

# Squelch Tales



Newsletter from the Merrymeeting Amateur Radio Assoc. for December 2006

## KS1R No.1 in 2F New England

By Steve Kercel, AA4AK  
MARA Field Day Coordinator

The scores for Field Day 2006 have been published. For class 2F stations (two transmitters, operating from an EOC) we blew out the field in the New England Division.

Class 2F Results for New England are as follows:

Call	Score	QSOs
KS1R	3346	640
W1EDM	1744	363
W1PD	1688	447
W1KOO	1396	453
N1EM	422	126

We did almost twice as well as our nearest competitor.

On the national scale, we also had a quite respectable performance. Across the entire ARRL/RAC field organization there were 64 class 2F entries, and we were 12<sup>th</sup>, easily in the top 20%. Even more remarkably, the entire contest had 2184 entries, and we were 483rd, well within the top 25% of all competitors, irrespective

of number of transmitters or transmitting power.

This was an outstanding performance for our first attempt at 2F operation, and once again I thank the many members and friends of MARA who made it possible. For 2007 Field Day, breaking into the top 10 for class 2F nationwide is easily within our reach. I hope to see everybody there next June.



MID COAST

## MARA & Mid Coast ARES participates in November SET

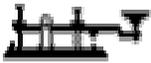
The 2006 ARES Simulated Emergency Test (SET) got underway at 8:00 AM on November 4<sup>th</sup>. The dedicated group of Mid Coast ARES volunteers

from the Red Cross building in Topsham, Sagadahoc County Courthouse in Bath, Phippsburg Fire station and from their homes jumped in to help relay messages and provide simulated situation reports.

MARA's two KS1R repeaters were employed with John Goran (K1JJS) acting as net control for the Mid Coast effort. John (KC6TVF), Michele (KC7LIF), Marjorie (KB1MRZ) and Lee (N1HOC) manned the VHF and UHF radios while Steve (AA4AK) manned the HF net at Red Cross HQ. Brian (AA1WI) checked in from his QTH in Brunswick and Sagadahoc EC Alan (WA1SCS) provided hourly situation report messages from the Phippsburg Fire Station. Bruce (W1ZE) fired up from home and simulated a set-up at Sagadahoc County EMA at the courthouse in Bath.

Two MARA members who live in Lincoln County, John (K2LOT) and Lincoln County EC Al (N1HNC) participated in the SET from their QTHs in Lincoln County.

Both groups did a professional job and they should be proud of their efforts....Well done ARES Team!



## NEWS FROM NEWINGTON



### LEAGUE SEEKS FCC'S WRC-07 SUPPORT FOR 150-KHZ 60-METER AMATEUR ALLOCATION

The ARRL wants the FCC to throw its support behind a Draft Proposal seeking to have World Radio communication Conference 2007 (WRC-07) delegates consider a worldwide, secondary Amateur Radio allocation from 5260 kHz to 5410 kHz. The ARRL included the request in comments

<http://www.arrl.org/announce/regulatory/WRC07/WRC-07-Comments-10-27-06.pdf> it filed October 27 in IB Docket 04-286, Recommendations approved by the Advisory Committee for the 2007 World Radio communication Conference." WRC-07 Agenda Item 1.13 will review allocations to all services between 4 and 10 MHz. The League told the FCC that a contiguous band of frequencies in the range of 5 MHz is an important goal of the amateur community - domestically & internationally.

"There are times when the propagation at 5 MHz bridges a significant gap between the Maximum Usable Frequency (MUF) when the MUF is below 7 MHz, but the Lowest Usable Frequency (LUF) is above the next lower Amateur Radio allocation at around 3.8 MHz," the League said, citing the Draft Proposal. "For reliable communications, an Amateur allocation in the vicinity of 5 MHz is the solution."

Originating with ARRL, the Draft Proposal from Informal Working Group 4 (IWG-4) follows up on disaster relief-related changes to Article 25 of the international Radio Regulations made at WRC-03.

"The amateur services provide emergency communications on a local, national and international basis as an adjunct to normal communications, and in many cases provide the first information about disasters and serve as the only communications link when communications infrastructures are destroyed," the IWG-4 Draft Proposal background information notes.

Several countries -- including the US, Canada, Finland, Iceland, Norway and the UK -- already have permitted Amateur Radio operation on spectrum between 5250 and 5450 kHz, the ARRL said, citing the Draft Proposal. "It notes that there is a successful history of amateur secondary use of bands in which incumbent primary users are present," the ARRL said, mentioning 30 meters as one example. The ARRL said the five 60-meter

channels have been in regular use by US radio amateurs since 2003 "without any instances of interference reported by primary users."

The League took issue with remarks contained in the ITU Conference Preparatory Meeting (CPM) draft report with respect to Agenda Item 1.13 that suggest otherwise. Among "disadvantages," the Draft CPM Report asserts, an allocation such as the League suggests "would increase congestion and potential interference to fixed and mobile services at 5 MHz." It argues that compatibility between amateur and fixed service systems in the vicinity of 5 MHz "has not been shown" and a decision to create an Amateur Service allocation there "could seriously affect reliable 24 hours [sic] communication capabilities of the fixed and mobile services." The Draft CPM Report also takes note of the advantages to the Amateur Service of such an allocation.

The proposed allocation is "well within the scope of existing resolutions from WRC-03," the League said. It reiterated that amateur use of the five current 60-meter channels "has not resulted in any apparent compromise in the use of the band" on the part of primary Fixed and Mobile services. "To the contrary, that use has demonstrated compatibility with primary users over a reasonable period of time," the ARRL said.

The ARRL's request in its IB Docket 04-286 comments is unrelated to the League's

October 10 Petition for Rule Making

[www.arrl.org/announce/regulatory/5MHz/5-MHz-Improvement-Petition-09-2006.pdf](http://www.arrl.org/announce/regulatory/5MHz/5-MHz-Improvement-Petition-09-2006.pdf), in which the ARRL asked the FCC to expand operating privileges on 60 meters and to swap one existing channel for a new one.

While the National Telecommunications and Information Administration (NTIA) has indicated its okay with the ARRL's October 10 petition request, it also said it could not support a request for a 50 kHz-wide domestic secondary allocation. The NTIA oversees spectrum allocated to federal government users, which includes the present 60 meter allocation.

Both the FCC and the NTIA provide input toward positions the US delegation ultimately will take on various WRC-07 issues. Should WRC-07 delegates eventually consider and agree to the international allocation at 5 MHz that ARRL proposes it still would be up to the FCC -- in conjunction with the NTIA -- whether to authorize such a band for US radio amateurs.



## Is digital voice (D-STAR) the wave of the future?

By Bruce Randall, W1ZE

The answer to that question is, maybe.

In the late 1950s and early 60s the predominate mode for

voice communications on all the ham bands was Amplitude Modulation (AM). During the mid 50s, the military was starting to use a suppressed carrier mode called Single Sideband (SSB) because it took up less bandwidth and the power in power from the unused carrier and opposite sideband could be put into just one sideband. In the late 50 only a few ham equipment manufacturers companies offered equipment generated SSB. B&W, Collins and a few others were in that small mix. In the early 60s, Collins, World Radio Labs (WRL), Swan, Heathkit and SBE were about the only equipment manufactures making SSB equipment for the ham radio market. By the mid 60s Hallicrafters, Drake and several others started making transmitters and transceivers designed for SSB operation. Most all were built for HF.

The bands above 50 MHz still used AM as the predominant voice mode until the late 60. About that time, used commercial VHF and UHF 2-way FM radios started appearing on the surplus market. They were easily

converted to the ham bands and the mode started to catch on.

The Ham equipment makers, noting the increased popularity of FM on the 2-meter band, started marketing plug-n-play 2-meter rigs. By the mid 70s FM was the predominate voice mode on the 146 and 440 MHz bands. It has stayed that way until the present day.

If you have been reading the ads in Q-street and other ham magazines you will see that Icom and soon Kenwood are offering transceivers with digital voice mode called D-STAR for the 144 to 1296 MHz bands. This mode was developed by the Japanese ham radio companies.

In the population zones on both coasts, D-STAR is starting to see increased activity. There are digital repeaters going up across the country. Most are on the 440 and 1280 MHz bands with backbone links on 10 GHz. Because two meter is so populated with FM repeaters there is little room for D-STAR type repeaters in that band in most parts of the country unless they

convert from FM to digital-voice. There are few 2-meter D-STAR repeaters here and there.

In early November, Donnie Dauphin (WD1F) and Bill Messier (K1MNW) purchased new dual-band Icom HTs that operates in both FM and digital (D-STAR) modes. They have found simplex D-STAR digital voice communications to be very reliable and noise free. They also found that the little hand held transceivers will do a lot of additional interesting things, such as:

The rigs digitally self identify and the received station will see the call sign of the transmitting station on the receiving transceivers LCD display. When hooked up to a PC, the transceivers will do text messaging like 1200-baud RTTY or ASCII. You can connect your GPS to the HT and it will send out the Latitude and Longitude coordinates that also appear on the display of the receiving station (simple APRS). It even has a voice answering capabilities. You may want to take a break from the radio but you know that a friend or friends with D-STAR

may want to contact you. You can set-up your transceiver to do automatic voice answer to an incoming D-Star signal those records into memory something like, "This is *WA1XYZ*. I'm away from my rig; I'll be back after six PM."

With all these features it has Bill and Donnie talking about a digital (D-STAR) 440 MHz repeater on Oak Hill.

It didn't take "*Bill on the Hill*" long to connect two commercial UHF transceivers together and build up a basic repeater. The coupling was easy. Bill took the digital square-wave signal in the receiver and connects it to the FM modulator in the transmitter. He was pleased to note that the digital signals passed through the repeater with ease. He lashed-up a simple carrier operated relay (COR) circuit and the simple repeater package was ready to move into the ham 440 MHz ham band.

Conversations between Donnie, Bill and Bruce (W1ZE Trustee) a review of available repeater frequency pairs in the 440 band had them select 447.575/442.525

MHz. Bruce will start the frequency coordination process with New England Spectrum Management Council.

Bill and Donnie plan to have a show and tell demo at the MARA's November meeting.

Here are some web-sites with info on D-Star and digital modes:

- <http://www.arrl.org/news/stories/2005/12/14/1/?nc=1>
- <http://members.cox.net/d-star/links.htm>
- <http://www.arrl.org/FandES/field/regulations/teacher/D-STAR.pdf>
- <http://www.arrl.org/tis/info/pdf/dstar.pdf>

Now I am not telling you to quickly sell you FM equipment because it is a dying mode. FM voice will be with us for many years to come, but you should expect to see a slow increase in digital voice on the VHF and UHF over the next ten plus years as more digital equipment becomes available and hams find out the versatility of the new mode.

In time, I expect that digital voice will be the predominate voice mode on the bands above 144 MHz. **73, W1ZE**



*You are invited  
to the MARA Year  
End Holidays  
Buffet Dinner on  
Saturday, December  
9<sup>th</sup>, 7:00 PM at the  
China Rose  
On Old Bath Road  
in Brunswick,  
Bring the better  
half, the kids or a  
friend.  
See'ya There!*



**Minutes of the October  
MARA meeting**

**Introductions:**

15 in attendance

**Treasurer's report:**

Bob Watson (N1GWE) reports he is moving and is looking for a replacement for treasurer. Shane was nominated but due to his age and dependence on his father for rides other nominations were sought out. Marjorie Turner

KB1MRZ was nominated, accepted the nomination and was voted in.

**New Business:**

Brian mentioned BOD re-elections were coming due soon and one replacement was needed. Brian nominated Steve Kercel AA4AK and he accepted. A vote was taken and Steve is now an acting board member.

**Last meeting minutes:**

Brian read notes from last meeting.

- There is a need to start and run the Generator at the Red Cross.
- RED 3 is postponed
- EOS2 has not been found.
- Fox hunt
- ARES ID cards were mentioned
- Touch tone access for the repeater.
- How we contact ARES members when they are needed.
- Light house weekend.

**Activities:**

- Lee (N1HOC) Activities person mentioned that events were quite a while out and we had lots of time to discuss.
- Brian suggested we arrange for our Christmas party. Do we want to go to the same location again? (China rose in Brunswick). Brian suggested December 9<sup>th</sup> for the Xmas party. China rose was selected as the location once again. Lee

has to check but the party will likely be on December 9<sup>th</sup>.

- Sagadahoc ARES -

There is a meeting on the SET Monday 9AM Monday the 30<sup>th</sup>. During the SET we are set up with the two Red Cross Brunswick and Portland buildings that can not communicate directly to use Hams to deliver traffic between buildings. The SET is on the 4<sup>th</sup> of November and Michelle has requested someone who can attend exercise the generator.

- Red Cross could see some changes coming down the line. There will be a new president soon. Red Cross should soon be getting a 47 MHz radio (Red Cross frequency)
- Steve AA4AK is still researching and setting up for the Popham Colony special event station. He is looking to get a 1X1 Call sign. They are looking for N1P but will take W1P.

**Old business:**

We discussed the Exercise - K1JJS presented some reports from the exercise. Several different issues were brought up. Intermod was the first. The disaster location was plagued by intermod because of multiple different fairly high power transmitters. When the EMA director requested the dispatch of radio operators we showed up without ID's. The hams were initially denied access to the site and then let in.

The ICP was not notified that hams were coming.

Bruce and John were at the EOC and John was assigned as a public information officer. John prepared his notes and stuff. He found out soon that the incident was to be the public information location. John pointed out that a disaster scene was no place to be gathering the media.

The military was left in the dark. Another incident where one of the fireman in the simulation contaminated lots of people. He moved them directly to the "Hot Zone". The event was stopped and continued once the appropriate actions were taking. In the Newcastle EOC they had left some equipment on in a communications vehicle and the battery went dead. One ham radio operator set up in the hot zone and had to be decontaminated. Hams did not check in when they showed up on a site and therefore were not told where to set up and where not to set up. There was a ton of discussion on what training people are suppose to have before a situation and what is suppose to happen when they get to site. They need to be trained enough to recognize a Haz-Mat situation. The hams lack of having a ID's could be a problem in future exersizes.

Steve added the discussion was about leadership at the

exercise. We need to hear about our mistakes so we can improve. One mistake was people many forgot to add that it was a drill from time to time. This could cause problems. There was confusion as to net control was. The Directed net rules were not always followed. At times people chatted between themselves on net frequencies.

**CERT** - Wednesday November 8<sup>th</sup> 5:30 at the Cooks corner fire station there will be a preliminary meeting for all those who will be interested in being there for the training.

Brian would like to make the CERT a permanent agenda listing for our meetings. It was unanimously decided that Cert would be on the agenda for future meetings.

**MOU:** Does the MARA have a Memorandum of Understanding (MOU) with the local Red Cross? We have the ARRL MOU with the Red Cross on the national level but nothing locally. We should have one and John KC6TVF has a copy of one that is being suggested for us.

**CALL SIGN:** Another note is that KS1R call sign can be used for emergency events. There is also discussion in getting a Red Cross call sign.

#### **WEB SITE:**

The web site Brian (AA1WI) suggested is being worked on. Brian is checking

with Maine Host to see if they can host it.

#### **ADJOURN:**

Brian (AA1WI) made a motion to adjourn and K2LOT brought up one last issue. The cups that Marjorie brought for the cider she brought were too small.

The meeting adjourned at 20:15PM.....



## **MARA and PAWA test sessions for 2007**

By Bryce, K1GAX  
MARA VE Liaison

### **Jan. 20,**

Sponsor: PAWA

Time: 9:00AM (walk-ins OK)

Contact: Bruce Howes, W1UJR  
(207) 749-0111 or Bryce Rumery,  
K1GAX (207) 799-1116

Email: w1ujr@arrl.net or

k1gax@juno.com

VEC: ARRL VEC

Location: Stewart Morrill  
American Legion Post #35, 413  
Broadway South Portland, ME  
04106

### **February 17**

Sponsor: MARA

Time: 10:00 AM (walk-in OK)

Contact: Bryce Rumery, K1GAX  
(207) 799-1116

Email: k1gax@juno.com

VEC: ARRL VEC

Location: Midcoast Chapter,  
American Red Cross, 16  
Community Way Topsham, ME  
04086

### **March 17**

Sponsor: PAWA

Time: 9:00 AM (walk-ins OK)

Contact: Bruce Howes, W1UJR  
(207) 749-0111 or Bryce Rumery,  
K1GAX (207) 799-1116

Email: w1ujr@arrl.net or

k1gax@juno.com

VEC: ARRL VEC

Location: Stewart Morrill  
American Legion Post #35, 413  
Broadway South Portland, ME  
04106

### **March 31**

Sponsor: MARA  
Time: 12:00 (Noon)  
Contact: Bryce Rumery, K1GAX  
(207) 799-1116  
Email: k1gax@juno.com  
VEC: ARRL VEC  
Location: Ramada Inn, 490  
Pleasant St Lewiston, ME 04240

### **April 21**

Sponsor: PAWA  
Time: 10:00 AM  
Contact: Bruce Howes, W1UJR  
(207) 749-0111 or Bryce Rumery,  
K1GAX (207) 799-1116  
VEC: ARRL VEC  
Location: Stewart Morrill  
American Legion Post #35, 413  
Broadway South Portland, ME  
04106

### **April 28**

Sponsor: MARA  
Time: 10:00 AM (walk-ins OK)  
Contact: Bryce Rumery, K1GAX  
(207) 799-1116  
Email: k1gax@juno.com  
VEC: ARRL VEC  
Location: Midcoast Chapter,  
American Red Cross, 16  
Community Way Topsham, ME  
04086

### **May 26**

Sponsor: PAWA  
Time: 9:00 AM (walk-ins OK)  
Contact: Bruce Howes, W1UJR  
(207) 749-0111 or Bryce Rumery,  
K1GAX (207) 799-1116  
Email: w1ujr@arrl.net or  
k1gax@juno.com  
VEC: ARRL VEC  
Location: Stewart Morrill  
American Legion Post #35, 413  
Broadway South Portland, ME  
04106

### **June 16**

Sponsor: MARA  
Time: 10:00 AM (walk-ins OK)  
Contact: Bryce Rumery, K1GAX  
(207) 799-1116  
Email: k1gax@juno.com  
VEC: ARRL VEC  
Location: Midcoast Chapter,  
American Red Cross, 16

Community Way Topsham, ME  
04086

### **July 7**

Sponsor: PAWA  
Time: 9:00 AM (walk-ins OK)  
Contact: Bruce Howes, W1UJR  
(207) 749-0111 or Bryce Rumery,  
K1GAX (207) 799-1116  
Email: w1ujr@arrl.net or  
k1gax@juno.com  
VEC: ARRL VEC  
Location: Stewart Morrill  
American Legion Post #35, 413  
Broadway South Portland, ME  
04106

### **August 4**

Sponsor: MARA  
Time: 10:00 AM (walk-ins OK)  
Contact: Bryce Rumery, K1GAX  
(207) 799-1116  
Email: k1gax@juno.com  
VEC: ARRL VEC  
Location: Midcoast Chapter,  
American Red Cross, 16  
Community Way Topsham, ME  
04086

### **September 15**

Sponsor: PAWA  
Time: 9:00 AM (walk-ins OK)  
Contact: Bruce Howes, W1UJR  
(207) 749-0111 or Bryce Rumery,  
K1GAX (207) 799-1116  
Email: w1ujr@arrl.net or  
k1gax@juno.com  
VEC: ARRL VEC  
Location: Stewart Morrill  
American Legion Post #35, 413  
Broadway South Portland, ME  
04106

### **October 20**

Sponsor: MARA  
Time: 10:00 AM (walk-ins OK)  
Contact: Bryce Rumery, K1GAX  
(207) 799-1116  
Email: k1gax@juno.com  
VEC: ARRL VEC  
Location: Midcoast Chapter,  
American Red Cross, 16  
Community Way Topsham, ME  
04086

### **November 17**

Sponsor: PAWA  
Time: 9:00 AM (walk-ins OK)  
Contact: Bruce Howes, W1UJR  
(207) 749-0111 or Bryce Rumery,  
K1GAX (207) 799-1116

Email: w1ujr@arrl.net or  
k1gax@juno.com  
VEC: ARRL VEC

Location: Stewart Morrill  
American Legion Post #35, 413  
Broadway South Portland, ME  
04106

### **December 15**

Sponsor: MARA  
Time: 10:00 AM (walk-ins OK)  
Contact: Bryce Rumery, K1GAX  
(207) 799-1116  
Email: k1gax@juno.com  
VEC: ARRL VEC  
Location: Midcoast Chapter,  
American Red Cross, 16  
Community Way Topsham, ME  
04086



*The MARA  
Board of  
Directors,  
Trustee and  
Newsletter  
Editor  
wishes you  
and your  
families all  
the  
Happiness  
and Joy this  
Holiday  
Season has to  
offer*

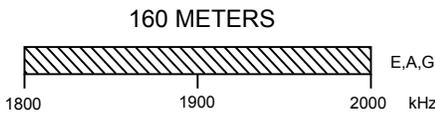
June 1, 2003

## Novice, Advanced and Technician Plus Allocations

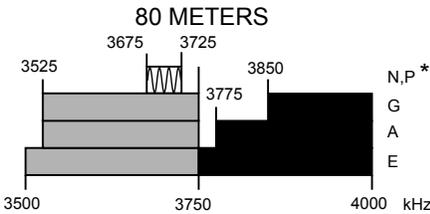
New Novice, Advanced and Technician Plus licenses are no longer being issued, but *existing* Novice, Technician Plus and Advanced class licenses are unchanged. Amateurs can continue to renew these licenses. Technicians who pass the 5 wpm Morse code exam *after* that date have Technician Plus privileges, although their license says Technician. They must retain the 5 wpm Certificate of Successful Completion of Examination (CSCE) as proof. The CSCE is valid indefinitely for operating authorization, but is valid only for 365 days for upgrade credit.

### US AMATEUR POWER LIMITS

At all times, transmitter power should be kept down to that necessary to carry out the desired communications. Power is rated in watts PEP output. Unless otherwise stated, the maximum power output is 1500 W. Power for all license classes is limited to 200 W in the 10,100-10,150 kHz band and in all Novice subbands below 28,100 kHz. Novices and Technicians are restricted to 200 W in the 28,100-28,500 kHz subbands. In addition, Novices are restricted to 25 W in the 222-225 MHz band and 5 W in the 1270-1295 MHz subband.

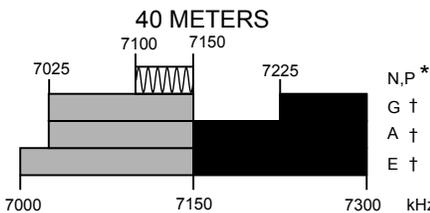


Amateur stations operating at 1900-2000 kHz must not cause harmful interference to the radiolocation service and are afforded no protection from radiolocation operations.



### 60 METERS

General, Advanced, and Amateur Extra licensees may use the following five channels on a secondary basis with a maximum effective radiated power of 50 W PEP relative to a half wave dipole. Only upper sideband suppressed carrier voice transmissions may be used. The frequencies are 5330.5, 5346.5, 5366.5, 5371.5 and 5403.5 kHz. The occupied bandwidth is limited to 2.8 kHz centered on 5332, 5348, 5368, 5373, and 5405 kHz respectively.



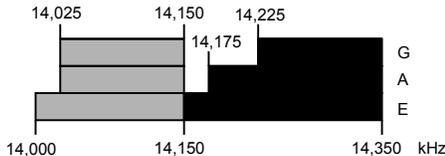
† Phone and Image modes are permitted between 7075 and 7100 kHz for FCC licensed stations in ITU Regions 1 and 3 and by FCC licensed stations in ITU Region 2 West of 130 degrees West longitude or South of 20 degrees North latitude. See Sections 97.305(c) and 97.307(f)(11). Novice and Technician Plus licensees outside ITU Region 2 may use CW only between 7050 and 7075 kHz. See Section 97.301(e). These exemptions do not apply to stations in the continental US.

### 30 METERS

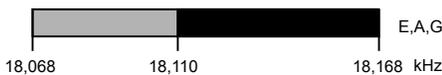


Maximum power on 30 meters is 200 watts PEP output. Amateurs must avoid interference to the fixed service outside the US.

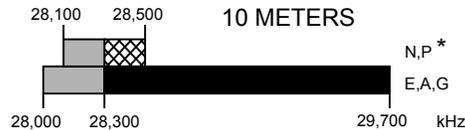
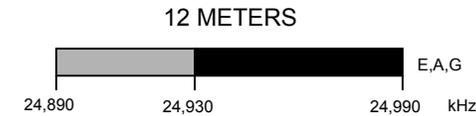
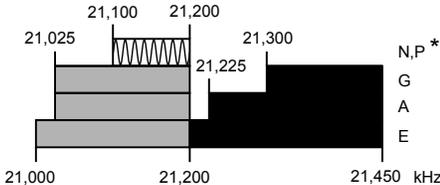
### 20 METERS



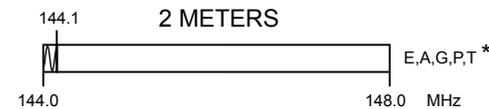
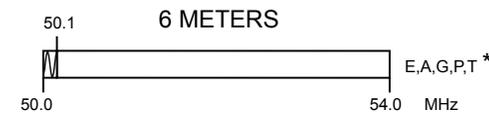
### 17 METERS



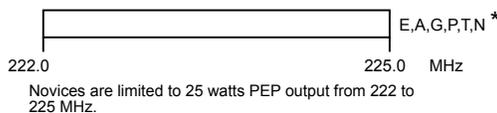
### 15 METERS



Novices and Technician Plus Licensees are limited to 200 watts PEP output on 10 meters.

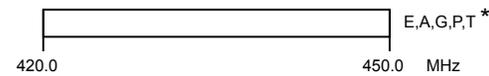


### 1.25 METERS \*\*\*

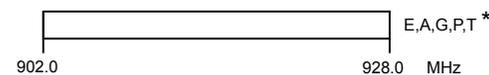


Novices are limited to 25 watts PEP output from 222 to 225 MHz.

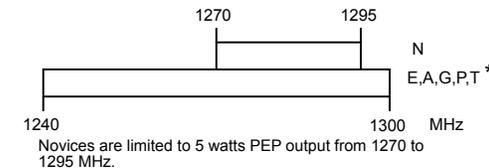
### 70 CENTIMETERS \*\*



### 33 CENTIMETERS \*\*



### 23 CENTIMETERS \*\*



Novices are limited to 5 watts PEP output from 1270 to 1295 MHz.

### KEY

- = CW, RTTY and data
- = CW, RTTY, data, MCW, test, phone and image
- = CW, phone and image
- = CW and SSB phone
- = CW, RTTY, data, phone, and image
- = CW only

- E = AMATEUR EXTRA
- A = ADVANCED
- G = GENERAL
- P = TECHNICIAN PLUS
- T = TECHNICIAN
- N = NOVICE

\* Technicians who have passed the □ 5 wpm Morse code exam are indicated as "TP".

\*\* Geographical and power restrictions apply to all bands with frequencies above 420 MHz. See *The ARRL's FCC Rule Book* for more information about your area.

\*\*\* 219-220 MHz allocated to amateurs on a secondary basis for fixed digital message forwarding systems only and can be operated by all licensees except Novices.

All licensees except Novices are authorized all modes on the following frequencies:

- 2300-2310 MHz
- 2390-2450 MHz
- 3300-3500 MHz
- 5650-5925 MHz
- 10.0-10.5 GHz
- 24.0-24.25 GHz
- 47.0-47.2 GHz
- 75.5-76.0, 77.0-81.0 GHz
- 119.98-120.02 GHz
- 142-149 GHz
- 241-250 GHz
- All above 300 GHz



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