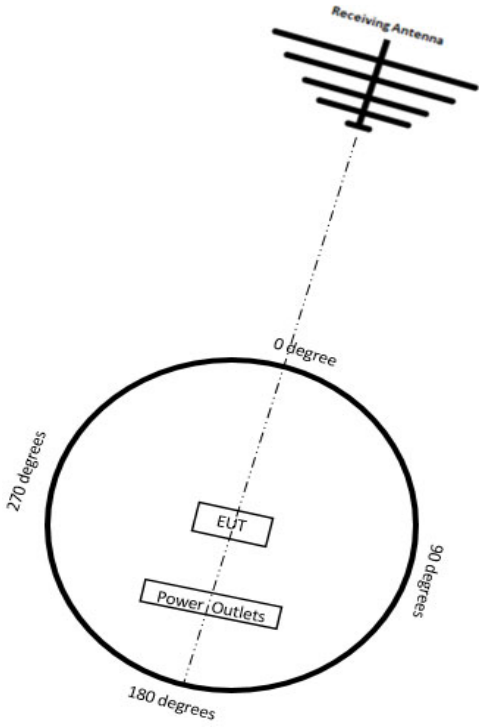
Frequency	Level	Pol	FCC 15.209/RSS-GEN		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
36.124	35.7	V	40.0	-4.3	Peak	27	2.5	
50.921	38.0	V	40.0	-2.0	Peak	50	1.0	
94.888	44.0	V	43.5	0.5	Peak	304	1.0	
298.516	49.0	H	46.0	3.0	Peak	273	1.0	

Maximized quasi-peak readings

Frequency	Level	Pol	FCC 15.209/RSS-GEN		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	PK/QP/AVG	degrees	meters	
94.888	39.7	V	43.5	-3.8	QP	312	1.0	QP (1.00s)
50.921	35.1	V	40.0	-4.9	QP	41	1.0	QP (1.00s)
298.516	31.2	H	46.0	-14.8	QP	254	1.0	QP (1.00s)
36.124	22.2	V	40.0	-17.8	QP	27	1.0	QP (1.00s)

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

Below 1GHz



Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-SCWCX01
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	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: 6/20/2023
Test Engineer: Rafael Varelas
Test Location: Fremont Chamber #7
Config. Used: 1
Config Change: None
Host PS Voltage: 120V/60Hz

General Test Configuration

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

Ambient Conditions:

Temperature: 23.4 °C
Rel. Humidity: 38 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power,120V/60Hz	FCC 15.207(a)	Pass	41.2 dBµV @ 26.158 MHz (-8.8 dB)
2	CE, AC Power,120V/60Hz	FCC 15.207(a)	Pass	42.2 dBµV @ 24.324 MHz (-7.8 dB)

Modifications Made During Testing

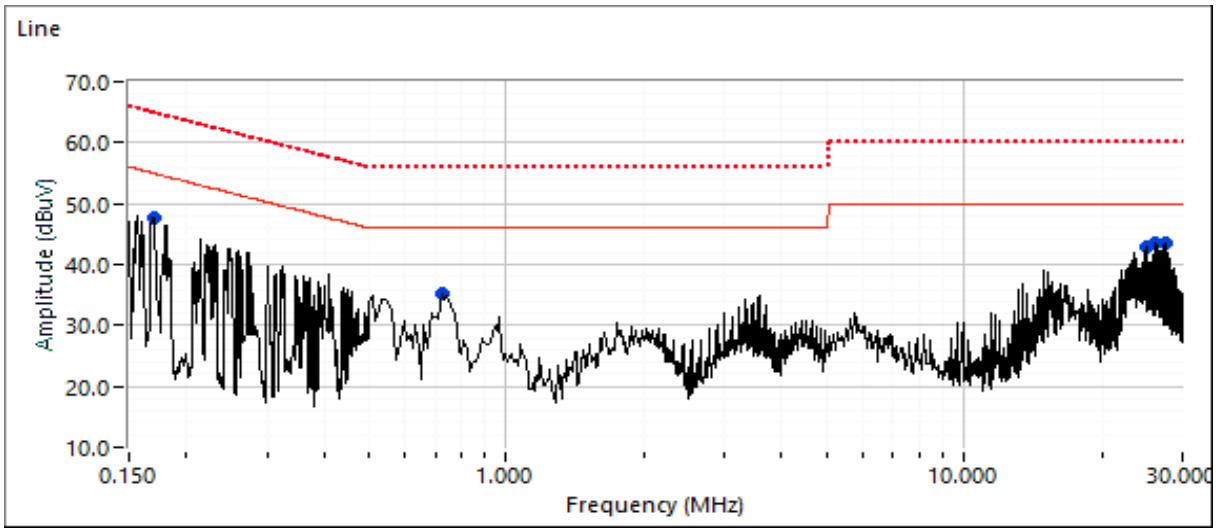
No modifications were made to the EUT during testing

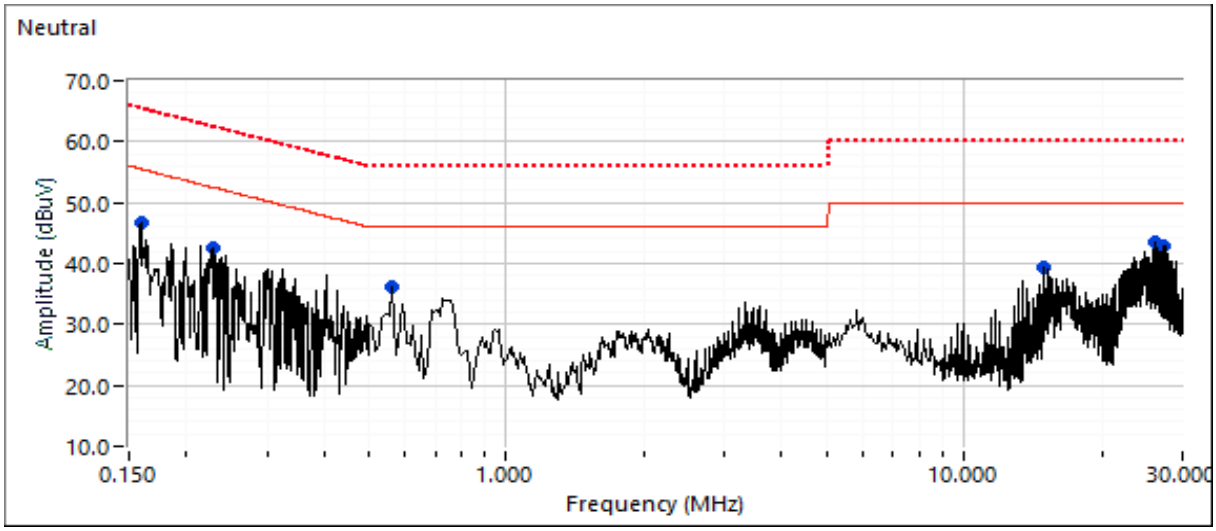
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-SCWCX01
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz
PS: BK Precision, w/o Pixel 6A phone, SCUP-05(120kHz-160kHz), NFC Terminated to 50 Ohm, w/o Inductor (3.3uH)





Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-SCWCX01
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

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

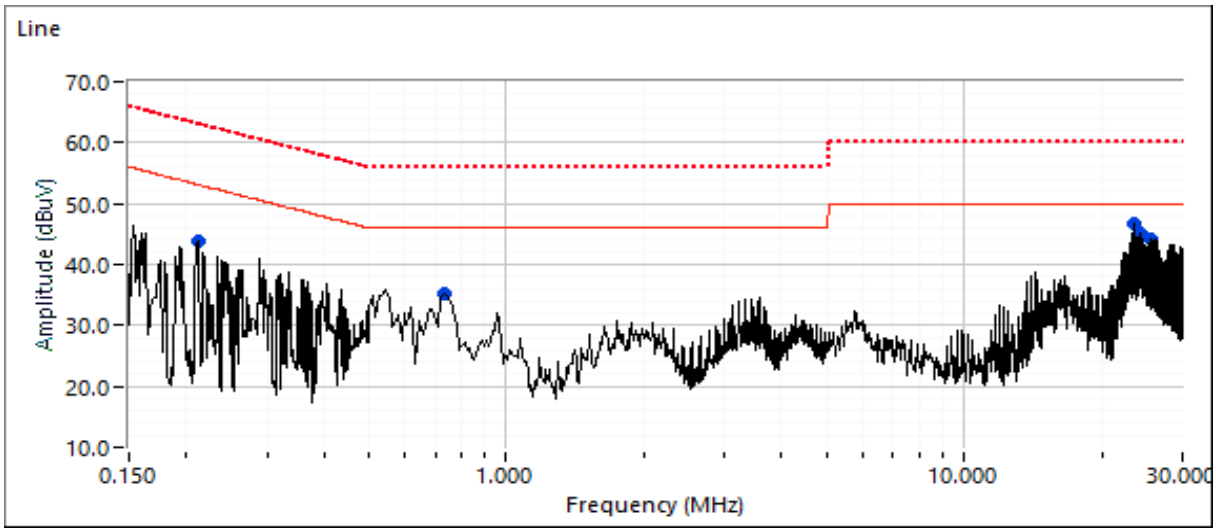
Frequency	Level	AC	FCC 15.207(a)		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/AVG	
0.158	46.6	Neutral	55.5	-8.9	Peak	
0.227	42.7	Neutral	52.5	-9.8	Peak	
0.547	36.2	Neutral	46.0	-9.8	Peak	
26.158	43.6	Neutral	50.0	-6.4	Peak	
27.326	42.9	Neutral	50.0	-7.1	Peak	
14.906	39.3	Neutral	50.0	-10.7	Peak	
0.170	47.7	Line 1	54.9	-7.2	Peak	
0.732	35.1	Line 1	46.0	-10.9	Peak	
24.990	42.8	Line 1	50.0	-7.2	Peak	
26.158	43.4	Line 1	50.0	-6.6	Peak	
27.619	43.4	Line 1	50.0	-6.6	Peak	

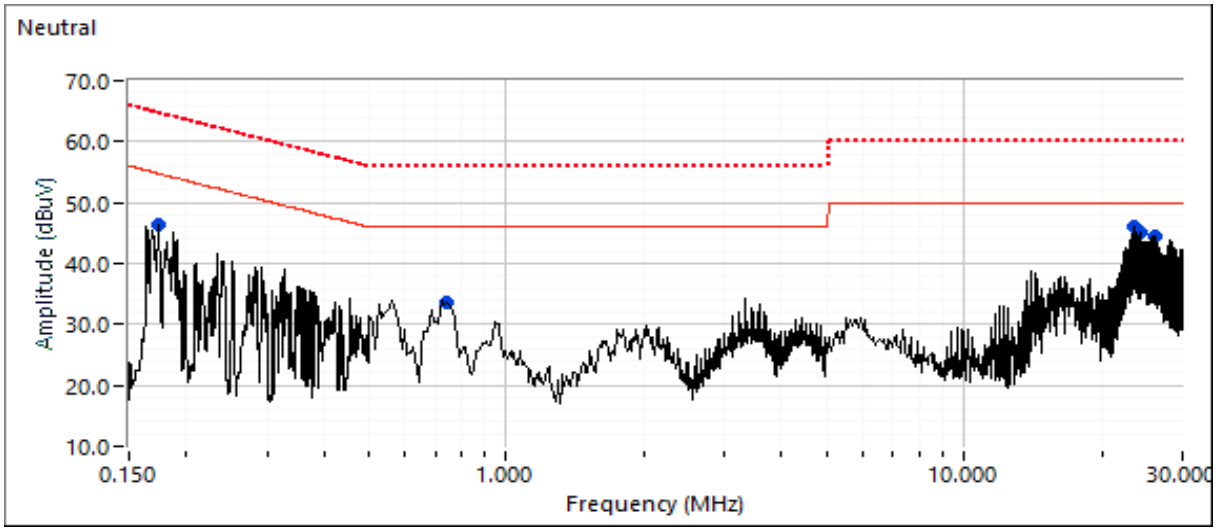
Final quasi-peak and average readings

Frequency	Level	AC	FCC 15.207(a)		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/AVG	
26.158	**41.2**	Line 1	50.0	**-8.8**	AVG	AVG (0.10s)
26.158	40.8	Neutral	50.0	-9.2	AVG	AVG (0.10s)
27.326	39.9	Neutral	50.0	-10.1	AVG	AVG (0.10s)
27.619	39.5	Line 1	50.0	-10.5	AVG	AVG (0.10s)
14.906	38.1	Neutral	50.0	-11.9	AVG	AVG (0.10s)
24.990	36.7	Line 1	50.0	-13.3	AVG	AVG (0.10s)
26.158	42.5	Neutral	60.0	-17.5	QP	QP (1.00s)
26.158	42.5	Line 1	60.0	-17.5	QP	QP (1.00s)
27.326	42.4	Neutral	60.0	-17.6	QP	QP (1.00s)
27.619	42.0	Line 1	60.0	-18.0	QP	QP (1.00s)
24.990	40.9	Line 1	60.0	-19.1	QP	QP (1.00s)
14.906	38.9	Neutral	60.0	-21.1	QP	QP (1.00s)
0.170	30.1	Line 1	55.0	-24.9	AVG	AVG (0.10s)
0.158	40.4	Neutral	65.6	-25.2	QP	QP (1.00s)
0.170	38.9	Line 1	65.0	-26.1	QP	QP (1.00s)
0.158	17.8	Neutral	55.6	-37.8	AVG	AVG (0.10s)

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-SCWCX01
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

Run #2: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz
PS: BK Precision, w/o Pixel 6A phone, SCUP-05(100kHz-133kHz), NFC Terminated to 50 Ohm, w/o Inductor (3.3uH)





EMC Test Data

Client:	Intuitive Surgical Inc.	PR Number:	PR172107
Model:	SCWCX01	T-Log Number:	TL172107-RA-SCWCX01
		Project Manager:	Deepa Shetty
Contact:	Tony Permsombut	Project Engineer:	David Bare
Standard:	FCC part, RSS-210	Class:	-

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

Frequency	Level	AC	FCC 15.207(a)		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/AVG	
0.211	43.7	Line 1	53.1	-9.4	Peak	
0.735	*35.3*	*Line 1*	*46.0*	*-10.7*	*Peak*	
23.430	46.6	Line 1	50.0	-3.4	Peak	
24.324	45.0	Line 1	50.0	-5.0	Peak	
25.468	44.2	Line 1	50.0	-5.8	Peak	
0.175	46.3	Neutral	54.8	-8.5	Peak	
0.744	*33.7*	*Neutral*	*46.0*	*-12.3*	*Peak*	
23.430	46.1	Neutral	50.0	-3.9	Peak	
24.323	45.1	Neutral	50.0	-4.9	Peak	
26.107	44.6	Neutral	50.0	-5.4	Peak	

Final quasi-peak and average readings

Frequency	Level	AC	FCC 15.207(a)		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/AVG	
24.324	**42.2**	Line 1	50.0	**-7.8**	AVG	AVG (0.10s)
24.323	42.0	Neutral	50.0	-8.0	AVG	AVG (0.10s)
23.430	41.9	Line 1	50.0	-8.1	AVG	AVG (0.10s)
25.468	41.9	Line 1	50.0	-8.1	AVG	AVG (0.10s)
26.107	41.8	Neutral	50.0	-8.2	AVG	AVG (0.10s)
23.430	41.7	Neutral	50.0	-8.3	AVG	AVG (0.10s)
23.430	46.1	Neutral	60.0	-13.9	QP	QP (1.00s)
23.430	45.9	Line 1	60.0	-14.1	QP	QP (1.00s)
24.324	44.4	Line 1	60.0	-15.6	QP	QP (1.00s)
24.323	44.4	Neutral	60.0	-15.6	QP	QP (1.00s)
26.107	44.0	Neutral	60.0	-16.0	QP	QP (1.00s)
25.468	43.4	Line 1	60.0	-16.6	QP	QP (1.00s)
0.211	34.4	Line 1	63.2	-28.8	QP	QP (1.00s)
0.211	19.3	Line 1	53.2	-33.9	AVG	AVG (0.10s)

End of Report

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