

4104A T.I. Online Challenge Entry

Boytone E BT-17DJM-C Record Player



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Introduction

We are 4104A, a VRC team from North Hardin High School. Our team wanted a unique idea to use for this challenge, so we went with a multi-purpose record player. The variety of functions it included were being able to play vinyl records, cassette tapes, USBs, SD Cards, and the radio. We thought we could learn a lot from this challenge in the hopes that it enhances our knowledge of electronics.



Fig. 1. Record Player (Isometric View)

Product Disassembly



Fig. 3. Once the glue holding the bottom wooden framework piece in place was broken, the disassembly of the internal electrical components had begun. Fig. 2. Process began with prying the bottom wooden framework piece off.





Fig. 4. Removal of the main motherboard, cassette motor, and the wires from inside of the record player.



Fig. 5. Removal of the user interface from its casing.



Fig. 6. Removal of the auxiliary and USB inputs from the user interface casing.



Fig. 6.1. Removal of the volume knob from the user interface casing.



Fig. 6.2. Removal of the SD card reader from the user interface casing.

Fig. 7. Once the electrical components in the record player were dismantled, the disassembly of the framework begun, starting with the cassette input cover.



Fig. 7.1. Removal of the record player speakers from the record player framework wall.





Fig. 8. Once the Framework Wall was fully disassembled, the record player was flipped over, and the removal of the top framework piece had begun.

Fig. 9. Lastly, the top framework piece was disassembled, starting with the turntable platter.





Fig. 9.1. Removal of the tone arm from the top framework piece.

Chips & Components

During the disassembly process, we dug deep into the heart of the record player. There were several interesting electrical components including a turntable driver, a user interface, the motherboard, and several other PCBs. Additionally, we took apart the framework of the record player and analyzed its functions. After we finished disassembling, we started documenting all of the components that we were able to find.





Fig. 10. Internal Structure Of The Record Player (Top View)

Fig. 11. Framework Of The Record Player (Isometric View)

Motherboard



Fig. 12. Record Player Motherboard (Top View)



Capacitor	Resistor	Diode	Integrated Circuit	Inductor
Connector	Transistor	Crystal	Capacitor Network	



Fig. 12.1. Record Player Motherboard (Top View) *COLOR CODED*

Fig. 12.2. A Large Coil/Inductor That Acts As A Radio Antenna

Main Motherboard PCB Components List			
Component Name	Quantity	Function	
CAPACITORS *C*	146	Used to store electricity in an electric field.	
CAPACITOR			
NETWORKS *CN*	4	A network of capacitors used to store electricity.	
RESISTORS *R*	135	Used to limit the amount of current in an electric circuit.	
DIODES *D*	10	Used to conduct current in one specific direction.	
TRANSISTORS *Q*	19	Used to amplify electronic signals.	
INTEGRATED			
CIRCUITS *U*	9	Used to fit more electrical components in a small volume.	
CRYSTAL		Used to create a precise electronic signal with a precise frequency in	
OSCILLATOR *Y*	1	order to stabilize radio waves.	
INDUCTORS *L*	20	Used to store energy in a magnetic field.	
CONNECTORS *J*	9	Used to connect one circuit board to another.	

User Interface



Fig. 13. Record Player User Interface (Top View)



Fig. 13.1. Record Player User Interface (Top View) *COLOR CODED*

Capacitor Capacitor Network Resistor Diode Integrated Circuit Connector Oscillator Transistor Switch



Fig. 13.2. LCD Display That Works As The Main Part Of The User Interface

User Interface PCB Components List			
Component Name	Quantity	Function	
CAPACITORS *C*	19	Used to store electricity in an electric field.	
CAPACITOR NETWORKS *CN*	2	A network of capacitors used to store electricity.	
RESISTORS *R*	84	Used to limit the amount of current in an electric circuit.	
DIODES *D*	3	Used to conduct current in one specific direction.	
SWITCHES *S OR SW*	12	Used to manually control current flow by making a circuit closed or opened.	
TRANSISTORS *Q*	3	Used to amplify electronic signals.	
INTEGRATED CIRCUITS *U*	2	Used to fit more electrical components in a small volume.	
OSCILLATOR *Y*	1	Used to manipulate voltage into moving backwards and forwards.	
CONNECTORS *J*	1	Used to connect one circuit board to another.	

SD Card Reader



Capacitor Network Resistor Inductor

Fig. 14. The SD Card Reader For The Record Player





Fig. 14.2. SD Card Shield That Is Soldered To The PCB Board

SD Card Reader PCB Components List			
Component Name	Quantity	Function	
RESISTORS *R*	4	Used to limit the amount of current in an electric circuit.	
CAPACITOR NETWORKS *CN*	1	A network of capacitors used to store electricity.	
INDUCTORS *L*	1	Used to store energy in a magnetic field.	

Other Electrical Components



Fig. 15. PCB Board For The USB And Auxiliary Inputs

Fig. 15.1. Shield For The USB Input

Fig. 15.2. Shield For The Auxiliary Input







Fig. 16. Volume Knob For Any Audio Output

Fig. 16.1. Potentiometer Used To Indicate The Volume Being Emitted





Fig. 17. Interconnect/Breakout PCB Board Used To Split Signals Among Connectors

Fig. 17.1. Trimmer Potentiometer That Assists in Regulating The Voltage In The Circuit





Fig. 18. Speakers For The Record Player



- Fig. 19. Turntable Driver Which Is Driven By A Belt System
 - Fig. 19.1. Motor For The Turntable





Fig. 19.2. Button For The Cassette Player That Is Connected To The Turntable Driver

> Fig. 19.3. Cassette Player Button Connected To The Framework





Fig. 20. Power Input Cable for the Record Player.

Fig. 20.1. Power Input Cable Mounted on the Record Player





Fig. 21. Tone Arm For The Record Player That Transfers The Signals Obtained From The Stylus To The Internal Wiring

> Fig. 21.1. End Of The Tone Arm Where The Stylus Is Attached



Framework



Fig. 22. Framework Wall For The Record Player



Fig. 23. Top Plastic Framework For The Record Player



- Fig. 24. Bottom Wooden Framework For The Record Player
 - Fig. 24.1. Record Player Feet Attached To The Bottom Framework To Help Prevent Vibrations From Reaching The Stylus On The Tone Arm





Fig. 25. Plastic Casing For The User Interface

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Fig. 26. Plastic Covering On The Record Player That Helps Protect The Record Being Played From Any External Threats





Fig. 27. Turntable Platter For Where The Record Will Be Placed On

Fig. 27.1. Turntable Platter Attached To The Record Player





Fig. 28. Speaker Casing for the Record Player



Fig. 29. Cassette Input Casing for the Record Player.

Research

User Interface Ics

1. #Ca69f32l3

- 1.1. Led LCD Driver
- 1.2. Manufacturer: Brocade Communications Systems

2. #Ht1621b

- 2.1. Multifunction LCD Driver
- 2.2. Manufacturer: Holtek Semiconductor Inc.

Motherboard Ics

- 1. #M5676a1
 - 1.1. 8-port 19.2gbps/ Switched Fabric Network Node
 - 1.2. Manufacturer: Unknown

2. #Ah1537

- 2.1. Voltage Controlled Attenuator
- 2.2. Manufacturer: Aphex Systems

3. #Hcf4052

- 3.1. 4-channel Analog Multiplexer/Demultiplexer
- 3.2. An Analog Data Selector; Increases The Amount Of Data Able To Be Sent Over A Network
- 3.3. Manufacturer: Stmicroelectronics

4. #Lm1117

- 4.1. Low Dropout Voltage Regulator
- 4.2. 1.2v Dropout; 800ma Load Current
- 4.3. Manufacturer: Texas Instruments

5. #D7312cp

5.1. Monolithic Integrated Circuit Designed For A Dual Preamp Circuit With Alc For Recording

On The Cassette Tape Recorder

5.2. Manufacturer: Silicore Corporation

6. #Ams1117

- 6.1. 1a Low Dropout Voltage Regulator
- 6.2. Manufacturer: Advanced Monolithic Systems, Inc.

7. **#**B772

- 7.1. Low-speed Transistor
- 7.2. Used As A Transistor For Low-voltage Current Drivers
- 7.3. Manufacturer: Auk Corporation

8. #L7805cv

- 8.1. Positive Voltage Regulator
- 8.2. These Regulators Can Provide Local On-card Regulation, Eliminating The Problems With

Single Point Regulation

8.3. Manufacturer: Stmicroelectronics

9. #Tea2025b

- 9.1. Stereo Audio Amplifier
- 9.2. Used As An Audio Amplifier For A Radio Cassette Player
- 9.3. Manufacturer: Stmicroelectronics

Bill of Materials

Boytone E BT-17DJM-C Record Player Bill of Materials (Manufactured Components) Component Name Manufacturer Part No. Quantity Function Datasheet Image Touch MCU Wide Decent Decent Decent Decent Decent Decent

Touch MCU Wide Voltage LED LCD Driver	Brocade Communications System	#CA69F32L3	1	Sends information to the LCD Display on what to display on it.		
Multifunction LCD Driver	Holtek Semiconductor Inc.	#HT1621B	1	Used to display multiple sets of information on the LCD Display when tasked to do so.	<u>Datasheet</u>	
4-Channel Analog Multiplexer/ Demultiplexer	STMicroelec- tronics	#HCF4054	1	Used to dissipate low dormant power over the full supply voltage.	<u>Datasheet</u>	TIMOT
LM1117 800-mA Low-Dropout Linear Regulator	Texas Instruments	#LM1117	1	Used to regulate the output voltage when the supply voltage is very close to the output voltage.	<u>Datasheet</u>	A CONTRACT OF A
Dual Channel Preamp	Silicore Corporation	#D7312CP	1	A monolithic integrated circuit designed for a dual preamp circuit with ALC for recording & playback on the cassette tape recorder.	<u>Datasheet</u>	
1a Low Dropout Voltage Regulator	Advanced Monolithic Systems, Inc.	#AMS1117	1	Used to regulate the output voltage when the supply voltage is very close to the output voltage.	<u>Datasheet</u>	æ
PNP Silicon Transistor	AUK Corporation	#STB772	1	Used to amplify electronic signals.	<u>Datasheet</u>	SOT32
Positive Voltage Regulator	STMicroelec- tronics	#L7805CV	1	These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation.	<u>Datasheet</u>	
Stereo Audio Amplifier	STMicroelec- tronics	#TEA2025B	1	Used as an audio amplifier for the radio & cassette player.	<u>Datasheet</u>	122222
Voltage Controlled Attenuator	Aphex Systems	#AH1537	1	Ensures accurate control for attached analog applications.	<u>Datasheet</u>	
Wifi Network Processor	*Unknown*	#M5676A1	1	Used to connect the Record Player to a Wifi Network.		

Boytone E BT-17DJM-C Record Player Bill of Materials (Printed Circuit Boards)

Component Name	Quantity	Function	Image
Main Motherboard	1	Used to control all of the functions of the record player and store vital information that is needed to help the record player function properly.	
User Interface	1	Used to read inputs driven by human activity, then sends that information to the internal components of the record player.	
SD Card Reader	1	Used to read information stored in a SD Card and sends it to the internal components of the record player.	
USB and Auxiliary Inputs	1	Used to read information obtained from USB and auxiliary cables and then sends it to the internal components of the record player.	
Volume Controller	1	Used to control the amount of volume received by using a volume knob that is read by a potentiometer.	No la constante
Interconnect/ Breakout	1	Used to split signals to different electrical components inside of the record player.	

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Boytone E BT-17DJM-C Record Player Bill of Materials (Other Electrical Components)

Component Name	Quantity	Function	Image
Record Player Speaker	2	Used to emit sound that is sent to it by the internal components of the record player.	
Tone Arm	1	Used to read the grooves on a record player using a stylus, and transmit that data to the internal components of the record player.	-
Turntable Driver	1	The overall structure of the internal part of the turntable that is used to dictate the movement of the turntable, and read information that is sent to it.	O
Turntable Motor	2	Used to drive the turntable depending on the data sent to the turntable driver.	
Cassette Player Push Switch	1	Used to activate the cassette player reader, and send data on it to the internal components of the record player.	
AC 12V Power Input	1	Used to obtain power from a AC 12V Power Cable.	

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Boytone E BT-17DJM-C Record Player Bill of Materials (Framework)

Component Name	Quantity	Function	Image
Turntable Platter	1	Used as the surface for where the record will spin on and helps maintain speed consistency.	0
User Interface Casing	1	Used to protect the User Interface PCB inside the record player.	
Wooden Framework Wall	1	Used as the wall of the record player framework where the top and bottom pieces are screwed onto.	
Outer Plastic Top Framework	1	Used as the top part of the framework and is where the turntable platter is placed.	0
Plastic Covering	1	Used to protect the record that is being played on the record player from any external threats.	
Outer Wooden Bottom Framework	1	Used as the bottom part of the framework and is where the record player feet is placed on.	
Record Player Feet	4	Used to suspend the record player up, and prevents any outside vibrations on the surface it's on from affecting the stylus.	0
Speaker Casing	2	Used to protect the speakers from any external threats.	
Cassette Input Casing	1	Used to be the basic framework for the cassette input	•

Conclusion

There were many lessons that we learned about during the disassembly of the record player. We realized that finding new things that you've never heard of can be a helpful learning experience. There were a variety of unfamiliar components that while doing research on, helped us learn more about digital electronics. We also learned how to be more thorough when we document our research on our findings. We plan to use these lessons that we came across as a learning experience to help prepare us for any more challenges we may face.