REPORT OF MEASUREMENTS
PART 15C (15.247) - INTENTIONAL RADIATOR

DEVICE:	902 – 928 MHz FREQUENCY HOPPING TRANSMITTER
MODEL:	RPT0006-001
MANUFACTURER:	ITRON, INC
ADDRESS:	2818 NORTH SULLIVAN ROAD PO BOX 15288 SPOKANE WA 99215-5288

WORK ORDER: 9245dp

1. General

1.1 Document History

REVISION	DATE	COMMENTS
-	13 March 2001	Initial Release, Paul G. Slavens

Note: Acme Testing Co. hereby makes the following statements so as to conform with Chapter 10 (Test Reports) Requirement of ANSI C63.4:1992 “Methods and Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”:

- The units described in this report were received at Acme Testing Co.’s facilities on 20 February 2001. Testing was performed on the units described in this report on 20 February 2001.
- The Test Results reported herein apply only to the Units actually tested, and to substantially identical Units.
- This test report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government, or any other foreign government.

1.2 Purpose

The purpose of this report is to show compliance to the FCC regulations for spread spectrum unlicensed devices operating under section 15.247 of the Code of Federal Regulations title 47.

THE DATA CONTAINED IN THIS REPORT WAS COLLECTED AND COMPILED BY:

PAUL G. SLAVENS CHIEF EMC ENGINEER	DANIEL B. STATON SENIOR EMC TECHNICIAN

1.3 Manufacturer

Company Name:	Itron, Inc.
Contact:	Scott Cumeralto
Street Address:	2818 North Sullivan Road
Mailing Address:	PO Box 15288
City/State/Zip:	Spokane WA 99215-5288
Telephone:	509 891-3446
Fax:	509 891-3355

1.4 Test location

Laboratory:	Test Site #2
Street Address:	2002 Valley Highway
Mailing Address:	PO Box 3
City/State/Zip:	Acme WA 98220-0003
Telephone:	888 226-3837
Fax:	360 595-2722
E-mail:	acmetest@acmetesting.com
Web:	www.acmetesting.com

1.5 Accreditation and Listing

Acme Testing Co.'s test facilities are accredited by A2LA for the specific scope of accreditation under Certificate Numbers: 0829-01 (Acme, WA), and 0829-02 (Plummer, ID). Acme Testing Co.'s test facilities that are used to perform radiated and conducted emissions are currently registered with the Federal Communications Commission under registration numbers: 90420 (Acme, WA), and 96502 (Plummer, ID). In addition test facilities are also registered with the Industry Canada under registration numbers: 3251 (Acme, WA), and 3618 (Plummer, ID).

2. Test Results Summary

Summary of Test Results

Requirement	CFR Section	Test Result
Radiated Spurs < 15.209	15.205(b)	COMPLIES
Conducted Emissions < 48.0 dBuV	15.207	COMPLIES
Channel Separation > 25 kHz	15.247(a1)	COMPLIES
Number of Channels = 25	15.247(a1i)	COMPLIES
20 dB BW < 500 kHz	15.247(a1i)	COMPLIES
Max Output Power < 0.25 W	15.247(b2)	COMPLIES
Antenna Gain < 6 dBi	15.247(b3)	COMPLIES
Conducted Spurious >-20 dBc	15.247(c)	COMPLIES

The signed original of this report, supplied to the client, represents the only "official" copy. Retention of any additional copies (electronic or non-electronic media) is at Acme Testing's discretion to meet internal requirements only. The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units, and meet the requirements of the specifications referenced herein.

The measurements contained in this report were made in accordance with the procedure ANSI C63.4 - 1992 and all applicable Public Notices received prior to the date of testing. All emissions from the device were found to be within the limits outlined in this report. Acme Testing assumes responsibility only for the accuracy and completeness of this data as it pertains to the sample tested.

_____ _____

Paul G. Slavens Date of Issuance
Chief EMC Engineer

3. Description of Equipment and Peripherals

3.1 Equipment Under Test (EUT)

Device:	902 – 928 MHz Frequency Hopping Transmitter
Model Number:	RPT0006-001
Serial Number:	71001009
Size of EUT:	32 cm x 27 cm x 11 cm
FCC ID:	EO9PETRPT
Power:	120 V/60 Hz
Grounding:	3 Wire A/C Plug
Measurement Distance:	3 Meter
Number of EUT Antennas	1
Type of Antenna	Omni-directional
Gain of Antenna	7.1 dBi

3.2 EUT Peripherals

Device	Manufacturer	Model Number	FCC ID	Serial Number
Co-Linear Antenna	Maxrad, Inc.	Z546	None	None

3.3 Description of Interface Cables

EUT/Co-Linear Antenna (LMR-400 Coaxial Cable)

Shielded	Unshielded	Flat	Round	Length	Ferrite
Yes	No	No	Yes	15.6 M	No

ARRANGEMENT OF INTERFACE CABLES: All interface cables were positioned for worst case maximum emissions within the manner assumed to be a typical operation condition (please reference photographs).

3.4 Mode of Operation During Tests

The transmitter was transmitting during testing. The transmitter was modulated or unmodulated and hopping or not hopping per the needs of each test.

3.5 Modifications Required for Compliance

The EUT required the following modifications during testing to bring the product into compliance:

1. None.

4. Antenna requirement

4.1 Regulation

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

4.2 Result

(a) The PETNET system documentation clearly specifies that its sole intended use is to provide water submetering services to companies that market these services to customers.

(b) The PETNET system is to be professionally installed by qualified and trained installers. The PETNET system transmitting components are provided with one type of antenna and coaxial assembly as well as instruction on proper installation of these mandatory components.

(c) The PETNET system is marketed to water submetering companies exclusively throughout the United States who install the equipment. The submetering companies provide both billing of water usage and the on-site service of any faulty equipment or system failures.

5. Conducted Emissions Tests

Test Requirement: FCC CFR47, Part 15C, 15.207

Test Procedure: ANSI C63.4:1992

Date of Test: 20 February 2001

Test Location: Test Site #2 (Acme, WA)

5.1 Test Equipment

⇒ Spectrum Analyzer (blue): Hewlett-Packard 8566B, Serial Number 2410A00168, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

⇒ RF Preselector (blue): Hewlett-Packard 85685A, Serial Number 2648A-00519, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

⇒ Quasi Peak Adapter (blue): Hewlett-Packard 85650A, Serial Number 2043A00327, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

⇒ Line Impedance Stabilization Network: EMCO 3825/2, Serial Number 9002-1601, Calibrated: 2 January 2001, Calibration due Date: 2 January 2002

5.2 Purpose

The purpose of this test is to evaluate the level of conducted noise the EUT imposes on the AC mains.

5.3 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that is placed above the groundplane. Floor standing equipment is placed directly on the groundplane. Any supplemental grounding mechanisms are connected, if appropriate. The EUT is connected to its associated peripherals, with any excess I/O cabling bundled to approximately 1 meter. The EUT is connected to a dedicated LISN and all peripherals are connected to a second separate LISN circuit. The LISNs are bonded to the groundplane.

Preview tests are performed to determine the "worst case" mode of operation. With the EUT operating in "worst case" mode, final conducted measurements are taken. Conducted measurements are made on each current carrying conductor with respect to ground.

Conducted Emissions Test Characteristics	
Frequency range	0.45 MHz - 30.0 MHz
Test instrumentation resolution bandwidth	9 kHz
Lines Tested	Line 1/Line 2

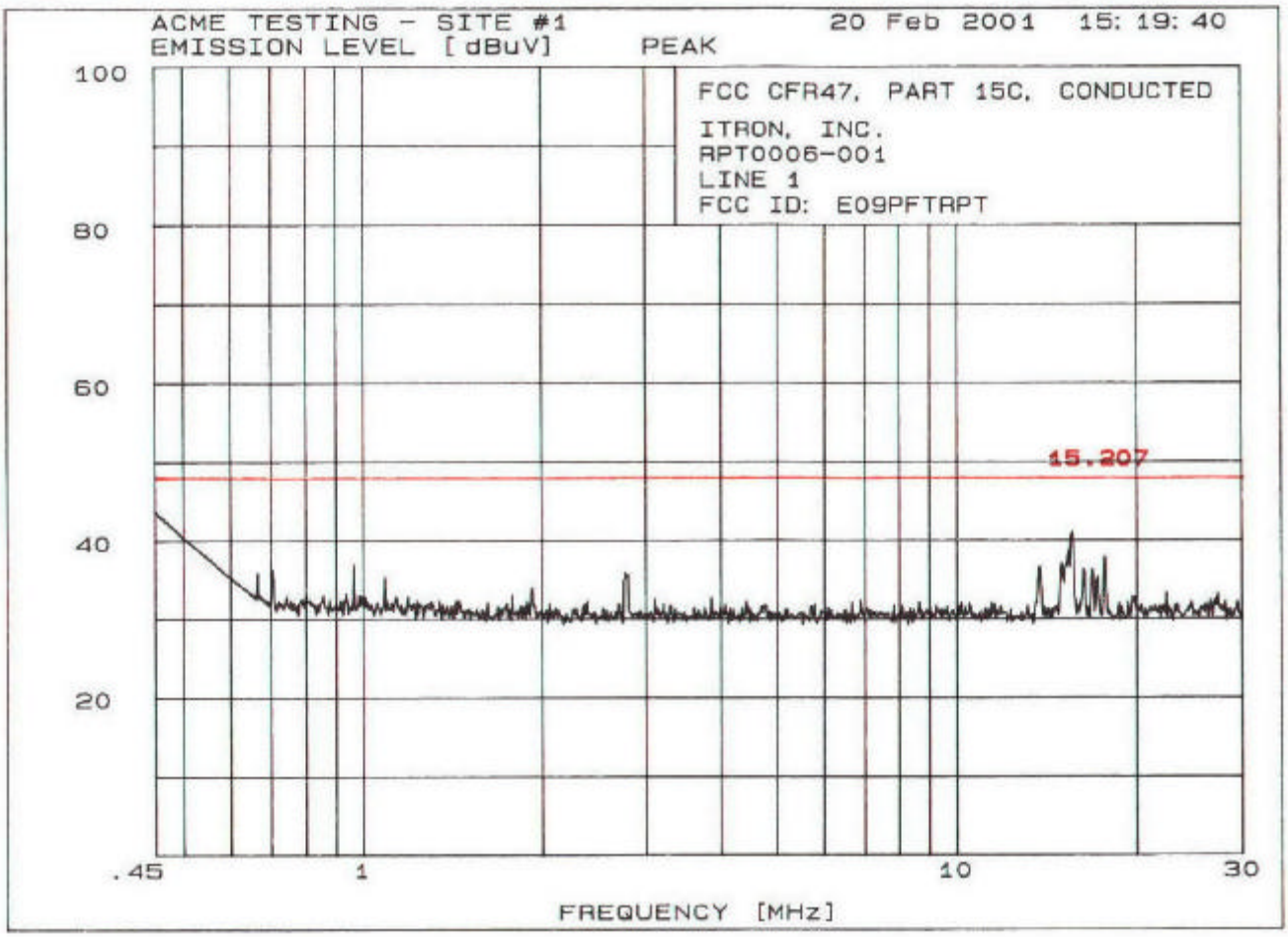
5.4 Test Results

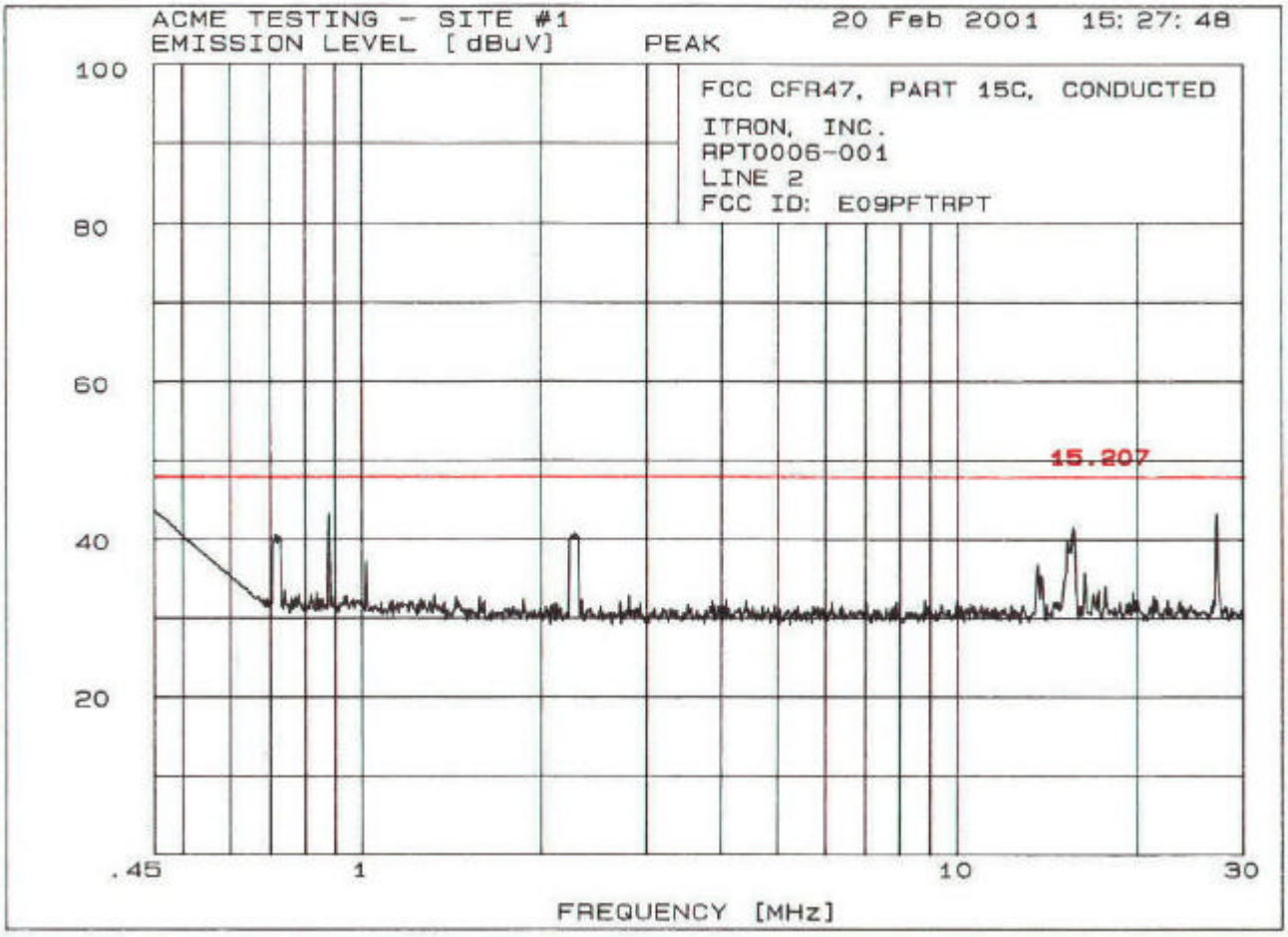
LINE 1

PEAK #	FREQ. (MHz)	AMPL (dBuV)
1	0.9657	36.9
2	13.75	36.6
3	15.59	41.0
4	16.26	36.3
5	16.81	36.3
6	17.61	37.8

LINE 2

PEAK #	FREQ. (MHz)	AMPL (dBuV)
1	0.7169	40.6
2	0.8842	43.2
3	1.02	37.2
4	2.273	40.7
5	15.53	41.5
6	27.01	43.2


ACME TESTING - SITE #1
20 Feb 2001 15:19:40
EMISSION LEVEL [dBuV]
PEAK
FCC CFR47, PART 15C, CONDUCTED
ITRON, INC.
RPT0006-001
LINE 1
FCC ID: E09PFTRPT
100
80
60
40
20
15.207
.45
1
10
30
FREQUENCY [MHz]


ACME TESTING - SITE #1
EMISSION LEVEL [dBuV]
20 Feb 2001 15:27:48
PEAK
FCC CFR47, PART 15C, CONDUCTED
ITRON, INC.
RPT0006-001
LINE 2
FCC ID: E09PFTRPT
15.207
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

6. 20 dB Bandwidth and Channel Separation

6.1 Regulation

15.247(a1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20-dB bandwidth of the hopping channel, whichever is greater. The system shall hop to channel frequencies that are selected at the system-hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

6.2 Test Equipment

⇒ Spectrum Analyzer (blue): Hewlett-Packard 8566B, Serial Number 2410A00168, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

⇒ RF Preselector (blue): Hewlett-Packard 85685A, Serial Number 2648A-00519, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

6.3 Test Procedures

The RF output of the EUT was connected to the RF input port of the RF preselector through a 10-dB pad. The following measurements were made with a RBW = 30 kHz and VBW = 100 kHz.

6.4 Test Results

A. The measured 20 dB bandwidth is 265.5 kHz (See plot).
B. The measured Carrier Frequency Separation is 400 kHz (See plot).
C. The description of the hopping algorithm is included below

Each hop sequence has 25 hops numbered 0 to 24. There are 256 different hop sequences used, numbered from 0 to 255. The following describes how the 256 new hop sequences were generated.
Synthesis Algorithm for a single hop sequence:
1. A random number between 0 and 24 is selected using the random number generator provided as a function within the compiler. The random number generator provides a uniform distribution of values.
2. The random number selected above is the "proposed" channel number to use for this hop. If this channel has not been previously assigned, it is assigned to the current position in the hop table. If the channel has been previously assigned, repeat step 1.
3. If all 25 positions in the hop sequence being generated are not filled, go to step 1 and begin the process of determining the next hop value. The above algorithm is applied to all 256 sequences.
The code segment below shows the actual code used to generate the 256 hop sequences. The random number generator can be seeded to start at different points. Each seed value renders an entirely new table. There are 65,535 possible tables with the given algorithm. The seed value selected for the table below is 11.

Basic Program Instructions, which developed the pseudorandom channel selection table:

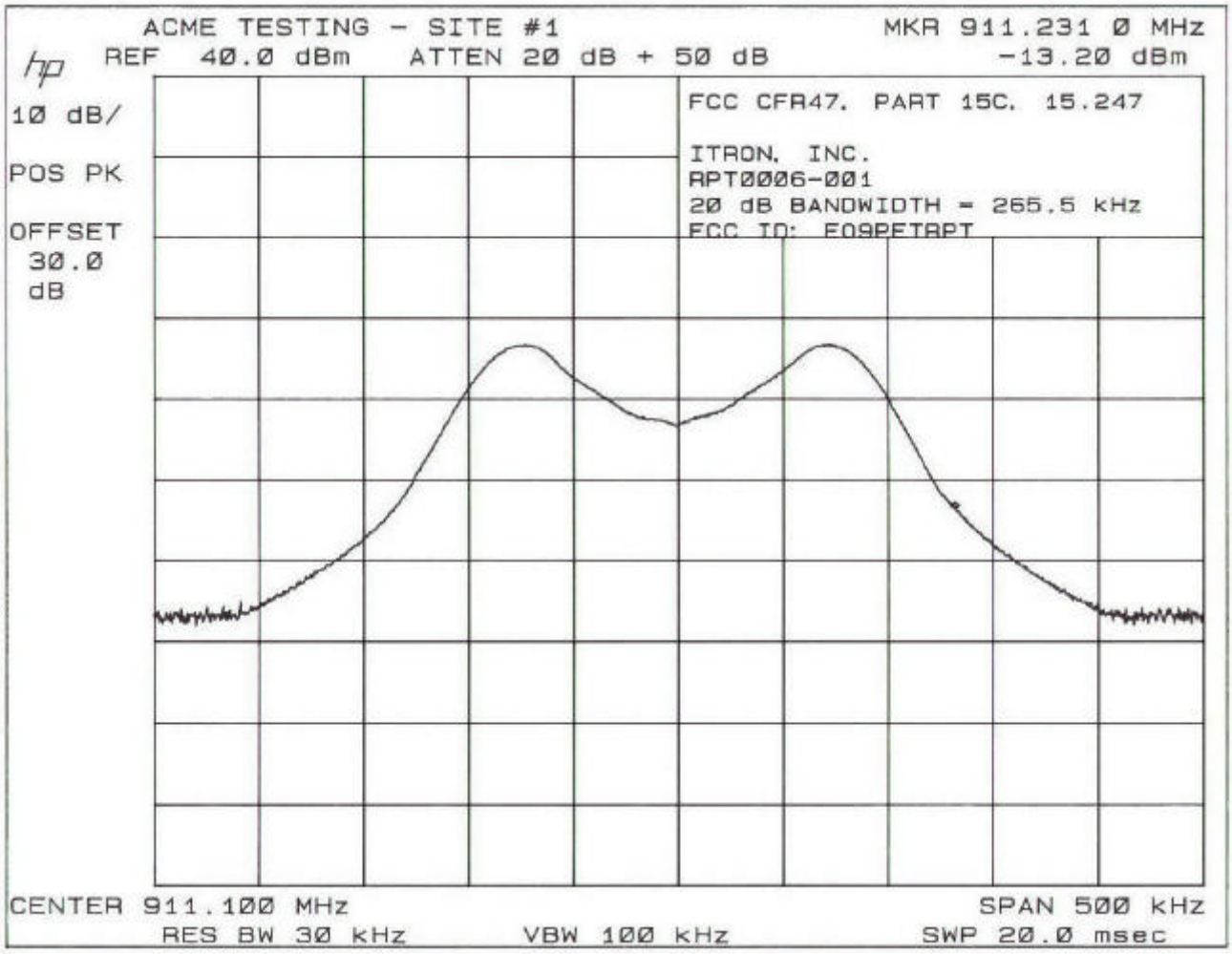
```
FOR seq% = 0 TO 255
PRINT "Working on sequence # "; seq%
'reinitialize used table
FOR hop% = 0 TO 24
UsedFreq%(hop%) = 0
NEXT hop%
FOR hop% = 0 TO 24
DO
'Pick a random hop
potentialhop% = RND(1) * 24
'See if the proposed hop is already used
IF UsedFreq%(potentialhop%) <> 1 THEN
'It is not used
UsedFreq%(potentialhop%) = 1
table%(seq%, hop%) = potentialhop%
EXIT DO
END IF
LOOP
NEXT hop%
NEXT seq%
Seed Value Selected = 11
Program Version = 1.2
```

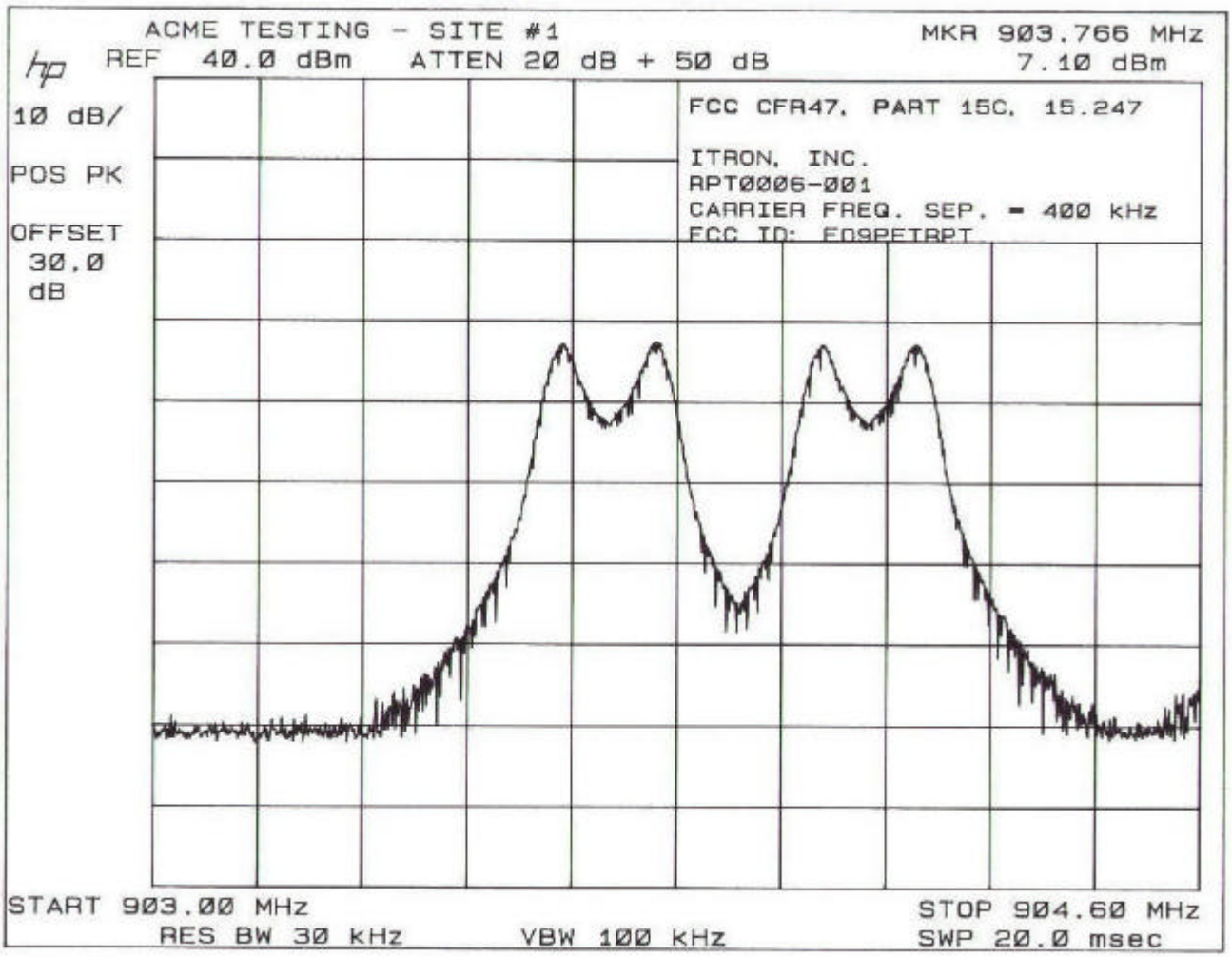
Example of Hop Sequence Table Used in PETNET system components:

Sequence 0: 3,1,21,13,10,22,2,18,12,9,16,19,6,11,4,5,8,23,20,15,7,24,0,14,17
Sequence 1: 12,24,7,10,18,13,2,17,0,19,16,4,23,5,15,11,22,3,21,9,1,20,14,8,6
Sequence 2: 9,10,12,15,13,8,21,11,19,14,22,1,2,18,4,3,5,24,17,7,6,16,20,0,23
Sequence 3: 12,18,20,11,2,8,1,9,3,4,22,19,14,16,0,7,5,15,10,21,24,6,17,23,13
Sequence 4: 16,8,12,5,3,6,22,7,2,0,1,23,20,4,17,21,11,14,13,15,24,9,19,18,10
Sequence 5: 15,20,17,18,2,11,0,9,6,4,23,7,5,19,13,3,12,14,1,16,22,8,21,10,24
Sequence 6: 10,23,11,4,14,22,8,5,3,16,18,17,19,7,21,9,15,1,2,6,20,24,13,0,12
Sequence 7: 3,13,12,7,11,20,23,4,5,24,17,1,8,14,2,10,21,22,18,6,15,16,19,9,0
Sequence 8: 17,3,21,15,18,19,5,1,2,0,4,8,16,24,10,12,9,20,11,23,6,7,13,14,22
Sequence 9: 19,9,5,15,18,16,12,2,17,8,23,13,4,0,22,24,7,1,6,21,11,20,10,3,14
Sequence 10: 16,9,23,6,11,21,3,22,5,17,14,13,2,7,10,19,1,20,24,0,18,15,4,12,8

D. The explanation of the receiver bandwidth is included below:

The Pet Repeater is equipped with a synthesized dual conversion super-heterodyne receiver. The low IF of the system utilizes a 10.7 MHz IF of 360 KHz at the 3 dB down points. The bandwidth is determined by the use of 3 stages of Toko ceramic filters, each filter with a 380 KHz bandpass. The composite bandpass of all filters results in a 360 KHz total bandwidth. The part number for these filters is SK107M0-AE-10. Attached, in PDF format, is the specification of the filters. The transmitter-occupied bandwidth is nominally 275 KHz. The remaining difference between the occupied bandwidth and the receiver bandwidth is necessary for frequency instability between the transmitter and receiver as well as component variations of the ceramic filters.


ACME TESTING - SITE #1
MKR 911.231 0 MHz
REF 40.0 dBm
ATTEN 20 dB + 50 dB
-13.20 dBm
10 dB/
POS PK
OFFSET
30.0
dB
FCC CFR47. PART 15C. 15.247
ITRON. INC.
RPT0006-001
20 dB BANDWIDTH = 265.5 kHz
FCC ID: FO9PETRPT
CENTER 911.100 MHz
SPAN 500 kHz
RES BW 30 kHz
VBW 100 kHz
SWP 20.0 msec


ACME TESTING - SITE #1
MKR 903.766 MHz
REF 40.0 dBm
ATTEN 20 dB + 50 dB
7.10 dBm
10 dB/
POS PK
OFFSET
30.0
dB
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
CARRIER FREQ. SEP. = 400 kHz
FCC ID: EO9PETRPT
START 903.00 MHz
STOP 904.60 MHz
RES BW 30 kHz
VBW 100 kHz
SWP 20.0 msec

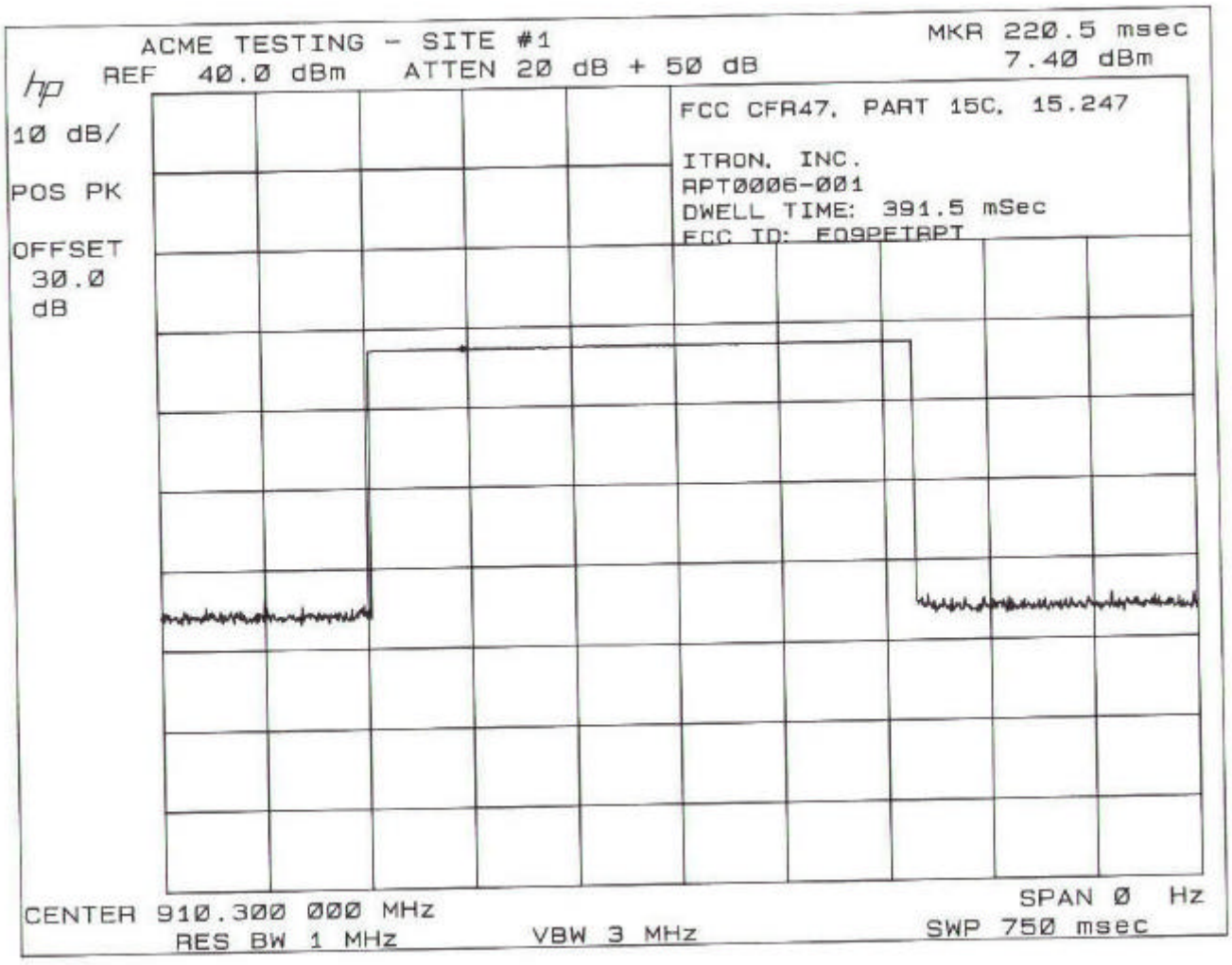
7. Number of Channels

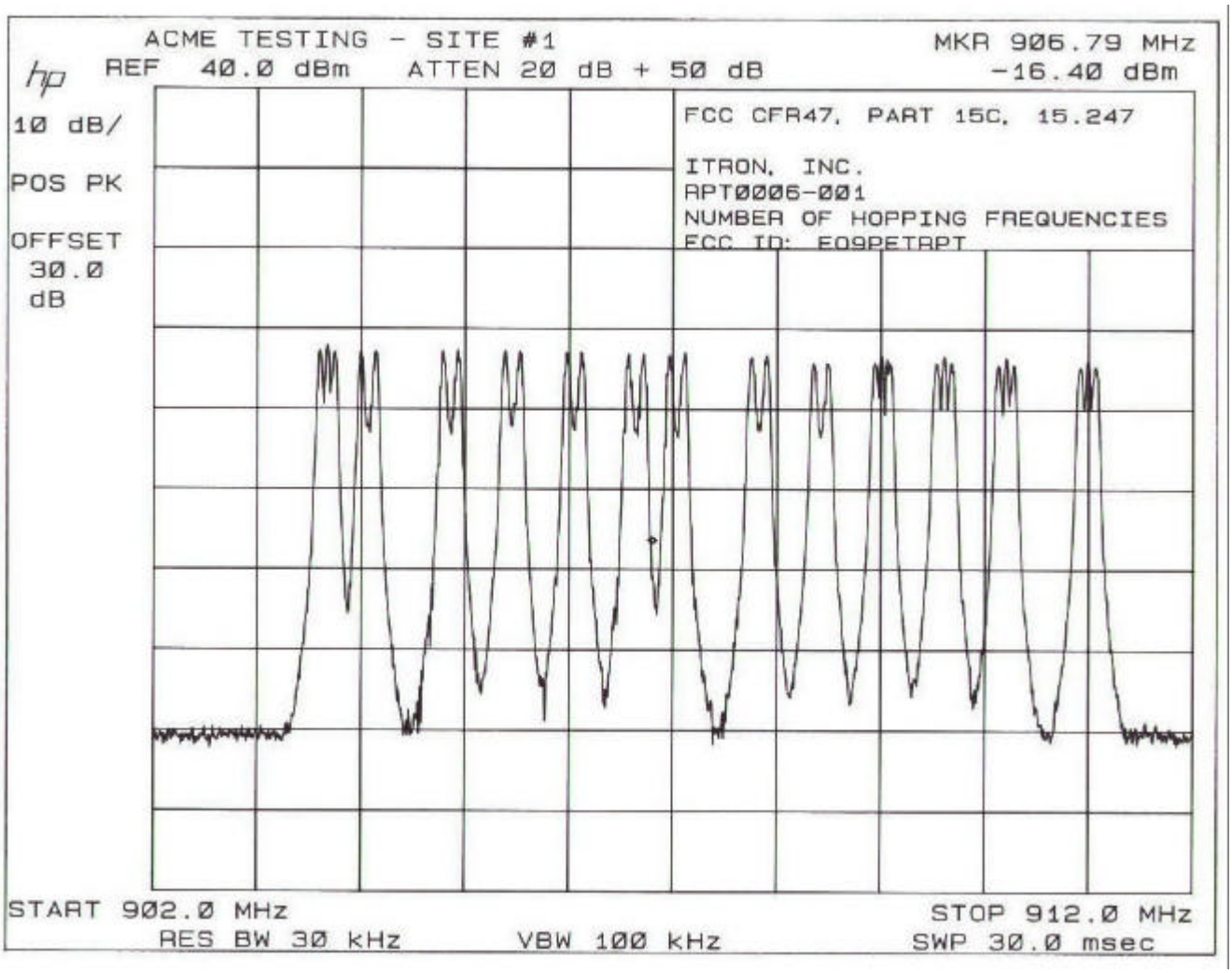
7.1 Regulation

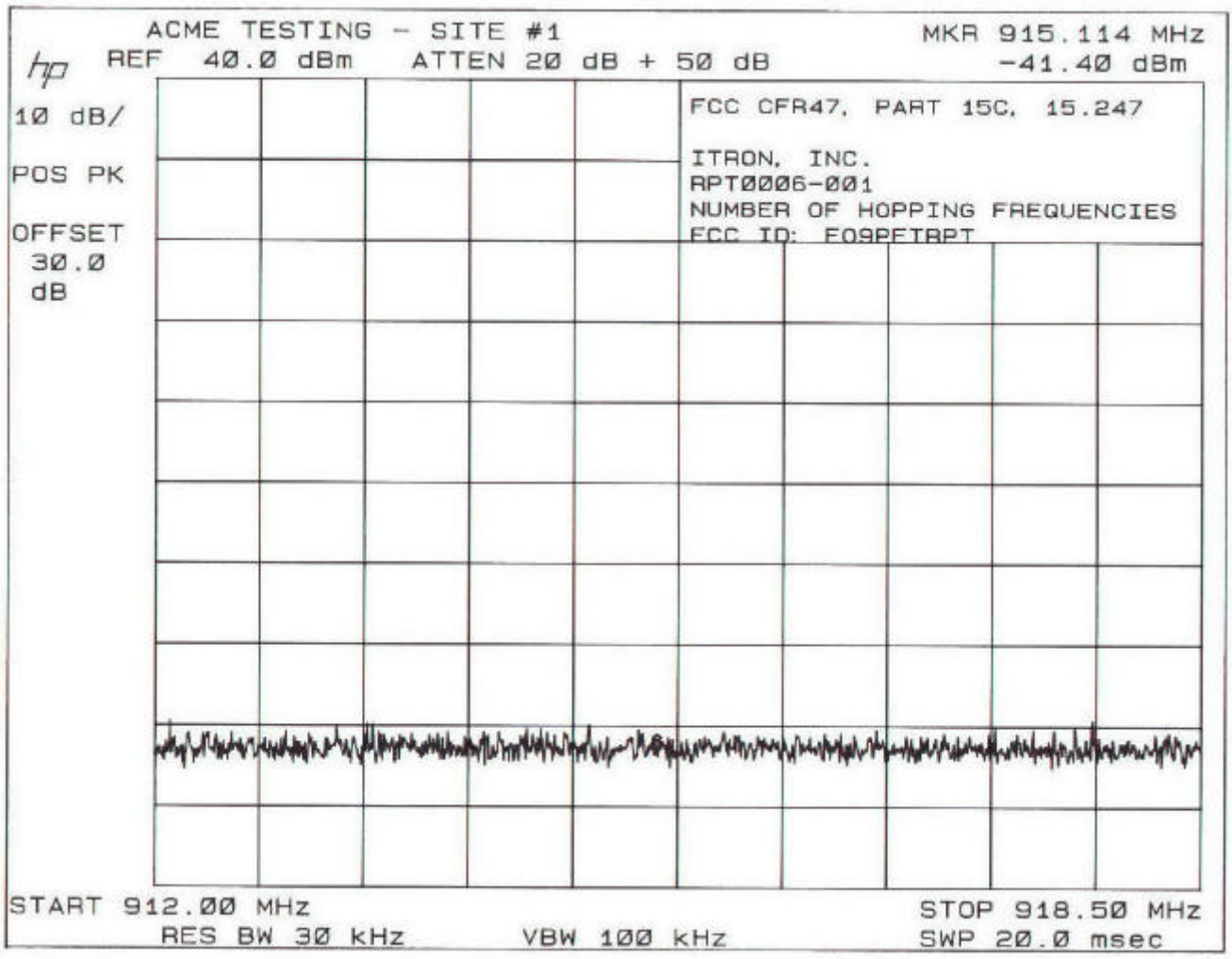
15.247(a1i) For frequency hopping systems operating in the 902-928 MHz band: if the 20-dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20-dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20-dB bandwidth of the hopping channel is 500 kHz.

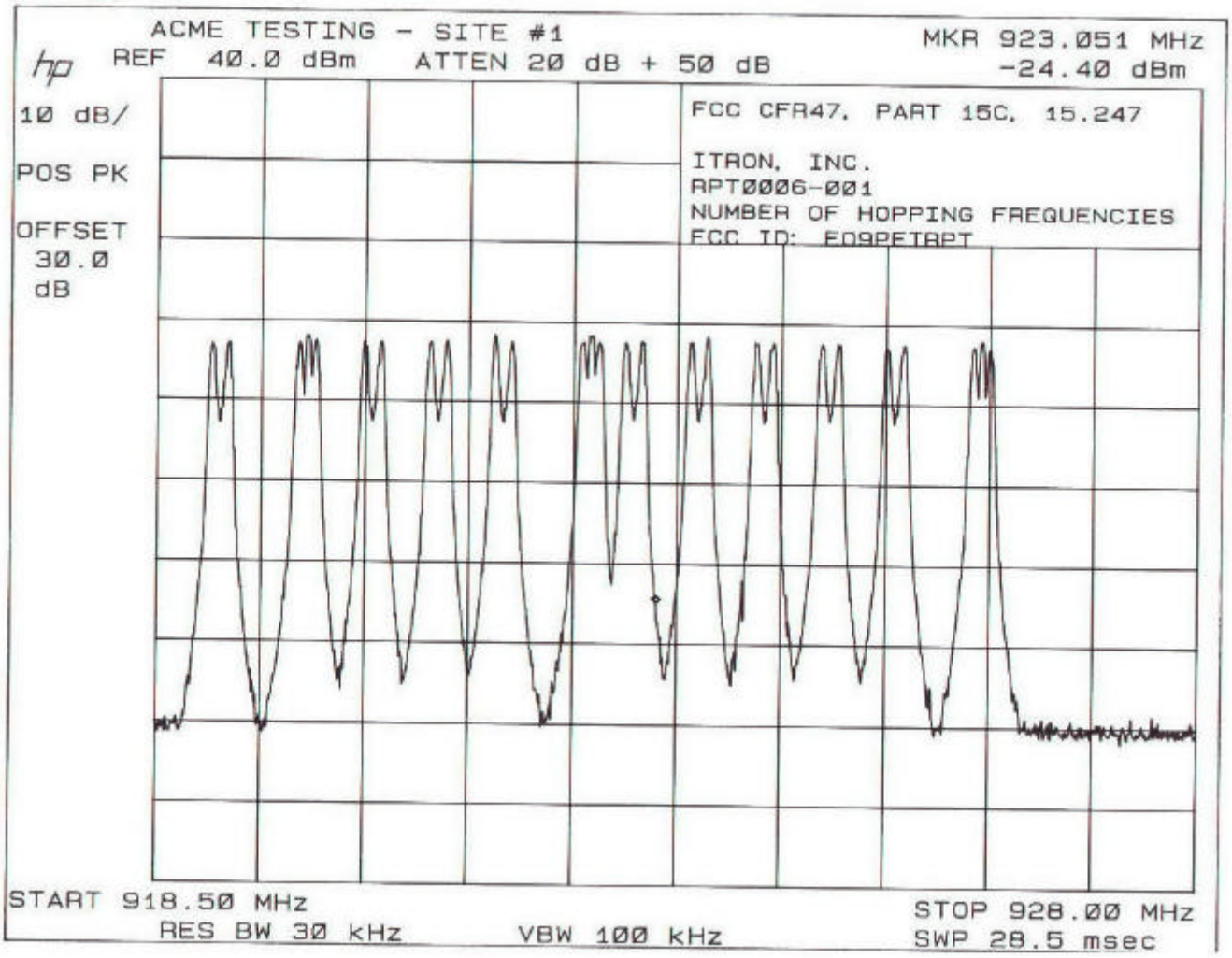
7.2 Test Results

A. The measured 20 dB bandwidth is 265.5 kHz (See previous plot).
B. The system uses 25 channels (See plots).
C. The measured on time on each channel is 395.1 milliseconds (See plot)
D. None of the 25 channels is repeated in any hop sequence so average time of occupancy in any 10 second time period is met (See algorithm in section 6)


ACME TESTING - SITE #1
MKR 220.5 msec
7.40 dBm
REF 40.0 dBm
ATTEN 20 dB + 50 dB
10 dB/
POS PK
OFFSET
30.0
dB
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
DWELL TIME: 391.5 mSec
FCC ID: F09PETRPT
CENTER 910.300 000 MHz
SPAN 0 Hz
RES BW 1 MHz
VBW 3 MHz
SWP 750 msec


ACME TESTING - SITE #1
MKR 906.79 MHz
REF 40.0 dBm
ATTEN 20 dB + 50 dB
-16.40 dBm
10 dB/
POS PK
OFFSET
30.0
dB
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
NUMBER OF HOPPING FREQUENCIES
FCC ID: E09PETRPT
START 902.0 MHz
STOP 912.0 MHz
RES BW 30 kHz
VBW 100 kHz
SWP 30.0 msec


ACME TESTING - SITE #1
MKR 915.114 MHz
REF 40.0 dBm
ATTEN 20 dB + 50 dB
-41.40 dBm
10 dB/
POS PK
OFFSET
30.0
dB
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
NUMBER OF HOPPING FREQUENCIES
FCC ID: EO9PEIRPT
START 912.00 MHz
STOP 918.50 MHz
RES BW 30 kHz
VBW 100 kHz
SWP 20.0 msec


ACME TESTING - SITE #1
MKR 923.051 MHz
REF 40.0 dBm
ATTEN 20 dB + 50 dB
-24.40 dBm
10 dB/
POS PK
OFFSET
30.0
dB
FCC CFR47. PART 15C. 15.247
ITRON, INC.
RPT0006-001
NUMBER OF HOPPING FREQUENCIES
FCC ID: E09PETRPT
START 918.50 MHz
RES BW 30 kHz
VBW 100 kHz
STOP 928.00 MHz
SWP 28.5 msec

8. Power Output

8.1 Regulation

15.247(b2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph 15.247(a)(1)(i).

8.2 Test Equipment

⇒ Spectrum Analyzer (blue): Hewlett-Packard 8566B, Serial Number 2410A00168, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

⇒ RF Preselector (blue): Hewlett-Packard 85685A, Serial Number 2648A-00519, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

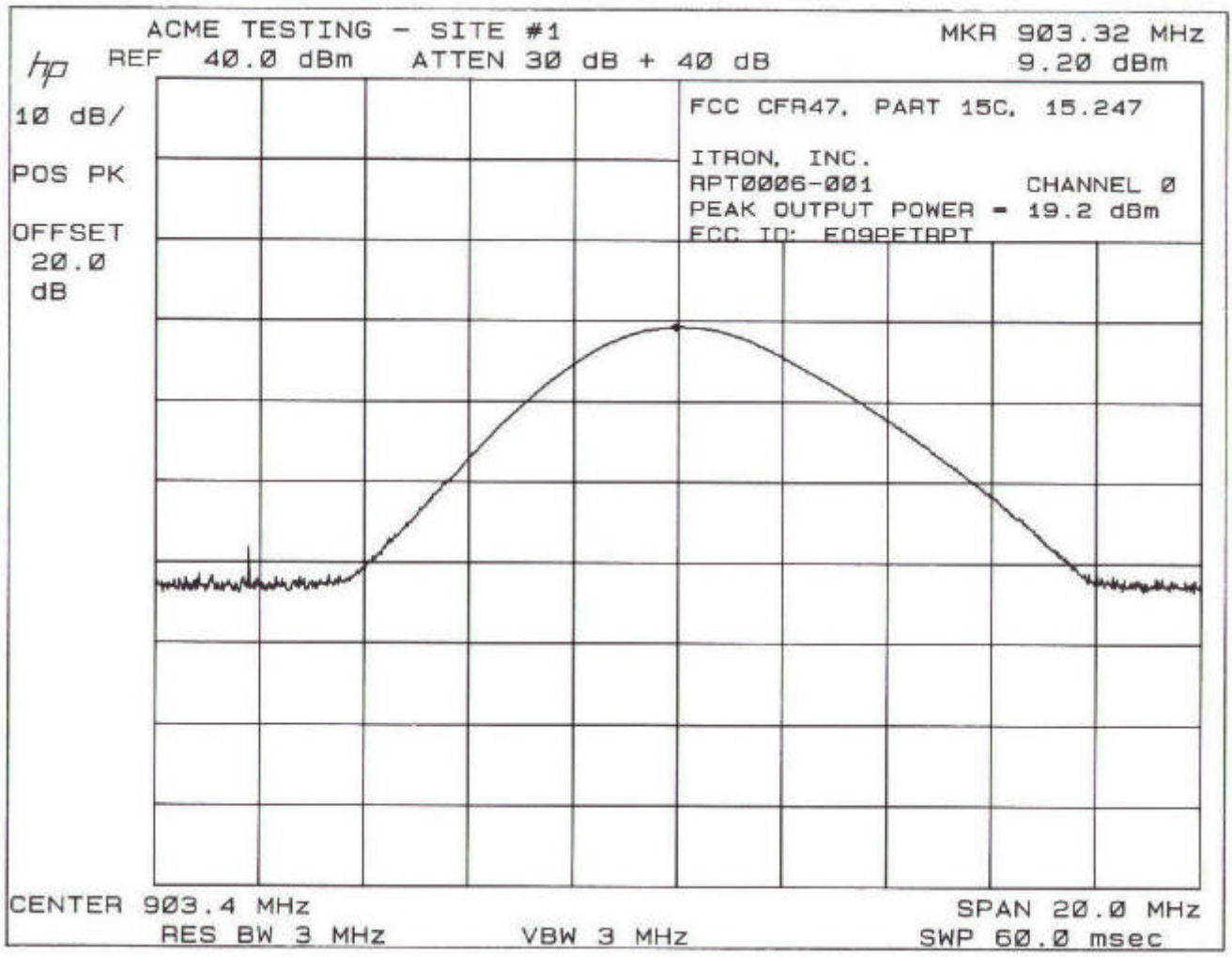
8.3 Test Procedures

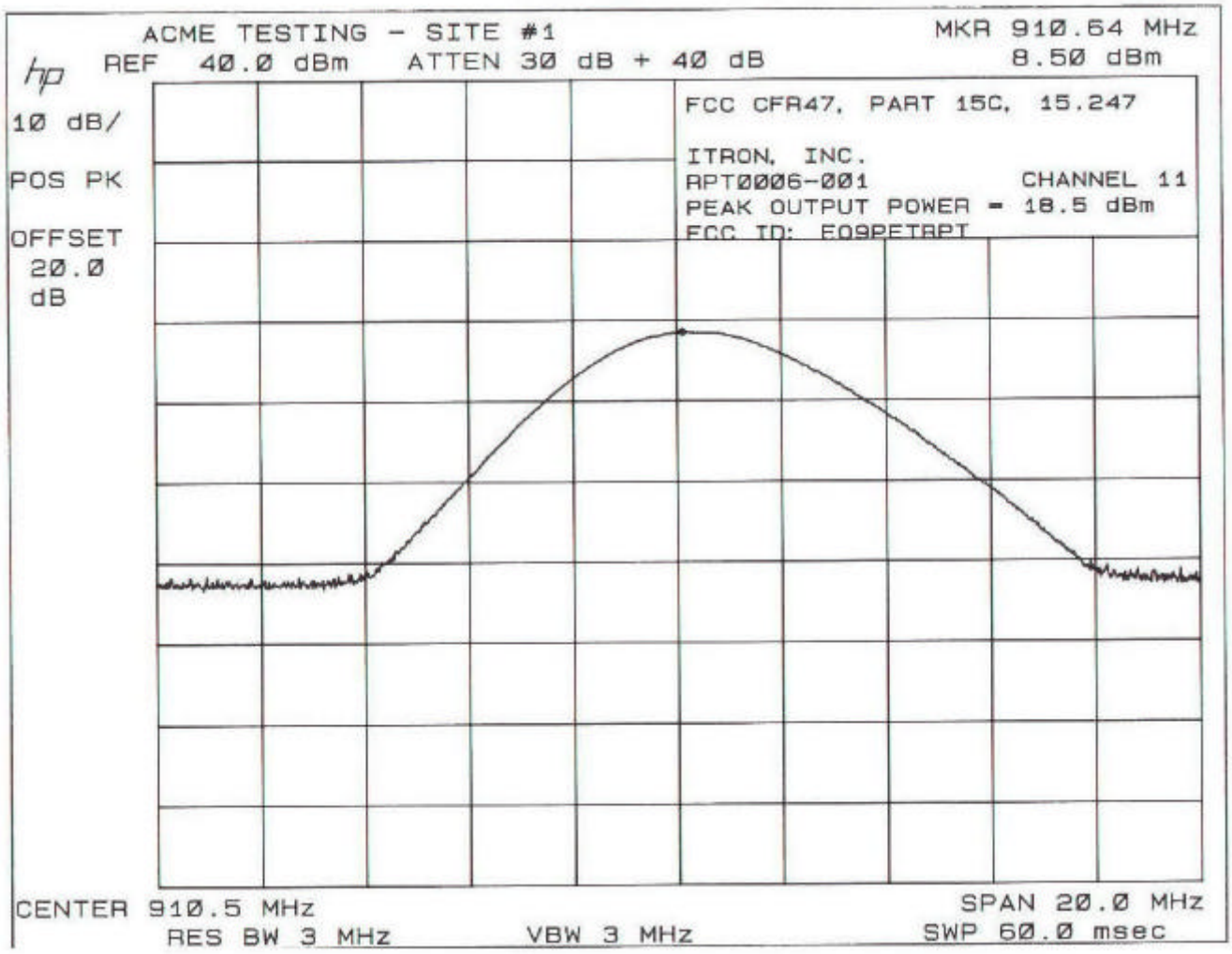
The RF output of the EUT was connected to the RF input port of the RF preselector through a 10-dB pad. The following measurements were made with a RBW = 3 MHz and VBW = 3 MHz.

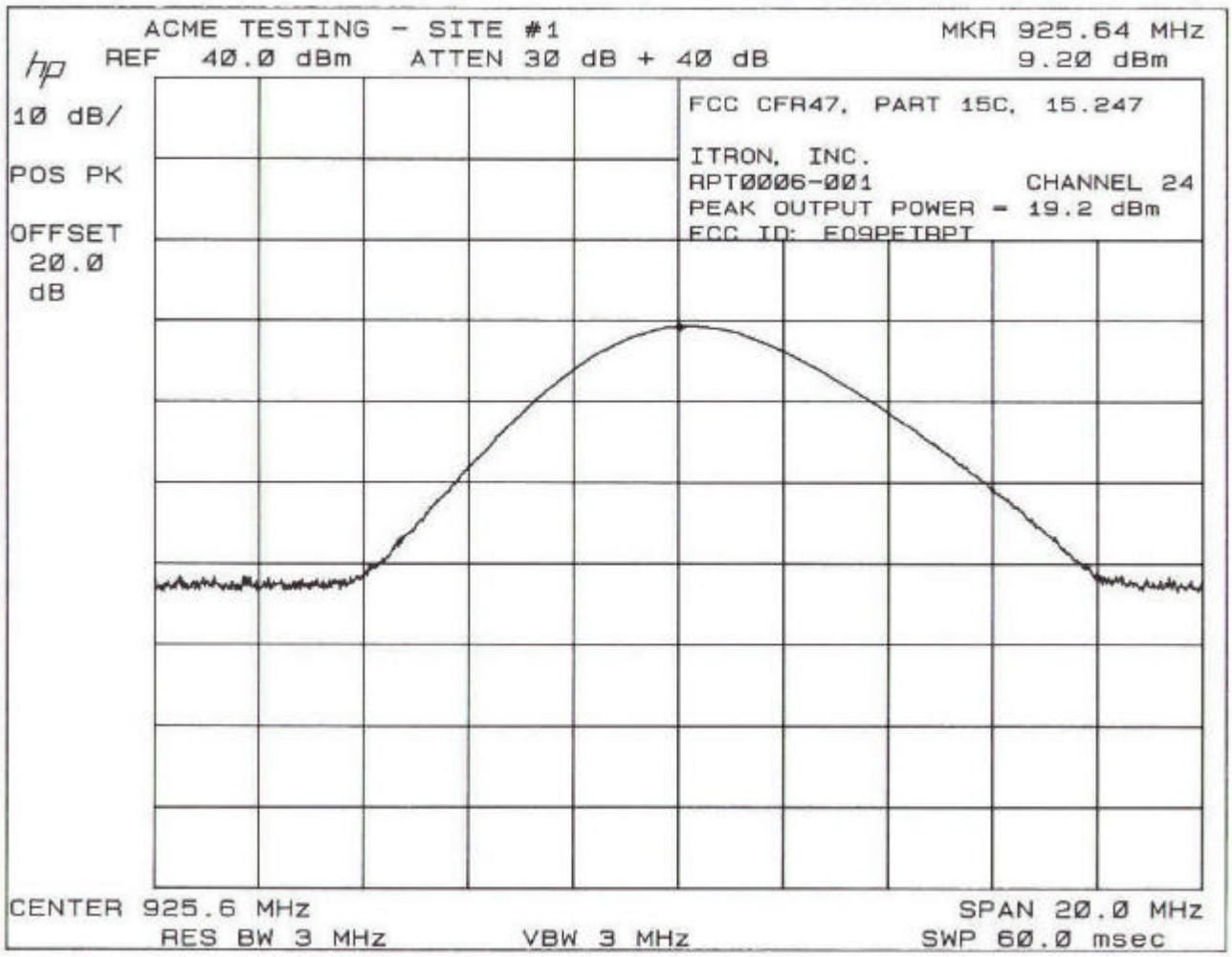
8.4 Test Results

The power was measured at the end of the minimum length coaxial cable supplied with the system. Measured maximum Peak Envelope Power was 19.2 dBm or 83 milliwatts. Please see plots. The power was also measured at 85% and 115% nominal line voltage with no change in conducted power.

.


ACME TESTING - SITE #1
MKR 903.32 MHz
REF 40.0 dBm
ATTEN 30 dB + 40 dB
9.20 dBm
10 dB/
POS PK
OFFSET
20.0
dB
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
CHANNEL 0
PEAK OUTPUT POWER = 19.2 dBm
FCC ID: E09PETRPT
CENTER 903.4 MHz
SPAN 20.0 MHz
RES BW 3 MHz
VBW 3 MHz
SWP 60.0 msec


ACME TESTING - SITE #1
MKR 910.64 MHz
REF 40.0 dBm
ATTEN 30 dB + 40 dB
8.50 dBm
10 dB/
POS PK
OFFSET
20.0
dB
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
CHANNEL 11
PEAK OUTPUT POWER = 18.5 dBm
FCC ID: EO9PETRPT
CENTER 910.5 MHz
SPAN 20.0 MHz
RES BW 3 MHz
VBW 3 MHz
SWP 60.0 msec


ACME TESTING - SITE #1
MKR 925.64 MHz
REF 40.0 dBm
ATTEN 30 dB + 40 dB
9.20 dBm
10 dB/
POS PK
OFFSET
20.0
dB
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
CHANNEL 24
PEAK OUTPUT POWER = 19.2 dBm
FCC ID: E09PETRPT
CENTER 925.6 MHz
SPAN 20.0 MHz
RES BW 3 MHz
VBW 3 MHz
SWP 60.0 msec

9. Antenna gain requirements

9.1 Regulation

15.247(b3) Except as shown below, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the above stated values by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

9.2 Result

The antenna system used by the PETNET repeater subsystem includes both the coaxial cable and antenna. The coax is LMR-400 manufactured by Times Microwave Systems. The length of the coax is 50 feet and is pre-terminated with a N-Male and N-female connectors. The connectors are of a crimp type and provided with heat shrink tubing to minimize water intrusion. The attenuation of the coax at 915 MHz is 2 dB. Providing both the antenna and coaxial cable to only qualified professional installers guarantees proper RF Effective Radiated Power not exceeding the FCC requirements. The following calculation is used to determine compliance: 5dBD Antenna, +2.14 Isotropic to Reference Dipole, -2 dB cable loss = 5.14 dBi antenna system gain.

10. Radio Frequency exposure

10.1 Regulation

15.247(b4) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. *See* §1.1307(b)(1) of this Chapter.

10.2 Result

1) The following calculations were used to determine the power density limits for the PETNET system. These limits are used to determine the Antenna Installation and configuration limits specified in the Installation manual.

Maximum PET Repeater Power Density:

Background:

The PET Repeater transmits at a rate never to exceed 90 messages each 400 ms long every half hour. The total transmission time is therefore 36000 ms each half hour.

Due to the standards for installation the closest one can get to the antenna is typically greater than 100 cm.

The maximum peak transmit power is 200 mw at the antenna port

The maximum antenna system gain is 3 db made up of a 5dB gain antenna and a coaxial cable loss of 2 db.

Thus the total power level radiated is 400 mw.

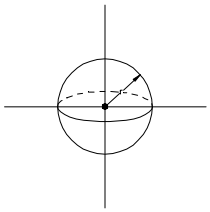
The average transmit power is therefore:

Pavr=400mw x 36,000/1,800= 20 mw

Compute the average power density:

The following analysis will give the worst case power density at 100 cm from the antenna. Referring to Figure 1 below, assume that all of the power is radiated from a point source (the dot located at the center of the sphere) contained in a sphere of radius 100 cm. The power density at the surface of the sphere is a worst case analysis in this example. In reality, the power will be distributed over a larger antenna, resulting in a lower average power density than that predicted by this analysis.

11.0 Figure 1



The Power density is equal to the total average transmitter power (averaged over a half hour period) divided by the surface area of the 100 cm radius sphere.

The surface area of the sphere is:

$$A\ sphere = 4 \times \pi \times r2 = 4 \times \pi \times 1002 = 125663\ cm2$$

The power density, PD, at the surface of the sphere then becomes:

$$PD = 20mw/125663\ cm2 = 0.1591\ uw/cm2$$

Conclusion:

The preceding analysis clearly demonstrates that the PET Repeater and associated antenna operated in close proximity to general public exceeds all safety requirements by several orders of magnitude.

2) The PETNET system is to be professionally installed by qualified and trained installers. The PETNET system transmitting components are provided with one type of antenna and coaxial assembly as well as instruction on proper installation of these mandatory components. Since only one antenna is provided and authorized for use with the PETNET system, compliance is ensured when properly installed by Itron and its qualified contractors.

3) The PETNET system is several orders of magnitude lower than the exposure limits specified in section 2.1091 of the FCC Regulations.

4) There are no other RF exposure related issues that may affect MPE compliance.

11. Conducted Spurious Emissions

11.1 Regulation

15.247 (c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

11.2 Test Equipment

⇒ Spectrum Analyzer (blue): Hewlett-Packard 8566B, Serial Number 2410A00168, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

⇒ RF Preselector (blue): Hewlett-Packard 85685A, Serial Number 2648A-00519, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

⇒ Quasi Peak Adapter (blue): Hewlett-Packard 85650A, Serial Number 2043A00327, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

11.3 Test Procedures

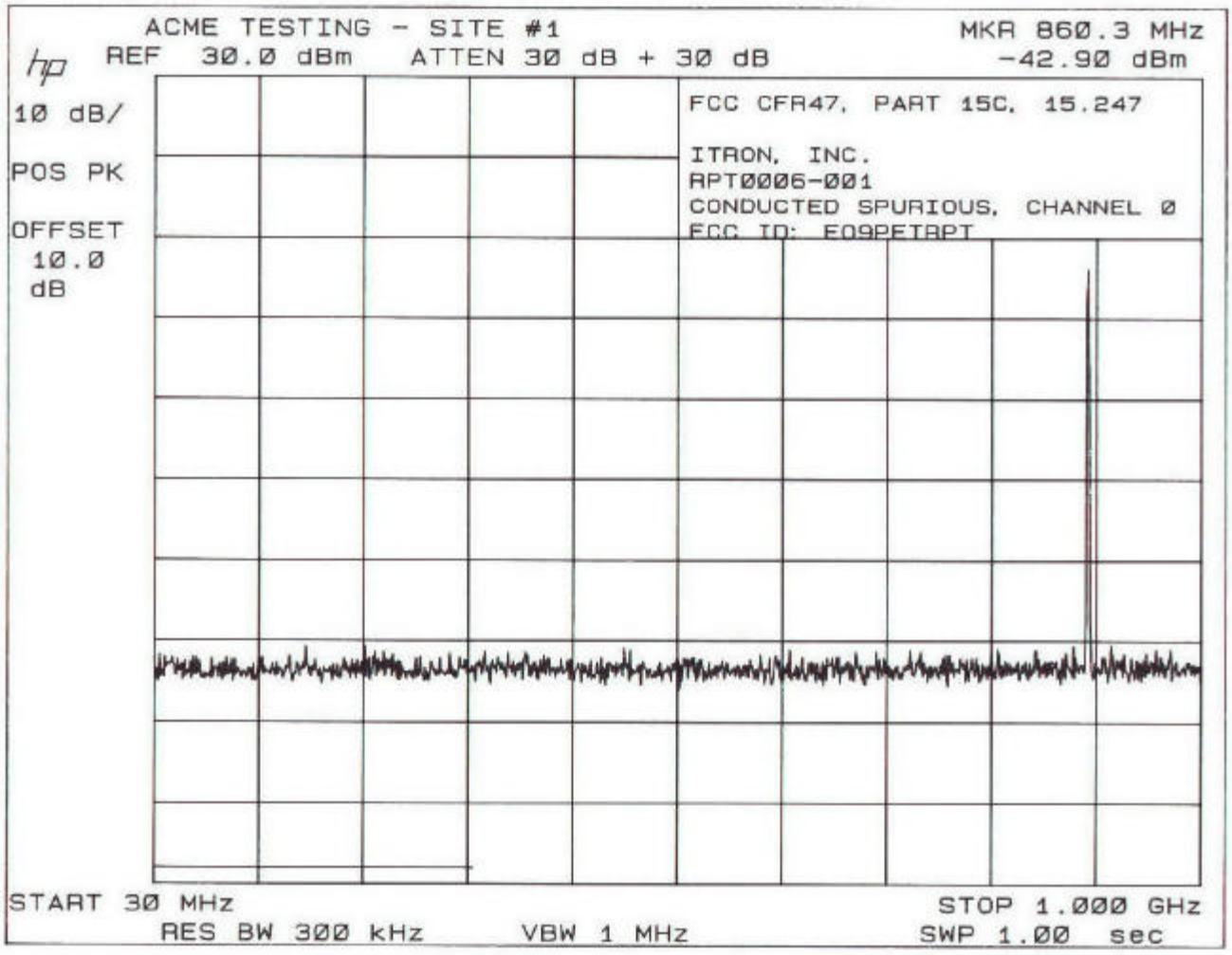
The RF output of the EUT was connected to the RF input port of the RF preselector through a 10 dB pad. The following measurements were made with a RBW = 100 kHz and VBW = 300 kHz.

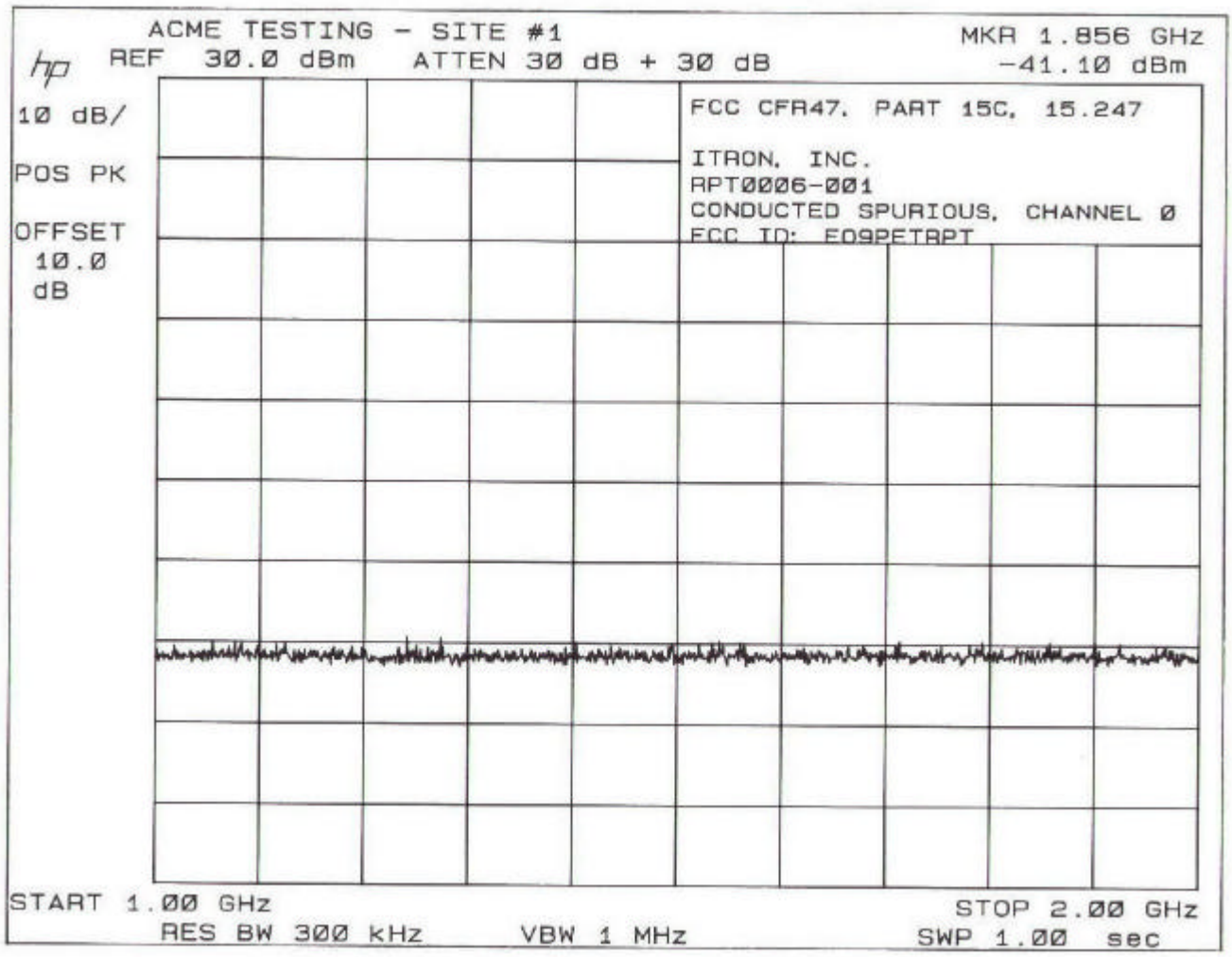
11.4 Test Results

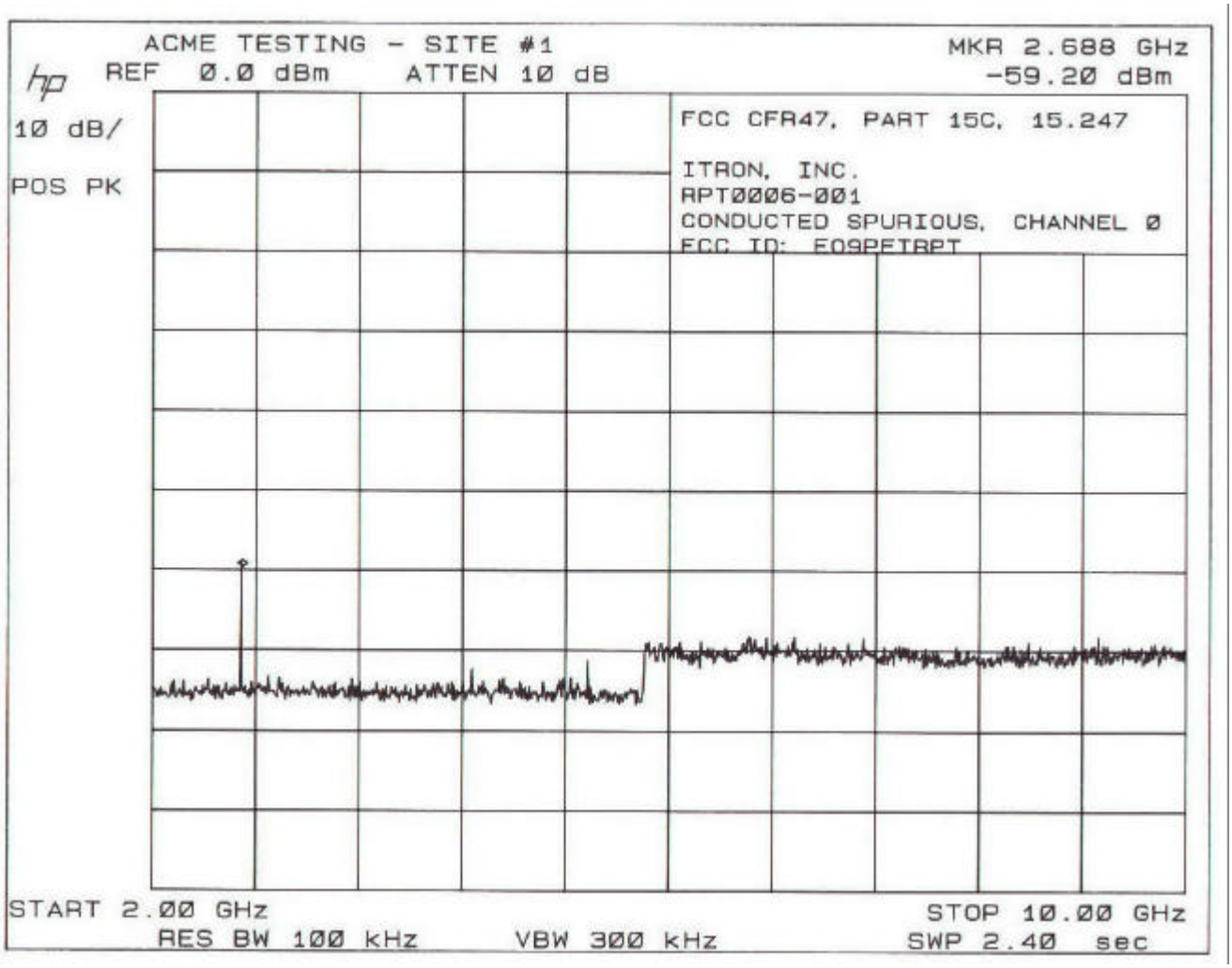
Please see plots

CONDUCTED SPURIOUS EMISSIONS CHANNEL 0

Frequency (MHz)	Absolute Level (dBm)	Relative Level (dBc)	Limit (dBc)
2711.1	-49.2	-68.4	-20.0

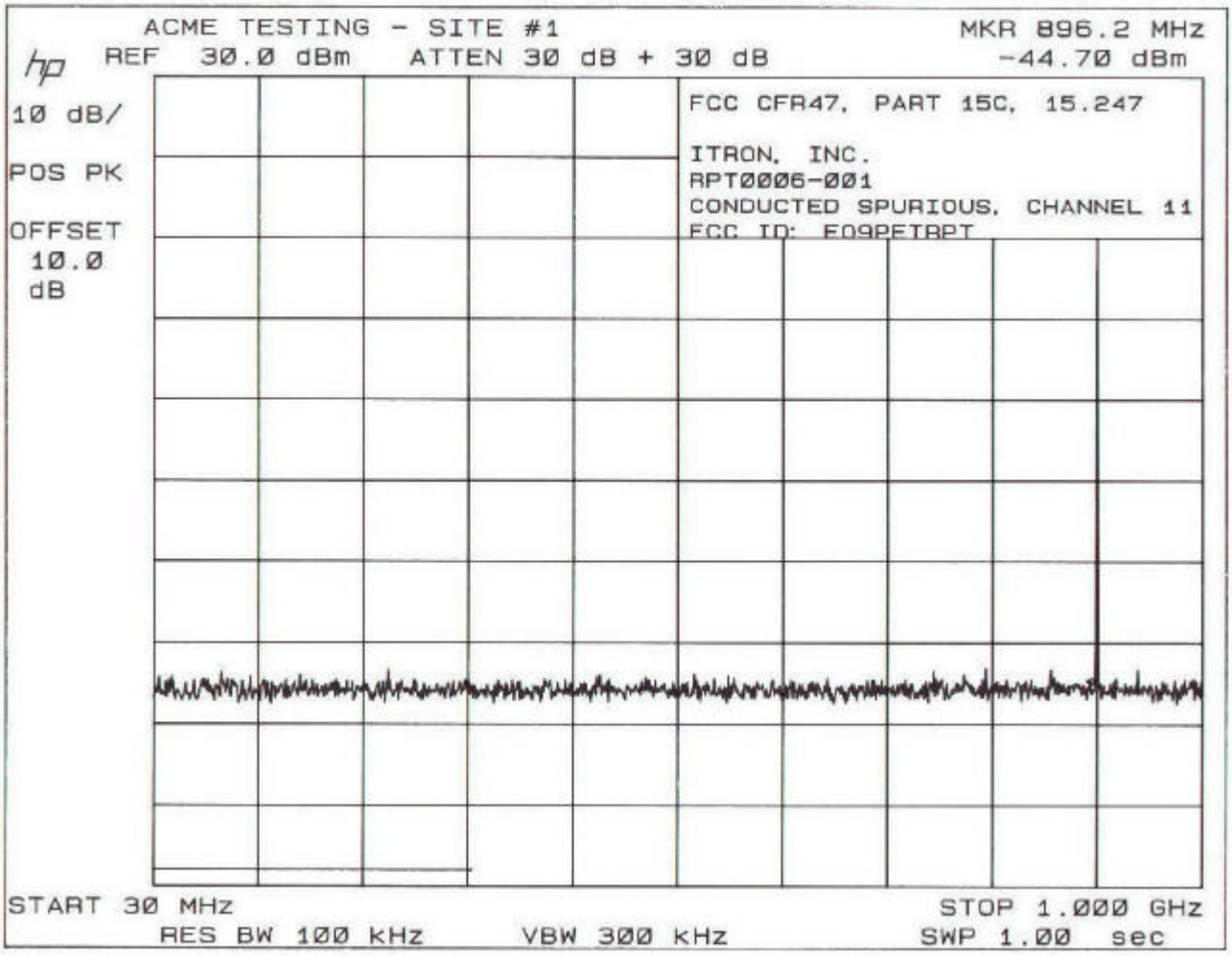


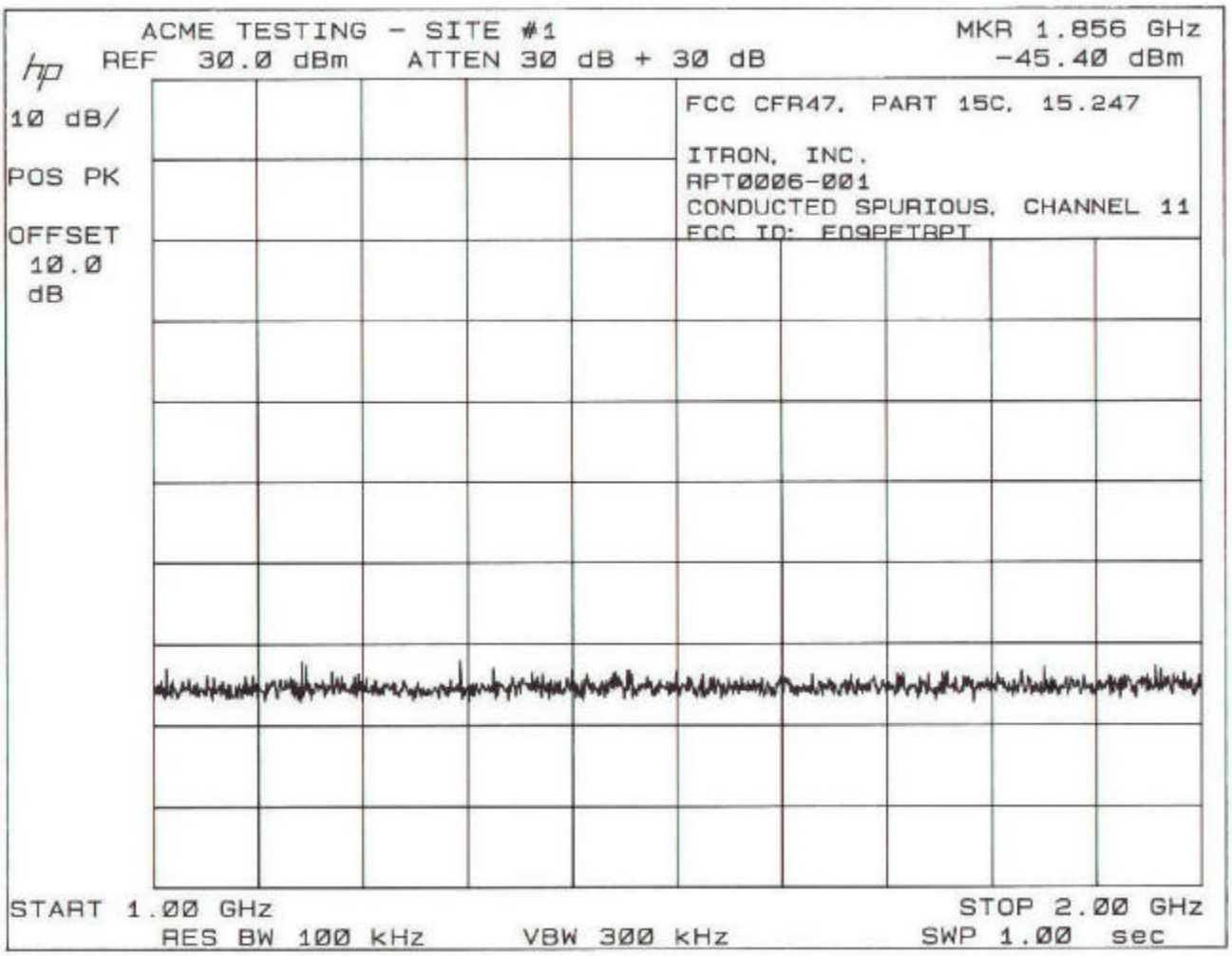

ACME TESTING - SITE #1
MKR 1.856 GHz
REF 30.0 dBm
ATTEN 30 dB + 30 dB
-41.10 dBm
10 dB/
POS PK
OFFSET
10.0
dB
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
CONDUCTED SPURIOUS, CHANNEL 0
FCC ID: EO9PETRPT
START 1.00 GHz
STOP 2.00 GHz
RES BW 300 kHz
VBW 1 MHz
SWP 1.00 sec

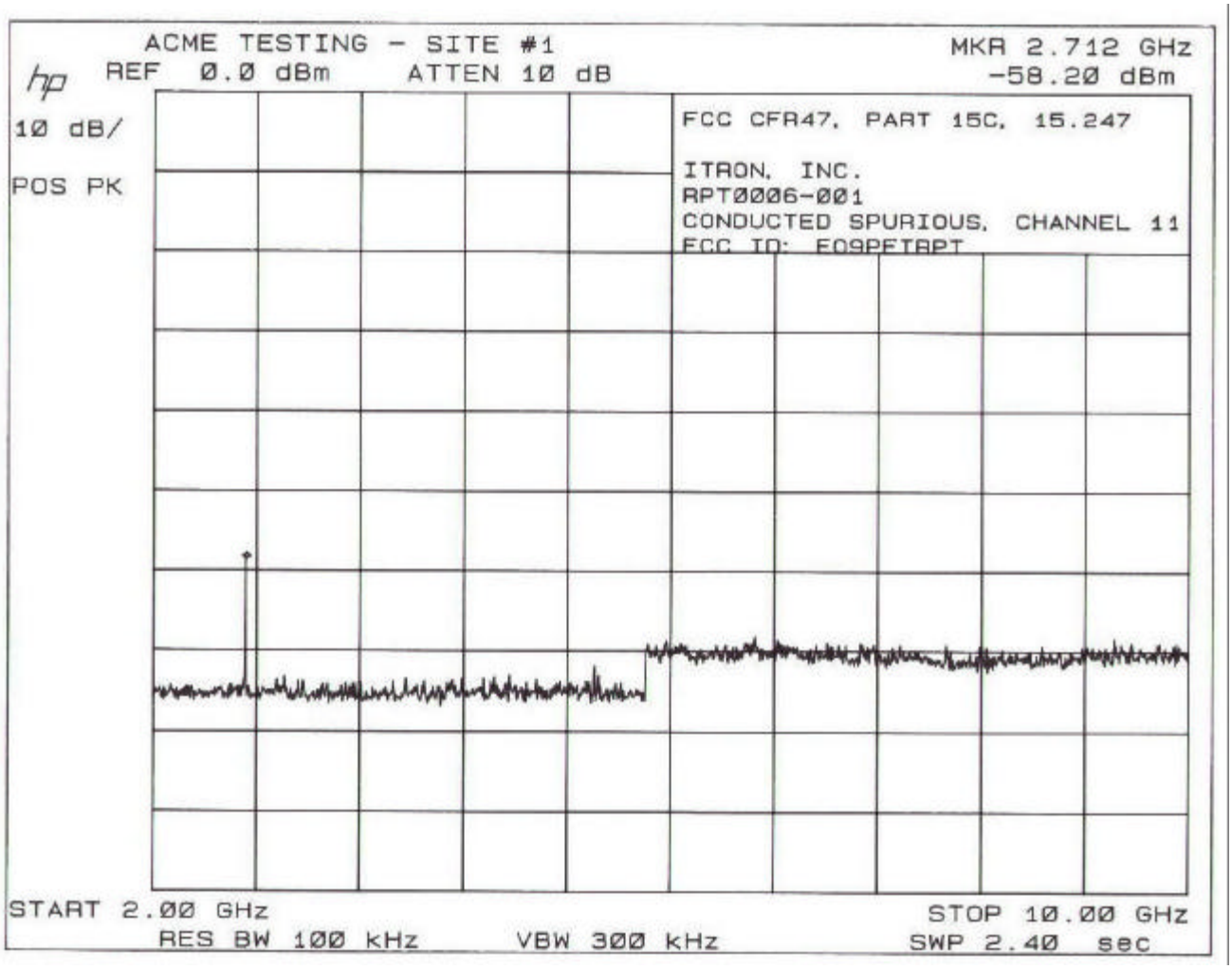

ACME TESTING - SITE #1
MKR 2.688 GHz
REF 0.0 dBm
ATTEN 10 dB
-59.20 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
CONDUCTED SPURIOUS, CHANNEL 0
FCC ID: E09PETRPT
START 2.00 GHz
STOP 10.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 2.40 sec

CONDUCTED SPURIOUS EMISSIONS CHANNEL 11

Frequency (MHz)	Absolute Level (dBm)	Relative Level (dBc)	Limit (dBc)
2730.9	-48.2	-66.7	-20.0

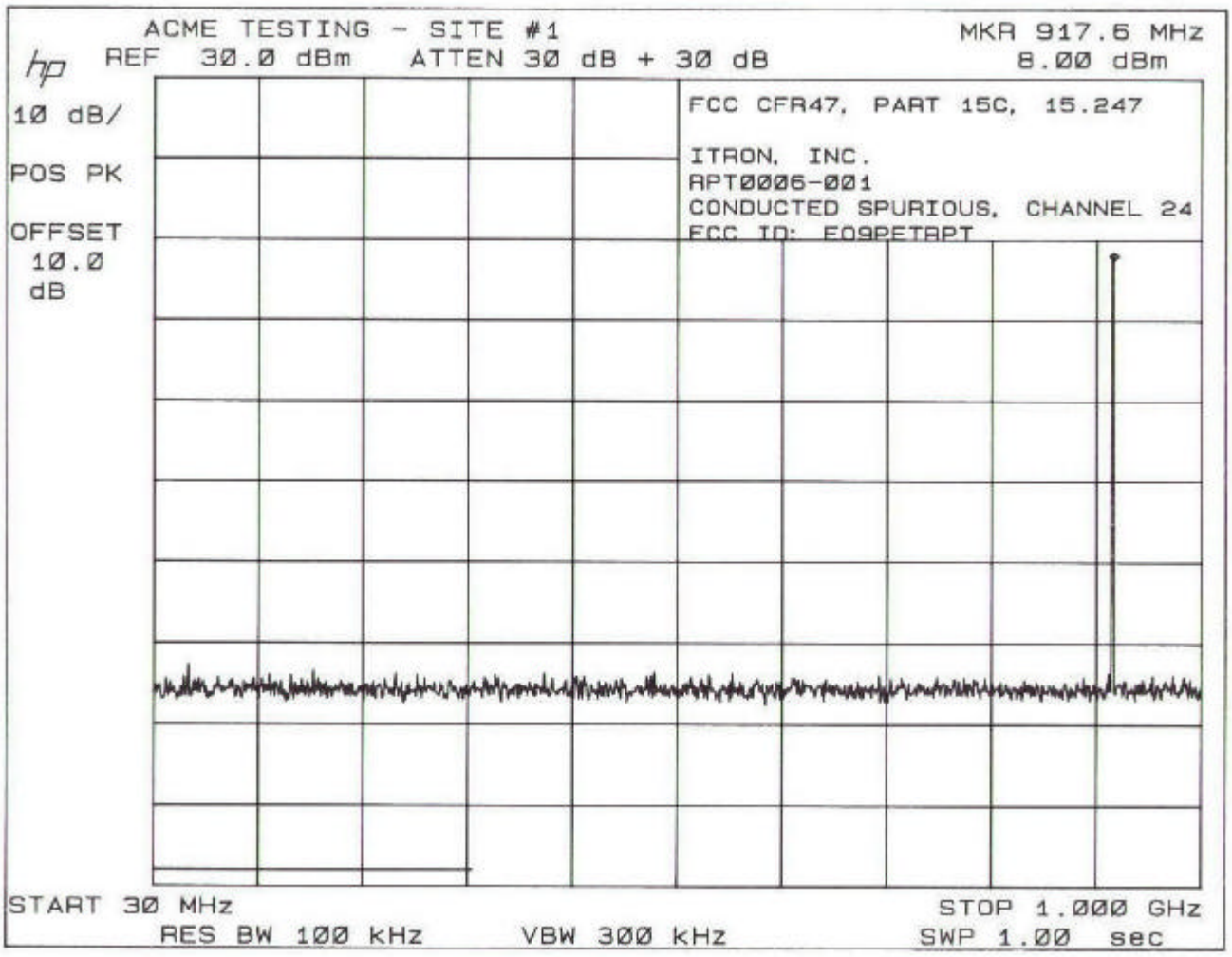


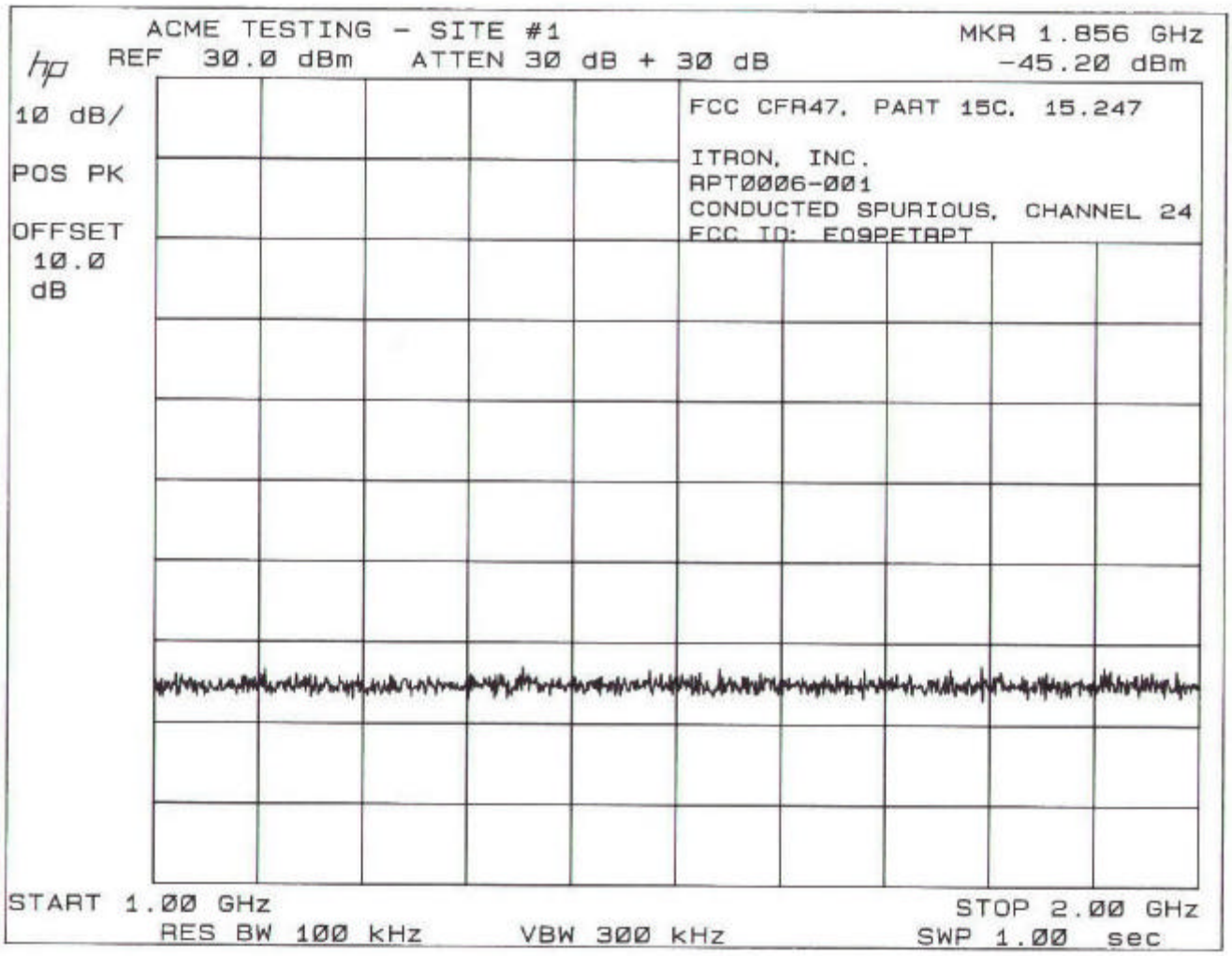

ACME TESTING - SITE #1
MKR 1.856 GHz
REF 30.0 dBm
ATTEN 30 dB + 30 dB
-45.40 dBm
10 dB/
POS PK
OFFSET
10.0
dB
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
CONDUCTED SPURIOUS, CHANNEL 11
FCC ID: EO9PETRPT
START 1.00 GHz
STOP 2.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 1.00 sec

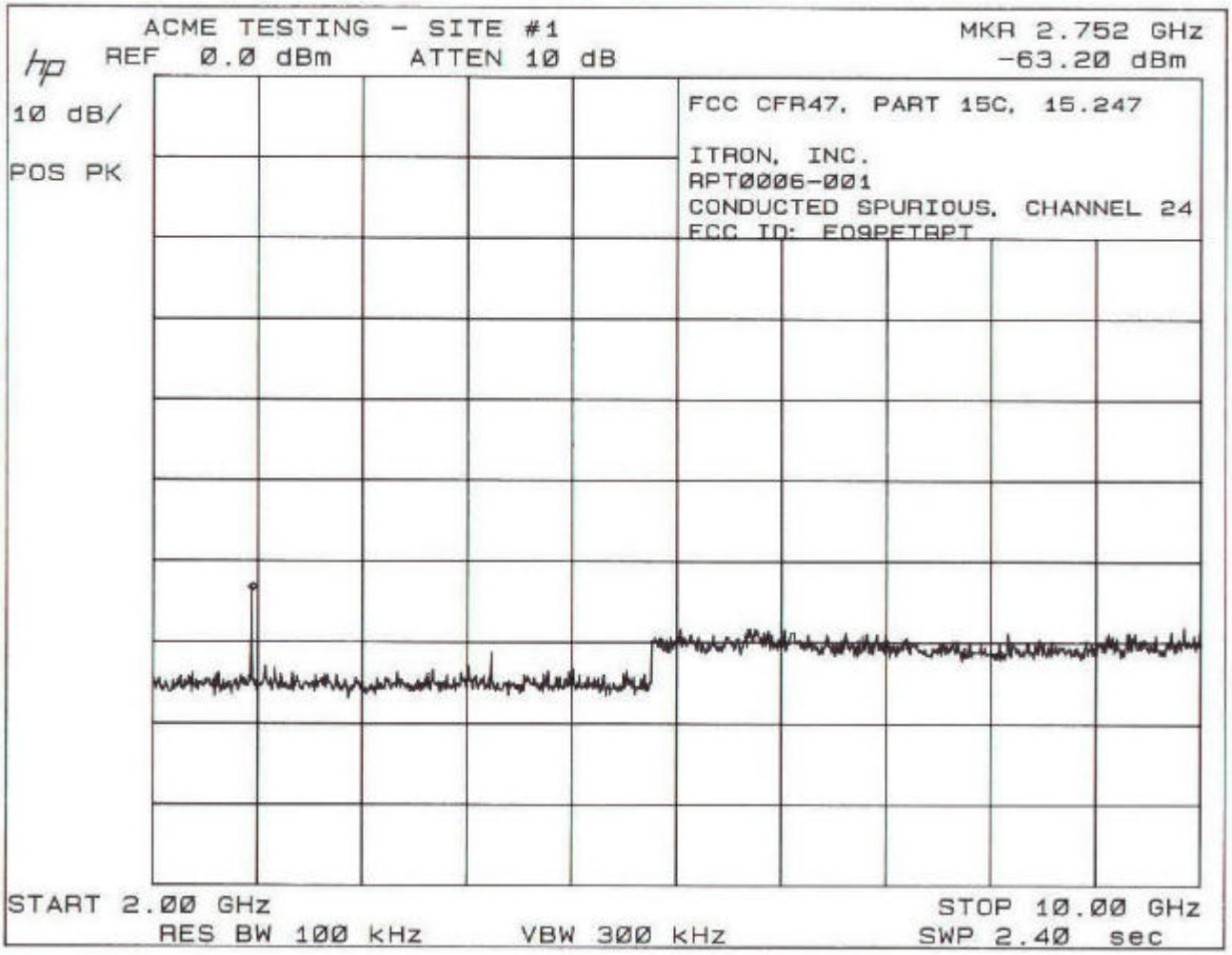

ACME TESTING - SITE #1
MKR 2.712 GHz
REF 0.0 dBm
ATTEN 10 dB
-58.20 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
CONDUCTED SPURIOUS, CHANNEL 11
FCC ID: E09PETRPT
START 2.00 GHz
STOP 10.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 2.40 sec

CONDUCTED SPURIOUS EMISSIONS CHANNEL 24

Frequency (MHz)	Absolute Level (dBm)	Relative Level (dBc)	Limit (dBc)
2778.3	-53.2	-72.4	-20.0




ACME TESTING - SITE #1
MKR 1.856 GHz
REF 30.0 dBm
ATTEN 30 dB + 30 dB
-45.20 dBm
10 dB/
POS PK
OFFSET
10.0
dB
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
CONDUCTED SPURIOUS, CHANNEL 24
FCC ID: E09PETRPT
START 1.00 GHz
STOP 2.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 1.00 sec


ACME TESTING - SITE #1
MKR 2.752 GHz
REF 0.0 dBm
ATTEN 10 dB
-63.20 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
ITRON, INC.
RPT0006-001
CONDUCTED SPURIOUS, CHANNEL 24
FCC ID: EO9PETRPT
START 2.00 GHz
STOP 10.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 2.40 sec

12. Radiated Spurious Emissions

12.1 Regulation

15.247 (c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c).

12.2 Test Equipment

⇒ Spectrum Analyzer (blue): Hewlett-Packard 8566B, Serial Number 2410A00168, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

⇒ RF Preselector (blue): Hewlett-Packard 85685A, Serial Number 2648A-00519, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

⇒ Quasi Peak Adapter (blue): Hewlett-Packard 85650A, Serial Number 2043A00327, Calibrated: 17 March 2000, Calibration due Date: 17 March 2001

⇒ Broadband Biconical Antenna (blue) (20 MHz to 200 MHz): EMCO 3110, Serial Number 1180, Calibrated: 19 June 2000, Calibration due Date: 19 June 2001

⇒ Broadband Log Periodic Antenna (blue) (200 MHz to 1000 MHz): EMCO 3146, Serial Number 2852, Calibrated: 19 June 2000, Calibration due Date: 19 June 2001

⇒ EUT Turntable Position Controller: Rothenbuhler Engineering, Custom, No Calibration Required

⇒ Antenna Mast: Compliance Design, model M100/200, No Calibration Required

⇒ 2 GHz to 10 GHz Low Noise Preamplifier: Milliwave 593-2898, Serial Number 2494, Calibrated: 5 May 2000, Calibration Due Date: 5 May 2001

⇒ Double Ridge Guide Horn Antenna: EMCO 3115, Serial Number 9807-5534, Calibrated: 5 January 2001, Calibration due Date: 5 January 2002

12.3 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that sits on a flush mounted metal turntable. Floor standing equipment is placed directly on the flush mounted metal turntable. The EUT is connected to its associated peripherals with any excess I/O cabling bundled to approximately 1 meter.

Preview tests are performed to determine the "worst case" mode of operation. With the EUT operating in "worst case" mode, emissions from the unit are maximized by adjusting the polarization and height of the receive antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz - 10000 MHz **15.205 RESTRICTED BANDS ONLY**
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz (30 MHz - 1000 MHz) 1 MHz (1000 MHz - 10000 MHz)
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

12.4 Test Results

PRODUCT EMISSIONS
CHANNEL 0

EMISSION FREQUENCY MHz	SPEC LIMIT dBuV/m	MEASUREMENTS ABS dBuV/m	dLIM dB	MODE	POL	SITE HGT cm	AZM deg	CORR FACTOR dB
2710.90	74.0	44.5	-23.5	PK	V	115	30	1.7
2710.90	54.0	39.9	-14.1	AVG	V	115	30	1.7
5421.86	54.0	45.9	-8.1	PK	V	100	280	8.3

PRODUCT EMISSIONS
CHANNEL 11

EMISSION FREQUENCY MHz	SPEC LIMIT dBuV/m	MEASUREMENTS ABS dBuV/m	dLIM dB	MODE	POL	SITE HGT cm	AZM deg	CORR FACTOR dB
2733.29	74.0	48.1	-25.9	PK	V	110	110	1.7
2733.29	54.0	43.2	-10.8	AVG	V	110	110	1.7
4555.47	54.0	44.4	-9.6	PK	V	100	320	5.7
5421.86	54.0	47.2	-6.8	PK	V	115	290	8.4

PRODUCT EMISSIONS
CHANNEL 24

EMISSION FREQUENCY MHz	SPEC LIMIT dBuV/m	MEASUREMENTS ABS dBuV/m	dLIM dB	MODE	POL	SITE HGT cm	AZM deg	CORR FACTOR dB
2778.07	54.0	44.5	-9.5	PK	V	110	90	1.8

13. Continuous Data and Short Transmissions

13.1 Regulation

15.247(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

13.2 Test Results

The PET Repeater is designed to operate as a frequency hopper in that it utilizes 25 pseudorandom channels. The RF channels equally used on average with a channels separation sufficient to provides non-overlapping transmitter occupied bandwidth emission greater than the -20 dB down point. The Transmitter has an occupied bandwidth of 275 KHz. The system receiver hops in synchronization with the transmitter and has a receive bandwidth equal to the transmitter occupied bandwidth. The system does not perform any interference avoidance algorithms.

The PET Repeater or transmitter is often presented with a continuous stream of data. The data or information is in the form short received RF transmission burst generated by submetering end point devices or PET modules that are connected to water meters. The PET Repeater accumulates the PET transmissions from up to 1000 devices, stores only the most recent information, reformats the information into larger packets and transmits this information at the repeaters' allotted time slot and pseudo-randomly selected frequency. The Repeaters transmission rate or channels selection process does not change when presented with continuous data from that process preformed when non-continuous data is presented to it. Since only the most recent information is stored for transmission, intermediate information from the continuous stream is overwritten. However, information between received transmissions is differentially computed at the head-end system providing sufficient resolution of the continuous stream of data to provide accurate information for the submetering application.

When the PET Repeater or transmitter is presented with a continuous stream of data or information the transmitter transmits only 1) in it's allotted time slot: 2) on its pseudo-randomly selected channel: 3) and for its preset transmission duration (less than 400 milliseconds).

14. Coordination of Frequency Hopping

14.1 Regulation

15.247(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

14.2 Result

The PET Repeater and the associated PETRC receiver utilize a time slot based system to coordinate transmission and reception of data communications messages. The system utilizes the same timing and pseudo-random channel selection process whether in a stand-alone operation or within the coverage range of another FHSS systems. When collision between FHSS system the PETNET system continues to operate in a predefined manner by retransmission of the corrupted message at it next scheduled transmission time at next pseudo-randomly selected channel.

15. Miscellaneous Comments and Notes

1. None.