Summary Report on a Solid State Pulsed Induction Generator

Over a period of 18 months two types of pulsed induction generators were built and tested to explore the suggestion that such generators, using the Back EMF pulses from their inductors, could provide useful power with a Coefficient of Performance >1. Firstly a rotor based system was built that had a fixed HV frequency determined by the rotor speed but which failed to show any net battery charging.

To explore the principle further a solid state version was constructed that allowed for variable and much higher frequencies than the rotor based system and with adjustable duty cycle to the coil driver(s) and therefore to the resulting HV pulses. The design was such as to allow for a variety of configurations of coils, driven singly or in sequence by a FET or BJT, and charging systems, direct and capacitive discharge, in order to determine the optimum arrangement for maximum output and effective battery charging.

Design

The schematic design in shown in Fig 1 and employed 7 coils with approximately 500 turns of 0.71 mm diameter wire on ferrite cores. The circuit power was provided by two sets of three 12V 7Ah batteries providing 36V for the inverter. Power to the coils (inductors), the batter swapper, signal generators and other components was supplied via a Buck Converter at 12V.

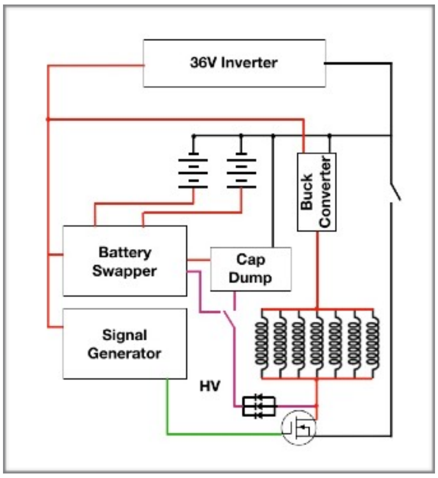

Fig 1

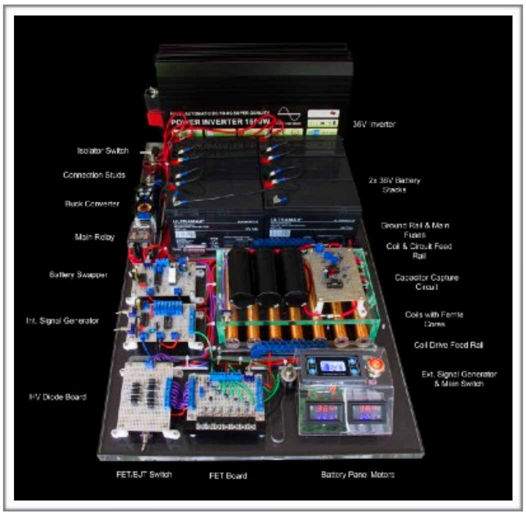

Fig 2

The final build of the device is shown in Fig 2 and included the option of either an internal or external signal generator as well as circuitry to allow the coil driver to be easily switched between a FET and a BJT. In early tests the square wave input signal was fed to each coil in a rotating chip controlled sequence, each with their own FET, so as to avoid unnecessarily high current but later the coils were joined in parallel with a combined resistance of 0.5 Ohms and a single driver.

The HV output, taken from the FET Drain or BJT Collector, was fed directly to either the battery swapper, and hence to one or other of the battery stacks, or to the capacitor dump circuit which would periodically discharge to the battery stacks via the relay when the receiving capacitors reached a predetermined voltage.

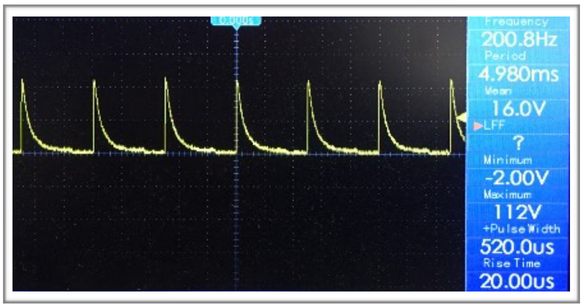

Fig 3

A typical generated HV pulse waveform is shown in Fig 3, measured with a 20:1 potential divider, where in this case the peak back EMF voltage from the coils was 2,240V.

Measurements

Measuring the voltage of the batteries was seen as the only way to determine their state of charge and as such was seen as the simplest means to evaluate the net effect of the HV pulses. To this end a regime was established where the generator was energised for periods of 30 mins, with the battery swapping system rotating the drive and charging sets of batteries every two mins, before switching off and allowing the batteries to stabilise for 1 hour before final voltage readings were taken.

Tests were conducted over weeks using various frequencies, duty cycles and battery configurations (stacks of 1, 2 or 3 batteries). Also observations were made regarding any configurations that might positively affect the net charging as measured by the stabilised change in battery voltage.

Various BJT and FET coil drivers were tested with the IRF840 MOSFET proving to be the most consistent and with least current drain and this was used for the results shown below. Also the HV was fed directly to the batteries as the use of the capacitive discharge circuit, that involves initially charging storage capacitors, showed no clear overall benefit to net battery charging.

Results

One of the most important run of tests was to examine the effect of a change of HV pulse frequency, derived from the square wave signal generator, on net battery charging. The charging of a single pair of rotating 12V batteries with varying HV frequency is shown in Fig 3. The blue line depicts the change in battery voltage against frequency and resulted in a constant drop of 0.05 V across all tested frequencies and with the total circuit current in the range of 1.2-1.7A.

In order to compare and contrast battery charging without the effect of the circuit power drain, another set of tests were done where the HV was directed to a single external battery while the voltage change due to the circuit power drain alone was measured as before and these are shown by the green and yellow lines.

Using the full triple sets of batteries, Fig 4 shows the net battery voltage against frequency with circuit current 0.1 - 0.2 A.

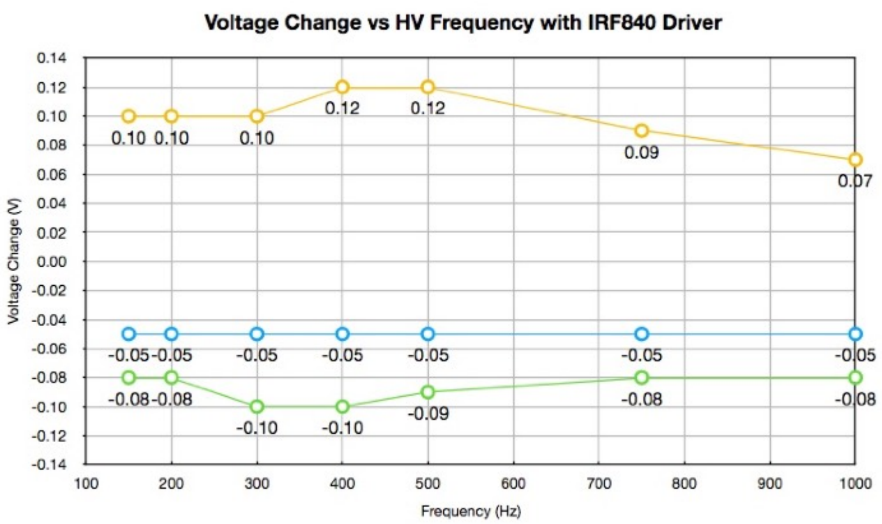

Fig 4

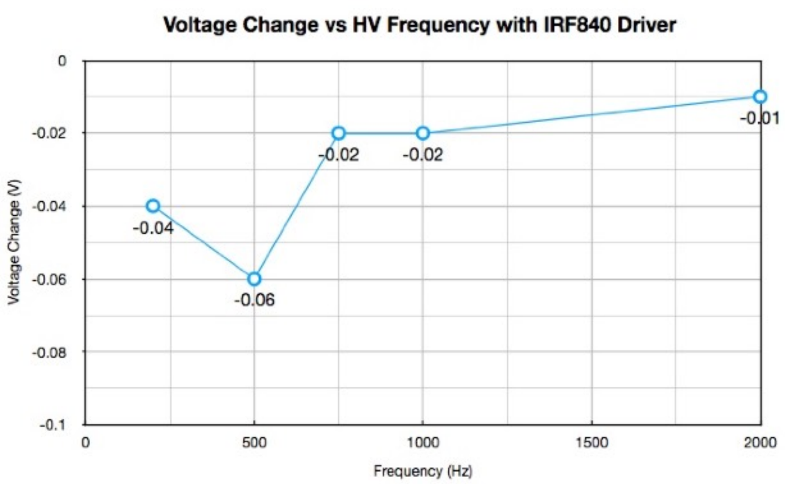

Fig 5

Specific observations of note are the following. Firstly that charging sets of three batteries instead of one resulted in lower overall circuit current due to the fact that the impedance presented to the HV pulses was increased. Secondly, it was noted that if the batteries had been recharged using a regular battery charger then the first generator test run following always resulted in a net positive charge. This effect fell away by the time of the second and subsequent test runs.

Discussion

As a summary report, in-depth discussion is precluded, however certain key findings will be presented here.

Perhaps the most important question sought to be answered by this research was whether a solid state pulsed induction generator could deliver useable net output power when equipped with a means to produce variable frequency HV pulses. Tests over the range 200Hz to 1kHz indicated that net charging of batteries did not increase proportionately with frequency but rather remained consistently negative such that there was no value in using significantly higher frequencies.

One proposed reason for this is that as the frequency being applied to the coils rose so did the reactive impedance, the opposition to AC from the coils inductance. This resulted in a decreasing component of output current in the HV pulses which has been quoted as an essential part of the pulses for effective battery charging. While ZPE theory suggests that a suitable voltage gradient (dV/dt) is all that is required to draw ZPE into the circuit, practical observations have shown that battery charging performs better with a component of regular electricity in the HV pulses. However the author suspects that there are most likely other factors at work here in the results.

With reference to Fig 4, the yellow plot shows that battery charging can take place as observed in the single external battery. Yet when the power drain from the circuit, shown by the green line, is subtracted then the overall charging effect is negative (blue line). This may be due to the fact that the batteries are swapping their discharge and charging status every 2 mins rather then being allowed to function in one or other continuously. However, comparing the green and yellow plots in Fig 4 would suggest that even if the batteries were maintained in one or other role, there would be no resulting net charge between them to power an external load or any useful size.

The odd occurrence of a net positive charge that was noted after a session of regular battery charging may be explained by the behaviour of the heavy ions in the battery after normal charging. As this mechanism cannot be explored here or integrated into a useable regime for the solid state generator, it seems to have little value to the overall performance.

Conclusions

Extensive tests have shown that in this specific design, HV pulses of significant voltage are unable to result in a net battery charging benefit that could result in useful power being made available for external loads.

While charging has been shown to take place, when taken in the context of the whole system, it has been unable to reach a sustainable status of over unity (CoP>1). This may be due to some specific feature of this design but other researchers have similarly found difficulties in achieving over unity. However, the fact that a few researchers have achieved over unity suggests that the conditions for doing so may be highly specific to particular arrangements and design features.

[Images relevant to this project may be found at: https://www.dropbox.com/sh/cwlace7c8hi6hxn/AACQkxPpZlc3SK3dd2Me5piba?dl=0]

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