The Hellgate Static
Nov 2024

Hellgate Amateur Radio Club
P.O. Box 3811, Missoula, MT. 59806-3811
Web: www.w7px.org

Inside this issue:

Oct Testing Results
Oct Meeting Minutes
HARC Inventory: These Items are for Sale
Basic Analog Power Supply Design
A Note on Efficiency
Nov Meeting Agenda
Nov HARC calendar
HARC Events

Officers:

President: NZ7S
Vice-President: W7RPG
Treasurer: KJ7YHG
Secretary: K7MSO

Positions:

Emergency Coordinator: contact_us@w7px.org
QSLs, Awards: contact_us@w7px.org
Webmaster: contact_us@w7px.org
Asst Webmaster: editor@w7px.org
License Exams Contact VE:
harc.ve.testing@gmail.com
Static Editor: editor@w7px.org

Repeater Committee:

W7RPG (Chair)
K7QA --- Dec 2022 for (23/24)
KG7WYO – Dec 2022 for (23/24)
N7PAS -- Dec 2023 for (24/25)
KI7PCR -- Dec 2023 for (24/25)

Buy-Sell Operations hfc@w7px.org
W7XT, K0SN, K7QA

Coming Events 2024

Nov	11	HARC Testing, Meeting
		Veterans Day
Nov	28	Thanksgiving Day
Dec	07	Skywarn Day - (1700F-1700S)
Dec	09	HARC Testing,
		Christmas Dinner Meeting

HARC Nov Meeting

Program: None

RADIO TESTING EXAMS AND MEETING

The testing and meeting are on the 2nd Monday of each Month.
We are having in-person, electronic testing and monthly meetings.
The Radio license Exams are from 5:30-6:30PM
Meetings which start at 7:00PM (Program & Business).
Both will be held at **The Church of Jesus Christ of Latter Day Saints**, 3026 South Avenue West, across the street from Big Sky High School.
Use the North entrance as all others will be locked.

Published: 6 Nov 2024 @ 6:00 PM by N7PAS

14 Oct 2024 Exam Testing Results

Congratulations to:

1. **Lance Fisher** of Missoula has passed his **Technician** exam. His call sign is **KK7VWE**.
2. **Saxton Holbrook** of Clinton has passed his **Technician** exam. His call sign is **KK7VVN**.
3. **William Stout** of Missoula has passed his **Technician** exam. His call sign is **KK7VWT**.
4. **Bradley Warren** of Hamilton has passed his **Tech & Gen** exam. His call sign is **KK7VXQ**.

14 Oct 2024 HARC Meeting Minutes

Meeting called to order @ 7:02 PM

1. **Attendance:** N7PAS, AG7FH, W7RPG, KK7QJH, K7INJ, K7MTD, K7MSO, K7QA, AI7XI, KK7NOM, NZ7S. **Quorum - Y**
   Visitors: Calvin Wright KB7AVD, Robin Wright
   NOTE: 11 Members / 2 Visitors present. Thank you to all that attended.

2. **Last meeting minutes, Jul:** Motion to approve minutes: 1st K7MTD 2nd N7PAS
   Discussion __None_____ Vote: Passed
3. **Treasurer's report Aug-Oct, KJ7YHG:** _Absent, Nothing to report _____
   _____ Motion to approve report 1st _____ 2nd _____Vote: Tabled
4. **Repeater Committee W7RPG:** Replacement 147.04 repeater is doing very well. Second repeater in the valley floor 146.80 Mhz, 88.5 hz tone_____ 1st _____ 2nd _____ Vote: ____
5. **HF Committee Report K0SN:** Needs some more people. Takes organizing. We have a lot of stuff.
   _____Motion to approve report 1st _____ 2nd _____ Vote: ____

6. **Up Coming Events:**
   1.) Shakeout 10/17 @ 10:17 147.04 Repeater
   2.) Mushers Dirt Dash Canceled
   3.) Skywarn Recognition Day on 7 December at Missoula Weather Service Office at airport.

7. **New Business:** **a.** Christmas Meeting: 9 December @ 7 p.m. Catered Dinner from Famous Dave's, No Alcohol, white elephant gift exchange. $10.00 per person, Club picks up the rest. Motion to approve above funds 1st W7RPG 2nd N7PAS Vote: Passed.
   b. Lance Collister will present the December program. The following from Lance:

Hi Dale,
I am currently still in ZD9 waiting for the ship to take me to Cape Town, South Africa next week. But my XYL Karen Orzech and I will attend the December meeting and I will present a PowerPoint of the first ever EME operation from the most remote settlement on Earth. VY 73, Lance W7GJ.

8. **Net Control Operators**

Oct	02	N7PAS	Nov	06	N7PAS
Oct	09	K7MSO	Nov	13	K7MSO
Oct	16	W7RPG	Nov	20	K7MSO
Oct	23	K7MSO	Nov	27	NZ7S
Oct	30	N7JGS	___	__	_____

9. **Good & Welfare:** 1.) K0SN sent K3 in for repair.

Meeting adjourned at 8:06 PM. Minutes by K7MSO

HARC INVENTORY -- FOR SALE

HARC INVENTORY For Sale IF YOU DON'T LIKE PRICE, MAKE AN OFFER!

SEND EMAIL TO HFC@W7PX FOR INFO OR TO MAKE PURCHASE

Lines 1-34 are new additions to list, donated by Terry Cook. Check 'em out!!

Displayed values are for item in good working order after being tested.

Line	ITEM	MAKE	MODEL	CONDITION	VALUE	STORED	Remarks
1	Custom Hotspot	Nex-Gen		untested	?	NZ7S	
2	Speech Intel. Enhancer	MFJ	616	untested	$75.00	NZ7S	Ebay used price $150
3	SignaLink USB	Tigertronics		untested	$65.00	NZ7S	New price $130
4	VHF Hand Held	BendixKing	LPH5143	untested	$37.00	NZ7S	Ebay used $75
5	VHF Hand Held	Icom	F70DT	untested	$45.00	NZ7S	Ebay used $85
6	VHF Hand Held	Alinco	DJ-G5	untested	$65.00	NZ7S	Ebay used $130
7	Foot Switch	?	?	untested	?	NZ7S	
8	Mounting Bracket	Icom	MBF-1	untested	$25.00	NZ7S	w/suction Cup
9	QRM Eliminator	X-phase		untested	$30.00	NZ7S	
10	Aluminum Proj. box			untested	$5.00	NZ7S	
11	Hybrid Phone Patch	Heathkit		untested	$5.00	NZ7S	
12	2M/440 Mobile Xcvr	Kenwood	TM721A	untested	$50.00	NZ7S	inc. diplexer
13	Pactor controller	SCS	PTC-II Pro	untested	$150.00	NZ7S	Ebay used $400
14	Multi-mode TNC	AEA	PK232 MBX	untested	$25.00	NZ7S	Ebay used $50-200
15	Noise cancelling spkr	BHI	?	untested	$30.00	NZ7S	works by DSP
16	Foot switch	Clipper		untested	$15.00	NZ7S	
17	Mobile Antenna Tuner	Icom	AH-4	untested	$75.00	NZ7S	Ebay used $250-350
18	Auto. Antenna tuner	Icom	AT-140	New	$275.00	NZ7S	Used $350, new $575
19	Deluxe Versa Tuner	MFJ		untested	$55.00	NZ7S	Ebay used $70-250
20	Bracket for mobile rad.	Icom	MBF-4	untested	$5.00	NZ7S	Ebay used $15
21	External Speaker	Icom	SP-35	untested	$15.00	NZ7S	
22	Speaker Mic	Motorola		untested	$5.00	NZ7S	
23	Remote Software	Icom	RS-BA1	untested	?	NZ7S	
24	HF + 50 mhz. xcvr	Icom	IC-7300	untested	$500.00	NZ7S	DXE New $1100
25	HF Mobile Xcvr	Kenwood	TK-90	untested	$500.00	NZ7S	w/ALE module. $1300
26	HF Xcvr	Icom	F-8101	New	$2,000.00	NZ7S	w/ALE new $2850
27	HF Xcvr	Icom	F-8101	untested	$1,400.00	NZ7S	used
28	AutoTuner, 150W.(qty3	SGC	SG230	untested	$200.00	NZ7S	Ebay used $165-700
29	Auto Tuner, 500 W.	SGC	SG235	untested	$350.00	NZ7S	
30	Microphone w/ boom	Heil	HM 12	untested	$60.00	NZ7S	New $160
31	Electronic Keyer	Heathkit		untested	$20.00	NZ7S	
32	Mobile Antenna Mount	SGC	QMS-??	untested	$40.00	NZ7S	new $90-170
33	12V Power Supply	Samlex	SEC-1235M	untested	$50.00	NZ7S	new $190
34	Auto Tuner	SEA	??	untested	$40.00	NZ7S	
35	Computer	Dell	Latitude	Fair	$100.00	?	
36	Pow Supply 220-225mhz	Mirage	C106G	Good	$25.00	?	
37	Radio-Hand Held 2 met.	Realistic	HTX 202	Good	$50.00	?	
38	Portable Repeater		TM-241X2	?		?	

39	Triband Beam	Hy-Gain		Few Missing parts	$100.00	K0SN	
40	Tuner	Signal Corps	BC939B	Parts only	$25.00	K0SN	parts only, no cabinet
41	Speaker + Power Supply	Drake	MS-4 + AC4	Not tested	$75.00	K7QA	needs upgrade
42	Reflected Pwr Mtr	Heathkit	HM-15	Works	$10.00	K7QA	
43	Mobile Tuning Mtr	Heathkit	PM-2	Untested	$10.00	K7QA	
44	Trap Vertical	Hygain	14AVQ	Untested	$150.00	K7QA	
45	2 Mtr HH Transceiver	Realistic	HTX-202	Error Code	$25.00	K7QA	
46	Spkr. w/vol. control	Yaesu		Untested	$50.00	K7QA	
47	1993 ARRL Handbook			like new	free	K7QA	
48	Handbooks	ARRL	1950-1980	OK	Free	KGVO	
49	Vintage Mic	Astatic	JT-30	Untested	$50.00	KGVO	Ebay sales $50-300
50	13.8V, 20A power supp.	Astron	RS20A	No output	$15.00	KGVO	
51	RC checker	CDE		untested	$30.00	KGVO	
52	Rotor	CDE?		untested	$50.00	KGVO	w/ control head
53	Transceiver	Collins	RT-91ARC-2	untested	$100.00	KGVO	Aircraft Military
54	Transverter Interface	Down E. Micro		untested	offer	KGVO	
55	Low pass Filter	Drake	TV-3300	untested	$20.00	KGVO	
56	Receiver	Hallicrafters	SX-100	fair	$150.00	KGVO	
57	Receiver	Hallicrafters	SX-62B	untested, poor	$75.00	KGVO	no cabinet top
58	Vintage Speaker	Hallicrafters	PM 23	Nice, untested	$150.00	KGVO	
59	Vintage Speaker	Hammarlund	S-100	Nice, untested	$60.00	KGVO	
60	AC Power Supply	Heath Kit	HP-23-A	works		KGVO	for the HW-101
61	SSB Transceiver	Heath Kit	HW-101	needs repair		KGVO	Ebay $90-300
62	HF Xcvr + Power Supply	Heathkit		untested	$150.00	KGVO	
63	Oscilloscope	Heathkit	IO-4105	untested	$30.00	KGVO	
64	Power/SWR Meter	Heathkit	HM15	untested		KGVO	
65	Vertical antenna		Dipole 80	?		NOAA	
66	Receiver	Heathkit	HR-10	untested, poor	offer	KGVO	Ebay sales $100-300
67	SSB Adapter	Heathkit		untested	$40.00	KGVO	
68	Test Oscillator	HP	650A	untested	offer	KGVO	
69	Rotor Control	Hygain	DCU-1	untested	$200.00	KGVO	
70	2M FM Transceiver	Kenwood	TR7400A	no output	$10.00	KGVO	
71	HF Transceiver +Man	Kenwood	TS-520	non-working	$100.00	KGVO	
72	Transmitter	Meissner	9-1160 (tube)	good		KGVO	was in use
73	Voice Keyer	MFJ	MFJ-432	untested	$30.00	KGVO	
74	Fwd/Refl. pwr meter	Midland	23-126	untested	$10.00	KGVO	
75	2 mtr mobile Xcvr	Radio Shack	HTX-242	untested	$40.00	KGVO	
76	Field str/SWR meter	Radio Shack		untested	$10.00	KGVO	
77	VHF/UHF/FM amp	Radio Shack		untested	$20.00	KGVO	
78	Gen. Coverage Rvr.	Realistic	DX302	untested	$125.00	K7MTD	Ebay sales $80-350
79	Receiver	Signal Corps	R-392/URR	fair	$300.00	KGVO	Stromberg Carlson
80	VTVM	Simpson	311	untested	$25.00	KGVO	
81	Oscilloscope	Telequip.		untested	$20.00	KGVO	
82	Var. power resistors	Tru-ohm, etc		untested	$10.00	KGVO	box of ~20
83	Scanner	Uniden	BC9000	works	$50.00	KGVO	
84	BUG KEY	unknown		fair		KGVO	

85	Speaker	Yaesu	SP-8	Good, works	$125.00	K0SN	
86	Many electronic parts too numerous to list.				offer	KGVO	some free, door prizes
87	Misc. meters			untested,	$40.00	KGVO	2 boxes full
88	RCA male Patch cords			good	$10.00	KGVO	box of ~20
89	Peter Dahl 10 HY @ 1 A		new	new		KGVO	
90	Peter Dahl 40 HY @.6 A		new	new		KGVO	
91	Peter Dahl 9 HY @ 1.5A		NEW	NEW	$200.00	KGVO	66 pounds – pick up only
92	Peter Dahl Swgng Choke		new	new		KGVO	
93	Antenna Tuner	Icom	AH-4			?	
94	Voice Synthesizer	Icom	UT-102			?	
95	Antenna Tuner + man	MFJ	MFJ-934			?	
96	RTTY CW	MFJ		?		?	
97	TRIPLEXER	Comet	CFX-324			K7MTD	
98	DUPLEXER	Comet		works		KGVO	
99	WATTMETER/SWR	MFJ	864	works	$10.00	K7MTD	
100	2 mtr, 30 Watt amp	Mirage	B23	works	$25.00	K7MTD	
101	Microphone	Astatic	D104, SE	needs work	offer	K7QA	
102	Vintage Mic	Astatic	JT-30	worn, untested	$50.00	KGVO	Ebay sales $50-300
103	Rotor Control	Hygain	DCU-1	untested	$100.00	KGVO	
104	Power Supply	Heathkit	HP23C	untested	$40.00	KGVO	Looks nice
105	VHF/UHF Transverter	Yaesu	FTV-700	untested		KGVO	Looks good
106	Transceiver-HF	Heathkit	SB-101	untested	$40.00	KGVO	Looks OK needs clean
107	Transmitter-HF	Heathkit	DX-20	untested	$30.00	KGVO	Looks good
108	Receiver	Knight	R-100	untested	$30.00	KGVO	
109	Tube Tester	Sencore	MightyMite7	untested	$30.00	KGVO	
110	RF Signal Generator	Heathkit		untested	$20.00	KGVO	
111	HF Transceiver	Yaesu	FT757GX	untested	$50.00	KGVO	Looks OK
112	Auto Antenna Tuner	Yaesu	FC-757AT	untested	$150.00	KGVO	Ebay used $300-400
113	Transmitter	Heathkit	DX-100B	untested	$30.00	KGVO	

HF COMMITTEE LOOKING FOR A FEW VOLUNTEERS
Some people are needed for following club projects.
Most will be done over the winter months.

- Testing and marketing of donated gear.
- Shipping sold gear.
- Maintenance & improvements on field day equipment- antennas, radio accessories, etc.
- Organizing club's equipment storage facility.
- Other items as decided by the HF committee.

Please send email to HFC@W7PX.org if you can help.

Basic Analog Power Supply Design

By Gerard Fonte

There's the old saying: “You can give a man a fish and he will eat for a day or you can teach a man to fish and he will eat forever.” There are many articles that give the reader a specific design for building a power supply, and there's nothing wrong with these cookbook designs. They often have very good performance. However, they don’t teach the readers how to design a power supply by themselves. This two-part article will start from the beginning and explain every step necessary to build a basic analog power supply. The design will focus on the ubiquitous three-terminal regulator and include a number of enhancements to the basic design.

It's always important to remember that the power supply — either for a particular product or as a general piece of test equipment — has the potential to electrocute the user, start a fire, or destroy the device it's powering. Obviously, these are not good things. For that reason, it's critical to approach this design conservatively. Provide plenty of margin for components. A well-designed power supply is one that is never noticed.

Input Power Conversion

Figure 1 shows the fundamental design for a typical analog power supply. It consists of three main components: input power conversion and conditioning; rectification and filtering; and regulation. The input power conversion is typically a power transformer and is the only method considered here. However, there are a couple of points that are important to mention.

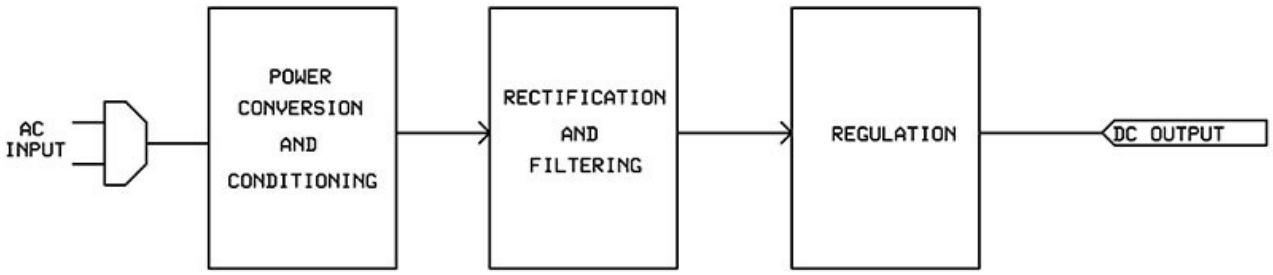

FIGURE 1. A basic analog power supply consists of three parts. The first two are discussed in this article and the last in the next installment.

The first is that 117 VAC (Volts Alternating Current) is really an RMS (Root Mean Square) measurement. (Note that I've seen ordinary household power specified anywhere from 110 VAC to 125 VAC. I just measured mine and found it to be precisely 120.0 VAC.) An RMS measurement of a sine wave is much lower than the actual peak voltage and represents the equivalent DC (Direct Current) voltage needed to provide the same power.

The RMS conversion varies according to the wave shape; for a sine wave, the value is 1.414. This means that the deviation around zero volts is actually 169.7 volts (for my 120 VAC power). The power goes from -169.7 volts to +169.7 volts each cycle. Therefore, the peak-to-peak voltage is actually 339.4 volts!

This voltage becomes especially important when adding bypass capacitors to the main power lines to suppress noise from entering or leaving the power supply (a common situation). If you think the actual voltage is 120 volts, you may use 150 volt capacitors. As you can see, this is not correct. The absolute minimum safe working voltage for your capacitors is 200 volts (250 volts is better). Don’t forget that if you expect to see noise/spikes on the line, you need to add that noise/spike voltage to the peak voltage.

The input frequency is universally 60 Hz in the USA. In Europe, 50 Hz is common. Transformers rated for 60 Hz will generally perform well on 50 Hz and vice versa. Additionally, the frequency stability of the power line is usually excellent and rarely a consideration. Occasionally, you may find 400 Hz transformers available. These are typically military or aeronautical devices and are generally not suitable for use on 50/60 Hz power (or vice versa).

The output of the transformer is also specified as an RMS voltage. Additionally, the voltage specified is the minimum voltage expected under full load. Often there is about a 10% increase in the rated output with no-load. (My 25.2 volt/two-amp transformer measures 28.6 volts with no load.) This means that the actual no-load/peak output voltage for my 25.2 volt transformer is 40.4 volts! As you can see, it's always important to remember that the rated RMS voltages for AC power are substantially less than the actual peak voltages.

Figure 2 provides a typical input power conversion and conditioning design. I prefer to use a double-pole switch although it's not absolutely necessary. It protects against miswired electrical outlets (which is rare today) or miswired power leads in the power supply itself (much more common). It's vital that when the power switch is off, the hot lead is disconnected from the power supply.

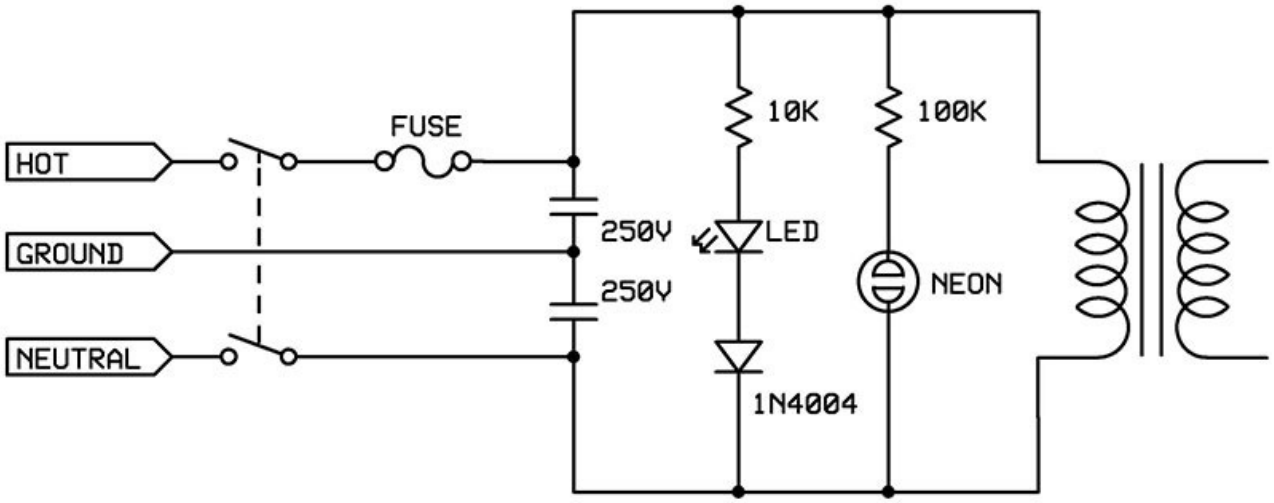

FIGURE 2. The input conditioning is pretty basic, but it must be remembered that the RMS voltage is not the same as the peak voltage. The peak voltage of 120 VAC RMS is about 170 volts.

The fuse (or circuit breaker) is necessary. Its main purpose is to prevent fires because without it, a transformer or primary circuit short will allow massive currents to flow causing metal parts to get red or even white hot. It's usually a slow-blow type rated at 250 volts. The current rating should be about double of what the transformer can expect to draw.

For example, the 25.2 volt two-amp transformer mentioned above will draw about 0.42 amps of primary current (25.2 volts/120 volts x two amps). So, a one amp fuse is reasonable. A fuse in the secondary will be discussed in the next article.

The bypass capacitors help to filter out noise and are optional. Since the peak voltage is about 170 volts, a 250 volt rating is better than a marginal 200 volt rating. You may want to use a “power-entry filter.” There are many types of these units. Some contain a standard power connector, switch, fuse holder, and filter in one small package. Others may have only some of these components. Typically, the ones with everything are fairly expensive, but surplus units can usually be found at very reasonable prices.

Being able to determine if the primary circuit is powered is important so a pilot light is used. Two typical circuits are shown. The neon lamp has been used for decades. It's simple and inexpensive. It has the drawbacks that it is somewhat fragile (being made of glass); can flicker if the resistor is too big; and can actually generate some electrical noise (due to the sudden ionic breakdown of the neon gas).

The LED circuit also requires a current-limiting resistor. At 10,000 hms, about 12 mA of current is provided. Most LEDs are rated for a maximum current of 20 mA, so 12 mA is reasonable. (High efficiency LEDs may work satisfactorily with only 1 or 2 mA, so the resistor can be increased as required.)

Note that LEDs have really poor reverse breakdown voltages (typically 10 to 20 volts). For that reason, a second diode is necessary. This must be able to operate with at least 170 volts of PIV (Peak Inverse Voltage). The standard 1N4003 is rated at 200 PIV which doesn’t provide much margin. The 1N4004 is rated at 400 PIV and costs perhaps a penny more. By placing it in series with the LED, the overall PIV is 400 plus the LED PIV.

Rectification and Filtering

Figures 3, **4**, and **5** show the most typical rectification circuits with the output waveform displayed above. (The filter capacitor is not shown because by adding it, the waveform changes to something like a DC voltage.) It's useful to examine these three basic circuits to identify the strengths and weaknesses of them.

Figure 3 shows the basic half-wave rectifier. The only redeeming characteristic of this is that it's very simple, using only a single rectifier. The bad feature is that it uses only half of the power cycle making the theoretical efficiency of the circuit less than 50% just to start. Often, half-wave rectifier power supplies are only 30% efficient. Since transformers are expensive items, this inefficiency is very costly. Secondly, the wave shape is very difficult to filter. Half the time there's no power at all coming from the transformer. Smoothing the output requires very high values of capacitance. It's rarely used for an analog power supply.

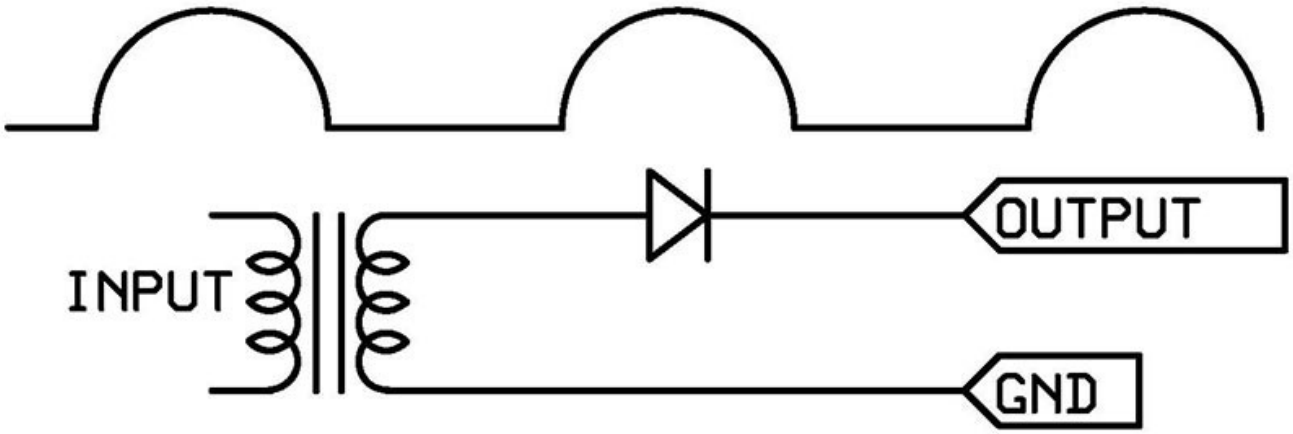

FIGURE 3. The half-wave rectifier circuit is simple but it produces a poor output waveform that is very difficult to filter. Additionally, half of the transformer power is wasted. (Note that the filtering capacitors are omitted for clarity because they change the waveform.)

An interesting and important thing happens when a filter capacitor is added to a half-wave rectifier circuit. The no-load voltage differential doubles. This is because the capacitor stores energy from the first half (positive part) of the cycle. When the second half occurs, the capacitor is holding the positive peak voltage and the negative peak voltage is applied to the other terminal causing a full peak-to-peak voltage to be seen by the capacitor and through that, the diode. Thus, for a 25.2 volt transformer above, the actual peak voltage seen by these components can be over 80 volts!

Figure 4 (top circuit) is an example of a typical full-wave/center-tap rectifier circuit. When this is used, in most cases, it probably shouldn’t be. It provides a nice output that is fully rectified. This makes filtering relatively easy. It uses only two rectifiers, so it’s pretty inexpensive. However, it's no more efficient than the half-wave circuit presented above.

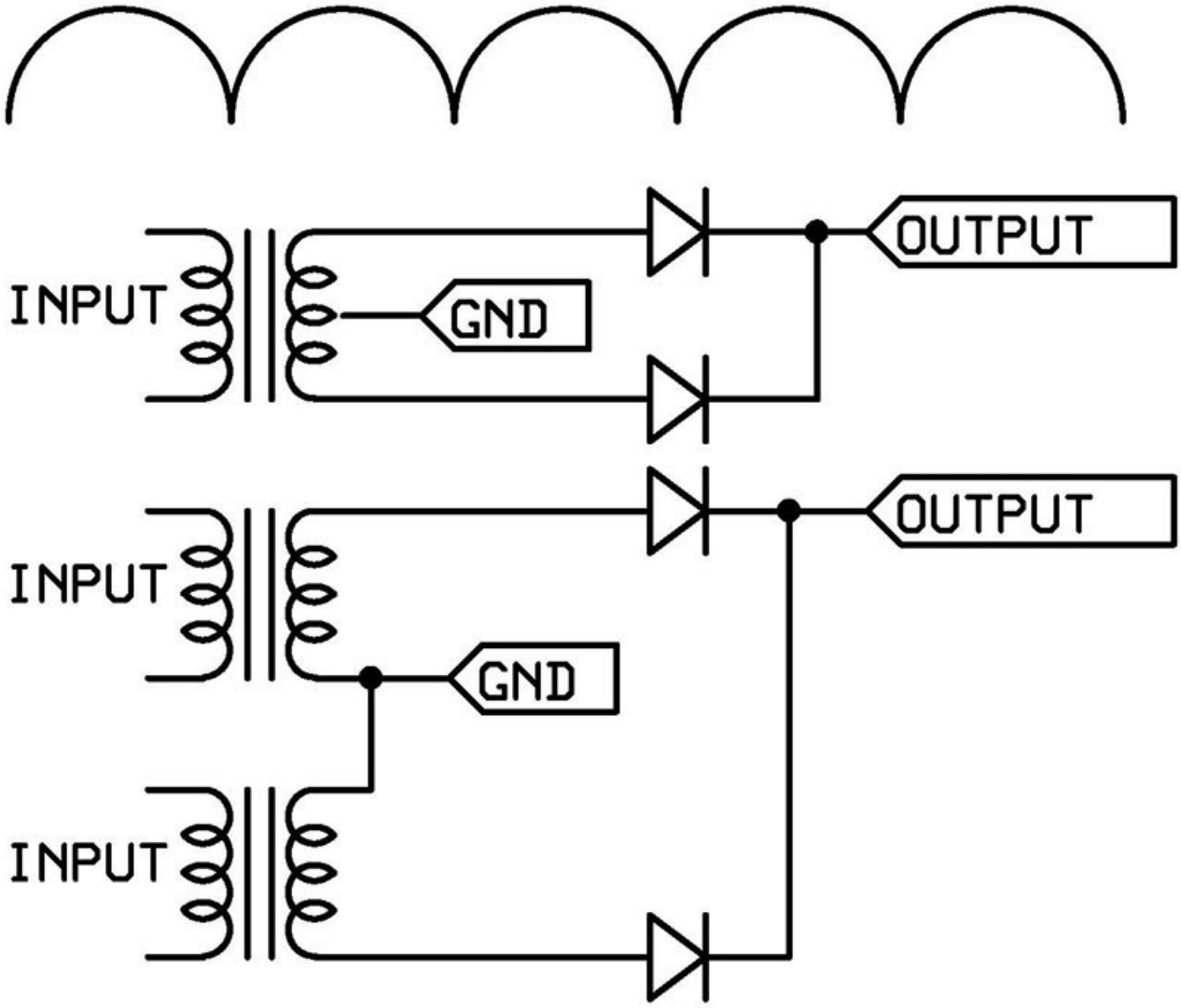

FIGURE 4. The full-wave design (top) produces a nice output. By redrawing the circuit (bottom), it can be seen that it's really just two half-wave rectifiers connected together. Again, half the transformer power is wasted.

This can be seen by re-drawing the circuit with two transformers (**Figure 4** bottom). When this is done, it becomes clear that the full-wave is really just two half-wave circuits connected together. Half of each transformer power cycle is not used. Thus, the maximum theoretical efficiency is 50% with real efficiencies around 30%.

The PIV of the circuit is one half of the half-wave circuit because the input voltage to the diodes is half of the transformer output. The center tap provides half the voltage to the two ends of the transformer windings. So, for the 25.2 volt transformer example, the PIV is 35.6 volts plus the no-load increase which is about 10% more.

Figure 5 presents the bridge rectifier circuit which should generally be the first choice. The output is fully rectified so filtering is fairly easy. Most importantly, however, it uses both halves of the power cycle. This is the most efficient design and gets the most out of the expensive transformer. Adding two diodes is much less expensive than doubling the transformer power rating (measured in “Volt-Amps” or VA).

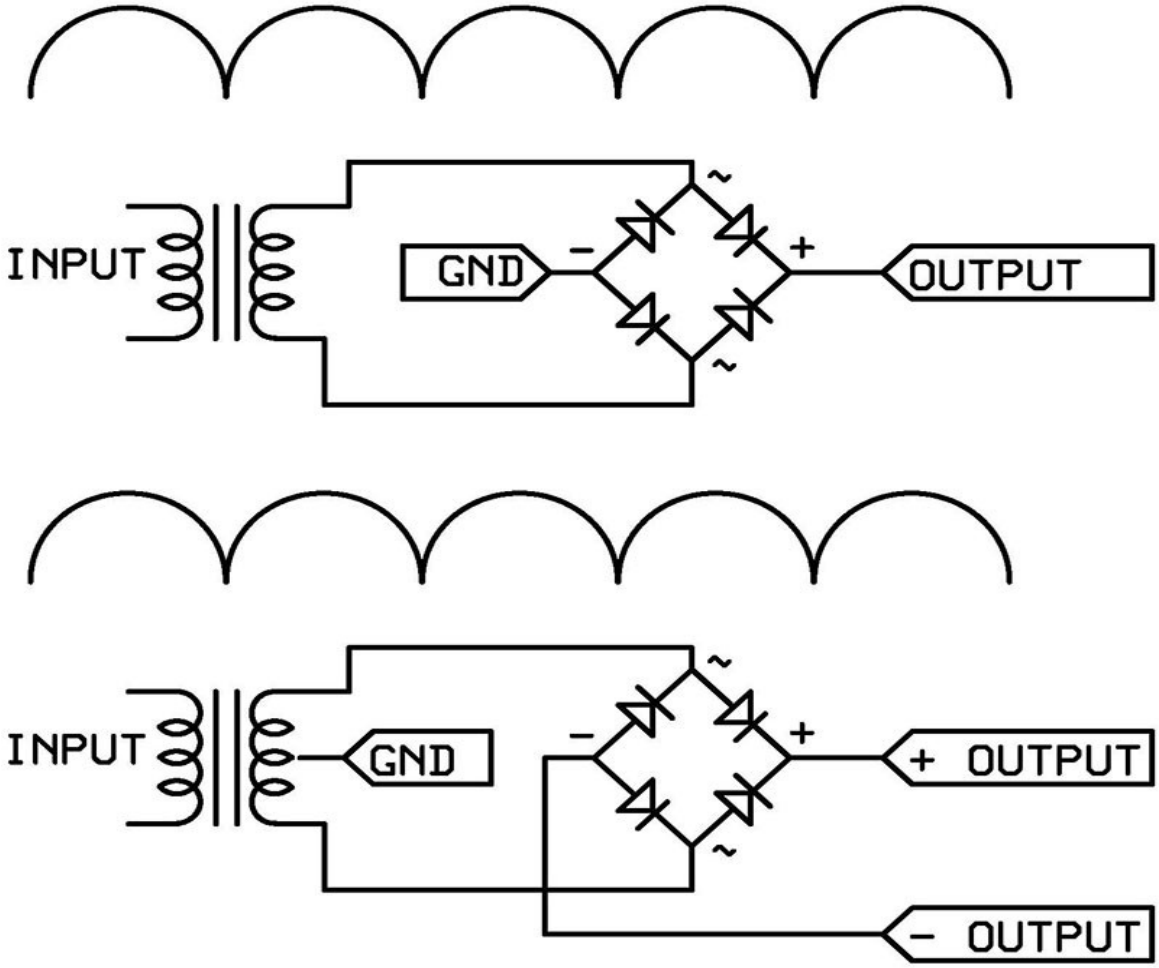

FIGURE 5. The bridge rectifier approach (top) provides full use of the transformer power and with a full-wave rectification. Additionally, by changing the ground reference (bottom), a dual voltage power supply can be obtained.

The only drawback to this design is that the power must pass through two diodes with a resulting voltage drop of 1.4 volts instead of 0.7 volts for the other designs. Generally, this is only a concern for low voltage power supplies where the additional 0.7 volts represents a substantial fraction of the output. (In such instances, a switching power supply is usually used rather than either of the above circuits.)

Since there are two diodes being used for each half-cycle, only half of the transformer voltage is seen by each. This makes the PIV equal to the peak input voltage or 1.414 times the transformer voltage, which is the same as the full-wave circuit above.

A very nice feature of the bridge rectifier is that the ground reference can be changed to create a positive and negative output voltage. This is shown in the bottom of **Figure 5**.

Circuit	Filter Needs	PIV Factor	Transformer Use
Half-Wave	Large	2.82	50% (theoretical)
Full-Wave	Small	1.414	50% (theoretical)
Bridge	Small	1.414	100% (theoretical)

TABLE 1. A summary of the characteristics of the various rectifier circuits.

Filtering

Nearly all filtering for an analog power supply comes from a filter capacitor. It's possible to use an inductor in series with the output, but at 60 Hz, these inductors must be quite large and are expensive. Occasionally, they are used for high-voltage power supplies where suitable capacitors are expensive.

The formula for calculating the filter capacitor (C) is quite simple, but you need to know the acceptable peak-to-peak ripple voltage (V), half-cycle time (T), and current drawn (I). The formula is C=I*T/V, where C is in microfarads, I is in milliamps, T is in milliseconds, and V is in volts. The half-cycle time for 60 Hz is 8.3 milliseconds (reference: 1997 *Radio Amateur's Handbook*).

It's clear from the formula that the filtering requirements are increased for high current and/or low ripple power supplies, but this is just common sense. An easy-to-remember example is 3,000 microfarads per ampere of current will provide about three volts of ripple. You can work various ratios from this example to provide reasonable estimates of what you need fairly quickly.

One important consideration is the surge of current at turn-on. The filter capacitors act as dead shorts until they get charged up. The larger the capacitors, the greater this surge will be. The bigger the transformer, the greater the surge will be. For most low voltage analog power supplies (<50 volts), the transformer winding resistance helps somewhat. The 25.2 volt/two amp transformer has a measured secondary resistance of 0.6 ohms. This limits the maximum inrush to 42 amps. Additionally, the inductance of the transformer reduces this somewhat. However, there is still a large potential current surge at turn-on.

The good news is that modern silicon rectifiers often have huge surge current capabilities. The standard 1N400x family of diodes is usually specified with 30 amps of surge current. With a bridge circuit, there are two diodes carrying this, so worst-case is 21 amps each which is below the 30 amp specification (assuming equal current sharing, which is not always the case). Tthis is an extreme example. Generally, a factor of about 10 is used, instead of 21.

Nevertheless, this current surge is not something to be ignored. Spending a few cents more to use a three-amp bridge instead of a one-amp bridge may be money well spent.

Practical Design

We can now put these rules and principles to use and start to design a basic power supply. We'll use the 25.2 volt transformer as the core of the design. **Figure 6** can be seen as a composite of the previous figures but with practical part values added. A second pilot light in the secondary indicates its status. It also shows if there's a charge on the capacitor. With such a large value, this is an important safety consideration. (Note that since this is a DC signal, the 1N4004 reverse voltage diode is not needed.)

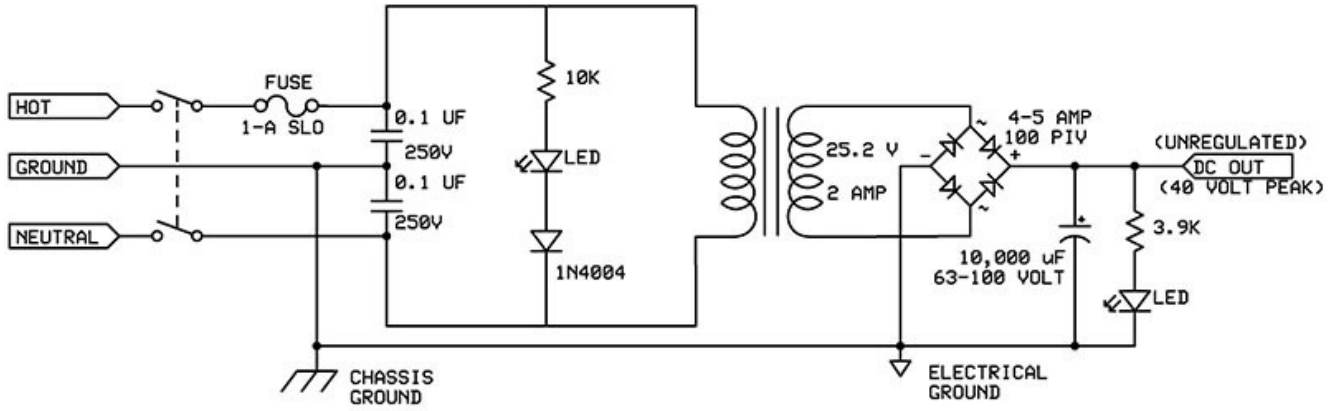

FIGURE 6. Final design of the power supply with practical parts specifications. Regulating the power is discussed in the next article.

It may be cheaper to use two smaller capacitors in parallel than one large one. The working voltage for the capacitor must be at least 63 volts; 50 volts is not enough margin for the 40 volt peak. A 50 volt unit provides only 25% margin. This may be fine for a non-critical application, but if the capacitor fails here, the results can be catastrophic. A 63 volt capacitor provides about a 60% margin while a 100 volt device gives a 150% margin. For power supplies, a general rule of thumb is between 50% and 100% margin for the rectifiers and capacitors. (The ripple should be about two volts, as shown.)

The bridge rectifier must be able to handle the high initial current surge, so spending an additional dime or two for improved reliability is worthwhile. Note that the bridge is specified by what the transformer can supply rather than what the power supply is eventually specified for. This is done in case there's an output short. In such a case, the full current of the transformer will be passed through the diodes. Remember, a power supply failure is a bad thing. So, design it to be robust.

Conclusion

Details are an important consideration in designing a power supply. Noting the difference between RMS voltage and peak voltage is critical in determining the proper working voltages for the supply. Additionally, the initial surge current is something that cannot be ignored.

In Part 2, we'll complete this project by adding a three-terminal regulator. We'll design a general-purpose, current-limited, adjustable voltage power supply with remote shut-off. Additionally, the principles used for this design can be applied to any power supply design. **NV**

A NOTE ON EFFICIENCY

Let me explain the difference between a full-wave rectifier design and a bridge — especially from the point of view of efficiency.

Remember I said half the power is wasted with a full-wave rectifier design. It's self-evident if you consider that a full-wave design is really made up of two half-wave designs. Combining two circuits that are each about 50% efficient doesn't in any way increase the total efficiency of the circuit. It's still about 50% overall.

The loss of efficiency comes from the amplitude of the resultant rectification. A half-wave circuit clearly provides half the amplitude that is available from the transformer. So does the full-wave version, but it's not as obvious. It only uses half of the total available voltage of the transformer.

The output of the full-wave rectifier is 1.414 times the voltage between the center tap and the end. The output of a bridge is the full end-to-end voltage of the transformer times 1.414. This is shown in **Figure A**.

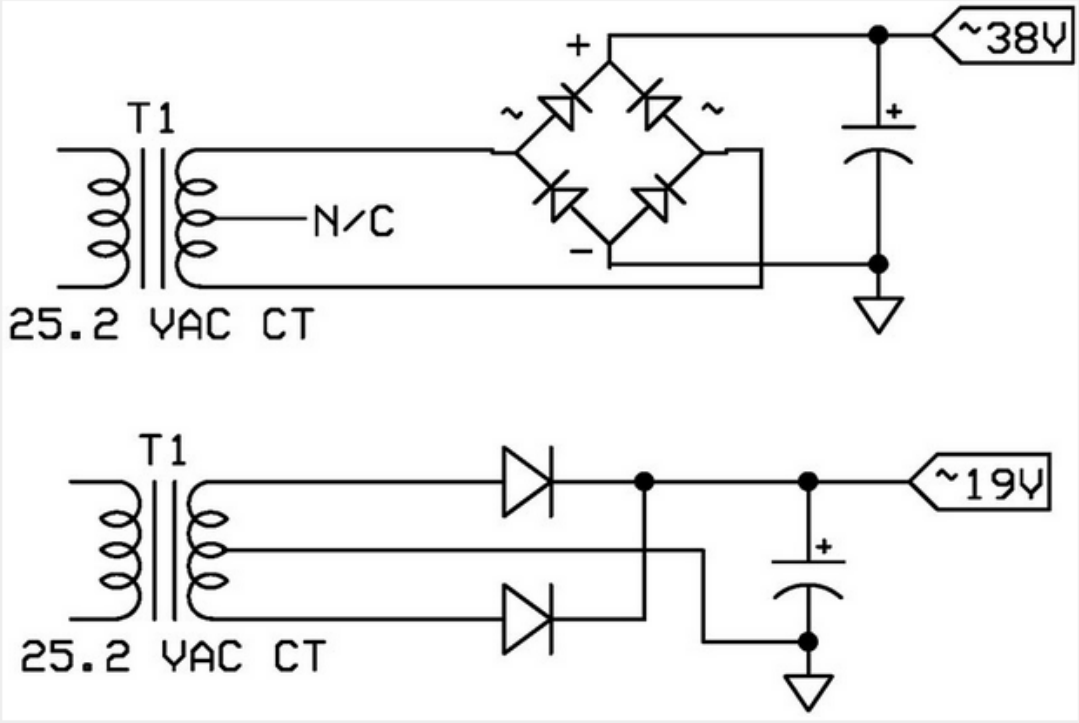

FIGURE A.

For the 25.2 volt transformer, the full-wave rectifier develops about 19 volts (unloaded). The bridge rectifier develops about 38 volts (unloaded). So, the full-wave rectifier does indeed waste about half the available power from the transformer.

HELLGATE AMATEUR RADIO CLUB

AGENDA – 11 Nov 2024 meeting

Meeting called to order at 7:__ PM (8 needed for business)
Introductions. Please make sure you signed the attendance sheet **Quorum Y/N ____**

Last meeting minutes, Oct: _____ Motion to approve minutes: 1St_____ 2nd_____
Discussion _____ Vote: P/F/T

Treasurer's report: KJ7HYG, _____Motion to approve report: 1St _____2nd _____
Discussion_____ _ Vote: P/F/T

Repeater Committee Report: W7RPG, _____Motion to approve report: 1St _____2nd _____
Discussion_____ _ Vote: P/F/T

HF Committee Report: K0SN, _____Motion to approve report: 1St_____2nd_____
Discussion _____ Vote: P/F/T

Events for 2024:

Nov	11	HARC Testing, Meeting, Veterns Day
Nov	28	Thanksgiving Day
Dec	07	Skywarn Day – (1700F-1700S) @ Weather Bureau
Dec	09	HARC Testing, Christmas Dinner Meeting

HARC Net every Saturday morning @ 9:00 AM on 147.040 Repeater – Buy/Sell – During.

HARC Discussion List

1. November – Nominations; and Voting for 2025 Officers _____
2. N7PAS is Chair for Christmas dinner on 9 December. Please sign up and pay your $10.00/ Person fee now so we can get an accurate count for the dinner. _____
3. _____

VHF Net Control Station assignments:

Nov	06	N7PAS	Dec	04	N7PAS	Jan	01	N7PAS
Nov	13	K7MSO	Dec	11	_____	Jan	08	_____
Nov	20	K7MSO	Dec	18	_____	Jan	13	HARC Meeting
Nov	27	NZ7S	Dec	25	_____			
___	__	_____	___	__	_____			

Reminder: Backup is always the next person in line as the net control.
Good and Welfare. _____

*** Next Club meeting: Dec 9 Dinner Only – No business will be conducted, Members Only ***
Is there any other business? _____
_____ Meeting Adjourned at _:__ PM.

Program: None

November 2024

Hellgate Amateur Radio Club

Calendar of Events

Board: NZ7S, W7RPG, KJ7THG, K7MSO

Editor – N7PAS

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			ERC Net 7:30 on 146.900-88.5T BARC Net 8:15 on 146.720-203.5T HARC Net 9:00 on 147.040-No Tone		1	2 HARC Saturday Net 9:00AM on 147.040 Repeater.
3	4	5	6 ERC Net 7:30 on 146.900-88.5T BARC Net 8:15 on 146.720-203.5T HARC Net 9:00 on 147.040-No Tone	7	8	9 HARC Saturday Net 9:00AM on 147.040 Repeater.
10	11 HARC Testing 5:30 & Meeting 7:00PM Program:??	12	13 ERC Net 7:30 on 146.900-88.5T BARC Net 8:15 on 146.720-203.5T HARC Net 9:00 on 147.040-No Tone	14	15	16 HARC Saturday Net 9:00AM on 147.040 Repeater
17	18	19	20 ERC Net 7:30 on 146.900-88.5T BARC Net 8:15 on 146.720-203.5T HARC Net 9:00 on 147.040-No Tone	21	22	23 HARC Saturday Net 9:00AM on 147.040 Repeater
24	25	26	27 ERC Net 7:30 on 146.900-88.5T BARC Net 8:15 on 146.720-203.5T HARC Net 9:00 on 147.040-No Tone	27	29	30

HARC Events: 2024 (Actual Dates to be filled in as they become known)

#	Month	Day	Activity
1.	Monthly		MARS Interoperability Exercises – Eric NZ7S will keep us advised. 1st week of each month for 2024. Check in on 60 meters. Noon and 8 pm.
2.	April		Grizzly Triathlon
3.	April	27	Riverbank Run
4.	June	04	Trail Rail Run
5.	June	22-23	Field Day
6.	June	28-30	Missoula Marathon – See Coming Events – pg 1
7.	July	04	W7PX Special 4th of July Event – Cabin needs to be reserved.
8	July	19-21	Glacier Waterton Hamfest
9.	Sept	03	Fox Hunt ?? 1 per year on Saturday from 10:00AM to 4:00PM
10.	Oct	??	Bitterroot Mushers Dirt Dash We have secured Lubrecht for Oct 10-12, 2025 and are planning to hold the event again next year and are excited to bring it back. Do you think your group would be interested? We sincerely appreciate your support and would have to significantly scale down our event without you
11.	Oct	17	Great Montana Shakeout Drill
12.	Oct	19-20	JOTA/JOTI
13.	Nov	05	Election Day - 5th ←------- We are here
14.	Dec	07	Sky Warn Recognition Day (0000Z-2359Z = 1700 Fri – 1659 Sat) Frist Fri Evening – Sat Morning/Afternoon every December – as listed below. *2 December 2023, **7 December 2024**, 6 December 2025, 5 December 2026, 4 December 2027, 2 December 2028, 1 December 2029*
15.	Dec	09	HARC Christmas Dinner Meeting

HARC Programs for 2025

Which amateur radio topic would you like to see presented?

Do you have a program that you would like to present?

Do you know of a person that has a certain level of expertise in amateur radio that could give a presentation?

If you would like to be involved in the presentations, please let me know.

Name_____

PH: _____

Email:_____

Please email me your thoughts @ dsbaldwin@live.com and I will compile a list of programs for the 2025 year

NOTE: Dec 09 is Christmas Dinner meeting – No business will be conducted.

This is a Members Only dinner, sign up is required.
There is a $10.00/Person fee (see 14 Oct 2024 HARC Meeting Minutes below.

7. New Business: a. Christmas Meeting: 9 December @ 7 p.m. Catered Dinner by Famous Dave's, No Alcohol, white elephant gift exchange. $10.00 per person, Club picks up the rest. Motion to approve above funds 1st W7RPG 2nd N7PAS Vote: Passed.)

Famous Dave's will be delivering and setting up the serving area @ about 6:45pm.

Dinner is 3 Meats, 2 Sides, Salad, + Dessert, Drinks, and Plates, Utinsels.
(I think I got this correct)

Please bring Dinner Fee with you and sign up at the 11 Nov meeting.

Thank You,

N7PAS is in charge of the Dinner and Fees.