MEASUREMENT AND TECHNICAL REPORT ON THE VERIFONE RF250 POINT OF SALE TERMINAL

Southwest Research Institute
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Project 10-2390-001
Report Number EMCR 98/100

Prepared for:

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The results of this test report apply only to the specific samples tested. If the manufacturer extends the test results to apply to other samples of the same model, or from the same lot or batch, the manufacturer should ensure the additional samples are manufactured using identical electrical and mechanical components.

Reviewed by:	Approved:
______________________________	______________________________
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1.0 GENERAL INFORMATION

1.1 Product Description

The VeriFone RF250, TIRIS MOBIL SPEEDPASS (VFI P/N P088-101-01-A) is a self contained device that when properly installed becomes an integral part of the Point of Sale (POS) equipment. The RF250 incorporates a Radio Frequency Identification Device (RFID) that is designed for use in conjunction with a handheld batteryless transponder (RI-TRP-Series keyring tag) that is carried by the user. The RF250 Terminal operates at 134.2 kHz and is subject to FCC Part 15, Subpart C, "Intentional Radiator," paragraph 15.207 and 15.209. Attachment 1 contains a detailed technical description and functionality of the RF250 Terminal and its components (*File: 19223.doc*). Attachment 2 contains the MOBIL SPEEDPASS Installation Guide (*File: RF250-a1.pdf*).

1.2 Related Grants

The RF250 Terminal incorporates an RF module operating at 134.2 kHz that received certification under FCC ID: A92MICRO.

1.3 Tested System Details

The RF250 Terminal is normally located next to the POS equipment, such as a cash register, and includes a self contained 134.2kHz low Q transceiver antenna with a tuning board, a low frequency (LF) transceiver module which is part of the PCB ASSY, RF250 MAIN TIRIS (VFI P/N 18256-01; *File:RFMain.pdf*), and a LED indicator PCBA (VFI P/N 18262-01; *File: RF_LED.pdf*). These components were assembled per drawing VFI PN 088-101-01-A (*File: Location.pdf*). These schematics are provided in Attachment 3. The RF250 Terminal incorporates an RF module operating at 134.2 kHz that received certification under FCC ID: A92MICRO. Schematics for the RF module are not included in Attachment 3, but were provided to the FCC with the certification report for A92MICRO.

The VeriFone Everest unit plugs into the RF250 unit and provides an operator with a keypad/display. The Everest unit schematics are also provided in Attachment 3 (VFI P/N 18082-01, *File: EVDIS.pdf;* and, VFI P/N 18114-XX, *File: EVSYS.pdf*).

The RF250 Terminal operates from a 120VAC power supply (VFI P/N 04250-01) with an output rated at 12VDC, 1000mA, which is regulated to 5VDC using circuitry on the RF250 Main PCBA (VFI P/N 18256-01;*File:RFMain.pdf*). The system description, functionality, and block diagrams are located in Attachment 1 (RF250 Theory of Operations (VFI Document No. 19223; *File: 19223.doc*). The components on the system are listed below in Table 1.1.

TABLE 1.1
RF250 TERMINAL COMPONENTS

Component Description	Model No.	Revision, Serial Number
VeriFone RF Unit	RF250	Revision 7, P/N P088-101-01, KHH, S/N 021-700-276
VeriFone Keypad/Display Unit	Everest	Revision E, P/N P003-341-04.H01, S/N 201-669-899
Cable with integral connector for power, RS232 and RS 485 ports; length: approx. 7 ft.	-----	Revision 3, P/N 14781-02
Cable for interconnecting VeriFone Everest and RF250 units; length: approx. 8.5 in.	-----	Revision A, P/N 14184-01
VeriFone 120VAC to 12VDC Class 2 Transformer	481210R03C0	P/N 04250-01

1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4-1992, and the limits prescribed in CFR 47, FCC 15.207 and 15.209.

1.5 Test Facility

The Open Area Test Site and Conducted Measurement Facility used to collect data are located at Southwest Research Institute, 6220 Culebra Road, San Antonio, Texas. Details concerning these test sites are found in the report entitled, "Description of Measurement Facility," dated 28 April 1997, which is on file with the FCC Laboratory Division in Columbia, Maryland. On June 12, 1997, the FCC approved the sites for the purpose of providing test results for submission with equipment authorization applications under the Commission's Equipment Authorization Program.

2.0 PRODUCT LABELING

2.1 FCC ID Label

The FCC ID label for the VeriFone RF250 Terminal is shown in Attachment 3 (*File: Label_SP.pdf*).

2.2 Location of Label on EUT

The label is located on the outside of the bottom case assembly of the RF250 device. Refer to Attachment 3, Unit Drawing, RF250 TIRIS Mobil Speedpass (VFI P/N 088-101-01-A; *File: Location.pdf*), part number twelve (12).

2.3 Supplemental Information to be in the RF250 Manual

In addition to reiteration of required information as on intentional radiator, in keeping with sections 15.21 and 15.105 of the FCC rules, the manual supplied with the reader will also include the following admonitions:

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NO MODIFICATIONS: Modifications to this device shall not be made without the written consent of VeriFone, Incorporated. Unauthorized modifications may void the authority granted under Federal Communications Commission Rules permitting the operation of this device.

3.0 SYSTEM TEST CONFIGURATION

3.1 Justification

Radiated tests were performed on the RF250 Terminal intentional radiator from 134 kHz to 30 MHz for the highest fundamental and harmonics. Radiated tests were performed up to 1 GHz for spurious emissions. Both vertical and horizontal polarizations were tested. Radiated signature scans were made at 3 meters in a shielded anechoic chamber.

Conducted tests were performed on the AC power of the RF250 Terminal from 450 kHz to 30 MHz.

3.2 EUT Exercise

The RF250 was powered by a 120VAC power supply. During testing, all three ports were exercised simultaneously by looping back data through ports one and three while establishing the interrogation reply sequence with a batteryless keytag through port two.

3.3 Special Accessories

In order to meet radiated emissions limits in paragraph 15.209 for spurious emissions , a ferrite bead was added to the RF250 cable (7 foot cable for power, RS232 and RS 485 ports) at its exit point from the terminal, as shown in the photograph (*File: Ferrite.pdf*) in Appendix D. The cable is looped through the ferrite bead one time. The VeriFone part number for the ferrite bead is CCLBF4503-01.

3.4 Equipment Modification

The need for special accessories noted in 3.3 above was determined during equipment testing.

3.5 Configuration of Tested System

Refer to Attachment 1 for block diagram of the EUT configuration.

Refer to Appendix 3 for photographs of the EUT test configuration.

4.0 BLOCK DIAGRAM OF THE RF250 TERMINAL

Refer to Attachment 1 for block diagram of the EUT configuration**.**

5.0 CONDUCTED AND RADIATED MEASUREMENT PHOTOS

Refer to Appendix B for photographs of the EUT test configuration for radiated and conducted tests.

6.0 CONDUCTED EMISSION DATA

6.1 Conducted Measurement Data

The initial step in collecting conducted data was to perform a spectrum analyzer peak scan of the measurement range to determine worst case. A computer-controlled spectrum analyzer was used to produce a peak measurement data plot. Quasi-peak measurements were made manually with a receiver of any emissions over the paragraph 15.207 conducted limit.

Peak measurements revealed the worst case conducted emissions level detected was 4 dB below the paragraph 15.207 limit at 450 kHz on the line side of the power line. The worst case peak conducted emission level detected on the neutral line was 6 dB below the paragraph 15.207 limit at 450 kHz. All other conducted emissions were greater than 4 dB below the paragraph 15.207 limit. Conducted measurement plots showing the level of the conducted emissions are provided in Appendix A.

6.2 Conducted Test Instrumentation

The test instrumentation used to make conducted measurements is given in Appendix C.

7.0 RADIATED EMISSION DATA

The data below are the corrected highest level EME measurements taken from the following radiated data sheets. The data sheets include the emission frequencies and the corrected level. An explanation of the field strength calculation is given in paragraph 7.3.

7.1 Radiated Measurement Data

Measurements were made of the fundamental frequency of 134.2 kHz at 20 meters. The fundamental emission was near ambient noise level at a distance of 20 meters. Additionally, the spectrum was investigated for harmonics and spurious emissions to 30 MHz. No harmonics or spurious emissions were evident. The measurement level of the fundamental and the ambient noise at the 2^{nd} and 3^{rd} harmonic frequencies is shown in Table 7.1. Radiated emissions data sheets are on the following pages.

TABLE 7.1
MEASUREMENTS OF FUNDAMENTAL FREQUENCY

Judgment: EUT Passed by 31.4 dB

Frequency (kHz)	**Corrected Level[1] dB(µV/m)**	**Limit[2] dB(µV/m) Peak/Average**
134.2	40.6	92/72 (20 meters)
268.4	43.8 (ambient only)	98/78 (10 meters)
402.6	35.5 (ambient only)	85/65 (10 meters)

[1] All readings are peak measurements made with a spectrum analyzer and signal generator. Peak emission level of fundamental was under both the peak and average limit.
[2] Limit is calculated using a 40 dB/decade extrapolation factor, in accordance with FCC Part 15, Subpart C, "Intentional Radiator," paragraph 15.31, (f), (2).

The spectrum from 30 MHz to 1 GHz was investigated for spurious emissions at a distance of 3 meters. The worst case spurious emissions are given in Table 7.2. A peak signature scan is provided in Appendix A. Radiated emissions data sheets are on the following pages.

TABLE 7.2
MEASUREMENTS OF SPURIOUS EMISSIONS

Judgment EUT passed by 5.3 dB

Frequency (MHz)	**Corrected Level [1] dB(µV/m)**	**Limit dB(µV/m)**	**dB under limit**
146.27	34.8	43.5	8.7
157.52	38.2	43.5	5.3
326.2	28.6	46	17.4
378.75	28.9	46	17.1
566.3	36.1	46	9.9

[1] All readings are quasi-peak manual measurements made with a receiver.

The frequency and amplitude stability of the EUT was verified by varying the AC power to the EUT between 85% and 115% of the nominal 115 VAC. No discernable change was noted in the frequency or power output.

FREQUENCY (~~MHz~~) KHz	134.2	134.2	268.4	402.6	NO OTHER EMISSIONS DETECTED UP TO 30MHz.					
TRANSDUCER	ALR-25 BAND 4 →	S/N 371 →	→	BAND 5						
TRANSDUCER DIST. from EUT(m)/HEIGHT(m)	20 / 1	10 / 1	10 / 1	10 / 1						
POLARIZATION (V,H) AMBIENT NOISE (A)	V Parallel →	V →	V A →	V A						
SIGNAL DIRECTION	0°	0°	0°	0°	°	°	°	°	°	°
RECEIVER ATTENUATION (dB)	—	—	—	—						
METER READING (dBμV)	-13	5.5	-10.1	-14.9	→	MEASUREMENTS MADE WITH SPECTRUM ANALYZER AND SIGNAL GENERATOR FOR SUBSTITUTION.				
TRANSDUCER FACTOR (dB)	52.5	52.5	52.8	49.3						
EXTERNAL GAIN/ CABLE LOSS (dB)	1.1	1.1	1.1	1.1						
CORRECTED LEVEL (dBμV/m)	40.6	59.1	43.8	35.5	→	PEAK MEASUREMENTS MADE WITH SPECTRUM ANALYZER; LEVELS WERE BELOW PEAK AND AVG. LIMIT				
LIMIT (dBμV/m) Peak/AVG.	92/72	104/84	98/78	85/65	→	LIMIT CALCULATED USING 40dB/decade ROLLOFF TO COMPENSATE FOR MEASUREMENTS MADE CLOSER THAN 300m				

Date: Jan 6, 1999 Detection Method: ___ CISPR _X_ PEAK ___ AVERAGE ___ Other

OPR/Asst.: CRUZ / CARMONY EUT VERIFONE RF250 TERMINAL

Conf. ___ Run ___ of ___
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Notes, Measurements made with terminal on its side to maximize the EUT fundamental radiation signal level; could not see fundamental emission with RCV loop antenna perpendicular or horizontal; Scan to 30MHz made with EUT both on its side and on its back (laying flat).

Project No.: 10-2390-001

Test Category: Part 15. Para 15.209

Time, Temp., & % r.H.: 1900/52°/88%

Approved: David A Carmony

FREQUENCY (MHz)	146.27	157.52	157.52	407.4	326.2	378.75	453.9	566.3		
TRANSDUCER	BDA-25S	→	→	T-2	→	→	→	T3		
TRANSDUCER DIST. from EUT(m)/HEIGHT(m)	3 / 3	3 / 2	3 / 1	3 / 1	3 / 1	3 / 1	3 / 2.8	3 / 1	/	/
POLARIZATION (V,H) AMBIENT NOISE (A)	V	H	V	V/A	H	H	H/A	V		
SIGNAL DIRECTION	75 °	90 °	180 °	180 °	130 °	130 °	130 °	180 °	°	°
RECEIVER ATTENUATION (dB)	30	30	30	20	10	10	40	10		
METER READING (dBμV)	9	14	14	18.3	18.5	16	14.5	17.5		
TRANSDUCER FACTOR (dB)	15.4	16.2	16.2	22	19.2	21	24.1	23.8		
EXTERNAL GAIN/ CABLE LOSS (dB)	-19.6	-22	-22	-17.7	-19.1	-18.1	-16.9	-15.2		
CORRECTED LEVEL (dBμV/m)	34.8	38.2	38.2	42.6	28.6	28.9	61.7	36.1		
LIMIT (dBμV/m)	43.5	43.5	43.5	46	46	46	46	46		

Date: 12/21 and 12/28/98

Detection Method: X CISPR ___ PEAK ___ AVERAGE ___ Other

OPR/Asst.: VINSON

EUT VeriFone RF250 TERMINAL

Conf. ____ Run ____ of ____

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Notes, EUT positioned flat on table as in normal operating condition.

Project No.: 10-2390-001

Test Category: FCC Part 15 . 209

Time, Temp., & % r.H.: 8-5:00 / 50-80°F / 70%

Approved: David A Carmany

7.2 Test Instrumentation for Radiated Measurements

Scans were made at an open area test site (OATS) and in an RF semi-anechoic chamber 28' long x 16' wide x 16' high with its interior lined on the ceiling and four walls with pyramidal absorber material up to four feet in length. Measurements were made with a spectrum analyzer and a quasi-peak adapter in the anechoic chamber and OATS. A receiver was also used at the OATS. The list of test instrumentation used to perform the testing is shown in Appendix C.

7.3 Field Strength Calculation

The field strength was calculated by adding the antenna factor and cable factor, and subtracting the amplifier gain (when used) from the measured reading. The basic equation with a sample calculation is provided below:

FS = RA + AF + CF - AG

Where FS = Field Strength (Receiver attenuator)
RA = Receiver Amplitude (Receiver meter reading)
AF = Antenna Factor
CF = Cable Attenuation
AG = Amplifier Gain

For example, reducing the first column of the enclosed radiated data sheet on the preceding page, 146.27 MHz yields:

30.0 dB
9.0 dB(μV)
15.4 dB(1/m)
-19.6 dB (CF/AG FACTOR)
FS = 34.8 dB(μV/m)

To equation convert the dB(μV/m) value to its corresponding level in μV/m is as follows:

Level in μV/m Common Antilogarithm [(34.8 dBμV/m)/20] = 54.95 μV/m

8.0 PHOTOS OF TESTED EUT

The photographs of the EUT are in Appendix D.

APPENDIX A

CONDUCTED AND RADIATED SIGNATURE MEASUREMENTS PLOTS

(See File: *Append_A.wpd*)

APPENDIX B

CONDUCTED AND RADIATED MEASUREMENTS PHOTOS

Test Setup	**File Name**
Conducted Emissions Test	*conduct.jpg*
Radiated Emissions - Anechoic Chamber	*anechoic.jpg*
Radiated Emissions - OATS	*OATS.jpg*

APPENDIX C

TEST INSTRUMENTATION

EQUIPMENT USE REPORT

MANUFACTURER	MODEL NO.	DESCRIPTION	SERIAL NO.	CAL DATE
		CONDUCTED EMISSIONS		
HP	8568B	ANALYZER, SPECTRUM	2344A05883 2338A03029	3MAR99
HP	85650A	Q-PEAK ADAPTER	2043A00213	12FEB99
RHODE SCHWARZ	ESH2-25 338.52	NETWORK, MAINS	881362/017	13FEB99
ANECHOIC CHAMBER				
HP	8568B	ANALYZER, SPECTRUM	2344A05883 2338A03029	3MAR99
SWRI	UTC 10 221-1	PREAMP	9112SN15	VERIFIED
HP	85650A	Q-PEAK ADAPTER	2043A00213	12FEB99
EMCO	3121-DB3	ANTENNA, DIPOLE	148	VERIFIED
EMCO	3121-DB4	ANTENNA, DIPOLE	1097	VERIFIED
EMCO	3121-DB2	ANTENNA, DIPOLE	147	VERIFIED
FAIRCHILD	ALR-25	ANTENNA, LOOP	840	4DEC98
HP	8447D	PREAMP	2727A0226	VERIFIED
OATS				
POLARAD	342.4020.33	RECEIVER, EMI, 20-1000 MHz	872149/027	24APR99
HP	8568B	ANALYZER, SPECTRUM	2344A05883 2338A03029	3MAR99
HP	85685A	PRESELECTOR	2510A00123	30APR99
HP	85650A	QUASI-PEAK ADAPTER	2043A00213	12FEB99
MARCONI	2031	SIGNAL GEN.	119807/056	21AUG00
FAIRCHILD	ALR-25	ANTENNA, LOOP	371	16JAN99
SWRI	14-82-020	OATS PRE-AMP	---	VERIFIED
HP	8447D	PREAMP	2727A0226	VERIFIED
ELECTROMETRICS	BDA25S	ANTENNA, DIPOLE	535	24MAR99
EMPIRE	DM-105-T2	ANTENNA, DIPOLE	L-000176B	24MAR99
EMPIRE	DM-105-T3	ANTENNA, DIPOLE	L-000108	24MAR99

APPENDIX D

PHOTOGRAPHS OF THE EUT

EUT Photo	**File Name**
VeriFone RF250 System	*system.jpg*
View Showing Ferrite Bead Attached to RF250 Cable	*Ferrite.jpg*
View Showing Everest and RF250 Separated	*2_parts.jpg*
Everest, View With Case Open	*Ev_open.jpg*
Everest Bottom PCB	*Ev_b_PCB.jpg*
Everest Top PCB	*Ev_t_PCB.jpg*
View of RF250 With Case Open	*250_open.jpg*
RF250 Antenna; Bottom Photo Shows Antenna Removed From Unit	*Antenna.jpg*
RF250 PCB Bottom View	*250_PCBb.jpg*
RF250 PCB, Top View; Also View of Antenna	*250_PCBt.jpg*

ATTACHMENT 1

TECHNICAL DESCRIPTION AND BLOCK DIAGRAM

(See RF250 Theory of Operations, VFI Document No. 19223; *File: 19223.doc*)

ATTACHMENT 2

INSTALLATION GUIDE

(see File: RF250-A1.PDF)

ATTACHMENT 3

TECHNICAL DOCUMENTATION

Schematic/Drawing	VFI P/N	File Name
PCB ASSY, RF250 MAIN TIRIS	18256-01	RFMain.pdf
LED indicator PCBA	18262-01	RF_LED.pdf
Assembly drawing (with FCC ID# label location)	088-101-01-A	Location.pdf
Everest unit schematics	18082-01 18114-XX	EVDIS.pdf EVSYS.pdf
FCC ID label	02001-20	Label_SP.pdf