

Building a dc to ac converter



Introduction

Otherwise known as a dual axis drive corrector, this unit is intended to provide 240 volts/50 Hz (or 120 volts/60 Hz with minor modifications) for a right ascension (ra) drive and a reversible declination motor. Both these outputs are isolated from ground and from the 12 volt supply. This isn't a complex project and uses readily available parts, but if you fancy building this project and don't possess the necessary electronic construction skills, there are likely to be fellow astronomers who can assist. I've built two of these units back in 1987 and they have worked without fault ever since.

The supply requirement is from 11 to 16 volts d.c. at 500 mA, a cheap "burglar alarm" sealed lead acid gel cell will provide sufficient capacity for a typical viewing or photography session.



Circuit description

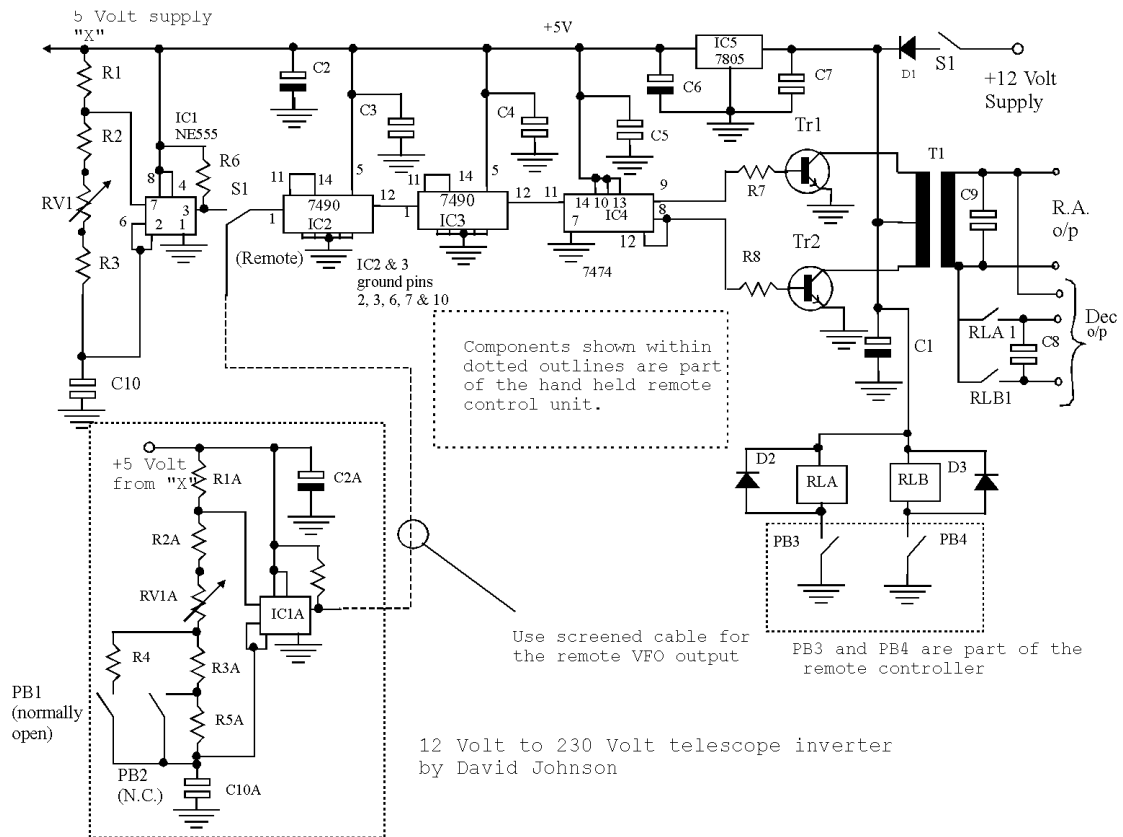
Please refer to the schematic.

Additionally, there is a PIA file available to download from <http://www.astromag.co.uk> that can be used to print PCB layouts, PIA is a shareware PCB design program that will print in the non registered version (the limitation being that you can't save files, other than that, everything fully works).

The 12 volt input is fed via a 2 amp fuse and series diode to both T1 and IC5. IC5 is a 5 volt output regulator feeding IC1 to IC4 including the remote controller.

IC1(A) (NE555) forms a free running oscillator with a frequency determined by the value of resistance between pins 6 and 7. The oscillator has a nominal frequency of 10 KHz, this relatively high frequency was chosen so that a high stability capacitor could be used at C10 to give minimum drift with changes in temperature. Virtually identical oscillators are fitted to both the main and remote units.

R4 and R5 are omitted from the main unit. Switch S1 is fitted to the front panel of the main unit and selects either local or remote oscillators.



The remote unit is connected via a latching "DIN" plug and socket or similar connectors. The remote unit is only required for photographic tracking and can be omitted altogether for visual work. IC2 and IC3 are wired to divide by 10, giving 1 KHz and 100 Hz outputs. The 100Hz output of IC3 is fed to the input of a flip flop (IC4) which feeds the signal alternately to the bases of TR1 and TR2, these switch the 12 volt supply to ground through transformer T1 which is a normal mains transformer connected in reverse.

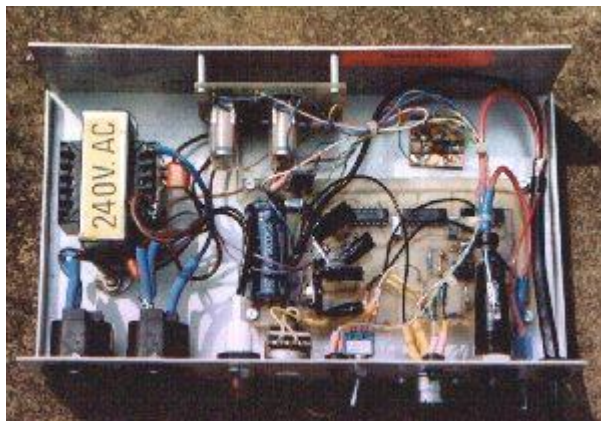
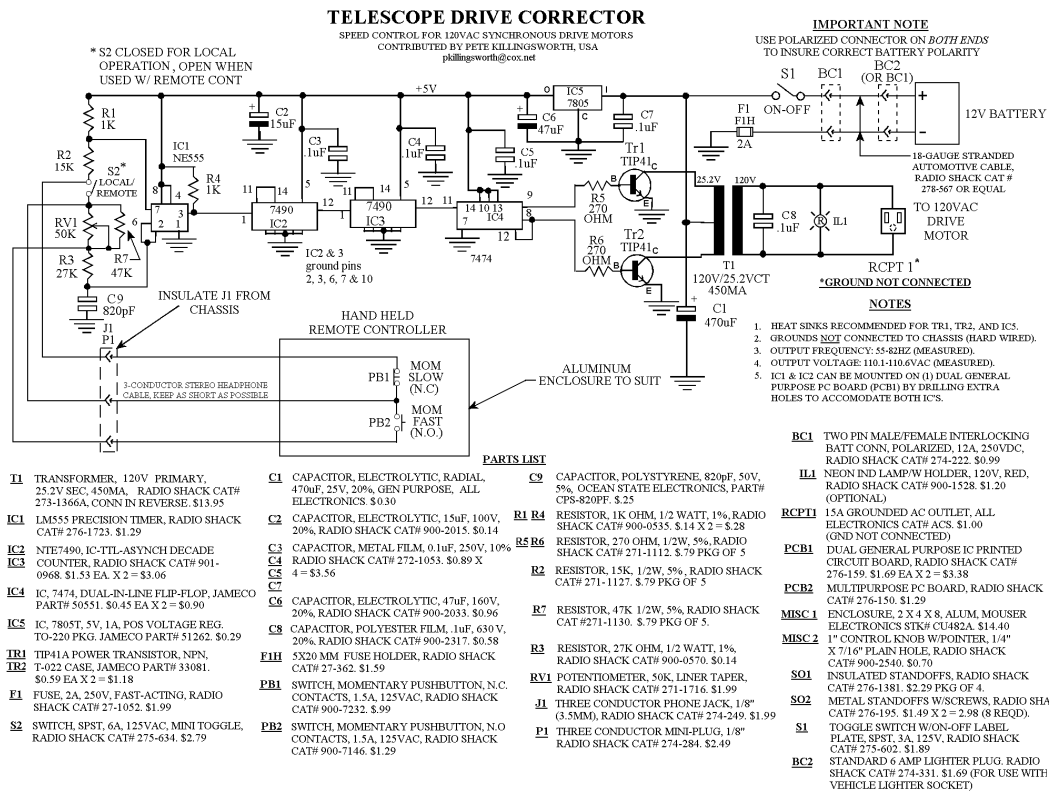


Diagram with USA part numbers



The switched declination output is taken from the output of T1 via RLA or RLB. Either of these relays being energised when PB3 or PB4 is pressed on the remote unit. A 0.1uF (400 volt working) capacitor gives a phase shift to the declination motor. Note the declination reversing switch mounted on the remote control, this is used to reverse the "sense" of the push buttons to match the view through the eyepiece when tracking (wire a double pole change over slide switch from corner to corner in a cross so that it reverses the connections, not shown on diagram).

The overall output frequency is adjustable from 47.5 Hz to 52.5 Hz by adjusting RV1 or from 40 Hz to 60 Hz by pressing PB1 or PB2 on the remote unit. This frequency is stabilised against voltage or temperature change. By changing the value of R2 and R2A the unit can be made to work for a 60 Hz motor rather than 50 Hz.

Note that references to IC1 also include IC1A of the remote unit.

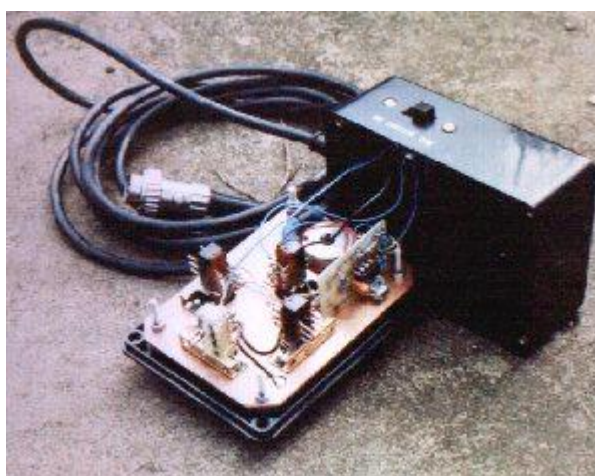
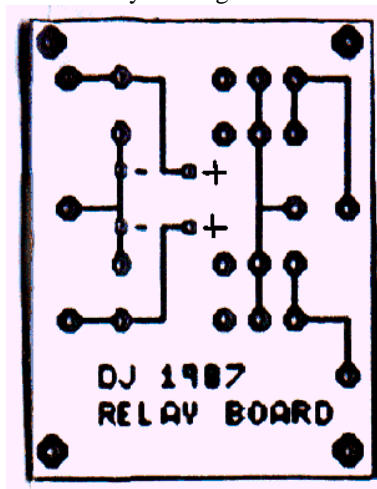
Modifications and USA part numbers (see Pete's diagram above)

I've received details of circuit changes to improve the output voltage and also USA part numbers from Pete Killingworth (pkillingworth@cox.net). The main change is to reduce the value of R7 and R8 to drive the output transistors with more current. Pete is driving a Bausch & Lomb 4000 and finds the inverter works well.

Construction

It is strongly suggested that you download the [PIA program](http://www.astromag.co.uk) and associated [zip files](http://www.astromag.co.uk) from the links at <http://www.astromag.co.uk>, using these to print a good quality board layout. There is also a layout for the hand held remote controller.

The relay board isn't (yet) available in PIA format, however it's a simple design and can be produced from this layout diagram



Various component locations are shown on the PIA board layouts, is it generally accepted practice to fit ic sockets, then resistors, capacitors, transistors etc. However the exact construction is very much up to the individual and is beyond the scope of this article, if you lack the experience to tackle a project such as this, there are likely to be plenty of electronics enthusiasts in your local astronomy club who can assist.

If you take a close look at the image of the remote controller, you will see that the various parts are mounted on a sub-board made from printed circuit board, this makes it easy to mount the push button switches without having to fix them to the front panel. The remote oscillator board is simply soldered onto this main board.

Perhaps the easiest way of producing a printed circuit board is to print the layout at the correct size, stick it to the copper side of a piece of blank copper PC board, drill through the holes, clean the board and draw the layout with an etch resist pen. Finally etch in ferric chloride and wash.

Parts List

T1	230 volt primary 12-0-12 volt secondary 6VA transformer (used in reverse) Maplin part number WB10L Make this a 120 volt primary for 120 volt output
IC1, IC1A	NE555
IC2, IC3	7490
IC4	7474
IC5	7805
TR1, TR2	TIP41C (with clip-on heatsinks)
D1, D2, D3	1N4001
C1	470uF 25 volt
C2, C2A	15uF 16 volt
C3, C4, C5, C7	0.1uF 50 volt min metallised polyester film
C6	47uF 25 volt
C8, C9	0.1uF 400 volt disc ceramic or polyester film
C10, C10A	820pF close tolerance polystyrene
R1, R1A, R6	1K
R7, R8	270R
R2, R2A	54K
R3, R3A	27K
R4A, R5A	15K
RV1, RV1A	10K potentiometer (Maplin YP07H)



- 2 miniature toggle switches (one for on/off, one for internal/external oscillator)
- 1 miniature DPDT slide switch (declination reverse) Maplin FH36P
- 2 relays, 12 volt coil, 240 (or 120) volt rated contacts Maplin YX98G
- Suitable mains rated sockets and plugs for the supply output to the motors (in the UK use IEC 6amp connectors)
- Panel mount neon to indicate high voltage output (mains rated neon)
- 4 push button switches (Maplin part number FH67X)
- Latching 5 way DIN plug and socket for connecting the remote unit

Notes

All fixed resistors are 1% metal film 1/4 watt

The 54K resistor is made up from 51K and 3K resistors, it is selected on test to give the required output frequency.

Parts for the oscillator in the hand controller are identical to those used on the main board.

While Maplin are mentioned as a supplier of some parts, nothing in this design is critical, there shouldn't be a problem with finding these parts at any of the usual suppliers. The frequency determining components around IC1 should be chosen with care to minimise drift due to changes in temperature, in particular a good quality potentiometer should be chosen for RV1.

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