

## The Altair Clone Cuter Amp Assembly

Back in May 2015, the Music System from Processor Technology was revealed on the Altair 8800 Clone web site ([http://altairclone.com/music\\_system.htm](http://altairclone.com/music_system.htm)). The original system was made up of a simple S100 based interface board and a software package. The concept was shown on a classic Altair 8800 and also on the Altair 8800 Clone. In the Clone's case two wires needed to be solder to main board between ground and the driven end of the current limiting resistor that drives the front panel INTE LED.

Once I saw the concept, I quickly made a bread board for testing followed by a printed circuit board following the circuit found in the Processor Technology documentation. The idea was to make a nice PC board and install it in my clone. Then I got to thinking. After the PC board comes some form of audio amp. Why not just integrate an amp on to the basic design to complete the overall package.

The schematic in Appendix A shows the resulting version amp board for the Altair Clone. The design uses the old dependable and easy to find LM386N. The LM386N can drive an eight ohm speaker up to one watt at 12 volts DC. For flexibility, the design has a board mounted volume control, a power switch and both internal 2-pin and external 3.5mm speaker plugs. The external plug is switched to cut off the internal speaker when an external speaker is connected to the 3.5mm plug.

The resulting assembled board is then mounted using both the power switch and the external speaker 3.5mm plug, to a serial infill panel. This final assembly is then bolted to one of the unused serial holes on the back of the clone.

Power to drive the amp assembly is derived by unplugging the clone's supplied fan from J5 on the Altair Clone's main board and inserting a three pin though cable between boards. The fan is then plugged in to a three pin connector on the amp board which just passes though power to drive it. This allows the use of the clone's front panel power switch to turn the amp on or off. The extra three pin plug is for another project that also uses the clone's front panel power switch.

The amp by its self, at full volume, draws less than 300mA at 12V in to eight ohms. So there should be no issues with just the amp. My test unit is plenty load using an eight ohm, two watt, 87mm square speaker. All my family members come to the lab in the basement to see what was going on during full volume testing.

Appendix B should be used during assembly for the location of each component on the printed circuit board while appendix D details the parts list for the assembly. Included is a suggested parts vendor (i.e. Digi-Key) and their part numbers. If you wish to go to someplace else for parts, also included for each part is the manufacture and their part number. While I have not included one on the parts list, inclusion of an 8-pin I.C. socket for U1 may be a nice option.

The hope was to find some premade infill panels on the internet and then modify them to add the two extra holes for the 3.5mm connector and the power switch. Back 30

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years ago you could find such infills at almost every computer parts store. In today's modern world with almost no RS232 serial being used, they are few easy to locate suppliers of these panels that will allow you to buy just one infill. This only left fabricating them ourselves.

Go to your local hardware store and buy aluminum bar stock at 3/4 x 1/16 in the shortest length you can get. The shortest at my store was 24 inches which will make ten plus infills if you need them. Otherwise the unused portion of the aluminum bar is spare for your next project that may need such bar stock.

Use the dimensions in appendix C to cut out a piece of bar stock and mark it for the four holes needed. Drill and tap as indicated, mount the board to the infill panel and place the whole assembly in one of the unused serial holes on the back of your Altair 8800 Clone.

*Note: when marking and drilling your holes, the 3.5mm connector is really off access down by 0.017 inches. The other three holes all align at the half way point.*

When mounting the infill panel to the PC assembled board, there will be a small gap between the infill panel and the power switch. Supplied with the switch, you should have received a 1/4" lock washer. Cut out a 40-50 degree area of this lock washer. Place the cut lock washer between the infill panel and the power switch so the cut section is closest to the PC board. The added lock washer helps to bridge the small gap reducing the tendency for the infill panel to warp.

I tried to place volume knob within the same serial hole as the switch and 3.5mm connector. There just is not enough room there. I ended up placing the volume on the board. For some, once you have the volume setup you may not need to adjust it again. If you wish to have access from the back of the clone, use some of the extra aluminum from above and create a second infill panel. This infill panel can be placed in a second serial hole located next to the PC board assembly. Mount a small potentiometer for an external volume knob. A short run of three 24-26AWG twisted wires can be soldered between the board and the volume potentiometer. Larger pads under the board mounted volume potentiometer have been supplied to allow for this option.

Once the assembly is completed and installed, all that remains is to build and run the interconnection cables. Header J1 is the signal input solder to the INTE drive on the Clone's main board. Make sure to twist this cable to help reduce electrical noise. Unplug the Clone's supplied fan from J5 on the main board. Create a three pin straight through cable and connect it between main board J5 and J2 on the amp assembly. Plug the fan's three pin power cable in to J3 (or J4) on the amp assembly. The remaining J4 connector is an extra to power other project needing the Clone's switched power.

Speakers are connected to J5 for an internal speaker and/or J6 the 3.5mm connector now on the back. Both the internal and external connectors may be connected to two

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separate speakers at the same time. The amp has been design to cut off the internal J5 speaker whenever there is a 3.5mm plug inserted in the J6 connector.

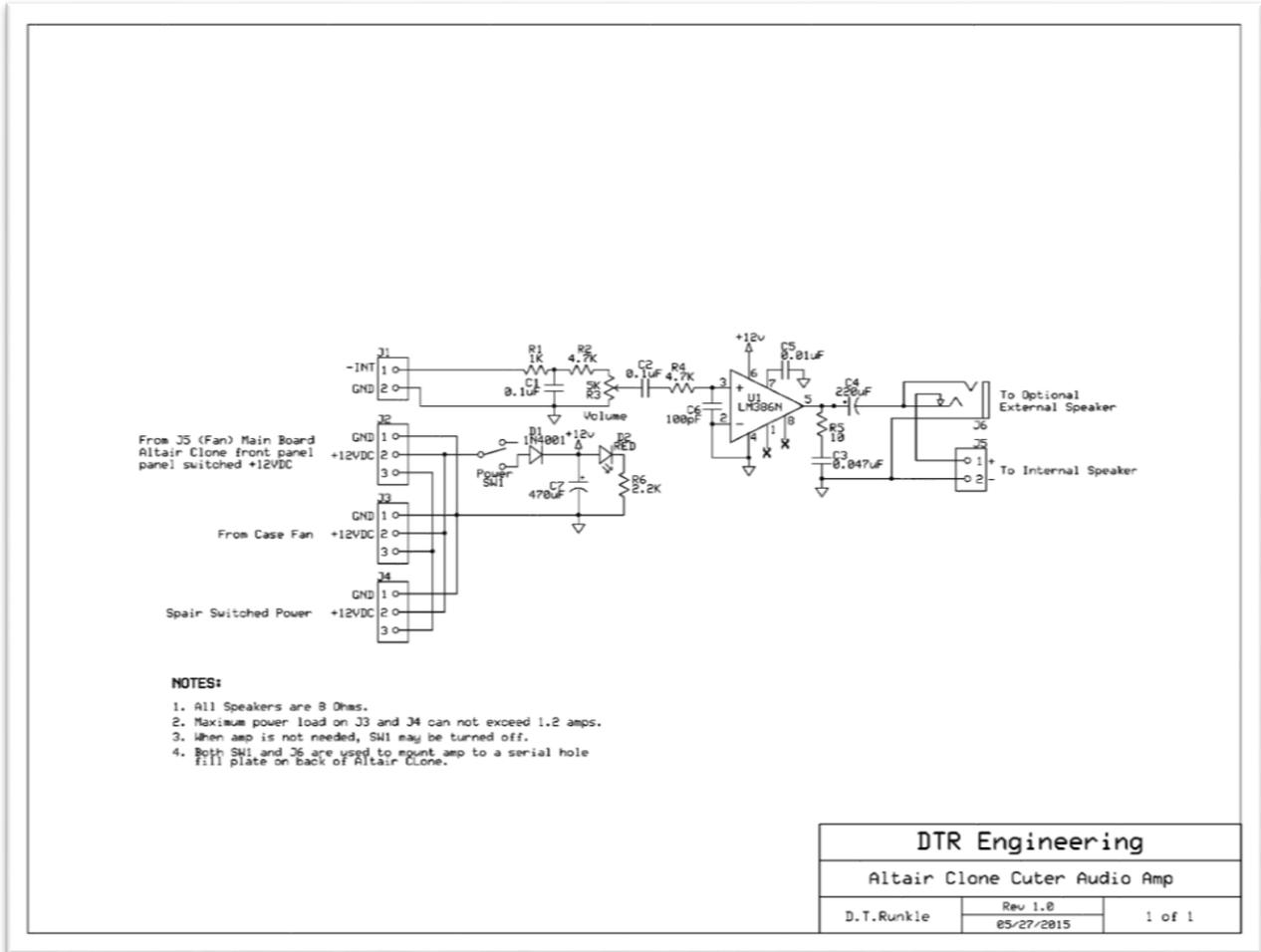
At this point all should be ready to use the amp. Look everything over looking for possible errors. Adjust the volume to middle range. If all looks good, power up the Altair Clone then power on the amp's power switch. The red LED on the amp assembly should light.

If you are using the boot ROM and CP/M on your clone, you can test the operation of the amp by booting to CP/M and perfuming some type of disk access. You should here some interesting beeps from the speaker as the OS strobes the INTE line during the drive access.

Assuming you have sound, you are all set. Use the video and instructions at the Altair 8800 Clone web site to load the Cuter ROM and music software. Load the song you wish and play. Adjust the volume to suit your taste. Enjoy!

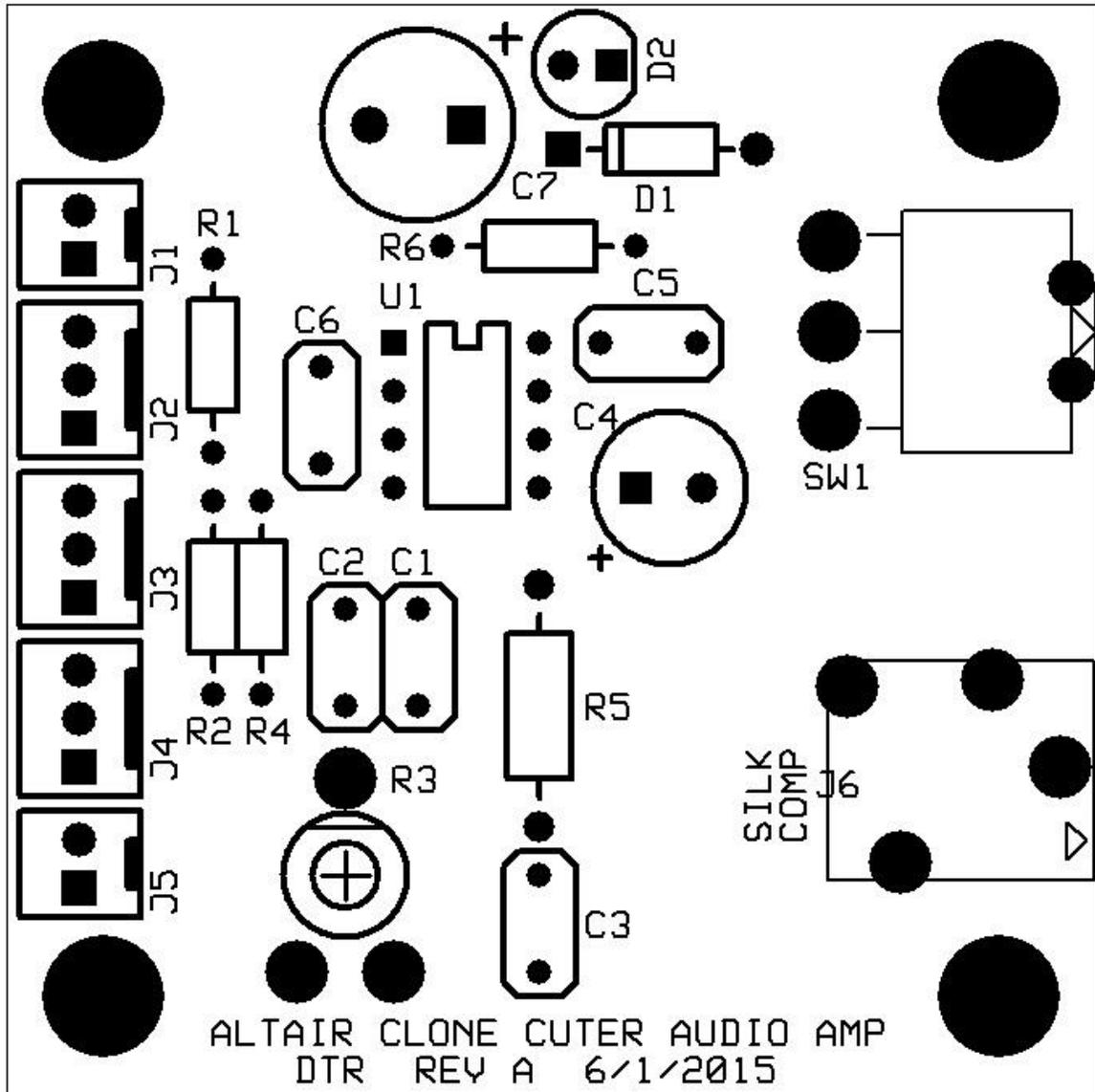
# The Altair Clone Cuter Amp Assembly

## Appendix A – Altair 8800 Clone Cuter Amp Schematic



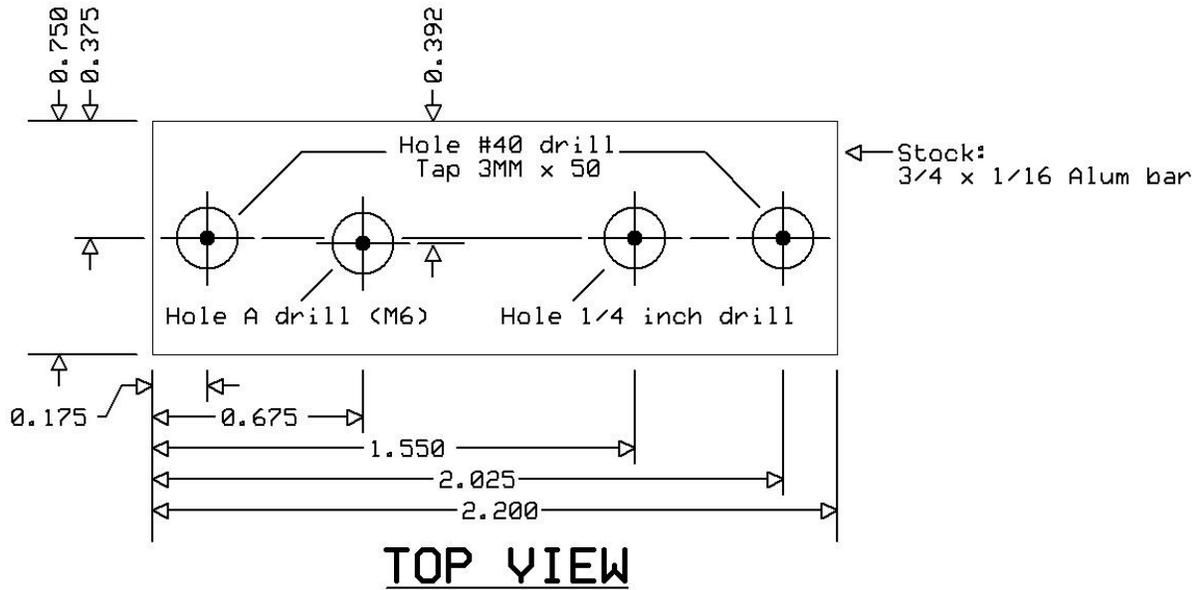
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## Appendix B – Component Placement



# The Altair Clone Cuter Amp Assembly

## Appendix C – Infill panel



# The Altair Clone Cutter Amp Assembly

## Appendix D – Parts List

| Location                                                      | Description                                          | Quantity | Vendor          | Vendor PN               | Manufacture                    | Manufacture PN  |
|---------------------------------------------------------------|------------------------------------------------------|----------|-----------------|-------------------------|--------------------------------|-----------------|
| C7                                                            | Capacitor alum 470uF 20% 16V radial                  | 1        | Digi-Key        | 495-5982-ND             | EPCOS (TDK)                    | B41821A4477M    |
| C4                                                            | Capacitor alum 220uF 20% 25V radial                  | 1        | Digi-Key        | 495-5983-ND             | EPCOS (TDK)                    | B41821A5227M    |
| C1,C2                                                         | Capacitor ceramic 0.1uF 100V 20% radial              | 2        | Digi-Key        | 399-4388-ND             | Kemet                          | C330C104M1U5TA  |
| C5                                                            | Capacitor ceramic 0.01uF                             | 1        | Digi-Key        | 399-9792-ND             | Kemet                          | C322C103J1R5TA  |
| C3                                                            | Capacitor ceramic 0.047uF 10% 100V radial            | 1        | Digi-Key        | 399-4370-ND             | Kemet                          | C322C473K1R5TA  |
| C6                                                            | Capacitor ceramic 100pF 5% 100V radial               | 1        | Digi-Key        | 399-9814-ND             | Kemet                          | C323C101J1G5TA  |
| D1                                                            | Diode general purpose 50V 1A DO41                    | 1        | Digi-Key        | 1N4001DICT-ND           | Diodes Incorporated            | 1N4001-T        |
| D2                                                            | LED SS 5mm 625nm RED deff                            | 1        | Digi-Key        | 754-1266-ND             | Kingbright                     | WP7113LID       |
| R1                                                            | Resistor 1K ohm 1/4W 5% axial                        | 1        | Digi-Key        | 1.0KQBK-ND              | Yageo                          | CFR-25JB-52-1K  |
| R2,R4                                                         | Resistor 4.7K ohm 1/4W 5% axial                      | 2        | Digi-Key        | 8.2KQBK-ND              | Yageo                          | CFR-25JB-52-8K2 |
| R3                                                            | Trimmer 5K ohm 0.5W PC pins                          | 1        | Digi-Key        | 3309P-502-ND            | Bourns Inc                     | 3309P-1-502     |
| R5                                                            | Resistor 10 ohm 1/2W 5% axial                        | 1        | Digi-Key        | 10H-ND                  | Yageo                          | CFR-50JB-52-10R |
| R6                                                            | Resistor 2.2K ohm 1/4W 5% axial                      | 1        | Digi-Key        | 2.2KQBK-ND              | Yageo                          | CFR-25JB-52-2K2 |
| U1                                                            | IC 1 Watt mono AB audio power amp 8 dip              | 1        | Digi-Key        | LM386N-4/NOPB-ND        | Texas Instruments              | LM386N-4/NOPB   |
| SW1                                                           | Switch toggle SPDT 5A 120V                           | 1        | Digi-Key        | CKN1457-ND              | C&K Components                 | 7101SYAQE       |
| J1,J5                                                         | Connector header vertical 2 pin 0.100 lead space tin | 2        | Digi-Key        | A1921-ND                | TE Connectivity Amp Connectors | 640456-2        |
| J2,J3,J4                                                      | Connector header vertical 3 pin 0.100 lead space tin | 3        | Digi-Key        | A19470-ND               | TE Connectivity Amp Connectors | 640456-3        |
| J6                                                            | Connector jack stereo right angle 4 pin 3.5mm        | 1        | Digi-Key        | CP1-3514-ND             | CUI Inc                        | SJ1-3514        |
| SP1                                                           | Speaker 8 ohm 2W 87mm square                         | 1        | Digi-Key        | GF0876-ND               | CUI Inc                        | GF0876          |
| PWB                                                           | Altair Clone Cutter Amp printed circuit board        | 1        | DTR Engineering | Altair Clone Cutter Amp | NA                             | NA              |
|                                                               | DB25 Cover plate                                     | 1        | DTR Engineering | DB25 Cover plate        | NA                             | NA              |
| <b>3-pin to 3-pin through cable assembly</b>                  |                                                      |          |                 |                         |                                |                 |
|                                                               | Connector housing 3-pos 0.1 pitch with ramp and rib  | 2        | Digi-Key        | WM2001-ND               | Molix Inc                      | 0022013037      |
|                                                               | Connector terminal female 22-30AWG Gold              | 6        | Digi-Key        | WM2313-ND               | Molix Inc                      | 0008520113      |
|                                                               | Wire red stranded 7/30 22AWG PVC copper tinned       | 24       | Digi-Key        | A2016R-100-ND           | Apphl Wire                     | 3051-RD005      |
|                                                               | Wire black stranded 7/30 22AWG PVC copper tinned     | 24       | Digi-Key        | A2016B-100-ND           | Apphl Wire                     | 3051-BK005      |
|                                                               | Wire yellow stranded 7/30 22AWG PVC copper tinned    | 24       | Digi-Key        | A2016Y-100-ND           | Apphl Wire                     | 3051-YL005      |
| <b>2-pin Altair 8800 Clone audio interface cable assembly</b> |                                                      |          |                 |                         |                                |                 |
|                                                               | Connector housing 2-pos 0.1 pitch with ramp and rib  | 1        | Digi-Key        | WM2000-ND               | Molix Inc                      | 0022013027      |
|                                                               | Connector terminal female 22-30AWG Gold              | 2        | Digi-Key        | WM2313-ND               | Molix Inc                      | 0008520113      |
|                                                               | Wire black stranded 7/30 22AWG PVC copper tinned     | 24       | Digi-Key        | A2016B-100-ND           | Apphl Wire                     | 3051-BK005      |
|                                                               | Wire yellow stranded 7/30 22AWG PVC copper tinned    | 24       | Digi-Key        | A2016Y-100-ND           | Apphl Wire                     | 3051-YL005      |