

2018 VEX Electronics Online Challenge Sponsored by Texas Instruments
Entry Submitted by VEX Team 8390
Notre Dame Academy High School

Looking Inside an Epson Printer

Because our “IT guy” was reluctant to add a sketchy, donated printer to the school network, an Epson 633 Workforce Printer ultimately fell into the hands of the robotics team. Upon opening this printer, we found a Pandora’s box hiding beneath the cover. We took a deep breath, slowly began to take it apart, and methodically cataloged the printed circuit boards and researched the components.



We found five PCBs, which handle the processing power of the electronic device, and we identified the microchips on them that enable data processing and storage. The following boards were found inside the machine: A power supply board, the panel board, the main board, the fax/modem, and a WLAN board. A smile came over our faces when we recognized the tiny Texas Instruments logos on five petite-sized chips on the panel board. We researched chips on all the boards to determine what purpose they served, and we spent extra time learning about the power supply board since it is fundamental to many machines.

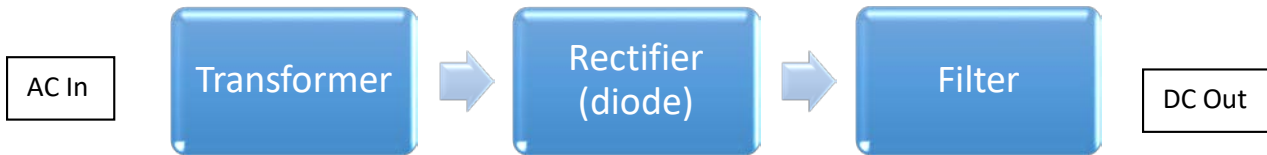
Our team found this opportunity to deconstruct a machine full of electronics a valuable experience and one that does not come our way very often. The first task required us to learn how to self-organize a group of students (a group of eight freshman and sophomore girls) to tackle a collaborative project, which is something that we feel is a desirable skill for future engineering projects where we are asked to, without the guidance of an adult, get a job done. We learned how to delegate and divide tasks among ourselves such that everyone had something to learn and share, and we learned how to manage our time wisely. We also learned how to conduct research into the electronic components that make up a device and how to present a summary report of our findings. The bonus was gaining a greater appreciation of what was under the hood of a printer, a technology that we take for granted and sometimes get mad at when the IT person is not around to fix the connection.

We also discovered a fun fact about why circuit boards are green. According to 4pcb.com, the original boards were a not so aesthetically pleasing brown color and by adding yellow and blue pigments, the resin became the green we know and expect today.

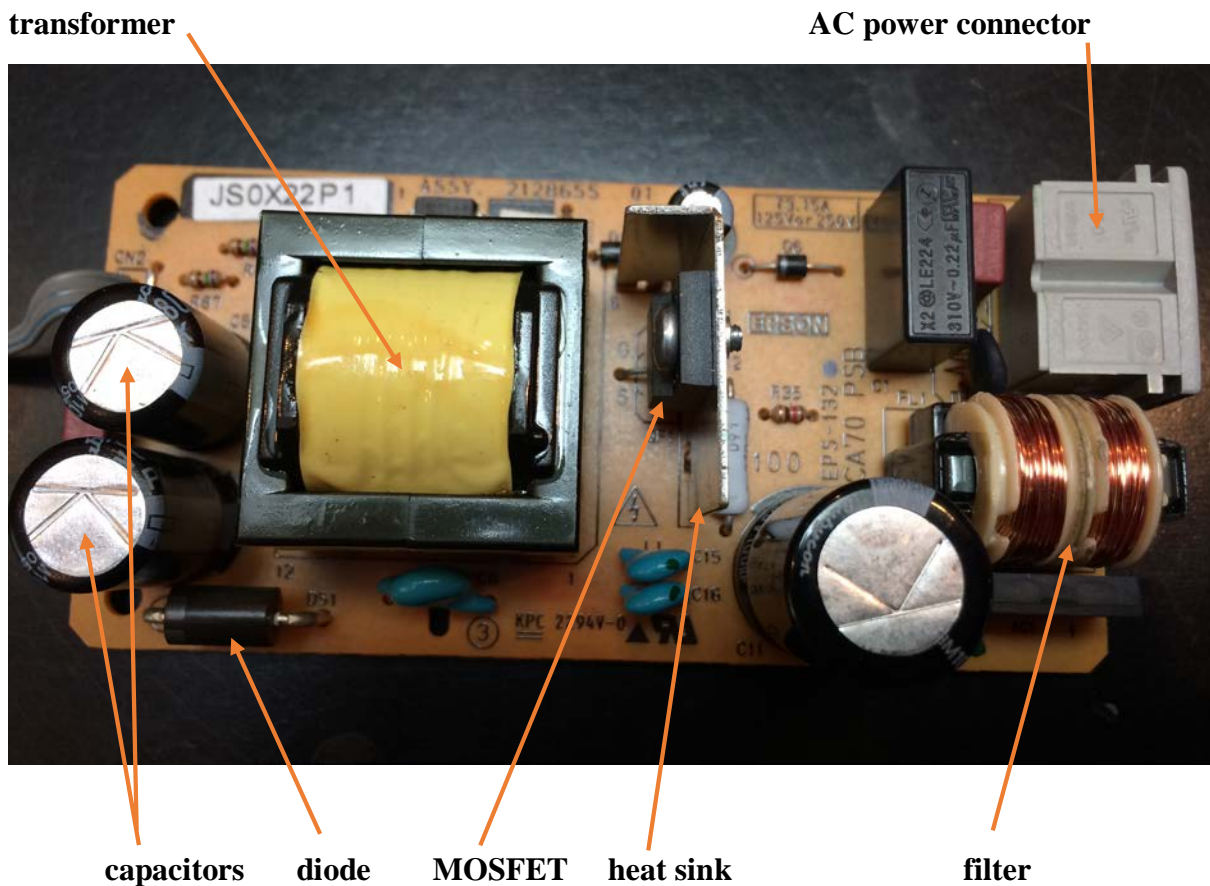
Below is our photodocumentation of the PCBs found inside the Epson 633 Workforce Printer.

The Power Supply Board

The function of a basic power supply board is to turn AC voltage coming into the machine into low voltage DC current that the circuits inside can use. This conversion requires three basic components:



The transformer steps-down the AC voltage, the diode forces the current to flow in one direction, resulting in pulsating DC, and the filter reduces the pulses to small “ripples.”

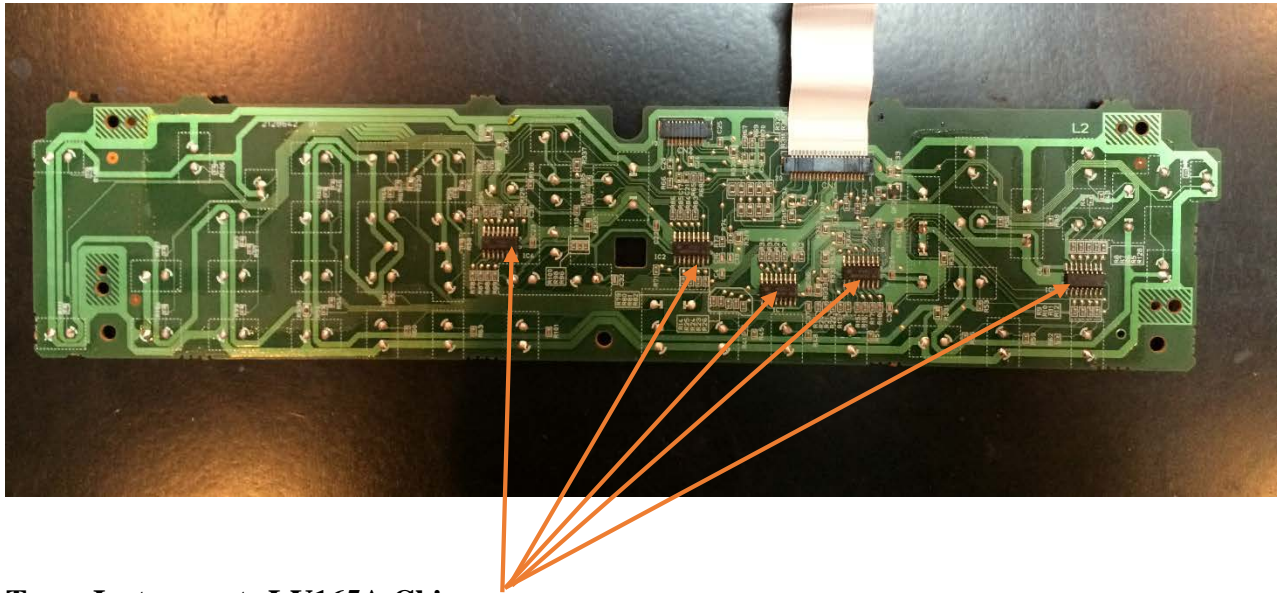


Power Supply Board		
Component	Function	Part Number
transformer	reduces AC voltage	PT 223 DELTA MP-130I D 1037D9
diode	allows electricity to flow with less resistance in one way than the other	3PHA 20
filter	reduces DC pulses	TS3280V
MOSFET (Metal Oxide Semiconductor Field-Effect Transistor)	voltage controlled device that controls current flow	Toshiba K5A50D
heat sink	dissapates heat from MOSFET	
AC power connector	for power cable	25S250V
(2) 50v 680 μ F capacitors	electrolytic, store electricity	Rubycon 3M1028
200v 180 μ F capacitor	"	Rubycon 3M1029
35V 47 μ F capacitor	"	Rubycon (no part number)
310V 0.22 μ F capacitor	electrical noise suppressor	X2 LE224
(3) blue capacitors	ceramic, store electricity	
(5) resistors	control the flow of current	
T2.0A/250V fuse	protects the circuit from excessive current	
T3.15A/250V fuse	"	

Panel Board

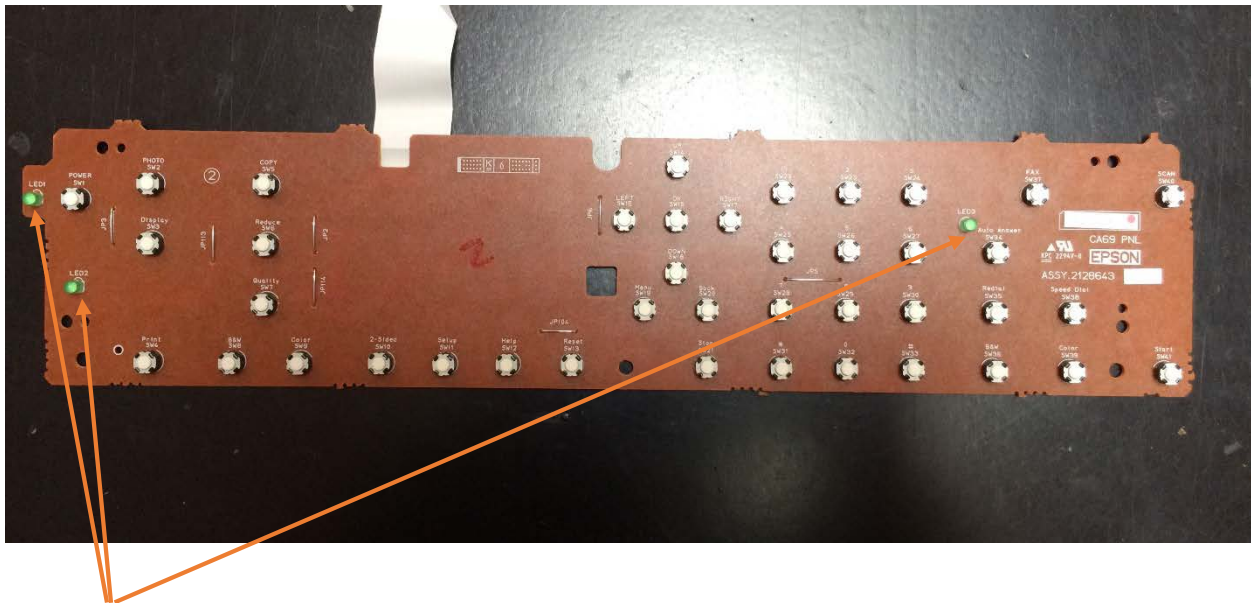
This circuit board lies underneath the front control panel and allows the user to select functions such as copy, scan, fax, dial, menu. The panel board contained five Texas Instrument chips that are parallel load 8-bit shift registers, which convert between parallel and serial data.

Side A



Texas Instruments LV165A Chips

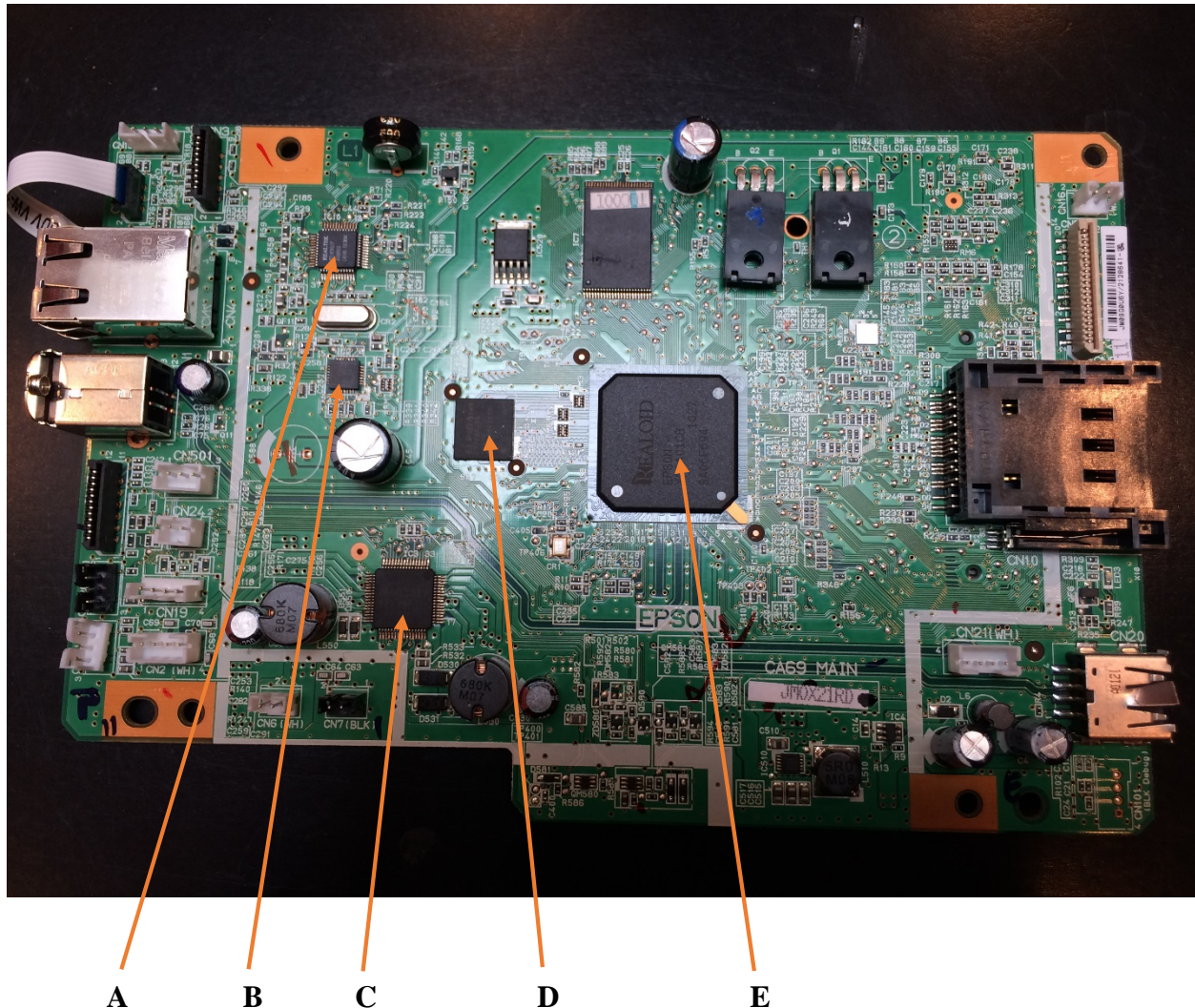
Side B



3 LED indicator lights (power, auto answer on, memory card access) and 41 buttons

Main Board

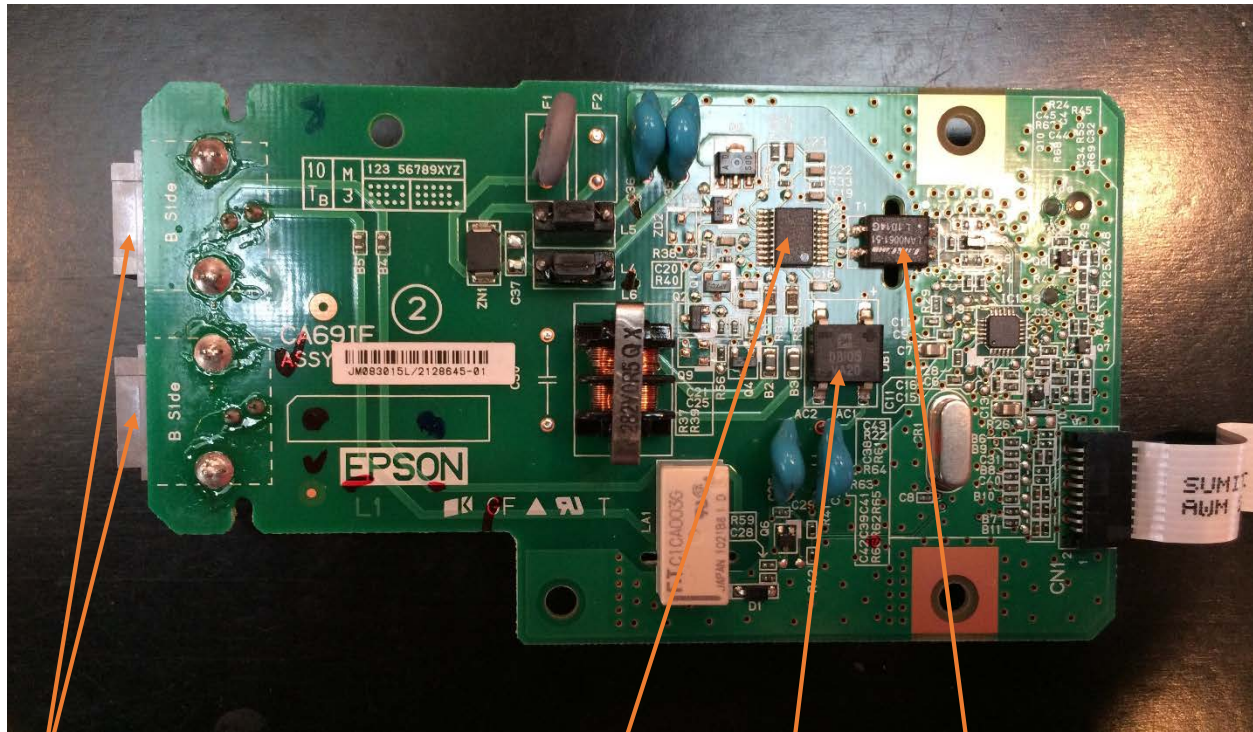
The Main Board functions much like the human brain. It is a center for processing information and much like the brain's thalamus, it relays commands to other areas for further action. (We just learned that in freshman biology.)



Main Board		
Chip	Manufacturer	Function
A	REALTEK RTL 8201CP	Fast Ethernet PHYceiver with selectable Media Independent Interface or Serial Network Interface to the MAC chip
B	ST M29W640GT	Flash memory
C	ROHM BD64532EKV	System driver for inkjet printers
D	ELPIDA E5108AJBG-6E-E	512M bits DDR2 SDRAM
E	REALOID Epson X01901CB 1027 SA06F694	No information could be found. This chip was made by Realoid for Epson. We assume this is the "brain" for the printer.

FAX/Modem Module

This unit allows the printer to use the phone line to send and receive FAX messages.



Phone Jacks

A

B

C

FAX/Modem Board		
Component	Manufacturer	Function
A	LSI CSP1040 DAA	Data Access Arrangement Chip for FAX/modem - allows the telephone network to connect to the modem
B	DB105 VA20	Single phase bridge rectifier - converts AC to DC via 4 diodes inside
C	LinkCom LAN0061-51 L 1014G	SMART-DAA transformer - reduces AC voltage for LSI SMART-DAA Solution

Wireless LAN Module

This board allows computers to wirelessly connect to the printer.

Front



MAC:18F46A30167B

Back



FCC ID: BKMFBSP88W8786
Manufactured by Anatel

Thank you for this opportunity to take a look at the electronics inside a printer!

- VEX Team 8390

