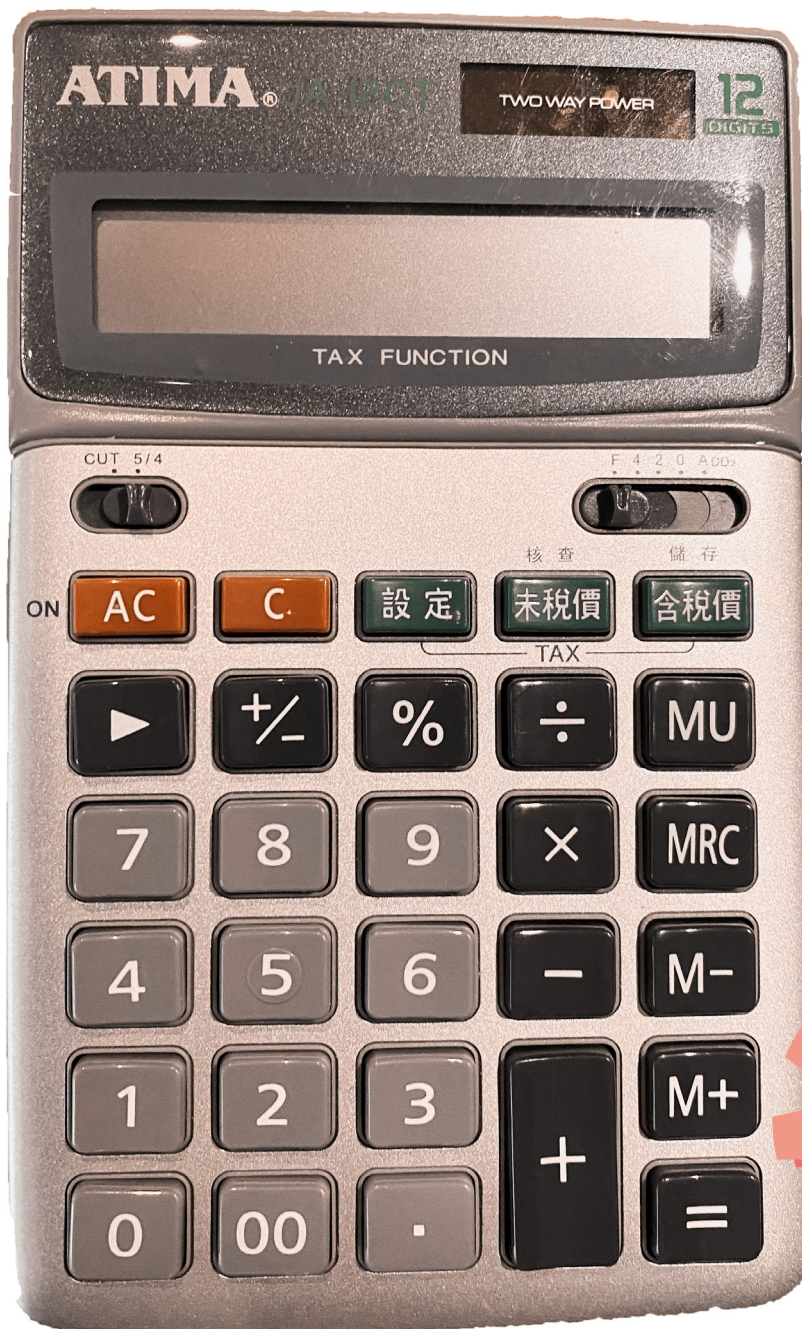


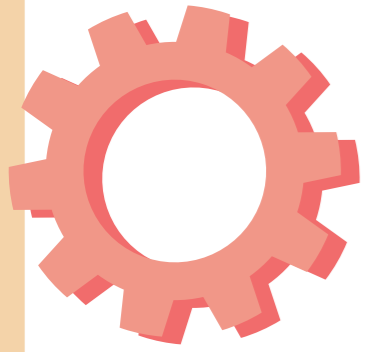
Alicia, Charlene, Kerrienne, Madeline, Rachel

REVERSE ENGINEERING

of the calculator

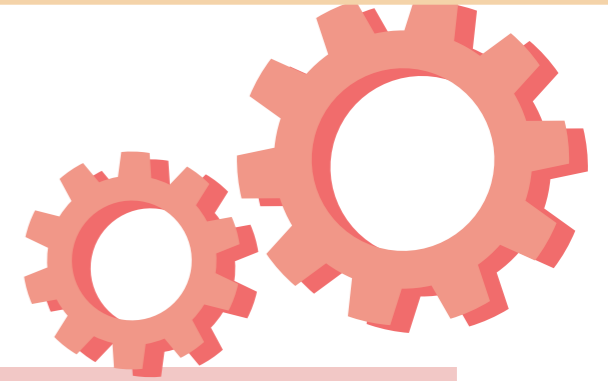
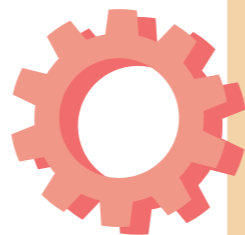


with 4253A in Taipei, Taiwan



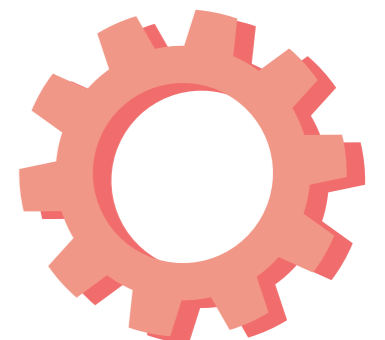
INTRODUCTION:

A calculator is an everyday object that performs simple arithmetic operations. This is the plainest way to put a, what we think, incredibly helpful, but neglected piece of device. Blaise Pascal invented the first digital calculator in the 17th century, and his creation has now become this revolutionary pocket-sized device everyone owns. However, few people have stopped to think about their calculators and the machinery inside their thin bodies that help them perform such complex functions. So how does a calculator, essentially the simplest form of a computer, still execute the algorithmic work fundamental to the operation of a computer?



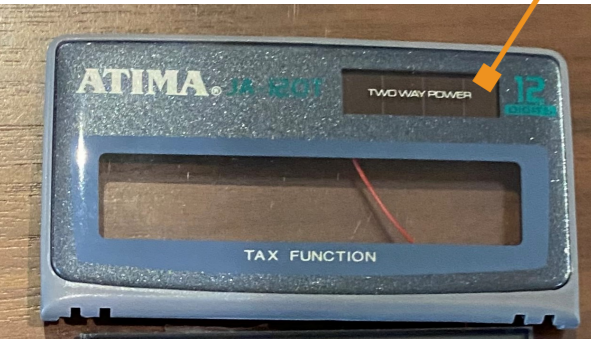
COMPONENTS:

1. Solar panels
2. Battery
3. Rubber membrane
4. Keyboard sensor
5. Processor chip
6. Traces (communication between components)
7. Capacitors (electrolytic capacitor, ceramic disk capacitor)
8. LCD
9. Detection diode
10. LED
11. Soldered joints

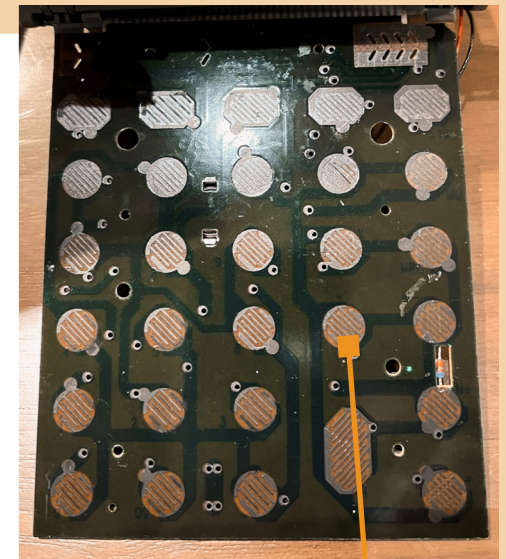
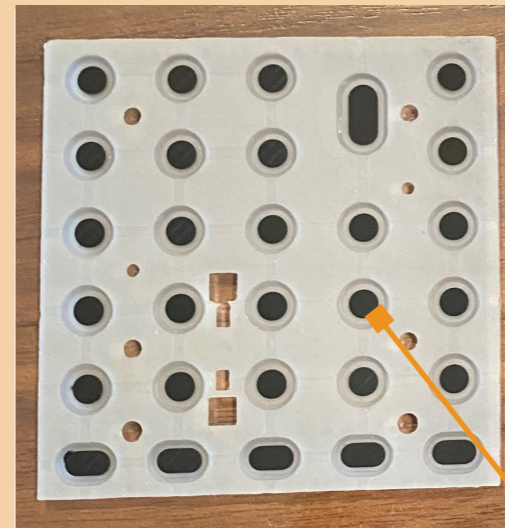
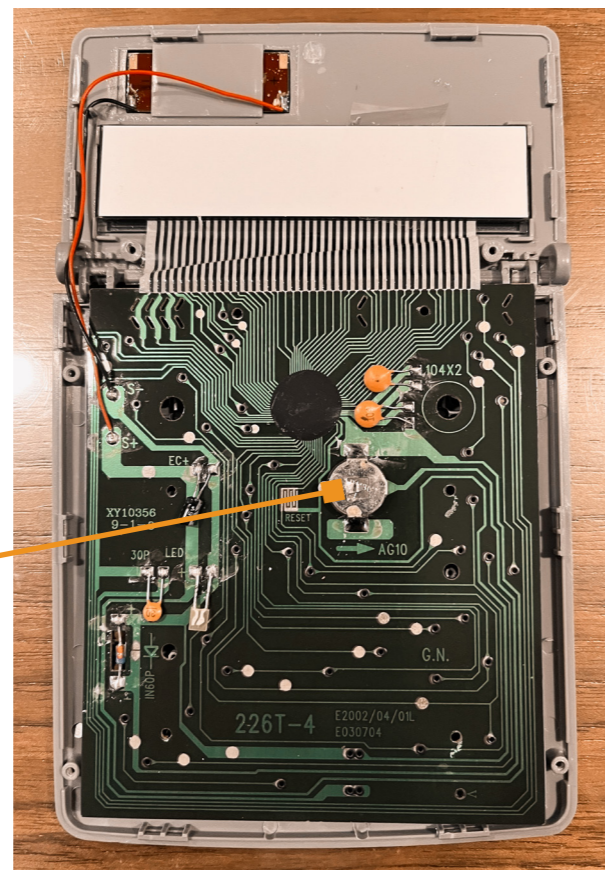


Our calculator...

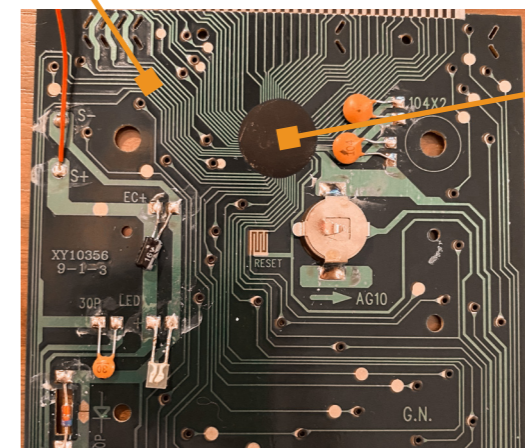
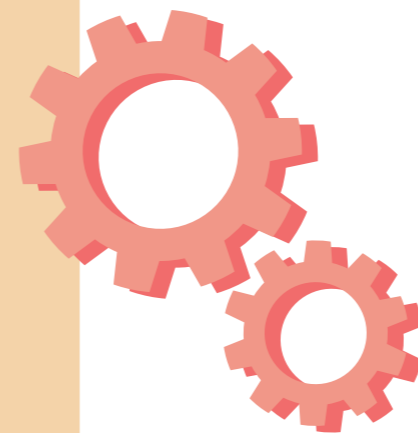
contains a solar panel that extends the calculator's life by recharging the main battery. Solar cells (photovoltaic cells) take the sun's energy to emit electrons through a process called the photoelectric effect. When sunlight shines on the solar panel, photons hit the silicon atoms and transfer energy to the electrons. Two silicon elements, the n-type (positively charged) and p-type (negatively charged), are created, forming an electric field for the calculator to power.



Nearly all solar panel calculators have a battery inside that powers the whole calculator. The calculator uses the AG10 battery.

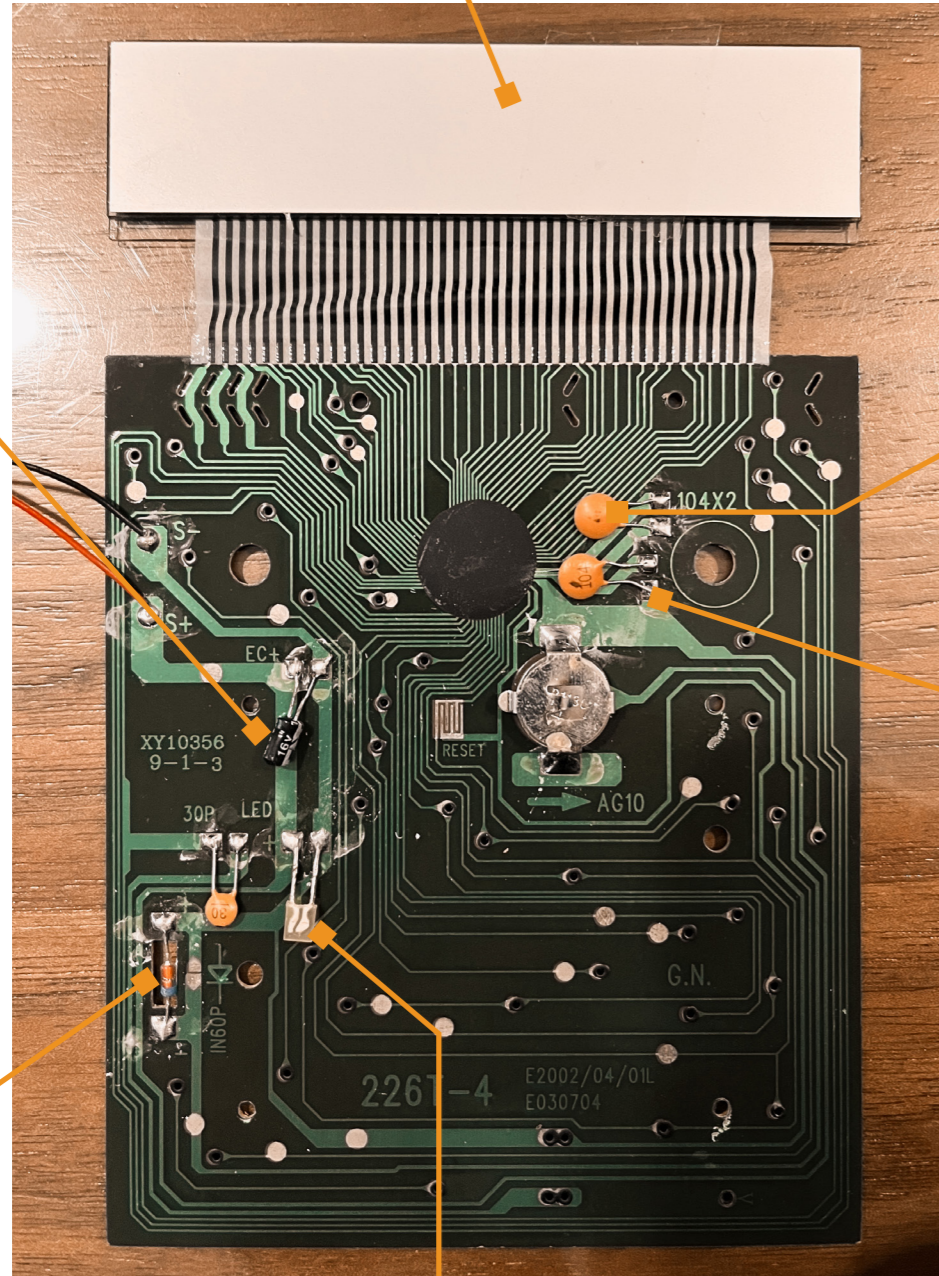


When a user presses a key, the rubber membrane (located right underneath the keys) is pushed down, making electrical contact between the keyboard sensor. The keyboard circuit detects it and sends the information to the processor chip, allowing the numbers to be stored in a register. After pressing the "=" sign, the binary code is processed in the Arithmetic Logic Unit, where a series of logic gates are used to compute binary data. Then, the computed data is sent as signals through the traces, lines between components that conduct signals.



The **electrolytic capacitor**, with one plate coated through electrolysis with an oxide (the dielectric), and another replaced by an electrolyte, filters through and smooths out rectified alternating voltage and components. (The ceramic disk capacitor is better for high frequencies, while the electronic capacitor is better for low frequencies.)

After any input, the result is shown on the **liquid crystal display or the LCD**. Each number is made from a different pattern of seven bars. The processor chip can display any number (0-9) by activating a different combination of these seven bars.

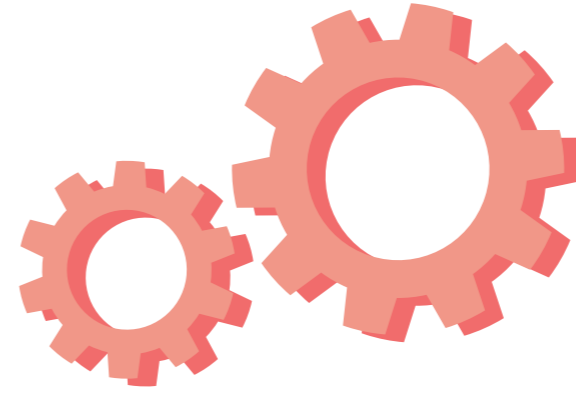


The ceramic layers within the two **ceramic disk capacitors** are dielectric. Their efficiencies are at 100,000 pF and 30pF.

The **detection diode** makes sure that electricity is conducted only in one direction.

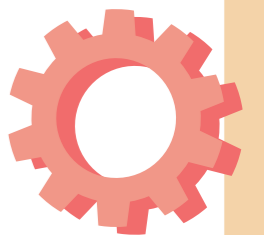
LED

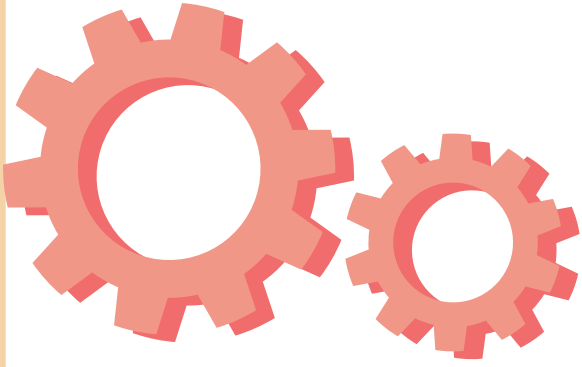
The **soldered joints**, a thin layer of alloy, hold components together and allow the electrical signal to travel without interruption by securing the point of contact against any external forces.



CONCLUSION:

Calculators are one of the most primitive forms of technology we have today, and as demonstrated in our project, are more complex than just buttons and a screen. We had a fruitful experience working on this project, from learning about components never before even heard of to understanding the intricate and thorough designs of such simple calculators.





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