

TEST RESULT SUMMARY

FCC PART 15 SUBPART C Section 15.231

MANUFACTURER'S NAME	Monarch Marking Systems Inc
NAME OF EQUIPMENT	Wanderer II 433.8 MHz Transceiver
MODEL NUMBER	7400
MANUFACTURER'S ADDRESS	170 Monarch Lane Miamisburg OH 45342
TEST REPORT NUMBER	W9178
TEST DATE	24 March 1999

According to testing performed at TÜV Product Service Inc, the above-mentioned unit is in compliance with the electromagnetic compatibility requirements defined in FCC Part 15.

It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics. Any modifications necessary for compliance made during testing on the above mentioned date(s) must be implemented in all production units for compliance to be maintained.

TÜV Product Service Inc, as an independent testing laboratory, declares that the equipment tested as specified above conforms to the requirements of FCC Part 15.

Date: 07 May 1999

Location: Taylors Falls MN
USA

Thomas K. Swanson
G. S. Jakubowski for GSS
Test Engineer

Joel T. Schneider
J. T. Schneider
NVLAP Signatory

EMC EMISSION - TEST REPORTTest Report File No. : **WC1G917801** Date of issue: 07 May 1999Model / Serial No. : **7400**Product Type : **Wanderer II 433.8 MHz Transceiver**Applicant : **Monarch Marking Systems Inc**Manufacturer : **Monarch Marking Systems Inc**License holder : **Monarch Marking Systems Inc**Address : **170 Monarch Lane**: **Miamisburg OH 45342**Test Result : ☒ **Positive** ☐ **Negative**Test Project Number :
Reference(s) : **W9178**Total pages including
Appendices : **24**

TÜV Product Service Inc is a subcontractor to TÜV Product Service, GmbH according to the principles outlined in ISO/IEC Guide 25 and EN 45001.

TÜV Product Service Inc reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. TÜV Product Service Inc shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV Product Service Inc issued reports.

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EMISSIONS TEST REGULATIONS :

The emissions tests were performed according to following regulations:

- | | | |
|--|---|------------------------------------|
| ☐ - EN 50081-1 / 1991 | ☐ - Group 1 | ☐ - Group 2 |
| ☐ - EN 55011 / 1991 | ☐ - Class A | ☐ - Class B |
| ☐ - EN 55013 / 1990 | ☐ - Household appliances and similar | |
| ☐ - EN 55014 / 1987 | ☐ - Portable tools | |
| | ☐ - Semiconductor devices | |
| ☐ - EN 55014 / A2:1990 | ☐ - Household appliances and similar | |
| ☐ - EN 55014 / 1993 | ☐ - Portable tools | |
| | ☐ - Semiconductor devices | |
| ☐ - EN 55015 / 1987 | | |
| ☐ - EN 55015 / A1:1990 | | |
| ☐ - EN 55015 / 1993 | | |
| ☐ - EN 55022 / 1987 | ☐ - Class A | ☐ - Class B |
| ☐ - EN 55022 / 1994 | ☐ - Class A | ☐ - Class B |
| ☐ - BS | | |
| ☐ - VCCI | ☐ - Class A | ☐ - Class B |
| ■ - FCC Part 15 Subpart C Section 15.231 | | |
| ☐ - FCC Part 15 Subpart B | ☐ - Class A | ☐ - Class B |
| ☐ - CISPR 11 (1990) | ☐ - Group 1 | ☐ - Group 2 |
| | ☐ - Class A | ☐ - Class B |
| ☐ - CISPR 22 (1993) | ☐ - Class A | ☐ - Class B |

Environmental conditions in the lab:

	<u>Actual</u>
Temperature	: 20 °C
Relative Humidity	: 9 %
Atmospheric pressure	: 99.2 kPa
Power supply system	: 9 VDC battery

Sign Explanations:

- ☐ - not applicable
- ☒ - applicable

Emissions Test Conditions: CONDUCTED EMISSIONS (Interference Voltage)

The *CONDUCTED EMISSIONS (INTERFERENCE VOLTAGE)* measurements were performed at the following test location:

☒ - Test not applicable

- ☐ - Wild River Lab Large Test Site (Open Area Test Site)
- ☐ - Wild River Lab Small Test Site (Open Area Test Site)
- ☐ - Oakwood Lab (Open Area Test Site)
- ☐ - Wild River Lab Screen Room
- ☐ - New Brighton Lab Shielded Room

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Date
--------------	--------------	-------------	---------------	----------

Use of the calibrated equipment on this list ensures traceability to national and international standards.

Emissions Test Conditions: RADIATED EMISSIONS (Magnetic Field)

The *RADIATED EMISSIONS (MAGNETIC FIELD)* measurements were performed at the following test location:

- ☐ - Wild River Lab Large Test Site (Open Area Test Site)
- ☐ - Wild River Lab Small Test Site (Open Area Test Site)
- ☐ - Oakwood Lab (Open Area Test Site)

at a test distance of :

- ☐ - 3 meters
- ☐ - 30 meters

☒ - Test not applicable

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Date
--------------	--------------	-------------	---------------	----------

Emissions Test Conditions: RADIATED EMISSIONS (Electric Field)

The *RADIATED EMISSIONS (ELECTRIC FIELD)* measurements, in the frequency range of 30 MHz-1000 MHz, were tested in a horizontal and vertical polarization at the following test location :

☐ - Test not applicable

- - Wild River Lab Large Test Site (Open Area Test Site)
- ☐ - Wild River Lab Small Test Site (Open Area Test Site)
- ☐ - Oakwood Lab (Open Area Test Site)

at a test distance of :

- - 3 meters
- ☐ - 10 meters
- ☐ - 30 meters

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Date
■ - 3146	Electro-Mechanics (EMCO)	Log Periodic Antenna	9103-3075	11-98
■ - 3108	Electro-Mechanics (EMCO)	Biconical Antenna	2429	6-98
■ - 8566B	Hewlett-Packard	Spectrum Analyzer	2221A01596	4-98
■ - 85662A	Hewlett-Packard	Analyzer Display	2152A03640	4-98
■ - 85650A	Hewlett-Packard	Quasi-Peak Adapter	2811A01127	4-98
■ - ZHL-1042J	Mini-Circuits	Preamplifier	H072294-11	4-98

Use of the calibrated equipment on this list ensures traceability to national and international standards.

Emissions Test Conditions: INTERFERENCE POWER

The *INTERFERENCE POWER* measurements were performed by using the absorbing clamp on the mains and interface cables in the frequency range 30 MHz - 300 MHz at the following test location :

■ - Test not applicable

- ☐ - Wild River Lab Large Test Site (Open Area Test Site)
- ☐ - Wild River Lab Small Test Site (Open Area Test Site)
- ☐ - Oakwood Lab (Open Area Test Site)
- ☐ - Wild River Lab Screen Room
- ☐ - New Brighton Lab Shielded Room

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Date
--------------	--------------	-------------	---------------	----------

Emissions Test Conditions: RADIATED EMISSIONS (Electric Field)

The *EQUIVALENT RADIATED EMISSIONS* measurements in the frequency range 1 GHz - 4.4 GHz were performed in a horizontal and vertical polarization at the following test location :

- ☒ - Wild River Lab Large Test Site (Open Area Test Site)
- ☐ - Wild River Lab Small Test Site (Open Area Test Site)
- ☐ - Oakwood Lab (Open Area Test Site)
- ☐ - Wild River Lab Screen Room

at a test distance of:

- ☐ - 1 meters
- ☒ - 3 meters
- ☐ - 10 meters

☐ - Test not applicable

Test equipment used :

	Model Number	Manufacturer	Description	Serial Number	Cal Date
☒ -	3115	Electro-Mechanics (EMCO)	Horn Antenna	9001-3275	9-98
☒ -	8566B	Hewlett-Packard	Spectrum Analyzer	2221A01596	4-98
☒ -	85662A	Hewlett-Packard	Analyzer Display	2152A03640	4-98
☒ -	85650A	Hewlett-Packard	Quasi-Peak Adapter	2811A01127	4-98
☒ -	ZHL-1042J	Mini-Circuits	Preamplifier	H072294-11	4-98
☒ -	AFT-8434	Avantek	Preamplifier	9112 Z221	4-98

Use of the calibrated equipment on this list ensures traceability to national and international standards.

Equipment Under Test (EUT) Test Operation Mode - Emission tests :

The device under test was operated under the following conditions during emissions testing:

- ☐ - Standby
- ☐ - Test program (H - Pattern)
- ☐ - Test program (color bar)
- ☐ - Test program (customer specific)
- ☐ - Practice operation
- ☐ - Normal Operating Mode
- ☒ - Transmitter on.

EUT Configuration of the device under test:

- ☐ - See Constructional Data Form in Appendix B - Page B2
- ☒ - See Product Information Form in Appendix B - beginning on Page B3

The following peripheral devices and interface cables were connected during the measurement:

- | | |
|---|----------------|
| ☐ - _____ | Type : _____ |
| ☐ - _____ | Type : _____ |
| ☐ - _____ | Type : _____ |
| ☐ - _____ | Type : _____ |
| ☐ - _____ | Type : _____ |
| ☐ - _____ | Type : _____ |
| ☐ - _____ | Type : _____ |
| ☐ - _____ | Type : _____ |
| ☐ - unshielded power cable | |
| ☐ - unshielded cables | |
| ☐ - shielded cables | MPS.No.: _____ |
| ☐ - customer specific cables | |
| ☐ - _____ | |
| ☐ - _____ | |

Emission Test Results:

Conducted emissions 10/150 kHz - 30 MHz

The requirements are ☐ - MET ☐ - NOT MET

Minimum limit margin _____ dB at _____ MHz

Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Radiated emissions (magnetic field) 10 kHz - 30 MHz

The requirements are ☐ - MET ☐ - NOT MET

Minimum limit margin _____ dB at _____ MHz

Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Radiated emissions (electric field) 30 MHz - 1000 MHz

The requirements are ☒ - MET ☐ - NOT MET

Minimum limit margin for xmtr fundamental _____ 4 dB at _____ 433.8 MHz

Minimum limit margin for xmtr spurious _____ 8 dB at _____ 867.7 MHz

Remarks: The fundamental was measured to be 75.6 dBuV/m in peak mode, minus 7 dB (based on 40% duty cycle) to get average measurement, or 68.6 dBuV/m (2691 uV/m) compared to a limit of 72.8 dBuV/m (4396 uV/m). The second harmonic was measured to be 51.5 dBuV/m in peak mode, minus 7 dB (based on 40% duty cycle) to get average measurement, or 44.5 dBuV/m (167 uV/m) compared to a limit of 52.8 dBuV/m (439 uV/m).

Interference Power at the mains and interface cables 30 MHz - 300 MHz

The requirements are ☐ - MET ☐ - NOT MET

Minimum limit margin _____ dB at _____ MHz

Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Equivalent Radiated emissions 1 GHz - 4.4 GHz

The requirements are ☒ - MET ☐ - NOT MET

Minimum limit margin for transmitter _____ 7 dB at _____ 1735.4 MHz

Maximum limit exceeding _____ dB at _____ MHz

Remarks: Peak analyzer reading of 52.8 dBuV/m, minus 7 dB (based on 40% duty cycle) to get average measurement, or 45.8 dBuV/m (194 uV/m) compared to a limit of 52.8 dBuV/m (439 uV/m).

DEVIATIONS FROM STANDARD:

None.

GENERAL REMARKS:

The bandwidth of the fundamental must be less than 0.25% of the center frequency, or 1.082 MHz. Page A7 of A7 shows the bandwidth to be less than 60 kHz. Pages A5-A6 of A7 show the transmitter on times.

SUMMARY:

The requirements according to the technical regulations are

☒ - met

☐ - not met.

The device under test does

☒ - fulfill the general approval requirements mentioned on page 3.

☐ - not fulfill the general approval requirements mentioned on page 3.

Testing Start Date: 24 March 1999

Testing End Date: 24 March 1999

- TÜV PRODUCT SERVICE INC -

Joel T. Schneider
J. T. Schneider
NVLAP Signatory

Thomas K. Swanson
Tested By:
G. S. Jakubowski *for GSJ*

Test-setup photo(s):
Conducted emission 10/150 kHz - 30 MHz

Not Applicable

Test-setup photo(s):
Radiated emission 30 MHz - 5 GHz

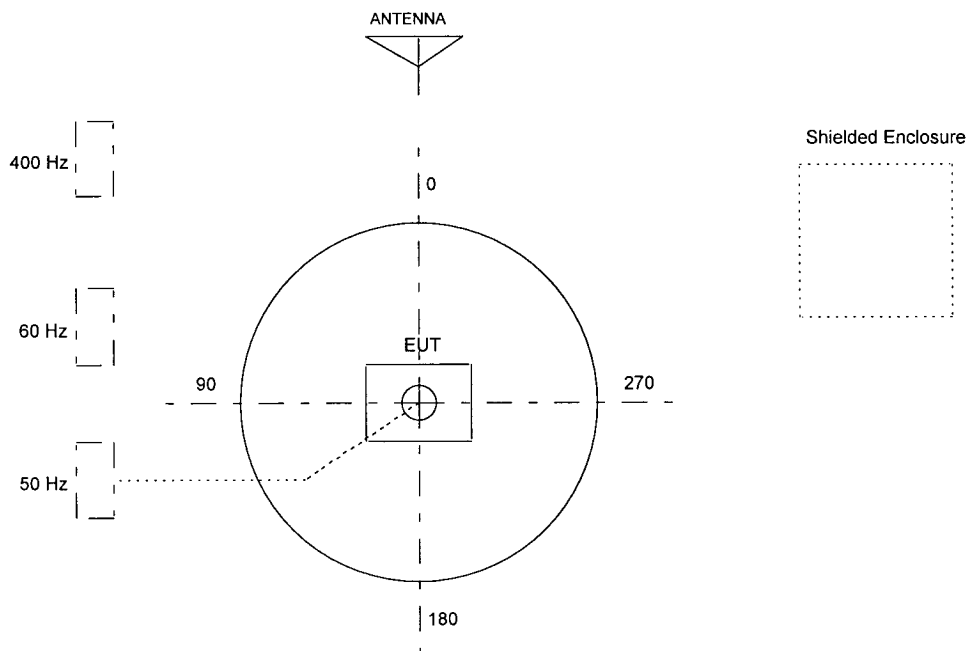


Appendix A

Test Data Sheets
and
Test Setup Drawing(s)

TEST SETUP FOR EMISSIONS TESTINGWILD RIVER LAB
Large Test Site**Notes:**

1. Items shown in dotted lines are located on the floor below the test area. It is 5 meters vertically from the ground floor to the test area.
2. 50 Hz, 60 Hz, and 400 Hz are power panels for alternating current.
3. The antenna may be positioned horizontally 3, 10 or 30 meters from the center of the turntable.
4. The circle is a 6.7 meter diameter turntable.
5. A ground plane is in the plane of this sheet.
6. The test sample is shown in the azimuthal position representing zero degrees.



T U V P R O D U C T S E R V I C E

RADIATED EMISSIONS

Large Test Site
 3 Meter Antenna Distance
 Equipment Under Test:
 MONARCH MARKING SYSTEMS
 WANDERER II

Notes: TRANSCEIVER (TRANSMITTER SCAN)

Report W9178 Run 1
 Date 03-24-99 Page 1
 Engineer _____
 Tech: GSJ JKS
 Requester _____

Frequency MHz	Level dBuV	Factor dB	Cable dB	Peak dBuV/m	Polar\ Height	Duty Cycle correction	Average dBuV/m	Limit 15.231(E)
0 DEGREES AZIMUTH = EUT FRONT, STANDING UPRIGHT								
FUNDAMENTAL MAXED AT 115 DEGREES, VERTICAL ANTENNA, 1.4 METERS HIGH								
433.86	56.58	17.1	2	75.6	V --	-7	68.6	72.8
2ND HARMONIC MAXED AT 320 DEG, HORIZ, 1 METER								
867.72	25.43	23.2	2.9	51.5	H --	-7	44.5	52.8
3RD HARMONIC MAXED AT 50 DEG, VERT, 1 METER								
1301.5	15.4	25.8	3.6	44.8	V --	-7	37.8	54
4TH HARMONIC MAXED AT 0 DEG, VERT, 1 METER								
1735.4	20.5	28	4.3	52.8	V --	-7	45.8	52.8
5TH HARMONIC MAXED AT 200 DEG, VERT, 1 METER								
2169.3	14	29.6	4.9	48.5	V --	-7	41.5	52.8
6TH HARMONIC MAXED AT 200 DEG, VERT, 1 METER								
2603.1	15.2	30.3	5.4	50.9	V --	-7	43.9	52.8
-7TH HARMONIC MAXED AT 245 DEG, VERT, 1.1 METERS								
3037.0	12.5	31.4	5.9	49.8	V --	-7	42.8	52.8
NO SIGNIFICANT SIGNALS DETECTED ABOVE 3037 MHz								

T U V P R O D U C T S E R V I C E

RADIATED EMISSIONS

Large Test Site
3 Meter Antenna Distance
Equipment Under Test:
MONARCH MARKING SYSTEMS
WANDERER II

Figure _____

Report W9178 Run 1
Date 03-24-99 Page 2
Engineer _____
Tech: JCS _____
Requester _____

Notes: TRANSCEIVER (TRANSMITTER SCAN)

Measurement Summary

Frequency MHz	----- Final dBuV/m	----- uV/m	Azimuth deg	Polar\ Height	Delta 15.231(E)	Delta
433.86	68.6	2691.5	--	V --	-4.2	
867.72	44.5	167.88	--	H --	-8.3	
1301.5	37.8	77.624	--	V --	-16.2	
1735.4	45.8	194.98	--	V --	-7	
2169.3	41.5	118.85	--	V --	-11.3	
2603.1	43.9	156.67	--	V --	-8.9	
3037.0	42.8	138.03	--	V --	-10	

File W9178 Run 1

MKR Δ 40.60 msec
18.40 dB

PG 26.2 dB

ATTEN 10 dB

REF 75.0 dBμV

hp

5 dB/

POS PK

MARKER Δ
40.60 msec
18.40 dB

CORR'D

CENTER 433.850 MHz
RES BW 1 MHz
OFFSET -0 Hz
VBW 1 MHz
SPAN 0 Hz
SWP 100 msec

MKR 10.00 msec
23.25 dBμV

REF 60.0 dBμV ATTN 10 dB

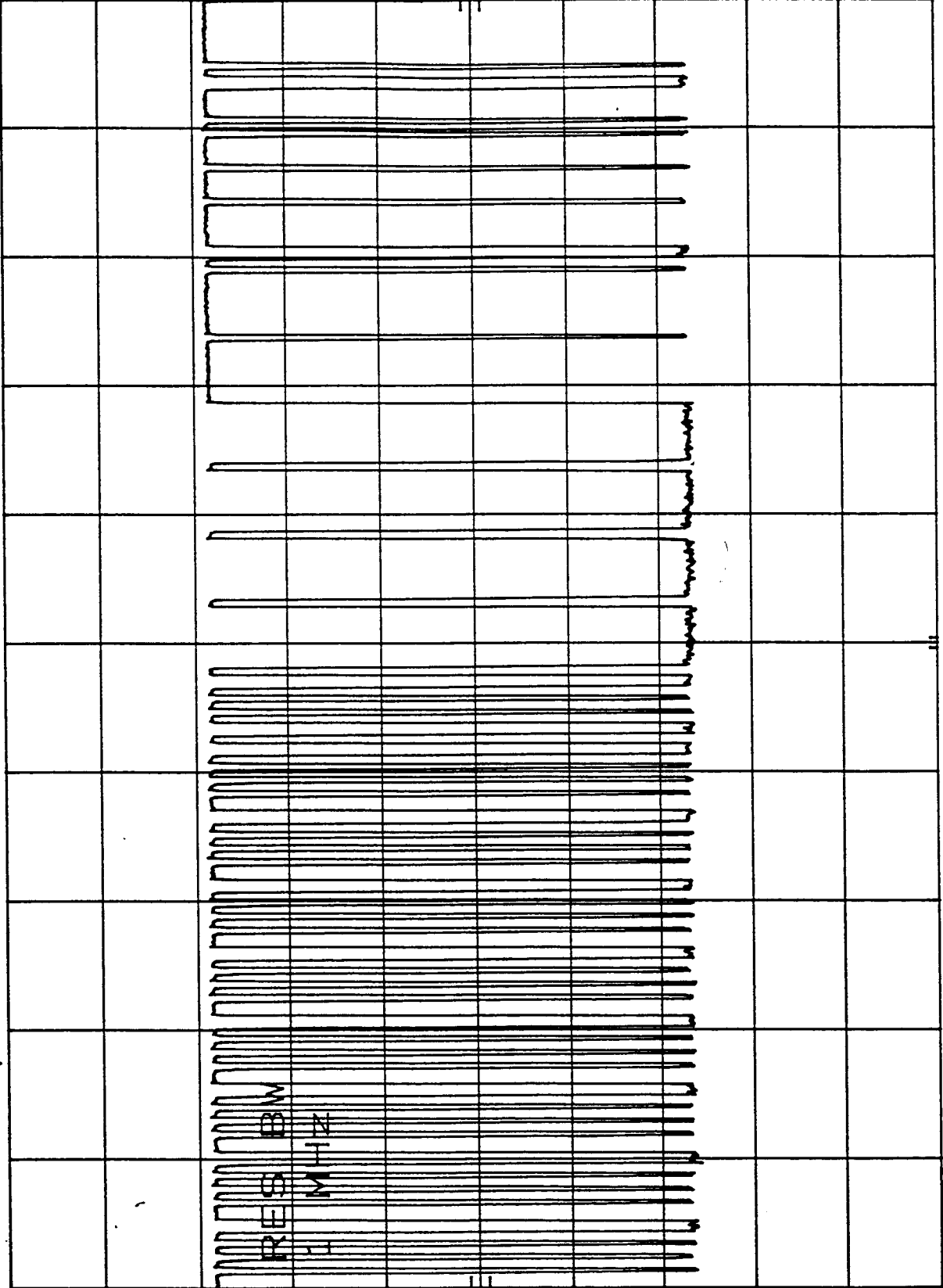
hp

5 dB/

POS PK

OFFSET
-26.2
dB

CORR'D



CENTER 433.811 984 MHz OFS -51.000 kHz
RES BW 1 MHz VBW 3 MHz

SPAN 0 Hz
SWP 20.0 msec

spec $\approx 1\text{MHz}$

MKR $\Delta -58.7\text{ kHz}$
 -0.10 dB

h_p REF 55.0 dB μ V ATTEN 10 dB

5 dB/

POS PK

OFFSET
-26.2
dB

DL
32.7
dB μ V

MARKER Δ

-58.7 kHz
-0.10 dB

CORR'D

CENTER 433.811 MHz
RES BW 10 kHz

OFS-51 kHz

VBW 3 MHz

SPAN 201 kHz
SWP 30.0 msec

Appendix B

Constructional Data Form
and
Product Information Form(s)

Constructional Data Form

Not Applicable

PRODUCT INFORMATION FORM

NOTE: It is required to complete both 1) a Product Information Form for each unit under test and 2) a Constructional Data Form for each system tested as outlined in the enclosed instructions.

*** Please show the exact spelling [including spacing, capitalization, etc] as you want shown on the After Test Documentation.**

***Company Name** Monarch Marking Systems

***Company Address** 170 Monarch Lane

Dayton OH 45342

Customer Representatives

***Equipment Description** Wanderer II 433 MHz Transmitter

***Model Number** 7400

***Serial Number**

Type of Test

- ☐ Development
☒ Initial Design Verification
☐ Design Change (Please describe exact changes below)
☒ Production Sample (Audit Test)
☐ Final Product Verification

Changes Made

Oscillator Frequencies

Power Interface n/a

Frequency

Voltage

of Phases

Current

Power Supply

Description

Manufacturer

Model Number

Switching Freq

9 V battery

Power Cable n/a

- | | |
|------------------------------------|-------------------------------------|
| ☐ Hardwired | ☐ Flexible |
| ☐ Shielded | ☐ Unshielded |
| ☐ Attached | ☐ Removable |

Power Line Filter n/a

Manufacturer

Model Number

Appendix C

MEASUREMENT PROTOCOL

GENERAL INFORMATION

Measurement Uncertainty

The test system for conducted emissions is defined as the LISN, tuned receiver or spectrum analyzer, and coaxial cable. The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. These test systems have a measurement uncertainty of ± 4.5 dB. The equipment comprising the test systems are calibrated on an annual basis.

Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into it's characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

CONDUCTED EMISSIONS

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\begin{aligned} \text{dB}\mu\text{V} &= 20(\log \mu\text{V}) \\ \mu\text{V} &= \text{Inverse log}(\text{dB}\mu\text{V}/20) \end{aligned}$$

RADIATED EMISSIONS

The final level, expressed in dB μ V/m, is arrived at by taking the reading from the spectrum analyzer (Level dB μ V) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has the FCC limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets in Attachment B. The amplifier gain is automatically accounted for by using an analyzer offset.

Example:

Frequency (MHz)	Level (dB μ V)	+	Factor & Cable (dB)	=	Final (dB μ V/m)	-	FCC B Limit (dB μ V/m)	=	Delta FCC B (dB)
32.21	13.9	+	16.3	=	30.2	-	40.0	=	-9.8

DETAILS OF TEST PROCEDURES**General Standard Information**

The test methods used comply with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

Conducted Emissions

Conducted emissions on the 60 Hz power interface of the EUT are measured in the frequency range of 450 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50 Ω /50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. In some cases, a pre-scan using a spectrum analyzer is initially performed on the units comprising the system under test to locate the highest emissions. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver or spectrum analyzer with quasi-peak and average detection and recorded on the data sheets.

Radiated Emissions

Radiated emissions from the EUT are measured in the frequency range of 30 to 1000 MHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak (or peak) detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 3 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees. Intentional radiators are rotated through three orthogonal axes to determine the attitude that maximizes the emissions.