UltraTech
Group of Labs

31040/SIT

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Aug. 06, 2002

BIOSCRYPT INC.
5000 Van Nuys Blvd., Suite 300
Sherman Oaks, CA
USA, 91403

Attn.: **Mr. Curt Harkless**

Subject: **FCC Certification Application Testing under FCC PART 15, Subpart C - Unlicensed Low Power Transmitter operating in the frequency band 13.553-13.567 MHz.**

Product: **V-SMART**
Model No.: **V-SMART, A**
FCC ID: **QC4VSMARTAHICLAS**

Dear Mr. Harkless,

The product sample, as provided by you, has been tested and found to comply with **FCC PART 15, Subpart C - Unlicensed Low Power Transmitter operating in the frequency band 13.553-13.567 MHz.**

Enclosed you will find copies of the engineering report. If you have any queries, please do not hesitate to contact us.

Yours truly,

Tri Minh Luu, P. Eng.,
V.P., Engineering

Encl

ENGINEERING TEST REPORT

V-SMART
Model No.: VSMART, A, H

FCC ID: QC4VSMARTAHICLAS

Applicant: **BIOSCRYPT INC.**
5000 Van Nuys Blvd., Suite 300
Sherman Oaks, CA
USA, 91403

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)
PART 15, SUBPART C
Unlicensed Low Power Transmitter
operating in the band 13.553-13.567 MHz

UltraTech's File No.: MYT-026F15.225

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: Aug. 06, 2002	
Report Prepared by: Tri Luu Issued Date: Aug. 06, 2002	Tested by: Hung Trinh, RFI Technician Test Dates: July 31 & Aug. 01, 2002

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
	Test Report	• Exhibit 1: Submittal check lists • Exhibit 2: Introduction • Exhibit 3: Performance Assessment • Exhibit 4: EUT Operation and Configuration during Tests • Exhibit 5: Summary of test Results • Exhibit 6: Measurement Data • Exhibit 7: Measurement Uncertainty • Exhibit 8: Measurement Methods	OK
1	Test Setup Photos	Photos # 1 to 3	OK
2	External Photos of EUT	Photos # 1 to 2	OK
3	Internal Photos of EUT	Photos of 1 to 5	OK
4	Cover Letters	• Letter from Ultratech for Certification Request	OK
5	Attestation Statements	• Letter from the Applicant to appoint Ultratech to act as an agent • Letter from the Applicant to request for Confidentiality Filing	OK Submitted by Prox
6	ID Label/Location Info	• ID Label • Location of ID Label	OK OK
7	Block Diagrams	Block Diagrams	Submitted by Prox
8	Schematic Diagrams	Schematic Diagrams	Submitted by Prox
9	Parts List/Tune Up Info	Parts List/Tune Up Info	Submitted by Prox
10	Operational Description	Operational Description	Submitted by Prox
11	RF Exposure Info	N/A	N/A
12	Users Manual	Users Manual	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Part 15, Subpart C - Unlicensed Low Power Transmitter
Title	Telecommunication - Code of Federal Regulations, CFR 47, Part 15, Subpart C
Purpose of Test:	This report is covered test results for Certification compliance with FCC regulations for Unlicensed Low Power Transmitter operating in the 13.553-13.567 MHz band.
Test Procedures	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - 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.
Environmental Classification:	• Light-industry, Commercial • Industry

2.2. RELATED SUBMITAL(S)/GRANT(S)

None

2.3. NORMATIVE REFERENCES

Publication	YEAR	Title
FCC CFR Parts 0-19	2001	Code of Federal Regulations – Telecommunication
ANSI C63.4	1992	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
CISPR 22 & EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1		Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT:	
Name:	BIOSCRYPT INC.
Address:	5000 Van Nuys Blvd., Suite 300 Sherman Oaks, CA USA, 91403
Contact Person:	Mr. Curt Harkless Phone #: 818-501-3908 (x13) Fax #: 818-561-0843 Email Address: curt.harkless@bioscrypt.com

MANUFACTURER:	
Name:	Knight Wah Technology Ltd.
Address:	16-19, 3/F, Tower B, Regent Centre 63-73 Wo Yi Hop Road Kwai Chung, NT Hong Kong
Contact Person:	Phone #: 852-2619-0162 Fax #: 852-2619-0132

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name	BIOSCRYPT INC.
Product Name	V-SMART
Model Name or Number	VSMART, A, H
Serial Number	Preproduction
Type of Equipment	Unlicensed Low Power Transmitter
Input Power Supply Type	External DC Sources

3.3. DESCRIPTION OF V-SMART, A, H OPERATION

V-Smart is accessory to an access control systems. It consists of two major functional parts:
Bioscrypt Inc.'s proprietary fingerprint-based biometric engine
HID iClass model R10, contactless smart card reader, and a micro controller that implements I/F between card reader and biometric engine.

3.3.1. Overall Operation

The characteristics of user's fingerprint, together with the data relevant for the access control ('template') are stored on the smart card. When user presents the smart card to the system, smart card reader reads the template and sends it to the biometric engine. Biometric engine enters verification mode, during which user is expected to present his finger to the fingerprint reader. Biometric engine then performs comparison between the received template, and features of acquired fingerprint image. The outcome of the verification is provided in audio/visual form to the user. In case of positive verification, biometric engine releases access control data to the access control panel.
V-Smart implements so called 'portable token' operation that enables each user to carry his own template. Therefore, templates are not stored in the system, and lost/stolen card is useless without owner's live finger presentation.
V-Smart is powered by 12 VDC (nominal), from the host system (battery).

3.3.2. Biometric Engine

The biometric engine is built around high-end 32-bit floating-point DSP, and semiconductor fingerprint reader. It has reach communication I/F that enables integration in almost all known types of access control systems (RS-232, RS-485, Wiegand).
It also has one service port (RS-232). The biometric engine is in standard EMI-coated enclosure, and is connected to power source, access control system, and smart card portion of V-Smart using pigtail cable.

3.3.3. HID iClass Model R10

The smart card reader implements ASK1/4 BIT CODING @ ISO 15963 standard for RF communication with smart cards. It implements RS-232 I/F between host system and contactless smart card reader. Typical operating distance is 25mm.

The HID iClass Model R10 is in separate enclosure together with interfacing micro controller, and is connected to biometric engine through pigtail cable.
Technical data:

Power Supply	8-12 VDC
Serial I/F baud rate	9.6 kbps to 57.6 kbps in I/F. No data for RF
Modulation	ASK1/4 BIT CODING @ ISO 15963

3.4. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	▪ Base station (fixed use) - Wall mounted
Intended Operating Environment:	▪ Commercial, light industry & heavy industry
ower Supply Requirement:	8 - 12 Vdc
RF Output Power Rating:	66.6 dBuV/m at 3 meters or 0.214 mV/m at 30 meters
Operating Frequency Range:	13.553-13.567 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	1
Duty Cycle:	100%
26 dB Bandwidth:	4.12 kHz
Modulation Type:	ASK1/4 BIT CODING @ ISO 15963
Data Rate:	9.6 kbps to 57.6 kbps in I/F. No data for RF
Emission Designation:	Low power transmitter
Oscillator Frequencies:	25 MHz, 14.7 MHz, 16 MHz and 7.37 MHz
Antenna Connector Type:	• Integral, permanently attached and located inside the enclosure.
Antenna Description:	Internal, integral PCB Loop Antenna

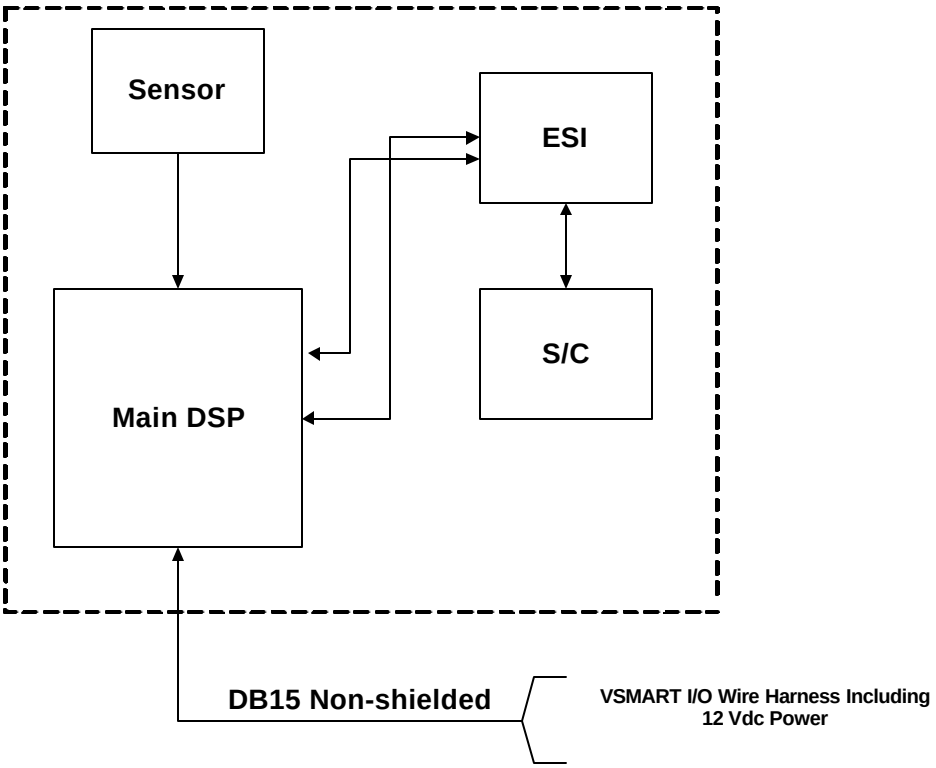
3.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Multi-purpose I/O and DC Power Port	1	DB15	Non-shielded - wiring harness (6" long)

3.6. ANCILLARY EQUIPMENT

None

3.7. BLOCK DIAGRAM OF TEST SETUP



DUT INTEGRATED ASSEMBLY

EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	8 - 12 Vdc

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The transmitter radiate 13.56 MHz continuously during testing
Special Test Software:	None
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as an integral antenna equipment.

EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

  The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: Aug. 08, 2001.

5.2. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

5.3. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	COMPLIANCE (YES/NO)
15.203 & 15.204	The transmitter shall use a transmitting antenna that is an integral part of the device	Yes
	Power Limits & 26 dB Bandwidth	Yes
15.225(a) & (b)	Field Strength of Emissions inside and outside the permitted band 13.553-13.567 MHz	Yes
15.225(c)	Frequency Stability	Yes
15.107 & 15.207	Class B - AC Power Conducted Emissions on Tx, Rx and standby modes	Not applicable for DC supply
15.109(b)	Class A - Radiated Emissions from Unintentional Radiators	Yes. A separate test report will be provided upon request.

EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report and ANSI C63-4:1992

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C64-3:1992, FCC 15.407 and CISPR 16-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER:

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

6.5. COMPLIANCE WITH FCC PART 15 – GENERAL TECHNICAL REQUIREMENTS

FCC Section	FCC Rules	
15.203	Described how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where EUT must be professionally installed. In order to demonstrate that professional installation is required, the following 3 points must be addressed: • The application (or intended use) of the EUT • The installation requirements of the EUT • The method by which the EUT will be marketed	Conforms. Integral, permanently attached and located inside the enclosure
15.204	Provided the information for every antenna proposed for use with the EUT: (a) type (e.g. Yagi, patch, grid, dish, etc…), (b) manufacturer and model number (c) gain with reference to an isotropic radiator	N/A

6.6. 26 DB BANDWIDTH @ FCC 15.407(A)

6.6.1. Limits

N/A. The 26 dB bandwidth shall be less than 14 kHz.

6.6.2. Method of Measurements

Refer to Exhibit 8, Sec. 8.3 of this test report.

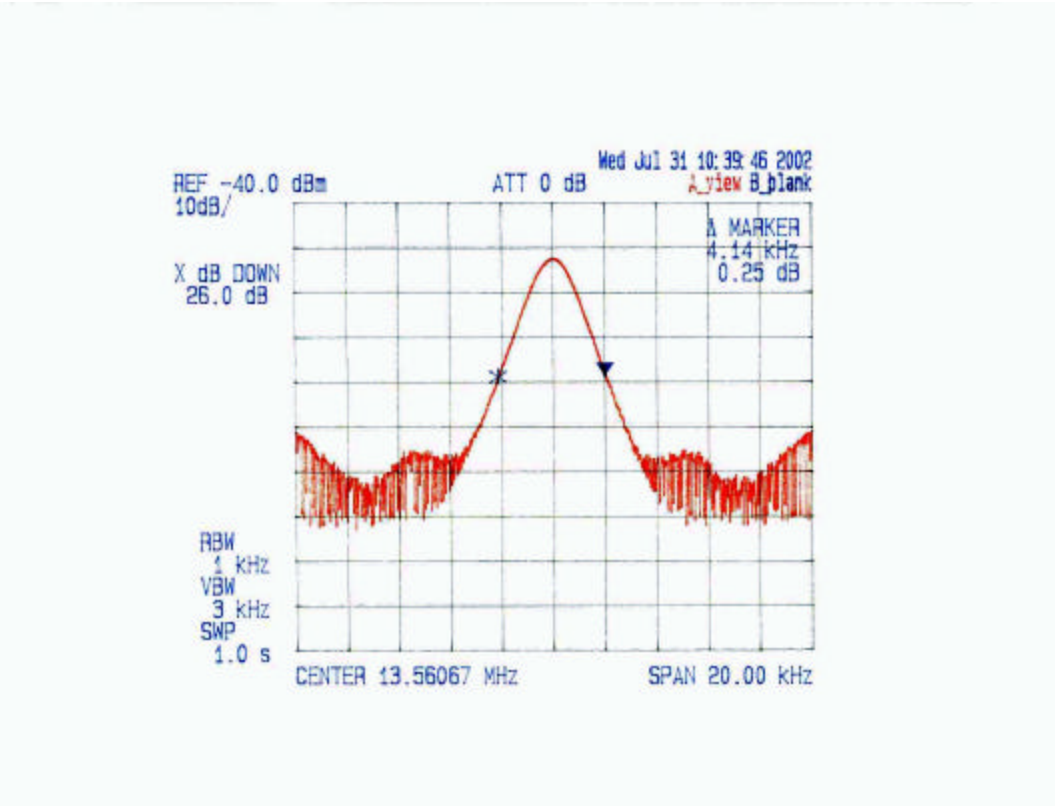
6.6.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8546A	…	9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors.
Biconilog Antenna	EMCO	3142	10005	30 MHz to 2 GHz

6.6.4. Test Data

CHANNEL FREQUENCY (MHz)	26 dB BANDWIDTH (kHz)
13.56	4.12

6.6.5. Plots of Measurements



6.7. FIELD STRENGTH OF EMISSIONS INSIDE & OUTSIDE THE PERMITTED BAND 13.553-13.567 MHZ @ 3 METERS, FCC 15.225(A) & (B)

6.7.1. Limits

(a) The field strength of any emissions within this band shall not exceed 10,000 microvolts/meter at 30 meters.
(b) The field strength of any emissions appearing outside of this band shall not exceed the general radiated emission limits shown in Sec. 15.209.

Remarks:

FCC CFR 47, Part 15, Subpart C, Para. 15.205(a) - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 – 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 – 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 – 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 – 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 – 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 – 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 – 156.9	2200 - 2300	9000 - 9200	

FCC CFR 47, Part 15, Subpart C, Para. 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

FREQUENCY (MHz)	FIELD STRENGTH LIMITS (microvolts/m)	DISTANCE (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

6.7.2. Method of Measurements

Refer to Exhibit 8, Sec. 8.2 of this test report and **ANSI 63.4-1992, Para. 8** for detailed radiated emissions measurement procedures.

Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. the maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and highpass filter are used for this measurement.

- For measurements from 9 KHz to 150 KHz, set RBW = 200 Hz, VBW ≥ RBW, SWEEP=AUTO.
- For measurements from 150 KHz to 30 MHz, set RBW = 10 KHz, VBW ≥ RBW, SWEEP=AUTO.
- For measurements from 30 MHz to 1 GHz, set RBW = 100 KHz, VBW ≥ RBW, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz, SWEEP=AUTO.

If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Peak Power Meter & Peak Power Sensor	Hewlett Packard	8900 8481A	2131A00124 2551A01965	0.1-18 GHz 50 Ohms Input
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Active Loop Antenna	EMCO	6507	8906-1167	1 kHz – 30 MHz
Log Periodic/Bow-Tie Antenna	EMCO	3143	1029	20 - 1000 MHz

6.7.4. Photographs of Test Setup

Refer to photos # 1 and 3 in Annex 1 for photos of test setup

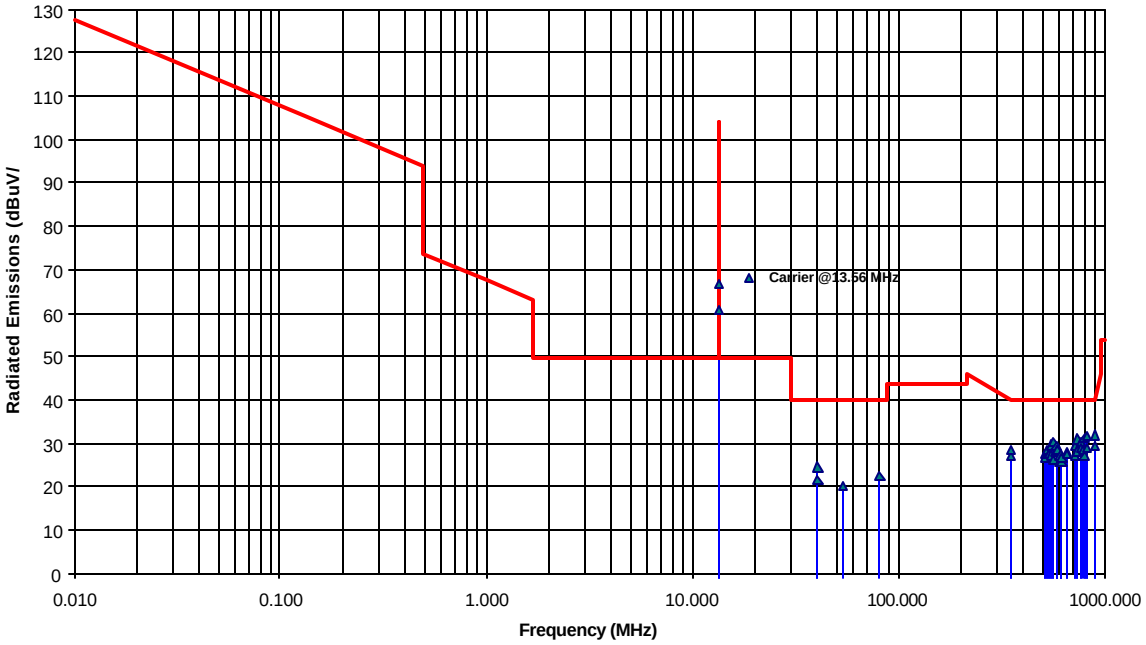
6.7.5. Test Data

FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209&19.225 (dBuV/m)	LIMIT MARGIN (dB)	PASS/ FAIL	Distance (m)
13.560	66.6	0 degree	103.8	37.2	PASS	3
13.560	60.7	90 degrees	103.8	43.1	PASS	3
40.68	24.6	V	40.0	15.4	PASS	3
40.68	21.5	H	40.0	18.5	PASS	3
54.24	20.2	V	40.0	19.8	PASS	3
81.36	22.6	V	40.0	17.4	PASS	3
352.56	27.1	V	40.0	12.9	PASS	3
352.56	28.6	H	40.0	11.4	PASS	3
515.30	26.8	V	40.0	13.2	PASS	3
515.30	27.6	H	40.0	12.4	PASS	3
528.86	27.9	V	40.0	12.1	PASS	3
528.86	28.5	H	40.0	11.5	PASS	3
542.42	27.5	V	40.0	12.5	PASS	3
542.42	27.5	H	40.0	12.5	PASS	3
555.97	27.4	V	40.0	12.6	PASS	3
555.97	29.6	H	40.0	10.4	PASS	3
569.53	26.2	V	40.0	13.8	PASS	3
569.53	30.2	H	40.0	9.8	PASS	3
583.90	28.2	V	40.0	11.8	PASS	3
583.90	29.5	H	40.0	10.5	PASS	3
596.66	28.2	V	40.0	11.8	PASS	3
596.66	28.5	H	40.0	11.5	PASS	3
610.23	25.9	V	40.0	14.1	PASS	3
610.23	27.4	H	40.0	12.6	PASS	3
623.79	25.7	V	40.0	14.3	PASS	3
623.79	26.7	H	40.0	13.3	PASS	3
664.46	28.1	V	40.0	11.9	PASS	3
664.46	27.7	H	40.0	12.3	PASS	3
718.70	29.5	V	40.0	10.5	PASS	3
718.70	27.4	H	40.0	12.6	PASS	3
745.82	31.0	V	40.0	9.0	PASS	3
745.82	28.3	H	40.0	11.7	PASS	3
772.94	30.4	V	40.0	9.6	PASS	3
772.94	28.9	H	40.0	11.1	PASS	3

FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209&19.225 (dBuV/m)	LIMIT MARGIN (dB)	PASS/ FAIL	Distance (m)
786.49	28.6	V	40.0	11.4	PASS	3
800.05	31.1	V	40.0	8.9	PASS	3
800.05	27.2	H	40.0	12.8	PASS	3
827.18	31.8	V	40.0	8.2	PASS	3
827.18	28.9	H	40.0	11.1	PASS	3
908.55	32.0	V	40.0	8.0	PASS	3
908.55	29.4	H	40.0	10.6	PASS	3

- The radiated emissions were scanned from 10 kHz to 1000 MHz, and all emission less than 20 dB below the Limit were recorded.

Transmitter Radiated Emissions Measurements at OFTS @ 3 Meters
Bioscrypt Modle no.: V-Smart A, H
TRANSMIT Freq.: 13.5 6MHz



All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

31040/SIT C-1376 46390-2049 200093-0 00-034

6.8. FREQUENCY STABILITY @ FCC §15.225(C)

6.8.1. Limits

The frequency tolerance of the carrier signal shall be maintained within <plus-minus>0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery

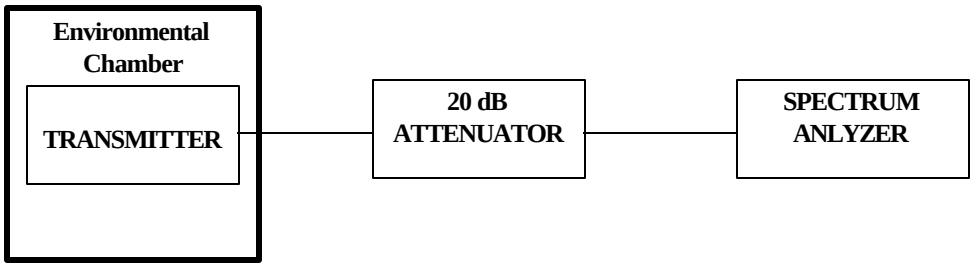
6.8.2. Method of Measurements

Refer to FCC § 2.1055 and Exhibit 8, Section 8.4 of this report for detailed test procedures.

6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Attenuator(s)	Bird	..	…	DC – 22 GHz
Temperature & Humidity Chamber	Tenney	T5	9723B	-40° to +60 ° C range

6.8.4. Test Arrangement



6.8.5. Test Data

Frequency Band:	13.553 - 13.567 MHz
Center Frequency:	13.56 MHz
Full Power Level:	66.6 dBuV/m at 3 meters
Frequency Tolerance Limit:	± 0.01% or 1356 Hz
Max. Frequency Tolerance Measured:	100 Hz or 0.00064%
Input Voltage Rating:	8 - 12 Vdc

Ambient Temperature (°C)	**Center Frequency & RF Power Output Variation**		
	Supply Voltage (Nominal) 12 Vdc	**Supply Voltage (85 % of lowest rating) 6.8 Vdc**	**Supply Voltage (115% of highest rating) 13.8 Vdc**
	Hz	**Hz**	**Hz**
-20	+100	N/A	N/A
+20	0	0	0
+50	-50	N/A	N/A

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

7.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k=2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 8. MEASUREMENT METHODS

8.1. GENERAL TEST CONDITIONS

The following test conditions shall be applied throughout the tests covered in this report.

8.1.1. Normal temperature and humidity

- Normal temperature: +15°C to +35°C
- Relative Humidity: +20% to 75%

The actual values during tests shall be recorded in the test report.

8.1.2. Normal power source

8.1.2.1. Mains Voltage

The nominal test voltage of the equipment to be connected to mains shall be the nominal mains voltage which is the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of test power source corresponding to the AC mains shall be between 59 Hz and 61 Hz.

8.1.2.2. Battery Power Source.

For operation from battery power sources, the nominal test voltage shall be as declared by the equipment manufacturer. This shall be recorded in the test report.

8.1.3. Operating Condition of Equipment under Test

- All tests were carried out while the equipment operated at the following frequencies:
  - The lowest operating frequency,
  - The middle operating frequency and
  - The highest operating frequency

- Modulation were applied using the Test Data sequence
- The transmitter was operated at the highest output power, or in the case the equipment able to operate at more than one power level, at the lowest and highest output powers

8.2. SPURIOUS EMISSIONS

For both conducted and radiated measurements, the spurious emissions were scanned from the lowest frequency generated by the EUT or 10 MHz whichever is lower to 10th harmonic of the highest frequency generated by the EUT.

- The radiated emission measurements were performed at the UltraTech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of OFTS have been filed to FCC, Industry Canada, ACA/Austel, NVLap and ITI.
- Radiated emissions measurements were made using the following test instruments:

1. Calibrated EMCO BiconiLog antenna in the frequency range from 30 MHz to 2000 MHz.
2. Calibrated Emco Horn antennas in the frequency range above 1000 MHz (1GHz - 40 GHz).
3. The test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

   - RBW = 100 kHz for f < 1GHz and RBW = 1 MHz for f ≥ 1 GHz
   - VBW = RBW
   - Sweep = auto
   - Detector function = peak
   - Trace = max hold
   - Follows the guidelines in ANSI C63.4-1992 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc.. A pre-amp and highpass filter are required for this test, in order to provide the measuring system with sufficient sensitivity.
   - Allow the trace to stabilize.
   - The peak reading of the emission, after being corrected by the antenna correction factor, cable loss, pre-amp gain, etc…. is the peak field strength which comply with the limit specified in Section 15.35(b)

   Calculation of Field Strength:

   The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength
RA = Receiver/Analyzer Reading
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

Example: If a receiver reading of 60.0 dBuV is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:
Field Level = 60 + 7.0 + 1.0 - 30 = 38.0 dBuV/m.

Field Level = $10^{(38/20)}$ = 79.43 uV/m.

- Submit this test data
- Now set the VBW to 10Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100ms, then the reading obtained may be further adjusted by a "duty cycle correction factor", derived from 10log(dwell time/100mS) in an effort to demonstrate compliance with the 15.209.
- Submit test data

Maximizing The Radiated Emissions:

- The frequencies of emissions was first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.
- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement were explored to produce the highest amplitude signal relative to the limit.

The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

Step1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

Step2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

Step3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

Step4: Move the antenna over its full allowable range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.

Step5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.

Step6: The effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

Step7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.

8.3. 26 DB BANDWIDTH MEASUREMENTS

- Couple the RF output signal to the spectrum analyzer by means of direct connection or by a receiving antenna.
- The spectrum analyzer shall be se as follows:
  - Span: Minimum span to fully display the entire emission, approximately 3 x emission BW.
  - Resolution RBW: 1% to 3% of the approximate emission BW
  - Video VBW: 3 x RBW
  - EMI Detector: Peak
  - Sweep Time: Coupled or set to a slow rate
  - Trace: Max-hold
- Place the marker at both sides of the emission slope and at -20 dB down from the peak value.
- The difference of frequencies of 2 markers will be the 20 dB bandwidth
- Record and plot the test results.

8.4. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stability circuitry need be subjected to the temperature variation test.

(c) The frequency stability supply shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provide with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(d) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements

showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).