



# RF

NEWSLETTER



ORANGE COUNTY AMATEUR RADIO CLUB, INC.

VOL. LIX NO. 03

P.O. BOX 3454, TUSTIN, CA 92781-3454

March 2018

## The Prez Sez.....

by Tim N6GP



The big news of the month is that Dr. Arnie Shatz, N6HC returned safely home on Feb. 19<sup>th</sup>, after being at sea for 31 days on the Bouvet Island DXpedition. He and the other expeditioners were extremely disappointed that they weren't able to land on the island and operate. He is looking forward to the Baker Island expedition in June. I hope he is able to make it to our General Meeting this month, so we can personally welcome him back.

Over 600 logs have been submitted for Winter Field Day, and the processing of the logs has begun. Hopefully the results will be published more rapidly this year, and we will know by May or so.

Planning for June Field Day has already begun, with Ron W6WG leading as Field Day Chairman. Our Field Day will be a little bit bigger this year for our 85<sup>th</sup> anniversary, and because we may have a few more operators available. We will have our first planning meeting on Wednesday April 4, and you are all invited.

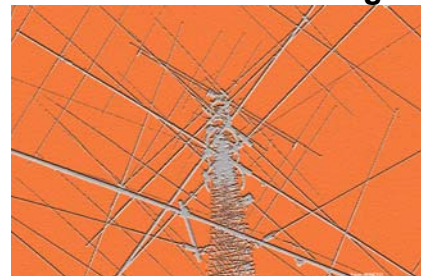
I am proud of our club, that so many of our members are providing communications for the police officers of the City of Orange in the upcoming Baker To Vegas (B2V) race. Our members in the COAR group provide a great service to the support teams over the difficult terrain.

Because this event conflicts with our General Meeting this month, our meeting is moved from **March 16h to March 23<sup>rd</sup>**. We hope to hear good things from those that participated at the Baker-2-Vegas event.

Also, I'm looking forward to Tim Duffy K3LR presentation via Skype. He is a great speaker, and he and his team have perhaps the premier US contest station. It looks incredible! Come join us.

Tim Goeppinger N6GP  
President

## Next General Meeting



The March 2017 OCARC General Meeting program will be presented by:

**Tim Duffy K3LR**

Topic will be about the amazing K3LR Contest Station presented via Skype

*The next General Meeting will be on:*

**Friday, \*March 23rd, 2018  
@ 7:00 PM**

ENTER from the WEST SIDE entrance of the Red Cross Building, Room 208  
Take elevator to the 2<sup>nd</sup> Floor. See you there! \*Revised

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### Submit articles:

[editors@w6ze.org](mailto:editors@w6ze.org)

## 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. & 4<sup>th</sup> St.)

### Club Breakfast (Board Mtg):

Normally First Saturday of month at 8am  
Marie Callender's Restaurant  
1821 North Grand Ave  
Santa Ana, CA  
(Between 17<sup>th</sup> & Santa Clara)

### Club Nets (Listen for W6ZE):

28.375 ± MHz SSB  
Wed- 7:30 PM - 8:30 PM  
Bob AF6C, Net Control  
Alt: Corey, KE6YHX, Net Control

146.55 MHz Simplex FM  
Wed- 8:30 PM - 9:30 PM  
Corey, KE6YHX, Net Control

7.086 ± MHz CW **OCWN**  
Sun- 9:00 AM – 10 AM  
Ann K6OIO, Net Control



### Club Dues for 2018:

Regular Members renewals\* - - - \$30  
Family renewal/Join\*\* - - - - - \$45  
New Member Join Jan-Feb\*\*\* - - \$30  
Replacement Badge\*\*\*\* - - - - - \$ 3

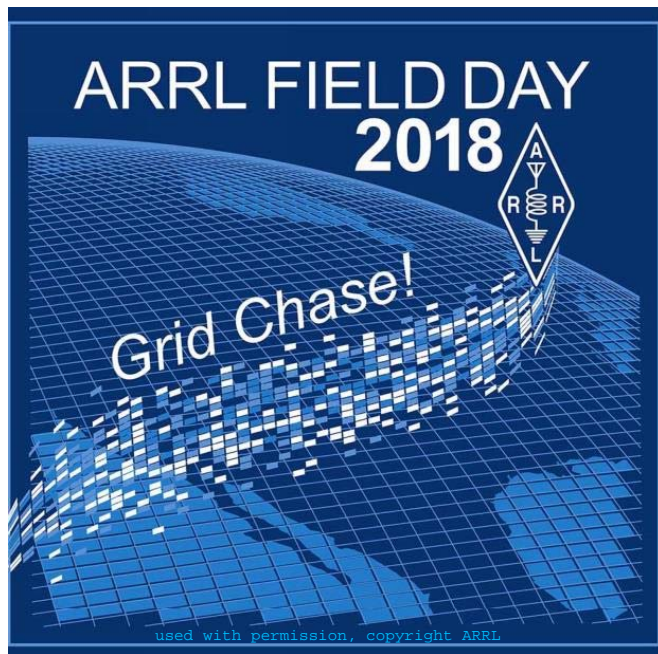
\* Member renewals Jan-Dec.

\*\* Two members or more, w/badge.

\*\*\* New members Jan-Mar, w/badge.

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





# Field Day 2018

Believe it or not, it's **time to start planning** for OCARC's participation in the "event of the year", the 2018 ARRL Field Day. OCARC will mark its 85<sup>th</sup> Anniversary in 2018. What better way to celebrate this milestone than to make a statement with our skills and organization and to have another outstanding Field Day performance.

Field Day is a great time to really get to know your fellow OCARC members and learn from their knowledge and experience. It's also a good time to pass on to others what you know about amateur radio and emergency preparedness. The increased comradery and exchange of ideas will strengthen our club and help it last another 85 years.

Our **first planning meeting will be on Wednesday April 4th, 2018**. The time and location of the meeting will be 6:00 pm at Tim's, N6GP, home located at 18122 Estes Way, Santa Ana. The meeting agenda will focus on the assigning Band Captains and "Coordinators".

As in the past the Band Captains will be responsible for the organization of their particular operating station, its operators and equipment. The new positions of Coordinators will be to aid the Band Captains with acquiring the needed rigs, shelters, power, computers, etc. There are multiple positions to fill and each position contributes to the success of OCARC. Hope to see there.

Submitted by,

Ron, W6WG, 2018 Field Day Chairman



## Radio~Activity Opportunities



*Dates and Activities well worth considering...*

### MARCH

- **Russian DX Contest:** 1200 UTC Saturday March 17 through 1200 UTC Sunday March 18
- **\*CQ WW WPX / SSB:** 0000 UTC Saturday March 24 through 2359 UTC Sunday March 25

### APRIL

- **Rookie Roundup:** Sunday April 20, 1800 UTC through 2359 UTC.
- **10-10 International Spring Contest/Digital:** 0001 UTC Saturday April 28 through 2359 UTC Sunday April 29

\* Indicates club entries are accepted

\*\* Indicates team entries are accepted

Note: When submitting logs for ARRL Contests indicate your club affiliation as "Orange County ARC"

### *Continuing Activity:*

- **ARRL International Grid Chase**  
January 1, 2018 through December 2018

### *Repeating Activities:*

- **Phone Fry** Every Tuesday night at 0230Z to 0300Z
- **SKCC** Weekend Sprintathon (Straight Key CW) on the first weekend of the month after the 6<sup>TH</sup> of the month. 1200 Sat. to 2359Z Sunday.
- **SKCC** Sprint (Straight Key CW) 0000Z to 0200Z on the 4<sup>th</sup> Tuesday night (USA) of the month.

To have your favorite activity included  
in next months *Radio~Activity* column  
send an email to Ron W6WG, [w6wg@w6ze.org](mailto:w6wg@w6ze.org)





[Click Here](#) to renew membership dues or to become a new member!

<http://www.w6ze.org/MemberForms/RenewForm.html#a2rf>

## IMPORTANT ANNOUNCEMENT



THE **MARCH** OCARC  
**GENERAL MEETING**  
ORIGINALLY SCHEDULED FOR MARCH 16,  
HAS BEEN  
**RESCHEDULED TO**  
THE FOURTH (4<sup>TH</sup>) FRIDAY  
**MARCH 23<sup>rd</sup>\***



*\*This is primarily due to numerous OCARC members involvement with the COAR Bake-2-Vegas (B2V) Event Friday March 16<sup>th</sup>.*



## USE ALEXA TO TELL YOU BAND CONDITIONS



Pavel Anni

22 hrs

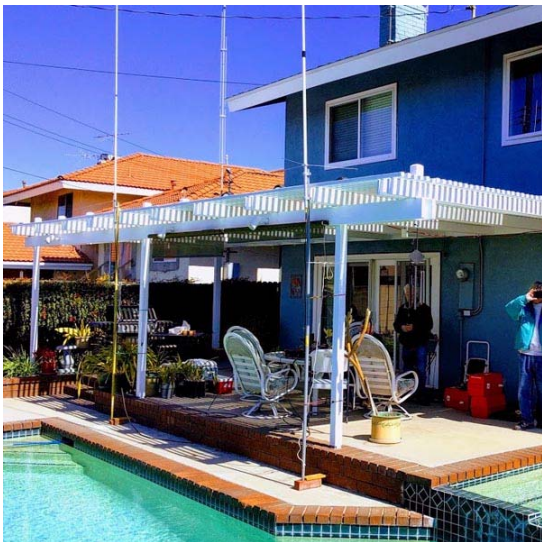
Ask Alexa about band conditions! I used the website [bandconditions.com](http://bandconditions.com) created by Biz K5BIZ and developed this simple Alexa skill to report about current band conditions. You can enable (install) this skill on your Alexa here: <https://www.amazon.com/dp/B07B8GS5L3/>  
The source code (Python + Flask-Alexa) is here: [https://github.com/pavelanni/band\\_conditions](https://github.com/pavelanni/band_conditions)  
Feel free to ask me questions, share your feedback and ideas on how to improve the application.  
73 de AC4PA



## Orange PD RACES test their equipment for Baker-2-Vegas Race by Ken W6HHC

Each year, over 250 different law enforcement teams compete in a 120 mile long relay-race through the desert between Baker-Shoshone-Pahrump-Las Vegas. The **City-of-Orange RACES team** spend several months planning and **preparing to support the Orange Police running team**. In addition to planning, preparations include testing all of the equipment that will be used at the five communications centers set-up by City-of-Orange RACES and the mobile operators.

Here are some photos taken on February 26 of testing-work-session for equipment to be used at Pahrump, NV communications center. The work-session was held at the QTH of Ken W6HHC.



The equipment to be used at Pahrump was set up in the back yard of W6HHC. The left antenna (2M) and the right antenna (2M/440) will be used for APRS and for voice.

(photo by Quent W6RI)



The SWR of both antennas was being measured by Ken W6HHC

(photo by Quent W6RI)



Ken offered bratwurst, Tom brought pastries. Tom W6ETC assisted with the grilling of bratwurst during the lunch time break. (photo by Bob AF6C)



"If you cook them, they will come." Enjoying lunch time are (R-L) Ken W6HHC, Quent W6RI, Jeff KK6YUP, Nicholas AF6CF, Cliff KG6MIG, Kris W6KJC, past-COAR-and-OCARC member Bruce KC6DLA, and Bruce's wife - Ann. (photo by Bob AF6C)



## Amateur Radio Instruction Opportunities

# Amateur Radio Technician Class

**Do you know someone who wants to earn a  
*Amateur Radio* license?**

Tuesday evening classes are being offered to assist those wanting help in a structured classroom environment to pass the Amateur Radio 'Technician' License the 'est. The Technician class license is the entry-level license of choice for most new ham radio operators. To earn the Technician license requires passing one examination totaling 35 questions on radio theory, regulations and operating practices.

This class is taught by past-OCARC member, Bob Maller WT6A. Register now online.

## Irvine Valley College

5500 Irvine Center Drive, Irvine, CA 92618

Tuesday Evenings staring April 10th through to May 8<sup>th</sup>

**by Bob Maller WT6A**

### ARTS & HOBBIES

#### Amateur Radio

Talk to interesting people around the world without a telephone. Help direct emergency relief after an earthquake or other natural disaster. Become a radio amateur! This course will introduce you to the fascinating world of amateur radio as it instructs you in the material required to pass the FCC Technician Class license examination. Learn basic electronics and government regulations. Only elementary math skills are used. No previous knowledge of electronics is required.

Fee: \$60 + \$30 materials fee payable at first class

Instructor: Bob Maller **WT6A**

7-9pm TU 4/10-5/8 CEC 3

**register at:  
IVC.Augusoft.net**



The license gives access to all Amateur Radio frequencies above 30 megahertz, allowing these licensees the ability to communicate locally and most often within North America. It also allows for some limited privileges on the HF (also called "short wave") bands used for international communications.



# UPCOMING EVENTS

**\*March 23<sup>rd</sup>, 2018 General Mtg.**

**SPECIAL DATE CHANGE**

(see 'ANNOUNCEMENT' above)

## **DX Engineering Presentation: via Skype K3LR Contest Station**

Tim Duffy, K3LR, from DX Engineering will present via Skype. The topic will be an introduction to the amazing Multi K3LR contest station.

**April 20th, 2018 General Mtg.**

**Cliff Guice, KG6MIG**

**"Near Vertical Incidence Skywave – NVIS"**

Cliff, KG6MIG, has been interested in **NVIS** for many years. He has collected historical and practical information and has studied and tried its use in various situations. Cliff

also envisions additional uses possibly for the upcoming Baker-2-Vegas race.

**May 18th, 2018**

**Marty Woll, N6VI**

**"Troubleshooting for the Non-Techie Ham"**

Marty, N6VI, is a prolific radio operator and is always willing to give presentations on many subjects at many events.

In this talk he presents that with the ability to solve a radio problem on the fly is what distinguishes Hams from almost all other radio users and is an invaluable skill whether you're into EmComm or DXpeditions.

This talk gives non-engineers a practical, systematic approach to "making it work".

**For the most current Upcoming event information go to the OCARC EVENTS website: <http://www.w6ze.org/Events.htm>**

## **What is an Elmer?**

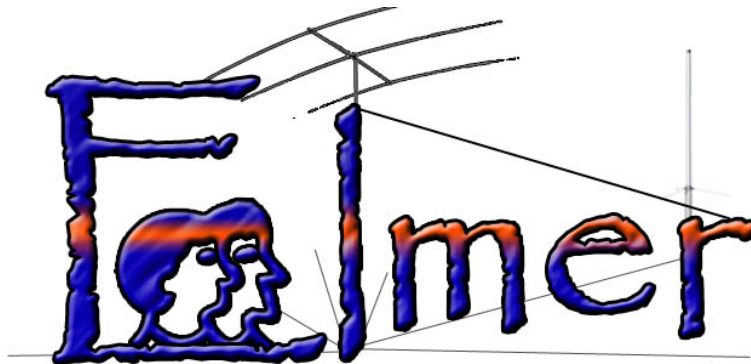


Image by Tom W6ETC

**Someone who provides personal guidance  
and assistance to would-be hams.**

Please consider being an Elmer to members (new and old) of the OCARC  
and to the Local Amateur Radio Community?



## Heathkit of the Month #83: by Bob Eckweiler, AF6C



### AMATEUR RADIO - SWL

#### Heathkit HG-10 / HG-10B Variable Frequency Oscillator (VFO)

##### Introduction:

Last October the Heathkit VF-1 VFO was covered (HotM #79). This VFO, originally built and styled for the AT-1 transmitter, also worked with the DX-20, DX-35 and DX-40 ham transmitters. In 1960 Heathkit replaced the DX-40 with the DX-60. Besides some technical changes, the DX-60's styling was modernized. With minor changes the VF-1 would work with the DX-60 though they clashed in appearance. VFOs were very popular at the time since novice class licensees were required to be crystal controlled ("rock-bound") until they upgraded to the general class license, at which time they could use a VFO to easily change the transmitter frequency. In 1972 the rules changed due mostly to technological advances and the crystal controlled requirement was dropped.

The popularity of the DX-60, and of VFOs in general, influenced Heathkit to design a completely new VFO for the DX-60. The result was the Heathkit HG-10 (Figure 1), and it was a marvel of springs, dial string and gears. The VF-1 sold for \$19.95, but the HG-10 was released in 1961 with a price tag of \$34.95. The HG-10 was produced for seven



Figure 1: Heathkit HG-10 VFO

years before, in 1966, it was replaced with the HG-10B (Figure 2).

##### The HG-10 VFO:

The HG-10 includes many changes over the older Heathkit VF-1 besides styling. The older VF-1 covers the 160-meter band as well as the (then) amateur 11-meter band. These

#### HG-10 / HG-10B FREQUENCIES

##### Freq. Range 1:

Band (M)	Band (mc)	VFO Freq. (mc)	x
80	3.500 - 4.000	3.500 - 4.000	1

##### Freq. Range 2:

Band (M)	Band (mc)	VFO Freq. (mc)	x
40	7.000 - 7.425	7.000 - 7.425	1
20	14.000 - 14.850	7.000 - 7.425	2
15	21.000 - 22.275	7.000 - 7.425	3
10	28.000 - 29.700	7.000 - 7.425	4

##### Freq. Range 3:

Band (M)	Band (mc)	VFO Freq. (mc)	x
6	50.000 - 54.000	8.333 - 9.000	6

##### Freq. Range 4:

Band (M)	Band (mc)	VFO Freq. (mc)	x
2	144.000 - 148.000	8.000 - 8.222	18

##### Notes:

1. x is the multiplication factor that occurs in the transmitter.

Table I - HG-10(B) Band Operation

Here is a link to the index of Heathkit of the Month (HotM) articles:

[http://www.w6ze.org/Heathkit/Heathkit\\_Index.html](http://www.w6ze.org/Heathkit/Heathkit_Index.html)

bands are both missing from the HG-10. Instead, the six and two-meter bands have been added. The older VF-1 has three individually calibrated frequency ranges while the HG-10 has four. These are shown in table I.

Frequency is read on a slide-rule dial. The tubular dial drum has a separate scale for each of the seven bands; the illuminated drum rotates with the band switch so only the scale for the band in use is visible. The HG-10 dial window is about 5-1/2" wide and the actual marked scale measures 4-5/8" (for 7.0 to 7.425 mc). Since 40-meters through 10 meters all use the same basic 7.000 - 7.425 frequency range, the length of the in-band portion of the scale is different for each band. The 10 meter band uses the full scale length, while 40-meters uses 70%, 20-meters 40% and 15-meters 35%. The other three bands, since they each have a custom frequency range, use 100% of the scale.

The VFO tuning uses a 28:1 vernier gear drive. The gears are anti-backlash. Though not complicated to build, due mostly to Heathkit's ability to produce clear assembly manuals, when you were done you might feel like you could fix your car's transmission. Specifications for the HG-10 are given in table II.

The B+ power requirements for the HG-10 are a little more complicated than the speci-



**Figure 2:** The Later Heathkit HG-10B VFO

### HG-10 SPECIFICATIONS (from Heathkit Ass'y Manual)

<b>Output Frequencies:</b>	<b>3500 - 4000, 7000 - 7425.</b> (kilocycles)
<b>Calibrated Bands:</b>	<b>80-40-20-15-10-6-2 M</b>
<b>RF Output:</b>	<b>&gt; 5 volts RMS (open ckt.)</b>
<b>Load Impedance:</b>	<b>&gt; 50 K<math>\Omega</math></b>
<b>Tube Complement:</b>	<b>1/2 6CH8 Oscillator (P) 1/2 6CH8 Cath. Follower (T) 0B2 Voltage Regulator</b>
<b>Power Requirements:</b>	<b>6.3 V AC at 0.75A 108 V DC at 25 mA (See text)</b>
<b>Cabinet Size:</b>	<b>9-3/8" W x 6-1/2" H x 9-1/8" D</b>
<b>Net Weight:</b>	<b>9-1/2 lbs.</b>

**Table II - HG-10 / HG-10B Specifications**

fications make them out to be. If you connect the HG-10 to 108 VDC B+ voltage you will have a problem. The 0B2 voltage regulator tube regulates at 108 V and it is connected to the B+ input through a 10K resistor. That resistor is going to drop some voltage and the 0B2 will not fire and thus not regulate. The DX-60/(A)/(B) and HW-16 provide about 300 - 350 VDC to their rear connector where the HG-10 is designed to plug in. With the internal 10K resistor these voltages will fire the 0B2 and keep the voltage at 108 VDC while drawing around 19 to 25 MA from the host. The older DX-40 provides 600 VDC to the rear connector, but it has a 15K 10W resistor in series with the wire to the connector. To use the DX-40 with the 15K resistor (IN THE DX-40) should be replaced with a 10K 10W resistor. The 10K 10W resistor in the HG-10 also needs to remain. The HG-10(B) manual presents a table that specifies the resistor size you should use in place of the



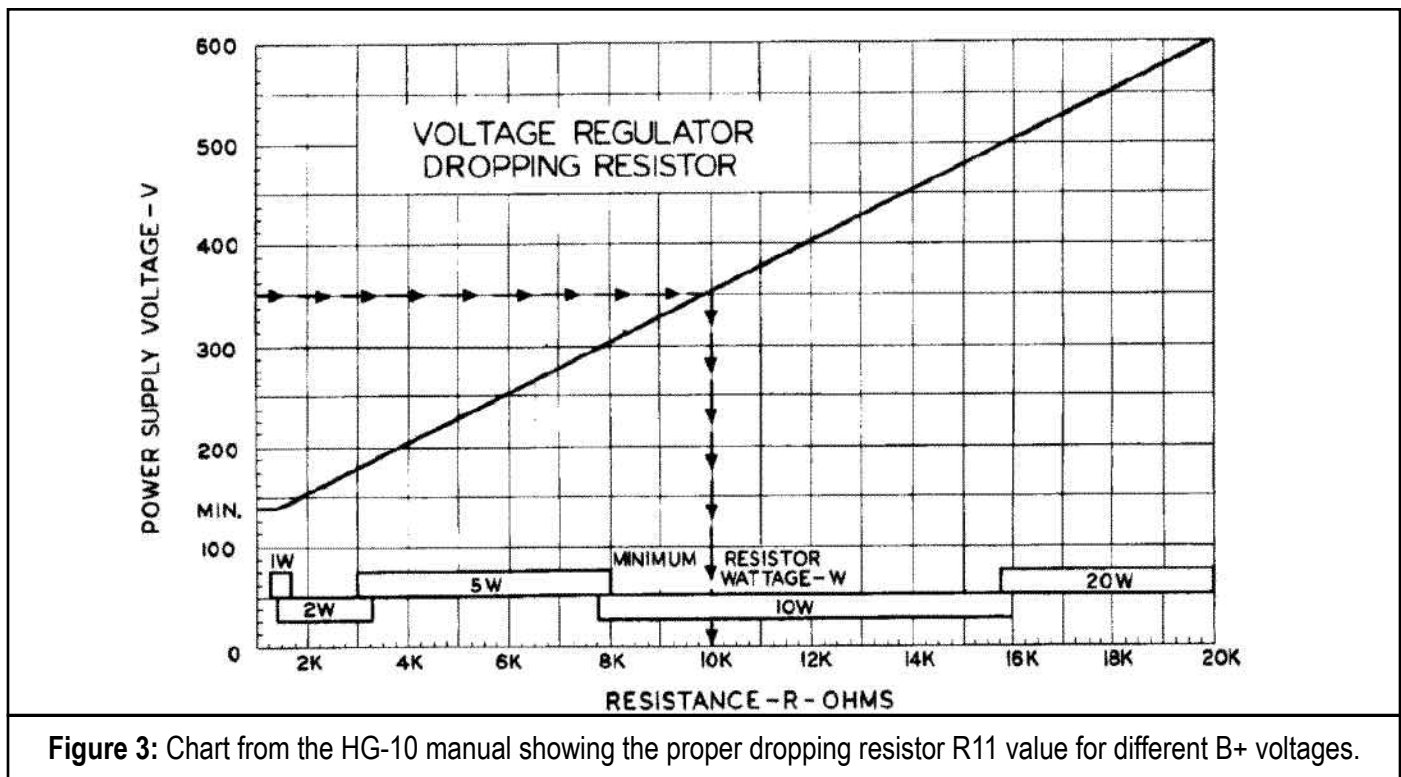


Figure 3: Chart from the HG-10 manual showing the proper dropping resistor R11 value for different B+ voltages.

10K 10W resistor in the HG-10 for other B+ voltages. This graph is shown in Figure 3.

### The HG-10B VFO:

In late 1966 Heathkit update the HG-10 to the HG-10B. Why there was no HG-10A is a mystery. However, the HG-10B came out around the time the DX-60A was replaced with the DX-60B, so maybe Heathkit wanted people to think that the new VFO was designed as a match to the DX-60B. And, while it is true the HG-10B has at least one minor circuit modification, most of the changes were paint and styling changes to match the new DX-60B. Most obvious is the paint which went from smooth to textured, and the colors that changed slightly; both features that also changed in the upgrade to the DX-60B.

### The HG-10B Controls:

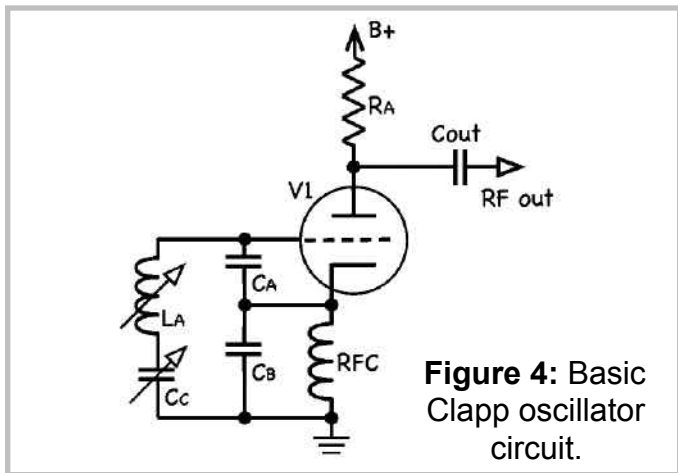
The layout of the HG-10(B) controls is simple and straightforward. Table III lists the front panel controls and the rear panel connections.

### The HG-10(B) circuit:

The HG-10 and HG-10B circuits are nearly identical. Any differences will be noted during this discussion. The HG-10 VFO may be broken down into the following parts: Power, oscillator, buffer and keying. Figure 9 shows the schematic of the original HG-10 VFO.

### Power Supply:

Power is supplied from an external source, usually the transmitter, though any external supply above about 140 volts will work with the proper dropping resistor as discussed earlier. Regulation is provided by a 0B2 gas tube. The 0B2 requires a minimum of 133 VDC to assure the gas will ionize and begin to conduct. Once the gas fires the voltage across the tube will remain at a nominal voltage of 108 volts as long as the current through the tube remains between 5 and 30 ma. The actual voltage varies by tube and manufacturer, but is between 101 and 114 volts. Actual regulation is specified as 1 volt average and 4 volts maximum over the 5 to 30 ma current range. When the tube fires



you can see a soft blue-violet glow within the tube. If you are having problems like the VFO changing frequency during keying, check that the tube continues to glow throughout the cycle; some change in intensity will occur.

### Oscillator:

Like the older VF-1, the HB-10 uses a pentode tube in an electron coupled Clapp oscillator circuit. The Clapp oscillator is a variant of the Colpitts oscillator with an added capacitance in series with the coil  $C_c$ . This capacitance is usually made variable and adjusts the frequency. Figure 4 shows the basic circuit.  $C_1$  and  $C_2$  are often identical in value and made up of multiple capacitors in parallel. These capacitors have different temperature coefficients and are chosen to keep the oscillator from drifting over temperature variations.  $C_3$  is also often made up of multiple capacitors, trimmers for setting the oscillator calibration as well as fixed capacitors for padding and temperature compensation.

Variable capacitors  $C_1$  and  $C_2$  are the two-section main FREQUENCY control. Each sec-

## **HG-10 / HG - 10B**

### **Controls and Connections**

#### **Top half of front panel (centered):**

Slide-Rule Dial - (Only selected band's scale shows)  
(Spacing: [minor tick], [mid tick], [major tick] - fig 5)

**80 METERS:** 3.5, 3.6, 3.7, 3.8, 3.9, 4.0 (mc)

Spacing: 10 kc, 50 kc, 100 kc.

**40 METERS:** 7.0, 7.1, 7.2, 7.3, 7.4 (mc)

Spacing: 10 kc, 50 kc, 100 kc.

**20 METERS:** 14.0, 14.1, 14.2, ..., 14.7, 14.8 (mc)

Spacing: 20 kc, (none), 100 kc.

**15 METERS:** 21.0, 21.1, 21.2, ..., 22.1, 22.2 (mc)

Spacing: 25 kc, 50 kc, 100 kc.

**10 METERS:** 28.0, 28.5, 29.0, 29.5 (mc)

Spacing: 50 kc, 100 kc, 500 kc  
(ticks continue to 29.7)

**6 METERS:** 50, 51, 52, 53, 54

Spacing: 100 kc, 500 kc, 1 mc.

**2 METERS:** 144, 145, 146, 147, 148

Spacing: 100 kc, 500 kc, 1 mc.

#### **Bottom half of front panel (L to R):**

**FUNCTION:** (rotary switch - 3 position)

STandBY, OPeRate, SPOT

**FREQUENCY** (dual 5 - 25  $\mu$ f variable capacitor)

28 : 1 geared vernier drive

**BAND:** (rotary switch - 7 position)

80, 40, 20, 15, 10, 6, 2

#### **Rear panel skirt (L to R from rear):**

**RF OUTPUT** (RCA Phono jack)

**KEY** (1/4" phone jack)

**POWER** (Cable with strain relief)

8-pin octal plug at far end of cable:

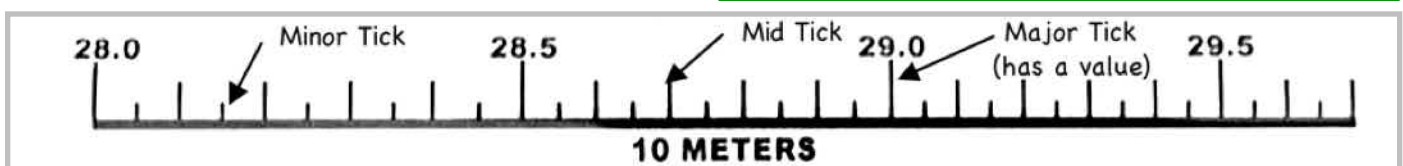
Pin 1: Ground (black)

Pin 2: Filament - 6.3 VAC (white)

Pin 4: B+ (red)

Pin 8: Key line (green)

**Table III**



**Figure 5:** Typical slide rule scale (10-Meters selected) identifying tick mark types for Table III



tion has a capacitance of 5 to 25  $\mu\text{f}$ ; C2 is in parallel with C1 when on the 80-meter band and not used on the other bands.

Table IV shows the frequency determining capacitors that make up the four different frequency ranges of the VFO. For frequency stability C11, C13, C17, C22 and C23 are N750 type that have a negative temperature coefficient of 750 parts per million (PPM) per degree Kelvin. This corrects drift from the rest of the capacitors that either have positive or no temperature drift (NPO).

Feedback for the oscillator is from the cathode of the pentode section of V1A. The RF choke (RFC2) prevents the RF from being bypassed to ground while R2 provides the DC path to ground when the VFO is operating.

In an electron coupled oscillator the screen provides voltage for the pentode and the RF signal passes through the grounded suppressor grid to the plate. This circuit tends to isolate the plate load from the oscillator, providing more stability. The plate is untuned and the RF is isolated from the B+ line by RFC1. Interestingly, RFC1 is the only component I've found that has changed value between the original HG-10 and the HG-10B. It was changed from 390  $\mu\text{H}$  down to 28  $\mu\text{H}$ . Why this was done may have been for cost reduction? However, in 1973 Heathkit released service bulletin HG-10B-1 which states:

**Hum On 40 Meters**

Replace RFC-1, 28 $\mu\text{H}$  [PN 45-18] with a 350  $\mu\text{H}$  choke coil, [PN 45-82]. This change will be put into production soon.

**Cathode Follower Buffer:**

V1B, the triode section of the 6CH8, is a cathode follower. They have been covered many times in HotM articles. It should suffice to say it provides isolation by having a

high input impedance and a low output impedance with a voltage gain of somewhat less than one. R3 through R6 set the tube's oper-

**HG-10 / HG-10B**

**Frequency Determining Components:**

On all bands:

C20 and C22<sup>1</sup> act as C<sub>A</sub>

C21 and C23<sup>1</sup> act as C<sub>B</sub>

When on 80 Meters (3500 - 4000 kc):

L3 acts as L<sub>A</sub>

C1<sup>5</sup>, C2<sup>5</sup>, C7<sup>6</sup>, C13<sup>1</sup> and C14 act as C<sub>C</sub>

C19 also affects the frequency <sup>2</sup>

When on 40 thru 10 Meters (7000 - 7425 kc):

L2 acts as L<sub>A</sub>

C1<sup>5</sup>, C6<sup>6</sup>, C11<sup>1</sup> and C12 act as C<sub>C</sub>

C18 also affects the frequency <sup>2</sup>

When on 6 Meters (8333 - 9000 kc):

L1 acts as L<sub>A</sub>

C1<sup>5</sup>, C5<sup>6</sup>, C9, and C10, act as C<sub>C</sub>

C16 and C17<sup>1</sup> also affect the frequency <sup>2</sup>

C15 also affects the frequency <sup>3</sup>

When on 2-Meters (8000 - 8222 kc):

L1 acts as L<sub>A</sub>

C1<sup>5</sup>, C5<sup>6</sup>, C9, C10, act as C<sub>C</sub>

C16 and C17<sup>1</sup> also affect the frequency <sup>2</sup>

C3<sup>6</sup>, C4<sup>6</sup>, and C8 also affect the frequency <sup>4</sup>

**Notes:**

1. These capacitors have a negative temperature coefficient (N750) for temperature compensation.
2. This capacitor is not shown in Figure 4. It is across the series capacitors C<sub>A</sub> and C<sub>B</sub>.
3. This capacitor is in series with C<sub>C</sub> reducing its overall capacitance.
4. These capacitors are in series and parallel with C1, the main tuning capacitor, reducing its overall tuning range.
5. C1 and C2 are the dual-section main tuning capacitor.
6. These capacitors are trimmers for calibration.

**Table IV**

ating parameters. The RF output is taken across R5 which sets the output impedance as R6 is bypassed to RF by C31.

### **Keying Circuits:**

The DX-60 series and the HW-16 use grid-block keying, while the DX-40 uses cathode keying. The HG-10(B) is designed to work with either with some minor wiring changes. The oscillator tube V1A can be prevented from oscillating by R7, the large resistor in the cathode circuit. This resistor raises the cathode voltage enough to prevent oscillation; shorting it out will key on the oscillator. The oscillator can also be prevented from oscillating by applying a negative voltage across R9 to bias the tube off.

When using grid-block keying the keying should be done at the transmitter. A low current, fairly high negative voltage (usually a bit greater than 100 VDC) appears across the open key. This negative voltage is applied to the necessary stages of the transmitter to cut them off; thus no signal appears at the output of the transmitter. When the key is closed the negative voltage is shorted to ground and the stages operate normally.

This negative keying voltage appears on the HG-10(B) VFO keying line that comes in via the octal plug from pin-8. This voltage is connected through an NE-2 neon bulb which lights with the key up and drops the keying voltage by 75 to 90 volts. With the **FUNCTION** switch in the **OPR** mode this lower negative voltage appears across R22 and biases off the oscillator tube V1A. At the same time the **FUNCTION** switch shorts R7 to ground, bringing the oscillator cathode near ground; now the only reason the oscillator is not functioning is the negative voltage across R9. When the key is closed in the transmitter the negative voltage drops to zero, the neon bulb goes out, and the voltage across R9

drops, causing the oscillator to start, and output to appear at the **RF OUTPUT** jack.

The HG-10 may be converted to cathode keying by two simple changes in the HG-10B circuitry as shown in the schematic. First, move the green wire on terminal strip A from terminal 2 to terminal 3. And second, remove the wire between terminals 2 and 3 on the **KEY** phone jack. The green wire mentioned above is the keying lead from the octal plug.

When the preceding modifications are made to the HG-10(B) it can be used with cathode keying. The two key jacks are now in parallel and a key may be used in either. With the **FUNCTION** switch in the **OPR** position the key is connected across R7, the large cathode resistor that is keeping the oscillator biased off. When the key is closed R7 becomes shorted and the cathode voltage drops allowing the oscillator to start. Thus the oscillator is keyed along with the transmitter.

When the **FUNCTION** switch is in the **STBY** (standby) position the key jack and keying lead are open and the oscillator is biased off; when the **FUNCTION** switch is in the **SPOT** position the key jack and keying lead are open and a short appears across R7 causing the oscillator to operate independently of the transmitter keying. The oscillator can be heard in the receiver and the receiver or VFO may be adjusted to the other's frequency.

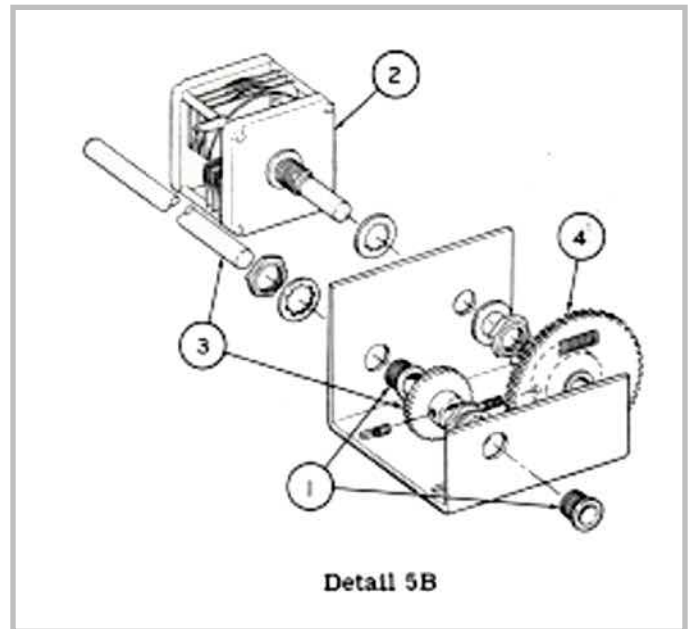
### **Mechanical Design:**

It would be amiss to discuss the HG-10(B) without commenting on the mechanical layout. Like its predecessor the VF-1, the HG-10(B) has heavy ceramic coils, a double bearing tuning capacitor and rigid construction to improve stability, but is also has features that made up a part of Heathkit design in the early sixties ham products. Someone on the Heath design team must have been a me-

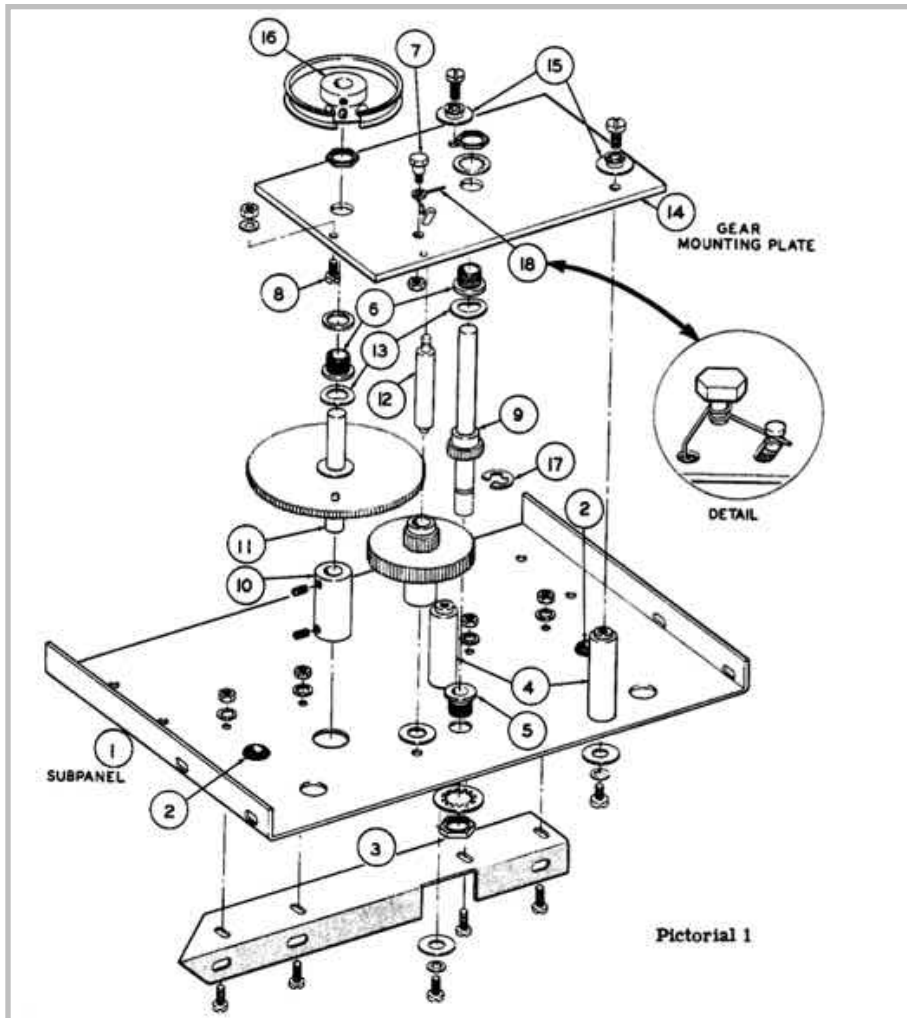


chanical engineer who loved gears and pulleys. Much of the ham gear of that period features a rotating drum that turns with the band-switch, showing only the current band to the user. They also feature a smooth geared drive for the tuning capacitor. This multi-gear tuning system mounts between the front panel and a sub-panel. Equipment of the day featuring such mechanical wonderment include the MR-1 ("Comanche" mobile receiver), MT-1 ("Cheyenne" mobile transmitter), RX-1 ("Mohawk" HF receiver), TX-1 ("Apache" HF transmitter), HR-20 (mobile SSB receiver), HX-20 (mobile SSB transmitter), and possibly others.

Figures 6 and 7 show the mechanical layout of the HG-10(B) gear reduction for the FREQUENCY tuning capacitor. The sub-panel



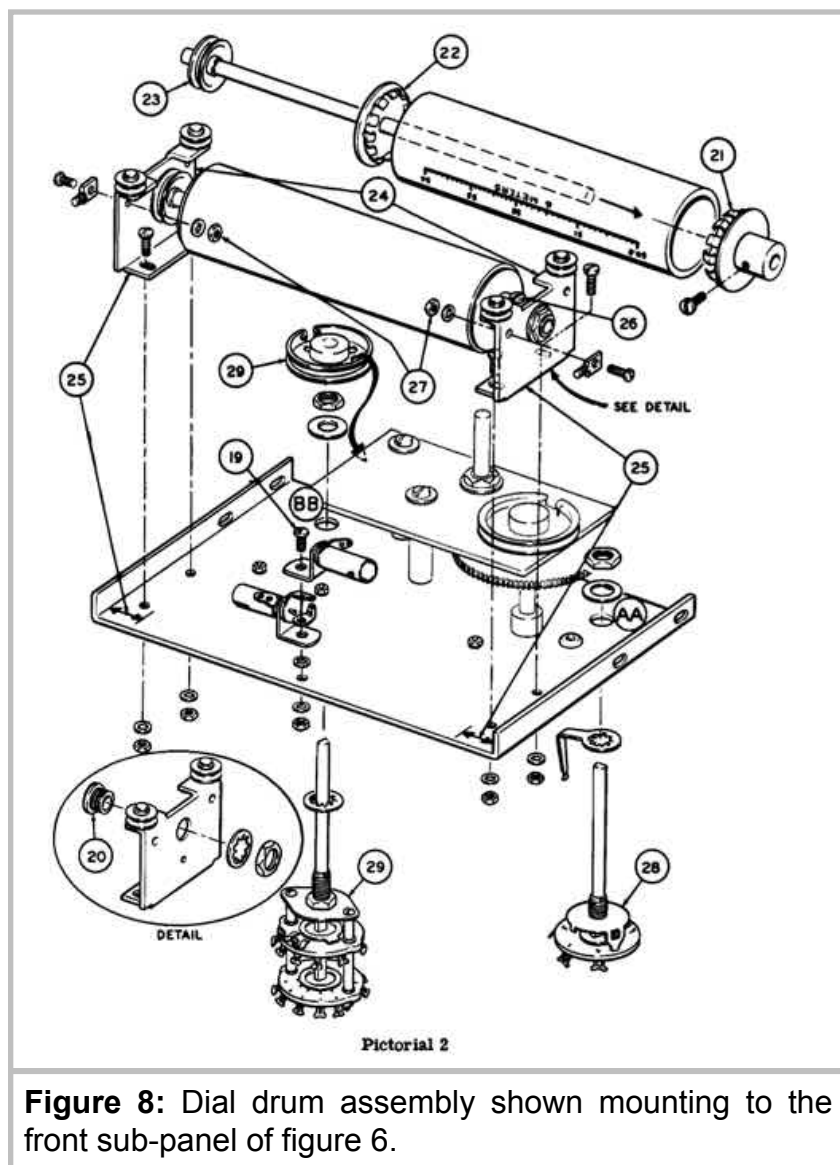
**Figure 7:** Drawing showing the HG-10 VFO capacitor. The long shaft #3 mates with the coupling #10 of figure 6.



mounts behind the front panel with the gear mounting plate towards the front. The shaft (#9) protrudes out the front and holds the main tuning knob. The pulley (#16) drives the dial pointer across the slide-rule dial via dial-cord and a bunch of idler pulleys not shown in these drawings.

Figure 8 shows the drum assembly. The pulley on the band-switch (#29) connects to the pulley (#23) on the dial drum via dial-string, causing it to rotate to the correct dial scale as the band-switch is turned.

**Figure 6:** Drawing showing the HG-10 VFO sub panel with gear mounting plate and set of reduction gears. The geared shaft #9 protrudes through the front panel and holds the FREQUENCY knob.



**Figure 8:** Dial drum assembly shown mounting to the front sub-panel of figure 6.

Proper alignment and lubrication is required to achieve the best dial results. A little extra time here pays off with smooth tuning.

### Summary:

While the change from crystal to VFO operation for the novices occurred in 1972, a lot of novice rigs were in use and many were still being sold due to their low price compared with a transmitter with built-in VFO. The more expensive radios used frequency synthesizers locked to a standard crystal providing frequency control as well as crystal stability. These radios were expensive and so VFOs continued to sell. It wasn't until older synthe-

sized radios began to come up on the used market at reasonable prices that the need for an external VFO began to decline. The HG-10B continued in production until 1976, four years after the rules changed.

Many HG-10(B) VFOs are also used on VHF. The oscillator has the stability to operate AM, and CW on 6 and 2-meters, and reports can be found that claim they were useable on 1-3/4 and even 3/4-meters on AM, and CW.

### General HotM Comments:

#### V-6 Voltmeter Restoration:

My V-6 voltmeter project is on hold while I wait for a part. Can you believe that a 0.01  $\mu\text{f}$  2KV axial lead capacitor would be hard to find? Mouser was out until just recently and so I have a few on the way along with some other parts for another Heathkit project. I was able to find a 200K 1% precision resistor that is part of the range attenuator. The original was open.

#### Why not a Link to the HotM Index?:

While looking over some old emails I came across correspondence from Dave, W6OVP (Dave provided me with a lot of very useful information for the HA-14 Compact KW Amplifier article for HotM #58). I don't remember seeing this before, but Dave commented:

*Suggest you could maybe put a link at the bottom of EACH of your review pages to steer viewers [...] back to the 'Orange County Club Heathkit Articles' [...] link. Potential customers should not have to hunt for your products. :-/.*

Great idea Dave! Sorry it took me so long to implement it. Starting with this article, I

will include the link to the Heathkit of the Month index on the first page of each article. From that index the articles can be accessed. Adding a link to previous articles may be difficult to do for reasons I may explain in a future article.

### What's Up Next?:

With taxes due and the Baker to Vegas race looming I may not get time to do an article next month. However, I was talking with Chuck Penson (author of those great Heathkit books, and he suggested I write on the O-12 oscilloscope. I actually have one here that is in need of restoring. I thought I'd do even more and cover the whole 'O-#' oscilloscope line, (there are twelve of them altogether) spending more time on history and evolution and less on circuit description. I was thinking of doing it in three parts, the O-1 to O-4, the O-5 to O-8 and the O-9 to O-12. I was able to obtain from Chuck a schematic of the O-1, the first Heathkit. It's missing some information but is reasonably complete. Unfortunately, it is not a good enough reproduction for an article, but the circuit is simple so maybe I can redraw it if I can't find a better copy. I don't think the manual (it was really a schematic, parts list and some assembly notes, I've been told, is available for sale. The three parts won't appear consecutively; I'll try to write on another kit or two in-between sections.

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*

## A HEATHKIT **Short**

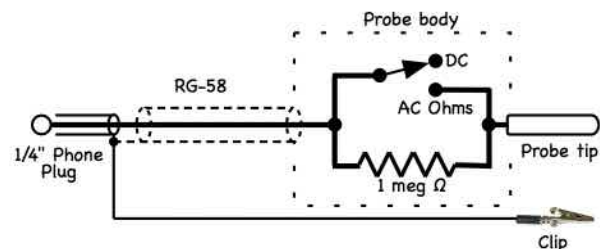
### Heathkit VTVM Probes:

Over the years the probes that came with Heathkit VTVMs changed. In older units there were three connectors on the front panel, Two banana jacks (red and black) for AC and Ohms measurements with appropriate red and black test leads, and a phone jack for a shielded cable with a black probe holding a 1 meg  $\Omega$  resistor that is in series with the lead, for DC voltage measurements.

With the release in 1961 of the IM-11, which replaced the V7-A, the three leads were combined into one that plugs into a phone jack. The plug-in test lead is a single shielded cable that goes to a new test probe. On that test probe is a switch that switches the 1 meg  $\Omega$  resistor in for DC measurements and out for AC and Ohms measurements. A black test lead with an alligator clip comes out of the phone plug separately and provides the common lead.

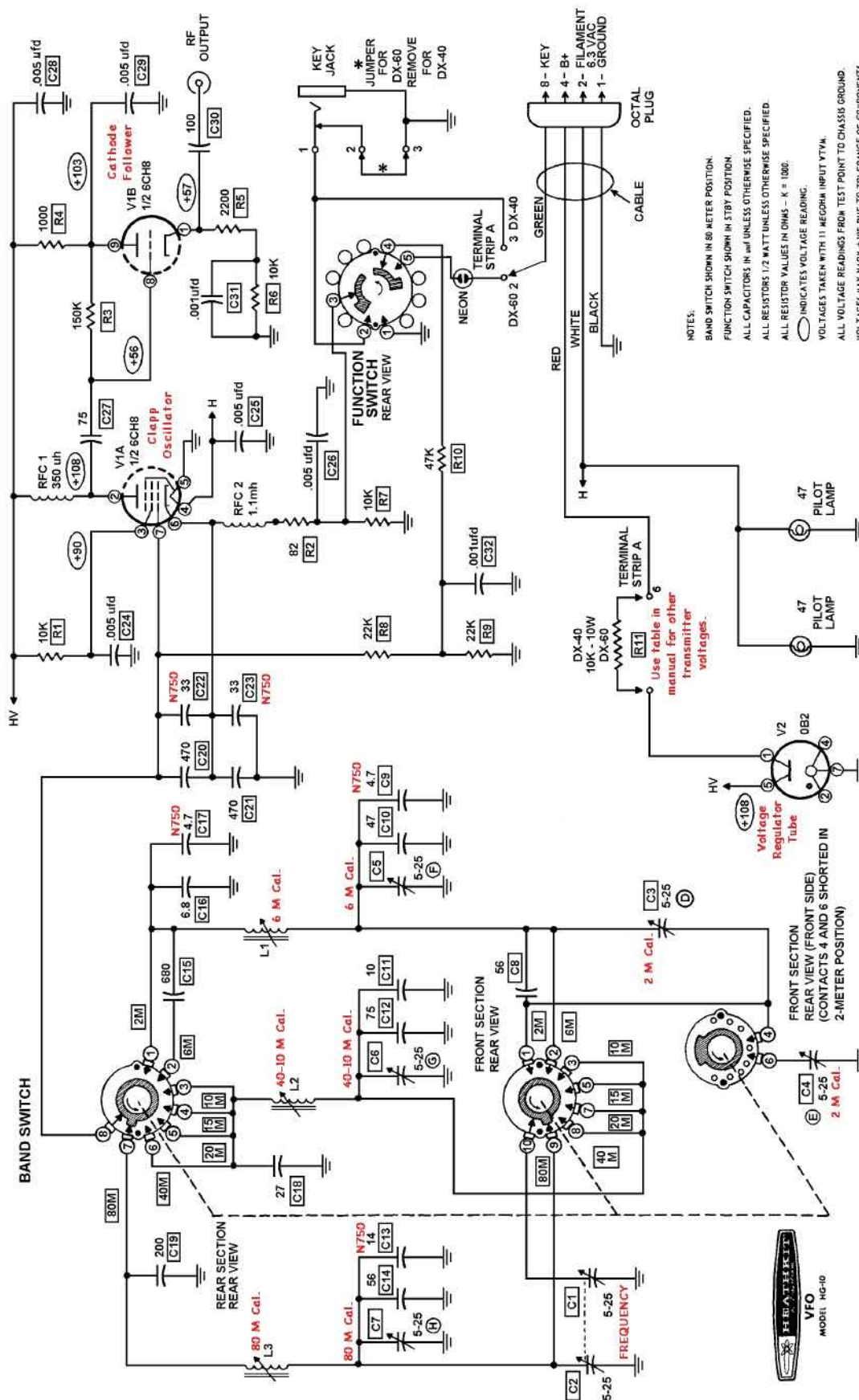
Those probes get broken or lost, thus there are numerous articles on replacing them. Some suggest placing the switching of the 1 meg  $\Omega$  resistor inside the VTVM. Don't do this. That resistor is located close to the test point to isolate the cable capacitance from the circuit under measurement. This capacitance can affect the circuit operation, even if you're measuring DC voltages.

73, from AF6C



A simple replacement probe for late VTVMs. Use a simple slide switch & Belden 8899-BLK for clip lead.





**Figure 9: Heathkit HG-10 Schematic**



Image: Tom W6ETC

## Top Ten Rules for Being a Great Amateur Radio Operator

Source: <http://radio.tomsmerk.com/top10.pdf>

The amateur radio community over the years has developed a level of high regard and respect from just about everybody, and it is important that anyone operating as a ham radio operator do everything within their power to continue to use amateur radio in a professional and courteous manner. Poor behavior has ruined other radio services such as Citizen's Band radio, and those of us that are serious about our ham radio privileges do not want to see the same thing happen to ham radio.

Unlike CB radio, ham radio has a set of rules, FCC Part 97, which must be strictly adhered to. In addition, the ARRL sponsors "official observers" to monitor amateur radio frequencies and report violations. I hope that everyone reading this will agree with these suggestions and pass on the information to other new ham radio operators so that we may continue to enjoy our hobby without distractions.

1. Give your full FCC call sign every ten minutes and at the end of your transmission.
2. Do not broadcast music or make any sort of transmission similar to commercial radio. Amateur radio is for non-commercial contacts between licensed operators.
3. Do not conduct business other than selling ham radio related items. Ham radio is for personal use and never for business use.
4. Do not use profane language, make threatening comments or racial slurs, or participate in any other disruptive behavior.
5. Do not exhibit unprofessional behavior.
6. Do not allow unlicensed operators, such as your children, to use your radio unless you are present and making sure that they observe all of the rules. It is better still to help your children obtain their own license!
7. Do not monopolize the frequency – pause occasionally to see if other hams want to use the frequency to make a contact. Allow other people to immediately use the channel if they have an emergency.
8. If you are using a repeater, you are doing so with the permission of the repeater owner, so learn and follow the rules and guidelines for this repeater.
9. Be courteous at all times.
10. Only use enough power to successfully make contact – too much power can be annoying to others within close range and also it may interfere with transmissions on nearby frequencies.

## OCARC BOARD MEETING MINUTES 2018-03-03

The March OCARC Board meeting was held at the Marie Callender's Restaurant at 1821 N. Grand Ave in Santa Ana on March 3, 2018. Meeting called to Order at 8:08 am.

**Roll Call:**

President: Tim N6GP, Present  
Vice President: Dan KI6X, Present  
Secretary: Jim AF6N, Present  
Membership: Bob AF6C, Present  
Technical: Kenan KR6J, Present  
Treasurer: Ken W6HHC, Present  
Activities: Ron W6WG, Present  
Publicity: Tim, N6TMT, Present

**Directors at Large:**

Corey KE6YHX, Absent  
Clem W0MEC, Absent

**Guests and Members attending:**

Don Rogers  
Greg W6ATB  
Gene KJ6OML

**DIRECTOR REPORTS:**

**Vice President** – Dan KI6X – Reported that the March program will be presented by DX Engineering via Skype. Dan has checked out his laptop for Skype operation. Jim AF6N brought a set of USB speakers but suggested checking for possible better on-site Red Cross speakers. Jim was asked to bring a Queen Mary DVD to the meeting as a backup to the Skype.

**Secretary** – Jim AF6N - No current report.

**Membership** – Bob AF6C – Reported 60 renewals received or about 60% of last year's 105 members.

**Technical** – Kenan KR6J – No current report.

**Treasurer** – Ken W6HHC – Distributed current Cash Flow accounting. Nothing unusual was reported thru February. Ken reported the Boy Scouts check is still uncashed thereby keeping the Credit Union account open. General agreement was to communicate to the Scouts our intention to cancel the original check and request an addressee for a replacement check. Tim N6TMT volunteered to send an email to that effect.

**Activities** – Ron W6WG reported expenditures for Opportunity Raffles. Meetings to date have reported \$46 income on \$71 spent. Expenditures for the upcoming meeting are only \$23 with the addition of one of the donated Bioenno batteries.

**Publicity** – Tim N6TMT reported receipt of an ICOM letter stating that our request for the \$100 IC-7300 rebate is submitted and a response has been mailed. Hopefully that response will be the check.

**Director at Large** – No current reports.

**OLD BUSINESS:**

**Newsletter Editors:** Tim N6GP listed the schedule for upcoming newsletter editors:  
March – Tom W6ETC, April – Jim AF6N, May - Tim N6GP. No volunteers came forth for June.

Ken W6HHC reported that the deadline for newsletter article contributions will be late evening on March 6.

**Entertainment:** Dan KI6X reported the following presentation schedule:

**March** – DX Engineering will present on "The K3LR Multi-Multi Station" via SKYPE.

**April** – Cliff Guice KG6MIG will present on "NVIS".

**May** – Marty Woll N6VI will present on "Troubleshooting for the Non-engineer".

**June** – TBA – Possible Chip K7JA or Carl WU6D for Field Day presentation.

**July** – TBA

**August** – Wayne KH6WZ, a frequent CQ writer, a possible "Maker Fairs" presentation.

*Entertainment continued on next page:*



*Entertainment Continued from previous page:*

**September** – OCARC Anniversary Meeting

**October** – Annual Club Auction

**November** – TBD

**December** – Christmas Dinner

**Club Historian:** - No current report.

**Wells Fargo Conversion:** Tim N6GP, Ken W6HHC, and Dan KI6X will go to Wells Fargo to complete the required signatures following this board meeting.

**85<sup>TH</sup> Anniversary Celebration:** Ron W6WG reported on anniversary embroidered shirt availability. Two vendors, "I initial" and "Garcia Embroidering" were visited and "I initial" is recommended. "I initial" prices were much lower at a total of \$13 plus the shirt with no extra charges involved such as artwork, individual setups, etc. Ron will order a shirt as a sample. Field Day delivery for members' shirts is the goal.

Ken W6HHC reminded that an order form was printed in prior newsletters and suggested that members might order directly from "I initial" rather than through the club.

Jim AF6N reported on commemorative mugs. The vendor list has been narrowed to "Café Press" at \$10.19 per cup and "Zazzle" at \$16.66 per cup based upon a quantity of 40. Pricing may change per quantity and/or discounting. A printout of the suggested logo was passed about with no objections. Vendors all require that a single order be submitted but individual artwork must be included showing name and call for each individual mug. Sample mugs from each vendor featuring earlier logo versions were passed around. General agreement was that the "Café Press" vendor appears to be preferred at this time.

Ken W6HHC suggested polling interested buyers at the upcoming meeting in order to estimate order quantity.

**June Field Day:** June Field Day was discussed. Tim N6GP reported that the Walter Knott site may



not be available this year and suggested starting negotiations with Ocean View as a backup site.

Ron W6WG has volunteered to serve as 2018 Field Day Chairman. Ron sent out a complete Field Day Package to all Board members. He explained the captain organization envisioned for 2018 which would include captains for bands, towers, network, utilities, etc.

Tim announced that our goal is to enter as a 7A site. Stations planned are: 20M CW, 20M Ph, 40M CW, 40m Ph, 80M, 15M, Sat/Dig, and GOTA. Discussion followed on towers and operator availability.

Tentative band captains assigned to date are: 20M phone - Ken W6HHC and Bob AF6C, 20 CW - Jim AF6N, 40M phone - Kenan KR6J, SAT/DIG - Greg W6ATB. A captains meeting was tentatively scheduled for March 28, 6pm at the N6GP QTH.

**NEW BUSINESS:** None.

**GOOD OF THE CLUB:**

Dan KI6X reported on the aborted Bouvet DXpedition. Arnie W6HC has returned home reporting the very dangerous weather and ice-berg conditions that prevented a landing on the island. The landing was eventually aborted when ship engine problems began and winds were too high to fly the helicopters. Conditions dictated a safer return via South Africa instead of Chile.

Tim, N6TVT reported that the February issue of CQ Magazine includes a map on page 91 showing the call letters of Greg W6ATB.

The meeting adjourned at 9:22.

Submitted by, **Jim Schultz, AF6N, OCARC Secretary**

# OCARC GENERAL MEETING MINUTES February 16<sup>th</sup>, 2018

The OCARC General meeting was held at the Santa Ana Red Cross Complex on February 16, 2018.

## Overview

### **Club Officers / Quorum:**

There was a quorum with all officers present with the exception of Kenan KR6J.

### **Attendance:**

The meeting was called to order at 7:05PM with 24 OCARC members and 5 guests in attendance. Meeting opened with the Pledge of Allegiance for the Flag and individual/speaker Introductions in attendance.

### **February Program:**

Dan, KI6X introduced the evening's presenter, Joe Moell, K0OV. Joe offered a very informative and interesting discussion on "Transmitter Hunting for the Whole Family".

Joe is a leader in radio direction finding for amateurs. He provides an extensive web page titled "Homing In" located at [homingin.com](http://homingin.com) and is a quarterly contributor to [CQ Magazine](http://CQ Magazine) as well. Check out the February 2018 issue of CQ Magazine.

Joe stressed that **hidden transmitter hunting is an activity very suited to fun family outings and not limited to licensed amateurs**. He spoke on the several types of hunts, various types of equipment, and classic transmitter hunting as well as Radio Orienteering. He offered examples of types of transmitter disguises and use of signal reflection from both the local mountains and also airplanes passing overhead.

Joe reported on the upcoming USA ARDF Championships that will be held on June 13-17, 2018 near Truckee, CA. He also invited members to participate in upcoming local hunts here in Southern California. Details of upcoming events are posted regularly on his "Homing In" website. Bring the kids!

Intermission was taken from 8:25 to 8:50 pm.

## Business Meeting

### **Director Reports:**

Ron, W6WG reported on the **Winter Field Day**. The OCARC participation was excellent resulting in over **600 QSO's and about 8400 points for our 4 station** activity.

True to Winter Field day tradition our Winter Field even included frost, a windstorm, and a late night sprinkler storm.

Ken, W6HHC, Don, K0VNI, and Dan KI6X reported on the planning of the upcoming Baker to Vegas Race. Members were reminded that the **OCARC General meeting has been rescheduled from the third to the fourth Friday, March 23** so as to not interfere with participation in the race.

### **Ask the**



Bob, AF6C reported random interference (beeping) on OCARC 2M (146.550 MHz weekly) Net frequency. Refer to the Show and Tell notes below for possible source(s) of interference and disruption?

Ron, W6WG requested help with LOTW access while using N3FJP logging. Several suggestions followed.

[Tim, N6GP](#) requested suggestions for methods for the quick ID of coax connector faults. Some discussion followed but Tim remains open to relevant [suggestions](#).

### **Show and Tell:**

Lito, WI6Y demonstrated a new DMR unit.

Tim, N6TMT showed a tiny Byonics transmitter (similar one shown below) such as used in transmitter hunts.



### **Announcements:**

Clem, W0MEC updated the members on news and location of the Bouvet Expedition.

Tim, N6GP reminded of Kosovo activity by Z60A and Z61DX currently at approximately 7-8 am. Also, this weekend is the ARRL International DX-CW contest.

Ken, W6KOS announced Volunteer Examiner Testing at HDSCS ON Saturday, March 3. Contact Ken at 714-651-6535 for testing info.

The meeting Adjourned at 9:21 pm

Submitted by,

**Jim Schultz, AF6N**  
**OCARC Secretary**



## OCARC Cash Flow

1/1/2018 through 2/28/2018

Category	1/1/2018- 2/28/2018
<b>INFLOWS</b>	
Donation	10.00
Dues, Family (PayPal)	172.89
Dues, Membership	540.00
Dues, Membership (PayPal)	345.96
Opportunity Drawing -Monthly	46.00
Refreshments Income	23.83
<b>TOTAL INFLOWS</b>	<b>1,138.68</b>
<b>OUTFLOWS</b>	
CU service Fee	10.00
Refreshments Expense	9.87
Storage Locker	164.00
Supplies	24.33
Web Site Hosting	50.97
<b>TOTAL OUTFLOWS</b>	<b>259.17</b>
<b>OVERALL TOTAL</b>	<b>879.51</b>

## AMATEUR-HUMOR

ALTERNATIVE DEFINITION'S WORTH ~~NOTHING~~ NOTING:

*What is...*

### 'BANDWIDTH'

A radio operator's waist size!

Source: <http://www.hamuniverse.com/humor.html>





# US AMATEUR RADIO BAND PLAN



## US Amateur Radio Bands

**US AMATEUR POWER LIMITS** — FCC 97.313 — An amateur station must use the minimum transmitter power necessary to carry out the desired communications. (b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.

Amateurs wishing to operate on either 2,200 or 630 meters must first register with the Utilities Technology Council online at <https://uttc.org/plc-database-amateur-notification-process/>. You need only register once for each band.

### 2,200 Meters (135 kHz)



### 630 Meters (472 kHz)

5 W EIRP maximum, except in Alaska within 496 miles of Russia where the power limit is 1 W EIRP.

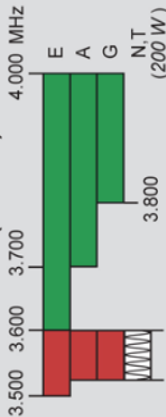


### 160 Meters (1.8 MHz)

Avoid interference to radiolocation operations from 1,900 to 2,000 MHz



### 80 Meters (3.5 MHz)

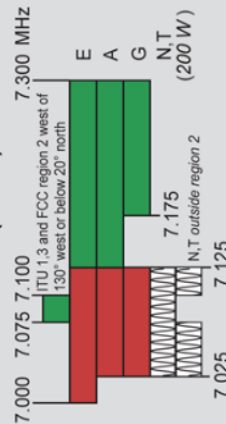


### 60 Meters (5.3 MHz)



General, Advanced, and Amateur Extra licensees may operate on these five channels on a secondary basis with a maximum effective radiated power (ERP) of 100 W PEP relative to a half-wave dipole. Permitted operating modes include upper sideband voice (USB), CW, RTTY, PSK31 and other digital modes such as PACTOR III. Only one signal at a time is permitted on any channel.

### 40 Meters (7 MHz)



See Sections 97.305(c), 97.307(f)(11) and 97.301(e). These exemptions do not apply to stations in the continental US.

### 30 Meters (10.1 MHz)

Avoid interference to fixed services outside the US.



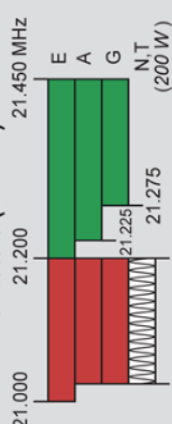
### 20 Meters (14 MHz)



### 17 Meters (18 MHz)



### 15 Meters (21 MHz)



### 12 Meters (24 MHz)



### 10 Meters (28 MHz)



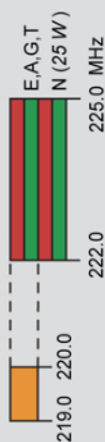
### 6 Meters (50 MHz)



### 2 Meters (144 MHz)



### 1.25 Meters (222 MHz)



\*Geographical and power restrictions may apply to all bands above 420 MHz. See *The ARRL Operating Manual* for information about your area.

### 70 cm (420 MHz)\*



### 33 cm (902 MHz)\*



### 23 cm (1240 MHz)\*



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

2300-2310 MHz	10.0-10.5 GHz ‡	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

‡ No pulse emissions

## KEY

**Note:**  
CW operation is permitted throughout all amateur bands.  
MCW is authorized above 50.1 MHz, except for 144.0-144.1 and 219-220 MHz.  
Test transmissions are authorized above 51 MHz, except for 219-220 MHz



E = Amateur Extra  
A = Advanced  
G = General  
T = Technician  
N = Novice

See [ARRL Web](http://www.arrl.org) at [www.arrl.org](http://www.arrl.org) for detailed band plans.

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