Elliott

Elliott Laboratories Inc.
www.elliottlabs.com

684 West Maude Avenue
Sunnyvale, CA 94086-3518

408-245-7800 Phone
408-245-3499 Fax

Electromagnetic Emissions Test Report and Request for Class II Permissive Change pursuant to FCC Part 15, Subpart C Specifiactions for a Intentional Radiator on the Cellnet Data Systems Model: Vectron MFMM

PRESENT FCC ID:	H6NCMM1301
GRANT DATE:	January 6, 1998
GRANTEE:	Cellnet Data Systems 125 Shoreway Road San Carlos, CA 94070
TEST SITE:	Elliott Laboratories, Inc. 684 W. MaudeAvenue Sunnyvale, CA 94086
REPORT DATE:	November 2, 1998
FINAL TEST DATE:	September 16, 1998

AUTHORIZED SIGNATORY: Mark Briggs

Mark Briggs
Manager, EMC Consulting Services

TABLE OF CONTENTS

COVER PAGE 1
TABLE OF CONTENTS 2
SCOPE 3
OBJECTIVE 3
TEST SITE 4
GENERAL INFORMATION 4
CONDUCTED EMISSIONS CONSIDERATIONS 4
RADIATED EMISSIONS CONSIDERATIONS 4
MEASUREMENT INSTRUMENTATION 5
RECEIVER SYSTEM 5
INSTRUMENT CONTROL COMPUTER 5
LINE IMPEDANCE STABILIZATION NETWORK (LISN) 5
FILTERS/ATTENUATORS 6
ANTENNAS 6
ANTENNA MAST AND EQUIPMENT TURNTABLE 6
INSTRUMENT CALIBRATION 6
TEST PROCEDURES 7
EUT AND CABLE PLACEMENT 7
CONDUCTED EMISSIONS 7
RADIATED EMISSIONS 7
SPECIFICATION LIMITS AND SAMPLE CALCULATIONS 8
CONDUCTED EMISSIONS SPECIFICATION LIMITS 8
RADIATED EMISSIONS SPECIFICATION LIMITS 8
SAMPLE CALCULATIONS - CONDUCTED EMISSIONS 9
SAMPLE CALCULATIONS - RADIATED EMISSIONS 10
EQUIPMENT UNDER TEST (EUT) DETAILS 11
GENERAL 11
ENCLOSURE 11
INPUT POWER 11
PRINTED WIRING BOARDS 11
TEST SOFTWARE 11
PROPOSED MODIFICATION DETAILS 12
GENERAL 12
PRINTED WIRING BOARD LAYOUT 12
TEST RESULTS 13
TEST DATA ANALYSIS - CONDUCTED 13
TEST DATA ANALYSIS - POWER AND BANDWIDTH 13
TEST DATA ANALYSIS - RADIATED HARMONIC AND SPURIOUS 13

EXHIBIT A Test Equipment Calibration
EXHIBIT C Test Measurement Data
EXHIBIT D Photographs of Test Configurations
EXHIBIT D Detailed Photographs of the Construction
EXHIBIT E Block Diagram
EXHIBIT F Schematic Diagrams
EXHIBIT G Theory of Operation
EXHIBIT H Operator's Manual

SCOPE

An electromagnetic emissions test has been performed on the Cellnet Data Systems spread spectrum radio model Vectron MFMM pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in FCC Rules This test has been performed to confirm continued compliance of a new version of the model Vectron MFMM in accordance with Part 2, Section 2.1043 of the FCC Rules for permissive changes to Certified devices.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Cellnet Data Systems model Vectron MFMM and therefore apply only to the tested sample. The sample was selected and prepared by Gilbert Roque of Cellnet Data Systems.

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. In this case, minor modifications to the design of the subject device require that additional testing be performed to demonstrate that the device continues to comply with the Rules. The original Grant of Equipment Authorization issued by the FCC for the Certification of the subject device will be valid for the new version once acceptance is received from the FCC.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a Grant of Equipment Authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units which are subsequently manufactured.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on September 16, 1998 at the Elliott Laboratories Open Area Test Site located at 684 West Maude Avenue, Sunnyvale, California. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

AN EMI receiver as specified in CISPER 16 is used for emissions measurements. The ESH3 receiver can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers, allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the particular detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

A Rohde and Schwarz EZM Spectrum Monitor/Controller is utilized to convert the receiver measurements to the field strength at the antenna, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate.

The EZM provides a visual display of the signal being measured. In addition, the EZM Spectrum Monitor runs the automated data collection programs which control both receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors, are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The 50 uH LISNs used were manufactured by Fischer Custom Communications, model LISN-3 in combination with a 250 uH Fischer Custom Communications LISN-3 CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used.

The antenna calibration factors are included in site factors which are programmed into the test receivers

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An appendix of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 to 1000 MHz. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

RADIATED EMISSIONS SPECIFICATION LIMITS

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20*LOG_{10}(D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Cellnet Data Systems model Vectron MFMM is a spread spectrum radio which is designed to transmit electricity-meter readings to a local base-station. The sample was received on September 16, 1998 and tested on September 14 and September 16, 1998. The EUT consisted of the following component:

Manufacturer/Model/Description	Serial Number	FCC ID Number
Cellnet Data Vectron MFMM Electric Meter	14 608 844	H6NCMM1301

ENCLOSURE

The EUT enclosure is primarily constructed of plastic It measures approximately 14 cm wide by 9.5 cm deep by 14 cm high.

INPUT POWER

The power supply is built into the transmitter printed circuit board and takes its power via a step-down transformer.

PRINTED WIRING BOARDS

The Cellnet Data Systems model Vectron MFMM contained the following printed wiring boards during emissions testing:

Manufacturer/Description	Assembly #	Rev.	Serial #	Crystals (MHz)
Cellnet/Main Transmiiter PCBA	25-1457	05	C083V3598000002 73	14.54
Schlumberger Electric Meter	-	-	14 608 844	-

TEST SOFTWARE

The EUT contained test software running during testing which continuously exercised the system by transmitting a typical data signal once every second.

PROPOSED MODIFICATION DETAILS

GENERAL

This section details the modifications to the Cellnet Data Systems model Vectron MFMM being proposed. All performance and construction deviations from the characteristics originally reported to the FCC are addressed

PRINTED WIRING BOARD LAYOUT

The layout of the printing wiring board has been modified to permit the installation of the EUT into different electricity-meters.

These proposed changes affected the output power and radiated spurious emissions. They will not affect the spectral content of the transmitted signal or the processing gain of the system. The radiated spurious emissions and output power were re-measured. As the spectral content of the output is unchanged, the power spectral density was assumed to be directly proportional to the output power and calculated using this relationship.

TEST RESULTS

TEST DATA ANALYSIS - CONDUCTED

The following measurements were extracted from the data recorded during the conducted emissions scan and represent the highest amplitude peaks relative to the specification limit. The actual test data and correction factors are contained in the appendices of this report.

Conducted Emissions, 0.45-30.0 MHz

Frequency MHz	Level dBuV	Power Lead	FCC B Limit	FCC B Margin	Detector Function	Comments
0.5150	45.1	Line 1	48.0	-2.9	QP	Note 1

Note 1: According to FCC part 15.207 (b) this emission is not consider to be broadband.

TEST DATA ANALYSIS - POWER AND BANDWIDTH

The output power was calculated from the radiated field strength to be 20.6 dBm. This was an increase of 6.2 dB from the 14.2 dBm output power originally reported to the FCC.

The power density was not re-measured. The spectral content of the output has not been changed from the original submittal.. As the fundamental output power increased by 6.2dB form the previously reported level, the power density will also have increased by 6.2dB, giving a level of -0.4dBm in a 3KHz bandwidth averaged over 1 second. (The level originally reported to the FCC was -6.6 dBm).

The proposed changes will not affect the 6dB bandwidth (1.260 MHz) reported in the original application for this device.

TEST DATA ANALYSIS - RADIATED HARMONIC AND SPURIOUS

The following measurements were extracted from the data recorded during the radiated electric field emissions scan and represent the highest amplitude peaks relative to the specification limit. The actual test data and correction factors are contained in the appendices of this report.

30- 9300 MHz

Frequency MHz	Level dBuV/m	Pol v/h	FCC B Limit	FCC B Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
7340.700	53.3	v	54.0	-0.7	Peak	40	1.0	Peak Reading, Avg Limit
611.716	40.5	v	46.0	-5.5	QP	30	1.6	Peak Reading, Avg Limit
611.716	40.1	h	46.0	-5.9	QP	15	1.2	
407.810	35.5	h	46.0	-10.5	QP	310	1.0	
961.279	40.2	v	54.0	-13.8	QP	70	1.0	
961.279	39.2	h	54.0	-14.8	QP	5	1.1	
112.512	27.8	h	43.5	-15.7	QP	290	1.6	

EXHIBIT A

Test Equipment Calibration

Test Equipment List - SVOATS#3

	Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☒	Elliott Laboratories	Biconical Antenna, 30-300 MHz	EL30.300	54, (F131)	12	11/24/97	11/24/98
☒	Elliott Laboratories	300-1000 MHz Log Periodic	EL300.1000	297, (F113)	12	11/10/97	11/10/98
☐	EMCO	Double Ridge Horn Antenna, 1-18	3115	487	12	6/18/98	6/18/99
☐	EMCO	Double Ridge Horn Antenna, 1-18	3115	786	12	11/13/97	5/13/99
☒	Fischer	LISN	FCC-LISN-50/2	810	12	1/29/98	1/29/99
☐	Hewlett Packard	Power Meter	432A	259, (F304)	12	3/10/98	3/10/99
☐	Hewlett Packard	Spectrum Analyzer	8563E	284, (F194)	24	1/14/98	1/14/2000
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5	8449B	263, (F303)	12	6/8/98	6/8/99
☐	Hewlett Packard	Thermistor Mount	478A	652	12	3/10/98	3/10/99
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	24	10/24/97	10/24/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	12	11/10/97	11/10/98
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	787	12	10/27/97	10/27/98
☐	Narda-West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/27/98	4/27/99
☐	Narda-West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	248	12	4/27/98	4/27/99
☒	Rohde &Schwarz	Test Receiver, 20-1300MHz	ESVP	213, (F196)	12	10/3/97	10/3/98
☒	Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	274	12	4/8/98	4/8/99
☒	Rohde& Schwarz	Pulse Limiter	ESH3Z2	812	12	2/5/98	2/5/99
☒	Solar Electronics	High Pass Filter, fc = 8 kHz	7930-8.0	223	12	7/27/98	7/27/99

File Number: 28206

Date: 9/14/98
Engr: Pamela Galvan

Test Equipment List - SVOATS#3

Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☐ Elliott Laboratories	Biconical Antenna, 30-300 MHz	EL30.300	54, (F131)	12	11/24/97	11/24/98
☐ Elliott Laboratories	300-1000 MHz Log Periodic	EL300.1000	297, (F113)	12	11/10/97	11/10/98
☐ EMCO	Double Ridge Horn Antenna, 1-18	3115	487	12	6/18/98	6/18/99
☑ EMCO	Double Ridge Horn Antenna, 1-18	3115	786	12	11/13/97	5/13/99
☐ Fischer	LISN	FCC-LISN-50/2	810	12	1/29/98	1/29/99
☐ Hewlett Packard	Power Meter	432A	259, (F304)	12	3/10/98	3/10/99
☑ Hewlett Packard	Spectrum Analyzer	8563E	284, (F194)	24	1/14/98	1/14/2000
☐ Hewlett Packard	Microwave Preamplifier, 1-26.5	8449B	263, (F303)	12	6/8/98	6/8/99
☐ Hewlett Packard	Thermistor Mount	478A	652	12	3/10/98	3/10/99
☐ Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	24	10/24/97	10/24/99
☑ Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	12	11/10/97	11/10/98
☐ Hewlett Packard	EMC Receiver /Analyzer	8595EM	787	12	10/27/97	10/27/98
☐ Narda-West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/27/98	4/27/99
☑ Narda-West	EMI Filter 2.4-GHz, High Pass	60583 HPF-161	248	12	4/27/98	4/27/99
☐ Rohde &Schwarz	Test Receiver, 20-1300MHz	ESVP	213, (F196)	12	10/3/97	10/3/98
☑ Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	274	12	4/8/98	4/8/99
☑ Rohde& Schwarz	Pulse Limiter	ESH3Z2	812	12	2/5/98	2/5/99
☐ Solar Electronics	High Pass Filter, fc = 8 kHz	7930-8.0	223	12	7/27/98	7/27/99

File Number: D28251

Date: 9/16/98
Engr: [illegible]

EXHIBIT B

Test Measurement Data

The following data includes conducted emission measurements of the Cellnet Data Systems model Vectron MFMM and maximized radiated emissions measurements of the complete system.

Elliott

EMC Test Log

Client:	Cellnet Data Systems	Date:	9/14/98	Test Engr:	Pamela Galvan
Product:	Vectron MFMM Electric Meter	File:	T28206	Proj. Eng:	Mark Briggs
Objective:	Final Qualification	Site:	SVOATS #3	Contact:	Gilbert Roque
Spec:	FCC Part 15	Page:	1 of 3	Approved:	
Revision	1.0				

Ambient Conditions	
Temperature:	18 °C
Humidity:	60 %

Test Objective

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification(s) defined above.

Test Summary

Run #1 - Output Power

PASS The output power was calculated from the peak field strength at a distance of 3m to be 20.6 dBm.

Run #2- UnMaximized Preliminary Radiated Emissions, 30 - 1000 MHz

PASS Results: FCC B - 5.5 dB Avg @ 611.716MHz Vertical

Run #3- Maximized Radiated Emissions, 30 - 1000 MHz

PASS Results: FCC B - 5.5 dB Avg @ 611.716MHz Vertical

Equipment Under Test (EUT) General Description

The EUT is a spread spectrum radio which is designed to transmit electricity-meter readings to a local base-station. When installed the EUT could be placed in a variety of locations. For the purposes of testing the unit was treated as table-top equipment. The EUT was, therefore, placed in this position during emissions testing to simulate the end user environment..

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Cellnet Data Vectron MFMM Electric Meter	14 608 844	H6NCMM1301

Power Supply and Line Filters

The power supply is built into the transmitter printed circuit board and takes its power via a step-down transformer.

Elliott

EMC Test Log

Client:	Cellnet Data Systems	Date:	9/14/98	Test Engr:	Pamela Galvan
Product:	Vectron MFMM Electric Meter	File:	T28206	Proj. Eng:	Mark Briggs
Objective:	Final Qualification	Site:	SVOATS #3	Contact:	Gilbert Roque
Spec:	FCC Part 15	Page:	2 of 3	Approved:	
Revision	1.0				

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Cellnet/Main Transmiiter PCBA	25-1457	05	C083V359800000273	14.54
Schlumberger Electric Meter	-	-	14 608 844	-

Subassemblies in EUT

Manufacturer/Description	Assembly Number	Rev.	Serial Number
None	-	-	-

EUT Enclosure(s)

The EUT enclosure is primarily constructed of plastic It measures approximately 14 cm wide by 9.5 cm deep by 14 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
None	-	-

Local Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
None	-	-

Remote Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
None	-	-

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
None	-	-	-

Note: No external interface cabling other than the AC mains connection.

Test Software

The EUT contained test software running during testing which continuously exercised the system by transmitting signal once every second.

General Test Conditions

During radiated testing, the EUT was connected to 120V, 60Hz power input. The EUT was located on the turntable for radiated testing.

Test Data Tables

See attached data

Elliott — Emissions Test Data

Client:	Cellnet	Date:	9/14/98	Test Engr:	Pamela Galvan
Product:	Vectron MFMM Electric Meter	File:	T28206	Proj. Engr:	Mark Hill
Objective	Permissive Change	Site:	SVOATS #3	Contact:	Gilbert Roque
Spec:	FCC B	Distance:	3 m	Approved:	

Ambient Conditions
Temperature: 25 ℃
Humidity: 53 %

S/N: 14 608 844

Run #1: Fundamental output power
With grounding wire

Frequency	Level	Pol	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Pk/QP/Avg	degrees	meters	
917.580	109.4	h	Pk	235	1.0	Fundamental Frequency, IF BW=1 MHz
917.580	115.8	v	Pk	310	1.0	Fundamental Frequency, IF BW=1 MHz

Output power = 20.6 dBm using P= (30.P.G) / d and assuming G = 0dBi.

Run #2: Initial radiated scan, 30-1000 MHz

Frequency	Level	Pol	FCC B	FCC B	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
611.716	40.5	v	46.0	-5.5	QP	30	1.6	
611.716	40.1	h	46.0	-5.9	QP	15	1.2	
407.810	35.5	h	46.0	-10.5	QP	310	1.0	
961.279	40.2	v	54.0	-13.8	QP	70	1.0	
961.279	39.2	h	54.0	-14.8	QP	5	1.1	
112.512	27.8	h	43.5	-15.7	QP	290	1.6	
112.512	26.4	v	43.5	-17.1	QP	240	1.0	
407.810	28.3	v	46.0	-17.7	QP	140	1.0	
75.007	19.1	v	40.0	-20.9	QP	0	2.0	
75.007	18.1	h	40.0	-21.9	QP	80	2.6	
305.300	59.7	h	89.4	-29.7	QP	315	1.0	Note 1
879.000	59.1	h	89.4	-30.3	QP	0	1.5	Note 1
879.000	62.9	v	95.8	-32.9	QP	80	1.0	
856.000	55.0	h	89.4	-34.4	QP	20	1.3	Note 1
856.000	51.6	v	95.8	-44.2	QP	310	1.0	Note 1
305.300	49.0	v	95.8	-46.8	QP	265	1.0	Note 1
834.600	40.8	h	89.4	-48.6	QP	10	1.2	Note 1
834.000	39.3	v	95.8	-56.5	QP	55	1.0	Note 1

Note 1: Unrestricted Band; Limit=Fundamental-20

Elliott

Emissions Test Data

Client:	Cellnet	Date:	9/14/98	Test Engr:	Pamela Galvan
Product:	Vectron MFMM Electric Meter	File:	T28206	Proj. Engr:	Mark Hill
Objective	Permissive Change	Site:	SVOATS #3	Contact:	Gilbert Roque
Spec:	FCC B	Distance:	3 m	Approved:	

Run #3: Maximized readings from run #2

Frequency	Level	Pol	FCC B	FCC B	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
611.716	40.5	v	46.0	-5.5	QP	30	1.6	
611.716	40.1	h	46.0	-5.9	QP	15	1.2	
407.810	35.5	h	46.0	-10.5	QP	310	1.0	
961.279	40.2	v	54.0	-13.8	QP	70	1.0	
961.279	39.2	h	54.0	-14.8	QP	5	1.1	
112.512	27.8	h	43.5	-15.7	QP	290	1.6	

Elliott

EMC Test Log

Client:	Cellnet Data Systems	Date:	9/16/98	Test Engr:	Rudy Suy
Product:	Vectron MFMM Electric Meter	File:	T28251	Proj. Eng:	Mark Briggs
Objective:	Final Qualification	Site:	SVOATS #3	Contact:	Gilbert Roque
Spec:	FCC Part 15	Page:	1 of 3	Approved:	
Revision	1.0				

Ambient Conditions	
Temperature:	18 °C
Humidity:	60 %

Test Objective

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification(s) defined above.

Test Summary

Run #1- Maximized Radiated Emissions, 1000 - 10000 MHz

PASS Results: FCC B -6.1 dB Avg @ 8258.276 MHz Horizontal

Run #2 - Conducted Emissions Scan of EUT, 0.45-30.00 MHz, 120V, 60Hz

PASS Results: FCC B -2.9 dB QP @ 0.5150 MHz Line

Equipment Under Test (EUT) General Description

The EUT is a spread spectrum radio which is designed to transmit electricity-meter readings to a local base-station. When installed the EUT could be placed in a variety of locations. For the purposes of testing the unit was treated as table-top equipment. The EUT was, therefore, placed in this position during emissions testing to simulate the end user environment..

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Cellnet Data Vectron MFMM Electric Meter	14 608 844	H6NCMM1301

Power Supply and Line Filters

The power supply is built into the transmitter printed circuit board and takes its power via a step-down transformer.

Elliott

EMC Test Log

Client:	Cellnet Data Systems	Date:	9/16/98	Test Engr:	Rudy Suy
Product:	Vectron MFMM Electric Meter	File:	T28251	Proj. Eng:	Mark Briggs
Objective:	Final Qualification	Site:	SVOATS #3	Contact:	Gilbert Roque
Spec:	FCC Part 15	Page:	2 of 3	Approved:	
Revision	1.0				

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Cellnet/Main Transmiiter PCBA	25-1457	05	C083V359800000273	14.54
Schlumberger Electric Meter	-	-	14 608 844	-

Subassemblies in EUT

Manufacturer/Description	Assembly Number	Rev.	Serial Number
None	-	-	-

EUT Enclosure(s)

The EUT enclosure is primarily constructed of plastic It measures approximately 14 cm wide by 9.5 cm deep by 14 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
None	-	-

Local Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
None	-	-

Remote Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
None	-	-

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
None	-	-	-

Note: No external interface cabling other than the AC mains connection.

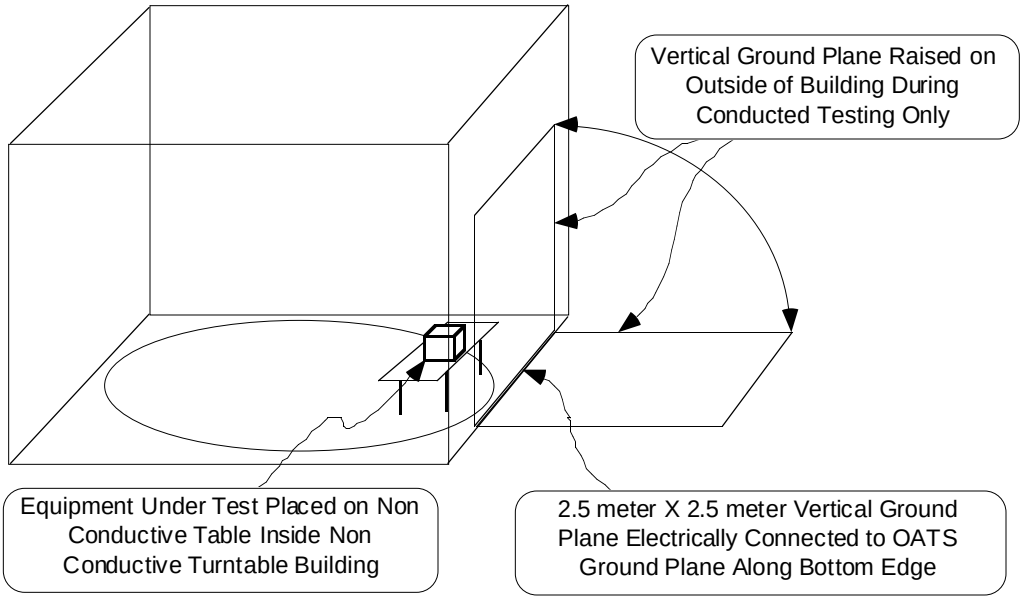
Test Software

The EUT contained test software running during testing which continuously exercised the system by transmitting signal once every second.

General Test Conditions

During radiated testing, the EUT was connected to 120V, 60Hz power input. The EUT was located on the turntable for radiated testing and conducted testing.

During conducted emissions testing, the EUT was connected to 120V, 60Hz power input as noted. A 2.5 meter X 2.5 meter ground plane was raised to a vertical position 40 cm from the EUT as shown below:



Test Data Tables

See attached data

Elliott — Emissions Test Data

Client:	Cellnet Data Systems	Date:	9/16/98	Test Engr:	Rudy Suy
Product:	Vectron MFMM Electric Meter	File:	D28251	Proj. Engr:	Mark Briggs
Objective	Final Qualification	Site:	SVOATS #3	Contact:	Gilbert Roque
Spec:	FCC Part 15	Distance:	3m	Approved:	

Ambient Conditions

Temperature: 18 °C

Humidity: 60 %

Elliott equimpent: Horn #786, Pre-Amp#785, Filter #248 and Analyzer #284.

Run #1: Initial radiated scan, 1000-10000 MHz, Restricted Band was Compared to FCC B,
Frequencies that do not fall within a Restricted Band must be 20dB below the Fundamental.
EUT grounded to ground plane during testing.
Serial #14 608 844 (0 001 220 908)

Frequency	Level	Pol	FCC B	FCC B	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7340.700	53.3	v	54.0	**-0.7**	Peak	40	1.0	Peak Reading, Avg Limit
7340.700	53.1	h	54.0	**-0.9**	Peak	330	1.9	Peak Reading, Avg Limit
8258.276	47.9	h	54.0	**-6.1**	Avg.	80	1.5	
9175.856	44.6	h	54.0	**-9.4**	Avg.	350	1.5	
9175.856	44.3	v	54.0	**-9.7**	Avg.	260	1.0	
8258.276	44.2	v	54.0	**-9.8**	Avg.	350	1.0	
4587.957	43.1	v	54.0	**-10.9**	Avg.	350	1.0	
4587.957	43.1	h	54.0	**-10.9**	Avg.	250	1.9	
3670.377	42.9	h	54.0	**-11.1**	Avg.	320	1.7	
4587.957	61.6	v	74.0	**-12.4**	Peak	350	1.0	
8258.276	60.7	h	74.0	**-13.3**	Peak	80	1.5	
4587.957	60.7	h	74.0	**-13.3**	Peak	250	1.9	
3670.377	40.6	v	54.0	**-13.4**	Avg.	50	1.0	
2752.797	40.1	v	54.0	**-13.9**	Avg.	50	1.0	
2752.797	40.1	h	54.0	**-13.9**	Avg.	10	1.6	
2752.797	59.7	v	74.0	**-14.3**	Peak	50	1.0	
2752.797	58.8	h	74.0	**-15.2**	Peak	10	1.6	
9175.856	57.7	v	74.0	**-16.3**	Peak	260	1.0	
8258.276	57.0	v	74.0	**-17.0**	Peak	350	1.0	
3670.377	57.0	h	74.0	**-17.0**	Peak	320	1.7	
9175.856	56.5	h	74.0	**-17.5**	Peak	350	1.5	
3670.377	56.3	v	74.0	**-17.7**	Peak	50	1.0	
1835.217	77.3	v	95.8	**-18.5**	Peak	10	1.0	Not in Restricted Band
1835.217	31.4	v	95.8	**-64.4**	Avg.	10	1.0	Not in Restricted Band
6423.111	63.6	v	95.8	**-32.2**	Peak	340	1.0	Not in Restricted Band
6423.111	46.4	v	95.8	**-49.4**	Avg.	340	1.0	Not in Restricted Band
1835.217	74.2	h	95.8	**-21.6**	Peak	40	1.6	Not in Restricted Band
1835.217	35.0	h	95.8	**-60.8**	Avg.	40	1.6	Not in Restricted Band

Note: No correction factor added to Average Reading yet.

Emissions Test Data

Client:	Cellnet Data Systems	Date:	9/16/98	Test Engr:	Rudy Suy
Product:	Vectron MFMM Electric Meter	File:	D28251	Proj. Engr:	Mark Briggs
Objective	Final Qualification	Site:	SVOATS #3	Contact:	Gilbert Roque
Spec:	FCC Part 15	Distance:	3m	Approved:	

Run #2: Conducted Emissions, 120V/60Hz

Frequency	Level	Power	FCC B	FCC B	Detector	Comments
MHz	dBuV	Lead	Limit	Margin	Function	
0.5150	45.1	Line 1	48.0	**-2.9**	QP	Note 1
0.6163	42.9	Line 1	48.0	**-5.1**	QP	Note 1
0.7189	42.2	Line 1	48.0	**-5.8**	QP	Note 1
0.9243	41.8	Line 1	48.0	**-6.2**	QP	Note 1
2.0493	41.1	Line 1	48.0	**-6.9**	QP	
2.1501	40.8	Line 1	48.0	**-7.2**	QP	
7.8000	36.0	Neutral	48.0	**-12.0**	QP	
4.2013	30.9	Neutral	48.0	**-17.1**	QP	
0.5150	30.6	Neutral	48.0	**-17.4**	QP	

Note 1 According to FCC part 15.207 (b) this emission is not consider to be broadband.

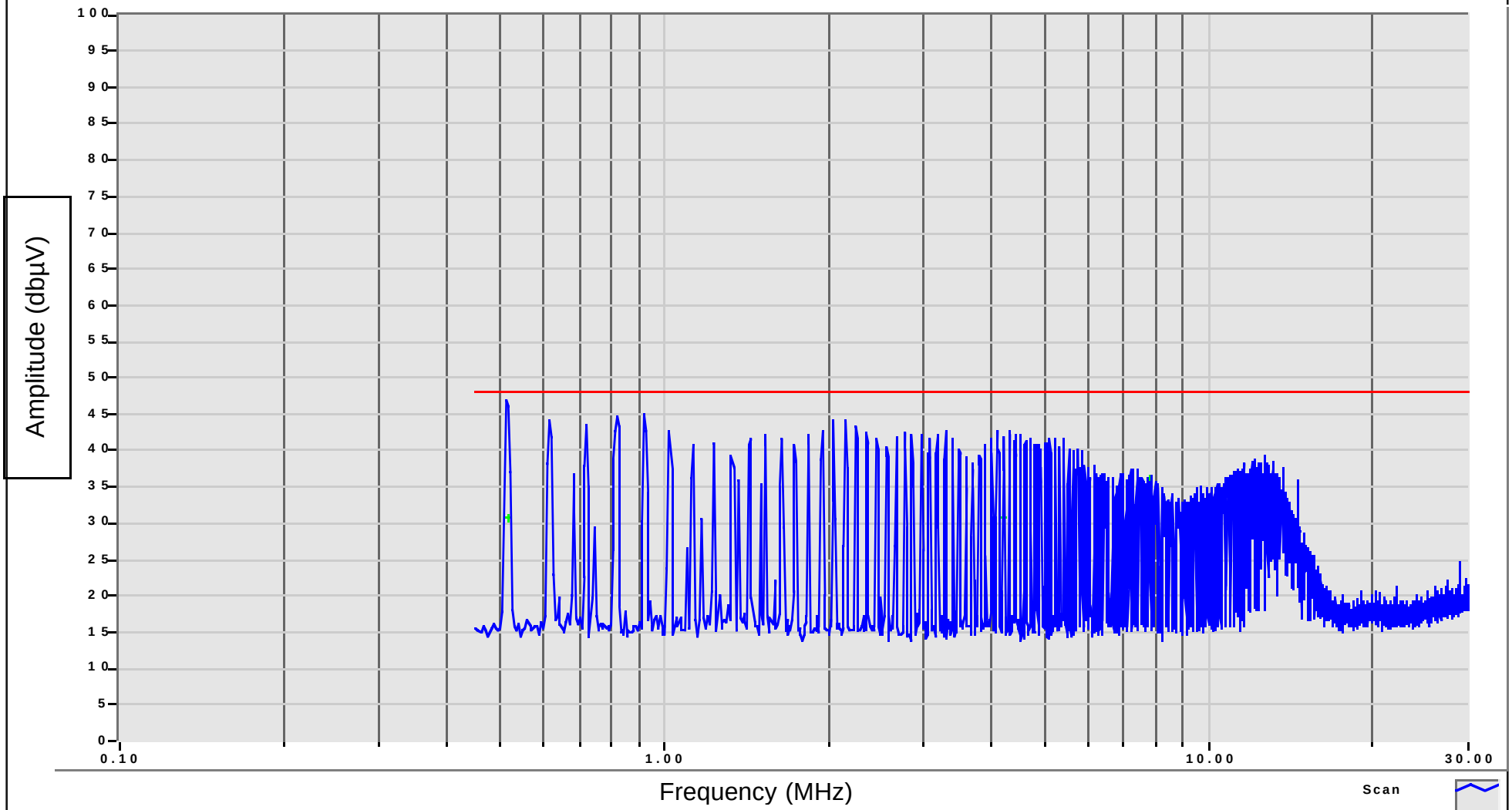
SVOATS #3: Cellnet Data Vectron MFMM Electric Meter Run 2

Elliott

Spec:

Mains Lead

Neutral



120V, 60Hz. Line with grounding wire to EUT

Scan
Peak
Quasi-peak
Average
QuasiPeak
Limit 2

12/8/98

Rudy Suy