W6OTX W6ARA PAARA NEWSLETTER K6OTA K6YQT
VOLUME 60, NUMBER 6, June 2010

PAARAgraphs

The Official Newsletter of the
Palo Alto Amateur Radio Association, Inc.
Celebrating 73 years as an *active* amateur radio club—*Since 1937*

CALENDAR

June 4, **PAARA Meeting**, 7:00 p.m.
Menlo Park Rec Ctr
700 Alma Street, Menlo Park

June 16, **Board Meeting,** 7:00 p.m.
Palo Alto Red Cross
400 Mitchell Lane

June 16, **DEADLINE** for July PAARAgraphs submissions
Send items for publication to Robin Yee, KI6YTA, at **KI6YTA@ARRL.net**, or Paul Petach, KI6QXV, at **paaraeditor@gmail.com**

You won't want to miss our next meeting!

JUNE 4, 2010

Our speaker will be…

...Dean Straw ~ N6BV

How to Be a Good Operator on Field Day

Dean has been a licensed ham for 50 years and has held 6 calls, starting with WH6DKD. He trained as an electronics engineer at Yale University, and his first job out of college was at National Radio Company, where he designed SSB and VHF radios. He worked in marine electronics industry for 25 years, eventually ending up in technical marketing.

Dean also worked for ARRL HQ for 15 years, specializing in antennas, transmission lines, and propagation. He was the editor of *The ARRL Antenna Book* and other books dealing with antennas. Dean retired from the ARRL in 2008. Few folks are so blessed by the Good Lord to have combined their work and hobby together!

President's Corner

Unbelievably it is nearly June already as I write this for the next issue of PAARAgraphs! I can't believe how quickly the year has almost reached its midpoint. Of course, if June is straight ahead, that can only mean one thing for hams: ARRL Field Day. It promises to be a great one this year.

Our May PAARA general meeting featured a chat with Bill Dale, N2RHV, the ARRL Section Manager for the Santa Clara Valley section. Bill filled us in on the happenings in the section and the ARRL in general. I also had a few moments to show some short video clips that were collected from the Solar Dynamics Observatory website. Those clips showed some of the high resolution imagery that can now be captured by the SDO, including some time-lapse movies of large solar prominences. The images are truly impressive.

Speaking of the sun, propagation has been back to the levels we were seeing during the minimum. There has been another long string of days with zero sunspots and the so-

(Continued on page 63)Pres Corner

Welcome New PAARA Members!

Sreendish Chinmayanilyam
KG6GBE
Redwood City

Joanna Dilley
KI6YRU
Redwood City

VE Exams, 3rd Saturday each month, 10:30AM, 145.23− PL=100Hz
Redwood City Main Library, Community Conference Room
1044 Middlefield Road, Redwood City, CA
contact: *http://amateur-radio.org/* or Al, WB6IMX@att.net

ELECTRONICS FLEA MARKET
Sponsorship by **A.S.V.A.R.O.**
(Association of **S**ilicon **V**alley **A**mateur **R**adio **O**rganizations)
Second Saturday of month, March-October, 6am–2pm
Howard M. Krawetz, N6HM 650-856-9761
Contact: *http://www.electronicsfleamarket.com/*

LIVERMORE SWAP MEET. Now in Robertson Park, Livermore, every first Sunday of the month. 7 am to 11:30 am. Free admission for buyers. For further info, see: *www.larkswap.com* or contact Ian Parker, W6TCP at *swapmeet@livermoreark.org*

PAARA Palo Alto Amateur Radio Association
Meets 1st Friday 7:00pm each month at Menlo Park Rec. Center; Net 145.230 - PL 100Hz Mondays at 8:30. See our website at http://www.paara.org/ for more information.
Or contact: Joel Wilhite KD6W, KD6W@ARRL.NET, 650-325-8239

FARS Foothills Amateur Radio Society
Meets 4th Friday each month at 7:30pm
contact: *http://www.fars.k6ya.org/*

NCDXC Northern California DX Club
meets 2nd Friday 7:30pm each month,
repeater for member info 147.360, Thursday 8:00PM
contact: http://ncdxc.org/ or Mike Gavin W6WZ, (650) 851 8699

QCWA Chapter 11
Northern California Quarter Century Wireless Association
Meets third Wednesday monthly at Harry's Hofbrau in Redwood City @ 11:30 AM.
Guests are welcome. Saturday morning net on 146.850 MHz, PL 114.8

NorCalQRP Northern California QRP Club
meets 1st Sunday each month
contact: http://www.norcalqrp.org/

SPECS Southern Peninsula Emergency Communication System
meets each Monday 8:00pm on Net 145.27, 440.80 MHz
contact: http://specsnet.org/ or Tom Cascone, KF6LWZ, 650-688-0441

SCARES South County Amateur Radio Emergency Service
meets 3rd Thursday 7:30pm each month, San Carlos City Hall.
Net is on 146.445 [PL 114.8] & 444.50 (PL-100) 7:30 Monday evenings.
contact: President Gary D. Aden, K6GDA 650-743-1265(D),650- 595-5590 (N)
Web: http://k6mpn.org **E-mail**: pres@k6mpn.org

SCCARA Santa Clara County Amateur Radio Association
Operates W6UU & W6UU/R, repeater 146.985-pl
Nets: 2m, 7:30pm Mon; 70cm, 442.425+ (pl 107.2) Thur.
meets 2nd Mon each month @ 7:30 PM.
contact: http://www.qsl.net/sccara/ or Clark Murphy KE6KXO 408-262-9334
ARRL/VEC license testing contact 408-507-4698

SVECS Silicon Valley Emergency Communications
Operates AA6BT repeater (146.115 MHz+)
contact: http://www.svecs.net/ or Lou Stierer WA6QYS 408 241 7999

TEARS The Elmer Amateur Radio Society
Dedicated to operational training, knowledge building &
FCC exam testing. KV6R repeater under construction.
Contact **AA6T@ARRL.NET** . Most members are Extra
class or VE's. See QRZ dot com/kv6r for class info

WVARA West Valley Amateur Radio Association
W6PIY six-meter repeater on 52.58mHz. Normally, six-meters is linked with 147 and 223, while 441 and 1286 repeaters are linked.
VHF: 52.58 (-500) 151.4 ctcss UHF:
147.39 (+600) 151.4 ctcss 441.35 (+5.0 88.5) ctcss
223.96 (+1.6) 156.7 ctcss 1286.20 (-12m) 100.0 ctcss
Meetings are 3rd Wednesday of every month.
contact: http://wvara.org/ , Bill Ashby N6FFC, 408-267-3118, N6FFC@Juno.com, or N6FFC@ARRL.NET

American Red Cross, **SANTA CLARA VALLEY CHAPTER**
contact: *http://santaclaravalley.redcross.org/* or Scott Hensley KB6UOO, (408) 967 7924
fshensley@Novell.com

***(please** send changes to PAARAgraphs editor: KI6YTA@arrl.net)*

Please contact Rick Melrose to settle your 2010 membership dues so you can keep receiving your PAARAgraphs.

Palo Alto Amateur Radio Association, Inc.

PO Box 911 Menlo Park, CA 94026

Officers

President	Kristen McInrtyre, K6WX kristen@alum.mit.edu	510-703-4942
Vice President	Doug Teter, KG6LWE dteter@wcwi.com	650-367-6200
Secretary	Rick Melrose K6RDM k6rdm@arrl.net	408-341-9070
Treasurer	Ron Chester, W6AZ ron@taxhelp.com	408-243 2221

Directors

Past President ('10)	Joel Wilhite, KD6W kd6w@arrl.net	650 325 8239
Director ('10)	Rob Riley, KI6INR kg6hvw@arrl.net	650 799-1607 (cell)
Director ('11)	Byron Beck KG6UOB kg6uob@arrl.net	408-735-8604
Director ('10)	Mark Cohen K6EF markc@binaryfaith.com	
Director ('10)	Larry Rebarchik N6CCH N6CCH@arrl.net	650-218-0091 (cell)

Appointed Positions

Membership	Vic Black, AB6SO ab6so@smrn.com	650-366 0636
Database	Rick Melrose K6RDM k6rdm@arrl.net	408-341-9070
Chaplain	Rev. Rick Line, KG6TMD kg6tmd@arrl.net	650 323 8544
Public Affairs	Vacant	
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Property Manager	Gerry Tucker, N6NV	
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Historian	Christopher McIntyre, KG6SVI	
Raffle Coordinator	Jim Rice, K6AK	650-851-2274
Ticket Master	Kyle Rice, KG6MSK	
Field Day Coordinator	Doug Teter, KG6LWE	
ASVARO Rep	Rolf Klibo, N6NFI n6nfi@arrl.net	650-856-2748
Webmaster	Mark Cohen K6EF markc@binaryfaith.com	
Technical Coordinator	Joel Wilhite. KD6W	650-325-8239
	kd6w@arrl.net	
QSL Manager	Rob Riley, KI6INR (cell) ki6inr@arrl.net	650 799-1607
Speaker Coordinator	Doug Teter, KG6LWE dteter@wcwi.com	650 325 8239

PAARA*graphs* Staff

Editorial Board
PAUL PETACH KI6QXV ROBIN YEE KI6YTA
Kristen McIntyre K6WX Vic Black AB6SO
Ron Chester W6AZ Joel Wilhite, KD6W

Editors	Paul Petach, KI6QXV paaraeditor@gmail.com	Robin Yee, KI6YTA KI6YTA@arrl.net
Advertising	Ron Chester, W6AZ ron@taxhelp.com	408-243-2221
Member Profiles	Terry Finn, AA6T	650-366-9111
Technical Tips	Vic Black, AB6SO ab6so@smrn.com	650-366 0636
Photographer	Bill Young, K6VWO jdsinger@sbcglobal.net	

PAARA 2010 General Meeting dates——1/8, 2/5, 3/5, 4/2, 5/7, 6/4, 7/2, 8/6, 9/3, 10/1, 11/5, 12/ 3——

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lar flux index is under 70 again. This is unfortunate for those of us who enjoy operating on the HF bands. At the beginning of May there were a few coronal mass ejections, or CMEs, but, since that time, things have been rather quiet. We had one old sunspot group rotate in, but nothing since then. Hopefully this condition of low solar activity will not persist until Field Day. Lets all send good thoughts that ol' Sol will smile upon us and make a few more ions so that we can have better propagation.

The big event of this past month for me was a chance to attend and exhibit oscilloscopes at the Maker Faire. This event was held at the San Mateo Expo Center on May 22 and 23rd. On the Friday before the main event, there was a kids' day preview of the Faire. Our club was there and we even made a special flyer for Field Day to hand out. PAARA members Michael Pechner, NE6RD, who organized our participation, Leigh Klotz, WA5ZNU, Norman Bradley, K6NBP, and myself were there on Friday with Chris Hoffman, KG6O, to set up our equipment and greet the children. Traffic was a little light on that Friday, but Saturday and Sunday more than made up for it. Starting from setup at 9AM, we all were joined by other PAARA, FARS, and SBARA members who helped man the oscilloscope demos and who staffed additional tables with ARRL information and an impressive combined APRS and SSTV demo. Leigh was demonstrating his homemade diode curve tracer and his rubidium reference oscillator. He had made a mechanical oscilloscope from an old disk drive and a laser and was using paper and markers to demonstrate the principles of the oscilloscope. I was showing how to measure the speed of sound using two microphones and an oscilloscope. I also dragged out my old Tektronics 491 Spectrum Analyzer and tuned it to an FM broadcast station to show what frequency modulation looks like. It was great fun and I had many interesting conversations. I even, by chance, managed to appear very briefly in a video about the Maker Faire at mashable.com (http://mashable.com/2010/05/23/robots-rockets-maker-faire/). All in all it was great fun and I'm looking forward to participating again next year.

For Field Day this year we are running a 4A station, and that means 4 transmitters on the air on HF simultaneously. There will be two phone stations and two CW stations. Please contact Doug, KG6LWE, or me, Kristen, K6WX, to get on the schedule to operate if you wish to do so. Operators will be needed throughout the night, so all of you night owls, this is your chance to not only stay up late, but stay up late and talk on the radio. You can't beat that combination! We also need help with a number of other tasks both large and small so please let us know if you have some time to help us out.

By the time I pen this column for the next issue of PAARAgraphs, Field Day will be upon us. It's a great time for all of us to get out and have some radio fun and to see those glorious antennas against the blue sky. Please come out and join us. I'm looking forward to seeing you there!

CUL ES 73 DE K6WX

Board Meeting Minutes 5/19/10

The Board Meeting was held at the Palo Alto Red Cross building, commencing at 7:17 PM on the 19th of May, 2010. Attending were Kristen McIntyre K6WX (Pres), Doug Teter KG6LWE (VP), Rick Melrose K6RDM (Sec, Database), Larry Rebarchik N6CCH (Dir), Byron Beck KG6UOB (Dir), Rob Riley KI6INR (Dir), Joel Wilhite KD6W (former Pres), Robin Yee KI6YTA (Editor), Gerry Tucker N6NV (Property Mgr), and Vic Black AB6SO (Membership). A quorum was present.

Secretary's Report: Rick K6RDM reports that the minutes of the 21st of April, Board meeting had been previously submitted and approved.

President's Report: Kristen K6WX reported that there was good attendance at the last general meeting, the SDO snippets were well received and she will be interlacing more in future meetings. Thanks to Mark Miller AA6TT for his donation that was auctioned off at the meeting. September 2010 is PAARA's turn to handle the DeAnza Flea Market logistics. Jim K6AK sent a PAARA Field Flyer to HRO. She also mentioned that the Maker Faire would be opening with a kid's day on Friday, the 21st and that our preparations were going well, expecting that it will be some nice PR for the club.

Discussion turned to the website and Kristen mentioned that she had obtained new passwords and been able to access the site and make some changes. Joel KD6W pointed out that there were actually three distinct positions with regard to the website; Administration, Construction and Maintenance, and that it was quite a lot for just one person. Rick K6RDM suggested it might be possible to get these positions covered more dependably if we tried to form a team to fill them separately, since the work seems to be a bit much for one person. Kristen indicated that we have a considerable amount of content (newsletters, photos, etc.) ready to be uploaded, an easy task if someone has the time. The membership is asked to consider taking a hand with helping us get these functions covered.

Treasurer's Report: While Ron W6AZ was unable to attend the meeting, Kristen relayed that he did report that receipts from the May Flea Market were excellent, and that the club was in compliance with IRS Form 990-N, thus preserving our non-profit status.

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LIFE MEMBERSHIP
Awarded by Action of the PAARA Board

Wally Porter K6URO Dec 2008
Steve Stuntz, K6FS Dec 2007

SmartMeters and Electric Power Measurement, Part 1

Steve Stearns, K6OIK

(This article appeared in its entirety in the April 2010 issue of the *FARS Relay*, http://archive.k6ya.org/relay/Relay1004.pdf)

Let's suppose that you are one of many who've returned home only to find a new SmartMeter on your house. Your electric utility provider installed it while you were out. You've read in the news that these new meters may read power differently, resulting in high electric bills. Is this true? Should you complain to your utility or the California Public Utility Commission? This article will review how the new electronic power meters work, and how your electric utility might be charging you more for electric power.

As you probably read in the news, Los Angeles attorney Michael L. Kelly of Kirtland & Packard LLP is suing electric utilities in California because the new SmartMeters report greater energy usage than the old meters they replaced. Watt-hour meters were electromechanical in the century after their development by Thomson, Duncan, General Electric, Tesla, Sangamo, Westinghouse, and others. Today, four companies make watt-hour meters: Landis+Gyr (formerly Siemens, Duncan), GE, Itron (formerly Schlumberger, Sangamo), and Elster (formerly ABB, Westinghouse). All four companies have historic roots dating to the 19th century, and all manufacture electronic watt-hour meters today. Elster is the last company to offer an electromechanical model.

First we will review some basics from AC circuit theory to understand what power means before tackling the question of how it is metered. Power is the rate at which energy is delivered. The unit of electric power is the watt (W). Mechanical engineers often use the horsepower as the unit of power. One horsepower is approximately 746 watts. The unit of electric energy is the joule (J), which is one watt-second. Electric utilities measure energy with a bigger unit, the kilowatt-hour (kWh). One kilowatt-hour is 3.6 Mega joules (MJ).

Imagine a circuit consisting of a voltage or current source connected to a load. The power delivered to the load at each instant of time is the product of the voltage across the load times the current flowing through the load. If the source waveform is periodic in time, then the instantaneous power can be averaged over one cycle to obtain real average power. In the electric power industry, it is called "active" power to contrast with "reactive" power. Real average (or active) power is the basis for metering and billing. When the source is sinusoidal and the load is linear the real average power delivered to the load is given by well known formulas

$$P = \frac{1}{2}\mathrm{Re}\left\{ VI^{*} \right\} = V_{rms} I_{rms} \cos\theta = P_{apparent} \times \text{Power Factor}$$

where V and I are complex phasors representing sinusoidal voltage and current, the superscript asterisk represents complex conjugate, Re{} denotes the real part of a complex number, V_{rms} and I_{rms} are the rms voltage and current, $P_{apparent}$ is the product $V_{rms}I_{rms}$ in volt-amps and is called "apparent power," and $\cos\theta$ is the cosine of the phase angle between V and I and is called "power factor." It is important to remember that these AC power formulas apply only when the source is sinusoidal and the load is linear.
More generally, if the load is nonlinear and its voltage and current waveforms are general periodic functions of time, then real average power is given by

$$P = \frac{1}{T}\int_{0}^{T} v(t)i(t)dt = \frac{1}{2}\sum_{n=1}^{\infty} \mathrm{Re}\left\{ V_n I_n^{*} \right\} = \sum_{n=1}^{\infty} P_n \le V_{rms} I_{rms} = P_{apparent}$$

The formula on the left states that the average power is the average of the instantaneous power averaged over one period of the voltage and current waveforms. The formulas in the middle state that the power is the sum of the powers of the harmonics. The inequality on the right is a statement of the Cauchy-Schwarz inequality, namely that the real average power cannot exceed the product of the rms load voltage times the rms load current. This product is called "apparent power," the same as in the sinusoidal case. Electric power metering is based on the integral on the left. The other expressions will help us understand the issues with SmartMeters.
Electromechanical watt-hour meters are induction motors. They have two coils for sensing voltage and current respectively. The voltage sensing coil induces a radial current in the rotor, which is a thin conducting disk, usually aluminum. Early disks were suspended on jewel bearings; later disks floated on magnetic suspension. The current sensing coil creates a magnetic field perpendicular to the disk that creates a force on the current in the disk according to the magnetic force law

$$\boldsymbol{F} = q\boldsymbol{v} \times \boldsymbol{B}$$

This force, in turn, creates a torque on the disk. A magnetic brake plus bearing friction supply drag forces that hold the disk's speed in check, preventing unlimited acceleration. The speed of rotation is proportional to a moving average of the instantaneous product

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of the currents in the voltage and current sensing coils. The disk is connected by gears to a register of dials that count its turns. Figure 1 shows a common arrangement.

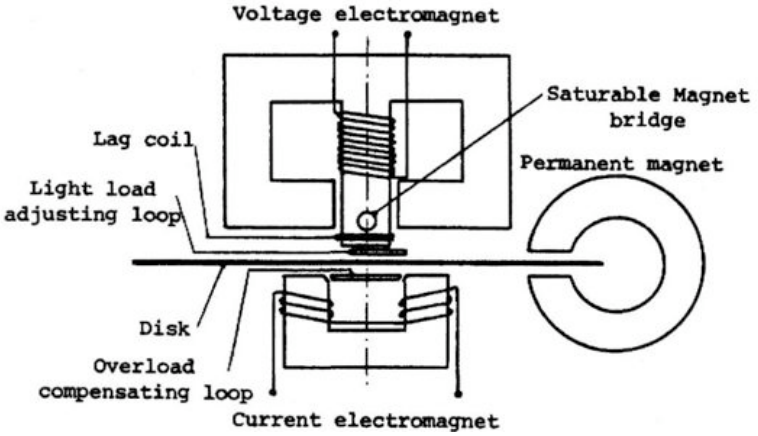

Figure 1. Electromechanical meter [Baghzouz].

The new meters are electronic rather than electromechanical motors. The voltage and current waveforms are sensed, either through isolation transformers or other coupling means, and digitized by A/D converters that sample the voltage and current waveforms at a high rate. Once digitized, a DSP processor multiplies the samples digitally to obtain instantaneous power. The products are summed to obtain real or active power. This method of power measurement includes the power in hamonics that are within the passbands of the transformers and anti-aliasing filters.

The definition of reactive power and the explanation of its measurement is more complicated. Landis+Gyr documents make it clear that the FOCUS AX meter is designed to measure and report the components of complex power – real and reactive, inductive and capacitive, current leading or lagging, positive or negative. This is easy to do when the voltage and current waveforms are sinusoids with only a relative phase shift between them. In this situation, power factor and reactive power are determined by measuring the phase shift between current and voltage. However, when waveforms are not sinusoidal, the situation is more complicated.

We can make general definitions of real and reactive power that include harmonic power

$$P = P_{real} = \frac{1}{2}\mathrm{Re}\left\{\sum_{n=1}^{\infty} V_n I_n^*\right\} = \frac{1}{2}\sum_{n=1}^{\infty}\mathrm{Re}\left\{V_n I_n^*\right\} = \sum_{n=1}^{\infty} P_n$$

$$Q = P_{reactive} = \frac{1}{2}\mathrm{Im}\left\{\sum_{n=1}^{\infty} V_n I_n^*\right\} = \frac{1}{2}\sum_{n=1}^{\infty}\mathrm{Im}\left\{V_n I_n^*\right\} = \sum_{n=1}^{\infty} Q_n$$

where the symbols P and Q denote active and reactive power respectively, i.e. the real and imaginary parts of the complex power $P + jQ$. In order to compute power according to these definitions, Fourier analysis must be performed on the voltage and current waveforms. An electronic meter can compute reactive power by the definition above if it has an FFT, which some meters do, but there are simpler ways to determine reactive power Q in single-phase power systems. First, notice that complex power has squared magnitude given by

$$P^2 + Q^2 = \left(V_{rms} \times I_{rms}\right)^2 = P_{apparent}^2$$

from which we obtain the magnitude of Q but not its sign

$$|Q| = \sqrt{\left(V_{rms} I_{rms}\right)^2 - P^2}$$

The units of reactive power are "volt-amperes reactive" or Vars, and can be positive or negative. Linear inductive loads have positive reactive power, and capacitive loads have negative reactive power. Nonlinear loads also have positive or negative reactive

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power. If the direction of metered power flow reverses, the algebraic signs of all power components are reversed. These conventions, taken from an L+G document, are shown in Figure 2. It is clear that Landis+Gyr meters measure *P* and *Q* as algebraically signed quantities.

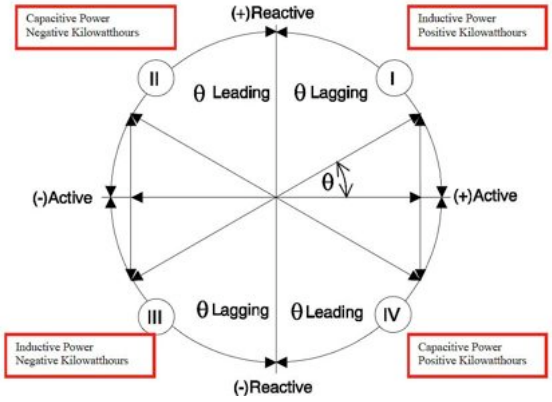

Figure 2. Landis+Gyr conventions for the real and reactive power.

Can a meter determine the sign of the reactive power *Q* without an FFT? A clue comes from the sinusoidal case that started this discussion.

$$Q = \frac{1}{2}\mathrm{Im}\left\{VI^*\right\} = \frac{1}{2}\mathrm{Re}\left\{-jV \times I^*\right\} = \frac{1}{2}\mathrm{Re}\left\{Ve^{\frac{-j\pi}{2}} \times I^*\right\} = \frac{1}{T}\int_0^T v_{delayed}(t)i(t)dt$$

We see that reactive power can be calculated by multiplying current and voltage time waveforms provided the voltage waveform is first delayed a quarter cycle before multiplying it by the current. Similarly for general loads, reactive power *Q* is found by multiplying the current waveform times a modified voltage waveform and averaging over a cycle.

$$Q = \sum_{n=1}^{\infty} Q_n = \frac{1}{2}\sum_{n=1}^{\infty}\mathrm{Im}\left\{V_n I_n^*\right\} = \frac{1}{2}\sum_{n=1}^{\infty}\mathrm{Re}\left\{-jV_n I_n^*\right\} = \frac{1}{2}\mathrm{Re}\left\{\sum_{n=1}^{\infty} V_n e^{\frac{-j\pi}{2}} I_n^*\right\} = \frac{1}{T}\int_0^T v_{\mathrm{mod}}(t)i(t)dt$$

The modified voltage waveform is obtained by delaying all of the voltage harmonics by a quarter cycle. This is easily done by passing the voltage waveform through a Hilbert transform filter. Such filters are readily implemented in DSP as finite impulse response (FIR) or infinite impulse response (IIR) filters. Landis+Gyr meters use FIRs based on a patent by Jurisch and Kramer. The preferred approach today is to use IIR filters, which require fewer multiplications than FIR filters for equal accuracy. More expensive electronic meters use chips such as the Cirrus Logic CS5463, which is a mixed-signal (analog and digital) chip that has an onboard FFT and a sigma-delta analog-to-digital converter that's clocked at more than 500 kHz.

Unlike an electromechanical meter, the display of an L+G electronic meter does not run backwards when the consumer supplies power to the grid. Rather, the meter records energy flow by accumulating complex power in four separate accumulators that correspond to the quadrants shown in Figure 2. This enables the utility provider to choose whether to credit a customer for power supplied to the grid, i.e. negative active power. Electromechanical meters did not give the utility a choice in this matter. Residential customers are by law billed only for real, active power.

"Smart" electric meters are made by adding a wireless digital communications module to an electronic watt-hour meter. PG&E buys its SmartMeters from GE and Landis+Gyr. Residential customers are getting the GE I-210+ or the Landis+Gyr single-phase FOCUS AX series meters. If you compare the readings of an old electromechanical meter with those of a new SmartMeter, you will find that both meters agree (within meter tolerance) on power consumed if the load is linear-real, e.g. a resistor. They also agree when the load impedance is linear-reactive $Z = R + jX$, e.g. motors and fluorescent lamps with magnetic ballasts. But they won't agree when the load is nonlinear, e.g. switching power supplies, light dimmers, fluorescent lamps with electronic ballast, CFLs, plug-in wall wart power supplies, and nearly all consumer electronics. The new meters measure instantaneous power in a much wider measurement bandwidth, ten times greater than the old meters – 3 kHz to 5 kHz or more, instead of 300 to 500 Hz for electromechanical meters. The new meters measure, and the consumer gets billed for, harmonic power that the old meters did not sense. The greater bandwidth and digital multiplication measurement technique mean that high-order harmonics now contribute to the power measurement, 50 to 100 harmonics instead of 5 to 10. The new electronic meters are able to sense and respond to as-

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pects of the voltage and current waveforms to which the old electromechanical meters were blind.

The measurement discrepancy does not lie in the "smart" part of the SmartMeter, which is just Part 15 low-power digital packet communication links – 400-mW, 900-MHz ISM band to the house and 100-mW, 2.4-GHz ZigBee to the utility – nor does it lie in the utility's data collection methods. Rather, it lies in the working guts, the electronic power measuring part of the meter. By measuring power using a different bandwidth, the new meters have indirectly redefined the electrical watt, or at least the billable watt. While the utility will claim that they are not billing consumers for reactive power, they are actually doing something else, billing for higher-order harmonic power – and unequally among different meter models. Moreover, depending on the internal algorithms for quadrant accumulation of power, it is shown below that the metering and billing algorithms can actually create phantom power that the consumer gets billed for.

The fact that electric utilities are installing different models of meters made by different manufacturers is problematic. There are no standards for meter bandwidth or waveform crest factor specified in the Canadian or ANSI standards for electric meter accuracy. Those standards do not consider the issues discussed here. Consequently, SmartMeters made by different manufacturers, such as GE and Landis+Gyr, can differ widely on such basic circuit parameters. Customers whose loads are linear (e.g. incandescent lamps and motors) will be billed equally, but, customers whose loads, are nonlinear (e.g. modern electronic devices) may be billed differently for the same power consumption. Without bandwidth and crest factor standards, the only remedy is that billing rates cannot be both universal and fair but should be tailored and specific to each model of meter.

Some people may reason that because the strength of harmonics ultimately fall off with frequency, it follows that high-order harmonics have a negligible contribution to total power. Such reasoning is incorrect. The infinite series

$$\sum_{n=1}^{\infty} \frac{1}{n},$$

which is called ironically a "harmonic" series, has terms that decrease as n increases. Yet this series sums to infinity, thereby proving that many vanishingly small things can indeed add up to a very big thing, infinity. Merely getting weaker is insufficient for high-order harmonics to contribute negligibly to total power. A stronger condition is needed.

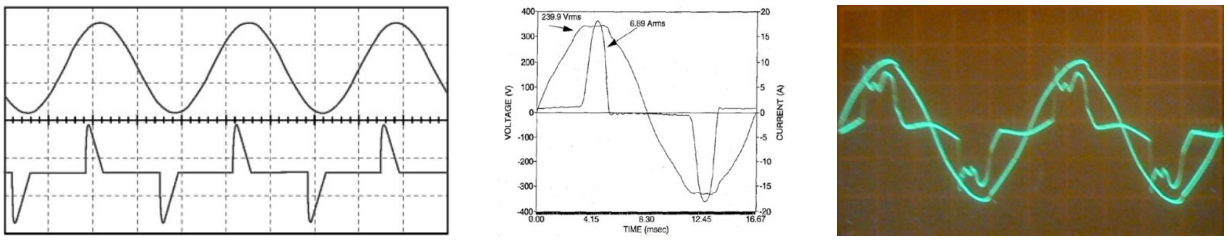


Figure 3. Voltage and current waveforms: (a) ideal switched-mode power supply; (b) measured heat pump [Domijan]; (c) measured CFL [Korsak].

Figure 3(a) on the left shows what the voltage and current waveforms of a switched-mode power supply might look like ideally. The voltage waveform is a pure sinusoid, but the current waveform is not. Power harmonics are created only if the voltage and current waveforms both have harmonics of the same order. So in this case, no harmonic power is created. However, this ideal case is only of academic interest because the power grid at the meter has a Thevenin source impedance that isn't zero. Small yes, zero no! Consequently, if a nonlinear load creates current harmonics, voltage harmonics are also created automatically by loading. The effect of current loading on voltage is shown in shown in Figure 3(b). The voltage waveform at the meter is no longer a sinusoid. Figure 3(c) shows similar waveforms for a compact fluorescent lamp (CFL), measured by A. Korsak, KR6DD. Again, the voltage waveform is visibly distorted and is not a pure sinusoid.

Watch for Part 2 of this article in the July issue of PAARAgraphs.

About the Author

Steve Stearns, K6OIK, started in ham radio while in high school at the height of the Heathkit era. He holds FCC Amateur Extra and a commercial General Radio Operator license with Radar endorsement. He previously held Novice, Technician, and 1st Class Radiotelephone licenses. He studied electrical engineering at California State University Fullerton, the University of Southern California, and Stanford, specializing in electromagnetics, communication engineering and signal processing. Steve is currently Senior Staff Engineer at Northrop Grumman's Electromagnetic Systems Laboratory in San Jose, California, where he leads advanced technology projects in advanced signal processing algorithms, active non-Foster circuit design, exotic antennas, and electromagnetic wave phenomena. Steve is vice-president of the Foothills Amateur Radio Society, and served previously as assistant director of ARRL Pacific Division. He has over 50 professional publications and nine patents. Steve has received numerous awards for professional and community volunteer activities.

(Board Meeting Minutes—Continued from page 63)

Vice President's Report: The remainder of the meeting was, for the most part, taken up with preparations for Field Day, which is only *one month* away! Doug KG6LWE and Larry N6CCH are planning a work party on the weekend of the 5th and 6th to finish the refurbishing of one of the KT-34 beams. Another is updated and ready for testing. Kristen indicated she has an antenna analyzer available for the task (Charles Hein, N6BO is thanked for the nice case he made for the analyzer). It will be necessary to get some replacement tubing for the end tips on the Force 12 antenna that was damaged slightly in a minor accident. Gerry N6NV entered the discussion regarding the logistics of getting towers and accessories into the testing process as well as arrangements for facilities and for coordinating with the city for services and liaison needed for the site.

Joel indicated that he has 4 Cisco IP phones that will enable communications through the Ethernet at the site if we can find someone with sufficient familiarity to help us get them up and running. If any of the membership can give us a hand with them, it will be appreciated. Rob KI6INR briefed the board on preparations for the GOTA station and the possibility of having PSK31 in operation. Phil K6TT is thanked for his contribution of three laptops for use in logging at the stations. We are still very much looking for operators and loggers for the stations and coaches for the operators at the GOTA station. And meanwhile, we are looking for venues to promote the GOTA opportunity; schools, scout troops, Y groups, any such that the membership may think of to suggest.

Consideration was also given to ancillary activities, NTS Radiogram traffic, solar powered gear, and other opportunities for picking up extra points. We've had excellent and rising statistics for the last couple of years and are intending to out do ourselves at Field Day next month.

The meeting was adjourned at 8:45 PM.

Tri-City VE Group Test Sessions

Where: Hurricane Electric
48233 Warm Springs Blvd
Fremont, CA

When: Thursday, **June 17**, 6:30 p.m.
Saturday, **July 10**, 9:00 a.m.
Thursday, **August 19**, 6:30 p.m.

For more information, contact
Rita, **KI6SSQ@arrl.net**, (510) 703-7090
or
Bernhard, **AE6YN@arrl.net**, (510) 364-0611
or visit
www.sbara.org.

Congratulations to the winners of the May 2010 Raffle!

1st Prize:	Pat Sullivan / W6ABA / Icom IC V-80 / 2m / 5.5W / HT
2nd Prize:	Bob Shelton / K6TGR / Super Antennas MP1
3rd Prize:	Andy Korsak / KR6DD / Two West Mountain COMspkr
4th Prize:	Doug Teter / KG6LWE / Two Uniden FRS / GMRS Radios
5th Prize:	Doyle Kisler / KG6YUN / APC Surge Protector 7 Outlet Power Strip
6th Prize:	David Ranch / KI6ZHD / Three / 3 LED Push-Lites
7th Prize:	Tony Kooij / W6AWK / ARRL 2009-2010 Repeater Directory
8th Prize:	Gerry Tucker / N6NV / Yaesu Log Book
9th Prize:	Pat Sullivan / W6ABA / Two Maker Faire Tickets

THANK YOU FOR YOUR SUPPORT
of PAARA's exciting monthly raffles!

Field Day 2010
ATTENTION!
Coaches Needed for GOTA!

If you are interested or have any questions, please contact Rob at KI6INR@arrl.net.

PAARA had a remarkable year in 2009! If you aren't a member, please join PAARA now and experience fun 2010 events with the "friendliest club around."

K6AK Jim

PAARA Exemplary Service Award
Gerry Tucker, N6NV 2005
Rice Family 2006
Jim K6AK, Lisa KG6KQS, Kyle KG6MSK
Wally Porter, K6URO 2007
Vic Black, AB6SO 2008
??? - 2009

PAARA*graphs*—June 2010
Celebrating 73 years as an *active* ham radio club—*Since 1937*

PAARA "The Friendliest Club Around"

June 4th Raffle Prizes

FIRST PRIZE: Icom IC-V80 / 2m / 5.5W / HT

- Rugged / Water Resistant / 750mW of Loud Audio
- NiMH / 1400mAh Battery Pack / 13 Hours Operating Time
- Drop-In Charging Base
- PC Programmable with Optional CS-V80
- WX Channel and Weather Alert Function (USA Version Only)
- Transceiver-to-Transceiver Cloning (Optional

SECOND PRIZE: 30 Amp Desktop Lightweight Switching Power Supply

- Weight: 3 pounds / Overall Dimensions: 6.1 x 5 x 2.5 inches
- Output Voltage: 13.85 VDC Fixed
- Output Amperage: 30 Intermittent, 25 Continuous
- Ripple Peak-to-Peak Max. < 100mVpp
- Quiet Internal Cooling Fan

THIRD PRIZE: wiREVO S300 Stereo Bluetooth v2.0 Wireless Headset with Neckband, USB 2.0, includes Charger ***(Thanks Bill K6VW0!)***

FOURTH PRIZE: Deltran Battery Tender Junior / 12V / 750mA / Auto Float Charge
FIFTH PRIZE: TWO Midland FRS/GMRS 2-Way Radios
SIXTH PRIZE: Book: *"Solder Smoke"—A Global Adventure in Radio Electronics*
SEVENTH PRIZE: LED Flashlight with Magnifying Lens for Long Distance
EIGHTH PRIZE: USB LED Light

Since February 2003, **178 Radios**, including THREE Elecraft K3's, a Yaesu FT-847, an Icom 706 MK IIG, a Yaesu FT-897D, and TWO Elecraft KX1's have gone to Fellow Hams.

Special Thanks to Bob, Howard, Jon, Mark, and everyone at HRO for their continued support!

de K6AK Jim

The following badges are ready for pickup:

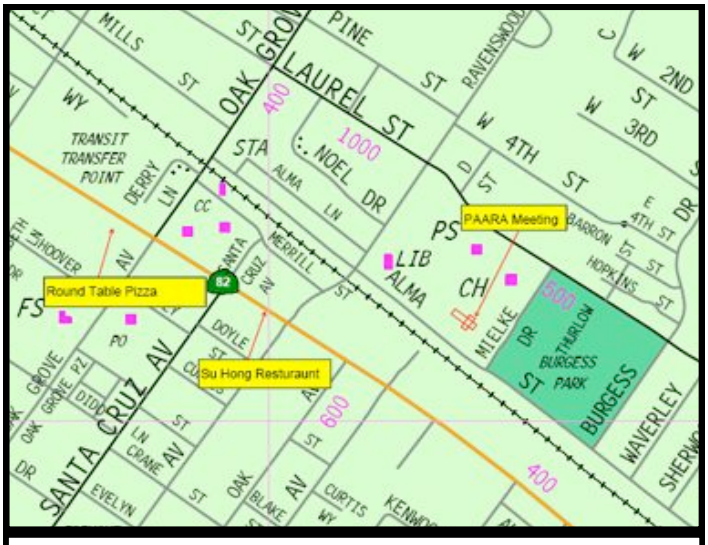
K4AZY, KJ6EOP, K6FEW, K6FTF, KJ6GBC, KI6GYY, N6JCY, KF6SRD, AF6TH, K6TSR, KG6QKN, KG6QKO, KI6VNI, and K6VVK

If you would like to order a badge, see **Lynn Gentry, KG6JPV.**

PAARA Weekly Radio Net

Info and Swap Session every Monday evening at 8:30pm on the N6NFI 145.230 MHz repeater.

Week	Control Operator
1st	Doug Teter - KG6LWE
2nd	Paul Petach - KI6QXV
3rd	Jack Pines - W1VSL
4th	Marty Wayne - W6NEV
5th	Mike Bray - N6MEB



Directions to PAARA meeting:
http://paara.org/meetings/

Join us for pre-meeting eyeball

Eye Ball QSO
gab & gobble

*Food will be served at **6:00** sharp, so guests will be on time for the PAARA meeting. Those arriving late will be responsible for their own food order.*

5:30 pm—at Su Hong Restaurant
1039 El Camino Real
Menlo Park

across from Kepler's Book Store
on El Camino Real
Walking distance from Caltrain!

Palo Alto Amateur Radio Association
P.O. Box 911, Menlo Park, California 94026-0911
Club meetings are on the first Friday of each month, 7:00pm at the Menlo Park Rec Center, 700 Alma Street, Menlo Park, CA.

Radio NET & Swap Session every Monday evening, at 8:30pm, on the 145.230 −600 MHz repeater, PL 100Hz.

Membership in PAARA is $20.00 per calendar year, which includes one subscription to PAARAgraphs
$6 for each additional family member (no newsletter).
Make payment to the Palo Alto Amateur Radio Association, P.O. Box 911, Menlo Park, CA 94026-0911

DON'T FORGET!

Amateur Radio Technology Day

June 12th, 2010

8AM to 9PM

at the SLAC National Accelerator Laboratory

PAARA*graphs* E-mail address:
ki6yta@arrl.net **or** *paaraeditor@gmail.com*
Submissions for PAARA*graphs* by the 3rd Wednesday

Text:	MSWORD, RTF, or TEXT
Photos:	JPEG or TIFF raster images

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Rick Melrose K6RDM, **1-888-725-1895**, k6rdm@arrl.net

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1. Not-for-profit ads by association members for ham-related items and wants. No cost for business card–size ads (additional space at $2.50 per business card size per issue).
2. For Profit organizations and/or individuals: $5-business card size, $25-half page, $50 full page or back cover per issue.

These fees may be reduced or waived in exchange for a valuable consideration that is given to the Association or its general membership. Such consideration must be in addition to any existing arrangements with the association. The PAARAgraphs editors reserve the right to reject any ad deemed to be not in the best interest of the Association.

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PAARA*graphs* — June 2010

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PAARA*graphs* Newsletter
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