Texas Instrument Electronic Online Challenge 2020

Samsun Galaxy Note 4 Disassembly

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TI Online VEX Challenge

The device we chose is the Samsung Galaxy Note 4. We chose this because it is a piece of technology we use every day. It's fascinating that something so small can do so many functions. We wanted to learn what was inside that makes the phone work and understand all the engineering that went into it. The phone we took apart was a broken phone from one of our parents.
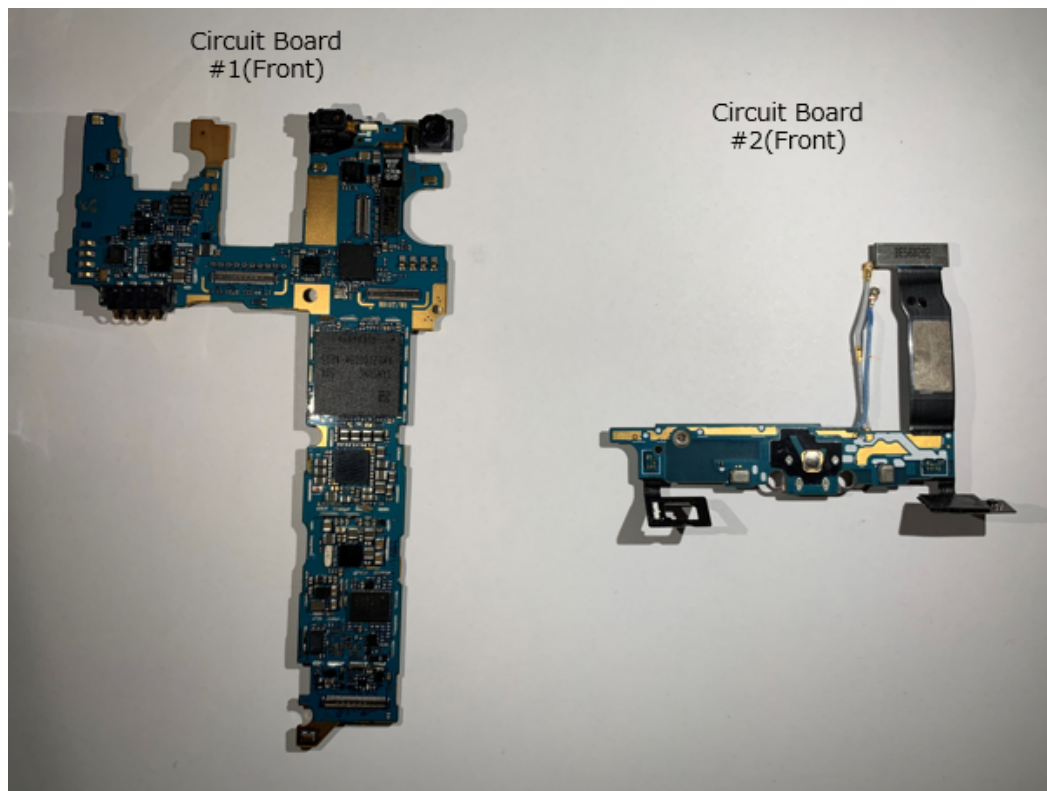
The phone consists of 8 parts shown in the following pictures. Picture #1 shows the S Pen, rear panel and rear cover. Picture #2 shows the front side of the two circuit boards. Picture #3 shows the back side of the two circuit boards since there are components on both sides. Picture #4 shows the center panel, the battery and the touch panel and display.
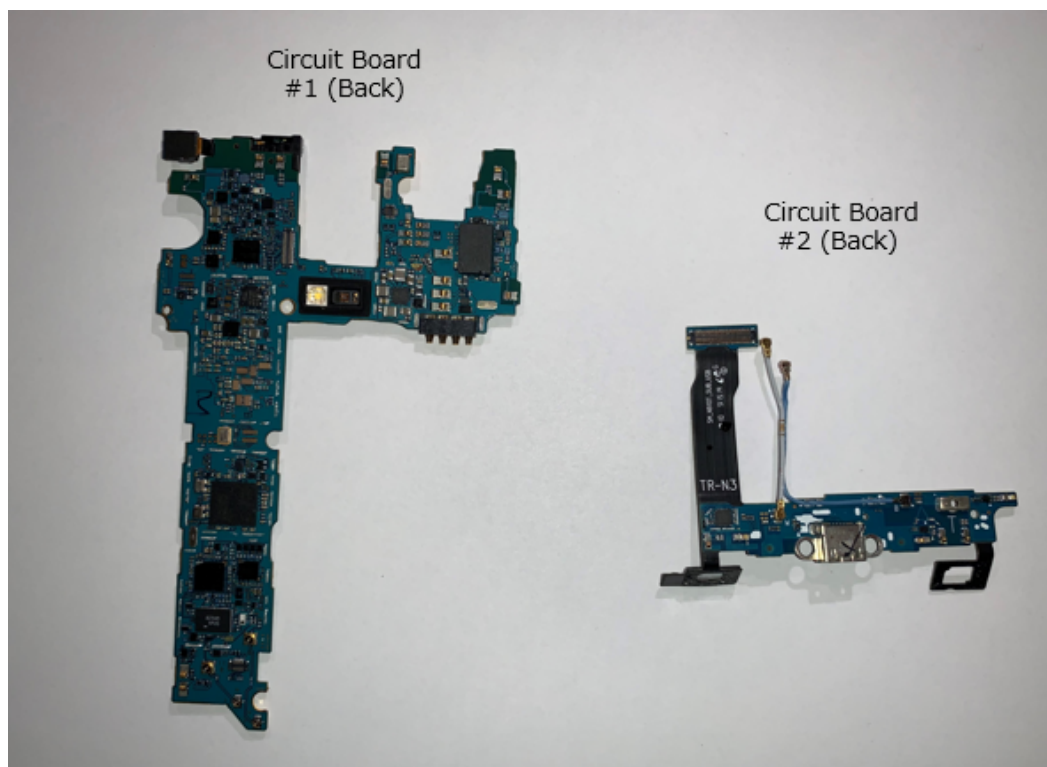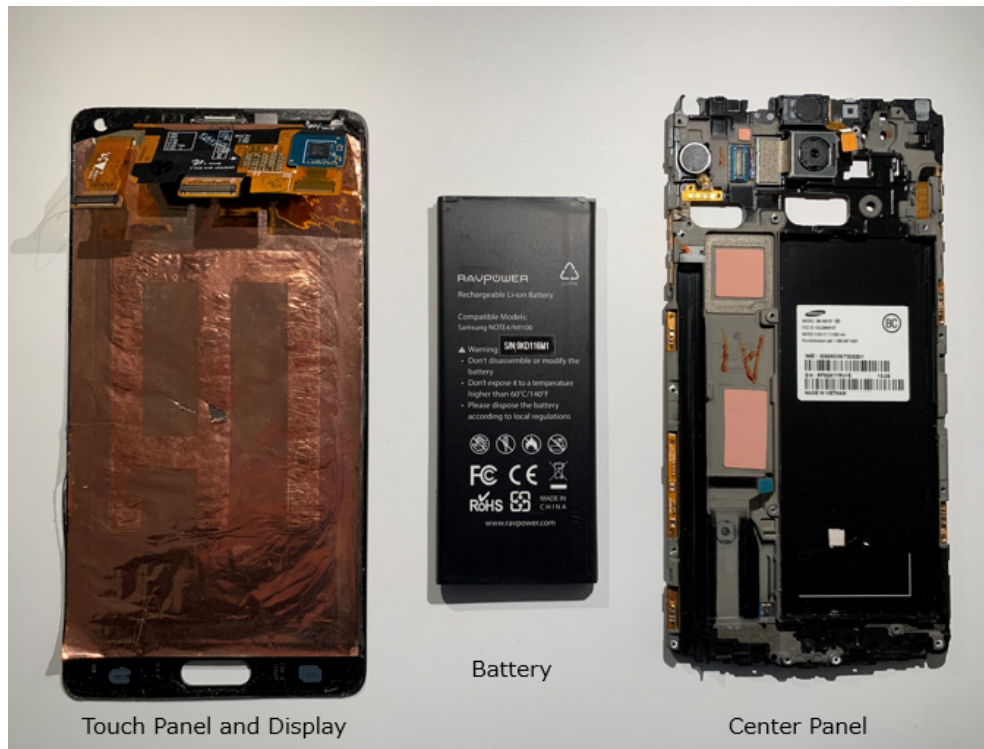
Picture #1

Rear Cover   Rear Panel   S Pen

Picture #2

Circuit Board
#1(Front)

Circuit Board
#2(Front)

Picture #3

Circuit Board
#1 (Back)

Circuit Board
#2 (Back)

Picture #4

Touch Panel and Display

Battery

Center Panel

The following list shows the parts we identified as well as the location they were found. We also included pictures of each part of the phone and designated each component with a number to help identify them. We had to pull off many metal shields that were covering many of the components on the circuit boards in order to see their part numbers.

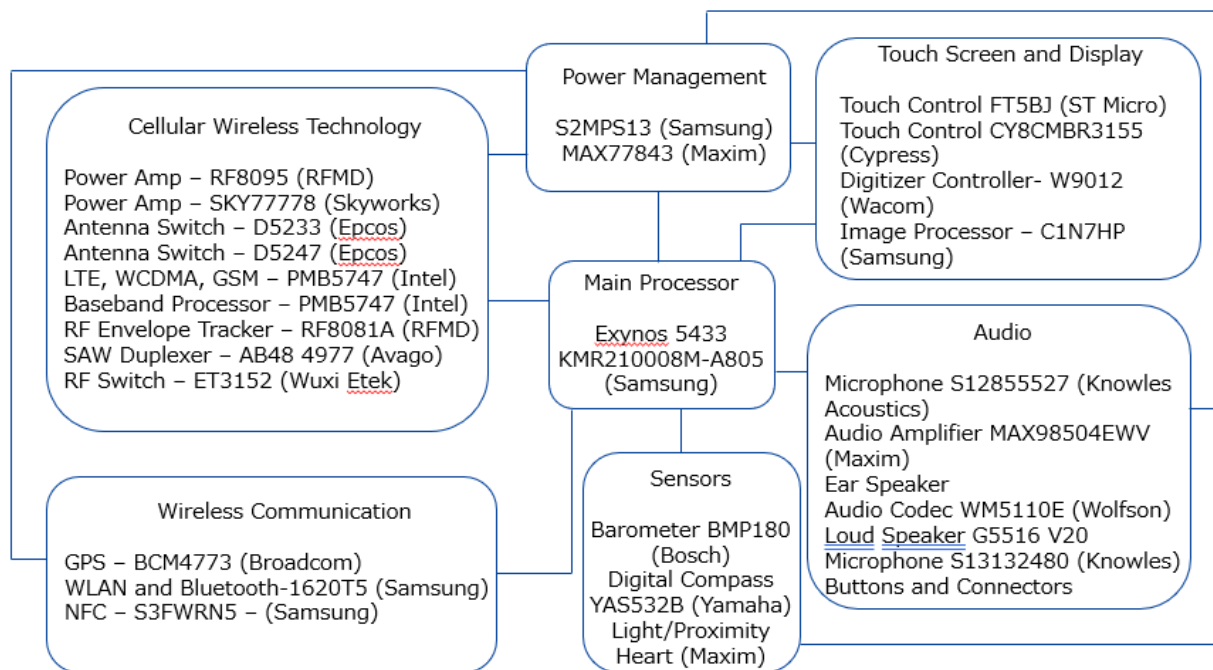| Part Identified	Manufacturer	Function	Location	Number Designation
RP-CB007	RavPower	Battery	Battery	1
Camera	Unknown	Camera	Center Panel	2
Unknown	Unknown	Vibrator Motor	Center Panel	3
Connector	Unknown	Camera to PCB #1 (Back) Connector	Center Panel	4
Speaker	Unknown	Ear Speaker	Center Panel	5
Connector	Unknown	Connection for Home Button to PCB #1 (Front)	Center Panel	6
Button	Unknown	Home Button (opposite side)	Center Panel	7
Connector	Unknown	Volume Button Connection to PCB #1 (Front)	Center Panel	8
Connector	Unknown	Power Button Connection to PCB #1 (Front)	Center Panel	9
Connector	Unknown	Connection for Display to PCB #1 (Front)	Flex PCB	10
Connector	Unknown	Connection for Touch Screen to PCB #1 (Front)	Flex PCB	11
FT5BJ	ST Microelectronics	Touch Screen Controller	Flex PCB	12
Foil	Unknown	Foil Shield	Touch Panel and Display	13
G5516 V20	Unknown	Loud Speaker	Rear Cover	14
Connector	Unknown	Speaker Connector to PCB #1 (Back)	Rear Cover	15
Connector	Unknown	Headphone Jack 3.5mm	Rear Cover	16
Connector	Unknown	Headphone Jack to PCB #1 (Back)	Rear Cover	17
D5233	Epcos	Antenna Switch	PCB #1 (Back)	18
PMB5747	Intel	LTE/WCDMA/GSM Transceiver	PCB #1 (Back)	19
D5247	Epcos	RF Front End Module + Antenna Switch	PCB #1 (Back)	20
S2MPS13	Samsung	Power Management	PCB #1 (Back)	21
Connector	Unknown	Battery Connector	PCB #1 (Back)	22
BCM4773	Broadcom	GPS	PCB #1 (Back)	23
IC2610	Invensense	Accelerometer and Gyroscope	PCB #1 (Back)	24
WM5110E	Wolfson	Audio Codec	PCB #1 (Back)	25
Sensor	Maxim	Heart Rate	PCB #1 (Back)	26
STOD32B	ST Microelectronics	LED Driver	PCB #1 (Back)	27
1620T5	Samsung	WLAN + Bluetooth	PCB #1 (Back)	28
S1313 2480	Knowles Acoustics	Microphone	PCB #1 (Back)	29
Connector	Unknown	Connector to Headphone Jack 3.5mm	PCB #1 (Back)	30
Connector	Unknown	Connector to Camera (Center Panel)	PCB #1 (Back)	31
Connector	Unknown	Connector to External Speaker (Center Panel)	PCB #1 (Back)	32
LED Flash	Unknown	Flash for Camera	PCB #1 (Back)	33
Connector	Unknown	Connector to Unknown Sensor on Rear Cover	PCB #1 (Back)	34
Connector	Unknown	U.FL Connector to PCB #2 (Back)	PCB#1 (Back)	60
SKY77778	Skyworks	Power Amplifier	PCB #1 (Front)	35
AB48 4977	Avago	SAW Duplexer	PCB #1 (Front)	36
ET3152	Wuxi Etek	RF Switch	PCB #1 (Front)	37
RF8095	RFMD	Power Amplifier	PCB #1 (Front)	38
RF8081A	RFMD	Envelope Tracker	PCB #1 (Front)	39
YAS532B	Yamaha	Digital Compass	PCB #1 (Front)	40
MAX77843	Maxim	Battery Management	PCB #1 (Front)	41
S3FWRN5	Samsung	NFC	PCB #1 (Front)	42
MAX98504EWV	Maxim	Audio Amplifier	PCB #1 (Front)	43
PMB9933	Intel	Baseband Processor	PCB #1 (Front)	44
KMR210008M-A805	Samsung	Exynos 5433 Application Processor	PCB #1 (Front)	45
BMP180	Bosch Sensortec	Barometer Sensor	PCB #1 (Front)	46
W9012	Wacom	Digitizer Controller	PCB #1 (Front)	47
C1N7HP	Samsung	Image Processor	PCB #1 (Front)	48
Camera	Unknown	Front Facing Camera	PCB #1 (Front)	49
Connector	Unknown	Connector for Touch Screen (Flex PCB)	PCB #1 (Front)	50
Connector	Unknown	Connector for LCD Display (Flex PCB)	PCB #1 (Front)	51
Sensor	Unknown	Light/Proximity Sensor	PCB #1 (Front)	52
Connector	Unknown	Connector for Power Side Button (Rear Cover)	PCB #1 (Front)	53
Connector	Unknown	Connector for Volume Side Button (Rear Cover)	PCB #1 (Front)	54
Connector	Unknown	Connector to PCB #2	PCB #1 (Front)	55
S1285 5527	Knowles Acoustics	Microphone x 2	PCB#2 (Front)	56
CY8CMBR3155	Cypress	Touch Panel Controller	PCB#2 (Back)	57
Wireless Coax	Unknown	U.FL Wireless Coax to PCB #1 (Back)	PCB#2 (Back)	58
Connector	Unknown	Connector to PCB #1 (Front)	PCB#2 (Back)	59

Unknown
Sensor
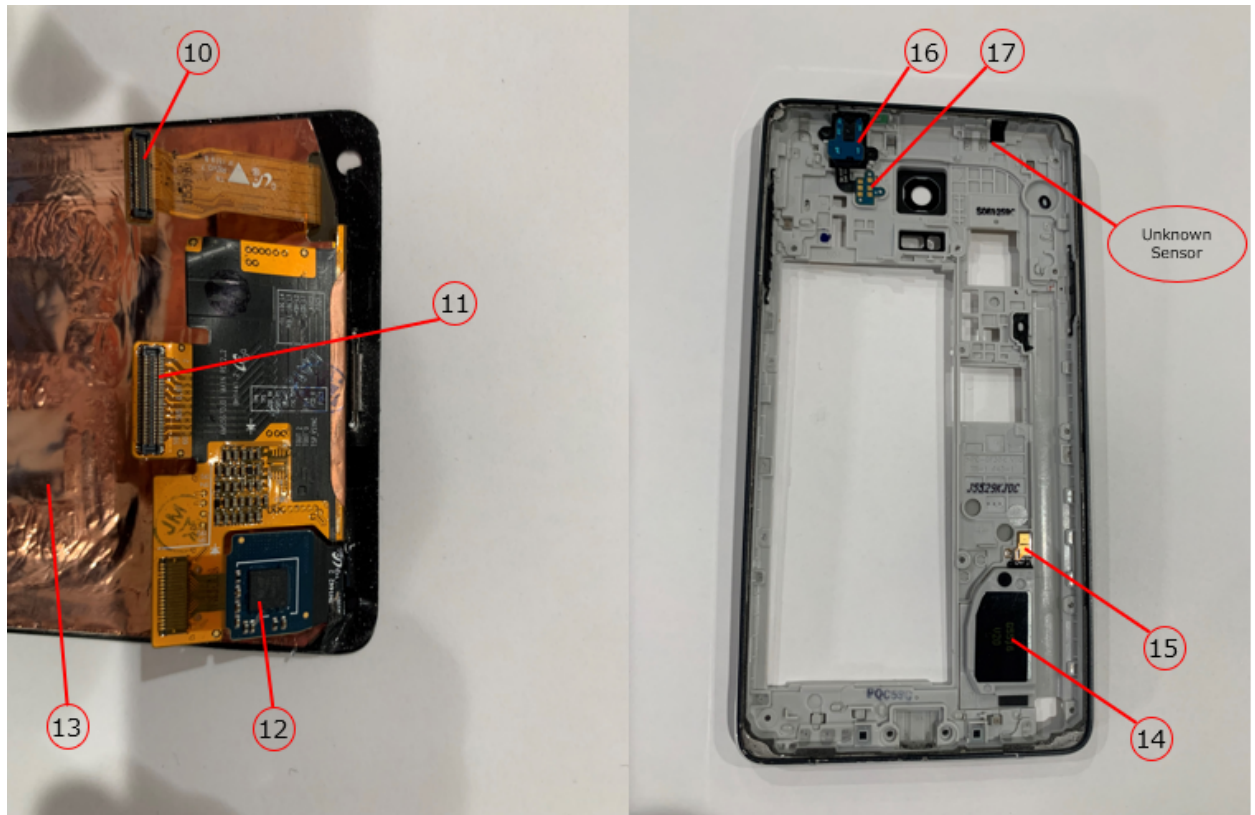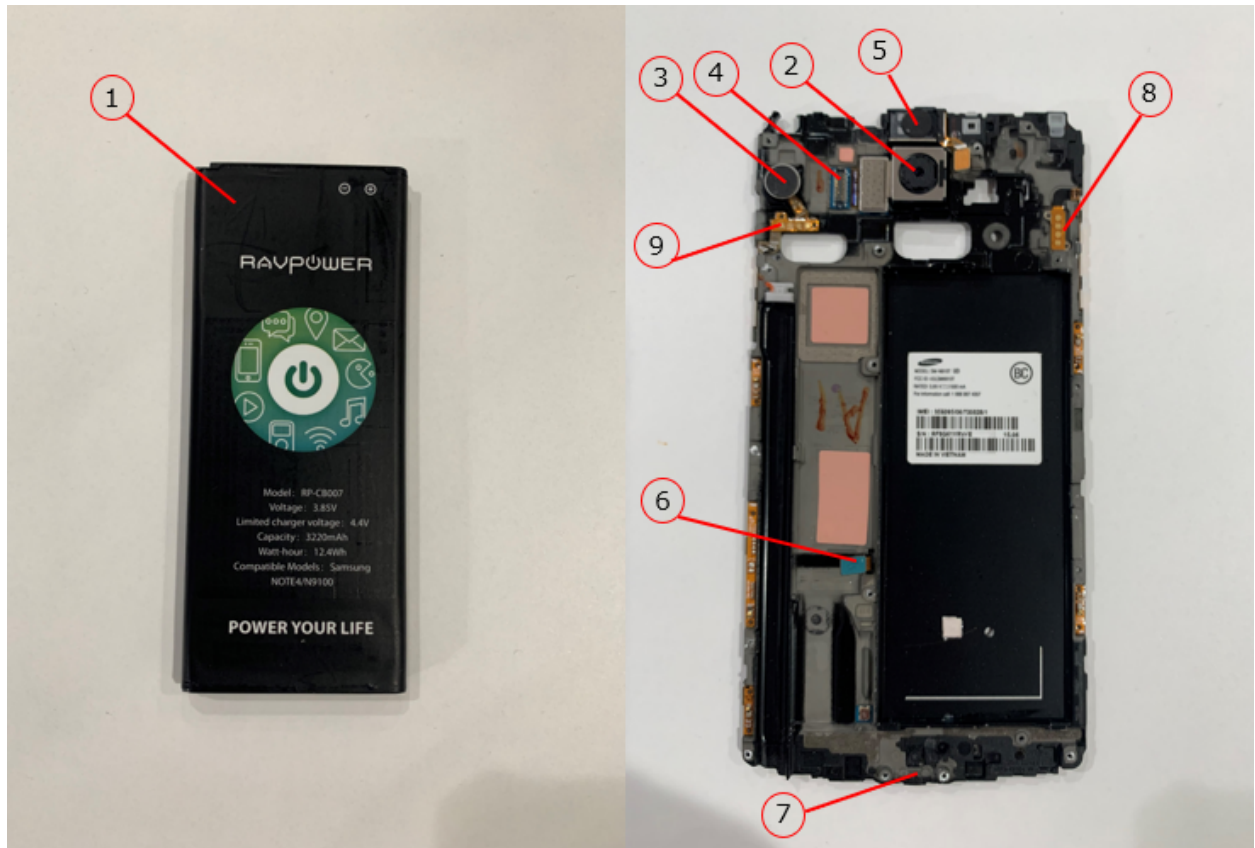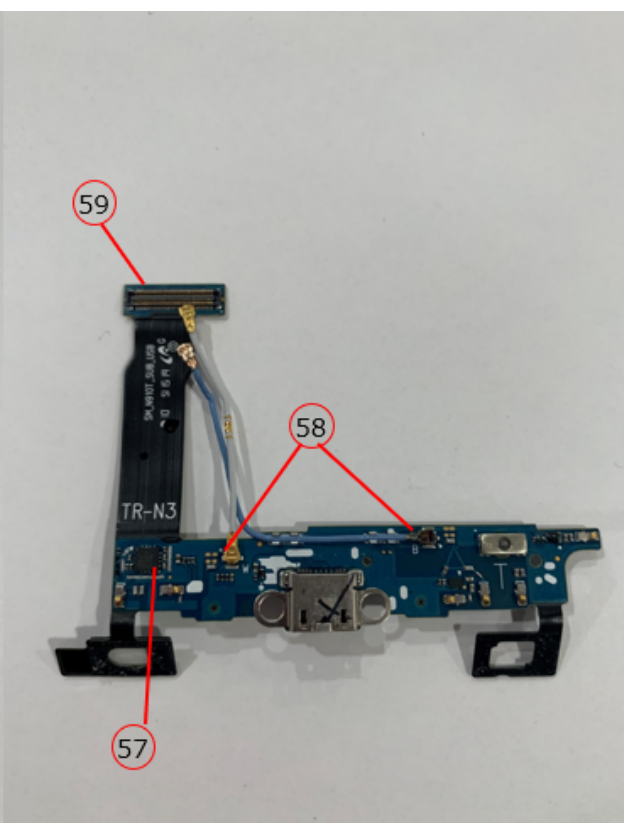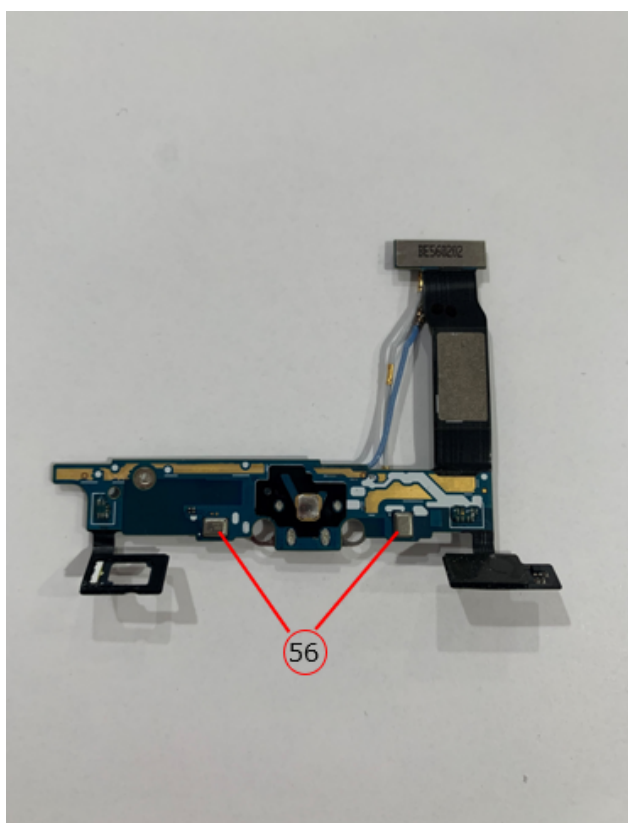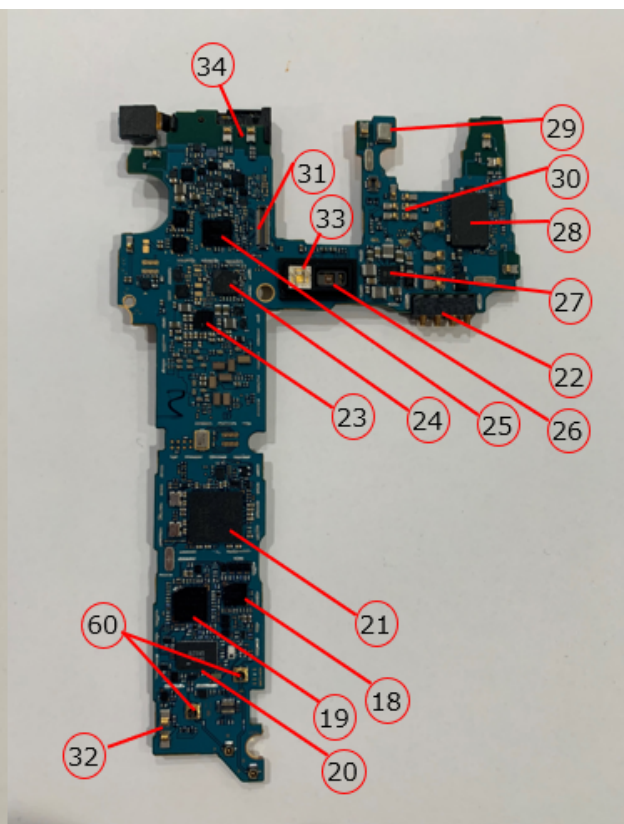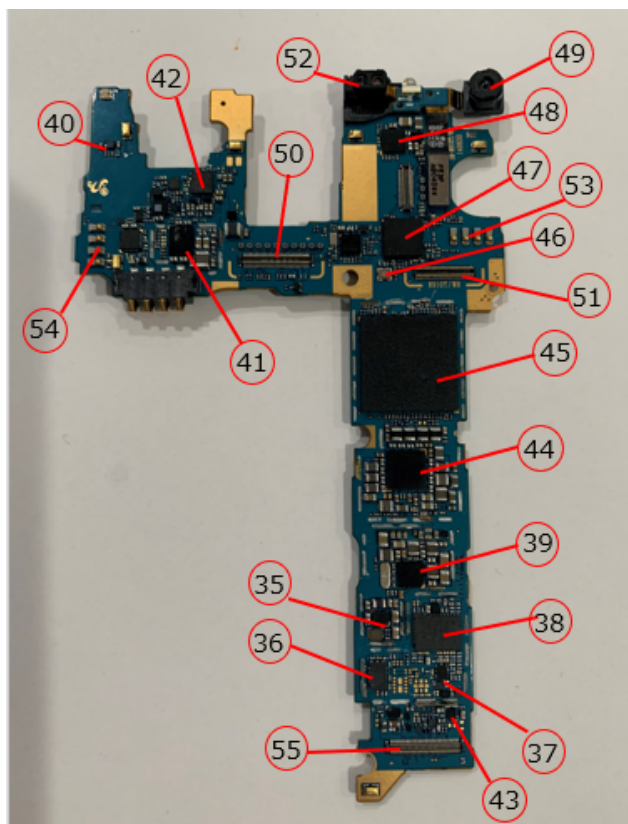
Unfortunately, we didn't identify any Texas Instruments parts when we reviewed all the components. In reviewing the Texas Instruments website and looking at the different parts that they offer, we identified the following areas that Texas Instruments could have been used for: LED driver, power management, battery management and audio amplifier.

It's amazing how the engineers that worked on this phone made everything fit perfectly. There are so many connectors on the circuit boards and everything has to line up perfectly in order to connect all the boards together and fit in a small form factor.

We researched how all of these components work in a cell phone and came up with the below diagram of the different technology functions and how the parts fit into those functions.

Power Management

S2MPS13 (Samsung)
MAX77843 (Maxim)

Touch Screen and Display

Touch Control FT5BJ (ST Micro)
Touch Control CY8CMBR3155 (Cypress)
Digitizer Controller- W9012 (Wacom)
Image Processor – C1N7HP (Samsung)

Cellular Wireless Technology

Power Amp – RF8095 (RFMD)
Power Amp – SKY77778 (Skyworks)
Antenna Switch – D5233 (Epcos)
Antenna Switch – D5247 (Epcos)
LTE, WCDMA, GSM – PMB5747 (Intel)
Baseband Processor – PMB5747 (Intel)
RF Envelope Tracker – RF8081A (RFMD)
SAW Duplexer – AB48 4977 (Avago)
RF Switch – ET3152 (Wuxi Etek)

Main Processor

Exynos 5433
KMR210008M-A805
(Samsung)

Audio

Microphone S12855527 (Knowles Acoustics)
Audio Amplifier MAX98504EWV (Maxim)
Ear Speaker
Audio Codec WM5110E (Wolfson)
Loud Speaker G5516 V20
Microphone S13132480 (Knowles)
Buttons and Connectors

Wireless Communication

GPS – BCM4773 (Broadcom)
WLAN and Bluetooth-1620T5 (Samsung)
NFC – S3FWRN5 – (Samsung)

Sensors

Barometer BMP180 (Bosch)
Digital Compass YAS532B (Yamaha)
Light/Proximity
Heart (Maxim)

This was an amazing project. We learned about all the functions that can be put into a small space by using certain components. There are many sensors that read things like light, heart rate and proximity. All of these things are connected to a central processor that reads them and takes other actions. Many components make up certain technical functions like cellular wireless. We identified 9 components and there are many resistors, capacitors and connectors that make up the whole solution. This is the same for all functional blocks. We can't imagine how many hours it took engineers to design this one phone with all of these components packed into such a small space and have everything connected together. It reminds us of a symphony of music where many things come together to make a masterpiece.