



Texas Instruments Online Challenge 2018

HP StorageWorks SDLT 320 External Tape Drive

Team 7447B Retribution



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River Bowling, Bentley Beavis

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When we chose to enter the Texas Instruments Online Challenge, we wanted to be sure that we were going to be deconstructing something that would be interesting for both us and the people who would be viewing our project. In order to obtain something that could accomplish this, we went to a local company's IT department and asked if there was anything that they would be willing to part with. That is how we ended up with the HP StorageWorks SDLT 320 External Tape Drive. It is a tape backup for an industrial server that keeps a record of data on tapes similar to cassette tapes. It is an older piece of technology that saw its highest use in the late 90's and early 2000's and is no longer widely used due to disk backups and cloud storage. None of us had ever seen one of these before so we had no idea what we would find inside of it. After removing the two metal shells that protected the electronic components, we were pleasantly surprised by the amount and diversity of the components found. There were some things that we could identify immediately such as the 4 motors, the laser that was used for data inscribing, the capacitors, fuses, resistors, and a few of the other small parts. For the most part though, we had to look up almost all of the parts we found on the circuit boards and the actual names of the subsystems that interacted with the tape such as the head and guide system and the take-up reel. Due to the age of the system, many of the electrical parts were hard to identify by their serial numbers since there were no data sheets available for the parts online. We were still able to identify most of them and found various brands of including Samsung, Motorola, Quantum and Texas Instruments. We almost missed the Texas Instruments components because the symbol was so small, but after we were able to identify it, we found a total of 31 components produced by them. There were so many electrical components that we organized them into a parts list so that we would be able to easily identify their maker and what they do. If there were any unlabeled components, they had already been labeled in the same or previous diagram, had

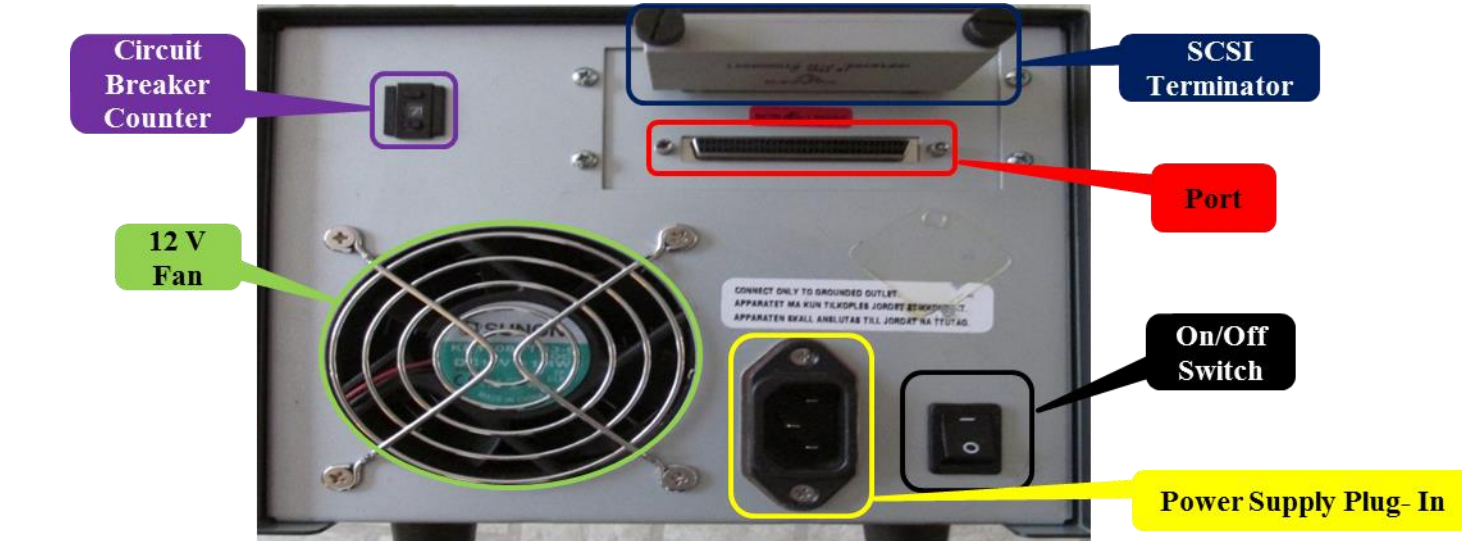
no markings that could identify them, or are likely integrated circuits whose function could not be determined. Throughout the project we learned many things that we most likely would not have gotten to unless we were in a workplace environment. It was nice to be able to teach ourselves about the workings of this device and what some of the components do. Though the technology inside may be outdated, newer versions of the electrical components can be found in almost any electrical device, and it was cool to be able to see how most components have not varied much over the years.



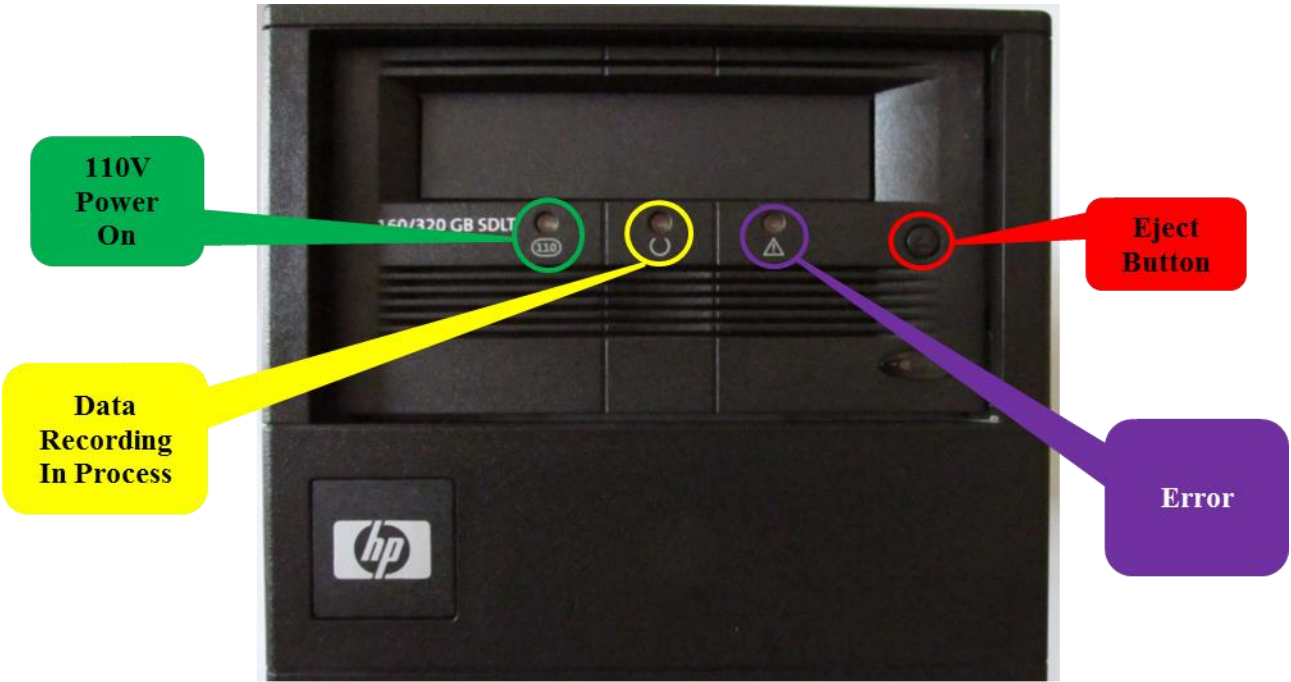
Top



Bottom



Back



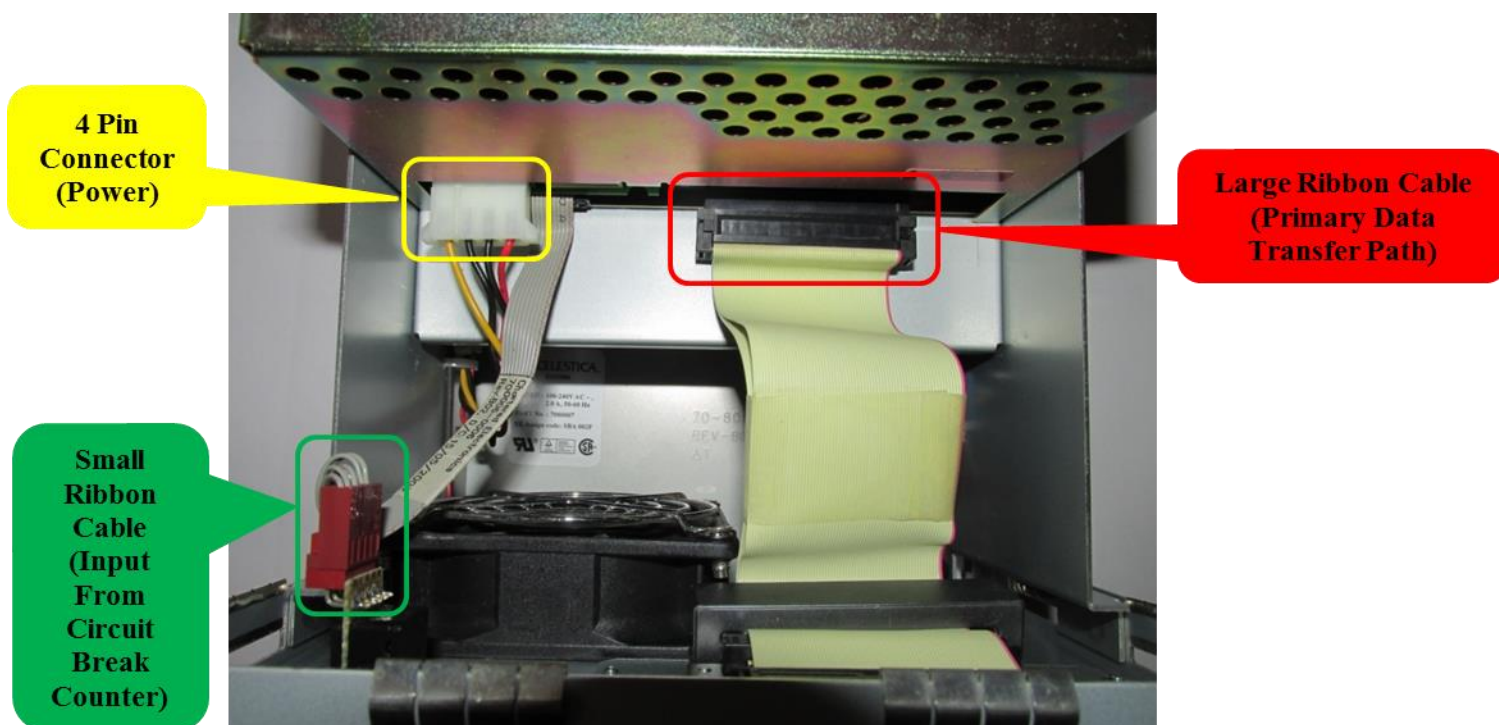
Front



Side



Top

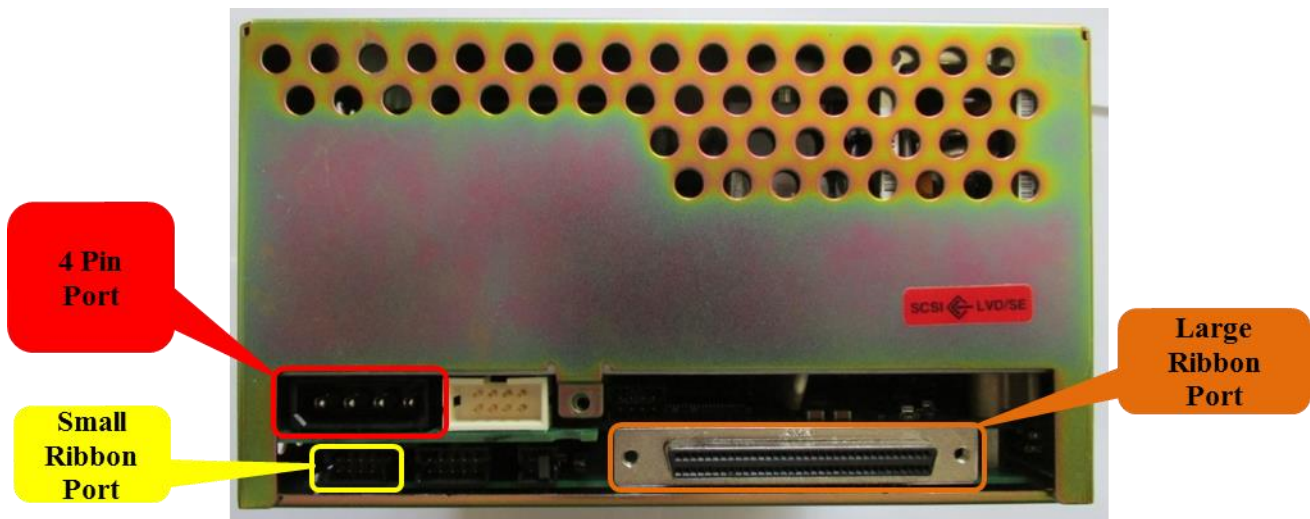




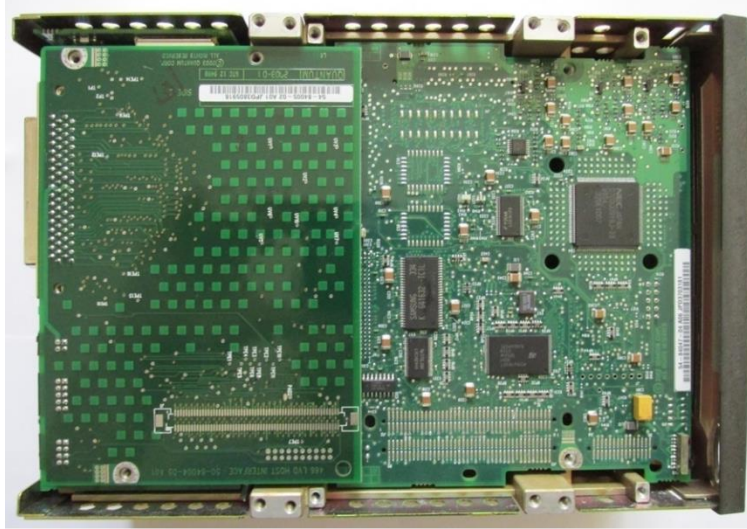
Top



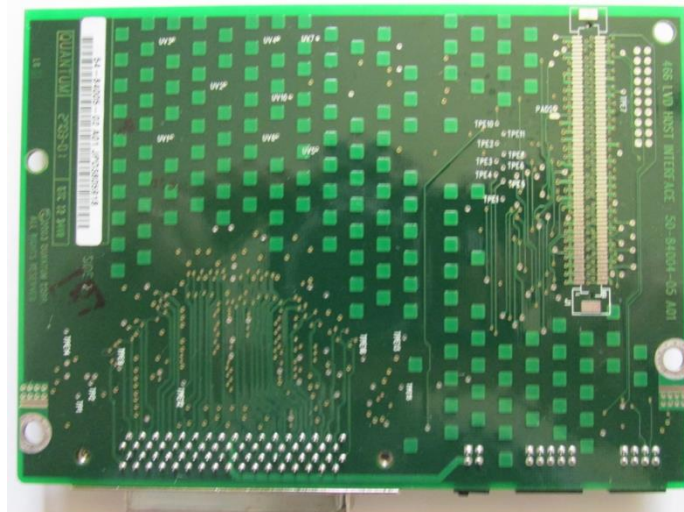
Side



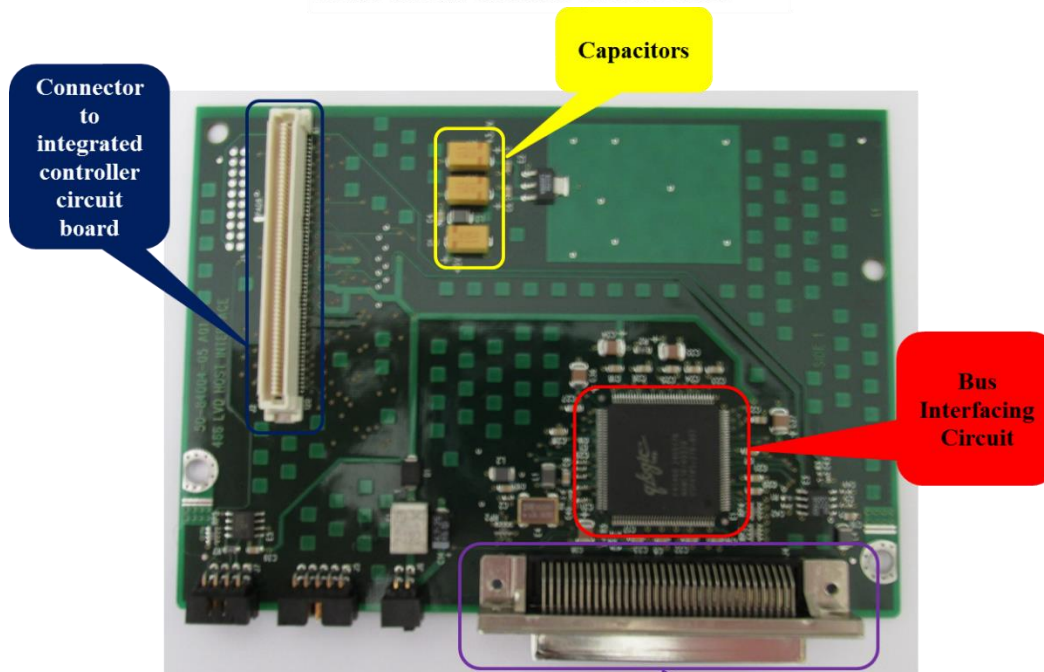
Back



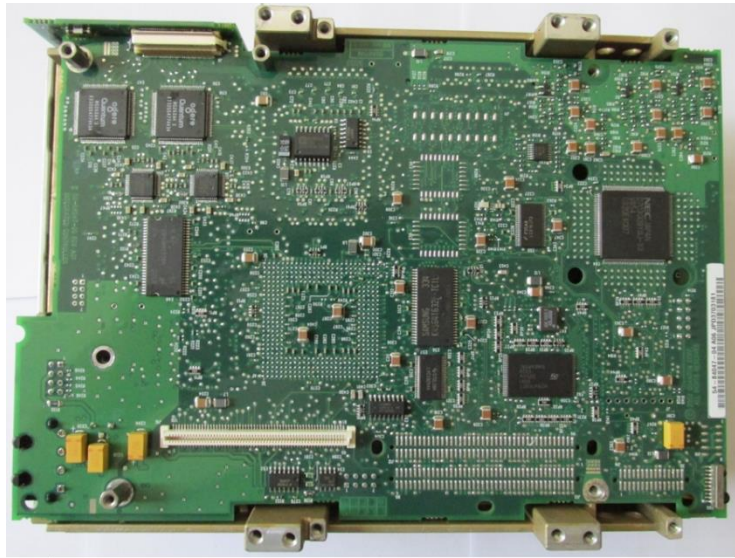
Bottom View After the Second Shell is Removed



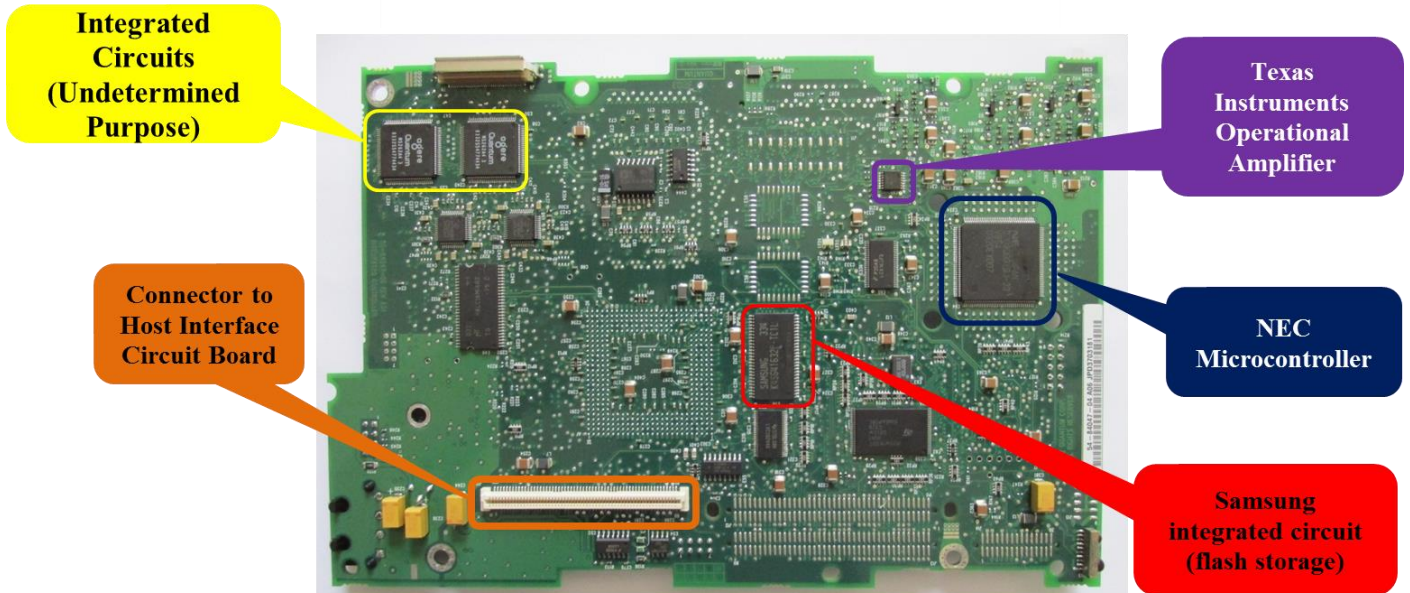
Front of Host Interface Circuit Board



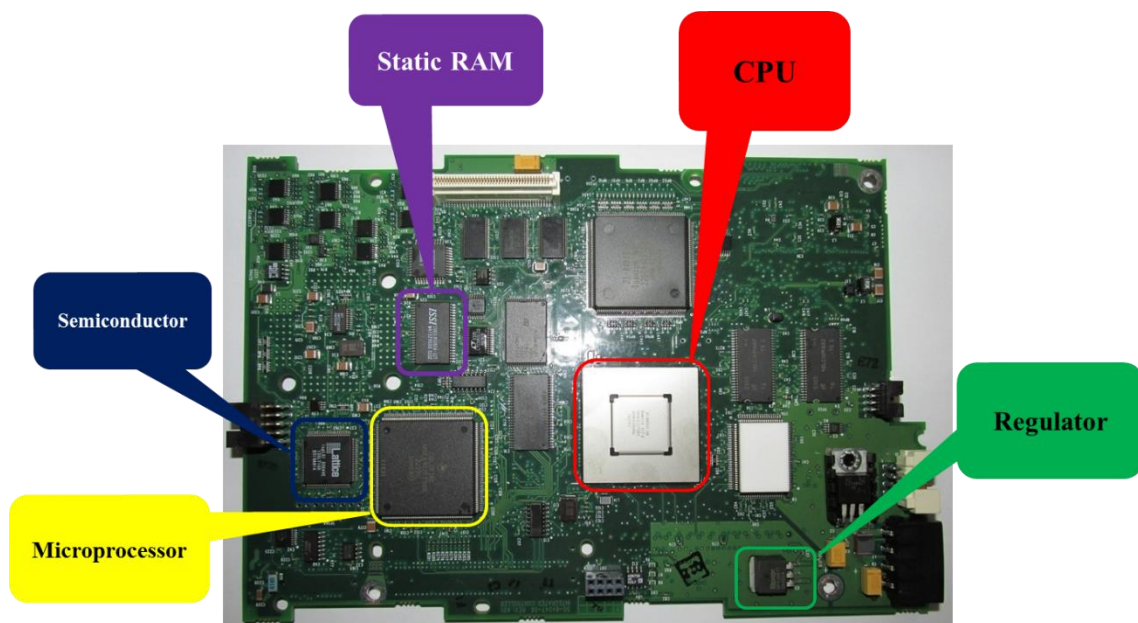
Back of Host Interface Circuit Board



View After Host Interface Circuit Board was Removed



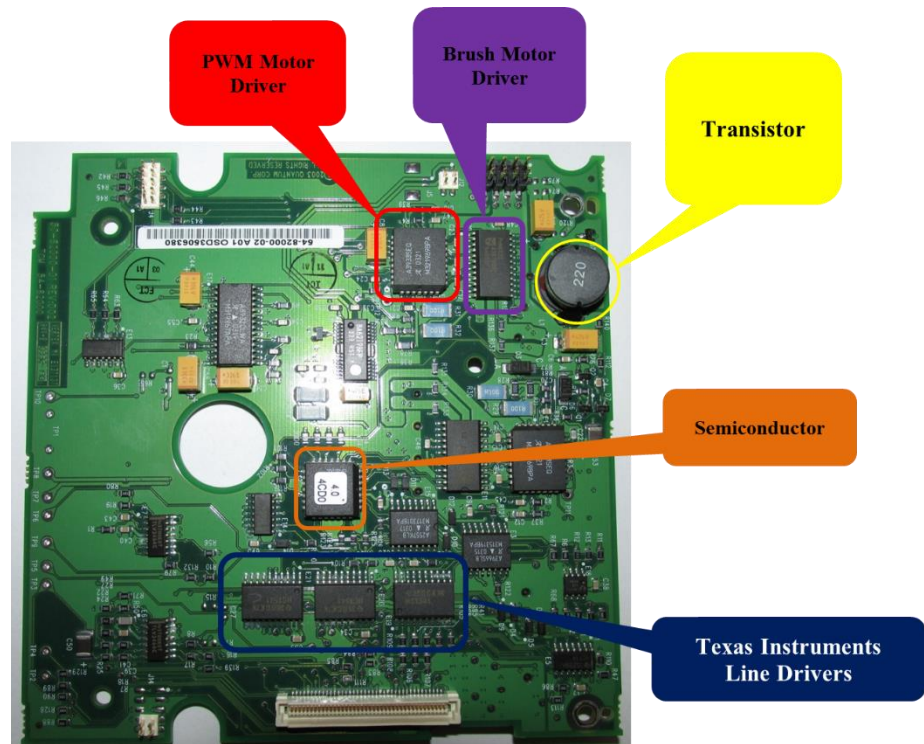
Integrated Controller Circuit Board Front



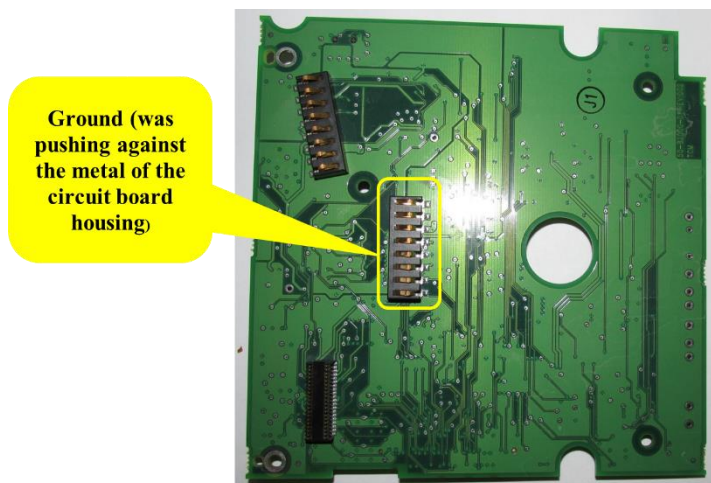
Integrated Controller Circuit Board Back



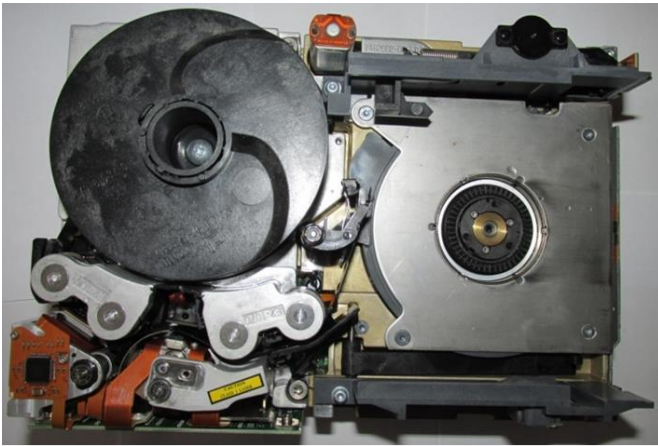
View After Integrated Controller Circuit Board Removed



Unspecified Circuit Board Front



Unspecified Circuit Board Back

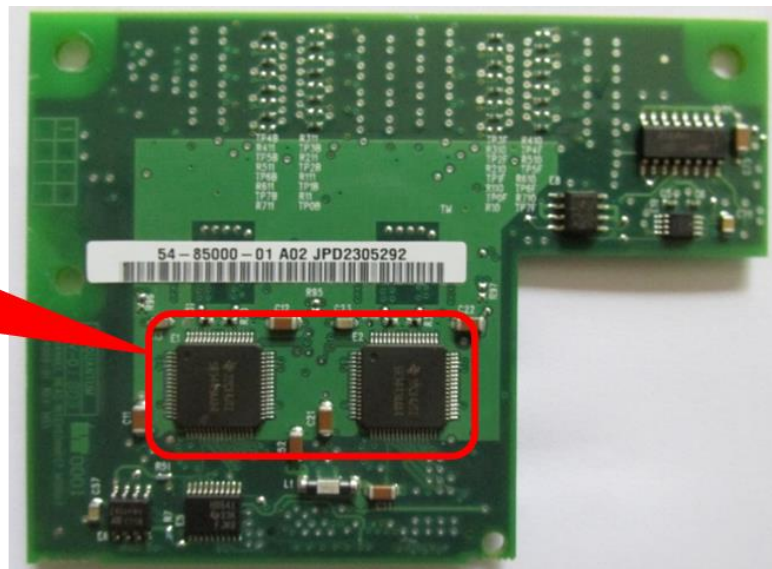


Top View After Second Shell Removed



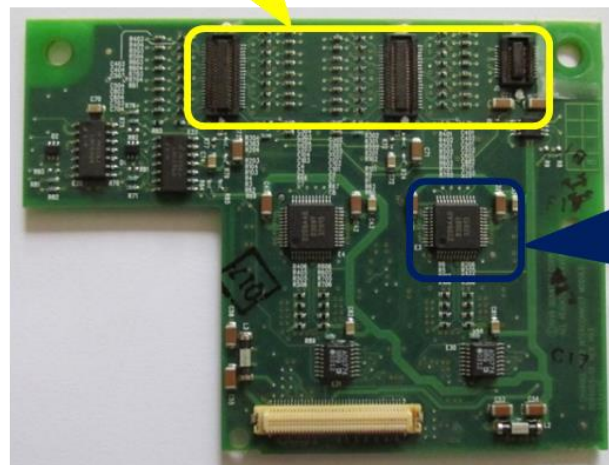
Side View After Second Shell Removed

**Texas
Instruments
Integrated
Circuit**



Front of Head Interconnect Module

**PCB
Connection
Points**

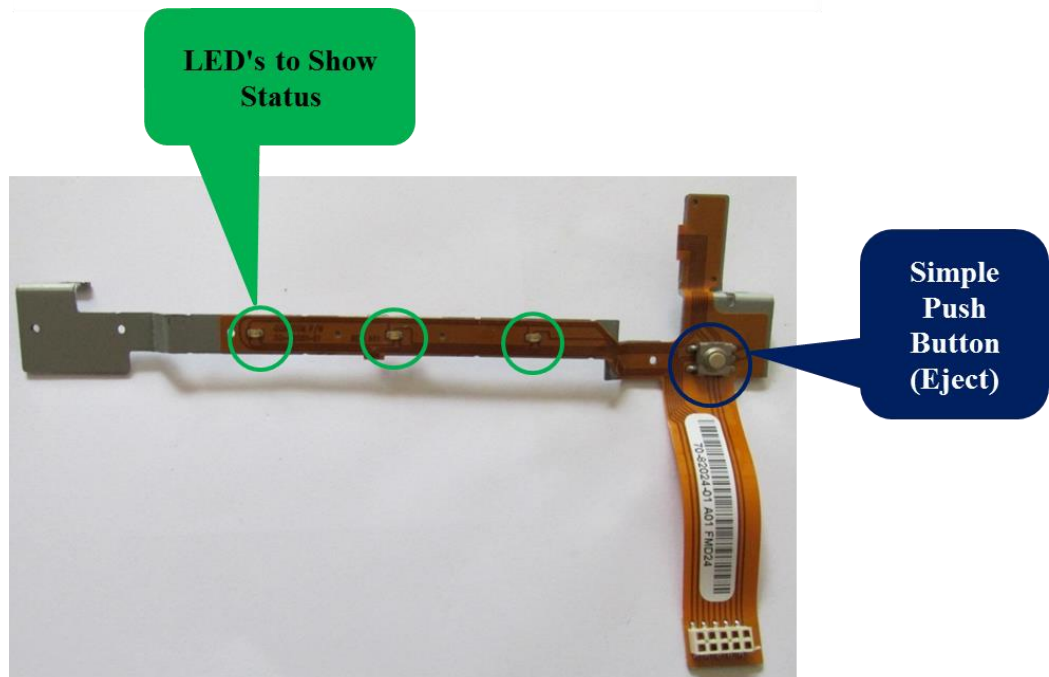


**Texas
Instruments
Integrated
Circuit (Not
Marked with
Logo, Serial
Number
Lookup
Required)**

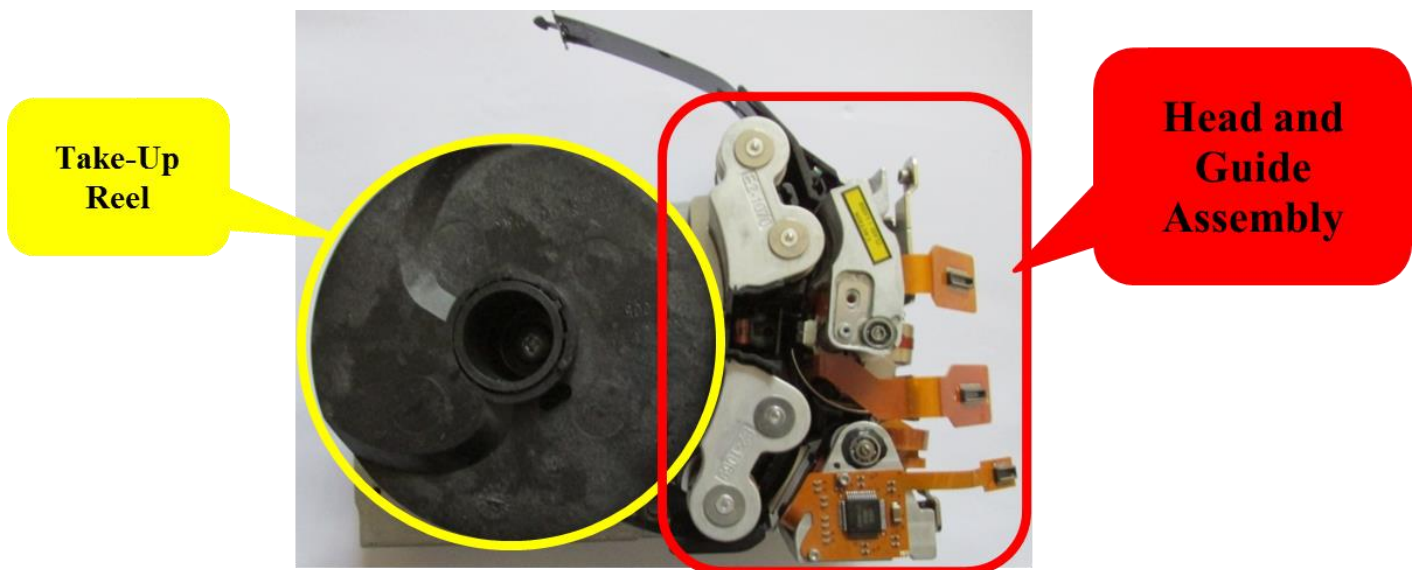
Back of Head Interconnect Module

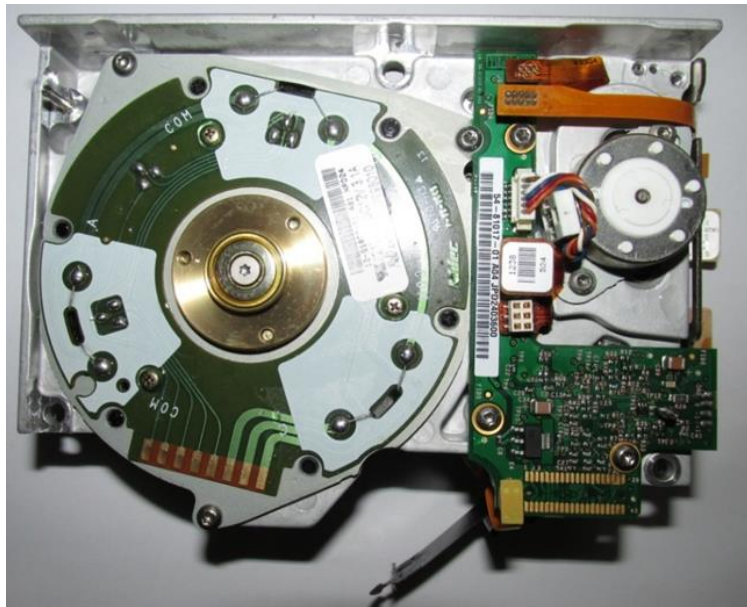


Front View After Second Shell Removed



PCB With Status LED's and Button

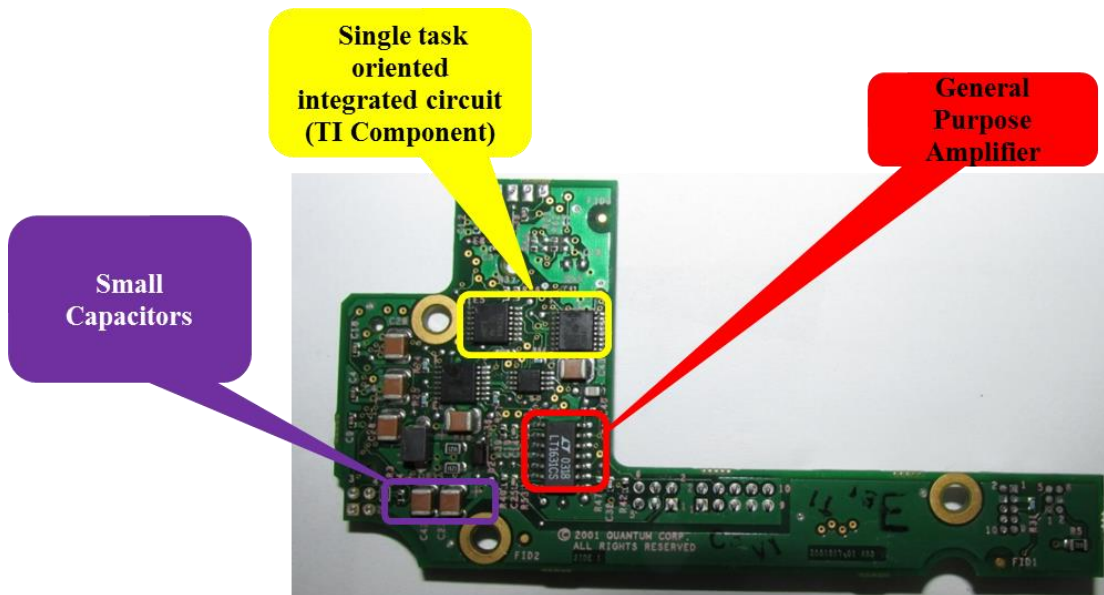




Bottom of Head and Guide Assembly and Take-Up Reel



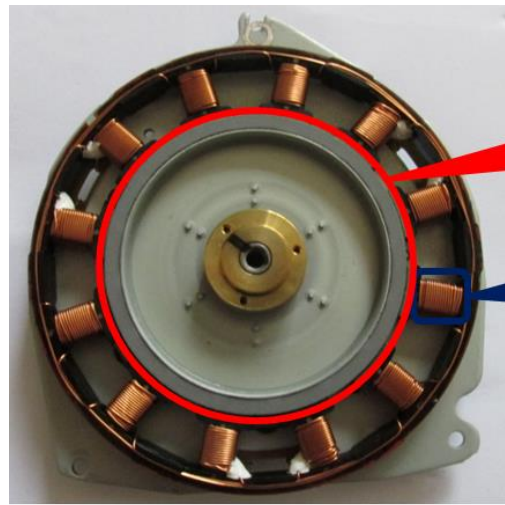
Front of Small, Unspecified Circuit Board



Back of Small, Unspecified Circuit Board



Thin, small motor used to turn the take-up reel



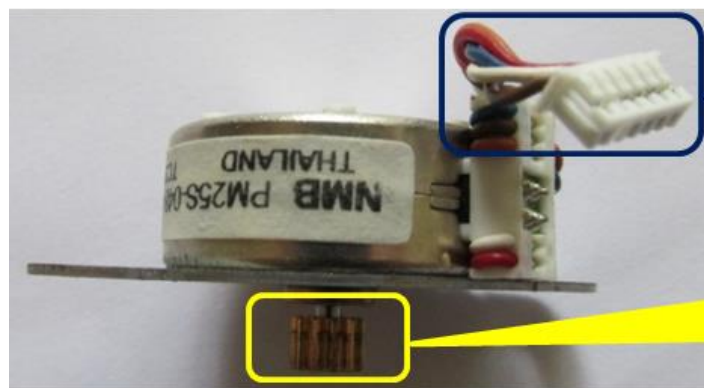
Rotating Center
(Turned By Magnetism)

Copper Wire
(Used to Make Magnetic Field)

Back of Motor



Take-Up Reel

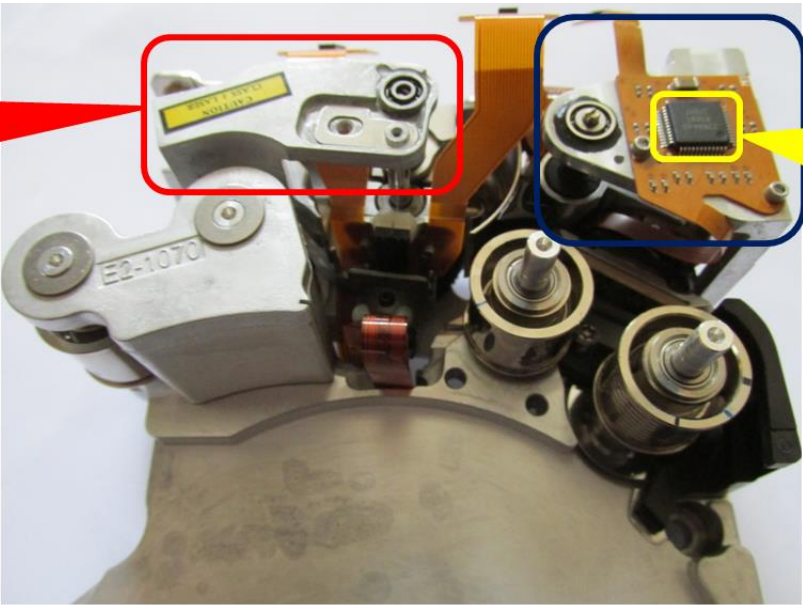


Power Supply for Motor

Small Driven Gear (12 Tooth)

Voice Coil motor that turns the gear beneath the subsystem containing the laser and tape reader

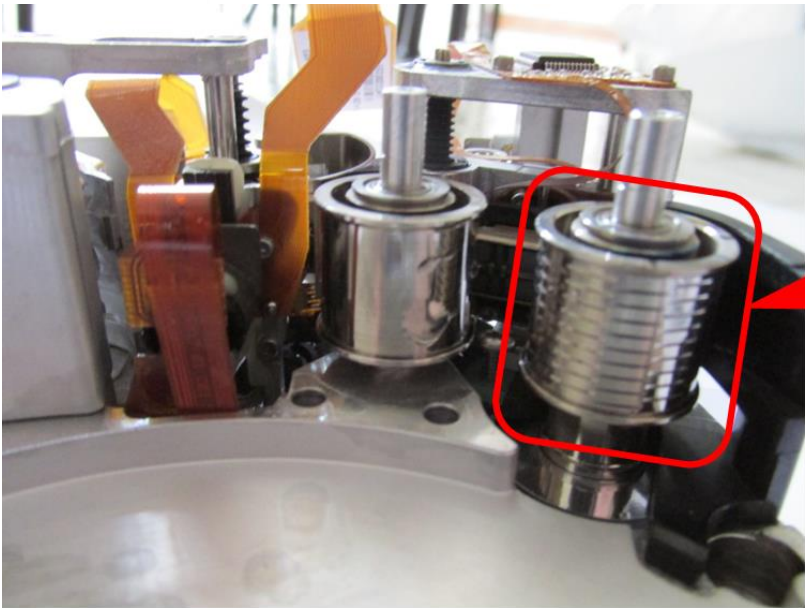
Laser Subsystem
(Used for writing the data onto the tape)



Unmarked Texas Instruments Integrated Circuit

Tape Subsystem

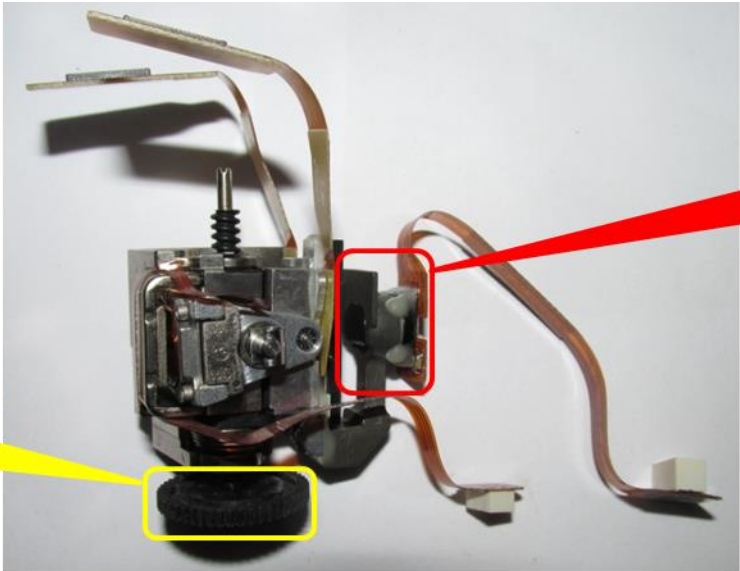
Head and Guide Subsystem



1 of 4 rollers in the head and guide assembly that keeps the tape straight and taut.

Close-Up of Head and Guide Subsystem

Gear that allows laser subsystem to rise and lower



Small Class 1 Laser

Laser Subsystem

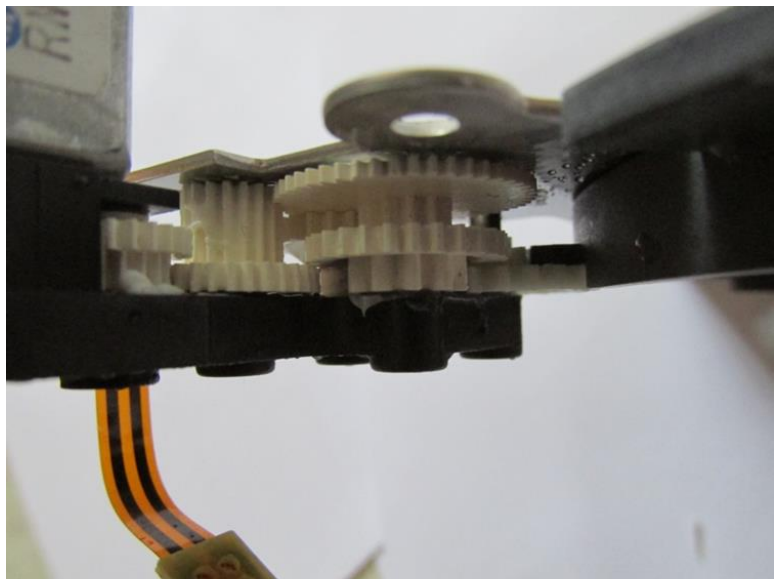


Brush Motor

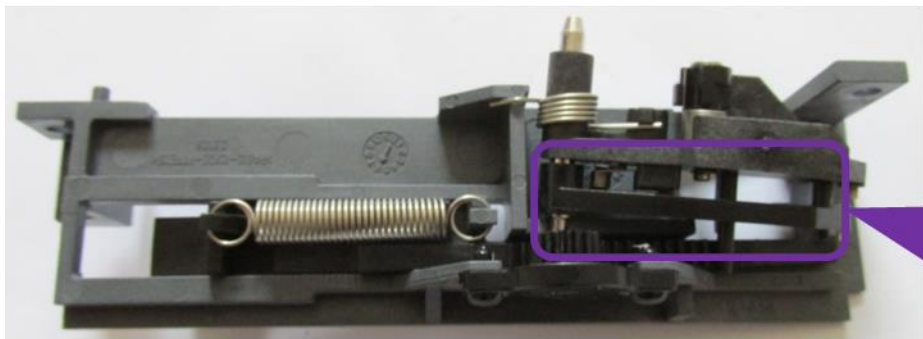
Tape Plateau (where the inserted tape cartridge sits)



Bottom of Tape Plateau

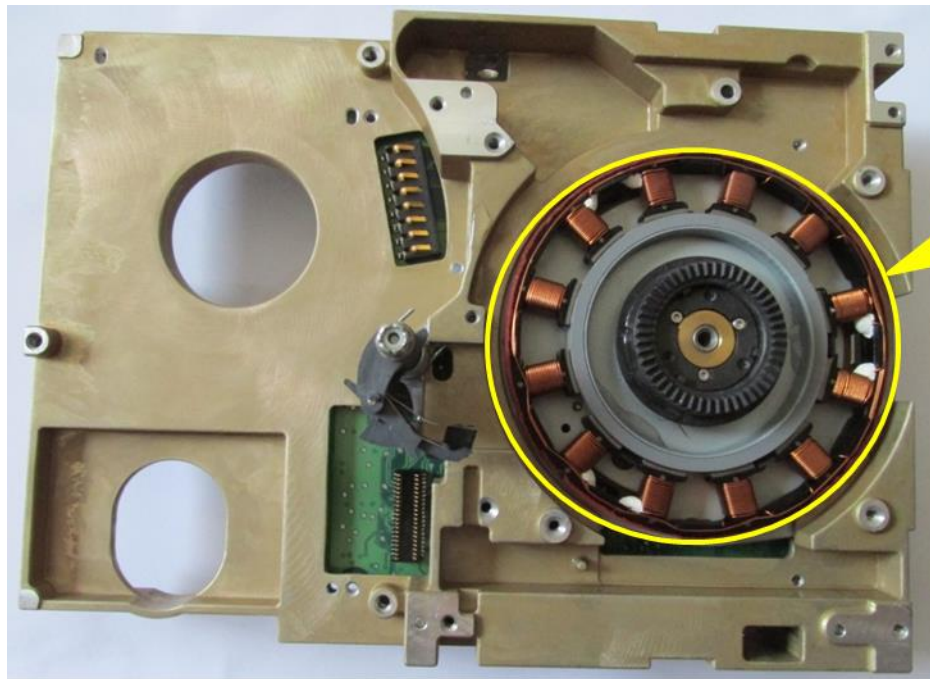


Close-up of the gearing on the tape plateau

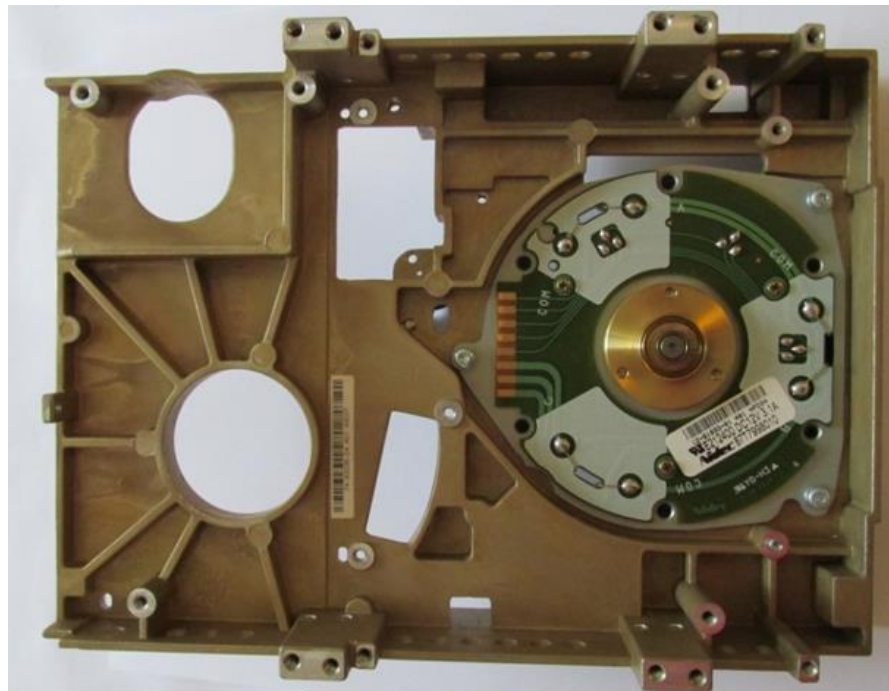


Ratchet gear that allows the tape cartridge to only turn in one direction unless the ratchet is pulled back.

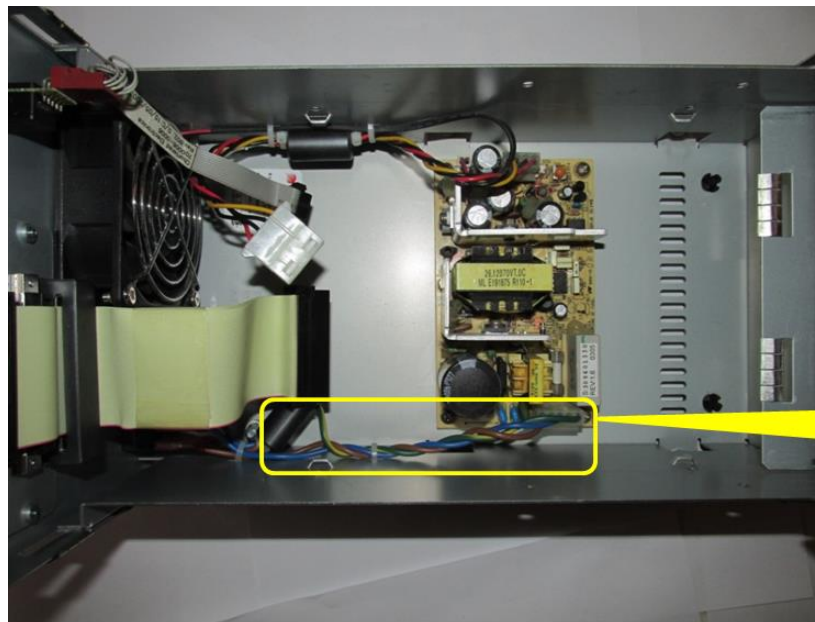
Ratcheting Gear Housing



Top of What is Left After Tape Plateau and Head and Lead System is removed

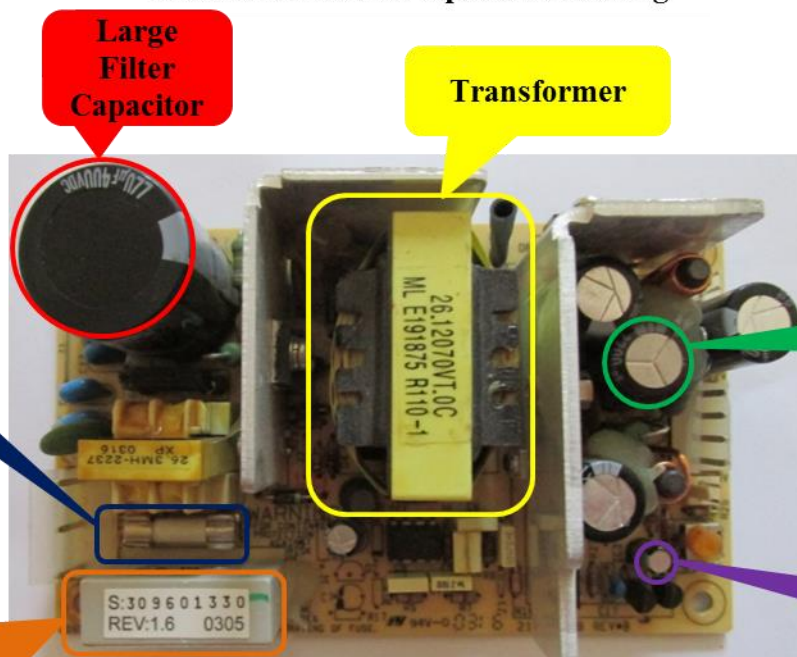


Bottom of the Leftover Support Metal



Power
Supply
Cord

Bottom of external tape drive housing



Large
Filter
Capacitor

Transformer

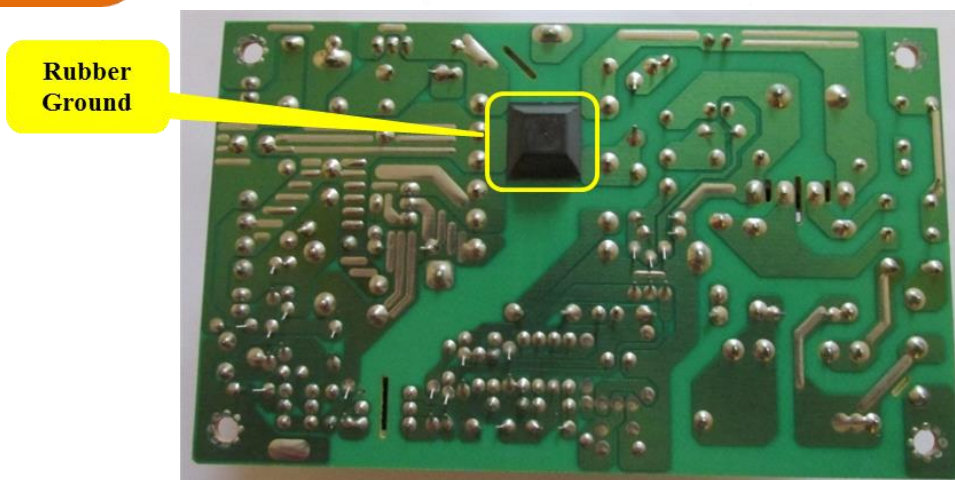
Fuse

Medium
Filter
Capacitor

Tells Specs for
Entire Power
Supply
(Model,
Voltage,
Watts, and
Input/Output)




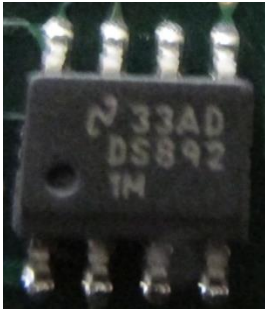
Small Filter
Capacitor





Top Power Supply










Rubber
Ground




Bottom Power Supply




Part Picture	Part Name	Manufacturer	Serial Number	Function	Quantity
	Rail-To-rail Input/Output Operational Amplifier	Texas Instruments	TV2454 Three Variants:D8X1, HDC4,and EJ9H	These electrical components are used when low voltage is available at the input but a range of voltages are needed at the output.	13
	General Purpose Amplifier	Linear Technology	LT1631CS	Produces an output voltage which is several times larger than the input voltage.	1
	Fast Architecture SCSI Processor	QLogic	FAS466	Allows the SCSI storage device to communicate with the operating system across a SCSI bus.	1
	Differential Line Driver	Texas Instruments	DS8921M	Communicate digital signals across circuit-board traces and cables.	1






	Diode	International Rectifier	IR1F	Two-terminal electronic component that conducts current primarily in 1 direction, having high resistance one direction and low resistance in the other direction.	1
	Synchronous Dynamic Random-Access Memory (SDRAM)	Samsung	K4S641632F-TC1L	Type of memory that synchronizes itself with a systems clock, allowing it to run at higher speeds than other memory types.	2
	Zero Delay Buffer	Cypress Semiconductor Corporation	CY2305	Electrical component that fans out a single clock signal into multiple clock signals with no delay.	1
	152-Bit Static Ram (SRAM)	Integrated Silicon Solution Inc.	IS61LV12816	It is random access memory that retains data as long as power is being supplied and is faster than DRAM.	1



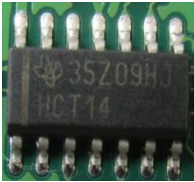
	Low Voltage Single Supply Flash Memory	ST Microelectronics	M29W400BT	Type of storage that can retain data in the absence of a power supply	1
	16 Bit Buffer/Driver	Texas Instruments	LVC16244A	Designed specifically to improve the performance of 3-state memory access drivers, clock drivers, and bus oriented receivers and transmitters.	3
	N/A	Quantum	MS262A4	N/A	2
	Low Dropout Voltage Regulator	Sipex	SPX1587T	Used to regulate an output voltage that is powered from a higher voltage input.	1
	Quad 10-Bit Digital-to-Analog Converter (DAC)	Analog Devices	AD7809BST	Converts binary or digital code into an analog signal.	1





	High Density Programmable Logic Device (PLD)	Lattice	135LT100	Used to build reconfigurable digital circuits, a PLD has an undefined function at the time of manufacturing and must be programmed before use.	1
	Integrated Microprocessor	Motorola	MCF5307FT90B	Is a multipurpose digital-integrated circuit which receives binary data as input, processes it according to instructions stored in its memory, and provides results as output.	1
	N/A	Texas Instruments	78L05A	N/A	1
	Microcontroller	NEC	D703009YGJ-33	Computer present in a single integrated circuit which is dedicated to perform one task and execute on specific application.	1



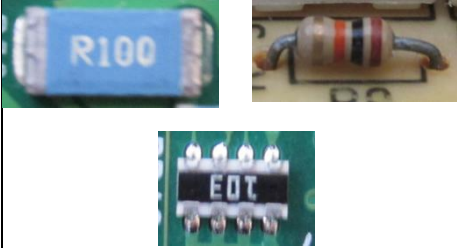
	Low Voltage 2-Input AND Gate	Fairchild Semiconductor	LCX08	A digital logic gate that implements logical conjunction. If both of the inputs are high, then the output will be high. If only one input is high then the output will be low.	3
	Low Voltage 16-Bit Transparent Latch	Fairchild Semiconductor	LCX16373	Contains 16 non-inverting latches with 3-state outputs intended for bus oriented applications. The flip-flops (circuit that has two stable states and can store information) appear transparent to the data when the latch is enabled.	1
	Reversible Motor Driver	ROHM Semiconductor	BA6219BFP	Reversible motor driver for brush motors. Two logic inputs allow four output modes: forward, reverse, idling, and braking.	1


	Octal Buffer and Line Driver	Texas Instruments	HCT541	Takes a low power input, copies the data, and provides a copy of the signal that can drive a high capacity load.	3
	Dual Full-Bridge PWM Motor Driver	Allegro	A3966SLB	Designed to drive both windings of a two-phase bipolar stepper motor. Device contains two-full bridges capable of continuous output currents of $\pm 650\text{mA}$ and operating voltages of 30V.	1
	Quad Low-Side Driver with Fault Detection and Sleep Mode	Allegro	A2557KLB	Helps control the output voltage by preventing voltages that are too high from going through the system and also is more cost effective than other versions due to the fact that if the current drops below $100\text{ }\mu\text{A}$.	1

	N/A	N/A	34P3402AGT	N/A	2
	3V Supply Flash Memory	ST Microelectronics	M29W160DT	Type of storage that can retain data in the absence of a power supply.	1
	N/A	Texas Instruments	SR3443AAA4	N/A	2
	Low-Power Rail-To-Rail Input/Output Operational Amplifier With Shutdown	Texas Instruments	TLV2464	Is used as a buffer between analog-to-digital converters and also allows for the output to produce a much higher potential than the input potential.	2
	Low-Power, Low-Offset Voltage, Dual Comparators	Texas Instruments	LM393	Device that compares two voltages or currents and outputs a digital signal indicating which is larger.	1

 <p>A black integrated circuit (IC) with 16 pins, labeled PHN603S, 83878007 01, and hn0329.</p>	Three Phase Brushless D.C. Motor Driver	Philips Semiconductors (Now NXP)	PHN603S	Intended application is in computer disk and tape drives as a 3 phase motor driver.	2
 <p>A black integrated circuit (IC) with 16 pins, labeled A8932CLWA, 0319, and M319961APA.</p>	Voice-Coil Motor Driver	Allegro	A8932CLWA	Provides control and drive over of the voice-coil motor used for head positioning in 5V disk drive applications.	1
 <p>A black integrated circuit (IC) with 14 pins, labeled 35Z09HJ and HCT14.</p>	Hex Schmitt-Trigger Inverter	Texas Instruments	HCT14	Contains six independent inverters that perform the Boolean Function $Y = \bar{A}$ in positive logic. They are designed to provide a minimum separation between positive and negative switching thresholds, allowing for the elimination of oscillation or excessive current draw.	1

	Wide Bandwidth Quad 2:1 Mux	Analog Devices	ADG774	A multiplexer that selects one of several analog or digital input signals and forwards the selected input into a single line.	1
	CMOS Quad Rail-to-Rail Input and Output Operational Amplifier	Texas Instruments	LMC6484	Electrical components used when low voltage is available at the input but a range of voltages are needed at the output. This versions wide range makes it ideal for data acquisition.	2
	N/A	Texas Instruments	2209AAD	N/A	2
	Quad General Purpose Transistor	ON Semiconductor	MMPQ2222A	Can amplify and switch electrical power and electronic signals. By applying a current or a voltage to one of the pairs of the terminals, there is a change in current through another pair of terminals.	1

	CPU	Quantum	240E3001TBB3	Central processing unit that executes a sequence of stored instructions, sometimes multiple instructions are executed simultaneously depending on how complex the CPU is.	1
	Capacitors	N/A	N/A	Passive, two terminal electrical component used to store electrical energy via an electric field. A variety of sizes were present, some almost too small to see.	~434 (Hand Counted, Human Error Expected)
	Resistors	N/A	N/A	Passive two-terminal electrical component that reduces current flow, adjusts signal levels, and divide voltages. A variety of sizes were present, some almost too small to see.	~318 (Hand Counted, Human Error Expected)

	Fuse	N/A	N/A	Protects electrical circuits from high current or overloading. It is an expendable component that is designed to break easier than the other components so that it will take the majority of the damage.	1
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Works Cited

alldatasheet.com. "ALLDATASHEET.COM - Datasheet search site for Electronic Components and Semiconductors and other semiconductors." ALLDATASHEET.COM - Datasheet search site for Electronic Components and Semiconductors and other semiconductors, www.alldatasheet.com/.

"Computer Hope's free computer help." Computer Hope's Free Computer Help, www.computerhope.com/.

"CY2305/CY2309, Low Cost 3.3 V Zero Delay Buffer." CY2305/CY2309, Low Cost 3.3 V Zero Delay Buffer | Cypress Semiconductor, www.cypress.com/documentation/datasheets/cy2305cy2309-low-cost-33-v-zero-delay-buffer.
"Diode Ir1f." Scribd, Scribd, www.scribd.com/mobile/document/156197290/Diode-Ir1f.

"DS8921M Texas Instruments | Mouser." Mouser Electronics, www.mouser.com/ProductDetail/?Texas-Instruments%2FDS8921M%2F&q=7X5t%252bdzoRHBCcNVVCNz69g%3D%3D.

JSDeBord, Inc. "Featured Products." SRAM, DRAM, SDRAM Memories | ISSI, www.icsi.com.tw/index.html.

“LT1631CS#PBF.” Linear Technology | Integrated Circuits (ICs) | DigiKey,
www.digikey.com/product-detail/en/linear-technology/LT1631CS-PBF/LT1631CS-PBF-ND/889326.

“TLV2464 (ACTIVE).” TLV2464 Quad Low Power, Rail-To-Rail Input/Output Operational Amplifier | TI.Com, www.ti.com/product/TLV2464