

Preface to Response:

The PETNET system is composed of three major components: PET Module (FCC ID: E09PET), PET RC unit (FCC ID: E09PETRC), and PET Repeater unit (FCC ID *to be*: E09PETRPTTR). The addition of the PET Repeater unit to the PETNET system in order to provide the required coverage of larger PETNET systems. This FCC application is for the PET Repeater unit.

The PET Repeater unit's (FCC ID *to be*: E09PETRPTTR) receiver operates within the same FCC guidelines as the PETRC (FCC ID: E09PETRC). The PET Repeater unit's transmitter operates similarly to the PET Module (FCC ID: E09PET) with the exception of its larger transmission block size, power output, and variable transmission timing. All acquisition, pseudorandom channels, and occupied bandwidth are identical to the PET module.

Filing and Measurement Guidelines
for Frequency Hopping Spread Spectrum Systems

Section 15.31(m):

This rule specifies the number of operating frequencies to be examined for tunable equipment. Unless otherwise specified, the hopping function must be disabled for the following tests, which should be performed with the EUT transmitting on the number of frequencies specified in this Section. The measurements made at the upper and lower ends of the band of operation should be made with the EUT tuned to the highest and lowest available channels.

Measurement to be provided by ACME.

Section 15.203:

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where the EUT must be professionally installed. In order to demonstrate that professional installation is required, the following three points must be addressed: (a) the application (or intended use) of the EUT, (b) the installation requirements of the EUT, and (c) the method by which the EUT will be marketed.

- (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.**

Section 15.204:

Provide the following information for every antenna proposed for use with the EUT: (a) type (e.g., Yagi, patch, grid, dish, etc.), (b) manufacturer and model number, and (c) gain with reference to an isotropic radiator.

- (a) The antenna provided with the PETNET repeater subsystem is a 5DbD omni-directional. The system requires the omni-directional antenna in order to provide communication from the PET module, which is typically equally distributed around the PET Repeater as well as the PETRC and other PET Repeaters. It is not envisioned that a directional antenna will be utilized.**
- (b) The manufacturer is Maxrad and the model is MFB9156RPC.**

- (c) 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.

Section 15.207:

If the unit is designed to be connected to the public utility power line, the voltage conducted back onto the AC power line must be measured, in order to demonstrate compliance with the limit specified in this Section. See ANSI C63.4-1992 for the proper set up and procedures.

Measurement to be provided by ACME.

Section 15.247(a):

Describe how the EUT meets the definition of a frequency hopping spread spectrum system, found in Section 2.1, based on the technical description.

The PET Repeater encodes information utilizing a conventional FM modulator which modulates the carrier frequencies at +/- 75 KHz at a rate of 16 Kbps. The transmissions are less than 400 ms on each of the 25 hopping frequencies. The frequencies are pseudo-randomly selected and changed at a fixed interval. The transmission frequency is not spread on each transmission over the entire width of the band; rather it hops on 25 different channels within the band.

Carrier Frequency Separation

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) $\geq$ 1% of the span

Video (or Average) Bandwidth (VBW) $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Measurement to be provided by ACME.

Number of Hopping Frequencies

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW $\geq$ 1% of the span

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Measurement to be provided by ACME.

Time of Occupancy (Dwell Time)

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel

RBW = 1 MHz

VBW $\geq$ RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

Measurement to be provided by ACME.

20 dB Bandwidth

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW $\geq$ 1% of the 20 dB bandwidth

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Measurement to be provided by ACME.

Pseudorandom Frequency Hopping Sequence

Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, in order to demonstrate that the sequence meets the requirement specified in the definition of a frequency hopping spread spectrum system, found in Section 2.1.

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

Equal Hopping Frequency Use

Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g., that each new transmission event begins on the next channel in the hopping sequence after the final channel used in the previous transmission event).

The PET Repeater utilizes a pseudo-randomly coded transmission hopping sequence from the table below. The selection of the hop sequence is determined by the lower 8 bits of the unit's identification number. In addition, the unit will, upon initial power up, select a random channel within its sequence to start the hopping process. The unit will continue to hop through all channels in its sequence before utilizing any channel again. This process will go on indefinitely, thus providing equal use of all 25 hopping channels. The unit will utilize a predetermined program time between each channel hop even when presented with continuous data. The time between transmissions will typically be set between 30 seconds and 5 minutes, depending on the application, but in no case will it be less than 20 seconds.

System Receiver Input Bandwidth

Describe how the associated receiver(s) complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.

The Pet Repeater is equipped with a synthesized dual conversion super-hetrodyne 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.



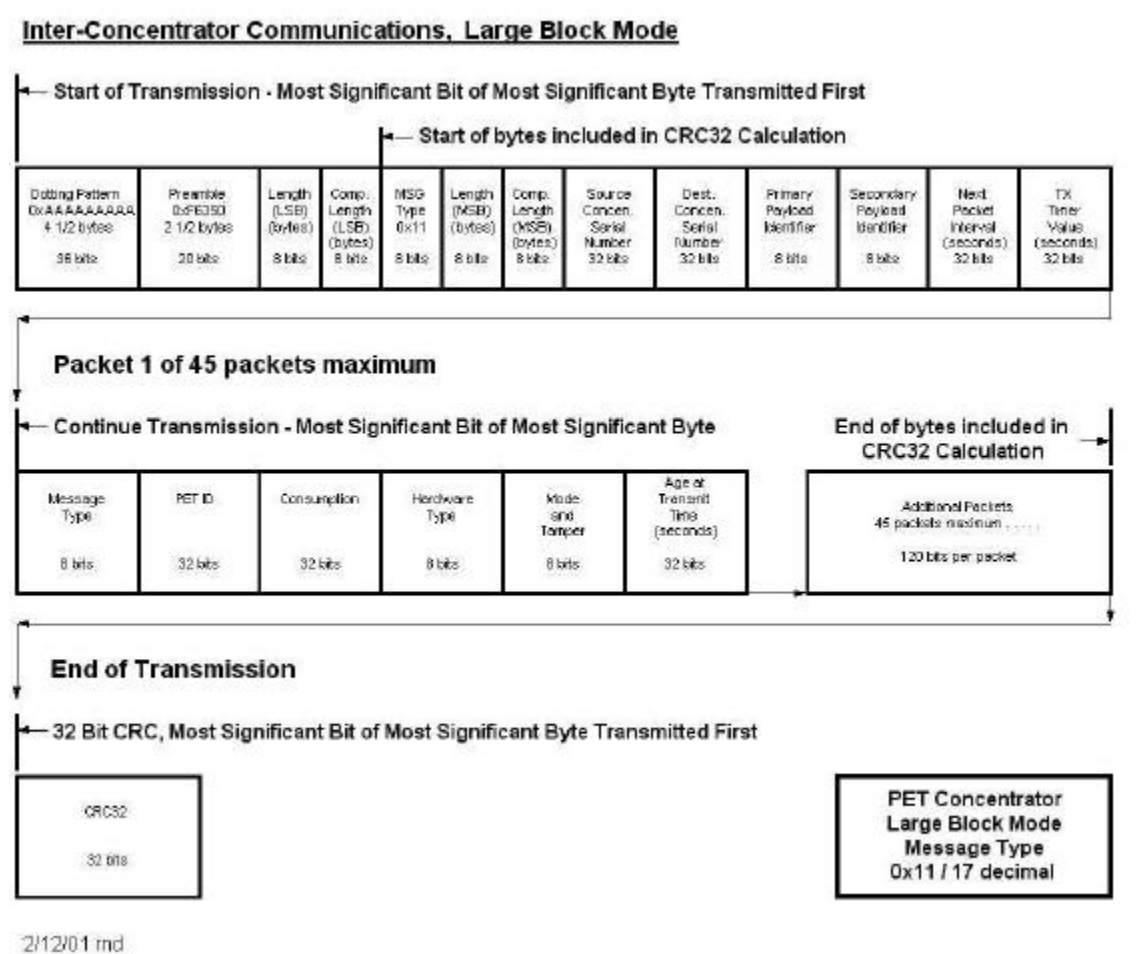
System Receiver Hopping Capability

Describe how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals.

The PETRC receiver shifts frequencies in synchronization with the PET Repeater's transmitter by utilizing a constant time slot and frequency that is determined in the

acquisition mode (25 channels in table below). During acquisition mode, the receiver is tuned to one of 7 acquisition channels and listens for transmissions from a PET Repeater. Upon reception of a valid message from a PET Repeater, the receiver has sufficient information (see message format below) to shift frequencies in synchronization with the transmitter. The information provided in the acquisition messaging is 1) the serial number of the transmitter and 2) the time between transmissions to be expected. The serial number provides the receiver information on the expected pseudo-random channels on which the transmitter will operate through the use of a common look up table of pseudo-randomly selected frequencies and serial numbers. The table (provided below) has 256 possible sequences that are associated to the lower 8 bits of the serial number.

Time between transmission information is contained in each transmission. The timing information is entered in the PET Repeater during installation and is held constant.



PET Channels

PETNET System: Guideline Responses

Sequence	Frequency	Channel
0	903.7	8
1	904.1	10
2	904.9	14
3	905.5	17
4	906.1	20
5	906.7	23
6	907.1	25
7	907.9	29
8	908.5	32
9	909.1	35
10	909.7	38
11	910.3	41
12	911.1	45
13	919.1	85
14	919.9	89
15	920.5	92
16	921.1	95
17	921.7	98
18	922.5	102
19	922.9	104
20	923.5	107
21	924.1	110
22	924.7	113
23	925.3	116
24	926.1	120

Bold Text Indicates Acquisition Channels

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
 Sequence 11: 6,22,16,14,11,0,2,7,8,12,5,17,4,15,20,18,3,19,13,21,9,1,23,24,10
 Sequence 12: 19,18,12,7,22,2,8,14,9,11,5,20,13,1,15,6,3,10,24,16,21,23,17,4,0
 Sequence 13: 14,6,23,24,22,4,12,19,1,5,10,8,0,16,15,2,11,20,13,7,9,21,17,3,18
 Sequence 14: 3,12,2,18,7,21,23,14,20,10,17,4,11,9,15,8,24,6,22,1,16,19,13,0,5
 Sequence 15: 5,22,20,11,0,19,1,23,14,24,13,15,10,21,8,17,6,2,9,16,12,4,18,7,3
 Sequence 16: 8,16,13,7,3,21,9,12,15,22,17,11,24,6,10,14,2,4,1,5,0,23,20,19,18
 Sequence 17: 10,22,7,0,2,12,23,18,15,6,21,3,16,24,11,9,19,4,20,13,5,14,17,1,8
 Sequence 18: 23,16,7,0,5,20,1,6,15,21,12,2,11,17,4,10,13,9,24,3,22,19,18,14,8
 Sequence 19: 10,18,13,15,1,23,2,8,6,4,22,12,7,20,9,5,11,14,0,17,16,24,3,19,21
 Sequence 20: 13,6,20,3,10,19,8,16,14,0,4,22,24,1,15,5,12,2,18,11,7,17,9,23,21
 Sequence 21: 23,1,9,8,13,17,15,16,19,12,10,24,22,6,3,5,11,7,4,14,21,18,20,0,2
 Sequence 22: 3,12,9,11,7,17,10,18,8,0,21,14,4,24,16,15,2,13,20,5,1,6,19,22,23
 Sequence 23: 18,8,7,3,9,17,21,12,1,15,19,20,24,23,14,13,5,0,6,22,2,10,16,4,11
 Sequence 24: 2,23,20,9,4,18,10,17,21,13,3,19,5,0,22,14,8,15,11,1,7,16,6,12,24
 Sequence 25: 6,19,1,21,4,9,13,0,18,11,16,15,10,7,20,2,22,17,12,23,14,5,8,3,24
 Sequence 26: 18,17,7,15,22,4,3,6,12,14,19,16,2,20,10,1,5,23,9,21,24,8,11,13,0
 Sequence 27: 20,4,23,12,14,5,2,21,7,19,3,6,1,16,15,24,13,22,18,8,9,10,11,17,0
 Sequence 28: 2,21,11,23,9,12,15,24,16,7,19,6,14,18,13,5,8,4,17,10,1,22,0,20,3
 Sequence 29: 9,7,14,18,15,24,21,13,6,19,2,0,16,11,22,17,10,5,20,3,8,12,4,23,1
 Sequence 30: 3,13,5,20,11,9,22,10,17,15,7,23,24,6,16,14,12,4,2,8,0,18,21,19,1
 Sequence 31: 1,21,18,10,15,14,17,12,23,6,19,8,11,2,20,9,5,13,22,16,3,0,7,4,24
 Sequence 32: 8,16,1,12,11,20,21,24,9,17,2,15,22,10,6,14,13,19,3,23,7,18,5,4,0
 Sequence 33: 16,1,12,5,4,11,21,15,10,3,8,22,20,7,24,18,19,6,2,0,9,17,23,13,14
 Sequence 34: 11,7,22,6,14,16,12,10,9,15,4,17,5,8,2,18,19,3,21,1,20,0,23,13,24
 Sequence 35: 5,10,11,15,22,21,6,16,13,3,14,19,17,9,7,4,20,18,1,2,24,8,23,12,0
 Sequence 36: 15,12,22,0,7,8,9,4,19,21,13,20,1,3,14,24,10,18,6,23,16,11,2,17,5
 Sequence 37: 11,13,5,8,9,2,20,17,7,23,1,6,18,16,0,3,21,4,12,14,10,19,15,22,24
 Sequence 38: 8,18,4,2,7,14,20,17,13,15,3,19,9,22,21,16,12,0,10,6,23,1,11,5,24
 Sequence 39: 22,9,8,15,14,5,21,3,18,10,7,1,17,20,11,23,12,6,13,2,4,19,16,0,24
 Sequence 40: 5,6,10,15,19,22,12,9,11,21,18,13,23,14,8,7,2,20,24,3,4,0,1,17,16
 Sequence 41: 4,5,23,2,22,7,3,20,18,16,8,15,13,14,21,12,9,6,11,10,1,17,0,19,24
 Sequence 42: 14,18,4,1,17,12,16,15,22,5,9,10,11,19,21,8,2,6,3,13,20,0,23,24,7

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Sequence 43: 1,17,7,24,5,16,10,21,3,2,8,9,15,12,6,19,20,14,18,22,13,0,23,11,4
Sequence 44: 19,9,24,23,22,21,4,16,7,5,2,6,20,1,10,18,14,12,11,3,8,17,0,15,13
Sequence 45: 17,6,4,12,11,8,22,9,7,20,16,13,1,14,3,23,19,5,2,21,10,18,15,0,24
Sequence 46: 18,22,14,2,10,5,7,15,6,19,21,1,0,9,4,23,12,3,8,16,11,24,17,20,13
Sequence 47: 15,10,22,1,2,4,7,20,21,16,17,9,6,8,18,14,24,5,12,0,23,19,11,3,13
Sequence 48: 8,19,16,10,2,20,0,4,22,11,24,3,15,23,6,14,1,21,9,13,12,7,18,17,5
Sequence 49: 16,1,12,5,22,13,3,20,14,4,10,17,11,21,23,6,18,2,24,9,15,7,0,8,19
Sequence 50: 8,23,18,20,1,3,4,16,0,11,5,21,6,2,19,24,17,13,15,22,14,7,12,9,10
Sequence 51: 7,20,4,21,24,1,17,11,18,19,5,0,14,12,16,15,3,22,23,8,10,13,6,2,9
Sequence 52: 6,18,17,15,2,14,12,11,16,20,9,13,21,7,1,10,8,5,23,24,3,22,4,0,19
Sequence 53: 4,5,3,7,9,18,10,17,19,1,21,16,20,6,14,8,12,11,22,23,15,24,2,13,0
Sequence 54: 5,20,0,4,19,1,16,14,17,2,7,15,8,6,12,23,21,9,11,13,10,18,3,22,24
Sequence 55: 16,12,19,5,11,7,0,1,3,13,10,24,15,8,14,20,22,4,2,21,18,9,17,6,23
Sequence 56: 10,2,20,9,14,17,15,21,13,5,11,23,7,22,1,18,3,4,6,8,19,12,16,0,24
Sequence 57: 14,1,7,0,8,12,11,20,19,23,17,2,22,9,5,18,3,16,4,13,15,21,6,10,24
Sequence 58: 21,20,22,18,2,4,6,13,5,10,19,3,7,8,16,9,15,14,11,17,23,12,24,0,1
Sequence 59: 6,4,18,10,13,8,3,20,19,12,5,15,16,9,23,22,2,11,0,7,17,1,21,14,24
Sequence 60: 22,15,16,4,2,10,23,13,3,19,0,18,8,5,14,12,9,6,20,11,21,7,17,24,1
Sequence 61: 6,18,17,12,10,2,16,9,4,14,22,19,8,3,24,15,23,11,21,13,1,5,7,0,20
Sequence 62: 16,14,15,3,23,5,7,21,6,19,10,0,18,9,8,17,22,4,20,13,11,1,24,2,12
Sequence 63: 19,9,7,20,24,5,15,11,8,22,4,23,18,17,21,0,3,1,14,2,12,13,10,16,6
Sequence 64: 3,11,12,20,7,6,9,16,0,22,14,10,23,17,2,13,18,8,21,19,15,4,1,5,24
Sequence 65: 12,0,18,24,5,15,6,20,21,2,10,17,8,4,14,11,3,1,22,7,9,16,19,23,13
Sequence 66: 11,14,3,17,4,15,9,19,22,18,8,2,5,23,20,6,13,7,10,0,1,24,16,21,12
Sequence 67: 9,20,18,16,17,15,10,22,1,13,21,5,3,2,6,7,11,14,23,4,19,8,24,12,0
Sequence 68: 21,14,8,13,15,11,9,19,7,22,17,3,10,16,4,20,18,2,23,5,1,12,6,0,24
Sequence 69: 18,13,10,12,4,14,11,7,22,20,8,21,1,24,19,15,16,6,5,17,9,23,0,2,3
Sequence 70: 16,11,5,12,2,3,23,21,8,18,20,10,4,1,19,9,22,14,6,15,13,7,24,17,0
Sequence 71: 22,7,18,17,9,15,2,24,0,16,21,20,11,23,3,19,13,14,1,6,10,8,5,4,12
Sequence 72: 21,6,16,5,3,17,1,2,15,0,20,23,9,14,19,7,10,12,13,11,4,18,8,24,22
Sequence 73: 15,19,21,24,20,7,14,9,3,23,1,4,11,0,6,2,16,18,8,13,5,12,17,10,22
Sequence 74: 8,7,5,21,15,20,14,9,3,2,23,1,18,4,10,22,24,6,16,19,13,12,11,17,0
Sequence 75: 18,12,4,7,14,22,16,20,11,21,15,2,19,23,1,8,6,13,17,0,3,9,24,5,10
Sequence 76: 7,4,13,0,14,6,8,11,10,15,21,19,22,18,23,5,16,12,9,2,17,1,20,3,24
Sequence 77: 13,24,7,14,17,18,15,12,4,8,10,1,21,9,0,11,16,22,5,3,19,2,23,6,20
Sequence 78: 24,23,18,14,21,8,5,9,4,1,12,13,10,17,19,22,20,0,11,6,7,15,3,16,2
Sequence 79: 1,23,5,22,20,2,3,17,4,14,6,7,24,8,10,9,19,11,18,21,13,15,16,12,0
Sequence 80: 21,15,0,14,13,23,3,1,20,10,5,11,12,7,2,18,6,4,24,8,9,16,19,17,22
Sequence 81: 11,1,16,23,20,14,6,22,4,19,7,3,8,12,21,15,17,10,5,18,13,24,9,2,0
Sequence 82: 7,1,21,6,2,14,24,9,4,18,13,11,5,3,23,8,15,17,20,22,16,12,10,19,0
Sequence 83: 9,13,23,22,12,21,8,3,15,7,18,11,2,17,4,14,5,19,6,20,16,10,0,24,1
Sequence 84: 3,10,17,18,11,1,15,20,5,7,6,2,21,4,14,22,9,12,0,19,13,23,16,8,24
Sequence 85: 13,23,20,17,12,3,8,15,24,10,19,21,14,6,22,11,18,2,0,16,7,5,4,9,1
Sequence 86: 24,18,16,14,11,13,1,12,5,21,9,17,22,10,6,15,3,20,19,23,8,7,2,0,4
Sequence 87: 15,12,2,17,3,13,10,1,4,20,22,5,23,14,11,6,9,18,7,16,8,24,21,19,0
Sequence 88: 1,22,13,11,21,23,2,4,3,12,20,24,15,10,6,9,18,7,17,5,0,16,8,19,14

Sequence 89: 12,6,9,1,11,10,20,21,22,17,2,8,23,19,3,15,14,4,5,13,7,18,16,0,24
Sequence 90: 23,13,18,4,5,14,9,12,2,21,16,8,6,11,15,20,3,7,24,17,1,10,22,19,0
Sequence 91: 17,15,21,13,2,8,18,23,1,20,4,22,3,11,6,16,0,5,10,12,19,9,7,24,14
Sequence 92: 22,24,13,2,14,8,4,21,16,17,6,19,18,20,9,1,11,12,3,10,15,5,0,23,7
Sequence 93: 21,6,2,8,5,22,4,1,10,9,12,13,7,16,11,14,0,3,20,17,24,19,23,15,18
Sequence 94: 20,3,22,15,8,19,2,11,21,6,1,4,5,17,13,18,23,14,7,10,16,9,12,24,0
Sequence 95: 13,6,5,12,15,24,14,20,9,11,3,10,18,2,7,16,1,23,22,17,21,19,8,0,4
Sequence 96: 11,6,17,21,10,16,4,8,22,7,2,9,1,5,14,3,19,20,12,0,23,13,18,15,24
Sequence 97: 17,5,10,24,21,14,13,18,22,9,7,12,20,1,2,6,19,0,11,3,23,4,16,15,8
Sequence 98: 17,7,2,1,21,20,3,15,22,8,12,13,18,10,0,5,16,6,24,9,11,14,4,19,23
Sequence 99: 7,17,9,20,21,16,13,10,0,12,23,15,5,2,18,8,24,4,1,22,19,14,3,11,6
Sequence 100: 8,16,11,6,9,10,15,13,14,12,23,18,5,24,2,20,7,19,3,0,1,4,17,21,22
Sequence 101: 7,1,19,11,21,20,4,9,8,12,2,17,0,22,18,23,24,14,10,13,5,3,15,6,16
Sequence 102: 1,4,21,17,16,5,19,3,7,6,18,24,11,14,23,8,9,12,10,20,2,22,0,13,15
Sequence 103: 4,5,11,9,16,19,13,3,7,18,6,15,2,14,1,12,20,23,10,17,8,24,22,0,21
Sequence 104: 12,23,5,8,9,22,20,6,16,1,17,21,11,18,10,4,13,14,15,7,2,24,3,19,0
Sequence 105: 12,8,1,22,20,9,23,24,7,2,17,10,15,19,6,14,3,4,18,5,16,11,0,21,13
Sequence 106: 12,7,13,14,8,21,10,4,23,19,1,5,20,22,9,16,15,3,17,11,18,6,24,0,2
Sequence 107: 13,23,5,2,4,11,24,12,1,14,7,6,10,17,16,0,15,21,9,8,22,18,20,3,19
Sequence 108: 21,10,9,19,12,3,4,17,15,22,1,5,23,24,6,14,16,0,7,2,13,8,11,18,20
Sequence 109: 13,9,3,7,8,18,0,5,6,24,19,17,22,1,11,20,23,2,10,21,4,12,15,14,16
Sequence 110: 2,0,12,4,21,23,18,1,13,15,10,5,19,17,3,6,14,7,16,9,11,20,22,8,24
Sequence 111: 17,6,22,15,12,0,9,8,5,19,18,2,11,21,4,1,13,10,16,20,3,14,23,24,7
Sequence 112: 10,5,15,13,3,11,16,21,9,12,6,18,7,19,8,4,22,20,0,17,14,1,24,2,23
Sequence 113: 20,19,6,2,9,16,13,11,21,14,5,15,12,10,8,4,22,17,23,18,0,1,24,7,3
Sequence 114: 5,16,10,14,24,13,23,18,2,9,8,4,6,7,20,3,11,12,15,1,21,19,17,22,0
Sequence 115: 8,17,10,3,23,5,1,18,9,4,19,12,11,7,24,2,21,20,22,15,6,13,14,16,0
Sequence 116: 7,22,3,5,21,9,1,24,4,14,16,2,13,10,23,18,15,6,17,11,20,8,0,12,19
Sequence 117: 18,7,8,3,1,21,19,9,12,22,13,14,5,23,0,20,11,2,17,10,4,24,15,6,16
Sequence 118: 13,16,21,9,2,15,10,1,20,3,4,6,19,17,14,12,23,11,0,18,5,22,7,24,8
Sequence 119: 19,1,5,3,17,13,7,6,23,15,22,14,24,9,18,2,12,8,4,20,16,11,21,0,10
Sequence 120: 8,19,14,21,15,5,3,13,2,12,11,9,20,0,18,6,4,16,1,10,24,23,22,7,17
Sequence 121: 18,23,1,16,10,19,24,4,15,5,13,17,7,8,2,3,21,22,9,0,12,20,11,14,6
Sequence 122: 3,12,13,1,11,14,7,16,15,4,19,23,18,17,20,5,0,2,21,24,22,6,8,9,10
Sequence 123: 1,7,11,16,19,5,23,13,8,9,20,17,15,14,18,4,10,2,3,12,21,0,6,24,22
Sequence 124: 0,2,18,12,1,11,15,23,10,16,19,17,21,20,13,22,6,24,3,14,7,4,8,9,5
Sequence 125: 23,1,10,11,8,4,18,15,13,12,3,17,19,7,16,9,22,6,24,0,20,5,14,2,21
Sequence 126: 2,1,17,16,19,9,18,15,3,23,0,10,14,4,6,11,24,7,5,20,8,13,12,21,22
Sequence 127: 2,10,6,9,13,7,5,0,14,17,11,3,19,15,8,4,24,12,23,20,21,1,16,22,18
Sequence 128: 2,18,15,13,12,9,16,3,24,10,0,17,5,7,19,11,14,22,23,21,6,4,20,8,1
Sequence 129: 7,1,4,12,9,13,11,17,10,5,21,16,23,6,18,24,14,3,19,8,15,2,0,22,20
Sequence 130: 3,1,9,17,15,7,16,22,23,21,13,14,10,4,11,18,12,2,8,6,5,0,24,20,19
Sequence 131: 3,2,17,15,1,8,19,12,11,22,23,14,5,20,9,4,21,24,18,6,16,10,7,13,0
Sequence 132: 5,24,4,22,23,9,3,12,19,20,18,8,17,16,21,1,7,10,0,15,13,14,2,11,6
Sequence 133: 13,0,16,14,24,20,2,5,9,23,1,3,19,15,22,17,18,21,10,8,7,12,6,4,11
Sequence 134: 3,12,18,11,19,17,21,1,14,6,4,15,20,8,9,13,0,5,16,2,23,10,22,7,24

Sequence 135: 14,23,12,8,9,16,13,21,18,7,10,19,11,22,0,2,5,6,15,3,20,17,4,1,24
Sequence 136: 18,4,5,1,15,21,16,6,13,14,19,8,3,12,22,17,7,2,11,23,10,20,9,0,24
Sequence 137: 24,16,8,12,21,20,14,17,15,11,19,1,3,7,18,22,0,9,23,5,13,4,10,2,6
Sequence 138: 24,13,15,7,21,2,8,1,19,3,5,14,6,23,18,16,10,22,4,9,20,12,17,11,0
Sequence 139: 18,7,9,13,14,19,4,12,21,2,10,16,22,8,23,1,0,6,20,3,24,11,15,5,17
Sequence 140: 22,7,4,5,12,10,13,20,11,8,0,21,23,18,1,6,19,9,17,16,15,2,14,24,3
Sequence 141: 17,14,6,1,18,3,11,9,7,16,2,4,22,23,15,20,5,0,12,13,21,8,19,10,24
Sequence 142: 7,9,6,5,23,16,11,15,21,20,4,17,24,8,3,14,22,1,18,2,13,19,12,0,10
Sequence 143: 20,17,4,8,3,0,5,14,21,6,9,12,7,15,11,18,13,22,24,10,23,16,2,19,1
Sequence 144: 4,11,13,19,1,23,20,2,10,0,17,15,3,9,18,8,14,16,5,12,22,6,7,24,21
Sequence 145: 18,11,10,9,3,15,19,12,23,7,13,1,17,16,22,6,2,21,20,8,5,4,0,14,24
Sequence 146: 12,1,20,3,13,23,2,14,15,5,17,10,11,9,8,22,16,7,19,21,18,6,4,0,24
Sequence 147: 16,14,2,23,5,18,13,8,3,12,11,6,4,22,17,21,20,9,10,1,15,19,24,7,0
Sequence 148: 15,7,23,10,4,20,19,6,2,9,5,14,12,1,21,8,22,3,17,16,13,11,24,18,0
Sequence 149: 4,10,18,15,21,6,19,8,2,7,9,1,13,23,17,22,11,14,12,20,5,0,24,16,3
Sequence 150: 10,4,23,19,2,20,21,18,15,24,5,3,13,7,1,17,11,22,16,14,6,12,9,0,8
Sequence 151: 16,2,19,3,4,22,12,1,18,20,8,0,11,24,6,7,13,14,9,5,10,17,23,21,15
Sequence 152: 12,9,8,6,21,23,22,17,20,19,3,11,15,5,2,16,0,10,1,24,4,14,18,7,13
Sequence 153: 11,16,22,13,14,4,21,7,19,2,0,6,8,15,12,10,23,20,1,18,5,9,24,17,3
Sequence 154: 21,15,22,6,14,16,2,3,10,1,17,7,23,20,9,18,0,13,11,5,19,24,8,12,4
Sequence 155: 10,24,15,16,4,12,1,7,11,6,17,0,14,5,22,23,3,9,2,18,21,8,20,13,19
Sequence 156: 23,18,3,10,9,2,17,4,1,12,22,11,5,21,6,7,19,20,14,13,16,8,24,15,0
Sequence 157: 1,12,8,18,22,24,10,21,7,4,20,23,13,3,16,6,0,2,17,19,15,9,5,11,14
Sequence 158: 1,10,20,21,4,5,2,13,0,11,22,23,18,19,15,17,12,9,16,6,3,7,8,14,24
Sequence 159: 19,12,18,4,7,20,3,9,13,5,10,1,23,2,16,22,11,6,8,21,15,17,24,0,14
Sequence 160: 21,24,17,10,23,2,14,20,5,22,19,18,8,11,9,15,7,3,13,16,4,0,1,12,6
Sequence 161: 13,3,12,0,15,20,17,5,14,6,19,22,2,1,10,8,7,11,9,23,21,4,18,24,16
Sequence 162: 13,16,8,4,1,5,19,20,22,2,9,6,7,18,11,10,14,12,17,23,15,3,0,21,24
Sequence 163: 2,9,4,3,20,11,21,17,8,18,16,15,0,12,23,22,1,19,6,24,14,13,10,7,5
Sequence 164: 12,16,17,11,9,8,23,15,3,19,24,5,22,14,18,10,20,0,13,21,1,4,6,7,2
Sequence 165: 7,5,15,24,11,2,6,20,4,1,21,12,9,19,18,14,16,8,17,13,23,22,0,3,10
Sequence 166: 24,23,5,7,14,21,17,19,3,4,9,15,13,2,12,1,16,20,10,18,22,6,8,11,0
Sequence 167: 11,10,4,21,22,9,14,3,20,16,15,5,23,13,0,12,2,19,8,17,18,1,6,7,24
Sequence 168: 22,5,2,9,3,18,8,12,11,24,4,10,17,13,0,1,19,20,23,7,16,14,15,21,6
Sequence 169: 21,23,15,3,16,14,8,20,19,13,4,1,7,2,17,5,18,10,9,22,6,24,12,11,0
Sequence 170: 6,14,23,8,16,13,15,19,2,4,5,9,11,22,7,18,21,17,20,10,0,3,1,12,24
Sequence 171: 3,5,11,19,4,0,9,20,8,17,10,2,24,1,15,18,13,16,14,12,23,22,6,21,7
Sequence 172: 8,13,7,16,17,14,18,15,11,19,12,5,9,1,2,21,4,0,10,3,23,20,6,22,24
Sequence 173: 4,21,2,17,8,15,6,3,20,9,14,12,7,18,13,16,1,24,10,23,22,11,19,5,0
Sequence 174: 7,21,11,20,10,18,19,14,16,22,23,15,5,9,4,8,2,12,17,13,24,1,6,0,3
Sequence 175: 2,4,1,5,19,15,8,23,11,7,21,10,13,3,17,14,18,0,20,16,12,22,24,6,9
Sequence 176: 8,17,1,10,7,12,13,0,24,21,5,11,14,4,3,15,22,16,2,23,20,18,19,6,9
Sequence 177: 21,2,22,24,8,17,15,4,9,3,19,14,1,7,18,23,10,0,11,5,12,16,13,20,6
Sequence 178: 4,17,1,7,14,3,23,6,13,15,18,8,9,11,5,20,19,16,21,0,24,10,12,2,22
Sequence 179: 19,21,4,12,20,7,9,14,6,18,15,8,1,0,10,3,2,22,23,16,5,13,24,11,17
Sequence 180: 14,1,20,17,7,21,5,3,4,9,6,12,8,18,11,13,16,0,19,10,2,23,15,22,24

Sequence 181: 15,6,8,18,21,1,13,2,7,24,5,10,14,12,3,22,16,17,11,23,19,4,9,20,0
Sequence 182: 0,13,14,23,22,6,9,24,11,18,17,7,21,12,1,3,5,2,10,15,4,20,16,19,8
Sequence 183: 18,2,3,22,7,23,8,1,17,9,21,12,5,15,19,14,16,4,20,6,0,11,13,10,24
Sequence 184: 10,8,16,11,22,17,18,0,4,13,14,12,1,19,9,5,24,7,23,20,6,2,15,21,3
Sequence 185: 13,17,21,16,4,14,19,6,5,3,1,8,23,9,24,2,15,0,22,7,20,18,12,11,10
Sequence 186: 16,8,2,23,20,13,14,9,22,12,11,21,5,10,17,18,15,6,0,3,24,19,7,4,1
Sequence 187: 20,13,24,23,4,8,18,10,16,7,19,14,9,15,21,22,2,12,17,3,11,5,1,6,0
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Sequence 189: 23,21,20,12,19,16,3,9,11,13,4,1,24,10,18,5,7,22,14,2,8,6,0,17,15
Sequence 190: 3,21,4,1,19,13,11,16,20,17,14,15,18,7,8,22,9,10,5,23,6,2,12,0,24
Sequence 191: 5,3,4,16,13,2,18,20,9,1,12,15,11,22,14,10,23,6,17,19,21,8,24,7,0
Sequence 192: 4,7,3,5,11,19,13,2,16,17,10,23,21,14,6,15,18,9,12,22,1,0,20,8,24
Sequence 193: 22,2,24,6,1,16,23,13,18,4,20,5,15,21,9,12,14,10,11,3,8,0,7,19,17
Sequence 194: 6,23,2,13,10,1,5,9,17,15,14,8,11,21,20,3,24,0,22,18,4,7,16,12,19
Sequence 195: 1,3,17,12,18,6,8,4,5,20,7,19,23,2,16,10,21,11,24,15,14,22,9,13,0
Sequence 196: 23,13,12,3,16,15,20,17,24,8,19,6,22,14,21,4,5,1,2,7,9,10,11,18,0
Sequence 197: 3,4,15,16,18,10,20,9,17,13,12,1,23,8,22,7,2,24,5,6,0,19,21,14,11
Sequence 198: 10,2,8,21,23,3,5,9,17,16,20,4,19,11,0,14,6,1,13,15,22,24,7,18,12
Sequence 199: 8,6,3,23,24,15,22,4,12,2,21,19,9,17,10,13,0,1,7,14,5,18,20,16,11
Sequence 200: 9,19,5,10,0,11,20,24,6,23,8,21,16,12,7,17,1,18,22,2,4,14,15,13,3
Sequence 201: 11,8,21,14,17,24,22,20,6,23,16,7,2,9,18,13,19,10,0,15,12,4,5,1,3
Sequence 202: 11,14,4,1,3,15,22,21,12,24,23,17,19,8,16,9,7,6,2,10,18,13,20,5,0
Sequence 203: 8,21,22,10,13,14,4,9,19,5,11,16,1,18,24,17,12,20,23,2,3,6,7,0,15
Sequence 204: 4,23,14,6,10,21,3,20,5,19,17,8,16,24,1,9,18,15,13,12,11,22,7,2,0
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Sequence 206: 9,11,1,6,19,12,8,13,16,22,4,21,20,10,5,18,24,23,15,14,3,7,2,17,0
Sequence 207: 10,16,6,14,15,18,4,13,23,22,1,3,20,21,11,12,8,5,7,9,24,19,17,2,0
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Sequence 209: 10,21,6,4,16,22,17,23,19,13,14,2,8,7,9,5,24,15,0,1,11,12,3,18,20
Sequence 210: 14,0,23,19,15,10,1,17,24,12,2,13,20,7,5,22,11,3,16,8,18,6,4,9,21
Sequence 211: 7,18,19,13,22,16,24,15,3,10,4,8,1,5,17,6,14,21,0,23,9,11,2,20,12
Sequence 212: 7,21,5,15,22,13,16,23,2,1,20,18,4,3,17,9,19,12,24,11,10,14,8,0,6
Sequence 213: 10,18,23,20,11,5,19,22,21,4,24,2,9,17,15,7,16,14,3,1,8,6,12,13,0
Sequence 214: 15,2,7,12,16,24,9,1,18,10,8,22,20,23,14,5,6,21,17,3,0,19,11,4,13
Sequence 215: 6,22,3,12,4,13,5,17,20,11,21,24,14,18,23,0,15,7,2,1,16,9,10,8,19
Sequence 216: 13,19,8,21,10,1,23,3,5,17,0,12,2,18,4,9,11,20,16,22,7,24,15,6,14
Sequence 217: 13,1,18,16,21,12,19,4,20,9,5,8,23,2,0,22,6,10,14,15,7,3,24,17,11
Sequence 218: 24,9,4,1,18,5,21,2,12,3,22,16,7,23,8,19,0,20,10,13,17,15,6,11,14
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Sequence 220: 21,11,16,13,6,1,4,14,17,7,9,3,24,5,23,18,10,15,8,12,22,20,2,0,19
Sequence 221: 15,8,3,0,14,17,21,6,5,2,11,13,18,4,24,10,7,1,23,12,20,19,16,22,9
Sequence 222: 18,22,10,1,20,24,15,9,11,19,5,6,8,21,23,2,0,16,17,7,14,13,12,4,3
Sequence 223: 2,17,13,4,16,24,19,14,7,20,6,23,0,22,9,21,11,10,5,1,18,3,8,15,12
Sequence 224: 5,7,22,21,12,15,2,9,16,3,18,19,13,1,20,10,0,17,11,4,14,23,6,8,24
Sequence 225: 20,4,18,19,1,13,0,23,21,5,16,7,9,22,11,8,3,6,14,10,12,24,2,15,17
Sequence 226: 11,10,4,17,7,19,3,12,22,8,14,2,9,15,20,13,1,6,16,24,18,0,5,21,23

Sequence 227: 14,12,18,17,24,20,5,6,16,8,3,9,19,11,15,7,13,22,2,21,1,10,4,23,0
Sequence 228: 20,19,17,23,3,24,9,13,15,16,0,2,5,4,11,18,12,7,1,22,6,21,10,14,8
Sequence 229: 1,22,12,19,18,8,7,13,23,2,20,3,11,10,6,14,4,16,9,5,15,0,21,24,17
Sequence 230: 19,15,10,4,14,13,17,5,8,23,20,2,6,22,21,7,24,12,1,11,0,18,9,3,16
Sequence 231: 20,14,5,7,1,21,16,12,17,13,2,6,4,23,10,18,8,3,0,11,24,15,22,19,9
Sequence 232: 18,21,9,4,7,8,14,11,22,6,3,16,17,2,12,1,23,15,0,13,19,20,24,10,5
Sequence 233: 24,11,12,22,2,20,9,10,23,14,18,6,4,1,0,8,3,21,7,13,16,17,15,5,19
Sequence 234: 6,7,10,8,1,20,12,11,14,5,17,19,13,15,9,18,22,24,2,21,16,23,4,3,0
Sequence 235: 20,13,8,17,4,1,9,5,12,21,15,19,2,7,24,18,10,11,14,0,22,6,23,3,16
Sequence 236: 24,12,4,14,3,18,6,22,1,7,13,17,20,16,0,11,9,10,2,19,15,8,5,23,21
Sequence 237: 5,15,3,4,9,17,19,0,12,6,8,10,18,7,16,20,11,22,21,1,23,14,24,13,2
Sequence 238: 9,17,14,13,12,0,4,10,24,6,1,23,19,22,20,5,8,2,21,18,11,15,7,3,16
Sequence 239: 2,7,8,17,20,5,23,13,21,12,15,3,6,14,10,22,11,18,1,4,16,19,24,9,0
Sequence 240: 21,15,17,20,11,2,5,24,8,22,10,4,7,1,6,9,14,18,12,16,0,13,3,23,19
Sequence 241: 8,3,17,16,11,1,4,18,24,10,6,0,22,9,21,13,5,20,2,19,23,14,12,15,7
Sequence 242: 6,18,15,11,3,9,16,22,10,21,2,5,1,8,19,0,13,12,24,20,23,14,7,17,4
Sequence 243: 2,7,23,8,0,12,14,5,19,20,3,1,10,13,18,17,16,6,9,22,11,4,15,21,24
Sequence 244: 18,16,13,6,20,2,14,3,9,23,10,21,17,0,15,11,7,1,5,24,8,22,12,4,19
Sequence 245: 7,8,9,15,0,21,18,16,17,22,19,4,20,10,1,3,23,6,11,24,2,13,12,5,14
Sequence 246: 14,0,11,7,21,15,17,12,10,5,4,1,22,3,8,19,9,2,6,23,18,13,24,20,16
Sequence 247: 0,21,6,10,3,9,20,14,2,19,24,11,5,18,7,22,23,13,12,15,17,1,16,8,4
Sequence 248: 4,16,18,1,9,19,11,3,12,15,22,8,23,6,2,17,5,14,20,10,13,21,7,24,0
Sequence 249: 12,0,24,7,14,9,21,20,23,15,5,13,19,2,8,3,22,1,4,17,11,6,18,16,10
Sequence 250: 23,13,14,15,21,6,2,10,22,8,11,9,19,20,12,1,18,4,0,5,24,16,3,17,7
Sequence 251: 2,8,17,12,6,16,5,1,11,10,15,13,22,14,7,23,19,18,24,3,21,0,9,20,4
Sequence 252: 20,8,5,10,7,16,4,13,19,12,0,17,18,11,9,14,2,21,22,3,15,24,23,1,6
Sequence 253: 7,14,6,9,5,22,10,2,12,4,21,3,16,8,1,24,19,20,18,13,15,23,11,0,17
Sequence 254: 20,11,5,6,10,8,17,12,23,4,18,16,2,13,3,19,0,15,1,7,9,22,14,21,24
Sequence 255: 15,24,7,18,0,4,6,10,23,11,20,14,8,5,2,17,21,19,12,9,1,3,22,16,13

Section 15.247(b):

Peak Output Power

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (see the NOTE above regarding external attenuation and cable loss). The limit is specified in one of the subparagraphs of this Section. Submit this plot. A peak responding power meter may be used instead of a spectrum analyzer.

Measurement to be provided by ACME.

De Facto EIRP Limit

Describe how the EUT complies with the *de facto* EIRP limit for every antenna proposed for use with the EUT. This includes those devices that will be used in point-to-point applications. If the peak output power, as measured above, must be reduced so that the *de facto* EIRP limit may be met for a particular antenna, describe exactly how much it will be reduced for that antenna. If the peak output power level is raised above the limit in order to compensate for cable loss between the EUT and the antenna, specify the minimum length of cable which will always be used, the type of cable, and its loss, in dB per unit length, for the frequency of the emission. The limit is specified in one of the subparagraphs of this Section. Also, specify who will be responsible for ensuring that compliant operation is maintained for every antenna that will be used with the EUT.

The PET Repeater unit transmit power is factory-set and is not to be field adjusted. The de facto EIRP cannot be exceeded with the components provided when properly installed. Since the EIRP limit is made up of the following components: transmitter power output, coaxial cable loss, and antenna gain, the system is factory engineered to be below the limits specified. 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.

The antenna provided with the PETNET repeater subsystem is a 5DbD omni-directional. The system requires the omni-directional antenna in order to provide communication from the PET module, which is typically equally distributed around the PET Repeater as well as the PETRC and other PET Repeaters. It is not envisioned that a directional antenna will be utilized.

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 .

Point-to-Point Operation

If the EIRP relaxation for point-to-point operation is proposed for any particular antenna, describe who will be responsible for ensuring that the EUT is only used in such an application.

The PETNET system does not use point-to-point operation and provides a complete omni-directional antenna system which never exceeds the EIRP limits specified by the FCC.

RF Exposure Compliance Requirements

Spread spectrum transmitters operating under Section 15.247 are categorically excluded from routine environmental evaluation for demonstrating RF exposure compliance with respect to MPE and/or SAR limits. These devices are not exempted from compliance. As indicated in Section 15.247(b)(4), these transmitters are required to operate in a manner that ensures that exposure to the public (users and nearby persons) does not exceed the Commission's RF exposure guidelines (see Sections 1.1307, 2.1091 and 2.1093). Unless a device operates at substantially low output power levels, with a low gain antenna(s), supporting information is generally needed to establish the various potential operating configurations and exposure conditions of a transmitter and its antenna(s), in order to determine compliance with the RF exposure guidelines.

In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed: (1) calculations that estimate the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits (defined for free-space), (2) antenna installation and device operating instructions for installers (professional and/or unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirements, (3) any caution statements and/or warning labels that are necessary in order for a device to comply with the exposure limits, and (4) any other RF exposure related issues that may affect MPE compliance.

For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (defined in body tissues) for near-field exposure conditions. If the maximum average output power, operating configurations, and exposure conditions are comparable to those of existing cellular and PCS phones, an SAR evaluation may be required in order to determine if such a device complies with the SAR limit. When SAR data is not available, and the additional supporting information cannot assure compliance, the Commission may request that an SAR evaluation be performed, as provided for in Section 1.1307(d).

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:

$$P_{avr}=400mw \times 36,000/1,800= 20 \text{ mw}$$

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.

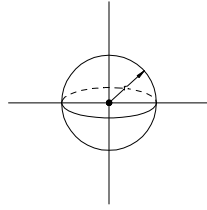


Figure 1

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:

$$A_{\text{sphere}} = 4 \times \pi \times r^2 = 4 \times \pi \times 100^2 = 125663 \text{ cm}^2$$

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

$$PD = 20\text{mw}/125663 \text{ cm}^2 = 0.1591 \text{ uw/cm}^2$$

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.

Installation/Operation Manual Requirements

Submit a copy of the information/instructions that will be included in the installation/operation manual pertaining to: (a) correct peak output power settings required for compliant operation for every antenna proposed for use with the EUT, (b) point-to-point operational requirements and responsibilities, (c) any RF exposure compliance requirements.

Itron has submitted as part of this application a complete installation manual. In addition, the PET Repeater unit transmit power is factory-set and is not to be field adjusted. The de facto EIRP cannot be exceeded with the components provided when properly installed. Since the EIRP limit is made up of the following components: transmitter power output, coaxial cable loss, and antenna gain, the system is factory engineered to be below the limits specified. 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.

Section 15.247(c):

Band-edge Compliance of RF Conducted Emissions

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW $\geq$ 1% of the span

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section. Submit this plot.

Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit. Submit this plot.

Measurement to be performed by ACME.

Spurious RF Conducted Emissions

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section. Submit these plots.

Measurement to be performed by ACME.

Spurious Radiated Emissions

This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.4-1992 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the

trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from $20\log(\text{dwell time}/100 \text{ ms})$, in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative "marker-delta" method, listed at the end of this document, may be employed.

Measurement to be performed by ACME.

Section 15.247(g):

Describe how the EUT complies with the requirement that it be designed to be capable of operating as a true frequency hopping system.

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).

Section 15.247(h):

Describe how the EUT complies with the requirement that it not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

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.