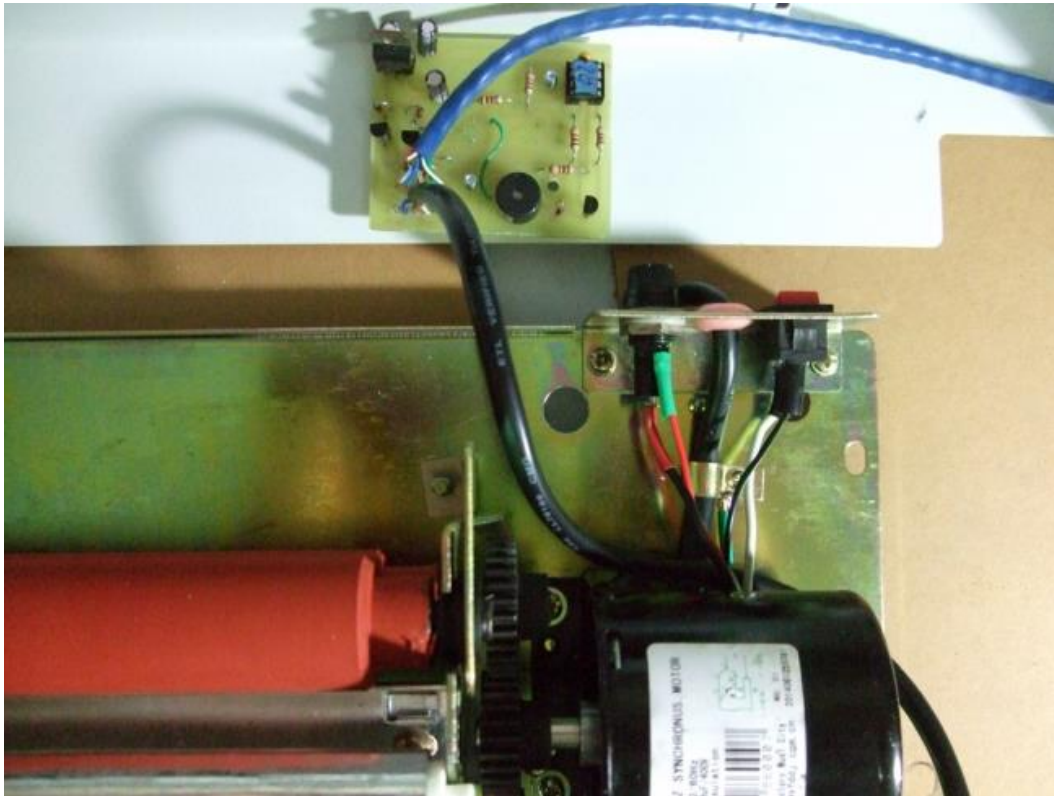


## Laminator Mod- PCB Toner Transfer from Parchment

Part No. : 2219461



**Time Required: 1-2 hours depending on experience**

**Experience Level: Intermediate**

### **Required tools and parts:**

- 25-30W Pencil type soldering iron
- 60/40 Electronic Rosin core
- Birdbeak pliers
- Flush cutter
- 3' of cat5/6 cable
- 2, 6-32, 1/2" machine screws
- Wire stripper or Xacto hobby knife
- DMM for optional debugging

### **Description:**

I've taken a robust document laminator (Apache AL13P) that features all metal construction, **silicone rollers** and temperature control, and added features to make it **more suitable, energy efficient, faster and safer** for toner transfer using readily available papers, including PCBFX.com professional PULSAR products & Dry Transfers!

## **Background:**

I have been frequently frustrated by having to use a combination of clothing iron and document laminator as reliable results are ever elusive.

Converting a laser printer to direct PCB printing is complex and not a project I wish to entertain. **It would be** heavily mechanical and the results **would** still require post printing 'fusing' of the print onto the copper. I decided to bite the bullet and purchase the easy to modify Apache AL13P from Amazon to simplify and streamline **my** PCB making using non photographic methods.

## **Powerful Capabilities:**

Reliable, repeatable, cost effective and time effective toner transfer to single or double sided copper clad board up to 1/16" (**1.6 mm**) thick. **Your board can be etching in under 5 minutes! Print; masking tape the print to the PCB; feed thru the hot laminator with the modification; soak/remove the paper and then etch!**

The detail of the toner transfer method can be as good as 5 mil using ½ oz copper clad! Thus, it is suitable for a lot of SMT applications as well.

I do single pass, double sided transfers, aligned/registered via 0.5mm - 0.8mm 'pinhole vias', built in to the layout at each PCB corner and then etching. This beats the multi-step, direct printing method which requires tricky, flip over & reprint alignment & resist curing for both sides of the printed board by baking or additional chemical baths before the etching. Also, direct printing requires a dedicated printer to hack apart, literally, as well as additional dedicated inks or toner/roller cartridges adding costs.

## **Feature List:**

- 1) Thermal sensor failure protection.
- 2) Speed control/reduction using multiple automatic forward/reverse passes suitable for synchronous AC motors.
- 3) Cool down function for rollers that over rides the heater AND keeps the rollers in motion for a fixed 2 minute period with an alert to shut-down afterward.
- 4) No other mods required other than tightening the rollers as standard (described later on).
- 5) **It takes less than 2 hours to make the modifications** including building the kit.
- 6) **It achieves** 10 mil traces with 1 oz copper reliably – one pass!
- 7) **Plug-n-Play** operation, **no soldering or modifications to laminator circuitry.**
- 8) Optimizes PCBFX Pulsar paper transfers & Dry transfer to metal products!
- 9) The Laminator can be toggled to do 'normal' paper & card laminations at the touch of a button! No loss of original function!

## **Specifications:**

It operates between **the 300 F and 330 F laminator preset** to span the range of board stock from scissors **cuttable** thru 1/16" thick double sided transfers. Well below the 379 F laminator maximum!

Net speed reduction is **approximately** 12:1 achieved by using recurring 5/8" forward and 1/2" linear reverse motions cycle with the rollers. The heater is OFF during reverse part of cycle to prevent roller hotspots.

This has the effects of applying multiple pressure and heat cycles to the toner transfer ensuring a good result without tampering with the 60 Hz synchronous motor operation & torque levels.

The net result is a single automated COMPLETE pass of the copper clad via multiple sub passes during the process.

The speed reduction can be altered by adjusting the trimmer potentiometer clockwise (**CW** increases net speed, **Maximum CCW is the default speed**).

## **Usage/operation:**

Turn on, allow preheat to desired temperature plus 5 minutes for roller temperature homogeneity.

Activate the speed reduction/overlapping passes via a click of the modifications tactile push button. A second click reverts to 'normal' speed.

Insert the **copper-clad** firmly with the laser printed paper secured via blue painters tape so that the rollers pull it in.

Return after a couple minutes to collect the finished transfer.

**A long press** of the tactile switch for a 1/2 second to trigger the cool down timing...there is a chirping sound during this 2 minute period.

The heater and any **speed** reduction...

## **COMPONENTS/BOM.**

- 1 × Beeper (3-5V) Jameco # 138713
- 2 × Capacitor 0.1 uF 50 Volt X7R (10V minimum) Jameco # 544921
- 3 × 10 uF 50 Volt Radial Capacitor (25V minimum) Jameco # 29891
- 1 × Resistor, Trimmer 10k Ohm Jameco # 770371
- 3 × Transistor General Purpose BJT NPN Jameco # 783421
- 2 × 6 Position Fem. MTA100 Connector 0.1" pitch. Jameco # 923403
- 7 × Resistor - 1.0k , 1/4W Jameco # 661503
- 1 × MCU 8-Bit PIC12 RISC 1.75KB - PIC 12F675 Jameco # 223781
- 4 × Diode Fast Recovery , 1n4148 Jameco # 743285
- 1 × Switch Push Button Tactile, N.O. Jameco # 149948
- 1 × 8 pin IC Socket Jameco # 51626
- 1 × 5V standard regulator Jameco # 786138
- Circuit board, 3' of CAT5 cable, soldering tools, 6-32x1/2" screws etc.

## • THEORY OF OPERATION

A document laminator is tuned to apply temperature and pressure suitable for sealing plastic pouches over paper and card stock. Heavier duty laminators can handle heavier pouches and heavier card and are capable of higher temperature operation. Print Toner is mainly pulverized plastic and melts within the range of laminator temperatures (around 150 Celsius, 300 F) at the rollers.

In order to optimize toner transfer to copper clad board of various thicknesses and copper weight, the laminator must increase its temperature, pressure or both. This is usually achieved by using multiple maximum temperature passes; up to 20 times for a particular toner transfer to be of good quality with no drop outs on non-optimized papers and laminators. This method is tedious and prone to repeatability issues based on such factors as the board length & thickness, copper weight, ambient temperature and the speed with which the board is returned to pass through laminator again.

This modification simply automates the multi-pass approach and adds both time & energy efficiency benefits **while** simultaneously enhancing **both** repeatability and safety. Relying on the 60 Hz A.C. synchronous motor speed, the linear motion of the rollers is controlled via forward & backward mini passes to achieve up to a 12:1 speed reduction of the original linear speed. No alteration to the rotational speed or torque is used. No tampering with the **120 VAC** power is done. Automatic overlapping heat/pressure passes occur, with insignificant copper clad board cooling in between; delivering energy and time savings.

The effectiveness of the approach is enhanced by the nature of the Apache AL13P control system which offers integral motor direction and temperature control. Adjusting the tension of the rollers via the 4 bottom screws as mentioned in the instructions also improves the transfer. The net result is a reliable transfer using less heat, pressure and time compared to other 'popular' laminator instructable type mods done before.

This modification circuit employs a small PIC 12F675 micro-controller to sense the OEM thermal sensor's condition as well as to control the timing of the roller motion and provides a simple **man-machine** interface for control. A beeper is included to provide for audible feedback or alerts based on the selected operation mode of the system or any alarm conditions. A thermal sensor failure will now result in an alarm sound and **failsafe** shutdown of the heater for safe operations.

All the features of the modification are optional and the laminator can serve its original purpose or switch to copper clad lamination or 'dry transfer foil to metal' at the touch of a button.. The modification's schematic details each pin function of the OEM controllers 6 pin cabling system for convenience of debugging. The mounting of the modification requires NO drilling, cutting or alteration of the laminator as it is mounted in an OEM provided fan cutout in the housing.

## • [BUILD INSTRUCTIONS](#)

Building the add-on, kitted PCB is simple, just a few parts. Start with the low profile resistors, wire bridges and diodes and then move to the taller components paying attention to polarity as marked on the PCB. You can test your build by applying 12V+ on pin 4 and a ground on pin 3 of the 6 pin inline wire to board pads. The Beeper should emit a 1 second beep. Building the CAT5 (15") 6pin cables to attach the female 6 pin connectors is critical. Don't mix up the pin numbering. Note the pictures showing pin 6 on both the stock Apache Relay Brd and Display Brd. Also the connector orientation for both cables is opposed, see the pic.

Opening the **UNPLUGGED** laminator is easy using the four bottom corner screws. Remove the two screws to the LED display first, let the display drop inside. Now u can remove the cover easily.

Use a hot air supply (hair dryer) to loosen the hot glue holding the 6 pin ribbon cable in place between the stock Relay & LED display seen in the PIC. Note the pin 6 identifier on both boards in the picture. Install the new 6 pin cat5 connectors. Match the add-on display connector to the display board and the relay/main connector to the relay board. Rout the cables away from the rollers. Install the LED Display back into its cutout and mount the add-on board in the fan cutout using a pair of 6-32 x 1/2" screws. Ensure the push button protrudes thru a slot and is operable without sticking. Also the trimmer pot should be accessible via a slot.

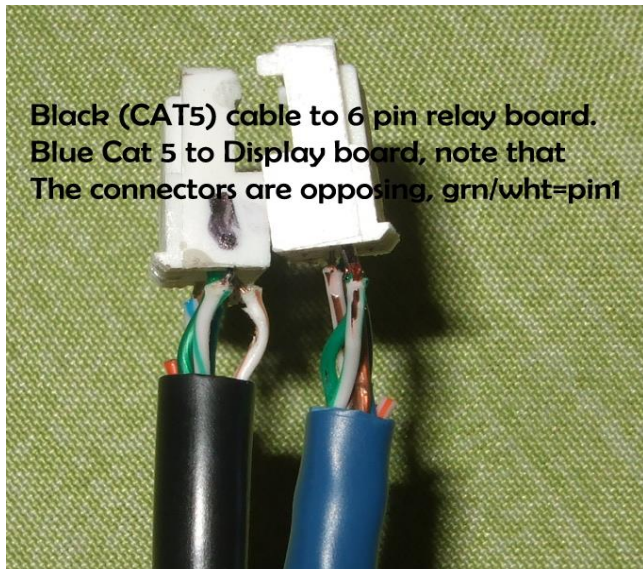
Your modification is complete. Just remove the grey flat piece of metal (with semicircles) on the top cover parallel to the rollers; it is attached via two twisted tabs. It can interfere with the PCB movement. If you haven't tightened the rollers, now is the time.

This link has a series of images to help:

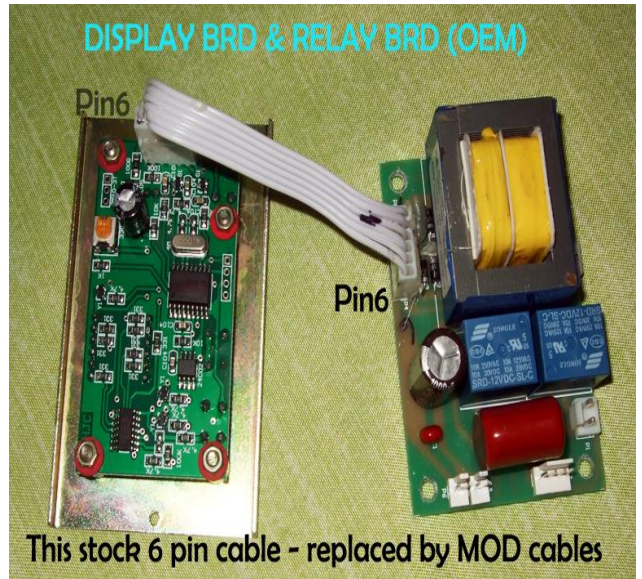
<http://blog.kamilon.com/?p=120>

Note the 4 screws with the springs near the corner of the rollers. Tighten them from the bottom of the laminator all the way....don't force though. Then loosen them **4 complete turns of each screw**. This tensions the rollers properly. Other mods call for 3 turns, but this mod places less stress on the system. Now close up the laminator and start your newly automated PCB fab!



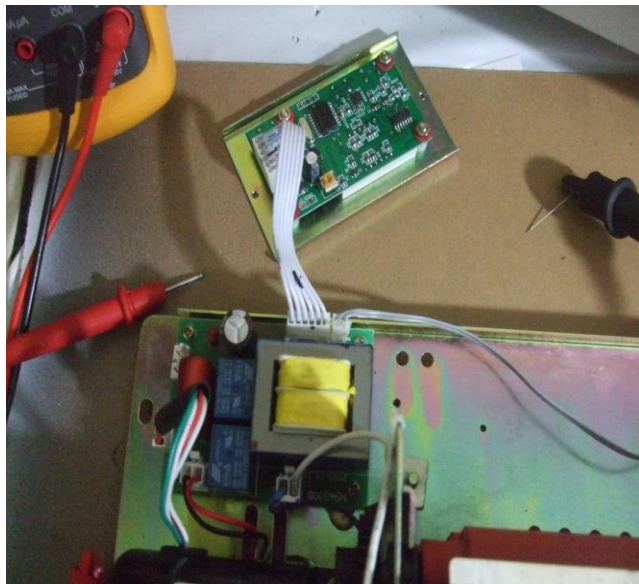


Black (CAT5) cable to 6 pin relay board.  
 Blue Cat 5 to Display board, note that  
 The connectors are opposing, grn/wht=pin1



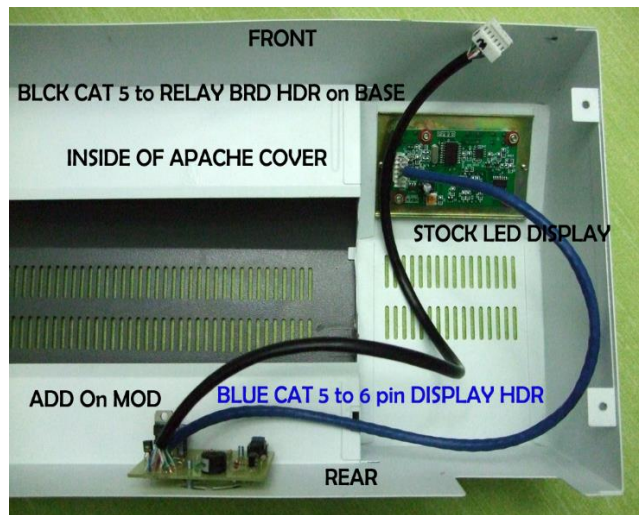
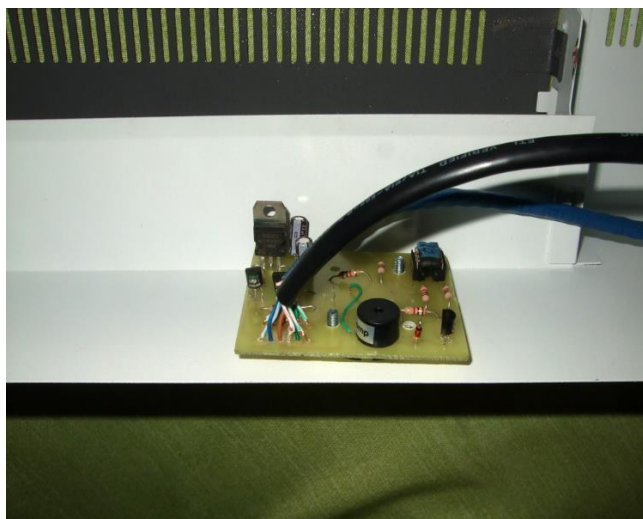
DISPLAY BRD & RELAY BRD (OEM)

This stock 6 pin cable - replaced by MOD cables



6 pin connector...note pin alignment in other PIC.

COMPLETE MOD with 15" CAT5 cables & 6 pin female 0.1" pitch connectors  
 Note 6-32 screw holes for securing in fan cutout on back of top cover.



FRONT  
 BLCK CAT 5 to RELAY BRD HDR on BASE  
 INSIDE OF APACHE COVER  
 STOCK LED DISPLAY  
 ADD On MOD  
 BLUE CAT 5 to 6 pin DISPLAY HDR  
 REAR



