ZTE V5 U9180 Smartphone Teardown and Analysis

ROBOTICS

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Submission to
Electronics Online Challenge
sponsored by Texas Instruments

TEXAS INSTRUMENTS

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Footnotes: [1] on title page is a trademark of Texas Instruments

Abbreviations/Acronyms:

CPU: Central Processing Unit

GPU: Graphics Processing Unit

IF: Intermediate Frequency

RF: Radio Frequency

IC: Integrated circuit

GSM: Global System for Mobile Communications

GSM-EDGE: Enhanced Data Rates for GSM Evolution

W-CDMA: Wideband Code Division Multiple Access

HSPA+: Evolved High Speed Packet Access

LTE: Long-Term Evolution

PAM: Power Amplifier Module

TI: Texas Instruments

SoC: System-on-a-chip

RAM: Random access Memory

DSP: Digital Signal Processor

ISP: Image Signal Processor

PCB: Printed Circuit Board

ASIC: Application-specific integrated circuit

DC: Direct Current

SIM card: subscriber identity module card

LED: Light Emitting Diode

UI: User Interface

SD card: Secure Digital Card

N.D: No Date

eMMC: Embedded Multimedia Card

Device choice

We elected to disassemble the ZTE V5 U9180, an old smartphone that a team member had. We thought it was complex enough to explore modern integrated circuits and pose a moderate challenge. (1)

Findings and Analysis

We found a plethora of chips and components inside the phone, but there were no TI components. We speculate that this is because TI components, which are used on flagship phones like iPhones, are more expensive, so they were omitted here. We faced some challenges identifying and photographing the ICs, but we identified these board components:

Samsung K4E6E304ED-AGCC

This component is an LPDDR3 RAM (Random Access Memory) chip from Samsung with a capacity of 1GB. The RAM is a temporary place for the system to store information, much like short-term memory for humans. However, RAM is volatile, meaning the information is lost when the chip loses power. (2)

Qualcomm MSM8926 Snapdragon 400 SoC

The SoC on this phone is the Snapdragon 400 from Qualcomm. The System-on-a-chip integrates the following:

- The CPU
- The GPU
- The modem
- The Digital Signal Processor (DSP)
- The Image Processing Unit (ISP)

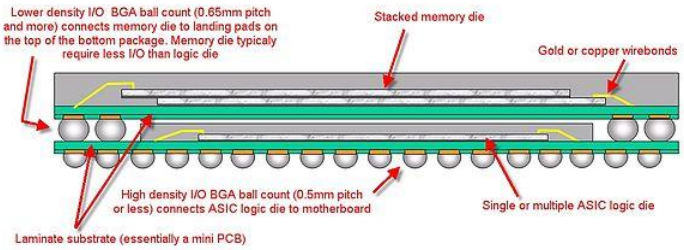


Figure 1: There is no photograph of the SoC since it is packaged under the RAM

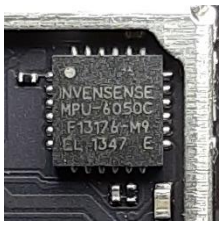
By Moody751 at English Wikipedia, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=13445857

The CPU is often considered the “brains” of a smartphone. The GPU handles graphics. The rest perform various functions that allow the phone to take images and make calls. This chip uses Package-on-a-Package like all smartphones, where the RAM is stacked on top of the CPU. This helps increase the density of components so devices can be made smaller. (3) (4)

SanDisk SDIN8DE

Figure 2: This is a SanDisk eMMC Flash drive, which stores the operating system, user data, and all the apps. eMMC is slower but cheaper. (13)

Figure 3: InvenSense MPU-6050C 3-axis gyroscope and accelerometer



InvenSense MPU-6050C

This IC is a motion processing unit by InvenSense that records motion in all six degrees of freedom. It is used to detect the orientation and acceleration of the device. (5)

WCD9302 Audio IC

Figure 4: WCD9302 Audio IC

This chip from Qualcomm is responsible for audio. It takes analogue input from the microphones and translates it for the CPU. It also acts as an DAC (digital-to-analog converter) and amplifier. It reads digital signals, translates them into analog signals, and then amplifies them to power the speaker. (6)

Qualcomm WTR1625L

The chip is an IF RF Transceiver. It consists of a radio transmitter and a receiver, hence the 'transceiver' in its name. It is used to connect to and communicate with cellular networks. (7) (8)

Figure 5: Qualcomm WTR1625L Transceiver

Triquint TQM7M9050 Quad band GSM-EDGE and Penta Band W/CDMA/HSPA+/LTE

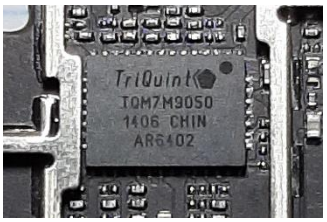


Figure 6: Triquint TQM7M9050

This chip is a multimode multiband GSM, W/CDMA, HSPA+, and LTE PAM. It drives the antennas on the phone to create a radio signal that the cell tower can decode. It can amplify 2.5G (GSM-EDGE) signals on four different bands, and 4G signals on five different bands, making it compatible with many networks. (9)

Qualcomm PM8926 Power IC

This chip is an IC made by Qualcomm. It performs DC to DC voltage conversion, power management, Battery charging, 'housekeeping', and UI features like LEDs. In essence, it controls power delivery to the system. (10) (11)

Figure 7: Qualcomm PM8926 IC

Qualcomm WCN3620

Figure 9: This IC enables network features like WLAN, Bluetooth, and FM Radio. It takes input from the CPU and then outputs to the antennas. (17)

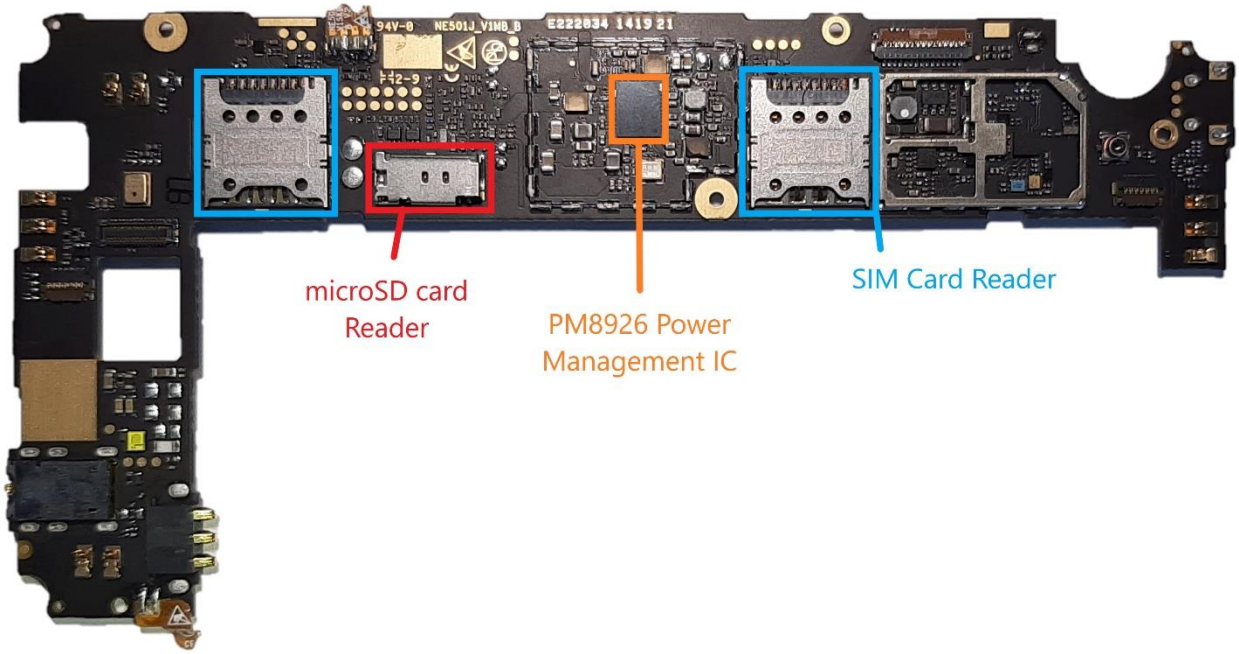
Goodix GT915

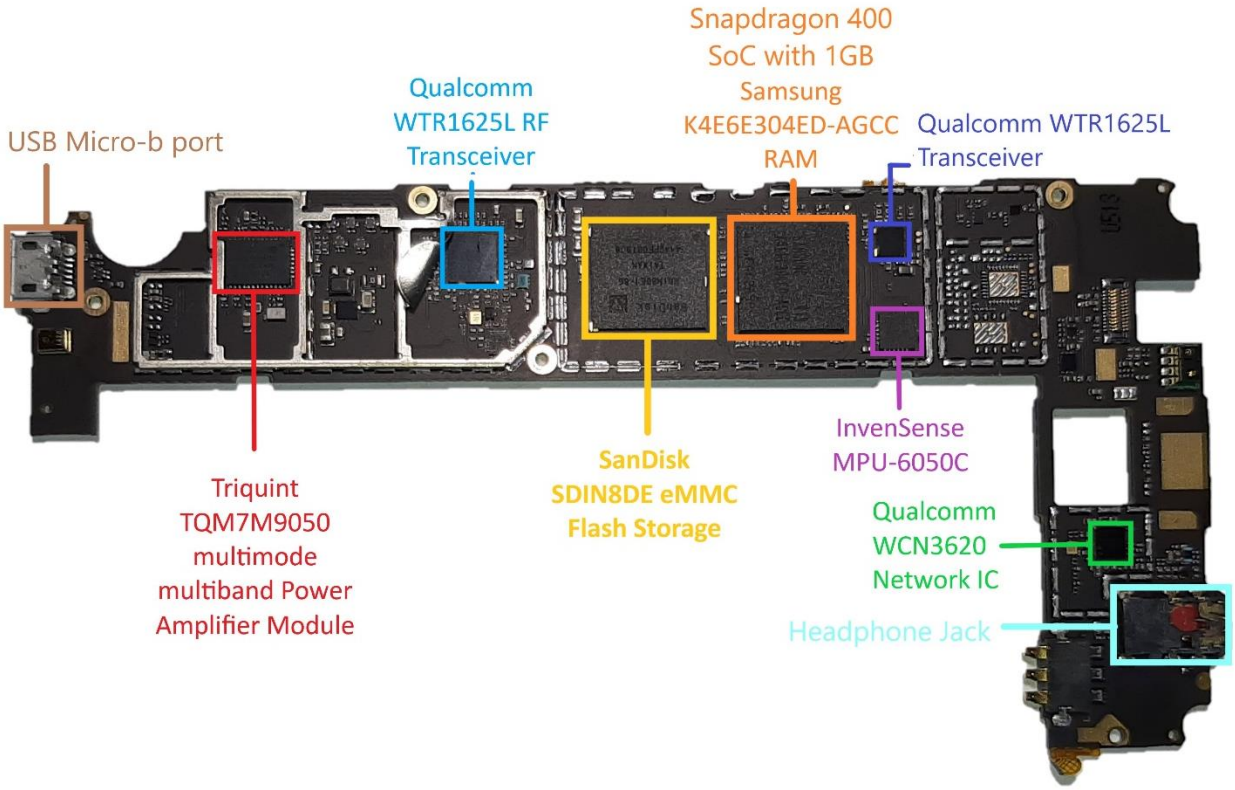
Figure 8: This 5-point touch controller converts touch input from the capacitive touchscreen into digital data. It supports 5 touchpoints at the same time (18)

Conclusion

We uncovered a multitude of ICs that served different purposes and what part they play in making the phone work. We learned how the different parts interact and communicate with each other to execute seemingly trivial common tasks We had a great learning experience from this research and have expanded our knowledge in electronics and ICs.

PCB Components labelled





Disassembly Process

Step 1

Figure 10: The plastic back is removed easily, showing the removable battery. There are also two SIM trays and one microSD card slot.

Step 2

Figure 11: We found the blue shroud has metal contacts that are embedded in tape on the outside. We think these are radio antennas.

Step 3

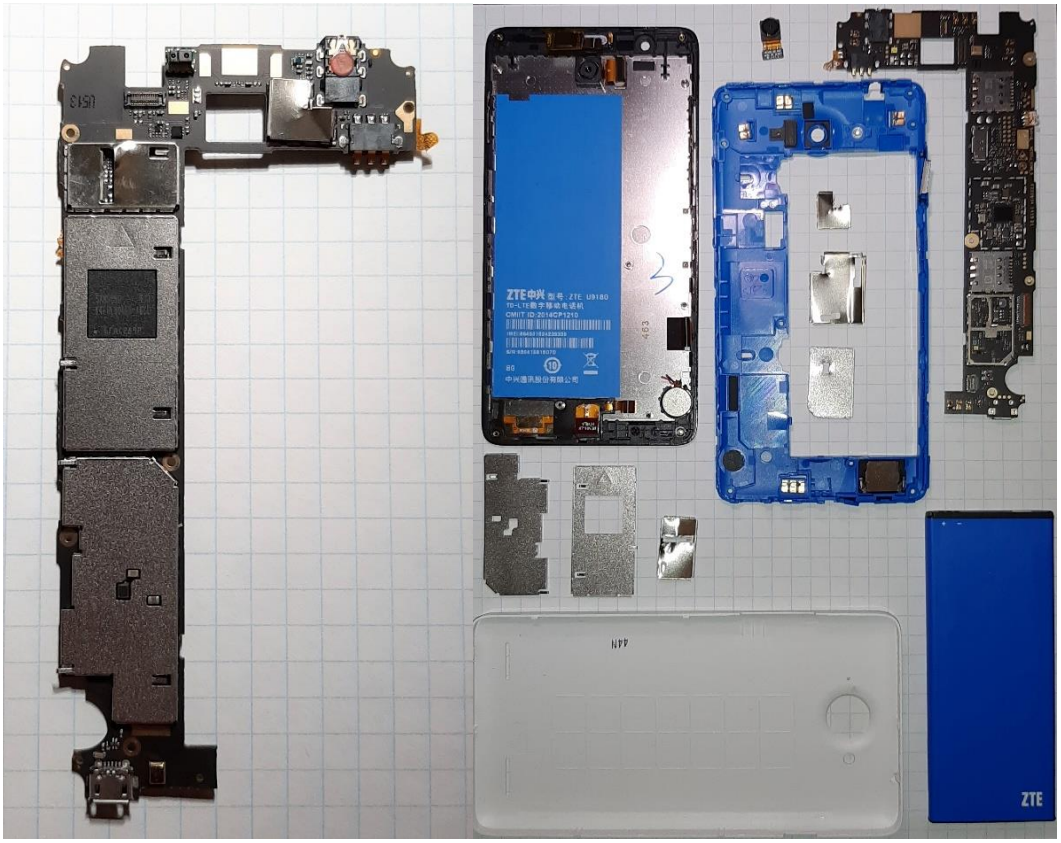


Figure 12: The mainboard is removed, and then there are metal covers that serve as faraday cages that we then remove. Disassembly complete.

Other Components

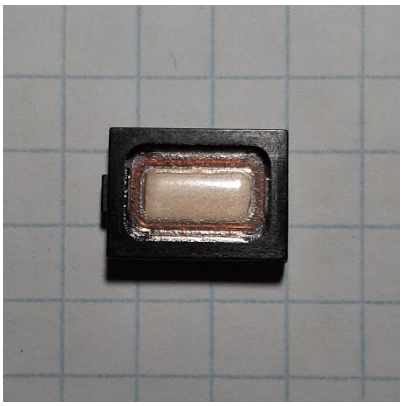


Figure 13: The single speaker can be removed too. The other speaker grille on the case is fake.

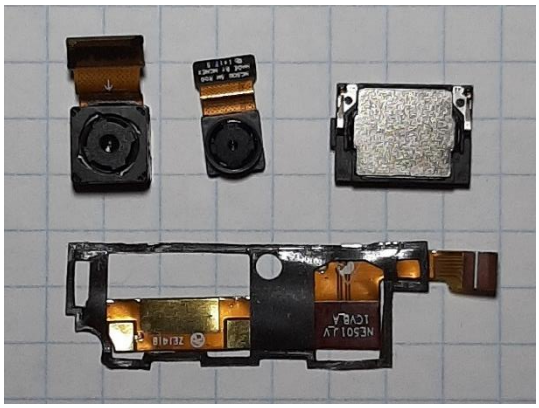


Figure 14: Cameras (top right) are glued on. The speaker (top left) connects to the extension (bottom) with pins. The extension peels off the shroud.

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