# Team 1826A

## Texas Instruments Electronics Online Challenge

The device that we decided to analyze is an HTC EVO 4G smartphone. We chose a smartphone because it is something that almost everyone uses each day of their lives, and we wanted to understand what goes into making one. We chose the HTC EVO 4G because it was no longer useable after Sprint shut their original 4G network down in 2015.

After we tore down the device and were able to look at all of the chips inside, we took a picture of the board with another smartphone so we could zoom in and read the markings on the chips. We made a list of all of the parts that we could read the markings on. In looking at the list of all of the numbers, the job of figuring out what the chips did seemed overwhelming. What we decided to do before we looked up the chips, was to make a list of all of the phone functions we could think of. The list that we came up with was:

1. Computer
    - Processor
    - Memory
    - Graphics Processor
    - WiFi
    - USB
2. Cell Phone
    - Talk/Listen/Text/Data to Cell Phone Network
3. Navigation
    - GPS
    - Compass
4. Sense Motion
5. Touchscreen
6. Camera
7. Battery/Power
8. Bluetooth
9. HDMI Output

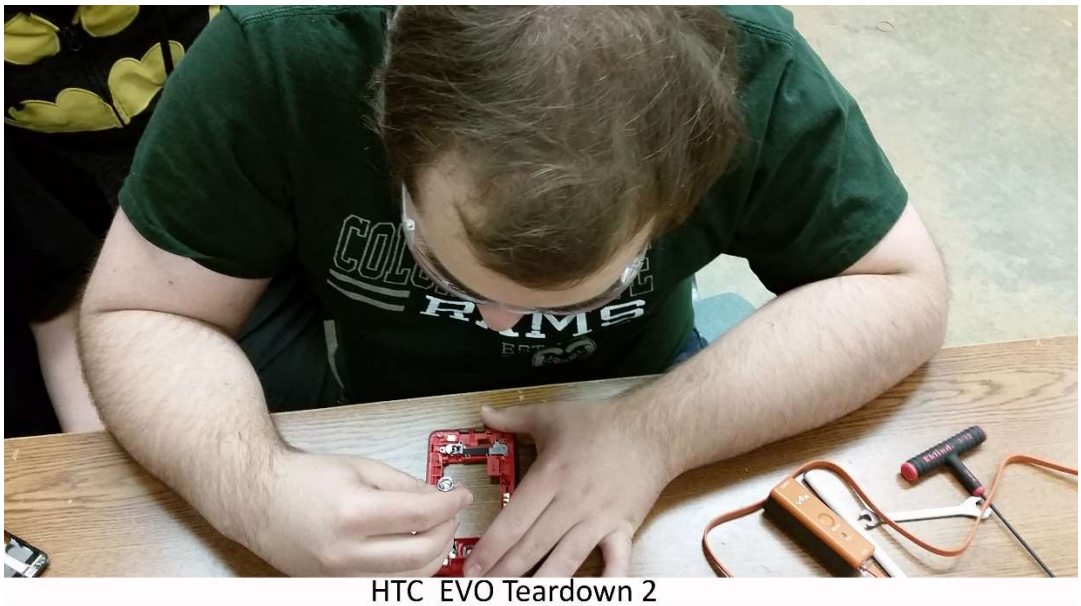
We looked up all of the numbers on the chips we could identify, and made a table that listed the manufacturer, the device, and the description that we found. This full parts list table is included at the end of the document. We did find three Texas Instruments components on the board. Based on what we found, the power and battery functions on the phone were handled by two Texas Instruments chips, the TPS65051 and TPS65200. Despite a great deal of searching, we could not find any datasheet or description of the other Texas Instruments component, which had the marking SN0901059.

Once we had the parts table complete with the descriptions we found, we were able to match our original list of phone functions to the parts.

| Original Phone Function | Component(s) | Manufacturer(s) |
|---|---|---|
| Processor | QSD8650 | Qualcomm |
| Memory | H8BFSOWU0MC8 | SkHynix |
| Graphics | QSD8650 | Qualcomm |
| WiFi | BCM4329 | Broadcom |
| USB | PM7540 | Qualcomm |
| Talk/Listen to Cell Phone Network | TQM613029<br>RTR6500<br>SQN1210<br>FEM7758 | Triquint Semiconductor<br>Qualcomm<br>Sequans Communications<br>Avago Technologies |
| GPS | RTR6500 | Qualcomm |
| Compass | AK8973 | Asahi Kasei Microsystem |
| Motion Sensor | BMA150 | Bosch Sensortec |
| Touch Sensor | MXT224 | Atmel |
| Camera | No markings on chip | N/A |
| Battery/Power | TPS65051<br>TPS65200 | Texas Instruments<br>Texas Instruments |
| Bluetooth | BCM4329 | Broadcom |
| HDMI Output | 9024ARBT | Silicon Image |

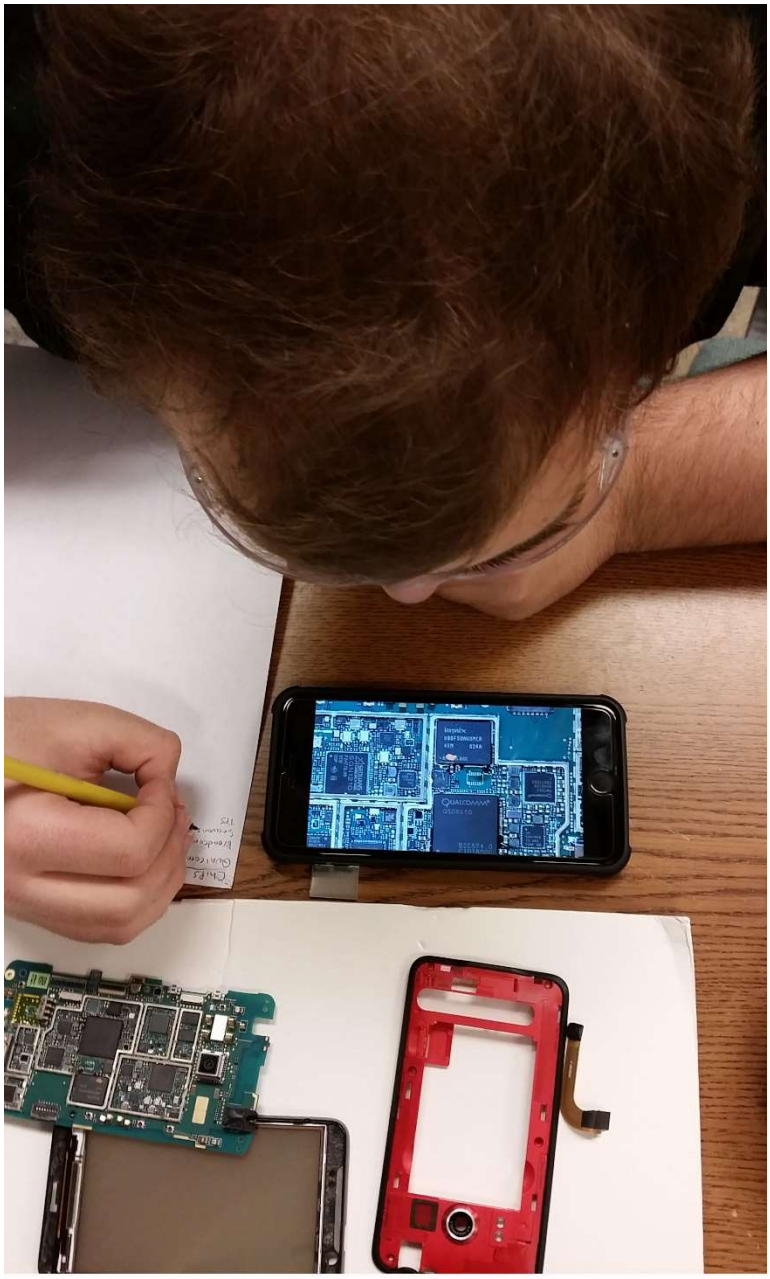
We feel that we learned a great deal from this challenge. It was actually not hard to figure out which chips did which functions once we compared their descriptions with the functions we had identified. We learned that some functions can require multiple chips to accomplish, and that one chip can also accomplish multiple functions. However, usually one function is accomplished with one chip. What was most amazing was how many different companies' parts go into making a smartphone.

Beginning teardown of the HTC EVO 4G



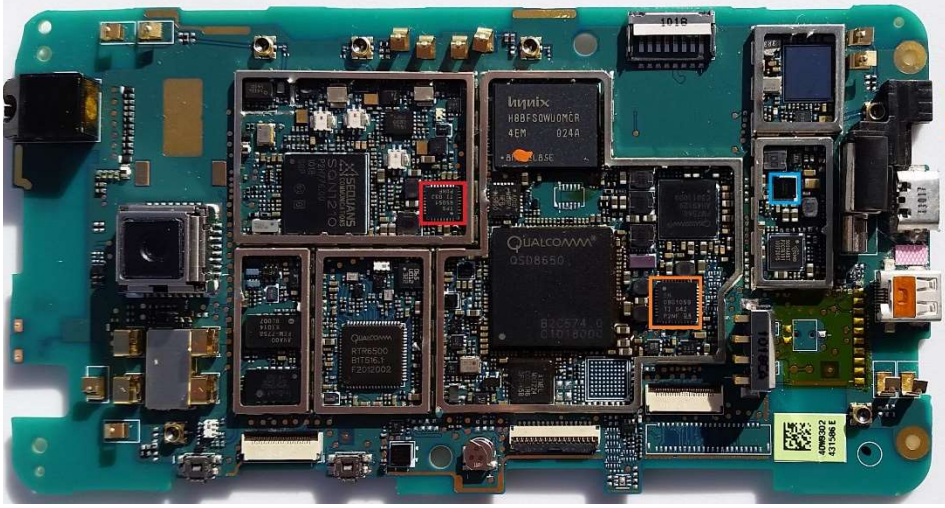
HTC  EVO Teardown 2


HTC EVO Teardown 3



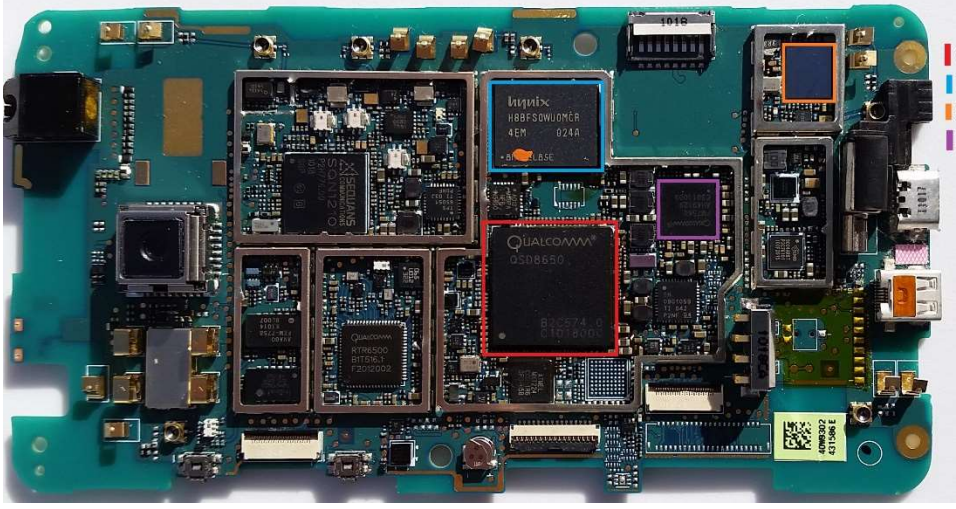
HTC EVO Teardown - Recording Chip Markings

## Texas Instruments Components



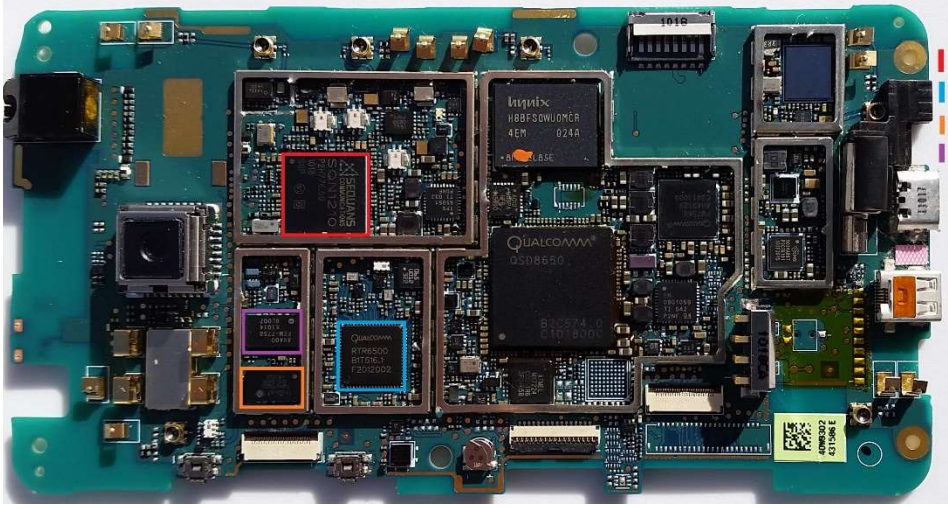
- TPS65051 - Power
- TPS65200 - Power/Battery Charge
- SN0901059 - Function Undetermined

## Computer Functions



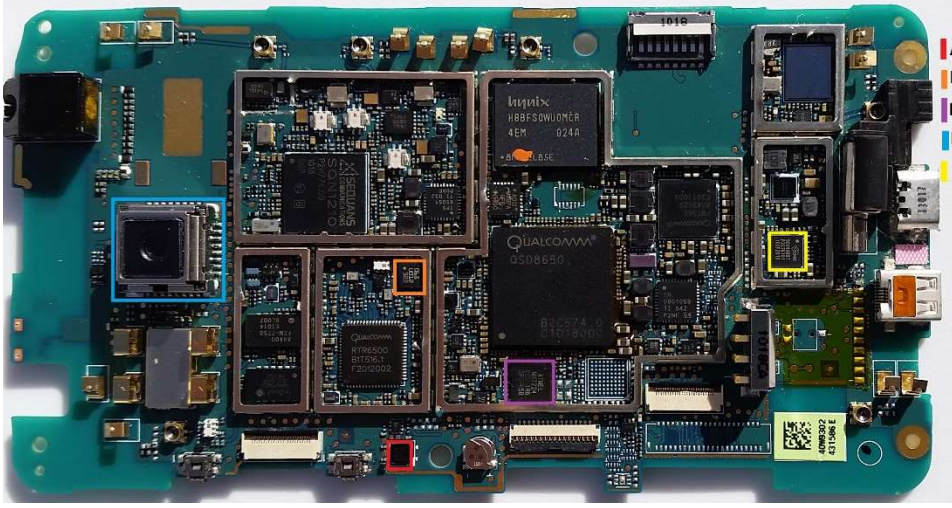
- QSD8650 - Processor/GPU
- H88BFSOWU0MC8 - Memory
- BCM4329 - WiFi/Bluetooth
- PM7540 - USB/Power

## Cell Network Talk/Listen and GPS



- SQN1210 - Wireless Broadband
- RTR6500 - Transceiver/GPS
- TQM613029 - CDMA Duplexer
- FEM7758 - CDMA Front End

## Sensors, Camera, and HDMI



- AK8973 - Digital Compass
- BMA150 - Triaxial Motion Sensor
- MXT224 - Touchscreen Sensor
- No Chip Markings - Camera
- 9024ARBT - HDMI Output

| Parts List with Manufacturer and Part Description | | |
|---|---|---|
| **Manufacturer** | **Device** | **Description** |
| Texas Instruments | TPS65051 | The TPS6505x-Q1 devices are integrated power management ICs for applications powered by one Ion or Li-Polymer cell, which require multiple power rails. |
| Texas Instruments | TPS65200 | Li+ Battery Swiching Charger With WLED Driver and Current Shunt Monitor |
| Texas Instruments | SN0901059 | Found part for sale, but no datasheet or description |
| Qualcomm | QSD8650 | First "Snapdragon" processor from Qualcomm. 1Ghz Scorpion CPU and Adreno 200 GPU |
| Sk hynix | H8BFSOWU0MC8 | Memory chip that has both ROM and RAM. MCP 8G Nand 512Mx16 + 4G mDDR 64Mx32 |
| Atmel | MXT224 | A 224-node highly configurable touchscreen controller that is part of the Atmel maXTouch product platform. An optimal and scalable architecture enables smart processing of a capacitive touch |
| Sequans Communications | SQN1210 | The SQN1210 delivers wireless broadband connectivity for fully mobile WiMAX® applications |
| Qualcomm | RTR6500 | the industry's first single-chip CDMA2000® radio frequency (RF) complementary metal oxide semiconductor (CMOS) transceiver with integrated receive diversity and simultaneous-GPS |
| Avago Technologies | FEM7758 | A fully matched CDMA Front-End Module featuring the integration of Power Amplifier, Duplexer, Band-pass Filter and Coupler |
| Triquint Semiconductor | TQM613029 | A fully matched CDMA cellular band PA-Duplexer module for use in mobile phones. The module integrates a single-ended transmit filter, duplexer, high efficiency PA die, RF power coupler, matching and built in voltage regulator functionality |
| Qualcomm | PM7540 | PMIC with USB tranceiver |
| Broadcom | BCM4329 | The Broadcom® BCM4329 family of single chip devices provides for the highest level of integration for a mobile or handheld wireless system, with integrated IEEE 802.11™ a/b/g and handheld device class 802.11n (MAC/baseband/radio), Bluetooth® 2.1 |
| Silicon Image | 9024ARBT | The SiI9022A/SiI9024A HDMI transmitter supports the High Definition Multimedia Interface (HDMI®) |
| Asahi Kasei Microsystem | AK8973 K09B | Magnetic Field and Orientation Sensor |
| Bosch Sensortec | BMA150 | Triaxial Acceleration Sensor |