Electronics online challenge

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Texas Instruments

Home Computer TI-99/4A

Team 8828A





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Device report

Released in 1981, the Texas Instruments TI-99/4A was a massive innovation in the home computing market. The TI-99 was one of the first commercially available home computers to sport a 16-bit processor. The parts we found in the TI-99/4A were primarily Texas Instruments parts. Among them were the adjustable linear voltage regulator, the serial linear voltage regulator, the differential comparator, the TMS9900 microprocessor, the power supply, the series logic gates, the video display controller, the programmable systems interface all of which we extensively researched and documented below. The non-Texas Instruments parts were as follows: the capacitor, the ROM and the static and visual RAM. Due to the TI-99/4A's future compatible chips its design had been extensively documented by fans and hobbyists who were eventually able to use the 16-bit processer to its full potential. The existing history and online community made it an excellent choice for this challenge because existing information could help us keep organized in our disassembly process and understand exactly what parts we were handling so we could properly identify the systems within the computer. While the TI-99/4A had powerful components, in hindsight it represents a lesson in excess. Its ambitious 16-bit processor, while its defining characteristic, was what led to its discontinuation. The eccentricities of TMS9900's architecture including its

decentralized memory limited the speed of the expensive hardware and effectively reduced the computer to an 8-bit system. Coupled with the price of production, and the involvement in a price war with commodore, Texas Instruments lost money on each unit sold and the TI-994A would mark the last home computer manufactured by Texas instruments.

As our team worked our way through the deconstruction and research, we learned quite a few things about the computer itself but also about the online community surrounding the TI-99/4A. As this computer is almost 40 years old, widespread documentation is not so readily available which meant that to find information on certain components of the computer we needed to explore consumer created forums and sites to find what we needed. As mentioned above, the TI-99/4A had a fanbase of users and modders that stayed around after the computer was long outdated to utilize the 16-bit processer. The fanbase created websites and research papers documenting the computer and its capabilities, leaving us plenty of information to find the full story of the computer. We were also able to advance our skills in soldering. As the computer used through-hole soldering, we were able to access and remove certain chips from the wafer as well as gain access to the keyboard and convert it into one we could actually still use. We wanted to end this project without wasting the

computer, and this small side project made the deconstruction a bit less wasteful. Our team overall learned a lot from this project and will use our increased skill in research in particular to improve our design processes in this VRC season and beyond.

Device deconstruction



The bottom is removed via 8 machine screws.



The computer it contained within 3 distinct boards, the PSU, the main processor board, and the keyboard.



The first board we deconstruct will be the power supply unit.



TI-99/4A Power Supply Unit; Model Number:1049689-



3300 microfarad 35V capacitor produced by Nichicon; used to store energy electrostatically in an electric field. The board includes other small capacitors.



UA79M05: Series linear voltage regulator; manufactured by Texas Instruments in El Salvador. Controls the voltage drop between input and output.



UA723CN: Adjustable linear voltage regulator; manufactured by Texas Instruments in Taiwan; automatically maintains a constant voltage but has resistors to adjust output voltage



TL331CP Differential Comparator; compares two voltages or currents and signals the large value; manufactured by Texas Instrument in Malaysia.

We continue the deconstruction to the main processing board:



The board is protected by a metal bracket(below) which can be removed via 6 machine screws



Once removed the front and back of the board can be accessed



Main circuit board of the TI-99/4A was built around the TMS9900 microprocessor; houses RAM, CPU, VDU (Visual Display Unit), and sound processing chips



SN74LS: Series logic gates - converts multiple inputs into a single output.; manufactured by Texas Instruments in El Salvador, Malaysia.



VDP RAM (Video Processing RAM) – secondary RAM allotted for the Visual Display Processor; used for screen display, variables, and your program.



Signitic's ROM (Read-Only Memory) – data stored that cannot be modified by consumers; non-volatile memory defined at production.



FR99 FlashRom 99 Cartridge: port for Texas Instrument game cartridges



TIM9904 four phase clock generator and driver by Texas Instruments. used to produce the required clock signals for the TMS9900 CPU.



MCM6810P: SRAM (Static RAM) – retains data bits in memory as long as power is supplied; Manufactured by Motorola, unknown country.



TMS 9901 Programmable Systems Interface: performs interrupt and I/O interface functions; 5V power supply; converts input signals from ports to usable outputs for processor.



Texas Instruments TMS 9918A – Video display controller that outputs video in composite 60hz; communicates to CPU with 8-bit bus eliminating benefits of the 16-bit processor.



Picture shows VDC (Video Display Controller) using thermal paste (shown above) to dissipate heat through the metal bracket



In order to better examine the CPU, we decided to desalter the chip from the board.



16-bit TMS9900 CPU 3MHZ: memory and peripherals are connected to the CPU through a 16-18bit multiplexer; one of the first 16-bit processors used in personal computers, although it was restricted.



We finally moved on to the last piece of the computer, the keyboard.



TI-99/4A has a 48 key QWERTY, full-stroke keyboard: ten keyless.



Although we purchased the TI-994A non-working, we were able to salvage the keyboard and create a macro pad capable of connecting to and current computer.

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