

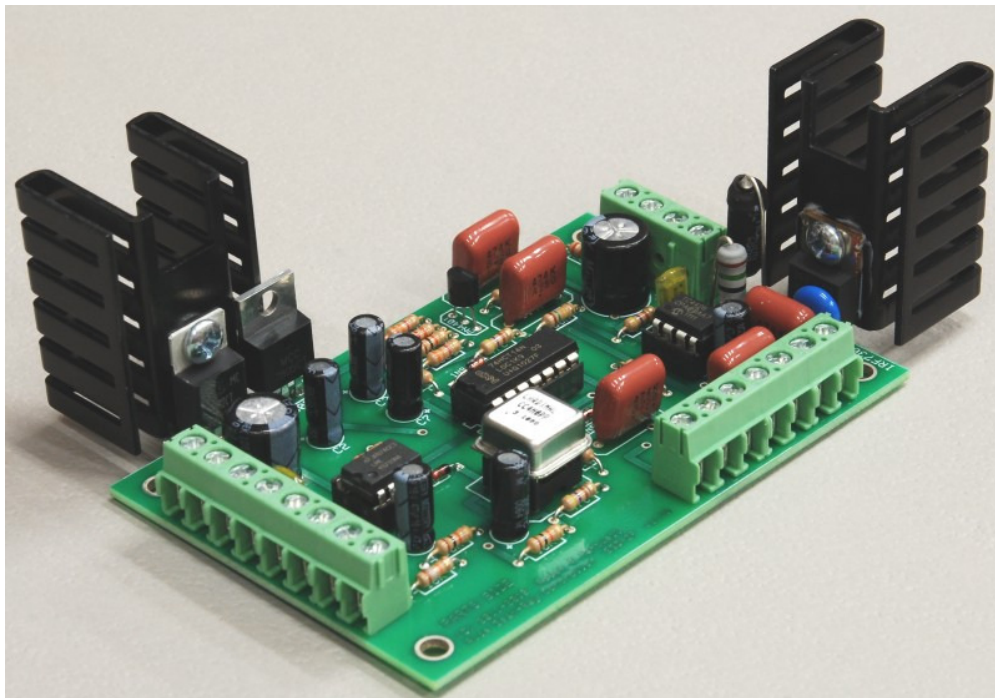
Instruction Manual

for the

SSQ-2F Controller Board

V3.10

For Rife Plasma Tube Systems



Manual v1.00

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You are advised to always consult with your physician or other health care professional at any time should you have or think you might have a health problem of some sort. Please check with your physician or other health care professional before starting any diet, exercise, taking OTC medications or supplements and especially before taking any prescribed medication. Never stop taking any prescribed medications without first consulting your physician.

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Important Note About the SSQ-2F v3.10

The SSQ-2F v3.10 is an updated and improved version of the SSQ-2F v1.41. Because of its special functions and abilities, it is important to read and understand the contents of this operations manual to prevent damage to the unit. The SSQ-2F v3.10 is a component of either a plasma tube or a contact system. It is designed to be incorporated into such systems by the experimenter. It is not a stand-alone device. Some fabrication and system integration will be required to obtain the best performance of your SSQ-2F v3.10.

About the Original SSQ-2F v1.41

The basic SSQ-2F v1.41 3.1 MHz Rife Controller Board is a compact unit which is designed to generate a square wave modulated RF carrier wave suitable for use in various types of Rife instruments. In particular, it has been designed to implement the 3.1 or 3.3 MHz Rife Sweep protocol as outlined in the document posted at:

http://rifevideos.com/dr_rife_and_philip_hoylands_3.3mhz_sweep.html

This sweep protocol calls for the use of a 3.1 or 3.3 MHz carrier that is 100% modulated by a square wave that slowly sweeps between 500 and 25,000 Hz. Specific “spot” frequencies may also be used.

The SSQ-2F v1.41 is able to operate over the RF carrier range of 0.5 to 15.0 MHz simply by replacing the plug-in oscillator module with one of the correct frequency.

Why is the SSQ-2F needed?

Most common computer sound cards are unable to reproduce sharp-edged square waves above a few hundred Hz, or even sine wave audio signals above 22,000 Hz, thus making computer sound cards virtually unusable when square wave modulated Rife systems are used.

Because most people will use computer sound cards to generate the required audio frequencies, all references to computer sound cards in this document also refer to audio waveforms that are recorded on MP3 players, CD, or DVD players and the like. It should be noted that MP3 players and CD and DVD players also suffer from the same inability to properly handle square waves.

The inability to generate sharp-edged square waves is a serious problem. In order to generate the higher frequency harmonic energy required for a Rife system to work properly, the leading and trailing edges of the square wave must be “sharp,” that is, it must have a very fast rise and fall time.

What does the SSQ-2F do?

To solve this problem, the SSQ-2F has been designed to accept sine wave audio frequencies within the frequency range that the computer sound card can generate. The SSQ-2F then doubles those frequencies and converts them to clean square waves before modulating the 3.1 MHz carrier wave.

By doubling the input frequency, modulation frequencies of up to 44,000 Hz may be obtained using a standard computer sound card as the signal source. This allows the 3.1 MHz carrier to be modulated across the entire 500 to 25,000 Hz frequency range required for the 3.1 MHz Rife sweep. Because of the frequency doubling action of the SSQ-2F, the computer sound card need only generate sine wave signals within the frequency range of 250 to 12,500 Hz, which is within the range of any computer sound card.

What types of audio signals does the SSQ-2F accept?

The SSQ-2F will accept sine, triangle, or square wave signals as an input and convert them to square waves before using them to modulate the 3.1 MHz or 3.3 MHz RF carrier wave.

What range of frequencies does the SSQ-2F accept?

Although the SSQ-2F will accept modulation signals within the frequency range of 4 to 600,000 Hz, the controller has been designed for optimum operation within the frequency range of 40 to 60,000 Hz, thus making it practical to use computer sound cards, MP3 players, as well as CD and DVD players to generate the audio modulation signal. Of course, a standard frequency or function generator may be used as an audio signal source for the SSQ-2F.

What are the differences between the SSQ-2F v1.41 and the SSQ-2F v3.10?

The SSQ-2F v1.41 was designed to provide a +5 volt or a +12 volt square wave output. This signal can be used to drive an external RF amplifier or it may be used as a low voltage contact device driver.

The SSQ-2F v3.10 contains a medium power RF amplifier built into the board itself. This allows the SSQ-2F v3.10 to produce enough RF power to drive a medium sized Rife plasma tube without the need for an external RF power amplifier. Two power supplies are required for the SSQ-2F v3.10, one for the logic circuits, and one for the RF amplifier. Depending on the RF output power level required, it is sometimes possible to use just one power supply.

Alternatively, the SSQ-2F can be supplied with a factory installed modification for use as a low power RF drive source so that the operator may employ a higher powered, solid state, external RF amplifier, such as a KL-300 or a KL-500. The operator may easily remove this modification in the field, should this be desired.

I am uncomfortable soldering wires to circuit boards. What do I do?

All connections to the SSQ-2F are made using screw terminals, so no soldering is required.

How can I power the SSQ-2F?

The SSQ-2F may be powered from an AC adapter or from batteries.

Is the SSQ-2F v3.10 a complete Rife system?

The short answer is no.

The SSQ-2F v3.10 is designed to produce a correctly modulated RF signal for a Rife plasma system. It contains an on-board RF power amplifier that will produce up to 100 watts peak power output. This power level is suitable for driving a moderate sized Rife plasma tube. In order to drive a plasma tube, the output from the SSQ-2F must be coupled to the plasma tube through some form of matching system.

The SSQ-2F is also suitable for driving a high power RF amplifier, such as a KL-300 or a KL-500 amplifier. When used for this purpose, the SSQ-2F v3.10 must be slightly modified to provide the correct output waveform to properly drive an external RF amplifier. If you specified it at the time you ordered your SSQ-2F v3.10, the modification will have already been made. This modification may be easily reversed should you ever wish to do so.

The SSQ-2F v3.10 may also be used as a contact device driver.

The diagrams on the next page show how the SSQ-2F is interconnected in typical Rife-type systems.

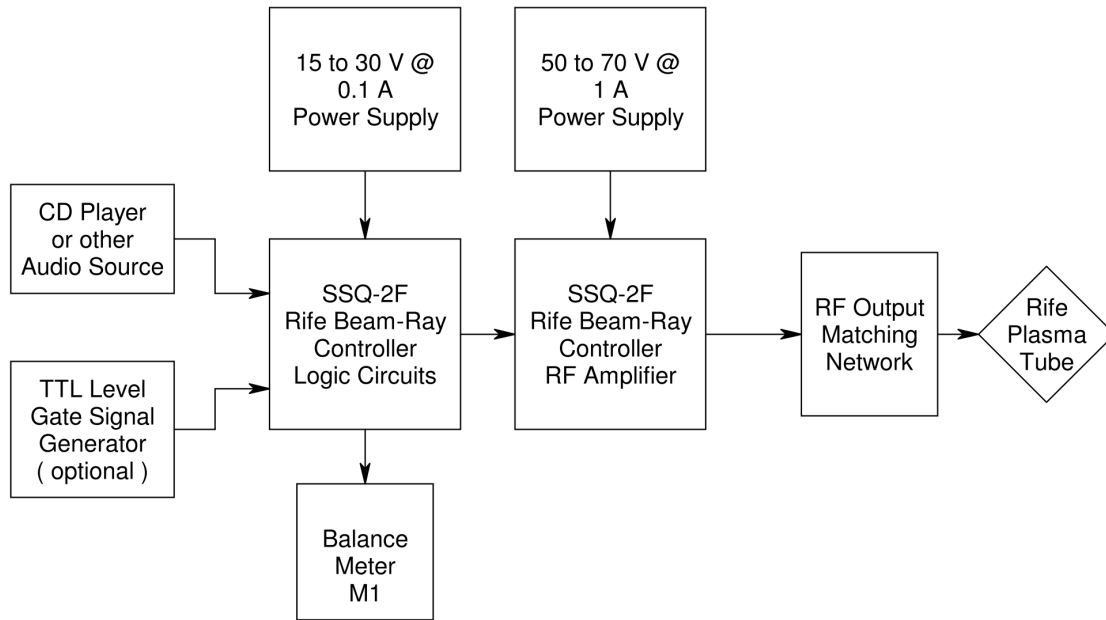


Figure 1

Block diagram of a typical Rife plasma system using the SSQ-2F v3.10.

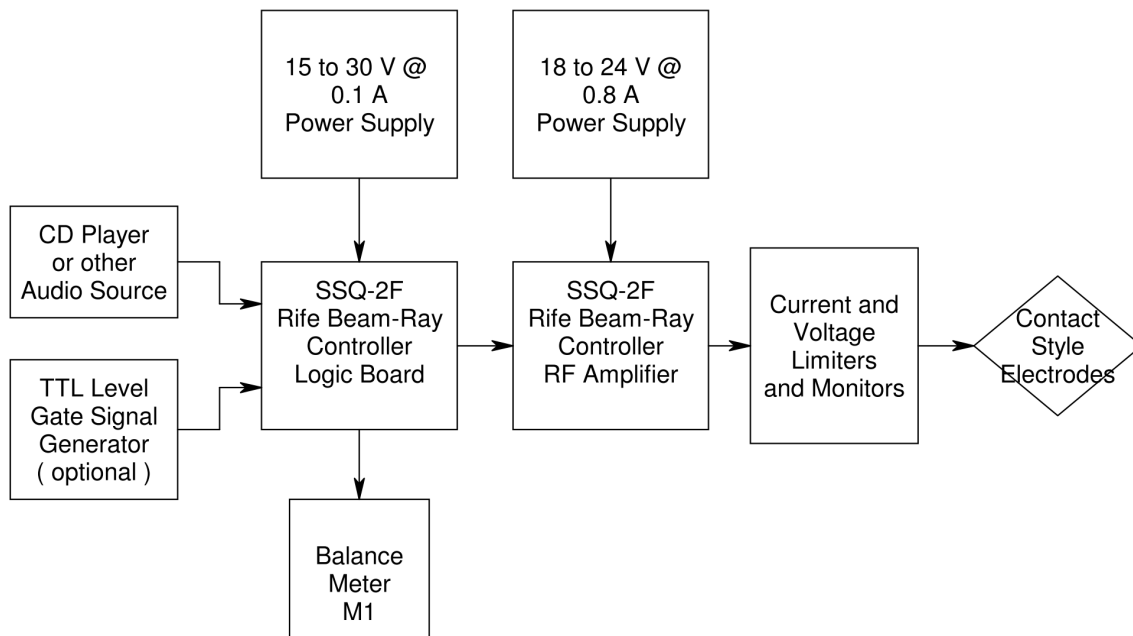


Figure 2

Block diagram of a typical Rife Contact System using the SSQ-2F v3.10.

CONNECTIONS:

All connections to the SSQ-2F are made by using the small screw terminals that are located in the plastic terminal blocks mounted on the edges of the circuit board. These will accept either solid or stranded conductor wire.

When tightening the screws, do not over tighten the screws to avoid damaging the connector. Just strip about 1/4" of insulation off the end of each wire and insert it into the hole in the terminal block, then gently tighten the screw to clamp the wire in place.

This diagram shows the relative position of the various connectors on the SSQ-2F. They have been color coded for ease of identification. Note that the terminal blocks on the SSQ-2F itself will usually all be the same color.

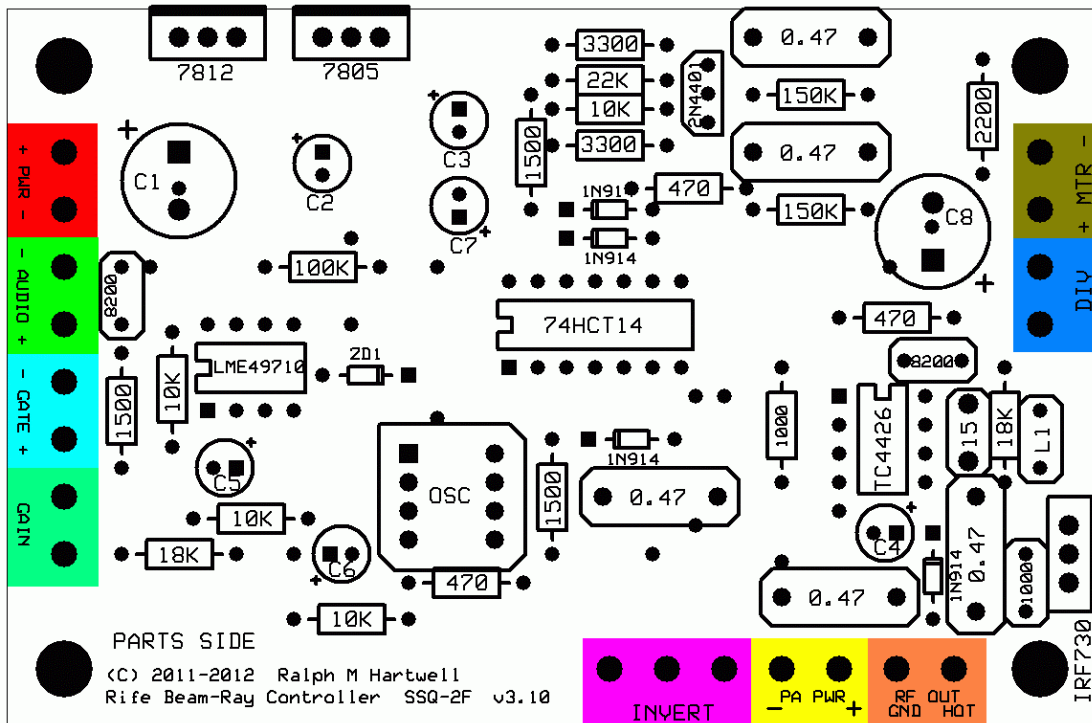


Figure 3

SSQ-2F Connector Identification.

Please refer to Figure 3 for the location of the following connections.

(+ PWR –)

This terminal block is used to connect DC power for the SSQ-2F. Any voltage between +15 to +30 volts may be used. Current required is 100 milliamperes.

(AUDIO IN)

Used to connect a shielded audio cable from the audio signal source to this connector.

Connect the cable shield to the connection closest to the PWR connector – this is the audio ground connection.

Connect the center wire of the shielded audio cable to the connection closest to the GAIN connector – this is the audio input connection.

(GATE)

This accepts a TTL level gate frequency signal which will turn the output of the SSQ-2F on and off at the gate frequency rate. Gating frequencies from DC to approximately 500 Hz may be used.

If there is no connection made to this terminal block, the gate function is disabled, and the output of the SSQ-2F will only be controlled by the audio input signal connected to the AUDIO terminal block.

When the TTL level signal goes low (0 volts) the SSQ-2F output is gated OFF. When the TTL level goes high (greater than +3 volts) the SSQ-2F output is gated ON.

A SPST switch may be connected to the GATE terminal block. This switch will turn the output of the SSQ-2F on and off at the operator's discretion.

(GAIN)

Leave these connections open to obtain the maximum audio gain from the SSQ-2F.

Short these connections together to obtain the lowest audio gain from the SSQ-2F.

Using a 100 K ohm linear taper potentiometer, connect the center (wiper) terminal of the potentiometer to either connection of this terminal block. Connect one of the remaining two connections of the potentiometer to the other connection of this terminal block.

Using the potentiometer, the audio gain of the SSQ-2F may be adjusted from minimum to maximum, as needed.

(INVERT)

Connect a single pole, double throw (SPDT) switch to this connector block.

The center arm of the switch goes to the center connection of the terminal block.

The two outer connections of the switch go to the two outer connections of the terminal block.

When the left and center connections are closed, the SSQ-2F will operate in the 0 to 50% duty cycle mode.

When the right and center connections are closed, the SSQ-2F will operate in the 50% to 100% duty cycle mode.

(- PA PWR +)

Connect the NEGATIVE (-) side of the RF amplifier power supply to the (-) connection of the PA PWR terminal block. Connect the POSITIVE (+) side of the RF amplifier power supply to the (+) connection of the PA PWR terminal block.

Note that the negative (-) connections of the PA PWR and the logic PWR terminal blocks are common, that is, they are connected together.

(RF OUT)

This terminal block is where the RF output of the SSQ-2F appears. Connection to this block requires the use of a shielded 50-ohm impedance coaxial cable between the terminal block and the matching system that will be connected to the plasma tube or the external RF amplifier (if used.)

If the SSQ-2F is to be used as a contact device, then a shielded 50-ohm impedance RF coaxial cable must be run from this terminal block to the shielded enclosure that houses the circuits that will feed the contact electrodes.

Connect the center wire of the coaxial cable to the connection of the RF OUT terminal block that is closest to the lower right side mounting hole of the board.

Connect the shield of the coaxial cable to the connection of the RF OUT terminal block that is closest to the PA PWR terminal block.

(DIV)

Connect a single pole, single throw (SPST) switch to this connector block.

This switch allows operation in either the 2 X mode (switch open) or the 1X mode (switch closed.)

(MTR)

Connect the negative (-) terminal of the duty cycle monitoring meter to the connection that is closest to the mounting hole in the upper right corner of the circuit board.

Connect the positive (+) terminal of the duty cycle monitoring meter to the connection that is closest to the DIV connector.

If you are using a meter that is different from the type M-1 meter you may need to insert a resistor in series with the meter to adjust the full scale reading to the correct value.

Mounting the SSQ-2F

The SSQ-2F should be mounted in a metal or plastic enclosure. If the SSQ-2F is mounted in a plastic enclosure, it should be mounted over a metal shield plate with dimensions of approximately 12 x 15 cm in size. This is required to prevent RF feedback when the unit is run at high power levels.

Four mounting holes located in the corners of the SSQ-2F are provided for mounting the board. If the SSQ-2F is mounted next to a metal surface, then the use of 6 mm diameter standoffs is suggested to prevent short circuits between the underside of the SSQ-2F and the metal mounting surface. Either metal or plastic spacers may be used.

Clearance has been provided between the outer edges of the mounting holes and the SSQ-2F circuit board traces to allow the use of metal standoffs of up to approximately 9 mm in diameter. It is not necessary to use all four mounting holes. Be careful that the mounting hardware does not cause short circuits on either side of the circuit board.

It is essential that proper grounding procedures be used when installing the SSQ-2F to prevent RF feedback from affecting the audio processing circuits. When mounting the SSQ-2F, install a short length of wire between the negative (-) pins on both of the PWR and MTR terminal blocks and the metal ground plate. These will help keep unwanted RF interference from entering the circuitry of the SSQ-2F.

Due to the sensitivity of the audio processing circuits of the SSQ-2F, it will likely be necessary to add a metal shield to the SSQ-2F to eliminate signal jitter when operating the SSQ-2F at power levels above 50 watts.

The shield may be constructed of any type of thin sheet metal such as aluminum or tin and bent to an “L” shape as shown in the picture below. The shield should be grounded by connecting three corners of the shield to the mounting screws that attach the SSQ-2F to the lower shield plate.

If the shield is not installed when operating at RF amplifier supply voltages above 48 volts, it is possible for the modulated RF output to exhibit time jitter, resulting in an erratic oscilloscope display. This is due to RF energy getting back into the audio processing circuits. Use of the shield will eliminate this problem. This time jitter causes the desired harmonic energy in the RF output to shift back and forth slightly in phase and amplitude. However, this will not harm the SSQ-2F, it just makes it more difficult to view the signal on an oscilloscope.

The following pages will show you the shield design and placement.

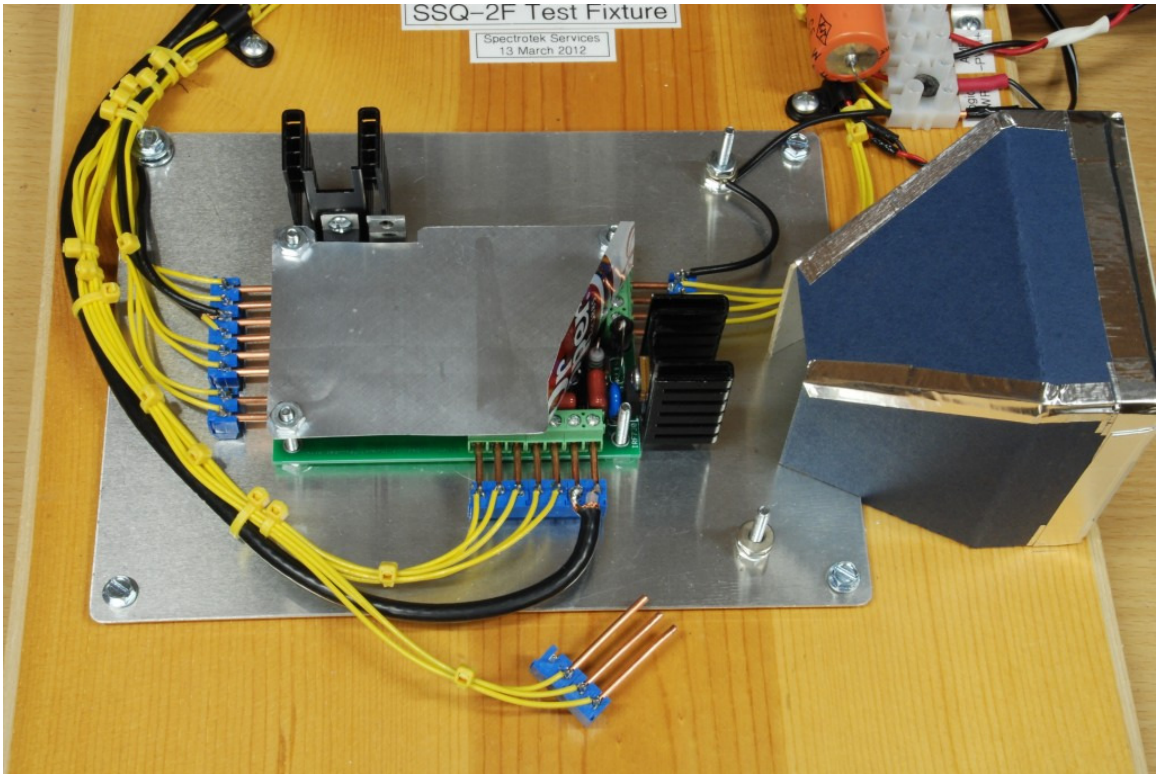


Figure 4.

This picture shows the SSQ-2F v3.10 mounted in the production test fixture. The shield over the SSQ-2F is constructed from a soft drink can.

The shield under the SSQ-2F holds the four mounting screws for the SSQ-2F. The SSQ-2F is not bolted down firmly during the test procedures. However, the upper shield is grounded to the lower shield by three of the four mounting bolts.

The copper probes are quick connectors so that the unit under test may be quickly changed as needed.

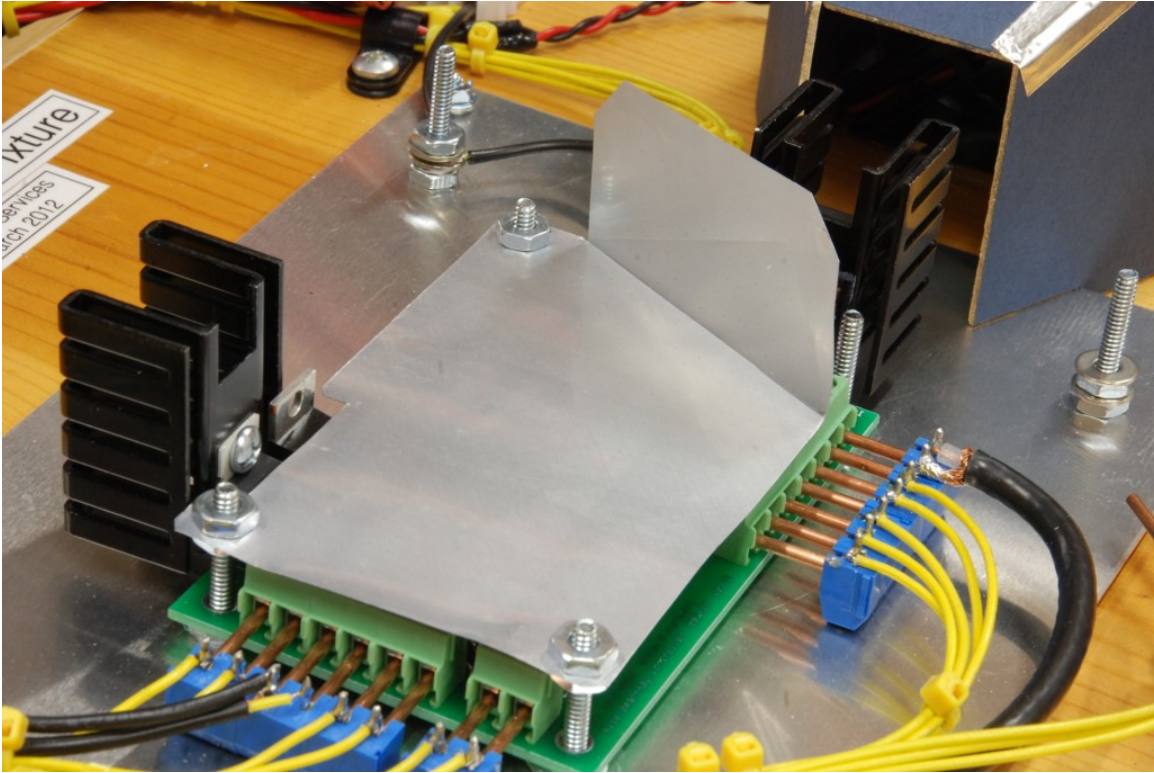


Figure 5.

This view shows how the shield is bent at right angles. The vertical portion of the shield prevents the electric field from the IRF730 from being “seen” by the rest of the circuitry on the SSQ-2F.

The upper RF shield is grounded to the lower shield by three of the four mounting screws. The sharp corners of the upper RF shield have been trimmed at a 45-degree angle to prevent injury to the operator.

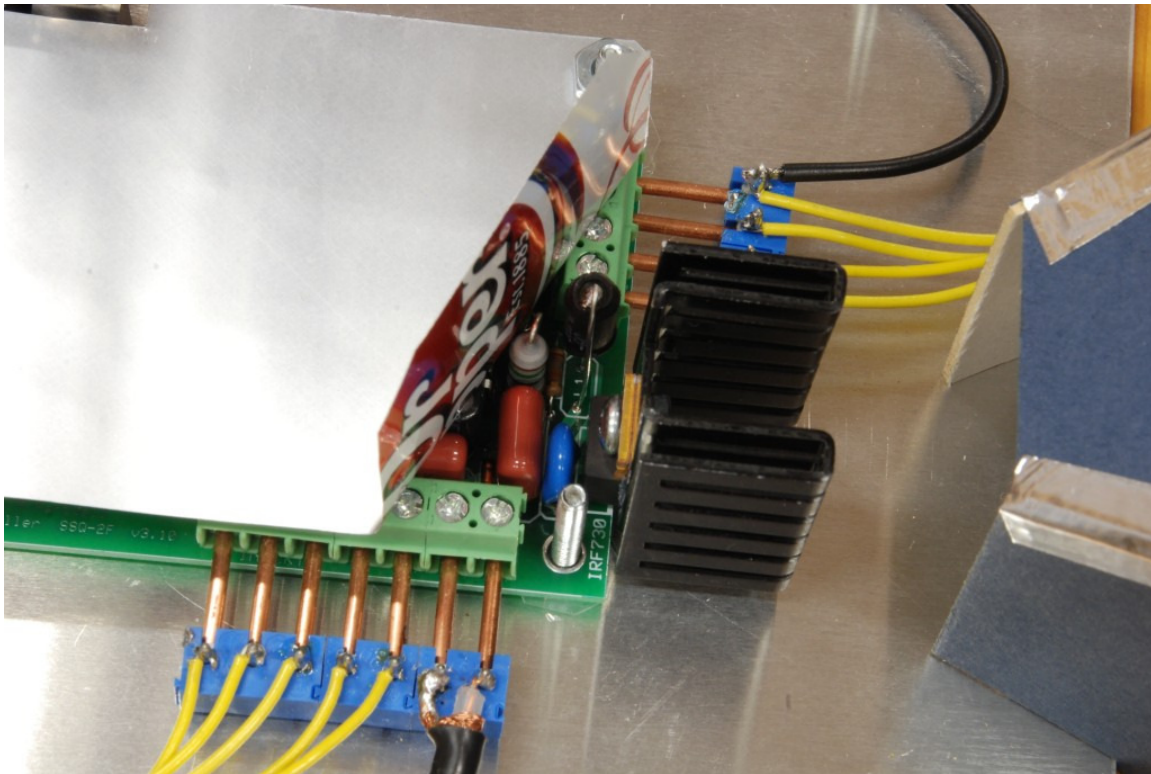


Figure 6.

This view shows that the shield really was made from a soft drink can! The RF shield just has to be electrically conductive; it does not have to be thick.

The shield must be bent so that it does not come in contact with the gray colored gate drive limit resistor which can be seen directly above the brown capacitor in the center of the photo.

Angling the shield in this direction allows the warm air to flow freely away from the heat sink. It also allows some cooling air to flow under the shield to cool the TC4426 gate driver IC.

Due to space limitations, you will probably not be able to install a nut on the mounting screw next to the IRF730 heat sink. That's OK using just two out of the four mounting points is sufficient. Please be sure you do not to allow the mounting hardware to short circuit anything under the circuit board when you clamp it down.

SSQ-2F v3.10 RF Shield
Spectrotek Services
March 16, 2012

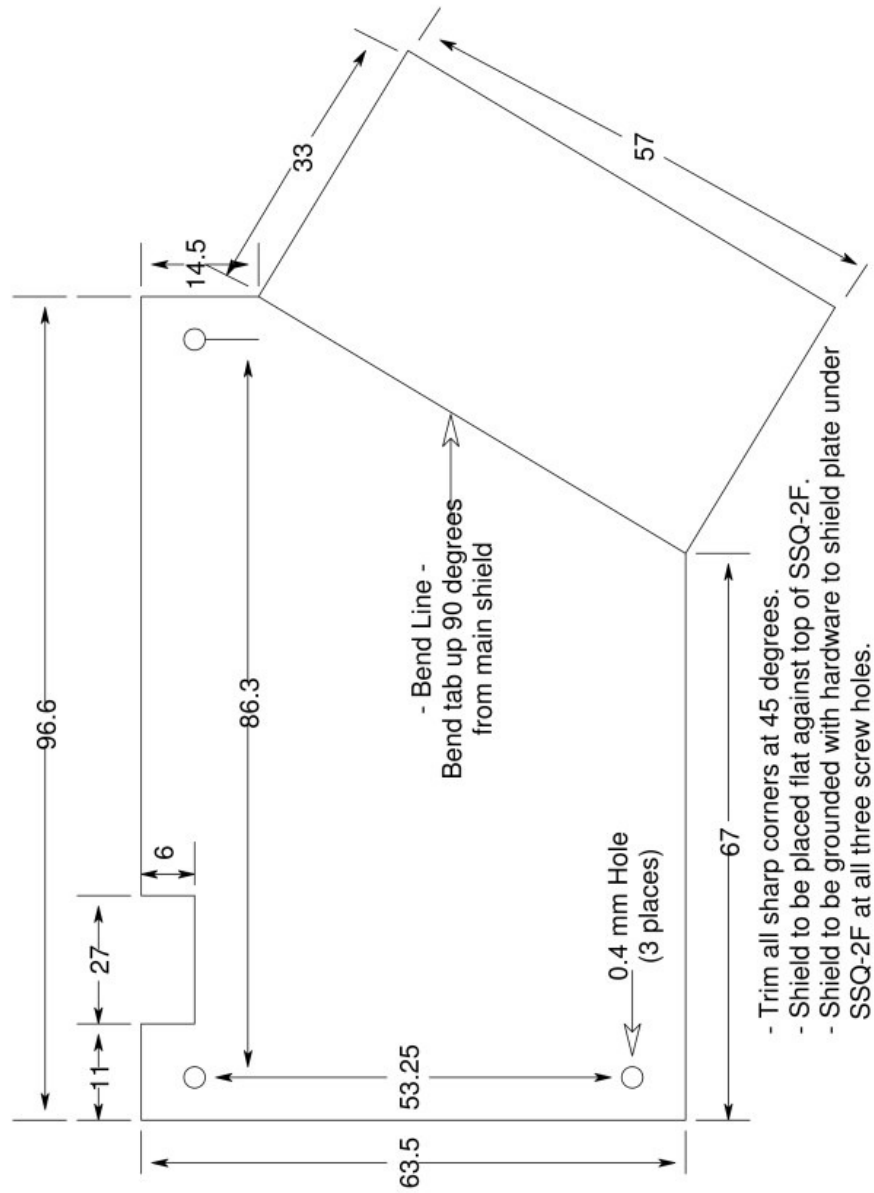


Figure 7.

Plan layout of the RF shield for the SSQ-2F v3.10.

Not to scale. All dimensions in millimeters.

RF Shielding Considerations to Prevent Interference to Other Devices

Provided that the RF output of the SSQ-2F is taken through a properly installed and terminated coaxial cable or twisted pair of wires, the incidental RF leakage from the SSQ-2F is minimal and no interference to radios or television receivers should occur due to radiation from the SSQ-2F itself.

However, it is very important to prevent outside RF energy, such as from an operating plasma tube, from entering the SSQ-2F. Unwanted RF ingress will cause erratic operation and incorrect modulation of the RF carrier.

The most common point of entry for unwanted RF energy is via the audio input cable. Using a shielded audio cable is a must. Make sure the cable is routed well away from the high-power RF components of the system. Use the shortest length of audio cable possible.

In severe cases of interference, looping the audio cable a half-dozen times through a ferrite toroid will usually eliminate the problem. Place the toroid as close to the input connections of the SSQ-2F as possible. Use a toroid core with material type 31 for best results.

A second cause of RF ingress is direct pickup by the circuit board traces of the SSQ-2F. Normally, this will only occur in cases where the ambient RF field is extremely high due to incorrect equipment placement.

To prevent this problem, it is suggested that a metal case be used to house the SSQ-2F. If this is not possible, then mount the SSQ-2F on a metal panel about 15 x 18 cm in size.

Another option when using a plastic case is to install a metal plate inside the case to which the SSQ-2F is mounted. The metal plate should be connected with a short lead to the ground terminal of the PWR and MTR terminal blocks of the SSQ-2F.

If a metal plate is not available, a layer of aluminum foil may be glued to the inside of the plastic case to act as shielding. Make sure the foil is well glued so it does not come loose at a later time and cause a short circuit against the traces on the underside of the SSQ-2F. The metal foil should be connected with a short lead to the ground terminal of the PWR and MTR terminal blocks of the SSQ-2F.

Heat Sink – Voltage Regulator

Although it is recommended that the heat sink be used at all times, if absolutely necessary, it may be removed to save space when mounting the SSQ-2F in a small enclosure. If this is done, the DC power supply voltage must be limited to no more than 18 volts to prevent overheating of the 7812 +12 volt regulator.

If the DC power supply voltage is above 18 volts, the heat sink **MUST** be attached to the 7812 +12 volt regulator to prevent overheating and possible failure of the regulator.

The preferred mounting position of the heat sink is such that cooling air will flow across the long dimension of the heat sink. If necessary, the heat sink may be rotated to either the horizontal or the vertical position, depending on how the SSQ-2F is mounted. The 7805 +5 volt regulator does not require a heat sink. Since both of the metal backs of the voltage regulators are connected to circuit ground, it does not matter whether or not the heat sink on the 7812 +12 volt regulator touches the 7805 +5 volt voltage regulator.

The heat sink attached to the 7812 +12 volt regulator is connected to electrical ground on the circuit board.

Heat Sink and Cooling the IRF730 RF Output Amplifier

Caution – The heat sink is directly connected to the drain of the IRF730. This means that the heat sink is connected to the hot (+) side of the PA PWR power supply. Accidentally shorting the heat sink to ground may damage the SSQ-2F and/or your power supply.

The IRF730 MOSFET, which is used as the RF power amplifier in the SSQ-2F v3.10, is a rugged device. However as with all semiconductor devices, excessive heat will cause failure. Evidence of IRF730 failure will depend on the type of power supply you have connected to the PA PWR terminal block.

If the supply is current limited, then the failure of the IRF730 will be quiet; the RF output will simply drop to zero. However, if you have a “stiff” power supply that can supply a large amount of current, the IRF730 may fail in a more spectacular manner, such as emitting smoke or bursting into flame or even exploding like a firecracker. Obviously, we do not want any failures!

As supplied, the IRF730 and the LM7812 voltage regulator both have the same type of heat sink. This heat sink is adequate in size for the IRF730 as long as the following two conditions are met.

First, the heat sink must be freely exposed to room temperature air of no more than 38° C. Second, the PA PWR voltage should be no greater than 24 volts DC. This will provide about 12.5 RF watts output.

If the SSQ-2F has been modified to drive an external power amplifier, the required PA PWR voltage will likely be in the range of 12 to 18 volts DC. Therefore the heat sink should not require any forced air cooling.

Because most uses for the SSQ-2F v3.10 will be in applications requiring substantially more RF output than 12.5 watts, improved cooling of the IRF730 is necessary. The easiest way to do this is by using a fan to force cooling air over the heat sink.

For most power levels, if the ambient air temperature does not exceed 30° C, a suitable cooling fan can be a high-speed computer case fan that is fitted with a cardboard shroud to concentrate and direct the cooling air over the heat sink. (See Figure 4.) It is essential to cool the entire heat sink, not just the fins; otherwise a “hot spot” may develop at the point where the IRF730 is attached to the heat sink.

The fan seen in figure 4 is an 80 mm x 25 mm, 12 volt, 0.30 ampere fan. It spins at about 4000 RPM. It is arranged to blow the cooling air directly against the center of the heat sink, forcing the air to impinge on the area where the IRF730 is mounted. A small centrifugal fan would also work well. The general rule is, you cannot have too much cooling air! Using this arrangement, the SSQ-2F works nicely up to a power output of 100 watts peak, 50 watts average power, at a 50% duty cycle modulation.

For higher power operation, it is strongly recommended that the supplied heat sink be removed and a much larger heat sink be installed. Because standard insulated thermal pads for transistors have a fairly high resistance to heat flow, it will be necessary to mount the IRF730 directly to the bare metal of the heat sink. This means the heat sink will be electrically “hot” with both DC and RF. Therefore, suitable electrical insulation of the heat sink must be provided.

If convenient, it is acceptable to remount the IRF730 so that it is parallel to the circuit board of the SSQ-2F in order to attach the IRF730 to a heat sink. Note that it may be necessary to unsolder the IRF730 from the heat sink in order to mount it flat, as the leads are rather short. If specified at the time of order, the leads will be left at the correct length for horizontal mounting of the IRF730.

Removing and Reattaching the Heat Sink of the IRF730

If the heat sink is removed from the IRF730, heat sink thermal compound must be used between the transistor and the heat sink when reattaching the original heat sink or installing a replacement heat sink on the IRF730.

Failure to use heat sink thermal compound may cause the IRF730 to fail due to overheating. In addition, the IRF730 must be mounted directly against the heat sink without the use of a thermal pad, as use of a thermal pad may cause overheating due to lowered heat transfer from the transistor to the heat sink.

Anodized aluminum thermal pads are marginally acceptable. However, when using these pads, the temperature of the IRF730 must be monitored to ensure that overheating does not occur during high power operation.

Metering the Square Wave Duty Cycle

If you have purchased Meter M1, simply connect terminals or meter M1 to the terminal block on the SSQ-2F marked MTR. Connect the (+) terminal of the meter to the (+) connection of the MTR terminal block. Connect the unmarked terminal of the meter to the unmarked connection of the MTR terminal block.

The meter readings will tell you the approximate duty cycle of the modulated RF square wave output. Please be aware that the meter reading is not an absolute value, but is reasonably close - within five percent or so.

There are unavoidable differences in individual meter movements, circuit component tolerances, etc., which will cause the meter reading to be slightly different from the true value. If you need an exact duty cycle value, you will need to use an oscilloscope to obtain a truly accurate measurement. However, for most uses, the M1 meter will provide a fast and easy way to set the duty cycle consistently.

Should you choose to use your own meter, it will be necessary to calibrate it to read correctly with your SSQ-2F. The metering circuitry of the SSQ-2F has been designed to operate correctly with the M1 meter, which has a 2 milliampere full-scale movement.

If your meter movement has a full-scale reading of less than 1 milliampere, it will be necessary to install a resistor in series with your meter to limit the full-scale reading to the proper value. It will also be necessary to replace capacitor C8 (470 uF @ 16 V as supplied) with a capacitor having a value of 47 uF @ 16 V. Changing the value of C8 is necessary because the 470 uF capacitor will cause sluggish meter response if you are using a meter with a full scale value below 1 milliampere.

To properly calibrate your meter, you will need to monitor the square wave modulated RF output of the SSQ-2F with an oscilloscope. Adjust the audio input level to the SSQ-2F until the modulated RF signal just shows a 100% carrier, meaning there are no off-time breaks in the waveform on the oscilloscope.

Adjust the value of the series resistor until your meter reads full scale. It is suggested that you use a variable resistor, such as a rheostat or a potentiometer to initially find the correct resistance value. After you have adjusted the resistance to obtain a full-scale reading, disconnect the variable resistor. Using an ohmmeter, read the resistance of the variable resistor that you inserted into the meter circuit. Now you can use a fixed value resistor of the measured resistance value to replace the variable resistor.

Use your oscilloscope to watch the RF waveform output at TP3 while you adjust the modulation of the 3.1 MHz RF carrier by adjusting the audio input level to the SSQ-2F. Determine the meter readings on your now calibrated meter for the various modulation percentages from 0% to 100%. You may either rescale your meter appropriately, or you may simply make a look-up chart for meter readings vs. modulation percentages.

General Operation of the SSQ-2F v3.10

Initial Setup

Power Supply

To use the SSQ-2F, you will need to connect a power supply of between +15 to +30 volts DC to the PWR terminal block. This provides power for the logic circuits of the SSQ-2F. The current required by the logic circuits is 0.1 amperes maximum.

You will also need to provide a power supply for the RF amplifier section of the SSQ-2F. This supply connects to the PA PWR terminal block. It is advisable to make provisions to switch this power supply on and off separate from the logic power supply.

IMPORTANT! Be sure to connect a large electrolytic capacitor of at least 1000 uF with a voltage rating of 75 volts DC or higher as close to the PA PWR terminal block as possible. This will help avoid power supply “bounce” and ripple in the RF output waveform that is caused when the RF amplifier section of the SSQ-2F draws pulses of current through the inductance of the wires from the power supply.

The RF power output from the amplifier section is adjusted by varying the DC supply voltage connected to the PA PWR terminal block.

If you are using the SSQ-2F to drive a plasma tube without using an external solid state RF amplifier, or using it to drive an external vacuum tube amplifier, the maximum voltage for the PA PWR connection should be limited to 70 volts. Forced air cooling of the IRF730 heat sink will also be required.

If you are using the SSQ-2F to drive an external solid state RF amplifier, the SSQ-2F must be modified by adding a low loss 2200 pF ceramic capacitor rated for 100 volts DC between the gate and source terminals of the IRF730 RF amplifier MOSFET. In addition, the maximum PA PWR voltage should be limited to 30 volts. Forced air cooling of the IRF730 heat sink may also be required.

If you are using the SSQ-2F to power a contact device, the PA PWR voltage may be adjusted as required. It is suggested that the PA PWR voltage be limited to a maximum of 24 volts DC. This supply voltage will produce an output voltage of about 60 volts AC at 3.1 MHz, depending on the load that is connected to the RF OUT terminal block of the SSQ-2F RF amplifier.

Audio Input Signal

Please do not exceed the maximum allowable input audio level voltage of + or - 6 volts peak to prevent damage to audio input amplifier U1. The audio signal may be offset by a maximum level of +6 or -6 volts DC without damaging input amplifier U1.

The SSQ-2F will ignore any DC offsets, as long as they are constant. A varying DC offset voltage will be interpreted by the SSQ-2F as a change in the audio input level and will result in a change in the modulation duty cycle.

You will need an audio signal source somewhere between 40 to 175 millivolts peak to peak. The audio signal must not change in amplitude as the frequency of the audio signal changes. Most computer sound cards will meet this requirement. Some CD and DVD players will not, but this can usually be remedied by placing a load resistor across the audio output of the CD or DVD player. The required resistance value will usually be within the range of 10 to 100 ohms.

In order to adjust the duty cycle of the modulated RF square wave output, it is necessary to be able to adjust the amplitude of the audio signal being sent to the SSQ-2F, either by adjusting the level at the source or by using a 100 K ohm potentiometer (R2) connected to the terminal block on the SSQ-2F marked GAIN.

If you have a convenient way to adjust the audio level external to the SSQ-2F, you may install a jumper wire between the connections of the GAIN terminal block. This will reduce the audio gain of the SSQ-2F to the lowest value. If more gain is required, installing a fixed resistor in place of the jumper will increase the audio gain. A resistance value of somewhere between zero and 100K ohms is required, with higher resistance values providing more audio gain. The resistor value will need to be determined by trial and error.

Note that the lower the gain, the flatter the audio bandwidth will be of the SSQ-2F. Using a 100K-ohm potentiometer connected to the GAIN terminal block is the easiest and most convenient method of adjusting the audio gain of the SSQ-2F.

Modes of Operation

The following figure shows the various operating modes of the SSQ-2F.

Type of Input Audio Signals	Sine, Triangle, Square*	Sine, Triangle
RF Carrier Output	Modulation Rate Equals Audio Frequency (1X Mode)	Modulation Rate Twice Audio Frequency (2X Mode)
0-50% Duty Cycle	Mode 1	Mode 2
50-100% Duty Cycle	Mode 3	Mode 4

* When using square wave input, only 50% duty cycle is available

Figure 8 – Operating Modes of the SSQ-2F

Selection between the operating modes is made by using jumper wires between the appropriate connections on the INVERT or DIV terminal blocks. For convenience, switches may be connected to the terminal blocks to allow for instant mode selection as needed.

Operation with Square Wave Audio signals

When operating in Modes 1 or 3, with square wave audio signals, increasing the audio signal level excessively or turning gain control R2 too high will result in erratic square wave output.

The SSQ-2F determines when to turn the RF carrier on and off by sensing the rate of amplitude change of the input audio signal. While sine and triangle waves have smooth rise and fall times, square waves are very abrupt, and the SSQ-2F cannot do anything except sense the rising and falling edges of square waves. This means that using square waves as an audio input will cause the modulation signal from the SSQ-2F to follow the rising and falling edges of the square wave, but with much faster rise and fall times.

Because of this, the frequency-doubling mode of the SSQ-2F will not work with square wave audio input signals. The output will always be in the 1X Mode (Modes 1 & 3.) Further, the duty cycle of the modulated RF output of the SSQ-2F will always follow the duty cycle of the input square wave signal.

If a square wave audio signal with other than a 50% duty cycle is sent to the input of the SSQ-2F, the polarity (and hence the duty cycle ratio) of the modulated RF output may be inverted by reversing the connections to the INVERT terminal block.

For instance, if a square wave audio signal with a duty cycle of 80% is connected to the input of the SSQ-2F, the modulated RF output of the SSQ-2F will be ON for 80% of the modulation cycle and OFF for the remaining 20%. Reversing the connections to the INVERT terminal block will result in the RF carrier being ON for 20% of the modulation cycle and OFF for the remaining 80%.

Driving an External Solid State RF Amplifier with the SSQ-2F

One of the uses of the SSQ-2F v3.10 is to serve as an exciter for a high power, external solid state RF amplifier. This is most commonly done when more power is required for driving a plasma tube than the SSQ-2F can supply on its own.

To properly drive a solid-state amplifier, the output waveform of the SSQ-2F must be modified slightly to obtain a more sinusoidal shape. This will provide a more balanced drive waveform for the external RF amplifier.

This modification may be accomplished in two ways. It may be added to the SSQ-2F by selecting the RF driver Capacitor option when the unit is ordered or it may be field installed by the user. The modification may be easily removed if and when the SSQ-2F is to be used for a different application.

The photo below shows the RF driver Capacitor installed on the SSQ-2F v3.10.

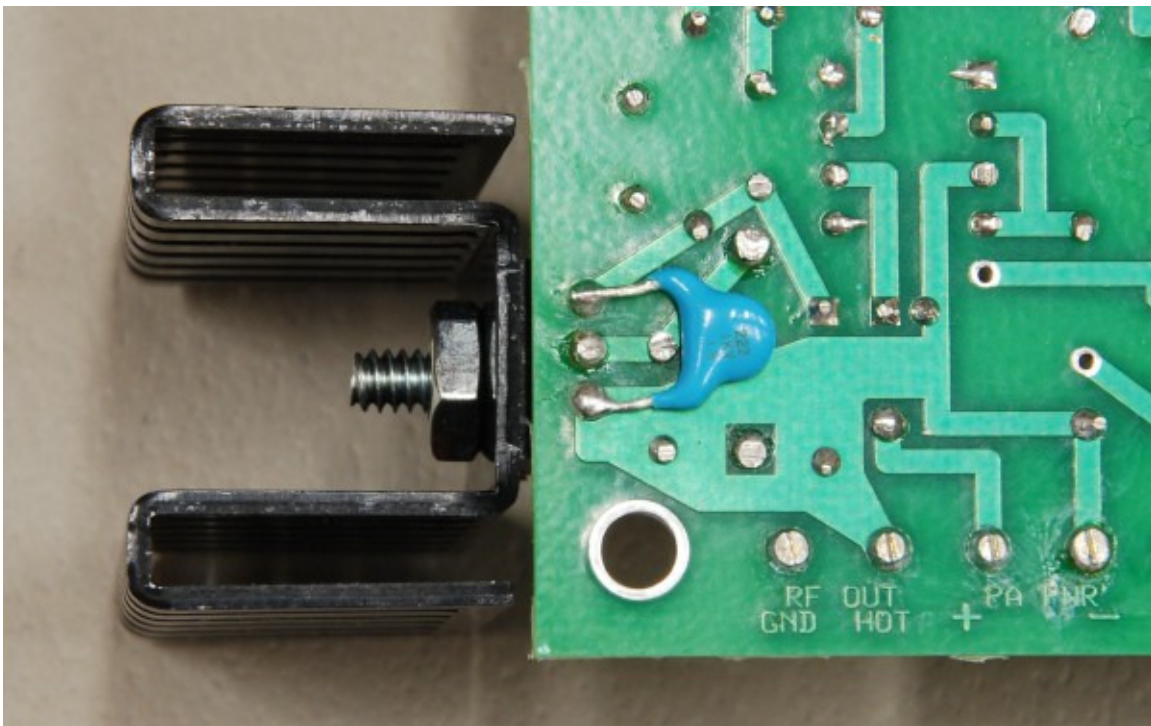


Figure 9

F Driver Capacitor installed on SSQ-2F v3.10.

The capacitor should be a low-loss ceramic capacitor, 2200 pF and rated for 100 VDC.

If the RF drive capacitor is to be disconnected, this may be accomplished by unsoldering one end of the capacitor and bending the unsoldered lead slightly away from any other connections on the circuit board. This will leave the capacitor still attached to the circuit board by one lead so that it will not become lost should you wish to reconnect it at a later time.

Setting the RF Drive Level From the SSQ-2F to the External Amplifier

When driving a solid state external RF amplifier, such as the KL-300 or the KL-500 series of amplifiers, it is important to limit the RF drive from the SSQ-2F that is sent to the external amplifier. Most of these amplifiers are designed to generate full power output with less than 15 watts of RF drive. Because the SSQ-2V can produce much more power than that, care must be taken not to overdrive the external amplifier and damage it. Remember that repairs can be expensive! Use the minimum power required for proper amplifier drive.

The addition of the RF drive capacitor modification to the SSQ-2F causes the output power of the SSQ-2F to be reduced considerably. In addition, it is necessary to lower the DC supply voltage that is connected to the PA PWR terminal block.

Most of the commercially available solid-state RF amplifiers are rated for a specific PEAK drive power, not AVERAGE drive power. Placing a standard RF wattmeter between the SSQ-2F and the RF input of the amplifier will give you an incorrect power reading. This is because most RF wattmeters are average reading devices and will only read correctly with a constant level, clean sine wave RF waveform.

The following figure shows the peak RF power output of the SSQ-2F v3.10 with the RF drive capacitor modification for various DC voltage inputs to the PA PWR terminal block:

PA PWR DC VOLTS	RF POWER OUT PEAK WATTS
+18	2.5
+24	5.0
+28	7.5
+36	12.5
+48	20.0

Figure 10

Due to the lower efficiency of the RF amplifier section of the SSQ-2F when the RF drive capacitor modification has been performed, the heat sink of the IRF730 MOSFET will become warmer than it would when it is operated at the same DC voltage as in the unmodified mode. It will be necessary to use forced air cooling of the IRF730 heat sink when using PA PWR DC supply voltages above 18 volts.

Turn On Caution When Using an External Solid-State RF Amplifier:

When first applying power to the SSQ-2F, the SSQ-2F will momentarily output a 100% carrier signal for about two seconds, even with no audio signal applied to the SSQ-2F. You will see the duty cycle meter M1 jump up from zero and then return to zero at power-on time. This is normal, and is due to the capacitors in the SSQ-2F initially charging up to their normal voltage level. As soon as the capacitors are charged, the output of the SQ-2F returns to normal.

If the external RF power amplifier has power applied to it before the SSQ-2F is powered on, the initial burst of carrier may cause the power amplifier to fault or its power supply to shut down due to overloading. ***For this reason, always turn on the SSQ-2F before you turn on the RF amplifier.***

Driving an External Vacuum Tube RF Amplifier with the SSQ-2F

The SSQ-2F v3.10 can provide enough RF power at 3.1 MHz to drive a vacuum tube amplifier. Because many vacuum tube amplifiers do not present a true 50-ohm load at their input connectors, it may be necessary to employ some form of impedance matching network between the SSQ-2F and the vacuum tube amplifier. This may be in the form of a low power antenna tuner.

The following figure shows the DC supply voltage and current requirements of the SSQ-2F RF amplifier section, and the peak RF power output that the SSQ-2F can supply.

PA PWR DC VOLTS	PA PWR DC AMPERES	PEAK RF WATTS OUTPUT @ 50 OHMS
15	0.2	3
20	0.3	7
24	0.35	10
28	0.4	16
30	0.45	20
36	0.5	25
40	0.6	35
48	0.7	50
50	0.75	53
60	0.8	75
70	1.1	100

Figure 11

Legend:

Green – Standard heat sink, no fan required.

Orange – Fan or larger heat sink required.

Red – Stronger fan and/or larger heat sink required. Disconnecting output cable during operation may cause MOSFET failure.

CAUTION ! ! Although the SSQ-2F is capable of operating at duty cycles up to 100%, unless a larger heat sink and/or vigorous forced air cooling of the heat sink is used for the IRF730, the use of modulation duty cycles above 70% is discouraged unless extreme care is taken.

Even with forced air cooling, heat cannot be removed from the IRF730 rapidly enough to prevent overheating at very high duty cycles when operating with DC supply voltages above 60 to 70 volts. Operation in ambient air temperatures above 25°C is not recommended.

When operating at high power levels and high duty cycles, it is necessary to monitor the temperature of the heat sink at the point where the IRF730 is bolted to the heat sink. The temperature of the heat sink should not be allowed to exceed a value of 71°C at the point of measurement. Failure of the IRF730 may be expected if the heat sink temperature is allowed to increase to 90° C or higher.

Connecting the SSQ-2F to the Vacuum Tube Amplifier

The connection of the SSQ-2F to the vacuum tube amplifier is straightforward. Simply connect a 50-ohm coaxial cable between the RF OUT terminal block of the SSQ-2F and the RF Input connector of the vacuum tube amplifier. If necessary, insert an impedance matching network or a small antenna tuner in the coaxial cable between the SSQ-2F and the amplifier.

Adjust the DC voltage connected to the PA PWR terminal block of the SSQ-2F for the desired grid drive on the vacuum tube amplifier. Adjust the impedance matching network for the lowest VSWR as seen by the SSQ-2F. This will normally correspond to the point of maximum grid drive on the vacuum tube amplifier.

Be sure to have sufficient forced air cooling on the heat sink of the IRF730. If the VSWR between the SSQ-2F and the input of the vacuum tube amplifier is excessive, the IRF730 may overheat excessively and be damaged.

Driving a Plasma Tube from the SSQ-2F Without an RF Amplifier

About Plasma Tubes

Because the SSQ-2F v3.10 can provide RF power levels of up to 100 watts peak power, it is possible to drive a moderate sized plasma tube from the SSQ-2F without the need for an external RF amplifier, however some form of coupling or matching system will be needed to match the 50 ohm output impedance of the SQ-2F to the load presented by the plasma tube.

Plasma tubes are of two basic types – internal and external electrode tubes. Internal electrode tubes are easier to light up because their electrodes are in intimate contact with the gas in the tube. The drawback is that the electrodes tend to absorb a lot of power during operation and they may become extremely hot, even to the point of glowing red. Should this happen, the electrodes will begin to give off gas (outgas) and contaminate the gas mixture in the tube. This result is an off-color glow or outright failure of the tube to light up.

To solve this problem, many experimenters switched to external electrode tubes. An external electrode tube has some form of metallic electrode wrapped around the ends of the tube. These electrodes may be in the form of a wrap-around collar, a spring-looking wire wrap, or a piece of metal screen wrapped around the ends of the tube. These electrodes are connected to the source of RF energy, just as would be the electrodes of an internal electrode tube.

External electrodes transfer the RF power to the gas in the tube by capacitive action – an AC current can pass through a capacitor, but not a DC current. Because almost all Rife plasma tube systems use an RF (AC) carrier to drive the tube, external electrodes work quite well. They are limited in power handling only by the maximum power the tube walls can withstand without melting. Generally, well before that point is reached, the gas inside the tube will heat up enough so as to increase the pressure and cause the tube to lose color and become dimmer, alerting the operator to the fact that the tube is too hot. An external electrode tube can handle ten times or more the power that the same size internal electrode tube can withstand.

RF Coupling Systems

Commercial Antenna Tuners

To couple the RF energy from the SSQ-2F to the plasma tube, a commercial antenna tuner of some sort may be used. This has been the standard practice for many plasma tube system operators. However, because the SSQ-2F operates at 3.1 MHz instead of the more commonly used frequency of 27.120 MHz, an antenna tuner designed for Amateur Radio service is necessary. Most Amateur Radio antenna tuners will go down to 1.8 MHz. Due to the continuous duty operation of plasma tube systems, you should obtain a tuner that is rated for at least 300 watts. Tuners with less power handling ability may overheat, and they will deliver less useful power from the SSQ-2F to your plasma tube.

Suitable commercial antenna tuners include the MFJ-949E and the MFJ-969. Of the two, the MFJ-969 is the better choice. Because it is a larger tuner, its internal losses will be lower. It is capable of handling the output from a high power RF amplifier should you decide to add one to your system in the future.

If you are using a commercial antenna tuner, you simply connect one end of a length of 50-ohm coaxial cable to the RF OUT terminal block of the SSQ-2F. Connect the other end of the coaxial cable to the input of the antenna tuner, usually labeled "Transmitter."

If the tuner has a balanced wire output, then it has an internal balun transformer. In this case, connect a pair of wires from the balanced wire terminals on the tuner to the electrodes of the plasma tube.

If the tuner has only coaxial cable antenna output connectors, then you will need to add an external balun. Connect the input of the balun transformer to the antenna output jacks of the tuner. Connect the output leads of the balun through a pair of wires to the electrodes of the plasma tube.

To prevent unwanted RF radiation, the wires leading to the plasma tube should be as short as possible and placed as close together as possible without shorting them together.

Start the initial tune up procedure with the SSQ-2F running at about 50 volts on the PA PWR terminal block. This is low enough to protect the IRF730 during the early stages of tuning. After tuning is complete, the DC voltage may be increased to the desired power level and the tuning touched up as needed.

3.1 MHz Link Coupler System

A lower loss and less expensive coupling system is a tuned tank coil link coupled matching system as seen at:

http://rife-beam-ray.com/3.1mhz_match/index.htm

Using this system eliminates most of the RF losses of the antenna tuner and gives the RF signal a sharper rise and fall time, resulting in a better, brighter plasma discharge.

Tuning the System to Resonance

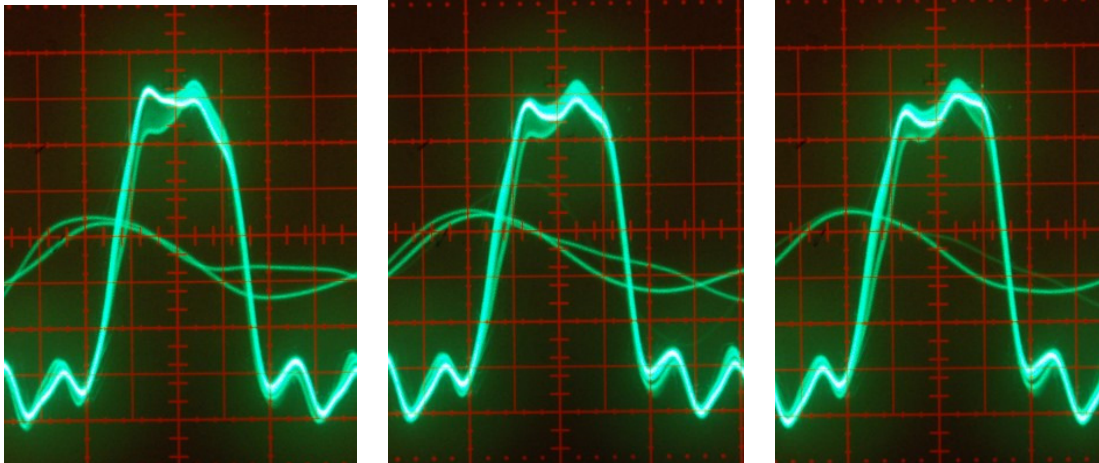
Regardless of whether you use a commercial antenna tuner or a link coupling system, the tuning is the same. You want to tune for the lowest VSWR reading and the brightest glow in the tube. Usually these will be close to the same tuning position.

Leave the PA PWR supply turned off. Now, set the audio frequency to about 6000 Hz. Next, adjust the audio level to the SSQ-2F so that you have a reading of about 50% duty cycle. Increase the PA PWR voltage to about 40 to 50 volts. This will give you a fair amount of RF power output without too much danger of blowing out the IRF730.

Now adjust the antenna tuner or link coupler tuning for the lowest VSWR / brightest glow in the tube. These should pretty much coincide. If you have an oscilloscope, you can “tweak” the tuning by observing the RF waveform at the RF OUT terminal block.

Tuning Waveforms

These pictures show the RF waveform at the RF output of the SSQ-2F. They are taken at TP3, the RF OUT terminal block. For these pictures, the SSQ-2F was connected to a plasma tube through the 3.1 MHz link coupler.



Tuned Low

Correct

Tuned High

Figure 12

Ignore the haze around the brightest part of the waveforms. Look at the double peak in the top of each wave.

The center picture shows what the waveform looks like at the point of lowest VSWR. This is also the point of the brightest glow in the plasma tube. Note that the two peaks in the waveform are of equal height.

The left picture shows what the waveform looks like when the tuning is set too LOW in frequency. This indicates that too much tuning capacity is being used. Note that the left peak is higher than the right peak. In this condition, the tube is dimmer than it should be, and the IRF730 is drawing less current than it does when the system is correctly tuned.

The right picture shows what the waveform looks like when the tuning is set too HIGH in frequency. This indicates that too little tuning capacity is being used. Note that the right peak is higher than the left peak. In this condition the tube is dimmer than it should be, and the IRF730 is drawing more current than it does when the system is correctly tuned. This extra current goes directly to losses and creates extra heat in the IRF730.

Due to the change in electrical characteristics of the ionized gas column in the plasma tube, you will find that as the RF power is increased through the tube, and the tuning will shift downwards in frequency. That means that if you do your initial system tuning at a lower power level than you will use in normal operation, you will need to retune and reduce the tuning capacity when you go to full power. You will also find that a hot tube will tune slightly differently than a cold tube. This is normal, and is caused by the change internal gas pressure that occurs as the gas heats up from the electrical current passing through the tube.

Driving an Contact System with the SSQ-2F v3.10

While the SSQ-2F v3.10 was not specifically designed for use as a contact device driver, it can be used for such service. Because the SSQ-2F v3.10 is designed to have a high RF power output, it must be used with care or damage to the unit and/or personal injury may result from radio frequency burns.

Spectrotek Services and Ralph M. Hartwell ARE NOT RESPONSIBLE for any damage or injuries of any sort or form that may be sustained by any person or persons, any animal, or to any equipment or any other thing or things while anyone is using, modifying testing or experimenting with the SSQ-2F in any manner whatsoever.

Using the SSQ-2F is done solely at your own risk.

Because the SSQ-2F was not originally designed for use as a contact device driver, it is necessary to run the SSQ-2F at near full power output, and the dumping most of the RF power into a dummy load. Then you must take a voltage sample of the RF power and send that to the contact electrodes.

This means that we must connect the RF output of the SSQ-2F to a suitable RF dummy load that can absorb at least 50 watts of RF power on a continuous basis. A suitable load is the MFJ-264.

<http://www.mfjenterprises.com/Product.php?productid=MFJ-264>

This procedure is needed in order to stabilize the waveform of the SSQ-2F. Without the dummy load, the IRF730 will overheat, and the rise and fall times of the RF waveform will be degraded.

When connecting the dummy load to the SSQ-2F, any convenient length of 50-ohm coaxial cable may be used so that the SSQ-2F and the dummy load may be placed in suitable locations. The dummy load will get hot during operation, so provision for a free flow of cool air through the dummy load must be provided.

A short (less than five feet) of 50-ohm coaxial cable should be connected in at the RF OUT terminal block. Connect this cable in parallel with the coaxial cable going to the dummy load. The other end of this second cable should connect to a metal enclosure that houses the voltage and current limiting components that will feed the contact electrodes. The shield of the coaxial cable should be firmly connected to the metal enclosure to prevent unwanted RF radiation.

The length of the connecting wires to the contact electrodes should be as short as practicable to prevent unwanted 3.1 MHz RF radiation. Placing the leads within a few inches of each other will help to reduce the unwanted radiation.

This figure shows the peak RF output voltage available for different PA PWR input DC voltages when the SSQ-2F v3.10 is used as a contact device driver.

PA PWR DC VOLTS	PEAK RF VOLTS OUTPUT
15	38
18	47
20	51
24	61
28	72
30	77
36	92
48	123
50	129
56	143
60	160
70	176

Figure 13

As you can see from this table, the SSQ-2F is capable of producing dangerous RF voltages. It is strongly recommended that you do not use a DC supply voltage higher than necessary to avoid injury or damage.

Note that the RF output of the SSQ-2F v3.10 is AC and is referenced to the ground/earthed/negative side of the DC supply voltage for both of the voltages connected to the PWR and PA PWR terminal blocks. If galvanic isolation between the equipment and the subject is required, it will be necessary to use approved power supplies that are life safety rated.

SPECIFICATIONS:

DC Power Supply Input:

- SSQ-2F v3.10 Logic Circuits +15 to +30 volts DC maximum, filtered, but need not be regulated, at 0.1 Ampere
- SSQ-2F v3.10 RF amplifier +12 to +70 volts DC filtered and regulated at 2.5 amperes, current required varies with power output and modulation duty cycle.

Input Audio Signal Waveform:

- Sine, triangular, symmetrical, or asymmetrical square wave.

Modulation Modes:

- 1X Mode - The modulation frequency equals the input audio frequency using sine, triangle, or square waves.
- 2 X Mode - The modulation frequency equals TWICE the input audio frequency using sine or triangle waves only.

Carrier Frequency:

- 3.1 (standard) or 3.3 MHz. Frequency to be specified at time of order.
- Customer requested frequencies are available on special order.
- The user may easily change the plug-in carrier oscillator module.
- With the appropriate oscillator module inserted in the Controller Board, carrier frequencies from 2.5 MHz to 4.5 MHz may be obtained.

RF Power Output:

- 1) When set for driving a plasma tube or as an exciter for an external vacuum tube RF amplifier, the SSQ-2F will produce up to 100 watts peak power, 50 watts average power as measured across a 50-ohm load when the carrier is modulated by a 50% duty cycle square wave.
- 2) When operating as a driver for an external solid state RF amplifier, the SSQ-2F will produce up to 15 watts peak, 7.5 watts average power as measured across a 50 ohm load when the carrier is modulated by a 50% duty cycle square wave.
- 3) When operating as a driver for a contact system, the SSQ-2F will produce up to 72 volts.
- The RF output power in (1) and (2) and the RF output voltage in (3) are adjustable by varying the DC input power to the RF amplifier PA PWR terminal block.

Modulation Frequency Ranges - 2 X Mode:

Input Audio Frequency Range in 2 X Mode @ 40 - 175 mv p/p input level with a Sine or Triangle Wave Input Signal:

- Low - 40 Hz.
- High - 30,000 Hz at maximum audio gain, or 60,000 Hz at minimum audio gain.
- This will square wave modulate the carrier over the range of 80 to 60,000 Hz or 80 to 120,000 Hz.

NOTE: In the 2 X mode, using a sine or triangle wave audio input, the output of the Controller Board will maintain a 50% duty cycle ratio to within 10% or less across the input frequency range of 40 to 30,000 Hz at maximum audio gain, or 40 to 60,000 Hz at minimum audio gain. This allows unattended operation of the equipment without the need for constant audio gain adjustments when using an audio sweep signal generated by a computer sound card. It is necessary to maintain a low source impedance and a constant voltage as the audio frequency changes during the sweep.

Modulation Frequency Ranges - 1X Mode:

Input Audio Frequency Range in 1X Mode, @ 50 - 140 mv p/p Input Level with a Sine or Triangle Wave Input Signal:

- Low - 4 Hz.
 - High - 200,000 Hz at any audio gain setting.
 - This will square wave modulate the carrier over the range of 4 to 200,000 Hz.

 - Usable frequency range from 4 to 400,000 Hz with increased audio input level.
 - This will square wave modulate the carrier over the range of 4 to 400,000 Hz.
-

Modulation Frequency with a Square Wave input signal of 50 - 75 mv p/p and minimum audio gain:

Note: *Square wave audio is usable in 1X Mode only, and a 50% duty cycle is output by the Controller Board.*

- Low - 75 Hz.
 - High - 200,000 Hz.
 - This will square wave modulate the carrier over the range of 75 to 200,000 Hz.

 - Usable frequency range from 50 to 600,000 Hz with increased audio input level.
 - This will square wave modulate the carrier over the range of 50 to 600,000 Hz.
-

Warranty

All our products carry a one (1) year warranty against manufacturing defects. Mechanical damage is not covered; i.e., you dropped it on the floor and then accidentally stepped on it. For warranty claims, you pay shipping to us; we pay shipping back to you.

Kits assembled by the purchaser are also have a one (1) year against component failure. Breakage or overheating damage from soldering of components during assembly is not covered under warranty.

Damage to the IRF730 MOSFET transistor due to over voltage operation or inadequate cooling is not covered under warranty.

For all warranty claims or equipment service, please contact us by email or telephone before returning equipment for service.

Out-of-Warranty repair service is at the rate of \$20/hour, with a maximum charge of \$50 per item, unless otherwise specified. Please contact us for additional pricing on custom repair services.

Contact us

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<http://rife-beam-ray.com>

<http://rifebeamray.com>

<http://w5jgv.com/rife>

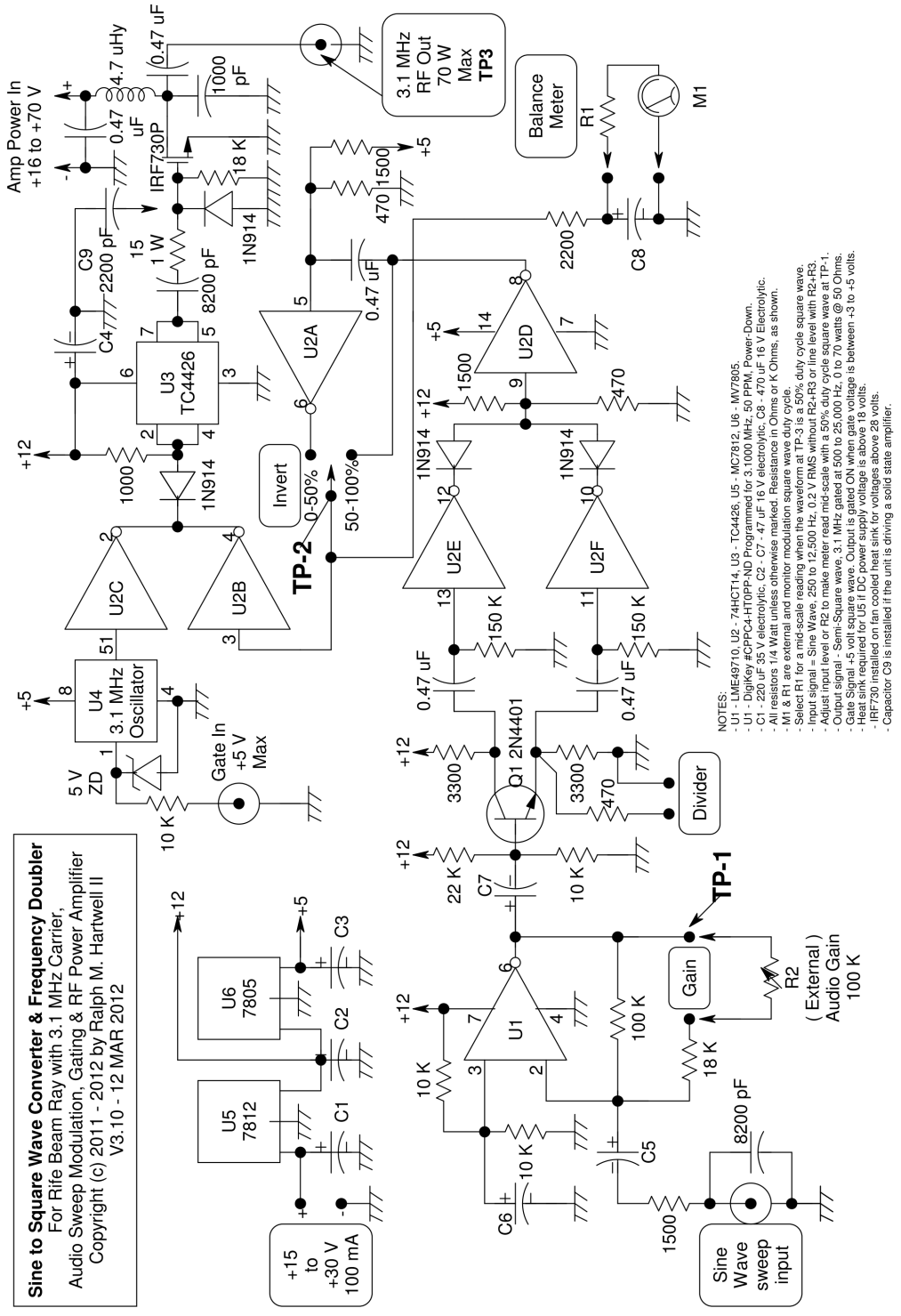


Figure 14

Schematic Diagram of the SSQ-2F v3.10.

WAVEFORMS

The following waveform photographs were taken with a Tektronix oscilloscope set to a 20 MHz bandwidth. The amplitude of the digital signals shown in the first six pictures is +5 volts peak, ground referenced, unless otherwise noted. The test points mentioned here are found on the schematic diagram. All waveforms are taken with a 6 KHz audio input signal to the SSQ-2F.

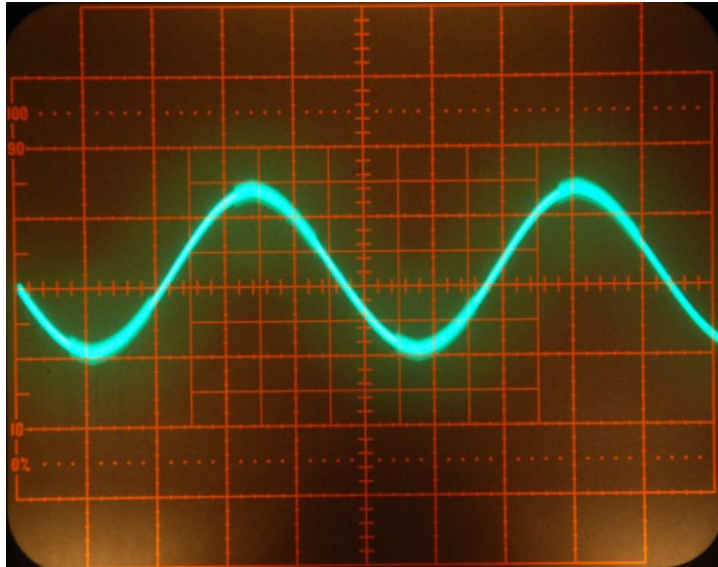


Figure 15
6 KHz audio signal at TP-1.

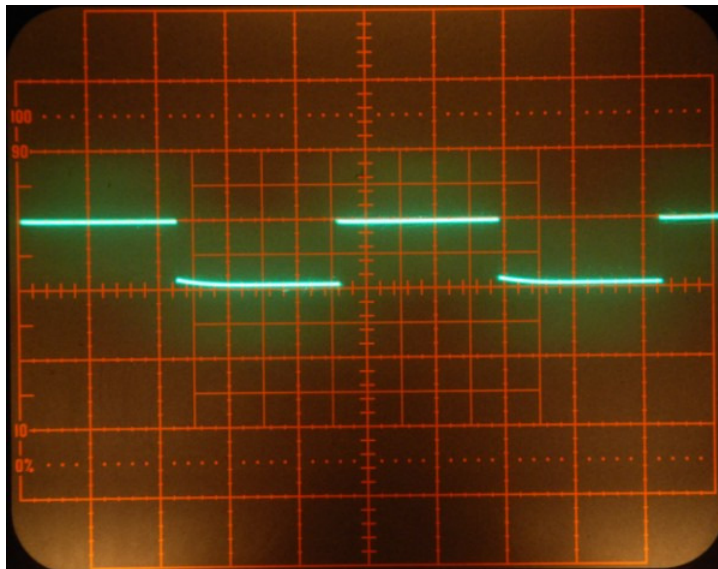


Figure 16
6 KHz 50% duty cycle square wave at TP-2. This is in the 1X mode.

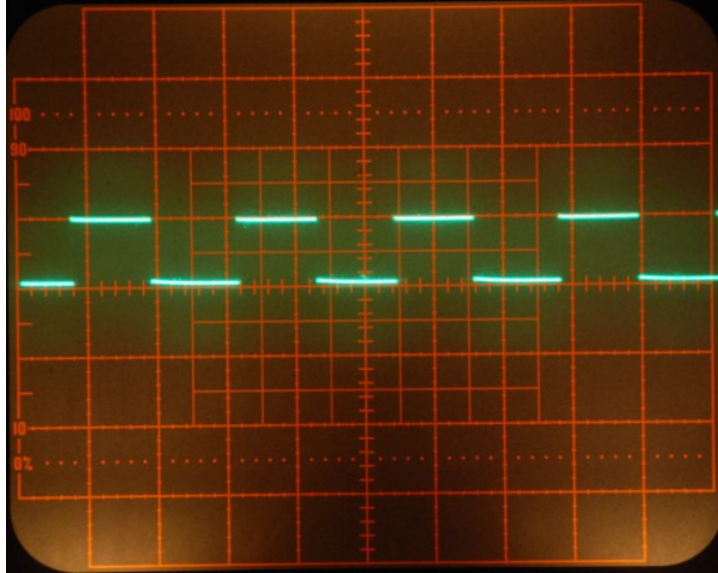


Figure 17

12 KHz 50% duty cycle square wave at TP2. This is in the 2 X mode.

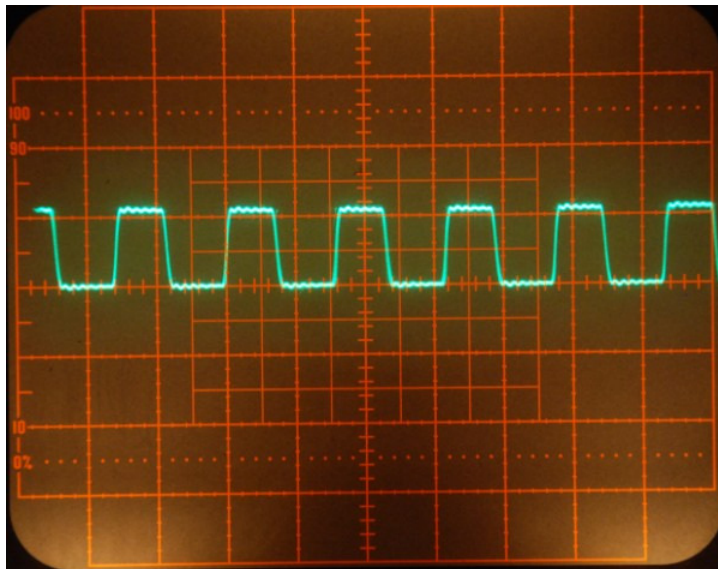


Figure 18

3.1 MHz carrier wave drive signal at U3, pins 5 & 7.

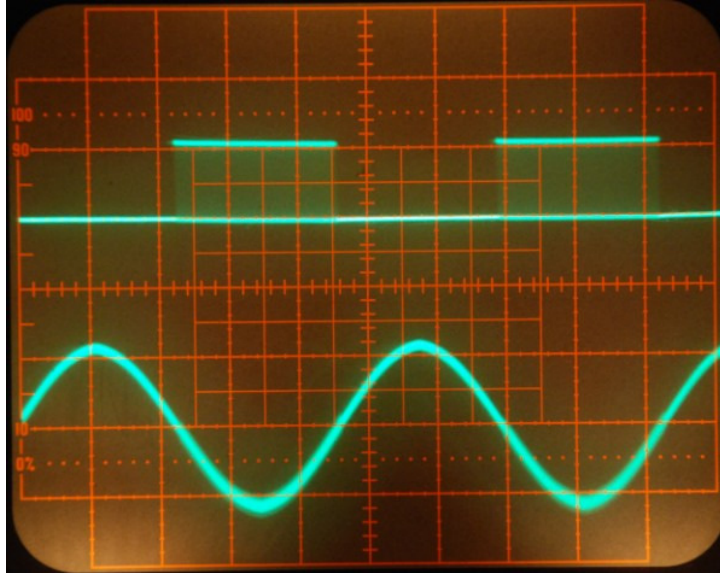


Figure 19

Bottom trace – TP-1 showing 6 KHz audio.

Top trace – TP-3 showing 3.1 MHz carrier at U3, pins 5 & 7, modulated at a 6 KHz rate by a 50% duty cycle square wave. This is in the 1X, non frequency doubling mode.

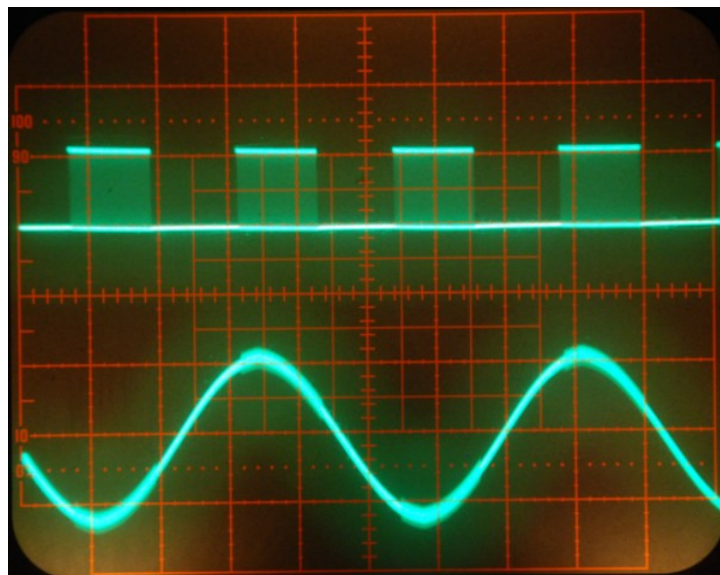


Figure 20

Bottom trace – TP-1 showing 6 KHz audio input signal.

Top trace – TP-3 showing 3.1 MHz carrier at U3, pins 5 & 7, modulated at a 12 KHz rate by a 50% duty cycle square wave. This is in the 2X, frequency doubling mode.

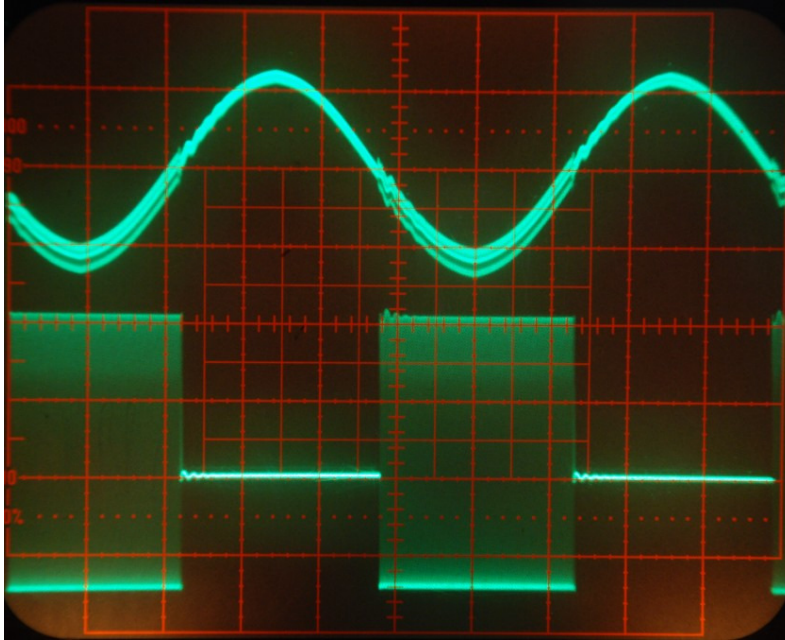


Figure 21

Top trace - TP-1 showing 6 KHz audio input signal.

Bottom trace - This is the 100 watt peak power 3.1 MHz RF carrier output waveform as seen at the RF output connector of the SSQ-2F (TP3).

The 3.1 MHz carrier is being modulated at a 50% duty cycle by a 6000 Hz audio signal. Note the very fast rise and fall times of the modulated RF pulses.

The slight ripple visible on the top leading edge of the signal burst and the ripple visible in the baseline immediately after the RF pulse is due to inductor ringing caused by the DC current flow through the output amplifier inductor.

In this picture, the SSQ-2F is being run in the 1X mode, (non-frequency doubling,) so there is only one modulated RF pulse per audio cycle.

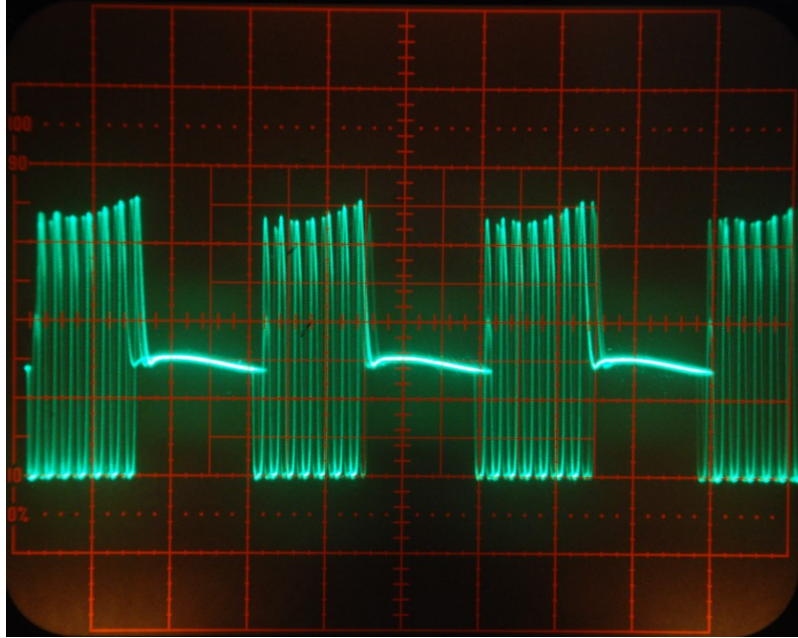


Figure 22

This is the 100 watt peak power 3.1 MHz RF carrier output waveform as seen at the RF output connector of the SSQ-2F (TP3).

The 3.1 MHz carrier is being modulated at a 50% duty cycle by a 210 KHz audio signal. There are only seven cycles of 3.1 MHz carrier in each modulation cycle. Note the very fast rise and fall times of the RF pulses.

The faint display blur is caused by the camera superimposing several oscilloscope traces on top of each other. The slight curve in the top of the signal burst and the curve in the baseline during the modulation OFF time is due to inductor ringing caused by the DC current flow through the output amplifier inductor.

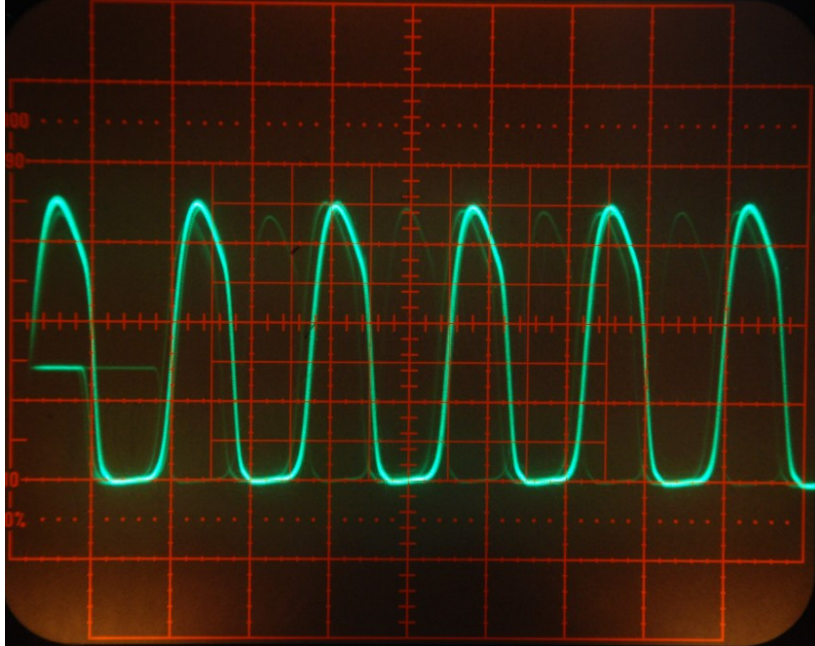


Figure 23

This is the 100 watt peak power 3.1 MHz RF carrier output waveform as seen at the RF output connector of the SSQ-2F (TP3).

The waveform is 350 volts peak to peak as measured across a 50-ohm dummy load resistance. The DC voltage to the RF amplifier section of the SSQ-2F is 70 volts. The peak RF power is 100 watts, and the average power at a 50% duty cycle is 50 watts.

This waveform is satisfactory for use in driving a vacuum tube RF amplifier, however it is not the right shape to properly drive a solid state RF amplifier. A simple modification is required to be done to the SSQ-2F to change the waveform to be more compatible with solid-state RF amplifiers.

- EOT -