

FCC/MELLON JAN 21 1990

EXHIBIT C

EMI TEST REPORT

**FCC PART 15 SUB-PART B & C
EMI TEST REPORT**

on

**Vectron Solid-State Polyphase Remote Meter Interface
FCC ID: NVCRM10006**

model names

110ES-VE00-PP (Internal Antenna)

110ES-VE02-PP (Internal Antenna)

&

110ES-VE01-PP (External Antenna)

110ES-VE03-PP (External Antenna)

provided for evaluation by

**Whisper Communications, Incorporated
3200 Coronado Drive
Santa Clara, California 95054**

tests and evaluation performed by

Rockford Engineering Services Inc.

9959 Calaveras Road, Box 543

Sunol, California 94586-0543

Tel: (925) 862-2944

Fax: (925) 862-9013

Email: service@rockfordengr.com

Web Site: <http://www.resemc.com>



EN45001 Accredited Compliance Laboratory [RES-GmbH]

Registration number: TTI-P-G 159/98-00 [RES-GmbH]

FCC PART 15 SUB-PART B & C EMI TEST REPORT

on

Vectron Solid-State Polyphase Remote Meter Interface 110ES-VE00-PP (Internal Antenna) 110ES-VE02-PP (Internal Antenna) & 110ES-VE01-PP (External Antenna) 110ES-VE03-PP (External Antenna)

provided for evaluation by

**Whisper Communications, Incorporated
3200 Coronado Drive
Santa Clara, California 95054**

This report contains 57 pages without attachments

AGENCY DECLARATION/DISCLAIMER

All services undertaken are subject to the following general policy: Reports are submitted for exclusive use of the client to whom they are addressed. Their significance is subject to the adequacy and representative character of the samples and to the comprehensiveness of the tests, examinations or surveys made. No quotations from reports or use of RES name or NVLAP or VCCI logo is permitted except as expressly authorized by RES or NVLAP or VCCI in writing. It is agreed between RES, NVLAP, VCCI and the client that no distribution in part of any test data herein or of this reports or analysis shall be made to any third party without the prior written consent of both parties. This report is not valid unless copied in full. All parties acknowledge that this report must not be used to claim product endorsement by RES and/or NVLAP or VCCI. Reports are maintained on file for a period of five years. Additional copies of reports are available at a nominal fee. In correspondence concerning this report please refer to the date, manufacturer's name and the report number.

Accepted by the Federal Communications Commission (FCC) for FCC Methods, CISPR Methods and AUSTEL Technical Standards (Ref: NVLAP Lab Code 200172-0)

Approved by the Industry Canada for Telecom Testing

Certified by Rockford Engineering Services GmbH for EMC Testing according to the European EMC Directive 89/336/EEC per EN45001

**Certified by Reg. TP for EMC Testing according to the European EMC Directive 89/336/EEC per EN45001
For RES GmbH (DAR-Registration number: TTI-P-G 159/98-00)**

**Certified by the Voluntary Control Council for Interference by Information Technology Equipment (VCCI)
For EMC testing, in accordance with the Regulations for Voluntary Control Measures, Article 8,
Registration Numbers- Site 1: C-714 & R-696 and Site 2: C-715 & R-697**

TABLE OF CONTENTS

Part 1 General	16
1.1 Test Methodology	16
1.1.2 Test Facility.....	16
1.1.3 Accuracy of Test Data	16
1.2 Summary	17
1.2.1 Description of EUT.....	17
1.2.2 Support Equipment Included in Tests	19
FCC Part 15 SubPart B	
Part 2 Power line Conducted Emissions	20
2.1 Configuration and Procedure	20
2.1.1 EUT Configuration	20
2.1.2 Test Procedure.....	20
2.1.3 Field Strength Calculation	20
2.2 Power line Conducted Emissions	21
2.2.1 Administrative Details.....	21
2.2.2 EUT Configuration Summary.....	21
2.2.3 Test Results	21
FCC Part 15 SubPart B	
Part 3 Open Field Radiated Emissions	26
3.1 Configuration and Procedure.....	26
3.1.1 EUT Configuration.....	26
3.1.2 Test Procedure.....	26
3.1.3 Field Strength Calculation	26
3.2 Open Field Radiated Emissions	27
3.2.1 Administrative Detail.....	27
3.2.2 EUT Configuration Summary.....	27
3.2.3 Test Results	27
FCC Part 15 SubPart C	
Part 4 Bandwidth Tests	29
4.1 Configuration and Procedure.....	29
4.1.1 EUT Configuration.....	29
4.1.2 Test Procedure.....	29
4.2 Bandwidth Tests	30
4.2.1 Administrative Detail.....	30
4.2.2 Fundamental & Harmonics of External Antenna Test Results	30

TABLE OF CONTENTS, CONTD.

TABLES

2.2.3	Powerline Conducted Emissions for Internal Antenna	21-23
2.2.3	Powerline Conducted Emissions for External Antenna	24-25
3.2.3	Open Field Radiated Emissions Internal Antenna	27
3.2.3	Open Field Radiated Emissions External Antenna	28
4.2.2	Fundamental & Harmonics of Internal Antenna, 903MHz (Low Channel)	30
4.2.3	Fundamental & Harmonics of Internal Antenna, 914MHz (Medium Channel) ...	31
4.2.4	Fundamental & Harmonics of Internal Antenna, 925MHz (High Channel)	32
4.3.1	Fundamental & Harmonics of External Antenna, 903MHz (Low Channel)	33
4.3.2	Fundamental & Harmonics of External Antenna, 914MHz (Medium Channel) ..	34
4.3.3	Fundamental & Harmonics of External Antenna, 925MHz (High Channel)	35

PLOTS

5.1.1	Plot of Output Power and 20dBW of Vectron RMI (110ES-VE02-PP) (Internal Antenna), Low Channel Frequency at 3m distance	36
5.1.2	Plot of Output Power and 20dBW of Vectron RMI (110ES-VE02-PP) (Internal Antenna), Medium Channel Frequency at 3m distance	37
5.1.3	Plot of Output Power and 20dBW of Vectron RMI (110ES-VE02-PP) (Internal Antenna), High Channel Frequency at 3m distance	38
5.1.4	Plot of Direct Conductive Output Power and 20dBW of Vectron RMI (110ES-VE03-PP) (External Antenna), Low Channel Frequency	39
5.1.5	Plot of Direct Conductive Output Power and 20dBW of Vectron RMI (110ES-VE03-PP) (External Antenna), Medium Channel Frequency	40
5.1.6	Plot of Direct Conductive Output Power and 20dBW of Vectron RMI (110ES-VE03-PP) (External Antenna), High Channel Frequency	41
5.1.7	Plot of Spectrum Showing Direct Conductive of 50 Random Channel Vectron 110ES-VE03-PP (External Antenna)	42
5.1.8	Plot of Conductive Channel Spacing of Vectron 110ES-VE03-PP (External Antenna)	43
5.1.9	Plot of Maximum Dwell Time of Vectron RMI (Less than 400 ms)	44
	Test Set-Up Photographs	45-48

TABLE OF CONTENTS, CONTD.

APPENDICES

A: Measurement Procedures..... 50
B: Description of Open Field Test Site... 52
C: Test Equipment..... 54-55
D: EUT Specifications..... 57

ATTACHMENTS

- ◆ List of 128 Hopping Channel Frequencies
- ◆ Channel Frequency Hopping Algorithm

EXHIBITS

- ◆ FCC Label Sample and Location
- ◆ Schematics
- ◆ Modification Letter
- ◆ EUT Photographs
- ◆ User Manual and Warning Statement

United States Department of Commerce
National Institute of Standards and Technology

NVLAP[®]



ISO/IEC GUIDE 25:1990
ISO 9002:1987

Certificate of Accreditation

ROCKFORD ENGINEERING SERVICES, INC.
SUNOL, CA

is recognized under the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. Accreditation is awarded for specific services, listed on the Scope of Accreditation for:

**ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS
FCC**

June 30, 1999

Effective through

For the National Institute of Standards and Technology

NVLAP Lab Code: 200172-0

ISO/IEC GUIDE 25:1990
ISO 9002:1987

Scope of Accreditation



Page: 1 of 2

**ELECTROMAGNETIC COMPATIBILITY
AND TELECOMMUNICATIONS**

NVLAP LAB CODE 200172-0

ROCKFORD ENGINEERING SERVICES, INC.

2100 Calaveras Road

P.O. Box 543

Sunol, CA 94586-0543

Mr. Michael Gbadebo

Phone: 510-862-2944 Fax: 510-862-9013

NVLAP Code Designation / Description

International Special Committee on Radio Interference (CISPR) Methods

12/CIS22 IEC/CISPR 22:1993: Limits and methods of measurement of radio disturbance characteristics of information technology equipment

Federal Communications Commission (FCC) Methods

12/F01 FCC Method - 47 CFR Part 15 - Digital Devices

12/F01a Conducted Emissions, Power Lines, 450 KHz to 30 MHz

12/F01b Radiated Emissions

12/T01 Terminal Equipment Network Protection Standards, FCC Method - 47 CFR Part 68 - Analog and Digital

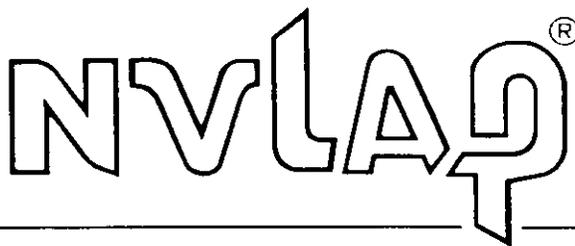
12/T01a 68.302 (Par. c,d,e,f) Environmental simulation; 68.304 Leakage current limit.; 68.306 Hazardous voltage limit.; 68.308 Signal power limit.; 68.310 Longitudinal balance limit.; 68.312 On-hook impedance limit.; 68.314 Billing protection

June 30, 1999

Effective through

For the National Institute of Standards and Technology

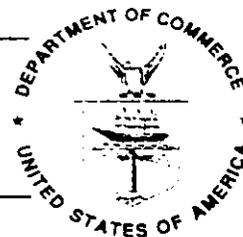
National Institute
of Standards and Technology



National Voluntary
Laboratory Accreditation Program

ISO/IEC GUIDE 25:1990
ISO 9002:1987

Scope of Accreditation



Page: 2 of 2

**ELECTROMAGNETIC COMPATIBILITY
AND TELECOMMUNICATIONS**

NVLAP LAB CODE 200172-0

ROCKFORD ENGINEERING SERVICES, INC.

<i>NVLAP Code</i>	<i>Designation / Description</i>
12/T01b	68.316 Hearing Aid Compatibility: technical standards
12/T01c	68.302 Environmental simulation (Par. a,b)

Australian Standards referred to by clauses in AUSTEL Technical Standards

12/T51	AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment
--------	---

June 30, 1999

Effective through

A handwritten signature in black ink, appearing to read 'Jan L. Gylf', is written over a horizontal line.

For the National Institute of Standards and Technology



CERTIFICATE

Facility: Site 1

(Conducted Interference Measurement)

Company : Rockford Engineering Services, Inc.

Address : 9959 Calaveras Road P.O. Box 543 Sunol, CA 94586-0543

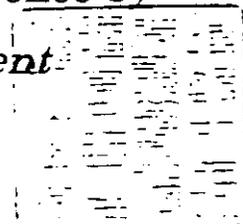
*This is to certify that the following measuring facility
has been registered in accordance with the Regulations
for Voluntary Control Measures, Article 8.*

Registration No. : C-714

Date of Registration : December 25, 1997

This Certificate is valid until August 24, 2000

*Voluntary Control Council for Interference by
Information Technology Equipment*





CERTIFICATE

Facility: Site1

(Radiation 3 and 10 meter site)

Company : Rockford Engineering Services, Inc.

Address : 9959 Calaveras Road P.O. Box 543 Sunol,

CA 94586-0543

*This is to certify that the following measuring facility
has been registered in accordance with the Regulations
for Voluntary Control Measures, Article 8.*

Registration No. : R-696

Date of Registration : December 25, 1997

This Certificate is valid until August 24, 2000

*Voluntary Control Council for Interference by
Information Technology Equipment*



Regulierungsbehörde für Telekommunikation und Post (Reg TP)

für die Akkreditierung verantwortliche Stelle

Deutsche Akkreditierungsstelle Technik (DATech) e.V.

Deutsche Akkreditierungsstelle für Informations- und
Telekommunikationstechnik (DEKITZ)

vertreten im

Deutschen Akkreditierungsrat



Akkreditierung

Hiermit wird bestätigt, daß das Prüflaboratorium

ROCKFORD Engineering Services GmbH
Robert-Bosch-Str. 2 - 4

D-61184 Karben

die Kompetenz nach DIN EN 45001 besitzt, Prüfungen in dem Bereich

Elektromagnetische Verträglichkeit (EMV)

nach den in der Anlage aufgeführten Normen und Spezifikationen
auszuführen.

Die Anlage ist Bestandteil der Urkunde und besteht aus 3 Seiten.

DAR-Registriernummer: TTI-P-G 159/98-00

Regulierungsbehörde für
Telekommunikation und Post
(Reg TP)

Bonn, 30. Juli 1998

Präsident

Deutsche
Akkreditierungsstelle Technik
(DATech) e.V.

Frankfurt, 30. Juli 1998

Leiter der
Akkr.-Stelle

Geschäftsführer
Leiter der Akkr.-Stelle

Deutsche Akkreditierungsstelle für
Informations- und
Telekommunikationstechnik (DEKITZ)

Berlin, 30. Juli 1998

Geschäftsführer
Leiter der Akkr.-Stelle

Vorsitzender

DATech, DEKITZ - Akkreditierungsstellen in der TGA - Trägergemeinschaft für Akkreditierung GmbH

Siehe Hinweise auf der Rückseite

Regulierungsbehörde für Telekommunikation und Post (Reg TP)

body responsible for the accreditation

Deutsche Akkreditierungsstelle Technik (DATech) e.V.

Deutsche Akkreditierungsstelle für Informations- und
Telekommunikationstechnik (DEKITZ)

represented in the

Deutschen AkkreditierungsRat



Akkreditierung

This is to certify that the Testing Laboratory

ROCKFORD Engineering Services GmbH

Robert-Bosch-Str. 2 - 4

D-61184 Karben

is competent under the terms of DIN EN 45 001 to carry out testing in the field

Electromagnetic Compatibility (EMC)

according to the annexed list of standards and specifications.

The annex is deemed part of this certificate and comprises 3 pages.

DAR-Registration number: TTI-P-G 159/98-00

Regulierungsbehörde für
Telekommunikation und Post
(Reg TP)

Bonn, 30 July 1998

Deutsche
Akkreditierungsstelle Technik
(DATech) e.V.

Frankfurt, 30 July 1998

Deutsche Akkreditierungsstelle
für Informations- und
Telekommunikationstechnik (DEKITZ)

Berlin, 30 July 1998

i.v. Hon

President

[Signature]

Head of the
Accr. Body

[Signature]

Managing Director
Head of the Accr. Body

[Signature]

Managing Director Head
of the Accr. Body

[Signature]

Chairman

DATech/DEKITZ - Accreditation Bodies in the TGA - Trägergemeinschaft für Akkreditierung GmbH

Anlage zur RegTP/DATech/DEKITZ-Akkreditierungsurkunde TTI-P-G 159/98-00
 (Annex to RegTP/DATech/DEKITZ accreditation certificate TTI-P-G 159/98-00)
 vom (dated) 30. Juli 1998 (30 July 1998)

Inhaber der Akkreditierungsurkunde:
 (Holder of this accreditation certificate):

ROCKFORD Engineering Services GmbH
Robert-Bosch-Str. 2 - 4
D-61184 Karben

Der Geltungsbereich der Akkreditierung erstreckt sich auf die nachstehend genannten Gebiete und Prüfbereiche:

(The scope of this accreditation indicates:)

Prüfgebiet (testing domains)	Prüfbereich (testing area)	Zugrundeliegende Normen (associated specifications)
Elektromagnetische Verträglichkeit (EMV) (Electromagnetic Compatibility (EMC))	Störaussendung (Emission)	siehe nachfolgend (see enclosed)
	Störfestigkeit (Immunity)	siehe nachfolgend (see enclosed)

Titel (Title)	Datum (Date)	Referenzdokument (Reference doc.: CISPR / ETSI / IEC)
EN 50065-1	1991	Signaling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz – Part 1: General requirements, frequency bands and electromagnetic disturbances
EN 50065-1, A1	1991	Amendment A1:1992 to EN 50065-1:1991 Signaling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz – Part 1: General requirements, frequency bands and electromagnetic disturbances
EN 50065-1, A2	1991	Amendment A2:1995 to EN 50065-1:1991 Signaling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz – Part 1: General requirements, frequency bands and electromagnetic disturbances
EN 50065-1, A3	1991	Amendment A3:1996 to EN 50065-1:1991 Signaling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz – Part 1: General requirements, frequency bands and electromagnetic disturbances
EN 50081-1	1992	Electromagnetic compatibility – Generic emission standard – Part 1: Residential, commercial and light industry

Anlage zur RegTP/DATech/DEKITZ-Akkreditierungsurkunde TTI-P-G 159/98-00
 (Annex to RegTP/DATech/DEKITZ accreditation certificate TTI-P-G 159/98-00)
 vom (dated) 30. Juli 1998 (30 July 1998)

Titel (Title)	Datum (Date)		Referenzdokument (Reference doc.: CISPR / ETSI / IEC)
EN 50081-2	1993	Electromagnetic compatibility – Generic emission standard – Part 2: Industrial environment	
EN 50082-1	1992	Electromagnetic compatibility – Generic immunity standard – Part 1: Residential, commercial and light industry	
EN 50082-1	1997	Electromagnetic compatibility – Generic immunity standard – Part 1: Residential, commercial and light industry	
EN 50082-2	1995	Electromagnetic compatibility – Generic immunity standard – Part 2: Industrial environment	
EN 55011	1991	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment	CISPR 11:1990 (Modified)
EN 55011, A1	1991	Amendment A1:1997 to EN 55011:1991 Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment	CISPR 11:1990 /A1:1996 (Modified)
EN 55011, A2	1996	Amendment A2:1996 to EN 55011:1991 Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment	CISPR 11:1990 /A2:1996
EN 55014-1	1993	Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission – Product family standard	CISPR 14:1993
EN 55014-1, A1	1997	Amendment A1:1997 to EN 55014-1:1993 Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission – Product family standard	CISPR 14:1993 /A1:1996
EN 55014-2	1997	Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 2: Immunity – Product family standard	CISPR 14-2:1997
EN 55022	1987	Limits and methods of measurement of radio interference characteristics of information technology equipment	CISPR 22:1985 (Modified)
EN 55022	1994	Limits and methods of measurement of radio disturbance characteristics of information technology equipment	CISPR 22:1993
EN 55022, A1	1995	Amendment A1:1995 to EN 55022:1994: Limits and methods of measurement of radio disturbance characteristics of information technology equipment	CISPR 22:1993 /A1:1995
EN 55022, A2	1997	Amendment A2:1997 to EN 55022:1994: Limits and methods of measurement of radio disturbance characteristics of information technology equipment	CISPR 22:1993/ A2:1996 (Modified)
EN 60555-2	1987	Disturbances in supply systems caused by household appliances and similar electrical equipment – Part 2 Harmonics	IEC 60555-2:1982 + A1:1985 (Modified)
EN 60555-3	1987	Disturbances in supply systems caused by household appliances and similar electrical equipment – Part 3: Voltage fluctuations	IEC 60555-3:1982

Anlage zur RegTP/DATech/DEKITZ-Akkreditierungsurkunde TTI-P-G 159/98-00
 (Annex to RegTP/DATech/DEKITZ accreditation certificate TTI-P-G 159/98-00)
 vom (dated) 30. Juli 1998 (30 July 1998)

Titel (Title)	Datum (Date)		Referenzdokument (Reference doc.: CISPR / ETSI / IEC)
EN 60555-3, A1		Amendment A1: 1991 to EN 60555-3:1987: Disturbances in supply systems caused by household appliances and similar electrical equipment – Part 3: Voltage fluctuations	IEC 60555-3:1982/ A1:1990
EN 60601-1-2	1993	Medical electrical equipment – Part 1: General requirements for safety – 2. Collateral standard: Electromagnetic compatibility – Requirements and tests	IEC 60601-1-2:1993
EN 61000-3-2	1995	Electromagnetic compatibility (EMC) – Part 3: Limits – Section 2: Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)	IEC 61000-3-2:1995 IEC 1000-3-2:1995
EN 61000-3-2, A13	1997	Amendment A13:1997 to EN 61000-3-2:1995 Electromagnetic compatibility (EMC) – Part 3: Limits – Section 2: Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)	
EN 61000-3-3	1995	Electromagnetic compatibility (EMC) – Part 3: Limits – Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current up to and including 16 A	IEC 61000-3-3:1994 IEC 1000-3-3:1994
EN 61000-4-2	1995	Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques, Section 2: Electro-Static-Discharge Immunity test	IEC 61000-4-2 : 1995 IEC 1000-4-2 : 1995
EN 61000-4-3	1996	Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques, Section 3: Radiated, radio frequency, electromagnetic immunity field test	IEC 61000-4-3 : 1995
ENV 50140	1993		EC 1000-4-3 : 1995
EN 61000-4-4	1995	Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques, Section 4: Electrical fast transient / burst immunity test	IEC 61000-4-4 : 1995 IEC 1000-4-4 : 1995
EN 61000-4-5	1995	Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques, Section 5: Surge immunity test	IEC 1000-4-5 : 1995
ENV 50142	1994		IEC 1000-4-5 : 1995
EN 61000-4-6	1996	Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques, Section 5: Immunity to conducted disturbances induced by radio frequency fields	IEC 61000-4-6 : 1996
ENV 50141	1993		IEC 1000-4-6 : 1996
EN 61000-4-8	1994	Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques, Section 8: Magnetic field immunity test	IEC 61000-4-8 : 1993 IEC 1000-4-8 : 1993
EN 61000-4-11	1995	Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques, Voltage dips and interruptions	IEC 61000-4-11 : 1993 IEC 1000-4-11 : 1993
ENV 50204	1995	Radiated electromagnetic field from digital radio telephones Immunity test	

Für die fachliche Richtigkeit der Prüfberichte verantwortlich:

(Technical responsibility for the test reports:)

Mr Syed, Mohammed Khysar

PART 1 - GENERAL

1.1. TEST METHODOLOGY

The electromagnetic interference tests which this report describes were performed by an independent electromagnetic compatibility consultant, Rockford Engineering Services Inc., in Accordance with the FCC test procedure ANSI C63.4-1992.

1.1.1 Test Facility

The open area test site, the conducted measurement facility, and the test equipment used to collect the emissions data is located in Sunol, California, and is fully described in site attenuation report. The site attenuation description is currently on file at the Federal Communications Commission and was reviewed and approved by the Commission.

1.1.2 Accuracy of Test Data

The test results contained in this report accurately represent the radiated; power line conducted electromagnetic emissions and bandwidth tests generated by the sample equipment under test.

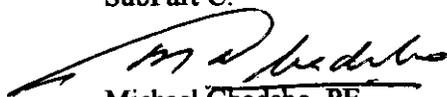
Equipment tested: Vectron Solid-State Polyphase Remote Meter Interface (RMI)
Models: 110ES-VE00-PP (Internal Antenna)
110ES-VE02-PP (Internal Antenna)
&
110ES-VE01-PP (External Antenna)
110ES-VE03-PP (External Antenna)

Date of test: December 10 - 23, 1998

Test Performed:

1. Power line conducted emissions in a shielded room utilizing two LISN's in accordance with the FCC test procedure 47 CFR §15.107. See Part 2 of this report for full details.
2. Radiated emissions in a 3-meter open area site in accordance with the FCC test procedure 47 CFR §15.109 & §15.109(g)(2). See Part 3 of this report for full details.
3. Bandwidth requirements are measured in accordance with 47CFR §15.247. See Part 4 of this report for full details.

The results show that the sample equipment tested as described in this report is in compliance with the FCC Rules Part 15, SubPart B conducted and radiated emissions and bandwidth requirement limits of, SubPart C.



Michael Gbadebo, PE
Chief Engineer/Principal Consultant

GENERAL CONTD.

1.2. SUMMARY

1.2.1 Description of Equipment Under Test (EUT)

The EUT is a True2Way™ Polyphase Solid-State Vectron Remote Meter Interface (RMI), which reads, stores and transmits meter data and alarms over the Whisper™ fixed-base wireless network. The Vectron RMI can display the energy usage in KWh or Kvarh or Kvah and can be programmed to display energy usage as maximum, cumulative, continuous cumulative, previous interval, instantaneous, and present demand. The Vectron can be attached to popular commercial, industrial and residential Polyphase meters. With appropriate host software, the Vectron RMI can supply both scheduled and on-demand communications. Scheduled RMI transmissions are normally used for regular RMI transmissions and are normally used for regular meter reads or status alarms. Unscheduled communications can be used to define power outage areas in near real-time, provide on-demand reads and support other value-added services.

The Vectron RMI can be programmed through optically isolated serial interface to send calculate energy usage in the Time-Of-Use (TOU) with different rate for each time block. The Time-Of-Use can be of calendar year schedules, daily schedules, seasonal schedules, and Holiday schedules. The Vectron RMI RF protocol accurately captures energy use data, ensures reliable communications with the host and permits the remote reconfiguration of RMI settings from a central base station and send/receive all required data to or from a base station and a Repeater. See Appendix E for more information

Features of the Vectron RMI:

- ◆ Scheduled meter reading: 1, 5, 15, 30, 60, 120, and 240 minutes
- ◆ Time-stamped interval data for peak power usage
- ◆ RMI clock synchronization to remote base
- ◆ Equal usage of each channel frequency on average requirements
- ◆ 128 channel frequency from 902 to 928 MHz band
- ◆ Each channel evenly spaced 180 kHz apart
- ◆ Pseudo random selection of 128 hopping channel frequency
- ◆ All data transmissions are acknowledged end-to-end across the True2Way network
- ◆ RMI report functions are programmable over the network via the base station
- ◆ Power outage and tamper detection
- ◆ Storage of 240 bytes of historical meter reads
- ◆ Optically isolated Serial bus interface
- ◆ Communication carry over of more than one minute upon power outage and sleep mode
- ◆ Resume normal operation upon power restoration
- ◆ Communication range of 1.8 miles or more
- ◆ Dwell time of less than 400 ms set by firmware code in 80C51 processor
- ◆ Output power of +22 dBm (160 mW)

1.2. SUMMARY, CONTD.**Features of the Vectron RMI, Continued:**

- ◆ External antenna version uses maximum 6 dBi antenna and is installed professionally by service personnel
- ◆ Internal antenna version uses ½ loop PCB board antenna, connected to RF board through 2-pin connector with copper ground in system
- ◆ Receiver uses Philips UAA2082 narrow-band FSK pager chip with built-in bandwidth gyrator filter
- ◆ Pager chip uses same bandwidth as the transmitter signal and is synchronized by micro-controller
- ◆ Vectron RMI can be installed as class 20A (CL20) or 200A (CL200) 3-wire Delta or 4-wire Wye

Model Name(s):

110ES-VE00-PP (Internal Antenna)
110ES-VE02-PP (Internal Antenna, KYZ & EOI outputs w/2-pin door tamper)
&
110ES-VE01-PP (External Antenna)
110ES-VE03-PP (External Antenna, KYZ & EOI outputs w/2-pin door tamper)

Model Differences:

The above models are identical to each other and use identical digital and RF boards. Both internal antenna models use ¼ wave ½ loop PCB board antenna, which is connected directly to RF board via 2-pin connector. In addition, model 110ES-VE02-PP is provided with isolated external KYZ signals for pulse counting and external EOI (End-Of-Interval) of data signals via output cables and also provided with a 2-pin door tamper detection.

External antenna models 110ES-VE01-PP & 110ES-VE03-PP use 18 AWG Teflon insulated wire with one end is soldered to RF board and other end is terminated in a BNC male connector which is secured to front cover of the meter for connection to an external antenna with maximum 6 dBi gain. In addition, model 110ES-VE03-PP is provided with isolated external KYZ signals for pulse counting and external EOI (End-Of-Interval) of transmitted data signals via output cables and also provided with a 2-pin door tamper detection.

Applicant:

Whisper Communications, Incorporated

Address:

3200 Coronado Drive
Santa Clara, California 95054
Tel: (408) 730-9555
Fax: (408) 738-2370

Client Contact:

Amir Ashtiani

1.2. SUMMARY, CONTD.

Test Technician: Bruce Gordon

Test Number: 1981116-1

1.2.2 Support Equipment Included in Tests

The Vectron Solid-State Polyphase Remote Meter Interface was tested as a stand-alone device.

PART 2 – POWER LINE CONDUCTED EMISSIONS Per FCC PART 15 SUB-PART B

2.1. CONFIGURATION AND PROCEDURE

2.1.1 EUT Configuration

Pre-scan measurements are first performed by collecting data with a spectrum analyzer. Significant peaks are marked and then quasi-peaked. Measurement range investigated was from 450KHz to 30MHz.

The Vectron Solid-State Polyphase Remote Meter Interface was set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was a receiver with bandwidth parameters as stipulated in ANSI C63.4-1992. Grounding was through the power cord and voltage was 220Vac.

The Vectron Solid-State Polyphase Remote Meter Interface was set up on a wooden non conductive table top, 80 cm above the ground reference plane, in a shielded room. The dimension of the table was 1.5m x 1.0m. Excess cords of the equipment such as KYZ output cords were folded back and forth, on top of LISN to form a 30-cm by 40-cm bundle.

2.1.2 Test Procedure

The system was set up as described above, with the Vectron RMI running in a continuous acquisition mode. The Vectron RMIs were operated in a worst case condition of constantly acquiring a base. Data with the EUT operating in acquisition mode is worst case and is recorded in the report as representative of the system. The power line conducted EMI tests were run on all phases of the current carrying conductors of the power cords of the EUT. The highest line conducted emissions were also analyzed in detail by operating the spectrum analyzer in fixed tuned mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables were moved around to maximize the emissions, and the position of the peripheral devices were interchanged to check for any changes in emissions.

2.1.3 Data Table Legend and Field Strength Calculation

'Margin' indicates the degree of compliance with the applicable limit. For example, a margin of -8 dB means that the emission is 8 dB below the limit (in compliance); A margin of +4 dB means that the emission is 4 dB over the limit (out of compliance).

The margin is calculated as follows:

$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$

where $\text{Corrected Amplitude} = \text{Amplitude} + \text{Cable Loss} - \text{Distance Factor}$, the amplitude measured in a quasi peak mode.

2.2. POWER LINE CONDUCTED EMISSIONS Per FCC PART 15 SUB-PART B

2.2.1 Administrative Details

Date(s) of Test: December 10 - 23, 1998
Emission Limits: Class B
Temperature/Humidity: 19.2°C / 63%
Test Technician(s): Bruce Gordon

Technician's Signature: 

2.2.2 EUT Configuration Summary

See 2.1.1.

2.2.3 Test Results for model 110ES-VE02-PP (Internal Antenna with KYZ & EOI outputs, 2-pin door tamper)

The table below shows a summary of the highest conducted emissions on all three phases and neutral current carrying conductors of the EUT power cord compared to the FCC Class B limit. The power cord is twisted, while the KYZ and EOI output cable is bundled

Phase A		CABLE CORR		COND	GND	CLASS B	
INDICATED	AMPL	LOSS	AMPL	-	-	LIMIT	MARGIN
FREQ (MHz)	dBuV	dB	dBuV	-	-	dBuV	(dB)
3.173	42.3	1.0	43.3	Hot	con	48.0	-4.7
9.600	32.0	1.0	33.0	Hot	con	48.0	-15.0
13.420	21.8	1.0	22.8	Hot	con	48.0	-25.2
22.750	20.1	1.0	21.1	Hot	con	48.0	-26.9
23.700	25.6	1.0	26.6	Hot	con	48.0	-21.4
24.560	26.9	1.0	27.9	Hot	con	48.0	-20.1

Table 2.2.3 Power line Conducted Emissions for model 110ES-VE02-PP

No emissions of significant levels were observed between 450 kHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequencies are shown in the above data and 30 MHz.

Conclusion: The EUT meets the requirements of the test reference for Power line Conducted Emissions.

2.2. POWER LINE CONDUCTED EMISSIONS per FCC PART 15 SUB-PART B, CONTD.

Test Results for model 110ES-VE02-PP (Internal Antenna with KYZ & EOI Outputs, 2-pin door tamper)

The table below shows a summary of the highest conducted emissions on all three phases and neutral current carrying conductors of the EUT power cord compared to the FCC Class B limit. The power cord is twisted, while the KYZ/EOI output cable is bundled

Phase B		CABLE	CORR	COND	GND	CLASS B	
INDICATED		LOSS	AMPL	-	-	LIMIT	MARGIN
FREQ	AMPL	LOSS	AMPL	-	-	dBuV	(dB)
(MHz)	dBuV	dB	dBuV	-	-		
3.380	40.0	1.0	41.0	Hot	con	48.0	-7.0
6.570	33.1	1.0	34.1	Hot	con	48.0	-13.9
7.540	32.1	1.0	33.1	Hot	con	48.0	-14.9
20.510	28.1	1.0	29.1	Hot	con	48.0	-18.9
21.080	28.2	1.0	29.2	Hot	con	48.0	-18.8
22.750	30.8	1.0	31.8	Hot	con	48.0	-16.2

Table 2.2.3 Power line Conducted Emissions for model 110ES-VE02-PP

Phase C		CABLE	CORR	COND	GND	CLASS B	
INDICATED		LOSS	AMPL	-	-	LIMIT	MARGIN
FREQ	AMPL	LOSS	AMPL	-	-	dBuV	(dB)
(MHz)	dBuV	dB	dBuV	-	-		
2.928	42.6	1.0	43.6	Hot	con	48.0	-4.4
3.240	43.0	1.0	44.0	Hot	con	48.0	-2.4
6.800	41.2	1.0	42.2	Hot	con	48.0	-5.8
7.660	40.9	1.0	41.9	Hot	con	48.0	-6.1
23.500	35.0	1.0	36.0	Hot	con	48.0	-12.0
24.300	34.7	1.0	35.7	Hot	con	48.0	-12.3

Table 2.2.3 Power line Conducted Emissions for model 110ES-VE02-PP

No emissions of significant levels were observed between 450 kHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequencies are shown in the above data and 30 MHz.

Conclusion: The EUT meets the requirements of the test reference for Power line Conducted Emissions.

2.2. POWER LINE CONDUCTED EMISSIONS per FCC PART 15 SUB-PART B, CONTD.

Test Results for model 110ES-VE02-PP (Internal Antenna with KYZ & EOI Outputs, 2-pin door tamper)

The table below shows a summary of the highest conducted emissions on all three phases and neutral current carrying conductors of the EUT power cord compared to the FCC Class B limit. The power cord is twisted, while the KYZ/EOI output cable is bundled

Neutral		CABLE	CORR	COND	GND	CLASS B	
INDICATED	AMPL	LOSS	AMPL	-	-	LIMIT	MARGIN
FREQ	dBuV	dB	dBuV	-	-	dBuV	(dB)
(MHz)							
.650	46.8	1.0	47.8	Neut	con	48.0	-.2
.760	46.8	1.0	47.8	Neut	con	48.0	-.2
.871	46.7	1.0	47.7	Neut	con	48.0	-.3
2.281	45.7	1.0	47.6	Neut	con	48.0	-.3
9.780	46.6	1.0	46.7	Neut	con	48.0	-1.3

Table 2.2.3 Power line Conducted Emissions for model 110ES-VE02-PP

No emissions of significant levels were observed between 450 kHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequencies are shown in the above data and 30 MHz.

Conclusion: The EUT meets the requirements of the test reference for Power line Conducted Emissions.

2.2. POWER LINE CONDUCTED EMISSIONS per FCC PART 15 SUB-PART B, CONTD.

Test Results for model 110ES-VE03-PP (External Antenna with KYZ & EOI Outputs, 2-pin door tamper)

The table below shows a summary of the highest conducted emissions on all three phases and neutral current carrying conductors of the EUT power cord compared to the FCC Class B limit.

The power cord is twisted, while the KYZ/EOI output cable is bundled

Phase A		CABLE LOSS	CORR AMPL	COND	GND	CLASS B	
INDICATED FREQ (MHz)	AMPL dBuV					AMPL dB	CON
2.963	46.6	1.0	47.6	Hot	con	48.0	- .4
3.160	44.3	1.0	45.3	Hot	con	48.0	-2.7
3.258	42.6	1.0	43.6	Hot	con	48.0	-4.4
16.004	35.5	1.0	36.5	Hot	con	48.0	-11.5
22.430	29.8	1.0	30.8	Hot	con	48.0	-17.2

Table 2.2.3 Power line Conducted Emissions for model 110ES-VE03-PP

Phase B		CABLE LOSS	CORR AMPL	COND	GND	CLASS B	
INDICATED FREQ (MHz)	AMPL dBuV					AMPL dB	CON
3.110	40.9	1.0	41.9	Hot	con	48.0	-6.1
3.264	41.7	1.0	42.7	Hot	con	48.0	-5.3
16.006	26.3	1.0	27.3	Hot	con	48.0	-20.7

No emissions of significant levels were observed between 450 kHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequencies are shown in the above data and 30 MHz.

2.2. POWER LINE CONDUCTED EMISSIONS per FCC PART 15 SUB-PART B, CONTD.

Test Results for model 110ES-VE03-PP (External Antenna with KYZ & EOI Outputs, 2-pin door tamper)

The table below shows a summary of the highest conducted emissions on all three phases and neutral current carrying conductors of the EUT power cord compared to the FCC Class B limit.

The power cord is twisted, while the KYZ/EOI output cable is bundled

Phase C		CABLE	CORR	COND	GND	CLASS B	
INDICATED		LOSS	AMPL	-	-	LIMIT	MARGIN
FREQ	AMPL	dB	dBuV	-	-	dBuV	(dB)
(MHz)	dBuV						
2.700	45.3	1.0	46.3	Hot	con	48.0	-1.7
3.200	44.6	1.0	45.6	Hot	con	48.0	-2.4
7.600	39.8	1.0	40.8	Hot	con	48.0	-7.2
16.140	39.4	1.0	40.4	Hot	con	48.0	-7.6
21.730	29.0	1.0	30.0	Hot	con	48.0	-18.0

Table 2.2.3 Power line Conducted Emissions for model 110ES-VE03-PP

Neutral		CABLE	CORR	COND	GND	CLASS B	
INDICATED		LOSS	AMPL	-	-	LIMIT	MARGIN
FREQ	AMPL	dB	dBuV	-	-	dBuV	(dB)
(MHz)	dBuV						
.650	46.8	1.0	47.8	Neut	con	48.0	-.2
.760	46.8	1.0	47.8	Neut	con	48.0	-.2
.871	46.7	1.0	47.7	Neut	con	48.0	-.3
2.281	45.7	1.0	47.6	Neut	con	48.0	-.3
9.780	46.6	1.0	46.7	Neut	con	48.0	-1.3

Table 2.2.3 Power line Conducted Emissions for model 110ES-VE03-PP

No emissions of significant levels were observed between 450 kHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequencies are shown in the above data and 30 MHz.

Conclusion: The EUT meets the requirements of the test reference for Power Line Conducted Emissions. The line conducted emission tests that were performed on the above Models 110ES-VE02-PP and 110ES-VE03-PP also represent the tests on models 110ES-VE00-PP and 110ES-VE01-PP, which are not provided with KYZ/EOI external output signals and the 2-pin door tamper connection.

PART 3 - OPEN FIELD RADIATED EMISSIONS per FCC PART 15 SUB-PART B

3.1. CONFIGURATION AND PROCEDURE

3.1.1 EUT Configuration

The Vectron Solid-State Polyphase Remote Meter Interface was set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was a Hewlett Packard 8567A Spectrum Analyzer with detector and bandwidth parameters as stipulated in C63.4-1992, §15.109(g)(2).

The Vectron Solid-State Polyphase Remote Meter Interface was set up on a wooden non conductive table top, 80 cm above the ground reference plane, in an open field. The table dimensions was 1.5m x 1.0m. Excess cord was folded back to form a 30-cm by 40-cm bundle, which was hanging in the middle distance above the ground plane. Frequency measurement was taken from 30MHz to 2000MHz.

3.1.2 Test Procedure

The system was set up as described above, with the Vectron RMI running in a continuous acquisition mode. The Vectron RMI units were operated in a worst case condition of constantly acquiring a base. Data with the EUT operating in continuous acquisition mode is worst case and is recorded in the report as representative of the system. Maximum emissions were obtained by varying the height of the antennas and then orienting the turntable in 360-degree turns with the analyzer in the manual mode.

The highest emissions were also analyzed in detail by operating the spectrum analyzer in fixed tuned quasi-peak mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables were moved around and the antenna height was varied between one and four meters, and polarization was changed between vertical and horizontal. The turntable was rotated to maximize emissions and the position of the peripheral devices were interchanged to check for any changes in emissions.

3.1.3 Data Table Legend and Field Strength Calculation

'Margin' indicates the degree of compliance with the applicable limit. For example, a margin of -8 dB means that the emissions are 8 dB below the limit (in compliance); a margin of +4 dB means that the emission is 4 dB over the limit (out of compliance).

The margin calculated as follows:

Margin = Corrected Amplitude - Limit

where Corrected Amplitude = Amplitude + Antenna Correction Factor + Cable Loss - Distance Factor, measured in quasi peak mode.

3.2. OPEN FIELD RADIATED EMISSIONS per FCC PART 15 SUB-PART B

3.2.1 Administrative Details

Date(s) of Test: December 10 - 23, 1998
Emission Limits: FCC Part 15 SubPart B
Temperature/Humidity: 19.2°C / 63%
ATM Pressure: 1015 Mbar
Test Technician(s): Bruce Gordon
Antenna Used: Biconical Antenna, model # 3104, S/N 3459 and
 Log Periodic Antenna, model # 3146, S/N 2075
 (calibrated June 29, 1998, next calibration due date
 is June 28, 1999)

Technician's Signature:

Bruce Gordon

3.2.2 EUT Configuration Summary

See 3.1.1.

3.2.3 Test Results for model 110ES-VE02-PP (Internal Antenna with KYZ & EOI outputs, 2-pin door tamper)

The table below shows a summary of the highest amplitudes of the radiated emissions from the equipment under test at various antenna heights, antenna polarization, and EUT orientations.

INDICATED	CORRECTION		FACT	CORR	TURNTAB		ANT	CLASS B	
FREQ	AMPL	ANT	DIST	AMPL	ANG	HGT	POL	LIMIT	MARGIN
(MHz)	dBuV/m	dB	dB	dBuV/m	DEG	(M)	-	dBuV/m	(dB)
60.24	21.2	9.2	2.9	0.0	33.3	90	2.0	VB	40.0 -6.7
87.16	0.0	6.4	3.3	0.0	9.7	90	2.0	VB	40.0 -30.3
122.52	11.3	13.6	4.1	0.0	29.0	90	2.0	HB	43.0 -14.0
127.51	13.2	12.2	4.2	0.0	29.6	180	2.0	HB	43.0 -13.4
147.52	18.0	11.4	4.4	0.0	33.8	180	2.0	HB	43.0 -9.2
151.13	9.0	12.1	4.4	0.0	25.5	90	2.0	VB	43.0 -17.5
167.52	12.1	14.8	4.6	0.0	31.5	180	2.0	HB	43.0 -11.5
172.54	8.9	15.3	4.7	0.0	28.9	180	2.0	HB	43.0 -14.1
197.53	8.1	14.0	5.2	0.0	27.3	180	2.0	HB	43.0 -15.7
207.51	15.7	9.3	5.4	0.0	30.4	90	2.0	HL	43.0 -12.6
217.52	16.4	9.4	5.5	0.0	31.3	90	2.0	HL	46.0 -14.7
237.52	17.9	11.0	5.7	0.0	34.6	90	2.0	HL	46.0 -11.4
400.00	0.5	13.0	7.9	0.0	21.4	90	2.0	VL	46.0 -24.6

Table 3.2.3 Open Field Radiated Emissions for model 110ES-VE02-PP

No emissions of significant levels were observed between 30 MHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequency shown in the above data and 2000MHz.

3.2. OPEN FIELD RADIATED EMISSIONS per FCC PART 15 SUB-PART B, CONTD.

Test Results for model 110ES-VE03-PP (External Antenna with KYZ & EOI Outputs, 2-pin door tamper)

The table below shows a summary of the highest amplitudes of the radiated emissions from the equipment under test at various antenna heights, antenna polarization, and EUT orientations.

INDICATED FREQ (MHz)	AMPL dBuV/m	CORRECTION		FACT DIST dB	CORR AMPL dBuV/m	TURNTAB		ANT POL	CLASS B LIMIT dBuV/m	MARGIN (dB)
		ANT dB	CAB dB			ANG DEG	HGT (M)			
48.02	10.9	9.1	1.6	0.0	21.5	0	2.0	VB	30.0	-8.5
64.02	-1.0	8.8	2.0	0.0	9.8	180	2.0	HB	30.0	-20.2
64.02	7.0	8.8	2.0	0.0	17.8	0	1.0	VB	30.0	-12.2
343.40	0.1	12.5	5.5	0.0	18.1	180	1.0	VL	37.0	-18.9
367.20	-0.7	12.6	5.6	0.0	17.5	180	1.0	HL	37.0	-19.5
766.00	0.0	18.9	9.1	0.0	28.0	180	1.0	VL	37.0	-9.0

Table 3.2.3 Open Field Radiated Emissions for model 110ES-VE03-PP

No emissions of significant levels were observed between 30 MHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest Frequency shown in the above data and 2000MHz.

Conclusion: The EUT meets the requirements of the test reference for Open Field Radiated Emissions. The radiated emission tests that were performed on the above Models 110ES-VE02-PP and 110ES-VE03-PP also represent the tests on models 110ES-VE00-PP and 110ES-VE01-PP, which are not provided with KYZ/EOI external output signals and the 2-pin door tamper connection.

PART 4 - PART 15 SUBPART C BANDWIDTH TESTS

4.1. CONFIGURATION AND PROCEDURE

4.1.1 EUT Configuration

The Vectron Solid-State Polyphase Remote Meter Interface was set up on a wooden non conductive table top, 80 cm above the ground reference plane, in an open field. The table dimensions was 1.5m x 1.0m.

4.1.2 Test Procedure

The EUT was adjusted for maximum response in accordance with the manufacturer's procedures, and was set up as described above to transmit continuously at low, medium and high channel frequency. The EUT was powered on and signals strength were monitored at an HP 8566B Spectrum analyzer, using a receiving horn antenna placed 3 meter away from the EUT. The EUT was also tuned to a selected low-end frequency, mid-range frequency and high-end frequency within the range during the tests. In this mode, each individual channel frequency were checked for the 20dB bandwidth, channel spacing, spurious, modulation products emission, harmonics, and conductive output power.

At the highest amplitudes observed, the EUT was rotated in the horizontal plane while changing the antenna polarization in the vertical plane to maximize the readings. Once the maximum readings were obtained then the antenna elevation and polarization was varied between specified limits to maximize the readings and plots were taken.

4.2. BANDWIDTH TEST (Internal Antenna) per FCC PART 15 SUB-PART C, SECTION §15.247

4.2.1 Administrative Details

Emission Limits: FCC Part 15 SubPart C
 Temperature/Humidity: 19.2°C / 63%
 ATM Pressure: 1015 Mbar
 Test Technician(s): Bruce Gordon
 Test Dates: December 10 - 23, 1989

Technician's Signature:

Bruce Gordon

4.2.2 Fundamental & Harmonics of model 110ES-VE02-PP (Internal Antenna with KYZ & EOI Outputs with 2-pin door tamper) at 903 MHz (Low Channel)

Model 110ES-VE02-PP (Internal Antenna)
 Low Channel Frequency

Harmonics	Frequency (MHz)	Peak Ampl dBuV/m	Antenna Loss (dB)	Cable Loss (dB)	Correction Factor (dB)	Limit (dBuV/m)	Margin (dB)
1	903.42	117.0	21.4	5.6	27.0	-	-
2	1806.84	47.9	27.2	4.1	31.3	54	-6.1
3	2710.26	43.2	29.4	7.6	37.0	54	-10.8
4	3613.68	34.8	32.6	14.1	46.7	54	-19.2
5	4517.10	33.5	33.5	13.8	47.3	54	-20.5
6	5420.52	22.1	35.3	17.3	52.6	54	-31.9
7	6323.94	20.2	35.9	22.2	58.1	54	-33.8
8	7227.36	18.9	37.2	26.6	63.8	54	-35.1
9	8130.78	18.2	38.0	27.4	65.4	54	-35.8
10	9034.20	18.1	37.9	28.6	66.5	54	-35.9

All harmonics of the fundamental frequencies meet 54 dBuV/m limits of section 15.247 a. There are no significant spurious emissions generated within and beyond 100 KHz of the fundamental frequency and meet the requirements of section 15.247 c.

4.2. BANDWIDTH TEST (Internal Antenna) per FCC PART 15 SUB-PART C, SECTION §15.247, CONTD.

4.2.3 Fundamental & Harmonics of model 110ES-VE02-PP (Internal Antenna with KYZ /EOI Outputs and 2-pin door tamper) at 914 MHz (Medium Channel)

Model 110ES-VE02-PP (Internal Antenna) Medium Channel Frequency

Harmonics	Frequency (MHz)	Peak Ampl dBuV/m	Antenna Loss (dB)	Cable Loss (dB)	Correction Factor (dB)	Limit (dBuV/m)	Margin (dB)
1	914.94	116.4	20.0	6.0	26.0	-	-
2	1829.88	46.7	27.3	6.4	33.7	54	-7.3
3	2744.82	44.5	29.5	7.9	37.4	54	-9.5
4	3659.76	36.2	32.8	14.3	47.1	54	-17.8
5	4574.70	33.9	33.7	13.3	47.0	54	-20.1
6	5489.64	24.3	35.3	17.5	52.8	54	-29.7
7	6404.58	20.1	35.9	22.1	58.0	54	-33.9
8	7319.52	20.4	37.3	26.9	64.2	54	-33.6
9	8223.46	18.9	38.3	27.3	65.6	54	-35.1
10	9149.40	19.3	38.0	28.4	66.4	54	-34.7

All harmonics of the fundamental frequencies meet 54 dBuV/m limits of section 15.247 (a).

There are no significant spurious emissions generated within or beyond 100 KHz of the fundamental frequency and meet the requirements of section 15.247 c.

4.2. BANDWIDTH TEST (Internal Antenna) per FCC PART 15 SUB-PART C, SECTION §15.247, CONTD.

4.2.4 Fundamental & Harmonics of model 110ES-VE02-PP (Internal Antenna with KYZ /EOI Outputs and 2-pin door tamper) at 925 MHz (High Channel)

Model 110ES-VE02-PP (Internal Antenna)
High Channel Frequency

Harmonics	Frequency (MHz)	Peak Ampl dBuV/m	Antenna Loss (dB)	Cable Loss (dB)	Correction Factor (dB)	Limit (dBuV/m)	Margin (dB)
1	925.38	117.0	17.4	7.6	25.0	-	-
2	1850.76	48.1	27.3	8.5	35.8	54	-5.9
3	2776.14	46.0	29.5	9.4	38.9	54	-8.0
4	3701.52	36.9	32.8	14.8	47.6	54	-17.1
5	4626.90	35.3	33.7	14.3	48.0	54	-18.7
6	5552.28	22.2	35.3	18.6	53.9	54	-31.8
7	6477.66	19.1	35.9	22.8	58.7	54	-34.9
8	7403.04	22.7	37.3	28.1	65.4	54	-31.3
9	8328.42	19.9	38.3	29.7	68.0	54	-34.1
10	9253.80	21.8	38.0	32.1	70.1	54	-32.2

All harmonics of the fundamental frequencies meet 54 dBuV/m limits of section 15.247 (a).

There are no significant spurious emissions generated within or beyond 100 KHz of the fundamental frequency and meet the requirements of section 15.247 c.

4.2. BANDWIDTH TEST (Internal Antenna) per FCC PART 15 SUB-PART C, SECTION §15.247, CONTD.

4.3.1 Fundamental & Harmonics of model 110ES-VE03-PP (External Antenna with KYZ & EOI Outputs with 2-pin door tamper) at 903 MHz (Low Channel), 3m distance.

Model 110ES-VE03-PP (External Antenna) Low Channel Frequency

Harmonics	Frequency (MHz)	Peak Ampl dBuV/m	Antenna Loss (dB)	Cable Loss (dB)	Correction Factor (dB)	Limit (dBuV/m)	Margin (dB)
1	903.42	119.6	21.4	5.6	27.0	-	-
2	1806.84	48.9	27.2	4.1	31.3	54	-5.1
3	2710.26	45.4	29.4	7.6	37.0	54	-8.6
4	3613.68	37.3	32.6	14.1	46.7	54	-16.7
5	4517.10	38.1	33.5	13.8	47.3	54	-15.9
6	5420.52	26.5	35.3	17.3	52.6	54	-27.5
7	6323.94	25.8	35.9	22.2	58.1	54	-28.2
8	7227.36	24.6	37.2	26.6	63.8	54	-29.4
9	8130.78	23.2	38.0	27.4	65.4	54	-30.8
10	9034.20	21.8	37.9	28.6	66.5	54	-32.2

All harmonics of the fundamental frequencies meet 54 dBuV/m limits of section 15.247 a.

There are no significant spurious emissions generated within and beyond 100 KHz of the fundamental frequency and meet the requirements of section 15.247 c.

4.3 BANDWIDTH TEST (External 4.2.BANDWIDTH TEST (Internal per FCC PART 15 SUB-PART C, SECTION §15.247, CONTD.

4.3.2 Fundamental & Harmonics of model 110ES-VE03-PP (External Antenna with KYZ & EOI Outputs with 2-pin door tamper) at 914 MHz (Medium Channel)

Model 110ES-VE03-PP (External Antenna)
Medium Channel Frequency

Harmonics	Frequency (MHz)	Peak Ampl dBuV/m	Antenna Loss (dB)	Cable Loss (dB)	Correction Factor (dB)	Limit (dBuV/m)	Margin (dB)
1	914.94	119.8	20.0	6.0	26.0	-	-
2	1829.88	47.8	27.3	6.4	33.7	54	-6.2
3	2744.82	45.9	29.5	7.9	37.4	54	-8.1
4	3659.76	41.5	32.8	14.3	47.1	54	-12.5
5	4574.70	39.0	33.7	13.3	47.0	54	-15.0
6	5489.64	35.4	35.3	17.5	52.8	54	-18.6
7	6404.58	28.3	35.9	22.1	58.0	54	-25.7
8	7319.52	24.2	37.3	26.9	64.2	54	-29.8
9	8223.46	22.8	38.3	27.3	65.6	54	-31.2
10	9149.40	22.1	38.0	28.4	66.4	54	-31.9

All harmonics of the fundamental frequencies meet 54 dBuV/m limits of section 15.247 (a).

There are no significant spurious emissions generated within and beyond 100 Khz of the fundamental frequency and meet the requirements of section 15.247 c.

4.3 BANDWIDTH TEST (External 4.2.BANDWIDTH TEST (Internal per FCC PART 15 SUB-PART C, SECTION §15.247, CONTD.

4.3.3 Fundamental & Harmonics of model 110ES-VE03-PP (External Antenna with KYZ /EOI Outputs and 2-pin door tamper) at 925 MHz (High Channel), 3m distance

Model 110ES-VE03-PP (External Antenna)
High Channel Frequency

Harmonics	Frequency (MHz)	Peak Ampl dBuV/m	Antenna Loss (dB)	Cable Loss (dB)	Correction Factor (dB)	Limit (dBuV/m)	Margin (dB)
1	925.38	120.3	17.4	7.6	25.0		
2	1850.76	49.2	27.3	8.5	35.8	54	-4.8
3	2776.14	46.4	29.5	9.4	38.9	54	-7.6
4	3701.52	43.3	32.8	14.8	47.6	54	-10.7
5	4626.90	40.6	33.7	14.3	48.0	54	-13.4
6	5552.28	35.5	35.3	18.6	53.9	54	-18.5
7	6477.66	29.9	35.9	22.8	58.7	54	-24.1
8	7403.04	28.5	37.3	28.1	65.4	54	-25.5
9	8328.42	24.3	38.3	29.7	68.0	54	-29.7
10	9253.80	22.9	38.0	32.1	70.1	54	-31.1

All harmonics of the fundamental frequencies meet 54 dBuV/m limits of section 15.247 (a).

There are no significant spurious emissions generated within or beyond 100 KHz of the fundamental frequency and meet the requirements of section 15.247 c.

5.1.1 Plot Of Output Power and 20dB BW of Vectron RMI (110ES VE02-HP) (Internal Antenna), Low Channel Frequency at 0m distance

OFF SET

27.0

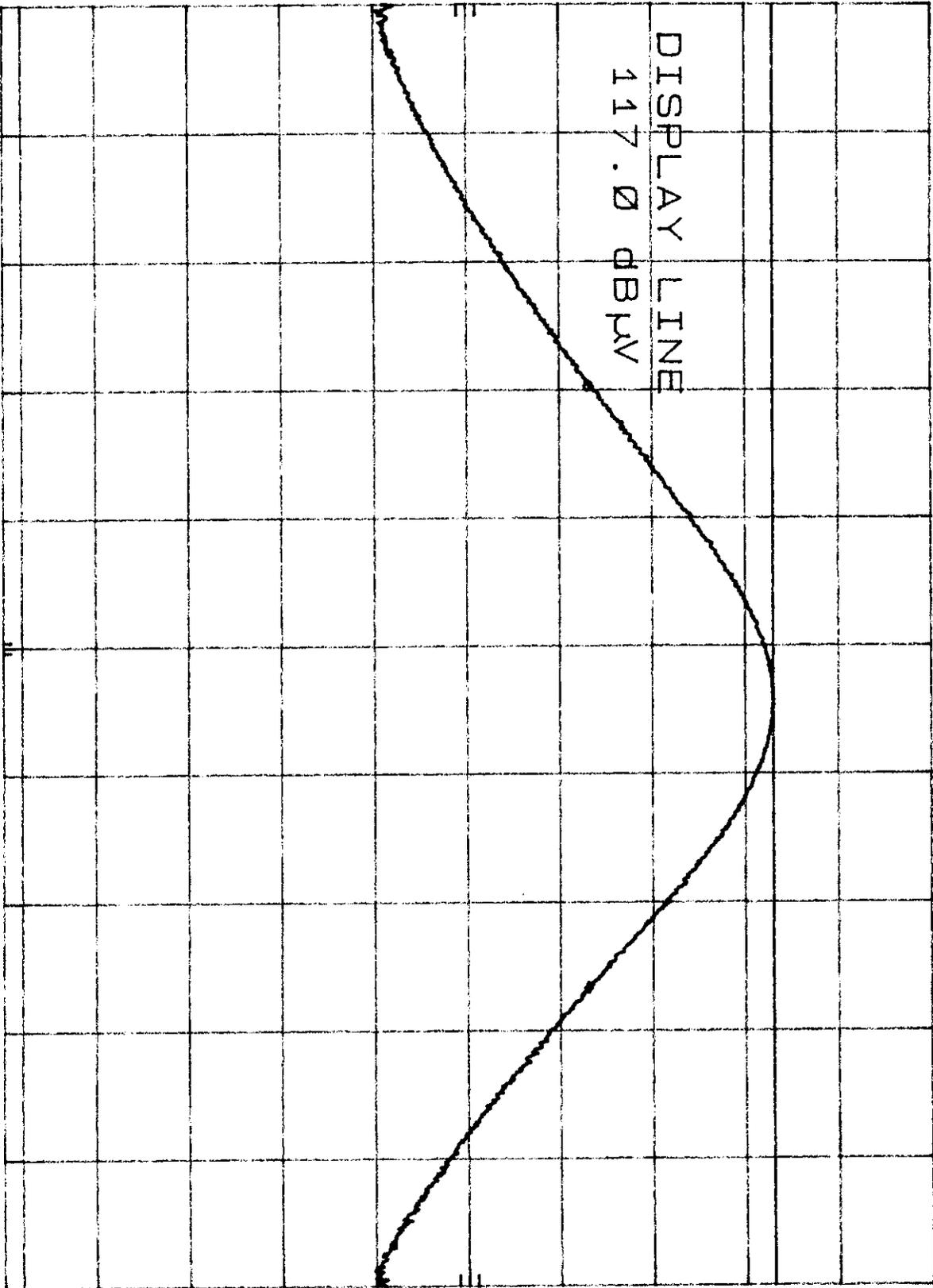
117.0

10 DB/

HP

VECTRON INT
REF 134.0 DBμV
ATTEN 10 DB +0 DB

MKR Δ 89.7 KHZ
0.00 DB



DISPLAY LINE

117.0 DBμV

CENTER 903.416 MHZ

RES BW 30 KHZ

VBW 30 KHZ

SPAN 191 KHZ

SMP 20.0 msec

HP

10 DB/

OFFSET

26.0

DB

DL

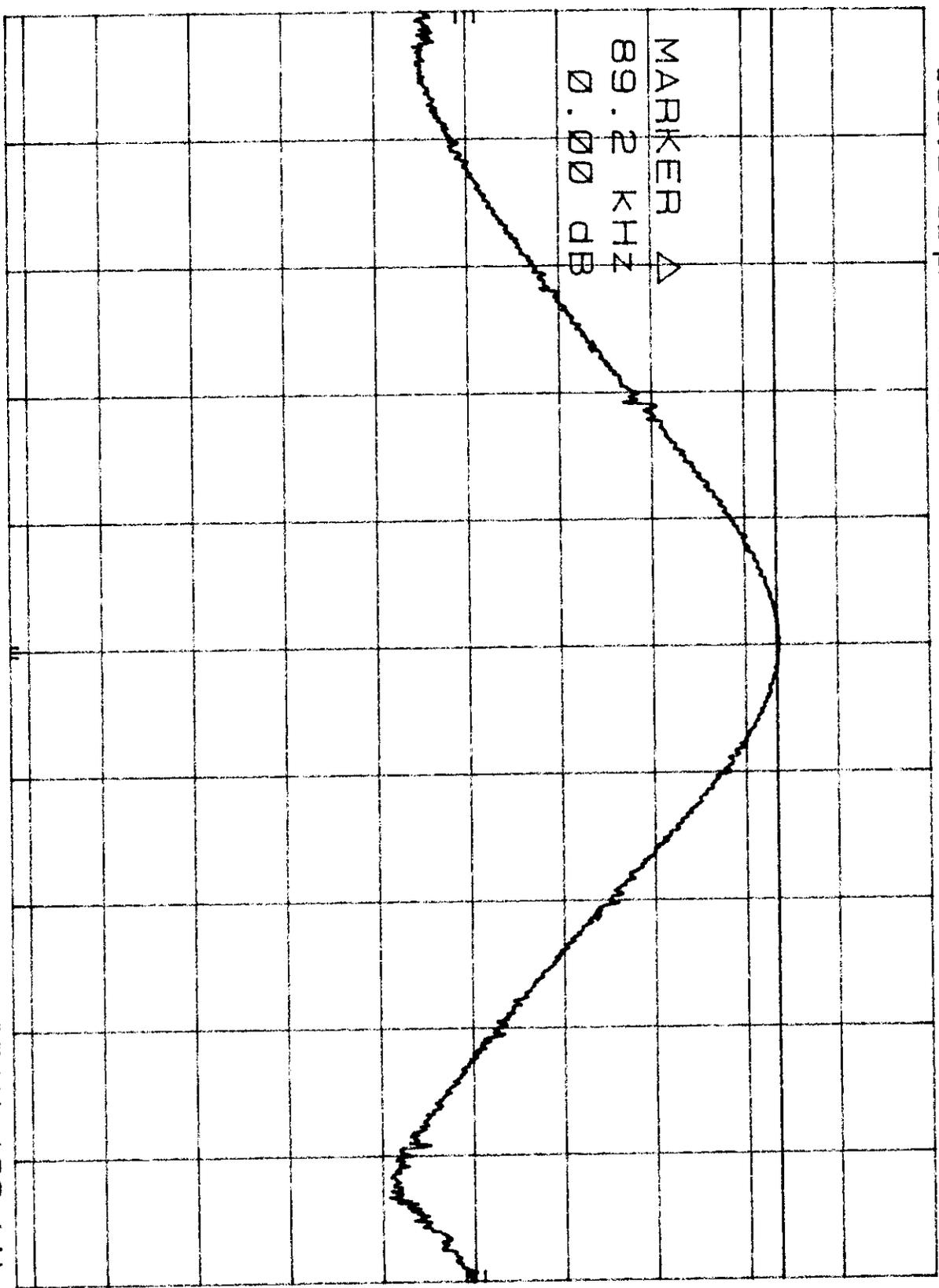
116.4

DBμV

5.1.2 Plot Of Output Power and 20dB BW of Vectron RMI (110ES-VE02-PP) (Internal Antenna), Medium Channel Frequency at 3m distance

VECTRON INT
REF 133.0 DBμV ATTEN 10 DB +0 DB

MKR Δ 89.2 KHZ
0.00 DB



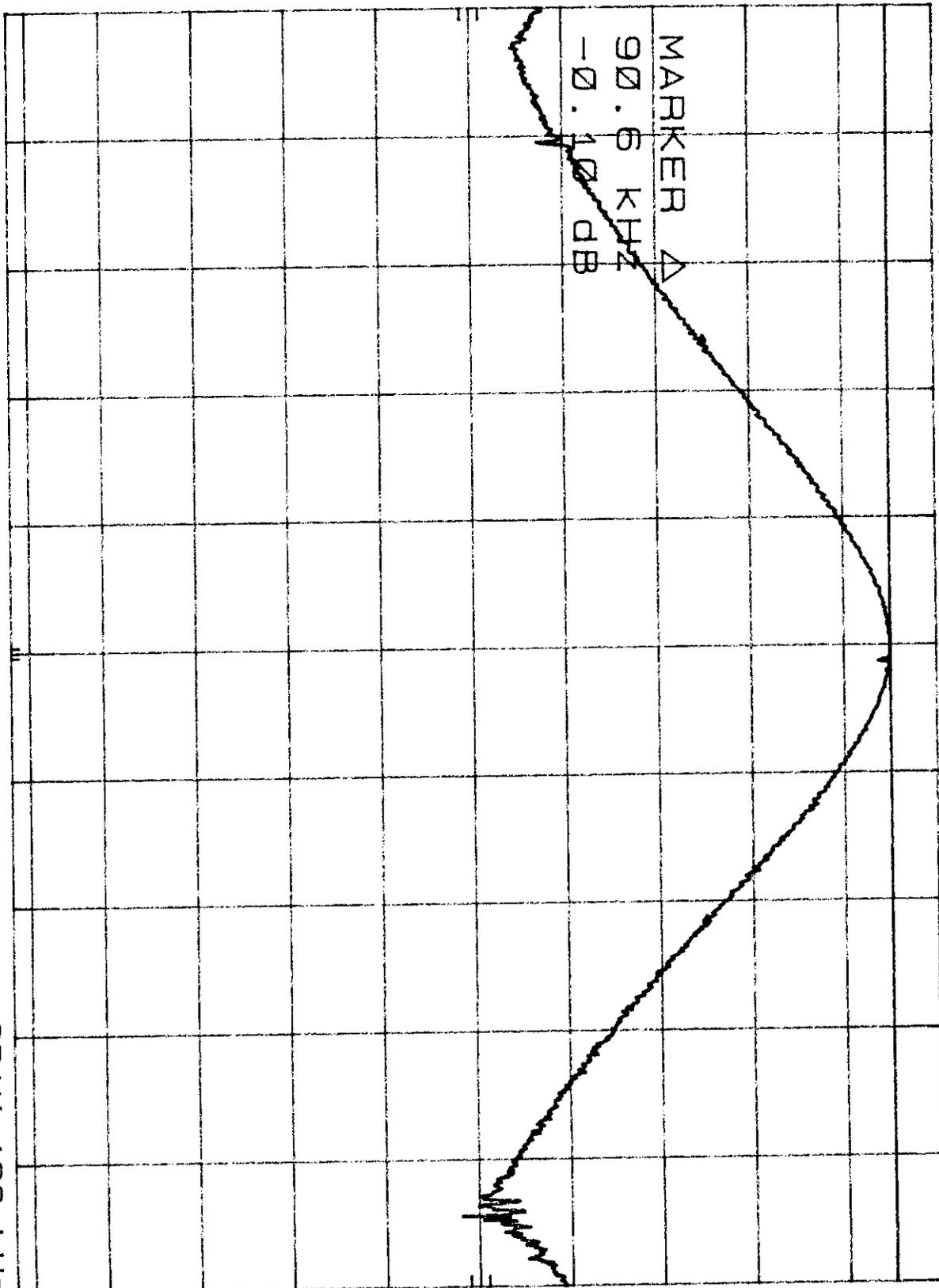
CENTER 914.942 MHZ
RES BW 30 KHZ
VBW 30 KHZ
SPAN 199 KHZ
SWP 20.0 msec

5.1.3 Plot Of Output Power and 20dB BW of Vectron RMI (110ES-VE02-PP) (Internal Antenna), High Channel Frequency at 3m distance

CENTER 925.382 MHz
RES BW 30 KHZ

VBW 30 KHZ

SPAN 199 KHZ
SWP 20.0 msec

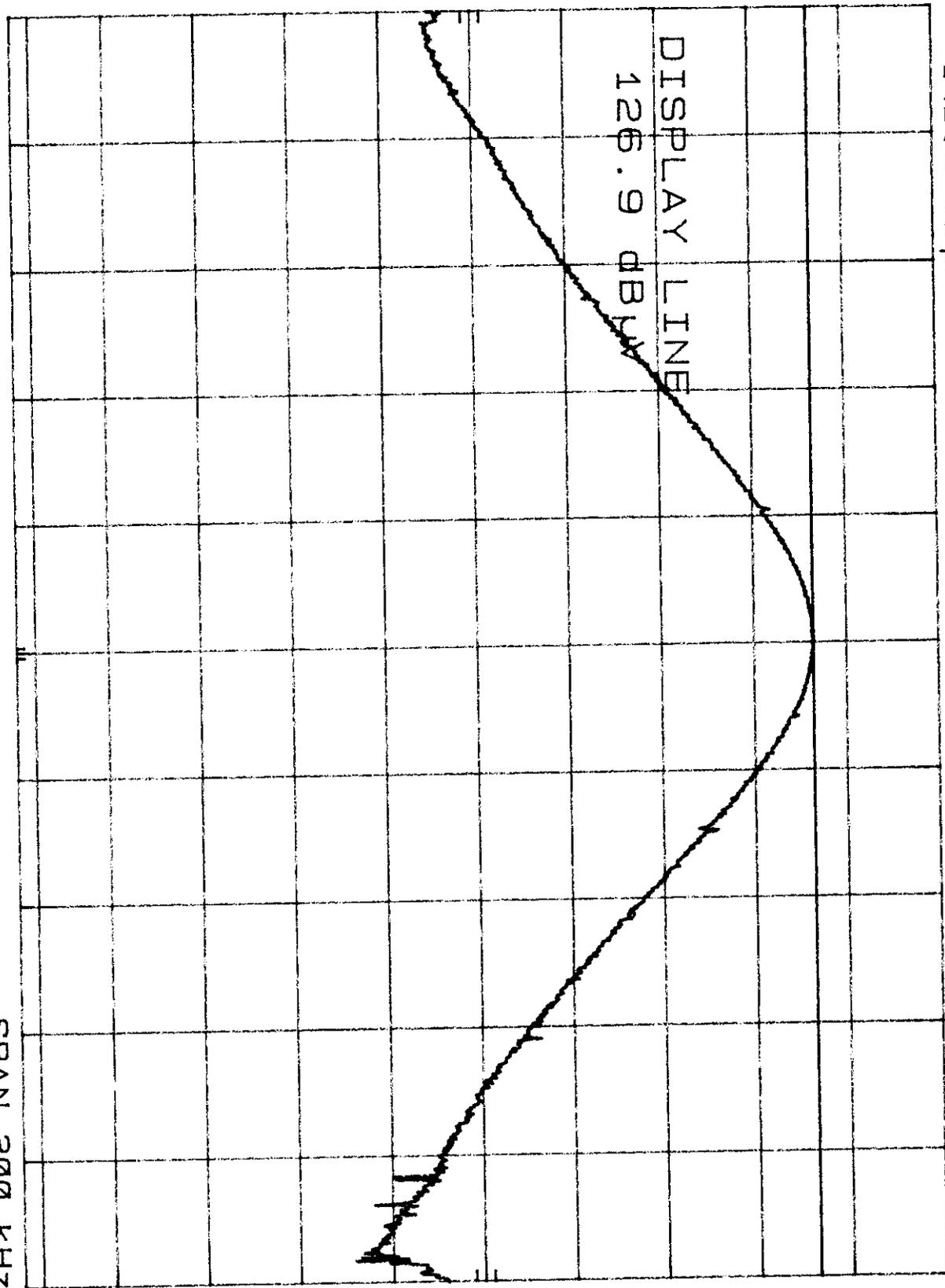


HP
10 DB/
OFFSET
25.0
DB
DL
117.0
DBµV

5.1.4 Plot of Direct Conductive Output Power and 20 dB BW of Vectron RMI 110ES-VE03-PP (External Antenna), Low Channel Frequency

CENTER 903.424 MHZ
RES BW 30 KHZ
VBW 30 KHZ
SPAN 200 KHZ
SMP 50.0 msec

HP
10 DB/
OFFSET 3.5 DB
DL 126.9 DBμV



VECTRON EXT
REF 140.5 DBμV
ATTEN 50 DB +0 DB

MKR Δ 90.4 KHZ
-0.10 DB

HP

VECTRON EXT
REF 138.8 DBµV ATTEN 50 DB +0 DB

MKR Δ 91.2 KHZ
0.00 DB

10 DB/

OFFSET
1.8

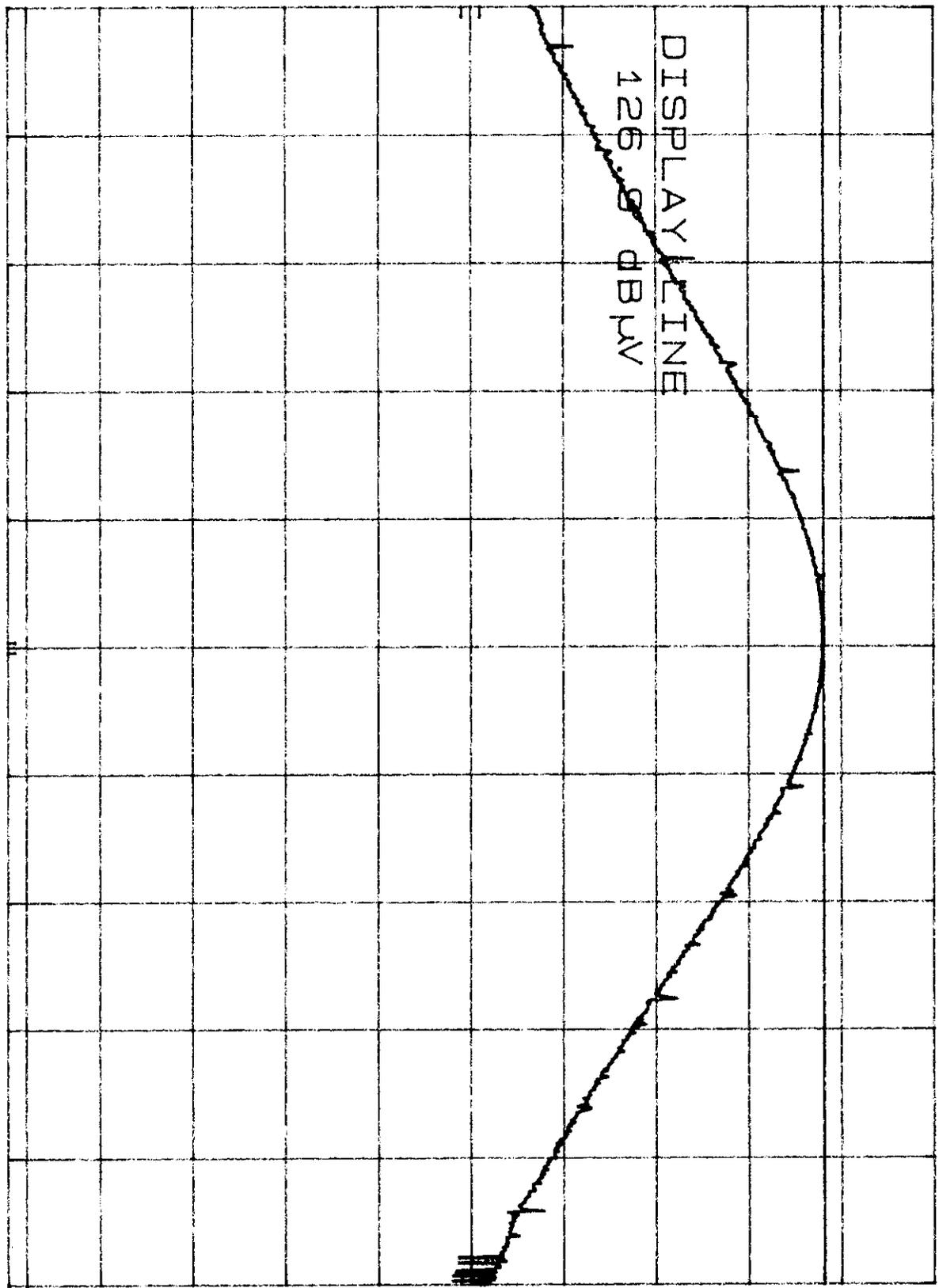
DB

DL

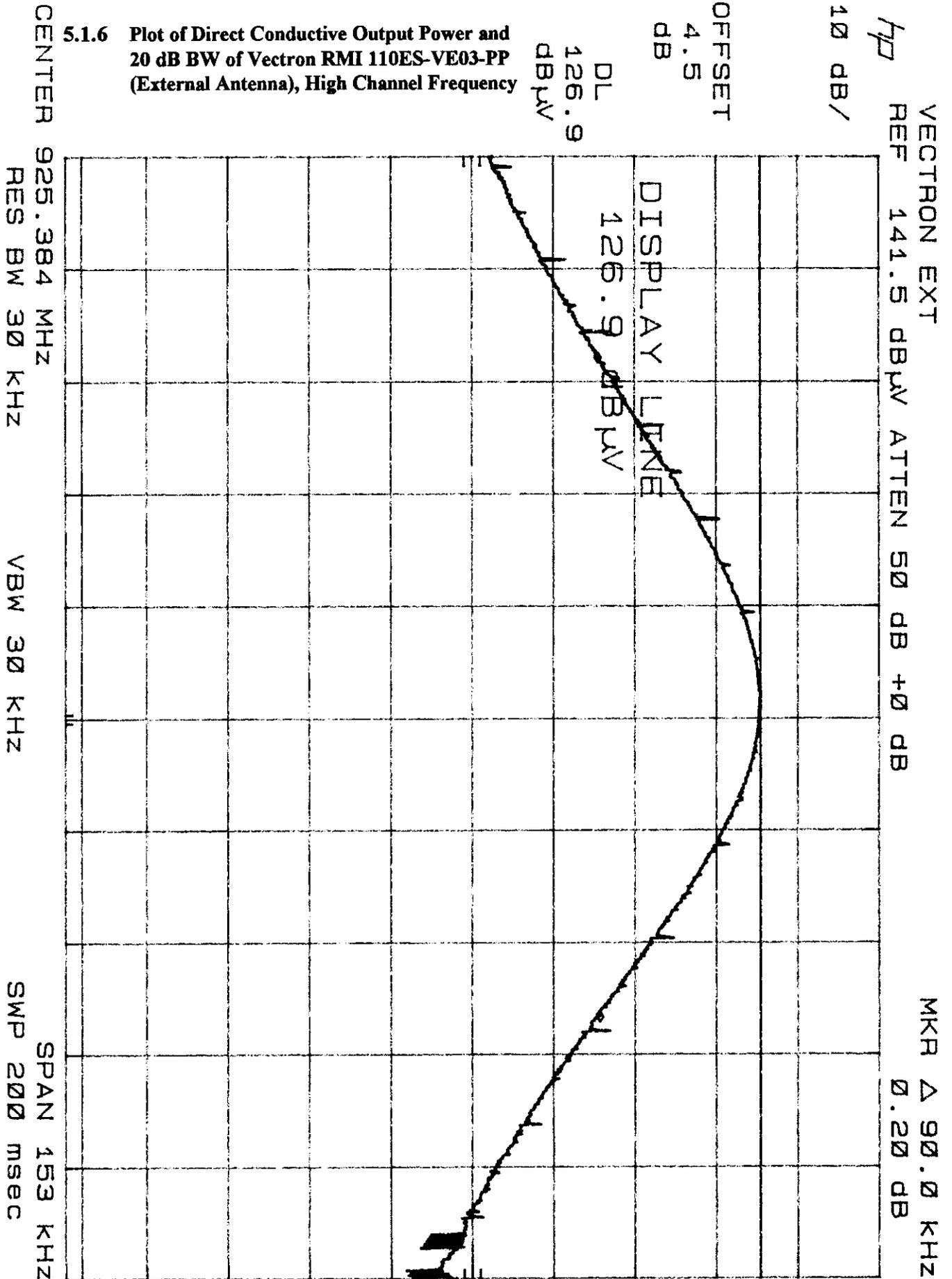
126.9
DBµV

5.1.5 Plot of Direct Conductive Output Power and
20 dB BW of Vectron RMI 110ES-VE03-PP
(External Antenna), Medium Channel Frequency

CENTER 914.944 MHZ
RES BW 30 KHZ
VBW 30 KHZ
SPAN 144 KHZ
SWP 100 msec



5.1.6 Plot of Direct Conductive Output Power and 20 dB BW of Vectron RMI 110ES-VE03-PP (External Antenna), High Channel Frequency



5.1.7 Plot of Spectrum Showing Direct Conductive of 50 Random Channel Vectron 110ES-VE03-PP (External Antenna)

10 dB/

hp

Vectron without bundling kHz output wire
REF 78.0 dBµV ATTEN 0 DB +0 DB

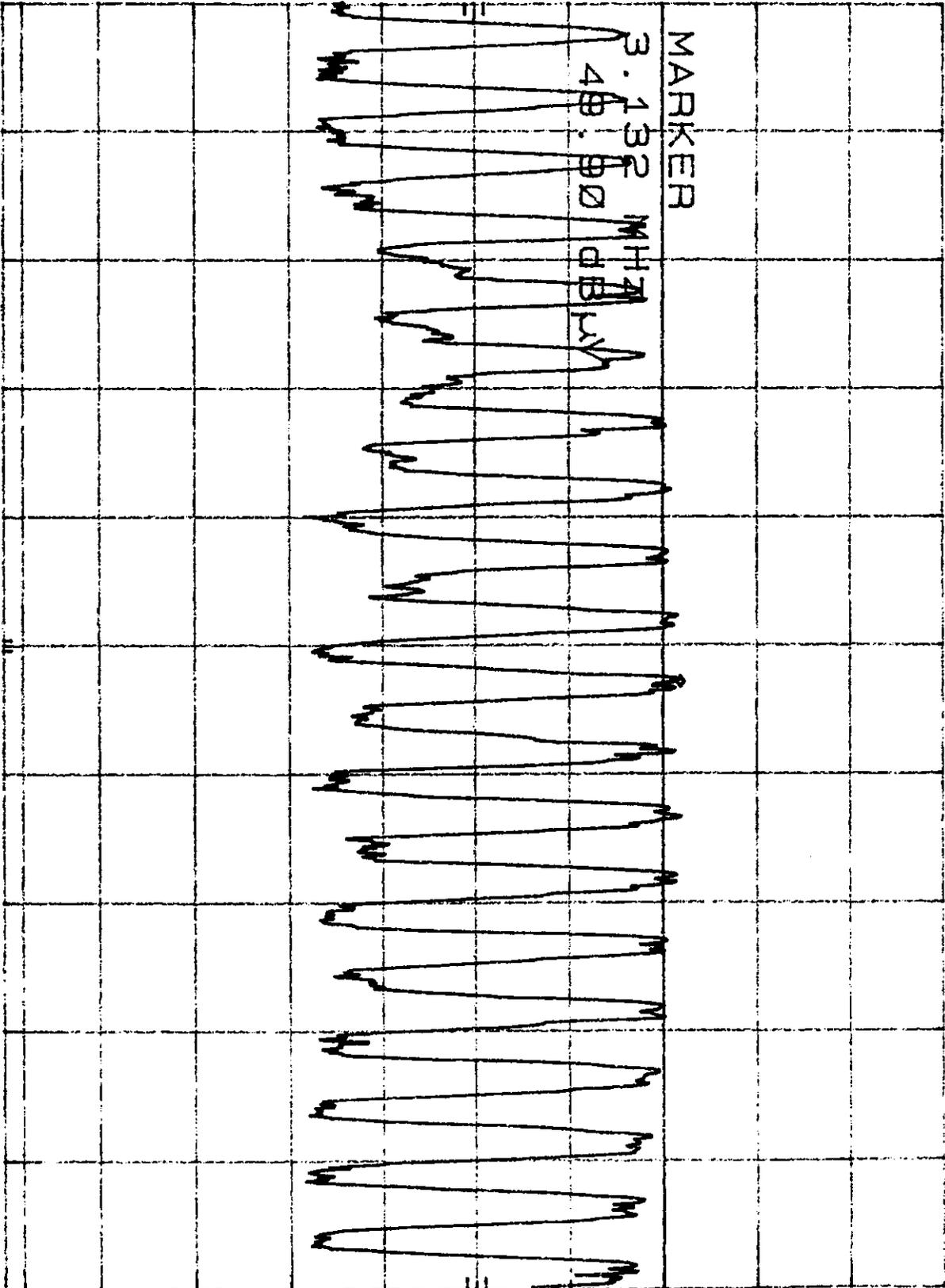
MKR 3.132 MHz
49.90 dBµV

OFFSET
1.0

dB

DL
48.0
dBµV

MARKER



CENTER 3.07 MHz

RES BW 10 KHZ

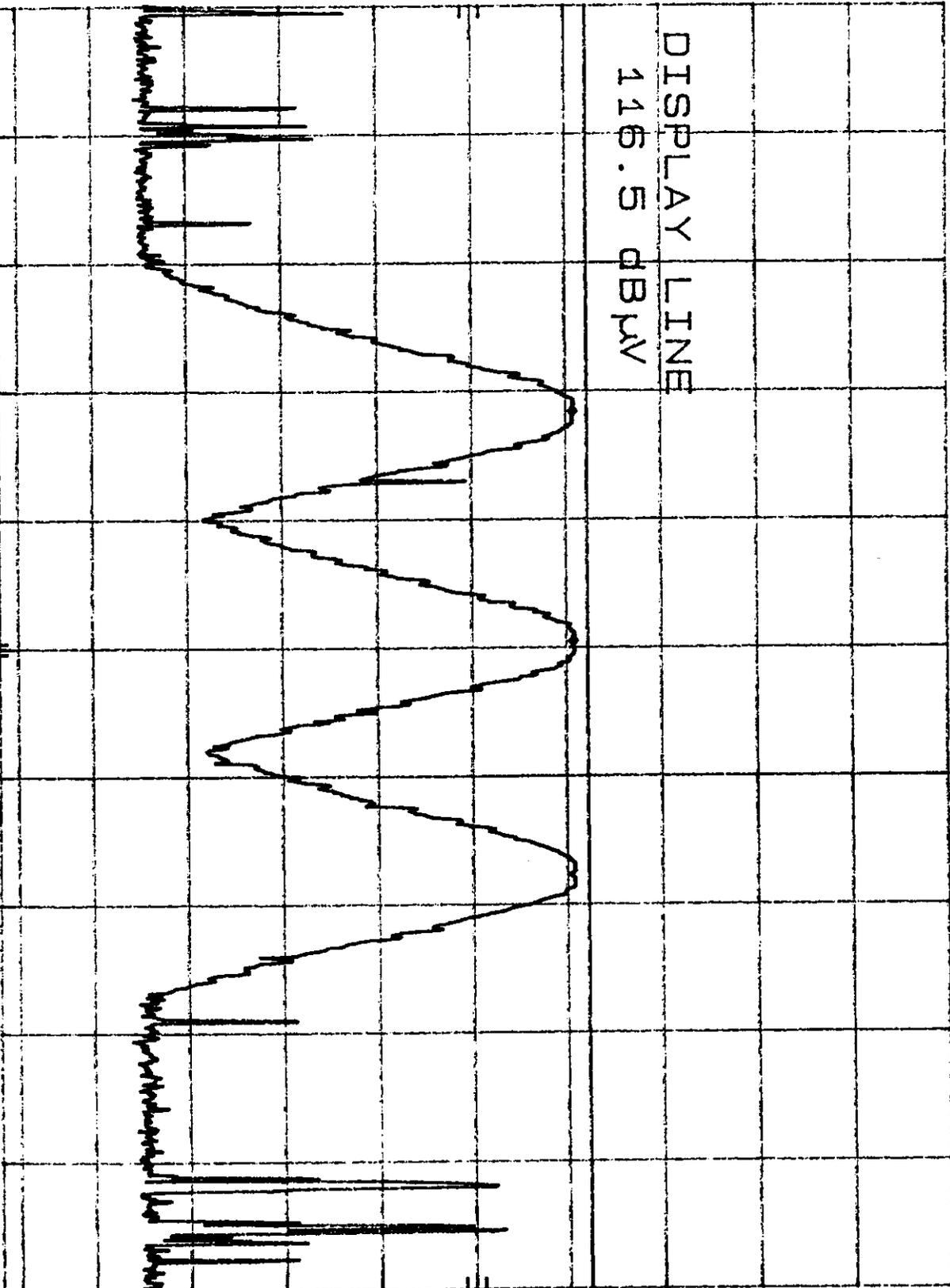
VBW 10 KHZ

SPAN 2.00 MHz
SWP 60.0 msec

5.1.8 Plot of Conductive Channel Spacing of Vectron RMI 110ES-VE03-PP (External Antenna)

CENTER 910.62 MHz RES BW 30 KHZ VBW 30 KHZ SPAN 1.00 MHz SWP 30.0 msec

HP REF 154.2 DBμV ATTEN 30 DB +0 DB
10 DB/
OFFSET 27.2 DB
DL 116.5 DBμV
DISPLAY LINE 116.5 DBμV

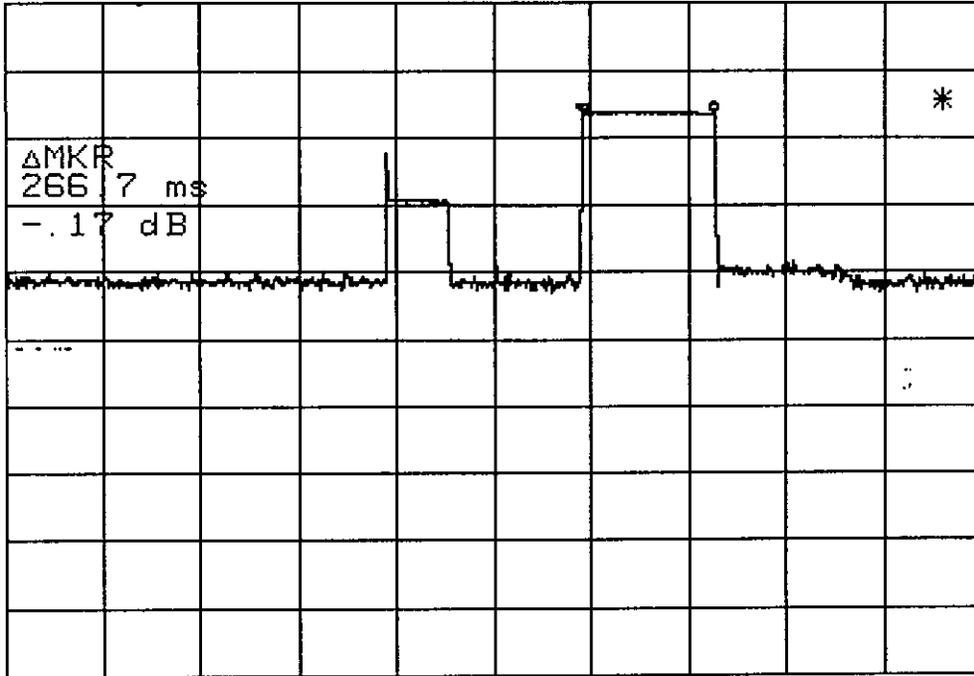


MKR Δ 179 KHZ
0.00 DB

ATTEN 10dB
RL -30.0dBm

10dB/

Δ MKR -.17dB
266.7ms



CENTER 907.740000MHz
RBW 1.0MHz VBW 1.0MHz

SPAN 0Hz
*SWP 2.00sec

5.1.9 Plot of Maximum Dwell Time of Vectron RMI (Less than 400 ms)

APPENDIX A

MEASUREMENT PROCEDURES

MEASUREMENT PROCEDURES

POWERLINE CONDUCTED EMISSIONS

The measurements are performed in a 21' x 14' x 9' shielded room. A wooden bench 80 cm in height is located at the center of the shielded room; desktop EUT are placed on top of this bench. The rear of the EUT and bench are placed 40 cm from the shielded room wall. All items on the table (or test-table) are placed at least 10 cm apart. Excess EUT power cord is folded back and forth to form a 30-cm by 40 cm long bundle, hanging approximately in the middle between the ground plane and table. The EUT power cord is plugged into a LISN 80 cm away, while all other devices are plugged into a second LISN, also 80 cm away from the closest part of the EUT.

The highest emissions are also analyzed in detail by operating the spectrum analyzer in fixed tuned mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables are moved around to maximize the emissions, and the position of the peripheral devices are interchanged to check for any changes in emissions.

RADIATED EMISSIONS

The EUT is set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992.

The EUT and support equipment are set up on the turntable of an open field site. Desktop EUT are set up on a wooden stand (test table), 80 cm above the ground plane. All items on the table are placed at least 10 cm apart. Interconnecting cables which hang closer than 40 cm to the ground plane are folded back and forth to form a 30 cm by 40 cm long bundle, hanging approximately between the ground plane and table.

The highest emissions are also analyzed, in detail, by operating the spectrum analyzer in fixed tuned quasi-peak mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables are moved around and at the highest amplitudes observed, the EUT is rotated in the horizontal plane while changing the antenna polarization in the vertical plane to maximize the reading. Once the maximum reading is obtained, the antenna elevation and polarization will be varied between specified limits to maximize the readings. The position of the peripheral devices are interchanged to check for any changes in emissions.

APPENDIX B
DESCRIPTION OF OPEN FIELD TEST SITE

DESCRIPTION OF OPEN FIELD TEST SITE

The open field test site is located on a 5.5 acre parcel, in the agriculturally zoned section of the City of Sunol, California. It is situated adjacent to Highway 680 on the West side, and adjacent to Calaveras Road in the South East. Distance of the site to each of these roads is a minimum of 200 feet. The north end of the site is surrounded by hills measuring up to 150 ft. high. The distance of the site to the hills is approximately 200 ft.

Supporting structures used to support device being measured and test instrumentation include the following:

- a. Test Platform measuring 50 ft by 100 ft. The platform is located on top of a very large ground screen, to enhance a homogeneous reflective surface.
- b. Test Site building measures approx. 5000 Sq. ft. This building houses the test laboratory, the shielded room, for performing Line Conducted test, test personnel and other support staff. The test building is an all-wooden building, constructed using 2 by 4-inch studs. It also contains all necessary electrical wiring and utilities.

The Rockford Engineering Services RFI test site described above has been approved for conducting contract RFI measurement work for client companies following the procedures stated in FCC/OET ANSI C63.4-1992, EN55011, EN55022 Vfg. 243/1991 and VDE-0877. The site attenuation characteristics are routinely measured and recorded every three months.

Test site approved by VDE, File # F-R HF-MK.

Test site approved by FCC, Registration # 31010/SIT/ Rockford.

Test site approved by VCCI, Membership # 242.

Test site approved by the Industry Canada, Registration # DEB 5072-7, DEB 90-3008.

APPENDIX C

TEST EQUIPMENT

TEST EQUIPMENT

Some or all of the following test equipment is currently used to measure the conducted and/or radiated emissions from the equipment under test:

TEST EQUIPMENT	MODEL	S/N
Spectrum Analyzer	Hewlett Packard 8590A	2752 A02715
Spectrum Monitor	Rhode & Schwarz EZM	881 334/025
Test Receiver (9KHz-30MHz)	Rhode & Schwarz ESH3	RES 0753
Test Receiver (20-1300MHz)	Rhode & Schwarz ESVP	RES 0749
Spectrum Analyzer	Hewlett-Packard 8566B	2618A02909
Spectrum Analyzer	Hewlett-Packard 8567A	2602A00239
Spectrum Analyzer Display (Site 1)	Hewlett-Packard 8590A	2542A11954
Spectrum Analyzer Display (Site 2)	Hewlett-Packard 85662A	2542A12593
Quasi Peak Adapter (Site 1)	Hewlett-Packard 85650	2521A00871
Quasi Peak Adapter (Site 2)	Hewlett-Packard 85650A	2521A00737
Preselector (Site 1)	Hewlett-Packard 85685A	2620A00265
Preselector (Site 2)	Hewlett-Packard 85685A	2648A00462
Preamp	Hewlett-Packard 8447D	2648A04855
Preamp	Hewlett-Packard 8449B	3008A00101
Computer	Hewlett-Packard 9000/300	RES 449
Absorbing Clamp	MDS21	891 092/025
Antenna Cable (OPTK45)	RG8/u	
Antenna System	EMCO 3230	
Biconical Antenna (Site 1)	EMCO 3104	3549
Biconical Antenna (Site 2)	EMCO 3104C	9111-4463
Log Periodic Antenna (Site 1) (200-1000MHz)	EMCO 3146	2075
Log Periodic Antenna (Site 2) (200-1000MHz)	EMCO 3146	9510-4202
Adj. Element Dipole Antenna (28 MHz-1GHz)	EMCO 3120	
Horn Antenna	Eaton 96001	2632
LISN (25 Amp)	EMCO 38825/2	9210-2008
LISN (100 Amp)	Solar 8610-50-TS-100N	
LISN	EMCO 3825/2R	1188/1001

TEST EQUIPMENT CONTD.

TEST EQUIPMENT	MODEL	S/N
Remote Controlled 8 ft Rotating Table	RES RT1	
Remote Controlled 25 ft Rotating Table	RES RT2	
Remote Controlled 4 ft Rotating Table	RES RT3, RT4, RT5	
Remote Controlled 4 m Antenna Mast	RES AM1	
Remote Controlled 6 m Antenna Mast	RES AM2, RES AM3	
Generator	3 Phase 220Vac/50Hz	DB7130B40
Oscilloscope (300MHz)	Tektronix 2465	
Digital Scope	Hitachi VC-6075	8110016
Power Analyzer	Valhalla Scientific/2101 RES 574	
Digital Thermometer	Omega 440	
DC Power Supply	Kepeco JQE 150-1.5m	H177085

The spectrum analyzers are self-calibrated before every shift and are calibrated to NIST standards annually

APPENDIX D
EUT TECHNICAL DESCRIPTION

<i>Applicant</i>	Whisper Communications, Incorporated
<i>EUT Tested</i>	Vectron Solid-State Polyphase Remote Meter Interface
<i>Model Names</i>	110ES-VE00-PP (Internal Antenna) 110ES-VE02-PP (Internal Antenna w/ KYZ & EOI) 110ES-VE01-PP (External Antenna) 110ES-VE03-PP (External Antenna w/ KYZ & EOI)
<i>FCC ID</i>	NVCRMI0006
<i>Technical Specification</i>	<i>Medium Power</i>
◆ Frequency Range	902-928 MHz
◆ Modulation	Frequency Hopping Spread Spectrum
◆ Output Power	+22 dBm
◆ Temperature Range	-40°C to 85°C
◆ Data Packet Length	Maximum 60 Bytes
◆ Data Rate	4Kbps (Tx), 2Kbps (Rx)
◆ Power Supply	3 Phase, 208 Vac
◆ Channel Capacity	128
◆ Channel Spacing	180 KHz
◆ Deviation	+/- 5 KHz
◆ Frequency Accuracy	+/- 10ppm