The Hellgate Static

December 2023

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

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Coming Events:

Dec	07	Hanukkah begins at Sunset
Dec	08	2nd Half Taxes DUE
Dec	08	HARC Testing and Meeting
Dec	21	First Day of Winter
Dec	24	Christmas Eve
Dec	25	Christmas
Dec	31	New Years Eve
Jan	01	News Year Day

Officers:

President: NZ7S (Open)
Vice-President: K7MTD (Open)
Treasurer: W7XT (Open)
Secretary: secretary@k7px.org (Open)

See discussion list under 13 Nov Minutes

Positions:

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

Repeater Operations:

K7MTD (Chair)
K0SN Dec 2021 for (22/23) (Open)
K7QA Dec 2022 for (23/24)
N7PAS Dec 2022 for (23 – 1Yr) (Open)
KG7WYQ Dec 2022 for (23/24)

C&BL – Board + N7PAS and W7RPG

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

HARC November Meeting Program:

Winlink in-depth overview
by Mike K7MSO & Dave K7MTD

Membership Dues are due Nov-Jan

This is a reminder that all memberships except life end on Dec 31st. Please remember to pay your dues for the year 2024. Thank You.

TESTING AND EXAMS

We are having in-person monthly meetings and live in person electronic testing. The testing and meeting are on the 2nd Monday of each Month.
Meetings 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.

Testing will begin at 5:30PM, and end at 6:30PM.
Meeting area will be set up between 6:30-7:00PM and meeting will begin at 7:00PM (Program & Business).

Published: 1 Dec 2023 @10:00 PM by N7PAS

13 Nov 2023 Exam Testing Results

Congratulations to:

1. Victor Cavanaugh of Missoula passed his Technician exam. His new call sign is KK7PLH.
2. Arturo Jessop of Missoula passed his Technician exam. His new call sign is KK7PKZ.
3. Thomas Parell of Conner passed his General exam. His current call sign is KK7ORX.
4. Dennis Shackelford of Missoula passed his Technician exam. His new call sign is KK7PKB.

13 Nov 2023 HARC Meeting Minutes

Meeting called to order @ 7:01 PM

1. **Attendance**: NZ7S N7DLP KF7GZR K7MTD K0SN N7PAS AG7FH
   K7QA N7MSO W7XT KJ7YHG KK7NOM KK7KEK

   Visitors: Dennis Shackelford, new Tech KK7PKB

   NOTE: 13 Members present. Thank you to all that attended.
2. **Last meeting minutes, Oct:** Motion to approve minutes: 1St K7MTD 2nd K7QA
   Discussion _None_____ Vote: Passed
3. **Treasurer's report:** by W7XT. Discussion:_On amounts in Account's, and Reimbursements owed to K7MTD and K7QA. Motion to approve report: 1St _N7PAS_ 2nd _K0SN_ Vote: Passed
4. **Repeater Committee: 1. - .**90 still noisy – K7MTD, 2. - No WiFi @ Point 6**.** 3. - Agreement made to revisit purchasing a FM/Digital Repeater System Next Year. Motion to accept report: Motion – Approved.
5. **HF Committee Report**: Discussion 1. - K0SN made motion to send K3 in to Elecraft for Service. Motion seconded by K7QA. Motion Passed.
6. **Discussion List:**
   a. President NZ7S, announced that nominations for club officers for 2023 will now be accepted.
   b. Opened up the floor for Nominations: 1. - NZ7S agreed to run for President. 2. - VP position is open. 3. - KJ7HYG agreed to Treasurer Position. 4. - K7MSO agreed to continue as Secretary
   2 Positions for Repeater Operations are open for 2024-2025 years. N7PAS nominated for one, The second position is still open.
7. **New Business:**
   a. N7PAS reported that a friend in Seeley Lake might be open to using his place as a repeater site.
   b. $50.00 donation mailed to Club by Dan Bradshaw KE7JUT, who became a SK 4 days later.
8. **Net Control Operators**

Dec	06 N7PAS	Jan	03 N7PAS
Dec	13 N7JGS	Jan	10 _____
Dec	20 NZ7S	Jan	17 _____
Dec	27 K7MTD	Jan	24 _____
___	__ _____	Jan	31 _____

8. Good & Welfare:
   Meeting adjourned at 8:01 PM. Minutes by K0SN & N7PAS

Program: Adam Davis gave an ad hoc presentation on CAP Foxhunting Equipment

HARC INVENTORY -- FOR SALE

Line	ITEM	MAKE	MODEL	CONDITION	VALUE	STORED	REMARKS
1	Computer	Dell	Latitude	Fair	100	N7GE	
2	Pow Supply 220-225mhz	Mirage	C106G	Good	25	N7GE	
3	Radio-Hand Held 2 met.	Realistic	HTX 202	Good	50	N7GE	
4	Radio--2 meter	Yaesu	FT-2500M	Fair	$100	N7GE	
5	Portable Repeater		TM-241X2	?		N7GE	
6	Triband Beam	Hy-Gain		Few Missing parts	200	K0SN	
7	Tuner	Signal Corps	BC939B	Parts only	25	K0SN	parts only, no cabinet
8	Speaker + Power Supply	Drake	MS-4 + AC4	Not tested	75	K7QA	needs upgrade
9	Reflected Pwr Mtr	Heathkit	HM-15	Works		K7QA	
10	Mobile Tuning Mtr	Heathkit	PM-2	Untested		K7QA	
11	Trap Vertical	Hygain	14AVQ	Clean, untested	150	K7QA	
12	Transceiver-2 mtr	Kenwood	TR-7400A	Works	70	K7QA	
13	2 Mtr HH Transceiver	Realistic	HTX-202	Error Code	25	K7QA	
14	Speaker w/volume control	Yaesu		Untested	50	K7QA	
15	1993 ARRL Handbook			like new	free	K7QA	
16	Handbooks	ARRL	1950-1980	OK	Free	KGVO	
17	Vintage Mic	Astatic	JT-30	worn, untested	50	KGVO	Ebay sales $50-300
18	13.8V, 12A power supply	Astron	RS12A	works	30	KGVO	
19	C&R checker	CDE		untested	30	KGVO	
21	Rotor	CDE?		untested	50	KGVO	w/ control head
22	Transceiver	Collins	RT-91ARC-2	untested	100	KGVO	Aircraft Military
23	Transverter Interface	Down E. Micro		untested	offer	KGVO	
24	Low pass Filter	Drake	TV-3300	untested	20	KGVO	
25	Receiver	Hallicrafters	SX-100	fair	150	KGVO	
26	Receiver	Hallicrafters	SX28	very good	900	K0SN	
27	Receiver	Hallicrafters	SX-62B	untested, rough	75	KGVO	no cabinet top
28	Vintage Speaker	Hallicrafters	PM 23	Nice, untested	150	KGVO	
29	Vintage Speaker	Hammarlund	S-100	Nice, untested	60	KGVO	
30	AC Power Supply	Heath Kit	HP-23-A	works		KGVO	for the HW-101
31	SSB Transceiver	Heath Kit	HW-101	needs repair		KGVO	Ebay $90-300
32	HF Xcvr + Power Supply	Heathkit		untested	150	KGVO	
33	Oscilloscope	Heathkit	IO-4105	untested	30	KGVO	
34	Power/SWR Meter	Heathkit	HM15	untested		KGVO	
35	Vertical antenna		Dipole 80	?		NOAA	
36	Receiver	Heathkit	HR-10	untested, rough	offer	KGVO	Ebay sales $100-300
37	SSB Adapter	Heathkit		untested	40	KGVO	
38	Transceiver	Heathkit	SB102	good	250	KGVO	W/ matching spkr. & p.s.
39	Test Oscillator	HP	650A	untested	offer	KGVO	
40	Rotor Control	Hygain	DCU-1	untested	200	KGVO	
41	VHF Mobile Transceiver	Icom	IC-25A	fair, untested	30	KGVO	
42	Transceiver	Kenwood	TS-450S	Excellent	400	KGVO	
43	2M FM Transceiver	Kenwood	TR7400A	no output	10	KGVO	
44	HF Transceiver +Man	Kenwood	TS-520	non-working	100	KGVO	
45	Transceiver	Kenwood	TS-940	Needs Repair	250	KGVO	No output on CW, others
46	Transmitter	Meissner	9-1160 (tube)	good		KGVO	was in use
47	Voice Keyer	MFJ	MFJ-432	untested	30	KGVO	
48	Fwd/Refl. pwr meter	Midland	23-126	untested	10	KGVO	
49	2 mtr, 30 Watt amp	Mirage	B23	untested	25	KGVO	
50	20-40M QRP Transceiver	Oak Hills	QRP Classic	untested	30	KGVO	
51	13.8V, 10A P.S.	Pyramid	PS15-KX	Nice, untested	30	KGVO	
52	2 mtr mobile Xcvr	Radio Shack	HTX-242	untested	40	KGVO	
53	25A switching P.S.	Radio Shack		untested	40	KGVO	
54	Field str/SWR meter	Radio Shack		untested	10	KGVO	
55	VHF/UHF/FM amp	Radio Shack		untested	20	KGVO	

56	Gen. Coverage Rvr.	Realistic	DX302	untested	125	KGVO	Ebay sales $80-350
57	12V DC p.s.	Samlex		untested	25	KGVO	
58	Receiver	Signal Corps	R-392/URR	fair	300	KGVO	Stromberg Carlson
59	VTVM	Simpson	311	untested	25	KGVO	
60	Oscilloscope	Telequipment		untested	20	KGVO	
61	Var. power resistors	Tru-ohm, etc		untested	10	KGVO	box of ~20
62	Scanner	Uniden	BC9000	untested	50	KGVO	
63	BUG KEY	unknown		fair		KGVO	
64	12V DC Backup Power	West Mtn	PG40S	good, untested	25	KGVO	
65	Radio-Sound card interface	West Mtn	Riblaster Plus			KGVO	
66	HF Transceiver	Yaesu	FT-840	fair, works	300	KGVO	
67	Speaker	Yaesu	SP-8	Good, untested	125	KGVO	
68	VHF FM Transceiver	Yaesu	FT720RU	untested	25	KGVO	
69	VHF Transceiver	Yaesu	1500M	untested	75	KGVO	
70	Many electronic parts for amps, tuners, other projects, too numerous to list.				offer	KGVO	some free, door prizes
71	Misc. panel mount meters			untested,	40	KGVO	2 boxes full
72	Patch cords w/ RCA male			good	10	KGVO	box of ~20
73	Peter Dahl 10 HY @ 1 A		new	new		KGVO	
74	Peter Dahl 40 HY @ .6 A		new	new		KGVO	
75	Peter Dahl 9 HY @ 1.5A		NEW	NEW	200	KGVO	66 pounds - pick up only
76	Peter Dahl Swgng Choke		new	new		KGVO	
77	Antenna Tuner	Icom	AH-4			NZ7S	
78	Voice Synthesizer	Icom	UT-102			NZ7S	
79	Transceivers, qty.2	Kenwood	220-225 mhz.	?		NZ7S	
80	Antenna Tuner + man	MFJ	MFJ-934			NZ7S	
81	RTTY CW	MFJ		?		NZ7S	
82	Wattmeter/SWR	Coax. Dynam.	81021	com	200	KGVO	

Contact K0SN or W7XT at hfc@w7px.org for further information.

Hi All,.
We, The Club, are still looking for a club member volunteer to help K0SN with the packing and shipping of sold club gear. This is an important position because it is the major way that The Club is funded. If you are interested in helping with this important position, please send an email to hfc@w7px.org.

For SALE

Contact Vick at email: K7VKMT@gmail.com

Tower: Freestanding Aluminum Tower, 40’ Universal Brand. Four Sections for 12-40 with rotator plate.
Needs new 9/16 each section bolts (12) and a B-22 base-mount footing for a concrete base.
$400
Description and price new at DX Engineering: 12-40 Universal Towers Tower Sections - Free Shipping on Most Orders Over $99 at DX Engineering
Specs at: uvt-12-40.pdf (dxengineering.com)

See top of next page

Yagi: 5 band Mosely Pro-57-B. 20-17-15-12-10 meters
Recommend cleaning of all traps and segment connections prior to reassembly. This is a heavy-duty, 92 lb aluminum antenna. Manual included.
$300.
Specs and price new at Mosley Electronics | Communication Antennas (mosley-electronics.com)

New Idaho and Montana "Parks on the Air" Locations Added

By k7vk K7VK@ARRL.NET

POTA, ***Parks on the Air*** is the cool 'portable ham radio activity' for those hams willing to visit designated Parks and to operate portable. One can also stay at home and 'chase' those operating in the Parks. Activation rules, Park lists and location maps, and other information can be found at Parks on the Air | POTA. A recent POTA article in QST, December 2023 page 52 is a good brief introduction.

Mapping coordinators for Idaho and Montana have recently added new Parks to the list of POTAs.

Montana added 10 Parks bringing the total to 131. Idaho added 50 Parks bringing that total to 179.

New additions near Missoula are ***Milltown State Park*** K-10175 at the junction of the Clarkfork and Blackfoot Rivers and ***Garnet Ghost Town BLM Historic Preservation Site*** K-10521 up the Blackfoot River near Greenough, MT. Montana Mapping Coordinator K0HAA Nolan assures us that more Parks will be added to the Montana list.

New Parks in Idaho and accessible from Missoula are for the ***Kooskia National Fish Hatchery*** K-10446 over Lolo Pass, the ***Frank Church-River of No Return Wilderness Area*** K-10381 south of the Magruder Corridor Road over Nez Perce Pass west of Darby, MT, the ***Middle Fork Clearwater River National Wild and Scenic River*** K-10429 accessed by two routes; west of Darby over Nez Perce Pass on the Magruder Corridor and down the Selway River to Paradise or over Lolo Pass and up the Selway River southeast of Lowell, ID, and the ***St Joe River National Wild and Scenic River***, K-10430 southwest of St Regis, MT.

Several members of Hellgate ARC are participating in POTA and would be happy to answer questions or assist you. A few are K7MTD, K7MSO, KF7CBY, KR7Q, K7VK, N7BIO, and W7RPG. Catch them on 2-meters, local nets or email. Missoula has many designated POTA Parks nearby. Load up your portable or mobile rig and go enjoy the Parks.

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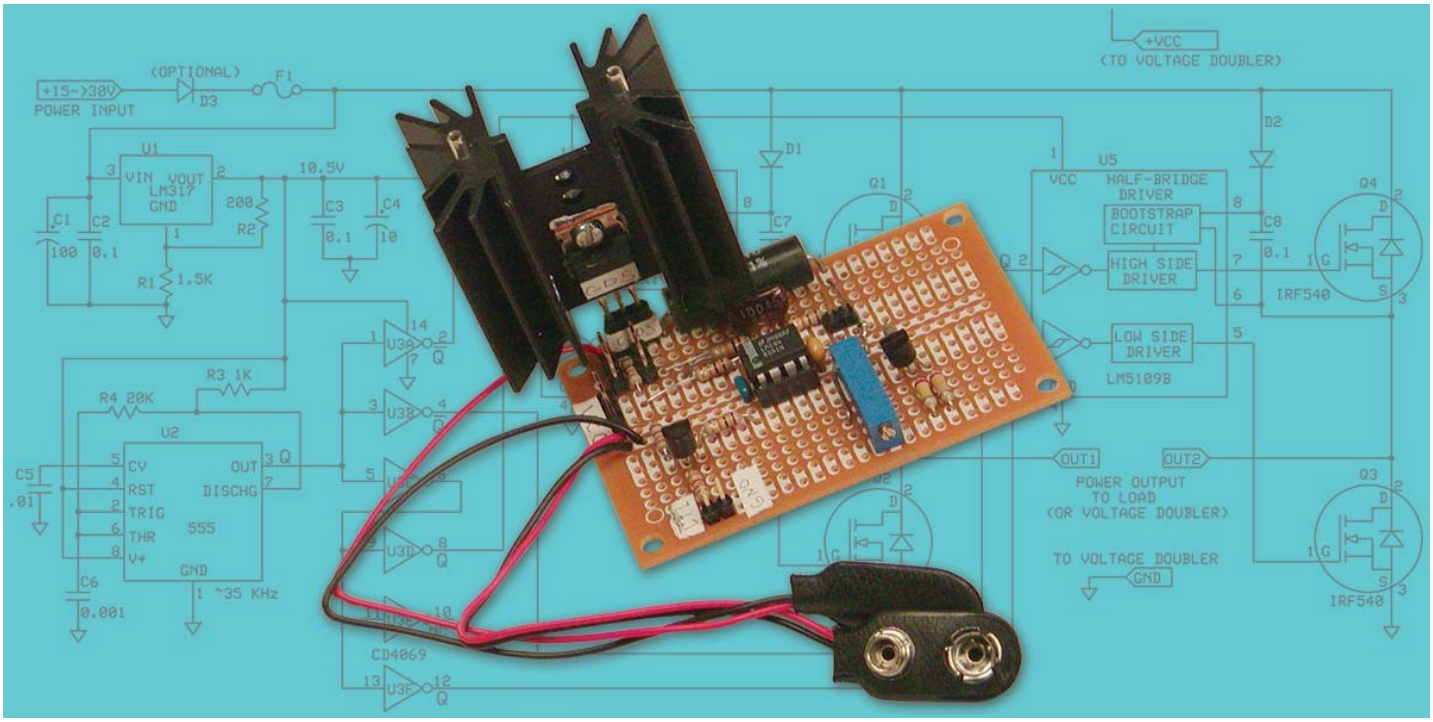

Power MOSFETs Part 2

By Gerard Fonte

Part 2: Projects

Last time, we examined how to use power MOSFETs. This time, we'll build two projects. The first is a transformerless voltage doubler that takes a DC voltage from 12 to 30 volts and doubles it. Unlike most other voltage doubler circuits, this design can supply amps of current. It incorporates a high-efficiency, full-bridge design that has additional applications such as a motor driver, power inverter, or even a Class D power audio amplifier.

The second project uses a power MOSFET in a linear (rather than switching) application. A simple constant current power supply is presented. With proper heatsinking, it can supply up to 20 amps. Each project can be built at a basic parts cost of about $15.

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The H-bridge

The voltage doubler is based on a standard H-bridge design, shown in **Figure 1**.

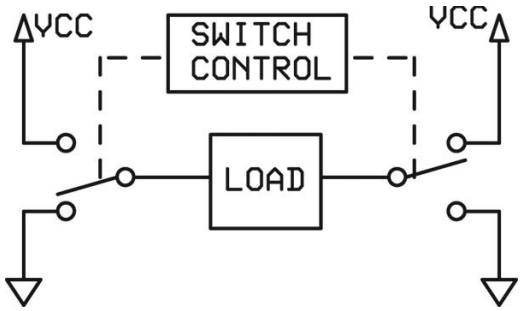


FIGURE 1. Conceptually, an H-bridge is just a double-pole, double-throw switch that reverses the polarity of the power to the load.

Basically, an H-bridge functions as a DPDT switch which reverses the polarity to a load. There are many applications for this circuit such as switching power supplies and motor control. Without getting into the details, switching at high speed gives good motor control and very efficient power supplies. The high frequency allows the use of smaller inductors and capacitors which can significantly reduce size, cost, and weight.

Our H-bridge is shown in **Figure 2**. It consists of several simple building blocks.

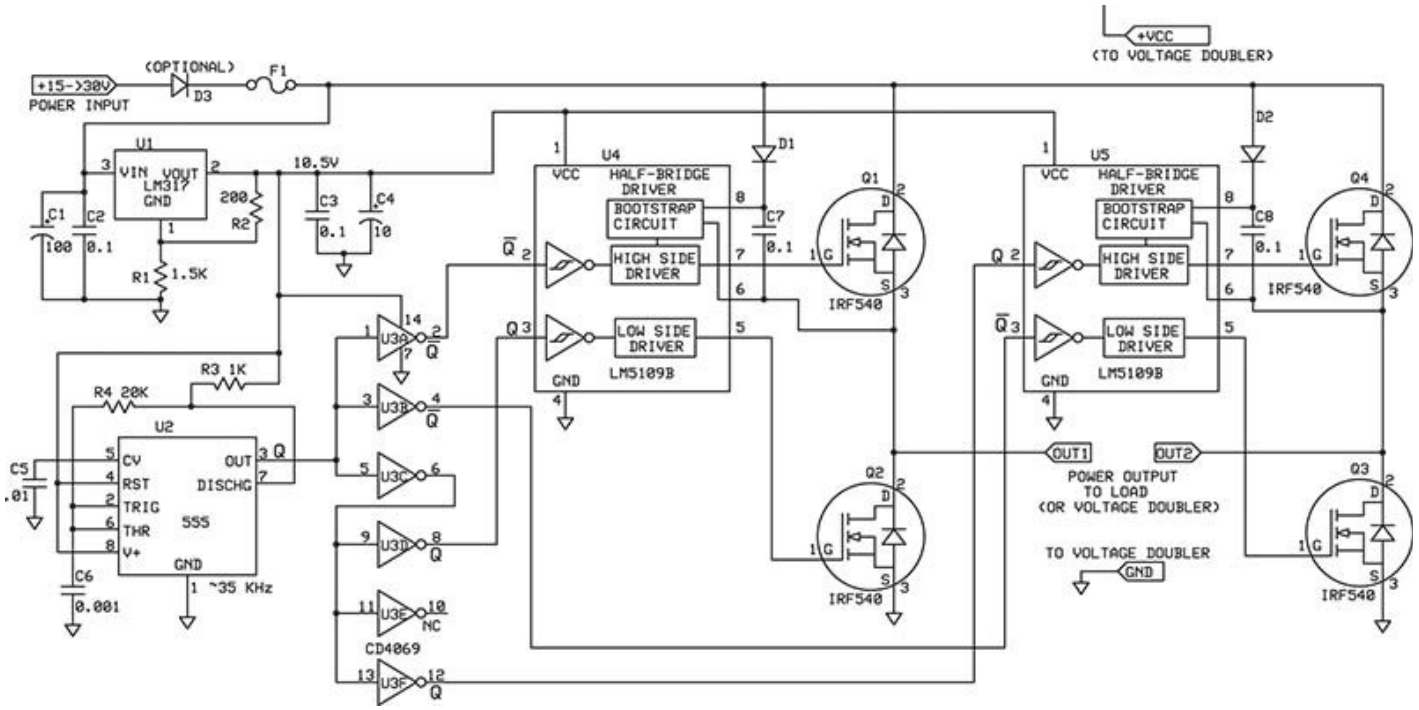


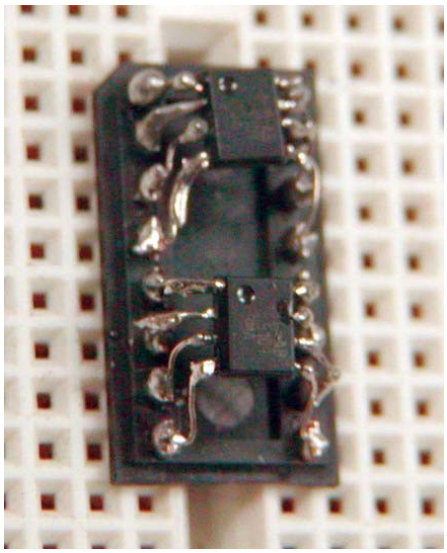
FIGURE 2. The basic H-bridge circuit. The power MOSFETS act as the DPDT switch. The control chips provide the proper gate voltages; the timer and inverter create the clock signals; and the voltage regulator sets a fixed voltage for the low voltage components.

The first is a regulated power supply (U1 and associated components). This is needed because other circuits may not be able to function over the full input range of the circuit. A three-terminal regulator is chosen to provide a stable 10.5 volts. Any voltage from 10 to 12 volts is fine for the low-power circuits. Generally, you want to keep it over eight volts for proper boot-strap operation (see **Part 1**). The other low voltage parts like to see something at 15 volts or less. A fixed 12 volt regulator (LM7812) can also be used here.

The second part is the master clock (U2 and associated parts) and is a simple 555 oscillator with a twist. As shown, it provides a very precise 50% duty cycle with a frequency of about 35 kHz. The twist is that the output pin is NOT used for the charging and discharging of the timing capacitor, as is the case for most other 50% duty cycle designs. This makes the circuit completely insensitive to output loading. Additionally, those other "50%" designs are more typically 45%-55%, or worse. Note that I verified proper operation with bipolar, CMOS, and low power 555 timer versions. A 50% duty cycle is not an absolute requirement for this design, but it distributes the power evenly through both halves of the bridge.

A DPDT switch makes and breaks contacts simultaneously (in theory). Since we are using N-channel parts for both the high side and low side, we will have to use a two phase clock. That is, both a "clock" signal and an "inverted clock" signal must be available. A CMOS 4069 inverter (U3) is used to invert the 555 signal. I chose to use separate inverters because they were available. You could run the Q signals directly from the 555 and the /Q inverted signals from a single inverter if desired.

As noted in **Part 1**, getting the power MOSFETs to switch quickly is not a trivial task. For that reason, I used special driver chips for this part of the circuit (U4 and U5). The LM5109 are inexpensive and easy to use. They provide a peak current of one amp to the gate of the MOSFET and typical switching times of 15 ns into 1,000 pF. They can support MOSFETs operating at up to 90 volts and can supply a bootstrap voltage of up to 108 volts. The Schmitt trigger inputs accept TTL and CMOS level signals.



Unfortunately, these drivers do not come in standard DIP packaging. I had to get SMT parts and fabricate an adapter as shown in **Photo 1**.

PHOTO 1. I made a DIP adapter for the surface mount drivers from a "component carrier." The large solder blobs on the carrier pins act as a heatsink when soldering to the driver chip. Once one pin is soldered, the rest go fairly easily.

It requires a steady hand with the soldering iron but is not too difficult. The trick is to put the component carrier in a protoboard (as shown) to support it and act as a heatsink for the pins. Put a blob of solder on a carrier pin and use #30 solid wire. Solder the carrier first because it acts as a heatsink. If you solder a wire to the SMT driver pin first, it may become unsoldered when you solder the wire to the carrier pin. Be careful with the heat because the carrier is made of thermoplastic and melts.

Last part of the circuit is the power MOSFETs themselves. I chose IRF540 devices. They cost about $0.75 each, operate up to 100 volts, and can handle 28 amps continuously with an on resistance of 0.77 ohms. In theory, this design can handle 2,500 watts of power. We won't be anywhere near that value.

The input voltage is limited to 30 volts because the voltage regulator that supplies power to the timer and other circuits is only rated at 35 volts. If you use a separate low-voltage power supply, the input can be theoretically increased to 90 volts where the driver chips fail. More realistically, the maximum safe input to the H-bridge is about 75 volts as shown.

The maximum continuous DC current — derated for heating — is about 14 amps for the MOSFETs. Since each MOSFET is on only 50% of the time and the switching speed is high, a full 28 amps through the bridge is a

reasonable figure. Note that each MOSFET will have to dissipate 50 to 60 watts in this scenario, so good heatsinking will be a requirement.

Output Circuits and Variations

We will be using a simple capacitor voltage doubler, shown in **Figure 3**.

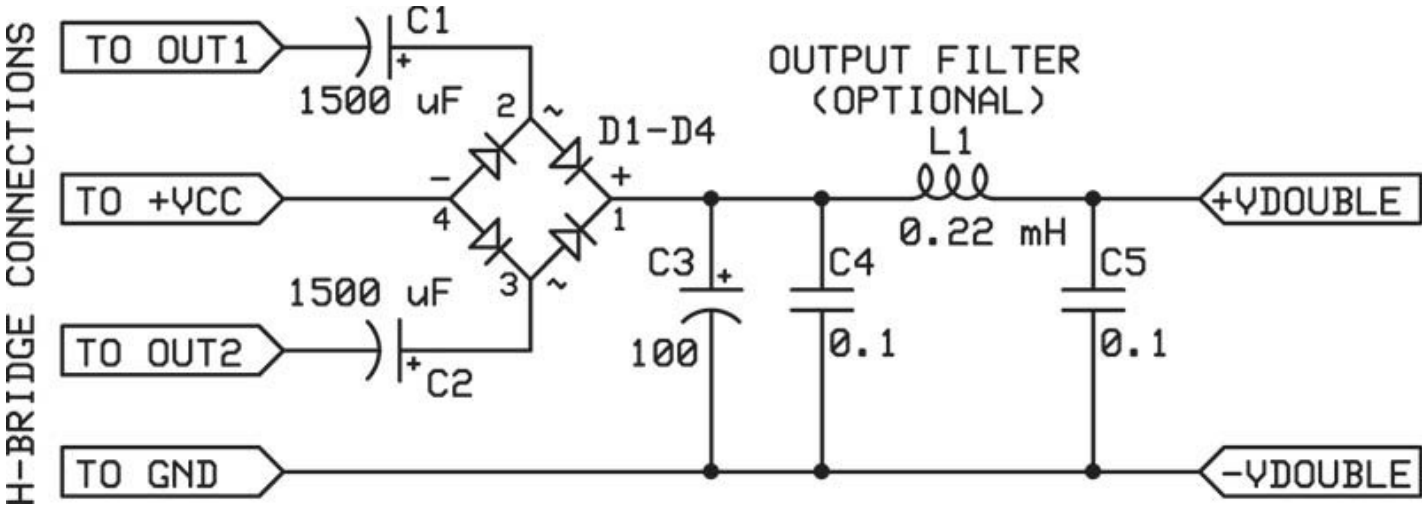


FIGURE 3. The voltage doubler circuit connects to the basic H-bridge (**Figure 2**) at four points. The output is close to a DC signal but switching glitches will be present. The optional filter (L2 and C3-C5) reduces the noise to about 200 mV.

It connects directly to the output of **Figure 2**. (In addition to the H-bridge outputs, connections to H-bridge power and ground are required.) Note that the doubled output voltage is theoretically a perfect DC signal right out of the bridge rectifier. In practice, switching glitches are present and can usually be removed with a simple filter as shown. The capacitor ratings in this voltage doubling circuit are critical. The use of improper capacitors can cause them to explode. *(See the sidebar on* **Switching Capacitors** *for details.)* Because of this failure possibility, it is strongly recommended that the project be housed in a sturdy box. Since the box only has input and output jacks, there seems little reason to show it.

If you want to do something other than voltage doubling, you can use **Figure 4's** circuit.

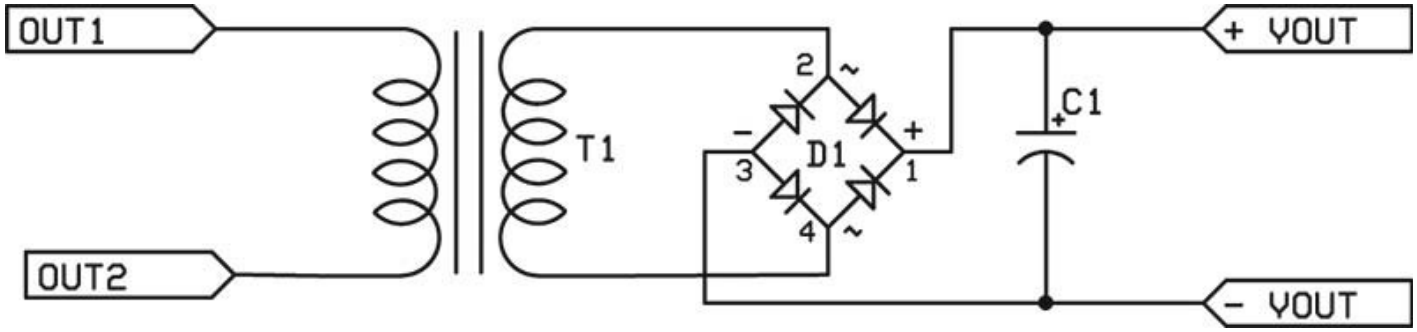


FIGURE 4. You can use a transformer to generate almost any voltage you want. The square wave input will require considerable output filtering, depending on the application. The transformer type and switching speed also have significant effects.

It's more conventional and easier to understand. Just remember that the switching frequency is 32 kHz, so ordinary 60 Hz transformers are marginal performers. (Of course, you can always change the circuit's frequency.) A toroidal transformer is usually incorporated here. Generally, they provide better efficiency and high frequency performance. I tried an ordinary 60 Hz power transformer and got reasonable results (considering the input was a square wave). Obviously, be sure your transformer is rated properly for current and voltage. Output filtering is required and is dependent on the frequency, transformer, and load.

A motor can be directly connected to the H-bridge. For optimal performance, you will want to be able to independently control the legs of the bridge. This cannot be done with a fixed oscillator. Instead, the Q and /Q signals should be adjustable. By changing the phase and pulse width, the motor's direction and speed can be controlled with precision. As noted above, if you want to use this H-bridge as a motor controller you should pay close attention to possible voltage and current spikes.

You can always use the H-bridge as an audio amplifier by attaching a loudspeaker to the output. This would be a "Class D" design where pulses are applied to the speaker. Again, the pulses would have to be precisely controlled, typically by a microcontroller. The high frequency pulses have to be filtered out to provide a low distortion audio signal. For good audio, the switching frequency should probably be increased to about 100 kHz. A Class D amplifier using this H-bridge has the potential of providing kilowatts of audio power (see the sidebar on **Bridge Power**).

Lastly, the circuit shown here operates at a nominal 35 kHz. By changing the timing capacitor in the 555 circuit, other frequencies can be obtained. There is a trade-off, however. The higher the frequency, the greater the switching losses. The capacitors and inductors (if used) can be smaller, though, which saves money and space. Additionally, the higher the operating frequency, the greater the likelihood of EMI (Electro-Magnetic Interference). Clearly, when you are switching kilowatts of power, you have to be concerned with unintentional RF (Radio Frequency) emissions. The square waves — so essential for efficiency — contain loads of higher frequency harmonics.

The Voltage Doubler Details

The design concept was to provide a simple voltage doubler for basic DC power supplies. In particular, I had a 0-30 volt, three amp supply. There are occasions when I needed a higher output voltage. Making the H-bridge voltage doubler is simplicity itself. Just connect two capacitors and a bridge rectifier as shown in **Figure 3**. The output will be a pretty good DC signal as shown in **Photo 2**.

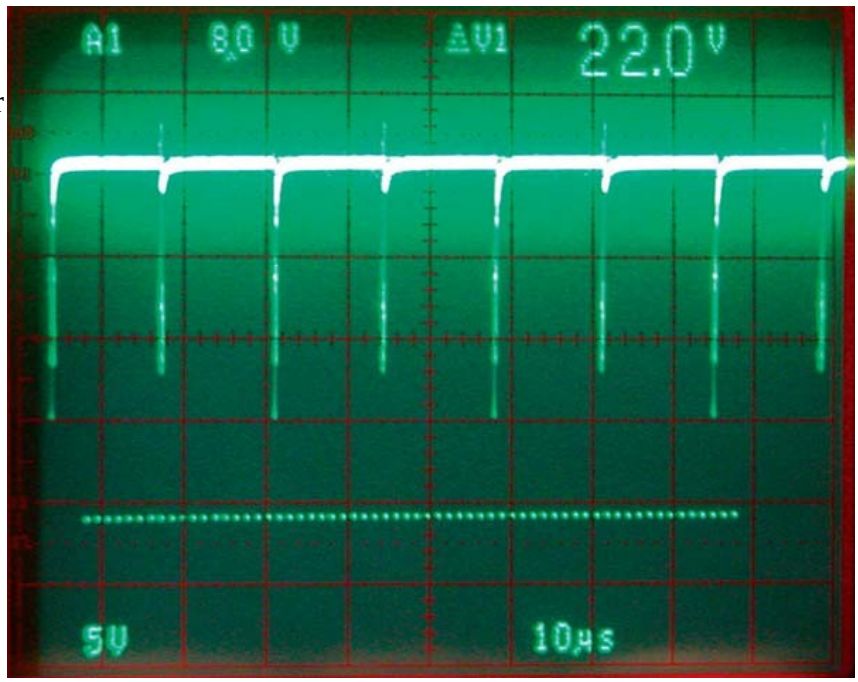
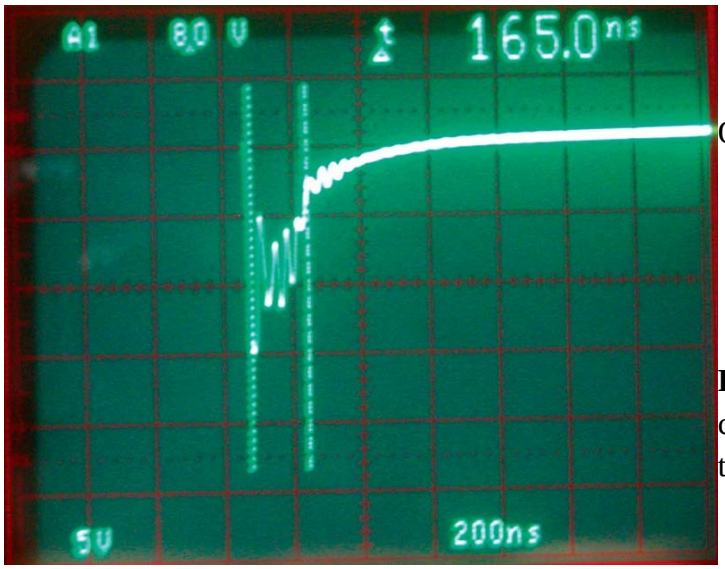


PHOTO 2. The output directly from the voltage doubler (without filtering) shows a DC signal with switching glitches. The simple filter shown in **Figure 3** reduces these glitches to about 200 mV.



Only 165 nS switching glitches are present (**photograph 3**). These glitches can be reduced to about 200 mV with the optional output filter.

PHOTO 3. The switching glitch is about 165 ns. This can be reduced or eliminated with proper fine tuning of the switching signals.

Note that these glitches can be significantly reduced or even eliminated by fine-tuning the switch timing. Some driver chips allow this. Alternatively, you could use a microcontroller or dedicated digital hardware for better switching control.

Photo 2 shows that there are 22 volts out of the circuit with a 12 volt input. The circuit load was a 68 ohm resistor which pulled about 1/3 of an amp and dissipated over seven watts of heat. The MOSFETs weren't even warm. However, the bridge rectifier got quite hot because it was deliberately under-rated (will discuss shortly).

Photo 4 shows the breadboard of the voltage doubler. It's important to keep things as close together as practical.

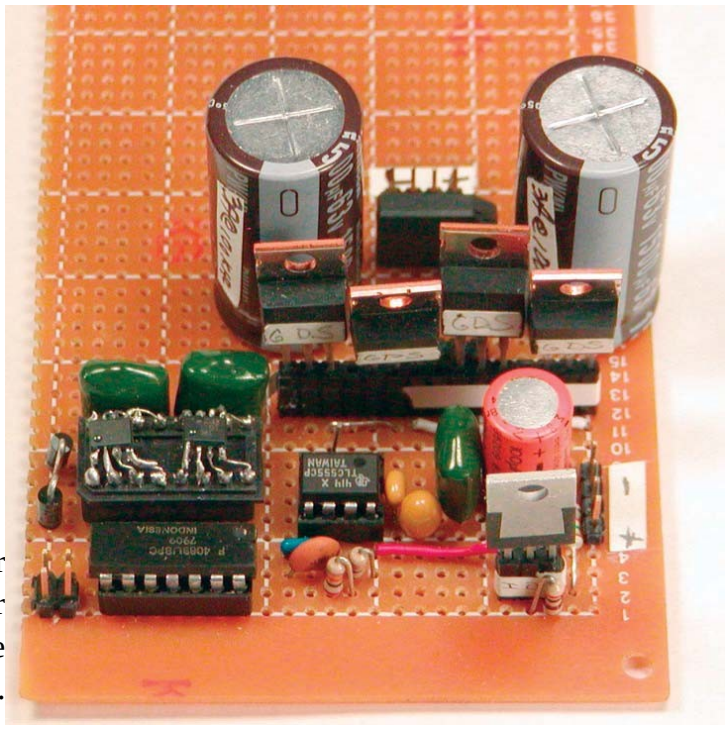


PHOTO 4. The breadboard of the voltage doubler (without filter). This is placed in a sturdy enclosure for safety (not shown, see text). Use short wires because the switching speeds are high.

Long leads with high frequencies can result in poor performance. Note that heatsinks for the MOSFETs are not needed for this typical operation of a few amps. I did not include the fuse because I will always be using it with a current-limited power supply. If you do not use such a supply, you should use a slow-blow fuse about 300% above the highest current output you expect. For example, if you power a device that draws one amp, use a three amp input fuse. This is because you will need more than twice the input current. The input diode (D3) is optional and is used to prevent damage if the input power is accidentally reversed. It will reduce the efficiency of the circuit. Make it about 10 times the expected output current with a PIV (Peak Inverse Voltage) of at least twice the maximum input voltage.

The major loss of power in the circuit is in the bridge rectifier. There is about 1.4 volts dropped across it. With an input voltage of 14 volts, at least 10% is lost here. With only one amp of current, it will have to dissipate 1.4 watts of power. For better heat control and efficiency, I recommend well oversized and separate diodes of 10-15 amps each with a heatsink (see Parts List). Using lower current diodes causes considerable heating which further increases the forward voltage drop. This causes even more heating and greater forward voltage drop, and so forth and so on. Losses can more than double if too small diodes are used. (*Note that I only used a two amp bridge because I have a specific application that uses little power.*)

Constant Current Supply

Power MOSFETs can be used in linear applications, as well. In such cases, they are typically treated as variable resistors which imply considerable heat losses. Proper heatsinking is necessary. Nevertheless, these devices allow you to control high power quite easily.

Figure 5 shows a simple constant current power supply. The theory of operation is very basic.

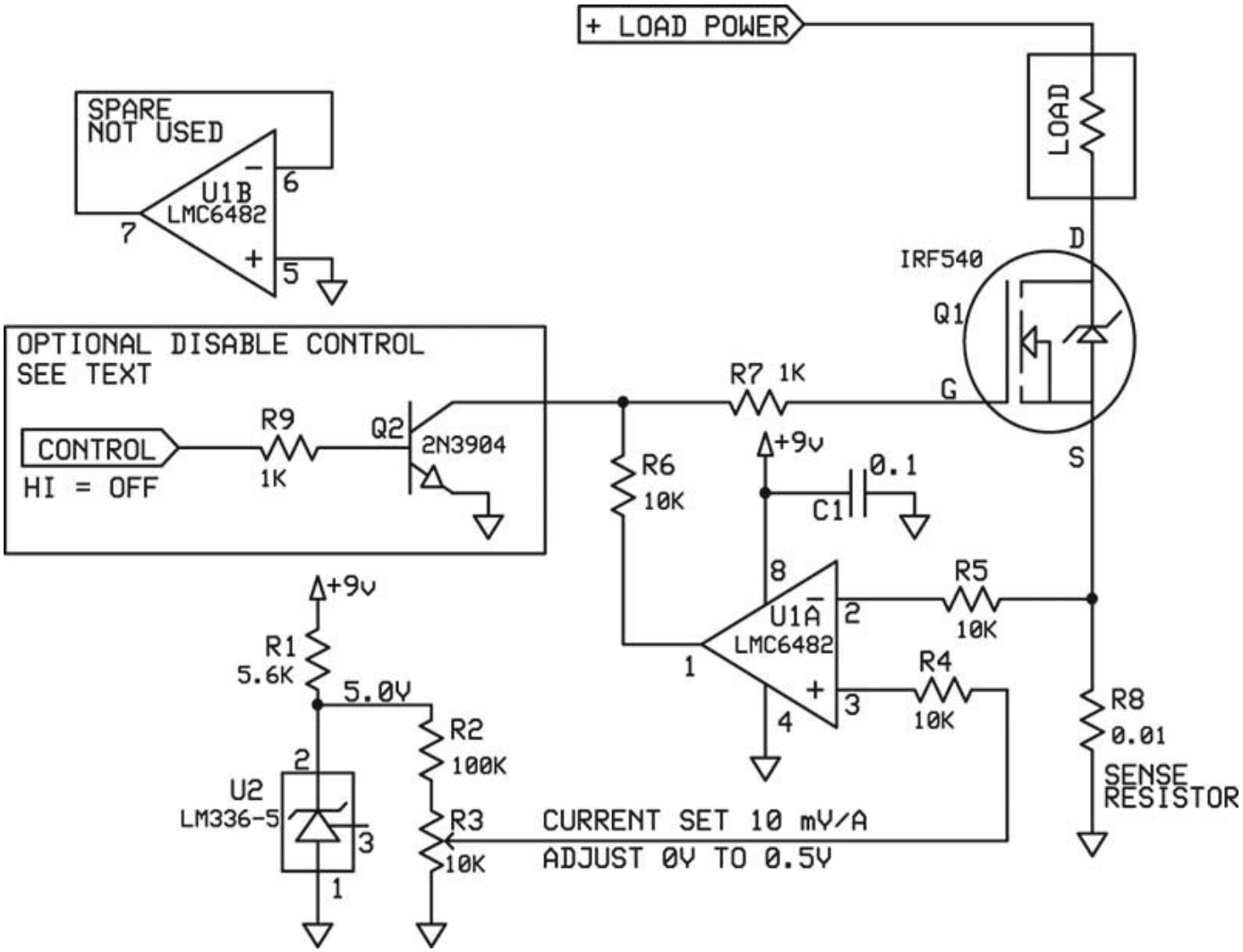


FIGURE 5. The analog constant current circuit is quite simple. A heatsink for the power MOSFET is required. For continuous use, R9 and Q2 can be omitted and R6 replaced with a wire.

A small voltage is developed across the 0.01 ohm sense resistor (R8) and is fed into the inverting input of the op-amp. This positive voltage is inverted by the op-amp, reducing the output voltage which reduces the voltage

across the sense resistor via the MOSFET. This stabilizes the output voltage to the value found at the non-inverting input. Any change in current through the sense resistor causes a voltage change at the inverting input which is exactly offset by the negative feedback. The result is a constant current through the sense resistor and load.

Determining the reference voltage to be applied to the non-inverting input is just an application of Ohm's Law. If there is one amp of current flowing through the 0.01 ohm sense resistor, there will be 0.01 volts across it. So, the voltage-to-current ratio is 1:100 or 0.01 volts per amp.

The reference circuit is pretty straightforward. We want a stable and adjustable voltage from 0.0 volts to about 0.500 volts. I used an LM336-5 five volt reference because that is what I had on hand. Then, I reduced voltage with a resistor network and used a 10 turn trimmer for fine adjustment. Other methods of generating the reference voltage can be used, as well. (You can substitute an analog signal for the reference voltage and get a constant current power amplifier.)

There are a few considerations for this circuit. The first is that separate power supplies should be used for the load and circuit power. This is because it's very easy to cause significant power supply variations with 20 amps of current being drawn. If you choose to use a different op-amp, be sure it can operate with inputs very close to ground. The breadboard circuit is shown in **Photo 5**. The heatsink shown (a requirement) is rated at 13 watts.

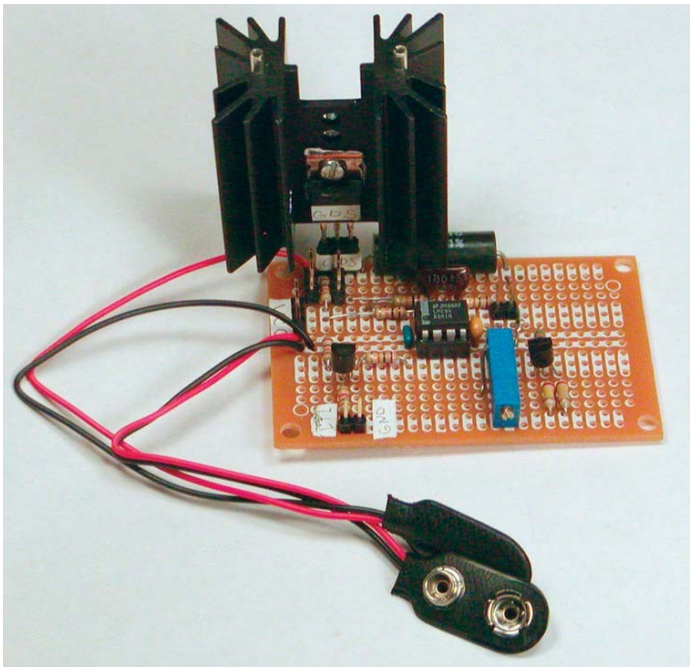


PHOTO 5. The breadboard of the constant current supply. Since the MOSFET is acting as a variable resistor, considerable heat is generated. A heatsink is required.

You may need a larger one for continuous use at 20 amps, depending on the load resistance. Remember that the MOSFET is acting like a resistor in this circuit. Depending on the load, its resistance can be relatively high or low and its power dissipation can be correspondingly high or low. Do the math to be sure. Note that at 20 amps, the five watt sense resistor (R8) dissipates four watts. If you plan on running this continuously at high current, you may want to increase R8 to seven or 10 watts.

Because of the very low sense resistance, ordinary circuit resistance can increase this significantly. (My circuit resistance was 30 milliohms.) The primary concern is that the voltage at the non-inverting input will be higher than expected (one amp per 13 mV rather than 10 mV). In most cases, this is not a problem for the proper operation of the circuit.

Since I didn't want to continuously run 20 amps while testing and for photography, I used a quick and dirty method of turning off the circuit. I simply used a transistor to pull the MOSFET gate to ground. This worked, but opened the feedback loop. As a result, when the transistor was turned off and normal linear operation was restored, there was considerable ringing as the loop re-stabilized. (If you don't want the disable control, you can eliminate R9 and Q2, and replace R6 with a wire.)

Photo 6 shows the circuit in operation. It is providing just about two volts into a 0.1 ohm load using a 14.4 volt portable tool battery. Thus, the current is about 20 amps. Not bad for a handful of components. In this 5% duty-cycle application, the heatsink was barely warm.

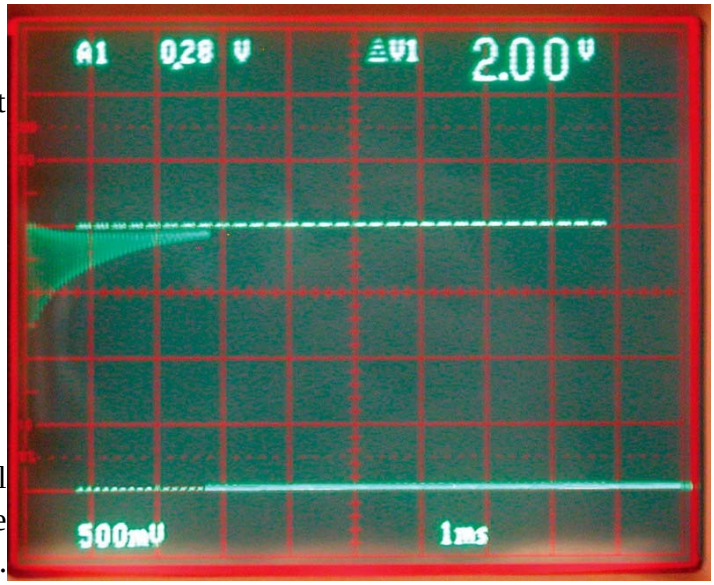


PHOTO 6. With a load of 0.1 ohms, this two volt signal means that 20 amps are flowing. The ringing is because the feedback loop was opened (see text).

Conclusion

Power MOSFETS can control a lot of power easily. An H-bridge voltage doubler circuit was seen to be suitable for this design, as well as other applications. An analog constant current project was able to easily provide 20 amps into a 0.1 ohm load. A nice feature of power MOSFETS is that if even higher currents are needed, they can be paralleled very easily. In short, power MOSFETs are an inexpensive and easy way of controlling significant power. **NV**

Switching Capacitor Ratings

It is extremely important to pay close attention to capacitor ratings in power switching circuits. These designs place a severe strain on the capacitor and it must be rated for this type of operation. Using the wrong type of capacitor can result in the capacitor exploding. Often, switching capacitors are chosen because of these other ratings rather than its capacitance. The two most important ratings to consider are: ESR and ripple current (typically at a switching frequency of 100 kHz). The ESR (Effective Series Resistance) says how much resistance the capacitor has. Ideally, a charge on one capacitor plate should freely interact with the other plate. But, capacitors 1 to 0.01 ohms. Everything else being equal, usually the larger the capacitor value is, the lower the ESR will be. So, if you are driving a heavy load (say a two ohm loudspeaker), a one ohm ESR will waste a lot of power and heat up the capacitor.

The second rating is the ripple current. This says how much RMS current can safely pass through the capacitor continuously. Again, typically, the larger the capacitor value, the higher current it can handle.

These capacitors usually fail because heat degrades the capacitor and increases the ESR. This causes a larger voltage drop across the capacitor and additional heating. Eventually, the capacitor gets too hot and bursts. This bursting can be mild or explosive. Most capacitors have relief points that reduce the chances of a violent explosion, but care should always be taken. Always house these types of circuits in a sturdy cabinet.

Bridge Power Ratings

In theory, a bridge circuit can provide up to four times more power to the load than a standard power control circuit. This seemingly impossible task is accomplished fairly directly and logically. However, it is a bit subtle. Suppose you have an ordinary audio amplifier running at eight volts and driving an eight ohm speaker. The voltage swing at the speaker will be a maximum of ±4 volts. Four volts into eight ohms is 0.5 amps. The peak output power is then two watts (Power = Current^2 x Resistance).

However, a bridge circuit changes the polarity to the load. This results in eight volts going in one direction and 8 volts going in the other direction for a ±8 volt swing. Doubling the voltage causes twice the current to flow, or one amp. Doubling the current results in four times as much power (P=I^2 x R). So, a bridge amplifier can provide up to four times as much power (eight watts) to the load as a non-bridge type.

The next question is why bridged power amplifiers are only rated at twice the non-bridged power, or less. This is because of the power handling of the amplifier rather than the theoretical power delivered to the load. If one amplifier can only dissipate enough heat to support X watts of power output, then two amplifiers can still only dissipate 2X watts, regardless of the voltage swing.

Constant Current Supply Parts List

Resistors 1/4, 5% unless specified.

R1, R9	5.6K
R2	100K
R3	10K 10-turn trimmer
R4, R5, R6	10K
R7	1K
R8	0.01Ω 5W

Capacitors

C1	0.1 µF 25 volts

Semiconductors

Q1	IRF540 Power MOSFET
Q2	2N3940 NPN transistor
U1	LMC6482 Op-amp
Q2Q	LM336-5 Five-volt reference

Misc: Heatsink for Q1

BASIC H-BRIDGE Parts LIST

Resistors (1/4W, 5% unless specified)

R1	1.5K
R3	200
R3	1K
R4	20K

Capacitors (25V unless specified)

C1	100 µF
C2, C3	0.1 µF
C4	10 µF
C5	0.01 µF
C6	0.001 µF
C7, C8	0.1 µF 150V

Semiconductors

D1, D2	1N4004
D3	Optional, see text
Q1-Q4	IRF540 Power MOSFET
U1	LM317 adjustable voltage regulator
U2	555 timer
U3	CD4069 CMOS hex inverter
U4, U5	LM5109B half-bridge driver

Misc.

F1	Slow-blow fuse (see text)
Case	Metal preferred for safety and EMI reduction (see text)

Additional parts for H-bridge Voltage Doubler (see text)

C1*, C2*	1,500 µF 63 volt switching capacitor
D1-D4	15 amp rectifier (Jameco #879318)
C3	100 µF 150 volts (optional, see text)
C4, C5	0.1 µF 150 volts (optional, see text)

* Critical part, safety related, see text.

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The On the Air podcast is a monthly companion to On the Air magazine, ARRL's magazine for beginner-to-intermediate ham radio operators....

Visit Website: On the Air There is more there than what is published here.

The Value of Contest Clubs
Thu, 09 Nov 2023 15:12:00 -0500
"Contesting encompasses so much of the hobby," says seasoned contester Craig Thompson, K9CT, "from station building, learning how to operate, understanding propagation, knowing rules, learning from your peers," that there's something in it for every ham radio operator. As current member and former president of the Society of Midwest Contesters, Craig knows the ins and outs of running a contest club and ensuring that the value proposition makes sense to the average member. In this episode, Craig talks about why you might want to get involved with a contest club, what it entails, and how these specialized clubs stir up on-air activity that benefits every ham. This discussion extends the November/December 2023 On the Air article, "Joining a Contest Club," by Leanna Figlewski, KC1RMP.

The Solar Eclipse QSO Party: When Operating is Science
Thu, 12 Oct 2023 08:26:16 -0400
Gary Mikitin's, AF8A, article, "The Solar Eclipse QSO Party: A Fun Way Support Radio Science" in the September/October 2023 issue of On the Air details how hams can contribute data to a study on how the ionosphere reflects radio signals during the eclipse via an easygoing on-air event called the Solar Eclipse QSO Party. Gary, who is the Amateur Radio Community Coordinator of HamSCI, joins us on the October episode of the On the Air podcast, to talk about just how easy it is to participate.

Foxhunting Basics: Tracking a Transmitter
Thu, 07 Sep 2023 10:57:00 -0400
The cover story of On the Air’s September/October 2023 issue, “Foxhunting Basics,” doesn’t have anything to do with chasing down a woodland creature. Foxhunting is a radio direction-finding activity that you can enjoy with a radio club or group, or even with just one other friend — and they don’t even have to be a ham! Rob Zielfelder, N1NUG, explains how to get started with a couple of handheld radios and a directional antenna that you can make from inexpensive hardware store materials. One player hides somewhere with a radio, and sends intermittent transmissions, while the other player tracks them with the help of the radio’s signal meter and a map. Listen to this month’s episode for more information on how to join the fun. Check out the video version on our YouTube channel: https://www.youtube.com/watch?v=N7OXP9cFa7Y&feature=youtu.be

Technical Coordinators: A Tech Resource in Your Section
Thu, 10 Aug 2023 12:11:00 -0400
This month, we talk with Steve Simons, W1SMS, the Technical Coordinator for the Connecticut Section, who shares his experiences as a TC, from coordinating with Emergency Operations Centers during an emergency, to presenting technical papers at ham club meetings, to working with the Section’s Technical Specialists to help local hams with troubleshooting and other technical matters. Check out the VIDEO edition on our YouTube channel: (3) Technical Coordinators: A Tech Resource in Your Section - YouTube

When Messages Matter: Passing Traffic
Thu, 13 Jul 2023 11:06:38 -0400
Passing traffic is a ham radio activity that’s nearly as old as ham radio itself, and getting accurate messages to their destination in a timely manner takes training and skill. In addition to participating in nets, hams also have the opportunity to take on ARRL Field Organization positions that are responsible for traffic. In this episode, we talk to Ethan Hansen, KC1OIP, who fulfills one such position, Official Relay Station, in ARRL’s National Traffic System. Listen in to learn about what it takes to become an Official Relay Station, how the position makes a difference in the community, and how it benefits your amateur radio skills and experience.

How to Get On the Air from an ARRL Field Day GOTA Station
Fri, 09 Jun 2023 08:08:00 -0400
For the June 2023 episode of the On the Air podcast, ARRL Radiosport & Regulatory Information Manager Bart Jahnke, W9JJ, and ARRL Contest Program Manager Paul Bourque, N1SFE, join us to talk about a popular Field Day fixture known as the GOTA (Get On the Air) Station. If you’re a newer ham, or new to Field Day operating, you can find a local Field Day setup that’s running one of these beginner-friendly stations. Tune in to find out how, so you can make plans to operate from a Field Day GOTA Station on Field Day weekend, June 24 and 25. Watch the video edition: (1) How to Get On the Air from an ARRL Field Day GOTA Station - YouTube

Getting On the Air for the June VHF Contest
Thu, 11 May 2023 12:57:00 -0400
With this year's ARRL June VHF Contest fast approaching on the weekend of June 10, seasoned VHF operator Bob Witte, KØNR, joins the podcast to talk about how to prepare yourself and your station to join in the fun of this beginner-friendly event. Watch the video edition: (1) On the Air Podcast — Getting On the Air for the June VHF Contest! - YouTube

Where Do Hams Fit Into the Incident Command System?
Thu, 13 Apr 2023 14:00:00 -0400
The March/April 2023 issue of On the Air featured an article on “The Incident Command System and Amateur Radio,” which introduced the Incident Command System (ICS), an emergency management system that public safety agencies use to respond to everything from small incidents to large-scale emergencies. ARRL Director of Emergency Management Josh Johnston, KE5MHV, joins this episode of the podcast to share more about the system’s origins and uses, where and how amateur radio operators fit into the system, and where to get ICS training. Video Edition of this Episode: (3) On the Air Podcast — Where Hams fit into the Incident Command System? - YouTube

The Thrill of the Chase: Radio Orienteering
Thu, 09 Mar 2023 14:07:00 -0500
Radio orienteering (aka Amateur Radio Direction Finding, or ARDF) is a radio sport like no other. It gets you out of your shack chair and bounding through the woods or a park, using a handheld receiver and directional antenna to find a transmitter that’s located somewhere in the vicinity. People of all ages and skill levels can have fun with radio orienteering – and you don’t even need a ham radio license to join in. In this episode, we talk to USA ARDF Co-coordinator Charles Scharlau, NZØI, about how to get involved in what he calls, “the only athletic radio sport.” Check out the video edition of this episode: (1) On the Air Podcast — The Thrill of the Chase: Radio Orienteering - YouTube

How to Be On the Air All Year with VOTA
Thu, 09 Feb 2023 10:33:00 -0500
ARRL has designated 2023 “The Year of the Volunteers,” to shed light on the work of the hundreds of volunteers who make ARRL and amateur radio what it is. We’ve got a year-long on-air event to go with it – Volunteers On the Air, or VOTA, is already taking the bands by storm, just two months into the fun. In this episode, we talk to ARRL Director of Operations Bob Naumann, W5OV, and ARRL Radiosport Manager Bart Jahnke, W9JJ, about rules, awards, special activations, and all things VOTA. Check out the video edition of this episode: (1) On the Air Podcast — How to Be On the Air All Year with VOTA - YouTube

The ARRL Field Organization

Thu, 12 Jan 2023 08:00:00 -0500

As the national association for Amateur Radio in the US, ARRL offers programs and services for its members across the country. Many of these are made possible by the ARRL Field Organization, a network of ARRL member-volunteers who give of their time and knowledge to other hams, as well as to the Amateur Radio Service itself. Field Organization volunteers are positioned all over the country, in the various ARRL Sections, doing everything from offering technical advice, to liaising with government contacts, to working with young hams. In this episode of the On the Air podcast, Editorial Director Becky Schoenfeld, W1BXY, talks with ARRL Field Services Manager Mike Walters, W8ZY, about how the Field Organization is structured, what kinds of positions and duties are available (truly, there's something for everyone, no matter what aspect of ham radio you're interested in), and how to get involved.

Running an Amateur Radio Net

Thu, 08 Dec 2022 00:05:00 -0500

For many new operators, nets are one of the easiest and best ways to connect with other hams. Some nets are focused solely on emergency communications, others provide the opportunity to pass formal traffic throughout a region, while others are purely social occasions where you can get to know other active hams. Scheduled nets can take place monthly, weekly, or daily, and no matter their frequency (see what we did there!), nets are a great way to practice using your radio and get comfortable with the conventions of communicating on the air. The success of any net is due, at least in part, to the Net Control operator. Net Control actually runs the net, keeping everything — and everyone — organized. What's it like running a net? What skills do you need? Are there common pitfalls? Best practices? In this episode, Ginger Wilder, KI5TJE, discusses her first time running the McKinney Amateur Radio Club (MARC) net and how she prepared to take on the challenge. She talks about her preparation and some of the unexpected things she learned from running the net. As a bonus, you can read a copy of MARC's Net Control script on the On the Air blog at www.arrl.org/ota-blog.

Operating Amateur Satellites

Thu, 10 Nov 2022 14:49:49 -0500

Even if you're accessing a repeater, the range of your VHF/UHF handheld can be a bit constraining. You'll probably never achieve coverage of, say, the entire US Eastern Seaboard or the Continental Divide in the lower 48. But with a couple of handhelds and the right Yagi antenna, you can access satellites in low Earth orbit that will provide you with a much wider "footprint" than just about any repeater. Sean Kutzko, KX9X, characterized satellite operation as "a bit of a competition. It's a bit of a game. It's a bit exciting." In this month's episode, he talks about how to get started using satellites and details the reach that satellites beyond low Earth orbit are only now making available to every licensed amateur radio operator.

Basic Gear for Public Service
Thu, 13 Oct 2022 16:22:00 -0400
Just over two weeks ago, Hurricane Ian devastated Sanibel Island and southwestern Florida. It caused tens of billions of dollars of damage and killed more than 100 people. Arc Thames, W4CPD, the Section Emergency Coordinator of ARRL's Northern Florida Section and Emergency Coordinator of Santa Rosa County Florida, passed traffic during the storm and shares some of his experiences. He discusses gear for ARES deployments (A handheld is just fine!) and what you need to know before going out in the field. For more information on prepping for EmComm, check out the article, "Basic Gear for Public Service" in the September/October 2022 issue of On The Air magazine.

Make a Two-Meter J-Pole Antenna from Lamp Cord
Thu, 08 Sep 2022 03:25:00 -0400
Building an antenna doesn’t have to involve yards of aluminum tubing and long runs of coax. It can be as simple as soldering and snipping (carefully!) a length of lamp cord. Frequent On the Air and QST contributor Dino Papas, KL0S, provides insight into the construction and tuning of this J-pole antenna, which he built for On the Air from a design by John H. Unrath, K6JHU. Along the way he and host Becky Schoenfeld, W1BXY, uncover a bit of J-pole history and dig into why an antenna analyzer is a must-have if you decide to build this project.

ARRL's On The Air - Episode 32
Thu, 11 Aug 2022 03:04:00 -0400
Getting the most out of your transceiver's scanning functions.

ARRL's On The Air - Episode 31
Thu, 14 Jul 2022 01:01:00 -0400
Is 222 MHz really a "forgotten" frequency band?

ARRL's On The Air -- Episode 30
Thu, 09 Jun 2022 01:31:00 -0400
Discussing ARRL Field Day in particular and off-the-grid operating in general with ARRL Contest Program Manager Paul Bourque, N1SFE.

ARRL's On The Air - Episode 29
Thu, 12 May 2022 01:13:00 -0400
Discover what "FM" really means, and how it is different from "AM."

ARRL's On The Air -- Episode 28
Thu, 14 Apr 2022 01:59:00 -0400
Should you invest in a Digital Multimeter (DMM)? As it turns out, a DMM doesn't have to be expensive and it is more useful than you might imagine.

ARRL's On The Air - Episode 27
Thu, 10 Mar 2022 01:04:00 -0500
Relax and take an audio tour of the 10 meter band!

HELLGATE AMATEUR RADIO CLUB

AGENDA – 11 Dec 2023 meeting

Program: Winlink in-depth overview by K7MSO & K7MTD

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: W7XY, Discussion _____
_____Motion to approve report: 1St _____2nd _____ Vote: P/F/T

Repeater Committee Report: K7MTD, Discussion _____
_____Motion to approve report: 1St _____2nd _____ Vote: P/F/T

HF Committee Report: ?????, Discussion _____
_____Motion to approve report: 1St _____2nd _____ Vote: P/F/T

Events for 2023:

Dec	21	First Day of Winter	HAVE
Dec	24	Christmas Eve	FUN &
Dec	25	Christmas	STAY
Dec	31	New Years Eve	SOBER
Jan	01	News Year Day	

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

HARC Discussion List

1. _Nominations for Officers for 2024, _____

2. _Membership dues are Due – Nov-Jan _____

3. _____

VHF Net Control Station assignments:

Dec	06 N7PAS	Jan	03 N7PAS
Dec	13 N7JGS	Jan	10 _____
Dec	20 NZ7S	Jan	17 _____
Dec	27 K7MTD	Jan	24 _____
___	__ _____	Jan	31 _____

Reminder: Backup is always the next person in line as the net control.

Good and Welfare. _____

***** Next Club meeting: Jan 08 *****

Is there any other business ? _____
Since there are no other items of business this meeting is Adjourned at _:__ PM.

December 2023

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
26	27	28	29	30	1	2 HARC 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 Net 9:00Am on 147.040 Repeater
10	11 HARC Testing 5:30 & Meeting 7:00 PM	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 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 Net 9:00Am on 147.040 Repeater
24 Christmas Eve	25 Christmas Day MERRY CHRISTMAS TO ALL	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	28	29	30 HARC Net 9:00Am on 147.040 Repeater
31 News Year's Eve	1	2	3	4	5	6

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You're Invited to Participate in Hellgate Amateur Radio Clubs' Proxy Voting Program

Hellgate Amateur Radio Club is providing members the opportunity to participate directly in the proxy voting process by giving members an opportunity to exercise their voting right.

Participation

Full Members, Life Members, Honorary Life Members, Family Members & Student Members paying dues **shall each be considered voting members** and entitled to one (1) vote for every motion, resolution, election or other voted action of the club. **Associate Members and Newsletter Subscribers** shall not gain voting privileges, nor shall they count as members for a quorum count.

Legal Notice:

This communication is intended for the addressed recipient only and is provided based on The Clubs membership list on file.

How to Participate

FIRST: Copy voting form and paste to email.

Caution – Spacing might get lost, reinsert

SECOND: Fill out the attached Proxy Voting form by changing the underscore to a Name or an X on the line you want to change, than email it back to secretary@k7px.org

VOTING IS DUE IN BY 7 DEC 2023
SO IT CAN BE TALLIED FOR THE
11 DEC MEETING.

Thank You, HARC Editor

Voting Dec 2023

OFFICERS

Officer positions are 1 year terms voted in by membership each year. Enter your choice below
Replace the right side underscore with an X.
For write-in replace the underscore with Name.
Just highlight the underscore and type.

President: Eric Sedgwick, NZ7S _

write-in _____

Vice Pres:
No nominations & current holder declined

write-in _____

Treasurer: Jim Ramsey, KJ7THG _

write-in _____

Secretary: Mike Leary K7MSO _

write-in _____

STANDING COMMITTEES

Repeater Advisory Committee (2 seats)

for years 2024/2025
Paul Shuey, N7PAS _

write-in _____

for years 2024/2025
No nominations & current holder declined

write-in _____