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 90
(406.1 MHz to 470 MHz)

Model: VTX-1

FCC ID:	2AAFWVTX1
COMPANY:	VISIPLEX 1287 Barclay Blvd Buffalo, IL 60089
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
REPORT DATE:	July 28, 2017
REISSUE DATE:	September 7, 2017
FINAL TEST DATES:	July 10 and 13, 2017
TOTAL NUMBER OF PAGES:	28

ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

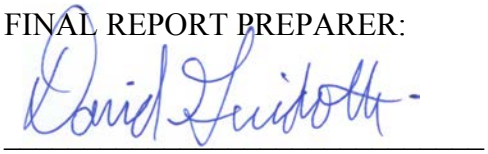
PROGRAM MGR

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
0	July 28, 2017	First release	

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SCOPE

Tests have been performed on the VISIPLEX model VTX-1, 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 Innovation Science and Economic Development Canada.

- Code of Federal Regulations (CFR) Title 47 Part 2
- CFR 47 Part 90 (Private Land Mobile Radio 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 June 2010
FCC KDB 971168 Licensed Digital Transmitters

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Innovation Science and Economic Development 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 VISIPLEX model VTX-1 and therefore apply only to the tested sample. The sample was selected and prepared by Ben Agam of VISIPLEX.

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 VISIPLEX model VTX-1 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 90.217

FCC		Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§2.1033 (c) (5) §90.35		Frequency range(s)	406.1 – 470 MHz	406.1 – 470 MHz	Complied
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 §90.217		RF power output at the antenna terminals	19.4 dBm	20.8 dBm	Complied
§2.1033 (c) (4) §2.1047 §90.217		Emission types	F3D, F7W	-	-
		Emission mask	Within mask	90.217	Complied
§2.1049 §90.217		Occupied Bandwidth	4.85 kHz 7.64 kHz	11.25 kHz	Complied
Transmitter spurious emissions					
§2.1051 §2.1057 §90.217		At the antenna terminals	-14.5 dBm (-33.9 dBc)	-30 dBc	Complied
Other details					
§2.1055 §90.217		Frequency stability	0.8 ppm	Must meet mask	Complied
§2.1093		RF Exposure	Refer to separate exhibit		
§2.1033 (c) (8)		Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range	5V, 1A		
-	-	Antenna Gain	3.0 dBi	-	-
Notes					

EXTREME CONDITIONS

Frequency stability is determined over extremes of temperature and voltage. The extremes of voltage were 85 to 115 percent of the nominal value. The extremes of temperature were -30°C to +50°C as specified in FCC §2.1055(a)(1).

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 (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}
RF power, conducted	dBm	25 to 7,000 MHz	± 0.52 dB
Conducted emission of transmitter	dBm	25 to 40,000 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 40,000 MHz	± 0.7 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The VISIPLEX model VTX-1 is a radio transceiver that is designed to receive/send wireless analog and digital data in applications such as paging encoders, data repeaters, wireless intercom controllers, etc. Since the EUT could be placed in any location during operation but would not be handheld, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 5 Volts DC supplied via a USB port.
The sample was received on April 6, 2017 and tested on July 10 and 13, 2017. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Visiplex	VTX-1	Radio Transceiver	None	2AAFWVTX-1

OTHER EUT DETAILS

The VTX-1 operates on 12.5 kHz channels in the 406.1 – 470 MHz frequency range.

ENCLOSURE

The EUT enclosure is primarily constructed of aluminum. It measures approximately 5.4 cm wide by 8.2 cm deep by 2.0 cm high.

MODIFICATIONS

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

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Motorola	5006ABU0500115	Power Adapter	None	-

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

Company	Model	Description	Serial Number	FCC ID
Visiplex	CT-104	Compact Transmitter	94220067	2AAFWCT10X

EUT INTERFACE PORTS

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

Port		Cable(s)		
From	To	Description	Shielded/Unshielded	Length(m)
USB	USB/AC	Multiwire	Shielded	1.2
TX	Load	Coax	Shielded	1.0
Rx	Not connected	-	-	-
Datal/O	Not connected	-	-	-

EUT OPERATION

During testing, the EUT was commanded to transmit at its programmed frequency at maximum power using a CT-104 compact transmitter. Depending on the test, the EUT was unmodulated or modulated.

TESTING

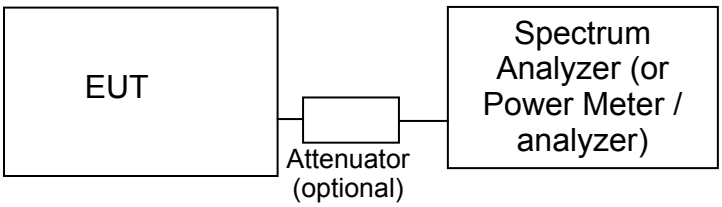
GENERAL INFORMATION

Antenna port measurements were taken at the National Technical Systems - Silicon Valley test site located at 41039 Boyce Road, Fremont, CA 94538-2435.

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

RF PORT MEASUREMENT PROCEDURES

Conducted measurements are performed with the EUT's rf input/output connected to the input of a spectrum analyzer, power meter or modulation analyzer. When required an attenuator, filter and/or dc block is placed between the EUT and the spectrum analyzer to avoid overloading the front end of the measurement device. Measurements are corrected for the insertion loss of the attenuators and cables inserted between the rf port of the EUT and the measurement equipment.



Test Configuration for Antenna Port Measurements

For devices with an integral antenna the output power and spurious emissions are measured as a field strength at a test distance of (typically) 3m and then converted to an eirp using a substitution measurement (refer to **Error! Reference source not found.**). All other measurements are made as detailed below but with the test equipment connected to a measurement antenna directed at the EUT.

OUTPUT POWER

Output power is measured using a power meter and an average sensor head, a spectrum analyzer or a power meter and peak power sensor head as required by the relevant rule part(s). Where necessary measurements are gated to ensure power is only measured over periods that the device is transmitting.

Power measurements made directly on the rf power port are, when appropriate, converted to an EIRP by adding the gain of the highest gain antenna that can be used with the device under test, as specified by the manufacturer.

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.

CONDUCTED SPURIOUS EMISSIONS

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 measurements). Where the limits are expressed as an average power the spectrum analyzer is tunes to that frequency with a narrow span (wide enough to capture the emission and its sidebands) and the resolution and video bandwidths are adjusted as required by the reference measurement standards. For transmitter measurements the appropriate detector (average, peak, normal ,sample, quasi-peak) is used when making measurements for licensed devices. For receiver conducted spurious measurements the detector is set to peak.

TRANSMITTER MASK MEASUREMENTS

The transmitter mask measurements are made using resolution bandwidths as specified in the pertinent rule part(s). Where narrower bandwidths are used the measurement is corrected to account for the reduced bandwidth by either using the adjacent channel power function of the spectrum analyzer to sum the power across the required measurement bandwidth. The frequency span of the analyzer is set to ensure the fundamental signal and all significant sidebands are displayed.

The top of the mask may be set by the total output power of the signal, the power of the unmodulated signal or the peak value of the signal in the reference bandwidth being used for the mask measurement.

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.

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS - CONDUCTED SPURIOUS EMISSIONS

Measurements are compared directly to the conducted emissions specification limit (decibel form). The calculation is as follows:

$$R_r - S = M$$

where:

R_r = Measured value in dBm
S = Specification Limit in dBm
M = Margin to Specification in +/- dB

Appendix A Test Equipment Calibration Data

Radio Antenna Port (Power and Spurious Emissions), 10-Jul-17

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Rohde & Schwarz	Power Meter, Dual Channel	NRVD	1071	5/1/2017	5/1/2018
Watlow	Temp Chamber (w/ F4 watlow Controller)	96A0	2171	7/8/2016	8/8/2017
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/22/2017	5/22/2018
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts use with 20dB attenuator sn:1031.6959.00 only	NRV-Z32	3225	10/27/2016	10/27/2017

Radio Antenna Port (Power and Spurious Emissions), 13-Jul-17

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/22/2017	5/22/2018

Appendix B Test Data

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Client:	Visiplex, Inc	Job Number:	JD104072
Product	VTX-1	T-Log Number:	T104092
System Configuration:	-	Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Emissions Standard(s):	FCC parts 15 and 90	Class:	A
Immunity Standard(s):		Environment:	Radio

EMC Test Data

For The

Visiplex, Inc

Product

VTX-1

Date of Last Test: 7/10/2017

Client:	Visiplex, Inc	Job Number:	JD104072
Model:	VTX-1	T-Log Number:	T104092
		Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Standard:	FCC parts 15 and 90	Class:	N/A

FCC Part 90.217

Power, Occupied Bandwidth, Frequency Stability and Spurious 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

With the exception of the radiated spurious emissions tests, all measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator or dc-block if necessary. All amplitude measurements are adjusted to account for the attenuation between EUT and measuring instrument. For frequency stability measurements the EUT was place inside an environmental chamber.

Ambient Conditions:

Temperature: 20-21 °C
Rel. Humidity: 38-40 %

Summary of Results

Run #	Spacing	Data Rate	Test Performed	Limit	Pass / Fail	Result / Margin
1	12.5 kHz		Output Power	20.8 dBm	Pass	19.4 dBm
2	12.5 kHz		Spectral Mask	90.217 (-30dBc > 25 kHz from center)	Pass	Within Mask
3	12.5 kHz		99% or Occupied Bandwidth	5 kHz 11.25 kHz	Pass	4.85 kHz 7.64 kHz
4	12.5 kHz		Spurious Emissions (conducted)	-30 dBc	Pass	-14.5 dBm @ 812.2 MHz
5	-		Frequency Stability	None, used for Mask	-	-

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: 7/10 & 7/13/2017
Test Engineer: David Bare and Mehran Birgani
Test Location: Fremont EMC Lab #4b

Config. Used: 1
Config Change: None
EUT Voltage: 5VDC from Adapter

Client:	Visiplex, Inc	Job Number:	JD104072
Model:	VTX-1	T-Log Number:	T104092
		Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Standard:	FCC parts 15 and 90	Class:	N/A

Run #1: Output Power

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W
-	406.100	19.4	87.1	3.0	Pass	22.4	0.174
-	435.000	19.1	81.3	3.0	Pass	22.1	0.162
-	469.999	18.4	69.2	3.0	Pass	21.4	0.138

Note 1:	Output power measured using a peak power meter
Note 2:	Power setting - the power for the samples is not settable.

Run #2: Spectral Mask, FCC Part 90.217

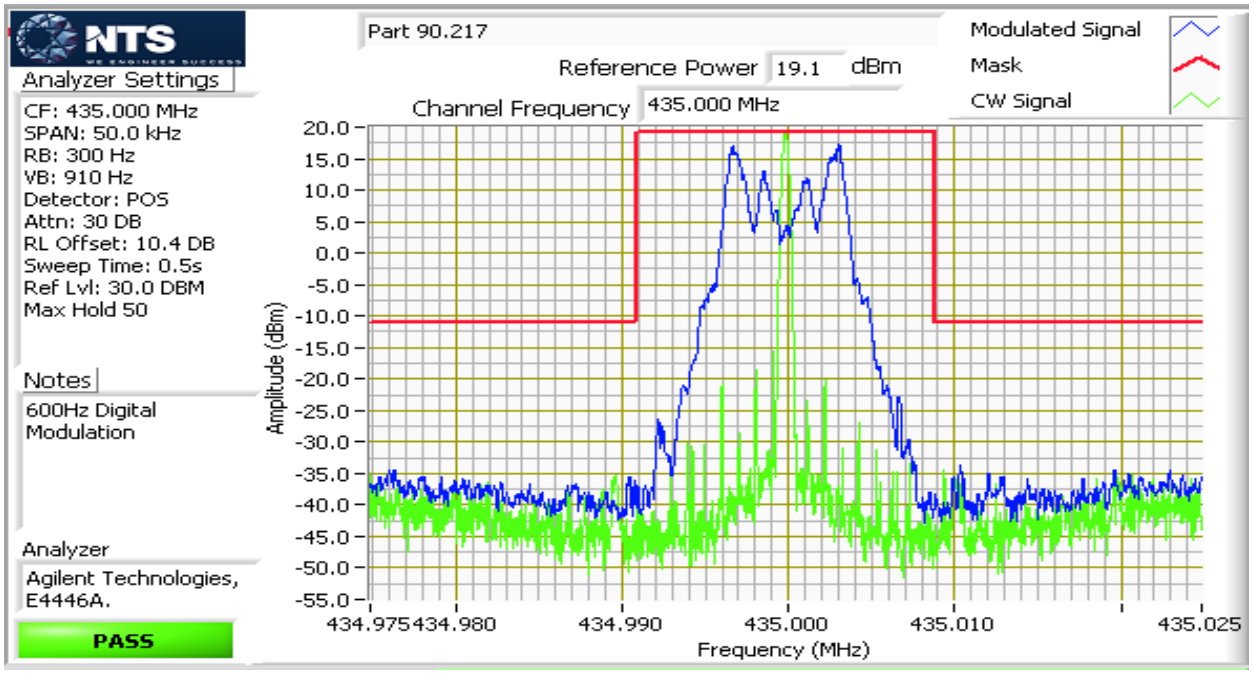
Cable Loss: 0.4 dB Attenuator: 10.0 dB Total Loss: 10.4 dB

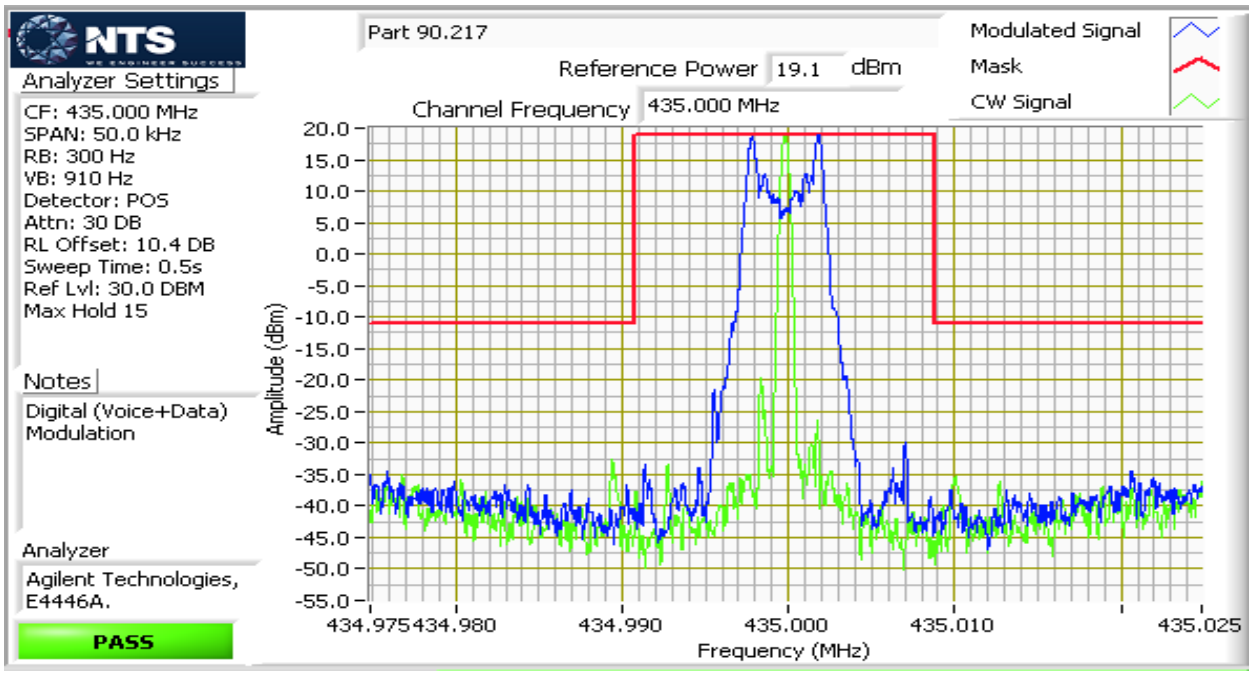
Cable ID(s): EL572 Attenuator IDs: 2100.0

Note 1:	Reference for the top of the mask was determined from the amplitude of the unmodulated carrier.
Note 2:	Requirement is -30dBc >25 KHz from the center of the channel but this offset frequency needs to include the frequency stability. Under reduced voltage conditions, the EUT moved by 16 kHz before shutoff, therefore -30dBc must be met > 9 kHz offset. The product complies with the requirement.

7K64F3D and 4K85F7W modulations use 12.5 kHz channel spacing.

Client:	Visiplex, Inc	Job Number:	JD104072
Model:	VTX-1	T-Log Number:	T104092
		Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Standard:	FCC parts 15 and 90	Class:	N/A



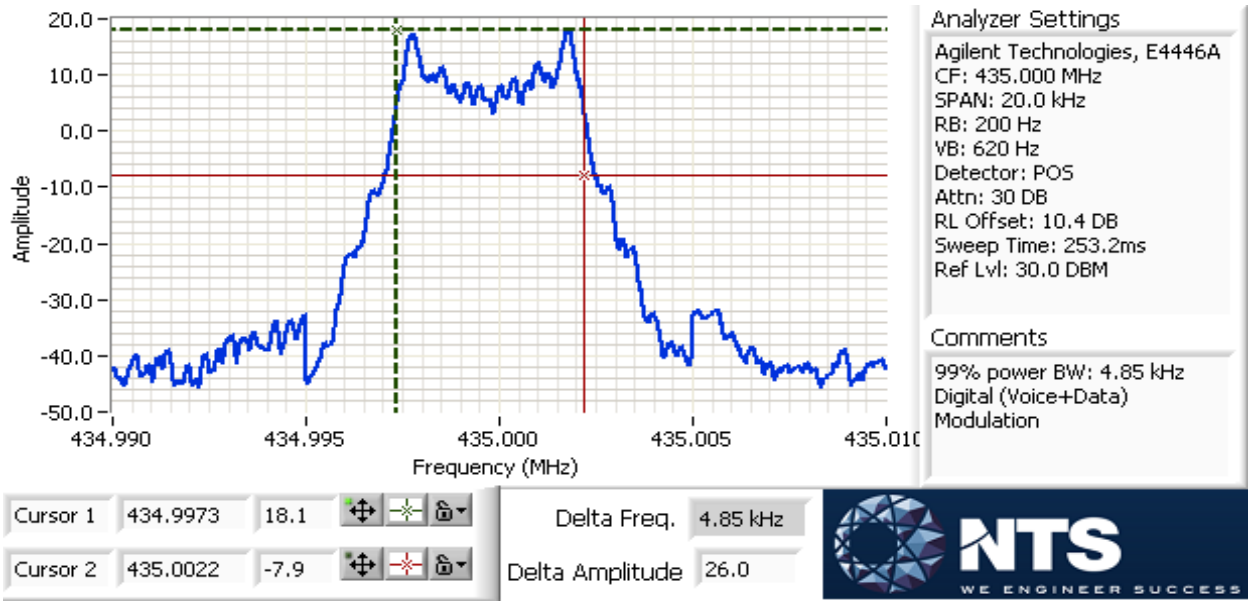


Client:	Visiplex, Inc	Job Number:	JD104072
Model:	VTX-1	T-Log Number:	T104092
		Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Standard:	FCC parts 15 and 90	Class:	N/A

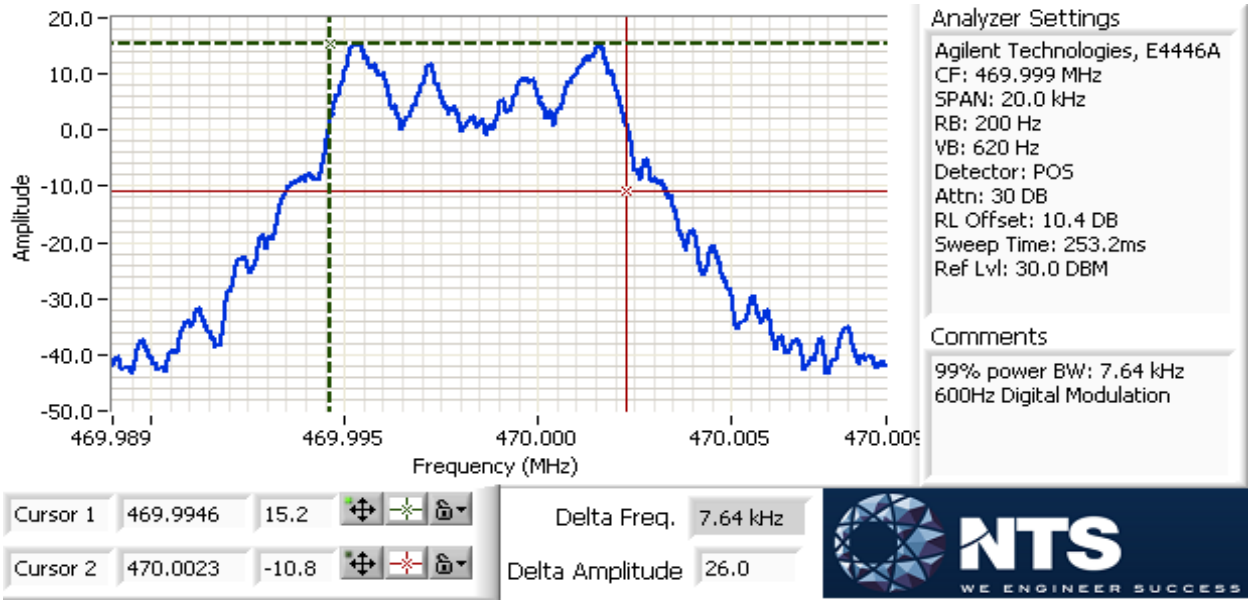
Run #3: Signal Bandwidth

Power Setting	Frequency (MHz)	Resolution Bandwidth	Bandwidth (kHz)	99%	
Max	469.999	200 Hz		7.64	7K64F3D
Max	469.999	200 Hz		4.85	4K85F7W

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:	Visiplex, Inc	Job Number:	JD104072
Model:	VTX-1	T-Log Number:	T104092
		Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Standard:	FCC parts 15 and 90	Class:	N/A



Run #4: Out of Band Spurious Emissions, Conducted

Frequency (MHz)	Limit	Result
406.100	-30dBc	Pass
435.000	-30dBc	Pass
469.999	-30dBc	Pass

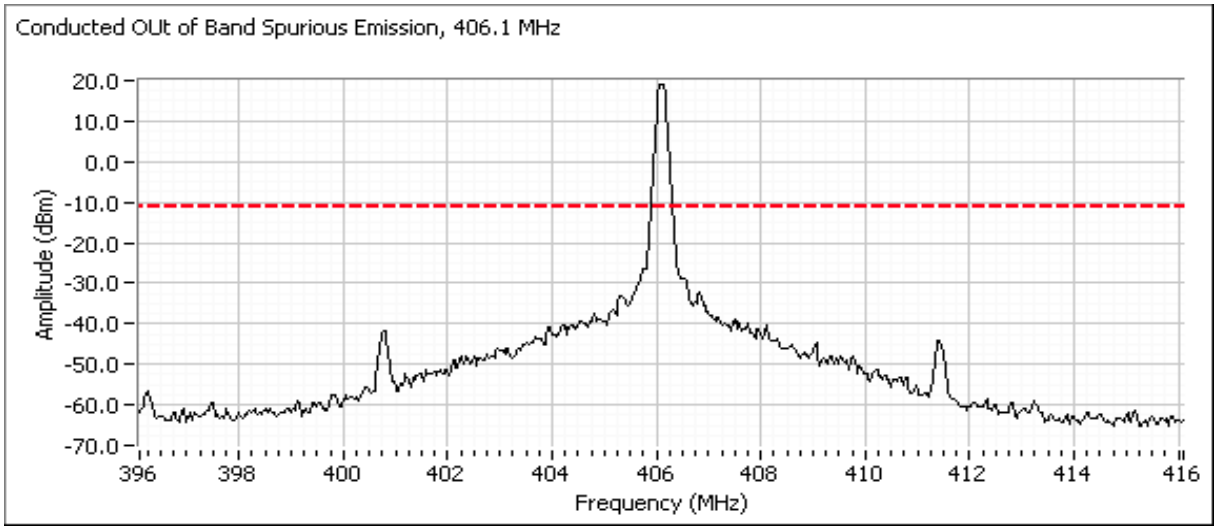
The limit is taken from FCC Part 90.217

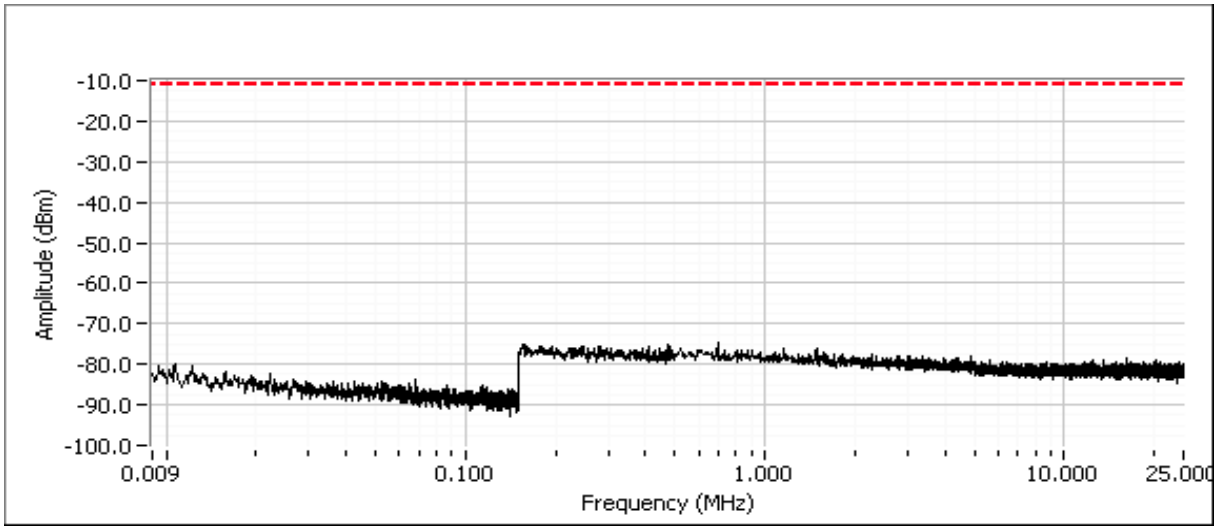
Plots 20 Mhz wide centered on the signal frequency also provided for each channel bandwidth/spacing.

Frequency	Level	Port	FCC 90.210(e)		Detector	Ch. Freq.	Comments
MHz	dBm		Limit	Margin	Pk/QP/Avg	MHz	
406.100	19.4	RF Port	-	-	PK		Fundamental
812.201	-14.5	RF Port	-10.6	-3.9	PK		
1218.300	-19.3	RF Port	-10.6	-8.7	PK		
435.000	19.1	RF Port	-	-	PK		Fundamental
870.000	-19.4	RF Port	-10.9	-8.5	PK		
1305.000	-16.2	RF Port	-10.9	-5.3	PK		
469.999	18.4	RF Port	-	-	PK		Fundamental
939.997	-21.8	RF Port	-11.6	-10.2	Peak		
1410.020	-16.5	RF Port	-11.6	-4.9	Peak		

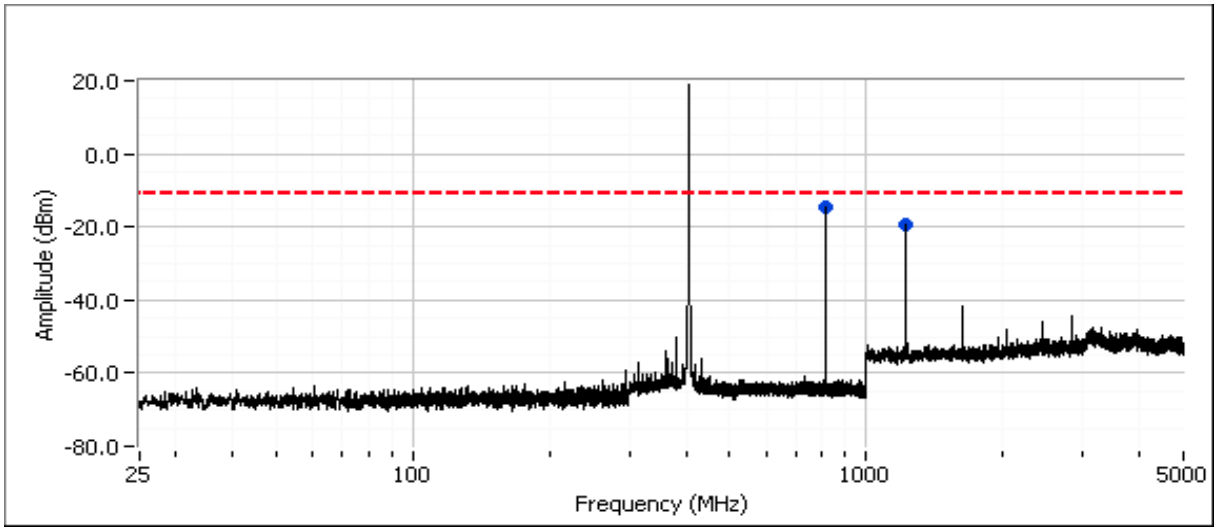
Client:	Visiplex, Inc	Job Number:	JD104072
Model:	VTX-1	T-Log Number:	T104092
		Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Standard:	FCC parts 15 and 90	Class:	N/A

Plots for low channel

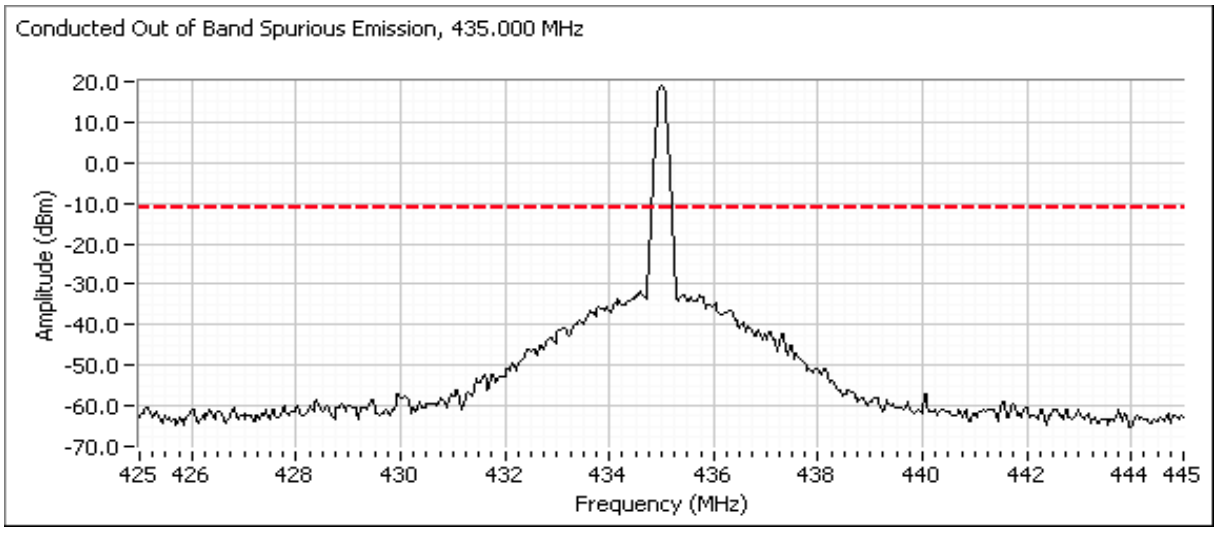




Client:	Visiplex, Inc	Job Number:	JD104072
Model:	VTX-1	T-Log Number:	T104092
		Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Standard:	FCC parts 15 and 90	Class:	N/A



Plots for center channel



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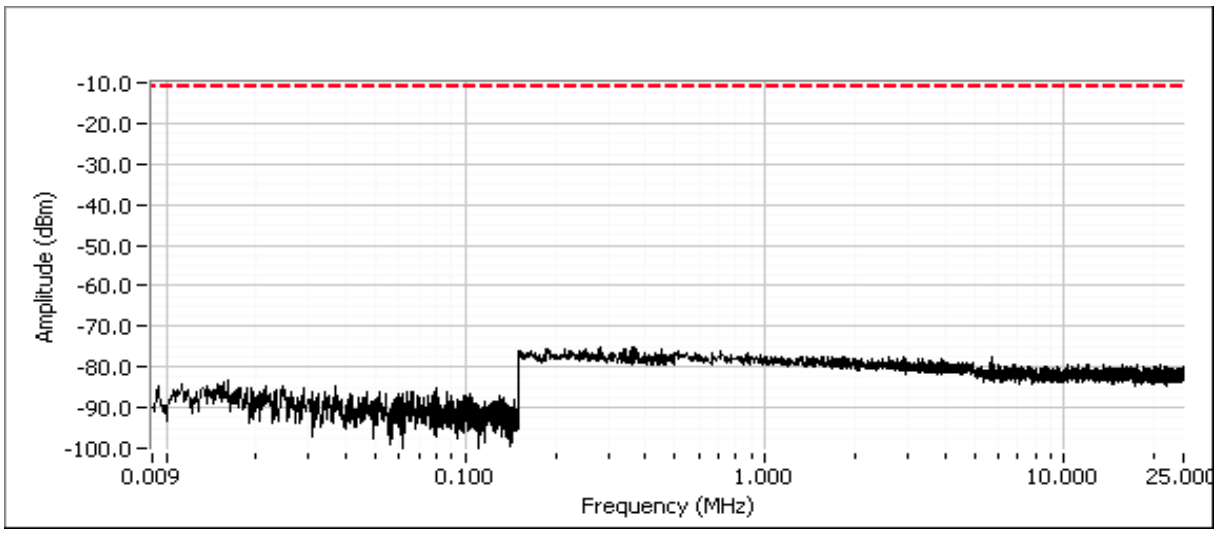
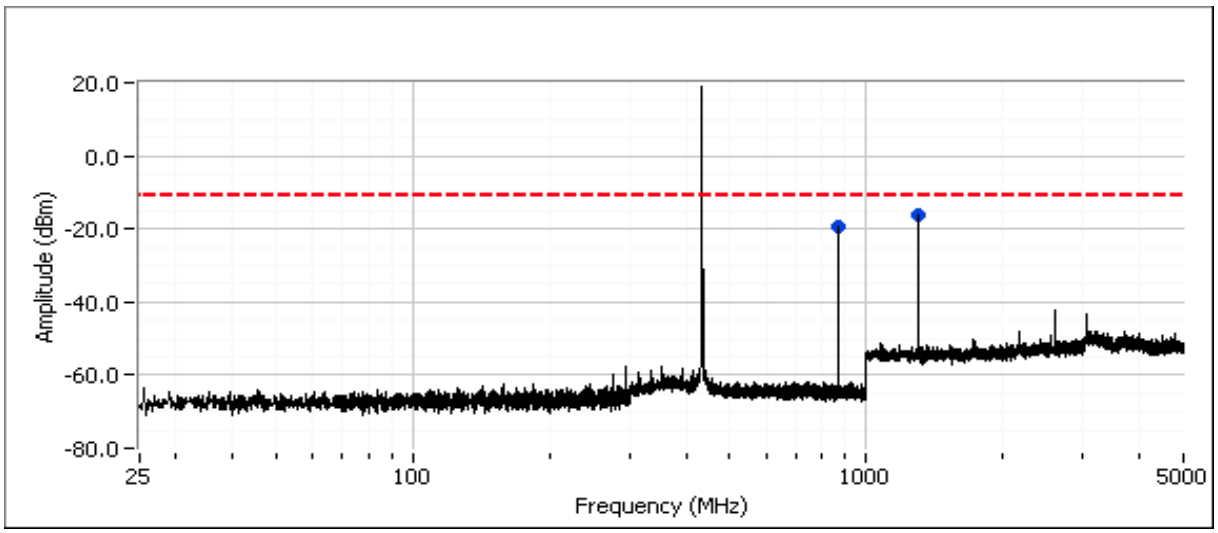
		Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Standard:	FCC parts 15 and 90	Class:	N/A





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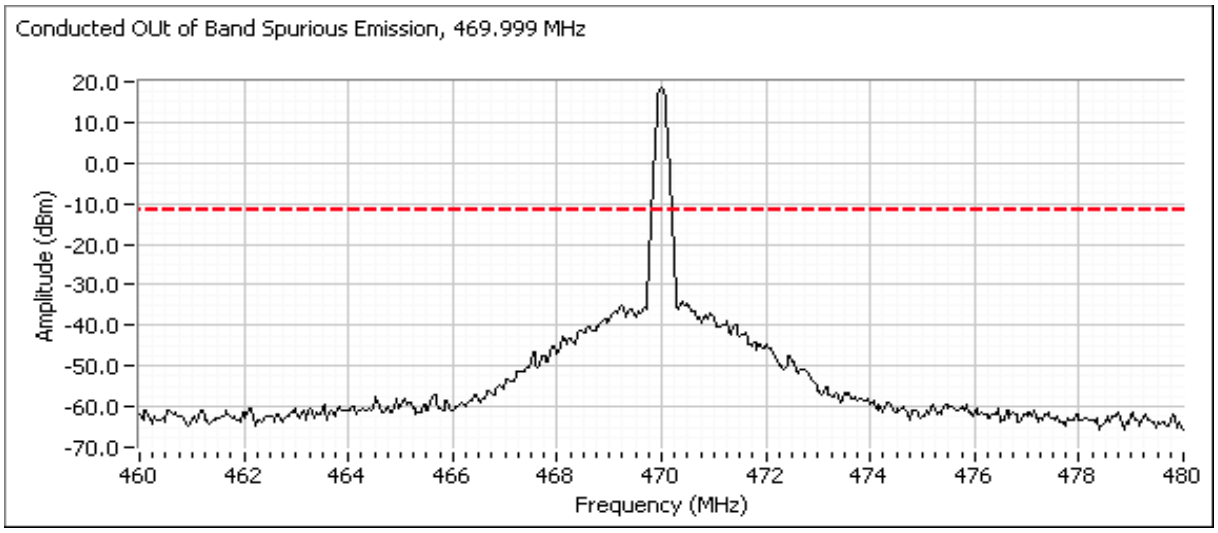
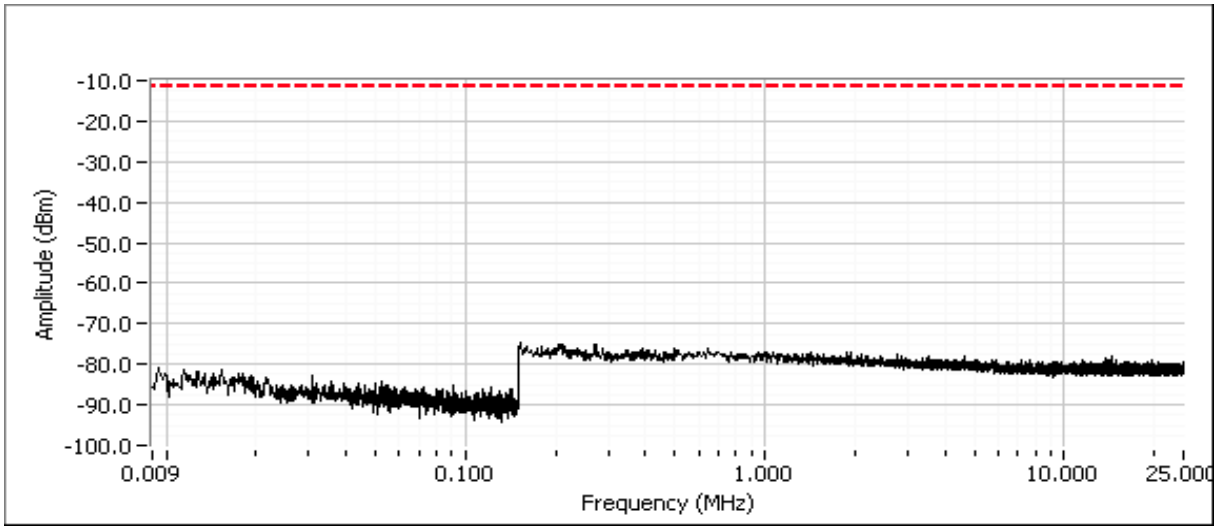
Model:	VTX-1	T-Log Number:	T104092
		Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Standard:	FCC parts 15 and 90	Class:	N/A

Plots for high channel





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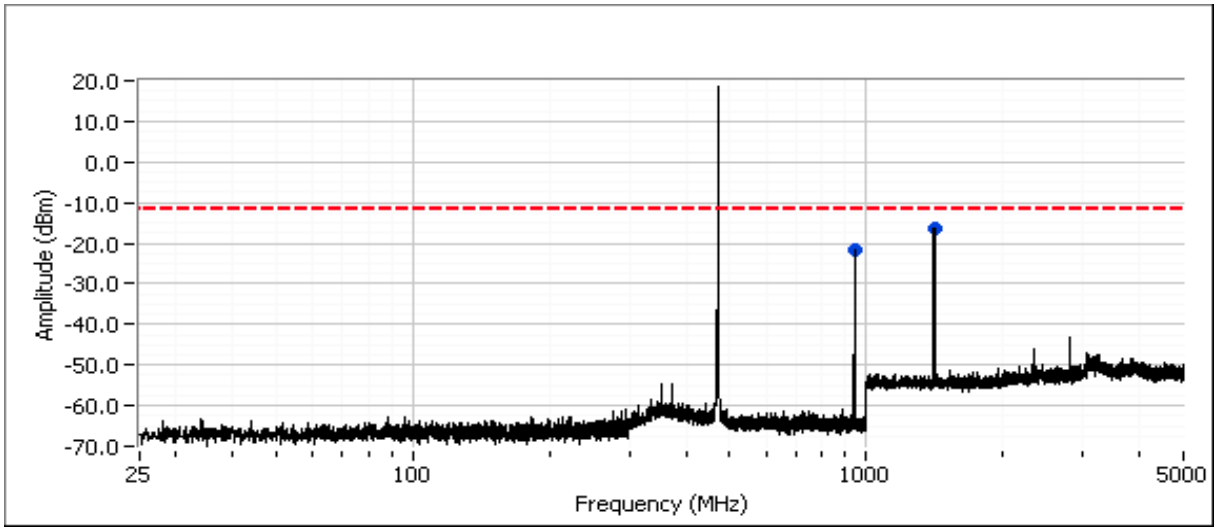

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Model:	VTX-1	T-Log Number:	T104092
		Project Manager:	Deepa Shetty
Contact:	Ben Agam	Project Coordinator:	-
Standard:	FCC parts 15 and 90	Class:	N/A

Run #5: Frequency Stability

Date of Test: 7/10/2017 Config. Used: 1

Test Engineer: D. Bare and M. Birgani Config Change: None

Test Location: Fremont EMC Lab #4b EUT Voltage: 5VDC from Adapter

Nominal Frequency: 435 MHz Unmodulated

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)
-30	434.999680	-320	-0.7
-20	434.999650	-350	-0.8
-10	434.999753	-247	-0.6
0	434.999803	-197	-0.5
10	434.999840	-160	-0.4
20	434.999860	-140	-0.3
30	434.999823	-177	-0.4
40	434.999760	-240	-0.6
50	434.999720	-280	-0.6
	Worst case:	-350	-0.8

Frequency Stability Over Input Voltage

Nominal Voltage is 5Vdc.

Voltage	Frequency Measured	Drift	
(DC)	(MHz)	(Hz)	(ppm)
4.25 (85%)	434.999860	-140	-0.3
5.75 (115%)	434.999860	-140	-0.3
	Worst case:	-140	-0.8

Note 1:	Maximum drift of fundamental frequency before it shut down at 2.0 Vdc was 16 kHz (36.8 ppm).

End of Report

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marks the last page of this test report.