



# RF



ORANGE COUNTY AMATEUR RADIO CLUB, INC.

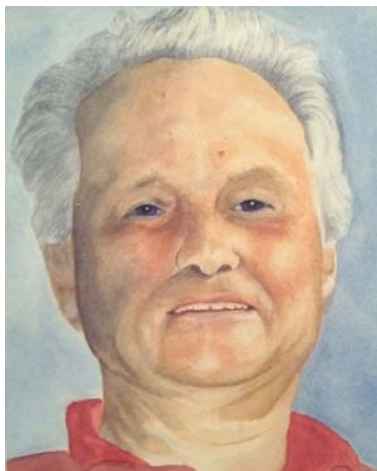
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P.O. BOX 3454, TUSTIN, CA 92781-3454

June 2013

## The Prez Sez.....

by Nicholas AF6CF



### QST QST QST!

June is finally here, and you know what this means... Field Day, Field Day and more Field Day. We are as ready as we can be, and our Club members are now ready for the final FD class with Professor Jeff W6UX. This month we will have a special general meeting date a week earlier than usual and will talk about the final preparations, details and schedule. The two co-chairs Dino and Bob are going to give the final advice to the membership so we should all be ready for a successful event.

As mentioned last month, the Generator is funded and now is the food donations turn. Speaking of food, the Food Committee Chairperson Kris KC6TOD has been working on a delicious meal for each person that shows up and helps at least a few hours on Friday. This year we will have Carolyn, KE6BUH as a

Public Relations person to show visitors around, and even some signs so people will not get lost looking for our location.

If you are a visitor and have a FCC license, this is the time to operate and have fun. On the other hand, if you have no license, there will be an on-site VE testing session so you can obtain or upgrade yours. There are a few positions open to help in different areas, so hurry up to volunteer. The final result of this effort will depend on the degree of everybody's participation, and there is no doubt in my mind that this year we will do very well and have TONS of FUN in the process. After the event, we will evaluate our experiences and see how we can improve next time.

Finally, don't forget the special September anniversary celebration, either. As usual, I look forward to an eyeball contact with you all at the next General Meeting.

73 DE AF6CF



One of Chip's 12-ele homebrew LFA Yagi for 432 MHz at FD

## General Meeting Friday June 14th

*Chip K7JA  
on Field Day*

Our June General Meeting will be held **ONE WEEK EARLY** because Field Day activities fall on the normal date. The meeting will be devoted to Field Day discussions and last minute FD planning

The next general meeting will be on:

**Friday, June 14th  
@ 7:00 PM**

As usual, we will be meeting in the east Red Cross Building, Room 208.  
See you there!

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**ORANGE COUNTY  
AMATEUR RADIO CLUB**  
[www.W6ZE.org](http://www.W6ZE.org)



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**Contact the Newsletter:**

Feedback & Corrections:  
[rf\\_feedback@w6ze.org](mailto:rf_feedback@w6ze.org)

Submit Articles:  
[editors@W6ZE.org](mailto:editors@W6ZE.org)

**Monthly Events:**

**General Meeting:**

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

**Club Breakfast:**

Second Saturday of every  
month at 8:00 AM  
Jagerhaus Restaurant  
2525 E. Ball Road  
(Ball exit off 57-Freeway)  
Anaheim, CA

**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

**VISIT OUR WEB SITE**

<http://www.w6ze.org>

for up-to-the-minute club  
information, the latest  
membership rosters, special  
activities, back issues of RF,  
links to ham-related sites,  
vendors and manufacturers,  
pictures of club events and much  
much more.

**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 Field Day Planning Corner



## CQ Field Day...Whisky 6 Zulu Echo...Field Day!

It's crunch time folks! We are less than 20 days out on the biggest Field Day in OCARC history, all in celebration of our 80th year as a club! If you haven't committed to help out yet, now is the time!

Our June club meeting is also our final Field Day Meeting. If you plan on participating in Field Day you will want to be at this meeting (June 14). If you want to improve your operating skills in a "contest" environment, show up a little earlier at 6PM to attend Jeff's Field Day University!

We will need all hands on deck starting Thursday evening (June 20th) at 5:00PM at Walter Knott School! Thursday is antenna building day! Friday is antenna raising day! We need good hands and sharp minds as we tilt up all these towers! If you have a hardhat, bring it! Saturday morning is generator time! It takes some work to get the power distributed across the field and all stations online by 10:00am! Decide how you can contribute to the success of this event and know you had a part in making this the best Field Day site on the West Coast! Remember, it's not a party without YOU so please come out and have a great time!

Dino Darling – KX6D  
Bob Harrington – AA6PW  
YOUR Field Day Chairmen

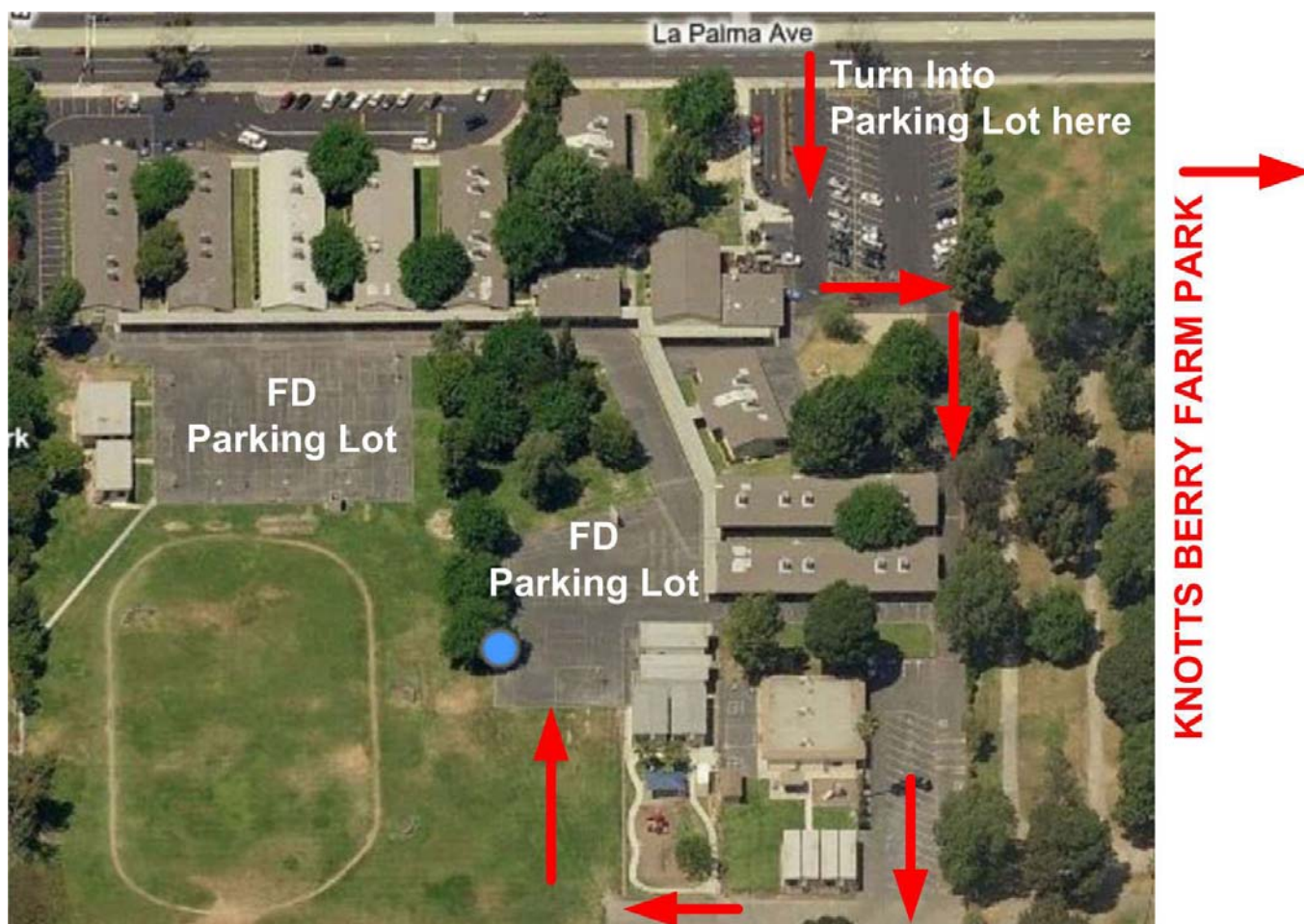


**OCARC Field Day Location Map**

Field Day will be again at last year's site (Walter Knott Education Center); however this year the access to the field is 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 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 buildings.

## OCARC Field Day Information

# More OCARC Field Day Info

### SET-UP

- Thursday Jun 20 - 5PM – Antenna construction/assembly
- Friday Jun 21 - start between 8 AM and 9 AM (while still cool) – Tower set-up
- Saturday Jun 22 - 11 AM – FD Operations starts
- Sunday Jun 23 - 11 AM – FD ends / Tear-down begins

### TALK-IN FREQUENCY

The simplex frequency of 446.520 MHz (FM) will be monitored for people needing directions to the FD location or needing info.

### BANDS and BAND CAPTAINS

10CW	Paul Gussow W6GMU	10PH	Jeff Hall W6GMU
15CW	Arnie Schatz N6HC	15PH	Tim Goepfinger N6GP
20CW	Bob Harrington AA6PW	20PH	Chip Margelli K7JA
40CW	Bill Scholz W1HIJ	40PH	Chip Margelli K7JA
80CW	Arnie Schatz N6HC	75PH	Chip Margelli K7JA
PSK31 Digital	Steve Brody N1AB	VHF/UHF PH	Kris Cutting W6KJC
		GOTA PH	Brett Collingwood W6BAC

### MEALS and FOOD

- The OCARC will be providing meals for those who are working Field Day
- Meals are planned for Fri dinner, Sat lunch, Sat dinner, Sun breakfast
- OCARC is looking for food donations at \$5 per meal (\$20 for the whole weekend)
- The OCARC will provide iced bottled-water and Gatorade
- Bring your own soda, iced-tea, etc



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



## QST QST QST W6ZE Field Day University for Phone Operators!

OCARC is commemorating its 80th year with a major Field Day operation! For our members who prefer to operate **Phone** there will be a 3-part training series offered for you to expand your CQ-ing and logging skills. Members of *all* Field Day experience levels are encouraged to attend!

These sessions will be held in our club's normal meeting room @ The Red Cross, 1 hour prior to the general meeting:

**Class 1: Friday, March 15th @ 6:00 pm – COMPLETED**

~~Fundamentals of holding a frequency, calling CQ, and exchanging Field Day reports~~

**Class 2: Friday, April 19th @ 6:00 pm – COMPLETED**

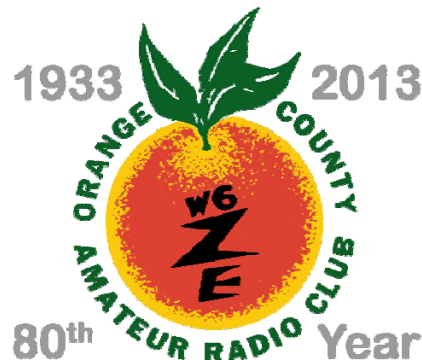
~~Logging with N3FJP software (while you hold the frequency!)~~

**Class 3: Friday, June 14th @ 6:00 pm - "pileup" management and fixing mistakes (while you hold the frequency AND log!)**

You will start with the basics and progressively add dimensions to your operating. Attend these classes and you'll prepare yourself for maximum fun on Field Day!

Please RSVP with Jeff, W6UX ([W6UX@W6ZE.ORG](mailto:W6UX@W6ZE.ORG)). This will help ensure there are enough handouts and instructors for each class.

See you there!





Field Day is around the corner and we have a great group working hard for another successful OCARC Field Day! We will have a FANTASTIC Public Relations and Hospitality Tent and VE Testing session. Look for the PR and Hospitality tent at the entrance to the Field Day site with greeters and detailed maps and descriptions of each area. Listed below is the information on the VE testing session if you are interested in upgrading your license or if you know someone who would like to test for the first time.



**ARRL AMATEUR RADIO VE TESTING**  
**OCARC Field Day 2013 – Saturday June 22, 2013**

**From 1:00 PM to 4:00 PM**

**Walter Knott Education Center**

**7300 La Palma Avenue**

**Buena Park, CA 90620**

**Walk-ins Welcome!**

**Pre-Registration is requested and preferred.**

**COPY OF YOUR LICENES REQUIRED**

**PHOTO I.D REQUIRED**

**Walk ins are welcome.**

**Contact V.E.: George T. Jacob Jr. N6VNI**

**Phone Numbers: Home 562-691-7898 Cell 562-544-7373**

**Email: [jac2247@gmail.com](mailto:jac2247@gmail.com) Or [N6VNI@arrl.net](mailto:N6VNI@arrl.net)**

**Thank you and remember please come join us for Field Day! 73... George N6vni**



## WHOis ... the Club Technical Chair?

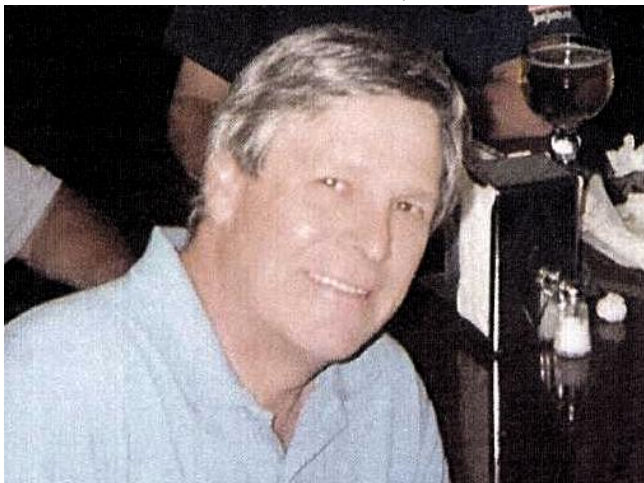
by  
**Ken – W6HHC**

(This is the sixth in a series of articles to inform you about the background of the officers and leaders of the OCARC.)

The 2013 Technical Officer for the OCARC is Bob Eckweiler – AF6C. Bob grew up in Manhasset on Long Island. He has three people to thank for first getting into ham radio:

- His father, Howard, had been 2CXX (no W2's then)
- A girl in school had a ham father, W2CJY
- A class mate in school was Todd who got his license first, and talked about ham radio a lot.

At age 13, Bob went down to the Arrow Electronics store in Mineola, LI to take the Novice test in 1959. His Novice call letters were WV2GUQ.



**Bob AF6C has been a ham since 1959**

His Novice station was a National NC-88 receiver, a Heathkit DX-40 transmitter and a 40M dipole that worked well on 40M and 15M. Then in 1960, he took his General test at the Federal Bldg in NYC and earned the call of WA2GUQ and traded his DX-40 for a Heathkit TX-1 Apache.. Bob "hammed it up" at home until he stored-away his ham gear and went off to school at Penn State to study Physics in 1963. Then Bob transferred to CSULB in 1966 and continued on to begin a MS degree. He soon joined Douglas Aircraft as an engineer in 1968.

Finally, Bob got active again with Ham Radio from the city of Orange in 1969. WA2GUQ became WB6QNU. His new station was the old Apache TX-1, new Heathkit SB-301 receiver and a new Hustler 4BTV vert. One of his early CW contacts in Orange was Ken W6HHC (who quickly asked to change modes to Phone).

Bob became involved with OCARC back in 1969 when Ken W6HHC invited him to drop by OCARC FD at "the cemetery" in Irvine. Bob planned to stay a few hours and ended up staying until tear-down was over. He joined OCARC at the next meeting. He became a member of the OCARC Board in 1971. He has been elected club President three times. Bob changed call to AF6C in 1978.

Bob's current interests in ham radio are:

- Technical aspects
- DXing
- OCARC nets
- War surplus
- Restoring older radios
- Building, restoring, and writing about Heathkit
- Antenna design
- Supporting COAR RACES during B2V
- OCARC web site

Bob still lives in the city of Orange. He worked in Flight and Lab Development designing instrumentation, conducting wind-tunnel testing, antenna testing and lightning testing. While with the new owner, Boeing, he worked on microwave links that supported communications for aircraft flight tests. There were seven microwave locations and three tracking ground stations. Bob's current station is a Kenwood TS440SAT, a Heath SB-220 linear, 3-ele Hygain TH4 beam. The back-up equipment consist of a SB-301/SB-401, SB-303, and Collins 51J4 receiver. Two Collins 51M7 aircraft receivers monitor the tower at SNA.



**Bob AF6C at his home station (around 2004)**

Here are some of Bob's favorite non-ham interests:

- Sports Car Club (Group Z and 240-Z)
- Rode horses and used pitch-fork at Thomas School
- Flying Piper Colt and V-Tail Model H Bonanza
- Apple computers
- Reading books

If you get a chance to talk to Bob at a meeting, ask him about goodies he could buy on Cortlandt Street in NYC.



## TechTalk110

# Inexpensive Home-constructed Microwave Dummy Load

by John Hudson G3RFL

*[This article is reprinted with permission from the first issue of the new (and free) online eMagazine called CQ-DATV. URL provided at end]*

In a senior moment, I managed to damage my RF dummy Load, by using it on a 13cms transmitter that was more than capable of delivering 120W. So it was time to consider a replacement and an upgrade to cope with the higher power Levels.

I started by purchasing a 50ohm 250W thick-film resistor. The flange-mount resistor I chose from Anaren has a specification (see data sheet in **Figure 5**) that will enable it to be used up to at least 2GHz, and cost £7. I have seen some on eBay for about the same price, but only 150W versions. The Henry Radio eBay store does sell 250W units manufactured by Res-Net Microwave for about US\$26 in quantities of one (including free shipping inside US).

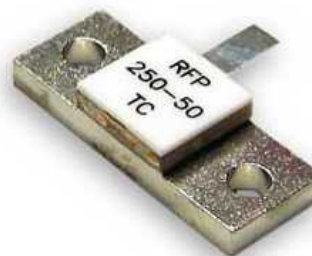


**Fig 1 – Completed Dummy Load with flange-resistor and N-connector installed on Heat Sink, but no fan.**

### Some Construction Details

I was fortunate to find suitable heat sink in my junk box, something I suspect was left over from a computer upgrade. It was a simple task to drill and tap threads into the heat sink and mount the resistor

flange applying a liberal dosage of heat transfer compound. I folded the resistor TAB back over onto the top of the resistor body. I also modified an "N" type of connector receptacle, filing the centre pin on the bottom down as much as possible. The connector is mounted centered over the resistor tab and the connector pin makes a compression electrical contact with the resistor tab, using the mounting four mounting bolts. Be careful not to over tighten the compression or you will break the resistor.



**Fig 2 – 50 ohm Flange-Mounted-Termination Thick-film resistors available from Res-Net Microwave and Aranen**

### Heat Sink Gets Too Hot

In theory the unit should work up to 2GHz, but my first test was on 2M with just 50W, the heat sink soon got too hot to hold, after only a few minutes.

So I decided to add a fan, quick search of my junk box and I failed to come up with a suitable fan for the heat sink, probably why the heat sink was in my junk box, so it was time to invest some of my children's inheritance in a commercial product. The 12V fan I chose came from CPC and was designed for use used on PCu/P and cost just over £7.

When the fan arrived I fitted it and repeated the experiment with the two meter source without running the fan. Once the heat sink became too hot to hold, I powered up the fan, and after only a few minutes the temperature dropped to just a few degrees above room temperature. I was well pleased with my £7 investment, in what proved to be a very quiet fan, well worth the £7. See **Figure 3** for the completed dummy load construction.

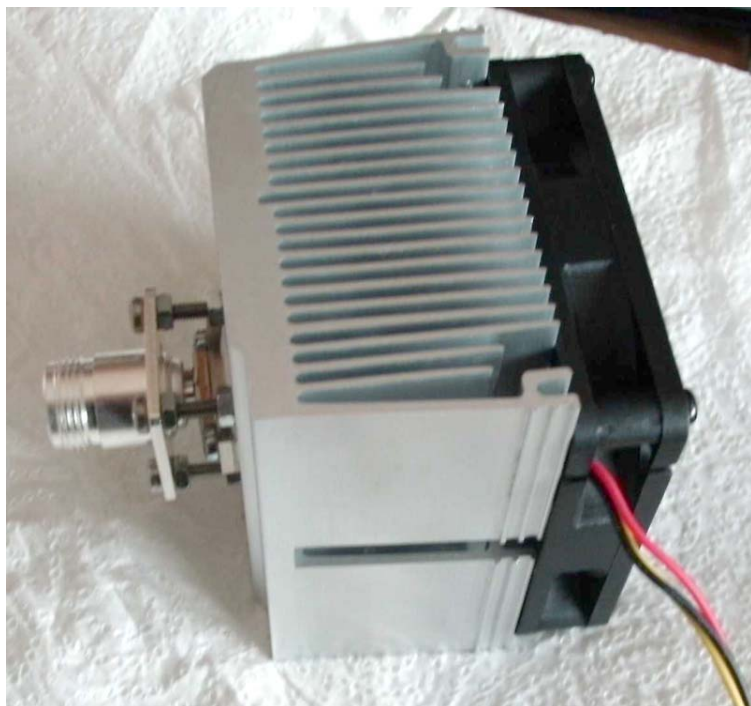


Fig 3 – Completed Dummy Load unit now fitted with a 12V cooling fan

### Future Plans

The fan also has the third wire which provides pulses to indicate the fan is spinning; this might be useful for the future when I develop the unit further. But my first addition will be a voltage detector interfaced to a PIC microprocessor so I can read out the POWER via a USB lead.....watch this space.

The author may be contacted via  
**G3RFL "at" talktalk.net**

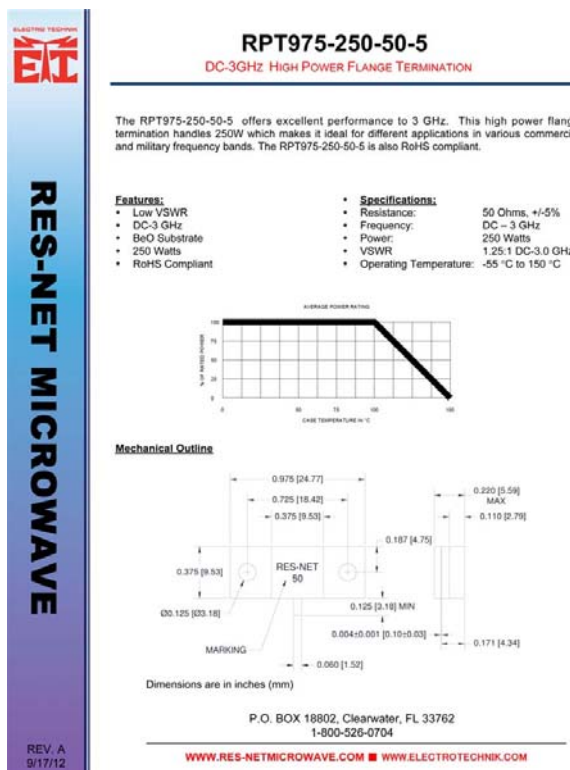


Fig 4 – Datasheet from Res-Net Microwave



Fig 5 – Datasheet from Anaren

### Related URLs:

- CQ-DATV online (free bi-monthly) e-magazine (ePub format) – see [www.CQ-DATV.mobi](http://www.CQ-DATV.mobi)
- Anaren High Power Flanged Termination Resistors – see [www.Anaren.com/products/militaryinstrumentation-resistive-products](http://www.Anaren.com/products/militaryinstrumentation-resistive-products)
- Henry Radio eBay store – see <http://stores.ebay.com/Henry-Radio>
- Henry Radio online store – see [www.HenryRadio.com](http://www.HenryRadio.com)
- John G3RFL home web page – see <http://G3RFL.co.uk>
- Yahoo Group for Digital ATV – see [groups.yahoo.com/group/DigitalATV/](http://groups.yahoo.com/group/DigitalATV/)
- Orange County ARC entire series of newsletter DATV articles – see [www.W6ZE.org/DATV/](http://www.W6ZE.org/DATV/)



## OCARC GENERAL MEETING MINUTES 2013-05-17

The OCARC General Meeting was held at the Red Cross Complex on May 17th 2013. The meeting was called to order at 7:01 PM. 21 members and three visitors were in attendance, including 5 board members: Prez AF6CF, VP N6GP, Treas W6HHC, Tech AF6C and Director-at-Large KB6CJZ. There was a quorum present.

The evening's program was a presentation by Nick Sava N6OMG on technology of radio controlled cars. Nick is quite accomplished in the RC Racing circuit, and has won many championships.



Fig 1 – One of Nick N6OMG's many racing trophies



Fig 2 - Nick N6OMG explaining design of RC motors



Fig 3 – Larry K6LDC (L) and Paul WD6FMX inspect the RC car as it travels past.

### OLD BIZ:

- Dino KX6D and Bob AA6PW reported the next FD planning meeting was going to be held Friday May 25...and the final FD planning would be held at June 14 General Mtg.
- Bob AF6C showed the new 6-foot OCARC banner that he ordered for identifying the FD site for visitors who can not see the actual set-up from La Palma Avenue. The banner cost only \$49 with shipping,



Fig 4 – Bob AF6C (R) and Larry K6LDC display new FD Banner to identify FD site from the street

### NEW BIZ:

Club treasurer, Ken W6HHC, made a motion for the club to spend up to \$2,000 for a Field Day expense Budget. The budget allocates expenses approximately as:

- Food – \$1185
- Generator rental - \$600
- FD Signage – \$100
- Incidental – \$100

The Field Day budget motion was approved.



**GOOD OF CLUB:**

- **Show-and-Tell** – Nicholas AF6CF brought in two home-brew battery packs that he uses for portable QRP operations. One unit provides 3500 mAH using NiCd and is built into a floppy drive case. A second unit provides 10 AH using NiMH and is built into a SCSI tape drive case.
- **HRO Ham Jam** - HRO is holding an open house on Saturday, June 15 called "HAM JAM". [See HRO flyer below these minutes.]

Meeting adjourned at 9:10pm.

Respectfully submitted by:  
Robbie Robinson KB6CJZ, Acting Secretary



Fig 5 - Nicholas AF6CF explains the construction of an 10 AH home-brew battery pack for QRP.

## HRO HAM JAM

### WELCOME TO JUNE AND PREPARATIONS FOR FIELD DAY!

**Come join Ham Radio Outlet, Anaheim for a Ham Jam on Saturday, June 15, 2013.**

Just a week before the ARRL annual Field Day weekend, take advantage of the expertise of hams who have operated and excelled at Field Day; seminars, exhibits, clubs, mfrs, drawings, testing...food!

Tour the American Red Cross van and learn about volunteering; hopefully the OC RACES van and volunteers as well will be on hand. ARRL will be here with information about the League, and Carl Gardenias WU6D, the ARRL Orange Section Mgr, will regale us with Field Day stories and ARRL tips and guidelines. Gordon West will be available with suggestions and his operating expertise from many a Field Day. Chip Margelli, K7JA, now with InnovAntennas and a Field Day Junkie since 1963, will share everything anyone wanted to know about antennas for portable or temporary operations. Heiko Peschel, AD6OI from the South Orange Amateur Radio Assn (SOARA) will detail VHF/UHF Field Day station organization and operating tips. We hope to have even more, more, more, and clubs wishing to set up a tent with information on their local Field Day sites are more than welcome to join us.

The American Heritage Girls will be serving lunch again this year; hot dogs, chips, soda @ \$1 each or all together for a \$2.00 lunch. All proceeds go to the girls, and maybe we can talk them into adding to the ranks of new, young hams by testing while they're here.

We will have several drawings, at 11AM, 1PM, and 3PM for various prizes, and hope to have several representatives here from some of the local manufacturers in case you have questions about specific radios. M2 is joining us this year to show some of their antenna options for Field Day type operations, and we hope to see reps from Yaesu and PowerWerx (Wouxun), and possibly others who are able to work us into their busy schedules. HRO staff will be on hand in full force to help in any way possible.

Please join us on Saturday, June 15 for Ham Radio Fun at Ham Radio Outlet, 933 N. Euclid St., Anaheim, CA 92801. Call us at 714-533-7373 for further details.

## Heathkit of the Month #49: by Bob Eckweiler, AF6C



### Heathkit SB-220 (and SB-221) 2KW HF RF Linear Amplifier

#### Introduction:

Back in September of 2011 (Heathkit of the Month #33) the SB-200 (1,200 watt linear amplifier) was discussed. This month we will take a look at its bigger brother the SB-220. Like the SB-200, the SB-220 required updating when the FCC outlawed commercial linear RF amplifiers from covering the 10-meter band due to their widespread illegal use on the nearby 11-meter CB band. These later amplifiers were given new model numbers: SB-201 and SB-221 replaced the SB-200 and SB-220, respectively.

#### The SB-220 RF Amplifier:

The SB-220 (Figure 1) was released in late 1969, about six years after the SB-200. Both remained on the market until 1978 when 10-meter capability was eliminated. They both continued in production in their modified state until 1983. The SB-220 originally sold for a factory catalog price of \$349.95. (Figure 2 is an ad from the inside rear cover of the December 1969 QST). The retail store price was slightly higher at \$369.95. By the 1982 spring/summer catalog the SB-221 price had increased to \$649.95.

On January 23, 1970 I visited the Heathkit retail store on Ball Road in Anaheim; adding the *then* 5% sales tax, I happily lumbered out \$388.45 poorer, but carrying two heavy boxes.

Table I shows the specifications of the SB-220. It is a heavy duty amplifier, especially if you run it off of 240 VAC. The final tubes are a pair of Eimac 3-500Z glass triodes specifically designed for improved grounded-grid linear operation. With 500 watts of plate dissipation per tube and a large cooling fan, the amplifier is



**Fig. 1 SB-220 2KW Amplifier. The SB-221 looks identical except for the 10 meter band switch markings.**

conservatively rated. The power supply is built into the amplifier which fits easily on a desk-top. Figure 3 shows an inside view of the amplifier tube section.

The SB-220 covers 80 through 10 meters. Using the SB-220 on the newer 12 and 17 meter WARC bands is spotty without modifications. A lot can be found on the subject by Googling *Heath SB-220 WARC*.

The SB-220 front panel meters and controls are uncluttered and laid-out in three rows. The front panel layout and nomenclature are listed in Table II. The mode switch sets the nominal plate voltage. In the **CW/TUNE** position it is 2.5 KV DC and in the **SSB** position it is 3.0 KV DC. The CW/TUNE position can be used for lower power SSB operation.

Like the front panel, the rear panel is simple and uncluttered with just eight items. They are listed in Table III. Instead of fuses, the amplifier uses two circuit breakers in the AC line, resettable by pressing the button on the tripped breaker. They are accessible on the rear panel. Also on the rear panel is the inlet to the fan which forces air over the 3-500Z final tubes and out the cabinet. The tubes are not in air-flow directing chimneys. The large fan is located so it also forces air over the tube sockets, cooling the critical filament pins that dissipate a significant amount of heat by themselves.

The SB-220 I bought was one of the early models. The plate transformer shipped in a separate box, and Heathkit warned in their documentation that shipping of an assembled SB-220 could result in damage to the unit due to the heavy transformers. If you were returning the SB-220 to the factory for repair, Heath recommended you order the SB-220 Service Packing kit, (Order # 171-3167 - \$5 deposit) and pack the kit using the instructions included with the kit. The deposit was refundable or creditable towards any repair bill.

My SB-220 came with an early release manual (11/29/69) and included a four page errata sheet that has three pages of changes and a new Pictorial 4-6. Heathkit spent a lot of time perfecting their manuals and it was interesting to see how they stayed on-top of keeping their highly praised documentation up to date along with their electronic technology.

### Assembling the SB-220:

Assembly began in the usual way for a kit. This is an important step that some people gloss

Bands:	80, 40, 20, 15, 10 Meters
Driving Power:	100 Watts
Power Input -	
SSB:	2,000 Watts PEP
CW / RTTY	1000 Watts
Duty Cycle -	
SSB:	Continuous
CW:	Continuous (Max. key-down 10 min.)
RTTY:	50% (Max. xmit time 10 min.)
3rd. Order Distortion:	better than -30 dB
Input Impedance:	52 $\Omega$ nominal, unbalanced
Output Impedance:	50 to 75 $\Omega$ unbalanced
SWR:	2.0 : 1 or less
Power Requirements -	
120 VAC:	20 A maximum, 50/60 Hz
240 VAC:	10 A maximum, 50/60 Hz
Cabinet Size:	14-7/8" W x 8-1/4" H x 14-1/2" D
Net Weight:	48 lbs (22 kg)

**Table I: SB-220 Specifications**

### Front Panel Top Row (L to R)

Model Emblem:	<b>HEATHKIT SB-220</b>
(nomenclature):	<b>2KW LINEAR AMPLIFIER</b>
Meter (lighted):	<b>PLATE AMPERES</b> – 0 to 1 A FS (0.1 A/ major div., 0.02 A/ minor div.)
Meter (lighted):	Multipurpose <b>PLATE VOLTAGE – KV</b> – 0 to 3.5 FS (500 V/ major div., 100 V/ minor div.)
	<b>GRID MA</b> – 0 to 350 mA FS (50 mA/ major div., 10 mA/ minor div.)
	<b>REL. RWR</b> - 0 to 350 arbitrary units (50 units/ major div., 10 units/ minor div.)

### Middle Row (L to R)

Capacitor:	Plate <b>TUNE</b> - white range areas (Approx. settings for: <b>80, 40, 20, 15, 10</b> )
Capacitor:	Plate <b>LOAD</b> 0 to 10 units (18°/ major div. – 180° total)
Switch - 5 pos. Rotary:	<b>BAND</b> <b>80, 40, 20, 15, 10 meters</b>
Potentiometer:	Relative Power meter adjustment <b>SENSITIVITY</b>
Switch - 3 pos. Rotary:	Multimeter function <b>GRID, REL. PWR., HV</b>

### Bottom Row (L to R)

Switch - Rocker	Power <b>OFF, ON</b>
Switch - Rocker	Mode <b>CW/TUNE, SSB</b>

**Table II: SB-220 Front Panel Controls, etc.**

over. It involves inventorying and familiarizing yourself with the individual parts. Rarely have I ever received a new Heathkit with any parts missing, though I occasionally find extra pieces of common small hardware.

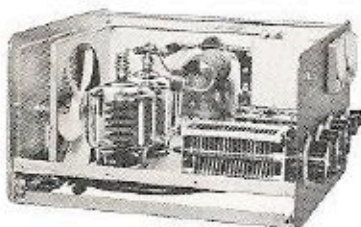
Once the inventory is completed, a small circuit board is stuffed; it holds the (14) high voltage silicon rectifier diodes, the meter scaling resistors and a 5.1V zener diode (ZD1) which sets the tube bias. The diode was originally mounted using two silver-plated strips that acted as heat sinks. More on this diode later. Finally, connecting wires are soldered to the



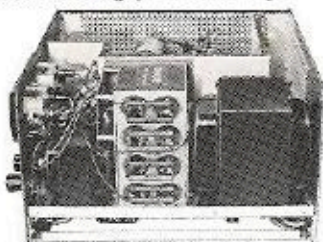
## The New Heathkit® 2-KW Linear Is Here (at last)



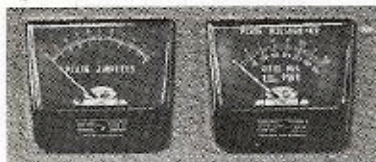
**New SB-220 . . . \$349.95\***



Two rugged, dependable Eimac 3-500Z finals for top performance. Zener regulated operating bias reduces idling Ip for cool running.



Reliable power supply . . . plate transformer on right, capacitor bank in center for excellent regulation, filament & bias circuitry on left.



Continuous monitoring of Ip plus switch selected monitoring of Rel Pwr., Ep & Ig.

It's not just a rumor anymore . . . the SB-220 is here, with a price and performance worth the wait.

The New Heathkit SB-220 uses a pair of conservatively rated Eimac 3-500Z's to provide up to 2000 watts PEP input on SSB, and 1000 watts on CW and RTTY. Requires only 100 watts PEP drive. Pretuned broad band pi input coils are used for maximum efficiency and low distortion on the 80-10 meter amateur bands.

**Built-In Solid State Power Supply** can be wired for operation from 120 or 240 VAC. Circuit breakers provide added protection and eliminate having to keep a supply of fuses on hand. Operating bias is Zener diode regulated to reduce idling plate current for cooler operation and longer life.

**Double Shielding For Maximum TVI Protection.** The new "220" is the only final on the market that's double shielded to reduce stray radiation. The heavy gauge chassis is partitioned for extra strength and isolation of components. When you put this kind of power on the air, you'd better be sure. With the SB-220, you are.

**Really Cool Running.** The layout of the SB-220 is designed for fast, high volume air flow, and a quiet fan in the PA compartment does the job. The "220" actually runs cooler than most excitors.

**Other Features** include ALC output for prevention of overdriving . . . safety interlock on the cover . . . easy 15 hour assembly and sharp Heathkit SB-Series styling.

**Tired Of Stumbling Barefoot Through The QRM?** Put on big shoes . . . the new Heathkit SB-220. Another hot one from the Hams At Heath.

**Kit SB-220, 55 lbs. . . . . \$349.95\***



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AM-228

board; their other ends will be connected when the board is later installed.

Next, the RF input coil assembly is built. The five input coils, one for each band, are installed on a small sub-chassis along with a wafer section of the band switch. The fixed capacitors that broadly tune these coils are then soldered in place, and the coils are wired to the band switch wafer. The remainder of the band switch is assembled along with its shaft on the outside of the sub-chassis, which acts as a shield. Shielded wires are added to carry the RF. Their other ends will be connected when the sub-chassis is installed.

The front panel is assembled next. The meters, nameplate, meter switch and sensitivity pot are added, as is the meter lighting circuitry.

Assembly then moves to the basic chassis. Tube sockets, rocker switches, relays, terminals, rear connectors and other hardware are installed. The ALC circuit components are added next on a terminal strip mounted to the chassis.

Top chassis assembly is then conducted. Part of the top RF shield is installed as is the HV interlock and some of the minor pi-network components. At this time the input sub-chassis, built earlier, is installed, followed by the major parts of the pi-network. The two large transformers and the previously wired front panel are attached to the chassis, as is the fan and numerous other chassis shielding components. At this stage you will find the assembly has become quite heavy!

The previously wired circuit board is then attached to the outside of a large capacitor bracket, into which eight well insulated 200  $\mu$ F 450V capacitors are installed, forming the power supply filter system. A series of high wattage bleeder resistors are wired to the capacitors.

Finally, the top and bottom wiring are completed; the amplifier is set for the correct line voltage, the tubes are installed and the amplifier is ready for test.

### Rear Panel Items (L to R)

Power Cord:	Heavy Duty 3-wire
Circuit Breakers (pair):	(10 Ampere)
Phono Jack (input):	<b>ANT RELAY</b> (Ground to switch amplifier to transmit)
Phono Jack (output):	<b>ALC</b> (Automatic Level Control)
RF Connector (input):	<b>RF – INPUT</b> SO-239 UHF Connector
Stud:	Ground Post #10-24 screw with washers and wing nut
RF Connector (output):	<b>RF – OUTPUT</b> SO-239 UHF Connector

**Table III: SB-220 Rear Panel Connections, etc.**

Plugging in a 2 KW amplifier for the first time can be intimidating. However, to Heathkit's credit, it came on without smoke, arcing or any other problems. Testing went smoothly with one minor exception, the fan motor was quite noisy. Heath quickly shipped a replacement fan under their warranty.

### The SB-220 Circuit:

Grounded-grid linear amplifier models using a pair of 3-500Z tubes are generally quite similar in their basic design. The design Heath used for the SB-220 follows it, with a few exceptions.

### The Power Supply:

The SB-220 uses a standard voltage doubler circuit to achieve the high voltage. The HV transformer has a Hypersil core. Hypersil is a material originally patented by Westinghouse. This grain aligned core provides more power per pound of core material, resulting in a smaller transformer that runs cooler. The transformer in the SB-220 is no wimp as its duty cycle specification shows. The transformer's 120/240V dual winding primary is tapped to provide 2,500 VDC or 3,000 VDC out of the voltage doubler. Each doubler leg uses seven 600V PRV diodes in series and four 200  $\mu$ F 450 volt electrolytic capacitors also in



series. Each capacitor is shunted by a 30K $\Omega$  7-watt bleeder resistor.

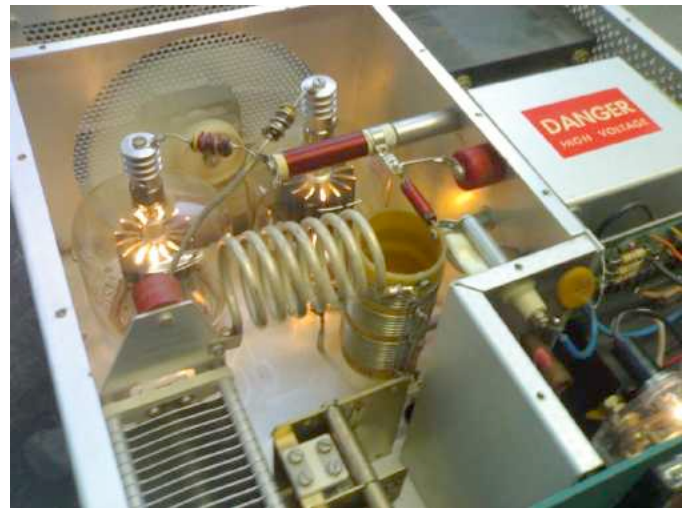
A separate filament transformer provides 5 VAC voltage to the two 3-500Z finals. The transformer is rated at 30 amperes. Each tube's filament draws 14.5 amperes. It is important that the soldering in the filament circuit be checked carefully. If the voltage drops below 4.75 volts the tube life may be negatively affected. The filament transformer also powers the two #47 meter lamps. A separate bias winding produces about 120 VDC after rectification and filtering. This voltage is used to bias the 3-500Z tubes, to operate the transfer relay and is tapped down to provide the ALC threshold voltage. These will be discussed more later.

### **The Input Circuit:**

A separate pi-network input circuit exists for each of the five bands: 80, 40, 20, 15, & 10M. The required network is selected by the band switch. The Q of these circuits is low, a bit more than 1. This affords good bandwidth but poor isolation to the amplifier tubes which swing from a very high impedance to a low impedance of less than 40 $\Omega$ . This is no problem for tube type exciters like the SB-401 to drive; however, solid-state transmitters may encounter difficulties matching the amplifier input. RF from the tuned network is AC coupled to the filaments (cathodes) of the tubes. A bifilar filament choke isolates the RF from the filament transformer.

### **Amplifier Circuit:**

The two 3-500Z tubes (see Fig. 4) are high mu power triodes, each capable of 1,110 watts PEP input. The tube's grids are effectively at AC ground and the input RF drives the filaments (cathodes). RF power fed to the cathode is effectively fed through to the output, adding to the power efficiency. The tube plates are connected to a pi-network output circuit. The tubes run at a plate voltage of 3 KV in SSB mode, and 2.5 KV in CW/TUNE mode. The pi-network has to handle high voltages and currents, both RF and DC; thus, components and



**Fig. 3 Inside view of the SB-220 showing the two 3-500Z tubes. Note large cooling fan. Photo courtesy of Kees – PA2X.**

Visit his site at: <http://www.heathkit.nl>

wiring must be conservative. The band switch contacts are probably the weakest part in this circuit.

### **Switching Circuit:**

A single 3PDT relay controls the amplifier. The relay is open when the amplifier is off or in receive. One set of contacts switches the input and one the output. When the amplifier is in receive (or off) these contacts route the input directly to the antenna, bypassing the amplifier; on transmit they connect the exciter to the amplifier input and the amplifier output to the antenna. The third set of contacts controls the bias. With the amplifier on and the relay open, approximately +115 V DC is applied to the center tap of the filament transformer raising the cathode voltage and making the grid of each tube very negative, cutting the tube off. When the relay closes, this voltage is fed to a zener diode lowering the cathode voltage to where the grid voltage is negative by only about 5.1 volts below the cathode. The result is the tubes start conducting plate current at about 45 to 60 ma each – a good bias voltage for class B operation. The relay is powered by the bias supply and is operated by an external circuit connected to the **ANT RELAY** jack on the rear panel.





Fig. 4: Eimac 3-500Z Triode Transmitting Tube.

### **Meter Circuits:**

The two meters are each  $\mu\text{A}$  full-scale with an internal resistance of  $1.4\text{K}\Omega$ . Each meter will read full scale when 0.28 volts is applied across it.

**Plate Current Meter** - This meter reads full scale when 1 ampere of plate current is flowing. All the plate current passes through R1, a  $1\Omega$  5W resistor in the negative side of the HV power supply. At 1 ampere this resistor will drop 1 volt. The meter is placed in series with a  $3.6\text{K}$  resistor which raises its effective resistance to  $5\text{K}\Omega$  causing

the meter to reach full scale ( $200\ \mu\text{A}$  when 1 amp flows through R1).

**Multimeter** - The second meter acts as a multimeter measuring grid current, relative power and high voltage depending on the position of the meter switch.

**a. Grid Current** - Grid current is returned to ground through the cathode, ZD1 and a  $0.82\Omega$  resistor; it is isolated from the plate current because the plate current meter circuit is returned to the negative end of the power supply filter chain. When in the **GRID** position the meter is switched across this resistor which produces 0.28V when 350 mA of grid current is flowing.

**b. Relative Power** - In the **REL PWR** position RF output voltage is sampled by a voltage divider consisting of R24 and R25, rectified and filtered by D17 and C54, scaled by the front panel **SENSITIVITY** control and fed to the meter, giving indication of relative output power.

**c. H. V.** - In the **HV** meter position, the meter reads 3.5 KV full scale. A voltage divider consisting of  $14.1\text{M}\Omega$  (three  $4.7\text{M}\Omega$  resistors in series) and  $1.12\text{K}\Omega$  ( $5.6\text{K}\Omega$  resistor in parallel with the  $1.4\text{K}\Omega$  meter resistance) results in 0.28V across the meter with 3.5 KV applied.

### **ALC Circuit:**

Finally the ALC circuit provides a voltage back to the exciter when the amplifier is being overdriven into a non-linear state. The exciter uses the voltage to reduce the RF output driving the amplifier.

A DC voltage of about 60VDC is tapped off the bias supply. This voltage reverse biases D18 which is coupled to the RF driving the amplifier. Should the peak negative driving voltage exceed the 60V threshold, D18 will conduct on the negative peak of each RF cycle. This negative voltage is filtered and fed to the ALC connector on the back of the SB-220/221.

**The SB-221 Changes:**

The major changes to prevent the SB-221 from operating on 10/11 meters include removal of the 10 meter contacts on the band switch, and the removal of the 10 meter input coil. Also installed in the input circuit is a sealed filter which is riveted to the input shield assembly and acts as a low-pass filter with a cutoff frequency below the 10 meter band.

Heathkit did allow licensed amateurs to purchase the needed parts to restore 10 meter operation on the SB-221. Doug DeMaw W1FB discussed the procedure in the May 1980 issue of *QST* on page 44.

**Early Modifications:**

Numerous modifications have been suggested for the SB-220 over the years. To discuss many of them is beyond the scope of this article. Perhaps a future article may cover some of the more important ones. So at this time we will just touch on a few important ones.

**Zener Diode Replacement Modification:  
(Kit SBM-220-1)**

Early SB-220 amplifiers began experiencing a problem where the idling plate current would suddenly increase to 300 mA instead of the expected 90 to 120 mA. This occurred most frequently on amplifiers operating RTTY. The cause was the failure of ZD-1 the 5.1-volt bias zener. Heathkit released a free modification kit to owners designated the SBM-220-1. This kit replaced the 1W zener with its attached heat sinks to a 10W stud-mounted 1N3996A (56-82) zener diode. The kit also included mounting hardware, wire, silicon heat sink grease and a 4-page instruction sheet. The diode mounts in an existing hole on the capacitor mounting bracket, and is wired in place of the circuit board mounted zener. This modification was incorporated into later SB-220 kits.

**Insulated Spacer Modification:**

A second modification answers a situation where arcing occurs between the diodes on the circuit board and the metal spacers mounting

the board. The two lower spacers should be replaced with #6-32 x 3/4" tapped phenolic spacers. The upper spacers must remain metal to provide a ground path for the board. This modification was also incorporated directly into later kits.

**240 V Failure Modification:**

A third modification involves SB-220 amplifiers wired to operate on the 240V line. Should the mode switch partially fail or a primary winding open up in the HV transformer, excessive current is drawn through the filament transformer primary causing it to fail. To prevent this the black-green and black yellow wires from the filament transformer should be removed from the four-screw terminal strip under the chassis and connected together with a wire nut. Do this only for 220V operation and restore to original configuration should the unit be returned to 120 V operation.

This modification is from Heathkit service bulletins SB-220-19, SB-220-27 and SB-221-14.

**Operation with Solid State Radios:**

The SB-220 was designed to work with the SB line of exciters and transceivers and other tube output transmitters of the late 60s and early 70s. Special considerations must be taken before these radios are used with newer solid-state radios:

a) Many solid-state transmitters have trouble matching to the input of the amplifier. An internal or external antenna tuner may be required.

b) To switch the Heathkit SB-200 and 220 series of amplifiers to transmit requires a switch capable of switching 150 VDC to ground. Many solid-state switching circuits use a transistor that cannot handle this high voltage. Either an external relay is required or a modification kit needs to be installed in the amplifier. Harbach Electronics offers such a kit – the SK-220 Soft Key kit (<http://harbachelectronics.com>).

c) AVC voltages from the SB-220 may run high for some solid-state exciters. Often a resistor divider or zener diode limiter can be incorporated to solve this problem. Many transceivers are not powerful enough to overdrive the amplifier and the ALC can just be left unconnected. Google your transceiver model and SB-220 to see how others have hooked up their transceiver. Heathkit service bulletin SB-220-26 discusses using ALC with Kenwood transceivers.

### Parasitics Problems:

There has been a lot written about parasitic oscillations occurring in the SB-220. This oscillation, usually around 110 MHz results in a large grid current pulse that creates a magnetic field, sometimes resulting in a grid to filament short in the tube. This parasitic oscillation also often results in arcing of the tuning capacitor, or in later units arcing at the delicate band switch contacts, as well as failed RF grid chokes and more.

Richard Measures - AG6K wrote a two part article starting at page 25 of the November 1990 issue of **QST** discussing improvements to the SB-220 including ways to reduce the possibility of the damaging VHF parasitic oscillations. Before condemning the Heathkit engineers and this amplifier, this problem is also found in other HF amplifiers, especially ones using newer high  $\mu$  tubes capable of operating at high gain above 15 MHz (the 3-500Z). Mr. Measures traced a significant contribution of the problem *"to the high VHF Q copper conductors between the tuning capacitor and the anode connections..."* Part of his solution is the use of low Q nichrome wire in place of the copper wire in the anode leads. ARRL members can download Mr. Measures' articles from the periodical archives at the ARRL website.

### Conclusion:

I've used my SB-220 amplifier for many years, until I encountered a period of little hamming due to the discovery of computers. The SB-220 sat so long that I wanted to clean it out and give

it a good dusting before putting it back in service. Switching from daily use of the SB-401/SB-301 to a Kenwood solid-state transceiver, knowing I'd have to rework the SB-220 to make it compatible with both radios, further delayed the refurbishment. It has recently gotten higher on the priority list thanks to my operating the recent WPX context.

I was one of the SB-220 owners who encountered the parasitic problem early in its use. A loud hum and a puff of smoke told of the problem. Switching off the amplifier immediately I found a grid choke "cooked" and a solid grid to plate short on one of the 3-500Z tubes. Heathkit replaced the tube under warranty but I also bought a spare at, what was then, Henry Radio on Euclid Ave. in Anaheim. (\$34 ea. back then!)

Interestingly, I was handling phone patches with Bill Orr - W6SAI (then portable KH6) with his daughter who lived down the coast. Bill sent me a lot of good information on the Eimac 3-500Z in Amateur Service. After replacing the tube, I never encountered the parasitic problem again. Still, I will be ordering a parasitic kit for the SB-220 sold by AG6K to be on the safe side. <http://www.somis.org/Price-Info.html>

Using the SB-220 in the early 1970s I worked close to 200 countries in a year and was spending less time in pileups than when running barefoot. All while working 60+ hour workweeks.

Yes, the SB-220 is still an excellent amplifier, if it is restored and some simple modifications added.

73, from AF6C



*This article is Copyright 2013 R. Eckweiler and The OCARC Inc.*

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

*Thanks - AF6C*

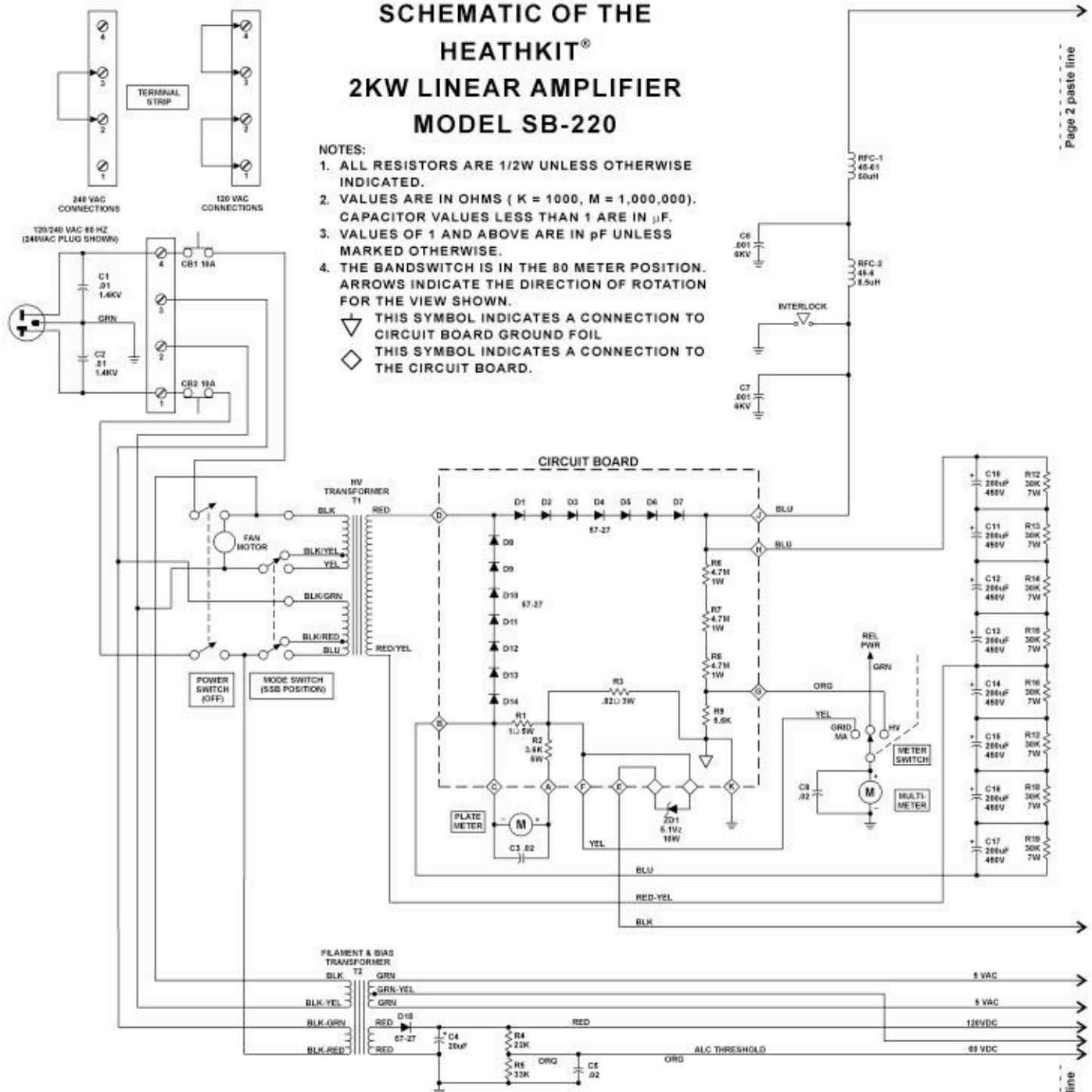


## SCHEMATIC OF THE HEATHKIT® 2KW LINEAR AMPLIFIER MODEL SB-220

## NOTES:

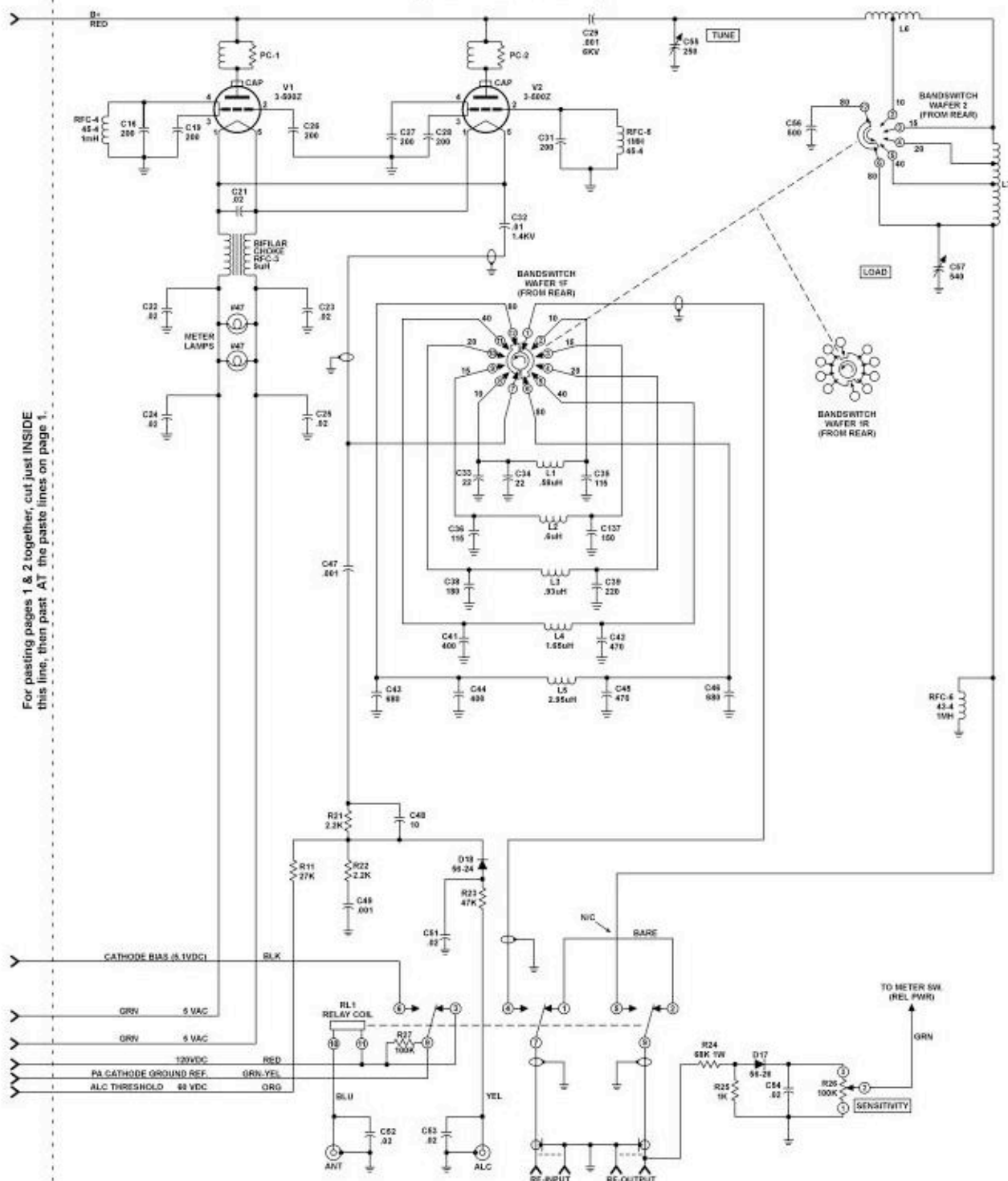
1. ALL RESISTORS ARE 1/2W UNLESS OTHERWISE INDICATED.
2. VALUES ARE IN OHMS ( K = 1000, M = 1,000,000). CAPACITOR VALUES LESS THAN 1 ARE IN  $\mu$ F.
3. VALUES OF 1 AND ABOVE ARE IN pF UNLESS MARKED OTHERWISE.
4. THE BANDSWITCH IS IN THE 80 METER POSITION. ARROWS INDICATE THE DIRECTION OF ROTATION FOR THE VIEW SHOWN.

- ▽ THIS SYMBOL INDICATES A CONNECTION TO CIRCUIT BOARD GROUND FOIL  
◇ THIS SYMBOL INDICATES A CONNECTION TO THE CIRCUIT BOARD.



SB-220 Schematic, redrawn by: Tom Hammond NØSS rev. 28 October, 2002  
Please report errors to <n0ss@arrl.net> so corrections can be made.  
In the e-mail address, above, the '0' is a ZERO, not an 'oh'.

# SCHEMATIC OF THE HEATHKIT® 2KW LINEAR AMPLIFIER MODEL SB-220 (PAGE 2 OF 2)



## OCARC Board Meeting Minutes

**May 11, 2013**

The OCARC Board meeting was held at the JagerHaus Restaurant, 2525 East Ball Road, Anaheim, and called to order to order by President Nicholas Haban AF6CF on Saturday, May 11, 2013 at 8:10 am. All directors except Jay – KI6WZU and Paul – W6GMU were present. Also present were members Gene Eckert–KJ6OML and George Jacob – N6VNI.

### DIRECTOR REPORTS

**Treas** – Ken W6HHC reports for the calendar year our accounts are up \$1300 after subtracting outflows from inflows.

**Secr** – Tim KJ6NGF reports that he will not be able to attend the next General Meeting and asked if someone would volunteer to take the minutes. After discussion it was determined that Robbie KB6CJZ would fulfill that duty.

**Activities** – Doug W6FKX will not be at May or June meets. Tim N6GP will run Opportunity drawing at May meeting and Jeff Hall will run at June meeting.

**Membership** – Jay KI6WZU was not available to report but Ken said he has an attendance form that he will supply to Jay to utilize at General meetings.

**Publicity** – Kris KC6TOD has copy of a “General News Release” to send out to various news agencies regarding our Field Day activities. Kris is also working on a plan to invite Buena Park PD personal to attend our Field Day.

**Tech** – Bob AF6C reports a former member has provided some radio equipment that can be sold at club auction but Bob needs help finding storage space in the interim time.

### OLD BUSINESS

- **June General Meeting** – Last month a “motion” was approved to move the June General Meeting to Friday June 14th subject to Red Cross approval for use of room. Room is available as requested.

### • Newsletter Editors:

- May – KI6WZU
- Jun – W6HHC
- Jul – W6GMU
- Aug – AF6C
- Sept – N6GP
- Oct – KC6TOD
- Nov – W6FKX
- Dec – KC6TOD

- **General Meeting Entertainment** – May – Nick Sava – RC Cars. June – Chip will be making Field Day related presentation. July working on Adriano and Pickax presenter. August - Ken – W6HHC doing Digital-ATV. September – Anniversary Party. October – Auction. November – Doug W6FKX on Long Beach Earthquake including Ham Radio response. December – Dinner.

### • Field Day –

- Bob Harrington explained they are looking for heavy duty ropes, possibly coaxial cable in 100 ft lengths. AA6PW also reported Dino is working with a source to get stakes made from cold rolled steel, however may need more of those as well. VE session is a go.
- **FD Banner** - Bob AF6C said the banner he ordered should be here by the May General meeting.
- **FD Public Relations Officer** – President has appointed Carolyn Jacob – KE6BUH the clubs PRO for Field Day. Carolyn has submitted a membership application and ordered a badge.
- **FD Aluminum Towers** – Bob – AF6C is working with aluminum-tower storage site owner, K6LDC, to ensure access to our tower sections for Field Day. Doug W6FKX related that he has the tower guy lines and pins.
- **FD Food Donation Can** - Money has started to be donated into the can with \$70 received as of 5/7/13. It was emphasized that members be encouraged to donate at least \$20 towards the Saturday and Sunday food expenses. If a member is anticipating not being there for the full time then they should consider donating at least \$5 per meal for the time they will be there. Also, the food donations do not cover the cost of Friday night's meal. That meal is prepared and provided only to members taking part in the setup of the Field Day site that day.
- **Preliminary FD Budget** – estimated FD expenses so far are around \$2000 with hopefully \$1100 covered by donations. Firmer cost numbers are still being gathered. FD Food expenses are always the more difficult one to pinpoint until we know how many people will participate.



**OLD BUSINESS – cont'd**

- **Logo items For Sale** - This item is tabled until July.
- **PayPal Account re-establishment** – the account is up and running and therefore should be soon available through our web-site for payments towards items like dues, donations towards food cost, Christmas Party tickets, etc...
- **September Reunion** – This item is tabled until after Field Day. However, Ken W6HHC has been asked to put together an extended historical presentation about one of our early club members, W6NGO (SK).

**NEW BUSINESS – (none)****GOOD OF CLUB**

- May 18th – Fullerton Radio Club – Antennas in the Park.

Board Meeting adjourned at 9:23 am

Respectfully submitted by:

*Tim Millard KJ6NGF, Secretary 2013.*

## **New On-Line eMagazine for Digital ATV**

A new free eMagazine, CQ-DATV, is being published every two months. The format is both ePub files (good for Windows, MAC, iPad, and Android devices)....and .MOBI files (good for Kindle).

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