NTS Silicon Valley
www.nts.com
41039 Boyce Road
Fremont, CA 94538
510-578-3500 Phone
510-440-9525 Fax

Radio Test Report

FCC Part 95
MedRadio Transmitter

Senza Implantable Pulse Generator, Model IPG2000

COMPANY:	Nevro Corporation 1800 Bridge Parkway Redwood City, CA 94065
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
REPORT DATE:	February 23, 2017
RE-ISSUED DATE:	October 3, 2017
FINAL TEST DATES:	January 9, 10 and 16, 2017
TOTAL NUMBER OF PAGES:	30

ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

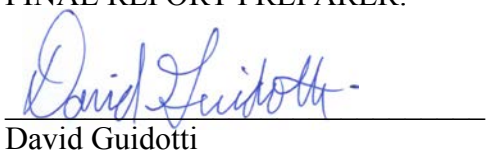
PROGRAM MGR

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
Technical Writer

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	February 23, 2017	First release	
1	October 3, 2017	Updated references for Part 95	dwb

TABLE OF CONTENTS

SCOPE

Tests have been performed on the Nevro Corporation Senza Implantable Pulse Generator, Model IPG2000, pursuant to the relevant requirements of the following standard(s) in order to obtain device certification against the regulatory requirements of the Federal Communications Commission and Industry Canada.

- Code of Federal Regulations (CFR) Title 47 Part 2
- CFR 47 Part 95 Subpart I (Medical Device Radio Communications Service)

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 C63.4:2014
ANSI TIA-603-D

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

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.

The test results recorded herein are based on a single type test of the Nevro Corporation Senza Implantable Pulse Generator, Model IPG2000 and therefore apply only to the tested sample. The sample was selected and prepared by Jon Parker of Nevro Corporation.

National Technical Systems - Silicon Valley 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, the device requires certification. Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification.

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 Nevro Corporation Senza Implantable Pulse Generator, Model IPG2000 complied with the requirements of the standards and frequency bands declared in the scope of this test report.

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.

DEVIATIONS FROM THE STANDARDS

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

TEST RESULTS

FCC Part 95

Rule Part	Description	Measured	Limit	Result
Transmitter frequency, power, bandwidth, modulation and unwanted emissions				
§2.1033(c) (5) § 95.2563(a)	Frequency range(s)	402.45 – 404.55 MHz	402-405 MHz	Complies
§2.1033(c) (6) §2.1033(c) (7) §2.1046 §95.2567(a)(1)	EIRP (Calculated from Field Strength)	0.122µW -33.1dBm	25µW –16dBm	Complies
§2.1033(c) (4) §2.1047 §95.2579(c)	Emission types	F1D	-	-
	Unwanted emissions	All > 20 dB below the fundamental	At least 20 dB dB > 150 kHz from Fc	Complies
§2.1049 §95.2573(a)	Authorized Bandwidth	243 kHz	300 kHz	Complies
Transmitter spurious emissions				
§2.1053 §2.1057 §95.2579(a)	Field strength	32.8 dBµV/m @ 48.94 MHz (-7.2 dB)	See table	Complies
Other details				
95.2559	Frequency Monitoring	Only required for programmer / control transmitters	N/A	-
§2.1055 §95.2565	Frequency stability	14 ppm	100 ppm	Complies
§2.1093	RF Exposure	Device is exempt from SAR testing as output power is less than 1 mW	-	Complies
§2.1033 (c) (8)	Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range	2.5V, 6.5mA	N/A	-
Notes				

EXTREME CONDITIONS

Frequency stability is determined over extremes of temperature and voltage. As the device is implanted, battery powered equipment, the supply voltage was reduced to the battery operating end point of 3.485Vdc as specified by the manufacturer.

The extremes of temperature were 25°C to 45°C for implanted transmitters as specified in FCC §95.2565.

MEASUREMENT UNCERTAINTIES

ISO Guide 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 (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF frequency	Hz	25 to 7,000 MHz	1.7×10^{-7}
Radiated emission (field strength)	dBµV/m	25 to 1,000 MHz 1 to 40 GHz	± 3.6 dB ± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Nevro Corporation Senza Implantable Pulse Generator, Model IPG2000 is an implantable pulse generator that is designed to deliver electrical stimulation to the spinal cord. Since the EUT would be placed in the body during operation, the EUT was placed in a human torso simulator during testing to simulate the end-user environment. The electrical rating of the EUT is 3.7 Volts DC provided by a non-removable, rechargeable battery.
The sample was received on January 9, 2017 and tested on January 9, 10 and 16, 2017. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Nevro Corporation	IPG2000	Implantable Pulse Generator	100922	XKYIPG2000

OTHER EUT DETAILS

The following EUT details should be noted: The IPG has an integral antenna that cannot be removed or adjusted. The radio transmit power and tuning are set by the firmware and are not adjustable. Firmware utilized during testing was "Production firmware", P/N SW-90037 rev E. Production firmware is identical to the final firmware utilized in human use, however the Production version adds additional test functionality such as Constant Carrier Wave (CCW) transmission, which is needed for compliance testing.
The IPG is classified as ULP-AMP class 2 per EN 301 489-27: "Medium reliable communication media, e.g. causing inconvenience to persons, which cannot simply be overcome by other means."

ENCLOSURE

The EUT enclosure is primarily constructed of titanium. It measures approximately 4 cm wide by 3 cm deep by 1 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at National Technical Systems - Silicon Valley.

SUPPORT EQUIPMENT

No local support equipment was used during testing.

The following equipment was used as remote support equipment for emissions testing:

Company	Model	Description	Serial Number	FCC ID
Nevro Corporation	Programmer Wand	Programmer Wand	PW1299	XKYWAND1000

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Leads	Unterminated	Single wires	Unshielded	0.4

EUT OPERATION

During emissions testing the EUT was set to transmit in a continuous modulated mode on the selected frequency for transmit mode tests, except for frequency stability for which an unmodulated (CW) mode was used. For receive mode, the transmitter was not set to transmit.

TESTING

GENERAL INFORMATION

Radiated spurious emissions measurements were taken at the National Technical Systems - Silicon Valley Anechoic Chambers and/or Open Area Test Site(s) listed below. The sites conform to the requirements of ANSI C63.4: 2014 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4:2007 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are on file with the FCC and industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
Chamber 7	US0027	2845B-7	41039 Boyce Road Fremont, CA 94538-2435

In the case of Open Area Test Sites, ambient levels are at least 6 dB below the specification limits with the exception of predictable local TV, radio, and mobile communications traffic.

Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN. The measurement bandwidth is set to be at least 1% of the instrument's frequency span.

FREQUENCY STABILITY

The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The temperature is varied across the specified frequency range in 10 degree increments with frequency measurements made at each temperature step. The EUT is allowed enough time to stabilize at each temperature variation.

The spectrum analyzer is configured to give a 5- or 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature. Where possible the device is set to transmit an unmodulated signal. Where this is not possible the frequency drift is determined by finding a stable point on the signal (e.g. the null at the centre of an OFDM signal) or by calculating a centre frequency based on the upper and lower XdB points (where X is typically 6dB or 10dB) on the signal's skirts.

RADIATED EMISSIONS MEASUREMENTS

Receiver radiated spurious emissions measurements are made in accordance with ANSI C63.4:2014 by measuring the field strength of the emissions from the device at a specific test distance and comparing them to a field strength limit calculated from the limit as described in 95.627(g). Where the field strength limit is specified at a longer distance than the measurement distance the measurement is extrapolated to the limit distance.

All radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in either an anechoic chamber or on an OATS during which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed across the complete frequency range of interest and at each operating frequency identified in the reference standard. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode).

During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit. For transmitter spurious emissions, where the limit is expressed as an effective radiated power, the eirp or erp is converted to a field strength limit.

Final measurements are made on an OATS or in a semi-anechoic chamber at the significant frequencies observed during the preliminary scan(s) using the same process of rotating the EUT and raising/lowering the measurement antenna to find the highest level of the emission. The field strength is recorded and, for receiver spurious emissions, compared to the field strength limit. For the final measurement the appropriate detectors (average, peak, normal, sample, quasi-peak) are used. For measurements below 1GHz the detector is a Quasi-Peak detector, above 1GHz a peak detector is used and the peak value (RB=VB=1MHz) and average value (RB=1MHz, VB=10Hz) are recorded.

INSTRUMENTATION

An EMI receiver as specified in CISPR 16-1-1 is used for radiated emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7000 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.

For measurements above the frequency range of the receivers and for all conducted measurements a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis.

Measurement bandwidths for the test instruments are set in accordance with the requirements of the standards referenced in this document.

Software control is used to correct the measurements for transducer factors (e.g. antenna) and the insertion loss of cables, attenuators and other series elements to obtain the final measurement value. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are exported in a graphic and/or tabular format, as appropriate.

FILTERS/ATTENUATORS

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

ANTENNAS

A combination of biconical, log periodic or bi-log antennas are used to cover the range from 30 MHz to 1000 MHz.

Above 1000 MHz, a dual-ridge guide horn antenna or octave horn antenna are used as reference and measurement antennas.

The antenna calibration factors are included in site factors that are programmed into the test receivers and instrument control software when measuring the radiated field strength.

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.

Implanted devices are placed at a height of 1.5 meters above the floor in a torso simulator, 6 cm from the surface of the simulator. The EUT is positioned on a motorized turntable to allow it to be rotated during testing to determine the angel with the highest level of emissions.

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH

Measurements of radiated field strength are compared directly to the specification limit (decibel form). The receiver and/or control software 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 is used when measurements are made at a test distance that is different to the specified limit distance 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:

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

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 –RADIATED POWER

The erp/eirp limits for transmitter spurious measurements are converted to a field strength in free space using the following formula:

$$E = \frac{\sqrt{30\ P\ G}}{d}$$

where:

E = Field Strength in V/m
P = Power in Watts
G = Gain of isotropic antenna (numeric gain) = 1
D = measurement distance in meters

The field strength limit is then converted to decibel form (dBuV/m) and the margin of a given emission peak relative to the limit is calculated (refer to *SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH*).

When substitution measurements are required (all signals with less than 20dB of margin relative to the calculated field strength limit) the eirp of the spurious emission is calculated using:

$$P_{EUT} = P_S - (E_S - E_{EUT})$$

and

$$P_S = G + P_{in}$$

where:

P_S = effective isotropic radiated power of the substitution antenna (dBm)
P_{in} = power input to the substitution antenna (dBm)
G = gain of the substitution antenna (dBi)
E_S = field strength the substitution antenna (dBm) at eirp P_S
E_{EUT} = field strength measured from the EUT

Where necessary the effective isotropic radiated power is converted to effective radiated power by subtracting the gain of a dipole (2.2dBi) from the eirp value.

Appendix A Test Equipment Calibration Data

Bandwidth, 09-Jan-17

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/6/2016	5/6/2017

Frequency Stability, 10-Jan-17

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Watlow	Temp Chamber (w/ F4 Watlow Controller)	F4	2170	7/8/2016	7/8/2017
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/6/2016	5/6/2017

Radiated Emissions, 30 - 1,000 MHz, 16-Jan-17

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	1549	6/2/2015	6/2/2017
Com-Power	Preamplifier, 30-1000 MHz	PA-103	1632	6/6/2016	6/6/2017
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	2/20/2016	2/20/2017

Radiated Emissions, 1,000 - 4,050 MHz, 16-Jan-17

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
NTS	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	Spectrum Analyzer (SA40) Red 30 Hz -40 GHz	8564E (84125C)	1148	10/31/2016	11/1/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	9/30/2016	9/30/2017

Appendix B Test Data

T103654 Pages 18 - 29

Client:	Nevro Corporation	Job Number:	JD103637
Product	Senza Implantable Pulse Generator, Model IPG2000	T-Log Number:	T103654
System Configuration:	-	Project Manager:	Christine Krebill
Contact:	Jon Parker	Project Coordinator:	-
Emissions Standard(s):	FCC Part 95, EN 301 839 V2.1.1	Class:	2
Immunity Standard(s):	EN 301 489-1 V2.1.1, EN 301 489-27 V2.1.1	Environment:	Radio

EMC Test Data

For The

Nevro Corporation

Product

Senza Implantable Pulse Generator, Model IPG2000

Date of Last Test: 1/16/2017

Client:	Nevro Corporation	Job Number:	JD103637
Model:	Senza Implantable Pulse Generator, Model IPG2000	T-Log Number:	T103654
		Project Manager:	Christine Krebill
Contact:	Jon Parker	Project Coordinator:	-
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2

Radiated Emissions

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

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: 22.4 °C
Rel. Humidity: 41 %

Summary of Results

Run #	Test Performed	Limit	Result	Value / Margin
2	Fundamental Signal Field Strength	FCC Part 95	Pass	62.1 dBuV/m @ 3m
2	Transmitter Radiated Spurious Emissions, 30 - 4,050 MHz	FCC Part 95	Pass	32.8 dBµV/m @ 48.94 MHz (-7.2 dB)
3	20dB Bandwidth	FCC Part 95	Pass	243 kHz
3	20dBc Frequencies	FCC Part 95	Pass	
3	Highest emission within 150kHz of fundamental	FCC Part 95	Pass	> -59.1 dBm
4	Receiver Radiated Spurious Emissions, 30 - 1,000 MHz	FCC 15.209	-	Not necessary as all emissions except the fundamental must be below the Part 15 receiver limit for a Part 95 transmitter

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.

EMC Test Data

Client:	Nevro Corporation	Job Number:	JD103637
Model:	Senza Implantable Pulse Generator, Model IPG2000	T-Log Number:	T103654
		Project Manager:	Christine Krebill
Contact:	Jon Parker	Project Coordinator:	-
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2

Run #1: Preliminary Radiated Emissions, 30-4050 MHz, Fundamental and Transmitter Spurious Emissions
Tests were performed on the sample in three orientations to determine orientation with highest emissions with the sample not in the phantom.
The resuls showed that the highest emssions are with the device in an upright position so the device was installed in this position in the phantom in this orientation.

Run #2: Radiated Emissions, 30-4050 MHz, Fundamental and Transmitter Spurious Emissions
EUT installed in phantom

Date of Test: 1/16/2017 Config. Used: 1
Test Engineer: Joseph Cadigal Config Change: none
Test Location: FT Chamber#7 EUT Voltage: Battery

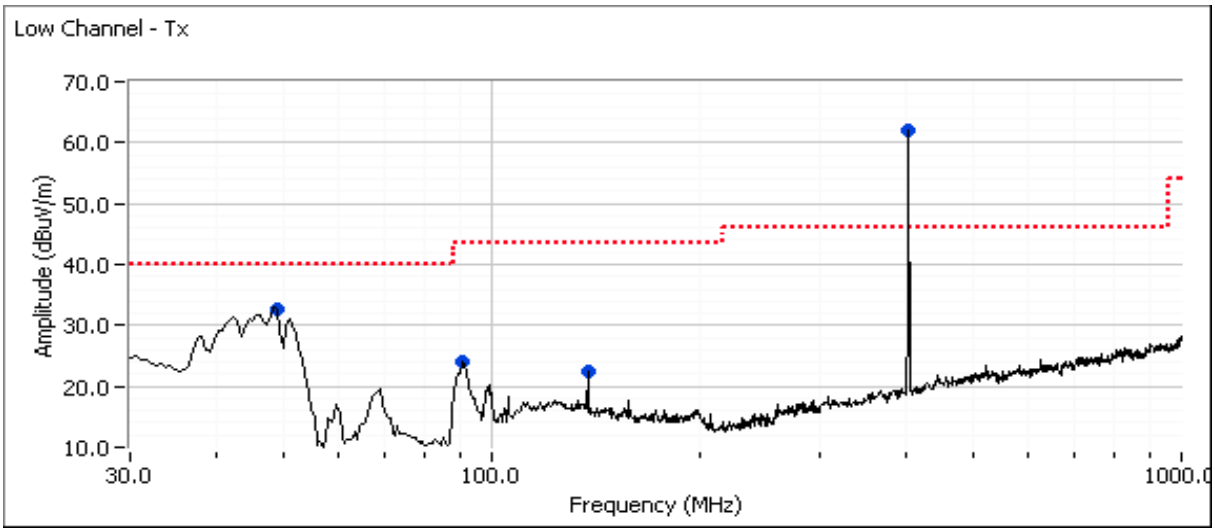
Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
30 - 4,050 MHz	3	3	0.0

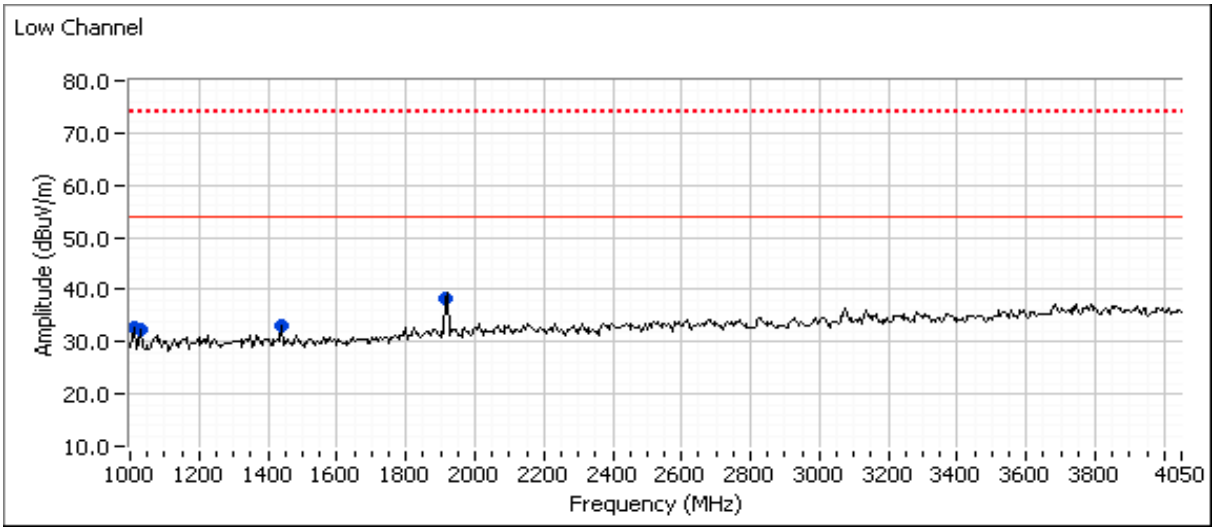
Note:	The limit in part 95 for the fundamental signal is 85.2dBuV/m Peak. Spurious emissions must comply with the Part 95 limits which are the same as 15.209 limits except in the 250 kHz range adjacent to the 402-405 MHz band (65.2 dBuV/m in 3kHz RB).
Note:	The field strength of any spurious emissions may not exceed the field strength of the fundamental signal.

Low Channel 402.45MHz

Frequency	Level	Pol	FCC Part 95		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
48.938	32.8	V	40.0	-7.2	Peak	276	3.5	
91.142	24.0	V	43.5	-19.5	Peak	182	3.5	
138.216	22.4	H	43.5	-21.1	Peak	4	2.0	
402.405	62.1	V	85.2	-23.1	Peak	227	1.0	Fundamental
1030.040	28.8	V	54.0	-25.2	AVG	125	1.0	RB 1 MHz;VB 10 Hz;Peak
1029.650	38.1	V	74.0	-35.9	PK	125	1.0	RB 1 MHz;VB 3 MHz;Peak
1436.680	26.4	V	54.0	-27.6	AVG	295	1.0	RB 1 MHz;VB 10 Hz;Peak
1437.200	37.7	V	74.0	-36.3	PK	295	1.0	RB 1 MHz;VB 3 MHz;Peak
1010.090	30.2	V	54.0	-23.8	AVG	336	1.0	RB 1 MHz;VB 10 Hz;Peak
1010.220	39.2	V	74.0	-34.8	PK	336	1.0	RB 1 MHz;VB 3 MHz;Peak
1916.370	28.8	V	54.0	-25.2	AVG	96	1.0	ambient signal
1915.450	41.1	V	74.0	-32.9	PK	96	1.0	ambient signal

Client:	Nevro Corporation	Job Number:	JD103637
Model:	Senza Implantable Pulse Generator, Model IPG2000	T-Log Number:	T103654
		Project Manager:	Christine Krebill
Contact:	Jon Parker	Project Coordinator:	-
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2





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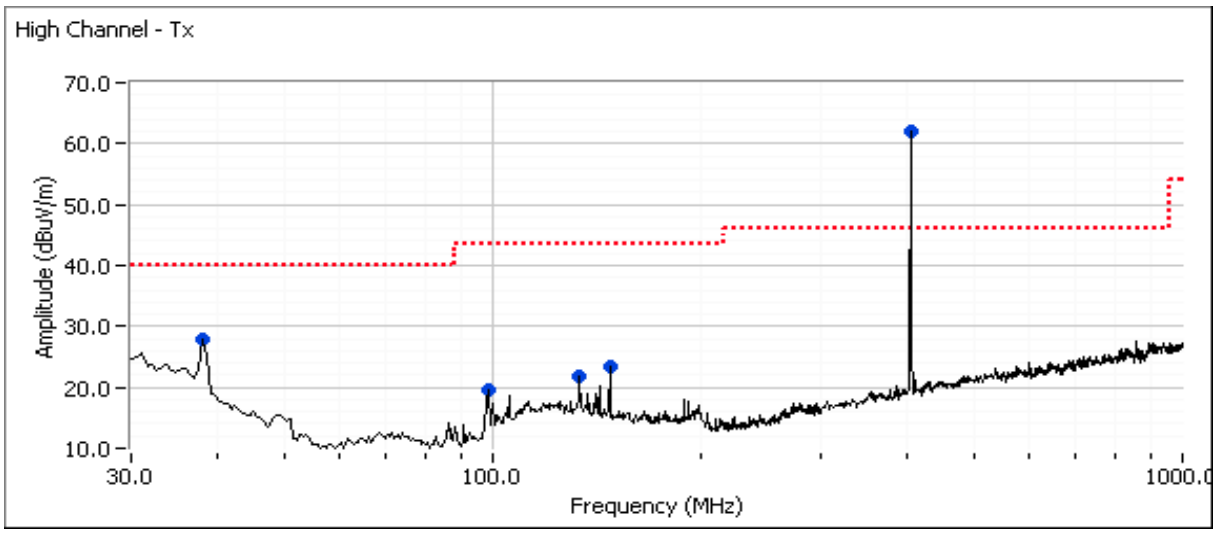
		Project Manager:	Christine Krebill
Contact:	Jon Parker	Project Coordinator:	-
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2

High Channel 404.55MHz

Frequency	Level	Pol	FCC Part 95		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1009.950	28.9	V	54.0	-25.1	AVG	6	1.0	RB 1 MHz;VB 10 Hz;Peak
1010.090	38.5	V	74.0	-35.5	PK	6	1.0	RB 1 MHz;VB 3 MHz;Peak
1798.740	28.2	V	54.0	-25.8	AVG	36	1.0	RB 1 MHz;VB 10 Hz;Peak
1797.280	39.1	V	74.0	-34.9	PK	36	1.0	RB 1 MHz;VB 3 MHz;Peak
38.116	27.8	V	40.0	-12.2	Peak	56	1.0	
98.717	19.6	H	43.5	-23.9	Peak	70	1.5	
133.888	21.7	H	43.5	-21.8	Peak	356	2.5	
147.956	23.5	V	43.5	-20.0	Peak	57	2.5	
404.550	61.9	V	85.2	-23.3	Peak	227	1.0	Fundamental
1920.020	37.4	V	54.0	-16.6	AVG	55	1.0	ambient signal
1919.040	44.9	V	74.0	-29.1	PK	55	1.0	ambient signal



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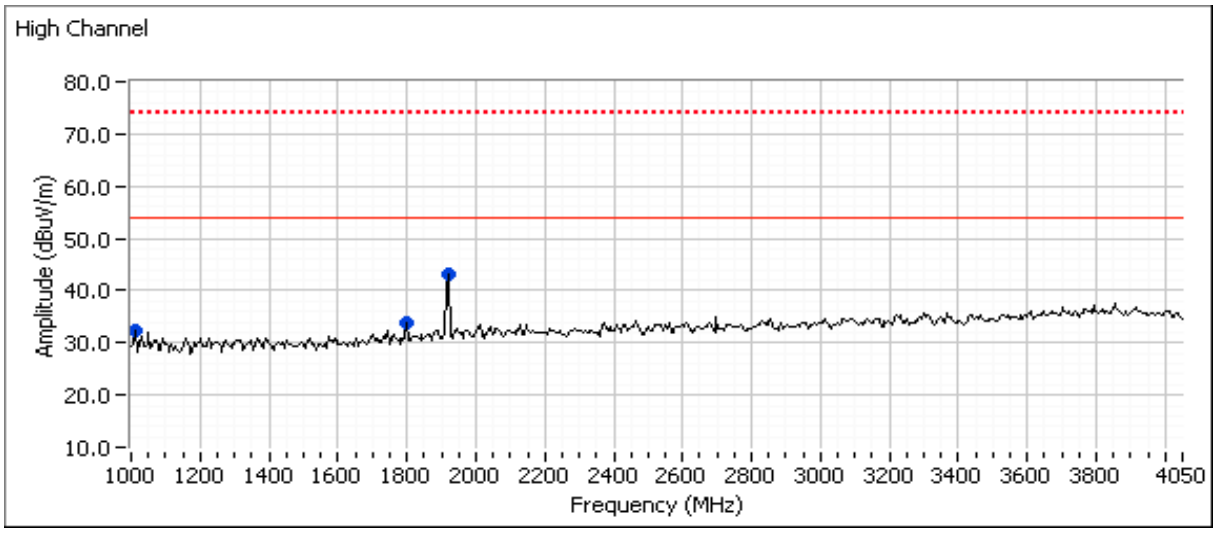
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2



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Contact:	Jon Parker	Project Coordinator:	-
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2

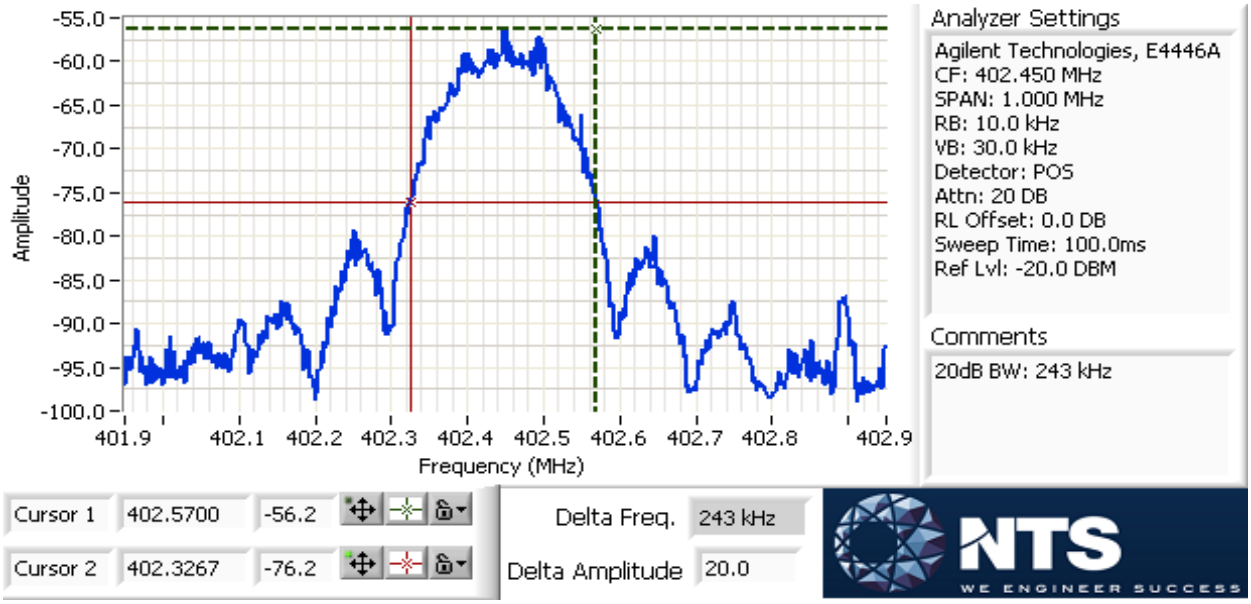
Run #3: Bandwidth Measurement(s)

Date of Test: 1/9/2017
Test Engineer: David Bare
Test Location: Fremont EMC Lab #4

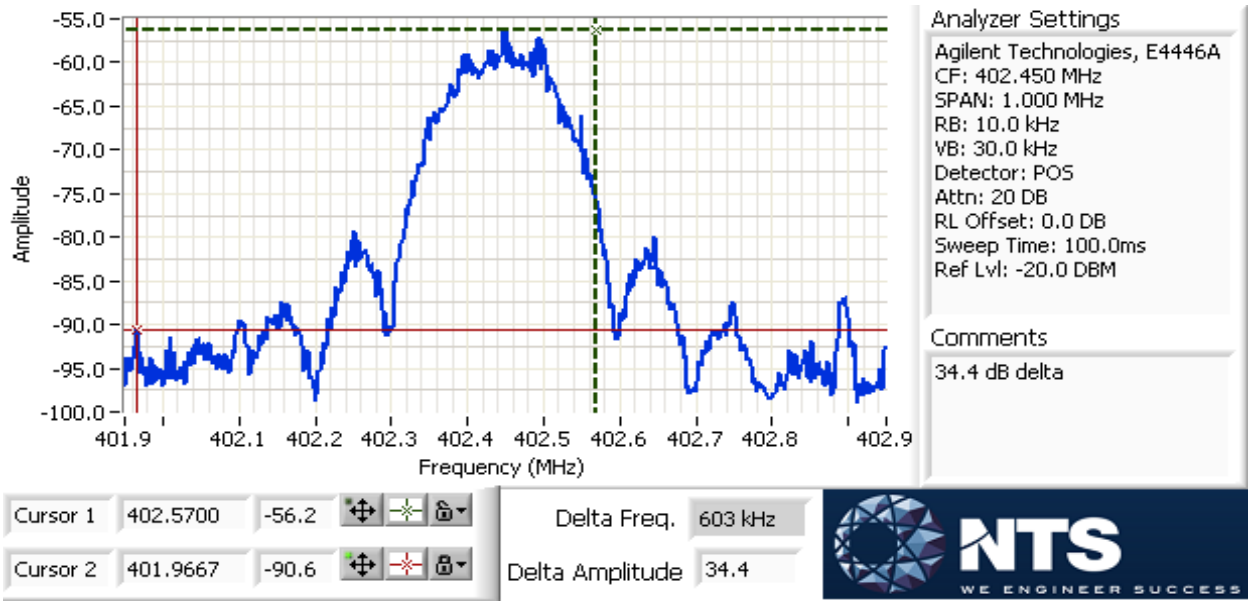
Config. Used:
Config Change:
EUT Voltage: Battery (4.1 V)

	Frequency (MHz)	Resolution Bandwidth	Video Bandwidth	20dB Bandwidth
	402.45	3.0 kHz	10.0 kHz	243.0 kHz
	404.55	3.0 kHz	10.0 kHz	240.0 kHz

Note 1:	20dB bandwidth measured with Span 2 - 5 times the actual bandwidth and RB > 1% and < 5% of the actual bandwidth and VB > 3xRB



Client:	Nevro Corporation	Job Number:	JD103637
Model:	Senza Implantable Pulse Generator, Model IPG2000	T-Log Number:	T103654
		Project Manager:	Christine Krebill
Contact:	Jon Parker	Project Coordinator:	-
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2



The delta in emissons level from the inband level to the level at 401.967 MHz is 34.4 dB. Subtracting this from the field strength of the fundamental at 1 MHz gives a value of 16.1 dBuV/m which complies with the spurious limit of 46 dBuV/m.

The delta in emissons level from the inband level to the highest level > 150 kHz from the center is > 20 dB. The power of any unwanted emmission is thus > -59.1 dBm since the power of the wanted emisisosn is -39.1 dBm calculated from the 62.1 dBuV/m FS.

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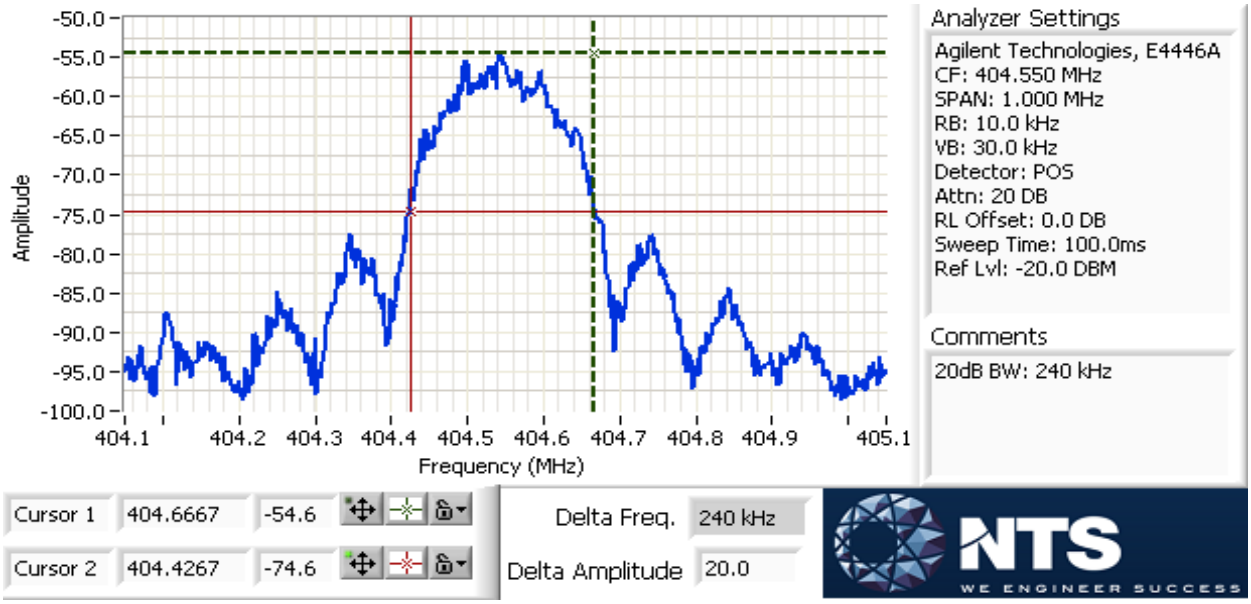
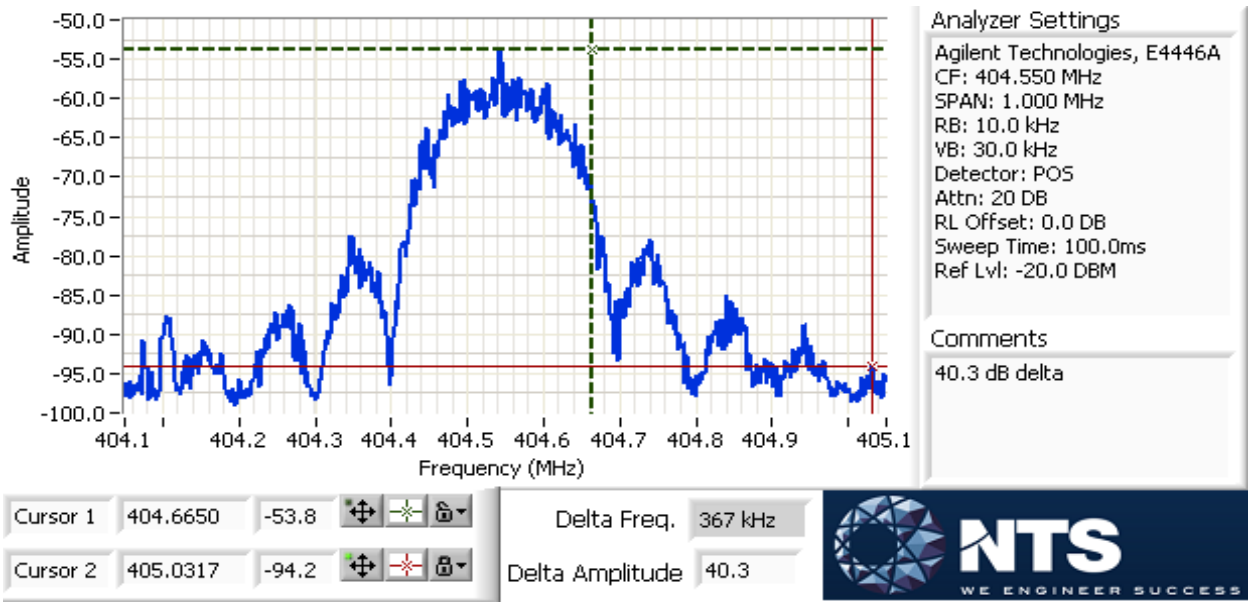
		Project Manager:	Christine Krebill
Contact:	Jon Parker	Project Coordinator:	-
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2





Client:	Nevro Corporation	Job Number:	JD103637
Model:	Senza Implantable Pulse Generator, Model IPG2000	T-Log Number:	T103654
		Project Manager:	Christine Krebill
Contact:	Jon Parker	Project Coordinator:	-
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2

The delta in emissons level from the inband level to the level at 405.032 MHz is 40.3 dB. Subtracting this from the field strength of the fundamental at 1 MHz gives a value of 21.6 dBuV/m which complies with the spurious limit of 46 dBuV/m.

Run #4: Receiver Spurious Emissions

Not necessary as all emissions except the fundamental must be below the Part 15 receiver limit for a Part 95 transmitter

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		Project Manager:	Christine Krebill
Contact:	Jon Parker	Project Coordinator:	-
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2

FCC Part 95.2565 and EN 301 839
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

With the exception of the radiated spurious emissions tests, all measurements are made with a probe. For frequency stability measurements the EUT was place 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: 20-21 °C

Rel. Humidity: 53-54 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result
1	Frequency Stability	100 ppm	Pass	14 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.

Client:	Nevro Corporation	Job Number:	JD103637
Model:	Senza Implantable Pulse Generator, Model IPG2000	T-Log Number:	T103654
		Project Manager:	Christine Krebill
Contact:	Jon Parker	Project Coordinator:	-
Standard:	FCC Part 95, EN 301 839 V2.1.1	Class:	2

Run #1: Frequency Stability

Date of Test: 1/10/2017
Test Engineer: Mehran Birgani
Test Location: Fremont EMC Lab #4

Config. Used: 1
Config Change: -
EUT Voltage: Battery

Nominal Frequency: 403.65 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.

Nominal Battery Voltage (4.1 Vdc)

Temperature	Frequency Measured	Drift	
(Celsius)	(MHz)	(Hz)	(ppm)
25	403.646757	-3243	-8
35	403.645641	-4359	-11
45	403.644157	-5843	-14
	Worst case:	-5843	-14

RB=100Hz; VB=300Hz; Span=10kHz

Battery endpoint (3.485 Vdc) for EN 301 839

Temperature	Frequency Measured	Drift	
(Celsius)	(MHz)	(Hz)	(ppm)
25	403.647774	-2226	-6
35	403.649574	-426	-1
45	403.648824	-1176	-3
	Worst case:	-2226	-6

Frequency Stability Over Input Voltage

Voltage	Frequency Measured	Drift	
(Dc)	(MHz)	(Hz)	(ppm)
4.1	403.645641	-4359	-11
3.485	403.649574	-426	-1

Note 1:	Maximum drift of fundamental frequency before it shut down at 3.2 Vdc was to 403.648856 MHz. No drift observed.

End of Report

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