Texas Instruments Electronic Online Challenge 2017

Dell Model 966 All-in-One Printer Disassembly

Team Number #9447A
Team Name: Team Toss Up!
School: Palmetto Scholars Academy

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Final Report:

Our team searched their homes for old electronics and we found a CD player, headphones, CD drive, game controller, and a printer. We chose to disassemble the printer because our members expressed interest in figuring out how these devices work since the insides of a printer are usually hidden by an opaque cover. The device we chose to disassemble was a Dell Printer (model 966) from 2006.

First, we opened all panels and hinges to see what joints, screws, and cables needed to be undone to get to the inside of the printer. The panels were taken off one-by-one from top to bottom. In order to gain a better view of the contents, the print bed and printer trolley were removed from their casing. After locating every board, we carefully removed them from their housing. We examined the chips and documented their respective manufacturer and part numbers. Using this information, we were able to find datasheets to determine the purpose for each chip.

Inside the printer, we found a total of 5 motors. Surprisingly only one of them is a stepper, the other motors are monitored by an optical encoder and a marked disc. The stepper controls the paper feed, while two others assist the movement of paper throughout the assembly. A single motor powered the movement of the scanner on top of the printer. The final motor moves the inkjet trolley along the print bed during printing. We found 4 major PCB (Printed Circuit Board) boards: the main controller board, the modem board, the card reading board, and the LCD/button panel board. On the boards, we found a variety of chips such as the CPU, RAM, some multiplexers and a clock along with a PCI riser for a wireless network card. There were 2 Texas Instruments chips, both identical, on the main board. Since these chips were outdated,

their datasheets and information were no longer available. The team expected to find more stepper motors but we did not expect to find so many smaller electrical components! Some of the smaller elements had such minuscule labels that we used an attachable 30x zoom digital microscope with a built-in LED light for mobile devices. We attached the macro photo lens to an iPhone in order to examine and identify the components.

Our team learned a lot during this process. We chose a printer because we use them quite a lot in robotics, school, and daily life with printing out documents and information. We expected the printer to be complex but we did not realize to such extent. We have a larger understanding of how electrical components work in order to operate a larger system. This project has sparked our interest and we intend to learn more about electrical systems and how they work to create the products we use every day.

Final Summary Word Count: 471 Words

Figure 1: Modem PCB Diagram
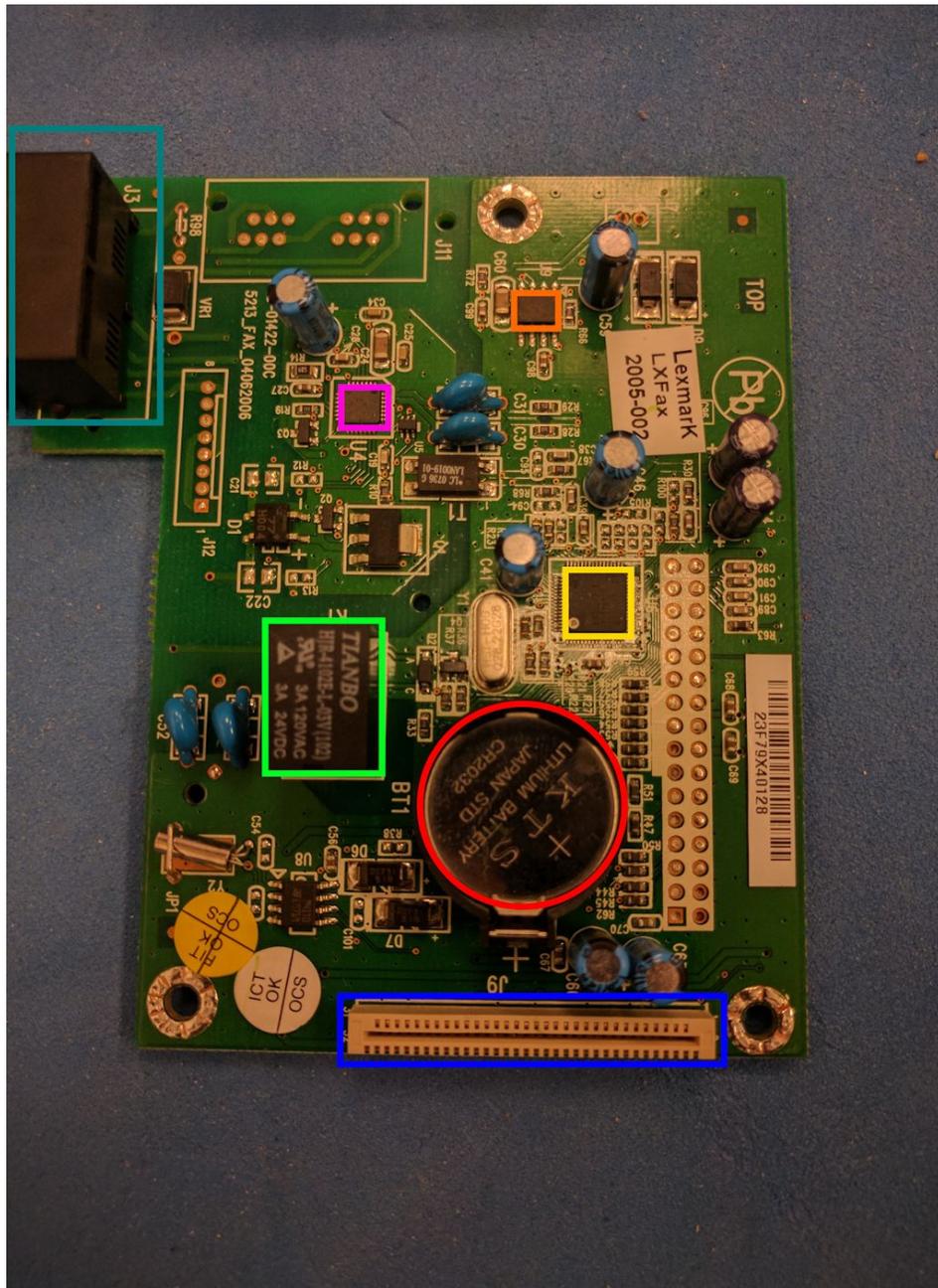
STMicroelectronics Serial Clock   Tianbo Power Relay   Dual RJ11 Jack

Conexant Smart Modem   Modem Battery

LX102974   Connector For Main Board

Figure 2: Main Board Diagram
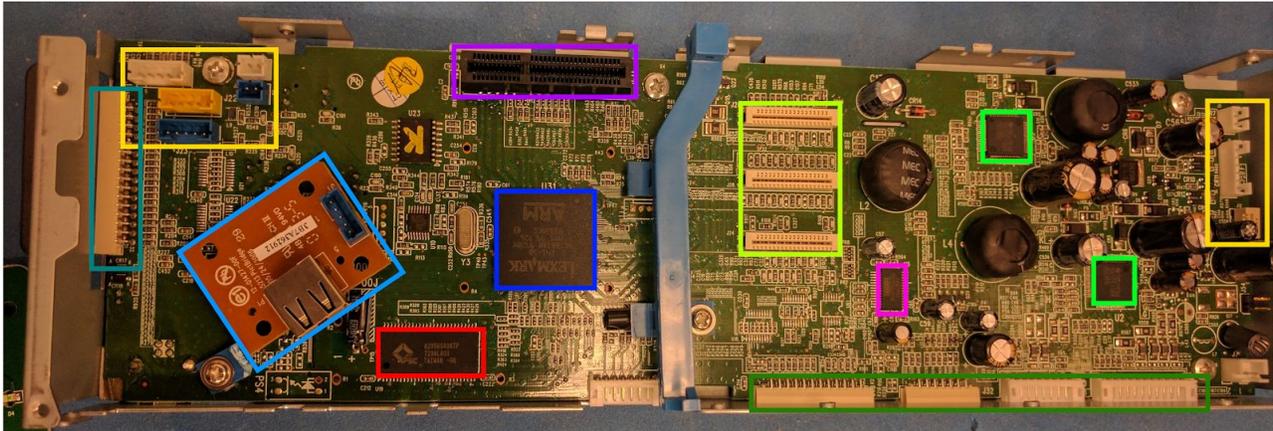
Motor Connections
Modem Board Connector
USB Board
PSC SDRAM Chip
Lexmark ARM CPU

PCIE Expansion Slot (For Wireless Networkd AIC)
Connectors For Trolley, Scanner, and Front LCD
WM Image Digitizer
Texas Instruments SN105108A
Connectors For PSU and Card reader Board

Figure 3: Card Reader Board Diagram
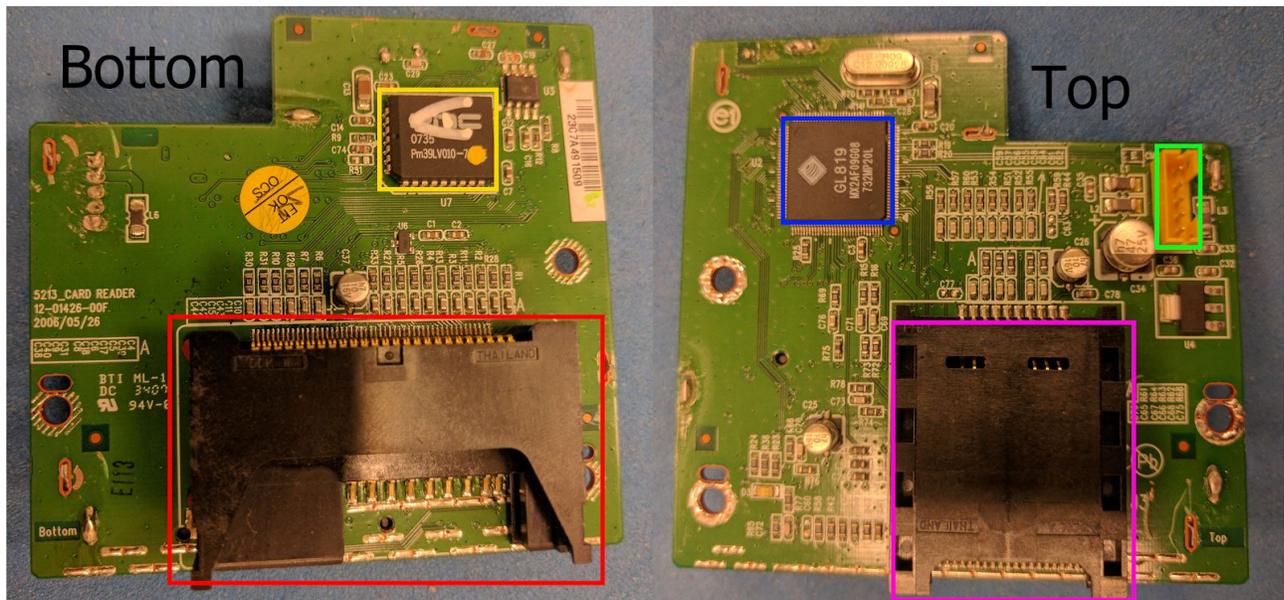
Memory Card Controller Chip
Memory Card Slot

SD Card Controller Chip
SD Card Slots
Connector To Main Board

Figure 4: Front Panel Board Diagram
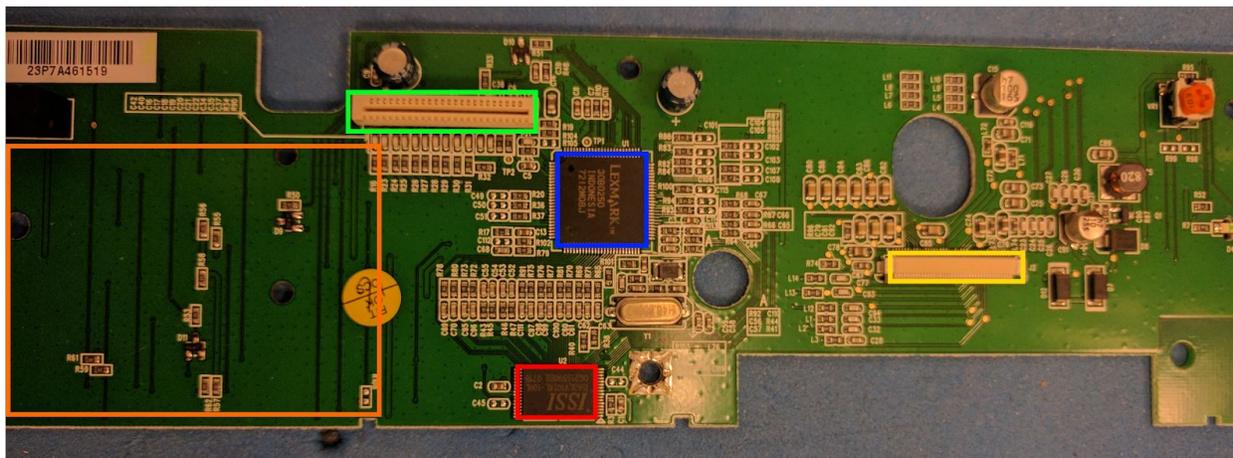
Space For Button Contacts
Main Board Connector
LEXMARK LCD Control Chip
ISSI CMOS RAM
LCD Connector
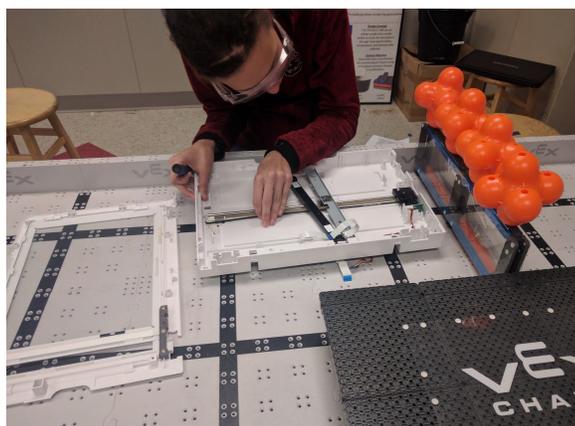
Figure 5 (To left): S. Huffman examines how the optical scanner is secured so she can remove it.

Figure 6 (to left): S. Huffman unscrews a panel. Disassembly took approximately two hours.

Figure 7 (above): K. Capitan examines and identifies the electronic components using an iPhone 30x zoom microscope.

Figure 8: Printer prior to disassembly

Figure 10: Main panels removed

Figure 11: The back panel was removed to gain access to internal components and determine most efficient and safe method to remove the printed circuit boards.
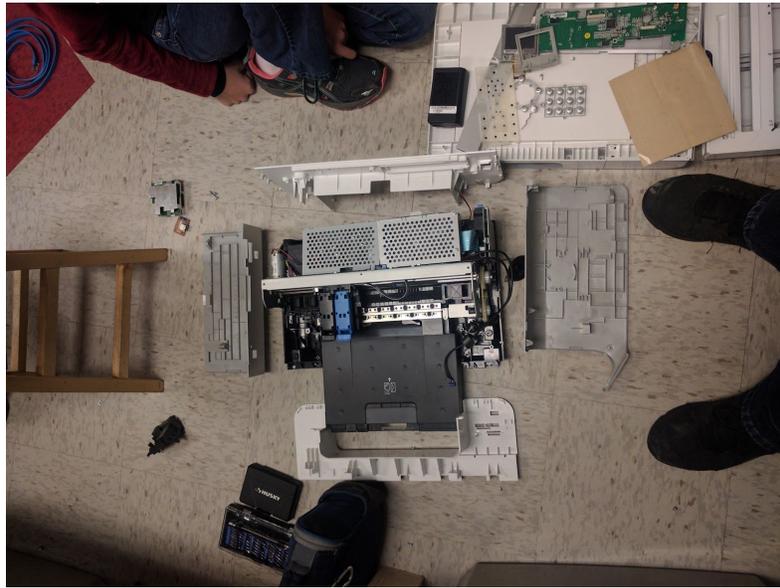
Figure 9: After main housing was removed
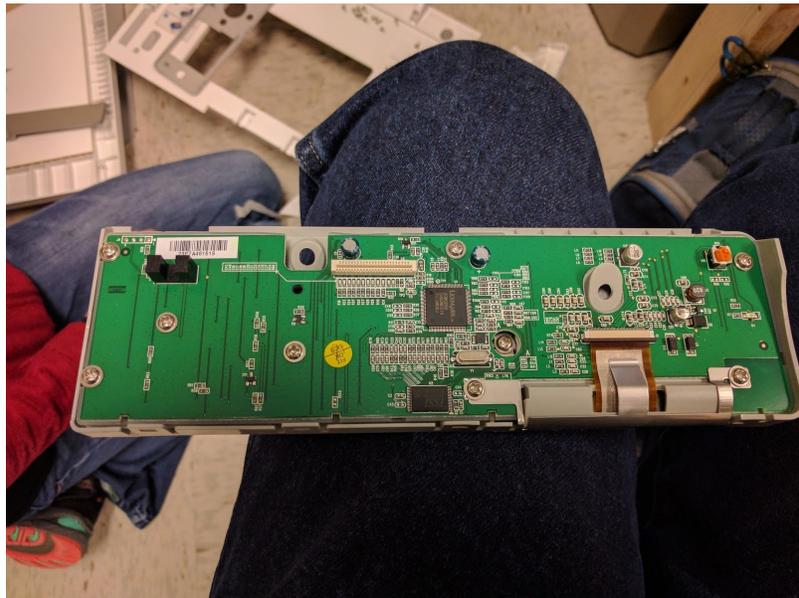
Figure 12: LCD Controller board attached to front panel after being removed

Table 1: PCB Board Components

| Resistors (R)		
Main Controller	928	Function: Adds electrical resistance to the circuit to reduce current.
Card Reading	79	
Modem	105	
LCD / Button Panel	105	
Total	1217	
Capacitors (C)		
Main controller	565	Function: A passive component that can store a small charge and discharge quickly. It can be used to remove noise or make a supply voltage more stable.
Card Reading	79	
Modem	99	
LCD / Button Panel	119	
Total	862	
Integrated Circuit Chips		
Main controller	31	Function: These chips are circuit boards shrunk into a small chip and can have many different uses.
Card Reading	7	
Modem	8	
LCD / Button Panel	2	
Total	48	
Coils, Inductors, & Ferrite Beads (L)		
Main controller	39	Function: Passive component used to resist changes in the electrical current
Card Reading	3	
Modem	11	
LCD / Button Panel	2	
Total	55	

Connectors (J)		
Main controller	39	Function: Connection points to other boards and components
Card Reading	6	
Modem	5	
LCD / Button Panel	75	
Total	125	
Oscillator (Y)		
Main controller	3	Function: A component that generates a periodic, oscillating signal, usually in the form of a sine wave or square wave. Convert DC signals to AC signals.
Card Reading	1	
Modem	2	
LCD / Button Panel	1	
Total	7	
Diode (D)		
Main controller	1	Function: A passive 2 terminal component that only lets current flow one direction.
Card Reading	0	
Modem	11	
LCD / Button Panel	12	
Total	24	
Battery (BT)		
Main controller	1	Function: Provides power to chips without the need for power from the power supply, or lets them run continuously during power interruptions.
Card Reading	0	
Modem	1	
LCD / Button Panel	0	
Total	2	
Transformer (T)		
Main controller	0	Function: A component used to

Card Reading	0	raise or lower voltages and current in a circuit.
Modem	1	
LCD / Button Panel	0	
Total	1	
Voltage Regulator (VR)		
Main controller	0	Function: An electromechanical component used to always give a desired voltage out, despite
Card Reading	0	
Modem	2	
LCD / Button Panel	1	
Total	3	
Transistor (Q)		
Main controller	29	Function: A semiconductor used to amplify or switch electronic signals.
Card Reading	0	
Modem	4	
LCD / Button Panel	0	
Total	33	
Switch (SW)		
Main controller	0	Function: Used to detect when the front panel buttons were pressed by connecting a circuit with conductive material on the bottom of the button.
Card Reading	0	
Modem	0	
LCD / Button Panel	29	
Total	29	
Power Supply (PS)		
Main controller	4	Function: Supplies a steady source of power to other components on the board.
Card Reading	0	
Modem	0	

LCD / Button Panel	1	
Total	5	
Fuse (F)		
Main controller	7	Function: A sacrificial device used to prevent dangerous overcurrent.
Card Reading	0	
Modem	0	
LCD / Button Panel	0	
Total	7	

Table 2: Chip Information

Count	Manufacturer	Part No.	Purpose	Datasheet	Image
2	Texas Instruments	SN105108A	150mA Single Output Low Dropout Regulator	_____	
1	Wolfson Microelectronics	WM8196 SCDS	16 bit analogue front end digitizer IC - Talks to CCD Sensors or Contact Image Sensors	Link	
1	Powerchip Semiconductor	A2V56S40BTP	SDR SDRAM	_____	
1	System Logic Semiconductor	HC4053	Analog Multiplexer / Demultiplexer	LINK	
1	Lexmark / ARM	VG7087809920X	Central Processing Unit	_____	
1	_____	5142 / 2ANKY	_____	_____	_____

1	Lexmark	30B0250	————————	———	
1	Integrated Silicon Solution Inc	IS63LV1024L	128K x 8 High Speed CMOS static RAM 3.3V	LINK	
1	CX	LX102974	————————	———	
1	STMicroelectronics	M41T0	Serial Real Time Clock	LINK	
1	CONEXANT	20493-31	Smart V.XX Modem	LINK	
1	PAIRUI	LMSA6L	Constant Current LED Drivers	LINK	
1	_NC (Chip Marked On)	0735 / PM39LV01071-16 E	————————	———	
1	Genesys Logic	GL819	USB 2.0 Controller / SD Card Reader	LINK	

Table 3: Other Components

System	Quantity	Product Name (Manufacturer)	Part Number	Function	Image

Motion	1	Stepping Motor (MITSUMI)	M42SP-6P P7830	6.8 ohm motor Feeds paper	
	2	Motor	——————	Guides Paper	
	1	Motor	HC385XL6 1030261 3H2812 33	Moves inkjet trolley	
	1	Motor (Ruhlatec)	RK-370CA-14445 TD107121	Moves Optical Scanner	
	3	Pioneer Rubber Belt	0721-0731 138 0721-0731 139 0721-0731 140	Allows movement of desired components	
Structure	1	Frame ADF	54-07236-00A 5213 ABS	Paper feeder	
	1	PVA Cover	ABS B# 54-07523-00A	Cover	
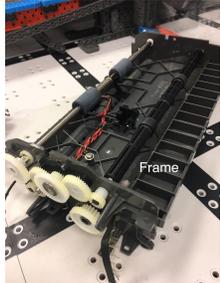
	1	Front Cover	54-07541-00A 5213 ABS	Front Cover	
	1	Top Housing	54-07549-00A 5213 B# ABS	Housing	
	1	Document Guide	54-07537-00A 5213 A1 ABS	Used to keep the Pages on track	
	1	Document Tray	5213 A1 54-07536-00A HIPS	Guides Pages	
	1	ADF Rear Cover	54-07504-00A 5213 A-2 ABS	Cover	
	1	ADF Front Cover	54-07503-00A A-2 5213 ABS	Cover	

	1	Guide Down	54-075242-00A HIPS 5213 A1	Guide Pages	
	1	Top Cover	54-07561-00A CAV B-1 HIPS 5213 ABS	Cover	
	1	Scanner Lid	A# 5213 54-07538-00A ABS	Closes while paper is scanned	
	1	OP Base Cover	B# 5213 54-07542-00A ABS	Cover	
	1	Inner Frame	A# 5312 ABS 54-07218-00A	Inner Frame to hold print bed	
	1	OP Panel	A1 ABS 5213 54-07524-00A A2 HIPS	Button Panel	
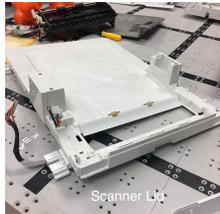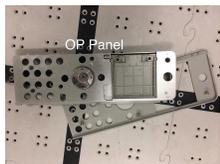
	1	Scanner Base	5213 - B# 54-07534-0 0A ABS	Base	Scanner Base
	1	Cover-Network DEC A1	54-07760-0 0A ABS	Network Expansion Slot Cover	———————
	1	Drawer Paper Input	5213 5203 A4 HIPS B#	Paper Input Drawer	Drawer Paper Input
	1	Back Cover (AIo)	54-07539-0 0A 5213 A2 ABS	Cover	Back Cover Aio
	1	SD card reader board mount	A3 HIPS	SD card reader board mount	
	1	Paper Exit Tray Extender	5213 A4 54-06135-0 2A	Holds paper after it has printed	Paper Exit Tray Extender
	1	Inkjet Trolley	A2 5213	Applies ink to page to form words and images	Cartridge Trolley
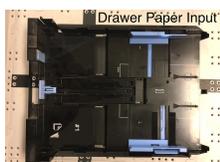
	1	Cover Exit Tray	5213 A-2 HIPS	Guides paper	Cover Exit Tray
	1	Foam tray	NA	Protects glass on the scanner/gives white background for scans	
	1	Right cover	54-07512-00a HIPS	Provides support for the right side of the printer	Right Cover
	1	Left Cover	54-07540-00A	Provides support for the left side of the printer	Left Cover
	1	Scan Left Warp Cover	54-07535-00A	Cover	Scan Left Warp Cover
Electrical	1	Main Controller Board	————	————————	Figure #2
	1	Card Reader/ USB Port	————	————————	
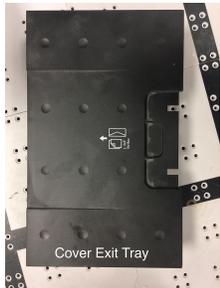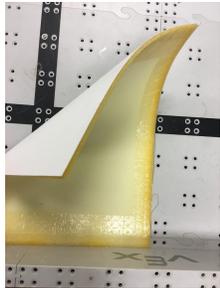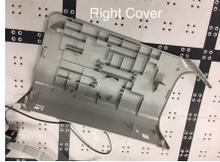
	1	LCD/ Front Button Panel Controller	————	Displays printer options and other information	
	1	Modem Board	————	————————	Figure #1
	1	Color Sensor	KAR00046	Allows images to be printed in color	————————
	2	Encoder	12-01425-00D 5312 3F7A362666	Paper Feed Encoder And inkjet trolley encoder	
	1	Optical Scanner (Asia Tech Image Ink China)	CM218CF A14 AD738A29 083	Scans documents and/or pictures	
	1	AC Adapter (Delta)	21H0302	Provide power to the printer	————————
	1	Speaker	KS502807	Provides sound	
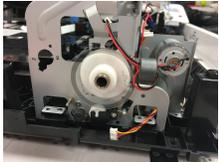
*horizontal lines indicate the information was not available or could not be located.