VISLINK
Law Enforcement & Public Safety

TEST REPORT

MOBILE MICROWAVE VIDEO TRANMITTER

FCC ID: FC3HDX044D

MODEL: HDX-1100C2

APPLICANT: VISLINK, Inc.

November 12, 2010

TABLE OF CONTENTS

SECTION 1 INTRODUCTION

GENERAL INFORMATION – 2.1033

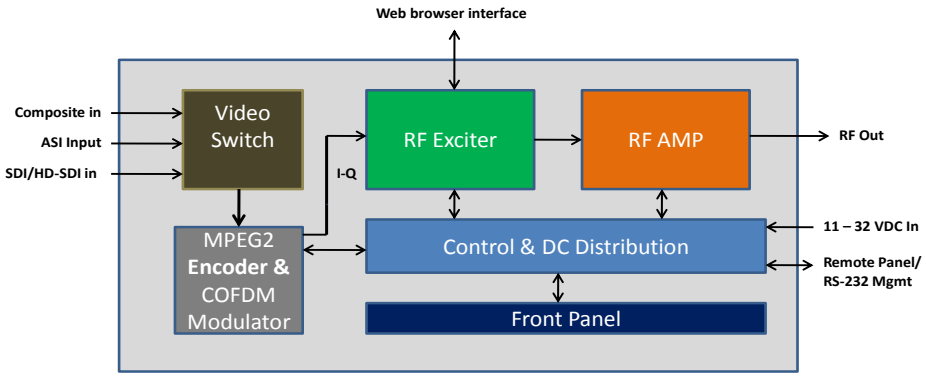
Applicant:	Vislink, Inc. 101 Billerica Avenue, Building 6 North Billerica, MA 01862 Tel. 978-671-5700 Attn: Sal Blatti, Compliance Manager
FCC ID:	FC3HDX044D
Installation and Operating Manual:	HDX-1100 User and Technical Manual attached
Equipment Description:	Mobile Video Transmitter – see below
Block Diagram:	See Technical Description, below
Equipment model:	HDX-1100C2
Frequency Range:	4940 – 4990 MHz
FCC Part number:	§90; subpart Y (90.1201 thru 90.1217)
Rated RF Power:	1.0 Watts (+33 dBm)
Frequency Tolerance:	0.0005 %
Emission Designator:	10M07WD

The data provided in this document will show that the Vislink/Microwave Radio Communications HDX1100C2 transmitter is in compliance with 47 CFR Part 90 for use by eligible Private Land Mobile Radio Services licensees in the 4940 – 4990 MHz band, under Subpart Y. Radiated emission tests were conducted by Parker Chromerics in their laboratory facility in Woburn, MA, while the part 90 emission testing was conducted in the Vislink/Microwave Radio Communications facility in North Billerica, MA.

The HDX1100C2 was designed to comply with permissible operation as specified in § 90.1205, for the transmission of video, audio, and data by a mobile transmitter. Under the referenced rules, the licensee may operate this equipment in a continuous and unattended mode if required. Typical applications may include surveillance, command center operations, emergency restoration, or other video, voice and data requirements as deemed necessary and appropriate for a specific mission.

Technical Description:

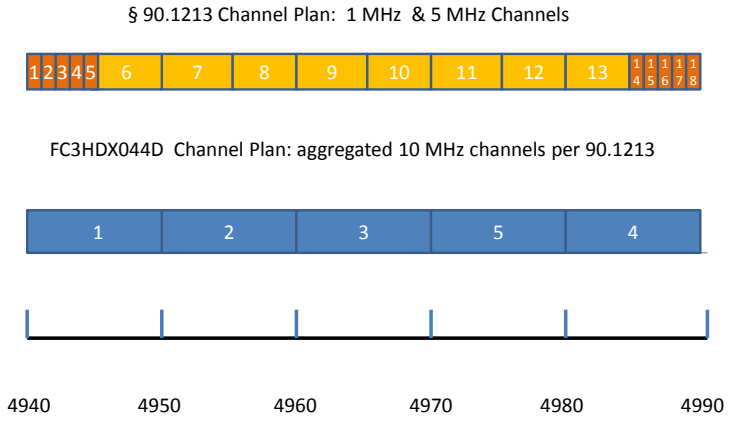
The HDX1100 FC3HDX044D is a compact, mobile transmitter, designed to be adaptable to a wide range of field applications; particularly those requiring ruggedized, vehicular mounted equipment. The transmitter accepts a wide range of SMPTE based video input signals, including HD-SDI, SDI, ASI, and NTSC. Raw video, audio, and data are delivered to an integral MPEG-2 Encoder which feeds a COFDM-DVB-T modulator, operating in the 2K carrier mode, to produce a 1705 carrier spectrum. The I and Q outputs of the COFDM modulator are supplied directly to an RF generator and up-converted to the operating band from 4940 to 4990 MHz at an RF power level of 100 mW (+20 dBm). A 10 dB gain RF amplifier follows the exciter to boost the final RF output power to + 30 dBm (1.0 Watt). The exciter RF drive level is factory set to limit the RF output from the PA to 1.0 Watt or less.



HDX1100 Functional Block Diagram

Figure 1

The specific operating frequency is determined by a high stability wide band VCO. The VCO set-up voltage is controlled by a microprocessor that is factory programmed to provide a channel plan in accordance with the rules as specified in § 90.1213, for aggregation of multiple channels to achieve the required 10 MHz bandwidth for video applications, as shown below:



FC3HDX044D/ HDX-1100-C2
Channel Plan

Std Plan	CH CTRs	CH B/W	Aggregate 10 MHz Video CH	CH CTRs
Ch 1	4940.5	1	Ch 1	4945
Ch 2	4941.5	1		
Ch 3	4942.5	1		
Ch 4	4943.5	1		
Ch 5	4944.5	1		
Ch 6	4947.5	5		
Ch 7	4952.5	5	Ch 2	4955
Ch 8	4957.5	5		
Ch 9	4962.5	5	Ch 3	4965
Ch 10	4967.5	5		
Ch 11	4972.5	5	Ch 4	4975
Ch 12	4977.5	5		
Ch 13	4982.5	5	Ch 5	4985
Ch 14	4985.5	1		
Ch 15	4986.5	1		
Ch 16	4987.5	1		
Ch 17	4988.5	1		
Ch 18	4989.5	1		

Table 1 - HDX-1100C2 Channel plan center frequencies

Digital modulation of the COFDM carriers changes between QPSK, 16QAM, and 64QAM as determined by user bit rate requirements. The symbol rate is limited to maintain the occupied bandwidth to be in compliance with the ETSI EN 300 744 V1.51 standards for an 8 MHz COFDM pedestal, which fits well in the aggregate 10 MHz channel bandwidth provision of § 90.1213.

An LCD touch screen display located on the front panel of the transmitter is used to control basic transmission parameters and provide operational status of internal systems. The transmitter can also be operated from an external remote panel via hard wired RS-232 link.

Additional information may be found in the HDX-1100 User and Technical Manual, included with this application.

SECTION 2 - MEASUREMENTS

TECHNICAL DATA SUMMARY

Frequency band: Operating frequency range is 4940 – 4990 MHz

Modulation Type: COFDM; QPSK, 16QAM, 64QAM.

License for Public Safety under CFR 47 part 90, Subpart Y(§90.1201 thru §90.1217)

Channel spacing: 10MHz (see section 1.0 for details)

Maximum measured output power@ antenna port: + 30dBm (1.0 Watt)

FCC ID: FC3HDX044D

Equipment Description: Mobile Video Transmitter

Equipment model: HDX-1100C2

Frequency Tolerance: 0.0005 %

Emission Designator: 10M07WD

RF Power Output Measurement per 2.1046

Applicable specification: + 30 dBm maximum in a 10 MHz channel (§90.1215)

The channel plan in § 90.1213 consists of 1 and 5MHz channel assignments, however the rules allow channels to be aggregated for bandwidths of 5, 10, 15 or 20MHz. The RF power measured in 10 MHz aggregated channels, as required for this application, is shown below:

Frequency Range	Rated Transmit Power (W) Conducted	Frequency Tolerance	Emission Designator
4940 - 4990	+30 dBm (1.0W)	5PPM	10M0W7D

Table 2 – Power measurement

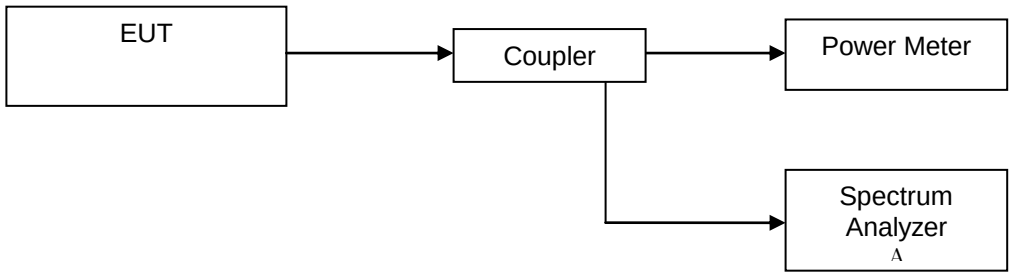


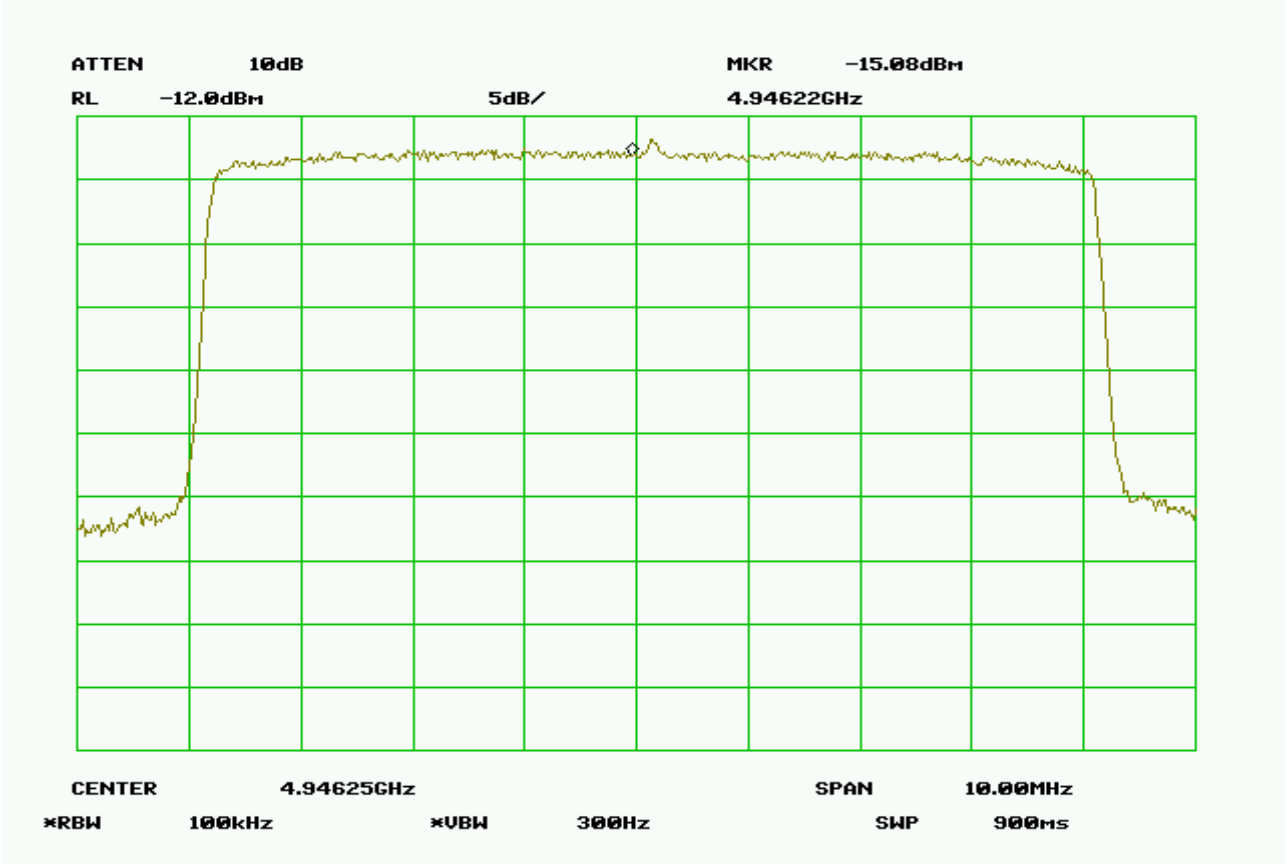
Figure 1 - Test Setup for Power Measurements

SECTION 2 A – MODULATION CHARACTERISTICS PER 2.1047

Applicable Specification: None

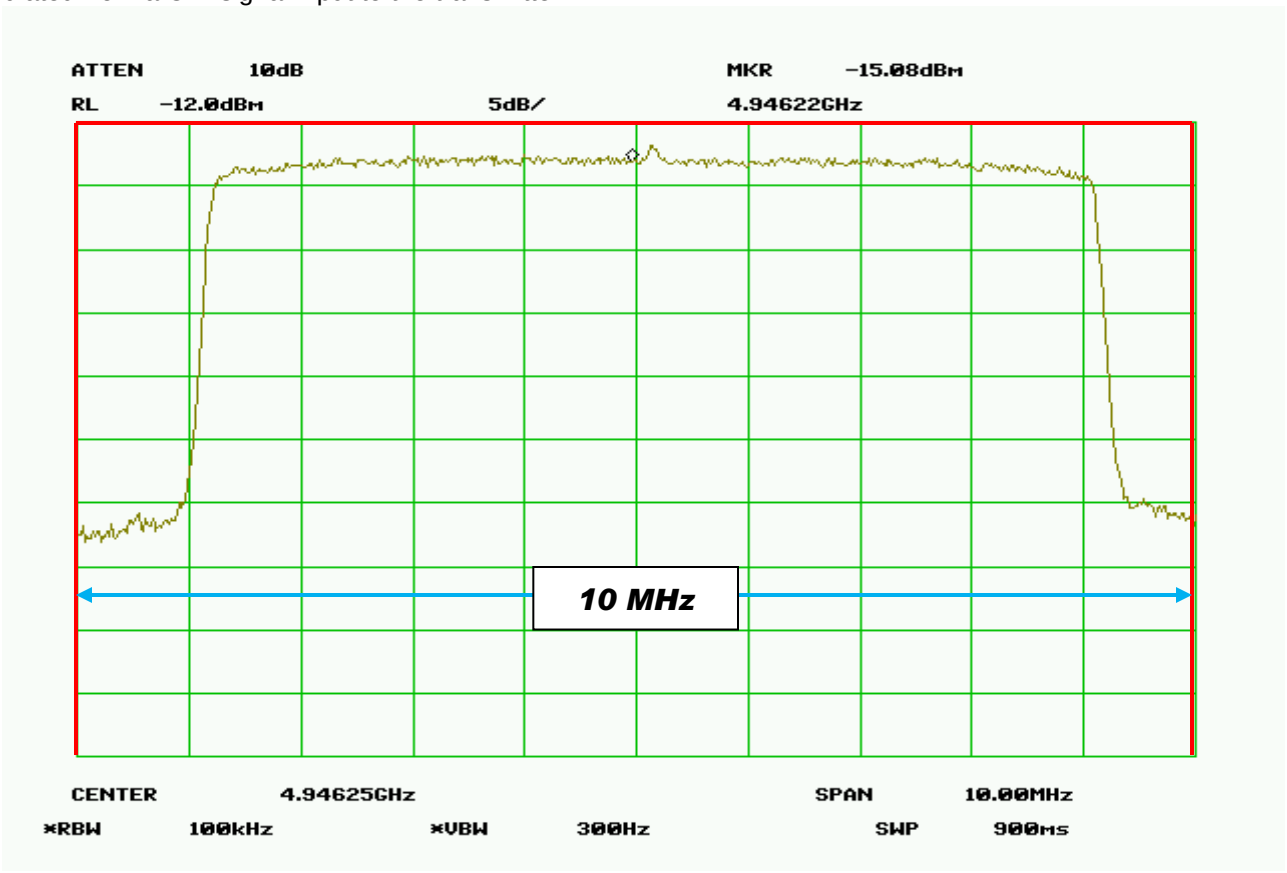
Measurement Frequency: 4945.26 MHz

Data: The unit under test is designed to be modulated by a combination of digital video, audio, and auxiliary data. The COFDM modulated spectrum shown in the image below shows compliance with the 8 MHz pedestal option in the DVB-T standard for the 2K carrier mode, per ETSI EN 300 744 V1.51. These carriers may be modulated in QPSK, 16QAM, or 64 QAM formats with no change in occupied bandwidth, as the symbol rate is fixed to maintain the same bandwidth.



SECTION 2B - OCCUPIED BANDWIDTH 2.1049

To measure the occupied bandwidth, the equipment was set up as shown below, and the transmitter was modulated with a digital COFDM pedestal of 7.61MHz (8MHz). The output of the transmitter was viewed on a spectrum analyzer. The current COFDM standard adopted by Vislink is the ETSI EN 300 744 V1.2.1 (2001-01) for framing structure, channel coding and modulation. Since the spectrum is digitally modulated, at the center frequency, calculations where performed by establishing a reference at Fo (4950.5MHz) and the amplitude readings where calculated from a CW signal input to the transmitter.



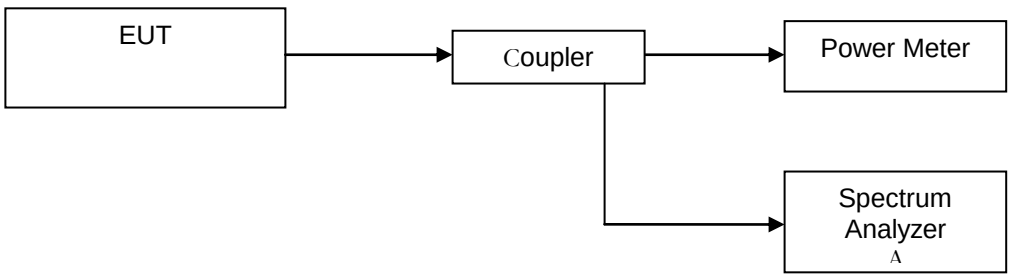


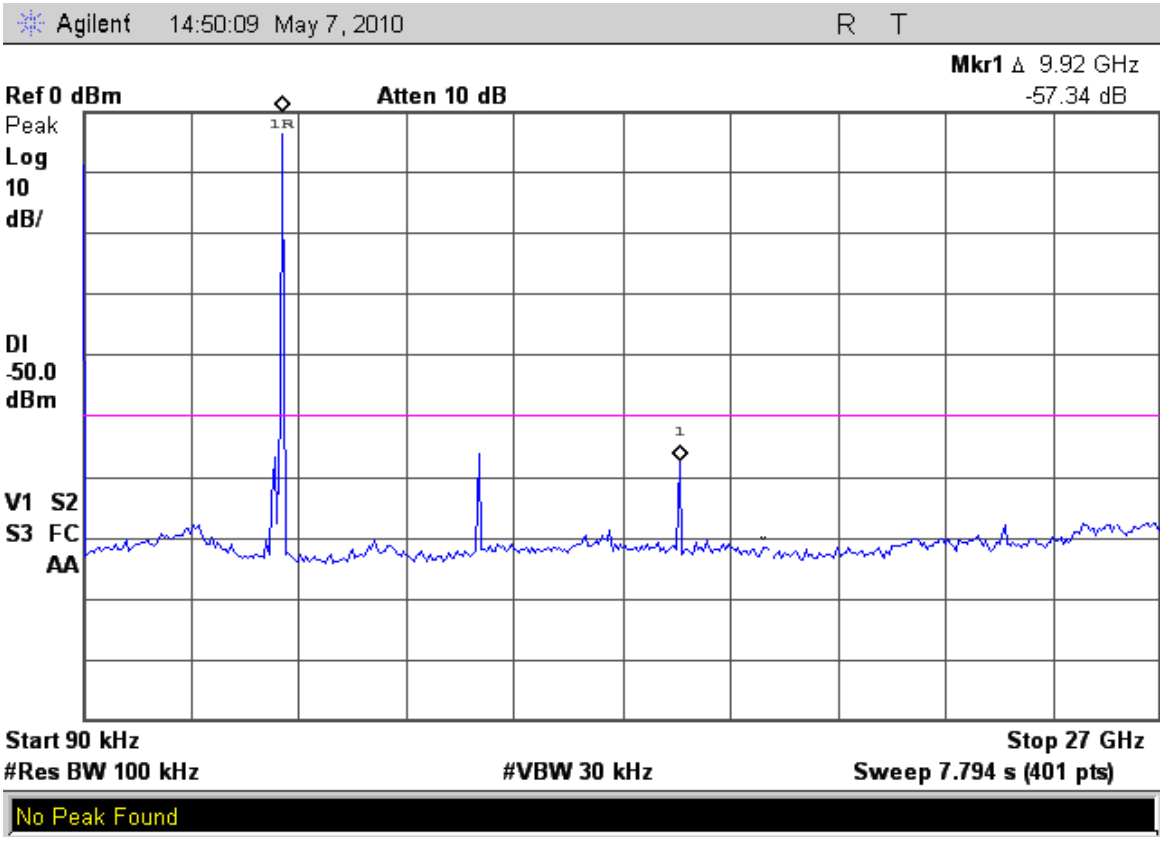
Figure 3 - Test Setup for Emission Mask, Occupied Bandwidth, and Spurious Emission Measurements

SECTION 2C SPURIOUS EMISSIONS AT THE ANTENNA TERMINAL: 2.1051

Applicable Specification: §90.210 (m)(6)

On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 50 dB or 55 + 10 log (P) dB, whichever is the lesser attenuation.

The Antenna conducted spurious emissions test were performed with the transmitter frequency set to 4971.250MHz, and with a measured output power of 930mW (+ 29.68 dBm). The spectrum analyzer was first tuned to a reference carrier level at the fundamental operating frequency. The output spectrum was then slowly scanned from 90KHz to 27GHz. Special attention was given to those frequencies that correspond to the possible harmonic and sub – harmonics.



HDX1100 (C2 Band) 10MHz Spurious Emission Plot CH 3 RF Power = 29.68 dBm /930mW
NOTE: Red line is 50 dB below unmodulated carrier output level.

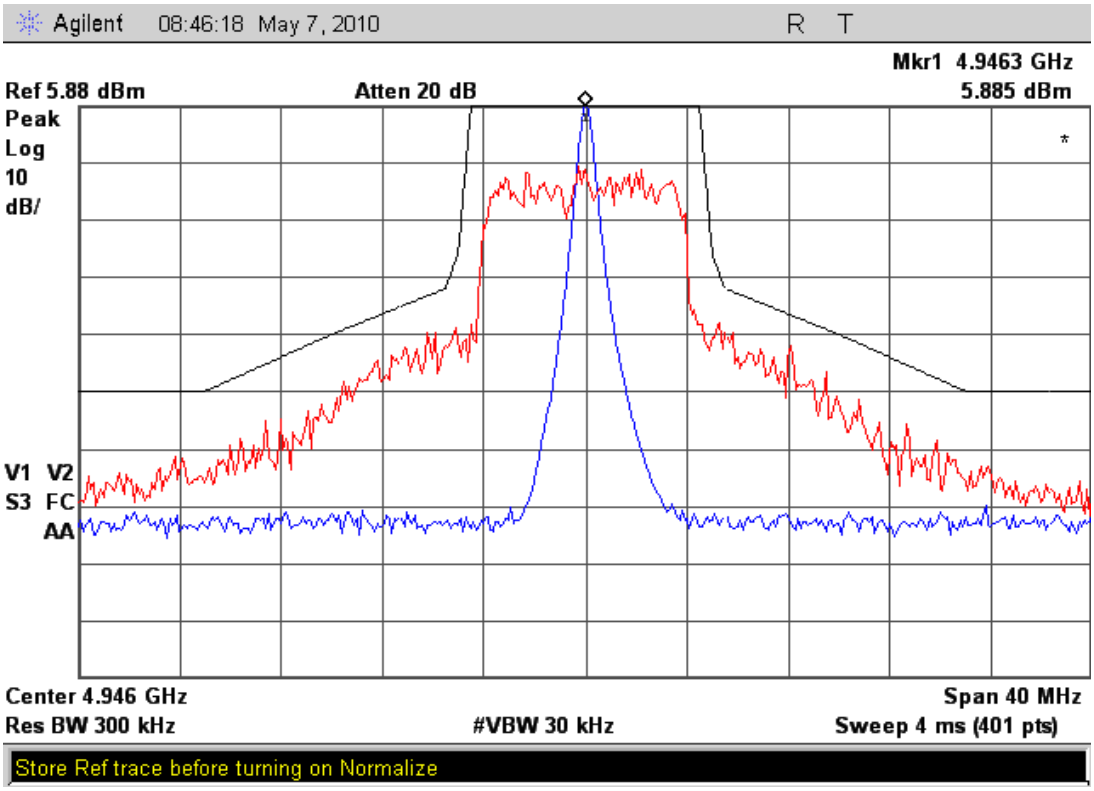
The FCC limits for Spurious emissions conducted at the antenna port per CFR 47 §2.1051 has been met.

SECTION 2D CONTINUED- EMISSION MASK PER 90.210(m)

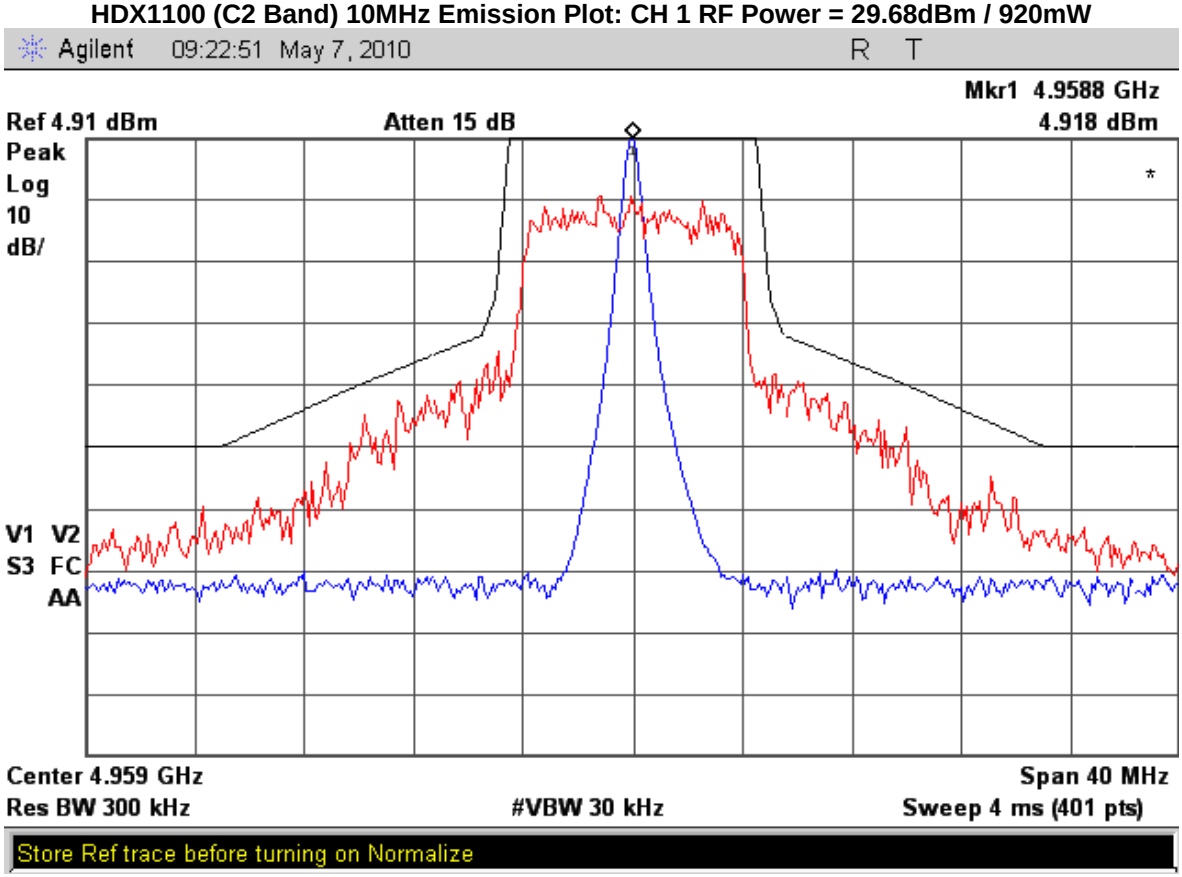
Applicable Specification: §90.210 (m)

Emission Mask M. For high power transmitters (greater than 20 dBm) operating in the 4940–4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

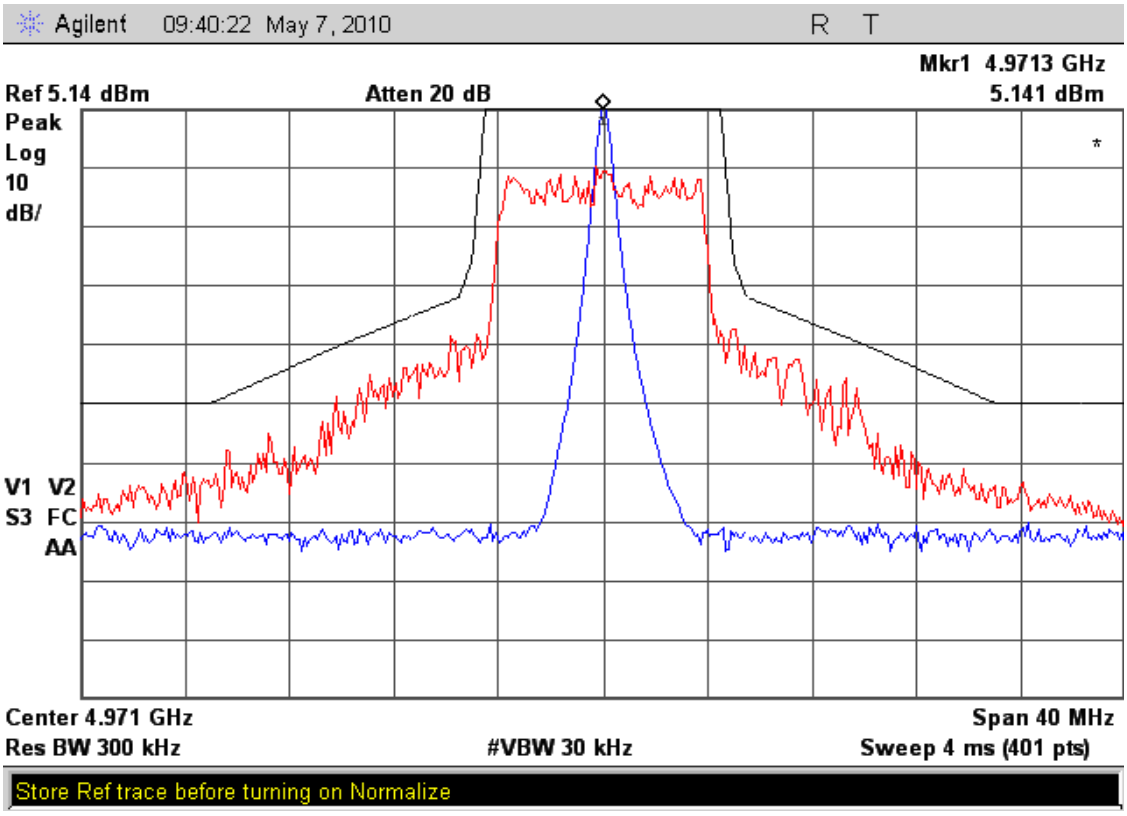
(1) On any frequency removed from the assigned frequency between 0–45% of the authorized bandwidth (BW): 0 dB.
(2) On any frequency removed from the assigned frequency between 45–50% of the authorized bandwidth: 568 log (% of (BW)/45) dB.
(3) On any frequency removed from the assigned frequency between 50–55% of the authorized bandwidth: 26 + 145 log (% of BW/50) dB.
(4) On any frequency removed from the assigned frequency between 55– 100% of the authorized bandwidth: 32 + 31 log (% of (BW)/55) dB.
(5) On any frequency removed from the assigned frequency between 100– 150% of the authorized bandwidth: 40 + 57 log (% of (BW)/100) dB.
(6) On any frequency removed from the assigned frequency between above 150% of the authorized bandwidth: 50 dB or 55 + 10 log (P) dB, whichever is
the lesser attenuation.
(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.



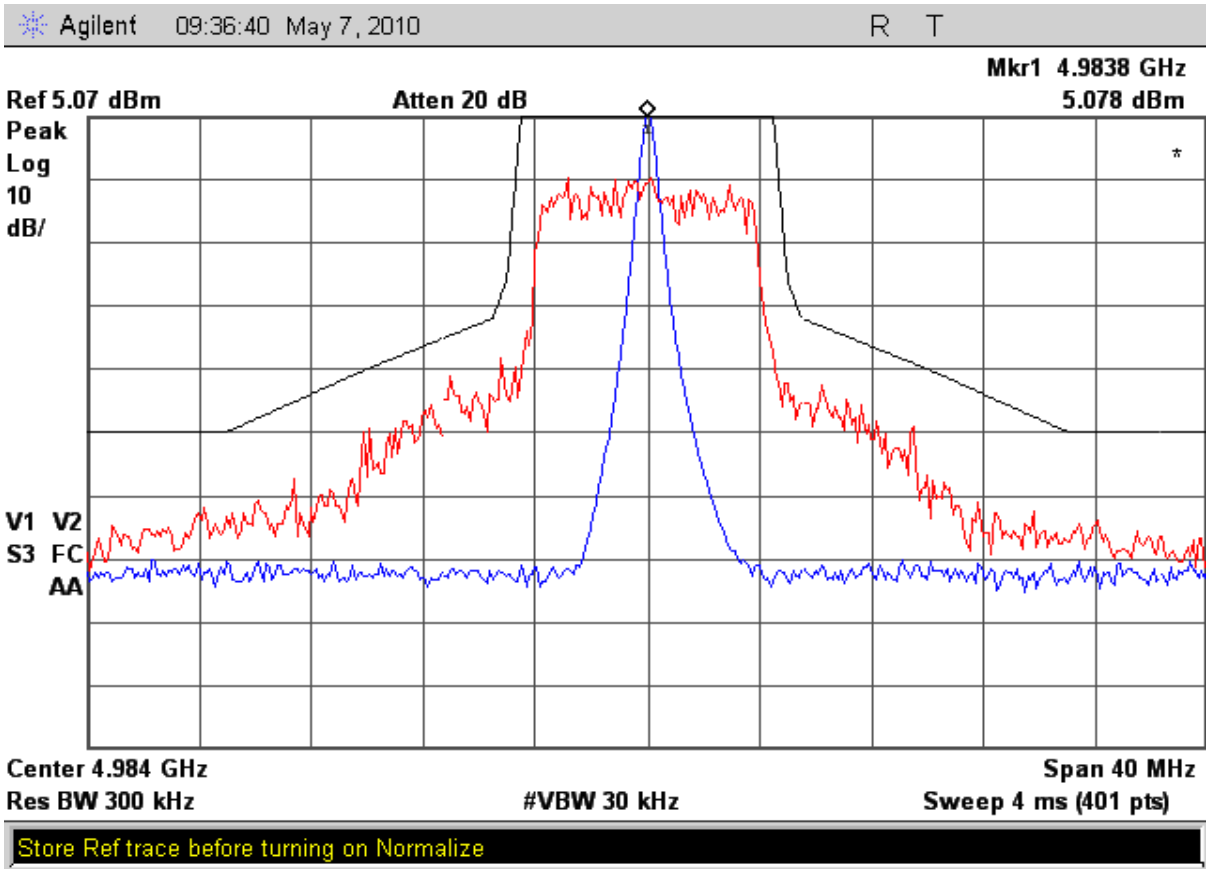
HDX1100 (C2 Band) 10MHz Emission Plot: CH 1 RF Power = 29.68dBm / 920mW



HDX1100 (C2 Band) 10MHz Emission Plot CH 2 RF Power = 29.5dBm / 890mW



HDX1100 (C2 Band) 10MHz Emission Plot CH 3 RF Power = 29.73dBm /930mW



HDX1100 (C2 Band) 10MHz Emission Plot CH 4 RF Power = 29.82dBm / 960mW

SECTION 2D - FIELD STRENGTH OF SPURIOUS RADIATION 2.1053

The case radiated spurious emission tests were conducted by Parker Chromerics. Please refer to section 2.0 of the attached report document, TR5629.10. This report represents spurious emissions observed and calculated to be acceptable according to rule part: 2.153 and FCC Part 15, subpart B.

SECTION 2E - FREQUENCY STABILITY OVER TEMPERATURE & VOLTAGE- 2.1055

The HDX1100 TRANSMITTER (FC3 HDX044D) was set-up to transmit CW signal. The measurement was made at the antenna port using a microwave frequency counter. Measurements were made to determine the transmitter frequency stability over the temperature range -20º C to +50 ºC. The transmitter was allowed to stabilize a minimum of 30 minutes before measurement.
Measurements were also made to determine transmitter frequency stability versus primary supply variation of the DC input voltage range of 18V to 36V.

- The Measurement Frequency was 4.971250GHz

Temperature	Measure Frequency (Hz)	Δ (PPM)	Δ (%)
-20º C	4971250400	0.08	0.000008
-10º C	4971250400	0.08	0.000008
0º C	4971250400	0.08	0.000008
+10º C	4971250500	0.10	0.000010
+20º C	4971250500	0.10	0.000010
+30º C	4971250500	0.10	0.000010
+40º C	4971250600	0.12	0.000012
+50º C	4971250600	0.12	0.000012

Voltage	Measure Frequency (Hz)	Δ (PPM)	Δ (%)
18	4971250400	0.08	0.000008
19	4971250400	0.08	0.000008
20	4971250400	0.08	0.000008
21	4971250500	0.10	0.000010
22	4971250500	0.10	0.000010
23	4971250500	0.10	0.000010
24	4971250500	0.10	0.000010
25	4971250500	0.10	0.000010
26	4971250500	0.10	0.000010
27	4971250500	0.10	0.000010
28	4971250500	0.10	0.000010
29	4971250500	0.10	0.000010
30	4971250500	0.10	0.000010
31	4971250500	0.10	0.000010
32	4971250500	0.10	0.000010
33	4971.250500	0.10	0.000010
34	4971250500	0.10	0.000010
35	4971250500	0.10	0.000010
36	4971250500	0.10	0.000010

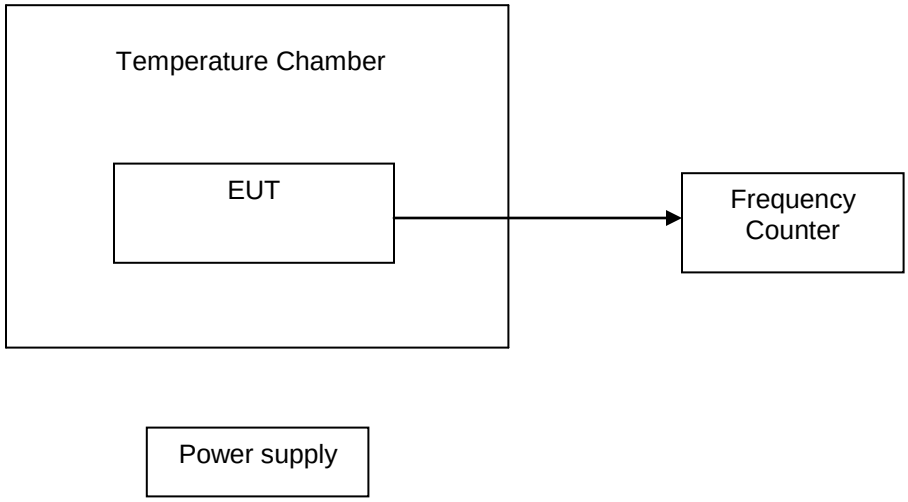


Figure 4 - Test Setup for Frequency Stability Measurements

QUALITY SYSTEM ISO 9000

Certificate of Registration

nqa global assurance

This is to certify that the Quality Management System of:

VISLINK – MRC
101 Billerica Avenue, Building #6
North Billerica, MA 01862

applicable to:

Design, manufacture, sale and service of microwave radio systems

has been assessed and approved by
National Quality Assurance, U.S.A., against the provisions of:

ISO 9001:2008

For and on behalf
of NQA, USA, Acton, MA 01720

ANAB ACCREDITED

Certificate Number: 10076
EAC Code: 19
First Issued: March 22, 1995
Valid Until: September 30, 2012
Reissued: September 30, 2009

This approval is subject to the company maintaining its system to the required standard, which will be monitored by NQA, USA, an accredited organization under the ANSI-ASQ National Accreditation Board.

SECTION 4 TRANSMITTER DESCRIPTION

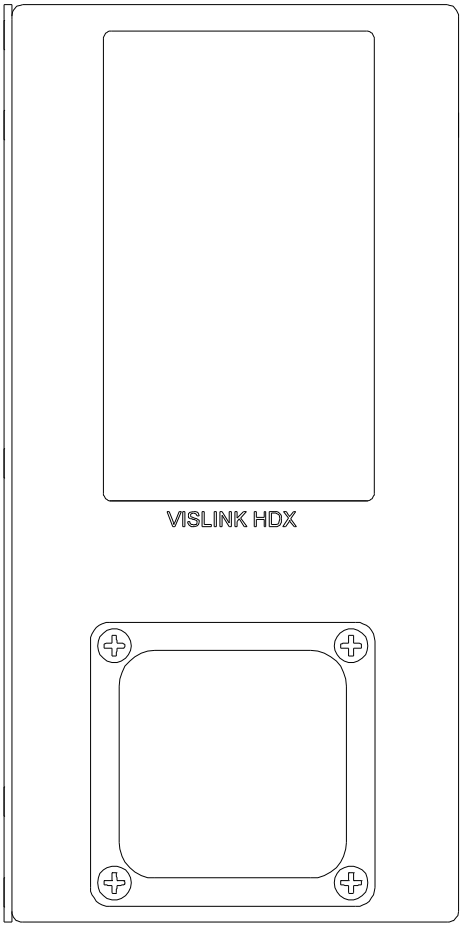
The Kamelyon™ HDX-1100 Mobile Digital Video Transmitter is a lightweight and rugged unit that is suited for mobile and aircraft environments; where constant vibration, shock, temperature swings, and humidity are expected. Common applications include live video feeds for law enforcement, fire, public safety and other agency surveillance tasks.

The HDX-1100 includes an H.264/MPEG-4 encoder to provide standard or high definition video (SD or HD), using DVB-T/ COFDM in the 2K carrier mode. Video inputs may be SD or HD in NTSC or PAL formats, plus two audio signals and an RS-232 data channel.

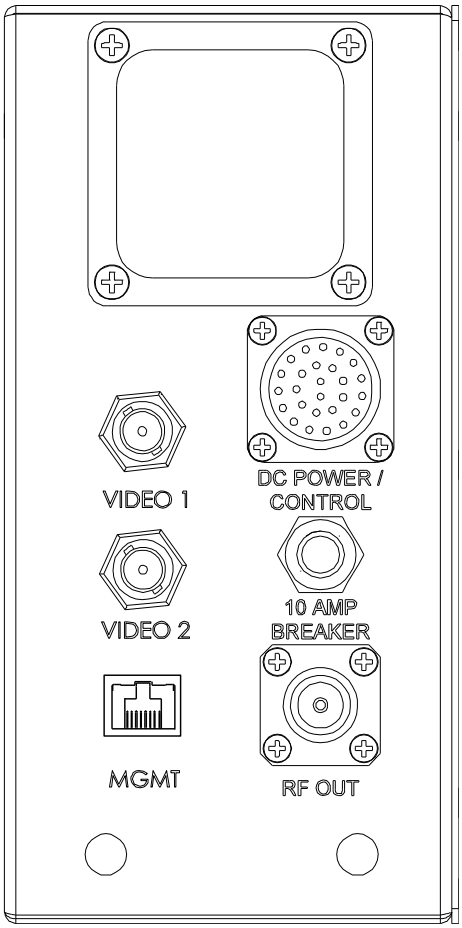
The amplifier operates at 1W in the high power mode, or 0.5W in the low power mode.

The HDX-1100 includes a touch screen maintenance interface or an optional remote panel (RCU). Service personnel may configure the transmitter module with a PC using a web browser.

Front View



Rear View



SECTION 4A TRANSMITTER BLOCK DIAGRAMS AND SCHEMATICS

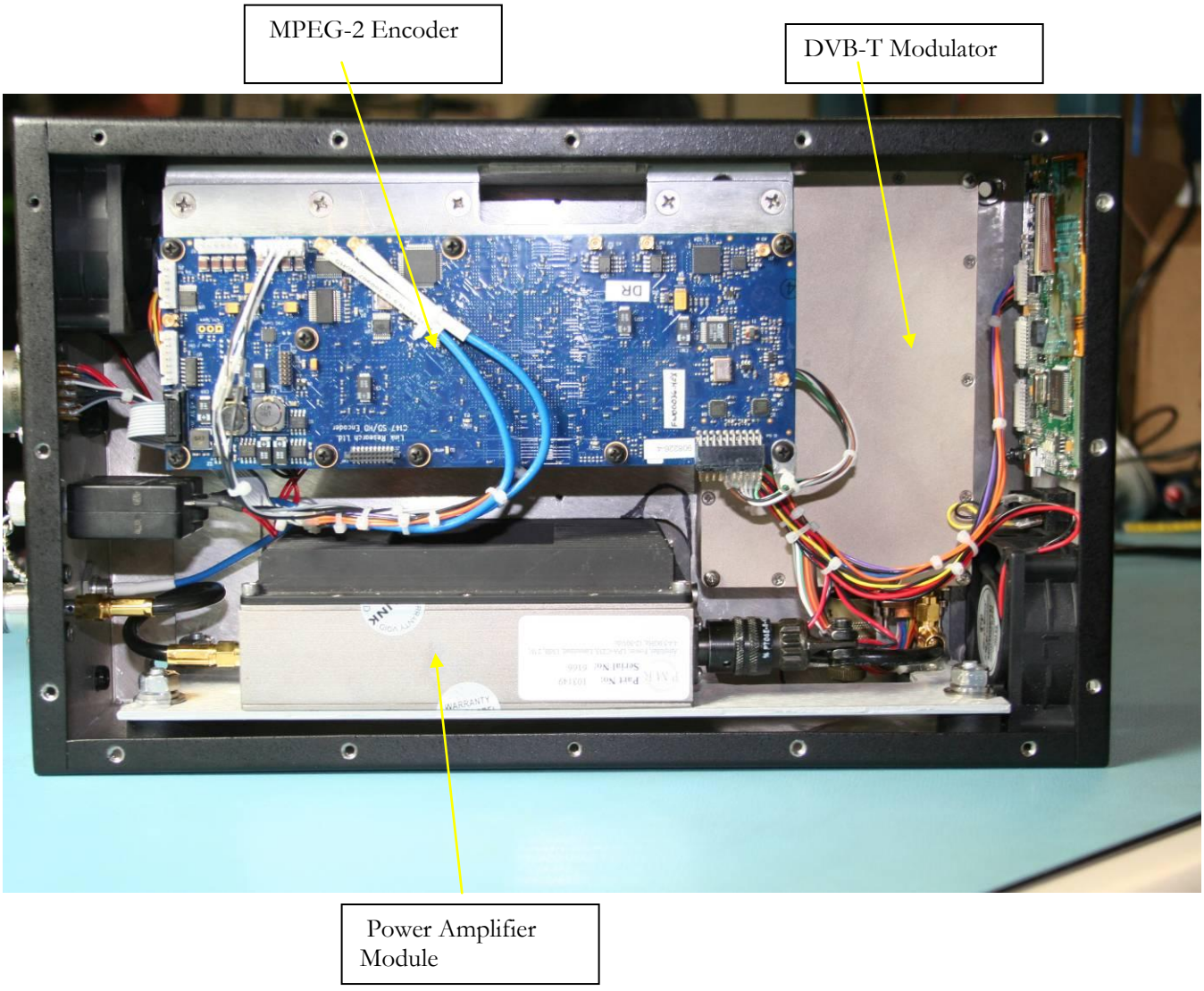
HDX1100 TX BOARD LEVEL SCHEMATICS

Note: The board level schematics have been submitted as an attachment and protected under a declaration of confidentiality

FC3 HDX044D
HDX1100 TRANSMITTER PHOTOS
MANUFACTURERS PART # 909310-1

FC3 HDX044D
FRONT PANEL VIEW

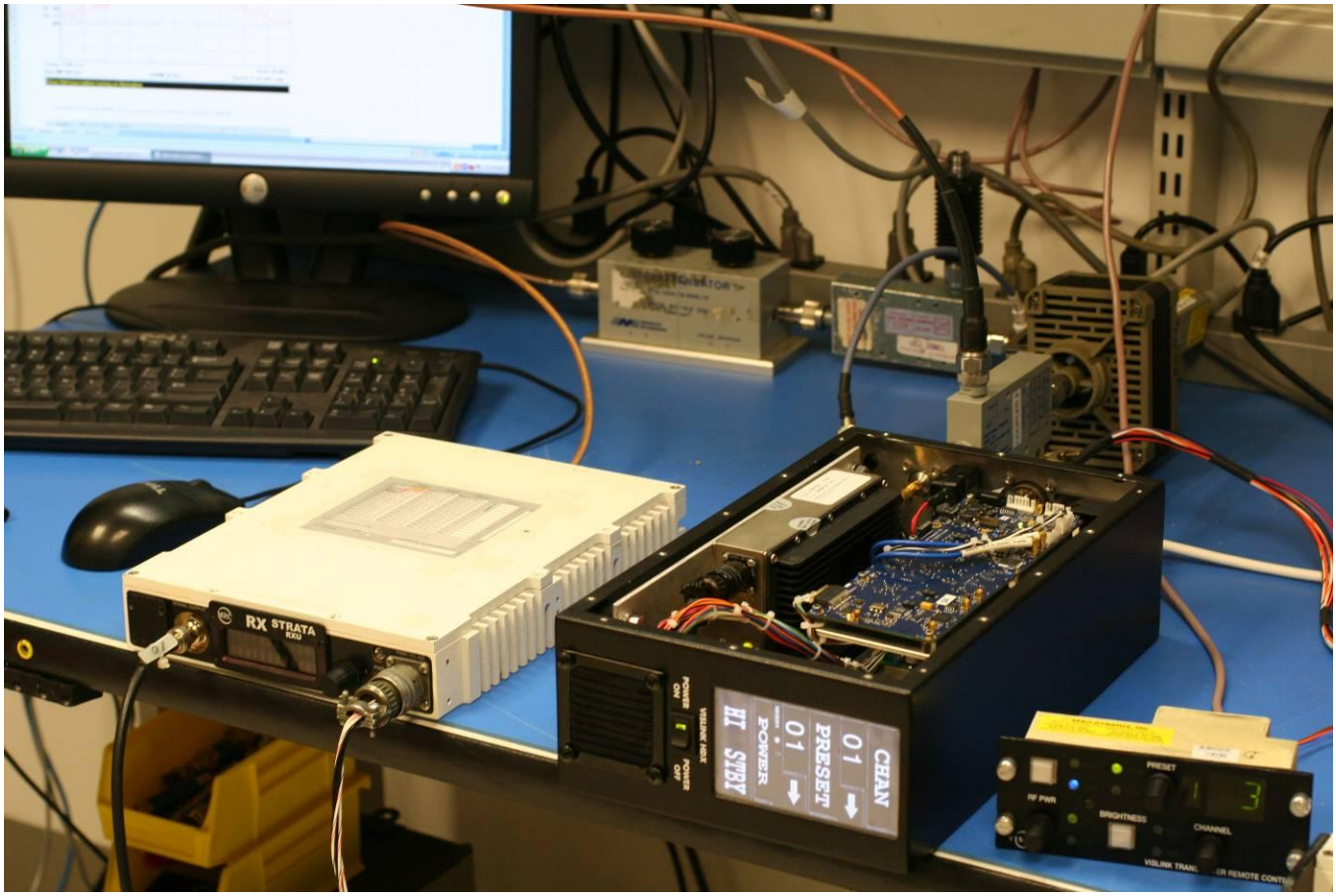
FC3 HDX044D
INTERNAL VIEW

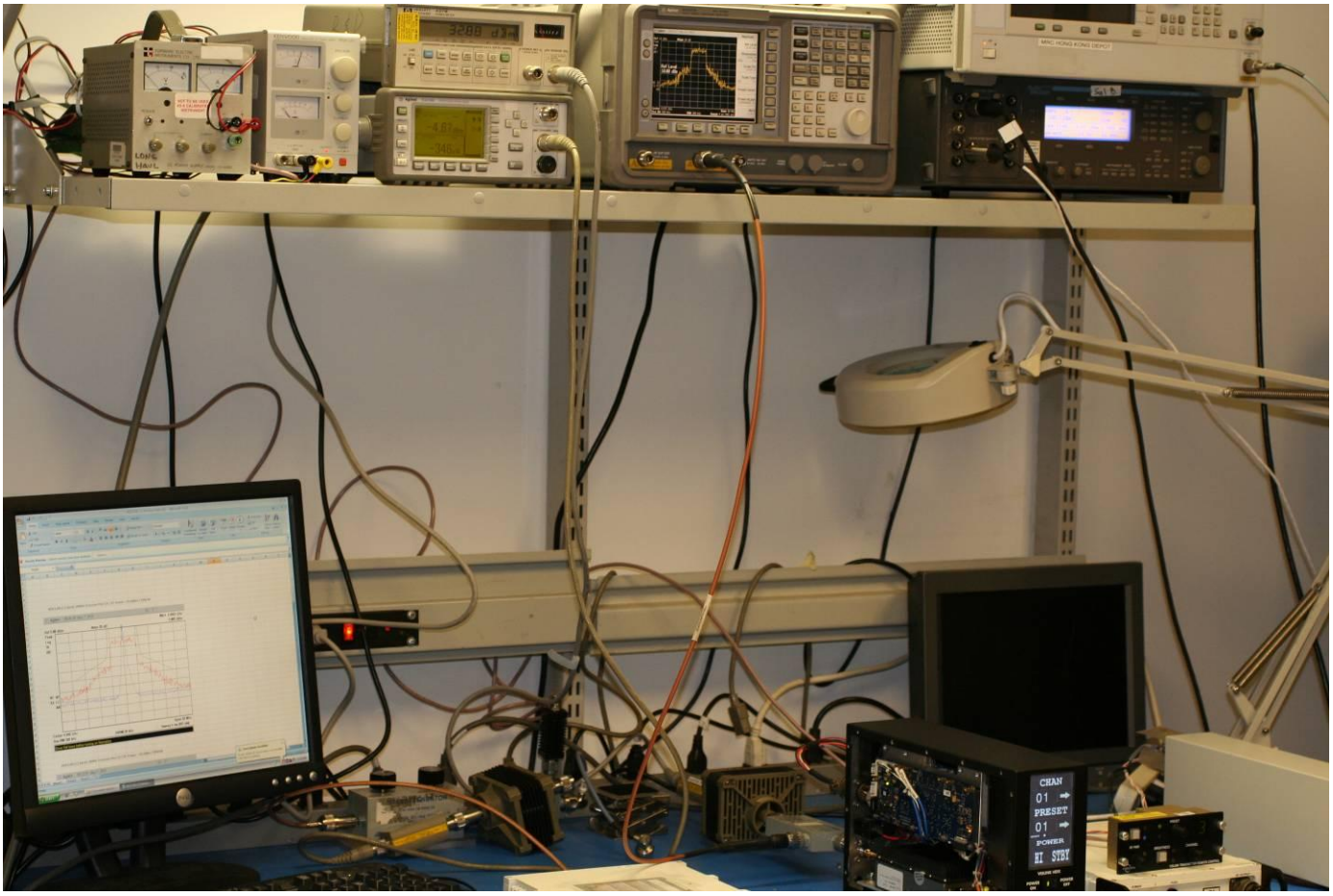


FC3 HDX044D
REAR VIEW

RF OUTPUT
CONNECTOR

SECTION 5 - TEST SET UP PHOTOS





TEST EQUIPMENT LIST

MODEL	SERIAL #	Due CAL DATE	DESCRIPTION	MANUFACTURER
FLK52	33624-65	6/16/11	THERMOMOTER	FLUKE
E4419B	MY45101749	9/21/11	POWER METER	HP
8481B	00389	7/5/11	POWER SENSSOR	HP
T30C	22779-06	N/A	TEMP. CHAMBER	TENNEY
FLK177	95210385	3/25/11	MULTIMETER	FLUKE
5350B	33625-269	1/9/11	FREQ. COUNTER	HP
E4407B	MY44210942	1-6/11	SPECTRUM ANALYZER	HP

Temperature chamber output power and frequency stability

6 Operating in Safety

Guidelines for safe operation are derived from OET bulletin 65, August 1997, as recommended by the Federal Communications Commission (FCC).

WARNING *High levels of RF power are present in the unit. Exposure to RF or microwave power can cause burns and may be harmful to health. Remove power from the unit before disconnecting any RF cables and before inspecting damaged cables and/or antennas. Avoid standing in front of high gain antennas (such as a dish antenna) and never look into the open end of a waveguide or cable where RF power may be present.*

The HDX-1000, operated without an antenna will not create RF energy exceeding 1.0 mW/cm^2, the FCC limit for exposure. Connecting an antenna to the unit greatly enhances the potential for harmful exposure, and you must maintain a certain distance from the radiator. The following table shows the Maximum Permissible Exposure (MPE) safe distances from the antenna.

Antenna Gain (dB1)	0	2	3	5	11
Safe Distance (cm)	4	6	6	8	15
Safe Distance (in)	1.57	2.36	2.36	3.15	5.9

Note Hazardous RF radiation limits and recommended distances may vary by country. Observe all applicable state and federal regulations when using this transmitter.

To perform calculations to understand the safe exposure margin (MPE), use the following formula suggested by OET 65. The calculations provided are for common antennas often used in the mobile microwave environment.

Calculating MPE

EIRP = P * (10 ^ (G / 10)) = (antilog of G/10) * P

P = RF power delivered to the antenna in mW
G = Power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna in centimeters
S = MPE in mW/cm² (milliwatts per square centimeters)

Conversions

dBi to numeric gain = Antilog (dBi/10)
Feet to centimeters = Feet * 30.48
Centimeters to Feet = cm * .0328
4 π = 12.57

User Input

RF power delivered to the antenna = Watts
Antenna gain (referenced to isotropic antenna) = dBi

Distance from the center of radiation = Feet

Calculation steps:

1. [P] RF power input. Watts to milliwatts = Watts * 1000
2. [G] Antenna gain dBi. Numeric gain = Antilog (dBi/10)
3. [EIRP] Multiply P * G
4. [R] Centimeters to feet = Centimeters * .0328
5. Square R
6. Multiply $R^2 * 4\pi$
7. [S] Divide ($R^2 * 4\pi$) into EIRP

   S = Power Density in milliwatts per square centimeters.

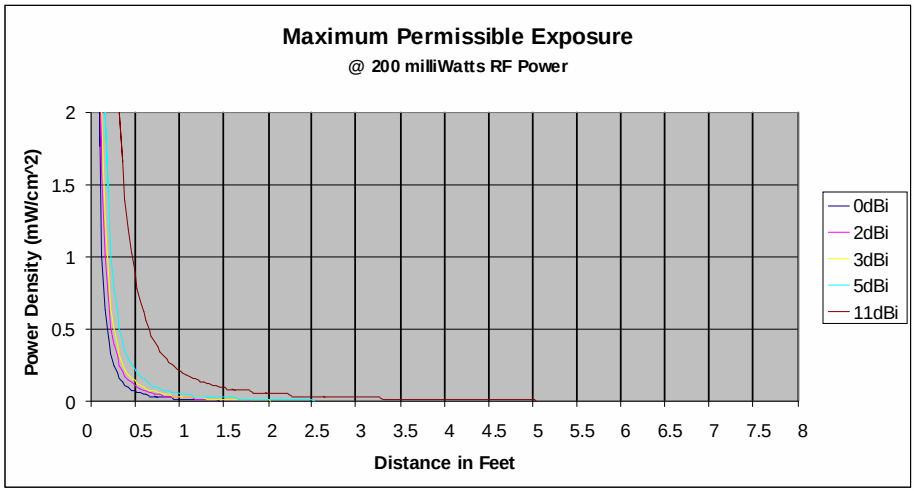
Note At frequencies above 1500 MHz, S must not be greater than 1.

Reference

FCC OET Bulletin 65, August 1997 - Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields

SECTION 7 RADIATION HAZARD WARNING

The figure to the right is a typical graph for a Vislink HDX-1000 Transmitter and shows the permissible exposure distance for various antennas. Graphs and data will vary, based on the actual transmitter, output power, frequency, and antenna utilized. One plot provides the permissible output of the transmitter for digital modulation, and the other plot for analog modulation.



Vislink, in accordance with the requirements set forth by the FCC, provides this information as a guide to the user and assumes the users of this equipment are licensed and qualified to operate the equipment per the guidelines and recommendations contained within the product user guides and in accordance with any FCC rules that may apply.

SECTION 7 TEST FACILITIES

TEST FACILITIES:

MICROWAVE RADIO COMMUNICATIONS 978-671-5700
101 Billerica Avenue
N. Billerica, MA. 01862

Parker Chomerics Test Services
77 Dragon Court 781-939-4158
Woburn, MA 01801

Prepared by:_____Sal Blatti
Manager

Authorized by:_____John Wood
Director

THE MANUFACTURER HEREBY DECLARES THAT IT WILL TAKE ALL MEASURES TO INSURE THE COMPLIANCE OF THE PRODUCT DETAILED IN THIS TECHNICAL FILE WITH THE FCC

_____
Sal Blatti
Compliance Manager

APPENDIX A - RADIO CHARACTERISTICS

RF SPECIFICATIONS

The RF specifications of the HDX1100 will be as follows:

RF OUTPUT

- Connector: Type N female
- Impedance: 50 Ohms
- Return loss: 17 dB minimum (output)
- Output stability: ± 1.0 dB, - 20^{o} to + 55^{o} C
- Harmonics: ≤ 60 dBc
- PA protection: Capable of operation into infinite VSWR, no time limit.
- Frequency Step Size: 250 KHz

RF power output in the US Part 90 band from 4940-4990 MHz will be limited in accordance with the table below:

Channel B/W	Max RF O/P dBm
1 MHz	+20
5 MHz	+27
10 MHz	+30
15 MHz	+31.8
20 MHz	+33

INPUT POWER

- DC Voltage: 11 - 32 VDC
- DC Current

  HDX-1100: 5.0 A max (120W)

- Protection: Reverse and overvoltage protection is provided.

NOTE: Additional details are in the User and Technical Manual, attached to this report.

APPENDIX B - FCC LABEL LOCATION

List of Attachments and Exhibits to this Application

Applicant:	Vislink, Inc.
FCC ID:	FC3HDX044D

1) Letter of Transmittal
2) Confidentiality Request pursuant to FCC § 0.457 and 0.459
3) Report TR5629.10 prepared by Parker Chromerics.
4) FC3HDX044D Test Report dated Nov 12, 2010 by Vislink