



# *The SPARC*

**Amateur Radio - Communicating Worldwide for A Century**

*Newsletter of the Boston Amateur Radio Club*

**Serving Hams in the Greater Boston Area**

**May 2017 - VOLUME 29, NUMBER 5**

**www.barc.org - w1bos@arrl.net**



## **Get Out and Operate! – Greg Bennett, KC1CIC**



Field Day 2017 is just around the corner. For many hams this will be the first and only time they go outside of their homes to operate. Many hams will (and should) take the opportunity to check their gear ahead of Field Day. Field Day will also be the first time or only time of year some will operate a radio. To these folks I will say you are missing out on a lot of fun and experience!

Experience is the key. The more you operate the more confident you become with your equipment and your skills. When I first started checking in to nets I was very nervous, when I first started taking on NCS duties I was terrified! However, as time and nets passed that has all gone away.

Any activity that can be done indoors can be done from a picnic bench or your vehicle. It can also be done year round depending on your tolerance of the weather. You can operate QRP (low power) like a couple of members do or you can bring a full power unit out with you. For the contesters in the group the field can add to the fun and challenge. Interested in ARES work? Get out and practice in the field!

Anyone who knows me knows that I love operating with the National Traffic System (NTS). It's just what I like to do. The NTS operates daily every day of the year on many nets and in several modes. I operate almost daily on VHF and HF (Voice and CW) from home and go to the "field" almost every Saturday and do the same. The field for me is typically Ft. Revere in Hull or Wompatuck State Park in Hingham.

In the field I set up an inverted V and run the coax either to a picnic table or the Jeep depending on the weather. Using a tuner I can also use a simple length of wire known as a longwire antenna. I usually operate using the Lithium Motorcycle Battery I reviewed recently which can give me a couple of hours operating time. I can either use my full sized go-kit or just bring my portable HF rig along. *(Continued on page 2.)*

## **BARC General Meeting Thursday, May 18, 2017 at 7:30 pm**

The next BARC General Meeting will be on Thursday, May 18, 2017, at 7:30 p.m. at Brookline Police Headquarters in Brookline. Directions to this location can be found elsewhere in this issue. The topic is CW (a/k/a Morse Code), presented by Harris Pitnof, WA1GXC.

**Repeaters: 145.230 ( - ) CTCSS 88.5**

**Simplex: 147.420**

**449.175 ( - ) DMR CC1**

## *The SPARC*

Here is my typical Saturday in the field:

4:30 p.m. – Arrive and set up the antenna and the radio gear.

5:00 p.m. – Check in to the Green Mountain Net 3.399KHz. This is a voice chat net out of VT and is great for evaluating local conditions.

6:00 p.m. – Start the MA RI Phone Net (MARIPN) as NCS 3.978KHz. Any station is welcome, traffic or not.

7:00 p.m. – Check in to the MA RI CW Net (MARICW) 3.565KHz. Any station is welcome, traffic or not. Net runs at 13 to 15 wpm but will slow down if asked (QRS).

7:30 p.m. – Have a snack and or operate digital modes (JT-65, RTTY) for a couple of contacts.

8:00 p.m. – Check in to the Eastern MA Traffic net on the BARC 2m repeater.

8:30 p.m. – Break down for the night.



One of the aspects I enjoy of field operating is the number of people who come up to me wondering what I am doing, especially when putting up the antenna. Older people tend to know what ham radio is but many others have no idea it exists. It is fun explaining to them what I am doing and why. I always let the younger kids either bang on the key or say hello in to the mic.

As you can see there is a lot of experience to be gained on a single day in the field not to mention a lot of fun. You can go by yourself or as a buddy team or group. In addition to the radio aspects it is a great social event to share with friends.

You bought the gear—get out there and use it!

### **Repeater Update – Joe Harris, N1QD**

In the last issue of the SPARC, we reported on the 145.22 repeater in Goffstown NH interfering with some of the 145.23's users. The owners of 145.22 have reduced its output power by 3 dB in an effort to minimize this interference. If you were previously having issues with this interference, please contact N1QD with updated signal reports.

### **BARC's Online Discussion Group – Joe Harris, N1QD**

BARC has an online forum at Yahoo groups. The Yahoo group serves as a sounding board for members to post their suggestions and comments, and is intended to foster discussion. The group can also be used to share photographs from club events! Come visit us at: <http://groups.yahoo.com/bostonARC>.

### **May General Meeting, Thursday, May 18 – Joe Harris, N1QD**

Join BARC for the May general meeting in the community room at Brookline Police Headquarters on Thursday May 18 at 7:30 pm. Our featured speaker is Harry WA1GXC, giving a talk on the history of CW:

Know it or not, many of the procedural signs, formats, and quirky habits we hams use on-the-air come down to us from late-1800's American landline telegraph. The presentation will focus on early American

|                                 |                         |                              |
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Morse, the transition to International (“Continental”) code by radio (Why the change?), and early ship radio communications. Then on to today, and how to make learning the Code fun for newcomers.

Once upon a time, they called us “Hams”, and it wasn’t a compliment!

QTX

73, Harry WA1GXC

We will also begin our preliminary Field Day discussions. Brookline Police is located at 350 Washington St, Brookline.

## **By-the-Book Volunteering at the BAA 5K – *Brett Smith, AB1RL***

The weekend leading up to the Marathon is chock full events for runners and spectators alike. One of the most notable is the BAA 5K, a quick run along Commonwealth and Boylston Streets in Boston. As at all BAA events, amateur radio volunteers support the medical team to ensure runners finish safe and healthy.

This year we worked alongside medical teams at water stations and around the finish line and area. We also supported them at the Invitational Mile races after the 5K, running around one block crossing the Marathon finish line on Boylston Street. Fortunately good running weather and a little luck came together to make for light work, but as always, the medical team saw our preparedness and appreciated it.

Thanks to Jim Clogher, N1ICN; Bill Collins, W1PL; Douglas Maggs, KK4UHK; Colin McArdle, KB1REL; Christine McArdle, KB1REM; Jack Stevenson, KD2MAI; and Peter Sullivan, W1ABC for coming out to volunteer to make the event safe and enjoyable for everyone. Extra thanks to Brittany Collins, KB1ZPS; Scott Gaudet, KO4W; Ann Glezen, KC1CFG; John Glezen, NORUN; Nora Nagle, KB1OHB; Rick Savage, KB1LYJ; and Kathy Savage, KB1LPW for taking the time to volunteer at both the 5K and the Marathon.

## **Field Day is Next Month! – *Joe Harris, N1QD***

Field Day is approaching!

Field Day is now just a few short weeks away. We have our site confirmed; we’ll be converging on the Bare Cove Fire Museum on the fourth full weekend of June. Aside from that, not much is set in stone yet. How many stations to set up? What antennas to use? Let’s take some time to think about what worked (and what didn’t work) in the past. Are there any changes you’d like to see?

BARC will hold an initial planning session at the May general meeting, and finish up planning at the June general meeting. See you there!

## **Preparedness Pays Off at the 2017 Boston Marathon – *Brett Smith, AB1RL***

I assume the Boston Marathon needs no introduction. It’s the premier public service event for amateur radio in the New England area, and even draws in volunteers from outside 1-land. The communications plan we worked on together with the BAA and other communications staff in 2015 continued to serve us well, and in the planning for 2017 our organizing focus primarily looked for ways to further refine its execution.

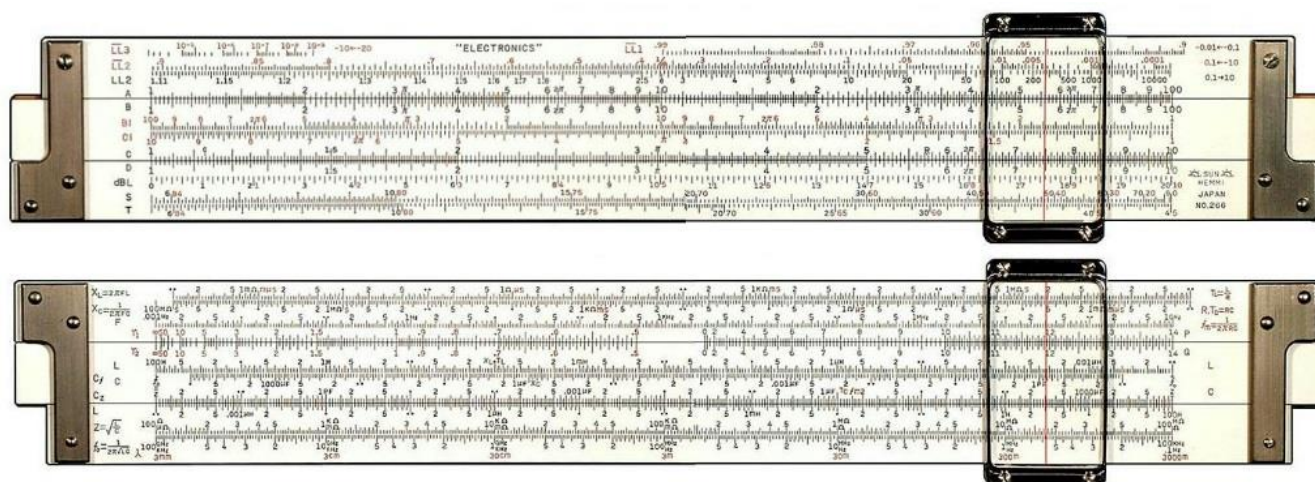
Leading up to Marathon Monday, we were bracing ourselves for a busy day. Forecast temperatures kept ticking up. It wasn’t going to reach the highs of 2012, but it was looking to put strain on medical services and all the communications teams that work with them. Fortunately, conditions on the day didn’t turn out quite as bad as we feared. There was still an observable uptick in runners requesting medical assistance, but our planning combined with a great volunteer team meant we could handle all the issues without breaking a sweat ourselves.

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Almost 300 amateur radio volunteers work at the Marathon every year—too many to list here. But the work wouldn't get done without the help of each and every volunteer who shows up on the day. My thanks to all of you for another successful Marathon.



Sun Hemmi 266 Electronics slide rule (see text below).

## Old-School Calculations – Joe Chapman, NV1W

I entered college in the final year of the slide rule era, so this will be an exercise in nostalgia for BARC members who are older than I am and yet another rambling Quarter-Century Wireless Association–style saga of the old days for those who are younger.

For those who have never seen one, a slide rule is a crude analog calculator that was responsible for most of the great engineering marvels of the twentieth century, including major bridges and buildings, the Interstate Highway system, the Mercury and Apollo spacecraft, as well as the slide rule's successors, the calculator and computer. The principle behind the slide rule is that you can multiply and divide by adding and subtracting logarithms, so if you add distances along a pair of sticks ruled with a logarithmic scale, you can read products off the scales.

The standard-sized slide rules were about ten inches long, with a center part that slid back and forth and a cursor with a hairline. Some scales were ruled backwards, so they'd divide instead of multiply; others might be "folded" at a constant like  $\pi$  or  $\log(0.5)$  so you could use them to automatically multiply by that constant. The different scales were identified by letter: C and D were the workhorse scales that you used to do ordinary multiplication. It wasn't high-precision, but neither were those 10% carbon resistors in your Heathkit receiver.

Working engineers (including, probably, several BARC members) generally favored slide rules that had a lot of inverted and folded scales for speed. Remember that if you had to make a table of twenty calculations you couldn't just do it with a spreadsheet, so the faster you could set up the rule to get a value, the better. Then you could go off and watch black and white TV and vote for Eisenhower. There were also specialized rules for various engineering disciplines that had funky scales to optimize certain calculations, including (if you were wondering what this article is doing in *The SPARC*) ones for radio design.

You will recall the big three formulas from your license exams: Inductive Reactance ( $2\pi fL$ ), Capacitive Reactance ( $1/(2\pi fC)$ ), and Resonant Frequency ( $1/(2\pi\sqrt{LC})$ ). These are not challenging problems for any slide rule, except maybe the tiny ones sold as tie clips back in the day. In 1938, J. F. Morrison of Bell Telephone Laboratories introduced an F scale, an inverted scale folded at  $1/2\pi$ . This saved one step in the solution (for example, placing  $f$  on the F scale gave you  $2\pi f$  on the DI scale, which you could then multiply by  $L$  to get  $X_L$ ).

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The F scale made it onto the Keuffel & Esser 4082-3, a fairly rare rule which was only made between 1942 and 1944. This was succeeded by the Cooke Radio Rule, which replaced F with a  $2\pi$  scale for calculating  $X_L$  and  $X_C$  and an LC scale, an inverted scale folded at  $1/(2\pi)^2$ . I've fiddled around with both rules and am not convinced this was an improvement, plus the Cooke rule axed the log-log scales used for exponentiation and roots.

A remarkable electronics rule, the 266, was produced by Sun Hemmi in Japan in 1966 (see illustration above). It has scales for calculating time constants, 3db frequency response, two labeled  $r_1/r_2$  for series/parallel resistances and capacitances, and P and Q scales for solving problems with Pythagorean distances. If I were an electrical engineer and a generation older, this would have been my weapon of choice.

Perhaps the most surprising rule with specialized electronics scales (including F) is the Squirrel "Soldier/Worker/Peasant" model 6508 from Cultural Revolution-era China in quality proletarian plastic. It was accompanied by the only technical documentation I have ever seen with an introduction by Chairman Mao. I am not sure why it has such great features for electronic calculations—perhaps those peasants built a lot of ham equipment in their spare time—but there you are.

I brought my Pickett N4-ES (which you can try out at <http://www.antiquark.com/sliderule/sim/n4es/virtual-n4es.html>) with me when I came to school, and I used it when I took my Tech exam at the FCC office in the Boston Custom House in 1976. Its days had been numbered since the HP-45 calculator came out in 1973, but since the HP-45 cost about \$400 (the equivalent of about \$2300 today) the N4-ES still had life in it as far as a ramen-eating undergraduate was concerned. I took a five-inch Post VersaLog with me as a calculator backup when I took the Extra exam back in 2011, and that paragon of preparedness, Linda NA1I, carries a slide rule around with her to this day.

## **Radio on the River: The 2017 Run of the Charles – Brett Smith, AB1RL**

The Run of the Charles is a mixed canoe and kayak race, running as long as 24 miles from Dedham to Boston. Each year amateur radio volunteers come together to support volunteer teams at each starting location and portage along the route. The event raises funds for the Charles River Watershed Association to protect the river.

The event organizers have been so happy with our support in recent years, this year they added to our responsibilities, asking us to provide communications to their sweep boat teams as well as the usual locations on land. Fortunately we had a couple of volunteers eager for the role, and sure enough, the additional communication helped the entire event run more smoothly. The sweep boats effectively set the schedule for closing the race course, so being able to receive updates from them while they were between portages gave everyone else a lot of useful additional information to work from.

Many thanks to all the volunteers who came out on a slightly wet Sunday to support this event: Scott Gaudet, KO4W; Alan Lewis, K1ALL; Allan Cox Jr., K1VQ; John Glezen, N0RUN; Henry Brown, K1WCC; Mark Richards, K1MGY; Gary Schwartz, N1ZCE; Dave Purrington, KC1GES; Dave Allen, KC1GEQ; Bill Bridgham, N1RYT; Ralph Devlin, N1LAH; Rick Savage, KB1LYJ; Kathy Savage, KB1LPW; Jim Clogher, N1ICN; Ed Curley, KC1CLA; Chris Handwerker, KB1WKI; Joe Walker, N2UEG; Jake McGill, W1JKM; Keilin Bickar, KE1LIN; Jonathan Traum, K1BTZ; Jim Hicks, KB1ZJO; and Jeff PinterParsons, W5UVO.

## **BARC Meeting Calendar for 2017**

Unless otherwise noted, all meetings will take place at the Brookline Police Headquarters.

### **General Meetings**

|              |      |     |                        |
|--------------|------|-----|------------------------|
| May 18       | 2017 | Thu | 7:30 pm — WA1GXC on CW |
| June 15      | 2017 | Thu | 7:30 pm — Elections    |
| September 21 | 2017 | Thu | 7:30 pm                |
| October 19   | 2017 | Thu | 7:30 pm                |
| November 16  | 2017 | Thu | 7:30 pm                |

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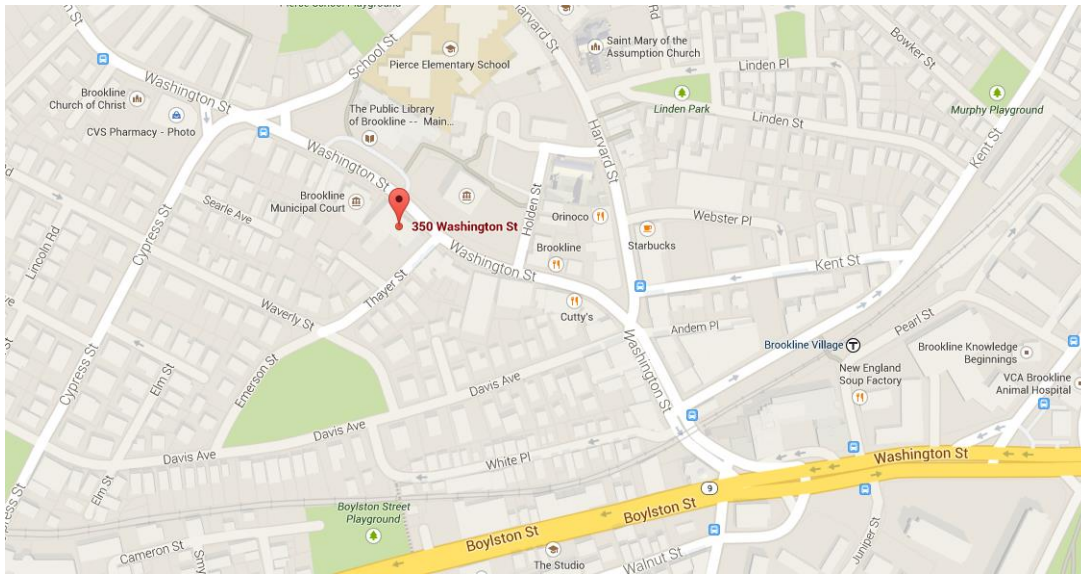
### Business Meetings

|             |      |     |         |
|-------------|------|-----|---------|
| June 1      | 2017 | Thu | 7:30 pm |
| September 7 | 2017 | Thu | 7:30 pm |
| December 7  | 2017 | Thu | 7:30 pm |

### VE Sessions

|           |      |     |         |
|-----------|------|-----|---------|
| July 10   | 2017 | Mon | 7:30 pm |
| October 9 | 2017 | Mon | 7:30 pm |

## Area Map for Brookline Police Headquarters, 350 Washington St., Brookline



## BARC Net Preamble

The control operator for the BARC Net is Joe, W1JF. He rarely misses a net, but when he does any ham can take up the position and run the net. To assist you in opening and closing the net The BARC Net Preamble is printed below. Do not be afraid to step up and take the challenge.

*Is there any further business for the repeater before we begin the Boston Amateur Radio Club Net? This is «**YOUR CALL**». Calling the Boston Amateur Radio Club Net. This is «**YOUR CALL**», my name is «**YOUR NAME**» and I am located in «**YOUR TOWN**». This net meets each Monday evening at 9 pm Eastern Time on the 145.230 Boston repeater, PL 88.5. This net is an informal round table discussion concerning matters of interest to the members of the Boston Amateur Radio Club and the Boston Amateur Radio community in general. When checking into the net, please say, "this is" and drop your carrier to check on doubling. Then give your call sign, name and location. All amateurs are welcome to join the net. Any check-in's for the Boston Amateur Radio Club Net please call now.*

[Compile the list of the check-in's and proceed with the net.]

*Is there any further business for the net before I close? Hearing nothing, this is «**YOUR CALL**» closing tonight's session of the Boston Amateur Radio Club Net. I would like to thank everyone who participated in the net and those who stood by while I ran the net. The Boston Amateur Radio Club Net will return next Monday evening at 9 pm Eastern Time. This is «**YOUR CALL**» returning the repeater to general amateur use. 73.*



## I See the Future

|                   |  |
|-------------------|--|
| <b>18 May</b>     | <b>BARC General Meeting, Brookline Police Headquarters, Brookline, 7:30 pm</b>             |
| 19–21 May         | Dayton Hamvention, Dayton, OH  |
| 21 May            | Flea at MIT, Cambridge   |
| 27–28 May         | CQ WW WPX Contest, CW  |
| <b>1 June</b>     | <b>BARC Business Meeting, Brookline Police Headquarters, Brookline, 7:30 pm</b>            |
| 3 June            | Deadline for articles for the June SPARC   |
| 10–12 June        | ARRL June VHF Contest  |
| <b>15 June</b>    | <b>BARC General Meeting, Brookline Police Headquarters, Brookline, 7:30 pm — Elections</b> |
| 18 June           | ARRL Kids Day  |
| 18 June           | Flea at MIT, Cambridge   |
| <b>24–25 June</b> | <b>Field Day, Bare Cove Fire Museum, Hingham</b>   |


▲ **Note change from usual date and/or location**  
**(Rp)** = BARC Repeater likely to be used

As you might expect, there are many more events (public service, hamfests, flea markets, etc.) taking place—some only peripheral to ham radio. For information on these, covering much of the Northeast, the “Ham - Electronic Flea Market” and the “PSLIST” lists tell the story. Of course, if you know of an event that would be of interest to the readers, please let the Editor know.

## See Yourself in Print! (well, PDF) – Joe Chapman, NV1W

We are always looking for articles for the newsletter. I have reserved this space for your articles, reviews, tips, how-tos, hints, kinks, photos, schematics, or other ham related information. Photos of you operating or your shack are especially welcome. Send your submissions to the Editor, Joe, NV1W, at [nv1w@arrl.net](mailto:nv1w@arrl.net). Articles for the June issue must be received by June 3.

Thanks to Greg, KC1CIC, and Brett, AB1RL, for their contributions to this month’s issue.



**The Clay Center Observatory Welcomes BARC members**

[www.claycenter.org](http://www.claycenter.org)

Public Astronomy Nights, Astronomy Day Events,  
 Amateur Radio Classes, Amateur Radio Youth Club,  
 Community and Adult Education, Weather Festival,  
 Science Lecture Series, Educational Outreach

**20 Newton St., Brookline, near Larz Anderson Park**



**This ONE TUBE covers them all!**

**RCA-807. The "Little Magician" of Beam Power Amplifier Tubes**

Most hams have used the RCA-807 Beam Power Amplifier, but not all are familiar with its ability to turn it into a power source for the various little tube. From crystal oscillator to doubler, quadriplier, buffer, Class C amplifier, this little magician of beam power tubes can do almost anything you can think of. It is especially useful for a low-power, portable transmitter. The RCA-807 is, without doubt, the best tube in any amateur shack. It will give you to get acquainted with all of its countless possibilities.

**RCA-807—HALF A DOZEN TUBES IN ONE**  
 Pin voltage, 750 V. Plate dissipation, 35 W. Anode heat, \$2.50

**Radio Tubes**

RCA MANUFACTURING CO., INC., CAMDEN, N. J.  
 A Division of the Radio Corporation of America

Repeaters: 145.230 ( - ) CTCSS 88.5

Simplex: 147.420

443.550 ( - ) CTCSS 110.9 Hz

## Quarterly Business Meetings – Bob Salow, WA1IDA

As the Bylaws require, BARC has Business meetings quarterly. Unless circumstances warrant, BARC Business meetings will be held on the first Thursdays of December, March, June, and September. The next such meeting will be on **1 June 2017** at Brookline Police Headquarters in Brookline. All members are urged to attend and participate in club affairs. This is where club functions are discussed and decided, and your help is needed to guide us.

A short opening period of each General meeting will continue to be used to bring any immediate business matters to everyone's attention.

To provide continuity of club business between meetings we also have a virtual business meeting via an email list. Any member interested in the affairs of the club can ask to be on this virtual meeting list—just give your name, call and your email address to President Joe Harris, N1QD.

## Businesses Can Advertise Here

The SPARC accepts commercial advertisements. BARC encourages monthly promotion of your products and services which would be of interest to hundreds of our members and others interested in the Amateur Radio Service.

The rates for display advertising are:

|                               |                                 |
|-------------------------------|---------------------------------|
| 1 col × 2 in. (business card) | \$15 per issue                  |
| 1 col × 2 in. (business card) | \$75 per 6 consecutive months   |
| 1 col × 2 in. (business card) | \$125 per 12 consecutive months |
| 1 col × 4 in. (½ column)      | \$30 per issue                  |
| 1 col × 9.5 in. (full column) | \$60 per issue                  |

Originals of ads must be presented to the Editor in MS Word or .jpg format to print 1:1. Other composition will be at extra cost. We will be glad to quote other ad sizes and durations. Members are urged to seek prospective advertisers who are appropriate to our readers. For additional information, contact Joe Chapman, NV1W, at 617.267.6349 or [nv1w@arrl.net](mailto:nv1w@arrl.net).

## BARC Volunteer Exam Sessions

The Boston Amateur Radio Club schedule has been revised to suit the needs and interests of the applicants and examiners. **The next exam session will be on July 10, 2017.** Generally, sessions are held at Brookline Police Headquarters, 350 Washington St. in the Community Room (across from the information desk).

We give all exams (Technician, General, and Extra). *Testing is by reservation only.* Please bring the following with you:

- Your current license and a photocopy for the ARRL, if you are upgrading
- Any CSCEs you are claiming, and a photocopy of them
- Valid picture ID or two valid non-picture IDs
- A pen and a calculator (if you want to)
- **\$15.00** (good for all the tests you take at that session, except for retests)

Note: Written tests can be taken sequentially at the same session for the same \$15 fee. The needed FCC forms will be provided.

To reserve a seat or for further information, contact: Jim Clogher, N1ICN, [n1icn@arrl.net](mailto:n1icn@arrl.net), or Linda Blair, NA1I, [na1i@arrl.net](mailto:na1i@arrl.net).

## Your Personal Ad Could Have Been Here

Are you a depressed BARC member because you have a treasure you must turn to cash? Cheer up, Bunky! The SPARC will run your (non-business) ad for free. Of course, a 10% donation if you sell it will be cheerfully accepted. Just send your ad to Joe Chapman, NV1W, [nv1w@arrl.net](mailto:nv1w@arrl.net).



## BARC Officers and Staff

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Vice President: Mark Duff, KB1EKN  
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Membership Services: Linda Blair, NA1I  
617.500.4406; na1i@arrl.net

Newsletter Editor: Joe Chapman, NV1W  
617.267.6349; nv1w@arrl.net

**The Boston Amateur Radio Club** is a non-commercial association of persons interested in the Amateur Radio Service. The Club is organized for the promotion of interest in Amateur Radio communication and education, for the establishment of emergency communications in the event of disasters or other emergencies, for the advancement of the radio art and the public welfare, for the representation of the radio amateur in legislative and regulatory matters, and for the maintenance of collegiality and a high standard of conduct.

The Club is open to all persons interested in Amateur Radio without regard to race, color, religion, creed, national origin, gender, disability, or sexual preference. Our General and Business meeting locations are handicap accessible. Other meeting and activity locations may be handicap accessible by arrangement.

The Club is an ARRL-affiliated club, and is a member of the Council of Eastern Massachusetts Amateur Radio Clubs (CEMARC) and the New England Spectrum Management Council (NESMC). The Club is also an associate member of the Courage HandiHams system.

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## Greater Boston Net Directory

|                       |                                       |   |
|-----------------------|---------------------------------------|---|
| Daily 7 pm            | MARI (Mass/Rhode Island CW Net) (NTS) | 3.565   |
| Daily 8 pm            | Eastern Mass 2M Traffic Net (NTS)     | 145.230 (PL 88.5)   |
| Daily 8 pm            | Slow Speed CW Net                     | 28.160  |
| First Mon 8:30 pm     | EMA Section ARES Net                  | 146.610 and all MMRA links  |
| Mon 8 pm              | New England DMR Net                   | DMR New England Talk Group (TG 3181)  |
| Mon 9 pm              | BARC Club Net                         | 145.230 (PL 88.5)   |
| Sun Mon Wed Fri 10 pm | Heavy Hitters Traffic Net (NTS)       | MMRA-linked repeaters:<br>146.610, 146.670, 146.715, 146.820, and all 222 and 440 repeaters |
| Tue 8 pm              | MMRA Club Net                         | 146.610 and all MMRA links  |
| Wed 8 pm              | Wellesley Amateur Radio Society Net   | 147.030; 444.600 (PL 88.5)  |
| Wed 9 pm              | Waltham Wranglers Swap Net            | 146.640 (PL 136.5)  |
| Sat 9 am              | Northeast SATERN Net                  | 7.265   |
| Sun 9:30 am           | Yankee SSB Net                        | 50.275  |
| Sun 8 pm              | Algonquin Amateur Radio Club Net      | 446.675 (PL 88.5)   |
| Sun 8:30 pm           | NSRA Net (with Newsline)              | 145.470 (PL 136.5)  |
| Sun 9 pm              | CAARAnet                              | 145.130 (PL 107.2)  |

145.230 ( - ) CTCSS 88.5

Simplex: 147.420

449.175 ( - ) DMR CC1