Using Solid-State Transceivers With Older Tube Amplifiers

(some Hines and Kinks on the Heath SB-220/200 that can be useful in your application)

Using The SB-220 Amplifier With Solid-State Transceivers

QST January 1988, p. 45

The Heathkit SB-220 is one of the most popular amplifiers ever sold. It was designed in an era when most amateur equipment was based on vacuum-tube technology. Because of this, special care is needed if the SB-220 is to be used with a solid-state transceiver.

The SB-220 goes into the transmit mode when the hot contact of its rear-panel ANT RLY jack (J1 in Fig. 1A) is shorted to ground, actuating K1, the SSB-220 antenna relay. The open-circuit dc voltage at this jack is 125; the short-circuit current is 25 mA. Vacuum-tube-based exciters usually have no trouble switching power at this level. Solid-state rigs are a different story.

My ICOM IC-740 transceiver can't switch 125 V at 25 mA because the maximum ratings for this amplifier-controlled relay contacts are 24 V/1 A dc. Other solid-state transceivers likely use relays or open-collector transistors of similar ratings for amplifier control. The switching problem is complicated by the fact that the SB-220 antenna-relay solenoid is not shunted by a spike-suppression diode. The transient voltage developed by a solenoid's collapsing magnetic field can exceed the supply voltage. (If you've never gotten a poke from relay-solenoid back EMF, you know that this voltage is not just theoretical!) With the 24-V rating of the IC-740's control contacts in mind, a direct amplifier-control connection between the SB-220 and the IC-740 seemed to invite trouble.

Fig 1B shows my solution to this problem. With Q1 and Q2 handling the actuation of K1, voltage at J1 is reduced to approximately +12. Short-circuit current through J1 is about 2 mA. Because the SB-220 must be opened to make this modification now's a good time to install an OPERATE/STANDBY switch, S1, to save switching the SB-220's tube filaments on and off.

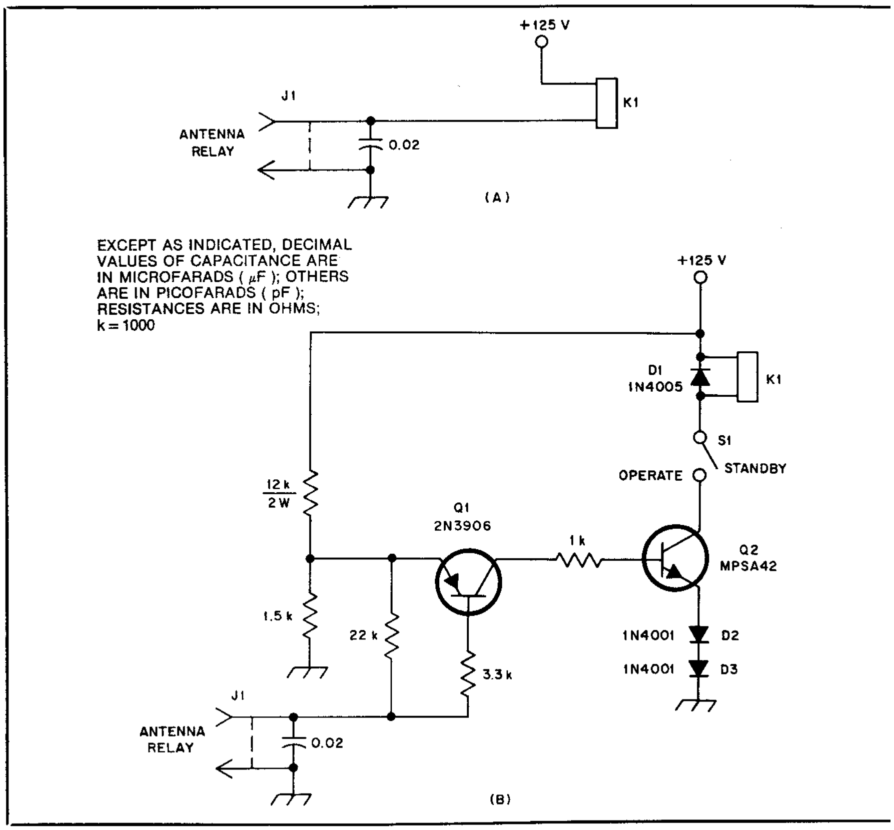

Fig 1—K8SS' SB-220 modification lowers the voltage at the ANT RLY jack, J1, from 125 at A to approximately 12 at B. Short-circuit current through J1 is reduced from 25 mA in the unmodified circuit to 2 mA in the circuit shown at B. J1, K1 and the 0.02-μF capacitor are SB-220 parts. Resistors are ¼-W, carbon-film units unless designated otherwise.

D1—1-A, 600-PIV diode.
D2, D3—1-A, 50-PIV diode.
Q1—General-purpose transistor.
Q2—High-voltage switching transistor, V_{ceo} = 300. ECG287 also suitable.
S1—SPST toggle.

There's plenty of room under the SB-220 chassis for mounting the switching components; the entire circuit can be assembled on a tie strip and mounted to an available under-chassis screw. I installed my version of the Fig. 1B circuit next to the SB-220's 125-V dc supply, just behind the SSB/CW rocker switch. (Take proper high-voltage safety precautions when you make this modification. Lethal voltages exist in the SB-220.) Dress the wiring for minimal coupling to RF circuits under the chassis and near the antenna relay. As installed in my SB-220, this circuit shows no susceptibility to RFI. – *James Herbert, K8SS*

An Improved Circuit for Interconnecting the SB-200 Amplifier and Solid-State Transceivers
QST May 1989, pp.48-49

I encountered a problem similar to that discussed by James Herbert (“Using the SB-220 Amplifier with Solid-State Transceivers,” QST, Jan 1988, p. 45, when I sought to drive my Heath SB-200 amplifier with a newly acquired Kenwood TS-940S transceiver. The hot contact of the SB-220’s relay-control jack exhibits an open circuit voltage of -130 to ground; the short-circuit current of the SB-200’s relay-control circuit is 50 mA. The open-circuit voltage could rise to as high as 170 under fault conditions in the SB-200. The Kenwood manual states that the TS-940’s control relay is intended for low-current applications; I infer that “low current" also means “low voltage.” As a result, I did not want to connect the SB-200’s 130-V control line to my TS-940S. Instead, and in order to get on the air quickly, I used a relay between the TS-940S and the SB-200. I wasn’t satisfied for long: It seemed ridiculous – and rather noisy – to use the transceiver relay to drive another relay that finally switched *another* relay in the SB-200.

To solve this problem, I designed an interface circuit (Fig 2) that uses a high-voltage, P-channel MOS power transistor – an IRF9612 – as a switch. The IRF9612 has a source-to-drain breakdown voltage of 200, can switch up to 1.5 A, exhibits a channel resistance of 4.5 Ω when turned on, comes in a TO-220 plastic package, and costs $3.50/unit* in small quantities. The IRF9612 also includes an integral drain-to-source protection diode capable of clamping transients that can result from switching inductive loads.

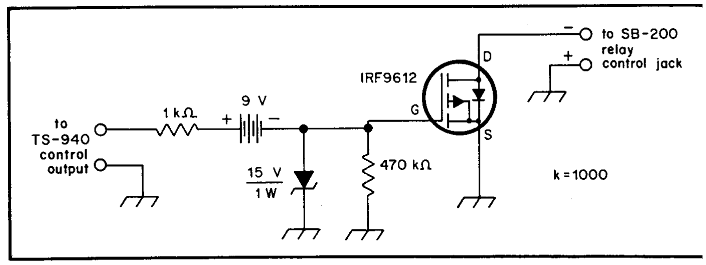

Fig 2—Richard Jaeger’s solid-state transceiver-to-amplifier interface uses a power MOSFET instead of a relay for amplifier control. For amplifiers that use a *positive* relay-control voltage, reverse the polarity of the Zener diode and battery, and use an IRF612 N-channel MOSFET instead of the IRF9612.

The circuit is powered by a 9-V battery, which provides enough voltage to drive the MOSFET in this low-current switching application. The 1-kΩ resistor limits the peak current flowing in the transceiver relay to approximately 9 mA and sets the MOSFET turn-on time to approximately 0.3 µs (this assumes that the MOSFET’s effective input capacitance is 300pF). The 470-kΩ resistor sets the turn-off time constant to 140 µs and limits the closed-circuit current to 20 µA. The 15-V Zener diode protects the transceiver should the MOSFET develop a gate-to-drain short circuit. (In that unlikely event, the Zener diode will limit the voltage applied to the transceiver to –24. If you intend to substitute a diode with a different Zener voltage for this part, remember that the Zener diode’s breakdown rating must comfortably exceed the battery voltage [9 in this application]).

I built the circuit on a piece of perfboard, mounted the board in a small metal box, and used shielded cable for connections between the interface box, amplifier and transceiver, Stray-RF problems have not occurred with this arrangement. Because the interface circuit is self-contained, the SB-200 and TS-940S need not be modified for operation with the interface. – *Richard C. Jaeger, K4IQJ*

More on Interfacing Solid-State Transceivers and the SB-220 Amplifier: A Power-MOSFET Source
QST January 1991, p. 37

My circuit for interfacing the TS-940S with the SB-200 has generated a lot of interest. But many people are having trouble finding the IRF9612 power MOSFET I used. The IRF9612 is an International Rectifier product sold under the trademark HEXFET. The IRF9610, 9620, 9630 and 9632 can all be used in place of the 9612, although they are slightly more expensive. My source is Digi-Key Corp**. – *Richard C. Jaeger, K4IQJ*

*check current prices and availability

** check TISfind database for contact information