N8XJK Boost Regulator Additional Information and FAQ

This document is a compiled list of FAQ and email sent to individuals interested in building the test supply since the publication of the original design in Nov 2004 QST.

I would like to thank you all for the interest in the boost regulator. It's been a long project for me, and it's great to get so much good feedback! Because of the interest in the supply, I have spent some time doing a redesign of the circuit board.

For those interested in purchasing the new board, Fred Reimers (KC9GX) of FAR Circuits (www.farcircuits.net) will be distributing the boards for the project. http://www.farcircuits.net/power1.htm

Also, if you build a supply please let me know how it works out for you. And if you can, send me a small picture or two! drk@pasty.net

General Information on Progress

Significant progress has been made on the boost regulator. I have designed and tested the new circuit board layout. The new design tested well, with significant reduction in Q5 and Q6 transient voltage levels, output ripple, and radiated and conducted EMI.

The new board layout shows a significant reduction in RFI as compared to the original published design. An Icom IC-706MKII was used to do a comparison between the supplies. During a the side by side test, no ‘birdies’ were found with the new supply. The only noise was some minor hash, with the RF detect (no antenna) attached to the radio. The strongest signal levels were below 1 S-unit in strength. With an antenna attached, the received noise floor completely drowned out the noise from the supply. The original board layout had some birdies, but they do not appear to be present on the new layout.

As for the remaining RFI, it appears that a good portion if it is radiated from the battery leads to the supply. It would be a good idea to keep them as short as possible or add filtering to them.

Here are a few changes to the design of the supply. Most of the changes are minor, and should add to the performance and appearance of the supply.

The first, most obvious thing is that the board layout has changed. It is a completely new layout. The board is now a 2.4 by 5.9 inch board. It is a double sided design with silk screen, solder mask, and through hole plated vias. The copper is 2oz for increased current carrying capacity. Overall it is a much nicer looking and more robust board than the single sided design.

Important! Take Note! The new double sided board uses a different pin layout for transformer T1. For the new board, the locations for pins 1 and 2 of T1 have been swapped. Take note of this when winding the transformer. The center tap is now located between the two primary leads of the transformer. (The rest of the winding details are the same, only swap the locations of the two pins).

A series of 18 surface mount capacitor pads were added to the high current leads on the bottom of the supply. These are optional components, but are recommended to help reduce EMI conducted out of the supply via the input and output power leads. The pads are for 1206 size SMT capacitors. In my test supply, I used eighteen 1uF 25Volt ceramic capacitors and noted a significant reduction in emissions above1.5Mhz.

A second fuse has been added in parallel with F1. Most people will find that a single 25 or 30 amp fuse will be sufficient. This change (by request) is to accommodate anyone interested in trying the supply at 30 or more amps output. Anyone doing so should take appropriate precautions and be aware of the corresponding risks. If you plan on trying this, proceed with caution as the booster was not designed for this level of power. However, a few pointers would be to increase the number of parallel wires used for the secondary of the transformer. Eight or more parallel #24 wires are probably in order. Also be aware that the filter capacitors get very warm at the higher power levels, thus their lifetime may be affected. I have tested the supply at 35+ amps continuous for short periods and found good heat sinking for Q5, Q6, and D7 to be a requirement. Other than that, test carefully!

Some minor component value changes have been made. Resistors R23 (4.7K Ohm) and R24 (4.7K Ohm) have been added. They slightly increase the speed at which Q5 and Q6 turn off. Resistors R15 and R17 have been changed to 33 Ohm resistors. This also increases the speed at which Q5 and Q6 turn on and off, reducing the switching losses slightly. D4 was changed to a 100K resistor and R20 was changed to 33K ohm resistor. The reason for the change of D4 and R20 was that in some installations the components would overheat, causing a failure in the RF detect circuit.

A power pad was added for the Enable Switch power. This is downstream from the main power switch. The enable function works as before, the additional pad is simply a switched source of 12 volt power for the enable function input.

An additional pad was placed under the transformer. This will allow anyone wishing to try shielding the transformer a place to attach to the ground plane of the board.

One suggested change to the supply is to add a diode in series with the power switch. This can help to prevent large transients from tripping battery protection circuit. The diode functions in conjunction with C14 to prevent fast voltage drops from being seen by the battery protection circuit. However, this will slightly affect the battery protection voltage set point values. It may be possible achieve this same effect with a small value resistor instead of the diode with a lesser effect on the set point.

FAQ section

Why was Diode D4 changed to a Resistor, and R20 changed in value from the original circuit?

In some installations, the RF detect circuit would overheat, causing a failure of the diodes D3 and D4. This happened in installations where the Antenna lead was directly connected to the RF detect input. Excessive current would flow through the diodes, causing failure of the devices. Diode D4 was changed to a 100K resistor and R20 was changed to a 33K resistor. A test was done with a 100W radio running full power key down CW on 160M through 6M, with no failures noted at the time of this FAQ. An additional change of diode D3 to a 200V or higher rated signal diode might be a good idea.

Will a full kit be available for the boost regulator?

No, there will not be a kit available at this time, due to the large capital and time investments involved in setting up such a venture. However, if anyone is interested making a kit available, please contact me and we can discuss the idea further.

Will completed and tested units be available for the boost regulator?

Under very limited circumstances. If you are legitimately disabled, such that you cannot build the supply and cannot locate any individuals willing to help you build a supply, I can try to locate someone willing to, or I will (if time permits) build and test a supply for you. Any units would be built and tested for functionality, however they would be provided “AS IS” with no warranty. Please contact the author if you are legitimately disabled and would like assistance in obtaining a supply for your station.

Why do the switching transistors get hot, with no load attached to the supply when it is enabled?

There are several possible reasons for this. The most likely possibility is that there is a shorted turn in the transformer, in which case the transformer will need to be rewound. A shorted transformer can happen if old wire with brittle insulation was used, if large wires were used and bent around sharp corners, or if chemical solvents were used to strip the leads of the transformer. It is also possible that the number of turns on the transformers primaries are not balanced, causing saturation of the transformer thus causing excessive current draw. Another possibility is that one or more of the filter capacitors was installed backwards on the output of the supply and is drawing excessive current. If this is the case, the capacitors may be damaged and may need to be replaced.

Why does the low battery light come on as soon as the supply is enabled with the RF Detect or Enable input?

When the supply is enabled, the output capacitors and load voltage is boosted to the desired output voltage. This jump in output voltage causes a large current to be drawn from the battery. The large transient current combined with contact resistance in fuses, switches, relays, and wiring resistance can cause enough voltage drop to trigger the low battery protection circuit.

Solutions are to check all connections to the supply, increase the wire size to the battery, and to shorten the battery leads as much as possible. If these do not help, a Shottky diode can be added in series with the power switch. The diode in conjunction with C14 will help to keep the transient voltage drops from being seen by the battery protection circuit. The diode will slightly affect the battery protection set point voltage. If these solutions do not help, check the battery voltage protection circuit as described in the QST article.

What changes are needed to allow the RF detect to work with higher voltage (higher power) radios?

The RF detect input has not been tested with radios over 100W Average power. That being said, areas of concern are identified as follows. Capacitors C19 and C20 may need to be changed to capacitors with higher voltage ratings. D3 and D4 may also require increased voltage ratings. The value of R20 may also need to be increased to prevent excess current into the base of Q9.

Can the supply boost 6 volts to 12 volts for use with older automobile charging systems?

None have been built to do so, but it is possible that the supply could be modified to boost 6 volts to 12 or more volts, but the output current would be reduced to somewhere around 15 amps. The changes require that the trace between R8 and C14 be cut and a jumper be installed to supply the output voltage to the R8 side of the break (The and control circuits should run from a 12 to 15 volt supply). Resistors R9, R10, R12, and R13 would need to be chosen for the correct low battery protection voltages. The transformer would need to be wound with more turns on the secondary to supply the level of boost necessary. The enable switch could be wired closed and the RF detect components could be omitted. Please note, this has not been tested, and any such modifications would require testing on the part of the builder.