FCC ID PER PART 15.225
EMI MEASUREMENT AND TEST REPORT

For

ViVOtech, Inc.

451 El Camino Real,
Santa Clara, CA 95050

FCC ID: Q5530XX

2003-05-22

This Report Concerns:	**Equipment Type:**
☒ Original Report	Wireless Payment Reader

Test Engineer:	Benjamin Jin
Report Number:	R0305131
Test Date:	2003-05-14
Reviewed By:	Hans Mellberg
Prepared By:	Bay Area Compliance Laboratory Corporation 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732-9164

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1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

The *ViVOtech, Inc.* 's product, model *ViVOpay 3000 / ViVOpay 3010* or the "EUT" as referred to in this report is a wireless payment reader. The EUT measures approximately 5.0" L x 3.9" W x 4.8" H.

The EUT was fed by CUI AC/DC Adapter, M/N: EPA-121DA-09.

** The test data gathered is from typical production samples provided by the manufacturer.*

1.2 Objective

This Type approval report is prepared on behalf of *ViVOtech, Inc.* in accordance with Part 2, Subpart J, and Part 15, Subparts A and B of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules, Part 15, sec 15.35, sec 15.209 and sec 15.225 for radiated emission, conducted emission and frequency stability.

1.3 Related Submittal(s)/Grant(s)

No Related Submittals.

1.4 Test Methodology

All measurements contained in this report were conducted with 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. All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 10 meters.

1.5 Test Facility

The Open Area Test site used by Bay Area Compliance Laboratory Corporation to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at Bay Area Compliance Laboratory Corporation has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-1992.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, Bay Area Compliance Laboratory Corporation is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (NVLAP). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, CISPR 22: 1997, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167-0.

1.6 Test Equipment List

Manufacturer	Description	Model	Serial Number	Cal. Due Date
HP	Spectrum Analyzer	8568B	Panel 2408A00105 Display 2403A06544	2004-05-01
HP	Spectrum Analyzer	8593A	29190A00242	2004-05-01
HP	Amplifier	8447E	1937A01054	2004-05-01
HP	Quasi-Peak Adapter	85650A	2521A00718	2004-05-01
Com-Power	Biconical Antenna	AB-100	14012	2004-05-01
Com-Power	LISN	LI-200	12005	2004-03-28
Com-Power	LISN	LI-200	12008	2004-03-28
Com-Power	Log Periodic Antenna	AL-100	16091	2004-05-01
Com-Power	Log Periodic Antenna	AB-900	15049	2004-05-01
Rohde & Schwarz	EMI Test Receiver	ESPI	1147 8007 07	2003-12-03

*** Statement of Traceability**: Bay Area Compliance Laboratory Corp. certifies that all calibration has been performed using suitable standards traceable to the NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

2 - SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT was configured for testing in a typical fashion (as normally used in a typical application).

2.2 EUT Exercise Software

The EUT exercising program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

2.3 Special Accessories

As shown in section 2.5, all interface cables used for compliance testing are shielded as normally supplied by INMAC, Monster Cable, Y.C. Cables and Qubbain Data Max. The peripherals featured shielded metal connectors.

2.4 Schematics and Block Diagram

Please refer to Appendix D.

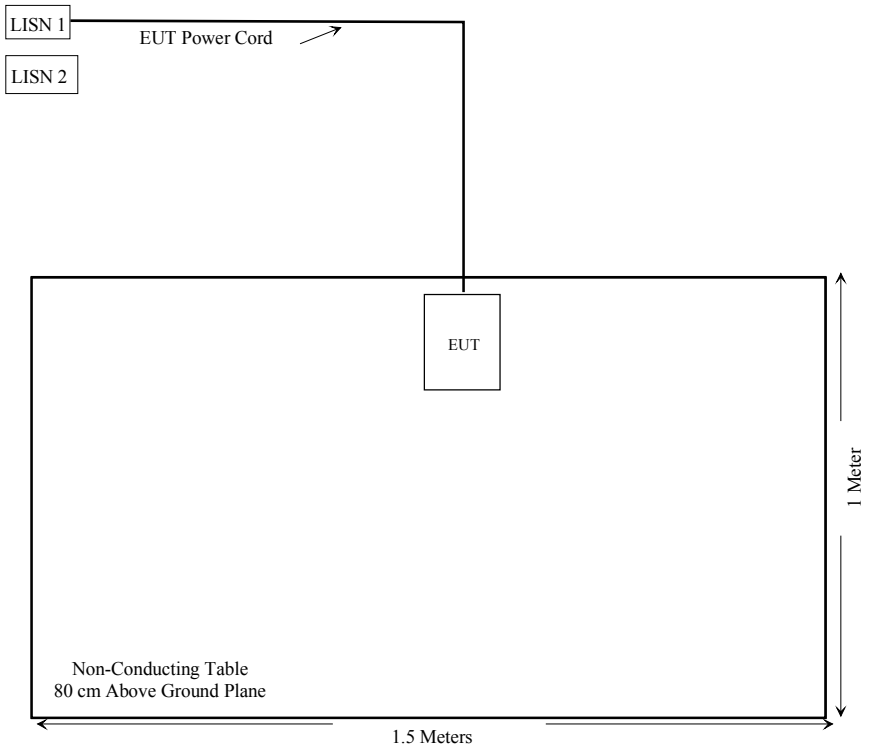
2.5 Equipment Modifications

No modifications were necessary for the EUT to comply.

2.6 Test Setup Configuration

EUT

2.7 Test Setup Block Diagram



3 - SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.207	Conducted Emission	Compliant
§ 15.225 § 15.209 § 15.35	Radiated Emission	Compliant
§15.225(c)	Frequency Stability	Compliant

4 - CONDUCTED EMISSIONS TEST

4.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at BACL is ±2.4 dB.

4.2 EUT Setup

The measurement was performed at the shielded room, using the same setup per ANSI C63.4 - 1992 measurement procedure. The specification used was the FCC15 Class B limits.

The EUT was placed on the center of the back edge on the test table, connected to a 120Vac/60Hz power source.

4.3 Spectrum Analyzer Setup

The spectrum analyzer was set with the following configurations:

Start Frequency	150 kHz
Stop Frequency	30 MHz
Sweep Speed	Auto
IF Bandwidth	10 kHz
Video Bandwidth	10 kHz
Quasi-Peak Adapter Bandwidth	9 kHz
Quasi-Peak Adapter Mode	Normal

4.4 Test Procedure

During the conducted emission test, the power cord of host PC was connected to the auxiliary outlet of the first LISN. Other support equipment power cords were connected to the second LISN. Maximizing procedure was also performed on the highest emissions to ensure EUT compliance using all installation combination.

All data was recorded in the peak detection mode. Quasi-peak readings were only performed when an emission was found to be marginal (within -4 dBμV of specification limits). Quasi-peak readings are distinguished with a "**Qp**".

4.5 Summary of Test Results

According to the data in section 3.6, the EUT complied with the FCC15 Class B Conducted margin for a Class B device, and these test results is deemed as satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations, with the *worst* margin reading of:

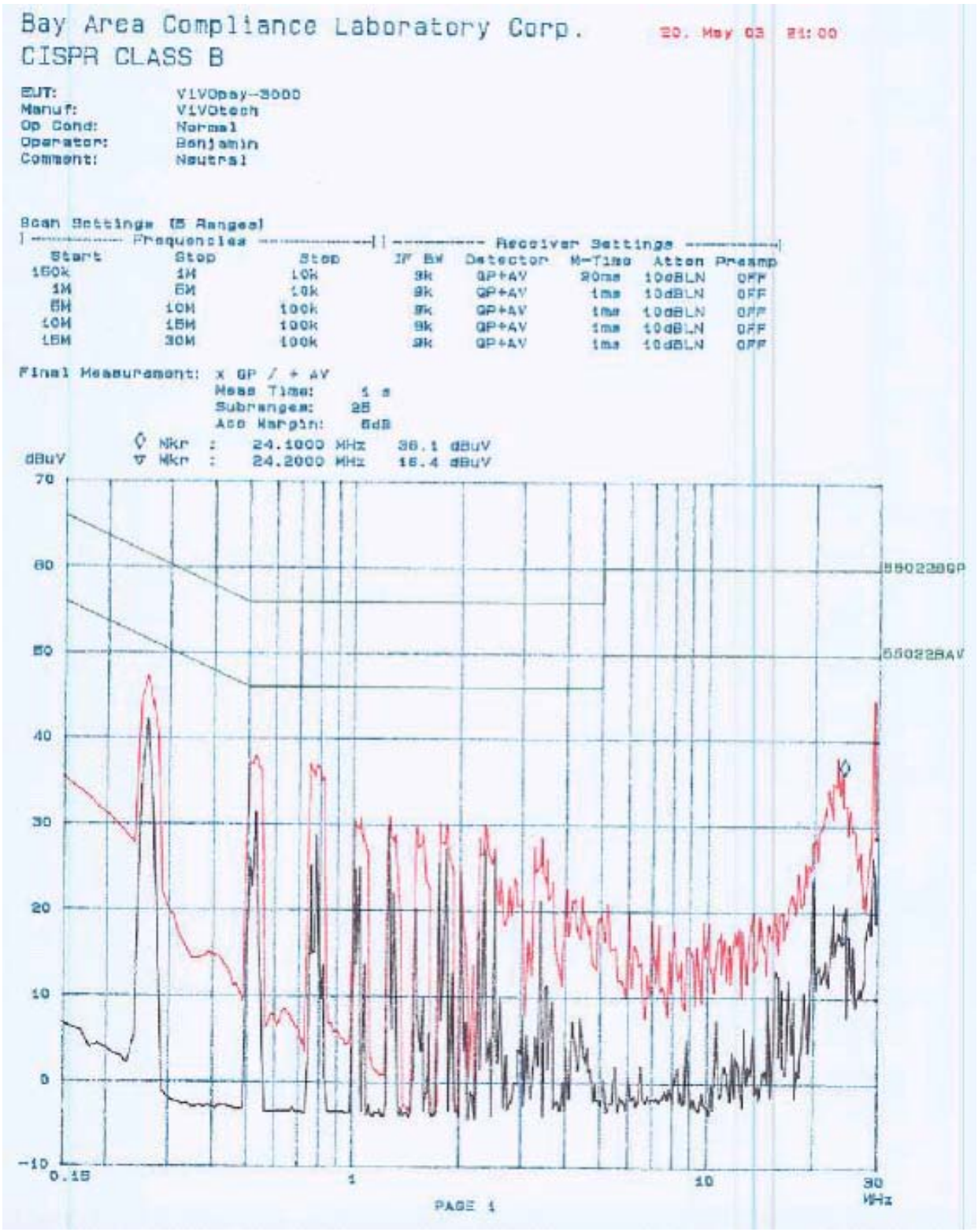
-13.5 dBμV at 0.52 MHz in the Neutral mode

4.6 Conducted Emissions Test Data

LINE CONDUCTED EMISSIONS				FCC 15 CLASS B	
Frequency	Amplitude	Detector	Phase	Limit	Margin
MHz	dBμV	QP/Ave/Peak	Line/Neutral	dBμV	dB
0.52	32.5	Ave	Neutral	46	-13.5
0.52	37.6	QP	Neutral	56	-18.4
0.53	26.2	Ave	Line	46	-19.8
0.53	34.9	QP	Line	56	-21.1
23.90	27.6	Ave	Line	50	-22.4
24.10	36.1	QP	Neutral	60	-23.9
23.80	35.0	QP	Line	60	-25.0
0.15	37.3	QP	Line	66	-28.7
0.15	36.4	QP	Neutral	66	-29.6
24.20	16.4	Ave	Neutral	50	-33.6
0.15	8.1	Ave	Line	56	-47.9
0.15	7.3	Ave	Neutral	56	-48.7

4.7 Plot of Conducted Emissions Test Data

Plot of Conducted Emissions Test Data is presented hereinafter as reference.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20. May 03 21:00
CISPR CLASS B
EUT: ViVOpay-3000
Manuf: ViVOtech
Op Cond: Normal
Operator: Benjamin
Comment: Neutral
Scan Settings (5 Ranges)
Frequencies
Receiver Settings
Start Stop Step IF BW Detector M-Time Atten Preamp
150k 1M 10k 9k QP+AV 20ms 10dBLN OFF
1M 5M 10k 9k QP+AV 1ms 10dBLN OFF
5M 10M 100k 9k QP+AV 1ms 10dBLN OFF
10M 15M 100k 9k QP+AV 1ms 10dBLN OFF
15M 30M 100k 9k QP+AV 1ms 10dBLN OFF
Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 6dB
◊ Mkr : 24.1000 MHz 38.1 dBuV
▽ Mkr : 24.2000 MHz 16.4 dBuV
dBuV
70
60
50
40
30
20
10
0
-10
0.15
1
10
30
MHz
55022BQP
55022BAV
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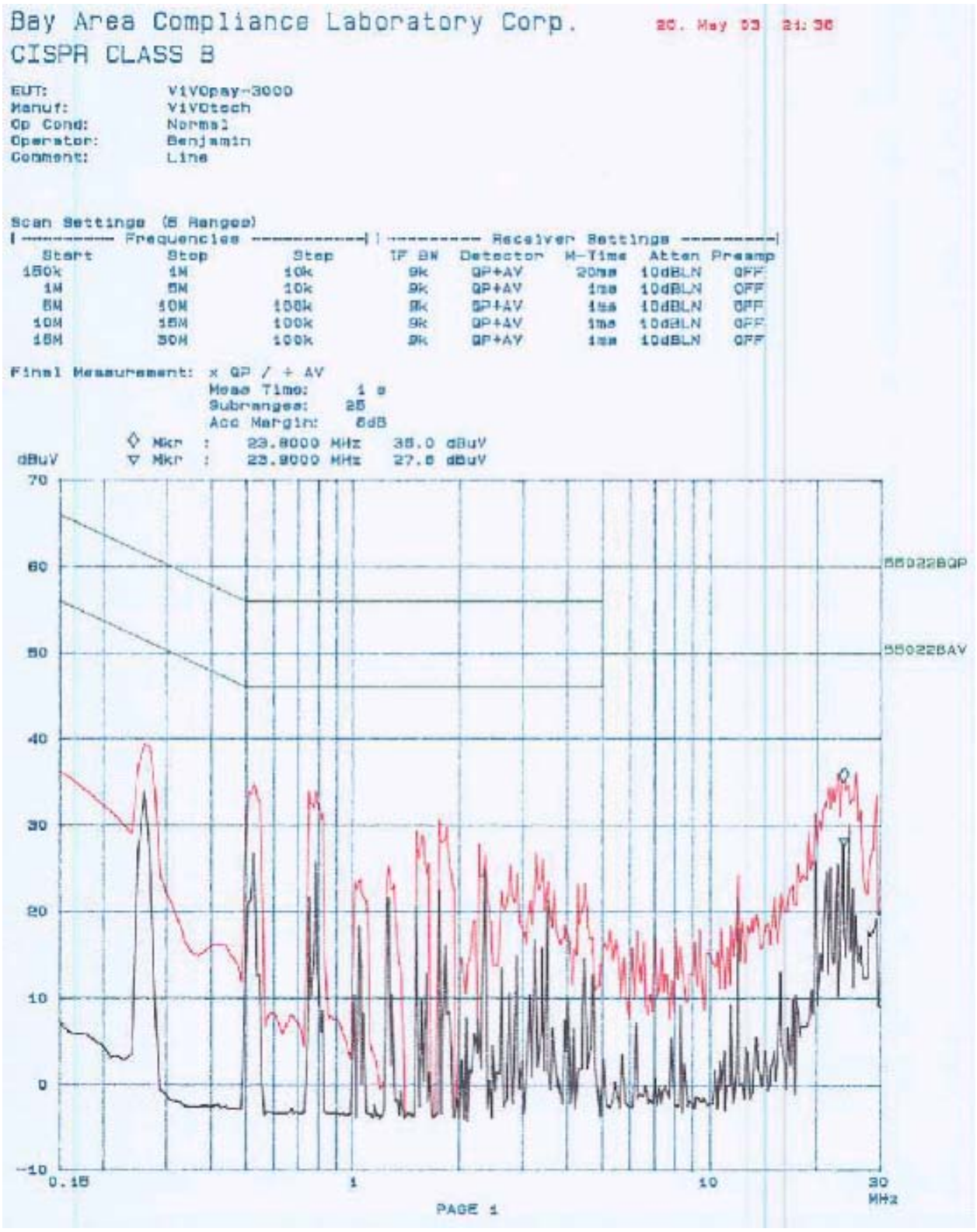
Bay Area Compliance Laboratory Corp.
20. May 03 21:36
CISPR CLASS B
EUT: ViVOpay-3000
Manuf: ViVOtech
Op Cond: Normal
Operator: Benjamin
Comment: Line
Scan Settings (6 Ranges)
Frequencies
Receiver Settings
Start Stop Step IF BW Detector M-Time Atten Preamp
150k 1M 10k 9k QP+AV 20ms 10dBLN OFF
1M 5M 10k 9k QP+AV 1ms 10dBLN OFF
5M 10M 100k 9k QP+AV 1ms 10dBLN OFF
10M 15M 100k 9k QP+AV 1ms 10dBLN OFF
15M 30M 100k 9k QP+AV 1ms 10dBLN OFF
Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 6dB
Mkr : 23.8000 MHz 38.0 dBuV
Mkr : 23.9000 MHz 27.6 dBuV
dBuV
70
60
50
40
30
20
10
0
-10
0.15
1
10
30
MHz
55022BQP
55022BAV
PAGE 1

5 - RADIATED EMISSION TEST

5.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is $\pm$4.0 dB.

5.2 EUT Setup

The radiated emission tests were performed in the open area 10-meter test site, using the setup accordance with the ANSI C63.4-1992. The specification used was the FCC Class B limits.

The EUT was placed on the center of the back edge on the test table, connected to a 120Vac/60Hz power source.

5.3 Spectrum Analyzer Setup

According to FCC Rules, 47 CFR 15.33, the EUT was tested to 1 GHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Start Frequency	1 MHz
Stop Frequency	1 GHz
Sweep Speed	Auto
IF Bandwidth	100 KHz
Video Bandwidth	100 KHz
Quasi-Peak Adapter Bandwidth	120 kHz
Quasi-Peak Adapter Mode	Normal
Resolution Bandwidth	100 KHz

5.4 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT is compliant with all installation combination.

All data was recorded in the peak detection mode. Quasi-peak readings performed only when an emission was found to be marginal (within -4 dBμV of specification limitation), and are distinguished with a "**QP**" in the data table.

The EUT was operating at normal to represent worst case during final qualification test. Therefore, this configuration was used for final test data recorded in the table(s) listed under section 4.7 of this report.

5.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBμV means the emission is 7dBμV below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. - Limit

5.6 Summary of Test Results

According to the final data in section 4.6, the EUT complied with the FCC 15.225, FCC 15.209 and FCC 15.35 standards, and had the worst margin of:

-2.1 dBμV at 14.37 MHz in the Horizontal polarization, ViVOpay 3000 & antenna 300-1018

-2.8 dBμV at 14.37 MHz in the Horizontal polarization, ViVOpay 3010 & antenna 300-1019

5.7 Radiated Emissions Test Result Data

5.7.1 Test Data for ViVOpay 3000 & antenna 300-1018

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR				CORRECTEI AMPLITUDI	FCC 15.225	
Frequency MHz	Reading dBμV	Angle Degree	Height Meter	Polar H/ V	Antenna dBμV/m	Cable dB	Amp. dB	15.31 Correction dB	Reading dBμV	Limit dBμ V	Margin dB
14.37	61.5	180	1.2	H10	10.8	1.5	26.4	20.0	27.4	29.5	-2.1
15.59	50.3	180	1.2	H10	10.8	1.5	26.4	20.0	16.2	29.5	-13.3
13.56*	83.8	90	1.2	H10	10.8	1.5	26.4	20.0	49.7	80	-30.3
13.56*	62.7	90	1.2	V10	10.8	1.5	26.4	20.0	28.6	80	-51.4

5.7.2 Test Data for ViVOpay 3010 & antenna 300-1019

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR				CORRECTEI AMPLITUDI	FCC 15.225	
Frequency MHz	Reading dBμV	Angle Degree	Height Meter	Polar H/ V	Antenna dBμV/m	Cable dB	Amp. dB	15.31 Correction dB	Reading dBμV	Limit dBμ V	Margin dB
14.37	60.8	180	1.2	H10	10.8	1.5	26.4	20.0	26.7	29.5	-2.8
15.59	48.7	180	1.2	H10	10.8	1.5	26.4	20.0	15.6	29.5	-13.9
13.56*	83.2	90	1.2	H10	10.8	1.5	26.4	20.0	49.1	80	-30.9
13.56*	61.9	90	1.2	V10	10.8	1.5	26.4	20.0	27.8	80	-52.2

* Fundamental Frequency

Compliance Statement:

According to FCC Part 15, at 3-meter distance the emission from an intentional radiator shall not exceed the field strength level 40 dBuV/m within 30-88 MHz, 43.5 dBuV/m within 88-216 MHz, 46dBuV/m within 226-960 MHz, 54BuV/m above 960 MHz. The level of any unwanted emissions shall not exceed the level of the fundamental frequency.

The levels of unwanted emission of this device were too low to be detected. This device was compliant with the FCC Part 15.

Note: Data corrected for test distance in accordance with FCC 15.31 40dB/Decade.

6 - FREQUENCY STABILITY MEASUREMENT

6.1 Provision Applicable

According to FCC §15.2259(c), the frequency tolerance of the carrier signal shall be maintained within ± 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.

6.2 Test Procedure

6.2.1 Frequency stability versus environmental temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feedthrough attenuators. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

6.2.2 Frequency Stability versus Input Voltage

At room temperature (25±5°C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

6.3 Test Equipment

Temperature Chamber, -50°C to +100°C
Hewlett Packard HP8566B Spectrum Analyzer
Hewlett Packard HP 7470A Plotter
Hewlett Packard HP 5383A Frequency Counter
Goldstar DC Power Supply, GR303

6.4 Test Results

Reference Frequency: 13.5600 MHz			
Environment Temperature (°C)	Power Supplied (Vac)	Frequency Measure with Time Elapsed	
		MCF (MHz)	PPM Error
50	110V	13.5606	44.2
40	110V	13.5606	44.2
30	110V	13.5605	36.8
20	110V	13.5605	36.8
10	110V	13.5605	36.8
0	110V	13.5605	36.8
-10	110V	13.5604	29.4
-20	110V	13.5604	29.4

Frequency Stability Versus Input Voltage

Reference Frequency: 13.5600 MHz						
Power Supplied (Vac)	Frequency Measure with Time Elapsed					
	2 Minutes		5 Minutes		10 Minutes	
	MHz	PPM	MHz	PPM	MHz	PPM
126.5V	462.5617	-1.5	462.5625	0.1	462.5624	-0.1
110V	462.5620	-0.9.	462.5624	-0.4	462.5619	-1.5
93.5V	462.5615	-1.9	462.5619	-1.5.	462.5629	1.1

End Point = 4.5 V

Conclusion: The EUT complied with the applicable Frequency Stability Limits.