Wireless Set A40 Part 2

Powering the A40 from a French inverter for the TR-PP-8A (ER-38A) 'Handie-Talkie'.

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Introduction

High tension (HT) batteries are obsolete. They also have a limited shelf life, so any left in some forgotten store are now useless. However, the enthusiast with a portable valve radio needs some form of HT supply to keep the set in operation.

The above is true for portable, military VHF FM valve radios of the 1950s. Those with a nominal 0.25W RF output included the British A40, the Canadian CPRC26, the US PRC-6, the German PRC-6/6 and the French TR-PP-8A (ER-38A). All used 45V and 90V HT batteries, but not the same battery. The A40 and CPRC26 used the squat, tubby BA-289 and the rest, the 'handie-talkies', the elongated BA-270.

Some of the 'handie-talkies' remained in service with European military and paramilitary forces well into the 1980s. The French produced a battery inverter for their TR-PP-8A to extend its service life. That inverter is now on the surplus market. This note describes the inverter and powering a British WS A40 from it.

General

The TR-PP-8A inverter provides stabilised 45V and 90V HT, plus a low current -4.5V for grid bias (GB) from battery supplies of 7.5V to 5.5V.

The overall inverter/battery unit consists of an open, double-sided battery rack that holds 9 off U2 cells (BA 030). 5 cells are fitted from one side of the rack and 4 from the other. The inverter module fits above the 4 cell stack and is little larger than a U2 cell.

The cells in the 4 cell stack are connected in parallel to provide the 1.5V filament supply. The cells in the 5 cell stack are connected in series to provide the 7.5V supply. The overall dimensions of the inverter, battery rack assembly is the same as the BA-270, i.e. 70 x 70 x 183 mm.

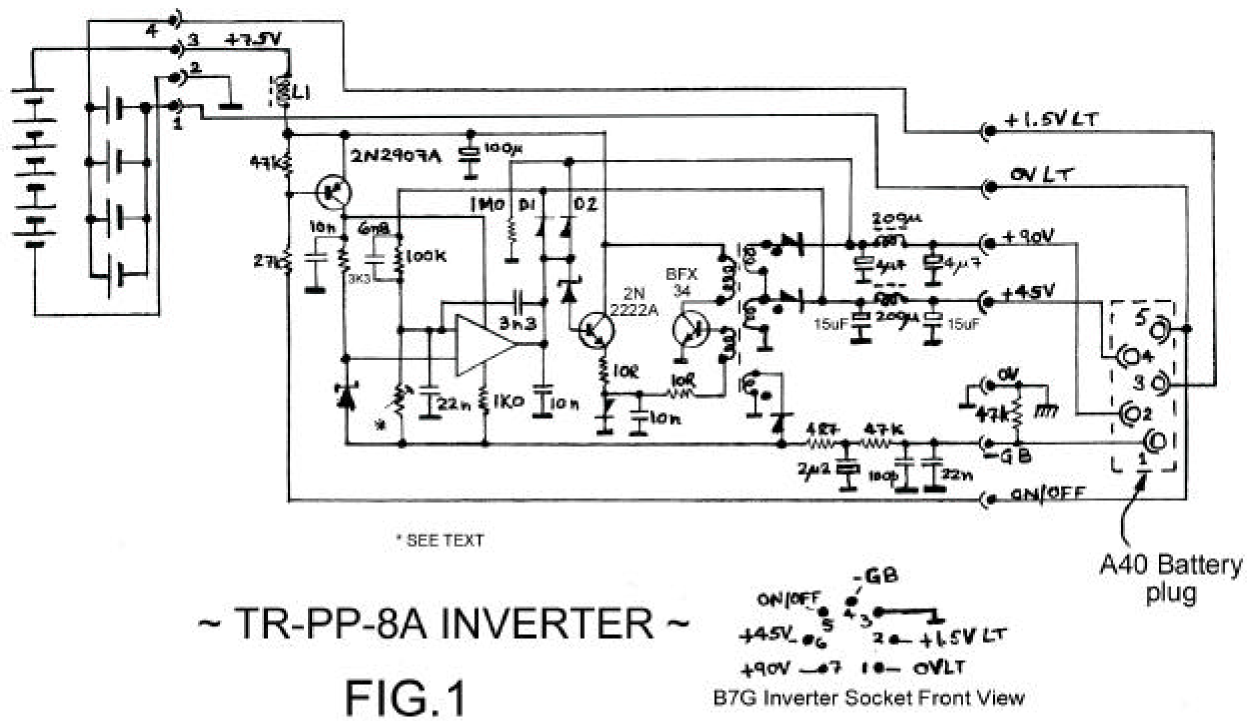
The inverter itself is contained in a small, open topped, pressed steel box 35 x 65 x 36 mm. It is constructed on 3 printed circuit boards (PCBs) stacked one over the other. The top PCB mounts a robust B7G socket with gold plated contacts for the TR-PP-8A battery plug, plus a 4 way in-line socket, also with gold plated contacts, which connects to the battery holder assembly. The middle PCB contains the radio frequency interference (RFI) filtering. The main circuitry of the inverter is on the bottom PCB.

The PCBs are potted in silicone rubber. The unit examined was dug out of the potting to trace its circuit.

Circuit

The traced circuit of the inverter is shown in Fig.1 as a guide only. The inverter pin out and operation on resistance load should be checked before connecting it to sets other than the TR-PP-8A.

On the basis - 'if you've got something good stick with it' - the basic TR-PP-8A inverter circuit is virtually the same as the earlier BA-511A



~ TR-PP-8A INVERTER ~

FIG.1

inverter for the PRC-10. It is not a conventional mark-space switching design, but regulates output by switching the inverter on and off. This avoids some of the RFI problems associated with fast mark-space switching and achieves overall efficiencies approaching 80%.

The main inverter transistor is an NPN silicon TO5 cased BFX34 without a heatsink. The transformer pot core is an LA4245. The bias amplifier is a TO18 silicon NPN transistor type 2N2222A. The inverter unit power on/off switch is a PNP TO18 transistor type 2N2907A. The control IC is an SFC 2741 operational amplifier in a TO5/8 case.

There are one or two circuit wrinkles in the TR-PP-8A. These are described below.

Load Fault Protection

Protection is provided against short circuits in the HT supplies of the TR-PP-8A set. Should such a fault occur, the affected HT supply voltage drops to near zero. The diode (D1 or D2) between the faulty HT circuit and the output of the IC amplifier becomes forward biased and bypasses the current that would normally provide the bias for the main inverter transistor. Deprived of bias, the switching transistor shuts down and the inverter is switched off to protect itself.

Mechanical Impact Protection

Each cell in the 5 cell stack, 7.5 V battery, has a reverse biased 1N4002 silicon diode soldered across its battery rack contacts. (These are not shown in Fig.1). If the assembly is physically jarred, a cell, or cells, can transiently lose electrical contact with the holders and a transient interruption of supply occurs. This generates a voltage spike from the input filter choke (L1 of Fig.1), which is capable of damaging the inverter. The 1N4002 flywheel diodes provide a decay path for the choke current so preventing the voltage spike and protecting the inverter.

Voltage Control

In the TR-PP-8A inverter assembly, only the HT supplies are stabilised. The valve filaments are directly fed from batteries and the set performance falls off as the filament battery discharges. This is partially compensated by using a proportionately larger capacity battery for the filament supply. Consequently, when the 7.5V U2 batteries are fully discharged the filament supply batteries are only partially discharged.

When the filament battery is completely discharged the set cannot draw HT current and without load, the inverter cannot control its HT outputs. The inverter sets back to a minimum ON period. The resultant pulses repetitively charge the output capacitors but, without an adequate discharge path, the capacitor voltages pump up to levels that are potentially harmful for the inverter and the set.

<u>The inverter must not be run unloaded or without healthy filament supplies.</u>

Grid Bias Supply

To provide supply voltage higher than 7.5V for the IC and sensing bridge, a negative voltage of about -4.5V is generated by the inverter and added to the battery supply voltage to provide a nominal 12V supply. The -4.5V negative voltage also provides the grid bias (GB) supply.

HT Voltage Adjustment

The inverter HT output voltages are set on works test by selectively shorting with solder, resistors in a graded 4 resistor chain. These resistors are not accessible after the inverter is potted.

Batteries

The selection of batteries to test power the inverter was made on the basis of what was available cheaply. At the New Year, Greenweld had unused 1Ahr 7.2V, cellphone NiCd battery packs at £2. Each pack contains 6 cells the same diameter as AA cells, but about 30% longer. The samples purchased had dry solder joints on their output terminals which required re-soldering before use.

Appendix 1 estimates that 1Ahr batteries should provide at least 4 hours HT service life on a 9:1 RECEIVE:TRANSMIT regime and that the corresponding LT requirement should be about 4 Ahr. This is too short a life for most rallies and displays. If an 8 hour life is needed, two 7.2V packs could be used in parallel and the filament supply increased to 8Ahr. This has not been tried. Tests have been limited to a 1Ahr 7.2V battery and a 4Ahr filament battery.

Interfacing

For use with the A40 the inverter box was removed from the TR-PP-8A battery rack. The inverter is intended to be switched ON and OFF by the power switch on the TR-PP-8A set. This switch connects the base circuit of the inverter PNP transistor to earth, turns on that transistor to power the control circuitry and so switches on the inverter. The TR-PP-8A has a 7way battery lead. Spare ways in this lead are used to switch the inverter ON and OFF by the set power switch.

The A40 has a 5way battery plug with no spare ways and no direct connection to chassis. The HT- and GB+ outputs of the inverter are connected to its screening box, as are the earths of its RFI decoupling. To maintain effective RFI filtering the inverter box requires to be connected to the A40 chassis. The LT supplies are isolated from the inverter circuit.

The A40 OFF/WHISPER/LOUD switch has a switch pole between battery common and chassis. If the common HT- and GB+ from the inverter are not connected to the A40 battery plug but are connected to the set case, this maintains effective RFI filtering.

There is no hard wired connection between the set case and the set chassis. The chassis has two beryllium copper springs that bear on unpainted tracks on the inner surface of the case. These springs and tracks should be cleaned to ensure good electrical contact between case and chassis. As an additional precaution, paint should be removed from under the four bolt heads and from under the nuts bolting the set front panel to the set case.

The base lead circuit from the inverter PNP ON/OFF transistor is then connected to the battery common pin of the A40 battery plug: this achieves the required auto switching of the inverter by the set OFF/WHISPER/LOUD switch.

The plug/socket interface from the TR-PP-8A inverter to the A40 was made from the socket of an A40 battery extension lead (from Bob Egerton) and a B7G header plug, as shown in Fig.1. To avoid altering the A40, the connection to its case was made by removing one of the countersunk screws retaining the set case battery plug, clearing paint from around the screw hole and fitting a 6 BA cheese head screw clamping a solder tag against the cleaned area of case.

The plastic underside of the interface 'battery' socket was cut away to accommodate the cheese head screw, solder tag and case lead to the inverter.

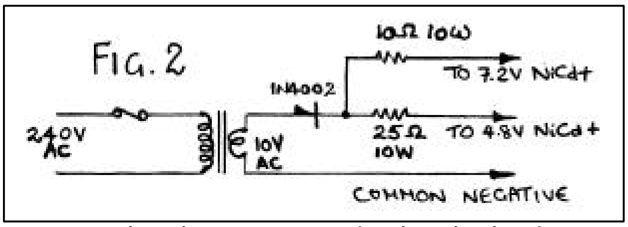
The -4.5V grid bias supply from the inverter is too high in voltage for the A40. It was reduced to -2.25V by connecting a 47kohm resistor from it to the common earth of the inverter.

Battery Charging

The relatively crude arrangement of Fig.2 was adopted to charge the NiCd batteries. The transformer is a 10V ac, 620mA 13 Amp plug-top unit for an old telephone answering machine. If a more comprehensive battery charging method is desired Greenweld have reasonably priced, surplus fast chargers/conditioners for cellphone batteries, which power from 12V car supplies, and the 7.2V battery packs have an internal charge diode and thermistor. These charger/conditioners would need modification but would merit the work.

NiCd cells do not charge effectively in parallel so the individual cells of the filament battery were connected to a 'D' socket. A charger 'D' plug mates with this socket with links on its plug pins to connect the cells in series for charging. A similar 'D' plug is wired to the inverter assembly with different links to connect the cells in parallel for service on the set.

9 pin 'D' connectors were used because they were to hand. Consequently, they had only one spare way. Starting from scratch connectors with a higher pin number, possibly 15, would be used so that the 7.2V battery could also fed through the connector to give a single battery pack connector for set and for charger connection.



Battery Life

The batteries were given three full charge discharge cycles to condition them. The set was then powered on RECEIVE and the time to HT collapse measured. It proved to be 5.5 hours, roughly in keeping with the predictions of Appendix 1.

Mechanical Arrangement

The mechanical arrangement of the batteries and inverter in the A40 battery box is dependent on the size of the batteries used. The test batteries took up less than 20% of the battery box volume. They were simply packed with sponge rubber to prevent them rattling. A final arrangement should be worked out to suit the particular batteries employed.

Source of Equipment

The TR-PP-8A inverter/battery pack for this note was purchased from:

Peter Gray,
Railway Cottage,
8. Rue des Genets,
14110, Pont Erambourg,
France

He presently stocks TR-PP-8As and their inverters.

Conclusion

The TR-PP-8A inverter and battery rack can be used 'as is' with the TR-PP-8A, PRC-6 and PRC-6/6 'handie-talkies', or adapted for use with available NiCd cells. As described in this note, it can be used to power the A40. It is believed that the A40 arrangement will power the CPRC-26 but this has not been tried.

Happy experimenting!

Appendix 1

Maximum A40 power requirements (on most sets HT current drains will be less):

Valve filament demand:
600mA at 1.25V on RECEIVE.
975mA at 1.25V on TRANSMIT.

Assuming a 9:1 RECEIVE:TRANSMIT ratio the average filament demand is:
600 x 0.9 + 975 x 0.1 = 637mA

For a 4 hour battery life the Ahr capacity of the filament battery must be at least:
0.637 x 4 = 2.55 Ahr

A 30% margin (see text) would increase this to 3.3 Ahr. Say 4 off 1Ahr cells

HT power in RECEIVE:
45V x 15.5mA = 0.697 Watts
90V x 3.5mA = 0.315 Watts
Total 1.012 Watts

HT power in TRANSMIT:
45V x 10mA = 0.45Watts
90V x 37mA = 3.33Watts
Total 3.78Watts

Assuming a 9:1 RECEIVE:TRANSMIT ratio the average HT power is:
1.012 x 0.9 + 3.78 x 0.1 = 1.289 Watts

Assuming an 80% inverter efficiency this rises to:
1.289/0.8 = 1.611 Watts

This corresponds to 1.611/7 = 230mA from a 7V supply.

For a 4 hour life the battery requires a capacity of at least: 4 x 0.23 = 0.92 Ahr.