PAWA LINES

The Newsletter of
The Portland Amateur Wireless Association
P.O. Box 1605 Portland, ME 04104
March 2004

PAWA Information

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Meetings and Programs

Meetings are held the first Wednesday of each month (September through June) at 7 pm at the Stewart Morrill American Legion Post # 35 413 Broadway South Portland

Wednesday, March 3, 2004

Program: The Yankee Clipper Contest Club with K1EU and a cast of several

PAWA Repeater – 146.73 (-) (100.0 Hz)

Web site: http://www.qsl.net/pawa

UPCOMING TEST SESSIONS

Test Sessions are held at 9 am at the American Legion Post # 35 413 Broadway South Portland, ME
For further information, Contact our exam coordinator:
Bruce Howes, W1UJR at 828-0248 (w1ujr@arrl.net)

Saturday, March 20, 2004

All examinees must bring two pieces of positive ID. Additionally, licensed Amateurs must bring the original copy of their current license.

The PAWA Lines is published monthly (excepting the months of July and August). All submissions for publication must be received not later than one week to the first day of the month of publication. Submissions may be made in writing or by e-mail to the editor.

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In This Issue

Reports, FM Corner, Hey, What's All That Noise?, 2004 Fleamarket, Special Service Club, Classes, Monthly Calendar, April Newsletter Deadline

Reports

President's Message: Not available

Secretary's Report: Not available (no Board meeting in February)

Treasurer's Report:

Beginning balance	$2739.19
Income	$ 224.00
Expenses	$ 11.79
Ending balance	$2951.40

Chief Op's Report: Not available

FM Corner

What Radio to Buy?

No, this is not an article recommending this or that radio. It is rather an article on what FM bands are most active and what FM bands are sparsely populated. It may help you to decide what radio you want to purchase.

Firstly, we are talking about 6 bands used primarily for FM operations; the upper end of 10 meters (FM in 29.5 – 29.7 MHz), 6 meters (50 – 54 MHz, FM in 50.12 – 54.0 MHz), 2 meters (144 – 148 MHz FM in 144.6 – 148.0 MHz), 1¼ meters (222 – 225 MHz, FM in 222.15 – 225.0 MHz), 70 centimeters (420 – 450 MHz, FM in 440.0 – 450.0 MHz) and 23 centimeters (1240 – 1300 MHz, FM in 1270 – 1294.5 MHz). Of course, there is other activity on each of these bands, but FM seems to dominate. 10 meters is propagated mainly by skywave. Ground wave communications is used, but very seldom. It is possible to make long distance FM contacts during the high side of the sunspot cycle and during periods of sporadic E propagation. There are some 10 meter repeaters around the country, but they are rare in Northern New England. 6 meters is really a transition band between the HF and VHF regions. It's often called the "magic band" for when 6 meters is open, one can commonly make long distance contacts easily. It is not unusual to make FM simplex contacts all along the East Coast and into the Midwest when the band is open. 6 meters can propagate in a number of ways; through normal skywave propagation at the high end of the sunspot cycle, via sporadic E propagation, via tropospheric ducting during certain weather conditions and by auroral propagation. There are not a lot of 6 meter repeaters in Northern New England. Many contacts are made on simplex. 2 meters is the most popular of the VHF bands. FM repeaters abound and simplex contacts are common for short range communications. Propagation on 2 meters is usually by tropospheric ducting, auroral propagation, satellite and even meteor scatter. 1 ¼ meters is a transition band between VHF and UHF. It displays the propagation characteristics of 2 meters and some characteristics of the UHF region. Propagation is usually via tropospheric ducting, auroral propagation and meteor scatter. 70 centimeters is in the UHF range. Long range propagation is rare and usually occurs via rare tropospheric openings and via satellite. 23 centimeters is commonly line of sight communications. Propagation usually only occurs via satellite.

Now, let's talk about Maine and Northern New England and FM and repeaters in the VHF/UHF bands.

10 meters is pretty sparse when it comes to repeaters in Northern New England. There are only two 10 meter repeaters listed in the ARRL Repeater Directory (Connecticut and Massachusetts). FM users are few and far between. Plan on doing a lot of simplex work when the band is open and very little local FM work on 10 meter FM.

6 meters is a bit more populated on FM. There are a total of 5 FM repeaters in Maine. Overall, they are pretty sparsely populated. I've noticed about a dozen or less users on each repeater. Expect to find users around during commute time (mornings and evenings). During the day and at night, contacts are pretty hard to find.

2 meters is far and away the most populated band for FM. Repeaters abound throughout the state of Maine. Some repeaters are stand alone and some are linked. Some are more local in their coverage and some have wide area coverage. The busiest time for 2 meter repeaters is during commute times, but you can usually scare up a contact most any time of the day or night.

1¼ meters has sporadic coverage in Maine. Because 1¼ meters is only an Amateur band in North and South America, equipment is not all that plentiful. Where there is a repeater, there are usually users. Get too far from a repeater and the users drop off. There are 7 1¼ meter repeaters in Maine. Busiest during commute time, a contact can occasionally be found during the day and evening.

70 centimeters, although there are 16 repeaters in Maine, is quite sparsely populated. Some 70 centimeter repeaters are linked to 2 meter repeaters, others are stand alone. The best bet for a contact is during the commute times. Contacts are pretty sparse during the day and at night.

23 centimeters is what could be called a "vast wasteland" for FM. There is only one repeater in Maine (Brunswick) and there are few users. I would say that there are perhaps less

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than a dozen users in the state. If you're planing on operating on 23 centimeters FM, plan on short distance contacts and simplex and darned few of those.

My recommendations on buying a new (or that first) rig: If you are looking for lots of FM contacts and plenty of repeaters, stick with 2 meters. A dual band radio (such as 2 meters/70 centimeters) is a good choice as well and lets you explore a UHF band. It's also good if you are planning to join an emergency communications group as it gives you another band to operate on during a disaster or emergency. If you're looking to explore a large number of FM bands, I might recommend looking into a multiband rig such as the Yaesu FT-8900 (10, 6, 2 meter and 70 centimeters), but don't expect a great deal of activity on anything but 2 meters. If you happen to have one of those jobs that takes you out of state a lot, you might look into a multiband rig for around most major population centers have many varied repeaters on the FM bands.

73, Bryce, K1GAX

Hey, What's All That Noise?

You're driving in almost any urban area of the country. You have your two meter rig tuned to the local repeater. As you traverse the urban zone, your rig spits out any amount of beeps, bleeps, screeches, unidentified voices and noise. What's wrong with my rig, you ask. In asking more experienced hams, they explain it away as "intermod" (intermodulation distortion or IMD). But is it more? Read on to discover "the rest of the story".

There was a time when VHF was a "vast wasteland". Some older hams remember this. Interference was unlikely as most stations inhabiting the VHF regions were few and far between. Most communications now associated with VHF was done in the upper reaches of HF.

VHF users today know the days of a quiet VHF region are gone forever. Literally thousands of transmitters operate above 50 MHz for business, public service, amateur and many other uses. Add to that countless unlicensed transmitters operating under FCC Part 15 and other sources of interference such as cable channels leaking into the region (such as a cable channel operating on 145.27) and it is likely that some of these radio and other systems will interact in less than desirable ways.

What Is Intermod?

Hams sometimes use the term intermod incorrectly. While intermodulation of two or more signals causes some VHF interference problems, other problems, such as front-end overload, poor IF (intermediate frequency) image rejection or IF leakage are sometimes the real culprits. Hams tend to call them all "intermod," which complicates the explanation a bit.

If everything were perfect, every amplifier would amplify signals without distortion, every mixer would convert RF signals to the IF perfectly, and a radio would hear only the desired signal. In the real world, however, all of these processes are nonlinear to some degree. This results in the creation of interference.

What does "nonlinear" mean? It means that the output voltage does not follow the input voltage perfectly. Nonlinear circuits can generate harmonics and mix signal frequencies. The RF amplifier or mixer circuits in a receiver can be somewhat nonlinear, creating additional signals from the desired signal--and perhaps others--present at the nonlinear stage.

Harmonics

When a single frequency (the *fundamental)* passes through a nonlinear circuit, distortion signals appear at integer multiples of the fundamental frequency (*harmonics*). We identify each harmonic by its relation to the fundamental: The second harmonic is at two times the original frequency, the third at three times the frequency, and so forth. We use frequency multiplier circuits to produce only desired harmonics. Unwanted harmonics can cause interference wherever they occur, ranging from HF-transmitter harmonics that interfere with a TV, to a 49-MHz transmitter's third harmonic that interferes with a 147-MHz 2-meter station ($49 \times 3 = 147$).

Mixers

By design, mixers are nonlinear devices. In a typical mixer used in a superheterodyne receiver, a desired signal mixes with that from a local oscillator (LO) to produce sum and difference signals. The IF circuitry selects and amplifies either the sum or difference signal. In older radios, the IF is usually the difference frequency. Modern radios, some of which use multiple conversions, sometimes use the sum frequency.

IMD, however, is a mixing process gone bad--a form of distortion. Whenever two or more signals are present in a nonlinear circuit at the same time, IMD creates new, unwanted frequencies from them.

The relationships between the two signals and the resultant distortion products can be quite complex. (We'll work with only two inputs, f1 and f2, to simplify our discussion.) Signals and their harmonics can mix together to form still more new frequencies. Any signals created in the circuit can then mix with each other and the original signals to form a complex spectrum, indeed.
The strongest IMD products are those that involve the sum and difference of the input frequencies, the harmonics of the input frequencies, and the mixing of the harmonics with each of the original input frequencies (harmonic mixing). There are higher-order mixing relationships, but they're more complicated than we want to discuss here.

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We often use the term order to describe a group of IMD products. Because IMD results from combining frequencies, we can identify each IMD product with an equation describing the sums and differences of the various signals involved. For example, f1 + f2, 2f1 - f2 and 3f2 - 2f1 are three such equations. An IMD product's order is the sum of the coefficients (in the term 2f1, 2 is f1's coefficient) of the terms in the equation. Remember that, even though you don't see it, a term like "f1" has a coefficient of 1.

IMD is more complex than simple sum and difference second-order relationships. A nonlinear circuit creates harmonics of *all* input signals, and those harmonics mix with all of the fundamental signals plus those created by the nonlinearity. Third-order IMD between paging systems causes much of the IMD problems that plague VHF operators.

The second harmonic of f1 or f2 can mix with the other fundamental to form a product. These products are especially important because they are low-order products, and therefore relatively strong. Also, when f1 and f2 are relatively close in frequency, these products are close to f1 and f2. These equations characterize third-order products:
2f1 - f2 (Eq 1)
2f2 - f1 (Eq 2)
2f1 + f2 (Eq 3)
2f2 + f1 (Eq 4)

The first two are probably the most important to the VHF operator because the frequencies involved are so close to the desired frequency. For example, a pager on 153.75 MHz (f1) can mix with a 160-MHz (f2) signal to produce an interfering signal ($2 \times 153.75 - 160 = 147.5$) on the 2-meter band, according to Eq 1. Some of these frequencies are assigned to paging transmitters, which are very common in urban areas.

IF Response and Image Rejection

IMD is only one of the mechanisms that can create interference. Poor IF response and poor image rejection in the VHF receiver cause some problems that operators commonly blame on intermod. All superheterodyne receivers are subject to these problems. In a superhet, a mixer circuit combines the desired signal with a local-oscillator (LO) signal. The IF then selects either the sum or difference product for further processing. The presence of unwanted signals can disturb this simple scheme.

Let’s look at a 146-MHz receiver with a 10.7-MHz IF. Ideally, a signal on 146 MHz mixes with the 156.7-MHz LO to produce a difference signal on 10.7 MHz that is identical to the original signal except for its frequency. If a signal on 167.4 MHz reaches the mixer, however, that signal also appears on 10.7 MHz (167.4 - 156.7 = 10.7).

The front-end filters of well-designed radios reject (attenuate) image signals, so that users hear images only when the unwanted signal is very strong. Inadequate front-end filters can pass image responses that are as strong as the desired response. Poor image rejection is more common in receivers designed to tune over a broad frequency range. For example, a ham H-T that also receives the NOAA weather broadcasts at 162 MHz is likely to have trouble rejecting IF-image signals at 165.4 to 169.4 MHz because the images lie near the receive passband.

It is also possible to have an unwanted signal leak past the front end and mixer into the IF section. Then it's processed like the desired signal and heard in the receiver's output. Even though the sizes of IF components and conductors are small compared to the wavelength of unwanted signals, the gain of modern active parts can be extremely high. As a result, IFs can respond to unwanted signals coupled through incredibly small antennas. For example, a telephone handset can pick up HF transmissions, even with a filter in the telephone cord.

All Radios Are Not Created Equal!

There are considerable differences in IMD performance among different radios. Many of these differences result from the radio design. A single-band radio that cannot receive frequencies outside that ham band usually offers good rejection of interference from nonham frequencies (such as the Radio Shack HTX-202). Some radios have tracking filters in the front end that automatically pass the frequency a user selects. Other differences in performance can result from the specific design of front- end or mixer circuits. Generally, the wider frequency receive range a radio has, the less selective it is and therefore the more susceptible it is to interference.

Band-Pass Versus Broadband Designs

Radios designed to receive only ham-band signals contain a band-pass filter in the RF stages. This filter significantly reduces out-of-band signals, such as those from pagers. Most ham-band-only equipment is fairly immune to IMD problems.

Many hams want to use their VHF equipment as general-coverage VHF receivers, however, to monitor the police, fire and aircraft bands. Although this is convenient, it usually means that these receivers have broadband front ends. A broadband front end offers little protection against many interfering signals. It may be nice to have a radio that tunes from "dc to daylight," but that convenience may come with an unwanted price: The resultant combination of harmonic distortion, poor IF-image rejection and IMD problems can make the radio unusable in some areas. Wideband HTs are especially susceptible to problems with the proper rejection of unwanted signals. As they shrink in size, there is less room for the filtering to reject unwanted signals.

Some receiver designs combine the best of both worlds: Track-

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ing front ends automatically tune the RF stage to pass the desired frequency. Thus, when you use the receiver on 146 MHz, the front-end filter passes 146 MHz and offers some rejection to paging signals near 152 MHz, for example.

The bottom line is to do your research in selecting a new radio. Look a product reviews and their tests of the rejection characteristics of unwanted signals. The ARRL tests for these in the review of a new radio.

External Filters

External filters can significantly improve the IMD performance of existing radios. These filters are usually either band-pass or band-reject (notch) designs. Several companies sell filters designed to solve IMD problems.

Band-Pass Designs and Notch Filters

Band-pass filters do just what the name implies--they pass a band of frequencies and attenuate all others. A well-designed filter can exhibit less than 1 dB of loss inside the passband and up to 60 dB or more attenuation outside the passband. Digital Communications Incorporated (DCI) manufacturers an excellent bandpass filter. This filter would make an excellent IMD filter for a base station. For mobile use, PAR Electronics manufacturers a good band-reject (notch) filter that is rather compact and fits well into most mobile installations. The DCI bandpass filter is much too large to use with a H-T, however. PAR also makes a band-reject (notch) filter suitable for HTs.

Attenuation

In some cases, a simple attenuator can help reduce IMD problems. Third-order IMD has an unusual property: When you reduce the level of a signal causing a third-order product by 1 dB, you reduce the third-order product by 3 dB. In cases where the desired signal fully quiets the receiver and yet is masked by IMD, a 10-dB attenuator placed between the receiver and antenna reduces the desired signal by 10 dB and the IMD by 30 dB! In many cases, a 10-dB reduction of the desired signal won't matter, but a 30-dB reduction of the IMD product makes the contact possible.

A directional antenna, such as a Yagi, is an "attenuator" solution to IMD problems that is sometimes overlooked. This solution is useful when the IMD source and desired signal come from different directions. Orient the antenna for either maximum desired-signal strength or minimum IMD.

External IMD

So far, I've discussed only IMD that occurs in an overloaded receiver. In rare cases, IMD can happen outside of the receiving system. Although a repeater receiver is prone to the same IMD problems as any other receiver, the repeater duplexer usually offers some protection from overload. (However, it may not be enough for pagers located on the same site!) Because of this protection, IMD to repeater systems sometimes comes from sources external to the receiver. Any nonlinear system or device can act as a mixer, generating harmonics and IMD. Once IMD is generated, any significant conductor connected to the nonlinear device will act as an antenna and radiate the signals, perhaps over a large area.

When talking about external IMD, most hams immediately think of the "rusty-bolt effect." Any poor electrical joint between two conductors can act as a diode mixer, so many hams blame rusty towers, gutters and downspouts for external IMD. In reality, this is rarely the case. Look for external IMD very close to one or both of the transmitters and then very close to the receiver. Locate external problems with direction-finding techniques.

One or more transmitters at a site can be the source of the problem. Strong signals from the antenna can mix in a transmitter output circuit, then be radiated from the antenna. Transmission-line stubs or additional filter cavities can reduce the unwanted signals.

In summary, IMD or “intermod” may not be the only source of noise and interference in our modern world. There are many factors involved. Our job, to quiet the problem, is to make sure our equipment is not part of the problem affecting our own receivers. Careful shopping and the addition of external filtering will help.

2004 Greater Portland Electronics Fleamarket

Mark your calendars for Saturday, April 17, 2004! The Greater Portland Electronics Fleamarket will be happening again this year from 8 a.m. until 12:00 noon at the Stewart P. Morrill American Legion Post #35, 413 Broadway South Portland.

Admission: $5.00 per person from 8 until 10 a.m., $3.00 after 10, and free after 11:30 a.m.
Children admitted free of charge (when accompanied by an adult)!

A multitude of electronic devices for sale. Not just ham gear, but all manner of electronic treasures and trash!

Tables and limited outdoor tailgate spaces available to display your items for sale. Tables are $8.00 in advance and $10.00 on the day of the day of event. Outdoor tailgating is just $5.00 (limited spaces).

Don’t have enough stuff for a whole table? Leave it at the “Country Store” (consignment table) and we will sell it for you!

Our commercial vendors include Kits ‘N Pieces and HR Distributors

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Demonstrations of a Vintage AM Station and other displays. Forums at 9 and 10 AM in the meeting room. ARRL Amateur Radio Test Session at 10:00 a.m. Door prizes and a 50/50 raffle drawn at Noon and, of course, food by the Stewart Morrill American Legion Post #35.

For more information, including map and directions, please visit our club web site at http://www.qsl.net/pawa. To reserve tables or display spaces, contact k1gax@juno.com or call Bryce, K1GAX at (207) 799-1116.

We are, as in the past, looking for volunteers to help at the Fleamarket. We need folks for setup at 6:00 AM Saturday, folks to staff the ticket table and Country Store as well as someone to run the 50/50 raffle. In addition, we need ARRL volunteer examiners for the test session. To volunteer, contact Bryce, K1GAX by e-mail to k1gax@juno.com or call (207) 799-1116. All volunteers get free admission and one door prize ticket.

PAWA Appointed As An ARRL Special Service Club

As of this month, the PAWA has been appointed as an ARRL Special Service Club (SSC). We had been a SSC from 1994 to 1998 but had not renewed our status with the ARRL. We have regained our status this month. Just what is an ARRL Special Service Club? Read how the ARRL defines it.

"Truly special Amateur Radio clubs are well balanced in their programs for serving the community, developing club members' Amateur Radio skills and social activities, striving each year to build on their successes to improve their effectiveness. The objective of the ARRL's Special Service Club program is to help good clubs organize and focus their efforts on those things that really count. Being an SSC should mean that members have certain skills, that the club as a group has the ability to improve service inside and outside the Amateur Radio community, and that it does so when needed."

To be accepted under the ARRL SSC program, the PAWA had to be actively involved in each of the following areas.

New Ham Development and Training

Purpose: Develop an effective, coordinated program of public relations, recruiting, training and ongoing assistance targeted to prospective and newly licensed hams in your community.

Public Relations

Purpose: Establish an effective Amateur Radio presence in your community, including contact with local media and coverage of your activities; Public Information Officer appointment.

Emergency Communications

Purpose: Club members should become skilled in communicating effectively during communications emergencies and be prepared to assist when needed; Official Emergency Station appointment and participation in ARES.

Technical Advancement

Purpose: Continuing education in the technical aspects of Amateur Radio to ensure that your club members are technically competent, familiar and comfortable with modern radio-electronics technology; Technical Specialist appointment.

Operating Activities

Purpose: Active participation as a club in one or more major operating or operating support activities to ensure that your club maintains a high level of operating skill.

Miscellaneous Activities

Purpose: Every active club has its special interests and activities that make it unique, that give it special personality. List three of these activities.

The PAWA has met or exceeded the requirements in all of these areas! It is indeed an honor to be appointed as a SSC. It proves that we, as a club, go the extra mile, above and beyond the average ARRL affiliated club.

Upcoming Technician Class Course

There is an entry level No Code Technician class scheduled beginning Thursday, April 1, 2004 and ending Thursday, May 13, 2004. The class will be held weekly. The class hours are from 6 to 8 PM at the Stewart Morrill American Legion Post #35, 413 Broadway in South Portland.

The text for the class is the ARRL's "Now You're Talking, 5th Edition" available from the American Radio Relay League (http://www.arrl.org).

If you know of anyone who is interested in amateur radio licensing, please let them know about this class.

To register or for more information, contact Bryce, K1GAX (k1gax@juno.com) or call (207) 799-1116.

Monthly Calendar

March 3 – PAWA monthly meeting
March 7 – Informal Breakfast – between 7:30 and 8 AM - Steve & Renee's Diner, 500 Washington Ave., Portland
March 14 - Informal Breakfast – between 7:30 and 8 AM - Steve & Renee's Diner, 500 Washington Ave., Portland

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March 18 – Radio Recess – 7 – 8:30 PM at the Legion Post
March 20 – VE Testing – 9 AM at the Legion Post
March 21 - Informal Breakfast – between 7:30 and 8 AM - Steve & Renee's Diner, 500 Washington Ave., Portland
March 27 – Newsletter inputs due for March issue of the PAWA Lines
March 26-27 – Maine Section ARRL Convention and Andy Hamfest, Ramada Inn, Lewiston.

March 28 - Informal Breakfast – between 7:30 and 8 AM - Steve & Renee's Diner, 500 Washington Ave., Portland

April Newsletter Deadline

The deadline for the March issue of the PAWA Lines is Saturday, March 27, 2004. Inputs should be e-mailed to Bryce, K1GAX (k1gax@juno.com)