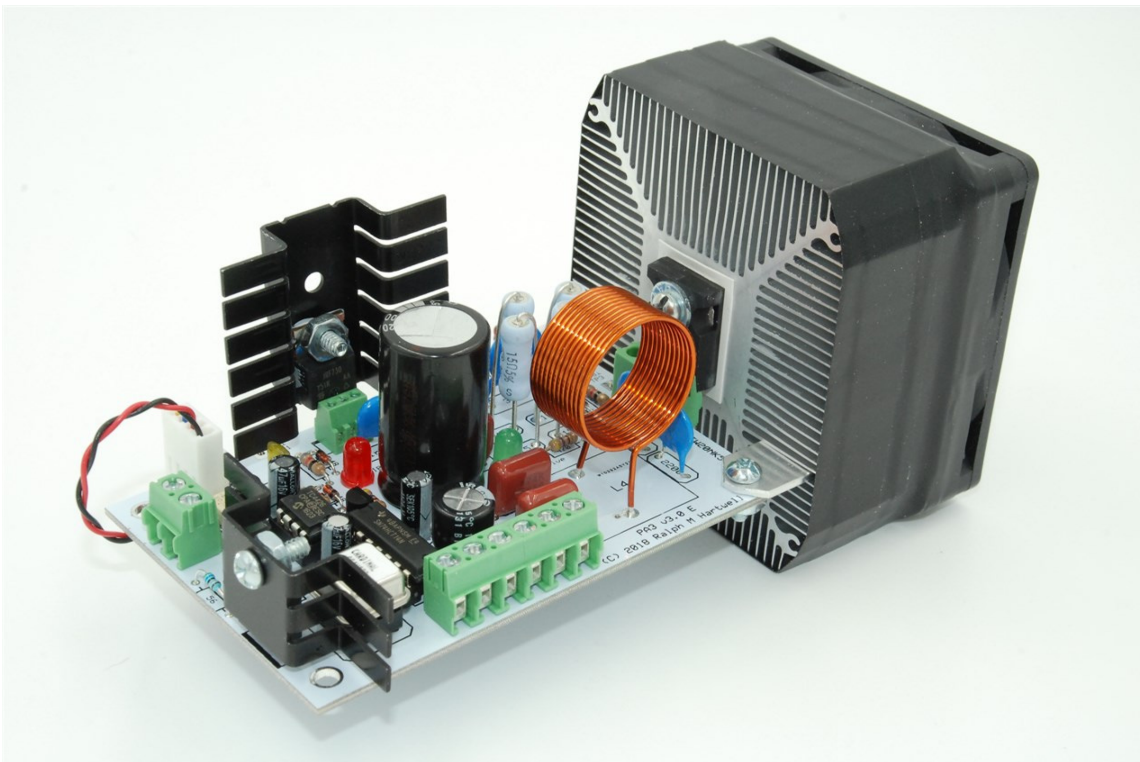
Instruction Manual

For the

PA3 v3.0 E Amplifier



22 February 2018

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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 PA3 in any manner whatsoever. This device has not been inspected or approved by any governmental or medical agency or inspection service. No medical claims are made for, nor implied by, the sale or use of this device. Using the PA3 is done solely at your own risk.

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. Please check with your physician or other health care professional before starting any diet, exercise, taking over-the-counter (OTC) medications or supplements and especially before taking any prescribed medication. Never stop taking any prescribed medications without first consulting your physician.

RADIO FREQUENCY WARNING NOTICE

- The PA3 is a high-frequency switch mode power supply module designed to furnish a square wave modulated high voltage alternating current at a frequency of approximately 3.1 MHz when connected to a 50 ohm resistive load.

- If the PA3 is installed incorrectly or used improperly, it is capable of causing severe radio frequency interference. To prevent this from occurring, please observe the following warnings:

- The PA3 is to be used as a research device only, or as part of a complete system to drive a plasma tube.

- The PA3 is not intended to be used for any form of radio transmission in any manner whatsoever.

- The PA3 is not intended to be connected to an antenna or to any radiating element or to be used for any form of radio communications purposes in any manner whatsoever.

- All connections to the output terminals of the PA3 are to be made using shielded 50 ohm coaxial cable capable of handling at least 500 watts.

- All connections are to be made in such a manner as to minimize any RF radiation from the connecting wires to the PA3.

- The PA3 has been specifically designed to be driven by a TTL square wave signal that from a standard signal generator, such as the UDB-series of frequency generators or any other signal generator capable of producing a duty cycle modulated square wave signal with an amplitude of 0 to +5 volts.

- The operating frequency range of the PA3 has been restricted to a 1 MHz portion of the spectrum centered at 3.1 MHz.

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About Power.

In this document, unless otherwise specified, when the word "**power**" is used it will mean **peak power**. For example, with a 50% duty cycle, 300 Watts peak power is the equivalent of 150 Watts **average power**. Likewise, with a 100% duty cycle, 300 watts peak power is equivalent of 300 watts **average power**.

About the PA3

The PA3 is not a conventional RF power amplifier, and it cannot be used as such. It will not accept an RF drive signal from a conventional transmitter, such as a CB radio. The PA3 is a fix tuned, high frequency switch mode amplifier.

The PA3 amplifier has been designed to allow researchers who already have an accurate signal generator which will supply adjustable square waves to construct their own high power plasma tube system. During operation, the PA3 requires modulation frequency input from an external signal generator and a source of DC power.

The modulation signal source may be any stand-alone frequency generator such as a UDB1108S, an F-series generator such as an F165, a GB-4000, or in some cases, a sine wave output signal generator. Modulation frequencies between 4 Hz and 400,000 Hz may be used with the PA3.

The PA3 has an on-board 3.1 MHz carrier oscillator module which may be swapped for an oscillator module of a different frequency should this be required.

The PA3 will operate across the range of 2.9 to 3.5 MHz. Operation outside this frequency range may cause serious damage to the PA3. The optimum operating frequency is 3.1 MHz.

All connections to the PA3 are made using screw terminals, so no soldering is required.

If you have assembled your PA3 from a kit, then depending upon the size and efficiency of the heat sink on which you have installed on the PA3, the power output of the PA3 may be between 300 to 500 Watts peak power / 150 to 250 Watts average power when using a 50% duty cycle modulation.

If the PA3 is installed on a sufficiently large heat sink, then higher duty cycle modulation may be used. This will provide a corresponding increase in output power from the PA3. With a large enough heat sink, the PA3 is capable of operating in excess of 500 watts peak power output. When mounted on the HS2 heat sink assembly, the PA3 will operate at full rated power.

For most large plasma tubes, 300 watts peak power is enough to properly drive the tube. Be aware that operation at high power levels may cause overheating and possible damage to your plasma tube. Please consult with your plasma tube manufacturer to determine the correct power level for your plasma tube.

Power for the PA3

Two power supply voltages are required to operate the PA3.

The output amplifier section of the PA3 may be powered from any power supply that has an output voltage of 15 to 190 volts DC. The maximum current required is approximately 3 amperes, although normal power levels required for plasma tubes will usually require lower DC current levels.

A smaller power supply with a voltage of 19 volts DC at a maximum current of 2.0 amperes is required to operate the signal processor circuits and to provide DC power for the driver amplifier stage and the heat sink cooling fan.

For best results when operating the PA3, the high voltage power supply for the output amplifier should be both voltage and current regulated. If the high voltage power supply is not current limited, then it is necessary to install a fast operating 3 ampere fuse in the positive voltage line to prevent possible damage to the PA3 circuit board in the event the output amplifier STW20NK50Z fails

Connections to the PA3

All connections to the PA3 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 terminals will accept either solid or stranded wires.

When tightening the screws, do not over tighten the screws to avoid damaging the connector. Remove approximately ¼ inch / 6 mm of insulation from the end of each wire and insert the wire into the hole of the terminal block, then gently tighten the screw to clamp the wire in place.

The following diagram shows the position of the various connectors on the PA3. They have been color coded in in this diagram to make them easier to locate. Note that the actual terminal blocks on the PA3 are all the same color.

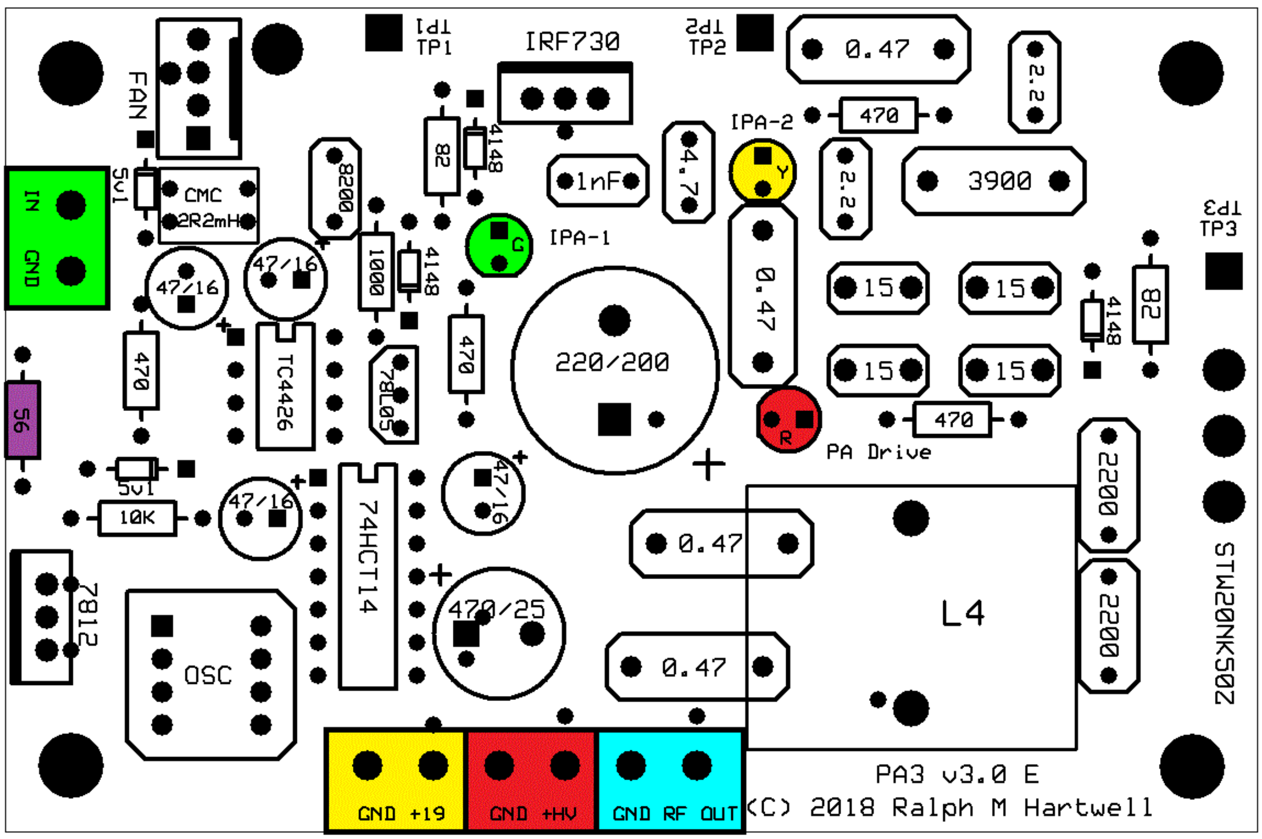

Figure 1

PA3 Terminal Blocks, Diagnostic LED's and Component Location.

Please refer to Figure 1 for the location of the following connections.

(GND +HV)

This terminal block is used to connect the high voltage DC power to the output amplifier stage of the PA3. The LEFT connection is power supply negative, and the RIGHT connection is power supply positive.

This power supply output voltage MUST be isolated from the AC mains for safety.

(GND +19)

This terminal block is used to connect a source of +19 volts DC power to the signal processor stages of the PA3 and the heat sink cooling fan. The LEFT connection on this terminal block is power supply negative, and the RIGHT connection is power supply positive. Voltages between +18 and +22 may be used, but +19 is preferred..

Note that the GROUND terminal next to the RF OUT connection, the GROUND terminal next to the +HV connection, the GROUND terminal next to the +19 terminal are all connected together and serve as the ground / earth connection for the PA3.

(RF IN - GROUND)

This terminal block accepts the square wave, TTL level drive signal from the signal source. You should use a length of standard coaxial cable or other shielded cable to make this connection. The characteristic impedance of the coaxial cable is not critical, so any shielded cable may be used.

Connect the cable shield to the RIGHT terminal of the RF IN terminal block. This is the ground / earth connection.

Connect the center wire of the coaxial cable to the LEFT terminal of the RF IN terminal block. This is the square wave signal input connection.

(GND - RF OUT)

This terminal block is the RF output of the PA3. Connection to this terminal block requires the use of shielded 50 ohm impedance, solid dielectric (not foam) coaxial cable between the terminal block of the PA3 and the matching system that will be connected to the plasma tube.

Connect the shield side of the coaxial cable to the LEFT connection of the RF OUT terminal block.

Connect the center wire of the coaxial cable to the RIGHT connection of the RF OUT terminal block.

Input Termination Resistor

The PA3 incorporates an input termination resistor to provide the correct loading for your frequency generator. This ensures the best quality waveform at all frequencies. Most frequency generators will require a 50 Ohm termination resistance. Factory assembled PA3 amplifiers have two termination resistors installed, a 56 Ohm resistor and a 470 Om resistor. These two resistors are in parallel with each other, the combined resistance providing a combined input termination value of 50 Ohms.

When a frequency generator with a high impedance output is used to drive the PA3, (such as a GB-4000,) a higher resistance is required for the input termination of the PA3. By disconnecting the 56 Ohm resistor (color coded purple in Figure 1) the value of the input termination resistance of the PA3 will be changed to 470 Ohms.

To disconnect the 56 Ohm resistor and change the termination resistance to 470 ohms, simply cut one of the leads of the 56 ohm resistor half way between the body of the resistor and the circuit board. This will allow the resistor to be reconnected by soldering the cut wire should the 50 ohm termination resistance be needed in the future.

Diagnostic LED’s

The PA3 v3.0 E incorporates 3 diagnostic LED’s on the circuit board. These LED’s allow the operator to ensure that the PA3 amplifier is functioning correctly. These LED’s also allow rapid diagnosis of internal fault conditions, should they occur. When the PA3 is operating normally, all three LED’s will be illuminated.

All of the LED’s will illuminate when 19 volt power is supplied to the amplifier and a proper modulation input signal is sent to the PA3. It is not necessary for high voltage to be applied to the amplifier output stage for the LED’s to illuminate.

IPA-1 (Green)

When the Intermediate Power Amplifier 1 LED is illuminated, this indicates that there is a good drive signal coming from the TC4426CPA and being sent to the input of the IFR730 intermediate power amplifier.

This LED must be illuminated for the IPA-2 and PA DRIVE LED’s to illuminate. If this LED is off when 19 volts and a drive signal is being sent to the PA3, then the TC4426CPA has probably failed.

IPA-2 (Yellow)

When the Intermediate Power Amplifier 2 LED is illuminated, this indicates that there is a good amplified drive signal being produced by the IFR730. The amplified signal is sent through a wave shaping network and then to the input of the STW20NK50Z output amplifier.

This LED must be illuminated for the PA DRIVE LED to illuminate. If this LED is off when 19 volts and a drive signal is being sent to the PA3, then the IRF730 has probably failed.

PA DRIVE (Red)

When the PA DRIVE LED is illuminated, this indicates that there is a good drive signal from the wave shaping network being sent to the input of the STW20NK50Z output amplifier.

If this LED is off when 19 volts and a drive signal is being sent to the PA3, then the STW20NK50Z has probably failed.

Mounting the PA3 and the HS2 Heat Sink / Cooling Fan Assembly

If you have purchased an assembled PA3 amplifier, it will be furnished already mounted on the HS2 heat sink / cooling fan assembly. The HS2 heat sink provides the proper cooling to allow the PA3 to operate at full rated power. Please be sure that nothing obstructs the flow of cooling air entering the fan or the warm discharge air leaving the heat sink.

When the PA3 is mounted on the HS2 heat sink, the result is a compact module that allows for easy incorporation of the PA3 into a complete plasma tube RF drive system.

The HS2 heat sink with the PA3 attached to it may be mounted in place in your system by the use of a clamp, a bracket, or some type of strap that will hold the heat sink assembly firmly in place. It is important that the airflow through the heat sink not be obstructed in any manner. A plentiful supply of cool air must be allowed to enter the fan and the heat sink assembly. Likewise, the warm exhaust air must be allowed to freely exit from the heat sink.

The Cooling Fan on the HS2 Heat Sink

The fan on the HS2 heat sink is powered by the PA3 circuit board, so there is no need for a separate power supply to operate the fan.

The fan is very quiet and does not make much noise. It is easy to forget that it is running while you are working with your system. Please be careful not to allow your fingers or anything else to come in contact with the fan blades while the fan is in operation. Accidentally hitting the fan blades with your finger or a hard object such as a screwdriver may break one of the blades off of the fan hub. If this happens, it will be necessary to replace the fan.

The fan discharges works by pulling air through the heat sink, then through the fan and exhausting the warm air away from the fan. The fan should not be placed close to anything that would obstruct the flow of air. If the fan is facing a solid obstruction, such as the inside wall of an enclosure, then the fan should be placed at least 3 inches away from the obstruction.

RF Shielding Considerations to Prevent Interference to Other Devices

If the RF output of the PA3 is taken through a properly installed and terminated coaxial cable, the incidental RF leakage from the PA3 will be minimal and no interference to radios or television receivers should occur due to radiation from the PA3 itself.

The most likely cause of electrical interference to other devices will occur if there is excessive RF radiation from the connecting wires between the plasma tube and the 3.1 MHz link coil coupler / antenna tuner. It is important to minimize the length of these connecting wires. These wires should be equal in length. Do not lengthen the electrode wires.

In most jurisdictions, it is the responsibility of the operator of any radio frequency producing equipment to prevent the equipment for producing interference to other users of the radio frequency spectrum or other electronic equipment. Please be aware of local regulations before operating this equipment.

Operation of the PA3

POWER SUPPLY

The PA3 requires two power supplies for operation. The first is a power supply with a voltage of 19 volts DC at a maximum current of 2.0 amperes. This power supply operates the signal processor circuits and provides DC power for the driver amplifier stage and the heat sink cooling fan.

The PA3 requires a second power supply which provides the high voltage for the output amplifier. It should provide a DC voltage between +15 to +190 volts, depending on the output power level you require. Higher voltages produce more power from the PA3. The current required is approximately 3 amperes maximum. The exact current drawn by the PA3 will depend upon the modulation duty cycle and the plasma tube load to which the PA3 is connected. The current is also affected by the tuning of the antenna tuner or the 3.1 MHz link coil coupler.

When using the PA3 and the LC31 link coupler to drive the Cheb 8 inch Phanotron plasma tube, a power supply voltage of between 100 and 130 V will be required.

When using the PA3 and the LC31 link coupler to drive the Cheb 1” x 16” SSQ-PT plasma tube, a power supply voltage of between 50 and 80 V will be required.

OUTPUT POWER ADJUSTMENT

The power output from the PA3 is adjusted by varying the DC supply voltage connected to the +HV terminal block.

MODULATION SIGNAL VOLTAGE LEVELS

Note that the PA3 amplifier turns ON when the input drive signal goes in the positive direction, and turns OFF when the input drive signal goes in the negative direction. In the absence of any valid input signal, the PA3 will turn OFF.

Operation of the PA3 with a square wave modulation signal

A minimum of 2.25 Volts Peak to Peak (VPP) is required to trigger the PA3. Ideally, the drive signal should be a square wave TTL signal, which has a voltage swing of 0 to +5 Volts.

Modulation Duty Cycle vs. Frequency with a square wave modulation signal

For a duty cycle of 1% to 50%: 1 Hz to 400 KHz
For a duty cycle of 1% to 89%: 2 Hz to 400 KHz
For a duty cycle of 1% to 98%: 3 Hz to 400 KHz
For a duty cycle of 1% to 99%: 4 Hz to 400 KHz

Operation of the PA3 with a sine wave modulation signal

An input signal voltage of approximately 2.5 volts peak to peak is required to trigger the PA3 when using sine waves. The maximum allowable sine wave voltage input should be limited to no more than 7.0 volts peak to peak to prevent possible damage to the input circuit of the PA3. When using sine waves, the duty cycle of the modulated output of the PA3 will be limited to the range of 20% to 58%. The duty cycle will be adjusted as the signal voltage is changed.

Modulation Duty Cycle percent vs. voltage with a sine wave modulation signal

2.5 VPP for 20% duty cycle (Minimum duty cycle % possible with sine waves)
3.12 VPP for 37% duty cycle (for Maximum Sidebands)
5.0 VPP for 50% duty cycle (for Normal Operation)
5.58 VPP for 58% duty cycle (Clipping of input signal occurs above this level)

The maximum recommended modulation frequency when using the PA3 is 400 KHz. By reducing the high voltage DC applied to the amplifier stage of the PA3 by at least 25%, modulation frequencies of up to 650 KHz or higher may be utilized at reduced output power.

Note that there is a risk of destroying the STW20NK50D at high modulation frequencies and high power levels.

Although the modulator circuits of the PA3 will work up to 6 MHz, when the modulation frequency exceeds 1/2 of the carrier frequency of 3.10 MHz, or 1.55 MHz, the resulting modulation sidebands "turn over," and begin dropping in frequency as the modulating frequency begins to approach the carrier frequency. Thus there is no point in using a modulation frequency exceeding 1.55 MHz.

CAUTION: When the modulation frequency begins to exceed about 400 KHz, excessive RF voltages will be developed in the PA3's tank circuit and the LC31 coupler. These voltages may cause the STW20NK50Z MOSFET in the PA3 to fail.

Operating conditions for the PA3 when used with Cheb Plasma Tubes

Cheb 5-inch Phanotron tube - With modulation frequencies from 0 to 400,000 Hz, the maximum DC supply voltage to the PA3 should be limited to 100 volts to avoid damage to the Phanotron tube. This will result in an approximate power of about 75 watts average power or 150 watts peak power.

Cheb 8-inch Phanotron tube - With modulation frequencies from 0 to 400,000 Hz, the maximum DC supply voltage to the PA3 should be limited to 115 volts to avoid damage to the Phanotron tube. This will result in an approximate power of about 125 watts average power or 250 watts peak power.

Cheb SSQ-ST (1) - With modulation frequencies from 0 to 40,000 Hz, the maximum DC supply voltage to the PA3 should be limited to 152 volts to avoid damage to the SSQ-ST or the PA3. This will result in an approximate power of about 175 watts average power or 350 watts peak power. Using DC voltages in excess of this value may cause the STW20NK50Z MOSFET in the PA3 to fail.

Cheb SSQ-ST (2) - With modulation frequencies from 40,000 to 400,000 Hz, the maximum DC supply voltage to the PA3 should be limited to 133 volts to avoid damage to the PA3. This will result in an approximate power of about 135 watts average power / 270 watts peak power. Using DC voltages in excess of this value may cause the STW20NK50Z MOSFET in the PA3 to fail.

Cheb SSQ-BAT - With modulation frequencies from 10 to 400,000 Hz, the maximum DC supply voltage to the PA3 should be limited to 170 volts to avoid damage to the PA3 amplifier. This will result in an approximate power output to the tube of about 200 watts average power / 400 watts peak power. Using DC voltages in excess of this value may cause the STW20NK50Z MOSFET to fail.

Using the PA3 with the UDB1108S signal generator

Note: If the PA3 is connected to the TTL connector on the rear panel of the UDB1108S generator, then the UDB1108S must be set to SQR or the duty cycle adjustment will not change the duty cycle of the square wave coming from the TTL connector of the UDB1108S generator.

When using SQUARE WAVES

- Connect the TTL jack on the rear of the UDB1108S to the input of the PA3.
- Set the UDB1108S for SQR wave output
- The OFFSET knob has no function.
- The AMPLITUDE knob has no function.
- Set the output frequency from the UDB1108S in the usual manner.
- Use the ADJUST knob to set the duty cycle to the desired value.

If you are using a computer program to run the UDB1108S, these functions should be handled automatically, according to the computer program instructions.

When using SINE WAVES

- Connect the OUT jack to the input of the PA3.
- Set the UDB1108S for SIN wave output.
- Set the OFFSET knob to center position (Zero volts DC offset.)
- NOTE: If the OFFSET knob is adjusted fully clockwise, then the maximum possible duty cycle available when using sine waves will be increased to a maximum of 70%.
- Set the AMPLITUDE knob for the desired duty cycle.

Using the PA3 with the GB-4000 (in Audio Mode only)

- Disconnect the 56 ohm input termination resistor of the PA3 as described on Page 112. This is necessary as the GB-4000 cannot provide sufficient drive voltage to the PA3 with the 56 ohm resistor connected. Removing the 56 ohm resistor increases the input termination resistance of the PA3 to 470 ohms.
- Connect a coaxial cable between the BNC output connector on the rear of the GB-4000 to the input connector of the PA3.
- Set the GB-4000 to AUDIO MODE – do not use RF MODE.
- Set the OUTPUT LEVEL control knob to the 11:00 o'clock position.
- Adjust the DUTY CYCLE of the GB-4000 as desired.
- Run all frequencies and auto channels on the GB-4000 just as you would when using the GB-4000 with the MOPA.

RF Coupling Systems

The LC31 Series Couplers

Using the LC31 coupler eliminates most of the RF losses of the antenna tuner and gives the RF signal at the plasma tube a sharper rise and fall time, resulting in a better, brighter plasma discharge and a more effective frequency output.

Using the LC31 coupler is easy. Simply connect a 23-foot length of solid dielectric 50 ohm coaxial cable between the output of the PA3 amplifier, and the input to the LC31 coupler. Connect the appropriate length of wire between the output of the LC31 coupler and the plasma tube. Then turn on the power. There are no tuning adjustments required.

Please see the LC31 instruction manual specific to the plasma tube you will be using for more information.

Commercial Antenna Tuners

The use of commercial antenna tuners with the PA3 is strongly discouraged. The PA3 was designed to work best with the LC31 link coil coupler. While it is possible to use a commercial antenna tuner with the PA3, because of the large number of tuners available, it is impossible to give specific instructions for using each tuner.

Replacing the STW20NK50Z on the PA3

Although the STW20NK50Z MOSFET that is used in the PA3 is a very a rugged device, it is still possible for it to fail if the PA3 is operated under an excessive load or under improper operating conditions. Should this happen, it will be necessary to replace the STW20NK50Z MOSFET. This is not particularly difficult to do. Please read the following sequence of operations before attempting to replace the transistor.

1 – Using a small flat-blade screwdriver, carefully loosen the three clamping screws in the terminal strip that fastens the leads of the STW20NK50Z MOSFET in place.

2 – Remove the two 6-32 x 3/8" Phillips head screws and nuts that hold the PA3 to aluminum mounting bars that are attached to the heat sink. Place the screws and nuts where they will not become lost.

3 – Carefully remove the PA3 from the heat sink assembly.

4 – Using a Phillips head or a flat-blade screwdriver, unscrew the 6-32 x ¾" screw and flat washer that clamps the STW20NK50Z MOSFET against the heat sink. Place the screw and flat washer where they will not become lost.

5 – Carefully remove the defective STW20NK50Z MOSFET from the heat sink.

If the MOSFET sticks to the Bergquist thermal pad that is between the MOSFET and the heat sink, you will have to use a pair of pliers to carefully remove the defective MOSFET free of the thermal pad. To do this, gently, but firmly, grasp the sides of the defective MOSFET with the pliers and "rock" the MOSFET from side to side until it breaks free of the thermal pad. Do NOT twist the MOSFET or the thermal pad will likely be damaged. Be careful not to damage the thermal pad. It is very soft, and scratches or punctures easily. If it is damaged in any way, it will be necessary to replace it with a new thermal pad of the same type before installing the new MOSFET against the heat sink.

6 – Take the new STW20NK50Z MOSFET and carefully bend its leads into the same shape as the leads of the defective MOSFET.

CAUTION: Do not bend the leads too sharply or they may weaken and break off at the bend.

7 – Carefully to trim approximately 1.5 mm from the end of each of the pins. Be careful not to remove too much of the pin length.

8 – Using a small piece of lint free cloth and 100% isopropyl alcohol, gently clean the surface of the Bergquist thermal pad and the metal surface of the STW20NK50Z MOSFET that will mount against the thermal pad.

9 – Carefully position the replacement MOSFET against the surface of the thermal pad, and press it firmly against the thermal pad.

10 – Using the 6-32 screw and the flat washer, clamp the new MOSFET firmly against the Bergquist thermal pad and heat sink. Do not allow the MOSFET and the thermal pad to twist sideways while tightening the screw.
Although it may seem that the length of the 6-32 screw is a longer than it needs to be, it is necessary to use a long screw in order to spread the clamping force across a number of screw threads that are tapped in the heat sink. The screw must be tightened very firmly against the transistor. The flat washer must be used to spread the clamping force over the transistor body and prevent cracking of the transistor case.

11 – Carefully position the PA3 circuit board so that the leads of the new STW20NK50Z enter the holes of the mounting block on the PA3. Be sure that you do not bend the leads of the STW20NK50Z in the process.

12 - When you observe that the leads have entered the mounting block correctly, then you may replace the two Phillips head screws and nuts that clamp the PA3 circuit board to the aluminum mounting bars that are attached to the heat sink.

13 – Gently, but firmly, tighten the three clamp screws that hold the leads of the STW20NK50Z to the PA3 circuit board. ***Do not omit this step or the MOSFET may be destroyed during operation!***

14 – Inspect your work to make sure that there are no short circuits, metal particles, or anything else that might interfere with the proper operation of the PA3. If all is correct, you may replace the heat sink assembly and the PA3 in your system and resume normal operation.

Electrically Insulating the STW20NK50Z from the heat sink

This section only applies when it is necessary to replace the output transistor on the PA3.

Because the STW20NK50Z generates a considerable amount of heat in a small package, a high quality thermal pad is required for safe operation of the STW20NK50Z.

The STW20NK50Z is operating at both a high DC voltage and a high RF voltage, therefore it is necessary to insert some form of electrical insulator (thermal pad) between the STW20NK50Z and the heat sink base plate. This insulator must be made of some material which both insulates the high voltage and at the same time it must be a good conductor for heat to allow the heat to flow from the STW20NK50Z to the heat sink base plate. Unfortunately, most materials which are good insulators for electricity are also good insulators for heat. Manufacturers have gone to a great deal of trouble and expense to produce devices, commonly referred to as "thermal pads" which will function properly.

The Bergquist SPA3000-0.015-00-104 thermal pad is recommended for use with the PA3. If this pad is not available, a Wakefield 174-9-250P thermal pad may be substituted. However, the heat transfer capability of the Wakefield pad is approximately 50% of the Bergquist pad. Therefore when using the Wakefield thermal pad, the PA3 should not be operated above 300 Watts output with modulation duty cycles above 70%.

Before attaching the STW20NK50Z and the Bergquist thermal pad to the heat sink, use a liquid cleaning solution, such as 100% isopropyl alcohol and a lint free rag to carefully clean the underside of the STW20NK50Z and the area of the heat sink where the STW20NK50Z is to be mounted. Make sure that both sides of the thermal pad are very clean. Be sure that there are no stray particles of metal, lint, fiber, or other materials on the surface of the transistor, the thermal pad, or the heat sink before mounting the STW20NK50Z to the heat sink.

When installing the thermal pad do NOT use any paste type thermal compound. Using paste type thermal compound will cause decreased heat transfer and may cause damage to the thermal pad and/or destruction of the STW20NK50Z.

SPECIFICATIONS:

DC Power Supply Input:

- For the Power Amplifier: +15 to +190 volts DC at a maximum current of 3.0 amperes; nominal operating current less than 2.1 amperes, depending on output power level and modulation duty cycle.
- For the Signal Processor and heat sink fan: +18 to +22 volts DC at a maximum current of 750 mA at a 100% duty cycle modulation rate.

Input Impedance:

- AC coupled, 50 Ohms for most frequency generators; or 470 Ohms for high impedance output signal generators.

Input Drive Signal Requirements:

- TTL level (0 to +5 volts) duty cycle modulated square wave from an external frequency generator.
- Modulation frequency range with square wave input: 4 Hz to 400,000 Hz for a duty cycle range of 1% to 100%
- Sine wave of 2.5 to 7.0 volts peak-to-peak. The voltage level of the sine wave adjusts the duty cycle of the PA3 output.
- Modulation frequency range with square wave input: 4 Hz to 400,000 Hz for a duty cycle range of 1% to 100%
- The modulation input of the PA3 is AC coupled, so it will ignore any DC offset voltage on the modulation input signal, however any DC offset voltage must be limited to a maximum of +/- 10 volts.

Carrier Operating Frequency:

- 2.9 to 3.5 MHz. Operation outside of this frequency range may cause damage to the PA3. The suggested operating frequency is 3.1 or 3.3 MHz. The PA3 is furnished with a 3.10 MHz oscillator, but customer selected frequencies may be specified at the time of order.
- The carrier frequency of the PA3 may be quickly changed by plugging in a different frequency oscillator module.

RF Power Output:

- Up to 500 watts peak power or 250 watts average power into a 50 ohm dummy load when the carrier is modulated by a 50% duty cycle square wave with frequencies from 1 to 400,000 Hz.
- When the PA3 is operated at a peak power level of 300 watts or less, the PA3 may be operated at any duty cycle between 0 to 100%.
- The power output of the PA3 may be adjusted by varying the DC voltage supplied to the PA3.
- To avoid possible damage to the PA3, when driving plasma tubes with modulation frequencies above 40 KHz, the DC power supply voltage to the PA3 should be limited to the maximum values as shown in the data below.

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 STW20NK50Z 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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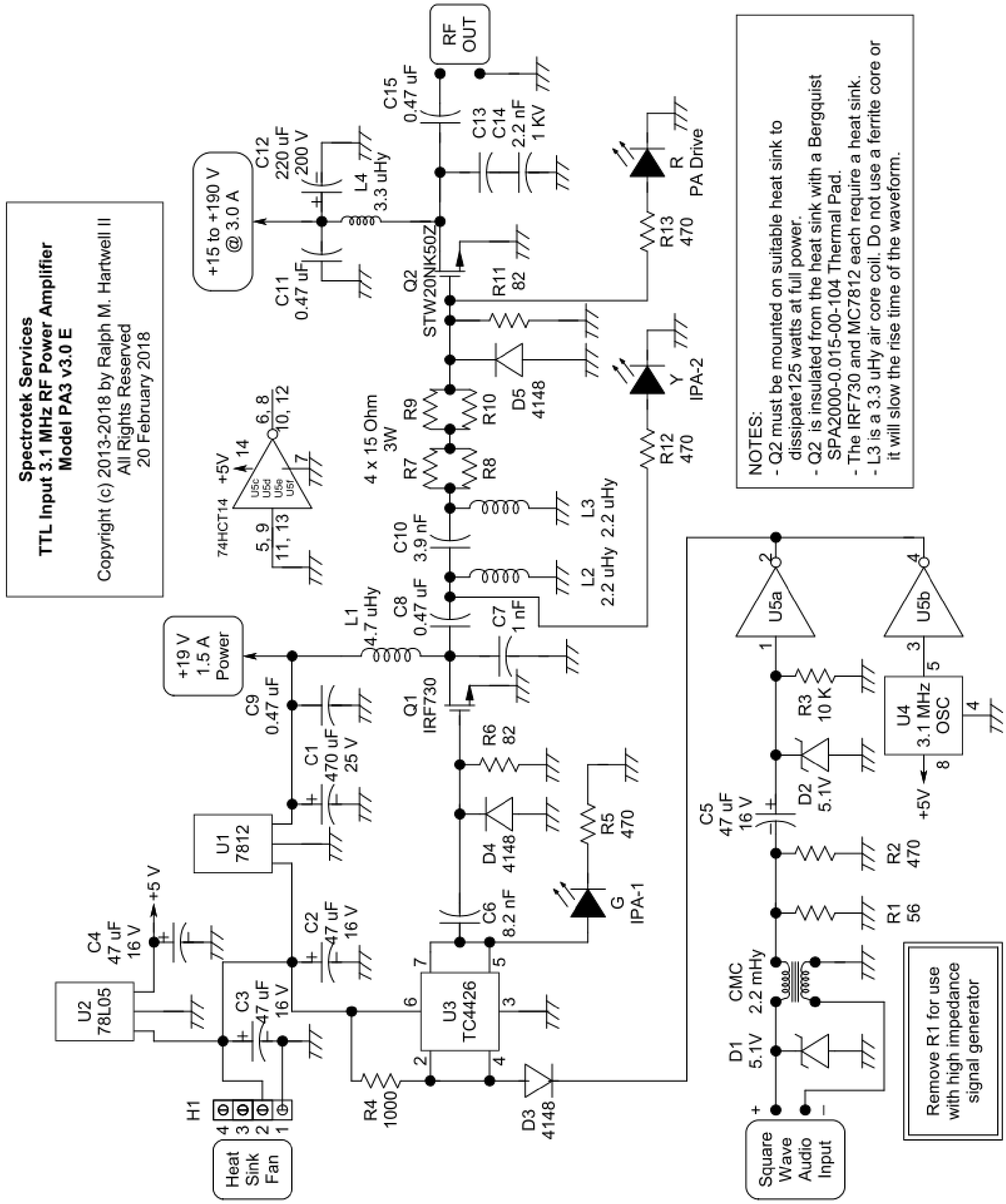

Figure 2

Schematic Diagram of the PA3 v3.0 E.

PA3 Output Waveforms at various modulation frequencies

To obtain the following waveforms, the PA3 was connected to a 50 ohm dummy load.

The PA3 was driven by a UDB1108S signal generator set to the square wave mode.

The output power level of the PA3 was 200 watts peak RF power to the dummy load.

The upper (red) trace is the output of the PA3, and the lower (yellow) trace is the input signal from the UDB1108S signal generator.

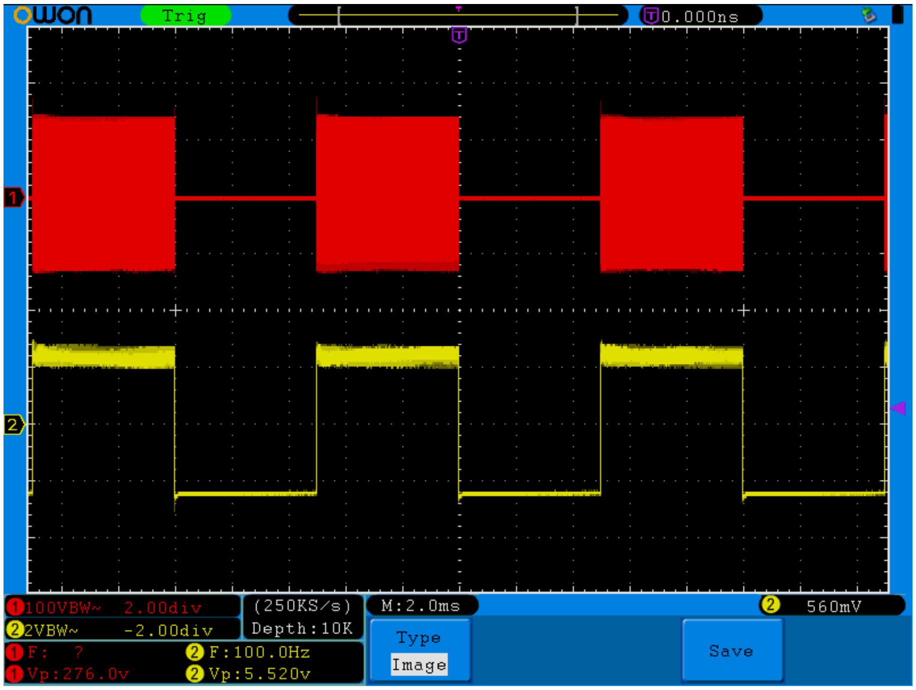

Figure 3 - 100 Hz, 50% duty cycle.

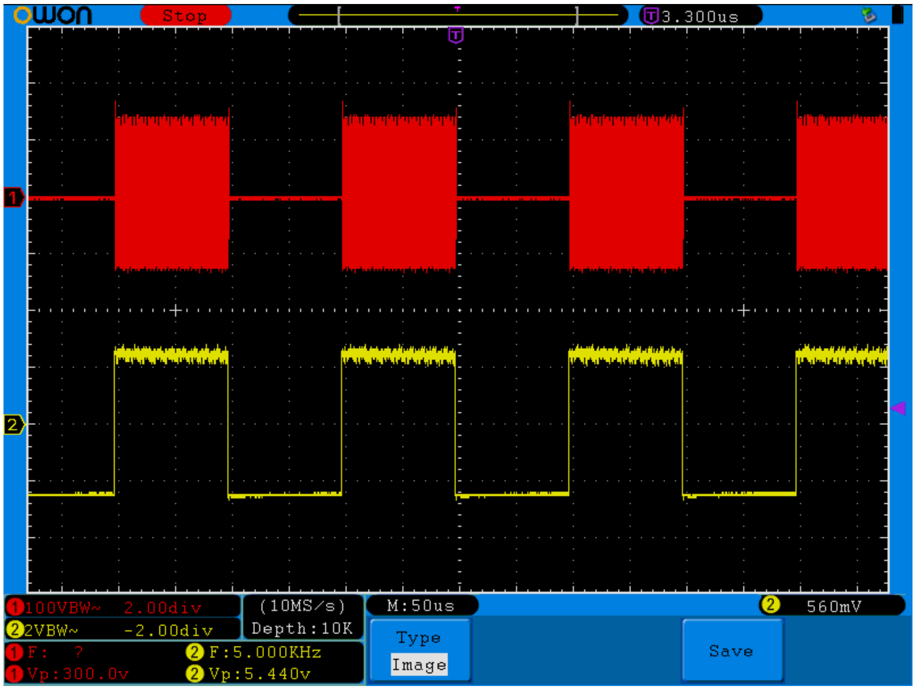

Figure 4 – 1,000 Hz, 50% duty cycle.

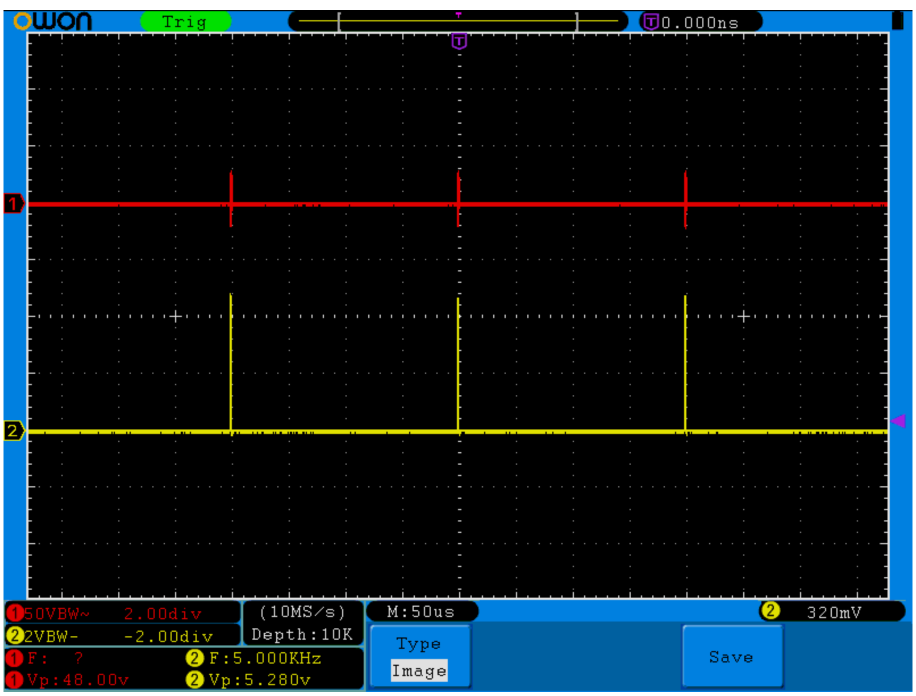

Figure 5 – 5,000 Hz, 1% duty cycle.

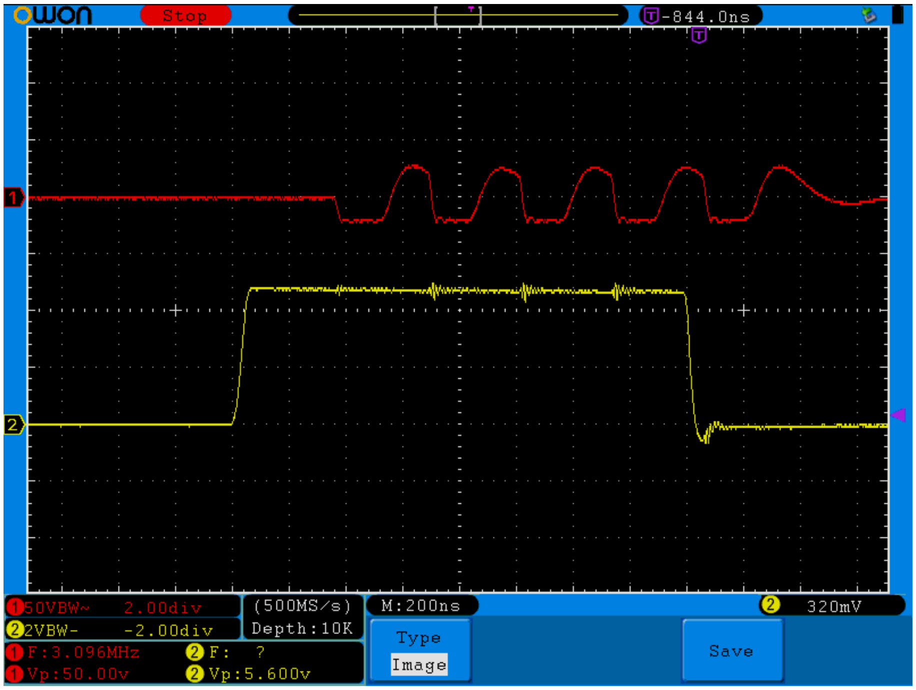

Figure 6 - 5,000 Hz, 1% duty cycle, expanded scale, showing individual RF cycles.

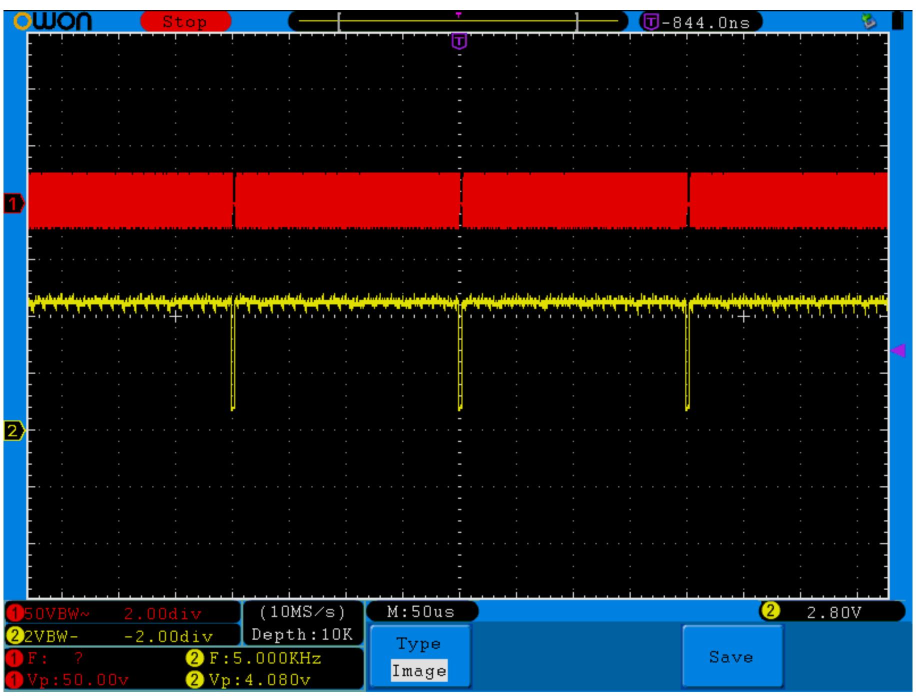

Figure 7 – 5,000 Hz, 99% duty cycle.

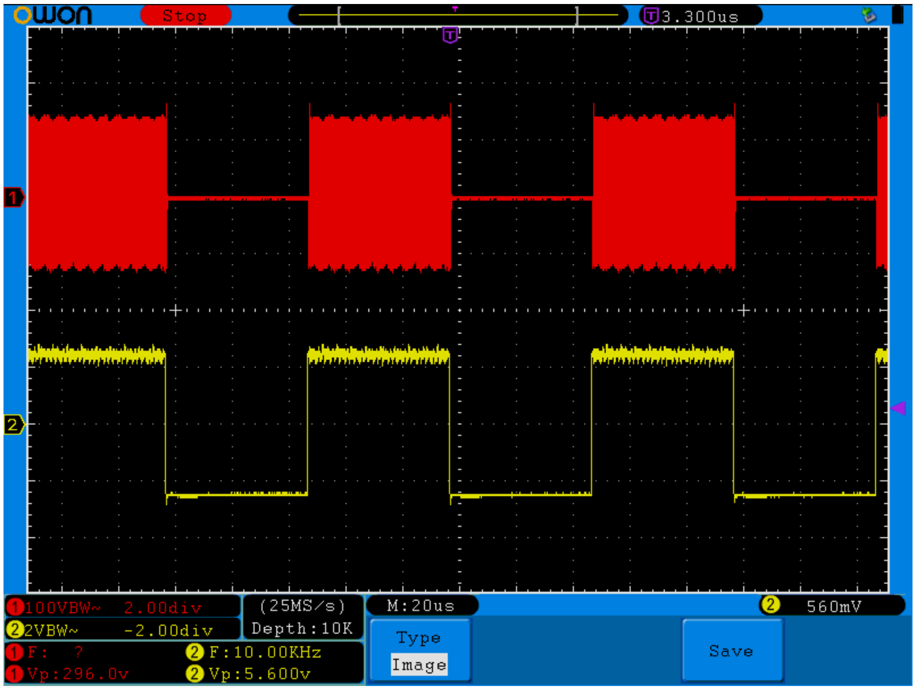

Figure 8 – 10,000 Hz, 50% duty cycle.

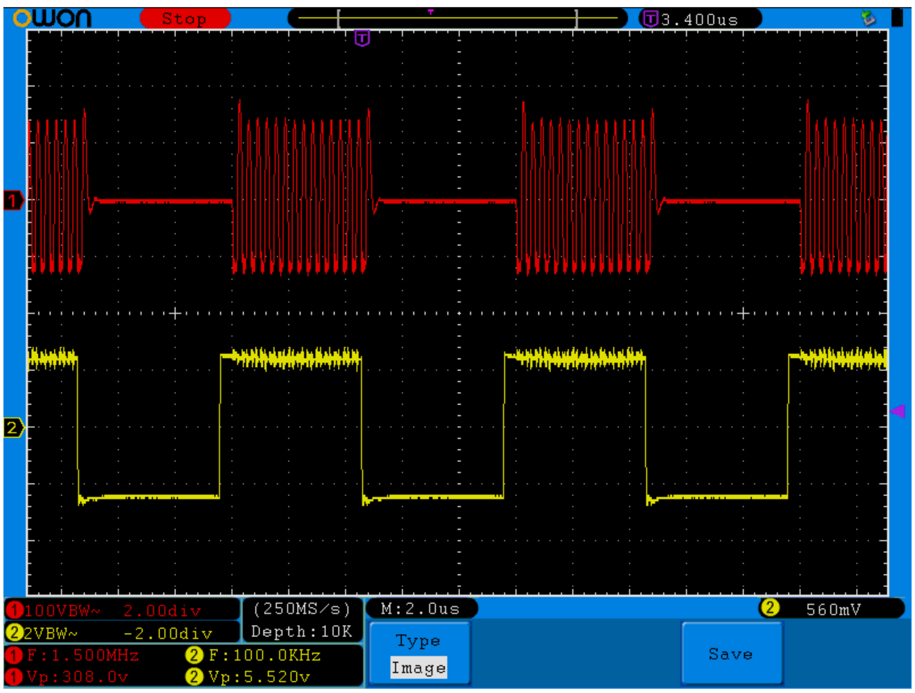

Figure 9 – 100,000 Hz, 50% duty cycle.

Figure 10 – 500,000 Hz, 50% duty cycle.

Figure 11 – 800,000 Hz, 50% duty cycle.

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