RF

ORANGE COUNTY AMATEUR RADIO CLUB, INC.

VOL. LVI NO. 03 P.O. BOX 3454, TUSTIN, CA 92781-3454 March 2015

The Prez Sez.....

by Tim N6TMT

Recently on a hike to Mt. Lee (home of the Hollywood sign), I was admiring the impressive antenna display when someone said to the Electrical Engineer in the crowd 'do you understand what occurs when a signal is sent through an antenna?" His answer was "no not really, my expertise is hardware design."

I would gather that most of us would not be able to answer that question very well either and there's nothing wrong with that because were amateurs and we likely know a little about many things.

Sure we may know a great deal about how to put a great signal out, but what about the physics involved; and what about the equally great mystery of propagation?

It is a curious thing we do when sending a signal out. We send it out not knowing if anyone else will hear us or if hearing will be able to respond. And that is just another of the mysteries we explore.

May all your signals be strong, constant and clear!

de N6TMT - Tim

Club Dues are due as soon as possible. We thank you in advance for your support!

Next Meeting

The next General Meeting of the OCARC will be held on **Friday, March 20th, 2015.** The presentation will be:

"Meteor Scatter QSOs"

Greg - W6ATB will talk on meteor scatter (aka meteor burst) communications at the March meeting. Don't miss this!!

The next general meeting will be on:

Friday, March 20th, 2015
@ 7:00 PM

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

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www.W6ZE.org

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Feedback & Corrections:
RF_feedback@w6ze.org

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Monthly Events:

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

Club Breakfast:
FIRST Saturday - **APRIL 04**
at 8:00 AM
Marie Callender's Restaurant
2525 North Grand Ave
(North of 17th Street)
Santa Ana, 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.

COAR RACES plans Communication Support for the Orange Police 2015 B2V Running Team

by Ken W6HHC

Each spring, law-enforcement running teams (from around the world) have entered in a competitive foot-relay-race through the desert. This race, known as "Baker-to-Vegas" (and aka B2V), is a 120 mile long race, that starts outside Baker (CA), runs through the desert to Shoshone, then runs through Pahrump, NV and finishes at the Hilton Hotel in Las Vegas. The B2V race is broken into 20 "legs" or stages. This year, more than 275 different law enforcement teams will participate. The runners of the Orange Police Department have been supported for many years with communications by hams belonging to COAR (City of Orange Amateur Radio) RACES, the OCARC members, and Communications Volunteers from Cypress. This year, the B2V event is scheduled to begin on Saturday, March 28, with runners reaching the finish line on Sunday, March 29.

The photo below shows many of the volunteers at a COAR RACES planning meeting for the B2V race communications that was held in early March. There are twelve OCARC members in this photo. The COAR RACES Chief Radio Officer is OCARC member Vern KG6OXD (standing in the back row, on the far left). The OPD volunteer coordinator for the COAR RACES organization is Carmen Cardenas, is on the right side of photo with Blue uniform.

Many members of COAR RACES and friends take a group photo during one of the Baker-2-Vegas Communications Planning Meetings. There are 11 OCARC members assisting COAR during B2V this year.

OCARC
General Meeting MINUTES
2015-02-20

The OCARC General Meeting was held at the Red Cross Complex on February 20th 2015. The meeting was called to order at 7:01 PM.

Our main speaker for the evening was **Dr. Arnold "Arnie" Shatz – N6HC**. Arnie was first licensed in 1969 as a novice with callsign KN3ANU in Philadelphia, Pennsylvania. After completing his medical school specialty in urology, Arnie served 2 years as a Lt. Cmdr. in the United States Public Health Service, Indian Health Service, on the Navajo and Hopi reservations. Arnie has been an ARRL member for more than fifty years and is a member of the Legacy Circle and Maxim Society, and is on the DXCC Honor Roll. He has been on many notable DXpeditions over the past decade, including FT5ZM, K7C, 3B7C, TX5C, K4M, T31A, T32C, NH8S, and *T33A.*

His topic for us is titled:

"DXpedition and the Physician…"

Arnie mentioned that a small group was operating from the USS Iowa on Feb 22 for the ship's 72nd birthday. He also noted that he appears on the W5KUB webcasts Tuesday nights at 6PM PST at **www.W5KUB.com** .

Arnie N6HC talking on his experience as a DXpedition doctor

Over the years that Arnie has been doing DXpedition doctoring, he has developed a medical questionnaire that is sent out to all DXpedition team members months ahead of the trip. The questions include allergies, hospitalizations, and a list of all the medications the person is on. All info on the form is kept confidential, and is not even shared with the DXpedition leaders. Up until now, on one has ever been deemed medically unfit for a DXpedition. Anyone who is on Medicare needs to buy travel insurance, because Medicare coverage does not extend beyond U.S. borders. The DXpeditioners are told to see both their doctor and dentist right before the trip. Recommends they go to www.travmed.com for the immunizations that are required for the destination. He tells them to buy appropriate clothing and footwear. i.e. no flip-flops on a coral beach. Everyone told to pack their own personal first aid kit, along with a good supply of prescription drugs they are on.

Arnie travels with a large, hard-sided Samsonite suitcase as his medical kit. While this kit is quite extensive, it has its limitations. If someone has a heart attack on a remote island, there would be little that he could do to treat this, and the patient would probably not survive. He is urging future expeditions to take along an AED (Automated External Defibrillator). Examples of items in his medical kit are: pills, injectables, ace bandages, sutures, and stethoscope.

Examples of some of his DXpedition Doctoring:

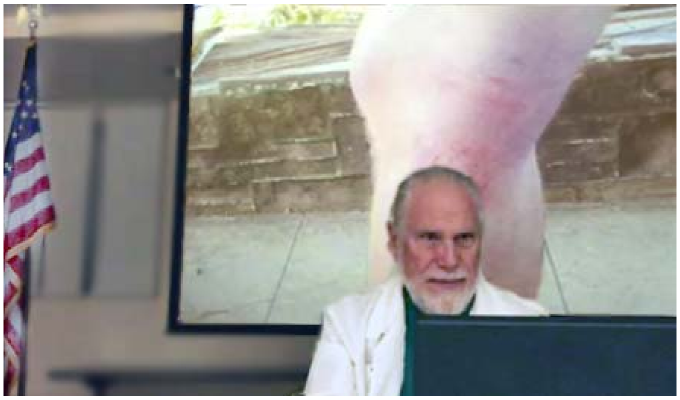
3B7C, St Brandon Island, Indian Ocean - A local fisherman had a severely lacerated leg. Since they were 35 hours away from any medical assistance, Arnie stitched up the wound. Shortly before they left the island, he removed the stiches. On that trip they had problems with tics that the birds were infested with. All team members were told to check themselves for tics on a daily basis.

K7K, Kure Island, Pacific - A woman injured one of her fingers in a door, and it had to be sewn up.

NH8S – Swains Island, Pacific – One diabetic man wearing flip flops got coral in his sandals, and was cutting his foot without him feeling it.

Gen Mtg Minutes – cont'd

NH8S – Swains Island, Pacific **cont'd** – He was put on antibiotics, and had to have the wounds cleaned every day.



Insect bites, cuts, skin rashes, and sun burns are very common ailments.

On the way to another DXpedition, one team member had a reaction to a Scopolamine sea-sickness medication patch. His mental ability was affected, he cut himself, and was bleeding all over the ship in the middle of the night. The ship crew found him. He was on the blood thinner Coumadin, so that made it very difficult to stop the bleeding. Based on Arnie's advice, he was sent back to port, and not allowed on the island. After successful hospitalization, the man recovered just fine.

T33A – Banaba Island – Pacific – They operated from a termite infested house. One team member's leg went through the floor when he got out of bed. Caused some laceration that was treated.

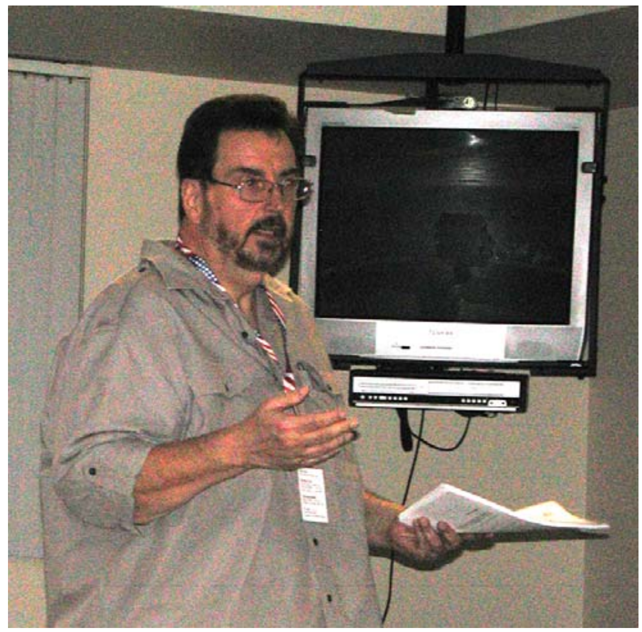
Arnie's next DXpedition is to the FK/c Chesterfield Islands in the South Pacific. He is not going on the South Sandwich Island VP8 expedition

Biz Meeting:

- **Survey** - Tom W6ETC said that the survey that was mailed out had 22 responses. He had paper copies at the meeting available. He stressed that it is important in planning talks for future meetings. He would appreciate comments.

Elmer Q & A - Tom W6ETC said that this is a new segment in the General Meetings. We have many members with a vast knowledge in the "radio art", and that there are new members who may have questions..

- A question about SCAF Filters was answered by Bob AF6C, who dealt with them in his engineering career.
- Another question was asked about Sky Loop antennas. How high to they have to be? The consensus was that they need to be ½ wavelength for the desired frequency band.



Tom W6ETC giving his Elmer presentation.

- Tom W6ETC had a question about placing an antenna at his QTH. The plywood in his roof has metallic radiant backing. No dipoles have worked for him because of this. K7JA recommended that a vertical would be better – use roof as groundplane. Don N6XBP has a vertical and offered to show it to Tom
- Tom W6ETC – asked about interference on a 450 MHz commercial repeater used by an emergency group. Tim N6GP said that Fred W6FNO is knowledgeable in that topic.

After the break, a roll-call of the Board of Directors was taken. A quorum was present with W6HHC, K6PGH, W6GMU, and AF6CF absent.

Membership Roster - Don N6XBP had question about when the club roster needs to be completed

…**Gen Mtg Minutes – cont'd**

and AF6C said having a roster ready by the April newsletter is fine.

Field Day - Tom W6ETC gave a report from the Field Day executive committed, Paul W6GMU and Don N6XBP are co-chairing Field Day. The software will be shown at the May meeting. Save the date. Please put June 26-28 on your calendars. Comment by Dan KI6X that the FD board determine a "scope-size" for our Field Day. The FD Board wants to focus more on fun rather than points this year. We are looking for corporate sponsors for food. Trying to get the food donated.

Our next General meeting is March 20th. Speaker will be our own Greg W6ATB on the topic of **Meteor Scatter Communications**.

Respectfully submitted by:
Tim Goeppinger, N6GP …acting secretary for Ken W6HHC

2015 Mojave Death Race - Call for Volunteers

The 2015 Mojave Death Race will take place on May 30-31. Obviously, this has become a very popular athletic event; the 2015 registration had to be closed in January at 20 teams (compared to 6 teams in 2013 and 13 teams in 2014).

Major changes in the communications plan this year include utilizing a portable 70Cm repeater at Mid-Hills with a link to a repeater in Arizona to better cover the eastern stages. This will replace our past practice of cross banding 2M/440. As in past years, the race will be staged from Nipton and Net Control will be at the same location. Another change will be having Amateur radio support in all medical support vehicles between stages 10 and the finish.
If we have enough volunteers the race organizers would like us to have communicators at each exchange point and hams accompanying the course Marshals.
To volunteer, please respond to this e-mail using n6isy6@gmail.com or call me at (714) 315-1637 if you have questions.

All volunteers will also have to register at www.mojavedeathrace.com, click on volunteers and scroll down to the ham radio volunteer window.

Thanks for your past participation and I'm Looking forward to working with you again his year.

Dick Bruno N6ISY

FCC "PAPERLESS" AMATEUR RADIO LICENSE POLICY NOW IN EFFECT

Effective February 17, the FCC no longer routinely issues paper license documents to Amateur Radio applicants and licensees. The FCC will continue to provide paper license documents to all licensees who notify the Commission that they prefer to receive one, but what arrives in the mail now will be printed on plain white recycled paper, instead of the more distinctive stock the FCC had been using until recently. All of this is part of the FCC's efforts to streamline procedures and save money.

"We find this electronic process will improve efficiency by simplifying access to official authorizations in ULS, shortening the time period between grant of an application and access to the official authorization, and reducing regulatory costs," the FCC Wireless Telecommunications Bureau (WTB) said. According to the WTB, the new procedures will save more than $300,000 a year, including staff expenses.

The Commission has maintained for some time now that the official Amateur Radio license authorization is the electronic Universal Licensing System (ULS) record, although the FCC had routinely continued to print and mail hard copy licenses until this week.

In mid-December, the FCC adopted final procedures to provide access to official electronic authorizations, as it had proposed in WT Docket 14-161 as part of its "process reform" initiatives. Under the new procedures, licensees will access their current official authorization ("Active" status only) via the ULS License Manager.

Licensees can also print an official license authorization -- as well as an unofficial "reference copy" -- from the ULS License Manager located at: http://wireless.fcc.gov/uls/

The ULS License Manager now permits licensees to change the default setting, so that the Bureau will print and mail a license document.

***It is with a sad heart** that we inform members that Diane Konechy, the wife of Ken - W6HHC, passed away on February 21st after suffering complications from heart surgery. In lieu of flowers, the Konechy's have asked to consider a donation be given to the American Heart Association. If you'd like to send a donation directly you may do so on the AHA website. Please make the gift as a memorial to Diane Josephine Konechy, 340 Craig St., Orange, CA 92869.*

Plans are underway to make a donation from the club; if, instead of donating directly, you'd like to add to the club's donation, you may send a check to the club's PO Box or give it to the club Treasurer directly.

Diane has worked behind the scenes supporting the club for the past four plus decades. She will be sorely missed.

Konechy, Diane Josephine

Diane passed away at St Joseph Hospital, surrounded by her family, on Saturday, Feb. 21, 2015. Born in Pittsburgh, PA, lived in Orange County since 1967; she died at the age of 71.

She is survived by her husband, Ken, of 49 years; children: David (proceeded in death), Sandra, Tony, Michelle (Leathers); grandchildren: Joshua, Michael, Jessica, Oia and Brody; and her sister, Pat Lieb.

She enjoyed bowling, bridge, gardening, Cheering for Pittsburgh Steelers, traveling and especially her family. She will be deeply missed by all whose lives she touched.

A funeral mass will be held Friday, Feb. 27, at 12:10 pm at Holy Family Cathedral in Orange, followed by burial at Holy Sepulcher Cemetery on Santiago Canyon Road in Orange.

Bob's TechTalk

Number 46
(OCARC TechTalk series #117)
by Bob Eckweiler, AF6C

How FM Stereo Works:

For last month's RF I wrote a *Heathkit of the Month* article on the AJ-14 Stereo FM Tuner. This tuner came out in mid-1965, not too many years after FM Stereo broadcasting became common. As I wrote the article, I realized it would be too long if I used the opportunity to also describe how stereo is broadcast so the two channels can be separated at the receive end. The solution was to write this separate technical article. Someone once said that *if you want to understand something, teach it*. During my research I gained a lot more insight into FM stereo multiplexing than I had when I began.

Commercial FM Transmission:

The commercial FM band runs from 87.8 to 108 MHz and and contains 101 channels, each 200 kHz apart. The channels are centered on odd tenths of a MHz. (88.1, 88.3, etc.) Channels that might interfere with local aircraft frequencies, and nearby channels that close to 10.7 MHz apart are not used. (Most FM receivers have a 10.7 MHz IF frequency and two strong signals 10.7 MHz apart may mix and cause interference in the receiver.) The channel at 87.9 MHz is reserved and not used as a normal FM station channel.

Frequency modulation is the process of sending information by modulating the carrier frequency of the broadcast energy. The amplitude is not modulated. The FCC defines 100% modulation on the FM broadcast band as a frequency deviation of ±75 kHz.

Pre-emphasis:

FM has an advantage for high fidelity radio transmission because most radio noise appears as amplitude variations which are ignored by the FM reception process. However, background noise is still a problem when transmitting and receiving high fidelity audio. Since this noise is more prominent at the higher audio frequencies the higher audio frequencies are "emphasized" by passing them through a high-pass filter prior to modulating the carrier to raise their signal-to-noise ratio. This filter has a knee frequency of 2.12 kHz representing a 3 dB boost, increasing 6 dB per octave; at 15 kHz the boost is about 17 dB.

At the receiver, after detection, the audio undergoes de-emphasis by passing it through a simple low- pass RC filter with a time constant of 75 µS (Europe uses 50 µS). This filter also has a knee (cutoff) frequency of 2.12 kHz and attenuates the high frequency audio signals back to their proper level.

Monaural FM Transmission:

Monaural Hi-Fi FM is transmitted with a frequency response of 50 Hz to 15 kHz. This is commonly referred to as the main channel carrying the baseband audio as shown in figure 1 in orange.

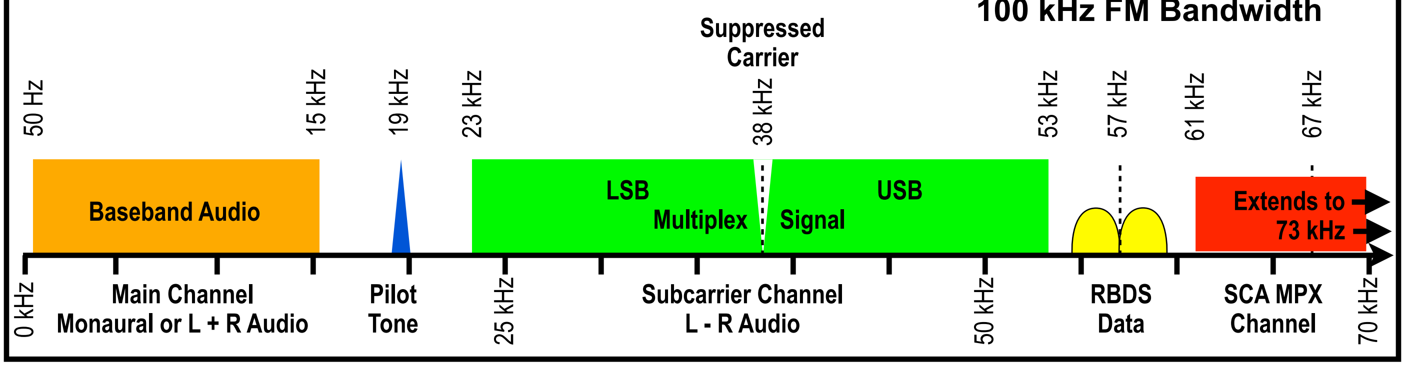


Figure 1: The first 70 kHz of the 100 kHz FM Bandwidth

Stereo FM Transmission:
Stereo FM requires the transmission of two channels. In order to accomplish this, a second channel is multiplexed on a subcarrier frequency of 38 kHz. This channel, shown in green in figure 1, is transmitted as a double-sideband suppressed-carrier signal (DSB). A pilot tone at 19 kHz, shown in blue in figure one, is also broadcast at a modulation level of about 10%. This tone has a 4 kHz guard buffer on either side, and is used during reception to sync the frequency and phase of a free-running 38 kHz oscillator that reinserts the carrier into the multiplexed DSB channel. It is transmitted in phase with and at exactly 1/2 the 38 kHz carrier.

Unfortunately, sending the left channel on the main channel and the right channel on the subcarrier channel presents a serious problem; people listening on a monaural receiver would only hear the left channel, and miss much of the content. The solution is to transmit the sum of the left and right channel on the main channel and the difference between the left and right channel on the subcarrier channel.

For stereo reception, the main and subcarrier channels are added to get the left channel and subtracted to get the right channel. Mathematically:

(L + R) + (L - R) = L + R + L - R = 2L

and:

(L + R) - (L - R) = L + R - L + R = 2R

Thus, a person hearing the monaural channel will hear both audio channels, though in monaural. *Remember this concept because it comes into play later on in a very interesting way.*

Typical waveforms:
Figure 2 shows a sample of channel waveforms that will be used throughout this article, and how they combine. Figure 2a represents two cycles of a 200 Hz., 10-volt peak sine wave being transmitted on the **left channel**; figure 2b represents seven cycles of a 700 Hz., 7-volt peak sine wave being transmitted on the **right channel**. In figure 2c the top two waveforms

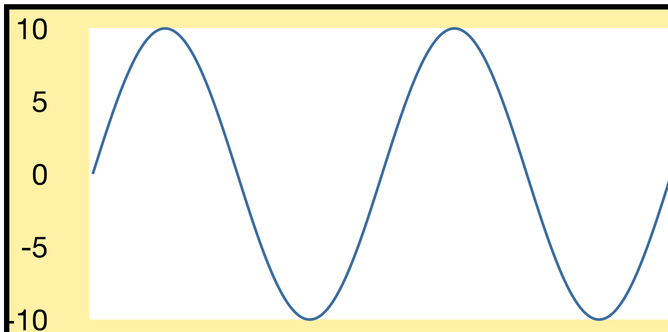


Figure 2a: Left Ch. 200 Hz., 20 V P-P

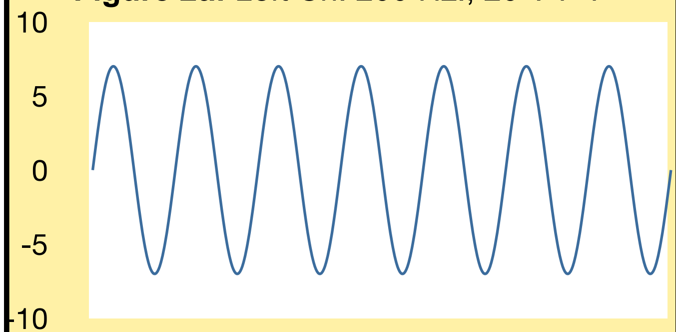


Figure 2b: Right Ch. 700 Hz., 14 V P-P

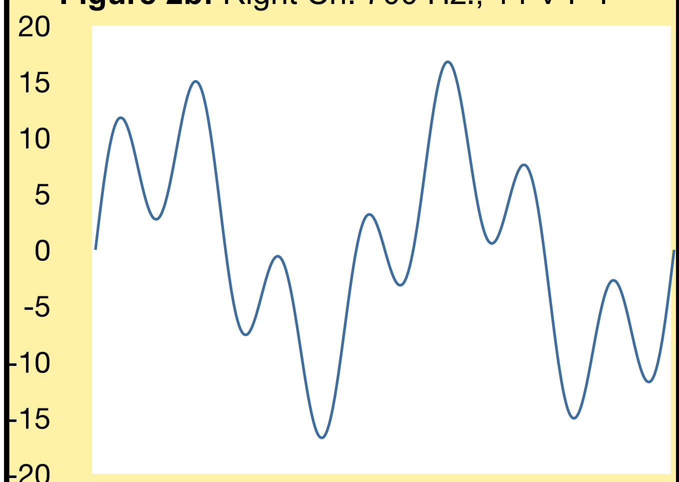


Figure 2c: Left + Right Channel

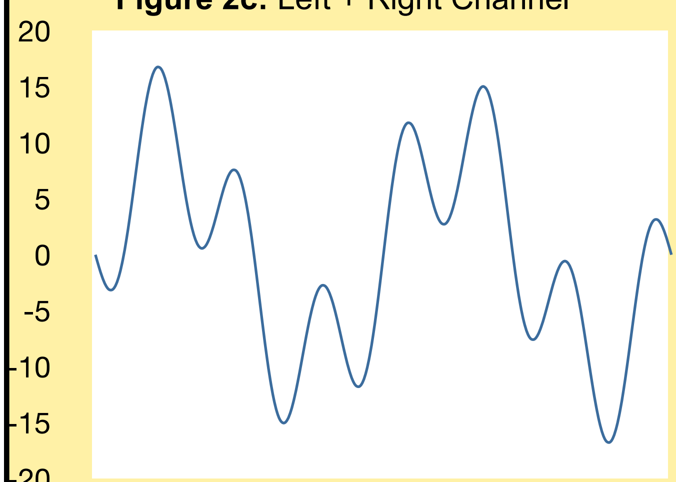


Figure 2d: Left – Right Channel

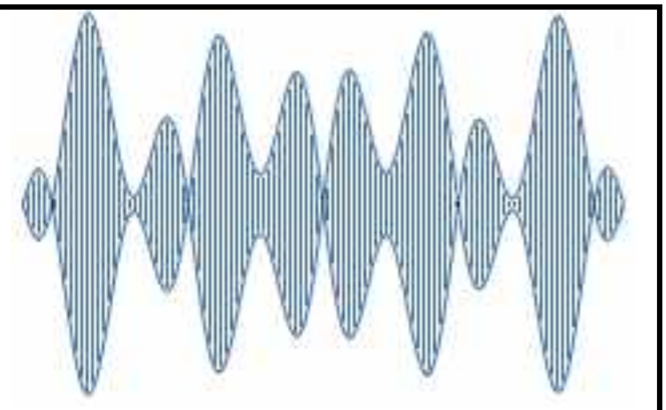


Figure 3: Fig. 2D (L – R) as a DSB signal

have been added showing the **sum of the two channels (L + R)** and in figure 2d the second waveform has been subtracted from the first waveform showing the **difference between the two waveforms (L - R)**. The horizontal axis represents 10 milliseconds of time in each waveform of figure 2.

The wave form of figure 2c is transmitted on the main (baseband) audio channel. The waveform of figure 2d is mixed in a balanced modulator with a 38 kHz carrier signal and is transmitted as the multiplexed subcarrier channel. Figure 3 shows the (L – R) signal of figure 2d as it appears as a 38 kHz DSB signal.

At the transmitter, the (L + R) audio, the 19 kHz pilot tone and the 38 kHz (L - R) subcarrier band are all combined and transmitted. There are other signals that may also be combined and transmitted above the (L - R) subcarrier band that are not directly associated with the stereo signal. These will be discussed later.

Stereo FM Reception:

Should you be listening to a stereo transmission on a monaural FM radio, the signal recovered from the FM detector contains all the transmitted signals, however, since only the main band (L + R) audio is of interest, the others are filtered out right after the FM detector.

Stereo reception recovers the main audio channel signal as well as the 19 kHz pilot tone

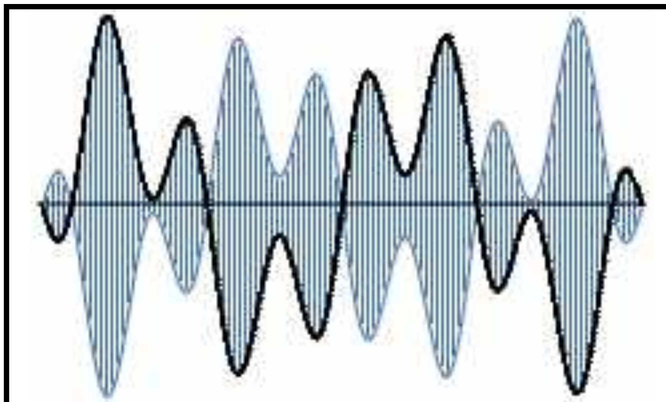


Figure 4a: Highlighting + [Plus] (L – R)

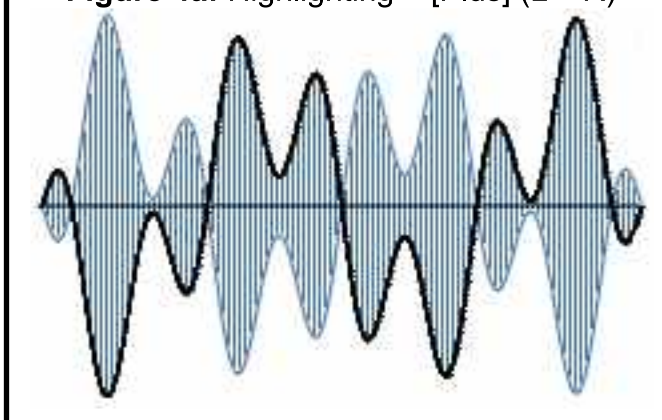


Figure 4b: Highlighting – [Minus] (L – R)

and the 38 kHz (L - R) subcarrier channel. The pilot tone is transmitted in phase with the suppressed carrier used to modulate the subcarrier tone. Some phase shift may have occurred during transmission, and in early stereo HI-FI FM tuners a PHASE control was often incorporated to allow the user to manually adjust the phase for best left and right channel separation.

The recovered 19 kHz pilot tone is used to sync a free running oscillator in the FM receiver to 38 kHz in exact frequency and phase with the 38 kHz oscillator used to modulate the DSB (L – R) subcarrier, and is used to accurately recover that subcarrier signal.

Let's go back to the DSB signal of figure 3. Looking closely at figures 4a and 4b, both of which are just figure 3 highlighted, we see the waveform amplitude contains the (L – R) signal of figure 2d as both the + (L – R) signal (4a) as well as the inverted – (L – R) signal (4b). The black line in figure 4a is the locus of points when the phase of the 38 kHz carrier

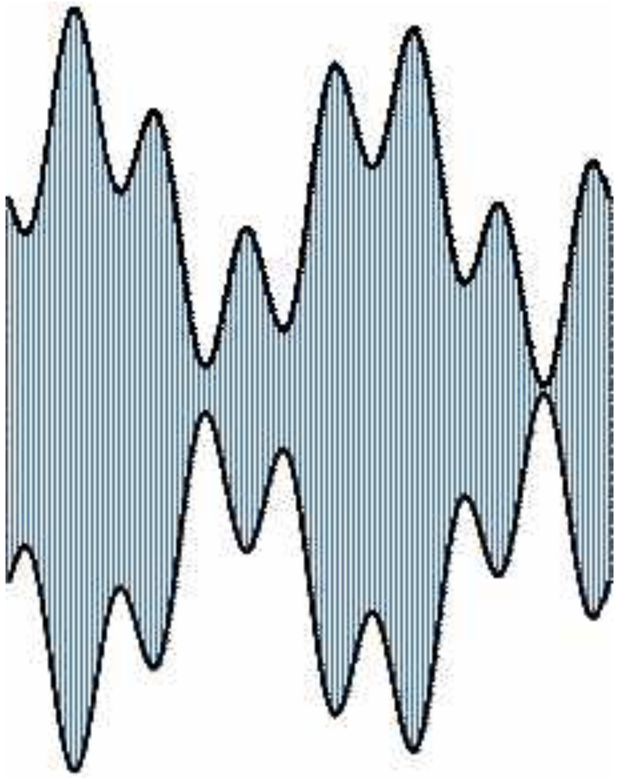


Figure 5: Figure 3 with the 38 kHz carrier reinserted (shown for clarification).

wave is at 90° (i.e. at its most positive point), and the black line in figure 4b is the locus of points when the phase of the 38 kHz carrier is at -90° (i.e. at its most negative point). [See Sidebar for more on degree notation]. Note that in figures 4a and 4 b the (L - R) subcarrier channel phase inverts with relation to the 38 KHz carrier each time the highlighted line crosses the X-axis.

Figure 5 shows for clarification the figure 3 waveform with the 38 kHz carrier reinserted. Note that the + (L - R) waveform is riding on the top points of the carrier (90° phase) and the – (L – R) waveform is riding on the bottom points of the carrier (–90° or 270° phase).

The signals coming out of the FM detector, after the 19 kHz pilot tone is recovered, and any other signal information not related to recovering the stereo channels are removed, are the DSB signal of figure 3 and the main channel audio (L + R). However, in reality the 38 kHz DSB signal of figure 3 is actually riding on top

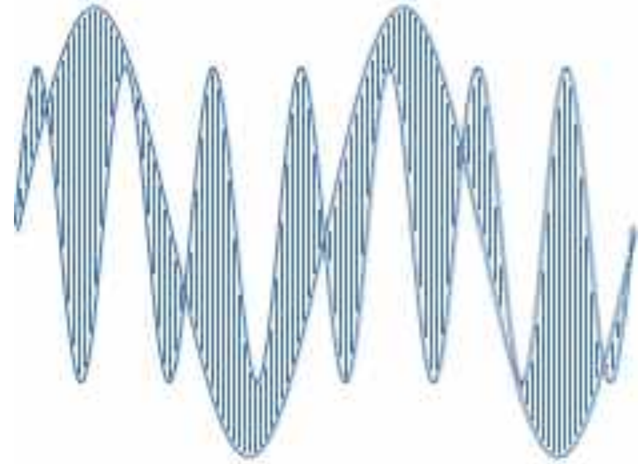


Figure 6a: This is what Fig. 3 looks like riding on top the main channel (L + R) signal.

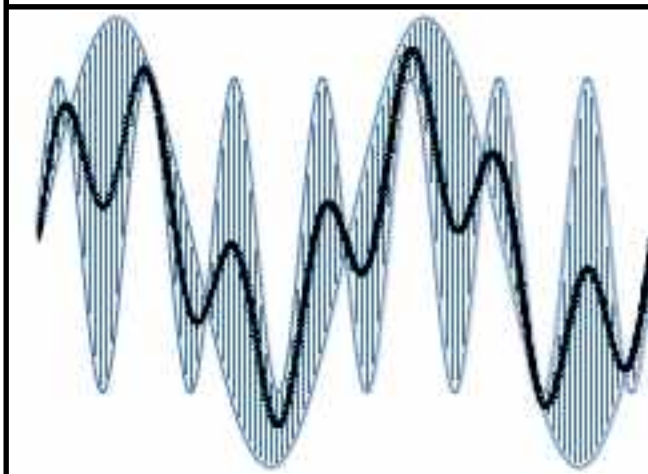


Figure 6b: This is Fig. 6a highlighting the main channel (L + R) signal.

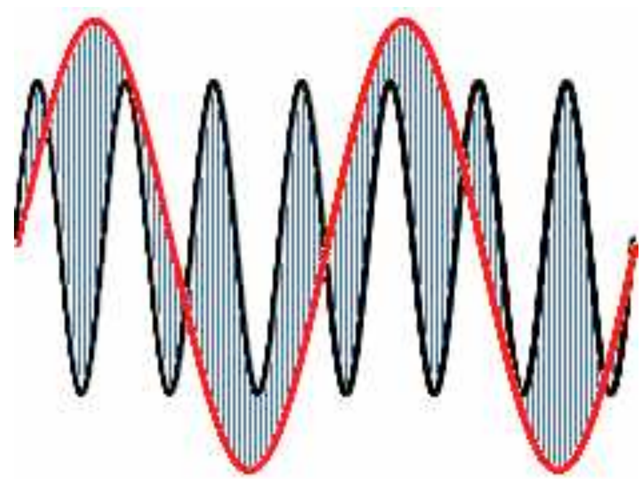


Figure 6c: This is Fig. 6a highlighting the Left channel (Red) and the Right channel (Black).

of the main channel audio as shown in figures 6a and 6b.

Go back to the two equations we introduced earlier. The DSB carrier which has (L – R) as its 90° waveform is riding on top (adding to) the main (L + R) audio channel resulting in:

(L + R) + (L – R) = 2L (Red in Fig. 6c)

And – (L – R) as its –90° (or 270°) waveform resulting in:

(L + R) – (L – R) = 2R (Black in Fig. 6c)

Figure 7 shows what figure 6 would look like if the 38 kHz carrier was reinserted. (Yes, that is the left channel on the top of the waveform and the right channel on the bottom of the waveform!)

However it is not actually necessary to reinsert the carrier; instead, it is only necessary to feed the signal of figure 6a into two switching transistors. One switch turns on momentarily each time phase of the 38 kHz oscillator is at the 90° phase point, charging a capacitor to the momentary level; thus recovering the left channel. And the other switch turns on each time the 38 kHz oscillator is at the –90° (270°) phase point, charging a separate capacitor and recovering the right channel. These switches each charge a capacitor that follows the recovered waveform for its channel. The audio channels are each then filtered to remove any residual 38 kHz signal, de-emphasized and output to separate left and right channel amplifiers.

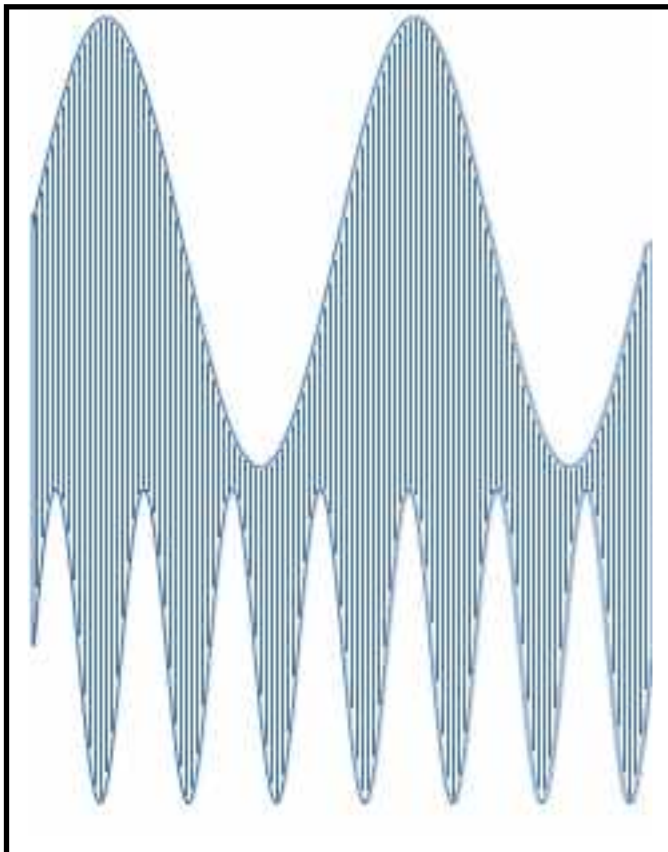


Figure 7: This is what figures 6 would all look like if the 38 kHz carrier was reinserted.

Other FM Subcarrier Signals:

Additional signals may be transmitted on the FM carrier, whether transmitting monaural or stereo signals. The one most talked about is the SCA (Subsidiary Communications Authorization) signal. Another less known signal is the RBDS (Radio Broadcast Data System - sometimes just RDS). This is used more heavily in Europe and Latin America but is growing in the US.

SCA: (Shown in red in figure 1 - at 67 kHz)
Monaural FM stations can transmit up to three SCA channels on FM modulated subcarriers. Subcarrier frequencies are typically located at 41 kHz, 67 kHz and 92 kHz, with 67 kHz being the most common. These channels have various uses. The most common use was once for commercial-free music (so-called "elevator music") for use in stores and offices; Musak used to be a big user of this service, but now uses a different system. Many states have book reading for the blind and visually handicapped offered on SCA channels, often in conjunction with PBS stations. An SCA channel may also send telemetry data from the remote transmitter to the station location to monitor transmitter parameters.

Stereo FM stations cannot use subcarriers below a frequency that would interfere with the high end of the 38 kHz multiplex band (about 54 kHz) so are usually limited to two SCA channels at most.

The arithmetic sum of the modulated SCA subcarriers may not exceed 20%, and subcarriers above 75 kHz may not exceed 10%. Thus the audio frequency response is not hi-fi; it is often not even as good as an AM broadcast station when more than one SCA subcarrier is in use. Still the channels are good for voice and for data. SCA is broadcast as a subcarrier using FM on its subcarrier. On 67 kHz an audio bandwidth of 4 to 6 kHz is typical.

The FCC has remained quite lenient on SCA standards since they were first introduced. Teletype and slow-scan TV can be used. More information may be found here:

http://www.fcc.gov/encyclopedia/broadcast-radio-subcarriers-or-subsidiary-communications-authority-sca

RBDS: (Shown in yellow in figure 1)
This signal is transmitted on a subcarrier at 57 kHz. (The third harmonic of the pilot tone). It has a narrow bandwidth and transmits only data at a rate of 1187.5 bits per second (bps) After error correction and framing overhead the data rate is reduced to 730 bps., or about 100 ascii characters per second. This data can be used for sending a variety of different information. Each type has a two or three letter code associated with it: Some of the codes are:

- AF (Alternate Frequency) - When used with a mobile receiver designed for the AF function, the receiver can switch to an alternate station that is broadcasting the same program material when the mobile gets out of range of the current station.
- CT (Clock Time) - this data can be used to synchronize the car clock.
- PS (Program Service) - An eight-character static data string of the station's call letters.
- RT (Radio Text) - sixty-four characters of text that can be used as desired by the station; often used to transmit the name and/or artist of the current song.
- PTY (Program Type) - Thirty-one pre-defined codes (news, sports, talk, oldies, top 40, country, etc.) Code 31 signifies an "Emergency" broadcast.

There are five other types, mostly involving traffic reporting and information, encoded station ID and "region specific" programming.

Radios that utilize these features are slowly coming on the market - mostly for automotive use. Integrated circuit manufacturers such as ST Microelectronics, Philips (now NXP), and Silicon Labs are producing RDS chipsets for incorporation into radios.

Summary:
Broadcasting multiple multiplexed signals on a single 200 kHz wide FM carrier requires some serious considerations. Any spurious or harmonic content from any of the signals can result in interference with another component of the composite transmission. Once the signals are combined, any significant nonlinearities, or restrictions on the bandwidth can cause undesired interaction. High feedline SWR, a transmitting antenna with too-narrow of a bandwidth, a failing transmitting tube and many other items can be troublesome to sending a clean composite signal. Yet with good engineering practices thousands of FM stations throughout the world transmit not just a stereo signal but also RDBS information, an SCA channel for public or private consumption and a subsidiary SCA channel that telemeters transmitter information back to the studio!

There is a lot more going on at that FM station you are tuned into than one imagines. The process allowing stereo to be sent so it can be detected easily when users listening on monaural receivers shows some good thought in implementation. A similar process had to be developed when color TV was developed.

Some links that might be useful if you want to look further into stereo FM broadcasting or some of the other signals that may be on the FM carrier are shown in table I.

73, from AF6C

A paper *Introduction to FM-Stereo-RDS Modulation* by Liang Ge, EK Tan and Joe Kelly of Verigy is available here:

https://www.advantest.com/cnsmprod/groups/public/documents/file/fm-stereo-rds.pdf

A paper *Subsidiary Communications and Stereophonic Broadcasting* by T.R. Humphrey and L.E. Hedlund of McMartin Industries covering SCA can be found at:

http://www.americanradiohistory.com/Archive-NAB-Engineering/NAB-6th-Edition/SCA-NAB-engineering-Handbook-6th-Edition.pdf

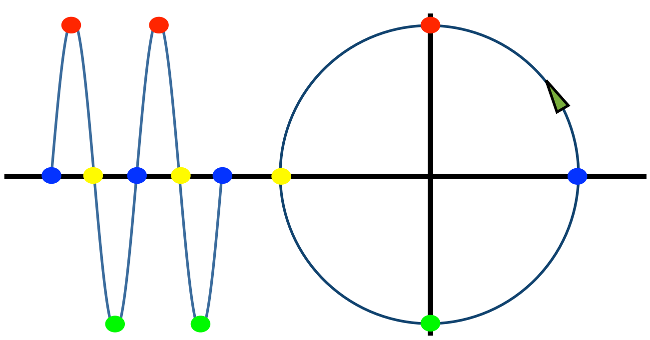
Further technical information on RBDS may be obtained from Silicon Labs technical note AN243 which can be obtained on the Internet at:

http://www.silabs.com/Support%20Documents/TechnicalDocs/AN243.pdf

Lot's more sites of varying technical levels can also be found: Search **FM Stereo Broadcasting Theory** on your favorite search engine.

TABLE I - Links

Sine Wave Degrees:
The figure contains two cycles of a constant amplitude sine wave next to a 360 degree circle. Going from left-to-right on the sine wave, and counter-clockwise on the circle, we start at 0° (blue dot). One-quarter way around the circle we reach the 90° point (red dot). One-halfway around the circle we reach the 180° point (yellow dot). Three-quarters way around the circle we reach the 270° point (green dot). And after another quarter of the way around the circle we return to the 0° point. The 270° point is also the -90° point.



If we go around the circle again we create the second sine wave, etc.

Note that each positive peak of a constant sine wave represents the +90° point and each negative peak represents the -90° point.

de AF6C

But What's This Have to Do With Ham Radio?
Many hams are interested in learning about everyday radio. The AM mode of ham radio was superseded, starting in the 50s, by SSB. If you compare figures 3 and 5, as well as figures 6a and 7, you see two examples of a benefit of double-sideband suppressed-carrier (DSB) transmission over the double sideband with carrier (AM) transmission. Both are transmitting the same signal at the same level but if you consider the size of all that 'blue' in the figures represents power, you quickly realize that DSB uses less power to transmit a complex signal level. Thus, if you increase the power of the DSB signal to that of the AM signal, your level is higher.

If after suppressing the carrier to get a DSB signal you also filter or phase out one of the sidebands you get a single-sideband suppressed-carrier (SSB) signal and you gain additional efficiency over AM.

A 1KW AM signal 100% modulated contains 1,000 watts in the carrier and 250 watts in each sideband - effectively a 250 watts of 'intelligence'. A 1KW SSB signal has effectively 1,000 watts of 'intelligence' in one sideband.

de AF6C

Heathkit of the Month #64:
by Bob Eckweiler, AF6C

Figure 1: Heathkit VC-3 Voltage Calibrator

Heathkit VC-3 Voltage Calibrator.

Introduction:

The August 2013 Heathkit of the Month (#51) covered the IG-4505 Deluxe Oscilloscope Calibrator. It also briefly covered the VC-3 Voltage Calibrator using information gleaned from catalogs. To my surprise Bill - K6WHP recently presented me with a VC-3 complete with manual. One look at the unusual schematic and I knew it deserved an article all its own.

The VC-3 (Figure 1), third in the Heathkit line of oscilloscope voltage calibrators that were first introduced in 1952, appeared in late 1956. Figure 2 shows an ad for the Heathkit VC-3 from the 1958 catalog. It remained in production through 1962 at a price of $12.50. In those days the oscilloscope was the most prolific of Heathkit's products. From the O-1 oscilloscope (Heathkit's first electronic kit) introduced in September of 1947 through the end of 1956 Heathkit sold 14 different models, the O-1 through O-11, the OL-1, the OM-1 and OM-2. All had 5" CRTs except the OL-1 (3"), and all had AC coupled amplifiers and multivibrator sweep circuits. DC coupling and triggered sweep were on the horizon for Heathkit, but not yet incorporated. The first Heathkit oscilloscope featuring these improvements came in the fall of 1958, the OP-1 Professional Oscilloscope Kit. It sold for $179.95, about 2-1/2 times more than their previous top-of-the line Heathkit oscilloscope.

The Heathkit VC-3:

Prior to the OP-1, most of the hobby-grade oscilloscopes on the market had at best a 1 volt peak-to-peak test point that one could use to approximate the voltage of a wave form. Since the gains were mostly uncalibrated and the attenuator steps a full decade apart, measuring voltage was difficult without a way to compare it with a known signal. The VC-3 provides the ability to make that comparison easily.

The VC-3 puts out a rather impressive approximate 1 kc square wave that has an accu-

Figure 2: Heathkit VC-3 ad from the main 1958 Catalog

rate peak-to-peak voltage that can be set to one of eight ranges: 30mV, 100mV, 300mV, 1.0V, 3.0V, 10V, 30V and 100V. Being a square wave with flat tops and bottoms the calibration can be more easily set than when using a sine wave. The VC-3 also has an input to accept the signal under test and an output that connects to the oscilloscope input, so the user can switch between the signal being observed and the calibration signal with the turn of a switch.

The layout of the Heathkit VC-3 front panel is straightforward with only two switches and two dual binding posts. On the left is a pair of five-way binding posts marked **SIGNAL**, the upper one being colored red and the lower one black. On the right is a similar set of binding posts marked **OUTPUT**. Dead-center on the front panel is a nine-position rotary switch. The switch positions are marked in clockwise order: **SIG**[nal], **30**, **100**, **300**, **1**, **3**, **10**, **30**, **100**. The second through fourth positions are bracketed with the nomenclature **M/VOLTS**, and the last five positions are bracketed **VOLTS**. **PEAK TO PEAK** is marked below the switch. Below the rotary switch is the power switch – a slide switch marked **OFF ON**. Other nomenclature on the front panel are: ***Heathkit* VOLTAGE CALIBRATOR** across the top, **MODEL VC-3** at left bottom and **HEATH COMPANY BENTON HARBOR, MICHIGAN** on two lines at right bottom.

The VC-3 is housed in a 4–3/4 H x 7–3/8 W x 4–1/8 D gray cabinet and a dark gray front panel with white nomenclature. The cabinet (part# 90-39) is the same as used in many other Heathkit models of the time including the AM-2 SWR bridge and the QF-1 Q-Multiplier.

Heathkit VC-3 Operation:

Operation is simple. Connect the VC-3 OUTPUT posts to the vertical input of the oscilloscope. Connect the signal to be viewed to the INPUT posts of the VC-3. Place the PEAK TO PEAK rotary switch in the SIG position and adjust the scope to view the signal as desired. Next, switch the PEAK TO PEAK switch slowly clockwise until the square wave vertical amplitude covers a reasonable amount of the screen's vertical real estate and adjust the scope's vertical gain a small amount as needed to have the square wave cover a number of vertical divisions on the scope graticule. You can then easily calculate the vertical volts/division at the current vertical gain setting. Now return the PEAK TO PEAK switch to SIG, adjust the vertical position as needed, but don't touch the vertical gain. Since you now know how many volts each division is, you can measure the signal's peak-to-peak amplitude.

VC-3 Limitations:

There is one caution Heathkit mentions in the manual about using the VC-3. It involves using the VC-3 inline with signals having sharp rise-times or high frequencies over 100 kilocycles. If you are measuring such signals then the signal should be applied directly to the scope and not through the VC-3. The necessitates swapping the signal and VC-3 at the scope terminals as needed to make a voltage measurement. The reason is simple, the signal path through the VC-3 involves wiring that adds about 35 µµf (pF in today's lingo) of shunt capacitance to the signal and this will cause attenuation of higher frequency components of complex waveforms. Still, having to swap leads at the scope vertical

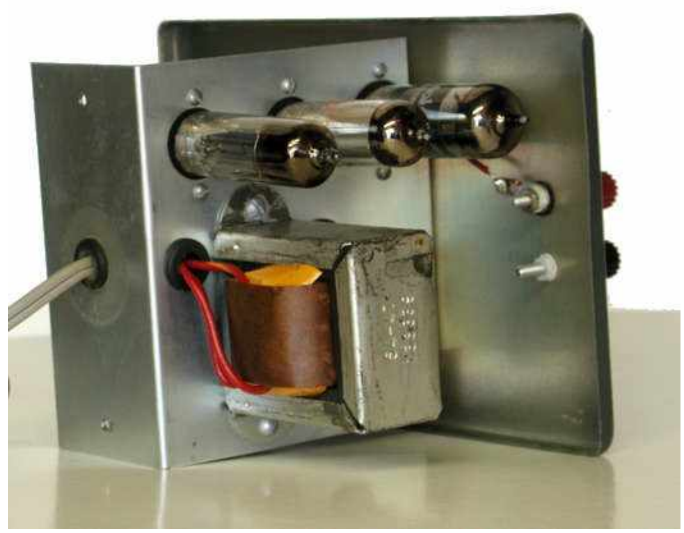


Figure 3: VC-3 inside left, showing the vertical chassis, transformer and three tubes (L to R) 6X4, 0A2 & 6AW8.

input is a small price to pay for being able to make reasonable voltage measurements on an otherwise uncalibrated piece of test equipment. For audio and low frequency measurements the oscilloscope can be left permanently connected through the VC-3.

VC-3 Circuit Description:

The schematic diagram of the VC-3 is shown in Figure 6. Probably what catches the eye first is that the tubes are drawn upside down! In fact looking a little closer the whole power supply is wired to produce a negative voltage. The VC-3 contains three tubes, a 6X4 dual diode rectifier, an 0A2 VR (voltage regulator) tube and a dual-section 6AW8 triode - pentode tube. The first two tubes function in the power supply while the third, dual-section, tube functions as a 1 kilocycle, symmetrical, free-running, square wave multivibrator. Output from the multivibrator goes through a switched precision voltage divider to produce proper calibrated voltage. Each of these three sections will be discussed separately.

<u>The VC-3 Power Supply Circuit</u>**:**

The power supply is transformer based, providing 6.3 VAC filament voltage to two of the tubes and 400 VCT to the plates of the 6X4 rectifier,

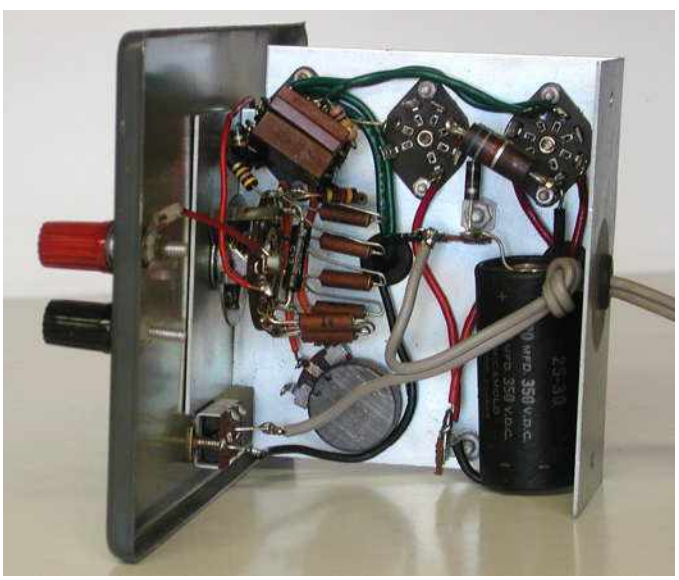


Figure 4: VC-3 inside right; the dual electrolytic capacitor is lower right, cal. pot lower center and rotary switch with precision resistors center towards left.

producing about 230 VDC relative to the center-tap of the transformer. The DC is filtered by a 20 uF electrolytic capacitor. The negative side of the 230 volts goes to the the cathode of the 0A2 “cold-cathode” VR tube, and the positive side goes to the plate of the 0A2 VR tube through a dropping resistance of 3.4 KΩ (composed of two 6.8 KΩ 2-watt resistors in parallel). “Cold-cathode” refers to the fact the tube has no filament. Instead the tube contains an inert gas mixture that conducts at a given voltage (150 volts nominal for the 0A2); as it conducts it draws more or less current through the 3.4KΩ resistance keeping the voltage at the anode constant with respect to the cathode. A jumper between pins is used to disconnect the circuit should the tube be removed, preventing higher and possibly damaging voltages appearing.

Placing a large capacitance across a VR tube often leads to instability, and the 20 μF electrolytic is 200 times higher than the recommended maximum capacitance, so a 100 Ω resistor is placed between the two for isolation. At first it was baffling as to why the resistor and capacitor are where they are. A simple C-R-C filter before the 3.4 KΩ dropping resistance would be a better choice - as the 100 Ω resistor reduces the regulation of the VR tube. Opening the unit revealed the answer - cost. The two 20 μF electrolytic capacitors are in the same package and share a common negative terminal. Hence the circuit was designed to fit this criteria. Using two separate capacitors would add significantly to the price of a kit that sold for $12.50, especially since the capacitor used was one common in many kits and bought in large quantities, likely at a good price break.

The output of the power supply is across the second 20 μF capacitor. The positive side is grounded and the negative side is passed through the jumper in the VR tube and on to the cathodes of the dual section multivibrator tube. Notice that neither side of the filament winding is grounded; instead one side is connected to the negative side of the power supply. This is done so the voltage between the cathode and filament will not exceed the filament to cathode maximum rating of 100 VDC.

The VC-3 Multivibrator Circuit:
The two 6AW8 tube sections are wired as a free running multivibrator. The triode section acting as one half the multivibrator and the pentode section as the other. The pentode section is wired as a triode with the screen-grid acting as the multivibrator plate with the actual plate isolated as in an electron-coupled oscillator. This isolation significantly reduces the influence of plate load changes on the frequency and waveform of the multivibrator. The frequency and duty cycle of the multivibrator are determined by the 470 KΩ and 4.7 KΩ plate resistors and the 0.0013 and 0.003 μF mica coupling capacitors. These values were selected for a nominal frequency of 1,000 cps and 50% duty factor. They vary significantly from each other due to the characteristics of the different tube sections.

VC-3 Output Switching Circuit:
The plate load of the pentode section of the 6AW8 is provided by a 20 KΩ precision voltage divider in series with an internal 10 KΩ variable calibration resistor. The positive side of the power supply is at ground potential, so one of the output terminals may be also. This is the reason that the power supply was designed with the positive side connected to ground.

Switch Position	Resistor	Resistor Sum	Voltage
1	n/a	n/a	(SIG)
2	6 Ω	6 Ω	0.03 V
3	14 Ω	20 Ω	0.1 V
4	40 Ω	60 Ω	0.3 V
5	140 Ω	200 Ω	1.0 V
6	400 Ω	600 Ω	3.0 V
7	1.4 KΩ	2.0 KΩ	10 V
8	4.0 KΩ	6.0 KΩ	30 V
9	14 KΩ	20 KΩ	100V

- Column Two is the values of the resistor chain. If you sum them all they add up to 20.0 KΩ
- Column Three is the sum of the resistors up to and including the switch position of the row.
- Column Four is the output voltage determined by: ((value in column 3) / 20 KΩ) * 100 V.

Table I - VC-3 Precision Voltage Divider Output Chain

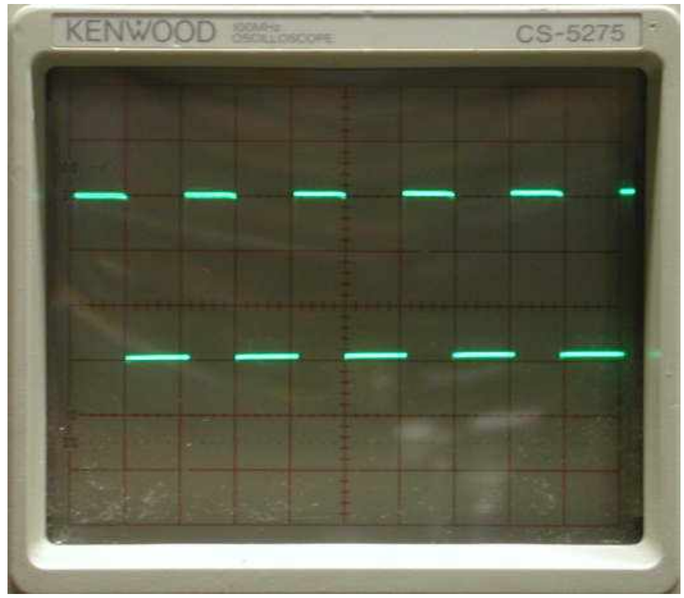


Figure 5: Modern oscilloscope screen showing the VC-3 output set to 3 V. (1 v/div Vert., 500 μS/div Horiz.)

The actual voltage at the plate (pin 9) of the pentode section varies from zero when the tube is cut off to approximately 135 volts negative when the tube is conducting. The calibration resistor connected between the voltage-divider chain and the plate is adjusted so the top of the chain is at -100 VDC when the tube is conducting. The resistor chain is composed of eight 1% precision resistors that sum to 20.0 KΩ. The resistor values and corresponding output voltages are given in Table I.

One obvious idiosyncrasy of the output signal is that it is a negative going square wave. This, however, should make no difference for AC coupled oscilloscope amplifiers, and eliminates capacitive coupling within the VC-3 that would only distort the waveform and introduce inaccuracies.

Since the impedance of the precision voltage divider is low compared to the one-megohm impedance of most Heathkit scopes of the day, negligible attenuation occurs. When the switch is in the SIG position, plate voltage is removed from the 6AW8 preventing calibrator noise on the output.

Summary:

Perusing the manual, the kit appears easy to assemble. The actual step-by-step instructions go from the bottom of page 6 to about an inch onto page 12, and two of those pages are full-page pictorials. Also included on those pages are seven figures and a detail drawing.

Looking at this manual, earlier manuals and more recent manuals it is evident the manuals, for which Heathkit is so well known, have evolved substantially over the years. This might make a good topic for a future Heathkit article.

Next month is the dreaded April issue. I have a few ideas but have not chosen one. Between now and then I'll be supporting the Baker-to-Vegas race and completing some family responsibilities that are time critical, (oh and taxes too.)

I've gotten numerous requests to write on the HW-12 & 12A series. If anyone has a PDF copy of the HW-12A, 22, 22A 32 or 32A manual please contact me and I'll try cover the series in a future Heathkit article; I have a copy of the HW-12 (non-A) manual.

I'd like to especially thank Bill - K6WHP for providing the VC-3 for this article, with a manual no less!

73, from AF6C

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

Thanks - AF6C

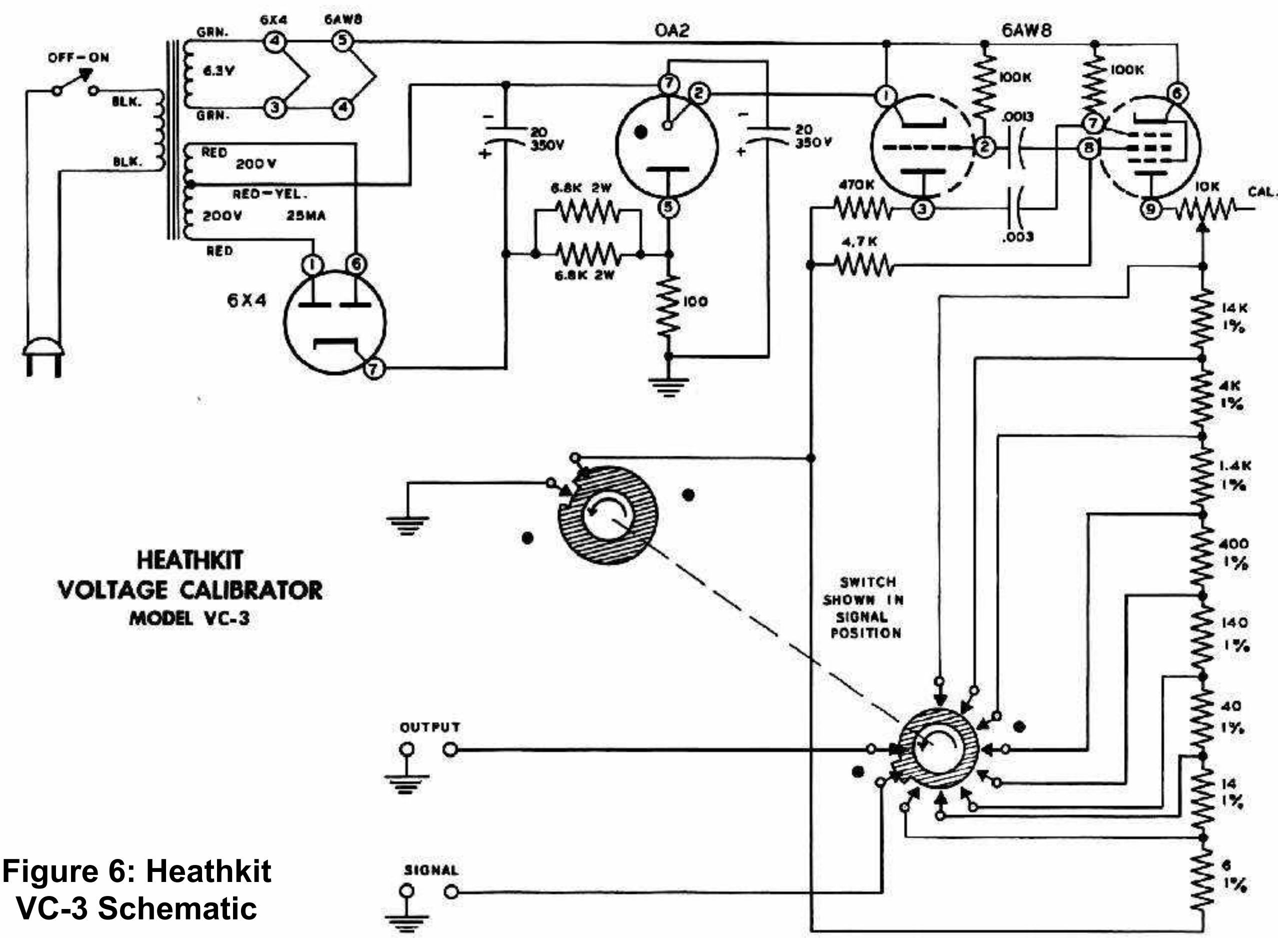


Figure 6: Heathkit VC-3 Schematic

Western Amateur Radio Association

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

Email: jac2247@gmail.com Or N6VNI@arrl.net

Sponsoring Club: N6ME Western Amateur Radio Association, Fullerton, Ca. "WARA"

Test site location:

La Habra Community Center.

101 W. La Habra Blvd., La Habra, CA 90631

Date and Times - Third Thursday of every month, @ 6 P.M. unless otherwise noted. Pre-Registration is requested and preferred. Walk-ins are welcome.

2015 TESTING SESSIONS

~~Thursday, January 15th, 2015 6 p.m.~~

Thursday, February 19th, 2015 6 p.m.

Thursday, March 19th, 2015 6 p.m.

Thursday, April 16th, 2015 6 p.m. NOTE: Location change –this date only

(Home of George N6VNI, 1901 W. El Portal Drive, La Habra, CA 90631)

Thursday, May 21st, 2015 6 p.m. NOTE: Location change – this date only

(Home of George N6VNI, 1901 W. El Portal Drive, La Habra, CA 90631)

Thursday, June 18th, 2015 6 p.m.

Thursday, July 16th, 2015 6 p.m.

Thursday, August 20th, 2015 6 p.m.

Thursday, Sept 17th, 2015 6 p.m.

Thursday, October 15th, 2015 6 p.m.

Thursday, Nov 19th, 2015 6 p.m.

On Exam Day Bring the Following Items

- A legal photo ID (driver's license, passport) or Two forms of non-photo ID; e.g., birth certificate, social security card, library card, utility bill or other business correspondence with name of the examinee as it appears on the Form 605 and current mailing address.
- Your Social Security Number (SSN) or FCC-issued Federal Registration Number (FRN).
- If applicable, the original and a photocopy of your current Amateur Radio license and any Certificates of Successful Completion of Examination (CSCE) you may have from previous exam session. (Photocopies will not be returned.)
- Two number two pencils with erasers, and a pen.
- Test Fee: $15.00 (cash or check).

If you fail an element and wish to retake it, we are required to charge an additional test fee. If you pass an element, we typically offer and encourage you to take the next element. We do not charge an additional test fee for this and it gives you the opportunity to see what the next exam element is like!

Visalia IDXC 2015 CONVENTION

April 17-19 2015

2015 will be the 66th consecutive year for the International DX Convention. The meeting, sponsored by the Northern California DX Club, will be held at the beautiful Visalia Convention Center in downtown Visalia, CA. IDXC, the premier DX Convention in the United States, is attended by over 800 serious DX'ers and contesters looking to improve their skills, their stations and see the latest equipment.

Convention Highlights:

Full day of training on Friday, April 17, 2015: Contesting and DXing Techniques

Friday Evening Dinner Options: TopBand, IOTA, and Contesting

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15-20 DX & Technical Seminars

35-40 Exhibitors in large Exhibit Hall

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Excellent Keynote Speakers and access to great California vacation destinations **Registration Starts: 12-08-2014**

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Sincerely,

John Miller (K6MM), Kevin Rowett (K6TD), Rich Seifert, (KE1 B)

IDXC 2015 Co-Chairmen

http://dxconvention.com/

HAM JOB OPPORTUNITY

Hello!
My name is Mike Page.
I am the Service Manager for PCI Race Radios, located in Signal Hill. We have an immediate need for a helmet radio technician.

There are 3 licensed ham operators who work here and I like the radio specific skill sets that they bring.
We can teach the specifics to someone with good electrical component/soldering skills.

Here is the link for our current opening:
http://losangeles.craigslist.org/lgb/mnu/4874730898.html

We will have other positions open in the near future.
Kindly share this open position to your members.
.

Thanks,
Regards,

Mike Page
Service Manager
PCI Race Radios, Inc.
2888 Gundry Avenue
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