MEASUREMENT AND TECHNICAL REPORT ON THE SAT CORPORATION SRM RFID SYSTEM

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1.0 GENERAL INFORMATION

1.1 Product Description

The SAT Corporation SRM RFID System communicates with Texas Instruments TIRIS transponders under the control of a host computer. The system consists of the SRM RFID Module, the SRM RFID Handle, connecting cables and software. The system is added as an accessory to the Telxon PTC-2134 and PTC-2234 handheld computers. The handheld computers provide power and control the SRM RFID System using Windows software. The SRM RFID System emits low-level radio-frequency energy at 134.2 kHz and is subject to FCC Part 15, Subpart C, "Intentional Radiator", paragraph 15.209. The SRM RFID system receives signals from TIRIS transponders in the same frequency range. Attachment 1 contains a detailed technical description and functionality of the SRM RFID System (*File: Theory of Operations.pdf*). Attachment 2 contains the SRM RFID System Users Guide (*File: Users Guide.pdf*).

1.2 Related Grants

The SRM RFID System incorporates an RF module operating at 134.2 kHz that received certification under FCC ID: A92MICRO.

1.3 Tested System Details

The SRM RFID System consists of a SRM RFID Module, SRM RFID Handle, adapter board and antenna. The SRM RFID Module resides inside the host, handheld computer. The SRM RFID handle attaches to the side of the host computer with the adapter board and antenna inside the handle. Details of the SRM RFID System are presented in Attachment 1. Schematics of the SRM RFID System are provided in Attachment 3. The SRM RFID System 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 handheld computer model tested was a Telxon PTC-2134.

The SRM RFID System power is provided entirely by the host computer. The PTC computers use a proprietary Lithium-Ion battery pack. The SRM RFID System description, functionality, and block diagrams are located in Attachment 1, Theory of Operations, SRM RFID System, Revision A (*File: Theory of Operations.pdf*).

1.4 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4-1992, and the limits prescribed in CFR 47, FCC 15.209. Conducted emissions testing was not accomplished there being no interface with power mains by the SRM RFID System and the host computer during normal use of the SRM RFID System.

1.5 Test Facility

The open area test site (OATS) which is used during data collection is located at Southwest Research Institute, 6220 Culebra Road, San Antonio, Texas. Details concerning the test site 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 site 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 SRM RFID System is shown in Attachment 3 (*File: PTC Label.pdf and Module Label.pdf*).

2.2 Location of Label on EUT

The label is located on the back of the host computer case as shown in Appendix D (*File: Location.jpg*).

2.3 Supplemental Information to be in the SRM RFID System 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 SRM RFID System intentional radiator from 100 kHz to 30 MHz for the fundamental and harmonic frequencies. Radiated tests were performed up to 1 GHz for spurious emissions. Frequencies below 30 MHz were tested in the vertical antenna polarization only. Above 30 MHz both vertical and horizontal antenna polarizations were tested. Radiated signature scans were made, at a distance of 3 meters from the EUT, in a shielded semi-anechoic chamber.

3.2 EUT Exercise

The SRM RFID System was operated in the transmit mode at a one second transmit interval with a duty cycle of 50%, (transmit on for 500 millisecond, off for 500 millisecond).

3.3 Special Accessories

No special accessories are required for the SRM RFID System.

3.4 Equipment Modification

The EUT was not modified during 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 SRM RFID SYSTEM

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

5.0 RADIATED MEASUREMENT PHOTOS

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

6.0 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 6.3.

6.1 Radiated Measurement Data

Measurements (average and peak) were made of the fundamental frequency at 134.47 kHz, the second harmonic at 268.94 kHz and the third harmonic at 403.41 kHz. Because the EUT lacked a clear direction of radiation, measurements were taken with the EUT rotated 0°, 90°, 180° and 270°for all three frequencies. Measurements were taken with the receive antenna located 30 meters from the EUT. Additionally, the spectrum was investigated for harmonics and spurious emissions to 30 MHz. No further harmonics or spurious emissions were evident. The measurement levels of the fundamental, second and third harmonic frequencies are shown in Table 6.1. Radiated emissions data sheets are on the following pages.

TABLE 6.1
MEASUREMENTS OF FUNDAMENTAL FREQUENCY

Judgment: EUT Passed by 11.4 dB				
Frequency (kHz)	Corrected Level dBµV/m Average	Corrected Level dBµV/m Peak	Limit① dBµV/m Average	Limit① dBµV/m Peak
134.47(fundamental)	35.9	64.6	65 (30 meters)	85 (30 meters)
268.96	34.4	55.1	59 (30 meters)	79 (30 meters)
403.41	30.4	41.8	55 (30 meters)	75 (30 meters)

① 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 from the EUT. No emissions related to the EUT were seen in this frequency range. Quasi-Peak measurements of the ambients for this frequency are provided in the data sheets on the following pages. Peak signature scan plots are provided in Appendix A.

The EUT fundamental frequency and amplitude stability was evaluated at timed intervals at a distance of 2.5 meters. The timing sequence was at startup, 2 minutes, 5 minutes and 10 minutes. At startup the EUT contained a freshly charged battery pack. The fundamental showed no deviation in frequency or amplitude over the 10 minute test period.

	①	②	④	③	①					
FREQUENCY (~~MHz~~) KHz	134.47	134.47	268.96 ~~134.47~~	268.96	403.4	403.41				
TRANSDUCER ALR 25	ANT04	→	→	→	BAND 5	→				
TRANSDUCER DIST. from EUT(m)/HEIGHT(m)	30 / 1	30 / 1	30 / 1	30 / 1	30 / 1	30 / 1	/	/	/	/
POLARIZATION (V,H) AMBIENT NOISE (A)	— □	— □	— □	∣ □	— □	— □				
SIGNAL DIRECTION	270 °	270 °	270 °	180 °	270 °	0 °	°	°	°	°
RECEIVER ATTENUATION (dB)	-	-	-	-	-	-	no other emission from EUT found up to 30MHz.			
METER READING (dBμV)	-20.7	8	-19.4	1.3	-19.6	-8.2				
TRANSDUCER FACTOR (dB)	56	56	53	53	49	49				
EXTERNAL GAIN/ CABLE LOSS (dB)	0.6	0.6	0.8	0.8	1.0	1.0				
CORRECTED LEVEL (dBμV/m)	35.9	64.6	34.4	55.1	30.4	41.8				
LIMIT (dBμV/m) ③	65	85	54	74	55	75				

Date: 19 FEB 99

Detection Method: ___ CISPR ✓ PEAK ✓ AVERAGE ___ Other

OPR/Asst.: Hale

EUT SRM RFID SYSTEM

Conf. ____ Run ____ of ____
Page ____ of ____

Notes, ① average detector
② peak detector
③ used 40/dB/decade roll-off to calculate limit at 30 meters

Project No.: 10-2333-021

Test Category: ____

Time, Temp., & % r.H.: 10:11 55° 30%

Approved: David A Carney

FREQUENCY (MHz)	35	70	95.7	95.4	40	70	130.2	130	146.2	195
TRANSDUCER	BDA-25									
TRANSDUCER DIST. from EUT(m)/HEIGHT(m)	3.0 / 1.5	3.0 / 1.5	3.0 / 1.5	3.0 / 1.5	3.0 / 1.5	3.0 / 1.5	3.0 / 1.5	3.0 / 1.5	3.0 / 1.5	3.0 / 1.5
POLARIZATION (V,H) AMBIENT NOISE (A)	V A	V A	V Fm	H Fm	H A	H A	H A	~~H~~ V A	~~V~~ H RS	~~H~~ V A ~~RS~~
SIGNAL DIRECTION	180°	180°	180°	180°	180°	180°	180°	180°	180°	180°
RECEIVER ATTENUATION (dB)										
METER READING (dBμV)	3.0	4.9	11.0	3.7	-4.1	-0.3	-3.0	-2.4	+25.7	17.0
TRANSDUCER FACTOR (dB)	13	5.9	10.4	10.6	13.0	5.9	12.7	12.7	14.9	19
EXTERNAL GAIN/ CABLE LOSS (dB)	2.8	6.25	4.6	4.6	2.9	6.25	5.4	5.4	-19.6	-21.5
CORRECTED LEVEL (dBμV/m)	18.8	17.1	26.0	18.3	11.8	11.9	15.1 ~~18.1~~	15.7	21.0	14.5
LIMIT (dBμV/m)	40	40	43.5	43.5	40	40	43.5	43.5	43.5	43.5

Date: 19 Feb 99

Detection Method: X CISPR ___ PEAK ___ AVERAGE ___ Other

OPR/Asst.: Hale

EUT SRM RFID System

Conf. ___ Run ___ of ___
Page ___ of ___

Notes,

Project No.: 10-2333-021

Test Category: ___

Time, Temp., & % r.H.: 14:45 67° 25%

Approved: David A Carmany

FREQUENCY (MHz)	250	450.4	220	455	625	960	625	960		
TRANSDUCER	T2	→	→	→	T3	→	→	→		
TRANSDUCER DIST. from EUT(m)/HEIGHT(m)	3 / 1.5	3 / 1.5	3 / 1.5	3 / 1.5	3 / 1.5	3 / 1.5	3 / 1.5	3 / 1.5	/	/
POLARIZATION (V,H) AMBIENT NOISE (A)	V A	V A	H A	H A	H A	H A	V A	V A		
SIGNAL DIRECTION	180 °	180 °	180 °	180 °	180 °	180 °	180 °	180 °	°	°
RECEIVER ATTENUATION (dB)	—	—	—	—	—	—	—	—		
METER READING (dBμV)	14.6	11.2	15.5	10.9	9.8	9.0	14.4	9.2		
TRANSDUCER FACTOR (dB)	21.5	24.5	21.0	25	24.5	32	24.5	32.0		
EXTERNAL GAIN/ CABLE LOSS (dB)	-20.5	-17	-21	-16.8	-14.3	-11.5	-14.3	-11.5		
CORRECTED LEVEL (dBμV/m)	15.6	18.7	15.5	19.1	20.2	29.5	24.6	29.7		
LIMIT (dBμV/m)	46	46	46	46	46	46	46	46		

Date: 19 Feb 99 Detection Method: (CISPR) ___ PEAK ___ AVERAGE ___ Other

OPR/Asst.: Hank EUT SAM REED System

Conf. ____ Run ____ of ____ Notes, _____
Page ____ of ____

Project No.: 16-2333-021

Test Category: _____

Time, Temp., & % r.H.: 15:33 74° 24%

Approved: David A Carmony

6.2 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 in conjunction with a quasi-peak adapter (to set test system bandwidths) in the semi-anechoic chamber. Measurements were made with a receiver at the OATS facility. The list of test instrumentation used to perform the testing is shown in Appendix C.

6.3 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, 250 MHz yields:

14.6 dB(µV)
21.5 dB(1/m)
-20.5 dB (CF/AG FACTOR)
FS = 15.6 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 [(15.6 dBµV/m)/20] = 6.03 µV/m

7.0 PHOTOS OF TESTED EUT

The photographs of the EUT are in Appendix D.

APPENDIX A

RADIATED SIGNATURE MEASUREMENT PLOTS

(See File: *appenda.wpd*)

APPENDIX B

RADIATED MEASUREMENTS PHOTOS

Test Setup	File Name
Radiated Emissions - OATS	*OATS_2.jpg*

APPENDIX C

TEST INSTRUMENTATION

EQUIPMENT USE REPORT

MANUFACTURER	MODEL NO.	DESCRIPTION	SERIAL NO.	CAL DUE
ANECHOIC CHAMBER PRESCAN MEASUREMENTS				
Hewlett Packard	8568B	Spectrum Analyzer	2403A07074 2415A00464	19 Apr 99
SwRI	UTC 10 221-1	Preamplifier	9112SN15	Verified
HP	85650A	Quasi-Peak Adapter	2043A00213	8 Aug 99
EMCO	3121-DB3	Dipole Antenna	148	Verified
EMCO	3121-DB4	Dipole Antenna	1097	Verified
EMCO	3121-DB2	Dipole Antenna	147	Verified
Fairchild	ALR-25	Loop Antenna	371	19 Feb 99
Hewlett Packard	9816	Computer/Controller	2510A19823	NCR
Hewlett Packard	9121	Disk Storage Device	2341A52063	NCR
Hewlett Packard	225A	Printer	2240S30389	NCR
Hewlett Packard	7470A	Plotter	2517A18642	NCR
Hewlett Packard	8447F	Preamplifier	2727A2261	Verified
OATS MEASUREMENTS				
Rhodes & Swartz	ESN	Test Receiver 9kHz-2050 Mhz	DE10231	24 APR 99
Fairchild	ALR-25	Loop Antenna	371	19 FEB 99
SwRI	14-82-020	Preamplifier	---	Verified
Electrometrics	BDA25S	Dipole Antenna	535	24 Mar 99
Empire	DM-105-T2	Dipole Antenna	L-000176B	24 Mar 99
Empire	DM-105-T3	Dipole Antenna	L-000108	24 Mar 99

APPENDIX D

PHOTOGRAPHS OF THE EUT

EUT Photo	File Name
PTC With SRM Handle	*ptchan.jpg*
PTC Rear With Battery Exposed (FCC ID Tag location)	*location.jpg*
PTC With Exposed SRM Module	*ptcmod.jpg*
SRM RFID Module	*srmrfid.jpg*
Module PCA Top	*modulet.jpg*
Module PCA Bottom	*moduleb.jpg*
Adapter PCA Top	*adaptert.jpg*
Adapter PCA Bottom	*adapterb.jpg*

ATTACHMENT 1

TECHNICAL DESCRIPTION AND BLOCK DIAGRAM

(See Theory of Operations, SRM RFID System; *File: Theory of Operations.pdf*)

ATTACHMENT 2

USERS GUIDE

(see *File: user guide.pdf*)

ATTACHMENT 3

TECHNICAL DOCUMENTATION

Schematic/Drawing	**File Name**
SRM RFID Module Schematic	module schematic.pdf
SRM RFID Handle Adapter Schematic	adapter schematic.pdf
SRM RFID System Interconnects Diagram	system interconnects.pdf
Aspen FCC Label Sketch	PTC label.pdf
SRM RFID Module FCC Label	Module label.pdf