



# RF



**ORANGE COUNTY AMATEUR RADIO CLUB, INC.**

**VOL. LXV NO. 7**

**PO Box 3454, Tustin, CA 92781**

**July 2024**

## The Prez Sez...

By Nicholas AF6CF



Again, this year's ARRL Field Day was outstanding, with lots of fun, contacts and food. Thanks to all our participants we had another successful Field Day. It was safe, with tons of fun and a PR success. Once more the capricious Gods of Propagation helped, with sporadic openings in a couple of bands. We even made a satellite contact thanks to the efforts of Tony N2VAJ. We had lots and lots of participants and visitors, even one from the East Coast that operated one of the voice stations. Many were impressed with the field setup and operations,

we have attained our operational objectives and Public Relations goals. Thanks to Professor Doug for manning the GOTA (Get On The Air) station which was very active with many "first timers" and young kids testing the waters before (hopefully) they get their radio licenses. Even a few licensed HAMS that were not operating on HF for some reason (HOA, etc) took advantage of the GOTA station. I would also like to extend a Special Thank You to the School District for allowing us to use their school grounds, all the Band Captains and logistics persons. Ron W6WG did a great job as organizer and Jim AF6N too as the Public Relations person. Thanks to Dino for being a Darling and lending us his portable tower. It helped a lot with the antennas for the CW tent. The scores, the results, QSO's, Bonus Points, etc are being tallied so we will have them ready for a next edition, but I can tell you that this year's effort was on par with our finest, given the conditions and personal circumstances of several of our members.

Continued page 15

## NEXT GENERAL MEETING

**Kevin Karamanos  
and Kevin Zanjani  
present**

**"12 Volt Power"**

**July 19<sup>th</sup>, 2024, at 7pm**

**at the**

**American Red  
Cross**

**Orange County Chapter  
Santa Ana, Room 208**

## NEXT BOARD MEETING

**Saturday, August 3<sup>rd</sup>, 2024**

See [www.w6ze.org](http://www.w6ze.org) for more info

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### Monthly Events

#### Membership Meetings\*

Time: 7:00 PM  
When: 3<sup>rd</sup> Friday of each Month  
Red Cross Orange County, Room 208  
600 N Parkcenter Dr, Santa Ana  
(Replaced by the Christmas Party  
in December.)

#### Board Meetings

First Saturday of each Month  
*Board will handle Club business now  
IN-PERSON.*

#### Club Nets (Listen for W6ZE)

##### **10M ~ 28.375 MHz SSB**

Wed- 7:30 PM - 8:30 PM  
Net Control: Corey, KE6YHX  
Alternate Net Control: AJ, KN6WNO

##### **2M ~ 146.55 MHz Simplex FM**

Wed- 8:30 PM - 9:00 PM  
Net Control: Corey, KE6YHX  
Alternate Net Control: AJ, KN6WNO  
Echolink Node: KK6TRC-L

##### **75M ~ 3.883 MHz LSB**

Tue @ 8:00 PM  
Net Control: Corey, KE6YHX

#### Other Nets

**Catalina Amateur  
Repeater Association (CARA)**  
**147.090 MHz (+0.600 MHz) No PL**  
Monday - Friday  
9:00AM & 9:00PM  
Prg. Director. Tom W6ETC  
COME JOIN US

### **OCARC 2024 DUES:**

*Membership period is:  
1 January to 31 December*

Individual New or Renewal: \$30  
Family New or Renewal: \$45  
Teen New or Renewal: \$15

*New Member Dues are prorated  
quarterly and includes a badge:*  
Additional Badges<sup>1</sup> \$3

Use one of our interactive online forms  
to calculate current prices, join, renew, or  
order badges:

<https://www.w6ze.org/FormsShortcut.html>

<sup>1</sup> \$3 or less + mailing. See form.

## July Speaker Intros

W6ZE is getting a double dose of good stuff at the July 19 meeting! We will be welcoming two guest speakers with analogous subject matters, and you will definitely come away with more knowledge about batteries, solar power, cabling, and DC power solutions than you can imagine.



From Bioenno Power comes Kevin Zanjani, KI6DHQ, National Sales Mgr. The company offers lithium iron phosphate batteries for ham radio applications and also solar panels and accessory products for running equipment. In this exciting presentation, he will be providing an overview of the technology and answering some frequently asked questions. Kevin began his career in Detroit working on RFID applications in the automotive industry and later came to Southern California where he worked on software in Santa Barbara. He then joined Bioenno Power in 2010. Kevin holds Bachelor and Master's degrees in electrical and computer engineering, from the Univ. of Michigan-Ann Arbor, and U.C. Irvine and also an MBA from the Univ. of Southern California.



From 12-Volt Power comes Kevin Karamanos, WD6DIH. An Advanced Class Amateur radio licensed for over 40 years, Kevin was Director of Sales at Yaesu USA for 12 years. The last 20

years he has worked in the Emergency & Specialty Vehicle Electronics field, specializing in DC Power and Communications. Recently Kevin started a company called "12 Volt Power" which supplies a complete line of DC power products to most amateur radio dealers and vehicle upfitters in the U.S. Featured products include: Radio DC power cables, power supplies, Anderson Powerpole connectors and assemblies, portable power meters and more! Many compatible products to be found between Bioenno and 12-Volt Power, so bring your questions to the meeting!

Don't forget as well, we now offer license exam testing sessions (new licensees and upgrades) at 5:30PM before our regularly scheduled meeting at 7PM. Requests for a seat should be sent to Ken Simpson, [w6kos@w6ze.org](mailto:w6kos@w6ze.org), or by calling 714-651-6535. The cost is \$15.

Join us Friday, July 19, 7PM, 600 Parkcenter Dr, Room 208, Santa Ana and be prepared to learn everything you ever wanted to know about DC powering your ham radio!

In this month's Member Q&A" feature we meet Fred, W0PE. As you will read, Fred is a seasoned and very knowledgeable amateur radio operator. He recently joined OCARC, and we are looking forward to getting to know him and having him share his great experience with the club.

Can you tell us something about yourself?

My journey started in about 1962 at Anaheim High School. I took three years of electronics there and then two years at Fullerton Jr College for an AA degree in Electronics. I am by trade a sound mechanic for the last 55 plus years. I started at Disneyland in the sound department (aka the "Sound Shop") in May of 1967. I thank my high school teacher, Riley Gaynor, originally WB6QVY, then W6HMB/SK, who kept me out of trouble for over 60 years. After 23 years at Disneyland, I moved across the street to the Anaheim Convention Center (maybe 2000 foot away!) and was there 21 years there as a Facility Event Electrician." I "retired" in October 2011 and immediately went back to work at HRO in Anaheim 2011 – 2019.

When did you first become interested in amateur radio?

I became interested in Amateur radio in about 1970 but it took me another 4 years to take the test for the Technician license in the summer of 1974. My call sign back then was WA6GSC (Girl Scout Cookies) inspired by Norm K6GSC/SK and shared by me thanks to Leroy Sparks W6SYC/SK). My main interest then was VHF and UHF.

What has been your amateur radio involvement so far?

One of my first projects was building a remote base system on Santiago Peak for the WA6OWW system. Back then everything was wire wrapped circuit boards and it took four of us over a year to build it. The control system worked really well; we used logic chips...we had no microcomputers back then. We designed and

built many things that controllers today don't even have, and we had some very talented engineers from Hughes Aircraft in Fullerton helping us.

Describe your current and future interests in amateur radio.

One of the recent things I've been working on the last 7 years is running remote radios. I have two remote VHF/UHF radios; one is at Running Springs and a remote HF station there. My cabin I am the fourth ham to own the property since 1957. I did not know until a few years ago Wayne Overbeck N6NB took care of the tower and antennas back 50 plus years ago for the first owner of the property.

On what equipment and antennas are you presently operating?

At home I use a Kenwood TS-480 HX for digital and a Yaesu FT-DX10 for CW and phone. My antenna is 43 ft vertical.

In Running Springs, my VHF/UHF remote radios are a Kenwood V71 and a Yaesu FT-8900. I built the V71 first and a friend in North Carolina asked if he could use it. Little did I know he would be on it 24/7 365 days a year so I built up an FT8900 that I can use. We also have one of the K6PIN repeaters there. My HF radio is a Yaesu FT-2000 with a dipole antenna and 5 to 100 watts.

On Sierra Peak, equipment is installed to operate the W0PE/R UHF (449.440) repeater.

What have you learned and what do you hope to learn from your membership in the Orange County Amateur Radio Club?

I have known about the Orange County Amateur Radio Club for years, but just never got around to joining. I am a VE and with the loss of the West Coast Amateur Radio Club, where I was previously a VE, I joined Ken W6KOS, a long-time OCARC member, to do license testing. I really enjoy doing the testing and hope we can get a lot of new members in the club.

**Heathkit of the Month #124:**  
by Bob Eckweiler, AF6C



**HEATH EDUCATIONAL PRODUCTS  
(MALMSTADT-ENKE INSTRUMENTATION LAB)  
(BERKELEY PHYSICS LAB)**

**Heathkit EUW-18  
Lab Meter - With Shunts**

**Introduction:**

In the early '60s Heathkit began designing and selling educational kits. Products like the Basic Electricity Course (EK-1), the two-part Basic Radio Course (EK-2A and EK-2B), the Basic Transistor Course (EK-3); the "How to Understand and Use..." educational products, such as "How to Understand and Use Your VTVM" (EF-1), "...Your Oscilloscope" (EF-2), "...Your Signal Generator (EF-3); and the "Electronic Workshop" kits: "6" (SK-30), "11" (SK-40) and "19" (SK-50) - the number refers to how many Heath designed experiments you can perform with each kit. While the SK-30 and SK-40 were dropped quickly, the SK-50 remained; evidently buyers opted for the more expanded kit.

Heathkit also expanded their educational products to support high schools and universities with the **Heath Berkeley Physics Laboratory (Figure 2)** and the **Malmstadt-Enke Instrumentation Lab (Figure 3)**. These were

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

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

1. Notes begin on page 10

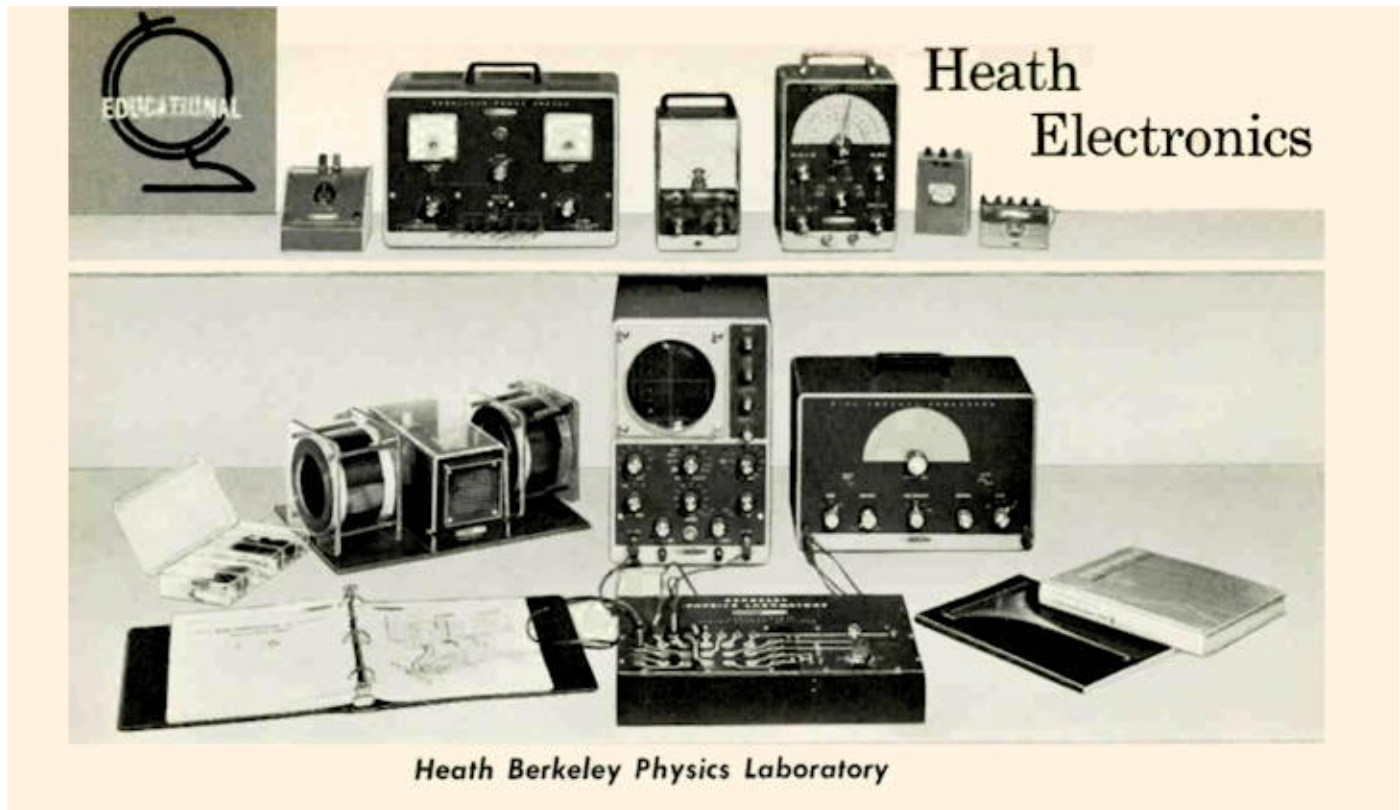


**Figure 1:** Heath EUW-18 Lab Meter, 0–1 mA, 50Ω meter movement (shown less shunts).

used throughout the U.S. in higher education institutions and research labs.

**The Heath Berkeley Physics Lab:**

The Heath Berkeley Lab consisted of three standard Heathkits, each available as a kit or factory wired: (the IP/[IPW]-32 Regulated HV Power Supply, the IM/[IMW]-11 VTVM and the IG-82<sup>1</sup> Sine - Square Wave Generator); two slightly modified Heathkits, the IO/[IOW]-12S<sup>2</sup> 5" Oscilloscope and the IG/[IGW]-102S<sup>3</sup> RF Signal Generator; an EUW-17<sup>4</sup> factory wired 0–35 VDC Transistorized Power Supply; and three items specifically for conducting experiments; the assembled EPW-14 Test Chassis and Small Parts for Group 'A' experiments<sup>5</sup>, with binder and Lab Manual, EPA-10-1 Battery Set<sup>6</sup>, and the assembled EPW-24 Cathode-Ray Tube & Deflection Coil Set with lab manual. In 1966 the Berkeley Physics Complete 2-student Lab sold for \$336.72 in kit form (EP-100A) or \$545.26 factory assembled (EPW-100A). Both are 110 lbs. shipping. Additional instruments and experiments were added in the months and years that followed.



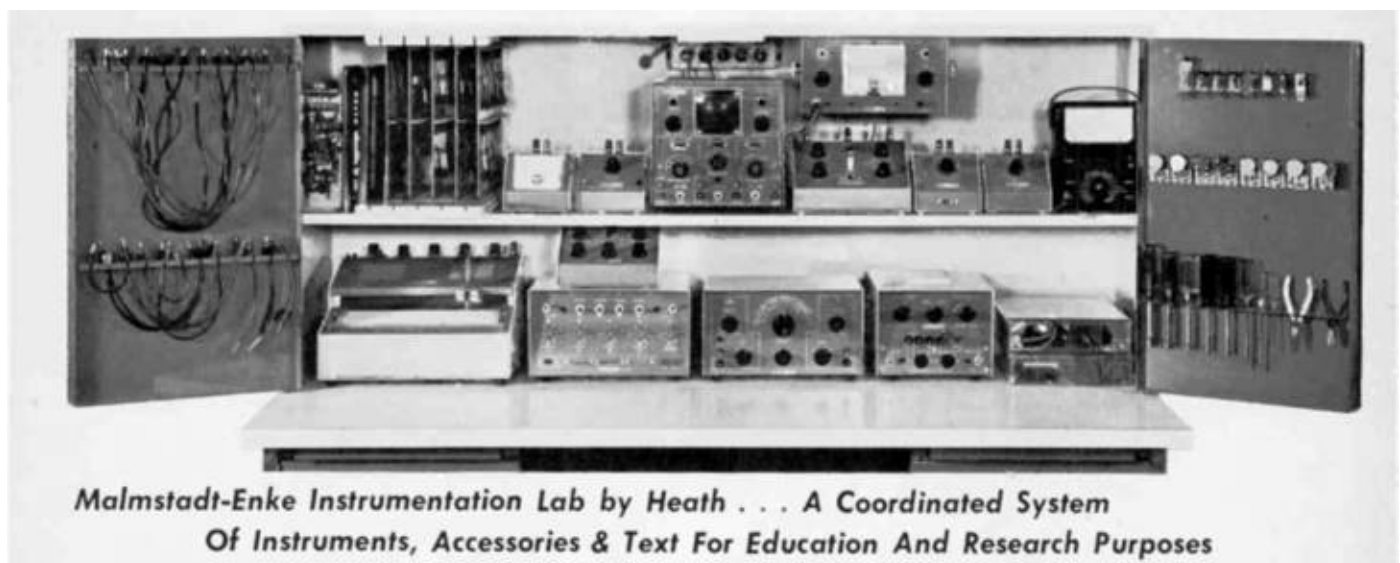
**Figure 2:** The Heath Berkeley Physics Lab (From Catalog 810/60A - 1966).

(Left to Right) Top Row: EUW-17 Transistorized Power Supply; IP-32 HV Power Supply; IM-11 VTVM; IG-102S RF Signal Generator; EP-10-1 Battery Set (2 pcs.). Row 2: Parts Package 'A'; EPW-24 Cathode-Ray Tube & Deflection Coil Set; IO-12S Laboratory 5" Oscilloscope; IG-82 Sine-Square Wave Generator; Row 3: Binder with Lab Manual; EPW-14 Test Chassis; Textbook and Workbook.

### The Malmstadt-Enke Instrumentation Lab:

As of the 1966 catalog [810/60A] the M – E Lab consisted of thirteen fully assembled in-

struments, two experimental chassis with parts (A group), manual, textbook and deluxe tool kit. The items could be purchased sepa-



**Figure 3:** Malmstadt - Enke Instrumentation Laboratory, See Table I for contents.

Malkstadt-Enke Instrumentation Lab		
Part #	Description	Price
EUA-11	Manual .....	\$ 2.50
EUP-11	Textbook, <i>Electronics For Scientists</i> ..	\$ 11.50
EU-13A	Universal Experimental Chassis & Parts .....	\$ 177.00
EU-14A	Special Experimental Chassis & Parts.....	\$ 64.00
EUW-15	Universal Power Supply <sup>a</sup> .....	\$ 75.00
EUW-16	Voltage Reference Source <sup>a</sup> .....	\$ 65.00
EUW-17	Transistorized Power Supply <sup>a</sup> .....	\$ 20.00
EUW-18	Lab Meter With Shunts <sup>a</sup> .....	\$ 22.00
EUW-19A	Operational Amplifier System <sup>a</sup> .....	\$ 135.00
EUW-20A	Servo Chart Recorder <sup>a</sup> .....	\$ 199.00
EUW-24	Vacuum Tube Voltmeter <sup>a</sup> .....	\$ 62.00
EUW-25	DC Oscilloscope <sup>a</sup> .....	\$ 163.00
EUP-26	Weston 980 Volt-Ohmmeter <sup>a</sup> .....	\$ 55.00
EUW-27	Sine & Square wave Generator <sup>a</sup> .....	\$ 94.00
EUW-28	Resistance Substitution Box <sup>a</sup> .....	\$ 16.00
EUW-29	Capacitance Substitution Box <sup>a</sup> .....	\$ 14.00
EUW-30	Decade Resistance Box <sup>a</sup> .....	\$ 34.00
GH-25	Deluxe Tool Set <sup>7</sup> .....	\$ 16.95
Total:	.....	\$ 1225.95
EU-100A	Special Group Price (All above) .....	\$ 1100.00
EUP-22A	All Steel Desk top Cabinet .....	\$ 130.00

a) factory Assembled Item.

**TABLE I**

rately or as a set of eighteen items at about an 11½% discount (**TABLE I**). Some instruments were updated, added and replaced during the Lab’s lifetime extending to 1974.

All the Heath factory built instruments in the M – E Lab originally came in a special style: a green front panel with white lettering and a cream colored cabinet. In later years there were some styling changes.

That is an overview of the early Heathkit movement into serious educational instrumentation for higher education institutions and research labs.

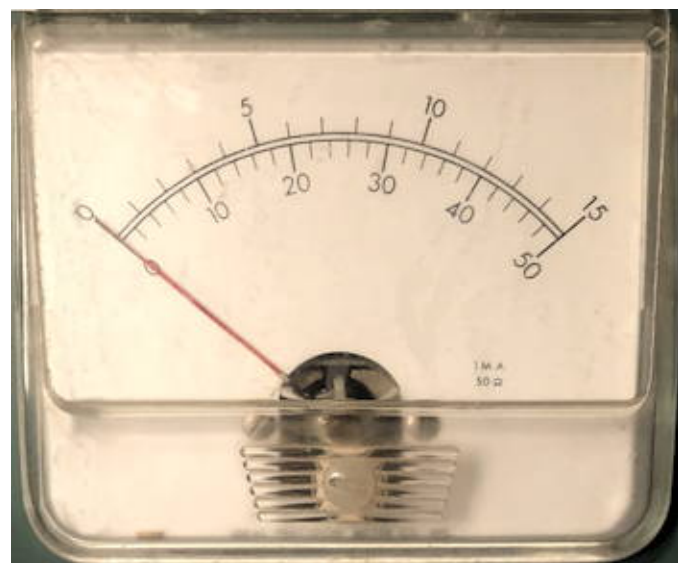
After that long introduction, let’s look at one of the simpler M – E instruments; the EUW-18 Laboratory Meter with shunts. **Figure 1.**

**The Heath EUW-18 Laboratory Meter:**

Most volt-ohmmeters (VOMs) also measure current, but sometimes it is valuable to have a dedicated meter that can be left in the circuit while your VOM is being used for other measurements. The EUW-18 is just that. It is a simple analog milliammeter mounted in a small sloping housing. The meter is precision with a range of 0–1 mA and an accurate internal meter resistance of 50 Ω. The meter leads are terminated at two 5-way binding posts on the top of the housing; one binding post is red (positive) and the other is black (negative). The two binding posts are 0.75 inches apart on centers, an industry standard. The meter has two linear scales 0 – 15 in increments of one, and 0 – 50 in increments of two. (**Figure 4**).

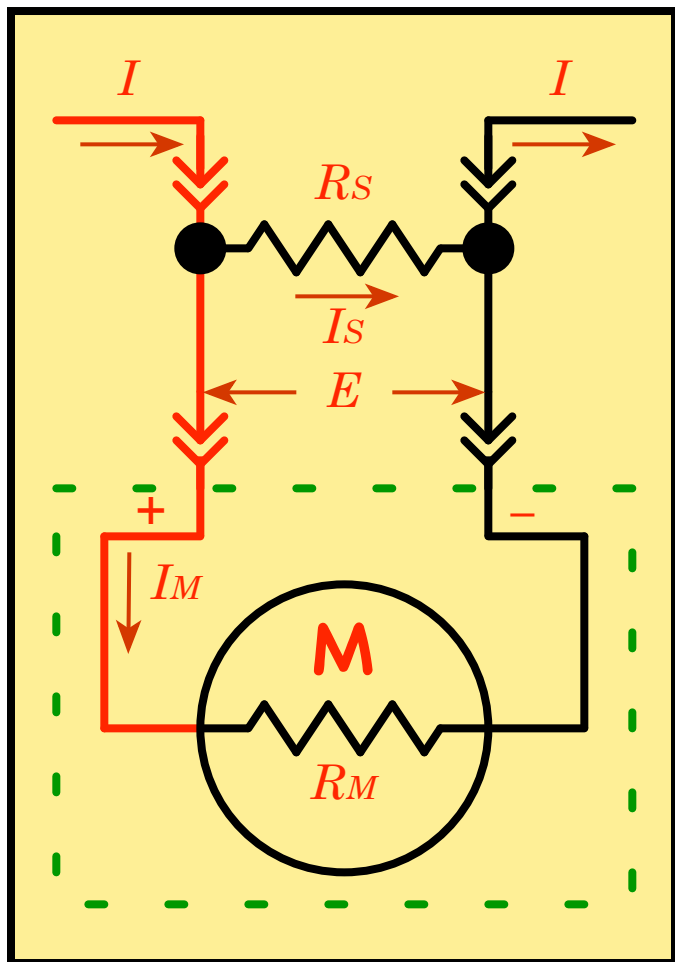
**The Heath EUW-18 Accessory Shunts:**

The meter came with four shunts that plugged into the two banana posts on the top



**Figure 4:** EUW-18 Laboratory Meter showing the two linear meter scales. Note: in small print are the meter specs: 1 mA [full scale] and 50 Ω [coil resistance]. The meter accuracy spec is 2% of FS.

of the meter cabinet. Though the meter came factory wired (just two wires and four solder joints!), the shunts came as set of parts. The four shunts have full-scale ranges of 1.5 mA, 5 mA, 15 mA and 50 mA.



**Figure 5:** Schematic of the EUW-18 Lab Meter showing shunt resistor and current flow.

$$R_M = 50 \Omega, \quad I_M = 1 \text{ mA}$$

The shunt parts were four dual-banana-plugs, two precision resistors (100  $\Omega$  1% and 1.02  $\Omega$  1%), two-feet of resistance wire at 9.99  $\Omega$ /ft and a length of insulated sleeving. These were used to construct the four shunts.

#### Calculating the shunt resistor values:

**Figure 5** is a schematic of the Lab Meter with a shunt plugged in. The meter will read full scale when a current of  $I_M$  is flowing through

the resistance  $R_M$  of the meter coil. This results in a voltage  $E$  appearing across the meter terminals.

$$E = I_M R_M \quad (\text{Eq. 1})$$

$$E = 1_{\text{mA}} * 50_{\Omega} = 50_{\text{mV}}$$

$I_S$ , the current through the shunt when the meter is reading full scales has to be:

$$I_S = I - I_M \quad (\text{Eq. 2})$$

where  $I$  is the desired full-scale current with the shunt resistor  $R_S$  across the meter terminals.

The voltage  $E$  across the shunt resistor is:

$$E = I_S R_S = (I - I_M) R_S \quad (\text{Eq. 3})$$

Since the meter and shunt are in parallel the voltage  $E$  across each are the same. Combining equations (Eq. 1) and (Eq. 3):

$$I_M R_M = (I - I_M) R_S$$

Simplifying, and solving for  $R_S$ :

$$R_S = \frac{I_M R_M}{(I - I_M)} \quad (\text{Eq. 4})$$

**Table II** shows the calculated shunt resistances for the four current shunts. Heath supplied 1% resistors for the 1.5 mA and 50 mA shunts. The other two shunts are made from the supplied two-foot length of resistance wire. The proper wire length is calcu-

Full Scale Current (mA)	Shunt Resistance (ohms)
1.5 mA	100.00 ohms
5.0 mA	12.50 ohms
15.0 mA	3.57 ohms
50.0 mA	1.02 ohms

**Table II**





Figure 6: Black Dual Banana Plug

lated, and a length about 1½” longer is cut off. The wire is then attached to one terminal of the dual banana plug, sleeved, wrapped around the dual banana plug and connected to the other banana plug terminal. **Figure 6** shows a typical dual banana plug. The wire is then shortened until the desired resistance is obtained. Calculated lengths for the two resistance wires are 15.02” for 12.5Ω and 4.29” for 3.57Ω. Since 3.57 is a standard 1% resistor value, one has to wonder why a resistor wasn’t also used? Also, 12.4Ω is a standard value and will only give an error of about 0.6%, smaller than the resistor and meter tolerances. **Figure 7** shows the banana plug with shunt resistor plugged into the EUW-18.

Equation Eq. 4 (on page 8) can be solved for  $I$  to calculate the full-scale current value for a given shunt resistance  $R_S$ :

$$I = \frac{I_M(R_M + R_S)}{R_S} \quad (\text{Eq. 5})$$

One needs to be concerned about power dissipation in shunt resistors as the current increases (the power increases as the square of the current), so it is wise to check wattage. In this case it is trivial, with the 1.5 mA, 5

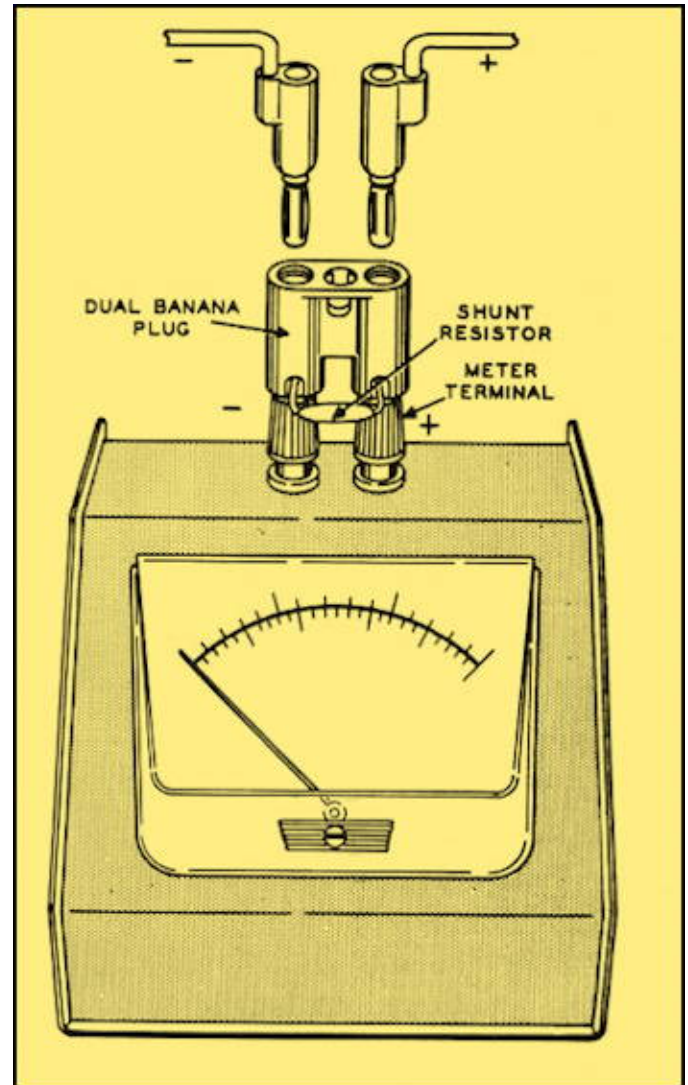


Figure 7: Meter with shunt attached.

mA and 15 mA shunts dissipating less than a milliwatt each., and the 50 mA shunt dissipating just over 2.5 mW.

#### Author Comments:

I remember being assigned the building of a Heathkit IP-32 in school as part of my physics class homework. By that time I’d had a lot of kit building experience and it was a very pleasant assignment, though it had to be done in the lab, on my own time.

The Heath EUW-18 Laboratory Meter was the first M – E Heath item added to my collection. It came without the four shunts and

was, for years, just a 1 mA meter in a box. I did put together a 150 mA shunt. The 150 mA shunt consisted of three precision  $1\Omega$  resistors in parallel giving  $0.3333\Omega$  instead of the calculated  $0.3356\Omega$ . The result is actually a 151 mA shunt, which is well inside the tolerance band.

Recently, Chuck Penson – WA7ZZE sent me a copy of *Electronics For Scientists* by Howard V. Malmstadt<sup>8</sup> and Christie G. Enke<sup>9</sup>. This textbook came as part of the M – E Lab. In the book was a discussion of the Ayrton shunt, which I had used occasionally, but never knew its name. The Ayrton shunt turned out to be ideal for the EUW-18. See the *Bob's Tech Talk* article (page 11) in this issue of RF.

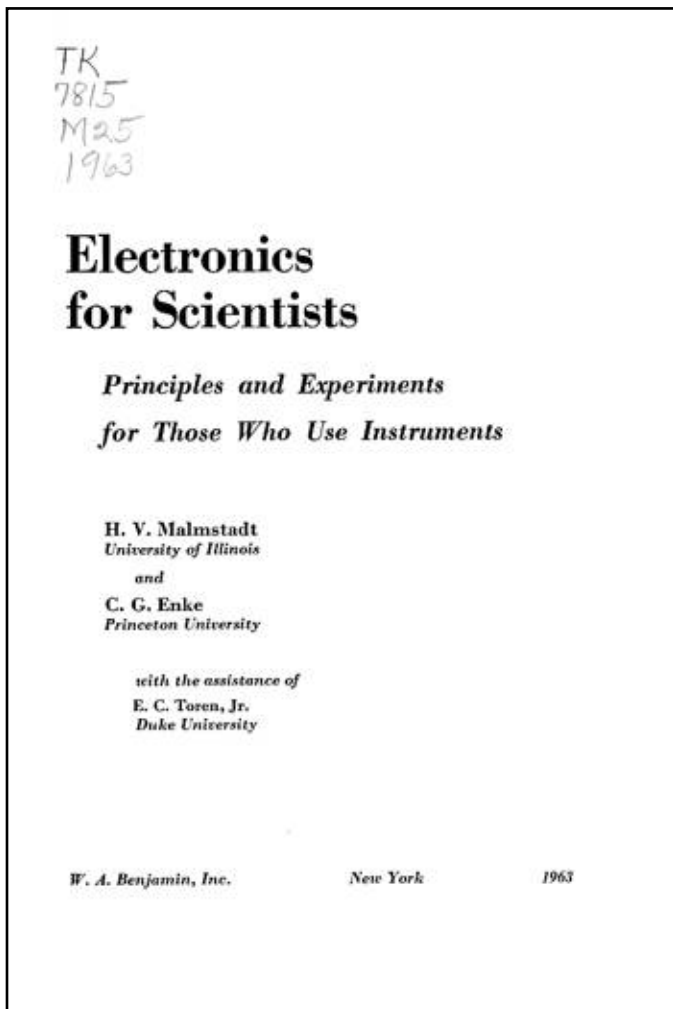


Figure 8: Title page of H. Malmstadt & C. Enke textbook.

I currently have one other M – E instrument in my collection, the EUW-27 Sine-Square Wave Generator. It is working and I recently succeeded in repairing and freeing up the vernier tuning control. The previous owner appears to have broken it while trying to unfreeze it, and ended up epoxying the concentric shafts together.

73, from AF6C



### Notes:

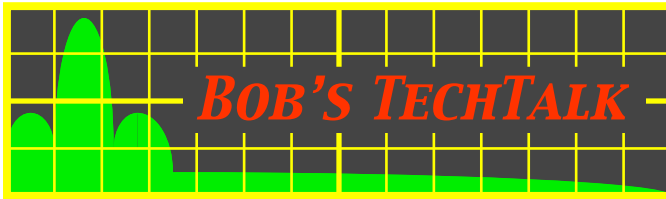
1. The Heathkit IG-82 was not available factory wired. Instead, you were sent the EUW-27 Sine - Square Wave Generator, which is similar to the IG-82 electronically but packaged differently. It is actually part of the Malmstadt - Enke Lab Instruments.
2. The IO-12S is the same as the IO-12 scope but includes "special jacks that permit connection to the HV and sweep circuits of the scope".
3. The IG102S is the same as the IO-102 "except that accuracy is 3% and includes RF jacks". In Canada it was sold as the IGW-19.
4. The EUW-17 was also part of the Malmstadt / Enke Lab.
5. The Berkeley Lab had parts groups A, B, C, and D. At the time of the catalog only the A parts group was available.
6. The Battery Set consists of a 0-22½-45 V. battery and a 0-1½-3-4½-6-7½ V battery.
7. GH-25 Tool Kit contents: Soldering iron, solder, solder aid, solder joint brush, needle-nose pliers, wire cutter - stripper, three-screwdriver set, a five-nut driver set and a Heath nut starter tool.
8. Howard Vincent Malmstadt Ph.D. Chemist (b. 1922, d. 2003). Widely considered the father of modern electronic and computerized instrumentation for chemistry.
9. Christie G. Enke Ph.D. Chemistry (b. 1933). Known for development of advanced mass spectrometry and chemical instrumentation.

Notes for HotM #124 (EUW-18) 6/2024

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

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*Thanks - AF6C*



**Number 55: Ayrton Current Shunt Circuit:**

(TechTalk #130)

by: Bob Eckweiler - AF6C

**INTRODUCTION:**

Heathkit of the Month # 124 (on page 5 of this issue) discusses the EUW-18 Laboratory Meter. This meter is a standard 1 mA milliammeter with an internal meter resistance of  $50\Omega$  and with two scales 0 –5 and 0–15. Originally it came with four shunts to allow the meter to measure 1.5 mA, 5.0 mA, 15 mA and 50 mA full-scale. Unfortunately the

shunts were missing when the meter was acquired, but a 150 mA shunt was made using three paralleled  $1.0\ \Omega$  1% resistors.

Recently, I was sent a textbook from Chuck Penson WA7ZZE: *Electronics for Scientists*, by H. V. Malmstadt and C. G. Enke; these are the engineers who inspired the **Malmstadt–Enke Instrumentation Lab** by Heath. In it I found a discussion of the Ayrton shunt circuit. It was a circuit I was familiar with, having worked in aerospace instrumentation for nigh-on 35 years, but never had heard it called by that name.

Reading the discussion, I thought it might be a practical solution to replace the missing shunts for the EUW-18 lab meter. If I was

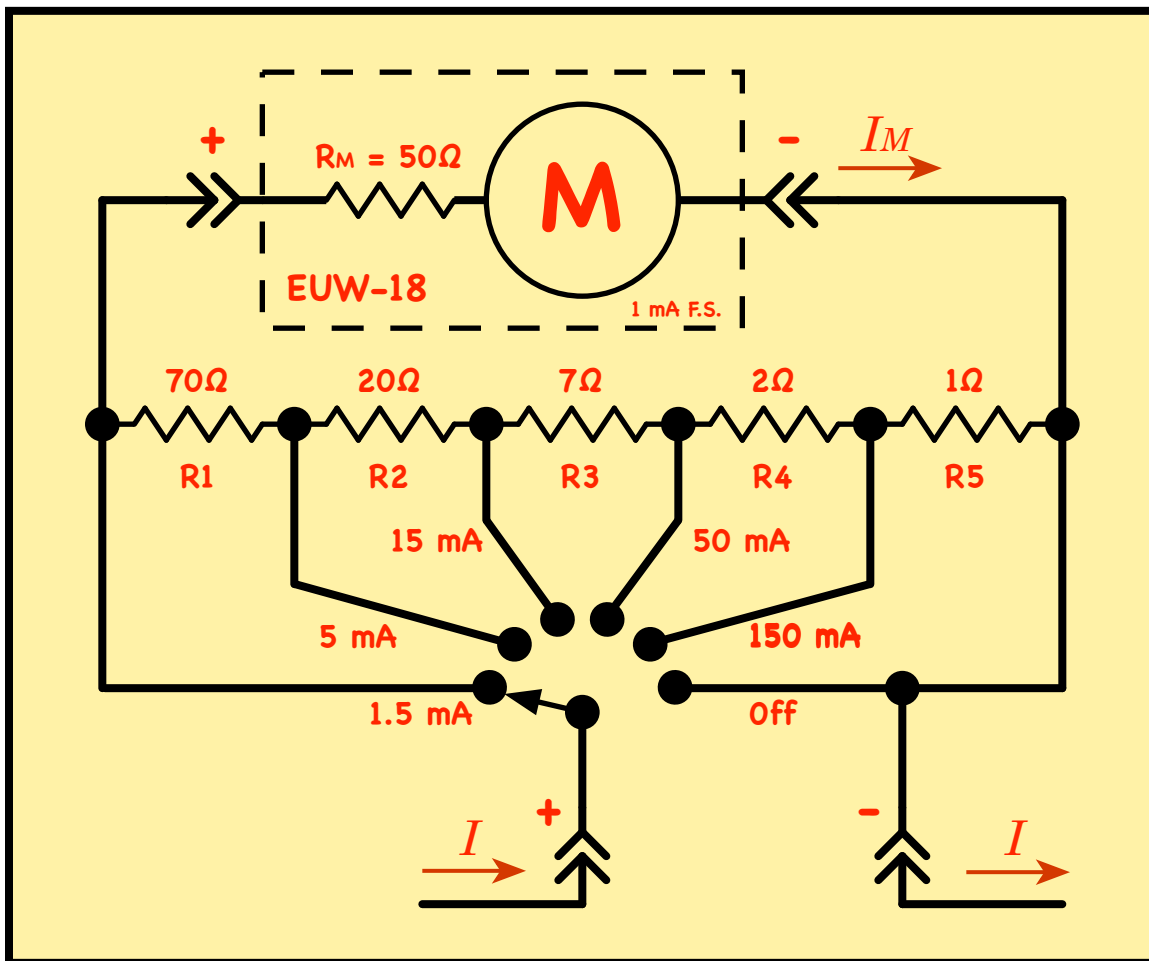


Figure 1: Ayrton Shunt Circuit for the Heath EUW-18 Lab Meter.

lucky, the resistor values needed would be close to standard values available at electronic parts dealers.

**The Ayrton Shunt:**

**Figure 1** is my schematic of an Ayrton shunt designed for the EUW-18 Laboratory Meter. The shunt allows switch selection of one of five ranges between 1.5 mA and 150 mA in 15, 50 steps to match the meter scales. It also has an OFF position which effectively disconnects the meter.

**Figure 2** is a simplified schematic showing the basic circuit. The current to be measured,  $I$ , is split into two resistive paths, one is the resistance  $r$ . the other is the resistance composed of  $R - r + R_m$ . Note that  $r$  is different for each switch position, as shown in Figure 1. The two resistance paths are in parallel, so they both have the same full-scale voltage across them. For the left branch:

$$E = I_m(R_m + R - r) \tag{Eq. 1}$$

and, for the right branch:

$$E = (I - I_m)r \tag{Eq. 2}$$

Setting Eq. 1 equal to Eq. 2 yields:

$$(I - I_m)r = I_m(R_m + R - r) \tag{Eq. 3}$$

Expanding, then simplifying:

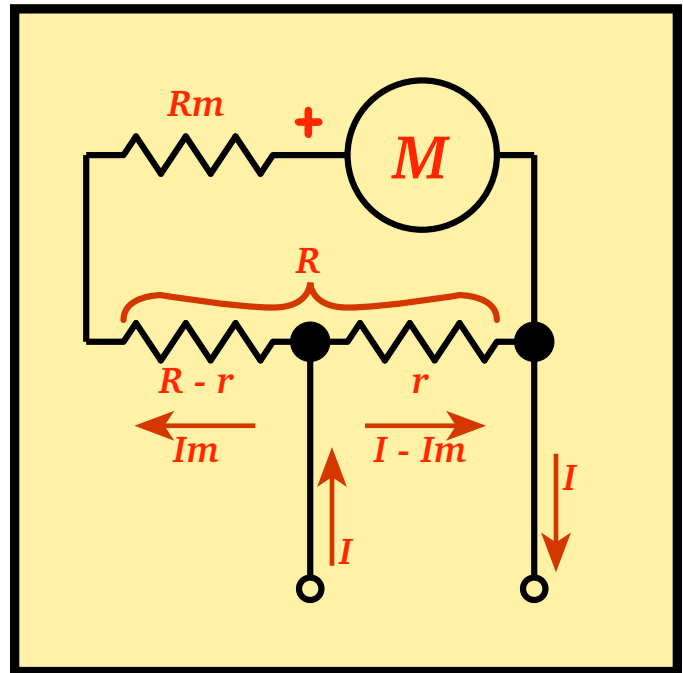
$$Ir - I_m r = I_m R_m + I_m R - I_m r$$

The two  $(-I_m r)$  terms cancel, and:

$$\frac{I}{I_m} = \frac{R_m + R}{r} \tag{Eq. 4}$$

The values chosen for the meter in this discussion come from the specification of the meter used in the EUW-18 Lab meter:

$$I_m = 1 \text{ mA}, \quad R_m = 50\Omega$$



**Figure 2:** Basic Ayrton Shunt Circuit

Other meters may have different values.

$I/I_m$  is the ratio of the total current to the meter current. For the EUW-18 these ratios are 1.5, 5, 15, 50 and 150 for the five currents - 1.5 mA thru 150 mA.

To determine the actual resistances  $r_1$  through  $r_5$ , start with the lowest current range (1.5 mA) where:

$$R = r = r_1 + r_2 + r_3 + r_4 + r_5 = r_{(1-5)}$$

Thus, from Eq. 4:

$$\frac{I}{I_m} = 1.5 = \frac{R_m}{r_{(1-5)}} + \frac{R}{r_{(1-5)}} = \frac{50}{r_{(1-5)}} + 1$$

$$r_{(1-5)} = \frac{50}{0.5} = 100\Omega \tag{Eq. 5}$$

And  $R$ , the sum of  $r_1 \dots r_5$ , is **100 ohms**.

Now we look at the switch in the next lowest current position, 5 mA. Now the ratio between  $I/I_m$  is 5, and now:

$$r = r_2 + r_3 + r_4 + r_5 = r_{(2-5)}$$

Again, using Eq. 4:

$$\frac{I}{I_m} = 5 = \frac{R_m + R}{r_{(2-5)}} = \frac{50 + 100}{r_{(2-5)}}$$

$$r_{(2-5)} = \frac{150}{5} = 30\Omega \quad (\text{Eq. 6})$$

repeating for the next three positions of the switch results in:

$$r_{(3-5)} = 10\Omega \quad (\text{Eq. 7})$$

$$r_{(4-5)} = 3\Omega \quad (\text{Eq. 8})$$

and  $r_5 = 1\Omega \quad (\text{Eq. 9})$

Now it is simple to find the actual resistor values  $R_1$  through  $R_5$  by using the results of Eq. 5 through Eq. 9:

$$R_1 = r_{(1-5)} - r_{(2-5)} = 100 - 30 = 70\Omega$$

$$R_2 = r_{(2-5)} - r_{(3-5)} = 30 - 10 = 20\Omega$$

$$R_3 = r_{(1-3)} - r_{(1-2)} = 10 - 3 = 7\Omega$$

$$R_4 = r_{(4-5)} - r_5 = 3 - 1 = 2\Omega$$

$$R_5 = 1\Omega$$

20 $\Omega$ , 2 $\Omega$  and 1 $\Omega$  are standard 1% values. 70 $\Omega$  and 7 $\Omega$  are not. However, the closest 1% values are 69.8 $\Omega$  and 6.98 $\Omega$  respectively, which is within 0.2%, and well within the 1% tolerance of the 1% resistors.

### Resistor Wattage:

When working with shunts it is always wise to make sure the resistors can carry the current. Remember, the wattage through a resistor increases as the square of the current, so it can increase quickly with increasing current. In the case of the circuit of **Figure 1**,

the currents are all quite small. Still it is worth checking:

The maximum current each resistor will see when the meter is reading full-scale is:

$$W_R = I^2 R$$

**Table I** shows the maximum power in milliwatts that each resistor will dissipate. 250 mW (¼-watt) resistors, in the worse case will give more than a 10 fold safety margin.

RESISTOR DISSIPATION CHECK				
#	I mA	I <sup>2</sup> mA <sup>2</sup>	R $\Omega$	W mW
R1	0.5	0.25	70	0.02
R2	4.0	16.0	20	0.32
R3	14.0	196.0	7	1.37
R4	49.0	2401.0	2	4.80
R5	149.0	22201.0	1	22.20

**TABLE I: RESISTOR MAX POWER DISSIPATION**

### Ayrton Advantages and Disadvantages:

The Ayrton current shunt has advantages of a simple design, superior meter protection, often uses more common resistor values, and allows shunts to be hot switched.

However, it has one significant drawback; it tends to introduce a higher voltage drop than the standard shunt. For the EUW-18, the standard shunts cause a full-scale voltage drop of 50 mV independent of the shunt current. The Ayrton shunt designed in this article has different voltage drops for each shunt, ranging from 50 mV on the 1.5 mA position to 149 mV on the 150 mA position. This may or may not be a problem and needs to be considered when making measurements.

73, from AF6C



# ? PUZZLER ?

No answer has been given yet to May's PUZZLER suggested by Fried - WA6WZO. As stated last month, a clue will be given each month until someone provides the correct answer. Previous clues are in **Blue**. The current clues are in **Red**.

### Here's the May Puzzler:

Find two three-digit numbers that, when multiplied together, have three three-digit partial products and a five-digit product. And the twenty (20) resulting digits consist of two each of the digits 0 to 9.

For this month's clue, two additional numbers (4 total) have been revealed in their correct positions. If the puzzler hasn't been solved by next month, two more will be revealed.

X7X Multiplicand

XXX Multiplier

X1X Partial product 1

XXX Partial product 2

XXX Partial product 3

=====  
X00XX Product

Send answer to [puzzler@w6ze.org](mailto:puzzler@w6ze.org).

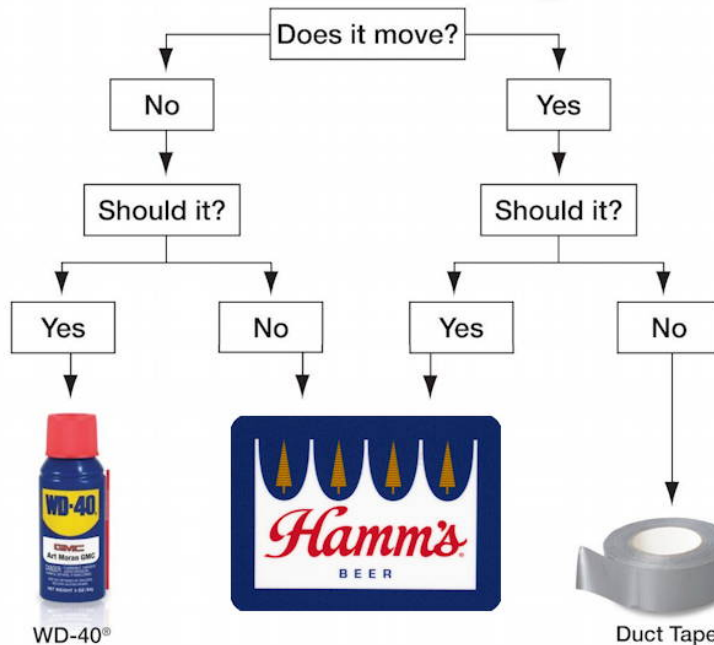
73, from WA6WZO & AF6C



# ? PUZZLER ?

## How to Fix Anything

W  
6  
Z  
E



W  
6  
N  
G  
O

Prez Sez continues from page 1

This month speakers will talk about the ubiquitous 12V power and how to store and distribute it. Do not miss this presentation. The VP is also working on some new and exciting activities with great speakers. I look forward to an eyeball contact with you all at the next General Meeting.

Again, thanks to all.

73 DE AF6CF

## RadioActivity July 2024

73 DE AF6CF

### July

- [IARU HF World Championships](#): 1200 UTC Saturday July 13 through 1200 UTC Sunday July 14.
- [\\*CQ WW VHF](#): 1800 UTC Saturday July 15 through 2100 UTC Sunday July 16.
- [\\*\\*North American QSO Party / RTTY](#): 1800 UTC Saturday July 20 through 2100 UTC Sunday July 21.
- [RSGB IOTA Contest](#): 1200 UTC Saturday July 27 through 1200 UTC Sunday July 28.
- [ARS Flight of the Bumblebees](#): 1700 UTC through 2100 UTC Sunday July 28.

### August

- [10-10 International Summer Contest, SSB](#): 0001 UTC Saturday August 3 through 2359 UTC Sunday August 4.
- [\\*\\*North American QSO Party / CW](#): 1800 UTC Saturday August 3 through 0559 UTC Sunday August 4.
- [WAE DX Contest, CW](#): 0000 UTC Saturday August 10 through 2359 UTC Sunday August 11.
- [\\*\\*North American QSO Party / SSB](#): 1800 UTC Saturday August 17 through 0559 UTC Sunday August 18.

- **US Islands QSO Party**: 1200 UTC Saturday August 24 through 0300 UTC Sunday August 25.
- **World Wide Digi DX Contest**: 1200 UTC Saturday August 24 through 1200 UTC Sunday August 25.

\* Indicates club entries are accepted

\*\* Indicates team entries are accepted

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

### State QSO Parties:

- [Maryland-DC QSO Party](#): 1400 UTC Saturday August 10 through 0400 UTC Sunday August 11.
- [Hawaii QSO Party](#): 0400 UTC Saturday August 24 through 0400 UTC Sunday August 26.
- [Ohio QSO Party](#): 1600 UTC Saturday August 24 through 0400 UTC Sunday August 26.
- [Kansas QSO Party](#): 1400 UTC Saturday August 24 through 2000 UTC Sunday August 25 and 1400 UTC through 2000 UTC August 25.

### Repeating Activities:

- **Phone Fray** Every Tuesday night at 0230Z to 0300Z
- **SKCC** Weekend Sprintathon (Straight Key CW) on the first weekend of the month after the 6<sup>TH</sup> of the month. 1200 Sat. to 2359Z Sunday.
- **SKCC** Sprint (Straight Key CW) 0000Z to 0200Z on the 4<sup>th</sup> Tuesday night (USA) of the month.
- **CWops** Every Wednesday 1300 UTC to 1400 UTC 1900 UTC to 2000 UTC and Thursday 0300 UTC to 0400 UTC
- **K1USN Slow Speed Test**: (CW, 20WPM Max.) Every Friday 2000 UTC to 2100 UTC Every Sunday night at 0000 UTC to 0100 UTC Monday
- **ICWC Medium Speed Test**: (CW, 25WPM Max.) Every Monday 1300 UTC to 1400 UTC 1900 UTC to 2000 UTC and Tuesday 0300 UTC to 0400 UTC

**OCARC Club Nets:**

- **75 Meter Net:** Every Tuesday night at 8:00 pm to 8:30 pm Local Time. SSB 3.883 MHz
- **10 Meter Net:** Every Wednesday night at 7:30 pm to 8:30 pm Local Time. SSB 28.375 MHz
- **2 Meter Net:** Every Wednesday night at 8:30 pm to 9:30 pm Local Time. FM Simplex 146.55 MHz

**Other Nets:**

- **Net-AT-9:** Wellness & Support  
Monday thru Friday 9:00 am and 9:00 pm Local Time 147.090 MHz (+600 MHz) No PL

**Other Links:**

[ARRL Contest Calendar](#)  
[VOACAP Online for Ham Radio](#)

Send an email to Ron W6WG, [w6wg@w6ze.org](mailto:w6wg@w6ze.org) to have your favorite activity or your recent RadioActivity listed in next month's column



August 7, 2024



## General Meeting June 14<sup>th</sup>, 2024

Vice President Janet Margelli KL7MF started the meeting promptly and proceeded with the Pledge of Allegiance followed by guest and visitor introductions.

Janet KL7MF introduced this evening's presentation preparer, Sean Kutzko, KX9X.

Sean's presentation was "Field Day 2024 at W6ZE"

## Planning

- Proper planning prevents problems
- Assemble your FD gear NOW. Confirm all cables, rigs, PCs, antennas are in good condition.
- Give the generator proper maintenance and confirm it starts reliably
- Define roles among the team. Who is FD coordinator? Safety Officer? PR representative?
- Do you have an operator schedule?
- Who is making coffee and ordering/cooking food?
- **READ THE RULES. [Arri.org/FieldDay](http://Arri.org/FieldDay)**



**KX9X Approved!**

**Field Day discussion** – Ron Mudry W6WG, 2024 Field Day chair.

Ron took time to answer questions and remind people what and where we will be operating at for Field Day.

After a short break the meeting continued with club business.

## Board Meeting

A quorum of board members was in attendance.

A donation can was circulated around the meeting to help defray some of the cost of putting on Field Day.

There will be a VE License Testing Exams offered at 5:30 before our next General Meeting on Jul 19<sup>th</sup>, walk in allowed but give a shout out if you know you will be there and want to test.

**VP Report** – next month's speakers are Kevin Karamanos – WD6DIH – 12 Volt Power and Comet Antennas and Kevin Zanjani – KI6DHQ from Bioenno Power.

**Membership Report** – Looking for newsletter editors for August and September.

**Motion to Adjourn** – made, seconded, and passed.

|

### July Board Meeting

OCARC Board Meeting Minutes for: July 6, 2024, The OCARC Board meeting was held at The Streamliner Lounge, 186 N. Atchison St., Orange, and called to order to order by President Nicholas Haban AF6CF at 8:15 am. A quorum of Board Members was in attendance.

**VP:** Has speakers arranged through September.

**Treasurer report** –Cash Flow has improved with the end of the 1<sup>st</sup> Quarter Membership renewals. Awaiting final receipts so that Field Day cost can be expensed.

**Membership report** – the club has 88 members however word was received that Jerry Rudmann KN6UKJ is SK.

**Secretary** – time to think about upcoming Auction and Flyer, also start the search for 2025 Board Members.

**Publicity** – Making plans to give a ham radio presentation at the Orange Senior Center. Also, setting up a VHF/UHF radio station at Orange Senior Center.

**Newsletter-** Jul Tim N6TMT, Aug AJ KN6WNO, Sep - open, Oct – Corey KE6YHX

**Speakers** –

Jul - Kevin Karamanos – WD6DIH – 12 Volt Power and Kevin Zanjani – KI6DHQ from Bioenno Power.

Aug – Bob Brehm, AK6R Palomar Engineers.

Sep – MFJ presentation but may change.

Oct - Auction

**VE Sessions** – Ken Simpson will be at Red Cross to offer license testing at our July meeting.

**Yorba Linda SK estate plan** – items retrieved and in temporary storage for club Auction. Requesting Tom W6ETC to prepare an updated flyer Tom has been contacted.

#### New business

**Winter Field Day** – report from Winter Field Day officials that they will be coming out with a more balanced scoring system as compared to what they first released. Discussion continued till new results are released.

**Activities** – AJ suggested having a potluck dinner in October at his QTH.

**Next year's Board** – looking for those interested in serving on the BOD for 2025.

**Tower 2 base repair** – Ron W6WG outlined repairs that should be made to Tower 2 base prior to our next use.

**Discussion on renewal of PO Box** -With Postal Service continuing to raise rates on their services it was discussed if it might make sense to get rid of the PO Box. Many varying opinions and therefore no resolution made to change.

#### Good of the Club

Adjournment occurred around 10:15 am.

FIELD DAY SUMMARY - with COVID-19 OCARC Aggregated score listed

FOR

THE ORANGE COUNTY AMATEUR RADIO CLUB - W6ZE

by: Ken / W6HHC & Bob / AF6C & Tim / N6GP

NOTE: Adjustments have not been made for duplicate contacts, and bonus points. Final scores appear in QST.

YEAR	160M SSB	80M CW	75M SSB	40M CW	40M SSB	20M CW	20M SSB	15M CW	15M SSB	10M CW	10M SSB	6M CW	6M PHN	2M CW	2M PHN	220 PHN	440 PHN	UHF CW	UHF PHN	ATV	RTTY/ Dig	SAT- ELLITE	GOTA	---- TOTAL ---- QSO's / (POINTS)
2024	0	72	0	604	178	1036	1267	854	1045	148	187	0	6	0	43	0	15	0	0	0	156	1	105	5,717 / 17,489
2023	0	104	35	625	590	1096	1145	414	283	3	1	0	4	0	94	0	22	0	0	0	254	1	85	4,756 / 14,504
2022	0	251	186	504	643	758	1354	90	107	1	30	0	10	0	63	0	14	0	3	0	264	1	67	4,346 / 12,428
2021 - W6ZE	0	104	0	462	913	274	1525	152	10	6	30	0	5	0	18	4	11	0	0	0	111	8	73	3,706 / 9,630
2021 OCARC Aggregate	0	4	1	105	163	220	207	24	2	0	0	0	0	0	26	0	3	0	0	0	265	0	0	1,020 / 3,276
2020 OCARC aggregate	0	80	7	433	682	528	291	26	0	1	1	3	21		339	14	113				1021	6	0	3,648 / 10,055
2019	0	43	34	392	566	536	322	29	0	0	7	0	10	0	18	3	8	0	0	0	271	6	0	2,239 / 7,032
2018	0	97	182	476	923	592	848	138	211	38	60	0	67	1	52	0	13	0	0	0	137	4	45	3,884 / 10,726
2017	0	0	12	449	852	262	787	0	0	0	0	0	25	0	51	0	0	0	0	0	91	4	50	2,583 / 6,770
2016	0	29	18	163	342	206	760	15	18	0	0	1	36	0	44	0	1	0	0	0	188	1	52	1,874 / 4,952
2015	0	53	121	115	507	661	1161	190	324	1	71	3	60	0	45	0	6	0	0	0	77	0	1	3,396 / 8,992
2014	0	111	122	756	723	1059	1113	559	382	57	134	25	133	0	43	0	11	0	0	0	121	23	47	5,419 / 16,214
2013	0	269	339	655	1052	895	1960	484	614	38	67	6	60	0	60	15	11	0	0	0	144	4	186	6,859 / 18,700
2012	0	14	51	125	78	215	735	185	330	0	12	1	50	0	37	5	5	0	0	0	13	0	408	2,264 / 5,634
2011	0	58	176	168	217	253	703	32	198	16	40	0	57	0	37	0	16	0	0	0	0	0	139	2,110 / 5,278
2010	0	0	0	240	342	223	727	49	0	0	0	1	96	0	32	1	7	0	0	0	0	0	160	1,878 / 4,786
2009	0	277	126	838	807	974	970	495	368	5	450	11	375	0	125	18	20	1	0	0	0	2	130	5,992 / 17,446
2008	0	179	204	690	405	411	878	141	43	22	68	15	135	0	34	2	14	0	3	0	0	5	16	3,265 / 9,468
2007	1	356	310	910	830	988	1285	381	320	18	150	9	145	2	175	40	70	2	9	0	2	11	142	6,156 / 17,648
2006	0	28	20	89	512	156	664	16	10	0	0	0	38	1	85	0	7	0	0	0	114	0	113	1,853 / 4,514
2005	0	113	6	158	481	337	534	122	17	0	0	0	74	0	36	16	20	0	0	0	0	0	31	1,945 / 5,350
2004	0	166	239	37	412	131	477	31	105	1	114	0	0	0	46	12	20			0	0	1	0	1,792 / 4,316
3003	0	0	85	52	127	27	295	0	191	0	41	0	52	0	64	1	13			0	0	0	0	948 / 2,054
2002	0	26	69	192	279	76	229	0	485	0	18	0	62	0	68	6	10			3	2	0	3	1,528 / 3,648
2001	0	0	25	101	251	0	432	0	675	0	109	0	48	0	28	1	0			0	0	3	-	1,673 / 3,548
2000	0	19	20	88	91	0	625	0	794	0	121	0	36	0	72	7	15			0	0	1	-	1,889 / 3,992
1999	0	13	20	15	237	0	996	0	724	0	22		5	0	2	0	0			0	0	0	-	2,034 / 4,124
1998	0	24	75	65	136	100	250	0	624	0	82		0	0	46	17	12			0	7	1	-	1,439 / 3,270
1997	5	81	131	83	306	150	853	14	275	0	106		32	0	79	4	0			0	32	1	-	2,152 / 5,024
1996	-	146	228	104	125	283	673	40	605	0	217		121	0	32	0	40			0	13	1	-	2,628 / 6,428
1995	-	145	272	203	94	443	572	51	451	0	131		66	0	93	29	8			0	33	6	-	2,597 / 6,944
1994	-	114	114	208	45	486	748	85	761	13	312		58	0	94	33	0			0	31	0	-	3,102 / 8,078
1993	-	150	100	159	81	530	700	131	812	0	179		40	0	86	12	16			0	35	0	-	3,061 / 8,132
1992	-	0	294	200	110	541	555	0	840	0	232		13	0	74	0	1			2	41	80	-	2,983 / 7,530
1991	-	105	308	182	182	400	623	9	463	0	104		4	0	141	23	11			0	48	0	-	2,626 / 6,740
1990	-	0	0	70	144	0	370	0	747	0	131		39	0	114	14	26			0	2	-	-	1,657 / 3,454
1989	-	30	0	98	5	0	906	21	172	0	238		3	0	121	24	9			1	18	-	-	1,646 / 3,590
1988	-	127	0	93	75	2	359	0	570	144	81		0	0	32	0	-			-	14	-	-	1,497 / 3,726
1987	-	22	0	0	39	0	708	0	18	117	0		1	0	51	0	-			-	5	-	-	962 / 2,202
1986	-	0	46	219	78	0	488	0	45	0	0		0	0	82	0	-			-	0	-	-	968 / 2,374
1985	-	85	0	315	91	35	662	78	0	0	0		0	0	22	0	-			-	-	-	-	1,288 / 3,602

7/5/2024

Cash Flow  
1/1/2024 through 7/1/2024

Page 1

Category	1/1/2024- 7/1/2024
<b>INFLOWS</b>	
Badge Income	6.00
Donations - Field Day	223.00
Dues, Membership	30.00
Dues, Membership (Paypal) 2024	1,363.46
Dues, Membership 2024	455.01
Field Day Food Income	210.00
Opportunity Drawing -Monthly	226.00
Sale Of Equipment	40.00
<b>TOTAL INFLOWS</b>	<b>2,553.47</b>
<b>OUTFLOWS</b>	
Bank Checks (Refill)	23.20
CA Statement Of Info filing	20.00
Field Day Rental - Tent	310.00
Flowers Expense	50.00
Guest Speaker Meal - Exp	137.00
Historian Expenses	91.90
PayPal Fee	70.86
Refreshments Expense	39.52
Software License	24.00
Storage of Equipment - Ann Millard	325.00
Web Site Hosting	150.00
WFD - Food	62.91
WFD - Propane	40.85
WFD Flowers	34.00
WFD Rental - Tent	170.00
<b>TOTAL OUTFLOWS</b>	<b>1,549.24</b>
<b>OVERALL TOTAL</b>	<b>1,004.23</b>

The **ORANGE COUNTY AMATEUR RADIO CLUB, INC.**

RF - VOLUME 65 ISSUE 7 - July 2024

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