

# RF



## ORANGE COUNTY AMATEUR RADIO CLUB, INC.

VOL. LV NO. 2

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

February 2014

### The Prez Sez.....

by Nicholas AF6CF



Greetings to all!

OCARC is a month into 2014 and we can already tell that this is going to be another great year for the Club. We have a big opportunity to enjoy the rest of the year with great plans and activities. Of course, Field Day is again front-and-center and we already started conversations about it, electing the Chairpersons to give it an early start. We hope FD will be in good hands with the two co-chairs Tim N6GP and myself. I can only promise that I will delegate most if not all activities to others. So we will have qualified people doing the job at hand for OCARC FD.

We also plan to participate in many other activities like the Baker to Vegas race, Antennas at the Park (or beach), open houses, parties and picnics and as usual a special September celebration. We know that the Board of Directors is doing a tremendous job to get all these activities scheduled. Last month we had a great turnout for our General Meeting, with an excellent presentation by Art W6XD that energized some of our members to do more about the general objectives of the hobby. This month we will have a highly awaited presentation about microcontrollers applied to HAM radio. I know that the VP is working tirelessly at getting more speakers like this one and we will not be disappointed. So Happy Valentine's Day and I'll see you all at the Meeting.

**73 DE AF6CF**

### OCARC 2014 DUES are DUE !!!

Don't forget to pay your OCARC dues for 2014. Still only \$20 per year! You have through end of March 2014 to pay your dues without falling in arrears. Don't miss out on the events planned by our new Board. You can send a check made out to OCARC to the PO Box (listed above) or pay at the club meetings.

### Next Meeting

The next [General Meeting](#) of the OCARC will be held on Friday, February 21<sup>th</sup>, 2013.

Our guest speaker is Bill Prats - K6ACJ. His topic is on:

**"...Arduino and Raspberry-Pi  
for hams...."**

Bill K6ACJ will be presenting on four projects from the ARRL Ham Radio for the Arduino and PICAXE and the remainder of the time on the Raspberry-Pi and ham radio applications. Don't miss this talk.

The next general meeting will be on:

**Friday, February 21<sup>th</sup>, 2014  
@ 7:00 PM**

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

### In This Issue: Page

The Prez Sez .....	1
Next meeting info.....	1
CLUB INFORMATION .....	2
San Diego Convention 2014 .....	3
TechTalk - Spectrum Analyzer .....	4
FT5ZM Amsterdam Island DXpedition .....	8
Orange RACES plan for B2V Race .....	9
Heathkit of the Month .....	10-16
Vintage Radio Auction in Orange .....	17
January General Mtg Minutes .....	18
February Board Mtg Minutes .....	19
January Board Mtg Minutes .....	20
WARA VE Testing Info .....	21
Order DATV-Express board now .....	22

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



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

**Monthly Events:**

**General Meeting:**

Third Friday of the month  
at 7:00 PM  
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.

# MARK YOUR CALENDAR NOW!!

## 2014 ARRL Southwestern Division Convention Dates: September 12 - 14, 2014



The ARRL SW Division Convention sponsored by SANDARC will be held at the Sheraton Four Points hotel located on Aero Drive near the Montgomery Field airport which is the same location of the 2010 convention.

Our convention will feature tech forums, vendor exhibits, on site radio station, grand banquet, flea market and many more activities. Check this site often to get the latest news regarding our ongoing convention events.

Vendors please check with Paul Rios at [kc6qls@cox.net](mailto:kc6qls@cox.net).

Check with Ann Rios, KC6TBG at [kc6tbg@cox.net](mailto:kc6tbg@cox.net) if wish to conduct a Tech Forum.

See [www.sandarc.net/convention2014.php](http://www.sandarc.net/convention2014.php) for more details



## TechTalk113

### DigitalATV – Using a Spectrum Analyzer

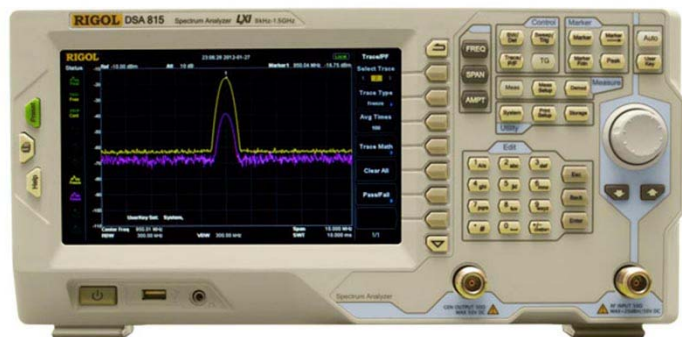
by Ken W6HHC

I will venture to guess that most hams do not use a “stand-alone” Spectrum Analyzer instrument. Quite a few hams have a Spectrum Analyzer built into their HF rig (like the Icom IC-7000, the Icom IC-7600, Yaesu FT DX 3000, or even a Yaesu FTM-4000M VHF/UHF rig, etc.) to look for signals on the band. In my situation, I was introduced to a built-in Spectrum Analyzer (SA) when I purchased an Icom IC-756-Pro3 in 2007 and a stand-alone Spectrum Analyzer instrument was purchased in 2013 because my involvement in digital-ATV.

Historically, “stand-alone” Spectrum Analyzer instruments were built for industry by companies like HP and Agilent and had huge price tags of \$20,000 to \$40,000 new! A ham could only hope to find a used Spectrum Analyzer for sale that still worked and had an affordable price tag. At least one instrumentation company based-in-China is now producing good-quality Spectrum Analyzers at a much more reasonable price.

#### Spectrum Analyzer Uses

Rigol Technologies produces many types of instruments, including several families of Spectrum Analyzers. Charles G4GUO pointed out to me that the Rigol Model DSA815 SA instrument is an entry-level unit that can operate up to 1500 MHz and has a base-price that is only US\$1295.

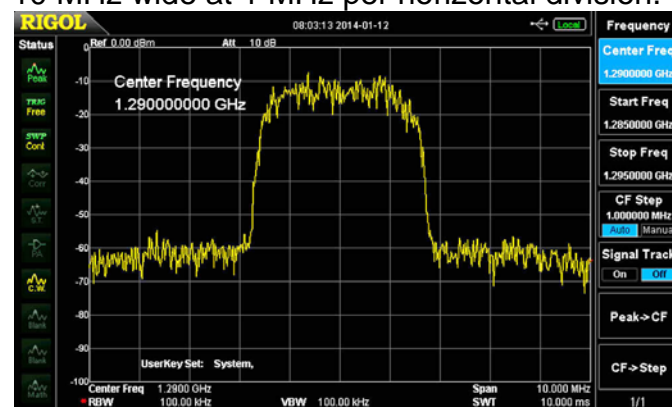


**Figure 1 - Rigol Model DSA815 Spectrum Analyzer can operate from 9 KHz to 1500 MHz**

The basic use of a Spectrum Analyzer is to analyze an RF signal over a range of frequencies.

This is especially useful in DigitalATV (DATV) where you are interested in measuring bandwidth, looking for distortion, side-spurs and harmonics.

**Fig02** shows a typical DVB-S/QPSK digital modulated signal on 1.290 GHz that is well-shaped and without distortion. The display is 10 MHz wide at 1 MHz per horizontal division.



**Figure 2 – Spectrum Analyzer display of QPSK digital modulation on 1290 MHz**

The design of a good quality spectrum analyzer that is useable up to 1500 MHz requires immense attention to details like shielding to prevent introducing cross-talk. **Fig03** shows that the Rigol unit utilized a complex shielding-box milled from a solid block of aluminum to contain the RF radiations of one part of the design from unintentionally interfering with another part of the circuit design.



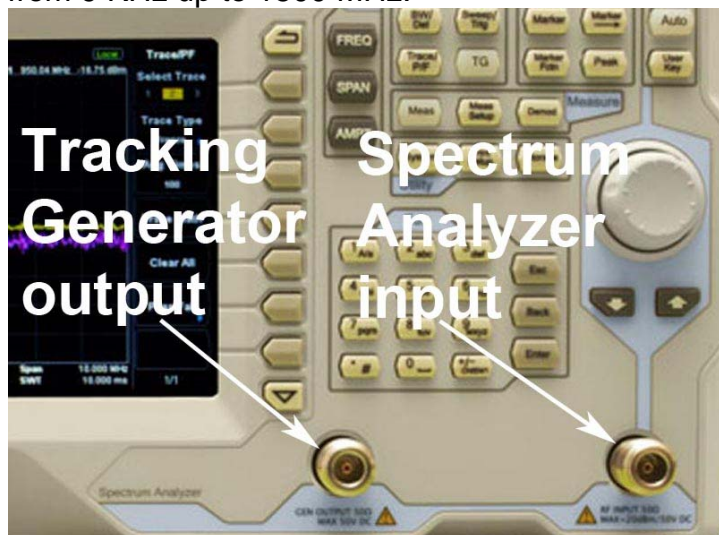
**Figure 3 – Construction of the RF shielding-box milled from solid aluminum block (Courtesy of YouTube EEV #391)**

There are quite a few other functions that can be performed by a Spectrum Analyzer, such as:

- Signal generation
- SWR measurements
- Power measurements

## Tracking Generator option

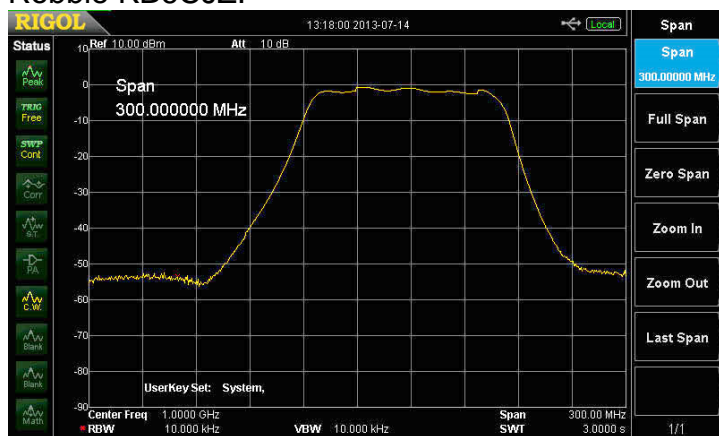
Rigol produces a variation of the base DSA815 SA unit that includes a "tracking generator" option. This model is called DSA815-TG. A tracking generator is a sweeping signal generator that tracks with the display span of the Spectrum Analyzer. Not only does the tracking generator help measure the performance of filters, but it makes a fine stand-alone RF signal generator that operates from 9 KHz up to 1500 MHz.



**Figure 4 – Location of Tracking Generator output relative to the input connector of the SA**

Want to calibrate a receiver...just place the tracking-generator output on the frequency of interest with a steady carrier and no sweeping.

As I mentioned earlier, one use of a tracking-generator option is to simplify the measurements of and displaying the performance of a filter. **Fig05** shows the measured performance a surplus tunable band-pass filter loaned to me for testing by Robbie KB6CJZ.



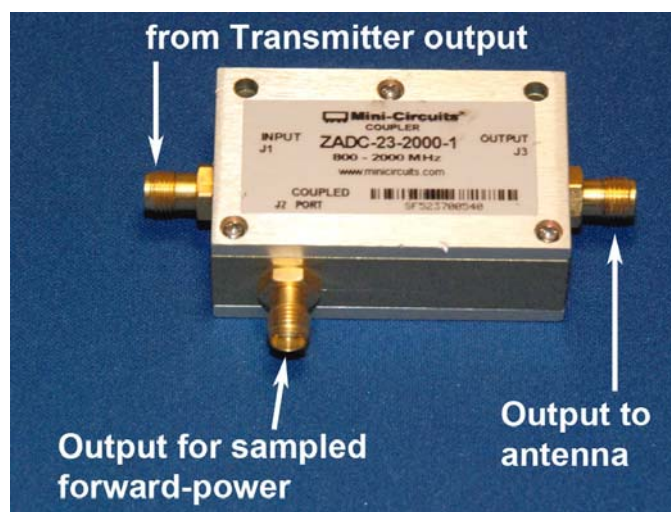
**Figure 5 – Spectrum display (center frequency set to 1.0 GHz) of a surplus tunable band-pass filter**

This tunable filter had the value of 1030 MHz hand-written on the unit. I think it is easy to envision using the Spectrum Analyzer to confirm re-tuning of this band-pass filter.

The Rigol Tracking-Generator option is priced at US\$200, but must be ordered as a model DSA 815-TG Spectrum Analyzer, since it is not a plug-in option. The price of a DSA815-TG unit is US\$1495, total.

## SWR option

Another neat aspect of a tracking-generator is that it simplifies measurement and reports for documenting SWR of an antenna. The heart of making an SWR measurement with a Spectrum Analyzer is using a microwave directional – coupler to take a sample of the reflected RF and puts that sampled signal back into the input connector of the SA. **Fig06** shows a typical surplus microwave directional coupler.



**Figure 6 – Typical surplus directional-coupler with forward-power sampled output connector**

Surplus directional-couplers are usually specified for a specific range of microwave frequencies. However for basic measurements of antenna SWR, you can use directional-couplers that are designed for a different frequency range. All that really changes is the gain of the sampled signal. Note - directional-couplers can be purchased with either SMA or N-connectors. Also, these units are reversible; connect the transmitter to the J3 connector...and now the sampling connector delivers reflective-power.

**Fig07** illustrates how a directional-coupler can be used with the Tracking-Generator output to

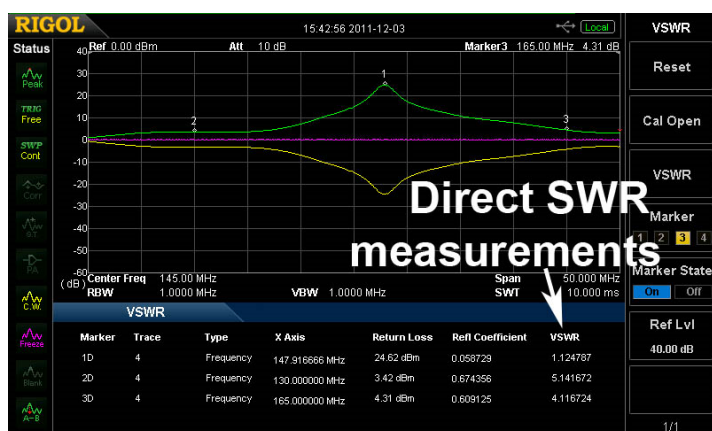


find resonance on an antenna and help you tune it to the correct frequency. As a NOTE: No special NO special Rigol optional-cost SWR software was used in **Fig07** to perform the test.



**Figure 7 – Using a direction-coupler to tune an antenna (but, no special SWR software)**

Next, because modern Spectrum Analyzers contain microprocessors, a little software can be offered as an option to measure all the displayed SWR signal values...calculate a few values...and can provide you with a finished SWR report.



**Figure 8 – The Rigol software DSA800-VSWR option measures values and displays SWR report**

Rigol optionally sells two SWR accessories. The software-only measurements-calculations accessory Model DSA800-VSWR software kit sells for US\$459 and provides professional reports that do all of the tedious calculations. Rigol also sells accessory Model VB1020 kit that includes (a) a specially designed directional-coupler hardware unit that has a frequency range from 1 MHz to 1500 MHz, (b) the hardware unit screws directly onto the TG-output and the SA-input connectors, and (c) the software measurements and SWR report code. The cost of the optional Rigol Model VB1020 kit is US\$599.

## Power Measurement option

All Spectrum Analyzers can perform power measurements on simple carriers and even complex digital modulation without special software. Just put the SA into the dBm scale. However, for the complex digital-modulation signals, you need to compensate for the video-bandwidth setting of the SA, compared to the channel-bandwidth of the digital-modulation signal.

For a simple un-modulated carrier signals, because the bandwidth of the signal is so narrow (less than 1 KHz), the peak reading of the carrier is directly equal to the output power-level.

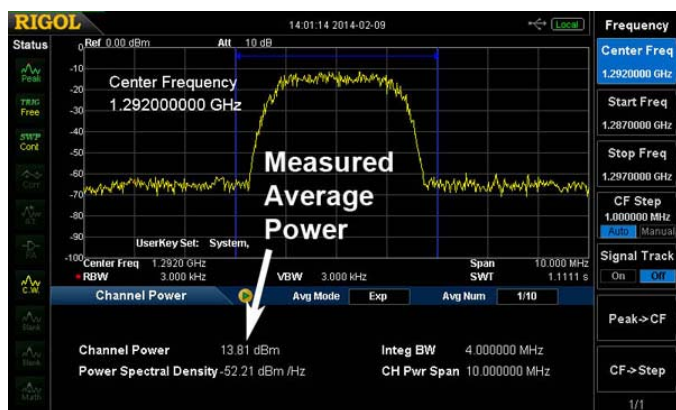
Mike WA6SVT (a commercial television station engineer) explained to me that for a more complicated RF signal such as a DVB-S/QPSK “hay-stack” (see **Fig02** of an example), the Video BandWidth (VBW) and Resolution BandWidth (RBW) setting on the Spectrum Analyzer has to be set to a value that is a little wider than the DATV signal you want to measure. If the RBW can be set correctly, then the DATV average power level is the value at the top of the “hay stack”.

On my entry-level Rigol DSA815, the largest VBW and RBW setting available is 300 KHz. This bandwidth is too small to directly measure power on a DATV signal that has 3 MHz or greater Occupied BandWidth. Fortunately there is a mathematical conversion that can compensate for a narrow VBW/RBW setting. Ron W6RZ and Rob MØDTS both suggested to me on the Yahoo DigitalATV Forum that the correction factor in dB for spectrum analyzers is

$$10 \cdot \log_{10} (\text{channel bandwidth} / \text{resolution bandwidth})$$

Rigol optionally sells a software-add-on accessory to measure power directly called DSA800-AMK (Advanced Measurements Kit). The Channel Power mode of this kit uses the built SA microprocessor to integrate the power level measurements over an “integration BW” that you can select. **Fig09** is a display of the optional Channel Power mode measuring the RF output of a bare-foot DATV-Express board signal running SR=2.2 MSymb/sec at 1292 MHz. The integration BW was set to 4 MHz for this measurement of 13.96 dBm power output. This Channel Power mode

option sure makes it simple to measure DATV power levels. No more worrying if the Bird power meter you are using is a bolometer/thermal type or not.....and without digging out your scientific log calculator. The optional cost of the Rigol Model DSA800-AMK kit is US\$499



**Figure 9 – Display of Channel Power option measuring 13.81 dBm average power (DVB-S at 2.2 MSymbols/sec)**

### “Secret” Demo-Mode for Options

One complaint that I have is that NONE of the Rigol (or Rigol distributor) literature or web site materials explains that most of the extra-cost software options are available as a free demo mode to try out. The time-out period on the demo-modes is 200 hours of Rigol Spectrum Analyzer power-on. A phone conversation with technical support of Rigol (quite good at helping me use the instrument) hinted about the unpublished demo-mode...but he did not have any real details of trial-period, etc. I finally discovered the demo-mode when I only had about 11 hours of use left to try them out.

### Easy Screen-Capture Feature

A small feature on the Rigol SA that I really enjoy using is the one-button screen capture directly to an inserted USB-memory-stick. Just plug the USB-memory into the front-panel USB port...make sure the screen displays what you want to record....and press the PRINT button on the SA. Capturing the screen (just as displayed) could not be easier. I wish Windows would think about providing a setting for printing the screen directly to a USB-memory-stick.

### Conclusion

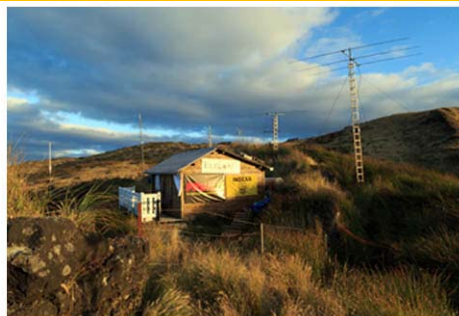
While not essential, a Spectrum Analyzer is a very useful instrument to have available for looking at DATV signals. For normal DATV usage, viewing the SA is perfect for adjusting the drive into RF power amplifiers. An over-driven PA starts to exhibit spectral-regrowth distortion where the distortion creates a signal that grows wider and wider as the drive level is increased. The problem with spectral-regrowth is that the received video still looks good, but more and more RF interference is occurring on the sides of your intended signal. DATV uses include:

- Adjusting RF power amplifier drive
- Inspecting quality of transmitted signal
- Confirming any spurs are low-level
- Checking for undesired harmonics
- Tuning band-pass filters
- Measuring power of digital-modulation
- Pointing antenna to weak DX signal (Spectrum Analyzer will see weak signal faster than STB can lock onto to signal)

### Useful URLs

- Rigol Technologies (North America) – see [www.Rigolna.com/](http://www.Rigolna.com/)
- Rigol (United Kingdom) – see [www.Rigol-UK.co.uk/](http://www.Rigol-UK.co.uk/)
- TEquipment USA Distributor for Rigol – see [www.TEquipment.net/](http://www.TEquipment.net/)
- YouTube “Tear-down” of Rigol DSA815-TG unit (EEVblog #391) – see [www.youtube.com/watch?v=EY0acWrCYjw](http://www.youtube.com/watch?v=EY0acWrCYjw)
- British ATV Club - Digital Forum – see [www.BATC.org.UK/forum/](http://www.BATC.org.UK/forum/)
- CQ-DATV online (free monthly) e-magazine – see [www.CQ-DATV.mobi](http://www.CQ-DATV.mobi)
- DATV-Express Project for DATV – see [www.DATV-Express.com](http://www.DATV-Express.com)
- DigiLite Project for DATV (derivative of the “Poor Man's DATV” design) – see [www.G8AJN.tv/dlindex.html](http://www.G8AJN.tv/dlindex.html)
- Orange County ARC entire series of newsletter DATV articles – see [www.W6ZE.org/DATV/](http://www.W6ZE.org/DATV/)
- Yahoo Group for Digital ATV - see [groups.yahoo.com/group/DigitalATV/](http://groups.yahoo.com/group/DigitalATV/)
- dBm to Watt power convertor – see [www.rapidtables.com/convert/power/dBm\\_to\\_mW.htm](http://www.rapidtables.com/convert/power/dBm_to_mW.htm)

## OCARC Member Arnie Shatz, N6HC Working the World from the Amsterdam Island DXpedition



by Tim N6GP

If you turned on your HF rig between Jan 26th and Feb 12th, especially around 0100z or 1600z, it is likely that you have heard the huge DX pileups from Amsterdam Island ZT5TM, in the middle of the Indian Ocean. OCARC member Arnie N6HC left for this expedition around January 10th. He met up with the international team in Perth Australia, and boarded the MV Braveheart for a 9 day boat ride to the island. Amsterdam & St Paul Islands is the 7th most needed DXCC entity, The budget for this DXpedition is \$450,000.

The Braveheart arrived at the island on January 24, and it took 50 trips in Zodiacs to bring all the equipment ashore. The team struggled to set up the antennas and equipment on the volcanic rock of the island. After 2 days of setup, they were on the air on January 26th.

One of the first OCARC members to work them was Chip K7JA who snagged Arnie on 10 meter CW short path at 0230z on Jan 26. That big monoband yagi that Chip put up last June is paying off.

Here is an audio recording that someone made of Arnie operating FT5ZM the first day on 10 SSB. <https://audioboo.fm/boos/1878097-ft5zm-10ssb-first-signals>

Several days into the expedition, Jeff W6UX was able to work them on 20 and 17 with 100 watts and his hex beam. Kenan KR6J, was able to make the contact on 40 meters mobile from his truck! That is over 11,000 miles!

As of the writing of this article, FT5ZM has made over 152,000 QSOs. They should finish the expedition around 170,000 which is phenomenal. It will be hard to top this for DXpedition of the Year.

Over 100 contacts have been made by OCARC members. John N6QQ, Ernie N6HY and Bill N6RV are certainly leading our pack. The following members have made at least 1 QSO with FT5ZM: Ron W6ZQ, Dan N6PEQ, Jim W6DF, Bob AF6C, Paul W6GMU, Jeff W6UX, Bob AA6PW, Carolyn KE6BUH, Kris KC6TOD, George N6VNI, Bill N6RV, Larry K6YUI, Chip K7JA, Janet KL7MF, Tim KJ6NGF, Dick K6HRT, Kenan KR6J, John N6QQ, Richard N6RU, Rich N6NH, Sharon K6IRD, Wayne W6IRD, and Dan KI6X.

We wish Arnie and the rest of the crew a safe voyage on the long trip on the way back, and look forward to hearing about this adventure when he returns. **Many thanks for a job well done!**



## **COAR RACES plans Communication Support for the Orange Police 2014 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 260 different law enforcement teams will participate.



**Members of COAR RACES and friends take a group photo during  
a Baker-2-Vegas Communications Planning Meeting  
Ten OCARC members are assisting COAR during B2V**

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 22, with runners reaching the finish line on Sunday, March 23.

The photo above shows many of the volunteers at a COAR RACES planning meeting for the B2V race communications that was held in early February. There are eight OCARC members in this photo (two members are missing). The COAR RACES Chief Radio Officer is Dave KG6RWU (standing in the row immediately behind Kevin KG6MIH in wheelchair...and Kevin's mom, Bobbie KG6MIF).



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



### Heathkit GD-48 Metal Locator.

#### Introduction:

Buried Treasure? Aye Matey, I was saving this series of Heathkits for September as that is the month of "Talk Like a Pirate Day" which falls on the 19th. Alas, so does the OCARC gatherin'. I expect a fun time!

However, our rotating editor this month is Ken, W6HHC, and since he passed along manuals for the GD-48 and GD-348, I thought I'd honor him with an article on them for his turn as editor.

I'm sure many a pirate of olde would have liked to have a metal locator for finding those treasures that they buried, only to later realize the map they made was later used at the bottom of the parrot's cage.

#### Heathkit Metal Locators:

Heathkit used the nomenclature "metal 'locator'" instead of "metal 'detector'" for their treasure seeking products. Heathkit produced four models over the years that I'm aware of. The first was the GD-48 which was listed as new in the 1969 Summer catalog. The Deluxe GD-348 followed in 1972 and sold concurrently with the less expensive GD-48 for five years.

Around 1978 Heathkit introduced the GD-1190, a third model designed specifically for hunting small coins. In ads it was called the "CoinTrack". Around 1979 the last of the Metal Locators, the deluxe GD-1290 "GroundTrack" was released.

Table 1 gives the production dates as best I can determine with the catalogs in my files.

#### Heathkit Metal 'Locators':

Model	Name	From	To
GD-48	(none)	1969	1977
GD-348	(none)	1972	1981
GD-1190	"CoinTrack"	1978	1983
GD-1290	"GroundTrack"	1979	1985

Table 1

#### The Heathkit GD-48 Metal Locator:

The first Heathkit metal locator, the GD-48 originally cost \$59.95. By 1976 the price had increased to \$69.95; but in the fall of that year it was offered again for \$59.95 on a "save \$10" special. The last catalog (1977) I have showing it listed had the price back at the original \$59.95.

The GD-48 is shown in Figure 1. It weighs 4 lbs. and has a

10.5" diameter coil housing. The arm length is adjustable from 26" to 36". It is powered by a NEDA #1602 9-volt battery (Heath part # GDA-48-1). This is a different battery than the common 9V battery used in so many products today. It is rated at 850 ma/hr and measures approximately 1.3" x 1.4" x 2.7". (The Eveready part # is 246). These batteries now run about \$11.00 each and will power the GD-48 for about 80 hours of operation. The cheaper, more available, NEDA #1604 may be used but will provide shorter operation time. The man-

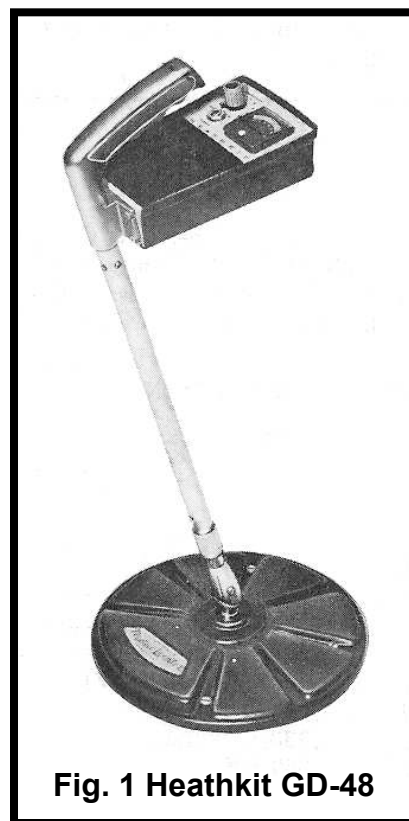


Fig. 1 Heathkit GD-48



Figure 2: NEDA 1602

### Assembly:

Most of the wiring for the GD-48 is on two circuit boards. The search circuit board mounts in the search-coil housing and the audio board mounts up in the control panel housing. The components are first mounted on these two boards. The search and pickup coils come pre-wound and attached to the coil housing base. After the search circuit board is mounted to the coil housing base, the five leads of the search coil, and the three terminals of the pickup coil are soldered to the board; the latter by short jumper wires.

Next the control panel is assembled. The speaker and its grill, the controls, phone jack and meter are attached. A short length of 8-conductor wire is then connected to the audio board, as is the negative lead of the battery connector. The handle is assembled and attached to the control panel.

A four wire spiral cable connects the two circuit boards (one of the wires is not used). This cable is now fed through the handle assembly and into the control panel before it is soldered to

ual warns that the smaller metal batteries can also short out the circuitry. Figure 2 shows the Eveready 246 #1602 battery.

The GD-48 is capable of detecting dime-size metal at 6", quarter-size metal at 7-1/2" and a 5" square piece of aluminum at 20".

The search-coil housing is not waterproof so it cannot be used in shallow water.

the still-loose circuit board. Finally the audio board is bolted to the back of the speaker and the eight-wire cable is dressed and wired to the meter, speaker, phone jack, and **SENSITIVITY** potentiometer which contains the **OFF**-on switch. The red battery lead is also connected to the switch.

The shaft and swivel are then assembled and the shaft is attached to the control panel and handle after the spiral cable is snaked through the shaft. Next, the coil housing top is connected to the shaft; the spiral cable is then sealed with a tube of supplied sealant where it enters the coil housing cover.

After the sealant is given time to dry, the spiral cable end is wired to the search circuit board and the two halves of the coil housing are joined by four non-magnetic screws. Finally the battery and the control panel cover are installed and the well known Heathkit "blue and white" label containing the model and serial numbers is placed on the outside of the control panel cover.

### Alignment:

Alignment involves adjustment of two capacitors C3 and C5 located on the search board. First they are moved to a preset condition, then they are adjusted in an iterative manner until the proper null is established. A "coin test" is then conducted to check for proper phasing and sensitivity. This test can be repeated occasionally to assure the metal locator alignment has not degraded.

### Final Assembly:

Once you've determined the GD-48 is working properly, the coil cover is removed, sealant is placed around part of the circuit board to prevent vibration or jarring, and the coil housing cover is sealed to the coil assembly using the remaining sealant.

### Circuit Description:

The Heathkit GD-48 uses eight transistors, all type 2N3393 (silicon small signal NPN), and a



single 1N4002 silicon diode (Heath part# 57-65). Figure 5 shows the block diagram and Figure 6 shows the schematic diagram.

The heart of the GD-48 metal locator is the search and pickup coils, L1 and L2 respectively. Q1 is a VLF oscillator that uses L1 and C2 to produce a 100 KHz signal. The transistor's bias is provided through R1. This oscillator has an additional feature; feedback is provided through an RC network that includes R2 and C1 which causes Q1 to stop and start oscillating at an audio rate of about 650 Hz, effectively modulating the 100 KHz signal with an audio tone. This circuit is called a relaxation oscillator.

The pickup coil is situated so that the coupling between it and the search coil is minimal. Trimmer capacitor C3 and fixed capacitor C10 each provide some coupling between the two coils; however, they are out of phase with each other so C3 can be adjusted to balance out any stray coupling. The pickup coil is tuned by C5, and any signal from the coil is capacitively coupled to two stages of direct coupled amplification provided by Q2 and Q3. All this circuitry is on the search board located in the coil housing.

The output of Q3 is fed up the three conductor spiral coil (which carries battery voltage, ground and the amplified pickup coil signal) to the audio board in the control assembly. On this board the signal is fed to a differential amplifier composed of Q4 and Q5. The transistors are coupled through a common emitter resistor. The signal is fed to the base of Q4 while a voltage level, adjusted by R16 the **SENSITIVITY** pot is fed to base of Q5. This level varies from approximately 2.2V fully CCW to 0.9V fully CW (maximum sensitivity). This voltage sets the current through the emitter resistor R14 and hence the bias point of Q4 with respect to the 0.37 volts on the base of Q4 (established by R11 and R12). The sensitivity pot is normally set to the point where, with no input signal Q4 is just cut off. When a signal becomes present Q4 conducts and amplifies the changes in the input signal. Transistors Q4 and

Q5 share the same metal heatsink; this is not for heat dissipation, but to keep the two transistors at the same temperature and reduce drift in the differential amplifier. The output of Q5 is further amplified by Q6, which is a basic common emitter amplifier.

The audio output and meter driving stage is handled by Q7 and Q8 which are wired as a single Darlington transistor running class B. A class B amplifier is biased so the transistor is just cutoff with no signal. You might be more familiar with class B push-pull amplifiers that are used in hi-fidelity audio. However, the GD-48 uses just half of the push-pull design since audio quality of the tone is not important in this case. Class B also means that there is little current used until metal is detected improving battery life. The meter effectively measures the collector current of Q7 and Q8. The diode and associated resistors scale and protect the meter from excessive overloads. The collector current also passes through the speaker. When earphones are plugged into the **PHONES** jack the speaker is disconnected and the current passes through the earphones.

### Operation:

The GD-48 has two operating modes, normal and high sensitivity. In normal mode the sensitivity control is adjusted, with the coil away from metal, until a tone is heard and then reduced until the tone just goes away.

In high sensitivity mode, the sensitivity control is advanced until the meter reads about 2 on the scale of 1 to 10. As metal is encountered the meter will increase. Its movement is much more noticeable than a change in the level of the tone.

Heathkit recommends that you practice with known pieces of metal to become familiar with the operation and sensitivity of the instrument. The most sensitive part of the search coil is underneath the spot just in front of where the swivel joins the coil housing.

**GD-48 Accessories:**

Heathkit offered two accessories for the GD-48, the GDA-48-1 NEDA 1602 battery (\$1.30 in 1969) and the GDA-396 2,000Ω earphones made by Suporex (\$3.50 in 1969). These headphones were also offered as accessories for many of the shortwave radios sold at the time.

**The Heathkit GD-348 Deluxe Metal Locator:**

The GD-348 (Figure 3) is a refined version of the GD-48. It was introduced in late 1972 at the price of \$89.95. It remained at this price in the catalogs I have until 1980 when the price actually dropped to \$79.95, which may have been a clearance price as it didn't appear in the 1981 catalog.

**Overview:**

The GD-348 weighs 3-1/2 lbs.; a half-pound lighter than its predecessor. It uses the same NEDA #1602 9-volt battery to provide 50 hours of operation. The sensitivity is given in the specifications as detecting "dime-sized metal at up to 6 inches in air", on a par with the non-deluxe model. The search coil housing is specified as waterproof up to 2' depth. Like the GD-48 the shaft is adjustable from 28" to 36".

The circuitry is significantly changed from the GD-48. The GD-348 uses ten transistors and four diodes. The relaxation oscillator itself uses two transistors to provide more stable operation. It also operates at a frequency of 100 KHz, but the modulation frequency has changed to 500 Hz. The amplifier that buffers the signal from the pickup coil now incorporates an active filter to reduce harmonics, and a diode detector to remove the 100 KHz carrier before it leaves the coil housing. Like its predecessor, the GD-348 also has two circuit boards, one in the coil housing that uses four transistors and handles the relaxation oscillator and active filter-amplifier, and one in the control handle that uses six transistors and processes the audio.

The audio processing board contains a fixed high-gain amplifier, followed by a temperature compensated variable gain amplifier that is set by the

**SENSITIVITY**

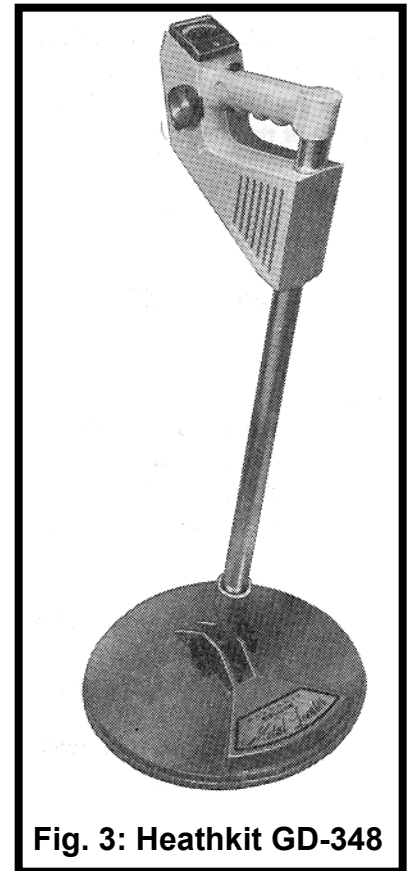
control. This amplifier drives a single transistor that drives the speaker and meter. The final transistor is a shunt across the meter that conducts on strong signals and protects the meter.

Another feature of the GD-348 is the coil nulling circuit. Instead of using adjusting capacitors in the head housing that time-to-time requires removal of the label and readjustment. The GD-348 uses a **BALANCE** potentiometer located on the handle control box. This pot is across two taps of the search coil and is capacitively coupled to the pickup coil. The two taps are located so as to be of equal voltage but opposite polarity resulting in a small signal of adjustable amplitude and phase that can be adjusted to cancel any residual coupling between the search and pickup coil. The advantage of this circuit is that the coil housing can be sealed and made waterproof. The older GD-48 has two holes for access to the adjusting capacitors which are sealed merely by a metallic label and is not considered waterproof.

The GD-348 continued production until 1981.

**GD-348 Accessories:**

Heathkit offered three accessories for their deluxe metal locator. The GDA-48-1 battery, the GDA-396 headphones, both described above, and the GDA-348-1 carrying case. These accessories cost \$3.25, \$5.95 and \$11.95 respectively in the Spring 1977 mail order catalog.



**Fig. 3: Heathkit GD-348**

**The Heathkit GD-1190 “CoinTrack”:**

In 1978 Heathkit introduced a new metal locator. It is believed to originally have sold for \$119.95. This device was designed specifically for finding small coins. The GD-1190 weighs 3.4 lbs. The over all length is adjustable from 22-1/2” to 45-1/2”. The small coil housing measures 6” in diameter. The meter may be assembled for left or right-hand operation. Power is supplied by 6 AA batteries. An optional nicad battery pack and charger are available. The cable from the coil housing to the control unit is external to the adjustable shaft and wraps around it. The cable can be unplugged at the control unit.

Unlike the coil system of the previous metal locators, this locator uses a search coil but no pickup coil. Instead of relying on the metal being located creating its own magnetic field that is then sensed by a pickup coil, the GD-1190 relies on the metal detuning the resonance of the coil and associated capacitance. The coil is excited by a stable 3.59 crystal oscillator divided down to 56 KHz. Detection is done by a discriminator circuit.

This is the first Heathkit metal locator to use integrated circuits. The five ICs are an LF211 FET comparator, LM2902 quad op-amp, CA3130 op-amp, CD4011 CMOS quad NAND gate and a CD4024 CMOS binary counter. One JFET and five bipolar transistors (one a Darlington) are also used, along with 4 diodes (one general purpose, one varactor and two zener diodes).

External controls include **VOLUME**, **DISCRIMINATE**, **TUNING**, a 4-position **MODE** switch and auto **TUNE** pushbutton. A meter, speaker and **PHONES** jack mount on the control cabinet which also supports a handle. The “CoinTracker” custom balances for less fatigue during use.

**GD-1190 Accessories:**

Three accessories were available for the GD-1190. The GDA-1190-1 nicad battery pack, the new GDA-1190-2 Superex headphones and the

GDA-110-3 carrying case. In the Fall 1980 catalog these sold for \$19.95, \$11.95 and \$11.95 respectively.

The accessory nicad battery pack can be charged either from a car cigarette lighter socket or from a standard 120V AC outlet.

**The Heathkit GD-1290 “GroundTrack”:**

In 1979, shortly after the GD-1190 was introduced, Heathkit introduced another metal locator, the GD-1290 “GroundTrack”. In the Fall 1980 catalog it sold for \$189.95. (Later it sold for \$219.95. The ad called this locator “Our finest Locator”; it was also the last locator that I am aware they built. Unlike the “CoinTrack” this unit uses search and pickup coils (induction balance) like the older units, though its circuitry is significantly advanced. Physically this locator is similar to the “CoinTrack” in size, weight and appearance, with some minor variations in controls.

**GD-1290 Accessories:**

The GD-1290 uses the same three accessories (the nicad battery pack, the Superex headphones, and the carrying case) that were available for the GD-1190.

**Comments:**

While I was in possession of manuals for the GD-48 and GD-348. Finding information, or even a clear schematic, for the other two units proved inadequate to give a more thorough description.

**GD-48 User Interview:**

I got a chance to interview Ken - W6HHC on his thoughts about the GD-48 Metal Locator. Mostly his comments were positive. The kit was easy to build, calibrated easily and operated as it was supposed to do. He mentioned he liked to take it along on the family outings to the beach; his kids enjoyed searching in the sand too.

Ken did comment on two faults he had with the GD-48. The first was that it needed to be adjusted whenever he took it out. However he said that once adjusted it stayed in adjustment



## Find buried valuables on dry land or at the beach with Heathkit's Metal Locator

With the Groundtrack Metal Locator you can punch through ground clutter to uncover rare coins, artifacts, old trinkets and treasure. The Groundtrack is a professional model — able to pinpoint even tiny metal objects in any kind of soil, even in ground submerged under two feet of water.

Built-in speaker provides clear signals

Pushbutton tuning and ON-OFF volume control

Headphone jack

Toggle switch selects Discrimination or Ground Balance modes

Battery test switch to monitor condition

Easy-to-read meter installs for right- or left-handed users

Easy-grip handle for fatigue-free use

- Find valuable objects where conventional locators are almost useless
- On/off with volume, meter, speaker, phonejack, discrimination, ground balance, tuning controls, battery test, charging jack and mode switch
- Uses 6 AA cells

Telescoping shaft collapses to 22"

Search head folds flat for easy storage, waterproof and submersible to 2 feet.

Reading controlled by discrimination setting. Needle deflects upscale and sound increases when object is within search field. Downscale deflection indicates a ferrous object.

**\$219<sup>95</sup>**

**Fully Adjustable Discrimination Circuit** filters background signals — screening out pulltabs, metal foil, bottle caps, ferrous and alloyed items. The Groundtrack can be used in high "junk" locations where the use of other locators is all but impossible. Have the sensitive pushbutton tuning of our best metal locator at a price far below the competition.

**A Ground Balance Mode** pinpoints treasures even in high-mineral soil. A Very-Low-Frequency induction balance system provides silent operation until that coin or artifact enters the 6-inch diameter search head field of detection. Then a clear tone sounds that grows louder as you approach vertical center.

**Use the Groundtrack anywhere.** It's lightweight and portable, with a telescoping shaft that collapses for storage. Operates on 6 AA cells (not included) or the optional Rechargeable Battery Pack, which includes AC outlet and DC lighter socket chargers for use at home or in-the-field.

**Kit GD-1290**, Shpg. wt. 5 lbs. .... **219.95**  
**GDA-1190-1**, AC/DC Rechargeable Battery Pack, Shpg. wt. 2 lbs. .... **24.95**  
**GDA-1190-2**, Superex Headphones, Shpg. wt. 2 lbs. .... **14.95**

**GD-1290 SPECIFICATIONS:** **Sensitivity:** Locates dime at 4" to 6" typical, may be less depending on soil conditions, mode of operation and amount of discrimination selected. **Method of Detection:** Induction-balance circuit. **Detector Output:** Meter, speaker, phone jack. **Power Requirement:** Six AA cells or Rechargeable Battery Pack. **Dimensions:** Extended height, 45½". **Net Weight:** 3.4 lbs.

until it was put away for another day. Ken's second complaint is one that probably most metal locator owners, who go looking for coins or treasure, have. The GD-48 has a poor ROI.

For those of you who don't know the phrase ROI, it is a business term that stands for *Return on Investment*! Ken's ROI was nominal. Maybe if aluminum recycling was in affect in the seventies, he might have been able to return all the can tabs he found. But alas, Ken never mentioned gold coins nor pieces-of-eight he located under the search head during his explorations.

I personally know of one dime he did find. I hid it under the carpet when we were checking his GD-48 out one afternoon.

When I asked Ken what happened to his metal locator, he said the swivel broke between the sense-head and the arm and he finally abandoned it. However he said it gave him good service for many years.

### Acknowledgements:

I'd like to thank Ken - W6HHC for saving and passing along his GD-48 manual after his unit broke beyond repair. He also provided the GD-348 manual that he acquired from a friend.

73, from AF6C

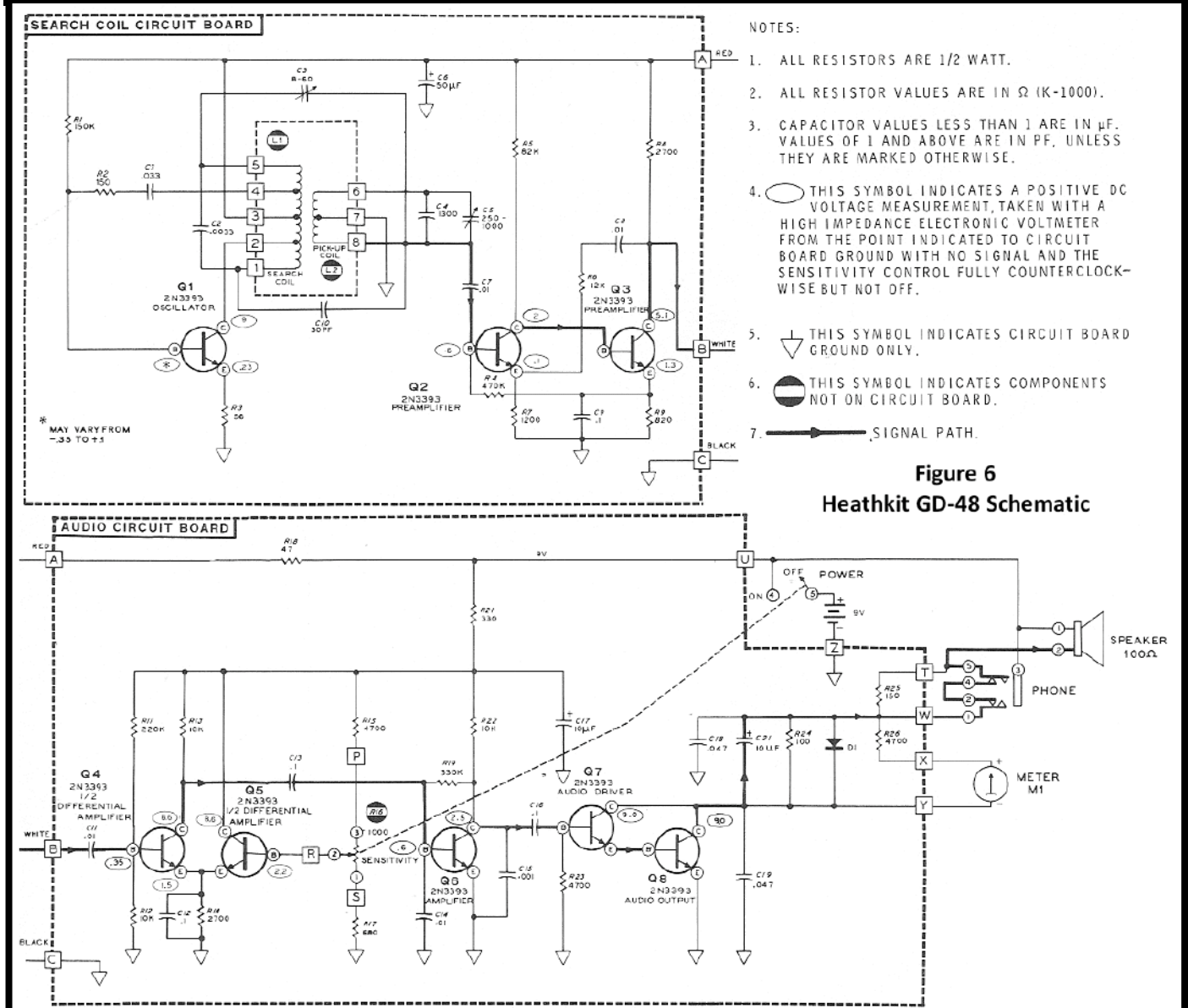
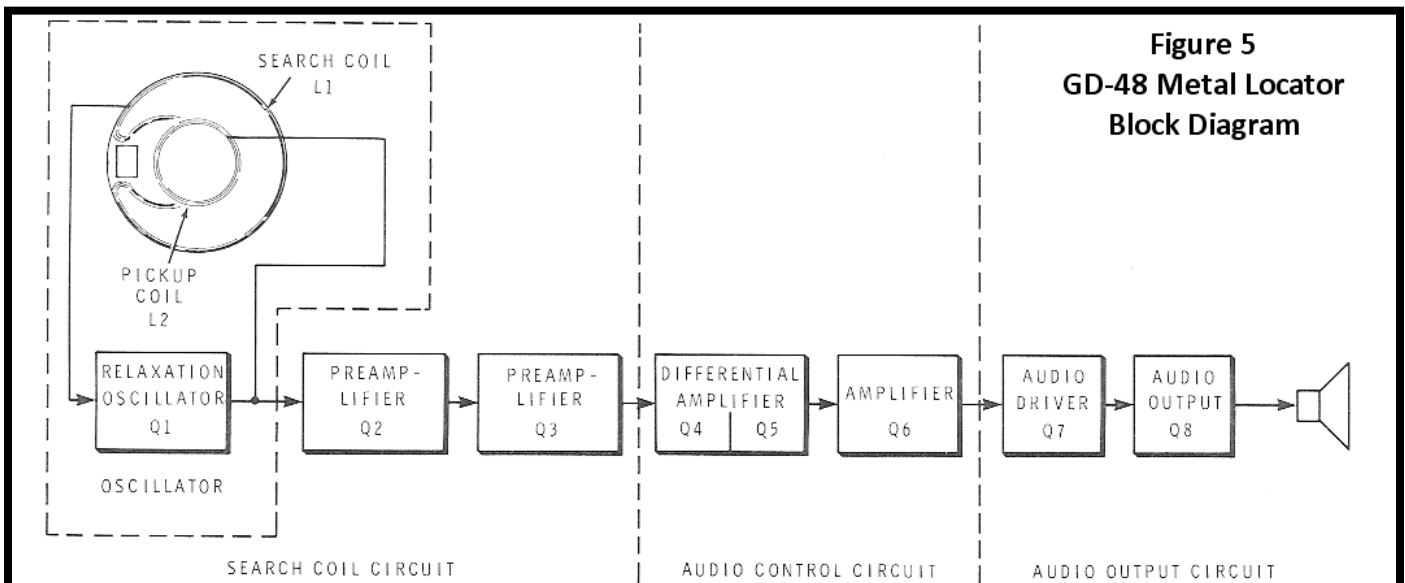


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*Remember, if you are getting rid of any old Heathkit Manuals or Catalogs, please pass them along to me for my research.*

*Thanks - AF6C*

Figure 4: GD-1290 "GroundTrack". The GD-1190 "CoinTrack" is similar in size and appearance. (From 1984 Catalog)





SOUTHERN CALIFORNIA  
ANTIQUE RADIO SOCIETY

# 2014 VINTAGE RADIO AUCTION



**SATURDAY FEBRUARY 22ND**

FIRST PRESBYTERIAN CHURCH  
GRAND STREET CENTER  
146 NORTH GRAND STREET  
ORANGE, CA 92866

**THIS IS AN INDOOR EVENT AND WILL TAKE PLACE - RAIN OR SHINE!**

## SCHEDULE

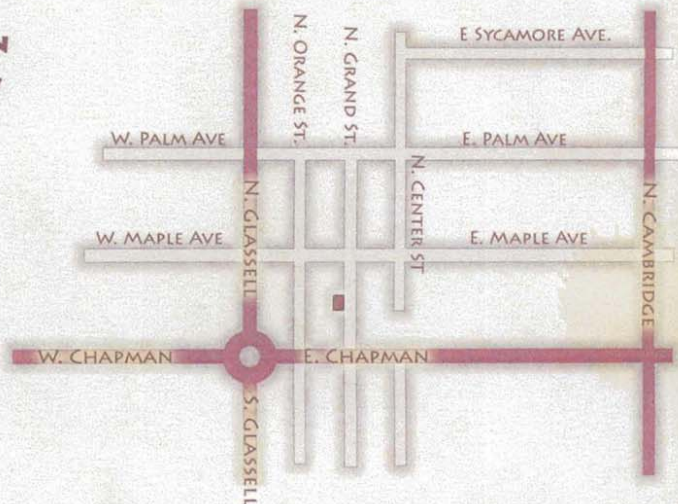
**7:30 - 8:30 AM: ITEM CHECK-IN**

**9:00 - 9:45 AM: ITEM PREVIEW**

**10:00 AM: AUCTION BEGINS**

**NOON - 1:00 PM: LUNCH\***

- \* - ANNUAL MEMBERSHIP \$20.
- MEMBERS ONLY BID CARD \$5.
- LUNCH PROVIDED TO MEMBERS  
WITH BID CARD PURCHASE.



YOU HAVE THE UNIQUE OPPORTUNITY TO SEE MANY  
RARE AND BEAUTIFUL ANTIQUE AND VINTAGE RADIOS  
AT THIS GREAT SOUTHERN CALIFORNIA VENUE.  
JOIN US!

FOR MORE INFORMATION, INCLUDING AUCTION RULES AND  
SELLER CHECK-IN FORMS, GO TO:

[HTTP://WWW.ANTIQUERADIOS.ORG/EVENTS.HTML](http://www.antiqueradios.org/events.html)





# OCARC

## GENERAL MEETING MINUTES

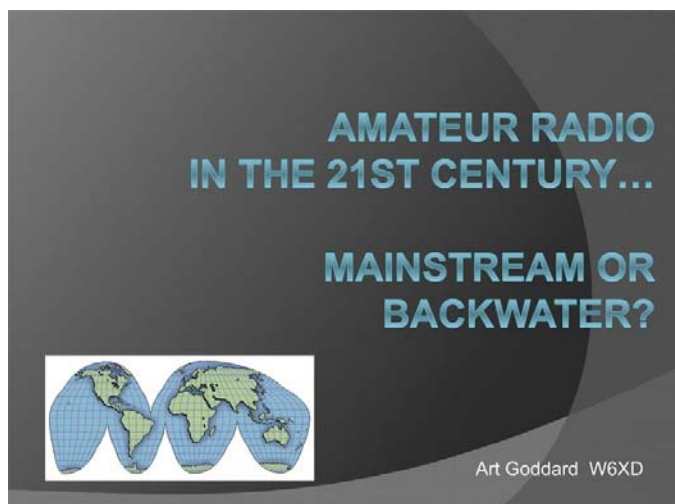
2014-01-17

The OCARC General Meeting was held at the Red Cross Complex on January 17th 2014. The meeting was called to order at 7:02 pm, 3:02 UTC. There were 29 people, including 5 visitors, in attendance. A quorum of officers was present as follows: Nicholas AF6CF, Tim N6GP, Ken W6HHC, Tim KJ6NGF, Kris KC6TOD, Bob AF6C. As we usually do, we started the meeting with the U.S. Pledge of Allegiance. Next we went around the table introducing ourselves.

### PROGRAM

Our main speaker for the evening was Art Goddard – W6XD. Art has been a Ham for 58 years and has served as the ARRL Southwestern District Director. He is also an accomplished DX'er, having travel throughout the world to put many locations on the air. His presentation was called:

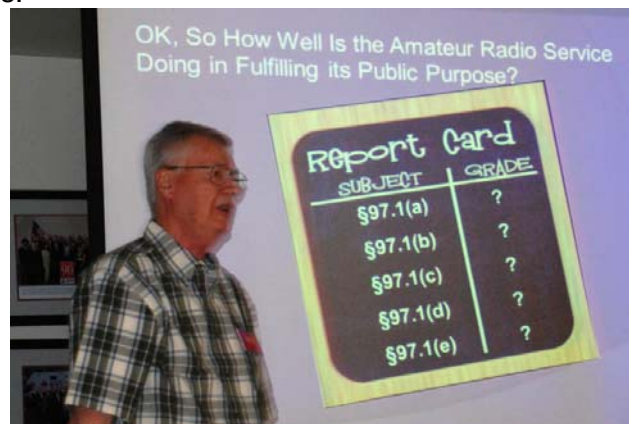
**“Amateur Radio in the 21st Century.  
Mainstream or Backwater?”**



Art's primary question to us was "Is Amateur Radio accountable to anyone?" Art thinks so and his answer is that it is accountable to the American people because we are granted "valuable spectrum" by the US Government. Art pointed out that there are many new technologies which can utilize the same radio spectrum currently made available to Amateurs. While the FCC may not take that spectrum away from ham's outright, sharing spectrum with other users is a real possibility.

Art's proposed solution is that the Amateur world, through leadership by ARRL, needs to find ways to measure and report all the positive benefits that are being provided to the American people. If we can do

that, then that will counter arguments that show all the money that can be derived by selling spectrum to other uses.



**Art W6XD discussed how to measure  
how well Hams fulfill a Public Purpose**

Art had several examples from other groups, such as the Red Cross and the Civil Air Patrol, and even a study that San Diego based ham groups did to show their local government the value they provided to the government and the San Diego communities.

### BUSINESS

After a short break the meeting was reconvened. We discussed possible plans for the 2014 Christmas Dinner. Members are asked to submit ideas for a location and cost to hold the event so that the membership can arrive at a consensus of our best option. When inquiring at a venue, please find out the cost. Ask if they have "a charge for use of a room" and if they require a "minimum number of committed guests". A poll was taken of the meeting attendees and it was found that 18 people would be willing to spend \$30 per person, but if the cost rose to \$40 then only 10 people at the meeting would be willing to attend.

A motion was made, seconded and approved that the club should send an official letter to ARRL Board and Management regarding the possibility of ARRL preparing an assessment of the value added by the US Amateur Community. This would be along the lines of similar documentation prepared by the Red Cross, Civil Air Patrol, and the San Diego Amateur Radio Community.

### ANNOUNCEMENTS

- The Baker to Vegas Race is on March 22nd -23rd. City of Orange RACES group needs a few more hams.
- 2014 ARRL Southwestern Division Convention is Sept 12-14 in San Diego (ed: see ad on Page 3).
- Club member Arnie Shatz – N6HC is part of the group on the FT5ZM DXpedition to Amsterdam Island (Ile Amsterdam) in the Indian Ocean.

Respectfully submitted by: Tim Millard, KJ6NGF, Secretary

**OCARC****BOARD MEETING MINUTES****2014-02-08**

The OCARC Board meeting was held at the World Famous JägerHaus Restaurant, in Anaheim, and called to order by President Nicholas AF6CF on Saturday, February 8, 2014 at 8:15 am. All directors except Doug – W6FKX, Bob – AF6C, Greg – W6ATB and Kris – KC6TOD were present. Club members Vern – KG6OXD, Jim – W6DF, and Dan – N6PEQ were also in attendance.

**DIRECTOR REPORTS**

**Treas** –Ken - W6HHC reported club has more money coming then going out.

**Secr** – Tim - KJ6NGF presented a renewal payment, one application and HRO invoice to our Treasurer.

**Publicity** – Robbie – KB6CJZ confirmed that the club flyer on our website is up to date and correct. He will be using it to make new copies for HRO.

**OLD BUSINESS**

- **Newsletter Editors:**

Feb-W6HHC; Mar-KJ6NGF; Apr-AF6C; May-W6GMU; Jun- W6ATB.

- General Meeting Programs: Feb – Bill Prats – K6ACJ on [PICAXE / Arduino for hams](#), Mar - Wayne Overbeck – N6NB on [Tower Trailers](#), Apr – Dennis Kidder – W6DQ on [History of Receivers](#).

- **Field Day**

- FD Co-chairs – Tim – N6GP co-chair for 2014 with Nicholas – AF6CF.
- 15M Beam Repairs - work party installed new beam reflector element parts, still need balun repaired.

- **OCARC Coffee Mug** – Paul – W6GMU will keep final orders open till next General Meeting on Feb. 21st. Any remaining orders will need to pay Ken by that evening.

- **2014 Christmas Banquet** – reservation has been made for Dec 12, 2014 at Marie Calendar's in Anaheim (91 Fwy).

- **OCARC at the Scout O Rama** – Tim – N6GP has discovered that there is a \$250 fee to have

a demonstration booth at the annual Scout O Rama on May 10th. This one-day trade show for Scouts often sees attendance of up to 10,000. Member Dan – N6PEQ offered to donate half that fee and wrote a check to the club on the spot. Nicholas – AF6CF stated he would put up the other half of the money. So plans are progressing towards this event.

**NEW BUSINESS**

- **Property Donation to OCARC** – Nicholas – AF6CF and Jim Day – W6DF discussed the Lee Shakelee Radio Ranch property near Anza California. When Lee Shakelee W6BH passed away, he had intended that his radio ranch property would become a club operating location with an annuity to fund ongoing operations. He had even considered our club would become trustee. However, that is not the current legal situation. If our club were to become trustee of the site we would need to find a means of generating revenue and/or donations to cover expenses and maintain the site. Basic cost would run somewhere between \$300 and \$400 a month just for insurance, taxes and electricity. That would not cover any up-keep or longer term cost. Location is 100 acres on a mountain top with 22 acres fenced off. Website shows many of the details at [w6bh.com/index.html](http://w6bh.com/index.html)

- **Letter to ARRL** – at January General meeting a motion was passed to contact ARRL headquarters regarding ARRL pursuing an analysis cost/benefit analysis that can be used for Congressional lobbying and publicity showing the many financial benefits that the US receives from its granting of frequency privileges to Amateurs. Since that time ARRL has passed their own motion regarding the whole matter so there is no reason for our club to write a letter as voted on in our meeting, however, the board did decide to send a letter to ARRL headquarters congratulating them on their action. Tim – N6GP will draft a letter as discussed.

- **Board Member Resignation** – Kris – KC6TOD indicated in an email dated January 23rd that because of other amateur radio commitments she is stepping down from her board position. Board agreed to accept here resignation and Nicholas has appointed Director at Large – Doug – W6FKX to take on the duties of Membership Chair.

**GOOD OF CLUB**

Nicholas – AF6CF attended Quartzfest 2014 in Arizona. However, after a day there, he decided it wasn't to his liking and moved on to the Salton Sea area for the remainder of his trip and operated QRP.

Respectfully submitted: Tim Millard, KJ6NGF, Secretary

## OCARC BOARD MEETING MINUTES

**2014-01-11**

The OCARC Board meeting was held at the JägerHaus Restaurant, 2525 East Ball Road, Anaheim, and called to order by President Nicholas Haban AF6CF on Saturday, January 11, 2014 at 8:10 am and all directors except Doug – W6FKX were present. Club member George – N6VNI was also in attendance.

### DIRECTOR REPORTS

**Treas** – Ken - W6HHC reported that club currently has about a \$5,000 account balance to start out the year.

**Secr** – Tim - KJ6NGF presented four membership dues payments to our Treasurer and an HRO invoice.

**Publicity** – Robbie – KB6CJZ was informed that club brochures are well stocked at Ham Radio Outlet.

### NEW BUSINESS

- **Newsletter Editors:** Jan AF6CF; Feb W6HHC; Mar KJ6NGF; Apr AF6C; May W6GMU; June W6ATB.
- **General Meeting Programs** – January – Art Goddard W6XD, Feb – Bill Prats – K6ACJ, Mar Wayne Overbeck – N6NB.
- **Field Day 2014** – start putting this into planning mode – no change to report at this time.
- **Field Day Repairs** - 15M Beam - Bob AF6C reported that the balun has been removed from the antenna for possible repair. There is a work party planned for Jan 18th to repair the 15M beam element.
- **2013 Financial Audit Committee** – audit has been approved by the committee and the final report is published in the January 2014 RF. Treasurer Ken W6HHC reported the club “returned about \$1000 back to the membership through activities” as directed by the Prez.
- **OCARC Coffee Mug** – final order will be placed next week for all paid Mug requests.

- **2013 and 2014 Christmas Banquet** – the 2013 banquet went well but we also want to consider other options for the future. The Board is investigating possible new locations for the 2014 banquet.
- **OCARC at the Scout O Rama** – plans are being made to offer a demonstration booth at the annual Scout O Rama on May 10th. This one-day trade show for Scouts often sees attendance of up to 10,000.
- **ARRL Special Services Club Status** – received notice that Special Services Club status has expired. Status can be easily reactivated by submitting request – Ken W6HHC and Bob AF6C will determine details so that the Secretary can submit the request.
- **Pay Pal Account** – Still plan takeover to full ownership of OCARC, Board wants to find out some more information from Jim Shryne – N6DHz regarding his experience setting up PayPal usage for the district convention web pages. Currently PayPal provides one “free” button available for a single item at a single price...a “shopping cart” arrangement appears to cost money. Our current membership billing allows various combinations of payment amounts so we need to determine if there is a way within PayPal to have multiple amounts without paying \$25-\$30 a month to support a behind-the-scenes bill management system.

Respectfully submitted: Tim Millard, KJ6NGF, Secr







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AMATEUR RADIO VE TESTING SESSIONS

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

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

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

Sponsoring Club: N6ME Western Amateur Radio Association, "WARA"

Test site location:

La Habra Community Center.

101 W. La Habra Blvd.

La Habra, Ca. 90631

Pre-Registration is requested and preferred. Walk-ins are welcome.

2014 TESTING SESSIONS

Thursday, Feb 20<sup>th</sup> 2014 6p.m.

Thursday, Jul 17<sup>th</sup> 2014 6p.m.

Thursday, Mar 20<sup>th</sup> 2014 6p.m.

Thursday, Aug 21<sup>st</sup> 2014 6p.m.

Thursday, Apr 17<sup>th</sup> 2014 6p.m.

Thursday, Sep 18<sup>th</sup> 2014 6p.m.

Thursday, May 15<sup>th</sup> 2014 6p.m.

Thursday, Oct 16<sup>th</sup> 2014 6p.m.

Thursday, Jun 19<sup>th</sup> 2014 6p.m.

Thursday, Nov 20<sup>th</sup> 2014 6p.m.

**On VE Exam Day Bring the Following Items**

1. A legal photo ID (driver's license, passport) or two other 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.
2. Your Social Security Number (SSN) or FCC-issued Federal Registration Number (FRN).
3. 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.)
4. Two number two pencils with erasers, and a pen.
5. A calculator with memory erased and formulas cleared (no iPhones, iPads, etc.).
6. Test Fee: \$15.00 (cash or check).

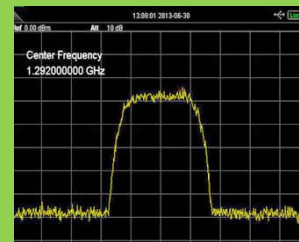
If you fail an element and wish to retake it, we are required to charge an additional test fee. If you pass an element, we typically offer and encourage you to take the next element. We do not charge an additional test fee for this and it gives you the opportunity to see what the next exam element is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



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