The QUARAE

Volume 21 Issue 3 | Editor John Lindvay WB3IFD | March 2020

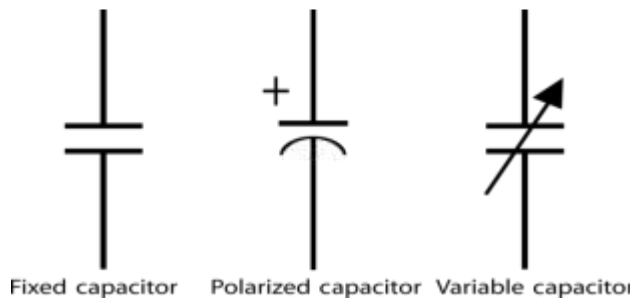
It Seems to Me

Kevin McKenna suggested we as a club take on the challenge of working the QSO parties to enter the year long QSO parties contest. I think it is a good idea. We can use the club station or work from home. There are quite a few state QSO parties in March, the North Carolina QSO party, the South Carolina party the next day. Also, there is the Oklahoma and Idaho QSO parties and the Wisconsin and the Virginia QSO parties.

Capacitors

A capacitor is a device that stores electrical energy in an electric field. It is a passive electronic component with two terminals.

The effect of a capacitor is known as capacitance. While some capacitance exists between any two electrical conductors in proximity in a circuit, a capacitor is a component designed to add capacitance to a circuit. The capacitor was originally known as a condenser or condensator. This name is still widely used in many languages, but rarely in English, with one notable exception being condenser microphones.



Capacitance Units

Not all capacitors are created equal. Each capacitor is built to have a specific amount of capacitance. The capacitance of a capacitor tells you how much charge it can store, more capacitance means more capacity to store charge. The standard unit of capacitance is called the farad, which is abbreviated *F*.

It turns out that a farad is a *lot* of capacitance, even 0.001F (1 millifarad -- 1mF) is a big capacitor. Usually you'll see capacitors rated in the pico- (10^{-12}) to microfarad (10^{-6}) range.

Prefix Name	Abbreviation	Weight	Equivalent Farads
Picofarad	pF	10^{-12}	0.000000000001 F
Nanofarad	nF	10^{-9}	0.000000001 F
Microfarad	µF	10^{-6}	0.000001 F
Milifarad	mF	10^{-3}	0.001 F
Kilofarad	kF	10^{3}	1000 F

Types of Capacitors

There are all sorts of capacitor types out there, each with certain features and drawbacks which make it better for some applications than others.

When deciding on capacitor types there are a handful of factors to consider:

- **Size** - Size both in terms of physical volume and capacitance. It's not uncommon for a capacitor to be the largest component in a circuit. They can also be very tiny. More capacitance typically requires a larger capacitor.
- **Maximum voltage** - Each capacitor is rated for a maximum voltage that can be dropped across it. Some capacitors might be rated for 1.5V, others might be rated for 100V. Exceeding the maximum voltage will usually result in destroying the capacitor.
- **Leakage current** - Capacitors aren't perfect. Every cap is prone to leaking some tiny amount of current through the dielectric, from one terminal to the other. This tiny current loss (usually nanoamps or less) is called leakage. Leakage causes energy stored in the capacitor to slowly, but surely drain away.
- **Equivalent series resistance (ESR)** - The terminals of a capacitor aren't 100% conductive, they'll always have a tiny amount of resistance (usually less than 0.01Ω) to them. This resistance becomes a problem when a lot of current runs through the cap, producing heat and power loss.
- **Tolerance** - Capacitors also can't be made to have an exact, precise capacitance. Each cap will be rated for their nominal capacitance, but, depending on the type, the exact value might vary anywhere from ±1% to ±20% of the desired value.

Ceramic Capacitors

The most commonly used and produced capacitor out there is the ceramic capacitor. The name comes from the material from which their dielectric is made.

Ceramic capacitors are usually both physically and capacitance-wise **small**. It's hard to find a ceramic capacitor much larger than 10µF. A surface-mount ceramic cap is commonly found in a tiny 0402 (0.4mm x 0.2mm), 0603 (0.6mm x 0.3mm) or 0805 package. Through-hole ceramic caps usually look like small (commonly yellow or red) bulbs, with two protruding terminals.

Compared to the equally popular electrolytic caps, ceramics are a more near-ideal capacitor (much lower ESR and leakage currents), but their small capacitance can be limiting. They are usually the least expensive option too. These caps are well-suited for high-frequency coupling and decoupling applications.

Aluminum and Tantalum Electrolytic

Electrolytics are great because they can pack *a lot* of capacitance into a relatively small volume. If you need a capacitor in the range of 1µF-1mF, you're most likely to find it in an electrolytic form. They're especially well suited to high-voltage applications because of their relatively high maximum voltage ratings.

Aluminum electrolytic capacitors, the most popular of the electrolytic family, usually look like little tin cans, with both leads extending from the bottom.

Unfortunately, electrolytic caps are usually **polarized**. They have a positive pin -- the anode -- and a negative pin called the cathode. When voltage is applied to an electrolytic cap, the anode must be at a higher voltage than the cathode. The cathode of an electrolytic capacitor is usually identified with a '-' marking, and a colored strip on the case. The leg of the anode might also be slightly longer as another indication. If voltage is applied in reverse on an electrolytic cap, they'll fail spectacularly (making a *pop* and bursting open), and permanently. After popping an electrolytic will behave like a short circuit.

These caps also notorious for **leakage** -- allowing small amounts of current (on the order of nA) to run through the dielectric from one terminal to the other. This makes electrolytic caps less-than-ideal for energy storage, which is unfortunate given their high capacity and voltage rating.

Supercapacitors

If you're looking for a capacitor made to store energy, look no further than supercapacitors. These caps are uniquely designed to have *very* high capacitances, in the range of farads.

While they can store a huge amount of charge, supercaps can't deal with very high voltages. This 10F supercap is only rated for 2.5V max. Any more than that will destroy it. Super caps are commonly placed in series to achieve a higher voltage rating (while reducing total capacitance).

The main application for supercapacitors is in **storing and releasing energy**, like batteries, which are their main competition. While supercaps can't hold as much energy as an equally sized battery, they can release it much faster, and they usually have a much longer lifespan.

Others

Electrolytic and ceramic caps cover about 80% of the capacitor types out there (and supercaps only about 2%, but they're super!). Another common capacitor type is the **film capacitor**, which features very low parasitic losses (ESR), making them great for dealing with very high currents.

There's plenty of other less common capacitors. **Variable capacitors** can produce a range of capacitances, which makes them a good alternative to variable resistors in tuning circuits. Twisted wires or PCBs can create capacitance (sometimes undesired) because each consists of two conductors separated by an insulator. Leyden Jars -- a glass jar filled with and surrounded by conductors was the first capacitor, invented by Ewald Georg von Kleist.

Capacitors in parallel and series circuits

Capacitors in a parallel configuration each have the same applied voltage. Their capacitances add up. Charge is apportioned among them by size. Using a schematic diagram to visualize parallel plates, it is apparent that each capacitor contributes to the total surface area.

Capacitors connected in series, a schematic diagram reveals that the separation distance, not the plate area, adds up. The capacitors each store instantaneous charge build-up equal to that of every other capacitor in the series. The total voltage difference from end to end is apportioned to each capacitor according to the inverse of its capacitance. The entire series acts as a capacitor *smaller* than any of its components. I hope this gives you a better idea on capacitors.

Best Practices for Sporting/ Non-Sporting Events

From the ARRL ARES E-Newsletter

The University of Southern Mississippi "NCS4" program publishes best practices, holds events, and offers training courses for sporting event organizers.

In late 2019, I was invited to represent Amateur Radio at the National Marathon and Running Events Safety and Security Summit in Orlando. I asked for a show of hands - about half the audience used Amateur Radio and about half also had taken the FEMA ICS-100 course on the Incident Command System.

The larger US marathons were represented -- New York, Boston, Chicago and Marine Corps -- and I talked to each representative, one on one. Responses were generally that their events probably use Amateur Radio operators/volunteers (but not always frequencies) in a direct medical communications tasking.

Our event is the large Medtronic Twin Cities Marathon. I explained that we support the following functions:

- Medical Command Center, staffed 100% by radio amateurs. All non-911 volunteer resources are in our scope. We also monitor 911 radio traffic using authorized volunteers to ensure our reports are accurate; e.g., the right bib number and runner cross street location.
- Provision of a fully redundant "lights out" backup radio system. This is a specific, requested function.
- Assignments on Command trucks, which house some of our net controls who provide liaison to government radio systems and are under our direction.
- At our events and others, 350 rented trunked radios are the backbone of event communications (a best practice). We provide net controls for the medical channels - the Incident Commander checks in and is on our rented radio nets all race.
- Transport tracking and hospital capacity management -- using secure systems and authorized officials we ensure families know where runners are transported. We do not share medical condition information.
- Family reunification -- if runners drop off the course or are injured, we reunite runners with their families.
- Wheel chair and medical electric cart dispatching.
- Aid station support on the course.
- Hams every mile for dropped out runner reporting and situational awareness.
- Shadows for key officials as requested.
- Medical tent runner check-in and check out.
- Support student EMTs, Medical Reserve Corps and volunteer resources, such as mutual aid at the sprawling finish line area.
- Support published disaster and evacuation plans.
- Support bike medics.
- Track SAG (Supplies and Gear) bus location and passengers.
- Train users on medical applications.
- Provide input to the development of ICS 205/206 frequency lists and Incident Action Plan (IAP).

The concept of redundant and backup communications came up regularly. There was even an idea floated of a backup EOC. Several presenters mentioned the importance of live video for situational awareness. This was tested by us on our area wide mesh network in 2019. -- *Erik Westgard, NY9D* [Westgard is the Medical Communications Coordinator for the Medtronic Twin Cities Marathon]

Ham Radio Calendar

February 29 – South Carolina QSO Party. See

March 1 - North Carolina QSO Party See ncqsoparty.org/rules

March 7 - ARRL International DX SSB Contest. See www.arrl.org/arrl-dx

March 14 - Oklahoma QSO Party. See k5cm.com/okqp.htm

March 14 - Idaho QSO Party. See pocatelloarc.org/idahoqsoparty

March 14 - Warren County Hamfest in Youngsville, Pa sponsored by BSA Venturing Crew 73

March 15 - Wisconsin QSO Party See warac.org/wqp/wqp.htm

March 15 - North American RTTY and Digital Sprint. See ncjweb.com

March 21 - Virginia QSO Party See qsl.net/sterling/VA_QSO_Party

March 29 - 48th Annual TRARC Hamfest/Computer Show in Mckeesport, PA sponsored by Two Rivers Amateur Radio Club.

March 29 - Vietnam War Veterans Day. W5KID, Baton Rouge, LA. Baton Rouge Amateur Radio Club. USS KIDD Amateur Radio Club, 305 S. River Road, Baton Rouge, LA 70802. Operation aboard the USS KIDD, DD-661, WW II Fletcher class destroyer. See qrz.com/db/w5kid