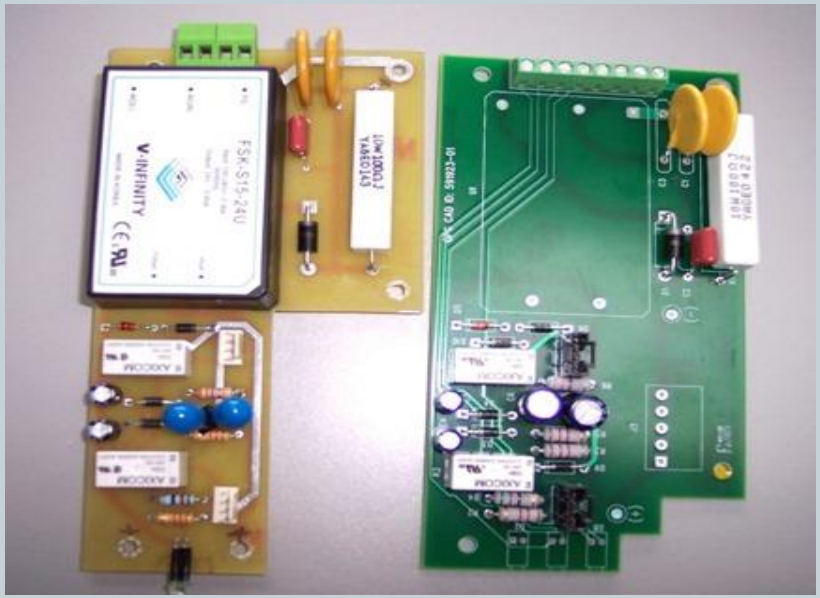
Workshop Reverse Engineering Lecture

NIAGARA COLLEGE TECHNOLOGY DEPT.

Purpose

- Often when designing circuits, you must convert an existing PCB into a schematic to analyze the theory or update it.
- Ex: Here a power supply is re-created at similar size by reverse engineering the original CCT.
- Useful when the schematic is lost or no longer available.



Reverse Engineering

- Must be able to identify components.
- Must be able to measure output waveforms, voltage levels, currents and determine power requirements.
- Watch for vias, multi-layered board, traces under components…

Reverse Engineering Methodology

- Step1: Identify all major components
  - ICs
  - Transistors, MOSFET, IGBT etc..
  - Relays
  - Any other large multi-pin device

  - Place them in the middle of your drawing, and **identify/label each pin** with their **function** *(have to find a datasheet!)*.

Reverse Engineering Methodology

- Step2: Identify all INPUTS, OUTPUTS, and POWER
  - Locate the inputs such as signal, Vcc, Vdd, Vee etc…
  - Locate all outputs such as signal, control, Vcc, etc…
  - Locate all power and ground connections
  - Draw the inputs on the left, and outputs on the right of your diagram.
    - If there are test points, you will include them as you go. Always include them.

Reverse Engineering Methodology

- Step3: Trace one pin at a time to Power Supply, GND, INPUT, OUTPUT, or other major components.
  - May need to use a DMM as a continuity tester to determine where traces end up.
  - Ensure you place a DOT on all junctions where three or more lines are connected.
  - Draw all interconnections with HORIZONTAL or VERTICAL lines ONLY.
  - Place component values in your schematic AS SOON AS YOU FIND THEM to be able to reference in other traces later.

Reverse Engineering Methodology

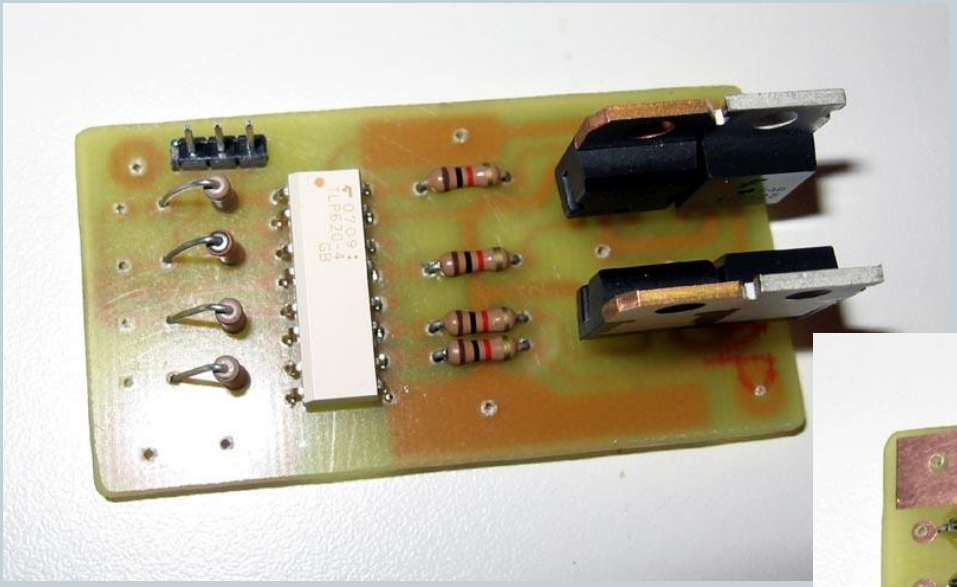
- Step4: Repeat STEP3 until all traces are complete.
  - Focus on one trace at a time, and always include junction DOTS.
  - If you come to passive components (resistors, capacitors), include them as well.
  - When complete, count number of components and double check that all are included.
  - Check that each input, output, pin and component is labelled.

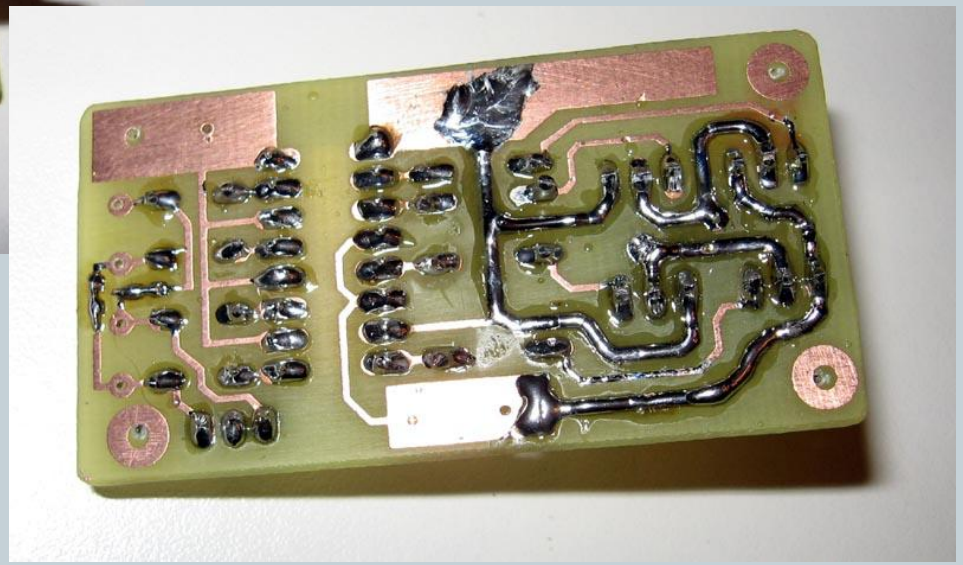
Reverse Engineering Methodology

- Step5: Final Check
  - Modify your traces (use pencil!) to ensure minimal crossovers.
  - Ensure all lines are either vertical or horizontal.
  - Verify component identification and that all pins are labelled.
    - Unused pins must be labelled, usually with ‘NC’ (Not connected).
  - Ensure no unattached connection points remain.

Example: H-Bridge Motor Driver

- Motor Driver Reverse Engineering





Final version, top and bottom.
(Original not shown)

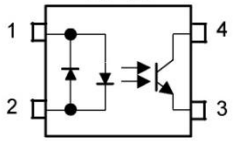
Example: H-Bridge Motor Driver

- Step1: Identification of components
  - 1x Opto-Isolation TLP620 16pin DIP
  - 2x TIP122 (NPN Darlington Transistor) TO220
  - 2x TIP127 (PNP Darlington Transistor) TO220
  - 1x 3pin header
  - 4x 1kOhm Resistor
  - 4x 2.2Kohm Resistor

TLP620 Datasheet Excerpt

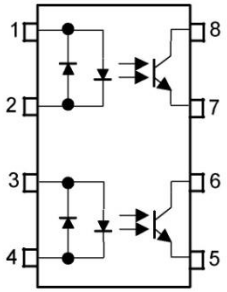
Pin Configurations (top view)

TLP620



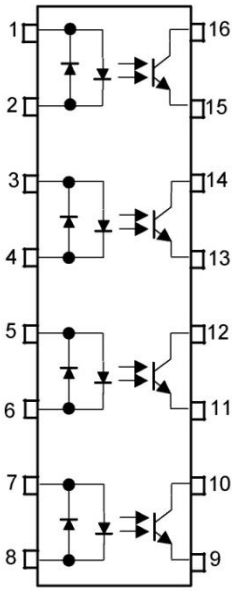
1 : ANODE
CATHODE
2 : CATHODE
ANODE
3 : EMITTER
4 : COLLECTOR

TLP620-2

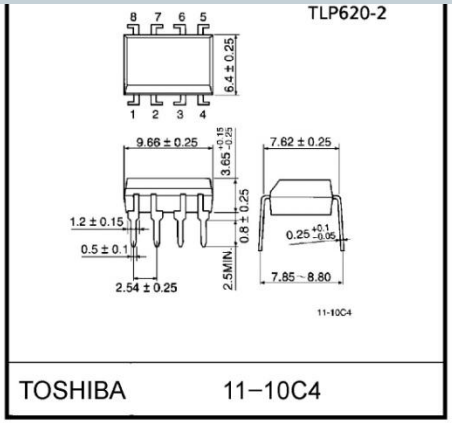


1, 3 : ANODE
CATHODE
2, 4 : CATHODE
ANODE
5, 7 : EMITTER
6, 8 : COLLECTOR

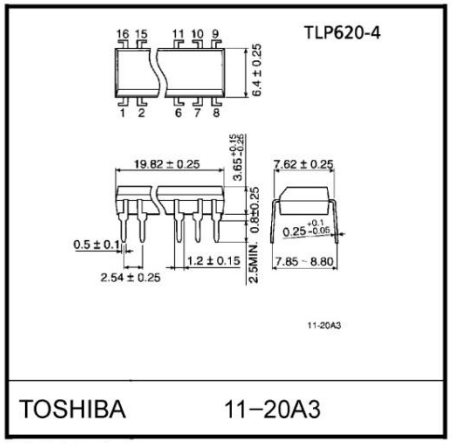
TLP620-4



1, 3, 5, 7 : ANODE, CATHODE
2, 4, 6, 8 : CATHODE, ANODE
9, 11, 13, 15 : EMITTER
10, 12, 14, 16 : COLLECTOR



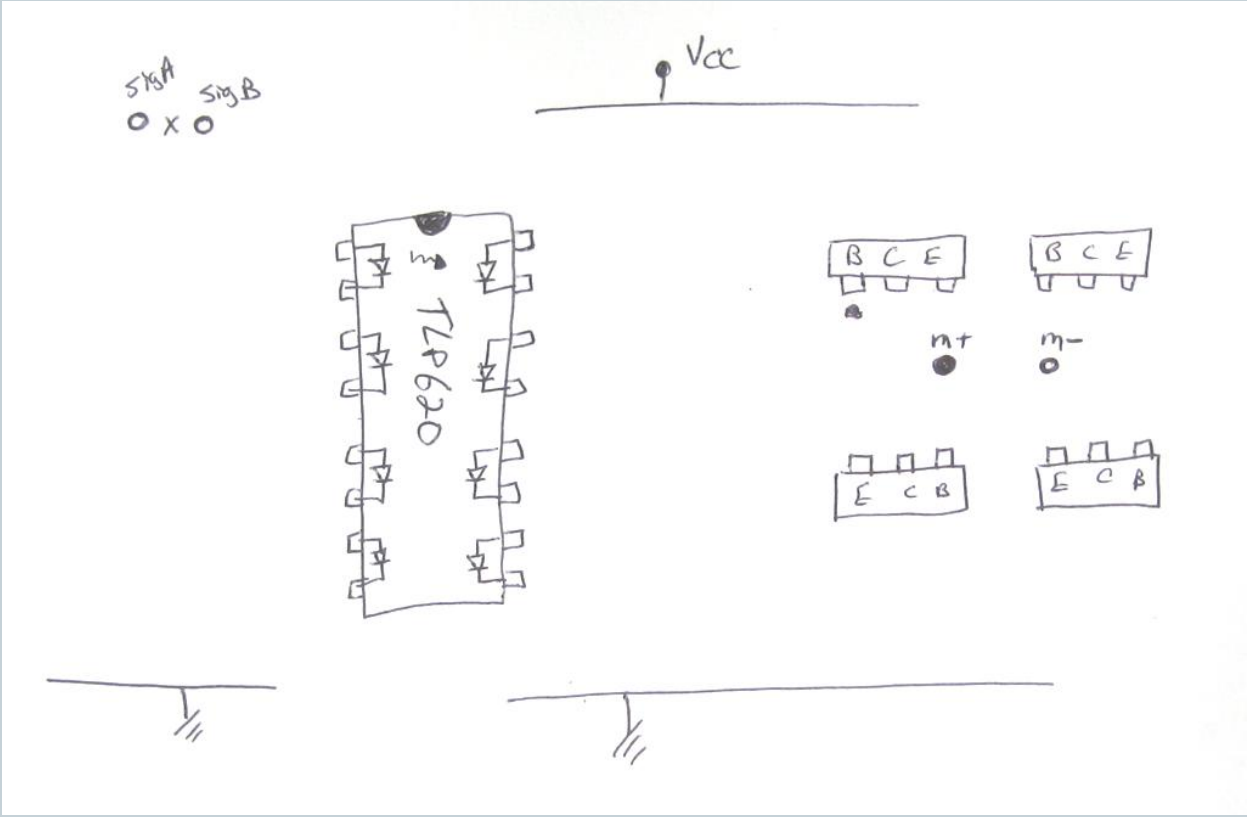
Weight: 0.54 g



Weight: 1.1 g

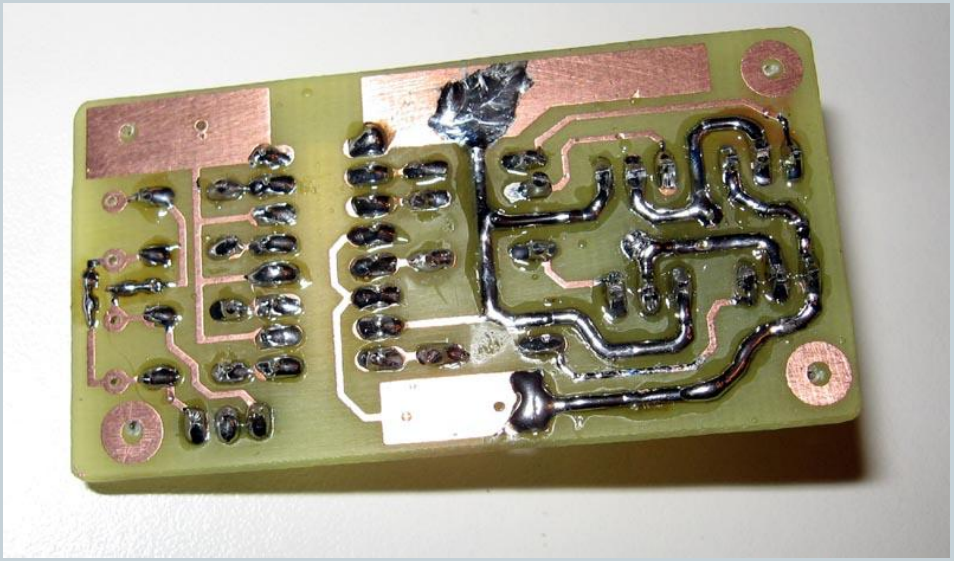
Example: H-Bridge Motor Driver

- Step 2: Draw the major components in the middle of your drawing:



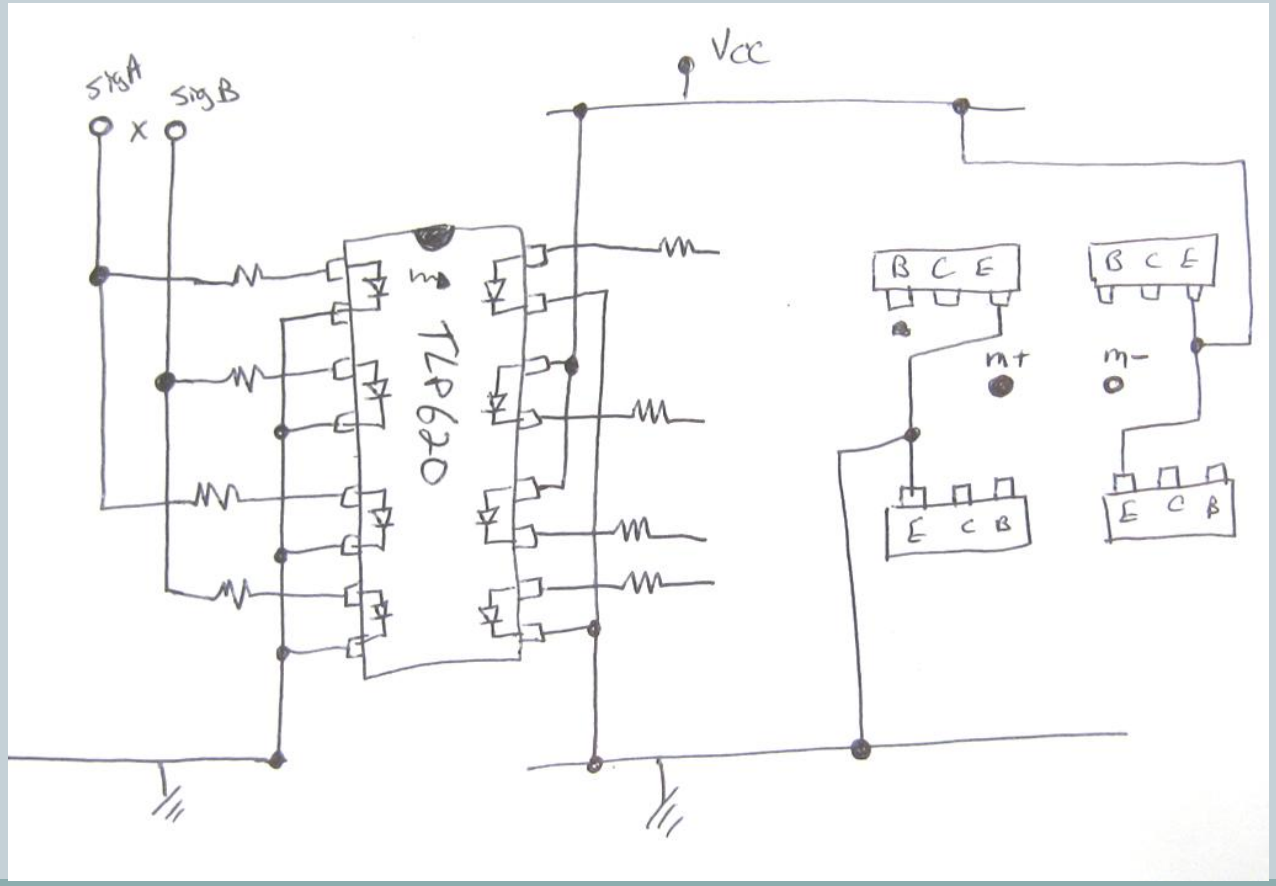
Example: H-Bridge Motor Driver

- Step 3: Trace pins of main component (DIP chip) one pin at a time.
  - Inputs: Power, GND, Signal-A, Signal-B
  - Outputs: Motor-Positive, Motor-Negative



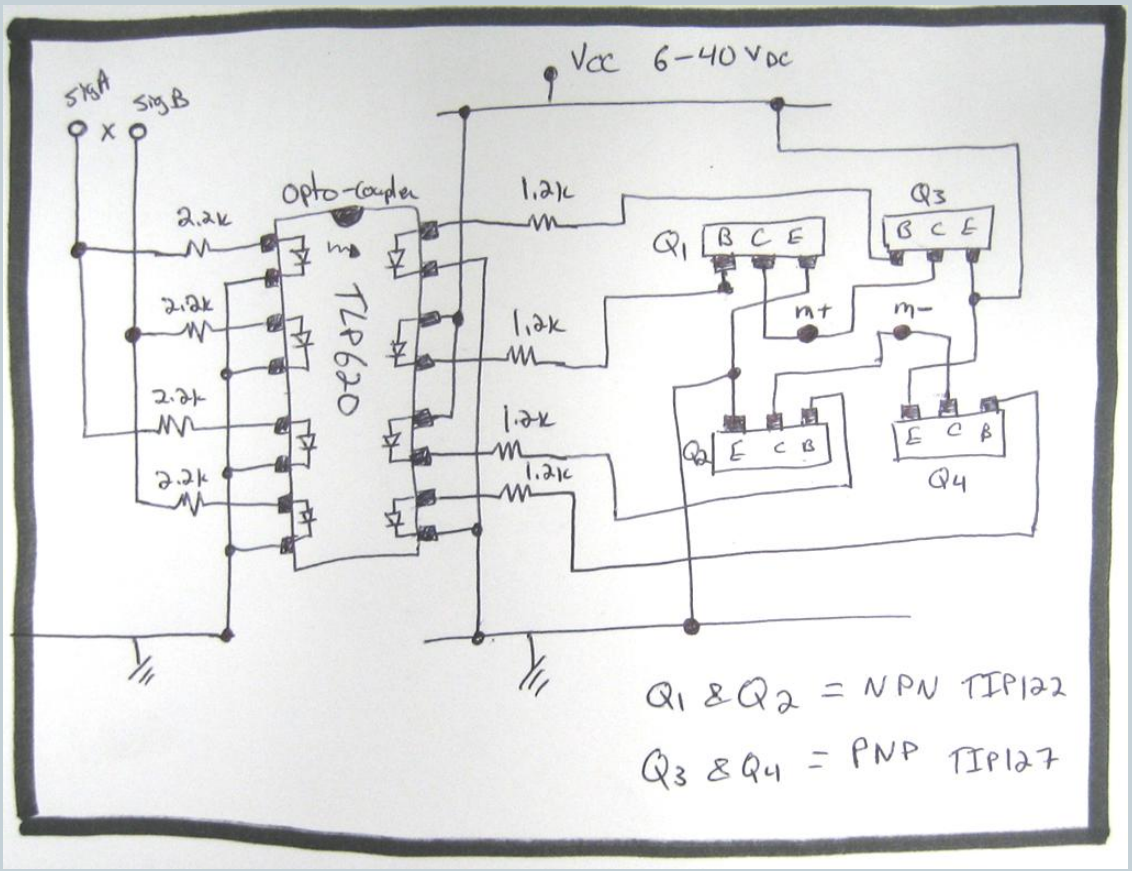
Example: H-Bridge Motor Driver

- Step 4: Repeat Step 3 until complete



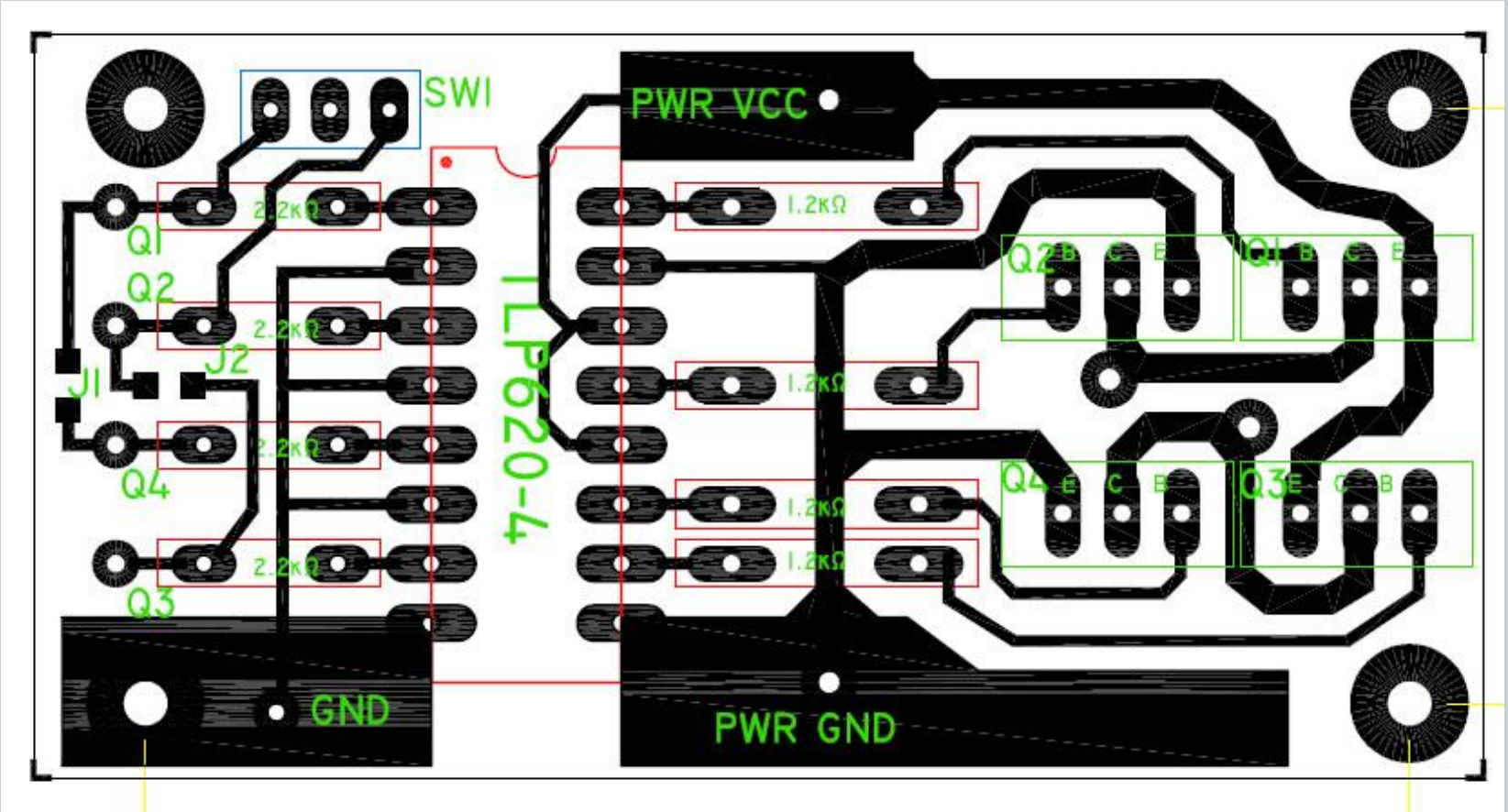
Example: H-Bridge Motor Driver

- Step 5: Label all component and double check each trace



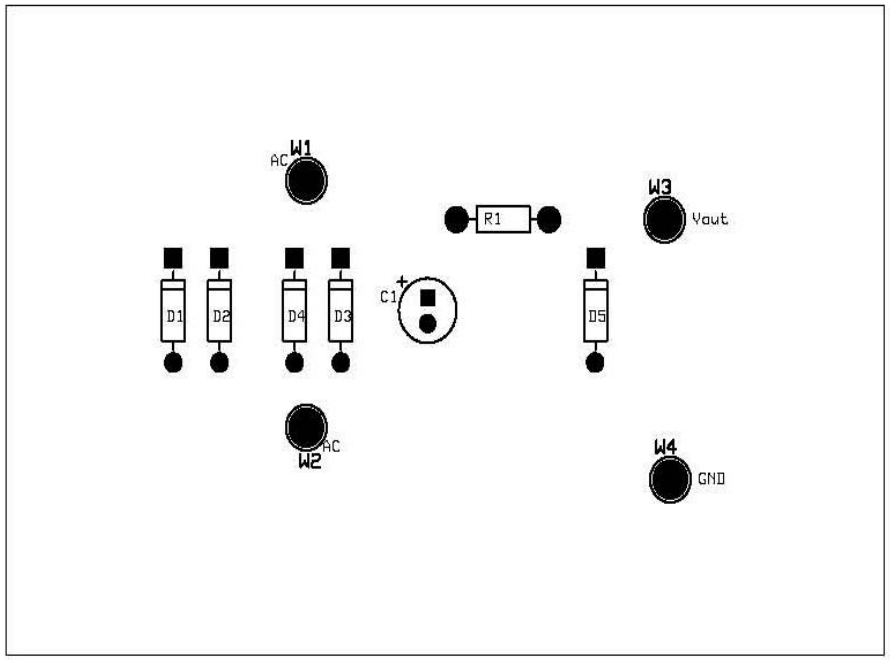
Example: H-Bridge Motor Driver

- Computer PCB Re-Design

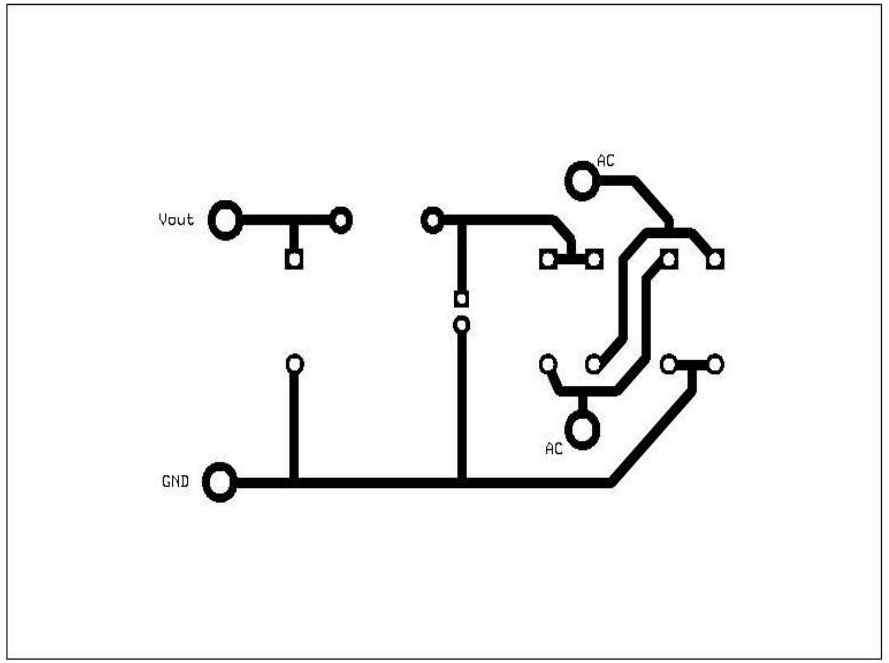


Reverse Engineering Example 2

- Silkscreen Top



- Bottom Copper (Bottom view)



Reverse Engineering Example 2

- Example 2 Schematic: