RF

ORANGE COUNTY AMATEUR RADIO CLUB, INC.

VOL. LVI NO. 06 P.O. BOX 3454, TUSTIN, CA 92781-3454 June 2015

The Prez Sez.....

By Tim N6TMT

CQ Field Day, CQ Field Day, CQ...

It's June, Field Day is upon us. Have you made plans? The club has! Perhaps you will join us in Buena Park!

For months, a dedicated team of people have worked diligently towards the goal of providing a fun and productive FD.

In addition to our efforts we also have members of the Catalina Repeater Association (CARA) and members of BSA Troop 440 who will be actively participating.

Troop 440 members have planned out a menu (more about menu and cost later in RF) for the event. They also will be utilizing their Troop call-sign (KI6ZPW) for the GOTO station and many of their members and adult leadership are licensed HAM operators. So they can and will actively participate throughout the event.

CARA members have been attending our recent general meetings and FD training sessions with anticipation and thanks to them we were put in touch with Troop 440.

Hope you can join us too!

May all your signals be strong, constant and clear!

de N6TMT – Tim

Next General Meeting

The next General Meeting will be on:

Friday, June 19th, 2015
@ 7:00 PM

As usual, we will be meeting in the east side entrance of the Red Cross Building, Room 208 (2nd Floor).
See you there!

The next General Meeting of the OCARC will be held on: **Friday, June 19th, 2015.**

The June presentation by Chip Margelli, K7JA will be "**A Tour of the World's Largest Antenna: The Arecibo Radio Telescope in Puerto Rico.**"

The Arecibo dish is the stuff of legends, having been used for a number of exciting discoveries, including one discovery that brought a Nobel Prize in Physics to Dr. Joe Taylor, K1JT.

Chip and Janet Margelli were in Puerto Rico in January for the ARRL Convention, and on Monday after the show they received a very special tour by the Operations Director (WP3R) that included a walk up the catwalk to the feed dome! Come see how scientists do leading-edge work at the Arecibo Radio Scope on Friday, June 19th."

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ORANGE COUNTY
AMATEUR RADIO CLUB
www.W6ZE.org

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Feedback & Corrections:
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Submit Articles:
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Monthly Events:

General Meeting:
Third Friday of the month
at 7:00 PM held at:
American Red Cross
600 Parkcenter Drive
Santa Ana, CA
(Near Tustin Ave. & 4th St.)

Club Breakfast:
First Saturday – July 4 at 8:00am
Marie Callender's Restaurant 2525
1821 North Grand Ave
Santa Ana, CA
(North of 17th Street)

Club Nets (Listen for W6ZE):
28.375 ± MHz SSB
Wed- 7:30 PM - 8:30 PM
Bob AF6C, Net Control

146.55 MHz Simplex FM
Wed- 8:30 PM - 9:30 PM
Bob, WB6IXN, Net Control

7.086 ± MHz CW **OCWN**
Sun- 9:00 AM – 10 AM
John WA6RND, Net Control

Club Dues:
Regular Members	...$20
Family Members*	...$10
Teenage Members	..$10
Club Badge**	……..$3

Dues run from Jan thru Dec and are prorated for new members.

*Additional members in the family of a regular member pay the family rate up to $30 per family.

**There is a $1.50 charge if you'd like to have your badge mailed to you.

OCARC HAM RADIO ARRL 2015 FIELD DAY

COME JOIN US

JUNE 27TH & 28TH

Location: Walter Knott Education Center - Buena Park, CA

For more information GO to www.w6ze.org/Field_Day/FieldDay.html

COLLAGE ABOVE BY KEN W6HHC & TOM W6ETC

DISCOVER FOR YOURSELF HOW MUCH FUN FIELD DAY CAN BE!

Field Day 2015 Event
Saturday June 27th 11AM to Sunday June 28th 11AM

Reprinted from OCARC RF Newsletter June 1994

"The Amateurs"

There's something about them you've got to admire,
They work for the love of the task, not for hire,
Every one of them's blessed with the heart of a boy!
While we to our regular schedules are keeping,
The amateurs do without eating or sleeping,

They worry their wives-since so short is the day-
They don't get to bed when they should, but they stay
Sending calls on the air; catching calls from afar-
And I think as I hear them hew patient they are!
How much better we'd work here If only we knew it
In that amateur spirit of wanting to do it!

Processionals weary sometimes and they shirk,
Since they're paid to perform they look on it as work,
They begin with reluctance; they're glad when they're through-
And they measure In money whatever they do;
But the amateur never begrudges a minute;
He goes to the job for the joy that is in it.

So here's to the amateurs-brave hearted throng--
Though short be their waves, may their lives all be long
May the wisdom they gain and the joys which they reap
Make up for the nights when they go without sleep
And may we--in their spirit and deep understanding
Of work and its joy-keep our amateur standing!

@ 1934 Edgar A. Guest

2015 ARRL FIELD DAY

HAM RADIO

ARRL The national association for AMATEUR RADIO

Field Day

June 27-28, 2015

Start: 1100 PDT Saturday ~ End 1100 PDT Sunday

Setup 0900 Friday June 26 - Takedown June 28th 1101 PDT

by Tom W6ETC

What is Field Day and who is welcome:
ARRL call Field Day as "part educational event, part operating event, part public relations event – and ALL about FUN! So what is OCARC objective for FD 2015 (Field Day 2015). To summarize we hope to work as many stations as possible on any of the designated bands assigned to each Band Captain. We also plan to learn how to operate in abnormal situations in less than optimal conditions. Field Day is OPEN to all amateurs (and the public – see GOTA station for more information) in the areas covered by the ARRL/RAC Field Organizations and countries with IARU Region 2. For the OCARC that means we are eligible to participate in this exciting event.

Dates/Times"
Field Day is always the fourth full weekend of June. In terms of actual dates FD 2015 begins at 1800 UTC Saturday (11AM PST) June 27th, 2015 and operations run for 24 hours through to 1800 UTC Sunday (11AM PST) June 28th, 2015.

It's important to note that we especially need help with set-up and take-down. If you're a new ham there is practical experience to be had especially when you're participating in set-up and take-down. It's a badge of honor if you take the time and effort to assist with set-up, event operations, and take-down that immediately follows the event.

Please email all your questions and sign-up with the Band Captains as indicated below or contact the Field Day Co-Chairmen with your availability and willingness to participate in Field Day set-up, event operations and take-down!

Bands:
Here is the list of OCARC FD 2015 Band Captain assignments:

OCARC FD 2015 Band Captain assignment:

Station #	Band / Transmission Type	Band Captain(s)
1	20 M SSB	Ken W6HHC & Bob AF6C
2	20 M CW	Paul W6GMU
3	15-40 M	Dan KI6X & Tim N6GP
4	10-80 M	Greg W6ATB & Doug K6PGH
5	6 M	Robbie KB6CJZ
6	Digital PSK-31 (6 M thru 10 M)	Greg W6ATB
Free	GOTA 10 M PSK (Call-sign BSA Troop 440 KI6ZPW*)	Corey KE6YHK
Free	VHF/UHF (2M + 440 MHz)	Robbie KB6CJZ

*Call-sign KI6ZPW – James Payne II KB6WUM (trustee)

Logging Software:

OCARC will utilize N3FJP ARRL Field Day Contest Log 4.7 Software. This can be downloaded by going to: http://www.n3fjp.com/fieldday.html

All Band Captains are to have this software loaded and operational prior to FD 2015. Just following the close of this event Tim N6GP will download the critical files from your laptop and will manage the task of consolidating the data. Once the data has been consolidated and information has been checked for accuracy this will be reported to the ARRL Event officials within the prescribed time.

Field Day 2015 Contact Information:

1. **Don N6XBP (Planning #1)**
2. **Paul W6GMU (Planning #2)**

To contact the individual Band Captains use the table information provided above.

Operations:

The OCARC will be operating in ARRL's designed Class "A".

The number of simultaneous transmitters we will be running for this event will be:

Six (6) for contesting (see 'Bands' above)

<u>Two (2) considered 'Free'</u>

Eight (8) Stations Total planned to be operational during the event.

Attention Technicians and Extra class operators! This is your opportunity to work some HF! If you've NOT worked a Field Day in the past come on out. If you're a veteran Field Day participant we'd love to have you work alongside us before, during and after the event.

If you are thinking about becoming a HAM operator and/or you're an unlicensed come and check-in at the visitor station and check-out free information regarding Amateur Radio. Once you've checked in then proceed to the 'GOTA' (Get On The Air) station to experience firsthand the enjoyment of touching the airwaves and operating a live ham radio during the event.

BSA Troop 440 will also attend and participate in the OCARC Field Day 2015 exercise.

Field Day Call-Sign:

For FD 2015 the 'callsign' utilized will be the club's W6ZE (Whiskey Six Zulu Echo) callsign for general operations. Pursuant to an agreement with the BSA Troop 440 the GOTA station will utilize an assigned callsign of KI6ZPW (Kilo India Six Zulu Papa Whiskey) callsign. The KI6ZPW callsign is under the direction of James KB6WUM (trustee).

Setup:

Friday June 26th 9:00AM (PST). Construction of antennas and towers is scheduled to begin at this time while temperatures remain cool. Come out and lend a hand in set-up!

Teardown:

Sunday June 28th 11:01AM (Immediately following the event). The event runs from Saturday 11AM to Sunday 11AM. The teardown process follow the event.

Field Day (FD) Contest Rules:

The ARRL FD 2015 contest rules, information packet, full rules, summary sheet, W1AW bulletin schedule and much more is available by going to the ARRL Field Day Page.

Visiting Club / CARA:

This year the OCARC is excited to announce that members of CARA (Catalina Amateur Repeater Association) will be joining us on FD 2015. The cooperation between the two clubs represents a spirit of collaboration and cooperation towards Emergency Communications practice and service to our community when a disaster strikes.

Meals and Food:

The Boy Scout troop will be providing meals at a fixed cost. This is a convenience to the club and a fund raiser for the Boy Scouts. There are two discount meal plans offer for FD participants who purchase food in advance. Please get your order in prior by June 19th OCARC Membership meeting.

Plan 1, four meals for $25 includes the meals as follows: (Great Bargain)

- **Saturday breakfast - 8:00 to 9:30 AM**
- **Saturday lunch - 12:00 to 1:30 PM**
- **Saturday dinner - 6:00 to 7:30 PM**
- **Sunday breakfast - 8:00 to 9:30 AM**

Plan 2, includes the four meals indicated in Plan 1 plus a Friday evening meal as indicated below: (Best Bargain)

- **Friday dinner - 7:00 to 8:30 PM**

A Limited amount of Individual meals may be available for purchased at $7.50

The Boy Scouts will also be running a "Trading Post" where misc. snacks and beverages may be purchased during daylight hours.

Menu:

Friday Evening - 7:00 - 8:30 PM

- **1 hamburger or cheeseburger**
- **1 bag of chips**

Saturday Morning Breakfast - 8:00 - 9:30 AM

- **3 pancakes**
- **1 scoop of scrambled eggs**
- **2 slices of bacon**
- **8 oz. orange juice or 8 oz. milk, ice water, hot tea and coffee**

Saturday Afternoon Lunch - 12:00 - 1:30 PM

- **3 street chicken tacos**
- **1 bowl green salad - Choice of dressing (Ranch or Italian)**
- **1 bowl of chips and salsa**
- **1 assorted cookie**
- **Lemonade, ice water, hot tea or coffee**

- **1 bowl green salad - Choice of dressing (Ranch or Italian)**
- **Lemonade, ice water, hot tea and coffee**

Saturday Evening Dinner - 6:00 - 7:30 PM

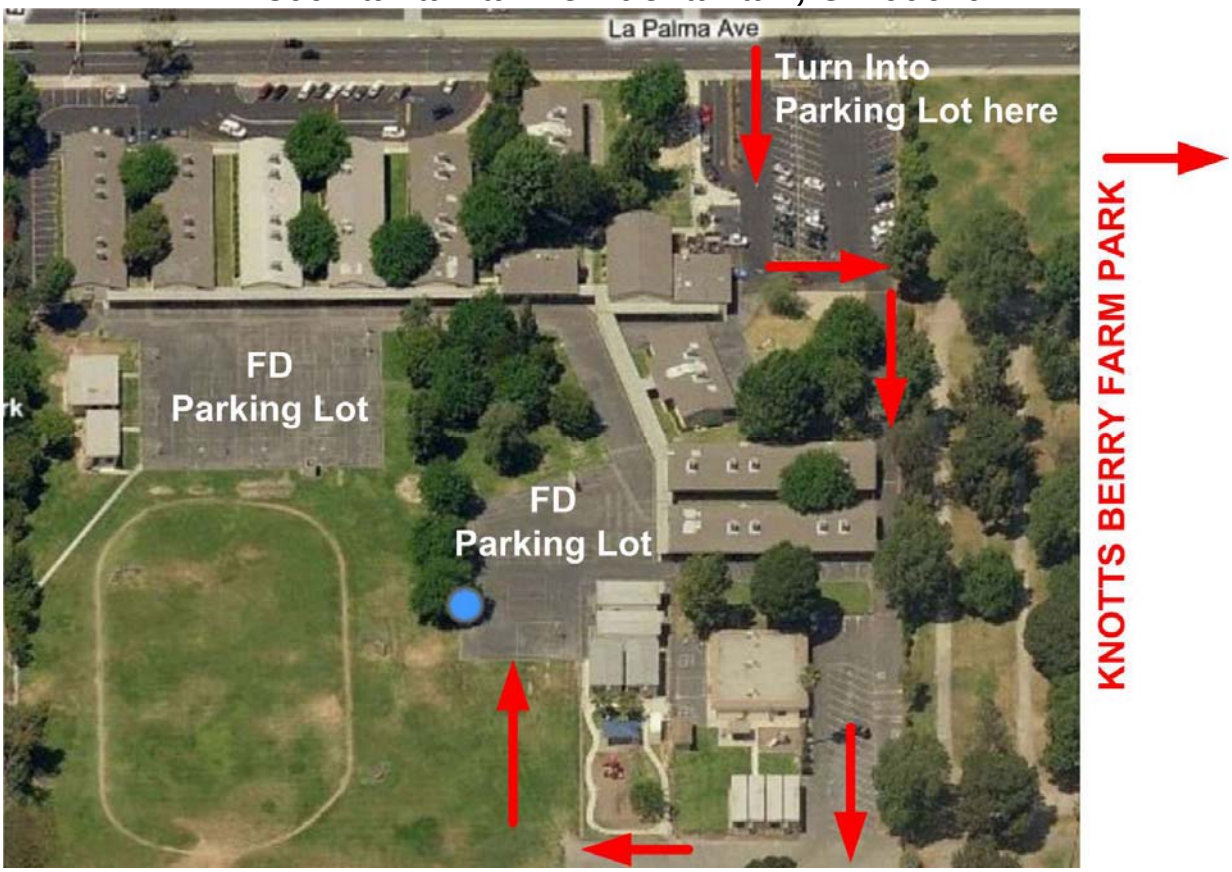
- **Spaghetti and 3 meatballs**
- **1 bowl green salad - Choice of dressing (Ranch or Italian)**
- **1 dinner roll**
- **1 assorted cookie**
- **Lemonade, ice water, hot tea or coffee**

Sunday Morning Breakfast - 7:00 - 8:30 AM

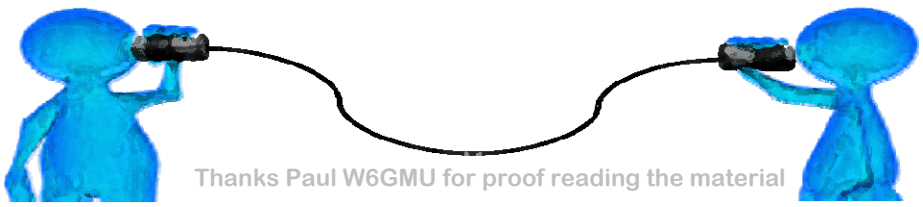
- **1 breakfast burrito (eggs, has brown, cheese and 1 slice of bacon)**
- **oatmeal**
- **8 oz. orange juice or 8 oz. milk, ice water, hot tea and coffee**

Field Day will be again at last year's site (Walter Knott Education Center); however this year the access to the field may be slightly different than some past years. You may have to drive on a grassy area to reach the Field Day parking lot. See aerial picture below for more details.

7300 La Palma Ave Buena Park, CA 90620



- Head for Knott's Berry Farm
- Take the Beach Blvd (south) exit from the 91 or the 5 FWY
- Turn right (west) on La Palma Ave, along the north edge of Knott's Berry Farm Park.
- Continue driving on La Palma, past the Knott's Berry Park to 7300 La Palma Ave.
- The school will be on your left on the south side of La Palma.
  >Use the first entrance on the East side of the school building
- The school grounds are behind the school building. Refer to map above.
- Vehicles are NOT permitted on school grass/grounds except where noted.
- Alcohol or Tobacco products are not allowed on the school premises.
- If you bring a dog it must be on a leash. Dog owners are responsible to dispose of their animal's waste materials.



Thanks Paul W6GMU for proof reading the material

Heathkit of the Month #66:
by Bob Eckweiler, AF6C

This article is the second in a Heathkit Maintenance series that I will occasionally write as I find myself doing something unusual to get or keep a Heathkit working.

MAINTENANCE
HD-1250 DIP METER - Meter Repair

Introduction:

The current project here is restoring an antique Hallicrafters S–40B communications receiver (Figure 1). The S-40B is a single conversion superheterodyne receiver with a 455 Kc intermediate frequency. When first purchased and powered up (with the usual precautions) it worked on three of four bands. It suffered the usual old age ills of scratchy pots, dirty switches, etc. Someone had recently replaced the multi-section filter capacitor can with another one that might be one of the last of its type manufactured, with a late eighties date code. It still checks good.

After the replacing all the paper capacitors, a couple of small electrolytic capacitors, and some resistors that were out of tolerance, band D (15.5 Mc to 44 Mc) still was receiving nothing. My tenet is to replace capacitors and resistors in a radio one stage at a time, checking that the radio is still working before continuing. It is a lot easier to troubleshoot a stage than a whole radio. When doing the RF stages all components (except the coils) related to Band D were removed and checked. Nothing obvious relating to the problem showed up. The Band D coils were checked with an ohmmeter, though that only confirmed the coils had continuity. Instead, the plan was to check the coils with my Heathkit HD-1250 solid-state dip meter. (See Heathkit of the Month #8).

Figure 1: Hallicrafters S-40B Under Restoration

One thing that was noticed when the radio was first examined was the Band D slugs were half out of their respective coils. Does the local oscillator tune above or below the received frequency? That information is not given in the S-40B manual, but it is in the earlier S-40 manual. The local oscillator tunes above the received frequency on Bands A, B and C, and below it on Band D. Perhaps someone also tried to tune the Band D local oscillator above. That would account for the coil slug positions.

Heathkit HD-1250 Dip Meter (S/N 08004):

It had been awhile since my HD-1250 dip meter had been used. A battery was put in and it was turned it on. The meter needle moved about one-fifth of the way up scale and stuck

Figure 2: Sticking Meter from HD-1250

there. This recalled memories of the last time it was used; back then it had begun showing signs of sticking, but nothing as bad as the current problem.

An HD-1250 Parts Unit (S/N 05722):
I also remembered picking up a second GD-1250 meter very cheaply for parts about the time I noticed the meter problem on mine, hoping for a good replacement meter. That dip meter had been left in its case for so long that the foam that holds everything in place had disintegrated, leaving a sticky, hard to clean, mess on the coils and the top panel of the dip meter and causing bad corrosion. However, the meter movement looked fine so I paid all of a buck and took it home, but never replaced the meter until I had the recent problem with the S-40B.

Repairing the HD-1250:
Replacing the meter on a Heathkit HD-1250 is not a simple task. To remove the meter you need to undo the sides of the case and two screws on either end that hold the top front panel on. Remove the panel and the meter can then unsoldered and it lifts right out. The complex part is reinstalling the front panel. One of the two screws, both of which fasten with a lock washer and nut, is situated so that you must remove the small oscillator board before you can secure the screw. This involves a lot of unsoldering of short leads and heavy braid in tight places.

Figure 3: My Heathkit HD-1250 – Repaired, re-calibrated and sporting a replacement meter.

Once the meters were removed from both units it was evident they were different, even though they shared the same part number. The later meter cover (from the parts unit) was held on by brass screws, but the damaged meter was held on by dried out cellophane tape (Figure 2). A quick check of the replacement meter with an appropriate current limiting resistor showed it to be working properly, with good balance and zero. The meter is rated at 150 μA full-scale.

After installing the good meter, the oscillator board was removed momentarily so the cover could be reinstalled. With the cover in place and the oscillator board reinstalled the dip meter was tested – it no longer worked. An examination showed nothing obvious. After isolating the amplifier circuit from the oscillator board a measurement across one section of the two-section variable capacitor, that should measure infinity, measured 150 ohms. The cause turned out to be some foreign junk caught in the little trimmer that is part of that capacitor section. - perhaps a piece of disintegrated foam? After reinstalling the oscillator board for the third time, the unit worked and so it was realigned.

Back to the S-40B:
Using the working dip meter, troubleshooting revealed the Band D oscillator wasn't working and that the resonant frequency was way off. A close examination showed a short between the coil primary and secondary where insulation had worn off at the point the coil leads crossed. After applying a dab of enamel insulating paint the coil was as good as new.

Band D immediately came to life, though signals were very weak which I attribute to the total lack of alignment on that band. The S-40B

now sits, its IF aligned but awaiting my construction of an RMA dummy antenna before the RF gets final alignment. By the way, this receiver while old on the inside is cherry on the outside with original paint. I think the owner must have polished it once a year!

That Bad HD-1250 Meter:

Being of a curious nature, the bad meter cover was removed and the meter examined with a loupe and bright light. Moving the needle carefully with a finger revealed the cause of the meter sticking. On the front edge of the moving coil were globs of what looked like glue. They looked stringy and two stuck out enough to interfere with the stationary frame that held the front meter pivot. With a pair of fine tweezers enough of the stringy material was removed to allow the meter to move freely.

After reading up on meter construction and repair it became obvious that the globs were some form of cement used as weights to balance the meter. The meter in the HD-1250 is inexpensive, and while most meters have three balancing arms with adjustable springs that can be moved to balance the meter movement, this meter was balanced by the weight of drops of cement. Evidently the cement used in the older style meter tended to swell with age and finally began to interfere with the surrounding support structure causing the meter to stick.

The repaired meter was no longer in balance with the weights gone. This meter is used for indication with just a relative 0 - 10 scale. Perfect balance is not an issue; still it was worth investigating the way to rebalance the meter, and do it!

Meter Balancing:

On the Heathkit Yahoo Group recently, one of the discussions turned to meter balancing. In one of the threads an article was referenced by Phil Atchley - KO6BB: In the September 1943 issue of QST*, page 40, William Triplett - W8OWW, a relative of Ray Triplett who founded Triplett Corporation, the meter company, wrote an article: *Rejuvenating Old Meters*. In a section of the article he covers the procedure for balancing meters. Using his technique the now-unstuck meter was balanced reasonably closely (within one needle width); however having to change weights by adding and removing drops of glue made the task hit and miss and time consuming to even get close. Here's the technique, and the order in which it should be performed:

Figure 4: Circled are two glue type tail-weights. The side weights have already been removed from the coil top. Note the hairy growth on the left weight. This growth on a side weight caused the meter to stick.

Setting Meter Zero:

Place the meter so the scale plate is parallel with the ground and the axis of the pivots is vertical (Figure 5A). In this position set the meter to point to zero using the zero adjusting screw. The meter in the HD-1250 doesn't have an external zero screw, but the zero was right on and no adjustment to it was needed.

Setting Tail Balance:

Once the zero is set, place the meter so the face is vertical and the meter needle is parallel with

* Available in the QST archives on the ARRL website; free for ARRL members.

the earth and pointing to the left (Figure 5B). If the needle now points upscale the tail weight needs to be reduced on the tail arm. If the meter has adjustable weight springs, the spring on the tail arm needs to be moved towards the pivot; if the weight is cement some cement needs to be removed. If the needle points off the scale below zero the weight needs to be adjusted/added in the opposite fashion.

Setting Side Balance:
Next, rotate the meter with the face vertical so the needle points up vertically (Figure 5C). If the meter reads upscale off zero you must increase the weight the on the left side arm and reduce the weight on the right side arm until the meter needle is vertical and points to zero. Try to make your adjustments equal and opposite on both side balances to prevent changing the spring torque.

Repeat the three step sequence a few times if needed to get the best balance.

The above procedure assumes the meter zero is on the left of the scale. If the zero is on the right (as is the case of the HD-1250 meter when oriented pointer up) you will need to reverse left and right in the steps above.

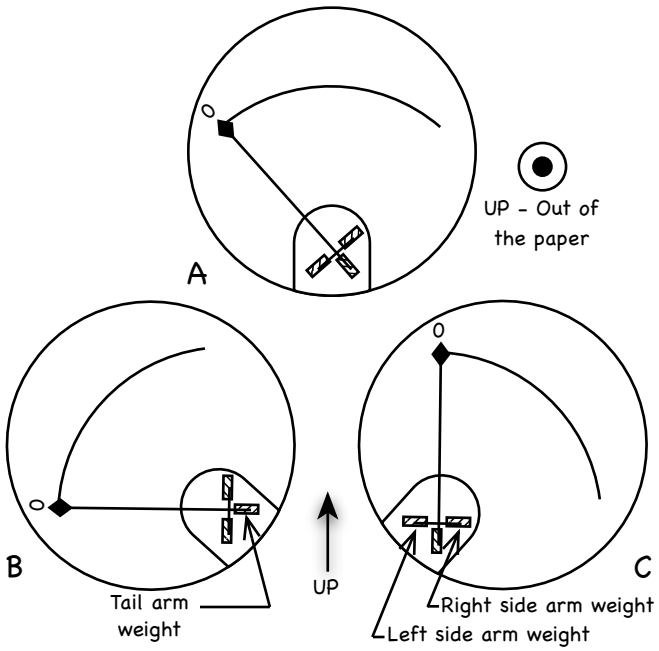


Figure 5: The three steps to balancing a meter.
A - set the zero; B - set the tail balance;
C - set the side balance

Adjusting weights:
The spring weights can be turned with a fine jeweler's needle-nose pliers. Be careful and go slowly.

On meters that use glue, I can recommend what not to use. My first attempt used Duco Cement. It was applied with a tiny toothpick. The glue wanted to stick to the toothpick and not to where I was trying to put it. Thinning it with acetone helped some, but I was afraid of damaging the meter movement or getting some on the plexiglass. Every time I got enough glue on, it was tall enough to recreate the original sticking problem. The cement is easy to remove before it gets hard, and I did this numerous times till I finally hit a balance that, while not perfect, was close enough.

I did get to play with the balancing spring weights on an old meter that whose needle was badly mangled but still had the rest of the movement intact. I was amazed that I was able to turn the weights and get the needle position to change.

Next Month
I hope to get back into a monthly schedule in the next month or two. I do have some small and large Heathkits that I plan on covering. I'm also gathering information on the HW-12 series of radios.

Everyone have a Fourth of July!

73, from AF6C

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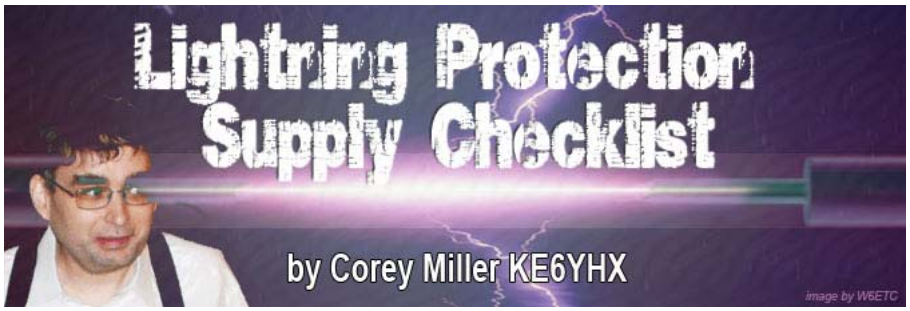
Remember, if you are getting rid of any old Heathkit Manuals or Catalogs, please pass them along to me for my research.
Thanks - AF6C



This is Part 2 continued from the OCARC RF Newsletter May 2015 article

Lightning Protection Supply Checklist

Addendum to The Lightning Protection Process
by Corey Miller KE6YHX

In the Winter 2013 RFs, "The Lightning Protection Process," the methods and procedures for doing so were covered. However, some of the tools and supplies are hard to find, and take long hours of internet research and store shopping to get the right items for the job. Fortunately, I did the searching for you, and they are all listed here for your convenience.

I hope this proves useful.

Materials (in chronological order)

☐ PolyPhasers (nuts and bolts included)	$61.95ea+tax at HRO
☐.150 Aircraft (Sheet) Aluminum	$ 1.90/lb+tax at Schorr Metals
☐ Hex-Head Sheet Metal Screws 1-1/2"	$ 0.18ea+tax at Ace Hardware
☐ CW7100 Silver Conductive Grease	$29.00 at Amazon.com:HMC Electronics
☐ Copper-Clad Ground Rod, 5/8"x8"	$25.50+tax at McFadden Dale
☐ 3/4x5 Black Nipple Threaded Pipe	$ 1.96+tax at Home Depot
☐ 3/4 Black Pipe Cap	$ 1.65+tax at Home Depot
☐ No. 4 Insulated Welding Cable	$ 2.50/ft+tax at McFadden Dale
☐ No. 4 3/8" Cable Lug	$ 2.99/2+tax at Harbor Freight Tools
☐ Erico Cadweld One-Shot Crucible	$ 7.17+shipping+tax at CADWELD GR1161L 5/8 ONE-SHOT
☐ Water Softener Sodium-Salt Pellets	$ 4.62/bag at Stater Bros
☐ Custom Feed Lines	$19.49 to $25.13ea+freight+tax at www.Cablexperts.com
☐ UHF PL-259 Solder Connectors	$ 2.69ea+tax at HRO
☐ UG-176 Reducer	$ 0.74ea+tax at HRO

Equipment (in chronological order):

☐ Long Straightedge	
☐ Measuring Tape	
☐ Jigsaw	
☐ Metal Cutting Jigsaw Blade	
☐ Drill	
☐ Set of Drill Bits	Various depending on the exact specs used
☐ Brass Brush	$ 1.60+tax at McFadden Dale
☐ Wire Stripper, for No. 4 cable	$ 7.93 – 24.97 Assorted Home Depot
☐ OES T-HM-8 H/D Hammer Crimper	$24.95+tax at Orvac Electronics
☐ Hex-Driver Bit	
☐ Metal Grinder, bench	
☐ Metal Grinder, hand	
☐ Digging Shovel	
☐ Heavy Sledgehammer	12lb:$34.20; 20lb:$49.50+tax at McFadden Dale
☐ ERC T320 Flint Ignitor for Cadweld	$ 9.09+shipping+tax at Gordon Electric Supply

Soldering Equipment

☐ Soldering Gun	☐ Nippy Cutters
☐ Solder	☐ Clip Stand
☐ Paste Flux for Electronics	☐ Small Ruler
☐ Wire Stripper	☐ Soldering Mat

Safety Equipment:

☐ Safety Glasses	$ 0.85 at Harbor Freight Tools
☐ Mechanic's Gloves	$ 6.15 at Harbor Freight Tools

Next month: Lightning Protection Steps Checklist…
--73, Corey Miller KE6YHX

Bob's TechTalk

Number 47
(OCARC TechTalk series #119)
by Bob Eckweiler, AF6C

Choosing Disc Ceramic Capacitors:

Recently I was ordering some replacement disc ceramic capacitors to restore an old tube receiver. On a distributor website I had a large choice to select from. One column gave the dielectric choices. From years past I remember NP0, Z5U, X7R, N750 and others, but to my surprise one capacitor was marked S3N. That was a totally new notation to me. So let's look at those letters and see what they mean.

Regular Parameters:

What parameters need to be specified to designate a common disc ceramic capacitor? The three obvious ones are capacitance, tolerance and working voltage. Others that may be important are physical size, RoHS status, temperature range and the temperature coefficient (capacitance change with temperature). If you 'homebrew', you are probably familiar with all except possibly the last three. Let's look at them:

RoHS (Restriction of Hazardous Substances):

RoHS compliancy is fairly recent. For a component to be RoHS compliant it must meet specific requirements as to the materials in its makeup. Full details may be found on the web; just Google "RoHS". However the predominant banned substance is lead. Sometimes RoHS components are also marked as lead-free. Lead is one of the major ingredients in common solder. Today, most commercial electronics manufacturing is done with lead-free solder.

[Operating] Temperature Range:

This is the temperature range that a capacitor was designed to operate at. Operating outside this range may cause damage to the capacitor or more likely cause its performance to fall outside its specifications.

Figure 1 - A class 1 disc ceramic capacitor
5 pF 1KV C0G (NPO)

Temperature Coefficient:

For one class of ceramic capacitor temperature coefficient specifies how much, and in what direction, the capacitance will change for a given change in temperature. These capacitors have a linear response to changes in temperature. For other classes of ceramic capacitors the capacitance change is not linear, and a temperature range is specified along with a ± tolerance over that entire temperature range. The temperature characteristics for both classes are given in a code like those shown in the first paragraph. For capacitors that change temperature linearly, the change is given in parts-per-million per degree change in Kelvin (ppm/°K). The Kelvin temperature scale has the same magnitude as the Celsius scale; however, the Celsius is based on the freezing point of water and the Kelvin scale is based on the absolute zero temperature. 0 °K = -273.15 °C.

Disc Capacitors:

We will hold our discussion to the common disc capacitors found in radios since the fifties (See figure 1). However much of this information relates to current ceramic capacitors. You will find the characteristic nomenclature is

Temp. Coef. 1st Letter		Multiplier Number		Temp. Tol. 2nd Letter	
C	0.0	0	–1	G	±30
B	0.3	1	–10	H	±60
M	1.0	2	–100	J	±120
P	1.5	3	–1,000	K	±250
R	2.2	5	+1	L	±500
S	3.3	6	+10	M	±1,000
T	4.7	7	+100	N	±2,500
U	7.5	8	+1,000		
Less Common Parameters					
L	0.8	4	–10,000		
A	0.9	9	+10,000		
V	5.6				

Table I - Class 1 Ceramic Capacitors
EIA Codes - All values in ppm/°K

used even on today's surface mounted ceramic chip capacitors.

To make things a little more difficult disc ceramic capacitors come in different classes and since it is human nature to complicate things, each class has its own standards. Yes, that's plural!

Class 1 Ceramic Capacitors:
Class 1 consists of smaller value capacitors such as might be used in resonant circuits. They offer stability, low loss and known temperature coefficients with good linearity. The upper capacitance range is on the order of one nF (1,000 pF or 0.001 µF). Their capacitance is independent of, and does not change from, applied voltage. Temperature characteristics are determined by the dielectric material used, and may be expressed in at least two formats, the newer EIA code or the older name code. Dielectric material of different formulas set the temperature linearity and characteristics. These dielectrics have low volumetric efficiency; thus limiting their capacitance for a given size (volume). They remain stable showing no aging tendencies.

Table I gives the EIA codes for type 1 capacitors. The code consists of a letter, followed by a number, followed by a second letter. The first letter specifies the temperature coefficient in ppm/°K. The number specifies a multiplier for the first letter. Multipliers of ±1, ±10, ±100 and ±1,000 may be specified. The second letter specifies the overall tolerance of the value given by the first two characters, and varies between ±30 ppm/°K and ±2,500 ppm/°K.

As an example, the S3N capacitor mentioned in the first paragraph will have a temperature coefficient of (3.3 times –1,000) or –3,300 ppm/°K with a tolerance of ±2,500 ppm/°K. Thus an S3N capacitor will change capacitance at least

Name	Temp. Coef.	Temp. Tol.	Equiv. EIA Code
P100	+100	±30	M7G
NP0	±0	±30	C0G
N33	–33	±30	S1G
N75	–75	±30	U1G
N150	–150	±60	P2H
N220	—220	±60	R2H
N330	–330	±60	S2H
N470	–470	±60	T2H
N750	–750	±120	U2J
N1000	–1000	±250	M3K
N1500	–1500	±250	P3K

Table II - Class 1 Ceramic Capacitors
Name Codes - & EIA Equiv. Values in ppm/°K

-800 ppm/°K, but no more than -5,800 ppm/°K. On the other hand a C0G capacitor will change capacitance between +30 and –30 ppm/°K.

Looking back in a 1963 Arrow Electronics catalog other codes were used to specify ceramic capacitor tolerances. Old-timers know what NP0 and N750 mean. These are the older "names" tolerances. They are still used often today. Table II gives the a list of them. Note that their tolerance is set by their name, and their temperature coefficient is given as the number in the "name". The letter(s) tell the direction of change "P" equals positive and "N" equals negative. The exception "NP" represents negative/positive and represents a temperature coefficient of zero (with a tolerance). Table II shows the "names" coefficient specifications along with their EIA code equivalent.

Figure 2 - A class 2 disc ceramic capacitor 0.022 µF 500V Z5U

One might wonder why there are all the different temperature coefficients. Getting an LC oscillator to limit its drifting during warmup and normal operations can be accomplished by using capacitors that drift in a way that is opposite the drift resulting from the other frequency determining components. This may be considered a black art by some, but in the fifties and sixties companies like Collins, National Radio, Hallicrafters, Hammarlund, Heathkit and others did a good job of using these capacitors to compensate for drift.

Other features of type 1 capacitors are that they are stable with age and their capacitance remains stable over a large voltage range. Their ratings are specified over a temperature range of 25 to 85 °C. However NPO (C0G) capacitors perform well between -55 and 125°C with a capacitance change of just over 0.5% or less. Figures 3 and 4 are charts of Class 1 capacitors vs. temperature.

Class 2 Ceramic Capacitors:

Class 2 consists of the mostly larger value capacitors from 0.002 µF up to 2 µF or so. Figure 2 shows a typical class 2 capacitor. These capacitors are normally used for bypass and coupling and are not used in frequency determining sections of a circuit. These capacitors are less stable temperature-wise and some even have microphonic tendencies. Neither of these tendencies is a problem in most bypass or coupling uses. Class 2 capacitors perform well at high frequencies and have reasonable capacitance changes with temperature. They also change capacitance with age and with changes in applied voltage. The dielectric material used in type 2 ceramic

Low Temp. 1st Letter		High Temp. Number		Tol. in Range 2nd Letter	
X	–55 °C	4	+65 °C	P	±10%
Y	–30 °C	5	+85 °C	R	±15%
Z	+10 °C	6	+105 °C	S	±22%
		7	+125 °C	T	+22/–33%
		8	+150 °C	U	+22/–56%
		9	+200 °C	V	+22/–82%
				F	±7.5%

Table III - Class 2 Ceramic Capacitors EIA Codes

capacitors is chosen for its better volumetric efficiency resulting in a lot higher capacitance for its size. However these dielectric materials vary with temperature in a non linear manner. Figures 5 and 6 are charts showing the capacitance change vs. temperature for some of the common class 2 types. The capacitance changes with frequency as well as applied voltage. Figure 7 is a chart of the change in capacitance vs. percent of rated voltage for nine common type 2 styles.

If one were designing a filter or oscillator requiring larger values of capacitance (thus at lower frequencies - audio, ULF and VLF ranges) one of the many types of film capacitors should be used instead of a type 2 ceramic capacitor.

Like the type 1 capacitors, the type 2 capacitors also have an EIA three character code. It is even made up similarly: a letter, followed by a number followed by a second letter. However, it is completely different from the type 1 specifications. The first digit specifies the minimum operating temperature, the number specifies the maximum operating temperature and the second letter specifies the capacitance tolerance over the range of temperatures from the minimum to the maximum temperature. Table III shows the specifications over the range that is of interest to most radio amateurs.

An example is the capacitor shown in Figure 2. It is clearly marked as Z5U. This signifies a low temperature of +10 °C and a high temperature of +85 °C; over that range the capacitance may vary between +22% and -58%. Thus a 0.022 µF Z5U capacitor will be within the range of about 0.027 µF down to about 0.010 µF over the temperature range of +10 to +85°C (+50 to +185 °F).

Likewise an X7R capacitor will be in the range of ±15% of its marked value over a temperature range of -55 °C to +125 °C (–67 to +257 °F).

Capacitance Change			Temperature	
CODE	ΔC/Co V=0	ΔC/Co V=R	CODE	Range
2B	±10%	+10/–15%	1	–55 to +125 °C
2C	±20%	+20/–30%	2	–55 to +85 °C
2D	+20/–30%	+20/–40%	3	–40 to +85 °C
2E	+22/–56%	+22/–70%	4	–25 to +85 °C
2F	+30/–80%	+30/–90%	5	–10 to +70 °C
2R	±15%	—	6	+10 to +85 °C
2X	±15%	+15/–25%		

Table IV - Class 2 Ceramic Capacitors IEC Codes

Common type 2 capacitors are X5R, X7R, X8R, X7S, Y5V and Z5U.

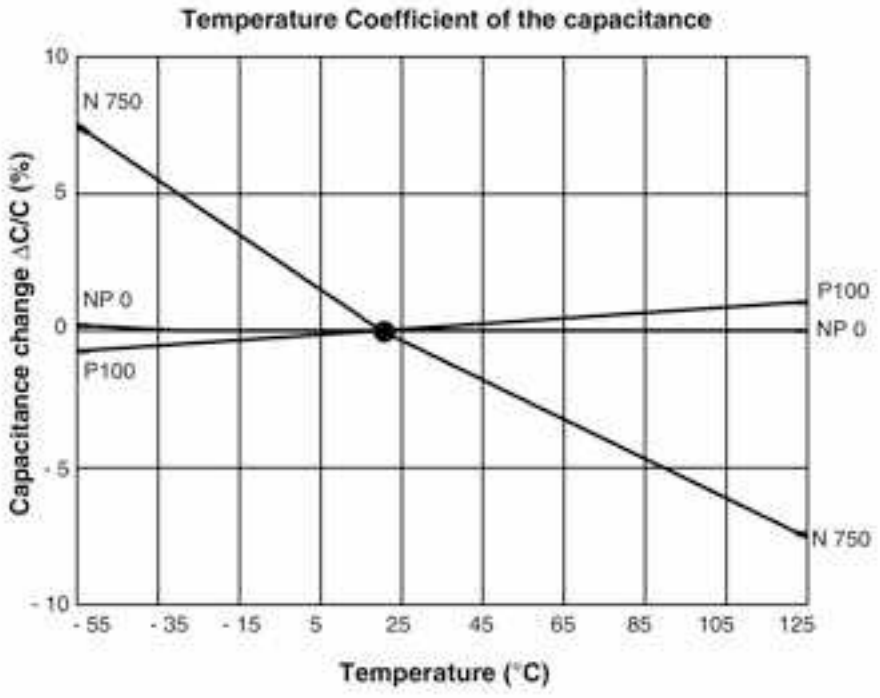


Figure 3: ΔC/C vs. °C for Class 1 N750, NP0 and P100

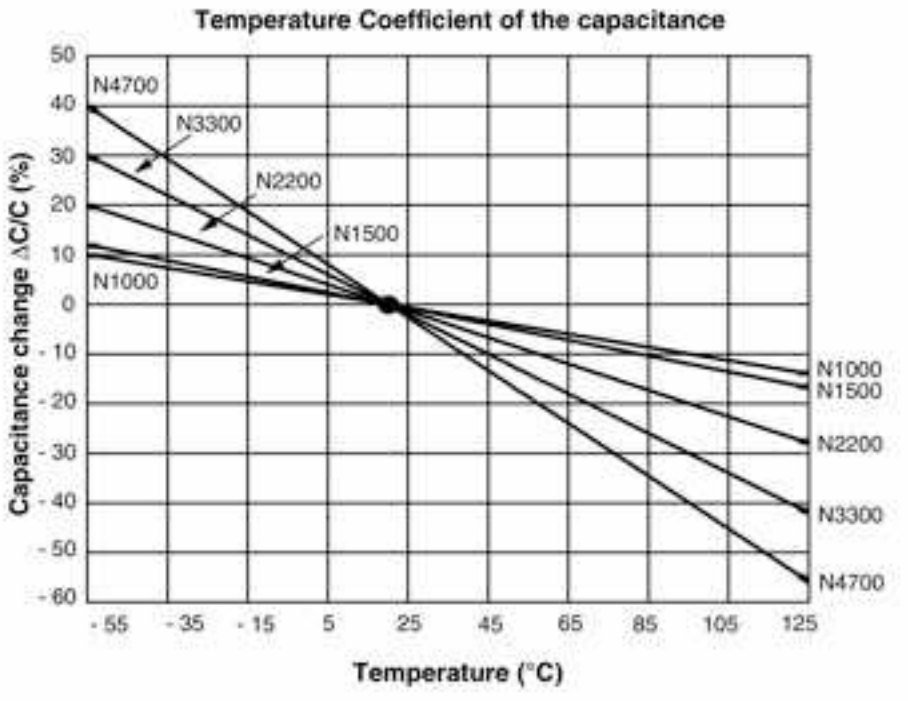


Figure 4: ΔC/C vs. °C for Class 1 N1000 through N4700 Capacitors

of its existence as it could be encountered at any time. Table IV shows the specification of this coding system. It consists of the number '2' followed by a letter and a second number. The letter designates the maximum capacitance change as a percentage of the nominal marked value (ΔC/Co) over the given temperature range. The actual temperature range is specified by the second number. Two different (ΔC/Co) ranges are given for each letter; one with an applied voltage of zero and one with the rated DC voltage applied.

A second coding system for specifying type 2 ceramic capacitors is published by the IEC under standard EN 60384. I have not come across capacitors so marked, but one should be aware

Not all EIA codes can be directly translated to IEC codes. The EIA Z5U capacitor of Figure 2 matches IEC's 2E6, but the EIA X7S is only close to the IEC 2C1. No IEC code exists for X8R.

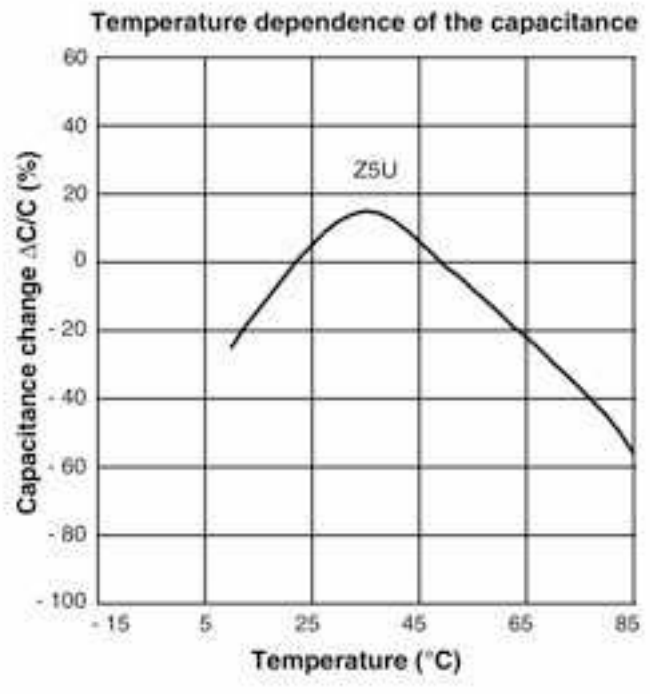


Figure 5: ΔC/C vs. °C for Class 2 Z5U Capacitor

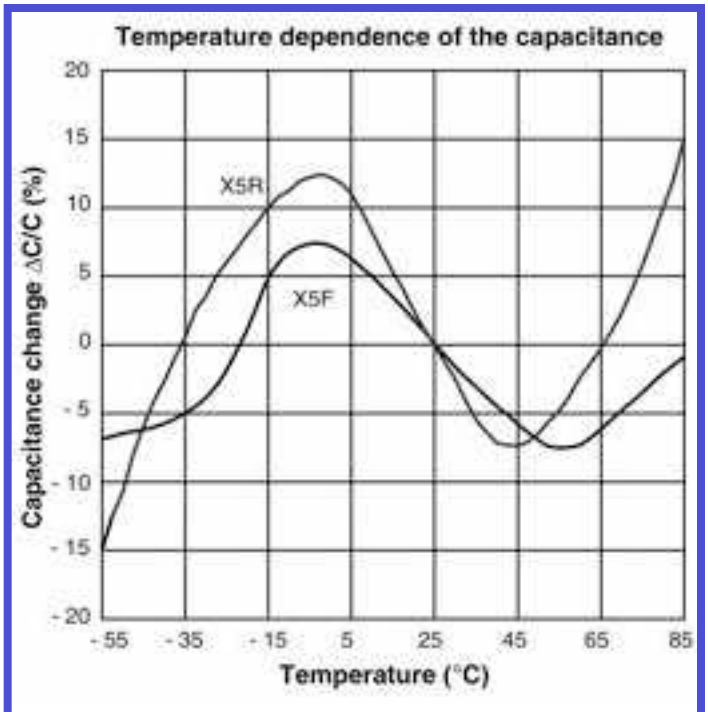


Figure 6: ΔC/C vs. °C for Class 2 X5R & X5F Capacitors

Code	Tolerance
C [1]	± 0.25 pF
D [1]	± 0.5 pF
J	± 5 %
K	± 10 %
M	± 20 %
Y	+ 50/– 20%
Z	+ 80/– 20%
P [2]	+ 100/– 0%

[1] Only for capacitors up to 10 pF
[2] Often designated GMV

Table V: - Standard Tolerances

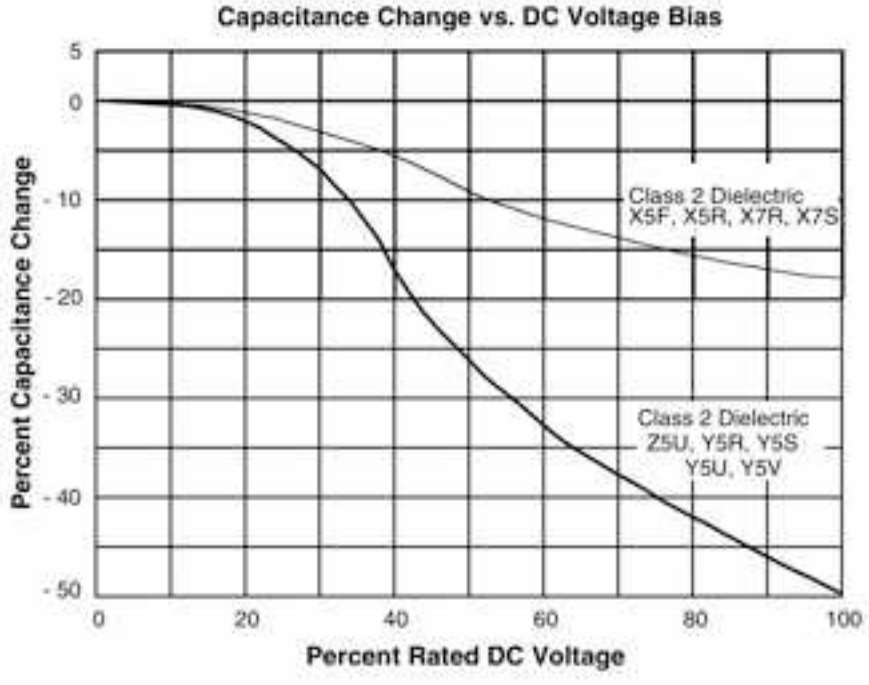


Figure 7: ΔC vs. Applied Voltage for numerous Class 2 Capacitors

Capacitor Tolerance:
Besides temperature dependent tolerances, capacitors also are rated for their tolerance at a particular temperature (usually at or near 25 °C). This represents the maximum deviation the capacitance will be from the marked value at the measuring temperature. The code is usually given by a single letter code as shown in Table V. These tolerance codes are the same as used on many other types of caoacitors

Summary:
So next time you are choosing a ceramic capacitor, keep this article in mind and spend a little time choosing the right capacitor for the job it will do. As usual, there is a trade off involving cost vs. selection.

Comments:
Back in Bob's TechTalk #43 and #44 I began a series on magnetism, coils, and inductance. It is hard to imagine that was back in 2010. I do plan to finish the series soon; I have already written the next installment, but need to refine it. Perhaps next month it will be ready and included in that issue of RF.

Previous articles in the Bob's TechTalk (Originally, just TechTalk) may be downloaded in PDF format from the OCARC website:

http://www.w6ze.org/btt/BTT_Index.html

I hope you find these articles useful and educational. I know I've learned a lot writing them. It is one thing to know something and it is another to know it well enough that you can describe it to others.

73, from AF6C

OCARC GENERAL MEETING MINUTES

2015-05-15

The OCARC General Meeting was held at the Red Cross Complex on May 15th 2015. The meeting was called to order at 7:00 PM. A quorum of officers was present with only Roland WW6RK absent. There were a total of 35 members and visitors in attendance.

Prior to the General Meeting beginning, professor Tim N6GP conducted a second hour-long Field Day University class to train hams new to FD what goes on at FD and how to correctly perform certain aspects of operating at FD, especially logging FD QSOs.

Professor Tim N6GP focused on FD logging during Field Day University training

Field Day

FD co-Chair Don N6XBP reported that plans were proceeding smoothly for FD….

1) Troop 440 from Buena Park will be joining us at FD this year…and have offered to cook the meals for OCARC at FD as part of their troop fundraiser.

2) Troop 440 has their own call letters - KI6ZPW

3) OCARC planned to charge $30 for 5 meals at FD with all proceeds going to Troop 440. OCARC will collect monies for pre-paid meals and will a write a check to the scouts for that amount.

4) Troop 440 plans to also cook a breakfast for Saturday morning, probably starting at 8:00 AM.

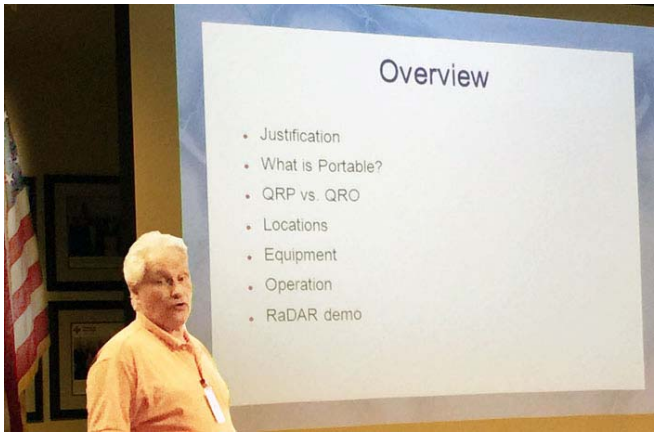
5) OCARC plans to build three rocket launchers to use at FD this year.

Program for General Meeting

Our speaker for the evening was OCARC member Nicholas Haban AF6CF talking on:

" Portable HF Operations…"

Nicholas AF6CF explained that there are many tradeoffs in portable operations.
(1) QRP or QRO? (more power normally means more weight)
(2) How heavy to carry?
(3) How difficult/complicated to set up?



Nicholas AF6CF describes many aspects of portable operations including some equipment choices

An important aspect to Nicholas is "fast set-up". This allows more operating time.

Nicholas demonstrates setting up a portable station in less than five minutes

Biz:

Technical Chairman – Prez Tim N6TMT explained that Roland WW6RK has resigned because he has a conflict with another commitment. N6TMT appointed Bob AF6C to be the club 2015 Technical Chairman.

Respectfully submitted by:
Ken W6HHC - secretary

OCARC
BOARD MEETING MINUTES
2015-06-06

The OCARC Board meeting was held at the Marie Callender's Restaurant on Grand Ave in Santa Ana on June 6th, 2015

Present: President Tim Millard N6TMT; Vice President Tom W6ETC; Membership Don N6XBP; Treasurer Greg W6ATB; Activities Doug K6PGH; Publicity Robbie KB6CJZ; Technical: Bob AF6C; Director at Large Nicholas AF6CF:Director at Large Paul W6GMU. Also present member Corey KE6YHX; visitors Steve Davis, and Boy Scout Troop 440 Leaders Cheyenne KK6MSK & Star La Rogers KI6SHG.

Director Reports:

- President: Tim N6TMT in contact with HAM operator from Canada wanting to participate in FD.
- Vice President: Agreement with Walter Knott Ed Ctr. signed by all parties. FD planning is nearing final stages. Recommend flyers be designed for Show & Tell members meeting in November.
- Treasurer – Greg W6ATB will provide receipt #'s for membership roster reconciliation process. P.O. box rental has been paid.
- Membership: Don N6XBP Revised roster is almost up to date. Missing receipt numbers for members paid for 2015 in 2015. Greg will research.
- Activities: Doug K6PGH commented FCC no longer sending paper copies of amateur license & licensees can print themselves.
- Technical: Bob AF6C will send $50 donation on behalf of club for previous motion to nonprofit in memory of Ken W6HHC wife (deceased). Motion made to add to audit list of prepaid members for next year in current year and monies received is reconciled.
- Director at Large: Nicholas AF6CF & Paul W6GMU comments were related to club raffle.

OLD BIZ:

- **Newsletter Editors**

Jun Tom W6ETC; Jul Nicholas AF6CF; Aug Tim N6TMT; Sept Paul W6GMU; Oct Corey KE6YHX; Nov Greg W6ATB; Dec Bob AF6C

- **Program Speakers for Club Meetings**

June will be Chip K7JA; July Bill K6ACJ; August - Panel of Experts (maybe); September-Pending; October-Auction; November-Show and Tell; December-Club Christmas Party

New Business:

- Discussion reviewing who has paid dues & how to pass the info for out-going treasure/membership in an incoming treasures/membership
- Discussion of status of Field Day planning.
- Field Day co-chairmen agreed that planning is going well and Band Captains are preparing for their FD tasks. Discussion regarding details related to commitments to Boy Scout Troop 440 for food & menu. BSA Troop 440 expects to participate on the air during FD (access to GOTA & other stations).
- Scout Troop will take care of meals. Cost as follows:
  5 Meals (Fri-Sat-Sun) Price $30.00
  4 Meals (Sat-Sun) Price $25.00
  Individual Meals Price $7.50

The club will collect money from the members along with designating which type of meal group each club member purchased and will give the money to the scouts. The scouts will give the club the appropriate number of wrist bands of each type to be given to the members who purchased them.

The club will by 5 additional meal passes from the scouts for $7.50 each to be used for VIP visitors.

The Scout Troop will supply colored wrist bands for the 5 and 4 meal purchasers.

The club plans to supply coffee and water, tea & hot chocolate for the hours the scouts are not on site (late night/early morning of event). Club to budjet $100 cost of coffee, tea, hot chocolate and a check to the scouts to purchase supplies for off hours. They will also set up a "Trading Post" offering snacks for a fee.

The Board reviewed the and approved the proposed menu for Friday evening through Sunday morning.
Motion carried unanimously.

The scout troop requested a walk thru of the site prior to Field Day / 21st of June was agreed date. Time TBD.

FD 2015: Ron Murdy will help pickup the large club generator.Gene will get the ramps for generator loading Tim M. will take over making the remaining two rocket launchers. Tim G. agreed to handle the software requirement of band captains and collection of critical files and consolidating it into a report to file with ARRL as required.

Band Captains mtg to be scheduled Sat. June 27th prior to FD event to review last minute software instructions and station mgt processes. Confirm sprinkers are turned off during event and obtain keys ASAP.
Meeting adjourned @ 9:44AM

Submitted by – Don N6XBP (acting secretary)

Estate Sale of Phil KI6VEN (SK)

Check the FOR SALE link on club web site for current status of these items. If anyone is interested in any of these items, Please contact me at 714-573-2965 or N6HC@aol.com Thank you, Arnie N6HC

Yaesu FTdx5000…….	~~$3,800~~ SOLD
Yaesu SM-5000 station monitor…….	~~$ 275~~ SOLD
Yaesu Speaker & filters…….	~~$ 100~~ SOLD
Yaesu DMU-2000 data management unit…	~~$ 725~~ SOLD
Ameritron AL-80B with Grid overload protection Boar…	~~$1,050~~ SOLD
Yaesu FT-2000D…	$2,200
Yaesu MH31B8 Microphone…	$ 45
Yaesu SP-2000 External Speaker…	$ 100
Yaesu Remote Control Keypad…	$ 65
Yaesu FP-2000 power supply…	$ 350
Yaesu FT-301D …	~~$ 150~~ SOLD
Yaesu FP-301 power supply…	~~$ 50~~ SOLD
Kenwood TS-850S …	$ 650
Kenwood SP-31 Speaker …	$ 50
Drake R4B and MS-4 Speaker …	$ 230
Drake R4C and MS-4 Speaker …	$ 370
Astron RS-12A …	$ 50
Astron RS-50A…	$ 200
Timewave DSP-59+ …	$ 175
Hallicrafter S82 FM 30-50 MHz receiver…	$ 50
Vertex MLS-100 mobile speaker…	$ 45
GE 40 channel CB radio station Help 34-5908, 4 watts …	$ 40
Palstar AT-2K antenna tuner …	~~$ 400~~ SOLD
Dentron Jr. antenna tuner …	$ 40
Dentron Super Super antenna tuner AT-3KW (10-160M) …	~~$ 175~~ SOLD
MFJ 945-D antenna tuner (30-300W) …	~~$ 60~~ SOLD
LDG memory tuner AT-200-Pro (5-200W) 6-160M …	~~$ 150~~ SOLD
MFJ 1700-C 6 position antenna switch / surge protector …	$ 60
Heil Headset with microphone …	$ 100
Sony Stereo Headphones MDR-V700 …	~~$ 200~~ SOLD
Telex C-1320 headset (20 ohm) …	$ 30
Telex C-610 headset (16 ohm) …	$ 30
MFJ-392B headset …	$ 15
Coby Headphones CV-195 noise cancelling …	$ 35
MFJ 462B multi-reader…	~~$ 100~~ SOLD
Signalink – Tigertronics Radio Interface & Sound card with Yaesu cable …	$ 60
Heathkit HO 1416 code practice oscillator …	$ 20
QSA-805 Dynamic microphone …	$ 100
Labtec AM-22 microphone …	$ 4
Panasonic microphone …	$ 4
Astatic D-104 with T-UGB stand …	~~$ 75~~ SOLD
Astatic DN-HZ microphone …	$ 145
GE regulated Power Supply Model 5-1210, 13.8V – 2.5A …	$ 40
P3 International Kill A Watt Electronic usage monitor …	$ 10
Yaesu – YSK-7800, Separation Kit …	$ 6

Vertex Standard CT-119 programming cable …	$ 30
Pace P-5453 dual meter (SWR, Field strength,)…	$ 25
Micronta triple meter (SWR, Field strength, modulation) 21-522 …	$ 25
Tektronix Oscilloscope T-922 …	$ 150
Alliance dual speed rotator controller …	$ 28
Cushcraft MA-5 B antenna …	$ 250
Cushcraft R-7 Vertical …	~~$ 100~~ SOLD
Rohn Tubular mast…	$ open
Ronard "Y" type chimney mount No. 15-1218 …	$ 15
Polyester antenna rope 100 ft 3/32" …	$ 8/ea
Longines Symphonic Portable Short Wave radio …	$ 25
Grundig 4070 U AM/FM/Short Wave radio (circa 1964) …	~~$ 200~~ SOLD
Harbor Freight 580 Pc terminal set …	~~$ 5~~ SOLD
Guardian camp lantern GN-60115 with AM/FM radio …	$ 10
Osaka Koha Voltage adjuster Model IV-300N …	$ open
Bushnell Citation Insta Focus binoculars …	$ 15
Drill Master Cordless Drill with Flashlight 18V # 69652 …	$ 15
Sony Infrared Receiver PCVA-IR8U …	$ 5
HP 20" Flatscreen LCD W2071D with LED backlight …	~~$ 75~~ SOLD
Viewsonic 19" LCD flatscreen VX1962WM …	$ 100
Western Digital "My Book Essential" external 3 TB hard drive …	$ 75
RT Systems USB-63 (USB to DB9 interface cable) …	$ 15
Shaxon USB 2.0 AM-AF cable – 6 ft - …	$ 2
I dot connect USB 3.0 AM-AM cable – 10 ft - …	$ 5
Sabrent USB – floppy disk drive Model SBT-UFDB …	$ 10
Diamond multimedia Wireless-N USB adapter …	$ 15

Silent Key Announcement

Lloyd T Harwood WB6ULU (SK)

by Ken Simpson W6KOS

Lloyd (Whiskey Bravo six Ugly Little Urchin) passed away Saturday morning April 25 at the age of 89. He will be missed.

He has been a long time member of OCARC and supporter of Amateur Radio for many years.
I first met Lloyd in 1981 as a member of West Coast ARC. While a member he served as a Volunteer Examiner in the early stages of that program. He also for a time served as a local Worked All States Awards Manager for the ARRL. Lloyd was also a member of the Hospital Disaster Support Communications System for a time.

I am uncertain on how long Lloyd was a member of the Orange County ARC. Increasing mobility and health problems finally led to Lloyd becoming a shut-in. Lloyd limited his club activities to the Orange County ARC which was closer to home and was convenient for friends such as Ken Simpson W6KOS for transportation to and from the meetings. He will be missed at the Orange Café for his regular Monday morning breakfast with W6KOS where he enjoyed being fussed over by the owner and waitresses. He remained active on HF until he had to move to an assisted living facility shortly before his death.

Anyone wishing to send a card to his family can send it to me and I will see that his daughter who lives in Fullerton will receive it. My address is good in the call book.

HAMCON 2015

HAMCON 2015

The 2015 ARRL Southwestern Division Convention is September 11-13, 2015, at the Torrance Marriott South Bay Hotel, 3635 Fashion Way, Torrance, CA 90503 .

Check our website at:

www.hamconinc.org

HAMCON 2015--also the 2015 ARRL Southwestern Division Convention-- is produced by 13 amateur radio clubs in Los Angeles and Orange Counties committed to providing a positive convention experience for all attendees.

The ARRL's annual Southwestern Division Convention rotates yearly from the Los Angeles-Orange County area to a location in Arizona, then to a site in Santa Barbara or Ventura County, and finally to the San Diego area before repeating this four-year cycle. The ARRL's Southwestern Division includes the Southern California counties of Imperial, Inyo, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura as well as the entire state of Arizona. It is 2nd largest of the ARRL's 15 Divisions in terms of amateur radio licenses issued—only the ARRL's Southeastern Division (all of Alabama, Florida, and Georgia) has slightly more amateur licenses outstanding.

We welcome all amateur operators to HAMCON 2015 during September 11-13, 2015, at the Torrance Marriott South Bay Hotel.

You don't need to be an ARRL member to attend and hams living outside the ARRL's Southwestern Division are also invited. No matter what you're amateur radio experience level we're sure you will find
many topics, products, and people of interest at HAMCON 2015.

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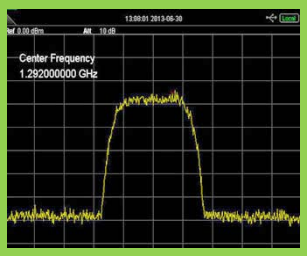

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