SAR TEST REPORT

Project Number: 3061521
6/30/2004

Evaluation of the
Vital Signs Transmitter
Model Number: VST3
FCC ID: SC7VST3

FCC Part 2.1093

For

Biowatch Medical

Test Performed by:
Intertek
731 Enterprise Drive
Lexington, KY 40510

Test Authorized by:
Biowatch Medical
1233 Washington St.
Columbia, SC 29201

Prepared By:_____**Date:**____ 6/30/2004_____

Vinay Kutty, Project Engineer

Approved By:_____**Date:**____ 6/30/2004_____

Bryan C. Taylor, EMC Team Leader

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Evaluation For:Biowatch Medical FCC ID: SC7VST3
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1 INTRODUCTION

The VST3 was evaluated for SAR in accordance with the requirements for RF Exposure compliance testing defined in FCC OET Bulletin 65, Supplement C (Edition 01-01). Testing was performed at the Intertek Testing Services facility in Lexington, Kentucky.

For the evaluation, the dosimetric assessment system DASY3 was used. The phantom employed was the "SAM Twin Phantom". The total uncertainty for the evaluation of the spatial peak SAR values averaged over a cube of 1g tissue mass had been assessed for this system to be ±27.4%.

The device was tested at the maximum output power. This was accomplished using a Rhode & Schwarz CMU-200 base station simulator to force the device into a “call”. Once in a “call” the base station simulator was configured to send the EUT an “all up bits” signal which forced the device to transmit at maximum power output.

The maximum spatial peak SAR value for the sample device averaged over 1g was found to be:

Phantom	Position	Worst Case Extrapolated SAR_{1g} mW/g[1]
Flat Section	PCS Band Channel 1175 with the Back of the VST3 Against the Phantom	1.086

Based on the worst case data presented above, the sample tested was found to be in compliance with the requirements defined in OET Bulletin 65, Supplement C (Edition 01-01).

[1] Data has been corrected for duty cycle.

2 JOB DESCRIPTION

2.1 Client information

The Vital Signs Transmitter has been tested at the request of

Company: Biowatch Medical
1233 Washington St.
Columbia, SC 29201

Name of contact: Paul Mulvaney
Telephone: (803) 233-0244
Fax: (803) 233-0240

2.2 Test plan reference:

Tests were performed to the following standards:

- FCC Part 2.1093

2.3 Equipment Under Test (EUT)

The Equipment Under Test (EUT) was an Vital Signs Transmitter that operated in the CDMA800 and CDMA1900 modes.

Product	Vital Signs Transmitter
EUT Model Number	VST3
EUT Serial Number	9900284004
Whether quantity (>1) production is planned	Quantity production is planned.
Cellular Phone standards	CDMA 800 and 1900
Type(s) of Emission	1M25F9W
RF Output Power	23.31 dBm – CDMA 800 23.83 dBm – CDMA1900
Frequency Range	824.7 – 848.31 MHz CDMA800 1850 – 1910 MHz CDMA1900
Antenna & Gain	Integrated, non-retractable (internal)
Detachable Antenna	None
Belt Clip	None
Battery Option	7.2V 750mAh Li-ion Battery[2].
External input	[x] Audio [X] Digital Data

EUT receive date: 6/1/2004
EUT receive condition: The EUT was received in good condition with no apparent damage.
Test start date: 6/25/2004
Test completion date: 7/2/2004

The test results in this report pertain only to the item tested.

[2]. No other battery options are offered.

2.3.1 System Support Equipment

Table 2-1 contains the details of the support equipment associated with the Equipment Under Test during the testing.

2.3.2 Table 2-1: System Support Equipment

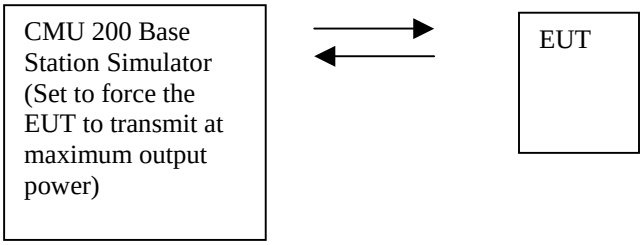
Description	Manufacturer	Model Number	Serial Number	FCC ID number
AC Battery Charger	Biowatch Medical	GTM21089-1305-W3	Not Labeled	Not Labeled

2.3.3 Cables associated with EUT

There were no cables used with the EUT. It was operated in a stand alone mode and powered by batteries.

2.3.4 System Block Diagram

The diagram shown below details the interconnection of the EUT and its accessories during the testing. For specific layout, refer to the test configuration photograph in the relevant section of this report.



2.3.5 Justification

The EUT was operated in the stand-alone configuration and tested with the side normally located against the body, against the phantom. Since the device could only be worn against the abdomen in one position during operation (with the sensors against the person wearing it), no other test configurations were evaluated.

2.3.6 Mode(s) of operation

The EUT was powered from a fully charged 7.2 Vdc 750 mAH Li-Ion Battery during all testing.

2.4 Modifications required for compliance

No modifications were implemented by Intertek.

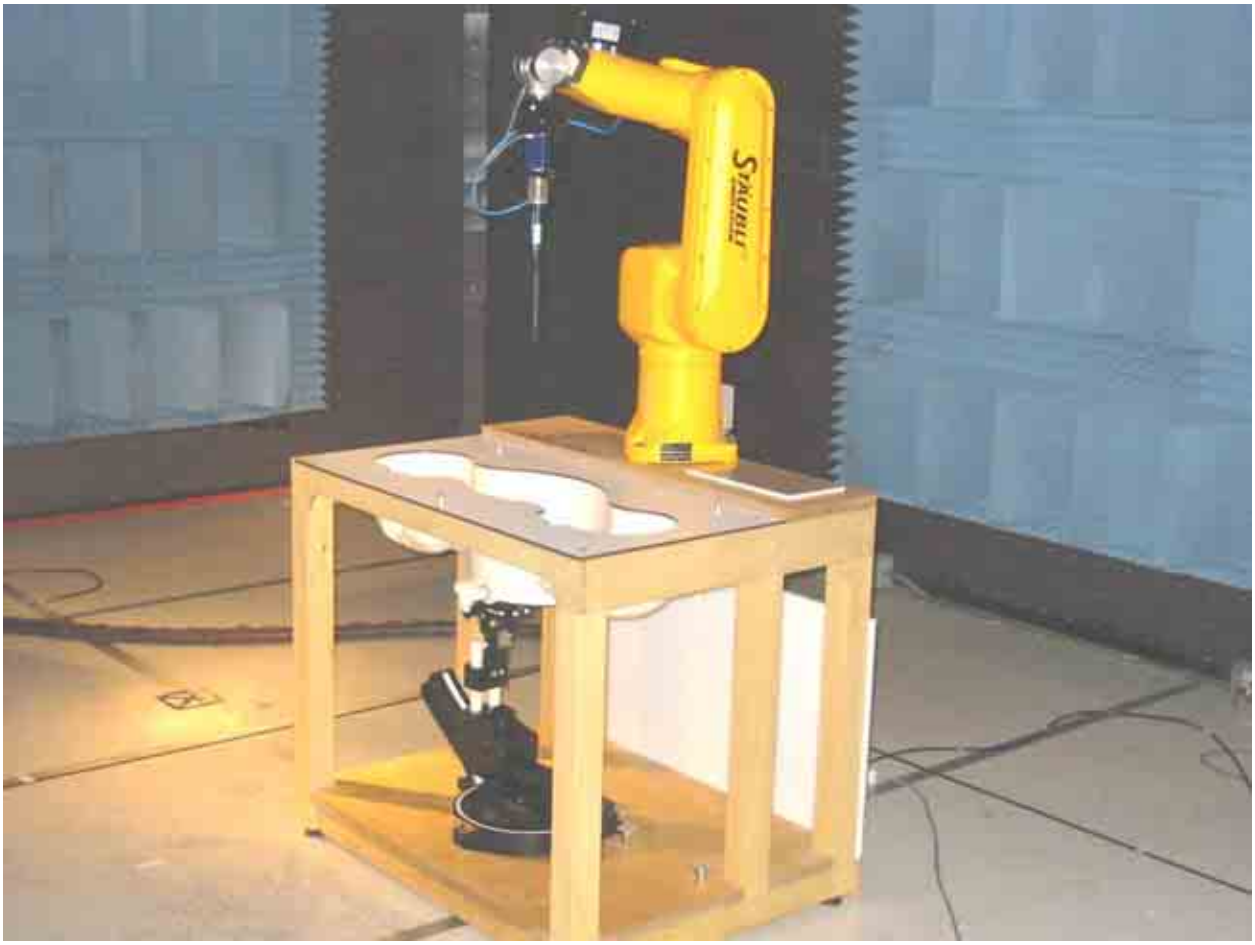
2.5 Related Submittal(s) Grants

Sierra Wireless CDMA Modem – FCC ID: N7NSB555

2.6 Test Site Description

The SAR test site located at 731 Enterprise Drive, Lexington KY 40510 is comprised of the SPEAG model DASY 3 automated near-field scanning system, which is a package, optimized for dosimetric evaluation of mobile radios [3]. This system is installed in an ambient-free shielded enclosure with RF absorbing material on the walls and ceiling. The Ambient temperature is controlled to 22.2 $\pm 2^{o}$C. Because the HVAC operates as a closed system, the relative humidity remains constant at 50 $\pm$5%. During the SAR evaluations, the RF ambient conditions are monitored continuously for signals that might interfere with the test results. The tissue simulating liquid is also stored and validated in this area in order to keep it at the same constant ambient temperature as the room.

Figure 2-1: SAR Test Site



2.7 Measurement Uncertainty

The Table below includes the uncertainty budget suggested by the IEEE Std 1528-200X and determined by SPEAG for the DASY3 measurement System. The extended uncertainty (K=2) was assessed to be 27.0 %

Uncertainty Component	Tolerance (± %)	Probability Distribution	Divisor	c_i	Standard Uncertainty, (± %)	v_i^2 or v_{eff}
Measurement System						
Probe Calibration	4.5	Normal	1	1	4.5	Inf.
Axial Isotropy	4.7	Rectangular	√3	$(1\text{-cp})^{1/2}$	1.9	Inf.
Spherical Isotropy	9.6	Rectangular	√3	$\sqrt{c_p}$	3.9	Inf.
Boundary Effect	5.5	Rectangular	√3	1	3.2	Inf.
Linearity	4.7	Rectangular	√3	1	2.7	Inf.
System Detection Limits	1.0	Rectangular	√3	1	0.6	Inf.
Readout Electronics	1.0	Normal	1	1	1.0	Inf.
Response Time	0.8	Rectangular	√3	1	0.5	Inf.
Integration Time	1.4	Rectangular	√3	1	0.8	Inf.
RF Ambient Conditions	3.0	Rectangular	√3	1	1.7	Inf.
Probe Positioner Mechanical Tolerance	0.4	Rectangular	√3	1	0.2	Inf.
Probe Positioning with respect to Phantom Shell	2.9	Rectangular	√3	1	1.7	Inf.
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	3.9	Rectangular	√3	1	2.3	Inf.
Test sample Related						
Test Sample Positioning	6.0	Normal	0.89	1	6.7	12
Device Holder Uncertainty	5.0	Normal	0.84	1	5.9	8
Output Power Variation - SAR drift measurement	7.0	Rectangular	√3	1	4	Inf.
Phantom and Tissue Parameters						
Phantom Uncertainty (shape and thickness tolerances)	4.0	Rectangular	√3	1	2.3	Inf.
Liquid Conductivity Target tolerance	3.0	Rectangular	√3	0.6	1.0	Inf.
Liquid Conductivity - measurement uncertainty	10.0	Rectangular	√3	0.6	3.5	Inf.
Liquid Permittivity Target tolerance	4.0	Rectangular	√3	0.6	1.3	Inf.
Liquid Permittivity - measurement uncertainty	5.0	Rectangular	√3	0.6	1.7	Inf.
Combined Standard Uncertainty					13.7	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)					27.4	

Notes.

1. The Divisor is a function of the probability distribution and degrees of freedom (ν_i and ν_{eff}). See NIST Technical Note TN1297, NIS 81 and NIS 3003.
2. c_i is the sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.

2.8 Measurement Tractability

All measurements described in this report are traceable to National Institute of Standards and Technology (NIST) standards or appropriate national standards.

3 SPECIFIC ABSORBTION RATE

3.1 Test Limits

The following FCC limits for SAR apply to devices operating in General Population/Uncontrolled Exposure environment:

Exposure (General Population/Uncontrolled Exposure environment)	SAR (W/kg)
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

3.2 Test Equipment

SAR Measurement System			
EQUIPMENT	**SPECIFICATIONS**	**S/N #**	**Last Cal. Data**
Robot	**Stäubli RX60L**	597412-01	N/A
	Repeatability: ± 0.025mm Accuracy: $0.806x10^{-3}$ degree Number of Axes: 6		
E-Field Probe	**ER3DV6**	1785	07/28/2003
	Dynamic Range: 5 µW/g to >100 mW/g Tip diameter: 6.8 mm Probe Linearity: ± 0.2 dB (30 MHz to 3 GHz) Axial isotropy: ± 0.2 dB Spherical isotropy: ± 0.2 dB Length: 34.5 cm Distance between the probe tip and the dipole center: 2.7 mm Calibration: 450, 835/900, 1800/1900, 2450 MHz for head & body liquid		
Data Acquisition	**DAE3**	317	N/A
	Measurement Range: 1µV to >200mV Input offset Voltage: < 1µV (with auto zero) Input Resistance: 200 M		
Phantom	**SAM Twin V4.0**	TP-1243	QD000P40CA
Complies with IEEE P1528-200x, draft 6.5 (See certificate in App. C)	Type SAM Twin, Homogenous Shell Material: Fiberglass Thickness: 2 ± 0.2 mm Capacity: 20 liter Size of the flat section: approx. 320 x 230 mm		
Device holder	Non-conductive holder supplied with DASY3, dielectric constant less than 5.0	N/A	N/A
Power Meter	**Boonton 5232 RF Power Meter / Voltmeter**	13601	10/08/03
	Power Meter Frequency Range: 10 kHz to 40 GHz Power Meter Measurement Range: -70 dBm to +44 dBm		
Signal Generator	**HP 83620 B**	3614A00199	8/21/03
	Frequency Range: 10MHz – 20 GHz Amplitude Range: -110 dBm – 25 dBm		
Base Station Simulator	**Rohde and Schwarz CMU 200**	2522	8/21/03
	Wireless Standards: GSM, IS-136 TDMA, AMPS, CDMA		

3.3 Tissue Simulating Liquid Description and Validation

Figure 3-1: Recommended Head Tissue Composition

Simulation Liquid; Frequency: 800 MHz	
Ingredient	**Body**
Water	41.45
Salt	1.45
Sugar	56.0
HEC	1.0
Bactericide	0.1

Figure 3-2: Recommended Body Tissue Composition

Simulation Liquid; Frequency: 1900 MHz	
Ingredient	**Body**
Water	40.4
Salt	0.5
Sugar	58.0
HEC	1.0
Bactericide	0.1

Note: The amounts of each ingredient specified in the tables are not the exact amounts of the final test solution. The final test solution was adjusted by adding small amounts of water, sugar, and/or salt to calibrate the solution to meet the proper dielectric parameters.

Figure 3-3: Body Tissue Parameters Measured Just Before SAR Testing

PCS Band Tissue Parameters								
Frequency Measure (MHz)	**Dielectric Constant Target**	**Dielectric Constant Measure**	**Dielectric % Deviation**	**Imaginary Part**	**Conductivity Target**	**Conductivity Measure**	**Conductivity % Deviation**	**Date**
1800	53.3	52.29	1.89	14.52	1.52	1.45	4.40	6/25/2004
1880	53.3	51.3	3.75	14.69	1.52	1.54	1.01	6/25/2004
1910	53.3	51.7	3.00	14.69	1.52	1.56	2.62	6/25/2004
2000	53.3	50.9	4.50	14.9	1.52	1.66	9.00	6/25/2004

Cell Band Tissue Parameters								
Frequency Measure (MHz)	**Dielectric Constant Target**	**Dielectric Constant Measure**	**Dielectric % Deviation**	**Imaginary Part**	**Conductivity Target**	**Conductivity Measure**	**Conductivity % Deviation**	**Date**
813	55.3	57.5	3.98	21.37	0.97	0.97	0.42	6/28/2004
900	55	57.08	3.78	21.37	1.05	1.07	1.84	6/28/2004
836.52	55.2	57.14	3.51	21.48	0.97	1.00	2.99	6/28/2004

PCS Band Tissue Parameters								
Frequency Measure (MHz)	**Dielectric Constant Target**	**Dielectric Constant Measure**	**Dielectric % Deviation**	**Imaginary Part**	**Conductivity Target**	**Conductivity Measure**	**Conductivity % Deviation**	**Date**
1800	53.3	53.5	0.38	14.7	1.52	1.47	3.22	7/1/2004
1880	53.3	53	0.56	14.64	1.52	1.53	0.67	7/1/2004
1910	53.3	52.7	1.13	14.5	1.52	1.54	1.30	7/1/2004
2000	53.3	51.6	3.19	14.7	1.52	1.63	7.53	7/1/2004

Cell Band Tissue Parameters								
Frequency Measure (MHz)	**Dielectric Constant Target**	**Dielectric Constant Measure**	**Dielectric % Deviation**	**Imaginary Part**	**Conductivity Target**	**Conductivity Measure**	**Conductivity % Deviation**	**Date**
813	55.3	57.72	4.38	22.1	0.97	1.00	2.98	7/1/2004
900	55	57.1	3.82	21.8	1.05	1.09	3.88	7/1/2004
836.52	55.2	57.1	3.44	21.5	0.97	1.00	3.08	7/1/2004

3.4 Dipole System Validation

Prior to the assessment, the system was verified by using the system validation kit. The validation was performed at 900 and 1800 MHz using 900 and 1800 MHz head tissue.

Figure 3-4: Dipole Validation Data

Reference Dipole Validation								
Frequency Measure (MHz)	**Dipole Type**	**Dipole Serial Number**	**Fluid Type**	**Dipole Power Input**	**Cal. Lab SAR (1g)**	**Measured SAR (1g)**	**% Error SAR (1g)**	**Date**
1800	D1800V2	224	1800 MHz Head	1W	39.7	38.23	3.70	6/25/2004
900	D900V2	13	900 MHz Head	1W	10.6	10.78	1.70	6/28/2004
1800	D1800V2	224	1800 MHz Head	1W	39.7	37.53	5.47	7/1/2004
900	D900V2	13	900 MHz Head	1W	10.6	10.79	1.79	7/1/2004

3.4.1 Test Procedure

Prior to any testing, the appropriate fluid was used to fill the phantom to a depth of 15 cm +0.2cm. The fluid parameters were verified and the dipole validation was performed as described in the previous sections.

3.4.2 Conducted Output Power:

Before SAR testing started, the conducted output power of the device was measured. The transmitter output was connected to a calibrated coaxial cable, the other end of which was connected to a CMU-200 Base Station Simulator. The EUT was placed into a call and the transmitter output was read off the CMU-200 in dBm. The power output at the transmitter antenna port was determined by adding the value of the cable insertion loss to the CMU-200 power reading.

Tests were performed at three frequencies (low, middle, and high channels) and on the highest power levels, which can be setup on the transmitters.

3.4.3 Test Positions:

The Device was positioned against the SAM and flat phantoms using the exact procedure described in Supplement C Edition 01 – 01 of Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C. 20554, 1997.

3.4.4 Reference Power Measurement:

The measurement probe was positioned at a fixed location above the reference point. A power measurement was made with the probe above this reference position so it could used for the assessing the power drift later in the test procedure.

3.4.5 Coarse Scan:

A coarse area scan with a horizontal grid spacing of 20 x 20 mm was performed in order to find the approximate location of the peak SAR value. This scan was performed with the measurement probe at a constant height in the simulating fluid. A two dimensional spline interpolation algorithm was then used to determine the peaks and gradients within the scanned area.

3.4.6 Zoom Scan:

A zoom scan was performed around the approximate location of the peak SAR as determined from the coarse scan. The zoom scan was comprised of a measurement volume of 32 x 32 x 34 mm based on 5 x 5 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

3.4.7 Data Extrapolation:

Since the center of the dipoles in the measurement probe are 2.7 mm away from the tip of the probe, and the distance between the surface and the lowest measurement point is 1.6 mm the data at the surface was extrapolated. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in the Z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

The maximum interpolated value was searched with a straightforward sorting algorithm. Around this maximum, the SAR values averaged over the spatial volumes (1g or 10g) were computed using a 3-D spline interpolation algorithm. The 3-D spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y and z directions). The volume was integrated with a trapezoidal algorithm. 1000 points (10 x 10 x 10) were interpolated to calculate the average. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

3.4.8 Reference Power Measurement:

The probe was positioned at precisely the same reference point and the reference power measurement was repeated. The difference between the initial reference power and the final one is referred to as the power drift.

3.4.9 RF Ambient Activity:

During the entire SAR evaluation, the RF ambient activity was monitored using a spectrum analyzer with an antenna connected to it. The spectrum analyzer was tuned to the frequency of measurement and with one trace set to max hold mode. In this way, it was possible to determine if at any point during the SAR measurement there were an interfering ambient signal. If an ambient signal was detected, then the SAR measurement was repeated.

3.4.10 Conducted RF Power:

The following conducted RF power measurements were obtained using the procedure outlined in section 3.4.2 above.

Table 3-1 RF Power

EUT Mode	TX Channel	Conducted Output Power (dBm)
CDMA 800	384	23.31
CDMA 800	777	22.9
CDMA 800	1013	23.25
CDMA 1900	25	23.83
CDMA 1900	600	23.26
CDMA 1900	1175	23.33

3.5 SAR Test Results

The VST3 was compliant with the requirements defined in OET Bulletin 65, Supplement C (Edition 01-01). Where the measured 1g SAR was closer than 3dB to the limit at the middle channel, testing was performed on the band edge channels. All scans were done with the back of the VST3 touching the flat phantom to simulate the worst case environment.

The high drift values are due to the fact that the VST3 was designed to transmit for short periods of time and each SAR scan required approximately 25 minutes. By forcing the VST3 to transmit for a much longer period of time than it was designed for, it got extremely hot due to excessive power consumption. This extreme change in temperature over the course of the 25minute SAR scan caused the drift to be larger than normal. The following data has been extrapolated for the SAR drift.

Body Mode SAR								
Channel	**Freq. (MHz)**	**Frequency Band (Cell / PCS)**	**Test Position**	**SAR Drift (dB)**	**Measured 1-g SAR (mW/g)**	**Meas. 10g-SAR (mw/g)**	**Extrapolated Worst Case 1-g SAR (mW/g)**	**Extrapolated Worst Case 10-g SAR (mW/g)**
600	1880.00	PCS	Back	-0.440	0.967	0.454	1.070	0.502
25	1851.25000	PCS	Back	-0.470	0.507	0.240	0.565	0.267
1175	1908.75000	PCS	Back	0.210	1.140	0.522	**1.086**	0.497
384	836.52000	Cell	Back	-0.840	0.038	0.020	0.046	0.025