

Reverse Engineering
A Heartfelt Decision:
The LATITUDE
COMMUNICATOR Model
6290
Monitoring System



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Table of Contents

1. Introduction	2
2. Plan of Action	2
3. Methodical Disassembly	3
4. Component Summary	4
5. Component Analysis	5
6. Findings	15
7. Lessons Learned	15
8. Resources	16

1. Introduction

After Ian’s grandfather, who loved watching Ian compete, passed away, his grandmother handed him the Boston Scientific Latitude Commander. This sophisticated remote monitoring system for cardiac implants like a pacemaker intrigued our team. It gathers data from implanted cardiac devices and transmits it securely using internet or cellular networks, enabling healthcare providers like the doctor to monitor the device’s performance remotely and securely. But to us, it wasn’t just a device. It symbolized Ian’s grandfather and the advanced medical technology he depended on. Nick was also reminded of its crucial role in monitoring their grandfather’s heart health. We chose this, seeing it as a marvel of technology that connects us to meaningful memories.

2. The Plan of Action

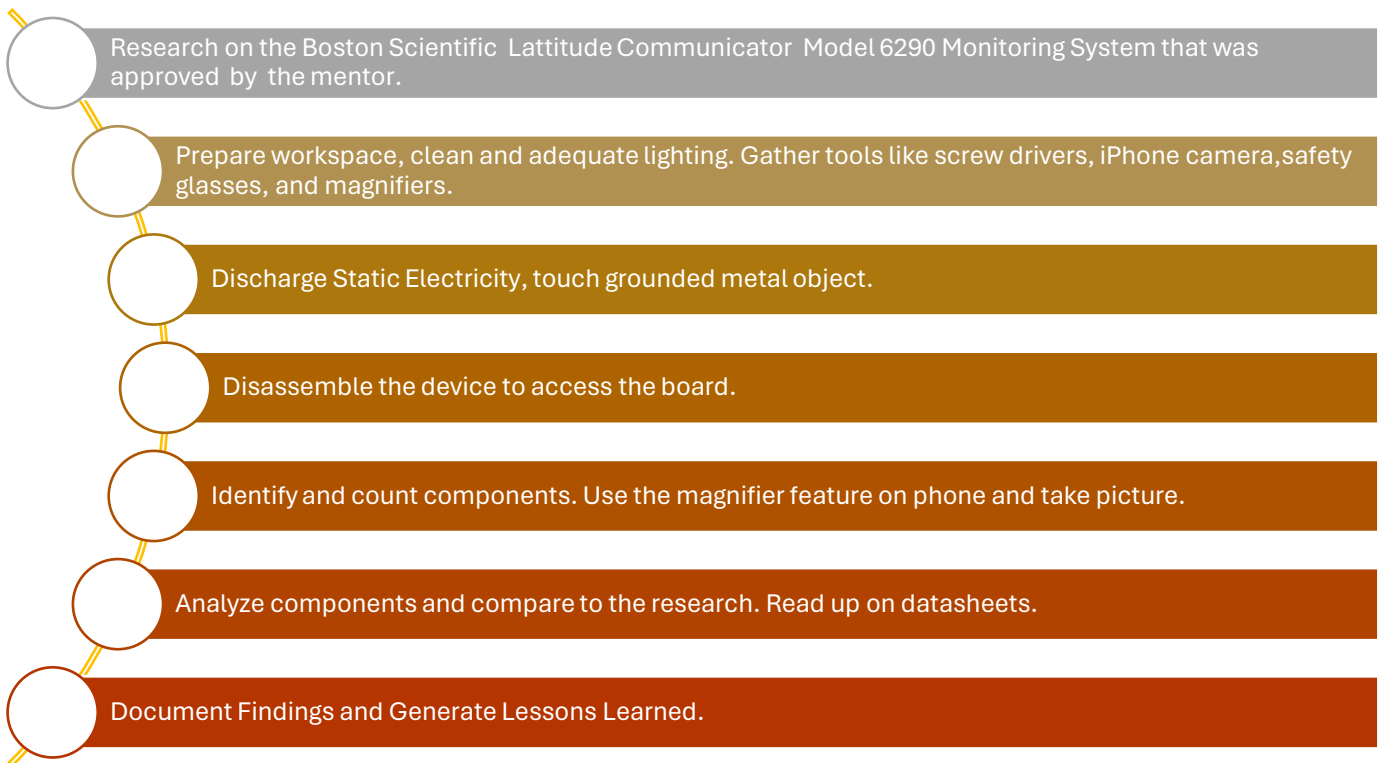


Figure 1: Strategy for Execution

3. Methodical Disassembly










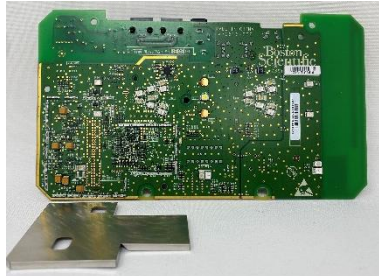
Step 1	Step 2	Step 3
<p>Remove power cord from the Latitude Communicator.</p> 	<p>Remove the 4 screws at the back of the device.</p> 	<p>Pull apart the case enclosures.</p> 
Step 4	Step 5	Step 6
<p>Remove center screw on the back of the motherboard.</p> 	<p>Remove metal shielding on the front of the motherboard.</p>   	<p>Remove metal shielding on the back of the motherboard.</p>   

Figure 2: Systematic Dismantling Process

4. Component Summary

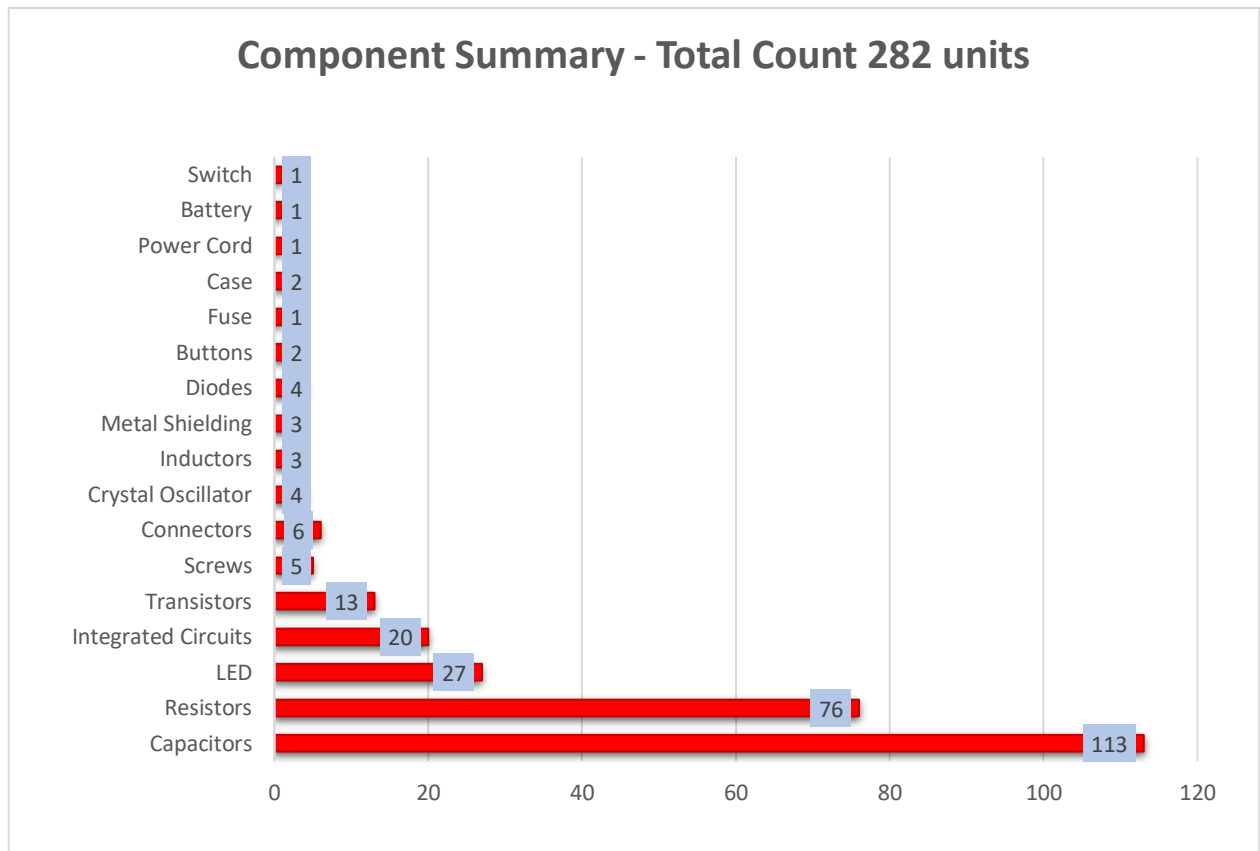


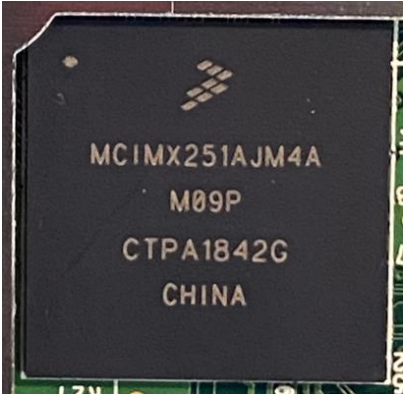





















Figure 3: Component Inventory: List of Device Components







5. Component Analysis

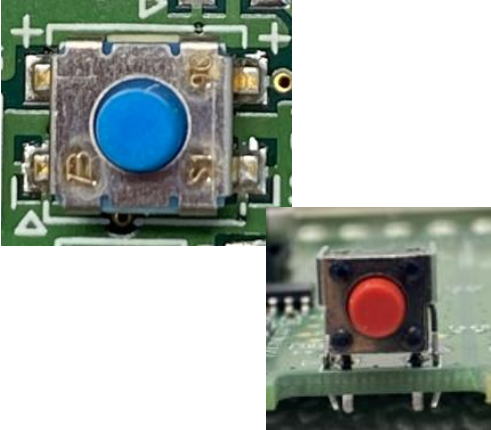

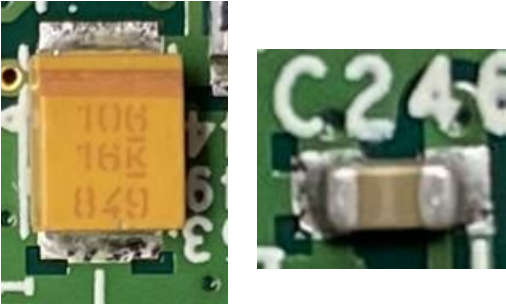
Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>Texas Instrument LC07A (Qty 1)</p> 	<p>This is a hex buffer and driver with open-drain outputs used for buffering and driving signals. The LATITUDE Communicator processes and transmits sensitive medical data. If its circuitry requires the type of signal buffering and driving provided by the SN74LVC07A, particularly with its open-drain output feature.</p> <p>Datasheet</p>	
<p>NXP Freescale Semiconductor MCIMX251AJM4A (Qty 1)</p> 	<p>i.MX25 32-bit MPU, ARM926EJ-S core, 400MHz, MAPBGA 400. The MCIMX251AJM4A is a microprocessor designed for multimedia applications. It is used in embedded systems, offering enhanced audio and video processing capabilities, low power consumption, various connectivity options, and support for multiple operating systems.</p> <p>Datasheet</p>	


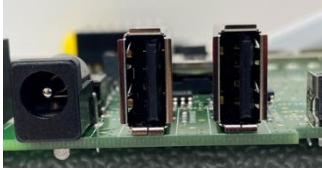





Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>Analog Devices LTC2912CTS8-2 (Qty 5)</p> 	<p>This is a Single UV/OV Voltage Monitor. It detects undervoltage and overvoltage in power supplies. It has filters on Voltage Low and Voltage high inputs to block small glitches, making sure there is smooth operation without incorrect triggers. Datasheet</p>	
<p>Analog Devices LT3220T (Qty 1)</p> 	<p>This is a 360mA universal 18-Channel Driver. This chip is used to control multiple LEDs with varying brightness. Each of the 18 channels can be controlled independently for on/off, brightness level, blinking, and gradation. This makes it suitable for complex lighting arrangements and displays. Datasheet</p>	
<p>Skyworks Inc SI2457-FT (Qty 1)</p> 	<p>Modem. V.90, V.34, V.32bis, V.22bis ISOMODEM® with Global DAA is a multi-standard modem compatible with international phone networks, offering flexibility for various communication speed and international use. Datasheet</p>	







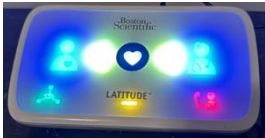
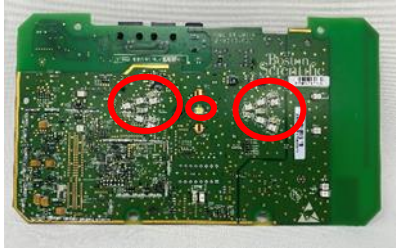
Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>Skyworks Inc. SI3018 (Qty 1)</p> 	<p>This chip is a Global Serial Interface Direct Access Arrangement. Its role is a Landline interface for the modem.</p> <p>Datasheet</p>	
<p>Texas Instrument 2041B (Qty 2)</p> 	<p>0.5A loading, +/-25% ILIMIT Accuracy, 2.7-5.5V, 70mOhm power switch, active low. It is a USB power distribution switch that can handle up to 0,5A of current, operates with USB voltage standards and is controlled by an active-low signal. It is typically used in USB hubs where power distribution is needed. We see this chip close to the USB hub.</p> <p>Datasheet</p>	
<p>Texas Instrument TPS717 marking BNB (Qty 2)</p> 	<p>This is a voltage regulator that ensures a stable and efficient power supply to protect components from voltage fluctuations. The unique feature is a low-dropout which allows it to operate even with a small difference between input voltage and the regulated output voltage.</p> <p>Datasheet</p>	

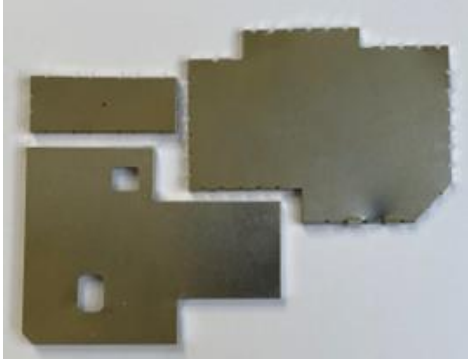
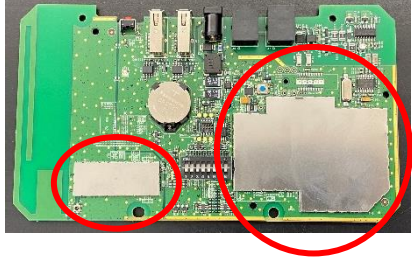




Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>NXP PCF8563 (Qty 1)</p> 	<p>Real-time clock/calendar. The PCF8563 is a real-time clock (RTC) chip used in electronic devices for accurate timekeeping. It features low power consumption, battery backup, an I2C communication interface, alarm functions, and calendar functionality. It's used to maintain correct time and date.</p> <p>Datasheet</p>	
<p>Micron MT47H32M16NF-25E D9SBJ Marking (Qty 1)</p> 	<p>It is a Double Data Rate 2 Synchronous Random-Access Memory. Designed for high-speed data storage and retrieval.</p> <p>Datasheet</p>	
<p>Texas Instruments CC1101 (Qty 1)</p> 	<p>Low power Sub-1 GHz wireless transceiver. The CC1101 is a low-power wireless transceiver chip used for transmitting and receiving radio signals.</p> <p>Datasheet</p>	

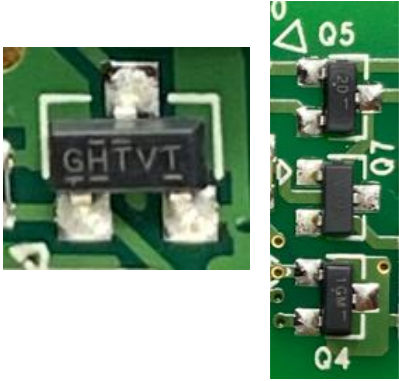





Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>Micron 512P30BF (Qty 1)</p> 	<p>Parallel NOR Flash Embedded Memory. This is a flash memory chip used for storing data. It keeps data even when the power is off and allows quick data access.</p> <p>Datasheet</p>	
<p>Analog Devices/Linear Technology LT1109A (Qty 1)</p> 	<p>This device is Micropower DC/DC Converter Flash Memory VPP Generator and Fixed 5V, 12V. Its role is to convert one level of D (Direct current) to another suitable level. It is essential for maintaining stable voltage levels and providing flexibility in using different power sources.</p> <p>Datasheet</p>	
<p>Battery Panasonic CR2032 (Qty 1)</p> 	<p>This is a small, coin-shaped lithium cell that can serve as a backup power source to maintain functions like memory or real-time clock operation in the absence of the main power supply.</p> <p>Datasheet</p>	

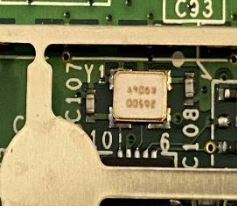

Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>Button (Qty 2)</p> 	<p>Buttons are switches that users press to control specific functions or actions of the device. The red button on the side of the board is the status button when pressed for a second. The indicators will stay on for 2 minutes and all six Collecting and Sending waves lit green. Then it means the Communicator is working correctly.</p>	
<p>Capacitors (Qty 113)</p> 	<p>Capacitors store and release electrical energy. They serve as an energy storage: store electrical energy temporarily and release when needed, helping to stabilize power supply. Its role is to 1) filter out noise from the power supply, ensuring a smoother operation of the machine 2) for signal processing: shaping and controlling signal waveforms which is important in communication and data processing.</p>	
<p>Case or Enclosure (Qty 2)</p> 	<p>The case provides physical protection for its internal components, safeguarding against damage from dust, impacts, moisture, ensuring durability and reliability.</p>	

Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>Connectors/interconnects/Jacks Molex 18441, others (Qty 6)</p>  	<p>Connects, interconnects. These 2 Molex connectors are for the phone and RJ45.</p> <p>There is one power supply jack to connect to the power supply.</p>	
<p>Crystal Oscillators (Qty 4)</p> 	<p>These provide a steady and accurate timing signal, essential for reliable data processing and communication.</p>	
<p>Diodes (Qty 4)</p> 	<p>Diodes allow current to flow in one direction. Its role is for</p> <ul style="list-style-type: none"> • Rectification – converting alternating current to direct current. • Protect sensitive components against damage from reverse polarity or voltage spikes. 	

Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>Fuse (Qty 1)</p> 	<p>This is a safety device designed to protect from excessive current. Its role is to prevent overcurrent, protect the device from excessive current and protect internal components from damage.</p>	
<p>Inductors (Qty 3)</p>  	<p>These are used to store energy in a magnetic field when electric current flows through. It is used for 1) filtering unwanted high frequency noise in circuits 2) signal processing – select specific frequencies 3) resist changes in current, so it helps protect from sudden current changes. energy storage – store energy temporarily and release it when needed.</p>	
<p>Light Emitting Diodes (Qty 27)</p> 	<p>LEDs emit light when an electric current passes through them. These are used as 1) indicators showing power status and signal strength 2) User interface – like indicating buttons or function 3) Providing light for the display.</p> 	

Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>Metal Shielding (Qty 3)</p> 	<p>This is key for preventing electromagnetic interference, maintaining clear signals, meeting medical standards, ensuring safety, and improving data security, essential for its reliable monitoring function.</p>	
<p>Power Cord (Qty 1)</p> 	<p>This is used for providing electrical power to the Latitude Communicator.</p>	
<p>SMD Resistors (Qty 76)</p> 	<p>Surface-Mount Device resistors are designed to be mounted directly onto the printed circuit board (PCB). It regulates and stabilizes the flow of electrical current in a circuit.</p>	

Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>Transistors (Qty 13)</p> 	<p>Transistors are used to amplify or switch electronic signals and electrical power. It functions as a switch to a signal on and off or as amplifier to increase signal strength.</p>	
<p>Screws (Qty 5)</p> 	<p>Screws are used to fasten the case or enclosures. It also attaches the circuit board to the case to secure it in place. It also allows for easy disassembly of the device like for our reverse online challenge.</p>	
<p>Switch (Qty 1)</p> 	<p>The 8 white switches must be set correctly for connection to the Clinician Website. Settings are either on (up) or off (down). The settings also depend on the country the patient resides in.</p>	

Components/Manufacturer Qty and Picture	What the Components Do and the Roles they Play in the System	Location
<p>Unknown – maybe an encryption part No data found</p> 	<p>Unknown part under the metal shielding. We tried to look for Export Control Classification Number to indicate if this device has encryption, but we were not able to find that too. This led us to believe this device might have the health records of my grandfather. Scary to think people are selling these devices in eBay.</p>	

6. Findings

In this challenge, we identified internal components like processors, memory chips, and connectivity modules which were essential in understanding the device’s hardware architecture. We faced challenges with small component marking, which often did not match actual part numbers, leading us to the detailed investigation for correct identification.

Datasheets posed another challenge; many were outdated or inconsistent, requiring cross-referencing from multiple sources for accuracy. We also observed evolving trends in the electronics design miniaturization. We gained a better understanding of how the device works and what it can do by looking at its hardware and software setup. Additionally, we investigated the security architecture. We examined the device for encryption and protection mechanisms, gaining insight into its security measures. We found a chip under the metal shielding with no available information, possibly containing my grandfather’s health records.

7. Lessons Learned

- Patience is essential. The process of reverse engineering is detailed and takes time. If you hurry, you might overlook important details.
- We developed skills in applying various research methods to locate the appropriate datasheets.
- We enhanced our ability to identify and understand various components even when information was scarce, as with the case with the chip under the shielding.
- The potential discovery of encrypted health data on chips underscored the importance of data security and privacy in electronic devices.

8. Resources

Note that datasheets are linked under its corresponding component.

Boston Scientific and Techs Place are credited for their images.

Boston Scientific LATITUDE Communicator Model 6290 & Vodafone USB Connect 4G V2. eBay, Techs Place, https://www.ebay.com/itm/225771343378?chn=ps&_trkparms=ispr%3D1&amdata=enc%3A1LZriIS0oSb27EYJYBTp4gA17&norover=1&mkevt=1&mkrid=711-117182-37290-0&mkcid=2&mkscid=101&itemid=225771343378&targetid=1585159290651&device=c&mktype=pla&googleloc=9031632&poi=&campaignid=19894961968&mkgroupid=148855406073&rlsatarget=pla-1585159290651&abclId=9307911&merchantid=6296724&gclid=Cj0KCQiA2eKtBhDcARIsAEGTG42SPqeWKzzzQawmQ3ILmsNZrl8DDfUePuhIVEIC_kyv90F4a9EV258aAj1YEALw_wcB. Accessed 22 Jan. 2024.

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