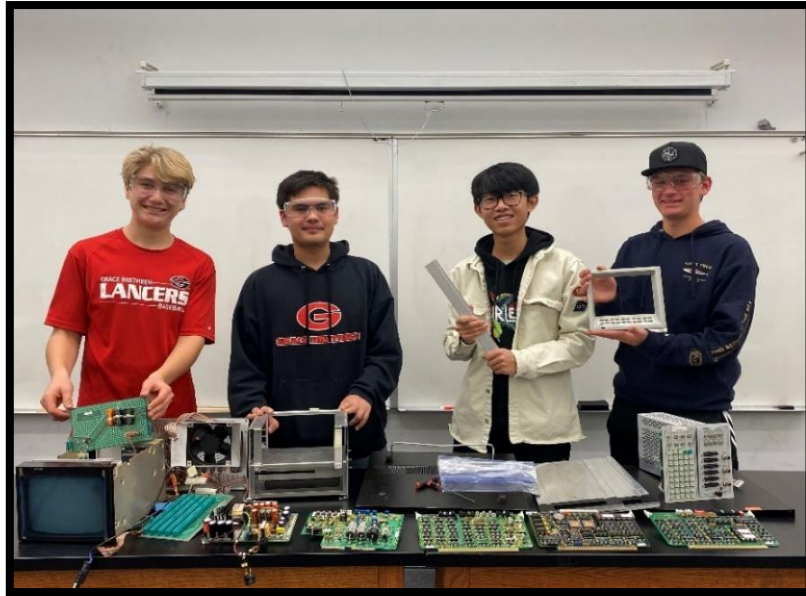


2022 Reverse Engineering Online Challenge

Disassembly and Analysis of a Data Precision 6100 Waveform Analyzer



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Team Name: Lancers

Location: Simi Valley, California



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Summary Report

Modern electronics have hundreds or thousands of components on a single chip, and almost microscopic parts covering circuit boards. Older equipment had much larger, often discrete parts that were easier to recognize, and layouts that helped visualize how the equipment worked. As a result, we really wanted to deconstruct bulky “old tech”. For years our school had a strange machine collecting dust in the physics building. We requested to disassemble it, but the school turned us down. One of our mentors overheard our plans, and how we were denied. He inquired about the “retro deconstruct”. And fortunately, he had a similar, antiquated device from the 80’s in storage at work: a Data Precision 6100 Waveform Analyzer.

The 6100 samples voltage and/or current of input signals up to 100MHz (radio frequency). It displays data like period, duty and frequency, and performs digital signal processing, including frequency spectrum analysis. Engineers used it to design, test, and troubleshoot circuits.

We opened the 6100’s chassis, and along with chunky black chips, we loved the large and colorful components, including a vintage display tube unlike anything we’d ever seen. We knew immediately it would make a great deconstruct project.










Disassembling the analyzer quickly presented challenges: multiple motherboards, several transformers, and a glass display that looked both menacing and fragile. We’d never seen capacitors this large, and it had a lot. Disassembly took over 6 hours, in part because of strict safety protocols mandated by our mentors. Although unplugged for over a decade, we grounded ourselves, and the 6100, and methodically tested all capacitors to ensure none were charged.

The 6100 had a mixture of analog and digital components. There were several logic gates that used the BUFFER, INVERTER, AND, NAND, OR, and EX-OR. There were 3 main boards: the Communication, Display, and CPU Boards. To better understand the 6100, we learned about truth tables along with basic Boolean algebra. Our background from programming robots and algebra classes helped.

We learned a lot from this deconstruct: the importance of safety, especially around capacitors; the significance of knowing the basics of logic gates and some of their uses in digital devices; how to read datasheets and schematics; that integrated circuits contain part markings to identify the chip and build information (that even allows tracking of bad parts); that even though the parts were more than 25 years old, to our surprise some chips like logic, op amps, transistor, and voltage regulators are still in current production!

While devices are more powerful and smaller today (some analyzers now fit in your pocket, while the 6100 weighed 40 lbs!), many of the same types of components are still used. OLEDs have replaced cathode ray tubes, and CPUs run 1000x faster, but modern electronic still use displays, logic gates and CPUs like the 6100. Electronics and computers, both analog and digital, are here to stay. Thank goodness for those vintage devices like the 6100 that helped pave the way for modern electronics.

Disassembly Process

Safety precautions were taken prior to disassembly. Power supplies were disconnected and removed. Team wore goggles, and ground straps. Device for disassembly was approved by mentor.		
Step1: Removed screws	Step 2: Opened and removed top chassis cover	Step 3: Removed the plastic latch holding the cables
		
Step 4: Removed ribbon cables connected to boards	Step 5: Pulled out 3 boards	Step 6: Unplugged connector of 4 th board
		
Step 7: Measured capacitors on the 4 th board for safety	Step 8: Unscrewed side panel	Step 9: Pulled out side panels
		

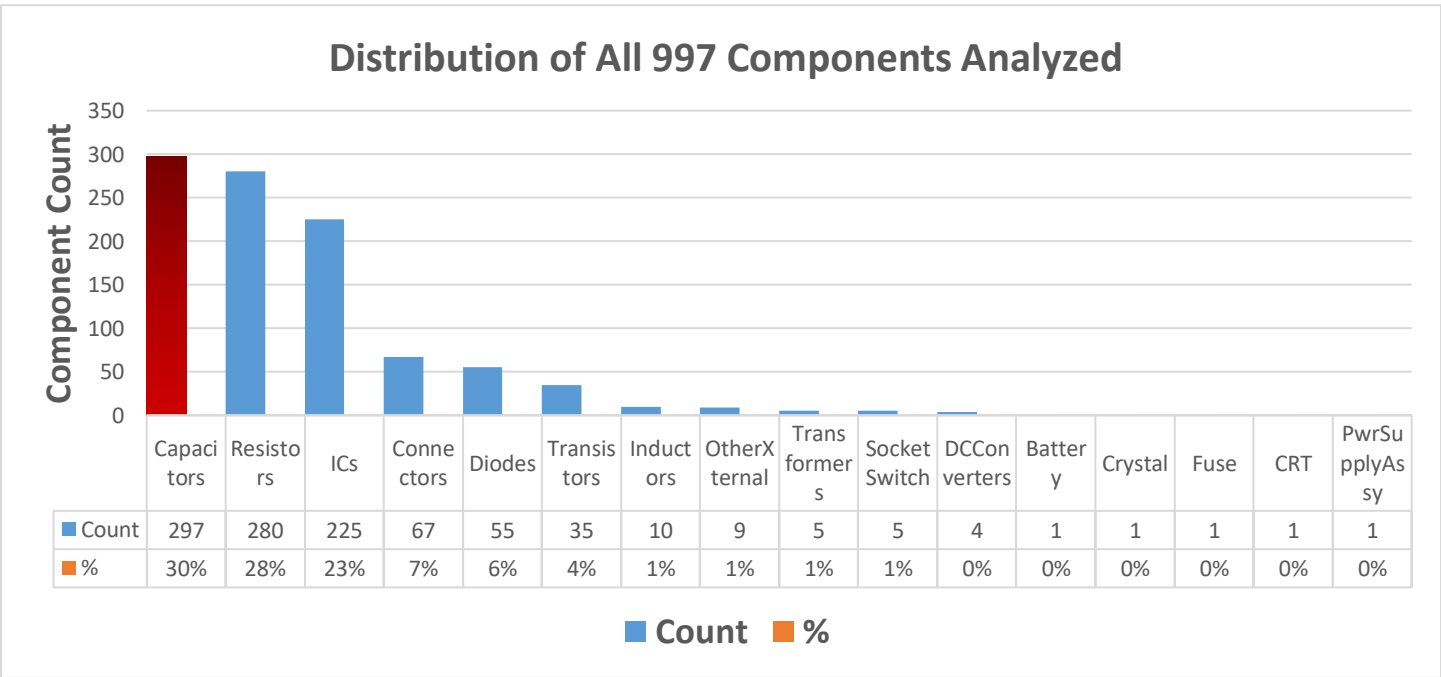
Step 10: Pulled out 5 th board	Step 11: Pulled out screen frame	Step 12: Pulled right chassis assembly
		
Step 13: Pulled out 6 th and 7 th board (back to back)	Step 14: Pulled 8 th board behind the front panel of right chassis	Step 15: Pulled out right chassis metal frame
		
Step 16: Pulled out 9 th board	Step 17: Pulled out 10 th board	Step 18: Pulled out 11 th board
		
The Disassembled Data Precision 6100 Waveform Analyzer		
		

Device Identification Summary and Analysis

Figure 1: Summary of Components and Quantity

Components	Count	%
Capacitors	297	30%
Resistors	280	28%
ICs	225	23%
Connectors	67	7%
Diodes	55	6%
Transistors	35	4%
Inductors	10	1%
Other External	9	1%
Transformers	5	1%
Sockets Switches	5	1%
DC-DC Converters	4	0%
Battery	1	0%
Crystal	1	0%
Fuse	1	0%
CRT	1	0%
Power Supply Assy	1	0%
Total	997	100%

Figure 2: Relative Distribution of Electrical Component Types



Images of Boards in the Device

Data Precision 6100 Waveform Analyzer



COM -Communication Interface Board



CPU – Central Processing Unit Board



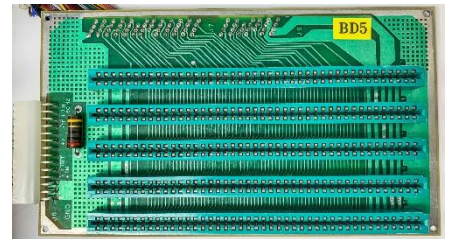
DIS – Display Board



BD4



BD5



BD6



BD7



BD8



BD9 – Power Supply Board



BD10




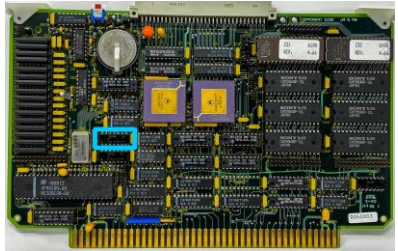












BD11

















Integrated Circuits








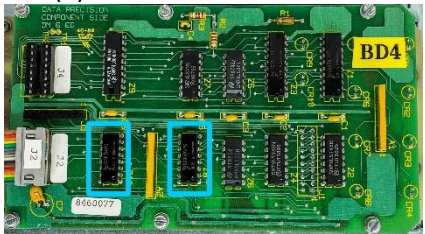
Integrated circuits are sets of electronic circuits that can be found in phones, computers, cars, or household appliances. ICs or chips for short, are made from semiconductor material like silicon, gallium arsenide, or germanium and come in different packages and function as a microprocessor, amplifier, timer, counter, switch, or memory.


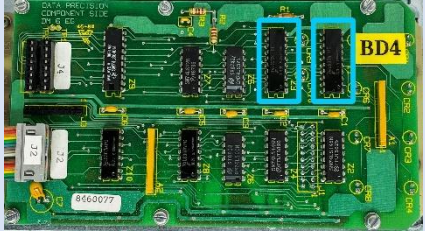








ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
1	74F04 Fairchild Semiconductor 	HEX Inverter The HEX inverter inverts six digital signals and is used for cleaning signals and level shifting. Datasheet	1	CPU(1) 
2	74F08 Fairchild Semiconductor 	Quad 2-Input AND Gate This chip executes the logic AND function. The outputs get a HIGH(1) value when all inputs are HIGH(1). If either is LOW(0), the output is LOW(0). The AND gate performs logical multiplication. Datasheet	1	CPU(1) 
3	74F32 Fairchild Semiconductor 	Quad 2-Input OR Gate This chip performs the logic OR function. If one or both inputs are HIGH(1), then outputs are HIGH(1). The OR gate performs logical addition. Datasheet	1	CPU(1) 
4	74LS00 Fairchild Semiconductor 	Quad 2-Input NAND Gate This chip executes the logic NAND function. All inputs must be HIGH(1) to get a LOW(0) output and if any of the input is LOW(0), the output will be HIGH(1). If any one of the inputs is HIGH(1), the output will be HIGH(1). Datasheet	2	DIS(2) 








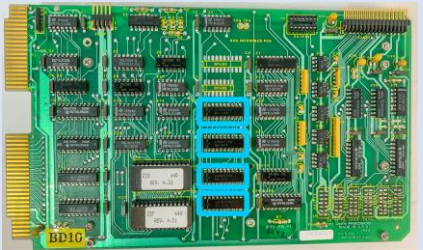
ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
5	74LS02 Fairchild Semiconductor 	Quad 2-Input NOR Gate This device executes the logical NOR function. All inputs must be LOW(0) to get a HIGH(1) output. If either or both are HIGH(1), then output is LOW(0). Datasheet	4	COM(2)  DIS(1)  BD10(1) 
6	74LS04 Fairchild Semiconductor 	HEX Inverting Gates This chip has six different gates each that executes the INVERT function. Its purpose is to invert the signal applied. If input is LOW(0), then output is HIGH(1) and vice versa. Datasheet	1	BD10(1) 











ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
7	74LS08 Fairchild Semiconductor 	Quad 2-Input AND Gates This chip performs the logic AND function. The outputs get a HIGH(1) value when all inputs are HIGH(1). If either is LOW(0), the output is LOW(0). The AND gate performs logical multiplication. Datasheet	4	COM(3)  BD10(1) 
8	74LS14 Fairchild Semiconductor 	Hex Inverter with Schmitt Trigger Inputs This chip has 6 different gates that perform the logic INVERT function. This is used to convert a slow changing input to a fast-changing output with no noise. Datasheet	2	BD10(2) 
9	74LS20 Fairchild Semiconductor 	Dual 4-Input NAND Gate This performs the logic NAND function. All inputs must be HIGH(1) to get a LOW(0) output and if any of the input is LOW(0), the output will be HIGH(1). If any one of the inputs is HIGH(1), the output will be HIGH(1). Datasheet	2	COM(2) 










ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
10	74LS32 Fairchild Semiconductor 	Quad 2-Input OR Gate This chip performs the logic OR function. If one or both inputs are HIGH(1), then outputs are HIGH(1). The OR gate performs logical addition. OR finds maximum between two binary digits. Datasheet	6	COM(4)  DIS(2) 
11	74LS38N Signetics 	Quadruple 2-Input Positive - NAND Buffers with Open-Collector Outputs This chip has four different dual input positive NAND buffer. The Open collector means it needs a pull up resistor to register a HIGH(1) output. This is used to interface with devices with different voltage levels. Equivalent Datasheet	1	BD10(1) 
12	74LS86 Fairchild Semiconductor 	Quad 2-Input Exclusive- OR Gate This chip performs the logic exclusive-OR (XOR) function. If only one input is HIGH(1), then output is HIGH(1). If both inputs are LOW(0) or both inputs are HIGH(1), then output is LOW(0). This gate implements binary addition. Datasheet	1	DIS(1) 









ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
13	74LS138 Fairchild Semiconductor 	Decoder/Demultiplexer This chip decodes encoded data. The input code has fewer bits than the bits in the output code. This is used in the user interface in the output device of the Cathode Ray Tube (CRT). Datasheet	1	DIS(1) 
14	74LS153 Fairchild Semiconductor 	Dual 1-of-4 Line Data Selectors/Multiplexers Multiplexers select several input signals and forwards it to a single output line. It performs parallel to serial conversion. Datasheet	2	COM(2) 
15	74LS273N Signetics 	8-Bit Register with Clear This device contains 8 flip flops that respond to 0-30MHz clock frequencies. It retains value if no control signal is asserted. Equivalent Datasheet	1	COM(1) 
16	74LS367APC Fairchild Semiconductor 	Hex Bus Drivers with 3 State Outputs These are used to improve the performance of the memory address driver, clock drivers. The user has a choice of combinations of inverting and noninverting outputs. Equivalent Datasheet	2	BD4(2) 










ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
17	74LS374 Fairchild Semiconductor 	3 State Octal D-Type Transparent Latches and Edge-Triggered Flip Flops The latch and flip-flop stores 1 bit of information and retains the information. Datasheet	2	BD4(2) 
18	74LS574 Fairchild Semiconductor 	Octal D-Type Flip-Flop with 3-STATE Outputs D means delay so this device delays the change state of an output signal. Datasheet	1	BD10(1) 
19	AD561JN Analog Devices 	Low Cost 10-Bit Monolithic D/A Converter This converts digital signal to its equivalent analog voltage or current. Datasheet	1	DIS(1) 
20	AM27S13APC Advanced Micro Devices 	2.048-Bit(512x4) Bipolar PROM . Programmable read only memory allows the user to put the data or program onto the memory. Once the data is transferred, it cannot be changed or erased. Datasheet	1	COM(1) 
21	CD74HC393E RCA 	High Speed CMOS Logic Dual 4-Stage Binary Counters Binary counters count the number of pulses that occur at the input. It is a counter. Alternate Datasheet TI	2	CPU(2) 





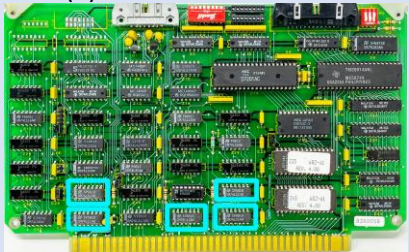




ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
22	CD74HCT02E RCA 	4 channel, 2-Input, 4.5V to 5.5V NOR gates with TTL-compatible CMOS inputs This device implements logical NOR function. If both inputs are LOW(0), then it results a HIGH(1); if one or both input is HIGH(1), then the output is LOW(0). Equivalent Datasheet	1	BD10(1) 
23	CD74HCT138E RCA 	High Speed CMOS Logic 3-to-8-Line Decoder /Demultiplexer Inverting and Noninverting This is also called a binary-to-octal decoder where the input is 3-bit binary numbers, and the outputs are eight digits in the octal numbering system. It is used for memory decoding and data routing. Equivalent Datasheet	2	CPU(2) 
24	CD74HCT164E RCA 	8-Bit Serial-In/Parallel-Out Shift Register This chip uses several flip flops to store the last eight values inputted and allows for the eight bits to be read. The bits shift every clock cycle. Equivalent Datasheet	2	CPU(2) 
25	CD74HCT299E RCA 	High Speed CMOS Logic 8-Bit Universal Shift Register with 3-State Outputs Shift registers are used to store or move data to the output on every clock cycle. Equivalent Datasheet	4	BD10(4) 


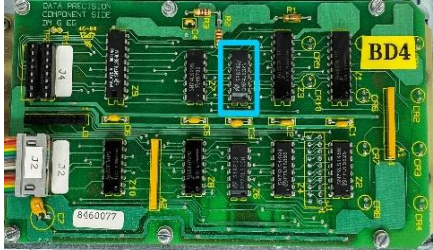






ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
26	CD74HCT540E RCA 	High Speed CMOS logic Octal Buffer and Line Drivers, Three State (Inverting) This chip acts like 8 normal buffers unless the output enable pin is HIGH(1) then it acts like a resistor. Equivalent Datasheet	3	CPU(3) 
27	CD74HCT541E RCA 	High Speed CMOS logic Octal Buffer and Line Drivers, Three State (Non-Inverting) This is used as a level converter for interfacing outputs to high-speed inputs. Equivalent Datasheet	1	CPU(1) 
28	CD74HCT573E RCA 	High Speed CMOS Logic Octal Transparent Latch, Three-State Output This chip has 8 latches or switches that store data when the latch is enabled and if not enabled, it stores the last reported value. Equivalent Datasheet	2	CPU(2) 
29	CXK5864BP-12L Sony 	8,192-Word x 8-bit High Speed CMOS Static Random-Access Memory The is a type of memory that saves the data bits in memory if power is supplied. Datasheet	6	CPU(6) 
30	D27010-250v05 Intel 	Erasable Programmable Read-Only Memory (1M 128Kx8) This is a type of memory that information in it can be cleared or erased and written again. It is organized as 128K words with 8 bits each. No datasheet	2	CPU(2) 








ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
31	D27128A Intel 	Advanced 128K Ultraviolet Erasable Programmable Read-Only Memory This is a type of memory that retains its data when power supply is off. Data or programs are stored in this and can be erased by using ultraviolet light source. Datasheet	4	COM(2)  BD10(2) 
32	D7201AC NEC 	Dual-channel, multiprotocol, serial communications controller It is a serial to parallel, parallel to serial controller. Datasheet	1	COM(1) 
33	D8253C-2 NEC 	Programmable Interval Timer This is a counter that produces an output signal when programmed count is reached. This chip is also used as elapsed time indicator. Datasheet	1	COM(1) 
34	DG211CJ Intersil 	Single Pole Single Throw 4-Channel Analog Switches This chip has 4 single input that connect to 4 single output switches. It blocks signals to 30 volts peak-to-peak. Datasheet	1	BD6(1) 


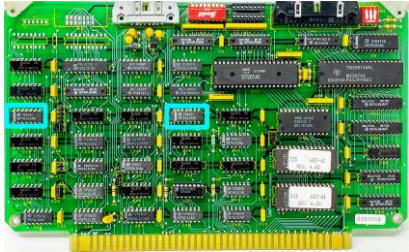





ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
35	DM7407N National Semiconductor 	Hex Buffers with High Voltage Open-Collector Outputs A hex buffer is a basic logic gate that passes the input to its output without change. The output is always equal to its input, so its purpose is to regenerate the input. Datasheet	1	CPU(1) 
36	DM74123N National Semiconductor 	Dual Retriggerable One-Shot with Clear and Complementary Outputs Once triggered it sends a HIGH(1) signal for a certain amount of time and triggered back to LOW(0). Its purpose is to send a consistent output pulse that can be sent multiple times. Datasheet	1	DIS(1) 
37	DM74LS00N National Semiconductor Acquired by Texas Instruments 	Quad 2-Input NAND Gate This performs the logic NAND function. All inputs must be HIGH(1) to get a LOW(0) output and if any of the input is LOW(0), the output will be HIGH(1). If any one of the inputs is HIGH(1), the output will be HIGH(1). Datasheet	3	COM(1)  BD4(1)  BD10(1) 









ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
38	DM74LS04N National Semiconductor 	Hex Inverting Gates This chip has 6 different gates each which executes the logic INVERT function. If input is HIGH(1), output is LOW(0) and vice versa. Datasheet	7	COM(2)  DIS(5) 
39	DM74LS05N National Semiconductor 	Hex Inverters with Open-Collector Outputs This chip has 6 independent gates of which perform the logic INVERT function. The open-collector outputs require an external pull-up resistor for proper logical operation. Datasheet	1	DIS(1) 
40	DM74LS08N National Semiconductor 	Quad 2-Input AND Gates This has 4 AND gates with 2 inputs. The outputs are HIGH value when all inputs are HIGH. If any put is LOW, the output is LOW. Used for safety device. Datasheet	3	DIS(3) 
41	DM74LS10N National Semiconductor 	Triple 3-Input NAND Gate This chip has 3 different gates with 3 inputs each that executes the NAND function. All 3 inputs must be HIGH to get a LOW output. Datasheet	2	DIS(2) 











ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
42	DM74LS11N National Semiconductor 	Triple 3-Input AND Gate This chip has 3 different gates with 3 inputs each that executes the AND function. If all 3 inputs are HIGH, then output is HIGH. Equivalent Datasheet	3	DIS(2)  BD10(1) 
43	DM74LS14N National Semiconductor 	Hex Inverter with Schmitt Trigger Inputs. This chip converts any form of an input signal into a digital output signal; thus, this cleans noisy signals. Datasheet	5	COM(5) 
44	DM74LS20N National Semiconductor 	Dual 4-Input NAND Gates. This has 2 different gates with 4 inputs each executing the logic NAND function. The output is a LOW, only if all 4 inputs are HIGH. Its role is to check if a single input has gone low. Datasheet	1	BD10(1) 
45	DM74LS27N National Semiconductor 	Triple 3-Input NOR Gates This chip has 3 different gates with 3 inputs each which perform the logic NOR function. All 3 inputs must be a LOW to get a HIGH. Datasheet	2	DIS(2) 








ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
46	DM74LS32N National Semiconductor 	Quad 2-Input OR Gates This has 4 OR gates with 2 inputs. If one or both inputs are HIGH, then outputs are HIGH. The OR gate performs logical addition. Datasheet	1	BD4(1) 
47	DM74LS38N National Semiconductor 	Quad 2-Input NAND Buffer with Open-Collector Outputs This chip has 4 independent gates which performs the logic NAND function. The open-collector outputs require external pull-up resistors to operate properly. Equivalent Datasheet	2	COM(1)  DIS(1) 
48	DM74LS74AN National Semiconductor 	Dual Positive-Edge-Triggered D Flip-Flops with Preset, Clear and Complementary Outputs This chip has 2 different D-type positive edge triggered flip-flops that changes its state only when an input signal becomes HIGH(1). Its role is to hold the output until the clock pulse changes from LOW(0) to HIGH(1). Datasheet	4	COM(2)  BD10(2) 










ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
49	DM74LS86N National Semiconductor 	Quad 2-Input Exclusive-OR Gates This chip has 4 different gates that execute the exclusive-OR function. When both inputs are equal either both HIGH(1) or both LOW(1), output will be LOW(0). This is used as a comparator which produces a HIGH(1) output when the two inputs are not equal. Datasheet	1	COM(1) 
50	DM74LS138N National Semiconductor 	Decoder/Demultiplexer The value of its one input is routed to one of the different outputs decided by the selector input and all other outputs will have a LOW(0) output. This is used for applications that require a single signal to be made active at a time. Equivalent Datasheet	3	COM(1)  BD10(2) 
51	DM74LS153N National Semiconductor 	Dual 4-Line to 1-Line Data Selectors/Multiplexers This chip has 4 data inputs, 2 selection lines and one output. Simply, a many to 1 circuit. Its role is to make it possible for many input signals to share one device. Datasheet	1	DIS(1) 




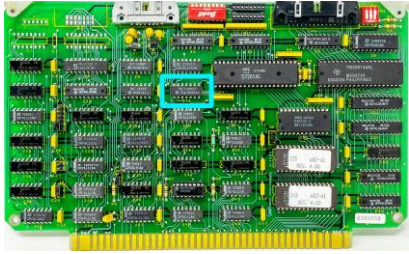




ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
52	DM74LS164N National Semiconductor 	8-Bit Serial In/Parallel Out Shift Register A sequential logic circuit that can store and transfer binary data. This is used for data conversion from serial to parallel. Datasheet	3	COM(2)  BD10(1) 
53	DP8419N-80 National Semiconductor 	256K Dynamic RAM Controller/Drivers This interfaces with the Dynamic Random-Access Memory and its role is to refresh tasks transparent to the CPU. Datasheet	1	CPU(1) 
54	DS75162AN National Semiconductor 	IEEE-488 GPIB Transceivers IEEE-488 is standard protocol developed by HP to link the test equipment to a computer. Transceivers transmit and receive signals. These are used to transfer data like video and audio. Datasheet	1	COM(1) 









ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
55	HI1-201-5 Harris Semiconductor/Intersil 	Dual/Quad SPST, CMOS Analog Switch This chip is a selectable single pole single throw switch used for high frequency analog switching. Datasheet	1	DIS(1) 
56	HP2631 Hewlett-Packard 	Dual Channel, High CMR, High Speed, TTL Compatible Optocouplers This chip transfers electrical signals between 2 isolated circuits by using light. This is used to isolate low and high voltages in microprocessor input/output switching. Datasheet	5	BD10(5) 
57	LH2126Z-12 Sharp 	256K x 1 Dynamic Random-Access Memories DRAMs store each bit of data in a memory cell. These are close to the processor (see gold chips in picture) for quick and easy access when processing. The data stored disappears when the system is turned off. Equivalent Datasheet	16	CPU(16) 
58	LM13080N National Semiconductor 	Programmable Power Operational Amplifier This chip amplifies the difference in voltage between two inputs and it includes a programming input. Datasheet	1	BD6(1) 








ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
59	LM301AN National Semiconductor 	Operational Amplifiers This is a device that amplifies the difference in voltage between two inputs. Datasheet	1	BD6(1) 
60	LM3146N National Semiconductor 	High Voltage Transistor Array From our understanding, this is a group of transistors connected to each other inside the chip that operate at a higher voltage. Its role is to regulate voltage flow. Datasheet	1	BD6(1) 
61	LM311N National Semiconductor 	Voltage Comparator This device compares two voltages and the outputs a HIGH(1) or LOW(0) to show which one is larger. This is checker to see if the input has reached a set value. Datasheet	1	BD7(1) 
62	LM318 National Semiconductor 	High Speed Operational Amplifier The role of the amplifier is to amplify the voltage input signals. Datasheet	2	DIS(2) 
63	LM337T Motorola 	Three Terminal Adjustable Output Negative Voltage Regulator The regulator regulates the voltage during power fluctuations. Datasheet	1	BD11(1) 




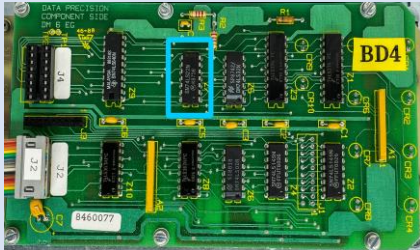




ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
64	LM340T5 National Semiconductor 	Linear Voltage Regulator This device is used to maintain constant voltage. Datasheet	1	BD9(1) 
65	LM3524N 	Voltage Regulators This regulator maintains the voltage of the power source within acceptable limits. This is needed to make sure voltages are in range. Datasheet	1	BD7(1) 
66	LM393N National Semiconductor 	Low Power Low Offset Voltage Dual Comparators The function of this device is to compare the input voltage with the reference voltage and change the output state based on the input if above or below the reference voltage. Datasheet	2	DIS(1)  BD7(1) 








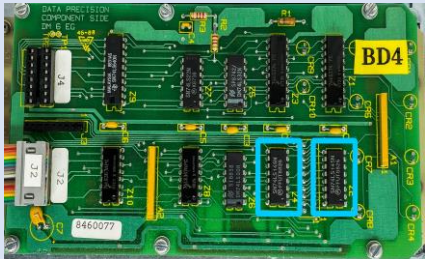
ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
67	LM78L National Semiconductor 	3-Terminal Positive Voltage Regulator This chip ensures a constant positive output voltage. Datasheet	2	DIS(1)  COM(1) 
68	LM7915CT National Semiconductor 	3-Terminal Negative Regulators This chip ensures a constant negative output voltage. Datasheet	1	BD9(1) 
69	LM79L12 No manufacturer logo/mark 	3-Terminal Negative Voltage Regulators This chip ensures a constant negative output voltage. Equivalent Datasheet	1	COM(1) 
70	M62428 Oki Semiconductor 	Direct Bus Connected CMOS Real Time Clock/Calendar This battery-powered chip has a timer that provides an accurate date and time. Datasheet	1	CPU(1) 








ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
71	MC1488P Motorola 	RS-232C Quad Line Driver This device converts a digital input to a line signal. Equivalent Datasheet	2	COM(2) 
72	MC1489AP Motorola 	Quad Line EIA-232D Receiver This chip takes a line signal and converts it to a digital signal complying with the EIA-232D standard. The EIA 232D is a standard everyone follows to specify connections between a computer and a modem. Datasheet	1	COM(1) 
73	M74ALS640P Mitsubishi 	We think this is like a DM74ALS640A Inverting Octal Bus Transceiver This transmits and receive data from bus A to B when HIGH(1) and bus B to A when LOW(0). No datasheet	2	BD10(2) 
74	MC68450RC8 Motorola 	Cathode Ray Tube Controller This device reads the video data from the Random-Access Memory attached to the CRT. Datasheet	1	CPU(1) 

ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
75	Motorola MC68HCOORC10 	Low Power JCMos 16-/32-Bit Microprocessor This chip is the brain that controls all other parts of the analyzer and performs the tasks like executing logical operations and programs stored in memory or decodes instructions. Datasheet	1	CPU(1) 
76	MC7812ACT Motorola 	Three-Terminal Positive Fixed Voltage Regulators This chip produces a fixed positive output voltage so that it would not damage any components of the board. Datasheet	1	BD11(1) 
77	MM74HCT74N National Semiconductor 	Dual D-Type Flip Flop with Preset and Clear The preset input sets the flip-flop while the clear input resets it. Equivalent Datasheet	1	CPU(1) 
78	SN74128N Texas Instruments 	Single 4-input, 4.75-V to 5.25-V bipolar NOR gate This device performs the logic NOR function. If both inputs are LOW(0), then output is a HIGH(1). If one or both input is HIGH(1), a LOW(0) output results. Datasheet	1	DIS(1) 


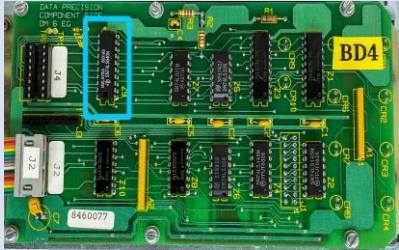





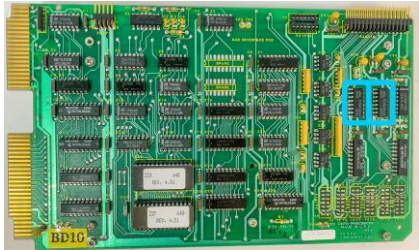
ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
79	SN74ALS540N Texas Instruments 	8-Channel, 4.5V to 5.5V Bipolar Inverters with 3-state Outputs The task of this device is to convert direct current (DC) input power to alternating current (AC) output power. Datasheet	9	COM(4)  BD10(5) 
80	SN74ALS1640AN Texas Instruments 	Octal Bus Transceivers with 3-State Outputs This chip transmits and receive data between data buses and operates at 4.5-5.5V. Datasheet	1	COM(1) 
81	SN74HCT640N Texas Instruments 	Octal Bus Transceivers With 3-State Outputs This chip transmits and receives data between data buses. This chip operates at a wider range of voltages (2-6V) than the chip above SN74AL1640AN. Equivalent Datasheet	2	CPU(2) 



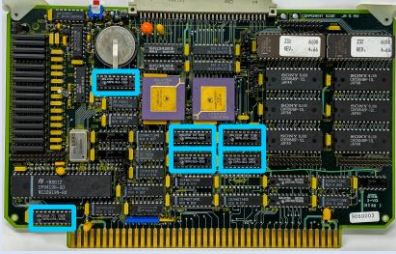

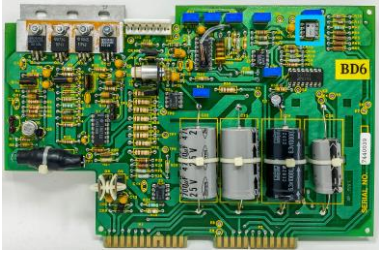




ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
82	SN74HCT645N Texas Instruments 	Octal Bus Transceivers With 3-State Outputs This chip transmits and receives data between buses and operates at a 4.5V to 5.5V. Datasheet	2	CPU(2) 
83	SN74LS22N Motorola 	Dual 4-Input NAND gate This has 2 NAND gates with 4 inputs. When any input or all inputs are LOW, the output is HIGH. When all inputs are HIGH, the output is LOW. This is used for detecting if a single input has gone LOW in a digital system. Datasheet	1	BD4(1) 
84	SN74LS32N Motorola 	Quad 2-Input OR gate This has 4 OR gates with 2 inputs. If one or both inputs are HIGH, then outputs are HIGH. The OR gate performs logical addition. Datasheet	1	BD10(1) 
85	SN74LS109AN Texs Instruments 	Dual J-K Positive Edge Triggered Flip Flops with Preset and Clear This stores data when two inputs J-K are not triggered. Datasheet	4	DIS(4) 






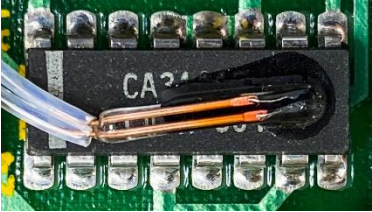

ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
86	SN74LS123N Motorola 	Retriggerable Monostable Multivibrator This chip's role is to increase the width of a pulse. Datasheet	1	CPU(1) 
87	SN74LS133N Motorola 	13-Input NAND Gate This device is a single gate with 13 inputs that executes the Logic NAND function. Only if all inputs are HIGH(1), then the output is LOW(0); if any input is LOW(0), then the output is HIGH(1). Datasheet	1	BD10(1) 
88	SN74LS139N Motorola 	Dual 1-of-4 Decoder/Multiplexer This is a data selector, with 4 data inputs and chooses which one to output. Datasheet	1	DIS(1) 
89	SN74LS145N Motorola 	1-of-10 Decoder/Driver Open-Collector The function of this device is an indicator/relay driver. It accepts binary coded decimal inputs and provide outputs to drive 10 displays Datasheet	2	BD4(2) 

ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
90	SN74LS166AN Texas Instruments 	Parallel-load 8-bit shift register These are used for data transfer and manipulation. Datasheet	2	DIS(2) 
91	SN74LS169N Motorola 	BCD Decade Modulo 16 Binary Synchronous Bi-Directional Counters The function of this chip is to keep track of how many times the event has happened. Datasheet	3	DIS(3) 
92	SN74LS174N Motorola 	Hex D Flip-Flop This chip's role is to store data. Datasheet	4	DIS(3)  BD10(1) 

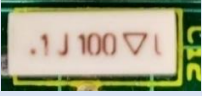

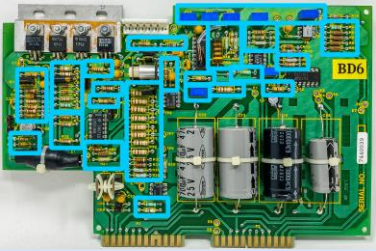


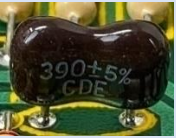



ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
93	SN74LS175N Texas Instruments 	Hex/Quadrupled D-Type Flip-Flops with Clear The purpose of this device is to store data and reset when clear input is applied. Datasheet	1	DIS(1) 
94	SN74LS348N Motorola 	8-Line To 3-Line Priority Encoder This encoder does priority decoding of the input to make sure that only the data line with the highest order is encoded. Equivalent Datasheet	1	CPU(1) 
95	SN74LS373N Texas Instruments 	Octal D-type Transparent Latches with 3-state Outputs When the clock input is high, these chips capture the logic level present on the Data line. Datasheet	4	DIS(4) 
96	SN74LS379N Texas Instruments 	Octal, Hex, and Quad D-Type Flip-Flops with Enable This chip is used to temporarily store the data. Datasheet	1	DIS(1) 

ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
97	SN74LS640N Texas Instruments 	Octal Bus Transceiver This bi-directional chip allows the flow of data between two busses. Datasheet	1	BD4(1) 
98	SN74LS648NT Texas Instruments 	3-State Inverting Octal Bus Transceivers and Registers This for 2-way transmission from A bus to B bus. Datasheet	2	COM(2) 
99	SN75160BN Texas Instruments 	Octal General-Purpose Interface Bus Transceiver This chip transmits and receive data between busses. This links the test equipment to a computer. Datasheet	1	COM(1) 
100	TC74HC4094P Toshiba 	8-Bit Shift and Store Register Shift registers store or move data to the output on every clock cycle while a register is a stores space for memory used to transfer data for instant data processing use by the Central Processing Unit. Datasheet	2	BD10(2) 



ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
101	<p>TIBAL16L8-25CN Texas Instruments</p>  <p>TIBPAL16R4-25CN Texas Instruments</p> 	<p>Low-Power High-Performance Impact PAL Circuit</p> <p>The Programmable Array Logic (PAL) contains programmable read-only memory and output logic to implement the applicable logic functions.</p> <p>Same Datasheet for Both Chips</p>	6	<p>CPU(6)</p> 
102	<p>TL061CP Texas Instruments</p> 	<p>Low-Power JFET Input Operational Amplifier</p> <p>This IC amplifies weak electric signals and uses less power.</p> <p>Datasheet</p>	1	<p>BD6(1)</p> 
103	<p>TL072C Texas Instruments</p> 	<p>Low-Noise JFET-Input Operational Amplifier</p> <p>This takes a weak input signal and amplifies it. The Junction Field Effect Transistor has less noise characteristic.</p> <p>Datasheet</p>	1	<p>BD6(1)</p> 
104	<p>TL084CN Texas Instruments</p> 	<p>Field Effect Transistor (FET) Input Operational Amplifier</p> <p>This takes a weak input signal and amplifies it. The FET is used because has a higher opposition to current flowing in from the electric source.</p> <p>Datasheet</p>	3	<p>DIS(3)</p> 

ID	Part Marking Manufacturer Image	Part Description What it Does/Role it Plays Datasheet	Tot Qty	Board Location (Qty on Board) Note: An IC can be in multiple boards
105	TMS9914ANL Texas Instruments 	GPIO Controller Also known as General Purpose Interface Bus. It links the test equipment Datasheet	1	COM(1) 
106	uA339PC Fairchild Semiconductor 	Quad Comparator This compares two analog input values and generates the output based on the comparison. Its role is to compare a measurable quantity with a standard like two voltages. Datasheet	1	CPU(1) 
107	uA741CP Texas Instruments 	General-Purpose Operational Amplifier This chip detects voltage differences between its input terminals. Its purpose is to boost weak signals and output the voltage difference between two input pins. Datasheet	1	BD7(1) 
108	Unidentified CA3 Our Guess is RCA Manufacturer 	Unidentified No datasheet	1	BD6(1) 

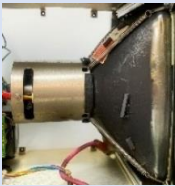
Capacitors

Types of Capacitors		What it Does/Role it Plays	Total Qty	Location of Capacitors on BD6
Film Capacitor 	Leaded Multilayer Ceramic 	<p>Capacitors store charge and energy.</p> <p>Film: used for stability, low inductance, and low cost</p> <p>Silver Mica: used in filters and oscillators for low capacitance and high stability.</p> <p>Electrolytic: used when large values are needed. Used for power supply filtering. Often see them next to power supply regulators.</p> <p>Tantalums: used in power conversion, filtering, energy storage</p>	297	
Ceramic Disc 	Radial Leaded Multilayer Ceramic 			
Silver Mica 				
Cylindrical Electrolytic 	Tantalum 			



Battery

Battery Image	What it Does/Role it Plays	Total Qty	Location of Battery on CPU Board
3V Lithium Button Battery 	Lithium button batteries provides power.	1	




Cathode Ray Tube

Cathode Ray Tube Assembly Image	What it Does/Role it Plays	Total Qty	Location of CRT
	The CRT projects the trace or image on the screen so you can see the output.	1	Stand alone and not attached to any of the 11 boards

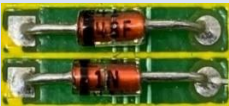

Crystal Oscillator

Crystal Oscillator Image	What it Does/Role it Plays	Total Qty	Location of Crystal on CPU Board
	Crystal oscillators are frequency stabilizers and provide a constant frequency output and has a high frequency of operation. It generates a stable clock signal in the CPU board.	1	



DC-DC Converter

DC-DC Converter Images	What it Does/Role it Plays	Total Qty	Location of DC-DC Converters on BD11
 	DC means direct current that does not change in polarity over time. DC-DC converters are switching regulators that convert one DC voltage to another.	4	






Diodes

Diode Images	What it Does/Role it Plays	Total Qty	Location of Diodes in BD7
Switching signal diode 1N4148 	Diodes only allow current flow in one direction but not the other. The switching signal diode operates up to about 100MHz and its role is to prevent surges during overvoltage.	55	Also in CPU, DIS, BD6, BD9, 




Fuse

Fuse Image	What it Does/Role it Plays	Total Qty	Location of Fuse on BD9
	An electrical safety device that provides overcurrent protections of an electric circuit	1	



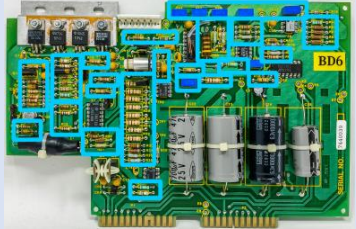
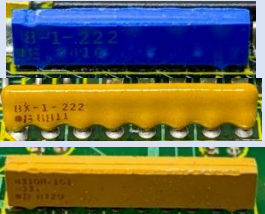


Inductors

Inductor Images	What it Does/Role it Plays	Total Qty	Location of Inductors on BD9
 	These inductors are electrical safety devices that provide overcurrent protections.	10	Also in BD6, BD11 
 			






Transformers

Transformer Images	What it Does/Role it Plays	Total Qty	Location of Transformers on BD7
 	A transformer is a passive electrical component that transfers electrical energy from one circuit to another by electromagnetic induction, and reduces or increases the electrical voltage.	5	Also in BD8, BD9 






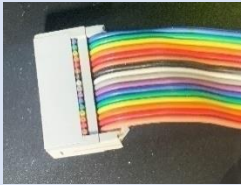


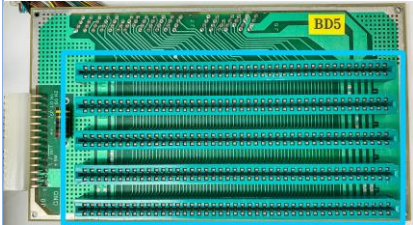
Resistors

Resistor Types and Images		What it Does/Role it Plays	Total Qty	Resistors on BD6
Carbon Film Resistor 	Resistor 	Resistors help regulate the amount of current that flows in the circuit. It also acts as a voltage divider.	280	In all boards except BD8 
Resistor Network 		Resistor Networks are multiple resistors connected. It acts as a voltage divider; it splits the voltage to smaller amounts.		
Round Trimming Potentiometer 	Square Trimming Potentiometer 	A potentiometer is a variable resistor. The round and square trimming potentiometers are often called trimmers and can be adjusted by thumb or a screwdriver. These are used to control, tune, and calibrate circuits.		









Transistors

Transistor Types and Images		What it Does/Role it Plays Datasheet	Total Qty	Transistors on BD6
NPN Power Transistor 	NPN Power Transistor 	Transistor are used for switching or as an amplifier. NPN/PNP Power Transistor is used to control high current-voltage rating.	35	Also in CPU, DIS, BD7, BD9 
PNP Audio Transistor 	PNP General Purpose 	PNP/NPN Audio Transistor amplify weak audio signals.		

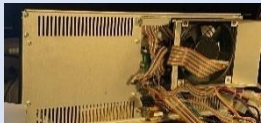
Connectors, Jacks and Plugs

Connectors, Jacks, Plugs Images	What it Does/Role it Plays	Total Qty	Locations on Boards
Jack 	A jack is the least movable connector of a connector pair. It may have “male” or “female” socket contacts and are used as connectors or an interface to another part.	24	Also COM,DIS, BD4, BD6, BD10 
Plug  	Plug connector may have “male” or “female” socket contacts and are used as connectors or an interface to another part.	3	Also in COM 
e Ribbon Cables 	Flat ribbon cables are used for internal connections.	25	Ribbon cables were attached from the inside connector of the External Control, IEEE48, RS232 HOST/DTE, to the connectors on the board
Socket/Pin/Analog Connectors  	<p>An end of a plug or jack or the edge of a card that connects into a port like an add on expansion card in a computer.</p> <p>The RS232 connector is a port for data exchange. The IEEE 488 is used to attach sensors and programmable devices to a computer</p>	15	<p>Also, in BD8, BD10, B11</p>  <p>The RS232s and IEEE 488 were attached to the back of the unit.</p>





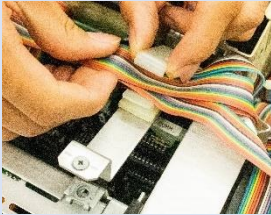
Sockets and Switches

Socket and Switch Images		What it Does/Role it Plays	Total Qty	Locations on CPU and COM Boards
LM2425 Button Battery Socket 		The battery socket holds the 3V button battery in place and makes a connection to the printed circuit board.	1	CPU(1) 
Piano Dual in Line Package Switch 	Rocker Dual in Line Package Switch 	These provide different electrical inputs to the device based on the position of each switch. These are used to set and configure systems.	2	COM(2) 
Pushbutton Switch  		This switch turns the device on or off on the device.	2	CPU(1) and up front 

Power Supply Assembly

Power Supply Assembly Image	What it Does/Role it Plays	Total Qty	Location
	Aside from supplying power to the analyzer, it also provides DC voltage to the motherboard and input/output devices.	1	The powersupply assembly was connected at the back of the device close to the fan assembly

Other Components

Other Component Images	What it Does/Role it Plays	Total Qty
<p>Chassis or System Unit</p> 	<p>The chassis houses and holds the electrical components. Its function is protection of internal electrical components and prevents electrical shock to users. It is made of rigid sheet-metal.</p>	3
<p>Front Panels/Face Plates with Buttons</p> 	<p>External Interface for the user to use buttons and plug interfaces to execute the desired task. It also identifies the make and model of the unit.</p>	3
<p>Fan</p> 	<p>The fan cools the components prevents the test equipment from shutting down due to high temperatures.</p>	1
<p>Backside of the Waveform Analyzer</p> 	<p>This is part of the chassis, and it protects the components, and it also protects the user from electric shock.</p>	1
<p>Plastic Latch</p> 	<p>The plastic latch held the cables in place.</p>	1

Citations and Resources

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