VIDEODRONE v1.00

BUILD NOTES & USER GUIDE

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This guide contains valuable information for kit builders as well as anyone self-sourcing parts. Information is provided on key components that was omitted from the schematic due to space limitations and for greater clarity. Special assembly instructions along with important notes on the use of the completed Videodrone are also included. This guide does not include information on basic electrical components or how to properly install them. Some components can be installed in different orientations physically, but electrically only one orientation will be correct and safe. This guide also does not cover the basics of soldering. If you are unfamiliar with these skills, there are many resources available on the internet to learn from before beginning the assembly of Videodrone.

Step by step build directions are included to help keep the build organized; however, the order is not absolutely vital for successful assembly. The design of Videodrone allows for a lot of room to work with no overlap or interference between parts. While there are a lot of components used to make Videodrone (105 resistors!), all parts on the board are clearly labeled with an annotation for easy reference. Resistors are also labeled with the correct resistance value printed underneath their footprint.

Please read through this guide completely before assembling a kit or sourcing parts. All sections contain important information on special parts and methods that will be useful for both choosing components and assembling a kit.

Please check that all parts are included and arrived undamaged before starting on your build. This is especially important for the circuit boards. Make sure they haven't been dented, cracked or otherwise damaged during shipping.

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SOURCING PARTS AND SUBSTITUTIONS

All Videodrone components use standard physical layouts and connections. Please consult the bill of materials for Digikey part numbers to see examples of compatible components even if you plan on ordering elsewhere. Substitutes should be readily available from other retailers.

- Unless they were unavailable, all resistors included in the kits are 1/4 watt, 1% metal film. I would suggest using the same if you are sourcing components. It is possible to use carbon resistors in many noncritical areas, but the small difference in price usually doesn't make the added complexity of sourcing two kinds of parts worthwhile, especially when building only one unit.
- It may not be possible to get 1% metal film resistors in the E24 series in which case the values of the E96 series won't line up perfectly with the E24 values. Using the closest value in the other series will not cause any problems. For example, the closest E96 equivalent of 47k is 47.5k. Kits may include E96 values in which case you may simply ignore the last digit.
- C12, C24 and C35 are optional. They have not been necessary in any of the builds I have done and I would not recommend installing them. They are not listed in the bill of materials or included in the kit.
- R4, R23 and R43 should ideally be a 3300ppm tempco for best temperature stability. I have used a 10k 3000ppm part made by TE Connectivity which is available from Digikey since it is low cost and easy to source. For the purposes of making drones with a stock Videodrone, a tempco isn't strictly necessary and the oscillators are stable enough without the specified tempco. On the other hand, more accurate tempcos may be used if you plan on modifying Videodrone for more sensitive purposes.
- 2k, 1.87k or a tempco of most any other value could be used instead of the 10k tempco specified so long as an appropriate change is also made to R5 and R6 (VCO 1), R24 and R25 (VCO 2) and R44 and R45 (VC clock) to maintain the same nominal one volt per octave response.

- C10, C22 and C34 are the timing capacitors for each of the oscillators. Polyester film box capacitors are supplied in the kit. For critical applications these could be replaced with metal film or film/ foil polypropylene capacitors. Polyester capacitors will work fine for a stock Videodrone build.
- The type of LED matrix that works with Videodrone uses an industry standard pin-out so most single color displays will work. Displays of the correct size are listed as 32mm by 32mm and use 3mm LEDs. Both row anode and row cathode displays are compatible.
- A compact 1000uF 35V electrolytic capacitor from Digikey is listed in the BOM and supplied with the kit. This part was chosen for its low height and a capacitance which is sufficient for the current draw of a stock Videodrone. It is possible to use larger capacitors if a greater output is required for use of the power supply with a heavily modified Videodrone or with another project. The footprint on the PSU board is labeled 2200uF but it will fit most 3300uF 35V capacitors and may even fit some 4700uF 35V capacitors. The footprint is designed to accommodate a 16mm diameter capacitor with a 7.5mm lead spacing. It might also fit some 18mm diameter capacitors.

MAIN BOARD

TEMPERATURE STABILITY

It is vital for temperature stability that the transistor pairs that make up the VCO and VC Clock exponential pairs (Q1 + Q2/ Q4 + Q5/ Q7 + Q8) be thermally connected to one another before they are soldered in place. I have been using superglue to glue the flat faces together. This method is easy and convenient. It also makes installing the transistor pair easier. Thermal grease is messier but may do a better job of ensuring the best thermal contact. I have not found this to be necessary for a stock Videodrone build.

MATCHING TRANSISTORS

Depending on your plans for Videodrone, matched transistors may not be required. I have not found transistor matching to be necessary with a stock Videodrone build. If you plan on modifying the VCOs to track together or with other oscillators then matching is important. These modifications and the process of transistor matching are beyond the scope of this document, but there is information available on the internet if you are interested.

TEMPCO

Each kit includes three 10k 3000ppm temperature compensating resistors (tempco) to be used for R4, R23, R43. These have shorter leads and a non-standard color code (they are marked brown/ black/ orange/ orange/ black) denoting the resistance value and tempco factor. These should also be thermally contacting their respective exponential pair. I have used hot glue in the past to hold them close together and in contact with each other. This has worked fine for stock builds. Again, thermal grease between components would be more effective. Some kind of thermal isolation from outside air currents around the exponential pair and tempco (for example, heat-shrink tubing wrapped around all three parts) would also help with stability, but is not required.

LED MATRIX

The type of single color LED matrix used in Videodrone comes in two different varieties: row anode and row cathode. This specifies the electrical orientation of the LED within the matrix. Two jumpers are used to determine which type of matrix Videodrone will work with by connecting four pads in two different ways. The jumper orientations for each type of matrix are labeled on opposite sides of the board for clarity, but the jumpers can be installed on either side as long as they connect the correct pads. Connect the pads vertically for a row anode display and horizontally for a row cathode display. Kits come with a row anode LED matrix unless otherwise marked.

Using the industry standard pin-out allows Videodrone to work with most single color LED matrices. This makes it worthwhile to attach the LED matrix using two eight pin SIP sockets so it can be quickly swapped out for a different display. There are many colors available in this format as well as square LED varieties.

STEP BY STEP

STEP 1: Solder all resistors and diodes in place with the diodes in the correct orientation.

STEP 2: Solder all IC sockets in place

STEP 3: Solder all ceramic disc capacitors in place. C12, C24 and C35 are optional. They are not included the kit.

STEP 4: Solder all transistors including the joined exponential pairs in place in the correct orientation. U2, U6 and U10 use the same TO-92 package used by the transistors and can be added at the same time. Use tweezers to carefully bend the middle leg of each part so it is able to sit suitably close to the board.

STEP 5: Solder the three tempco resistors in place such that they are suspended off the board far enough to be able to physically contact the exponential pair. Hot glue or otherwise secure the tempcos to their exponential pair.

STEP 6: Solder the polyester box capacitors and electrolytic capacitors in place with the electrolytic capacitors in the correct orientation.

STEP 7: Cut two power headers to the correct length to make a 5x2 10 pin header. (The kit includes a 40x2 double row pin header for this purpose.) Solder the power headers in place. It helps to attach an IDC connector while soldering the header to keep the pins in the correct spacing and orientation as it is easy to overheat and melt the plastic of the header even when being careful.

STEP 8: Solder the three trimmer potentiometers in place.

STEP 9: Install the two jumpers in the correct orientation for the type of LED matrix being used. A short length of 22 awg wire is included in the kit for this purpose, but the trimmed leg of an installed component would also work.

STEP 10: Before installing the front panel components, clean the entire front panel of any flux residue with a solvent that is safe for the electrical components and is appropriate for the type of flux you are using. I have been using denatured alcohol to clean the standard rosin flux core solder I use.

STEP 11: Solder all front panel components including potentiometers, switches and jacks.

STEP 12: A 40 pin SIP socket is included in the kit to use with the LED matrix. Cut two 8 pin sockets and install them in the two 8 pin rows of pads that sit under the matrix. I would recommend attaching the LED matrix using the socket even if you don't plan on swapping the matrix regularly. It is possible to solder the matrix directly in place if you would prefer.

STEP 13: Clean the back of the board of any flux residue. Alternatively, you could use no-clean solder to attach the front panel components since the back of the board won't be directly visible.

STEP 14: Insert all ICs into their sockets in the correct orientation. Pin one on each IC should always be located near the rectangular marking on the footprint. Pin one is also designated by a square pad.

STEP 15: Insert the LED matrix into its socket in the correct orientation. Pin one (the pins are usually labeled on the underside of the matrix) should be located in the lower left corner when looking at Videodrone from the front.

POWER SUPPLY

STEP BY STEP

STEP 1: Bend the leads of both voltage regulators at a right angle such that the leads fit into their respective holes while also allowing for the hole in their tab to line up with the hole in the board.

STEP 2: Add thermal grease between the voltage regulator and the heatsink. Insert one of the shorter 1/4 inch screws up from the bottom of the board, through the heatsink and finally through the tab on the voltage regulator. Add a nut and securely tighten it down against the tab of the voltage regulator.

STEP 3: Solder the leads of the voltage regulator to their respective pads.

STEP 4: Solder all resistors, diodes, the 0.1uF ceramic capacitors and the 100uF electrolytic capacitors in place with the diodes and electrolytic capacitors in the correct orientation.

STEP 5: Solder the 1000uF electrolytic capacitors in place in the correct orientation.

STEP 6: Solder the 2.1mm power connector in place.

STEP 7: Cut two more power headers to the correct length to make 5x2 10 pin headers. (Again, use the 40x2 double row pin header included in the kit.) Solder the power headers in place using an IDC connector to keep the pins in the correct spacing and orientation.

POWER CABLE

The power cable is made from three IDC connectors and a ten conductor ribbon cable. This is the same type of connector used to distribute power in a Eurorack modular system. The power connections on Videodrone are completely consistent with that standard. There are special tools available to install IDC connectors onto ribbon cable, but I use a small vise to slowly and evenly compress the two connector halves onto the cable.

To make the power cable, first attach one IDC connector to one end of the cable. All of the following IDC connectors should be attached to the same side of the ribbon cable as the first. The second connector needs to be spaced over so that the first two connectors can comfortably attach to the two power connections on the main board. They should be attached 3 3/8 inches (86mm) between the centers of the connectors. The third connector should be attached 3 7/8 inches (99mm) from the center of the second connector. Once the third connector is attached, cut off the excess ribbon cable.

STARTUP AND ADJUSTMENTS

FIRST STARTUP CHECKLIST

- Check for shorts between the power rails on the power supply board.
- With the main board disconnected, plug in the power supply and check that it is outputting a stable +12V on the positive rail and -12V on the negative rail.
- Check for shorts between the power rails on the main board.
- Connect the power supply to the main board with the power cable. Check that the +12V, GND and -12V connections are lined up and connected correctly between the PSU and main boards. All power headers are clearly labeled.
- You can double check that the power connector is connected correctly using a multimeter to confirm that the +12V, GND and -12V connections for each of the sections are electrically connected only to themselves and by re-checking for shorts between the power rails.
- When powering up for the first time, be ready to remove power quickly while looking (and smelling) for any obvious faults such as components getting too hot.
- If Videodrone appears to be stable, you can start testing for correct functionality.

INITIAL ADJUSTMENTS

There are three trimmer potentiometers on Videodrone. One trimmer each is used to set the initial pitch of the VCOs and one trimmer is used to set the initial rate of the VC clock. These work in the same way as the front panel controls but allow for an alternate way to set the lowest pitch or rate available.

- For the VCOs, first set the front panel pitch control fully counter-clockwise. Change the initial pitch trimmer until the VCO reaches your preferred lowest pitch setting. I typically set the lowest pitch to 25hz.
- For the VC clock, first set the front panel rate control fully counter-clockwise. Change the initial rate trimmer until the frame rate reaches your preferred lowest rate setting. I typically set the lowest frame rate to five frames per second.

FINAL ASSEMBLY

STEP BY STEP

STEP 1: Attach the power supply to the acrylic back panel using the four 3/8 inch screws and four nuts. The four 1/8 inch plastic standoffs should be installed between the power supply board and the acrylic back plate.

STEP 2: Attach the six aluminum standoffs to the back plate with six of the 1/4 inch screws.

STEP 3: Attach the power cable to both headers on the main board using the two more closely spaced IDC connectors. The cable should be installed so the third connector points out to the right side of the main board when viewed from the back. Attach the last connector to the header on the power supply board. This should allow the main board to hinge down into place like a book with the power cable neatly folding onto itself.

STEP 4: Attach the main PCB to the aluminum standoffs with the six remaining 1/4 inch screws.

STEP 5: Add the four rubber bumpers to the back four corners of the acrylic back plate.

CONNECTING TO VIDEODRONE

AUDIO OUT

The audio output jack presents a line level signal that should be suitable for most consumer (-10dBV) and pro (+4dBu) line level inputs. The output is stereo with the same signal copied to the left and right channels. This connection is ideal for connecting directly to most modern consumer audio systems with a stereo line in such as mp3 player docks, computer speakers, home theater systems and many new cars (please don't Videodrone and drive.)

Most pro audio gear such as audio interfaces and mixing desks use balanced mono inputs which means if you apply the same signal into both sides of the balanced input it will reject everything and be very quiet. For this type of input, you can use a Y cable or splitter that puts the left and right channels on their own mono plug. Unbalanced mono inputs are safe to connect directly as long as a stereo cable is used.

- DO NOT use a 3.5mm mono plug to connect to Videodrone. This type of connector will short both outputs to ground and silence them.
- DO NOT plug headphones directly into the audio out jack. Most modern headphones will overload the output.
- DO NOT connect Videodrone directly to a balanced input.
- USE a 3.5mm stereo to stereo cable with any stereo or unbalanced mono line in.
- USE a 3.5mm stereo to dual RCA for hi-fi and component systems that use two separate mono RCA jacks for their stereo inputs.
- USE a 3.5mm stereo to dual mono Y cable or splitter for balanced inputs.

VIDEO IN

Any cable with a 3.5mm stereo or mono plug is safe to connect to the video in. Regardless of which type of cable you use, when connecting a stereo output to the video in jack only the left channel will be used to drive the video.

POWER INPUT

The power adapter should be a rated to output 12VAC and 500 to 1000mA. The input voltage and frequency do not matter so long as the output rating is correct. The adapter should be of the simple transformer-in-a-box variety. It should NOT be a switch-mode, regulated or DC-output adapter. The power supply's barrel jack fits standard 2.1mm x 5.5mm connectors.

TEST POINTS

To get started with the test points, you can add a 100k ohm resistor in series with a jumper to protect all the inputs and outputs and to give the right input resistance to get a basic idea of the effects that are available. From there, adding a 100k ohm potentiometer wired as an attenuator will let you vary the depth of the effect for more meaningful control over the modulation. With this simple setup, Videodrone can act as a completely patchable system except for the inhibit and reset test points which would need some extra circuitry to work properly with all of the outputs.

A great deal of augmentation is possible using the test points beyond simply connecting them together. Please carefully review the schematic for a better understanding of how to interface with the different inputs and outputs.