Ham Station Control and Monitor

You can do without this handy project—or can you?

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The accessory described here is designed primarily for QRP home stations, but the methods used are applicable to QRO stations as well. All stations that use a storage battery of any type for backup power in case of loss of AC or during brownouts will find this design very handy. And even if you don't use a battery backup, you'll find it very useful because it does so much so simply.

What it does

Normal operation of two separate transceivers, such as one HF and one VHF/UHF (or any combination), will normally use the AC-operated power supply (PSU) for operation. If a backup battery is used, it will be on float charge at all times the AC power supply is in use, and totally disconnected at all other times. QRPers like to keep their small gel cell batteries topped off for quick use in the field or in emergencies. And in case of power loss, a quick flick of one switch connects the storage battery to supply 12 volts to the station to keep it operating. This unit is also fused for protection.

A surplus meter mounted on the panel, in conjunction with a 2-pole 3-position rotary switch, allows rapid checking of DC voltage and current. The third position of this switch performs some RF magic and allows easy setting of the antenna tuner (ATU) for maximum output power simultaneous with the absolute minimum SWR the ATU is capable of producing. This proves your RF power is radiating, eliminating the need for an SWR meter and a field strength meter (FSM) at the operating position. More about this function later.

Provisions are incorporated to switch both audio out and key line input from your choice of two rigs to jacks on the panel for speaker and key. A headphone jack is included and mutes the speaker when the phones are plugged in.

The main DC line is heavily bypassed, both where it enters from the station power supply and at the multiple DC output connectors which provide power to both transceivers and all accessories. This precludes any electrical hash being transmitted between power supply and rigs.

As designed, operating voltage is indicated on a suppressed-zero, expanded-scale meter for the best accuracy. Even very small voltage changes will be easily noticed.

What it has in it

Not much, really—just mainly inexpensive connectors, three switches, surplus meter, three diodes, and a very few resistors and capacitors. Refer to **Fig. 1**, the schematic diagram, for the complete picture.

The cost to build this unit using all new (surplus) parts will easily be less than $30, not including the enclosure. In fact, most hams will have all or most of the parts in their junk boxes. If a suitable-quality meter is missing from the junk box, do not despair. You can get five high-quality surplus meters for only $10 from Fair Radio Sales Co., P.O. Box 1105, Lima OH 45802; (419) 223-2196; catalog number 47-84. Shipping is extra. Although the choice of the meters you get is theirs, not yours, at least one meter, and probably two, will be exactly what you need to build this unit. Too, you will have four nice meters left over for other projects.

Making your meter read volts and amps

For a comprehensive but simple and understandable description of how to

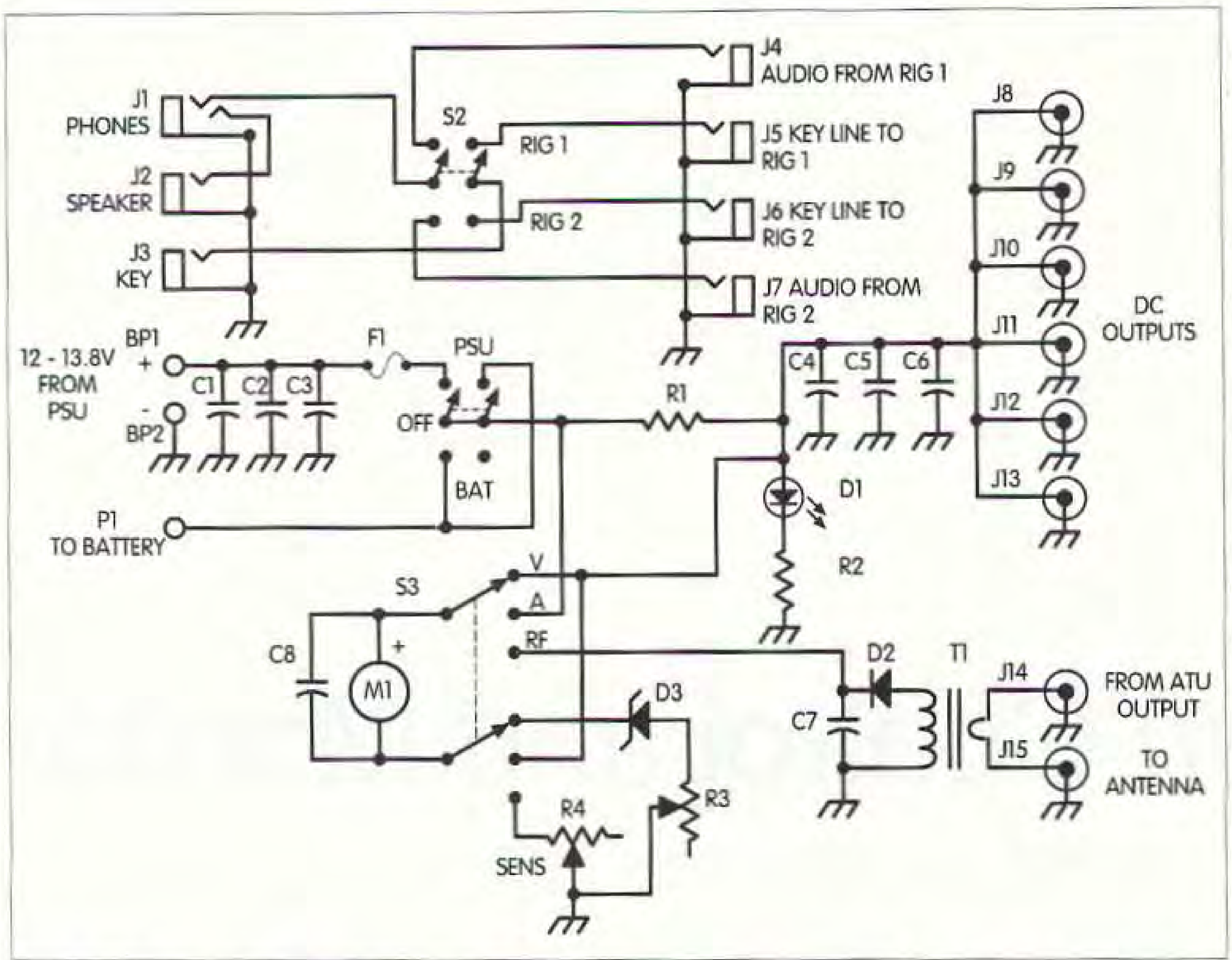

Fig. 1. Schematic diagram. Note: The following components should be placed on the front panel: J1, J3, M1, R4, S1, S2, S3. Remaining connectors should be mounted on the rear deck.

disassemble (to remove shunts, rectifiers, and multipliers, or change the scale), reassemble, and measure meter movements, please refer to my article, "Use Those Surplus Meters," *73 Amateur Radio Today*, January 1992, page 42. If you don't have or can't locate a copy, you can order photocopies of articles or back copies of the magazine direct from *73*.

However, I'll give you some quick and simple methods for making your meter into a suppressed-zero, expanded-scale voltmeter, and how to make a shunt so that it will indicate over the desired current range.

You must know the resistance of the meter movement, the full scale current, and the voltage drop across the meter movement at full scale, but these are easier to determine than you may imagine.

First, measure the resistance with a DMM on ohms scale. It might be anything between 2 and 2000 ohms. If it is much higher than 2000 ohms, it probably contains an internal voltage multiplier and will have to be taken apart to have the multiplier removed and replaced by a short wire, or simply shorted out with a piece of wire. Or, you may have another meter that will work just as well.

Caution: Do not ever use an analog VOM on ohms to measure meter resistance! The VOM voltage and current are so high that it can wrap the needle around the pin or burn out the movement of your meter. Use *only* a DMM!

In many instances, the full scale current is printed on the meter face. Ignore whatever scale the meter has. Look low on either side of the movement through the front glass of the meter. It is usually on the right side. Look for very small print such as: "F.S. 50 µA" or "F.S. 1 mA." If it isn't present you can do it the hard way, with a flashlight battery, potentiometer, and DMM set to measure current. When the needle on your meter is at full scale, *write this value down and save it!* Make sure you also wrote down the meter resistance. You will need this figure later, too.

Now, using Ohm's Law, meter resistance and full scale current, determine the voltage drop across the meter. *Write this figure down and save it.* You'll need it later as well.

Suppressed-zero, expanded-scale

A zener diode, D3 in **Fig. 1**, is used to suppress zero so that the meter cannot indicate until the zener voltage is reached. Because your operating voltage is usually 12 to 13.8 VDC, and a fully discharged storage battery has a terminal voltage of 10.5, an 11-volt zener is recommended.

Assuming an 11-volt zener is used, and 16 volts is a bit higher than any you will use in the station, what you will have is a 5-volt meter that measures only the five-volt span between 11 and 16 volts. Using Ohm's Law and the full scale current of the meter, determine the value of the meter multiplier resistance.

As an example, assume your meter has a full-scale current of 500 µA (0.0005 A) and you want to measure the above mentioned voltage range between 11 and 16 volts:

$$R = E/I = 5/.0005 = 10{,}000 \text{ ohms.}$$

You would probably use a 10k trimpot in series with 2k or 3k fixed resistor for R3 in **Fig. 1**. Applying 16 volts across the meter, D3 and R3 in series, adjust the trimpot for a full-scale indication on the meter. Or simply measure the voltage of your station power supply fed across this series arrangement and adjust the trimpot so the meter indicates the same as your station power supply does.

Making the shunt

Now you will need the full-scale voltage drop you measured earlier. But first, what is the actual maximum current either rig is expected to draw? Add one ampere to this figure, round it off at the nearest higher figure, and write this number down. Assume your final figure is 5 amperes.

Now pull out the *Handbook* and look up the copper wire table. I'll tell you now that AWG 22 is fine for a 5- or 6-ampere shunt. Look over across the table under "Ohms per 1000 Feet." Divide this down to determine the resistance of *one inch* of AWG 22 wire. It happens to be 0.0013 ohms, and four decimal places are more than sufficient to guarantee reasonable accuracy. With these two figures, and the meter movement voltage drop at full-scale, you will do a tiny bit more arithmetic. Assume meter voltage is 0.044V.

Parts List	
Designation	Part
BP1	Red binding post
BP2	Black binding post
C1, C4	.001 µF ceramic disc
C2, C5	.1 µF ceramic disc
C3, C6	10 µF 16 V tantalum (or 100 µF aluminum electrolytic)
C7, C8	.01 µF ceramic disc
D1	LED, green
D2	Germanium: 1N34A, 1N60, 1N270, etc.
D3	Zener diode, 11 V, 400 mW (see text)
F1	Fuse appropriate for current drawn
J1–J7	3.5 mm mono phone jack or your choice
J8–J13	DC connectors, your choice
J14, J15	SO-239 or your choice RF connectors
M1	Meter, 50 µA to 1 mA (see text)
P1	Connector to storage battery if used, your choice
R1	Shunt (see text)
R2	2.4 k 5% 1/4 W
R3	Trimpot voltage set (see text)
R4	50 k pot. RF sensitivity.
S1	DPDT center off toggle, must carry full DC current
S2	DPDT toggle
S3	2-pole 3-pos. rotary
T1	T50-2 or T50-6, 30T AWG 24 secondary. Primary is straight wire through center of core, J14 to J15

***Table 1.** Parts list.*

R(shunt) = .044(V)/5(A) = .0088 (ohms).

Now, to determine how many inches of AWG 22 wire you will need for your 5-ampere shunt, use the following:

L (in.) = 0.0088/0.0013 = 6.769 in., or a bit over 6-3/4 inches.

You can now cut the wire a half-inch longer at each end for connection, wind it over a ballpoint-pen body, slip it off, strip and tin the half-inch ends, and solder it to a 2-terminal strip. Small stranded hookup wire is used between the shunt and the rotary switch contacts.

RF magic

The simple circuit composed of C7, D2, T1, J14, and J15 is essentially identical to that I described in my article, "Home-Brew RF Ammeter for the Shack," *73 Amateur Radio Today,* July 1998, page 29. The article thoroughly describes how it functions and why it can tell you when your RF output is as high as possible, simultaneous with an SWR as low as your ATU can get it. Because it also shows you the relative RF power going into the shack ends of your feeders, you know the antenna is radiating it—so you no longer need an SWR meter or FSM in the shack. Just adjust the ATU for the highest peak on M1 with S3 in the RF position. I incorporated this circuit into this design to make it even more valuable as a necessary part of my ham station.

A final word

All wiring that carries the full load of current should be at least AWG 14 for up to 5 amperes or less, to reduce voltage drop through the wiring. If your station is QRO you will be using larger wire—at least AWG 12.

I operate only QRP and have two main rigs, an SG-2020 and a QRP++ as a backup. Both these rigs are controlled and monitored through my Ham Station Control and Monitor, and my backup battery is a 12-volt 12 Ah gel cell.

I built this unit in a Ten-Tec TG-36 that I bought on sale a couple of years ago. It measures approximately 6" W x 3" H x 4" D and matches all the rest of my home-brew accessories and test equipment. I also have several monoband CW transceivers, and when I want to use one, it is easy and quick to plug one in to temporarily replace the QRP++. Of course, it would be simple to expand this unit to handle as many as four separate transceivers. Above that number, the needed toggle switches probably are not even manufactured.

For those of you with HF rigs interested in the HF satellites, having two rigs ready at the same time with one on 10 and one on 15 meters would allow you to have a pretty inexpensive satellite station! It's a thought.