

PAARAgraphs



The Official Newsletter of the

Palo Alto Amateur Radio Association, Inc.

The Friendliest Club Around

Celebrating 87 years as an *active* amateur radio club—*Since 1937*<http://www.paara.org/>

What's so fantastic about Meshtastic Benjamin Faershtein, KO6CNT

This meeting is an introduction to what Meshtastic is and the network we have in the Bay Area. Meshtastic is an open-source project that allows people to text long distances without cell service over LoRa 900mhz (Unlicensed ISM Band). The presentation will focus on what Meshtastic is, how it works, and how to join our local Meshtastic network.

Benjamin Faershtein (KO6CNT) who was recently licensed 5 months ago is a 17-year-old youth Ham. Ben is the President of his high school radio club and leads the Meshastic Bay Area Group's Discord.

This meeting will be a Hybrid Meeting Zoom and In Person

Time: June 7, 2024 07:00 PM Pacific Time
Please check <https://www.paara.org> for
Zoom Details

President's Corner

June 2024

Now that Memorial Day weekend is behind us and summer has unofficially started, it's time to look at recent and upcoming PAARA events.



By the time you read my column, the PAARA-sponsored Electronics Flea Market (EFM) will be over. I want to thank all the volunteers who helped make the event a smashing success! Volunteers included (not

Upcoming Events

June 7***	PAARA General Meeting, 7:00 PM
July 12 Aug 2	*** Zoom and In Person Meeting
June 19	Board Meeting, 7:00 PM.
July 17 Aug 21	Everyone welcome! Zoom Meeting, eMail President for details!



listed in any specific order), Clark, KK6ISP; Rob, KC6TYD; Darryl, KI6LDM; Mikko, AB6RF; Margaret, K6WEK; Bob, KN6YGN; Perry, KI6OPZ; Doug, KG6LWE; Jeff, KA6UIX; Dona, KI6DAR; and Stiv, K9STV. A few others from ASVARO or other clubs assisted in setup and cleanup. I apologize if I unintentionally missed naming anyone who assisted. Without everyone's assistance, it would not be possible for PAARA to host this important money-making event. The question on the minds of most is, did PAARA turn a profit? Yes, we did turn a profit that is large enough to make it all worthwhile and cover the costs of PAARA events this year. A BIG shoutout goes to Rob, KC6TYD, who came with a large load of SK items to sell. He single-handedly sold almost as much equipment as the food sales generated. Great job, Rob!

Stiv, K9STV, set up an FT8 station using a simple vertical antenna near the food tent where interested parties could learn about Ham radio. He also had Gridtracker running so people could see where contacts were being made. He's hoping someone from PAARA will set up a similar station at the June 9th EFM. Stiv will not be able to set up his station

(President — Continued on page 4)

What we Used do Before Transistors A Historical Perspective

Rich Stiebel, W6APZ

Transistors have been around for so long that we tend to forget that once they were “the new kid on the block.” The CK722 was the first low-cost junction transistor available to the general public. It was a small-signal unit produced by Raytheon in early 1953 and cost about \$7. It was principally useful as an audio amplifier. I built several amplifiers, using the CK722 at the time.

Power transistors, switching transistors, and HF and VHF transistors were still being developed.

Amateur radio equipment of that era used regular vacuum tubes, as did TV sets. These required high voltages on the tube’s plates to attract the electron stream given off by the cathode. Many of the less expensive ham transmitters used the rugged TV-sweep tubes as final amplifiers.

Vibrators

Mobile equipment was more challenging. The creation of the 27 MHz Citizen’s Band in 1958 created a need for home and mobile CB gear. Tubes of that era needed high voltage for their plates, but car batteries produced a nominal 12 Volts DC. For CB and low-power ham mobile rigs, a vibrator was used in the power supply. A vibrator is an electro-mechanical device for chopping up DC. The vibrator was essentially a single-pole double throw-switch that operated very rapidly to switch the battery voltage first across one half of the primary winding of a power transformer, and then across the other half of the winding, thus enabling the DC to be transformed into high-voltage AC, which could then be rectified to produce 250 – 350 Volts DC for the plate voltages of regular vacuum tubes.

Switching Transistors

When switching power transistors became available, they were used instead of vibrators to generate the high-voltage DC to power the

vacuum tubes used in the public address systems of the day. Those of you who flew on commercial airlines at the time will remember hearing the high-pitched squeal of the switching frequency coming over the aircraft PA system the moment the stewardess keyed the microphone. As higher frequency power transistors were developed, the switching frequency was moved above the audio range, and the squeal disappeared.

Dynamotors

In the mid-1950s, 2 meters was just beginning to catch on in the Chicago area, where I was living. Surplus taxi radios became available on the ham market. I purchased a Motorola FMTRU80D, an 80-Watt-output taxi radio, and converted it to 2 meters. It used a dynamotor to produce the high voltage DC needed by the vacuum tubes. A dynamotor is an electro-mechanical motor-generator for converting electrical power from the car battery to high-voltage DC.

Car radios initially used regular vacuum tubes and vibrators to provide the plate voltages needed.

A Better Way

As with most technologies, many approaches to solving a problem coexist. Today we have the all electric Tesla and Leaf, along with hybrids such as Prius and Camry which are being sold along with more traditional gas-powered cars. So back in the 1950s, engineers were developing vacuum tubes that required only 12 Volts DC on their plates.

Recently I came across a Sylvania data sheet dated 1957 for a 12U7. Yes, 12U7, not 12AU7, with which many of us are familiar. This brought back memories. My first job out of college was for Stromberg-Carlson Company. We were building the car radio for the Ford Edsel. This was the era of audio transistors; nothing higher in frequency capability was commercially available then. This radio used 12-Volt vacuum tubes for all the electronics except the audio amplifier, which was

(Vacuum Tubes — Continued on page 4)



engineering data service

SYLVANIA

12U7

MECHANICAL DATA

Bulb	T-6 1/2
Base	E9-1, Miniature Button 9-Pin
Outline	6-2
Basing	9A
Cathode	Coated Unipotential
Mounting Position	Any

ELECTRICAL DATA

HEATER CHARACTERISTICS

Heater Voltage ¹	12.6 Volts
Heater Current	150 Ma
Heater-Cathode Voltage (Design Center Values)	
Heater Positive with Respect to Cathode	30 Volts Max.
Heater Negative with Respect to Cathode	30 Volts Max.

DIRECT INTERELECTRODE CAPACITANCES

	Section 1 ²		Section 2	
	Shielded ³	Unshielded	Shielded	Unshielded
Grid to Plate	1.5	1.5	1.5	1.5 μmf
Input: g to (h+k)	1.8	1.6	1.8	1.6 μmf
Output: p to (h+k)	2.0	0.4	2.0	0.32 μmf

RATINGS (Design Center Values)

Plate Voltage	30 Volts	Max.
Cathode Current	15 Ma	Max.
Grid Circuit Resistance		
Fixed Bias	0.25 Megohm	Max.
Cathode Bias	1.0 Megohm	Max.

CHARACTERISTICS AND TYPICAL OPERATION

Class A₁ Amplifier—Each Section

Plate Voltage	12.6 Volts
Grid Voltage	0 Volts
Plate Current	1.0 Ma
Transconductance	1600 μmhos
Amplification Factor	20
Plate Resistance (Approx.)	12,500 Ohms
Grid Voltage for $I_b = 10 \mu\text{a}$ (Approx.)	-1.5 Volts

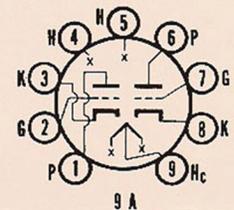
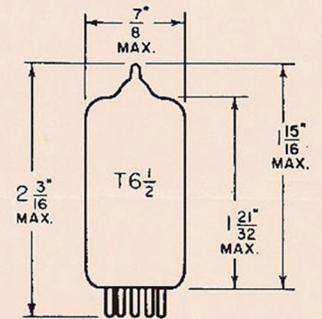
NOTES:

1. This tube is intended for use in automobile radios operated from a nominal 12 volt battery. Design of the tube is such that the heater will operate satisfactorily over the range 10.0 volts to 15.9 volts, and that the maximum ratings provide a safety factor for the wide voltage variation encountered with this type of supply.
2. Section 1 connects to pins 6, 7 and 8. Section 2 connects to pins 1, 2 and 3.
3. External shield No. 315 connected to cathode of section under test.

QUICK REFERENCE DATA

The Sylvania Type 12U7 is a general purpose, medium μ , dual triode, having separate cathodes for each section.

It is designed for operation where the heater and plate voltages are supplied directly from a 12 volt automotive storage battery.



SYLVANIA ELECTRIC
 PRODUCTS INC.
 RADIO TUBE DIVISION
 EMPORIUM, PA.

Prepared and Released By The
 TECHNICAL PUBLICATIONS SECTION
 EMPORIUM, PENNSYLVANIA

FEBRUARY, 1957

PAGE 1 OF 3

(Vacuum Tubes — Continued from page 2)

implemented using a pair of audio-power-transistors.

By 12-Volt I'm referring to both the filaments AND the plate voltage! These 12-Volt-on-the-plate tubes eliminated the vibrator. Elimination of the vibrator and the associated high voltage circuitry required by regular tubes at the time was considered a great breakthrough in the industry and a substantial cost savings.

Since no one knew when/if RF transistors would be available, the tube industry developed a product line of tubes that required only 12 Volts on the plate. The 12U7 is a dual-triode vacuum tube that was used in that Edsel radio. A whole line of 12-Volt tubes was developed at the time. I've attached a scan of the first page of the 12U7 data sheet to give you an idea of the tube's parameters. Complete data sheets are available on the Internet.

This data sheet gives no information as to how high in frequency this tube can be operated.

Nuvistors

The nuvistor is a type of vacuum tube produced by RCA in 1959. Most nuvistors are smaller than a thimble and much smaller than conventional vacuum tubes of the day, almost approaching the compactness of early discrete transistor casings. Triodes and a few tetrodes were made.

The nuvistor worked well in TV tuners and other VHF, UHF equipment, but its advantages were soon overtaken by developments in the semiconductor industry.

Semiconductors

As we are all aware, today semiconductors have taken over all electronics into the microwave bands except for very high power applications.

Now you know some of the history of how our electronics progressed to where it is today.

(President — Continued from page 1)

again as his club, SPECS, is sponsoring the June 9th EFM. Please reach out to Stiv or me if you're interested.

Field Day is June 22nd & 23rd with setup starting on June 21st. Again, Doug, KG6LWE, is coordinating all the efforts to make this special weekend a success. We have the city permit along with key equipment reservations taken care of. The first antenna party was held on May 11th and successfully setup and tested the KT34XA. The next antenna party is on May 25th when we will be assembling and testing the Quad element 40M beam. Additionally, volunteers are needed to set up the towers and antennas on 6/21 and take them down on the 23rd. Contact Doug to let him know how you'd be interested in helping us. The station operation signup sheet is online and can be found at, tinyurl.com/FieldDaySchedule. I hope to see everyone there!

If you aren't sure what Field Day is all about, check out our website at: <https://www.paara.org/pages/fieldday.html>. Additional information can also be found at: <http://www.arrrl.org/field-day>. We'll again be in the 2A class unless we can find another station captain. ARRL's slogan this year is "Be Radio Active". If you can't attend our event, try to be as radio active as possible wherever you are!

In late breaking news, the next PAARA in the Park will be on Saturday, September 28th in Cupertino's Memorial Park. Make sure to mark your calendars so you can join us in another day of fun at the park. Thanks go to Darryl, KI6LDM, for making the reservation. Stay tuned for information regarding a build project. If you have any ideas for an antenna or something else that others would be interested in building, let Daryl know.

Looking ahead, please note the July meeting will be on the 12th and NOT July 5th as that's the Fourth of July weekend.

I look forward to seeing all the smiling faces at the June 7th meeting. The meeting will be both an IRL and Zoom meeting.

73, Jim K6SV

Get on the air to keep the airwaves alive!

May 2024 Board Meeting Minutes

Present were President Jim Thielemann K6SV, Vice President Rob Fenn KC6TYD, Secretary Ric Hulett N6AJS, Treasurer Margaret Cooper K6WEK, and directors Walt Gyger K6WGY, Darryl Presley KI6LDM, Bob Ridenour KN6YGN, Doug Teter KG6LWE, and ASVARO rep Clark Martin KK6ISP. A quorum was present. The meeting was called to order at 7:03 pm.

President's Report — The sun has been very active lately, emitting a barrage of X-class flares and other mischief. Yesterday, the HF bands were blocked for a period of time in the daylight zones. Remarkably, the bay area has seen some aurora borealis in recent days, and aurora borealis was reported Grand Canyon! We hope the sun is in a calmer mood come Field Day.

Secretary's Report — The membership list is up to date, and I have sent a file with contact information to the Webmaster. Members, you can access this list with a password: Contact any board member for that password. Bob KN6YGN has agreed to cover PAARAgaphs mailing this month, as the Secretary will be "portable zero".

Treasurer's Report — Petty cash is on hand for Sunday's Electronics Flea Market stations: Gate fees and concessions. The accountant has time available now, so our reports are being updated.

VP / Program Chair Report — Our speaker for the June meeting will be Benjamin Faershtein, KO6CNT. Ben's topic is "What's so Fantastic about Meshtastic?"

- Field Day T-Shirt orders have been received and T-shirts are on order.

Old Business

- PAARAgaphs is always in need of interesting content from our members. Become a published author! Jot a few paragraphs of ham radio content and send to our editor, Jim K6SV. Member content makes PAARAgaphs special!
- The question for June will be, "What's right or wrong with this picture of an antenna installation?"
- We have prepared a promotional flyer for PAARA. We will e-mail or mail it to local VEC, including Livermore.
- Rob KC6TYD and Darryl KI6LDM will send out

invitation cards to new Hams who earned their license in March and April.

- PAARAgaphs advertising: We have received payment for advertisements from HRO and Anchor Electronics. Walt K6WGY will follow up with vendors who have not paid.
- 900 MHz repeater: Work is ongoing on the 900MHz system; the receive sensitivity is quite low. DMR repeaters are working well. KG6LWE will evaluate the site cleanup situation.
- The next PAARA Field Trip will be to the Computer History Museum. Probably in August.
- We are still evaluating the choice of logging programs (N1MM vs. WriteLog). At this time we will continue with WriteLog for Field Day.
- Dream to Reality Raffle: We are still working with the State to give them all required documents for approval to restart the raffle.
- Electronic Flea Market (EFM). PAARA is sponsoring the EFM on May 19. We discussed logistics for this event.
- PAARA Member Badges: Ric N6AJS will coordinate with Shri KA6Q to update the website and PayPal ordering.
- Club Liability Insurance: We have signed a binding agreement with Philadelphia Insurance Companies, but we are still negotiating some details. The policy will be routed to the board for approval when it is ready.
- ARRL Field Day, June 22 and 23. We discussed logistics for FD, including: Permits, Antenna Parties, U-Haul trucks, T-shirts and Station Captains (N6AJS and K4YR). PAARA will once again operate from Bedwell Bayfront Park in Menlo Park. Rob Fenn KC6TYD will be our safety officer.

New Business

- PAARA in the Park: We will hold our next "Barbecue with Radio" on September 28, at Memorial Park in Cupertino. We'll investigate whether our educational activity can be assembly of a simple kit, with soldering.

The meeting was adjourned at: 9:01 pm.

Respectfully Submitted,
Ric Hulett N6AJS
PAARA Secretary



Question of the Month

What is right or wrong with this antenna installation?



The antenna party crew is checking the SWR of the 40M mono band antenna in preparation for Field Day.



Former PAARAgaphs editor, Chuck, N6VFH, and former presidents, Lily, N6PGM, and Gerry, N6NV, get together for a PAARA and Ham Radio history session over a Baji's brunch. Chuck and Gerry are sporting original PAARA hats.

Palo Alto Amateur Radio Association, Inc.

PO Box 911 Menlo Park, CA 94026

Officers

President	Jim Thielemann, K6SV	408-839-6815
	thielem@pacbell.net	
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Director ('24)	Doug Teter, KG6LWE	650-743-7892
	dteter@wcv.com	
Director ('24)	Darryl Presley, KI6LDM	650 255-2454
	ki6ldm@arrl.net	

Appointed Positions

Membership	Ric Hulett, N6AJS	408-332-4593
	N6AJS@arrl.net	
Database.....	Ric Hulett, N6AJS	408-332-4593
	N6AJS@arrl.net	
Station Trustee.....	K6OTA Ron Chester, W6AZ	
Property Manager	Doug Teter, KG6LWE	
Badge Coordinator.....	Doug Teter, KG6LWE	650-743-7892
	dteter@wcv.com	
Historian Position	<i>Position Vacant</i>	
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	kc6tyd@gmail.com	
	Shrikumar, KA6Q	
	shri.paara@enablery.org	
Field Day Coordinator.....	Doug Teter, KG6LWE	650-743-7892
ASVARO Rep	Clark Martin, KK6ISP	
	kk6isp@sonic.net	
Webmaster.....	Shrikumar, KA6Q	
	webaron@gmail.com	
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QSL Manager.....	Ric Hulett, N6AJS	408-332-4593
Speaker Coordinator.....	Rob Fenn, kc6tyd	650-888-9060

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Member Profiles	<i>Position Vacant</i>	
Technical Tips.....	Ric Hulett, N6AJS	
Photographer	<i>Position Vacant</i>	

VE Exams

De Anza Park, Sunnyvale, 2nd Saturday 10:30 am each month except November and December. See website for details and exceptions: <http://amateur-radio.org>

Electronics Flea Market (EFM)

Sponsorship: Association of Silicon Valley Amateur Radio Organizations (ASVARO). The Electronics Flea Market is held at West Valley College, 14000 Fruitvale Ave, Saratoga.
 Website: <http://www.electronicfleamarket.com/>

PAARA — Palo Alto Amateur Radio Association

Meets 1st Friday 7:00pm each month at Room H-6, Cubberley Community Center; Net 145.230 - PL 100Hz Mondays at 8:30. See website at <http://www.paara.org>. For more information. contact: Joel Wilhite KD6W, KD6W@ARRL.NET, 650-325-8239

FARS — Foothills Amateur Radio Society

Meets 4th Friday each month at 7:00pm at Covington School, Los Altos.
 Website: <http://www.fars.k6va.org>

NCDXC — Northern California DX Club

Meets 3rd Thursday 7:00pm each month,
 Repeater for member info 147.360. Contact president@ncdxc.org. Website: <http://ncdxc.org>. YouTube content: "The Northern California DX Club Official Channel". Cohost of the International DX Convention.

The 50MHz & Up Group of Northern California

This organization specializes in vhf + wak signal and microwave activities. Meetings are held on the first Tuesday of each month. Time is usually 5pm for in person meetings, and 7pm for Zoom only meetings. In person meetings are held Sports Basement, 1177 Kern Ave, Sunnyvale. Always check the website, <http://50MhzandUp.org>, for correct information. Zoom information is also there.

San Mateo Radio Club W6UQ.ORG

Meets, 3rd Friday, January through November.
 Tuesdays & Thursdays, [Directed] Net, 7pm, N6ZX 145.370Hz, -600KHz, PL107.2Hz
 Contact: SanMateoRadioClub@gmail.com, Website: <http://W6UQ.org/calendar>

SPECS

Southern Peninsula Emergency Communication System users Group

Meets each Monday 7:30pm and 8:00pm.
 See: <https://specsnet.org/monday-night-net> for more info.
 Contact: <https://www.specsnet.org/contact> or board@specsnet.org

SCARES

South County Amateur Radio Emergency Service

Meets 3rd Thursday 7:30pm each month, Belmont EOC, Belmont City Hall, One Twin Pines Lane, Belmont CA 94002. 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, 10M (28.385) 8PM Thur.
 Meets 2nd Mon each month @ 7:30 PM.
 ARRL/VEC license testing contact 408-507-4698

SVECS — Silicon Valley Emergency Communications

Operates AA6BT repeater (146.115 MHz+)
 Website: <http://www.svecs.net> or contact: Lou Stierer WA6QYS 408 241 7999

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 2nd Wednesday of every month except July, August and December.

Website: <http://wvara.org>. Contact: info@wvara.org

(Please send changes to PAARAgaphs editor)



PAARA Weekly Radio Net

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

Week Control Operator

1 st	Doug - KG6LWE
2 nd	Doug - KG6LWE
3 rd	Ric - N6AJS
4 th	Rob - KC6TYD
5 th	Rob - KC6TYD

If you're interested in trying out at Net Control, Contact Doug, KG6LWE. It's good practice, and lots o' fun! Give it a try.

Electronics Give Away

Over the many years I've been a ham, I've collected a lot of equipment. Most of it is still in good working order. A few items may need repair, such as a new filter capacitor... nothing serious.

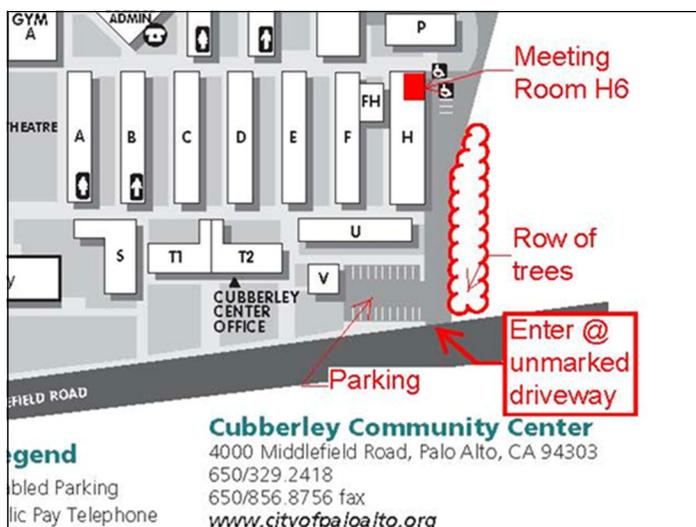
Given my advancing age, I'd like to get this equipment into the hands of younger hams who can use it. The list of gear is too long to list here, but includes signal generators, power supplies, amplifiers, test equipment, etc.

Please pass this on especially to hams under 21 who might be interested.

They can reach me at: 650-494-0128. If I'm not available to take your call, after the 4th ring, the phone will go to my answering machine and you can leave a message with your name, phone number, and when is a good time to reach you.

Alternately, they can send me an email at: W6APZ@comcast.net with the Subject: "Electronics Give Away" and I'll respond.

Rich, W6APZ



**Meeting Location — Middlefield Road
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Email: KARLDRESDEN@juno.com

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 Room H-6, Cubberley Community Center.

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

Membership in PAARA is \$25.00 per calendar year,
 which includes one subscription to PAARAgaphs
 \$6 for each additional family member (no newsletter).

Make payment to the
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ARV'S, WA6UUT (SK)
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PAARA W6OTX Repeaters Located near Alum Rock Park, San Jose		
VHF DMR	144.9625 MHz +2.5 MHz CC3	Slot 1: Dynamic Slot 2: NorCal BM (31068)
UHF DMR	444.475 MHz +5 MHz CC1	Slot 1: Dynamic Slot 2: NorCal BM (31068)
33cm FM	927.225 MHz -25 MHz	PL 100 Hz

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PAARA Badges

Badges can be ordered through
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 pages/members-current.html](https://www.paara.org/pages/members-current.html).

Scroll to the bottom of the page
 and fill out the info. All badges will
 be mailed.

The cost for a badge is \$25.00.

PAARAgaphs Ad Rates

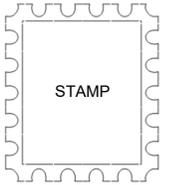
PAARAgaphs accepts paid advertisements from non-members. (short personal ads remain free for members in good standing). **All ad rates listed are per issue.**

- 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).
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PAARAgaphs — June 2024

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Palo Alto Amateur Radio Association, Inc.
 PAARAgaphs Newsletter
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FDX101MP | 200W HF/50MHz Transceiver

- Hybrid SDR Configuration • Unparalleled 70 dB Max. Attenuation VC-Tune • New Generation Scope Display 30SS • ABL (Active Band Indicator) & MPVD (Multi-Purpose VFO Outer Dial) • PC Remote Control Software to Expand the Operating Range • Includes External Power With Matching Front Speaker



FT-710 Aess | HF/50MHz 100W SDR Transceiver

- Unmatched SDR Receiving Performance • Band Pass Filters Dedicated for the Amateur Bands • High Res. 4.3-inch TFT Color Touch Display • AESS Acoustic Enhanced Speaker System with SP-40 For High-Fidelity Audio • Built-in High Speed Auto Antenna Tuner



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FDX101 | HF/50MHz 100 W SDR Transceiver

- Narrow Band and Direct Sampling SDR • Down Conversion, 9MHz IF Roofing Filters Produce Excellent Stage Factor • 5-Full-Color Touch Panel W/3D Spectrum Stream • High Speed Auto Antenna Tuner • Microphone Amplifier W/3-Stage Parametric Equalizer • Remote Operation w/optional LAN Unit (SD-LAN10)



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- Stable 100 Watt Output • 32-Bit DSP • Large Dot Matrix LCD Display with Quick Spectrum Scope • USB Port Allows Connection to PC with a Single Cable • CAT Control, FT118TTY Control



FT-70DR C4FM/FTM 144/430MHz Xcvr

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 • PHONE - Toll-free phone hours 9:30AM - 5:30PM
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